The Tellun Corporation

TLN-864 Switching Comparator

User Guide, Rev. 1.1

Scott Juskiw The Tellun Corporation scott@tellun.com	TLN-864 User Guide Revision 1.1 August 31, 2006

1. Introduction

The TLN-864 Switching Comparator combines a comparator and an analogue switch. A typical comparator has two inputs (A & B) and produces an output that is high (H) if A > B, and low (L) if A < B. Rather than using fixed voltages for the H and L states, the TLN-864 allows the voltages to be manually set using two front panel pots. For example, H can be -1V and L can be +3V. In addition, two front panel jacks allow any external signal to be used for the H and L states. For example, H could be the SINE wave output from an oscillator and L could be the inverted output from a sample and hold module. Anything goes in, anything goes out. Reversing attenuators are used on the A, B, H, and L inputs so that all input signals can be scaled and inverted. When nothing is plugged into the A, B, H, and L inputs, the front panel pot is used to select a fixed voltage reference from -5V to +5V.

The switching portion of the comparator has two modes of operation. The first mode (HL:X) is a 2-to-1 switch in which the signals at A and B determine whether H or L appear at output X. In other words:

```
If ( A > B )
  X = H
else
  X = L
```

The Y output is not used in this mode.

The second mode (H:XY) is a 1-to-2 switch in which the signals at A and B determine whether H appears at the X or Y output. In other words:

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If ( A > B )
  X = H
else
  Y = H
```

The L input is not used in this mode.

The panel controls are as follows:

- LEVEL A: reversing attenuator for A input (normalled to +5V reference).
- LEVEL B: reversing attenuator for B input (normalled to +5V reference).
- LEVEL H: reversing attenuator for H input (normalled to +5V reference).
- LEVEL L: reversing attenuator for L input (normalled to +5V reference).
- MODE: selects the switch mode, 2-to-1 or 1-to-2.
- LED: bicolour LED is RED when A is less than B and GREEN when A is greater than B.

2. *Circuit Description*

This circuit is quite simple and consists of a comparator, an analogue switch, an LED driver, and four reversing attenuators. U5a is configured as a comparator with a tiny bit of hysteresis supplied by R27. If the voltage on pin 3 is higher than the voltage on pin 2, the output at pin 1 is about +13.5V, otherwise the output is about –13.5V. This “high or low” logic signal controls the AD419 analogue switch U6 and is also buffered by U5b to drive a bicolour LED. The rest of the circuitry comprises four reversing attenuators to select the input and output signals.

The reversing attenuator for the A input is built around U1. U1a inverts the signal present at J1 (IN A) and VR1 (LEVEL A) selects the amount of inverted or non-inverted signal sent to the rest of the circuit. The output from VR1 (the centre pin of VR1) is inverted again by U1b before being fed to the comparator’s positive input (pin 2 of U5). An on-board +5V reference is normalled to the switching lug of J1 so that a constant value from –5V to +5V can be dialed in with VR1 when nothing is plugged into J1.

The reversing attenuator for the B input is built around U2 and is identical to the A input except that the output feeds the negative input of the comparator (pin 3 of U5).

The reversing attenuator for the H input is split between U3a and U4a. The first half is identical to the circuit used for the A and B inputs with jack (J3) normalled to the +5V reference, an inverter (U3a), and a pot (VR3). The output from VR3 is sent to MODE switch SW1 and then to the analogue switch U6. How U4a is used depends on the setting of the MODE switch (more on this later). U4a is configured as an inverter with a capacitor (C17) in the feedback loop to help avoid high frequency oscillations when using long leads on J5 (OUT X). The two resistors in the feedback loop, R20 and R21, protect the output of U4a from a short circuit to ground and eliminate voltage drops that can lead to pitch problems when driving the frequency control inputs of oscillators.

The reversing attenuator for the L input is split between U3b and U4b and is similar to the H input in that the MODE switch determines how the H and L inputs and the X and Y outputs are connected together.

In the HL:X mode, the centre pins of VR3 (LEVEL H) and VR4 (LEVEL L) are fed to the S1 and S2 pins of U6, respectively, and the D pin of U6 is connected to U4a. When the comparator output (U5a) is high, S2 is connected to D on U6, so the H input signal goes through U3a/VR3, then through the MODE switch, then through the analogue switch U6 (pins S2 and D) and finally goes to U4a and exits via J5 (OUT X). When the comparator output (U5a) is low, S1 is connected to D on U6, so the L input signal goes through U3b/ VR4, then through the MODE switch, then through the analogue switch U6 (pins S1 and D) and finally to U4a and exits via J5 (OUT X). J6 (OUT Y) is not used in this mode.

