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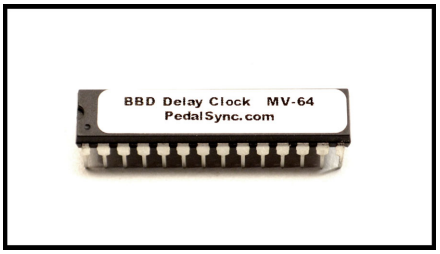
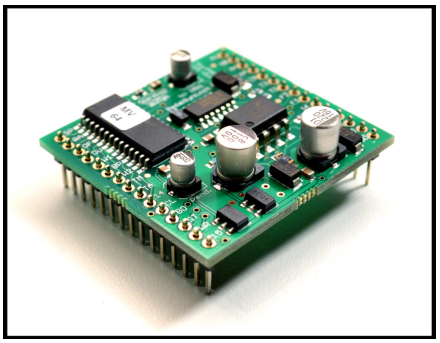
PedalSync™

BBD Delay Clock





Chip MV-64 *and* **Module v1.1**

Key Features

- Control clock for classic analog Bucket Brigade Delay chips, including MN3205 and MN3208
- Unparalleled Tap Tempo accuracy
- Stores and recalls Delay Time, Delay Ratio, Clock/Pot Status, Bypass Status, Modulation Rate/Ratio, Offset, and Depth
- MIDI, Tap, Pulse, and Pot control are all possible
- Robust, 128 program storage
- Simple, intuitive user interface
- Real-time control of potentiometers
- Can be used with 4 different pin-selectable BBD chip configurations
- Nine (9) musically-useful Modulation Ratios
- Four (4) Separate Delay Time Ratios
- Offset control allows users to offset the modulation waveform against the incoming clock for syncopation
- Up to 360-degrees of modulation phase shift vs. incoming clock
- Deep (up to 50%) modulation depth
- Backwards-Compatible with MIDI
- Scalable - combine chips like building blocks to make elaborate designs
- Efficiently Designed to ensure Low part count
- Thru-Hole or SMT
- Easy to create stand-alone pedals that can be used traditionally and tested in-store
- Use PedalSync™ trademark on your devices and in advertising
- CadSoft Eagle footprint available for module

BBD Clock Output

With proper buffer circuitry the MV-64 Clock Output (pin 14) provides a signal capable of driving the clock input on MN3205 or MN3208 (pin 7) over a wide range of delay times.

Note: The pin 14 clock output has limited current and is only 3 volts, so voltage conversion and current limiting circuitry are necessary, such as the JFET configuration in the schematic, *below*.

Connection to MN3205 and MN3208

Use of an MN3102 chip as a buffer is a easy and practical way to buffer the MV-64 clock output. It has the advantages of supplying the proper BBD reference voltage (Vgg, pin 8), and it works as a flip-flop, supplying the 2 out-of-phase clocks.

A common alternate method of buffering the chip is with a 4047 multivibrator.

Although there are other methods of buffering the clock, they are beyond the scope of this datasheet.

Note: **MN3102 and 4047 clock buffers cut the clock output frequency in half**, resulting in delay times that are twice as long. **Be certain to connect the proper Chip Select pins for the actual chip configuration.**

See the schematics, below, for suggested connections.

Delay Time Ratios

Users select one of 4 Delay Ratios using a four-position switch. It is a simple matter to only allow a subset of available ratios by using particular pin combinations and a different type of switch.

Following are the ratios:

1:1 = Neither pin grounded (quarter note)
3:4 = Pin 6 only grounded (dotted eighth)
1:3 = Pin 9 only grounded (eighth note triplet)
2:3 = Pins 6 and 9 grounded (quarter note triplet)

Note: Delay Ratios may have no effect if the chip is auto-scaling the MIDI Clock-based delay time. In other words, if the chip has auto-scaled the delay time by 3, and a 1:3 delay ratio is selected, there will not be an *additional* division by 3.

Delay Ratio LEDs

The currently selected ratio is indicated by the two Delay Ratio LEDs. LED 2 (pin 22) indicates **3:4**, LED 1 (pin 12) indicates **1:3**, both off indicate **2:3**, and both on indicate **1:1**. It is also possible to use a red/green bi-color LED to indicate the waveform.

*Note: The Delay Ratio LED outputs are **inverted on the module**. As such, LED 1 (pin 12) indicates 3:4, LED 2 (pin 22) indicates 1:3, both on indicate 2:3, and both off indicate 1:1.*

Chip Select Pins

Proper connection of the Chip Select Pins (pins 23 and 24) is essential to synchronizing the delay timing with the tap and clock inputs.

