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Propeller 2 Eval Board Rev C (64000)

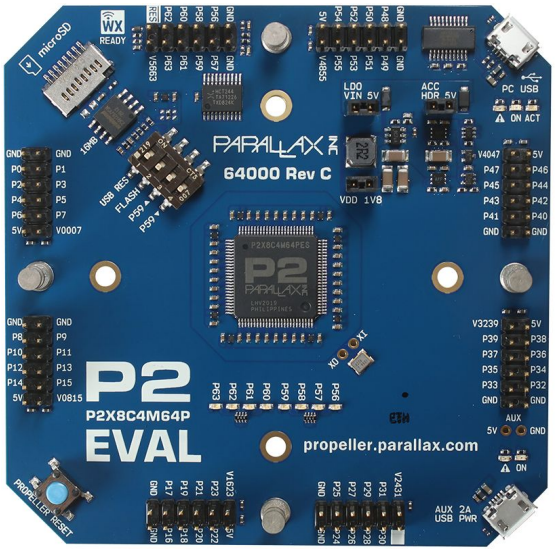
This document supports the Rev C PCB. *Please see version 1.0 for Rev A PCB support*, or *version 2.0 for Rev B PCB support*.

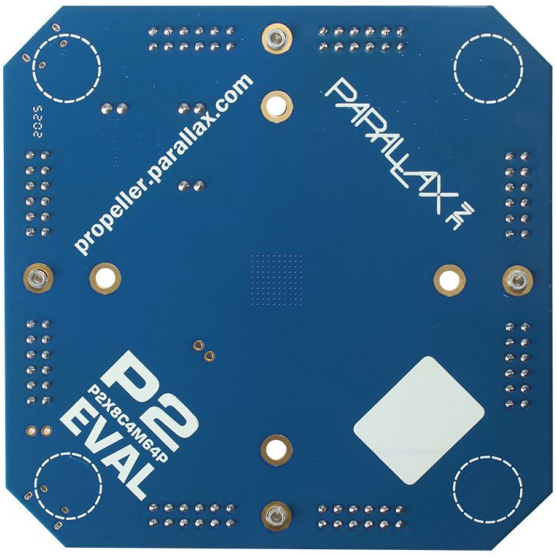
Note: commenting is enabled, so please feel free to request clarification on any point.

The Propeller 2 Eval Board is designed for experimentation and characterization of the Propeller 2 multicore microcontroller. The Propeller 2 features a user-code adjustable operating frequency, and has been designed to operate at a maximum recommended clock frequency of 180 MHz.

Multiple ground points, power supplies, and power enable & breakout headers are included for simpler testing and interfacing with standard test equipment. The PCB is organized to keep each subsystem clearly defined in groups, and spaced well apart, making room for test probes to be attached.

The eight I/O Pin Breakout Edge Headers accommodate the 2x6 pass-through headers on eight different accessory add-ons, for experimenting with HyperBus memory, audio, video, and more. See the Propeller 2 product family page for options.





P2-ES Eval Board Features

- Propeller 2 multicore microcontroller engineering sample, Rev C silicon approved for production
- 20 MHz crystal
- Adjustable operating frequency; recommended maximum 180 MHz clock
- Overclocking possible beyond 300 MHz
- 16 MB SPI Flash memory
- 64 Smart I/O pins brought out to edge headers, with 58 fully free
- Buffered LEDs on top eight I/O pins
- Onboard 1.8 V 2-Amp switching regulator with short-circuit and over-current fault protection for P2 VDD, and brownout detection connected to Propeller reset
- Onboard LDO 3.3 V regulators for P2 VIOs
- Power headers for current measurement and alternative voltage source injection
- Dual power inputs via micro-USB sockets; suitable for USB charger (not supplied) or host computer USB port connection
- Built-in FTDI to USB programming interface, with TX/RX activity indicator LED
- USB current limiters with short-circuit and over-current fault protection
- USB active and USB fault LEDs
- MicroSD card socket with power-cycle function when reset button is pressed
- WX Compatible for programming the P2 microcontroller over WiFi with the WX WiFi SIP Module (#32420S - not included)

