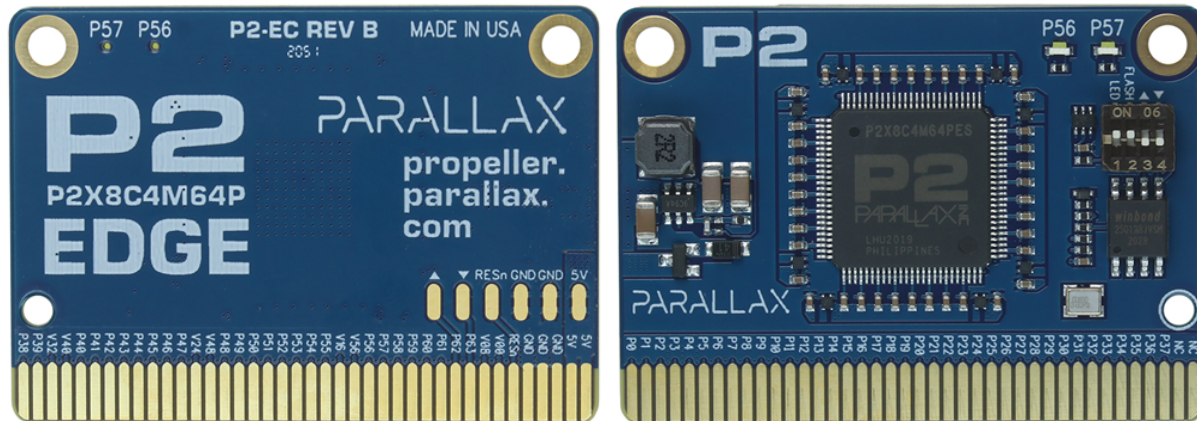# P2 Edge Module (#P2-EC)

The P2 Edge Module is a simple way to get started with the Propeller 2 multicore microcontroller. In addition to speeding development, this module provides an optimal P2 building block for system integrators and designers to include in their products.

The Propeller 2 P2X8C4M64P chip contains over 32 million transistors and >70 mm^2 of custom silicon, 10x that of a typical microcontroller. The P2 contains 8 independent processors with analog pad rings and Smart-pin functionality at all 64 I/O pins. Each smart I/O pin is capable of many autonomous analog and digital functions, including ADC, DAC, PWM, USB, SERIAL, Waveform generation, SMPS, Comparator, SCHMITT and LOGIC modes.

The P2 Edge Module includes the exposed-pad 100-pin TQFP P2X8C4M64P, core and I/O power regulators, power filtering capacitors, crystal, flash memory, boot configuration switches, and two user-configurable on-board LEDs to indicate system states. The PCB's six-layer design features solid thermal and signal reference planes isolating each signal layer. The design is optimized for low-noise analog and digital operation, and with low temperature rise even at high-speed operation.

For development, the P2 Edge Module fits in the card edge socket of the spacious P2 Edge Module Breadboard, the compact P2 Edge Mini Breakout Board, or the bare-bones P2 Edge 80-pin Adapter Kit. For product integration, several edge socket choices are available. This arrangement allows developers to integrate the Propeller 2 into products without the need for multi-layer cost or expertise. See the Propeller 2 section of www.parallax.com for options.

Features

- Compact module with Propeller 2 P2X8C4M64P multicore microcontroller
- 6-layer, low noise, system-on-board module
- Integrated thermal planes for low temperature rise characteristics at high speed operation
- Double-sided 80 way 0.05" (1.27mm) edge connector
- Orientation / module locking hole
- Two mounting holes connected to the module ground planes
- 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 the Edge Connector
- Buffered LEDs on I/O pins P56 and P57, visible from both sides of the module PCB
- Onboard LED feature enable/disable switch
- Onboard 1.8 V 2-Amp switching regulator with short-circuit, over-current fault and brownout detection protection for the P2 core (VDD)
- Onboard low-noise LDO 3.3 V regulators for the P2 smart-pins (VIO), with short-circuit and over-current fault protection
- Dual power inputs via the edge connector or optional header pads on the back of the module, with reverse polarity protection
- Compatible with the Parallax Prop-Plug #32201 for system programming

