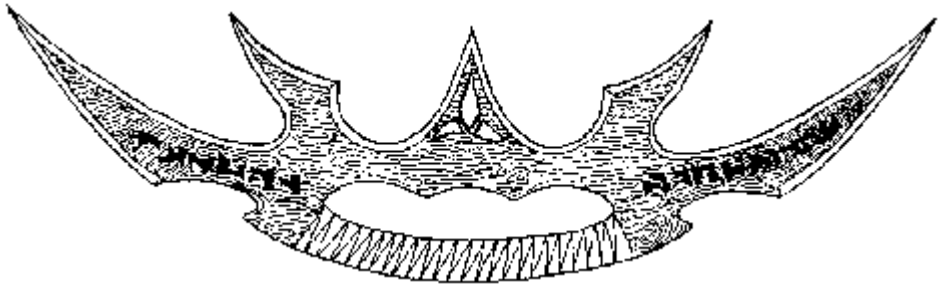

The Tellun Corporation

TLN-854 Sword of Kahless

Warrior Class Ribbon Controller

User Guide, Rev. 1.0

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1. Introduction

The TLN-854 Sword of Kahless is an amalgamation of a Doepfer R2M Ribbon to MIDI Interface and an unreleased ribbon controller I built for myself in early 2005. The R2M has some nice features (programmable, pitch quantization, no droop, MIDI in/out, position and pressure sensor) but is rather weak in the analogue control voltage section with only two outputs (position and pressure) and one gate output (position only). The TLN-854 remedies these limitations by using the R2M as the core of the ribbon controller and adding a substantially enhanced analogue output section (see feature list below). The R2M is itself not modified, merely enhanced, and thus all of its features are still available. You can download the R2M User Guide from Doepfer, but be warned that the section describing the analogue control voltage section is not correct; they need to update it.

In order to build this module, you will need: an R2M from Doepfer (including both the control box and the manual[1]), the TLN-854 printed circuit board (and all necessary parts), and a suitable panel. The R2M is mounted behind the top part of the panel using threaded standoffs glued to the back of the panel. The TLN-854 PCB is mounted behind the panel using Stooge brackets. You may also want to consider repackaging the R2M manual into a proper Bat'leth worthy of the warrior within you. Do a search for Bat'leth or Klingon weapons on the Internet and you'll find plenty of fine examples.

Features:

1. VOLTAGE or CURRENT DRIVE. The R2M uses a voltage source to drive the manual. This is bad because if you touch the manual in two places at once you get a voltage that is somewhere in between the two positions. A better solution is a current source, which gives you low note priority (or high note priority depending on the orientation of the manual) like that found on your old analogue monosynths. The DRIVE switch allows selecting either voltage or current drive for the position sensor.
2. CV 1, GATE 1 with LED. CV 1 is the position output from the R2M. GATE 1 is a reconditioned version of the gate signal from the R2M. This is not your wimpy Terran +5 volt gate, like what you get from the R2M. This is a razor sharp 11.3 volt gate with an LED and a jumper to select either positive voltage gate or S-TRIG style gate.
3. CV 2 with OFFSET and WIDTH, GATE 2 with LED. The R2M can only generate voltages between 0 and +5 volts, useless if you want to use it like a pitch bend wheel. The OFFSET control adds a negative offset to CV 1 and presents this at the CV 2 output so you can set a zero voltage point anywhere along the manual and get both positive and negative voltages from the position sensor. The WIDTH control sets the width of the dead-band range around the zero point, from approximately +/- 1 volt to 0 volts (completely off). This makes it much easier to use the ribbon controller as a pitch bender since you don't have to be so precise when you tap the middle (0 volt) position. GATE 2 is a new gate signal that is derived directly from the position

[1] Doepfer use the term “manual” for the ribbon (or wand). The same terminology will be used here.

sensor, not from GATE 1. The gate signal from the R2M is odd; there are some operating modes where no gate signal is generated at all, and some operating modes where the gate signal will retrigger as you slide your finger along the manual. GATE 2 is a gate signal that goes on when you touch the manual and stays on until you stop touching the manual. Like GATE 1, GATE 2 is a razor sharp 11.3 volt gate with an LED and a jumper to select either positive voltage gate or S-TRIG style gate.

4. HOLD 1 and HOLD 2. The position output from the R2M always holds the last voltage when you release your finger from the manual. What on earth were they thinking? It's like having the sustain pedal permanently pressed on your keyboard. There needs to be a way to turn the hold function off so that the output voltage drops to 0 volts when you release your finger from the manual (think Keith Emerson playing Tarkus and shooting fireworks from his ribbon controller). To remedy this, CV 1 and CV 2 both have HOLD ON/OFF switches, with LEDs to indicate when HOLD is enabled, and jacks for turning the hold function ON and OFF with an external control signal or foot switch.
5. CV 3, GATE 3 with LED and THRESHOLD. CV 3 is the pressure sensor output from the R2M. GATE 3 is a gate whose trigger point is set by the THRESHOLD control (gate goes high when pressure sensor output exceeds THRESHOLD). Like GATE 1, GATE 3 is a razor sharp 11.3 volt gate with an LED and a jumper to select either positive voltage gate or S-TRIG style gate.

