MODEL 612A/AM
VV100B, VV100BTB,
LINEAR AMPLIFIERS

Revised
September 1988

A T T E N T I O N

OPERATION OF THIS MODULE REQUIRES +6 V. (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 ADDENDA.

THE VV100B IS NOT A DIRECT REPLACEMENT OF THE VV100. SEE SECTION 2.3.

A T T E N T I O N

GENERAL INFORMATION

PURPOSE

This manual is intended to provide instruction regarding the setup and operation of the covered instruments. In addition, it describes the theory of operation and presents other information regarding its functioning and application.

The Service Documentation should be consulted for the schematics, parts lists and other materials that apply to the specific version of the instrument as identified by its ECO number.

UNPACKING AND INSPECTION

It is recommended that the shipment be thoroughly inspected immediately upon delivery. All material in the container should be checked against the enclosed Packing List and shortages reported promptly. If the shipment is damaged in any way, please notify the Customer Service Department or the local field service office. If the damage is due to mishandling during shipment, you may be requested to assist in contacting the carrier in filing a damage claim.

WARRANTY

LeCroy warrants its instrument products to operate within specifications under normal use and service for a period of one year from the date of shipment. Component products, replacement parts, and repairs are warranted for 90 days. This warranty extends only to the original purchaser. Software is thoroughly tested, but is supplied "as is" with no warranty of any kind covering detailed performance. Accessory products not manufactured by LeCroy are covered by the original equipment manufacturers warranty only.

In exercising this warranty, LeCroy will repair or, at its option, replace any product returned to the Customer Service Department or an authorized service facility within the warranty period, provided that the warrantor's examination discloses that the product is defective due to workmanship or materials and has not been caused by misuse, neglect, accident or abnormal conditions or operations.

The purchaser is responsible for the transportation and insurance charges arising from the return of products to the servicing facility. LeCroy will return all in-warranty products with transportation prepaid.

This warranty is in lieu of all other warranties, express or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. LeCroy shall not be liable for any special, incidental, or consequential damages, whether in contract, or otherwise.

PRODUCT ASSISTANCE

Answers to questions concerning installation, calibration,

and use of LeCroy equipment are available from the Research System Division Customer Services Department, 700 Chestnut Ridge Road, Chestnut Ridge, New York 10977-6499 (914) 578-6030, or your local field service office.

MAINTENANCE AGREEMENTS

LeCroy offers a selection of customer support service. For example, Blue Ribbon service provides guaranteed three-day turn around on repairs, a direct access number for product application assistance, yearly calibration and the addition of engineering improvements. Maintenance agreements provide extended warranty that allows the customer to budget maintenance costs after the initial warranty has expired. Other services such as installation, training, on-site repair, and addition of engineering improvements are available through specific Supplemental Support Agreements. Please contact the Customer Service Department or the local field service office for details.

DOCUMENTATION DISCREPANCIES

LeCroy is committed to providing state-of-the-art instrumentation and is continually refining and improving the performance of its products. While physical modifications can be implemented quite rapidly, the corrected documentation frequently requires more time to produce. Consequently, this manual may not agree in every detail with the accompanying product and the schematics in the Service Documentation. There may be small discrepancies in the values of components for the purposes of pulse shape, timing, offset, etc., and, occasionally, minor logic changes. Where any such inconsistencies exist, please be assured that the unit is correct and incorporates the most up-to-date circuitry.

SOFTWARE LICENSING AGREEMENT

Software products are licensed for a single machine. Under this license you may:

- Copy the software for backup or modification purposes in support of your use of the software on a single machine.

- Modify the software and/or merge it into another program for your use on a single machine.

- Transfer the software and the license to another party if the other party accepts the terms of this agreement and you relinquish all copies, whether in printed or machine readable form, including all modified or merged versions.

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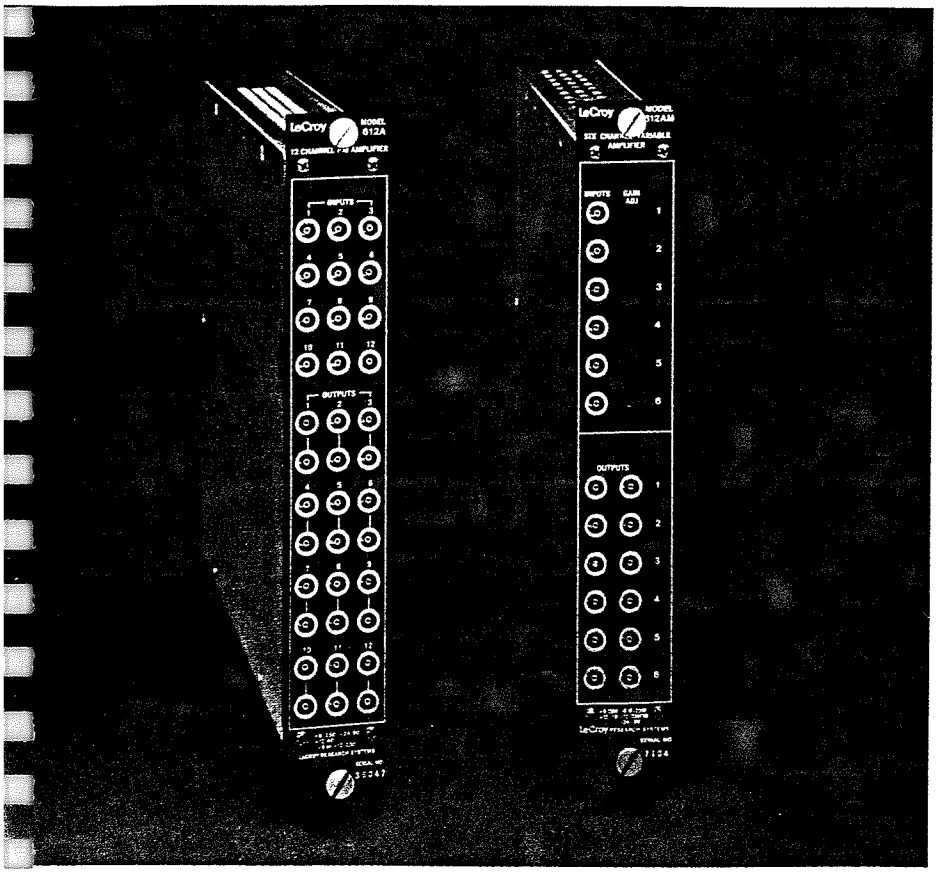
PHOTOMULTIPLIER AMPLIFIERS
MULTIPLE INPUT/OUTPUT

