OLED Panel

- I²C slave operating at 100kHz or 400kHz

- Reports input events in an event FIFO

- Rotary encoder quadrature decode

- Button press debounce

- LED PWM brightness control

- Piezo sounder tone generation

- 4 GPIO lines capable of output or input, including change reporting

Basic Operation

The control chip on an OLED Panel Module is a self-contained microcontroller accessible as an I²C slave. This chip handles operation of the rotary encoder and push-buttons, LEDs, piezo sounder, and GPIO header on the board.

The chip responds to wheel rotation and press events, and can autonomously drive the piezo sounder to make a beep sound when these occur, independently of the host MCU.

An 8-level FIFO of events is maintained, which reports input events on the rotary encoder or changes in state of the GPIO lines. Whenever this FIFO is non-empty, the INT output line is pulled low. When the FIFO is emptied, the INT line is returned to hi-Z state.

I²C Operation

The control chip is accessed via a standard I²C bus, which can operate at 100kHz or 400kHz. The 1MHz "fast mode" is not supported. The default slave address is 0x3D (0x7A write, 0x7B read).
The chip makes use of SCL clock stretching to insert delays on the bus when it requires extra time to respond, so needs a bus master that can accept this. If any bus isolation or multiplexing is used, that too will need to support SCL clock stretching by slaves.

The chip operates as a simple register-based slave, containing a set of individually-numbered registers. Each register may be read or written to (though some registers are notionally read-only, and attempts to write will be ignored).

Register Writes

Registers may be written to in a single WRITE transaction, consisting of a START condition, slave-addressing byte, register address, value, and STOP condition.

START	Slave (W)	ACK	Addr	ACK	Value	ACK	STOP
	Master sends the slave writing address; 0x7A		Master sends a register number - see the section below		Master sends the new value for the register		

Register Reads

Registers may be read from in a single WRITE-then-READ transaction, consisting of a START, slave-addressing byte, register address, repeated START, another slave-addressing byte, reading the value, STOP.

START	Slave (W)	ACK	Addr	ACK	RE-START	Slave (R)	ACK	Value	ACK	STOP
	Master sends the slave writing address; 0x7A		Master sends a register number - see the section below			Master sends the slave reading address; 0x7B		Slave sends the current value of the register		

Detailed Register List

EVENT

Address: 0x01

Direction: R

Default value: 0x00

Implements an 8-level deep FIFO of input events. Each event is formed of a single byte. The top three bits of the event classify it into a category, the remaining bits are specific to that category.

0b000xxxxx	**No event** 0b00000000 / 0x00
0b001xxxxx	**Wheel rotation:** lower bits give the wheel direction 0b001xxx01 / 0x21 - wheel downwards (anticlockwise) 0b001xxx10 / 0x22 - wheel upwards (clockwise) next three bits identify increments (when 'encoder acceleration' option is enabled) 0b001000xx / 0x20 to 0b001111xx / 0x3C – 1 to 8 increments
0b010xxxxx	**Button:** lowest bit gives the button press/release state 0b010xxx00 / 0x40 - button release 0b010xxx01 / 0x41 - button press 0b010xxx10 / 0x42 - button held next three bits identify the button 0b010000xx / 0x40 - wheel button 0b010001xx / 0x44 - main button 0b010010xx / 0x48 - left soft button 0b010011xx / 0x4C - right soft button
0b011xxxxx	**GPIO state change:** lower 4 bits give the GPIO line state at the time the event occurred 0b01100000 / 0x60 to 0b00101111 / 0x6F - GPIO state captured

When an input event occurs, the INT line will be pulled low. Reading from this register will clear the event from the queue, causing the next to appear. If there are no more events waiting, the register will read as zero and the INT line will be returned to high impedance state.

RELEASEMASK

Address: 0x02

Direction: R/W

Default value: 0x00

Controls whether buttons will send event reports on release as well as press (bits set to 1), or on press only (bits set to 0).

`0b.......x`	Ignored
`0b......x.`	Wheel button
`0b.....x..`	Main button
`0b....x...`	Left soft button
`0b...x....`	Right soft button

DEBOUNCE_TIME

Address: 0x03

Direction: R/W

Default value: 0x14 / 20

Gives the duration in milliseconds for key debounce detection.

BTNHOLD_TIME

Address: 0x04

Direction: R/W

Default value: 0x4b / 75

Gives the duration in centiseconds for reporting a "button held" event.

KEYBEEP_DURATION

Address: 0x10

Direction: R/W

Default value: 0x0A / 10

Gives the duration in centiseconds for an autonomous keybeep.

