

MODEL 612A
12 CHANNEL AMPLIFIER
and
MODEL 612AM
6-CHANNEL AMPLIFIER

May, 1983

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ALL SHIPMENTS OF LECROY INSTRUMENTS FOR REPAIR OR ADJUSTMENT should be made via Air Freight or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

IN EVENT OF DAMAGE IN SHIPMENT to original purchaser the instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the LeCroy factory or the nearest service facility).

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ANY APPLICATION OR USE QUESTIONS, which will enhance your use of this instrument will be happily answered by a member of our Engineering Services Department, telephone 914-425-2000 or your local distributor. You may address any correspondence to:

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A T T E N T I O N

OPERATION OF THIS MODULE REQUIRES +6 VOLTS. (SEE SECTION 2.1).

UNUSED OUTPUTS SHOULD BE TERMINATED IN 50 Ω (SEE SECTION 2.1).

CRATE POWER SHOULD BE TURNED OFF DURING INSERTION AND REMOVAL OF UNIT TO AVOID POSSIBLE DAMAGE CAUSED BY MOMENTARY MISALIGNMENT OF CONTACTS.

SEE POCKET IN BACK OF MANUAL FOR SCHEMATICS, PARTS LISTS AND ADDITIONAL ADDENTA.

A T T E N T I O N

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SPECIFICATIONS

NIM Model 612A

12-CHANNEL PHOTOMULTIPLIER AMPLIFIER

INPUT CHARACTERISTICS

Impedance:	50 Ω .
Input Protection:	± 5 A for 0.5 μ sec; ± 500 mA continuous input voltage; clamps at ± 0.6 V.
Reflection Coefficient:	Less than 5% over input dynamic range.
Quiescent Voltage:	± 0.5 mV.

OUTPUT CHARACTERISTICS (Both outputs of each used channel must be terminated for optimum waveshape.)

Maximum Positive Amplitude (Linear):	+200 mV.
Maximum Negative Amplitude (Linear):	-2 volts with -6 V supply; -5 volts with -12 V supply.
Overshoot:	Less than $\pm 10\%$ for input risetimes ≥ 1.5 nsec.
Quiescent Voltage:	0 V ± 3 mV.
Output Voltage DC Offset Temperature Coefficient:	100 μ V/ $^{\circ}$ C maximum.
Output Voltage Variation with Supply Voltage:	< 1 mV for $\pm 1\%$ variation of any supply voltage.

GENERAL

Gain:	Fixed gain of 10, non-inverting. Long-term stability $\pm 1\%$. Gain tolerance $\pm 5\%$.
Linearity:	0.1% integral.
Coupling:	Direct.
Risetime:	< 2.0 nsec, 10% to 90%.
Delay:	Approx. 4 nsec.
Noise:	Less than 50 μ V rms, referred to input, total.
Interchannel Crosstalk:	Output in one channel affects any other channel by no more than -70 dB.
Overload Recovery:	a) Operation with -12 volt supply: saturated for approximately 15 nsec after 10X overload. b) Operation with -6 volt supply: saturated for approximately 50 nsec after 10X overload. For wide pulses (i.e., > 5 μ sec) it is recommended to use -12 V supply for best overload recovery.
Packaging:	RF-shielded AEC/NIM #1 width module conforming to specifications outlined in AEC Report TID-20893; Lemo-type connectors.
Current Requirements:	In rear panel selected 6 V mode: +6 V at 350 mA, -6 V at 275 mA, +12 V at 5 mA, -12 V at 5 mA, -24 V at 80 mA, or in 12 V mode: +6 V at 350 mA +12 V at 5 mA, -12 V at 275 mA, -24 V at 80 mA.

SPECIFICATIONS SUBJECT TO CHANGE



VV100B/VV101A Hybrid Circuit Wideband Pulse Amplifier

FEATURES:

- **WIDE BANDWIDTH** risetime: <2 nsec VV100B
<1 nsec VV101A
- **DIRECT-COUPLED DESIGN** permits high rate application without baseline shifts.
- **10X GAIN, CASCADABLE** to 1000X for direct compatibility with a wide range of input amplitude applications.
- $\pm 0.2\%$, **INTEGRAL LINEARITY** to outputs of -3 V.

