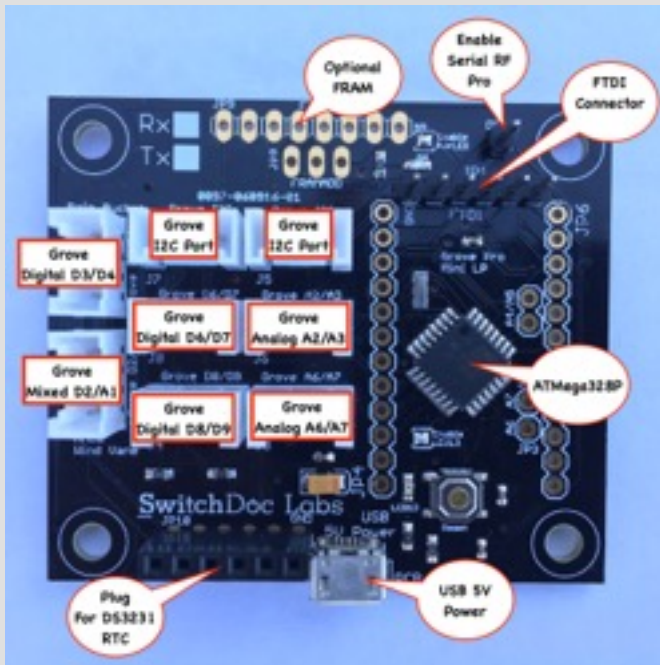


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Features and Benefits:

- 8MHz Low Power Processor
- 12 GPIO pins
- 1 Hardware Serial Port
- 8 - 10 Bit Analog ports
- I2C Interface
- Reset Pin
- Multiple SoftSerial Ports
- SPI Interface
- Really Low Power Usage (for Solar applications!)
- Grove Connector Compatibility for IOT Prototyping
- ATMega328P Processor
- Arduino Pro Mini Compatible Pinout
- Under 1mA sleep current
- DS3231 Real Time Clock Included
- 3.3V - 5V
- Arduino IDE Compatible
- Thousands of drivers available
- Compatible with Hundreds of Grove Sensors
- Low Cost
- Full Test Code Supplied
- Quantity Discounts Available
- Immediate Availability

The **Grove Pro Mini LP** is an Arduino compatible computer board with a full set of Grove devices. It is designed for use in Low Power applications such as battery and Solar Power applications. The Grove connectors allow quick and solderless prototyping of IOT applications.

- Full Compatible Pinout with the Arduino Pro Mini
- 8 Different Grove Connectors
- Allows you to build circuits with no soldering

Introduction



The Arduino family of processors is a fabulous prototyping and building system for Makers. The combination of the Arduino IDE with its thousands of available drivers for sensors and the ATmega line of processors have spawned a tremendous burst of creativity around the world.

We redesigned the Arduino Pro Mini LP board to be very low power. We removed the regulating power supply, modified the circuit to run the processor at 8MHz and provided 3.3V and 5V compatibility.

