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GENERAL ATOMICS
ELECTROMAGNETICS

NMP-1000, MULTI-RANGE LINEAR MODULE

USER MANUAL

DOCUMENT
T3401000-1UM

Revision B: June 2015

Document Level 1

[redacted]

GENERAL ATOMICS
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Customer Service - (858) 522-8300

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Technical Writer		
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ABSTRACT

This document is based on information available at the time of its publication. While efforts have been made to render accuracy to its content, the information contained herein does not purport to cover all details or variations in hardware or software, or to provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein, which are not present in all hardware and software systems. General Atomics assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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RECORD OF REVISIONS

REVISION	DATE ENTERED	SUMMARY OF CHANGES
A	JANUARY 2014	Original issue by GA
B	JUNE 2015	Incorporated customer feedback. Added information and appendices related to FCO-673, FCO-674 for Test Currents. Added new appendix with site calibration notes. Added information regarding compensating voltage options. Corrected typographical errors.

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LIST OF ABBREVIATIONS

ANS	American Nuclear Society
ANSI	American National Standards Institute
B/T	Bistable Trip
CCS	Console Computer System
CD	Compact Disc
COTS	Commercial-Off-The-Shelf
CSC	Control System Console
DAC	Data Acquisition and Control
ERS	East Radiography Station
I&C	Instrumentation and Control
I/O	Input/Output
IEEE	Institute of Electrical and Electronic Engineers
LCD	Liquid Crystal Display
LINUX	Unix-like Computer Operating System
NRS	North Radiography Station
NTE	Not-To-Exceed
O&M	Operator and Maintenance
PCA	Printed Circuit Assembly
RPI	Rod Position Indication
RPS	Reactor Protection System
RWP	Rod Withdrawal Prohibit
TRIGA	Training, Research, Isotopes, General Atomic
UPS	Uninterruptible Power Supply

NOTICE

Although GA has attempted to prepare the material contained in this manual with accuracy, no warranty or representation is expressed or implied with respect to the accuracy or completeness of such information, and no liability is assumed for any loss or damages resulting from the use of the equipment or any information contained in this manual.

The following are used throughout the manual to draw your attention to Items or procedures that require special notice or care.

NOTE: Used to identify important information.

CAUTION
Used to identify Information that may be useful in preventing damage to equipment.

WARNING
Used to identify information about situations that may present a danger to the technician.

1.0 GENERAL INFORMATION

1.1 INTRODUCTION

The NMP-1000 is a microprocessor based wide-range linear power module which provides percent reactor power indication and bi-stable trip circuits. The module is packaged in a metal enclosure suitable for mounting in a reactor control console. The NMP-1000 module processes current of 1E-11 to 1E-3 Amperes from any detector producing current within input range, e.g. ion chamber or fission chamber. A compensating voltage power supply is provided for use with compensated ion chambers. The input current is converted into 0 to 10V in 9 one-decade ranges. The appropriate decade is selected either automatically by software (auto mode) or by the user (manual mode) via the touch screen display or a remote input

The NMP-1000 has two modes of operation, local or remote. In local mode, the module accepts commands via the front panel touch screen or a remote display*. In remote mode, the module accepts commands via the Ethernet port or the analog remote Interface connectors on the rear panel. A detailed list of the remote interface pinouts is given in section 6 of this manual.

Three (3) bi-stable trips are used to alarm on low high voltage to the detector and two independently adjustable levels of reactor power. Three relays are provided with two sets of normally open and normally closed contacts for customer use. The relays are held energized in a fail-safe condition until an alarm de-energizes the coil.

The NMP-1000 has test modes to allow the user to test the proper performance of the electrometer and to ensure the functionality of all trip circuits. Test modes include HV, calibrate high, calibrate low, and manual current. The HV and calibrate high test modes cause the bi-stable trips to alarm; current low gives fixed power indication in the highest range; and manual test lets the user vary the current over all ranges with a front panel potentiometer. Test modes can be enabled via the touch screen or a remote interface.

A photo of the NMP-1000 is provided in Figure 1-1.

* The remote display is available as an option. It is identical to the front panel display and connects to the RS-232 port on the rear panel.

Figure 1-1 NMP-1000

This manual includes an overview of the NMP-1000 along with the following sections: the major subassemblies, the specifications, and references. Also, control and operating instructions and maintenance details for the NMP-1000 are included. The manual includes the following sections:

Section 1.0	GENERAL INFORMATION
Section 2.0	DESCRIPTION
Section 3.0	OPERATING INSTRUCTIONS (MENUS AND DISPLAYS)
Section 4.0	MAINTENANCE (CALIBRATION AND TEST PROCEDURES)
Section 5.0	ENGINEERING DRAWINGS
Section 6.0	SUMMARY OF REAR PANEL CONNECTIONS

1.2 SPECIFICATIONS

The following specifications are for the NMP-1000.

Dimensions (Approximate)		Maximum 4.6 inches (W) by 8.3 inches (H) X 15.6 (16.7 with connectors and front panel potentiometer) inches (D)
Weight (Approximate)		11 pounds
Temperature (Range)		50 to 131°F (Design)
Pressure		Atmospheric (Design)
Power		117 Vac ± 10%, 50/60 Hz @ 1.0 Amp
Response Time Constants		[redacted]
Outputs:	Isolated:	0-10 V or 4–20 mA, % Power, Two configurable outputs
	High voltage:	0 to 1000 Vdc at 3mA at max voltage
	Compensation:	T3401000-001: -30 to -200 Vdc T3401000-002: -8 to -50 Vdc T3401000-003: -23 to -150 Vdc Low end drop-out voltage may vary slightly. All models provide 300µA at max voltage
Digital Outputs:	Range Indication	Relay contacts (9 outputs)
Bistable Trips	High voltage trip	Adjustable, two Form C contacts
	High power trip	Adjustable, two Form C contacts
	High power alarm	Adjustable, two Form C contacts
Calibration/Test		Two fixed currents for self-test One adjustable current for multi-range function test and trip testing[1].

[1] When Test Mode is entered, the trips are placed in a failsafe condition (meaning the relays are actually tripped) but the front panel LED and the Ethernet output do NOT indicate a trip since they are based on the measured parameter exceeding a setpoint in the comparator circuit (the Trip Logic signal). As the front panel manual current potentiometer is turned and the trip setpoint is crossed, the comparator flips state, the Trip Logic signal

	HV trip test Test modes selected individually by touch screen buttons
Temperature Coefficient	±0.15%/°C maximum in the range of 10° to 55°C
Linearity	[redacted]
Input Range:	1E-11 to 1E-3 A in nine one decade ranges. Touch screen buttons provided to switch ranges in manual mode Automatic range switching Remote range switching capability

1.3 REFERENCE DOCUMENTS

Table 1-1 lists applicable reference documents for this manual.

Table 1-1 Reference Documents

Document Name	Document Number
TRIGA® Reactor Control System Operation And Maintenance Manual	T9S900D100-1OM
Acceptance Test Procedure (ATP), Multi-Range Linear Module NMP-1000	T3401000-1AT

1.4 STANDARDS

The NMP-1000 was developed and tested in accordance with ANS/ASME NQA-1-2000, Quality Assurance Requirements for Nuclear Facility Applications. Performance of these additional quality assurance activities should support use of the NMP-1000 as digital safety equipment.

occurs, and the front panel LED will light and the Ethernet link will send the trip signal. This is a latching indication, so turning the knob down afterwards will not extinguish the LED.

2.0 DESCRIPTION

2.1 BLOCK DIAGRAM

Figure 2-1 is a block diagram for the NMP-1000 Module.

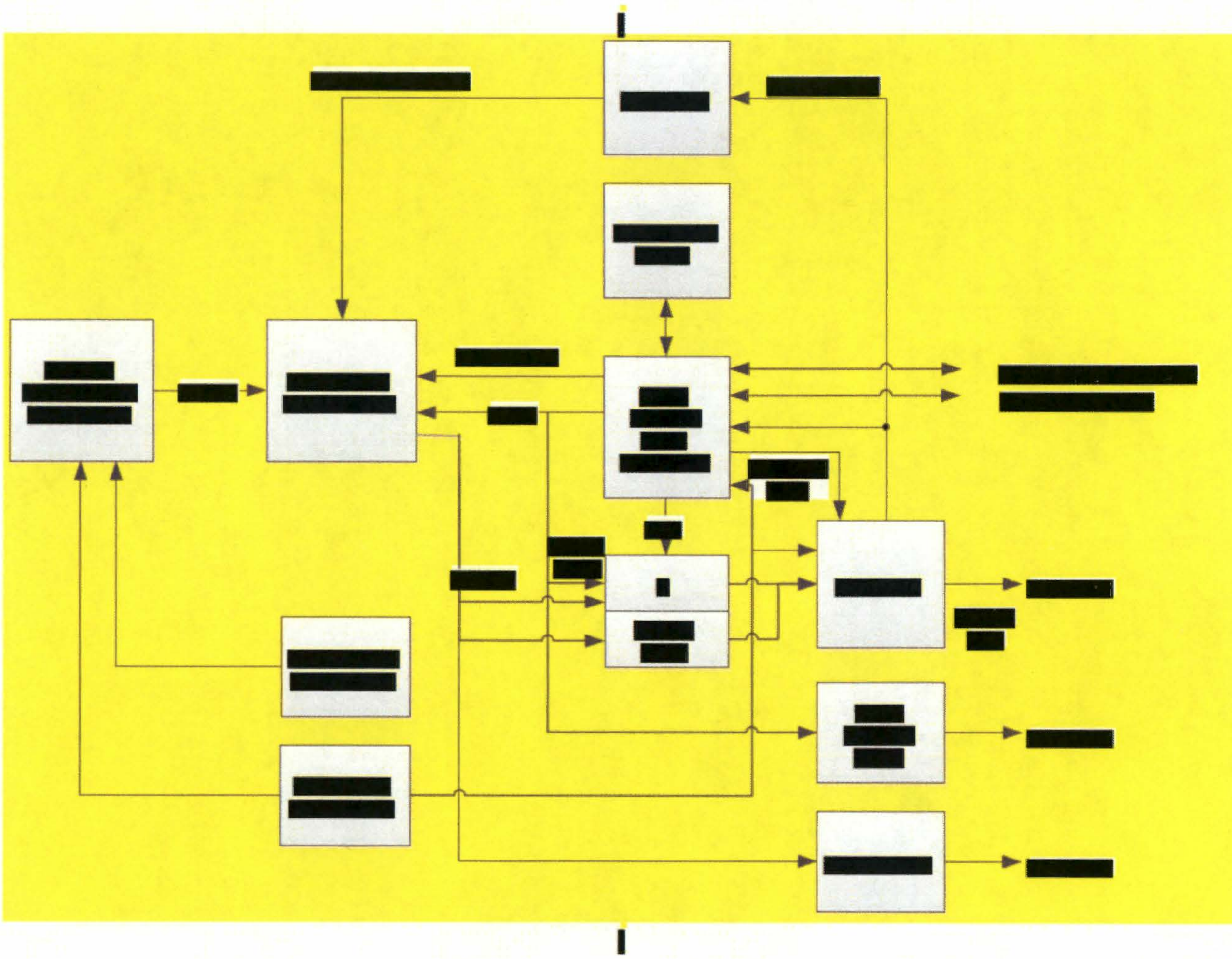


Figure 2-1 NMP-1000 Block Diagram

2.2 MAJOR SUBASSEMBLIES

Table 2-1 identifies the monitor major subassemblies, which are further described in the following paragraphs.

