

# PWR-I/O-DB Power and I/O Daughterboard (#28301)

## General Description

The PWR-I/O-DB daughterboard provides convenient interfacing between a Parallax motherboard and various external devices, including servos, serial LCDs, and potentiometers.

**Before using your PWR-I/O-DB, please read and understand this entire document.**

## Features

- Compact size: plugs into, and matches the footprint of, Parallax motherboards.
- Designed to be compatible with all present and future Parallax motherboards.
- Flexible power supply: can be externally powered from a wall transformer, or powered from the motherboard. The DB-GPIO can also power the motherboard itself.
- Onboard +5V regulator and 1000µF filter capacitor for powering servos without introducing noise to logic circuitry.
- Six channels of standard 3-pin interface headers.

## Compatibility

The PWR-I/O-DB is compatible with all MoBoStamps and the MoBoProp.

## Application Ideas

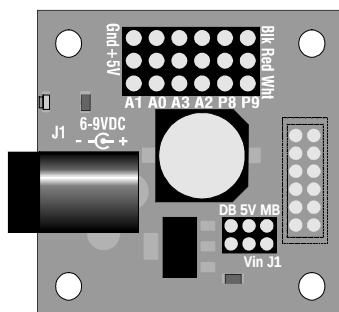
- Robotics
- Remote Sensing
- Data Acquisition
- Industrial Control
- Desktop Appliances

## Resources and Downloads

Check out the PWR-I/O-DB Power and I/O Daughterboard product page for example source code and other resources:

[http://www.parallax.com/detail.asp?product\\_id=28301](http://www.parallax.com/detail.asp?product_id=28301)

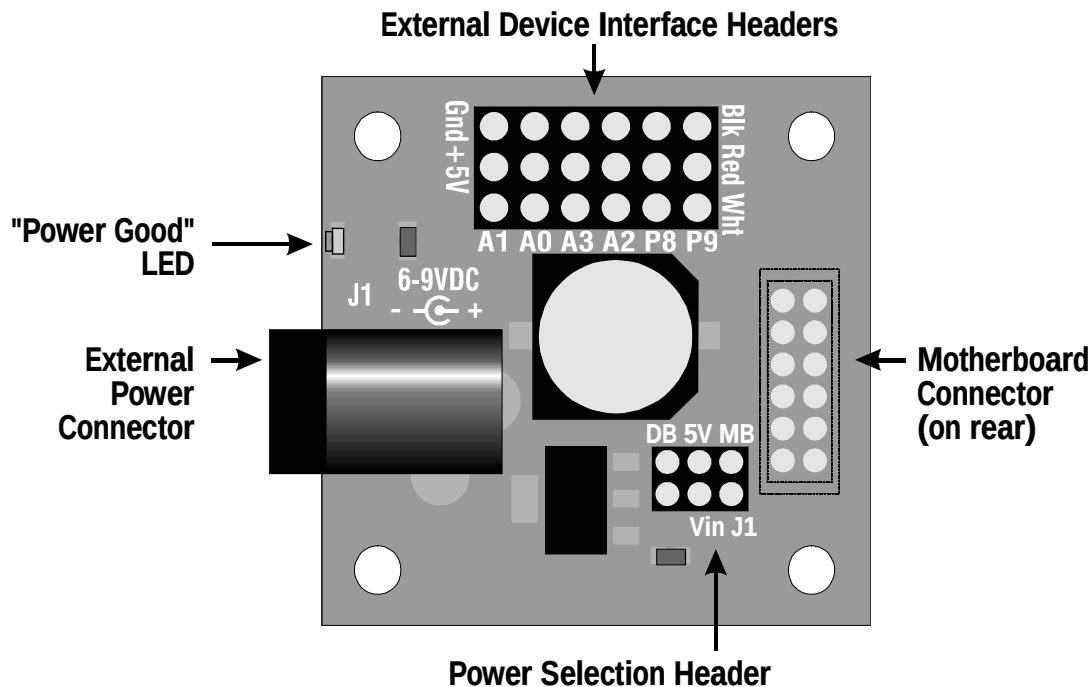
## What's Included



1 ea. PWR-I/O-DB Daughterboard

■ 2 ea. 2mm Jumpers

## Interface Connections and Jumpers



### External Power Connector

The external power connector enables the connection of a filtered, unregulated 6-9VDC power supply to power the motherboard. An example would be Parallax's 7.5V wall transformer (#750-00009). If you will be powering servos from this supply, use as low a power supply voltage as possible. This will help to prevent the onboard 5V regulator from overheating.