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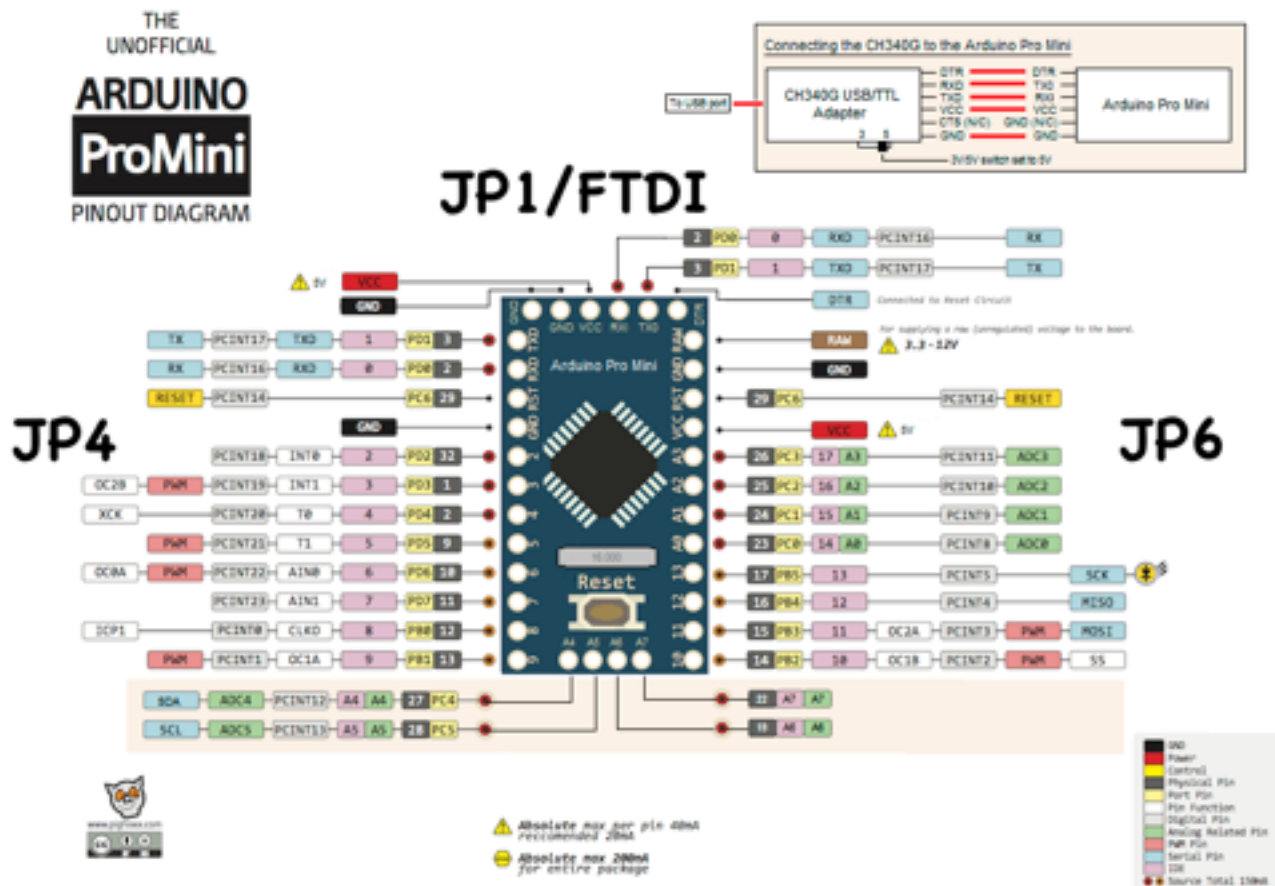
Each Grove Pro Mini LP Board ships with a plug-in DS3231 highly accurate RTC (Real Time Clock) that can be used to wake the Grove Pro Mini LP up at regular intervals or even on specific dates! (Software provided).

Combine the Grove Pro Mini LP with a SunAir or SunAirPlus board to create a solar powered IOT device

Additional code and examples on www.switchdoc.com on the Grove Pro Mini LP Product Page

Theory of Operation

Pro Mini Arduino Operation



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This section is a modified version of the official Arduino Pro Mini documentation modified for low power operation (the Grove Low Power Pro Mini LP).

Power

The Grove Pro Mini can be powered with an FTDI cable or breakout board connected to its six pin header, or with a regulated 3.3V or 5V supply on the VDD pin. On the Grove Pro Mini LP, the RAW pin is not connected. There is no voltage regulator on the board. You must supply regulated 3.3V or 5V to the VDD pin. The power pins are as follows:

RAW - No Connect

VDD - The regulated 3.3 or 5 volt supply.

GND - Ground pins.

Memory

The ATmega328 has 32 kB of flash memory for storing code (of which 0.5kB is used for the bootloader). It has 2 kB of SRAM and 1kB of EEPROM (which can be read and written with the [EEPROM library](#)).

Input and Output

Each of the 14 digital pins on the Grove Pro Mini LP can be used as an input or output, using [pinMode](#), [digitalWrite](#), and [digitalRead](#) functions. They operate at 3.3 or 5 volts (depending on what VDD is connected to). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the TX-0 and RX-1 pins of the six pin header.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the [attachInterrupt](#) function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the [analogWrite](#) function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Grove Pro Mini LP has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). Four of them are on the headers on the edge of the board; two (inputs 4 and 5) on holes in the interior of the board. The analog inputs measure from ground to VDD. Additionally, some pins have specialized functionality:

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I2C: A4 (SDA) and A5 (SCL). Support I2C (TWI) communication using the [Wire library](#).

