

The Tellun Corporation

TLN-442 Voltage Controlled Lowpass Filter

User Guide, Rev. 1.1

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Introduction

The TLN-442 is a four pole low pass filter built around a Curtis Electromusic Specialties CEM 3320 chip. A built in mixer allows for three audio inputs. The filter frequency can be set using a panel mounted pot, a “one volt per octave” external control voltage, or via two external FM inputs with attenuators (one reversing). Filter resonance can be set using a panel mounted pot or an external control voltage with a reversing attenuator.

Circuit Description

The CEM 3320 provides four gain cell blocks that can be configured into a variety of filters. The TLN-442 uses each of these gain cell blocks as a one pole low pass filter and cascades them to create a four pole low pass response. The onboard Resonance Control Cell is used for voltage controlled resonance.

Refer to page 2 of the schematic for the following discussion on the filter design. C7 and C8 are bypass caps for the power supply. R38 and TP2 limit the negative supply current and allow trimming the frequency control voltage feed through (see the Calibration section). Each filter section is identical requiring a gain cell block, a feedback resistor, a capacitor, and two resistors to feed the output to the next filter section. The first low pass filter section comprises R27, C14, and gain cell block G1-C1-B1. The output of the first filter is fed to the second filter section via R31 and R34. The remaining three filter sections are identical to the first in construct except that the fourth section feeds the onboard Resonance Control Cell through C12 and R37. The audio input signal is fed to the first filter via R8.

Refer to page 1 of the schematic for the following discussion on the input and output design. The filter output is non-inverting with respect to the input signal. This is intentional as it allows the output to be fed back to the filter input to further enhance the filter effect. The low pass output is AC coupled through C12 (on page 2 of the schematic) and then fed to an inverting amplifier with a gain of two. The three audio signals appearing at IN1, IN2, and IN3 are attenuated by VR6, VR7, and VR8 before being mixed by an inverting summer with unity gain. This signal is then AC coupled to the filter via C11. Filter resonance is set either manually via VR1, or externally via the RESM input and VR2 through a reversing attenuator built around U1. Filter frequency can be set manually using VR5, externally via the 1V/OCT input, externally via the FM2 input and attenuator VR3, or externally via the FM1 input and a reversing attenuator built around U2. R10, TP1, and R15 derive an 18 mV/octave frequency control voltage from these combined controls and input signals (see the Calibration section).

Construction Tips

Use a socket for the CEM 3320; this is a rare and expensive chip. Sockets are not necessary for the other chips.

Coax cable should be used for the three audio input signals (J5, J6, J7) and the audio output signal (J8). Consider using two-conductor coax (microphone cable) for connecting the three audio input attenuators (VR6, VR7, VR8).

R15 is a Tempco resistor and must be mounted on top of the CEM 3320 chip. Use a dab of heat sink compound to thermally connect R15 to the CEM 3320. R15 should be the last component installed on the PCB.

The PCB uses 0.4" spacing for the resistor pads and 0.2" spacing for most of the capacitor pads. The exceptions being C14, C15, C16, and C17 (axially mounted polystyrene caps) which have a 0.6" pad spacing.

Save some scrap resistor leads and use them to connect the switching lug of the phone jacks to ground for the inputs (J1-J7).

Panel Wiring Guide

<i>Panel Designation</i>	<i>PCB Designation</i>	<i>Wire Length (inches)</i>	<i>Wire Type</i>
RES pot	VR1	2	twisted
RESM pot	VR2	5	twisted
FM 2 pot	VR3	3	twisted
FM 1 pot	VR4	2	twisted
FREQ pot	VR5	4	twisted
IN 1 pot	VR6	4	coax or twisted
IN 2 pot	VR7	4	coax or twisted
IN 3 pot	VR8	4	coax or twisted
RESM jack	J1	8	twisted
1V/OCT jack	J2	7	twisted
FM 2 jack	J3	6	twisted
FM 1 jack	J4	6	twisted
IN 1 jack	J5	6	coax
IN 2 jack	J6	6	coax
IN 3 jack	J7	6	coax
OUT jack	J8	4	coax

For VR1-VR8, 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.

Calibration

Let the filter warm up for a few minutes before attempting calibration.