The following table is based on used of the 4096-stage MN3205 delay chip. If the 2048-stage **MN3208** is used, delay times will be 50% shorter at the same clock speed. Adjust your Chip Select value accordingly (*e.g.* 2x 3208 w/3102 = 1x 3205 w/3102):

Table of values dependent on Chip Select:

Chip Selection	**1x 3205 w/3102 2x 3205, no 3102**	**2x 3205 w/3102 4x 3205, no 3102**	**3x 3205 w/3102**	**4x 3205 w/3102**
Pin Setting	Both High	Pin 1 High	Pin 2 High	Both Low
Delay Time Min. (mS)	55.7	55.9	55.5	55.9
Delay Time Min. (mS) (1:4 Delay Ratio)	13.9	14.0	13.9	14.0
Delay Time Max. (mS)	341.3	682.6	1024.0	1365.3
Delay Time - Program Default (mS)	250	500	750	1000
Tap Interval Min. (mS)	~100	~100	~100	~100
Tap Interval Max. (mS)	341.3	682.6	1024.0	1365.3

The Delay Time pot range is the same as the Delay Time Min.-Max. interval.

Table of values independent of Chip Select:

MIDI Clock Min. (bpm)	24
MIDI Clock Max. (bpm)	240
Modulation Rate Pot Min. (S)	0.0625
Modulation Rate Pot Max. (S)	5
Modulation Ratio Min.	1/4 Delay Time
Modulation Ratio Max.	8x Delay Time

Note: Because of the analog nature of the underlying delay chip, distortion may occur at extreme delay times.

Pots

Delay Time (*pin 2, pot0*)

In Pot Mode (Clock LED off), the Delay Time pot adjusts the delay time between the limits set forth above. This range can be further adjusted using the Delay Ratio switches.

Turning the Delay Pot will override any tapped tempo. Conversely, if two or more taps are received, the tapped tempo will override the Delay Time pot.

Note: The Delay Time pot and Tap button can change the *Pot Mode* delay time while the chip is in *Clock Mode*, however changes will not be apparent until the chip is switched to Pot Mode.

Modulation Ratio/Rate (*pin 3, pot1*)

Modulation Ratio/Rate Select Pin 15 is used to select the function of this potentiometer input. Leave the pin disconnected to select Modulation Ratio. Ground the pin to select Modulation Rate.

Ratio

The Modulation Ratio pot multiplies or divides the Modulation frequency relative to the incoming clock (in Clock Mode), or speed knob/tapped speed (in Pot Mode).

The Modulation Ratios are based on nine (9) musical subdivisions: two whole notes; whole note; half note; half note triplet; quarter note (tap speed); quarter note triplet; 8th note; 8th note triplet; 16th note. As a result, synchronized devices can oscillate at different yet complimentary rates.

The Modulation Ratio pot range is divided into nine (9) subdivisions, with the center quarter note range slightly larger than the others. If a subset of the modulation ratios is desired, consider using a rotary switch and a resistor ladder to send the proper voltage to pin 3.

Table of Modulation Ratio Pot Ranges

	Min.	Max.	Range
16th note	0.0%	10.6%	10.6%
8th note triplet	11.0%	21.6%	10.6%
8th note	22.0%	32.5%	10.6%
quarter note triplet	32.9%	43.5%	10.6%
quarter note (tap speed)	43.9%	56.1%	12.2%
half note triplet	56.5%	67.1%	10.6%
half note	67.5%	78.0%	10.6%
whole note	78.4%	89.0%	10.6%
two whole notes	89.4%	100.0%	10.6%

Rate

The Modulation Rate pot adjusts the modulation rate between 0.0625 and 5.0 seconds.

Note: *The lower the pot voltage, the higher the modulation rate. Reverse the pot connection if faster modulation is desired when the pot is turned clockwise*.

Modulation Offset (*pin 4, pot2*)

The modulation waveform is a sine wave.

The Modulation Offset pot adjusts the delay modulation against the incoming clock with up to 360 degrees of phase shift. The modulating delay signal can accent, syncopate, push the beat, or get right in the pocket.

Modulation Depth (*pin 5, pot3*)

The Modulation Depth pot adjusts depth of the modulation waveform between zero and 50% of the current delay time.

Note: **The modulation depth is limited by the Delay Time Max. As such, at the maximum delay time, no modulation will occur.**

MIDI Clock Input

The range of allowable MIDI Clock (F8) input is 24-240 bpm. The chip may not function properly outside this range.

If MIDI Clock stops flowing (or flows below 24 bpm), MV-64 will set the delay time based on the last quarter-note interval received.

Auto-Scaling

At slow MIDI Clock tempos, the calculated delay time may be longer than the delay time allowed under the particular chip configuration. In that case, MV-64 automatically scales the delay time by dividing by 2 until an allowable delay time is reached.

The Tempo LED will reflect the *adjusted* tempo.