There is another pin on the board:

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a n external reset function.

Communication

The Grove Pro Mini LP has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL serial communication, which is available on digital pins 0 (RX) and 1 (TX). The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board via a USB connection.

A [SoftwareSerial library](#) allows for serial communication on any of the Pro Mini's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a [Wire library](#) to simplify use of the I2C bus; see the [reference](#) for details. To use the SPI communication, please see the ATmega328 datasheet.

Programming

The Grove Pro Mini LP can be programmed with the Arduino software [download](#). For details, see the [reference](#) and [tutorials](#).

The ATmega328 on the Grove Pro Mini LP comes preburned with a [bootloader](#) that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol [reference](#) , [C header files](#).

You can also bypass the bootloader and program the ATmega328 with an external programmer; see [these instructions](#) for details.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino Pro Mini is designed in a way that allows it to be reset by software running on a connected computer. One of the pins on the six-pin header is connected to the reset line of the ATmega328 via a 100 nF capacitor. This pin connects to one of the hardware flow control lines of the USB-to-serial convertor connected to the header: RTS when using an FTDI cable. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of the reset line can be well-coordinated with the start of the upload.

This setup has other implications. When the Grove Pro Mini LP is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the boot loader is running on the Pro. While it is programmed to ignore malformed data

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(i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

Software

Software and drivers for Grove Pro Mini LP boards for the Raspberry Pi and the Arduino can be located on the SwitchDoc Labs Grove Pro Mini LP product page (www.switchdoc.com). The Pro Mini LP can be programmed as any Arduino compatible device through the Arduino IDE (select Arduino Pro or Pro Mini from Board Manager and then ATmega328 (3.3V, 8Mhz). Note you can run the board at 5V, but you must still



choose the 3.3V, 8MHz from the menu. This board runs at 8MHz to reduce current consumption.

I2C Interface

The I2C interface has two sections. J3 and J7 provide Grove I2C connectors (3.3V or 5V) and JP4 provides a pin header I2C interface.

DS3231/EEPROM Real Time Clock

The SwitchDoc Labs DS3231/EEPROM combination is included with the Grove Pro Mini LP board. It is plugged in by the user into JP11, taking care to having the battery facing the top of the board.

The DS3231 is a low-cost, extremely accurate I2C real-time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains

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accurate timekeeping when main power to the device is interrupted. The integration of the crystal resonator enhances the long-term accuracy of the device.

The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator. Two programmable time-of-day alarms and a programmable square-wave output are provided. Address and data are transferred serially through the I2C bidirectional bus.

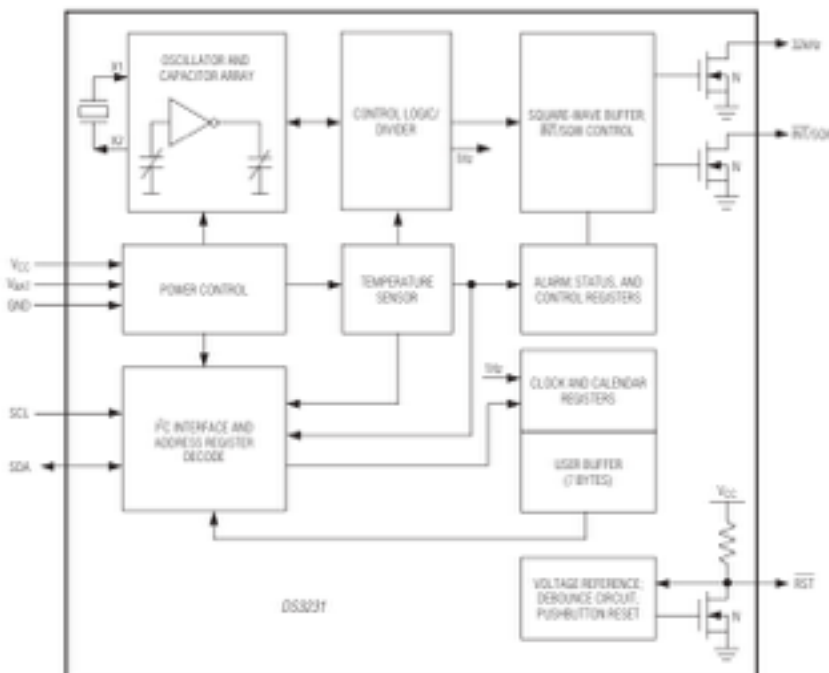
A precision temperature-compensated voltage reference and comparator circuit monitors the status of VDD to detect power failures, to provide a reset output, and to automatically switch to the backup supply (battery included) when necessary. Additionally, the RST pin is monitored as a pushbutton input for generating a μ P reset.

