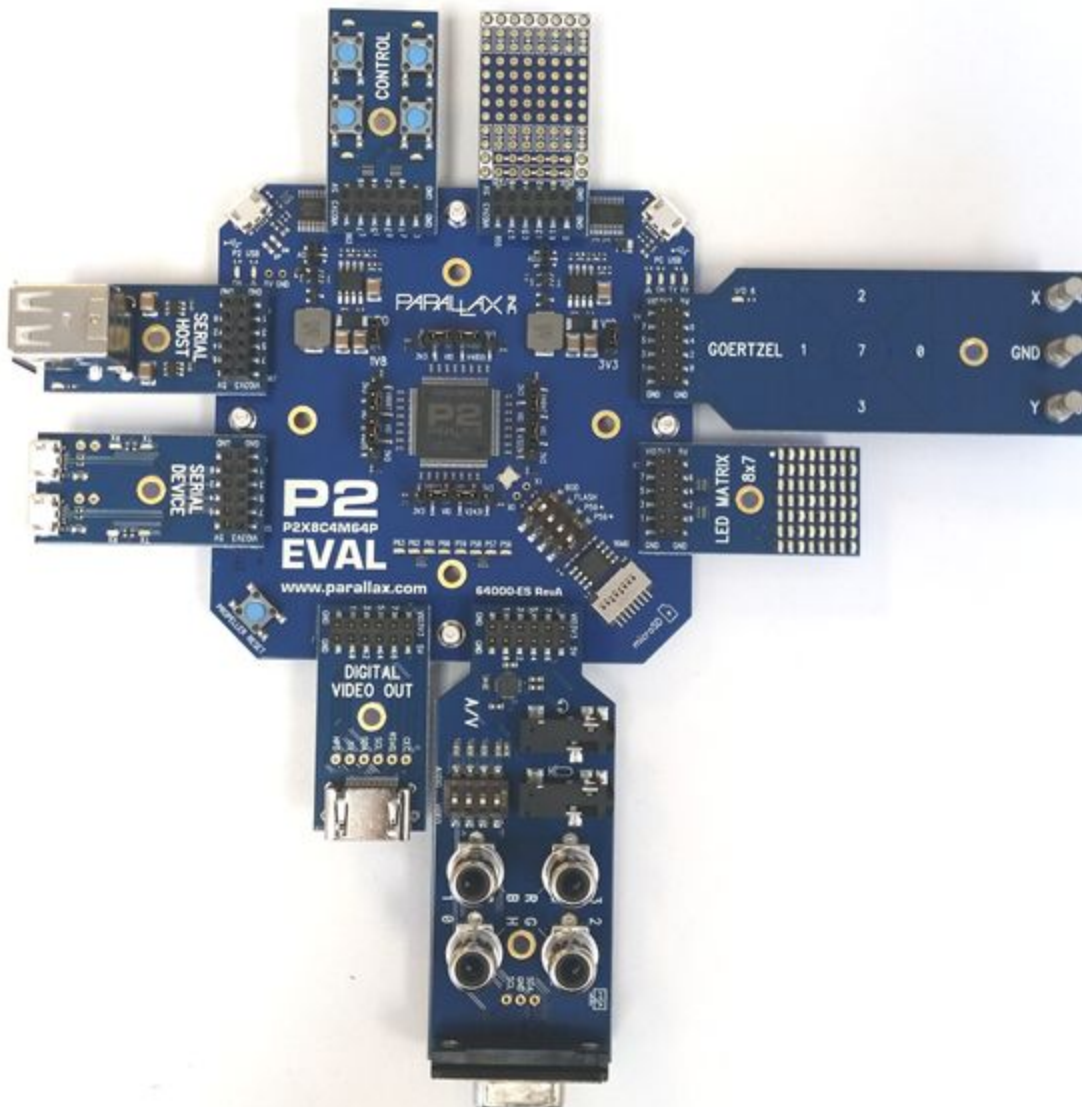# P2-ES Accessory Set (#64006-ES)

This limited edition accessory set is designed specifically for use with the also-limited edition P2-ES Eval Board (#64000-ES). Each accessory board features a 2x6 pass-through socket that stacks on top of a P2-ES Eval Board I/O Pin Breakout Edge Header. All eight boards can be connected at the same time, making it very convenient to fully explore the capabilities of the Propeller 2 multicore microcontroller (engineering sample.)
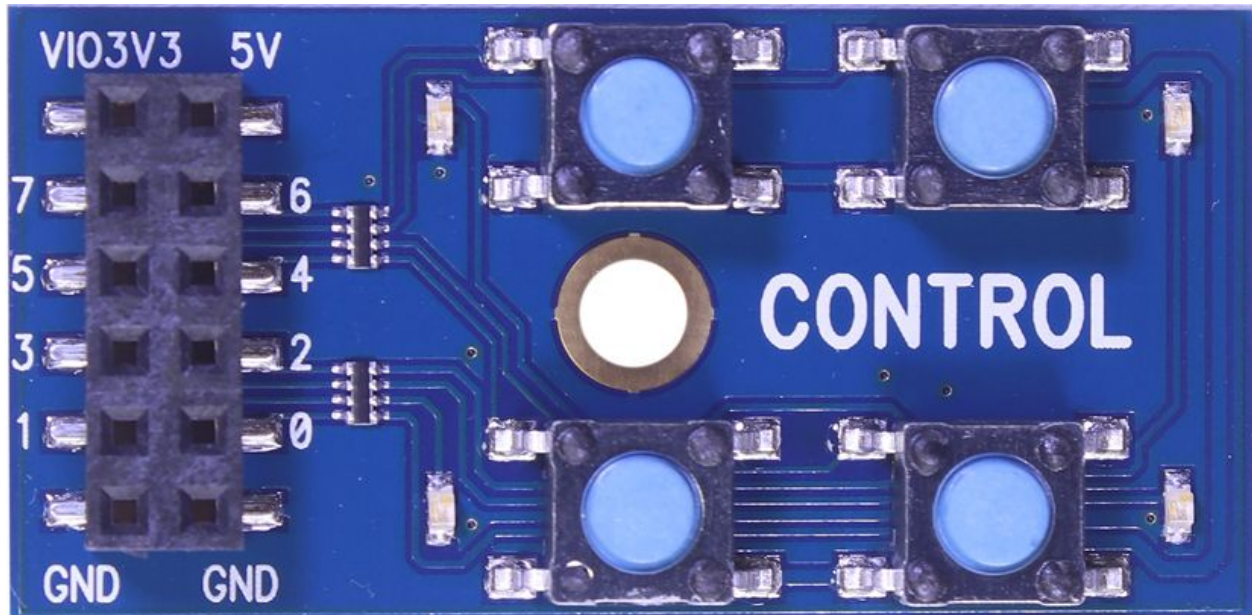
Accessory Boards Included