Note: The modulation waveform does *not* automatically scale with the delay time, but instead stays in time with the incoming Clock. If desired, the modulation can be scaled by changing the Modulation Ratio.

MIDI Start

The Modulation waveform is reset with each MIDI Start command (FA) that is received following more than a quarter note duration.

User Interface

Startup

MV-64 reads the four input pots, Clock or Pot/Tap mode switch, and Ratio Select switches on startup, and sets the output accordingly. MV-64 ignores the Delay Time pot if the chip is in Clock mode at startup.

Program Storage

The BBD Delay Clock chip stores 128 programs. Programs are stored by toggling the Write Switch (*pin 16*) or upon a command from the PedalSync Master Control MV-58(B). When using the Write Switch, the program is written to the currently-selected program number.

Program Recall

Programs are recalled using the PedalSync Master Control MV-58 (B), standard MIDI Program Change messages on Channel 15, or the PedalSync 4 Presets chip (MV-59).

Write switch (*pin 16*)

It is possible to use a momentary pushbutton for the Write switch, however a toggle switch is recommended to make it difficult for users to accidentally program a setting.

Using a toggle switch, the user will close the switch, then open it again to write the current settings to the currently selected program. If the switch is in the closed position, the user will need to open, close, then open again.

Status LED (*pin 17*)

The Status LED is normally on. When a program is written, the Status LED will blink.

Whenever the potentiometers are not stable (*i.e.* when they are moving or have recently moved), the Status LED will turn off until they become stable again. Each pot will stabilize after approximately three (3) seconds of no motion.

Tap button (*pin 11*)

When in Pot/Tap Mode (Clock LED off), the delay time can be adjusted by tapping a momentary switch two or more times. The timing between the last two taps determines the delay time. The tap button times out differently based upon the chip selection, as set forth in the table, *above*.

Tapping two or more times overrides any pot-based Delay Time. If the Delay Time knob is moved after a delay time has been tapped in, the Delay Time knob will override the tapped time.

The chip switches from Pot to Tap mode, at the moment of the second tap.

Unlike with MIDI Start, tapping does not reset the modulation waveform.

Note: The Delay Time pot and Tap button can change the *Pot Mode* output delay time while the chip is in *Clock Mode*, however changes will not be apparent until the chip is switched to Pot Mode.

Tempo LED (*pin 10*)

Pin 10 will output a (0 - 3.1 volt) square wave that corresponds to the delay time.

In Clock Mode, the Tempo LED is synchronized to any incoming clock, but is also reflects any Delay Ratio.

The Tempo LED output is always pulsing. Further, in Clock mode, the Tempo LED keeps pulsing even when no clock signal is being received.

Clock or Pot/Tap mode switch (*pin 25*)

The Delay timing source is selected with a switch:

[a] Clock, or
[b] Delay Time Pot and Tap Button

When the pin is grounded, Pot/Tap is selected. Disconnecting the pin places the chip into Clock mode. If the design does not use an incoming MIDI clock, the Clock/Pot pin should be grounded.

When a program is read from memory, the Clock or Pot/Tap mode is recalled. If, for example, the program uses Clock mode and the pin is already grounded, the user will need to toggle the switch twice to enter Pot/Tap mode.

The program default is Pot, allowing stand-alone effects that do not require an external clock.

In Clock mode, the delay clock output is sent even when no clock is coming in. The delay time stored and recalled from memory will be the delay time that was happening at the time it was stored.

In Clock mode, the modulation waveform resets upon each MIDI Start command.

Clock Mode LED (*pin 26*)

The Clock Mode LED is lit (pin 26 high) when then delay time is controlled by the incoming clock. When the delay time is controlled by the Delay Time Pot or Tap button the LED is not lit (pin 26 low).

When in Clock Mode, the tempo is controlled by an incoming PedalSync or MIDI Clock at pin 21. If no Clock is present, the LFO runs at the last incoming quarter-note interval, which is also stored when a program is written.

Bypass Switch (*pin 7*)

The Bypass Output (pin 18) is toggled each time the Bypass Switch is grounded.

The program default for Bypass is ON. If using the Relay Bypass chip (MV-57), this corresponds to having the effect loop engaged.

Modulation is only on when the effect is engaged (Pin 18 high).

In Pot/Tap Mode, the modulation waveform resets each time the bypass is switched to *engaged*.

Bypass Output (*pin 18*)

Pin 18 can be used to control the PedalSync Logic-Controlled Relay Bypass chip (MV-57), and/or to indicate whether Modulation is engaged.

Delay Ratio Select switches and LEDs

See the ***BBD Clock Output*** section, *above*.

Control Voltage (CV) Input

In Pot/Tap mode, a Control Voltage (CV) can be used to continuously control the delay time. Have the control voltage trigger a 4066 CMOS Quad Bilateral Switch to ground pin 11 (the Tap button input). In the alternative, consider an optocoupler or transistor.