Note that the 32KHz line and the NINT/SQW Line are connected to D3/D2 on the Grove Pro Mini LP respectively. This allows you to use the DS3231 as a timer and alarm source of interrupts.

The specifications for this device is on the SwitchDoc Labs Grove Pro Mini LP product page.

AT24C32 32KB EEPROM

The AT24C32 provides 32,768 bits of serial electrically erasable and programmable read only memory (EEPROM) organized as 4096 words of 8 bits each. The EEPROM drivers are included in the SwitchDoc driver software.

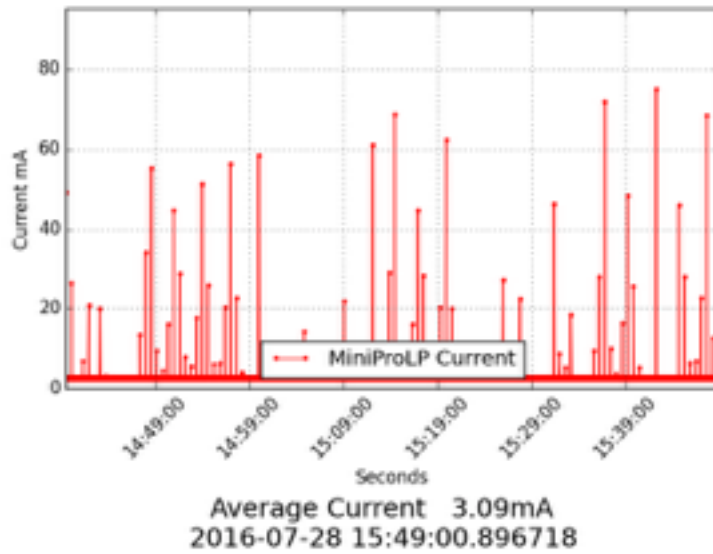


Operating Values

	Min	Normal	Max	Unit
VDD	3.313V		5.25	V
Idd*		<5		mA

*Grove Pro Mini LP Power Consumption depends on what other devices you have added to the board.

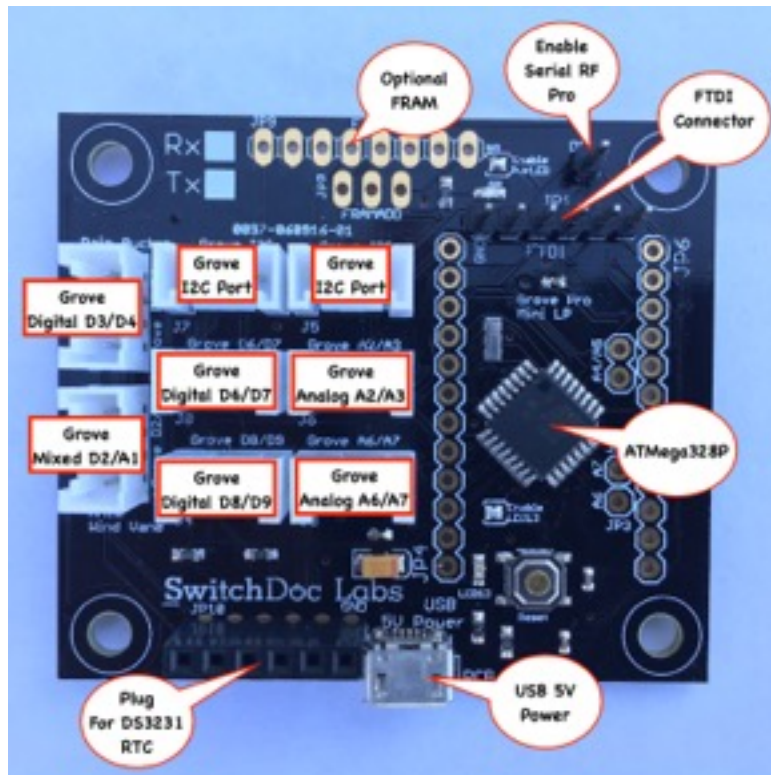
Actual Current Measurement Results. The tall spikes are when the radio transmitter is on (for a very short time - we still end up with < 5mA average current).



