ckb-next

beta-v0.2.8 at branch testing

Generated by Doxygen 1.8.6

Sat Jun 17 2017 13:44:02

Contents

1 README 1

2 Building ckb 9

3 cbk Improvements Roadmap 11

4 DAEMON 13

5 Todo List 21

6 Data Structure Index 23

6.1 Data Structures . . . 23

7 File Index 25

7.1 File List . . . 25

8 Data Structure Documentation 27

8.1 devcmd.__unnamed__ Struct Reference . . . 27

8.1.1 Detailed Description . . . 28

8.1.2 Field Documentation . . . 28

8.1.2.1 active . . . 28

8.1.2.2 allocprofile . . . 28

8.1.2.3 bind . . . 28

8.1.2.4 dpi . . . 28

8.1.2.5 dpisel . . . 28

8.1.2.6 erase . . . 28

8.1.2.7 eraseprofile . . . 28

8.1.2.8 freeprofile . . . 28

8.1.2.9 fwupdate . . . 28

8.1.2.10 get . . . 28

8.1.2.11 hwload . . . 28

8.1.2.12 hwsave . . . 29

8.1.2.13 iauto . . . 29

8.1.2.14 id . . . 29

8.1.2.15 idle . . . 29
8.1.2.16 inotify . . . 29
8.1.2.17 ioff . . . 29
8.1.2.18 ion . . . 29
8.1.2.19 lift . . . 29
8.1.2.20 loadprofile . . . 29
8.1.2.21 macro . . . 29
8.1.2.22 name . . . 29
8.1.2.23 notify . . . 29
8.1.2.24 pollrate . . . 29
8.1.2.25 profileid . . . 29
8.1.2.26 profilename . . . 29
8.1.2.27 rebind . . . 29
8.1.2.28 restart . . . 29
8.1.2.29 rgb . . . 29
8.1.2.30 setmodeindex . . . 29
8.1.2.31 snap . . . 29
8.1.2.32 start . . . 29
8.1.2.33 unbind . . . 29
8.1.2.34 updatedpi . . . 29
8.1.2.35 updateindicators . . . 29
8.1.2.36 updatergb . . . 29

9 File Documentation **31**

9.1 BUILD.md File Reference . . . 31
9.2 DAEMON.md File Reference . . . 31
9.3 README.md File Reference . . . 31
9.4 ROADMAP.md File Reference . . . 31
9.5 src/ckb-daemon/command.c File Reference . . . 31
9.5.1 Macro Definition Documentation . . . 32
9.5.1.1 TRY_WITH_RESET . . . 32
9.5.2 Function Documentation . . . 32
9.5.2.1 readcmd . . . 32
9.5.3 Variable Documentation . . . 36
9.5.3.1 cmd_strings . . . 36
9.6 src/ckb-daemon/command.h File Reference . . . 36
9.6.1 Data Structure Documentation . . . 38
9.6.1.1 union devcmd . . . 38
9.6.2 Macro Definition Documentation . . . 38
9.6.2.1 CMD_COUNT . . . 38

9.6.2.2 CMD_DEV_COUNT . . . 39
9.6.3 Typedef Documentation . . . 39
9.6.3.1 cmdhandler . . . 39
9.6.3.2 cmdhandler_io . . . 39
9.6.3.3 cmdhandler_mac . . . 39
9.6.3.4 devcmd . . . 39
9.6.4 Enumeration Type Documentation . . . 39
9.6.4.1 cmd . . . 39
9.6.5 Function Documentation . . . 41
9.6.5.1 readcmd . . . 41
9.7 src/ckb-daemon/device.c File Reference . . . 45
9.7.1 Function Documentation . . . 46
9.7.1.1 _start_dev . . . 46
9.7.1.2 start_dev . . . 47
9.7.2 Variable Documentation . . . 48
9.7.2.1 devlistmutex . . . 48
9.7.2.2 devmutex . . . 48
9.7.2.3 hwload_mode . . . 48
9.7.2.4 inputmutex . . . 48
9.7.2.5 keyboard . . . 48
9.7.2.6 macromutex . . . 48
9.7.2.7 macromutex2 . . . 49
9.7.2.8 macrovar . . . 49
9.8 src/ckb-daemon/device.h File Reference . . . 49
9.8.1 Macro Definition Documentation . . . 50
9.8.1.1 ACT_LIGHT . . . 50
9.8.1.2 ACT_LOCK . . . 50
9.8.1.3 ACT_M1 . . . 50
9.8.1.4 ACT_M2 . . . 51
9.8.1.5 ACT_M3 . . . 51
9.8.1.6 ACT_MR_RING . . . 51
9.8.1.7 ACT_NEXT . . . 51
9.8.1.8 ACT_NEXT_NOWRAP . . . 51
9.8.1.9 DEV_MAX . . . 51
9.8.1.10 dmutex . . . 51
9.8.1.11 imutex . . . 51
9.8.1.12 IN_CORSAIR . . . 51
9.8.1.13 IN_HID . . . 51
9.8.1.14 IS_CONNECTED . . . 52
9.8.1.15 mmutex . . . 52

9.8.1.16 mmutex2 . . . 52
9.8.1.17 mvar . . . 52
9.8.1.18 setactive . . . 52
9.8.2 Function Documentation . . . 52
9.8.2.1 cmd_active_kb . . . 52
9.8.2.2 cmd_active_mouse . . . 53
9.8.2.3 cmd_idle_kb . . . 53
9.8.2.4 cmd_idle_mouse . . . 53
9.8.2.5 cmd_pollrate . . . 54
9.8.2.6 setactive_kb . . . 54
9.8.2.7 setactive_mouse . . . 56
9.8.2.8 setmodeindex_nrgb . . . 57
9.8.2.9 start_dev . . . 58
9.8.2.10 start_kb_nrgb . . . 58
9.8.3 Variable Documentation . . . 58
9.8.3.1 devmutex . . . 58
9.8.3.2 inputmutex . . . 58
9.8.3.3 keyboard . . . 58
9.8.3.4 macromutex . . . 59
9.8.3.5 macromutex2 . . . 59
9.8.3.6 macrovar . . . 59
9.9 src/ckb-daemon/device_keyboard.c File Reference . . . 59
9.9.1 Function Documentation . . . 59
9.9.1.1 cmd_active_kb . . . 59
9.9.1.2 cmd_idle_kb . . . 60
9.9.1.3 setactive_kb . . . 60
9.9.1.4 setmodeindex_nrgb . . . 62
9.9.1.5 start_kb_nrgb . . . 62
9.10 src/ckb-daemon/device_mouse.c File Reference . . . 63
9.10.1 Function Documentation . . . 63
9.10.1.1 cmd_active_mouse . . . 63
9.10.1.2 cmd_idle_mouse . . . 64
9.10.1.3 cmd_pollrate . . . 64
9.10.1.4 setactive_mouse . . . 64
9.11 src/ckb-daemon/device_vtable.c File Reference . . . 66
9.11.1 Function Documentation . . . 67
9.11.1.1 cmd_io_none . . . 67
9.11.1.2 cmd_macro_none . . . 67
9.11.1.3 cmd_none . . . 67
9.11.1.4 int1_int_none . . . 67

9.11.1.5 int1_void_none . . . 67
9.11.1.6 loadprofile_none . . . 67
9.11.2 Variable Documentation . . . 68
9.11.2.1 vtable_keyboard . . . 68
9.11.2.2 vtable_keyboard_nonrgb . . . 68
9.11.2.3 vtable_mouse . . . 68
9.12 src/ckb-daemon/devnode.c File Reference . . . 68
9.12.1 Data Structure Documentation . . . 69
9.12.1.1 struct _readlines_ctx . . . 69
9.12.2 Macro Definition Documentation . . . 70
9.12.2.1 MAX_BUFFER . . . 70
9.12.2.2 S_GID_READ . . . 70
9.12.3 Function Documentation . . . 70
9.12.3.1 _mkdevpath . . . 70
9.12.3.2 _mknotifynode . . . 73
9.12.3.3 _rmnotifynode . . . 74
9.12.3.4 _updateconnected . . . 74
9.12.3.5 mkdevpath . . . 75
9.12.3.6 mkfwnode . . . 76
9.12.3.7 mknotifynode . . . 77
9.12.3.8 readlines . . . 77
9.12.3.9 readlines_ctx_free . . . 78
9.12.3.10 readlines_ctx_init . . . 79
9.12.3.11 rm_recursive . . . 79
9.12.3.12 rmdevpath . . . 80
9.12.3.13 rmnotifynode . . . 80
9.12.3.14 updateconnected . . . 81
9.12.4 Variable Documentation . . . 82
9.12.4.1 devpath . . . 82
9.12.4.2 gid . . . 82
9.13 src/ckb-daemon/devnode.h File Reference . . . 82
9.13.1 Macro Definition Documentation . . . 83
9.13.1.1 S_CUSTOM . . . 83
9.13.1.2 S_CUSTOM_R . . . 83
9.13.1.3 S_READ . . . 83
9.13.1.4 S_READDIR . . . 83
9.13.1.5 S_READWRITE . . . 83
9.13.2 Typedef Documentation . . . 84
9.13.2.1 readlines_ctx . . . 84
9.13.3 Function Documentation . . . 84

9.13.3.1 mkdevpath . . . 84
9.13.3.2 mkfwnode . . . 85
9.13.3.3 mknotifynode . . . 85
9.13.3.4 readlines . . . 86
9.13.3.5 readlines_ctx_free . . . 87
9.13.3.6 readlines_ctx_init . . . 87
9.13.3.7 rmdevpath . . . 88
9.13.3.8 rmnotifynode . . . 88
9.13.3.9 updateconnected . . . 89
9.13.4 Variable Documentation . . . 90
9.13.4.1 devpath . . . 90
9.13.4.2 gid . . . 90
9.14 src/ckb-daemon/dpi.c File Reference . . . 90
9.14.1 Function Documentation . . . 90
9.14.1.1 cmd_dpi . . . 90
9.14.1.2 cmd_dpisel . . . 91
9.14.1.3 cmd_lift . . . 91
9.14.1.4 cmd_snap . . . 91
9.14.1.5 loaddpi . . . 92
9.14.1.6 printdpi . . . 93
9.14.1.7 savedpi . . . 93
9.14.1.8 updatedpi . . . 94
9.15 src/ckb-daemon/dpi.h File Reference . . . 95
9.15.1 Function Documentation . . . 95
9.15.1.1 cmd_dpi . . . 95
9.15.1.2 cmd_dpisel . . . 96
9.15.1.3 cmd_lift . . . 96
9.15.1.4 cmd_snap . . . 97
9.15.1.5 loaddpi . . . 97
9.15.1.6 printdpi . . . 98
9.15.1.7 savedpi . . . 98
9.15.1.8 updatedpi . . . 99
9.16 src/ckb-daemon/extra_mac.c File Reference . . . 100
9.17 src/ckb-daemon/firmware.c File Reference . . . 100
9.17.1 Macro Definition Documentation . . . 101
9.17.1.1 FW_MAXSIZE . . . 101
9.17.1.2 FW_NOFILE . . . 101
9.17.1.3 FW_OK . . . 101
9.17.1.4 FW_USBFAIL . . . 101
9.17.1.5 FW_WRONGDEV . . . 101

9.17.2 Function Documentation . . . 101
9.17.2.1 cmd_fwupdate . . . 101
9.17.2.2 fwupdate . . . 102
9.17.2.3 getfwversion . . . 104
9.18 src/ckb-daemon/firmware.h File Reference . . . 105
9.18.1 Function Documentation . . . 105
9.18.1.1 cmd_fwupdate . . . 106
9.18.1.2 getfwversion . . . 106
9.19 src/ckb-daemon/includes.h File Reference . . . 107
9.19.1 Macro Definition Documentation . . . 109
9.19.1.1 __FILE_NOPATH__ . . . 109
9.19.1.2 ckb_err . . . 109
9.19.1.3 ckb_err_fn . . . 109
9.19.1.4 ckb_err_nofile . . . 109
9.19.1.5 ckb_fatal . . . 109
9.19.1.6 ckb_fatal_fn . . . 109
9.19.1.7 ckb_fatal_nofile . . . 109
9.19.1.8 ckb_info . . . 109
9.19.1.9 ckb_info_fn . . . 110
9.19.1.10 ckb_info_nofile . . . 110
9.19.1.11 ckb_s_err . . . 110
9.19.1.12 ckb_s_out . . . 110
9.19.1.13 ckb_warn . . . 110
9.19.1.14 ckb_warn_fn . . . 110
9.19.1.15 ckb_warn_nofile . . . 110
9.19.1.16 INDEX_OF . . . 110
9.19.1.17 timespec_eq . . . 110
9.19.1.18 timespec_ge . . . 111
9.19.1.19 timespec_gt . . . 111
9.19.1.20 timespec_le . . . 111
9.19.1.21 timespec_lt . . . 111
9.19.2 Typedef Documentation . . . 111
9.19.2.1 uchar . . . 111
9.19.2.2 ushort . . . 111
9.19.3 Function Documentation . . . 111
9.19.3.1 timespec_add . . . 111
9.20 src/ckb-daemon/input.c File Reference . . . 111
9.20.1 Macro Definition Documentation . . . 113
9.20.1.1 IS_WHEEL . . . 113
9.20.2 Function Documentation . . . 113

9.20.2.1 _cmd_macro . . . 113
9.20.2.2 cmd_bind . . . 115
9.20.2.3 cmd_macro . . . 115
9.20.2.4 cmd_rebind . . . 115
9.20.2.5 cmd_unbind . . . 116
9.20.2.6 freebind . . . 116
9.20.2.7 initbind . . . 116
9.20.2.8 inputupdate . . . 117
9.20.2.9 inputupdate_keys . . . 118
9.20.2.10 macro_pt_dequeue . . . 120
9.20.2.11 macro_pt_enqueue . . . 121
9.20.2.12 macro_pt_first . . . 121
9.20.2.13 macromask . . . 122
9.20.2.14 play_macro . . . 122
9.20.2.15 updateindicators_kb . . . 124
9.20.3 Variable Documentation . . . 125
9.20.3.1 pt_head . . . 125
9.20.3.2 pt_tail . . . 125
9.21 src/ckb-daemon/input.h File Reference . . . 125
9.21.1 Data Structure Documentation . . . 127
9.21.1.1 struct parameter . . . 127
9.21.1.2 struct ptlist . . . 128
9.21.2 Macro Definition Documentation . . . 128
9.21.2.1 IS_MOD . . . 128
9.21.3 Typedef Documentation . . . 128
9.21.3.1 parameter_t . . . 128
9.21.3.2 ptlist_t . . . 128
9.21.4 Function Documentation . . . 128
9.21.4.1 cmd_bind . . . 129
9.21.4.2 cmd_macro . . . 129
9.21.4.3 cmd_rebind . . . 129
9.21.4.4 cmd_unbind . . . 130
9.21.4.5 freebind . . . 130
9.21.4.6 initbind . . . 130
9.21.4.7 inputupdate . . . 131
9.21.4.8 os_inputclose . . . 132
9.21.4.9 os_inputopen . . . 132
9.21.4.10 os_keypress . . . 133
9.21.4.11 os_mousemove . . . 134
9.21.4.12 os_setupindicators . . . 135

9.21.4.13 updateindicators_kb . . . 136
9.22 src/ckb-daemon/input_linux.c File Reference . . . 136
9.22.1 Function Documentation . . . 137
9.22.1.1 _ledthread . . . 137
9.22.1.2 isync . . . 138
9.22.1.3 os_inputclose . . . 138
9.22.1.4 os_inputopen . . . 139
9.22.1.5 os_keypress . . . 140
9.22.1.6 os_mousemove . . . 141
9.22.1.7 os_setupindicators . . . 141
9.22.1.8 uinputopen . . . 142
9.23 src/ckb-daemon/input_mac.c File Reference . . . 143
9.24 src/ckb-daemon/input_mac_mouse.c File Reference . . . 143
9.25 src/ckb-daemon/keymap.c File Reference . . . 143
9.25.1 Macro Definition Documentation . . . 144
9.25.1.1 BUTTON_HID_COUNT . . . 144
9.25.2 Function Documentation . . . 144
9.25.2.1 corsair_kbcopy . . . 144
9.25.2.2 corsair_mousecopy . . . 145
9.25.2.3 hid_kb_translate . . . 145
9.25.2.4 hid_mouse_translate . . . 147
9.25.3 Variable Documentation . . . 148
9.25.3.1 keymap . . . 148
9.26 src/ckb-daemon/keymap.h File Reference . . . 148
9.26.1 Data Structure Documentation . . . 149
9.26.1.1 struct key . . . 149
9.26.2 Macro Definition Documentation . . . 150
9.26.2.1 BTN_WHEELDOWN . . . 150
9.26.2.2 BTN_WHEELUP . . . 150
9.26.2.3 KEY_BACKSLASH_ISO . . . 150
9.26.2.4 KEY_CORSAIR . . . 150
9.26.2.5 KEY_NONE . . . 151
9.26.2.6 KEY_UNBOUND . . . 151
9.26.2.7 LED_DPI . . . 151
9.26.2.8 LED_MOUSE . . . 151
9.26.2.9 MOUSE_BUTTON_FIRST . . . 151
9.26.2.10 MOUSE_EXTRA_FIRST . . . 151
9.26.2.11 N_BUTTONS_EXTENDED . . . 151
9.26.2.12 N_BUTTONS_HW . . . 151
9.26.2.13 N_KEY_ZONES . . . 151

9.26.2.14 N_KEYBYTES_EXTENDED . . . 151
9.26.2.15 N_KEYBYTES_HW . . . 152
9.26.2.16 N_KEYBYTES_INPUT . . . 152
9.26.2.17 N_KEYS_EXTENDED . . . 152
9.26.2.18 N_KEYS_EXTRA . . . 152
9.26.2.19 N_KEYS_HW . . . 152
9.26.2.20 N_KEYS_INPUT . . . 152
9.26.2.21 N_MOUSE_ZONES . . . 152
9.26.2.22 N_MOUSE_ZONES_EXTENDED . . . 152
9.26.2.23 SCAN_KBD . . . 152
9.26.2.24 SCAN_MOUSE . . . 152
9.26.2.25 SCAN_SILENT . . . 153
9.26.3 Function Documentation . . . 153
9.26.3.1 corsair_kbcopy . . . 153
9.26.3.2 corsair_mousecopy . . . 153
9.26.3.3 hid_kb_translate . . . 154
9.26.3.4 hid_mouse_translate . . . 155
9.26.4 Variable Documentation . . . 156
9.26.4.1 keymap . . . 156
9.27 src/ckb-daemon/keymap_mac.h File Reference . . . 156
9.28 src/ckb-daemon/led.c File Reference . . . 157
9.28.1 Function Documentation . . . 158
9.28.1.1 cmd_iauto . . . 158
9.28.1.2 cmd_inotify . . . 158
9.28.1.3 cmd_ioff . . . 159
9.28.1.4 cmd_ion . . . 159
9.28.1.5 cmd_rgb . . . 159
9.28.1.6 has_key . . . 160
9.28.1.7 iselect . . . 160
9.28.1.8 printrgb . . . 161
9.29 src/ckb-daemon/led.h File Reference . . . 163
9.29.1 Function Documentation . . . 163
9.29.1.1 cmd_iauto . . . 163
9.29.1.2 cmd_inotify . . . 164
9.29.1.3 cmd_ioff . . . 164
9.29.1.4 cmd_ion . . . 165
9.29.1.5 cmd_rgb . . . 165
9.29.1.6 loadrgb_kb . . . 166
9.29.1.7 loadrgb_mouse . . . 168
9.29.1.8 printrgb . . . 168

9.29.1.9 savergb_kb . . . 170
9.29.1.10 savergb_mouse . . . 171
9.29.1.11 updatergb_kb . . . 171
9.29.1.12 updatergb_mouse . . . 173
9.30 src/ckb-daemon/led_keyboard.c File Reference . . . 174
9.30.1 Macro Definition Documentation . . . 197
9.30.1.1 BR1 . . . 197
9.30.1.2 BR2 . . . 197
9.30.1.3 BR4 . . . 197
9.30.1.4 O0 . . . 197
9.30.1.5 O1 . . . 197
9.30.1.6 O2 . . . 197
9.30.1.7 O3 . . . 197
9.30.1.8 O4 . . . 197
9.30.1.9 O5 . . . 197
9.30.1.10 O6 . . . 197
9.30.1.11 O7 . . . 197
9.30.1.12 O8 . . . 197
9.30.2 Function Documentation . . . 198
9.30.2.1 loadrgb_kb . . . 198
9.30.2.2 makergb_512 . . . 200
9.30.2.3 makergb_full . . . 200
9.30.2.4 ordered8to3 . . . 201
9.30.2.5 quantize8to3 . . . 201
9.30.2.6 rgbcmp . . . 202
9.30.2.7 savergb_kb . . . 202
9.30.2.8 updatergb_kb . . . 204
9.30.3 Variable Documentation . . . 205
9.30.3.1 bit_reverse_table . . . 206
9.31 src/ckb-daemon/led_mouse.c File Reference . . . 207
9.31.1 Function Documentation . . . 207
9.31.1.1 isblack . . . 207
9.31.1.2 loadrgb_mouse . . . 208
9.31.1.3 rgbcmp . . . 208
9.31.1.4 savergb_mouse . . . 209
9.31.1.5 updatergb_mouse . . . 209
9.32 src/ckb-daemon/main.c File Reference . . . 210
9.32.1 Function Documentation . . . 211
9.32.1.1 localecase . . . 211
9.32.1.2 main . . . 212

9.32.1.3 quit . . . 214
9.32.1.4 quitWithLock . . . 215
9.32.1.5 restart . . . 216
9.32.1.6 sighandler . . . 217
9.32.1.7 sighandler2 . . . 218
9.32.1.8 timespec_add . . . 218
9.32.2 Variable Documentation . . . 219
9.32.2.1 features_mask . . . 219
9.32.2.2 hwload_mode . . . 219
9.32.2.3 main_ac . . . 219
9.32.2.4 main_av . . . 219
9.32.2.5 reset_stop . . . 219
9.33 src/ckb-daemon/notify.c File Reference . . . 219
9.33.1 Macro Definition Documentation . . . 220
9.33.1.1 HW_STANDARD . . . 220
9.33.1.2 HWMODE_OR_RETURN . . . 220
9.33.2 Function Documentation . . . 221
9.33.2.1 _cmd_get . . . 221
9.33.2.2 cmd_get . . . 223
9.33.2.3 cmd_notify . . . 224
9.33.2.4 cmd_restart . . . 224
9.33.2.5 nprintf . . . 225
9.33.2.6 nprintind . . . 226
9.33.2.7 nprintkey . . . 226
9.33.2.8 restart . . . 227
9.34 src/ckb-daemon/notify.h File Reference . . . 228
9.34.1 Function Documentation . . . 229
9.34.1.1 cmd_get . . . 229
9.34.1.2 cmd_notify . . . 230
9.34.1.3 cmd_restart . . . 230
9.34.1.4 nprintf . . . 230
9.34.1.5 nprintind . . . 231
9.34.1.6 nprintkey . . . 232
9.35 src/ckb-daemon/os.h File Reference . . . 232
9.35.1 Macro Definition Documentation . . . 233
9.35.1.1 _DEFAULT_SOURCE . . . 233
9.35.1.2 _GNU_SOURCE . . . 233
9.35.1.3 euid_guard_start . . . 233
9.35.1.4 euid_guard_stop . . . 233
9.35.1.5 UINPUT_VERSION . . . 234

9.36 src/ckb-daemon/profile.c File Reference . . . 234
9.36.1 Function Documentation . . . 235
9.36.1.1 _freeprofile . . . 235
9.36.1.2 allocprofile . . . 235
9.36.1.3 cmd_erase . . . 236
9.36.1.4 cmd_eraseprofile . . . 237
9.36.1.5 cmd_id . . . 237
9.36.1.6 cmd_name . . . 238
9.36.1.7 cmd_profileid . . . 238
9.36.1.8 cmd_profilename . . . 239
9.36.1.9 freemode . . . 239
9.36.1.10 freeprofile . . . 240
9.36.1.11 gethwmodename . . . 240
9.36.1.12 gethwprofilename . . . 241
9.36.1.13 getid . . . 242
9.36.1.14 getmodename . . . 242
9.36.1.15 getprofilename . . . 243
9.36.1.16 hwtonative . . . 244
9.36.1.17 initmode . . . 244
9.36.1.18 loadprofile . . . 245
9.36.1.19 nativetohw . . . 245
9.36.1.20 printname . . . 246
9.36.1.21 setid . . . 247
9.36.1.22 u16dec . . . 247
9.36.1.23 u16enc . . . 248
9.36.1.24 urldecode2 . . . 249
9.36.1.25 urlencode2 . . . 249
9.36.2 Variable Documentation . . . 250
9.36.2.1 utf16to8 . . . 250
9.36.2.2 utf8to16 . . . 250
9.37 src/ckb-daemon/profile.h File Reference . . . 250
9.37.1 Macro Definition Documentation . . . 251
9.37.1.1 hwloadprofile . . . 251
9.37.2 Function Documentation . . . 251
9.37.2.1 allocprofile . . . 251
9.37.2.2 cmd_erase . . . 252
9.37.2.3 cmd_eraseprofile . . . 253
9.37.2.4 cmd_hwload_kb . . . 253
9.37.2.5 cmd_hwload_mouse . . . 254
9.37.2.6 cmd_hwsave_kb . . . 255

9.37.2.7 cmd_hwsave_mouse . . . 256
9.37.2.8 cmd_id . . . 257
9.37.2.9 cmd_name . . . 257
9.37.2.10 cmd_profileid . . . 258
9.37.2.11 cmd_profilename . . . 258
9.37.2.12 freeprofile . . . 259
9.37.2.13 gethwmodename . . . 259
9.37.2.14 gethwprofilename . . . 260
9.37.2.15 getid . . . 261
9.37.2.16 getmodename . . . 261
9.37.2.17 getprofilename . . . 262
9.37.2.18 hwtonative . . . 263
9.37.2.19 loadprofile . . . 263
9.37.2.20 nativetohw . . . 264
9.37.2.21 setid . . . 264
9.38 src/ckb-daemon/profile_keyboard.c File Reference . . . 265
9.38.1 Function Documentation . . . 265
9.38.1.1 cmd_hwload_kb . . . 265
9.38.1.2 cmd_hwsave_kb . . . 266
9.38.1.3 hwloadmode . . . 267
9.39 src/ckb-daemon/profile_mouse.c File Reference . . . 268
9.39.1 Function Documentation . . . 268
9.39.1.1 cmd_hwload_mouse . . . 269
9.39.1.2 cmd_hwsave_mouse . . . 270
9.40 src/ckb-daemon/structures.h File Reference . . . 270
9.40.1 Data Structure Documentation . . . 272
9.40.1.1 struct usbid . . . 272
9.40.1.2 struct macroaction . . . 273
9.40.1.3 struct keymacro . . . 274
9.40.1.4 struct binding . . . 275
9.40.1.5 struct dpiset . . . 276
9.40.1.6 struct lighting . . . 277
9.40.1.7 struct usbmode . . . 278
9.40.1.8 struct usbprofile . . . 279
9.40.1.9 struct hwprofile . . . 280
9.40.1.10 struct usbinput . . . 281
9.40.1.11 struct usbdevice . . . 282
9.40.2 Macro Definition Documentation . . . 284
9.40.2.1 CLEAR_KEYBIT . . . 284
9.40.2.2 DPI_COUNT . . . 284

9.40.2.3 FEAT_ADJRATE . . . 284
9.40.2.4 FEAT_ANSI . . . 284
9.40.2.5 FEAT_BIND . . . 284
9.40.2.6 FEAT_COMMON . . . 284
9.40.2.7 FEAT_FWUPDATE . . . 284
9.40.2.8 FEAT_FWVERSION . . . 285
9.40.2.9 FEAT_HWLOAD . . . 285
9.40.2.10 FEAT_ISO . . . 285
9.40.2.11 FEAT_LMASK . . . 285
9.40.2.12 FEAT_MONOCHROME . . . 285
9.40.2.13 FEAT_MOUSEACCEL . . . 285
9.40.2.14 FEAT_NOTIFY . . . 285
9.40.2.15 FEAT_POLLRATE . . . 285
9.40.2.16 FEAT_RGB . . . 285
9.40.2.17 FEAT_STD_NRGB . . . 286
9.40.2.18 FEAT_STD_RGB . . . 286
9.40.2.19 HAS_ANY_FEATURE . . . 286
9.40.2.20 HAS_FEATURES . . . 286
9.40.2.21 HWMODE_K70 . . . 286
9.40.2.22 HWMODE_K95 . . . 286
9.40.2.23 HWMODE_MAX . . . 286
9.40.2.24 I_CAPS . . . 286
9.40.2.25 I_NUM . . . 286
9.40.2.26 I_SCROLL . . . 286
9.40.2.27 IFACE_MAX . . . 287
9.40.2.28 KB_NAME_LEN . . . 287
9.40.2.29 LIFT_MAX . . . 287
9.40.2.30 LIFT_MIN . . . 287
9.40.2.31 MACRO_MAX . . . 287
9.40.2.32 MD_NAME_LEN . . . 287
9.40.2.33 MODE_COUNT . . . 287
9.40.2.34 MSG_SIZE . . . 287
9.40.2.35 NEEDS_FW_UPDATE . . . 287
9.40.2.36 OUTFIFO_MAX . . . 288
9.40.2.37 PR_NAME_LEN . . . 288
9.40.2.38 SCROLL_ACCELERATED . . . 288
9.40.2.39 SCROLL_MAX . . . 288
9.40.2.40 SCROLL_MIN . . . 288
9.40.2.41 SERIAL_LEN . . . 288
9.40.2.42 SET_KEYBIT . . . 288

9.40.3 Variable Documentation . . . 288
9.40.3.1 vtable_keyboard . . . 288
9.40.3.2 vtable_keyboard_nonrgb . . . 288
9.40.3.3 vtable_mouse . . . 289
9.41 src/ckb-daemon/usb.c File Reference . . . 289
9.41.1 Function Documentation . . . 290
9.41.1.1 _resetusb . . . 290
9.41.1.2 _setupusb . . . 290
9.41.1.3 _usbrecv . . . 295
9.41.1.4 _usbsend . . . 296
9.41.1.5 closeusb . . . 297
9.41.1.6 devmain . . . 299
9.41.1.7 get_vtable . . . 301
9.41.1.8 product_str . . . 302
9.41.1.9 revertusb . . . 303
9.41.1.10 setupusb . . . 304
9.41.1.11 usb_tryreset . . . 305
9.41.1.12 vendor_str . . . 306
9.41.2 Variable Documentation . . . 306
9.41.2.1 features_mask . . . 306
9.41.2.2 hwload_mode . . . 306
9.41.2.3 reset_stop . . . 307
9.41.2.4 usbmutex . . . 307
9.42 src/ckb-daemon/usb.h File Reference . . . 307
9.42.1 Detailed Description . . . 310
9.42.2 Macro Definition Documentation . . . 311
9.42.2.1 DELAY_LONG . . . 311
9.42.2.2 DELAY_MEDIUM . . . 311
9.42.2.3 DELAY_SHORT . . . 311
9.42.2.4 IS_FULLRANGE . . . 311
9.42.2.5 IS_K65 . . . 311
9.42.2.6 IS_K70 . . . 311
9.42.2.7 IS_K95 . . . 312
9.42.2.8 IS_M65 . . . 312
9.42.2.9 IS_MONOCHROME . . . 312
9.42.2.10 IS_MONOCHROME_DEV . . . 312
9.42.2.11 IS_MOUSE . . . 312
9.42.2.12 IS_MOUSE_DEV . . . 312
9.42.2.13 IS_RGB . . . 312
9.42.2.14 IS_RGB_DEV . . . 312

9.42.2.15 IS_SABRE . . . 312
9.42.2.16 IS_SCIMITAR . . . 313
9.42.2.17 IS_STRAFE . . . 313
9.42.2.18 NK95_HWOFF . . . 313
9.42.2.19 NK95_HWON . . . 313
9.42.2.20 NK95_M1 . . . 313
9.42.2.21 NK95_M2 . . . 313
9.42.2.22 NK95_M3 . . . 313
9.42.2.23 nk95cmd . . . 313
9.42.2.24 P_K65 . . . 314
9.42.2.25 P_K65_LUX . . . 314
9.42.2.26 P_K65_LUX_STR . . . 314
9.42.2.27 P_K65_NRGB . . . 314
9.42.2.28 P_K65_NRGB_STR . . . 314
9.42.2.29 P_K65_RFIRE . . . 314
9.42.2.30 P_K65_RFIRE_STR . . . 314
9.42.2.31 P_K65_STR . . . 314
9.42.2.32 P_K70 . . . 314
9.42.2.33 P_K70_LUX . . . 314
9.42.2.34 P_K70_LUX_NRGB . . . 315
9.42.2.35 P_K70_LUX_NRGB_STR . . . 315
9.42.2.36 P_K70_LUX_STR . . . 315
9.42.2.37 P_K70_NRGB . . . 315
9.42.2.38 P_K70_NRGB_STR . . . 315
9.42.2.39 P_K70_RFIRE . . . 315
9.42.2.40 P_K70_RFIRE_NRGB . . . 315
9.42.2.41 P_K70_RFIRE_NRGB_STR . . . 315
9.42.2.42 P_K70_RFIRE_STR . . . 315
9.42.2.43 P_K70_STR . . . 315
9.42.2.44 P_K95 . . . 315
9.42.2.45 P_K95_NRGB . . . 316
9.42.2.46 P_K95_NRGB_STR . . . 316
9.42.2.47 P_K95_PLATINUM . . . 316
9.42.2.48 P_K95_PLATINUM_STR . . . 316
9.42.2.49 P_K95_STR . . . 316
9.42.2.50 P_M65 . . . 316
9.42.2.51 P_M65_PRO . . . 316
9.42.2.52 P_M65_PRO_STR . . . 316
9.42.2.53 P_M65_STR . . . 316
9.42.2.54 P_SABRE_L . . . 316

9.42.2.55 P_SABRE_L_STR . . . 316
9.42.2.56 P_SABRE_N . . . 317
9.42.2.57 P_SABRE_N_STR . . . 317
9.42.2.58 P_SABRE_O . . . 317
9.42.2.59 P_SABRE_O2 . . . 317
9.42.2.60 P_SABRE_O2_STR . . . 317
9.42.2.61 P_SABRE_O_STR . . . 317
9.42.2.62 P_SCIMITAR . . . 317
9.42.2.63 P_SCIMITAR_PRO . . . 317
9.42.2.64 P_SCIMITAR_PRO_STR . . . 317
9.42.2.65 P_SCIMITAR_STR . . . 317
9.42.2.66 P_STRAFE . . . 318
9.42.2.67 P_STRAFE_NRGB . . . 318
9.42.2.68 P_STRAFE_NRGB_STR . . . 318
9.42.2.69 P_STRAFE_STR . . . 318
9.42.2.70 resetusb . . . 318
9.42.2.71 USB_DELAY_DEFAULT . . . 318
9.42.2.72 usbrecv . . . 318
9.42.2.73 usbsend . . . 318
9.42.2.74 V_CORSAIR . . . 319
9.42.2.75 V_CORSAIR_STR . . . 319
9.42.3 Function Documentation . . . 319
9.42.3.1 _nk95cmd . . . 319
9.42.3.2 _resetusb . . . 320
9.42.3.3 _usbrecv . . . 321
9.42.3.4 _usbsend . . . 323
9.42.3.5 closeusb . . . 324
9.42.3.6 os_closeusb . . . 326
9.42.3.7 os_inputmain . . . 327
9.42.3.8 os_resetusb . . . 330
9.42.3.9 os_sendindicators . . . 332
9.42.3.10 os_setupusb . . . 334
9.42.3.11 os_usbrecv . . . 335
9.42.3.12 os_usbsend . . . 337
9.42.3.13 product_str . . . 339
9.42.3.14 revertusb . . . 340
9.42.3.15 setupusb . . . 341
9.42.3.16 usb_tryreset . . . 342
9.42.3.17 usbkill . . . 343
9.42.3.18 usbmain . . . 344

9.42.3.19 vendor_str . . . 345
9.43 src/ckb-daemon/usb_linux.c File Reference . . . 346
9.43.1 Data Structure Documentation . . . 348
9.43.1.1 struct _model . . . 348
9.43.2 Macro Definition Documentation . . . 348
9.43.2.1 DEBUG . . . 348
9.43.2.2 N_MODELS . . . 348
9.43.2.3 TEST_RESET . . . 348
9.43.3 Function Documentation . . . 349
9.43.3.1 _nk95cmd . . . 349
9.43.3.2 os_closeusb . . . 350
9.43.3.3 os_inputmain . . . 350
9.43.3.4 os_resetusb . . . 354
9.43.3.5 os_sendindicators . . . 355
9.43.3.6 os_setupusb . . . 356
9.43.3.7 os_usbrecv . . . 357
9.43.3.8 os_usbsend . . . 359
9.43.3.9 strtrim . . . 361
9.43.3.10 udev_enum . . . 362
9.43.3.11 usb_add_device . . . 363
9.43.3.12 usb_rm_device . . . 364
9.43.3.13 usbadd . . . 365
9.43.3.14 usbclaim . . . 367
9.43.3.15 usbkill . . . 367
9.43.3.16 usbmain . . . 368
9.43.3.17 usbunclaim . . . 369
9.43.4 Variable Documentation . . . 370
9.43.4.1 kbsyspath . . . 370
9.43.4.2 models . . . 370
9.43.4.3 udev . . . 371
9.43.4.4 udevthread . . . 371
9.43.4.5 usbthread . . . 371
9.44 src/ckb-daemon/usb_mac.c File Reference . . . 371

Index **373**

Chapter 1

README

ckb-next: RGB Driver for Linux and OS X

ckb-next is an open-source driver for Corsair keyboards and mice. It aims to bring the features of their proprietary CUE software to the Linux and Mac operating systems. This project is currently a work in progress, but it already supports much of the same functionality, including full RGB animations. More features are coming soon. Testing and bug reports are appreciated!

Disclaimer: ckb-next is not an official Corsair product. It is licensed under the GNU General Public License (version 2) in the hope that it will be useful, but with NO WARRANTY of any kind.

What happened to the original `ckb`?

We don't know. The author of **ckb** `ccMSC` suddenly disappeared and hasn't showed up since July 2016. So the community around ckb decided to take the project over and continue its development. That's how **ckb-next** was created. Currently it's not rock solid and very easy to set up on newer systems but we are actively working on this. Nevertheless the project already incorporates a notable amount of fixes and patches in comparison to the original ckb.

Contents

- `Current Status`
- `Device Support`
- `Linux Installation`
- `OS X/macOS Installation`
- `Usage`
- `Troubleshooting`
- `Known Issues`
- `Contributing`

See also:

- https://github.com/mattanger/ckb-next/blob/master/DAEMON.md "Manual for the driver daemon"
- `ckb testing repository` (updated more frequently, but may be unstable)

Device Support

Keyboards:

- K65 RGB
- K70
- K70 RGB
- K70 LUX RGB
- K95∗
- K95 RGB
- Strafe
- Strafe RGB
- = hardware playback not supported. Settings will be saved to software only.

Mice:

- M65 RGB
- M65 PRO RGB
- Sabre RGB
- Scimitar RGB

Linux Installation

Pre-made packages:

ckb-next packages:

- Fedora 24/25, CentOS/RHEL 7 (maintained by):
  - `'johanh/ckb'` - based on `master` branch

ckb packages (deprecated):

- Arch Linux (maintained by):
  - `'aur/ckb-git'` - based on `master` branch (more stable)
  - `'aur/ckb-git-latest'` - based on `testing` branch (less stable but fresher)
- Gentoo (maintained by): `emerge -av app-misc/ckb`

If you are a package maintainer or want to discuss something with package maintainers let us know in the issues, so we can have an accountable and centralized communication about this. *If you would like to maintain a package for your favorite distro/OS, please let us know as well.*

Preparation:

ckb-next requires Qt5 (Qt 5.6 recommened for OS X), libudev, zlib, gcc, g++, and glibc.

- Ubuntu: `sudo apt-get install build-essential libudev-dev qt5-default zlib1g-dev libappindicator-dev`
- Fedora: `sudo dnf install zlib-devel qt5-qtbase-devel libgudev-devel libappindicator-de systemd-devel gcc-c++`
- Arch: `sudo pacman -S base-devel qt5-base zlib`
- Other distros: Look for `qt5` or `libqt5*-devel`

Note: If you build your own kernels, ckb-next requires the uinput flag to be enabled. It is located in `Device Drivers -> Input Device Support -> Miscellaneous devices -> User level driver support`. If you don't know what this means, you can ignore this.

Installing:

You can download ckb-next using the "Download zip" option on the right. Extract it and open the ckb-master directory. The easiest way to install ckb is to double-click the `quickinstall` script and run it in a Terminal. It will attempt to build ckb and then ask if you'd like to install/run the application. If the build doesn't succeed, or if you'd like to compile ckb manually, see https://github.com/ccMSC/ckb/blob/master/BUILD.md "'BUILD.md'" for instructions.

Upgrading:

To install a new version of ckb, or to reinstall the same version, first delete the ckb-master directory and the zip file from your previous download. Then download the source code again and re-run `quickinstall`. The script will automatically replace the previous installation. You may need to reboot afterward.

Uninstalling:

First, stop the ckb-daemon service and remove the service file.

- If you have systemd (Ubuntu versions starting with 15.04): "' sudo systemctl stop ckb-daemon sudo rm -f /usr/lib/systemd/system/ckb-daemon.service "'
- If you have Upstart (Ubuntu versions earlier than 15.04): "' sudo service ckb-daemon stop sudo rm -f /etc/init/ckb-daemon.conf "'
- If you have OpenRC: "' sudo rc-service ckb-daemon stop sudo rc-update del ckb-daemon default sudo rm -f /etc/init.d/ckb-daemon "
- `If you're not sure, re-run the`quickinstall`script and proceed to the service installation. The script will say`System service: Upstart detected`or`System service: systemd detected'. Please be aware that OpenRC is currently not detected automatically.

Afterward, remove the applications and related files: "' sudo rm -f /usr/bin/ckb /usr/bin/ckb-daemon /usr/share/applications/ckb.desktop /usr/share/icons/hicolor/512x512/apps/ckb.png sudo rm -rf /usr/lib/ckb-animations "'

Before https://github.com/mattanger/ckb-next/commit/f347e60df211c60452f95084b6c46dc4ec5f42 animations were located elsewhere, try removing them as well: "' sudo rm -rf /usr/bin/ckb-animations "'

OS X/macOS Installation

Binary download:

The latest OS X/macOS binary can be downloaded here: https://github.com/mattanger/ckb-next/releases/late

Click on `ckb.pkg` under the Downloads section. This is an automated installer which will set up the driver for you. After it's finished, open ckb.app (it will be installed to your Applications directory) to get started.

Building from source:

Install the latest version of Xcode from the App Store. Open Xcode, accept the license agreement, and wait for it to install any additional components (if necessary). When you see the "Welcome to Xcode" screen, the setup is finished and you can close the app. Then install Xcode Command Line Tools package issuing `xcode-select --install` in a Terminal app. Afterwards install Qt5 from here: http://www.qt.-io/download-open-source/

The easiest way to build the driver is with the `quickinstall` script, which is present in the ckb-master folder. Double-click on `quickinstall` and it will compile the app for you, then ask if you'd like to install it system-wide. If the build fails for any reason, or if you'd like to compile manually, see https://github.com/ccMSC/ckb/blob/master/-BUILD.md "'BUILD.md'".

Upgrading (binary):

Download the latest `ckb.pkg`, run the installer, and reboot. The newly-installed driver will replace the old one.

Upgrading (source):

Remove the existing ckb-master directory and zip file. Re-download the source code and run the `quickinstall` script again. The script will automatically replace the previous installation. You may need to reboot afterward.

Uninstalling:

Drag `ckb.app` into the trash. If the system service file isn't cleaned up automatically, you can find it and remove it here: `/Library/LaunchDaemons/com.ckb.daemon.plist`.

Usage

The user interface is still a work in progress.

Major features:

- Control multiple devices independently
- United States and European keyboard layouts
- Customizable key bindings
- Per-key lighting and animation
- Reactive lighting
- Multiple profiles/modes with hardware save function
- Adjustable mouse DPI with ability to change DPI on button press
- Key macros (G-Keys also); Have a look at https://youtu.be/qhrKP03_NrM for a short video tutorial
- Key macro delays: Handle delays between keystrokes when playing a macro

Closing ckb will actually minimize it to the system tray. Use the Quit option from the tray icon or the settings screen to exit the application.

Roadmap (roughly in order)

- **v0.3 release:**
- Ability to store profiles separately from devices, import/export them
- More functions for the Win Lock key
- **v0.4 release:**

- Ability to import CUE profiles
- Ability to tie profiles to which application has focus
- **v0.5 release:**
- Key combos
- Timers?
- **v1.0 release:**
- OSD? (Not sure if this can actually be done)
- Extra settings?
- ????

Troubleshooting

Linux

If you have problems connecting the device to your system (device doesn't respond, ckb-daemon doesn't recognize or can't connect it) and/or you experience long boot times when using the keyboard, try adding the following to your kernel's `cmdline`:

- K65 RGB: `usbhid.quirks=0x1B1C:0x1B17:0x20000408`
- K70: `usbhid.quirks=0x1B1C:0x1B09:0x0x20000408`
- K70 RGB: `usbhid.quirks=0x1B1C:0x1B13:0x20000408`
- K95: `usbhid.quirks=0x1B1C:0x1B08:0x20000408`
- K95 RGB: `usbhid.quirks=0x1B1C:0x1B11:0x20000408`
- Strafe: `usbhid.quirks=0x1B1C:0x1B15:0x20000408`
- Strafe RGB: `usbhid.quirks=0x1B1C:0x1B20:0x20000408`
- M65 RGB: `usbhid.quirks=0x1B1C:0x1B12:0x20000408`
- Sabre RGB Optical: `usbhid.quirks=0x1B1C:0x1B14:0x20000408`
- Sabre RGB Laser: `usbhid.quirks=0x1B1C:0x1B19:0x20000408`
- Scimitar RGB: `usbhid.quirks=0x1B1C:0x1B1E:0x20000408`

For instructions on adding `cmdline` parameters in Ubuntu, see https://wiki.ubuntu.com/Kernel/-KernelBootParameters

If you have multiple devices, combine them with commas, starting after the `=`. For instance, for K70 RGB + M65 RGB: `usbhid.quirks=0x1B1C:0x1B13:0x20000408,0x1B1C:0x1B12:0x20000408`

If it still doesn't work, try replacing `0x20000408` with `0x4`. Note that this will cause the kernel driver to ignore the device(s) completely, so you need to ensure ckb-daemon is running at boot or else you'll have no input. This will not work if you are using full-disk encryption.

If you see **GLib** critical errors like 'GLib-GObject-CRITICAL **: g_type_add_interface_static: assertion 'G_TYPE_-IS_INSTANTIATABLE (instance_type)' failed' and you are using:

- Qt 5.8 and newer, remove your Qt configuration files and restart the ckb GUI. Also watch out for different style overridings in dotfiles under ~/ generated by Qt automatically, remove them as well.
- Qt 5.7 and lower, install `qt5ct` package on Arch Linux (find a similar one for your distribution). That's all. This is a known Qt bug. It happened because Qt did not ship required GTK files.

If you're using **Unity** and the tray icon doesn't appear correctly, run `sudo apt-get install libappindicator-dev`. Then reinstall ckb.

OS X/macOS

- ∗∗“ckb.pkg” can’t be opened because it is from an unidentified developer∗∗ Open `System Preferences > Security & Privacy > General` and click `Open Anyway`.
- **Modifier keys (Shift, Ctrl, etc.) are not rebound correctly** ckb does not recognize modifier keys rebound from System Preferences. You can rebind them again within the application.
- ∗∗∼ key prints §±∗∗ Check your keyboard layout on ckb’s Settings screen. Choose the layout that matches your physical keyboard.
- **Compile problems** Can usually be resolved by rebooting your computer and/or reinstalling Qt. Make sure that Xcode works on its own. If a compile fails, delete the `ckb-master` directory as well as any automatically generated `build-ckb` folders and try again from a new download.
- **Scroll wheel does not scroll** As of #c3474d2 it’s now possible to **disable scroll acceleration** from the GUI. You can access it under "OSX tweaks" in the "More settings" screen. Once disabled, the scroll wheel should behave consistently.

General

Please ensure your keyboard firmware is up to date. If you’ve just bought the keyboard, connect it to a Windows computer first and update the firmware from Corsair’s official utility.

Before reporting an issue, connect your keyboard to a Windows computer and see if the problem still occurs. If it does, contact Corsair. Additionally, please check the Corsair user forums to see if your issue has been reported by other users. If so, try their solutions first.

Common issues:

- **Problem:** ckb says "No devices connected" or "Driver inactive"
- **Solution:** Try rebooting the computer and/or reinstalling ckb. Try removing the keyboard and plugging it back in. If the error doesn’t go away, try the following:
- **Problem:** Keyboard doesn’t work in BIOS, doesn’t work at boot
- **Solution:** Some BIOSes have trouble communicating with the keyboard. They may prevent the keyboard from working correctly in the operating system as well. First, try booting the OS *without* the keyboard attached, and plug the keyboard in after logging in. If the keyboard works after the computer is running but does not work at boot, you may need to use the keyboard’s BIOS mode option.
- BIOS mode can be activated using the poll rate switch at the back of the keyboard. Slide it all the way to the position marked "BIOS". You should see the scroll lock light blinking to indicate that it is on. (Note: Unfortunately, this has its own problems - see Known Issues. You may need to activate BIOS mode when booting the computer and deactivate it after logging in).
- **Problem:** Keyboard isn’t detected when plugged in, even if driver is already running
- **Solution:** Try moving to a different USB port. Be sure to follow `Corsair’s USB connection requirements`. Note that the keyboard does not work with some USB3 controllers - if you have problems with USB3 ports, try USB2 instead. If you have any USB hubs on hand, try those as well. You may also have success sliding the poll switch back and forth a few times.

Reporting issues

If you have a problem that you can’t solve (and it isn’t mentioned in the Known Issues section below), you can report it on `the GitHub issue tracker`. Before opening a new issue, please check to see if someone else has reported your problem already - if so, feel free to leave a comment there.

Known issues

- Using the keyboard in BIOS mode prevents the media keys (including mute and volume wheel), as well as the K95's G-keys from working. This is a hardware limitation.
- The tray icon doesn't appear in some desktop environments. This is a known Qt bug. If you can't see the icon, reopen ckb to bring the window back.
- When starting the driver manually, the Terminal window sometimes gets spammed with enter keys. You can stop it by unplugging and replugging the keyboard or by moving the poll rate switch.
- When stopping the driver manually, the keyboard sometimes stops working completely. You can reconnect it by moving the poll rate switch.

Contributing

You can contribute to the project by `opening a pull request`. It's best if you base your changes off of the `testing` branch as opposed to the `master`, because the pull request will be merged there first. If you'd like to contribute but don't know what you can do, take a look at `the issue tracker` and see if any features/problems are still unresolved. Feel free to ask if you'd like some ideas.

Chapter 2

Building ckb

Linux

You can build the project by running `./qmake-auto && make` in a Terminal inside the ckb-master directory. The binaries will be placed in a new `bin` directory assuming they compile successfully. If you get a `No suitable qmake found` error, make sure Qt5 is installed and up to date. You may have to invoke qmake manually, then run `make` on its own. If you have Qt Creator installed, you can open `ckb.pro` (when asked to configure the project, make sure "Desktop" is checked) and use `Build > Build Project "ckb" (Ctrl+B)` to build the application instead.

Running as a service:

First copy the binary and the service files to their system directories:

- Upstart (Ubuntu, prior to 15.04): `sudo cp -R bin/* /usr/bin && sudo cp service/upstart/ckb-daemon.conf /etc/init`
- Systemd (Ubuntu 15.04 and later): `sudo cp -R bin/* /usr/bin && sudo cp service/systemd/ckb-daemon.service /usr/lib/systemd/system`
- OpenRC: `sudo cp -R bin/* /usr/bin && sudo cp service/openrc/ckb-daemon /etc/init.d/`

To launch the driver and enable it at start-up:

- Upstart: `sudo service ckb-daemon start`
- Systemd: `sudo systemctl start ckb-daemon && sudo systemctl enable ckb-daemon`
- OpenRC: `sudo rc-service ckb-daemon start && sudo rc-update add ckb-daemon default`

Open the `bin` directory and double-click on `ckb` to launch the user interface. If you want to run it at login, add `ckb --background` to your Startup Applications.

Running manually:

Open the `bin` directory in a Terminal and run `sudo ./ckb-daemon` to start the driver. To start the user interface, run `./ckb`. Running the driver manually may be useful for testing/debugging purposes, but you must leave the terminal window open and you'll have to re-run it at every reboot, so installing it as a service is the best long-term solution.

OSX

Open ckb.pro in Qt Creator. You should be prompted to configure the project (make sure the "Desktop" configuration is selected and not iOS). Once it's finished loading, press `Cmd+B` or select `Build > Build Project "ckb"` from the menu bar. When it's done, you should see a newly-created `ckb.app` in the project directory. Exit Qt Creator.

Alternatively, open a Terminal in the ckb-master directory and run `./qmake-auto && make`. It will detect Qt automatically if you installed it to one of the standard locations. You should see a newly created `ckb.app` if the build is successful.

Running as a service:

Copy `ckb.app` to your Applications folder. Copy the file `'service/launchd/com.ckb.daemon.plist'` to your computer's `/Library/LaunchDaemons` folder (you can get to it by pressing `Cmd+Shift+G` in Finder and typing the location). Then open a Terminal and run the following commands to launch the driver:

"' sudo chown root:wheel /Library/LaunchDaemons/com.ckb.daemon.plist sudo chmod 0700 /Library/LaunchDaemons/com.ckb.daemon.plist sudo launchctl load /Library/LaunchDaemons/com.ckb.daemon.plist "'

After you're done, open `ckb.app` to launch the user interface.

Running manually:

Open a Terminal in the ckb directory and run `sudo ckb.app/Contents/Resources/ckb-daemon` to start the driver. Open `ckb.app` to start the user interface. Note that you must leave the terminal window open and must re-launch the driver at every boot if you choose this; installing as a service is the better long term solution.

Chapter 3

cbk Improvements Roadmap

Short term plan

- merge existing PR submitted to original ckb repo
- Contact other developers interested in collaboration on a new and improved version of ckb
- Figure out the issues relating to MacOS Sierra and other version
- Device support:
  - Determine which will need support other than just USB id additions
- Address existing bugs. Not help requests.

Chapter 4

DAEMON

The daemon provides devices at `/dev/input/ckb*`, where `*` is the device number, starting at 1. Up to 9 devices may be connected at once and controlled independently. The daemon additionally provides `/dev/input/ckb0`, which stores driver information.

Mac note: The devices on OSX are located at `/var/run/ckb*` and not `/dev/input/ckb*`. So wherever you see `/dev/input` in this document, replace it with `/var/run`.

`/dev/input/ckb0` contains the following files:

- `connected`: A list of all connected devices, one per line. Each line contains a device path followed by the device's serial number and its description.
- `pid`: The process identifier of the daemon.
- `version`: The daemon version.

Other `ckb*` devices contain the following:

- `cmd`: Keyboard controller.
- `notify0`: Keyboard- or mouse notifications.
- `notify1`: Keyboard- or mouse notifications, used for macro recording.
- `features`: Device features.
- `fwversion`: Device firmware version (not present on all devices).
- `model`: Device description/model.
- `pollrate`: Poll rate in milliseconds (not present on all devices).
- `productid`: Contains the USB productID of the hardware
- `serial`: Device serial number. `model` and `serial` will match the info found in `ckb0/connected`

Commands

The `/dev/input/ckb*/cmd` nodes accept input in the form of text commands. They are normally accessible to all users on the system (see Security section). Commands should be given in the following format: `[mode <n>] command1 [paramter1] [command2] [parameter2] [command3] [parameter3] ...`

In a terminal shell, you can do this like `echo mycommand > /dev/input/ckb1/cmd`. Programmatically, you can open and write them as regular files. When programming, you must append a newline character and flush the output before your command(s) will actually be read.

The mode parameter is used to group settings. Most (but not all) settings are mode-specific; that is, changing mode 1 will not affect mode 2. By default, all commands affect the current mode. Use mode <n> switch to change the current mode.

When plugged in, all devices start in hardware-controlled mode (also known as idle mode) and will not respond to commands. Before issuing any other commands, write active to the command node, like echo active > /dev/input/ckb1/cmd. To put the device back into hardware mode, issue the idle command.

Features

The features node describes features supported by the device, which may not be present on all devices. The first two words in the features node are always <vendor> <model>, like corsair k70. After that, any of the following features may appear:

- adjrate: Device supports adjustable poll rate.
- bind: Device supports key rebinding.
- fwupdate: Device supports firmware updates.
- fwversion: Device has a detectable firmware version (stored in the fwversion node).
- notify: Device supports key notifications.
- pollrate: Device has a detectable poll rate (stored in the pollrate node).
- rgb: Device supports RGB lighting.

Keyboard layout

The driver has no concept of keyboard layouts; all keys are referred to by their English names regardless of the underlying hardware. This means that, for instance, in an AZERTY layout the q key in ckb-daemon corresponds to A on the physical keyboard. Note that on UK/european (ISO) layouts, the backslash key (beside left shift) is called bslash_iso, while bslash refers to the backslash on the US keyboard. The key next to Enter on the ISO keyboard is known as hash. See src/ckb-daemon/keymap.c for the full table of supported keys.

For technical reasons, the OSX driver may swap the bslash_iso and grave keys if the keyboard layout is not set correctly. To compensate for this, write layout iso or layout ansi to the command node.

Poll rate

A device's current poll rate can be read from its pollrate node, assuming it has one. Keyboards have a hardware switch to control poll rate and cannot be adjusted via software. However, mice have a software-controlled poll rate. You can change it by issuing pollrate <interval> to the command node, where interval is the time in milliseconds. Valid poll rates are 1, 2, 4, and 8.

Profiles and modes

Each mode has its own independent binding and lighting setup. When the daemon starts or a keyboard is plugged in, the profile will be loaded from the hardware. By default, all commands will update the currently selected mode. The mode <n> command may be used to change the settings for a different mode. Up to 6 modes are available. Each keyboard has one profile, which may be given a name. Mode 1 may be saved to the device hardware, or modes 1-3 in the case of the K95. Modes 4 through 6 are software-only. Profile management commands are as follows:

- profilename <name> sets the profile's name. The name must be written without spaces; to add a space, use %20.

- `name <name>` sets the current mode's name. Use `mode <n> name <name>` to set a different mode's name.
- `profileid <guid> [<modification>]` sets a profile's ID. The GUID must be written in registry format, like `{12345678-ABCD-EF01-2345-6789ABCDEF01}`. The optional modification number must be written with 8 hex digits, like `ABCDEF01`.
- `id <guid> [<modification>]` sets a mode's ID.
- `mode <n> switch` switches the keyboard to mode N. If the mode does not exist, it will be created with a blank ID, black lighting, and default bindings.
- `hwload` loads the RGB profile from the hardware. Key bindings and non-hardware RGB modes are unaffected.
- `hwsave` saves the RGB profile to the hardware.
- `erase` erases the current mode, resetting its lighting and bindings. Use `mode <n> erase` to erase a different mode.
- `eraseprofile` erases the entire profile, deleting its name, ID, and all of its modes.

Examples:

- `profilename My%20Profile mode 1 name Mode%201 mode 2 name Mode%202 mode 3 name Mode%203` will name the profile "My Profile" and name modes 1-3 "Mode 1", "Mode 2", and "Mode 3".
- `eraseprofile hwload` resets the entire profile to its hardware settings.

LED commands

The backlighting is controlled by the `rgb` commands.

- `rgb <RRGGBB>` sets the entire keyboard to the color specified by the hex constant RRGGBB.
- `rgb <key>:<RRGGBB>` sets the specified key to the specified hex color.

Examples:

- `rgb ffffff` makes the whole keyboard white.
- `rgb 000000` makes the whole keyboard black.
- `rgb esc:ff0000` sets the Esc key red but leaves the rest of the keyboard unchanged.

Multiple keys may be changed to one color when separated with commas, for instance:

- `rgb w,a,s,d:0000ff` sets the WASD keys to blue.

Additionally, multiple commands may be combined into one, for instance:

- `rgb ffffff esc:ff0000 w,a,s,d:0000ff` sets the Esc key red, the WASD keys blue, and the rest of the keyboard white (note the lack of a key name before `ffffff`, implying the whole keyboard is to be set).

By default, the controller runs at 30 FPS, meaning that attempts to animate the LEDs faster than that will be ignored. If you wish to change it, send the command `fps <n>`. The maximum frame rate is 60.

For devices running in 512-color mode, color dithering can be enabled by sending the command `dither 1`. The command `dither 0` disables dithering.

Indicators

The indicator LEDs (Num Lock, Caps Lock, Scroll Lock) are controlled with the `i` commands.

- `ioff <led>` turns an indicator off permanently. Valid LED names are `num`, `caps`, and `scroll`.
- `ion <led>` turns an indicator on permanently.
- `iauto <led>` turns an indicator off or on automatically (default behavior).

Binding keys

Keys may be rebound through use of the `bind` commands. Binding is a 1-to-1 operation that translates one keypress to a different keypress regardless of circumstance.

- `bind <key1>:<key2>` remaps key1 to key2.
- `unbind <key>` unbinds a key, causing it to lose all function.
- `rebind <key>` resets a key, returning it to its default binding.

Examples:

- `bind g1:esc` makes G1 become an alternate Esc key (the actual Esc key is not changed).
- `bind caps:tab tab:caps` switches the functions of the Tab and Caps Lock keys.
- `unbind lwin rwin` disables both Windows keys, even without using the keyboard's Windows Lock function.
- `rebind all` resets the whole keyboard to its default bindings.

Key macros

Macros are a more advanced form of key binding, controlled with the `macro` command.

- `macro <keys>:<command>` binds a key combination to a command, where the command is a series of key presses. To combine keys, separate them with `+`; for instance, `lctrl+a` binds a macro to (left) Ctrl+A. In the command field, enter `+<key>` to trigger a key down or `-<key>` to trigger a key up. To simulate a key press, use `+<key>,-<key>`.
- `macro <keys>:clear` clears commands associated with a key combination. Only one macro may be assigned per combination; assigning a second one will overwrite the first.
- `macro clear` clears all macros.

Examples:

- `macro g1:+lctrl,+a,-a,-lctrl` triggers a Ctrl+A when G1 is pressed.
- `macro g2+g3:+lalt,+f4,-f4,-lalt` triggers an Alt+F4 when G2 and G3 are pressed simultaneously.

Assigning a macro to a key will cause its binding to be ignored; for instance, `macro a:+b,-b` will cause A to generate a B character regardless of its binding. However, `macro lctrl+a:+b,-b` will cause A to generate a B only when Ctrl is also held down.

Macro playback delay

There are two types of playback delay that can be set with macros; global and local. Setting a *global delay* value introduces a time delay between events during macro execution or playback. *Local delay* allows setting the delay after an individual event, overriding the global delay value for that event. Thus global delay can be used to set the overall playback speed of macros and local delays can be used to tune individual events within a macro.

All delay values are specified in microseconds (us) and are positive values from `0` to `UINT_MAX - 1`. This means delays range from 0 to just over 1 hour (4,294,967,294us, 4,294 seconds, 71 minutes, or 1.19 hours). A value of zero (0) represents no delay between actions.

Global macro delay (default delay)

Global delay allows macro playback speed to be changed. It sets the time between (actually after) each recorded macro event. If global delay is set to 1 microsecond then a 1 ms delay will follow each individual macro event when the macro is triggered.

The *global delay* is set with the ckb-daemon's existing (in testing branch) `delay` command followed by an unsigned integer representing the number of microseconds to wait after each macro action and before the next.

Global delay can also be set to `on` which maintains backwards compatibility with the current development of `ckb-daemon` for long macro playback. That is, setting the global delay to `on` introduces a 30us and a 100us delay based on the macro's length during playback.

NOTE: This setting also introduces a delay after the last macro action. This functionality exists in the current testing branch and was left as-is. It is still to be determined if this is a bug or a feature.

Examples:

- `delay 1000` sets a 1,000us delay between action playback.
- `delay on` sets long macro delay; 30us for actions between 20 and 200, 100us for actions > 200.
- `delay off` sets no delay (same as 0).
- `delay 0` sets no delay (same as off).
- `delay spearmint-potato` is invalid input, sets no delay (same as off).

Local macro delay (keystroke delay)

Local Delay allows each macro action to have a post-action delay associated with it. This allows a macro to vary it's playback speed for each event. If no local delay is specified for a macro action, then the global `delay` (above) is used. All delay values are in microsecods (us) as with the global delay setting.

Examples:

- `macro g5:+d,-d,+e=5000,-e,+l,-l=10000,+a,-a,+y,-y=1000000,+enter,-enter` define a macro for `g5` with a 5,000us delay between the `e` down and `e` up actions. A 1,000us delay between `l` up and `a` down, a delay of one second (1,000,000us) after `y` up and before `enter`, and the global delay for all other actions.
- `macro g5:+d,-d=0` use default delay between `d` down and `d` up and no delay (0us) after `d` up. This removes the noted feature/bug (above) where the last action has a trailing delay associated with it.

DPI and mouse settings

DPI settings are stored in a bank. They are controlled with the `dpi` command.

- `dpi <stage>:<x>,<y>` sets the DPI for a given `stage` to `x` by `y`. Valid stages are `0` through `5`. In hardware, `1` is the first (lowest) stage and `5` is the highest. Stage `0` is used for Sniper mode.
- `dpi <stage>:<xy>` sets both X and Y.

- `dpi <stage>:off` disables a DPI stage.
- `dpisel <stage>` sets the current stage selection.

In order to change the mouse's current DPI, first update one of the stages with the value you want, then select that stage. For instance:

- `dpi 1:1000 dpisel 1` sets the current DPI to 1000x1000.

Additional mouse settings:

- `lift <height>` sets the lift height, from `1` (lowest) to `5` (highest)
- `snap <on|off>` enables or disables Angle Snap.

Notifications

The keyboard can be configured to generate user-readable notifications on keypress events. These are controlled with the `notify` commands. In order to see events, read from `/dev/input/ckb*/notify0`. In a terminal, you can do this like `cat /dev/input/ckb1/notify0`. Programmatically, you can open it for reading like a regular file.

Note that the file can only reliably be read by one application: if you try to open it in two different programs, they may both fail to get data. Data will be buffered as long as no programs are reading, so you will receive all unread notifications as soon as you open the file. If you'd like to read notifications from two separate applications, send the command `notifyon <n>` to the keyboard you wish to receive notifications from, where N is a number between 1 and 9. If `/dev/input/ckb*/notify<n>` does not already exist, it will be created, and you can read notifications from there without disrupting any other program. To close a notification node, send `notifyoff <n>`.

`notify0` is always open and will not be affected by `notifyon`/`notifyoff` commands. By default, all notifications are printed to `notify0`. To print output to a different node, prefix your command with `@<node>`.

Notifications are printed with one notification per line. Commands are as follows:

- `notify <key>:on` or simply `notify <key>` enables notifications for a key. Each key will generate two notifications: `key +<key>` when the key is pressed, and `key -<key>` when it is released.
- `notify <key>:off` turns notifications off for a key.

Examples:

- `notify w a s d` sends notifications whenever W, A, S, or D is pressed.
- `notify g1 g2 g3 g4 g5 g6 g7 g8 g9 g10 g11 g12 g13 g14 g15 g16 g17 g18 mr m1 m2 m3 light lock` prints a notification whenever a non-standard key is pressed.
- `notify all:off` turns all key notifications off.
- `@5 notify esc` prints Esc key notifications to `notify5`.

Note: Key notifications are *not* affected by bindings. For instance, if you run `echo bind a:b notify a > /dev/input/ckb1/cmd` and then press the A key, the notifications will read `key +a key -a`, despite the fact that the character printed on screen will be `b`. Likewise, unbinding a key or assigning a macro to a key does not affect the notifications.

Indicator notifications

You can also choose to receive notifications for the indicator LEDs by using the `inotify` command. For instance, `inotify caps:on` or simply `inotify caps` will print notifications whenever the Caps Lock LED is toggled. The notifications will read `i +caps` when the light is turned on and `i -caps` when it is turned off. It is also possible to toggle all indicators at once using `inotify all` or `inotify all:off`.

Like key notifications, indicator notifications are not affected by bindings, nor by the `ion`, `ioff`, or `iauto` commands. The notifications will reflect the state of the LEDs as seen be the event device.

Getting parameters

Parameters can be retrieved using the `get` command. The data will be sent out as a notification. Generally, the syntax to get the data associated with a command is `get :<command>` (note the colon), and the associated data will be returned in the form of `<command> <data>`. The following data may be gotten:

- `get :mode` returns the current mode in the form of a `switch` command. (Note: Do not use this in a line containing a `mode` command or it will return the mode that you selected, rather than the keyboard's current mode.)
- `get :name` returns the current mode's name in the form of `mode <n> name <name>`. To see the name of another mode, use `mode <n> get :name`. The name is URL-encoded; spaces are written as %20. The name may be truncated, so `name <some long string> get :name` may return something shorter than what was entered.
- `get :profilename` returns the profile's name, in the form of `profilename <name>`. As above, it is URL-encoded and may be truncated.
- `get :hwname` and `get :hwprofilename` return the same thing except taken from the current hardware profile instead of the in-memory profile. The output is identical but will read `hwname` instead of `name` and `hwprofilename` instead of `profilename`.
- `get :id` returns the current mode's ID and modification number in the form of `mode <n> id <guid> <modification>`.
- `get :profileid` returns the current profile's ID and modification number in the form of `profileid <guid> <modification>`.
- `get :hwid` and `get :hwprofileid` return the same thing except from the current hardware profile/mode. As before, the ouput will be the same but with `hwid` and `hwprofileid` instead of `id` and `profileid`.
- `get :rgb` returns an `rgb` command equivalent to the current RGB state.
- `get :hwrgb` does the same thing, but retrieves the colors currently stored in the hardware profile. The output will say `hwrgb` instead of `rgb`.
- `get :dpi` returns a `dpi` command equivalent to the current DPI bank.
- `get :dpisel` returns a `dpisel` command for the currently-selected DPI stage.
- `get :lift` returns a `lift` command for the current lift height.
- `get :snap` returns the current angle snap status.
- `get :hwdpi`, `get :hwdpisel`, `get :hwlift`, and `get :hwsnap` return the same properties, but for the current hardware profile.
- `get :keys` and `get :i` return the current keypress status and indicator status, respectively. They will indicate all currently pressed keys and all currently active indicators, like `key +enter` and `i +num`.

Like `notify`, you must prefix your command with `@<node>` to get data printed to a node other than `notify0`.

Firmware updates

WARNING: Improper use of `fwupdate` may brick your device; use this command *at your own risk*. I accept no responsibility for broken keyboards.

The latest firmware versions and their URLs can be found in the `FIRMWARE` document. To update your keyboard's firmware, first extract the contents of the zip file and then issue the command `fwupdate /path/to/fw/file.bin` to the keyboard you wish to update. The path name must be absolute and must not include spaces. If it succeeded, you should see `fwupdate <path> ok` logged to the keyboard's notification node and then the device will disconnect and reconnect. If you see `fwupdate <path> invalid` it means that the firmware file was not valid for the device; more info may be available in the daemon's `stdout`. If you see `fwupdate <path> fail` it means that the file was valid but the update failed at a hardware level. The keyboard may disconnect/reconnect anyway or it may remain in operation.

When the device reconnects you should see the new firmware version in its `fwversion` node; if you see `0000` instead it means that the keyboard did not update successfully and will need another `fwupdate` command in order to function again. If the update fails repeatedly, try connecting the keyboard to a Windows PC and using the official firmware update in CUE.

Restart

Because sometimes the communication between the daemon and the keyboard is corrupted after resuming from standby or suspend, a restart function is implemented. It first calls the quit() function, then it calls main() again with the original parameter list.

There are two ways to restart the daemon:

- send the string "restart some-description-as-one-word" to the cmd-pipe (normally /dev/input/ckb1/cmd or /dev/input/ckb2/cmd, depending on what device gets which ID.
- send SIGUSR1 to the daemon process (as root).

Later on, there may be a user interface in the client for the first method.

Security

By default, all of the `ckb*` nodes may be accessed by any user. For most single-user systems this should not present any security issues, since only one person will have access to the computer anyway. However, if you'd like to restrict the users that can write to the `cmd` nodes or read from the `notify` nodes, you can specify the `--gid=<group>` option at start up. For instance, on most systems you could run `ckb-daemon --gid=1000` to make them accessible only by the system's primary user. `ckb-daemon` must still be run as root, regardless of which `gid` you specify. The `gid` option may be set only at startup and cannot be changed while the daemon is running.

The daemon additionally supports a `--nonotify` option to disable key notifications, to prevent unauthorized programs from logging key input. Note that this will interfere with some of `ckb`'s abilities. It is also highly unlikely to increase security unless you are using the program in a stripped down terminal environment without Xorg. For most use cases there are many other (more likely) ways that a keylogger program could compromise your system. Nevertheless, the option is provided for the sake of paranoia. If you'd like to disable key rebinding as well, launch the daemon with `--nobind`. `--nobind` implies `--nonotify`, so notifications will also be disabled. As with `--gid`, these options must be set at startup and cannot be changed while the daemon is running.

Chapter 5

Todo List

Global _usbsend (usbdevice ∗kb, const uchar ∗messages, int count, const char ∗file, int line)

A lot of different conditions are combined in this code. Don't think, it is good in every combination...

Check whether this is the same in the macOS variant. It is not dramatic, but if errors occur, it can certainly irritate the devices completely if they receive incomplete data streams. Do we have errors with the messages "Wrote YY bytes (expected 64)" in the system logs? If not, we do not need to look any further.

Global closeusb (usbdevice ∗kb)

What is not yet comprehensible is the call to updateconnected() BEFORE os_closeusb(). Should that be in the other sequence? Or is updateconnected() not displaying the connected usb devices, but the representation which uinput devices are loaded? Questions about questions ...

Global devmain (usbdevice ∗kb)

Hope to find the need for dmutex usage later.

Should this function be declared as pthread_t∗ function, because of the defintion of pthread-create? But void∗ works also...

readcmd() gets a **line**, not **lines**. Have a look on that later.

Is the condition IS_CONNECTED valid? What functions change the condititon for the macro?

Global get_vtable (short vendor, short product)

Is the last point really a good decision and always correct?

Global inputupdate_keys (usbdevice ∗kb)

If we want to get all keys typed while a macro is played, add the code for it here.

Global macro_pt_enqueue ()

find a better exit strategy if no more mem available.

Global os_inputmain (void ∗context)

This function is a collection of many tasks. It should be divided into several sub-functions for the sake of greater convenience:

Global os_resetusb (usbdevice ∗kb, const char ∗file, int line)

it seems that no one wants to try the reset again. But I'v seen it somewhere...

Global os_setupusb (usbdevice ∗kb)

in these modules a pullrequest is outstanding

Global os_usbsend (usbdevice ∗kb, const uchar ∗out_msg, int is_recv, const char ∗file, int line)

Since the handling of endpoints has already led to problems elsewhere, this implementation is extremely hardware-dependent and critical!

Eg. the new keyboard K95PLATINUMRGB has a version number significantly less than 2.0 - will it run with this implementation?

Global product_str (short product)

There are macros defined in usb.h to detect all the combinations below. the only difference is the parameter: The macros need the *kb*∗, product_str() needs the *product ID*

Global revertusb (usbdevice ∗kb)

Why is this useful? Are there problems seen with deactivating a device with older fw-version??? Why isn't this an error indicating reason and we return success (0)?

The return value of nk95cmd() is ignored (but sending the ioctl may produce an error and _nk95_cmd will indicate this), instead revertusb() returns success in any case.

Global udevthread

These two thread vasriables seem to be unused: usbtread, udevthread

Global udevthread

These two thread vasriables seem to be unused: usbtread, udevthread

Global usb_add_device (struct udev_device ∗dev)

So why the hell not a transformation between the string and the short presentation? Lets check if the string representation is used elsewhere.

Global usb_tryreset (usbdevice ∗kb)

Why does usb_tryreset() hide the information returned from resetusb()? Isn't it needed by the callers?

Global usbmain ()

Why isn't missing of uinput a fatal error?

lae. here the work has to go on...

Global usbmutex

We should have a look why this mutex is never used.

Chapter 6

Data Structure Index

6.1 Data Structures

Here are the data structures with brief descriptions:

devcmd.__unnamed__ 27

Chapter 7

File Index

7.1 File List

Here is a list of all files with brief descriptions:

src/ckb-daemon/command.c . . . 31
src/ckb-daemon/command.h . . . 36
src/ckb-daemon/device.c . . . 45
src/ckb-daemon/device.h . . . 49
src/ckb-daemon/device_keyboard.c . . . 59
src/ckb-daemon/device_mouse.c . . . 63
src/ckb-daemon/device_vtable.c . . . 66
src/ckb-daemon/devnode.c . . . 68
src/ckb-daemon/devnode.h . . . 82
src/ckb-daemon/dpi.c . . . 90
src/ckb-daemon/dpi.h . . . 95
src/ckb-daemon/extra_mac.c . . . 100
src/ckb-daemon/firmware.c . . . 100
src/ckb-daemon/firmware.h . . . 105
src/ckb-daemon/includes.h . . . 107
src/ckb-daemon/input.c . . . 111
src/ckb-daemon/input.h . . . 125
src/ckb-daemon/input_linux.c . . . 136
src/ckb-daemon/input_mac.c . . . 143
src/ckb-daemon/input_mac_mouse.c . . . 143
src/ckb-daemon/keymap.c . . . 143
src/ckb-daemon/keymap.h . . . 148
src/ckb-daemon/keymap_mac.h . . . 156
src/ckb-daemon/led.c . . . 157
src/ckb-daemon/led.h . . . 163
src/ckb-daemon/led_keyboard.c . . . 174
src/ckb-daemon/led_mouse.c . . . 207
src/ckb-daemon/main.c . . . 210
src/ckb-daemon/notify.c . . . 219
src/ckb-daemon/notify.h . . . 228
src/ckb-daemon/os.h . . . 232
src/ckb-daemon/profile.c . . . 234
src/ckb-daemon/profile.h . . . 250
src/ckb-daemon/profile_keyboard.c . . . 265
src/ckb-daemon/profile_mouse.c . . . 268
src/ckb-daemon/structures.h . . . 270
src/ckb-daemon/usb.c . . . 289

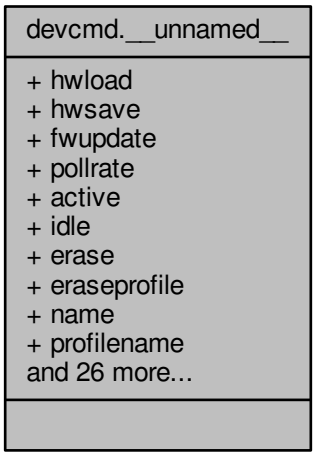
src/ckb-daemon/usb.h
Definitions for using USB interface 307
src/ckb-daemon/usb_linux.c 346
src/ckb-daemon/usb_mac.c 371

Chapter 8

Data Structure Documentation

8.1 devcmd.__unnamed__ Struct Reference

Collaboration diagram for devcmd.__unnamed__:



Data Fields

- cmdhandler_io hwload
- cmdhandler_io hwsave
- cmdhandler_io fwupdate
- cmdhandler_io pollrate
- cmdhandler_io active
- cmdhandler_io idle
- cmdhandler erase
- cmdhandler eraseprofile
- cmdhandler name
- cmdhandler profilename
- cmdhandler id

- cmdhandler profileid
- cmdhandler rgb
- cmdhandler ioff
- cmdhandler ion
- cmdhandler iauto
- cmdhandler bind
- cmdhandler unbind
- cmdhandler rebind
- cmdhandler_mac macro
- cmdhandler_mac dpi
- cmdhandler dpisel
- cmdhandler lift
- cmdhandler snap
- cmdhandler notify
- cmdhandler inotify
- cmdhandler get
- cmdhandler restart
- int(∗ start)(usbdevice ∗kb, int makeactive)
- void(∗ setmodeindex)(usbdevice ∗kb, int index)
- void(∗ allocprofile)(usbdevice ∗kb)
- int(∗ loadprofile)(usbdevice ∗kb)
- void(∗ freeprofile)(usbdevice ∗kb)
- int(∗ updatergb)(usbdevice ∗kb, int force)
- void(∗ updateindicators)(usbdevice ∗kb, int force)
- int(∗ updatedpi)(usbdevice ∗kb, int force)

8.1.1 Detailed Description

Definition at line 78 of file command.h.

8.1.2 Field Documentation

8.1.2.1

8.1.2.2

8.1.2.3

8.1.2.4

8.1.2.5

8.1.2.6

8.1.2.7

8.1.2.8

8.1.2.9

8.1.2.10

8.1.2.11

8.1.2.12

8.1.2.13

8.1.2.14

8.1.2.15

8.1.2.16

8.1.2.17

8.1.2.18

8.1.2.19

8.1.2.20

8.1.2.21

8.1.2.22

8.1.2.23

8.1.2.24

8.1.2.25

8.1.2.26

8.1.2.27

8.1.2.28

8.1.2.29

8.1.2.30

8.1.2.31

8.1.2.32

8.1.2.33

8.1.2.34

8.1.2.35

8.1.2.36

The documentation for this struct was generated from the following files:

Chapter 9

File Documentation

9.1 BUILD.md File Reference

9.2 DAEMON.md File Reference

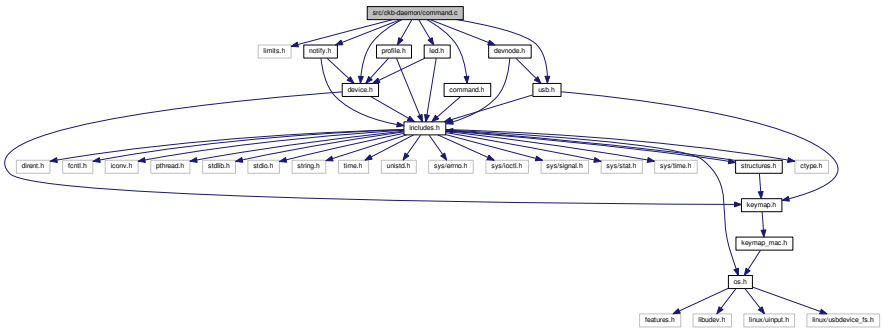
9.3 README.md File Reference

9.4 ROADMAP.md File Reference

9.5 src/ckb-daemon/command.c File Reference

```
#include <limits.h>
#include "command.h"
#include "device.h"
#include "devnode.h"
#include "led.h"
#include "notify.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for command.c:



Macros

- #define TRY_WITH_RESET(action)

Functions

- int readcmd (usbdevice *kb, const char *line)

Variables

- static const char *const cmd_strings [(CMD_LAST-CMD_FIRST+2)-1]

9.5.1 Macro Definition Documentation

9.5.1.1 #define TRY_WITH_RESET(*action*)

Value:

```
while(action){              \
        if(usb_tryreset(kb)){   \
            free(word);         \
            return 1;           \
        }                       \
    }
```

Definition at line 59 of file command.c.

Referenced by readcmd().

9.5.2 Function Documentation

9.5.2.1 int readcmd (usbdevice * *kb*, const char * *line*)

< Because length of word is length of line + 1, there should be no problem with buffer overflow.

Definition at line 68 of file command.c.

References ACCEL, ACTIVE, usbdevice::active, BIND, CMD_COUNT, CMD_FIRST, cmd_strings, usbprofile::currentmode, DELAY, usbdevice::delay, DITHER, usbdevice::dither, devcmd::do_cmd, devcmd::do_io, devcmd::do_macro, DPI, DPISEL, ERASE, ERASEPROFILE, FEAT_ANSI, FEAT_BIND, FEAT_ISO, FEAT_LMASK, FEAT_MOUSEACCEL, FEAT_NOTIFY, usbdevice::features, lighting::forceupdate, FPS, FWUPDATE, GET, HAS_FEATURES, HWLOAD, HWSAVE, IAUTO, ID, IDLE, INDEX_OF, INOTIFY, IOFF, ION, IS_FULLRANGE, IS_MOUSE_DEV, keymap, LAYOUT, LIFT, usbmode::light, MACRO, mknotifynode(), MODE, usbprofile::mode, MODE_COUNT, N_KEYS_EXTENDED, NAME, NEEDS_FW_UPDATE, NONE, NOTIFY, NOTIFYOFF, NOTIFYON, OUTFIFO_MAX, POLLRATE, usbdevice::profile, PROFILEID, PROFILENAME, REBIND, RESTART, RGB, rmnotifynode(), SCROLL_ACCELERATED, SCROLL_MAX, SCROLL_MIN, SCROLLSPEED, SNAP, SWITCH, TRY_WITH_RESET, UNBIND, usbdevice::usbdelay, and usbdevice::vtable.

Referenced by devmain().

```
68                                          {
69     char* word = malloc(strlen(line) + 1);
70     int wordlen;
71     const char* newline = 0;
72     const devcmd* vt = kb->vtable;
73     usbprofile* profile = kb->profile;
74     usbmode* mode = 0;
75     int notifynumber = 0;
76     // Read words from the input
77     cmd command = NONE;
78     while(sscanf(line, "%s%n", word, &wordlen) == 1){
79         line += wordlen;
80         // If we passed a newline, reset the context
81         if(line > newline){
82             mode = profile->currentmode;
83             command = NONE;
84             notifynumber = 0;
85             newline = strchr(line, '\n');
86             if(!newline)
87                 newline = line + strlen(line);
```

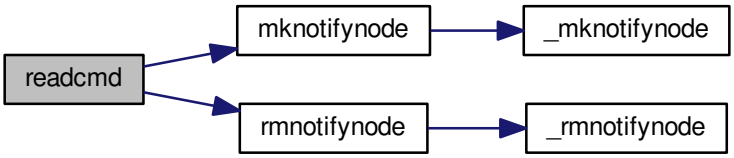
```
88          }
89          // Check for a command word
90          for(int i = 0; i < CMD_COUNT - 1; i++){
91              if(!strcmp(word, cmd_strings[i])){
92                  command = i + CMD_FIRST;
93  #ifndef OS_MAC
94                  // Layout and mouse acceleration aren't used on Linux; ignore
95                  if(command == LAYOUT || command == ACCEL || command ==
      SCROLLSPEED)
96                      command = NONE;
97  #endif
98                  // Most commands require parameters, but a few are actions in and of themselves
99                  if(command != SWITCH
100                         && command != HWLOAD && command != HWSAVE
101                         && command != ACTIVE && command != IDLE
102                         && command != ERASE && command != ERASEPROFILE
103                         && command != RESTART)
104                     goto next_loop;
105                 break;
106             }
107         }
108
109         // Set current notification node when given @number
110         int newnotify;
111         if(sscanf(word, "@%u", &newnotify) == 1 && newnotify < OUTFIFO_MAX){
112             notifynumber = newnotify;
113             continue;
114         }
115
116         // Reject unrecognized commands. Reject bind or notify related commands if the keyboard doesn't
       have the feature enabled.
117         if(command == NONE
118                 || ((!HAS_FEATURES(kb, FEAT_BIND) && (command ==
      BIND || command == UNBIND || command == REBIND || command ==
      MACRO || command == DELAY))
119                         || (!HAS_FEATURES(kb, FEAT_NOTIFY) && command ==
      NOTIFY))){
120             next_loop:
121             continue;
122         }
123         // Reject anything not related to fwupdate if device has a bricked FW
124         if(NEEDS_FW_UPDATE(kb) && command != FWUPDATE && command !=
      NOTIFYON && command != NOTIFYOFF)
125             continue;
126
127         // Specially handled commands - these are available even when keyboard is IDLE
128         switch(command){
129         case NOTIFYON: {
130             // Notification node on
131             int notify;
132             if(sscanf(word, "%u", &notify) == 1)
133                 mknotifynode(kb, notify);
134             continue;
135         } case NOTIFYOFF: {
136             // Notification node off
137             int notify;
138             if(sscanf(word, "%u", &notify) == 1 && notify != 0) // notify0 can't be removed
139                 rmnotifynode(kb, notify);
140             continue;
141         } case GET:
142             // Output data to notification node
143             vt->get(kb, mode, notifynumber, 0, word);
144             continue;
145         case LAYOUT:
146             // OSX: switch ANSI/ISO keyboard layout
147             if(!strcmp(word, "ansi"))
148                 kb->features = (kb->features & ~FEAT_LMASK) |
      FEAT_ANSI;
149             else if(!strcmp(word, "iso"))
150                 kb->features = (kb->features & ~FEAT_LMASK) |
      FEAT_ISO;
151             continue;
152 #ifdef OS_MAC
153         case ACCEL:
154             // OSX mouse acceleration on/off
155             if(!strcmp(word, "on"))
156                 kb->features |= FEAT_MOUSEACCEL;
157             else if(!strcmp(word, "off"))
158                 kb->features &= ~FEAT_MOUSEACCEL;
159             continue;
160         case SCROLLSPEED:{
161             int newscroll;
162             if(sscanf(word, "%d", &newscroll) != 1)
163                 break;
164             if(newscroll < SCROLL_MIN)
165                 newscroll = SCROLL_ACCELERATED;
166             if(newscroll > SCROLL_MAX)
```

```
167                 newscroll = SCROLL_MAX;
168             kb->scroll_rate = newscroll;
169             continue;
170         }
171 #endif
172         case MODE: {
173             // Select a mode number (1 - 6)
174             int newmode;
175             if(sscanf(word, "%u", &newmode) == 1 && newmode > 0 && newmode <=
    MODE_COUNT)
176                 mode = profile->mode + newmode - 1;
177             continue;
178         }
179         case FPS: {
180             // USB command delay (2 - 10ms)
181             uint framerate;
182             if(sscanf(word, "%u", &framerate) == 1 && framerate > 0){
183                 // Not all devices require the same number of messages per frame; select delay
     appropriately
184                 uint per_frame = IS_MOUSE_DEV(kb) ? 2 : IS_FULLRANGE(kb) ? 14 : 5;
185                 uint delay = 1000 / framerate / per_frame;
186                 if(delay < 2)
187                     delay = 2;
188                 else if(delay > 10)
189                     delay = 10;
190                 kb->usbdelay = delay;
191             }
192             continue;
193         }
194         case DITHER: {
195             // 0: No dither, 1: Ordered dither.
196             uint dither;
197             if(sscanf(word, "%u", &dither) == 1 && dither <= 1){
198                 kb->dither = dither;
199                 profile->currentmode->light.forceupdate = 1;
200                 mode->light.forceupdate = 1;
201             }
202             continue;
203         }
204         case DELAY: {
205             long int delay;
206             if(sscanf(word, "%ld", &delay) == 1 && 0 <= delay && delay < UINT_MAX) {
207                 // Add delay of `newdelay` microseconds to macro playback
208                 kb->delay = (unsigned int)delay;
209             } else if(strcmp(word, "on") == 0) {
210                 // allow previous syntax, `delay on` means use old `long macro delay`
211                 kb->delay = UINT_MAX;
212             } else {
213                 // bad parameter to handle false commands like "delay off"
214                 kb->delay = 0; // No delay.
215             }
216             continue;
217         }
218         case RESTART: {
219             char mybuffer[] = "no reason specified";
220             if (sscanf(line, " %[^\n]", word) == -1) {
221                 word = mybuffer;
222             }
223             vt->do_cmd[command](kb, mode, notifynumber, 0, word);
224             continue;
225         }
226         default:;
227         }
228 
229         // If a keyboard is inactive, it must be activated before receiving any other commands
230         if(!kb->active){
231             if(command == ACTIVE)
232                 TRY_WITH_RESET(vt->active(kb, mode, notifynumber, 0, 0));
233             continue;
234         }
235         // Specially handled commands only available when keyboard is ACTIVE
236         switch(command){
237         case IDLE:
238             TRY_WITH_RESET(vt->idle(kb, mode, notifynumber, 0, 0));
239             continue;
240         case SWITCH:
241             if(profile->currentmode != mode){
242                 profile->currentmode = mode;
243                 // Set mode light for non-RGB K95
244                 int index = INDEX_OF(mode, profile->mode);
245                 vt->setmodeindex(kb, index);
246             }
247             continue;
248         case HWLOAD: case HWSAVE:{
249             char delay = kb->usbdelay;
250             // Ensure delay of at least 10ms as the device can get overwhelmed otherwise
251             if(delay < 10)
```

```
252                 kb->usbdelay = 10;
253             // Try to load/save the hardware profile. Reset on failure, disconnect if reset fails.
254             TRY_WITH_RESET(vt->do_io[command](kb, mode, notifynumber, 1, 0));
255             // Re-send the current RGB state as it sometimes gets scrambled
256             TRY_WITH_RESET(vt->updatergb(kb, 1));
257             kb->usbdelay = delay;
258             continue;
259         }
260         case FWUPDATE:
261             // FW update parses a whole word. Unlike hwload/hwsave, there's no try again on failure.
262             if(vt->fwupdate(kb, mode, notifynumber, 0, word)){
263                 free(word);
264                 return 1;
265             }
266             continue;
267         case POLLRATE: {
268             uint rate;
269             if(sscanf(word, "%u", &rate) == 1 && (rate == 1 || rate == 2 || rate == 4 || rate == 8))
270                 TRY_WITH_RESET(vt->pollrate(kb, mode, notifynumber, rate, 0));
271             continue;
272         }
273         case ERASEPROFILE:
274             // Erase the current profile
275             vt->eraseprofile(kb, mode, notifynumber, 0, 0);
276             // Update profile/mode pointers
277             profile = kb->profile;
278             mode = profile->currentmode;
279             continue;
280         case ERASE: case NAME: case IOFF: case ION: case IAUTO: case
    INOTIFY: case PROFILENAME: case ID: case PROFILEID: case
    DPISEL: case LIFT: case SNAP:
281             // All of the above just parse the whole word
282             vt->do_cmd[command](kb, mode, notifynumber, 0, word);
283             continue;
284         case RGB: {
285             // RGB command has a special response for a single hex constant
286             int r, g, b;
287             if(sscanf(word, "%02x%02x%02x", &r, &g, &b) == 3){
288                 // Set all keys
289                 for(int i = 0; i < N_KEYS_EXTENDED; i++)
290                     vt->rgb(kb, mode, notifynumber, i, word);
291                 continue;
292             }
293             break;
294         }
295         case MACRO:
296             if(!strcmp(word, "clear")){
297                 // Macro has a special clear command
298                 vt->macro(kb, mode, notifynumber, 0, 0);
299                 continue;
300             }
301             break;
302         default:;
303         }
304         // For anything else, split the parameter at the colon
305         int left = -1;
306         sscanf(word, "%*[^:]%n", &left);
307         if(left <= 0)
308             continue;
309         const char* right = word + left;
310         if(right[0] == ':')
311             right++;
312         // Macros and DPI have a separate left-side handler
313         if(command == MACRO || command == DPI){
314             word[left] = 0;
315             vt->do_macro[command](kb, mode, notifynumber, word, right);
316             continue;
317         }
318         // Scan the left side for key names and run the requested command
319         int position = 0, field = 0;
320         char keyname[11];
321         while(position < left && sscanf(word + position, "%10[^:,]%n", keyname, &field) == 1){
322             int keycode;
323             if(!strcmp(keyname, "all")){
324                 // Set all keys
325                 for(int i = 0; i < N_KEYS_EXTENDED; i++)
326                     vt->do_cmd[command](kb, mode, notifynumber, i, right);
327             } else if((sscanf(keyname, "#%d", &keycode) && keycode >= 0 && keycode <
    N_KEYS_EXTENDED)
328                       || (sscanf(keyname, "#x%x", &keycode) && keycode >= 0 && keycode <
    N_KEYS_EXTENDED)){
329                 // Set a key numerically
330                 vt->do_cmd[command](kb, mode, notifynumber, keycode, right);
331             } else {
332                 // Find this key in the keymap
333                 for(unsigned i = 0; i < N_KEYS_EXTENDED; i++){
334                     if(keymap[i].name && !strcmp(keyname, keymap[i].name)){
```

```
335                         vt->do_cmd[command](kb, mode, notifynumber, i, right);
336                         break;
337                     }
338                 }
339             }
340             if(word[position += field] == ',')
341                 position++;
342         }
343     }
344
345     // Finish up
346     if(!NEEDS_FW_UPDATE(kb)){
347         TRY_WITH_RESET(vt->updatergb(kb, 0));
348         TRY_WITH_RESET(vt->updatedpi(kb, 0));
349     }
350     free(word);
351     return 0;
352 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.5.3 Variable Documentation

9.5.3.1 const char* const cmd_strings[(CMD_LAST-CMD_FIRST+2)-1] [static]

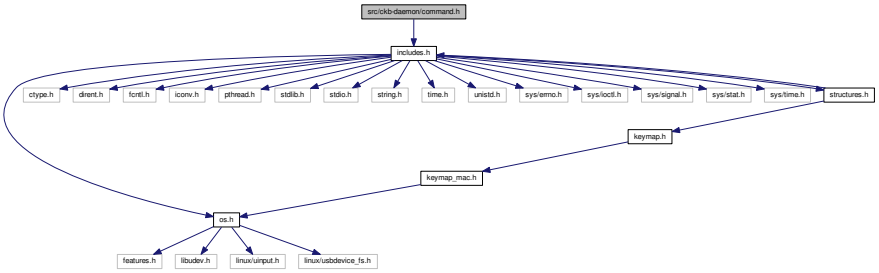
Definition at line 10 of file command.c.

Referenced by readcmd().

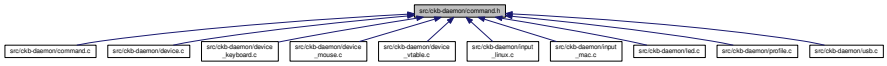
9.6 src/ckb-daemon/command.h File Reference

```
#include "includes.h"
```

Include dependency graph for command.h:



This graph shows which files directly or indirectly include this file:



Data Structures

- union devcmd
- struct devcmd.__unnamed__

Macros

- #define CMD_COUNT (CMD_LAST - CMD_FIRST + 2)
- #define CMD_DEV_COUNT (CMD_LAST - CMD_VT_FIRST + 1)

Typedefs

- typedef void(* cmdhandler)(usbdevice *kb, usbmode *modeidx, int notifyidx, int keyindex, const char *parameter)
- typedef int(* cmdhandler_io)(usbdevice *kb, usbmode *modeidx, int notifyidx, int keyindex, const char *parameter)
- typedef void(* cmdhandler_mac)(usbdevice *kb, usbmode *modeidx, int notifyidx, const char *keys, const char *assignment)
- typedef union devcmd devcmd

Enumerations

- enum cmd {
  NONE = -11, DELAY = -10, CMD_FIRST = DELAY, MODE = -9,
  SWITCH = -8, LAYOUT = -7, ACCEL = -6, SCROLLSPEED = -5,
  NOTIFYON = -4, NOTIFYOFF = -3, FPS = -2, DITHER = -1,
  HWLOAD = 0, CMD_VT_FIRST = 0, HWSAVE, FWUPDATE,
  POLLRATE, ACTIVE, IDLE, ERASE,
  ERASEPROFILE, NAME, PROFILENAME, ID,
  PROFILEID, RGB, IOFF, ION,
  IAUTO, BIND, UNBIND, REBIND,
  MACRO, DPI, DPISEL, LIFT,
  SNAP, NOTIFY, INOTIFY, GET,
  RESTART, CMD_LAST = RESTART }

Functions

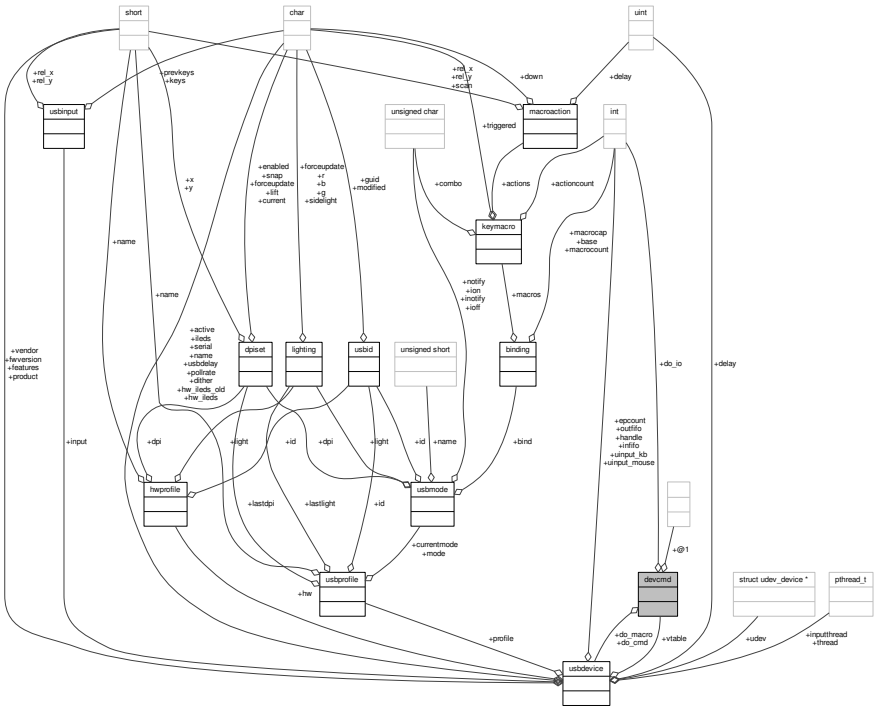
- int readcmd (usbdevice *kb, const char *line)

9.6.1 Data Structure Documentation

9.6.1.1 union devcmd

Definition at line 73 of file command.h.

Collaboration diagram for devcmd:



Data Fields

struct devcmd	__unnamed__	
cmdhandler	do_cmd[(CMD_-LAST-CMD_VT-_FIRST+1)]	
cmdhandler_io	do_io[(CMD_LA-ST-CMD_VT_FI-RST+1)]	
cmdhandler_-mac	do_macro[(CM-D_LAST-CMD_-VT_FIRST+1)]	

9.6.2 Macro Definition Documentation

9.6.2.1 #define CMD_COUNT (CMD_LAST - CMD_FIRST + 2)

Definition at line 65 of file command.h.

Referenced by readcmd().

9.6.2.2 #define CMD_DEV_COUNT (CMD_LAST - CMD_VT_FIRST + 1)

Definition at line 66 of file command.h.

9.6.3 Typedef Documentation

9.6.3.1 typedef void(∗ cmdhandler)(usbdevice ∗kb, usbmode ∗modeidx, int notifyidx, int keyindex, const char ∗parameter)

Definition at line 70 of file command.h.

9.6.3.2 typedef int(∗ cmdhandler_io)(usbdevice ∗kb, usbmode ∗modeidx, int notifyidx, int keyindex, const char ∗parameter)

Definition at line 71 of file command.h.

9.6.3.3 typedef void(∗ cmdhandler_mac)(usbdevice ∗kb, usbmode ∗modeidx, int notifyidx, const char ∗keys, const char ∗assignment)

Definition at line 72 of file command.h.

9.6.3.4 typedef union devcmd devcmd

9.6.4 Enumeration Type Documentation

9.6.4.1 enum cmd

Enumerator

NONE

DELAY

CMD_FIRST

MODE

SWITCH

LAYOUT

ACCEL

SCROLLSPEED

NOTIFYON

NOTIFYOFF

FPS

DITHER

HWLOAD

CMD_VT_FIRST

HWSAVE

FWUPDATE

POLLRATE

ACTIVE

IDLE

ERASE

ERASEPROFILE

NAME

PROFILENAME

ID

PROFILEID

RGB

IOFF

ION

IAUTO

BIND

UNBIND

REBIND

MACRO

DPI

DPISEL

LIFT

SNAP

NOTIFY

INOTIFY

GET

RESTART

CMD_LAST

Definition at line 7 of file command.h.

```
7             {
8     // Special - handled by readcmd, no device functions
9     NONE        = -11,
10     DELAY       = -10,   CMD_FIRST = DELAY,
11     MODE        = -9,
12     SWITCH      = -8,
13     LAYOUT      = -7,
14     ACCEL       = -6,
15     SCROLLSPEED = -5,
16     NOTIFYON    = -4,
17     NOTIFYOFF   = -3,
18     FPS         = -2,
19     DITHER      = -1,
20
21     // Hardware data
22     HWLOAD      = 0,    CMD_VT_FIRST = 0,
23     HWSAVE,
24     FWUPDATE,
25     POLLRATE,
26
27     // Software control on/off
28     ACTIVE,
29     IDLE,
30
31     // Profile/mode metadata
32     ERASE,
33     ERASEPROFILE,
34     NAME,
35     PROFILENAME,
36     ID,
37     PROFILEID,
38
39     // LED control
40     RGB,
41     IOFF,
42     ION,
43     IAUTO,
44
45     // Key binding control
46     BIND,
```

```
47     UNBIND,
48     REBIND,
49     MACRO,
50
51     // DPI control
52     DPI,
53     DPISEL,
54     LIFT,
55     SNAP,
56
57     // Notifications and output
58     NOTIFY,
59     INOTIFY,
60     GET,
61     RESTART,
62
63     CMD_LAST = RESTART
64 } cmd;
```

9.6.5 Function Documentation

9.6.5.1 int readcmd (usbdevice * *kb*, const char * *line*)

< Because length of word is length of line + 1, there should be no problem with buffer overflow.