> The ideal CV signal will have a 50% duty cycle At the downbeat, pin 11 should be grounded. If this is not the case, invert your CV signal.

MIDI Compatibility

The exclusive MIDI channel for the PedalSync system is MIDI Channel 15. MIDI Program Change messages sent on any other channel will be ignored by the chip.

The MV-64 BBD Delay Clock chip also responds to standard MIDI Start, Stop, and Clock messages.

Program Defaults

- Not Bypassed
- Pot/Tap mode
- Delay Time - *see Chip Select table, above*
- Delay Ratio = 1:1
- Modulation Ratio = 1:1
- Modulation Rate = 2.5 seconds
- Modulation Offset = zero
- Modulation Depth = zero

Electrical Considerations

All digital input pins have weak an internal weak pull-up resistor. As a result, it is acceptable to leave them disconnected if not required.

Any unused analog potentiometer inputs should be tied to ground, or to the voltage corresponding to the desired setting.

9 volts DC maximum on the power input to the module. At least 7.5 volts input.

The schematic, *below*, shows the necessary, as well as optional, connections. Note that you can use different resistors for the LEDs depending on the type of LED used, but do not exceed the current limits of the underlying chip as set forth below.

If you require brighter LEDs, consider using buffers or ultra-bright LEDs.

The datasheet for the underlying dsPIC33FJ64GP802 chip can be found here:
http://www.microchip.com/wwwproducts/Devices.aspx?dDocName=en532310

Noise

It is very important to properly filter your power supply as shown in the schematic. To minimize digital noise bleeding into your audio circuit, be careful to run three separate grounds as indicated on the schematic.

Follow proper PCB layout design rules and isolate the digital and analog sections of your circuit as much as possible, connecting the grounds at a common point at the power supply.

The Ferrite on AVDD may not be totally necessary but will quiet down and stabilize the analog voltage. Thru hole values for ferrites are limited and may not be available beyond 800 ohms. The recommended part which appears on the BBD Delay Clock Module is a 2.5 KOhm Impedance 50mA Ferrite, such as Murata P/N BLM18BD252SN1D.