    (a) Control
    (b) Serial Host
    (c) LED Matrix
    (d) Digital Video Out
    (e) Mini Prototyping
    (f) Serial Device
    (g) Goertzel
    (h) AV Breakout

Except for the Mini-Prototyping board, each accessory board has a mounting hole which is connected to GND, and is suitable for M3 (UNC 4- 40) hardware. The hole is 3.2 mm (126 mil) and the pad ring is 5 mm (200 mil). This could be used to fit a 9.5 mm long standoff to act as a leg, and provide support when connected to the P2-EVAL board (#64000-ES).

The modules come in three sizes; refer to the PCB Dimensions drawing for details. Two small modules, or one large and one small module, can fit side-by-side on each edge of the P2-EVAL Board.

Note: It is strongly recommended to connect the auxiliary power supply to the P2-EVAL board P2-USB socket when experimenting with the accessory boards, as power requirements may exceed what is available from the PC-USB socket.
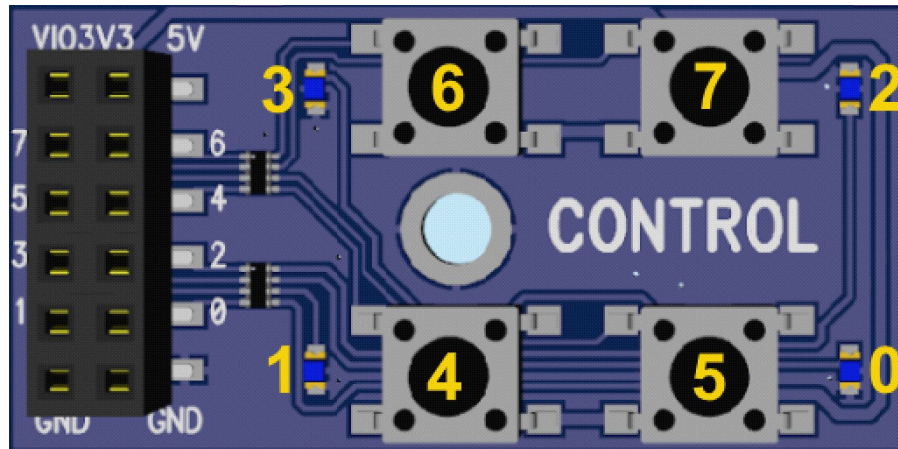
(a) Control

The Control accessory board includes four push-buttons and four blue LEDs.
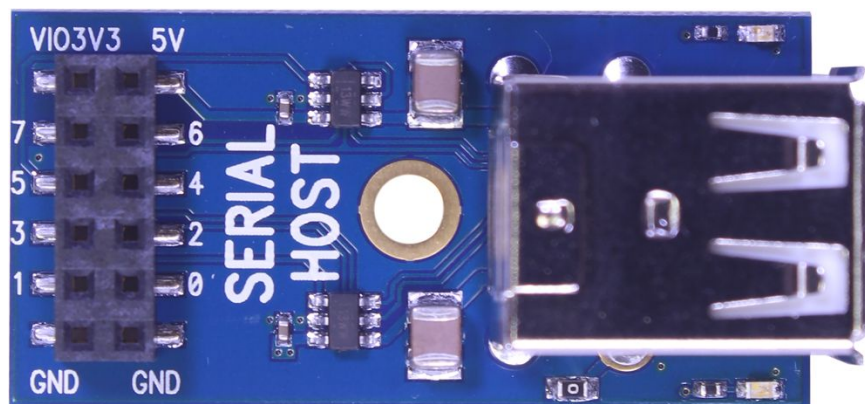
The push-buttons allow simple digital input control of other circuits or processes. Each active-high push-button has a 470 Ω series resistor to allow the I/O pin to be driven low while the button is asserted.

The LEDs are active-high and positioned next to each button. Each LED is controlled by its own independent I/O pin for flexibility.

