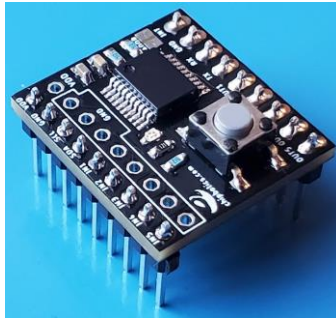# Chipbotics ButtonBoard Datasheet

Button processor and I/O expander

Description

ButtonBoard provides button debouncing and recognition of common gestures such as double-press and long-press for up to five buttons. Each button can function as a switch that toggles an output pin upon detection of a gesture. The device communicates as I2C slave or via serial UART and is highly configurable. The configuration is stored in flash.

The board has an LED that can be assigned to any of the switch outputs or can be digitally controlled. An onboard button allows for easy testing. By default the onboard button and LED are both assigned to the first channel. By default each of the switch outputs is configured to toggle on one of five common gestures, so the board can be used via pin inputs/outputs out of the box (See *I2C Register Defaults*).

The board can be used as an I/O expander by digitally reading input pins and overriding output pins. Channels configured for button processing can take their input from either an input pin or be digitally overridden.
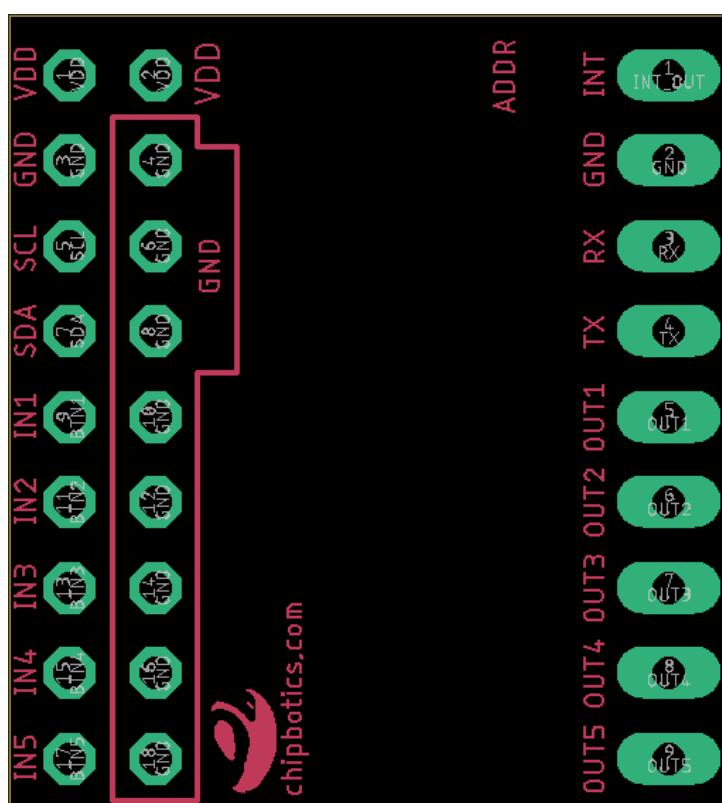
Features

- 5x Button processing
- I/O expander mode (up to 5x inputs + 5x outputs)
- I2C slave (address configurable, default 0x34) and UART interfaces
- Toggle switch output for each button (switch mode configurable)
- Detects single, multiple, and long press and release events
- Interrupt output pin on event
- Buffered button events (minimum 10)
- Configurable debounce and event times
- Configured for common button gestures out-of-the-box
- Configuration stored in flash
- Onboard button
- Onboard LED (configurable)
- Up to 5x weak pull-ups, 1x strong pull-up, 1x strong pull-down
- 2.8V – 5.5V Power (VDD), I/O pins max VDD
- Fits on breadboard (with 2x single row headers)

