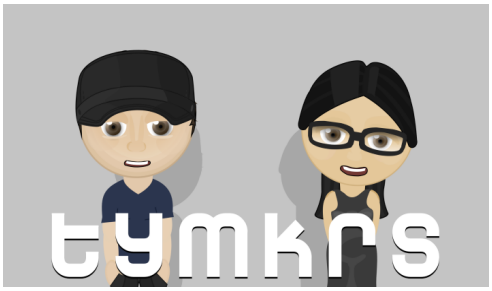
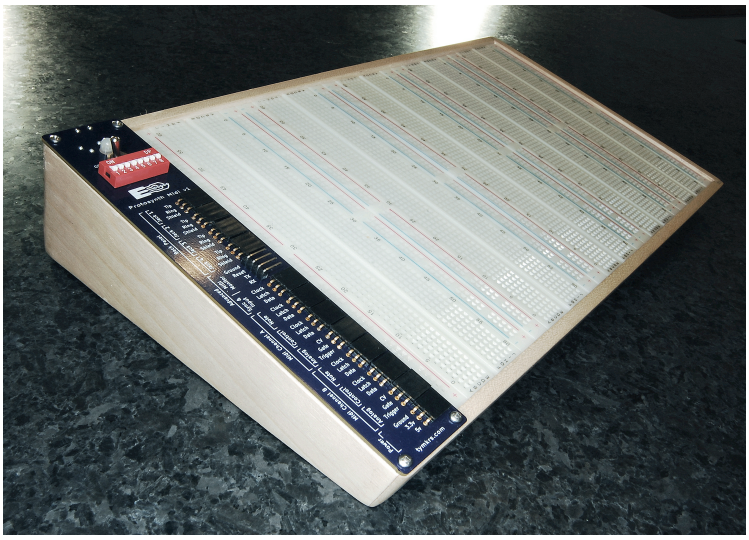


The Toymakers @ tymkrs.com
Questions? Please contact us:
feedback@tymkrs.com

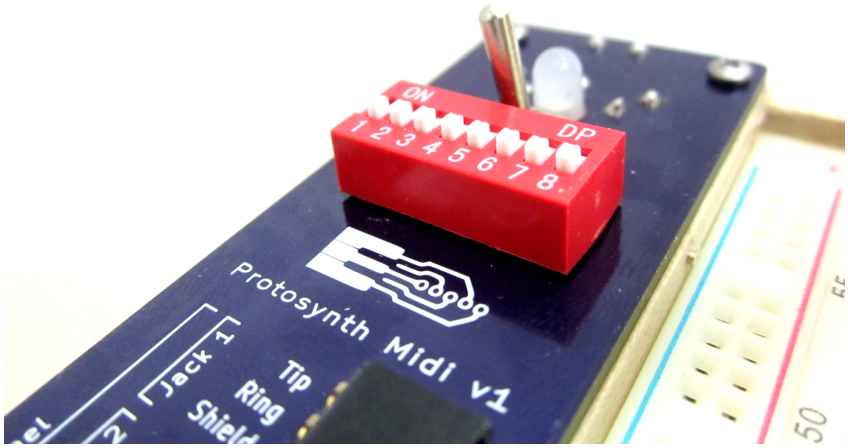
USER MANUAL



Protosynth Midi

The Protosynth Midi is a MIDI prototyping platform that converts incoming MIDI events into electrical signals that make experimentation very simple!

From designing your own synthesizer to controlling all types of electronic devices, your imagination is your only limitation!



Chapter I. What is the Protosynth MIDI?

The Protosynth Midi is a MIDI prototyping platform that converts incoming MIDI events into electrical signals that make experimentation very simple! You can use this to prototype a MIDI-based circuit you've been meaning to work on, or you can use MIDI signals to control other electrical components such as servos, LEDs, and any other components you can think of!

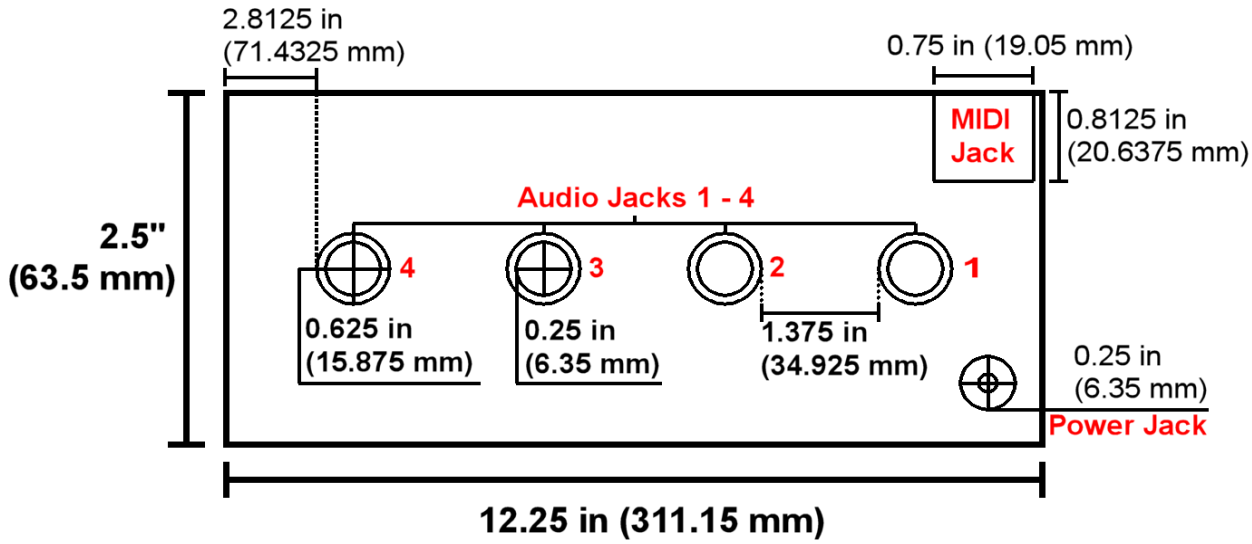
Chapter II. Technical Specifications of Protosynth MIDI Connections

