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; ic_test.asm
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start:
    ldi r16, 0xFF       ; load r16 with all 1s
    out VPORTD_DIR, r16 ; VPORTD - all pins configured as outputs
    ldi r16, 0x0F       ; load r16 with 0000 1111
    out VPORTA_DIR, r16 ; VPORTA - pins 0-3 as outputs, 4-7 as inputs
    ldi r16, 0x00       ; load r16 with all 0s
    out VPORTC_DIR, r16 ; VPORTC - all pins configured as inputs
    cbi VPORTE_DIR, 0   ; set direction for PE0 as input
    sbi VPORTE_DIR, 1   ; set direction for PE1 as output
    cbi VPORTE_DIR, 2   ; set direction for PE2 as input

post:
    ldi r16, 0xC0
    out VPORTD_OUT, r16 ; turn on all working LEDs
    rjmp one_sec_delay
    ldi r16, 0xFF
    out VPORTD_OUT, r16 ; turn all LEDs OFF

again:
    sbi VPORTE_OUT, 1   ; set PE1 to 1 to "unclear" the DFF
    sbic VPORTE_IN, 0   ; skip if PE0 is 0
    rjmp again

; Wait for the pushbutton to send clock signal to DFF and output to PE00
wait_for_push:
    sbis VPORTE_IN, 0   ; skip if PE0 is 1
    rjmp wait_for_push
    ldi r16, 0xDF       ; load r16 with 1101 1111
    out VPORTD_OUT, r16 ; white LED ON, all other LEDs OFF

test_type:
    in r16, VPORTC_IN   ; load switch positions to r16
    andi r16, 0x07      ; mask for relevant info
    cpi r16, 0x00       ; is it NAND / 74HC00
    breq test_nand
    cpi r16, 0x01       ; is it AND / 74HC08
    breq long_jump_and
    cpi r16, 0x02       ; is it OR / 74HC32
    breq long_jump_or
    cpi r16, 0x03       ; is it XOR / 74HC86
    breq long_jump_xor

test_ls_nand:           ; test 74LS03, default
    ldi r18, 0x08       ; load r18 with 0000 1000
                        ; enable pull-up resistors
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```
53      sts PORTA_PIN4CTRL, r18
54      sts PORTA_PIN5CTRL, r18
55      sts PORTA_PIN6CTRL, r18
56      sts PORTA_PIN7CTRL, r18
57
58      ldi r17, 0x00       ; load r17 with all 0s
59      out VPORTA_OUT, r17 ; send inputs AB = 00 to device
60      nop
61      nop
62      in r17, VPORTA_IN   ; read VPORTA
63      andi r17, 0xF0      ; mask for PA4 - PA7
64      cpi r17, 0xF0       ; check if device outputs 1s
65      brne test_fail_jump
66
67      ldi r17, 0x04       ; load r17 with 0000 0100
68      out VPORTA_OUT, r17 ; send inputs AB = 01 to device
69      nop
70      nop
71      in r17, VPORTA_IN   ; read VPORTA
72      andi r17, 0xF0      ; mask for PA4 - PA7
73      cpi r17, 0xF0       ; check if device outputs 1s
74      brne test_fail_jump
75
76      ldi r17, 0x08       ; load r17 with 0000 1000
77      out VPORTA_OUT, r17 ; send inputs AB = 10 to device
78      nop
79      nop
80      in r17, VPORTA_IN   ; read VPORTA
81      andi r17, 0xF0      ; mask for PA4 - PA7
82      cpi r17, 0xF0       ; check if device outputs 1s
83      brne test_fail_jump
84
85      ldi r17, 0x0C       ; load r17 with 0000 1100
86      out VPORTA_OUT, r17 ; send inputs AB = 11 to device
87      nop
88      nop
89      in r17, VPORTA_IN   ; read VPORTA
90      andi r17, 0xF0      ; mask for PA4 - PA7
91      cpi r17, 0x00       ; check if device outputs 0s
92      brne test_fail_jump
93
94      rjmp test_pass
95
96  long_jump_and:
97      rjmp test_and
98
99  long_jump_or:
100     rjmp test_or
101
102 long_jump_xor:
103     rjmp test_xor
104
```

