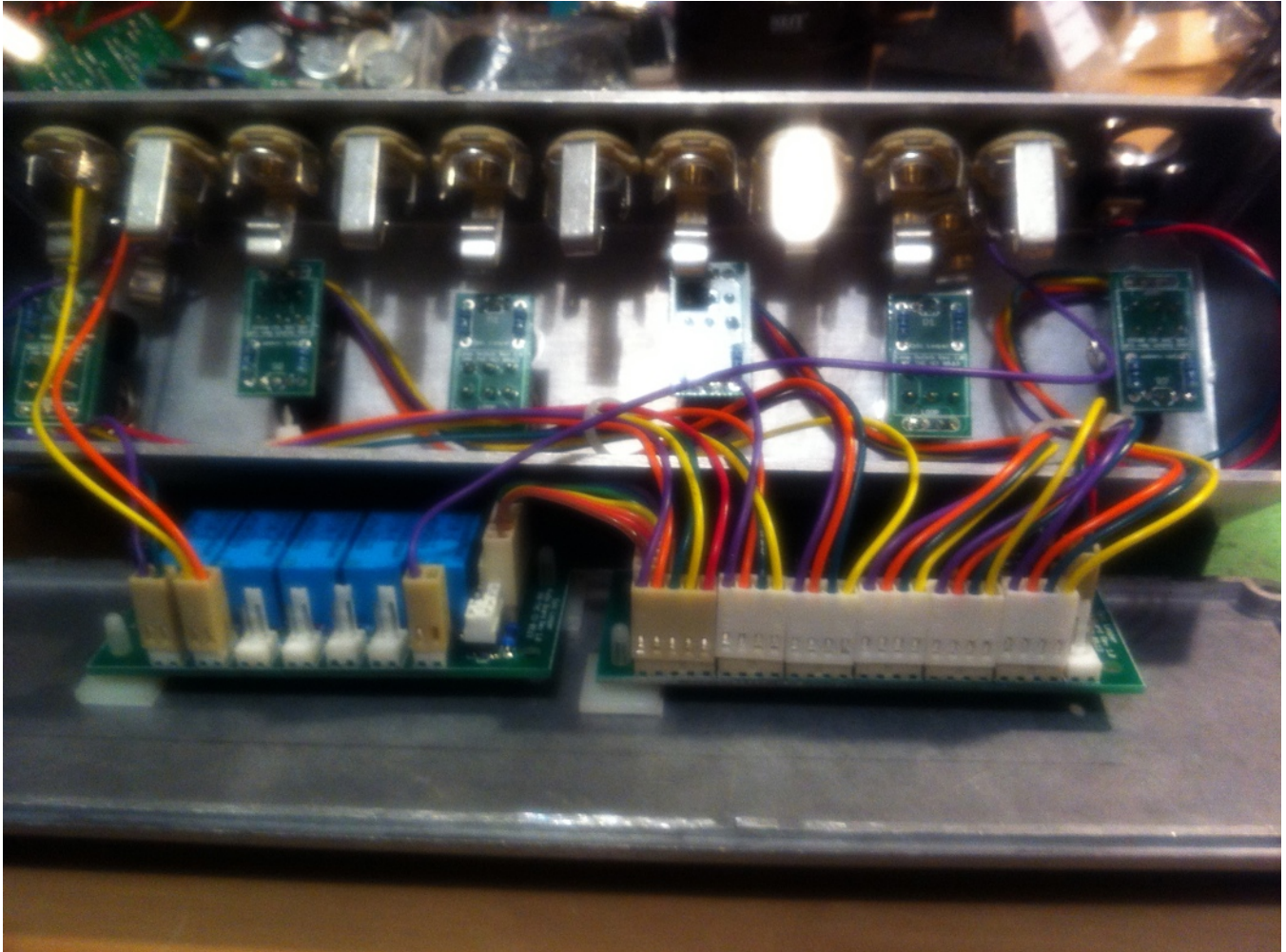JMK PCBS/THC EFFECTS PRESENTS...

THE EPIC LOOPER

PCB AND SCHEMATIC ARTWORK (C) 2013 JMK PEDALS
REV 1.0.1: 12/23/2013

INTRODUCING THE EPIC LOOPER!

- 5 True Bypass loops for switching either single or multiple effects in and out of a signal chain. These loops feature relay controlled true bypass, which completely removes unused effects from the chain, as well as operating with little or no noise or popping.

- Four banks hold five programmable presets in each bank. These presets are made up of any combination the five true bypass loops in sequential (1-5) order.

- Each Preset gives the ability to allow a user to switch several effects on or off at once without having to do the typical 'tap dancing act' that conventional bypass units still rely on. Each set of combinations is accessed using five loop switches with dual colour LEDs that indicate both which preset and which loops are on or off.

- A 'fifth' bank is dedicated to be used in 'manual mode.' Manual mode allows the user to turn each of the five loop bypass loops on or off as a typical bypass unit would allow. There are no presets in this mode, which allows a user to simply choose a combination of loops on the fly without needing to program.

- The bank switch cycles through the five banks available (manual mode plus banks 1-4) and is also used for programming each loop. It is accompanied by an RGB LED indicating which bank is currently active with five different colors.

- The Epic Looper is easy to program! You only need to use your feet to program any preset - you can do so while standing and holding your instrument.

- The fifth loop can also be set using internal jumpers to be used as a switch for an external device. This feature could be used for switching functions on an amp on or off, or for switching on any device that uses an open/closed latching switch between tip and ground.