In the H:XY mode, the centre pin of VR3 (LEVEL H) is fed to the D pin of U6, the S2 pin of U6 is connected to U4a (OUT X), and the S1 pin of U6 is connected to U4b (OUT

Y). When the comparator output (U5a) is high, S2 is connected to D on U6, so the H input signal goes through U3a/VR3, then through the MODE switch, then through the analogue switch U6 (pins D and S2) and finally goes to U4a and exits via J5 (OUT X). When the comparator output (U5a) is low, S1 is connected to D on U6, so the H input signal again goes through U3a/VR3, then through the MODE switch, then through the analogue switch U6 (pins D and S1) and finally goes to U4b and exits via J6 (OUT Y). J4 (IN L) is not used in this mode.

Note that in H:XY mode, only one of the X and Y outputs is connected to the H input at any time. The disconnected output is not left floating, but is pulled to ground. If the disconnected output were not pulled to ground, it would not float at whatever voltage was last output but would eventually discharge to ground at a rate determined by the capacitance of the cables on that output and whatever modules it is connected to. If you want the outputs to maintain the last voltage when disconnected, you will have to hook up a Sample and Hold module on the outputs.

The +5V reference is constructed from a 78L05 regulator (U7). The raw output from the regulator is sent to pin 5 on the analogue switch (U6) to set the logic level. To avoid the possibility of momentarily shorting the regulator output to ground when a jack is inserted into J1-J4, a protection resistor (R31) is inserted between the regulator output and the switching lugs.

C13 and C14 are power supply bypass caps. Normally these would each be 22 uF caps if the circuit is being built on one monolithic PCB. When building this circuit onto MUUBs, I recommend breaking each of these caps into dual 10 uF caps and placing them onto separate circuit boards. See the section on MUUB construction for more details. If you are using a different circuit board, then there’s no need to split C13 and C14.

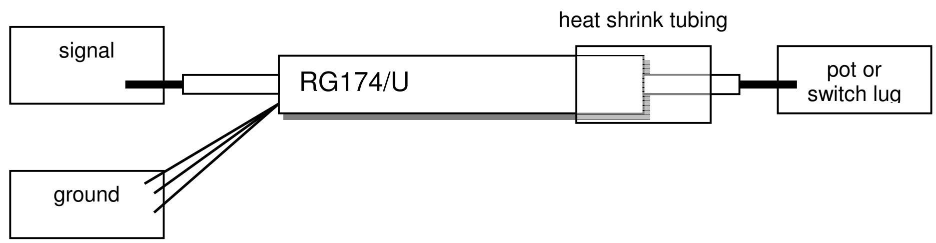
3. Construction Tips

Use 1% resistors wherever they are shown in the schematic.

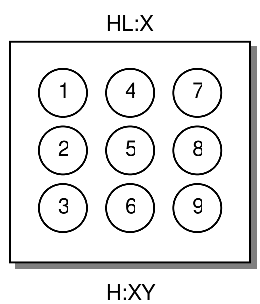
If you use Bourns or Spectrol pots with the Alco PKES60 knobs, you might want to trim 1/8” off the end of the pot shafts to get the knobs to sit closer to the panel. I did not do this for the TLN-864 seen in the website pictures.

The Lumex bicolour LED is difficult to buy in small quantities. I bought some from Synthesis Technologies and they came with red and black wires already attached. The schematic shows which wire connects to R30 and which connects to ground so that the red LED is lit when A < B and the green LED is lit when A > B. Reverse these two wires if you want the opposite colour scheme.

Use coax cable for the jack, switch, and pot connections. The TLN-864 can be used with audio signals, so it’s a good idea to use coax cable to keep noise out of the circuit. When hooking up coax between the PCB and pots or switches, connect the coax shield to ground at one end only. Clip the coax shield from the other end and cover with a piece of heat shrink tubing to prevent any stray strands from coming into contact with anything. At this clipped end, connect the core (inside) conductor to the pot or switch lug.



SW1 is a 3PDT switch (with nine pins in total) that should be connected to the PCB with coax cable. The nine pins of SW1 are labeled on the schematic. Use the drawing below to match the switch pins to the correct locations on the PCB. Note that pins 4 and 9 are connected together, and pins 6 and 7 are also connected together. You can eliminate two pieces of coax if you run a jumper across these pins at the switch.



Switch viewed from behind (pins facing toward you). With switch in the up position (HL:X) pins 2 and 3 are connected, pins 5 and 6 are connected, and pins 8 and 9 are connected.