Contents

Physical Connections

Name	Interface	Function
VDD (2.8V-5.5V)	Power	Digital Power
GND	Power	Digital Ground
I2C SCL	I2C	I2C Clock
I2C SDA	I2C	I2C Data
Btn1 IN	Input	Button 1 Input (also onboard button)
Btn2 IN	Input	Button 2 Input
Btn3 IN	Input	Button 3 Input
Btn4 IN	Input	Button 4 Input
Btn5 IN	Input	Button 5 Input
INT	Output	Event Interrupt
GND	Power	Digital Ground
RX	Input	UART Receive
TX	Output	UART Transmit
Output 1	Output	Output Port 1
Output 2	Output	Output Port 2
Output 3	Output	Output Port 3
Output 4	Output	Output Port 4
Output 5	Output	Output Port 5
ADDR	Input	I2C Address Selector (solder link)

Protocol

I2C Interface

To write a register, use the following sequence:

[START][I2C ADDR][REGISTER][WRITE DATA BYTES][STOP]

Less than the full register size may be written.

To read a register, use the following sequence:

[START][I2C ADDR][REGISTER][RESTART][READ DATA BYTES][STOP]

The INT pin will be set high if a button event has occurred and cleared when the <Button Events> register is read.

I2C Registers

Register	Name	Type	Bytes	Format
0x00	Firmware Version	R	1	[U8 Firmware Version]
0x01	Switch Mode	R/W	5	5x [U8 Switch Mode]
0x02	Switch Multi Mode	R/W	5	5x [U8 Switch Multi Mode]
0x03	Switch Multi Count	R/W	5	5x [U8 Switch Multi Count]
0x04	Switch Initial State	R/W	5	5x [U8 Switch Initial State]
0x05	Button Input Config	R/W	5	5x [U8 Button Input Config]
0x06	Output Port Config	R/W	5	5x [U8 Output Port Config]
0x07	Input Pin Pull	R/W	5	5x [U8 Input Pin Pull]
0x08	LED Config	R/W	1	[U8 LED Config]
0x09	Button Events	R	10	5x ([U8 Button Event][U8 Button Presses])
0x0A	Button Debounce (ms)	R/W	5	5x [U8 Button Debounce (ms)]
0x0B	Button Multi Timeout (ms)	R/W	10	5x [U16 Button Multi Timeout (ms)]
0x0C	Button Hold Timeout (ms)	R/W	10	5x [U16 Button Hold Timeout (ms)]
0x0D	Command	R/W	1	[U8 Command]
0x0E	Port Values	R	4	[U8 Input Pins][U8 Button Inputs] [U8 Switch Outputs][U8 Output Pins]
0x0F	UART Config	R/W	1	[U8 UART Config]
0x10	I2C Addresses	R/W	3	[U8 I2C Address 1 (Open)][U8 I2C Address 2 (Closed)] [U8 I2C Address Override]
0x11	Current I2C Address	R	1	[U8 Current I2C Address]

I2C Register Data Types

Data Type	Format
Firmware Version	Byte 0-255
Switch Mode	00 – Disabled 01 – Capture (switch output equals input) 02 – Pressed (switch toggled on button press) 03 – Released (switch toggled on button release) 04 – Short Released (switch toggled if button released before multi-press timeout) 05 – Multi Pressed (switch toggled if button held longer than multi-press timeout) 06 – Multi Released (switch toggled if button released after multi-press timeout) 07 – Hold (switch toggled if button held longer than hold timeout) 08 – Hold Released (switch toggled if button released after hold timeout)
Switch Multi Mode	(Subject to *Switch Mode* and *Switch Multi Count*) 00 – Threshold (switch toggled each time after *Switch Multi Count* button presses) 01 – Match (switch toggled only upon exactly *Switch Multi Count* button presses)
Switch Multi Count	(Subject to *Switch Mode* and *Switch Multi Mode*) Number of presses before switch is toggled Byte 0-255
Switch Initial State	Switch state when initialised or 'apply config' command is executed. 00 – Unchanged (switch state is left as it is) 01 – On (switch state is set to on) 02 – Off (switch state is set to off) 03 – Capture (switch state is captured from button input)
Button Input Config	Configures the input to each button 0x00 – Button input captured from associated input pin 0x08 – Button input captured from associated input pin, but inverted 0x10 – Button input override, set to low 0x11 – Button input override, set to high
Output Port Config	Configures the output port pins 0x00 – Switch 1 Output 0x01 – Switch 2 Output 0x02 – Switch 3 Output 0x03 – Switch 4 Output 0x04 – Switch 5 Output 0x08 – Switch 1 Output inverted 0x09 – Switch 2 Output inverted 0x0A – Switch 3 Output inverted 0x0B – Switch 4 Output inverted 0x0C – Switch 5 Output inverted 0x10 – Output override, set to low 0x11 – Output override, set to high
Input Pin Pull	Configures pin pull-up or pull-down for input pins 0x00 – Disabled 0x01 – Weak pull-up 0x02 – Strong pull-up (only supported on Output 1) 0x03 – Strong pull-down (only supported on Output 1)