I/O Pin	Function
0	Blue LED with 470 Ω series resistor. Assert high to light. Use PWM for brightness control.
1	Blue LED with 470 Ω series resistor. Assert high to light. Use PWM for brightness control.
2	Blue LED with 470 Ω series resistor. Assert high to light. Use PWM for brightness control.
3	Blue LED with 470 Ω series resistor. Assert high to light. Use PWM for brightness control.
4	Tactile push switch with 470 Ω series resistor, active high.
5	Tactile push switch with 470 Ω series resistor, active high.
6	Tactile push switch with 470 Ω series resistor, active high.
7	Tactile push switch with 470 Ω series resistor, active high.

(b) Serial Host

The Serial Host accessory board has twin USB-type A sockets, each protected with a current-limited load switch that allows up to 500 mA continuous current, subject to overall available system power. Additional protection includes reverse current blocking, short-circuit protection, over temperature protection and VBUS soft start.
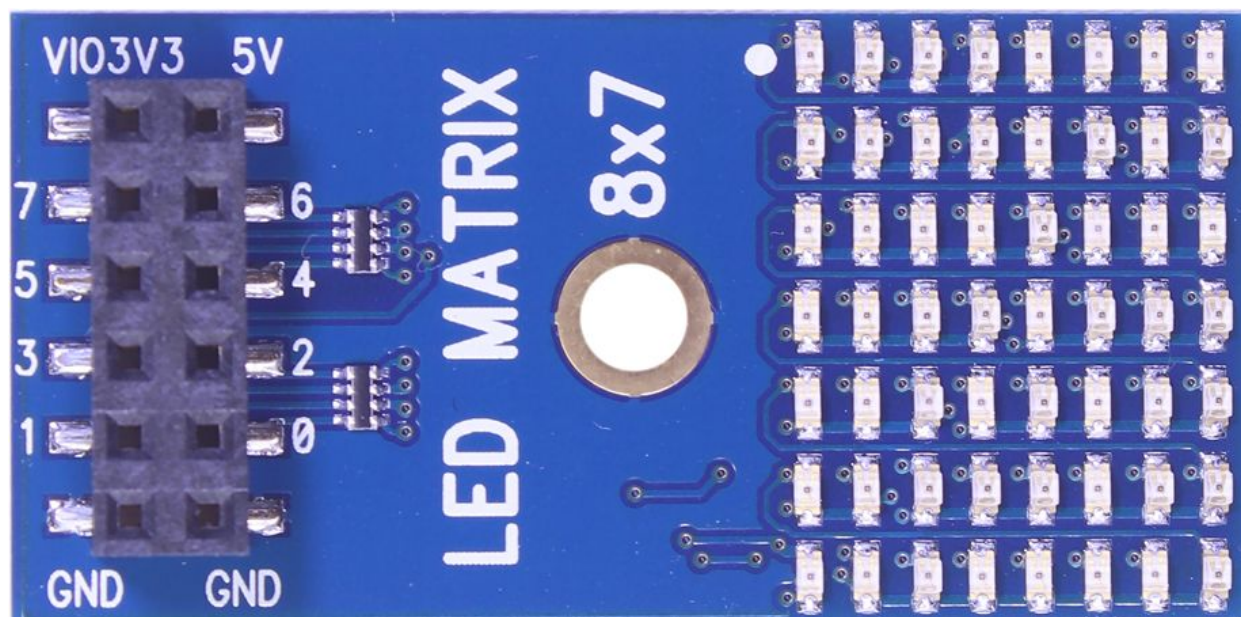
This accessory board allows two USB-type devices to be connected simultaneously, such as a keyboard and mouse. Two user controlled blue activity LEDs are located beside the USB-type A socket.

To enable the Serial Host 5V power output on each channel, set the corresponding channel enable pin high. I/O pin 1 for channel 1, and I/O pin 5 for channel 2.

Note that the Serial Host accessory board requires 5V to function. When used with the P2-ES Eval Board Rev B, the shunt jumper must connect that board's ACC HDR and 5V pins to supply 5V to its I/O Pin Breakout Edge Headers.

I/O Pin	Function
0	Blue LED with 1 kΩ series resistor. Assert high to light. Use PWM for brightness control.
1	Serial channel 1 : Enable, active high
2	Serial channel 1 : Data D-
3	Serial channel 1 : Data D+
4	Blue LED with 1 kΩ series resistor. Assert high to light. Use PWM for brightness control.
5	Serial channel 2 : Enable, active high
6	Serial channel 2 : Data D-
7	Serial channel 2 : Data D+

(c) LED Matrix

This board features an 8 x 7 grid of Charlieplexed green LEDs. It can be used to display text of graphics across 56 LEDs using only 8 I/O pins! The technique of Charlieplexing is described here: https://en.wikipedia.org/wiki/Charlieplexing. Charlieplexing allows for control of more LEDs with fewer I/O pins by taking advantage of the one-way current flow properties of diodes (including Light Emitting Diodes), along with the tri-state properties of the Propeller 2 I/O pins.