i. **Back Panel:**
   1. **Power Jack:** The 7.5VDC power supply, capable of sourcing 1 amp, is provided with your Protosynth MIDI. The power jack plug is a standard 2.1mm center-positive barrel jack supporting 5-7.5VDC.

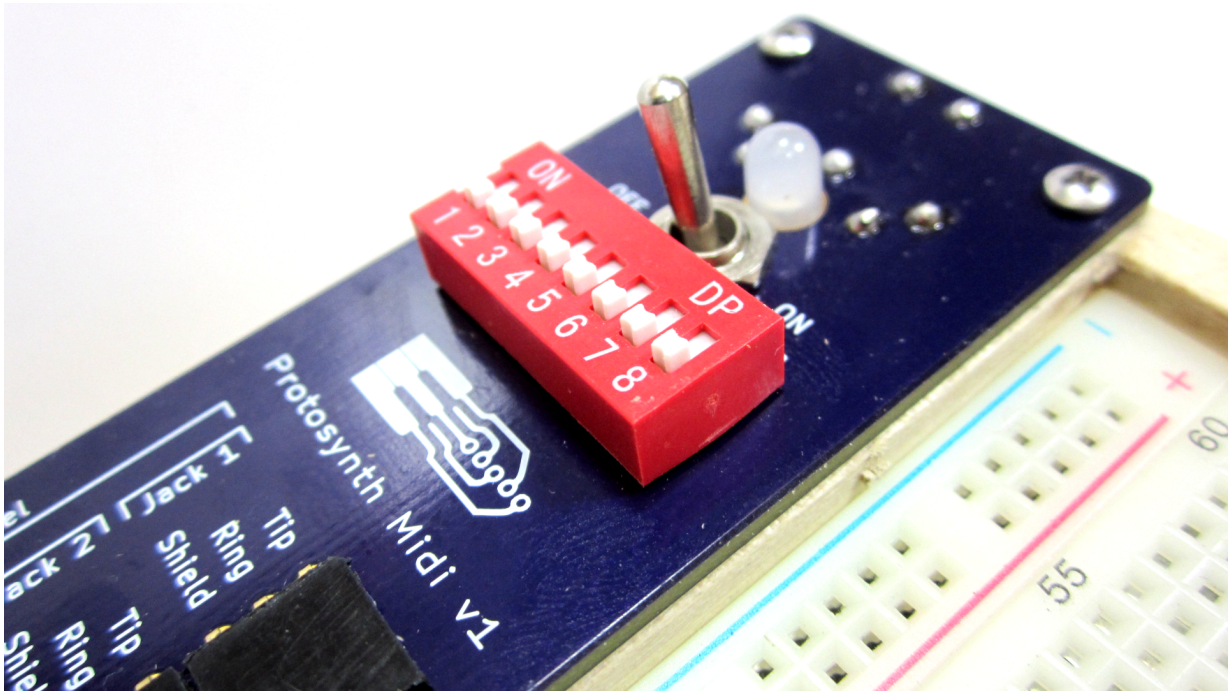
Power Supply Specifications:

Parameter	Minimum Rating	Nominal Rating	Maximum Rating	Units
AC Input Voltage	100		240	VAC
DC Output Voltage	0		7.5	VDC
Load	0		1	A
Output Adapter		5.5 x 2.1		mm
Dimension		7.6 x 7.5 x 2.6		cm
Length of cable		110		cm

   2. **Jacks 1 – 4:** Four standard 1/4" TRS female jacks are mounted to the back panel. Connections to each tip, ring, and shield are accessible via the patch panel. Each tip, ring, and shield of a 1/4" jack are isolated from the rest of the circuit except where indicated on the patch panel.
   3. **MIDI Jack:** This supports a standard 5-pin DIN MIDI cable. The MIDI jack meets MIDI specifications and is an optically isolated input.