LeCroy

612A 12 CHANNEL, FIXED GAIN
612AM 6 CHANNEL, VARIABLE GAIN



- 200 MHz Bandwidth
- Direct Coupled
- 2.5X to 40X Gain
- 5 V Linear Range
- Two Outputs Per Channel
- Low Cost

FOR HIGH FIDELITY AMPLIFICATION OF FAST SIGNALS

The Models 612A and 612AM are multiple-channel NIM-standard modules, optimized for faithful amplification of fast photomultiplier-type signals. With high stability and integral linearity, plus a wide dynamic range, these amplifiers allow the use of economical, low gain phototubes, even in demanding direct-coupled ADC applications.

A high-speed operational amplifier design makes the performance of the amplifier virtually independent of external variables, such as supply voltages or temperature. Input and output levels remain negligibly small even when the module is moved from bin to bin, or under extremes of operating temperature. There is virtually no warm-up drift on turn-on. The amplifiers simply magnify the input without significant distortion or operating constraints.

FEATURES

Multiple Independent Inputs - The 612A contains 12 independent amplifiers and the 612AM contains six. Packaged in a #1 width NIM-standard module, both offer a correspondingly low cost per channel.

Two Outputs Per Channel - Both amplifiers offer a built-in fanout of two, simplifying simultaneous use of the same photomultiplier signal for multiple purposes.

High Bandwidth - The Model 612A offers a 200 MHz bandwidth while the 612AM offers 140 MHz, adapted to handle all but the fastest photomultiplier tubes.

Flexible Gain Configurations - The 612A has 12 channels of a fixed 10X gain. Each channel of the 612AM, on the other hand, uses two internal amplifiers to achieve a higher but variable gain up to 40X. With the variable gain of the 612AM, simple high voltage distribution may be used where the gains are equalized by the amplifier rather than the high voltage. This technique avoids photomultiplier propagation delay changes resulting from varying the high voltage supply.

Convenient Linear Range - The linear range extends from +200 mV to -5 V, directly compatible with LeCroy current integrating ADC's and discriminators.

High Signal Fidelity - DC coupling, fast risetimes, 1 mV DC stability at the output, 0.1% integral linearity, low overshoot and DC offset temperature coefficient insure faithful reproduction of signal shape after amplification.

Well Protected - Both input and output are protected against overload conditions, and recovery rate is swift.

SPECIFICATIONS

	Model 612AM	Model 612A
INPUT CHARACTERISTICS		
Impedance:	50 Ω	50 Ω
Input Protection:	±5 A for 0.5 µsec; ±0.5 A for continuous input voltage; clamps at ±0.6 V	±5 A for 0.5 µsec; ±0.5 A for continuous input voltage; clamps at ±0.6 V
Reflection Coefficient:	Less than 5% over input dynamic range	Less than 5% over input dynamic range
Quiescent Voltage:	±0.5 mV	±0.5 mV
OUTPUT CHARACTERISTICS		
Maximum Positive Amplitude (Linear):	+200 mV	+200 mV
Maximum Negative Amplitude (Linear):	-2 V with 6 V supply; -5 V with -12 V supply	-2 V with -6 V supply; -5 V with -12 V supply
Overshoot:	Less than ±10% for input risetimes ≥1.5 nsec and gains >4X. Slightly larger for gains <4X.	Less than ±10% for input risetimes ≥1.5 nsec