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Arduino Device Power Comparison			
Device	Current while Running	Current While Sleeping	Operating Voltage
Arduino UNO	59mA	43mA	5V
Arduino Mega2560	85mA	62mA (estimate)	5V
Arduino Mini Pro	18mA	11mA	5V
Grove Mini Pro LP	9mA	0.600mA	5V
Grove Mini Pro LP	3.8mA	< 0.400mA	3.3V

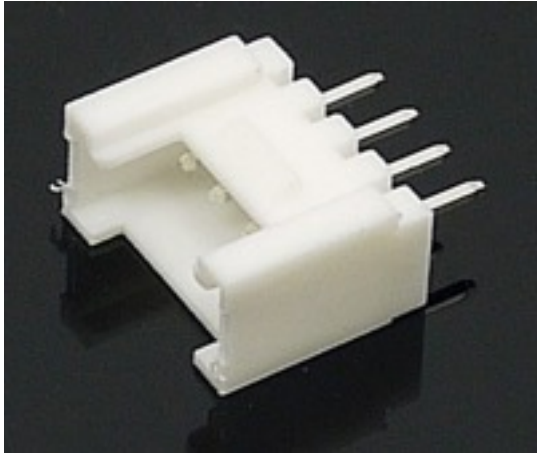
Grove Pro Mini LP Board Jumper Pin and Plug Locations



Physical dimensions of board: 50mm x 50mm x 10.0mm(max). Mounting holes inset 3.2mm x 3.2mm from each corner to center of hole. Diameter of hole 3mm.

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What is a Grove Connector?



The way we have been wiring I2C connections before just didn't work for large projects. Basically, we used to put the I2C bus to screw terminals or snap down connectors and then ran wires to each device. This would not work for complex projects. Because of this, we moved to Grove connectors.

There are dozens of Grove I2C sensors out now. Many different kinds of cables and I2C Hubs.

We quickly found the connectors and their respective cables very useful. With the large selection of Grove I2C devices available, we decided to include a Grove connector on all our future I2C boards. The white connectors on the Grove Pro Mini LP board picture at the top are Grove connectors for easy, non-soldered connections to the

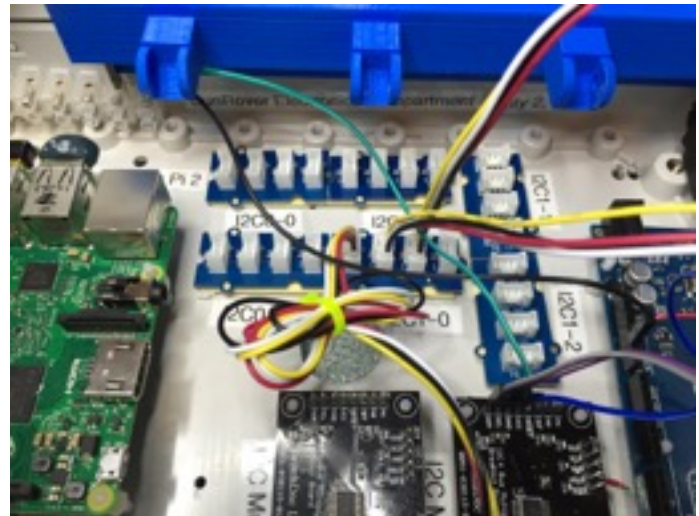
I2C bus and for data inputs. The picture below shows the SunRover robot built using Grove connectors for the 8 different I2C busses in the robot. A Grove OLED display is shown underneath the picture.



Connecting to Grove Connectors

There are a number of Grove shields and Hats for Raspberry Pi and Arduino devices.

Grove I2C Connectors are keyed so they can not be plugged in incorrectly. Below is the I2CMux board hooked up with both Grove and non-Grove devices.





What Grove Connectors Are On The Grove Pro Mini LP?

There are two types of Grove Connectors on the Grove Pro Mini LP board. There is two Grove I2C connectors, three Grove Digital connectors, two Grove Analog connectors and one Mixed Digital/Analog connector.