For VR1-VR4, 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. These pins are labeled on the schematic.

For the 78L05 regulator, the pin out is (left to right): 3, 2, 1 when viewing the front of the regulator (flat side facing you) with the leads facing down. These pins are labeled on the schematic.

4. Modifications

You can substitute LT1013 op-amps for U3 and U4 if you want the best DC performance. But LT1013s are slow for audio signals. You can substitute OP275 op-amps for U3 and U4 if you want the best audio performance, but they have poorer DC performance. I used TL072 op-amps throughout since they are a good compromise between the LT1013 and

OP275 and give good results for both DC and audio signals. There's no advantage to using LT1013 or OP275 op-amps for U1, U2, and U5; use TL072 op-amps for these.

Resistor R31 produces a small voltage drop (around 10 mV) on the +5V reference. You can lower this resistor value a bit to reduce the voltage drop if it bothers you. Just be careful that you don't short out the switching lug for too long if you use a lower resistor.

You don't have to use a bicolour LED. You can use two LEDs in parallel, or just one LED. If you use just one LED, connect the anode (longer lead) to R30 so that the LED will light when A > B.

If you want to increase the hysteresis window, use a lower value for R27. You probably shouldn't go lower than 1M for R27.

5. Building the Switching Comparator with MUUBs

Be sure to check out the construction pictures on the website. Most of what I try to describe below can best be understood just by looking at the pictures.

You'll need two MUUB-4s and one MUUB-2 to build the TLN-864. If you look at the pictures on the website, you'll see the three boards mounted on the stooge brackets (from top to bottom):

MUUB-4, board #1: inputs A & B, +5V reference, power connector
MUUB-2, board #2: comparator, analogue switch, LED driver
MUUB-4, board #3: inputs H & L, outputs X & Y

I built the TLN-864 with Stooge modular brackets and a Stooge compatible 1U wide panel (a prototype panel made from plexiglass). Prepare your panel and Stooge brackets before you do any soldering. Get all the mechanical issues dealt with first. You'll need two of the Stooge "2 jack modular bracket" and one of the Stooge "flat plate modular bracket". If you use the same panel layout shown on the website, note that the pots are 1/8" closer to the middle of the panel than the jacks. When you attach the jack brackets to the panel (at the LEVEL H pot and the IN L/OUT Y jacks), they will not be in the same plane. This is easy to remedy by simply inserting an extra nut between the flat plate bracket and the jack bracket that attaches to the IN L/OUT Y jacks.

Once you get the three bracket parts bolted together (use ¼" #6 screws) and attached to the panel, you should have enough space to mount two MUUB-4s and one MUUB-2 to the bracket using ¼" spacers and ½" #6 screws. Make sure you leave enough space for the Switchcraft 112A jacks so that they don't interfere with the lower MUUB-4 board. If you used an extra nut between the flat plate and the lower jack bracket, you'll need a 3/8" spacer to mount the right side of the lower MUUB-4 board to the bracket (because the extra nut is 1/8" thick) and a ¾" #6 screw. I recommend getting some ¼" and 3/8" spacers, a wide selection of #6 screws in different lengths (from ¼” to 1”), and some extra #6 nuts.

5.1. Building Board #1 (MUUB-4)

This board has an additional bit of circuitry to construct in the lower left corner for the +5V reference. Study the schematic and the pictures on the website to see how I fit C15, C16, R31, and U7 into that small square of 25 holes. Bend the leads of the components on the underside of the PCB to connect everything up. The centre pin of U7 connects to ground using the square hole of JD5. You will need one small wire to jumper U7 pin 1 to the +15V supply (the holes labeled V+ on the PCB). This is the small red wire in the website pictures. Place this wire in the hole to the left of U7 pin 1, then bend it underneath the PCB so that it touches U7 pin 1.

This circuit board also contains the power supply connector (MTA-156), two ferrite beads (L1-L2), and two 10 uF caps (C13a and C14a). Power and ground will be supplied to the other two MUUBs by running wires from this board to the other boards. C13b and C14b will be installed on board #2 (MUUB-2).

Use the following table to place components from the TLN-864 schematic onto board #1. For short jumpers, use a scrap resistor lead. For longer jumpers, use a piece of #22 wire. Check the website pictures.