- The Epic Looper also features a Midi Output option, which allows the user to program a midi controllable unit to work in conjunction with the presets in each of the 4 programmable banks of the Epic Looper. In Manual Mode, Midi is inactive. Currently, there is no midi input support available.

- For power, the Epic Looper runs on typical Boss standard 9VDC tip negative power supplies. The estimated amperage use of the unit is under 400mA.

- The Epic Looper is designed to be built into standard, already available enclosure easily sourced from common DIY pedal supply shops. In particular, the 4site 1032L Looper enclosure is supported, as is the common Hammond 1411 sized enclosures, both of which are available from Pedal Parts Plus.

SHOPPING FOR PARTS TO BUILD THE EPIC LOOPER

The Epic Looper is designed so that a builder could choose to source parts from one universal location if desired (aside from the PCB set and possibly the enclosure). However, there are parts that a user might be able to find a better deal on elsewhere. The cost of additional shipping has to be weighed against the cost benefits of less expensive parts from multiple vendors.

- Mouser: A builder could order all the parts needed aside from the PCB set from Mouser, including appropriate enclosures. However, the recommended enclosure is not available from Mouser, and the prices on some parts are expensive. That said, they can have just about all the parts you need for this project to your door in as little as 24 hours, AND you may still be placing an order with Mouser for this project as they have great prices on some of the necessary parts you will NEED for this build. It's convenient to order from one place, and the cost is still within reason, just not the cheapest. So, if you're going to make an order with Mouser, choose whether you'll buy some or all the parts there.

- Tayda: Some of the parts needed for this build are available at Tayda, but not all. The benefit to ordering from Tayda is that some of the parts they supply are nearly as good and much, much less expensive than those available from other suppliers. Moreover, taking advantage of the discount sales that Tayda offer as well as their fairly inexpensive shipping rates might mean you can save a lot while still ordering from multiple suppliers. In particular, one might consider Tayda when purchasing some passive components, sockets, RGB LED, Header/Housing assemblies**.

- Pedal Parts Plus: Our favourite location to get the recommended enclosure (4site 1032L) is from Pedal Parts Plus (PPP). Their service and product are both fantastic. One of the benefits to buying from PPP includes being able to select a color of powdercoat for the 1032L enclosure at a very reason able rate (~$20 for a painted enclosure). However, shipping from PPP to those outside the US is often expensive, so if you are not willing to spend that much, look for other options.

- Other: Especially for those not in North America, there are other supply options for many of these parts. Mouser, Tayda, and PPP are international suppliers, which certainly helps, but you may be able to find all or even most of the parts needed from your own favorite vendor. Keep on eye on those shipping rates!

** Header and Housing assemblies are optional for this build. The Molex headers available from Mouser are fantastic but expensive. Tayda has an inexpensive version that's similar and a fraction of the price. See the 'wiring' section for more details.

A special note about RGB LEDs

RGB LEDs are fickle things, and despite trying out best to find a good, inexpensive option, it might mean you need to make multiple orders. The Kingbright RGB from Mouser is not a good option. But, the RGB from Tayda is pretty good. The best one we found was an option was a Hanhua RGB LED we found on Ebay.

EPIC LOOPER SHOPPING LIST

#	Part	Mouser	Tayda
1	5 Position DIP Switch	774-2085	n/a
1	6 Pin Bussed 100K Resistor Array	652-4606X-1LF-100K	n/a
1	100R 1/4 Watt Resistor	660-MF1/4DCT52R1000F	link
5	2.2M 1/4 Watt Resistor	660-MF1/4LCT52R225G	link
10	330R 1/4 Watt Resistor	660-MF1/4LCT52R331J	link
2	220R 1/4 Watt Resistor	660-MF1/4LCT52R221J	link
3	3K 1/4 Watt Resistor	660-MF1/4LCT52R302G	link
5	Red/Green Diffused LED (Common Cathode)	604-WP59EGW	n/a
1	RGB Diffused LED (Common Cathode)	604-WP154A4-RGB	link
4-8	3/16" Plastic Standoff	561-187TAB	n/a
1	Neutrik NYS325 Midi Jack	568-NYS325	n/a
12	Neutrik NYS229 1/4" Jack	568-NYS229	link
1	DC Jack	n/a	link
6	Alpha DPDT Momentary Switch	107-SF12011F-M	link
1	2x4 Pin Header	571-5-146254-4	link
6	Black Nylon LED Bezel	604-CB55	link
5	Fujitsu 5V Low Signal Relay	817-RY-5W-K	n/a
3	16 pin IC Socket	517-4816-3004-CP	link
1	18 pin IC Socket	517-4818-3004-CP	link
3	Header Shunt	649-68786-302LF	n/a
2	100nF Capacitor	80-R82DC3100AA50J	link
3	220uF Radial Electrolytic Capacitor	647-UVR1C221MED	link
2	74HC595 LED Driver	595-SN74HC595N	n/a
1	ULN2003A Darlington Array	511-ULN2003A	link
1	L7805 1.0A 5V Regulator	511-L7805ABV	link
1	1N4001 Diode	625-1N4001E-E3/54	link

OPTIONAL PIN HEADER/HOUSING SHOPPING LIST

#	Part	Mouser	Tayda
60	Bulk Crimp Terminal	538-08-50-0032	link
9	2 Position Header	538-22-27-2021	link
9	2 Position Housing	538-22-01-2025	link
5	4 Position Header	538-22-27-2041	link
5	4 Position Housing	538-22-01-2045	link
1	5 Position Header	538-22-27-2051	link
1	5 Position Housing	538-22-01-2055	link
2	7 Position Header	538-22-27-2071	link
2	7 Position Housing	538-22-01-2075	link

POPULATING THE EPIC LOOPER PCBS

Please note - **The Epic Looper is NOT a beginner level project**. If you are unfamiliar with DIY Pedal building, or are new and inexperienced with large scale projects, we suggest getting a few projects under your belt before tackling the Epic Looper. Check out www.jmkpcbs.com and diy.thcustom.com for some project ideas.