	Model 612AM	Model 612A
Quiescent Voltage:	0 V ±3 mV	0 V ±3 mV
Output Voltage DC Offset Temperature Coefficient:	400 μV/°C maximum	100 μV/°C maximum
Output Voltage Variation with Supply Voltage:	<4 mV for ±1% variation of any supply voltage	<1 mV for ±1% variation of any supply voltage
GENERAL		
Gain:	2.5 to 40, non-inverting. Long term stability ±1%	Fixed gain of 10, non-inverting. Long term stability ±1%. Gain tolerance ±5%
Linearity:	0.2% integral	0.1% integral
Coupling:	Direct	Direct
Risetime:	<3.0 nsec, 10% to 90%	<2.0 nsec, 10% to 90%
Delay:	Approx. 5.5 nsec	Approx. 4 nsec
Noise:	Less than 50 μV RMS, referred to input, total	Less than 50 μV RMS, referred to input, total
Interchannel Crosstalk:	Output in one channel affects any other channel by no more than -40 dB	Output in one channel affects any other channel by no more than -70 dB
Overload Recovery:	a) Operation with -12 V supply: saturated for approximately 15 nsec after 10X overload b) Operation with -6 V supply: saturated for approximately 50 nsec after 10X overload. For wide pulses (i.e., >5 μsec) it is recommended to use -12 V supply for best overload recovery	a) Operation with -12 V supply: saturated for approximately 15 nsec after 10X overload b) Operation with -6 V supply: saturated for approximately 50 nsec after 10X overload. For wide pulses (i.e., >5 μsec) it is recommended to use -12 V supply for best overload recovery
Packaging:	RF-shielded AEC/NIM #1 width module conforming to specifications outlines in AEC Report TID-20893; Lemo connectors	RF-shielded AEC/NIM #1 width module conforming to specifications outlines in AEC Report TID-20893; Lemo connectors
Current Requirements:	In rear panel selected 6 V mode: +6 V at 350 mA, -6 V at 275 mA, +12 V at 10 mA, -12 V at 5 mA, -24 V at 80 mA, or in 12 V mode: +6 V at 350 mA, +12 V at 10 mA, -12 V at 275 mA, -24 V at 80 mA	In rear panel selected 6 V mode: +6 V at 350 mA, -6 V at 275 mA, +12 V at 10 mA, -12 V at 5 mA, -24 V at 80 mA, or in 12 V mode: +6 V at 350 mA, +12 V at 10 mA, -12 V at 275 mA, -24 V at 80 mA

HYBRID COMPONENT
HIGH PERFORMANCE AMPLIFIER

LeCroy

Model VV100B
Wideband Pulse Amplifier

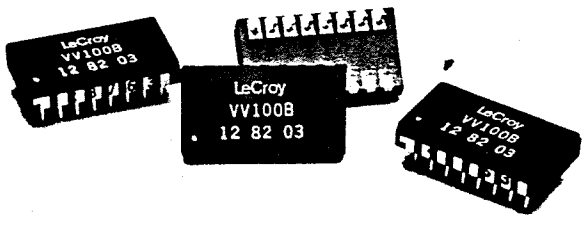
- **Wide Bandwidth** risetime: <2 nsec VV100B
- **Direct-Coupled Design** permits high rate application without baseline shifts.
- **10 × Gain, Cascadable** to 1000 × for direct compatibility with a wide range of input amplitude applications.
- **Excellent DC Stability** (<1 mV long term) assures optimum performance in DC coupled applications.
- **± 0.2%, Integral Linearity**
- **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.
- **Ideal for Fast Photomultipliers**

The LeCroy Model VV100B 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 provides unprecedented performance in demanding direct-coupled, high-duty-cycle applications.

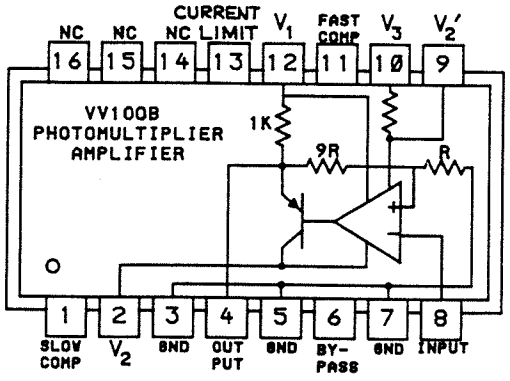
A new high speed amplifier circuit design makes the performance of the VV100B virtually independent of external variables such as supply voltages or temperature. Shifts in the DC output level remain negligibly small even when the amplifier is subjected to extremes of operating temperature or varlatlons in power supplied. There is virtually no warmup drift at turn-on.

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

PACKAGING



LOGIC DIAGRAM (TOP VIEW)



Corporate Headquarters: 700 Chestnut Ridge Road, Chestnut Ridge, NY 10977-6499, USA. Tel: (914) 578-6013 TWX: 710-577-2832

SPECIFICATIONS
Hybrid Circuit Model VV100B
WIDEBAND PULSE AMPLIFIER

Gain:	10 FIXED, ±5% tolerance, non-inverting, long term stability ±1%
Linearity:	±0.2% integral (0 to −3 V)
Maximum Output Swing:	−5 V at 200 mA Note 1 +250 mV at 5 mA Note 3
Output Impedance:	<0.2 Ω 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
Risetime (10% to 90%):	⩽2 nsec
Input Signal Range:	
Maximum Safe Input Signal	±1 V; external clamp diodes recommended Note 6
Linear Range	−0.5 V to +0.01 V
Wideband Output Noise: (referred to input)	<50 μV rms
Input Impedance:	>1 kΩ
Input Bias Current:	−25 μA
Drift vs. Temperature	250 nA/°C
Input Offset Voltage:	
Typical	2 mV, adjustable to 0
Drift vs. Temperature	10 μV/°C (max)
Drift vs. Supply Voltage	<100 μV, for ±1% variation
Drift vs. Time	<100 μV, long term
Coupling:	
Input	Direct
Output	Direct
Temperature Range:	0°C to 70°C
Power Supply Rejection Ratio:	90 dB at 120 Hz
Power Supply:	(Two Voltage Operation) Note 4
Rated Voltage, Quiescent Current	V_1 = 30 mA at +6 V V_2 = −20 mA at −6 V to −12 V (Tie pin 9 to pin 2)
Power Supply:	(Three Voltage operation) Note 5
Rated Voltage, Quiescent Current	V_1 = 30 mA at +6 V V_2 = −28 mA at −6 V to −12 V V_3 = −8 mA at V_2 − 12 V (e.g., −24 V when V_2 = −12 V and pin 9 open)
Overload Recovery:	Operation with V_2 = −12 V supply: saturated for approximately 15 nsec after 10× overload.
Package:	Standard 16-pin dual in-line hybrid integrated circuit. Note 8