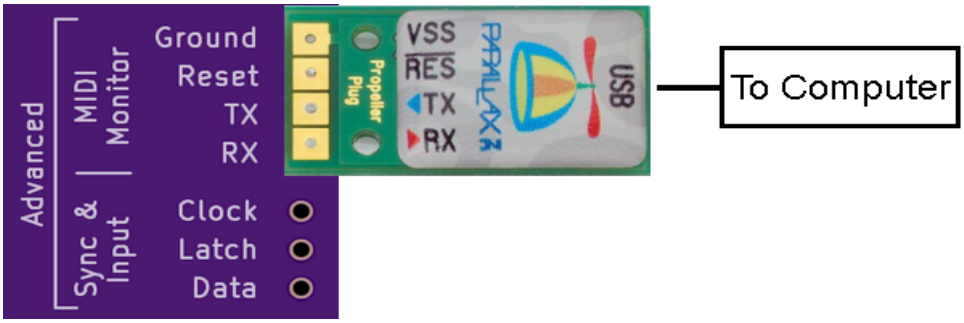


ii. **MIDI Channel Selectors** – There are a total of 16 MIDI channels. Each Protosynth MIDI can monitor up to two of these MIDI channels simultaneously. On Protosynth MIDI, these channels are referred to as MIDI Channel A and MIDI Channel B. The MIDI channel that MIDI Channel A monitors is determined by the states of the left four switches on the MIDI Channel selector. Similarly, the MIDI channel that MIDI Channel B monitors is determined by the states of the right four switches on the MIDI Channel selector. See the figure below for switch configuration.

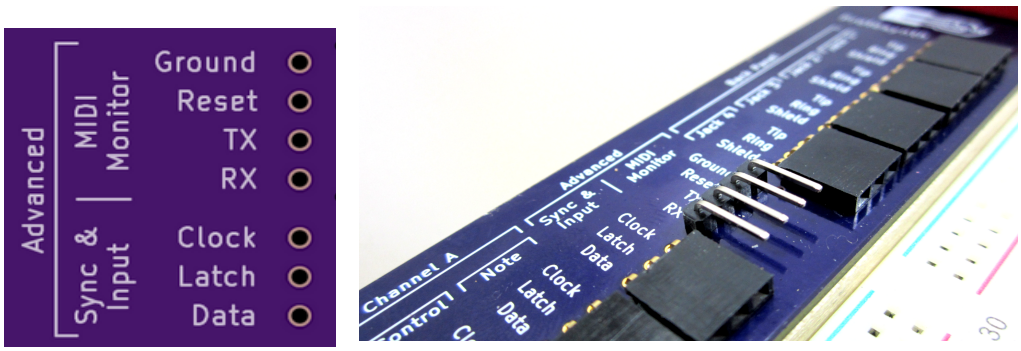


iii. Advanced Options

1. **MIDI Monitor:** This is a standard 2-pin 115,200 baud UART RX/TX header. When connected to a serial terminal or a serial terminal program via USB-to-serial cable, the user can monitor MIDI events and access configuration options. Optionally, with a Prop Plug and the Propeller Tool (available at Parallax.com), this header is used to update the Protosynth MIDI firmware.



2. **Sync & Input:** The functionality of this 3-pin header is determined by the MODE option which can be changed via the MIDI monitor serial console (accessed by pressing 'm' in the console). On first boot, or after a factory reset, Protosynth MIDI defaults to MODE 1.

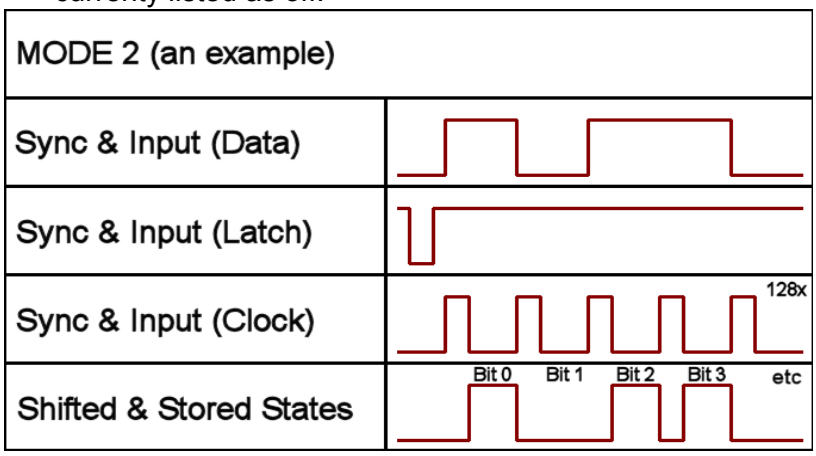


   a. **MODE 1: MIDI Clock Sync Mode**
      - In MODE 1, Protosynth MIDI monitors incoming MIDI clock and MIDI Start events on the MIDI Channel selected by MIDI Channel A.
        - Each time a MIDI Start event occurs on this channel, the Latch pin briefly goes HIGH and then goes LOW. Similarly, the Clock pin will go HIGH and then LOW for each MIDI Clock event but this behavior can be adjusted through the MIDI monitor serial console to pulse each clock-tick, each 32nd note, each 16th note, each quarter note, each half note, or each whole note (accessed by pressing 't' in the console).