The Epic Looper is a modular PCB system, which allows the user to include or leave out certain features if desired.

- The heart of the Epic Looper system lies in the Control Board, which houses the digital elements - micro controller and other ICs - the 'brain' if you will.

- The Audio Board houses the relays and connections for the loops - rest assured that your signal does not go near any digital elements.

- The Bank Switch Board mounts to an Alpha style DPDT momentary switch, and handles both the programming details and cycles through the banks

- The Loop Switch Boards also mount to Alpha style DPDT momentary switches, and control the individual loops or act as presets

It should be noted that there are some elements that are necessary for this build to function correctly. These elements are not optional:
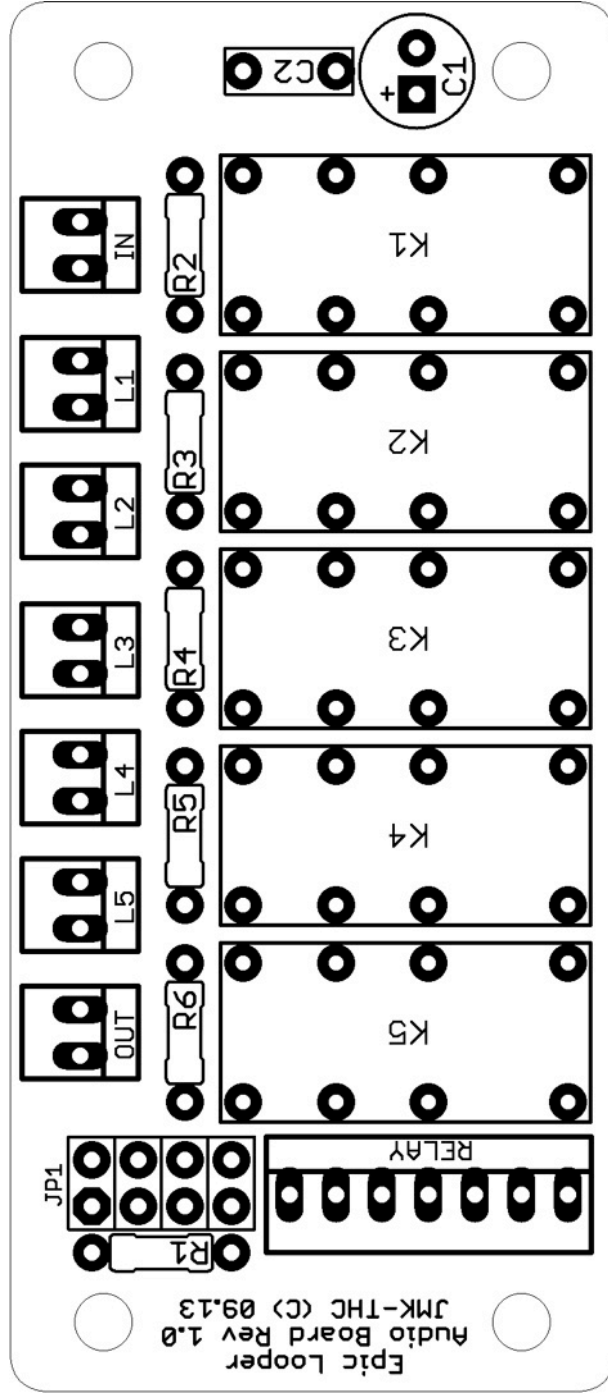
- Input and output Jacks

- 1/4" Jacks, Switch PCB, LED, relays and resistors for each bypass loop (1-5)

- The 4 ICs and the power regulator on the Control Board PCB

- The 4x2 pin header that is required for setting Loop 5 to either loop bypass or switching mode

- Loop 5 must be used at minimum among the 5 loops available

- Bank Switch PCB with DPDT switch, RGB LED and resistors

- The passive components on the Control and Audio Board PCBs

- The DC Jack

There are elements that are not necessary to the operation of the Epic Looper. The following are optional:

- A user may choose to use less than 5 loops (leave off loops 1-4 if fewer than 5 loops/presets are desired). To do so, you may leave off the jacks, relay and resistors for each loop you desire to leave out. Note that jumpers are required for this method to function. Email us to learn about how to set this up as an option.

- Midi Jack, R1, R2, and 5 pin DIP switch on the Control Board can be left off if the user does not desire Midi Output for their unit.

- You don't have to use 4 standoffs, but there are holes for 8. It's up to you how many get used.