Definition at line 68 of file command.c.

References ACCEL, ACTIVE, usbdevice::active, BIND, CMD_COUNT, CMD_FIRST, cmd_strings, usbprofile::currentmode, DELAY, usbdevice::delay, DITHER, usbdevice::dither, devcmd::do_cmd, devcmd::do_io, devcmd::do_macro, DPI, DPISEL, ERASE, ERASEPROFILE, FEAT_ANSI, FEAT_BIND, FEAT_ISO, FEAT_LMASK, FEAT_MOUSEACCEL, FEAT_NOTIFY, usbdevice::features, lighting::forceupdate, FPS, FWUPDATE, GET, HAS_FEATURES, HWLOAD, HWSAVE, IAUTO, ID, IDLE, INDEX_OF, INOTIFY, IOFF, ION, IS_FULLRANGE, IS_MOUSE_DEV, keymap, LAYOUT, LIFT, usbmode::light, MACRO, mknotifynode(), MODE, usbprofile::mode, MODE_COUNT, N_KEYS_EXTENDED, NAME, NEEDS_FW_UPDATE, NONE, NOTIFY, NOTIFYOFF, NOTIFYON, OUTFIFO_MAX, POLLRATE, usbdevice::profile, PROFILEID, PROFILENAME, REBIND, RESTART, RGB, rmnotifynode(), SCROLL_ACCELERATED, SCROLL_MAX, SCROLL_MIN, SCROLLSPEED, SNAP, SWITCH, TRY_WITH_RESET, UNBIND, usbdevice::usbdelay, and usbdevice::vtable.

Referenced by devmain().

```
68                                          {
69     char* word = malloc(strlen(line) + 1);
70     int wordlen;
71     const char* newline = 0;
72     const devcmd* vt = kb->vtable;
73     usbprofile* profile = kb->profile;
74     usbmode* mode = 0;
75     int notifynumber = 0;
76     // Read words from the input
77     cmd command = NONE;
78     while(sscanf(line, "%s%n", word, &wordlen) == 1){
79         line += wordlen;
80         // If we passed a newline, reset the context
81         if(line > newline){
82             mode = profile->currentmode;
83             command = NONE;
84             notifynumber = 0;
85             newline = strchr(line, '\n');
86             if(!newline)
87                 newline = line + strlen(line);
88         }
89         // Check for a command word
90         for(int i = 0; i < CMD_COUNT - 1; i++){
91             if(!strcmp(word, cmd_strings[i])){
92                 command = i + CMD_FIRST;
93 #ifndef OS_MAC
94                 // Layout and mouse acceleration aren't used on Linux; ignore
95                 if(command == LAYOUT || command == ACCEL || command ==
    SCROLLSPEED)
96                     command = NONE;
97 #endif
98                 // Most commands require parameters, but a few are actions in and of themselves
99                 if(command != SWITCH
100                         && command != HWLOAD && command != HWSAVE
101                         && command != ACTIVE && command != IDLE
102                         && command != ERASE && command != ERASEPROFILE
103                         && command != RESTART)
```

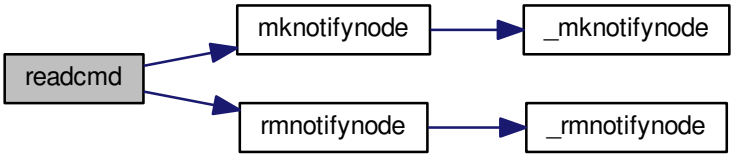
```
104                     goto next_loop;
105                 break;
106             }
107         }
108 
109         // Set current notification node when given @number
110         int newnotify;
111         if(sscanf(word, "@%u", &newnotify) == 1 && newnotify < OUTFIFO_MAX){
112             notifynumber = newnotify;
113             continue;
114         }
115 
116         // Reject unrecognized commands. Reject bind or notify related commands if the keyboard doesn't
     have the feature enabled.
117         if(command == NONE
118                 || ((!HAS_FEATURES(kb, FEAT_BIND) && (command ==
    BIND || command == UNBIND || command == REBIND || command ==
    MACRO || command == DELAY))
119                         || (!HAS_FEATURES(kb, FEAT_NOTIFY) && command ==
    NOTIFY))){
120             next_loop:
121             continue;
122         }
123         // Reject anything not related to fwupdate if device has a bricked FW
124         if(NEEDS_FW_UPDATE(kb) && command != FWUPDATE && command !=
    NOTIFYON && command != NOTIFYOFF)
125             continue;
126 
127         // Specially handled commands - these are available even when keyboard is IDLE
128         switch(command){
129         case NOTIFYON: {
130             // Notification node on
131             int notify;
132             if(sscanf(word, "%u", &notify) == 1)
133                 mknotifynode(kb, notify);
134             continue;
135         } case NOTIFYOFF: {
136             // Notification node off
137             int notify;
138             if(sscanf(word, "%u", &notify) == 1 && notify != 0) // notify0 can't be removed
139                 rmnotifynode(kb, notify);
140             continue;
141         } case GET:
142             // Output data to notification node
143             vt->get(kb, mode, notifynumber, 0, word);
144             continue;
145         case LAYOUT:
146             // OSX: switch ANSI/ISO keyboard layout
147             if(!strcmp(word, "ansi"))
148                 kb->features = (kb->features & ~FEAT_LMASK) |
    FEAT_ANSI;
149             else if(!strcmp(word, "iso"))
150                 kb->features = (kb->features & ~FEAT_LMASK) |
    FEAT_ISO;
151             continue;
152 #ifdef OS_MAC
153         case ACCEL:
154             // OSX mouse acceleration on/off
155             if(!strcmp(word, "on"))
156                 kb->features |= FEAT_MOUSEACCEL;
157             else if(!strcmp(word, "off"))
158                 kb->features &= ~FEAT_MOUSEACCEL;
159             continue;
160         case SCROLLSPEED:{
161             int newscroll;
162             if(sscanf(word, "%d", &newscroll) != 1)
163                 break;
164             if(newscroll < SCROLL_MIN)
165                 newscroll = SCROLL_ACCELERATED;
166             if(newscroll > SCROLL_MAX)
167                 newscroll = SCROLL_MAX;
168             kb->scroll_rate = newscroll;
169             continue;
170         }
171 #endif
172         case MODE: {
173             // Select a mode number (1 - 6)
174             int newmode;
175             if(sscanf(word, "%u", &newmode) == 1 && newmode > 0 && newmode <=
    MODE_COUNT)
176                 mode = profile->mode + newmode - 1;
177             continue;
178         }
179         case FPS: {
180             // USB command delay (2 - 10ms)
181             uint framerate;
182             if(sscanf(word, "%u", &framerate) == 1 && framerate > 0){
```

```
183                 // Not all devices require the same number of messages per frame; select delay
    appropriately
184                 uint per_frame = IS_MOUSE_DEV(kb) ? 2 : IS_FULLRANGE(kb) ? 14 : 5;
185                 uint delay = 1000 / framerate / per_frame;
186                 if(delay < 2)
187                     delay = 2;
188                 else if(delay > 10)
189                     delay = 10;
190                 kb->usbdelay = delay;
191             }
192             continue;
193         }
194         case DITHER: {
195             // 0: No dither, 1: Ordered dither.
196             uint dither;
197             if(sscanf(word, "%u", &dither) == 1 && dither <= 1){
198                 kb->dither = dither;
199                 profile->currentmode->light.forceupdate = 1;
200                 mode->light.forceupdate = 1;
201             }
202             continue;
203         }
204         case DELAY: {
205             long int delay;
206             if(sscanf(word, "%ld", &delay) == 1 && 0 <= delay && delay < UINT_MAX) {
207                 // Add delay of `newdelay` microseconds to macro playback
208                 kb->delay = (unsigned int)delay;
209             } else if(strcmp(word, "on") == 0) {
210                 // allow previous syntax, `delay on` means use old `long macro delay`
211                 kb->delay = UINT_MAX;
212             } else {
213                 // bad parameter to handle false commands like "delay off"
214                 kb->delay = 0; // No delay.
215             }
216             continue;
217         }
218         case RESTART: {
219             char mybuffer[] = "no reason specified";
220             if (sscanf(line, " %[^\n]", word) == -1) {
221                 word = mybuffer;
222             }
223             vt->do_cmd[command](kb, mode, notifynumber, 0, word);
224             continue;
225         }
226         default:;
227         }
228
229         // If a keyboard is inactive, it must be activated before receiving any other commands
230         if(!kb->active){
231             if(command == ACTIVE)
232                 TRY_WITH_RESET(vt->active(kb, mode, notifynumber, 0, 0));
233             continue;
234         }
235         // Specially handled commands only available when keyboard is ACTIVE
236         switch(command){
237         case IDLE:
238             TRY_WITH_RESET(vt->idle(kb, mode, notifynumber, 0, 0));
239             continue;
240         case SWITCH:
241             if(profile->currentmode != mode){
242                 profile->currentmode = mode;
243                 // Set mode light for non-RGB K95
244                 int index = INDEX_OF(mode, profile->mode);
245                 vt->setmodeindex(kb, index);
246             }
247             continue;
248         case HWLOAD: case HWSAVE:{
249             char delay = kb->usbdelay;
250             // Ensure delay of at least 10ms as the device can get overwhelmed otherwise
251             if(delay < 10)
252                 kb->usbdelay = 10;
253             // Try to load/save the hardware profile. Reset on failure, disconnect if reset fails.
254             TRY_WITH_RESET(vt->do_io[command](kb, mode, notifynumber, 1, 0));
255             // Re-send the current RGB state as it sometimes gets scrambled
256             TRY_WITH_RESET(vt->updatergb(kb, 1));
257             kb->usbdelay = delay;
258             continue;
259         }
260         case FWUPDATE:
261             // FW update parses a whole word. Unlike hwload/hwsave, there's no try again on failure.
262             if(vt->fwupdate(kb, mode, notifynumber, 0, word)){
263                 free(word);
264                 return 1;
265             }
266             continue;
267         case POLLRATE: {
268             uint rate;
```

```
269             if(sscanf(word, "%u", &rate) == 1 && (rate == 1 || rate == 2 || rate == 4 || rate == 8))
270                 TRY_WITH_RESET(vt->pollrate(kb, mode, notifynumber, rate, 0));
271             continue;
272         }
273         case ERASEPROFILE:
274             // Erase the current profile
275             vt->eraseprofile(kb, mode, notifynumber, 0, 0);
276             // Update profile/mode pointers
277             profile = kb->profile;
278             mode = profile->currentmode;
279             continue;
280         case ERASE: case NAME: case IOFF: case ION: case IAUTO: case
    INOTIFY: case PROFILENAME: case ID: case PROFILEID: case
    DPISEL: case LIFT: case SNAP:
281             // All of the above just parse the whole word
282             vt->do_cmd[command](kb, mode, notifynumber, 0, word);
283             continue;
284         case RGB: {
285             // RGB command has a special response for a single hex constant
286             int r, g, b;
287             if(sscanf(word, "%02x%02x%02x", &r, &g, &b) == 3){
288                 // Set all keys
289                 for(int i = 0; i < N_KEYS_EXTENDED; i++)
290                     vt->rgb(kb, mode, notifynumber, i, word);
291                 continue;
292             }
293             break;
294         }
295         case MACRO:
296             if(!strcmp(word, "clear")){
297                 // Macro has a special clear command
298                 vt->macro(kb, mode, notifynumber, 0, 0);
299                 continue;
300             }
301             break;
302         default:;
303         }
304         // For anything else, split the parameter at the colon
305         int left = -1;
306         sscanf(word, "%*[^:]%n", &left);
307         if(left <= 0)
308             continue;
309         const char* right = word + left;
310         if(right[0] == ':')
311             right++;
312         // Macros and DPI have a separate left-side handler
313         if(command == MACRO || command == DPI){
314             word[left] = 0;
315             vt->do_macro[command](kb, mode, notifynumber, word, right);
316             continue;
317         }
318         // Scan the left side for key names and run the requested command
319         int position = 0, field = 0;
320         char keyname[11];
321         while(position < left && sscanf(word + position, "%10[^:,]%n", keyname, &field) == 1){
322             int keycode;
323             if(!strcmp(keyname, "all")){
324                 // Set all keys
325                 for(int i = 0; i < N_KEYS_EXTENDED; i++)
326                     vt->do_cmd[command](kb, mode, notifynumber, i, right);
327             } else if((sscanf(keyname, "#%d", &keycode) && keycode >= 0 && keycode <
    N_KEYS_EXTENDED)
328                       || (sscanf(keyname, "#x%x", &keycode) && keycode >= 0 && keycode <
    N_KEYS_EXTENDED)){
329                 // Set a key numerically
330                 vt->do_cmd[command](kb, mode, notifynumber, keycode, right);
331             } else {
332                 // Find this key in the keymap
333                 for(unsigned i = 0; i < N_KEYS_EXTENDED; i++){
334                     if(keymap[i].name && !strcmp(keyname, keymap[i].name)){
335                         vt->do_cmd[command](kb, mode, notifynumber, i, right);
336                         break;
337                     }
338                 }
339             }
340             if(word[position += field] == ',')
341                 position++;
342         }
343     }
344
345     // Finish up
346     if(!NEEDS_FW_UPDATE(kb)){
347         TRY_WITH_RESET(vt->updatergb(kb, 0));
348         TRY_WITH_RESET(vt->updatedpi(kb, 0));
349     }
350     free(word);
351     return 0;
```

```
352 }
```

Here is the call graph for this function:

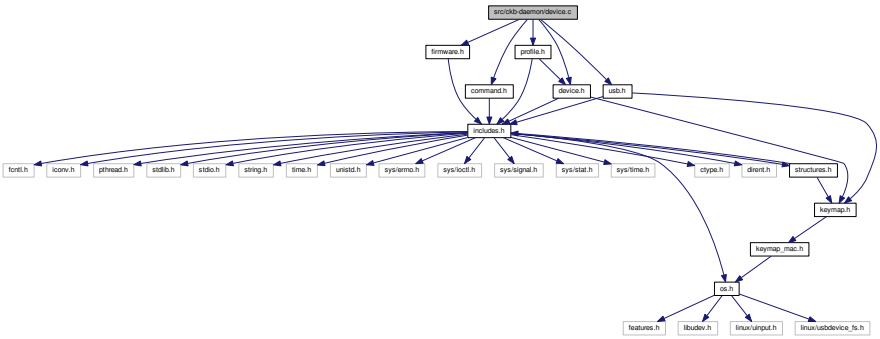


Here is the caller graph for this function:

9.7 src/ckb-daemon/device.c File Reference

```
#include "command.h"
#include "device.h"
#include "firmware.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for device.c:



Functions

- int _start_dev (usbdevice *kb, int makeactive)
- int start_dev (usbdevice *kb, int makeactive)

Variables

- int hwload_mode = 1

hwload_mode = 1 means read hardware once. should be enough

- usbdevice keyboard [9]

  remember all usb devices. Needed for closeusb().
- pthread_mutex_t devlistmutex = PTHREAD_MUTEX_INITIALIZER
- pthread_mutex_t devmutex [9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

  Mutex for handling the usbdevice structure.
- pthread_mutex_t inputmutex [9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

  Mutex for dealing with usb input frames.
- pthread_mutex_t macromutex [9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

  Protecting macros against lightning: Both use usb_send.
- pthread_mutex_t macromutex2 [9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

  Protecting the single link list of threads and the macrovar.
- pthread_cond_t macrovar [9] = { [0 ... 9 -1] = PTHREAD_COND_INITIALIZER }

  This variable is used to stop and wakeup all macro threads which have to wait.

9.7.1 Function Documentation

9.7.1.1 int _start_dev (usbdevice * *kb*, int *makeactive*)

_start_dev get fw-info and pollrate; if available, install new firmware; get all hardware profiles.

Parameters

kb	the normal kb pointer to the usbdevice. Is also valid for mice.
makeactive	if set to 1, activate the device via setactive()

Returns

0 if success, other else

- This hacker code is tricky in mutliple aspects. What it means is:

  if hwload_mode == 0: just set pollrate to 0 and clear features in the bottom lines of the if-block.

  if hwload_mode == 1: if the device has FEAT_HWLOAD active, call getfwversion(). If it returns true, there was an error while detecting fw-version. Put error message, reset FEAT_HWLOAD and finalize as above.

  if hwload_mode == 2: if the device has FEAT_HWLOAD active, call getfwversion(). If it returns true, there was an error while detecting fw-version. Put error message and return directly from function with error.

  Why do not you just write it down?
- Now check if device needs a firmware update. If so, set it up and leave the function without error.
- Device needs a firmware update. Finish setting up but don't do anything.
- Load profile from device if the hw-pointer is not set yet and hw-loading is possible and allowed.

  return error if mode == 2 (load always) and loading got an error. Else reset HWLOAD feature, because hwload must be 1.

  That is real Horror code.

Definition at line 25 of file device.c.

References usbdevice::active, ckb_info, ckb_warn, FEAT_ADJRATE, FEAT_FWUPDATE, FEAT_FWVERSION, FEAT_HWLOAD, FEAT_POLLRATE, FEAT_RGB, usbdevice::features, usbdevice::fwversion, getfwversion(), HAS_FEATURES, usbdevice::hw, hwload_mode, hwloadprofile, NEEDS_FW_UPDATE, usbdevice::pollrate, and setactive.

Referenced by start_dev().

```
25                                          {
26     // Get the firmware version from the device
27     if(kb->pollrate == 0){
35         if(!hwload_mode || (HAS_FEATURES(kb, FEAT_HWLOAD) &&
     getfwversion(kb))){
36             if(hwload_mode == 2)
37                 // hwload=always. Report setup failure.
38                 return -1;
39             else if(hwload_mode){
40                 // hwload=once. Log failure, prevent trying again, and continue.
41                 ckb_warn("Unable to load firmware version/poll rate\n");
42                 kb->features &= ~FEAT_HWLOAD;
43             }
44             kb->pollrate = 0;
45             kb->features &= ~(FEAT_POLLRATE | FEAT_ADJRATE);
46             if(kb->fwversion == 0)
47                 kb->features &= ~(FEAT_FWVERSION |
     FEAT_FWUPDATE);
48         }
49     }
54     if(NEEDS_FW_UPDATE(kb)){
56         ckb_info("Device needs a firmware update. Please issue a fwupdate command.\n");
57         kb->features = FEAT_RGB | FEAT_FWVERSION |
     FEAT_FWUPDATE;
58         kb->active = 1;
59         return 0;
60     }
66     if(!kb->hw && hwload_mode && HAS_FEATURES(kb,
     FEAT_HWLOAD)){
67         if(hwloadprofile(kb, 1)){
68             if(hwload_mode == 2)
69                 return -1;
70             ckb_warn("Unable to load hardware profile\n");
71             kb->features &= ~FEAT_HWLOAD;
72         }
73     }
74     // Active software mode if requested
75     if(makeactive)
76         return setactive(kb, 1);
77     return 0;
78 }
```

Here is the call graph for this function:

Here is the caller graph for this function:

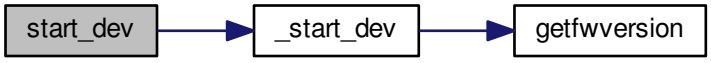
9.7.1.2 int start_dev (usbdevice * *kb*, int *makeactive*)

Definition at line 80 of file device.c.

References _start_dev(), USB_DELAY_DEFAULT, and usbdevice::usbdelay.

```
80                                          {
81     // Force USB interval to 10ms during initial setup phase; return to nominal 5ms after setup completes.
82     kb->usbdelay = 10;
83     int res = _start_dev(kb, makeactive);
84     kb->usbdelay = USB_DELAY_DEFAULT;
85     return res;
86 }
```

Here is the call graph for this function:



9.7.2 Variable Documentation

9.7.2.1 pthread_mutex_t devlistmutex = PTHREAD_MUTEX_INITIALIZER

Definition at line 11 of file device.c.

9.7.2.2 pthread_mutex_t devmutex[9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

Definition at line 12 of file device.c.

Referenced by _updateconnected(), quitWithLock(), and usb_rm_device().

9.7.2.3 int hwload_mode = 1

hwload_mode is defined in device.c

Definition at line 7 of file device.c.

Referenced by _start_dev(), _usbrecv(), _usbsend(), and main().

9.7.2.4 pthread_mutex_t inputmutex[9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

Definition at line 13 of file device.c.

9.7.2.5 usbdevice keyboard[9]

Definition at line 10 of file device.c.

Referenced by _mkdevpath(), _mknotifynode(), _rmnotifynode(), _setupusb(), _updateconnected(), closeusb(), main(), mkfwnode(), os_closeusb(), os_inputmain(), os_inputopen(), os_setupusb(), quitWithLock(), rmdevpath(), usb_rm_device(), and usbadd().

9.7.2.6 pthread_mutex_t macromutex[9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

Definition at line 14 of file device.c.

9.7.2.7 pthread_mutex_t macromutex2[9] = { [0 ... 9 -1] = PTHREAD_MUTEX_INITIALIZER }

Definition at line 15 of file device.c.

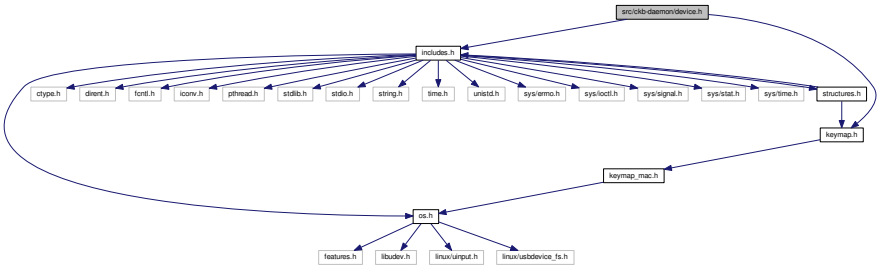
9.7.2.8 pthread_cond_t macrovar[9] = { [0 ... 9 -1] = PTHREAD_COND_INITIALIZER }

Definition at line 16 of file device.c.

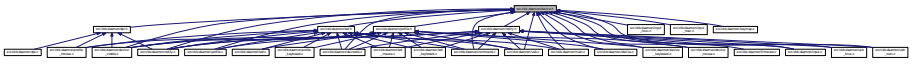
9.8 src/ckb-daemon/device.h File Reference

```
#include "includes.h"
#include "keymap.h"
```

Include dependency graph for device.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define DEV_MAX 9
- #define IS_CONNECTED(kb) ((kb) && (kb)->handle && (kb)->uinput_kb && (kb)->uinput_mouse)
- #define dmutex(kb) (devmutex + INDEX_OF(kb, keyboard))
- #define imutex(kb) (inputmutex + INDEX_OF(kb, keyboard))
- #define mmutex(kb) (macromutex + INDEX_OF(kb, keyboard))
- #define mmutex2(kb) (macromutex2 + INDEX_OF(kb, keyboard))
- #define mvar(kb) (macrovar + INDEX_OF(kb, keyboard))
- #define setactive(kb, makeactive) ((makeactive) ? (kb)->vtable->active((kb), 0, 0, 0, 0) : (kb)->vtable->idle((kb), 0, 0, 0, 0))

  setactive() calls via the corresponding kb->vtable either the active() or the idle() function.
  active() is called if the parameter makeactive is true, idle if it is false.
  What function is called effectively is device dependent. Have a look at device_vtable.c for more information.
- #define IN_HID 0x80
- #define IN_CORSAIR 0x40
- #define ACT_LIGHT 1
- #define ACT_NEXT 3
- #define ACT_NEXT_NOWRAP 5
- #define ACT_LOCK 8
- #define ACT_MR_RING 9

- #define ACT_M1 10
- #define ACT_M2 11
- #define ACT_M3 12

Functions

- int start_dev (usbdevice *kb, int makeactive)
- int start_kb_nrgb (usbdevice *kb, int makeactive)
- int setactive_kb (usbdevice *kb, int active)
- int setactive_mouse (usbdevice *kb, int active)
- int cmd_active_kb (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- int cmd_active_mouse (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- int cmd_idle_kb (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- int cmd_idle_mouse (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- int cmd_pollrate (usbdevice *kb, usbmode *dummy1, int dummy2, int rate, const char *dummy3)
- void setmodeindex_nrgb (usbdevice *kb, int index)

Variables

- usbdevice keyboard [9]

  remember all usb devices. Needed for closeusb().
- pthread_mutex_t devmutex [9]

  Mutex for handling the usbdevice structure.
- pthread_mutex_t inputmutex [9]

  Mutex for dealing with usb input frames.
- pthread_mutex_t macromutex [9]

  Protecting macros against lightning: Both use usb_send.
- pthread_mutex_t macromutex2 [9]

  Protecting the single link list of threads and the macrovar.
- pthread_cond_t macrovar [9]

  This variable is used to stop and wakeup all macro threads which have to wait.

9.8.1 Macro Definition Documentation

9.8.1.1 #define ACT_LIGHT 1

Definition at line 68 of file device.h.

Referenced by setactive_kb().

9.8.1.2 #define ACT_LOCK 8

Definition at line 71 of file device.h.

Referenced by setactive_kb().

9.8.1.3 #define ACT_M1 10

Definition at line 73 of file device.h.

Referenced by setactive_kb().

9.8.1.4 #define ACT_M2 11

Definition at line 74 of file device.h.

Referenced by setactive_kb().

9.8.1.5 #define ACT_M3 12

Definition at line 75 of file device.h.

Referenced by setactive_kb().

9.8.1.6 #define ACT_MR_RING 9

Definition at line 72 of file device.h.

Referenced by setactive_kb().

9.8.1.7 #define ACT_NEXT 3

Definition at line 69 of file device.h.

9.8.1.8 #define ACT_NEXT_NOWRAP 5

Definition at line 70 of file device.h.

9.8.1.9 #define DEV_MAX 9

Definition at line 8 of file device.h.

Referenced by _updateconnected(), quitWithLock(), usb_rm_device(), and usbadd().

9.8.1.10 #define dmutex(*kb*) (devmutex + INDEX_OF(kb, keyboard))

Definition at line 18 of file device.h.

Referenced by _ledthread(), _setupusb(), closeusb(), devmain(), and usbadd().

9.8.1.11 #define imutex(*kb*) (inputmutex + INDEX_OF(kb, keyboard))

Definition at line 22 of file device.h.

Referenced by _setupusb(), closeusb(), cmd_bind(), cmd_erase(), cmd_eraseprofile(), cmd_get(), cmd_macro(), cmd_notify(), cmd_rebind(), cmd_unbind(), os_inputmain(), setactive_kb(), setactive_mouse(), and setupusb().

9.8.1.12 #define IN_CORSAIR 0x40

Definition at line 65 of file device.h.

Referenced by setactive_kb(), and setactive_mouse().

9.8.1.13 #define IN_HID 0x80

Definition at line 64 of file device.h.

Referenced by setactive_kb(), and setactive_mouse().

9.8.1.14 #define IS_CONNECTED(*kb*) ((kb) && (kb)->handle && (kb)->uinput_kb && (kb)->uinput_mouse)

Definition at line 12 of file device.h.

Referenced by _updateconnected(), devmain(), quitWithLock(), and usbadd().

9.8.1.15 #define mmutex(*kb*) (macromutex + INDEX_OF(kb, keyboard))

Definition at line 26 of file device.h.

Referenced by _usbrecv(), _usbsend(), and play_macro().

9.8.1.16 #define mmutex2(*kb*) (macromutex2 + INDEX_OF(kb, keyboard))

Definition at line 28 of file device.h.

Referenced by play_macro().

9.8.1.17 #define mvar(*kb*) (macrovar + INDEX_OF(kb, keyboard))

Definition at line 30 of file device.h.

Referenced by play_macro().

9.8.1.18 #define setactive(*kb, makeactive*) ((makeactive) ? (kb)->vtable->active((kb), 0, 0, 0, 0) : (kb)->vtable->idle((kb), 0, 0, 0, 0))

Definition at line 44 of file device.h.

Referenced by _start_dev(), and revertusb().

9.8.2 Function Documentation

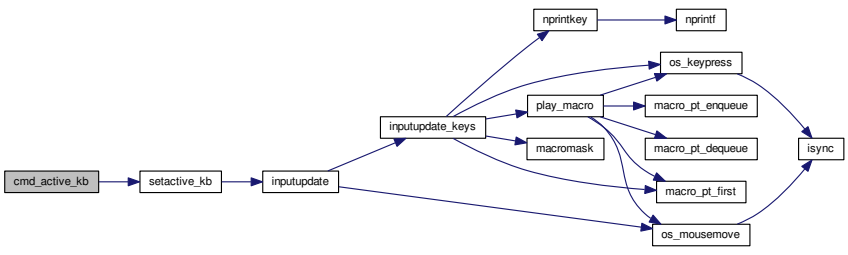
9.8.2.1 int cmd_active_kb (usbdevice * *kb,* usbmode * *dummy1,* int *dummy2,* int *dummy3,* const char * *dummy4*)

Definition at line 112 of file device_keyboard.c.

References setactive_kb().

```
112                                                                                 {
113     return setactive_kb(kb, 1);
114 }
```

Here is the call graph for this function:



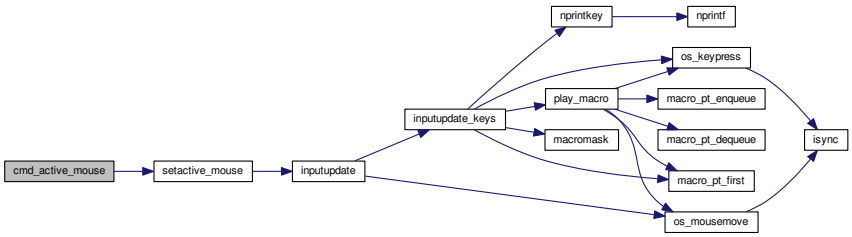
9.8.2.2 int cmd_active_mouse (usbdevice * kb, usbmode * dummy1, int dummy2, int dummy3, const char * dummy4)

Definition at line 44 of file device_mouse.c.

References setactive_mouse().

```
44                                                                                  {
45     return setactive_mouse(kb, 1);
46 }
```

Here is the call graph for this function:



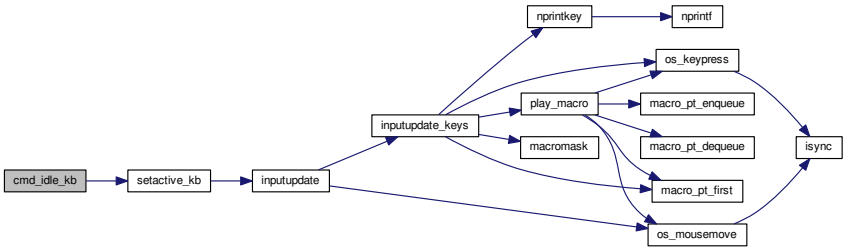
9.8.2.3 int cmd_idle_kb (usbdevice * kb, usbmode * dummy1, int dummy2, int dummy3, const char * dummy4)

Definition at line 116 of file device_keyboard.c.

References setactive_kb().

```
116                                                                                 {
117     return setactive_kb(kb, 0);
118 }
```

Here is the call graph for this function:



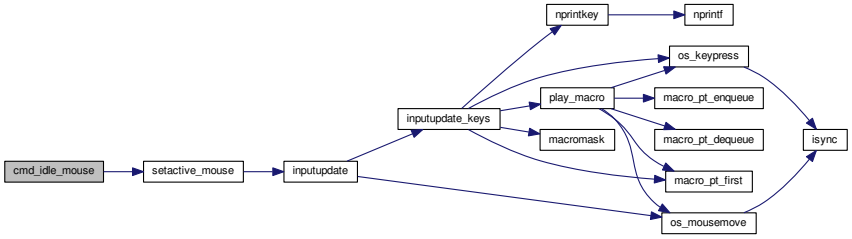
9.8.2.4 int cmd_idle_mouse (usbdevice * kb, usbmode * dummy1, int dummy2, int dummy3, const char * dummy4)

Definition at line 48 of file device_mouse.c.

References setactive_mouse().

```
48                                                                                  {
49     return setactive_mouse(kb, 0);
50 }
```

Here is the call graph for this function:



9.8.2.5 int cmd_pollrate (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *rate*, const char * *dummy3*)

Definition at line 52 of file device_mouse.c.

References MSG_SIZE, usbdevice::pollrate, and usbsend.

```
52                                                                                                  {
53     uchar msg[MSG_SIZE] = {
54         0x07, 0x0a, 0, 0, (uchar)rate
55     };
56     if(!usbsend(kb, msg, 1))
57         return -1;
58     // Device should disconnect+reconnect, but update the poll rate field in case it doesn't
59     kb->pollrate = rate;
60     return 0;
61 }
```

9.8.2.6 int setactive_kb (usbdevice * *kb*, int *active*)

Definition at line 18 of file device_keyboard.c.

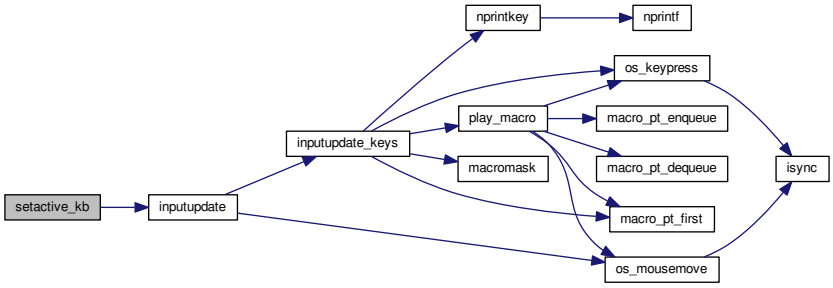
References ACT_LIGHT, ACT_LOCK, ACT_M1, ACT_M2, ACT_M3, ACT_MR_RING, usbdevice::active, DELAY_-MEDIUM, lighting::forceupdate, imutex, IN_CORSAIR, IN_HID, usbdevice::input, inputupdate(), keymap, usbinput-::keys, usbprofile::lastlight, MSG_SIZE, N_KEYS_HW, NEEDS_FW_UPDATE, usbdevice::profile, usbsend, and usbdevice::vtable.

Referenced by cmd_active_kb(), and cmd_idle_kb().

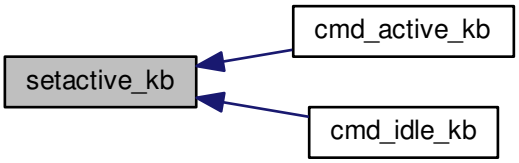
```
18                                                {
19     if(NEEDS_FW_UPDATE(kb))
20         return 0;
21
22     pthread_mutex_lock(imutex(kb));
23     kb->active = !!active;
24     kb->profile->lastlight.forceupdate = 1;
25     // Clear input
26     memset(&kb->input.keys, 0, sizeof(kb->input.keys));
27     inputupdate(kb);
28     pthread_mutex_unlock(imutex(kb));
29
30     uchar msg[3][MSG_SIZE] = {
31         { 0x07, 0x04, 0 },                  // Disables or enables HW control for top row
32         { 0x07, 0x40, 0 },                  // Selects key input
33         { 0x07, 0x05, 2, 0, 0x03, 0x00 }    // Commits key input selection
34     };
35     if(active){
36         // Put the M-keys (K95) as well as the Brightness/Lock keys into software-controlled mode.
37         msg[0][2] = 2;
38         if(!usbsend(kb, msg[0], 1))
39             return -1;
40         DELAY_MEDIUM(kb);
41         // Set input mode on the keys. They must be grouped into packets of 60 bytes (+ 4 bytes header)
42         // Keys are referenced in byte pairs, with the first byte representing the key and the second byte
       representing the mode.
```

```
43          for(int key = 0; key < N_KEYS_HW; ){
44              int pair;
45              for(pair = 0; pair < 30 && key < N_KEYS_HW; pair++, key++){
46                  // Select both standard and Corsair input. The standard input will be ignored except in
    BIOS mode.
47                  uchar action = IN_HID | IN_CORSAIR;
48                  // Additionally, make MR activate the MR ring (this is disabled for now, may be back later)
49                  //if(keymap[key].name && !strcmp(keymap[key].name, "mr"))
50                  //    action |= ACT_MR_RING;
51                  msg[1][4 + pair * 2] = key;
52                  msg[1][5 + pair * 2] = action;
53              }
54              // Byte 2 = pair count (usually 30, less on final message)
55              msg[1][2] = pair;
56              if(!usbsend(kb, msg[1], 1))
57                  return -1;
58          }
59          // Commit new input settings
60          if(!usbsend(kb, msg[2], 1))
61              return -1;
62          DELAY_MEDIUM(kb);
63      } else {
64          // Set the M-keys back into hardware mode, restore hardware RGB profile. It has to be sent twice
    for some reason.
65          msg[0][2] = 1;
66          if(!usbsend(kb, msg[0], 1))
67              return -1;
68          DELAY_MEDIUM(kb);
69          if(!usbsend(kb, msg[0], 1))
70              return -1;
71          DELAY_MEDIUM(kb);
72  #ifdef OS_LINUX
73          // On OSX the default key mappings are fine. On Linux, the G keys will freeze the keyboard. Set the
    keyboard entirely to HID input.
74          for(int key = 0; key < N_KEYS_HW; ){
75              int pair;
76              for(pair = 0; pair < 30 && key < N_KEYS_HW; pair++, key++){
77                  uchar action = IN_HID;
78                  // Enable hardware actions
79                  if(keymap[key].name){
80                      if(!strcmp(keymap[key].name, "mr"))
81                          action = ACT_MR_RING;
82                      else if(!strcmp(keymap[key].name, "m1"))
83                          action = ACT_M1;
84                      else if(!strcmp(keymap[key].name, "m2"))
85                          action = ACT_M2;
86                      else if(!strcmp(keymap[key].name, "m3"))
87                          action = ACT_M3;
88                      else if(!strcmp(keymap[key].name, "light"))
89                          action = ACT_LIGHT;
90                      else if(!strcmp(keymap[key].name, "lock"))
91                          action = ACT_LOCK;
92                  }
93                  msg[1][4 + pair * 2] = key;
94                  msg[1][5 + pair * 2] = action;
95              }
96              // Byte 2 = pair count (usually 30, less on final message)
97              msg[1][2] = pair;
98              if(!usbsend(kb, msg[1], 1))
99                  return -1;
100         }
101         // Commit new input settings
102         if(!usbsend(kb, msg[2], 1))
103             return -1;
104         DELAY_MEDIUM(kb);
105 #endif
106     }
107     // Update indicator LEDs if the profile contains settings for them
108     kb->vtable->updateindicators(kb, 0);
109     return 0;
110 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.8.2.7 int setactive_mouse (usbdevice * *kb*, int *active*)

Definition at line 9 of file device_mouse.c.

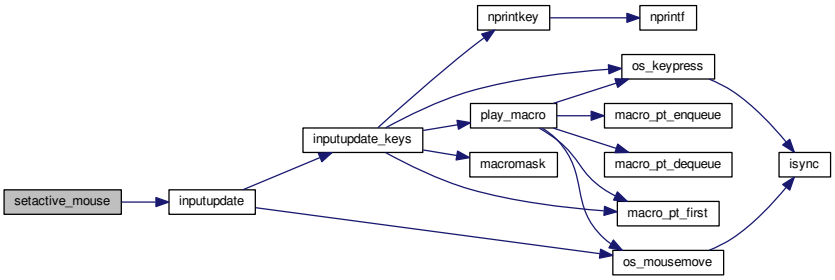
References usbdevice::active, lighting::forceupdate, imutex, IN_CORSAIR, IN_HID, usbdevice::input, inputupdate(), usbinput::keys, usbprofile::lastlight, MSG_SIZE, NEEDS_FW_UPDATE, usbdevice::profile, and usbsend.

Referenced by cmd_active_mouse(), and cmd_idle_mouse().

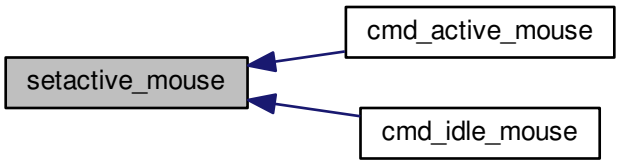
```
9                                               {
10      if(NEEDS_FW_UPDATE(kb))
11          return 0;
12      const int keycount = 20;
13      uchar msg[2][MSG_SIZE] = {
14          { 0x07, 0x04, 0 },                  // Disables or enables HW control for DPI and Sniper button
15          { 0x07, 0x40, keycount, 0 },        // Select button input (simlilar to the packet sent to
        keyboards, but lacks a commit packet)
16      };
17      if(active)
18          // Put the mouse into SW mode
19          msg[0][2] = 2;
20      else
21          // Restore HW mode
22          msg[0][2] = 1;
23      pthread_mutex_lock(imutex(kb));
24      kb->active = !!active;
25      kb->profile->lastlight.forceupdate = 1;
26      // Clear input
27      memset(&kb->input.keys, 0, sizeof(kb->input.keys));
28      inputupdate(kb);
29      pthread_mutex_unlock(imutex(kb));
30      if(!usbsend(kb, msg[0], 1))
31          return -1;
32      if(active){
```

```
33          // Set up key input
34          if(!usbsend(kb, msg[1], 1))
35              return -1;
36          for(int i = 0; i < keycount; i++){
37              msg[1][i * 2 + 4] = i + 1;
38              msg[1][i * 2 + 5] = (i < 6 ? IN_HID : IN_CORSAIR);
39          }
40      }
41      return 0;
42  }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.8.2.8 void setmodeindex_nrgb (usbdevice * *kb*, int *index*)

Definition at line 120 of file device_keyboard.c.

References NK95_M1, NK95_M2, NK95_M3, and nk95cmd.

```
120                                                 {
121      switch(index % 3){
122      case 0:
123          nk95cmd(kb, NK95_M1);
124          break;
125      case 1:
126          nk95cmd(kb, NK95_M2);
127          break;
128      case 2:
129          nk95cmd(kb, NK95_M3);
130          break;
131      }
132  }
```

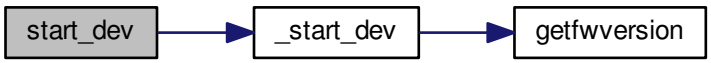
9.8.2.9 int start_dev (usbdevice * kb, int makeactive)

Definition at line 80 of file device.c.

References _start_dev(), USB_DELAY_DEFAULT, and usbdevice::usbdelay.

```
80                                              {
81     // Force USB interval to 10ms during initial setup phase; return to nominal 5ms after setup completes.
82     kb->usbdelay = 10;
83     int res = _start_dev(kb, makeactive);
84     kb->usbdelay = USB_DELAY_DEFAULT;
85     return res;
86 }
```

Here is the call graph for this function:



9.8.2.10 int start_kb_nrgb (usbdevice * kb, int makeactive)

Definition at line 9 of file device_keyboard.c.

References usbdevice::active, NK95_HWOFF, nk95cmd, and usbdevice::pollrate.

```
9                                                   {
10     // Put the non-RGB K95 into software mode. Nothing else needs to be done hardware wise
11     nk95cmd(kb, NK95_HWOFF);
12     // Fill out RGB features for consistency, even though the keyboard doesn't have them
13     kb->active = 1;
14     kb->pollrate = -1;
15     return 0;
16 }
```

9.8.3 Variable Documentation

9.8.3.1 pthread_mutex_t devmutex[9]

Definition at line 12 of file device.c.

Referenced by _updateconnected(), quitWithLock(), and usb_rm_device().

9.8.3.2 pthread_mutex_t inputmutex[9]

Definition at line 13 of file device.c.

9.8.3.3 usbdevice keyboard[9]

Definition at line 10 of file device.c.

Referenced by _mkdevpath(), _mknotifynode(), _rmnotifynode(), _setupusb(), _updateconnected(), closeusb(), main(), mkfwnode(), os_closeusb(), os_inputmain(), os_inputopen(), os_setupusb(), quitWithLock(), rmdevpath(), usb_rm_device(), and usbadd().

9.8.3.4 pthread_mutex_t macromutex[9]

Definition at line 14 of file device.c.

9.8.3.5 pthread_mutex_t macromutex2[9]

Definition at line 15 of file device.c.

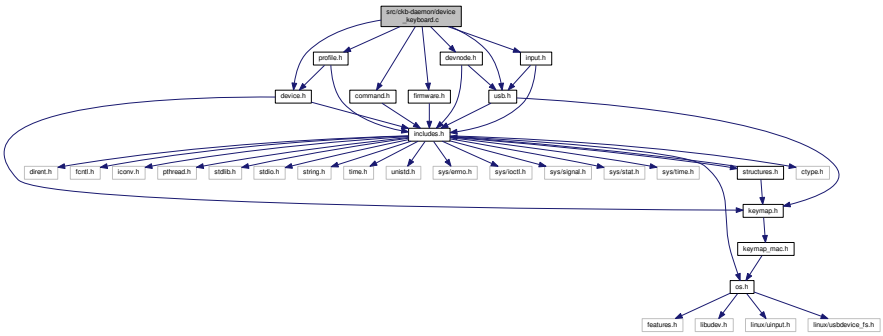
9.8.3.6 pthread_cond_t macrovar[9]

Definition at line 16 of file device.c.

9.9 src/ckb-daemon/device_keyboard.c File Reference

```
#include "command.h"
#include "device.h"
#include "devnode.h"
#include "firmware.h"
#include "input.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for device_keyboard.c:



Functions

- int start_kb_nrgb (usbdevice *kb, int makeactive)
- int setactive_kb (usbdevice *kb, int active)
- int cmd_active_kb (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- int cmd_idle_kb (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- void setmodeindex_nrgb (usbdevice *kb, int index)

9.9.1 Function Documentation

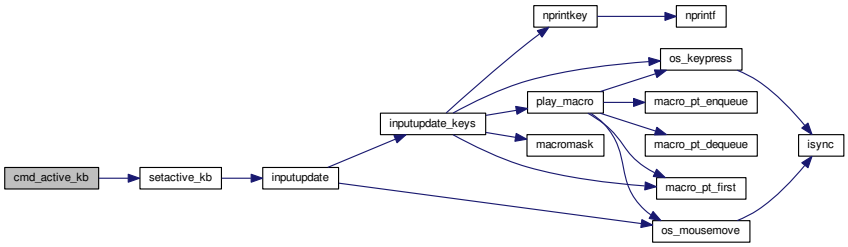
9.9.1.1 int cmd_active_kb (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*)

Definition at line 112 of file device_keyboard.c.

References setactive_kb().

```
112                                                                                 {
113     return setactive_kb(kb, 1);
114 }
```

Here is the call graph for this function:



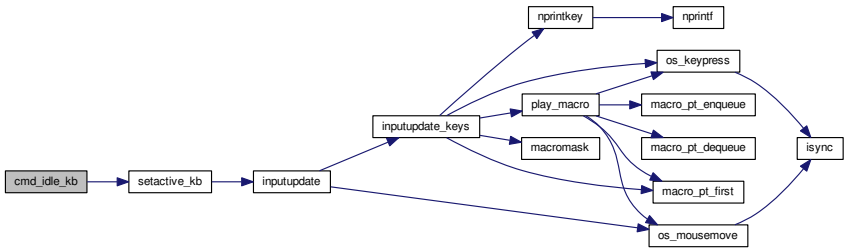
9.9.1.2 int cmd_idle_kb (usbdevice * *kb,* usbmode * *dummy1,* int *dummy2,* int *dummy3,* const char * *dummy4*)

Definition at line 116 of file device_keyboard.c.

References setactive_kb().

```
116                                                                                 {
117     return setactive_kb(kb, 0);
118 }
```

Here is the call graph for this function:



9.9.1.3 int setactive_kb (usbdevice * *kb,* int *active*)

Definition at line 18 of file device_keyboard.c.

References ACT_LIGHT, ACT_LOCK, ACT_M1, ACT_M2, ACT_M3, ACT_MR_RING, usbdevice::active, DELAY_-MEDIUM, lighting::forceupdate, imutex, IN_CORSAIR, IN_HID, usbdevice::input, inputupdate(), keymap, usbinput-::keys, usbprofile::lastlight, MSG_SIZE, N_KEYS_HW, NEEDS_FW_UPDATE, usbdevice::profile, usbsend, and usbdevice::vtable.

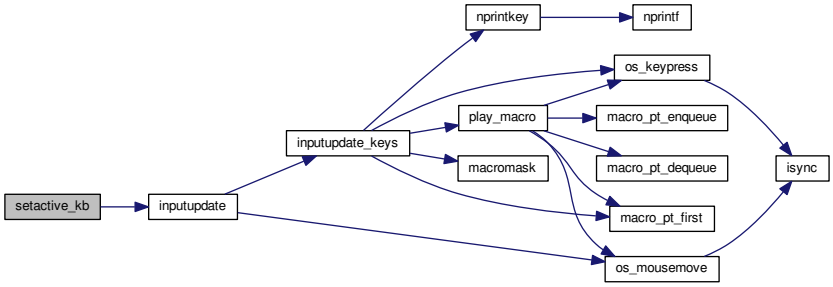
Referenced by cmd_active_kb(), and cmd_idle_kb().

```
18                                          {
19     if(NEEDS_FW_UPDATE(kb))
20         return 0;
21
22     pthread_mutex_lock(imutex(kb));
```

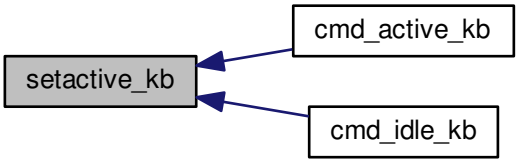
```
23      kb->active = !!active;
24      kb->profile->lastlight.forceupdate = 1;
25      // Clear input
26      memset(&kb->input.keys, 0, sizeof(kb->input.keys));
27      inputupdate(kb);
28      pthread_mutex_unlock(imutex(kb));
29
30      uchar msg[3][MSG_SIZE] = {
31          { 0x07, 0x04, 0 },                  // Disables or enables HW control for top row
32          { 0x07, 0x40, 0 },                  // Selects key input
33          { 0x07, 0x05, 2, 0, 0x03, 0x00 }    // Commits key input selection
34      };
35      if(active){
36          // Put the M-keys (K95) as well as the Brightness/Lock keys into software-controlled mode.
37          msg[0][2] = 2;
38          if(!usbsend(kb, msg[0], 1))
39              return -1;
40          DELAY_MEDIUM(kb);
41          // Set input mode on the keys. They must be grouped into packets of 60 bytes (+ 4 bytes header)
42          // Keys are referenced in byte pairs, with the first byte representing the key and the second byte
        representing the mode.
43          for(int key = 0; key < N_KEYS_HW; ){
44              int pair;
45              for(pair = 0; pair < 30 && key < N_KEYS_HW; pair++, key++){
46                  // Select both standard and Corsair input. The standard input will be ignored except in
        BIOS mode.
47                  uchar action = IN_HID | IN_CORSAIR;
48                  // Additionally, make MR activate the MR ring (this is disabled for now, may be back later)
49                  //if(keymap[key].name && !strcmp(keymap[key].name, "mr"))
50                  //    action |= ACT_MR_RING;
51                  msg[1][4 + pair * 2] = key;
52                  msg[1][5 + pair * 2] = action;
53              }
54              // Byte 2 = pair count (usually 30, less on final message)
55              msg[1][2] = pair;
56              if(!usbsend(kb, msg[1], 1))
57                  return -1;
58          }
59          // Commit new input settings
60          if(!usbsend(kb, msg[2], 1))
61              return -1;
62          DELAY_MEDIUM(kb);
63      } else {
64          // Set the M-keys back into hardware mode, restore hardware RGB profile. It has to be sent twice
        for some reason.
65          msg[0][2] = 1;
66          if(!usbsend(kb, msg[0], 1))
67              return -1;
68          DELAY_MEDIUM(kb);
69          if(!usbsend(kb, msg[0], 1))
70              return -1;
71          DELAY_MEDIUM(kb);
72  #ifdef OS_LINUX
73          // On OSX the default key mappings are fine. On Linux, the G keys will freeze the keyboard. Set the
        keyboard entirely to HID input.
74          for(int key = 0; key < N_KEYS_HW; ){
75              int pair;
76              for(pair = 0; pair < 30 && key < N_KEYS_HW; pair++, key++){
77                  uchar action = IN_HID;
78                  // Enable hardware actions
79                  if(keymap[key].name){
80                      if(!strcmp(keymap[key].name, "mr"))
81                          action = ACT_MR_RING;
82                      else if(!strcmp(keymap[key].name, "m1"))
83                          action = ACT_M1;
84                      else if(!strcmp(keymap[key].name, "m2"))
85                          action = ACT_M2;
86                      else if(!strcmp(keymap[key].name, "m3"))
87                          action = ACT_M3;
88                      else if(!strcmp(keymap[key].name, "light"))
89                          action = ACT_LIGHT;
90                      else if(!strcmp(keymap[key].name, "lock"))
91                          action = ACT_LOCK;
92                  }
93                  msg[1][4 + pair * 2] = key;
94                  msg[1][5 + pair * 2] = action;
95              }
96              // Byte 2 = pair count (usually 30, less on final message)
97              msg[1][2] = pair;
98              if(!usbsend(kb, msg[1], 1))
99                  return -1;
100         }
101         // Commit new input settings
102         if(!usbsend(kb, msg[2], 1))
103             return -1;
104         DELAY_MEDIUM(kb);
105 #endif
```

```
106     }
107     // Update indicator LEDs if the profile contains settings for them
108     kb->vtable->updateindicators(kb, 0);
109     return 0;
110 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.9.1.4 void setmodeindex_nrgb (usbdevice * *kb*, int *index*)

Definition at line 120 of file device_keyboard.c.

References NK95_M1, NK95_M2, NK95_M3, and nk95cmd.

```
120                                                 {
121     switch(index % 3){
122     case 0:
123         nk95cmd(kb, NK95_M1);
124         break;
125     case 1:
126         nk95cmd(kb, NK95_M2);
127         break;
128     case 2:
129         nk95cmd(kb, NK95_M3);
130         break;
131     }
132 }
```

9.9.1.5 int start_kb_nrgb (usbdevice * *kb*, int *makeactive*)

Definition at line 9 of file device_keyboard.c.

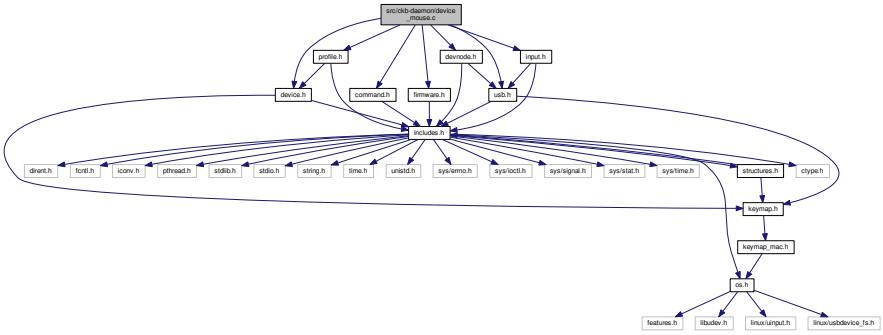
References usbdevice::active, NK95_HWOFF, nk95cmd, and usbdevice::pollrate.

```
9                                                   {
10      // Put the non-RGB K95 into software mode. Nothing else needs to be done hardware wise
11      nk95cmd(kb, NK95_HWOFF);
12      // Fill out RGB features for consistency, even though the keyboard doesn't have them
13      kb->active = 1;
14      kb->pollrate = -1;
15      return 0;
16  }
```

9.10 src/ckb-daemon/device_mouse.c File Reference

```
#include "command.h"
#include "device.h"
#include "devnode.h"
#include "firmware.h"
#include "input.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for device_mouse.c:



Functions

- int setactive_mouse (usbdevice ∗kb, int active)
- int cmd_active_mouse (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int dummy3, const char ∗dummy4)
- int cmd_idle_mouse (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int dummy3, const char ∗dummy4)
- int cmd_pollrate (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int rate, const char ∗dummy3)

9.10.1 Function Documentation

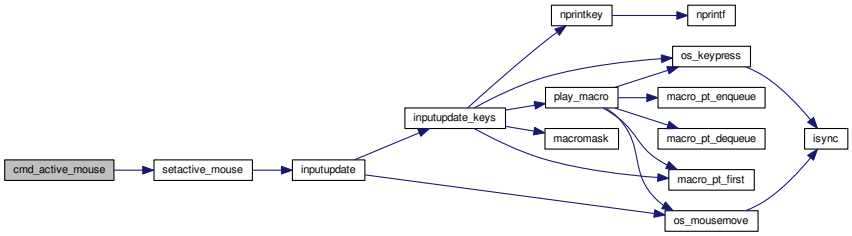
9.10.1.1 int cmd_active_mouse (usbdevice ∗ *kb*, usbmode ∗ *dummy1*, int *dummy2*, int *dummy3*, const char ∗ *dummy4*)

Definition at line 44 of file device_mouse.c.

References setactive_mouse().

```
44                                                                                  {
45      return setactive_mouse(kb, 1);
46  }
```

Here is the call graph for this function:



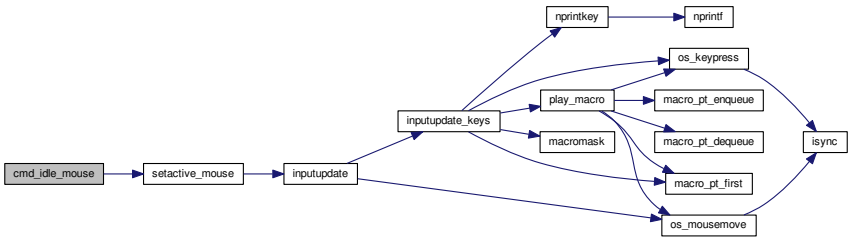
9.10.1.2 int cmd_idle_mouse (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*)

Definition at line 48 of file device_mouse.c.

References setactive_mouse().

```
48                                                                                                  {
49     return setactive_mouse(kb, 0);
50 }
```

Here is the call graph for this function:



9.10.1.3 int cmd_pollrate (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *rate*, const char * *dummy3*)

Definition at line 52 of file device_mouse.c.

References MSG_SIZE, usbdevice::pollrate, and usbsend.

```
52                                                                                                  {
53     uchar msg[MSG_SIZE] = {
54         0x07, 0x0a, 0, 0, (uchar)rate
55     };
56     if(!usbsend(kb, msg, 1))
57         return -1;
58     // Device should disconnect+reconnect, but update the poll rate field in case it doesn't
59     kb->pollrate = rate;
60     return 0;
61 }
```

9.10.1.4 int setactive_mouse (usbdevice * *kb*, int *active*)

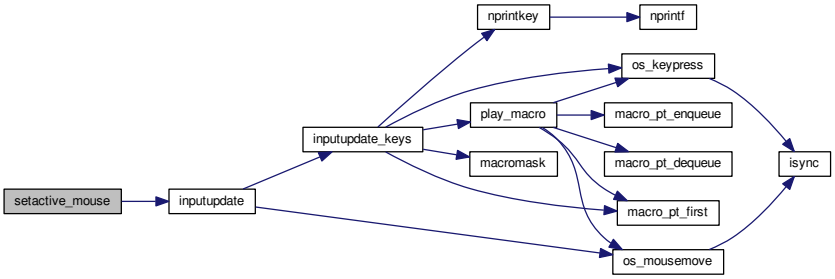
Definition at line 9 of file device_mouse.c.

References usbdevice::active, lighting::forceupdate, imutex, IN_CORSAIR, IN_HID, usbdevice::input, inputupdate(), usbinput::keys, usbprofile::lastlight, MSG_SIZE, NEEDS_FW_UPDATE, usbdevice::profile, and usbsend.

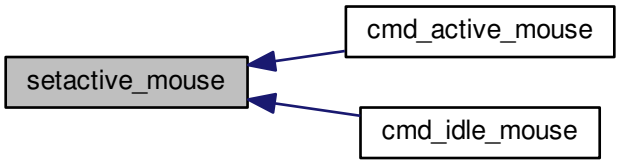
Referenced by cmd_active_mouse(), and cmd_idle_mouse().

```
9                                                   {
10      if(NEEDS_FW_UPDATE(kb))
11          return 0;
12      const int keycount = 20;
13      uchar msg[2][MSG_SIZE] = {
14          { 0x07, 0x04, 0 },                  // Disables or enables HW control for DPI and Sniper button
15          { 0x07, 0x40, keycount, 0 },        // Select button input (simlilar to the packet sent to
        keyboards, but lacks a commit packet)
16      };
17      if(active)
18          // Put the mouse into SW mode
19          msg[0][2] = 2;
20      else
21          // Restore HW mode
22          msg[0][2] = 1;
23      pthread_mutex_lock(imutex(kb));
24      kb->active = !!active;
25      kb->profile->lastlight.forceupdate = 1;
26      // Clear input
27      memset(&kb->input.keys, 0, sizeof(kb->input.keys));
28      inputupdate(kb);
29      pthread_mutex_unlock(imutex(kb));
30      if(!usbsend(kb, msg[0], 1))
31          return -1;
32      if(active){
33          // Set up key input
34          if(!usbsend(kb, msg[1], 1))
35              return -1;
36          for(int i = 0; i < keycount; i++){
37              msg[1][i * 2 + 4] = i + 1;
38              msg[1][i * 2 + 5] = (i < 6 ? IN_HID : IN_CORSAIR);
39          }
40      }
41      return 0;
42  }
```

Here is the call graph for this function:



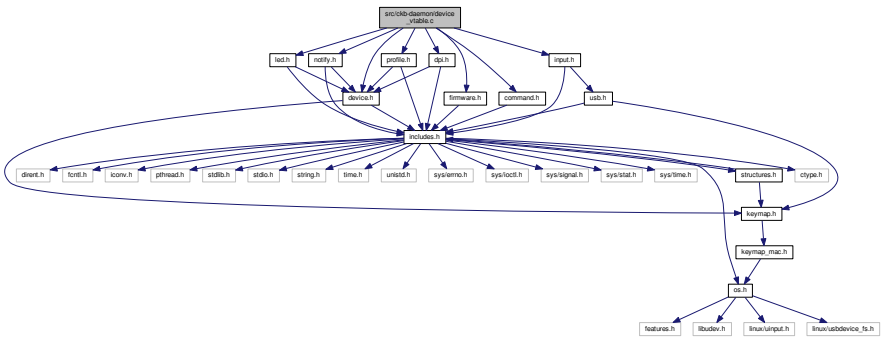
Here is the caller graph for this function:



9.11 src/ckb-daemon/device_vtable.c File Reference

```
#include "command.h"
#include "device.h"
#include "dpi.h"
#include "firmware.h"
#include "input.h"
#include "led.h"
#include "notify.h"
#include "profile.h"
```

Include dependency graph for device_vtable.c:



Functions

- static void cmd_none (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int dummy3, const char ∗dummy4)
- static int cmd_io_none (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int dummy3, const char ∗dummy4)
- static void cmd_macro_none (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, const char ∗dummy3, const char ∗dummy4)
- static int loadprofile_none (usbdevice ∗kb)
- static void int1_void_none (usbdevice ∗kb, int dummy)
- static int int1_int_none (usbdevice ∗kb, int dummy)

Variables

- const devcmd vtable_keyboard

RGB keyboard vtable holds functions for each device type.

- const devcmd vtable_keyboard_nonrgb
- const devcmd vtable_mouse

9.11.1 Function Documentation

9.11.1.1 static int cmd_io_none (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*) [static]

Definition at line 13 of file device_vtable.c.

```
13                                                                                                  {
14     return 0;
15 }
```

9.11.1.2 static void cmd_macro_none (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, const char * *dummy3*, const char * *dummy4*) [static]

Definition at line 16 of file device_vtable.c.

```
16
        {
17 }
```

9.11.1.3 static void cmd_none (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*) [static]

Definition at line 11 of file device_vtable.c.

```
11                                                                                                  {
12 }
```

9.11.1.4 static int int1_int_none (usbdevice * *kb*, int *dummy*) [static]

Definition at line 23 of file device_vtable.c.

```
23                                                {
24     return 0;
25 }
```

9.11.1.5 static void int1_void_none (usbdevice * *kb*, int *dummy*) [static]

Definition at line 21 of file device_vtable.c.

```
21                                                  {
22 }
```

9.11.1.6 static int loadprofile_none (usbdevice * *kb*) [static]

Definition at line 18 of file device_vtable.c.

```
18                                          {
19     return 0;
20 }
```

9.11.2 Variable Documentation

9.11.2.1 const devcmd vtable_keyboard

Definition at line 29 of file device_vtable.c.

Referenced by get_vtable().

9.11.2.2 const devcmd vtable_keyboard_nonrgb

Definition at line 76 of file device_vtable.c.

Referenced by get_vtable().

9.11.2.3 const devcmd vtable_mouse

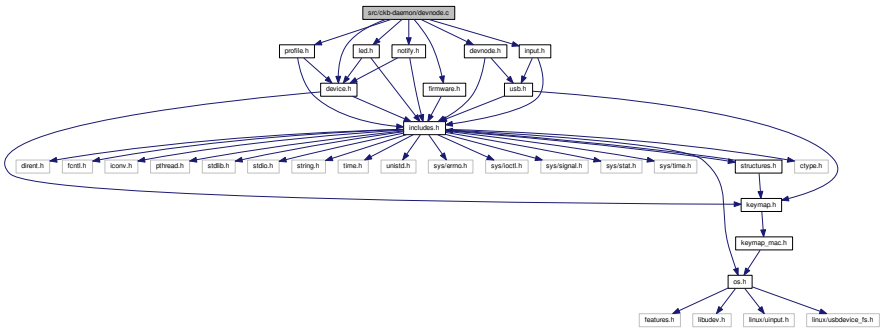
Definition at line 123 of file device_vtable.c.

Referenced by get_vtable().

9.12 src/ckb-daemon/devnode.c File Reference

```
#include "device.h"
#include "devnode.h"
#include "firmware.h"
#include "input.h"
#include "led.h"
#include "notify.h"
#include "profile.h"
```

Include dependency graph for devnode.c:



Data Structures

- struct _readlines_ctx

Macros

- #define S_GID_READ (gid >= 0 ? S_CUSTOM_R : S_READ)
- #define MAX_BUFFER (1024 * 1024 - 1)

Functions

- int rm_recursive (const char *path)
- void _updateconnected ()

  _updateconnected Update the list of connected devices.
- void updateconnected ()

  Update the list of connected devices.
- int _mknotifynode (usbdevice *kb, int notify)
- int mknotifynode (usbdevice *kb, int notify)

  Creates a notification node for the specified keyboard.
- int _rmnotifynode (usbdevice *kb, int notify)
- int rmnotifynode (usbdevice *kb, int notify)

  Removes a notification node for the specified keyboard.
- static int _mkdevpath (usbdevice *kb)
- int mkdevpath (usbdevice *kb)

  Create a dev path for the keyboard at index. Returns 0 on success.
- int rmdevpath (usbdevice *kb)

  Remove the dev path for the keyboard at index. Returns 0 on success.
- int mkfwnode (usbdevice *kb)

  Writes a keyboard's firmware version and poll rate to its device node.
- void readlines_ctx_init (readlines_ctx *ctx)
- void readlines_ctx_free (readlines_ctx ctx)
- unsigned readlines (int fd, readlines_ctx ctx, const char **input)

Variables

- const char *const devpath = "/dev/input/ckb"
- long gid = -1

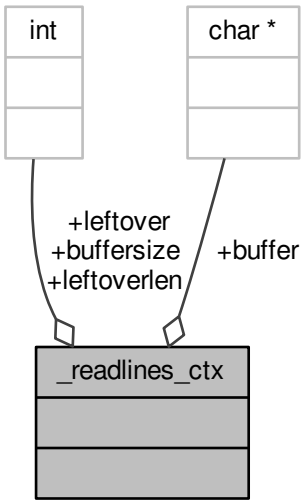
  Group ID for the control nodes. -1 to give read/write access to everybody.

9.12.1 Data Structure Documentation

9.12.1.1 struct _readlines_ctx

Definition at line 335 of file devnode.c.

Collaboration diagram for _readlines_ctx:



Data Fields

char *	buffer	
int	buffersize	
int	leftover	
int	leftoverlen	

9.12.2 Macro Definition Documentation

9.12.2.1 #define MAX_BUFFER (1024 * 1024 - 1)

Definition at line 334 of file devnode.c.

Referenced by readlines().

9.12.2.2 #define S_GID_READ (gid >= 0 ? S_CUSTOM_R : S_READ)

Definition at line 17 of file devnode.c.

Referenced by _mkdevpath(), _mknotifynode(), _updateconnected(), and mkfwnode().

9.12.3 Function Documentation

9.12.3.1 static int _mkdevpath (usbdevice * *kb*) [static]

Definition at line 136 of file devnode.c.

References _mknotifynode(), _updateconnected(), ckb_err, ckb_warn, devpath, FEAT_ADJRATE, FEAT_BIND, FEAT_FWUPDATE, FEAT_FWVERSION, FEAT_MONOCHROME, FEAT_NOTIFY, FEAT_POLLRATE, FEAT_RGB, gid, HAS_FEATURES, INDEX_OF, usbdevice::infifo, keyboard, mkfwnode(), usbdevice::name, usbdevice-

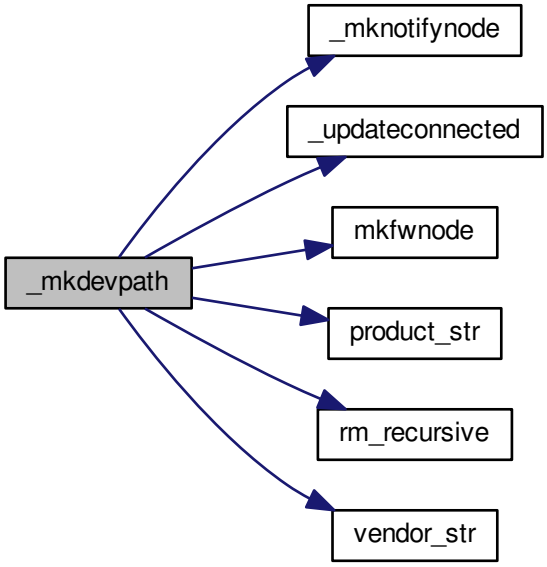
::product, product_str(), rm_recursive(), S_CUSTOM, S_GID_READ, S_READ, S_READDIR, S_READWRITE, usbdevice::serial, usbdevice::vendor, and vendor_str().

Referenced by mkdevpath().

```
136                                     {
137     int index = INDEX_OF(kb, keyboard);
138     // Create the control path
139     char path[strlen(devpath) + 2];
140     snprintf(path, sizeof(path), "%s%d", devpath, index);
141     if(rm_recursive(path) != 0 && errno != ENOENT){
142         ckb_err("Unable to delete %s: %s\n", path, strerror(errno));
143         return -1;
144     }
145     if(mkdir(path, S_READDIR) != 0){
146         ckb_err("Unable to create %s: %s\n", path, strerror(errno));
147         rm_recursive(path);
148         return -1;
149     }
150     if(gid >= 0)
151         chown(path, 0, gid);
152 
153     if(kb == keyboard + 0){
154         // Root keyboard: write a list of devices
155         _updateconnected();
156         // Write version number
157         char vpath[sizeof(path) + 8];
158         snprintf(vpath, sizeof(vpath), "%s/version", path);
159         FILE* vfile = fopen(vpath, "w");
160         if(vfile){
161             fprintf(vfile, "%s\n", CKB_VERSION_STR);
162             fclose(vfile);
163             chmod(vpath, S_GID_READ);
164             if(gid >= 0)
165                 chown(vpath, 0, gid);
166         } else {
167             ckb_warn("Unable to create %s: %s\n", vpath, strerror(errno));
168             remove(vpath);
169         }
170         // Write PID
171         char ppath[sizeof(path) + 4];
172         snprintf(ppath, sizeof(ppath), "%s/pid", path);
173         FILE* pfile = fopen(ppath, "w");
174         if(pfile){
175             fprintf(pfile, "%u\n", getpid());
176             fclose(pfile);
177             chmod(ppath, S_READ);
178             if(gid >= 0)
179                 chown(vpath, 0, gid);
180         } else {
181             ckb_warn("Unable to create %s: %s\n", ppath, strerror(errno));
182             remove(ppath);
183         }
184     } else {
185         // Create command FIFO
186         char inpath[sizeof(path) + 4];
187         snprintf(inpath, sizeof(inpath), "%s/cmd", path);
188         if(mkfifo(inpath, gid >= 0 ? S_CUSTOM : S_READWRITE) != 0
189                 // Open the node in RDWR mode because RDONLY will lock the thread
190                 || (kb->infifo = open(inpath, O_RDWR) + 1) == 0){
191             // Add one to the FD because 0 is a valid descriptor, but ckb uses 0 for uninitialized devices
192             ckb_err("Unable to create %s: %s\n", inpath, strerror(errno));
193             rm_recursive(path);
194             kb->infifo = 0;
195             return -1;
196         }
197         if(gid >= 0)
198             fchown(kb->infifo - 1, 0, gid);
199 
200         // Create notification FIFO
201         _mknotifynode(kb, 0);
202 
203         // Write the model and serial to files
204         char mpath[sizeof(path) + 6], spath[sizeof(path) + 7];
205         snprintf(mpath, sizeof(mpath), "%s/model", path);
206         snprintf(spath, sizeof(spath), "%s/serial", path);
207         FILE* mfile = fopen(mpath, "w");
208         if(mfile){
209             fputs(kb->name, mfile);
210             fputc('\n', mfile);
211             fclose(mfile);
212             chmod(mpath, S_GID_READ);
213             if(gid >= 0)
214                 chown(mpath, 0, gid);
215         } else {
216             ckb_warn("Unable to create %s: %s\n", mpath, strerror(errno));
```

```
217             remove(mpath);
218         }
219         FILE* sfile = fopen(spath, "w");
220         if(sfile){
221             fputs(kb->serial, sfile);
222             fputc('\n', sfile);
223             fclose(sfile);
224             chmod(spath, S_GID_READ);
225             if(gid >= 0)
226                 chown(spath, 0, gid);
227         } else {
228             ckb_warn("Unable to create %s: %s\n", spath, strerror(errno));
229             remove(spath);
230         }
231         // Write the keyboard's features
232         char fpath[sizeof(path) + 9];
233         snprintf(fpath, sizeof(fpath), "%s/features", path);
234         FILE* ffile = fopen(fpath, "w");
235         if(ffile){
236             fprintf(ffile, "%s %s", vendor_str(kb->vendor),
    product_str(kb->product));
237             if(HAS_FEATURES(kb, FEAT_MONOCHROME))
238                 fputs(" monochrome", ffile);
239             if(HAS_FEATURES(kb, FEAT_RGB))
240                 fputs(" rgb", ffile);
241             if(HAS_FEATURES(kb, FEAT_POLLRATE))
242                 fputs(" pollrate", ffile);
243             if(HAS_FEATURES(kb, FEAT_ADJRATE))
244                 fputs(" adjrate", ffile);
245             if(HAS_FEATURES(kb, FEAT_BIND))
246                 fputs(" bind", ffile);
247             if(HAS_FEATURES(kb, FEAT_NOTIFY))
248                 fputs(" notify", ffile);
249             if(HAS_FEATURES(kb, FEAT_FWVERSION))
250                 fputs(" fwversion", ffile);
251             if(HAS_FEATURES(kb, FEAT_FWUPDATE))
252                 fputs(" fwupdate", ffile);
253             fputc('\n', ffile);
254             fclose(ffile);
255             chmod(fpath, S_GID_READ);
256             if(gid >= 0)
257                 chown(fpath, 0, gid);
258         } else {
259             ckb_warn("Unable to create %s: %s\n", fpath, strerror(errno));
260             remove(fpath);
261         }
262         // Write firmware version and poll rate
263         mkfwnode(kb);
264     }
265     return 0;
266 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.12.3.2 int _mknotifynode (usbdevice * *kb,* int *notify*)

Definition at line 87 of file devnode.c.

References ckb_warn, devpath, gid, INDEX_OF, keyboard, usbdevice::outfifo, OUTFIFO_MAX, and S_GID_READ.

Referenced by _mkdevpath(), and mknotifynode().

```
87                                          {
88     if(notify < 0 || notify >= OUTFIFO_MAX)
89         return -1;
90     if(kb->outfifo[notify] != 0)
91         return 0;
92     // Create the notification node
93     int index = INDEX_OF(kb, keyboard);
94     char outpath[strlen(devpath) + 10];
95     snprintf(outpath, sizeof(outpath), "%s%d/notify%d", devpath, index, notify);
96     if(mkfifo(outpath, S_GID_READ) != 0 || (kb->outfifo[notify] = open(outpath, O_RDWR |
       O_NONBLOCK) + 1) == 0){
97         // Add one to the FD because 0 is a valid descriptor, but ckb uses 0 for uninitialized devices
98         ckb_warn("Unable to create %s: %s\n", outpath, strerror(errno));
99         kb->outfifo[notify] = 0;
100         remove(outpath);
101         return -1;
102     }
103     if(gid >= 0)
104         fchown(kb->outfifo[notify] - 1, 0, gid);
105     return 0;
106 }
```

Here is the caller graph for this function:

9.12.3.3 int _rmnotifynode (usbdevice * *kb*, int *notify*)

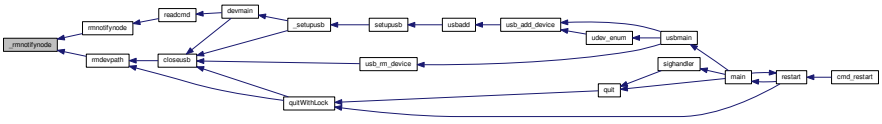
Definition at line 115 of file devnode.c.

References devpath, INDEX_OF, keyboard, usbdevice::outfifo, and OUTFIFO_MAX.

Referenced by rmdevpath(), and rmnotifynode().

```
115                                                 {
116     if(notify < 0 || notify >= OUTFIFO_MAX || !kb->outfifo[notify])
117         return -1;
118     int index = INDEX_OF(kb, keyboard);
119     char outpath[strlen(devpath) + 10];
120     snprintf(outpath, sizeof(outpath), "%s%d/notify%d", devpath, index, notify);
121     // Close FIFO
122     close(kb->outfifo[notify] - 1);
123     kb->outfifo[notify] = 0;
124     // Delete node
125     int res = remove(outpath);
126     return res;
127 }
```

Here is the caller graph for this function:



9.12.3.4 void _updateconnected ( )

<devicepath> normally is /dev/input/ckb or /input/ckb.

Open the normal file under <devicepath>0/connected for writing. For each device connected, print its devicepath+number, the serial number of the usb device and the usb name of the device connected to that usb interface.

eg:

/dev/input/ckb1 0F022014ABABABABABABABABABABA999 Corsair K95 RGB Gaming Keyboard

/dev/input/ckb2 0D02303DBACBACBACBACBACBACBAC998 Corsair M65 RGB Gaming Mouse

Set the file ownership to root. If the glob var gid is explicitly set to something different from -1 (the initial value), set file permission to 640, else to 644. This is used if you start the daemon with –gid=<GID> Parameter.

Because several independent threads may call updateconnected(), protect that procedure with locking/unlocking of **devmutex**.

Definition at line 55 of file devnode.c.

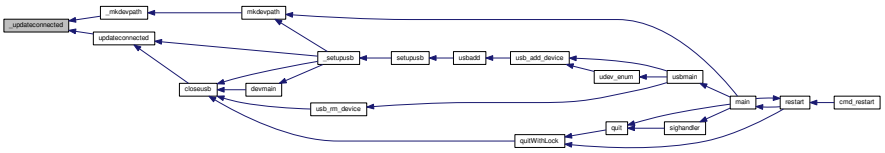
References ckb_warn, DEV_MAX, devmutex, devpath, gid, IS_CONNECTED, keyboard, and S_GID_READ.

Referenced by _mkdevpath(), and updateconnected().

```
55                         {
```

```
56      pthread_mutex_lock(devmutex);
57      char cpath[strlen(devpath) + 12];
58      snprintf(cpath, sizeof(cpath), "%s0/connected", devpath);
59      FILE* cfile = fopen(cpath, "w");
60      if(!cfile){
61          ckb_warn("Unable to update %s: %s\n", cpath, strerror(errno));
62          pthread_mutex_unlock(devmutex);
63          return;
64      }
65      int written = 0;
66      for(int i = 1; i < DEV_MAX; i++){
67          if(IS_CONNECTED(keyboard + i)){
68              written = 1;
69              fprintf(cfile, "%s%d %s %s\n", devpath, i, keyboard[i].serial,
    keyboard[i].name);
70          }
71      }
72      if(!written)
73          fputc('\n', cfile);
74      fclose(cfile);
75      chmod(cpath, S_GID_READ);
76      if(gid >= 0)
77          chown(cpath, 0, gid);
78      pthread_mutex_unlock(devmutex);
79  }
```

Here is the caller graph for this function:



9.12.3.5 int mkdevpath (usbdevice * *kb*)

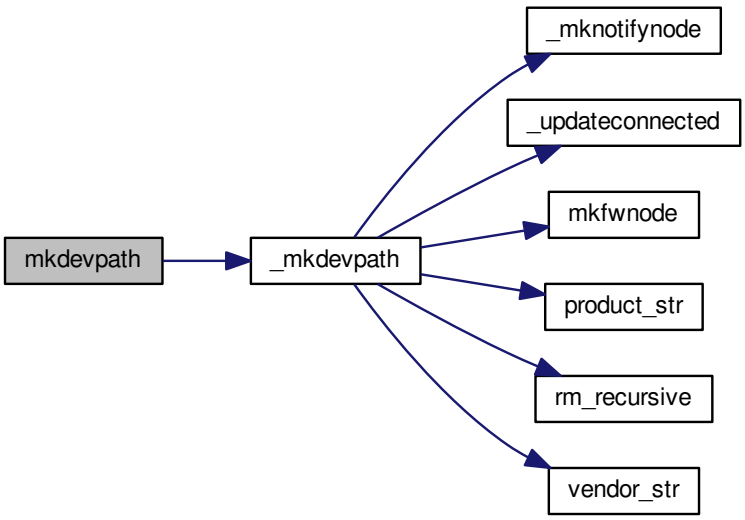
Definition at line 268 of file devnode.c.

References _mkdevpath(), euid_guard_start, and euid_guard_stop.

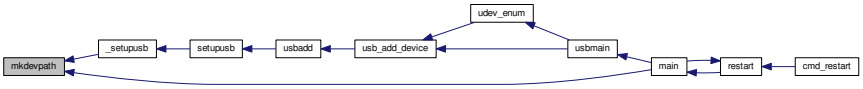
Referenced by _setupusb(), and main().

```
268                             {
269      euid_guard_start;
270      int res = _mkdevpath(kb);
271      euid_guard_stop;
272      return res;
273  }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.12.3.6 int mkfwnode (usbdevice * *kb*)

Definition at line 299 of file devnode.c.

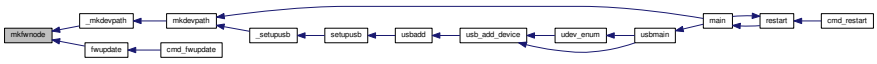
References ckb_warn, devpath, usbdevice::fwversion, gid, INDEX_OF, keyboard, usbdevice::pollrate, and S_GID_-READ.

Referenced by _mkdevpath(), and fwupdate().

```
299                          {
300     int index = INDEX_OF(kb, keyboard);
301     char fwpath[strlen(devpath) + 12];
302     snprintf(fwpath, sizeof(fwpath), "%s%d/fwversion", devpath, index);
303     FILE* fwfile = fopen(fwpath, "w");
304     if(fwfile){
305         fprintf(fwfile, "%04x", kb->fwversion);
306         fputc('\n', fwfile);
307         fclose(fwfile);
308         chmod(fwpath, S_GID_READ);
309         if(gid >= 0)
310             chown(fwpath, 0, gid);
311     } else {
312         ckb_warn("Unable to create %s: %s\n", fwpath, strerror(errno));
313         remove(fwpath);
314         return -1;
315     }
316     char ppath[strlen(devpath) + 11];
317     snprintf(ppath, sizeof(ppath), "%s%d/pollrate", devpath, index);
318     FILE* pfile = fopen(ppath, "w");
```

```
319     if(pfile){
320         fprintf(pfile, "%d ms", kb->pollrate);
321         fputc('\n', pfile);
322         fclose(pfile);
323         chmod(ppath, S_GID_READ);
324         if(gid >= 0)
325             chown(ppath, 0, gid);
326     } else {
327         ckb_warn("Unable to create %s: %s\n", fwpath, strerror(errno));
328         remove(ppath);
329         return -2;
330     }
331     return 0;
332 }
```

Here is the caller graph for this function:



9.12.3.7 int mknotifynode (usbdevice * *kb*, int *notify*)

Definition at line 108 of file devnode.c.

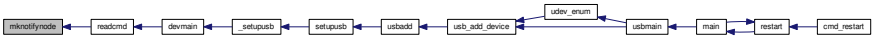
References _mknotifynode(), euid_guard_start, and euid_guard_stop.

Referenced by readcmd().

```
108                                         {
109     euid_guard_start;
110     int res = _mknotifynode(kb, notify);
111     euid_guard_stop;
112     return res;
113 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.12.3.8 unsigned readlines (int *fd*, readlines_ctx *ctx*, const char ** *input*)

Definition at line 353 of file devnode.c.

References _readlines_ctx::buffer, _readlines_ctx::buffersize, ckb_warn, _readlines_ctx::leftover, _readlines_ctx::leftoverlen, and MAX_BUFFER.

Referenced by devmain().

```
353                                                                 {
354     // Move any data left over from a previous read to the start of the buffer
355     char* buffer = ctx->buffer;
356     int buffersize = ctx->buffersize;
357     int leftover = ctx->leftover, leftoverlen = ctx->leftoverlen;
358     memcpy(buffer, buffer + leftover, leftoverlen);
359     // Read data from the file
360     ssize_t length = read(fd, buffer + leftoverlen, buffersize - leftoverlen);
361     length = (length < 0 ? 0 : length) + leftoverlen;
362     leftover = ctx->leftover = leftoverlen = ctx->leftoverlen = 0;
363     if(length <= 0){
364         *input = 0;
365         return 0;
366     }
367     // Continue buffering until all available input is read or there's no room left
368     while(length == buffersize){
369         if(buffersize == MAX_BUFFER)
370             break;
371         int oldsize = buffersize;
372         buffersize += 4096;
373         ctx->buffersize = buffersize;
374         buffer = ctx->buffer = realloc(buffer, buffersize + 1);
375         ssize_t length2 = read(fd, buffer + oldsize, buffersize - oldsize);
376         if(length2 <= 0)
377             break;
378         length += length2;
379     }
380     buffer[length] = 0;
381     // Input should be issued one line at a time and should end with a newline.
382     char* lastline = memrchr(buffer, '\n', length);
383     if(lastline == buffer + length - 1){
384         // If the buffer ends in a newline, process the whole string
385         *input = buffer;
386         return length;
387     } else if(lastline){
388         // Otherwise, chop off the last line but process everything else
389         *lastline = 0;
390         leftover = ctx->leftover = lastline + 1 - buffer;
391         leftoverlen = ctx->leftoverlen = length - leftover;
392         *input = buffer;
393         return leftover - 1;
394     } else {
395         // If a newline wasn't found at all, process the whole buffer next time
396         *input = 0;
397         if(length == MAX_BUFFER){
398             // Unless the buffer is completely full, in which case discard it
399             ckb_warn("Too much input (1MB). Dropping.\n");
400             return 0;
401         }
402         leftoverlen = ctx->leftoverlen = length;
403         return 0;
404     }
405 }
```

Here is the caller graph for this function:

9.12.3.9 void readlines_ctx_free (readlines_ctx *ctx*)

Definition at line 348 of file devnode.c.

References _readlines_ctx::buffer.

Referenced by devmain().

```
348                                         {
```

```
349     free(ctx->buffer);
350     free(ctx);
351 }
```

Here is the caller graph for this function:

9.12.3.10 void readlines_ctx_init (readlines_ctx * ctx)

Definition at line 341 of file devnode.c.

Referenced by devmain().

```
341                                         {
342     // Allocate buffers to store data
343     *ctx = calloc(1, sizeof(struct _readlines_ctx));
344     int buffersize = (*ctx)->buffersize = 4095;
345     (*ctx)->buffer = malloc(buffersize + 1);
346 }
```

Here is the caller graph for this function:

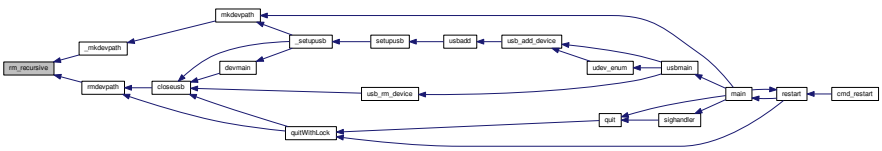
9.12.3.11 int rm_recursive (const char * path)

Definition at line 19 of file devnode.c.

Referenced by _mkdevpath(), and rmdevpath().

```
19                                      {
20     DIR* dir = opendir(path);
21     if(!dir)
22         return remove(path);
23     struct dirent* file;
24     while((file = readdir(dir)))
25     {
26         if(!strcmp(file->d_name, ".") || !strcmp(file->d_name, ".."))
27             continue;
28         char path2[FILENAME_MAX];
29         snprintf(path2, FILENAME_MAX, "%s/%s", path, file->d_name);
30         int stat = rm_recursive(path2);
31         if(stat != 0)
32             return stat;
33     }
34     closedir(dir);
35     return remove(path);
36 }
```

Here is the caller graph for this function:



9.12.3.12 int rmdevpath (usbdevice * kb)

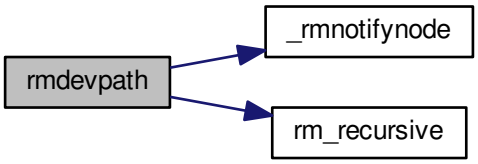
Definition at line 275 of file devnode.c.

References _rmnotifynode(), ckb_info, ckb_warn, devpath, euid_guard_start, euid_guard_stop, INDEX_OF, usbdevice::infifo, keyboard, OUTFIFO_MAX, and rm_recursive().

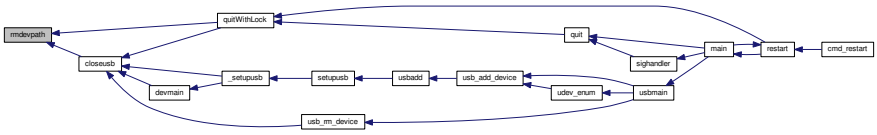
Referenced by closeusb(), and quitWithLock().

```
275                             {
276     euid_guard_start;
277     int index = INDEX_OF(kb, keyboard);
278     if(kb->infifo != 0){
279 #ifdef OS_LINUX
280         write(kb->infifo - 1, "\n", 1); // hack to prevent the FIFO thread from perma-blocking
281 #endif
282         close(kb->infifo - 1);
283         kb->infifo = 0;
284     }
285     for(int i = 0; i < OUTFIFO_MAX; i++)
286         _rmnotifynode(kb, i);
287     char path[strlen(devpath) + 2];
288     snprintf(path, sizeof(path), "%s%d", devpath, index);
289     if(rm_recursive(path) != 0 && errno != ENOENT){
290         ckb_warn("Unable to delete %s: %s\n", path, strerror(errno));
291         euid_guard_stop;
292         return -1;
293     }
294     ckb_info("Removed device path %s\n", path);
295     euid_guard_stop;
296     return 0;
297 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.12.3.13 int rmnotifynode (usbdevice * kb, int notify)

Definition at line 129 of file devnode.c.

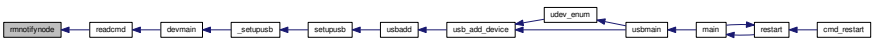
References _rmnotifynode(), euid_guard_start, and euid_guard_stop.

Referenced by readcmd().

```
129                                             {
130     euid_guard_start;
131     int res = _rmnotifynode(kb, notify);
132     euid_guard_stop;
133     return res;
134 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.12.3.14 void updateconnected ( )

Definition at line 81 of file devnode.c.

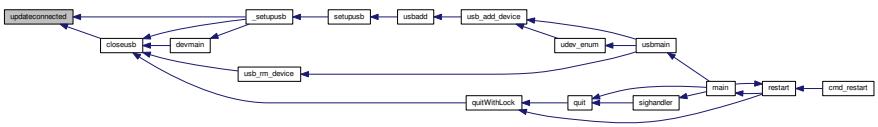
References _updateconnected(), euid_guard_start, and euid_guard_stop.

Referenced by _setupusb(), and closeusb().

```
81                          {
82     euid_guard_start;
83     _updateconnected();
84     euid_guard_stop;
85 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.12.4 Variable Documentation

9.12.4.1 const char* const devpath = "/dev/input/ckb"

Definition at line 11 of file devnode.c.

Referenced by _mkdevpath(), _mknotifynode(), _rmnotifynode(), _setupusb(), _updateconnected(), closeusb(), main(), mkfwnode(), os_inputmain(), os_setupusb(), and rmdevpath().

9.12.4.2 long gid = -1

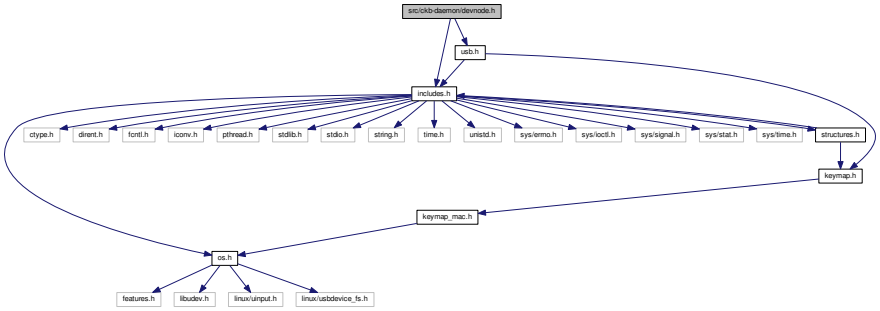
Definition at line 16 of file devnode.c.

Referenced by _mkdevpath(), _mknotifynode(), _updateconnected(), main(), and mkfwnode().

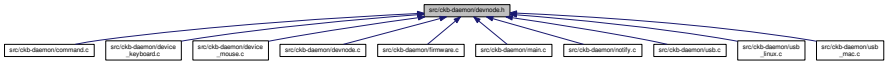
9.13 src/ckb-daemon/devnode.h File Reference

```
#include "includes.h"
#include "usb.h"
```

Include dependency graph for devnode.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define S_READDIR (S_IRWXU | S_IRGRP | S_IROTH | S_IXGRP | S_IXOTH)
- #define S_READ (S_IRUSR | S_IRGRP | S_IROTH | S_IWUSR)
- #define S_READWRITE (S_IRUSR | S_IRGRP | S_IROTH | S_IWUSR | S_IWGRP | S_IWOTH)
- #define S_CUSTOM (S_IRUSR | S_IWUSR | S_IRGRP | S_IWGRP)
- #define S_CUSTOM_R (S_IRUSR | S_IWUSR | S_IRGRP)

Typedefs

- typedef struct _readlines_ctx * readlines_ctx

  Custom readline is needed for FIFOs. fopen()/getline() will die if the data is sent in too fast.

Functions

- void updateconnected ()

  Update the list of connected devices.
- int mkdevpath (usbdevice ∗kb)

  Create a dev path for the keyboard at index. Returns 0 on success.
- int rmdevpath (usbdevice ∗kb)

  Remove the dev path for the keyboard at index. Returns 0 on success.
- int mknotifynode (usbdevice ∗kb, int notify)

  Creates a notification node for the specified keyboard.
- int rmnotifynode (usbdevice ∗kb, int notify)

  Removes a notification node for the specified keyboard.
- int mkfwnode (usbdevice ∗kb)

  Writes a keyboard's firmware version and poll rate to its device node.
- void readlines_ctx_init (readlines_ctx ∗ctx)
- void readlines_ctx_free (readlines_ctx ctx)
- unsigned readlines (int fd, readlines_ctx ctx, const char ∗∗input)

Variables

- const char ∗const devpath

  Device path base ("/dev/input/ckb" or "/var/run/ckb")
- long gid

  Group ID for the control nodes. -1 to give read/write access to everybody.

9.13.1 Macro Definition Documentation

9.13.1.1 #define S_CUSTOM (S_IRUSR | S_IWUSR | S_IRGRP | S_IWGRP)

Definition at line 17 of file devnode.h.

Referenced by _mkdevpath().

9.13.1.2 #define S_CUSTOM_R (S_IRUSR | S_IWUSR | S_IRGRP)

Definition at line 18 of file devnode.h.

9.13.1.3 #define S_READ (S_IRUSR | S_IRGRP | S_IROTH | S_IWUSR)

Definition at line 15 of file devnode.h.

Referenced by _mkdevpath().

9.13.1.4 #define S_READDIR (S_IRWXU | S_IRGRP | S_IROTH | S_IXGRP | S_IXOTH)

Definition at line 14 of file devnode.h.

Referenced by _mkdevpath().

9.13.1.5 #define S_READWRITE (S_IRUSR | S_IRGRP | S_IROTH | S_IWUSR | S_IWGRP | S_IWOTH)

Definition at line 16 of file devnode.h.

Referenced by _mkdevpath().

9.13.2 Typedef Documentation

9.13.2.1 typedef struct _readlines_ctx* readlines_ctx

Definition at line 39 of file devnode.h.

9.13.3 Function Documentation

9.13.3.1 int mkdevpath (usbdevice * kb)

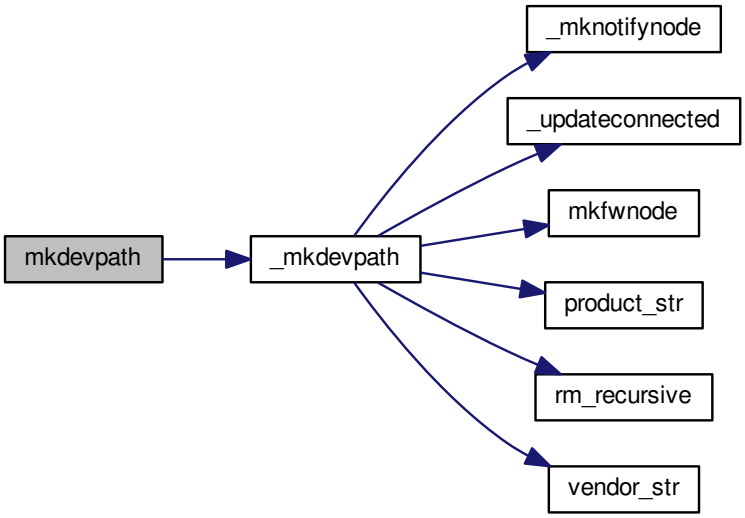
Definition at line 268 of file devnode.c.

References _mkdevpath(), euid_guard_start, and euid_guard_stop.

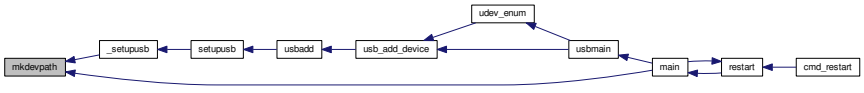
Referenced by _setupusb(), and main().

```
268                                {
269     euid_guard_start;
270     int res = _mkdevpath(kb);
271     euid_guard_stop;
272     return res;
273 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.13.3.2 int mkfwnode (usbdevice * kb)

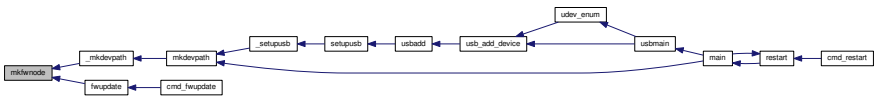
Definition at line 299 of file devnode.c.

References ckb_warn, devpath, usbdevice::fwversion, gid, INDEX_OF, keyboard, usbdevice::pollrate, and S_GID_READ.

Referenced by _mkdevpath(), and fwupdate().

```
299                             {
300     int index = INDEX_OF(kb, keyboard);
301     char fwpath[strlen(devpath) + 12];
302     snprintf(fwpath, sizeof(fwpath), "%s%d/fwversion", devpath, index);
303     FILE* fwfile = fopen(fwpath, "w");
304     if(fwfile){
305         fprintf(fwfile, "%04x", kb->fwversion);
306         fputc('\n', fwfile);
307         fclose(fwfile);
308         chmod(fwpath, S_GID_READ);
309         if(gid >= 0)
310             chown(fwpath, 0, gid);
311     } else {
312         ckb_warn("Unable to create %s: %s\n", fwpath, strerror(errno));
313         remove(fwpath);
314         return -1;
315     }
316     char ppath[strlen(devpath) + 11];
317     snprintf(ppath, sizeof(ppath), "%s%d/pollrate", devpath, index);
318     FILE* pfile = fopen(ppath, "w");
319     if(pfile){
320         fprintf(pfile, "%d ms", kb->pollrate);
321         fputc('\n', pfile);
322         fclose(pfile);
323         chmod(ppath, S_GID_READ);
324         if(gid >= 0)
325             chown(ppath, 0, gid);
326     } else {
327         ckb_warn("Unable to create %s: %s\n", fwpath, strerror(errno));
328         remove(ppath);
329         return -2;
330     }
331     return 0;
332 }
```

Here is the caller graph for this function:



9.13.3.3 int mknotifynode (usbdevice * kb, int notify)

Definition at line 108 of file devnode.c.

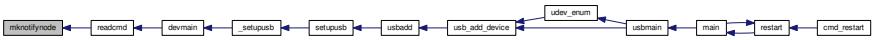
References _mknotifynode(), euid_guard_start, and euid_guard_stop.

Referenced by readcmd().

```
108                                         {
109     euid_guard_start;
110     int res = _mknotifynode(kb, notify);
111     euid_guard_stop;
112     return res;
113 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.13.3.4 unsigned readlines (int *fd*, readlines_ctx *ctx*, const char ** *input*)

Definition at line 353 of file devnode.c.

References _readlines_ctx::buffer, _readlines_ctx::buffersize, ckb_warn, _readlines_ctx::leftover, _readlines_ctx::leftoverlen, and MAX_BUFFER.

Referenced by devmain().

```
353                                                                 {
354     // Move any data left over from a previous read to the start of the buffer
355     char* buffer = ctx->buffer;
356     int buffersize = ctx->buffersize;
357     int leftover = ctx->leftover, leftoverlen = ctx->leftoverlen;
358     memcpy(buffer, buffer + leftover, leftoverlen);
359     // Read data from the file
360     ssize_t length = read(fd, buffer + leftoverlen, buffersize - leftoverlen);
361     length = (length < 0 ? 0 : length) + leftoverlen;
362     leftover = ctx->leftover = leftoverlen = ctx->leftoverlen = 0;
363     if(length <= 0){
364         *input = 0;
365         return 0;
366     }
367     // Continue buffering until all available input is read or there's no room left
368     while(length == buffersize){
369         if(buffersize == MAX_BUFFER)
370             break;
371         int oldsize = buffersize;
372         buffersize += 4096;
373         ctx->buffersize = buffersize;
374         buffer = ctx->buffer = realloc(buffer, buffersize + 1);
375         ssize_t length2 = read(fd, buffer + oldsize, buffersize - oldsize);
376         if(length2 <= 0)
377             break;
378         length += length2;
379     }
380     buffer[length] = 0;
381     // Input should be issued one line at a time and should end with a newline.
382     char* lastline = memrchr(buffer, '\n', length);
383     if(lastline == buffer + length - 1){
384         // If the buffer ends in a newline, process the whole string
385         *input = buffer;
386         return length;
387     } else if(lastline){
388         // Otherwise, chop off the last line but process everything else
389         *lastline = 0;
390         leftover = ctx->leftover = lastline + 1 - buffer;
391         leftoverlen = ctx->leftoverlen = length - leftover;
392         *input = buffer;
393         return leftover - 1;
394     } else {
395         // If a newline wasn't found at all, process the whole buffer next time
```

```
396         *input = 0;
397         if(length == MAX_BUFFER){
398             // Unless the buffer is completely full, in which case discard it
399             ckb_warn("Too much input (1MB). Dropping.\n");
400             return 0;
401         }
402         leftoverlen = ctx->leftoverlen = length;
403         return 0;
404     }
405 }
```

Here is the caller graph for this function:

9.13.3.5 void readlines_ctx_free (readlines_ctx *ctx*)

Definition at line 348 of file devnode.c.

