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INSTRUCTION MANUAL

MODEL LDX-3207
PRECISION CURRENT SOURCE

August 8, 1986

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Bozeman, Montana, U.S.A.
406/586-1244

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This warranty does not apply to fuses, lamps, or batteries or to defects caused by abuse, modification or use of the product for which it was not intended.

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Before returning an instrument, obtain a return authorization number from the factory. The instrument should be shipped in the original packing carton or one that will provide equal protection. Shipping damage is not covered by this warranty. Send the instrument, transportation pre-paid to the factory, referencing the return authorization number. Repairs will be made and the instrument will be returned, transportation pre-paid. Repairs are warranted for the remainder of the original warranty or for 90 days, whichever is greater.

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CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains operation and maintenance information for the LDX-3207 Precision Current Source and optional Model 1205 GPIB/IEEE-488 Interface. If you want to get started right away you may want to skip to Chapters 2 and 3 which cover Operation and Remote Programming.

1.2 PRODUCT OVERVIEW

The LDX-3207 is a precision current source optimized for driving laser diodes and LEDs with an output range of 0 to 200 mA and a compliance voltage of 5 volts. Multiple built-in protection features ensure that the supply output is transient free and bounded under all conditions. The output level of the 3207 is controllable in three modes: (1) manually via a 10-turn precision control knob, (2) through an analog voltage control/modulation port, and (3) remotely via the optional model 1205 GPIB/IEEE-488 Interface.

Features of the LDX-3207 include:

- Intuitive front panel layout
- Highly visible green LED display
- Display resolution of 0.1 mA
- Fully independent, precision current limit control
- DC - 100 KHz voltage control/modulation port
- Safe output off/on switch
- Audible and visual fault condition indicators

1.3 AVAILABLE OPTIONS AND ACCESSORIES

Options and accessories available for the LDX-3207 include the following:

DESCRIPTION	MODEL NUMBER
GPIB/IEEE Interface	1205
Rack mount flange kit	310
Rack mount, 1/2 width filler panel kit	324
Enclosure interlocking kit	330

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The 1205 interface permits GPIB bus control of the LDX-3207 making possible many automated test and measurement applications. For more information on this interface option see Chapter 3 on Remote Programming.

The LDX-3207 enclosure is a half-width, rack mountable module designed to be rack mounted either by itself or interlocked with other ILX Lightwave, X-series enclosure modules. The 300 series accessories listed above make possible rack mounting and interlocking of these enclosure modules.

1.4 SPECIFICATIONS

OUTPUT

OUTPUT CURRENT RANGE:	0 to 200 mA, floating.
COMPLIANCE VOLTAGE:	> 5 volts.
TEMPERATURE COEFFICIENT:	< 100 PPM/C ambient.
NOISE AND RIPPLE (@ 100mA output):	< 0.01 % rms, typical.

DISPLAY

TYPE:	3-1/2 digit LED display.
MAXIMUM READING:	199.9 mA.
ACCURACY (25 C):	+/- 0.1 mA.
TEMPERATURE COEFFICIENT:	< 100 ppm/C.

CURRENT LIMIT

RANGE:	0 to 200 mA.
ACCURACY:	+/- 1.0 mA, independent of output compliance voltage.

Current limit adjustment does not interfere with normal output operation (a dummy load is not required). Current limit setting takes precedence in all modes of operation.

MODULATION/VOLTAGE CONTROL

INPUT:	Differential input.
TRANSFER FUNCTION:	100 mA/V.
TRANSFER FUNCTION ERROR:	< 1%
BANDWIDTH (3db, Iout = 50 mA P-P):	DC to 100 KHz.

IEEE-488 BUS IMPLEMENTATION (with optional model 1205 interface).

GENERAL:	Implements talker/listener functions.
INTERFACE MESSAGES:	REN,DCL, LLO, GTL, SDC

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DEVICE DEPENDENT COMMAND STRUCTURE:

Command	Function
O0,O1	Switch output: 0=off, 1=on
Cnnn.nnn	Set output current to nnn.nnn mA.
B1	Beep.
G0	Get error status.

ISOLATION:	Instrument is optically isolated from IEEE-488 bus.
CONTROL RESOLUTION:	12 bits (0.05 mA).
CONTROL ACCURACY:	+/- 0.1 mA.

GENERAL

POWER REQUIREMENTS:	105-125V or 210-250V (jumper selectable), 50-60 Hz.
SIZE:	88 mm x 21 mm x 269 mm (3.46" x 8.36" x 10.6")
TEMPERATURE RANGE:	0 to 50 C operating, -40 to 70 C storage.
WARMUP:	1 hour to rated accuracy.
CONNECTORS:	Output, binding post (isolated from chassis ground), modulation input, BNC (differential input).

1.5 YOUR COMMENTS

Our goal is to make the best laser diode instrumentation available anywhere. To achieve this end we need your ideas and comments on ways we can improve our products. We invite you to contact us at any time with your suggestions.

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CHAPTER 2
OPERATION

2.1 INSTALLATION

2.2 AC Power Considerations

The LDX-3207 can be configured to operate at line voltages ranging from 105-125 VAC or 210-250 VAC. Normally, this is done at the factory and need not be changed before operating the instrument. However, check to be sure that the voltage printed on the rear panel of the instrument matches the power-line voltage in your area. Refer to Chapter 5 (Maintenance) if it is necessary to reconfigure the input voltage range.

WARNING

To avoid electrical shock hazard, connect the instrument only to properly earth-grounded, 3-prong receptacles. Failure to observe this precaution can result in severe injury or death in the event of an internal malfunction.

2.3 Tilt-Foot Adjustment

The LDX-3207 is supplied with special, extendable front legs. The front of the instrument can be tilted up for better viewing by rotating the legs downward until they snap into the down and locked position.

2.4 Rack Mounting

The LDX-3207 may be rack mounted singly by installing a rack mount flange on one side of the enclosure and a 1/2 width filler panel on the other side. Alternatively, two X-series enclosures can be interlocked side-by-side and then rack mounted as a unit by using a pair of rack mount flanges. Detailed mounting instructions are supplied with all rack mount accessory kits. Refer to Section 1.3 for applicable rack mount accessory part numbers.

2.5 LDX-3207 FAMILIARIZATION

2.6 Front Panel

Figure 2.1 shows the layout of features on the front panel. Generally you will find the LDX-3207 controls and features to be simple and intuitively easy to use. However, the following paragraphs provide descriptions of each front panel feature.

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AUDIBLE TONES:

Repeating 1 second tone indicates current limit condition.

Single 3 second tone indicates that an open circuit condition has occurred.

INSTRUMENT STATUS INDICATORS:

OPEN CKT Output is an open circuit or requires greater than 5 volt compliance.

LIMIT Output is in current limit mode.

LIMIT DISP Display is reading the current limit setting.

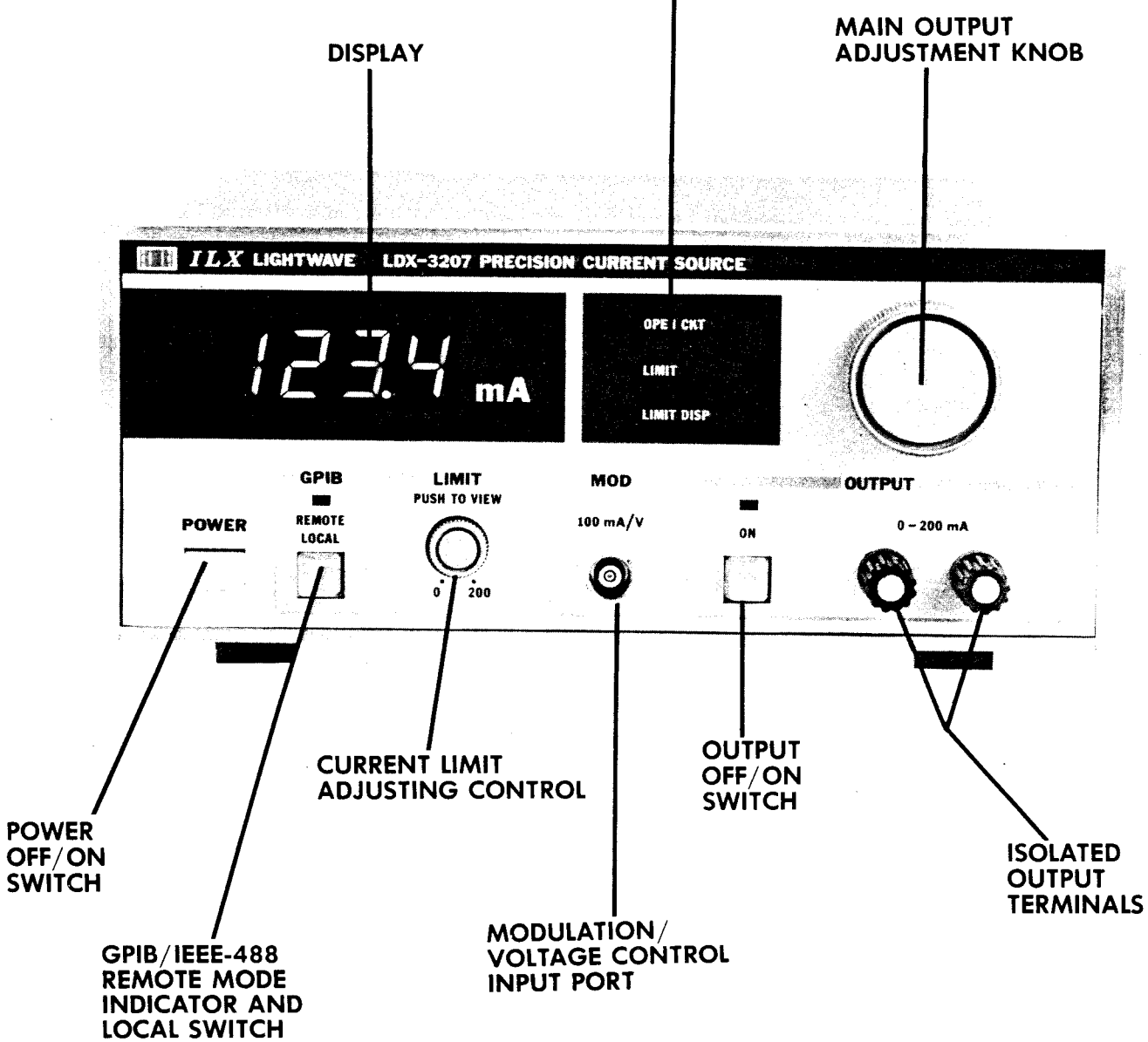


FIGURE 2-1 LDX-3207 FRONT PANEL LAYOUT

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2.7 Power-Up Sequence

With the LDX-3207 properly connected to an AC power source, pressing the POWER off/on switch causes the unit to initiate its power-up sequence. During this sequence the audible fault indicatior (beeper) will sound momentarily and the display may briefly indicate a non-zero reading. However, during this period the output terminals are unconditionally shorted and the output off/on switch is inhibited for several seconds preventing current from leaving the output terminals. After approximately two seconds the disply should read 0.0 mA.

2.8 Current Limit Adjustment

The front panel LIMIT control setting determines the maximum output current for all modes of operation. This current limit is set by rotating the LIMIT knob to the desired value. The current limit setting can be estimated by observing position of the knob indicator line relative to the 0 and 200 mA markings or determined precisely by momentarily depressing the knob. Once the LIMIT knob has been depressed, the display will read the current limit setting for approximately 5 seconds. During this 5 second interval the LIMIT DISP (limit display) indicator remains on.

The current limit setting is independent of the voltage drop of the device connected to the output of the 3207 and therefore no dummy load is required for precise adjustment of the current limit. Furthermore, since the current limit circuitry is fully independent of the main current control, the current limit can be adjusted safely even while the output is active.

2.9 Output Current Adjustment

Primary output current control is provided by the large knob located on the front panel of the LDX-3207. This knob is connected to a precision 10-turn potentiometer and can easily be used to achieve a setting resolution of 0.05 mA (or 0.02 mA with some care). Depending on whether the 3207 is in LOCAL or REMOTE mode, the output current is also affected by any control voltage applied to the MOD input connector and commands sent to the optional GPIB/IEEE-488 interface (when installed). Under all modes of operation the output current is unconditionally limited to the value set by the LIMIT adjustment.

Local Mode - When initially turned on the LDX-3207 is in LOCAL mode. In this operating mode the output current is determined by the setting of the main output current adjustment knob and any control signal applied to the MOD input connector. The control level generated by the control knob is summed with the control signal applied to the MOD input. In effect the control knob acts as a DC bias (offset) adjustment to the signal applied to the MOD input.