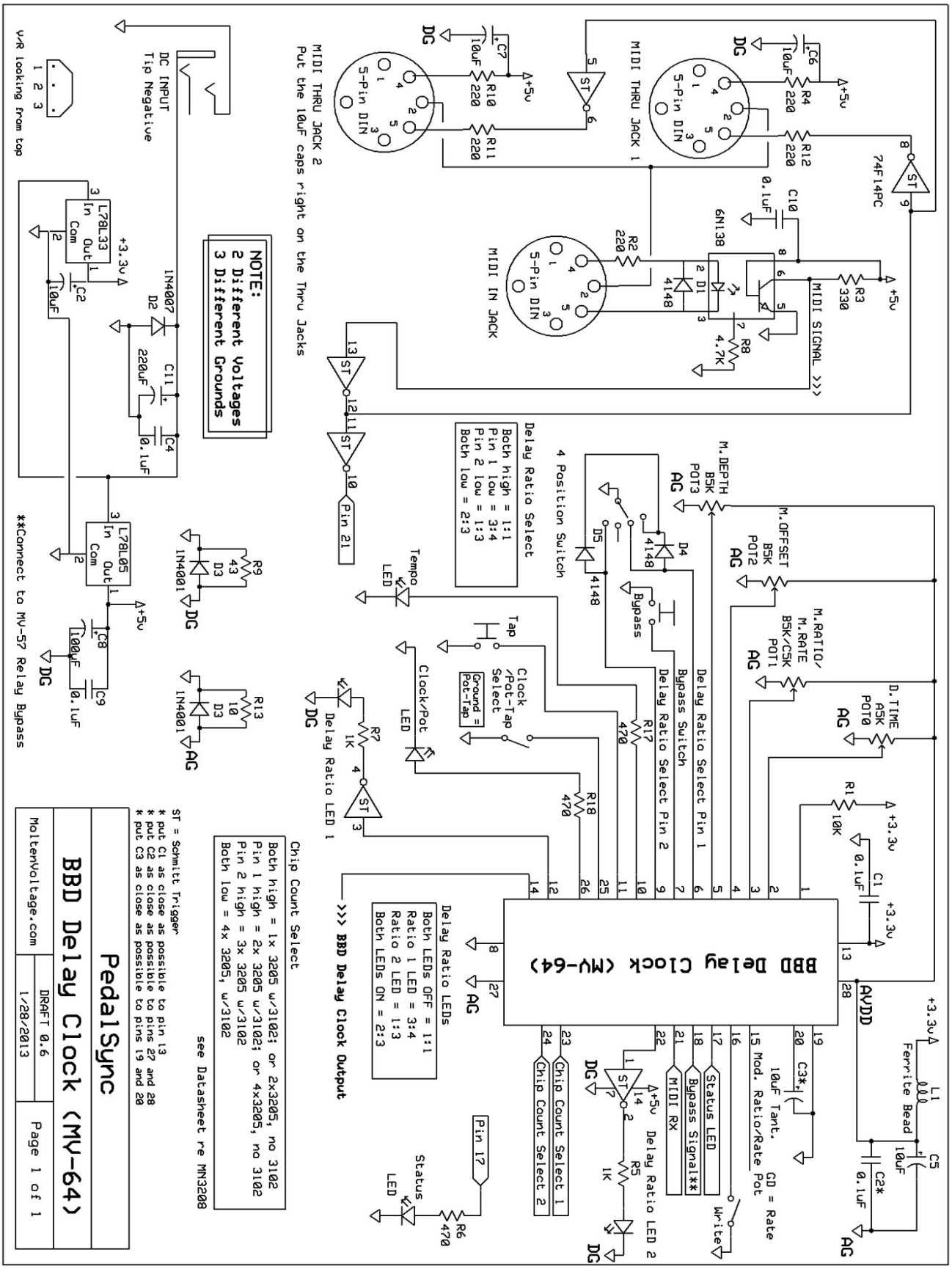
Module

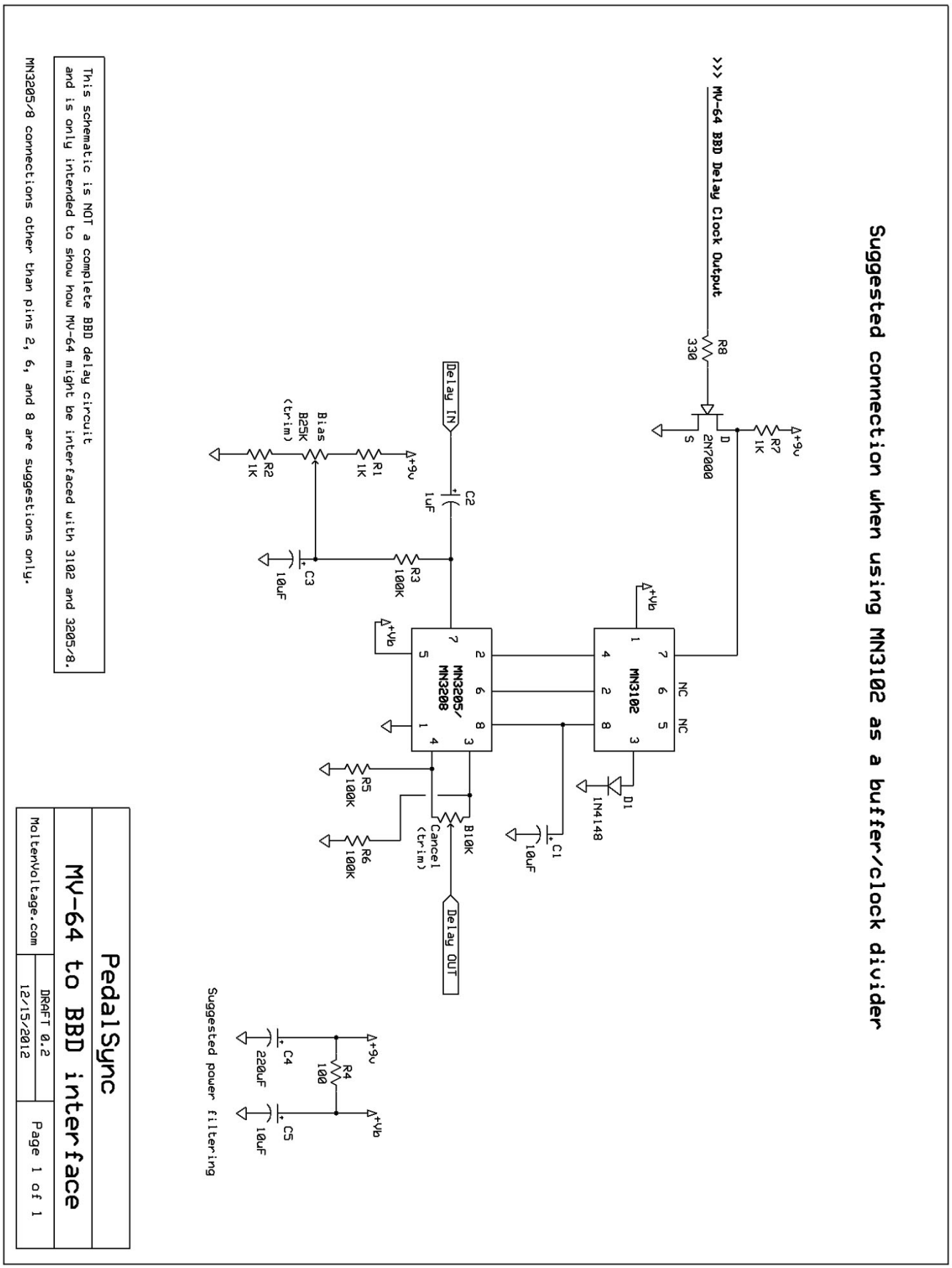
The MV-64 BBD Delay Clock Module includes most, but not all of the external connections shown in the schematic. The available connections are set forth in the Table of BBD Delay Clock Module v 1.1 Pin Assignments, *below*.