NOTES:

1. Overload protected to limit the average output current to <60 mA. See application notes.
2. No overload protection. Average output current should be <50 mA to avoid damage to the unit.
3. For increased positive swing, see applicaiton notes.
4. Three voltage operation recommended for most applications.
5. Three voltage operation provides increased bandwidth.
6. See Figure 1.
7. For two voltage operation install a 6.8 μF capacitor from pin 13 to ground with the positive lead grounded.
8. The VV100B is not pin-for-pin compatible with the VV100. Please contact LeCroy for details.

SPECIFICATIONS SUBJECT TO CHANGE

APPLICATION NOTES

The LeCroy model VV100B 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 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 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 kΩ resistor and a 500 kΩ potentiometer. Trim T2 is set by the 1 MΩ potentiometer and series 100 kΩ 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.

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 μsec.

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

$$V^{-}_{Min} = (0.06\ V)\frac{R_P\ R_L}{R_P + R_L}; \qquad V^{-}_{Min} \geq -5\ V$$

LAYOUT

Because of the extremely high bandwidth of the VV100B, 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 TI 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.

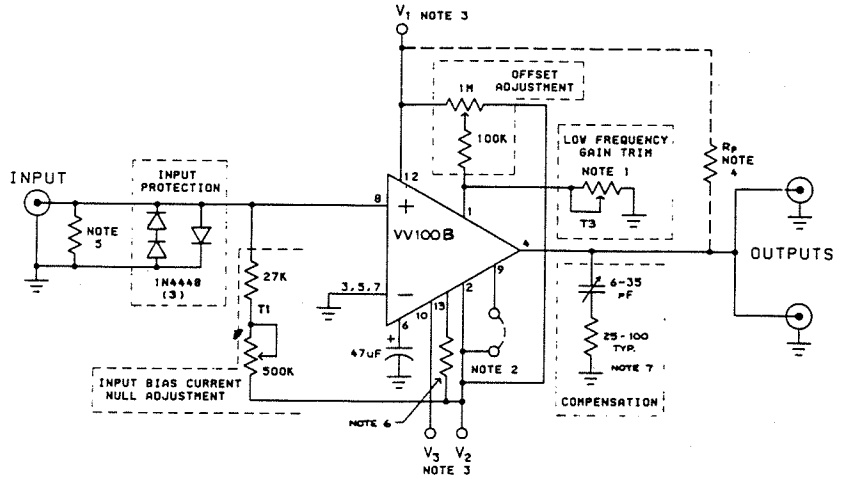


Figure 1

NOTES:

1. Typical value = 7.5 kΩ
2. Add jumper for 2-supply operation
3. All power supply voltage lines should include a high frequency bypass, typically a 6.8 μF capacitor to ground and a 50 μH series choke.
4. Optional pull-up for extended positive voltages 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.

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 VV100B requires about 8 mA from the V_3 supply. Proper bypass requires at least 6.8 μF tantalum capacitors to ground from pins 2, 12, (and 10 if three voltages are used) and 47 μF on pin 6. Minimum length leads should be employed. Be sure to observe proper polarity. See Figure 1. Model VV100B can be operated with only two proper power supplies at the expense of risetime 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 VV100B 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 fan-out). 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. 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 μsec. 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 averaging 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 μsec time constant.

TRIMS

The VV100B requires 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 VV100B is replaced. All trims should be made with the VV100B 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 kΩ to 300 kΩ.

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 kΩ to 1 MΩ.

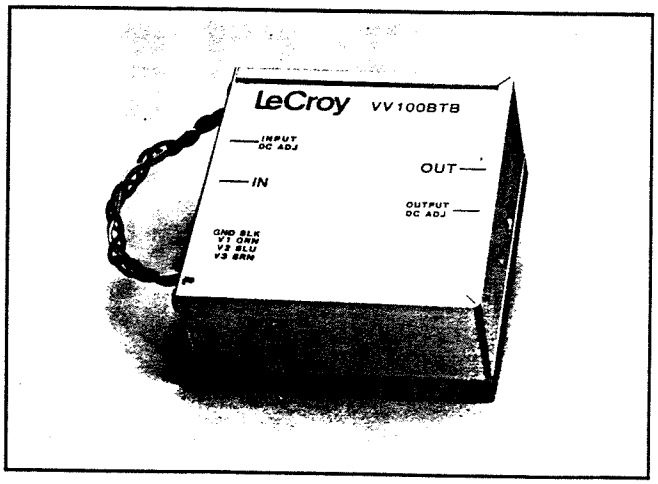
The last trim is an RC adjustment of the overshoot of the output. A 6-35 pF trimmer capacitor in series with a 25-100 Ω resistor is required to minimize the overshoot. Using a fast risetime input pulse, observe the output of the VV100B. Adjust the trim capacitor to give the best output pulse shape.