Remote Mode - When the model 1205 GPIB/IEEE-488 interface is installed, the LDX-3207 may be operated in REMOTE mode. This

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mode of operation is activated in response to commands sent to the 3207 via the interface. Once in REMOTE mode, the output current level is determined by appropriate commands sent over the GPIB/IEEE-488 bus. For example, the command "C50.01" will cause the output of the 3207 to go to 50.01 mA to within the control accuracy of the interface. In this mode of operation the main current adjustment knob and MOD input are disabled. The 3207 may be returned to LOCAL mode by momentarily pressing the LOCAL button. For more information on the REMOTE mode of operation refer to Chapter 3.

2.10 Output Connectors

The front panel output connectors supplied with the LDX-3207 are two standard binding posts on 0.75 inch centers. Current flows out of the red connector and returns via the black connector. These output connectors are fully floating with respect to the chassis ground.

2.11 Output Off/On Button

The output off/on switch is located just to the left of the output terminals and is used to turn the output of the 3207 off and on. When the output is active, the LED indicator just above the button is lit indicating that current is flowing from the positive to negative terminals. The off/on button has a toggling action: if the ouput is off, pressing it will cause the ouptut to come on, and vice versa.

When the ouptut is off, a low impedence shunt is active across the output terminals. In this state it is safe to connect or remove sensitive devices from the 3207 even though power supply itself is on. Turning the output on initiates a slow turn-on sequence that takes a few seconds to complete. During this period, the impedence of the internal shunt slowly increases diverting current through the output terminals.

When the 3207 is first turned on, the off/on button is inhibited for several seconds. This forces the internal, low impedence shunt to remain active across the output terminals until the 3207 control circuits are stabilized. Additionally, there are two other conditions that will automatically cause the output to reset to the off state:

Power Drop-outs - AC line power drop-outs lasting more than about 10 msec will trigger an internal power monitor and cause the output to switch unconditionally to the off state. This sequence is also initiated when the 3207 is switched off or unplugged.

Open Circuit - If the compliance voltage of the externally connected circuit exceeds about 6 volts, the output is switched to the off state and OPEN CKT indicator is activated. Most commonly this occurs when the output off/on button is pressed without a load attached. (See also Section 2.13)

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If either of these conditions occur, the output may be turned on again by simply pressing the front-panel output off/on switch.

2.12 Modulation/Analog Control Port

The modulation/analog control port provides a means of modulating the output current of the LDX-3207 with a 3 db bandwidth of DC through 100 KHz. Input connection is provided by an isolated BNC connector designated MOD on the front panel. This connector provides a true differential input and need not use the same ground and the output terminals. The only restriction is that the control signal applied to the MOD connector should be within approximately 12 volts of the output terminals.

Modulation/Analog Control Port
(MOD Input)

TRANSFER FUNCTION	100 mA/volt
CONTROL BANDWIDTH (3 db)	100 KHz
INPUT IMPEDENCE	1,000 ohms
INPUT POLARITY	center pin, POSITIVE shell, NEGATIVE

Any control signal applied to the MOD input summed with the control signal due to the main current control knob setting. The transfer function of the modulation/voltage control input is +100 mA/volt with the center pin of the input BNC connector being positive with respect to the shell. Thus, with the main current control knob set to 100 mA and a 0.5 volt input present at the MOD input, the resulting current output would be 150 mA.

The MOD input, like the main current control knob, is disabled when the 3207 is in REMOTE mode.

2.13 Fault Indicators

The LDX-3207 has two visual front-panel fault indicators, OPEN CKT and LIMIT, and an audible tone that are used to identify open circuit and current limit conditions.

OPEN CKT indicates that the compliance voltage required at the 3207 output terminals has exceeded approximately 6 volts. Most commonly this happens when there is no load attached to the output or the load becomes disconnected when the output is active. When an OPEN CKT condition occurs, the 3207 outputs is automatically turned off, the OPEN CKT indicator latches on, and a tone sounds for approximately 3 seconds. The OPEN CKT indicator will remain on until the ouput is turned on again either manually or via the GPIB/IEEE-488 interface.

LIMIT indicates that 3207 output is being limited to the setting of the front panel LIMIT knob. When a LIMIT condition occurs, the LIMIT indicator is lit and a tone is repeatedly

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sounded. Due to the unique design of the 3207, the LIMIT indicators are operative even while the ouput is off.

If the 3207 is repetitively driven into the current limit mode by a time varying signal applied to the MOD input, the LIMIT indicator will light and a tone will sound. The tone may sound continuous or intermittent depending on the frequency of the modulation signal. With the 1205 interface installed, the status of both the OPEN CKT and LIMIT indicators may be read back over the GPIB/IEEE-488 bus. For more information on this feature see Chapter 3.

2.14 GPIB Remote/Local Switch

The GPIB LOCAL switch is used to return the LDX-3207 to local control after it has been put in REMOTE mode via the GPIB/IEEE-488 bus. In REMOTE mode, both the main current control knob and the MOD input are disabled and the 3207 output may be controlled only via the GPIB/IEEE-488 bus. This control mode is available only when the optional model 1205 GPIB/IEEE-488 interface is installed. For more information see Chapter 3.

2.15 Rear Panel

The rear panel contains the AC power input connector, fuse holder, 9-pin D-connector, and serial number sticker. When the optional model 1205 GPIB/IEEE-488 interface is installed, the rear panel additionally contains the standard GPIB/IEEE-488 bus connector and address selector switch. Output current is available at the 9-pin D-connector, J104. With the 3154 Photodiode Feedback module installed, J104 is utilized for the photodiode input signal. If the LDX-3207 is utilized in a LDS-7000 system configuration, J104 also contains an interlock which will disable the current output unless defeated. See Section 2.18 for detailed information. For information on the fuse replacement see Section 5.7. For information regarding programming in preparation for using the GPIB/IEEE-488 interface see Section 3.3.

2.16 **WARM-UP AND ENVIRONMENTAL CONSIDERATIONS**

The LDX-3207 should be operated at an ambient temperature between 0 and 50 degrees centigrade. Storage temperatures should be in the range -40 to 70 C. In order to achieve rated accuracy the LDX-3207 should be allowed to warm up for about 1 hour before use.

2.17 **OPERATING INSTRUCTIONS**

2.18 Connecting to Your Device

When connecting laser diodes and other sensitive devices to the LDX-3207 we recommend that the 3207 should be powered-up with the output off. In this condition a low impedence shunt is active across the output terminals. When disconnecting devices it is only necessary to turn the output off.

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System Interlock and Photodiode Feedback

The 9-pin connector (J104) on the rear panel contains the current supply output and earth ground. With the 3154 Photodiode Feedback module installed, the photodiode signal is input at the connector. When the LDX-3207 is part of a system, then an interlock is incorporated at J104 and is defeated by internal wiring located inside the hood of the supplied interconnect cable. In standard units the interlock is internally defeated. If the interlock feature is required, please contact ILX Lightwave for information.

When the interlock function is to be utilized, then a switch must be wired across pins 1 and 2 of J104. To do this, open the cable hood located at the end which connects to J104. The connections are made across pins 1 and 2 of the cable connector. When the desired wiring has been installed, replace the hood on the cable. The switch must be electrically isolated from all other circuits including earth ground. Refer to Fig. 2.2 for more information. For detail on the 3154 Photodiode Feedback module, please refer to the enclosed manual.

2.19 Grounding Considerations

The outputs of the LDX-3207 are isolated from chassis ground allowing either output terminal to be grounded at the user's option.

2.20 General Operating Procedure

The LDX-3207 can be operated in several modes. The following operating procedure is applicable to most common usage.

1. Plug the 3207 into an AC power source supplying the correct voltage and frequency for your unit (refer to the rear panel serial number sticker for the correct ratings).

2. Turn on the 3207 and allow one hour warm-up period for rated accuracy operation.

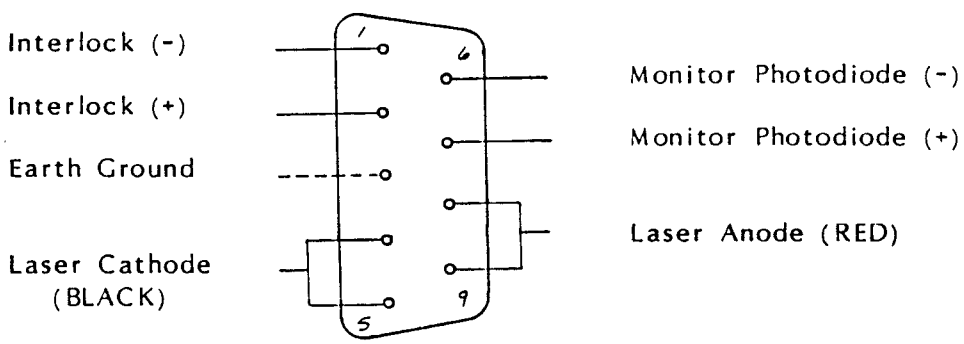
3. Momentarily depress the LIMIT knob and then adjust it to the maximum current that you wish to source.

4. With the output off, make the necessary external circuit connections. Double check to ensure that the correct polarity has been observed when connecting to laser diodes and other devices sensitive to being reverse biased.

5. Switch the output on and adjust the current to the desired DC level using the main current setting knob.

6. As needed, connect the modulation/control signal to the MOD input.
At any time during the operation of the 3207, the output current limit setting may be viewed by momentarily depressing the LIMIT

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LDX-3207 D-Connector Pinout (J104)

Fig. 2.2

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CHAPTER 3
REMOTE PROGRAMMING

3.1 INTRODUCTION

When properly installed, the model 1205 GPIB/IEEE-488 interface turns the LDX-3207 into a programmable current source for use with the IEEE Standard 488-1978 interface bus. This arrangement permits the LDX-3207 to be controlled by most computers and makes possible a wide variety of automated test and measurement applications.

To implement IEEE-488 bus control you will generally need to have an IEEE-488 interface adapter in your host computer. These adapters along with appropriate software are readily available from several manufacturers and for most popular computers. This manual assumes that you have a basic knowledge of the GPIB/IEEE-488 interface bus and its use for instrument control. However, if you need application assistance feel free to call ILX Lightwave at the number listed at the front of this manual.

3.2 CAPABILITIES

The model 1205 GPIB/IEEE-488 interface provides control of the LDX-3207 output current level with 12 bit (0.05 mA) resolution as well as control over the output off/on switch and audible tone. In addition, the instrument status (OPEN CKT, LIMIT, ON, REMOTE) can be read back over the bus. Other features include:

- A simple and predictable command set
- 35 msec command throughput
- Full local/remote capability including LOCAL LOCKOUT

In addition to several device dependent commands the 1205 interface supports the following interface messsages: REN, DCL, LLO, GTL and SDC.

3.3 PREPARATION FOR BUS CONTROL

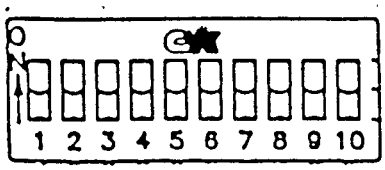
Once the 1205 interface has been properly installed in the LDX-3207 (see Section 6.3), the following steps should be taken to prepare the instrument for bus control:

1. Turn off the power to the LDX-3207 and set the GPIB/IEEE-488 interface address switch as shown in Figure 3.1. The address you choose should be different from that of any other instrument connected to the bus.

2. Plug the GPIB/IEEE-488 bus cable into the LDX-3207 rear panel connector and secure it with the plug-mounted screws.

3. Turn on the instrument.

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	SWITCH POSITIONS				
ADDRESS	1	2	3	4	5
00	0	0	0	0	0
01	1	0	0	0	0
02	0	1	0	0	0
03	1	1	0	0	0
04	0	0	1	0	0
05	1	0	1	0	0
06	0	1	1	0	0
07	1	1	1	0	0
08	0	0	0	1	0
09	1	0	0	1	0
10	0	1	0	1	0
11	1	1	0	1	0
12	0	0	1	1	0
13	1	0	1	1	0
14	0	1	1	1	0
15	1	1	1	1	0
16	0	0	0	0	1
17	1	0	0	0	1
18	0	1	0	0	1
19	1	1	0	0	1
20	0	0	1	0	1
21	1	0	1	0	1
22	0	1	1	0	1
23	1	1	1	0	1
24	0	0	0	1	1
25	1	0	0	1	1
26	0	1	0	1	1
27	1	1	0	1	1
28	0	0	1	1	1
29	1	0	1	1	1
30	0	1	1	1	1
31	--NOT ALLOWED--				

Figure 3.1. Bus Address Selector Switch Settings

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3.4 REMOTE PROGRAMMING PROCEDURE

In general the LDX-3207/1205 is programmed by simply sending it an ASCII string of characters that is comprised of one or more commands. A simple example would be:

"O1C50.2" In this example the 3207 output is turned on and the current set to 50.2 mA.

On receiving this command string the 3207 is placed in remote mode, the slow turn-on sequence is initiated (if the output is not already on), and the current level is commanded to go to 50.2 mA.