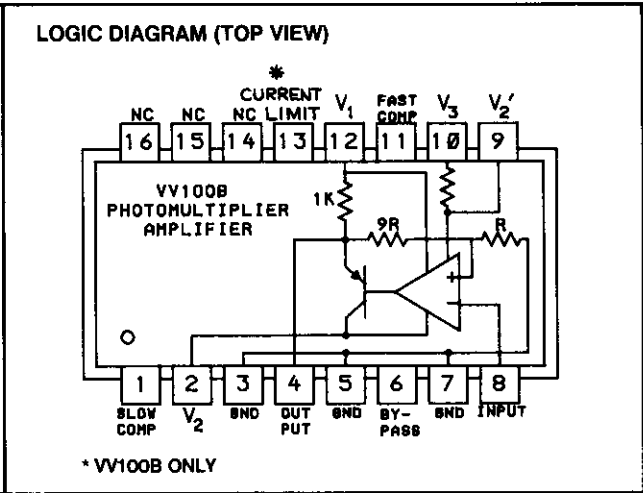
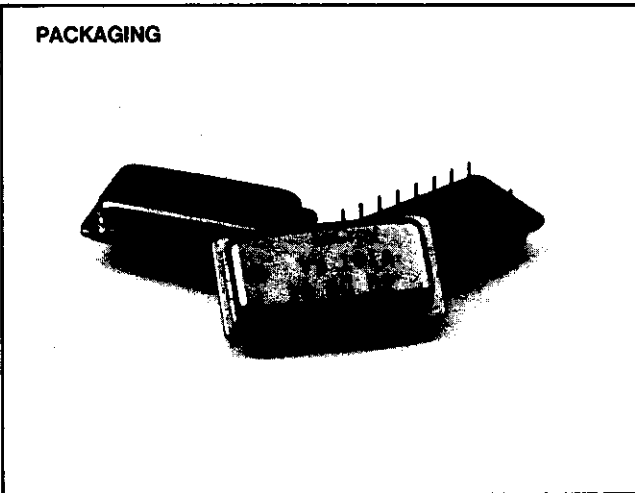
- **EXCELLENT DC STABILITY** (<1 mV long term) assures optimum performance in dc coupled applications.
- **LOW IMPEDANCE OUTPUT** designed to drive two 50 Ω loads, allowing the amplified signal to be used directly for both logic and analog functions.
- **COMPACT PACKAGING** permits the complete amplifier to be mounted near the pulse source in a standard 16-pin DIP socket, thereby reducing amplification of extraneous noise.

The LeCroy Model VV100B/VV101A is a wide-bandwidth, gain-of-10 pulse amplifier packaged as a standard 16-pin DIP hybrid circuit. Representing a major advance in fast amplifier bandwidth, stability, dynamic range, and general utility, the VV100B/VV101A provides unprecedented performance in demanding, direct-coupled, high-duty-cycle applications.

temperature. Shifts in the dc output level remain negligibly small even when the amplifier is subjected to extremes of operating temperature or variations in power supplies. There is virtually no warm-up drift at turn-on.

A new high-speed amplifier circuit design makes the performance of the VV100B/ VV101A virtually independent of external variables such as supply voltages or

An ideal "transparent gain" element would simply magnify the input signal without significant distortion or operating constraints. The VV100B/VV101A performance is very close to this ideal by virtue of its extraordinary stability, speed, linearity, and noise characteristics.