### +5V "On" LED

This LED comes on when the board's +5V power level is active. When the board is powered externally, this will occur whenever external power is applied. When the board is powered from the motherboard, the LED will come on once the motherboard's +5V becomes active.

### Power Selection Header

This header, and the jumpers provided for it, serve two purposes:

1. To select the source of the daughterboard's +5V supply, and
2. To enable the external power connector.

The top row, labeled "DB 5V MB", selects the +5V source. By jumpering DB to 5V, the board will be powered from the onboard 5V regulator which, in turn, is powered from the external power connector. By jumpering 5V to MB, the board's +5V source is connected to the motherboard's +5V power supply.

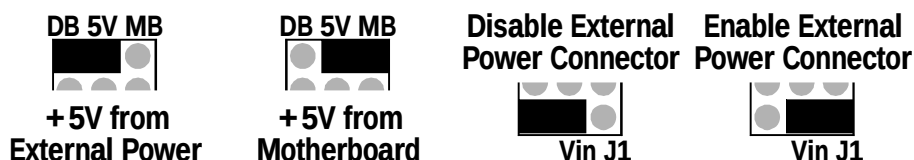
**Important:** When operating servos or other noisy or high-current devices, it is strongly recommended to use external power and *not* the motherboard's +5V supply.

To enable the external power connector, jumper Vin to J1. You will also need to select external power on your motherboard, rather than USB power, to power it from J1 as well. See your motherboard's manual

for the correct jumper selection. This option is only available if the daughterboard is plugged into the motherboard's "A" socket. There is no Vin connection to the "B" socket.

**Important:** When the Vin/J1 jumper is in place, *never* connect power to both the motherboard's and daughterboard's external power connectors simultaneously. When the Vin is sourced from the motherboard, always disconnect the Vin/J1 jumper.

The following diagram summarizes these connections:



### Motherboard Connector

The motherboard connector can be used to plug the daughterboard into either the "A" or "B" socket on the motherboard. When the daughterboard is not otherwise supported by card slots (e.g. in an extrusion), you should use two of the threaded standoffs that came with the motherboard (with screws) in the motherboard's corner holes to secure the daughterboard in place.

### External Device Interface Headers

This header block is configured as six 3-pin headers. Each header provides +5V, ground, and one signal line to an external device. The legend on the daughterboard indicates which motherboard signals appear at each connector, *when the daughterboard is plugged into socket "A"*. When it's plugged into socket "B", these signals will be different. The following table summarizes these differences for the MoBoStamps:

| Legend | Socket "A" Signals                                   | Socket "B" Signals                                  |
|--------|------------------------------------------------------|-----------------------------------------------------|
| A1     | <b>A1</b> (AVR I/O & analog input)                   | <b>B1</b> (AVR I/O & analog input)                  |
| A0     | <b>A0</b> (AVR I/O & analog input)                   | <b>B0</b> (AVR I/O & analog input)                  |
| A3     | <b>A3/P12</b> (AVR/BASIC Stamp I/O & AVR PWM output) | <b>B3/P5</b> (AVR/BASIC Stamp I/O & AVR PWM output) |
| A2     | <b>A2/P11</b> (AVR/BASIC Stamp I/O & AVR PWM output) | <b>B2/P7</b> (AVR/BASIC Stamp I/O & AVR PWM output) |
| P8     | <b>P8</b> (BASIC Stamp I/O w/ pull-up & SDA)         | <b>P0</b> (BASIC Stamp I/O w/ pull-up & SDA)        |
| P9     | <b>P9</b> (BASIC Stamp I/O w/ pull-up & SCL)         | <b>P1</b> (BASIC Stamp I/O w/ pull-up & SCL)        |