References _readlines_ctx::buffer.

Referenced by devmain().

```
348                                         {
349     free(ctx->buffer);
350     free(ctx);
351 }
```

Here is the caller graph for this function:

9.13.3.6 void readlines_ctx_init (readlines_ctx * *ctx*)

Definition at line 341 of file devnode.c.

Referenced by devmain().

```
341                                          {
342     // Allocate buffers to store data
343     *ctx = calloc(1, sizeof(struct _readlines_ctx));
344     int buffersize = (*ctx)->buffersize = 4095;
345     (*ctx)->buffer = malloc(buffersize + 1);
346 }
```

Here is the caller graph for this function:

9.13.3.7 int rmdevpath (usbdevice * kb)

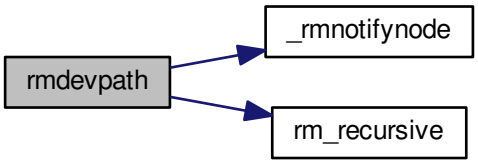
Definition at line 275 of file devnode.c.

References _rmnotifynode(), ckb_info, ckb_warn, devpath, euid_guard_start, euid_guard_stop, INDEX_OF, usbdevice::infifo, keyboard, OUTFIFO_MAX, and rm_recursive().

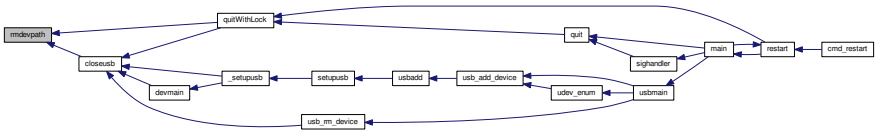
Referenced by closeusb(), and quitWithLock().

```
275                             {
276     euid_guard_start;
277     int index = INDEX_OF(kb, keyboard);
278     if(kb->infifo != 0){
279 #ifdef OS_LINUX
280         write(kb->infifo - 1, "\n", 1); // hack to prevent the FIFO thread from perma-blocking
281 #endif
282         close(kb->infifo - 1);
283         kb->infifo = 0;
284     }
285     for(int i = 0; i < OUTFIFO_MAX; i++)
286         _rmnotifynode(kb, i);
287     char path[strlen(devpath) + 2];
288     snprintf(path, sizeof(path), "%s%d", devpath, index);
289     if(rm_recursive(path) != 0 && errno != ENOENT){
290         ckb_warn("Unable to delete %s: %s\n", path, strerror(errno));
291         euid_guard_stop;
292         return -1;
293     }
294     ckb_info("Removed device path %s\n", path);
295     euid_guard_stop;
296     return 0;
297 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.13.3.8 int rmnotifynode (usbdevice * kb, int notify)

Definition at line 129 of file devnode.c.

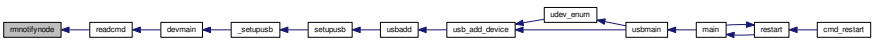
References _rmnotifynode(), euid_guard_start, and euid_guard_stop.

Referenced by readcmd().

```
129                                             {
130     euid_guard_start;
131     int res = _rmnotifynode(kb, notify);
132     euid_guard_stop;
133     return res;
134 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.13.3.9 void updateconnected ( )

Definition at line 81 of file devnode.c.

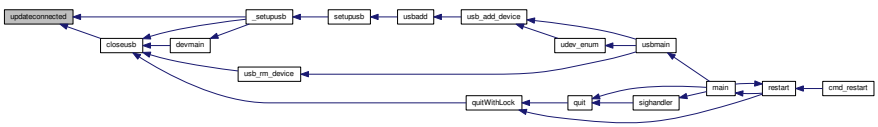
References _updateconnected(), euid_guard_start, and euid_guard_stop.

Referenced by _setupusb(), and closeusb().

```
81                          {
82     euid_guard_start;
83     _updateconnected();
84     euid_guard_stop;
85 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.13.4 Variable Documentation

9.13.4.1 const char* const devpath

Definition at line 8 of file devnode.h.

9.13.4.2 long gid

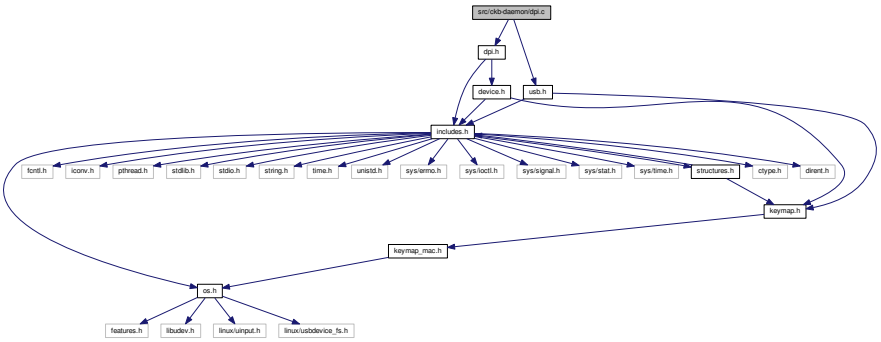
Definition at line 16 of file devnode.c.

Referenced by _mkdevpath(), _mknotifynode(), _updateconnected(), main(), and mkfwnode().

9.14 src/ckb-daemon/dpi.c File Reference

```
#include "dpi.h"
#include "usb.h"
```

Include dependency graph for dpi.c:



Functions

- void cmd_dpi (usbdevice *kb, usbmode *mode, int dummy, const char *stages, const char *values)
- void cmd_dpisel (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *stage)
- void cmd_lift (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *height)
- void cmd_snap (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *enable)
- char * printdpi (const dpiset *dpi, const usbdevice *kb)
- int updatedpi (usbdevice *kb, int force)
- int savedpi (usbdevice *kb, dpiset *dpi, lighting *light)
- int loaddpi (usbdevice *kb, dpiset *dpi, lighting *light)

9.14.1 Function Documentation

9.14.1.1 void cmd_dpi (usbdevice * *kb*, usbmode * *mode*, int *dummy*, const char * *stages*, const char * *values*)

Definition at line 4 of file dpi.c.

References usbmode::dpi, DPI_COUNT, dpiset::enabled, dpiset::x, and dpiset::y.

```
4                                                                                {
5     int disable = 0;
6     ushort x, y;
7     // Try to scan X,Y values
8     if(sscanf(values, "%hu,%hu", &x, &y) != 2){
```

```
9         // If that doesn't work, scan single number
10        if(sscanf(values, "%hu", &x) == 1)
11            y = x;
12        else if(!strncmp(values, "off", 3))
13            // If the right side says "off", disable the level(s)
14            disable = 1;
15        else
16            // Otherwise, quit
17            return;
18    }
19    if((x == 0 || y == 0) && !disable)
20        return;
21    // Scan the left side for stage numbers (comma-separated)
22    int left = strlen(stages);
23    int position = 0, field = 0;
24    char stagename[3];
25    while(position < left && sscanf(stages + position, "%2[^,]%n", stagename, &field) == 1){
26        uchar stagenum;
27        if(sscanf(stagename, "%hhu", &stagenum) && stagenum < DPI_COUNT){
28            // Set DPI for this stage
29            if(disable){
30                mode->dpi.enabled &= ~(1 << stagenum);
31                mode->dpi.x[stagenum] = 0;
32                mode->dpi.y[stagenum] = 0;
33            } else {
34                mode->dpi.enabled |= 1 << stagenum;
35                mode->dpi.x[stagenum] = x;
36                mode->dpi.y[stagenum] = y;
37            }
38        }
39        if(stages[position += field] == ',')
40            position++;
41    }
42 }
```

9.14.1.2 void cmd_dpisel (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *stage*)

Definition at line 44 of file dpi.c.

References dpiset::current, usbmode::dpi, and DPI_COUNT.

```
44                                                                                  {
45    uchar stagenum;
46    if(sscanf(stage, "%hhu", &stagenum) != 1)
47        return;
48    if(stagenum > DPI_COUNT)
49        return;
50    mode->dpi.current = stagenum;
51 }
```

9.14.1.3 void cmd_lift (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *height*)

Definition at line 53 of file dpi.c.

References usbmode::dpi, dpiset::lift, LIFT_MAX, and LIFT_MIN.

```
53                                                                                  {
54    uchar heightnum;
55    if(sscanf(height, "%hhu", &heightnum) != 1)
56        return;
57    if(heightnum > LIFT_MAX || heightnum < LIFT_MIN)
58        return;
59    mode->dpi.lift = heightnum;
60 }
```

9.14.1.4 void cmd_snap (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *enable*)

Definition at line 62 of file dpi.c.

References usbmode::dpi, and dpiset::snap.

```
62                                                                                                  {
63     if(!strcmp(enable, "on"))
64         mode->dpi.snap = 1;
65     if(!strcmp(enable, "off"))
66         mode->dpi.snap = 0;
67 }
```

9.14.1.5 int loaddpi (usbdevice * *kb,* dpiset * *dpi,* lighting * *light*)

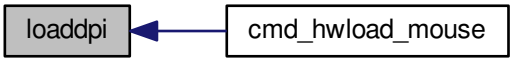
Definition at line 152 of file dpi.c.

References lighting::b, ckb_err, dpiset::current, DPI_COUNT, dpiset::enabled, lighting::g, LED_MOUSE, dpiset::lift, LIFT_MAX, LIFT_MIN, MSG_SIZE, N_MOUSE_ZONES, lighting::r, dpiset::snap, usbrecv, dpiset::x, and dpiset::y.

Referenced by cmd_hwload_mouse().

```
152                                                                                                 {
153     // Ask for settings
154     uchar data_pkt[4][MSG_SIZE] = {
155         { 0x0e, 0x13, 0x05, 1, },
156         { 0x0e, 0x13, 0x02, 1, },
157         { 0x0e, 0x13, 0x03, 1, },
158         { 0x0e, 0x13, 0x04, 1, }
159     };
160     uchar in_pkt[4][MSG_SIZE];
161     for(int i = 0; i < 4; i++){
162         if(!usbrecv(kb, data_pkt[i], in_pkt[i]))
163             return -2;
164         if(memcmp(in_pkt[i], data_pkt[i], 4)){
165             ckb_err("Bad input header\n");
166             return -3;
167         }
168     }
169     // Copy data from device
170     dpi->enabled = in_pkt[0][4];
171     dpi->enabled &= (1 << DPI_COUNT) - 1;
172     dpi->current = in_pkt[1][4];
173     if(dpi->current >= DPI_COUNT)
174         dpi->current = 0;
175     dpi->lift = in_pkt[2][4];
176     if(dpi->lift < LIFT_MIN || dpi->lift > LIFT_MAX)
177         dpi->lift = LIFT_MIN;
178     dpi->snap = !!in_pkt[3][4];
179
180     // Get X/Y DPIs
181     for(int i = 0; i < DPI_COUNT; i++){
182         uchar data_pkt[MSG_SIZE] = { 0x0e, 0x13, 0xd0, 1 };
183         uchar in_pkt[MSG_SIZE];
184         data_pkt[2] |= i;
185         if(!usbrecv(kb, data_pkt, in_pkt))
186             return -2;
187         if(memcmp(in_pkt, data_pkt, 4)){
188             ckb_err("Bad input header\n");
189             return -3;
190         }
191         // Copy to profile
192         dpi->x[i] = *(ushort*)(in_pkt + 5);
193         dpi->y[i] = *(ushort*)(in_pkt + 7);
194         light->r[LED_MOUSE + N_MOUSE_ZONES + i] = in_pkt[9];
195         light->g[LED_MOUSE + N_MOUSE_ZONES + i] = in_pkt[10];
196         light->b[LED_MOUSE + N_MOUSE_ZONES + i] = in_pkt[11];
197     }
198     // Finished. Set SW DPI light to the current hardware level
199     light->r[LED_MOUSE + 2] = light->r[LED_MOUSE +
      N_MOUSE_ZONES + dpi->current];
200     light->g[LED_MOUSE + 2] = light->g[LED_MOUSE +
      N_MOUSE_ZONES + dpi->current];
201     light->b[LED_MOUSE + 2] = light->b[LED_MOUSE +
      N_MOUSE_ZONES + dpi->current];
202     return 0;
203 }
```

Here is the caller graph for this function:



9.14.1.6 char* printdpi (const dpiset * *dpi,* const usbdevice * *kb*)

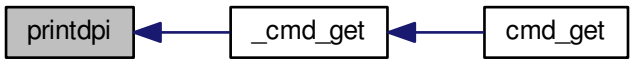
Definition at line 69 of file dpi.c.

References _readlines_ctx::buffer, DPI_COUNT, dpiset::enabled, dpiset::x, and dpiset::y.

Referenced by _cmd_get().

```
69                                                          {
70     // Print all DPI settings
71     const int BUFFER_LEN = 100;
72     char* buffer = malloc(BUFFER_LEN);
73     int length = 0;
74     for(int i = 0; i < DPI_COUNT; i++){
75         // Print the stage number
76         int newlen = 0;
77         snprintf(buffer + length, BUFFER_LEN - length, length == 0 ? "%d%n" : " %d%n", i, &newlen);
78         length += newlen;
79         // Print the DPI settings
80         if(!(dpi->enabled & (1 << i)))
81             snprintf(buffer + length, BUFFER_LEN - length, ":off%n", &newlen);
82         else
83             snprintf(buffer + length, BUFFER_LEN - length, ":%u,%u%n", dpi->x[i], dpi->
      y[i], &newlen);
84         length += newlen;
85     }
86     return buffer;
87 }
```

Here is the caller graph for this function:



9.14.1.7 int savedpi (usbdevice * *kb,* dpiset * *dpi,* lighting * *light*)

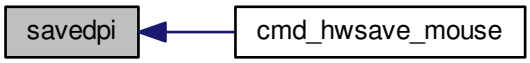
Definition at line 124 of file dpi.c.

References lighting::b, dpiset::current, DPI_COUNT, dpiset::enabled, lighting::g, LED_MOUSE, dpiset::lift, MSG_-SIZE, N_MOUSE_ZONES, lighting::r, dpiset::snap, usbsend, dpiset::x, and dpiset::y.

Referenced by cmd_hwsave_mouse().

```
124                                                     {
125     // Send X/Y DPIs
126     for(int i = 0; i < DPI_COUNT; i++){
127         uchar data_pkt[MSG_SIZE] = { 0x07, 0x13, 0xd0, 1 };
128         data_pkt[2] |= i;
129         *(ushort*)(data_pkt + 5) = dpi->x[i];
130         *(ushort*)(data_pkt + 7) = dpi->y[i];
131         // Save the RGB value for this setting too
132         data_pkt[9] = light->r[LED_MOUSE + N_MOUSE_ZONES + i];
133         data_pkt[10] = light->g[LED_MOUSE + N_MOUSE_ZONES + i];
134         data_pkt[11] = light->b[LED_MOUSE + N_MOUSE_ZONES + i];
135         if(!usbsend(kb, data_pkt, 1))
136             return -1;
137     }
138
139     // Send settings
140     uchar data_pkt[4][MSG_SIZE] = {
141         { 0x07, 0x13, 0x05, 1, dpi->enabled },
142         { 0x07, 0x13, 0x02, 1, dpi->current },
143         { 0x07, 0x13, 0x03, 1, dpi->lift },
144         { 0x07, 0x13, 0x04, 1, dpi->snap, 0x05 }
145     };
146     if(!usbsend(kb, data_pkt[0], 4))
147         return -2;
148     // Finished
149     return 0;
150 }
```

Here is the caller graph for this function:



9.14.1.8 int updatedpi (usbdevice * *kb*, int *force*)

Definition at line 89 of file dpi.c.

References usbdevice::active, dpiset::current, usbprofile::currentmode, usbmode::dpi, DPI_COUNT, dpiset::enabled, dpiset::forceupdate, usbprofile::lastdpi, dpiset::lift, MSG_SIZE, usbdevice::profile, dpiset::snap, usbsend, dpiset::x, and dpiset::y.

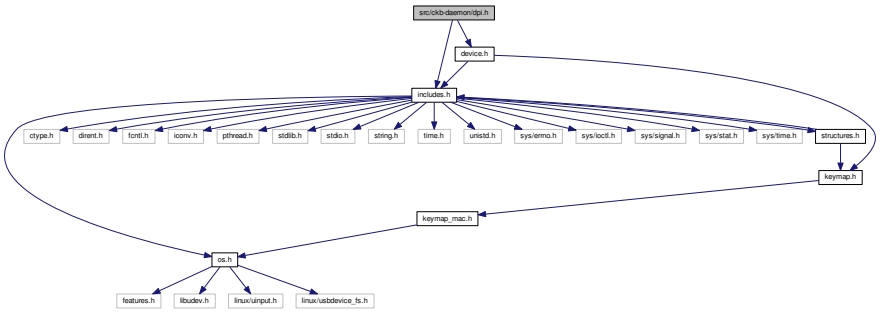
```
89                                          {
90     if(!kb->active)
91         return 0;
92     dpiset* lastdpi = &kb->profile->lastdpi;
93     dpiset* newdpi = &kb->profile->currentmode->dpi;
94     // Don't do anything if the settings haven't changed
95     if(!force && !lastdpi->forceupdate && !newdpi->forceupdate
96             && !memcmp(lastdpi, newdpi, sizeof(dpiset)))
97         return 0;
98     lastdpi->forceupdate = newdpi->forceupdate = 0;
99
100     // Send X/Y DPIs
101     for(int i = 0; i < DPI_COUNT; i++){
102         uchar data_pkt[MSG_SIZE] = { 0x07, 0x13, 0xd0, 0 };
103         data_pkt[2] |= i;
104         *(ushort*)(data_pkt + 5) = newdpi->x[i];
105         *(ushort*)(data_pkt + 7) = newdpi->y[i];
106         if(!usbsend(kb, data_pkt, 1))
107             return -1;
108     }
109
110     // Send settings
111     uchar data_pkt[4][MSG_SIZE] = {
112         { 0x07, 0x13, 0x05, 0, newdpi->enabled },
113         { 0x07, 0x13, 0x02, 0, newdpi->current },
114         { 0x07, 0x13, 0x03, 0, newdpi->lift },
```

```
115         { 0x07, 0x13, 0x04, 0, newdpi->snap, 0x05 }
116     };
117     if(!usbsend(kb, data_pkt[0], 4))
118         return -2;
119     // Finished
120     memcpy(lastdpi, newdpi, sizeof(dpiset));
121     return 0;
122 }
```

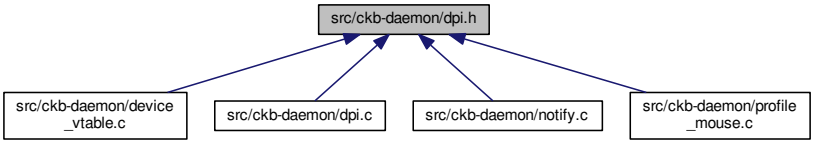
9.15 src/ckb-daemon/dpi.h File Reference

```
#include "includes.h"
#include "device.h"
```

Include dependency graph for dpi.h:



This graph shows which files directly or indirectly include this file:



Functions

- int updatedpi (usbdevice ∗kb, int force)
- int savedpi (usbdevice ∗kb, dpiset ∗dpi, lighting ∗light)
- int loaddpi (usbdevice ∗kb, dpiset ∗dpi, lighting ∗light)
- char ∗ printdpi (const dpiset ∗dpi, const usbdevice ∗kb)
- void cmd_dpi (usbdevice ∗kb, usbmode ∗mode, int dummy, const char ∗stages, const char ∗values)
- void cmd_dpisel (usbdevice ∗kb, usbmode ∗mode, int dummy1, int dummy2, const char ∗stage)
- void cmd_lift (usbdevice ∗kb, usbmode ∗mode, int dummy1, int dummy2, const char ∗height)
- void cmd_snap (usbdevice ∗kb, usbmode ∗mode, int dummy1, int dummy2, const char ∗enable)

9.15.1 Function Documentation

9.15.1.1 void cmd_dpi (usbdevice ∗ *kb*, usbmode ∗ *mode*, int *dummy*, const char ∗ *stages*, const char ∗ *values*)

Definition at line 4 of file dpi.c.

References usbmode::dpi, DPI_COUNT, dpiset::enabled, dpiset::x, and dpiset::y.

```
4                                                                                                {
5     int disable = 0;
6     ushort x, y;
7     // Try to scan X,Y values
8     if(sscanf(values, "%hu,%hu", &x, &y) != 2){
9         // If that doesn't work, scan single number
10         if(sscanf(values, "%hu", &x) == 1)
11             y = x;
12         else if(!strncmp(values, "off", 3))
13             // If the right side says "off", disable the level(s)
14             disable = 1;
15         else
16             // Otherwise, quit
17             return;
18     }
19     if((x == 0 || y == 0) && !disable)
20         return;
21     // Scan the left side for stage numbers (comma-separated)
22     int left = strlen(stages);
23     int position = 0, field = 0;
24     char stagename[3];
25     while(position < left && sscanf(stages + position, "%2[^,]%n", stagename, &field) == 1){
26         uchar stagenum;
27         if(sscanf(stagename, "%hhu", &stagenum) && stagenum < DPI_COUNT){
28             // Set DPI for this stage
29             if(disable){
30                 mode->dpi.enabled &= ~(1 << stagenum);
31                 mode->dpi.x[stagenum] = 0;
32                 mode->dpi.y[stagenum] = 0;
33             } else {
34                 mode->dpi.enabled |= 1 << stagenum;
35                 mode->dpi.x[stagenum] = x;
36                 mode->dpi.y[stagenum] = y;
37             }
38         }
39         if(stages[position += field] == ',')
40             position++;
41     }
42 }
```

9.15.1.2 void cmd_dpisel (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *stage*)

Definition at line 44 of file dpi.c.

References dpiset::current, usbmode::dpi, and DPI_COUNT.

```
44                                                                                                {
45     uchar stagenum;
46     if(sscanf(stage, "%hhu", &stagenum) != 1)
47         return;
48     if(stagenum > DPI_COUNT)
49         return;
50     mode->dpi.current = stagenum;
51 }
```

9.15.1.3 void cmd_lift (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *height*)

Definition at line 53 of file dpi.c.

References usbmode::dpi, dpiset::lift, LIFT_MAX, and LIFT_MIN.

```
53                                                                                                {
54     uchar heightnum;
55     if(sscanf(height, "%hhu", &heightnum) != 1)
56         return;
57     if(heightnum > LIFT_MAX || heightnum < LIFT_MIN)
58         return;
59     mode->dpi.lift = heightnum;
60 }
```

9.15.1.4 void cmd_snap (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *enable*)

Definition at line 62 of file dpi.c.

References usbmode::dpi, and dpiset::snap.

```
62                                                                                  {
63     if(!strcmp(enable, "on"))
64         mode->dpi.snap = 1;
65     if(!strcmp(enable, "off"))
66         mode->dpi.snap = 0;
67 }
```

9.15.1.5 int loaddpi (usbdevice * *kb*, dpiset * *dpi*, lighting * *light*)

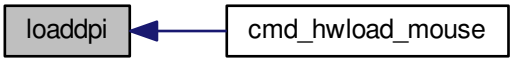
Definition at line 152 of file dpi.c.

References lighting::b, ckb_err, dpiset::current, DPI_COUNT, dpiset::enabled, lighting::g, LED_MOUSE, dpiset::lift, LIFT_MAX, LIFT_MIN, MSG_SIZE, N_MOUSE_ZONES, lighting::r, dpiset::snap, usbrecv, dpiset::x, and dpiset::y.

Referenced by cmd_hwload_mouse().

```
152                                                                                 {
153     // Ask for settings
154     uchar data_pkt[4][MSG_SIZE] = {
155         { 0x0e, 0x13, 0x05, 1, },
156         { 0x0e, 0x13, 0x02, 1, },
157         { 0x0e, 0x13, 0x03, 1, },
158         { 0x0e, 0x13, 0x04, 1, }
159     };
160     uchar in_pkt[4][MSG_SIZE];
161     for(int i = 0; i < 4; i++){
162         if(!usbrecv(kb, data_pkt[i], in_pkt[i]))
163             return -2;
164         if(memcmp(in_pkt[i], data_pkt[i], 4)){
165             ckb_err("Bad input header\n");
166             return -3;
167         }
168     }
169     // Copy data from device
170     dpi->enabled = in_pkt[0][4];
171     dpi->enabled &= (1 << DPI_COUNT) - 1;
172     dpi->current = in_pkt[1][4];
173     if(dpi->current >= DPI_COUNT)
174         dpi->current = 0;
175     dpi->lift = in_pkt[2][4];
176     if(dpi->lift < LIFT_MIN || dpi->lift > LIFT_MAX)
177         dpi->lift = LIFT_MIN;
178     dpi->snap = !!in_pkt[3][4];
179
180     // Get X/Y DPIs
181     for(int i = 0; i < DPI_COUNT; i++){
182         uchar data_pkt[MSG_SIZE] = { 0x0e, 0x13, 0xd0, 1 };
183         uchar in_pkt[MSG_SIZE];
184         data_pkt[2] |= i;
185         if(!usbrecv(kb, data_pkt, in_pkt))
186             return -2;
187         if(memcmp(in_pkt, data_pkt, 4)){
188             ckb_err("Bad input header\n");
189             return -3;
190         }
191         // Copy to profile
192         dpi->x[i] = *(ushort*)(in_pkt + 5);
193         dpi->y[i] = *(ushort*)(in_pkt + 7);
194         light->r[LED_MOUSE + N_MOUSE_ZONES + i] = in_pkt[9];
195         light->g[LED_MOUSE + N_MOUSE_ZONES + i] = in_pkt[10];
196         light->b[LED_MOUSE + N_MOUSE_ZONES + i] = in_pkt[11];
197     }
198     // Finished. Set SW DPI light to the current hardware level
199     light->r[LED_MOUSE + 2] = light->r[LED_MOUSE +
      N_MOUSE_ZONES + dpi->current];
200     light->g[LED_MOUSE + 2] = light->g[LED_MOUSE +
      N_MOUSE_ZONES + dpi->current];
201     light->b[LED_MOUSE + 2] = light->b[LED_MOUSE +
      N_MOUSE_ZONES + dpi->current];
202     return 0;
203 }
```

Here is the caller graph for this function:



9.15.1.6 char* printdpi (const dpiset * *dpi,* const usbdevice * *kb*)

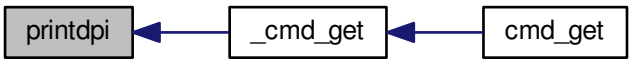
Definition at line 69 of file dpi.c.

References _readlines_ctx::buffer, DPI_COUNT, dpiset::enabled, dpiset::x, and dpiset::y.

Referenced by _cmd_get().

```
69                                                      {
70     // Print all DPI settings
71     const int BUFFER_LEN = 100;
72     char* buffer = malloc(BUFFER_LEN);
73     int length = 0;
74     for(int i = 0; i < DPI_COUNT; i++){
75         // Print the stage number
76         int newlen = 0;
77         snprintf(buffer + length, BUFFER_LEN - length, length == 0 ? "%d%n" : " %d%n", i, &newlen);
78         length += newlen;
79         // Print the DPI settings
80         if(!(dpi->enabled & (1 << i)))
81             snprintf(buffer + length, BUFFER_LEN - length, ":off%n", &newlen);
82         else
83             snprintf(buffer + length, BUFFER_LEN - length, ":%u,%u%n", dpi->x[i], dpi->
      y[i], &newlen);
84         length += newlen;
85     }
86     return buffer;
87 }
```

Here is the caller graph for this function:



9.15.1.7 int savedpi (usbdevice * *kb,* dpiset * *dpi,* lighting * *light*)

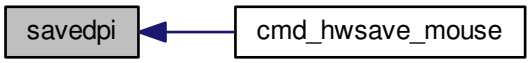
Definition at line 124 of file dpi.c.

References lighting::b, dpiset::current, DPI_COUNT, dpiset::enabled, lighting::g, LED_MOUSE, dpiset::lift, MSG_-SIZE, N_MOUSE_ZONES, lighting::r, dpiset::snap, usbsend, dpiset::x, and dpiset::y.

Referenced by cmd_hwsave_mouse().

```
124                                                     {
125     // Send X/Y DPIs
126     for(int i = 0; i < DPI_COUNT; i++){
127         uchar data_pkt[MSG_SIZE] = { 0x07, 0x13, 0xd0, 1 };
128         data_pkt[2] |= i;
129         *(ushort*)(data_pkt + 5) = dpi->x[i];
130         *(ushort*)(data_pkt + 7) = dpi->y[i];
131         // Save the RGB value for this setting too
132         data_pkt[9] = light->r[LED_MOUSE + N_MOUSE_ZONES + i];
133         data_pkt[10] = light->g[LED_MOUSE + N_MOUSE_ZONES + i];
134         data_pkt[11] = light->b[LED_MOUSE + N_MOUSE_ZONES + i];
135         if(!usbsend(kb, data_pkt, 1))
136             return -1;
137     }
138
139     // Send settings
140     uchar data_pkt[4][MSG_SIZE] = {
141         { 0x07, 0x13, 0x05, 1, dpi->enabled },
142         { 0x07, 0x13, 0x02, 1, dpi->current },
143         { 0x07, 0x13, 0x03, 1, dpi->lift },
144         { 0x07, 0x13, 0x04, 1, dpi->snap, 0x05 }
145     };
146     if(!usbsend(kb, data_pkt[0], 4))
147         return -2;
148     // Finished
149     return 0;
150 }
```

Here is the caller graph for this function:



9.15.1.8 int updatedpi (usbdevice * *kb*, int *force*)

Definition at line 89 of file dpi.c.

References usbdevice::active, dpiset::current, usbprofile::currentmode, usbmode::dpi, DPI_COUNT, dpiset::enabled, dpiset::forceupdate, usbprofile::lastdpi, dpiset::lift, MSG_SIZE, usbdevice::profile, dpiset::snap, usbsend, dpiset::x, and dpiset::y.

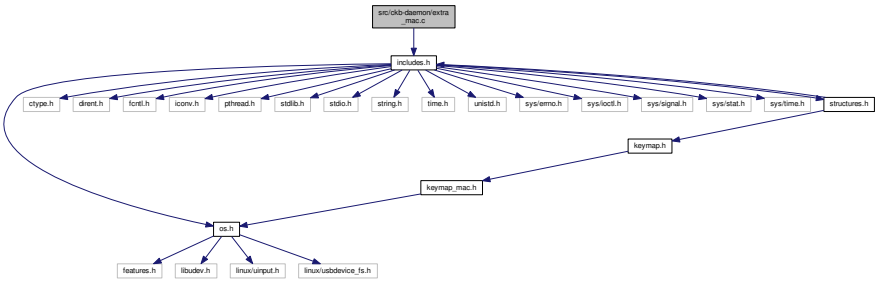
```
89                                          {
90     if(!kb->active)
91         return 0;
92     dpiset* lastdpi = &kb->profile->lastdpi;
93     dpiset* newdpi = &kb->profile->currentmode->dpi;
94     // Don't do anything if the settings haven't changed
95     if(!force && !lastdpi->forceupdate && !newdpi->forceupdate
96             && !memcmp(lastdpi, newdpi, sizeof(dpiset)))
97         return 0;
98     lastdpi->forceupdate = newdpi->forceupdate = 0;
99
100     // Send X/Y DPIs
101     for(int i = 0; i < DPI_COUNT; i++){
102         uchar data_pkt[MSG_SIZE] = { 0x07, 0x13, 0xd0, 0 };
103         data_pkt[2] |= i;
104         *(ushort*)(data_pkt + 5) = newdpi->x[i];
105         *(ushort*)(data_pkt + 7) = newdpi->y[i];
106         if(!usbsend(kb, data_pkt, 1))
107             return -1;
108     }
109
110     // Send settings
111     uchar data_pkt[4][MSG_SIZE] = {
112         { 0x07, 0x13, 0x05, 0, newdpi->enabled },
113         { 0x07, 0x13, 0x02, 0, newdpi->current },
114         { 0x07, 0x13, 0x03, 0, newdpi->lift },
```

```
115         { 0x07, 0x13, 0x04, 0, newdpi->snap, 0x05 }
116     };
117     if(!usbsend(kb, data_pkt[0], 4))
118         return -2;
119     // Finished
120     memcpy(lastdpi, newdpi, sizeof(dpiset));
121     return 0;
122 }
```

9.16 src/ckb-daemon/extra_mac.c File Reference

```
#include "includes.h"
```

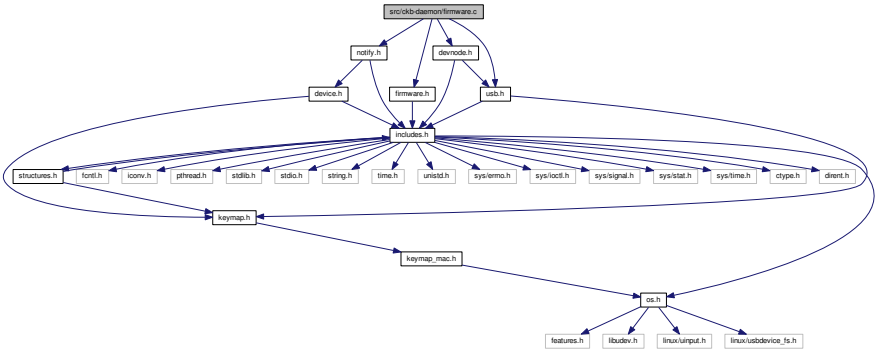
Include dependency graph for extra_mac.c:



9.17 src/ckb-daemon/firmware.c File Reference

```
#include "devnode.h"
#include "firmware.h"
#include "notify.h"
#include "usb.h"
```

Include dependency graph for firmware.c:



Macros

- #define FW_OK 0
- #define FW_NOFILE -1
- #define FW_WRONGDEV -2
- #define FW_USBFAIL -3
- #define FW_MAXSIZE (255 * 256)

Functions

- int getfwversion (usbdevice *kb)
- int fwupdate (usbdevice *kb, const char *path, int nnumber)
- int cmd_fwupdate (usbdevice *kb, usbmode *dummy1, int nnumber, int dummy2, const char *path)

9.17.1 Macro Definition Documentation

9.17.1.1 #define FW_MAXSIZE (255 * 256)

Definition at line 51 of file firmware.c.

Referenced by fwupdate().

9.17.1.2 #define FW_NOFILE -1

Definition at line 7 of file firmware.c.

Referenced by cmd_fwupdate(), and fwupdate().

9.17.1.3 #define FW_OK 0

Definition at line 6 of file firmware.c.

Referenced by cmd_fwupdate(), and fwupdate().

9.17.1.4 #define FW_USBFAIL -3

Definition at line 9 of file firmware.c.

Referenced by cmd_fwupdate(), and fwupdate().

9.17.1.5 #define FW_WRONGDEV -2

Definition at line 8 of file firmware.c.

Referenced by cmd_fwupdate(), and fwupdate().

9.17.2 Function Documentation

9.17.2.1 int cmd_fwupdate (usbdevice * *kb*, usbmode * *dummy1*, int *nnumber*, int *dummy2*, const char * *path*)

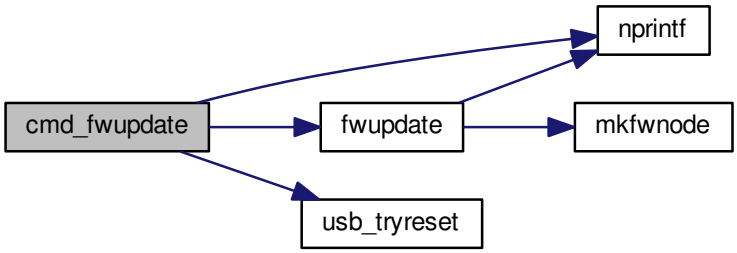
Definition at line 154 of file firmware.c.

References FEAT_FWUPDATE, FW_NOFILE, FW_OK, FW_USBFAIL, FW_WRONGDEV, fwupdate(), HAS_FEATURES, nprintf(), and usb_tryreset().

```
154                                                                                 {
155     if(!HAS_FEATURES(kb, FEAT_FWUPDATE))
156         return 0;
157     // Update the firmware
158     int ret = fwupdate(kb, path, nnumber);
159     while(ret == FW_USBFAIL){
160         // Try to reset the device if it fails
161         if(usb_tryreset(kb))
162             break;
163         ret = fwupdate(kb, path, nnumber);
164     }
165     switch(ret){
166     case FW_OK:
167         nprintf(kb, nnumber, 0, "fwupdate %s ok\n", path);
```

```
168         break;
169     case FW_NOFILE:
170     case FW_WRONGDEV:
171         nprintf(kb, nnumber, 0, "fwupdate %s invalid\n", path);
172         break;
173     case FW_USBFAIL:
174         nprintf(kb, nnumber, 0, "fwupdate %s fail\n", path);
175         return -1;
176     }
177     return 0;
178 }
```

Here is the call graph for this function:



9.17.2.2 int fwupdate (usbdevice * *kb*, const char * *path*, int *nnumber*)

Definition at line 55 of file firmware.c.

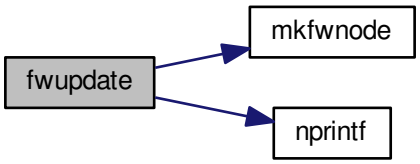
References ckb_err, ckb_info, FW_MAXSIZE, FW_NOFILE, FW_OK, FW_USBFAIL, FW_WRONGDEV, usbdevice::fwversion, mkfwnode(), MSG_SIZE, nprintf(), usbdevice::product, usbdevice::usbdelay, usbsend, and usbdevice::vendor.

Referenced by cmd_fwupdate().

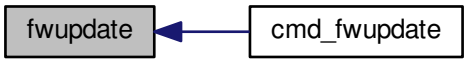
```
55                                                      {
56     // Read the firmware from the given path
57     char* fwdata = calloc(1, FW_MAXSIZE + 256);
58     int fd = open(path, O_RDONLY);
59     if(fd == -1){
60         ckb_err("Failed to open firmware file %s: %s\n", path, strerror(errno));
61         return FW_NOFILE;
62     }
63     ssize_t length = read(fd, fwdata, FW_MAXSIZE + 1);
64     if(length <= 0x108 || length > FW_MAXSIZE){
65         ckb_err("Failed to read firmware file %s: %s\n", path, length <= 0 ? strerror(errno) : "
       Wrong size");
66         close(fd);
67         return FW_NOFILE;
68     }
69     close(fd);
70
71     short vendor, product, version;
72     // Copy the vendor ID, product ID, and version from the firmware file
73     memcpy(&vendor, fwdata + 0x102, 2);
74     memcpy(&product, fwdata + 0x104, 2);
75     memcpy(&version, fwdata + 0x106, 2);
76     // Check against the actual device
77     if(vendor != kb->vendor || product != kb->product){
78         ckb_err("Firmware file %s doesn't match device (V: %04x P: %04x)\n", path, vendor, product);
79         return FW_WRONGDEV;
80     }
81     ckb_info("Loading firmware version %04x from %s\n", version, path);
82     nprintf(kb, nnumber, 0, "fwupdate %s 0/%d\n", path, (int)length);
83     // Force the device to 10ms delay (we need to deliver packets very slowly to make sure it doesn't get
       overwhelmed)
```

```
84      kb->usbdelay = 10;
85      // Send the firmware messages (256 bytes at a time)
86      uchar data_pkt[7][MSG_SIZE] = {
87          { 0x07, 0x0c, 0xf0, 0x01, 0 },
88          { 0x07, 0x0d, 0xf0, 0 },
89          { 0x7f, 0x01, 0x3c, 0 },
90          { 0x7f, 0x02, 0x3c, 0 },
91          { 0x7f, 0x03, 0x3c, 0 },
92          { 0x7f, 0x04, 0x3c, 0 },
93          { 0x7f, 0x05, 0x10, 0 }
94      };
95      int output = 0, last = 0;
96      int index = 0;
97      while(output < length){
98          int npackets = 1;
99          // Packet 1: data position
100         data_pkt[1][6] = index++;
101         while(output < length){
102             npackets++;
103             if(npackets != 6){
104                 // Packets 2-5: 60 bytes of data
105                 memcpy(data_pkt[npackets] + 4, fwdata + output, 60);
106                 last = output;
107                 output += 60;
108             } else {
109                 // Packet 6: 16 bytes
110                 memcpy(data_pkt[npackets] + 4, fwdata + output, 16);
111                 last = output;
112                 output += 16;
113                 break;
114             }
115         }
116         if(index == 1){
117             if(!usbsend(kb, data_pkt[0], 1)){
118                 ckb_err("Firmware update failed\n");
119                 return FW_USBFAIL;
120             }
121             // The above packet can take a lot longer to process, so wait for a while
122             sleep(3);
123             if(!usbsend(kb, data_pkt[2], npackets - 1)){
124                 ckb_err("Firmware update failed\n");
125                 return FW_USBFAIL;
126             }
127         } else {
128             // If the output ends here, set the length byte appropriately
129             if(output >= length)
130                 data_pkt[npackets][2] = length - last;
131             if(!usbsend(kb, data_pkt[1], npackets)){
132                 ckb_err("Firmware update failed\n");
133                 return FW_USBFAIL;
134             }
135         }
136         nprintf(kb, nnumber, 0, "fwupdate %s %d/%d\n", path, output, (int)length);
137     }
138     // Send the final pair of messages
139     uchar data_pkt2[2][MSG_SIZE] = {
140         { 0x07, 0x0d, 0xf0, 0x00, 0x00, 0x00, index },
141         { 0x07, 0x02, 0xf0, 0 }
142     };
143     if(!usbsend(kb, data_pkt2[0], 2)){
144         ckb_err("Firmware update failed\n");
145         return FW_USBFAIL;
146     }
147     // Updated successfully
148     kb->fwversion = version;
149     mkfwnode(kb);
150     ckb_info("Firmware update complete\n");
151     return FW_OK;
152 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.17.2.3 int getfwversion (usbdevice * *kb*)

Definition at line 11 of file firmware.c.

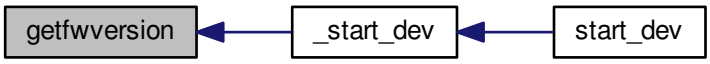
References ckb_err, ckb_warn, FEAT_POLLRATE, usbdevice::features, usbdevice::fwversion, MSG_SIZE, usbdevice::pollrate, usbdevice::product, usbrecv, and usbdevice::vendor.

Referenced by _start_dev().

```
11                                {
12      // Ask board for firmware info
13      uchar data_pkt[MSG_SIZE] = { 0x0e, 0x01, 0 };
14      uchar in_pkt[MSG_SIZE];
15      if(!usbrecv(kb, data_pkt, in_pkt))
16          return -1;
17      if(in_pkt[0] != 0x0e || in_pkt[1] != 0x01){
18          ckb_err("Bad input header\n");
19          return -1;
20      }
21      short vendor, product, version, bootloader;
22      // Copy the vendor ID, product ID, version, and poll rate from the firmware data
23      memcpy(&version, in_pkt + 8, 2);
24      memcpy(&bootloader, in_pkt + 10, 2);
25      memcpy(&vendor, in_pkt + 12, 2);
26      memcpy(&product, in_pkt + 14, 2);
27      char poll = in_pkt[16];
28      if(poll <= 0){
29          poll = -1;
30          kb->features &= ~FEAT_POLLRATE;
31      }
32      // Print a warning if the message didn't match the expected data
33      if(vendor != kb->vendor)
34          ckb_warn("Got vendor ID %04x (expected %04x)\n", vendor, kb->
    vendor);
35      if(product != kb->product)
36          ckb_warn("Got product ID %04x (expected %04x)\n", product, kb->
    product);
37      // Set firmware version and poll rate
38      if(version == 0 || bootloader == 0){
```

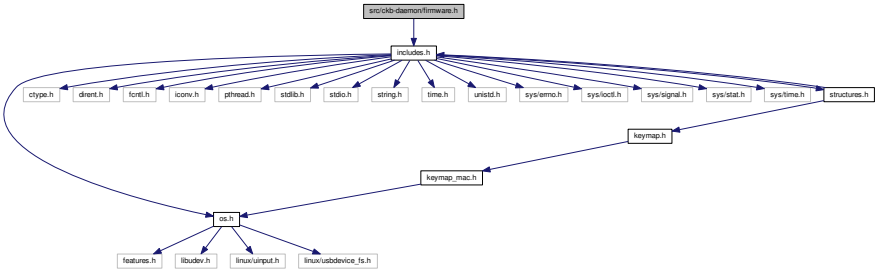
```
39         // Needs firmware update
40         kb->fwversion = 0;
41         kb->pollrate = -1;
42     } else {
43         if(version != kb->fwversion && kb->fwversion != 0)
44             ckb_warn("Got firmware version %04x (expected %04x)\n", version, kb->
    fwversion);
45         kb->fwversion = version;
46         kb->pollrate = poll;
47     }
48     return 0;
49 }
```

Here is the caller graph for this function:

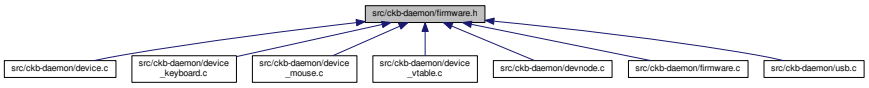


9.18 src/ckb-daemon/firmware.h File Reference

`#include "includes.h"`
Include dependency graph for firmware.h:



This graph shows which files directly or indirectly include this file:



Functions

- int getfwversion (usbdevice ∗kb)
- int cmd_fwupdate (usbdevice ∗kb, usbmode ∗dummy1, int nnumber, int dummy2, const char ∗path)

9.18.1 Function Documentation

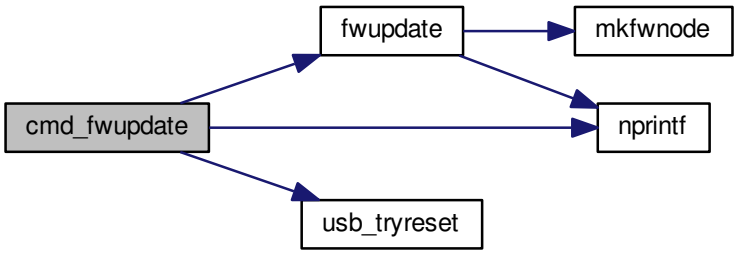
9.18.1.1 int cmd_fwupdate (usbdevice * *kb*, usbmode * *dummy1*, int *nnumber*, int *dummy2*, const char * *path*)

Definition at line 154 of file firmware.c.

References FEAT_FWUPDATE, FW_NOFILE, FW_OK, FW_USBFAIL, FW_WRONGDEV, fwupdate(), HAS_FEATURES, nprintf(), and usb_tryreset().

```
154                                                                                 {
155     if(!HAS_FEATURES(kb, FEAT_FWUPDATE))
156         return 0;
157     // Update the firmware
158     int ret = fwupdate(kb, path, nnumber);
159     while(ret == FW_USBFAIL){
160         // Try to reset the device if it fails
161         if(usb_tryreset(kb))
162             break;
163         ret = fwupdate(kb, path, nnumber);
164     }
165     switch(ret){
166     case FW_OK:
167         nprintf(kb, nnumber, 0, "fwupdate %s ok\n", path);
168         break;
169     case FW_NOFILE:
170     case FW_WRONGDEV:
171         nprintf(kb, nnumber, 0, "fwupdate %s invalid\n", path);
172         break;
173     case FW_USBFAIL:
174         nprintf(kb, nnumber, 0, "fwupdate %s fail\n", path);
175         return -1;
176     }
177     return 0;
178 }
```

Here is the call graph for this function:



9.18.1.2 int getfwversion (usbdevice * *kb*)

Definition at line 11 of file firmware.c.

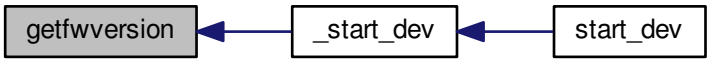
References ckb_err, ckb_warn, FEAT_POLLRATE, usbdevice::features, usbdevice::fwversion, MSG_SIZE, usbdevice::pollrate, usbdevice::product, usbrecv, and usbdevice::vendor.

Referenced by _start_dev().

```
11                                {
12     // Ask board for firmware info
13     uchar data_pkt[MSG_SIZE] = { 0x0e, 0x01, 0 };
14     uchar in_pkt[MSG_SIZE];
15     if(!usbrecv(kb, data_pkt, in_pkt))
16         return -1;
17     if(in_pkt[0] != 0x0e || in_pkt[1] != 0x01){
18         ckb_err("Bad input header\n");
19         return -1;
```

```
20      }
21      short vendor, product, version, bootloader;
22      // Copy the vendor ID, product ID, version, and poll rate from the firmware data
23      memcpy(&version, in_pkt + 8, 2);
24      memcpy(&bootloader, in_pkt + 10, 2);
25      memcpy(&vendor, in_pkt + 12, 2);
26      memcpy(&product, in_pkt + 14, 2);
27      char poll = in_pkt[16];
28      if(poll <= 0){
29          poll = -1;
30          kb->features &= ~FEAT_POLLRATE;
31      }
32      // Print a warning if the message didn't match the expected data
33      if(vendor != kb->vendor)
34          ckb_warn("Got vendor ID %04x (expected %04x)\n", vendor, kb->
    vendor);
35      if(product != kb->product)
36          ckb_warn("Got product ID %04x (expected %04x)\n", product, kb->
    product);
37      // Set firmware version and poll rate
38      if(version == 0 || bootloader == 0){
39          // Needs firmware update
40          kb->fwversion = 0;
41          kb->pollrate = -1;
42      } else {
43          if(version != kb->fwversion && kb->fwversion != 0)
44              ckb_warn("Got firmware version %04x (expected %04x)\n", version, kb->
    fwversion);
45          kb->fwversion = version;
46          kb->pollrate = poll;
47      }
48      return 0;
49  }
```

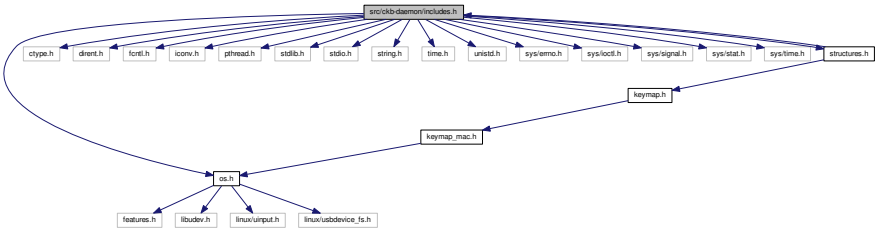
Here is the caller graph for this function:



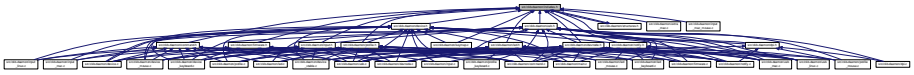
9.19 src/ckb-daemon/includes.h File Reference

```
#include "os.h"
#include <ctype.h>
#include <dirent.h>
#include <fcntl.h>
#include <iconv.h>
#include <pthread.h>
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <time.h>
#include <unistd.h>
#include <sys/errno.h>
#include <sys/ioctl.h>
#include <sys/signal.h>
#include <sys/stat.h>
#include <sys/time.h>
#include "structures.h"
```

Include dependency graph for includes.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define INDEX_OF(entry, array) (int)(entry - array)
- #define ckb_s_out stdout
- #define ckb_s_err stdout
- #define __FILE_NOPATH__ (strrchr(__FILE__, '/') ? strrchr(__FILE__, '/') + 1 : __FILE__)
- #define ckb_fatal_nofile(fmt, args...) fprintf(ckb_s_err, "[F] " fmt, ## args)
- #define ckb_fatal_fn(fmt, file, line, args...) fprintf(ckb_s_err, "[F] %s (via %s:%d): " fmt, __func__, file, line, ## args)
- #define ckb_fatal(fmt, args...) fprintf(ckb_s_err, "[F] %s (%s:%d): " fmt, __func__, __FILE_NOPATH__, __LINE__, ## args)
- #define ckb_err_nofile(fmt, args...) fprintf(ckb_s_err, "[E] " fmt, ## args)
- #define ckb_err_fn(fmt, file, line, args...) fprintf(ckb_s_err, "[E] %s (via %s:%d): " fmt, __func__, file, line, ## args)
- #define ckb_err(fmt, args...) fprintf(ckb_s_err, "[E] %s (%s:%d): " fmt, __func__, __FILE_NOPATH__, __LINE__, ## args)
- #define ckb_warn_nofile(fmt, args...) fprintf(ckb_s_out, "[W] " fmt, ## args)
- #define ckb_warn_fn(fmt, file, line, args...) fprintf(ckb_s_out, "[W] %s (via %s:%d): " fmt, __func__, file, line, ## args)
- #define ckb_warn(fmt, args...) fprintf(ckb_s_out, "[W] %s (%s:%d): " fmt, __func__, __FILE_NOPATH__, __LINE__, ## args)
- #define ckb_info_nofile(fmt, args...) fprintf(ckb_s_out, "[I] " fmt, ## args)
- #define ckb_info_fn(fmt, file, line, args...) fprintf(ckb_s_out, "[I] " fmt, ## args)
- #define ckb_info(fmt, args...) fprintf(ckb_s_out, "[I] " fmt, ## args)
- #define timespec_gt(left, right) ((left).tv_sec > (right).tv_sec || ((left).tv_sec == (right).tv_sec && (left).tv_nsec > (right).tv_nsec))
- #define timespec_eq(left, right) ((left).tv_sec == (right).tv_sec && (left).tv_nsec == (right).tv_nsec)
- #define timespec_ge(left, right) ((left).tv_sec > (right).tv_sec || ((left).tv_sec == (right).tv_sec && (left).tv_nsec >= (right).tv_nsec))
- #define timespec_lt(left, right) (!timespec_ge(left, right))
- #define timespec_le(left, right) (!timespec_gt(left, right))

Typedefs

- typedef unsigned char uchar
- typedef unsigned short ushort

Functions

- void timespec_add (struct timespec *timespec, long nanoseconds)

9.19.1 Macro Definition Documentation

9.19.1.1 #define __FILE_NOPATH__ (strrchr(__FILE__, '/') ? strrchr(__FILE__, '/') + 1 : __FILE__)

Definition at line 40 of file includes.h.

9.19.1.2 #define ckb_err(*fmt, args...*) fprintf(ckb_s_err, "[E] %s (%s:%d): " fmt, __func__, __FILE_NOPATH__, __LINE__, ## args)

Definition at line 49 of file includes.h.

Referenced by _mkdevpath(), fwupdate(), getfwversion(), loaddpi(), loadrgb_kb(), loadrgb_mouse(), macro_pt_dequeue(), os_inputmain(), os_sendindicators(), os_setupusb(), restart(), setupusb(), uinputopen(), usb_tryreset(), usbadd(), and usbclaim().

9.19.1.3 #define ckb_err_fn(*fmt, file, line, args...*) fprintf(ckb_s_err, "[E] %s (via %s:%d): " fmt, __func__, file, line, ## args)

Definition at line 48 of file includes.h.

Referenced by _nk95cmd(), _usbrecv(), os_usbrecv(), and os_usbsend().

9.19.1.4 #define ckb_err_nofile(*fmt, args...*) fprintf(ckb_s_err, "[E] " fmt, ## args)

Definition at line 47 of file includes.h.

9.19.1.5 #define ckb_fatal(*fmt, args...*) fprintf(ckb_s_err, "[F] %s (%s:%d): " fmt, __func__, __FILE_NOPATH__, __LINE__, ## args)

Definition at line 46 of file includes.h.

Referenced by usbmain().

9.19.1.6 #define ckb_fatal_fn(*fmt, file, line, args...*) fprintf(ckb_s_err, "[F] %s (via %s:%d): " fmt, __func__, file, line, ## args)

Definition at line 45 of file includes.h.

9.19.1.7 #define ckb_fatal_nofile(*fmt, args...*) fprintf(ckb_s_err, "[F] " fmt, ## args)

Definition at line 44 of file includes.h.

Referenced by main().

9.19.1.8 #define ckb_info(*fmt, args...*) fprintf(ckb_s_out, "[I] " fmt, ## args)

Definition at line 55 of file includes.h.

Referenced by _setupusb(), _start_dev(), closeusb(), cmd_restart(), fwupdate(), main(), os_inputmain(), os_setupusb(), quitWithLock(), rmdevpath(), usb_tryreset(), usbadd(), and usbclaim().

9.19.1.9 #define ckb_info_fn(*fmt, file, line, args...*) fprintf(ckb_s_out, "[I] " fmt, ## args)

Definition at line 54 of file includes.h.

9.19.1.10 #define ckb_info_nofile(*fmt, args...*) fprintf(ckb_s_out, "[I] " fmt, ## args)

Definition at line 53 of file includes.h.

Referenced by main().

9.19.1.11 #define ckb_s_err stdout

Definition at line 36 of file includes.h.

9.19.1.12 #define ckb_s_out stdout

Definition at line 35 of file includes.h.

9.19.1.13 #define ckb_warn(*fmt, args...*) fprintf(ckb_s_out, "[W] %s (%s:%d): " fmt, __func__, __FILE_NOPATH__, __LINE__, ## args)

Definition at line 52 of file includes.h.

Referenced by _mkdevpath(), _mknotifynode(), _start_dev(), _updateconnected(), getfwversion(), hid_kb_translate(), isync(), mkfwnode(), os_inputclose(), os_keypress(), os_mousemove(), readlines(), rmdevpath(), uinputopen(), and usbmain().

9.19.1.14 #define ckb_warn_fn(*fmt, file, line, args...*) fprintf(ckb_s_out, "[W] %s (via %s:%d): " fmt, __func__, file, line, ## args)

Definition at line 51 of file includes.h.

Referenced by os_usbrecv(), and os_usbsend().

9.19.1.15 #define ckb_warn_nofile(*fmt, args...*) fprintf(ckb_s_out, "[W] " fmt, ## args)

Definition at line 50 of file includes.h.

Referenced by main().

9.19.1.16 #define INDEX_OF(*entry, array*) (int)(entry - array)

Definition at line 27 of file includes.h.

Referenced by _mkdevpath(), _mknotifynode(), _rmnotifynode(), _setupusb(), closeusb(), mkfwnode(), nprintf(), os_closeusb(), os_inputmain(), os_inputopen(), os_setupusb(), readcmd(), and rmdevpath().

9.19.1.17 #define timespec_eq(*left, right*) ((left).tv_sec == (right).tv_sec && (left).tv_nsec == (right).tv_nsec)

Definition at line 60 of file includes.h.

9.19.1.18 #define timespec_ge(*left, right*) ((left).tv_sec > (right).tv_sec || ((left).tv_sec == (right).tv_sec && (left).tv_nsec >= (right).tv_nsec))

Definition at line 61 of file includes.h.

9.19.1.19 #define timespec_gt(*left, right*) ((left).tv_sec > (right).tv_sec || ((left).tv_sec == (right).tv_sec && (left).tv_nsec > (right).tv_nsec))

Definition at line 59 of file includes.h.

9.19.1.20 #define timespec_le(*left, right*) (!timespec_gt(left, right))

Definition at line 63 of file includes.h.

9.19.1.21 #define timespec_lt(*left, right*) (!timespec_ge(left, right))

Definition at line 62 of file includes.h.

9.19.2 Typedef Documentation

9.19.2.1 typedef unsigned char uchar

Definition at line 24 of file includes.h.

9.19.2.2 typedef unsigned short ushort

Definition at line 25 of file includes.h.

9.19.3 Function Documentation

9.19.3.1 void timespec_add (struct timespec * *timespec,* long *nanoseconds*)

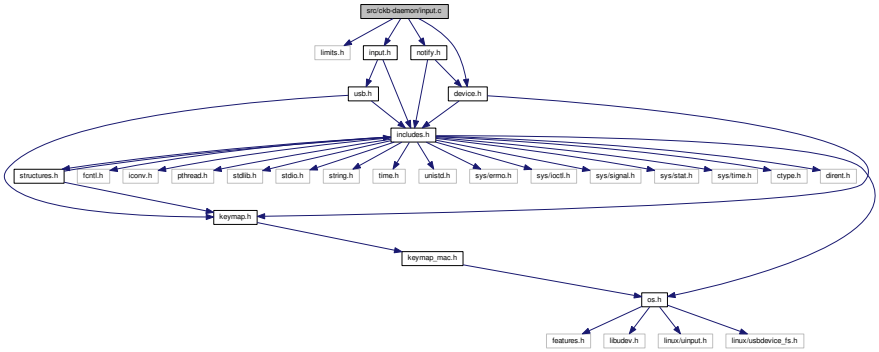
Definition at line 19 of file main.c.

```
19                                                          {
20     nanoseconds += timespec->tv_nsec;
21     timespec->tv_sec += nanoseconds / 1000000000;
22     timespec->tv_nsec = nanoseconds % 1000000000;
23 }
```

9.20 src/ckb-daemon/input.c File Reference

```
#include <limits.h>
#include "device.h"
#include "input.h"
#include "notify.h"
```

Include dependency graph for input.c:



Macros

- #define IS_WHEEL(scan, kb) (((scan) == KEY_VOLUMEUP || (scan) == KEY_VOLUMEDOWN || (scan) == BTN_WHEELUP || (scan) == BTN_WHEELDOWN) && !IS_K65(kb))

Functions

- int macromask (const uchar *key1, const uchar *key2)
- static void macro_pt_enqueue ()

  macro_pt_enqueue Save the new thread in the single linked list (FIFO).
- static pthread_t macro_pt_dequeue ()

  macro_pt_dequeue gets the first thread id of the list and returns the thread_id stored in it.
- static pthread_t macro_pt_first ()

  macro_pt_first returns the first pthread_id but does not remove the first entry.
- static void * play_macro (void *param)

  play_macro is the code for all threads started to play a macro.
- static void inputupdate_keys (usbdevice *kb)

  inputupdate_keys Handle input from Keyboard or mouse; start Macrof if detected.
- void inputupdate (usbdevice *kb)
- void updateindicators_kb (usbdevice *kb, int force)
- void initbind (binding *bind)
- void freebind (binding *bind)
- void cmd_bind (usbdevice *kb, usbmode *mode, int dummy, int keyindex, const char *to)
- void cmd_unbind (usbdevice *kb, usbmode *mode, int dummy, int keyindex, const char *to)
- void cmd_rebind (usbdevice *kb, usbmode *mode, int dummy, int keyindex, const char *to)
- static void _cmd_macro (usbmode *mode, const char *keys, const char *assignment)
- void cmd_macro (usbdevice *kb, usbmode *mode, const int notifynumber, const char *keys, const char *assignment)

Variables

- static ptlist_t * pt_head = 0

  pt_head is the head pointer for the single linked thread list managed by macro_pt_en/dequeue().
- static ptlist_t * pt_tail = 0

  pt_tail is the tail pointer for the single linked thread list managed by macro_pt_en/dequeue().

9.20.1 Macro Definition Documentation

9.20.1.1 #define IS_WHEEL(*scan, kb*) (((scan) == KEY_VOLUMEUP || (scan) == KEY_VOLUMEDOWN || (scan) == BTN_WHEELUP || (scan) == BTN_WHEELDOWN) && !IS_K65(kb))

Referenced by inputupdate_keys().

9.20.2 Function Documentation

9.20.2.1 static void _cmd_macro (usbmode * *mode,* const char * *keys,* const char * *assignment*) [static]

Definition at line 345 of file input.c.

References keymacro::actioncount, keymacro::actions, usbmode::bind, keymacro::combo, macroaction::delay, macroaction::down, keymap, MACRO_MAX, binding::macrocap, binding::macrocount, binding::macros, N_KEYBYTES_INPUT, N_KEYS_INPUT, macroaction::scan, key::scan, and SET_KEYBIT.

Referenced by cmd_macro().

```
345                                                                                 {
346     binding* bind = &mode->bind;
347     if(!keys && !assignment){
348         // Null strings = "macro clear" -> erase the whole thing
349         for(int i = 0; i < bind->macrocount; i++)
350             free(bind->macros[i].actions);
351         bind->macrocount = 0;
352         return;
353     }
354     if(bind->macrocount >= MACRO_MAX)
355         return;
356     // Create a key macro
357     keymacro macro;
358     memset(&macro, 0, sizeof(macro));
359     // Scan the left side for key names, separated by +
360     int empty = 1;
361     int left = strlen(keys), right = strlen(assignment);
362     int position = 0, field = 0;
363     char keyname[24];
364     while(position < left && sscanf(keys + position, "%10[^+]%n", keyname, &field) == 1){
365         int keycode;
366         if((sscanf(keyname, "#%d", &keycode) && keycode >= 0 && keycode <
    N_KEYS_INPUT)
367                 || (sscanf(keyname, "#x%x", &keycode) && keycode >= 0 && keycode <
    N_KEYS_INPUT)){
368             // Set a key numerically
369             SET_KEYBIT(macro.combo, keycode);
370             empty = 0;
371         } else {
372             // Find this key in the keymap
373             for(unsigned i = 0; i < N_KEYS_INPUT; i++){
374                 if(keymap[i].name && !strcmp(keyname, keymap[i].name)){
375                     macro.combo[i / 8] |= 1 << (i % 8);
376                     empty = 0;
377                     break;
378                 }
379             }
380         }
381         if(keys[position += field] == '+')
382             position++;
383     }
384     if(empty)
385         return;
386     // Count the number of actions (comma separated)
387     int count = 1;
388     for(const char* c = assignment; *c != 0; c++){
389         if(*c == ',')
390             count++;
391     }
392     // Allocate a buffer for them
393     macro.actions = calloc(count, sizeof(macroaction));
394     macro.actioncount = 0;
395     // Scan the actions
396     position = 0;
397     field = 0;
398     // max action = old 11 chars plus 12 chars which is the max 32-bit int 4294967295 size
399     while(position < right && sscanf(assignment + position, "%23[^,]%n", keyname, &field) == 1){
400         if(!strcmp(keyname, "clear"))
401             break;
```

```
402
403         // Check for local key delay of the form '[+-]<key>=<delay>'
404         long int long_delay;    // scanned delay value, used to keep delay in range.
405         unsigned int delay = UINT_MAX; // computed delay value. UINT_MAX means use global delay value.
406         char real_keyname[12];  // temp to hold the left side (key) of the <key>=<delay>
407         int scan_matches = sscanf(keyname, "%11[^=]=%ld", real_keyname, &long_delay);
408         if (scan_matches == 2) {
409             if (0 <= long_delay && long_delay < UINT_MAX) {
410                 delay = (unsigned int)long_delay;
411                 strcpy(keyname, real_keyname); // keyname[24], real_keyname[12]
412             }
413         }
414
415         int down = (keyname[0] == '+');
416         if(down || keyname[0] == '-'){
417             int keycode;
418             if((sscanf(keyname + 1, "#%d", &keycode) && keycode >= 0 && keycode < N_KEYS_INPUT)
419                     || (sscanf(keyname + 1, "#x%x", &keycode) && keycode >= 0 && keycode <
    N_KEYS_INPUT)){
420                 // Set a key numerically
421                 macro.actions[macro.actioncount].scan =
    keymap[keycode].scan;
422                 macro.actions[macro.actioncount].down = down;
423                 macro.actions[macro.actioncount].delay = delay;
424                 macro.actioncount++;
425             } else {
426                 // Find this key in the keymap
427                 for(unsigned i = 0; i < N_KEYS_INPUT; i++){
428                     if(keymap[i].name && !strcmp(keyname + 1, keymap[i].name)){
429                         macro.actions[macro.actioncount].scan =
    keymap[i].scan;
430                         macro.actions[macro.actioncount].down = down;
431                         macro.actions[macro.actioncount].delay = delay;
432                         macro.actioncount++;
433                         break;
434                     }
435                 }
436             }
437         }
438         if(assignment[position += field] == ',')
439             position++;
440     }
441
442     // See if there's already a macro with this trigger
443     keymacro* macros = bind->macros;
444     for(int i = 0; i < bind->macrocount; i++){
445         if(!memcmp(macros[i].combo, macro.combo, N_KEYBYTES_INPUT)){
446             free(macros[i].actions);
447             // If the new macro has no actions, erase the existing one
448             if(!macro.actioncount){
449                 for(int j = i + 1; j < bind->macrocount; j++)
450                     memcpy(macros + j - 1, macros + j, sizeof(keymacro));
451                 bind->macrocount--;
452             } else
453                 // If there are actions, replace the existing with the new
454                 memcpy(macros + i, &macro, sizeof(keymacro));
455             return;
456         }
457     }
458
459     // Add the macro to the device settings if not empty
460     if(macro.actioncount < 1)
461         return;
462     memcpy(bind->macros + (bind->macrocount++), &macro, sizeof(
    keymacro));
463     if(bind->macrocount >= bind->macrocap)
464         bind->macros = realloc(bind->macros, (bind->macrocap += 16) * sizeof(
    keymacro));
465 }
```

Here is the caller graph for this function:

9.20.2.2 void cmd_bind (usbdevice * kb, usbmode * mode, int dummy, int keyindex, const char * to)

Definition at line 307 of file input.c.

References binding::base, usbmode::bind, imutex, keymap, N_KEYS_INPUT, and key::scan.

```
307                                                                                                 {
308     if(keyindex >= N_KEYS_INPUT)
309         return;
310     // Find the key to bind to
311     int tocode = 0;
312     if(sscanf(to, "#x%ux", &tocode) != 1 && sscanf(to, "#%u", &tocode) == 1 && tocode <
    N_KEYS_INPUT){
313         pthread_mutex_lock(imutex(kb));
314         mode->bind.base[keyindex] = tocode;
315         pthread_mutex_unlock(imutex(kb));
316         return;
317     }
318     // If not numeric, look it up
319     for(int i = 0; i < N_KEYS_INPUT; i++){
320         if(keymap[i].name && !strcmp(to, keymap[i].name)){
321             pthread_mutex_lock(imutex(kb));
322             mode->bind.base[keyindex] = keymap[i].scan;
323             pthread_mutex_unlock(imutex(kb));
324             return;
325         }
326     }
327 }
```

9.20.2.3 void cmd_macro (usbdevice * kb, usbmode * mode, const int notifynumber, const char * keys, const char * assignment)

Definition at line 467 of file input.c.

References _cmd_macro(), and imutex.

```
467
         {
468     pthread_mutex_lock(imutex(kb));
469     _cmd_macro(mode, keys, assignment);
470     pthread_mutex_unlock(imutex(kb));
471 }
```

Here is the call graph for this function:

9.20.2.4 void cmd_rebind (usbdevice * kb, usbmode * mode, int dummy, int keyindex, const char * to)

Definition at line 337 of file input.c.

References binding::base, usbmode::bind, imutex, keymap, N_KEYS_INPUT, and key::scan.

```
337                                                                                                 {
338     if(keyindex >= N_KEYS_INPUT)
339         return;
340     pthread_mutex_lock(imutex(kb));
341     mode->bind.base[keyindex] = keymap[keyindex].scan;
342     pthread_mutex_unlock(imutex(kb));
343 }
```

9.20.2.5 void cmd_unbind (usbdevice * *kb*, usbmode * *mode*, int *dummy*, int *keyindex*, const char * *to*)

Definition at line 329 of file input.c.

References binding::base, usbmode::bind, imutex, KEY_UNBOUND, and N_KEYS_INPUT.

```
329                                                                                                 {
330     if(keyindex >= N_KEYS_INPUT)
331         return;
332     pthread_mutex_lock(imutex(kb));
333     mode->bind.base[keyindex] = KEY_UNBOUND;
334     pthread_mutex_unlock(imutex(kb));
335 }
```

9.20.2.6 void freebind (binding * *bind*)

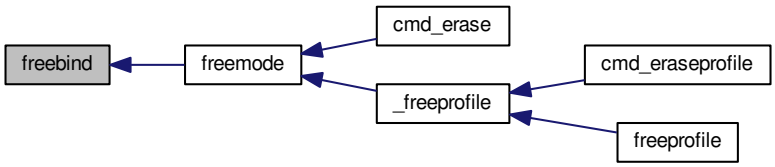
Definition at line 300 of file input.c.

References keymacro::actions, binding::macrocount, and binding::macros.

Referenced by freemode().

```
300                             {
301     for(int i = 0; i < bind->macrocount; i++)
302         free(bind->macros[i].actions);
303     free(bind->macros);
304     memset(bind, 0, sizeof(*bind));
305 }
```

Here is the caller graph for this function:



9.20.2.7 void initbind (binding * *bind*)

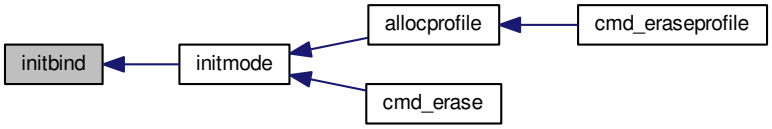
Definition at line 292 of file input.c.

References binding::base, keymap, binding::macrocap, binding::macrocount, binding::macros, N_KEYS_INPUT, and key::scan.

Referenced by initmode().

```
292                             {
293     for(int i = 0; i < N_KEYS_INPUT; i++)
294         bind->base[i] = keymap[i].scan;
295     bind->macros = calloc(32, sizeof(keymacro));
296     bind->macrocap = 32;
297     bind->macrocount = 0;
298 }
```

Here is the caller graph for this function:



9.20.2.8 void inputupdate (usbdevice * *kb*)

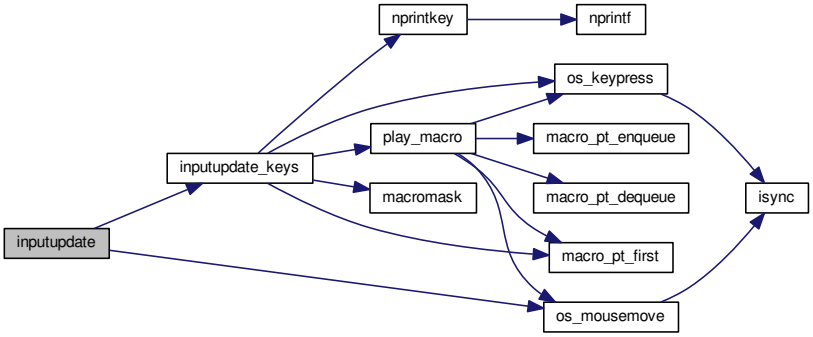
Definition at line 241 of file input.c.

References usbdevice::input, inputupdate_keys(), os_mousemove(), usbdevice::profile, usbinput::rel_x, usbinput::rel_y, usbdevice::uinput_kb, and usbdevice::uinput_mouse.

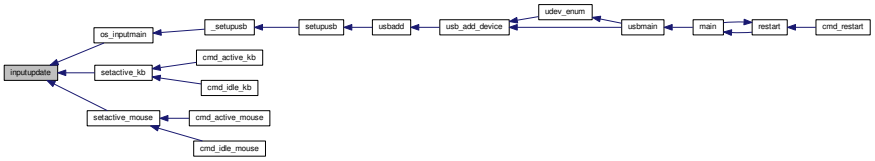
Referenced by os_inputmain(), setactive_kb(), and setactive_mouse().

```
241                                {
242 #ifdef OS_LINUX
243     if((!kb->uinput_kb || !kb->uinput_mouse)
244 #else
245     if(!kb->event
246 #endif
247             || !kb->profile)
248         return;
249     // Process key/button input
250     inputupdate_keys(kb);
251     // Process mouse movement
252     usbinput* input = &kb->input;
253     if(input->rel_x != 0 || input->rel_y != 0){
254         os_mousemove(kb, input->rel_x, input->rel_y);
255         input->rel_x = input->rel_y = 0;
256     }
257     // Finish up
258     memcpy(input->prevkeys, input->keys, N_KEYBYTES_INPUT);
259 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.20.2.9 static void inputupdate_keys (usbdevice * *kb*) [static]

Parameters

kb	

Process all queued keypresses if no macro is running yet.

Todo If we want to get all keys typed while a macro is played, add the code for it here.

Definition at line 134 of file input.c.

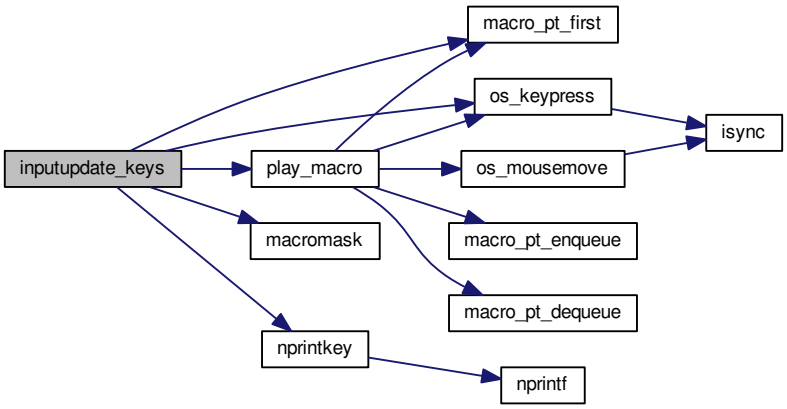
References usbdevice::active, binding::base, usbmode::bind, keymacro::combo, usbprofile::currentmode, usbdevice::input, IS_MOD, IS_WHEEL, parameter::kb, keymap, usbinput::keys, parameter::macro, macro_pt_first(), binding::macrocount, macromask(), binding::macros, N_KEYBYTES_INPUT, N_KEYS_INPUT, usbmode::notify, nprintkey(), os_keypress(), OUTFIFO_MAX, play_macro(), usbinput::prevkeys, usbdevice::profile, key::scan, SCAN_SILENT, and keymacro::triggered.

Referenced by inputupdate().

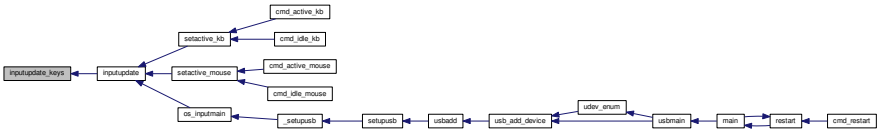
```
134                                         {
135     usbmode* mode = kb->profile->currentmode;
136     binding* bind = &mode->bind;
137     usbinput* input = &kb->input;
138 
139     // Don't do anything if the state hasn't changed
140     if(!memcmp(input->prevkeys, input->keys, N_KEYBYTES_INPUT))
141         return;
142     // Look for macros matching the current state
143     if (kb->active) {
144         for (int i = 0; i < bind->macrocount; i++) {
145             keymacro* macro = &bind->macros[i];
146             if (macromask(input->keys, macro->combo)) {
147                 if (!macro->triggered) {
148                     parameter_t* params = malloc(sizeof(parameter_t));
149                     if (params == 0) {
150                         perror("inputupdate_keys got no more mem:");
151                     } else {
152                         pthread_t thread = 0;
153                         params->kb = kb;
154                         params->macro = macro;
155                         int retval = pthread_create(&thread, 0, play_macro, (void*)params);
156                         if (retval) {
157                             perror("inputupdate_keys: Creating thread returned not null");
158                         } else {
159                             macro->triggered = 1;
160                         }
161                     }
162                 }
163             } else macro->triggered = 0;
164         }
165     }
166     // Make a list of keycodes to send. Rearrange them so that modifier keydowns always come first
167     // and modifier keyups always come last. This ensures that shortcut keys will register properly
168     // even if both keydown events happen at once.
169     // N_KEYS + 4 is used because the volume wheel generates keydowns and keyups at the same time
170     // (it's currently impossible to press all four at once, but safety first)
171     int events[N_KEYS_INPUT + 4];
172     int modcount = 0, keycount = 0, rmodcount = 0;
173     for(int byte = 0; byte < N_KEYBYTES_INPUT; byte++){
174         char oldb = input->prevkeys[byte], newb = input->keys[byte];
175         if(oldb == newb)
```

```
176             continue;
177         for(int bit = 0; bit < 8; bit++){
178             int keyindex = byte * 8 + bit;
179             if(keyindex >= N_KEYS_INPUT)
180                 break;
181             const key* map = keymap + keyindex;
182             int scancode = (kb->active) ? bind->base[keyindex] : map->
    scan;
183             char mask = 1 << bit;
184             char old = oldb & mask, new = newb & mask;
185             // If the key state changed, send it to the input device
186             if(old != new){
187                 // Don't echo a key press if there's no scancode associated
188                 if(!(scancode & SCAN_SILENT)){
189                     if(IS_MOD(scancode)){
190                         if(new){
191                             // Modifier down: Add to the end of modifier keys
192                             for(int i = keycount + rmodcount; i > 0; i--)
193                                 events[modcount + i] = events[modcount + i - 1];
194                             // Add 1 to the scancode because A is zero on OSX
195                             // Positive code = keydown, negative code = keyup
196                             events[modcount++] = scancode + 1;
197                         } else {
198                             // Modifier up: Add to the end of everything
199                             events[modcount + keycount + rmodcount++] = -(scancode + 1);
200                         }
201                     } else {
202                         // Regular keypress: add to the end of regular keys
203                         for(int i = rmodcount; i > 0; i--)
204                             events[modcount + keycount + i] = events[modcount + keycount + i - 1];
205                         events[modcount + keycount++] = new ? (scancode + 1) : -(scancode + 1);
206                         // The volume wheel and the mouse wheel don't generate keyups, so create them
    automatically
207 #define IS_WHEEL(scan, kb)  (((scan) == KEY_VOLUMEUP || (scan) == KEY_VOLUMEDOWN || (scan) == BTN_WHEELUP
    || (scan) == BTN_WHEELDOWN) && !IS_K65(kb))
208                         if(new && IS_WHEEL(map->scan, kb)){
209                             for(int i = rmodcount; i > 0; i--)
210                                 events[modcount + keycount + i] = events[modcount + keycount + i - 1];
211                             events[modcount + keycount++] = -(scancode + 1);
212                             input->keys[byte] &= ~mask;
213                         }
214                     }
215                 }
216                 // Print notifications if desired
217                 if(kb->active){
218                     for(int notify = 0; notify < OUTFIFO_MAX; notify++){
219                         if(mode->notify[notify][byte] & mask){
220                             nprintkey(kb, notify, keyindex, new);
221                             // Wheels doesn't generate keyups
222                             if(new && IS_WHEEL(map->scan, kb))
223                                 nprintkey(kb, notify, keyindex, 0);
224                         }
225                     }
226                 }
227             }
228         }
229     }
232     if (!macro_pt_first()) {
233         int totalkeys = modcount + keycount + rmodcount;
234         for(int i = 0; i < totalkeys; i++){
235             int scancode = events[i];
236             os_keypress(kb, (scancode < 0 ? -scancode : scancode) - 1, scancode > 0);
237         }
238     }
239 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.20.2.10 static pthread_t macro_pt_dequeue ( ) [static]

Returns

the ptread_id of the first element. If list is empty, return 0.

Attention

Becuase multiple threads may use this function in parallel, save the critical section with a mutex.

< why are we called?

< Was last element in the list, so clear tail.

< save the return value before deleting element

Definition at line 49 of file input.c.

References ckb_err, ptlist::next, pt_head, and ptlist::thread_id.

Referenced by play_macro().

```
49                                      {
50     pthread_t retval = 0;
51     ptlist_t* elem = 0;
52     if (pt_head == 0 && pt_tail == 0) {
53         ckb_err("macro_pt_dequeue: called on empty list.\n");
54         return 0;
55     }
56     elem = pt_head;
57     pt_head = pt_head->next;
```

```
58     if (pt_head == 0) pt_tail = 0;
59     retval = elem->thread_id;
60     free(elem);
61     return retval;
62 }
```

Here is the caller graph for this function:

9.20.2.11 static void macro_pt_enqueue ( ) [static]

Attention

Becuase multiple threads may use this function in parallel, save the critical section with a mutex.

< exit on critical situation;

Todo find a better exit strategy if no more mem available.

< The element knows its ID byself

< new list, first element

< existing list, append on last element (FIFO)

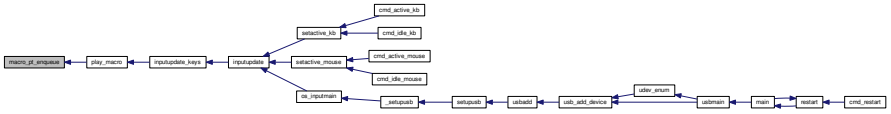
Definition at line 27 of file input.c.

References ptlist::next, and ptlist::thread_id.

Referenced by play_macro().

```
27                                {
28     ptlist_t* new_elem = malloc(sizeof(ptlist_t));
29     if (!new_elem) {
30         perror("macro_pt_enqueue: ");
31         exit (-1);
32     }
33     new_elem->next = 0;
34     new_elem->thread_id = pthread_self();
35     if (pt_head == 0) {
36         pt_head = pt_tail = new_elem;
37     } else {
38         pt_tail->next = new_elem;
39         pt_tail = new_elem;
40     }
41 }
```

Here is the caller graph for this function:



9.20.2.12 static pthread_t macro_pt_first ( ) [static]

Returns

the pthread_id of the first element in the list or 0 if list is empty.

Attention

Becuase multiple threads may use this function in parallel, save the critical section with a mutex (avoid NIL-ptr)

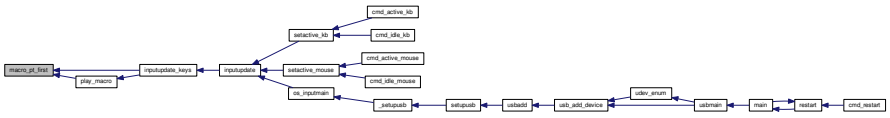
Definition at line 70 of file input.c.

References ptlist::thread_id.

Referenced by inputupdate_keys(), and play_macro().

```
70                                      {
71     return pt_head? pt_head->thread_id : 0;
72 }
```

Here is the caller graph for this function:



9.20.2.13 int macromask (const uchar * *key1*, const uchar * *key2*)

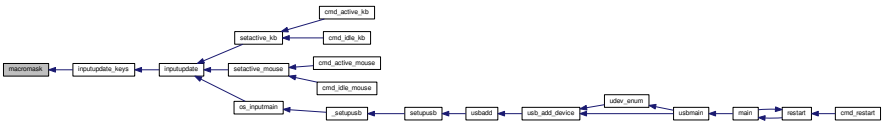
Definition at line 6 of file input.c.

References N_KEYBYTES_INPUT.

Referenced by inputupdate_keys().

```
6                                                       {
7     // Scan a macro against key input. Return 0 if any of them don't match
8     for(int i = 0; i < N_KEYBYTES_INPUT; i++){
9         // if((key1[i] & key2[i]) != key2[i])
10         if(key1[i] != key2[i])  // Changed to detect G-keys + modifiers
11             return 0;
12     }
13     return 1;
14 }
```

Here is the caller graph for this function:



9.20.2.14 static void* play_macro (void * *param*) [static]

Parameters

param	*parameter_t* to store Kb-ptr and macro-ptr (thread may get only one user-parameter)

Returns

0 on success, -1 else (no one is interested in it except the kernel...)

First have a look if we are the first and only macro-thread to run. If not, wait. So enqueue our thread first, so it is remembered for us and can be seen by all others.

< If the first thread in the list is not our, another one is running

< Give all new threads the chance to enter the block.

Send events for each keypress in the macro

< Synchonization between macro output and color information

< use this unlock / relock for enablling the parallel running colorization

< local delay set

< use default global delay

< use delays depending on macro length

< protect the linked list and the mvar

< Wake up all waiting threads

< for the linked list and the mvar

< Sync keyboard input/output and colorization

Definition at line 79 of file input.c.

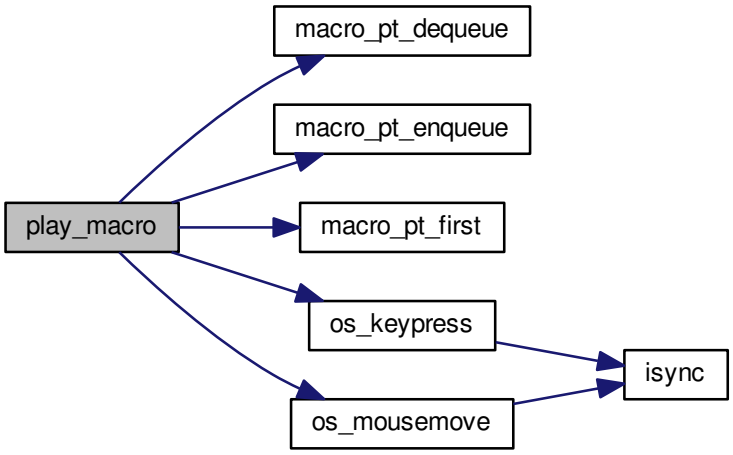
References keymacro::actioncount, keymacro::actions, macroaction::delay, usbdevice::delay, macroaction::down, parameter::kb, parameter::macro, macro_pt_dequeue(), macro_pt_enqueue(), macro_pt_first(), mmutex, mmutex2, mvar, os_keypress(), os_mousemove(), macroaction::rel_x, macroaction::rel_y, and macroaction::scan.

Referenced by inputupdate_keys().

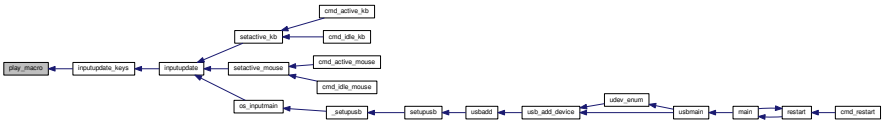
```
79                                      {
80     parameter_t* ptr = (parameter_t*) param;
81     usbdevice* kb = ptr->kb;
82     keymacro* macro = ptr->macro;
83
86     pthread_mutex_lock(mmutex2(kb));
87     macro_pt_enqueue();
88     // ckb_info("Entering critical section with 0x%lx. Queue head is 0x%lx\n",  (unsigned long
       int)pthread_self(), (unsigned long int)macro_pt_first());
89     while (macro_pt_first() != pthread_self()) {
90         // ckb_info("Now waiting with 0x%lx because of 0x%lx\n", (unsigned long int)pthread_self(),
       (unsigned long int)macro_pt_first());
91         pthread_cond_wait(mvar(kb), mmutex2(kb));
92         // ckb_info("Waking up with 0x%lx\n", (unsigned long int)pthread_self());
93     }
94     pthread_mutex_unlock(mmutex2(kb));
95
97     pthread_mutex_lock(mmutex(kb));
98     for (int a = 0; a < macro->actioncount; a++) {
99         macroaction* action = macro->actions + a;
100         if (action->rel_x != 0 || action->rel_y != 0)
101             os_mousemove(kb, action->rel_x, action->rel_y);
102         else {
103             os_keypress(kb, action->scan, action->down);
104             pthread_mutex_unlock(mmutex(kb));
105             if (action->delay != UINT_MAX && action->delay) {
106                 usleep(action->delay);
107             } else if (kb->delay != UINT_MAX && kb->delay) {
108                 usleep(kb->delay);
109             } else if (a < (macro->actioncount - 1)) {
110                 if (a > 200) {
111                     usleep (100);
112                 } else if (a > 20) {
113                     usleep(30);
114                 }
```

```
115             }
116             pthread_mutex_lock(mmutex(kb));
117         }
118     }
119
120     pthread_mutex_lock(mmutex2(kb));
121     // ckb_info("Now leaving 0x%lx and waking up all others\n", (unsigned long int)pthread_self());
122     macro_pt_dequeue();
123     pthread_cond_broadcast(mvar(kb));
124     pthread_mutex_unlock(mmutex2(kb));
125
126     pthread_mutex_unlock(mmutex(kb));
127     return 0;
128 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.20.2.15 void updateindicators_kb (usbdevice * *kb*, int *force*)

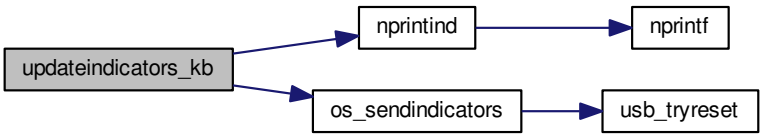
Definition at line 261 of file input.c.

References usbdevice::active, usbprofile::currentmode, DELAY_SHORT, usbdevice::hw_ileds, usbdevice::hw_ileds_old, I_CAPS, I_NUM, I_SCROLL, usbdevice::ileds, usbmode::inotify, usbmode::ioff, usbmode::ion, nprintind(), os_sendindicators(), OUTFIFO_MAX, and usbdevice::profile.

```
261                                                 {
262     // Read current hardware indicator state (set externally)
263     uchar old = kb->ileds, hw_old = kb->hw_ileds_old;
264     uchar new = kb->hw_ileds, hw_new = new;
265     // Update them if needed
266     if(kb->active){
```

```
267         usbmode* mode = kb->profile->currentmode;
268         new = (new & ~mode->ioff) | mode->ion;
269     }
270     kb->ileds = new;
271     kb->hw_ileds_old = hw_new;
272     if(old != new || force){
273         DELAY_SHORT(kb);
274         os_sendindicators(kb);
275     }
276     // Print notifications if desired
277     if(!kb->active)
278         return;
279     usbmode* mode = kb->profile->currentmode;
280     uchar indicators[] = { I_NUM, I_CAPS, I_SCROLL };
281     for(unsigned i = 0; i < sizeof(indicators) / sizeof(uchar); i++){
282         uchar mask = indicators[i];
283         if((hw_old & mask) == (hw_new & mask))
284             continue;
285         for(int notify = 0; notify < OUTFIFO_MAX; notify++){
286             if(mode->inotify[notify] & mask)
287                 nprintind(kb, notify, mask, hw_new & mask);
288         }
289     }
290 }
```

Here is the call graph for this function:



9.20.3 Variable Documentation

9.20.3.1 ptlist_t* pt_head = 0 [static]

Definition at line 18 of file input.c.

Referenced by macro_pt_dequeue().

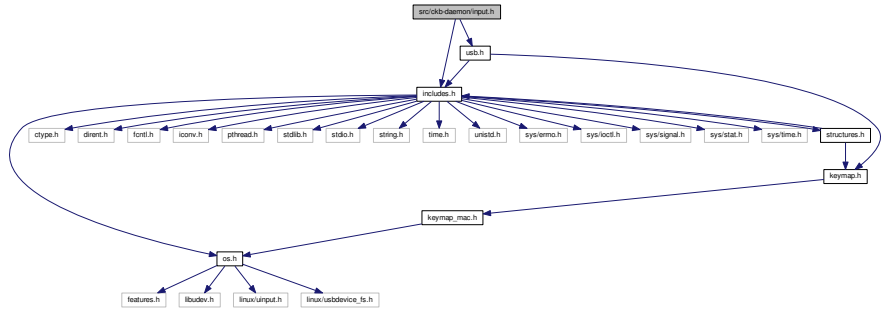
9.20.3.2 ptlist_t* pt_tail = 0 [static]

Definition at line 20 of file input.c.

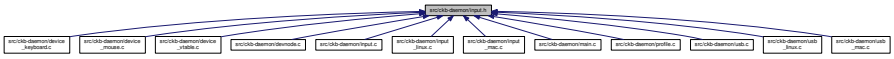
9.21 src/ckb-daemon/input.h File Reference

```
#include "includes.h"
#include "usb.h"
```

Include dependency graph for input.h:



This graph shows which files directly or indirectly include this file:



Data Structures

- struct parameter

  struct parameter contains the values for a fresh started macro_play thread. parameter_t is the typedef for it. More...
- struct ptlist

  struct ptlist is one element in the single linked list to store macro_play threads waiting for their execution ptlist_t is the typedef for it. More...

Macros

- #define IS_MOD(s) ((s) == KEY_CAPSLOCK || (s) == KEY_NUMLOCK || (s) == KEY_SCROLLLOCK || (s) == KEY_LEFTSHIFT || (s) == KEY_RIGHTSHIFT || (s) == KEY_LEFTCTRL || (s) == KEY_RIGHTCTRL || (s) == KEY_LEFTMETA || (s) == KEY_RIGHTMETA || (s) == KEY_LEFTALT || (s) == KEY_RIGHTALT || (s) == KEY_FN)

Typedefs

- typedef struct parameter parameter_t

  struct parameter contains the values for a fresh started macro_play thread. parameter_t is the typedef for it.
- typedef struct ptlist ptlist_t

  struct ptlist is one element in the single linked list to store macro_play threads waiting for their execution ptlist_t is the typedef for it.

Functions

- int os_inputopen (usbdevice *kb)

  os_inputopen
- void os_inputclose (usbdevice *kb)
- void inputupdate (usbdevice *kb)
- void updateindicators_kb (usbdevice *kb, int force)
- void initbind (binding *bind)

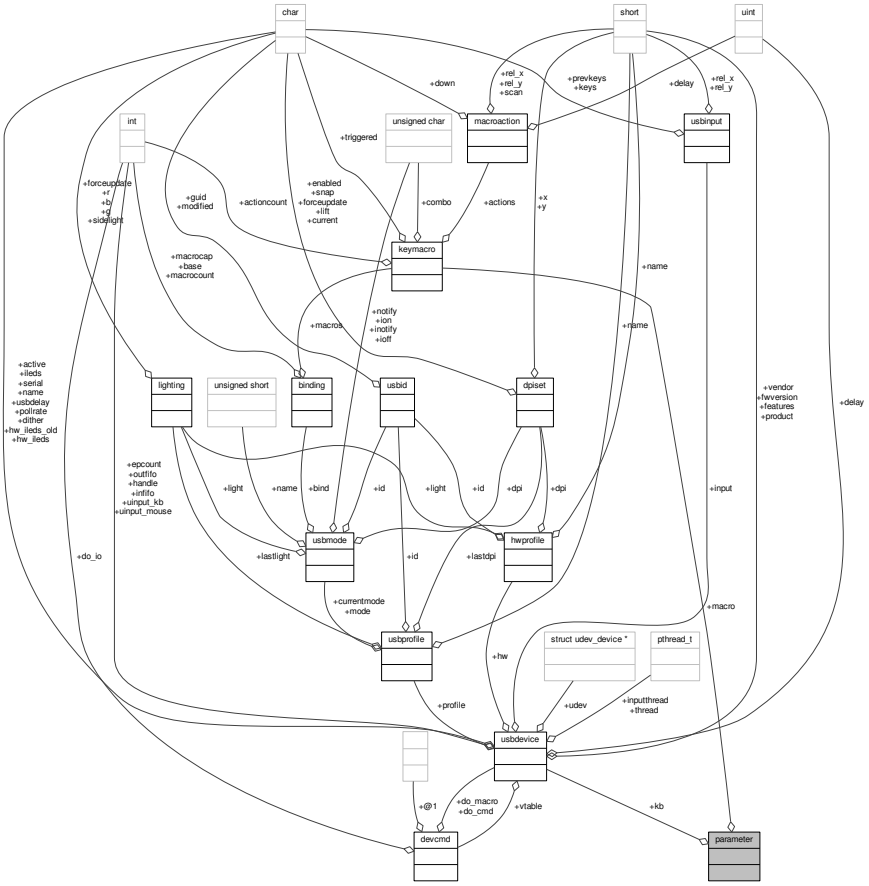
- void freebind (binding ∗bind)
- void cmd_bind (usbdevice ∗kb, usbmode ∗mode, int dummy, int keyindex, const char ∗to)
- void cmd_unbind (usbdevice ∗kb, usbmode ∗mode, int dummy, int keyindex, const char ∗ignored)
- void cmd_rebind (usbdevice ∗kb, usbmode ∗mode, int dummy, int keyindex, const char ∗ignored)
- void cmd_macro (usbdevice ∗kb, usbmode ∗mode, const int notifynumber, const char ∗keys, const char ∗assignment)
- void os_keypress (usbdevice ∗kb, int scancode, int down)
- void os_mousemove (usbdevice ∗kb, int x, int y)
- int os_setupindicators (usbdevice ∗kb)

9.21.1 Data Structure Documentation

9.21.1.1 struct parameter

Definition at line 54 of file input.h.

Collaboration diagram for parameter:



Data Fields

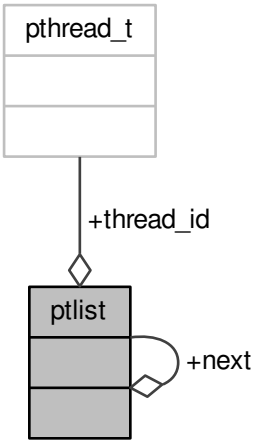
usbdevice ∗	kb	

keymacro *	macro	

9.21.1.2 struct ptlist

Definition at line 62 of file input.h.

Collaboration diagram for ptlist:



Data Fields

struct ptlist *	next	
pthread_t	thread_id	

9.21.2 Macro Definition Documentation

9.21.2.1 #define IS_MOD(s) ((s) == KEY_CAPSLOCK || (s) == KEY_NUMLOCK || (s) == KEY_SCROLLLOCK || (s) == KEY_LEFTSHIFT || (s) == KEY_RIGHTSHIFT || (s) == KEY_LEFTCTRL || (s) == KEY_RIGHTCTRL || (s) == KEY_LEFTMETA || (s) == KEY_RIGHTMETA || (s) == KEY_LEFTALT || (s) == KEY_RIGHTALT || (s) == KEY_FN)

Definition at line 34 of file input.h.

Referenced by inputupdate_keys().

9.21.3 Typedef Documentation

9.21.3.1 typedef struct parameter parameter_t

9.21.3.2 typedef struct ptlist ptlist_t

9.21.4 Function Documentation

9.21.4.1 void cmd_bind (usbdevice * *kb*, usbmode * *mode*, int *dummy*, int *keyindex*, const char * *to*)

Definition at line 307 of file input.c.

References binding::base, usbmode::bind, imutex, keymap, N_KEYS_INPUT, and key::scan.

```
307                                                                                                 {
308     if(keyindex >= N_KEYS_INPUT)
309         return;
310     // Find the key to bind to
311     int tocode = 0;
312     if(sscanf(to, "#x%ux", &tocode) != 1 && sscanf(to, "#%u", &tocode) == 1 && tocode <
    N_KEYS_INPUT){
313         pthread_mutex_lock(imutex(kb));
314         mode->bind.base[keyindex] = tocode;
315         pthread_mutex_unlock(imutex(kb));
316         return;
317     }
318     // If not numeric, look it up
319     for(int i = 0; i < N_KEYS_INPUT; i++){
320         if(keymap[i].name && !strcmp(to, keymap[i].name)){
321             pthread_mutex_lock(imutex(kb));
322             mode->bind.base[keyindex] = keymap[i].scan;
323             pthread_mutex_unlock(imutex(kb));
324             return;
325         }
326     }
327 }
```

9.21.4.2 void cmd_macro (usbdevice * *kb*, usbmode * *mode*, const int *notifynumber*, const char * *keys*, const char * *assignment*)

Definition at line 467 of file input.c.

References _cmd_macro(), and imutex.

```
467
         {
468     pthread_mutex_lock(imutex(kb));
469     _cmd_macro(mode, keys, assignment);
470     pthread_mutex_unlock(imutex(kb));
471 }
```

Here is the call graph for this function:

9.21.4.3 void cmd_rebind (usbdevice * *kb*, usbmode * *mode*, int *dummy*, int *keyindex*, const char * *ignored*)

Definition at line 337 of file input.c.

References binding::base, usbmode::bind, imutex, keymap, N_KEYS_INPUT, and key::scan.

```
337                                                                                                 {
338     if(keyindex >= N_KEYS_INPUT)
339         return;
340     pthread_mutex_lock(imutex(kb));
341     mode->bind.base[keyindex] = keymap[keyindex].scan;
342     pthread_mutex_unlock(imutex(kb));
343 }
```

9.21.4.4 void cmd_unbind (usbdevice * *kb*, usbmode * *mode*, int *dummy*, int *keyindex*, const char * *ignored*)

Definition at line 329 of file input.c.

References binding::base, usbmode::bind, imutex, KEY_UNBOUND, and N_KEYS_INPUT.

```
329                                                                                                 {
330     if(keyindex >= N_KEYS_INPUT)
331         return;
332     pthread_mutex_lock(imutex(kb));
333     mode->bind.base[keyindex] = KEY_UNBOUND;
334     pthread_mutex_unlock(imutex(kb));
335 }
```

9.21.4.5 void freebind (binding * *bind*)

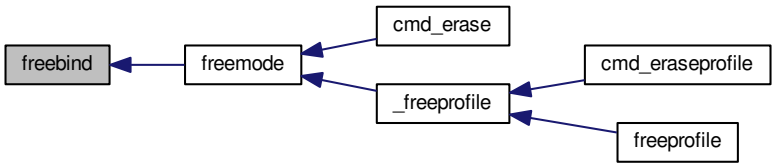
Definition at line 300 of file input.c.

References keymacro::actions, binding::macrocount, and binding::macros.

Referenced by freemode().