Key Specifications

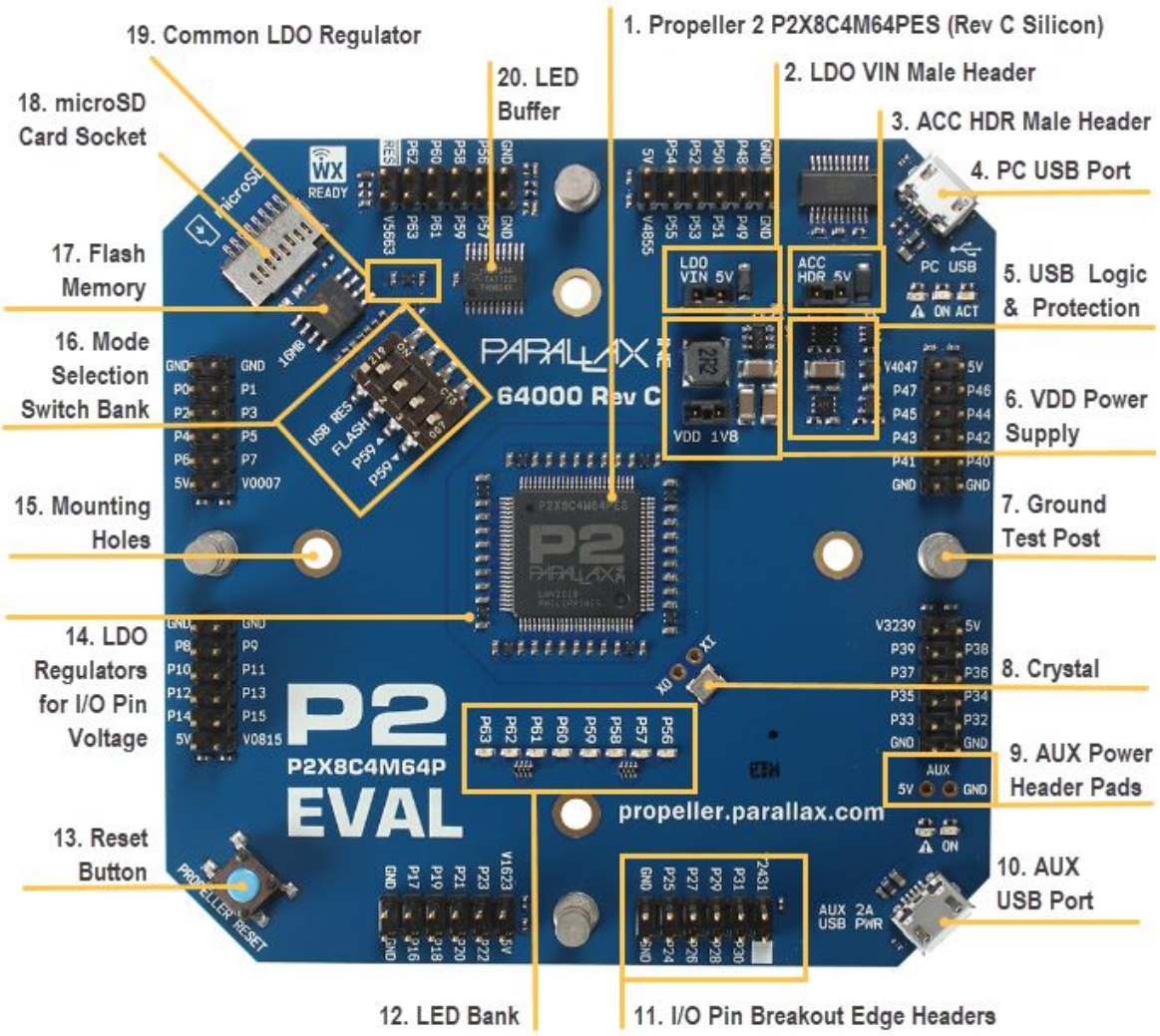
- Voltage input requirements: USB 5 VDC, absolute maximum 5.5 VDC
- USB protection: current-limiter and short-circuit detection
- Propeller 2 chip: P2X8C4M64PES (8 cogs, 512 KB hub RAM, 64 smart pins)
- Non-volatile Memory: 16 MB (128 Mb) SPI Flash
- Crystal: 20 MHz SMT
- Smart I/O pins: 64 accessible, 58 fully free, grouped in 8 sets of 8 via headers
- Smart I/O pin supply voltage: 3.3 V
- Core supply voltage: 1.8 V
- Input Current limits:
    - 500 mA from PC USB port
    - 2000 mA from AUX USB port
- VDD Power Supply: 1.8 V up to 2 A, 1 MHz nominal switching frequency
- VIO Power Supplies: 3.3V up to 300 mA per 8 I/O pins
- Programming: Serial over micro-USB
- USB programming and serial data speed: User selectable up to 3 Mbps
- Operating temperature: -40 to +185 °F (-40 to +85 °C)
- PCB Dimensions: 3.55” x 3.55” (90 x 90 cm)

What's New for Rev C?

