The Tellun Corporation

TLN-862 Lag Processor

User Guide, Rev. 1.0

Based on Harry Bissell's MorphLag

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1. Introduction

The TLN-862 Lag Processor is my implementation of Harry Bissell's MorphLag circuit. This circuit provides independent control of lag time for both rising and falling voltages as well as a means to alter the response between linear and logarithmic.

Description of panel controls:

- UP control: sets the lag time for rising voltages (from 1.25 ms to 9 seconds depending on SHAPE control setting).
- DOWN control: sets the lag time for falling voltages (from 1.25 ms to 9 seconds depending on SHAPE control setting).
- SHAPE control: sets the response to linear (fully counter-clockwise), logarithmic (fully clockwise) or a mix of the two.
- IN jack: input signal.
- OUT jack: output signal.

2. Circuit Description

I'm not going to try to explain how this circuit works. I'll merely explain the changes I made to Harry's original schematic. All component part numbers refer to the TLN-862 schematic.

1. The ATTACK/DECAY controls in the original circuit were reversed. I also changed the labels to UP/DOWN.
2. The SHAPE control was originally a 10K pot. I didn't have any 10K pots but had lots of 100K pots. Changing this pot to 100K necessitated changing R1, R4, R5, and R10.
3. Substituted LT1013 op-amps for the TL072 op-amps and added bias offset compensating resistors (R2, R8).
4. Added a unity gain output buffer that is similar to the type used in the MOTM-820 lag processor.
5. Lowered R6 a little to reduce the minimum lag time.
6. Added R3 to remove an annoying ring that occurred when the SHAPE pot was set to the linear position.

3. Construction Tips

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

This circuit relies on an electrolytic cap being charged through a potentiometer to set both the up and down lag times. Because both of these components are typically +/-20% accurate, you are really at their mercy in terms of getting accurate and repeatable results. I measured several Bourns 91A1DB28D25 1M pots and found the maximum resistance

varied from 790K to 1040K. If possible, try to pick pots with similar values so that you will get up and down times that are fairly close when the front panel controls are set the same.

Use log pots for VR1 and VR2 to get more resolution with short lag times. If you use the Bourns 91A1DB28D25 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-862 seen in the website pictures.

You can use a non-polarized electrolytic capacitor for C7 but these typically have tolerances in the +/- 20% range. For greater accuracy, consider using a polyester capacitor. But be warned that these are much more expensive and **HUGE**. So think about how you'll mount it before you buy it.

Use coax cable for the jack connections if you intend to use the lag processor with audio signals.

Use a scrap resistor lead to connect the switched lug (the middle lug) to the ground lug on input jack J1.

For VR1-VR3, 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.

4. Modifications

You can substitute TL072 op-amps for the LT1013 op-amps.

You can change the lag time range by changing C7. Higher values will result in longer lag times, lower values will result in shorter lag times. Using 4.7 uF, I measured these lag times:

Shape	*Min*	*Max*
Linear	1.25 milliseconds	1.75 seconds
Log	8.75 milliseconds	9 seconds

A value of 10 uF will double these times (confirmed by testing).

5. Building the Lag Processor 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 one MUUB-4 to build one instance of the TLN-862. I built two TLN-862s as independent circuits mounted to Stooge modular brackets and a Stooge compatible 1U

wide panel (a prototype panel made from plexiglass). Described below are details for building a single TLN-862. You'll need to duplicate this effort to build a dual version like mine.

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 UP B pot and the IN B/OUT B 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 B/OUT B 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 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.

Before beginning the soldering, note the following labeling conventions used in this document for diodes and pots.

1. Diodes: banded end is cathode, other end is anode.
2. Pots: when viewing the back of the pot (the shaft facing away from you) with the leads facing down, the pins are (left to right): 3, 2, 1. These pins are labeled on the schematic.

5.1. PCB Assembly

Use the following table to place components from the TLN-862 schematic onto a MUUB-4 board. 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*
R1-100K	RD2
R2-33K	RD13
R3-4K7	RD15
R4-200K	RD5
R5-200K	RD6
R6-442	RA1
R7-100K	RC1
R8-49K9	RC13
R9-100K	RC9
R10-100K	RD1

R11-470	RB14
R12-47K	RB10
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)
C5-10M	C1 (power supply bypass cap)
C6-10M	C2 (power supply bypass cap)
C7-4M7	CA3, middle and bottom holes
C8-1N	CB3, top and bottom holes
C9-1N	CB4, top and bottom holes
D1-1N4148	RC7, cathode (band) in right hole, anode in left hole
D2-1N4148	RC5, cathode (band) in left hole, anode in right hole
L1	L1 (ferrite bead)
L2	L2 (ferrite bead)
JP1	MTA-156 power connector
jumper	RA13
jumper	RA14
jumper	TA2, middle to ground hole (at immediate left)
jumper	CA1, middle and bottom holes
jumper	RC14
jumper	TC2, middle to ground hole (at immediate left)
jumper	CC1, middle and bottom holes
jumper	TD2, middle to ground hole (at immediate left)
jumper	CD1, middle and top holes

The website pictures show a jumper in RD3, but this is not necessary so leave it out.

