The performance of the 5612/5613 system can be achieved only if the proper plastic sleeves on the optical connectors are used.

The 5612 contains a sealed lead-acid battery. Normal care to avoid overcharging, deep discharging and short-circuiting this battery should be taken.

Always tilt the detachable rear cover upwards before removing it to avoid the battery sliding out.

Do not power the 5612 from the charger supplied unless the battery is fitted and connected.

Crate power should be turned off during the insertion and the removal of a unit to avoid possible damage caused by momentary misalignment of contacts.

See pocket in the back of this manual for additional addenda with any changes to this manual.
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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.

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 Customer Service Department, 700 Chestnut Ridge Road, Chestnut Ridge, New York, 10977-6499, (914) 578-6030.

MAINTENANCE AGREEMENTS

LeCroy offers a selection of customer support services. For example, 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 for more information.
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.

SERVICE PROCEDURE

Products requiring maintenance should be returned to the Customer Service Department or authorized service facility. If under warranty, LeCroy will repair or replace the product at no charge. The purchaser is only responsible for the transportation charges arising from return of the goods to the service facility. For all LeCroy products in need of repair after the warranty period, the customer must provide a Purchase Order Number before any inoperative equipment can be repaired or replaced. The customer will be billed for the parts and labor for the repair as well as for shipping. All products returned for repair should be identified by the model and serial numbers and include a description of the defect or failure, name and phone number of the user. In the case of products returned, a Return Authorization Number is required and may be obtained by contacting the Customer Service Department at (914) 578-6030.
5612 TRANSMITTER

Power

The 5612 is supplied with an internal battery that, when fully charged, can operate it for a total period up to 24 hours. If the 5612 is switched to standby mode when not in use, the 24 hours of operation can be spread over several months without recharging the battery. Power can also be supplied to the 5612 via its external +12 V input connector (PIN B = 0 V, PIN C = +12 V) from an external 12 V battery or from a power supply. The 5612 can tolerate a supply between 10 V and 16 V and draws a current of about 250 mA.

A three-position slide switch under the rear cover determines whether the power source is the internal battery or the external supply. (Tilt the cover upwards while opening it.) The center position of this switch turns the 5612 off.

The battery charger supplied with the 5612 will charge the internal battery in about 16 hours if the 5612 is not in use. There is an optional battery charger available with quick-charge capabilities, as opposed to the standard charger supplied with the 5612. The quick-charge battery charger will charge a completely discharged battery in approximately 7 hours if the 5612 is not in use. The charger will then automatically shut off to avoid over charging the battery. The LeCroy part numbers for ordering the charger are: 312-911-110 or 312-912-220, whereas the last three digits indicate the input voltage to the charger. Either charger can also be used to power the 5612, but in this case, the battery will not charge to its full capacity. Either charger must NOT be used to power a 5612 whose battery is not connected.

Note that connecting an external power source can considerably degrade the system signal-to-noise ratio.

Control Mode

The input range and the calibration modes of the 5612 can be controlled either from the 5613 via the optical link or from the 5612 itself. A two-position slide switch, under the rear cover, sets the 5612 into its Local or its Remote mode.

In Local mode the 5612 can be turned on and off only by the power selector switch under the rear cover. Its input range can be set only by using a screwdriver and adjusting the 16-position switch located under the rear cover. The ranges as set by this switch are shown in Figure 1.
In Remote mode the 5612 can be switched on and off remotely by a 5613, provided its power selector switch has been set to the power source in use. The input range and calibration mode can be set only from a 5613.

Optical Link

One optical fiber is used to transmit data from the 5612 to the 5613 and a second fiber to transmit control signals from the 5613 to the 5612.

These fibers can be up to 500 m long. They can have a core diameter of either 100 or 200 micrometers, and can be terminated with either an Amphenol 905 or 906 series connector at each end. See Application Notes AN-27 and AN-29, attached to this manual, for more details.

In certain fixed input applications, the 5612 can be used in its Local mode and the control fiber omitted.

If the 5612/5613 link is to be used with high voltage between the units, care should be taken to ensure that the connecting fiber does not contain a steel strengthening member.