- Production-approved P2X8C4M64P Engineering Sample Rev C silicon
- P0–P15 and P32–P47 are trace-length matched for high-speed data experiments (such as HyperRAM).
- BOD (Brown Out Detection) is removed from the dip switch and instead, Propeller RESn is permanently connected to the 1.8V regulator PG (Power Good) signal, which will hold the P2 in reset if the regulator voltage drops below ~1.5V.
- USB RES is on the dip switch, which enables the user to disconnect the USB reset (DTR) signal from the Propeller RESn pin.
- The 5V pin which was next to P30 has been removed, and that pin is now unconnected.
- The 5V pin which was next to P62 has been replaced with a RESET input to the Propeller RESn.
- The unpopulated DTR/RESn pads which RevB had (near the SD socket) have been removed.
- Improvements to the USB power circuit to improve protection from edge-case faults.
- WX WiFi Compatible —The P56–P63 edge header works with the Parallax SIP WiFi module for wireless programming. More details will follow after the Rev C Eval board is released.

Feature Descriptions

Read the full explanation of each labeled feature on the pages that follow this diagram.



1. Propeller 2 P2X8C4M64P - Engineering Sample (Rev C Silicon)

This is the 3rd edition, production-approved Rev C Silicon engineering sample of the Propeller 2 microcontroller. The Propeller 2 has 8 cores, 512 KB of hub RAM, and 64 Smart I/O pins. See the draft Propeller 2 (Rev B/C Silicon) Google Document for detailed information about this device. Be aware that this is an engineering sample and not a production chip.

PNUT P2 programming software version v34s or greater recommended :
https://drive.google.com/file/d/1VBu5lolMkVPxPBrgwD9MvGVzEslaYELu

During active development, the latest version and history of PNUT can be found in the 1st post on page one of this forum thread : http://forums.parallax.com/discussion/171196

2. LDO VIN Male Header

The 2-pin LDO VIN power breakout header is used to connect the common 5V USB supply to the 3.3V LDO regulators powering VIO, microSD card, and flash memory chip.

In normal use a jumper would be connected across the 2-pin header. For experimentation, the jumper could be removed and an external power source or inline current meter could be connected here, instead.

Note: Power MUST be connected at the LDO VIN header for the Propeller P2 to operate.

3. ACC HDR Male Header

The 2-pin ACC HDR power breakout header is used to connect the common 5V USB supply directly to every 5V pin on the edge expansion headers.

The P2-EVAL board is supplied with the jumper located on the 5V pin only, and not connected to the ACC HDR pin. This is the “OFF” position, and means that power is not routed from the 5V output pin to each of the edge headers via the ACC HDR pin.

To enable the 5V supply at the edge headers, move the jumper across both pins to join them together. Certain accessory boards require a 5V supply, such as the USB accessory part-number 64006-ES(b).

For experimentation, the jumper could be removed and an external power source or inline current meter connected here instead.

Note: If 5V supply is not required at the edge headers, the jumper can be removed for safety.

4. PC USB Port

The microUSB PC USB port can perform the following functions:

- Load programs from a computer into the Propeller 2 microcontroller
- Support serial-over-USB communications to a terminal program on a computer
- Supply 5 V power from a computer’s USB port

The PC-USB port includes protection that will disable the supply if 500 mA current draw is exceeded. When using the Propeller 2 with an external USB hub, be sure to use a powered hub.

If an alternative power source is connected to the AUX USB Port, that port will take precedence and power from the PC USB socket will be disabled. However, the PC USB socket will continue to function as a serial connection to the computer, and the PC USB "ON" LED will remain lit while the PC USB port is connected to your computer and is active.

While transmitting or receiving data, the ACT (blue) LED will blink to indicate your computer is communicating with the P2-EVAL Board.

When a short circuit, over-current, or over-temperature fault condition is detected by the USB protection circuit, power will be disconnected and the corresponding red fault LED, marked by a warning triangle label, will light until the fault is remedied.

In the special case that the PC USB connection is suspended by your computer, the "ON" LED will go off, and the blue ACT LED may glow dimly. It would usually be necessary to unplug/reconnect the USB cable in this situation, so that the computer can renegotiate the USB connection.