```
105 test_nand:              ; test 74HC00
106     ldi r17, 0x00       ; load r17 with all 0s
107     out VPORTA_OUT, r17 ; send inputs AB = 00 to device
108     nop
109     nop
110     in r17, VPORTA_IN   ; read VPORTA
111     andi r17, 0xF0      ; mask for PA4 - PA7
112     cpi r17, 0xF0       ; check if device outputs 1s
113     brne test_fail_jump
114
115     ldi r17, 0x04       ; load r17 with 0000 0100
116     out VPORTA_OUT, r17 ; send inputs AB = 01 to device
117     nop
118     nop
119     in r17, VPORTA_IN   ; read VPORTA
120     andi r17, 0xF0      ; mask for PA4 - PA7
121     cpi r17, 0xF0       ; check if device outputs 1s
122     brne test_fail_jump
123
124     ldi r17, 0x08       ; load r17 with 0000 1000
125     out VPORTA_OUT, r17 ; send inputs AB = 10 to device
126     nop
127     nop
128     in r17, VPORTA_IN   ; read VPORTA
129     andi r17, 0xF0      ; mask for PA4 - PA7
130     cpi r17, 0xF0       ; check if device outputs 1s
131     brne test_fail_jump
132
133     ldi r17, 0x0C       ; load r17 with 0000 1100
134     out VPORTA_OUT, r17 ; send inputs AB = 11 to device
135     nop
136     nop
137     in r17, VPORTA_IN   ; read VPORTA
138     andi r17, 0xF0      ; mask for PA4 - PA7
139     cpi r17, 0x00       ; check if device outputs 0s
140     brne test_fail_jump
141
142     rjmp test_pass
143
144 test_fail_jump:
145     rjmp test_fail
146
147 test_and:
148     ldi r17, 0x00       ; load r17 with all 0s
149     out VPORTA_OUT, r17 ; send inputs AB = 00 to device
150     nop
151     nop
152     in r17, VPORTA_IN   ; read VPORTA
153     andi r17, 0xF0      ; mask for PA4 - PA7
154     cpi r17, 0x00       ; check if device outputs 0s
155     brne test_fail_jump
156
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```
157      ldi r17, 0x04       ; load r17 with 0000 0100
158      out VPORTA_OUT, r17 ; send inputs AB = 01 to device
159      nop
160      nop
161      in r17, VPORTA_IN   ; read VPORTA
162      andi r17, 0xF0      ; mask for PA4 - PA7
163      cpi r17, 0x00       ; check if device outputs 0s
164      brne test_fail_jump
165
166      ldi r17, 0x08       ; load r17 with 0000 1000
167      out VPORTA_OUT, r17 ; send inputs AB = 10 to device
168      nop
169      nop
170      in r17, VPORTA_IN   ; read VPORTA
171      andi r17, 0xF0      ; mask for PA4 - PA7
172      cpi r17, 0x00       ; check if device outputs 0s
173      brne test_fail_jump
174
175      ldi r17, 0x0C       ; load r17 with 0000 1100
176      out VPORTA_OUT, r17 ; send inputs AB = 11 to device
177      nop
178      nop
179      in r17, VPORTA_IN   ; read VPORTA
180      andi r17, 0xF0      ; mask for PA4 - PA7
181      cpi r17, 0xF0       ; check if device outputs 1s
182      brne test_fail_jump
183
184      rjmp test_pass
185
186  test_or:
187      ldi r17, 0x00       ; load r17 with all 0s
188      out VPORTA_OUT, r17 ; send inputs AB = 00 to device
189      nop
190      nop
191      in r17, VPORTA_IN   ; read VPORTA
192      andi r17, 0xF0      ; mask for PA4 - PA7
193      cpi r17, 0x00       ; check if device outputs 0s
194      brne test_fail
195
196      ldi r17, 0x04       ; load r17 with 0000 0100
197      out VPORTA_OUT, r17 ; send inputs AB = 01 to device
198      nop
199      nop
200      in r17, VPORTA_IN   ; read VPORTA
201      andi r17, 0xF0      ; mask for PA4 - PA7
202      cpi r17, 0xF0       ; check if device outputs 1s
203      brne test_fail
204
205      ldi r17, 0x08       ; load r17 with 0000 1000
206      out VPORTA_OUT, r17 ; send inputs AB = 10 to device
207      nop
208      nop
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```
209      in r17, VPORTA_IN   ; read VPORTA