Table 2-1 Major Subassemblies

Description	Part Number
MULTI-RANGE LINEAR CHANNEL NMP-1000	T3401000-001
A1 PWA, NMP-1000 MOTHERBOARD	T3400113-001
A2 PWA, ANALOG AMPLIFIER	T3400133-001
A3 PWA, DIGITAL INTERFACE	T3133303-001
A4 PWA, TRIP/ALARM	T3301133-001
A5 PWA, ISOLATION AMPLIFIER	T3133113-001
A6 DISPLAY, 3.8" LCD MODULE, TRANSFLECTIVE	304922
A7 PWA, FRONT PANEL	T3400123-001
PS1 POWER SUPPLY	305855
PS2 COMPENSATION POWER SUPPLY	T3401000-001: 306495 T3401000-002: 307127 T3401000-003: 307128

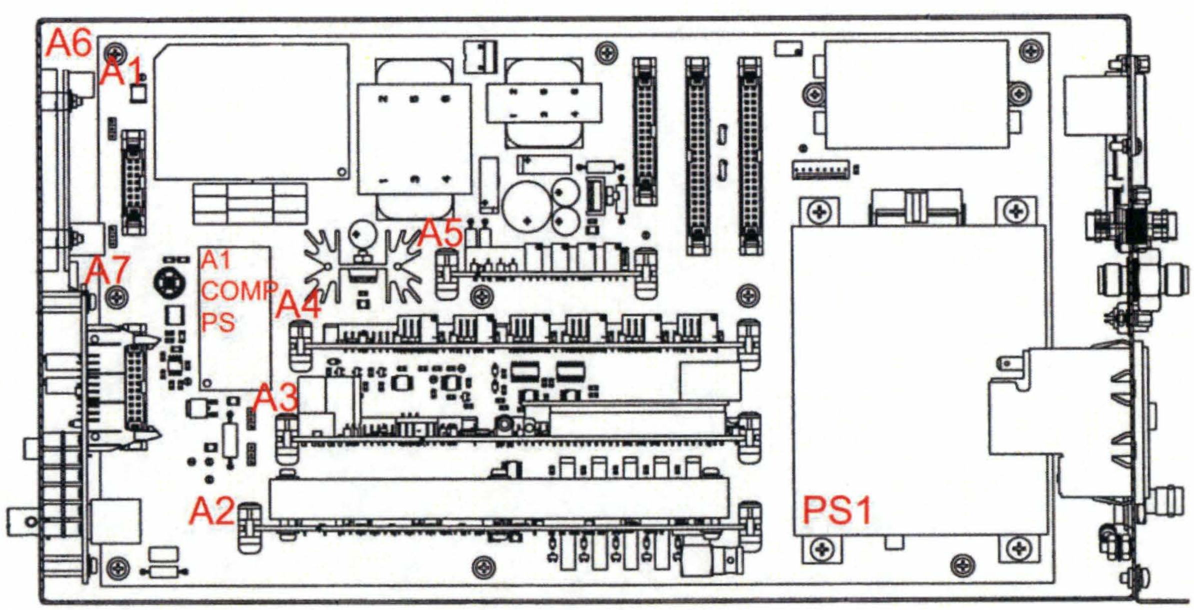


Figure 2-2 Multi-range Linear Module NMP-1000, Board Layout

[redacted]

Figure 2-3 Multi-range Linear Module NMP-1000, Interior View

2.2.1 Motherboard (T3400113-001)

Refer to schematic T3400111 for circuit details.

The NMP motherboard serves as the backplane for all NMP PWA's (daughter cards). It provides the power for all daughter cards, HV power supply and compensation power supply. It contains some circuitry for monitoring voltage levels and range indicators. Connections between all daughter cards and peripheral devices such as the display or remote connectors are made via the motherboard.

The motherboard provides a number of connectors where all daughter cards plug in. Connectors are keyed and of different pin count, and in combination with card guides, only allow one type of daughter card to be installed in a particular slot. Additional connectors accept the cable connections to the rear panel remote connectors, as well as connections to the display and front panel PWA. Incoming signal lines for control signals originating at the remote

connector on the rear panel are protected by a resistor/diode network. Outgoing signals are generally isolated via relays, opto-isolators, or another method.

Additional circuitry ties in with the trip/alarm PWA. If either the watch dog timer or operate signals are lost, the NMP will go out of operate and set all trips. While the NMP is in auto mode and also not in the highest range (e.g. 1E-3), the percent power signal is pulled low, essentially preventing a power trip from occurring. If the NMP is taken out of auto mode, or the highest range has been reached, the percent power signal is released and the trip circuits are enabled. Jumper settings let the user configure which current range is the highest range. The software receives indication that the highest range has been reached via a feedback circuit.

Table 2-2 Jumpers (Motherboard – Highest Range)

Highest Range	JP1	JP2	Notes
1E-3	X	1-2	Factory Default
1E-4	1-2	2-3	Install FCO-673 (see appendix)
1E-5	2-3	2-3	Install FCO-674 (see appendix)

In the factory default condition, the Test Currents (see section 4.3.4) are in the appropriate range; Hi Test Current can be adjusted from about 95% to 125% power, and Lo Test Current is hard-wired to about 18% power. If JP1 and JP2 must be repositioned to accommodate a different high range, the Test Currents will not change unless the corresponding FCO, as listed in Table 2-2, is installed.

All relays that indicate the active power range to the user are located on the motherboard. The relays are controlled by the microprocessor by the same signal that also sets the range on the analog amplifier.

There are two jumpers on the motherboard that affect the start-up mode of the display. One jumper lets the user set the program mode. When the program mode is enabled, the display will accept programming to the flash. This setting is used only when it is necessary to reload the Display OS or when the code that was compiled has locked up the display. The other jumper will start up the display in calibration mode. In normal use, the calibration mode can be accessed via the About menu of the NMP. Changing this jumper should only be necessary if the display brightness and contrast are very far out of calibration and calling the calibration routine from the screen is impossible.

Table 2-3 Potentiometers (Motherboard – Startup Mode)

Mode	JP3 (prog)	JP4 (cal)
Normal Use	2-3	2-3
Program/Calibrate	1-2	1-2

All analog ±15 Vdc power for the NMP is generated by two linear power supplies on the motherboard. Transformers step down the 117 Vac nominal input voltage which then gets rectified by bridge rectifiers and filtered. Linear regulators convert the primary DC voltages into ±15 Vdc. The transformers are sized to provide sufficient voltage to the linear regulators with 90% AC line input. +15 Vdc is also routed to the rear panel connector that is accessible to the customer for external auxiliary circuits. This external supply voltage is fused with a 100mA, self-resetting fuse.

A 25W switching power supply on the motherboard generates +24 Vdc to provide power to the HV power supply and digital circuitry. The input is fused with a 3A, slow acting glass fuse. +24 Vdc is also routed to the rear panel connector that is accessible to the customer for external auxiliary circuits. This external supply is fused with a 250mA, self-resetting fuse.

2.2.2 Analog Amplifier Board (T3400133-001)

Refer to schematic T3400131 for circuit details.

The analog amplifier board measures the incoming current signal from the detector and converts it into a linear analog voltage in nine one-decade ranges. For every decade of current, the analog board returns a 0 to +10 Vdc signal. Because the NMP is designed to measure power up to 120% of nominal reactor power, an output voltage of +10 Vdc represents 1.2 x nominal current in every decade (e.g. 120nA or 1.2mA). In general, the NMP-1000 and detector should be setup such that 1mA equals 100% reactor power. This is accomplished by performing the bench calibration in section 4.3, reinstalling the instrument, operating the reactor to determine actual power levels (via other instrumentation), and then physically repositioning the detector so the NMP indicated power equals actual power.

At the heart of the analog amplifier board is a high input impedance operational amplifier. For every decade of current, a relay switches in the appropriate feedback resistor to generate the expected output signal. The 1E-11 is the default range and always active. Other ranges are switched into the circuit in parallel as determined by the microprocessor. Every range has an adjustment potentiometer that allows for calibration of the circuit. The high impedance amplifier is followed by a buffer amplifier with an adjustable gain potentiometer.

Table 2-4 Potentiometers (Analog Amplifier – Range Calibration)

Potentiometer	Function
R84	1E-3 range calibration
R83	1E-4 range calibration
R82	1E-5 range calibration
R64	1E-6 range calibration
R65	1E-7 range calibration
R66	1E-8 range calibration
R48	1E-9 range calibration
R30	1E-10 range calibration
R4	1E-11 range calibration
R1	Amplifier offset calibration
R18	Overall gain calibration

[redacted]

Table 2-5 Potentiometers (Analog Amplifier – Offset)

Potentiometer	Function
R49	Offset Compensation

Three self-test circuits are located on the analog board: calibration low, calibration high and manual current. The user can initiate these tests via the touch screen or remote connectors. The calibration low circuit will generate a current signal of approximately 0.2mA. It is not adjustable. The calibration high current can be adjusted by the user via a potentiometer and is usually set around 1.2mA. The manual current is adjusted with a potentiometer on the front panel of the NMP. The circuit is designed to generate a current from 0 to >1.2mA over the range of the potentiometer.

Table 2-6 Potentiometers (Analog Amplifier – Cal Hi)

Potentiometer	Function
R37	Cal Hi Current Adjust

While any of the test modes are active, a relay disconnects the current input from the detector to the NMP. A signal from the microprocessor activates this relay. This relay can be activated via the Ethernet interface or via a remote connector.

2.2.3 Digital Interface Board (T3133303-001)

Refer to schematic T3133301 for circuit details.

The digital interface board houses the microprocessor and circuitry that interfaces with the all the other boards. It also contains power supplies for digital power, A/D converters, communications circuitry, and the watch dog timer. The microprocessor is part of the microprocessor assembly, a commercially available microprocessor with integrated memory, Ethernet communication, and other peripherals. An 8-position DIP switch lets the user set the Ethernet address and other parameters as described in the communications interface document.

The +24 Vdc, generated on the motherboard, is converted by two switching power supplies to +3.3 Vdc and +5 Vdc digital power. The +3.3 Vdc supply is mainly used to power the microprocessor assembly, whereas the +5 Vdc is used to power the GPIO (General Purpose I/O) circuitry and the display.

Digital inputs originating at the remote connectors or other board assemblies within the module are routed to the digital interface board. The nominal input is +15 Vdc and zero. First, the incoming signals get level shifted to +5 Vdc, and then read by GPIO integrated circuits. The GPIO ICs then communicate via an isolated SPI bus with the microprocessor board. Outgoing signals are generated by the microprocessor, sent to the GPIO ICs via SPI bus, and then level shifted to +15 Vdc. There are a total of 24 inputs and 24 outputs available.

[redacted] The incoming analog signals (+10 Vdc full scale) are divided in half by op-amp circuitry and sent to the A/D converter. The A/D converter communicates with the microprocessor via isolated SPI bus. An additional [redacted] stand-alone A/D converter communicates with the microprocessor via parallel bus. It is intended to be used for reading fast pulsed signals. The input to this A/D converter is designed to be +2.5 Vdc. Two op-amp circuits perform the input signal conditioning. One circuit can be used to divide an incoming +10 Vdc signal by 4, the other to multiply a +1 Vdc signal by 2.5.

Table 2-7 Jumpers (Analog Amplifier – Divide/Multiply)

Jumper	Divide by 4	Multiply by 2.5
JP1	1-2	2-3

The microprocessor contains two Universal Asynchronous Receiver/Transmitter (UARTs) that are used for communication with the display and the remote display/maintenance port on the rear panel via RS-232. The remote display/maintenance port is isolated with its own power supply and digital isolator. The nominal isolation voltage is >1,500 Vrms.

A watch dog timer (WDT) monitors the activity of the microprocessor. If the WDT receives no input from the microprocessor for more than 1.6 seconds, the WDT sends an alarm and takes the module out of operate. When a WDT alarm occurs, the heartbeat LED will stop blinking, the loss of communications will cause all trips to set, and the console WDT Alarm will occur. A WDT alarm is latching in the instrument and can only be reset by cycling power (or, if the instrument cover is off and the instrument is in Test Mode, by pressing S2 on the Digital Interface Board). The heartbeat LED indicates the activity of the microprocessor and will blink about once per second as long as all software tasks are executing properly. A WDT alarm is expected to be an extremely rare event.

2.2.3.1 Component Location

[redacted]

S1
not in
view

D1
heartbeat

S2

Figure 2-4 Digital Interface Board

S1 NETBURNER (8 POS) DIP Switch
S2 RESET Switch (used for development and testing only)
D1 Heartbeat LED

2.2.3.2 Dipswitches on the Microprocessor Daughterboard

NOTE: For the S1 DIP switch, logic 1 is an OFF setting of the switch and logic 0 is an ON setting of the switch. The signal logic is active low. Therefore, the printed legend on the DIP switches is backwards.