2. Circuit Description

Before describing the TLN-854, it will help to understand a bit about how the R2M works.

R2M Description:

There are four signals and a ground connection between the R2M control box and the manual. Two of the signals are for the position sensor (Position A and Position B), the other two are for the pressure sensor (Pressure A and Pressure B). The position sensor can best be thought of as a 10K potentiometer with a wiper that can be disconnected. One side of the potentiometer is connected to ground, the other side is connected to +2.5 volts (Position A). When the manual is not being touched, the pot wiper (Position B) is disconnected from the potentiometer and is pulled up to +3.65 volts. Touching the manual connects the wiper to the potentiometer and a voltage of between 0 and +2.5 volts appears at the wiper, depending on where the manual is touched. When the manual is released, the voltage on the wiper immediately jumps back up to +3.65 volts.

The voltage at the wiper (Position B) does not appear directly at the output of the R2M. Instead, the R2M processes the raw wiper voltage to generate both MIDI data and the position control voltage and gate signals. This processing results in a delay of between 2.5 msec and 7.5 msec between when the wiper voltage first drops below +2.5 volts and when the R2M gate signal goes high. The position control voltage changes 50 µsec before the gate signal goes high. When the manual is released, there is a delay of between 0.3

msec and 5.0 msec between when the wiper voltage first goes above +2.5 volts and when the R2M gate signal goes low.

The pressure sensor simply acts a pressure sensitive resistor. With no pressure applied the resistance is large, many megohms, with increasing pressure the resistance drops, to near zero with excessive force. This resistance appears as the Pressure A and Pressure B signals.

TLN-854 Description:

The current drive circuitry is shown in the lower left on page 1 of the schematic. U1a, Q8, and associated resistors form a current source that is applied to the Position A side of the manual when switch SW3 is in the CURRENT position. This circuit, or one similar, is often used for the keyboard controller of analogue monosynths. But instead of driving a string of resistors (one for each key on a keyboard), here it is driving the 10K resistance of the manual. Switch SW3 selects either the +2.5 volt voltage source from the R2M or the current source from the TLN-854 as the Position A signal. Trimmer TP1 adjusts the current source so that the same voltage will appear at Position B in both VOLTAGE and CURRENT modes.

The R2M gate signal, DGATE, is reconditioned by U2d (centre of page 1 of the schematic) and comparator U5 (top of page 1 of the schematic). The output from U2d is used to generate the GATE 2 signal (discussed below). U5 is a comparator with pull up to +11.3 volts. Q1 drives LED1 and inverts the gate into an S-TRIG gate. JP1 selects either a positive voltage gate or an S-TRIG gate for the GATE 1 signal at J1.

The GATE 2 circuitry is shown in the middle and lower centre on page 1 of the schematic. The raw wiper voltage (Position B) appears as WPOS to U2b. When WPOS drops below +2.5 volts, U2b goes high and starts to charge C25 through R50. After 7.5 msec, U2a will go high. When the raw wiper voltage rises above +2.5 volts, C25 discharges rapidly through D5 and R49 and U2a will immediately go low. Recall from the prior description of the R2M that there is a worst case delay of 7.5 msec (minus 50 µsec) from when the manual is touched to when the position voltage is ready. Thus, the output from U2a is a gate signal that is guaranteed not to rise before the position voltage is ready, but will still go low without any delay. The gate signals from U2d and U2a are OR'd together to create RGATE. Thus if the R2M generates a gate signal before the 7.5 msec worst case scenario, RGATE will go high as soon as DGATE goes high. RGATE will also stay high even if DGATE goes low (as it does in some modes on the R2M). The RGATE signal is reconditioned by comparator U6 with pull up to +11.3 volts to create the GATE 2 signal. Q2 drives LED2 and inverts the gate into an S-TRIG gate. JP2 selects either a positive voltage gate or an S-TRIG gate for the GATE 2 signal at J2.

The HOLD 1 circuitry is shown in the upper right corner on page 1 of the schematic (borrowed from the MOTM-820). The HOLD 1 signal (pin 3 of Q4) is enabled if the voltage at J7 goes below 1.25 volts or if switch S1 is closed. Note that a foot pedal that connects to ground when pressed will also enable the HOLD 1 signal (if plugged into J7).

Q5 turns on LED4 when HOLD 1 is enabled. The HOLD 1 signal is OR'd with RGATE to control analogue switch U3b. This connects either ground or the position control voltage (DCV1) from the R2M to the CV 1 output at J4. Thus U3b will pass the R2M position control voltage if the manual is touched, or if the manual is released and HOLD 1 is enabled, otherwise the output will be 0 volts. U4a buffers the position control voltage without incurring any voltage drops across the output protection resistors (borrowed from the MOTM-820).

The HOLD 2 circuitry is shown in the upper right corner on page 2 of the schematic and is identical to the HOLD 1 circuitry except that the HOLD 2 signal switches U3a between ground and CV 2.

The circuitry for generating CV 2 is shown in the lower right on page 2 of the schematic. A variable DC offset is added to the position control voltage (DVC1) of the R2M via VR1 and U9c/U9a. Ignoring the connections at points B1 & B2 for the moment, this offset version of DVC1 is passed to the analogue switch U3a then through buffer U4b to CV 2 at J5.