Key Specifications

- Voltage input requirements: 5 VDC; absolute maximum 5.5 VDC
- Input Current requirements:
- Recommended minimum 100 mA
- Typical experimentation 500–1000 mA
- Maximum according to customer application
- Voltage input protection: reverse voltage
- Propeller 2 chip: P2X8C4M64P (8 cogs, 512 KB shared hub RAM, 64 smart pins)
- Non-volatile Memory: 16 MB (128 Mb) SPI Flash
- Crystal: 20 MHz SMT
- Smart I/O pins: 64 accessible, 56 fully free, grouped in 8 sets of 8 I/Os
- Smart I/O pin logic voltage: 3.3 V
- Internal 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
- Edge Connector: Double sided 80 way 0.05" (1.27mm) pitch edge slot
- Programming: Serial up to 2 MBaud
- Operating temperature: -40 to +185 °F (-40 to +85 °C)
- PCB Dimensions: 1.45 in x 2.04 in (37mm x 52mm)

Feature Descriptions

Read the full explanation of each labeled feature on the pages that follow this diagram.
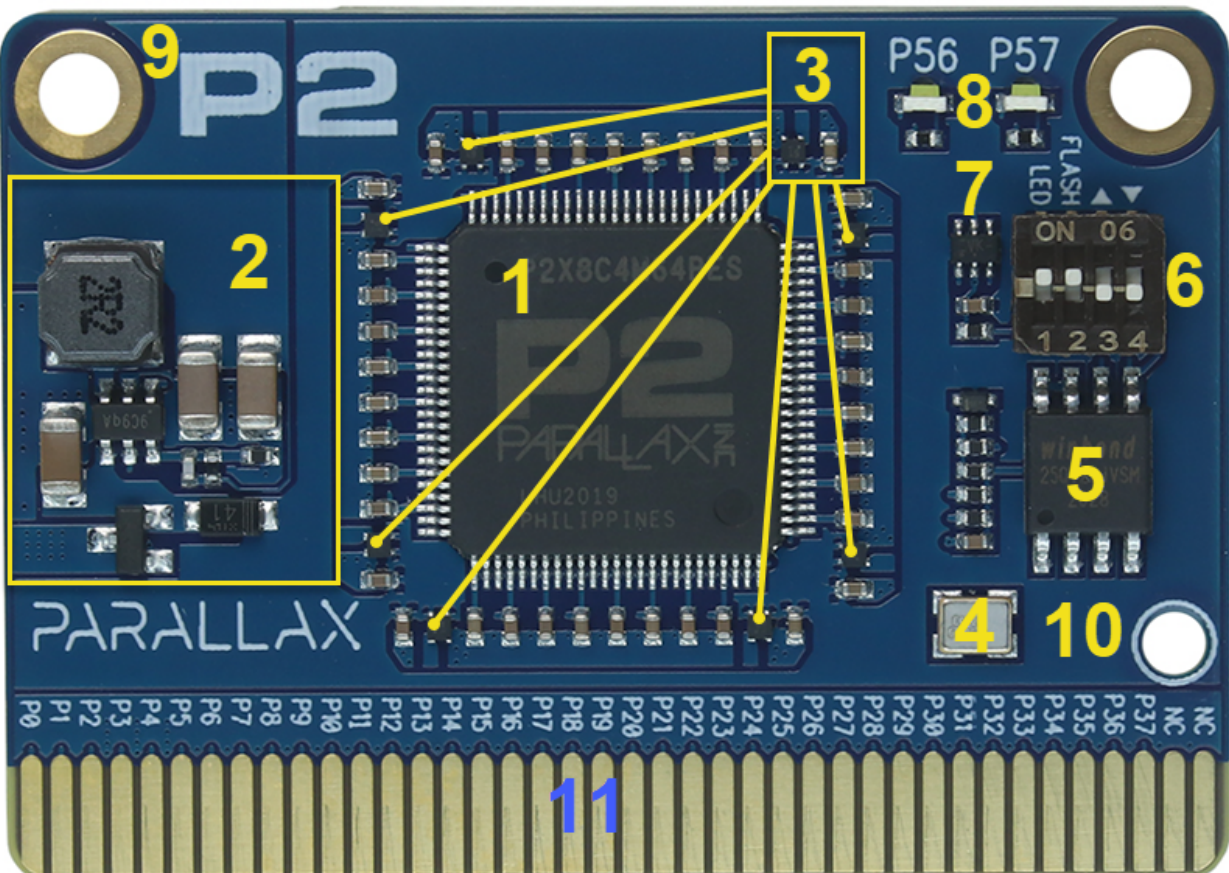
1. Propeller 2 P2X8C4M64P

The Propeller 2 has 8 independent processor cogs, 512 KB of shared hub RAM, and 64 Smart I/O pins. See the Propeller 2 documentation section of www.parallax.com for detailed information about this device. All I/O pins are brought out to the card edge pads; see 11. Edge connector.