TP1 sets the filter's "one volt per octave" tracking. Disconnect any signals from the FM1, FM2, IN1, IN2, IN3, and RESM inputs. Set TP1 to the middle of its range. Set the RES control fully clockwise to get the filter to oscillate. Set the FREQ control to the 2 position. Alternately apply 0.000 and 2.000 volts to the 1V/OCT input and adjust TP1 until the filter pitch is two octaves apart at these two voltages. Use a frequency counter or a calibrated reference oscillator for comparison. Don't adjust the FREQ knob on the TLN-442 while setting TP1, adjust the frequency of the reference oscillator instead. Don't worry about trying to get the filter to track perfectly over a wide range; it's just a filter, it's not an oscillator.

TP2 sets the frequency input control voltage rejection. Disconnect any signals from the FM1, FM2, IN1, IN2, IN3, and RESM inputs. Set TP2 to the middle of its range. Set the FREQ and RES controls fully counter clockwise. Apply a sawtooth waveform from an oscillator into the 1V/OCT input. The oscillator should be in the audible range. Adjust TP2 for the minimum output signal. Use an oscilloscope or listen to the output.

Modifications

TL072 op amps can be used instead of the MXL1013 and OP275GP op amps.

The FM2 input has a gain of 2.0 but the FM1 input only has a gain of 1.33. To get a gain of 2.0 with the FM1 input, lower R17 and R18 from 49.9K to 36K. However, this will also lower the input impedance on the FM1 input accordingly.

R11 and R12 can be tweaked to change the filter frequency response. R11 sets the filter frequency when the FREQ control is at minimum (fully CCW). Increasing the value of R11 will raise the filter frequency when the FREQ control is at minimum. R12 sets the filter frequency when the FREQ control is at the maximum (fully CW). Decreasing R12 will decrease the filter frequency when the FREQ control is at maximum. Note that R11 should always be adjusted before R12 because R11 affects both the minimum and maximum frequency. Thus, changing R11 will likely require changing R12 as well.

R2 sets the point where the filter will oscillate. The suggested value of 39K is the minimum value that will allow the filter to resonate at all settings of the FREQ control. The filter oscillates more easily at higher frequencies. When the FREQ control is greater than 5, oscillation will begin when the RES control is at the 7 position. With the FREQ control at 0, oscillation will occur when the RES control is at the 10 position. Lowering R2 to 33K will allow the filter to oscillate more easily at any FREQ control setting. R2 can be increased to prevent the filter from resonating at any FREQ control setting.

TLN-442 Parts List

Resistors

Quantity	Description	Part No.	Notes
9	100 K	R20, R21, R22, R23, R24, R27, R28, R29, R30	5% or better, Mouser #291-100K
1	1 K	R26	5% or better, Mouser #291-1K
1	200 K	R25	5% or better, Mouser #291-200K
4	91 K	R8, R31, R32, R33	5% or better, Mouser #291-91K
3	240 K	R34, R35, R36	5% or better, Mouser #291-240K
1	51 K	R37	5% or better, Mouser #291-51K
1	820 ohm	R38	5% or better, Mouser #291-820
1	300 K	R5	1%, Mouser #271-300K
7	100 K	R1, R3, R4, R9, R14, R16, R19	1%, Mouser #271-100K
5	49.9 K	R6, R7, R13, R17, R18	1%, Mouser #271-49.9K
1	44.2 K	R10	1%, Mouser #271-44.2K
1	39 K	R2	1%, Mouser #271-39K
1	1 K	R15	1% Tempco, PT146 or similar
1	180 K	R11	1%, Mouser #271-180K
1	150 K	R12	1%, Mouser #271-150K

Capacitors

Quantity	Description	Part No.	Notes
2	4.7 uF 35V electrolytic	C11, C12	can substitute 3.3 uF, or use bipolar, Mouser #140-XRL35V4.7
1	33 pF ceramic	C13	can substitute 22 pF, Mouser #140-50N5-330J
4	150 pF polystyrene	C14, C15, C16, C17	axial lead, Mouser #23PS115
8	0.1 uF ceramic	C1 – C8	Mouser #147-72-104
2	22 uF 25V electrolytic	C9, C10	can use 35V, Mouser #140-XRL25V22