In order to insure that the 3207 has successfully executed these instructions it may be desirable to read back the status of the instrument. This can be accomplished using the G0 command:

"G0" Loads the instrument status into the interface output buffer.

Transmission of this command should be followed by execution of an instruction to read ASCII data from the interface. The interface will respond by sending a string of five ASCII characters that indicate whether or not the last command was understood and the status of the front panel indicators: OPEN CKT, LIMIT, ON, REMOTE. For example, the string 00011 indicates that the previous command was understood and executed and that the instrument is operating normally in remote mode with the output on. The G0 command is described fully in Section 3.7.

3.5 DEVICE DEPENDENT COMMAND SET

The complete LDX-3207/1205 device-dependent command set is summarized in Table 3.1 below. Each of the listed commands is described fully in Sections 3.6 through 3.9.

On receiving any of the device dependent commands the LDX-3207/1205 is placed in REMOTE mode.

TABLE 3.1
LDX-3207/1205 DEVICE-DEPENDENT COMMAND SET

B1	Triggers the audible tone in the LDX-3207
Cn	Sets the output current of the LDX-3207
G0	Loads the instrument status into the interface output buffer
On	Turns the LDX-3207 output off or on

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3.6 B1 (Beep Command)

On receiving the B1 command the audible tone in the 3207 is triggered. The duration of the tone is approximately 3 seconds.

3.7 Cn (Current Set Command)

The Cn command is used to set the output current of the LDX-3207 over the GPIB/IEEE-488 bus. The numeric field "n" following the command letter "C" may be formatted in a number of ways. The examples in Figure 3.2 illustrate both correctly and incorrectly formatted commands.

CORRECT	INCORRECT
C50	CB50
C123.11	C%100
C+25	C-25
c199.	

Figure 3.2. Cn Command Format Examples

Note that the numeric field itself must be an integer or decimal number that has a value in the range of 0 to 200.

Upon receiving a correctly formatted Cn command, the LDX-3207 will switch to remote mode (if it was previously in local mode) and produce an output current equal to the value of the numeric field in milliamps. That is, the command C25 will result in an output of 25.0 milliamps. If the Cn command is incorrectly formatted, the LDX-3207 will still switch to remote mode (if it was previously in local mode) but the remote mode output level will remain at its previously set level. Additionally, the software command error flag is set whenever a command is received that cannot be interpreted. This error flag may be read using the G0 command (see Section 3.7).

The 1205 GPIB/IEEE-488 interface has a 12 bit (0.05 mA) analog control resolution and an accuracy of 0.1% or better.

3.8 G0 (Get Instrument Status Command)

The G0 command is used to read the LDX-3207/1205 instrument status over the interface bus. Upon receiving the G0 command the 1205 interface switches the LDX-3207 to remote mode (if it was previously in local mode), reads the status of the internal software command error flag, the OPEN CKT, LIMIT, REMOTE, and ON front-panel indicators and then loads appropriate ASCII characters into an output buffer. The 5 character ASCII string generated by the G0 command may be read back over the bus by

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executing a read immediately after sending the G0 command. Figure 3.5 shows the interpretation of each of the characters in the returned ASCII string. See the example programs at the end of this chapter for illustrations of how the G0 command may be used.

After loading the 5 character ASCII string into the interface output buffer, the software command error flag is reset.

3.9 On (Output Off/On Command)

The On command is used to switch the LDX-3207 output off and on. Upon receiving the On command the LDX-3207/1205 switches to remote mode (if it was previously in local mode) and then switches the output off or on depending on the value of the numeric field "n". The On can take two forms as indicated below:

O1	Turns the output on
O0	Turns the output off

It is important to point out here that since the LDX-3207 has a turn-on sequence that takes approximately 3 seconds to complete, appropriate delays must be programmed into controlling software to avoid using the output during the turn-on sequence. In cases where it is only necessary to reduce the LDX-3207 output to zero (rather than actually shorting the output terminals) we prefer to execute a "C0" command rather than a "O0" command. In this case the LDX-3207 output can be rapidly increased again by simply executing another "Cn" command.

3.10 INPUT SYNTAX

This section describes the syntax rules for constructing device dependent command strings used to control the LDX-3207/1205. In general, a command string is formed by a series of individual commands followed by a terminator.

There are four recognized commands (see Sections 3.6 through 3.9), each composed of a letter followed by one or more numerics. The LDX-3207/1205 accepts alphabetic characters in either upper or lower case. Commands may be strung together into an ASCII string up to 30 characters long. Any characters beyond the 30th are truncated. Certain characters are ignored and may be included anywhere in a command string for clarity. These ignored characters are shown in Figure 3.3.

Space	" "
Back slash	"/"

Figure 3.3. Ignored Characters.

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A command string must be concluded with one or more input terminators. Acceptable input terminators are shown in Figure 3.4. Processing of the command string begins when the first input terminator is received.

Carriage return	[CR]	ASCII (013)
Line feed	[LF]	ASCII (010)
EOI	[EOI]	

Figure 3.4. Input Terminators.

Illegal commands and unrecognized characters (eg, O3) cause the software error flag to be set but are otherwise ignored. Examples of correct and incorrect command strings are given in Table 3.2.

3.11 OUTPUT SYNTAX

The LDX-3207/1205 loads the instrument status into the interface output buffer in response to a G0 command. The output is comprised of a string of five ASCII characters followed by an EOI. The interpretation of these characters is shown in Figure 3.5.

3.12 INTERFACE MESSAGES

In addition to the device dependent command set described above (Sections 3.6 through 3.9), the 1205 responds to a number of interface messages in order to participate in IEEE-488 bus communication. Programmers working with high level languages (like BASIC) generally need not be concerned with these messages since they are often handled by the internal software drivers. The interface messages understood by the 1205 are listed in Table 3.3. All of these messages originate at the controller.

3.13 EXAMPLE PROGRAMS

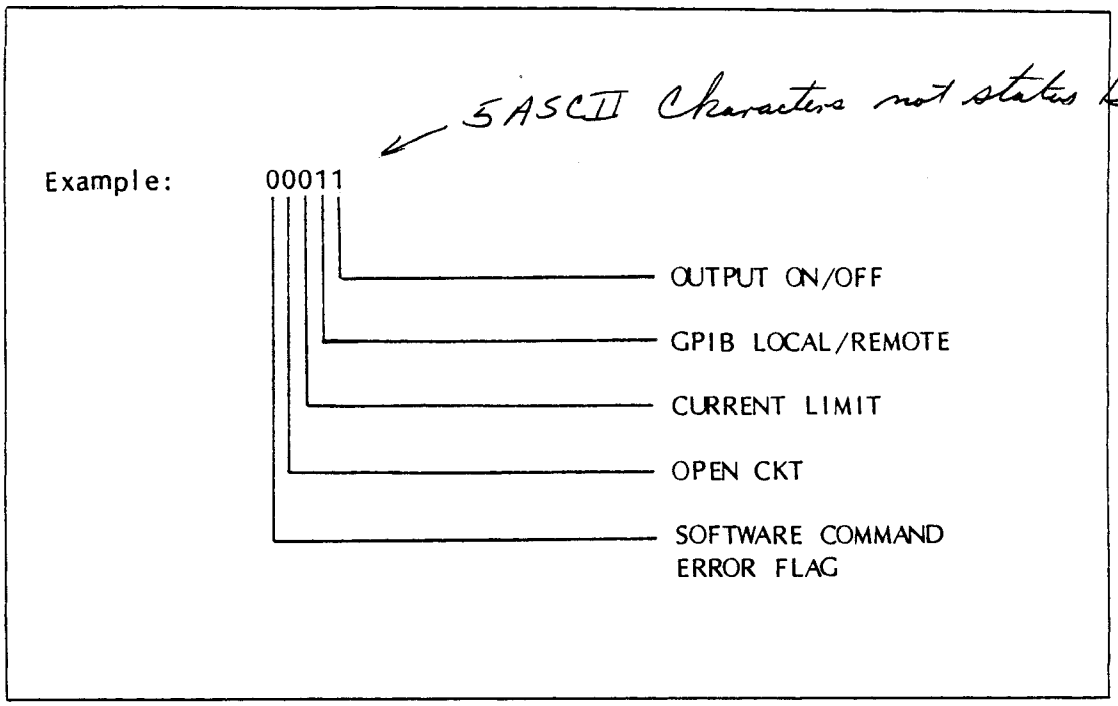
Two example programs are shown in Example 3.1 and 3.2. These programs exercise all of the remotely accessible LDX-3207/1205 features in the process of recording a laser diode's output vs drive current characteristic.

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TABLE 3.2. COMMAND STRING EXAMPLES

CORRECT COMMAND STRINGS	
O1C100[CR]	Turns the output on and causes the output to go to 100 mA. Note that if the output was previously off, the turn-on sequence will take approximately 3 seconds to complete.
c0c100c0[CR][LF]	Either upper or lower case alphabetic characters may be used. This command string results in an output current pulse approximately 35 msec long.
C+10 G0/[EOI]	Spaces (and back slashes) may be used within the command string for clarity. This command string causes the output to go to 10 mA and then loads the instrument status into the output buffer.
O1 C25.378 B1 [LF]	Causes the output to go to 25.378 mA (to within the resolution and accuracy of the interface) and then sound the LDX-3207/1205 internal beeper.
INCORRECT COMMAND STRINGS	
O1 @ C100 [EOI]	The '@' is an unrecognized character. When the '@' is encountered the software error status bit is set and processing continues normally.
C0 C100.0 C B1 [CR]	A numeric was expected following the third 'C'. The ommission of this numeric will cause the software error status bit to be set but processing will continue normally beginning with B1 command.
O1 B3 c10.011 [CR]	'B3' is an unknown command. When the B3 command is encountered the software error status bit will be set and processing will continue normally with the next command.
C1.00E-1 B1 [CR]	This command will cause the output to go to 1.00 mA followed by a beep. Although '1.00E-1' is often used as scientific notation to mean 0.100, the LDX-3207/1205 does not recognize this form of notation. In this case the 'E-1' is interpreted as an unrecognized command causing the software error status bit to be set.

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		N = 0	N = 1
OUTPUT	nnnnN	OFF	ON
GPIB LOCAL/REMOTE	nnnNn	LOCAL	REMOTE
CURRENT LIMIT	nnNnn	NOT ACTIVE	ACTIVE
OPEN CKT	nNnnn	NOT ACTIVE	ACTIVE
SOFTWARE COMMAND ERROR FLAG	Nnnnn	NOT SET	SET

Figure 3.5. Interpretation of the ASCII string generated in response to a G0 command.

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TABLE 3.3. INTERFACE MESSAGES

MLA	My Listen Address - Addresses the 1205 to listen.
MTA	My Talk Address - Addresses the 1205 to talk.
UNL	Unlisten - Addresses all devices to unlisten.
UNT	Untalk - Addresses all talkers to untalk.
ATN	Attention - A uniline message that instructs the 1205 to interpret a mulitline message as an interface message (as opposed to a device dependent command).
DCL	Device Clear - A multiline message that causes the 1205 to reset to its power-up configuration: output current set to 0.00 mA, mode set to local.
LLO	Local Lockout - A multiline message that disables all LDX-3207 front-panel controls except the LIMIT knob.
GTL	Go To Local - Causes the LDX-3207 to switch to LOCAL mode.
SDC	Selected Device Clear - Causes the 1205 to reset to its power-up configuration: output off, mode set to local. This command differs from DCL above in that it affects only the addressed interface whereas DCL affects all listeners on the bus.