```
300                             {
301     for(int i = 0; i < bind->macrocount; i++)
302         free(bind->macros[i].actions);
303     free(bind->macros);
304     memset(bind, 0, sizeof(*bind));
305 }
```

Here is the caller graph for this function:



9.21.4.6 void initbind (binding * *bind*)

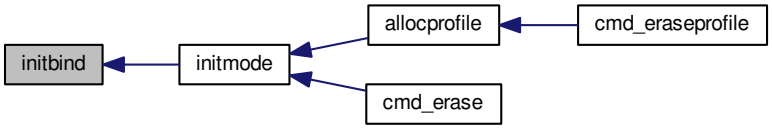
Definition at line 292 of file input.c.

References binding::base, keymap, binding::macrocap, binding::macrocount, binding::macros, N_KEYS_INPUT, and key::scan.

Referenced by initmode().

```
292                             {
293     for(int i = 0; i < N_KEYS_INPUT; i++)
294         bind->base[i] = keymap[i].scan;
295     bind->macros = calloc(32, sizeof(keymacro));
296     bind->macrocap = 32;
297     bind->macrocount = 0;
298 }
```

Here is the caller graph for this function:



9.21.4.7 void inputupdate (usbdevice * *kb*)

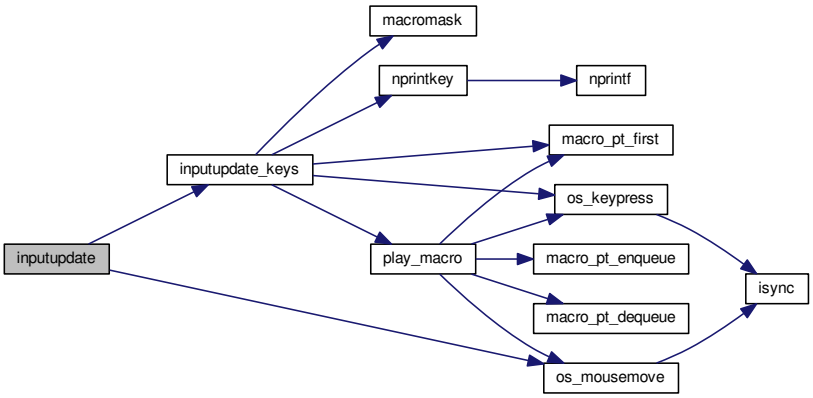
Definition at line 241 of file input.c.

References usbdevice::input, inputupdate_keys(), os_mousemove(), usbdevice::profile, usbinput::rel_x, usbinput::rel_y, usbdevice::uinput_kb, and usbdevice::uinput_mouse.

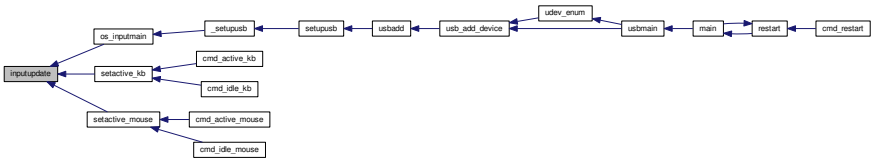
Referenced by os_inputmain(), setactive_kb(), and setactive_mouse().

```
241                                {
242 #ifdef OS_LINUX
243     if((!kb->uinput_kb || !kb->uinput_mouse)
244 #else
245     if(!kb->event
246 #endif
247             || !kb->profile)
248         return;
249     // Process key/button input
250     inputupdate_keys(kb);
251     // Process mouse movement
252     usbinput* input = &kb->input;
253     if(input->rel_x != 0 || input->rel_y != 0){
254         os_mousemove(kb, input->rel_x, input->rel_y);
255         input->rel_x = input->rel_y = 0;
256     }
257     // Finish up
258     memcpy(input->prevkeys, input->keys, N_KEYBYTES_INPUT);
259 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.21.4.8 void os_inputclose (usbdevice * *kb*)

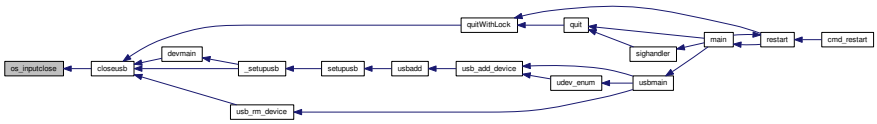
Definition at line 76 of file input_linux.c.

References ckb_warn, usbdevice::uinput_kb, and usbdevice::uinput_mouse.

Referenced by closeusb().

```
76                                  {
77      if(kb->uinput_kb <= 0 || kb->uinput_mouse <= 0)
78          return;
79      // Set all keys released
80      struct input_event event;
81      memset(&event, 0, sizeof(event));
82      event.type = EV_KEY;
83      for(int key = 0; key < KEY_CNT; key++){
84          event.code = key;
85          if(write(kb->uinput_kb - 1, &event, sizeof(event)) <= 0)
86              ckb_warn("uinput write failed: %s\n", strerror(errno));
87          if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
88              ckb_warn("uinput write failed: %s\n", strerror(errno));
89      }
90      event.type = EV_SYN;
91      event.code = SYN_REPORT;
92      if(write(kb->uinput_kb - 1, &event, sizeof(event)) <= 0)
93          ckb_warn("uinput write failed: %s\n", strerror(errno));
94      if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
95          ckb_warn("uinput write failed: %s\n", strerror(errno));
96      // Close the keyboard
97      ioctl(kb->uinput_kb - 1, UI_DEV_DESTROY);
98      close(kb->uinput_kb - 1);
99      kb->uinput_kb = 0;
100      // Close the mouse
101      ioctl(kb->uinput_mouse - 1, UI_DEV_DESTROY);
102      close(kb->uinput_mouse - 1);
103      kb->uinput_mouse = 0;
104 }
```

Here is the caller graph for this function:



9.21.4.9 int os_inputopen (usbdevice * *kb*)

Parameters

kb	

Returns

Some tips on using `uinput_user_dev in`

Definition at line 55 of file input_linux.c.

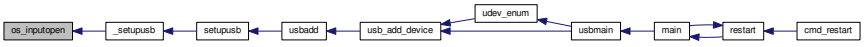
References usbdevice::fwversion, INDEX_OF, keyboard, usbdevice::name, usbdevice::product, usbdevice::uinput_kb, usbdevice::uinput_mouse, uinputopen(), and usbdevice::vendor.

Referenced by _setupusb().

```
55                                {
56     // Create the new input device
57     int index = INDEX_OF(kb, keyboard);
58     struct uinput_user_dev indev;
59     memset(&indev, 0, sizeof(indev));
60     snprintf(indev.name, UINPUT_MAX_NAME_SIZE, "ckb%d: %s", index, kb->name);
61     indev.id.bustype = BUS_USB;
62     indev.id.vendor = kb->vendor;
63     indev.id.product = kb->product;
64     indev.id.version = kb->fwversion;
65     // Open keyboard
66     int fd = uinputopen(&indev, 0);
67     kb->uinput_kb = fd;
68     if(fd <= 0)
69         return 0;
70     // Open mouse
71     fd = uinputopen(&indev, 1);
72     kb->uinput_mouse = fd;
73     return fd <= 0;
74 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.21.4.10 void os_keypress (usbdevice * *kb*, int *scancode*, int *down*)

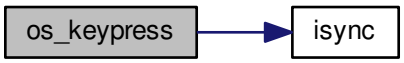
Definition at line 118 of file input_linux.c.

References BTN_WHEELDOWN, BTN_WHEELUP, ckb_warn, isync(), SCAN_MOUSE, usbdevice::uinput_kb, and usbdevice::uinput_mouse.

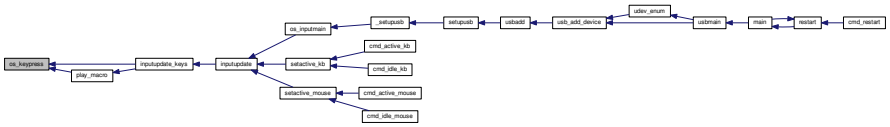
Referenced by inputupdate_keys(), and play_macro().

```
118                                                 {
119     struct input_event event;
120     memset(&event, 0, sizeof(event));
121     int is_mouse = 0;
122     if(scancode == BTN_WHEELUP || scancode == BTN_WHEELDOWN){
123         // The mouse wheel is a relative axis
124         if(!down)
125             return;
126         event.type = EV_REL;
127         event.code = REL_WHEEL;
128         event.value = (scancode == BTN_WHEELUP ? 1 : -1);
129         is_mouse = 1;
130     } else {
131         // Mouse buttons and key events are both EV_KEY. The scancodes are already correct, just remove the
    ckb bit
132         event.type = EV_KEY;
133         event.code = scancode & ~SCAN_MOUSE;
134         event.value = down;
135         is_mouse = !!(scancode & SCAN_MOUSE);
136     }
137     if(write((is_mouse ? kb->uinput_mouse : kb->uinput_kb) - 1, &event, sizeof(event))
    <= 0)
138         ckb_warn("uinput write failed: %s\n", strerror(errno));
139     else
140         isync(kb);
141 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.21.4.11 void os_mousemove (usbdevice * *kb*, int *x*, int *y*)

Definition at line 143 of file input_linux.c.

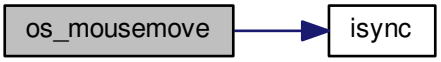
References ckb_warn, isync(), and usbdevice::uinput_mouse.

Referenced by inputupdate(), and play_macro().

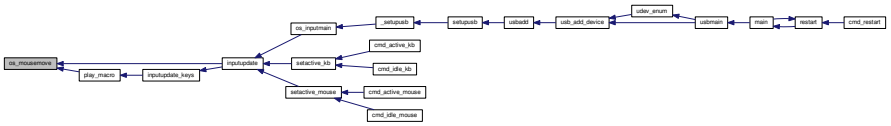
```
143                                                 {
144     struct input_event event;
145     memset(&event, 0, sizeof(event));
146     event.type = EV_REL;
147     if(x != 0){
148         event.code = REL_X;
149         event.value = x;
150         if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
151             ckb_warn("uinput write failed: %s\n", strerror(errno));
152         else
153             isync(kb);
154     }
155     if(y != 0){
```

```
156         event.code = REL_Y;
157         event.value = y;
158         if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
159             ckb_warn("uinput write failed: %s\n", strerror(errno));
160         else
161             isync(kb);
162     }
163 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.21.4.12 int os_setupindicators (usbdevice * *kb*)

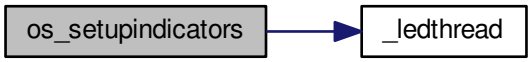
Definition at line 189 of file input_linux.c.

References _ledthread(), usbdevice::hw_ileds, usbdevice::hw_ileds_old, and usbdevice::ileds.

Referenced by _setupusb().

```
189                                     {
190     // Initialize LEDs to all off
191     kb->hw_ileds = kb->hw_ileds_old = kb->ileds = 0;
192     // Create and detach thread to read LED events
193     pthread_t thread;
194     int err = pthread_create(&thread, 0, _ledthread, kb);
195     if(err != 0)
196         return err;
197     pthread_detach(thread);
198     return 0;
199 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

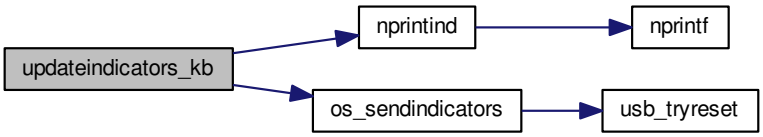
9.21.4.13 void updateindicators_kb (usbdevice * *kb*, int *force*)

Definition at line 261 of file input.c.

References usbdevice::active, usbprofile::currentmode, DELAY_SHORT, usbdevice::hw_ileds, usbdevice::hw_ileds_old, I_CAPS, I_NUM, I_SCROLL, usbdevice::ileds, usbmode::inotify, usbmode::ioff, usbmode::ion, nprintind(), os_sendindicators(), OUTFIFO_MAX, and usbdevice::profile.

```
261                                                 {
262     // Read current hardware indicator state (set externally)
263     uchar old = kb->ileds, hw_old = kb->hw_ileds_old;
264     uchar new = kb->hw_ileds, hw_new = new;
265     // Update them if needed
266     if(kb->active){
267         usbmode* mode = kb->profile->currentmode;
268         new = (new & ~mode->ioff) | mode->ion;
269     }
270     kb->ileds = new;
271     kb->hw_ileds_old = hw_new;
272     if(old != new || force){
273         DELAY_SHORT(kb);
274         os_sendindicators(kb);
275     }
276     // Print notifications if desired
277     if(!kb->active)
278         return;
279     usbmode* mode = kb->profile->currentmode;
280     uchar indicators[] = { I_NUM, I_CAPS, I_SCROLL };
281     for(unsigned i = 0; i < sizeof(indicators) / sizeof(uchar); i++){
282         uchar mask = indicators[i];
283         if((hw_old & mask) == (hw_new & mask))
284             continue;
285         for(int notify = 0; notify < OUTFIFO_MAX; notify++){
286             if(mode->inotify[notify] & mask)
287                 nprintind(kb, notify, mask, hw_new & mask);
288         }
289     }
290 }
```

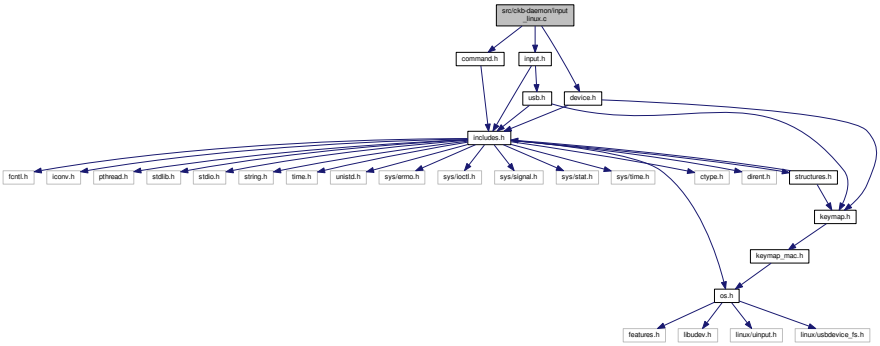
Here is the call graph for this function:



9.22 src/ckb-daemon/input_linux.c File Reference

```
#include "command.h"
#include "device.h"
#include "input.h"
```

Include dependency graph for input_linux.c:



Functions

- int uinputopen (struct uinput_user_dev *indev, int mouse)
- int os_inputopen (usbdevice *kb)

  os_inputopen
- void os_inputclose (usbdevice *kb)
- static void isync (usbdevice *kb)
- void os_keypress (usbdevice *kb, int scancode, int down)
- void os_mousemove (usbdevice *kb, int x, int y)
- void * _ledthread (void *ctx)
- int os_setupindicators (usbdevice *kb)

9.22.1 Function Documentation

9.22.1.1 void* _ledthread (void * *ctx*)

Definition at line 165 of file input_linux.c.

References dmutex, usbdevice::hw_ileds, usbdevice::uinput_kb, and usbdevice::vtable.

Referenced by os_setupindicators().

```
165                          {
166     usbdevice* kb = ctx;
167     uchar ileds = 0;
168     // Read LED events from the uinput device
169     struct input_event event;
170     while (read(kb->uinput_kb - 1, &event, sizeof(event)) > 0) {
171         if (event.type == EV_LED && event.code < 8){
172             char which = 1 << event.code;
173             if(event.value)
174                 ileds |= which;
175             else
176                 ileds &= ~which;
177         }
178         // Update them if needed
179         pthread_mutex_lock(dmutex(kb));
180         if(kb->hw_ileds != ileds){
181             kb->hw_ileds = ileds;
182             kb->vtable->updateindicators(kb, 0);
183         }
184         pthread_mutex_unlock(dmutex(kb));
185     }
186     return 0;
187 }
```

Here is the caller graph for this function:

9.22.1.2 static void isync (usbdevice * kb) [static]

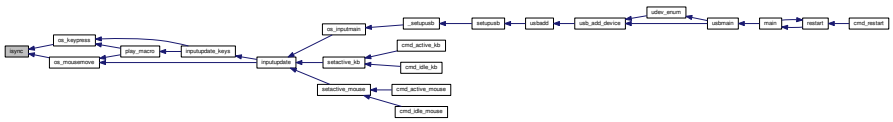
Definition at line 107 of file input_linux.c.

References ckb_warn, usbdevice::uinput_kb, and usbdevice::uinput_mouse.

Referenced by os_keypress(), and os_mousemove().

```
107                                 {
108     struct input_event event;
109     memset(&event, 0, sizeof(event));
110     event.type = EV_SYN;
111     event.code = SYN_REPORT;
112     if(write(kb->uinput_kb - 1, &event, sizeof(event)) <= 0)
113         ckb_warn("uinput write failed: %s\n", strerror(errno));
114     if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
115         ckb_warn("uinput write failed: %s\n", strerror(errno));
116 }
```

Here is the caller graph for this function:



9.22.1.3 void os_inputclose (usbdevice * kb)

Definition at line 76 of file input_linux.c.

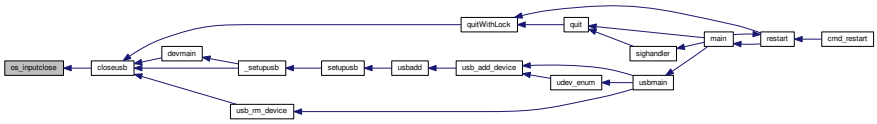
References ckb_warn, usbdevice::uinput_kb, and usbdevice::uinput_mouse.

Referenced by closeusb().

```
76                                  {
77     if(kb->uinput_kb <= 0 || kb->uinput_mouse <= 0)
78         return;
79     // Set all keys released
80     struct input_event event;
81     memset(&event, 0, sizeof(event));
82     event.type = EV_KEY;
83     for(int key = 0; key < KEY_CNT; key++){
84         event.code = key;
85         if(write(kb->uinput_kb - 1, &event, sizeof(event)) <= 0)
86             ckb_warn("uinput write failed: %s\n", strerror(errno));
87         if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
88             ckb_warn("uinput write failed: %s\n", strerror(errno));
89     }
90     event.type = EV_SYN;
91     event.code = SYN_REPORT;
92     if(write(kb->uinput_kb - 1, &event, sizeof(event)) <= 0)
93         ckb_warn("uinput write failed: %s\n", strerror(errno));
94     if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
95         ckb_warn("uinput write failed: %s\n", strerror(errno));
96     // Close the keyboard
97     ioctl(kb->uinput_kb - 1, UI_DEV_DESTROY);
98     close(kb->uinput_kb - 1);
99     kb->uinput_kb = 0;
100     // Close the mouse
```

```
101     ioctl(kb->uinput_mouse - 1, UI_DEV_DESTROY);
102     close(kb->uinput_mouse - 1);
103     kb->uinput_mouse = 0;
104 }
```

Here is the caller graph for this function:



9.22.1.4 int os_inputopen (usbdevice * *kb*)

Parameters

kb	

Returns

Some tips on using `uinput_user_dev in`

Definition at line 55 of file input_linux.c.

References usbdevice::fwversion, INDEX_OF, keyboard, usbdevice::name, usbdevice::product, usbdevice::uinput_kb, usbdevice::uinput_mouse, uinputopen(), and usbdevice::vendor.

Referenced by _setupusb().

```
55                                  {
56     // Create the new input device
57     int index = INDEX_OF(kb, keyboard);
58     struct uinput_user_dev indev;
59     memset(&indev, 0, sizeof(indev));
60     snprintf(indev.name, UINPUT_MAX_NAME_SIZE, "ckb%d: %s", index, kb->name);
61     indev.id.bustype = BUS_USB;
62     indev.id.vendor = kb->vendor;
63     indev.id.product = kb->product;
64     indev.id.version = kb->fwversion;
65     // Open keyboard
66     int fd = uinputopen(&indev, 0);
67     kb->uinput_kb = fd;
68     if(fd <= 0)
69         return 0;
70     // Open mouse
71     fd = uinputopen(&indev, 1);
72     kb->uinput_mouse = fd;
73     return fd <= 0;
74 }
```

Here is the call graph for this function:

Here is the caller graph for this function:

9.22.1.5 void os_keypress (usbdevice * *kb*, int *scancode*, int *down*)

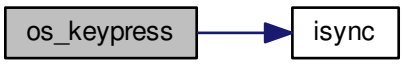
Definition at line 118 of file input_linux.c.

References BTN_WHEELDOWN, BTN_WHEELUP, ckb_warn, isync(), SCAN_MOUSE, usbdevice::uinput_kb, and usbdevice::uinput_mouse.

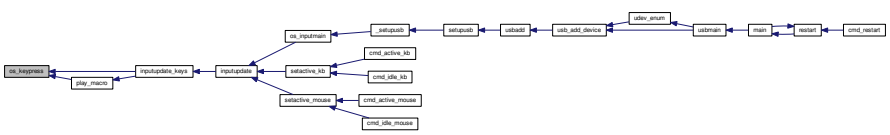
Referenced by inputupdate_keys(), and play_macro().

```
118                                                     {
119     struct input_event event;
120     memset(&event, 0, sizeof(event));
121     int is_mouse = 0;
122     if(scancode == BTN_WHEELUP || scancode == BTN_WHEELDOWN){
123         // The mouse wheel is a relative axis
124         if(!down)
125             return;
126         event.type = EV_REL;
127         event.code = REL_WHEEL;
128         event.value = (scancode == BTN_WHEELUP ? 1 : -1);
129         is_mouse = 1;
130     } else {
131         // Mouse buttons and key events are both EV_KEY. The scancodes are already correct, just remove the
    ckb bit
132         event.type = EV_KEY;
133         event.code = scancode & ~SCAN_MOUSE;
134         event.value = down;
135         is_mouse = !!(scancode & SCAN_MOUSE);
136     }
137     if(write((is_mouse ? kb->uinput_mouse : kb->uinput_kb) - 1, &event, sizeof(event))
    <= 0)
138         ckb_warn("uinput write failed: %s\n", strerror(errno));
139     else
140         isync(kb);
141 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.22.1.6 void os_mousemove (usbdevice * kb, int x, int y)

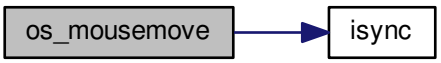
Definition at line 143 of file input_linux.c.

References ckb_warn, isync(), and usbdevice::uinput_mouse.

Referenced by inputupdate(), and play_macro().

```
143                                                 {
144     struct input_event event;
145     memset(&event, 0, sizeof(event));
146     event.type = EV_REL;
147     if(x != 0){
148         event.code = REL_X;
149         event.value = x;
150         if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
151             ckb_warn("uinput write failed: %s\n", strerror(errno));
152         else
153             isync(kb);
154     }
155     if(y != 0){
156         event.code = REL_Y;
157         event.value = y;
158         if(write(kb->uinput_mouse - 1, &event, sizeof(event)) <= 0)
159             ckb_warn("uinput write failed: %s\n", strerror(errno));
160         else
161             isync(kb);
162     }
163 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.22.1.7 int os_setupindicators (usbdevice * kb)

Definition at line 189 of file input_linux.c.

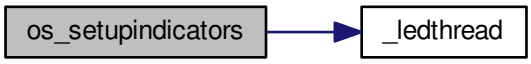
References _ledthread(), usbdevice::hw_ileds, usbdevice::hw_ileds_old, and usbdevice::ileds.

Referenced by _setupusb().

```
189                                         {
190     // Initialize LEDs to all off
191     kb->hw_ileds = kb->hw_ileds_old = kb->ileds = 0;
192     // Create and detach thread to read LED events
193     pthread_t thread;
194     int err = pthread_create(&thread, 0, _ledthread, kb);
195     if(err != 0)
```

```
196         return err;
197     pthread_detach(thread);
198     return 0;
199 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.22.1.8 int uinputopen (struct uinput_user_dev * *indev*, int *mouse*)

Definition at line 9 of file input_linux.c.

References ckb_err, and ckb_warn.

Referenced by os_inputopen().

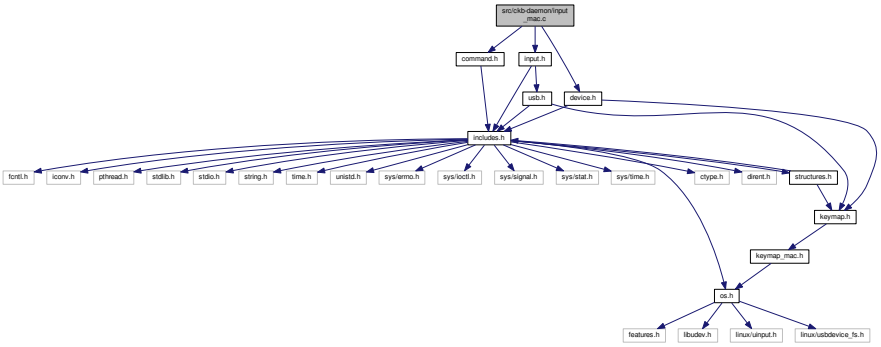
```
9                                                       {
10     int fd = open("/dev/uinput", O_RDWR);
11     if(fd < 0){
12         // If that didn't work, try /dev/input/uinput instead
13         fd = open("/dev/input/uinput", O_RDWR);
14         if(fd < 0){
15             ckb_err("Failed to open uinput: %s\n", strerror(errno));
16             return 0;
17         }
18     }
19     // Enable all keys and mouse buttons
20     ioctl(fd, UI_SET_EVBIT, EV_KEY);
21     for(int i = 0; i < KEY_CNT; i++)
22         ioctl(fd, UI_SET_KEYBIT, i);
23     if(mouse){
24         // Enable mouse axes
25         ioctl(fd, UI_SET_EVBIT, EV_REL);
26         for(int i = 0; i < REL_CNT; i++)
27             ioctl(fd, UI_SET_RELBIT, i);
28     } else {
29         // Enable LEDs
30         ioctl(fd, UI_SET_EVBIT, EV_LED);
31         for(int i = 0; i < LED_CNT; i++)
32             ioctl(fd, UI_SET_LEDBIT, i);
33         // Eanble autorepeat
34         ioctl(fd, UI_SET_EVBIT, EV_REP);
35     }
36     // Enable sychronization
37     ioctl(fd, UI_SET_EVBIT, EV_SYN);
38     // Create the device
39     if(write(fd, indev, sizeof(*indev)) <= 0)
40         ckb_warn("uinput write failed: %s\n", strerror(errno));
41     if(ioctl(fd, UI_DEV_CREATE)){
42         ckb_err("Failed to create uinput device: %s\n", strerror(errno));
43         close(fd);
44         return 0;
45     }
46     return fd + 1;
47 }
```

Here is the caller graph for this function:

9.23 src/ckb-daemon/input_mac.c File Reference

```
#include "command.h"
#include "device.h"
#include "input.h"
```

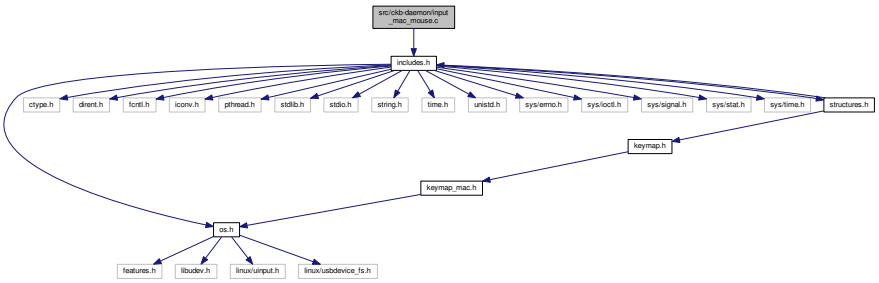
Include dependency graph for input_mac.c:



9.24 src/ckb-daemon/input_mac_mouse.c File Reference

```
#include "includes.h"
```

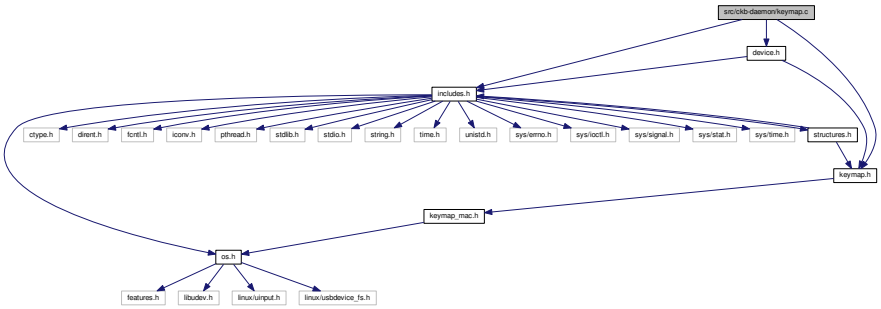
Include dependency graph for input_mac_mouse.c:



9.25 src/ckb-daemon/keymap.c File Reference

```
#include "device.h"
#include "includes.h"
#include "keymap.h"
```

Include dependency graph for keymap.c:



Macros

- #define BUTTON_HID_COUNT 5

Functions

- void hid_kb_translate (unsigned char ∗kbinput, int endpoint, int length, const unsigned char ∗urbinput)
- void hid_mouse_translate (unsigned char ∗kbinput, short ∗xaxis, short ∗yaxis, int endpoint, int length, const unsigned char ∗urbinput)
- void corsair_kbcopy (unsigned char ∗kbinput, int endpoint, const unsigned char ∗urbinput)
- void corsair_mousecopy (unsigned char ∗kbinput, int endpoint, const unsigned char ∗urbinput)

Variables

- const key keymap [(((152+3+12)+25)+11)]

9.25.1 Macro Definition Documentation

9.25.1.1 #define BUTTON_HID_COUNT 5

Definition at line 364 of file keymap.c.

Referenced by corsair_mousecopy(), and hid_mouse_translate().

9.25.2 Function Documentation

9.25.2.1 void corsair_kbcopy (unsigned char ∗ *kbinput*, int *endpoint*, const unsigned char ∗ *urbinput*)

Definition at line 394 of file keymap.c.

References N_KEYBYTES_HW.

Referenced by os_inputmain().

```
394                                                                                 {
395     if(endpoint == 2 || endpoint == -2){
396         if(urbinput[0] != 3)
397             return;
398         urbinput++;
399     }
400     memcpy(kbinput, urbinput, N_KEYBYTES_HW);
401 }
```

Here is the caller graph for this function:

9.25.2.2 void corsair_mousecopy (unsigned char ∗ *kbinput,* int *endpoint,* const unsigned char ∗ *urbinput*)

Definition at line 403 of file keymap.c.

References BUTTON_HID_COUNT, CLEAR_KEYBIT, MOUSE_BUTTON_FIRST, N_BUTTONS_HW, and SET_KEYBIT.

Referenced by os_inputmain().

```
403                                                                                                    {
404     if(endpoint == 2 || endpoint == -2){
405         if(urbinput[0] != 3)
406             return;
407         urbinput++;
408     }
409     for(int bit = BUTTON_HID_COUNT; bit < N_BUTTONS_HW; bit++){
410         int byte = bit / 8;
411         uchar test = 1 << (bit % 8);
412         if(urbinput[byte] & test)
413             SET_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
414         else
415             CLEAR_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
416     }
417 }
```

Here is the caller graph for this function:

9.25.2.3 void hid_kb_translate (unsigned char ∗ *kbinput,* int *endpoint,* int *length,* const unsigned char ∗ *urbinput*)

Definition at line 223 of file keymap.c.

References ckb_warn, CLEAR_KEYBIT, and SET_KEYBIT.

Referenced by os_inputmain().

```
223                                                                                                    {
224     if(length < 1)
225         return;
226     // LUT for HID -> Corsair scancodes (-1 for no scan code, -2 for currently unsupported)
227     // Modified from Linux drivers/hid/usbhid/usbkbd.c, key codes replaced with array indices and K95 keys
        added
228     static const short hid_codes[256] = {
229         -1,  -1,  -1,  -1,  37,  54,  52,  39,  27,  40,  41,  42,  32,  43,  44,  45,
230         56,  55,  33,  34,  25,  28,  38,  29,  31,  53,  26,  51,  30,  50,  13,  14,
231         15,  16,  17,  18,  19,  20,  21,  22,  82,   0,  86,  24,  64,  23,  84,  35,
232         79,  80,  81,  46,  47,  12,  57,  58,  59,  36,   1,   2,   3,   4,   5,   6,
233          7,   8,   9,  10,  11,  72,  73,  74,  75,  76,  77,  78,  87,  88,  89,  95,
234         93,  94,  92, 102, 103, 104, 105, 106, 107, 115, 116, 117, 112, 113, 114, 108,
235        109, 110, 118, 119,  49,  69,  -2,  -2,  -2,  -2,  -2,  -2,  -2,  -2,  -2,  -2,
236         -2,  -2,  -2,  -2,  -2,  -2,  -2,  -2,  98,  -2,  -2,  -2,  -2,  -2,  -2,  97,
237        130, 131,  -1,  -1,  -1,  -2,  -1,  -2,  -2,  -2,  -2,  -2,  -2,  -1,  -1,  -1,
238         -2,  -2,  -2,  -2,  -2,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,
239         -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,
240         -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,
241         -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -1,  -3,  -1,  -1,  -1,  // <- -3 = non-RGB
        program key
```

```
242         120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 136, 137, 138, 139, 140, 141,
243          60,  48,  62,  61,  91,  90,  67,  68, 142, 143,  99, 101,  -2, 130, 131,  97,
244          -2, 133, 134, 135,  -2,  96,  -2, 132,  -2,  -2,  71,  71,  71,  71,  -1,  -1,
245     };
246     switch(endpoint){
247     case 1:
248     case -1:
249         // EP 1: 6KRO input (RGB and non-RGB)
250         // Clear previous input
251         for(int i = 0; i < 256; i++){
252             if(hid_codes[i] >= 0)
253                 CLEAR_KEYBIT(kbinput, hid_codes[i]);
254         }
255         // Set new input
256         for(int i = 0; i < 8; i++){
257             if((urbinput[0] >> i) & 1)
258                 SET_KEYBIT(kbinput, hid_codes[i + 224]);
259         }
260         for(int i = 2; i < length; i++){
261             if(urbinput[i] > 3){
262                 int scan = hid_codes[urbinput[i]];
263                 if(scan >= 0)
264                     SET_KEYBIT(kbinput, scan);
265                 else
266                     ckb_warn("Got unknown key press %d on EP 1\n", urbinput[i]);
267             }
268         }
269         break;
270     case -2:
271         // EP 2 RGB: NKRO input
272         if(urbinput[0] == 1){
273             // Type 1: standard key
274             if(length != 21)
275                 return;
276             for(int bit = 0; bit < 8; bit++){
277                 if((urbinput[1] >> bit) & 1)
278                     SET_KEYBIT(kbinput, hid_codes[bit + 224]);
279                 else
280                     CLEAR_KEYBIT(kbinput, hid_codes[bit + 224]);
281             }
282             for(int byte = 0; byte < 19; byte++){
283                 char input = urbinput[byte + 2];
284                 for(int bit = 0; bit < 8; bit++){
285                     int keybit = byte * 8 + bit;
286                     int scan = hid_codes[keybit];
287                     if((input >> bit) & 1){
288                         if(scan >= 0)
289                             SET_KEYBIT(kbinput, hid_codes[keybit]);
290                         else
291                             ckb_warn("Got unknown key press %d on EP 2\n", keybit);
292                     } else if(scan >= 0)
293                         CLEAR_KEYBIT(kbinput, hid_codes[keybit]);
294                 }
295             }
296             break;
297         } else if(urbinput[0] == 2)
298             ;       // Type 2: media key (fall through)
299         else
300             break;  // No other known types
301     case 2:
302         // EP 2 Non-RGB: media keys
303         CLEAR_KEYBIT(kbinput, 97);          // mute
304         CLEAR_KEYBIT(kbinput, 98);          // stop
305         CLEAR_KEYBIT(kbinput, 99);          // prev
306         CLEAR_KEYBIT(kbinput, 100);         // play
307         CLEAR_KEYBIT(kbinput, 101);         // next
308         CLEAR_KEYBIT(kbinput, 130);         // volup
309         CLEAR_KEYBIT(kbinput, 131);         // voldn
310         for(int i = 0; i < length; i++){
311             switch(urbinput[i]){
312             case 181:
313                 SET_KEYBIT(kbinput, 101);   // next
314                 break;
315             case 182:
316                 SET_KEYBIT(kbinput, 99);    // prev
317                 break;
318             case 183:
319                 SET_KEYBIT(kbinput, 98);    // stop
320                 break;
321             case 205:
322                 SET_KEYBIT(kbinput, 100);   // play
323                 break;
324             case 226:
325                 SET_KEYBIT(kbinput, 97);    // mute
326                 break;
327             case 233:
328                 SET_KEYBIT(kbinput, 130);   // volup
```

```
329                 break;
330             case 234:
331                 SET_KEYBIT(kbinput, 131);   // voldn
332                 break;
333             }
334         }
335         break;
336     case 3:
337         // EP 3 non-RGB: NKRO input
338         if(length != 15)
339             return;
340         for(int bit = 0; bit < 8; bit++){
341             if((urbinput[0] >> bit) & 1)
342                 SET_KEYBIT(kbinput, hid_codes[bit + 224]);
343             else
344                 CLEAR_KEYBIT(kbinput, hid_codes[bit + 224]);
345         }
346         for(int byte = 0; byte < 14; byte++){
347             char input = urbinput[byte + 1];
348             for(int bit = 0; bit < 8; bit++){
349                 int keybit = byte * 8 + bit;
350                 int scan = hid_codes[keybit];
351                 if((input >> bit) & 1){
352                     if(scan >= 0)
353                         SET_KEYBIT(kbinput, hid_codes[keybit]);
354                     else
355                         ckb_warn("Got unknown key press %d on EP 3\n", keybit);
356                 } else if(scan >= 0)
357                     CLEAR_KEYBIT(kbinput, hid_codes[keybit]);
358             }
359         }
360         break;
361     }
362 }
```

Here is the caller graph for this function:

9.25.2.4 void hid_mouse_translate (unsigned char * *kbinput*, short * *xaxis*, short * *yaxis*, int *endpoint*, int *length*, const unsigned char * *urbinput*)

Definition at line 366 of file keymap.c.

References BUTTON_HID_COUNT, CLEAR_KEYBIT, MOUSE_BUTTON_FIRST, MOUSE_EXTRA_FIRST, and SET_KEYBIT.

Referenced by os_inputmain().

```
366
                                {
367     if((endpoint != 2 && endpoint != -2) || length < 10)
368         return;
369     // EP 2: mouse input
370     if(urbinput[0] != 1)
371         return;
372     // Byte 1 = mouse buttons (bitfield)
373     for(int bit = 0; bit < BUTTON_HID_COUNT; bit++){
374         if(urbinput[1] & (1 << bit))
375             SET_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
376         else
377             CLEAR_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
378     }
379     // Bytes 5 - 8: movement
380     *xaxis += *(short*)(urbinput + 5);
381     *yaxis += *(short*)(urbinput + 7);
382     // Byte 9: wheel
383     char wheel = urbinput[9];
384     if(wheel > 0)
385         SET_KEYBIT(kbinput, MOUSE_EXTRA_FIRST);         // wheelup
386     else
387         CLEAR_KEYBIT(kbinput, MOUSE_EXTRA_FIRST);
388     if(wheel < 0)
```

```
389         SET_KEYBIT(kbinput, MOUSE_EXTRA_FIRST + 1);     // wheeldn
390     else
391         CLEAR_KEYBIT(kbinput, MOUSE_EXTRA_FIRST + 1);
392 }
```

Here is the caller graph for this function:

9.25.3 Variable Documentation

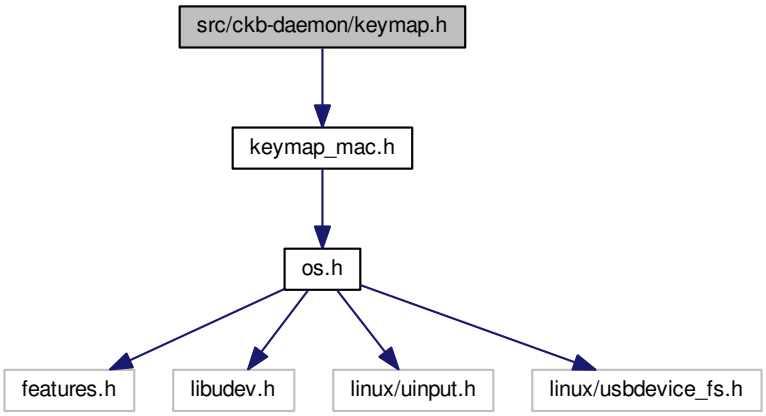
9.25.3.1 const key keymap[(((152+3+12)+25)+11)]

Definition at line 5 of file keymap.c.

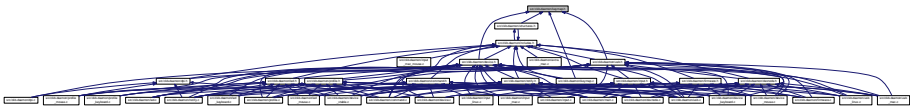
Referenced by _cmd_get(), _cmd_macro(), cmd_bind(), cmd_rebind(), cmd_rgb(), initbind(), inputupdate_keys(), nprintkey(), printrgb(), readcmd(), and setactive_kb().

9.26 src/ckb-daemon/keymap.h File Reference

`#include "keymap_mac.h"`
Include dependency graph for keymap.h:



This graph shows which files directly or indirectly include this file:



Data Structures

- struct key

Macros

- #define KEY_NONE -1
- #define KEY_CORSAIR -2
- #define KEY_UNBOUND -3
- #define BTN_WHEELUP 0x1f01
- #define BTN_WHEELDOWN 0x1f02
- #define KEY_BACKSLASH_ISO KEY_BACKSLASH
- #define N_KEYS_HW 152
- #define N_KEYBYTES_HW ((N_KEYS_HW + 7) / 8)
- #define N_KEY_ZONES 3
- #define N_KEYS_EXTRA 12
- #define N_BUTTONS_HW 20
- #define N_BUTTONS_EXTENDED 25
- #define MOUSE_BUTTON_FIRST (N_KEYS_HW + N_KEY_ZONES + N_KEYS_EXTRA)
- #define MOUSE_EXTRA_FIRST (MOUSE_BUTTON_FIRST + N_BUTTONS_HW)
- #define N_KEYS_INPUT (MOUSE_BUTTON_FIRST + N_BUTTONS_EXTENDED)
- #define N_KEYBYTES_INPUT ((N_KEYS_INPUT + 7) / 8)
- #define LED_MOUSE N_KEYS_HW
- #define N_MOUSE_ZONES 5
- #define N_MOUSE_ZONES_EXTENDED 11
- #define LED_DPI (LED_MOUSE + 2)
- #define N_KEYS_EXTENDED (N_KEYS_INPUT + N_MOUSE_ZONES_EXTENDED)
- #define N_KEYBYTES_EXTENDED ((N_KEYS_EXTENDED + 7) / 8)
- #define SCAN_SILENT 0x8000
- #define SCAN_KBD 0
- #define SCAN_MOUSE 0x1000

Functions

- void hid_kb_translate (unsigned char *kbinput, int endpoint, int length, const unsigned char *urbinput)
- void hid_mouse_translate (unsigned char *kbinput, short *xaxis, short *yaxis, int endpoint, int length, const unsigned char *urbinput)
- void corsair_kbcopy (unsigned char *kbinput, int endpoint, const unsigned char *urbinput)
- void corsair_mousecopy (unsigned char *kbinput, int endpoint, const unsigned char *urbinput)

Variables

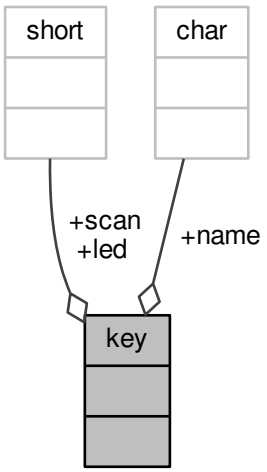
- const key keymap [(((152+3+12)+25)+11)]

9.26.1 Data Structure Documentation

9.26.1.1 struct key

Definition at line 49 of file keymap.h.

Collaboration diagram for key:



Data Fields

short	led	
const char *	name	
short	scan	

9.26.2 Macro Definition Documentation

9.26.2.1 #define BTN_WHEELDOWN 0x1f02

Definition at line 13 of file keymap.h.

Referenced by os_keypress().

9.26.2.2 #define BTN_WHEELUP 0x1f01

Definition at line 12 of file keymap.h.

Referenced by os_keypress().

9.26.2.3 #define KEY_BACKSLASH_ISO KEY_BACKSLASH

Definition at line 20 of file keymap.h.

9.26.2.4 #define KEY_CORSAIR -2

Definition at line 8 of file keymap.h.

9.26.2.5 #define KEY_NONE -1

Definition at line 7 of file keymap.h.

9.26.2.6 #define KEY_UNBOUND -3

Definition at line 9 of file keymap.h.

Referenced by cmd_unbind().

9.26.2.7 #define LED_DPI (LED_MOUSE + 2)

Definition at line 43 of file keymap.h.

Referenced by loadrgb_mouse(), and savergb_mouse().

9.26.2.8 #define LED_MOUSE N_KEYS_HW

Definition at line 39 of file keymap.h.

Referenced by isblack(), loaddpi(), loadrgb_mouse(), rgbcmp(), savedpi(), savergb_mouse(), and updatergb_mouse().

9.26.2.9 #define MOUSE_BUTTON_FIRST (N_KEYS_HW + N_KEY_ZONES + N_KEYS_EXTRA)

Definition at line 33 of file keymap.h.

Referenced by corsair_mousecopy(), and hid_mouse_translate().

9.26.2.10 #define MOUSE_EXTRA_FIRST (MOUSE_BUTTON_FIRST + N_BUTTONS_HW)

Definition at line 34 of file keymap.h.

Referenced by hid_mouse_translate().

9.26.2.11 #define N_BUTTONS_EXTENDED 25

Definition at line 32 of file keymap.h.

9.26.2.12 #define N_BUTTONS_HW 20

Definition at line 31 of file keymap.h.

Referenced by corsair_mousecopy().

9.26.2.13 #define N_KEY_ZONES 3

Definition at line 27 of file keymap.h.

9.26.2.14 #define N_KEYBYTES_EXTENDED ((N_KEYS_EXTENDED + 7) / 8)

Definition at line 46 of file keymap.h.

9.26.2.15 #define N_KEYBYTES_HW ((N_KEYS_HW + 7) / 8)

Definition at line 25 of file keymap.h.

Referenced by corsair_kbcopy().

9.26.2.16 #define N_KEYBYTES_INPUT ((N_KEYS_INPUT + 7) / 8)

Definition at line 37 of file keymap.h.

Referenced by _cmd_macro(), inputupdate_keys(), and macromask().

9.26.2.17 #define N_KEYS_EXTENDED (N_KEYS_INPUT + N_MOUSE_ZONES_EXTENDED)

Definition at line 45 of file keymap.h.

Referenced by printrgb(), and readcmd().

9.26.2.18 #define N_KEYS_EXTRA 12

Definition at line 29 of file keymap.h.

9.26.2.19 #define N_KEYS_HW 152

Definition at line 24 of file keymap.h.

Referenced by loadrgb_kb(), makergb_512(), rgbcmp(), and setactive_kb().

9.26.2.20 #define N_KEYS_INPUT (MOUSE_BUTTON_FIRST + N_BUTTONS_EXTENDED)

Definition at line 36 of file keymap.h.

Referenced by _cmd_get(), _cmd_macro(), cmd_bind(), cmd_notify(), cmd_rebind(), cmd_unbind(), initbind(), and inputupdate_keys().

9.26.2.21 #define N_MOUSE_ZONES 5

Definition at line 40 of file keymap.h.

Referenced by isblack(), loaddpi(), rgbcmp(), savedpi(), and updatergb_mouse().

9.26.2.22 #define N_MOUSE_ZONES_EXTENDED 11

Definition at line 41 of file keymap.h.

9.26.2.23 #define SCAN_KBD 0

Definition at line 57 of file keymap.h.

9.26.2.24 #define SCAN_MOUSE 0x1000

Definition at line 58 of file keymap.h.

Referenced by os_keypress().

9.26.2.25 #define SCAN_SILENT 0x8000

Definition at line 56 of file keymap.h.

Referenced by inputupdate_keys().

9.26.3 Function Documentation

9.26.3.1 void corsair_kbcopy (unsigned char * *kbinput*, int *endpoint*, const unsigned char * *urbinput*)

Definition at line 394 of file keymap.c.

References N_KEYBYTES_HW.

Referenced by os_inputmain().

```
394                                                                                                 {
395     if(endpoint == 2 || endpoint == -2){
396         if(urbinput[0] != 3)
397             return;
398         urbinput++;
399     }
400     memcpy(kbinput, urbinput, N_KEYBYTES_HW);
401 }
```

Here is the caller graph for this function:

9.26.3.2 void corsair_mousecopy (unsigned char * *kbinput*, int *endpoint*, const unsigned char * *urbinput*)

Definition at line 403 of file keymap.c.

References BUTTON_HID_COUNT, CLEAR_KEYBIT, MOUSE_BUTTON_FIRST, N_BUTTONS_HW, and SET_KEYBIT.

Referenced by os_inputmain().

```
403                                                                                                 {
404     if(endpoint == 2 || endpoint == -2){
405         if(urbinput[0] != 3)
406             return;
407         urbinput++;
408     }
409     for(int bit = BUTTON_HID_COUNT; bit < N_BUTTONS_HW; bit++){
410         int byte = bit / 8;
411         uchar test = 1 << (bit % 8);
412         if(urbinput[byte] & test)
413             SET_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
414         else
415             CLEAR_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
416     }
417 }
```

Here is the caller graph for this function:

9.26.3.3 void hid_kb_translate (unsigned char * *kbinput*, int *endpoint*, int *length*, const unsigned char * *urbinput*)

Definition at line 223 of file keymap.c.

References ckb_warn, CLEAR_KEYBIT, and SET_KEYBIT.

Referenced by os_inputmain().

```
223                                                
```

```
298             ;       // Type 2: media key (fall through)
299         else
300             break;  // No other known types
301     case 2:
302         // EP 2 Non-RGB: media keys
303         CLEAR_KEYBIT(kbinput, 97);          // mute
304         CLEAR_KEYBIT(kbinput, 98);          // stop
305         CLEAR_KEYBIT(kbinput, 99);          // prev
306         CLEAR_KEYBIT(kbinput, 100);         // play
307         CLEAR_KEYBIT(kbinput, 101);         // next
308         CLEAR_KEYBIT(kbinput, 130);         // volup
309         CLEAR_KEYBIT(kbinput, 131);         // voldn
310         for(int i = 0; i < length; i++){
311             switch(urbinput[i]){
312             case 181:
313                 SET_KEYBIT(kbinput, 101);   // next
314                 break;
315             case 182:
316                 SET_KEYBIT(kbinput, 99);    // prev
317                 break;
318             case 183:
319                 SET_KEYBIT(kbinput, 98);    // stop
320                 break;
321             case 205:
322                 SET_KEYBIT(kbinput, 100);   // play
323                 break;
324             case 226:
325                 SET_KEYBIT(kbinput, 97);    // mute
326                 break;
327             case 233:
328                 SET_KEYBIT(kbinput, 130);   // volup
329                 break;
330             case 234:
331                 SET_KEYBIT(kbinput, 131);   // voldn
332                 break;
333             }
334         }
335         break;
336     case 3:
337         // EP 3 non-RGB: NKRO input
338         if(length != 15)
339             return;
340         for(int bit = 0; bit < 8; bit++){
341             if((urbinput[0] >> bit) & 1)
342                 SET_KEYBIT(kbinput, hid_codes[bit + 224]);
343             else
344                 CLEAR_KEYBIT(kbinput, hid_codes[bit + 224]);
345         }
346         for(int byte = 0; byte < 14; byte++){
347             char input = urbinput[byte + 1];
348             for(int bit = 0; bit < 8; bit++){
349                 int keybit = byte * 8 + bit;
350                 int scan = hid_codes[keybit];
351                 if((input >> bit) & 1){
352                     if(scan >= 0)
353                         SET_KEYBIT(kbinput, hid_codes[keybit]);
354                     else
355                         ckb_warn("Got unknown key press %d on EP 3\n", keybit);
356                 } else if(scan >= 0)
357                     CLEAR_KEYBIT(kbinput, hid_codes[keybit]);
358             }
359         }
360         break;
361     }
362 }
```

Here is the caller graph for this function:

9.26.3.4 void hid_mouse_translate (unsigned char * *kbinput*, short * *xaxis*, short * *yaxis*, int *endpoint*, int *length*, const unsigned char * *urbinput*)

Definition at line 366 of file keymap.c.

References BUTTON_HID_COUNT, CLEAR_KEYBIT, MOUSE_BUTTON_FIRST, MOUSE_EXTRA_FIRST, and SET_KEYBIT.

Referenced by os_inputmain().

```
366
                                {
367     if((endpoint != 2 && endpoint != -2) || length < 10)
368         return;
369     // EP 2: mouse input
370     if(urbinput[0] != 1)
371         return;
372     // Byte 1 = mouse buttons (bitfield)
373     for(int bit = 0; bit < BUTTON_HID_COUNT; bit++){
374         if(urbinput[1] & (1 << bit))
375             SET_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
376         else
377             CLEAR_KEYBIT(kbinput, MOUSE_BUTTON_FIRST + bit);
378     }
379     // Bytes 5 - 8: movement
380     *xaxis += *(short*)(urbinput + 5);
381     *yaxis += *(short*)(urbinput + 7);
382     // Byte 9: wheel
383     char wheel = urbinput[9];
384     if(wheel > 0)
385         SET_KEYBIT(kbinput, MOUSE_EXTRA_FIRST);          // wheelup
386     else
387         CLEAR_KEYBIT(kbinput, MOUSE_EXTRA_FIRST);
388     if(wheel < 0)
389         SET_KEYBIT(kbinput, MOUSE_EXTRA_FIRST + 1);      // wheeldn
390     else
391         CLEAR_KEYBIT(kbinput, MOUSE_EXTRA_FIRST + 1);
392 }
```

Here is the caller graph for this function:

9.26.4 Variable Documentation

9.26.4.1 const key keymap[(((152+3+12)+25)+11)]

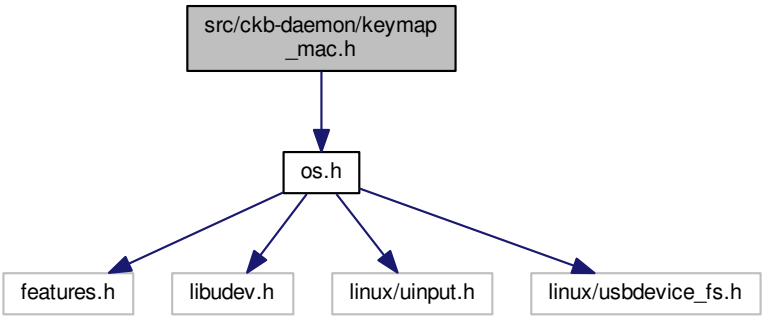
Definition at line 5 of file keymap.c.

Referenced by _cmd_get(), _cmd_macro(), cmd_bind(), cmd_rebind(), cmd_rgb(), initbind(), inputupdate_keys(), nprintkey(), printrgb(), readcmd(), and setactive_kb().

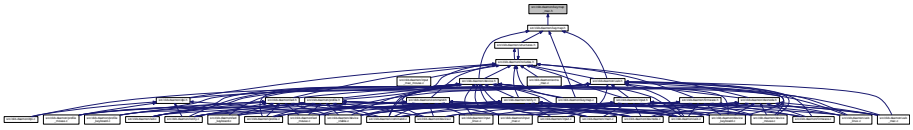
9.27 src/ckb-daemon/keymap_mac.h File Reference

```
#include "os.h"
```

Include dependency graph for keymap_mac.h:



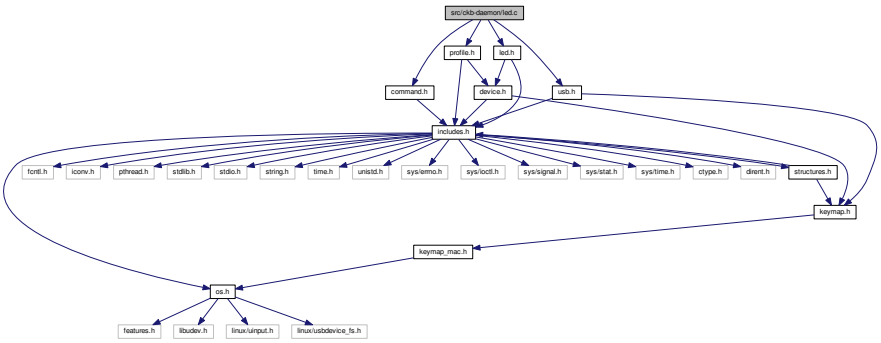
This graph shows which files directly or indirectly include this file:



9.28 src/ckb-daemon/led.c File Reference

```
#include "command.h"
#include "led.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for led.c:



Functions

- void cmd_rgb (usbdevice ∗kb, usbmode ∗mode, int dummy, int keyindex, const char ∗code)
- static uchar iselect (const char ∗led)
- void cmd_ioff (usbdevice ∗kb, usbmode ∗mode, int dummy1, int dummy2, const char ∗led)

- void cmd_ion (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *led)
- void cmd_iauto (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *led)
- void cmd_inotify (usbdevice *kb, usbmode *mode, int nnumber, int dummy, const char *led)
- static int has_key (const char *name, const usbdevice *kb)
- char * printrgb (const lighting *light, const usbdevice *kb)

9.28.1 Function Documentation

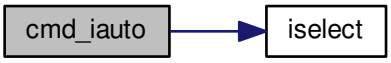
9.28.1.1 void cmd_iauto (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *led*)

Definition at line 54 of file led.c.

References usbmode::ioff, usbmode::ion, iselect(), and usbdevice::vtable.

```
54                                                                                  {
55     uchar bits = iselect(led);
56     // Remove the bits from both ioff and ion
57     mode->ioff &= ~bits;
58     mode->ion &= ~bits;
59     kb->vtable->updateindicators(kb, 0);
60 }
```

Here is the call graph for this function:



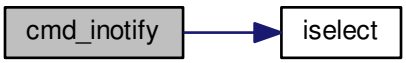
9.28.1.2 void cmd_inotify (usbdevice * *kb*, usbmode * *mode*, int *nnumber*, int *dummy*, const char * *led*)

Definition at line 62 of file led.c.

References usbmode::inotify, and iselect().

```
62                                                                                  {
63     uchar bits = iselect(led);
64     if(strstr(led, ":off"))
65         // Turn notifications for these bits off
66         mode->inotify[nnumber] &= ~bits;
67     else
68         // Turn notifications for these bits on
69         mode->inotify[nnumber] |= bits;
70 }
```

Here is the call graph for this function:



9.28.1.3 void cmd_ioff (usbdevice * kb, usbmode * mode, int dummy1, int dummy2, const char * led)

Definition at line 38 of file led.c.

References usbmode::ioff, usbmode::ion, iselect(), and usbdevice::vtable.

```
38                                                                                  {
39     uchar bits = iselect(led);
40     // Add the bits to ioff, remove them from ion
41     mode->ioff |= bits;
42     mode->ion &= ~bits;
43     kb->vtable->updateindicators(kb, 0);
44 }
```

Here is the call graph for this function:

9.28.1.4 void cmd_ion (usbdevice * kb, usbmode * mode, int dummy1, int dummy2, const char * led)

Definition at line 46 of file led.c.

References usbmode::ioff, usbmode::ion, iselect(), and usbdevice::vtable.

```
46                                                                                  {
47     uchar bits = iselect(led);
48     // Remove the bits from ioff, add them to ion
49     mode->ioff &= ~bits;
50     mode->ion |= bits;
51     kb->vtable->updateindicators(kb, 0);
52 }
```

Here is the call graph for this function:

9.28.1.5 void cmd_rgb (usbdevice * kb, usbmode * mode, int dummy, int keyindex, const char * code)

Definition at line 6 of file led.c.

References lighting::b, lighting::g, keymap, key::led, usbmode::light, lighting::r, and lighting::sidelight.

```
6                                                                                   {
7     int index = keymap[keyindex].led;
```

```
8     if(index < 0) {
9         if (index == -2){     // Process strafe sidelights
10            uchar sideshine;
11            if (sscanf(code, "%2hhx",&sideshine)) // monochromatic
12                mode->light.sidelight = sideshine;
13        }
14        return;
15    }
16    uchar r, g, b;
17    if(sscanf(code, "%2hhx%2hhx%2hhx", &r, &g, &b) == 3){
18        mode->light.r[index] = r;
19        mode->light.g[index] = g;
20        mode->light.b[index] = b;
21    }
22 }
```

9.28.1.6 static int has_key (const char * *name*, const **usbdevice** * *kb*) [static]

Definition at line 73 of file led.c.

References IS_K65, IS_K95, IS_MOUSE, IS_SABRE, IS_SCIMITAR, usbdevice::product, and usbdevice::vendor.

Referenced by printrgb().

```
73                                                      {
74    if(!name)
75        return 0;
76    if(IS_MOUSE(kb->vendor, kb->product)){
77        // Mice only have the RGB zones
78        if((IS_SABRE(kb) || IS_SCIMITAR(kb)) && !strcmp(name, "wheel"))
79            return 1;
80        if(IS_SCIMITAR(kb) && !strcmp(name, "thumb"))
81            return 1;
82        if(strstr(name, "dpi") == name || !strcmp(name, "front") || !strcmp(name, "back"))
83            return 1;
84        return 0;
85    } else {
86        // But keyboards don't have them at all
87        if(strstr(name, "dpi") == name || !strcmp(name, "front") || !strcmp(name, "back") || !strcmp(name,
      "wheel") || !strcmp(name, "thumb"))
88            return 0;
89        // Only K95 has G keys and M keys (G1 - G18, MR, M1 - M3)
90        if(!IS_K95(kb) && ((name[0] == 'g' && name[1] >= '1' && name[1] <= '9') || (name[0] == 'm' &&
       (name[1] == 'r' || name[1] == '1' || name[1] == '2' || name[1] == '3'))))
91            return 0;
92        // Only K65 has lights on VolUp/VolDn
93        if(!IS_K65(kb) && (!strcmp(name, "volup") || !strcmp(name, "voldn")))
94            return 0;
95        // K65 lacks numpad and media buttons
96        if(IS_K65(kb) && (strstr(name, "num") == name || !strcmp(name, "stop") || !strcmp(name, "prev
      ") || !strcmp(name, "play") || !strcmp(name, "next")))
97            return 0;
98    }
99    return 1;
100 }
```

Here is the caller graph for this function:

9.28.1.7 static uchar iselect (const char * *led*) [static]

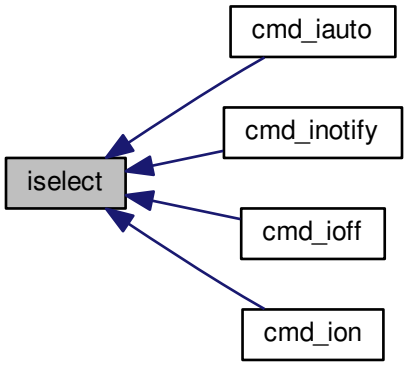
Definition at line 25 of file led.c.

References I_CAPS, I_NUM, and I_SCROLL.

Referenced by cmd_iauto(), cmd_inotify(), cmd_ioff(), and cmd_ion().

```
25                                      {
26     int result = 0;
27     if(!strncmp(led, "num", 3) || strstr(led, ",num"))
28         result |= I_NUM;
29     if(!strncmp(led, "caps", 4) || strstr(led, ",caps"))
30         result |= I_CAPS;
31     if(!strncmp(led, "scroll", 6) || strstr(led, ",scroll"))
32         result |= I_SCROLL;
33     if(!strncmp(led, "all", 3) || strstr(led, ",all"))
34         result |= I_NUM | I_CAPS | I_SCROLL;
35     return result;
36 }
```

Here is the caller graph for this function:



9.28.1.8 char* printrgb (const lighting * *light*, const usbdevice * *kb*)

Definition at line 102 of file led.c.

References lighting::b, lighting::g, has_key(), keymap, key::led, N_KEYS_EXTENDED, key::name, and lighting::r.

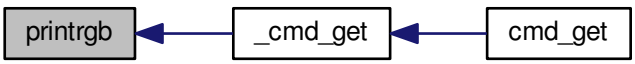
Referenced by _cmd_get().

```
102                                                             {
103     uchar r[N_KEYS_EXTENDED], g[N_KEYS_EXTENDED], b[
      N_KEYS_EXTENDED];
104     const uchar* mr = light->r;
105     const uchar* mg = light->g;
106     const uchar* mb = light->b;
107     for(int i = 0; i < N_KEYS_EXTENDED; i++){
108         // Translate the key index to an RGB index using the key map
109         int k = keymap[i].led;
110         if(k < 0)
111             continue;
112         r[i] = mr[k];
113         g[i] = mg[k];
114         b[i] = mb[k];
115     }
116     // Make a buffer to track key names and to filter out duplicates
117     char names[N_KEYS_EXTENDED][11];
118     for(int i = 0; i < N_KEYS_EXTENDED; i++){
119         const char* name = keymap[i].name;
120         if(keymap[i].led < 0 || !has_key(name, kb))
121             names[i][0] = 0;
122         else
```

```
123             strncpy(names[i], name, 11);
124     }
125     // Check to make sure these aren't all the same color
126     int same = 1;
127     for(int i = 1; i < N_KEYS_EXTENDED; i++){
128         if(!names[i][0])
129             continue;
130         if(r[i] != r[0] || g[i] != g[0] || b[i] != b[0]){
131             same = 0;
132             break;
133         }
134     }
135     // If they are, just output that color
136     if(same){
137         char* buffer = malloc(7);
138         snprintf(buffer, 7, "%02x%02x%02x", r[0], g[0], b[0]);
139         return buffer;
140     }
141     const int BUFFER_LEN = 4096;    // Should be more than enough to fit all keys
142     char* buffer = malloc(BUFFER_LEN);
143     int length = 0;
144     for(int i = 0; i < N_KEYS_EXTENDED; i++){
145         if(!names[i][0])
146             continue;
147         // Print the key name
148         int newlen = 0;
149         snprintf(buffer + length, BUFFER_LEN - length, length == 0 ? "%s%n" : " %s%n", names[i], &newlen);
150         length += newlen;
151         // Look ahead to see if any other keys have this color. If so, print them here as well.
152         uchar kr = r[i], kg = g[i], kb = b[i];
153         for(int j = i + 1; j < N_KEYS_EXTENDED; j++){
154             if(!names[j][0])
155                 continue;
156             if(r[j] != kr || g[j] != kg || b[j] != kb)
157                 continue;
158             snprintf(buffer + length, BUFFER_LEN - length, ",%s%n", names[j], &newlen);
159             length += newlen;
160             // Erase the key's name so it won't get printed later
161             names[j][0] = 0;
162         }
163         // Print the color
164         snprintf(buffer + length, BUFFER_LEN - length, ":%02x%02x%02x%n", kr, kg, kb, &newlen);
165         length += newlen;
166     }
167     return buffer;
168 }
```

Here is the call graph for this function:

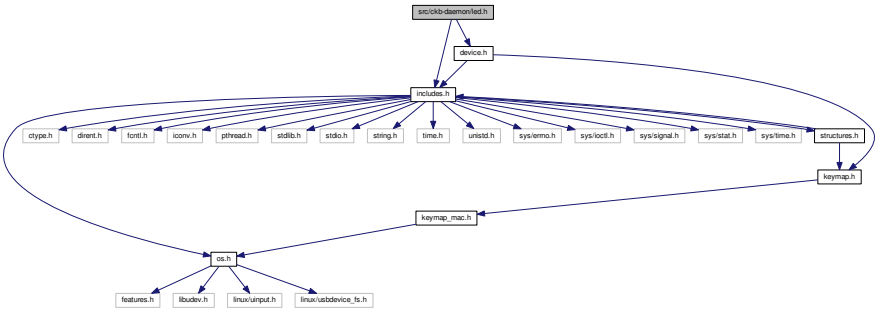
Here is the caller graph for this function:



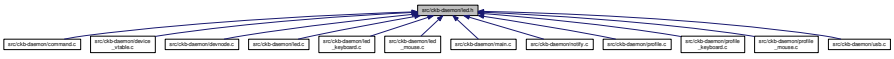
9.29 src/ckb-daemon/led.h File Reference

```
#include "includes.h"
#include "device.h"
```

Include dependency graph for led.h:



This graph shows which files directly or indirectly include this file:



Functions

- int updatergb_kb (usbdevice ∗kb, int force)
- int updatergb_mouse (usbdevice ∗kb, int force)
- int savergb_kb (usbdevice ∗kb, lighting ∗light, int mode)
- int savergb_mouse (usbdevice ∗kb, lighting ∗light, int mode)
- int loadrgb_kb (usbdevice ∗kb, lighting ∗light, int mode)
- int loadrgb_mouse (usbdevice ∗kb, lighting ∗light, int mode)
- char ∗ printrgb (const lighting ∗light, const usbdevice ∗kb)
- void cmd_rgb (usbdevice ∗kb, usbmode ∗mode, int dummy, int keyindex, const char ∗code)
- void cmd_ioff (usbdevice ∗kb, usbmode ∗mode, int dummy1, int dummy2, const char ∗led)
- void cmd_ion (usbdevice ∗kb, usbmode ∗mode, int dummy1, int dummy2, const char ∗led)
- void cmd_iauto (usbdevice ∗kb, usbmode ∗mode, int dummy1, int dummy2, const char ∗led)
- void cmd_inotify (usbdevice ∗kb, usbmode ∗mode, int nnumber, int dummy, const char ∗led)

9.29.1 Function Documentation

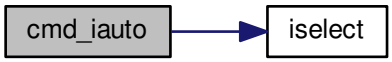
9.29.1.1 void cmd_iauto (usbdevice ∗ *kb*, usbmode ∗ *mode*, int *dummy1*, int *dummy2*, const char ∗ *led*)

Definition at line 54 of file led.c.

References usbmode::ioff, usbmode::ion, iselect(), and usbdevice::vtable.

```
54                                                                                  {
55     uchar bits = iselect(led);
56     // Remove the bits from both ioff and ion
57     mode->ioff &= ~bits;
58     mode->ion &= ~bits;
59     kb->vtable->updateindicators(kb, 0);
60 }
```

Here is the call graph for this function:



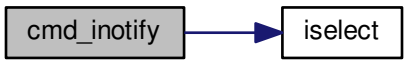
9.29.1.2 void cmd_inotify (usbdevice * *kb*, usbmode * *mode*, int *nnumber*, int *dummy*, const char * *led*)

Definition at line 62 of file led.c.

References usbmode::inotify, and iselect().

```
62                                                                                  {
63     uchar bits = iselect(led);
64     if(strstr(led, ":off"))
65         // Turn notifications for these bits off
66         mode->inotify[nnumber] &= ~bits;
67     else
68         // Turn notifications for these bits on
69         mode->inotify[nnumber] |= bits;
70 }
```

Here is the call graph for this function:



9.29.1.3 void cmd_ioff (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *led*)

Definition at line 38 of file led.c.

References usbmode::ioff, usbmode::ion, iselect(), and usbdevice::vtable.

```
38                                                                                  {
39     uchar bits = iselect(led);
40     // Add the bits to ioff, remove them from ion
41     mode->ioff |= bits;
42     mode->ion &= ~bits;
43     kb->vtable->updateindicators(kb, 0);
44 }
```

Here is the call graph for this function:

9.29.1.4 void cmd_ion (usbdevice * kb, usbmode * mode, int dummy1, int dummy2, const char * led)

Definition at line 46 of file led.c.

References usbmode::ioff, usbmode::ion, iselect(), and usbdevice::vtable.

```
46                                                                                  {
47     uchar bits = iselect(led);
48     // Remove the bits from ioff, add them to ion
49     mode->ioff &= ~bits;
50     mode->ion |= bits;
51     kb->vtable->updateindicators(kb, 0);
52 }
```

Here is the call graph for this function:

9.29.1.5 void cmd_rgb (usbdevice * kb, usbmode * mode, int dummy, int keyindex, const char * code)

Definition at line 6 of file led.c.

References lighting::b, lighting::g, keymap, key::led, usbmode::light, lighting::r, and lighting::sidelight.

```
6                                                                                   {
7     int index = keymap[keyindex].led;
8     if(index < 0) {
9         if (index == -2){     // Process strafe sidelights
10            uchar sideshine;
11            if (sscanf(code, "%2hhx",&sideshine)) // monochromatic
12                mode->light.sidelight = sideshine;
13        }
14        return;
15    }
16    uchar r, g, b;
17    if(sscanf(code, "%2hhx%2hhx%2hhx", &r, &g, &b) == 3){
18        mode->light.r[index] = r;
19        mode->light.g[index] = g;
20        mode->light.b[index] = b;
21    }
22 }
```

9.29.1.6 int loadrgb_kb (usbdevice * *kb,* lighting * *light,* int *mode*)

Since Firmware Version 2.05 for K95RGB the answers for getting the stored color-maps from the hardware has changed a bit. So comparing for the correct answer cannot validate against the cmd, and has to be done against a third map. Up to now we know, that K70RGB Pro and K70 Lux RGB have firmware version 2.04 and having the problem also. So we have to determine in the most inner loop the firmware version and type of KB to select the correct compare-table.

Read colors

```
                                                    < That is the old comparison method: you get back what you sent.
```

Normally a firmware version >= 2.05 runs with the new compare array. Up to now there is a 2.04 running in K70 RGB Lux with the same behavior. It seems that K70RGB has the same problem

Definition at line 181 of file led_keyboard.c.

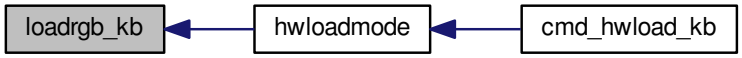
References lighting::b, ckb_err, usbdevice::fwversion, lighting::g, MSG_SIZE, N_KEYS_HW, P_K70_LUX, P_K70-_LUX_NRGB, usbdevice::product, lighting::r, usbrecv, and usbsend.

Referenced by hwloadmode().

```
181                                                     {
182     if(kb->fwversion >= 0x0120){
183         uchar data_pkt[12][MSG_SIZE] = {
184             { 0x0e, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x01 },
185             { 0xff, 0x01, 60, 0 },
186             { 0xff, 0x02, 60, 0 },
187             { 0xff, 0x03, 24, 0 },
188             { 0x0e, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x02 },
189             { 0xff, 0x01, 60, 0 },
190             { 0xff, 0x02, 60, 0 },
191             { 0xff, 0x03, 24, 0 },
192             { 0x0e, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x03 },
193             { 0xff, 0x01, 60, 0 },
194             { 0xff, 0x02, 60, 0 },
195             { 0xff, 0x03, 24, 0 },
196         };
197         uchar in_pkt[4][MSG_SIZE] = {
198             { 0x0e, 0x14, 0x03, 0x01 },
199             { 0xff, 0x01, 60, 0 },
200             { 0xff, 0x02, 60, 0 },
201             { 0xff, 0x03, 24, 0 },
202         };
203
209
210         uchar cmp_pkt[4][4] = {
211             { 0x0e, 0x14, 0x03, 0x01 },
212             { 0x0e, 0xff, 0x01, 60 },
213             { 0x0e, 0xff, 0x02, 60 },
214             { 0x0e, 0xff, 0x03, 24 },
215         };
217         uchar* colors[3] = { light->r, light->g, light->b };
218         for(int clr = 0; clr < 3; clr++){
219             for(int i = 0; i < 4; i++){
220                 if(!usbrecv(kb, data_pkt[i + clr * 4], in_pkt[i]))
221                     return -1;
222
223                 uchar* comparePacket = data_pkt[i + clr * 4];
224                 if ((kb->fwversion >= 0x205)
228                         || ((kb->fwversion >= 0x204)
229                             && ((kb->product == P_K70_LUX_NRGB) || (kb->
    product == P_K70_LUX)))) {
230                     comparePacket = cmp_pkt[i];
231                 }
232
233                 if (memcmp(in_pkt[i], comparePacket, 4)) {
234                     ckb_err("Bad input header\n");
235                     ckb_err("color = %d, i = %d, mode = %d\nOutput (Request): %2.2x %2.2x %2.2x
     %2.2x\nInput(Reply): %2.2x %2.2x %2.2x %2.2x %2.2x %2.2x %2.2x %2.2x\n", clr, i, mode,
236                         comparePacket[0], comparePacket[1], comparePacket[2], comparePacket[3],
237                         in_pkt[i][0], in_pkt[i][1], in_pkt[i][2], in_pkt[i][3], in_pkt[i][4], in_pkt[i][5],
     in_pkt[i][6], in_pkt[i][7]);
238                     in_pkt[2][0] = 0x99;
239                     in_pkt[2][1] = 0x99;
240                     in_pkt[2][2] = 0x99;
241                     in_pkt[2][3] = 0x99;
242                     usbrecv(kb, in_pkt[2], in_pkt[2]); // just to find it in the wireshark log
243                     return -1;
244                 }
```

```
245             }
246             // Copy colors to lighting. in_pkt[0] is irrelevant.
247             memcpy(colors[clr], in_pkt[1] + 4, 60);
248             memcpy(colors[clr] + 60, in_pkt[2] + 4, 60);
249             memcpy(colors[clr] + 120, in_pkt[3] + 4, 24);
250         }
251     } else {
252         uchar data_pkt[5][MSG_SIZE] = {
253             { 0x0e, 0x14, 0x02, 0x01, 0x01, mode + 1, 0 },
254             { 0xff, 0x01, 60, 0 },
255             { 0xff, 0x02, 60, 0 },
256             { 0xff, 0x03, 60, 0 },
257             { 0xff, 0x04, 36, 0 },
258         };
259         uchar in_pkt[4][MSG_SIZE] = {
260             { 0xff, 0x01, 60, 0 },
261             { 0xff, 0x02, 60, 0 },
262             { 0xff, 0x03, 60, 0 },
263             { 0xff, 0x04, 36, 0 },
264         };
265         // Write initial packet
266         if(!usbsend(kb, data_pkt[0], 1))
267             return -1;
268         // Read colors
269         for(int i = 1; i < 5; i++){
270             if(!usbrecv(kb, data_pkt[i],in_pkt[i - 1]))
271                 return -1;
272             if(memcmp(in_pkt[i - 1], data_pkt[i], 4)){
273                 ckb_err("Bad input header\n");
274                 return -1;
275             }
276         }
277         // Copy the data back to the mode
278         uint8_t mr[N_KEYS_HW / 2], mg[N_KEYS_HW / 2], mb[
    N_KEYS_HW / 2];
279         memcpy(mr,      in_pkt[0] +  4, 60);
280         memcpy(mr + 60, in_pkt[1] +  4, 12);
281         memcpy(mg,      in_pkt[1] + 16, 48);
282         memcpy(mg + 48, in_pkt[2] +  4, 24);
283         memcpy(mb,      in_pkt[2] + 28, 36);
284         memcpy(mb + 36, in_pkt[3] +  4, 36);
285         // Unpack LED data to 8bpc format
286         for(int i = 0; i < N_KEYS_HW; i++){
287             int     i_2 = i / 2;
288             uint8_t r, g, b;
289
290             // 3-bit intensities stored in alternate nybbles.
291             if (i & 1) {
292                 r = 7 - (mr[i_2] >> 4);
293                 g = 7 - (mg[i_2] >> 4);
294                 b = 7 - (mb[i_2] >> 4);
295             } else {
296                 r = 7 - (mr[i_2] & 0x0F);
297                 g = 7 - (mg[i_2] & 0x0F);
298                 b = 7 - (mb[i_2] & 0x0F);
299             }
300             // Scale 3-bit values up to 8 bits.
301             light->r[i] = r << 5 | r << 2 | r >> 1;
302             light->g[i] = g << 5 | g << 2 | g >> 1;
303             light->b[i] = b << 5 | b << 2 | b >> 1;
304         }
305     }
306     return 0;
307 }
```

Here is the caller graph for this function:



9.29.1.7 int loadrgb_mouse (usbdevice * *kb*, lighting * *light*, int *mode*)

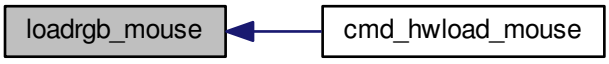
Definition at line 81 of file led_mouse.c.

References lighting::b, ckb_err, lighting::g, IS_SABRE, IS_SCIMITAR, LED_DPI, LED_MOUSE, MSG_SIZE, lighting::r, and usbrecv.

Referenced by cmd_hwload_mouse().

```
81                                                          {
82     uchar data_pkt[MSG_SIZE] = { 0x0e, 0x13, 0x10, 1, 0 };
83     uchar in_pkt[MSG_SIZE] = { 0 };
84     // Load each RGB zone
85     int zonecount = IS_SCIMITAR(kb) ? 4 : IS_SABRE(kb) ? 3 : 2;
86     for(int i = 0; i < zonecount; i++){
87         if(!usbrecv(kb, data_pkt, in_pkt))
88             return -1;
89         if(memcmp(in_pkt, data_pkt, 4)){
90             ckb_err("Bad input header\n");
91             return -2;
92         }
93         // Copy data
94         int led = LED_MOUSE + i;
95         if(led >= LED_DPI)
96             led++;          // Skip DPI light
97         light->r[led] = in_pkt[4];
98         light->g[led] = in_pkt[5];
99         light->b[led] = in_pkt[6];
100         // Set packet for next zone
101         data_pkt[2]++;
102     }
103     return 0;
104 }
```

Here is the caller graph for this function:



9.29.1.8 char* printrgb (const lighting * *light*, const usbdevice * *kb*)

Definition at line 102 of file led.c.

References lighting::b, lighting::g, has_key(), keymap, key::led, N_KEYS_EXTENDED, key::name, and lighting::r.

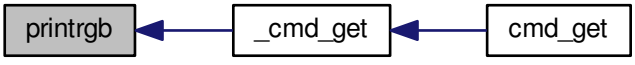
Referenced by _cmd_get().

```
102                                                          {
103     uchar r[N_KEYS_EXTENDED], g[N_KEYS_EXTENDED], b[
      N_KEYS_EXTENDED];
104     const uchar* mr = light->r;
105     const uchar* mg = light->g;
106     const uchar* mb = light->b;
107     for(int i = 0; i < N_KEYS_EXTENDED; i++){
108         // Translate the key index to an RGB index using the key map
109         int k = keymap[i].led;
110         if(k < 0)
111             continue;
112         r[i] = mr[k];
113         g[i] = mg[k];
114         b[i] = mb[k];
115     }
116     // Make a buffer to track key names and to filter out duplicates
117     char names[N_KEYS_EXTENDED][11];
118     for(int i = 0; i < N_KEYS_EXTENDED; i++){
```

```
119         const char* name = keymap[i].name;
120         if(keymap[i].led < 0 || !has_key(name, kb))
121             names[i][0] = 0;
122         else
123             strncpy(names[i], name, 11);
124     }
125     // Check to make sure these aren't all the same color
126     int same = 1;
127     for(int i = 1; i < N_KEYS_EXTENDED; i++){
128         if(!names[i][0])
129             continue;
130         if(r[i] != r[0] || g[i] != g[0] || b[i] != b[0]){
131             same = 0;
132             break;
133         }
134     }
135     // If they are, just output that color
136     if(same){
137         char* buffer = malloc(7);
138         snprintf(buffer, 7, "%02x%02x%02x", r[0], g[0], b[0]);
139         return buffer;
140     }
141     const int BUFFER_LEN = 4096;    // Should be more than enough to fit all keys
142     char* buffer = malloc(BUFFER_LEN);
143     int length = 0;
144     for(int i = 0; i < N_KEYS_EXTENDED; i++){
145         if(!names[i][0])
146             continue;
147         // Print the key name
148         int newlen = 0;
149         snprintf(buffer + length, BUFFER_LEN - length, length == 0 ? "%s%n" : " %s%n", names[i], &newlen);
150         length += newlen;
151         // Look ahead to see if any other keys have this color. If so, print them here as well.
152         uchar kr = r[i], kg = g[i], kb = b[i];
153         for(int j = i + 1; j < N_KEYS_EXTENDED; j++){
154             if(!names[j][0])
155                 continue;
156             if(r[j] != kr || g[j] != kg || b[j] != kb)
157                 continue;
158             snprintf(buffer + length, BUFFER_LEN - length, ",%s%n", names[j], &newlen);
159             length += newlen;
160             // Erase the key's name so it won't get printed later
161             names[j][0] = 0;
162         }
163         // Print the color
164         snprintf(buffer + length, BUFFER_LEN - length, ":%02x%02x%02x%n", kr, kg, kb, &newlen);
165         length += newlen;
166     }
167     return buffer;
168 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.29.1.9 int savergb_kb (usbdevice * kb, lighting * light, int mode)

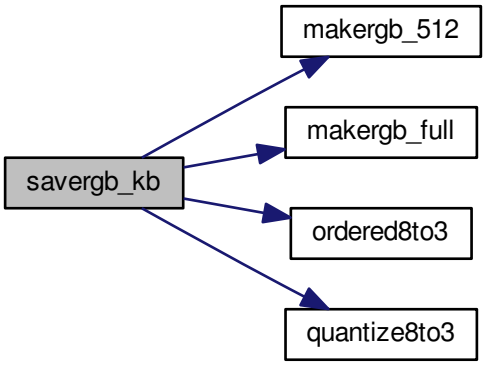
Definition at line 139 of file led_keyboard.c.

References usbdevice::dither, usbdevice::fwversion, IS_STRAFE, makergb_512(), makergb_full(), MSG_SIZE, ordered8to3(), quantize8to3(), and usbsend.

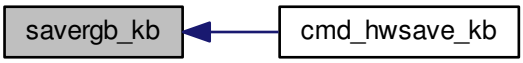
Referenced by cmd_hwsave_kb().

```
139                                                     {
140     if(kb->fwversion >= 0x0120){
141         uchar data_pkt[12][MSG_SIZE] = {
142             // Red
143             { 0x7f, 0x01, 60, 0 },
144             { 0x7f, 0x02, 60, 0 },
145             { 0x7f, 0x03, 24, 0 },
146             { 0x07, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x01 },
147             // Green
148             { 0x7f, 0x01, 60, 0 },
149             { 0x7f, 0x02, 60, 0 },
150             { 0x7f, 0x03, 24, 0 },
151             { 0x07, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x02 },
152             // Blue
153             { 0x7f, 0x01, 60, 0 },
154             { 0x7f, 0x02, 60, 0 },
155             { 0x7f, 0x03, 24, 0 },
156             { 0x07, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x03 }
157         };
158         makergb_full(light, data_pkt);
159         if(!usbsend(kb, data_pkt[0], 12))
160             return -1;
161         if (IS_STRAFE(kb)){ // end save
162             uchar save_end_pkt[MSG_SIZE] = { 0x07, 0x14, 0x04, 0x01, 0x01 };
163             if(!usbsend(kb, save_end_pkt, 1))
164                 return -1;
165         }
166     } else {
167         uchar data_pkt[5][MSG_SIZE] = {
168             { 0x7f, 0x01, 60, 0 },
169             { 0x7f, 0x02, 60, 0 },
170             { 0x7f, 0x03, 60, 0 },
171             { 0x7f, 0x04, 36, 0 },
172             { 0x07, 0x14, 0x02, 0x00, 0x01, mode + 1 }
173         };
174         makergb_512(light, data_pkt, kb->dither ? ordered8to3 :
    quantize8to3);
175         if(!usbsend(kb, data_pkt[0], 5))
176             return -1;
177     }
178     return 0;
179 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.29.1.10 int savergb_mouse (usbdevice * *kb*, lighting * *light*, int *mode*)

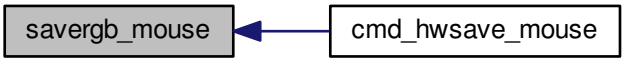
Definition at line 62 of file led_mouse.c.

References lighting::b, lighting::g, IS_SABRE, IS_SCIMITAR, LED_DPI, LED_MOUSE, MSG_SIZE, lighting::r, and usbsend.

Referenced by cmd_hwsave_mouse().

```
62                                                      {
63     uchar data_pkt[MSG_SIZE] = { 0x07, 0x13, 0x10, 1, 0 };
64     // Save each RGB zone, minus the DPI light which is sent in the DPI packets
65     int zonecount = IS_SCIMITAR(kb) ? 4 : IS_SABRE(kb) ? 3 : 2;
66     for(int i = 0; i < zonecount; i++){
67         int led = LED_MOUSE + i;
68         if(led >= LED_DPI)
69             led++;          // Skip DPI light
70         data_pkt[4] = light->r[led];
71         data_pkt[5] = light->g[led];
72         data_pkt[6] = light->b[led];
73         if(!usbsend(kb, data_pkt, 1))
74             return -1;
75         // Set packet for next zone
76         data_pkt[2]++;
77     }
78     return 0;
79 }
```

Here is the caller graph for this function:



9.29.1.11 int updatergb_kb (usbdevice * *kb*, int *force*)

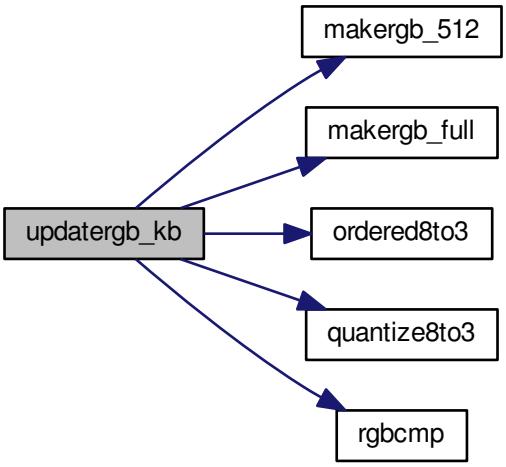
Definition at line 77 of file led_keyboard.c.

References usbdevice::active, usbprofile::currentmode, usbdevice::dither, lighting::forceupdate, IS_FULLRANGE, usbprofile::lastlight, usbmode::light, makergb_512(), makergb_full(), MSG_SIZE, ordered8to3(), usbdevice::profile, quantize8to3(), rgbcmp(), lighting::sidelight, and usbsend.

```
77                                          {
```

```
78      if(!kb->active)
79          return 0;
80      lighting* lastlight = &kb->profile->lastlight;
81      lighting* newlight = &kb->profile->currentmode->
    light;
82      // Don't do anything if the lighting hasn't changed
83      if(!force && !lastlight->forceupdate && !newlight->forceupdate
84              && !rgbcmp(lastlight, newlight) && lastlight->sidelight == newlight->
    sidelight)   // strafe sidelights
85          return 0;
86      lastlight->forceupdate = newlight->forceupdate = 0;
87
88      if(IS_FULLRANGE(kb)){
89          // Update strafe sidelights if necessary
90          if(lastlight->sidelight != newlight->sidelight) {
91              uchar data_pkt[2][MSG_SIZE] = {
92                   { 0x07, 0x05, 0x08, 0x00, 0x00 },
93                   { 0x07, 0x05, 0x02, 0, 0x03 }
94               };
95               if (newlight->sidelight)
96                   data_pkt[0][4]=1;    // turn on
97               if(!usbsend(kb, data_pkt[0], 2))
98                   return -1;
99          }
100          // 16.8M color lighting works fine on strafe and is the only way it actually works
101          uchar data_pkt[12][MSG_SIZE] = {
102              // Red
103              { 0x7f, 0x01, 0x3c, 0 },
104              { 0x7f, 0x02, 0x3c, 0 },
105              { 0x7f, 0x03, 0x18, 0 },
106              { 0x07, 0x28, 0x01, 0x03, 0x01, 0},
107              // Green
108              { 0x7f, 0x01, 0x3c, 0 },
109              { 0x7f, 0x02, 0x3c, 0 },
110              { 0x7f, 0x03, 0x18, 0 },
111              { 0x07, 0x28, 0x02, 0x03, 0x01, 0},
112              // Blue
113              { 0x7f, 0x01, 0x3c, 0 },
114              { 0x7f, 0x02, 0x3c, 0 },
115              { 0x7f, 0x03, 0x18, 0 },
116              { 0x07, 0x28, 0x03, 0x03, 0x02, 0}
117          };
118          makergb_full(newlight, data_pkt);
119          if(!usbsend(kb, data_pkt[0], 12))
120              return -1;
121      } else {
122          // On older keyboards it looks flickery and causes lighting glitches, so we don't use it.
123          uchar data_pkt[5][MSG_SIZE] = {
124              { 0x7f, 0x01, 60, 0 },
125              { 0x7f, 0x02, 60, 0 },
126              { 0x7f, 0x03, 60, 0 },
127              { 0x7f, 0x04, 36, 0 },
128              { 0x07, 0x27, 0x00, 0x00, 0xD8 }
129          };
130          makergb_512(newlight, data_pkt, kb->dither ?
    ordered8to3 : quantize8to3);
131          if(!usbsend(kb, data_pkt[0], 5))
132              return -1;
133      }
134
135      memcpy(lastlight, newlight, sizeof(lighting));
136      return 0;
137  }
```

Here is the call graph for this function:



9.29.1.12 int updatergb_mouse (usbdevice * *kb*, int *force*)

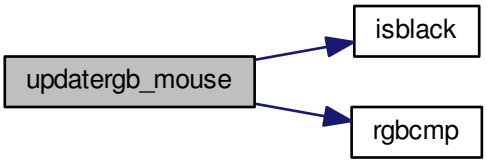
Definition at line 20 of file led_mouse.c.