MODE 1 (an example)	
MIDI Event (MIDI Start)	
Sync & Input (Latch)	
MIDI Event (MIDI Clock)	
Sync & Input (Clock)	

b. MODE 2: Local Keystate Override Mode

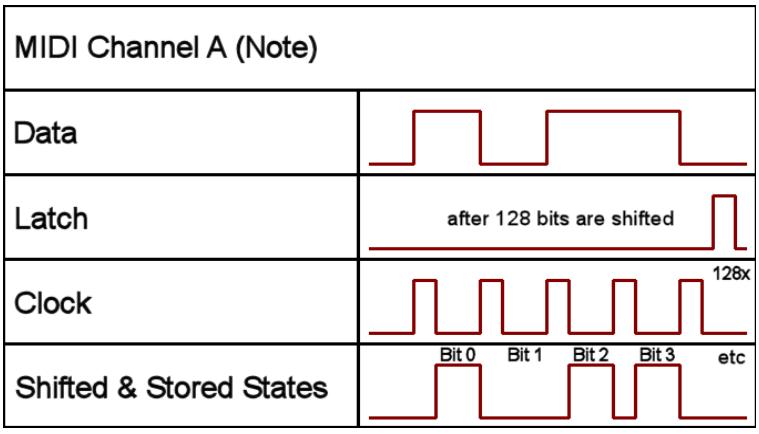
- In MODE 2, Protosynth MIDI shifts in note states via an optional chain of 74HC165 shift registers (or similar logic) connected to the Sync & Input port. Each MIDI channel has 128 notes.
  - Protosynth MIDI does this first by bringing the Latch pin LOW and then HIGH, then bringing the Clock pin HIGH and then LOW 128 times. After each of the Clock pulses, Protosynth MIDI notes the state of the data input pin (HIGH for on, LOW for off). After all 128 notes have been shifted in, Protosynth MIDI stores them. While in MODE 2, any stored note states that are HIGH/on override the state of that note even if MIDI events have it currenty listed as off.



iv. MIDI Channel A

1. Note

- This port allows you to use MIDI Note On and Note Off events from your MIDI master to directly control electronic circuits. This is made particularly easy using any of the Protosynth MIDI compatible ToyMod chainable modules. From gating notes on your AND8 based polyphonic synth, to switching lights or relays in time with music playing live from your DAW, the Note port is perfect anywhere you need to control many binary states.
- Protosynth MIDI perpetually shifts out 128 bits representing the states of all of the notes for the MIDI channel currently selected for MIDI Channel A. Protosynth MIDI does this by setting the state of Data pin to the state of each note (note 127 - note 0) in turn (HIGH for on, LOW for off) then bringing clock HIGH then LOW. After all 128 notes have been shifted out, Protosynth MIDI brings Latch HIGH then LOW to apply the note states to the outputs of the optional chain of 74HC595 shift registers (or similar logic) connected to the Midi Channel A Note port.

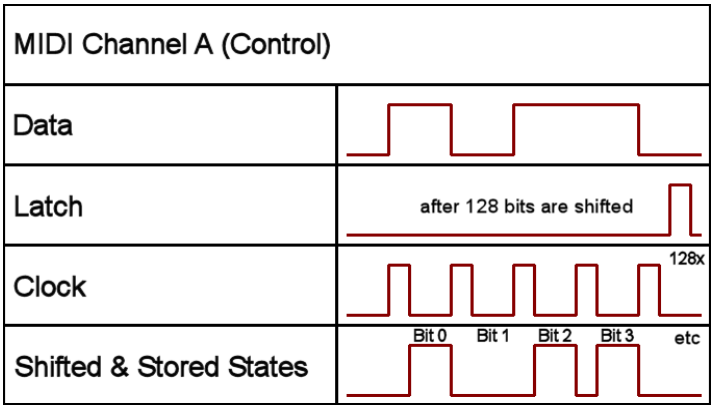


2. Control

- This port allows you to use MIDI controller value change events from your MIDI master to directly control electronic circuits. This is made particularly easy using

any of the Protosynth Midi compatible ToyMod chainable modules. From controlling digital to analog voltages with the Analog Shift, to controlling the positions of an array of hobby servos with the Servo Shift, the Control port is perfect anywhere you need to control many range values.

- Protosynth MIDI perpetually shifts out 1016 bits representing the values of all of the control values for the MIDI channel currently selected for MIDI Channel A. Protosynth MIDI does this by setting the state of Data pin to the state of each bit (bit 0 LSB - bit 7 MSB) of each value (control 127 – control 1) in turn (HIGH for on, LOW for off) then bringing Clock HIGH then LOW. After all 127 control values have been shifted out, Protosynth MIDI brings Latch HIGH then LOW to apply the control values to the outputs of the optional chain of 74HC595 shift registers (or similar logic) connected to the Midi Channel A Note port. MIDI uses 7 bits of resolution for control values (bit 0 - bit 6). Shift registers, however, use 8 bits for each byte in the chain. To line these up, Protosynth MIDI always sets the unused most significant bit to low (bit 7).