- It's up to you if you'd like to use LED Bezels. We recommend plastic ones because the legs of the LEDs may touch the sides of the Bezels - metal would ground out.
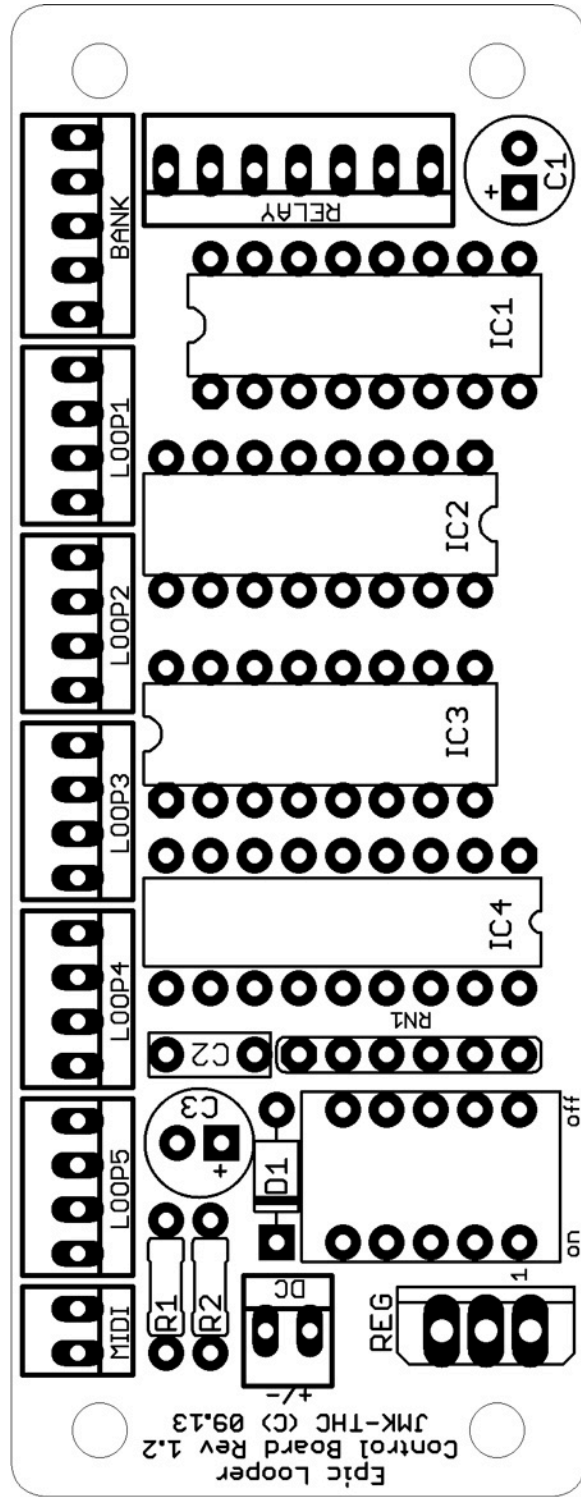
THE AUDIO BOARD LAYOUT

Epic Looper
Audio Board Rev 1.0
JMK-THC (C) 09.13

IN
L1
L2
L3
L4
L5
OUT

R2
R3
R4
R5
R6

K1
K2
K3
K4
K5

C2
C1 +

JP1
R1
RELAY

Passives		Other	
R1	100R	JP1	4x2 Pin Header
R2-R6	2.2M	K1-K5	5V Low Signal Relays
C1	220uF		
C2	100nF		

THE CONTROL BOARD LAYOUT

BANK

LOOP1

LOOP2

LOOP3

LOOP4

LOOP5

MIDI

RELAY

C1

IC1

IC2

IC3

IC4

RN1

C2

C3

D1

R1

R2

DC

REG

on

off

1

+/-

Epic Looper
Control Board Rev 1.2
JMK-THC (C) 09.13

Passives			ICs			Other	
R1, R2	220R		IC1	ULN2003		Unmarked	5DIP Switch
C1, C3	220uF		IC2	74HC595			
C2	100nF		IC3	74HC595			
D1	1N4001		IC4	PIC16			
RN1	6 pin100K Resistor Array		REG	7805			

Note Rev 1.1 of the Control Board features a backwards Silkscreen image for the Regulator. Orient the regulator as above, with the tab towards the DIP switch.

Note Rev 1.1 of this PCB does NOT include the power protection diode D1. All subsequent versions do include it however.
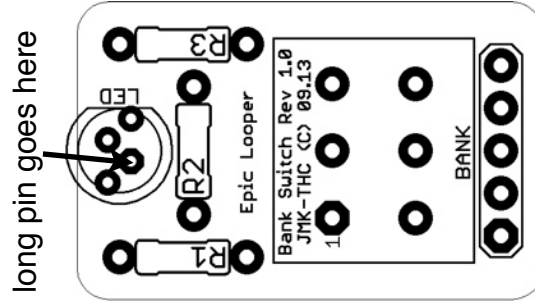
THE SWITCH BOARD LAYOUTS

long pin goes here

R3 **R1**
LED
R2
Epic Looper
Bank Switch Rev 1.0
JMK-THC (C) 09.13
1
BANK
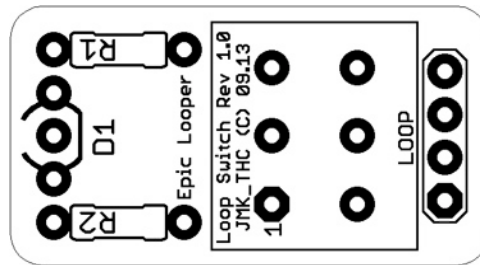
<- Loop Switch

R1, R2	1K	
D1	Red/Green Dual Color LED	
Switch	Momentary DPDT	

Bank Switch ->

R1-R3	3K	
LED	RGB LED	
Switch	Momentary DPDT	

R1 **R2**
D1
Epic Looper
Loop Switch Rev 1.0
JMK-THC (C) 09.13
1
LOOP

Note To properly orient the Dual Colour LEDs, we recommend comparing the datasheet of the LED you have purchased to the Loop Switch board. Keep in mind that the R2 side Loop on/off side, and R1 is the Preset on/off side. So, if you want green to be your loop colour, and red to be your preset colour, orient your LED accordingly.