KEYBEEP_MASK

Address: 0x11

Direction: R/W

Default value: 0x00

Controls which button events cause an autonomous keybeep.

`0b.......x`	Wheel rotation
`0b......x.`	Wheel button
`0b.....x..`	Main button
`0b....x...`	Left soft button
`0b...x....`	Right soft button

BEEP_DURATION

Address: 0x12

Direction: R/W

Default value: 0x00

Writing a non-zero value into this register will immediately cause a beep of the given duration, in centiseconds. Reading the value will give a current countdown of the remaining time for the ongoing beep.

BEEP_TONE

Address: 0x13

Direction: R/W

Default value: 0xC8 / 200

Sets the frequency of the beep tone, in units of 10Hz. The default value of 200 sets a tone of 2kHz, which is ideal for the piezo sounder being used. Note that altering this value will also change the tone used by the autonomous keybeep.

BEEP_FREQ

Address: 0x14-0x15

Direction: R/W

Default value: 0x07D0 / 2000

A 16bit big-endian alternative to the BEEP_TONE register, which sets the frequency of the beep tone, in units of 1Hz. The default value of 2000 sets a tone of 2kHz, which is ideal for the piezo sounder being used. Note that altering this value will also change the tone used by the autonomous keybeep.

LED1_PWM

Address: 0x20

Direction: R/W

Default value: 0x00

Sets the brightness of LED1, which is connected to the red LED in the main button. The default value of 0 is off, and 255 is full brightness. Values in-between will be pulse-width modulated at a frequency of around 4kHz.

LED2_PWM

Address: 0x21

Direction: R/W

Default value: 0x00

Sets the brightness of LED2, which is connected to the green LED in the main button. The default value of 0 is off, and 255 is full brightness. Values in-between will be pulse-width modulated at a frequency of around 4kHz.

GPIO_DIR

Address: 0x30

Direction: R/W

Default value: 0x00

Sets the drive direction on each of the GPIO lines. Bits set low (0) are inputs; set high (1) are outputs. The lower four bits are used; the upper four are ignored.

GPIO_IO

Address: 0x31

Direction: R/W

Default value: 0x00

Writes to this register set the output state for any GPIO lines currently set as outputs. The state of pins set as inputs is ignored. The lower four bits are used; the upper four are ignored.

Reads from this register return the current state of all four GPIO lines, regardless of drive state.

GPIO_PULLUP

Address: 0x32

Direction: R/W

Default value: 0x00

Enables pullup resistors on any of the GPIO lines with bits set high (1). This pullup is about 50kohm; sufficient to hold a high state around a button or similar input. The lower four bits are used; the upper four are ignored.

GPIO_EVENTMASK

Address: 0x33

Direction: R/W

Default value: 0x00

Sets a mask used for level change event detection on the GPIO lines. A change of state on any lines which are set as inputs and have the mask bit high (1) will be reported as a GPIO event into the event FIFO. This event will capture the current value of all four lines at the time the level changed.

SWVERSION

Address: 0xF0

Direction: R

Default value: 0x02 / 2

Reports the driver software version.

EEPROM STORED PARAMETERS (active after next reset)

I2CADDRESS

Address: 0xC0

Direction: R/W

Default value: 0x3D / 61

Set the i2c address used to communicate with the panel

OPTIONS

Address: 0xC1

Direction: R/W

Default value: 0x00 / 0

`0b.......x`	Enable encoder acceleration
`0bx.......`	Reverse encoder direction

DEBOUNCE_TIME

Address: 0xC2

Direction: R/W

Default value: 0x14 / 20

Gives the duration in milliseconds for key debounce detection.

BTNHOLD_TIME

Address: 0xC3

Direction: R/W

Default value: 0x4b / 75

Gives the duration in centiseconds for reporting a "button held" event.

REMAP_MASK

Address: 0xC4

Direction: R/W

Default value: 0x00 / 0

Redirect buttons status to GPIO pins

0b.......x	Wheel button on GPIO0
0b......x.	Main button on GPIO1
0b.....x..	Left soft button on GPIO2
0b....x...	Right soft button on GPIO3

REMAP_POLARITY

Address: 0xC5

Direction: R/W

Default value: 0x00 / 0

Change polarity for redirected keys

ENCODER_ACC

Address: 0xC6

Direction: R/W

Default value: 0x19 / 25

Increment factor for wheel steps

ENCODER_DEC

Address: 0xC7

Direction: R/W

Default value: 0x02 / 2

Decrement factor for wheel steps