Plugging this card into a MoBoProp motherboard will make these connections:

| Legend | Socket "A" Signals                                               | Socket "B" Signals                                               |
|--------|------------------------------------------------------------------|------------------------------------------------------------------|
| A1     | <b>A1</b> (Propeller I/O)<br><b>A19</b> (Propeller analog input) | <b>A9</b> (Propeller I/O)<br><b>A16</b> (Propeller analog input) |
| A0     | <b>A0</b> (Propeller I/O)<br><b>A21</b> (Propeller analog input) | <b>A8</b> (Propeller I/O)<br><b>A18</b> (Propeller analog input) |
| A3     | <b>A3</b> (Propeller I/O)                                        | <b>A11</b> (Propeller I/O)                                       |
| A2     | <b>A2</b> (Propeller I/O)                                        | <b>A10</b> (Propeller I/O)                                       |
| P8     | <b>A5</b> (Propeller I/O w/ pull-up)                             | <b>A13</b> (Propeller I/O w/ pull-up)                            |
| P9     | <b>A4</b> (Propeller I/O w/ pull-up)                             | <b>A12</b> (Propeller I/O w/ pull-up)                            |

**Important:** The power provided at the external device headers is always +5V, regardless of your Vdd selection on the motherboard. This may have unintended consequences if your motherboard is running with a Vdd of 3.3V. For most devices where the signal line is an output to the device (e.g. servos and serial LCDs), this should not be an issue. But for 5V-powered devices that provide an input to the daughterboard (and, hence to the motherboard), the incoming signal level could exceed the safe level for 3.3V operation. In such a case, use a Vdd of 5V instead, or apply external current limiting to the incoming signal.

## Interfacing External Devices

This section gives examples of how to interface various external devices to the daughterboard. However, the range of devices that can be plugged in is not limited to those in the examples and includes the following Parallax products (with part numbers):

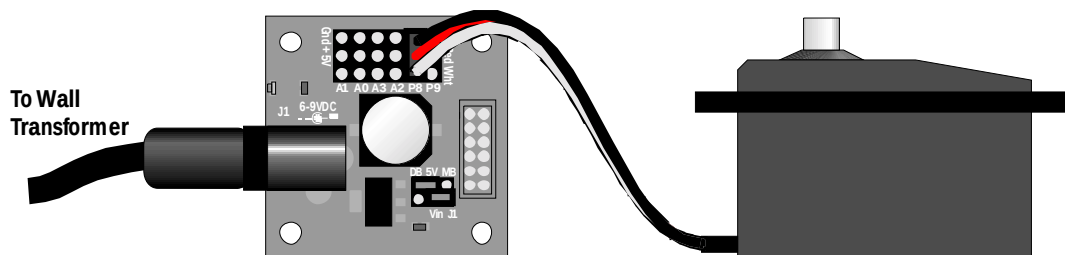
- Ping))) Ultrasonic Rangefinder (28015)
- 2x16 Serial LCD (27976, 27977)
- 4x20 Serial LCD (27979)
- Standard Servo (900-00005)
- Standard Continuous Rotation Servo (900-00008)
- Mini Servo (900-00010)
- LM34 Temperature Probe (800-00027)
- DS2760 Thermocouple Kit (28022)
- QTI Line Sensor (555-27401)
- Passive Infrared (Motion) Sensor (555-28027)

### Servos

Servos can be connected to any of the six headers. However, for servos to work on A0 and A1, there needs to be special firmware loaded into the AVR to pulse them. Such firmware could also pulse servos connected to A2 and A3. Servos connected to A2, A3, P8, and P9 can be pulsed directly from the BASIC Stamp.