U9b, U9d, diodes D1-D4, and VR2 are used to create a "dead-band" response in the CV 2 circuitry. D1-D4 form a diode bridge that is placed in the feedback loop of U9a (see Jung's IC Op-Amp Cookbook). When the WIDTH control is fully off (counter-clockwise) the bridge is off and has no effect on U9a. As the WIDTH control is turned clockwise, an increasing positive voltage is applied to R62, which feeds current to the bridge via D1/D2, and an increasing negative voltage is applied to R65, which feeds current to the bridge via D3/D4. This gradually turns on the bridge and warps the response of U9a. With the WIDTH control fully clockwise, the dead-band width is approximately +/- 1 volt. Note that the circuit is still active, it is not completely dead, it is just much less sensitive around 0 volts as the dead-band width increases.

The circuitry for the pressure control voltage is shown in the upper left on page 2 of the schematic. The pressure control voltage from the R2M is buffered by U1b in a similar manner to that used for the CV 1 and CV 2 outputs. The R2M has an annoying offset of +50 millivolts that is nulled by trimmer TP2. The pressure output CV 3 appears at J6.

The R2M does not have a gate signal for the pressure output. U8 is a comparator with a variable threshold between 0 volts and +4 volts (the usable output range for the pressure sensor). Similar to the GATE 1 and GATE 2 circuitry, Q3 drives LED3 and inverts the gate into an S-TRIG gate. JP3 selects either a positive voltage gate or an S-TRIG gate for the GATE 3 signal at J3.

Page 3 of the schematic shows all the power connections for the ICs, power connections for the two on board regulators (for all the gate and logic signals), and the various connections between the R2M to the TLN-854.

3. Power Considerations

The TLN-854 uses +/-15V and analogue ground. The R2M uses +5V and digital ground. The preferred method of supplying power to both circuits is to use a 6-pin MTA-156 connector and a power supply that can provide all 5 sources: +/-15V, analogue ground, +5V, digital ground. Alternatively, you can use a 4-pin MTA-156 connector to provide +/-15V and analogue ground to the TLN-854, and the AC adapter that came with the R2M to power the R2M. Both methods are described below.

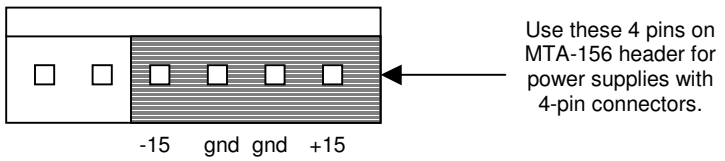
3.1. Using a 6-pin MTA-156 and +/-15V, +5V, AGnd, DGnd Power Supply

The TLN-854 has a 6-pin MTA-156 connector onboard (JP4). This connector routes the +/- 15V and analogue ground to the circuitry on the TLN-854 PCB. The +5V and digital ground are not used by the TLN-854 circuitry. Instead, they are routed to JP5 to provide power to the R2M. The R2M has a +5V regulator that needs to be removed (IC7, a 7805). The easiest way to remove this is to clip the leads from the topside of the board to get the regulator out of the way, then use your desoldering tools to remove the three pins and free up the holes. The middle pin of the regulator is digital ground and connects to the DGND pin at JP5 on the TLN-854 PCB. The pin closest to C8 on the R2M is +5V and connects to +5 at JP5 on the TLN-854 PCB. The third pin (nearest the USB connector on the R2M) should be left unconnected. Use 22-gauge wire for these two wires going between the R2M and JP5; thicker gauges will not fit in the holes on the R2M.

Analogue ground and digital ground need to be bridged together at some point. Normally, this is done at the power supply to maintain a star ground throughout your system. If, for some reason, your power supply leaves them separate, you must connect a jumper at JP9 on the TLN-854 PCB.

3.2. Using a 4-pin MTA-156 and +/-15V, AGnd, Power Supply

If you have a power supply with only 4-pin connectors, plug the power connector into the right-most 4 pins on the TLN-854 and leave the 2 left-most pins unconnected. This will provide power to the TLN-854 (see below).



Use the AC adapter that came with your R2M to supply power to the R2M. You may need to fiddle with the position of the power connector on the R2M if it conflicts with your cabinet.

You must run a wire from digital ground on the R2M to the DGND pin at JP5 on the TLN-854 PCB and install a jumper at JP9 on the TLN-854 PCB. Analogue and digital ground must be bridged together at some point and this is the best way to do it. There are numerous places to find digital ground on the R2M: at the three sockets for CV1/CV2/GATE, at the USB connector, at the power connector, etc.

4. Modifications

The circuitry that generates gate signals GATE 1 and GATE 2 has a fairly high threshold voltage. If you experience problems with these gate signals (e.g. they never go on), try increasing R3/R11 from 15K to 18K.