5. USB Logic & Protection

The USB Logic and Protection section is the bridge between the USB power sources and the common 5V rail which provides power to the LDO VIN header, ACC HDR and the VDD Power Supply.

The USB power source is selected automatically, either from the PC USB socket or preferentially from the AUX USB port if a higher current power supply is connected. Each power source has its own current limit: PC-USB is 500 mA, AUX-USB is 2000 mA.

In case of over-current, short-circuit, or over-temperature, the USB Logic IC's will shut down, disconnect power, and light the corresponding fault LED to indicate the problem.

6. VDD Power Supply

The VDD power supply is for the Propeller 2 core. This onboard power supply is based on a switching buck regulator, capable of delivering 2 A at 1.8 V. Short circuit, over-current protection and brownout detection are also included.

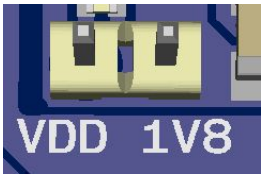
VDD is typically expected to be 1.8 V. This voltage powers the internal circuits of the P2 microcontroller. In case of a serious prolonged short-circuit or over-voltage condition, the VDD regulator will shutdown and remain locked off to prevent any serious damage.

In this case, the short-circuit should be remedied, and then the power supply will need to be power-cycled to attempt a restart. If the fault remains, then the VDD regulator will immediately go into the shut-down and locked off state again.

The VDD power supply includes Brown-out Detection, which will keep the P2 in reset whilst VDD is below approximately 1.5V.

Important! In case of experimentation with the VDD voltage level via the VDD Male Header (explained below), the absolute maximum voltage you should set or connect to P2 VDD is 2.2V.

VDD Male Header



The 2-pin VDD male header is used to connect the switching regulator output to the Propeller 2 VDD input pins. In normal use a jumper spans the 2-pin VDD header. For experimentation, the jumper may be removed and an external power source or inline current meter connected here instead. **Note: Power MUST be connected at the VDD header for the Propeller P2 to operate.**

7. Ground Test Posts

The four ground test posts are suitable for test clips and scope probes; one is positioned at each edge of the board.

8. Crystal

The P2-ES Eval Board is equipped with a 20 MHz crystal, as well as XO / XI pad connections. Operational frequency is adjustable; for full operating frequency configuration details, options, and limits, refer to the Propeller 2 (Rev B Silicon) Google Document.

The Propeller 2's on-chip crystal oscillator with internal 9 pF load capacitance drives the 20 MHz crystal to provide a base clock frequency for the Propeller. The actual operating frequency is selected in code, and can be almost any value or fractional value by using three special multiply and divide registers.

XO / XI Pads

The pads marked XO and XI above the oscillator are connected directly to the on-board oscillator and the Propeller 2 XO (Xtal Out, physical pin 50) and XI (Xtal In, physical pin

51) pins. Test equipment could be connected to these pads, or an alternative clock source connected to XI. Note that the P2-ES Eval board has a 20 MHz crystal, and the clock source type and frequency must be specified in the user code; refer to the Propeller 2 (Rev B Silicon) Google Document.

Overclocking

The clock frequency of Propeller 2 is defined by user code. It can be adjusted very precisely using three multiply and divide registers that set the actual operating frequency based on a function of the crystal oscillator frequency.

All this means that overclocking is possible and early unsupported experiments have been running the Propeller 2 overclocked at 390 MHz without significant heat rise!

While special cooling arrangements are not typically required when operating at the recommended maximum clock frequency of 180 MHz, the Propeller 2 ES Evaluation Board bottom layer features a continuous 4 oz copper ground plane which is designed to remove heat from the Propeller 2. There are also four mounting holes spaced 40mm apart, which could accommodate a 50 mm fan or heatsink.

9. AUX Power Header Pads (Customer Option)

Marked 5V and GND, these 0.1" spaced pads connect directly to the AUX-USB 5V power rail to provide a convenient power source for an external fan when an AUX-USB power source is connected.

These same 5V and GND pads could also be used to connect a power source to power the P2-EVAL PCB, instead of using the AUX-USB port. In this case, the supply voltage range can be 4.5V to 5.5V, and **MUST NOT exceed 5.5V!**

When used to provide power to the Eval board, the Auxiliary power pads are protected by the same USB protection circuit as the AUX USB Port; refer to the AUX USB Port description for more details.

Warning! DO NOT connect a power source to both the USB socket and 5V pads at the same time! Users wanting to use this functionality should refer to the P2-ES Eval Board schematic and proceed at their own risk.