Note: There are a limited number of P2 RevC chips with the extended part number P2X8C4M64PES instead of P2X8C4M64P. Be aware that both are identical other than the part marking. The ES edition is a limited initial batch and the P2 Edge module will be sold with ES marked chips only while stocks last.

2. VDD Power Supply with reverse polarity input protection

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, reverse-input polarity 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.

3. LDO regulators for I/O Pin Voltage

The 8 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 or Vxx.

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 3.3 V regulation.

With the P2 Edge Module, the voltage supply connections have been brought out in groups of 8 I/O pins each. Each group has a dedicated LDO regulator with the VIO output labelled Vxx at the edge connector. The two digits after the V refer to the first of 8 I/O pins that the LDO provides power to. For example, V08 would mean VIO voltage for I/O pins 8 to 15.

Note: While it would be possible (and typical) to have a single larger regulator to power all the 3.3 V I/O supplies, the distributed LDOs allow for better local regulation, higher current and isolation per I/O group, low noise, improved protection, less voltage drop under load, and better thermal characteristics. The distributed power scheme is not a requirement of the P2 microprocessor; rather a design choice for this particular module.

4. Crystal

The P2 Edge Module is equipped with a 20 MHz crystal. Operational frequency is adjustable; for full operating frequency configuration details, options, and limits, refer to the Propeller 2 documentation at www.parallax.com.

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 2. 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.

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. The nominal maximum is 180 MHz, though many early users have been running the Propeller 2 overclocked at 320 MHz. Advice about overclocking can be found at https://forums.parallax.com.

5. 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.

6. Mode Selection Switch Bank

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

LED Power Control (On board LEDs enable)

This switch controls power to two onboard LEDs, labelled and connected to I/Os P56 and P57. Switch ON to enable the LEDs. Switch OFF to disable the LEDs.

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, $\triangle$ and $\triangledown$ are used to select the Boot Mode, and the options include booting (loading code) from USB-Serial, SD card or SPI Flash memory.

Tip: △ and ▽ are both connected to the Propeller 2 I/O pin P59; one with a pull-up resistor to 3.3V, and the other with a pull-down resistor to GND. You may see these boot mode selection pins referred to in other documentation as P59 up and P59 down.

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

Boot Mode Selection	FLASH	△	▽
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

Tip: If required for booting, an SD card socket can be connected to the P2 Edge Module's edge connector, perhaps on a breakout board, using these connections:

- P58 - DI/CD (data in and card detect)
- P59 - DO (data out)
- P60 - /CS (active low chip select).
- P61 - CLK (clock)
- V56 - 3.3V power to the microSD card socket
- Common Gnd between P2 Edge module and microSD card socket

7. LED Buffer

The LED buffer is a dual Schmitt-trigger buffer that has high impedance connections to the P2 microprocessor I/Os P56 and P57, and drives the corresponding status LED ON when the P2 I/O signal line is high.

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 edge connector P56 and P57 pins. This design choice means that those 2 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.

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.

If the LEDs are not required, the P2 Edge Module dip-switch marked "LED" could be switched "OFF" to disable LED power.

8. LEDs P56 and P57

These two LEDs are mounted so that they are visible from both sides of the P2 Edge Module PCB. They are connected via an LED Buffer to pins P56 and P57. The buffer isolates the LEDs so they will not influence the I/O signals.

If the LEDs are not required, the P2 Edge Module dip-switch marked "LED" could be switched "OFF" to disable LED power.

9. Mounting Holes

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

10. Orientation Hole

The single unplated orientation hole could be used by a customer application to fix the module in-place or ensure correct orientation. See the PCB Dimensions section for the hole position and dimensions.

11. Edge connector

The 0.05" (1.27 mm) pitch 8- way edge connector extends on both sides of the module, with 40 connections on each side. Refer to Edge Connector Pin Assignment for full details.