There are five resistors that set the brightness of the two HOLD and three GATE LEDs. You should set these resistors to provide the brightness you prefer with the LEDs you have chosen. Here are the resistor/LED combinations I chose:

HOLD 1	R37 = 3.3K	LED4 = Lumex super red, Digikey #67-1158-ND
HOLD 2	R44 = 3.3K	LED5 = Lumex super red, Digikey #67-1158-ND
GATE 1	R8 = 1K	LED1 = Lumex green, Digikey #67-1156-ND
GATE 2	R16 = 1K	LED2 = Lumex green, Digikey #67-1156-ND
GATE 3	R23 = 680	LED3 = Lumex yellow, Digikey #67-1157-ND

5. Construction Tips

Deal with the mechanical issues before doing any soldering. Prepare your panel first, drill all the holes and test fit the R2M. The R2M attaches to the back of the panel using threaded standoffs. You can drill holes through the front of the panel and use screws, or just epoxy the standoffs to the back of the panel. The R2M will attach to the standoffs with screws. The TLN-854 attaches to the panel using a Stooge bracket.

5.1. Prepping the Bracket:

The TLN-854 PCB can be mounted to the panel with a three pot long Stooge bracket. Align the PCB with the back edge of the bracket and mark locations for drilling 4 holes for attaching the PCB to the bracket. The bracket attaches to the panel with the three pots VR1-VR3. Note that the hole spacing on the bracket does not align with the pot holes on the panel. You can use one of the holes but you'll need to drill the other two. ***I recommend attaching the bracket to the panel such that the PCB is upside down***. This will minimize the wire lengths when hooking up all the front panel components. Attach the bracket (upside down) with a pot in the THRESHOLD location. From the front of the panel, mark the locations on the bracket where new holes will be drilled for the OFFSET

and WIDTH pots. Before you drill, check that the bracket has not been positioned too high so that it conflicts with the R2M.

5.2. Prepping the R2M:

Remove the MIDI sockets, the CV1/CV2/GATE jacks, and the 7805 regulator (if not using the AC adapter to power the R2M). You may want to try to remove the USB and power connectors. On my R2M, the USB and power connectors are held in place by a huge dollop of glue. Since they didn't conflict with my cabinet, I just left them alone. You will likely want to replace the rectangular LEDs on the R2M with round ones. This is a good time to work that out.

5.3. Miscellaneous:

There are two holes on the TLN-854 PCB labeled "TT1" near JP6 and JP7. This is a test point used in the calibration. Make a loop out of a scrap resistor lead and put it into the two holes so that you can clip a DVM probe onto it.

IC sockets aren't necessary, but I like to use them. Coax cable is not necessary for this circuit.

The PCB uses 0.4" spacing for the resistor pads, 0.4" spacing for the ferrite bead pads, 0.3" for the diode pads, and 0.2" spacing for most of the capacitor pads. The electrolytic caps have a 0.1" pad spacing.

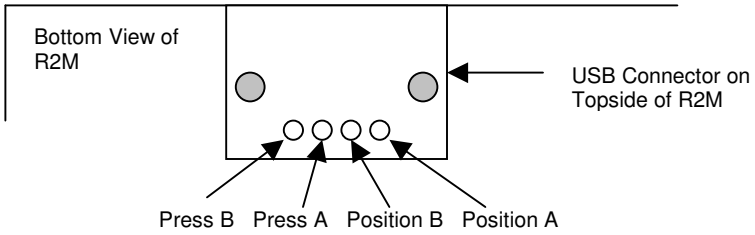
For VR1-VR3, the square pad on the PCB indicates pin 1, the middle pad is pin 2, and the remaining pad is pin 3. The pin out for most pots is (left to right): 3, 2, 1 when viewing the back of the pot with the leads facing down.

For J1-J8, the square pad on the PCB indicates the ground connection.

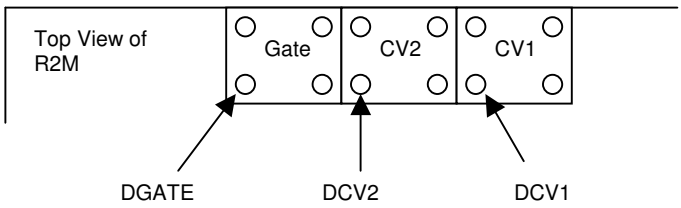
For the LED connection points, the square pad indicates the cathode. The cathode is normally the shorter lead on an LED.

For SW1-SW2, the two wires connect to the middle and bottom lug. For SW3, the square pad on the PCB connects to the top lug, the middle pad connects to the middle lug, and the third pad connects to the bottom lug.

For JP6, the square pin is pin 1. If we call this the top-most pin, then from top to bottom the connections for JP6 are: Pressure B, Pressure A, Position B, Position A. These wires connect to the USB connector on the R2M. Reading from left to right on the bottom side of the R2M (the bottom side has the LCD panel), these connections are in the same order: Pressure B, Pressure A, Position B, Position A.

