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Large Dynamic Range Amplifier

13 AMP 003

Operator's Manual

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MELLES GRIOT

Large Dynamic Range Amplifier

13 AMP 003

Operator's Manual

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1 LARGE DYNAMIC RANGE AMPLIFIER OPERATION GUIDE

1.1 General Description

The Large Dynamic Range Detector Current Amplifier is a compact, general purpose battery operated amplifier intended for use with photoconductive and photovoltaic detectors that require the "transimpedance" configuration. The unit converts current signals from a detector to a voltage while maintaining a constant zero bias across the detector independent of the signal. Nine gain settings from 1 gigohm to 10 ohms permit processing of signals from as low as 1 picoamp to 100 milliamps. The unit has a 3 1/2 digit DVM that provides direct readout of the amplifier in addition to range setting and battery status. Other features include offset adjustment to null background readings, a BNC signal monitor for utility purposes and a rear panel banana jack connection to case ground. Replaceable AA size NiCad batteries provide a minimum of 8 hours of portable operation. The amplifier may also be operated from a wall mounted plug-in power supply while simultaneously charging the batteries.

1.2 Front Panel Controls & Inputs

1.2.1 RANGE Switch

The RANGE switch allows selection of maximum full scale input current of either polarity in nine ranges. The input current ranges are arranged in descending orders of magnitude from the counter clockwise position towards the clockwise stop. Note that the scale is also 'grouped' into mA, uA, and nA bands. While the unit is fairly tolerant of overrange conditions, it is best to begin measurements with the RANGE switch set on the '100 mA' scale to start with in order to avoid possible damage to the transimpedance amplifier inputs when initial input current magnitudes are unknown.

1.2.2 Offset Adjustment

This adjustment is intended to serve as a 'background null' adjustment. It will provide full scale offsets of either polarity from the 2 nA range through the 2 mA range inclusive. Offset adjustment capabilities are also provided for both the 20 mA and 100 mA ranges, but are limited to approx. 2 mA for both ranges. In order to 'zero' the instrument to obtain accurate readings of input currents, turn the unit on and adjust the control. Note that the Offset Adjustment maintains a <u>percentage</u> of full scale value between the ranges when adjusted .. i.e. if the Offset

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Adjustment is set to 5.74 uA with the RANGE switch on the 20 uA position, selecting the 2 uA position will result in .574 uA of offset current (plus or minus 1%), and switching to the 200 uA position will change the relative offset to 57.4 uA of offset current.

1.2.3 Signal Input

This BNC connector accepts the input current to the unit. The outer barrel is connected to the amplifier circuit ground (and the case of the unit); the center is connected to the input of the transimpedance amplifier and is a 'virtual ground'. Bias voltage at this input is a function of the amplifier used in the transimpedance configuration, and is typically 0.3 mV.

1.2.4 Monitor Output

The Monitor Out BNC provides an analog voltage output where (plus or minus) two volts represents full scale output of the range selected. For example, if the RANGE switch is on the "20 uA" position, 1.999 volts represents 19.99 microamps of current; if the RANGE switch is on the "2 mA" position 1.999 volts would represent 1.999 milliamps of current. The output is intended to serve as a method of connecting to an oscilloscope or similar monitor in order to observe A.C. as well as D.C. characteristics of the input current. Note that under most circumstances, this output will operate without clipping to about 2.5 volts (the LCD display will overrange at 2 volts).

1.3 Front Panel Digital Readout

1.3.1 Annunciators

The LCD readout will display "mA" in the lower right hand corner when gain resistors 10^1, 10^2, and 10^3 are selected, "uA" when gain resistors 10^4, 10^5, and 10^6 are selected, and will extinguish when "nA" (gain resistors 10^7, 10^8, and 10^9) is selected. In addition, the decimal points will switch as appropriate through the ranges to indicate "1.234", "12.34", and "123.4" as appropriate to the full scale range selected.