November 1981

Innovators in Instrumentation

SPECIFICATIONS

Hybrid Circuit Models VV100B/VV101A

WIDEBAND PULSE AMPLIFIER

	VV100B	VV101A
GAIN:	10 FIXED, $\pm 5\%$ tolerance, non-inverting, long term stability $\pm 1\%$	Same as VV100B
LINEARITY:	$\pm 0.2\%$ intergral (0 to -3 V)	Same as VV100B
MAXIMUM OUTPUT SWING:	-5 V at 200 mA ^{Note 1} $+250$ mV at 5 mA ^{Note 3}	-5 V at 200 mA ^{Note 2} Same as VV100B
OUTPUT IMPEDANCE:	$<0.2 \Omega$ for negative outputs	$<0.3 \Omega$ for negative outputs
FREQUENCY RESPONSE: Full Signal Bandwidth (3 dB)	≥ 170 MHz for 2 voltage operation ^{Notes 4, 7} ≥ 200 MHz for 3 voltage operation	≥ 350 MHz for 2 voltage operation ^{Note 4} ≥ 380 MHz for 3 voltage operation
RISETIME (10% to 90%):	≤ 2 nsec	≤ 1 nsec
INPUT SIGNAL RANGE: Maximum Safe Input Signal	± 1 V; external clamp diodes recommended ^{Note 6}	Same as VV100B
Linear Range	-0.5 V to $+0.01$ V	Same as VV100B
WIDEBAND OUTPUT NOISE: (referred to input)	$<50 \mu\text{V rms}$	$<60 \mu\text{V rms}$
INPUT IMPEDANCE:	$>1 \text{ k}\Omega$	Same as VV100B
INPUT BIAS CURRENT: Drift vs. Temperature	$-25 \mu\text{A}$ $250 \text{ nA}/^\circ\text{C}$	Same as VV100B Same as VV100B
INPUT OFFSET VOLTAGE: Typical Drift vs. Temperature Drift vs. Supply Voltage Drift vs. Time	2 mV, adjustable to 0 $10 \mu\text{V}/^\circ\text{C}$ (max) $<100 \mu\text{V}$ for $\pm 1\%$ variation $<100 \mu\text{V}$, long term	Same as VV100B
COUPLING: Input Output	Direct Direct	Direct Direct
TEMPERATURE RANGE:	0°C to 70°C	Same as VV100B
POWER SUPPLY REJECTION RATIO:	90 dB at 120 Hz	Same as VV100B
POWER SUPPLY: (Two Voltage Operation) ^{Note 4} Rated Voltage, Quiescent Current	$V_1 = +6$ V at 30 mA $V_2 = -6$ V to -12 V at -20 mA (Tie pin 9 to pin 2)	Same as VV100B
POWER SUPPLY: (Three Voltage Operation) ^{Note 5} Rated Voltage, Quiescent Current	$V_1 = +6$ V at 30 mA $V_2 = -6$ V to -12 V at -28 mA $V_3 = V_2 - 12$ V (e.g., -24 V when $V_2 = -12$ V and pin 9 open) at -8 mA	Same as VV100B
OVERLOAD RECOVERY:	Operation with $V_2 = -12$ V supply: saturated for approximately 15 nsec after $10\times$ overload.	Same as VV100B
PACKAGE:	Standard 16-pin dual in-line hybrid integrated circuit.	Same as VV100B

NOTES:

- Overload protected to limit the average output current to <60 mA. See application notes.
- No overload protection. Average output current should be <50 mA to avoid damage to the unit.
- For increased positive swing, see application notes.
- Three voltage operation recommended for most applications.
- Three voltage operation provides increased bandwidth.
- See figure 1.
- For two voltage operation install a $6.8 \mu\text{F}$ capacitor from pin 13 to ground with the positive lead grounded.

SPECIFICATIONS SUBJECT TO CHANGE.

APPLICATION NOTES

The LeCroy Model VV100B/VV101A is a hybrid circuit designed as a high bandwidth amplifier primarily intended for amplification of negative pulses such as those from photomultiplier tubes. It has a fixed gain of 10 and a risetime of less than 2 / 1 nsec. The output is capable of driving two 50 Ω loads (25 Ω). The linear range of the VV100B is +200 mV to - 5 V. The Model VV101A provides similar performance with twice the bandwidth.

The user may supply suitable input impedance for his particular needs. The unit requires an input terminating resistor, power supply bypass capacitors, input and output dc trims and an output shape capacitive trim.

Figure 1 shows a typical application circuit for the VV100B and is the circuit on the LeCroy VV100BTB amplifier. Here input trim T1 is accomplished by the series combination of a 27 k Ω resistor and a 500 k Ω potentiometer. Trim T2 is set by the 1 M Ω potentiometer and series 100 k Ω fixed resistor. A fixed resistor to ground sets the low frequency gain trim (T3). High frequency compensation is set by the 51 Ω , 6-35 pF combination.