TIPS FOR ASSEMBLING AND WIRING THE EPIC LOOPER

The Epic Looper is designed to be wired using either soldered wires **or** pin headers and wire housings. The builder has the choice which they'd like to use:

- Soldered wires: This option has the least cost, but creates the hazard of being difficult to disassemble the entire unit if trouble shooting and repair becomes an issue. Once it's built, It is not recommended to remove the wiring. De-soldering wire is possible, but there is always the risk of ruining pads on the PCB after too many de-solder and re-solder passes.

- Headers/Housings: This option can be costly, but the benefit is that a user can assemble and disassemble the elements of this PCB for maintenance or trouble shooting without needing to remove every element from an enclosure. In addition, Headers and Pins keep the wiring <u>very</u> tidy and organized. Keep in mind, if you've never worked with these before, there's a learning curve, and you may need to google for some advice or tutorials.

It's highly recommended that, whichever option they choose, the builder should work to keep the wiring both neat and tidy and with wires being reasonably short in length. Here are some ideas to consider:

- Keep the Audio and Control board next to each other with the 7 pin header connections on the same edge. This will allow you to run a simple, fairly straight, and short connection between these two main boards.

- If possible, orient the Audio and Control PCBs in the enclosure so that the switch connections made to the control board, and the jack connections made to the audio board, are arranged in the same direction. You should be able cross wires without issues, however the boards are designed so that both the switches and the jacks work together starting from the same end and progressing together along the enclosure without needing to cross them or mix them up.

- Carefully drill the holes for your LEDs or Bezels at the correct distance from the switches. This will allow you to mount the LEDs directly to the switch boards. This is not necessary, but it certainly cuts down on the wiring.

- For the entire build, there could be nearly 50 wires, each with a soldered or molex end. Use consistent colored wiring for your wiring to help with trouble shooting, and consider that 100 solder joints for those wires is no small task and may take some time to put together.

When contemplating your build, consider the following:

- The enclosure we recommend (the 1032L) is easily capable of mounting 6 stomp switches in either a staggered or straight pattern. It's also easily capable of mounting the 12 necessary jacks. The PCBs should easily fit mounted on the lid.

- Plan carefully, and measure several times before drilling and mounting the build.

- The Audio and Control boards have 4 holes in the corners. These are available for using either plastic or metal standoffs.

EPIC LOOPER WIRING DIAGRAM

IN

GND

Loop 1
Return - Send

Loop 5
Return - Send

OUT

GND

+9V

GND
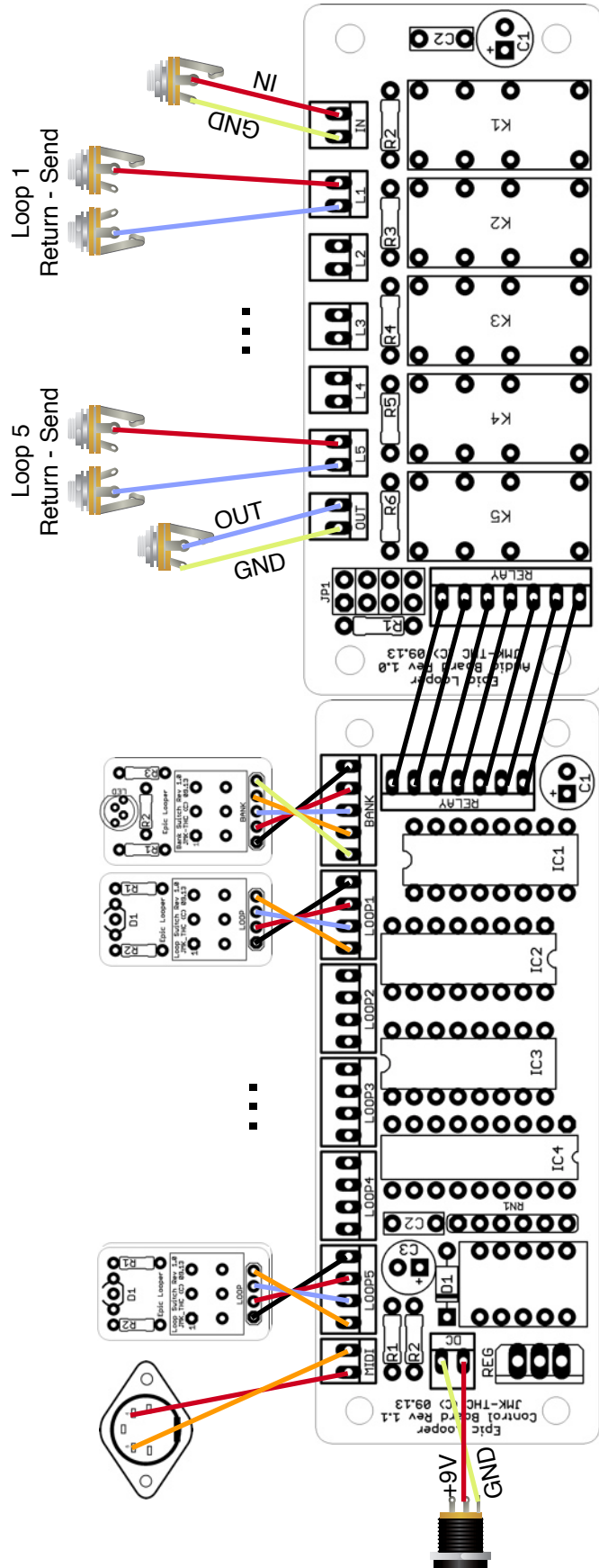
Please note - the grounds on each of the jacks should connect somehow, either through the enclosure or with wired connections
- The Input and Output both have a ground connection and you don need to use both if you are using open frame metal jacks