* Occasionally an additional slow compensation trim (T3) is required. To make this trim, a flat-topped pulse of about 10 μsec duration is applied to the VV100B input. A resistor in the range of 10 kΩ to 300 kΩ 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 provides the high bandwidth circuitry, shown in Figure 1, in a ready-to-use format. The 3 inch × 3 inch × 1.6 inch enclosure size of the device allows one to use the Model VV100B 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. The trim and compensation variables are factory adjusted for optimum high-speed performance.

MODEL	DESCRIPTION
VV100B	Amplifier hybrid.
VV100BTB	VV100B mounted in circuit board. Lemo connectors.



Model VV100BTB wideband amplifier module.

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 V 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 V. Twelve volt operation extends the linear operation region from -2 V to about -5 V. The 612A and 612AM incorporate a dual diode limiting input stage. For small ($\pm$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.

2.3 Special Note to Users of 612 and VV100

The replacement for the VV100 hybrid used in the LeCroy Model 612 and some older VV100 Test Boards is the VV100B. The two hybrids are not directly compatible without first modifying the circuit.

To replace the VV100 with the VV100B you must first isolate pin 13 on

the old VV100 from ground, then connect a 10 Ω 1/8 with resistor from pin 13 to pin 2. This completes the modification. The unit must now be retrimmed for input offset and output offset nolls. See procedure in Section 2.2 above.