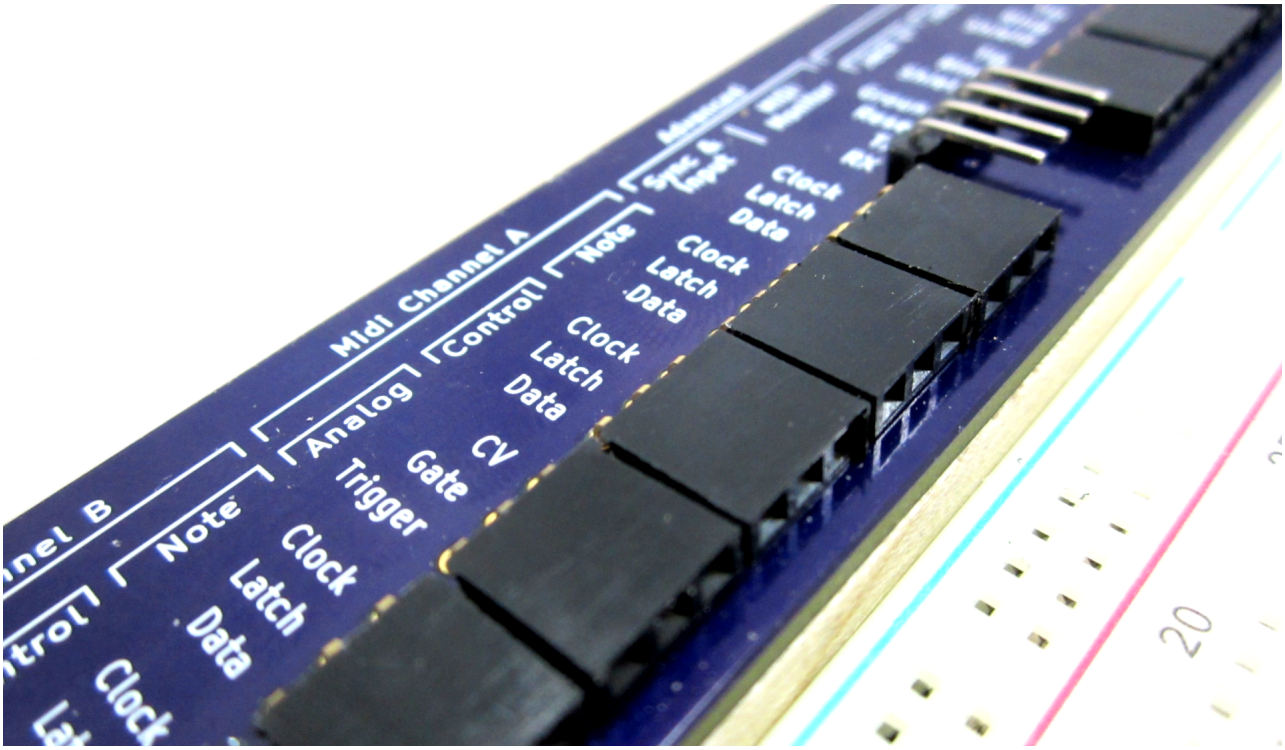
- As an example, place an Analog Shift (available at tymkrs.com) on your breadboard area and connect it to this Control port. Connect a typical MIDI keyboard to Protosynth MIDI. Control 1 of this type of MIDI master device is generally a Modulation Wheel. With the MIDI Channel Selector for this channel set to match the MIDI channel that the keyboard is set up to use, move the keyboard's Modulation Wheel up and down. Fully down, Analog Shift will generate an output voltage of 0VDC. Fully up, Analog Shift will generate an output voltage of 3.3VDC. You can now adjust the wheel to any voltage in between with 7 bits of resolution.

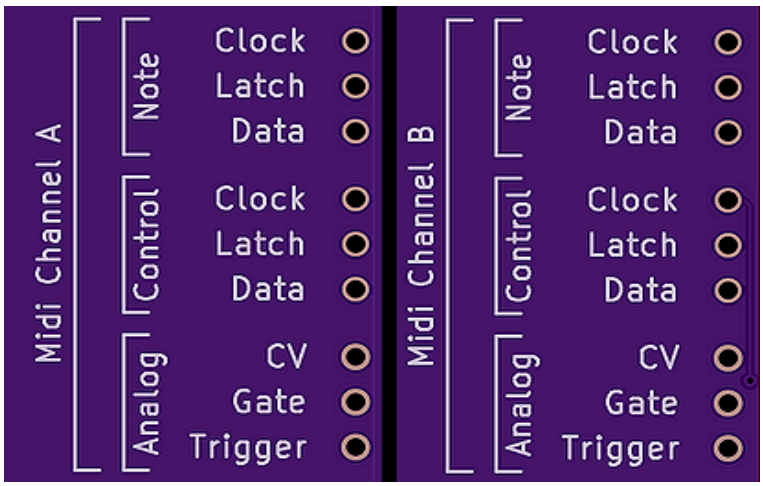
3. Analog

- This port allows you to use MIDI to control CV(control voltage)/Gate/Trigger based electronics. From control voltage inputs on guitar pedals, analog synth keyboards, drum machines and modular synth modules to prototyping your own voltage controlled analog oscilators, amplifiers, and filters; the Analog port is perfect anywhere you need to use modern MIDI events to control classic analog gear.
- **uCV:** Each time Protosynth MIDI receives a Note On event for the MIDI channel selected by the MIDI Channel Selector for this channel uCV is updated to reflect a new voltage. There are 128 distinct voltages in ~0.025 volt increments from 0VDC to 3.3VDC. These 128 voltages are used to describe (in analog) which of the 128 MIDI notes was last turned on.
  - There have been many CV standards over the years. The popular standards rely on voltage levels not generally seen in modern hobbyist electronics. Protosynth MIDI introduces a new standard for CV, uCV (micro control voltage). The uCV standard is 0.309375 volts per octave (or 0.02578125 volts per note).
  - uCV enables modern, low voltage devices to describe (in analog) all 128 notes in the standard MIDI range. By using a volts per octave scheme, uCV can be easily be scaled with a DC amplifier to the most popular industry standard today: 1 volt per octave.