Schematic	*MUUB-4 Location (board #1)*
R1-100K	RC1
R2-100K	RC9
R3-49K9	RC13
R4-100K	RD1
R5-100K	RD9
R6-49K9	RD13
R7-100K	RA1
R8-100K	RA9
R9-49K9	RA13
R10-100K	RB1
R11-100K	RB9
R12-49K9	RB13
C1-100N	C5 (bypass cap for U1)
C2-100N	C6 (bypass cap for U1)
C3-100N	C3 (bypass cap for U2)
C4-100N	C4 (bypass cap for U2)
C13a-10M	C1 (power supply bypass cap)
C14a-10M	C2 (power supply bypass cap)
L1	L1 (ferrite bead)
L2	L2 (ferrite bead)
JP1	MTA-156 power connector
jumper	RC14
jumper	TC2, middle to ground hole (at immediate left)
jumper	CC1, middle and bottom holes
jumper	RD14

jumper	TD2, middle to ground hole (at immediate left)
jumper	CD1, middle and top holes
jumper	RA14
jumper	TA2, middle to ground hole (at immediate left)
jumper	CA1, middle and bottom holes
jumper	RB14
jumper	TB2, middle to ground hole (at immediate left)
jumper	CB1, middle and top holes

No additional wires are required on this board.

5.2. Building Board #2 (MUUB-2)

This board has an additional bit of circuitry to construct in the lower left corner for the AD419 analogue switch. Study the schematic and the pictures on the website to see how I fit C11, C12, and an 8 pin socket into that small square of 25 holes. Bend the leads of the components on the underside of the PCB to connect everything up. Notice how I fit C12 inside the socket. You can always mount C12 underneath the PCB if you don't have space inside your socket (or aren't using a socket). I created a ground buss underneath the PCB by running one lead from C11 over to the square hole of JB5. The ground pin of C12 connects to this ground buss as does pin 3 of U6.

You also need to run +15V and –15V wires to pins 4 and 7 of U6, respectively. These are the red and black wires that run from the V+ and V- pads to U6 in the website pictures. In both cases, connect the wire to the hole nearest to pin 4 (or 7) on U6, leave enough wire exposed so that you can bend it underneath the PCB to connect it to pin 4 (or 7). Make sure you get power, ground, and the bypass caps hooked up to U7 before continuing.

This circuit board also contains the remaining two 10 uF caps (C13b and C14b) for power supply bypassing. This board contains all the switching logic, so placing these two caps on this board helps to minimize the amount of noise propagated to the other PCBs.

Use the following table to place components from the TLN-864 schematic onto board #2. For short jumpers, use a scrap resistor lead. For longer jumpers, use a piece of #22 wire. Check the website pictures.

Schematic	*MUUB-2 Location (board #2)*
R27-3M3	RA12
R28-10K	RA5
R29-10K	RA1
R30-1K2	RB14
C9-100N	C3 (bypass cap for U5)
C10-100N	C4 (bypass cap for U5)
C13b-10M	C1 (power supply bypass cap)
C14b-10M	C2 (power supply bypass cap)
jumper	CA1, middle and bottom holes
jumper	CA2, middle and bottom holes
jumper	CB2, top and middle holes

Two additional wires are required on this board to connect the output from U5a to the LED driver and to the analogue switch U6. The first wire goes from the bottom hole of CA3 to the left hole of RB12 (the orange wire in the website picture). The second wire goes from the top hole of CB2 to the hole below pin 6 of U6 (the white wire in the website picture). Leave a long enough piece of wire exposed so you can bend it on the underside of the PCB to touch pin 6 of U6 when it's soldered in place.

5.3. Building Board #3 (MUUB-4)

Use the following table to place components from the TLN-864 schematic onto board #3. For short jumpers, use a scrap resistor lead. For longer jumpers, use a piece of #22 wire. Check the website pictures.

Schematic	*MUUB-4 Location (board #3)*
R13-100K	RC1
R14-100K	RC9
R15-49K9	RC13
R16-100K	RD1
R17-100K	RD9
R18-49K9	RD13
R19-100K	RA1
R20-100K	RA10
R21-100	RA14
R22-49K9	RA13
R23-100K	RB1
R24-100K	RB10
R25-100	RB14
R26-49K9	RB13
C5-100N	C5 (bypass cap for U3)
C6-100N	C6 (bypass cap for U3)
C7-100N	C3 (bypass cap for U4)
C8-100N	C4 (bypass cap for U5)
C17-100N	CA3 (top and bottom holes)
C18-100N	CB3 (top and bottom holes)
jumper	RC14
jumper	TC2, middle to ground hole (at immediate left)
jumper	CC1, middle and bottom holes
jumper	RD14
jumper	TD2, middle to ground hole (at immediate left)
jumper	CD1, middle and top holes
jumper	TA2, middle to ground hole (at immediate left)
jumper	CA1, middle and bottom holes
jumper	TB2, middle to ground hole (at immediate left)
jumper	CB1, middle and top holes

No additional wires are required on this board.