BYPASS/SWITCHING WITH LOOP FIVE

There are two ways to set up loop five to operate:

- Loop five can operate in 'Loop Mode' as a normal true bypass loop, just as loops one through four would operate

- Loop five can operate in 'Switching Mode' as a switching device typically used for toggling an amp channel, or reverb, or some other device or function which utilizes a remote switch.

Keep in mind that when in 'Switching Mode' instead of 'Loop mode' that the signal passes from loop four to the output. This means that you can still use the first four loops in the standard format, and simply control your switched device as needed.

While in 'Switching Mode,' the two jacks for loop five change from 'send' and 'return' to the following function:

- The Send Jack is 'open,' meaning that the tip of the jack is disconnected from Ground when the switch is off. When the switch is turned on, the send jack becomes 'closed,' meaning that the tip of the jack is connected to ground.

- The Return Jack operates in reverse from the send jack. The Return jack is 'closed' when the switch is off, and is 'open' when the switch is on.

Consult your device or amp for the required switching scheme needed to determine if the Epic Looper is capable of handling your switching needs, and which jack to utilize. Currently, TRS switching jacks are not supported, so keep that in mind if when using this element of the Epic Looper.

SETTING LOOP FIVE FOR SWITCHING OR BYPASS

Setting loop five for Switching or Bypass simply requires 3 shunts, which connect three sets of two pins on the 2x4 pin header located on the Audio Board. They need to be set in one of the following configurations:

Switching

JP1

Bypass

JP1

SELECTING YOUR CHANNEL FOR MIDI

In order to send a Program Change message via Midi, you need to make sure that the midi device you are trying to change and the device you are controlling it with (the Epic Looper for example) are using the same Midi Channel. There is a potential for 16 different channels of midi communication, and you can set your Epic Looper to 'speak' on any of those 16 different channels. Here's a description on how to set your channel:
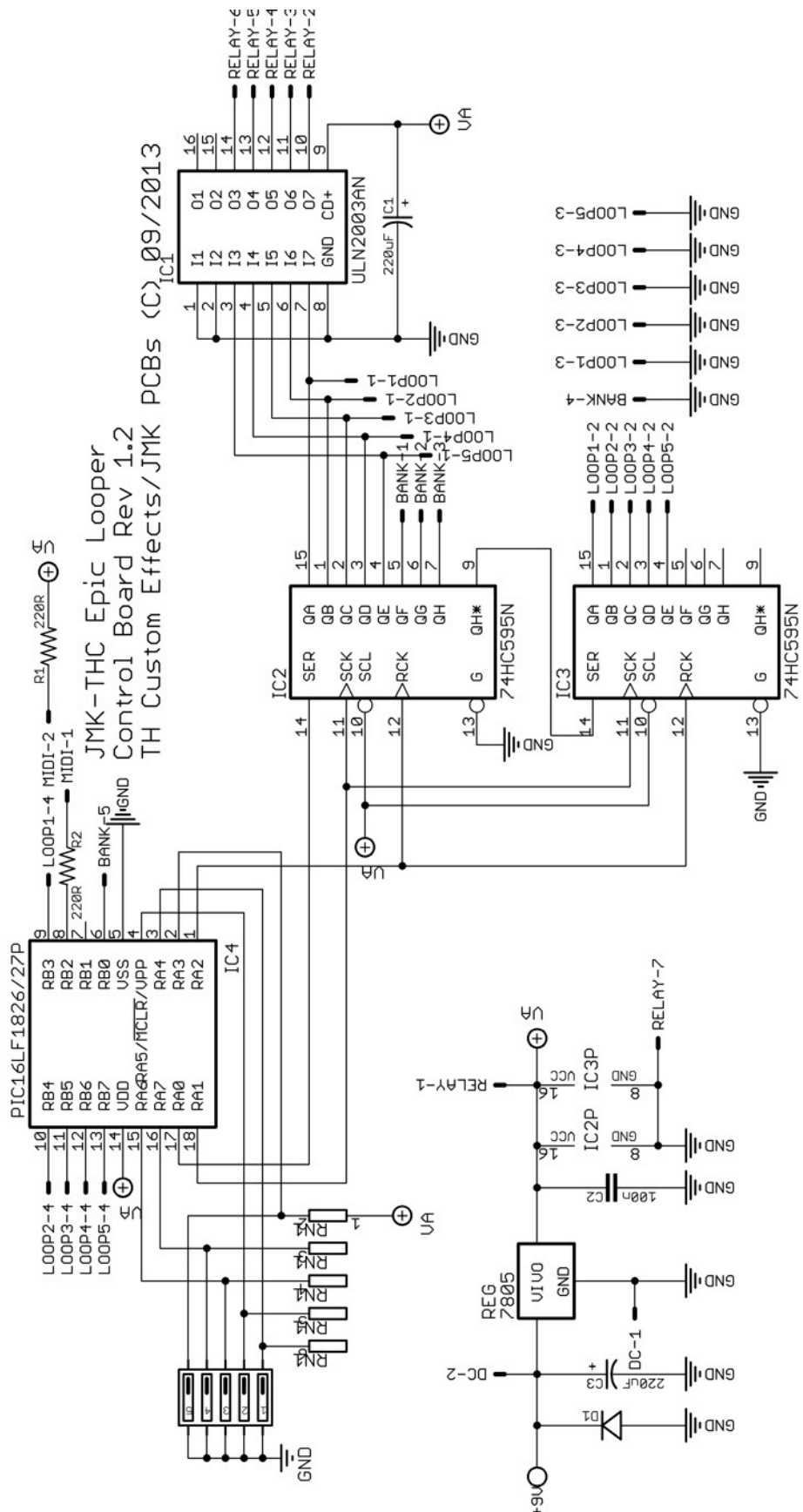
Midi Channel	Dip Switch 1	Dip Switch 2	Dip Switch 3	Dip Switch 4
1	off	off	off	off
2	on	off	off	off
3	off	on	off	off
4	on	on	off	off
5	off	off	off	on
6	on	off	off	on
7	off	on	off	on
8	on	on	off	on
9	off	off	on	off
10	on	off	on	off
11	off	on	on	off
12	on	on	on	off
13	off	off	on	on
14	on	off	on	on
15	off	on	on	on
16	on	on	on	on