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```
10 !                        * * *  LIDATA1  * * *
12 !
14 ! Program to measure and print light output vs current input for
16 ! a laser diode or LED.
18 !
20 ! An LDX-3207 is used to drive the emitter and the light output is
22 ! measured using a silicon photodiode driving a Fluke 8840A DMM in DC
24 ! current mode.
26 !
28 ! The GPIB bus addresses of the instruments must be set up as follows:
30 !
32 ! FLUKE 8840A          Bus Address:  1
34 ! LDX-3207            Bus Address:  2
36 !
38 ! This program is written in TBASIC (TBASIC is a trademark of the
40 ! TransEra Corporation, Provo, UT).
100 !
102 ! ================================== INITIALIZE PROGRAM PARAMETERS
104 !
106 Idmin = 0 !                          Set min drive current
108 Idmax = 70 !                         Set max drive current
110 Idinc = 2 !                          Set drive current step increment
118 !
120 Resp = 0.4 !                         Detector responsivity (A/W)
150 !
152 ! ================================== INITIALIZE OUTPUT/PRINT HEADER
154 !
162 CLEAR !                              Clear the screen
170 !
172 PRINT "          * * *  LASER/LED OUTPUT vs DRIVE CURRENT  * * *"
174 PRINT
176 PRINT "                    DRIVE CURRENT        OUTPUT"
178 PRINT "                        (mA)              (mW)"
180 PRINT "                    ============     ============"
200 !
202 ! ================================== INITIALIZE DMM AND CURRENT SOURCE
204 !
212 PRINT @1:"F5R1S1T2" !                Set DMM for the following modes:
214 !                                          F5     mA DC
216 !                                          R1     2000 mA full scale
218 !                                          S1     Medium rate
220 !                                          T2     External trigger
232 PRINT @2:"O1C0" !                    Set LDX-3207 as follows:
234 !                                          O1     Output on
236 !                                          C0     Output current = 0
240 !
242 FOR X = 1 TO 1000 ! NEXT X !         Wait for 3207 output turn-on
244 !                                    sequence to complete
300 !
302 ! ================================== TAKE DATA
304 !
312 FOR I = Idmin TO Idmax STEP Idinc !  Initialize current loop
320   !
322   PRINT TO C$ USING "3D.2DS":I !     Write I to an ASCII string
324   C$ = "C" & C$ !                    Append the "C" command character
330   !
332   PRINT @2:C$ !                      Send current level to LDX-3207
334   PRINT @2:"G0" !                    Command 3207 to load status bits
336   INPUT @2:A$ !                      Get instrument status bits
338   IF VAL(A$)<>11 THEN 950 !          Check instrument status
340   !
342   PRINT @1:"?" !                     Trigger DMM
344   INPUT @1:A$ !                      Read DMM
346   L = Resp*VAL(A$)*1000 !            Convert reading to milliwatts
400   !
```

Example 3.1. Remote Programming Example
Using TBASIC (TransEra Corp.).

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```
402    ! ================================ PRINT OUT RESULTS
404    !
412    PRINT USING "21X3D.2D,12X,3D.2D":I,L ! Print out results
500    !
502    ! ================================ DONE
504    !
512 NEXT I !                               Close loop
520 !
522 END
900 !
902 ! ================================== ERROR RETURN PROCESSING
904 !
950 !
952 SOUND "C" !                            Sound tone
954 PRINT "CURRENT SOURCE NOT READY." !    Print error message
956 END
```

Example 3.1. Remote Programming Example
Using TBASIC (TransEra Corp.) Cont'd.

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```
10 '                        * * *  LIDATA2  * * *
12 '
14 ' Program to measure and print light output vs current input for
16 ' a laser diode or LED.
18 '
20 ' An LDX-3207 is used to drive the emitter and the light output is
22 ' measured using a silicon photodiode driving a Fluke 8840A DMM in DC
24 ' current mode.
28 ' The GPIB bus addresses of the instruments must be set up as follows:
30 '
32 ' FLUKE 8840A          Bus Address:  1
34 ' LDX-3207            Bus Address:  2
36 '
38 ' This program is written in IBM DOS BASICA and uses the National
40 ' Instruments BASICA language interface software for the GPIB-PC2A
42 ' GPIB interface board.
50 '
52 '================================  INITIALIZE GPIB INTERFACE
54 '
55 ' The following code reads in and initializes the BASICA language interface
56 ' software.
57 '
58      CLEAR   ,60172!
60      IBINIT1 = 60172!
62      IBINIT2 = IBINIT1 + 3
64      BLOAD "\GPIB\BIB.M",IBINIT1
66      CALL IBINIT1(IBFIND,IBTRG,IBCLR,IBPCT,IBSIC,IBLOC,IBPPC,IBBNA,IBONL,IBRSC
,IBSRE,IBRSV,IBPAD,IBSAD,IBIST,IBDMA,IBEOS,IBTMO,IBEOT,IBRDF,IBWRTF)
68      CALL IBINIT2(IBGTS,IBCAC,IBWAIT,IBPOKE,IBWRT,IBWRTA,IBCMD,IBCMDA,IBRD,IBR
DA,IBSTOP,IBRPP,IBRSP,IBDIAG,IBXTRC,IBRDI,IBWRTI,IBRDIA,IBWRTIA,IBSTA%,IBERR%,IB
CNT%)
74 '
76      A$ = "DEV1"                         'Initialize bus address 1
78      CALL IBFIND(A$,BD1%)
80      IF BD1% < 0 THEN 920                'Check for error return
82 '
84      A$ = "DEV2"                         'Initialize bus address 2
86      CALL IBFIND(A$,BD2%)
88      IF BD2% < 0 THEN 920                'Check for error return
100 '
102 ' ================================= INITIALIZE PROGRAM PARAMETERS
104 '
106 IDMIN = 0 '                             Set min drive current
108 IDMAX = 70 '                            Set max drive current
110 IDINC = 2 '                             Set drive current step increment
118 '
120 RESP = 1! '                             Detector responsivity (A/W)
150 '
152 ' ================================= INITIALIZE OUTPUT/PRINT HEADER
154 '
162 CLS    '                                Clear the screen
170 '
172 PRINT "          * * *  LASER/LED OUTPUT vs DRIVE CURRENT  * * *"
174 PRINT
176 PRINT "                    DRIVE CURRENT         OUTPUT"
178 PRINT "                        (mA)               (mW)"
180 PRINT "                    =============     ============="
200 '
202 ' ================================= INITIALIZE DMM AND CURRENT SOURCE
204 '
210 A$="F5R1S1T2"
212 CALL IBWRT(BD1%,A$) '                   Set DMM for the following modes:
214 '                                           F5     mA DC
216 '                                           R1     2000 mA full scale
218 '                                           S1     Medium rate
220 '                                           T2     External trigger
```

Example 3.2. Remote Programming Example
Using BASICA (National Instruments Interface Software).

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```
230 A$="01C0"
232 CALL IBWRT(BD2%,A$) '                Set LDX-3207 as follows:
234 '                                           01      Output on
236 '                                           C0      Output current = 0
240 '
242 FOR X = 1 TO 1000 : NEXT X '          Wait for 3207 output turn-on
244 '                                     sequence to complete
300 '
302 ' ================================== TAKE DATA
304 '
306 GO$="G0"
308 TRIG$="?"
310 '
312 FOR I = IDMIN TO IDMAX STEP IDINC '   Initialize current loop
320   '
322   C$ = STR$(I) '                      Write I to an ASCII string
324   C$ = "C" + C$ '                     Append the "C" command character
330   '
332   CALL IBWRT(BD2%,C$) '               Send current level to LDX-3207
334   CALL IBWRT(BD2%,G0$) '              Command 3207 to load status bits
336   A$=SPACE$(5) : CALL IBRD(BD2%,A$) 'Get instrument status bits
338   IF VAL(A$)<>11 THEN 950 '           Check instrument status
340   '
342   CALL IBWRT(BD1%,TRIG$) '            Trigger DMM
344   A$=SPACE$(20) :CALL IBRD(BD1%,A$) 'Read DMM
346   L = RESP*VAL(A$)*1000 '             Convert reading to milliwatts
400   '
402   ' ================================ PRINT OUT RESULTS
404   '
412   IMAGE$="                        ###.##            ###.##"
414   PRINT USING IMAGE$;I,L '            Print out results
500   '
502   ' ================================ DONE
504   '
512 NEXT I '                              Close loop
520 '
522 END
900 '
902 ' ================================== ERROR RETURN PROCESSING
904 '
920 '
922 BEEP '                                Sound tone
924 PRINT "COULD NOT INITIALIZE DEVICE: "; A$
926 END
950 '
952 BEEP '                                Sound tone
954 PRINT "CURRENT SOURCE NOT READY." '   Print error message
956 END
```

Example 3.2. Remote Programming Example
Using BASICA (National Instruments Interface Software) Cont'd.

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CHAPTER 4
THEORY OF OPERATION

4.1 OVERVIEW

An overall functional block diagram of the LDX-3207 is shown in Figure 4.1. The fundamental current path is along the right-hand side of the figure, flowing from top to bottom. When the output is active, regulated current is produced in the current source and is then either dumped to ground or diverted to the positive output terminal. The precise amount of current flowing though the output terminals is determined by the lower, precision current sink. The output is switched off and on by an FET switch in parallel with the output terminals. When the output is off, the FET is "on", causing the current to bypass the outputs. This arrangement of current source, sink and FET shunt switch provides current control redundancy, precision current limit capability, and transient-free operation.

The amount of current sourced by the upper current source is determined by the current limit setting. This current always flows except briefly when the compliance voltage of the supply is exceeded. Current leaving the current source can: (1) pass through the output terminals, (2) bypass the output terminals via the FET switch, or (3) dump to ground bypassing both the FET switch and output terminals.

Control of the precision current sink depends on the operating mode of the LDX-3207:

> LOCAL MODE - In this mode the amount of current entering the precision current sink depends on the sum of the control setting of the main current set control knob and the control signal derived from the modulation input port.
>
> REMOTE MODE - In this mode the amount of current entering the precision current sink depends on a control signal originating at the optional 1205 GPIB/IEEE-488 interface.

In either case the maximum amount of current available to the precision current sink is limited to the current being produced by the upper current source.

4.2 INTERNAL POWER SUPPLIES

The internal power supplies include an unregulated 12 volt supply for the current source and +15, -15, and two +5 volt regulated supplies for the internal analog and digital circuitry. The extra +5 volt isolated supply is used by the 1205 GPIB/IEEE-488 interface board when it is installed. Since all I/O lines to and from the interface board are optically isolated, this allows the LDX-3207 ground system to remain floating with respect to the GPIB bus.

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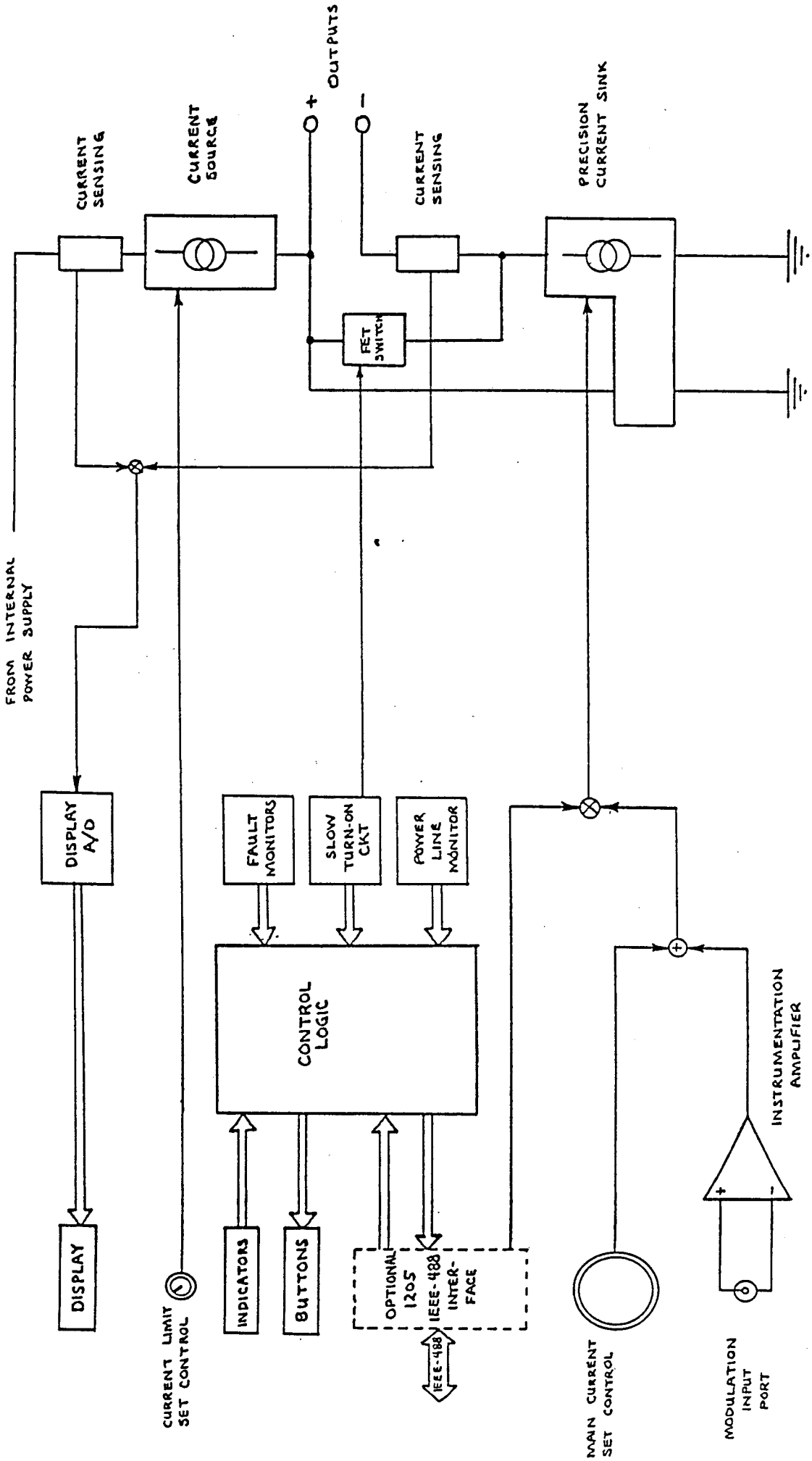


Figure 4.1. LDX-3207 Functional Block Diagram

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The +15 and -15 volt supplies use a conventional full-wave, center-tapped bridge rectifier (B1) arrangement followed by three-terminal regulators (U1,U2). Similarly, each of the +5 volt supplies is based on a conventional full-wave bridge rectifier (B2,B3) followed by a three-terminal regulator (U3,U4). The main +5 volt supply shares the same bridge rectifier used by the current source (B2) although each is supplied by a separate filter capacitor (C5,C6).