5.4. Power Connections

Run three power lines (+/-15V and ground) from board #1 to board #2 and from board #1 to board #3. Make sure you tap the +/-15V lines on board #1 after the ferrite beads (where they connect to the two 10uF caps). I recommend using the V+ and V- pads, the holes are too small for #18 wire, but you should be able to fit #22 wire in them. On boards #2 and #3, connect these +/-15V lines to the (unused) right holes for L1 and L2. There are lots of unused ground connections on the MUUB boards (e.g. the square holes for JA1-8, JB1-8, JC1-8, JD1-8). Pick ones that are close to the power supply connection points and run a ground wire from board #1 to board #2 and from board #1 to board #3. Avoid the urge to daisy chain the power supply lines from board to board. Maintain a star connection by connecting boards #2 and #3 directly to board #1.

Future versions of the MUUB boards will have larger holes specifically for chaining power supply connections between boards.

5.5. Board to Board Wiring

There are three wires that need to be hooked up between the MUUB boards. You do not need to use coax for these connections. Use the table below to hook up these wires. The wire length and colour (as seen in the website pictures) is also given.

Board # and Location	*Board # and Location*	*Length (inches)*
board #1, JD9	board #2, JA5 (right hole)	2 (yellow)
board #1, JB9	board #2, JA1 (right hole)	3.5 (orange)
board #1, U7 pin 3	board #2, U6 pin 5	3 (blue)

The wire that goes to pin 5 of U6 connects directly to the regulator output (pin 3 of U7) not to the +5V reference (which is after R31). Leave a long enough piece of wire exposed so you can bend it on the underside of the PCB to touch pin 5 of U6 and pin 3 of U7 when it's soldered in place.

5.6. Panel Wiring

Use coaxial cable to hook up the jacks, pots, and switch. You don't need coax cable for the LED or the +5V reference. The coax connection for jacks is connected to ground at both the jack and on the PCB. The coax connection for pots and switches is connected to ground only at the PCB. The square holes on the PCB for the input and output connections (JA1-9, JB1-9, JC1-9, JD1-9) are ground. To minimize wiring between panel components, most panel connections are brought back to the PCB. There are plenty of unused holes on the PCB that are used as anchor points to tie two coax connections together. When applicable, bend the centre wire of the coax connection underneath the PCB to connect to the adjacent hole as indicated in the table below.

Panel Item	*PCB connection*	*Length (inches)*
LED	board #2, black wire in JB9 right hole, red wire in JB9 left hole	4 (twisted pair)
J1-J4 switching lug	board #1, +5V reference (R31)	7 (single wire)
VR1, pin 1 LEVEL A	board #1, JC2, bend wire in right hole underneath PCB to connect to right hole of JC1	6.5 (coax)
VR1, pin 2 LEVEL A	board #1, JD1	6.5 (coax)
VR1, pin 3 LEVEL A	board #1, JC9	6.5 (coax)
VR2, pin 1 LEVEL B	board #1, JA2, bend wire in right hole underneath PCB to connect to right hole of JA1	5 (coax)
VR2, pin 2 LEVEL B	board #1, JB1	5 (coax)
VR2, pin 3 LEVEL B	board #1, JA9	5 (coax)
VR3, pin 1 LEVEL H	board #3, JC2, bend wire in right hole underneath PCB to connect to right hole of JC1	7 (coax)
VR3, pin 2 LEVEL H	board #3, JC5, bend wire in right hole underneath PCB to connect to right hole of JC6	7 (coax)
VR3, pin 3 LEVEL H	board #3, JC9	7 (coax)
VR4, pin 1 LEVEL L	board #3, JD2, bend wire in right hole underneath PCB to connect to right hole of JD1	6.5 (coax)
VR4, pin 2 LEVEL L	board #3, JD5, bend wire in right hole underneath PCB to connect to right hole of JD6	6.5 (coax)
VR4, pin 3 LEVEL L	board #3, JD9	6.5 (coax)
J1, signal lug IN A	board #1, JC1, bend wire in right hole underneath PCB to connect to right hole of JC2	6.5 (coax)
J2, signal lug IN B	board #1, JA1, bend wire in right hole underneath PCB to connect to right hole of JA2	6.5 (coax)
J3, signal lug IN H	board #3, JC1, bend wire in right hole underneath PCB to connect to right hole of JC2	4.5 (coax)
J4, signal lug IN L	board #3, JD1, bend wire in right hole underneath PCB to connect to right hole of JD2	5 (coax)
J5, signal lug OUT X	board #3, JA9	3.5 (coax)
J6, signal lug OUT Y	board #3, JB9	3 (coax)
SW1, pin 1	board #3, JB1	4.5 (coax)
SW1, pin 2	board #2, JB3 (then jumper to U6 pin 2)	5 (coax)
SW1, pin 3	board #3, JD6, bend wire in right hole underneath PCB to connect to right hole of JD5	6.5 (coax)
SW1, pin 4 & 9	board #3, JA1	3.5 (coax)
SW1, pin 5	board #2, JB7 (then jumper to U6 pin 8)	5 (coax)
SW1, pin 6 & 7	board #3, JC6, bend wire in right hole underneath PCB to connect to right hole of JC5	5 (coax)
SW1, pin 8	board #2, JB4 (then jumper to U6 pin 1)	5 (coax)

Run one wire from the +5V reference (which is after R31) to the switching lug of J3 (IN H), then daisy chain three 2" jumpers to the switching lugs of J1, J2, and J4 (IN A, IN B, IN L). This is the only wiring that goes between panel components. All other wires go from panel components to the PCBs.