Suitable connectors are available from the Parallax webshop:

- Card Edge Socket, Through Hole, Right Angle (#450-00308)
- Card Edge Socket, Straight, SMT (#450-00309)
- Card Edge Socket, Straight, Through Hole (#450-00310)
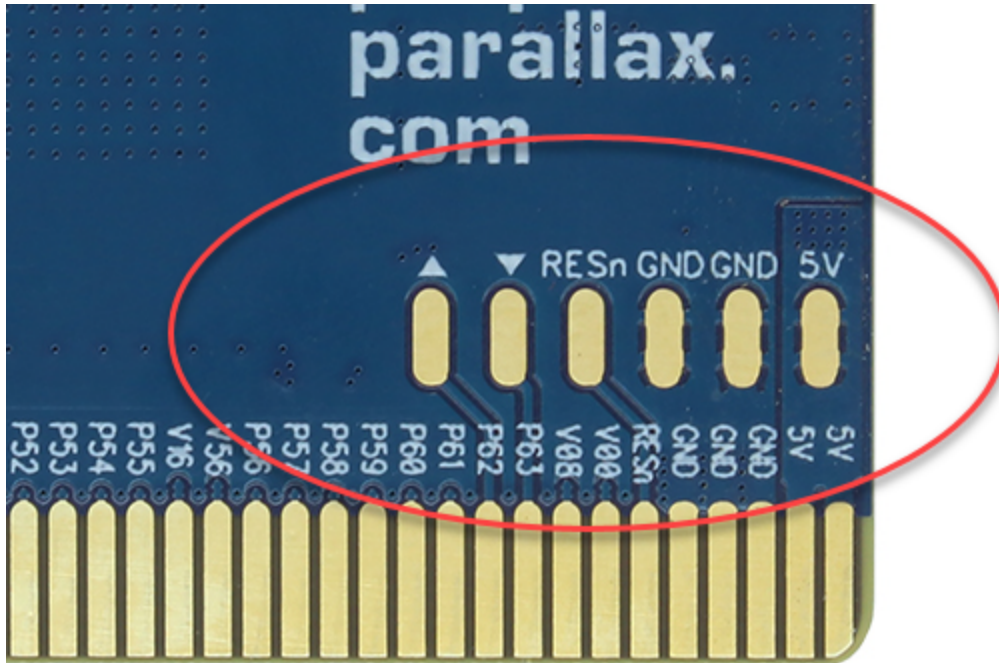
12. Optional 6 way Header Pads (Customer Option)

These six 0.1" spaced pads connect to the Programming pads and 5V Power pads at the edge connector, and may be used to provide power and to program the P2 Edge Module with a Prop Plug programming tool (#32201). A suitable header from Samtec: TSM-106-01-F-SH.

Programming Header Pads

Marked △ ▽ RESn GND, the programming pins are compatible with the Parallax Prop Plug programming tool (#32201). The P2 Edge Module can also be programmed through the edge connector, but for customers that would like to use an existing Prop Plug (or similar) programming method, these pads provide a convenient option. Refer to Programming Header Pin Assignments for more information.

Power Header Pads

Marked GND and 5V, these 0.1" spaced pads connect directly to the 5V power rail to provide a convenient power source for customer expansion. These 5V and GND pads may be used to connect a power source to power the P2 Edge Module PCB, instead of using the edge connector. In this case, the supply voltage range can be 4.5V to 5.5V, and **MUST NOT exceed 5.5V!**

> ⚠️ **Warning! DO NOT connect a power source to both the edge connector and power header 5V pads at the same time! Users wanting to use this functionality should refer to the P2 Edge Module schematic and proceed at their own risk.**

Propeller 2 Physical Pins

This illustration identifies the physical pins on the Propeller 2. See the Propeller 2 documentation at www.parallax.com for detailed information about the device. In this document, see the Edge Connector Pin Assignments section for details on how they are used on the P2 Edge Module.