Transient protection begins with a line filter (Z1) at the power entry point. A filter capacitor (C42) across the transformer primaries eliminates transients that would otherwise arise when the line power is switched on and off. Additionally, the power transformer (T1) is wound on a split-bobbin minimizing capacitive coupling from the transformer primaries to secondaries.

4.3 CURRENT SOURCE

The internal current source is formed by U5, Q3, and R5. Current flowing through R5 is sensed and compared to a reference level set by the position of the front-panel current limit knob. U5 drives the base of Q3 to maintain the current source output level at the desired point. R5 also acts as the current sensing resistor for the limit current when the LIMIT DISP mode is active.

The voltage across R5 is sensed by the differential input amplifier formed by N1 and U10. The output of this amplifier is sampled by the front-panel display A/D converter when the LIMIT DISP (limit display) mode is active. This mode becomes active when the front-panel current limit knob is momentarily pressed closing S5 and triggering a 5 second control pulse generated by U26. This control pulse is level shifted by comparators in U12 which in turn drive the analog switch U9 connecting the display A/D converter to the output of U10.

4.4 PRECISION CURRENT SINK

The precision current sink is formed by U7, Q1, R11, and R12. Amplifier U7 compares the voltage produced by the current sensing resistors R11 and R12 to a control voltage at its inverting input and drives the gate of Q1 to ensure that these voltages are equal. Depending on the operating mode of the LDX-3207, the control voltage is derived either from the setting of the main current control knob summed with and control signal present at the MOD input or from the optional 1205 GPIB/IEEE-488 interface board (when installed).

LOCAL MODE - In this mode the control signal comes from summing amplifier U6. This amplifier sums control signals derived from the main current control knob and from the MOD input via an instrumentation amplifier (see also Section 4.6).

REMOTE MODE - In this mode the control signal comes from the 1205 GPIB/IEEE-488 interface board via a calibration trim network formed by R34, R35, and R36.

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4.5 OUTPUT OFF/ON SWITCH

Output off/on switching is accomplished by a JFET (Q2) which shunts the output terminals. When the gate of Q2 is near ground potential the FET channel resistance is low, causing current to bypass the output terminals, effectively shutting off the output. Even though a small on-state drain-source voltage will exist across Q2 (due to its finite on resistance), diodes D7, D8, and D18 ensure that no current flows through the output terminals.

The gate of Q2 is tied to ground through a large capacitor C18. In order to turn the outputs on, Q2 must be biased off by charging C18 to at least -8 volts. The slow LDX-3207 turn-on characteristic is accomplished by limiting the charge rate of C18 via R29.

The output is turned off rapidly by discharging C18 through Q4. The base of Q4 is controlled by the open collector output of comparator U13 which is controlled by the output of a flip-flop in U15. Pressing the front-panel ON button (S4) triggers a pulse from a one-shot (U24) which in turn toggles U15. The output of U15 is reset (off) for several seconds following power-up and whenever a power line drop-out is detected. U15 receives additional control inputs from the OPEN CKT fault monitor and from the 1205 GPIB/IEEE-488 interface (when installed).

4.6 MODULATION/VOLTAGE CONTROL INPUT PORT

The front-panel MOD input connector drives a precision, wide-band instrumentation amplifier (U11) allowing the control signal applied to this port to use a different ground than the current output terminals of the LDX-3207. However, due to the input common mode voltage restrictions of the U11, the MOD input should be within about +/- 12 volts of the current output terminals.

The inputs to U11 are connected so that when the center pin of the MOD input BNC connector is positive with respect to the shell, an increase in output current results. The inputs to U11 are protected by the network formed by R15, R16, and D9 through D12.

4.7 GPIB/IEEE-488 BUS CONTROL

With the optional 1205 GPIB/IEEE-488 interface installed, the LDX-3207 may be controlled by most computers via the GPIB/IEEE-488 bus. When the 1205 interface receives any of its recognized commands it sends a control pulse to the LDX-3207 main circuit board putting the LDX-3207 in remote mode. In this mode the precision current sink receives its analog control signal from the 1205 interface baord rather than from the main current control knob and MOD input (see also Section 4.4). Additionally, other logic control signals originating on the 1205 interface board gain access to the LDX-3207 control logic. These logic control signals can control the LDX-3207 operating mode (local/remote), output state (off/on), beeper, and can initiate a LOCAL LOCKOUT mode.

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When the local lockout mode is active, all front-panel controls are inhibited and the LDX-3207 may only be controlled via the GPIB/IEEE-488 interface. This mode is useful when the instrument is used in an automated test setup where front-panel control is undesirable.

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CHAPTER 5
MAINTENANCE

WARNING

THE SERVICE PROCEDURES DESCRIBED IN THIS CHAPTER ARE FOR USE BY QUALIFIED PERSONNEL. POTENTIALLY LETHAL VOLTAGES EXIST WITHIN THE LDX-3207. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY OF THE PROCEDURES DESCRIBED IN THIS CHAPTER UNLESS YOU ARE QUALIFIED TO DO SO.

5.1 OVERVIEW

This chapter contains information necessary to maintain the LDX-3207. Included are sections covering calibration, fuse replacement, line voltage selection, and disassembly.

5.2 CALIBRATION

The LDX-3207 should be recalibrated every 12 months or whenever performance verification indicates that recalibration is necessary.

5.3 Recommended Equipment

Recommended test equipment for calibrating the LDX-3207 is listed in Table 5.1. Equipment other than that shown in the table may be used so long as the specifications meet or exceed those listed.

Table 5.1 Recommended Test Equipment

Description	Mfr./Model	Specification	
DMM	Fluke 8840A	DC Volts (@ 1.0 V): Resistance (@ 10 ohms):	0.008 % 0.054 %
Resistor, 10 ohm	Wirewound, 3 W	Low TC:	50 ppm/C
DC Power Supply	Capable of 1 V output	Ripple:	< 5 mV

5.4 Environmental Conditions

Calibration should be performed under laboratory conditions. We recommend calibration at 23 C +/- 1 C. However, when necessary the LDX-3207 may be calibrated at its intended use temperature so long as this is within the specified operating temperature range of 0 to 50 C.

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5.5 Warm-Up

The LDX-3207 should be allowed to warm up for at least 1 hour before calibration is performed. During the warm-up period the LIMIT knob should be set to approximately half scale (100 mA).

5.6 Calibration Adjustments

In the calibration procedure that follows, the output current of the LDX-3207 is determined by measuring the voltage drop across a shunt resistor and then calculating the current using Ohm's Law (I=V/R). Although this procedure is more cumbersome than direct current measurement, it generally yields greater accuracy than direct current measurement when using conventional 5-1/2 digit DMMs.

1. Measure Resistance of 10 Ohm Shunt - With the Fluke 8840A in 4-WIRE OHMS mode, measure and record the resistance of the 10 ohm (nominal) shunt resistor.

The following steps require that the top cover of the 3207 be removed. This is easily accomplished by removing the two screws on either side of the cover near the rear of the instrument (see also Section 5.9). Where possible perform the calibration steps with the cover slid back about 1 inch.

2. Display Calibration -

a. Disconnect any signals applied to the front panel MOD input connector.
b. Connect the shunt resistor to the output of the 3207.
c. Adjust the LIMIT setting to approximately 120 mA, turn the output on and adjust the output current to approximately 100 mA.
d. With the Fluke 8840A in VOLTS mode, measure the voltage drop across the shunt resistor. Calculate and record the "actual" output of the 3207 by using the previously recorded shunt resistance, measured voltage drop and Ohm's Law:

$$I = V / R$$

e. Adjust R24 (see Diagram 7.1) until the LDX-3207 display reads the correct output current as recorded in the previous step.

3. Modulation Zero Adjustment -

a. Disconnect any signals applied to the front panel MOD input connector.
b. With the Fluke 8840A in VOLTS mode, measure the voltage between U11 pins 11 and 12 (see Diagram 7.1). Adjust R19 until this voltage is within 10 millivolts of zero.

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4. Modulation Gain Adjustment -

a. Connect the 10 ohm shunt resistor (or any low ohm shunt) across the 3207 output terminals.
b. With a DC power supply apply a nominally 1.00 volt signal to the 3207 front panel MOD input connector with the center pin of the connector positive with respect to the shell.
c. With the Fluke 8840A in VOLTS mode, measure and record the actual voltage applied to the MOD input.
d. Adjust R9 (see Diagram 7.1) until the output display of the 3207 indicates an output current equal to the MOD input voltage multiplied by the scale factor 100 mA/volt:

$$I = (100\ mA/volt) \bullet (Input\ voltage)$$

For example if the input voltage is 1.012 volts, then adjust R9 until the 3207 display reads 101.2 mA.

If your LDX-3207 is equipped with the 1205 GPIB/IEEE-488 interface refer to section 6.5 for additional calibration procedures. Otherwise this completes the calibration procedure. Reinstall the top cover and its retaining screws.

5.7 FUSE REPLACEMENT

The fuse is accessible from the rear panel of the LDX-3207. Before replacing the fuse, turn power off and disconnect the line cord. Use only the fuses indicated below in Table 5.2.

Table 5.2
Fuse Replacement

Line voltage	Fuse Replacement
105 - 125 VAC	1/4 Amp, 3AG, Slow Blow
210 - 250	1/8 Amp, 3AG, Slow Blow

5.8 LINE VOLTAGE SELECTION

Line voltage selection is made by installing jumpers accessible with the bottom cover of the LDX-3207 removed. Normally these jumpers are factory preset. However, when necessary they may be moved to accomodate new line voltage conditions. To proceed, turn over the LDX-3207 and remove the bottom cover. Locate the zero-ohm jumpers located on the main circuit board near the rear panel of the instrument. In order to change the line voltage selection these jumpers must be relocated as indicated in Figure 5.1. Carefully unsolder the jumpers and then reinstall them in the new position.

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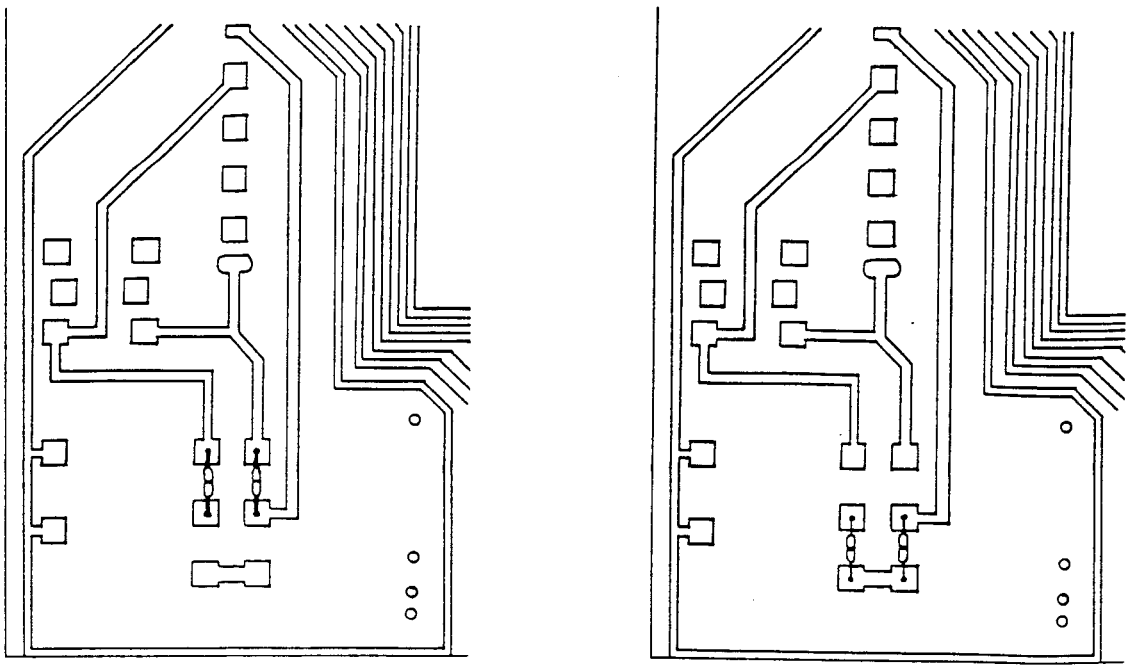


Figure 5.1. Line Voltage Selection.