Grove Digital

A digital Grove connector consists of the standard four lines coming into the Grove plug. The two signal lines are generically called D0 and D1. Most modules only use D0, but some do (like the LED Bar Grove display) use both. Often base units will have the first connector called D0 and the second called D1 and they will be wired D0/D1 and then D1/D2, etc.

Grove Digital		
Pin 1	D0	Primary Digital Input/Output
Pin 2	D1	Secondary Digital Input/Output

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Grove Digital		
Pin 3	VDD	Power for Grove Module (5V or 3.3V)
Pin 4	GND	Ground

Grove Analog

An Grove Analog connector consists of the standard four lines coming into the Grove plug. The two signal lines are generically called A0 and D0. Most modules only use A0. Often base units will have the first connector called A0 and the second called A1 and they will be wired A0/A1 and then A1/A2, etc.

Grove Analog		
Pin 1	A0	Primary Analog Input
Pin 2	A1	Secondary Analog Input
Pin 3	VDD	Power for Grove Module (5V or 3.3V)
Pin 4	GND	Ground

Grove I2C

SwitchDoc Labs customers know that our favorite devices are I2C sensors. There are many types of I2C Grove sensors available. Most are 5V/3.3V devices, but there are a few that are only 3.3V or 5.0V. You need to check the specifications.

The Grove I2C connector has the standard layout. Pin 1 is the SCL signal and Pin 2 is the SDA signal. Power and Ground are the same as the other connectors. This is another special version of the Grove Digital Connector. In fact, often the I2C bus on a controller (like the ESP8266, Raspberry Pi and the Arduino) just uses Digital I/O pins to implement the I2C bus. The pins on the Raspberry Pi and Arduino are special with hardware support for the I2C bus. The ESP8266 is purely software.

Note that the Grove I2C Connectors on the Grove Pro Mini LP is a 5V or 3.3V (depending on what VDD is connected to) I2C connector.

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Grove I2C		
Pin 1	SCL	I2C Clock
Pin 2	SDA	I2C Data
Pin 3	VDD	Power for Grove Module (5V or 3.3V)
Pin 4	GND	Ground

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I/O Key:

I - Digital Input
O - Digital Output
A - Analog

Grove Connections

J3 - Grove Analog

J3 - Grove I2C		
Pin 1	A6	Analog A6 Input
Pin 2	A7	Analog A7 Input
Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

J6 - Grove Analog

J6 - Grove I2C		
Pin 1	A2	Analog A2 Input
Pin 2	A3	Analog A3 Input
Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

J5 - Grove I2C

This Connector can be used to connect up to a processor such as the Raspberry PI or to an I2C Hub expander. See articles and application notes on www.switchdoc.com.

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J5 - Grove I2C

Pin 1	SCL	I2C Clock
Pin 2	SDA	I2C Data
Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

J7 - Grove I2C

This Connector can be used to connect up to a processor such as the Raspberry PI or to an I2C Hub expander. See articles and application notes on www.switchdoc.com.

J7 - Grove I2C

Pin 1	SCL	I2C Clock
Pin 2	SDA	I2C Data
Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

J1 - Grove Digital

J1 - Grove Digital

Pin 1	D3	Digital I/O Pin 3
Pin 2	D4	Digital I/O Pin 4
Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

J4 - Grove Digital

J4 - Grove Digital

Pin 1	D8	Digital I/O Pin 8
Pin 2	D9	Digital I/O Pin 9

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J4 - Grove Digital

Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

J8 - Grove Digital

J8 - Grove Digital

Pin 1	D6	Digital I/O Pin 6
Pin 2	D7	Digital I/O Pin 7
Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

J2 - Grove Digital / Analog Mixed Port

This port has one digital signal and one analog signal. It is a specialized port designed for the WXLINK Application and hooking up to the WeatherRack Weather Sensors. It can be used by other applications.

J2 - Grove Digital / Analog

Pin 1	D2	Digital I/O Pin 2
Pin 2	A1	Analog A1 Input
Pin 3	VDD	Power for Grove Module
Pin 4	GND	Ground

Jumper Pin Functions

D5 Pin - Connects to D5 on the Grove Pro Mini LP Board

This pin is generally used to connect to the enable pin on the Serial RF Pro board to reduce power usage. It is a general use pin connected to D5.