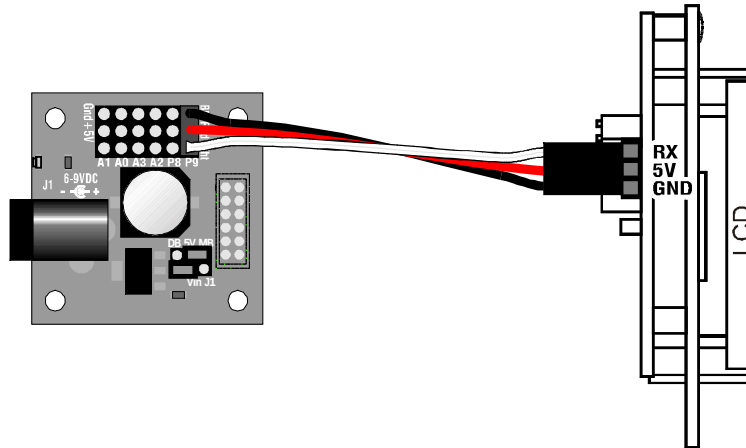
**Important:** When using the PWR-I/O-DB with servos, be sure to use as low a voltage on Vin as possible to keep the 5V regulator from overheating – especially during stall conditions.

A typical servo installation will look like the following:



### Serial Devices

Serial devices, such as LCD displays, interface readily to the PWR-I/O-DB. They can be connected using the Parallax "LCD Extension Cables" (#805-00011 and #805-00012). A typical LCD installation is shown below:



Serial devices can communicate directly with the BASIC Stamp on headers A2, A3, P8, and P9. They can communicate with the AVR on headers A0, A1, A2, and A3, but to do so requires the appropriate AVR firmware to be loaded.

**Important:** Serial devices which communicate back to the BASIC Stamp, AVR, or Propeller will likely do so with a 5V signal level for “high”. For this reason, it is important to set Vdd on the MoBoStamp motherboard to 5V or to use a current-limiting resistor (4.7K for A0-A2, 1.2K for P8-P9) in series with the white signal wire. When interfacing to the MoBoProp motherboard, use 2.2K current-limiting resistors.

### Analog Input

Analog voltage levels can be coupled to A0 and A1 to be measured by the AVRs on MoBoStamp boards. This function is included in the GPIO-3 coprocessor firmware preinstalled in the MoBoStamp motherboard. Analog readings are referred either to the AVR's Vdd or to its internal 1.1V reference. This has some consequences for both accuracy and component safety, depending on how the mother- and daughterboard's power select jumpers are set. There are two measures of accuracy: 1) Absolute, which refers to the ability to determine a specific voltage, and 2) Ratiometric, which determines the ability to measure a voltage as a percentage of the device header's 5V supply (source ref). The following table approximates these relationships for the MoBoStamp. Other contributory factors will include further down-regulation of the source reference and electrical noise.

| DB 5V | MB USB/EXT | MB 5V/3.3V | Source Ref | AVR's Ref         | Absolute Accuracy | Ratiometric Accuracy |
|-------|------------|------------|------------|-------------------|-------------------|----------------------|
| DB    | USB        | 5V         | DB 5V Reg  | Vdd (USB 5V)      | Poor              | Poor                 |
|       |            |            | DB 5V Reg  | Int 1.1V Ref      | Good *            | Fair *               |
|       |            | 3.3V       | DB 5V Reg  | Vdd (MB 3.3V Reg) | Good †            | Fair †               |
|       |            |            | DB 5V Reg  | Int 1.1V Ref      | Good *†           | Fair *†              |
|       | EXT        | 5V         | DB 5V Reg  | Vdd (MB 5V Reg)   | Good              | Fair                 |
|       |            |            | DB 5V Reg  | Int 1.1V Ref      | Good *            | Fair *               |
|       |            | 3.3V       | DB 5V Reg  | Vdd (MB 3.3V Reg) | Good †            | Fair †               |
|       |            |            | DB 5V Reg  | Int 1.1V Ref      | Good *†           | Fair *†              |
| MB    | USB        | 5V         | USB 5V     | Vdd (USB 5V)      | Poor              | Good                 |
|       |            |            | USB 5V     | Int 1.1V Ref      | Good *            | Poor *               |
|       |            | 3.3V       | USB 5V     | Vdd (MB 3.3V Reg) | Good †            | Poor †               |
|       |            |            | USB 5V     | Int 1.1V Ref      | Good *†           | Poor *†              |
|       | EXT        | 5V         | MB 5V Reg  | Vdd (MB 5V Reg)   | Good              | Good                 |
|       |            |            | MB 5V Reg  | Int 1.1V Ref      | Good *            | Fair *               |
|       |            | 3.3V       | MB 5V Reg  | Vdd (MB 3.3V Reg) | Good †            | Fair †               |
|       |            |            | MB 5V Reg  | Int 1.1V Ref      | Good *†           | Fair *†              |