10. AUX USB Port

The microUSB AUX USB Port is for power input only, and is provided as a means to attach a high current power supply to the P2-EVAL PCB. A 2-Amp rated device is recommended.

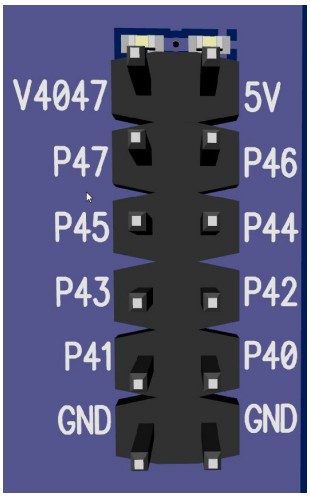
When power is connected to AUX USB, this will automatically take priority over power from the lower current PC-USB port. The AUX USB port includes protection that will disable the supply if 2A current draw is exceeded.

When a short-circuit, over-current or over-temperature fault condition is detected by the USB protection circuit, power will be disconnected* and the corresponding fault LED, marked by a warning triangle label, will light until the fault is remedied.

*** Note: Power disconnection occurs at the Eval board USB protection circuit.** The Auxiliary power header pads are located before that protection circuit because they are in parallel with the Aux USB Port to provide both a power input and output. As such, when power disconnection occurs in a fault condition, the Auxiliary power header pads will be able to continue sourcing power.

11. I/O Pin Breakout Edge Headers (with 5V output)

Each of the 64 smart I/O pins is connected to an edge header, in specific groups of eight.



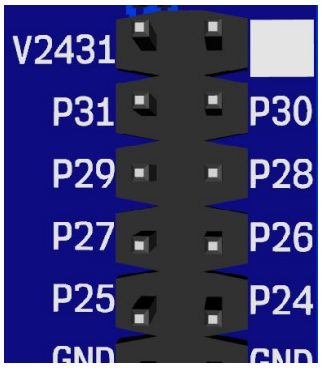
Each edge header also provides two GND connections, a Vxxxx output pin supplying the voltage from the corresponding 3.3 V LDO voltage regulator, described above in LDO regulators for I/O Pin Voltage, and optionally a 5 V output connection (controlled by the ACC HDR Male Header).

There are two special usage edge header banks which do not supply the 5V output. Refer to the details here: 11a. I/O Pin Breakout Edge Headers (without 5V output)

DO NOT APPLY VOLTAGE TO THE Vxxxx Pin; it is a voltage output! Be aware that some I/O pins are also connected to other peripheral circuits; see the I/O Pin Assignments section.

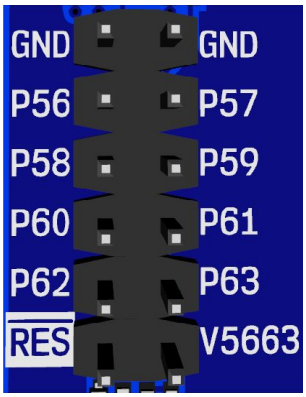
11a. I/O Pin Breakout Edge Headers (without 5V output)

There are two edge headers which do not have 5V routed to them.



The header for P24 to P31 is shown with a white silk square for the pin beside the Vxxxx pin. This unlabelled pin is unconnected, but could be used for connecting a user signal or voltage to a user accessory board or prototype board.

The header for P56 to P63 has the RES pin beside the V5663 pin. The RES pin is active low, and is connected to the Propeller 2 microcontroller RESn circuit. Momentarily set this pin low to reset the Propeller. This header is ideal for connecting to a WiFi module (such as the Parallax WX Module : https://www.parallax.com/product/32420s), in order to program the Propeller 2 wirelessly.



Tip: When using wireless programming it is recommended to switch off the USB Reset "USB RES" feature at the Mode Selection Switch Bank.

12. LED Bank

This bank of eight LEDs is connected via an LED Buffer to pins P56 through P63. The buffer isolates the LEDs so they will not influence the I/O signals. P56-P63 LEDs are connected to the USB data and P2 memory signals (see I/O Pin Assignments) so these LEDs will be especially active at power-up and after a reset.

After start-up, some of the LEDs can be used as user-programmable indicators. For example, P56 and P57 are free by default.

13. Reset Button

Use the Reset button button to restart the Propeller 2 microcontroller's program and also power cycle the flash memory and microSD socket. Press and hold to keep the microcontroller in reset. Press and release to reset and execute the selected Propeller 2 boot sequence; see the Boot Mode Selection for the necessary switch settings.