AUDIO BOARD SCHEMATIC
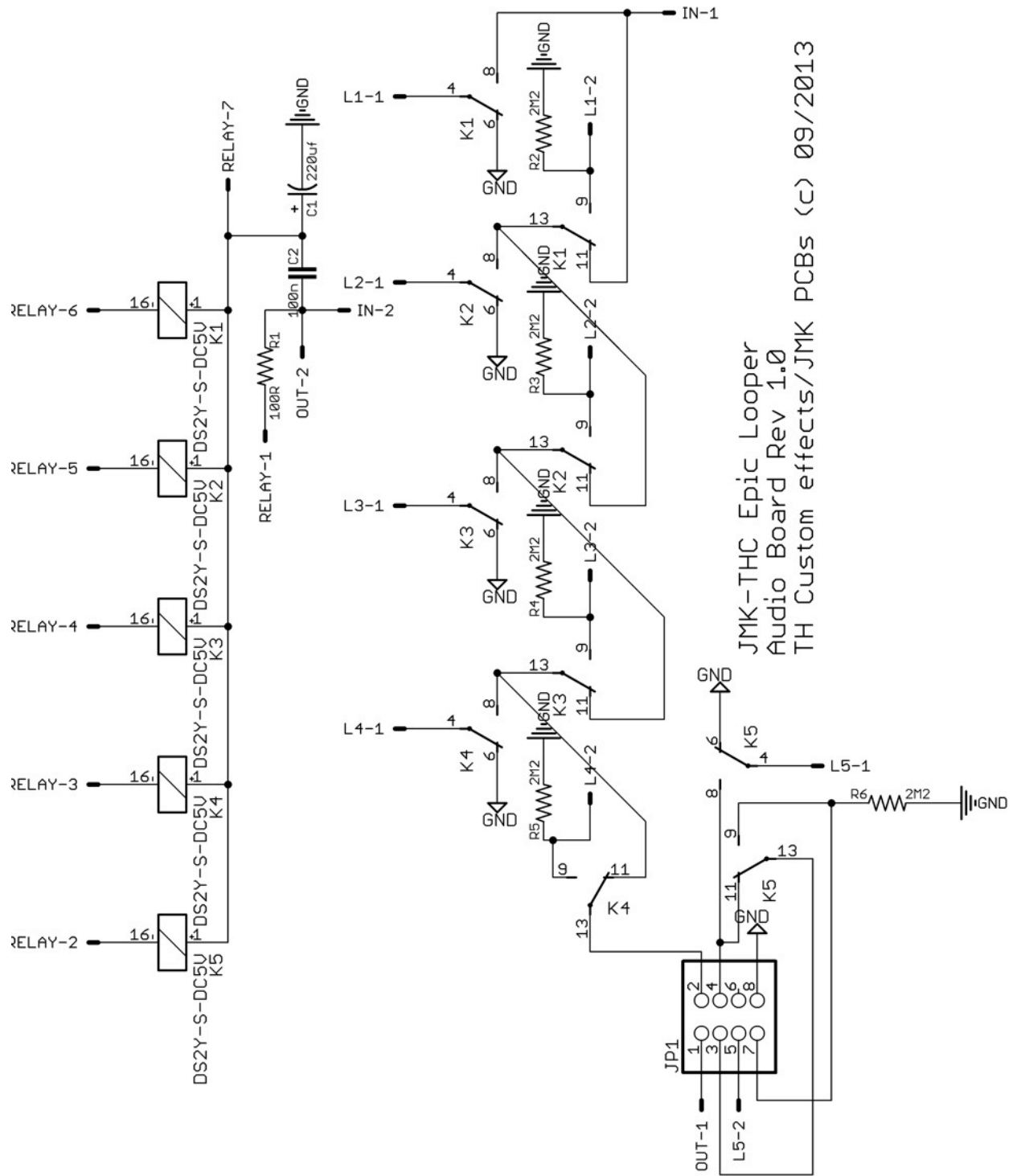
JMK-THC Epic Looper
Audio Board Rev 1.0
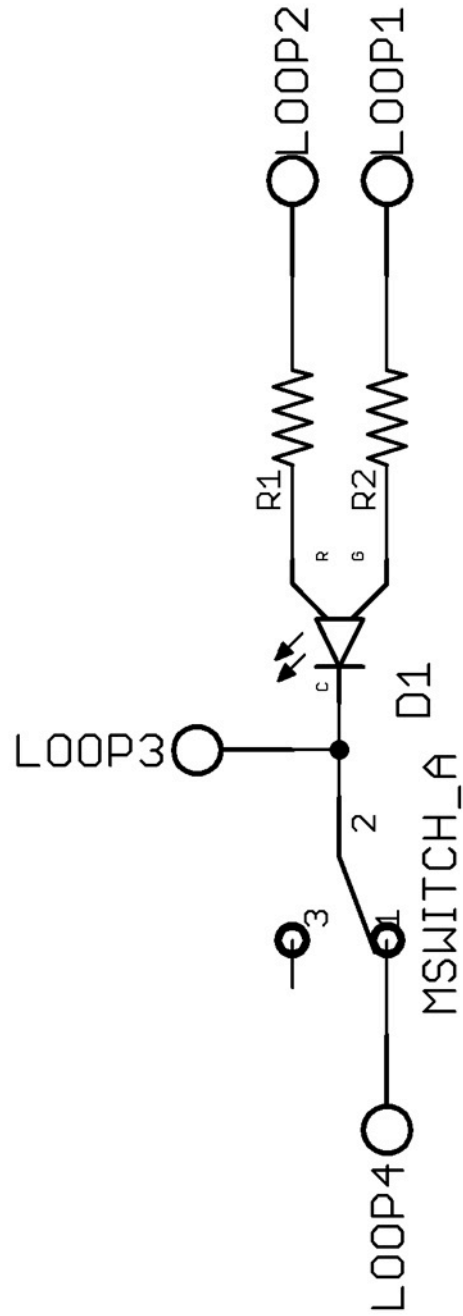TH Custom effects/JMK PCBs (c) 09/2013