- Amplify the maximum 3.3VDC uCV value up to 10.67VDC to line up perfectly with 1 volt per octave (check out tymkrs.com for a uCV to 1v/oct CV amplifier kit).

- **Gate:** As long as any notes on the MIDI channel selected by the MIDI Channel Selector for this channel are on, Gate stays HIGH (3.3VDC). When all of the notes are off, Gates goes LOW (0VDC).
- **Trigger:** When a Note On event occurs on the MIDI channel selected by the MIDI Channel Selector for this channel, Trigger goes HIGH (3.3VDC) then LOW (0VDC).



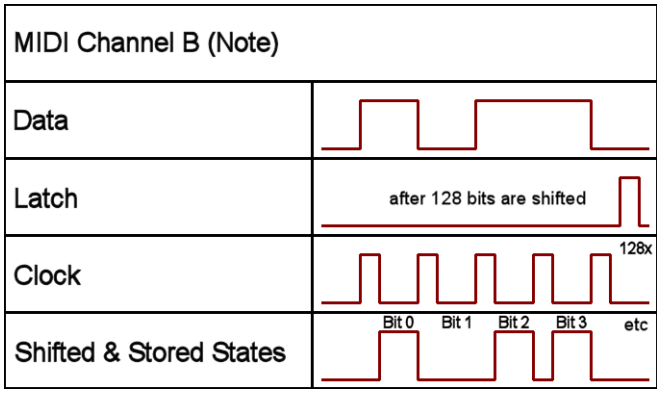


v. MIDI Channel B

1. Note

- This port allows you to use MIDI Note On and Note Off events from your MIDI master to directly control electronic circuits. This is made particularly easy using any of the Protosynth MIDI compatible ToyMod chainable modules. From gating notes on your AND8 based polyphonic synth, to switching lights or relays in time with music playing live from your DAW, the Note port is perfect anywhere you need to control many binary states.

- Protosynth MIDI perpetually shifts out 128 bits representing the states of all of the notes for the MIDI channel currently selected for MIDI Channel B. Protosynth MIDI does this by setting the state of Data pin to the state of each note (note 127 - note 0) in turn (HIGH for on, LOW for off) then bringing clock HIGH then LOW. After all 128 notes have been shifted out, Protosynth MIDI brings Latch HIGH then LOW to apply the note states to the outputs of the optional chain of 74HC595 shift registers (or similar logic) connected to the Midi Channel B Note port.



2. **Control**
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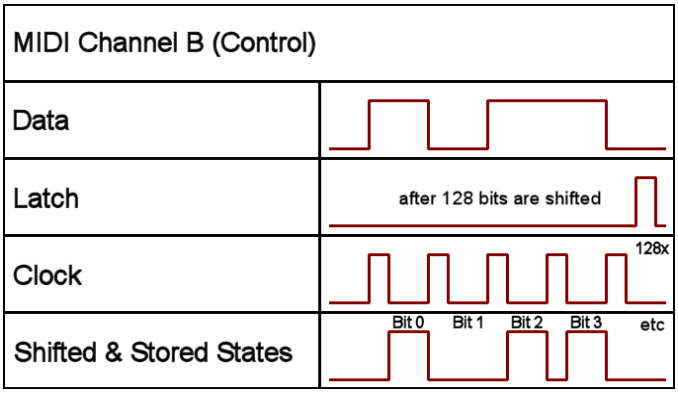
   - Protosynth MIDI perpetually shifts out 1016 bits representing the values of all of the control values for the MIDI channel currently selected for MIDI Channel B. Protosynth MIDI does this by setting the state of Data pin to the state of each bit (bit 0 LSB - bit 7 MSB) of each value (control 127 – control 1) in turn (HIGH for on, LOW for off) then bringing Clock HIGH then LOW. After all 127 control values have been shifted out, Protosynth MIDI brings Latch HIGH then LOW to apply the control values to the outputs of the optional chain of 74HC595 shift registers (or similar logic) connected to the Midi Channel B Note port. MIDI uses 7 bits of resolution for control values (bit 0 - bit 6). Shift registers, however, use 8 bits for each byte in the chain. To line these up, Protosynth MIDI always sets the unused most significant bit to low (bit 7).