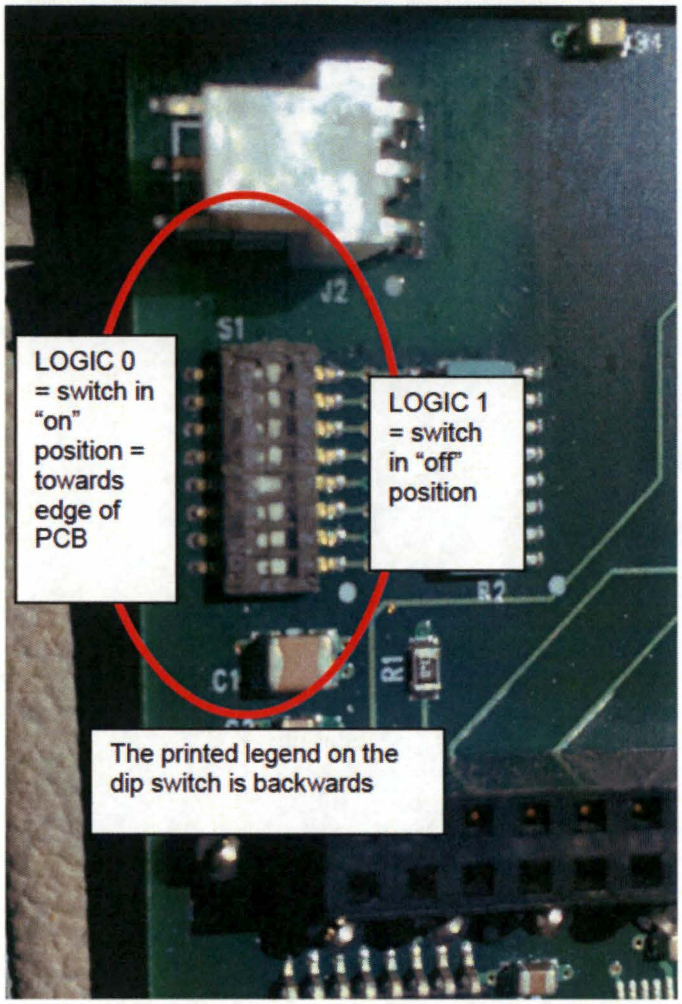


Figure 2-5 Digital Interface Board DIP switch S1

The microprocessor daughterboard contains 1 DIP (labelled S1) with 8 switches, see Figure 2-5. These switches have the following uses:

Table 2-8 S1 Dip Switches (Microprocessor)

Dip Switch	Purpose	Default Setting
1	Static IP address selection (bit #0)	1
2	Static IP address selection (bit #1)	1
3	Static IP address selection (bit #2)	1
4	Watchdog test	1
5	Ethernet multiple connections enabled.	1
6	COM port control bit #0	1
7	COM port control bit #1	1
8	Test mode enabled	1

The module can be programmed to one of four different static IP address. Dip switches #1, #2, and #3 select one of the seven possible IP addresses as follows:

Table 2-9 S1 Dip Switches LOGIC settings (Ethernet Addresses)

Dip Sw #3	Dip Sw #2	Dip Sw #1	Static IP Address
0	0	0	Ethernet access disabled
0	0	1	base address+6
0	1	0	base address+5
0	1	1	base address+4
1	0	0	base address+3
1	0	1	base address+2
1	1	0	base address+1
1	1	1	base address

The base address for the NMP-1000 is [redacted]

If dipswitch #5 is in the LOGIC 1 position (and dip switches #1, #2 and #3 are not all LOGIC 0), then the microprocessor will support multiple connections over the Ethernet (at least two, maximum is dependent upon the microprocessor). If dipswitch #5 is in the LOGIC 0 position (and dip switches #1, #2 and #3 are not all LOGIC 0), then the microprocessor will support only a single connection on the TCP/IP socket.

NOTE: If dipswitches #1, #2 and #3 are all in the LOGIC 0 position ("000"), then no Ethernet communications is possible.

Dip switches #6 and #7 control the communications ports as follows:

Table 2-10 S1 Dip Switches LOGIC settings (Com Ports)

Dip Sw #7	Dip Sw #6	COM port status
0	0	COM0 disabled, COM1 drives LCD display in/out
0	1	Reserved
1	0	COM0 LCD in/out, COM1 LCD in/out (independent operation)
1	1	COM0 is status/maintenance port, COM1 drives display in/out.

If dipswitch #8 is in the LOGIC 1 position, then the system will accept test commands over the Ethernet. This dipswitch is only used during initial factory and site testing and is placed “OFF” at the conclusion of testing. When dipswitch #8 is enabled, the instrument responds to a remote ‘Test’ command. When dipswitch #8 is disabled, a remote ‘Test’ command will result in an error signal.

2.2.4 Trip/Alarm Board (T3301133-001)

Refer to schematic T3301131 for circuit details.

The trip/alarm board contains six identical circuits to generate all trip and alarm indications. Every circuit is jumper configurable for a rising or falling trip. A comparator monitors an incoming signal voltage and compares it to a reference voltage. The reference voltage is user adjustable via a potentiometer. When the circuit is configured for a rising trip, the comparator will switch states when the amplitude of the incoming signal exceeds the reference signal. A falling trip works the opposite way; when the incoming signal amplitude falls below the reference voltage, the comparator will switch states. Once a trip has occurred, the circuit latches in the tripped state. The only way to unlatch the circuit is for the user to apply a reset signal, even if all signal levels return to nominal prior to the reset.

Every trip has a DPDT (Form C) relay that the user can connect to via the remote connectors. The relay is controlled by the output of the comparator and the operate signal. Taking the NMP out of operate mode (such as during a self-test) will immediately activate all trip relays. This is considered the failsafe condition - when all trips are set and latched, but not necessarily indicated by the front panel LEDs or remotely.

The trip logic signal (comparator output) is only activated when the comparator input exceeds its setpoint. Simply taking the NMP out of operate mode will not activate the trip logic signal. The front panel LEDs, opto-isolator

outputs, and Ethernet indications are driven by the trip logic signal, and so will only indicate a trip when the comparator input exceeds the setpoint.

Because entering any self-test mode causes the loss of the operate signal and therefore activates the trip relay; the user may, in some cases, choose to bypass the operate signal on a trip circuit. To disable this feature, jumper settings have been provided to prevent a given trip when the instrument enters a test mode.

NOTE: this feature does not change operation of the trip in normal operations – the trip will still activate the relay if the setpoint is exceeded. It simply prevents an automatic trip when entering test mode.

Important: The Operate and WDT signals are logically tied together on the motherboard PWA. Bypassing the operate signal on a trip circuit also bypasses the WDT on the same trip. All trip circuits are independent of each other, so jumper settings and Operate Enable/Bypass for any one trip will not affect any others. The front panel LEDs and Ethernet output are not affected by this jumper.

Detailed Trip Settings:

Table 2-11 Detailed Trip Settings:

Trip #	Jumper #	Rising	Falling	Reference Adjustment	Operate Enable	Operate Bypass
1	JP18				2-3	1-2
	JP17	2-3	1-2	R75		
	JP16	1-2	2-3			
2	JP15				2-3	1-2
	JP14	1-2	2-3	R61		
	JP13	2-3	1-2			
3	JP12				2-3	1-2
	JP11	1-2	2-3	R47		
	JP10	2-3	1-2			
4	JP9				2-3	1-2
	JP8	2-3	1-2	R33		
	JP7	1-2	2-3			
5	JP6				2-3	1-2
	JP5	1-2	2-3	R19		
	JP4	2-3	1-2			
6	JP3				2-3	1-2
	JP2	2-3	1-2	R5		
	JP1	1-2	2-3			

As an example, consider the HV trip jumper set to Operate Bypass. If the operator enters any test mode, all trips except the HV trip will go to failsafe mode (meaning, the trips activate). If the operator then initiates the HV trip test; the HV trip will occur, the front panel LED will light, and the Ethernet trip signal will be sent. If the operator returns to normal operations (but does not change the jumper position), the HV trip is still active and will trip if a HV fault occurs. However, if only a WDT occurs, the HV trip will NOT indicate a fault (all other trips not in Operate Bypass will go to failsafe).

2.2.5 Isolation Amplifier Board (T3133113-001)

Refer to schematic T3133111 for circuit details.

The isolation amplifier board houses two isolated outputs that can be jumper configured for either voltage or current output. The isolators are commercially available programmable voltage to current converters. The converters provide 1500Vrms galvanic isolation. Adjustment potentiometers allow the isolators to be calibrated for offset and span.

Table 2-12 Analog Outputs Jumper Settings

Output	Offset	Span
A	R12	R11
B	R14	R13

A 0 to +10 Vdc input will generate a 4 to 20mA or 0 to +10 Vdc output that is available to the user via the remote connectors. The minimum compliance voltage for current loop operation is +8 Vdc. Voltage output is achieved by inserting a shunt resistor into the loop. The receiving device should have an input impedance >50kΩ, otherwise unacceptable measurement errors may occur.

Table 2-13 Potentiometers (Isolated Outputs)

Output	Jumper	4-20mA	0-10V
A	JP1	1-2	2-3
	JP2	2-3	1-2
B	JP3	1-2	2-3
	JP4	2-3	1-2

2.2.6 Display

The display on the front of the module is a Monochrome LCD Display with white LED backlight. The display has a viewing area of 3.8 inches (diagonal) and a resolution of 320 X 240 (QVGA). The display includes an integrated touch panel and integrated digital backlight & contrast controls. A complete graphical operating system that executes GUI applications built in dynamic HTML is included with the display.

2.2.7 Front Panel Board (T3400123-001)

Refer to schematic T3400121 for circuit details.

The front panel board houses the red LED indicators for all trips, activated by the trip/alarm board. The remote/local switch lets the user control whether the module is in remote or local mode. A green LED indicator is wired in with the switch; it is lit when the module is in remote mode.

A potentiometer lets the user manually control the current in test mode. This potentiometer is accessible with a knob on the front panel. Two recessed potentiometers, accessible via the front panel with an adjustment tool, let the user adjust the compensation power supply voltage on the NMP.

Table 2-14 Potentiometers (Front Panel)

Potentiometer	Function
R20	Manual current adjust
R6	Compensation Power Supply Coarse Adjust
R21	Compensation Power Supply Fine Adjust

2.2.8 PS1 Power Supply

The 4W high voltage power supply is powered from +24 Vdc and can supply up to +1,000 Vdc with a maximum of 2mVp-p ripple. An internal sense circuit returns 0 to +1 Vdc for an output of 0 to +1,000 Vdc. Circuitry on the motherboard amplifies this sense voltage to +10 Vdc at maximum output. Additional circuitry is connected to the sense line to enable the HV self-test. A potentiometer located on the motherboard lets the user manually adjust the HV output.

Table 2-15 Potentiometer (High Voltage)

Potentiometer	Function
R4	High Voltage Adjustment

2.2.9 Compensation Power Supply

The compensation power supply produces an output voltage from -8 to -200 Vdc (depending on the part number, see below) with a ripple of less than 10 mVp-p. The +5 Vdc input power is derived from the +15 Vdc analog supply and a linear regulator. The output of the compensation power supply is controlled by a 0 to +3 Vdc programming voltage that can be adjusted by the user with potentiometers accessible on the front panel of the NMP. The compensation power supply is short circuit protected with two external resistors. As a result, depending on the load, the maximum voltage may not be available to the load, as the protection resistors will drop some voltage. A voltage sense circuit monitors the output and returns 0 to +10 Vdc for 0 to maximum output voltage. To accommodate a variety of detection systems and user situations, three different compensation power supplies are available:

- Part number T3401000-001 provides a -30 to -200 Vdc compensation power supply.
- Part number T3401000-002 provides a -8 to -50 Vdc compensation power supply.
- Part number T3401000-001 provides a -23 to -150 Vdc compensation power supply.