References usbdevice::active, lighting::b, usbprofile::currentmode, lighting::forceupdate, lighting::g, isblack(), usbprofile::lastlight, LED_MOUSE, usbmode::light, MSG_SIZE, N_MOUSE_ZONES, usbdevice::profile, lighting::r, rgbcmp(), and usbsend.

```
20                                              {
21     if(!kb->active)
22         return 0;
23     lighting* lastlight = &kb->profile->lastlight;
24     lighting* newlight = &kb->profile->currentmode->
       light;
25     // Don't do anything if the lighting hasn't changed
26     if(!force && !lastlight->forceupdate && !newlight->forceupdate
27             && !rgbcmp(lastlight, newlight))
28         return 0;
29     lastlight->forceupdate = newlight->forceupdate = 0;
30
31     // Send the RGB values for each zone to the mouse
32     uchar data_pkt[2][MSG_SIZE] = {
33         { 0x07, 0x22, N_MOUSE_ZONES, 0x01, 0 }, // RGB colors
34         { 0x07, 0x05, 0x02, 0 }                 // Lighting on/off
35     };
36     uchar* rgb_data = &data_pkt[0][4];
37     for(int i = 0; i < N_MOUSE_ZONES; i++){
38         *rgb_data++ = i + 1;
39         *rgb_data++ = newlight->r[LED_MOUSE + i];
40         *rgb_data++ = newlight->g[LED_MOUSE + i];
41         *rgb_data++ = newlight->b[LED_MOUSE + i];
42     }
43     // Send RGB data
44     if(!usbsend(kb, data_pkt[0], 1))
45         return -1;
46     int was_black = isblack(kb, lastlight), is_black = isblack(kb, newlight);
47     if(is_black){
48         // If the lighting is black, send the deactivation packet (M65 only)
49         if(!usbsend(kb, data_pkt[1], 1))
50             return -1;
51     } else if(was_black || force){
52         // If the lighting WAS black, or if we're on forced update, send the activation packet
53         data_pkt[1][4] = 1;
54         if(!usbsend(kb, data_pkt[1], 1))
```

```
55              return -1;
56      }
57
58      memcpy(lastlight, newlight, sizeof(lighting));
59      return 0;
60  }
```

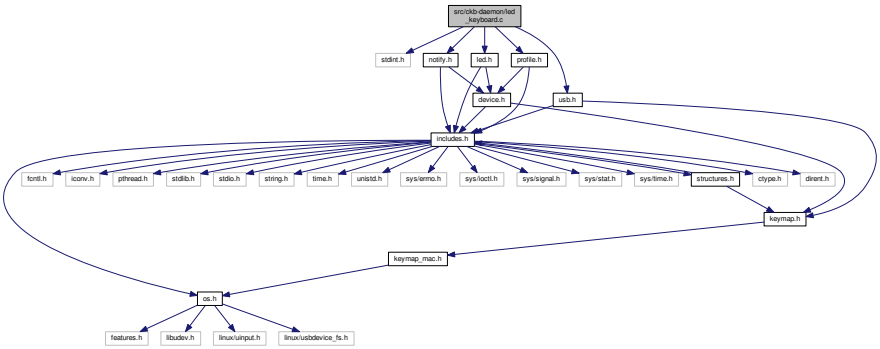
Here is the call graph for this function:



9.30 src/ckb-daemon/led_keyboard.c File Reference

```
#include <stdint.h>
#include "led.h"
#include "notify.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for led_keyboard.c:



Macros

- #define BR1(x) ((((x) & 0xaa) >> 1) | (((x) & 0x55) << 1))
- #define BR2(x) (((BR1(x) & 0xcc) >> 2) | ((BR1(x) & 0x33) << 2))
- #define BR4(x) (((BR2(x) & 0xf0) >> 4) | ((BR2(x) & 0x0f) << 4))
- #define O0(i) BR4(i),
- #define O1(i) O0(i) O0((i) + 1)
- #define O2(i) O1(i) O1((i) + 2)
- #define O3(i) O2(i) O2((i) + 4)
- #define O4(i) O3(i) O3((i) + 8)
- #define O5(i) O4(i) O4((i) + 16)

- #define O6(i) O5(i) O5((i) + 32)
- #define O7(i) O6(i) O6((i) + 64)
- #define O8(i) O7(i) O7((i) + 127)

Functions

- static uchar ordered8to3 (int index, uchar value)
- static uchar quantize8to3 (int index, uchar value)
- static void makergb_512 (const lighting *light, uchar data_pkt[5][64], uchar(*ditherfn)(int, uchar))
- static void makergb_full (const lighting *light, uchar data_pkt[12][64])
- static int rgbcmp (const lighting *lhs, const lighting *rhs)
- int updatergb_kb (usbdevice *kb, int force)
- int savergb_kb (usbdevice *kb, lighting *light, int mode)
- int loadrgb_kb (usbdevice *kb, lighting *light, int mode)

Variables

- static uchar bit_reverse_table [256] = { ((((((((((0) & 0xaa) >> 1) | (((0) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) & 0xaa) >> 1) | (((0) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) & 0xaa) >> 1) | (((0) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) & 0xaa) >> 1) | (((0) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 8) + 1) & 0xaa) >> 1) | ((((0) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 8) + 1) & 0xaa) >> 1) | ((((0) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 8) + 1) & 0xaa) >> 1) | ((((0) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 8) + 1) & 0xaa) >> 1) | ((((0) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 8) + 2) + 1) & 0xaa) >>

1) | (((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 1) & 0xaa) >> 1) | ((((0) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 1) & 0xaa) >> 1) | ((((0) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 1) & 0xaa) >> 1) | ((((0) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 1) & 0xaa) >> 1) | ((((0) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 2) & 0xaa) >> 1) | ((((0) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 2) & 0xaa) >> 1) | ((((0) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 2) & 0xaa) >> 1) | ((((0) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 2) & 0xaa) >> 1) | ((((0) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 4) & 0xaa) >> 1) | ((((0) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 4) & 0xaa) >> 1) | ((((0) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 4) & 0xaa) >> 1) | ((((0) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 4) & 0xaa) >> 1) | ((((0) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | (((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | (((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | (((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | (((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | (((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | (((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | (((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | (((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 8) & 0xaa) >> 1) | ((((0) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 8) & 0xaa) >> 1) | ((((0) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 8) & 0xaa) >> 1) | ((((0) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 8) & 0xaa) >> 1) | ((((0) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | (((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) +

16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 32) & 0xaa) >> 1) | (((0) + 32) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) & 0xaa) >> 1) | (((0) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 32) & 0xaa) >> 1) | (((0) + 32) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) & 0xaa) >> 1) | (((0) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 32) + 1) & 0xaa) >> 1) | ((((0) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) + 1) & 0xaa) >> 1) | ((((0) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 32) + 1) & 0xaa) >> 1) | ((((0) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) + 1) & 0xaa) >> 1) | ((((0) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 32) + 2) & 0xaa) >> 1) | ((((0) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) + 2) & 0xaa) >> 1) | ((((0) + 32) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 32) + 2) & 0xaa) >> 1) | ((((0) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) + 2) & 0xaa) >> 1) | ((((0) + 32) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 32) + 2) + 1) & 0xaa) >> 1) | (((((0) + 32) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 2) + 1) & 0xaa) >> 1) | (((((0) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 32) + 2) + 1) & 0xaa) >> 1) | (((((0) + 32) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 2) + 1) & 0xaa) >> 1) | (((((0) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 32) + 4) & 0xaa) >> 1) | ((((0) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) + 4) & 0xaa) >> 1) | ((((0) + 32) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 32) + 4) & 0xaa) >> 1) | ((((0) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 32) + 4) & 0xaa) >> 1) | ((((0) + 32) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 32) + 4) + 1) & 0xaa) >> 1) | (((((0) + 32) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 4) + 1) & 0xaa) >> 1) | (((((0) + 32) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 32) + 4) + 1) & 0xaa) >> 1) | (((((0) + 32) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 4) + 1) & 0xaa) >> 1) | (((((0) + 32) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 32) + 4) + 2) & 0xaa) >> 1) | (((((0) + 32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 4) + 2) & 0xaa) >> 1) | (((((0) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 32) + 4) + 2) & 0xaa) >> 1) | (((((0) + 32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 4) + 2) &

0xaa) >> 1) | (((((((0) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc)

>> 2) | (((((((((((0) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((

(((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 64) & 0xaa) >> 1) | ((((0) + 64) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) & 0xaa) >> 1) | ((((0) + 64) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 64) & 0xaa) >> 1) | (((0) + 64) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) & 0xaa) >> 1) | (((0) + 64) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 64) + 1) & 0xaa) >> 1) | ((((0) + 64) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 1) & 0xaa) >> 1) | ((((0) + 64) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 64) + 1) & 0xaa) >> 1) | ((((0) + 64) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 1) & 0xaa) >> 1) | ((((0) + 64) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 64) + 2) & 0xaa) >> 1) | ((((0) + 64) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 2) & 0xaa) >> 1) | ((((0) + 64) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 64) + 2) & 0xaa) >> 1) | ((((0) + 64) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 2) & 0xaa) >> 1) | ((((0) + 64) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 64) + 2) + 1) & 0xaa) >> 1) | (((((0) + 64) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 2) + 1) & 0xaa) >> 1) | (((((0) + 64) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 64) + 2) + 1) & 0xaa) >> 1) | (((((0) + 64) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 2) + 1) & 0xaa) >> 1) | (((((0) + 64) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 64) + 4) & 0xaa) >> 1) | ((((0) + 64) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 4) & 0xaa) >> 1) | ((((0) + 64) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 64) + 4) & 0xaa) >> 1) | ((((0) + 64) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 4) & 0xaa) >> 1) | ((((0) + 64) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 64) + 4) + 1) & 0xaa) >> 1) | (((((0) + 64) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 4) + 1) & 0xaa) >> 1) | (((((0) + 64) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 64) + 4) + 1) & 0xaa) >> 1) | (((((0) + 64) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 4) + 1) & 0xaa) >> 1) | (((((0) + 64) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 64) + 4) + 2) & 0xaa) >> 1) | (((((0) + 64) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 64) + 4) + 2) & 0xaa) >> 1) | (((((0) + 64) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 64) + 4) + 2) & 0xaa) >> 1) | (((((0) + 64) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 4) + 2) & 0xaa) >> 1) | (((((0) + 64) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 64) + 8) & 0xaa) >> 1) | ((((0) + 64) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 8) & 0xaa) >> 1) | ((((0) + 64) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 64) + 8) & 0xaa) >> 1) | ((((0) + 64) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 8) & 0xaa) >> 1) | ((((0) + 64) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 64) + 8) + 1) & 0xaa) >> 1) | (((((0) + 64) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 8) + 1) & 0xaa) >> 1) | (((((0) + 64) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 64) + 8) + 1) & 0xaa) >> 1) | (((((0) + 64) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 8) + 1) & 0xaa) >> 1) | (((((0) + 64) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 64) + 8) + 2) & 0xaa) >> 1) | (((((0) + 64) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 8) + 2) & 0xaa) >> 1) | (((((0) + 64) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 64) + 8) + 2) & 0xaa) >> 1) | (((((0) + 64) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 64) + 8) + 2) & 0xaa) >> 1) | (((((0) + 64) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 64) + 8) + 4) & 0xaa) >> 1) | ((((0) + 64) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 8) + 4) & 0xaa) >> 1) | ((((0) + 64) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 64) + 8) + 4) & 0xaa) >> 1) | ((((0) + 64) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 64) + 8) + 4) & 0xaa) >> 1) | ((((0) + 64) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 8) + 4) + 1) & 0xaa) >> 1)

| (((((((0) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 64) + 16) & 0xaa) >> 1) | (((((0) + 64) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 64) + 16) & 0xaa) >> 1) | (((((0) + 64) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 16) & 0xaa) >> 1) | (((((0) + 64) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 64) + 16) & 0xaa) >> 1) | (((((0) + 64) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 16) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 16) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 16) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 16) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 64) + 16) + 2) & 0xaa) >> 1) | (((((0) + 64) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 64) + 16) + 2) & 0xaa) >> 1) | (((((0) + 64) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 16) + 2) & 0xaa) >> 1) | (((((0) + 64) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 64) + 16) + 2) & 0xaa) >> 1) | (((((0) + 64) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((

((0) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) & 0xaa) >> 1) | (((((0) + 64) + 32) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 64) + 32) & 0xaa) >> 1) | (((((0) + 64) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 64) + 32) & 0xaa) >> 1) | (((((0) + 64) + 32) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 64) + 32) & 0xaa) >> 1) | (((((0) + 64) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 1) & 0x55) << 1)) & 0x33) << 2))

& 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 64) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 64) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 64) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 64) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) &

0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 64) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 64) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 64) + 32) + 16) + 8) + 2)

+ 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 127) & 0xaa) >> 1) | ((((0) + 127) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 127) & 0xaa) >> 1) | ((((0) + 127) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 127) & 0xaa) >> 1) | ((((0) + 127) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 127) & 0xaa) >> 1) | ((((0) + 127) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 127) + 1) & 0xaa) >> 1) | ((((0) + 127) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 127) + 1) & 0xaa) >> 1) | ((((0) + 127) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 127) + 1) & 0xaa) >> 1) | ((((0) + 127) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 127) + 1) & 0xaa) >> 1) | ((((0) + 127) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 127) + 2) & 0xaa) >> 1) | ((((0) + 127) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 127) + 2) & 0xaa) >> 1) | ((((0) + 127) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 127) + 2) & 0xaa) >> 1) | ((((0) + 127) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 127) + 2) & 0xaa) >> 1) | ((((0) + 127) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 127) + 2) + 1) & 0xaa) >> 1) | (((((0) + 127) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 2) + 1) & 0xaa) >> 1) | (((((0) + 127) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 127) + 2) + 1) & 0xaa) >> 1) | (((((0) + 127) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 2) + 1) & 0xaa) >> 1) | (((((0) + 127) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 127) + 4) & 0xaa) >> 1) | ((((0) + 127) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 4) & 0xaa) >> 1) | ((((0) + 127) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 127) + 4) & 0xaa) >> 1) | ((((0) + 127) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 127) + 4) & 0xaa) >> 1) | ((((0) + 127) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 4) + 1) & 0xaa) >> 1) | (((((0) + 127) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 4) + 1) & 0xaa) >> 1) | (((((0) + 127) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 4) + 1) & 0xaa) >> 1) | (((((0) + 127) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 4) + 1) & 0xaa) >> 1) | (((((0) + 127) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 4) + 2) & 0xaa) >> 1) | (((((0) + 127) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 4) + 2) & 0xaa) >> 1) | (((((0) + 127) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 4) + 2) & 0xaa) >> 1) | (((((0) + 127) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 4) + 2) & 0xaa) >> 1) | (((((0) + 127) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((

(0) + 127) + 8) & 0xaa) >> 1) | (((((0) + 127) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 8) & 0xaa) >> 1) | (((((0) + 127) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 127) + 8) & 0xaa) >> 1) | (((((0) + 127) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 8) & 0xaa) >> 1) | (((((0) + 127) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 8) + 2) & 0xaa) >> 1) | (((((0) + 127) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 8) + 2) & 0xaa) >> 1) | (((((0) + 127) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 127) + 8) + 2) & 0xaa) >> 1) | (((((0) + 127) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 8) + 2) & 0xaa) >> 1) | (((((0) + 127) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 8) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 16) & 0xaa) >> 1) | ((((0) + 127) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 16) & 0xaa) >> 1) | ((((0) + 127) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 127) + 16) & 0xaa) >> 1) | ((((0) + 127) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 16) & 0xaa) >> 1) | ((((0) + 127) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 16) + 1) & 0xaa) >> 1) | (((((0) + 127) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 16) + 1) & 0xaa) >> 1) | (((((0) + 127) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 127) + 16) + 1) & 0xaa) >> 1) | (((((0) + 127) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 16) + 1) & 0xaa) >> 1) | (((((0) + 127) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 16) + 2) & 0xaa) >> 1) | (((((0) + 127) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 16) + 2) & 0xaa) >> 1) | (((((0) + 127) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 127) + 16) + 2) & 0xaa) >> 1) | (((((0) + 127) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 16) + 2) & 0xaa) >> 1) | (((((0) + 127) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 16) + 4) & 0xaa) >> 1) | (((((0) + 127) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 16) + 4) & 0xaa) >> 1) | (((((0) + 127) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 127) + 16) + 4) & 0xaa) >> 1) | (((((0) + 127) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((

(((0) + 127) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 16) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33)

<< 2)) & 0x0f) << 4)), ((((((((((((0) + 127) + 32) & 0xaa) >> 1) | (((((0) + 127) + 32) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 32) & 0xaa) >> 1) | (((((0) + 127) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 127) + 32) & 0xaa) >> 1) | (((((0) + 127) + 32) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 32) & 0xaa) >> 1) | (((((0) + 127) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 32) + 2) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 32) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 32) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 32) + 8) + 4) & 0xaa)

>> 1) | (((((((0) + 127) + 32) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 127) + 32) + 16) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 32) +

16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 127) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 32) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 64) & 0xaa) >> 1) | (((((0) + 127) + 64) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 64) & 0xaa) >> 1) | (((((0) + 127) + 64) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 127) + 64) & 0xaa) >> 1) | (((((0) + 127) + 64) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 64) & 0xaa) >> 1) | (((((0) + 127) + 64) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0)

>> 4) | ((((((((((((0) + 127) + 64) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 64) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 64) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 64) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 8) +

4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 64) + 16) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 64) + 16) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 16) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 16) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 16) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 16) + 8) & 0xaa) >> 1) | (((((((0) +

127) + 64) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 8) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 64) + 32) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 64) + 32) & 0xaa) >> 1) | (((((0) + 127) + 64) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((0) + 127) + 64) + 32) & 0xaa) >> 1) | (((((0) + 127) + 64) + 32) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((0) + 127) + 64) + 32) & 0xaa) >> 1) | (((((0) + 127) + 64) + 32) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((0) + 127) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 32) + 1) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((0) + 127) + 64) + 32) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((0) + 127) + 64) + 32) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64

) + 32) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
((((0) + 127) + 64) + 32) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 2) & 0x55) << 1)) &
0x33) << 2)) & 0x0f) << 4)), ((((((((((
(((((0) + 127) + 64) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0
) + 127) + 64) + 32) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 2) +
1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >>
4) | (((((((((((((0) + 127) + 64) + 32) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 2)
+ 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 2) + 1) & 0xaa) >> 1) | ((((((
((0) + 127) + 64) + 32) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
((((0) + 127) + 64) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) |
((((((
((((0) + 127) + 64) + 32) + 4) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 4) & 0x55) <<
1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 4) & 0xaa) >> 1) | (((((((0) +
127) + 64) + 32) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
((((0) + 127) + 64) + 32) + 4) & 0xaa) >>
1) | (((((((0) + 127) + 64) + 32) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
((((0) + 127) + 64) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 4) + 1) & 0x55) << 1))
& 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) +
32) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 4) +
1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 4) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 4) + 1) & 0x55) <<
1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
((((0) + 127) + 64) + 32) + 4) + 2) & 0xaa) >> 1) | ((((((
((0) + 127) + 64) + 32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32)
+ 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) &
0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 4) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 6) +
32) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 4) + 2) & 0xaa) >>
1) | (((((((0) + 127) + 64) + 32) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
(((((0) + 127) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 4) + 2) + 1
) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 4) + 2) + 1) &
0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) +
127) + 64) + 32) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 4) + 2) + 1) &
0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
((((0) + 127) + 64) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 8) & 0x55) << 1)) &
0xcc) >> 2) | ((((((
((((0) + 127) + 64) + 32) + 8) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 8)
& 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 8) & 0xaa) >> 1) |
(((((((0) + 127) + 64) + 32) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
((((0) + 127) + 64) + 32) +
8) & 0xaa) >> 1) | ((((((0) + 127) + 64) + 32) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)),
((((((((((
((((0) + 127) + 64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 1
) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0
) + 127) + 64) + 32) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) +
64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 1) & 0x55) << 1)) & 0xcc)
>> 2) | ((((((
(((((0) + 127) + 64) + 32) + 8) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8
) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
(((((0) + 127) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) |
((((((
(((((0) + 127) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 2) & 0x55) <<
1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0
) + 127) + 64) + 32) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 8) + 2) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 2) & 0x55) << 1)) &
0x33) << 2)) & 0x0f) << 4)), ((((((((((
(((((0) + 127) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 2) + 1) &
0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) +
127) + 64) + 32) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 2) + 1) &
0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
(((((0) + 127) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) |
((((((
(((((0) + 127) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 8) + 4) & 0x55) <<
1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) +
127) + 64) + 32) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((
(((((0) + 127) + 64) + 32) + 8) + 4) & 0xaa) >> 1) | (((((((0) + 127) + 64) +
32) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((
(((((0) + 127) + 64) + 32) + 8)

+ 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((0) + 127) + 64) + 32) + 16) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 32) + 16) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((0) + 127) + 64) + 32) + 16) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((0) + 127) + 64) + 32) + 16) & 0xaa) >> 1) | (((((((0) + 127) + 64) + 32) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 2) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 4)

+ 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0xaa) >> 1) | (((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0xaa) >> 1) | ((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((((((0) + 127) + 64) + 32) + 16) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), }

9.30.1 Macro Definition Documentation

9.30.1.1 #define BR1(x) ((((x) & 0xaa) >> 1) | (((x) & 0x55) << 1))

Definition at line 9 of file led_keyboard.c.

9.30.1.2 #define BR2(x) (((BR1(x) & 0xcc) >> 2) | ((BR1(x) & 0x33) << 2))

Definition at line 10 of file led_keyboard.c.

9.30.1.3 #define BR4(x) (((BR2(x) & 0xf0) >> 4) | ((BR2(x) & 0x0f) << 4))

Definition at line 11 of file led_keyboard.c.

9.30.1.4 #define O0(i) BR4(i),

Definition at line 12 of file led_keyboard.c.

9.30.1.5 #define O1(i) O0(i) O0((i) + 1)

Definition at line 13 of file led_keyboard.c.

9.30.1.6 #define O2(i) O1(i) O1((i) + 2)

Definition at line 14 of file led_keyboard.c.

9.30.1.7 #define O3(i) O2(i) O2((i) + 4)

Definition at line 15 of file led_keyboard.c.

9.30.1.8 #define O4(i) O3(i) O3((i) + 8)

Definition at line 16 of file led_keyboard.c.

9.30.1.9 #define O5(i) O4(i) O4((i) + 16)

Definition at line 17 of file led_keyboard.c.

9.30.1.10 #define O6(i) O5(i) O5((i) + 32)

Definition at line 18 of file led_keyboard.c.

9.30.1.11 #define O7(i) O6(i) O6((i) + 64)

Definition at line 19 of file led_keyboard.c.

9.30.1.12 #define O8(i) O7(i) O7((i) + 127)

Definition at line 20 of file led_keyboard.c.

9.30.2 Function Documentation

9.30.2.1 int loadrgb_kb (usbdevice * *kb,* lighting * *light,* int *mode*)

Since Firmware Version 2.05 for K95RGB the answers for getting the stored color-maps from the hardware has changed a bit. So comparing for the correct answer cannot validate against the cmd, and has to be done against a third map. Up to now we know, that K70RGB Pro and K70 Lux RGB have firmware version 2.04 and having the problem also. So we have to determine in the most inner loop the firmware version and type of KB to select the correct compare-table.

Read colors

```
                                                    < That is the old comparison method: you get back what you sent.
```

Normally a firmware version >= 2.05 runs with the new compare array. Up to now there is a 2.04 running in K70 RGB Lux with the same behavior. It seems that K70RGB has the same problem

Definition at line 181 of file led_keyboard.c.

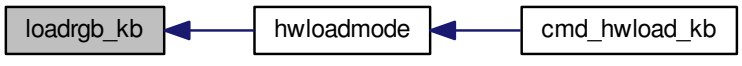
References lighting::b, ckb_err, usbdevice::fwversion, lighting::g, MSG_SIZE, N_KEYS_HW, P_K70_LUX, P_K70-_LUX_NRGB, usbdevice::product, lighting::r, usbrecv, and usbsend.

Referenced by hwloadmode().

```
181                                                     {
182     if(kb->fwversion >= 0x0120){
183         uchar data_pkt[12][MSG_SIZE] = {
184             { 0x0e, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x01 },
185             { 0xff, 0x01, 60, 0 },
186             { 0xff, 0x02, 60, 0 },
187             { 0xff, 0x03, 24, 0 },
188             { 0x0e, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x02 },
189             { 0xff, 0x01, 60, 0 },
190             { 0xff, 0x02, 60, 0 },
191             { 0xff, 0x03, 24, 0 },
192             { 0x0e, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x03 },
193             { 0xff, 0x01, 60, 0 },
194             { 0xff, 0x02, 60, 0 },
195             { 0xff, 0x03, 24, 0 },
196         };
197         uchar in_pkt[4][MSG_SIZE] = {
198             { 0x0e, 0x14, 0x03, 0x01 },
199             { 0xff, 0x01, 60, 0 },
200             { 0xff, 0x02, 60, 0 },
201             { 0xff, 0x03, 24, 0 },
202         };
203
209
210         uchar cmp_pkt[4][4] = {
211             { 0x0e, 0x14, 0x03, 0x01 },
212             { 0x0e, 0xff, 0x01, 60 },
213             { 0x0e, 0xff, 0x02, 60 },
214             { 0x0e, 0xff, 0x03, 24 },
215         };
217         uchar* colors[3] = { light->r, light->g, light->b };
218         for(int clr = 0; clr < 3; clr++){
219             for(int i = 0; i < 4; i++){
220                 if(!usbrecv(kb, data_pkt[i + clr * 4], in_pkt[i]))
221                     return -1;
222
223                 uchar* comparePacket = data_pkt[i + clr * 4];
224                 if ((kb->fwversion >= 0x205)
228                         || ((kb->fwversion >= 0x204)
229                             && ((kb->product == P_K70_LUX_NRGB) || (kb->
      product == P_K70_LUX)))) {
230                     comparePacket = cmp_pkt[i];
231                 }
232
233                 if (memcmp(in_pkt[i], comparePacket, 4)) {
234                     ckb_err("Bad input header\n");
235                     ckb_err("color = %d, i = %d, mode = %d\nOutput (Request): %2.2x %2.2x %2.2x
       %2.2x\nInput(Reply): %2.2x %2.2x %2.2x %2.2x %2.2x %2.2x %2.2x %2.2x\n", clr, i, mode,
236                         comparePacket[0], comparePacket[1], comparePacket[2], comparePacket[3],
237                         in_pkt[i][0], in_pkt[i][1], in_pkt[i][2], in_pkt[i][3], in_pkt[i][4], in_pkt[i][5],
       in_pkt[i][6], in_pkt[i][7]);
238                     in_pkt[2][0] = 0x99;
239                     in_pkt[2][1] = 0x99;
240                     in_pkt[2][2] = 0x99;
241                     in_pkt[2][3] = 0x99;
```

```
242                     usbrecv(kb, in_pkt[2], in_pkt[2]); // just to find it in the wireshark log
243                     return -1;
244                 }
245             }
246             // Copy colors to lighting. in_pkt[0] is irrelevant.
247             memcpy(colors[clr], in_pkt[1] + 4, 60);
248             memcpy(colors[clr] + 60, in_pkt[2] + 4, 60);
249             memcpy(colors[clr] + 120, in_pkt[3] + 4, 24);
250         }
251     } else {
252         uchar data_pkt[5][MSG_SIZE] = {
253             { 0x0e, 0x14, 0x02, 0x01, 0x01, mode + 1, 0 },
254             { 0xff, 0x01, 60, 0 },
255             { 0xff, 0x02, 60, 0 },
256             { 0xff, 0x03, 60, 0 },
257             { 0xff, 0x04, 36, 0 },
258         };
259         uchar in_pkt[4][MSG_SIZE] = {
260             { 0xff, 0x01, 60, 0 },
261             { 0xff, 0x02, 60, 0 },
262             { 0xff, 0x03, 60, 0 },
263             { 0xff, 0x04, 36, 0 },
264         };
265         // Write initial packet
266         if(!usbsend(kb, data_pkt[0], 1))
267             return -1;
268         // Read colors
269         for(int i = 1; i < 5; i++){
270             if(!usbrecv(kb, data_pkt[i],in_pkt[i - 1]))
271                 return -1;
272             if(memcmp(in_pkt[i - 1], data_pkt[i], 4)){
273                 ckb_err("Bad input header\n");
274                 return -1;
275             }
276         }
277         // Copy the data back to the mode
278         uint8_t mr[N_KEYS_HW / 2], mg[N_KEYS_HW / 2], mb[
    N_KEYS_HW / 2];
279         memcpy(mr,      in_pkt[0] +  4, 60);
280         memcpy(mr + 60, in_pkt[1] +  4, 12);
281         memcpy(mg,      in_pkt[1] + 16, 48);
282         memcpy(mg + 48, in_pkt[2] +  4, 24);
283         memcpy(mb,      in_pkt[2] + 28, 36);
284         memcpy(mb + 36, in_pkt[3] +  4, 36);
285         // Unpack LED data to 8bpc format
286         for(int i = 0; i < N_KEYS_HW; i++){
287             int     i_2 = i / 2;
288             uint8_t r, g, b;
289
290             // 3-bit intensities stored in alternate nybbles.
291             if (i & 1) {
292                 r = 7 - (mr[i_2] >> 4);
293                 g = 7 - (mg[i_2] >> 4);
294                 b = 7 - (mb[i_2] >> 4);
295             } else {
296                 r = 7 - (mr[i_2] & 0x0F);
297                 g = 7 - (mg[i_2] & 0x0F);
298                 b = 7 - (mb[i_2] & 0x0F);
299             }
300             // Scale 3-bit values up to 8 bits.
301             light->r[i] = r << 5 | r << 2 | r >> 1;
302             light->g[i] = g << 5 | g << 2 | g >> 1;
303             light->b[i] = b << 5 | b << 2 | b >> 1;
304         }
305     }
306     return 0;
307 }
```

Here is the caller graph for this function:



9.30.2.2 static void makergb_512 (const lighting * *light*, uchar *data_pkt[5][64]*, uchar(*)(int, uchar) *ditherfn*) [static]

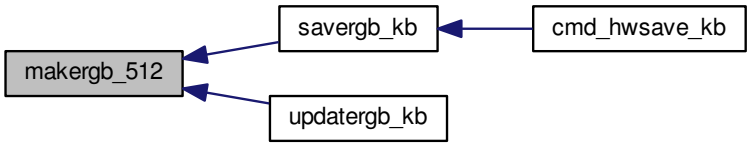
Definition at line 36 of file led_keyboard.c.

References lighting::b, lighting::g, N_KEYS_HW, and lighting::r.

Referenced by savergb_kb(), and updatergb_kb().

```
37                                                          {
38     uchar r[N_KEYS_HW / 2], g[N_KEYS_HW / 2], b[N_KEYS_HW / 2];
39     // Compress RGB values to a 512-color palette
40     for(int i = 0; i < N_KEYS_HW; i += 2){
41         char r1 = ditherfn(i, light->r[i]), r2 = ditherfn(i + 1, light->r[i + 1]);
42         char g1 = ditherfn(i, light->g[i]), g2 = ditherfn(i + 1, light->g[i + 1]);
43         char b1 = ditherfn(i, light->b[i]), b2 = ditherfn(i + 1, light->b[i + 1]);
44         r[i / 2] = (7 - r2) << 4 | (7 - r1);
45         g[i / 2] = (7 - g2) << 4 | (7 - g1);
46         b[i / 2] = (7 - b2) << 4 | (7 - b1);
47     }
48     memcpy(data_pkt[0] + 4, r, 60);
49     memcpy(data_pkt[1] + 4, r + 60, 12);
50     memcpy(data_pkt[1] + 16, g, 48);
51     memcpy(data_pkt[2] + 4, g + 48, 24);
52     memcpy(data_pkt[2] + 28, b, 36);
53     memcpy(data_pkt[3] + 4, b + 36, 36);
54 }
```

Here is the caller graph for this function:



9.30.2.3 static void makergb_full (const lighting * *light*, uchar *data_pkt[12][64]*) [static]

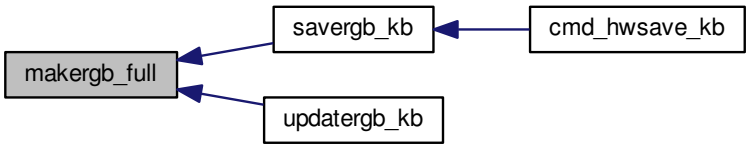
Definition at line 56 of file led_keyboard.c.

References lighting::b, lighting::g, and lighting::r.

Referenced by savergb_kb(), and updatergb_kb().

```
56                                                                  {
57     const uchar* r = light->r, *g = light->g, *b = light->b;
58     // Red
59     memcpy(data_pkt[0] + 4, r, 60);
60     memcpy(data_pkt[1] + 4, r + 60, 60);
61     memcpy(data_pkt[2] + 4, r + 120, 24);
62     // Green (final R packet is blank)
63     memcpy(data_pkt[4] + 4, g, 60);
64     memcpy(data_pkt[5] + 4, g + 60, 60);
65     memcpy(data_pkt[6] + 4, g + 120, 24);
66     // Blue (final G packet is blank)
67     memcpy(data_pkt[8] + 4, b, 60);
68     memcpy(data_pkt[9] + 4, b + 60, 60);
69     memcpy(data_pkt[10] + 4, b + 120, 24);
70 }
```

Here is the caller graph for this function:



9.30.2.4 static uchar ordered8to3 (int *index*, uchar *value*) [static]

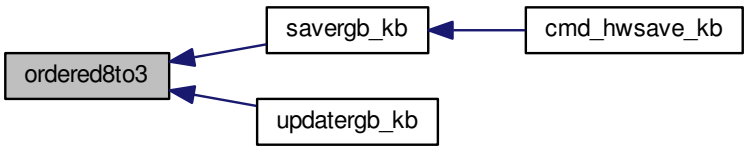
Definition at line 24 of file led_keyboard.c.

References bit_reverse_table.

Referenced by savergb_kb(), and updatergb_kb().

```
24                                                  {
25     int m = value * 7;
26     int b = m / 255;
27     if((m % 255) > bit_reverse_table[index & 0xff])
28         b++;
29     return b;
30 }
```

Here is the caller graph for this function:



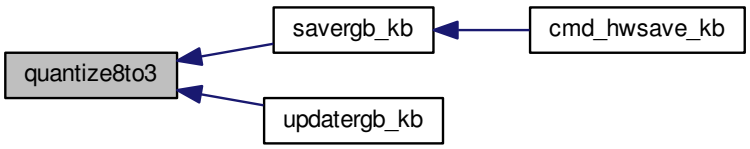
9.30.2.5 static uchar quantize8to3 (int *index*, uchar *value*) [static]

Definition at line 32 of file led_keyboard.c.

Referenced by savergb_kb(), and updatergb_kb().

```
32                                                  {
33     return value >> 5;
34 }
```

Here is the caller graph for this function:



9.30.2.6 static int rgbcmp (const lighting * *lhs*, const lighting * *rhs*) [static]

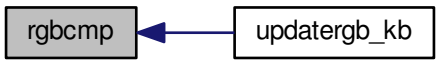
Definition at line 72 of file led_keyboard.c.

References lighting::b, lighting::g, N_KEYS_HW, and lighting::r.

Referenced by updatergb_kb().

```
72                                                          {
73     // Compare two light structures, ignore mouse zones
74     return memcmp(lhs->r, rhs->r, N_KEYS_HW) || memcmp(lhs->g, rhs->
       g, N_KEYS_HW) || memcmp(lhs->b, rhs->b, N_KEYS_HW);
75 }
```

Here is the caller graph for this function:



9.30.2.7 int savergb_kb (usbdevice * *kb*, lighting * *light*, int *mode*)

Definition at line 139 of file led_keyboard.c.

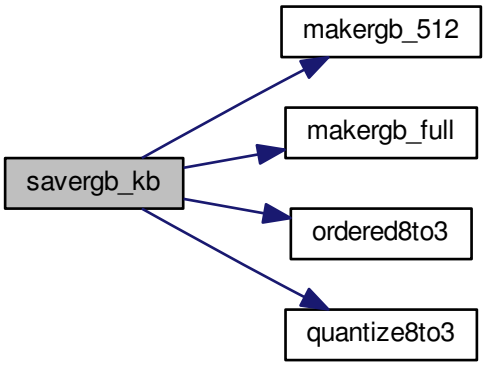
References usbdevice::dither, usbdevice::fwversion, IS_STRAFE, makergb_512(), makergb_full(), MSG_SIZE, ordered8to3(), quantize8to3(), and usbsend.

Referenced by cmd_hwsave_kb().

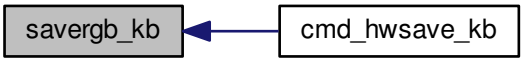
```
139                                                         {
140     if(kb->fwversion >= 0x0120){
141         uchar data_pkt[12][MSG_SIZE] = {
142             // Red
143             { 0x7f, 0x01, 60, 0 },
144             { 0x7f, 0x02, 60, 0 },
145             { 0x7f, 0x03, 24, 0 },
146             { 0x07, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x01 },
147             // Green
148             { 0x7f, 0x01, 60, 0 },
149             { 0x7f, 0x02, 60, 0 },
150             { 0x7f, 0x03, 24, 0 },
```

```
151             { 0x07, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x02 },
152             // Blue
153             { 0x7f, 0x01, 60, 0 },
154             { 0x7f, 0x02, 60, 0 },
155             { 0x7f, 0x03, 24, 0 },
156             { 0x07, 0x14, 0x03, 0x01, 0x01, mode + 1, 0x03 }
157         };
158         makergb_full(light, data_pkt);
159         if(!usbsend(kb, data_pkt[0], 12))
160             return -1;
161         if (IS_STRAFE(kb)){ // end save
162             uchar save_end_pkt[MSG_SIZE] = { 0x07, 0x14, 0x04, 0x01, 0x01 };
163             if(!usbsend(kb, save_end_pkt, 1))
164                 return -1;
165         }
166     } else {
167         uchar data_pkt[5][MSG_SIZE] = {
168             { 0x7f, 0x01, 60, 0 },
169             { 0x7f, 0x02, 60, 0 },
170             { 0x7f, 0x03, 60, 0 },
171             { 0x7f, 0x04, 36, 0 },
172             { 0x07, 0x14, 0x02, 0x00, 0x01, mode + 1 }
173         };
174         makergb_512(light, data_pkt, kb->dither ? ordered8to3 :
    quantize8to3);
175         if(!usbsend(kb, data_pkt[0], 5))
176             return -1;
177     }
178     return 0;
179 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



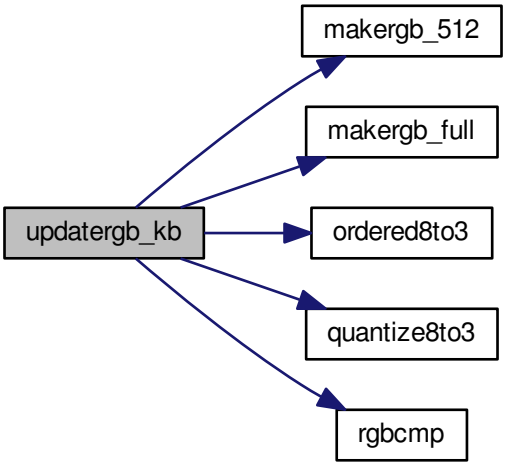
9.30.2.8 int updatergb_kb (usbdevice * *kb*, int *force*)

Definition at line 77 of file led_keyboard.c.

References usbdevice::active, usbprofile::currentmode, usbdevice::dither, lighting::forceupdate, IS_FULLRANGE, usbprofile::lastlight, usbmode::light, makergb_512(), makergb_full(), MSG_SIZE, ordered8to3(), usbdevice::profile, quantize8to3(), rgbcmp(), lighting::sidelight, and usbsend.

```
77                                          {
78     if(!kb->active)
79         return 0;
80     lighting* lastlight = &kb->profile->lastlight;
81     lighting* newlight = &kb->profile->currentmode->
       light;
82     // Don't do anything if the lighting hasn't changed
83     if(!force && !lastlight->forceupdate && !newlight->forceupdate
84             && !rgbcmp(lastlight, newlight) && lastlight->sidelight == newlight->
       sidelight)   // strafe sidelights
85         return 0;
86     lastlight->forceupdate = newlight->forceupdate = 0;
87
88     if(IS_FULLRANGE(kb)){
89         // Update strafe sidelights if necessary
90         if(lastlight->sidelight != newlight->sidelight) {
91             uchar data_pkt[2][MSG_SIZE] = {
92                  { 0x07, 0x05, 0x08, 0x00, 0x00 },
93                  { 0x07, 0x05, 0x02, 0, 0x03 }
94              };
95              if (newlight->sidelight)
96                  data_pkt[0][4]=1;    // turn on
97              if(!usbsend(kb, data_pkt[0], 2))
98                  return -1;
99         }
100         // 16.8M color lighting works fine on strafe and is the only way it actually works
101         uchar data_pkt[12][MSG_SIZE] = {
102             // Red
103             { 0x7f, 0x01, 0x3c, 0 },
104             { 0x7f, 0x02, 0x3c, 0 },
105             { 0x7f, 0x03, 0x18, 0 },
106             { 0x07, 0x28, 0x01, 0x03, 0x01, 0},
107             // Green
108             { 0x7f, 0x01, 0x3c, 0 },
109             { 0x7f, 0x02, 0x3c, 0 },
110             { 0x7f, 0x03, 0x18, 0 },
111             { 0x07, 0x28, 0x02, 0x03, 0x01, 0},
112             // Blue
113             { 0x7f, 0x01, 0x3c, 0 },
114             { 0x7f, 0x02, 0x3c, 0 },
115             { 0x7f, 0x03, 0x18, 0 },
116             { 0x07, 0x28, 0x03, 0x03, 0x02, 0}
117         };
118         makergb_full(newlight, data_pkt);
119         if(!usbsend(kb, data_pkt[0], 12))
120             return -1;
121     } else {
122         // On older keyboards it looks flickery and causes lighting glitches, so we don't use it.
123         uchar data_pkt[5][MSG_SIZE] = {
124             { 0x7f, 0x01, 60, 0 },
125             { 0x7f, 0x02, 60, 0 },
126             { 0x7f, 0x03, 60, 0 },
127             { 0x7f, 0x04, 36, 0 },
128             { 0x07, 0x27, 0x00, 0x00, 0xD8 }
129         };
130         makergb_512(newlight, data_pkt, kb->dither ?
       ordered8to3 : quantize8to3);
131         if(!usbsend(kb, data_pkt[0], 5))
132             return -1;
133     }
134
135     memcpy(lastlight, newlight, sizeof(lighting));
136     return 0;
137 }
```

Here is the call graph for this function:



9.30.3 Variable Documentation

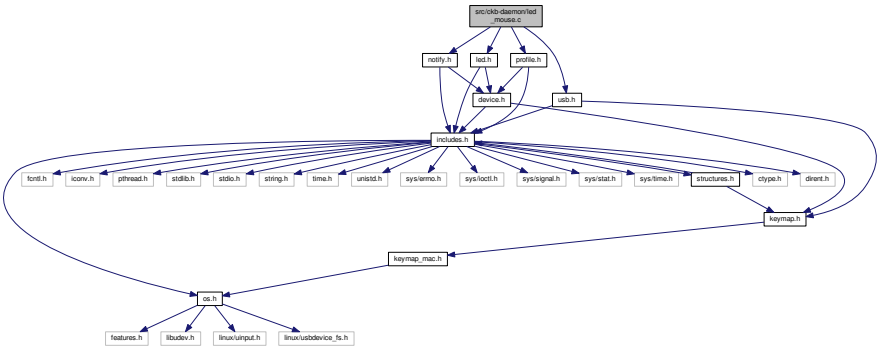
9.30.3.1 uchar bit_reverse_table[256] = { (((((((((0) & 0xaa) >> 1) | ((((0) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) & 0xaa) >> 1) | ((((0) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((0) & 0xaa) >> 1) | ((((0) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) & 0xaa) >> 1) | ((((0) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 1) & 0xaa) >> 1) | ((((0) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 2) & 0xaa) >> 1) | ((((0) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 2) + 1) & 0xaa) >> 1) | (((((0) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 4) & 0xaa) >> 1) | ((((0) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 4) + 1) & 0xaa) >> 1) | (((((0) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 4) + 2) & 0xaa) >> 1) | (((((0) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 4) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 8) & 0xaa) >> 1) | ((((0) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 8) + 1) & 0xaa) >> 1) | (((((0) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) + 1) & 0xaa) >> 1) | (((((0) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 8) + 1) & 0xaa) >> 1) | (((((0) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) + 1) & 0xaa) >> 1) | (((((0) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) + 2) & 0xaa) >> 1) | (((((0) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 8) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 8) + 4) & 0xaa) >> 1) | (((((0) + 8) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 8) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 8) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 8) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 8) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 8) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0xcc) >> 2) | (((((0) + 16) & 0xaa) >> 1) | ((((0) + 16) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 16) + 1) & 0xaa) >> 1) | (((((0) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 1) & 0xaa) >> 1) | (((((0) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 16) + 1) & 0xaa) >> 1) | (((((0) + 16) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 1) & 0xaa) >> 1) | (((((0) + 16) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 16) + 2) & 0xaa) >> 1) | (((((0) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 2) & 0xaa) >> 1) | (((((0) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 16) + 2) & 0xaa) >> 1) | (((((0) + 16) + 2) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 2) & 0xaa) >> 1) | (((((0) + 16) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 4) & 0xaa) >> 1) | (((((0) + 16) + 4) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 4) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 4) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 4) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 4) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0xcc) >> 2) | ((((((0) + 16) + 8) & 0xaa) >> 1) | (((((0) + 16) + 8) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 1) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), (((((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | ((((((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0xcc) >> 2) | (((((((0) + 16) + 8) + 2) & 0xaa) >> 1) | ((((((0) + 16) + 8) + 2) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)), ((((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0xf0) >> 4) | (((((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0xcc) >> 2) | ((((((((0) + 16) + 8) + 2) + 1) & 0xaa) >> 1) | (((((((0) + 16) + 8) + 2) + 1) & 0x55) << 1)) & 0x33) << 2)) & 0x0f) << 4)) }

Referenced by ordered8to3().

9.31 src/ckb-daemon/led_mouse.c File Reference

```
#include "led.h"
#include "notify.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for led_mouse.c:



Functions

- static int rgbcmp (const lighting *lhs, const lighting *rhs)
- static int isblack (const usbdevice *kb, const lighting *light)
- int updatergb_mouse (usbdevice *kb, int force)
- int savergb_mouse (usbdevice *kb, lighting *light, int mode)
- int loadrgb_mouse (usbdevice *kb, lighting *light, int mode)

9.31.1 Function Documentation

9.31.1.1 static int isblack (const usbdevice * *kb*, const lighting * *light*) [static]

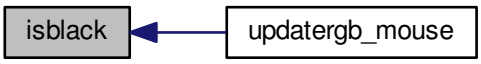
Definition at line 13 of file led_mouse.c.

References lighting::b, lighting::g, IS_M65, LED_MOUSE, N_MOUSE_ZONES, and lighting::r.

Referenced by updatergb_mouse().

```
13                                                          {
14     if(!IS_M65(kb))
15         return 0;
16     uchar black[N_MOUSE_ZONES] = { 0 };
17     return !memcmp(light->r + LED_MOUSE, black, sizeof(black)) && !memcmp(light->
       g + LED_MOUSE, black, sizeof(black)) && !memcmp(light->b + LED_MOUSE, black, sizeof(
       black));
18 }
```

Here is the caller graph for this function:



9.31.1.2 int loadrgb_mouse (usbdevice * *kb*, lighting * *light*, int *mode*)

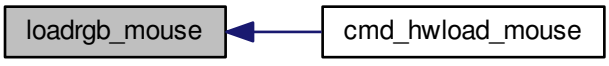
Definition at line 81 of file led_mouse.c.

References lighting::b, ckb_err, lighting::g, IS_SABRE, IS_SCIMITAR, LED_DPI, LED_MOUSE, MSG_SIZE, lighting::r, and usbrecv.

Referenced by cmd_hwload_mouse().

```
81                                                          {
82     uchar data_pkt[MSG_SIZE] = { 0x0e, 0x13, 0x10, 1, 0 };
83     uchar in_pkt[MSG_SIZE] = { 0 };
84     // Load each RGB zone
85     int zonecount = IS_SCIMITAR(kb) ? 4 : IS_SABRE(kb) ? 3 : 2;
86     for(int i = 0; i < zonecount; i++){
87         if(!usbrecv(kb, data_pkt, in_pkt))
88             return -1;
89         if(memcmp(in_pkt, data_pkt, 4)){
90             ckb_err("Bad input header\n");
91             return -2;
92         }
93         // Copy data
94         int led = LED_MOUSE + i;
95         if(led >= LED_DPI)
96             led++;          // Skip DPI light
97         light->r[led] = in_pkt[4];
98         light->g[led] = in_pkt[5];
99         light->b[led] = in_pkt[6];
100         // Set packet for next zone
101         data_pkt[2]++;
102     }
103     return 0;
104 }
```

Here is the caller graph for this function:



9.31.1.3 static int rgbcmp (const lighting * *lhs*, const lighting * *rhs*) [static]

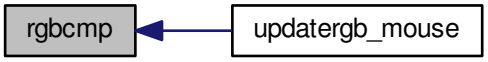
Definition at line 7 of file led_mouse.c.

References lighting::b, lighting::g, LED_MOUSE, N_MOUSE_ZONES, and lighting::r.

Referenced by updatergb_mouse().

```
7                                                                   {
8       return memcmp(lhs->r + LED_MOUSE, rhs->r + LED_MOUSE,
        N_MOUSE_ZONES) || memcmp(lhs->g + LED_MOUSE, rhs->g +
        LED_MOUSE, N_MOUSE_ZONES) || memcmp(lhs->b + LED_MOUSE, rhs->
        b + LED_MOUSE, N_MOUSE_ZONES);
9   }
```

Here is the caller graph for this function:



9.31.1.4 int savergb_mouse (usbdevice * *kb*, lighting * *light*, int *mode*)

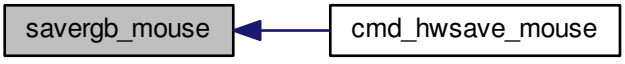
Definition at line 62 of file led_mouse.c.

References lighting::b, lighting::g, IS_SABRE, IS_SCIMITAR, LED_DPI, LED_MOUSE, MSG_SIZE, lighting::r, and usbsend.

Referenced by cmd_hwsave_mouse().

```
62                                                                  {
63      uchar data_pkt[MSG_SIZE] = { 0x07, 0x13, 0x10, 1, 0 };
64      // Save each RGB zone, minus the DPI light which is sent in the DPI packets
65      int zonecount = IS_SCIMITAR(kb) ? 4 : IS_SABRE(kb) ? 3 : 2;
66      for(int i = 0; i < zonecount; i++){
67          int led = LED_MOUSE + i;
68          if(led >= LED_DPI)
69              led++;          // Skip DPI light
70          data_pkt[4] = light->r[led];
71          data_pkt[5] = light->g[led];
72          data_pkt[6] = light->b[led];
73          if(!usbsend(kb, data_pkt, 1))
74              return -1;
75          // Set packet for next zone
76          data_pkt[2]++;
77      }
78      return 0;
79  }
```

Here is the caller graph for this function:



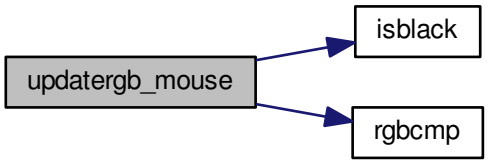
9.31.1.5 int updatergb_mouse (usbdevice * *kb*, int *force*)

Definition at line 20 of file led_mouse.c.

References usbdevice::active, lighting::b, usbprofile::currentmode, lighting::forceupdate, lighting::g, isblack(), usbprofile::lastlight, LED_MOUSE, usbmode::light, MSG_SIZE, N_MOUSE_ZONES, usbdevice::profile, lighting::r, rgbcmp(), and usbsend.

```
20                                                  {
21     if(!kb->active)
22         return 0;
23     lighting* lastlight = &kb->profile->lastlight;
24     lighting* newlight = &kb->profile->currentmode->
       light;
25     // Don't do anything if the lighting hasn't changed
26     if(!force && !lastlight->forceupdate && !newlight->forceupdate
27             && !rgbcmp(lastlight, newlight))
28         return 0;
29     lastlight->forceupdate = newlight->forceupdate = 0;
30
31     // Send the RGB values for each zone to the mouse
32     uchar data_pkt[2][MSG_SIZE] = {
33         { 0x07, 0x22, N_MOUSE_ZONES, 0x01, 0 }, // RGB colors
34         { 0x07, 0x05, 0x02, 0 }                 // Lighting on/off
35     };
36     uchar* rgb_data = &data_pkt[0][4];
37     for(int i = 0; i < N_MOUSE_ZONES; i++){
38         *rgb_data++ = i + 1;
39         *rgb_data++ = newlight->r[LED_MOUSE + i];
40         *rgb_data++ = newlight->g[LED_MOUSE + i];
41         *rgb_data++ = newlight->b[LED_MOUSE + i];
42     }
43     // Send RGB data
44     if(!usbsend(kb, data_pkt[0], 1))
45         return -1;
46     int was_black = isblack(kb, lastlight), is_black = isblack(kb, newlight);
47     if(is_black){
48         // If the lighting is black, send the deactivation packet (M65 only)
49         if(!usbsend(kb, data_pkt[1], 1))
50             return -1;
51     } else if(was_black || force){
52         // If the lighting WAS black, or if we're on forced update, send the activation packet
53         data_pkt[1][4] = 1;
54         if(!usbsend(kb, data_pkt[1], 1))
55             return -1;
56     }
57
58     memcpy(lastlight, newlight, sizeof(lighting));
59     return 0;
60 }
```

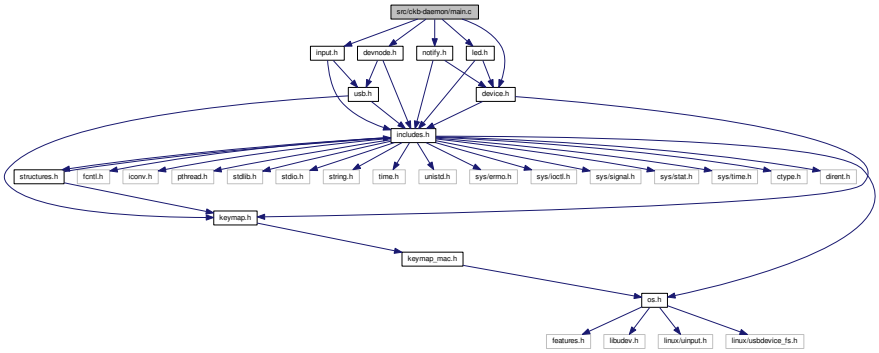
Here is the call graph for this function:



9.32 src/ckb-daemon/main.c File Reference

```
#include "device.h"
#include "devnode.h"
#include "input.h"
#include "led.h"
#include "notify.h"
```

Include dependency graph for main.c:



Functions

- static void quitWithLock (char mut)

  quitWithLock
- int restart ()
- void timespec_add (struct timespec ∗timespec, long nanoseconds)
- static void quit ()

  quit Stop working the daemon. function is called if the daemon received a sigterm In this case, locking the device-mutex is ok.
- void sighandler2 (int type)
- void sighandler (int type)
- void localecase (char ∗dst, size_t length, const char ∗src)
- int main (int argc, char ∗∗argv)

Variables

- static int main_ac
- static char ∗∗ main_av
- volatile int reset_stop

  brief .
- int features_mask

  brief .
- int hwload_mode

  hwload_mode = 1 means read hardware once. should be enough

9.32.1 Function Documentation

9.32.1.1 void localecase (char ∗ *dst*, size_t *length*, const char ∗ *src*)

Definition at line 71 of file main.c.

```
71                                                      {
72     char* ldst = dst + length;
73     char s;
74     while((s = *src++)){
75         if(s == '_')
76             s = '-';
77         else
78             s = tolower(s);
79         *dst++ = s;
```

```
80          if(dst == ldst){
81              dst--;
82              break;
83          }
84      }
85      *dst = 0;
86  }
```

9.32.1.2 int main (int *argc*, char ** *argv*)

Definition at line 88 of file main.c.

References ckb_fatal_nofile, ckb_info, ckb_info_nofile, ckb_warn_nofile, devpath, FEAT_BIND, FEAT_MOUSE-ACCEL, FEAT_NOTIFY, features_mask, gid, hwload_mode, keyboard, main_ac, main_av, mkdevpath(), quit(), restart(), sighandler(), and usbmain().

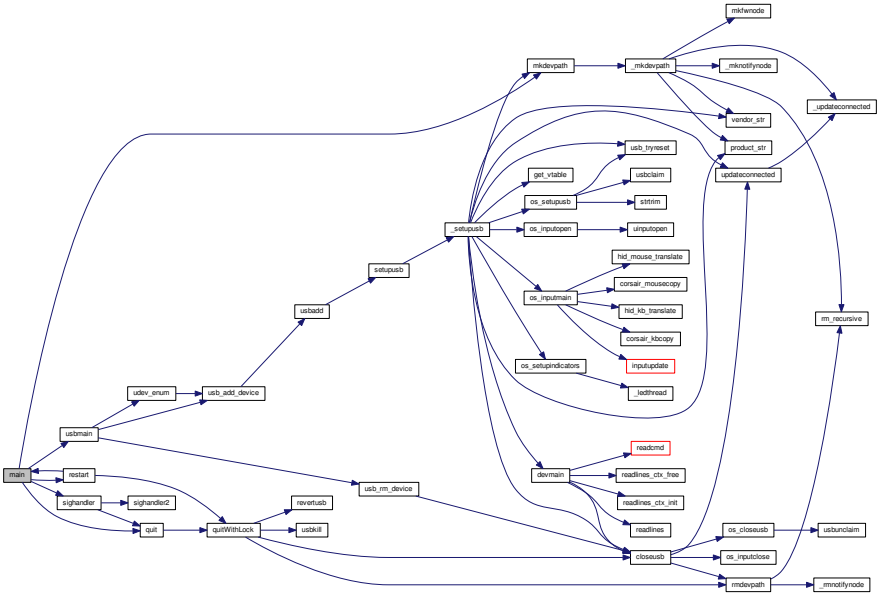
Referenced by restart().

```
88                                  {
89      // Set output pipes to buffer on newlines, if they weren't set that way already
90      setlinebuf(stdout);
91      setlinebuf(stderr);
92      main_ac = argc;
93      main_av = argv;
94
95      printf("    ckb: Corsair RGB driver %s\n", CKB_VERSION_STR);
96      // If --help occurs anywhere in the command-line, don't launch the program but instead print usage
97      for(int i = 1; i < argc; i++){
98          if(!strcmp(argv[i], "--help")){
99              printf(
100 #ifdef OS_MAC
101                         "Usage: ckb-daemon [--gid=<gid>] [--hwload=<always|try|never>] [--nonotify]
    [--nobind] [--nomouseaccel] [--nonroot]\n"
102 #else
103                         "Usage: ckb-daemon [--gid=<gid>] [--hwload=<always|try|never>] [--nonotify]
    [--nobind] [--nonroot]\n"
104 #endif
105                         "\n"
106                         "See https://github.com/ccMSC/ckb/blob/master/DAEMON.md for full instructions.\n"
107                         "\n"
108                         "Command-line parameters:\n"
109                         "    --gid=<gid>\n"
110                         "        Restrict access to %s* nodes to users in group <gid>.\n"
111                         "        (Ordinarily they are accessible to anyone)\n"
112                         "    --hwload=<always|try|never>\n"
113                         "        --hwload=always will force loading of stored hardware profiles on
    compatible devices. May result in long start up times.\n"
114                         "        --hwload=try will try to load the profiles, but give up if not immediately
    successful (default).\n"
115                         "        --hwload=never will ignore hardware profiles completely.\n"
116                         "    --nonotify\n"
117                         "        Disables key monitoring/notifications.\n"
118                         "        Note that this makes reactive lighting impossible.\n"
119                         "    --nobind\n"
120                         "        Disables all key rebinding, macros, and notifications. Implies --nonotify.
    \n"
121 #ifdef OS_MAC
122                         "    --nomouseaccel\n"
123                         "        Disables mouse acceleration, even if the system preferences enable it.\n"
124 #endif
125                         "    --nonroot\n"
126                         "        Allows running ckb-daemon as a non root user.\n"
127                         "        This will almost certainly not work. Use only if you know what you're
    doing.\n"
128                         "\n", devpath);
129             exit(0);
130         }
131     }
132
133     // Check PID, quit if already running
134     char pidpath[strlen(devpath) + 6];
135     snprintf(pidpath, sizeof(pidpath), "%s0/pid", devpath);
136     FILE* pidfile = fopen(pidpath, "r");
137     if(pidfile){
138         pid_t pid;
139         fscanf(pidfile, "%d", &pid);
140         fclose(pidfile);
141         if(pid > 0){
142             // kill -s 0 checks if the PID is active but doesn't send a signal
143             if(!kill(pid, 0)){
144                 ckb_fatal_nofile("ckb-daemon is already running (PID %d). Try `killall
```

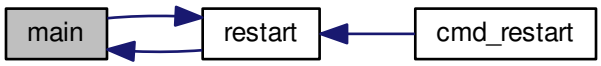
```
    ckb-daemon`.\n", pid);
145                 ckb_fatal_nofile("(If you're certain the process is dead, delete %s and try
    again)\n", pidpath);
146                 return 0;
147             }
148         }
149     }
150 
151     // Read parameters
152     int forceroot = 1;
153     for(int i = 1; i < argc; i++){
154         char* argument = argv[i];
155         unsigned newgid;
156         char hwload[7];
157         if(sscanf(argument, "--gid=%u", &newgid) == 1){
158             // Set dev node GID
159             gid = newgid;
160             ckb_info_nofile("Setting /dev node gid: %u\n", newgid);
161         } else if(!strcmp(argument, "--nobind")){
162             // Disable key notifications and rebinding
163             features_mask &= ~FEAT_BIND & ~FEAT_NOTIFY;
164             ckb_info_nofile("Key binding and key notifications are disabled\n");
165         } else if(!strcmp(argument, "--nonotify")){
166             // Disable key notifications
167             features_mask &= ~FEAT_NOTIFY;
168             ckb_info_nofile("Key notifications are disabled\n");
169         } else if(sscanf(argument, "--hwload=%6s", hwload) == 1){
170             if(!strcmp(hwload, "always") || !strcmp(hwload, "yes") || !strcmp(hwload, "y") || !strcmp(
    hwload, "a")){
171                 hwload_mode = 2;
172                 ckb_info_nofile("Setting hardware load: always\n");
173             } else if(!strcmp(hwload, "tryonce") || !strcmp(hwload, "try") || !strcmp(hwload, "once") || !
    strcmp(hwload, "t") || !strcmp(hwload, "o")){
174                 hwload_mode = 1;
175                 ckb_info_nofile("Setting hardware load: tryonce\n");
176             } else if(!strcmp(hwload, "never") || !strcmp(hwload, "none") || !strcmp(hwload, "no") || !
    strcmp(hwload, "n")){
177                 hwload_mode = 0;
178                 ckb_info_nofile("Setting hardware load: never\n");
179             }
180         } else if(!strcmp(argument, "--nonroot")){
181             // Allow running as a non-root user
182             forceroot = 0;
183         }
184 #ifdef OS_MAC
185         else if(!strcmp(argument, "--nomouseaccel")){
186             // On OSX, provide an option to disable mouse acceleration
187             features_mask &= ~FEAT_MOUSEACCEL;
188             ckb_info_nofile("Mouse acceleration disabled\n");
189         }
190 #endif
191     }
192 
193     // Check UID
194     if(getuid() != 0){
195         if(forceroot){
196             ckb_fatal_nofile("ckb-daemon must be run as root. Try `sudo %s`\n", argv[0]);
197             exit(0);
198         } else
199             ckb_warn_nofile("Warning: not running as root, allowing anyway per command-line
    parameter...\n");
200     }
201 
202     // Make root keyboard
203     umask(0);
204     memset(keyboard, 0, sizeof(keyboard));
205     if(!mkdevpath(keyboard))
206         ckb_info("Root controller ready at %s0\n", devpath);
207 
208     // Set signals
209     sigset_t signals;
210     sigfillset(&signals);
211     sigdelset(&signals, SIGTERM);
212     sigdelset(&signals, SIGINT);
213     sigdelset(&signals, SIGQUIT);
214     sigdelset(&signals, SIGUSR1);
215     // Set up signal handlers for quitting the service.
216     sigprocmask(SIG_SETMASK, &signals, 0);
217     signal(SIGTERM, sighandler);
218     signal(SIGINT, sighandler);
219     signal(SIGQUIT, sighandler);
220     signal(SIGUSR1, (void (*)())restart);
221 
222     // Start the USB system
223     int result = usbmain();
224     quit();
225     return result;
```

```
226 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.32.1.3 static void quit ( ) [static]

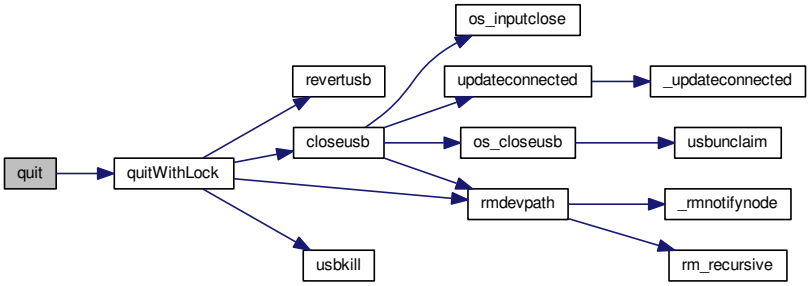
Definition at line 30 of file main.c.

References quitWithLock().

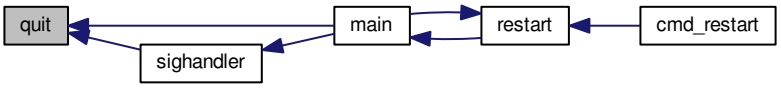
Referenced by main(), and sighandler().

```
30                  {
31     quitWithLock(1);
32 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.32.1.4 void quitWithLock (char *mut*) [static]

Parameters

mut	try to close files maybe without locking the mutex if mut == true then lock

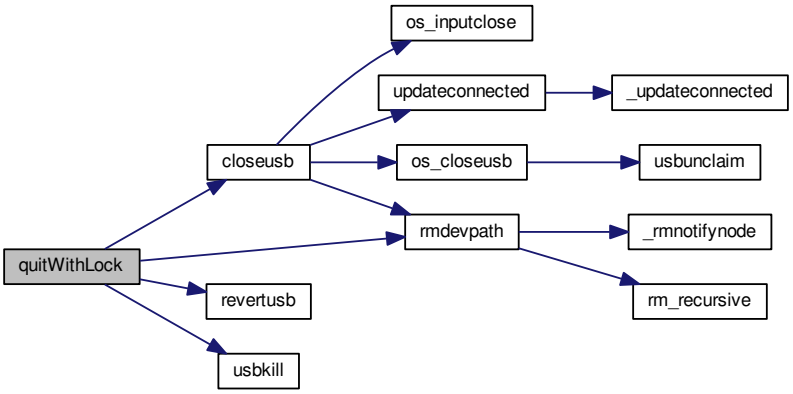
Definition at line 40 of file main.c.

References ckb_info, closeusb(), DEV_MAX, devmutex, IS_CONNECTED, keyboard, reset_stop, revertusb(), rmdevpath(), and usbkill().

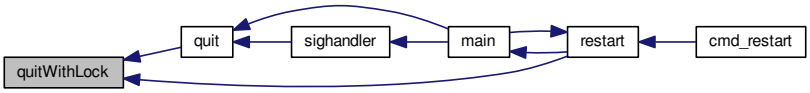
Referenced by quit(), and restart().

```
40                              {
41     // Abort any USB resets in progress
42     reset_stop = 1;
43     for(int i = 1; i < DEV_MAX; i++){
44         // Before closing, set all keyboards back to HID input mode so that the stock driver can still talk
       to them
45         if (mut) pthread_mutex_lock(devmutex + i);
46         if(IS_CONNECTED(keyboard + i)){
47             revertusb(keyboard + i);
48             closeusb(keyboard + i);
49         }
50         pthread_mutex_unlock(devmutex + i);
51     }
52     ckb_info("Closing root controller\n");
53     rmdevpath(keyboard);
54     usbkill();
55 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.32.1.5 int restart ( )

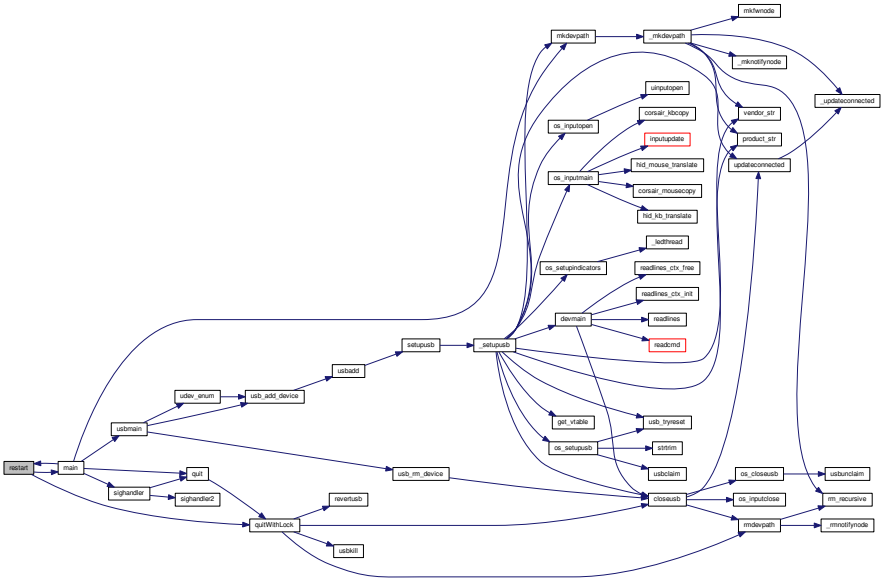
Definition at line 228 of file main.c.

References ckb_err, main(), main_ac, main_av, and quitWithLock().

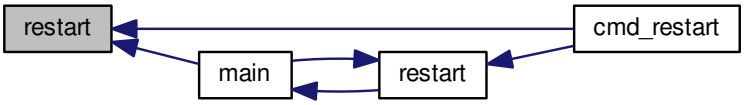
Referenced by cmd_restart(), and main().

```
228             {
229     ckb_err("restart called, running quit without mutex-lock.\n");
230     quitWithLock(0);
231     return main(main_ac, main_av);
232 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.32.1.6 void sighandler (int *type*)

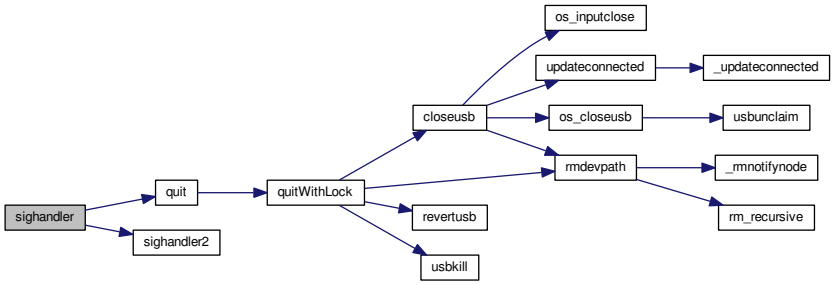
Definition at line 62 of file main.c.

References quit(), and sighandler2().

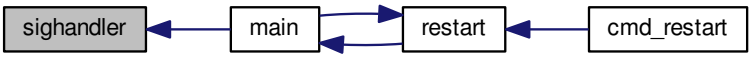
Referenced by main().

```
62                          {
63     signal(SIGTERM, sighandler2);
64     signal(SIGINT, sighandler2);
65     signal(SIGQUIT, sighandler2);
66     printf("\n[I] Caught signal %d\n", type);
67     quit();
68     exit(0);
69 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



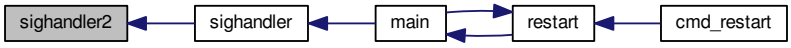
9.32.1.7 void sighandler2 (int *type*)

Definition at line 57 of file main.c.

Referenced by sighandler().

```
57                          {
58     // Don't use ckb_warn, we want an extra \n at the beginning
59     printf("\n[W] Ignoring signal %d (already shutting down)\n", type);
60 }
```

Here is the caller graph for this function:



9.32.1.8 void timespec_add (struct timespec * *timespec*, long *nanoseconds*)

Definition at line 19 of file main.c.

```
19                                                          {
20     nanoseconds += timespec->tv_nsec;
21     timespec->tv_sec += nanoseconds / 1000000000;
22     timespec->tv_nsec = nanoseconds % 1000000000;
23 }
```

9.32.2 Variable Documentation

9.32.2.1 int features_mask

features_mask Mask of features to exclude from all devices

That bit mask ist set to enable all (-1). When interpreting the input parameters, some of these bits can be cleared.

At the moment binding, notifying and mouse-acceleration can be disabled via command line.

Have a look at *main()* in main.c for details.

Definition at line 35 of file usb.c.

Referenced by _setupusb(), and main().

9.32.2.2 int hwload_mode

Definition at line 7 of file device.c.

Referenced by main().

9.32.2.3 int main_ac [static]

Definition at line 7 of file main.c.

Referenced by main(), and restart().

9.32.2.4 char** main_av [static]

Definition at line 8 of file main.c.

Referenced by main(), and restart().

9.32.2.5 volatile int reset_stop

reset_stop is boolean: Reset stopper for when the program shuts down.

Is set only by *quit()* to true (1) to inform several usb_* functions to end their loops and tries.

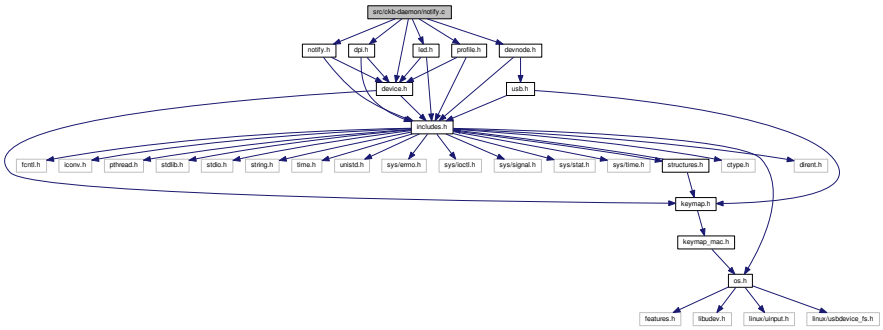
Definition at line 25 of file usb.c.

Referenced by _usbrecv(), _usbsend(), quitWithLock(), and usb_tryreset().

9.33 src/ckb-daemon/notify.c File Reference

```
#include "device.h"
#include "devnode.h"
#include "dpi.h"
#include "led.h"
#include "notify.h"
#include "profile.h"
```

Include dependency graph for notify.c:



Macros

- #define HWMODE_OR_RETURN(kb, index)
- #define HW_STANDARD

Functions

- void nprintf (usbdevice *kb, int nodenumber, usbmode *mode, const char *format,...)
- void nprintkey (usbdevice *kb, int nnumber, int keyindex, int down)
- void nprintind (usbdevice *kb, int nnumber, int led, int on)
- void cmd_notify (usbdevice *kb, usbmode *mode, int nnumber, int keyindex, const char *toggle)
- static void _cmd_get (usbdevice *kb, usbmode *mode, int nnumber, const char *setting)
- void cmd_get (usbdevice *kb, usbmode *mode, int nnumber, int dummy, const char *setting)
- int restart ()
- void cmd_restart (usbdevice *kb, usbmode *mode, int nnumber, int dummy, const char *content)

9.33.1 Macro Definition Documentation

9.33.1.1 #define HW_STANDARD

Value:

```
if(!kb->hw)                                         \
        return;                                     \
    unsigned index = INDEX_OF(mode, profile->mode); \
    /* Make sure the mode number is valid */        \
    HWMODE_OR_RETURN(kb, index)
```

Definition at line 83 of file notify.c.

Referenced by _cmd_get().

9.33.1.2 #define HWMODE_OR_RETURN(*kb, index*)

Value:

```
if(IS_K95(kb)){                 \
        if((index) >= HWMODE_K95)   \
            return;                 \
    } else {                        \
        if((index) >= HWMODE_K70)   \
            return;                 \
    }
```

Definition at line 73 of file notify.c.

9.33.2 Function Documentation

9.33.2.1 static void _cmd_get (usbdevice * kb, usbmode * mode, int nnumber, const char * setting) [static]

Definition at line 90 of file notify.c.

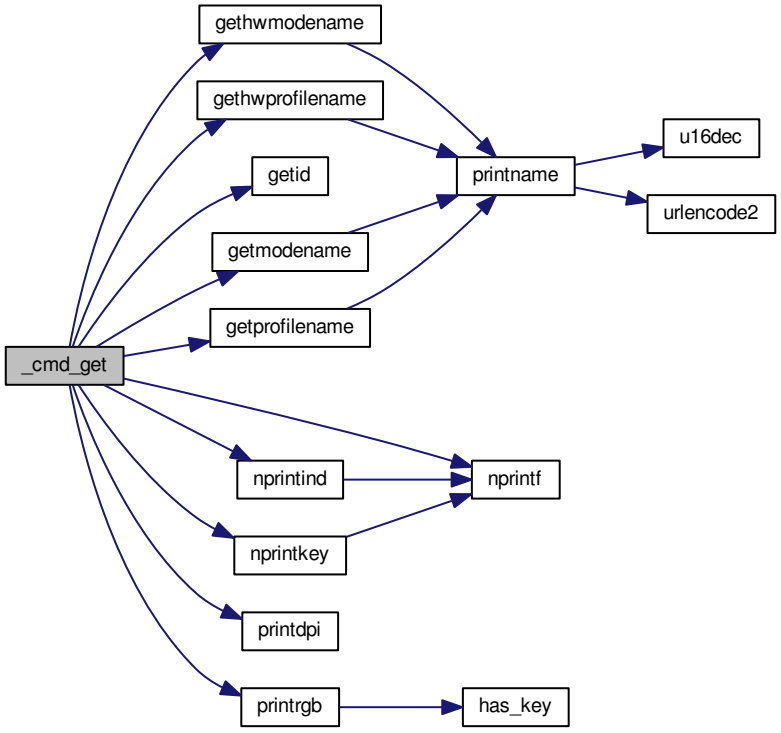
References dpiset::current, usbmode::dpi, hwprofile::dpi, gethwmodename(), gethwprofilename(), getid(), getmodename(), getprofilename(), usbdevice::hw, usbdevice::hw_ileds, HW_STANDARD, I_CAPS, I_NUM, I_SCROLL, usbmode::id, usbprofile::id, hwprofile::id, usbdevice::input, keymap, usbinput::keys, dpiset::lift, usbmode::light, hwprofile::light, usbid::modified, N_KEYS_INPUT, nprintf(), nprintind(), nprintkey(), printdpi(), printrgb(), usbdevice::profile, and dpiset::snap.

Referenced by cmd_get().

```
90                                                                                                  {
91      usbprofile* profile = kb->profile;
92      if(!strcmp(setting, ":mode")){
93          // Get the current mode number
94          nprintf(kb, nnumber, mode, "switch\n");
95          return;
96      } else if(!strcmp(setting, ":rgb")){
97          // Get the current RGB settings
98          char* rgb = printrgb(&mode->light, kb);
99          nprintf(kb, nnumber, mode, "rgb %s\n", rgb);
100          free(rgb);
101          return;
102      } else if(!strcmp(setting, ":hwrgb")){
103          // Get the current hardware RGB settings
104          HW_STANDARD;
105          char* rgb = printrgb(kb->hw->light + index, kb);
106          nprintf(kb, nnumber, mode, "hwrgb %s\n", rgb);
107          free(rgb);
108          return;
109      } else if(!strcmp(setting, ":profilename")){
110          // Get the current profile name
111          char* name = getprofilename(profile);
112          nprintf(kb, nnumber, 0, "profilename %s\n", name[0] ? name : "Unnamed");
113          free(name);
114      } else if(!strcmp(setting, ":name")){
115          // Get the current mode name
116          char* name = getmodename(mode);
117          nprintf(kb, nnumber, mode, "name %s\n", name[0] ? name : "Unnamed");
118          free(name);
119      } else if(!strcmp(setting, ":hwprofilename")){
120          // Get the current hardware profile name
121          if(!kb->hw)
122              return;
123          char* name = gethwprofilename(kb->hw);
124          nprintf(kb, nnumber, 0, "hwprofilename %s\n", name[0] ? name : "Unnamed");
125          free(name);
126      } else if(!strcmp(setting, ":hwname")){
127          // Get the current hardware mode name
128          HW_STANDARD;
129          char* name = gethwmodename(kb->hw, index);
130          nprintf(kb, nnumber, mode, "hwname %s\n", name[0] ? name : "Unnamed");
131          free(name);
132      } else if(!strcmp(setting, ":profileid")){
133          // Get the current profile ID
134          char* guid = getid(&profile->id);
135          int modified;
136          memcpy(&modified, &profile->id.modified, sizeof(modified));
137          nprintf(kb, nnumber, 0, "profileid %s %x\n", guid, modified);
138          free(guid);
139      } else if(!strcmp(setting, ":id")){
140          // Get the current mode ID
141          char* guid = getid(&mode->id);
142          int modified;
143          memcpy(&modified, &mode->id.modified, sizeof(modified));
144          nprintf(kb, nnumber, mode, "id %s %x\n", guid, modified);
145          free(guid);
146      } else if(!strcmp(setting, ":hwprofileid")){
147          // Get the current hardware profile ID
148          if(!kb->hw)
149              return;
150          char* guid = getid(&kb->hw->id[0]);
151          int modified;
152          memcpy(&modified, &kb->hw->id[0].modified, sizeof(modified));
153          nprintf(kb, nnumber, 0, "hwprofileid %s %x\n", guid, modified);
```

```
154         free(guid);
155     } else if(!strcmp(setting, ":hwid")){
156         // Get the current hardware mode ID
157         HW_STANDARD;
158         char* guid = getid(&kb->hw->id[index + 1]);
159         int modified;
160         memcpy(&modified, &kb->hw->id[index + 1].modified, sizeof(modified));
161         nprintf(kb, nnumber, mode, "hwid %s %x\n", guid, modified);
162         free(guid);
163     } else if(!strcmp(setting, ":keys")){
164         // Get the current state of all keys
165         for(int i = 0; i < N_KEYS_INPUT; i++){
166             if(!keymap[i].name)
167                 continue;
168             int byte = i / 8, bit = 1 << (i & 7);
169             uchar state = kb->input.keys[byte] & bit;
170             if(state)
171                 nprintkey(kb, nnumber, i, 1);
172         }
173     } else if(!strcmp(setting, ":i")){
174         // Get the current state of all indicator LEDs
175         if(kb->hw_ileds & I_NUM) nprintind(kb, nnumber,
    I_NUM, 1);
176         if(kb->hw_ileds & I_CAPS) nprintind(kb, nnumber,
    I_CAPS, 1);
177         if(kb->hw_ileds & I_SCROLL) nprintind(kb, nnumber,
    I_SCROLL, 1);
178     } else if(!strcmp(setting, ":dpi")){
179         // Get the current DPI levels
180         char* dpi = printdpi(&mode->dpi, kb);
181         nprintf(kb, nnumber, mode, "dpi %s\n", dpi);
182         free(dpi);
183         return;
184     } else if(!strcmp(setting, ":hwdpi")){
185         // Get the current hardware DPI levels
186         HW_STANDARD;
187         char* dpi = printdpi(kb->hw->dpi + index, kb);
188         nprintf(kb, nnumber, mode, "hwdpi %s\n", dpi);
189         free(dpi);
190         return;
191     } else if(!strcmp(setting, ":dpisel")){
192         // Get the currently-selected DPI
193         nprintf(kb, nnumber, mode, "dpisel %d\n", mode->dpi.current);
194     } else if(!strcmp(setting, ":hwdpisel")){
195         // Get the currently-selected hardware DPI
196         HW_STANDARD;
197         nprintf(kb, nnumber, mode, "hwdpisel %d\n", kb->hw->dpi[index].
    current);
198     } else if(!strcmp(setting, ":lift")){
199         // Get the mouse lift height
200         nprintf(kb, nnumber, mode, "lift %d\n", mode->dpi.lift);
201     } else if(!strcmp(setting, ":hwlift")){
202         // Get the hardware lift height
203         HW_STANDARD;
204         nprintf(kb, nnumber, mode, "hwlift %d\n", kb->hw->dpi[index].
    lift);
205     } else if(!strcmp(setting, ":snap")){
206         // Get the angle snap status
207         nprintf(kb, nnumber, mode, "snap %s\n", mode->dpi.snap ? "on" : "off");
208     } else if(!strcmp(setting, ":hwsnap")){
209         // Get the hardware angle snap status
210         HW_STANDARD;
211         nprintf(kb, nnumber, mode, "hwsnap %s\n", kb->hw->dpi[index].
    snap ? "on" : "off");
212     }
213 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

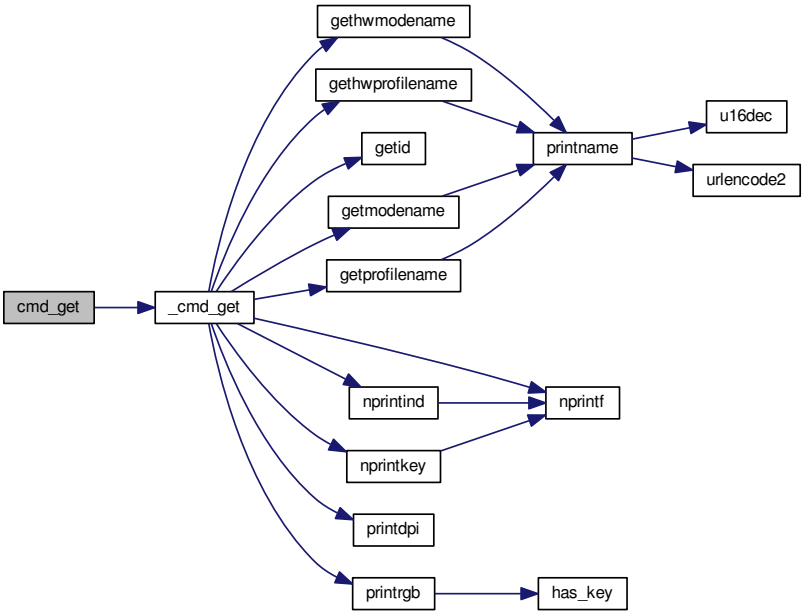
9.33.2.2 void cmd_get (usbdevice * *kb*, usbmode * *mode*, int *nnumber*, int *dummy*, const char * *setting*)

Definition at line 215 of file notify.c.

References _cmd_get(), and imutex.

```
215                                                                                 {
216     pthread_mutex_lock(imutex(kb));
217     _cmd_get(kb, mode, nnumber, setting);
218     pthread_mutex_unlock(imutex(kb));
219 }
```

Here is the call graph for this function:



9.33.2.3 void cmd_notify (usbdevice * *kb*, usbmode * *mode*, int *nnumber*, int *keyindex*, const char * *toggle*)

Definition at line 61 of file notify.c.

References CLEAR_KEYBIT, imutex, N_KEYS_INPUT, usbmode::notify, and SET_KEYBIT.

```
61                                                                                  {
62     if(keyindex >= N_KEYS_INPUT)
63         return;
64     pthread_mutex_lock(imutex(kb));
65     if(!strcmp(toggle, "on") || *toggle == 0)
66         SET_KEYBIT(mode->notify[nnumber], keyindex);
67     else if(!strcmp(toggle, "off"))
68         CLEAR_KEYBIT(mode->notify[nnumber], keyindex);
69     pthread_mutex_unlock(imutex(kb));
70 }
```

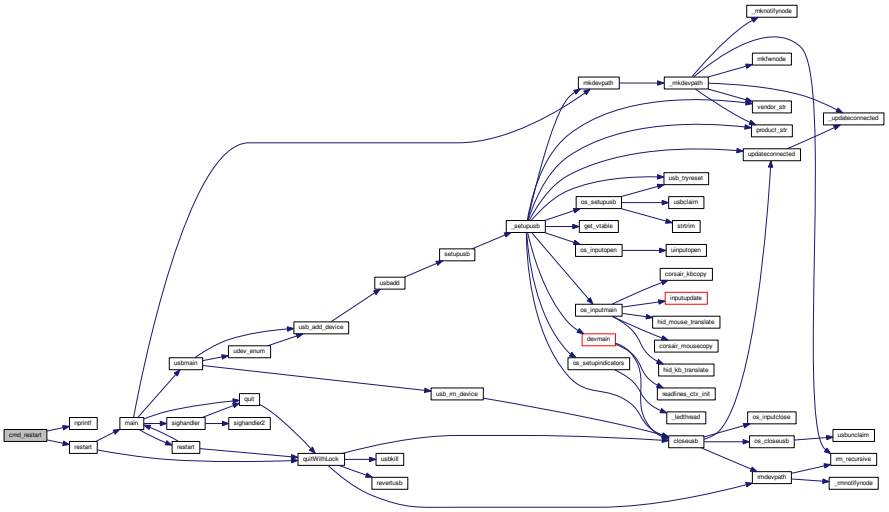
9.33.2.4 void cmd_restart (usbdevice * *kb*, usbmode * *mode*, int *nnumber*, int *dummy*, const char * *content*)

Definition at line 223 of file notify.c.

References ckb_info, nprintf(), and restart().

```
223                                                                                 {
224     ckb_info("RESTART called with %s\n", content);
225     nprintf(kb, -1, 0, "RESTART called with %s\n", content);
226     restart();
227 }
```

Here is the call graph for this function:



9.33.2.5 void nprintf (usbdevice ∗ *kb*, int *nodenumber*, usbmode ∗ *mode*, const char ∗ *format*, ...)

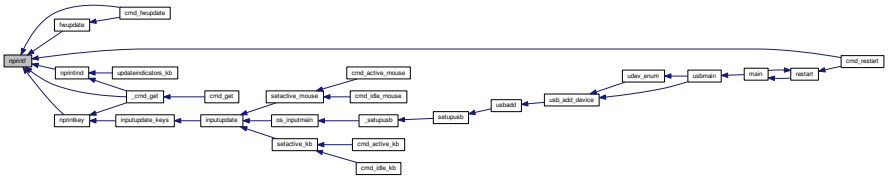
Definition at line 8 of file notify.c.

References INDEX_OF, usbprofile::mode, usbdevice::outfifo, OUTFIFO_MAX, and usbdevice::profile.

Referenced by _cmd_get(), cmd_fwupdate(), cmd_restart(), fwupdate(), nprintind(), and nprintkey().

```
8                                                                                    {
9     if(!kb)
10         return;
11     usbprofile* profile = kb->profile;
12     va_list va_args;
13     int fifo;
14     if(nodenumber >= 0){
15         // If node number was given, print to that node (if open)
16         if((fifo = kb->outfifo[nodenumber] - 1) != -1){
17             va_start(va_args, format);
18             if(mode)
19                 dprintf(fifo, "mode %d ", INDEX_OF(mode, profile->mode) + 1);
20             vdprintf(fifo, format, va_args);
21         }
22         return;
23     }
24     // Otherwise, print to all nodes
25     for(int i = 0; i < OUTFIFO_MAX; i++){
26         if((fifo = kb->outfifo[i] - 1) != -1){
27             va_start(va_args, format);
28             if(mode)
29                 dprintf(fifo, "mode %d ", INDEX_OF(mode, profile->mode) + 1);
30             vdprintf(fifo, format, va_args);
31         }
32     }
33 }
```

Here is the caller graph for this function:



9.33.2.6 void nprintind (usbdevice * *kb*, int *nnumber*, int *led*, int *on*)

Definition at line 43 of file notify.c.

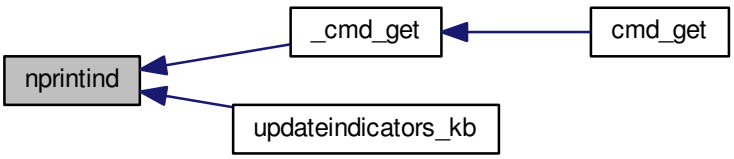
References I_CAPS, I_NUM, I_SCROLL, and nprintf().

Referenced by _cmd_get(), and updateindicators_kb().

```
43                                                                  {
44     const char* name = 0;
45     switch(led){
46     case I_NUM:
47         name = "num";
48         break;
49     case I_CAPS:
50         name = "caps";
51         break;
52     case I_SCROLL:
53         name = "scroll";
54         break;
55     default:
56         return;
57     }
58     nprintf(kb, nnumber, 0, "i %c%s\n", on ? '+' : '-', name);
59 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.33.2.7 void nprintkey (usbdevice * *kb*, int *nnumber*, int *keyindex*, int *down*)

Definition at line 35 of file notify.c.

References keymap, key::name, and nprintf().

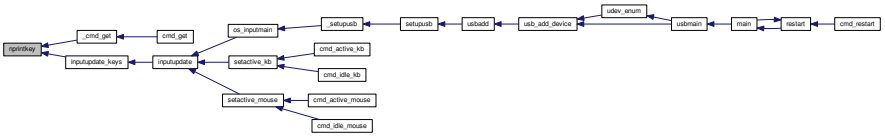
Referenced by _cmd_get(), and inputupdate_keys().

```
35                                                                  {
36     const key* map = keymap + keyindex;
37     if(map->name)
```

```
38         nprintf(kb, nnumber, 0, "key %c%s\n", down ? '+' : '-', map->name);
39     else
40         nprintf(kb, nnumber, 0, "key %c#%d\n", down ? '+' : '-', keyindex);
41 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.33.2.8 int restart ( )

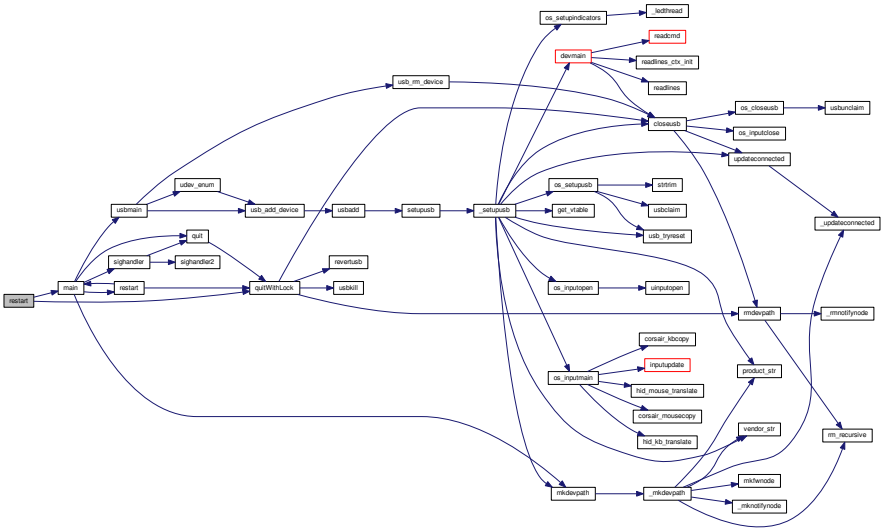
Definition at line 228 of file main.c.

References ckb_err, main(), main_ac, main_av, and quitWithLock().

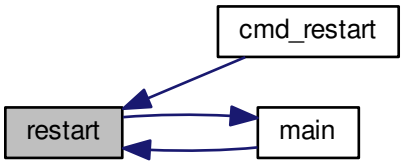
Referenced by cmd_restart(), and main().

```
228             {
229     ckb_err("restart called, running quit without mutex-lock.\n");
230     quitWithLock(0);
231     return main(main_ac, main_av);
232 }
```

Here is the call graph for this function:



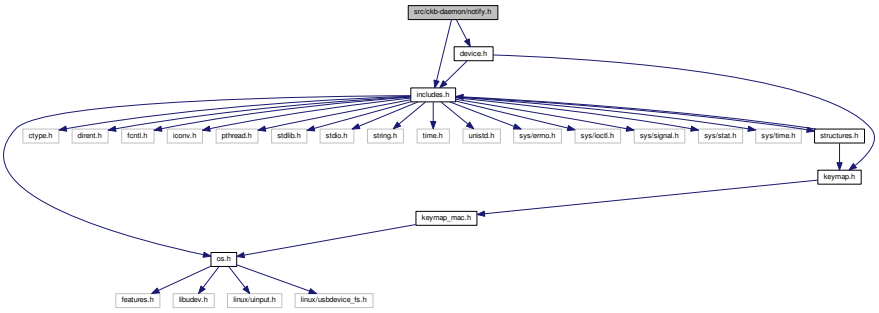
Here is the caller graph for this function:



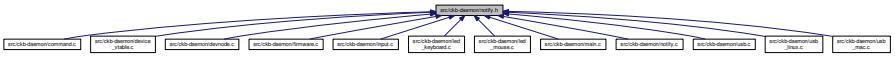
9.34 src/ckb-daemon/notify.h File Reference

```
#include "includes.h"
#include "device.h"
```

Include dependency graph for notify.h:



This graph shows which files directly or indirectly include this file:



Functions

- void nprintf (usbdevice *kb, int nodenumber, usbmode *mode, const char *format,...)
- void nprintkey (usbdevice *kb, int nnumber, int keyindex, int down)
- void nprintind (usbdevice *kb, int nnumber, int led, int on)
- void cmd_notify (usbdevice *kb, usbmode *mode, int nnumber, int keyindex, const char *toggle)
- void cmd_get (usbdevice *kb, usbmode *mode, int nnumber, int dummy, const char *setting)
- void cmd_restart (usbdevice *kb, usbmode *mode, int nnumber, int dummy, const char *content)

9.34.1 Function Documentation

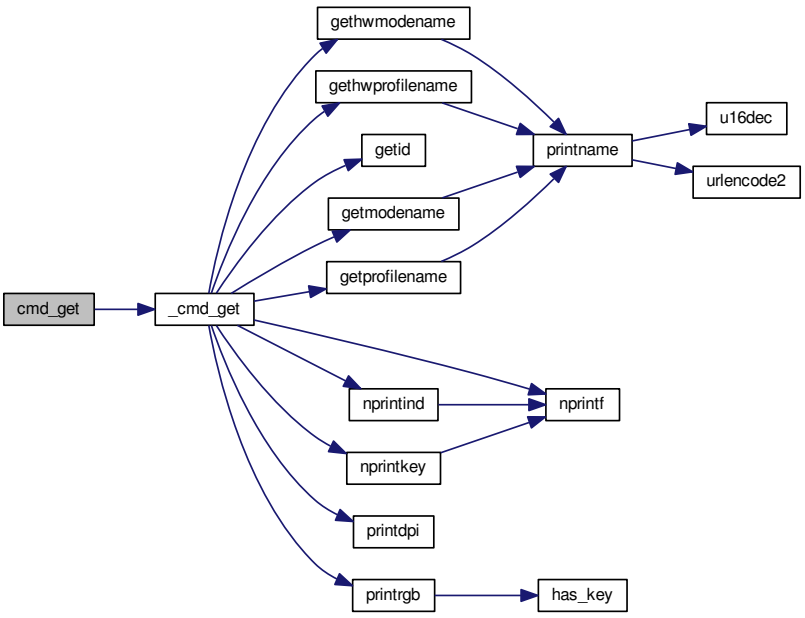
9.34.1.1 void cmd_get (usbdevice * *kb,* usbmode * *mode,* int *nnumber,* int *dummy,* const char * *setting*)

Definition at line 215 of file notify.c.

References _cmd_get(), and imutex.

```
215                                                                                                 {
216     pthread_mutex_lock(imutex(kb));
217     _cmd_get(kb, mode, nnumber, setting);
218     pthread_mutex_unlock(imutex(kb));
219 }
```

Here is the call graph for this function:



9.34.1.2 void cmd_notify (usbdevice * kb, usbmode * mode, int nnumber, int keyindex, const char * toggle)

Definition at line 61 of file notify.c.

References CLEAR_KEYBIT, imutex, N_KEYS_INPUT, usbmode::notify, and SET_KEYBIT.

```
61                                                                                                  {
62     if(keyindex >= N_KEYS_INPUT)
63         return;
64     pthread_mutex_lock(imutex(kb));
65     if(!strcmp(toggle, "on") || *toggle == 0)
66         SET_KEYBIT(mode->notify[nnumber], keyindex);
67     else if(!strcmp(toggle, "off"))
68         CLEAR_KEYBIT(mode->notify[nnumber], keyindex);
69     pthread_mutex_unlock(imutex(kb));
70 }
```

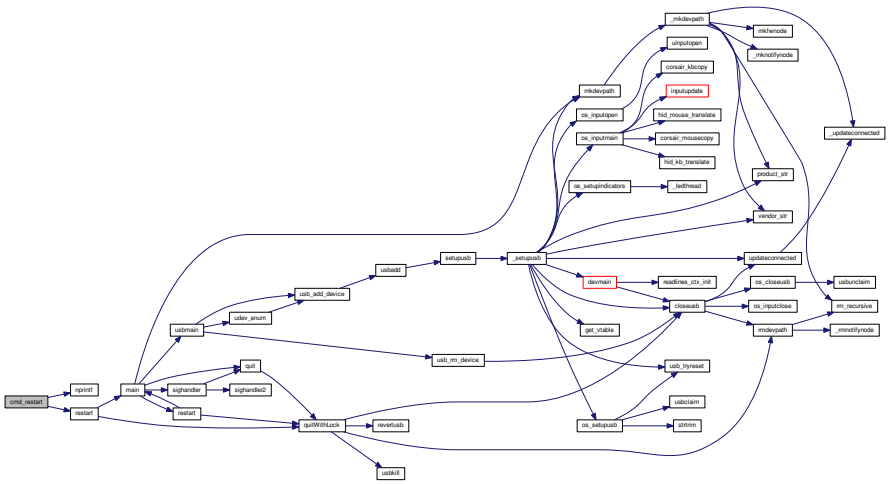
9.34.1.3 void cmd_restart (usbdevice * kb, usbmode * mode, int nnumber, int dummy, const char * content)

Definition at line 223 of file notify.c.

References ckb_info, nprintf(), and restart().

```
223                                                                                                 {
224     ckb_info("RESTART called with %s\n", content);
225     nprintf(kb, -1, 0, "RESTART called with %s\n", content);
226     restart();
227 }
```

Here is the call graph for this function:



9.34.1.4 void nprintf (usbdevice * kb, int nodenumber, usbmode * mode, const char * format, ...)

Definition at line 8 of file notify.c.

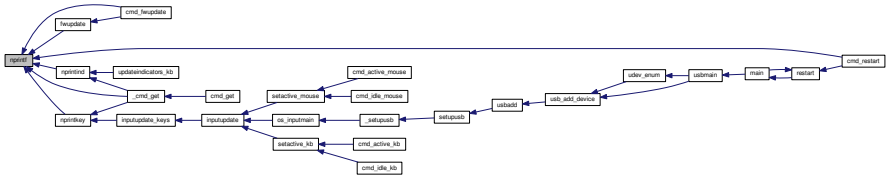
References INDEX_OF, usbprofile::mode, usbdevice::outfifo, OUTFIFO_MAX, and usbdevice::profile.

Referenced by _cmd_get(), cmd_fwupdate(), cmd_restart(), fwupdate(), nprintind(), and nprintkey().

```
8                                                                                                   {
9     if(!kb)
10         return;
11     usbprofile* profile = kb->profile;
12     va_list va_args;
13     int fifo;
```

```
14      if(nodenumber >= 0){
15          // If node number was given, print to that node (if open)
16          if((fifo = kb->outfifo[nodenumber] - 1) != -1){
17              va_start(va_args, format);
18              if(mode)
19                  dprintf(fifo, "mode %d ", INDEX_OF(mode, profile->mode) + 1);
20              vdprintf(fifo, format, va_args);
21          }
22          return;
23      }
24      // Otherwise, print to all nodes
25      for(int i = 0; i < OUTFIFO_MAX; i++){
26          if((fifo = kb->outfifo[i] - 1) != -1){
27              va_start(va_args, format);
28              if(mode)
29                  dprintf(fifo, "mode %d ", INDEX_OF(mode, profile->mode) + 1);
30              vdprintf(fifo, format, va_args);
31          }
32      }
33  }
```

Here is the caller graph for this function:



9.34.1.5 void nprintind (usbdevice * *kb*, int *nnumber*, int *led*, int *on*)

Definition at line 43 of file notify.c.

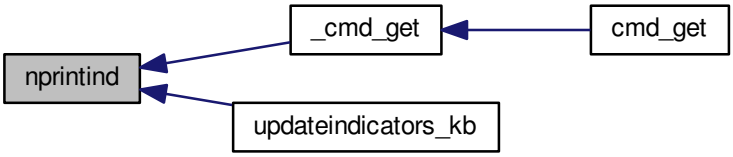
References I_CAPS, I_NUM, I_SCROLL, and nprintf().

Referenced by _cmd_get(), and updateindicators_kb().

```
43                                                                  {
44      const char* name = 0;
45      switch(led){
46      case I_NUM:
47          name = "num";
48          break;
49      case I_CAPS:
50          name = "caps";
51          break;
52      case I_SCROLL:
53          name = "scroll";
54          break;
55      default:
56          return;
57      }
58      nprintf(kb, nnumber, 0, "i %c%s\n", on ? '+' : '-', name);
59  }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.34.1.6 void nprintkey (usbdevice * *kb,* int *nnumber,* int *keyindex,* int *down*)

Definition at line 35 of file notify.c.

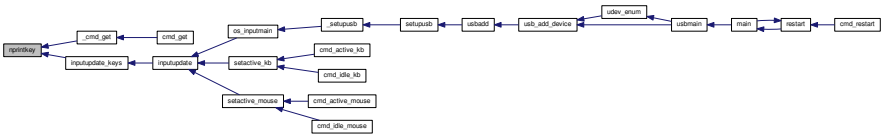
References keymap, key::name, and nprintf().

Referenced by _cmd_get(), and inputupdate_keys().

```
35                                                                  {
36     const key* map = keymap + keyindex;
37     if(map->name)
38         nprintf(kb, nnumber, 0, "key %c%s\n", down ? '+' : '-', map->name);
39     else
40         nprintf(kb, nnumber, 0, "key %c#%d\n", down ? '+' : '-', keyindex);
41 }
```

Here is the call graph for this function:

Here is the caller graph for this function:

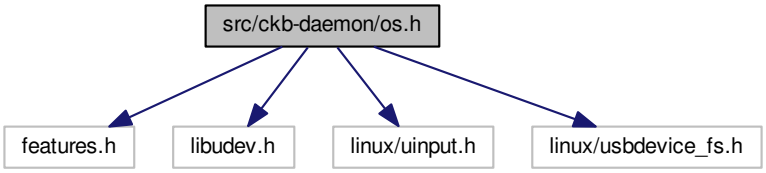


9.35 src/ckb-daemon/os.h File Reference

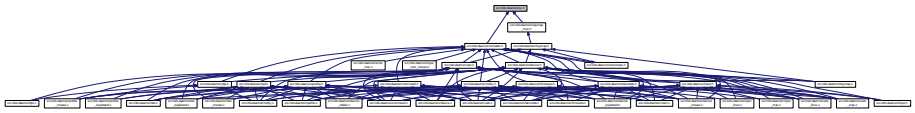
```
#include <features.h>
```

```
#include <libudev.h>
#include <linux/uinput.h>
#include <linux/usbdevice_fs.h>
```

Include dependency graph for os.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define _DEFAULT_SOURCE
- #define _GNU_SOURCE
- #define UINPUT_VERSION 2
- #define euid_guard_start
- #define euid_guard_stop

9.35.1 Macro Definition Documentation

9.35.1.1 #define _DEFAULT_SOURCE

Definition at line 22 of file os.h.

9.35.1.2 #define _GNU_SOURCE

Definition at line 26 of file os.h.

9.35.1.3 #define euid_guard_start

Definition at line 40 of file os.h.

Referenced by mkdevpath(), mknotifynode(), rmdevpath(), rmnotifynode(), and updateconnected().

9.35.1.4 #define euid_guard_stop

Definition at line 41 of file os.h.

Referenced by mkdevpath(), mknotifynode(), rmdevpath(), rmnotifynode(), and updateconnected().

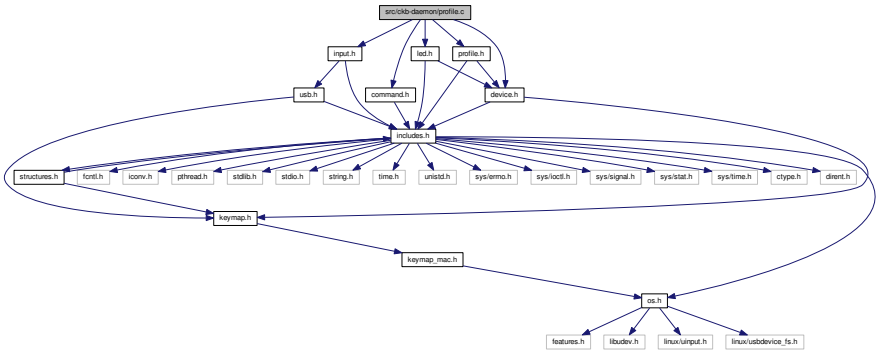
9.35.1.5 #define UINPUT_VERSION 2

Definition at line 35 of file os.h.

9.36 src/ckb-daemon/profile.c File Reference

```
#include "command.h"
#include "device.h"
#include "input.h"
#include "led.h"
#include "profile.h"
```

Include dependency graph for profile.c:



Functions

- void urldecode2 (char *dst, const char *src)
- void urlencode2 (char *dst, const char *src)
- int setid (usbid *id, const char *guid)
- char * getid (usbid *id)
- void u16enc (char *in, ushort *out, size_t *srclen, size_t *dstlen)
- void u16dec (ushort *in, char *out, size_t *srclen, size_t *dstlen)
- void cmd_name (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *name)
- void cmd_profilename (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *name)
- char * printname (ushort *name, int length)
- char * getmodename (usbmode *mode)
- char * getprofilename (usbprofile *profile)
- char * gethwmodename (hwprofile *profile, int index)
- char * gethwprofilename (hwprofile *profile)
- void cmd_id (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *id)
- void cmd_profileid (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *id)
- static void initmode (usbmode *mode)
- void allocprofile (usbdevice *kb)
- int loadprofile (usbdevice *kb)
- static void freemode (usbmode *mode)
- void cmd_erase (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *dummy3)
- static void _freeprofile (usbdevice *kb)
- void cmd_eraseprofile (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- void freeprofile (usbdevice *kb)
- void hwtonative (usbprofile *profile, hwprofile *hw, int modecount)
- void nativetohw (usbprofile *profile, hwprofile *hw, int modecount)

Variables

- static iconv_t utf8to16 = 0
- static iconv_t utf16to8 = 0

9.36.1 Function Documentation

9.36.1.1 static void _freeprofile (usbdevice * kb) [static]

Definition at line 210 of file profile.c.

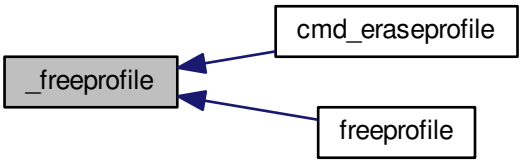
References freemode(), usbprofile::mode, MODE_COUNT, and usbdevice::profile.

Referenced by cmd_eraseprofile(), and freeprofile().

```
210                                         {
211     usbprofile* profile = kb->profile;
212     if(!profile)
213         return;
214     // Clear all mode data
215     for(int i = 0; i < MODE_COUNT; i++)
216         freemode(profile->mode + i);
217     free(profile);
218     kb->profile = 0;
219 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.36.1.2 void allocprofile (usbdevice * kb)

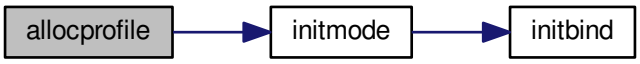
Definition at line 182 of file profile.c.

References usbprofile::currentmode, dpiset::forceupdate, lighting::forceupdate, initmode(), usbprofile::lastdpi, usbprofile::lastlight, usbprofile::mode, MODE_COUNT, and usbdevice::profile.

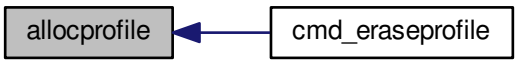
Referenced by cmd_eraseprofile().

```
182                                 {
183     if(kb->profile)
184         return;
185     usbprofile* profile = kb->profile = calloc(1, sizeof(
      usbprofile));
186     for(int i = 0; i < MODE_COUNT; i++)
187         initmode(profile->mode + i);
188     profile->currentmode = profile->mode;
189     profile->lastlight.forceupdate = profile->lastdpi.
      forceupdate = 1;
190 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



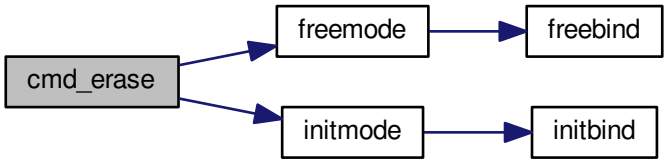
9.36.1.3 void cmd_erase (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *dummy3*)

Definition at line 203 of file profile.c.

References freemode(), imutex, and initmode().

```
203                                                                                 {
204     pthread_mutex_lock(imutex(kb));
205     freemode(mode);
206     initmode(mode);
207     pthread_mutex_unlock(imutex(kb));
208 }
```

Here is the call graph for this function:



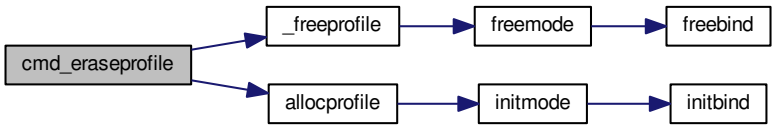
9.36.1.4 void cmd_eraseprofile (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*)

Definition at line 221 of file profile.c.

References _freeprofile(), allocprofile(), and imutex.

```
221                                                                                                 {
222     pthread_mutex_lock(imutex(kb));
223     _freeprofile(kb);
224     allocprofile(kb);
225     pthread_mutex_unlock(imutex(kb));
226 }
```

Here is the call graph for this function:



9.36.1.5 void cmd_id (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *id*)

Definition at line 160 of file profile.c.

References usbmode::id, usbid::modified, and setid().

```
160                                                                                                 {
161     // ID is either a GUID or an 8-digit hex number
162     int newmodified;
163     if(!setid(&mode->id, id) && sscanf(id, "%08x", &newmodified) == 1)
164         memcpy(mode->id.modified, &newmodified, sizeof(newmodified));
165 }
```

Here is the call graph for this function:

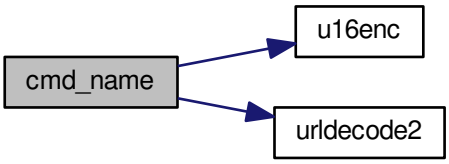
9.36.1.6 void cmd_name (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *name*)

Definition at line 117 of file profile.c.