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3. **Analog**
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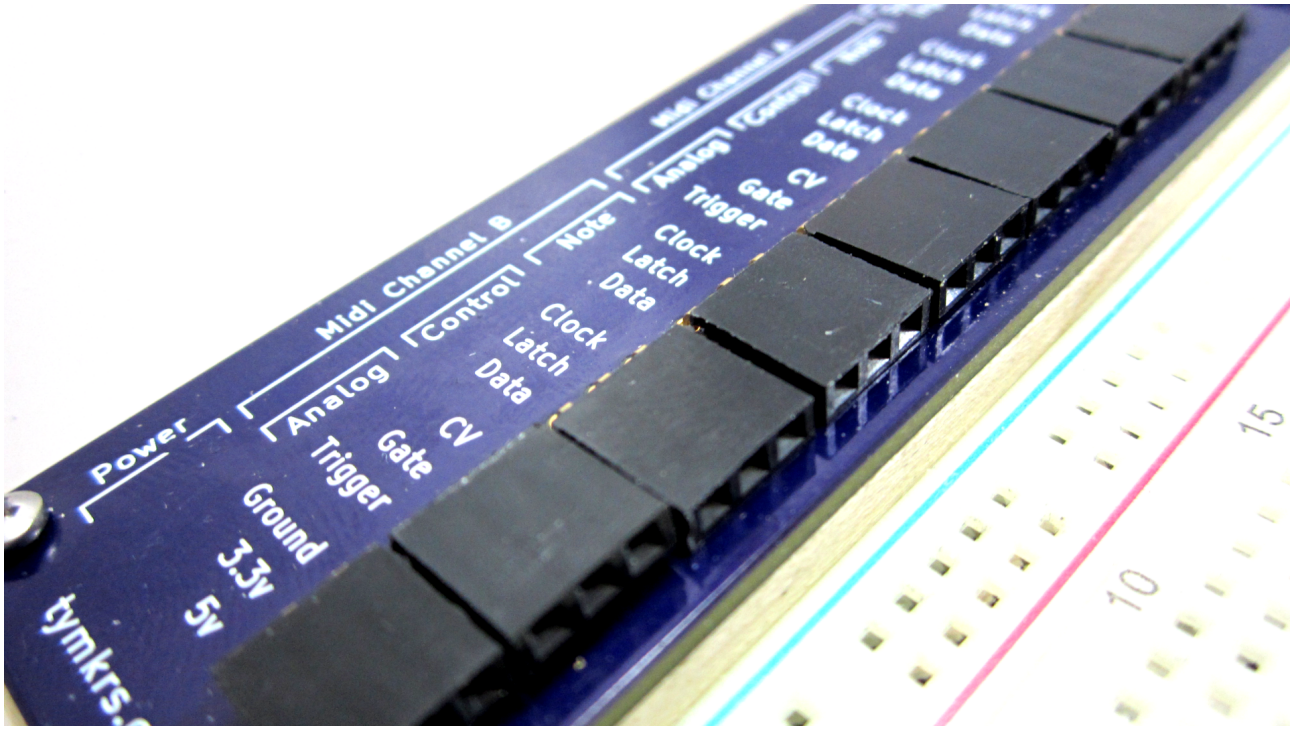
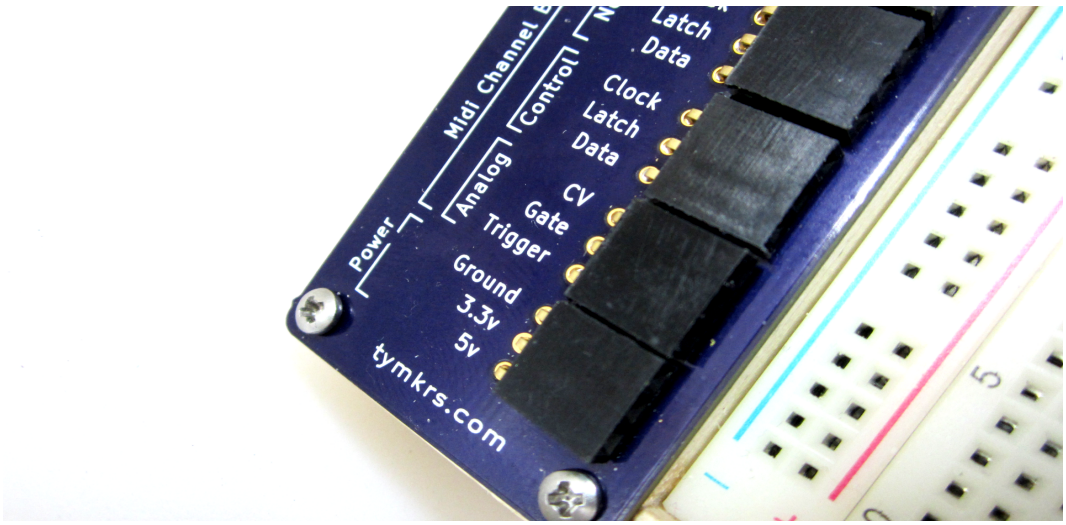
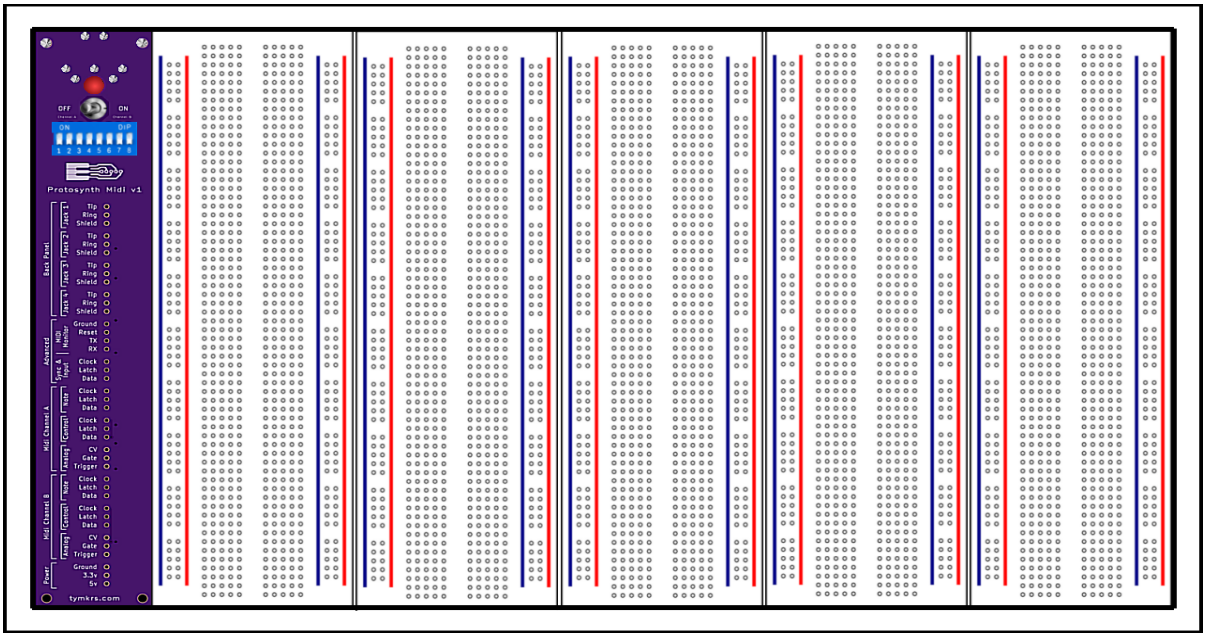
   - **Gate:** As long as any notes on the MIDI channel selected by the MIDI Channel Selector for this channel are on, Gate stays HIGH (3.3VDC). When all of the notes are off, Gates goes LOW (0VDC).
   - **Trigger:** When a Note On event occurs on the MIDI channel selected by the MIDI Channel Selector for this channel, Trigger goes HIGH (3.3VDC) then LOW (0VDC).