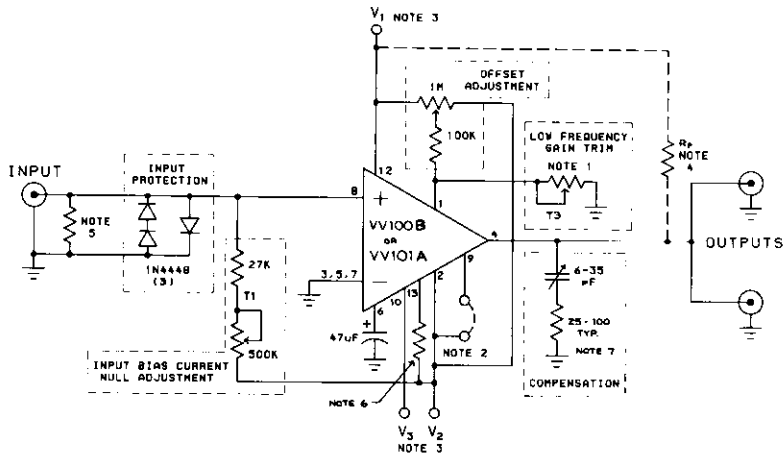


Figure 1

NOTES:

1. Typical value = 7.5 k Ω
2. Add jumper for 2-supply operation
3. All power supply voltage lines should include a high frequency bypass, typically a 6.8 μ F capacitor to ground and a 50 μ H series choke.
4. Optional pull-up for extended positive voltage excursions.
5. Input termination resistor, chosen to match input cable impedance.
6. 10 Ω current limiting resistor should be added when driving 25 Ω load (VV100B only).
7. For VV101A, 6-35 pF in series with 25 Ω connected from pin 11 to ground provides additional compensation.

The VV100B contains output protection circuitry which limits the average output current to 60 mA. The time constant of the limiting circuit is approximately 6 μ sec. This feature is not provided in the VV101A, so caution should be used to avoid damage by short circuit of its output. One common failure mode results when several stages of VV101A are cascaded. The second stage should not have diode protection of its input, otherwise an overdrive of the first stage will activate the second stage protection circuit, shorting and possibly damaging the first VV101A.

The internal current limiting of the VV100B may be defeated by placing a jumper between pins 13 and 2. This connection allows bipolar operation if an additional resistor is connected from the output to a positive supply voltage. All positive current delivered to the load is through this additional resistor. The dc value of this added current should be held to less than 40 mA.

If internal current limiting is not defeated, the maximum positive voltage excursion into a load R_L is

$$V_{Max}^+ = \frac{6 R_L}{R_p + R_L}$$

The most negative will be given by

$$V_{Min}^- = (0.06 V) \frac{R_p R_L}{R_p + R_L}; \quad V_{Min}^- \geq -5 V$$

LAYOUT

Because of the extremely high bandwidth of the VV100B and VV101A, care should be used in layout of the printed circuit board. Continuous ground plane construction is essential. To ensure minimum inductance, low profile sockets like the T1 or AUGAT should be used. Insertion pins (Berg 75315-001 or equivalent) are even better. Input busses should be separated from the output. Interconnections to other circuitry greater than 3 cm away should be made only by properly terminated coaxial cable. Input protection circuitry and bypass capacitors as described below should be located as close to the hybrid as possible.

THE INPUT

Proper termination and protection must be supplied to the input. In most cases, input to the amplifier will be via 50 Ω cable. In this case, a 50 Ω resistor from the input (pin 8) to ground should be employed. In addition, three 1N4448 or equivalent diodes to ground as shown in figure 1 will provide overload protection. The input dc level must be trimmed to zero by a trim resistor (T1) to a negative supply. Where the best dc stability is required, this supply should be regulated. Note that fluctuations in the input offset will appear at the output amplified 10-fold.