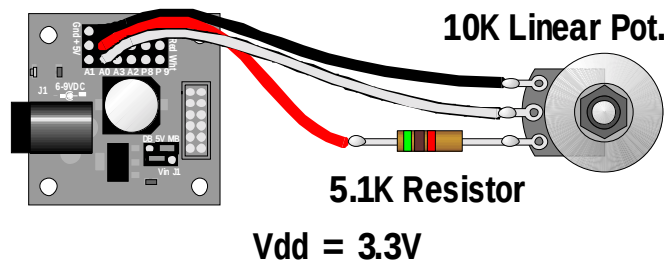
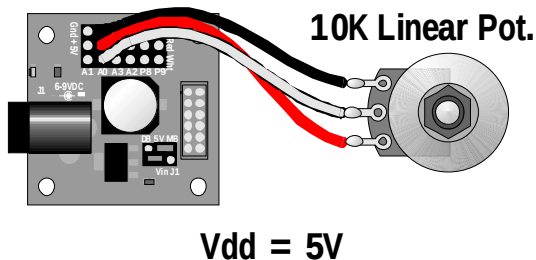
"Reg" stands for "regulator"; "Int", for "internal".

\* Use a divider to divide fullscale output to 1.1V. Voltages above 1.1V will read as \$3FF.

† **Input voltage must not exceed 3.3V.** Use a divider to divide fullscale output to 3.3V, or use a series current-limiting resistor to limit voltages above 3.3V to 3.3V at the AVR's input.

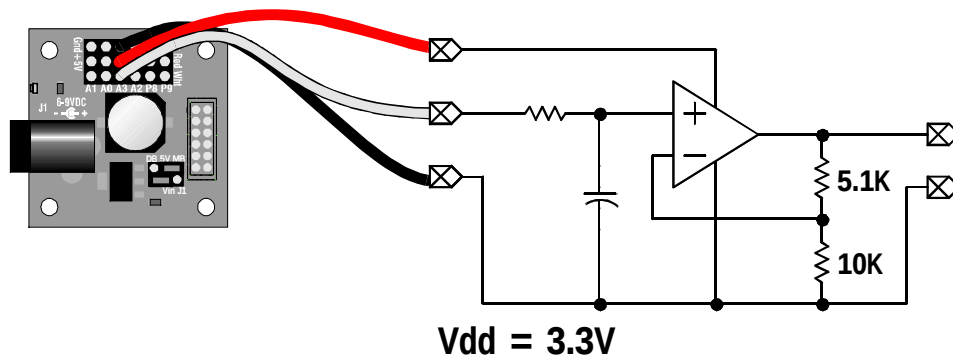
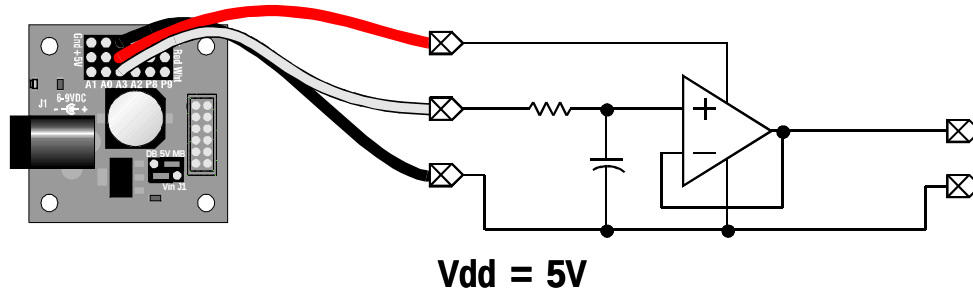
Absolute accuracy is deemed "poor" if the AVR's voltage reference is unregulated; "good", otherwise. Ratiometric accuracy is deemed "poor" if the source reference and AVR reference are different, and at least one of them is unregulated; "fair", if the two references are different, but both are regulated; "good", if both references are the same, whether regulated or not.