Input

The 5612 is provided with input ranges from +200 mV to +100 V. An input signal greater than the currently selected range will not damage the 5612 but can cause a misleading output to be generated at the 5613. Over voltage protection is provided to limit the input voltage to a peak of 350 V. This relies on the source resistance to limit the input current under fault conditions.

The input connector is triaxial. The input signal is measured between the inner lead and the inner braid while the outer braid is linked to the case of the 5612. There is an internal connection between the two screens and either can be used as the ground connection if a coaxial cable is used.

The input impedance is 10 MΩ.

5613 RECEIVER/LINK CONTROLLER

Power

The 5613 is constructed as a standard double-width CAMAC module and is normally used in a CAMAC crate.

Control Modes

Each 5613 can control two 5612 transmitters. Instructions for the transmitters can originate from the CAMAC controller or from the user directly via four front-panel switches. These switches can be used to turn the 5612s on and off and to change their input voltage range or calibration mode.

LED displays indicate which ranges have been selected. They do not indicate that the 5612 has actually switched to the range required.

The CAMAC commands recognized by the 5613 are shown in the data sheet.
If the LAM (Look-at-Me) Enable is set, for the 5613, any manual switch operation will generate a LAM flag. This enables the computer control system to recognize that a manual change has been made and to take the appropriate action.

**Optical Link**

Each 5613 employs two independent optical receiver channels for the analog signal path of the 5612/5613 combination. Two 5612 units can be “read” by one 5613. Each optical receiver has cable fault detection such that, if the input fiber optic cable were to be broken or transmission were to be interrupted, the output of the 5613 would go to +12 V DC. This capability will be available in the 5613 modules which were produced after July 1, 1988.

The fiber connected to the Transmitter Output of the 5612 (signal fiber) should be coupled to one of the input connectors on the rear of the 5613. The other fiber (control fiber) should be connected to the corresponding output connector. See Figure 2 for details.

![Figure 2: View of the 5612 from the rear](image)

Both fibers attached to the 5612 should be fitted with short sleeves. The 5613 control fiber should be fitted with a short sleeve and the signal fiber with a long sleeve. See Appendix A and Application Note AN-29 attached to this manual.

**Signal Output**

The 5613 has two output connectors on the front panel for the electrical analog output signal, one for each 5612. These connectors have two pins, pin 1 being the signal output and pin 2 being signal ground. Full scale corresponds to +2.0 V into a high impedance load or +1.0 V into 50 Ω. The outputs can be short-circuited without damage.
5612 TEST PROCEDURE

Equipment needed
1 - 5612
1 - 5613
2 - 100 micron fiber optic cables
1 - FG504 Tektronic signal generator
1 - DC voltage standard
1 - LeCroy 9450 oscilloscope
1 - frequency counter
1 - volt meter

A) Connect for Remote Operation with 5613 Std.

1) **Adjust 1 V range**: Input ±1 V at 100 kHz. Use C17 & C18 to get desired overshoot to less than 5%.* If ringing or oscillation occurs when changing ranges, adjust C21.

2) **Adjust 100 V range**: Input ±100 V at 1 kHz. Use CV1, C9, C10 & C13 to get a flat square wave.

3) **Adjust 10 V range**: Input ±10 V at 1 kHz. Use C9 & CV1 to get flat square wave.

4) **Recheck 100 V range** for proper square wave. *Go back and forth between 10 V & 100 V ranges until they are both relatively flat.

5) **Check 100 V range**: Input ±100 V at 100 kHz. Check for overshoot less than 5%. Use CV1, C9, C10 & C13.

6) **Adjust 50 V range**: Input ±50 V at 1 kHz. Check for flat square wave. Input ±50 V at 100 kHz. Use C19 to adjust overshoot to less than 5%.

7) **Adjust 20 V range**: Input ±20 V at 1 kHz. Check for flat square wave. Input ±50 V at 100 kHz. Use C14 to adjust overshoot to less than 5%.

8) **Adjust 10 V range**: Input ±10 V at 100 kHz. Use C17 & C18 to adjust overshoot to less than 5%. If adjustment is needed, recheck all prior ranges.

9) **Adjust 5 V range**: Input ±5 V at 100 kHz. Use C19 to adjust overshoot to less than 5%. If adjustment is needed, recheck 50 V range before continuing.