References MD_NAME_LEN, usbmode::name, u16enc(), and urldecode2().

```
117                                                                                                 {
118     char decoded[strlen(name) + 1];
119     urldecode2(decoded, name);
120     size_t srclen = strlen(decoded), dstlen = MD_NAME_LEN;
121     u16enc(decoded, mode->name, &srclen, &dstlen);
122 }
```

Here is the call graph for this function:



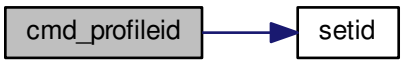
9.36.1.7 void cmd_profileid (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *id*)

Definition at line 167 of file profile.c.

References usbprofile::id, usbid::modified, usbdevice::profile, and setid().

```
167                                                                                                 {
168     usbprofile* profile = kb->profile;
169     int newmodified;
170     if(!setid(&profile->id, id) && sscanf(id, "%08x", &newmodified) == 1)
171         memcpy(profile->id.modified, &newmodified, sizeof(newmodified));
172
173 }
```

Here is the call graph for this function:



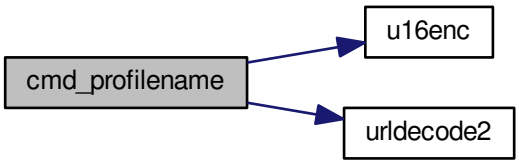
9.36.1.8 void cmd_profilename (usbdevice * kb, usbmode * dummy1, int dummy2, int dummy3, const char * name)

Definition at line 124 of file profile.c.

References usbprofile::name, PR_NAME_LEN, usbdevice::profile, u16enc(), and urldecode2().

```
124                                                                                                 {
125     usbprofile* profile = kb->profile;
126     char decoded[strlen(name) + 1];
127     urldecode2(decoded, name);
128     size_t srclen = strlen(decoded), dstlen = PR_NAME_LEN;
129     u16enc(decoded, profile->name, &srclen, &dstlen);
130 }
```

Here is the call graph for this function:



9.36.1.9 static void freemode (usbmode * mode) [static]

Definition at line 198 of file profile.c.

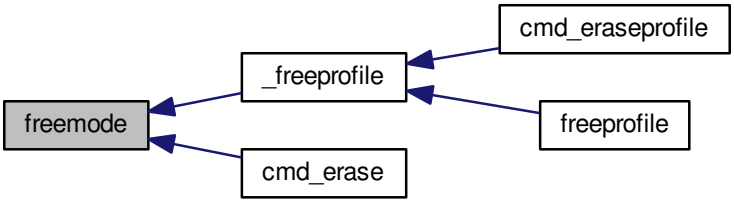
References usbmode::bind, and freebind().

Referenced by _freeprofile(), and cmd_erase().

```
198                                 {
199     freebind(&mode->bind);
200     memset(mode, 0, sizeof(*mode));
201 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



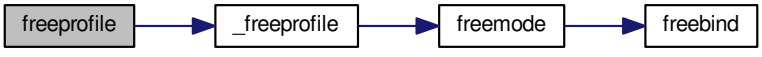
9.36.1.10 void freeprofile (usbdevice * *kb*)

Definition at line 228 of file profile.c.

References _freeprofile(), and usbdevice::hw.

```
228                                {
229     _freeprofile(kb);
230     // Also free HW profile
231     free(kb->hw);
232     kb->hw = 0;
233 }
```

Here is the call graph for this function:



9.36.1.11 char* gethwmodename (hwprofile * *profile,* int *index*)

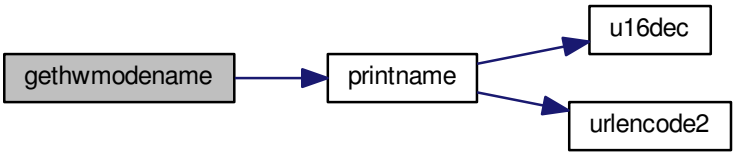
Definition at line 152 of file profile.c.

References MD_NAME_LEN, hwprofile::name, and printname().

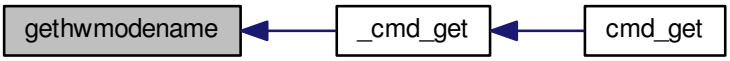
Referenced by _cmd_get().

```
152                                                 {
153     return printname(profile->name[index + 1], MD_NAME_LEN);
154 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.36.1.12 char* gethwprofilename (hwprofile * *profile*)

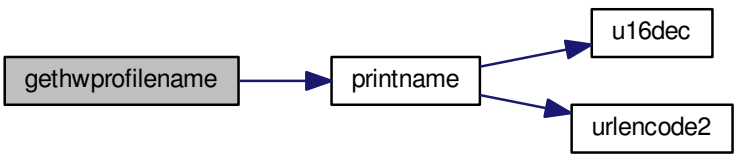
Definition at line 156 of file profile.c.

References MD_NAME_LEN, hwprofile::name, and printname().

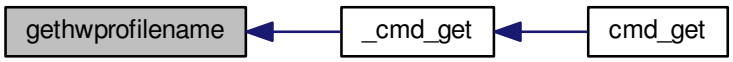
Referenced by _cmd_get().

```
156                                                 {
157     return printname(profile->name[0], MD_NAME_LEN);
158 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.36.1.13 char* getid (usbid * *id*)

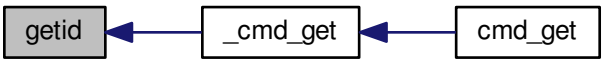
Definition at line 79 of file profile.c.

References usbid::guid.

Referenced by _cmd_get().

```
79                      {
80     int32_t data1;
81     int16_t data2, data3, data4a;
82     char data4b[6];
83     memcpy(&data1, id->guid + 0x0, 4);
84     memcpy(&data2, id->guid + 0x4, 2);
85     memcpy(&data3, id->guid + 0x6, 2);
86     memcpy(&data4a, id->guid + 0x8, 2);
87     memcpy(data4b, id->guid + 0xA, 6);
88     char* guid = malloc(39);
89     snprintf(guid, 39, "{%08X-%04hX-%04hX-%04hX-%02hhX%02hhX%02hhX%02hhX%02hhX%02hhX}",
90              data1, data2, data3, data4a, data4b[0], data4b[1], data4b[2], data4b[3], data4b[4], data4b[5])
     ;
91     return guid;
92 }
```

Here is the caller graph for this function:



9.36.1.14 char* getmodename (usbmode * *mode*)

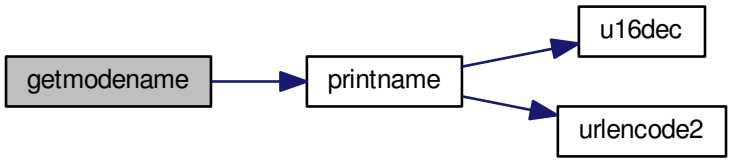
Definition at line 144 of file profile.c.

References MD_NAME_LEN, usbmode::name, and printname().

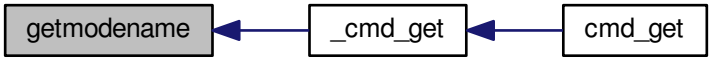
Referenced by _cmd_get().

```
144                                 {
145     return printname(mode->name, MD_NAME_LEN);
146 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.36.1.15 char* getprofilename (usbprofile * *profile*)

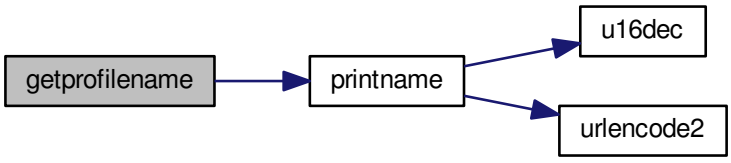
Definition at line 148 of file profile.c.

References usbprofile::name, PR_NAME_LEN, and printname().

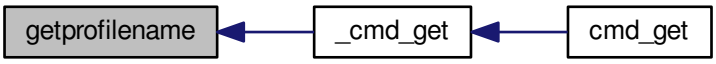
Referenced by _cmd_get().

```
148                                          {
149     return printname(profile->name, PR_NAME_LEN);
150 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.36.1.16 void hwtonative (usbprofile * *profile,* hwprofile * *hw,* int *modecount*)

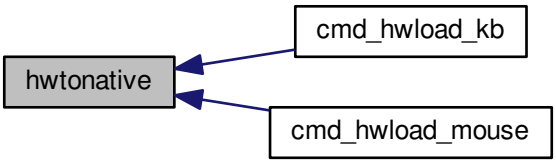
Definition at line 235 of file profile.c.

References usbmode::dpi, hwprofile::dpi, dpiset::forceupdate, lighting::forceupdate, usbmode::id, usbprofile::id, hwprofile::id, usbprofile::lastdpi, usbprofile::lastlight, usbmode::light, hwprofile::light, MD_NAME_LEN, usbprofile::mode, usbmode::name, usbprofile::name, hwprofile::name, and PR_NAME_LEN.

Referenced by cmd_hwload_kb(), and cmd_hwload_mouse().

```
235                                                                 {
236     // Copy the profile name and ID
237     memcpy(profile->name, hw->name[0], PR_NAME_LEN * 2);
238     memcpy(&profile->id, hw->id, sizeof(usbid));
239     // Copy the mode settings
240     for(int i = 0; i < modecount; i++){
241         usbmode* mode = profile->mode + i;
242         memcpy(mode->name, hw->name[i + 1], MD_NAME_LEN * 2);
243         memcpy(&mode->id, hw->id + i + 1, sizeof(usbid));
244         memcpy(&mode->light, hw->light + i, sizeof(lighting));
245         memcpy(&mode->dpi, hw->dpi + i, sizeof(dpiset));
246         // Set a force update on the light/DPI since they've been overwritten
247         mode->light.forceupdate = mode->dpi.forceupdate = 1;
248     }
249     profile->lastlight.forceupdate = profile->lastdpi.
      forceupdate = 1;
250 }
```

Here is the caller graph for this function:



9.36.1.17 static void initmode (usbmode * *mode*) [static]

Definition at line 175 of file profile.c.

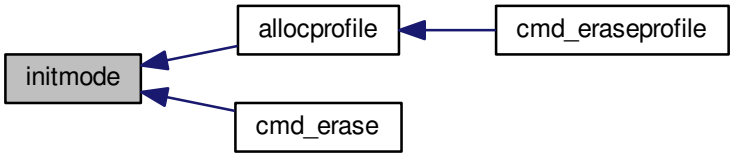
References usbmode::bind, usbmode::dpi, dpiset::forceupdate, lighting::forceupdate, initbind(), and usbmode::light.

Referenced by allocprofile(), and cmd_erase().

```
175                                     {
176     memset(mode, 0, sizeof(*mode));
177     mode->light.forceupdate = 1;
178     mode->dpi.forceupdate = 1;
179     initbind(&mode->bind);
180 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.36.1.18 int loadprofile (usbdevice * *kb*)

Definition at line 192 of file profile.c.

References hwloadprofile.

```
192                                 {
193     if(hwloadprofile(kb, 1))
194         return -1;
195     return 0;
196 }
```

9.36.1.19 void nativetohw (usbprofile * *profile*, hwprofile * *hw*, int *modecount*)

Definition at line 252 of file profile.c.

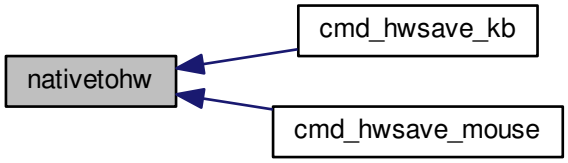
References usbmode::dpi, hwprofile::dpi, usbmode::id, usbprofile::id, hwprofile::id, usbmode::light, hwprofile::light, MD_NAME_LEN, usbprofile::mode, usbmode::name, usbprofile::name, hwprofile::name, and PR_NAME_LEN.

Referenced by cmd_hwsave_kb(), and cmd_hwsave_mouse().

```
252                                                                 {
253     // Copy name and ID
254     memcpy(hw->name[0], profile->name, PR_NAME_LEN * 2);
255     memcpy(hw->id, &profile->id, sizeof(usbid));
256     // Copy the mode settings
```

```
257     for(int i = 0; i < modecount; i++){
258         usbmode* mode = profile->mode + i;
259         memcpy(hw->name[i + 1], mode->name, MD_NAME_LEN * 2);
260         memcpy(hw->id + i + 1, &mode->id, sizeof(usbid));
261         memcpy(hw->light + i, &mode->light, sizeof(lighting));
262         memcpy(hw->dpi + i, &mode->dpi, sizeof(dpiset));
263     }
264 }
```

Here is the caller graph for this function:



9.36.1.20 char* printname (ushort * *name*, int *length*)

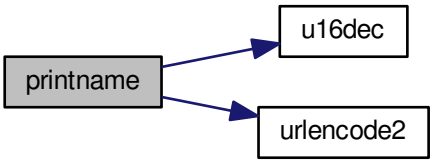
Definition at line 132 of file profile.c.

References u16dec(), and urlencode2().

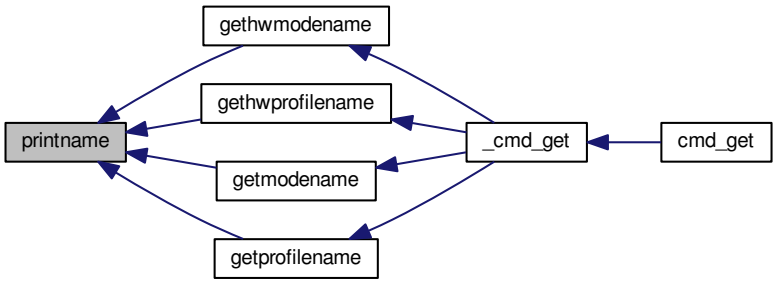
Referenced by gethwmodename(), gethwprofilename(), getmodename(), and getprofilename().

```
132                                         {
133     // Convert the name to UTF-8
134     char* buffer = calloc(1, length * 4 - 3);
135     size_t srclen = length, dstlen = length * 4 - 4;
136     u16dec(name, buffer, &srclen, &dstlen);
137     // URL-encode it
138     char* buffer2 = malloc(strlen(buffer) * 3 + 1);
139     urlencode2(buffer2, buffer);
140     free(buffer);
141     return buffer2;
142 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.36.1.21 int setid (usbid * *id,* const char * *guid*)

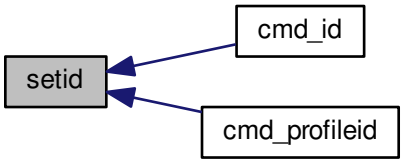
Definition at line 64 of file profile.c.

References usbid::guid.

Referenced by cmd_id(), and cmd_profileid().

```
64                                      {
65     int32_t data1;
66     int16_t data2, data3, data4a;
67     char data4b[6];
68     if(sscanf(guid, "{%08X-%04hX-%04hX-%04hX-%02hhX%02hhX%02hhX%02hhX%02hhX%02hhX}",
69               &data1, &data2, &data3, &data4a, data4b, data4b + 1, data4b + 2, data4b + 3, data4b + 4,
      data4b + 5) != 10)
70         return 0;
71     memcpy(id->guid + 0x0, &data1, 4);
72     memcpy(id->guid + 0x4, &data2, 2);
73     memcpy(id->guid + 0x6, &data3, 2);
74     memcpy(id->guid + 0x8, &data4a, 2);
75     memcpy(id->guid + 0xA, data4b, 6);
76     return 1;
77 }
```

Here is the caller graph for this function:



9.36.1.22 void u16dec (ushort * *in,* char * *out,* size_t * *srclen,* size_t * *dstlen*)

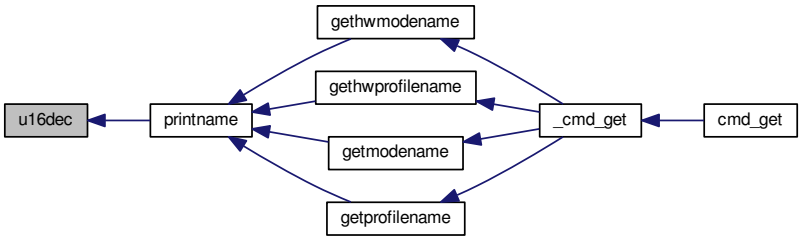
Definition at line 105 of file profile.c.

References utf16to8.

Referenced by printname().

```
105                                                                     {
106     if(!utf16to8)
107         utf16to8 = iconv_open("UTF-8", "UTF-16LE");
108     size_t srclen2 = 0, srclenmax = *srclen;
109     for(; srclen2 < srclenmax; srclen2++){
110         if(!in[srclen2])
111             break;
112     }
113     *srclen = srclen2 * 2;
114     iconv(utf16to8, (char**)&in, srclen, &out, dstlen);
115 }
```

Here is the caller graph for this function:



9.36.1.23 void u16enc (char * *in*, ushort * *out*, size_t * *srclen*, size_t * *dstlen*)

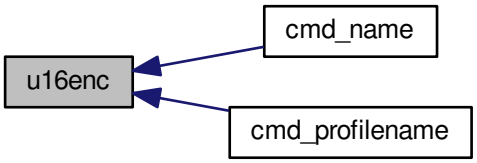
Definition at line 97 of file profile.c.

References utf8to16.

Referenced by cmd_name(), and cmd_profilename().

```
97                                                                      {
98     if(!utf8to16)
99         utf8to16 = iconv_open("UTF-16LE", "UTF-8");
100     memset(out, 0, *dstlen * 2);
101     *dstlen = *dstlen * 2 - 2;
102     iconv(utf8to16, &in, srclen, (char**)&out, dstlen);
103 }
```

Here is the caller graph for this function:



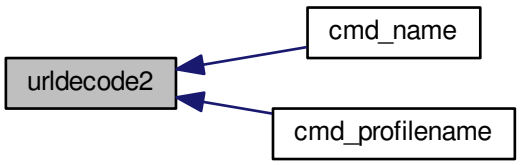
9.36.1.24 void urldecode2 (char * *dst*, const char * *src*)

Definition at line 8 of file profile.c.

Referenced by cmd_name(), and cmd_profilename().

```
8                                           {
9       char a, b;
10       char s;
11       while((s = *src)){
12           if((s == '%') &&
13                   ((a = src[1]) && (b = src[2])) &&
14                   (isxdigit(a) && isxdigit(b))){
15               if(a >= 'a')
16                   a -= 'a'-'A';
17               if(a >= 'A')
18                   a -= 'A' - 10;
19               else
20                   a -= '0';
21               if(b >= 'a')
22                   b -= 'a'-'A';
23               if(b >= 'A')
24                   b -= 'A' - 10;
25               else
26                   b -= '0';
27               *dst++ = 16 * a + b;
28               src += 3;
29           } else {
30               *dst++ = s;
31               src++;
32           }
33       }
34       *dst = '\0';
35   }
```

Here is the caller graph for this function:



9.36.1.25 void urlencode2 (char * *dst*, const char * *src*)

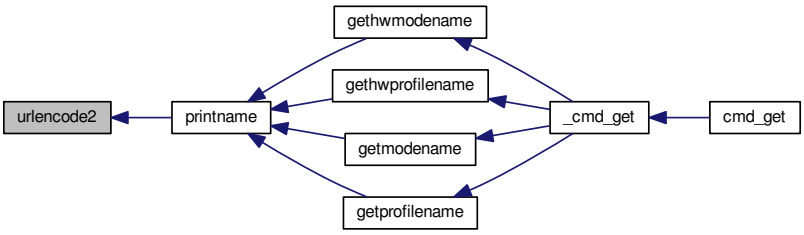
Definition at line 37 of file profile.c.

Referenced by printname().

```
37                                           {
38       char s;
39       while((s = *src++)){
40           if(s <= ',' || s == '/' ||
41                   (s >= ':' && s <= '@') ||
42                   s == '[' || s == ']' ||
43                   s >= 0x7F){
44               char a = s >> 4, b = s & 0xF;
45               if(a >= 10)
46                   a += 'A' - 10;
47               else
48                   a += '0';
49               if(b >= 10)
50                   b += 'A' - 10;
51               else
```

```
52                 b += '0';
53             dst[0] = '%';
54             dst[1] = a;
55             dst[2] = b;
56             dst += 3;
57         } else
58             *dst++ = s;
59     }
60     *dst = '\0';
61 }
```

Here is the caller graph for this function:



9.36.2 Variable Documentation

9.36.2.1 iconv_t utf16to8 = 0 [static]

Definition at line 95 of file profile.c.

Referenced by u16dec().

9.36.2.2 iconv_t utf8to16 = 0 [static]

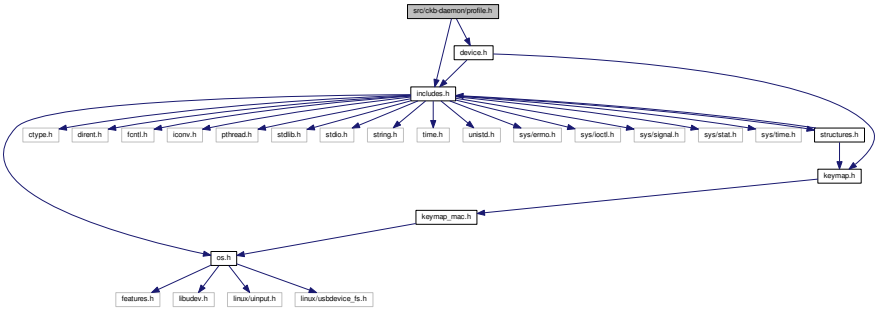
Definition at line 95 of file profile.c.

Referenced by u16enc().

9.37 src/ckb-daemon/profile.h File Reference

```
#include "includes.h"
#include "device.h"
```

Include dependency graph for profile.h:



This graph shows which files directly or indirectly include this file:

Macros

- #define hwloadprofile(kb, apply) (kb)->vtable->hwload(kb, 0, 0, apply, 0)

Functions

- void allocprofile (usbdevice *kb)
- int loadprofile (usbdevice *kb)
- void freeprofile (usbdevice *kb)
- void cmd_erase (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *dummy3)
- void cmd_eraseprofile (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- void cmd_name (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *name)
- void cmd_profilename (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *name)
- char * getmodename (usbmode *mode)
- char * getprofilename (usbprofile *profile)
- char * gethwmodename (hwprofile *profile, int index)
- char * gethwprofilename (hwprofile *profile)
- int setid (usbid *id, const char *guid)
- char * getid (usbid *id)
- void hwtonative (usbprofile *profile, hwprofile *hw, int modecount)
- void nativetohw (usbprofile *profile, hwprofile *hw, int modecount)
- void cmd_id (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *id)
- void cmd_profileid (usbdevice *kb, usbmode *mode, int dummy1, int dummy2, const char *id)
- int cmd_hwload_kb (usbdevice *kb, usbmode *dummy1, int dummy2, int apply, const char *dummy3)
- int cmd_hwload_mouse (usbdevice *kb, usbmode *dummy1, int dummy2, int apply, const char *dummy3)
- int cmd_hwsave_kb (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)
- int cmd_hwsave_mouse (usbdevice *kb, usbmode *dummy1, int dummy2, int dummy3, const char *dummy4)

9.37.1 Macro Definition Documentation

9.37.1.1 #define hwloadprofile(*kb, apply*) (kb)->vtable->hwload(kb, 0, 0, apply, 0)

Definition at line 52 of file profile.h.

Referenced by _start_dev(), and loadprofile().

9.37.2 Function Documentation

9.37.2.1 void allocprofile (usbdevice * *kb*)

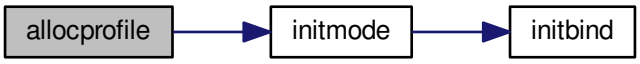
Definition at line 182 of file profile.c.

References usbprofile::currentmode, dpiset::forceupdate, lighting::forceupdate, initmode(), usbprofile::lastdpi, usbprofile::lastlight, usbprofile::mode, MODE_COUNT, and usbdevice::profile.

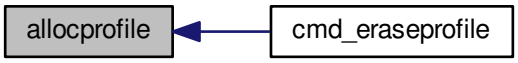
Referenced by cmd_eraseprofile().

```
182                                 {
183     if(kb->profile)
184         return;
185     usbprofile* profile = kb->profile = calloc(1, sizeof(
    usbprofile));
186     for(int i = 0; i < MODE_COUNT; i++)
187         initmode(profile->mode + i);
188     profile->currentmode = profile->mode;
189     profile->lastlight.forceupdate = profile->lastdpi.
    forceupdate = 1;
190 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



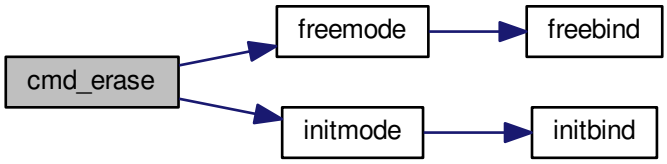
9.37.2.2 void cmd_erase (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *dummy3*)

Definition at line 203 of file profile.c.

References freemode(), imutex, and initmode().

```
203                                                                 {
204     pthread_mutex_lock(imutex(kb));
205     freemode(mode);
206     initmode(mode);
207     pthread_mutex_unlock(imutex(kb));
208 }
```

Here is the call graph for this function:



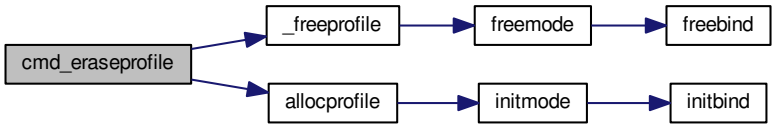
9.37.2.3 void cmd_eraseprofile (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*)

Definition at line 221 of file profile.c.

References _freeprofile(), allocprofile(), and imutex.

```
221                                                                                                 {
222     pthread_mutex_lock(imutex(kb));
223     _freeprofile(kb);
224     allocprofile(kb);
225     pthread_mutex_unlock(imutex(kb));
226 }
```

Here is the call graph for this function:



9.37.2.4 int cmd_hwload_kb (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *apply*, const char * *dummy3*)

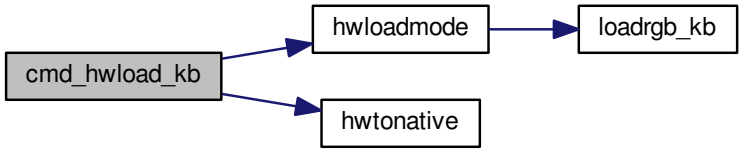
Definition at line 16 of file profile_keyboard.c.

References DELAY_LONG, usbdevice::hw, hwloadmode(), HWMODE_K70, HWMODE_K95, hwtonative(), hwprofile::id, IS_K95, MSG_SIZE, hwprofile::name, PR_NAME_LEN, usbdevice::profile, and usbrecv.

```
16                                                                                                  {
17     DELAY_LONG(kb);
18     hwprofile* hw = calloc(1, sizeof(hwprofile));
19     // Ask for profile and mode IDs
20     uchar data_pkt[2][MSG_SIZE] = {
21         { 0x0e, 0x15, 0x01, 0 },
22         { 0x0e, 0x16, 0x01, 0 }
23     };
24     uchar in_pkt[MSG_SIZE];
25     int modes = (IS_K95(kb) ? HWMODE_K95 : HWMODE_K70);
26     for(int i = 0; i <= modes; i++){
27         data_pkt[0][3] = i;
28         if(!usbrecv(kb, data_pkt[0], in_pkt)){
```

```
29              free(hw);
30              return -1;
31          }
32          memcpy(hw->id + i, in_pkt + 4, sizeof(usbid));
33      }
34      // Ask for profile name
35      if(!usbrecv(kb, data_pkt[1], in_pkt)){
36          free(hw);
37          return -1;
38      }
39      memcpy(hw->name[0], in_pkt + 4, PR_NAME_LEN * 2);
40      // Load modes
41      for(int i = 0; i < modes; i++){
42          if(hwloadmode(kb, hw, i)){
43              free(hw);
44              return -1;
45          }
46      }
47      // Make the profile active (if requested)
48      if(apply)
49          hwtonative(kb->profile, hw, modes);
50      // Free the existing profile (if any)
51      free(kb->hw);
52      kb->hw = hw;
53      DELAY_LONG(kb);
54      return 0;
55  }
```

Here is the call graph for this function:



9.37.2.5 int cmd_hwload_mouse (usbdevice * *kb,* usbmode * *dummy1,* int *dummy2,* int *apply,* const char * *dummy3*)

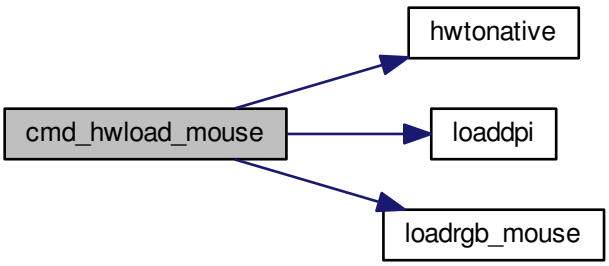
Definition at line 6 of file profile_mouse.c.

References DELAY_LONG, hwprofile::dpi, usbdevice::hw, hwtonative(), hwprofile::id, hwprofile::light, loaddpi(), loadrgb_mouse(), MSG_SIZE, hwprofile::name, PR_NAME_LEN, usbdevice::profile, and usbrecv.

```
6                                                                                   {
7       DELAY_LONG(kb);
8       hwprofile* hw = calloc(1, sizeof(hwprofile));
9       // Ask for profile and mode IDs
10      uchar data_pkt[2][MSG_SIZE] = {
11          { 0x0e, 0x15, 0x01, 0 },
12          { 0x0e, 0x16, 0x01, 0 }
13      };
14      uchar in_pkt[MSG_SIZE];
15      for(int i = 0; i <= 1; i++){
16          data_pkt[0][3] = i;
17          if(!usbrecv(kb, data_pkt[0], in_pkt)){
18              free(hw);
19              return -1;
20          }
21          memcpy(hw->id + i, in_pkt + 4, sizeof(usbid));
22      }
23      // Ask for profile and mode names
24      for(int i = 0; i <= 1; i++){
25          data_pkt[1][3] = i;
26          if(!usbrecv(kb, data_pkt[1],in_pkt)){
27              free(hw);
28              return -1;
29          }
```

```
30          memcpy(hw->name[i], in_pkt + 4, PR_NAME_LEN * 2);
31      }
32
33      // Load the RGB and DPI settings
34      if(loadrgb_mouse(kb, hw->light, 0)
35              || loaddpi(kb, hw->dpi, hw->light)){
36          free(hw);
37          return -1;
38      }
39
40      // Make the profile active (if requested)
41      if(apply)
42          hwtonative(kb->profile, hw, 1);
43      // Free the existing profile (if any)
44      free(kb->hw);
45      kb->hw = hw;
46      DELAY_LONG(kb);
47      return 0;
48  }
```

Here is the call graph for this function:



9.37.2.6 int cmd_hwsave_kb (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*)

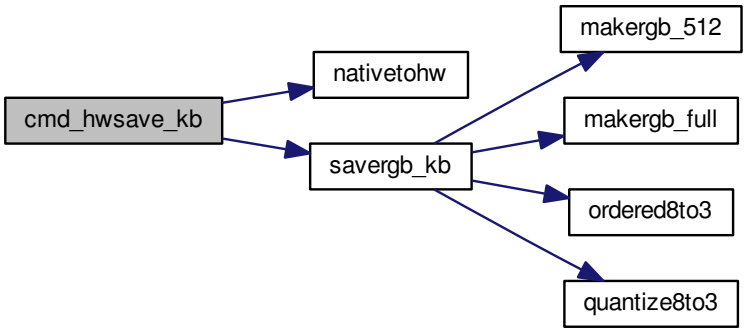
Definition at line 57 of file profile_keyboard.c.

References DELAY_LONG, usbdevice::hw, HWMODE_K70, HWMODE_K95, hwprofile::id, IS_K95, hwprofile::light, MD_NAME_LEN, MSG_SIZE, hwprofile::name, nativetohw(), usbdevice::profile, savergb_kb(), and usbsend.

```
57                                                                                  {
58      DELAY_LONG(kb);
59      hwprofile* hw = kb->hw;
60      if(!hw)
61          hw = kb->hw = calloc(1, sizeof(hwprofile));
62      int modes = (IS_K95(kb) ? HWMODE_K95 : HWMODE_K70);
63      nativetohw(kb->profile, hw, modes);
64      // Save the profile and mode names
65      uchar data_pkt[2][MSG_SIZE] = {
66          { 0x07, 0x16, 0x01, 0 },
67          { 0x07, 0x15, 0x01, 0 },
68      };
69      // Save the mode names
70      for(int i = 0; i <= modes; i++){
71          data_pkt[0][3] = i;
72          memcpy(data_pkt[0] + 4, hw->name[i], MD_NAME_LEN * 2);
73          if(!usbsend(kb, data_pkt[0], 1))
74              return -1;
75      }
76      // Save the IDs
77      for(int i = 0; i <= modes; i++){
78          data_pkt[1][3] = i;
79          memcpy(data_pkt[1] + 4, hw->id + i, sizeof(usbid));
80          if(!usbsend(kb, data_pkt[1], 1))
81              return -1;
82      }
```

```
83      // Save the RGB data
84      for(int i = 0; i < modes; i++){
85          if(savergb_kb(kb, hw->light + i, i))
86              return -1;
87      }
88      DELAY_LONG(kb);
89      return 0;
90  }
```

Here is the call graph for this function:



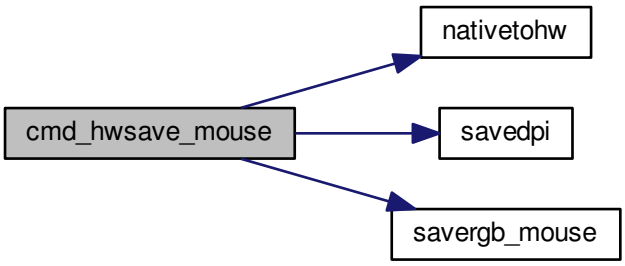
9.37.2.7 int cmd_hwsave_mouse (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*)

Definition at line 50 of file profile_mouse.c.

References DELAY_LONG, hwprofile::dpi, usbdevice::hw, hwprofile::id, hwprofile::light, MD_NAME_LEN, MSG_SIZE, hwprofile::name, nativetohw(), usbdevice::profile, savedpi(), savergb_mouse(), and usbsend.

```
50                                                                                                  {
51      DELAY_LONG(kb);
52      hwprofile* hw = kb->hw;
53      if(!hw)
54          hw = kb->hw = calloc(1, sizeof(hwprofile));
55      nativetohw(kb->profile, hw, 1);
56      // Save the profile and mode names
57      uchar data_pkt[2][MSG_SIZE] = {
58          { 0x07, 0x16, 0x01, 0 },
59          { 0x07, 0x15, 0x01, 0 },
60      };
61      for(int i = 0; i <= 1; i++){
62          data_pkt[0][3] = i;
63          memcpy(data_pkt[0] + 4, hw->name[i], MD_NAME_LEN * 2);
64          if(!usbsend(kb, data_pkt[0], 1))
65              return -1;
66      }
67      // Save the IDs
68      for(int i = 0; i <= 1; i++){
69          data_pkt[1][3] = i;
70          memcpy(data_pkt[1] + 4, hw->id + i, sizeof(usbid));
71          if(!usbsend(kb, data_pkt[1], 1))
72              return -1;
73      }
74      // Save the RGB data for the non-DPI zones
75      if(savergb_mouse(kb, hw->light, 0))
76          return -1;
77      // Save the DPI data (also saves RGB for those states)
78      if(savedpi(kb, hw->dpi, hw->light))
79          return -1;
80      DELAY_LONG(kb);
81      return 0;
82  }
```

Here is the call graph for this function:



9.37.2.8 void cmd_id (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *id*)

Definition at line 160 of file profile.c.

References usbmode::id, usbid::modified, and setid().

```
160                                                                                 {
161     // ID is either a GUID or an 8-digit hex number
162     int newmodified;
163     if(!setid(&mode->id, id) && sscanf(id, "%08x", &newmodified) == 1)
164         memcpy(mode->id.modified, &newmodified, sizeof(newmodified));
165 }
```

Here is the call graph for this function:

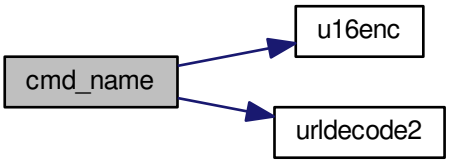
9.37.2.9 void cmd_name (usbdevice * *kb*, usbmode * *mode*, int *dummy1*, int *dummy2*, const char * *name*)

Definition at line 117 of file profile.c.

References MD_NAME_LEN, usbmode::name, u16enc(), and urldecode2().

```
117                                                                                 {
118     char decoded[strlen(name) + 1];
119     urldecode2(decoded, name);
120     size_t srclen = strlen(decoded), dstlen = MD_NAME_LEN;
121     u16enc(decoded, mode->name, &srclen, &dstlen);
122 }
```

Here is the call graph for this function:



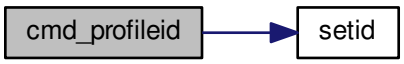
9.37.2.10 void cmd_profileid (usbdevice * kb, usbmode * mode, int dummy1, int dummy2, const char * id)

Definition at line 167 of file profile.c.

References usbprofile::id, usbid::modified, usbdevice::profile, and setid().

```
167                                                                                 {
168     usbprofile* profile = kb->profile;
169     int newmodified;
170     if(!setid(&profile->id, id) && sscanf(id, "%08x", &newmodified) == 1)
171         memcpy(profile->id.modified, &newmodified, sizeof(newmodified));
172
173 }
```

Here is the call graph for this function:



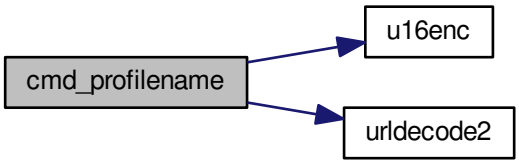
9.37.2.11 void cmd_profilename (usbdevice * kb, usbmode * dummy1, int dummy2, int dummy3, const char * name)

Definition at line 124 of file profile.c.

References usbprofile::name, PR_NAME_LEN, usbdevice::profile, u16enc(), and urldecode2().

```
124                                                                                 {
125     usbprofile* profile = kb->profile;
126     char decoded[strlen(name) + 1];
127     urldecode2(decoded, name);
128     size_t srclen = strlen(decoded), dstlen = PR_NAME_LEN;
129     u16enc(decoded, profile->name, &srclen, &dstlen);
130 }
```

Here is the call graph for this function:



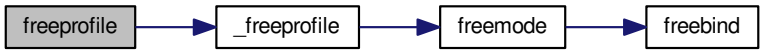
9.37.2.12 void freeprofile (usbdevice * kb)

Definition at line 228 of file profile.c.

References _freeprofile(), and usbdevice::hw.

```
228                                {
229     _freeprofile(kb);
230     // Also free HW profile
231     free(kb->hw);
232     kb->hw = 0;
233 }
```

Here is the call graph for this function:



9.37.2.13 char* gethwmodename (hwprofile * profile, int index)

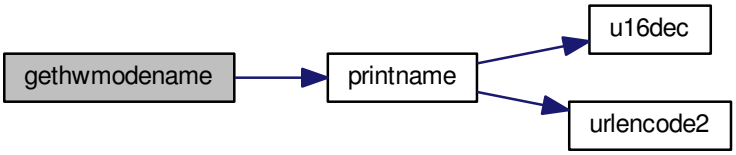
Definition at line 152 of file profile.c.

References MD_NAME_LEN, hwprofile::name, and printname().

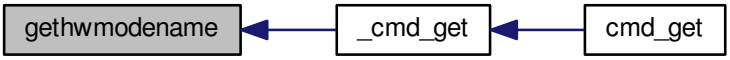
Referenced by _cmd_get().

```
152                                                {
153     return printname(profile->name[index + 1], MD_NAME_LEN);
154 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.37.2.14 char* gethwprofilename (hwprofile * *profile*)

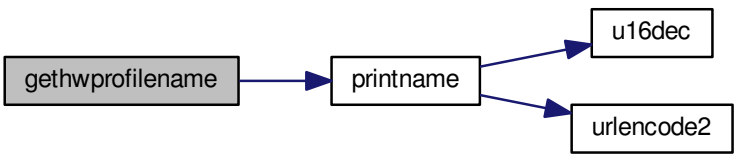
Definition at line 156 of file profile.c.

References MD_NAME_LEN, hwprofile::name, and printname().

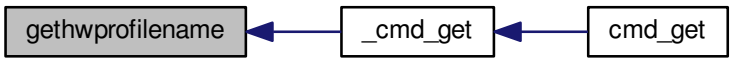
Referenced by _cmd_get().

```
156                                          {
157     return printname(profile->name[0], MD_NAME_LEN);
158 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.37.2.15 char* getid (usbid * *id*)

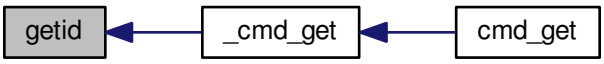
Definition at line 79 of file profile.c.

References usbid::guid.

Referenced by _cmd_get().

```
79                      {
80     int32_t data1;
81     int16_t data2, data3, data4a;
82     char data4b[6];
83     memcpy(&data1, id->guid + 0x0, 4);
84     memcpy(&data2, id->guid + 0x4, 2);
85     memcpy(&data3, id->guid + 0x6, 2);
86     memcpy(&data4a, id->guid + 0x8, 2);
87     memcpy(data4b, id->guid + 0xA, 6);
88     char* guid = malloc(39);
89     snprintf(guid, 39, "{%08X-%04hX-%04hX-%04hX-%02hhX%02hhX%02hhX%02hhX%02hhX%02hhX}",
90              data1, data2, data3, data4a, data4b[0], data4b[1], data4b[2], data4b[3], data4b[4], data4b[5])
     ;
91     return guid;
92 }
```

Here is the caller graph for this function:



9.37.2.16 char* getmodename (usbmode * *mode*)

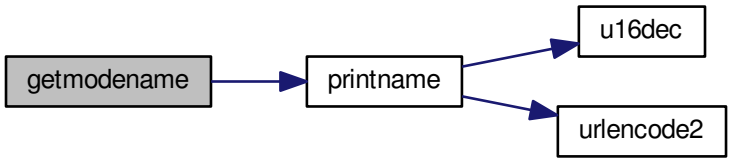
Definition at line 144 of file profile.c.

References MD_NAME_LEN, usbmode::name, and printname().

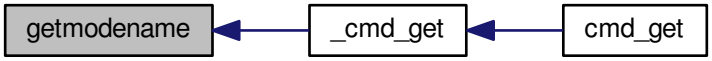
Referenced by _cmd_get().

```
144                                 {
145     return printname(mode->name, MD_NAME_LEN);
146 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.37.2.17 char* getprofilename (usbprofile * *profile*)

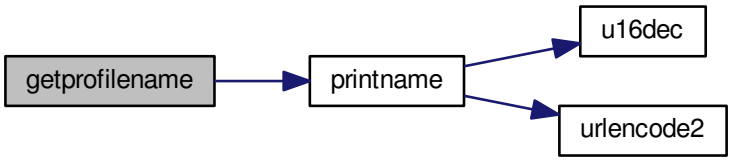
Definition at line 148 of file profile.c.

References usbprofile::name, PR_NAME_LEN, and printname().

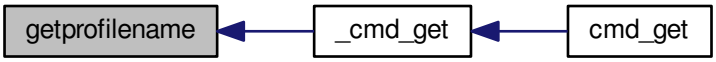
Referenced by _cmd_get().

```
148                                          {
149     return printname(profile->name, PR_NAME_LEN);
150 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.37.2.18 void hwtonative (usbprofile * *profile,* hwprofile * *hw,* int *modecount*)

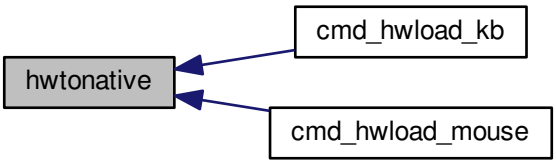
Definition at line 235 of file profile.c.

References usbmode::dpi, hwprofile::dpi, dpiset::forceupdate, lighting::forceupdate, usbmode::id, usbprofile::id, hwprofile::id, usbprofile::lastdpi, usbprofile::lastlight, usbmode::light, hwprofile::light, MD_NAME_LEN, usbprofile::mode, usbmode::name, usbprofile::name, hwprofile::name, and PR_NAME_LEN.

Referenced by cmd_hwload_kb(), and cmd_hwload_mouse().

```
235                                                                    {
236     // Copy the profile name and ID
237     memcpy(profile->name, hw->name[0], PR_NAME_LEN * 2);
238     memcpy(&profile->id, hw->id, sizeof(usbid));
239     // Copy the mode settings
240     for(int i = 0; i < modecount; i++){
241         usbmode* mode = profile->mode + i;
242         memcpy(mode->name, hw->name[i + 1], MD_NAME_LEN * 2);
243         memcpy(&mode->id, hw->id + i + 1, sizeof(usbid));
244         memcpy(&mode->light, hw->light + i, sizeof(lighting));
245         memcpy(&mode->dpi, hw->dpi + i, sizeof(dpiset));
246         // Set a force update on the light/DPI since they've been overwritten
247         mode->light.forceupdate = mode->dpi.forceupdate = 1;
248     }
249     profile->lastlight.forceupdate = profile->lastdpi.
      forceupdate = 1;
250 }
```

Here is the caller graph for this function:



9.37.2.19 int loadprofile (usbdevice * *kb*)

Definition at line 192 of file profile.c.

References hwloadprofile.

```
192                                 {
193     if(hwloadprofile(kb, 1))
194         return -1;
195     return 0;
196 }
```

9.37.2.20 void nativetohw (usbprofile * *profile,* hwprofile * *hw,* int *modecount*)

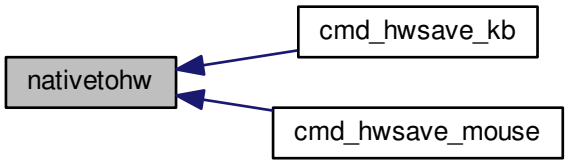
Definition at line 252 of file profile.c.

References usbmode::dpi, hwprofile::dpi, usbmode::id, usbprofile::id, hwprofile::id, usbmode::light, hwprofile::light, MD_NAME_LEN, usbprofile::mode, usbmode::name, usbprofile::name, hwprofile::name, and PR_NAME_LEN.

Referenced by cmd_hwsave_kb(), and cmd_hwsave_mouse().

```
252                                                                     {
253     // Copy name and ID
254     memcpy(hw->name[0], profile->name, PR_NAME_LEN * 2);
255     memcpy(hw->id, &profile->id, sizeof(usbid));
256     // Copy the mode settings
257     for(int i = 0; i < modecount; i++){
258         usbmode* mode = profile->mode + i;
259         memcpy(hw->name[i + 1], mode->name, MD_NAME_LEN * 2);
260         memcpy(hw->id + i + 1, &mode->id, sizeof(usbid));
261         memcpy(hw->light + i, &mode->light, sizeof(lighting));
262         memcpy(hw->dpi + i, &mode->dpi, sizeof(dpiset));
263     }
264 }
```

Here is the caller graph for this function:



9.37.2.21 int setid (usbid * *id,* const char * *guid*)

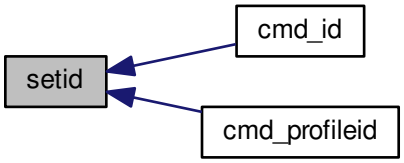
Definition at line 64 of file profile.c.

References usbid::guid.

Referenced by cmd_id(), and cmd_profileid().

```
64                                      {
65     int32_t data1;
66     int16_t data2, data3, data4a;
67     char data4b[6];
68     if(sscanf(guid, "{%08X-%04hX-%04hX-%04hX-%02hhX%02hhX%02hhX%02hhX%02hhX%02hhX}",
69               &data1, &data2, &data3, &data4a, data4b, data4b + 1, data4b + 2, data4b + 3, data4b + 4,
      data4b + 5) != 10)
70         return 0;
71     memcpy(id->guid + 0x0, &data1, 4);
72     memcpy(id->guid + 0x4, &data2, 2);
73     memcpy(id->guid + 0x6, &data3, 2);
74     memcpy(id->guid + 0x8, &data4a, 2);
75     memcpy(id->guid + 0xA, data4b, 6);
76     return 1;
77 }
```

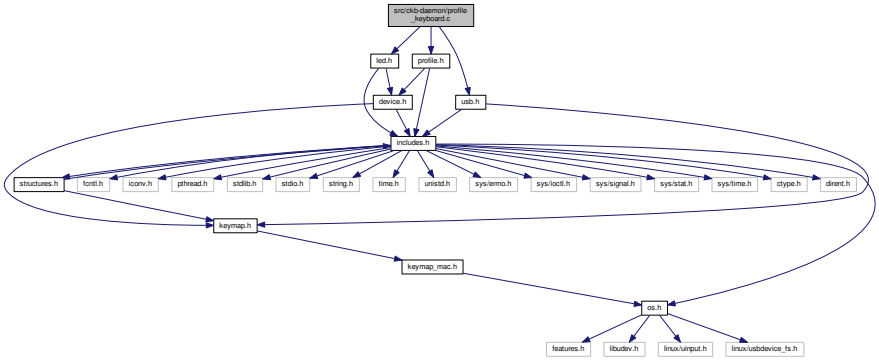
Here is the caller graph for this function:



9.38 src/ckb-daemon/profile_keyboard.c File Reference

```
#include "profile.h"
#include "usb.h"
#include "led.h"
```

Include dependency graph for profile_keyboard.c:



Functions

- static int hwloadmode (usbdevice ∗kb, hwprofile ∗hw, int mode)
- int cmd_hwload_kb (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int apply, const char ∗dummy3)
- int cmd_hwsave_kb (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int dummy3, const char ∗dummy4)

9.38.1 Function Documentation

9.38.1.1 int cmd_hwload_kb (usbdevice ∗ *kb,* usbmode ∗ *dummy1,* int *dummy2,* int *apply,* const char ∗ *dummy3*)

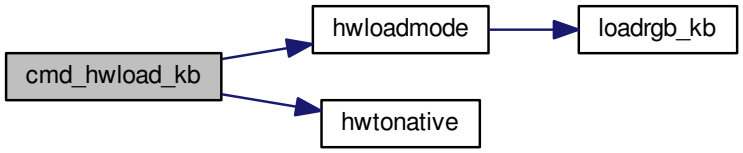
Definition at line 16 of file profile_keyboard.c.

References DELAY_LONG, usbdevice::hw, hwloadmode(), HWMODE_K70, HWMODE_K95, hwtonative(), hwprofile::id, IS_K95, MSG_SIZE, hwprofile::name, PR_NAME_LEN, usbdevice::profile, and usbrecv.

```
16                                                                              {
17     DELAY_LONG(kb);
18     hwprofile* hw = calloc(1, sizeof(hwprofile));
19     // Ask for profile and mode IDs
```

```
20      uchar data_pkt[2][MSG_SIZE] = {
21          { 0x0e, 0x15, 0x01, 0 },
22          { 0x0e, 0x16, 0x01, 0 }
23      };
24      uchar in_pkt[MSG_SIZE];
25      int modes = (IS_K95(kb) ? HWMODE_K95 : HWMODE_K70);
26      for(int i = 0; i <= modes; i++){
27          data_pkt[0][3] = i;
28          if(!usbrecv(kb, data_pkt[0], in_pkt)){
29              free(hw);
30              return -1;
31          }
32          memcpy(hw->id + i, in_pkt + 4, sizeof(usbid));
33      }
34      // Ask for profile name
35      if(!usbrecv(kb, data_pkt[1], in_pkt)){
36          free(hw);
37          return -1;
38      }
39      memcpy(hw->name[0], in_pkt + 4, PR_NAME_LEN * 2);
40      // Load modes
41      for(int i = 0; i < modes; i++){
42          if(hwloadmode(kb, hw, i)){
43              free(hw);
44              return -1;
45          }
46      }
47      // Make the profile active (if requested)
48      if(apply)
49          hwtonative(kb->profile, hw, modes);
50      // Free the existing profile (if any)
51      free(kb->hw);
52      kb->hw = hw;
53      DELAY_LONG(kb);
54      return 0;
55  }
```

Here is the call graph for this function:



9.38.1.2 int cmd_hwsave_kb (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *dummy3*, const char * *dummy4*)

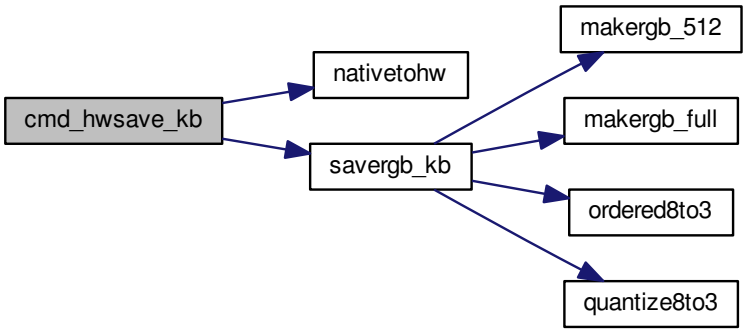
Definition at line 57 of file profile_keyboard.c.

References DELAY_LONG, usbdevice::hw, HWMODE_K70, HWMODE_K95, hwprofile::id, IS_K95, hwprofile::light, MD_NAME_LEN, MSG_SIZE, hwprofile::name, nativetohw(), usbdevice::profile, savergb_kb(), and usbsend.

```
57                                                                                  {
58      DELAY_LONG(kb);
59      hwprofile* hw = kb->hw;
60      if(!hw)
61          hw = kb->hw = calloc(1, sizeof(hwprofile));
62      int modes = (IS_K95(kb) ? HWMODE_K95 : HWMODE_K70);
63      nativetohw(kb->profile, hw, modes);
64      // Save the profile and mode names
65      uchar data_pkt[2][MSG_SIZE] = {
66          { 0x07, 0x16, 0x01, 0 },
67          { 0x07, 0x15, 0x01, 0 },
68      };
69      // Save the mode names
70      for(int i = 0; i <= modes; i++){
71          data_pkt[0][3] = i;
```

```
72          memcpy(data_pkt[0] + 4, hw->name[i], MD_NAME_LEN * 2);
73          if(!usbsend(kb, data_pkt[0], 1))
74              return -1;
75      }
76      // Save the IDs
77      for(int i = 0; i <= modes; i++){
78          data_pkt[1][3] = i;
79          memcpy(data_pkt[1] + 4, hw->id + i, sizeof(usbid));
80          if(!usbsend(kb, data_pkt[1], 1))
81              return -1;
82      }
83      // Save the RGB data
84      for(int i = 0; i < modes; i++){
85          if(savergb_kb(kb, hw->light + i, i))
86              return -1;
87      }
88      DELAY_LONG(kb);
89      return 0;
90  }
```

Here is the call graph for this function:



9.38.1.3 static int hwloadmode (usbdevice * *kb*, hwprofile * *hw*, int *mode*) [static]

Definition at line 5 of file profile_keyboard.c.

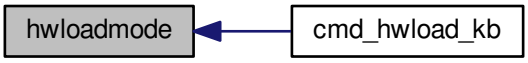
References hwprofile::light, loadrgb_kb(), MD_NAME_LEN, MSG_SIZE, hwprofile::name, and usbrecv.

Referenced by cmd_hwload_kb().

```
5                                                       {
6       // Ask for mode's name
7       uchar data_pkt[MSG_SIZE] = { 0x0e, 0x16, 0x01, mode + 1, 0 };
8       uchar in_pkt[MSG_SIZE];
9       if(!usbrecv(kb, data_pkt, in_pkt))
10          return -1;
11       memcpy(hw->name[mode + 1], in_pkt + 4, MD_NAME_LEN * 2);
12      // Load the RGB setting
13      return loadrgb_kb(kb, hw->light + mode, mode);
14  }
```

Here is the call graph for this function:

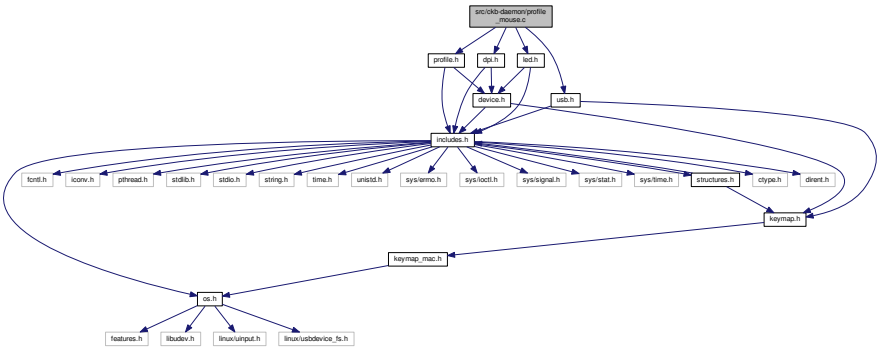
Here is the caller graph for this function:



9.39 src/ckb-daemon/profile_mouse.c File Reference

```
#include "dpi.h"
#include "profile.h"
#include "usb.h"
#include "led.h"
```

Include dependency graph for profile_mouse.c:



Functions

- int cmd_hwload_mouse (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int apply, const char ∗dummy3)
- int cmd_hwsave_mouse (usbdevice ∗kb, usbmode ∗dummy1, int dummy2, int dummy3, const char ∗dummy4)

9.39.1 Function Documentation

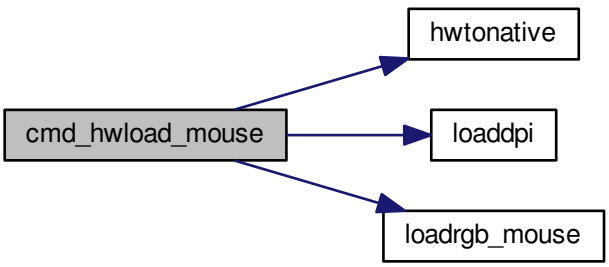
9.39.1.1 int cmd_hwload_mouse (usbdevice * *kb*, usbmode * *dummy1*, int *dummy2*, int *apply*, const char * *dummy3*)

Definition at line 6 of file profile_mouse.c.

References DELAY_LONG, hwprofile::dpi, usbdevice::hw, hwtonative(), hwprofile::id, hwprofile::light, loaddpi(), loadrgb_mouse(), MSG_SIZE, hwprofile::name, PR_NAME_LEN, usbdevice::profile, and usbrecv.

```
6                                                                                                   {
7       DELAY_LONG(kb);
8       hwprofile* hw = calloc(1, sizeof(hwprofile));
9       // Ask for profile and mode IDs
10       uchar data_pkt[2][MSG_SIZE] = {
11           { 0x0e, 0x15, 0x01, 0 },
12           { 0x0e, 0x16, 0x01, 0 }
13       };
14       uchar in_pkt[MSG_SIZE];
15       for(int i = 0; i <= 1; i++){
16           data_pkt[0][3] = i;
17           if(!usbrecv(kb, data_pkt[0], in_pkt)){
18               free(hw);
19               return -1;
20           }
21           memcpy(hw->id + i, in_pkt + 4, sizeof(usbid));
22       }
23       // Ask for profile and mode names
24       for(int i = 0; i <= 1; i++){
25           data_pkt[1][3] = i;
26           if(!usbrecv(kb, data_pkt[1],in_pkt)){
27               free(hw);
28               return -1;
29           }
30           memcpy(hw->name[i], in_pkt + 4, PR_NAME_LEN * 2);
31       }
32
33       // Load the RGB and DPI settings
34       if(loadrgb_mouse(kb, hw->light, 0)
35               || loaddpi(kb, hw->dpi, hw->light)){
36           free(hw);
37           return -1;
38       }
39
40       // Make the profile active (if requested)
41       if(apply)
42           hwtonative(kb->profile, hw, 1);
43       // Free the existing profile (if any)
44       free(kb->hw);
45       kb->hw = hw;
46       DELAY_LONG(kb);
47       return 0;
48   }
```

Here is the call graph for this function:



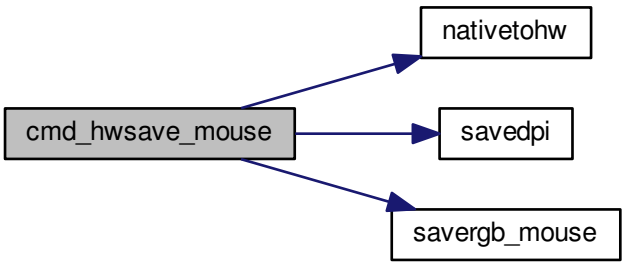
9.39.1.2 int cmd_hwsave_mouse (usbdevice * kb, usbmode * dummy1, int dummy2, int dummy3, const char * dummy4)

Definition at line 50 of file profile_mouse.c.

References DELAY_LONG, hwprofile::dpi, usbdevice::hw, hwprofile::id, hwprofile::light, MD_NAME_LEN, MSG_SIZE, hwprofile::name, nativetohw(), usbdevice::profile, savedpi(), savergb_mouse(), and usbsend.

```
50                                                                                                  {
51     DELAY_LONG(kb);
52     hwprofile* hw = kb->hw;
53     if(!hw)
54         hw = kb->hw = calloc(1, sizeof(hwprofile));
55     nativetohw(kb->profile, hw, 1);
56     // Save the profile and mode names
57     uchar data_pkt[2][MSG_SIZE] = {
58         { 0x07, 0x16, 0x01, 0 },
59         { 0x07, 0x15, 0x01, 0 },
60     };
61     for(int i = 0; i <= 1; i++){
62         data_pkt[0][3] = i;
63         memcpy(data_pkt[0] + 4, hw->name[i], MD_NAME_LEN * 2);
64         if(!usbsend(kb, data_pkt[0], 1))
65             return -1;
66     }
67     // Save the IDs
68     for(int i = 0; i <= 1; i++){
69         data_pkt[1][3] = i;
70         memcpy(data_pkt[1] + 4, hw->id + i, sizeof(usbid));
71         if(!usbsend(kb, data_pkt[1], 1))
72             return -1;
73     }
74     // Save the RGB data for the non-DPI zones
75     if(savergb_mouse(kb, hw->light, 0))
76         return -1;
77     // Save the DPI data (also saves RGB for those states)
78     if(savedpi(kb, hw->dpi, hw->light))
79         return -1;
80     DELAY_LONG(kb);
81     return 0;
82 }
```

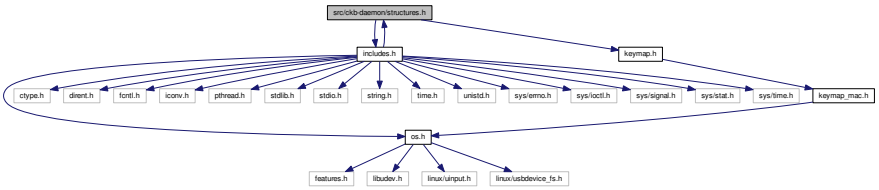
Here is the call graph for this function:



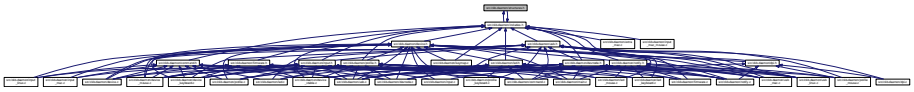
9.40 src/ckb-daemon/structures.h File Reference

```
#include "includes.h"
#include "keymap.h"
```

Include dependency graph for structures.h:



This graph shows which files directly or indirectly include this file:



Data Structures

- struct usbid
- struct macroaction
- struct keymacro
- struct binding
- struct dpiset
- struct lighting
- struct usbmode
- struct usbprofile
- struct hwprofile
- struct usbinput
- struct usbdevice

Macros

- #define SET_KEYBIT(array, index) do { (array)[(index) / 8] |= 1 << ((index) % 8); } while(0)
- #define CLEAR_KEYBIT(array, index) do { (array)[(index) / 8] &= ~(1 << ((index) % 8)); } while(0)
- #define I_NUM 1
- #define I_CAPS 2
- #define I_SCROLL 4
- #define OUTFIFO_MAX 10
- #define MACRO_MAX 1024
- #define DPI_COUNT 6
- #define LIFT_MIN 1
- #define LIFT_MAX 5
- #define MD_NAME_LEN 16
- #define PR_NAME_LEN 16
- #define MODE_COUNT 6
- #define HWMODE_K70 1
- #define HWMODE_K95 3
- #define HWMODE_MAX 3
- #define FEAT_RGB 0x001
- #define FEAT_MONOCHROME 0x002
- #define FEAT_POLLRATE 0x004

- #define FEAT_ADJRATE 0x008
- #define FEAT_BIND 0x010
- #define FEAT_NOTIFY 0x020
- #define FEAT_FWVERSION 0x040
- #define FEAT_FWUPDATE 0x080
- #define FEAT_HWLOAD 0x100
- #define FEAT_ANSI 0x200
- #define FEAT_ISO 0x400
- #define FEAT_MOUSEACCEL 0x800
- #define FEAT_COMMON (FEAT_BIND | FEAT_NOTIFY | FEAT_FWVERSION | FEAT_MOUSEACCEL | FEAT_HWLOAD)
- #define FEAT_STD_RGB (FEAT_COMMON | FEAT_RGB | FEAT_POLLRATE | FEAT_FWUPDATE)
- #define FEAT_STD_NRGB (FEAT_COMMON)
- #define FEAT_LMASK (FEAT_ANSI | FEAT_ISO)
- #define HAS_FEATURES(kb, feat) (((kb)->features & (feat)) == (feat))
- #define HAS_ANY_FEATURE(kb, feat) (!!((kb)->features & (feat)))
- #define NEEDS_FW_UPDATE(kb) ((kb)->fwversion == 0 && HAS_FEATURES((kb), FEAT_FWUPDATE | FEAT_FWVERSION))
- #define SCROLL_ACCELERATED 0
- #define SCROLL_MIN 1
- #define SCROLL_MAX 10
- #define KB_NAME_LEN 40
- #define SERIAL_LEN 34
- #define MSG_SIZE 64
- #define IFACE_MAX 4

Variables

- const union devcmd vtable_keyboard

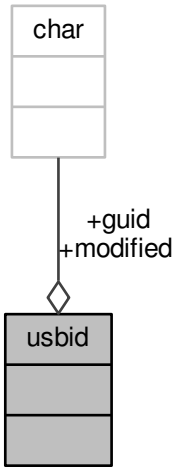
  RGB keyboard vtable holds functions for each device type.
- const union devcmd vtable_keyboard_nonrgb
- const union devcmd vtable_mouse

9.40.1 Data Structure Documentation

9.40.1.1 struct usbid

Definition at line 8 of file structures.h.

Collaboration diagram for usbid:



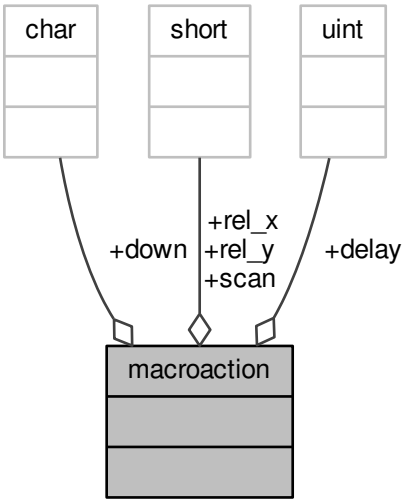
Data Fields

char	guid[16]	
char	modified[4]	

9.40.1.2 struct macroaction

Definition at line 27 of file structures.h.

Collaboration diagram for macroaction:



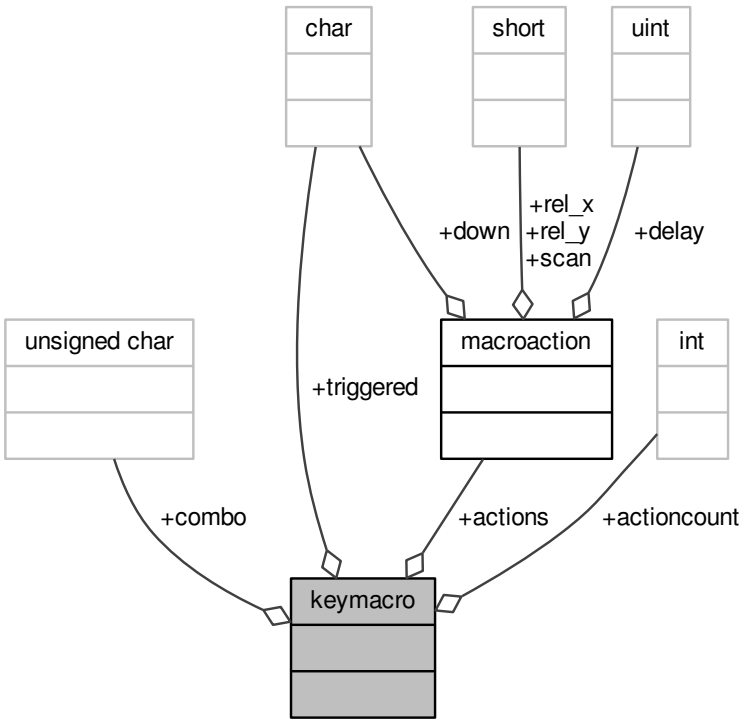
Data Fields

uint	delay	
char	down	
short	rel_x	
short	rel_y	
short	scan	

9.40.1.3 struct keymacro

Definition at line 35 of file structures.h.

Collaboration diagram for keymacro:



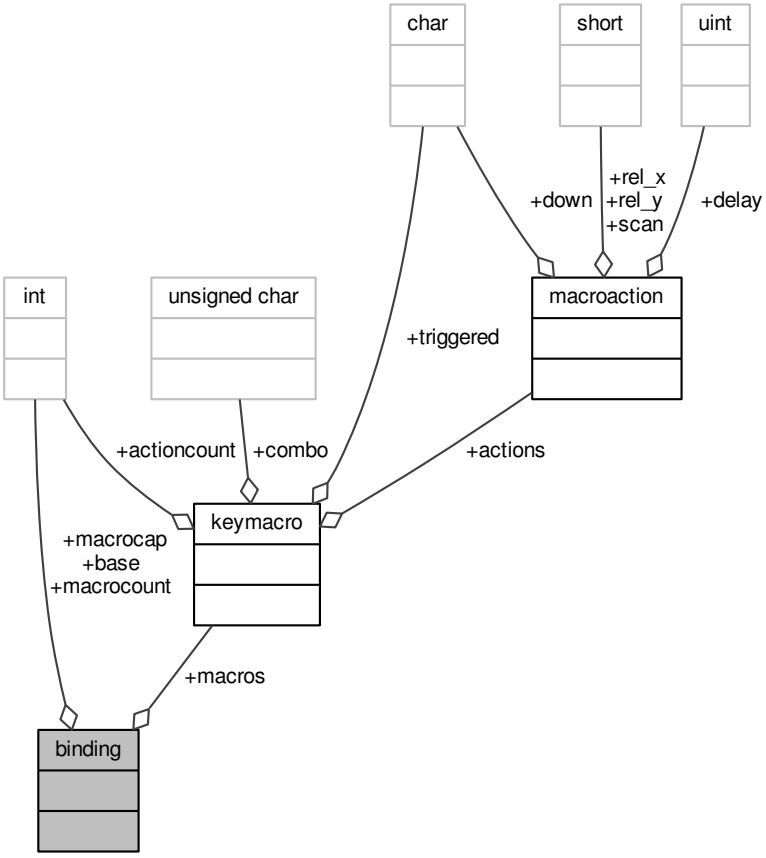
Data Fields

int	actioncount	
macroaction *	actions	
uchar	combo[(((((152+3+12)+25)+7)/8)]	
char	triggered	

9.40.1.4 struct binding

Definition at line 43 of file structures.h.

Collaboration diagram for binding:



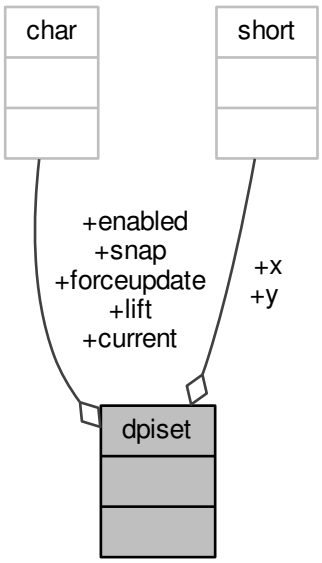
Data Fields

int	base[((152+3+12)+25)]	
int	macrocap	
int	macrocount	
keymacro *	macros	

9.40.1.5 struct dpiset

Definition at line 57 of file structures.h.

Collaboration diagram for dpiset:



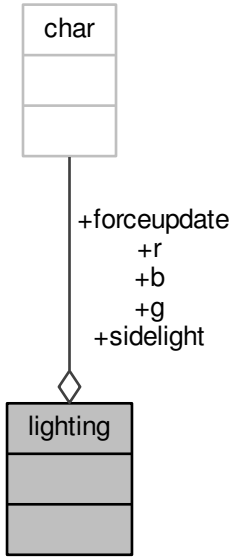
Data Fields

uchar	current	
uchar	enabled	
uchar	forceupdate	
uchar	lift	
uchar	snap	
ushort	x[6]	
ushort	y[6]	

9.40.1.6 struct lighting

Definition at line 73 of file structures.h.

Collaboration diagram for lighting:



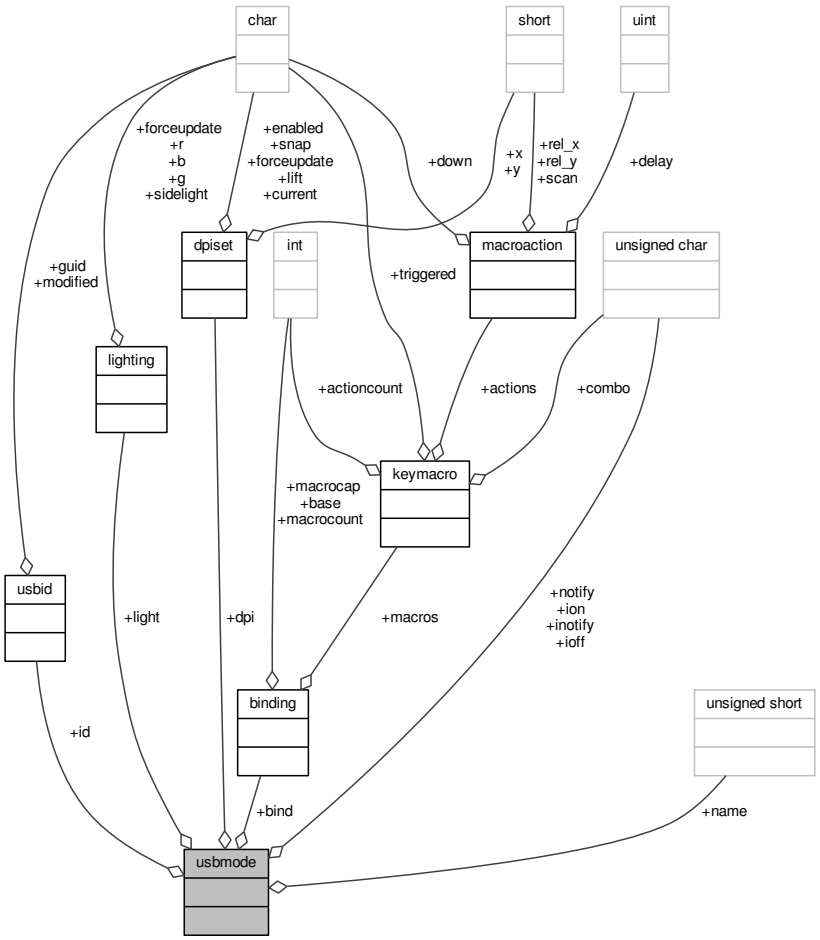
Data Fields

uchar	b[152+11]	
uchar	forceupdate	
uchar	g[152+11]	
uchar	r[152+11]	
uchar	sidelight	

9.40.1.7 struct usbmode

Definition at line 83 of file structures.h.

Collaboration diagram for usbmode:



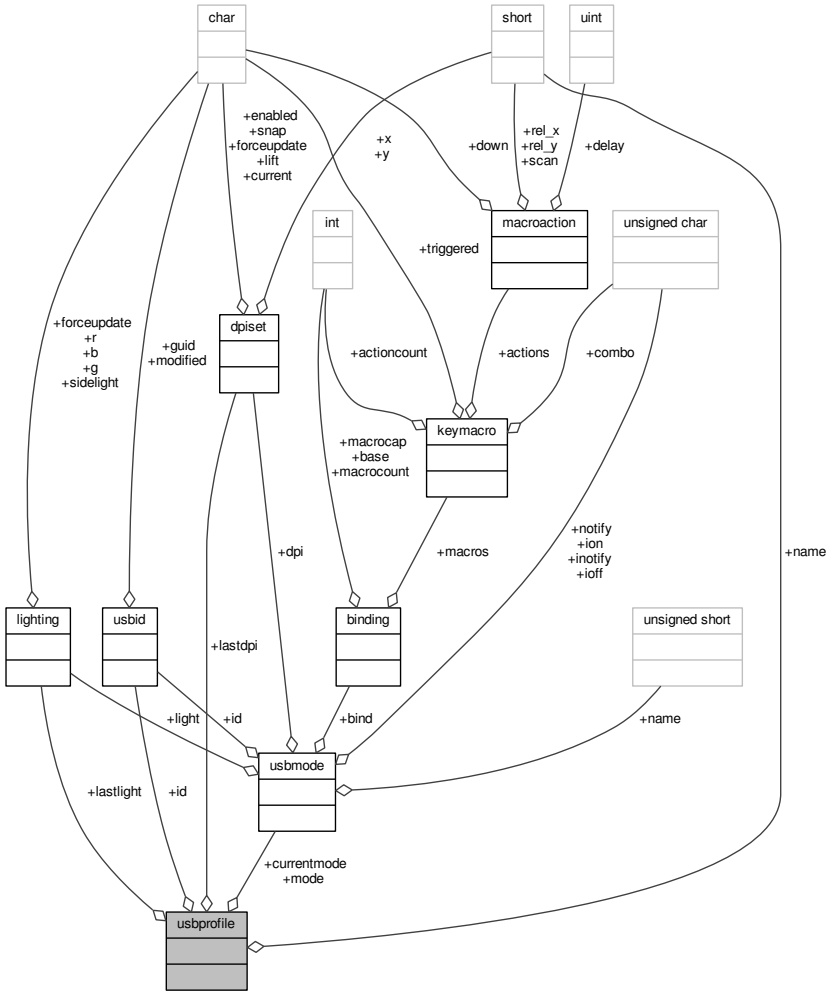
Data Fields

binding	bind	
dpiset	dpi	
usbid	id	
uchar	inotify[10]	
uchar	ioff	
uchar	ion	
lighting	light	
ushort	name[16]	
uchar	notify[10][((((152+3+12)+25)+7)/8)]	

9.40.1.8 struct usbprofile

Definition at line 101 of file structures.h.

Collaboration diagram for usbprofile:



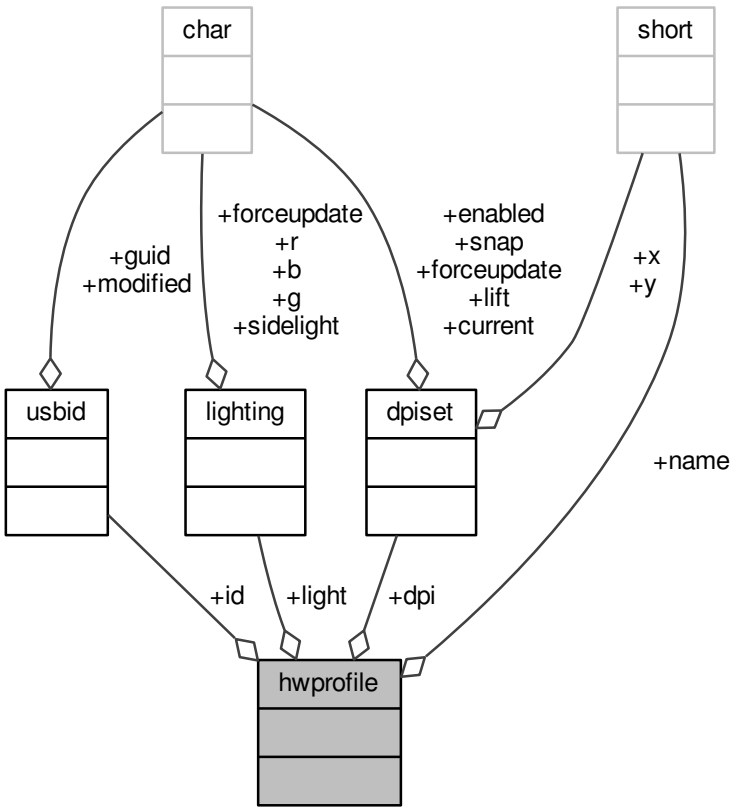
Data Fields

usbmode *	currentmode	
usbid	id	
dpiset	lastdpi	
lighting	lastlight	
usbmode	mode[6]	
ushort	name[16]	

9.40.1.9 struct hwprofile

Definition at line 118 of file structures.h.

Collaboration diagram for hwprofile:



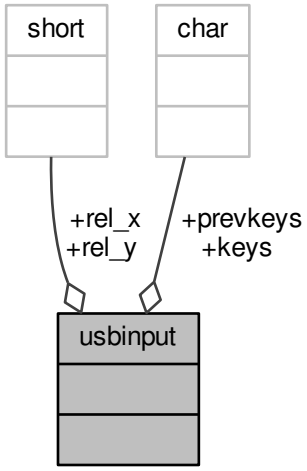
Data Fields

dpiset	dpi[3]	
usbid	id[3+1]	
lighting	light[3]	
ushort	name[3+1][16]	

9.40.1.10 struct usbinput

Definition at line 129 of file structures.h.

Collaboration diagram for usbinput:



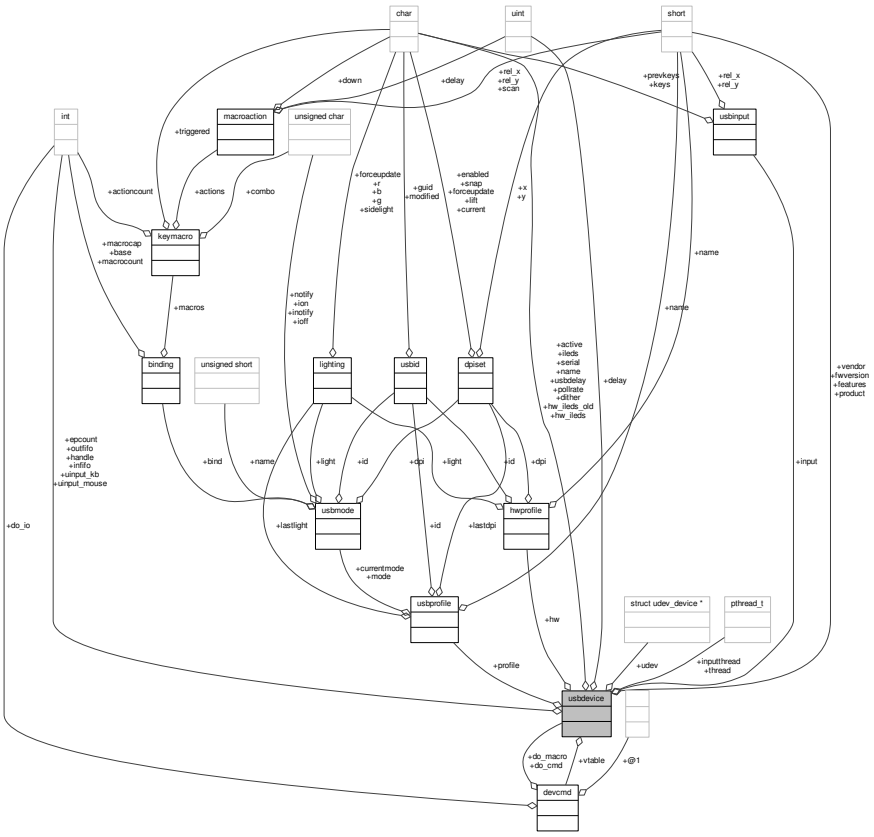
Data Fields

uchar	keys[((((152+3+12)+25)+7)/8)]	
uchar	prevkeys[((((152+3+12)+25)+7)/8)]	
short	rel_x	
short	rel_y	

9.40.1.11 struct usbdevice

Definition at line 178 of file structures.h.

Collaboration diagram for usbdevice:



Data Fields

char	active	
uint	delay	
char	dither	
int	epcount	
ushort	features	
ushort	fwversion	
int	handle	
hwprofile *	hw	
uchar	hw_ileds	
uchar	hw_ileds_old	
uchar	ileds	
int	infifo	
usbinput	input	
pthread_t	inputthread	
char	name[40+1]	
int	outfifo[10]	
char	pollrate	

short	product	
usbprofile *	profile	
char	serial[34]	
pthread_t	thread	
struct udev_device *	udev	
int	uinput_kb	
int	uinput_mouse	
char	usbdelay	
short	vendor	
const union devcmd *	vtable	

9.40.2 Macro Definition Documentation

9.40.2.1 #define CLEAR_KEYBIT(*array, index*) do { (array)[(index) / 8] &= ~(1 << ((index) % 8)); } while(0)

Definition at line 16 of file structures.h.

Referenced by cmd_notify(), corsair_mousecopy(), hid_kb_translate(), and hid_mouse_translate().

9.40.2.2 #define DPI_COUNT 6

Definition at line 54 of file structures.h.

Referenced by cmd_dpi(), cmd_dpisel(), loaddpi(), printdpi(), savedpi(), and updatedpi().

9.40.2.3 #define FEAT_ADJRATE 0x008

Definition at line 139 of file structures.h.

Referenced by _mkdevpath(), _setupusb(), and _start_dev().

9.40.2.4 #define FEAT_ANSI 0x200

Definition at line 146 of file structures.h.

Referenced by readcmd().

9.40.2.5 #define FEAT_BIND 0x010

Definition at line 140 of file structures.h.

Referenced by _mkdevpath(), main(), and readcmd().

9.40.2.6 #define FEAT_COMMON (FEAT_BIND | FEAT_NOTIFY | FEAT_FWVERSION | FEAT_MOUSEACCEL | FEAT_HWLOAD)

Definition at line 151 of file structures.h.

9.40.2.7 #define FEAT_FWUPDATE 0x080

Definition at line 143 of file structures.h.

Referenced by _mkdevpath(), _start_dev(), and cmd_fwupdate().

9.40.2.8 #define FEAT_FWVERSION 0x040

Definition at line 142 of file structures.h.

Referenced by _mkdevpath(), and _start_dev().

9.40.2.9 #define FEAT_HWLOAD 0x100

Definition at line 144 of file structures.h.

Referenced by _start_dev().

9.40.2.10 #define FEAT_ISO 0x400

Definition at line 147 of file structures.h.

Referenced by readcmd().

9.40.2.11 #define FEAT_LMASK (FEAT_ANSI | FEAT_ISO)

Definition at line 154 of file structures.h.

Referenced by readcmd().

9.40.2.12 #define FEAT_MONOCHROME 0x002

Definition at line 137 of file structures.h.

Referenced by _mkdevpath(), and _setupusb().

9.40.2.13 #define FEAT_MOUSEACCEL 0x800

Definition at line 148 of file structures.h.

Referenced by main(), and readcmd().

9.40.2.14 #define FEAT_NOTIFY 0x020

Definition at line 141 of file structures.h.

Referenced by _mkdevpath(), main(), and readcmd().

9.40.2.15 #define FEAT_POLLRATE 0x004

Definition at line 138 of file structures.h.

Referenced by _mkdevpath(), _start_dev(), and getfwversion().

9.40.2.16 #define FEAT_RGB 0x001

Definition at line 136 of file structures.h.

Referenced by _mkdevpath(), _start_dev(), revertusb(), and usbunclaim().

9.40.2.17 #define FEAT_STD_NRGB (FEAT_COMMON)

Definition at line 153 of file structures.h.

Referenced by _setupusb().

9.40.2.18 #define FEAT_STD_RGB (FEAT_COMMON | FEAT_RGB | FEAT_POLLRATE | FEAT_FWUPDATE)

Definition at line 152 of file structures.h.

Referenced by _setupusb().

9.40.2.19 #define HAS_ANY_FEATURE(*kb, feat*) (!!((kb)->features & (feat)))

Definition at line 158 of file structures.h.

9.40.2.20 #define HAS_FEATURES(*kb, feat*) (((kb)->features & (feat)) == (feat))

Definition at line 157 of file structures.h.

Referenced by _mkdevpath(), _start_dev(), cmd_fwupdate(), readcmd(), revertusb(), and usbunclaim().

9.40.2.21 #define HWMODE_K70 1

Definition at line 115 of file structures.h.

Referenced by cmd_hwload_kb(), and cmd_hwsave_kb().

9.40.2.22 #define HWMODE_K95 3

Definition at line 116 of file structures.h.

Referenced by cmd_hwload_kb(), and cmd_hwsave_kb().

9.40.2.23 #define HWMODE_MAX 3

Definition at line 117 of file structures.h.

9.40.2.24 #define I_CAPS 2

Definition at line 20 of file structures.h.

Referenced by _cmd_get(), iselect(), nprintind(), and updateindicators_kb().

9.40.2.25 #define I_NUM 1

Definition at line 19 of file structures.h.

Referenced by _cmd_get(), iselect(), nprintind(), and updateindicators_kb().

9.40.2.26 #define I_SCROLL 4

Definition at line 21 of file structures.h.

Referenced by _cmd_get(), iselect(), nprintind(), and updateindicators_kb().

9.40.2.27 #define IFACE_MAX 4

Definition at line 177 of file structures.h.

9.40.2.28 #define KB_NAME_LEN 40

Definition at line 174 of file structures.h.

Referenced by _setupusb(), and os_setupusb().

9.40.2.29 #define LIFT_MAX 5

Definition at line 56 of file structures.h.

Referenced by cmd_lift(), and loaddpi().

9.40.2.30 #define LIFT_MIN 1

Definition at line 55 of file structures.h.

Referenced by cmd_lift(), and loaddpi().

9.40.2.31 #define MACRO_MAX 1024

Definition at line 51 of file structures.h.

Referenced by _cmd_macro().

9.40.2.32 #define MD_NAME_LEN 16

Definition at line 82 of file structures.h.

Referenced by cmd_hwsave_kb(), cmd_hwsave_mouse(), cmd_name(), gethwmodename(), gethwprofilename(), getmodename(), hwloadmode(), hwtonative(), and nativetohw().

9.40.2.33 #define MODE_COUNT 6

Definition at line 100 of file structures.h.

Referenced by _freeprofile(), allocprofile(), and readcmd().

9.40.2.34 #define MSG_SIZE 64

Definition at line 176 of file structures.h.

Referenced by _usbsend(), cmd_hwload_kb(), cmd_hwload_mouse(), cmd_hwsave_kb(), cmd_hwsave_mouse(), cmd_pollrate(), fwupdate(), getfwversion(), hwloadmode(), loaddpi(), loadrgb_kb(), loadrgb_mouse(), os_inputmain(), os_usbrecv(), os_usbsend(), savedpi(), savergb_kb(), savergb_mouse(), setactive_kb(), setactive_mouse(), updatedpi(), updatergb_kb(), and updatergb_mouse().

9.40.2.35 #define NEEDS_FW_UPDATE(*kb*) ((kb)->fwversion == 0 && HAS_FEATURES((kb), FEAT_FWUPDATE | FEAT_FWVERSION))

Definition at line 161 of file structures.h.

Referenced by _start_dev(), readcmd(), revertusb(), setactive_kb(), and setactive_mouse().

9.40.2.36 #define OUTFIFO_MAX 10

Definition at line 24 of file structures.h.

Referenced by _mknotifynode(), _rmnotifynode(), inputupdate_keys(), nprintf(), readcmd(), rmdevpath(), and updateindicators_kb().

9.40.2.37 #define PR_NAME_LEN 16

Definition at line 99 of file structures.h.

Referenced by cmd_hwload_kb(), cmd_hwload_mouse(), cmd_profilename(), getprofilename(), hwtonative(), and nativetohw().

9.40.2.38 #define SCROLL_ACCELERATED 0

Definition at line 164 of file structures.h.

Referenced by readcmd().

9.40.2.39 #define SCROLL_MAX 10

Definition at line 166 of file structures.h.

Referenced by readcmd().

9.40.2.40 #define SCROLL_MIN 1

Definition at line 165 of file structures.h.

Referenced by readcmd().

9.40.2.41 #define SERIAL_LEN 34

Definition at line 175 of file structures.h.

Referenced by _setupusb(), and os_setupusb().

9.40.2.42 #define SET_KEYBIT(*array, index*) do { (array)[(index) / 8] |= 1 << ((index) % 8); } while(0)

Definition at line 15 of file structures.h.

Referenced by _cmd_macro(), cmd_notify(), corsair_mousecopy(), hid_kb_translate(), and hid_mouse_translate().

9.40.3 Variable Documentation

9.40.3.1 const union devcmd vtable_keyboard

Definition at line 29 of file device_vtable.c.

Referenced by get_vtable().

9.40.3.2 const union devcmd vtable_keyboard_nonrgb

Definition at line 76 of file device_vtable.c.

Referenced by get_vtable().

9.40.3.3 const union devcmd vtable_mouse

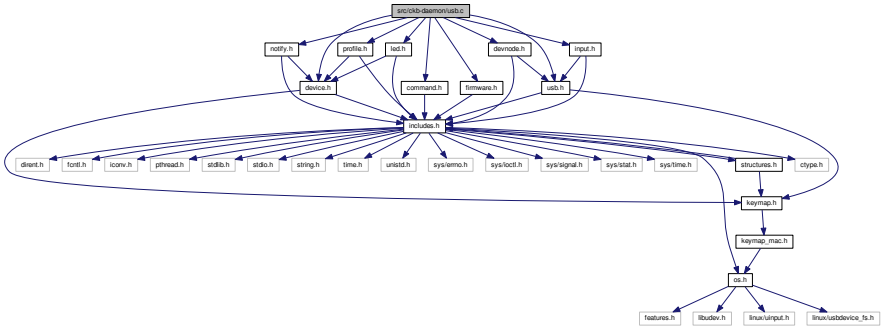
Definition at line 123 of file device_vtable.c.

Referenced by get_vtable().

9.41 src/ckb-daemon/usb.c File Reference

```
#include "command.h"
#include "device.h"
#include "devnode.h"
#include "firmware.h"
#include "input.h"
#include "led.h"
#include "notify.h"
#include "profile.h"
#include "usb.h"
```

Include dependency graph for usb.c:



Functions

- const char * vendor_str (short vendor)

  brief .
- const char * product_str (short product)

  brief .
- static const devcmd * get_vtable (short vendor, short product)

  brief .
- static void * devmain (usbdevice *kb)

  brief .
- static void * _setupusb (void *context)

  brief .
- void setupusb (usbdevice *kb)
- int revertusb (usbdevice *kb)
- int _resetusb (usbdevice *kb, const char *file, int line)
- int usb_tryreset (usbdevice *kb)
- int _usbsend (usbdevice *kb, const uchar *messages, int count, const char *file, int line)
- int _usbrecv (usbdevice *kb, const uchar *out_msg, uchar *in_msg, const char *file, int line)
- int closeusb (usbdevice *kb)

Variables

- pthread_mutex_t usbmutex = PTHREAD_MUTEX_INITIALIZER

  brief .
- volatile int reset_stop = 0

  brief .
- int features_mask = -1

  brief .
- int hwload_mode

  hwload_mode is defined in device.c

9.41.1 Function Documentation

9.41.1.1 int _resetusb (usbdevice * *kb,* const char * *file,* int *line*)

_resetusb Reset a USB device.

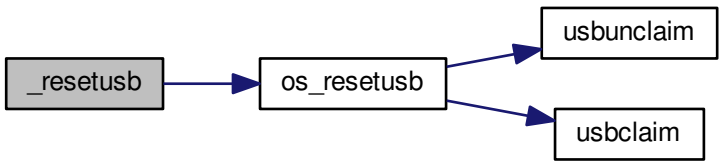
First reset the device via os_resetusb() after a long delay (it may send something to the host). If this worked (retval == 0), give the device another long delay Then perform the initialization via the device specific start() function entry in kb->vtable and if this is successful also, return the result of the device depenten updatergb() with force=true.

Definition at line 426 of file usb.c.

References usbdevice::active, DELAY_LONG, os_resetusb(), and usbdevice::vtable.

```
426                                                         {
427     // Perform a USB reset
428     DELAY_LONG(kb);
429     int res = os_resetusb(kb, file, line);
430     if(res)
431         return res;
432     DELAY_LONG(kb);
433     // Re-initialize the device
434     if(kb->vtable->start(kb, kb->active) != 0)
435         return -1;
436     if(kb->vtable->updatergb(kb, 1) != 0)
437         return -1;
438     return 0;
439 }
```

Here is the call graph for this function:



9.41.1.2 static void* _setupusb (void * *context*) [static]

_setupusb A horrible function for setting up an usb device

Parameters

context	As _setupusb() is called as a new thread, the kb∗ is transferred as void∗

Returns

a ptread_t∗ 0, here casted as void∗. Retval is always null

The basic structure of the function is somewhat habituated. It is more like an assembler routine than a structured program. This is not really bad, but just getting used to.

After every action, which can be practically fault-prone, the routine goes into the same error handling: It goes via goto to one of two exit labels. The difference is whether or not an unlock has to be performed on the imutex variable. In both cases, closeusb() is called, then an unlock is performed on the dmutex.

The only case where this error handling is not performed is the correct return of the call to devmain(). Here simply the return value of devmain() is passed to the caller.

In either case, the routine terminates with a void∗ 0 because either devmain() has returned constant null or the routine itself returns zero.

The basic idea of this routine is the following:

First some initialization of kb standard structured and local vars is done.

- **kb** is set to the pointer given from start environment
- local vars **vendor** and **product** are set to the values from the corresponding fields of kb
- local var **vt and** the **kb-**>**vtable** are both set to the retval of *get_vtable()*
- **kb-**>**features** are set depending on the type of hardware connected:
  - set either to standard non rgb (all common flags like binding, notify, FW, hardware-loading etc) or in case of RGB-device set to standard + RGB, pollrate-change and fw-update
  - exclude all features which are disabled via feature_mask (set by daemon CLI parameters)
  - if it is a mouse, add adjust-rate
  - if it is a monochrome device, set the flag for RGB-protocol, but single color
- the standard delay time is initialized in kb->usbdelay
- A fixed 100ms wait is the start. **Although the DELAY_LONG macro is given a parameter, it is ignored. Occasionally refactor it.**
- The first relevant point is the operating system-specific opening of the interface in os_setupusb(). As a result, some parameters should be set in kb (name, serial, fwversion, epcount = number of usb endpoints), and all endpoints should be claimed with usbclaim(). Claiming is the only point where os_setupusb() can produce an error (-1, otherwise 0).
- The following two statements deal with possible errors when setting the kb values in the current routine: If the version or the name was not read correctly, they are set to default values:
  - serial is set to "<vendor>: <product> -NoID"
  - the name is set to "<vendor> <product>".
- Then the user level input subsystem is activated via os_openinput(). There are two file descriptors, one for the mouse and one for the keyboard. **As mentioned in structures.h, not the just opened FD numbers are stored under kb-**>**uinput_kb or kb-**>**uinput_mouse, but the values increased by 1!** The reason is, if the open fails or not open has been done until now, that struct member is set to 0, not to -1 or other negative value. So all usage of this kb->handle must be something like "`kb->handle - 1`", as you can find it in the code.
- The next action is to create a separate thread, which gets as parameter kb and starts with os_inputmain(). The thread is immediately detached so that it can return its resource completely independently if it should terminate.

- The same happens with os_setupindicators(), which initially initializes all LED variables in kb to off and then starts the _ledthread() thread with kb as parameter and then detaches it. Here again only the generation of the thread can fail.

- Via an entry in the vable (allocprofile, identical for all three vtable types), allocprofile() is called in profile.c. With a valid parameter kb, a usbprofile structure is allocated and stored as a kb->profile. Then initmode() is called for each of the initializable modes (MODE_COUNT, currently 6). This procedure creates the memory space for the mode information, initializes the range to 0, and then sets the light.forceupdate and dpi.forceupdate to true. This forces an update later in the initialization of the device.

  The first mode is set as the current mode and two force flags are set (this seems to be mode-intersecting flags for light and update).

  Warning

  There is no error handling for the allocprofile() and initmode() procedures. However, since they allocate storage areas, the subsequent assignments and initializations can run in a SEGV.

- Not completely understandable is why now via the vtable the function updateindicators() is called. But this actually happens in the just started thread _ledthread(). Either the initialization is wrong und must done here with force or the overview is lost, what happens when...

  Regardless: For a mouse nothing happens here, for a keyboard updateindicators_kb() is called via the entry in kb->vtable. The first parameter is kb again, the second is constant 1 (means force = true). This causes the LED status to be sent after a 5ms delay via os_sendindicators() (ioctl with a `usbdevfs_ctrltransfer`).

  The notification is sent to all currently open notification channels then.

  Setupindicators() and with it updateindicators_kb() can fail.

- From this point - if an error is detected - the error label is addressed by goto statement, which first performs an unlock on the imutex. This is interesting because the next statement is exactly this: An unlock on the imutex.

- Via vtable the *kb->start()* function is called next. This is the same for a mouse and an RGB keyboard: start_dev(), for a non RGB keyboard it is start_kb_nrgb().

  First parameter is as always kb, second is 0 (makeactive = false).

  - In start_kb_nrgb() set the keyboard into a so-called software mode (NK95_HWOFF) via ioctl with `usbdevfs_ctrltransfer` in function _nk95cmd(), which will in turn is called via macro nk95cmd() via start_kb_nrgb().

    Then two dummy values (active and pollrate) are set in the kb structure and ready.
  - start_dev() does a bit more - because this function is for both mouse and keyboard. start_dev() calls - after setting an extended timeout parameter - _start_dev(). Both are located in device.c.
  - First, _start_dev() attempts to determine the firmware version of the device, but only if two conditions are met: hwload-mode is not null (then hw-loading is disabled) and the device has the FEAT_HWLOAD feature. Then the firmware and the poll rate are fetched via getfwversion().

    If hwload_mode is set to "load only once" (==1), then the HWLOAD feature is masked, so that no further reading can take place.
  - Now check if device needs a firmware update. If so, set it up and leave the function without error.
  - Else load the hardware profile from device if the hw-pointer is not set and hw-loading is possible and allowed.

    Return error if mode == 2 (load always) and loading got an error. Else mask the HWLOAD feature, because hwload must be 1 and the error couold be a repeated hw-reading.

    Puh, that is real Horror code. It seems to be not faulty, but completely unreadable.
  - Finally, the second parameter of _startdev() is used to check whether the device is to be activated. Depending on the parameter, the active or the idle-member in the correspondig vtable is called. These are device-dependent again:

Device	active	idle
RGB Keyboard	cmd_active_kb() means: start the device with a lot of kb-specific initializers (software controlled mode)	cmd_idle_kb() set the device with a lot of kb-specific initializers into the hardware controlled mode)
non RGB Keyboard	cmd_io_none() means: Do nothing	cmd_io_none() means: Do nothing
Mouse	cmd_active_mouse() similar to cmd_active_kb()	cmd_idle_mouse similar to cmd_idle_kb()

- If either *start()* succeeded or the next following usb_tryreset(), it goes on, otherwise again a hard abort occurs.
- Next, go to mkdevpath(). After securing the EUID (effective UID) especially for macOS, work starts really in _mkdevpath(). Create - no matter how many devices were registered - either the ckb0/ files **version**, **pid** and **connected** or the **cmd** command fifo, the first notification fifo **notify0**, **model** and **serial** as well as the **features** of the device and the **pollrate**.
- If all this is done and no error has occurred, a debug info is printed ("Setup finished for ckbx") updateconnected() writes the new device into the text file under ckb0/ and devmain() is called.

devmain()'s return value is returned by _setupusb() when we terminate.

- The remaining code lines are the two exit labels as described above

Definition at line 214 of file usb.c.

References ckb_info, closeusb(), DELAY_LONG, devmain(), devpath, dmutex, FEAT_ADJRATE, FEAT_MONOCHROME, FEAT_STD_NRGB, FEAT_STD_RGB, usbdevice::features, features_mask, get_vtable(), imutex, INDEX_OF, usbdevice::inputthread, IS_MONOCHROME, IS_MOUSE, IS_RGB, KB_NAME_LEN, keyboard, mkdevpath(), usbdevice::name, os_inputmain(), os_inputopen(), os_setupindicators(), os_setupusb(), usbdevice::product, product_str(), usbdevice::serial, SERIAL_LEN, updateconnected(), USB_DELAY_DEFAULT, usb_tryreset(), usbdevice::usbdelay, usbdevice::vendor, vendor_str(), and usbdevice::vtable.