This lookup table shows the required state of the Propeller I/O pins to illuminate each LED. For example, to light the LED at Row 3 Col 6, the table shows 3 HIGH 0 LOW. In this case, we would set IO 3 HIGH and IO 0 LOW to light this LED. Set both IO pins to INPUT mode to turn the LED off.
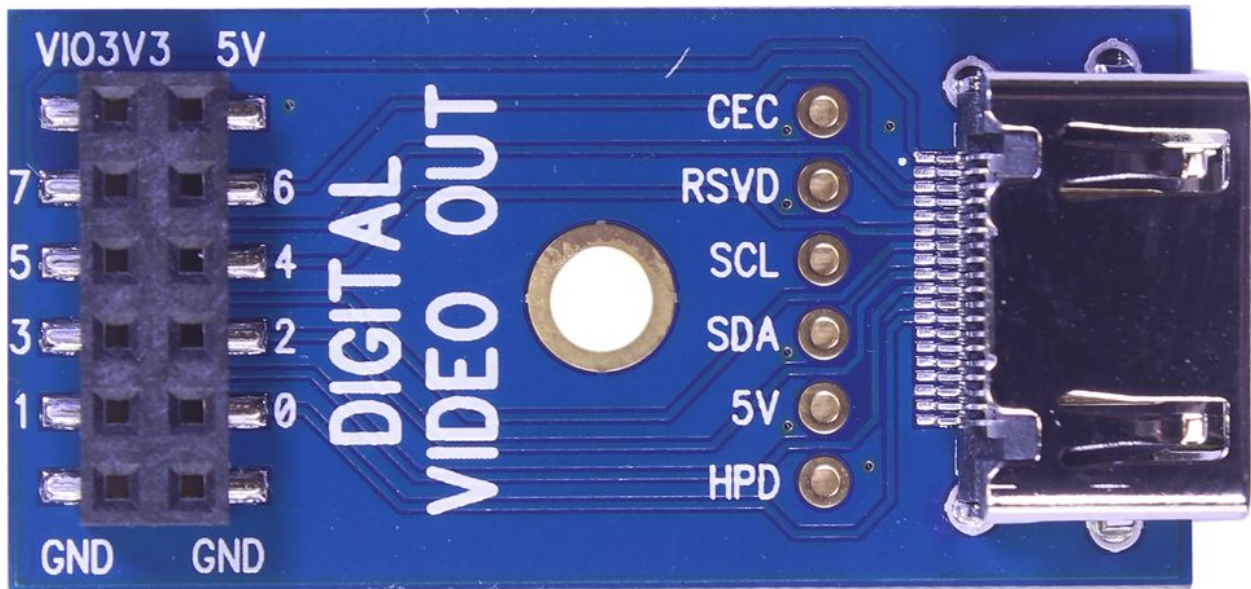
	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
Row 1	0 HIGH 1 LOW	0 HIGH 2 LOW	0 HIGH 3 LOW	0 HIGH 4 LOW	0 HIGH 5 LOW	0 HIGH 6 LOW	0 HIGH 7 LOW	1 HIGH 0 LOW
Row 2	1 HIGH 2 LOW	1 HIGH 3 LOW	1 HIGH 4 LOW	1 HIGH 5 LOW	1 HIGH 6 LOW	1 HIGH 7 LOW	2 HIGH 0 LOW	2 HIGH 1 LOW
Row 3	2 HIGH 3 LOW	2 HIGH 4 LOW	2 HIGH 5 LOW	2 HIGH 6 LOW	2 HIGH 7 LOW	3 HIGH 0 LOW	3 HIGH 1 LOW	3 HIGH 2 LOW
Row 4	3 HIGH 4 LOW	3 HIGH 5 LOW	3 HIGH 6 LOW	3 HIGH 7 LOW	4 HIGH 0 LOW	4 HIGH 1 LOW	4 HIGH 2 LOW	4 HIGH 3 LOW
Row 5	4 HIGH 5 LOW	4 HIGH 6 LOW	4 HIGH 7 LOW	5 HIGH 0 LOW	5 HIGH 1 LOW	5 HIGH 2 LOW	5 HIGH 3 LOW	5 HIGH 4 LOW
Row 6	5 HIGH 6 LOW	5 HIGH 7 LOW	6 HIGH 0 LOW	6 HIGH 1 LOW	6 HIGH 2 LOW	6 HIGH 3 LOW	6 HIGH 4 LOW	6 HIGH 5 LOW
Row 7	6 HIGH 7 LOW	7 HIGH 0 LOW	7 HIGH 1 LOW	7 HIGH 2 LOW	7 HIGH 3 LOW	7 HIGH 4 LOW	7 HIGH 5 LOW	7 HIGH 6 LOW

To light multiple LEDs, rely on the fast operating speed of the Propeller 2. While Charlieplexing doesn't actually light the LEDs simultaneously, it switches them on and off fast enough to trick the human eye into believing they are on simultaneously.

When Propeller 2 code switches each LED on and off at least 50 times a second (50 Hz), flickering should not be noticeable and the LEDs will appear to be permanently on. (For the Propeller 2 this switching speed is no problem as each I/O could switch faster than 180 MHz, which is plenty of time to turn on every LED if needed).