14. LDO regulators for I/O Pin Voltage

The LDO regulators are fixed 3.3 V low-noise regulators, which power the P2 I/O smart-pins. Each regulator has short-circuit and over-current protection. You may see this voltage referred to as VIO (Voltage for IO), or by group of I/O pins in the format Vxxxx.

At the actual microcontroller, the Propeller 2 Smart I/O pins are grouped such that each 4 I/O's have a dedicated voltage supply connection. If you refer to the diagram Propeller 2 Physical Pins you will see the voltage supply connections labelled as V0003, V0407, V0811, etc.

This allows pins that will be performing sensitive analog functions to use dedicated quiet, local 3.3V regulation.

With the P2-EVAL PCB, the voltage supply connections have been brought out in groups of 8 I/O pins each. Each group has a VIO output labelled Vxxxx at each of the corresponding I/O Pin Breakout Edge Headers, which describes the I/O range that the LDO supplies. For example, V0815 would mean VIO voltage for I/O pins 8 to 15.

Note: While it would also be typical to have a single larger switching regulator to power all the 3.3 V I/O supplies, the distributed LDO's allow for better local regulation, low noise, isolation of I/O groups, improved protection, less voltage drop under load, and better thermal characteristics.

15. Mounting Holes

The four plated mounting holes are attached to the ground plane. See the PCB Dimensions section for mounting hole spacing.

16. Mode Selection Switch Bank

This bank of dip switches controls the USB Reset and Boot Mode Selection functions. The dip switches are not set to any particular state on a new Eval board, although the four switches will all usually be set to the OFF position.

USB RES (USB Reset Connection)

This switch controls the connection of the USB "DTR" Reset signal to the Propeller reset circuit. Switch ON to allow the PC-USB interface to reset the propeller by toggling the DTR signal (as required for PC-USB programming). Switch OFF to disable that reset signal.

This switch would usually be kept switched ON for programming via PC-USB cable, and switched OFF for programming via an external serial programmer or WiFi module connected to the top-left (P62/P63) edge header.

Boot Mode Selection

Upon startup or after reset, the Propeller 2 will always proceed according to the boot mode selection table shown below. The three switches labelled Flash, P59 △ and P59 ▽ are used to select the Boot Mode, and the options include booting (loading code) from USB-Serial, SD card or SPI Flash memory.

Important! To avoid inconsistent behavior, only switch one of the P59 dip-switches ON.

Boot Mode Selection	FLASH	P59 △	P59 ▽
Serial window of 60 seconds, default. (When SD card is NOT inserted)	OFF	OFF	OFF
Serial window of 60 seconds, overrides SPI Flash and SD card.	ON or OFF	ON	OFF
Serial window of 100 ms, then SPI flash. If SPI flash fails then serial window of 60 seconds.	ON	OFF	OFF
SPI flash only (fast boot), no serial window. If SPI flash fails then shutdown.	ON	OFF	ON
SD card with serial window on failure. If SD card fails then serial window of 60 seconds.	OFF	OFF	OFF
SD card only, no serial window. If SD card fails then shutdown.	OFF	OFF	ON

Note: A switch is in the "off" position when the actuator is pointing toward the corresponding pcb label.

17. Flash Memory

The flash memory can be used to store user code or data, and is selectable as the prefered Boot device, See the Boot Mode Selection section for the necessary switch settings.

The device uses SPI protocol, with 16 MB (128 Mbit) capacity. Refer to the W25Q128JVSIM manufacturer datasheet for full details.

18. microSD Card Socket

A microSD card can be used to store the code which is run by the P2 when it starts up, provided the proper Boot Mode is selected. The same card can also be used to store (read or write) user data during run time. Uses include accessing large lookup tables, playing audio files, and data logging.

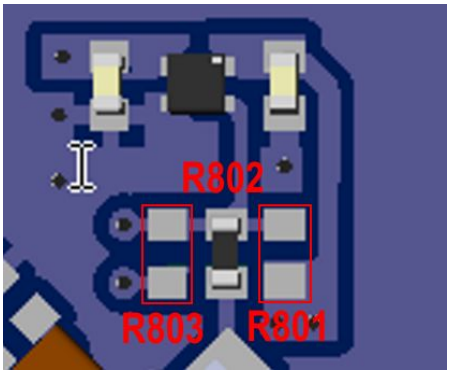
This socket is hardwired to four Propeller 2 I/O pins:

- P58 - DI/CD (data in and card detect)
- P59 - DO (data out)
- P60 - /CS (active low chip select).
- P61 - CLK (clock)

Power for the microSD card socket is supplied by the Common LDO regulator, which has an optional connection to P57 that would allow user code to toggle power on/off. Refer to the Common LDO regulator section for more details.