Referenced by setupusb().

```
214                                     {
227     usbdevice* kb = context;
228     // Set standard fields
229     short vendor = kb->vendor, product = kb->product;
230     const devcmd* vt = kb->vtable = get_vtable(vendor, product);
231     kb->features = (IS_RGB(vendor, product) ? FEAT_STD_RGB :
    FEAT_STD_NRGB) & features_mask;
232     if(IS_MOUSE(vendor, product)) kb->features |= FEAT_ADJRATE;
233     if(IS_MONOCHROME(vendor, product)) kb->features |=
    FEAT_MONOCHROME;
234     kb->usbdelay = USB_DELAY_DEFAULT;
235
236     // Perform OS-specific setup
240     DELAY_LONG(kb);
241
247     if(os_setupusb(kb))
248         goto fail;
249
255     // Make up a device name and serial if they weren't assigned
256     if(!kb->serial[0])
257         snprintf(kb->serial, SERIAL_LEN, "%04x:%04x-NoID", kb->
    vendor, kb->product);
258     if(!kb->name[0])
259         snprintf(kb->name, KB_NAME_LEN, "%s %s", vendor_str(kb->
    vendor), product_str(kb->product));
260
261     // Set up an input device for key events
269     if(os_inputopen(kb))
270         goto fail;
274     if(pthread_create(&kb->inputthread, 0, os_inputmain, kb))
275         goto fail;
276     pthread_detach(kb->inputthread);
282     if(os_setupindicators(kb))
283         goto fail;
284
285     // Set up device
298     vt->allocprofile(kb);
```

```
309     vt->updateindicators(kb, 1);
314     pthread_mutex_unlock(imutex(kb));
348     if(vt->start(kb, 0) && usb_tryreset(kb))
349         goto fail_noinput;
355     // Make /dev path
356     if(mkdevpath(kb))
357         goto fail_noinput;
363     // Finished. Enter main loop
364     int index = INDEX_OF(kb, keyboard);
365     ckb_info("Setup finished for %s%d\n", devpath, index);
366     updateconnected();
369     return devmain(kb);
372     fail:
373     pthread_mutex_unlock(imutex(kb));
374     fail_noinput:
375     closeusb(kb);
376     pthread_mutex_unlock(dmutex(kb));
377     return 0;
378 }
```

Here is the call graph for this function:

Here is the caller graph for this function:

9.41.1.3 int _usbrecv (usbdevice * *kb*, const uchar * *out_msg*, uchar * *in_msg*, const char * *file*, int *line*)

_usbrecv Request data from a USB device by first sending an output packet and then reading the response.

To fully understand this, you need to know about usb: All control is at the usb host (the CPU). If the device wants to communicate something to the host, it must wait for the host to ask. The usb protocol defines the cycles and periods in which actions are to be taken.

So in order to receive a data packet from the device, the host must first send a send request.

This is done by _usbrecv() in the first block by sending the MSG_SIZE large data block from **out_msg** via os_usbsend() as it is a machine depending implementation. The usb target device is as always determined over kb.

For os_usbsend() to know that it is a receive request, the **is_recv** parameter is set to true (1). With this, os_usbsend () generates a control package for the hardware, not a data packet.

If sending of the control package is not successful, a maximum of 5 times the transmission is repeated (including the first attempt). If a non-cancelable error is signaled or the drive is stopped via reset_stop, _usbrecv() immediately returns 0.

After this, the function waits for the requested response from the device using os_usbrecv ().

os_usbrecv() returns 0, -1 or something else.

Zero signals a serious error which is not treatable and _usbrecv() also returns 0.

-1 means that it is a treatable error - a timeout for example - and therefore the next transfer attempt is started after a long pause (DELAY_LONG) if not reset_stop or the wrong hwload_mode require a termination with a return value of 0.

After 5 attempts, _usbrecv () returns and returns 0 as well as an error message.

When data is received, the number of received bytes is returned. This should always be MSG_SIZE, but os_usbrecv() can also return less. It should not be more, because then there would be an unhandled buffer overflow, but it could be less. This would be signaled in os_usbrecv () with a message.

The buffers behind **out_msg** and **in_msg** are MSG_SIZE at least (currently 64 Bytes). More is ok but useless, less brings unpredictable behavior. < Synchonization between macro and color information

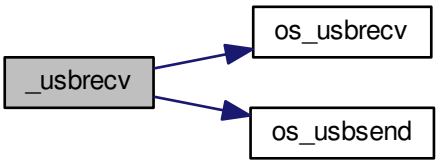
Definition at line 601 of file usb.c.

References ckb_err_fn, DELAY_LONG, DELAY_MEDIUM, DELAY_SHORT, hwload_mode, mmutex, os_usbrecv(), os_usbsend(), and reset_stop.

```
601                                                                                                 {
602     // Try a maximum of 5 times
603     for (int try = 0; try < 5; try++) {
604         // Send the output message
605         pthread_mutex_lock(mmutex(kb));
606         DELAY_SHORT(kb);
607         int res = os_usbsend(kb, out_msg, 1, file, line);
608         pthread_mutex_unlock(mmutex(kb));
609         if (res == 0)
610             return 0;
611         else if (res == -1) {
612             // Retry on temporary failure
613             if (reset_stop)
614                 return 0;
615             DELAY_LONG(kb);
616             continue;
617         }
618         // Wait for the response
619         DELAY_MEDIUM(kb);
620         res = os_usbrecv(kb, in_msg, file, line);
621         if(res == 0)
622             return 0;
623         else if(res != -1)
624             return res;
625         if(reset_stop || hwload_mode != 2)
626             return 0;
627         DELAY_LONG(kb);
628     }
629     // Give up
630     ckb_err_fn("Too many send/recv failures. Dropping.\n", file, line);
631     return 0;
```

```
632 }
```

Here is the call graph for this function:



9.41.1.4 int _usbsend (usbdevice * *kb*, const uchar * *messages*, int *count*, const char * *file*, int *line*)

_usbsend send a logical message completely to the given device

Todo A lot of different conditions are combined in this code. Don't think, it is good in every combination...

The main task of _usbsend () is to transfer the complete logical message from the buffer beginning with *messages* to **count** * **MSG_SIZE**.

According to usb 2.0 specification, a USB transmits a maximum of 64 byte user data packets. For the transmission of longer messages we need a segmentation. And that is exactly what happens here.

The message is given one by one to os_usbsend() in MSG_SIZE (= 64) byte large bites.

Attention

This means that the buffer given as argument must be n * MSG_SIZE Byte long.

An essential constant parameter which is relevant for os_usbsend() only is is_recv = 0, which means sending.

Now it gets a little complicated again:

- If os_usbsend() returns 0, only zero bytes could be sent in one of the packets, or it was an error (-1 from the systemcall), but not a timeout. How many Bytes were sent in total from earlier calls does not seem to matter, _usbsend() returns a total of 0.
- Returns os_usbsend() -1, first check if **reset_stop** is set globally or (incomprehensible) hwload_mode is not set to "always". In either case, _usbsend() returns 0, otherwise it is assumed to be a temporary transfer error and it simply retransmits the physical packet after a long delay.
- If the return value of os_usbsend() was neither 0 nor -1, it specifies the numer of bytes transferred.

  Here is an information hiding conflict with os_usbsend() (at least in the Linux version):

  If os_usbsend() can not transfer the entire packet, errors are thrown and the number of bytes sent is returned. _usbsend() interprets this as well and remembers the total number of bytes transferred in the local variable **total_sent**. Subsequently, however, transmission is continued with the next complete MSG_SIZE block and not with the first of the possibly missing bytes.

  Todo Check whether this is the same in the macOS variant. It is not dramatic, but if errors occur, it can certainly irritate the devices completely if they receive incomplete data streams. Do we have errors with the messages "Wrote YY bytes (expected 64)" in the system logs? If not, we do not need to look any further.

When the last packet is transferred, _usbsend() returns the effectively counted set of bytes (from **total_sent**). This at least gives the caller the opportunity to check whether something has been lost in the middle.

A bit strange is the structure of the program: Handling the **count** MSG_SIZE blocks to be transferred is done in the outer for (...) loop. Repeating the transfer with a treatable error is managed by the inner while(1) loop.

This must be considered when reading the code; The "break" on successful block transfer leaves the inner while, not the for (...). < Synchonization between macro and color information

Definition at line 532 of file usb.c.

References DELAY_LONG, DELAY_SHORT, hwload_mode, mmutex, MSG_SIZE, os_usbsend(), and reset_stop.

```
532                                                                                                    {
533     int total_sent = 0;
534     for(int i = 0; i < count; i++){
535         // Send each message via the OS function
536         while(1){
537             pthread_mutex_lock(mmutex(kb));
538             DELAY_SHORT(kb);
539             int res = os_usbsend(kb, messages + i * MSG_SIZE, 0, file, line);
540             pthread_mutex_unlock(mmutex(kb));
541             if(res == 0)
542                 return 0;
543             else if(res != -1){
544                 total_sent += res;
545                 break;
546             }
547             // Stop immediately if the program is shutting down or hardware load is set to tryonce
548             if(reset_stop || hwload_mode != 2)
549                 return 0;
550             // Retry as long as the result is temporary failure
551             DELAY_LONG(kb);
552         }
553     }
554     return total_sent;
555 }
```

Here is the call graph for this function:

9.41.1.5 int closeusb (usbdevice * *kb*)

closeusb Close a USB device and remove device entry.

An imutex lock ensures first of all, that no communication is currently running from the viewpoint of the driver to the user input device (ie the virtual driver with which characters or mouse movements are sent from the daemon to the operating system as inputs).

If the **kb** has an acceptable value != 0, the index of the device is looked for and with this index os_inputclose() is called. After this no more characters can be sent to the operating system.

Then the connection to the usb device is capped by os_closeusb().

Todo What is not yet comprehensible is the call to updateconnected() BEFORE os_closeusb(). Should that be in the other sequence? Or is updateconnected() not displaying the connected usb devices, but the representation which uinput devices are loaded? Questions about questions ...

If there is no valid **handle**, only updateconnected() is called. We are probably trying to disconnect a connection under construction. Not clear.

The cmd pipe as well as all open notify pipes are deleted via rmdevpath ().

This means that nothing can happen to the input path - so the device-specific imutex is unlocked again and remains unlocked.

Also the dmutex is unlocked now, but only to join the thread, which was originally taken under **kb->thread** (which started with _setupusb()) with pthread_join() again. Because of the closed devices that thread would have to quit sometime

See Also

the hack note with rmdevpath())

As soon as the thread is caught, the dmutex is locked again, which is what I do not understand yet: What other thread can do usb communication now?

If the vtabel exists for the given kb (why not? It seems to have race conditions here!!), via the vtable the actually device-specific, but still everywhere identical freeprofile() is called. This frees areas that are no longer needed. Then the **usbdevice** structure in its array is set to zero completely.

Error handling is rather unusual in closeusb(); Everything works (no matter what the called functions return), and closeusb() always returns zero (success).

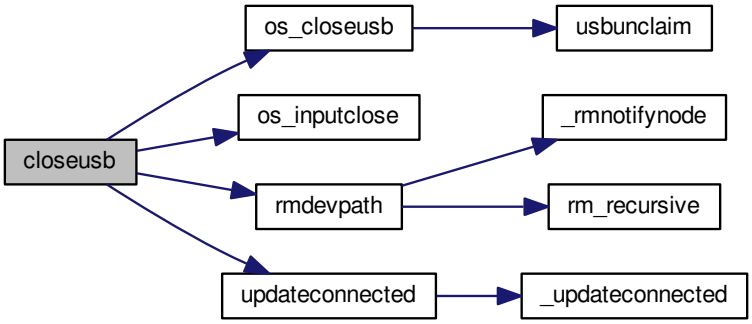
Definition at line 677 of file usb.c.

References ckb_info, devpath, dmutex, usbdevice::handle, imutex, INDEX_OF, keyboard, os_closeusb(), os_inputclose(), rmdevpath(), usbdevice::thread, updateconnected(), and usbdevice::vtable.

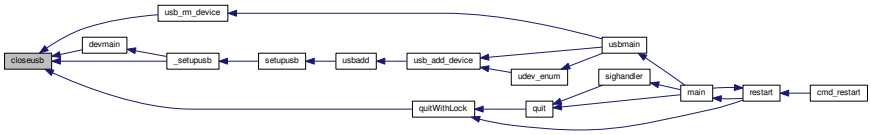
Referenced by _setupusb(), devmain(), quitWithLock(), and usb_rm_device().

```
677                             {
678     pthread_mutex_lock(imutex(kb));
679     if(kb->handle){
680         int index = INDEX_OF(kb, keyboard);
681         ckb_info("Disconnecting %s%d\n", devpath, index);
682         os_inputclose(kb);
683         updateconnected();
684         // Close USB device
685         os_closeusb(kb);
686     } else
687         updateconnected();
688     rmdevpath(kb);
689 
690     // Wait for thread to close
691     pthread_mutex_unlock(imutex(kb));
692     pthread_mutex_unlock(dmutex(kb));
693     pthread_join(kb->thread, 0);
694     pthread_mutex_lock(dmutex(kb));
695 
696     // Delete the profile and the control path
697     if(!kb->vtable)
698         return 0;
699     kb->vtable->freeprofile(kb);
700     memset(kb, 0, sizeof(usbdevice));
701     return 0;
702 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.41.1.6 static void* devmain (usbdevice * *kb*) [static]

devmain is called by _setupusb

Parameters

kb	the pointer to the device. Even if it has the name kb, it is valid also for a mouse (the whole driver seems to be implemented first for a keyboard).

Returns

always a nullptr

Synchronization

The syncing via mutexes is interesting:

1. *imutex* (the Input mutex)

   This one is locked in `setupusb()`. That function does only two things: Locking the mutex and trying to start a thread at `_setupusb()`. _setupusb() unlocks *imutex* after getting some buffers and initalizing internal structures from the indicators (this function often gets problems with error messages like "unable to read indicators" or "Timeout bla blubb").

Warning

have a look at *updateindicators()* later.
if creating the thread is not successful, the *imutex* remains blocked. Have a look at setupusb() later.

2. *dmutex* (the Device mutex)

   This one is very interesting, because it is handled in devmain(). It seems that it is locked only in *_ledthread()*, which is a thread created in *os_setupindicators()*. os_setupindicators() again is called in *_setupusb()* long before calling devmain(). So this mutex is locked when we start the function as the old comment says.

   Before reading from the FIFO and direct afterwards an unlock..lock sequence is implemented here. Even if only the function readlines() should be surrounded by the unlock..lock, the variable definition of the line pointer is also included here. Not nice, but does not bother either. Probably the Unlock..lock is needed so that now another process can change the control structure *linectx* while we wait in readlines().

   Todo Hope to find the need for dmutex usage later.
   Should this function be declared as pthread_t∗ function, because of the defintion of pthread-create? But void∗ works also...

Attention

dmutex should still be locked when this is called

First a *readlines_ctx* buffer structure is initialized by `readlines_ctx_init()`.

After some setup functions, beginning in _setupusb() which has called devmain(), we read the command input--Fifo designated to that device in an endless loop. This loop has two possible exits (plus reaction to signals, not mentioned here).

If the reading via readlines() is successful (we might have read multiple lines), the interpretation is done by readcmd() iff the connection to the device is still available (checked via IS_CONNECTED(kb)). This is true if the kb-structure has a handle and an event pointer both != Null). If not, the loop is left (the first exit point).

if nothing is in the line buffer (some magic interrupt?), continue in the endless while without any reaction.

Todo readcmd() gets a **line**, not **lines**. Have a look on that later.

Is the condition IS_CONNECTED valid? What functions change the condititon for the macro?

If interpretation and communication with the usb device got errors, they are signalled by readcmd() (non zero retcode). In this case the usb device is closed via closeusb() and the endless loop is left (the second exit point).

After leaving the endless loop the readlines-ctx structure and its buffers are freed by readlines_ctx_free().

Definition at line 135 of file usb.c.

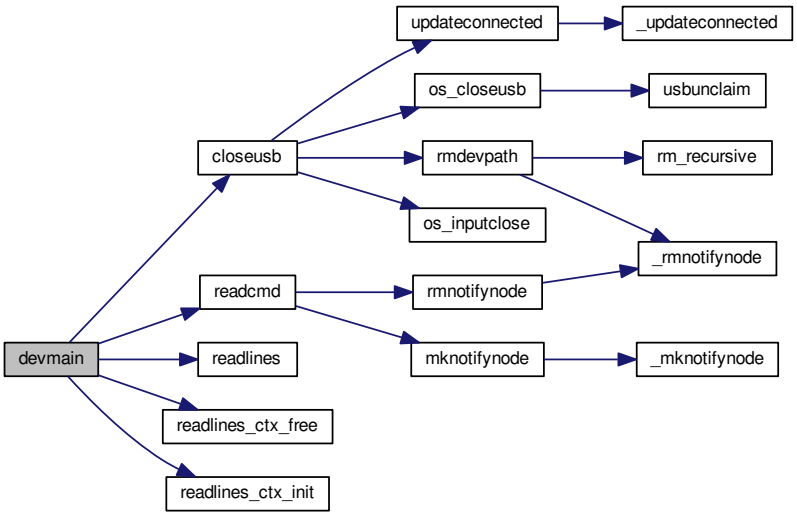
References closeusb(), dmutex, usbdevice::infifo, IS_CONNECTED, readcmd(), readlines(), readlines_ctx_free(), and readlines_ctx_init().

Referenced by _setupusb().

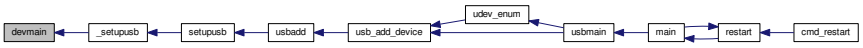
```
135                                     {
137     int kbfifo = kb->infifo - 1;
140     readlines_ctx linectx;
141     readlines_ctx_init(&linectx);
146     while(1){
153         pthread_mutex_unlock(dmutex(kb));
154         // Read from FIFO
155         const char* line;
156         int lines = readlines(kbfifo, linectx, &line);
157         pthread_mutex_lock(dmutex(kb));
158         // End thread when the handle is removed
159         if(!IS_CONNECTED(kb))
160             break;
164         if(lines){
167             if(readcmd(kb, line)){
173                 // USB transfer failed; destroy device
174                 closeusb(kb);
175                 break;
```

```
176             }
177         }
178     }
179     pthread_mutex_unlock(dmutex(kb));
182     readlines_ctx_free(linectx);
183     return 0;
184 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.41.1.7 static const devcmd* get_vtable (short *vendor*, short *product*) [static]

get_vtable returns the correct vtable pointer

Parameters

vendor	short usb vendor ID
product	short usb product ID

Returns

Depending on the type and model, the corresponding vtable pointer is returned (see below)

At present, we have three different vtables:

- `vtable_mouse` is used for all mouse types. This may be wrong with some newer mice?
- `vtable_keyboard` is used for all RGB Keyboards.
- `vtable_keyboard_nonrgb` for all the rest.

Todo Is the last point really a good decision and always correct?

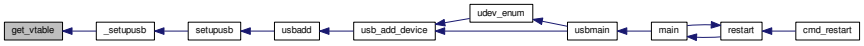
Definition at line 102 of file usb.c.

References IS_MOUSE, IS_RGB, vtable_keyboard, vtable_keyboard_nonrgb, and vtable_mouse.

Referenced by _setupusb().

```
102                                                                    {
103     return IS_MOUSE(vendor, product) ? &vtable_mouse :
      IS_RGB(vendor, product) ? &vtable_keyboard : &
      vtable_keyboard_nonrgb;
104 }
```

Here is the caller graph for this function:



9.41.1.8 const char* product_str (short *product*)

product_str returns a condensed view on what type of device we have.

At present, various models and their properties are known from corsair products. Some models differ in principle (mice and keyboards), others differ in the way they function (for example, RGB and non RGB), but they are very similar.

Here, only the first point is taken into consideration and we return a unified model string. If the model is not known with its number, *product_str* returns an empty string.

The model numbers and corresponding strings wwith the numbers in hex-string are defined in `usb.h`

At present, this function is used to initialize `kb->name` and to give information in debug strings.

Attention

The combinations below have to fit to the combinations in the macros mentioned above. So if you add a device with a new number, change both.

Todo There are macros defined in usb.h to detect all the combinations below. the only difference is the parameter: The macros need the *kb**, product_str() needs the *product ID*

Definition at line 70 of file usb.c.

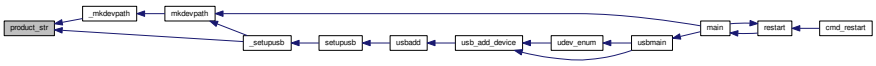
References P_K65, P_K65_LUX, P_K65_NRGB, P_K65_RFIRE, P_K70, P_K70_LUX, P_K70_LUX_NRGB, P_K70_NRGB, P_K70_RFIRE, P_K70_RFIRE_NRGB, P_K95, P_K95_NRGB, P_K95_PLATINUM, P_M65, P_M65_PRO, P_SABRE_L, P_SABRE_N, P_SABRE_O, P_SABRE_O2, P_SCIMITAR, P_SCIMITAR_PRO, P_STRAFE, and P_STRAFE_NRGB.

Referenced by _mkdevpath(), and _setupusb().

```
70                                        {
71     if(product == P_K95 || product == P_K95_NRGB || product ==
      P_K95_PLATINUM)
72         return "k95";
73     if(product == P_K70 || product == P_K70_NRGB || product ==
      P_K70_LUX || product == P_K70_LUX_NRGB || product ==
      P_K70_RFIRE || product == P_K70_RFIRE_NRGB)
74         return "k70";
75     if(product == P_K65 || product == P_K65_NRGB || product ==
      P_K65_LUX || product == P_K65_RFIRE)
76         return "k65";
77     if(product == P_STRAFE || product == P_STRAFE_NRGB)
```

```
78          return "strafe";
79      if(product == P_M65 || product == P_M65_PRO)
80          return "m65";
81      if(product == P_SABRE_O || product == P_SABRE_L || product ==
        P_SABRE_N || product == P_SABRE_O2)
82          return "sabre";
83      if(product == P_SCIMITAR || product == P_SCIMITAR_PRO)
84          return "scimitar";
85      return "";
86  }
```

Here is the caller graph for this function:



9.41.1.9 int revertusb (usbdevice * *kb*)

revertusb sets a given device to inactive (hardware controlled) mode if not a fw-ugrade is indicated

First is checked, whether a firmware-upgrade is indicated for the device. If so, revertusb() returns 0.

Todo Why is this useful? Are there problems seen with deactivating a device with older fw-version??? Why isn't this an error indicating reason and we return success (0)?

Anyway, the following steps are similar to some other procs, dealing with low level usb handling:

- If we do not have an RGB device, a simple setting to Hardware-mode (NK95_HWON) is sent to the device via n95cmd().

  Todo The return value of nk95cmd() is ignored (but sending the ioctl may produce an error and _nk95_cmd will indicate this), instead revertusb() returns success in any case.

- If we have an RGB device, setactive() is called with second param active = false. That function will have a look on differences between keyboards and mice.

  More precisely setactive() is just a macro to call via the kb->vtable enties either the active() or the idle() function where the vtable points to. setactive() may return error indications. If so, revertusb() returns -1, otherwise 0 in any other case.

Definition at line 407 of file usb.c.

References FEAT_RGB, HAS_FEATURES, NEEDS_FW_UPDATE, NK95_HWON, nk95cmd, and setactive.

Referenced by quitWithLock().

```
407                             {
408     if(NEEDS_FW_UPDATE(kb))
409         return 0;
410     if(!HAS_FEATURES(kb, FEAT_RGB)){
411         nk95cmd(kb, NK95_HWON);
412         return 0;
413     }
414     if(setactive(kb, 0))
415         return -1;
416     return 0;
417 }
```

Here is the caller graph for this function:

9.41.1.10 void setupusb (usbdevice * *kb*)

setupusb starts a thread with kb as parameter and _setupusb() as entrypoint.

Set up a USB device after its handle is open. Spawns a new thread _setupusb() with standard parameter kb. dmutex must be locked prior to calling this function. The function will unlock it when finished. In kb->thread the thread id is mentioned, because closeusb() needs this info for joining that thread again.

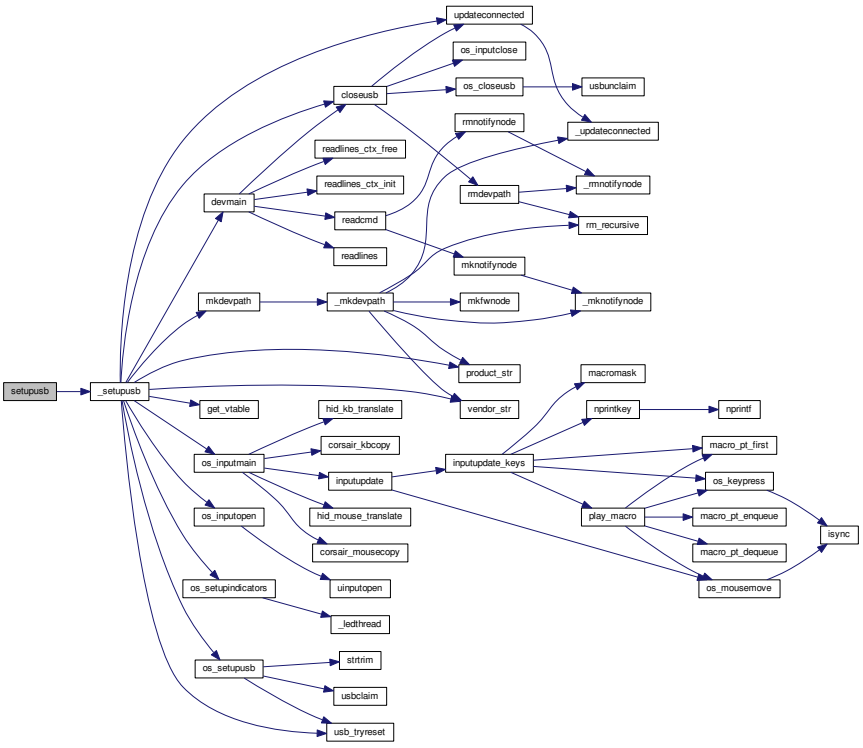
Definition at line 386 of file usb.c.

References _setupusb(), ckb_err, imutex, and usbdevice::thread.

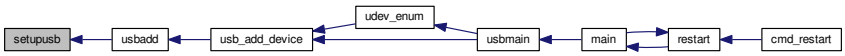
Referenced by usbadd().

```
386                         {
387     pthread_mutex_lock(imutex(kb));
388     if(pthread_create(&kb->thread, 0, _setupusb, kb))
389         ckb_err("Failed to create USB thread\n");
390 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.41.1.11 int usb_tryreset (usbdevice * kb)

usb_tryreset does what the name means: Try to reset the usb via resetusb()

This function is called if an usb command ran into an error in case of one of the following two situations:

- When setting up a new usb device and the start() function got an error (

  See Also

  _setupusb())

- If upgrading to a new firmware gets an error (

  See Also

  cmd_fwupdate()).

  The previous action which got the error will NOT be re-attempted.

In an endless loop usb_tryreset() tries to reset the given usb device via the macro resetusb().

This macro calls _resetusb() with debugging information.

_resetusb() sends a command via the operating system dependent function os_resetusb() and - if successful - reinitializes the device. os_resetusb() returns -2 to indicate a broken device and all structures should be removed for it.

In that case, the loop is terminated, an error message is produced and usb_tryreset() returns -1.

In case resetusb() has success, the endless loop is left via a return 0 (success).

If the return value from resetusb() is -1, the loop is continued with the next try.

If the global variable **reset_stop** is set directly when the function is called or after each try, usb_tryreset() stops working and returns -1.

Todo Why does usb_tryreset() hide the information returned from resetusb()? Isn't it needed by the callers?

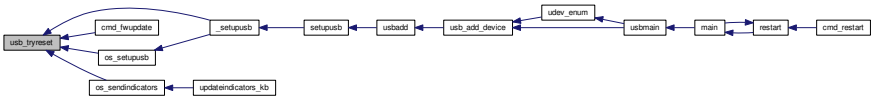
Definition at line 465 of file usb.c.

References ckb_err, ckb_info, reset_stop, and resetusb.

Referenced by _setupusb(), cmd_fwupdate(), os_sendindicators(), and os_setupusb().

```
465                                {
466     if(reset_stop)
467         return -1;
468     ckb_info("Attempting reset...\n");
469     while(1){
470         int res = resetusb(kb);
471         if(!res){
472             ckb_info("Reset success\n");
473             return 0;
474         }
475         if(res == -2 || reset_stop)
476             break;
477     }
478     ckb_err("Reset failed. Disconnecting.\n");
479     return -1;
480 }
```

Here is the caller graph for this function:



9.41.1.12 const char* vendor_str (short *vendor*)

uncomment the following Define to see USB packets sent to the device

vendor_str returns "corsair" iff the given *vendor* argument is equal to *V_CORSAIR* (0x1bc) else it returns ""

Attention

There is also a string defined V_CORSAIR_STR, which returns the device number as string in hex "1b1c".

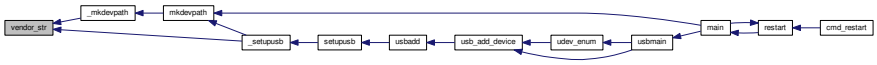
Definition at line 43 of file usb.c.

References V_CORSAIR.

Referenced by _mkdevpath(), and _setupusb().

```
43                                      {
44     if(vendor == V_CORSAIR)
45         return "corsair";
46     return "";
47 }
```

Here is the caller graph for this function:



9.41.2 Variable Documentation

9.41.2.1 int features_mask = -1

features_mask Mask of features to exclude from all devices

That bit mask ist set to enable all (-1). When interpreting the input parameters, some of these bits can be cleared.

At the moment binding, notifying and mouse-acceleration can be disabled via command line.

Have a look at *main()* in main.c for details.

Definition at line 35 of file usb.c.

Referenced by _setupusb(), and main().

9.41.2.2 int hwload_mode

hwload_mode is defined in device.c

Definition at line 7 of file device.c.

Referenced by _start_dev(), _usbrecv(), and _usbsend().

9.41.2.3 volatile int reset_stop = 0

reset_stop is boolean: Reset stopper for when the program shuts down.

Is set only by *quit()* to true (1) to inform several usb_∗ functions to end their loops and tries.

Definition at line 25 of file usb.c.

Referenced by _usbrecv(), _usbsend(), quitWithLock(), and usb_tryreset().

9.41.2.4 pthread_mutex_t usbmutex = PTHREAD_MUTEX_INITIALIZER

usbmutex is a never referenced mutex!

Todo We should have a look why this mutex is never used.

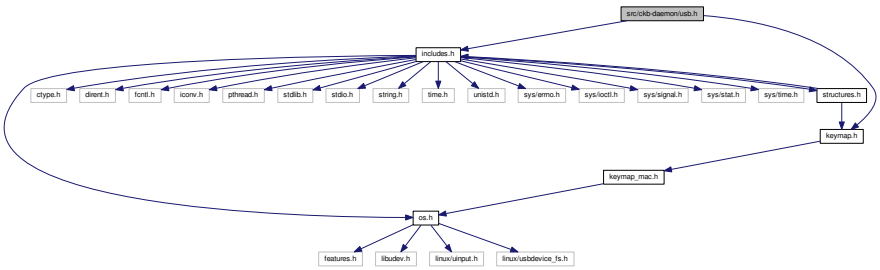
Definition at line 17 of file usb.c.

9.42 src/ckb-daemon/usb.h File Reference

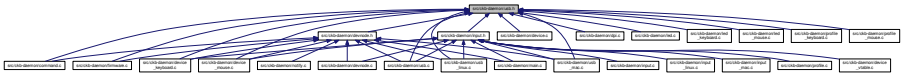
Definitions for using USB interface.

```
#include "includes.h"
#include "keymap.h"
```

Include dependency graph for usb.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define V_CORSAIR 0x1b1c

  For the following Defines please see "Detailed Description".
- #define V_CORSAIR_STR "1b1c"
- #define P_K65 0x1b17
- #define P_K65_STR "1b17"
- #define P_K65_NRGB 0x1b07
- #define P_K65_NRGB_STR "1b07"
- #define P_K65_LUX 0x1b37

- #define P_K65_LUX_STR "1b37"
- #define P_K65_RFIRE 0x1b39
- #define P_K65_RFIRE_STR "1b39"
- #define IS_K65(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_K65 || (kb)->product == P_K65_NRGB || (kb)->product == P_K65_LUX || (kb)->product == P_K65_RFIRE))
- #define P_K70 0x1b13
- #define P_K70_STR "1b13"
- #define P_K70_NRGB 0x1b09
- #define P_K70_NRGB_STR "1b09"
- #define P_K70_LUX 0x1b33
- #define P_K70_LUX_STR "1b33"
- #define P_K70_LUX_NRGB 0x1b36
- #define P_K70_LUX_NRGB_STR "1b36"
- #define P_K70_RFIRE 0x1b38
- #define P_K70_RFIRE_STR "1b38"
- #define P_K70_RFIRE_NRGB 0x1b3a
- #define P_K70_RFIRE_NRGB_STR "1b3a"
- #define IS_K70(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_K70 || (kb)->product == P_K70_NRGB || (kb)->product == P_K70_RFIRE || (kb)->product == P_K70_RFIRE_NRGB || (kb)->product == P_K70_LUX || (kb)->product == P_K70_LUX_NRGB))
- #define P_K95 0x1b11
- #define P_K95_STR "1b11"
- #define P_K95_NRGB 0x1b08
- #define P_K95_NRGB_STR "1b08"
- #define P_K95_PLATINUM 0x1b2d
- #define P_K95_PLATINUM_STR "1b2d"
- #define IS_K95(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_K95 || (kb)->product == P_K95_NRGB || (kb)->product == P_K95_PLATINUM))
- #define P_STRAFE 0x1b20
- #define P_STRAFE_STR "1b20"
- #define P_STRAFE_NRGB 0x1b15
- #define P_STRAFE_NRGB_STR "1b15"
- #define IS_STRAFE(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_STRAFE || (kb)->product == P_STRAFE_NRGB))
- #define P_M65 0x1b12
- #define P_M65_STR "1b12"
- #define P_M65_PRO 0x1b2e
- #define P_M65_PRO_STR "1b2e"
- #define IS_M65(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_M65 || (kb)->product == P_M65_PRO))
- #define P_SABRE_O 0x1b14 /* optical */
- #define P_SABRE_O_STR "1b14"
- #define P_SABRE_L 0x1b19 /* laser */
- #define P_SABRE_L_STR "1b19"
- #define P_SABRE_N 0x1b2f /* new? */
- #define P_SABRE_N_STR "1b2f"
- #define P_SABRE_O2 0x1b32 /* Observed on a CH-9000111-EU model SABRE */
- #define P_SABRE_O2_STR "1b32"
- #define IS_SABRE(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_SABRE_O || (kb)->product == P_SABRE_L || (kb)->product == P_SABRE_N || (kb)->product == P_SABRE_O2))
- #define P_SCIMITAR 0x1b1e
- #define P_SCIMITAR_STR "1b1e"
- #define P_SCIMITAR_PRO 0x1b3e
- #define P_SCIMITAR_PRO_STR "1b3e"

- #define IS_SCIMITAR(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_SCIMITAR || (kb)->product == P_SCIMITAR_PRO))
- #define IS_RGB(vendor, product) ((vendor) == (V_CORSAIR) && (product) != (P_K65_NRGB) && (product) != (P_K70_NRGB) && (product) != (P_K95_NRGB))

  RGB vs non-RGB test (note: non-RGB Strafe is still considered "RGB" in that it shares the same protocol. The difference is denoted with the "monochrome" feature).
- #define IS_MONOCHROME(vendor, product) ((vendor) == (V_CORSAIR) && (product) == (P_STRAFE_NRGB))

  *The difference between non RGB and monochrome is, that monochrome has lights, but just in one color. nonRGB has no lights. Change this if new **monochrome** devices are added.*
- #define IS_RGB_DEV(kb) IS_RGB((kb)->vendor, (kb)->product)

  For calling with a usbdevice∗, vendor and product are extracted and IS_RGB() is returned.
- #define IS_MONOCHROME_DEV(kb) IS_MONOCHROME((kb)->vendor, (kb)->product)

  For calling with a usbdevice∗, vendor and product are extracted and IS_MONOCHROME() is returned.
- #define IS_FULLRANGE(kb) (IS_RGB((kb)->vendor, (kb)->product) && (kb)->product != P_K65 && (kb)->product != P_K70 && (kb)->product != P_K95)

  Full color range (16.8M) vs partial color range (512)
- #define IS_MOUSE(vendor, product) ((vendor) == (V_CORSAIR) && ((product) == (P_M65) || (product) == (P_M65_PRO) || (product) == (P_SABRE_O) || (product) == (P_SABRE_L) || (product) == (P_SABRE_N) || (product) == (P_SCIMITAR) || (product) == (P_SCIMITAR_PRO) || (product) == (P_SABRE_O2)))

  Mouse vs keyboard test.
- #define IS_MOUSE_DEV(kb) IS_MOUSE((kb)->vendor, (kb)->product)

  For calling with a usbdevice∗, vendor and product are extracted and IS_MOUSE() is returned.
- #define DELAY_SHORT(kb) usleep((int)(kb)->usbdelay ∗ 1000)

  USB delays for when the keyboards get picky about timing That was the original comment, but it is used anytime. The short delay is used before any send or receive.
- #define DELAY_MEDIUM(kb) usleep((int)(kb)->usbdelay ∗ 10000)

  the medium delay is used after sending a command before waiting for the answer.
- #define DELAY_LONG(kb) usleep(100000)

  The longest delay takes place where something went wrong (eg when resetting the device)
- #define USB_DELAY_DEFAULT 5

  *This constant is used to initialize **kb->usbdelay**. It is used in many places (see macros above) but often also overwritten to the fixed value of 10. Pure Hacker code.*
- #define resetusb(kb) _resetusb(kb, __FILE_NOPATH__, __LINE__)

  resetusb() is just a macro to call _resetusb() with debuggin constants (file, lineno)
- #define usbsend(kb, messages, count) _usbsend(kb, messages, count, __FILE_NOPATH__, __LINE__)

  usbsend macro is used to wrap _usbsend() with debugging information (file and lineno)
- #define usbrecv(kb, out_msg, in_msg) _usbrecv(kb, out_msg, in_msg, __FILE_NOPATH__, __LINE__)

  usbrecv macro is used to wrap _usbrecv() with debugging information (file and lineno)
- #define nk95cmd(kb, command) _nk95cmd(kb, (command) >> 16 & 0xFF, (command) & 0xFFFF, __FILE_NOPATH__, __LINE__)

  nk95cmd() macro is used to wrap _nk95cmd() with debugging information (file and lineno). the command structure is different:
  Just the bits 23..16 are used as bits 7..0 for bRequest
  Bits 15..0 are used as wValue
- #define NK95_HWOFF 0x020030

  Hardware-specific commands for the K95 nonRGB,.
- #define NK95_HWON 0x020001

  Hardware playback on.
- #define NK95_M1 0x140001

  Switch to mode 1.
- #define NK95_M2 0x140002

  Switch to mode 2.
- #define NK95_M3 0x140003

  Switch to mode 3.

Functions

- const char * vendor_str (short vendor)

  uncomment the following Define to see USB packets sent to the device
- const char * product_str (short product)

  product_str returns a condensed view on what type of device we have.
- int usbmain ()

  Start the USB main loop. Returns program exit code when finished.
- void usbkill ()

  Stop the USB system.
- void setupusb (usbdevice *kb)

  setupusb starts a thread with kb as parameter and _setupusb() as entrypoint.
- int os_setupusb (usbdevice *kb)

  os_setupusb OS-specific setup for a specific usb device.
- void * os_inputmain (void *context)

  os_inputmain is run in a separate thread and will be detached from the main thread, so it needs to clean up its own resources.
- int revertusb (usbdevice *kb)

  revertusb sets a given device to inactive (hardware controlled) mode if not a fw-ugrade is indicated
- int closeusb (usbdevice *kb)

  closeusb Close a USB device and remove device entry.
- void os_closeusb (usbdevice *kb)

  os_closeusb unclaim it, destroy the udev device and clear data structures at kb
- int _resetusb (usbdevice *kb, const char *file, int line)

  _resetusb Reset a USB device.
- int os_resetusb (usbdevice *kb, const char *file, int line)

  os_resetusb is the os specific implementation for resetting usb
- int _usbsend (usbdevice *kb, const uchar *messages, int count, const char *file, int line)

  _usbsend send a logical message completely to the given device
- int _usbrecv (usbdevice *kb, const uchar *out_msg, uchar *in_msg, const char *file, int line)

  _usbrecv Request data from a USB device by first sending an output packet and then reading the response.
- int os_usbsend (usbdevice *kb, const uchar *out_msg, int is_recv, const char *file, int line)

  os_usbsend sends a data packet (MSG_SIZE = 64) Bytes long
- int os_usbrecv (usbdevice *kb, uchar *in_msg, const char *file, int line)

  os_usbrecv receives a max MSGSIZE long buffer from usb device
- void os_sendindicators (usbdevice *kb)

  os_sendindicators update the indicators for the special keys (Numlock, Capslock and what else?)
- int _nk95cmd (usbdevice *kb, uchar bRequest, ushort wValue, const char *file, int line)

  _nk95cmd If we control a non RGB keyboard, set the keyboard via ioctl with usbdevfs_ctrltransfer
- int usb_tryreset (usbdevice *kb)

  usb_tryreset does what the name means: Try to reset the usb via resetusb()

9.42.1 Detailed Description

Vendor/product codes

The list of defines in the first part of the file describes the various types of equipment from Corsair and summarizes them according to specific characteristics.

Each device type is described with two defines:

- On the one hand the device ID with which the device can be recognized on the USB as a short
- and on the other hand the same representation as a string, but without leading "0x".

First entry-pair is the Provider ID (vendorID) from Corsair.

Block No.	contains	Devices are bundled via
1	The first block contains the K65-like keyboards, regardless of their properties (RGB, ...).	In summary, they can be queried using the macro IS_K65().
2	the K70-like Keyboards with all their configuration types	summarized by IS_K70().
3	the K95 series keyboards	collected with the macro IS_K95().
4	strafe keyboards	IS_STRAFE()
5	M65 mice with and without RGB	IS_M65()
6	The SABRE and HARPOON mice. Maybe this will be divided int two different blocks later because of different nummber of special keys	IS_SABRE()
7	The Scimitar mouse devices	IS_SCIMITAR()

Definition in file usb.h.

9.42.2 Macro Definition Documentation

9.42.2.1 #define DELAY_LONG(*kb*) usleep(100000)

Definition at line 155 of file usb.h.

Referenced by _resetusb(), _setupusb(), _usbrecv(), _usbsend(), cmd_hwload_kb(), cmd_hwload_mouse(), cmd_hwsave_kb(), and cmd_hwsave_mouse().

9.42.2.2 #define DELAY_MEDIUM(*kb*) usleep((int)(kb)->usbdelay * 10000)

Definition at line 152 of file usb.h.

Referenced by _usbrecv(), and setactive_kb().

9.42.2.3 #define DELAY_SHORT(*kb*) usleep((int)(kb)->usbdelay * 1000)

Definition at line 149 of file usb.h.

Referenced by _usbrecv(), _usbsend(), and updateindicators_kb().

9.42.2.4 #define IS_FULLRANGE(*kb*) (IS_RGB((kb)->vendor, (kb)->product) && (kb)->product != P_K65 && (kb)->product != P_K70 && (kb)->product != P_K95)

Definition at line 138 of file usb.h.

Referenced by readcmd(), and updatergb_kb().

9.42.2.5 #define IS_K65(*kb*) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_K65 || (kb)->product == P_K65_NRGB || (kb)->product == P_K65_LUX || (kb)->product == P_K65_RFIRE))

Definition at line 49 of file usb.h.

Referenced by has_key().

9.42.2.6 #define IS_K70(*kb*) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_K70 || (kb)->product == P_K70_NRGB || (kb)->product == P_K70_RFIRE || (kb)->product == P_K70_RFIRE_NRGB || (kb)->product == P_K70_LUX || (kb)->product == P_K70_LUX_NRGB))

Definition at line 63 of file usb.h.

9.42.2.7 #define IS_K95(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_K95 || (kb)->product == P_K95_NRGB || (kb)->product == P_K95_PLATINUM))

Definition at line 71 of file usb.h.

Referenced by cmd_hwload_kb(), cmd_hwsave_kb(), and has_key().

9.42.2.8 #define IS_M65(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_M65 || (kb)->product == P_M65_PRO))

Definition at line 83 of file usb.h.

Referenced by isblack().

9.42.2.9 #define IS_MONOCHROME(vendor, product) ((vendor) == (V_CORSAIR) && (product) == (P_STRAFE_NRGB))

Definition at line 129 of file usb.h.

Referenced by _setupusb().

9.42.2.10 #define IS_MONOCHROME_DEV(kb) IS_MONOCHROME((kb)->vendor, (kb)->product)

Definition at line 135 of file usb.h.

9.42.2.11 #define IS_MOUSE(vendor, product) ((vendor) == (V_CORSAIR) && ((product) == (P_M65) || (product) == (P_M65_PRO) || (product) == (P_SABRE_O) || (product) == (P_SABRE_L) || (product) == (P_SABRE_N) || (product) == (P_SCIMITAR) || (product) == (P_SCIMITAR_PRO) || (product) == (P_SABRE_O2)))

Definition at line 141 of file usb.h.

Referenced by _setupusb(), get_vtable(), has_key(), and os_inputmain().

9.42.2.12 #define IS_MOUSE_DEV(kb) IS_MOUSE((kb)->vendor, (kb)->product)

Definition at line 144 of file usb.h.

Referenced by readcmd().

9.42.2.13 #define IS_RGB(vendor, product) ((vendor) == (V_CORSAIR) && (product) != (P_K65_NRGB) && (product) != (P_K70_NRGB) && (product) != (P_K95_NRGB))

Definition at line 124 of file usb.h.

Referenced by _setupusb(), get_vtable(), and os_inputmain().

9.42.2.14 #define IS_RGB_DEV(kb) IS_RGB((kb)->vendor, (kb)->product)

Definition at line 132 of file usb.h.

9.42.2.15 #define IS_SABRE(kb) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_SABRE_O || (kb)->product == P_SABRE_L || (kb)->product == P_SABRE_N || (kb)->product == P_SABRE_O2))

Definition at line 93 of file usb.h.

Referenced by has_key(), loadrgb_mouse(), and savergb_mouse().

9.42.2.16 #define IS_SCIMITAR(*kb*) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_SCIMITAR || (kb)->product == P_SCIMITAR_PRO))

Definition at line 99 of file usb.h.

Referenced by has_key(), loadrgb_mouse(), and savergb_mouse().

9.42.2.17 #define IS_STRAFE(*kb*) ((kb)->vendor == V_CORSAIR && ((kb)->product == P_STRAFE || (kb)->product == P_STRAFE_NRGB))

Definition at line 77 of file usb.h.

Referenced by savergb_kb().

9.42.2.18 #define NK95_HWOFF 0x020030

See Also

usb2.0 documentation for details. Set Hardware playback off

Definition at line 301 of file usb.h.

Referenced by start_kb_nrgb().

9.42.2.19 #define NK95_HWON 0x020001

Definition at line 304 of file usb.h.

Referenced by revertusb().

9.42.2.20 #define NK95_M1 0x140001

Definition at line 307 of file usb.h.

Referenced by setmodeindex_nrgb().

9.42.2.21 #define NK95_M2 0x140002

Definition at line 310 of file usb.h.

Referenced by setmodeindex_nrgb().

9.42.2.22 #define NK95_M3 0x140003

Definition at line 313 of file usb.h.

Referenced by setmodeindex_nrgb().

9.42.2.23 #define nk95cmd(*kb, command*) _nk95cmd(kb, (command) >> 16 & 0xFF, (command) & 0xFFFF, __FILE_NOPATH__, __LINE__)

Definition at line 296 of file usb.h.

Referenced by revertusb(), setmodeindex_nrgb(), and start_kb_nrgb().

9.42.2.24 #define P_K65 0x1b17

Definition at line 41 of file usb.h.

Referenced by product_str().

9.42.2.25 #define P_K65_LUX 0x1b37

Definition at line 45 of file usb.h.

Referenced by product_str().

9.42.2.26 #define P_K65_LUX_STR "1b37"

Definition at line 46 of file usb.h.

9.42.2.27 #define P_K65_NRGB 0x1b07

Definition at line 43 of file usb.h.

Referenced by product_str().

9.42.2.28 #define P_K65_NRGB_STR "1b07"

Definition at line 44 of file usb.h.

9.42.2.29 #define P_K65_RFIRE 0x1b39

Definition at line 47 of file usb.h.

Referenced by product_str().

9.42.2.30 #define P_K65_RFIRE_STR "1b39"

Definition at line 48 of file usb.h.

9.42.2.31 #define P_K65_STR "1b17"

Definition at line 42 of file usb.h.

9.42.2.32 #define P_K70 0x1b13

Definition at line 51 of file usb.h.

Referenced by product_str().

9.42.2.33 #define P_K70_LUX 0x1b33

Definition at line 55 of file usb.h.

Referenced by loadrgb_kb(), and product_str().

9.42.2.34 #define P_K70_LUX_NRGB 0x1b36

Definition at line 57 of file usb.h.

Referenced by loadrgb_kb(), and product_str().

9.42.2.35 #define P_K70_LUX_NRGB_STR "1b36"

Definition at line 58 of file usb.h.

9.42.2.36 #define P_K70_LUX_STR "1b33"

Definition at line 56 of file usb.h.

9.42.2.37 #define P_K70_NRGB 0x1b09

Definition at line 53 of file usb.h.

Referenced by product_str().

9.42.2.38 #define P_K70_NRGB_STR "1b09"

Definition at line 54 of file usb.h.

9.42.2.39 #define P_K70_RFIRE 0x1b38

Definition at line 59 of file usb.h.

Referenced by product_str().

9.42.2.40 #define P_K70_RFIRE_NRGB 0x1b3a

Definition at line 61 of file usb.h.

Referenced by product_str().

9.42.2.41 #define P_K70_RFIRE_NRGB_STR "1b3a"

Definition at line 62 of file usb.h.

9.42.2.42 #define P_K70_RFIRE_STR "1b38"

Definition at line 60 of file usb.h.

9.42.2.43 #define P_K70_STR "1b13"

Definition at line 52 of file usb.h.

9.42.2.44 #define P_K95 0x1b11

Definition at line 65 of file usb.h.

Referenced by product_str().

9.42.2.45 #define P_K95_NRGB 0x1b08

Definition at line 67 of file usb.h.

Referenced by _nk95cmd(), and product_str().

9.42.2.46 #define P_K95_NRGB_STR "1b08"

Definition at line 68 of file usb.h.

9.42.2.47 #define P_K95_PLATINUM 0x1b2d

Definition at line 69 of file usb.h.

Referenced by product_str().

9.42.2.48 #define P_K95_PLATINUM_STR "1b2d"

Definition at line 70 of file usb.h.

9.42.2.49 #define P_K95_STR "1b11"

Definition at line 66 of file usb.h.

9.42.2.50 #define P_M65 0x1b12

Definition at line 79 of file usb.h.

Referenced by product_str().

9.42.2.51 #define P_M65_PRO 0x1b2e

Definition at line 81 of file usb.h.

Referenced by product_str().

9.42.2.52 #define P_M65_PRO_STR "1b2e"

Definition at line 82 of file usb.h.

9.42.2.53 #define P_M65_STR "1b12"

Definition at line 80 of file usb.h.

9.42.2.54 #define P_SABRE_L 0x1b19 /* laser */

Definition at line 87 of file usb.h.

Referenced by product_str().

9.42.2.55 #define P_SABRE_L_STR "1b19"

Definition at line 88 of file usb.h.

9.42.2.56 #define P_SABRE_N 0x1b2f /* new? */

Definition at line 89 of file usb.h.

Referenced by product_str().

9.42.2.57 #define P_SABRE_N_STR "1b2f"

Definition at line 90 of file usb.h.

9.42.2.58 #define P_SABRE_O 0x1b14 /* optical */

Definition at line 85 of file usb.h.

Referenced by product_str().

9.42.2.59 #define P_SABRE_O2 0x1b32 /* Observed on a CH-9000111-EU model SABRE */

Definition at line 91 of file usb.h.

Referenced by product_str().

9.42.2.60 #define P_SABRE_O2_STR "1b32"

Definition at line 92 of file usb.h.

9.42.2.61 #define P_SABRE_O_STR "1b14"

Definition at line 86 of file usb.h.

9.42.2.62 #define P_SCIMITAR 0x1b1e

Definition at line 95 of file usb.h.

Referenced by product_str().

9.42.2.63 #define P_SCIMITAR_PRO 0x1b3e

Definition at line 97 of file usb.h.

Referenced by product_str().

9.42.2.64 #define P_SCIMITAR_PRO_STR "1b3e"

Definition at line 98 of file usb.h.

9.42.2.65 #define P_SCIMITAR_STR "1b1e"

Definition at line 96 of file usb.h.

9.42.2.66 #define P_STRAFE 0x1b20

Definition at line 73 of file usb.h.

Referenced by product_str().

9.42.2.67 #define P_STRAFE_NRGB 0x1b15

Definition at line 75 of file usb.h.

Referenced by product_str().

9.42.2.68 #define P_STRAFE_NRGB_STR "1b15"

Definition at line 76 of file usb.h.

9.42.2.69 #define P_STRAFE_STR "1b20"

Definition at line 74 of file usb.h.

9.42.2.70 #define resetusb(*kb*) _resetusb(kb, __FILE_NOPATH__, __LINE__)

Definition at line 214 of file usb.h.

Referenced by usb_tryreset().

9.42.2.71 #define USB_DELAY_DEFAULT 5

Definition at line 160 of file usb.h.

Referenced by _setupusb(), and start_dev().

9.42.2.72 #define usbrecv(*kb, out_msg, in_msg*) _usbrecv(kb, out_msg, in_msg, __FILE_NOPATH__, __LINE__)

Parameters

kb	THE usbdevice*
IN]	out_msg What information does the caller want from the device?
OUT]	in_msg Here comes the answer; The names represent the usb view, not the view of this function! So INput from usb is OUTput of this function.

Definition at line 256 of file usb.h.

Referenced by cmd_hwload_kb(), cmd_hwload_mouse(), getfwversion(), hwloadmode(), loaddpi(), loadrgb_kb(), and loadrgb_mouse().

9.42.2.73 #define usbsend(*kb, messages, count*) _usbsend(kb, messages, count, __FILE_NOPATH__, __LINE__)

Parameters

kb	THE usbdevice*
IN]	messages a Pointer to the first byte of the logical message

IN]	count how many MSG_SIZE buffers is the logical message long?

Definition at line 239 of file usb.h.

Referenced by cmd_hwsave_kb(), cmd_hwsave_mouse(), cmd_pollrate(), fwupdate(), loadrgb_kb(), savedpi(), savergb_kb(), savergb_mouse(), setactive_kb(), setactive_mouse(), updatedpi(), updatergb_kb(), and updatergb_mouse().

9.42.2.74 #define V_CORSAIR 0x1b1c

Warning

When adding new devices please update src/ckb/fwupgradedialog.cpp as well.
It should contain the same vendor/product IDs for any devices supporting firmware updates.
In the same way, all other corresponding files have to be supplemented or modified: Currently known for this are **usb_linux.c** and **usb_mac.c**

Definition at line 38 of file usb.h.

Referenced by usb_add_device(), and vendor_str().

9.42.2.75 #define V_CORSAIR_STR "1b1c"

Definition at line 39 of file usb.h.

Referenced by udev_enum(), and usb_add_device().

9.42.3 Function Documentation

9.42.3.1 int _nk95cmd (usbdevice * *kb*, uchar *bRequest*, ushort *wValue*, const char * *file*, int *line*)

Parameters

kb	THE usbdevice*
bRequest	the byte array with the usb request
wValue	a usb wValue
file	for error message
line	for error message

Returns

1 (true) on failure, 0 (false) on success.

To send control packets to a non RGB non color K95 Keyboard, use this function. Normally it is called via the nk95cmd() macro.

If it is the wrong device for which the function is called, 0 is returned and nothing done. Otherwise a usbdevfs_ctrltransfer structure is filled and an USBDEVFS_CONTROL ioctl() called.

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0x40	see table below to switch hardware-modus at Keyboard	wValue	device	MSG_SIZE	5ms	the message buffer pointer

Host to Device, Type=Vendor, Recipi-ent=Device	bRequest parameter	given wValue Parameter	device 0	0 data to write	5000	null

If a 0 or a negative error number is returned by the ioctl, an error message is shown depending on the errno or "No data written" if retval was 0. In either case 1 is returned to indicate the error. If the ioctl returned a value $>$ 0, 0 is returned to indicate no error.

Currently the following combinations for bRequest and wValue are used:

Device	what it might to do	constant	bRequest	wValue
non RGB Keyboard	set HW-modus on (leave the ckb driver)	HWON	0x0002	0x0030
non RGB Keyboard	set HW-modus off (initialize the ckb driver)	HWOFF	0x0002	0x0001
non RGB Keyboard	set light modus M1 in single-color keyboards	NK95_M1	0x0014	0x0001
non RGB Keyboard	set light modus M2 in single-color keyboards	NK95_M2	0x0014	0x0002
non RGB Keyboard	set light modus M3 in single-color keyboards	NK95_M3	0x0014	0x0003

See Also

usb.h

Definition at line 190 of file usb_linux.c.

References ckb_err_fn, usbdevice::handle, P_K95_NRGB, and usbdevice::product.

```
190                                                                                 {
191     if(kb->product != P_K95_NRGB)
192         return 0;
193     struct usbdevfs_ctrltransfer transfer = { 0x40, bRequest, wValue, 0, 0, 5000, 0 };
194     int res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
195     if(res <= 0){
196         ckb_err_fn("%s\n", file, line, res ? strerror(errno) : "No data written");
197         return 1;
198     }
199     return 0;
200 }
```

9.42.3.2 int _resetusb (usbdevice * *kb*, const char * *file*, int *line*)

Parameters

kb	THE usbdevice*
file	filename for error messages
line	line where it is called for error messages

Returns

Returns 0 on success, -1 if device should be removed

_resetusb Reset a USB device.

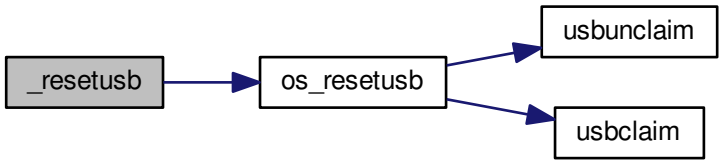
First reset the device via os_resetusb() after a long delay (it may send something to the host). If this worked (retval == 0), give the device another long delay Then perform the initialization via the device specific start() function entry in kb->vtable and if this is successful also, return the result of the device depenten updatergb() with force=true.

Definition at line 426 of file usb.c.

References usbdevice::active, DELAY_LONG, os_resetusb(), and usbdevice::vtable.

```
426                                                     {
427     // Perform a USB reset
428     DELAY_LONG(kb);
429     int res = os_resetusb(kb, file, line);
430     if(res)
431         return res;
432     DELAY_LONG(kb);
433     // Re-initialize the device
434     if(kb->vtable->start(kb, kb->active) != 0)
435         return -1;
436     if(kb->vtable->updatergb(kb, 1) != 0)
437         return -1;
438     return 0;
439 }
```

Here is the call graph for this function:



9.42.3.3 int _usbrecv (usbdevice * *kb*, const uchar * *out_msg*, uchar * *in_msg*, const char * *file*, int *line*)

Parameters

kb	THE usbdevice*
IN]	out_msg What information does the caller want from the device?
OUT]	in_msg Here comes the answer; The names represent the usb view, not the view of this function! So INput from usb is OUTput of this function.
IN]	file for debugging
IN]	line for debugging
IN]	reset_stop global variable is read

Returns

number of bytes read or zero on failure.

_usbrecv Request data from a USB device by first sending an output packet and then reading the response.

To fully understand this, you need to know about usb: All control is at the usb host (the CPU). If the device wants to communicate something to the host, it must wait for the host to ask. The usb protocol defines the cycles and periods in which actions are to be taken.

So in order to receive a data packet from the device, the host must first send a send request.

This is done by _usbrecv() in the first block by sending the MSG_SIZE large data block from **out_msg** via os-_usbsend() as it is a machine depending implementation. The usb target device is as always determined over kb.

For os_usbsend() to know that it is a receive request, the **is_recv** parameter is set to true (1). With this, os_usbsend () generates a control package for the hardware, not a data packet.

If sending of the control package is not successful, a maximum of 5 times the transmission is repeated (including the first attempt). If a non-cancelable error is signaled or the drive is stopped via reset_stop, _usbrecv() immediately returns 0.

After this, the function waits for the requested response from the device using os_usbrecv ().

os_usbrecv() returns 0, -1 or something else.

Zero signals a serious error which is not treatable and _usbrecv() also returns 0.

-1 means that it is a treatable error - a timeout for example - and therefore the next transfer attempt is started after a long pause (DELAY_LONG) if not reset_stop or the wrong hwload_mode require a termination with a return value of 0.

After 5 attempts, _usbrecv () returns and returns 0 as well as an error message.

When data is received, the number of received bytes is returned. This should always be MSG_SIZE, but os_-usbrecv() can also return less. It should not be more, because then there would be an unhandled buffer overflow, but it could be less. This would be signaled in os_usbrecv () with a message.

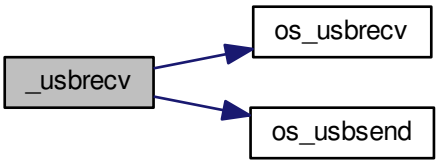
The buffers behind **out_msg** and **in_msg** are MSG_SIZE at least (currently 64 Bytes). More is ok but useless, less brings unpredictable behavior. < Synchonization between macro and color information

Definition at line 601 of file usb.c.

References ckb_err_fn, DELAY_LONG, DELAY_MEDIUM, DELAY_SHORT, hwload_mode, mmutex, os_usbrecv(), os_usbsend(), and reset_stop.

```
601                                                                                                 {
602     // Try a maximum of 5 times
603     for (int try = 0; try < 5; try++) {
604         // Send the output message
605         pthread_mutex_lock(mmutex(kb));
606         DELAY_SHORT(kb);
607         int res = os_usbsend(kb, out_msg, 1, file, line);
608         pthread_mutex_unlock(mmutex(kb));
609         if (res == 0)
610             return 0;
611         else if (res == -1) {
612             // Retry on temporary failure
613             if (reset_stop)
614                 return 0;
615             DELAY_LONG(kb);
616             continue;
617         }
618         // Wait for the response
619         DELAY_MEDIUM(kb);
620         res = os_usbrecv(kb, in_msg, file, line);
621         if(res == 0)
622             return 0;
623         else if(res != -1)
624             return res;
625         if(reset_stop || hwload_mode != 2)
626             return 0;
627         DELAY_LONG(kb);
628     }
629     // Give up
630     ckb_err_fn("Too many send/recv failures. Dropping.\n", file, line);
631     return 0;
632 }
```

Here is the call graph for this function:



9.42.3.4 int _usbsend (usbdevice * *kb,* const uchar * *messages,* int *count,* const char * *file,* int *line*)

Parameters

	kb	THE usbdevice*
	IN]	messages a Pointer to the first byte of the logical message
	IN]	count how many MSG_SIZE buffers is the logical message long?
	IN]	file for debugging
	IN]	line for debugging
in	*reset_stop*	global variable is read

Returns

number of Bytes sent (ideal == count * MSG_SIZE);
0 if a block could not be sent and it was not a timeout OR **reset_stop** was required or **hwload_mode** is not set to "always"

_usbsend send a logical message completely to the given device

Todo A lot of different conditions are combined in this code. Don't think, it is good in every combination...

The main task of _usbsend () is to transfer the complete logical message from the buffer beginning with *messages* to **count** * **MSG_SIZE**.

According to usb 2.0 specification, a USB transmits a maximum of 64 byte user data packets. For the transmission of longer messages we need a segmentation. And that is exactly what happens here.

The message is given one by one to os_usbsend() in MSG_SIZE (= 64) byte large bites.

Attention

This means that the buffer given as argument must be n * MSG_SIZE Byte long.

An essential constant parameter which is relevant for os_usbsend() only is is_recv = 0, which means sending.

Now it gets a little complicated again:

- If os_usbsend() returns 0, only zero bytes could be sent in one of the packets, or it was an error (-1 from the systemcall), but not a timeout. How many Bytes were sent in total from earlier calls does not seem to matter, _usbsend() returns a total of 0.
- Returns os_usbsend() -1, first check if **reset_stop** is set globally or (incomprehensible) hwload_mode is not set to "always". In either case, _usbsend() returns 0, otherwise it is assumed to be a temporary transfer error and it simply retransmits the physical packet after a long delay.

- If the return value of os_usbsend() was neither 0 nor -1, it specifies the numer of bytes transferred.

  Here is an information hiding conflict with os_usbsend() (at least in the Linux version):

  If os_usbsend() can not transfer the entire packet, errors are thrown and the number of bytes sent is returned. _usbsend() interprets this as well and remembers the total number of bytes transferred in the local variable **total_sent**. Subsequently, however, transmission is continued with the next complete MSG_SIZE block and not with the first of the possibly missing bytes.

  Todo Check whether this is the same in the macOS variant. It is not dramatic, but if errors occur, it can certainly irritate the devices completely if they receive incomplete data streams. Do we have errors with the messages "Wrote YY bytes (expected 64)" in the system logs? If not, we do not need to look any further.

When the last packet is transferred, _usbsend() returns the effectively counted set of bytes (from **total_sent**). This at least gives the caller the opportunity to check whether something has been lost in the middle.

A bit strange is the structure of the program: Handling the **count** MSG_SIZE blocks to be transferred is done in the outer for (...) loop. Repeating the transfer with a treatable error is managed by the inner while(1) loop.

This must be considered when reading the code; The "break" on successful block transfer leaves the inner while, not the for (...). < Synchonization between macro and color information

Definition at line 532 of file usb.c.

References DELAY_LONG, DELAY_SHORT, hwload_mode, mmutex, MSG_SIZE, os_usbsend(), and reset_stop.

```
532                                                                                                 {
533     int total_sent = 0;
534     for(int i = 0; i < count; i++){
535         // Send each message via the OS function
536         while(1){
537             pthread_mutex_lock(mmutex(kb));
538             DELAY_SHORT(kb);
539             int res = os_usbsend(kb, messages + i * MSG_SIZE, 0, file, line);
540             pthread_mutex_unlock(mmutex(kb));
541             if(res == 0)
542                 return 0;
543             else if(res != -1){
544                 total_sent += res;
545                 break;
546             }
547             // Stop immediately if the program is shutting down or hardware load is set to tryonce
548             if(reset_stop || hwload_mode != 2)
549                 return 0;
550             // Retry as long as the result is temporary failure
551             DELAY_LONG(kb);
552         }
553     }
554     return total_sent;
555 }
```

Here is the call graph for this function:

9.42.3.5 int closeusb (usbdevice * *kb*)

Parameters

IN,OUT]	kb

Returns

Returns 0 (everytime. No error handling is done!)

closeusb Close a USB device and remove device entry.

An imutex lock ensures first of all, that no communication is currently running from the viewpoint of the driver to the user input device (ie the virtual driver with which characters or mouse movements are sent from the daemon to the operating system as inputs).

If the **kb** has an acceptable value != 0, the index of the device is looked for and with this index os_inputclose() is called. After this no more characters can be sent to the operating system.

Then the connection to the usb device is capped by os_closeusb().

Todo What is not yet comprehensible is the call to updateconnected() BEFORE os_closeusb(). Should that be in the other sequence? Or is updateconnected() not displaying the connected usb devices, but the representation which uinput devices are loaded? Questions about questions ...

If there is no valid **handle**, only updateconnected() is called. We are probably trying to disconnect a connection under construction. Not clear.

The cmd pipe as well as all open notify pipes are deleted via rmdevpath ().

This means that nothing can happen to the input path - so the device-specific imutex is unlocked again and remains unlocked.

Also the dmutex is unlocked now, but only to join the thread, which was originally taken under **kb->thread** (which started with _setupusb()) with pthread_join() again. Because of the closed devices that thread would have to quit sometime

See Also

the hack note with rmdevpath())

As soon as the thread is caught, the dmutex is locked again, which is what I do not understand yet: What other thread can do usb communication now?

If the vtabel exists for the given kb (why not? It seems to have race conditions here!!), via the vtable the actually device-specific, but still everywhere identical freeprofile() is called. This frees areas that are no longer needed. Then the **usbdevice** structure in its array is set to zero completely.

Error handling is rather unusual in closeusb(); Everything works (no matter what the called functions return), and closeusb() always returns zero (success).

Definition at line 677 of file usb.c.

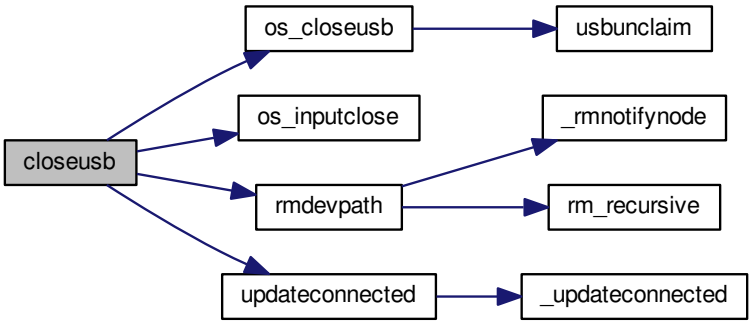
References ckb_info, devpath, dmutex, usbdevice::handle, imutex, INDEX_OF, keyboard, os_closeusb(), os_inputclose(), rmdevpath(), usbdevice::thread, updateconnected(), and usbdevice::vtable.

Referenced by _setupusb(), devmain(), quitWithLock(), and usb_rm_device().

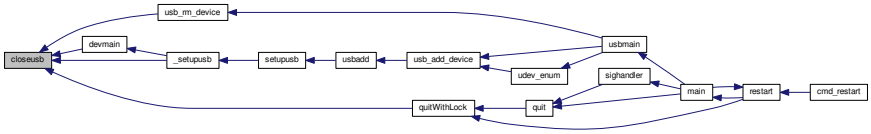
```
677                             {
678     pthread_mutex_lock(imutex(kb));
679     if(kb->handle){
680         int index = INDEX_OF(kb, keyboard);
681         ckb_info("Disconnecting %s%d\n", devpath, index);
682         os_inputclose(kb);
683         updateconnected();
684         // Close USB device
685         os_closeusb(kb);
686     } else
687         updateconnected();
688     rmdevpath(kb);
689
```

```
690     // Wait for thread to close
691     pthread_mutex_unlock(imutex(kb));
692     pthread_mutex_unlock(dmutex(kb));
693     pthread_join(kb->thread, 0);
694     pthread_mutex_lock(dmutex(kb));
695
696     // Delete the profile and the control path
697     if(!kb->vtable)
698         return 0;
699     kb->vtable->freeprofile(kb);
700     memset(kb, 0, sizeof(usbdevice));
701     return 0;
702 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.42.3.6 void os_closeusb (usbdevice * *kb*)

Parameters

IN,OUT]	kb THE usbdevice*

os_closeusb unclaim it, destroy the udev device and clear data structures at kb

os_closeusb is the linux specific implementation for closing an active usb port.

If a valid handle is given in the kb structure, the usb port is unclaimed (usbunclaim()).

The device in unrefenced via library function udev_device_unref().

handle, udev and the first char of kbsyspath are cleared to 0 (empty string for kbsyspath).

Definition at line 437 of file usb_linux.c.

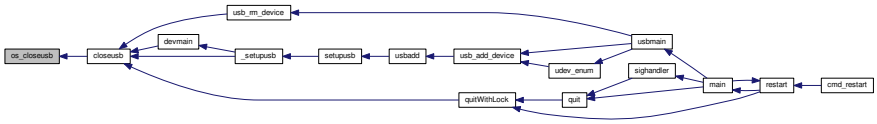
References usbdevice::handle, INDEX_OF, kbsyspath, keyboard, usbdevice::udev, and usbunclaim().

Referenced by closeusb().

```
437                                 {
438     if(kb->handle){
439         usbunclaim(kb, 0);
440         close(kb->handle - 1);
441     }
442     if(kb->udev)
443         udev_device_unref(kb->udev);
444     kb->handle = 0;
445     kb->udev = 0;
446     kbsyspath[INDEX_OF(kb, keyboard)][0] = 0;
447 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.42.3.7 void* os_inputmain (void * *context*)

Parameters

context	THE usbdevice* ; Because os_inputmain() is started as a new thread, its formal parameter is named "context".

Returns

null

os_inputmain is run in a separate thread and will be detached from the main thread, so it needs to clean up its own resources.

Todo This function is a collection of many tasks. It should be divided into several sub-functions for the sake of greater convenience:

1. set up an URB (Userspace Ressource Buffer) to communicate with the USBDEVFS_* ioctl()s
2. perform the ioctl()
3. interpretate the information got into the URB buffer or handle error situations and retry operation or leave the endless loop
4. inform the os about the data
5. loop endless via 2.

6. if endless loop has gone, deinitalize the interface, free buffers etc.

7. return null

Here the actions in detail:

Monitor input transfers on all endpoints for non-RGB devices For RGB, monitor all but the last, as it's used for input/output

Get an usbdevfs_urb data structure and clear it via memset()

Hopefully the buffer lengths are equal for all devices with congruent types. You can find out the correctness for your device with lsusb –v or similar on macOS. Currently the following combinations are known and implemented:

device	detect with macro combination	endpoint #	buffer-length
each	none	0	8
RGB Mouse	IS_RGB && IS_MOUSE	1	10
RGB Keyboard	IS_RGB && !IS_MOUSE	1	21
RGB Mouse or Keyboard	IS_RGB	2	MSG_SIZE (64)
non RGB Mouse or Keyboard	!IS_RGB	1	4
non RGB Mouse or Keyboard	!IS_RGB	2	15

Now submit all the URBs via ioctl(USBDEVFS_SUBMITURB) with type USBDEVFS_URB_TYPE_INTERRUPT (the endpoints are defined as type interrupt). Endpoint number is 0x80..0x82 or 0x83, depending on the model.

The userSpaceFS knows the URBs now, so start monitoring input

if the ioctl returns something != 0, let's have a deeper look what happened. Broken devices or shutting down the entire system leads to closing the device and finishing this thread.

If just an EPIPE ocurred, give the device a CLEAR_HALT and resubmit the URB.

A correct REAPURB returns a Pointer to the URB which we now have a closer look into. Lock all following actions with imutex.

Process the input depending on type of device. Interprete the actual size of the URB buffer

device	detect with macro combination	seems to be endpoint #	actual buffer-length	function called
mouse (RGB and non RGB)	IS_MOUSE	nA	8, 10 or 11	hid_mouse_-translate()
mouse (RGB and non RGB)	IS_MOUSE	nA	MSG_SIZE (64)	corsair_-mousecopy()
RGB Keyboard	IS_RGB && !IS_MOUSE	1	8 (BIOS Mode)	hid_kb_translate()
RGB Keyboard	IS_RGB && !IS_MOUSE	2	5 or 21, KB inactive!	hid_kb_translate()
RGB Keyboard	IS_RGB && !IS_MOUSE	3?	MSG_SIZE	corsair_kbcopy()
non RGB Keyboard	!IS_RGB && !IS_MOUSE	nA	nA	hid_kb_translate()

The input data is transformed and copied to the kb structure. Now give it to the OS and unlock the imutex afterwards.

Re-submit the URB for the next run.

If the endless loop is terminated, clean up by discarding the URBs via ioctl(USBDEVFS_DISCARDURB), free the URB buffers and return a null pointer as thread exit code.

Definition at line 240 of file usb_linux.c.

References usbdevice::active, ckb_err, ckb_info, corsair_kbcopy(), corsair_mousecopy(), devpath, usbdevice-::epcount, usbdevice::handle, hid_kb_translate(), hid_mouse_translate(), imutex, INDEX_OF, usbdevice::input, inputupdate(), IS_MOUSE, IS_RGB, keyboard, usbinput::keys, MSG_SIZE, usbdevice::product, usbinput::rel_x,

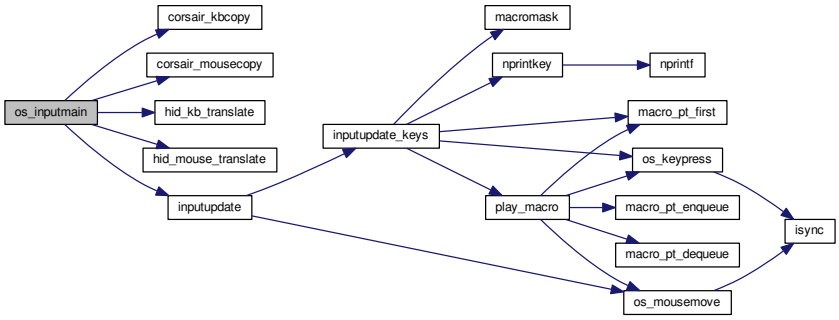
usbinput::rel_y, and usbdevice::vendor.

Referenced by _setupusb().

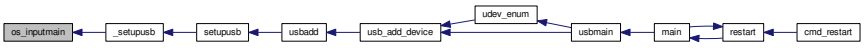
```
240                                 {
241     usbdevice* kb = context;
242     int fd = kb->handle - 1;
243     short vendor = kb->vendor, product = kb->product;
244     int index = INDEX_OF(kb, keyboard);
245     ckb_info("Starting input thread for %s%d\n", devpath, index);
246 
251     int urbcount = IS_RGB(vendor, product) ? (kb->epcount - 1) : kb->
    epcount;
252     if (urbcount == 0) {
253         ckb_err("urbcount = 0, so there is nothing to claim in os_inputmain()\n");
254         return 0;
255     }
256 
258     struct usbdevfs_urb urbs[urbcount + 1];
259     memset(urbs, 0, sizeof(urbs));
260 
274     urbs[0].buffer_length = 8;
275     if(urbcount > 1 && IS_RGB(vendor, product)) {
276         if(IS_MOUSE(vendor, product))
277             urbs[1].buffer_length = 10;
278         else
279             urbs[1].buffer_length = 21;
280         urbs[2].buffer_length = MSG_SIZE;
281         if(urbcount != 3)
282             urbs[urbcount - 1].buffer_length = MSG_SIZE;
283     } else {
284         urbs[1].buffer_length = 4;
285         urbs[2].buffer_length = 15;
286     }
287 
290     for(int i = 0; i < urbcount; i++){
291         urbs[i].type = USBDEVFS_URB_TYPE_INTERRUPT;
292         urbs[i].endpoint = 0x80 | (i + 1);
293         urbs[i].buffer = malloc(urbs[i].buffer_length);
294         ioctl(fd, USBDEVFS_SUBMITURB, urbs + i);
295     }
296 
298     while (1) {
299         struct usbdevfs_urb* urb = 0;
300 
303         if (ioctl(fd, USBDEVFS_REAPURB, &urb)) {
304             if (errno == ENODEV || errno == ENOENT || errno == ESHUTDOWN)
305                 // Stop the thread if the handle closes
306                 break;
307             else if(errno == EPIPE && urb){
309                 ioctl(fd, USBDEVFS_CLEAR_HALT, &urb->endpoint);
310                 // Re-submit the URB
311                 if(urb)
312                     ioctl(fd, USBDEVFS_SUBMITURB, urb);
313                 urb = 0;
314             }
315             continue;
316         }
317 
321         if (urb) {
322 
334             pthread_mutex_lock(imutex(kb));
335             if(IS_MOUSE(vendor, product)){
336                 switch(urb->actual_length){
337                 case 8:
338                 case 10:
339                 case 11:
340                     // HID mouse input
341                     hid_mouse_translate(kb->input.keys, &kb->
    input.rel_x, &kb->input.rel_y, -(urb->endpoint & 0xF), urb->actual_length, urb->buffer)
    ;
342                     break;
343                 case MSG_SIZE:
344                     // Corsair mouse input
345                     corsair_mousecopy(kb->input.keys, -(urb->endpoint & 0xF), urb
    ->buffer);
346                     break;
347                 }
348             } else if(IS_RGB(vendor, product)){
349                 switch(urb->actual_length){
350                 case 8:
351                     // RGB EP 1: 6KRO (BIOS mode) input
352                     hid_kb_translate(kb->input.keys, -1, urb->actual_length, urb->
    buffer);
353                     break;
354                 case 21:
355                 case 5:
```

```
356                     // RGB EP 2: NKRO (non-BIOS) input. Accept only if keyboard is inactive
357                     if(!kb->active)
358                         hid_kb_translate(kb->input.keys, -2, urb->actual_length,
    urb->buffer);
359                     break;
360                 case MSG_SIZE:
361                     // RGB EP 3: Corsair input
362                     corsair_kbcopy(kb->input.keys, -(urb->endpoint & 0xF), urb->
    buffer);
363                     break;
364                 }
365             } else {
366                 // Non-RGB input
367                 hid_kb_translate(kb->input.keys, urb->endpoint & 0xF, urb->
    actual_length, urb->buffer);
368             }
371             inputupdate(kb);
372             pthread_mutex_unlock(imutex(kb));
373 
375             ioctl(fd, USBDEVFS_SUBMITURB, urb);
376             urb = 0;
377         }
378     }
379 
383     ckb_info("Stopping input thread for %s%d\n", devpath, index);
384     for(int i = 0; i < urbcount; i++){
385         ioctl(fd, USBDEVFS_DISCARDURB, urbs + i);
386         free(urbs[i].buffer);
387     }
388     return 0;
389 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.42.3.8 int os_resetusb (usbdevice * *kb*, const char * *file*, int *line*)

Parameters

kb	THE usbdevice*

file	filename for error messages
line	line where it is called for error messages

Returns

Returns 0 on success, -2 if device should be removed and -1 if reset should by tried again

os_resetusb is the os specific implementation for resetting usb

Try to reset an usb device in a linux user space driver.

1. unclaim the device, but do not reconnect the system driver (second param resetting = true)
2. reset the device via USBDEVFS_RESET command
3. claim the device again. Returns 0 on success, -2 if device should be removed and -1 if reset should by tried again

Todo it seems that no one wants to try the reset again. But I'v seen it somewhere...

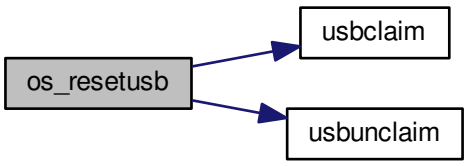
Definition at line 499 of file usb_linux.c.

References usbdevice::handle, TEST_RESET, usbclaim(), and usbunclaim().

Referenced by _resetusb().

```
499                                                     {
500     TEST_RESET(usbunclaim(kb, 1));
501     TEST_RESET(ioctl(kb->handle - 1, USBDEVFS_RESET));
502     TEST_RESET(usbclaim(kb));
503     // Success!
504     return 0;
505 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.42.3.9 void os_sendindicators (usbdevice * *kb*)

Parameters

kb	THE usbdevice*

os_sendindicators update the indicators for the special keys (Numlock, Capslock and what else?)

os_sendindicators update the indicators for the special keys (Numlock, Capslock and what else?)

Read the data from kb->ileds ans send them via ioctl() to the keyboard.

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0x21	0x09	0x0200	Interface 0	MSG_SIZE 1 Byte	timeout 0,5ms	the message buffer pointer
Host to Device, Type=Class, Recipient=Interface (why not endpoint?)	9 = SEND?	specific	0	1	500	struct* kb->ileds

The ioctl command is USBDEVFS_CONTROL.

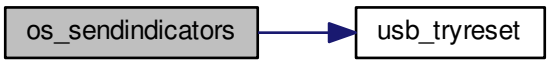
Definition at line 215 of file usb_linux.c.

References ckb_err, usbdevice::handle, usbdevice::ileds, and usb_tryreset().

Referenced by updateindicators_kb().

```
215                                     {
216     static int countForReset = 0;
217     struct usbdevfs_ctrltransfer transfer = { 0x21, 0x09, 0x0200, 0x00, 1, 500, &kb->
      ileds };
218     int res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
219     if(res <= 0) {
220         ckb_err("%s\n", res ? strerror(errno) : "No data written");
221         if (usb_tryreset(kb) == 0 && countForReset++ < 3) {
222             os_sendindicators(kb);
223         }
224     }
225 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.42.3.10 int os_setupusb (usbdevice * *kb*)

Parameters

kb	THE usbdevice*

Returns

0 on success, -1 otherwise.

os_setupusb OS-specific setup for a specific usb device.

Perform the operating system-specific opening of the interface in os_setupusb(). As a result, some parameters should be set in kb (name, serial, fwversion, epcount = number of usb endpoints), and all endpoints should be claimed with usbclaim(). Claiming is the only point where os_setupusb() can produce an error (-1).

- Copy device description and serial
- Copy firmware version (needed to determine USB protocol)
- Do some output about connecting interfaces
- Claim the USB interfaces

Todo in these modules a pullrequest is outstanding

< Try to reset the device and recall the function

< Don't do this endless in recursion

< os_setupusb() has a return value (used as boolean)

Definition at line 537 of file usb_linux.c.

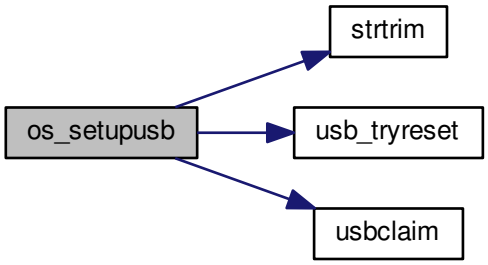
References ckb_err, ckb_info, devpath, usbdevice::epcount, usbdevice::fwversion, INDEX_OF, KB_NAME_LEN, keyboard, usbdevice::name, usbdevice::serial, SERIAL_LEN, strtrim(), usbdevice::udev, usb_tryreset(), and usbclaim().

Referenced by _setupusb().

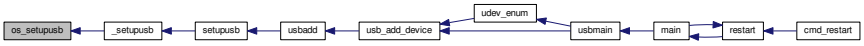
```
537                                {
540     struct udev_device* dev = kb->udev;
541     const char* name = udev_device_get_sysattr_value(dev, "product");
542     if(name)
543         strncpy(kb->name, name, KB_NAME_LEN);
544     strtrim(kb->name);
545     const char* serial = udev_device_get_sysattr_value(dev, "serial");
546     if(serial)
547         strncpy(kb->serial, serial, SERIAL_LEN);
548     strtrim(kb->serial);
551     const char* firmware = udev_device_get_sysattr_value(dev, "bcdDevice");
552     if(firmware)
553         sscanf(firmware, "%hx", &kb->fwversion);
554     else
555         kb->fwversion = 0;
556     int index = INDEX_OF(kb, keyboard);
557
559     ckb_info("Connecting %s at %s%d\n", kb->name, devpath, index);
560
566     const char* ep_str = udev_device_get_sysattr_value(dev, "bNumInterfaces");
567 #ifdef DEBUG
568     ckb_info("claiming interfaces. name=%s, serial=%s, firmware=%s; Got >>%s<< as ep_str\n", name,
      serial, firmware, ep_str);
569 #endif //DEBUG
570     kb->epcount = 0;
571     if(ep_str)
572         sscanf(ep_str, "%d", &kb->epcount);
573     if(kb->epcount < 2){
574         // IF we have an RGB KB with 0 or 1 endpoints, it will be in BIOS mode.
575         ckb_err("Unable to read endpoint count from udev, assuming %d and reading >>%s<< or device
      is in BIOS mode\n", kb->epcount, ep_str);
576         if (usb_tryreset(kb) == 0) {
577             static int retryCount = 0;
```

```
578             if (retryCount++ < 5) {
579                 return os_setupusb(kb);
580             }
581         }
582         return -1;
583         // ToDo are there special versions we have to detect? If there are, that was the old code to handle
    it:
584         // This shouldn't happen, but if it does, assume EP count based onckb_warn what the device is
    supposed to have
585         // kb->epcount = (HAS_FEATURES(kb, FEAT_RGB) ? 4 : 3);
586         // ckb_warn("Unable to read endpoint count from udev, assuming %d and reading >>%s<<...\n",
    kb->epcount, ep_str);
587     }
588     if(usbclaim(kb)){
589         ckb_err("Failed to claim interfaces: %s\n", strerror(errno));
590         return -1;
591     }
592     return 0;
593 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.42.3.11 int os_usbrecv (usbdevice * *kb*, uchar * *in_msg*, const char * *file*, int *line*)

Parameters

kb	THE usbdevice*
in_msg	the buffer to fill with the message received
file	for debugging
line	for debugging

Returns

-1 on timeout, 0 on hard error, numer of bytes received otherwise

os_usbrecv does what its name says:

The comment at the beginning of the procedure causes the suspicion that the firmware versionspecific distinction is missing for receiving from usb endpoint 3 or 4. The commented code contains only the reception from EP4, but this may be wrong for a software version 2.0 or higher (see the code for os-usbsend ()).

So all the receiving is done via an ioctl() like in os_usbsend. The ioctl() is given a struct usbdevfs_ctrltransfer, in which the relevant parameters are entered:

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0xA1	0x01	0x0200	endpoint to be addressed from epcount - 1	MSG_SIZE	5ms	the message buffer pointer
Device to Host, Type=Class, Recipi-ent=Interface	1 = RECEIVE?	specific	Interface #	64	5000	in_msg

The ioctl() returns the number of bytes received. Here is the usual check again:

- If the return value is -1 AND the error is a timeout (ETIMEOUT), os_usbrecv() will return -1 to indicate that it is probably a recoverable problem and a retry is recommended.
- For another negative value or other error identifier OR 0 bytes are received, 0 is returned as an identifier for a heavy error.
- In all other cases, the function returns the number of bytes received.

If this is not the entire blocksize (MSG_SIZE bytes), an error message is issued on the standard error channel [warning "Read YY bytes (expected 64)"].

Definition at line 130 of file usb_linux.c.

References ckb_err_fn, ckb_warn_fn, usbdevice::epcount, usbdevice::handle, and MSG_SIZE.

Referenced by _usbrecv().

```
130                                                                         {
131     int res;
132     // This is what CUE does, but it doesn't seem to work on linux.
133     /*if(kb->fwversion >= 0x130){
134         struct usbdevfs_bulktransfer transfer;
135         memset(&transfer, 0, sizeof(transfer));
136         transfer.ep = 0x84;
137         transfer.len = MSG_SIZE;
138         transfer.timeout = 5000;
139         transfer.data = in_msg;
140         res = ioctl(kb->handle - 1, USBDEVFS_BULK, &transfer);
141     } else {*/
142         struct usbdevfs_ctrltransfer transfer = { 0xa1, 0x01, 0x0300, kb->
    epcount - 1, MSG_SIZE, 5000, in_msg };
143         res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
144     //}
145     if(res <= 0){
146         ckb_err_fn("%s\n", file, line, res ? strerror(errno) : "No data read");
147         if(res == -1 && errno == ETIMEDOUT)
148             return -1;
149         else
150             return 0;
151     } else if(res != MSG_SIZE)
152         ckb_warn_fn("Read %d bytes (expected %d)\n", file, line, res,
    MSG_SIZE);
153 #ifdef DEBUG_USB_RECV
154     char converted[MSG_SIZE*3 + 1];
155     for(int i=0;i<MSG_SIZE;i++)
156         sprintf(&converted[i*3], "%02x ", in_msg[i]);
157     ckb_warn_fn("Recv %s\n", file, line, converted);
158 #endif
159     return res;
160 }
```

Here is the caller graph for this function:

9.42.3.12 int os_usbsend (usbdevice * *kb,* const uchar * *out_msg,* int *is_recv,* const char * *file,* int *line*)

Parameters

kb	THE usbdevice*
out_msg	the MSGSIZE char long buffer to send
is_recv	if true, just send an ioctl for further reading packets. If false, send the data at **out_msg**.
file	for debugging
line	for debugging

Returns

-1 on timeout (try again), 0 on hard error, numer of bytes sent otherwise

os_usbsend has two functions:

- if is_recv == false, it tries to send a given MSG_SIZE buffer via the usb interface given with kb.
- otherwise a request is sent via the usb device to initiate the receiving of a message from the remote device.

The functionality for sending distinguishes two cases, depending on the version number of the firmware of the connected device:

If the firmware is less or equal 1.2, the transmission is done via an ioctl(). The ioctl() is given a struct usbdevfs_ctrltransfer, in which the relevant parameters are entered:

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0x21	0x09	0x0200	endpoint / IF to be addressed from epcount-1	MSG_SIZE	5000 (=5ms)	the message buffer pointer
Host to Device, Type=Class, Recipient=Interface	9 = Send data?	specific	last or pre-last device #	64	5000	out_msg

The ioctl command is USBDEVFS_CONTROL.

The same constellation is used if the device is requested to send its data (is_recv = true).

For a more recent firmware and is_recv = false, the ioctl command USBDEVFS_CONTROL is not used (this tells the bus to enter the control mode), but the bulk method is used: USBDEVFS_BULK. This is astonishing, because all of the endpoints are type Interrupt, not bulk.

Anyhow, forthis purpose a different structure is used for the ioctl() (struct **usbdevfs_bulktransfer**) and this is also initialized differently:

The length and timeout parameters are given the same values as above. The formal parameter out_msg is also passed as a buffer pointer. For the endpoints, the firmware version is differentiated again:

For a firmware version between 1.3 and <2.0 endpoint 4 is used, otherwise (it can only be >=2.0) endpoint 3 is used.

Todo Since the handling of endpoints has already led to problems elsewhere, this implementation is extremely hardware-dependent and critical!

Eg. the new keyboard K95PLATINUMRGB has a version number significantly less than 2.0 - will it run with this implementation?

The ioctl() - no matter what type - returns the number of bytes sent. Now comes the usual check:

- If the return value is -1 AND the error is a timeout (ETIMEOUT), os_usbsend() will return -1 to indicate that it is probably a recoverable problem and a retry is recommended.
- For another negative value or other error identifier OR 0 bytes sent, 0 is returned as a heavy error identifier.
- In all other cases, the function returns the number of bytes sent.

If this is not the entire blocksize (MSG_SIZE bytes), an error message is issued on the standard error channel [warning "Wrote YY bytes (expected 64)"].

If DEBUG_USB is set during compilation, the number of bytes sent and their representation are logged to the error channel.

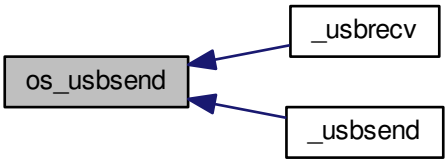
Definition at line 68 of file usb_linux.c.

References ckb_err_fn, ckb_warn_fn, usbdevice::epcount, usbdevice::fwversion, usbdevice::handle, and MSG_SIZE.

Referenced by _usbrecv(), and _usbsend().

```
68                                                                                                  {
69     int res;
70     if (kb->fwversion >= 0x120 && !is_recv) {
71         struct usbdevfs_bulktransfer transfer;
72         memset(&transfer, 0, sizeof(transfer));
73         transfer.ep = (kb->fwversion >= 0x130 && kb->fwversion < 0x200) ? 4 : 3;
74         transfer.len = MSG_SIZE;
75         transfer.timeout = 5000;
76         transfer.data = (void*)out_msg;
77         res = ioctl(kb->handle - 1, USBDEVFS_BULK, &transfer);
78     } else {
79         struct usbdevfs_ctrltransfer transfer = { 0x21, 0x09, 0x0200, kb->
      epcount - 1, MSG_SIZE, 5000, (void*)out_msg };
80         res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
81     }
82
83     if (res <= 0){
84         ckb_err_fn(" %s, res = 0x%x\n", file, line, res ? strerror(errno) : "No data written",
      res);
85         if(res == -1 && errno == ETIMEDOUT)
86             return -1;
87         else
88             return 0;
89     } else if (res != MSG_SIZE)
90         ckb_warn_fn("Wrote %d bytes (expected %d)\n", file, line, res,
      MSG_SIZE);
91 #ifdef DEBUG_USB
92     char converted[MSG_SIZE*3 + 1];
93     for(int i=0;i<MSG_SIZE;i++)
94         sprintf(&converted[i*3], "%02x ", out_msg[i]);
95     ckb_warn_fn("Sent %s\n", file, line, converted);
96 #endif
97     return res;
98 }
```

Here is the caller graph for this function:



9.42.3.13 const char* product_str (short *product*)

Parameters

product	is the *short* USB device product ID

Returns

string to identify a type of device (see below)

product_str returns a condensed view on what type of device we have.

At present, various models and their properties are known from corsair products. Some models differ in principle (mice and keyboards), others differ in the way they function (for example, RGB and non RGB), but they are very similar.

Here, only the first point is taken into consideration and we return a unified model string. If the model is not known with its number, *product_str* returns an empty string.

The model numbers and corresponding strings wwith the numbers in hex-string are defined in `usb.h`

At present, this function is used to initialize `kb->name` and to give information in debug strings.

Attention

The combinations below have to fit to the combinations in the macros mentioned above. So if you add a device with a new number, change both.

Todo There are macros defined in usb.h to detect all the combinations below. the only difference is the parameter: The macros need the *kb**, product_str() needs the *product ID*

Definition at line 70 of file usb.c.

References P_K65, P_K65_LUX, P_K65_NRGB, P_K65_RFIRE, P_K70, P_K70_LUX, P_K70_LUX_NRGB, P_K70_NRGB, P_K70_RFIRE, P_K70_RFIRE_NRGB, P_K95, P_K95_NRGB, P_K95_PLATINUM, P_M65, P_M65_PRO, P_SABRE_L, P_SABRE_N, P_SABRE_O, P_SABRE_O2, P_SCIMITAR, P_SCIMITAR_PRO, P_STRAFE, and P_STRAFE_NRGB.

Referenced by _mkdevpath(), and _setupusb().

```
70                                      {
71      if(product == P_K95 || product == P_K95_NRGB || product ==
        P_K95_PLATINUM)
72          return "k95";
73      if(product == P_K70 || product == P_K70_NRGB || product ==
        P_K70_LUX || product == P_K70_LUX_NRGB || product ==
```

```
      P_K70_RFIRE || product == P_K70_RFIRE_NRGB)
74         return "k70";
75      if(product == P_K65 || product == P_K65_NRGB || product ==
      P_K65_LUX || product == P_K65_RFIRE)
76         return "k65";
77      if(product == P_STRAFE || product == P_STRAFE_NRGB)
78         return "strafe";
79      if(product == P_M65 || product == P_M65_PRO)
80         return "m65";
81      if(product == P_SABRE_O || product == P_SABRE_L || product ==
      P_SABRE_N || product == P_SABRE_O2)
82         return "sabre";
83      if(product == P_SCIMITAR || product == P_SCIMITAR_PRO)
84         return "scimitar";
85      return "";
86  }
```

Here is the caller graph for this function:

9.42.3.14 int revertusb (usbdevice * *kb*)

Parameters

kb	THE usbdevice*

Returns

0 on success or if device needs firmware upgrade, -1 otherwise

revertusb sets a given device to inactive (hardware controlled) mode if not a fw-ugrade is indicated

First is checked, whether a firmware-upgrade is indicated for the device. If so, revertusb() returns 0.

Todo Why is this useful? Are there problems seen with deactivating a device with older fw-version??? Why isn't this an error indicating reason and we return success (0)?

Anyway, the following steps are similar to some other procs, dealing with low level usb handling:

- If we do not have an RGB device, a simple setting to Hardware-mode (NK95_HWON) is sent to the device via n95cmd().

  Todo The return value of nk95cmd() is ignored (but sending the ioctl may produce an error and _nk95_cmd will indicate this), instead revertusb() returns success in any case.

- If we have an RGB device, setactive() is called with second param active = false. That function will have a look on differences between keyboards and mice.

  More precisely setactive() is just a macro to call via the kb->vtable enties either the active() or the idle() function where the vtable points to. setactive() may return error indications. If so, revertusb() returns -1, otherwise 0 in any other case.

Definition at line 407 of file usb.c.

References FEAT_RGB, HAS_FEATURES, NEEDS_FW_UPDATE, NK95_HWON, nk95cmd, and setactive.

Referenced by quitWithLock().

```
407                             {
408     if(NEEDS_FW_UPDATE(kb))
409         return 0;
410     if(!HAS_FEATURES(kb, FEAT_RGB)){
411         nk95cmd(kb, NK95_HWON);
412         return 0;
413     }
414     if(setactive(kb, 0))
415         return -1;
416     return 0;
417 }
```

Here is the caller graph for this function:

9.42.3.15 void setupusb (usbdevice * *kb*)

Attention

Lock a device's dmutex (see device.h) before accessing the USB interface.

Parameters

kb	THE usbdevice* used everywhere
OUT]	kb->thread is used to store the thread ID of the fresh created thread.

setupusb starts a thread with kb as parameter and _setupusb() as entrypoint.

Set up a USB device after its handle is open. Spawns a new thread _setupusb() with standard parameter kb. dmutex must be locked prior to calling this function. The function will unlock it when finished. In kb->thread the thread id is mentioned, because closeusb() needs this info for joining that thread again.

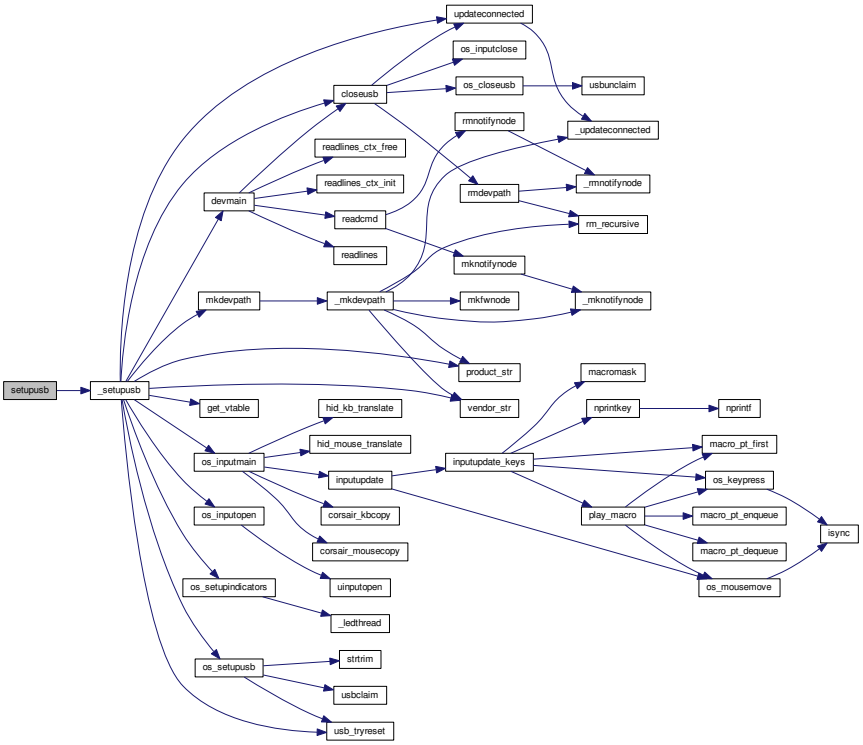
Definition at line 386 of file usb.c.

References _setupusb(), ckb_err, imutex, and usbdevice::thread.

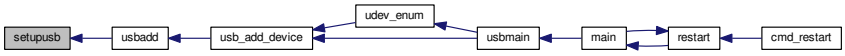
Referenced by usbadd().

```
386                             {
387     pthread_mutex_lock(imutex(kb));
388     if(pthread_create(&kb->thread, 0, _setupusb, kb))
389         ckb_err("Failed to create USB thread\n");
390 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.42.3.16 int usb_tryreset (usbdevice * *kb*)

Parameters

in,out	*kb*	THE usbdevice*
in	*reset_stop*	global variable is read

Returns

0 on success, -1 otherwise

usb_tryreset does what the name means: Try to reset the usb via resetusb()

This function is called if an usb command ran into an error in case of one of the following two situations:

- When setting up a new usb device and the start() function got an error (

See Also

_setupusb())

- If upgrading to a new firmware gets an error (

See Also

cmd_fwupdate()).

The previous action which got the error will NOT be re-attempted.

In an endless loop usb_tryreset() tries to reset the given usb device via the macro resetusb().

This macro calls _resetusb() with debugging information.

_resetusb() sends a command via the operating system dependent function os_resetusb() and - if successful - reinitializes the device. os_resetusb() returns -2 to indicate a broken device and all structures should be removed for it.

In that case, the loop is terminated, an error message is produced and usb_tryreset() returns -1.

In case resetusb() has success, the endless loop is left via a return 0 (success).