Semiconductors

Quantity	Description	Part No.	Notes
2	MXL1013 (or LT1013) dual op amp	U1, U2	can substitute TL072, Allied #735-3671
1	OP275GP dual op amp	U3	can substitute TL072, Allied #630-9295
1	CEM 3320 filter	U4	

Potentiometers & Trimmers

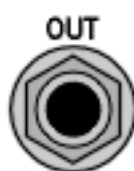
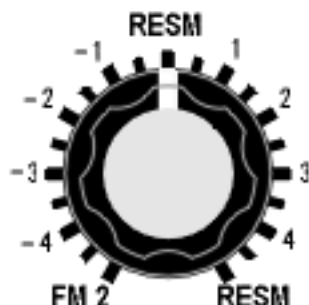
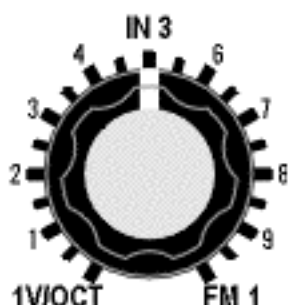
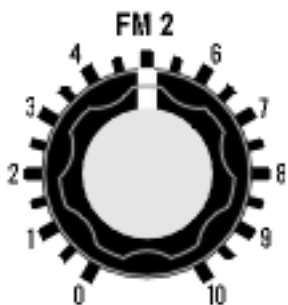
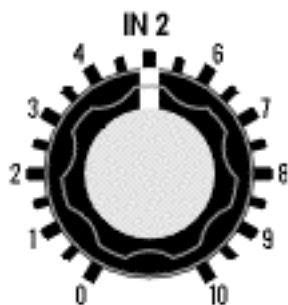
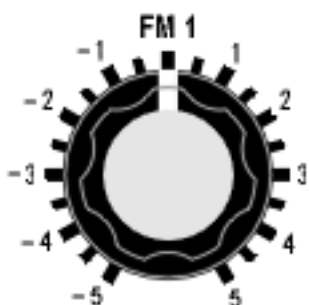
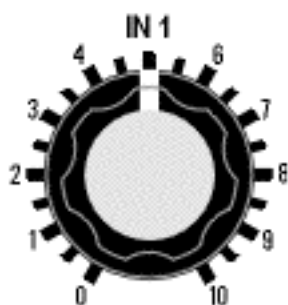
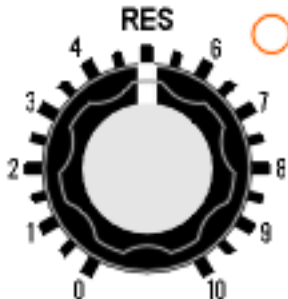
Quantity	Description	Part No.	Notes
3	100 K log pot	VR6, VR7, VR8	Bournes 91 series, Allied #754-9820
5	100 K linear pot	VR1, VR2, VR3, VR4, VR5	Spectrol 149 series, Allied #970-1791, or Bournes 91 series, Allied #754-9420
1	25 K trimmer (multi-turn)	TP1	Mouser #72-T93YA-25K
1	1 K trimmer (multi-turn)	TP2	Mouser #72-T93YA-1K

Miscellaneous

<i>Quantity</i>	<i>Description</i>	<i>Part No.</i>	<i>Notes</i>
8	phone jack	J1 – J8	Switchcraft 112A, Allied #932-9391
1	18 pin DIP socket		for U4
3	8 pin DIP socket		for U1 - U3 (optional)
2	axial ferrite beads	L1, L2	Active #MURJP2141, or Mouser #623-2743002112
1	MTA-156 power connector	JP1	Mouser #571-6404454

Hardware

<i>Quantity</i>	<i>Description</i>	<i>Notes</i>
8	knobs	ALCO PKES90B1/4
1	TLN-442 panel	front panel
1	TLN-442 pcb	printed circuit board
1	4 pot short Stoooge bracket	Stoooge bracket
4	#6-32 screw, spacer, and nut	for mounting circuit board to Stoooge bracket
4	pot nut	for mounting Stoooge bracket to front panel
4	#8-32 black screw	for mounting module to cabinet
1	power cable	with MTA-156 connectors
	heat shrink cable	
	wire ties	
	coax cable	
	hookup wire	
	solder	both organic and no clean
	heat sink compound	



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 December 2002