Each LED consumes approximately 4 mA when lit. If all the LEDs were continuously powered on, they could consume 224 mA together. But, Charlieplexing needs only to light one LED at a time, so total current consumption at any instant in time remains only 4 mA!
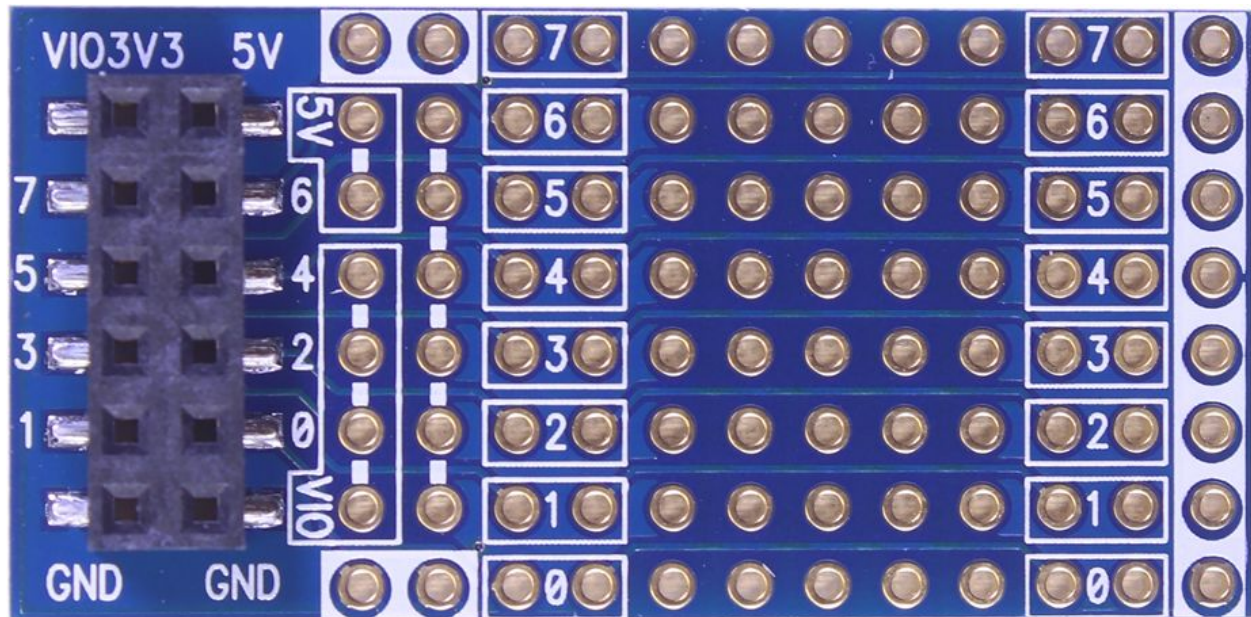
(d) Digital Video Out

The Digital Video Out Accessory Board provides an HDMI-type connector which can be used for experimenting with various video standards. The signal pins which are connected to the P2-EVAL header are shown in this table:

I/O Pin	0	1	2	3	4	5	6	7
Function	CLK -	CLK +	D0 -	D0 +	D1 -	D1 +	D2 -	D2 +

Unused signal pins from the video connector are labelled on the PCB next to an unpopulated 0.1" pitch row of 6 pads: CEC, RSVD, SCL, SDA, 5V, HPD
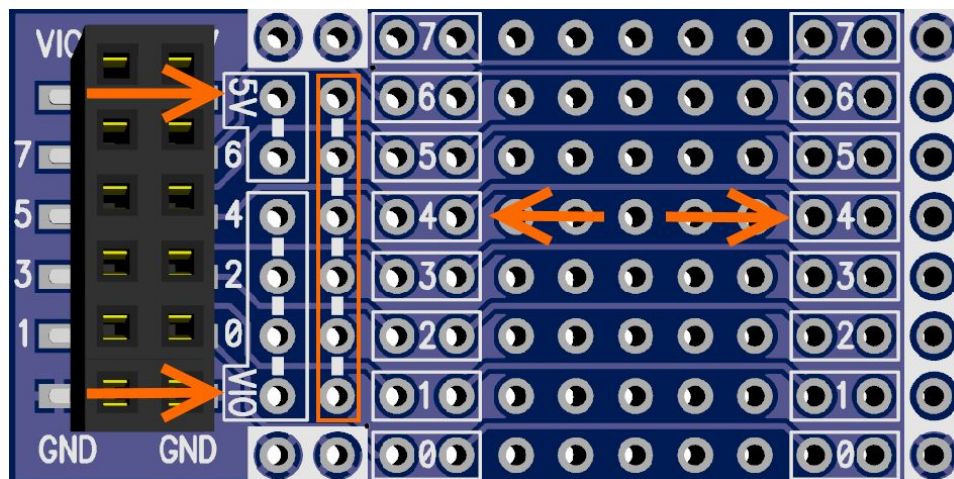
(e) Mini Prototyping Board

The Mini Prototyping Board provides an 8x12 grid of plated thru-holes.

Ground holes are connected on both sides of the PCB, and marked on the top side by white silk blocks.
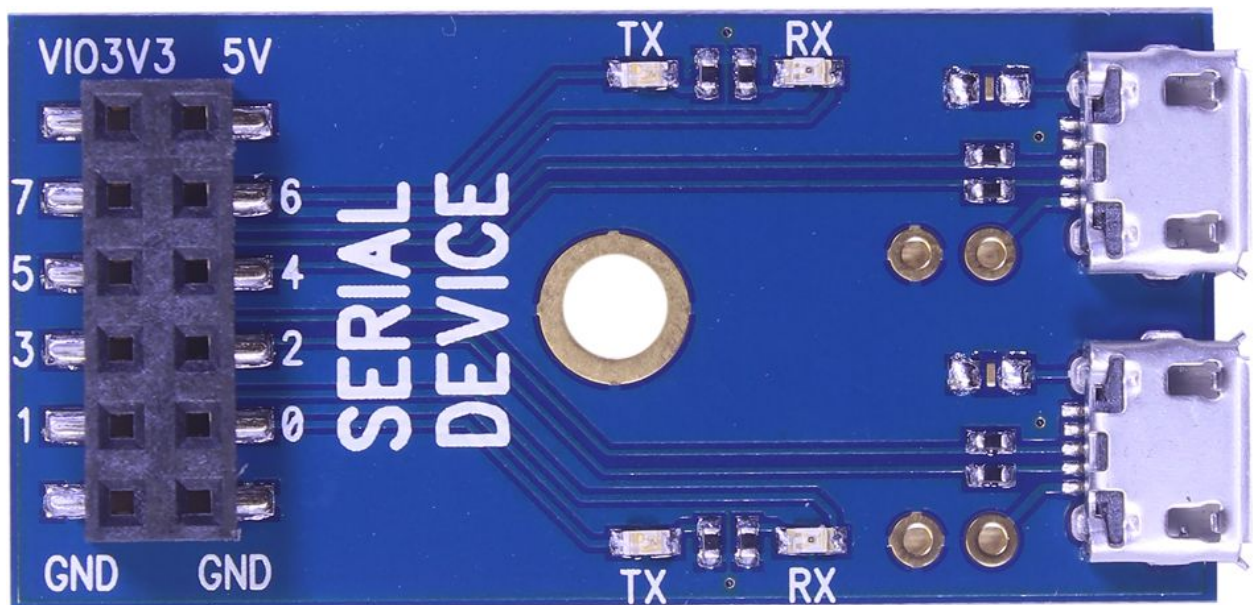
Other holes that are joined are marked on the top side of the PCB with silk dashes or boxes. And they are linked on the bottom of the PCB with copper traces that are isolated clearly to enable easy cutting as required.