Three of the coax wires from the switch connect to pins 1, 2, and 8 of U6. The easiest way to make these connections is to connect the coax wires to board #2 at JB3, JB4, and JB7 as indicated in the table above. Then use three scrap resistor leads to connect the left holes of RB3, RB4, and RB7 to U6 pins 2, 1, and 8 (respectively) underneath the PCB. See the website pictures to see an example of this.

6. Testing

Below are some simple test procedures you can use to get acquainted with the TLN-864. Note the following notation conventions for the four panel pots:

- fully clockwise (5 0'clock) is +5
- straight up (12 o'clock) is 0
- fully counter clockwise (7 o'clock) is -5

6.1. Basic Comparator

Create a simple patch on your synthesizer with an oscillator (MOTM 300 or 310) feeding into a VCA (MOTM 110 or 190) and an envelope generator (MOTM 800) controlling the VCA level. Set the EG ADR times to 0 (minimum) and the sustain level to 10 (maximum). Patch the X output from the TLN-864 to the GATE input of the EG. Patch a sine or triangle LFO to the A input of the TLN-864. Set the LFO frequency to 1 Hz.

Set the TLN-864 panel controls as follow: LEVEL A = +5, LEVEL B = 0, LEVEL H = +5, LEVEL L = 0, MODE = HL:X. The LED should be red for ½ second and then green for ½ second. When the LED is green (the positive half of the LFO signal), the EG should fire and you should hear a sound. Try different settings for LEVEL B and note the effect it has on the width of the gate signal sent to the EG.

Set the TLN-864 panel controls as follow: LEVEL A = +5, LEVEL B = 0, LEVEL H = 0, LEVEL L = +5, MODE = HL:X. The EG should still be firing every ½ second, but now it's firing when the LED is red (during the negative half of the LFO signal).

6.2. Random Gate Generator

Create the simple patch from the Basic Comparator Test but patch a random source to the A input of the TLN-864 (the SLOW output from the MOTM-101 works well). Increase the RELEASE time of the EG to 2. Set the TLN-864 panel controls as follow: LEVEL A = +5, LEVEL B = +5, LEVEL H = +5, LEVEL L = 0, MODE = HL:X. The LED should be red most of the time, but not all the time. You should be hearing random bursts of sound as the TLN-864 sends random gates to the EG. Depending on the level of your random source, you may need to adjust either LEVEL A or LEVEL B to get any random gates to appear. Continue to adjust LEVEL A and LEVEL B to set the density of the gates.

6.3. Dual Gate Generator

Create two copies of the simple patch from the Basic Comparator Test (you can share the oscillator, but you'll need two VCAs and two EGs). Pan the first VCA output to the left speaker and pan the second VCA output to the right speaker. Patch the X output from the TLN-864 to the GATE input of the first EG. Patch the Y output from the TLN-864 to the GATE input of the second EG. Patch a sine or triangle LFO to the A input of the TLN-864. Set the LFO frequency to 1 Hz.

Set the TLN-864 panel controls as follow: LEVEL A = +5, LEVEL B = 0, LEVEL H = +5, LEVEL L = 0, MODE = H:XY. The LED should be red for ½ second and then green for ½ second. When the LED is green (the positive half of the LFO signal), the first EG should fire and you should hear a sound from the left speaker. When the LED is red (the negative half of the LFO signal), the second EG should fire and you should hear a sound from the right speaker. Try different settings for LEVEL B and note the effect it has on the width of the gate signal sent to the two EGs.