POWER

A current of about 30 mA from +6 V must be supplied at pin 12. In addition, two negative supplies, V_2 and V_3 , are recommended. V_2 (pin 2) requirement is 20 mA at a voltage between -6 and -12. V_3 (pin 10) is to be set 12 V more negative than V_2 . For example, with V_2 set to -12 V, V_3 should be -24 V. The VV101A and VV100B each require about 8 mA from the V_3 supply. Proper bypass requires at least 6.8 μ F tantalum capacitors to ground from pins 2, 12, (and 10 if three voltages are used) and 47 μ F on pin 6. Minimum length leads should be employed. Be sure to observe proper polarity. See figure 1. Either VV100B or the VV101A can be operated with only two proper power supplies at the expense of rise time and linearity. For this configuration, tie pin 2 to pin 9, set $V_2 = -6$ V to -12 V, V_3 is omitted and $V_1 = +6$ V.

THE OUTPUT

The VV100 Series is optimized for a 25 Ω load in order to drive two 50 Ω cables simultaneously. If only one cable is to be driven, a 50 Ω resistor should be connected from the output of the VV100B to ground, to provide a net 25 Ω load. Other numbers of cables, and cables of impedances other than 50 Ω may be driven, always taking care to maintain the required 25 Ω through the use of additional series or shunt resistance. For example, three 91 Ω cables require an additional 142 Ω shunt to ground; five 50 Ω cables may be driven via five 75 Ω series resistors (yielding reduced gain and output swing as the price of the additional fanout). Driving loads other than 25 Ω will cause output shape and stability problems. Loads less than 25 Ω degrade risetime, gain, and linear range; loads larger than 25 Ω produce ringing and oscillation.

OUTPUT PROTECTION

The output of the VV100B is protected against sustained shorts to ground in the presence of dc inputs. The VV101A is not. This short circuit protection is implemented by an integrating stage which senses output current and limits it to an average current of 60 mA. The time constant of the limiting stage is approximately 6 μ sec. The maximum pulse output current is a function of the input pulse width, amplitude and repetition rate.

When limiting occurs, this integrating stage must recover before linear operation may resume. Longer averaging times can be achieved by adding capacitance from pin 13 to ground. Current limiting may be defeated by a jumper from pin 2 to pin 13. Under this condition, safe operation requires $(V_{out} - V_2) i_{out} < 1$ w.

The limiting circuitry is based upon the average output current of the VV100B. The maximum output swing for pulses less than the average time will be

$$d_{max} = \frac{(60 \text{ mA})}{D}$$

Here, D is the duty factor. For larger widths the VV100B output will begin to shut down after a time t_{limit} and approach 60 mA with a 6 μ sec time constant.

TRIMS

Amplifiers in the VV100 Series require three separate trims: input dc level, output dc level, and fast compensation.* The values of these trims must be selected for each VV100B and hence must be reset if the VV100 is replaced. All trims should be made with the VV100 output loaded with 25 Ω .

The first trim, T1, is used to set the input dc offset. With no input to the VV100B, install a resistor between the input connector and a regulated negative supply. The value of the resistor should be chosen to set the input voltage to 0.0 mV. Typical values of this trim are 30 k Ω to 300 k Ω .

The second trim, T2, is used to set the output dc level to zero. This trim is a resistor from pin 1 to either the negative or positive supply, depending upon the polarity of the initial dc offset. Typical values of this trim are 100 k Ω to 1 M Ω .

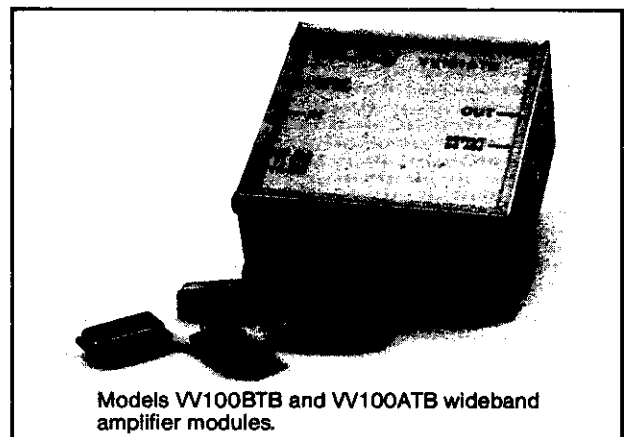
The last trim is an RC adjustment of the overshoot of the output. A 6-35 pF trimmer capacitor in series with a 25-100 Ω resistor is required to minimize the overshoot. Using a fast risetime input pulse, observe the output of the VV100B. Adjust the trim capacitor to give the best output pulse shape.