Data Type	Format
LED Config	Configures the LED drive 0x00 – Switch 1 Output 0x01 – Switch 2 Output 0x02 – Switch 3 Output 0x03 – Switch 4 Output 0x04 – Switch 5 Output 0x08 – Switch 1 Output inverted 0x09 – Switch 2 Output inverted 0x0A – Switch 3 Output inverted 0x0B – Switch 4 Output inverted 0x0C – Switch 5 Output inverted 0x10 – LED override, set to OFF 0x11 – LED override, set to ON
Button Event	Button event bit masks 0x01 – Button Pressed 0x02 – Button Released 0x04 – Button Hold 0x08 – Button Hold Released 0x10 – Button Multi Press Timeout 0x20 – Button State at Multi Press Timeout 0x80 – Current Button State
Button Presses	Number of times button has been pressed before *Multi Press Timeout* occurred Byte 0-255
Button Debounce (ms)	Button debounce time in milliseconds Byte 0-255
Button Multi Timeout (ms)	Time before a multi-press event is registered
Button Hold Timeout (ms)	Time before a hold event is registered
Command	Execute Command 0x00 – Indicates idle state / command executed 0x01 – Apply Config 0x02 – Save Config 0x03 – Load Config 0x04 – Load Config Defaults 0x05 – Soft Reset *Apply Config* applies current configuration by re-initializing buttons, pin pulls and I2C address. This must be used for any of these settings to take effect.
Input Pins Button Inputs Switch Outputs Output Pins	These four bytes all have the same format. Bits 0-4 indicate the state of pin/input/output • Input Pins contains the state of the physical input pins. • Button Inputs contains the state of the inputs to the button engine. • Switch Outputs contains the state of the switch outputs from the button engine. • Output Pins contains the state of the physical output pins.
UART Config	UART configuration bit masks 0x01 – Human-readable output enabled 0x02 – ASCII HEX output enabled
I2C Address 1 (Open)	Contains the I2C address used when the solder link is open and *I2C Address Override* is zero (default)
I2C Address 2 (Closed)	Contains the I2C address used when the solder link is closed and *I2C Address Override* is zero (default)

Data Type	Format
I2C Address Override	Contains I2C address used when this is non-zero
Current I2C Address	Currently active I2C address