The following illustrations show how a potentiometer can be connected as an analog input device to the PWR-I/O-DB:



## Analog Output

The AVR offers two PWM outputs, which, with filtering, can be converted to an analog voltage. The Propeller offers duty-cycle outputs, which can also be filtered to yield an analog voltage. The illustrations below show a couple analog output configurations that yield a 0-5V output:

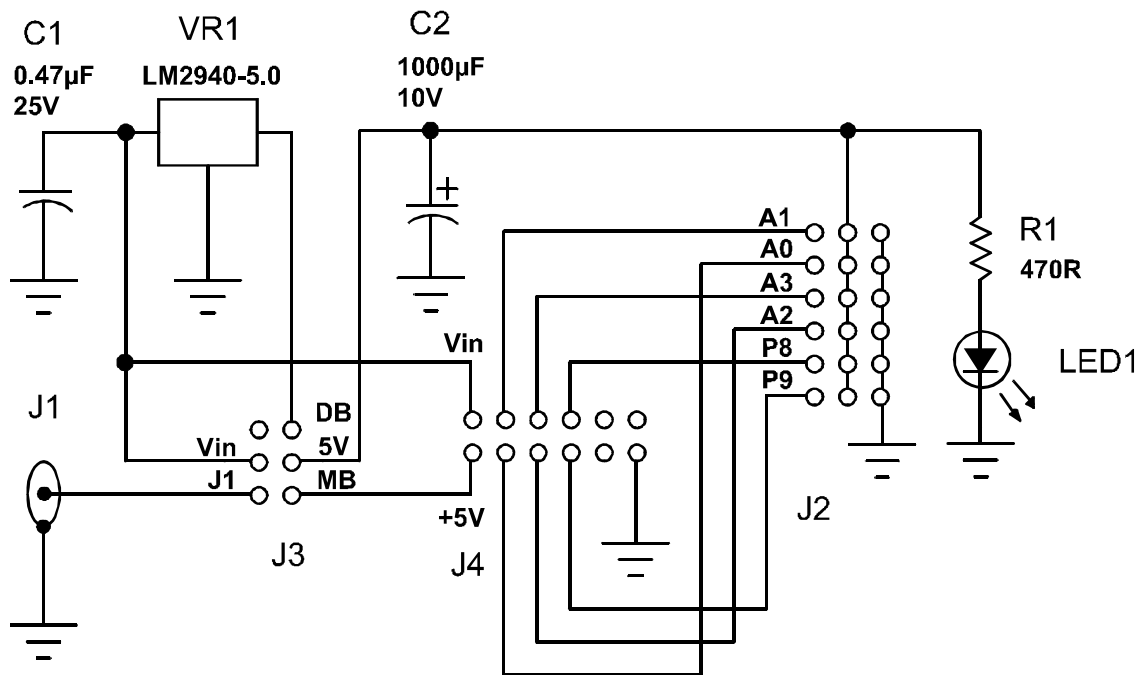


In each case, the op amp should be selected to accommodate rail-to-rail inputs and outputs.

## Specifications

|                                        |                                       |
|----------------------------------------|---------------------------------------|
| Circuit Board Size                     | 1.35" x 1.35"                         |
| Mounting Hole Centers                  | 1.00" square                          |
| External Supply (optional)             | 6 – 9 VDC                             |
| +5V Supply from Motherboard (optional) | 4 – 5 VDC                             |
| External device connectors             | 0.025" square headers on 0.1" centers |
| External Power Connector               | 2.1mm Coaxial                         |

## Schematic





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