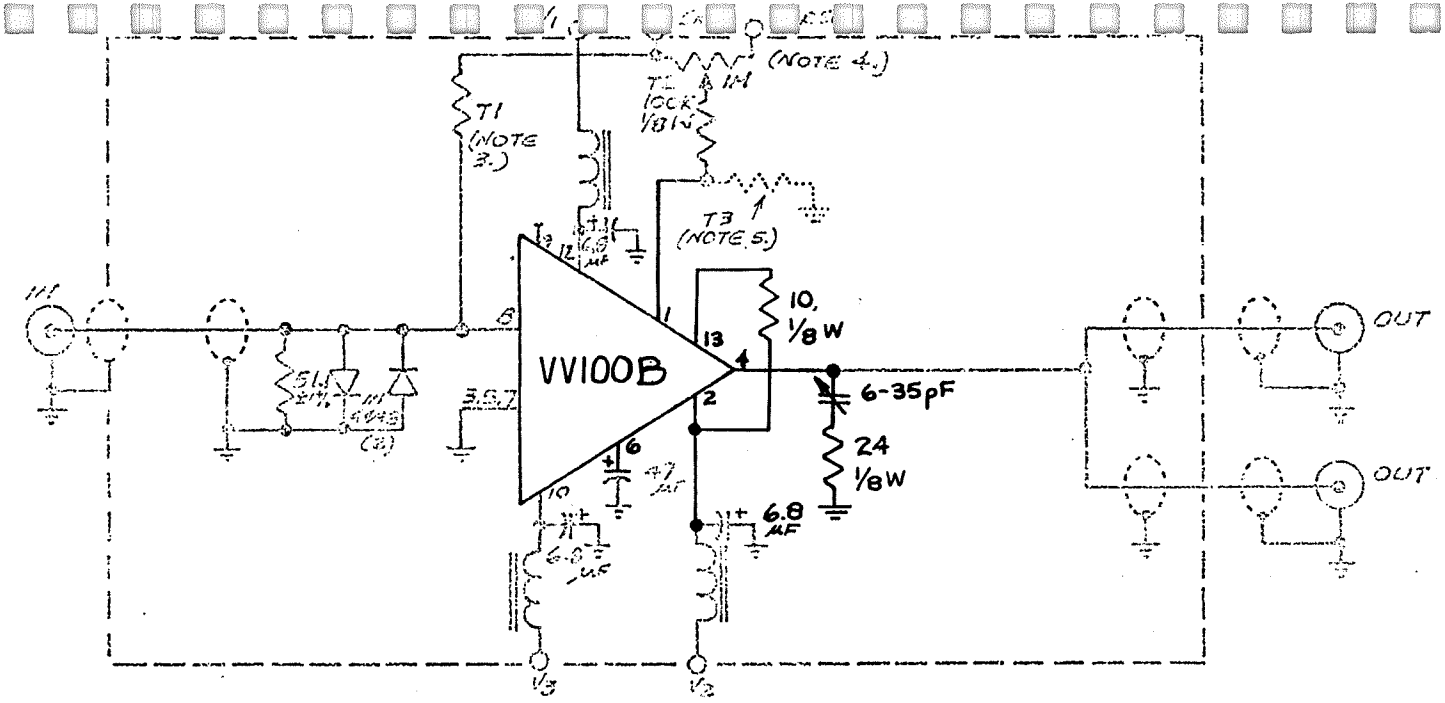
TECHNICAL INFORMATION

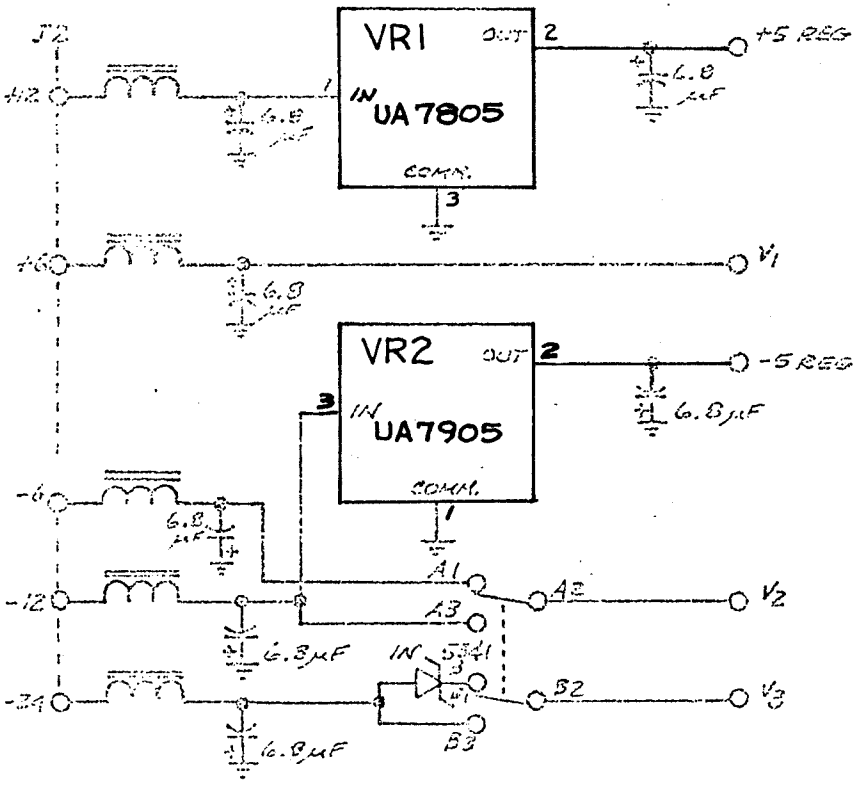
(SCHEMATICS, PARTS LISTS)

PART NUMBER	DESCRIPTION REMARK	QTY PER
142124476	CAP TANT DIP CASE 47 UF	12
142824685	CAP TANT DIP CASE 6.8 UF	44
158849005	CAP VARIABLE 6.0-35 PF	12
161030000	RES COMP ZERO OHMS	7
161225100	RES CARBON FILM 10 OHMS	12
161225104	RES CARBON FILM 100 K	12
161225240	RES CARBON FILM 24 OHMS	12
161335240	RES CARBON FILM 24 OHMS	6
168531269	RES PREC RN55D 51.1 OHMS	12
168531269	RES PREC RN55D 51.1 OHMS	18
181457105	RES VARI CERMET 1 MEG	12
182537202	RES VARI CERMET 2 K	6
208122002	IC VOLT REG POS UA7805	1
208124002	IC VOLT REG -5V UA7905UC	1
230110005	DIODE SWITCHING 1N4448	24
240035341	DIODE ZENER 6.2V 1N5341B	1
300010001	BEAD SHIELDING FERRITE	12
300020001	BEAD SHIELDING "1/2" SIZE	6
300050001	CHOKE FERRITE SINGLE LEAD	41
400030016	SOCKET IC SOLD TAIL DIP-16	12
402030000	CONN CO-AX LEMO	36
402030000	CONN CO-AX LEMO	18
402030001	HOOD FOR BULKHD LEMO CONN	36
402030001	HOOD FOR BULKHD LEMO CONN	18
402030002	SPANNER NUT SMALL OD LEMO	36
402030002	SPANNER NUT SMALL OD LEMO	18
402030003	GROUND LUG NONLOCK LEMO	0
402030003	GROUND LUG NONLOCK LEMO	2
402030004	GROUND STRAP "H" LEMO	0
402030052	SIGNAL RING LEMO RED	0
405112001	CONNECTOR BLOCK (PIN)	1
405212002	GUIDE PIN (MALE)	1
405213001	GUIDE PIN (MALE)	1
405312001	GUIDE PIN (FEMALE)	2
405410016	CONNECTOR PIN (MALE)	6
405613001	CONNECTOR HOOD	1
420212001	SWITCH SLIDE DPDT	1
521400024	SPACER ROUND #4 3/4	4
523400012	ROLL PIN SIZE #4 3/8 LONG	6
540103103	SIDE COVER NIM RIGHT	1
540105001	BRACKET NIM WRAP SIZE #1	2
555611001	CAPTIVE SCREW 6-32	2
555621002	CAPTIVE SCREW RETAINER	2
560440005	SCREW PHILIPS 4-40X5/16	7
560440005	SCREW PHILIPS 4-40X5/16	6
560440014	SCREW PHILIPS 4-40X7/8	4
560440015	SCREW PHILIPS 4-40X15/16	4
567256004	SCREW FLAT PHIL 2-56X1/4	4
568440003	SCREW FLAT PHIL 4-40X3/16	10
578400001	WASHER SHAKEPROOF SIZE 4	4
580440001	NUT HEX STANDARD 4-40	2
581440001	NUT HEX SMALL OD SIZE 4	2