6.4. Dual Random Gate Generator

Continuing from the previous test, patch a random source to the A input of the TLN-864 (the SLOW output from the MOTM-101 works well). Increase the DECAY and RELEASE times of the EGs to 2, and set the SUSTAIN to 0. Adjust the LEVEL A and LEVEL B controls to set the density of the random gates (settings near zero for both controls works well).

6.5. Pulse Width Modulation

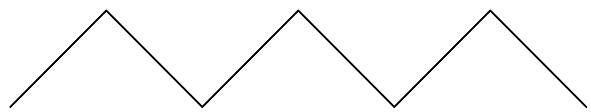
Create a simple patch on your synthesizer with an oscillator (MOTM 300) triangle, sine, or sawtooth wave into the A input of the TLN-864. Patch the X output of the TLN-864 to your amplifier. Set the TLN-864 panel controls as follow: LEVEL A = +5, LEVEL B = 0, LEVEL H = +5, LEVEL L = -5, MODE = HL:X. You should be hearing a square wave at the X output. Adjust LEVEL B to set the pulse width. Patch a sine or triangle wave LFO to the B input of the TLN-864. Adjust LEVEL B to set the depth of pulse width modulation.

6.6. Wicked Waveforms

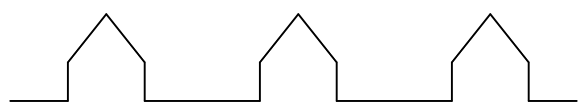
If you have an oscilloscope, use it to monitor the waveforms produced by this test. What this test does is create new waveforms that are derived from one of more oscillators by using the TLN-864 to switch between multiple waveforms. There's no limit to what you can achieve using such techniques, here are some examples to get you started.

Create a simple patch on your synthesizer with an oscillator (MOTM 300) triangle wave into both the A and H inputs of the TLN-864. Patch the X output of the TLN-864 to your amplifier. Hook the oscilloscope's first input channel to the driving oscillator's signal (so you can trigger off it). Hook the oscilloscope's second channel up to the X output of the TLN-864.

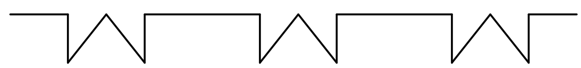
Set the TLN-864 panel controls as follow: LEVEL A = +5, LEVEL B = -5, LEVEL H = +5, LEVEL L = -5, MODE = HL:X. At the X output, you should be hearing, and seeing, the same triangle wave that is going to the A and H inputs:



Adjust the LEVEL B control and note the effect it has on the X output. Set LEVEL B to 0, the X output looks like this:



Adjust the LEVEL L control and note the effect it has on the flat-line portion of the X output. Set LEVEL L to +5, the X output looks like this:



Reset the controls to the way they were at the beginning of this test. Patch the sine wave output from the MOTM-300 to the H input (continue to patch the triangle output from the MOTM-300 to the A input), and repeat the procedure. You'll see waveforms that are a hybrid between triangle and sine waves as you adjust the LEVEL B and LEVEL L controls (too complicated for me to draw). In particular, when LEVEL A = +5, LEVEL H = +5, and LEVEL L = +5, adjust LEVEL B from –5 (to get just the triangle wave) to +5 (to get just the sine wave).

Here are some additional tips for generating wicked waveforms:

1. Try using different oscillators for the A, B, H, and L inputs. Interesting things happen when the oscillators are tuned to harmonic intervals of each other (or not), or are synced to each other (or not).