I2C Register Defaults

Register	Name	Defaults
0	Firmware Version	N/A
1	Switch Mode	0x02 – Pressed 0x01 – Capture 0x03 – Released 0x03 – Released 0x07 – Hold
2	Switch Multi Mode	0x00 – Threshold 0x00 – Threshold 0x00 – Threshold 0x01 – Match 0x00 – Threshold
3	Switch Initial State	0x02 – Off 0x03 – Capture 0x02 – Off 0x02 – Off 0x02 – Off
4	Switch Multi Count	0x00 – 0 Presses 0x00 – 0 Presses 0x01 – 1 Press 0x02 – 2 Presses 0x00 – 0 Presses
5	Button Input Config	0x08 – Input Invert 0x08 – Input Invert 0x08 – Input Invert 0x08 – Input Invert 0x08 – Input Invert
6	Output Port Config	0x00 – Output Pin 1 0x01 – Output Pin 2 0x02 – Output Pin 3 0x03 – Output Pin 4 0x04 – Output Pin 5
7	Input Pin Pull	0x02 – Strong Pull Up 0x01 – Weak Pull Up 0x01 – Weak Pull Up 0x01 – Weak Pull Up 0x01 – Weak Pull Up
8	LED Config	0x00 – Switch 0 Output
9	Button Events	N/A
10	Button Debounce (ms)	0x32 – 50ms 0x32 – 50ms 0x32 – 50ms 0x32 – 50ms 0x32 – 50ms
11	Button Multi Timeout (ms)	0x012C – 300ms 0x012C – 300ms 0x012C – 300ms 0x012C – 300ms 0x012C – 300ms

Register	Name	Defaults
12	Button Hold Timeout (ms)	0x03E8 – 1000ms
		0x03E8 – 1000ms
		0x03E8 – 1000ms
		0x03E8 – 1000ms
		0x03E8 – 1000ms
13	Command	0x00 – Idle
14	Port Values	N/A
15	UART Config	0x03 – TEXT + HEX
16	I2C Addresses	0x34 – I2C Address (Open) = 0x34
		0x35 – I2C Address (Closed) = 0x35
		0x00 – I2C Address Override = 0x00
17	Current I2C Address	I2C Address (Open) = 0x34

UART Interface

- The UART interface uses 115200 baud, 8-bit data, 1-bit start/stop, no parity.
- Every command to ButtonBoard must be terminated by a carriage return character (ASCII 13, '\r'). Line feeds are ignored.
- Every response from ButtonBoard is followed by a carriage return and line feed ("\r\n").
- Every command to ButtonBoard is acknowledged by either '#OK', '#FAIL' or '#R…'.
- Two event output ASCII formats are available, human-readable strings or ASCII HEX formatted strings. Each can be enabled using the *UART Config* register.
- ASCII HEX responses from ButtonBoard always start with a hash character ('#'). Human-readable strings will never start with a hash character.

UART Commands

Command	Description	Response
RXX	Read I2C Register XX=register number as 2x HEX digits. Example: 'R0E' to read port values.	#RXXYY[YY] XX=register number as 2x HEX digits. YY=register contents as 2x HEX digits per byte. Example: '#R0E1F000000'
WXXYY[YY]	Write I2C Register XX=register number as 2x HEX digits. YY=register contents as 2x HEX digits per byte. Example: 'W0A323C' to set button 1 and 2 debounce time to 50ms and 60ms.	#OK
CA	Apply Config	#OK
CS	Save Config to Flash	#OK
CL	Load Config from flash to memory	#OK
CD	Load Default Config to memory	#OK
CR	Soft Reset	#OK

UART HEX Responses

Response	Description
#EIIVVPPNNBBSSOO	Button Event, always starts with '#E'. Printed automatically when a button event occurs and HEX mode is enabled. See *I2C Register Data Types* for details. II=Button Index as 2x HEX digits (00-04). VV=Events Bits as 2x HEX digits. PP=Number of Presses as 2x HEX digits. NN=Input Port bits as 2x HEX digits. BB=Button Input bits as 2x HEX digits. SS=Switch Output bits as 2x HEX digits. OO=Output Port bits as 2x HEX digits.
#RXXYY[YY]	See *Read I2C Register* command.

#OK	Command executed successfully.
#FAIL	Command failed.

UART Human-Readable Responses

If enabled, button events are printed in a human-readable format, along with switch state. See *UART Config*.

Example: '`Btn0 Pressed 3 Switch 1`'
where 'Btn0' indicates which button was pressed, '3' indicates that the button has been pressed three times and '1' indicates that the switch output is currently high.