Six additional wires are required. Use the following table to make these connections. The wire length and colour (as seen in the website pictures) is also given

From	*To*	*Length (inches)*
RD9 (right hole)	RC6 (right hole)	1.5 (orange)
RA9 (right hole)	RB12 (left hole)	2 (orange)
JC7 (right hole)	JD5 (right hole)	2 (blue)
JC5 (right hole)	JD6 (right hole)	2 (blue)
JC9 (right hole)	JD1 (right hole)	2 (green)
JA9 (right hole)	JC1 (right hole)	3 (green)

5.2. Power Considerations

If you're building a dual TLN-862, you'll need to supply power to both circuits. A simple way to do this is to use a pass-thru MTA-156 connector. This connector can be installed on an existing MOTM power cable to provide two outlets from one cable.

Otherwise, you can install the MTA-156 and ferrite beads on the first of the MUUB-4 boards and run three power lines (+/-15V and ground) over to the second MUUB-4 board. If you go this route, make sure you tap the +/-15V lines on the first board 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 the second board, 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 between the two MUUB boards.

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

5.3. Panel Wiring

The UP and DOWN panel pots (VR1 and VR2) require only two wires. Solder pins 3 and 2 together on these pots, and run a single wire from pins 3/2 and another wire from pin 1 to the PCB. It doesn't matter which wire goes into which hole for the UP and DOWN pots. The SHAPE pot (VR3) needs all three pins connected to the PCB. You don't need to use coaxial cable for any of the pot connections.

Use coaxial cable to hook up the jacks. The shield for these wires is connected to ground at both the jack and on the PCB. The square holes on the PCB indicate the ground connections for JA1-9, JB1-9, JC1-9, and JD1-9. Use a scrap resistor lead to connect the switched lug (the middle lug) to the ground lug on input jack J1.

The wire lengths given below are the ones I used to build the dual lag processor. The first number is for the B channel (mounted first, closest to the pots), the second number is for the A channel (mounted second, closest to the jacks). Some of the wire connections on the PCB are simply anchor points to tie several connections together. When applicable, bend the wire underneath the PCB to connect to the adjacent hole as indicated in the table below.

Panel Item	*PCB connection*	*Length (inches)*
J1 (input jack)	JD2	7 (B) and 4.5 (A) (coax)
J2 (output jack)	JB9	6 (B) and 2.5 (A) (coax)
UP pot	JC8 (right hole) and JA2 (right hole), bend each wire underneath the PCB so that JC8 connects to JC7 and JA2 connects to JA1	5 (B) and 7 (A) (twisted pair)
DOWN pot	JC6 (right hole) and JA1 (right hole), bend the wire in JC6 underneath the PCB so that JC6 connects to JC5	6 (B) and 6 (A) (twisted pair)
SHAPE pot	pin 1 connects to RD14 (left hole) pin 2 connects to CD2 (middle hole) pin 3 connects to RD4 (right hole)	7 (B) and 5 (A) (twisted triplet)

6. Testing

If wired correctly, the UP and DOWN controls should introduce the minimum amount of lag time when they are fully counter-clockwise, and the maximum when they are fully clockwise. The SHAPE pot should give a linear response when fully counter-clockwise and logarithmic when fully clockwise.

Patch a square wave from an LFO into the FM input of an oscillator. Set the LFO frequency quite low and adjust the FM level so that the oscillator switches between a high and low frequency every few seconds.

Patch the LFO output to the IN jack of the TLN-862 and patch the TLN-862 output to the oscillator's FM input. Set all the controls on the TLN-862 fully counter-clockwise. The oscillator should continue to switch between the two frequencies without much perceptible lag/portamento.