Top pins (left to right, 100–76):
RESN (100), P63 (99), P62 (98), V6063 (97), P61 (96), P60 (95), VDD (94), P59 (93), P58 (92), V5659 (91), P57 (90), P56 (89), VDD (88), P55 (87), P54 (86), V5255 (85), P53 (84), P52 (83), VDD (82), P51 (81), P50 (80), V4851 (79), P49 (78), P48 (77), VDD (76)

Left pins (top to bottom, 1–25):
TEST (1), VDD (2), P0 (3), P1 (4), V0003 (5), P2 (6), P3 (7), VDD (8), P4 (9), P5 (10), V0407 (11), P6 (12), P7 (13), VDD (14), P8 (15), P9 (16), V0811 (17), P10 (18), P11 (19), VDD (20), P12 (21), P13 (22), V1215 (23), P14 (24), P15 (25)

Right pins (top to bottom, 75–51):
P47 (75), P46 (74), V4447 (73), P45 (72), P44 (71), VDD (70), P43 (69), P42 (68), V4043 (67), P41 (66), P40 (65), VDD (64), P39 (63), P38 (62), V3639 (61), P37 (60), P36 (59), VDD (58), P35 (57), P34 (56), V3235 (55), P33 (54), P32 (53), VDD (52), XI (51)

Bottom pins (left to right, 26–50):
VDD (26), P16 (27), P17 (28), V1619 (29), P18 (30), P19 (31), VDD (32), P20 (33), P21 (34), V2023 (35), P22 (36), P23 (37), VDD (38), P24 (39), P25 (40), V2427 (41), P26 (42), P27 (43), VDD (44), P28 (45), P29 (46), V2831 (47), P30 (48), P31 (49), XO (50)

Chip markings: P2X8C4M64P, P2, PARALLAX INC, AWLYYWW, CCCCC

Edge Connector 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 Propeller 2 documentation at www.parallax.com for detailed information about the full capabilities of the Propeller 2 Smart I/O pins.

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 connector pin V00.
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 connector pin V08.
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 connector pin V16.
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 connector pin V24. Note: Avoid using these I/O pins for high speed digital functions where multiple pins are simultaneously switching together at near the system clock frequency.
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 connector pin V32.
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 connector pin V40.
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 connector pin V48.
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 connector pin V56.
	Alternative functions for P56-P63
P56	Buffered LED
P57	Buffered LED
P58	Flash SPI DO (MISO)
P59	Flash SPI DI (MOSI)
P60	Flash SPI CLK
P61	Flash SPI CS
P62	Prop-Plug RX (P2 TX)
P63	Prop-Plug TX (P2 RX)

Other Pins	Description
RESn	Internally pulled up to 3.3V with 10K resistor. Propeller chip will reset when RESn driven low; all cogs disabled and I/O pins floating. Propeller restarts 3 ms after RESn transitions from low to high.
5V	Power input pins for the Edge Module. Connect both 5V edge connector pads to a good quality 5VDC supply. **The supply voltage MUST NOT exceed 5.5V!** Recommended minimum supply current 100mA, up to 3A depending on customer code and circuit. Factors contributing to current requirements include operating frequency, number of operating cogs, smart pin instruction types and external I/O circuitry.
GND	Provides common signal and supply voltage ground. Connection of all edge connector GND pads to a solid ground plane on an external layer recommended.
NC	Not Connected. Reserved for future use. Recommended "Do Not Connect" in customer designs.

Programming Header Pin Assignments

The P2 Edge Module uses the following markings for the optional programming header pads located on the back of the module : △ ▽ RESn GND. The arrows point inward (toward) the pad for RX and outward (away from) the pad for TX.

When using a serial programming device, such as Prop Plug, ensure that the Prop Plug TX pin connects to the P2 Edge RX pin, and that that Prop Plug RX pin connects to the P2 Edge TX pin.

Programming Software

Propeller Tool is our recommended tool for programming the P2 Edge Module in SPIN and PASM languages. Other programming languages are possible using third party tools, such as C, BASIC, Forth.

You can find links to the latest tools at the P2 Edge Module product page. Visit https://www.parallax.com and search for "P2-EC."

Resources and Downloads

Check for the latest version of this document, free software, and example programs from the P2 Edge Module product page. Go to www.parallax.com and search P2-EC.