5.9 DISASSEMBLY

The top and bottom covers of the LDX-3207 may be removed by simply removing the countersunk screws located on the sides of the instrument near the rear panel. Once these screws are removed, either cover may be removed by sliding it towards the rear of the instrument and then pulling it up and off.

If the front panel of the instrument must be removed, first peel out the decorative plastic inserts located on the sides of the front bezel. Removal of these inserts allows access to the four front panel retaining screws. There are two of these screws on each side of the bezel. On each side they are located above and below two, larger flat head screws. Once the four retaining screws are removed, the front panel may be pressed out by pressing on the back of the front panel circuit board (the top cover must be removed to allow access to this circuit board).

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CHAPTER 6
OPTIONAL MODEL 1205 GPIB/IEEE-488 INTERFACE

6.1 OVERVIEW

This chapter describes the optional model 1205 GPIB/IEEE-488 interface which allows the LDX-3207 to be remotely programmed via the IEEE standard 488-1978 interface bus. For a description of the remote programming procedure refer to Chapter 3.

6.2 SPECIFICATIONS

IEEE-488 BUS IMPLEMENTATION

GENERAL: Implements talker/listener functions.

INTERFACE MESSAGES: REN, DCL, LLO, GTL, SDC

DEVICE DEPENDENT COMMAND STRUCTURE:

Command	Function
O0,O1	Switch output: 0=off, 1=on
Cnnn.nnn	Set output current to nnn.nnn mA.
B1	Beep.
G0	Get error status.

ISOLATION: Instrument is optically isolated from IEEE-488 bus.

COMMAND EXECUTION TIME: Approximately 40 msec.

ACCURACY:

ANALOG CONTROL RESOLUTION: 12 bit (0.05 mA).
ANALOG CONTROL ACCURACY: +/- 0.1 mA.

POWER REQUIREMENTS:

ISOLATED SUPPLY: +5 volts, 500 mA max.

INSTRUMENT SUPPLY: +5 volts, 100 mA max.
+15 volts, 10 mA, max.
-15 volts, 10 mA, max.

SIGNAL INPUTS FROM INSTRUMENT:

Four digital sense lines.

SIGNAL OUTPUTS TO INSTRUMENT:

Three TTL digital signal lines and a strobe. One 0 to 10 volt analog control signal.

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6.3 INSTALLATION

The model 1205 interface may be user installed by following the procedure outlined below:

a. Turn off the LDX-3207 and disconnect it from the AC line.
b. Remove the top cover of the 3207 by removing the two cover retaining screws located on either side of the instrument near the rear panel.
c. Temporarily remove the 3207 rear panel by unscrewing the four screws located in the corners of the panel.
d. Remove the small aluminum plate fastened to the rear panel of the 3207, covering the GPIB connector and address selector switch cutouts.
e. Fasten the 1205 interface board onto the rear panel ensuring that the GPIB connector and address selector switch are centered in their respective panel cutout holes. Note that the 1205 interface board must be mounted upside down (components facing down) to be correctly installed. Use the supplied GPIB connector retaining screws, lockwashers and nuts to secure the circuit board to the rear panel.

NOTE

The 1205 GPIB/IEEE-488 interface board contains static sensitive parts. Handle the circuit board only by its edges and work at a static free work station.

f. Insert the supplied side rail support into the upper channel of the 3207's right-hand side rail. Slide the support to a position approximately 1.5 inches from the front bezel. (See Figure 6.1).

g. Temporarily place the rear panel back in its original position at the rear of the 3207 and adjust the position of the 1205 interface board and side rail support so that the interface board's mounting hole nearest to the 10 pin connector correctly locates on the internal side rail support. (See Figure 6.1).

h. Carefully remove the rear panel again and tighten the GPIB connector screws. Tighten the screw in the side rail support locking the support into place.

i. Install the two jumper cables onto pin headers J101 and J103 located on the main circuit board (see Diagram 7.1). When correctly installed the cables run in towards the center of the main circuit board (see Figure 6.1) without any twists.

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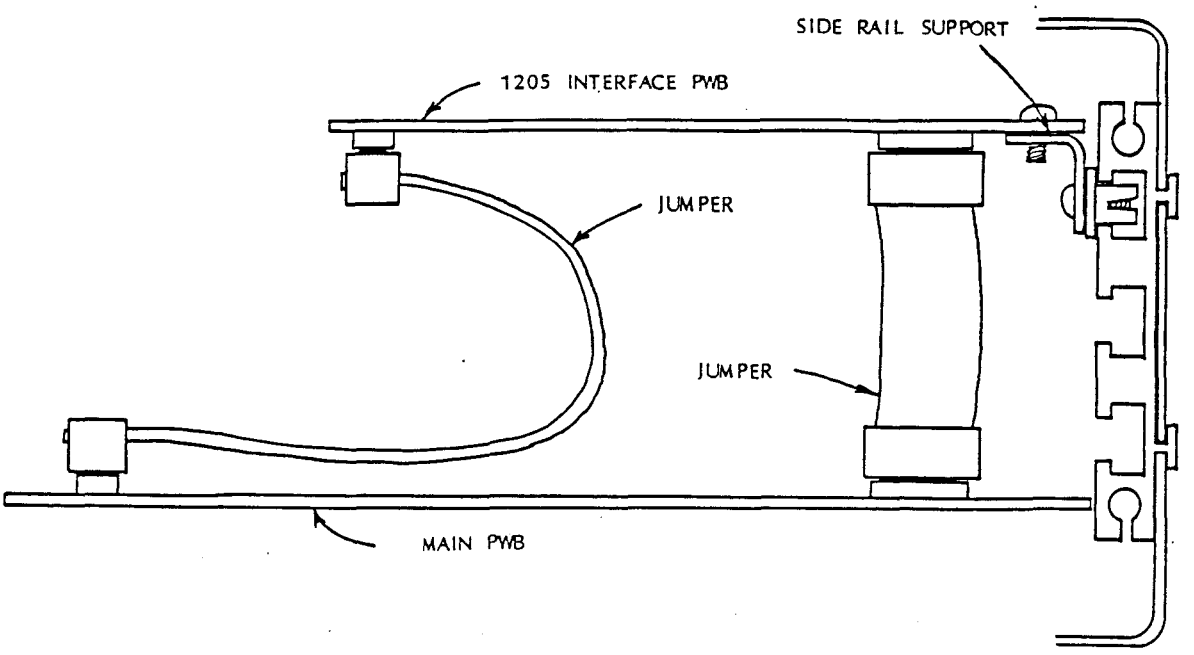


Figure 6.1. Cross-Sectional View of Properly Installed 1205 Interface Board. (Looking toward rear of instrument.)

j. Reinstall the 3207 rear panel and attached 1205 interface board. Install and fasten the four retaining screws on the rear panel as well as the supplied side rail mounting screw.

k. Proceed with the calibration outlined below in Section 6.5.

6.4 MAINTENANCE

The following calibration procedure should be performed annually as a part of the overall LDX-3207 calibration or after installing the 1205 interface board for the first time.

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6.5 Calibration

WARNING

THE SERVICE PROCEDURES DESCRIBED IN THIS SECTION ARE FOR USE BY QUALIFIED PERSONNEL. POTENTIALLY LETHAL VOLTAGES EXIST WITHIN THE LDX-3207. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY OF THE PROCEDURES DESCRIBED IN THIS SECTION UNLESS YOU ARE QUALIFIED TO DO SO.

Before performing the procedures described below, ensure that the LDX-3207 is fully warmed up with both covers in place (see Section 5.5). To perform the following calibration steps you will need a Fluke 8840A, 5-1/2 digit DMM (or equivalent) and 10 ohm shunt resistor as described in Section 5.3 (Recommended Equipment).

In the calibration procedure that follows, the output current of the LDX-3207 is determined by measuring the voltage drop across a shunt resistor and then calculating the current using Ohm's Law (I=V/R). Although this procedure is more cumbersome than direct current measurement, it generally yields greater accuracy with conventional 5-1/2 digit DMMs.

1. Measure Resistance of 10 Ohm Shunt - With the Fluke 8840A in 4-WIRE OHMS mode, measure and record the resistance of the 10 ohm (nominal) shunt resistor. Calculate the voltage drop across the shunt resistor for a 100.00 mA output current:

V = (0.1000) * (Measured Shunt Resistance)

Record this calculated voltage for use in Step 2 below.

The following steps require that the top cover of the 3207 be removed. This is easily accomplished by removing the two screws on either side of the cover near the rear of the instrument (see also Section 5.9). Where possible perform the calibration steps with the cover slid back about 1 inch.

2. 1205 GPIB/IEEE-488 Interface Calibration -

a. Connect the 10 ohm shunt resistor to the output of the LDX-3207.
b. Set the address of the 1205 interface to an unused address (see Section 3.3) and connect the interface to the GPIB bus via the rear panel connector.
c. Send the following ASCII string to the 1025 interface from the bus controller:

'O1 C100'

This will put the LDX-3207 in REMOTE mode, turn the output ON, and set the output to approximately 100.0 mA.

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6.5 Calibration

WARNING

THE SERVICE PROCEDURES DESCRIBED IN THIS SECTION ARE FOR USE BY QUALIFIED PERSONNEL. POTENTIALLY LETHAL VOLTAGES EXIST WITHIN THE LDX-3207. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY OF THE PROCEDURES DESCRIBED IN THIS SECTION UNLESS YOU ARE QUALIFIED TO DO SO.

Before performing the procedures described below, ensure that the LDX-3207 is fully warmed up with both covers in place (see Section 5.5). To perform the following calibration steps you will need a Fluke 8840A, 5-1/2 digit DMM (or equivalent) and 10 ohm shunt resistor as described in Section 5.3 (Recommended Equipment).

In the calibration procedure that follows, the output current of the LDX-3207 is determined by measuring the voltage drop across a shunt resistor and then calculating the current using Ohm's Law (I=V/R). Although this procedure is more cumbersome than direct current measurement, it generally yields greater accuracy with conventional 5-1/2 digit DMMs.

1. Measure Resistance of 10 Ohm Shunt - With the Fluke 8840A in 4-WIRE OHMS mode, measure and record the resistance of the 10 ohm (nominal) shunt resistor. Calculate the voltage drop across the shunt resistor for a 100.00 mA output current:

V = (0.1000) * (Measured Shunt Resistance)

Record this calculated voltage for use in Step 2 below.

The following steps require that the top cover of the 3207 be removed. This is easily accomplished by removing the two screws on either side of the cover near the rear of the instrument (see also Section 5.9). Where possible perform the calibration steps with the cover slid back about 1 inch.

2. 1205 GPIB/IEEE-488 Interface Calibration -

a. Connect the 10 ohm shunt resistor to the output of the LDX-3207.
b. Set the address of the 1205 interface to an unused address (see Section 3.3) and connect the interface to the GPIB bus via the rear panel connector.
c. Send the following ASCII string to the 1025 interface from the bus controller:

'O1 C100'

This will put the LDX-3207 in REMOTE mode, turn the output ON, and set the output to approximately 100.0 mA.

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Refer to Example 6.1 for an illustration of how this command string would be sent using an IBM PC and National Instruments PC-2A GPIB/IEEE-488 interface board as the system controller. For a more complete description of remote programming of the 1205 refer to Chapter 3.

d. With the Fluke 8840A in DC VOLT mode, measure the voltage drop across the 10 ohm shunt resistor. Adjust R35 (see Diagram 7.1) until the voltage drop is equal to that calculated for a 100.00 mA current as calculated above in step 1.

This completes the 1205 interface calibration procedure. Reinstall the LDX-3207 cover and retaining screws. The LDX-3207 may be returned to LOCAL mode by pressing the front panel LOCAL button.