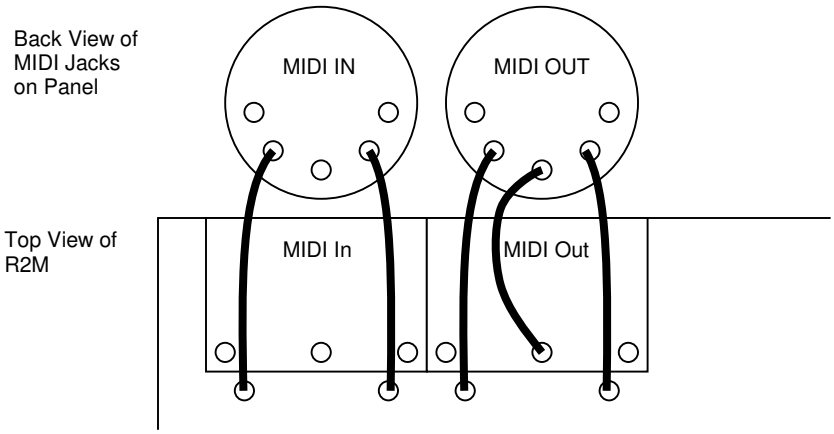


For JP7, the square pin is pin 1. If we call this the top-most pin, then from top to bottom the connections for JP7 are: DGATE, DCV2, DCV1. These wires connect to the Gate, CV2, and CV1 jacks on the R2M. With the jacks removed from the R2M, there are four holes for each of the sockets. From the topside of the R2M, the top two holes are ground connections, the bottom right hole is unused, and the bottom left hole is where you need to attach the wires that go to JP7.



For JP8, the square pin is pin 1. If we call this the top-most pin, then from top to bottom the connections for JP8 are: ground, Pressure B, Pressure A, Position B, Position A.

The MIDI sockets on the panel connect directly to the R2M (replacing the two MIDI sockets on the R2M). The MIDI IN connection uses two wires, but the MIDI OUT connection uses three wires. The extra wire on the MIDI OUT connection is a (digital) ground connection. This is normal and is meant to avoid ground loops. See the MIDI 1.0 specification for more details.



To hook up the manual to the TLN-854, you will likely need to create a new cable that has four conductors plus a shield. I call this the "manual cable". USB cables are usually short and quite stiff. I found some great cable at a pro audio store. I don't have a part number for it; it just says "MIDI CABLE" on the outside. It has a black outer casing and is quite flexible, just like instrument cable, but inside there are four conductors plus a shield.

I selected a Lemo style connector for the end of the manual cable that connects to the TLN-854. I chose this connector because it is very rugged, quickly snaps in and out, and is unlikely to be confused with any other kind of connection. Unfortunately, it is also very expensive. You can select any kind of five-pin connector; even a MIDI connector will work. I think it's a bad idea to use MIDI connectors for non-MIDI signals (or USB connectors for non-USB signals) because it's too easy to inadvertently plug MIDI gear into what is not a MIDI connection and something could be damaged. If you do go with a DIN plug, choose one that has different pin spacing than MIDI connectors.

I'm currently using a USB connector for the end of the manual cable that plugs into the manual. I would like to use something else, like a Lemo, but there isn't much room on the manual to attach a good connector. I'm still working on this one.

The trickiest part of building this module is making sure that the four wires from the USB connector on the R2M end up at the correct locations on the manual. Three of the wires (Position B, Pressure A, and Pressure B) go straight through from the R2M to the manual. Position A goes straight through only when SW3 is in the VOLTAGE position. I recommend spending some time drawing up a wiring guide (colour coded) to help you get it straight.

6. Wiring Guide

These wire lengths are only applicable if you install the TLN-854 and Stooge bracket upside down, as suggested in the previous section.

6.1. TLN-854 PCB to Panel

Panel Designation	*PCB Designation*	*Wire Length (inches)*	*Wire Type*
OFFSET pot	VR1	4	twisted (3 wire)
WIDTH pot	VR2	4.5	twisted (3 wire)
THRESHOLD pot	VR3	3	twisted (3 wire)
HOLD 1 switch	SW1	7	twisted (2 wire)
HOLD 2 switch	SW2	7	twisted (2 wire)
DRIVE switch	SW3	4	twisted (3 wire)
GATE 1 LED	LED1	8	twisted (2 wire)
GATE 2 LED	LED2	7	twisted (2 wire)
GATE 3 LED	LED3	3	twisted (2 wire)
HOLD 1 LED	LED4	6.5	twisted (2 wire)
HOLD 2 LED	LED5	6.5	twisted (2 wire)

GATE 1 jack	J1	8	twisted (2 wire)
GATE 2 jack	J2	7	twisted (2 wire)
GATE 3 jack	J3	4	twisted (2 wire)
CV 1 jack	J4	7	twisted (2 wire)
CV 2 jack	J5	7.5	twisted (2 wire)
CV 3 jack	J6	6	twisted (2 wire)
HOLD 1 jack	J7	7	twisted (2 wire)
HOLD 2 jack	J8	7	twisted (2 wire)
BAT'LETH jack	JP8	6	twisted (5 wire)

6.2. TLN-854 PCB to R2M

R2M Designation	*TLN-854 Designation*	*Wire Length (inches)*	*Wire Type*
*IC7 (7805 regulator)	JP5	9	22 gauge 2 wire
USB connector	JP6	8	twisted (4 wire)
Gate/CV2/CV1	JP7	9	twisted (3 wire)

*If not using the AC adapter to power the R2M

6.3. R2M to Panel

Panel Designation	*R2M Designation*	*Wire Length (inches)*	*Wire Type*
MIDI IN	MIDI In	8.5	twisted (2 wire)
MIDI OUT	MIDI Out	8.5	twisted (3 wire)

7. Calibration

Before beginning calibration, the R2M must be configured so that it outputs a positive voltage gate signal when touched and the pressure sensor outputs an increasing positive voltage with increasing pressure. The pressure output should be set to the maximum range. Also make sure the R2M is set to output a positive voltage gate, not an S-TRIG gate (see the R2M user guide for instructions on how to do this).