NOTE: All of the compensating power supplies drop out around 15-20% of their maximum output voltage. This is a result of fundamental design characteristics from the OEM and cannot be changed.

2.3 FRONT PANEL CONTROLS AND INDICATORS

The front panel of the NMP-1000 is shown in Figure 2-6. Each control and indication is described in Table 2-16.

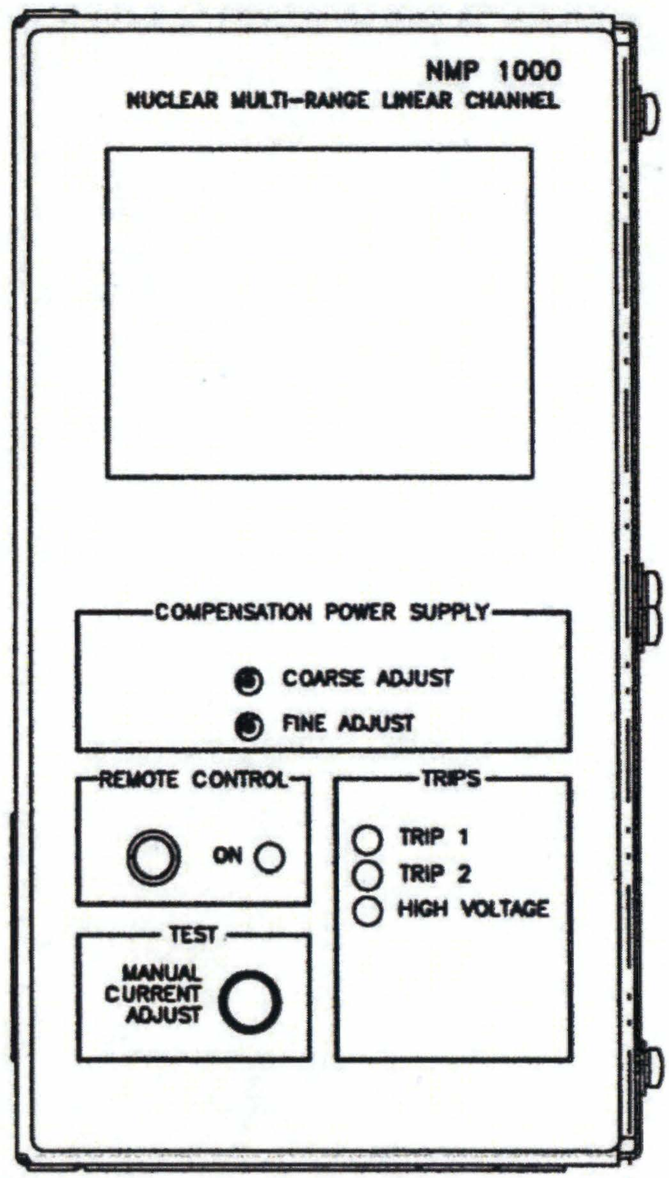


Figure 2-6 Multi-range Linear module NMP-1000, Front View

Table 2-16 Controls and Indicators, Front Panel

Label	Description
LCD Display	
Touchscreen Display	User interface
Compensation Power Supply	
Coarse Adjust	CCW: Decreases current CW: Increases current
Fine Adjust	CCW: Decreases current CW: Increases current
Remote Control	
Button Switch	Depressed/engaged to enter local mode, out/disengaged for remote mode[2]
On (Green)	Illuminates when in remote mode
Test	
Manual Current Adjust	CW: Increases current CCW: Decreases current
Trips	
Trip 1 (Red)	Illuminates when percent reactor power setpoint is exceeded, independent of Trip 2.
Trip 2 (Red)	Illuminates when percent reactor power setpoint is exceeded, independent of Trip 1.
High Voltage (Red)	Illuminates when HV goes below the HV setpoint

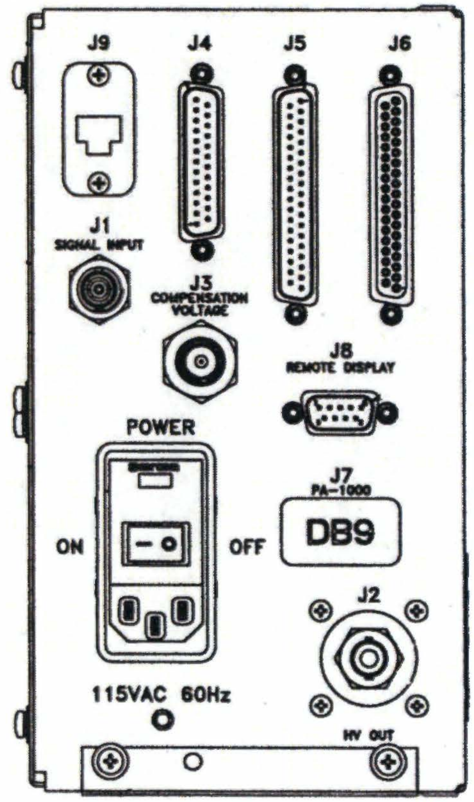
2.4 REAR PANEL CONNECTORS

The rear panel connectors of the NMP-1000 are described in Table 2-17.

[2] When the NMP-1000 is operated in remote mode, it is necessary to select a range (REM_1E-11 to REM_1E-3 or REM_AUTO) via the rear panel connector J6. If no range is selected, the instrument will default to the 1E-3 range. This is true even if the instrument is otherwise controlled via the Ethernet port (trip reset and test modes). For details on the remote connectors, see section 6 of this manual.

Table 2-17 Connectors, Rear Panel

Ref. Des	Type	Label	Signal
J1	BNC Coax	Signal (Current) Input	From detector
J2	MHV (Coax)	HV Out	High Voltage output for detector
J3	TNC Coax	Compensation Voltage	Compensation voltage for detector
J4	DB25 pin (male)		Trip relay outputs
J5	DB37 pin (male)		Remote inputs, trip outputs and analog outputs
J6	DB37 socket (female)		Range indication contacts, remote selection inputs
J7	DB9	PA-1000	Not used (for PA-1000)
J8	DB9 (male)	Remote Display	RS232 external communication to remote display or maintenance computer
J9	RJ45	Comms with console	Ethernet
Power	ON/OFF switch and power connector	Power 115 Vac, 60Hz	AC power



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3.0 OPERATING INSTRUCTIONS (MENUS AND DISPLAYS)

This section contains detailed information on initial operation, monitor startup/shutdown and normal monitor operating procedures.

3.1 INITIAL OPERATION

Before applying power to the NMP-1000 for the first time, perform the following:

a. Verify that the power switch on the rear panel is in the OFF position.

b. Verify connection of ac power to power connector on the back of the module and to an ac outlet.

c. If a detector is to be connected, verify that the signal cable is connected to J1, SIGNAL INPUT, on the rear panel, and that the high voltage cable is connected to J2, HV OUT, on the rear panel. (Refer to Table 1-2 for connection information.) If the detector is a compensated ion chamber, connect the compensation volts cable to J3, COMPENSATION VOLTAGE, on the rear panel. Just prior to connecting any detector cable to the instrument, it is recommended to discharge any static electricity from the center pin by momentarily shorting the center pin to ground.

d. If the outputs for the remote display, for the network or for trip outputs are to be connected, verify the cables are connected for those devices.

3.2 STARTUP OPERATION

For local control follow these instructions:

a. Set the power switch on the Power connector on the rear panel to the ON position.

b. Set the module to Local Mode by depressing/engaging the Remote Control button switch.

c. Verify the green LED is extinguished.

d. Verify the NMP-1000 LCD displays the Main Menu Display.

e. Ensure all trip and the High Voltage indicators are extinguished. Press Trip Reset on Main Menu if necessary.

3.3 NORMAL OPERATION (LOCAL)

a. On the Front Panel, ensure the Remote Control button switch is depress/engaged.

b. Verify that the green LED is extinguished to indicate that the module is in Local Mode.

c. On the Front Panel, turn the Manual Current Adjust potentiometer to full CCW.

d. On the LCD press the Gain button. In the Gain menu Display, press the Auto button.

e. On LCD press the Test/Cal button. In the Test/Cal menu Display, press the OPERATE button.

f. Ensure all the trips on the front panel are extinguished.

3.4 NORMAL OPERATION (REMOTE)

a. On the Front Panel, ensure the Remote Control button switch is not depressed/engaged.

b. Ensure the green LED is illuminated to indicate that the module is in the Remote Mode.

3.5 SHUTDOWN OPERATION

To shut down the module, set the power switch on the rear panel to the OFF position.

3.6 LCD DISPLAY SCREENS

3.6.1 Description

There are four menu displays available on the NMP-1000. The first three displays have buttons to select any of the four displays and on their screen power in percent is displayed. From About Menu display only the Test/Cal Menu display is selectable.

- Main Menu: general information
- Gain: current range selectable
- Test/Cal: operation and test modes are selectable.
- About: software information and display control adjustable

NOTE: In the following descriptions of the menus, it is assumed the NMP-1000 is in Local Mode.

To enter the NMP-1000 Local Mode, depress the Remote button on the NMP-1000 front panel, and verify the green ON LED is extinguished.

3.6.2 Main Menu Display

The Main Menu provides several different parameter readings, a bar graph, trip reset, watchdog indication and a menu.

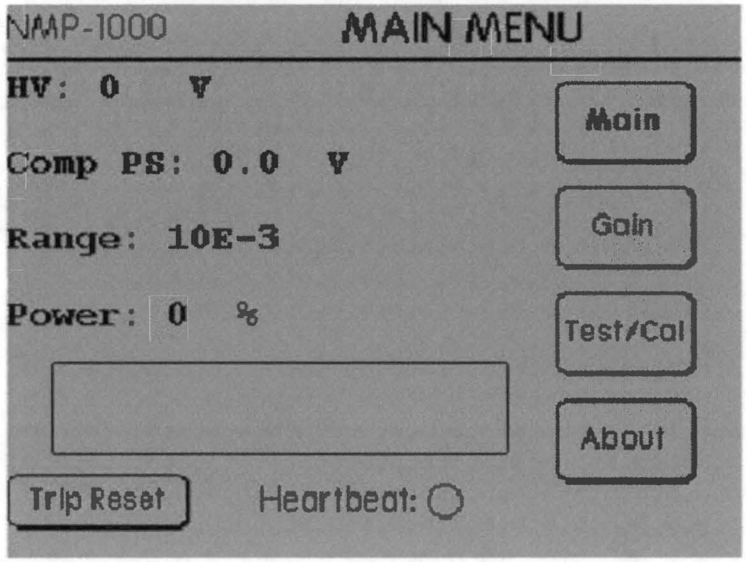

Figure 3-1 Main Menu

3.6.2.1 Display Parameters

The parameter readings are a single value except power which also displayed in a bar graph.

- HV — high voltage for the detector (0 to 1000 volts dc)
- Comp PS — absolute value of voltage setting of compensation power supply output (0 to maximum Vdc range)
- Range — selected range of electrometer (10E-11 to 10E-3 amps)
- Power — percent reactor power measured by the detector (0 to 120 %)

3.6.2.2 Bar Graph

The bar graph is used to display percent reactor power scaled from on a linear scale of 0 to 120%.

3.6.2.3 Navigation Buttons

Four navigation buttons are provided.

- Main — used to indicate Main is being displayed
- Gain — used to select the Gain display
- Test/Cal — used to select the Test/Cal display
- About — used to select the About display

3.6.2.4 Trip Reset

The Trip Reset is used to extinguish the trip indicators if the trip is cleared.

3.6.2.5 Heartbeat Indicator

The Heartbeat indicator flashes between black and blank to indicate that the microprocessor is functioning and the software has not hung. A momentary glitch that restores microprocessor functionality in less than about 1.6 seconds will not trip the WDT; and the Heartbeat indicator will simply pick up its flashing display. If a WDT does activate, it is a latching trip; and the only recovery is to cycle power on the instrument (or press S2 on the DIB with the instrument cover off). The WDT is only reset during system startup.