10) **Adjust 2 V range**: Input ±2 V at 100 kHz. Use C14 to adjust overshoot less than 5%. If adjustment is needed, recheck 20 V before continuing.

11) **Adjust 1 V range**: Input ±1 V at 100 kHz. Check for overshoot less than 5%. This should still be correct from step number 1.

12) **Adjust 0.5 V range**: Input ±0.5 at 100 kHz. Use C19 to adjust overshoot less than 5%. If adjustment needed, recheck 50 V & 5 V ranges.
(13) **Adjust 0.2 V range:** Input ±0.2 V at 100 kHz. Use C14 to adjust overshoot to less than 5%. If adjustment is needed, recheck 20 V & 2 V ranges.

**B) Connect DC Voltage Standard to Input of 3512. Switch to Local Mode at Setting #8**

1. With input at 0.0 V, use voltmeter to adjust R33 center pin (wiper) to 0.0 V ±100 mV.
2. With input at 0.0 V, use frequency counter connected to TP4, adjust R31 to get 9.000 MHz.
3. Input 1 V, use R32 to get 8.00 MHz.
4. Input -1V, check for 10 MHz.

**C) Connect a Sinewave to the Input (Stay in Local Mode)**

1. Input ±0.2 V at 100 kHz. Go to local mode setting ‘A’ and check for 3 db drop as you sweep up to 700 kHz minimum (1 MHz maximum).
2. Input corresponding voltages and check all other ranges as in step #1 with corresponding switch settings.
3. For increased bandwidth adjust C17 & C18. This will increase overshoot.

5612 Orientation Drawing (for ECO level 2010 and below)
5613 TEST PROCEDURE

Equipment

Generator(s) capable of providing:
- 100 kHz square wave 1 V amplitude
- 8 to 10 MHz square wave TTL level, e.g. Wavetek 148

Oscilloscope >10 MHz
100 micrometer fiber with Amphenol connectors. Two lengths of 100 m.
Frequency meter 10 MHz 6 digits
True RMS voltmeter (10 Hz to >1 MHz) e.g. HP 3400A or Fluke 8920A
NIM bin
5-digit DVM
Photodyne 1500XP waveform analyzer
Two Correctly set up 5612s
A LeCroy Model 5310T and connector
A LeCroy Model 1927 CAMAC tester
Test cables

Initial Check

Connect the 5613 to the NIM bin via a cable or a 1927 with provision for measuring supply currents.

Check for:
- +6 V 600 to 900 mA
- +24 V 100 to 120 mA
- -24 V 100 to 120 mA

DIGITAL BOARD (5613-1)

Manual Control

Press both “transmitter” switches down and check that the only LEDs lit are the two red “OFF” lamps.

Press both “transmitter” switches up and check that the two green “ON” LEDs are lit and that one of the range/calibration LEDs is lit in each channel.

Check that pushing the range switches up causes the lit range/calibration LED to step to the 100 V position and to stop there. Check that pressing the switches down causes the lit LED to step down to the -1 V calibration position.

No LEDs should fail to light.

Couple each FO output in turn to a 5612 switched to its remote mode and check that it can be turned on and off by using the 5613 on/off switches, e.g. measure its +12 V supply current.

Switch the range and check that all range commands are correctly received. (See Table 1). Repeat for the other FO output.
CAMAC Control

Using the LeCroy Model 1927 or a CAMAC test system check the following commands.