*Occasionally an additional slow compensation trim (T3) is required. To make this trim, a flat-topped pulse of about 10 μ sec duration is applied to the VV100B or VV101A input. A resistor in the range of 10k to 300k connected from pin 1 to pin 4 (or ground as required) is used to trim the output pulse to a flat top.

ORDERING INFORMATION

The LeCroy Model VV100BTB/VV101ATB provides the high-bandwidth circuitry, shown in Figure 1, in a ready-to-use format. The 3 inch \times 3 inch \times 1.6 inch enclosure size of this device allows one to use the Model VV100B or VV101A in locations too small for many fast amplifiers. The amplifiers employ LEMO type coaxial cable connectors. The units may be purchased with a Model VV100B or VV101A. The trim and compensation variables are factory adjusted for optimum high-speed performance.

MODEL	DESCRIPTION
VV101A	Amplifier hybrid.
VV100B	Amplifier hybrid.
VV101ATB	VV101A mounted in circuit board. LEMO connectors.
VV100BTB	VV100B mounted in circuit board. LEMO connectors.



Models VV100BTB and VV100ATB wideband amplifier modules.

SECTION 2

OPERATION

The LeCroy Model 612A is a twelve channel DC coupled, wideband pulse amplifier, packaged in a single width NIM module. Each channel of the 612A has a fixed gain of ten. The gain for each of the six channels on the 612AM may be adjusted via a front panel potentiometer. The individual channels each consist of a LeCroy VV100B hybrid amplifier and various external bypassing and trimming circuitry.

2.1 General Operating Information

Operation is extremely simple and consists of cabling to inputs and outputs. All channels are factory compensated for a 25 Ω output load. Thus, if only a single 50 Ω output is used, the other output should be terminated into 50 Ω . The VV100B incorporates an integrating output stage which senses and limits output current to an average value of 120 mA. Thus, output peak currents are a function of input pulse amplitude, width and repetition rate. Note that +6 volts is always required to operate this module. Some older NIM bins do not provide this voltage. A switch on the rear panel of the 612A allows operation from either -6 or -12 volts. Twelve volt operation extends the linear operation region from -2 volts to about -5 volts. The 612A and 612AM incorporate a dual diode limiting input stage. For small (<300 mV) inputs, the input impedance is 50 Ω nominal. But at higher pulse levels or DC offset input levels, the diode impedances will shunt the 50 Ω resistive termination. Because the input is DC coupled, several channels may be cascaded. However, in cascaded operation, the user should always be aware of the effects of both input noise and input DC offset. For instance, four cascaded amplifiers must maintain an input offset of less than 0.5 mV over the entire temperature range in order to ensure linear operation.

2.2 Replacement Information

In the event that a channel of VV100B must be replaced, the trims described in the VV100B data sheet (TRIMS) must be readjusted. Trims T1 and T3 are fixed resistors soldered onto the board. Trim T2 is accomplished by an on-board 1 M Ω potentiometer and high frequency compensation is set by a variable capacitor. Before the fixed resistors are removed, the user should check to see whether input DC offset and low frequency gain are within acceptable limits with the new VV100B installed.