Holes inside a white box are joined to the signal or power marked. Referring to the image, 5V, VIO and the I/O pins 0 thru 7 are highlighted with arrows. Holes joined by dashes are joined together, but are not joined to any signal. Referring to the image, these holes are highlighted with an orange box.

There is one exposed ground strip on the bottom of the PCB (marked in orange below) to allow easy bridging of the neighboring thru-holes to Ground.
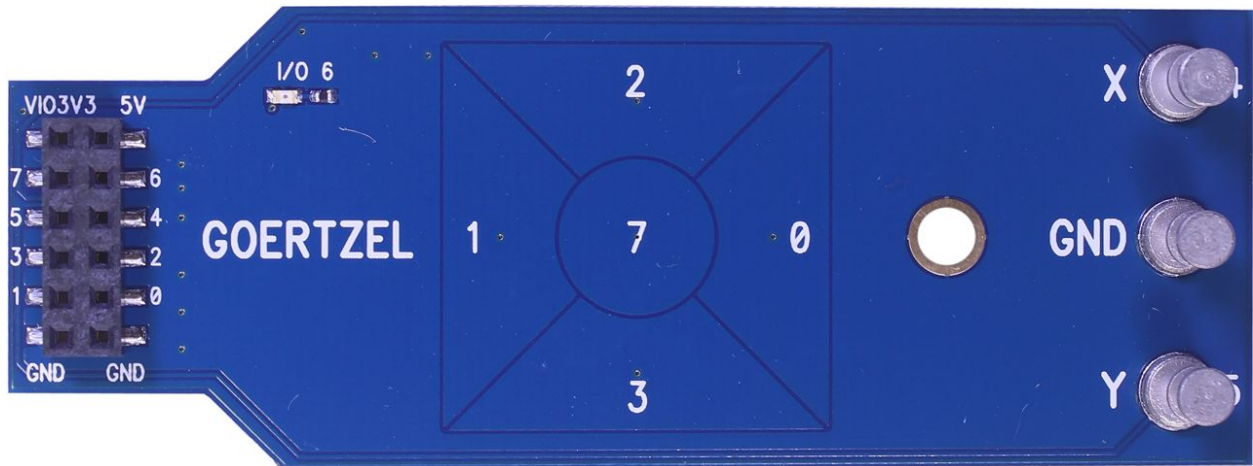
(f) Serial Device

The Serial Device accessory board has two microUSB-type sockets, each with two activity LEDs.

This accessory board allows the Propeller 2 to behave as up to two USB-type devices, connecting to a USB host such as a computer or other USB capable microcontroller.

Two user controlled activity LEDs (red and blue) are located beside each microUSB-type socket.

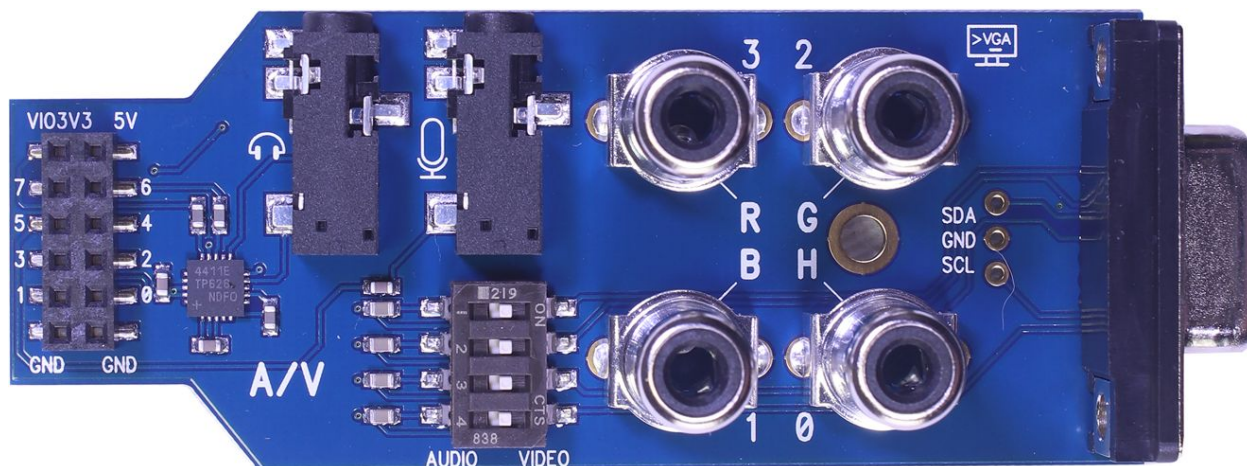| I/O Pin	Function
0	Blue LED with 1 kΩ series resistor. Assert high to light.
1	Red LED with 1 kΩ series resistor. Assert high to light.
2	Serial channel 1 : Data D-
3	Serial channel 1 : Data D+
4	Serial channel 2 : Data D-
5	Serial channel 2 : Data D+
6	Blue LED with 1 kΩ series resistor. Assert high to light.
7	Red LED with 1 kΩ series resistor. Assert high to light.