<table>
<thead>
<tr>
<th>CAMAC Commands</th>
<th>Result expected at 5613</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z or C</td>
<td>Both transmitter OFF LEDs lit. Switch both channels on manually, 100 V range should have been set.</td>
</tr>
<tr>
<td>F(16)+A(0)+W</td>
<td>Should set range LED of Channel A to range W (see Table 1).</td>
</tr>
<tr>
<td>F(0)+A(0)+R</td>
<td>R should equal range set on Channel A.</td>
</tr>
<tr>
<td>F(16)+A(1)+W</td>
<td>Should set range LED of Channel B.</td>
</tr>
<tr>
<td>F(0)+A(1)+R</td>
<td>R should equal range set on Channel B.</td>
</tr>
<tr>
<td>F(24)+A(0)</td>
<td>Should set Channel A transmitter OFF.</td>
</tr>
<tr>
<td>F(24)+A(1)</td>
<td>Should set Channel B transmitter OFF.</td>
</tr>
<tr>
<td>F(26)+A(0)</td>
<td>Should set Channel A transmitter ON.</td>
</tr>
<tr>
<td>F(26)+A(1)</td>
<td>Should set Channel B transmitter ON.</td>
</tr>
<tr>
<td>F(0)+A(2)+R</td>
<td>Bit R1 should indicate status of transmitter A (1 = ON). Bit R2 should indicate status of transmitter B (1 = ON).</td>
</tr>
<tr>
<td>F(6)+A(0)+R</td>
<td>R should read 12755 (octal). (Set the DIL switches on 5613-1 board if necessary, see Figure 3.)</td>
</tr>
</tbody>
</table>
LAM Tests:

Send Z then F(26)+A(2)
Send F(8)+A(0) and verify that no Q returns.
Operate all four panel switches in turn and verify that the green 'L' LED turns on for each switch. Send F(10)+A(0) after each operation to turn the LED off again.

Verify that F(8)+A(0) returns Q when the 'L' LED is lit.

Send F(24)+A(2) and verify that switch operations no longer light 'L'.

Send F(8)+A(0) and verify that no Q returns.
Send F(10)+A(0).
Send F(0)+A(2) and check that Bit R3 and R4 of the response are zero. Operate either switch on Channel A.
Send F(0)+A(2) and check that Bit R3 is set.
Operate either switch on Channel B.
Send F(0)+A(2) again and check that Bit R4 is now set.

Send F(0)+A(0) and check that X returns.
Send F(1)+A(0) and check for no X.
Send F(0)+A(3) and check for no X.

Optical Output

Connect 100 m of 100 micrometer fiber to each FO output in turn.
Connect its other end to the Photodyne 1500XP and look at the output waveform.

Switch each transmitter on and check the output waveform. A mixture of sine waves should appear.

The peak height should be ~ 20 mW and the minimum should not be clipped.
**ANALOG BOARD (5613-2)**

**DC Calibration**

Connect the input of the 5310T to a pulse generator set to give a TTL level square output. Couple the output of the 5310T to one of the optical inputs on the 5613.

Connect the DVM to Test Point 1 (see Figure 4).

Set the generator to give 9.000 MHz ±0.001 MHz.

Adjust the zero trimmer of the optical receiver to give 0.00 V ±0.01 V on the DVM.

Set the generator to 8.000 MHz and adjust the Gain trimmer to give +1.00 V ±0.01 V on the DVM.

*Figure 4*
Connect the DVM to the appropriate output socket.
Set the generator to 9.000 MHz.
Adjust the zero trimmer to give 0.000 +0.001 V on the DVM.
Set the generator to 8.000 MHz and adjust the output gain trimmer (VR1) to give 2.000 V. Repeat 9.000 MHz and 8.000 MHz adjustments until the output reads 0.000 V and 2.000 V.

Repeat the procedure for the other channel.

**NOTE:** The Test Procedure for the 5613 MOD 100, 200, 201 and 300 are the same as a standard 5613, with the exception of the modifications gain. Therefore, the 8.000 MHz adjustment would be 2.000 V times the gain of the modification.

**AC Compensation**
Apply a 1 V p-p 100 kHz square wave to the input of the 5612.
Set the 5612 to range 8, local mode. Couple its output to one of the optical receiver inputs on the 5613-2 board. Connect the oscilloscope to the appropriate output connector.
Adjust VC1 and VC2 to give a level response with 500 nsec rise time or less, and 3% overshoot. (A slight dip after the peak of the leading edge seems to be a feature of the optical receiver.)
Check with sinewave (1 V p-p) that -3 dB bandwidth is 700 kHz or more.
Repeat for the second channel.

**Output Level Check**
Apply a +1 V 10 kHz triangular signal to the input of the 5612.
Switch the 5612 to range 8.
Connect a 50 Ω load to the output of the 5613.
Check that the output shows +1.00 V.
Increase the input until clipping occurs.
The output should be at least +1.25 V before this happens.