Turn the UP control clockwise to introduce lag to the upper frequency swing. Turn the DOWN control clockwise to introduce lag to the lower frequency swing. Note that you can have different amounts of lag for the upper and lower swing. Set the UP and DOWN controls so that there is a short but noticeable lag, then turn the SHAPE control fully clockwise to change the response from linear to logarithmic. The lag times will also increase; this is normal. Note the differences between linear and logarithmic lag. Adjust the SHAPE control to taste (like adding salt to food): sometimes linear works best, sometimes logarithmic works best, sometimes a mixture between the two works best.

TLN-862 Parts List

This bill of materials (BOM) is for building one instance of the TLN-862. If you are building a dual version, you must double all of these parts (except for the panel and brackets).

Resistors (12)

Quantity	*Description*	*Part No.*	*Notes*
1	470	R11	5% or better, Mouser #291-470
1	47 K	R12	5% or better, Mouser #291-47K
1	442	R6	1%, Mouser #271-442
1	4.7 K	R3	1%, Mouser #271-4.7K
1	33 K	R2	1%, Mouser #271-33K
1	49.9 K	R8	1%, Mouser #271-49.9K
4	100 K	R1, R7, R9, R10	1%, Mouser #271-100K
2	200 K	R4, R5	1%, Mouser #271-200K

Capacitors (9)

Quantity	*Description*	*Part No.*	*Notes*
2	1N poly	C8, C9	Mouser #581-BF014D0102J
4	100N ceramic	C1 – C4	Mouser #147-72-104 Mouser #581-SA105E104M
2	10 uF 35V elec.	C5, C6	Mouser #140-XRL35V10 (35V)
1	4.7 uF non-polarized	C7	Mouser #140-NPRL50V4.7 (electrolytic) Mouser #146-250V4.7K (poly)

Semiconductors (4)

Quantity	*Description*	*Part No.*	*Notes*
2	MXL1013 (or LT1013) dual op amp	U1 – U2	Allied #735-3671 Mouser # 595-LT1013CP can substitute TL072
2	1N4148 diode (can substitute 1N914)	D1 – D2	Allied #263-1538 Mouser #512-1N4148 Digkey #1N4148FS-ND

Potentiometers & Trimmers (3)

Quantity	*Description*	*Part No.*	*Notes*
2	1M log pot	VR1 – VR2	Bourns #91A1DB28D25, Mouser lists these but minimum order is 500
1	100 K linear pot	VR3	Spectrol 149 series, Allied #970-1791, or Bournes 91 series, Allied #754-9420

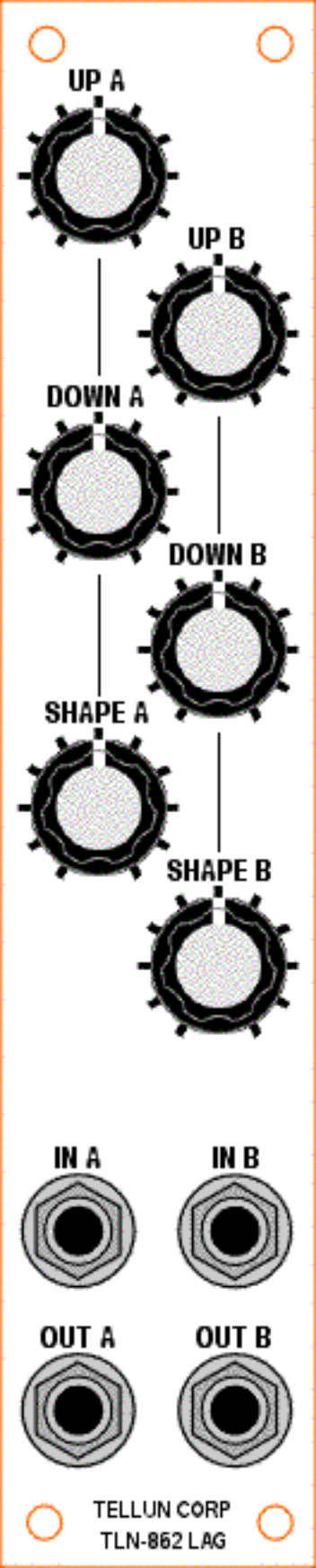
Miscellaneous

Quantity	*Description*	*Part No.*	*Notes*
2	phone jack Switchcraft 112A	J1 – J2	Allied #932-9391 Mouser #502-112A
2	8 pin DIP socket		for U1 – U2
2	axial ferrite bead	L1, L2	Active #MURJP2141 Mouser #623-2743002112

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-862 panel	front panel
1	MUUB-4	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


UP A
UP B
DOWN A
DOWN B
SHAPE A
SHAPE B
IN A
IN B
OUT A
OUT B
TELLUN CORP
TLN-862 LAG