(g) Goertzel

The Goertzel experimenter board features a set of five pads for non-contact position sensing and a green activity LED. There are three oscilloscope probe posts for monitoring, X, Y, and GND.

I/O Pin	Function
0	Goertzel E (3 O'Clock)
1	Goertzel W (9 O'Clock)
2	Goertzel N (12 O'Clock)
3	Goertzel S (6 O'Clock)
4	Scope Turret - Signal X
5	Scope Turret - Signal Y
6	Green LED with 1 kΩ series resistor. Assert high to light.
7	Goertzel C (Center common pad)

(h) A/V Breakout

The A/V breakout accessory board includes the following capabilities:

- Amplified Audio Out (80mW) / Headphone Socket (3.5 mm Stereo Jack)
- Audio Input / Microphone Socket (3.5 mm Mono Jack)
- Audio-to-RCA 4-band
- Component Video-to-RCA 4-band (Composite Sync, RGBS)
- Digital component video (RCA Socket)
- Composite Video (RCA Socket)
- VGA (15-pin VGA socket)

Some features share the same IO pins and sockets. The A/V board features a dip switch which allows switching the 4x RCA sockets from Audio to Video mode.
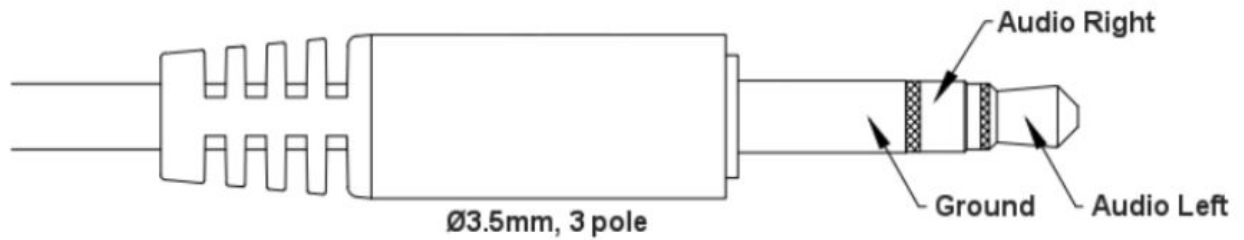
I/O Pin	Function 1 Common connection regardless of dip switch setting	Function 2 Dip switch VIDEO selected	Function 3 Dip switch AUDIO selected
0	VGA 15-pin socket - HSync	RCA Socket 0 (H - HSync)	RCA Socket 0 via 22uF cap
1	VGA 15-pin socket - Blue	RCA Socket 1 (B - Blue)	RCA Socket 1 via 22uF cap
2	VGA 15-pin socket - Green	RCA Socket 2 (G - Green)	RCA Socket 2 via 22uF cap
3	VGA 15-pin socket - Red	RCA Socket 3 (R - Red)	RCA Socket 3 via 22uF cap
4	VGA 15-pin socket - VSync	**Tip:** Always use the P2-EVAL **3.3V LDO** Power selection when working with Audio!	
5	Microphone socket via 1uF cap		
6	Output to Audio amp (Left)		
7	Output to Audio amp (Right)		

The two audio jack sockets are compatible with 3.5 mm jack plugs.

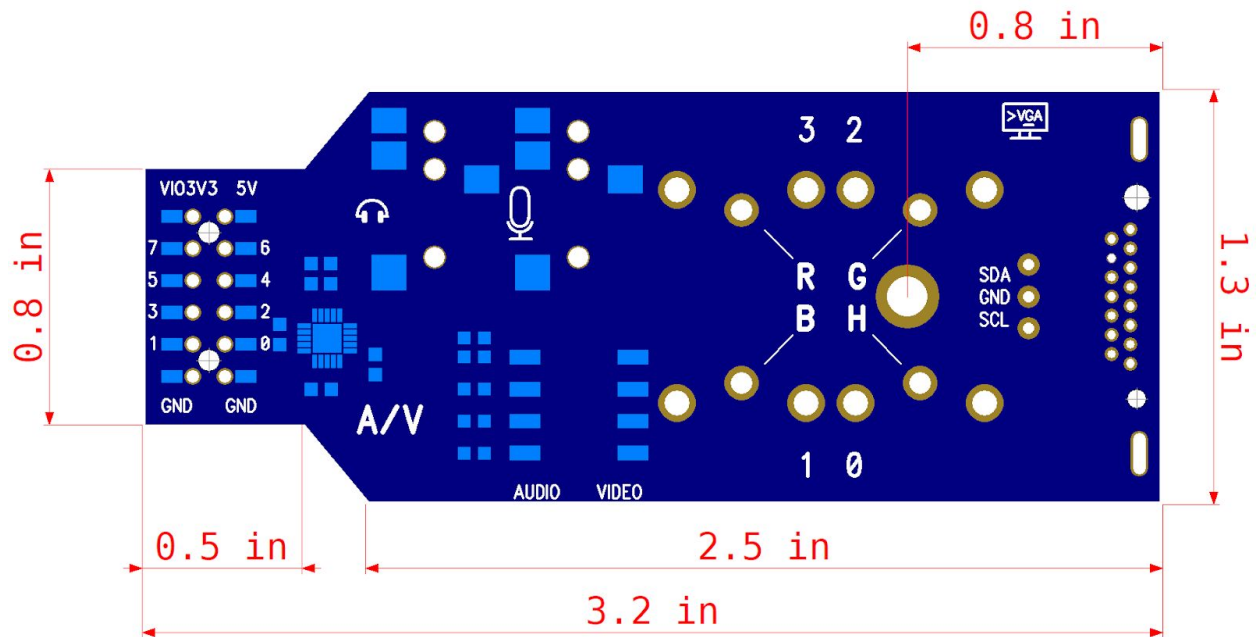The microphone socket is wired: Tip = signal, Sleeve = ground