3.6.3 Gain Menu Display

The gain menu display provides buttons to select the detector measurement range (decade) and automatic software range selection mode. In the automatic mode, the software selects range based on the current range by switching one range lower when the current is below 8% of range and switching up one range when the current exceeds 95% of range.

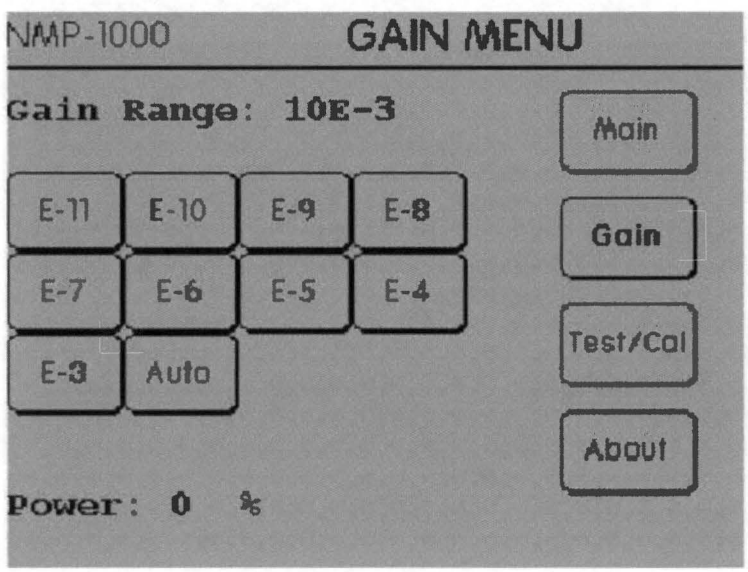

Figure 3-2 Gain Menu

3.6.3.1 Display Parameters

The display parameters are as follows:

- Gain Range: The current selected range is displayed.

- Selectable Ranges: In local mode, the buttons can be used to select a range or Auto.
- Power: The percent power is displayed.

3.6.3.2 Navigation Buttons

Four navigation buttons are provided.

- Main used to select Main
- Gain used to indicate Gain is displayed
- Test/Cal used to select the Test/Cal display
- About used to select the About display

3.6.4 Test/Cal Menu Display

The Test/Cal menu display provides four self-tests buttons and an Operate button. The NMP-1000 returns to Operate after 50 seconds of inactivity. The self-tests are Calibrate High, Calibrate Low, Manual Current and HV Test.

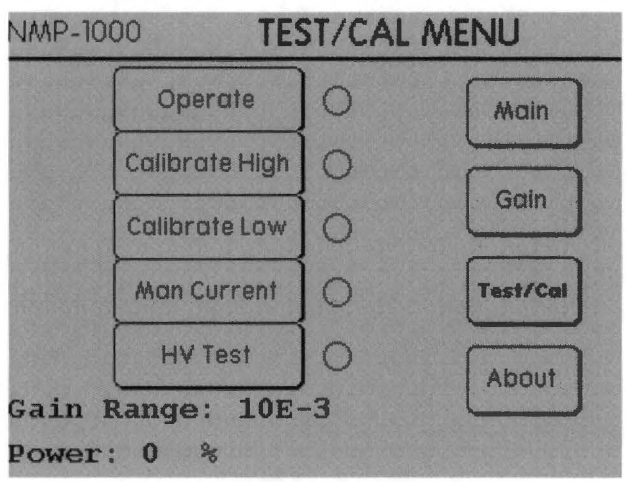

Figure 3-3 Test/Cal Menu

3.6.4.1 Display Parameters

The display parameters are as follows:

- Test Mode Buttons: In local mode, the buttons can be used to select a self-test or Operate
- Power: percent power

3.6.4.2 Test Mode Buttons

The display includes five Test Mode buttons: Operate, Calibrate High, Calibrate Low, Man Current and HV Test.

3.6.4.2.1 Operate Mode Button

This button is used to select the Operate mode and to indicate the module is in Operate.

3.6.4.2.2 Calibrate High Mode Button

This button is used to test Trips 1 and 2. A setting of 120% power or 1.2 mA is used as factory setting.

a. Press Calibrate High.

b. Verify Trip 1 LED illuminates.

c. Verify Trip 2 LED illuminates.

d. In the Test/Calibration Menu press the Operate button.

e. To reset the trips, select Main Menu and press Trip Reset.

3.6.4.2.3 Calibrate Low Mode Test

This button is used to test the performance of the module at a low current. A setting of approximately 0.19 mA is used. No trips should occur.

a. Press Calibrate Low.

b. Verify that no trips occur and that approximately 19% power is indicated.

3.6.4.2.4 Manual Current Test Mode

This button is used to test the automatic range selection. The Current Adjust knob can be used to adjust from 1E-1E-11 to 1E-3 amps.

a. Verify that the Gain is set to Auto on the Gain Menu Display.

b. Ensure that the Current Adjust knob is set to minimum (full CCW)

c. Press Man Current.

d. Turn the Manual Current Adjust knob clockwise on the Front Panel to obtain an increasing value% power. Verify that software autoranges by selecting the next decade.

e. Repeat the previous step for each decade being used.

f. In the Test/Calibration Menu press the Operate button.

g. To reset the trips, select Main Menu and press Trip Reset.

3.6.4.2.5 HV Test Mode

This button is used to test the HV trip. A high voltage of about 9% of the high voltage nominal value is used for the test. During this test, the HV to the detector is disconnected so there is no power output on the J2 connector on the rear panel.

a. Press HV Test.

b. Verify High Voltage Trip LED illuminates.

c. In the Test/Cal Menu Display, press the Operate button.

d. To reset the trips, select Main Menu and press Trip Reset.

3.6.4.3 Navigation Buttons

Four navigation buttons are provided.

- Main used to select Main
- Gain used to select Gain
- Test/Cal used to indicate Test/Cal is displayed
- About used to select the About display

3.6.5 About Menu Display

The About Menu Display provides software version information, IP address, and adjustments for contrast and backlight.

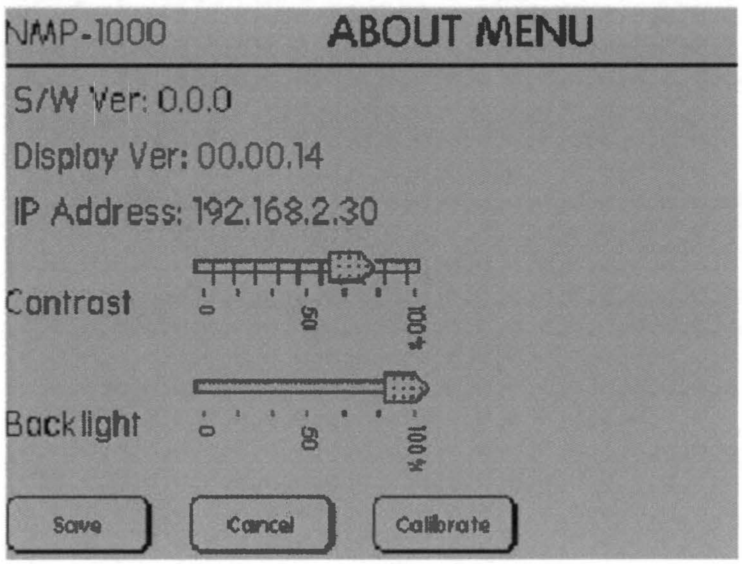

Figure 3-4 About Menu

3.6.5.1 Display Parameters

The display parameters are as follows:

NOTE: The software and display version will always be identical.

- software (microprocessor) version
- display (Display) software version
- IP address

3.6.5.2 Adjustments

The display includes two slide controls for the display.

- contrast
- backlight

3.6.5.3 Buttons

- Calibrate opens the Calibrate Display
- Save saves the LCD settings made on this Display
- Cancel does not retain any setting changes and returns to Main Menu display

3.6.6 Calibrate Display

The Calibrate Display provides a method to adjust the screen edges for selectable area. A Touch Center is provided in the upper left, lower right and center.

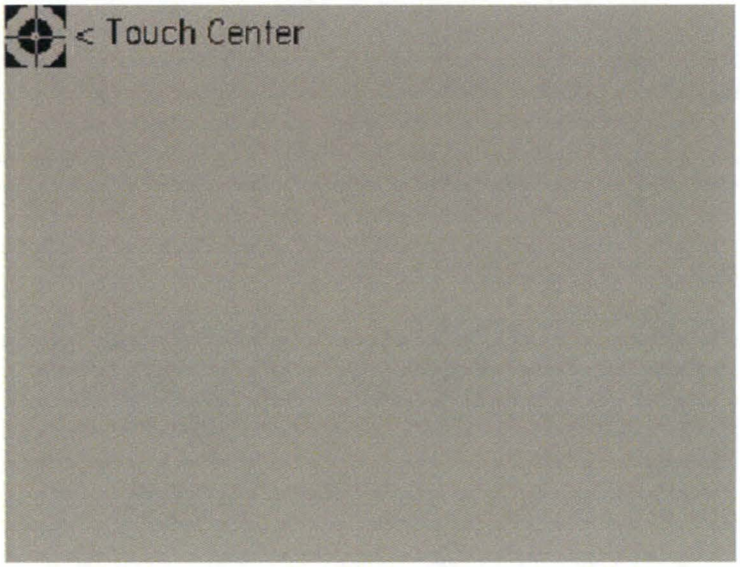

Figure 3-5 Calibrate Display

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4.0 MAINTENANCE (CALIBRATION)

4.1 PRELIMINARIES

All instructions in Section 4 use these preliminaries unless otherwise specified.

The NMP-1000, Multi-Range Linear Channel, P/N T3401000-001, -002, -003.

NOTE: It is assumed the microprocessor and Display code is properly installed.

NOTE: Cycling the AC power at any time, whether in normal operation or during maintenance, does not invalidate the calibration in any way.

4.1.1 Reference Documents

See Section 5, Engineering Drawings.

4.1.2 Test Equipment

a. AC power cord

b. Current source with range of 1pA to >1.2mA and BNC output cable

c. Extender card for A2 Analog Amplifier, GA-ESI P/N T3400183-001 or equivalent

d. Remote display with power source, if applicable

e. RS232 cable, DB9M to DB9F, straight through for the remote display, if applicable

f. DMM, Fluke 787 or equivalent

CAUTION

AC and DC voltages are present during this test
on the NMP-1000. Observe proper safety precautions.

4.1.3 Setup

a. Remove the cover from the NMP-1000.

b. Connect the AC power cord to the NMP-1000 and plug it in, but do not turn on the power.

c. Connect the current source to J1 on the NMP-1000.

d. Set the following dip switch settings on S1 on the Digital Interface Board. Reference Figure 2-5.

Table 4-1 Dip Switch Logic Settings

Switch	Purpose	Setting
1	Static IP address Selection (bit #0)	NOTE 1
2	Static IP address Selection (bit #1)	NOTE 1
3	Static IP address Selection (bit #2)	NOTE 1
4	Reserved for module-specific purposes	1
5	Ethernet multiple connection enabled	0
6	COM port control bit # 0	1
7	COM port control bit # 1	0
8	Test mode enabled	1

NOTE 1: See Section 2.2.3.2 for important information regarding switch labels.
Dip Switch settings are customer specific.

4.2 MOTHERBOARD (HVPS) CALIBRATION

4.2.1 Component Location

Use the following graphics to locate calibration components.