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```
10 '                          * * *  CALCMD  * * *
12 '
14 'Program to put the LDX-3207 in REMOTE mode, turn the output ON, and set
16 'the output to 100.0 mA.  This program is written on an IBM PC in BASICA
18 'and assumes that a National Instruments GPIB-PC2A controller card is in-
20 'installed.
22 '
24 'This program also assumes that the address of the LDX-3207/1205 is set
26 'to 1.
100 '
102 '================================   INITIALIZE GPIB INTERFACE
104 '
106 '
110     CLEAR   ,60172!
112     IBINIT1 = 60172!
114     IBINIT2 = IBINIT1 + 3
116     BLOAD "\GPIB\BIB.M",IBINIT1
118     CALL IBINIT1(IBFIND,IBTRG,IBCLR,IBPCT,IBSIC,IBLOC,IBPPC,IBBNA,IBONL,IBRS
C,IBSRE,IBRSV,IBPAD,IBSAD,IBIST,IBDMA,IBEOS,IBTMO,IBEOT,IBRDF,IBWRTF)
120     CALL IBINIT2(IBGTS,IBCAC,IBWAIT,IBPOKE,IBWRT,IBWRTA,IBCMD,IBCMDA,IBRD,IB
RDA,IBSTOP,IBRPP,IBRSP,IBDIAG,IBXTRC,IBRDI,IBWRTI,IBRDIA,IBWRTIA,IBSTA%,IBERR%,I
BCNT%)
300 '
302 '================================   SEND COMMANDS
320 '
322     A$ = "DEV1"                     'Initialize the device
324     CALL IBFIND(A$,BD%)
326     IF BD% < 0 THEN 920             'Check for error return
330 '
332     A$ = "O1 C100"                  'Write ASCII command string
334     CALL IBWRT(BD%,A$)
336     IF IBSTA% < 0 THEN 930          'Check for error return
400 '
402 '================================   DONE
404 '
412     PRINT "PROGRAM SUCCESSFULLY TERMINATED."
414     END
900 '
902 '================================   PROCESS ERROR RETURNS
920 '
922     BEEP
924     PRINT "COULD NOT INITIALIZE DEV1"
926     END
930 '
932     BEEP
934     PRINT "COULD NOT SEND COMMANDS TO DEVICE AT ADDRESS 1"
936     END
```

Example 6.1. Program Example for Calibration Command Sequence. This example is based on an IBM PC with a National Instruments PC-2A GPIB/IEEE-488 interface card as the system controller.

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PROGRAM TO MEASURE AND PRINT LIGHT OUTPUT VS CURRENT
INPUT FOR A LASER DIODE OR LED

```
40 ! An LDX-3207 is used to drive the emitter and the light output is
50 ! measured using a silicon photodiode driving a FLUKE 8840 DMM
60 ! in DC current mode.
70 ! GPIB address of the instruments set as follows:
80 ! Fluke 8840A Bus address 1
90 ! LDX-3207     Bus address 2
100 !
110 ! This program is written and run on an HP-87XM controller
120 !
130 !
140 ! ============ Initialize program parameters ========
150 IDMIN=0 !              set min drive current
160 IDMAX=70 !             set max drive current
170 IDINC=2 !              set drive current step increment
180 !
190 RESP=.4 !             detector responsivity (A/W)
200 !
210 ! ============ Initialize output/print header
220 !
230 CLEAR !                  clear screen
240 !
250 DISP "       * * *  LASER/LED OUTPUT vs DRIVE CURRENT * * *"

260 DISP
270 DISP "              DRIVE CURRENT          OUTPUT"
280 DISP "                 (mA)                (mW)"
290 !
300 ! ============ Initialize DMM and Current source
310 !
320 OUTPUT 701 ;"F5R1S1T2" !   set DMM for the following modes:
330 !                           F5   mA DC
340 !                           R1   2000 mA full scale
350 !                           S1   Medium rate
360 !                           T2   External trigger
370 OUTPUT 702 ;"O1C0" !    set LDX 3207 as follows:
380 !                           O1   Output on
390 !                           C0   Output current = 0
400 !
410 FOR I=1 TO 1000 ! wait for 3207 output turn-on
420 NEXT I !           sequence to complete
430 !
440 ! ============  Take data ==========
450 !
460 FOR I=IDMIN TO IDMAX STEP IDINC ! Initialize current loop
470 !
480 OUTPUT 702 ;"C";I !        Set 3207 current
490 OUTPUT 702 ;"G0" !         Command 3207 to load status bits
500 ENTER 702 ; ER$ !             Check 3207 status
510 IF ER$ <> "00011" THEN GOTO 1000 !   If error detected
520 !
```

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```
530 OUTPUT 701 ;"?" !            Trigger DMM
540 ENTER 701 ; A !              Read DMM vaule
550 L=RESP*A*1000 !              Convert reading to milliwatts
560 !
570 DISP "       ";I,"       ";L
580 NEXT I
600 OUTPUT 702 ;"O0C0" !         Set 3207 current to 0 and turn off
output
700 STOP
1000 BEEP
1010 DISP "3207 ERROR"
1020 END
```

PROGRAM TO STEP A 3207 OUTPUT IN 1 MA. INCREMENTS

```
10 OUTPUT 701 ;"O1C0S1" !    Set 3207 output on with current to zero
15 !                         and set step size to 1 mA
20 FOR I=0 TO 70
30 TRIGGER 701 !             Send trigger to tell 3207 to step current
40 NEXT I
100 GOTO 10
```

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CHAPTER 7
SCHEMATIC DIAGRAMS

7.1 Main Circuit Board Component Layout

7.2 Front-Panel Circuit Board Component Layout

7.3 Main Circuit Board Analog Section Schematic Diagram

7.4 Main Circuit Board Digital Section Schematic Diagram

7.5 Main Circuit Board Power Supplies Schematic Diagram

7.6 Front-Panel Circuit Board Schematic Diagram

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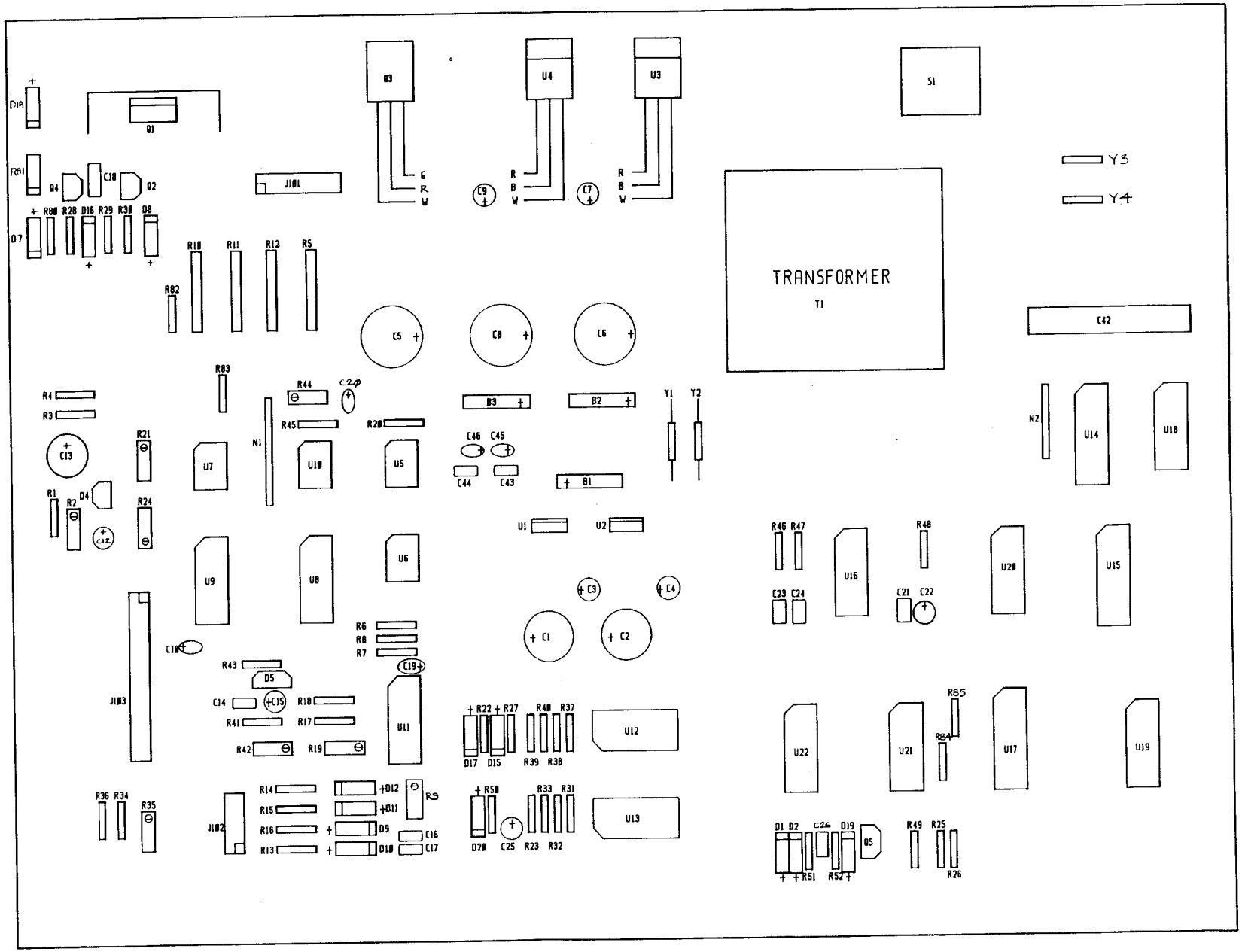


Diagram 7.1. Main Circuit Board
Component Layout

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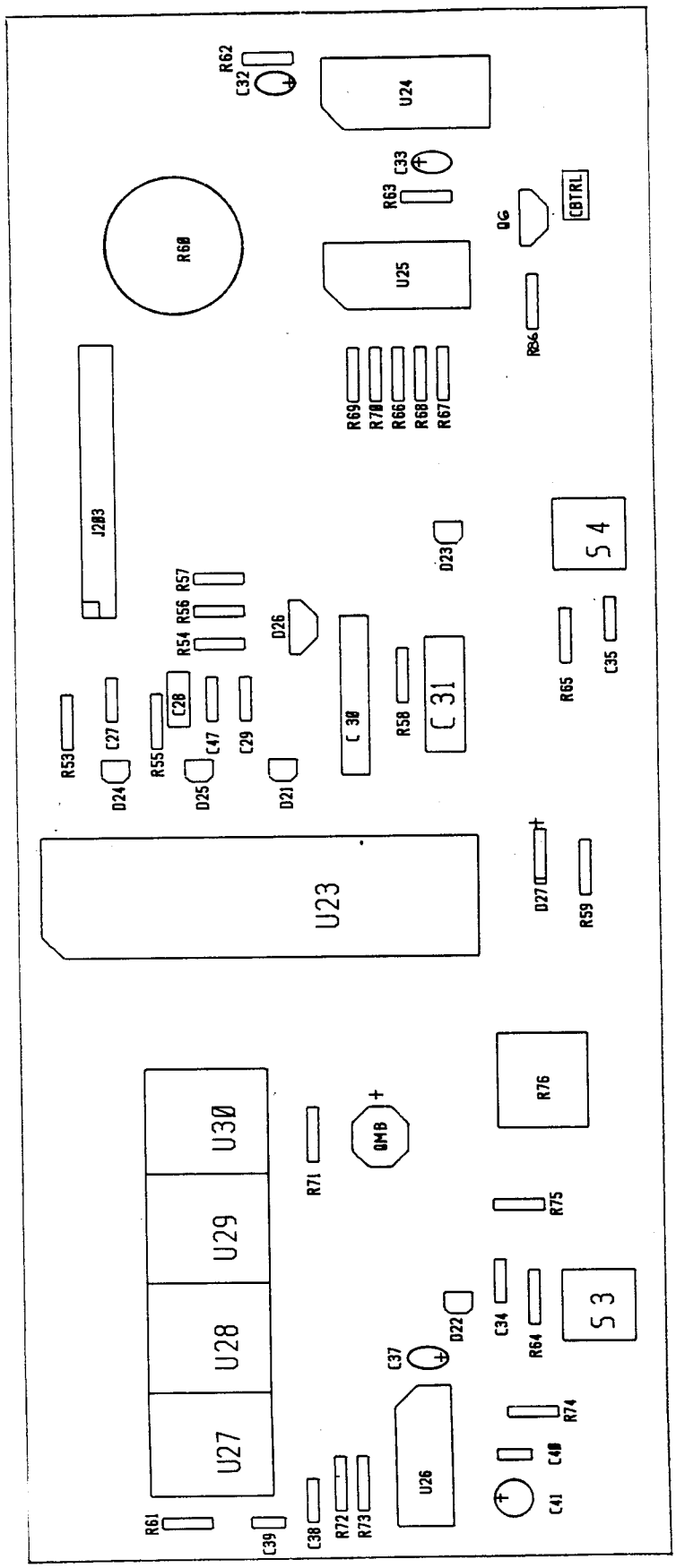