- **Power**
  - GND
  - 3.3V (MCP1700) – Maximum current output = 250mA
  - 5V (L4941) – Maximum current output = 1 A



Chapter III. Additional Diagrams



A
OFF
ON
ON
DIP
1 2 3 4 5 6 7 8
Protosynth Midi v1
B
Back Panel
Jack 1
Tip
Ring
Shield
Jack 2
Tip
Jack 3
Tip
Shield
Jack 4
Tip
Ring
Shield
C
Advanced
MIDI Monitor
Sync & Input
Ground
Reset
RX
Data
D
Midi Channel A
Note
Control
Analog
Clock
Latch
Data
CV
Gate
Trigger
E
Midi Channel B
Note
Control
Analog
Clock
Latch
Data
CV
Gate
Trigger
F
Power
3.3v
G

Zone	Content
A	• **Power Light Indicator:** This is lit when the unit is provided power and the ON switch is set to the ON position. • **On Switch:** The On switch is labeled ON and OFF. Switch it on by turning it to the ON position. • **Midi Channel Selector:** Channel A is on the left side, Channel B on the other side. Note: Look at the MIDI Channel Selectors section to understand how exactly to set up the position of the switches.
B	• **Back Panel:** Connections to each tip, ring, and shield of the 1/4" jacks on the back of the Protosynth MIDI are accessible via the patch panel in Zone B.
C	• **MIDI Monitor:** When connected to a serial terminal or a serial terminal program via USB-to-serial cable, the user can monitor MIDI events and access configuration options. With a Prop Plug and the Propeller Tool, this header is used to update the Protosynth MIDI firmware. • **Sync & Input:** There are 2 modes accessible via this port. ◦ **MODE 1** is the MIDI Clock Sync Mode which monitors incoming MIDI clock and MIDI Start events on the MIDI channel selected by MIDI Channel A ◦ **MODE 2** is the Local Keystate Override Mode where the Protosynth MIDI shifts in note states via an optional chain of 74HC595 shift registers connected to the Sync & Input port.
D	• **MIDI Channel A** ◦ **Note:** This port allows you to use MIDI Note On and Note Off events from your MIDI master to directly control electronic circuits. ◦ **Control:** This port allows you to use MIDI controller value change events from your MIDI master to directly control electronic circuits. ◦ **Analog:** This port allows you to use MIDI to control CV (control voltage), Gate and Trigger based electronics.
E	• **MIDI Channel B** ◦ **Note:** This port allows you to use MIDI Note On and Note Off events from your MIDI master to directly control electronic circuits. ◦ **Control:** This port allows you to use MIDI controller value change events from your MIDI master to directly control electronic circuits. ◦ **Analog:** This port allows you to use MIDI to control CV (control voltage), Gate and Trigger based electronics.
F	• **Power Section** ◦ GND ◦ 3.3V (MCP1700) – Maximum current output = 250mA ◦ 5V (L4941) – Maximum current output = 1 A
G	• **Breadboarding/prototyping section:** There are 5 breadboards that make up this section – each with positive and negative rails on either side of each breadboard. ToyMod modules (available on http://tindie.com/stores/tymkrs) can be placed on this breadboard for use.

Chapter IV. Serial Command Console

The serial command Console is an advanced feature and not required for normal use. The console can be accessed from a Windows PC using a Prop Plug (from Parallax.com) and the Parallax Serial Terminal Software. Similarly, the console can be reached via any standard USB to Serial cable and PuTTY, or other terminal emulator software.

Protosynth MIDI console Commands (accessed in the console by the 'h' key)

- **m:** Set operation mode for the Sync & Input port
- **o:** Adust chain starting offsets (transpose)
- **t:** Adjust MIDI ticks per sync pulse
- **p:** Print current settings
- **f:** Factory reset
- **r:** Reset