PART NUMBER	DESCRIPTION REMARK	QTY PER
585141237	RIVET "POP" ALU 1/8X.237	2
590001022	WIRE TEFLON 7/30 BLK 22	1
590111022	WIRE TEFLON 7/30 BRN 22	1
590331022	WIRE TEFLON 7/30 ORA 22	1
590551022	WIRE TEFLON 7/30 GRN 22	1
590661022	WIRE TEFLON 7/30 BLU 22	1
590881022	WIRE TEFLON 7/30 GRAY 22	1
590991022	WIRE TEFLON 7/30 WHT 22	2
593910001	CABLE CO-AXIAL RG178B/U	38
593910001	CABLE CO-AXIAL RG178B/U	25
594120001	TIEWRAP	13
594120001	TIEWRAP	6
710612023	PC BD PREASS'Y 612A/612AM	1
720612013	FRONT PNL PREASS'Y 612A	1
720612023	FRONT PNL PREASS'Y 612AM	1
730612012	SIDE NIM LEFT 612A	1
740612012	WRAPAROUND NIM 1 612A	1
SM661186270	CAP CERA CHIP 10% 27 PF	6
VV100B	LINEAR AMPLIFIER	12

End of report. 114 Details encountered.





NOTES:

1).

2). OUTLINED SECTION IS ONE OF TWELVE CHANNELS.

3). INPUT DC ZERO.

4). OUTPUT DC ZERO.

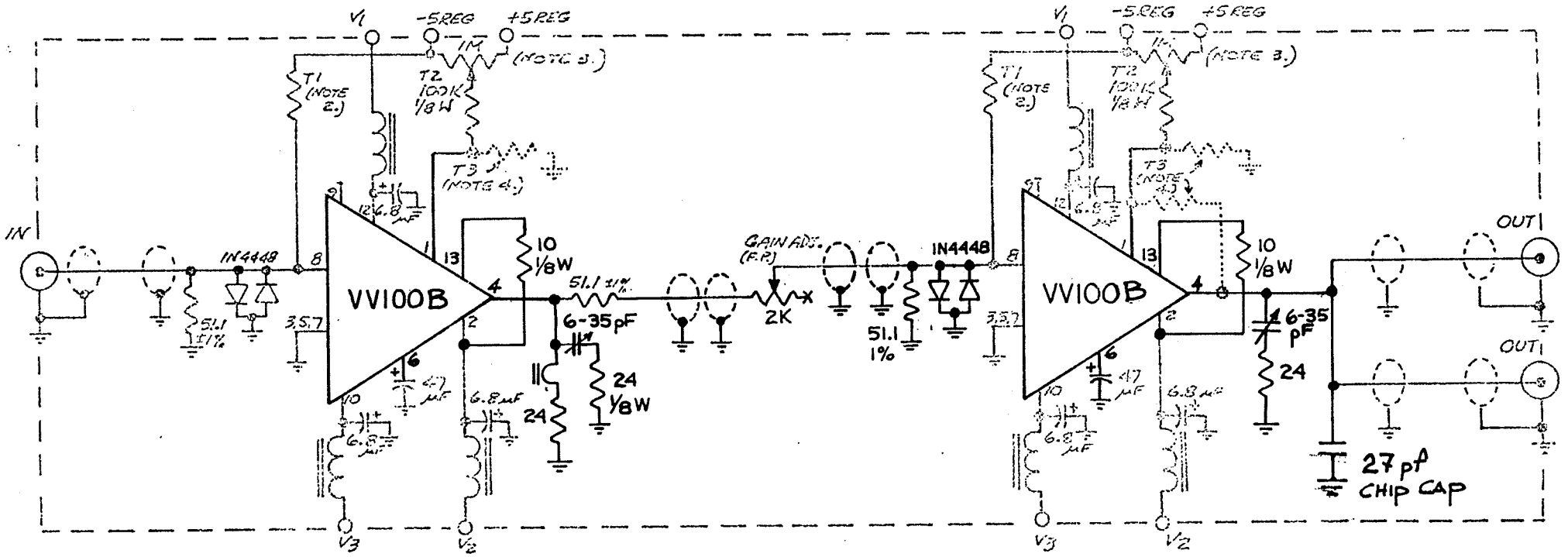
5). SLOW COMP; T3 CONNECTED TO GROUND.

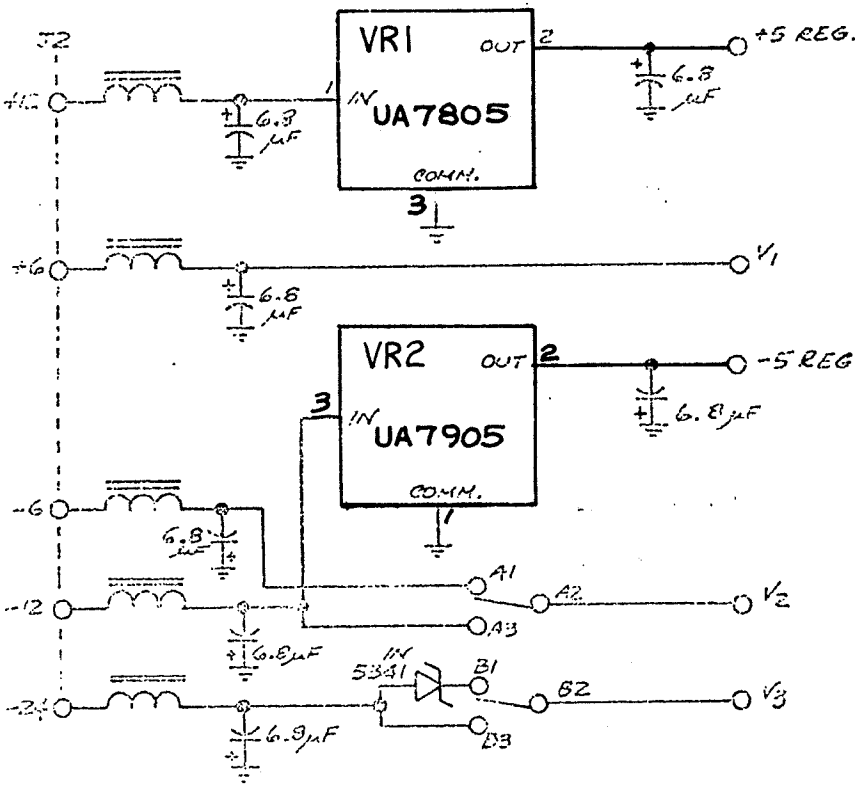
LeCROY RESEARCH SYSTEMS CORPORATION WEST NYACK, NEW YORK	
DRAWN A. ANDREWS	12-CHANNEL PHOTOMULTIPLIER AMPLIFIER
CHECKED	MODEL 612A
DATE 8/18/77	
DRAWING No. 612A-SI	SHEET 1 ECO No 1008 OF 1