Input and Output header pins are provided for all necessary connections, but **series resistors are necessary for many of the LEDs**. *See* Table of BBD Delay Clock Module v 1.1 Pin Assignments for more information.

The Module accepts a *maximum* 9-volt DC input, and provides regulated, filtered power for the 3.3 and 5 volt circuits, as well as off-board connections for 5V and AV, as well as grounds AG and DG.

Refer to the schematic, *below*, for information on connecting pots, MIDI Jacks, and switches.





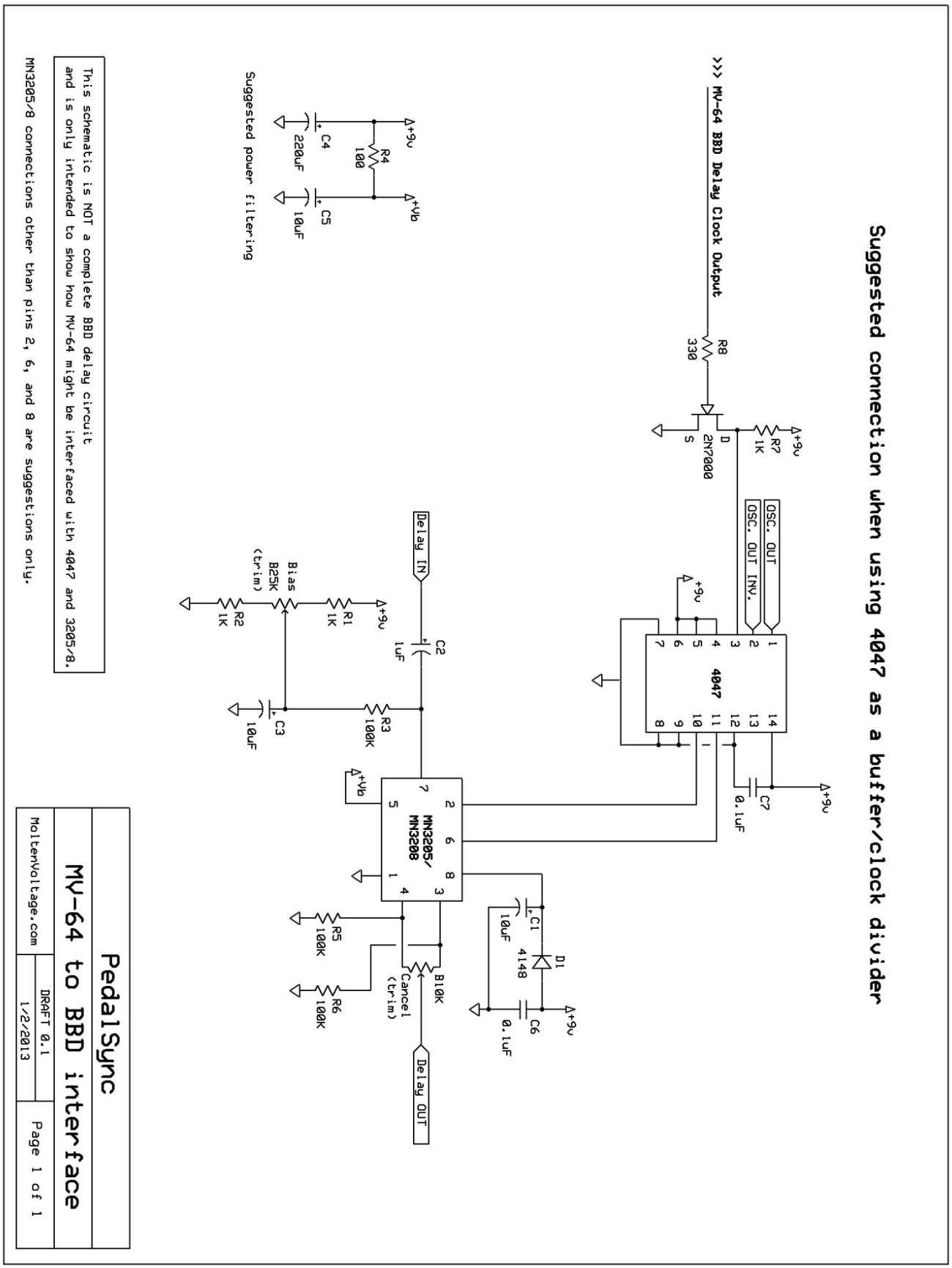
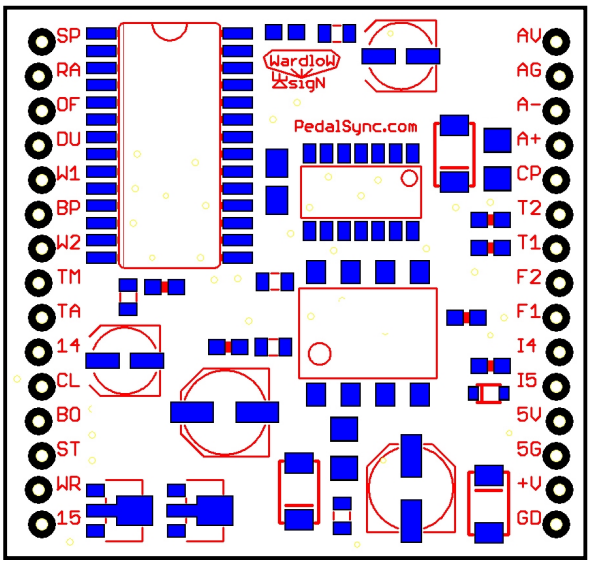