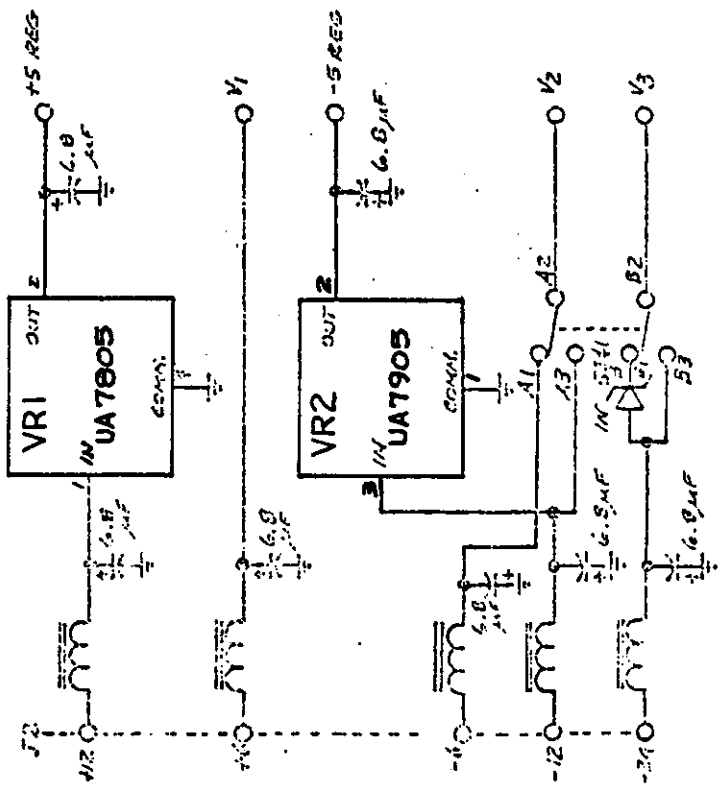
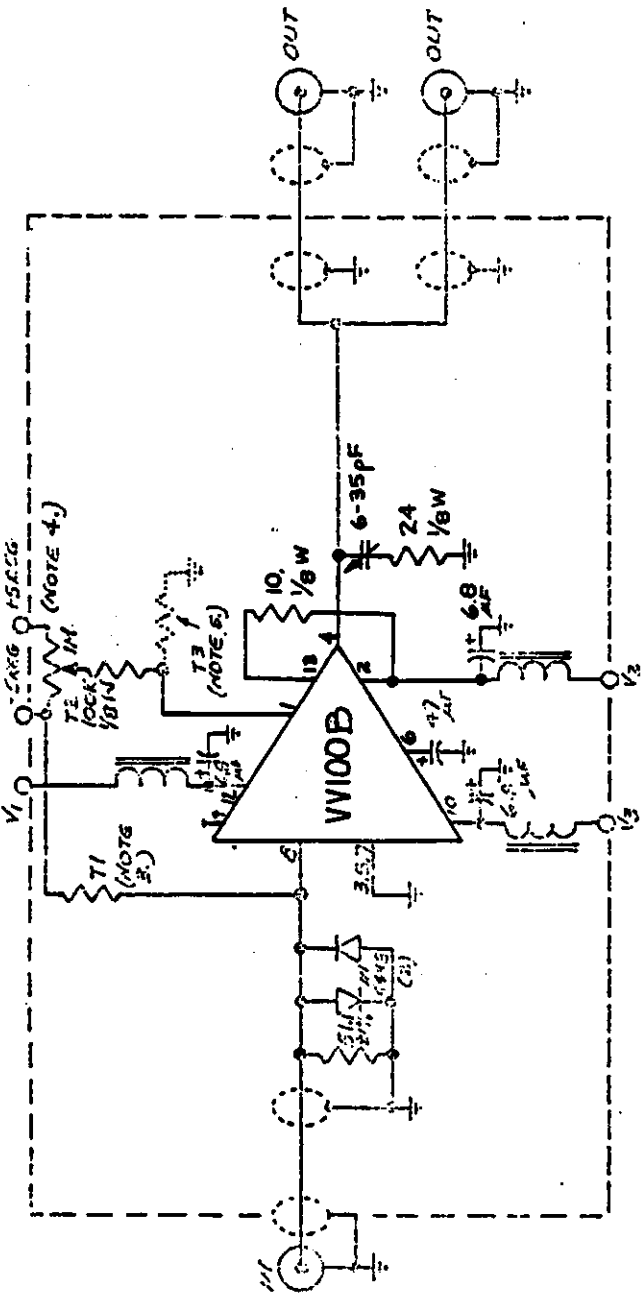
MODEL NO 612A
ECON 1007