JP9 - Optional Non-Volatile FRAM

The MB85RC256V is a 256K-bits FRAM with serial interface (I2C), using the ferroelectric process and CMOS process technologies for forming the nonvolatile memory cells. A FRAM is able to write high-speed even though it is a nonvolatile memory. The optional FRAM module is much faster to read and write to than the included EEPROM device. You can get this device from Adafruit (<https://www.adafruit.com/products/1895>)

It is suitable for the log management and the storage of the resume data, etc. Project Curacao (www.switchdoc.com) uses it to record Weather data during the night when the Raspberry Pi is not powered up. Each byte can be read and written instantaneously (like SRAM) but will keep the memory for 95 years at room temperature. Each byte can be read/written 10,000,000,000,000 times.

NAME	PIN	I/O	DESCRIPTION
VDD	JP6 / 1	A	VDD
GND	JP6 / 2	A	GND
WP	JP6 / 3	I	Write Protect pin. This is used to force write protection so you cannot write to the FRAM. It has an internal pulldown. Bring to a high voltage (VCC) to turn on WP
SCL	JP6 / 4	I	Serial bus clock line; open-drain input. No Pullup on Weather Board board.
SDA	JP6 / 5	I/O	Serial bus data line; open-drain input/output. No Pullup on Weather Board board
A2	JP6 / 6	I	High selection bit (use A2,A1,A0 as three bits and add to 0x50)
A1	JP6 / 7	I	Middle selection bit (use A2,A1,A0 as three bits and add to 0x50)
A0	JP7 / 8	I	Low selection bit (use A2,A1,A0 as three bits and add to 0x50)

JP8 - Optional FRAM Address

Used to set other I2C addresses for the Optional I2C FRAM Module. These are the I2C address selection pins. By

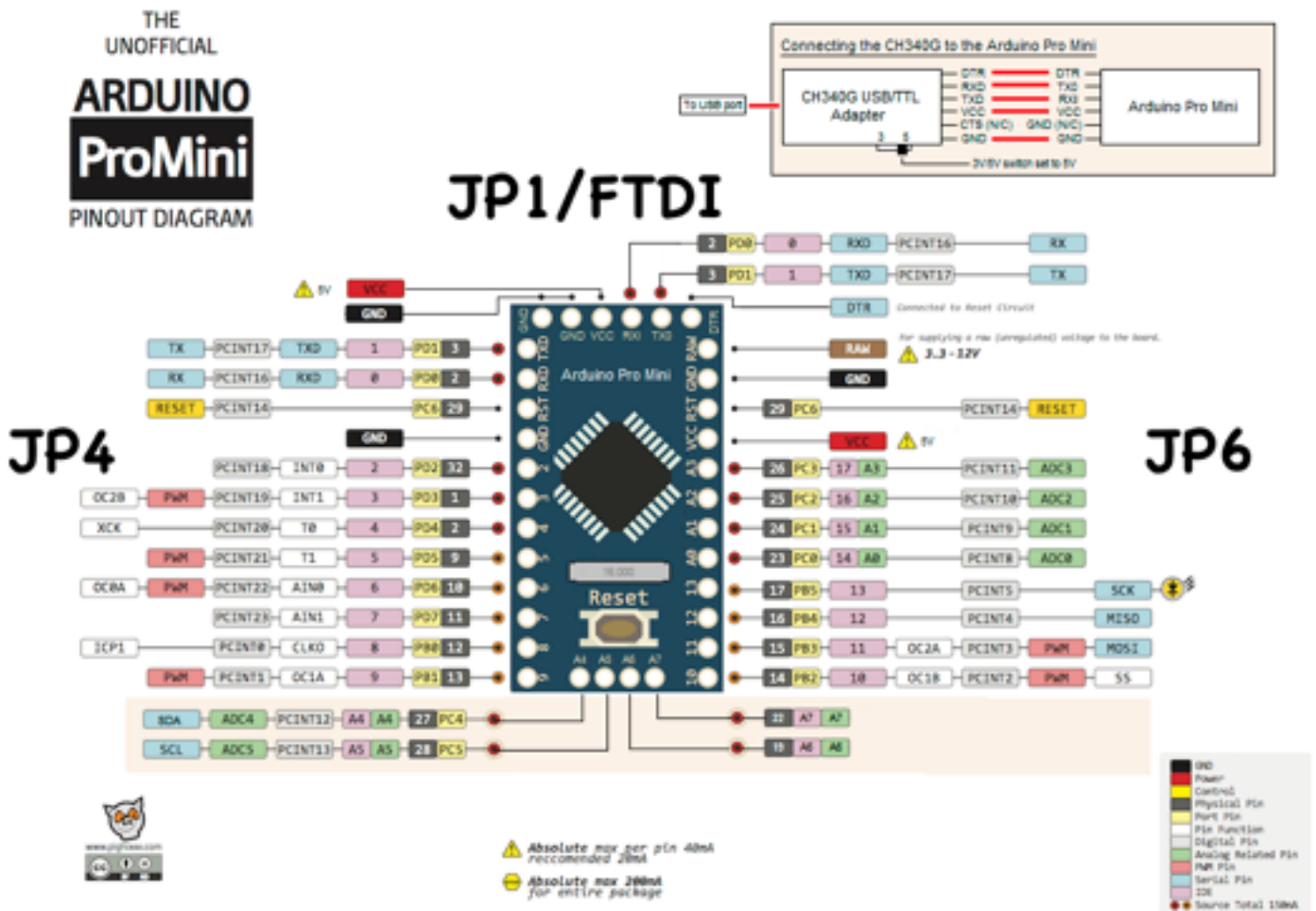
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default the I2C address is 0x50. Connecting these pins to VDD and power cycling the chip will adjust the lower three bits of the address. For example, if A0 is high, the address is 0x51. If A1 and A2 are high, the address is 0x56