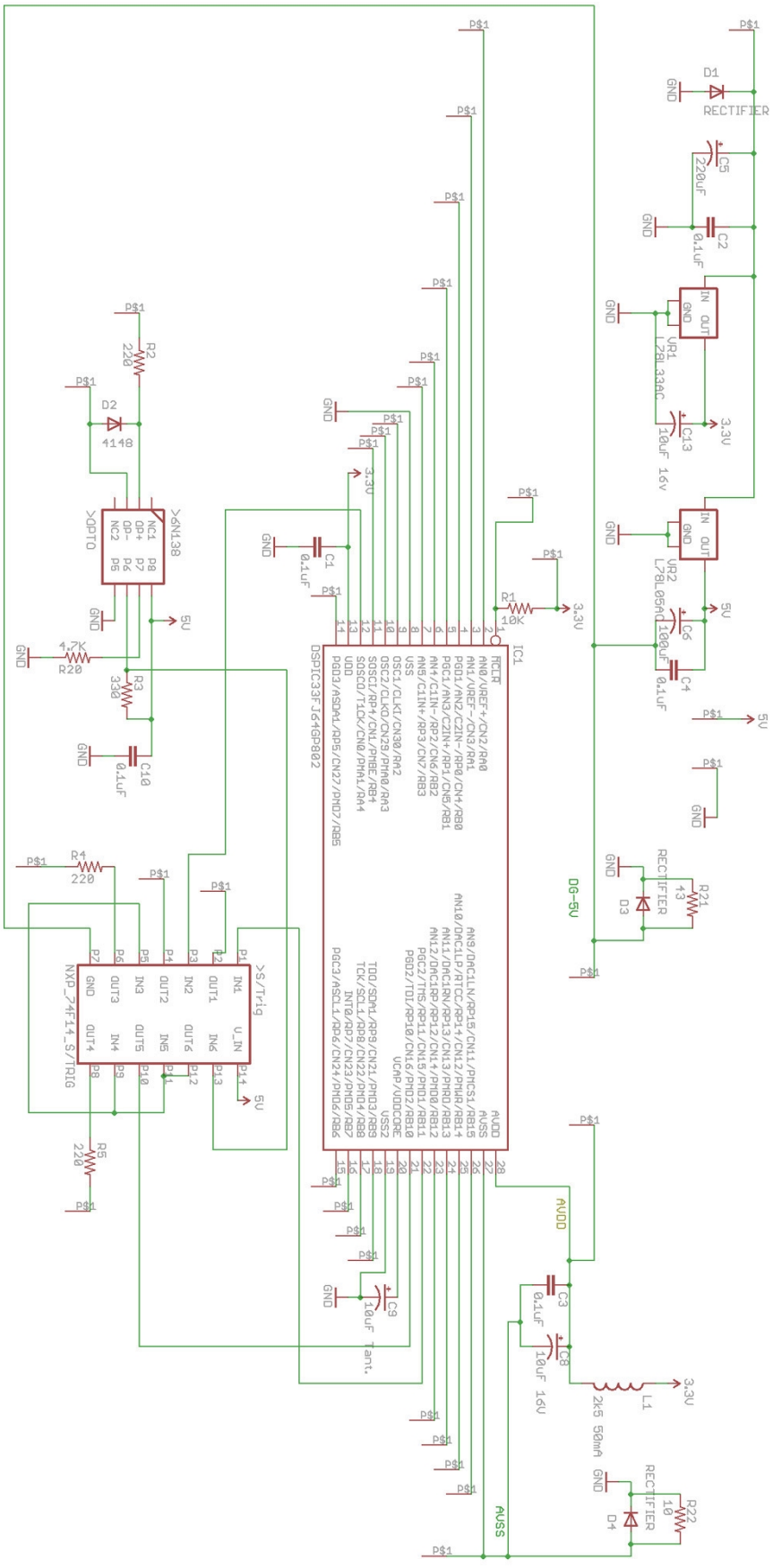
Table of BBD Delay Clock Module v 1.1 Pin Assignments