CONTROL BOARD SCHEMATIC

JMK-THC Epic Looper
Control Board Rev 1.2
TH Custom Effects/JMK PCBs (C) 09/2013

BANK SWITCH SCHEMATIC

LED

R3
R2
R1

BANK3
BANK2
BANK1

BANK4

MSWITCH_A

2

3
1

BANK5
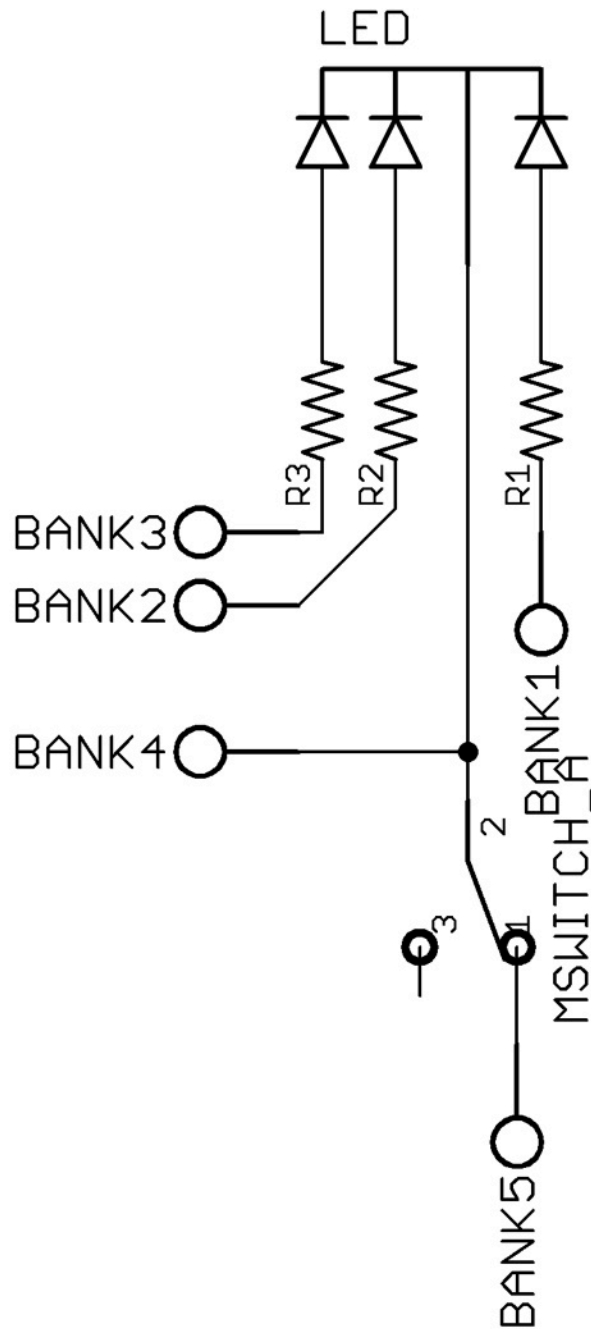
JMK-THC Epic Looper
Bank Switch Board Rev 1.0
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LOOP SWITCH SCHEMATIC

LOOP2

LOOP1

R1

R2

R

G

LOOP3

D1

MSWITCH_A

2

3

1

LOOP4

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Loop Switch Board Rev 1.0
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