If the return value from resetusb() is -1, the loop is continued with the next try.

If the global variable **reset_stop** is set directly when the function is called or after each try, usb_tryreset() stops working and returns -1.

Todo Why does usb_tryreset() hide the information returned from resetusb()? Isn't it needed by the callers?

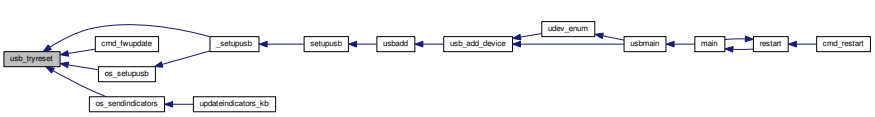
Definition at line 465 of file usb.c.

References ckb_err, ckb_info, reset_stop, and resetusb.

Referenced by _setupusb(), cmd_fwupdate(), os_sendindicators(), and os_setupusb().

```
465                                 {
466     if(reset_stop)
467         return -1;
468     ckb_info("Attempting reset...\n");
469     while(1){
470         int res = resetusb(kb);
471         if(!res){
472             ckb_info("Reset success\n");
473             return 0;
474         }
475         if(res == -2 || reset_stop)
476             break;
477     }
478     ckb_err("Reset failed. Disconnecting.\n");
479     return -1;
480 }
```

Here is the caller graph for this function:



9.42.3.17 void usbkill ( )

Definition at line 837 of file usb_linux.c.

Referenced by quitWithLock().

```
837             {
838     udev_unref(udev);
839     udev = 0;
840 }
```

Here is the caller graph for this function:

9.42.3.18 int usbmain ( )

Start the USB main loop. Returns program exit code when finished.

usbmain is called by main() after setting up all other stuff.

Returns

0 normally or -1 if fatal error occurs (up to now only if no new devices are available)

First check whether the uinput module is loaded by the kernel.

Todo Why isn't missing of uinput a fatal error?

Create the udev object with udev_new() (is a function from libudev.h) terminate -1 if error

Enumerate all currently connected devices

Todo lae. here the work has to go on...

Definition at line 777 of file usb_linux.c.

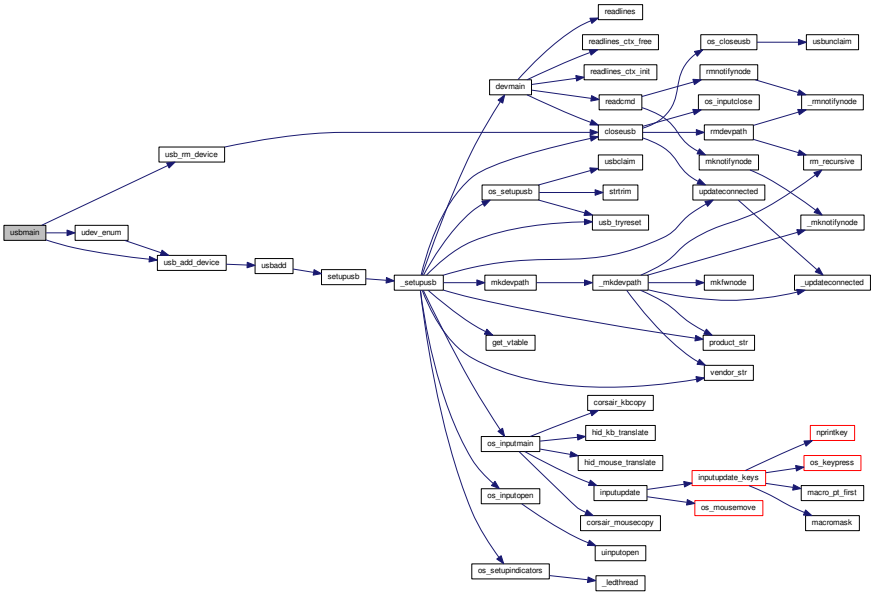
References ckb_fatal, ckb_warn, udev_enum(), usb_add_device(), and usb_rm_device().

Referenced by main().

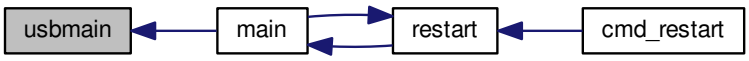
```
777             {
782     // Load the uinput module (if it's not loaded already)
783     if(system("modprobe uinput") != 0)
784         ckb_warn("Failed to load uinput module\n");
785
789     if(!(udev = udev_new())) {
790         ckb_fatal("Failed to initialize udev in usbmain(), usb_linux.c\n");
791         return -1;
792     }
793
796     udev_enum();
797
800     // Done scanning. Enter a loop to poll for device updates
801     struct udev_monitor* monitor = udev_monitor_new_from_netlink(udev, "udev");
802     udev_monitor_filter_add_match_subsystem_devtype(monitor, "usb", 0);
803     udev_monitor_enable_receiving(monitor);
804     // Get an fd for the monitor
805     int fd = udev_monitor_get_fd(monitor);
806     fd_set fds;
807     while(udev){
808         FD_ZERO(&fds);
809         FD_SET(fd, &fds);
810         // Block until an event is read
811         if(select(fd + 1, &fds, 0, 0, 0) > 0 && FD_ISSET(fd, &fds)){
812             struct udev_device* dev = udev_monitor_receive_device(monitor);
813             if(!dev)
814                 continue;
```

```
815             const char* action = udev_device_get_action(dev);
816             if(!action){
817                 udev_device_unref(dev);
818                 continue;
819             }
820             // Add/remove device
821             if(!strcmp(action, "add")){
822                 int res = usb_add_device(dev);
823                 if(res == 0)
824                     continue;
825                 // If the device matched but the handle wasn't opened correctly, re-enumerate (this
        sometimes solves the problem)
826                 if(res == -1)
827                     udev_enum();
828             } else if(!strcmp(action, "remove"))
829                 usb_rm_device(dev);
830             udev_device_unref(dev);
831         }
832     }
833     udev_monitor_unref(monitor);
834     return 0;
835 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.42.3.19 const char* vendor_str (short *vendor*)

uncomment to see USB packets sent from the device vendor_str Vendor/product string representations

Parameters

vendor	*short* vendor ID

Returns

a string: either "" or "corsair"

uncomment the following Define to see USB packets sent to the device

vendor_str returns "corsair" iff the given *vendor* argument is equal to *V_CORSAIR* (0x1bc) else it returns ""

Attention

There is also a string defined V_CORSAIR_STR, which returns the device number as string in hex "1b1c".

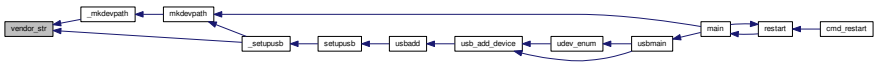
Definition at line 43 of file usb.c.

References V_CORSAIR.

Referenced by _mkdevpath(), and _setupusb().

```
43                                      {
44     if(vendor == V_CORSAIR)
45         return "corsair";
46     return "";
47 }
```

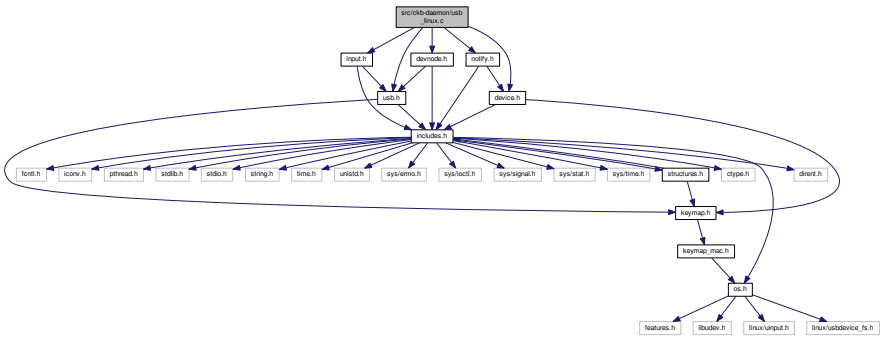
Here is the caller graph for this function:



9.43 src/ckb-daemon/usb_linux.c File Reference

```
#include "device.h"
#include "devnode.h"
#include "input.h"
#include "notify.h"
#include "usb.h"
```

Include dependency graph for usb_linux.c:



Data Structures

- struct _model

Macros

- #define DEBUG

  all open usb devices have their system path names here in this array.
- #define TEST_RESET(op)

  TEST_RESET doesa "try / catch" for resetting the usb interface.
- #define N_MODELS (sizeof(models) / sizeof(_model))

Functions

- int os_usbsend (usbdevice *kb, const uchar *out_msg, int is_recv, const char *file, int line)

  os_usbsend sends a data packet (MSG_SIZE = 64) Bytes long
- int os_usbrecv (usbdevice *kb, uchar *in_msg, const char *file, int line)

  os_usbrecv receives a max MSGSIZE long buffer from usb device
- int _nk95cmd (usbdevice *kb, uchar bRequest, ushort wValue, const char *file, int line)

  _nk95cmd If we control a non RGB keyboard, set the keyboard via ioctl with usbdevfs_ctrltransfer
- void os_sendindicators (usbdevice *kb)
- void * os_inputmain (void *context)

  os_inputmain This function is run in a separate thread and will be detached from the main thread, so it needs to clean up its own resources.
- static int usbunclaim (usbdevice *kb, int resetting)
- void os_closeusb (usbdevice *kb)
- static int usbclaim (usbdevice *kb)
- int os_resetusb (usbdevice *kb, const char *file, int line)
- void strtrim (char *string)
- int os_setupusb (usbdevice *kb)
- int usbadd (struct udev_device *dev, short vendor, short product)
- static int usb_add_device (struct udev_device *dev)

  Add a udev device. Returns 0 if device was recognized/added.
- static void usb_rm_device (struct udev_device *dev)

  usb_rm_device find the usb port to remove and close it via closeusb().
- static void udev_enum ()

  udev_enum use the udev_enumerate_add_match_subsystem() to get all you need but only that.
- int usbmain ()
- void usbkill ()

  Stop the USB system.

Variables

- static char kbsyspath [9][FILENAME_MAX]
- static struct udev * udev

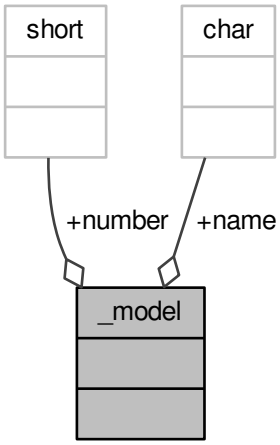
  struct udef is defined in /usr/include/libudev.h
- pthread_t usbthread
- pthread_t udevthread
- static _model models []

9.43.1 Data Structure Documentation

9.43.1.1 struct _model

Definition at line 647 of file usb_linux.c.

Collaboration diagram for _model:



Data Fields

const char *	name	
short	number	

9.43.2 Macro Definition Documentation

9.43.2.1 #define DEBUG

Definition at line 11 of file usb_linux.c.

9.43.2.2 #define N_MODELS (sizeof(models) / sizeof(_model))

Definition at line 684 of file usb_linux.c.

Referenced by usb_add_device().

9.43.2.3 #define TEST_RESET(*op*)

Value:

```
if(op){                                                                 \
        ckb_err_fn("resetusb failed: %s\n", file, line, strerror(errno));   \
        if(errno == EINTR || errno == EAGAIN)                           \
            return -1;              /* try again if status code says so */  \
        return -2;                  /* else, remove device */               \
    }
```

Definition at line 481 of file usb_linux.c.

Referenced by os_resetusb().

9.43.3 Function Documentation

9.43.3.1 int _nk95cmd (usbdevice * kb, uchar bRequest, ushort wValue, const char * file, int line)

To send control packets to a non RGB non color K95 Keyboard, use this function. Normally it is called via the nk95cmd() macro.

If it is the wrong device for which the function is called, 0 is returned and nothing done. Otherwise a usbdevfs_ctrltransfer structure is filled and an USBDEVFS_CONTROL ioctl() called.

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0x40	see table below to switch hardware-modus at Keyboard	wValue	device	MSG_SIZE	5ms	the message buffer pointer
Host to Device, Type=Vendor, Recipient=Device	bRequest parameter	given wValue Parameter	device 0	0 data to write	5000	null

If a 0 or a negative error number is returned by the ioctl, an error message is shown depending on the errno or "No data written" if retval was 0. In either case 1 is returned to indicate the error. If the ioctl returned a value $>$ 0, 0 is returned to indicate no error.

Currently the following combinations for bRequest and wValue are used:

Device	what it might to do	constant	bRequest	wValue
non RGB Keyboard	set HW-modus on (leave the ckb driver)	HWON	0x0002	0x0030
non RGB Keyboard	set HW-modus off (initialize the ckb driver)	HWOFF	0x0002	0x0001
non RGB Keyboard	set light modus M1 in single-color keyboards	NK95_M1	0x0014	0x0001
non RGB Keyboard	set light modus M2 in single-color keyboards	NK95_M2	0x0014	0x0002
non RGB Keyboard	set light modus M3 in single-color keyboards	NK95_M3	0x0014	0x0003

See Also

usb.h

Definition at line 190 of file usb_linux.c.

References ckb_err_fn, usbdevice::handle, P_K95_NRGB, and usbdevice::product.

```
190                                                                                 {
191     if(kb->product != P_K95_NRGB)
```

```
192         return 0;
193     struct usbdevfs_ctrltransfer transfer = { 0x40, bRequest, wValue, 0, 0, 5000, 0 };
194     int res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
195     if(res <= 0){
196         ckb_err_fn("%s\n", file, line, res ? strerror(errno) : "No data written");
197         return 1;
198     }
199     return 0;
200 }
```

9.43.3.2 void os_closeusb (usbdevice * *kb*)

os_closeusb unclaim it, destroy the udev device and clear data structures at kb

os_closeusb is the linux specific implementation for closing an active usb port.

If a valid handle is given in the kb structure, the usb port is unclaimed (usbunclaim()).

The device in unrefenced via library function udev_device_unref().

handle, udev and the first char of kbsyspath are cleared to 0 (empty string for kbsyspath).

Definition at line 437 of file usb_linux.c.

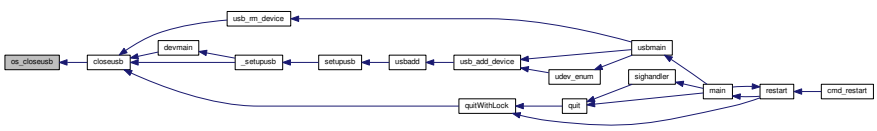
References usbdevice::handle, INDEX_OF, kbsyspath, keyboard, usbdevice::udev, and usbunclaim().

Referenced by closeusb().

```
437                                 {
438     if(kb->handle){
439         usbunclaim(kb, 0);
440         close(kb->handle - 1);
441     }
442     if(kb->udev)
443         udev_device_unref(kb->udev);
444     kb->handle = 0;
445     kb->udev = 0;
446     kbsyspath[INDEX_OF(kb, keyboard)][0] = 0;
447 }
```

Here is the call graph for this function:

Here is the caller graph for this function:



9.43.3.3 void* os_inputmain (void * *context*)

os_inputmain is run in a separate thread and will be detached from the main thread, so it needs to clean up its own resources.

Todo This function is a collection of many tasks. It should be divided into several sub-functions for the sake of greater convenience:

1. set up an URB (Userspace Ressource Buffer) to communicate with the USBDEVFS_∗ ioctl()s
2. perform the ioctl()
3. interpretate the information got into the URB buffer or handle error situations and retry operation or leave the endless loop
4. inform the os about the data
5. loop endless via 2.
6. if endless loop has gone, deinitalize the interface, free buffers etc.
7. return null

Here the actions in detail:

Monitor input transfers on all endpoints for non-RGB devices For RGB, monitor all but the last, as it's used for input/output

Get an usbdevfs_urb data structure and clear it via memset()

Hopefully the buffer lengths are equal for all devices with congruent types. You can find out the correctness for your device with lsusb –v or similar on macOS. Currently the following combinations are known and implemented:

device	detect with macro combination	endpoint #	buffer-length
each	none	0	8
RGB Mouse	IS_RGB && IS_MOUSE	1	10
RGB Keyboard	IS_RGB && !IS_MOUSE	1	21
RGB Mouse or Keyboard	IS_RGB	2	MSG_SIZE (64)
non RGB Mouse or Keyboard	!IS_RGB	1	4
non RGB Mouse or Keyboard	!IS_RGB	2	15

Now submit all the URBs via ioctl(USBDEVFS_SUBMITURB) with type USBDEVFS_URB_TYPE_INTERRUPT (the endpoints are defined as type interrupt). Endpoint number is 0x80..0x82 or 0x83, depending on the model.

The userSpaceFS knows the URBs now, so start monitoring input

if the ioctl returns something != 0, let's have a deeper look what happened. Broken devices or shutting down the entire system leads to closing the device and finishing this thread.

If just an EPIPE ocurred, give the device a CLEAR_HALT and resubmit the URB.

A correct REAPURB returns a Pointer to the URB which we now have a closer look into. Lock all following actions with imutex.

Process the input depending on type of device. Interprete the actual size of the URB buffer

device	detect with macro combination	seems to be endpoint #	actual buffer-length	function called
mouse (RGB and non RGB)	IS_MOUSE	nA	8, 10 or 11	hid_mouse_-translate()
mouse (RGB and non RGB)	IS_MOUSE	nA	MSG_SIZE (64)	corsair_-mousecopy()
RGB Keyboard	IS_RGB && !IS_MOUSE	1	8 (BIOS Mode)	hid_kb_translate()

RGB Keyboard	IS_RGB && !IS_MOUSE	2	5 or 21, KB inactive!	hid_kb_translate()
RGB Keyboard	IS_RGB && !IS_MOUSE	3?	MSG_SIZE	corsair_kbcopy()
non RGB Keyboard	!IS_RGB && !IS_MOUSE	nA	nA	hid_kb_translate()

The input data is transformed and copied to the kb structure. Now give it to the OS and unlock the imutex afterwards.

Re-submit the URB for the next run.

If the endless loop is terminated, clean up by discarding the URBs via ioctl(USBDEVFS_DISCARDURB), free the URB buffers and return a null pointer as thread exit code.

Definition at line 240 of file usb_linux.c.

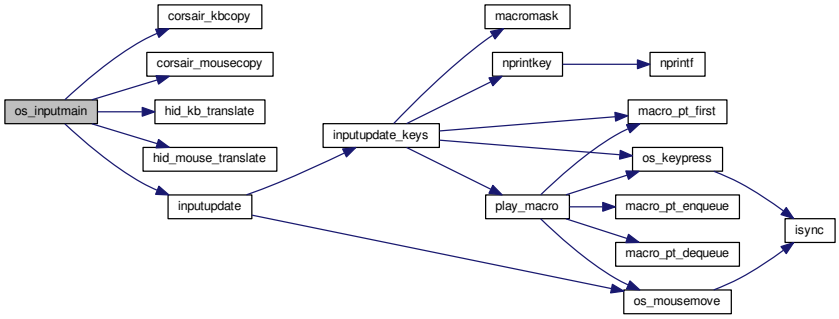
References usbdevice::active, ckb_err, ckb_info, corsair_kbcopy(), corsair_mousecopy(), devpath, usbdevice::epcount, usbdevice::handle, hid_kb_translate(), hid_mouse_translate(), imutex, INDEX_OF, usbdevice::input, inputupdate(), IS_MOUSE, IS_RGB, keyboard, usbinput::keys, MSG_SIZE, usbdevice::product, usbinput::rel_x, usbinput::rel_y, and usbdevice::vendor.

Referenced by _setupusb().

```
240                                 {
241     usbdevice* kb = context;
242     int fd = kb->handle - 1;
243     short vendor = kb->vendor, product = kb->product;
244     int index = INDEX_OF(kb, keyboard);
245     ckb_info("Starting input thread for %s%d\n", devpath, index);
246 
251     int urbcount = IS_RGB(vendor, product) ? (kb->epcount - 1) : kb->
    epcount;
252     if (urbcount == 0) {
253         ckb_err("urbcount = 0, so there is nothing to claim in os_inputmain()\n");
254         return 0;
255     }
256 
258     struct usbdevfs_urb urbs[urbcount + 1];
259     memset(urbs, 0, sizeof(urbs));
260 
274     urbs[0].buffer_length = 8;
275     if(urbcount > 1 && IS_RGB(vendor, product)) {
276         if(IS_MOUSE(vendor, product))
277             urbs[1].buffer_length = 10;
278         else
279             urbs[1].buffer_length = 21;
280         urbs[2].buffer_length = MSG_SIZE;
281         if(urbcount != 3)
282             urbs[urbcount - 1].buffer_length = MSG_SIZE;
283     } else {
284         urbs[1].buffer_length = 4;
285         urbs[2].buffer_length = 15;
286     }
287 
290     for(int i = 0; i < urbcount; i++){
291         urbs[i].type = USBDEVFS_URB_TYPE_INTERRUPT;
292         urbs[i].endpoint = 0x80 | (i + 1);
293         urbs[i].buffer = malloc(urbs[i].buffer_length);
294         ioctl(fd, USBDEVFS_SUBMITURB, urbs + i);
295     }
296 
298     while (1) {
299         struct usbdevfs_urb* urb = 0;
300 
303         if (ioctl(fd, USBDEVFS_REAPURB, &urb)) {
304             if (errno == ENODEV || errno == ENOENT || errno == ESHUTDOWN)
305                 // Stop the thread if the handle closes
306                 break;
307             else if(errno == EPIPE && urb){
309                 ioctl(fd, USBDEVFS_CLEAR_HALT, &urb->endpoint);
310                 // Re-submit the URB
311                 if(urb)
312                     ioctl(fd, USBDEVFS_SUBMITURB, urb);
313                 urb = 0;
314             }
315             continue;
316         }
317 
321         if (urb) {
322 
334             pthread_mutex_lock(imutex(kb));
```

```
335             if(IS_MOUSE(vendor, product)){
336                 switch(urb->actual_length){
337                 case 8:
338                 case 10:
339                 case 11:
340                     // HID mouse input
341                     hid_mouse_translate(kb->input.keys, &kb->
    input.rel_x, &kb->input.rel_y, -(urb->endpoint & 0xF), urb->actual_length, urb->buffer)
    ;
342                     break;
343                 case MSG_SIZE:
344                     // Corsair mouse input
345                     corsair_mousecopy(kb->input.keys, -(urb->endpoint & 0xF), urb
    ->buffer);
346                     break;
347                 }
348             } else if(IS_RGB(vendor, product)){
349                 switch(urb->actual_length){
350                 case 8:
351                     // RGB EP 1: 6KRO (BIOS mode) input
352                     hid_kb_translate(kb->input.keys, -1, urb->actual_length, urb->
    buffer);
353                     break;
354                 case 21:
355                 case 5:
356                     // RGB EP 2: NKRO (non-BIOS) input. Accept only if keyboard is inactive
357                     if(!kb->active)
358                         hid_kb_translate(kb->input.keys, -2, urb->actual_length,
    urb->buffer);
359                     break;
360                 case MSG_SIZE:
361                     // RGB EP 3: Corsair input
362                     corsair_kbcopy(kb->input.keys, -(urb->endpoint & 0xF), urb->
    buffer);
363                     break;
364                 }
365             } else {
366                 // Non-RGB input
367                 hid_kb_translate(kb->input.keys, urb->endpoint & 0xF, urb->
    actual_length, urb->buffer);
368             }
371             inputupdate(kb);
372             pthread_mutex_unlock(imutex(kb));
373 
375             ioctl(fd, USBDEVFS_SUBMITURB, urb);
376             urb = 0;
377         }
378     }
379 
383     ckb_info("Stopping input thread for %s%d\n", devpath, index);
384     for(int i = 0; i < urbcount; i++){
385         ioctl(fd, USBDEVFS_DISCARDURB, urbs + i);
386         free(urbs[i].buffer);
387     }
388     return 0;
389 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.43.3.4 int os_resetusb (usbdevice * *kb*, const char * *file*, int *line*)

os_resetusb is the os specific implementation for resetting usb

Try to reset an usb device in a linux user space driver.

1. unclaim the device, but do not reconnect the system driver (second param resetting = true)
2. reset the device via USBDEVFS_RESET command
3. claim the device again. Returns 0 on success, -2 if device should be removed and -1 if reset should by tried again

Todo it seems that no one wants to try the reset again. But I'v seen it somewhere...

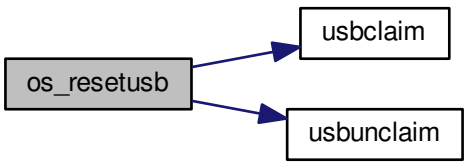
Definition at line 499 of file usb_linux.c.

References usbdevice::handle, TEST_RESET, usbclaim(), and usbunclaim().

Referenced by _resetusb().

```
499                                                     {
500     TEST_RESET(usbunclaim(kb, 1));
501     TEST_RESET(ioctl(kb->handle - 1, USBDEVFS_RESET));
502     TEST_RESET(usbclaim(kb));
503     // Success!
504     return 0;
505 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.43.3.5 void os_sendindicators (usbdevice * *kb*)

os_sendindicators update the indicators for the special keys (Numlock, Capslock and what else?)

os_sendindicators update the indicators for the special keys (Numlock, Capslock and what else?)

Read the data from kb->ileds ans send them via ioctl() to the keyboard.

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0x21	0x09	0x0200	Interface 0	MSG_SIZE 1 Byte	timeout 0,5ms	the message buffer pointer
Host to Device, Type=Class, Recipi-ent=Interface (why not endpoint?)	9 = SEND?	specific	0	1	500	struct* kb->ileds

The ioctl command is USBDEVFS_CONTROL.

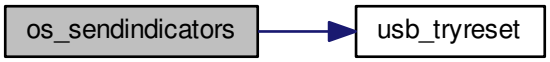
Definition at line 215 of file usb_linux.c.

References ckb_err, usbdevice::handle, usbdevice::ileds, and usb_tryreset().

Referenced by updateindicators_kb().

```
215                                     {
216     static int countForReset = 0;
217     struct usbdevfs_ctrltransfer transfer = { 0x21, 0x09, 0x0200, 0x00, 1, 500, &kb->
    ileds };
218     int res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
219     if(res <= 0) {
220         ckb_err("%s\n", res ? strerror(errno) : "No data written");
221         if (usb_tryreset(kb) == 0 && countForReset++ < 3) {
222             os_sendindicators(kb);
223         }
224     }
225 }
```

Here is the call graph for this function:



Here is the caller graph for this function:

9.43.3.6 int os_setupusb (usbdevice * *kb*)

os_setupusb OS-specific setup for a specific usb device.

Perform the operating system-specific opening of the interface in os_setupusb(). As a result, some parameters should be set in kb (name, serial, fwversion, epcount = number of usb endpoints), and all endpoints should be claimed with usbclaim(). Claiming is the only point where os_setupusb() can produce an error (-1).

- Copy device description and serial
- Copy firmware version (needed to determine USB protocol)
- Do some output about connecting interfaces
- Claim the USB interfaces

Todo in these modules a pullrequest is outstanding

< Try to reset the device and recall the function

< Don't do this endless in recursion

< os_setupusb() has a return value (used as boolean)

Definition at line 537 of file usb_linux.c.

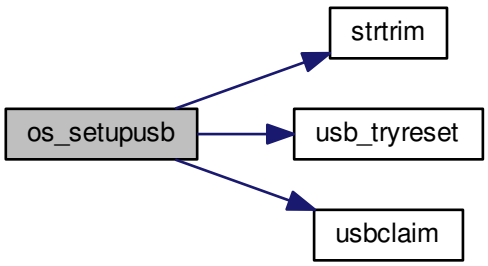
References ckb_err, ckb_info, devpath, usbdevice::epcount, usbdevice::fwversion, INDEX_OF, KB_NAME_LEN, keyboard, usbdevice::name, usbdevice::serial, SERIAL_LEN, strtrim(), usbdevice::udev, usb_tryreset(), and usbclaim().

Referenced by _setupusb().

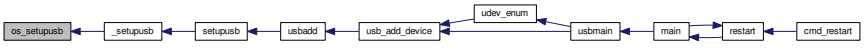
```
537                                {
540     struct udev_device* dev = kb->udev;
541     const char* name = udev_device_get_sysattr_value(dev, "product");
542     if(name)
543         strncpy(kb->name, name, KB_NAME_LEN);
544     strtrim(kb->name);
545     const char* serial = udev_device_get_sysattr_value(dev, "serial");
546     if(serial)
547         strncpy(kb->serial, serial, SERIAL_LEN);
548     strtrim(kb->serial);
551     const char* firmware = udev_device_get_sysattr_value(dev, "bcdDevice");
552     if(firmware)
553         sscanf(firmware, "%hx", &kb->fwversion);
554     else
555         kb->fwversion = 0;
556     int index = INDEX_OF(kb, keyboard);
557
559     ckb_info("Connecting %s at %s%d\n", kb->name, devpath, index);
560
566     const char* ep_str = udev_device_get_sysattr_value(dev, "bNumInterfaces");
567 #ifdef DEBUG
568     ckb_info("claiming interfaces. name=%s, serial=%s, firmware=%s; Got >>%s<< as ep_str\n", name,
      serial, firmware, ep_str);
569 #endif //DEBUG
```

```
570     kb->epcount = 0;
571     if(ep_str)
572         sscanf(ep_str, "%d", &kb->epcount);
573     if(kb->epcount < 2){
574         // IF we have an RGB KB with 0 or 1 endpoints, it will be in BIOS mode.
575         ckb_err("Unable to read endpoint count from udev, assuming %d and reading >>%s<< or device
    is in BIOS mode\n", kb->epcount, ep_str);
576         if (usb_tryreset(kb) == 0) {
577             static int retryCount = 0;
578             if (retryCount++ < 5) {
579                 return os_setupusb(kb);
580             }
581         }
582         return -1;
583         // ToDo are there special versions we have to detect? If there are, that was the old code to handle
    it:
584         // This shouldn't happen, but if it does, assume EP count based onckb_warn what the device is
    supposed to have
585         // kb->epcount = (HAS_FEATURES(kb, FEAT_RGB) ? 4 : 3);
586         // ckb_warn("Unable to read endpoint count from udev, assuming %d and reading >>%s<<...\n",
    kb->epcount, ep_str);
587     }
588     if(usbclaim(kb)){
589         ckb_err("Failed to claim interfaces: %s\n", strerror(errno));
590         return -1;
591     }
592     return 0;
593 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.43.3.7 int os_usbrecv (usbdevice * *kb*, uchar * *in_msg*, const char * *file*, int *line*)

os_usbrecv does what its name says:

The comment at the beginning of the procedure causes the suspicion that the firmware versionspecific distinction is missing for receiving from usb endpoint 3 or 4. The commented code contains only the reception from EP4, but this may be wrong for a software version 2.0 or higher (see the code for os-usbsend ()).

So all the receiving is done via an ioctl() like in os_usbsend. The ioctl() is given a struct usbdevfs_ctrltransfer, in which the relevant parameters are entered:

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0xA1	0x01	0x0200	endpoint to be addressed from epcount - 1	MSG_SIZE	5ms	the message buffer pointer
Device to Host, Type=Class, Recipient=Interface	1 = RECEIVE?	specific	Interface #	64	5000	in_msg

The ioctl() returns the number of bytes received. Here is the usual check again:

- If the return value is -1 AND the error is a timeout (ETIMEOUT), os_usbrecv() will return -1 to indicate that it is probably a recoverable problem and a retry is recommended.

- For another negative value or other error identifier OR 0 bytes are received, 0 is returned as an identifier for a heavy error.

- In all other cases, the function returns the number of bytes received.

If this is not the entire blocksize (MSG_SIZE bytes), an error message is issued on the standard error channel [warning "Read YY bytes (expected 64)"].

Definition at line 130 of file usb_linux.c.

References ckb_err_fn, ckb_warn_fn, usbdevice::epcount, usbdevice::handle, and MSG_SIZE.

Referenced by _usbrecv().

```
130                                                                         {
131     int res;
132     // This is what CUE does, but it doesn't seem to work on linux.
133     /*if(kb->fwversion >= 0x130){
134         struct usbdevfs_bulktransfer transfer;
135         memset(&transfer, 0, sizeof(transfer));
136         transfer.ep = 0x84;
137         transfer.len = MSG_SIZE;
138         transfer.timeout = 5000;
139         transfer.data = in_msg;
140         res = ioctl(kb->handle - 1, USBDEVFS_BULK, &transfer);
141     } else {*/
142         struct usbdevfs_ctrltransfer transfer = { 0xa1, 0x01, 0x0300, kb->
    epcount - 1, MSG_SIZE, 5000, in_msg };
143         res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
144     //}
145     if(res <= 0){
146         ckb_err_fn("%s\n", file, line, res ? strerror(errno) : "No data read");
147         if(res == -1 && errno == ETIMEDOUT)
148             return -1;
149         else
150             return 0;
151     } else if(res != MSG_SIZE)
152         ckb_warn_fn("Read %d bytes (expected %d)\n", file, line, res,
    MSG_SIZE);
153 #ifdef DEBUG_USB_RECV
154     char converted[MSG_SIZE*3 + 1];
155     for(int i=0;i<MSG_SIZE;i++)
156         sprintf(&converted[i*3], "%02x ", in_msg[i]);
157     ckb_warn_fn("Recv %s\n", file, line, converted);
158 #endif
159     return res;
160 }
```

Here is the caller graph for this function:

9.43.3.8 int os_usbsend (usbdevice * *kb*, const uchar * *out_msg*, int *is_recv*, const char * *file*, int *line*)

os_usbsend has two functions:

- if is_recv == false, it tries to send a given MSG_SIZE buffer via the usb interface given with kb.
- otherwise a request is sent via the usb device to initiate the receiving of a message from the remote device.

The functionality for sending distinguishes two cases, depending on the version number of the firmware of the connected device:

If the firmware is less or equal 1.2, the transmission is done via an ioctl(). The ioctl() is given a struct usbdevfs_ctrltransfer, in which the relevant parameters are entered:

bRequest-Type	bRequest	wValue	EP	size	Timeout	data
0x21	0x09	0x0200	endpoint / IF to be addressed from epcount-1	MSG_SIZE	5000 (=5ms)	the message buffer pointer
Host to Device, Type=Class, Recipient=Interface	9 = Send data?	specific	last or pre-last device #	64	5000	out_msg

The ioctl command is USBDEVFS_CONTROL.

The same constellation is used if the device is requested to send its data (is_recv = true).

For a more recent firmware and is_recv = false, the ioctl command USBDEVFS_CONTROL is not used (this tells the bus to enter the control mode), but the bulk method is used: USBDEVFS_BULK. This is astonishing, because all of the endpoints are type Interrupt, not bulk.

Anyhow, forthis purpose a different structure is used for the ioctl() (struct **usbdevfs_bulktransfer**) and this is also initialized differently:

The length and timeout parameters are given the same values as above. The formal parameter out_msg is also passed as a buffer pointer. For the endpoints, the firmware version is differentiated again:

For a firmware version between 1.3 and <2.0 endpoint 4 is used, otherwise (it can only be >=2.0) endpoint 3 is used.

Todo Since the handling of endpoints has already led to problems elsewhere, this implementation is extremely hardware-dependent and critical!

Eg. the new keyboard K95PLATINUMRGB has a version number significantly less than 2.0 - will it run with this implementation?

The ioctl() - no matter what type - returns the number of bytes sent. Now comes the usual check:

- If the return value is -1 AND the error is a timeout (ETIMEOUT), os_usbsend() will return -1 to indicate that it is probably a recoverable problem and a retry is recommended.
- For another negative value or other error identifier OR 0 bytes sent, 0 is returned as a heavy error identifier.
- In all other cases, the function returns the number of bytes sent.

If this is not the entire blocksize (MSG_SIZE bytes), an error message is issued on the standard error channel [warning "Wrote YY bytes (expected 64)"].

If DEBUG_USB is set during compilation, the number of bytes sent and their representation are logged to the error channel.

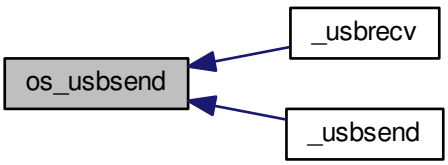
Definition at line 68 of file usb_linux.c.

References ckb_err_fn, ckb_warn_fn, usbdevice::epcount, usbdevice::fwversion, usbdevice::handle, and MSG_SIZE.

Referenced by _usbrecv(), and _usbsend().

```
68                                                                                                  {
69     int res;
70     if (kb->fwversion >= 0x120 && !is_recv) {
71         struct usbdevfs_bulktransfer transfer;
72         memset(&transfer, 0, sizeof(transfer));
73         transfer.ep = (kb->fwversion >= 0x130 && kb->fwversion < 0x200) ? 4 : 3;
74         transfer.len = MSG_SIZE;
75         transfer.timeout = 5000;
76         transfer.data = (void*)out_msg;
77         res = ioctl(kb->handle - 1, USBDEVFS_BULK, &transfer);
78     } else {
79         struct usbdevfs_ctrltransfer transfer = { 0x21, 0x09, 0x0200, kb->
    epcount - 1, MSG_SIZE, 5000, (void*)out_msg };
80         res = ioctl(kb->handle - 1, USBDEVFS_CONTROL, &transfer);
81     }
82
83     if (res <= 0){
84         ckb_err_fn(" %s, res = 0x%x\n", file, line, res ? strerror(errno) : "No data written",
    res);
85         if(res == -1 && errno == ETIMEDOUT)
86             return -1;
87         else
88             return 0;
89     } else if (res != MSG_SIZE)
90         ckb_warn_fn("Wrote %d bytes (expected %d)\n", file, line, res,
    MSG_SIZE);
91 #ifdef DEBUG_USB
92     char converted[MSG_SIZE*3 + 1];
93     for(int i=0;i<MSG_SIZE;i++)
94         sprintf(&converted[i*3], "%02x ", out_msg[i]);
95     ckb_warn_fn("Sent %s\n", file, line, converted);
96 #endif
97     return res;
98 }
```

Here is the caller graph for this function:



9.43.3.9 void strtrim (char * *string*)

strtrim trims a string by removing leading and trailing spaces.

Parameters

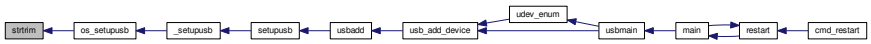
string	

Definition at line 512 of file usb_linux.c.

Referenced by os_setupusb().

```
512                          {
513     // Find last non-space
514     char* last = string;
515     for(char* c = string; *c != 0; c++){
516         if(!isspace(*c))
517             last = c;
518     }
519     last[1] = 0;
520     // Find first non-space
521     char* first = string;
522     for(; *first != 0; first++){
523         if(!isspace(*first))
524             break;
525     }
526     if(first != string)
527         memmove(string, first, last - first);
528 }
```

Here is the caller graph for this function:



9.43.3.10 static void udev_enum ( ) [static]

Reduce the hits of the enumeration by limiting to usb as technology and corsair as idVendor. Then filter with udev-_enumerate_scan_devices () all hits.

The following call to udev_enumerate_get_list_entry() fetches the entire hitlist as udev_list_entry ∗.

Use udev_list_entry_foreach() to iterate through the hit set.

If both the device name exists (udev_list_entry_get_name) and the subsequent creation of a new udev_device (udev_device_new_from_syspath) is ok, the new device is added to the list with usb_add_device().

If the latter does not work, the new device is released again (udev_device_unref ()).

After the last iteration, the enumerator is released with udev_enumerate_unref ().

Definition at line 749 of file usb_linux.c.

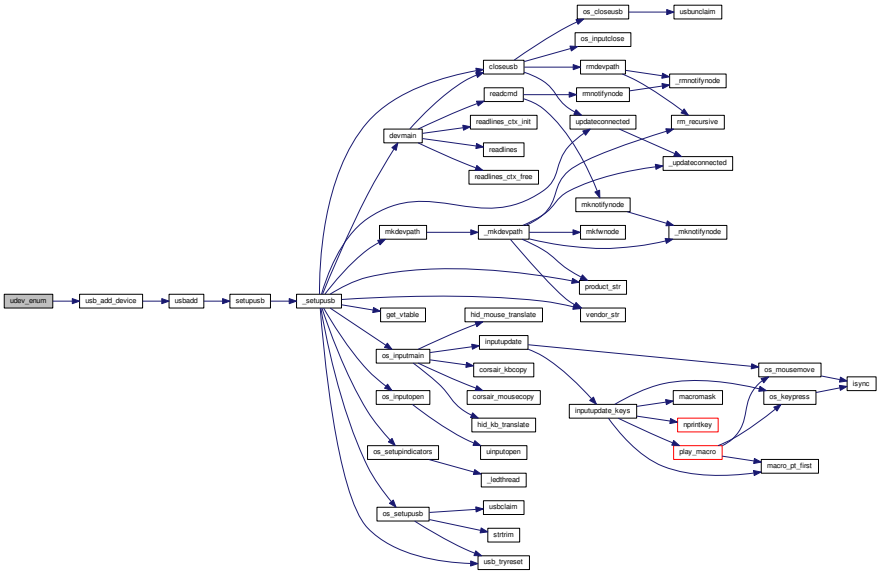
References usb_add_device(), and V_CORSAIR_STR.

Referenced by usbmain().

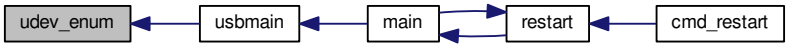
```
749                          {
750     struct udev_enumerate* enumerator = udev_enumerate_new(udev);
751     udev_enumerate_add_match_subsystem(enumerator, "usb");
752     udev_enumerate_add_match_sysattr(enumerator, "idVendor", V_CORSAIR_STR);
753     udev_enumerate_scan_devices(enumerator);
754     struct udev_list_entry* devices, *dev_list_entry;
755     devices = udev_enumerate_get_list_entry(enumerator);
756
757     udev_list_entry_foreach(dev_list_entry, devices){
758         const char* path = udev_list_entry_get_name(dev_list_entry);
759         if(!path)
760             continue;
761         struct udev_device* dev = udev_device_new_from_syspath(udev, path);
762         if(!dev)
763             continue;
764         // If the device matches a recognized device ID, open it
765         if(usb_add_device(dev))
766             // Release device if not
```

```
767             udev_device_unref(dev);
768     }
769     udev_enumerate_unref(enumerator);
770 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.43.3.11 static int usb_add_device (struct udev_device * *dev*) [static]

If the device id can be found, call usbadd() with the appropriate parameters.

Parameters

dev	the functions usb_*_device get a struct udev* with the neccessary hardware-related information.

Returns

the retval of usbadd() or 1 if either vendor is not corsair or product is not mentioned in model[].

First get the idVendor via udev_device_get_sysattr_value(). If this is equal to the ID-string of corsair ("1b1c"), get the idProduct on the same way.

If we can find the model name in the model array, call usbadd() with the model number.

Todo So why the hell not a transformation between the string and the short presentation? Lets check if the string representation is used elsewhere.

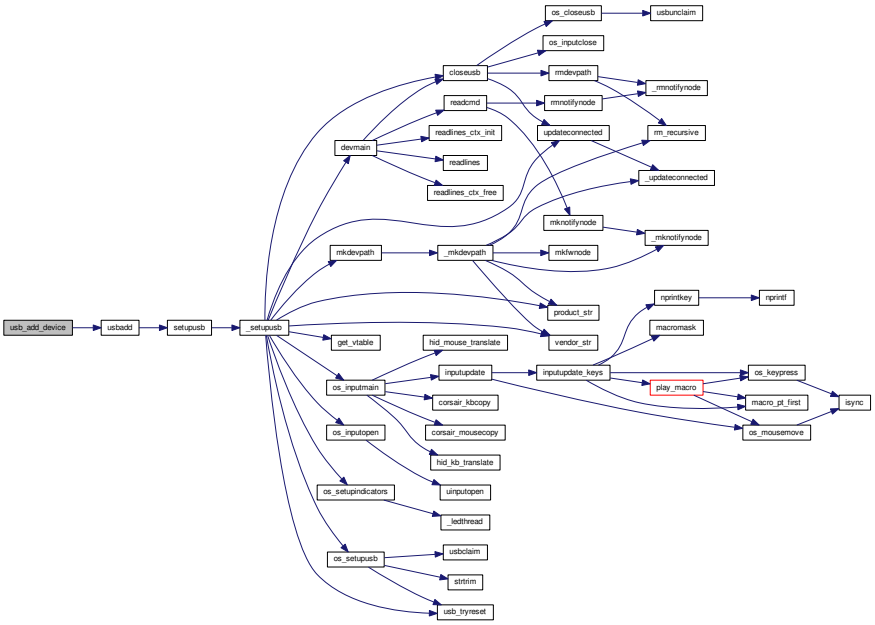
Definition at line 697 of file usb_linux.c.

References N_MODELS, usbadd(), V_CORSAIR, and V_CORSAIR_STR.

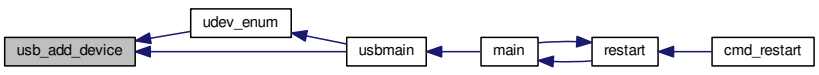
Referenced by udev_enum(), and usbmain().

```
697                                                 {
698     const char* vendor = udev_device_get_sysattr_value(dev, "idVendor");
699     if(vendor && !strcmp(vendor, V_CORSAIR_STR)){
700         const char* product = udev_device_get_sysattr_value(dev, "idProduct");
701         if(product){
702             for(_model* model = models; model < models +
      N_MODELS; model++){
703                 if(!strcmp(product, model->name)){
704                     return usbadd(dev, V_CORSAIR, model->number);
705                 }
706             }
707         }
708     }
709     return 1;
710 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.43.3.12 static void usb_rm_device (struct udev_device * *dev*) [static]

Parameters

dev	the functions usb_∗_device get a struct udev∗ with the neccessary hardware-related information.

First try to find the system path of the device given in parameter dev. The index where the name is found is the same index we need to address the global keyboard array. That array holds all usbdevices.

Searching for the correct name in kbsyspath-array and closing the usb via closeusb() are protected by lock..unlock of the corresponding devmutex arraymember.

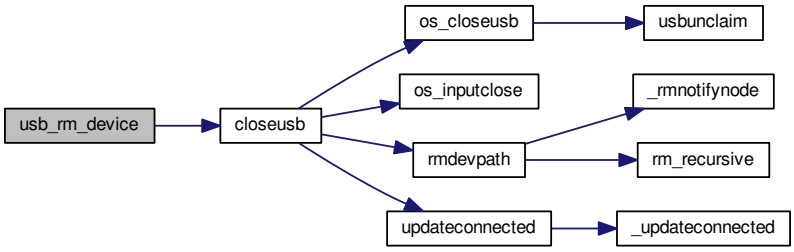
Definition at line 722 of file usb_linux.c.

References closeusb(), DEV_MAX, devmutex, kbsyspath, and keyboard.

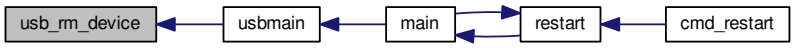
Referenced by usbmain().

```
722                                                 {
723     // Device removed. Look for it in our list of keyboards
724     const char* syspath = udev_device_get_syspath(dev);
725     if(!syspath || syspath[0] == 0)
726         return;
727     for(int i = 1; i < DEV_MAX; i++){
728         pthread_mutex_lock(devmutex + i);
729         if(!strcmp(syspath, kbsyspath[i]))
730             closeusb(keyboard + i);
731         pthread_mutex_unlock(devmutex + i);
732     }
733 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.43.3.13 int usbadd (struct udev_device ∗ *dev*, short *vendor*, short *product*)

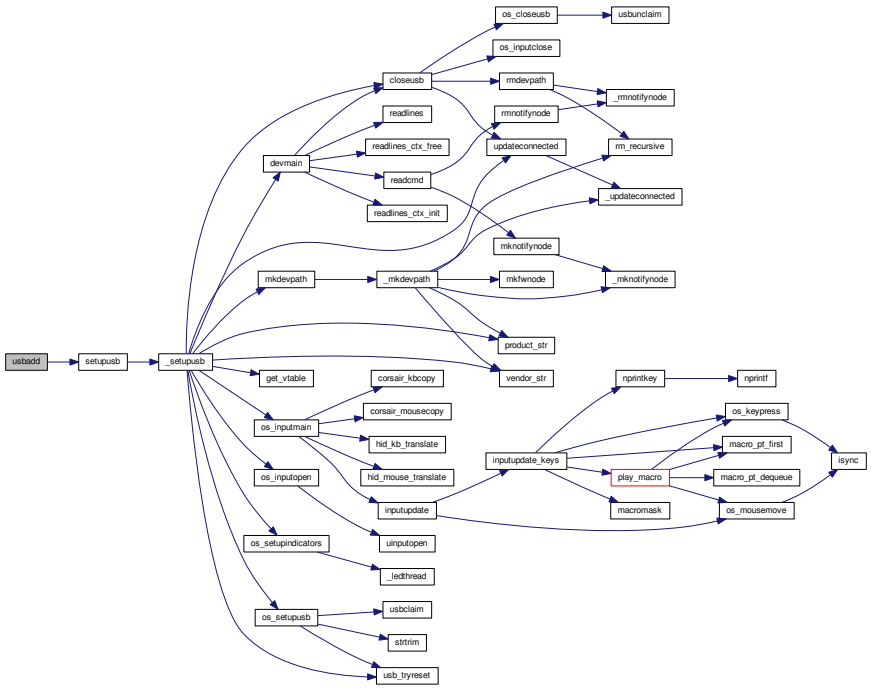
Definition at line 595 of file usb_linux.c.

References ckb_err, ckb_info, DEV_MAX, dmutex, usbdevice::handle, IS_CONNECTED, kbsyspath, keyboard, usbdevice::product, setupusb(), usbdevice::udev, and usbdevice::vendor.

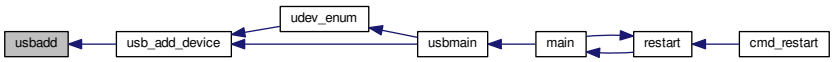
Referenced by usb_add_device().

```
595                                                                     {
596     const char* path = udev_device_get_devnode(dev);
597     const char* syspath = udev_device_get_syspath(dev);
598     if(!path || !syspath || path[0] == 0 || syspath[0] == 0){
599         ckb_err("Failed to get device path\n");
600         return -1;
601     }
602 #ifdef DEBUG
603     ckb_info(">>>vendor = 0x%x, product = 0x%x, path = %s, syspath = %s\n", vendor, product, path,
    syspath);
604 #endif // DEDBUG
605     // Find a free USB slot
606     for(int index = 1; index < DEV_MAX; index++){
607         usbdevice* kb = keyboard + index;
608         if(pthread_mutex_trylock(dmutex(kb))){
609             // If the mutex is locked then the device is obviously in use, so keep going
610             if(!strcmp(syspath, kbsyspath[index])){
611                 // Make sure this existing keyboard doesn't have the same syspath (this shouldn't happen)
612                 return 0;
613             }
614             continue;
615         }
616         if(!IS_CONNECTED(kb)){
617             // Open the sysfs device
618             kb->handle = open(path, O_RDWR) + 1;
619             if(kb->handle <= 0){
620                 ckb_err("Failed to open USB device: %s\n", strerror(errno));
621                 kb->handle = 0;
622                 pthread_mutex_unlock(dmutex(kb));
623                 return -1;
624             } else {
625                 // Set up device
626                 kb->udev = dev;
627                 kb->vendor = vendor;
628                 kb->product = product;
629                 strncpy(kbsyspath[index], syspath, FILENAME_MAX);
630                 // Mutex remains locked
631                 setupusb(kb);
632                 return 0;
633             }
634         }
635         pthread_mutex_unlock(dmutex(kb));
636     }
637     ckb_err("No free devices\n");
638     return -1;
639 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.43.3.14 static int usbclaim (usbdevice * kb) [static]

usbclaim does claiming all EPs for the usb device gicen by kb.

Parameters

kb	THE usbdevice*

Returns

0 on success, -1 otherwise.

Claim all endpoints for a given device (remeber the decrementing of the file descriptor) via ioctl(USBDEVFS_DISCONNECT) and ioctl(USBDEVFS_CLAIMINTERFACE).

Error handling is done for the ioctl(USBDEVFS_CLAIMINTERFACE) only. If this fails, now an error message is thrown and -1 is returned. Function is called in usb_linux.c only, so it is declared as static now.

Definition at line 461 of file usb_linux.c.

References ckb_err, ckb_info, usbdevice::epcount, and usbdevice::handle.

Referenced by os_resetusb(), and os_setupusb().

```
461                                 {
462     int count = kb->epcount;
463 #ifdef DEBUG
464     ckb_info("claiming %d endpoints\n", count);
465 #endif // DEBUG
466
467     for(int i = 0; i < count; i++){
468         struct usbdevfs_ioctl ctl = { i, USBDEVFS_DISCONNECT, 0 };
469         ioctl(kb->handle - 1, USBDEVFS_IOCTL, &ctl);
470         if(ioctl(kb->handle - 1, USBDEVFS_CLAIMINTERFACE, &i)) {
471             ckb_err("Failed to claim interface %d: %s\n", i, strerror(errno));
472             return -1;
473         }
474     }
475     return 0;
476 }
```

Here is the caller graph for this function:

9.43.3.15 void usbkill ( )

Definition at line 837 of file usb_linux.c.

Referenced by quitWithLock().

```
837             {
838     udev_unref(udev);
839     udev = 0;
840 }
```

Here is the caller graph for this function:

9.43.3.16 int usbmain ( )

Start the USB main loop. Returns program exit code when finished.

usbmain is called by main() after setting up all other stuff.

Returns

0 normally or -1 if fatal error occurs (up to now only if no new devices are available)

First check whether the uinput module is loaded by the kernel.

Todo Why isn't missing of uinput a fatal error?

Create the udev object with udev_new() (is a function from libudev.h) terminate -1 if error

Enumerate all currently connected devices

Todo lae. here the work has to go on...

Definition at line 777 of file usb_linux.c.

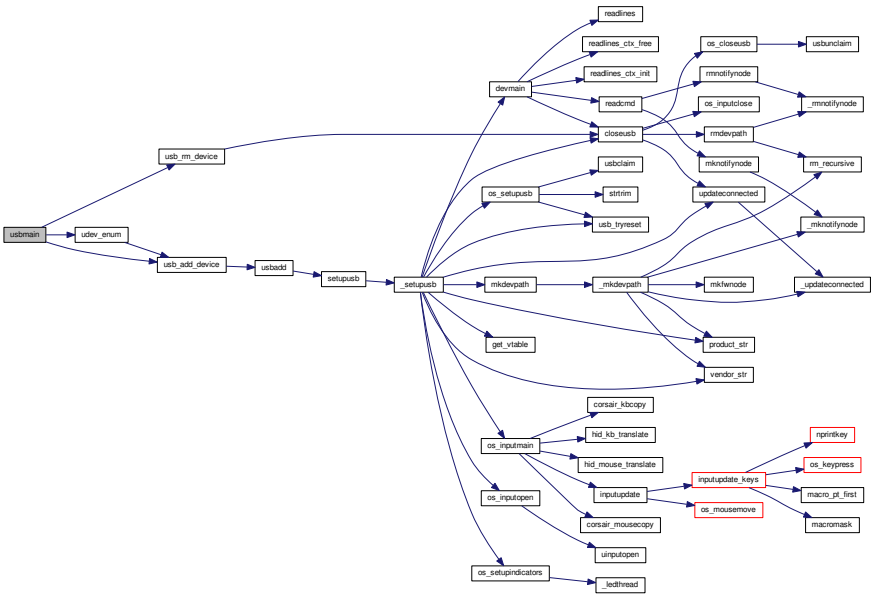
References ckb_fatal, ckb_warn, udev_enum(), usb_add_device(), and usb_rm_device().

Referenced by main().

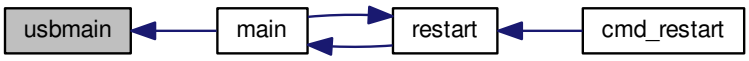
```
777             {
782     // Load the uinput module (if it's not loaded already)
783     if(system("modprobe uinput") != 0)
784         ckb_warn("Failed to load uinput module\n");
785
789     if(!(udev = udev_new())) {
790         ckb_fatal("Failed to initialize udev in usbmain(), usb_linux.c\n");
791         return -1;
792     }
793
796     udev_enum();
797
800     // Done scanning. Enter a loop to poll for device updates
801     struct udev_monitor* monitor = udev_monitor_new_from_netlink(udev, "udev");
802     udev_monitor_filter_add_match_subsystem_devtype(monitor, "usb", 0);
803     udev_monitor_enable_receiving(monitor);
804     // Get an fd for the monitor
805     int fd = udev_monitor_get_fd(monitor);
806     fd_set fds;
807     while(udev){
808         FD_ZERO(&fds);
809         FD_SET(fd, &fds);
810         // Block until an event is read
811         if(select(fd + 1, &fds, 0, 0, 0) > 0 && FD_ISSET(fd, &fds)){
812             struct udev_device* dev = udev_monitor_receive_device(monitor);
813             if(!dev)
814                 continue;
```

```
815             const char* action = udev_device_get_action(dev);
816             if(!action){
817                 udev_device_unref(dev);
818                 continue;
819             }
820             // Add/remove device
821             if(!strcmp(action, "add")){
822                 int res = usb_add_device(dev);
823                 if(res == 0)
824                     continue;
825                 // If the device matched but the handle wasn't opened correctly, re-enumerate (this
        sometimes solves the problem)
826                 if(res == -1)
827                     udev_enum();
828             } else if(!strcmp(action, "remove"))
829                 usb_rm_device(dev);
830             udev_device_unref(dev);
831         }
832     }
833     udev_monitor_unref(monitor);
834     return 0;
835 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



9.43.3.17 static int usbunclaim (usbdevice * *kb*, int *resetting*) [static]

usbunclaim do an unclaiming of the usb device gicen by kb.

Parameters

kb	THE usbdevice*
resetting	boolean flag: If resseting is true, the caller will perform a bus reset command after unclaiming the device.

Returns

always 0.

Unclaim all endpoints for a given device (remeber the decrementing of the file descriptor) via ioctl(USBDEVFS_DISCARDURB).

Afterwards - if ressetting is false - do a USBDEVFS_CONNECT for EP 0 and 1. If it is a non RGB device, connect EP 2 also. The comment mentions RGB keyboards only, but as I understand the code, this is valid also for RGB mice.

There is no error handling yet. Function is called in usb_linux.c only, so it is declared as static now.

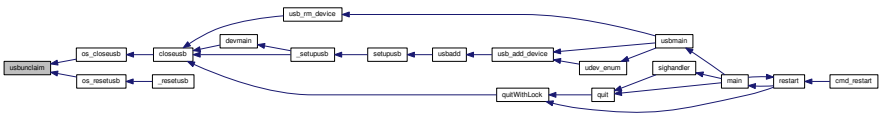
Definition at line 408 of file usb_linux.c.

References usbdevice::epcount, FEAT_RGB, usbdevice::handle, and HAS_FEATURES.

Referenced by os_closeusb(), and os_resetusb().

```
408                                                 {
409     int handle = kb->handle - 1;
410     int count = kb->epcount;
411     for (int i = 0; i < count; i++) {
412         ioctl(handle, USBDEVFS_RELEASEINTERFACE, &i);
413     }
414     // For RGB keyboards, the kernel driver should only be reconnected to interfaces 0 and 1 (HID), and
        only if we're not about to do a USB reset.
415     // Reconnecting any of the others causes trouble.
416     if (!resetting) {
417         struct usbdevfs_ioctl ctl = { 0, USBDEVFS_CONNECT, 0 };
418         ioctl(handle, USBDEVFS_IOCTL, &ctl);
419         ctl.ifno = 1;
420         ioctl(handle, USBDEVFS_IOCTL, &ctl);
421         // Also reconnect iface #2 (HID) for non-RGB keyboards
422         if(!HAS_FEATURES(kb, FEAT_RGB)){
423             ctl.ifno = 2;
424             ioctl(handle, USBDEVFS_IOCTL, &ctl);
425         }
426     }
427     return 0;
428 }
```

Here is the caller graph for this function:



9.43.4 Variable Documentation

9.43.4.1 char kbsyspath[9][FILENAME_MAX] [static]

Definition at line 13 of file usb_linux.c.

Referenced by os_closeusb(), usb_rm_device(), and usbadd().

9.43.4.2 _model models[] [static]

Initial value:

```
= {

    {  "1b17" ,  0x1b17  },
    {  "1b07" ,  0x1b07  },
    {  "1b37" ,  0x1b37  },
    {  "1b39" ,  0x1b39  },
    {  "1b13" ,  0x1b13  },
    {  "1b09" ,  0x1b09  },
    {  "1b33" ,  0x1b33  },
    {  "1b36" ,  0x1b36  },
    {  "1b38" ,  0x1b38  },
    {  "1b3a" ,  0x1b3a  },
    {  "1b11" ,  0x1b11  },
    {  "1b08" ,  0x1b08  },
    {  "1b2d" ,  0x1b2d  },
    {  "1b20" ,  0x1b20  },
    {  "1b15" ,  0x1b15  },

    {  "1b12" ,  0x1b12  },
    {  "1b2e" ,  0x1b2e  },
    {  "1b14" ,  0x1b14   },
    {  "1b19" ,  0x1b19   },
    {  "1b2f" ,  0x1b2f   },
    {  "1b1e" ,  0x1b1e  },
    {  "1b3e" ,  0x1b3e  },
    {  "1b32" ,  0x1b32   }
}
```

Attention

when adding new hardware this file hat to be changed too.

In this structure array *models*[] for each device the name (the device id as string in hex without leading 0x) and its usb device id as short must be entered in this array.

Definition at line 657 of file usb_linux.c.

9.43.4.3 struct udev* udev [static]

Definition at line 641 of file usb_linux.c.

9.43.4.4 pthread_t udevthread

Definition at line 644 of file usb_linux.c.

9.43.4.5 pthread_t usbthread

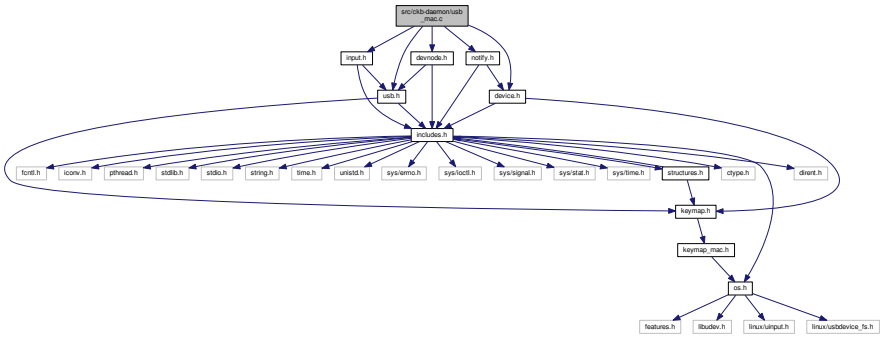
Todo These two thread vasriables seem to be unused: usbtread, udevthread

Definition at line 644 of file usb_linux.c.

9.44 src/ckb-daemon/usb_mac.c File Reference

```
#include "device.h"
#include "devnode.h"
#include "input.h"
#include "notify.h"
#include "usb.h"
```

Include dependency graph for usb_mac.c:



Index

_model, 348
_readlines_ctx, 69
_DEFAULT_SOURCE
    os.h, 233
_GNU_SOURCE
    os.h, 233
__FILE_NOPATH__
    includes.h, 109
_cmd_get
    notify.c, 221
_cmd_macro
    input.c, 113
_freeprofile
    profile.c, 235
_ledthread
    input_linux.c, 137
_mkdevpath
    devnode.c, 70
_mknotifynode
    devnode.c, 73
_nk95cmd
    usb.h, 319
    usb_linux.c, 349
_resetusb
    usb.c, 290
    usb.h, 320
_rmnotifynode
    devnode.c, 74
_setupusb
    usb.c, 290
_start_dev
    device.c, 46
_updateconnected
    devnode.c, 74
_usbrecv
    usb.c, 294
    usb.h, 321
_usbsend
    usb.c, 296
    usb.h, 323

ACCEL
    command.h, 39
ACTIVE
    command.h, 39
ACT_LIGHT
    device.h, 50
ACT_LOCK
    device.h, 50
ACT_M1
    device.h, 50
ACT_M2
    device.h, 50
ACT_M3
    device.h, 51
ACT_MR_RING
    device.h, 51
ACT_NEXT
    device.h, 51
ACT_NEXT_NOWRAP
    device.h, 51
active
    devcmd.__unnamed__, 28
allocprofile
    devcmd.__unnamed__, 28
    profile.c, 235
    profile.h, 251

BIND
    command.h, 40
BR1
    led_keyboard.c, 197
BR2
    led_keyboard.c, 197
BR4
    led_keyboard.c, 197
BTN_WHEELDOWN
    keymap.h, 150
BTN_WHEELUP
    keymap.h, 150
BUILD.md, 31
BUTTON_HID_COUNT
    keymap.c, 144
bind
    devcmd.__unnamed__, 28
binding, 275
bit_reverse_table
    led_keyboard.c, 205

CMD_FIRST
    command.h, 39
CMD_LAST
    command.h, 40
CMD_VT_FIRST
    command.h, 39
CLEAR_KEYBIT
    structures.h, 284
CMD_COUNT
    command.h, 38
CMD_DEV_COUNT

command.h, 38
ckb_err
includes.h, 109
ckb_err_fn
includes.h, 109
ckb_err_nofile
includes.h, 109
ckb_fatal
includes.h, 109
ckb_fatal_fn
includes.h, 109
ckb_fatal_nofile
includes.h, 109
ckb_info
includes.h, 109
ckb_info_fn
includes.h, 109
ckb_info_nofile
includes.h, 110
ckb_s_err
includes.h, 110
ckb_s_out
includes.h, 110
ckb_warn
includes.h, 110
ckb_warn_fn
includes.h, 110
ckb_warn_nofile
includes.h, 110
closeusb
usb.c, 297
usb.h, 324
cmd
command.h, 39
cmd_active_kb
device.h, 52
device_keyboard.c, 59
cmd_active_mouse
device.h, 52
device_mouse.c, 63
cmd_bind
input.c, 115
input.h, 128
cmd_dpi
dpi.c, 90
dpi.h, 95
cmd_dpisel
dpi.c, 91
dpi.h, 96
cmd_erase
profile.c, 236
profile.h, 252
cmd_eraseprofile
profile.c, 237
profile.h, 253
cmd_fwupdate
firmware.c, 101
firmware.h, 105
cmd_get
notify.c, 223
notify.h, 229
cmd_hwload_kb
profile.h, 253
profile_keyboard.c, 265
cmd_hwload_mouse
profile.h, 254
profile_mouse.c, 268
cmd_hwsave_kb
profile.h, 255
profile_keyboard.c, 266
cmd_hwsave_mouse
profile.h, 256
profile_mouse.c, 269
cmd_iauto
led.c, 158
led.h, 163
cmd_id
profile.c, 237
profile.h, 257
cmd_idle_kb
device.h, 53
device_keyboard.c, 60
cmd_idle_mouse
device.h, 53
device_mouse.c, 64
cmd_inotify
led.c, 158
led.h, 164
cmd_io_none
device_vtable.c, 67
cmd_ioff
led.c, 158
led.h, 164
cmd_ion
led.c, 159
led.h, 165
cmd_lift
dpi.c, 91
dpi.h, 96
cmd_macro
input.c, 115
input.h, 129
cmd_macro_none
device_vtable.c, 67
cmd_name
profile.c, 238
profile.h, 257
cmd_none
device_vtable.c, 67
cmd_notify
notify.c, 224
notify.h, 229
cmd_pollrate
device.h, 54
device_mouse.c, 64
cmd_profileid

profile.c, 238
profile.h, 258
cmd_profilename
profile.c, 239
profile.h, 258
cmd_rebind
input.c, 115
input.h, 129
cmd_restart
notify.c, 224
notify.h, 230
cmd_rgb
led.c, 159
led.h, 165
cmd_snap
dpi.c, 91
dpi.h, 96
cmd_strings
command.c, 36
cmd_unbind
input.c, 115
input.h, 129
cmdhandler
command.h, 39
cmdhandler_io
command.h, 39
cmdhandler_mac
command.h, 39
command.h
ACCEL, 39
ACTIVE, 39
BIND, 40
CMD_FIRST, 39
CMD_LAST, 40
CMD_VT_FIRST, 39
DELAY, 39
DITHER, 39
DPI, 40
DPISEL, 40
ERASE, 39
ERASEPROFILE, 39
FPS, 39
FWUPDATE, 39
GET, 40
HWLOAD, 39
HWSAVE, 39
IAUTO, 40
ID, 40
IDLE, 39
INOTIFY, 40
IOFF, 40
ION, 40
LAYOUT, 39
LIFT, 40
MACRO, 40
MODE, 39
NAME, 40
NONE, 39
NOTIFY, 40
NOTIFYOFF, 39
NOTIFYON, 39
POLLRATE, 39
PROFILEID, 40
PROFILENAME, 40
REBIND, 40
RESTART, 40
RGB, 40
SCROLLSPEED, 39
SNAP, 40
SWITCH, 39
UNBIND, 40
command.c
cmd_strings, 36
readcmd, 32
TRY_WITH_RESET, 32
command.h
CMD_COUNT, 38
CMD_DEV_COUNT, 38
cmd, 39
cmdhandler, 39
cmdhandler_io, 39
cmdhandler_mac, 39
devcmd, 39
readcmd, 41
corsair_kbcopy
keymap.c, 144
keymap.h, 153
corsair_mousecopy
keymap.c, 145
keymap.h, 153

DELAY
command.h, 39
DITHER
command.h, 39
DPI
command.h, 40
DPISEL
command.h, 40
DAEMON.md, 31
DEBUG
usb_linux.c, 348
DELAY_LONG
usb.h, 311
DELAY_MEDIUM
usb.h, 311
DELAY_SHORT
usb.h, 311
DEV_MAX
device.h, 51
DPI_COUNT
structures.h, 284
devcmd, 38
command.h, 39
devcmd.__unnamed__, 27
active, 28
allocprofile, 28

bind, 28
dpi, 28
dpisel, 28
erase, 28
eraseprofile, 28
freeprofile, 28
fwupdate, 28
get, 28
hwload, 28
hwsave, 28
iauto, 29
id, 29
idle, 29
inotify, 29
ioff, 29
ion, 29
lift, 29
loadprofile, 29
macro, 29
name, 29
notify, 29
pollrate, 29
profileid, 29
profilename, 29
rebind, 29
restart, 29
rgb, 29
setmodeindex, 29
snap, 29
start, 29
unbind, 29
updatedpi, 29
updateindicators, 29
updatergb, 29
device.c
_start_dev, 46
devlistmutex, 48
devmutex, 48
hwload_mode, 48
inputmutex, 48
keyboard, 48
macromutex, 48
macromutex2, 48
macrovar, 49
start_dev, 47
device.h
ACT_LIGHT, 50
ACT_LOCK, 50
ACT_M1, 50
ACT_M2, 50
ACT_M3, 51
ACT_MR_RING, 51
ACT_NEXT, 51
ACT_NEXT_NOWRAP, 51
cmd_active_kb, 52
cmd_active_mouse, 52
cmd_idle_kb, 53
cmd_idle_mouse, 53
cmd_pollrate, 54
DEV_MAX, 51
devmutex, 58
dmutex, 51
IN_CORSAIR, 51
IN_HID, 51
IS_CONNECTED, 51
imutex, 51
inputmutex, 58
keyboard, 58
macromutex, 58
macromutex2, 59
macrovar, 59
mmutex, 52
mmutex2, 52
mvar, 52
setactive, 52
setactive_kb, 54
setactive_mouse, 56
setmodeindex_nrgb, 57
start_dev, 57
start_kb_nrgb, 58
device_keyboard.c
cmd_active_kb, 59
cmd_idle_kb, 60
setactive_kb, 60
setmodeindex_nrgb, 62
start_kb_nrgb, 62
device_mouse.c
cmd_active_mouse, 63
cmd_idle_mouse, 64
cmd_pollrate, 64
setactive_mouse, 64
device_vtable.c
cmd_io_none, 67
cmd_macro_none, 67
cmd_none, 67
int1_int_none, 67
int1_void_none, 67
loadprofile_none, 67
vtable_keyboard, 68
vtable_keyboard_nonrgb, 68
vtable_mouse, 68
devlistmutex
device.c, 48
devmain
usb.c, 299
devmutex
device.c, 48
device.h, 58
devnode.c
_mkdevpath, 70
_mknotifynode, 73
_rmnotifynode, 74
_updateconnected, 74
devpath, 82
gid, 82
MAX_BUFFER, 70

mkdevpath, 75
mkfwnode, 76
mknotifynode, 77
readlines, 77
readlines_ctx_free, 78
readlines_ctx_init, 79
rm_recursive, 79
rmdevpath, 79
rmnotifynode, 80
S_GID_READ, 70
updateconnected, 81
devnode.h
devpath, 90
gid, 90
mkdevpath, 84
mkfwnode, 84
mknotifynode, 85
readlines, 86
readlines_ctx, 84
readlines_ctx_free, 87
readlines_ctx_init, 87
rmdevpath, 87
rmnotifynode, 88
S_CUSTOM, 83
S_CUSTOM_R, 83
S_READ, 83
S_READDIR, 83
S_READWRITE, 83
updateconnected, 89
devpath
devnode.c, 82
devnode.h, 90
dmutex
device.h, 51
dpi
devcmd.__unnamed__, 28
dpi.c
cmd_dpi, 90
cmd_dpisel, 91
cmd_lift, 91
cmd_snap, 91
loaddpi, 92
printdpi, 93
savedpi, 93
updatedpi, 94
dpi.h
cmd_dpi, 95
cmd_dpisel, 96
cmd_lift, 96
cmd_snap, 96
loaddpi, 97
printdpi, 98
savedpi, 98
updatedpi, 99
dpisel
devcmd.__unnamed__, 28
dpiset, 276

ERASE
command.h, 39
ERASEPROFILE
command.h, 39
erase
devcmd.__unnamed__, 28
eraseprofile
devcmd.__unnamed__, 28
euid_guard_start
os.h, 233
euid_guard_stop
os.h, 233

FPS
command.h, 39
FWUPDATE
command.h, 39
FEAT_ADJRATE
structures.h, 284
FEAT_ANSI
structures.h, 284
FEAT_BIND
structures.h, 284
FEAT_COMMON
structures.h, 284
FEAT_FWUPDATE
structures.h, 284
FEAT_FWVERSION
structures.h, 284
FEAT_HWLOAD
structures.h, 285
FEAT_ISO
structures.h, 285
FEAT_LMASK
structures.h, 285
FEAT_MONOCHROME
structures.h, 285
FEAT_MOUSEACCEL
structures.h, 285
FEAT_NOTIFY
structures.h, 285
FEAT_POLLRATE
structures.h, 285
FEAT_RGB
structures.h, 285
FEAT_STD_NRGB
structures.h, 285
FEAT_STD_RGB
structures.h, 286
FW_MAXSIZE
firmware.c, 101
FW_NOFILE
firmware.c, 101
FW_OK
firmware.c, 101
FW_USBFAIL
firmware.c, 101
FW_WRONGDEV
firmware.c, 101
features_mask

main.c, 219
usb.c, 306
firmware.c
cmd_fwupdate, 101
FW_MAXSIZE, 101
FW_NOFILE, 101
FW_OK, 101
FW_USBFAIL, 101
FW_WRONGDEV, 101
fwupdate, 102
getfwversion, 104
firmware.h
cmd_fwupdate, 105
getfwversion, 106
freebind
input.c, 116
input.h, 130
freemode
profile.c, 239
freeprofile
devcmd.__unnamed__, 28
profile.c, 240
profile.h, 259
fwupdate
devcmd.__unnamed__, 28
firmware.c, 102

GET
command.h, 40
get
devcmd.__unnamed__, 28
get_vtable
usb.c, 301
getfwversion
firmware.c, 104
firmware.h, 106
gethwmodename
profile.c, 240
profile.h, 259
gethwprofilename
profile.c, 241
profile.h, 260
getid
profile.c, 242
profile.h, 261
getmodename
profile.c, 242
profile.h, 261
getprofilename
profile.c, 243
profile.h, 262
gid
devnode.c, 82
devnode.h, 90

HWLOAD
command.h, 39
HWSAVE
command.h, 39
HAS_ANY_FEATURE
structures.h, 286
HAS_FEATURES
structures.h, 286
HW_STANDARD
notify.c, 220
HWMODE_K70
structures.h, 286
HWMODE_K95
structures.h, 286
HWMODE_MAX
structures.h, 286
HWMODE_OR_RETURN
notify.c, 220
has_key
led.c, 160
hid_kb_translate
keymap.c, 145
keymap.h, 153
hid_mouse_translate
keymap.c, 147
keymap.h, 155
hwload
devcmd.__unnamed__, 28
hwload_mode
device.c, 48
main.c, 219
usb.c, 306
hwloadmode
profile_keyboard.c, 267
hwloadprofile
profile.h, 251
hwprofile, 280
hwsave
devcmd.__unnamed__, 28
hwtonative
profile.c, 244
profile.h, 263

IAUTO
command.h, 40
ID
command.h, 40
IDLE
command.h, 39
INOTIFY
command.h, 40
IOFF
command.h, 40
ION
command.h, 40
I_CAPS
structures.h, 286
I_NUM
structures.h, 286
I_SCROLL
structures.h, 286
IFACE_MAX
structures.h, 286

IN_CORSAIR
device.h, 51
IN_HID
device.h, 51
INDEX_OF
includes.h, 110
IS_CONNECTED
device.h, 51
IS_FULLRANGE
usb.h, 311
IS_K65
usb.h, 311
IS_K70
usb.h, 311
IS_K95
usb.h, 311
IS_M65
usb.h, 312
IS_MOD
input.h, 128
IS_MONOCHROME
usb.h, 312
IS_MONOCHROME_DEV
usb.h, 312
IS_MOUSE
usb.h, 312
IS_MOUSE_DEV
usb.h, 312
IS_RGB
usb.h, 312
IS_RGB_DEV
usb.h, 312
IS_SABRE
usb.h, 312
IS_SCIMITAR
usb.h, 312
IS_STRAFE
usb.h, 313
IS_WHEEL
input.c, 113
iauto
devcmd.__unnamed__, 29
id
devcmd.__unnamed__, 29
idle
devcmd.__unnamed__, 29
imutex
device.h, 51
includes.h
__FILE_NOPATH__, 109
ckb_err, 109
ckb_err_fn, 109
ckb_err_nofile, 109
ckb_fatal, 109
ckb_fatal_fn, 109
ckb_fatal_nofile, 109
ckb_info, 109
ckb_info_fn, 109
ckb_info_nofile, 110
ckb_s_err, 110
ckb_s_out, 110
ckb_warn, 110
ckb_warn_fn, 110
ckb_warn_nofile, 110
INDEX_OF, 110
timespec_add, 111
timespec_eq, 110
timespec_ge, 110
timespec_gt, 111
timespec_le, 111
timespec_lt, 111
uchar, 111
ushort, 111
initbind
input.c, 116
input.h, 130
initmode
profile.c, 244
inotify
devcmd.__unnamed__, 29
input.c
_cmd_macro, 113
cmd_bind, 115
cmd_macro, 115
cmd_rebind, 115
cmd_unbind, 115
freebind, 116
IS_WHEEL, 113
initbind, 116
inputupdate, 117
inputupdate_keys, 118
macro_pt_dequeue, 120
macro_pt_enqueue, 121
macro_pt_first, 121
macromask, 122
play_macro, 122
pt_head, 125
pt_tail, 125
updateindicators_kb, 124
input.h
cmd_bind, 128
cmd_macro, 129
cmd_rebind, 129
cmd_unbind, 129
freebind, 130
IS_MOD, 128
initbind, 130
inputupdate, 131
os_inputclose, 132
os_inputopen, 132
os_keypress, 133
os_mousemove, 134
os_setupindicators, 135
parameter_t, 128
ptlist_t, 128
updateindicators_kb, 136

input_linux.c
_ledthread, 137
isync, 138
os_inputclose, 138
os_inputopen, 139
os_keypress, 140
os_mousemove, 140
os_setupindicators, 141
uinputopen, 142
inputmutex
device.c, 48
device.h, 58
inputupdate
input.c, 117
input.h, 131
inputupdate_keys
input.c, 118
int1_int_none
device_vtable.c, 67
int1_void_none
device_vtable.c, 67
ioff
devcmd.__unnamed__, 29
ion
devcmd.__unnamed__, 29
isblack
led_mouse.c, 207
iselect
led.c, 160
isync
input_linux.c, 138

KB_NAME_LEN
structures.h, 287
KEY_BACKSLASH_ISO
keymap.h, 150
KEY_CORSAIR
keymap.h, 150
KEY_NONE
keymap.h, 150
KEY_UNBOUND
keymap.h, 151
kbsyspath
usb_linux.c, 370
key, 149
keyboard
device.c, 48
device.h, 58
keymacro, 274
keymap
keymap.c, 148
keymap.h, 156
keymap.c
BUTTON_HID_COUNT, 144
corsair_kbcopy, 144
corsair_mousecopy, 145
hid_kb_translate, 145
hid_mouse_translate, 147
keymap, 148
keymap.h
BTN_WHEELDOWN, 150
BTN_WHEELUP, 150
corsair_kbcopy, 153
corsair_mousecopy, 153
hid_kb_translate, 153
hid_mouse_translate, 155
KEY_BACKSLASH_ISO, 150
KEY_CORSAIR, 150
KEY_NONE, 150
KEY_UNBOUND, 151
keymap, 156
LED_DPI, 151
LED_MOUSE, 151
MOUSE_BUTTON_FIRST, 151
MOUSE_EXTRA_FIRST, 151
N_BUTTONS_EXTENDED, 151
N_BUTTONS_HW, 151
N_KEY_ZONES, 151
N_KEYBYTES_EXTENDED, 151
N_KEYBYTES_HW, 151
N_KEYBYTES_INPUT, 152
N_KEYS_EXTENDED, 152
N_KEYS_EXTRA, 152
N_KEYS_HW, 152
N_KEYS_INPUT, 152
N_MOUSE_ZONES, 152
SCAN_KBD, 152
SCAN_MOUSE, 152
SCAN_SILENT, 152

LAYOUT
command.h, 39
LIFT
command.h, 40
LED_DPI
keymap.h, 151
LED_MOUSE
keymap.h, 151
LIFT_MAX
structures.h, 287
LIFT_MIN
structures.h, 287
led.c
cmd_iauto, 158
cmd_inotify, 158
cmd_ioff, 158
cmd_ion, 159
cmd_rgb, 159
has_key, 160
iselect, 160
printrgb, 161
led.h
cmd_iauto, 163
cmd_inotify, 164
cmd_ioff, 164
cmd_ion, 165
cmd_rgb, 165
loadrgb_kb, 165

loadrgb_mouse, 167
printrgb, 168
savergb_kb, 170
savergb_mouse, 171
updatergb_kb, 171
updatergb_mouse, 173
led_keyboard.c
BR1, 197
BR2, 197
BR4, 197
bit_reverse_table, 205
loadrgb_kb, 198
makergb_512, 199
makergb_full, 200
O0, 197
O1, 197
O2, 197
O3, 197
O4, 197
O5, 197
O6, 197
O7, 197
O8, 197
ordered8to3, 201
quantize8to3, 201
rgbcmp, 202
savergb_kb, 202
updatergb_kb, 203
led_mouse.c
isblack, 207
loadrgb_mouse, 208
rgbcmp, 208
savergb_mouse, 209
updatergb_mouse, 209
lift
devcmd.__unnamed__, 29
lighting, 277
loaddpi
dpi.c, 92
dpi.h, 97
loadprofile
devcmd.__unnamed__, 29
profile.c, 245
profile.h, 263
loadprofile_none
device_vtable.c, 67
loadrgb_kb
led.h, 165
led_keyboard.c, 198
loadrgb_mouse
led.h, 167
led_mouse.c, 208
localecase
main.c, 211

MACRO
command.h, 40
MODE
command.h, 39
MACRO_MAX
structures.h, 287
MAX_BUFFER
devnode.c, 70
MD_NAME_LEN
structures.h, 287
MODE_COUNT
structures.h, 287
MOUSE_BUTTON_FIRST
keymap.h, 151
MOUSE_EXTRA_FIRST
keymap.h, 151
MSG_SIZE
structures.h, 287
macro
devcmd.__unnamed__, 29
macro_pt_dequeue
input.c, 120
macro_pt_enqueue
input.c, 121
macro_pt_first
input.c, 121
macroaction, 273
macromask
input.c, 122
macromutex
device.c, 48
device.h, 58
macromutex2
device.c, 48
device.h, 59
macrovar
device.c, 49
device.h, 59
main
main.c, 212
main.c
features_mask, 219
hwload_mode, 219
localecase, 211
main, 212
main_ac, 219
main_av, 219
quit, 214
quitWithLock, 215
reset_stop, 219
restart, 216
sighandler, 217
sighandler2, 218
timespec_add, 218
main_ac
main.c, 219
main_av
main.c, 219
makergb_512
led_keyboard.c, 199
makergb_full
led_keyboard.c, 200

mkdevpath
devnode.c, 75
devnode.h, 84
mkfwnode
devnode.c, 76
devnode.h, 84
mknotifynode
devnode.c, 77
devnode.h, 85
mmutex
device.h, 52
mmutex2
device.h, 52
models
usb_linux.c, 370
mvar
device.h, 52

NAME
command.h, 40
NONE
command.h, 39
NOTIFY
command.h, 40
NOTIFYOFF
command.h, 39
NOTIFYON
command.h, 39
N_BUTTONS_EXTENDED
keymap.h, 151
N_BUTTONS_HW
keymap.h, 151
N_KEY_ZONES
keymap.h, 151
N_KEYBYTES_EXTENDED
keymap.h, 151
N_KEYBYTES_HW
keymap.h, 151
N_KEYBYTES_INPUT
keymap.h, 152
N_KEYS_EXTENDED
keymap.h, 152
N_KEYS_EXTRA
keymap.h, 152
N_KEYS_HW
keymap.h, 152
N_KEYS_INPUT
keymap.h, 152
N_MODELS
usb_linux.c, 348
N_MOUSE_ZONES
keymap.h, 152
NEEDS_FW_UPDATE
structures.h, 287
NK95_HWOFF
usb.h, 313
NK95_HWON
usb.h, 313
NK95_M1
usb.h, 313
NK95_M2
usb.h, 313
NK95_M3
usb.h, 313
name
devcmd.__unnamed__, 29
nativetohw
profile.c, 245
profile.h, 264
nk95cmd
usb.h, 313
notify
devcmd.__unnamed__, 29
notify.c
_cmd_get, 221
cmd_get, 223
cmd_notify, 224
cmd_restart, 224
HW_STANDARD, 220
HWMODE_OR_RETURN, 220
nprintf, 225
nprintind, 225
nprintkey, 226
restart, 227
notify.h
cmd_get, 229
cmd_notify, 229
cmd_restart, 230
nprintf, 230
nprintind, 231
nprintkey, 232
nprintf
notify.c, 225
notify.h, 230
nprintind
notify.c, 225
notify.h, 231
nprintkey
notify.c, 226
notify.h, 232

O0
led_keyboard.c, 197
O1
led_keyboard.c, 197
O2
led_keyboard.c, 197
O3
led_keyboard.c, 197
O4
led_keyboard.c, 197
O5
led_keyboard.c, 197
O6
led_keyboard.c, 197
O7
led_keyboard.c, 197
O8

led_keyboard.c, 197
OUTFIFO_MAX
structures.h, 287
ordered8to3
led_keyboard.c, 201
os.h
_DEFAULT_SOURCE, 233
_GNU_SOURCE, 233
euid_guard_start, 233
euid_guard_stop, 233
UINPUT_VERSION, 233
os_closeusb
usb.h, 326
usb_linux.c, 350
os_inputclose
input.h, 132
input_linux.c, 138
os_inputmain
usb.h, 327
usb_linux.c, 350
os_inputopen
input.h, 132
input_linux.c, 139
os_keypress
input.h, 133
input_linux.c, 140
os_mousemove
input.h, 134
input_linux.c, 140
os_resetusb
usb.h, 330
usb_linux.c, 354
os_sendindicators
usb.h, 331
usb_linux.c, 355
os_setupindicators
input.h, 135
input_linux.c, 141
os_setupusb
usb.h, 333
usb_linux.c, 356
os_usbrecv
usb.h, 335
usb_linux.c, 357
os_usbsend
usb.h, 337
usb_linux.c, 359

POLLRATE
command.h, 39
PROFILEID
command.h, 40
PROFILENAME
command.h, 40
P_K65
usb.h, 313
P_K65_LUX
usb.h, 314
P_K65_LUX_STR
usb.h, 314
P_K65_NRGB
usb.h, 314
P_K65_NRGB_STR
usb.h, 314
P_K65_RFIRE
usb.h, 314
P_K65_RFIRE_STR
usb.h, 314
P_K65_STR
usb.h, 314
P_K70
usb.h, 314
P_K70_LUX
usb.h, 314
P_K70_LUX_NRGB
usb.h, 314
P_K70_LUX_NRGB_STR
usb.h, 315
P_K70_LUX_STR
usb.h, 315
P_K70_NRGB
usb.h, 315
P_K70_NRGB_STR
usb.h, 315
P_K70_RFIRE
usb.h, 315
P_K70_RFIRE_NRGB
usb.h, 315
P_K70_RFIRE_NRGB_STR
usb.h, 315
P_K70_RFIRE_STR
usb.h, 315
P_K70_STR
usb.h, 315
P_K95
usb.h, 315
P_K95_NRGB
usb.h, 315
P_K95_NRGB_STR
usb.h, 316
P_K95_PLATINUM
usb.h, 316
P_K95_PLATINUM_STR
usb.h, 316
P_K95_STR
usb.h, 316
P_M65
usb.h, 316
P_M65_PRO
usb.h, 316
P_M65_PRO_STR
usb.h, 316
P_M65_STR
usb.h, 316
P_SABRE_L
usb.h, 316
P_SABRE_L_STR

usb.h, 316
P_SABRE_N
usb.h, 316
P_SABRE_N_STR
usb.h, 317
P_SABRE_O
usb.h, 317
P_SABRE_O2
usb.h, 317
P_SABRE_O2_STR
usb.h, 317
P_SABRE_O_STR
usb.h, 317
P_SCIMITAR
usb.h, 317
P_SCIMITAR_PRO
usb.h, 317
P_SCIMITAR_PRO_STR
usb.h, 317
P_SCIMITAR_STR
usb.h, 317
P_STRAFE
usb.h, 317
P_STRAFE_NRGB
usb.h, 318
P_STRAFE_NRGB_STR
usb.h, 318
P_STRAFE_STR
usb.h, 318
PR_NAME_LEN
structures.h, 288
parameter, 127
parameter_t
input.h, 128
play_macro
input.c, 122
pollrate
devcmd.__unnamed__, 29
printdpi
dpi.c, 93
dpi.h, 98
printname
profile.c, 246
printrgb
led.c, 161
led.h, 168
product_str
usb.c, 302
usb.h, 339
profile.c
_freeprofile, 235
allocprofile, 235
cmd_erase, 236
cmd_eraseprofile, 237
cmd_id, 237
cmd_name, 238
cmd_profileid, 238
cmd_profilename, 239
freemode, 239
freeprofile, 240
gethwmodename, 240
gethwprofilename, 241
getid, 242
getmodename, 242
getprofilename, 243
hwtonative, 244
initmode, 244
loadprofile, 245
nativetohw, 245
printname, 246
setid, 247
u16dec, 247
u16enc, 248
urldecode2, 248
urlencode2, 249
utf16to8, 250
utf8to16, 250
profile.h
allocprofile, 251
cmd_erase, 252
cmd_eraseprofile, 253
cmd_hwload_kb, 253
cmd_hwload_mouse, 254
cmd_hwsave_kb, 255
cmd_hwsave_mouse, 256
cmd_id, 257
cmd_name, 257
cmd_profileid, 258
cmd_profilename, 258
freeprofile, 259
gethwmodename, 259
gethwprofilename, 260
getid, 261
getmodename, 261
getprofilename, 262
hwloadprofile, 251
hwtonative, 263
loadprofile, 263
nativetohw, 264
setid, 264
profile_keyboard.c
cmd_hwload_kb, 265
cmd_hwsave_kb, 266
hwloadmode, 267
profile_mouse.c
cmd_hwload_mouse, 268
cmd_hwsave_mouse, 269
profileid
devcmd.__unnamed__, 29
profilename
devcmd.__unnamed__, 29
pt_head
input.c, 125
pt_tail
input.c, 125
ptlist, 128

ptlist_t
input.h, 128

quantize8to3
led_keyboard.c, 201
quit
main.c, 214
quitWithLock
main.c, 215

REBIND
command.h, 40
RESTART
command.h, 40
RGB
command.h, 40
README.md, 31
ROADMAP.md, 31
readcmd
command.c, 32
command.h, 41
readlines
devnode.c, 77
devnode.h, 86
readlines_ctx
devnode.h, 84
readlines_ctx_free
devnode.c, 78
devnode.h, 87
readlines_ctx_init
devnode.c, 79
devnode.h, 87
rebind
devcmd.__unnamed__, 29
reset_stop
main.c, 219
usb.c, 306
resetusb
usb.h, 318
restart
devcmd.__unnamed__, 29
main.c, 216
notify.c, 227
revertusb
usb.c, 303
usb.h, 340
rgb
devcmd.__unnamed__, 29
rgbcmp
led_keyboard.c, 202
led_mouse.c, 208
rm_recursive
devnode.c, 79
rmdevpath
devnode.c, 79
devnode.h, 87
rmnotifynode
devnode.c, 80
devnode.h, 88

SCROLLSPEED
command.h, 39
SNAP
command.h, 40
SWITCH
command.h, 39
S_CUSTOM
devnode.h, 83
S_CUSTOM_R
devnode.h, 83
S_GID_READ
devnode.c, 70
S_READ
devnode.h, 83
S_READDIR
devnode.h, 83
S_READWRITE
devnode.h, 83
SCAN_KBD
keymap.h, 152
SCAN_MOUSE
keymap.h, 152
SCAN_SILENT
keymap.h, 152
SCROLL_ACCELERATED
structures.h, 288
SCROLL_MAX
structures.h, 288
SCROLL_MIN
structures.h, 288
SERIAL_LEN
structures.h, 288
SET_KEYBIT
structures.h, 288
savedpi
dpi.c, 93
dpi.h, 98
savergb_kb
led.h, 170
led_keyboard.c, 202
savergb_mouse
led.h, 171
led_mouse.c, 209
setactive
device.h, 52
setactive_kb
device.h, 54
device_keyboard.c, 60
setactive_mouse
device.h, 56
device_mouse.c, 64
setid
profile.c, 247
profile.h, 264
setmodeindex
devcmd.__unnamed__, 29
setmodeindex_nrgb
device.h, 57

device_keyboard.c, 62
setupusb
usb.c, 304
usb.h, 341
sighandler
main.c, 217
sighandler2
main.c, 218
snap
devcmd.__unnamed__, 29
src/ckb-daemon/command.c, 31
src/ckb-daemon/command.h, 36
src/ckb-daemon/device.c, 45
src/ckb-daemon/device.h, 49
src/ckb-daemon/device_keyboard.c, 59
src/ckb-daemon/device_mouse.c, 63
src/ckb-daemon/device_vtable.c, 66
src/ckb-daemon/devnode.c, 68
src/ckb-daemon/devnode.h, 82
src/ckb-daemon/dpi.c, 90
src/ckb-daemon/dpi.h, 95
src/ckb-daemon/extra_mac.c, 100
src/ckb-daemon/firmware.c, 100
src/ckb-daemon/firmware.h, 105
src/ckb-daemon/includes.h, 107
src/ckb-daemon/input.c, 111
src/ckb-daemon/input.h, 125
src/ckb-daemon/input_linux.c, 136
src/ckb-daemon/input_mac.c, 143
src/ckb-daemon/input_mac_mouse.c, 143
src/ckb-daemon/keymap.c, 143
src/ckb-daemon/keymap.h, 148
src/ckb-daemon/keymap_mac.h, 156
src/ckb-daemon/led.c, 157
src/ckb-daemon/led.h, 163
src/ckb-daemon/led_keyboard.c, 174
src/ckb-daemon/led_mouse.c, 207
src/ckb-daemon/main.c, 210
src/ckb-daemon/notify.c, 219
src/ckb-daemon/notify.h, 228
src/ckb-daemon/os.h, 232
src/ckb-daemon/profile.c, 234
src/ckb-daemon/profile.h, 250
src/ckb-daemon/profile_keyboard.c, 265
src/ckb-daemon/profile_mouse.c, 268
src/ckb-daemon/structures.h, 270
src/ckb-daemon/usb.c, 289
src/ckb-daemon/usb.h, 307
src/ckb-daemon/usb_linux.c, 346
src/ckb-daemon/usb_mac.c, 371
start
devcmd.__unnamed__, 29
start_dev
device.c, 47
device.h, 57
start_kb_nrgb
device.h, 58
device_keyboard.c, 62
strtrim
usb_linux.c, 360
structures.h
CLEAR_KEYBIT, 284
DPI_COUNT, 284
FEAT_ADJRATE, 284
FEAT_ANSI, 284
FEAT_BIND, 284
FEAT_COMMON, 284
FEAT_FWUPDATE, 284
FEAT_FWVERSION, 284
FEAT_HWLOAD, 285
FEAT_ISO, 285
FEAT_LMASK, 285
FEAT_MONOCHROME, 285
FEAT_MOUSEACCEL, 285
FEAT_NOTIFY, 285
FEAT_POLLRATE, 285
FEAT_RGB, 285
FEAT_STD_NRGB, 285
FEAT_STD_RGB, 286
HAS_ANY_FEATURE, 286
HAS_FEATURES, 286
HWMODE_K70, 286
HWMODE_K95, 286
HWMODE_MAX, 286
I_CAPS, 286
I_NUM, 286
I_SCROLL, 286
IFACE_MAX, 286
KB_NAME_LEN, 287
LIFT_MAX, 287
LIFT_MIN, 287
MACRO_MAX, 287
MD_NAME_LEN, 287
MODE_COUNT, 287
MSG_SIZE, 287
NEEDS_FW_UPDATE, 287
OUTFIFO_MAX, 287
PR_NAME_LEN, 288
SCROLL_ACCELERATED, 288
SCROLL_MAX, 288
SCROLL_MIN, 288
SERIAL_LEN, 288
SET_KEYBIT, 288
vtable_keyboard, 288
vtable_keyboard_nonrgb, 288
vtable_mouse, 288
TEST_RESET
usb_linux.c, 348
TRY_WITH_RESET
command.c, 32
timespec_add
includes.h, 111
main.c, 218
timespec_eq
includes.h, 110
timespec_ge

includes.h, 110
timespec_gt
includes.h, 111
timespec_le
includes.h, 111
timespec_lt
includes.h, 111

u16dec
profile.c, 247
u16enc
profile.c, 248
UNBIND
command.h, 40
UINPUT_VERSION
os.h, 233
USB_DELAY_DEFAULT
usb.h, 318
uchar
includes.h, 111
udev
usb_linux.c, 371
udev_enum
usb_linux.c, 362
udevthread
usb_linux.c, 371
uinputopen
input_linux.c, 142
unbind
devcmd.__unnamed__, 29
updateconnected
devnode.c, 81
devnode.h, 89
updatedpi
devcmd.__unnamed__, 29
dpi.c, 94
dpi.h, 99
updateindicators
devcmd.__unnamed__, 29
updateindicators_kb
input.c, 124
input.h, 136
updatergb
devcmd.__unnamed__, 29
updatergb_kb
led.h, 171
led_keyboard.c, 203
updatergb_mouse
led.h, 173
led_mouse.c, 209
urldecode2
profile.c, 248
urlencode2
profile.c, 249
usb.c
_resetusb, 290
_setupusb, 290
_usbrecv, 294
_usbsend, 296
closeusb, 297
devmain, 299
features_mask, 306
get_vtable, 301
hwload_mode, 306
product_str, 302
reset_stop, 306
revertusb, 303
setupusb, 304
usb_tryreset, 305
usbmutex, 307
vendor_str, 306
usb.h
_nk95cmd, 319
_resetusb, 320
_usbrecv, 321
_usbsend, 323
closeusb, 324
DELAY_LONG, 311
DELAY_MEDIUM, 311
DELAY_SHORT, 311
IS_FULLRANGE, 311
IS_K65, 311
IS_K70, 311
IS_K95, 311
IS_M65, 312
IS_MONOCHROME, 312
IS_MONOCHROME_DEV, 312
IS_MOUSE, 312
IS_MOUSE_DEV, 312
IS_RGB, 312
IS_RGB_DEV, 312
IS_SABRE, 312
IS_SCIMITAR, 312
IS_STRAFE, 313
NK95_HWOFF, 313
NK95_HWON, 313
NK95_M1, 313
NK95_M2, 313
NK95_M3, 313
nk95cmd, 313
os_closeusb, 326
os_inputmain, 327
os_resetusb, 330
os_sendindicators, 331
os_setupusb, 333
os_usbrecv, 335
os_usbsend, 337
P_K65, 313
P_K65_LUX, 314
P_K65_LUX_STR, 314
P_K65_NRGB, 314
P_K65_NRGB_STR, 314
P_K65_RFIRE, 314
P_K65_RFIRE_STR, 314
P_K65_STR, 314
P_K70, 314
P_K70_LUX, 314

P_K70_LUX_NRGB, 314
P_K70_LUX_NRGB_STR, 315
P_K70_LUX_STR, 315
P_K70_NRGB, 315
P_K70_NRGB_STR, 315
P_K70_RFIRE, 315
P_K70_RFIRE_NRGB, 315
P_K70_RFIRE_STR, 315
P_K70_STR, 315
P_K95, 315
P_K95_NRGB, 315
P_K95_NRGB_STR, 316
P_K95_PLATINUM, 316
P_K95_PLATINUM_STR, 316
P_K95_STR, 316
P_M65, 316
P_M65_PRO, 316
P_M65_PRO_STR, 316
P_M65_STR, 316
P_SABRE_L, 316
P_SABRE_L_STR, 316
P_SABRE_N, 316
P_SABRE_N_STR, 317
P_SABRE_O, 317
P_SABRE_O2, 317
P_SABRE_O2_STR, 317
P_SABRE_O_STR, 317
P_SCIMITAR, 317
P_SCIMITAR_PRO, 317
P_SCIMITAR_PRO_STR, 317
P_SCIMITAR_STR, 317
P_STRAFE, 317
P_STRAFE_NRGB, 318
P_STRAFE_NRGB_STR, 318
P_STRAFE_STR, 318
product_str, 339
resetusb, 318
revertusb, 340
setupusb, 341
USB_DELAY_DEFAULT, 318
usb_tryreset, 342
usbkill, 343
usbmain, 344
usbrecv, 318
usbsend, 318
V_CORSAIR, 319
V_CORSAIR_STR, 319
vendor_str, 345
usb_add_device
usb_linux.c, 363
usb_linux.c
_nk95cmd, 349
DEBUG, 348
kbsyspath, 370
models, 370
N_MODELS, 348
os_closeusb, 350
os_inputmain, 350
os_resetusb, 354
os_sendindicators, 355
os_setupusb, 356
os_usbrecv, 357
os_usbsend, 359
strtrim, 360
TEST_RESET, 348
udev, 371
udev_enum, 362
udevthread, 371
usb_add_device, 363
usb_rm_device, 364
usbadd, 365
usbclaim, 367
usbkill, 367
usbmain, 368
usbthread, 371
usbunclaim, 369
usb_rm_device
usb_linux.c, 364
usb_tryreset
usb.c, 305
usb.h, 342
usbadd
usb_linux.c, 365
usbclaim
usb_linux.c, 367
usbdevice, 282
usbid, 272
usbinput, 281
usbkill
usb.h, 343
usb_linux.c, 367
usbmain
usb.h, 344
usb_linux.c, 368
usbmode, 278
usbmutex
usb.c, 307
usbprofile, 279
usbrecv
usb.h, 318
usbsend
usb.h, 318
usbthread
usb_linux.c, 371
usbunclaim
usb_linux.c, 369
ushort
includes.h, 111
utf16to8
profile.c, 250
utf8to16
profile.c, 250

V_CORSAIR
usb.h, 319
V_CORSAIR_STR
usb.h, 319

vendor_str
usb.c, 306
usb.h, 345
vtable_keyboard
device_vtable.c, 68
structures.h, 288
vtable_keyboard_nonrgb
device_vtable.c, 68
structures.h, 288
vtable_mouse
device_vtable.c, 68
structures.h, 288