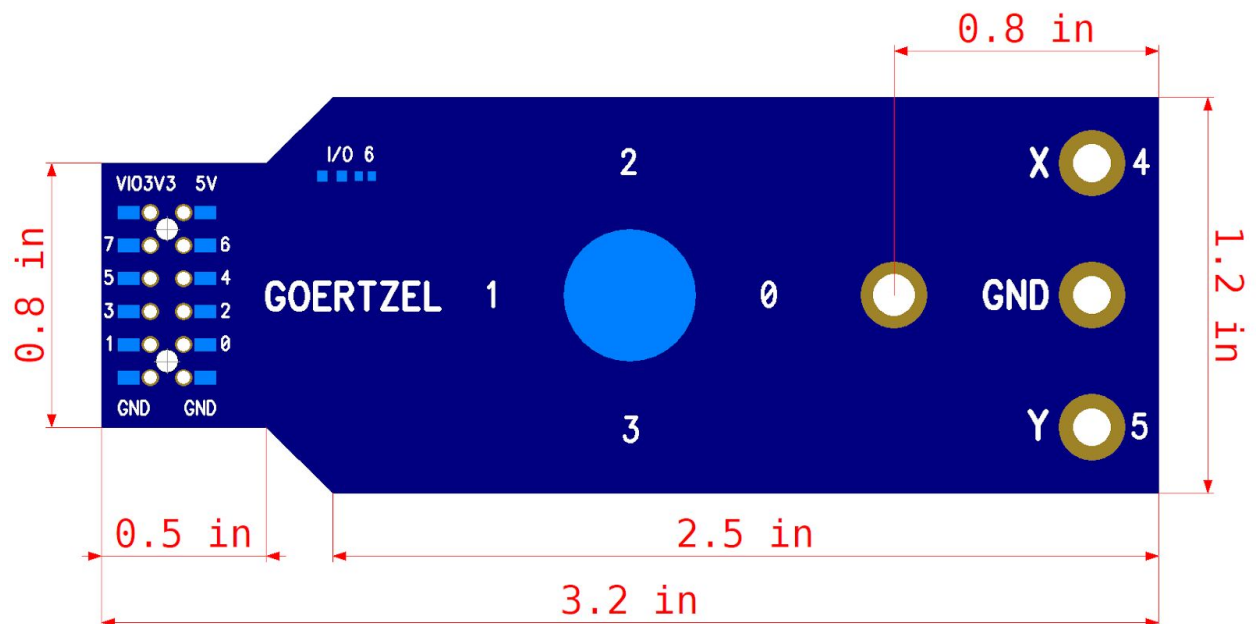The audio output (headphone) socket is wired: Tip = left, Ring = right, Sleeve = ground

PCB Dimensions

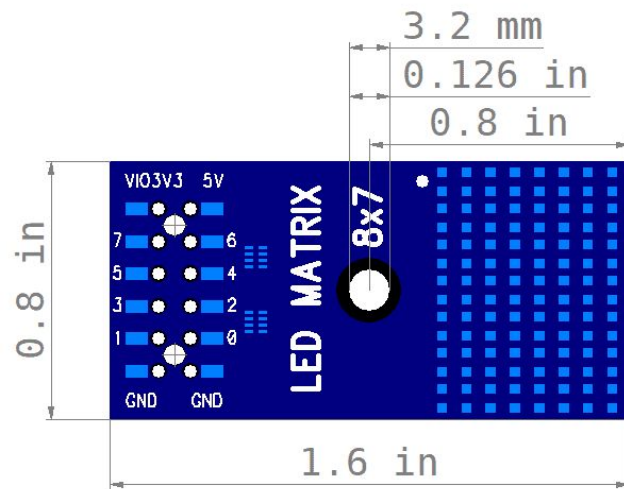There are three sizes for the accessory set boards:

A/V module

Goertzel module

Small modules

Revision History

Version 1.0: original release as a Google Document visible to the public via a shared link with commenting enabled; edits tracked by the Google tools and not individually enumerated.

Version 1.1: Updated for Propeller 2 ES Eval Board Rev B note regarding the need to connect the ACC HDR/5V pins with a shunt jumper to supply 5V power to the Serial Device board via the I/O Pin Breakout Edge Headers.