Trimmer TP1 adjusts the current source so that the same voltage will appear at Position B in both VOLTAGE and CURRENT modes. Attach a DVM to test point TT1 on the TLN-854 PCB. With switch SW3 in the VOLTAGE position, touch the manual nearest the end where the cable connects to it. When the GATE 1 signal is high, measure the voltage at TT1, it should be very near +2.5 volts. Without moving your finger on the manual, switch SW3 to the CURRENT position and adjust TP1 so that the voltage at TT1 is identical to that measured when the switch was in the VOLTAGE position. This is not a critical setting, but you should be able to get it quite close.

Trimmer TP2 nulls an offset that appears at the pressure output jack. Without touching the manual, attach a DVM to the CV 3 output jack and adjust TP2 so that the voltage is 0.0 volts.

8. Other Useful Information

The R2M has a jumper (JP3) for selecting either positive voltage gate or S-TRIG gate. This jumper should always be set to generate a positive voltage gate. The TLN-854 won't work properly if you have this jumper set to S-TRIG gate. Use jumpers JP1-JP3 on the TLN-854 to select between positive voltage and S-TRIG gates.

For JP1-JP3, jumper the two pins nearest the top edge of the TLN-854 PCB (i.e. nearest the power supply connections) for positive voltage gates, jumper the two pins nearest the bottom edge for S-TRIG gates. There should have been labels printed on the PCB to designate this (oops).

The R2M has a trimmer (P1) that can be used to adjust the volt/octave scaling.

TLN-854 Parts List

Resistors (65)

Quantity	*Description*	*Part No.*	*Notes*
2	100	R31, R38	5% or better, Mouser #291-100
3	470	R24, R26, R28	5% or better, Mouser #291-470
1	680	R23	5% or better, Mouser #291-680
6	1 K	R5, R8, R13, R16, R20, R49	5% or better, Mouser #291-1K
2	2.2 K	R34, R41	5% or better, Mouser #291-2.2K
2	3.3 K	R37, R44	5% or better, Mouser #291-3.3K
2	4.7 K	R51, R52	5% or better, Mouser #291-4.7K
13	10 K	R6, R7, R14, R15, R21, R22, R32, R35, R36, R39, R42, R43, R48	5% or better, Mouser #291-10K
2	15 K	R3, R11	5% or better, Mouser #291-15K
4	22 K	R1, R9, R17, R46	5% or better, Mouser #291-22K
6	47 K	R25, R27, R29, R33, R40, R61	5% or better, Mouser #291-47K
1	82 K	R45	5% or better, Mouser #291-82K
3	100 K	R4, R12, R47	5% or better, Mouser #291-100K
1	130 K	R50	5% or better, Mouser #291-130K
1	200 K	R19	5% or better, Mouser #291-200K
4	3.3 M	R2, R10, R18, R30	5% or better, Mouser #291-200K
4	10 K	R59, R60, R63, R64	1%, Mouser #271-10K
2	22 K	R53, R55	1%, Mouser #271-22K
1	47 K	R54	1%, Mouser #271-47K
4	100 K	R56, R57, R62, R65	1%, Mouser #271-100K
1	300 K	R58	1%, Mouser #271-300K

Capacitors (30) (Note: there is no C3)

Quantity	*Description*	*Part No.*	*Notes*
19	0.1 uF ceramic	C6 – C24	Mouser #147-72-104 Mouser #581-SA105E104M (for p/s decoupling)
2	22 uF 35V elec.	C1 – C2	Mouser #140-XRL35V22 (for p/s decoupling)
2	10 uF 35V elec.	C4 – C5	Mouser #140-XRL35V10 (for p/s decoupling)
1	0.1 uF multi-layer film	C25	Mouser #581-BF014D0104J
6	1 nF multi-layer film	C26 – C31	Mouser #581-BF014D0102J

Semiconductors (39)

Quantity	*Description*	*Part No.*	*Notes*
1	TL072 dual op amp	U4	Allied #735-2727 Mouser #595-TL072CP
3	LM311N comparator	U5, U6, U8	Mouser #511-LM311N Digikey #LM311NNS-ND
1	CD4001 quad 2 input CMOS NOR gate	U7	Mouser #595-CD4001UBE
1	MX1013 dual op amp	U1	Allied #735-3671 Mouser #595-LT1013CP