PART NUMBER	DESCRIPTION REMARK	QTY PER
142124476	CAP TANT DIP CASE 47 UF	12
142824685	CAP TANT DIP CASE 6.8 UF	44
158849005	CAP VARIABLE 6.0-35 PF	12
161030000	RES COMP ZERO OHMS	7
161225100	RES CARBON FILM 10 OHMS	12
161225104	RES CARBON FILM 100 K	12
161225240	RES CARBON FILM 24 OHMS	12
161335240	RES CARBON FILM 24 OHMS	6
168531269	RES PREC RN55D 51.1 OHMS	18
181457105	RES VARI CERMET 1 MEG	12
182537202	RES VARI CERMET 2 K	6
208122002	IC VOLT REG POS UA7805	1
208124002	IC VOLT REG -5V UA7905UC	1
230110005	DIODE SWITCHING 1N4448	24
240035341	DIODE ZENER 6.2V 1N5341B	1
300020001	BEAD SHIELDING "1/2" SIZE	6
300050001	CHOKE FERRITE SINGLE LEAD	41
400030016	SOCKET IC SOLD TAIL DIP-16	12
402030000	CONN CO-AX LEMO	18
402030001	HOOD FOR BULKHD LEMO CONN	18
402030002	SPANNER NUT SMALL OD LEMO	18
402030003	GROUND LUG NONLOCK LEMO	2
402030004	GROUND STRAP "H" LEMO	0
402030052	SIGNAL RING LEMO RED	0
405112001	CONNECTOR BLOCK (PIN)	1
405212002	GUIDE PIN (MALE)	1
405213001	GUIDE PIN (MALE)	1
405312001	GUIDE PIN (FEMALE)	2
405410016	CONNECTOR PIN (MALE)	6
405613001	CONNECTOR HOOD	1
420212001	SWITCH SLIDE DPDT	1
521400024	SPACER ROUND #4 3/4	4
523400012	ROLL PIN SIZE #4 3/8 LONG	6
540103103	SIDE COVER NIM RIGHT	1
540105001	BRACKET NIM WRAP SIZE #1	2
555611001	CAPTIVE SCREW 6-32	2
555621002	CAPTIVE SCREW RETAINER	2
560440005	SCREW PHILIPS 4-40X5/16	6
560440015	SCREW PHILIPS 4-40X15/16	4
567256004	SCREW FLAT PHIL 2-56X1/4	4
568440003	SCREW FLAT PHIL 4-40X3/16	10
578400001	WASHER SHAKEPROOF SIZE 4	4
580440001	NUT HEX STANDARD 4-40	2
585141237	RIVET "POP" ALU 1/8X.237	2
590001022	WIRE TEFLON 7/30 BLK 22	1
590111022	WIRE TEFLON 7/30 BRN 22	1
590331022	WIRE TEFLON 7/30 ORA 22	1
590551022	WIRE TEFLON 7/30 GRN 22	1
590661022	WIRE TEFLON 7/30 BLU 22	1
590881022	WIRE TEFLON 7/30 GRAY 22	1
590991022	WIRE TEFLON 7/30 WHT 22	2
593910001	CABLE CO-AXIAL RG178B/U	25

PART NUMBER	DESCRIPTION REMARK	QTY PER
594120001	TIEWRAP	6
710612023	PC BD PREASS'Y 612A/612AM	1
720612023	FRONT PNL PREASS'Y 612AM	1
730612012	SIDE NIM LEFT 612A	1
740612012	WRAPAROUND NIM 1 612A	1
SM661186270	CAP CERA CHIP 10% 27 PF	6
VV100B	LINEAR AMPLIFIER	12

End of report. 59 Details encountered.





NOTES:

1). OUTLINED SECTION IS ONE OF SIX IDENTICAL CHANNELS.

2). INPUT DC ZERO

3). OUTPUT DC ZERO.

4). SLOW COMP. ; T3 CONNECTED TO GROUND

LeCROY RESEARCH SYSTEMS CORPORATION WEST NYACK, NEW YORK	
DRAWN A. ANDRES	6-CHANNEL PHOTOMULTIPLIER AMPLIFIER
CHECKED	MODEL 612AM
DATE 8/18/77	
DRAWING No. 612AM-S1	ECO No 1073