**System Noise Check**
Couple 5612 outputs to the FO inputs of the 5613 and turn the 5612 on.
Connect the output of channel A to the true rms voltmeter with a 50 Ω input impedance.
Switch the rms voltmeter to 5 mV and read the noise voltage. If less than 2.5 mV, the unit is acceptable (2.5 mV rms noise corresponds to a rms signal to rms noise ratio of 283 (=49 dB).
Proceed with channel B.

**5613 MOD 100**
The 5613 MOD 100 differs from the standard 5613 in the following:

1. System gain is 1.25 times higher; and
2. Maximum output voltage swing is 1.25 times higher than for the standard 5613.

For example, if the user applies a 1 V signal to the 5612 and selects the 1 V range, the standard 5613 will output a 1 V signal whereas the 5613 MOD 100 will output 1.25 V.
To convert a standard 5613 into a 5613 MOD the setting of the gain adjustment trim resistor R8 (located near the output amplifier) must be changed to give 25% more gain (one trim resistor for each channel).

To convert a 5613 MOD 100 into a standard 5613 the setting of the gain adjustment trim resistor R8 must be lowered to give 25% lower gain.

Whenever the gain setting is changed the link should be checked for correct pulse and frequency response. If necessary, a correction of any misadjustment can be made by adjusting the frequency response trim capacitors C4 and C11 (1 pair for each channel).

5613 MOD 201

The 5613 MOD 201 employs a modified receiver module to allow a maximum signal swing of + V (20 mA) into high impedance (>250 Ω). This option allows the 5613 to be used with the 8210 transient recorder modules.

Note that with this modification the 5612/5613 MOD 201 combination now has a gain of 5. An example of this would be if the user applied a +1 V signal to the input of the 5612 and set the 5613 to the +1 V range, the output of the 5613 would be +5 V.

The 5613 MOD 201 has cable fault detection whereas, if the input fiber optic cable were to be broken or transmission were to be interrupted, the output of the 5613 MOD 201 would go to +12 V DC. This capability will be available in 5613 modules which were produced after July 1, 1988.

5613 MOD 300

The 5613 MOD 300 employs a modified receiver module to allow a maximum signal swing of +10 V (10 mA) into high impedance (>1K Ω). The 5613 MOD 300 has cable fault detection capabilities. Whereas, if the input fiber optic cable were to be broken or transmission were to be interrupted, the output of the 5613 MOD 300 would go to +12 V DC. This capability will be available in 5613 modules which were produced after July 1, 1988.

Note that with this modification the 5612/5613 MOD 300 combination now has a gain of 10. An example of this would be if the user applied a +1 V signal to the input of the 5612 and set the 5613 to the +1 V range, the output of the 5613 would be +10 V.

MATING OF FIBER OPTIC CABLES

The mating end of an Amphenol 906 connector has a smaller diameter than the body of the connector. This is intended to locate the plastic sleeve which is used to align the connector with the mating part.

When two fibers are connected using two 906 connectors and a matching barrel connector, a single long sleeve must be used. When the connection is unmated, the sleeve may remain attached to either of the mated connectors. When reconnecting the fiber, care must be taken to ensure that the two connectors share one and only one sleeve. Since it is difficult to tell if the connector inside the barrel has retained a sleeve the safest procedure is to fit a sleeve to the free connector and attempt to mate it. If it fits, all is well. If it fails to mate there is a sleeve already in
the barrel, and the one on the free connector should be removed by
gripping it firmly with the fingers and twisting it off. Nearly all LeCroy
fiber optic transmitters use LED’s fitted with pigtails and hence the output
connector is of this double-ended barrel type and uses the long sleeve.

When the end of a fiber is coupled directly into a detector diode or to a
surface emitting LED the incoming fiber is aligned by a short plastic
sleeve which covers the tip of the 906 connector but does not extend
beyond it. This sleeve may remain within the panel connector when the
free connector is unmated. If a second sleeve is then fitted to the
connector and the connector screwed in considerable damage can be
done to the detector diode. Care should always be taken to ensure that
only one sleeve is being used; 906 connectors can be used without this
sleeve but poorer optical coupling will result.

The Amphenol 905 series connectors do not use plastic sleeves for
alignment but are only intended for use with 200 micrometer fiber.
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