NAME	PIN	I/O	DESCRIPTION
A2	JP3 / 1	I	High selection bit (use A2,A1,A0 as three bits and add to 0x50)
A1	JP3 / 2	I	Middle selection bit (use A2,A1,A0 as three bits and add to 0x50)
A0	JP3 / 3	I	Low selection bit (use A2,A1,A0 as three bits and add to 0x50)

The Pro Mini Processor Pinouts (JP1/JP4/JP6)

JP1, JP4 and JP6 are given below in the Arduino Pro Mini diagram. Note that RAW is a no connect on the Grove Pro Mini LP Board as there is no power regulator on the board. You must supply regulated VDD through the VDD pin (VCC pin on the diagram) or through the USB power port on the board. Note that there is no second I2C/Analog pin header as shown at the bottom of the board. This is replaced by Grove connectors and by JP2 and JP3.



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JP2 - I2C Pins

These two pins can be used to provide additional I2C connections. Usually the Grove I2C connectors would be used. These are either 3.3V or 5V depending on the power supply (VDD) fed to the board.

NAME	PIN	I/O	DESCRIPTION
A4	JP2 / 1	A	SDA
A5	JP2 / 2	A	SCL

JP3 - A7/A8 Pins

These two pins provide additional access to A6 and A7 (also on Grove J3).

NAME	PIN	I/O	DESCRIPTION
A6	JP3 / 1	A	Analog A6
A7	JP3 / 2	A	Analog A7

JP10 - Socket for Included DS3231/EEPROM Real Time Clock and Storage

The DS3231 is a low-cost, extremely accurate I²C real-time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted. This is included with the Weather Board Board. **When plugging the DS321 module into the Weather Board make sure to align the GND pins. Battery side towards the center of the board.**



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NAME	PIN	I/O	DESCRIPTION
32K	JP10 / 1	O	32kHz Output. When enabled this is connected to D2 on the Grove Pro Mini LP. It allows you to use this output as an Interrupt source to the Pro Mini LP. You must turn on the internal Arduino pullup on D2 to use.
SQW	JP10 / 2	O	Active-Low Interrupt or Square-Wave Output. This is an open-drain pin. When enabled it is connected to D3 on the Grove Pro Mini LP. Often used as an alarm output from the DS3231. You must turn on the internal Arduino pullup on D3 to use.
SCL	JP10 / 3	I	Serial bus clock line; open-drain input. SCL
SDA	JP10 / 4	I/O	Serial bus data line; open-drain input/output. SDA
VDD	JP10 / 5	A	VDD
GND	JP10 / 6	A	GND

USB Power - 5V USB Power Micro USB

This plug is used to supply 5V power (commonly from a SunAirPlus/SunAir board in solar powered systems). It has no data pins. It is strictly a power plug.