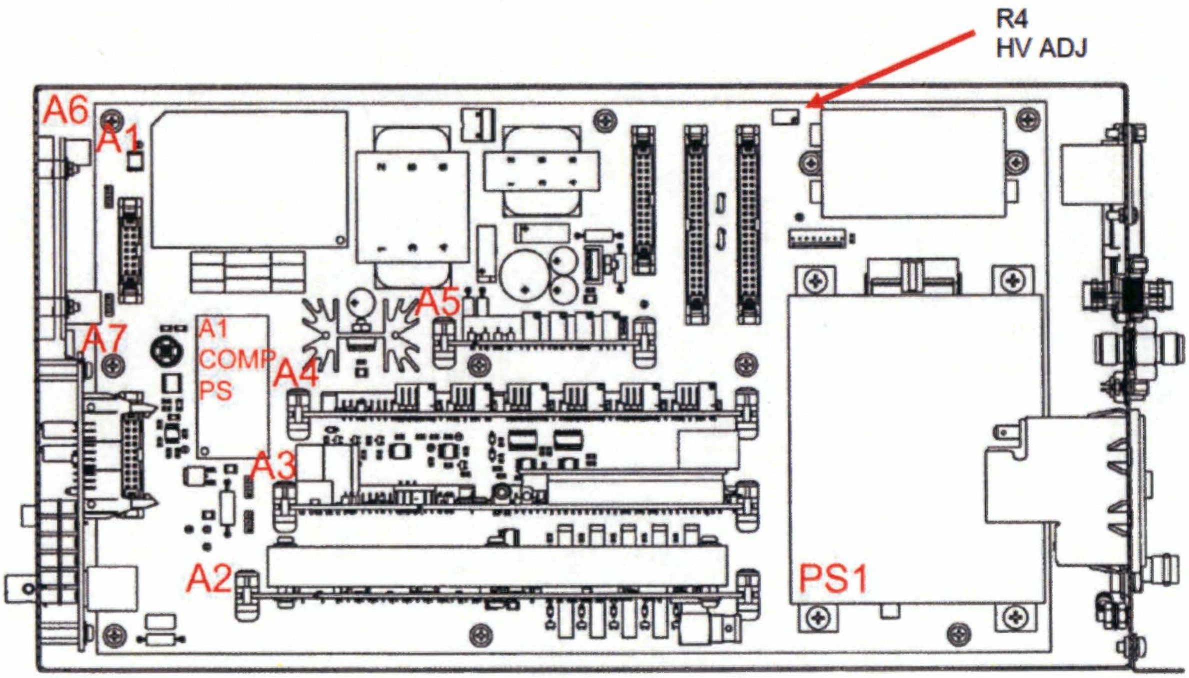

Figure 4-1 Motherboard Layout

4.2.2 High Voltage Calibration

NOTE: This is a functional checkout. The actual high voltage will have to be set based on detector requirements.

a. Monitor the output voltage of the HV power supply on rear panel connector J2 with a DMM capable of reading up to 1000 Vdc.

b. Vary R4 on the motherboard and verify that the power supply produces between 300 and 1000 Vdc.

c. Set the power supply output for 800 Vdc with R4.

d. Verify the HV value on the MAIN MENU Display is 800V ± 12V.

4.3 PWA, ANALOG AMPLIFIER – CALIBRATION

4.3.1 Component Location

Use the following graphics to locate calibration components.

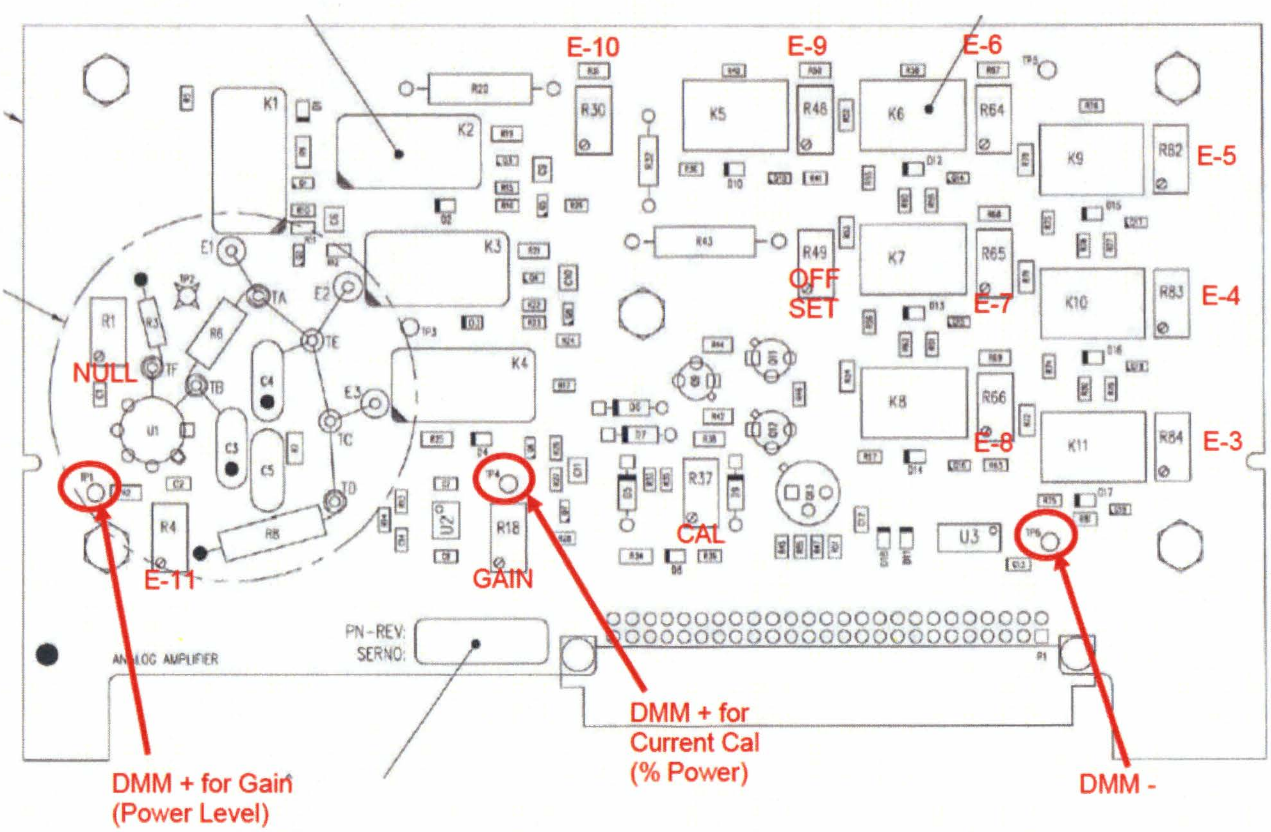

Figure 4-2 Analog Amplifier Board Layout

4.3.2 Power/Current Calibration

In general, the NMP-1000 and detector should be setup such that 1mA equals 100% reactor power. This is accomplished by first performing the bench calibration described below, then reinstalling the instrument, operating the reactor to determine actual power levels (via other instrumentation), and physically repositioning the detector so the NMP indicated power equals actual power.

4.3.2.1 Setup - Null

NOTE: Anytime any circuit boards are removed or installed, instrument power must be OFF to prevent damage to the circuits. Use caution and discharge static electricity to the extent practicable before handling or working with circuits.

a. Install the extender card for the analog amplifier and install the EMI shield.

b. Connect a DMM to TP1 (+) and TP6 (-) on the Analog Amplifier PWA.

c. Set the current source for an output of zero current (0.000nA), and wait at least 5 minutes. Adjust potentiometer R1 until the DMM reads 0.00 ± 0.05 Vdc on TP1. After every adjustment, wait at least 5 minutes for the voltage to settle. Readjust until the desired accuracy is reached.

NOTE: When adjusting the offset voltage, pay attention to the compliance voltage of the current source. If necessary, readjust R1 until the compliance voltage displayed by the current source is a positive value. Any positive value is fine. A negative value will cause the manual current test to fail (range will not be adjustable down to 10E-11 range with the front panel potentiometer), as it will produce a small current that is additive to the expected current from the manual current source.

When setting R1 for a positive compliance voltage rather than 0V offset, a small measurement error will be introduced in the lowest current range. That error is dependent on the amplitude of the compliance voltage and is typically less than 10% at 5pA.

d. On the MAIN MENU Display, select the Gain button to enter the GAIN MENU Display.

4.3.2.2 E-11

a. Select the E-11 button on the GAIN MENU Display.

b. Set the current source for an output of 10pA.

c. Adjust potentiometer R4 until the DMM reads -10.00 ± 0.05 Vdc.

NOTE: It may take several minutes for the reading to stabilize in the lowest ranges. Wait for the reading to stabilize before making final adjustments.

d. Set the current source for an output of 5pA.

e. Verify that the DMM reads -5.00 ± 2 Vdc after the reading has stabilized.

4.3.2.3 E-10

a. Select the E-10 button on the GAIN MENU Display.

b. Set the current source for an output of 100pA.

c. Adjust potentiometer R30 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.2.4 E-9

a. Select the E-9 button on the GAIN MENU Display.

b. Set the current source for an output of zero current.

c. Adjust potentiometer R49 until the DMM reads 0.00 ± 0.05 Vdc, or until R49 is adjusted fully CCW.

d. Set the current source for an output of 1nA.

e. Adjust potentiometer R48 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.2.5 E-8

a. Select the E-8 button on the GAIN MENU Display.

b. Set the current source for an output of 10nA.

c. Adjust potentiometer R66 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.2.6 E-7

a. Select the E-7 button on the GAIN MENU Display.

b. Set the current source for an output of 100nA.

c. Adjust potentiometer R65 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.2.7 E-6

a. Select the E-6 button on the GAIN MENU Display.

b. Set the current source for an output of 1μA.

c. Adjust potentiometer R64 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.2.8 E-5

a. Select the E-5 button on the GAIN MENU Display.

b. Set the current source for an output of 10µA.

c. Adjust potentiometer R82 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.2.9 E-4

a. Select the E-4 button on the GAIN MENU Display.

b. Set the current source for an output of 100µA.

c. Adjust potentiometer R83 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.2.10 E-3

a. Select the E-3 button on the GAIN MENU Display.

b. Set the current source for an output of 1mA.

c. Adjust potentiometer R84 until the DMM reads -10.00 ± 0.05 Vdc.

4.3.3 Gain

NOTE: This adjustment should not be used to make indicated power equal actual power during reactor operation, as repeated adjustments could cause the instrument to operate above 1.2 mA (or outside the calibrated range). The preferred method is to perform the bench calibration first, then physically reposition the detector to make indicated power equal actual power.

a. Connect a DMM to TP4 (+) and TP6 (-) on the NMP-1000 and set it to measure Vdc. Alternately, connect a DMM to the corresponding signal on the extender card (instead of TP4) for easier access.

b. GAIN 100%: Set the current source for an output of 1 mA. Adjust potentiometer R18 until the DMM reads 8.33 ± 0.05 Vdc on TP4.

c. GAIN 120%: Set the current source for an output of 1.2 mA. Verify the DMM reads 10.00 ± 0.05 Vdc on TP4.

4.3.4 Calibrate and Test Current

4.3.4.1 Calibrate High

NOTE: Tests time out and the NMP returns to normal operation after 50 seconds. Re-enable the test mode if the adjustment is not completed within that time.

a. Select the AUTO button on the GAIN MENU Display.

b. Select the Test/Cal button on the GAIN MENU Display to enter the TEST/CAL MENU Display.

c. Select the Calibrate High button on the TEST/CAL MENU Display.

d. Adjust potentiometer R37 until the DMM reads >10.0 Vdc on TP4.

NOTE: Adjusting R37 until the DMM reads >10.0V ensures the test circuit produces more than 1.2mA (or 120% power), which is the nominal high power trip setpoint. To set the test current to a different value, adjust R37 accordingly.

Example: If a high power trip test current of 1.1mA (or 110% power) is desired, adjust R37 for a DMM reading of ~9.167Vdc.

4.3.4.2 Calibrate Low

a. Select the Calibrate Low button on the TEST/CAL MENU Display.

b. Observe the voltage on TP4 should read about 1.50 ± 0.1 Vdc.

4.3.4.3 Test (Man) Current

a. Turn the MANUAL CURRENT ADJUST potentiometer on the front panel fully counter clockwise (CCW).

b. Select the Man Current button on the TEST/CAL MENU Display.

c. Observe the Gain Range on the TEST/CAL Menu Display.

d. Slowly start turning the MANUAL CURRENT ADJUST potentiometer on the front panel clockwise (CW).

e. As the potentiometer is turned CW, observe the Gain Range change from 10E-11 to 10E-3 over the range of the potentiometer.