2	TL074 quad op amp	U2, U9	Mouser #595-TL074CN
1	ADG436 dual SPDT switch	U3	Digikey #ADG436BN-ND
9	1N4148 diode	D1 – D9	Allied #950-1550 Mouser #512-1N4148 (can substitute 1N914)
7	BC549B transistor (NPN)	Q1 – Q7	Mouser #625-BC549B, (can substitute BC550)
1	BC559B transistor (PNP)	Q8	Mouser #625-BC559B, (can substitute BC560)
1	LM78L12 +12V regulator TO-92	U10	Mouser #511-L78L12ACZ
1	LM79L12 –12V regulator TO-92	U11	Mouser #511-L79L12ACZ
2	Lumex green LEDs	LED1 – LED2	Digikey #67-1156-ND
1	Lumex yellow LED	LED3	Digikey #67-1157-ND
2	Lumex red LEDs (super red)	LED4 – LED5	Digikey #67-1158-ND
6	T1 LEDs		for replacing the rectangular ones in the R2M

Potentiometers & Trimmers (5)

Quantity	*Description*	*Part No.*	*Notes*
3	100 K linear pot	VR1 – VR3	Spectrol 149 series, Allied #970-1791, or Bournes 91 series, Allied #754-9420
1	5 K trimmer (multi-turn)	TP1	Mouser #72-T93YA-5K
1	100 K trimmer (multi-turn)	TP2	Mouser #72-T93YA-100K

Miscellaneous

Quantity	*Description*	*Part No.*	*Notes*
8	phone jack Switchcraft 112A	J1 – J8	Allied #932-9391 Mouser #512-112A
1	16 pin DIP socket		for ADG436
3	14 pin DIP socket		for TL074 and CD4001
5	8 pin DIP socket		for MXL1013, LM311N, and TL072
3	axial ferrite bead	L1, L2, L3	Active #MURJP2141, Mouser #623-2743002112
3	SPDT switch, NKK M2012ES1W01	SW1, SW2, SW3	Allied #870-8646 Mouser #633-M201202
3	3 position 0.1” header	JP1, JP2, JP3	Digikey #A26512-ND (40 pin, break away as many pins as you need) Mouser #571-6404523 (3 pin)
1	2 position 0.1” header	JP9	Digikey #A26512-ND (40 pin, break away as many pins as you need) Mouser #571-6404522 (2 pin)
4	2 pin shunt for JP1, JP3, JP3, and JP9		Mouser #517-952-10
1	MTA-156 6 pin header	JP4	Mouser #571-6404456 Digikey #A1973-ND (for power supply, see text)

1	MTA-100 4 pin connector	JP6	Mouser #571-6404564 (header) Mouser #571-6404404 (receptacle) Mouser #571-6405504 (dust cover)
1	MTA-100 3 pin connector	JP7	Mouser #571-6404563 (header) Mouser #571-6404403 (receptacle) Mouser #571-6405503 (dust cover)
1	MTA-156 2 pin connector	JP5	Mouser #571-6404452 (header) Mouser #571-6404262 (receptacle) Mouser #571-6405512 (dust cover)
2	MIDI (DIN) jacks		Mouser #16HR655 (for R2M MIDI in and out)
1	manual jack (5 pin)		Mouser #649-JBXER1G05FSSDSR (for connecting manual to module, this is a very expensive connector, see text for other options)
1	manual plug (5 pin)		Mouser #649-JBXFD1G05MSSDSR (for connecting manual to module, this is a very expensive connector, see text for other options)

Hardware

Quantity	*Description*	*Notes*
3	knob ALCO PKES60B1/4	Mouser #506-PKES60B1/4 (not the same size as MOTM knobs, this is the smaller knob found on Encore's UEG and Frequency Shifter, Radio Shack has a knob that looks almost identical to this)
1	TLN-854 panel	front panel
1	TLN-854 PCB	printed circuit board
1	3 pot long Stooge bracket	Stooge bracket
4	#6-32 screw, 1/4" spacer, and nut	(for mounting main circuit board to Stooge bracket)
3	pot nut	Mouser #534-1456 (for mounting Stooge bracket to front panel)
1	MTA-156 power cable (need two receptacles and two dust covers)	Digikey #A1953-ND (6 pin receptacle) Digikey #A19764-ND (6 pin dust cover) Mouser #571-6404266 (6 pin receptacle) Mouser #571-6405516 (6 pin dust cover)
1	Doepfer R2M	Ribbon to MIDI circuit board and manual
4	#8-32 black screw	(for mounting module to cabinet)
1	USB connector	(for connecting cable to manual, see text)
	4 conductor plus shield cable	(for connecting manual to module, see text)
	desoldering tools	(for removing unneeded items from R2M, see text)
	heat shrink cable	
	cable ties	
	hookup wire	
	solder	both organic and no clean