210      andi r17, 0xF0      ; mask for PA4 - PA7
211      cpi r17, 0xF0       ; check if device outputs 1s
212      brne test_fail
213
214      ldi r17, 0x0C       ; load r17 with 0000 1100
215      out VPORTA_OUT, r17 ; send inputs AB = 11 to device
216      nop
217      nop
218      in r17, VPORTA_IN   ; read VPORTA
219      andi r17, 0xF0      ; mask for PA4 - PA7
220      cpi r17, 0xF0       ; check if device outputs 1s
221      brne test_fail
222
223      rjmp test_pass
224
225  test_xor:
226      ldi r17, 0x00       ; load r17 with all 0s
227      out VPORTA_OUT, r17 ; send inputs AB = 00 to device
228      nop
229      nop
230      in r17, VPORTA_IN   ; read VPORTA
231      andi r17, 0xF0      ; mask for PA4 - PA7
232      cpi r17, 0x00       ; check if device outputs 0s
233      brne test_fail
234
235      ldi r17, 0x04       ; load r17 with 0000 0100
236      out VPORTA_OUT, r17 ; send inputs AB = 01 to device
237      nop
238      nop
239      in r17, VPORTA_IN   ; read VPORTA
240      andi r17, 0xF0      ; mask for PA4 - PA7
241      cpi r17, 0xF0       ; check if device outputs 1s
242      brne test_fail
243
244      ldi r17, 0x08       ; load r17 with 0000 1000
245      out VPORTA_OUT, r17 ; send inputs AB = 10 to device
246      nop
247      nop
248      in r17, VPORTA_IN   ; read VPORTA
249      andi r17, 0xF0      ; mask for PA4 - PA7
250      cpi r17, 0xF0       ; check if device outputs 1s
251      brne test_fail
252
253      ldi r17, 0x0C       ; load r17 with 0000 1100
254      out VPORTA_OUT, r17 ; send inputs AB = 11 to device
255      nop
256      nop
257      in r17, VPORTA_IN   ; read VPORTA
258      andi r17, 0xF0      ; mask for PA4 - PA7
259      cpi r17, 0x00       ; check if device outputs 0s
260      brne test_fail
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261
262     rjmp test_pass
263
264 test_fail:
265     ldi r16, 0xEF       ; mask for red LED
266     out VPORTD_OUT, r16 ; red LED ON, all other LEDs OFF
267     rjmp clear_and_reset
268
269 test_pass:
270     ldi r18, 0x08
271     or r16, r18         ; bitwise add r16 and 0000 1000 for green LED
272     com r16
273     out VPORTD_OUT, r16 ; white and red LEDs OFF, green LED ON and bargraph
274
275 clear_and_reset:
276     ldi r18, 0x00       ; load r18 with all 0s
277                         ; disable pull-up resistors
278     sts PORTA_PIN4CTRL, r18
279     sts PORTA_PIN5CTRL, r18
280     sts PORTA_PIN6CTRL, r18
281     sts PORTA_PIN7CTRL, r18
282     cbi VPORTE_OUT, 1   ; clear the DFF
283
284 wait_for_release:       ; debounce release of pushbutton
285     sbic VPORTE_IN, 2   ; skip if PE2 is 0
286     rjmp wait_for_release
287     rcall var_delay
288     sbic VPORTE_IN, 2   ; skip if PE2 is 0
289     rjmp wait_for_release
290     rjmp again
291
292 ; Delay r18 * 0.100475 ms
293 var_delay:
294     ldi r18, 0xFF       ; for delay of ~25.6ms
295     var_outer_loop:
296         ldi r17, 133
297     var_inner_loop:
298         dec r17
299         brne var_inner_loop
300         dec r18
301         brne var_outer_loop
302     ret ; return to caller
303
304 ; 1.00008575 seconds @ 4 MHz system clock, 192 us resolution
305 one_sec_delay:
306     ldi r30, LOW(5202)  ;outer loop 16- bit iteration count
307     ldi r31, HIGH(5202) ;16-bit value in r31:r30
308     outer_loop:
309         ldi r18, $FF        ;inner loop 8-bit iteration count
310     inner_loop:
311         dec r18             ;subtract 1 from inner loop count
312         brne inner_loop
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313          sbiw r31:r30, 1     ;subtract 1 from outer loop count
314          brne outer_loop
315      ret
```