NOTE: Refer to step 4.3.2.1. If the amplifier offset was set to 0V rather than a positive compliance voltage, it may not be possible to manually adjust the potentiometer into the lowest gain ranges.

f. Turn the MANUAL CURRENT ADJUST potentiometer on the front panel fully counter clockwise (CCW).

4.3.5 Auto-Range Setpoints

a. Select GAIN on the Display, select Auto, then select Main.

b. Set the current on the current source to 0.1µA. Using steps of 0.1 µA, increase current to 0.9 µA. Observe that the range is switched to the next higher range at ~90% Power.

c. Using steps of 0.1µA, decrease the current of 0.9 µA to 0.1 µA. Observe that the range is switched to the next lower range at ~8% Power.

NOTE: The auto-range setpoints are encoded in the NMP firmware and not user adjustable. The above steps merely replicate the factory acceptance test to verify correct functionality of the software and hardware.

4.4 PWA, TRIP/ALARM – CALIBRATION AND FUNCTIONAL CHECK

4.4.1 Component Location

Use the following graphics to locate calibration components.

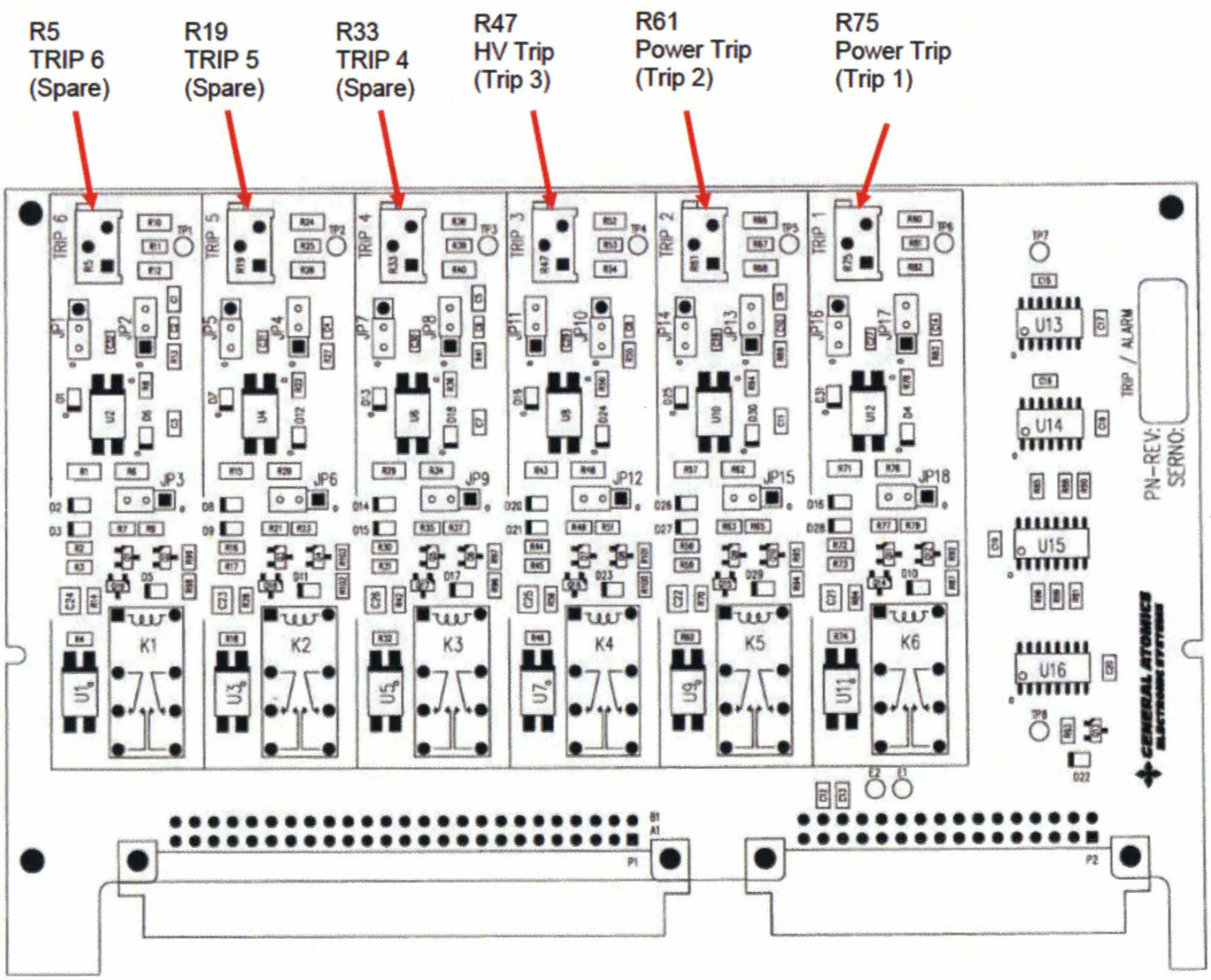

Figure 4-3 Trip/Alarm Board Layout

4.4.2 Calibration of Trips

4.4.2.1 Setup, Normal Operation

NOTE: The trip relay connections on the remote connectors may be checked as part of this calibration. Refer to the remote connector description tables in Section 6.0 SUMMARY OF REAR PANEL CONNECTIONS.

NOTE: Power trips 1 and 2 are user configurable. One trip circuit is usually chosen to be the reactor power high alarm, the other trip circuit is the reactor power high trip. Functionality is based on the overall system configuration. For the purpose of this calibration procedure, trip 1 has been assigned the high power trip functionality, and trip 2 the high power alert. It is the user's responsibility to verify these assignments and adjust the trip settings accordingly.

a. Verify the Trip/Alarm board jumpers are configured per the following table.

NOTE: If the site jumper configuration is different, record the site configuration so that it can be restored after testing.

Table 4-2 Trip/Alarm Jumper Settings

<table>
<tr><th>Jumper</th><th>PINS</th><th>Name</th></tr>
<tr><td>JP18</td><td>2-3</td><td rowspan="3">Trip 1</td></tr>
<tr><td>JP17</td><td>2-3</td></tr>
<tr><td>JP16</td><td>1-2</td></tr>
<tr><td>JP15</td><td>2-3</td><td rowspan="3">Trip 2</td></tr>
<tr><td>JP14</td><td>1-2</td></tr>
<tr><td>JP13</td><td>2-3</td></tr>
<tr><td>JP12</td><td>2-3</td><td rowspan="3">HV Trip</td></tr>
<tr><td>JP11</td><td>2-3</td></tr>
<tr><td>JP10</td><td>1-2</td></tr>
<tr><td>JP9</td><td>2-3</td><td rowspan="3">N/A</td></tr>
<tr><td>JP8</td><td>2-3</td></tr>
<tr><td>JP7</td><td>1-2</td></tr>
<tr><td>JP6</td><td>2-3</td><td rowspan="3">N/A</td></tr>
<tr><td>JP5</td><td>1-2</td></tr>
<tr><td>JP4</td><td>2-3</td></tr>
<tr><td>JP3</td><td>2-3</td><td>N/A</td></tr>
</table>

Jumper	PINS	Name
JP2	2-3	
JP1	1-2	

b. Select the Main button on the TEST/CAL MENU Display to enter the MAIN MENU Display.

> **NOTE:** The HV trip should be set to the setpoint that is determined to be correct for the site. 300 Vdc is used as a setpoint for test purposes.

c. Adjust R4 on the Motherboard until the display displays HV: 300V, or as selected by the customer.

d. Turn R75 on the Trip/Alarm board fully CW.

e. Turn R61 on the Trip/Alarm board fully CW.

f. Turn R47 on the Trip/Alarm board fully CCW.

g. Set the current source for an output of 1.1mA.

> **NOTE:** This is the current level expected for a high power alert and corresponds to 110% reactor power. If a different value is desired, adjust the current accordingly.

Example: For 105% reactor power high alert, set the current source to 1.05mA.

h. Select the Trip Reset button on the GAIN MENU Display.

i. Observe that all front panel trip indicator LEDs are off.

4.4.2.2 Trip 2

a. Turn R61 CCW slowly until the Trip 1 LED on the front panel lights up.

4.4.2.3 Trip 1

a. Set the current source for an output of 1.2mA.

> **NOTE:** This is the current level expected for a high power trip and corresponds to 120% reactor power. If a different value is desired, adjust the current accordingly.

Example: For 110% reactor high power trip, set the current source to 1.1mA.

b. Turn R75 CCW slowly until the Trip 2 LED on the front panel lights up.

4.4.2.4 High Voltage

a. Turn R47 CW slowly until the High Voltage LED on the front panel lights up at just below the setpoint of 300V.

4.4.2.5 Restore System, Normal Operation

a. Adjust R4 on the Motherboard until the Main Menu displays HV: 800 ±12 Vdc.

b. Set the current source for an output of 1.0mA.

c. Select the Trip Reset button on the GAIN MENU Display.

d. Observe that all front panel trip indicator LEDs are off.

4.5 PWA, ISOLATION AMPLIFIER – CALIBRATION AND FUNCTIONAL CHECK

4.5.1 Component Location

Use the following graphics to locate calibration components.

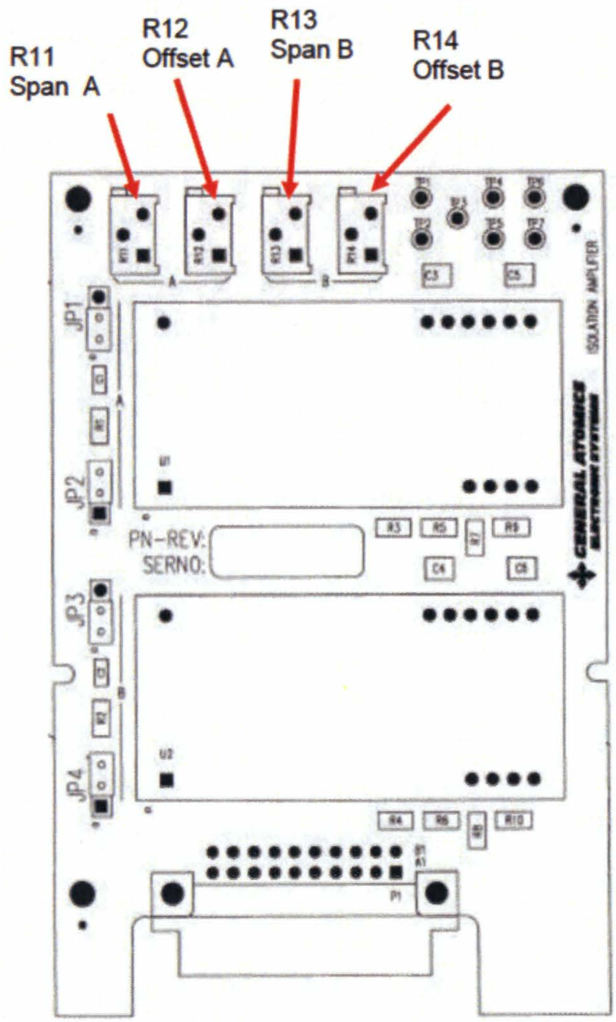

Figure 4-4 Isolation Amplifier Board Layout

4.5.2 Calibration of Isolation Amplifier

There are 2 isolation amplifier outputs, A and B, which indicate the percent power value. They can be jumper configured to either 4-20mA or 0-10V. This calibration section is written for the 4-20 mA output. If 0-10 Vdc is desired, change the switch setting and convert the mA values to Vdc.

Table 4-3 Analog Outputs Jumper Settings

Output		4-20mA	0-10V
A	JP1	1-2	2-3
	JP2	2-3	1-2
B	JP3	1-2	2-3
	JP4	2-3	1-2

4.5.2.1 Setup

a. Verify that the jumpers are set for the 4-20 mA configuration on the Isolation Amplifier board per Table 4-3.