DOEPFER

R2M RIBBON TO MIDI INTERFACE

PRESET

STORE

2|Start/Stop [1]
1|Tempo(Bpm):120

NEXT

PREV

CV PARAM | MIDI EVENT | MIDI PARAM | MODE | ARP | START STOP

DRIVE

CURRENT

VOLTAGE

OFFSET

WIDTH

THRESHOLD

MIDI IN

MIDI OUT

HOLD

ON 1 OFF

ON 2 OFF

GATE 1

GATE 2

GATE 3

BAT'LETH

HOLD 1

HOLD 2

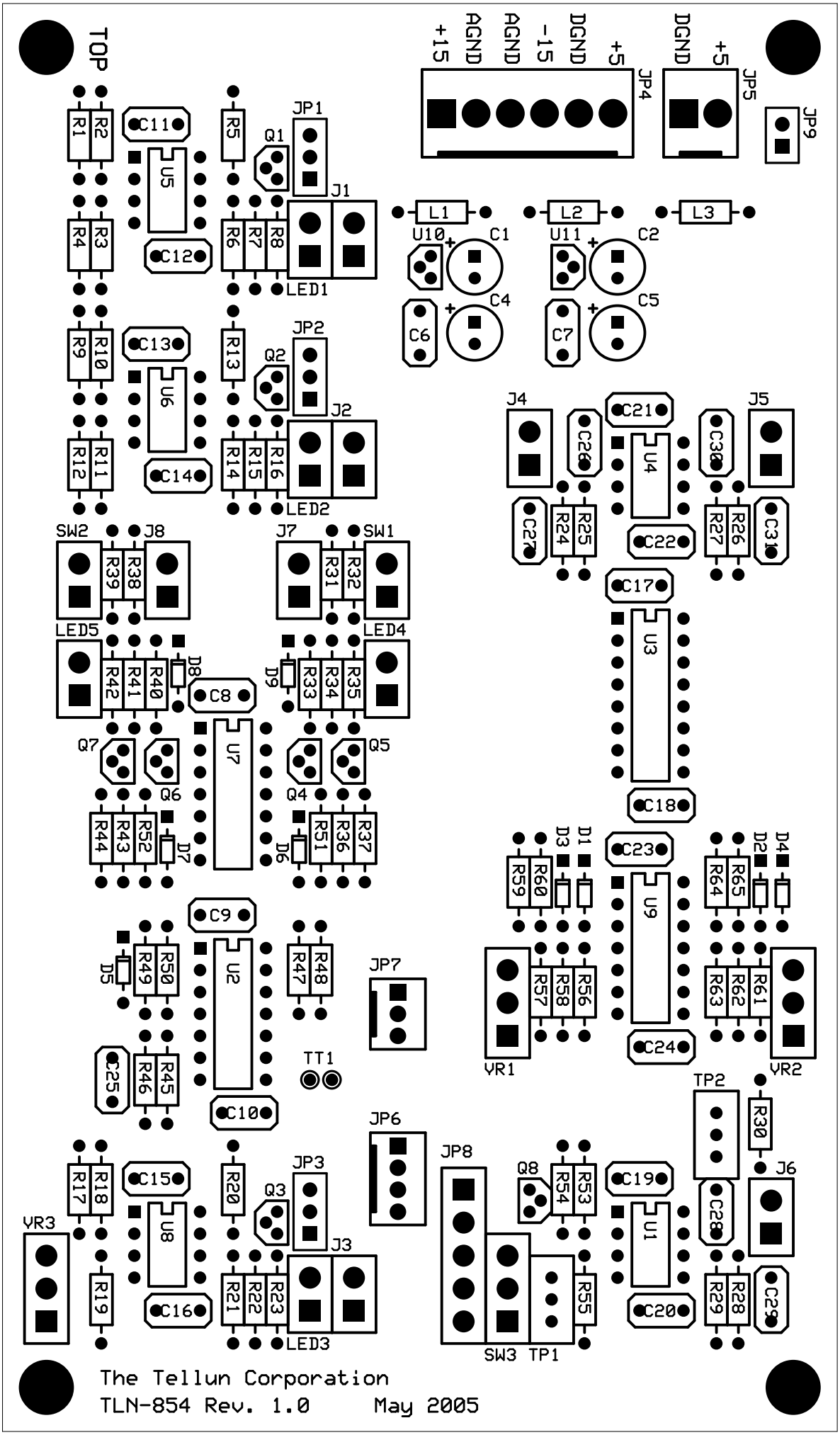
CV 1

CV 2

CV 3

THE TELLUN CORPORATION

TLN-854 SWORD OF KAHLESS


TOP
+15
AGND
AGND
-15
DGND
+5
JP4
DGND
+5
JP5
JP9
JP1
Q1
J1
LED1
JP2
Q2
J2
LED2
L1
L2
L3
U10
C1
U11
C2
C4
C5
C6
C7
J4
J5
U4
U5
U6
U7
U8
U9
U1
U2
U3
C11
C12
C13
C14
C15
C16
C17
C18
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
SW2
J8
J7
SW1
LED5
LED4
D8
D9
C8
Q7
Q6
Q5
Q4
D7
D6
R39
R38
R31
R32
R42
R41
R40
R33
R34
R35
R44
R43
R52
R51
R36
R37
C9
C10
D5
R49
R50
R47
R48
R46
R45
JP7
TT1
JP6
JP8
JP3
Q3
J3
LED3
SW3
TP1
Q8
R54
R53
R55
R21
R22
R23
VR1
VR2
VR3
D3
D1
D2
D4
R59
R60
R64
R65
R57
R58
R56
R63
R62
R61
TP2
R30
J6
R29
R28
C19
R20
The Tellun Corporation
TLN-854 Rev. 1.0
May 2005