19. Common LDO regulator

The Common LDO regulator is a fixed 3.3 V low-noise regulator. It powers the microSD card and SPI Flash memory chip, and also provides a common pull-up voltage for boot mode features.



R803 is an unpopulated pad that would connect P57 to the Common LDO enable pin. This would allow the user to power-cycle the microSD card, perhaps for code development and experimentation.

One option to use this feature would be to move R802 to R803, and then install an 0402 100 kΩ resistor at R801. It is not recommended to keep both R802 and R803 installed. Consult the schematic before making adjustments and proceed at your own risk!

20. LED Buffer

The LED buffer is an octal line driver that has high impedance connections to P56–P63, and drives the corresponding status LED in the LED Bank on when the P2 I/O signal line is low.

All I/O signals from the P2 microcontroller are high impedance by default, which means the LEDs will be sensitive to objects moving close to the top-left edge header that provides access to the P56–P63 pins.

In user code those pins could be driven high or low, or have I/O pin pull-ups activated, to control the LEDs without the high-impedance behaviour. Another option is for the user application or breakout board to add pull-up resistors at the relevant edge header pins. This design choice means that those 8 I/O pins are not impacted by the presence of the LEDs or external pull-up resistors by default, and are completely flexible and free for the user to use as required.

Propeller 2 Physical Pins

This illustration identifies the physical pins on the Propeller 2. See the draft Propeller 2 (Rev B/C Silicon) Google Document for detailed information about the device. In this document, see the I/O Pin Assignments section for details on how they are used on the Propeller 2 ES Evaluation Board.

I/O Pin Assignments

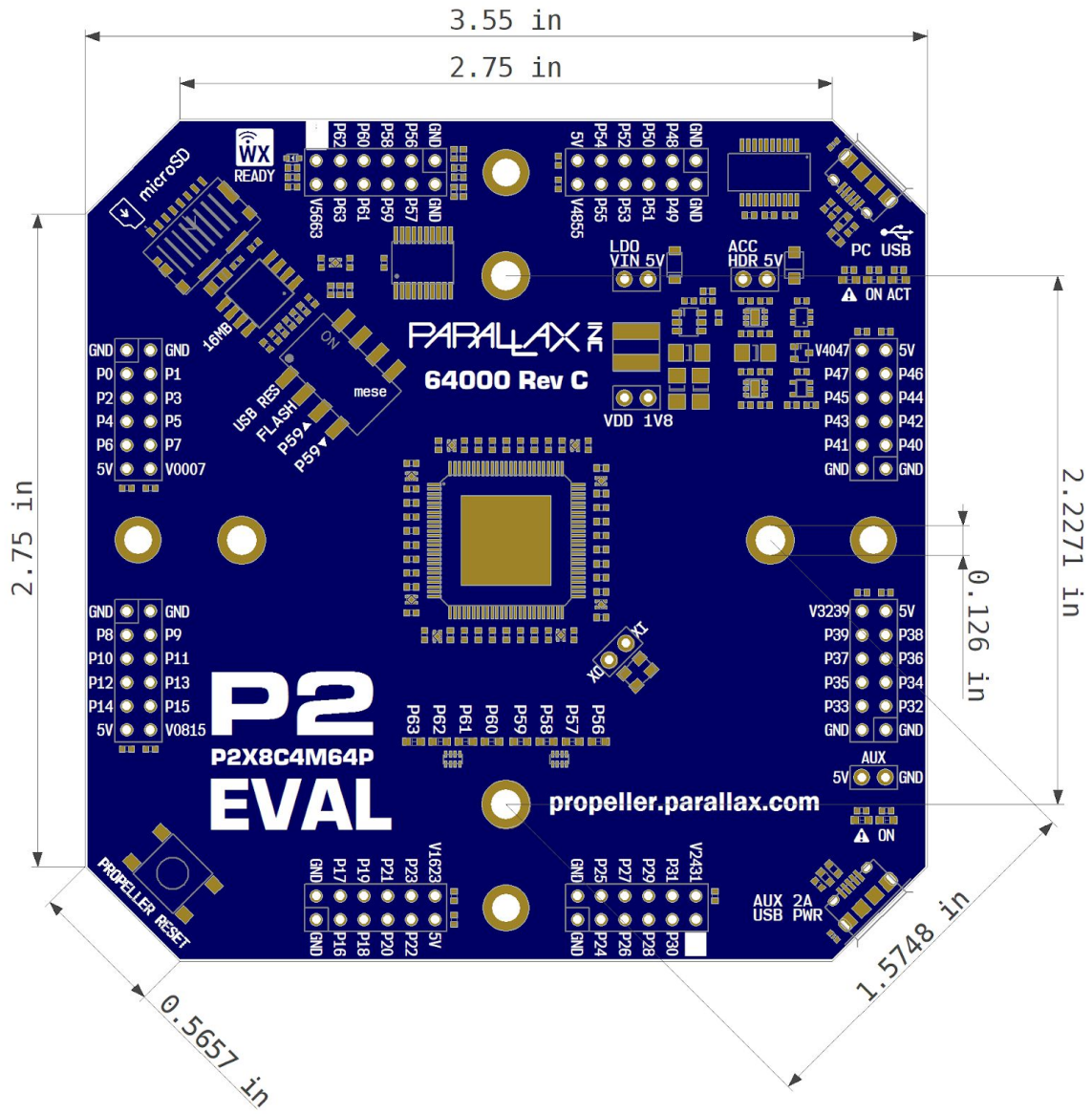
Smart I/O pins P0–P55 are fully free; P56–P63 are routed to peripheral circuits and/or have special functions related to Propeller 2 boot sequence options. Each smart I/O pin is capable of many autonomous analog and digital functions. Examples include ADC, DAC, PWM, USB, SERIAL, Waveform generation, SMPS, Comparator, SCHMITT and LOGIC modes.