Recommend and Absolute Maximum Ratings

Symbol	Quantity	Recommended	Maximum	Units
5 VDC	DC Barrel Jack Supply Voltage †	5	5.5	V
P0 - P63	Any I/O Pin	3.3	3.6	V
RESn	Reset input, active low	3.3	3.6	V

Module Dimensions
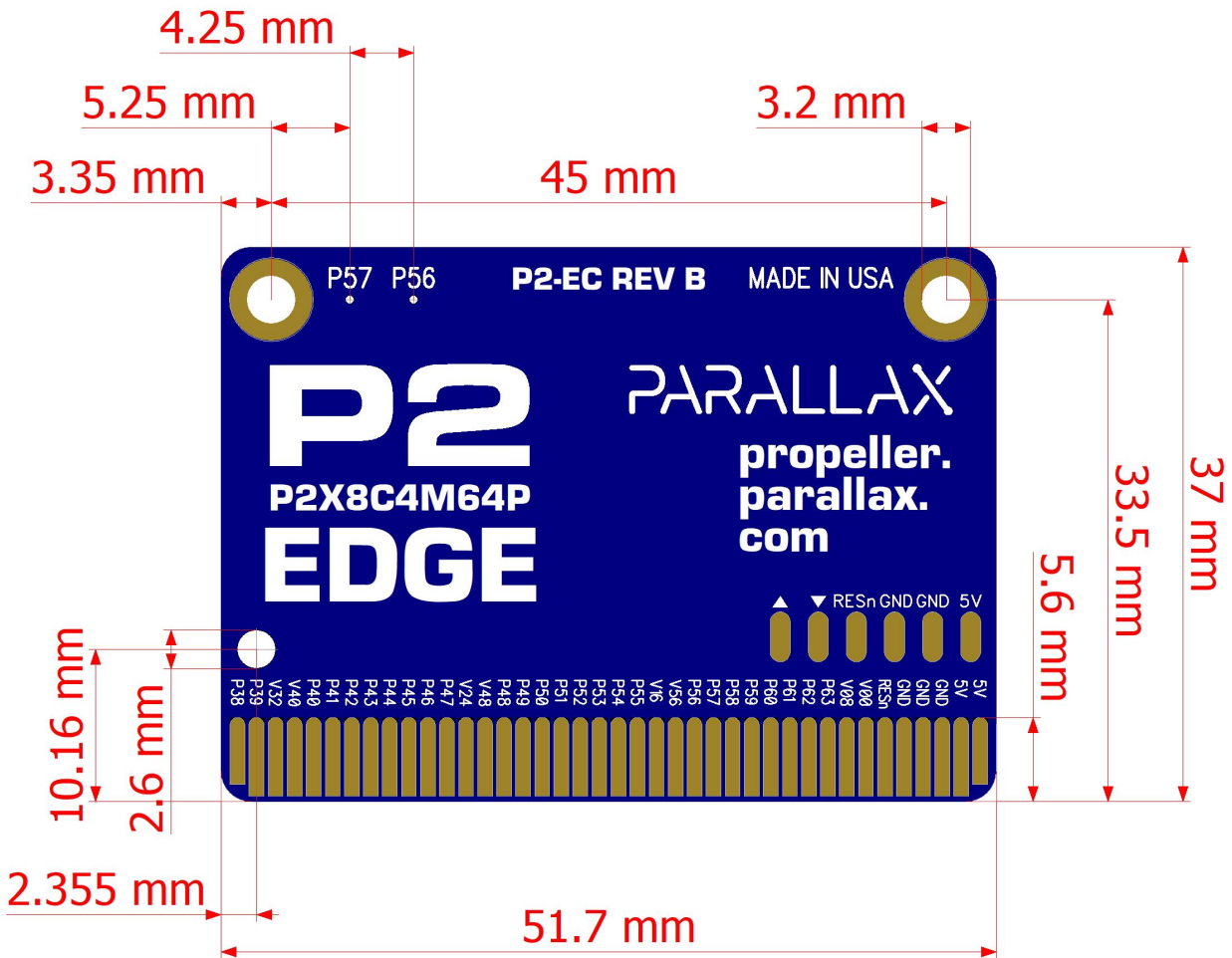
Revision History

Version 1.0: original release.

Version 1.5: Updated for RevB release.

- Silk screen markings added/improved.
- Narrow/adjust the edge pads to allow for thicker copper plating.
- Increase copper plating from 1.5oz to 2oz.
- On-board LEDs P56/P57; color changed to white (previous versions were green).

Version 1.6: Edge Connector Pin Assignments table entry for P24-P31 updated.

Version 1.6: Edge Connector Pin Assignments table entry for P24-P31 updated.