12-CH PM AMPLIFIER

PRINTED 02-Nov-81
REV DATE 28-Oct-81

LRS PART NO	DESCRIPTION	QTY
142 124 476	CAP TANT DIP CASE 47 UF 6.3V 20%	12
142 824 685	CAP TANT DIP CASE 6.8 UF 35V 20%	44
158 849 **5	CAP VARIABLE 6.0-35 PF	12
161 *30 **0	RES COMP ZERO OHMS	7
161 225 100	RES COMP 1/8W 5% 10 OHMS	12
161 225 104	RES COMP 1/8W 5% 100 K	12
161 225 240	RES COMP 1/8W 5% 24 OHMS	12
168 531 269	RES PREC RN55D 51.1 OHMS	12
181 457 105	RES VARI CERMET 1 MEG 1/2W 10%	12
208 122 **2	IC VOLT REG POS UA7805 5V OUTPUT TO-220 PACKAGE	1
208 124 **2	IC VOLT REG -5V UA7905UC TO -220 PKG	1
210 *40 *31	IC AMPLIFIER UV100B DIP-16	12
230 110 **5	DIODE SWITCHING 1N4448	24
240 *35 341	DIODE ZENER 6.2V 1N5341B SW/CASE DO-29 OR 59-02	1
300 *10 **1	BEAD SHIELDING FERRITE	12
300 *50 **1	CHOKE FERRITE SINGLE LEAD	41
400 *30 *16	SOCKET IC ST DIP-16 BONDED TIN CONTACTS/COPP-NICKEL PINS	12*
402 *30 **0	CONNECTOR CO-AXIAL LEMO	36
402 *30 **1	HOOD FOR BULKHD LEMO CONN LEMO CR00.001.250	36
402 *30 **2	SPANNER NUT SMALL OD LEMO	36
402 *30 **3	GROUND LUG NONLOCK LEMO	A/R
402 *30 **4	GROUND STRAP 'H' LEMO	A/R
405 112 **1	CONNECTOR BLOCK (PIN) 42 'MIXED'	1
405 212 **2	GUIDE PIN (MALE) CADMIUM PLATED BRASS	1
405 213 **1	GUIDE PIN (MALE) BRASS	1
405 312 **1	GUIDE PIN (FEMALE) CADMIUM PLATED BRASS	2
405 410 *16	CONNECTOR PIN (MALE)	6
405 613 **1	CONNECTOR HOOD CADMIUM PLATED STEEL/INT CLOSED END	1
420 212 **1	SWITCH SLIDE DPDT	1
521 400 *24	SPACER ROUND #4 3/4	4
540 103 102	SIDE COVER NIM LEFT	1M
540 103 103	SIDE COVER NIM RIGHT	1
540 104 101	WRAPAROUND NIM SIZE #1 WITH BIN GATE	1M
540 105 **1	BRACKET NIM WRAP SIZE #1	2
555 611 **1	CAPTIVE SCREW 6-32	2
555 621 **2	CAPTIVE SCREW RETAINER NICKEL PLATED BRASS	2
567 256 **4	SCREW FLAT PHIL 2-56X1/4	4
710 612 *23	PC BD PREASS'Y 612A/612AM	1
720 612 *13	FRONT PNL PREASS'Y 612A 540102001(1)555621002(2)	1
730 612 *12	SIDE NIM LEFT 612A 540103102(1)	1
740 612 *12	WRAPAROUND NIM 1 612A 540104101(1)	1

- NOTE: 1 SE ONLY TI LOW PROFILE SOCKETS
 NOTE: 2
 NOTE: 3
 NOTE: 4
 NOTE: 5
 NOTE: 6
 NOTE: 7
 NOTE: 8
 NOTE: 9
 NOTE: 10
 NOTE: 11
 NOTE: 12



NOTES:

- 1). [unclear]
- 2). OUTLINED SECTION IS ONE OF TWELVE CHANNELS.
- 3). INPUT DC ZERO.
- 4). OUTPUT DC ZERO.
- 5). SLOW COMP; T3 CONNECTED TO GROUND.

LOCRUY RESEARCH SYSTEMS CORPORATION WEST NYACK, NEW YORK	
DRAWN A. STUDER'S	12-CHANNEL PHOTOMULTIPLIER AMPLIFIER
CHECKED	MODEL 612A
DATE 8/18/77	
DRAWING NO. 612A-S1	REV. 1 ECO No. 1007 DATE 10/28/81