See the draft Propeller 2 (Rev B/C Silicon) Google Document for detailed information about the full capabilities of the Propeller 2 Smart I/O pins. Refer to sections VDD - 1V8 Male Header and LDO VIN Male Header for instructions on applying power to enable the Smart I/O pins. This capability was added to the Eval PCB for evaluation and testing of the P2 ES engineering sample.

I/O Pin	Description		
P0-P7	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300 mA total, shared by this I/O pin group and edge header pin V0007.		
P8-P15	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300 mA total, shared by this I/O pin group and edge header pin V0815.		
P16-P23	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300 mA total, shared by this I/O pin group and edge header pin V1623.		
P24-P31	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300 mA total, shared by this I/O pin group and edge header pin V2431.		
P32-P39	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300 mA total, shared by this I/O pin group and edge header pin V3239.		
P40-P47	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300 mA total, shared by this I/O pin group and edge header pin V4047.		
P48-P55	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300mA total, shared by this I/O pin group and edge header pin V4855.		
P56-P63	Smart I/O pins, 3.3 V logic level, source or sink 30 mA per I/O pin. On-board LDO regulator supplies 300 mA total, shared by this I/O pin group and edge header pin V5663.		
	Alternative functions for P56-P63		
P56	No alternative function		Buffered LED
P57	Routed to Common LDO enable pin (not connected by default, user option)		Buffered LED
P58	microSD MISO (SDO)	Flash SPI DO	Buffered LED
P59	microSD MOSI (SDI)	Flash SPI DI	Buffered LED
P60	microSD CS	Flash SPI CLK	Buffered LED
P61	microSD CLK	Flash SPI CS	Buffered LED
P62	PC-USB RXD (P2 TXD)		Buffered LED

P63	PC-USB TXD (P2 RXD)		Buffered LED
Other Pins	**Description**		
TEST	MUST be connected to Ground for P2 to operate correctly.		
XO	Xtal Out for clock source. (Connected to 20MHz crystal oscillator and XO header pad)		
XI	Xtal In for clock source. (Connected to 20MHz crystal oscillator and XI header pad)		
RESn	MUST be pulled up, typically with 10K resistor. P2 will reset when RESn driven low.		
GND	Ground pad is under the chip, and must be connected to PCB ground. Provides common signal and supply voltage ground, and important path for heat dissipation. Connection to solid ground plane under the P2 chip and on an external layer recommended.		

PCB Dimensions



Revision History

Version 1.0: [Please see the version 1.0 document for Rev A PCB support](#).
Version 2.0: Supports the P2-ES Rev B silicon and the Eval Board Rev B.
Version 3.0: Supports the P2-ES Rev C silicon and the Eval Board Rev C.