Diagram 7.2. Front-Panel Circuit Board Component Layout

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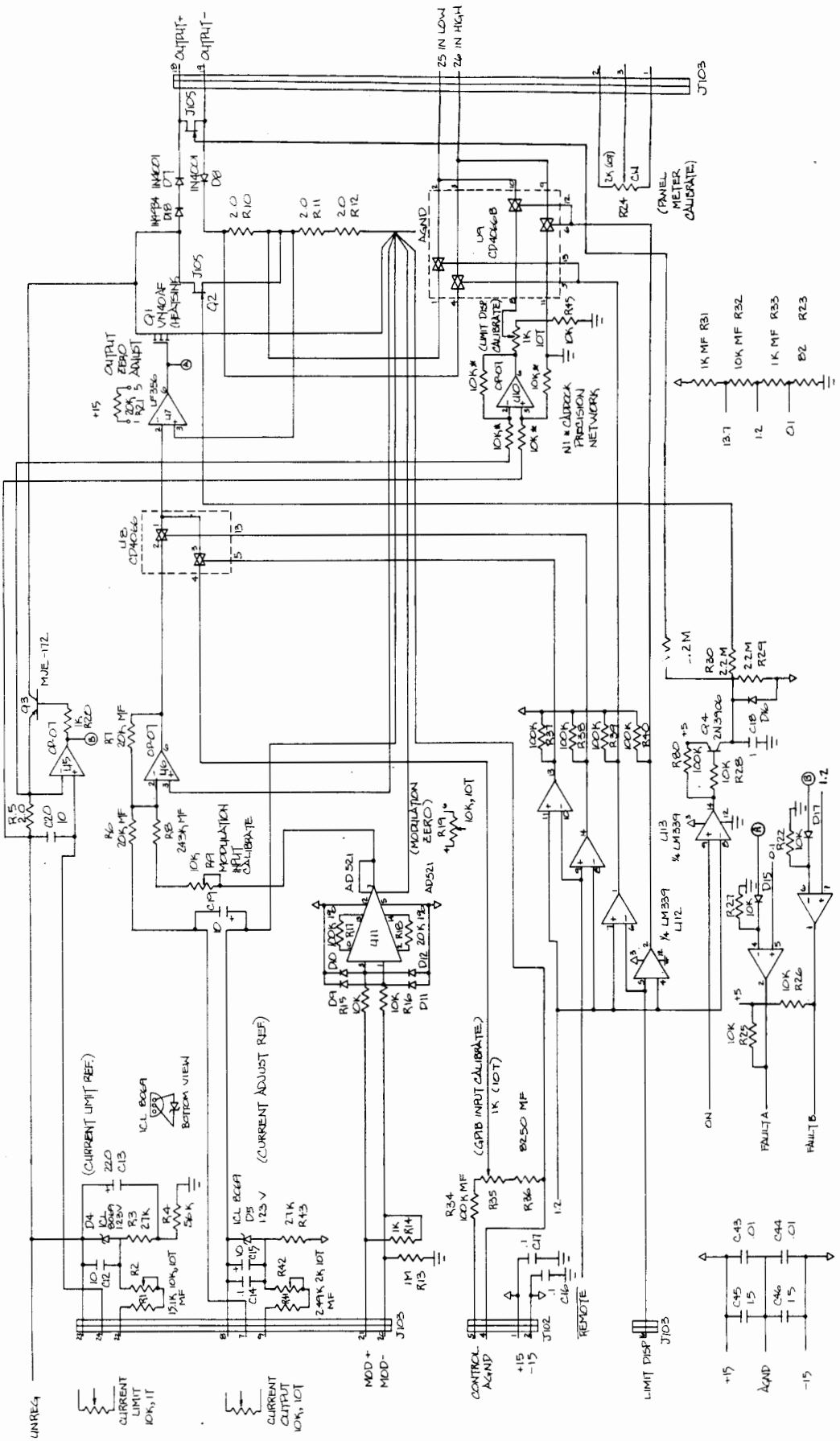


Diagram 7.3. Main Circuit Board Analog Section Schematic Diagram

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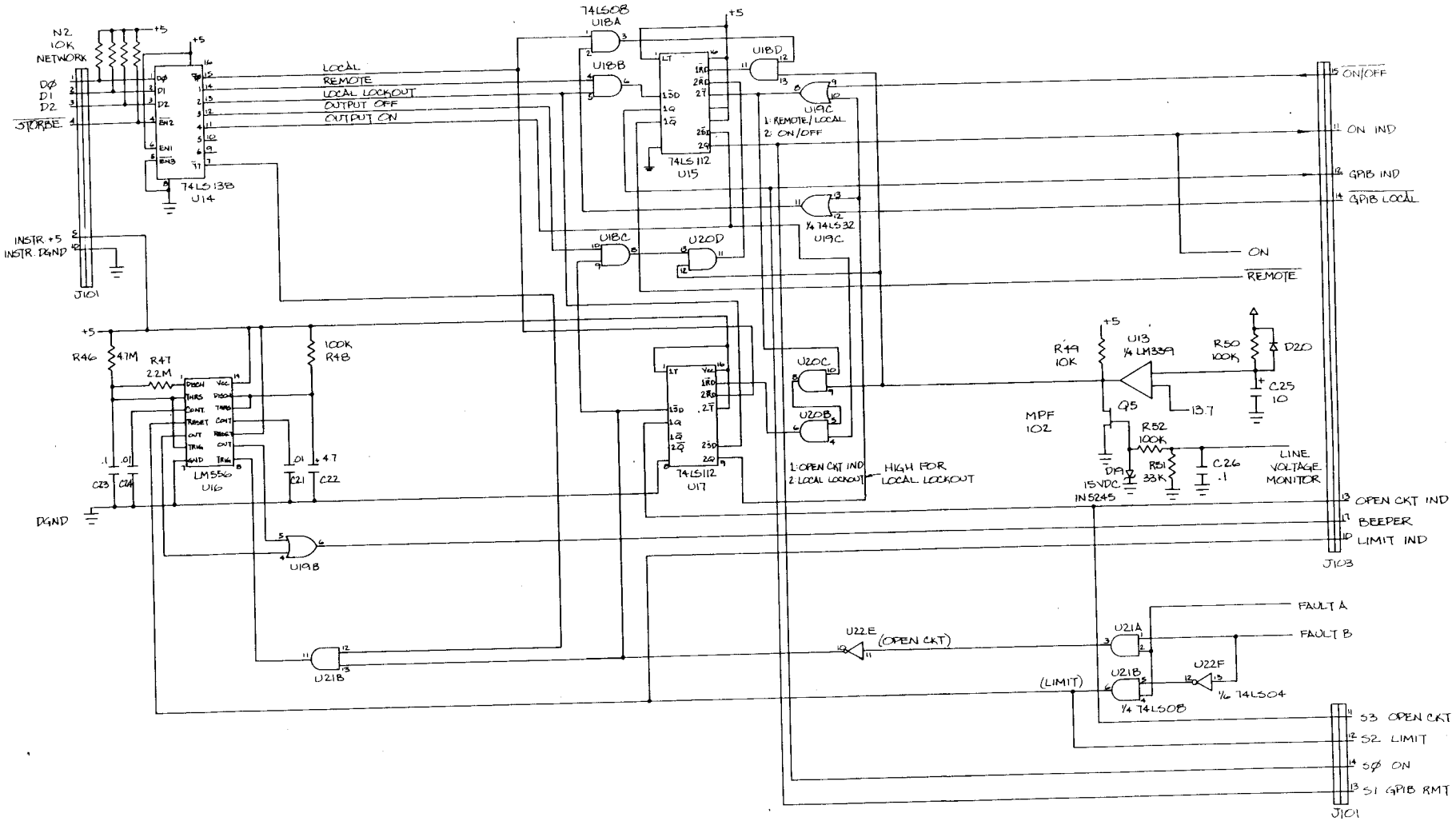


Diagram 7.4. Main Circuit Board Digital Section Schematic Diagram

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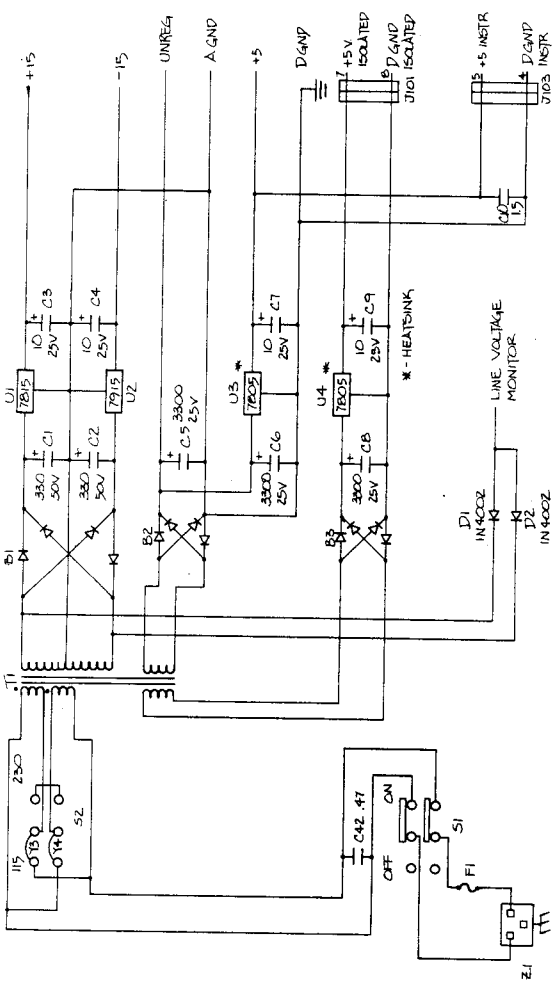


Diagram 7.5. Main Circuit Board Power Supplies Schematic Diagram

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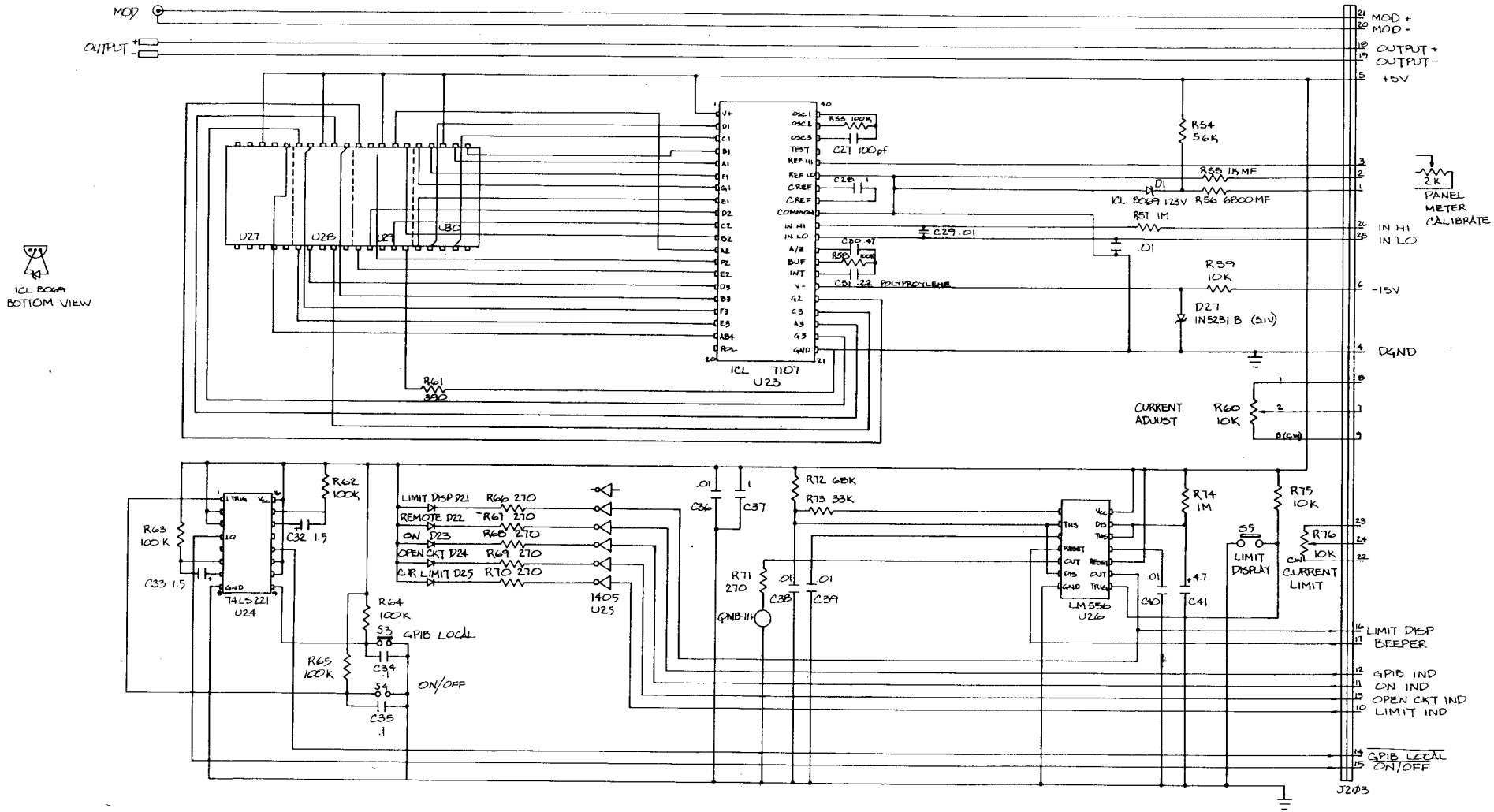


Diagram 7.6. Front-Panel Circuit Board Schematic Diagram

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