In addition to the above annunciators, a "LO BAT" annunciator will appear in the upper left hand corner of the display whenever one or both of the battery packs has discharged to 25% or less of their useful capacity. When this happens, the displayed value as well as analog output may no longer be accurate. The unit's accuracy may be

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restored by plugging in the external AC power source at that time. See section 1.5.1 for more information regarding this.

1.3.2 Numeric Readout

The numeric readout displays the actual value of the input current (the D.C. voltage at the Monitor Output divided by the gain resistor selected). The LCD display itself is basically a 3 1/2 digit self-contained Digital Panel Meter. Since the display circuitry only updates readings about 3 times per second, the displayed value is not an accurate reflection of any A.C. components of the input current. Instead, the reading reflects the D.C. component of the input current plus (or minus!) the average of any A.C. component. It is recommended that an oscilloscope or similar instrument be used in conjunction with the Detector Current Amplifier if A.C. considerations are important to the measurements being taken.

1.4 Rear Panel Inputs

1.4.1 External Power Input

A "standard" (.080 tip) receptacle is provided on the rear panel to plug the A.C. wall-mounted power source into in order to recharge the battery packs and/or run the instrument from A.C. power. Either U.S. or European power sources are provided with the instrument, depending on the model ordered. The input power source to the Amplifier MUST be A.C. If a D.C. source is plugged into the unit within the voltage ratings given (12 - 18 volts), the unit may appear to operate properly, but will eventually fail. It is reassuring to note, however, that no permanent damage to the unit should occur if this does happen.

1.4.2 Case Ground Banana Jack

The A.C. supply mentioned in section 1.4.1 "floats" ... i.e. it is NOT earth grounded. If an earth ground is desired, the "CASE GND" banana jack may be used, which will apply an earth ground to the case (as well as circuitry ground) of the Amplifier. The unit was designed this way to allow flexibility in grounding arrangements.

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1.5 Rechargeable Batteries

1.5.1 Charging considerations

The AA NiCad batteries provided with the unit will initially provide more than 16 hours of use. Over time, all NiCad batteries will lose capacity to store a charge, and eventually the batteries will need to be replaced. The batteries shipped with each Amplifier unit are considered "new" (they have been tested through one or two complete charge/discharge cycles).

The amount of time required to completely charge the battery packs will vary with the amount of charge remaining in each pack when a charge is initiated. If the batteries are completely "flat", this will require 14 hours. It is recommended that the batteries be allowed occasionally to become fully discharged -- this helps extend the shelf life of the cells.

When the "LO BAT" indicator appears on the LCD display of the Amplifier, one or both battery packs have less than 25% of their useful capacity remaining. At this point, the A.C. adaptor may be plugged into the back of the unit to recharge the packs. The unit may be used while recharging the packs. Leave the charger plugged in for 14 hours: whether the unit is turned on or not is not important. Immediately upon plugging the A.C. source into the unit, the "LO BATT" annunciator should disappear, indicating that the circuitry has enough voltage to maintain accuracy. The A.C. adaptor may be used continuously, if desired, even when the batteries are fully charged. Note, however, that there will be an increase in the input referred noise levels, due to increased noise levels on the circuitry power caused by the voltage regulators used in the unit.

It is possible to use the Amplifier with input currents exceeding 100 mA for brief periods. ("Brief" is relative to the amount of input current in excess of 100 mA and the condition/charge of the battery packs.) Should the output current capability of the charger be exceeded, and the battery pack(s) be low, the "LO BATT" annunciator will again appear on the display. Whenever the "LO BATT" annunciator is visible, the indicated readings may not be accurate.

1.5.2 Replacing batteries

DO NOT use batteries other than rechargeable NiCads. As with any other battery-operated product, doing so can result

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in damage to the unit, especially when the charger is plugged in (alkaline batteries can leak or even explode if subjected to a "charging").

In order to replace batteries, remove the four corner screws securing the rear panel of the Amplifier to the case and slide the rear panel and printed circuit board straight out of the unit noting which 'slot' the board is located in for replacement. If it becomes necessary to unplug the connector from the printed circuit board, note the orientation of the connector before removing it. All batteries are installed with the "-" end contacting the spring in each holder.

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