2. Set the MODE switch to H:XY and use both the X and Y outputs to create stereo wicked waveforms.
3. Patch LFOs, S&H, random generators, and EGs into the B, H, and L inputs to modulate the harmonic content.

TLN-864 Parts List

Resistors (31)

Quantity	*Description*	*Part No.*	*Notes*
1	1.2 K	R30	5% or better, Mouser #291-1.2K
2	10 K	R28, R29	5% or better, Mouser #291-10K
1	3.3 M	R27	5% or better, Mouser #291-3.3M
3	100	R21, R25, R31	1%, Mouser #271-100
8	49.9 K	R3, R6, R9, R12, R15, R18, R22, R26	1%, Mouser #271-49.9K
16	100 K	R1, R2, R4, R5, R7, R8, R10, R11, R13, R14, R16, R17, R19, R20, R23, R24	1%, Mouser #271-100K

Capacitors (20)

Quantity	*Description*	*Part No.*	*Notes*
2	33 pF ceramic	C17, C18	Mouser #140-50N5-330J
13	100N ceramic	C1 – C12, C16	Mouser #147-72-104 Mouser #581-SA105E104M
5	10 uF 35V elec.	C13a, C13b, C14a, C14b, C15	Mouser #140-XRL35V10 (35V)

Semiconductors (15)

Quantity	*Description*	*Part No.*	*Notes*
5	TL072 dual op amp	U1 – U5	Allied #735-2727 Mouser #595-TL072CP Digikey #296-1775-5-ND
1	ADG419 analogue switch	U6	Digkey #ADG419BN-ND Allied #630-5019
1	LM78L05	U7	Mouser #511-L78L05ACZ
1	bicolour LED	LED1	Lumex #SSI-LXH387HGW, Mouser & Digikey lists these but minimum order is 100

Potentiometers & Trimmers (2)

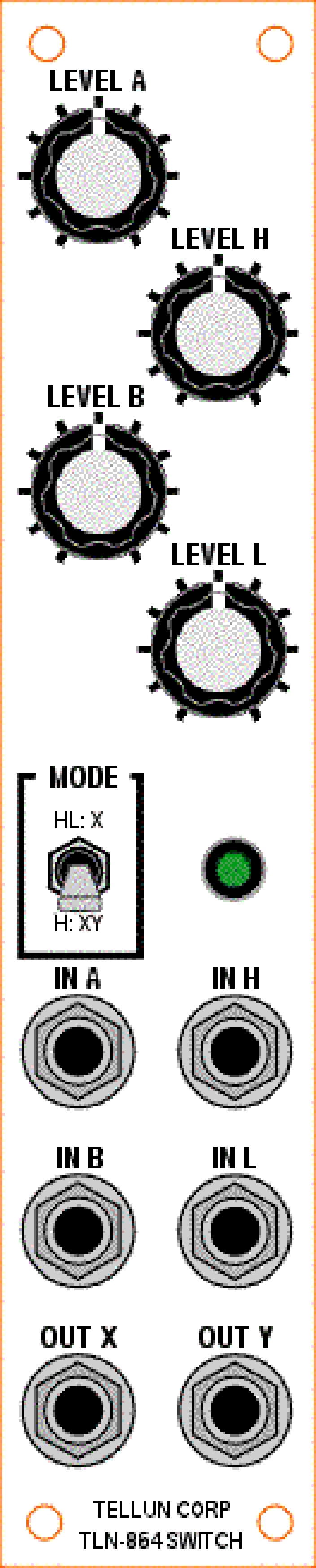
Quantity	*Description*	*Part No.*	*Notes*
4	100 K linear pot	VR1 – VR4	Spectrol 149 series, Allied #970-1791, or Bournes 91 series, Allied #754-9420

Miscellaneous

Quantity	*Description*	*Part No.*	*Notes*
6	phone jack Switchcraft 112A	J1 – J6	Allied #932-9391 Mouser #502-112A
6	8 pin DIP socket		for U1 – U6
2	axial ferrite bead	L1, L2	Active #MURJP2141 Mouser #623-2743002112
1	3PDT switch, NKK M2032ES1W01	SW1	Digikey # 360-1053-ND
1	MTA-156 4 pin header	JP1	Mouser #571-6404454 Digikey #A1973-ND

Hardware

Quantity	*Description*	*Notes*
4	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-864 panel	front panel
2	MUUB-4	printed circuit board
1	MUUB-2	printed circuit board
2	2 jack modular bracket	Stooge bracket
1	flat plate modular bracket	Stooge bracket
	#6-32 screws (1/4", ½", ¾", 1") spacers (1/4", 3/8") #6-32 nuts #6-32 lock washers	Mouser part numbers: 534-405, 534-407 (spacers) 5721-632-1/4, 5721-632-1/2, 5721-632-3/4 (screws) 5721-632 (nuts), 5721-LWI-6 (lockwashers) (for mounting main circuit boards to Stooge bracket)
	pot nut	Mouser #534-1456 (for mounting Stooge bracket to front panel)
1	MTA-156 power cable	Mouser #571-6404264 (connector) Mouser #571-6405514 (dust cover)
4	#8-32 black screw	(for mounting module to cabinet)
	cable ties	
	coax cable (RG174/U)	Mouser #566-8216-100 (100 foot spool)
	hookup wire	
	solder	both organic and no clean


LEVEL A
LEVEL H
LEVEL B
LEVEL L
MODE
HL: X
H: XY
IN A
IN H
IN B
IN L
OUT X
OUT Y
TELLUN CORP
TLN-864 SWITCH