Pin	Label	Connection
1	**SP**	Delay Time Pot (pin 2)
2	**RA**	Modulation Ratio/Rate Pot (pin 3)
3	**OF**	Modulation Offset Pot (pin 4)
4	**DU**	Modulation Depth Pot (pin 5)
5	**W1**	Delay Ratio Pin 1 (pin 6 - no diode)
6	**BP**	Bypass Switch (pin 7)
7	**W2**	Delay Ratio Pin 2 (pin 9 - no diode)
8	**TM**	Tempo LED (pin 10 - no series resistor)
9	**TA**	Delay Tap Button Input (pin 11)
10	**14**	BBD Clock Output (pin 14)
11	**CL**	Clock/Pot status LED (pin 26 - no series resistor)
12	**BO**	Bypass Output/LED (pin 18 - no series resistor)
13	**ST**	Status LED (pin 17 - no series resistor)
14	**WR**	Write (PGM) Switch (pin 16)
15	**15**	Modulation Ratio/Rate Select (pin 15)



Pin	Label	Connection
30	**AV**	Analog Power Rail (AVDD)
29	**AG**	Analog Ground Rail (AVSS) [AG]
28	**A-**	Chip Count Select Pin 2 (pin 24)
27	**A+**	Chip Count Select Pin 1 (pin 23)
26	**CP**	Clock/Pot Toggle Switch Input (pin 25)
25	**T2**	Pin 5 - MIDI Thru Jack 2 (buffered & 220 ohm series resistor)
24	**T1**	Pin 5 - MIDI Thru Jack 1 (buffered & 220 ohm series resistor)
23	**F2**	Delay Ratio LED 2 (buffered, inverted - no series resistor)
22	**F1**	Delay Ratio LED 1 (buffered, inverted - no series resistor)
21	**I4**	Pin 4 of Input MIDI Jack
20	**I5**	Pin 5 of Input MIDI Jack
19	**5V**	5 Volt Rail - for MIDI Thru
18	**5G**	Digital 5 volt ground [DG]
17	**+V**	9 volt Power Supply Input
16	**GD**	Common Ground (Power Supply)

The MV-64 BBD Delay Clock Module currently uses the same circuit board as the Tru-Foot LFO Module. Pin number assignments will not change but some labels will.



Specifications

Pin Voltage and Current Limits

Pin	Max Voltage	Max Current*
1	5	4
2	3.3	12
3	3.3	12
4	3.3	12
5	3.3	12
6	3.3	4
7	3.3	4
8	GND	
9	3.3	4
10	3.3	**25**
11	3.3	12
12	3.3	4
13	3.3	
14	5	12
15	5	12
16	5	4
17	5	12
18	5	12
19	GND	
20	N/A	
21	5	12
22	5	12
23	3.3	4
24	3.3	4
25	3.3	4
26	3.3	4
27	GND	
28	3.3	

* 200 mA max current sink or source for the whole chip at any given time, except on the Module which is limited to ~50 mA. Keep your currents low to minimize noise.

Power Consumption (typical) ~ 90mA

Min. Output Clock Frequency ~ 9.1 KHz
Max. Output Clock Frequency ~ 293.1 KHz

see also:
Microchip dsPIC33FJ64GP802 Datasheet
http://www.microchip.com/wwwproducts/Devices.aspx?dDocName=en532310

Module Dimensions

Circuit board: 1.7 x 1.6”

Header pins are spaced 0.1” and the two header strips are 1.5” apart

A complete set of CadSoft Eagle footprints for PedalSync modules is available for download at: www.PedalSync.com

Related Products

- Use with Four Pots chip (MV-56) to save Feedback, Blend, and Gain settings.
- Use with 4 Presets chip (MV-59) to make stand-alone devices that store and recall four programs. **MV-59 can be connected directly to MV-64 Pin 21 with a 330 ohm resistor in series in stand-alone devices, without the other MIDI circuitry.**

Support

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