4.5.2.2 Analog Output A

a. Set the current source for an output of zero current.

b. Set the DMM to measure mA and connect it to Pins 22 (+) and 23 (-) of J5 (DB-37 Connector) on the rear of the NMP-1000.

c. On the front panel screen select Gain and E-3.

d. Adjust R12 on the Isolation Amplifier board until the DMM reads 4.0 ±0.2 mA.

e. Set the current source for an output of 1.2 mA.

f. Adjust R11 on the Isolation Amplifier board until the DMM reads 20.0 ±0.2 mA.

4.5.2.3 Analog Output B

a. Connect the DMM set to measure mA to Pins 24 (+) and 25 (-) of J5 (DB-37 Connector) on the rear of the NMP-1000.

b. Set the current source for an output of zero current.

c. Adjust R14 on the Isolation Amplifier board until the DMM reads 4.0 ±0.2 mA.

d. Set the current source for an output of 1.2 mA.

e. Adjust R13 on the Isolation Amplifier board until the DMM reads 20.0 ±0.2 mA.

4.6 COMPENSATION POWER SUPPLY –FUNCTIONAL CHECK

4.6.1 Minimum Value – Full CCW

a. Turn both the Coarse Adjust and Fine Adjust potentiometers on the front panel fully CCW.

b. On the MAIN MENU Display, verify COMP PS: VALUE is less than 2V.

4.6.2 Maximum Value - Full CW

a. Turn both the Coarse Adjust and Fine Adjust potentiometers on the front panel fully CW.

b. On the MAIN MENU Display, verify COMP PS: VALUE is larger than 99% of the rated maximum compensating voltage for the unit under test.

4.6.3 Normal Operation

a. Adjust the Coarse Adjust and Fine Adjust potentiometers for a COMP PS value of about 50 Vdc or as determined by the customer.

4.7 REMOTE DISPLAY VERIFICATION

NOTE: This section is not applicable to sites that do not have remote displays.

4.7.1 Setup

a. Connect the remote display via the RS-232 cable.

b. Verify the remote screen software version number displayed on the ABOUT MENU matches the software version installed in the NLW-1000 Local Display.

c. Verify that the backlight and contrast can be adjusted

d. On the remote display, select Trip Reset, select Gain, and then select E-3.

4.7.2 Trip Occurs

a. Using the current source and starting at 0.9mA, increase the current using steps of 0.1 mA until a current of 1.2 mA is achieved.

b. Verify that both TRIP 1 and TRIP 2 LEDs on the front panel are illuminated.

4.7.3 Return to Normal Operation

a. Decrease current source output to 1.0mA.

b. Select Trip Reset on the Remote Screen. Trip 1 and Trip 2 LED on the front panel should be extinguished.

4.8 REMOTE SIGNAL FUNCTIONS

4.8.1 Electrometer Pulse Disconnect

a. Set the NMP-1000 to Remote Mode.
b. Jumper J5 Pin 20 (GND) to J6 Pin 26 (sets to Auto Range Select) on the D-Sub connectors in the rear of the NMP.
c. Set the current source to 1nA.
d. Verify the front panel screen shows power to be within 7% and 13% and the range to be 10E-8.
e. Jumper J5 Pin 29 (+15 Vdc) to J5 Pin 9 to open the pulse disconnect relay.
f. Verify the electrometer is disconnected as indicated by the percentage of power to be within 7% - 13% and the range set to 10E-11.
g. Remove the jumper from J5 Pin 28 to J5 Pin 9.
h. Verify the power range has returned to 10E-8.

4.8.2 Remote Select Test/Cal Modes

a. On the front panel of the NMP-1000, press Trip Reset.
b. Press the Test/Cal button located on the Main Menu.
c. Verify that the NMP-1000 is in Operate mode.
d. Momentarily connect J5 Pin 28 (+15 vdc) to J5 Pin 16. This may best be accomplished with a push button switch. Verify the NMP has advanced to the first test mode.
e. Continue to momentarily connect J5 Pin 28 (+15 vdc) to J5 Pin 16 and cycle through all 5 modes i.e. Operate, Calibrate High, Calibrate Low, Man Current, and HV test.

4.8.3 Remote Trip Reset

a. On the front panel of the NMP-1000, select Test/Cal Menu.
b. On the front panel, verify that Trip 1, Trip 2, and High Voltage LED's are lit.
c. Select Operate mode.
d. Momentarily Jumper J5 Pin 20 (GND) to J5 Pin 19 to activate the trip reset.
e. Verify that all trips are cleared by verifying Trip 1, Trip 2, and High Voltage LEDs are off.

4.9 REMOTE VOLTAGE

a. Verify the voltage reading between J5 Pin 28 (+15V) and J5 Pin 27 (Ground) is +15.0 Vdc ± 0.5 Vdc.
b. Verify the voltage reading between J5 Pin 30 (+24V) and J5 Pin 27 (Ground) is +24.0 Vdc ± 0.5 Vdc.

4.10 WATCH DOG TIMER

a. Select trip reset on the front panel screen.
b. Verify no trip LEDs on the front panel are illuminated.
c. On the digital interface board, set dip switch 4 on S1 to the OFF position. Verify the heartbeat has stopped pulsing on the NLW.
d. Verify the contact between Connector J4 Pin 20 (Trip_1_A-NO) and Pin 24 (Trip_1_A-C) is open (TRIP 1).
e. Verify the contact between Connector J4 Pin 14 (Trip_2_A-NO) and Pin 18 (Trip_2_A-C) is open (TRIP 2).
f. Verify the contact between Connector J4 Pin 13 (HV_Trip_A-NO) and Pin 9 (HV_Trip_A-C) is open (HV TRIP).
g. On Digital Interface board reset dip switch 4 to ON position and cycle power on the NLW. Verify heartbeat is pulsing.

5.0 ENGINEERING DRAWINGS

5.1 LIST OF ENGINEERING DRAWINGS

Table 5-1 lists the engineering drawings by assembly for the NMP-1000. The drawings marked with an asterisk (*) are not included with this manual.

Table 5-1 Engineering Drawing List

Description	Drawing Number
MULTI-RANGE LINEAR CHANNEL NMP-1000	**T3401000**
PARTS LIST, MULTI-RANGE LINEAR CHANNEL NMP-1000	T3401000-001 T3401000-002 T3401000-003 Depending on compensating PS
A1 PWA, NMP-1000 MOTHERBOARD	T3400113
SCHEMATIC, A1 PWA, NLP-1000 MOTHERBOARD	T3400111
A2 PWA, ANALOG AMPLIFIER	T3400133
SCHEMATIC, A2 PWA, ANALOG AMPLIFIER	T3400131
A3 PWA, DIGITAL INTERFACE	T3133303
SCHEMATIC, A3 PWA, DIGITAL INTERFACE	T3133301
A4 PWA, TRIP/ALARM	T3301133
SCHEMATIC, A4 PWA, TRIP/ALARM	T3301131
A5 PWA, ISOLATION AMPLIFIER	T3133113
SCHEMATIC, A5 PWA, ISOLATION AMPLIFIER	T3133111
A6 DISPLAY, 3.8" LCD MODULE, TRANSFLECTIVE	304922*
A7 PWA, FRONT PANEL	T3400123
SCHEMATIC, A7 PWA, FRONT PANEL	T3400121
PS1 POWER SUPPLY	305855*
PS2 COMPENSATION POWER SUPPLY (200 Vdc maximum)	306495*
PS2 COMPENSATION POWER SUPPLY (50 Vdc maximum)	307127*
PS2 COMPENSATION POWER SUPPLY (150 Vdc maximum)	307128*

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6.0 SUMMARY OF REAR PANEL CONNECTIONS

This is the detailed list of all inputs and outputs from the remote/rear panel.

Table 6-1 Rear Panel Connectors

Connector	Type	Function
J1	BNC	Current input from detector, isolated from chassis
J2	MHV	High voltage output to detector, isolated from chassis
J3	TNC	Compensation voltage output to ion chamber, isolated from chassis
POWER	AC	AC input power, line filter, with fuses and on/off switch Fuses (2): 3A, time delay
J8	DB-9 (male)	RS-232 communication port for maintenance and remote display Pin 2: RX (to pin 2 TX on Display) Pin 3: TX (to pin 3 RX on Display) Pin 5: GND (to pin 5 GND on Display) **NOTE:** For connection to a PC in maintenance mode, use a null-modem cable.
J9	Ethernet	Ethernet port for communication with console

Table 6-2 DB-25 (J4)

Remote DB-25 connector J4, pin (male)			
Pin	**Name**	**Function**	**Rating**
1, 2, 3, 4, 5, 6, 7	NC	Not Connected	
8	HV_TRIP_B-NO	HV trip relay, contact B, NO	Imax = 1A; Vmax = 30 Vdc
9	HV_TRIP_A-C	HV trip relay, contact A, common	Imax = 1A; Vmax = 30 Vdc
10	HV_TRIP_B-NC	HV trip relay, contact B, NC	Imax = 1A; Vmax = 30 Vdc
11	HV_TRIP_A-NC	HV trip relay, contact A, NC	Imax = 1A; Vmax = 30 Vdc
12	HV_TRIP_B-C	HV trip relay, contact B, common	Imax = 1A; Vmax = 30 Vdc
13	HV_TRIP_A-NO	HV trip relay, contact A, NO	Imax = 1A; Vmax = 30 Vdc
14	TRIP_2_A-NO	Trip relay 2, contact A, NO	Imax = 1A; Vmax = 30 Vdc
15	TRIP_2_B-C	Trip relay 2, contact B, common	Imax = 1A; Vmax = 30 Vdc
16	TRIP_2_A-NC	Trip relay 2, contact A, NC	Imax = 1A; Vmax = 30 Vdc
17	TRIP_2_B-NC	Trip relay 2, contact B, NC	Imax = 1A; Vmax = 30 Vdc
18	TRIP_2_A-C	Trip relay 2, contact A, common	Imax = 1A; Vmax = 30 Vdc
19	TRIP_2_B-NO	Trip relay 2, contact B, NO	Imax = 1A; Vmax = 30 Vdc
20	TRIP_1_A-NO	Trip relay 1, contact A, NO	Imax = 1A; Vmax = 30 Vdc
21	TRIP_1_B-C	Trip relay 1, contact B, common	Imax = 1A; Vmax = 30 Vdc
22	TRIP_1_A-NC	Trip relay 1, contact A, NC	Imax = 1A; Vmax = 30 Vdc
23	TRIP_1_B-NC	Trip relay 1, contact B, NC	Imax = 1A; Vmax = 30 Vdc
24	TRIP_1_A-C	Trip relay 1, contact A, common	Imax = 1A; Vmax = 30 Vdc
25	TRIP_1_B-NO	Trip relay 1, contact B, NO	Imax = 1A; Vmax = 30 Vdc

Table 6-3 DB-37 (J5)

Remote DB-37 connector J5, pin (male)		
Pin	**Name**	**Function**
1, 2	GND	Ground
3, 4, 5, 6, 7, 8	NC	Not connected
9	REM_PULSE_DIS	Disconnects electrometer when reactor is pulsed Active high (+15V); Zin = 100kΩ
10	HV_TRIP_LOGIC-	HV trip emitter Opto-isolated transistor
11	TRIP1_LOGIC-	Logic trip 1 emitter Opto-Isolated transistor
12	TRIP1_LOGIC+	Logic trip 1 collector Opto-isolated transistor, use with pull-up resistor VCEmax = 80V; ICmax = 50mA
13	HV_TRIP_LOGIC+	HV trip collector Opto-isolated transistor, use with pull-up resistor VCEmax = 80V; ICmax = 50mA
14	TRIP2_LOGIC+	Logic trip 2 collector Opto-isolated transistor, use with pull-up resistor VCEmax = 80V; ICmax = 50mA
15	TRIP2_LOGIC-	Logic trip 2 emitter Opto-isolated transistor
16	REM_SEL	Remotely enables test/cal modes Expect momentary logic high to cycle through test modes Active high (+15V); Zin = 100kΩ
17	NC	Not Connected
18	NC	Not Connected
19	REM_TRIP_RESET	Resets all trips from the remote Expect momentary logic low (GND) to activate Open circuit voltage = 15V; Zout = 500Ω
20	GND	Ground
21	NC	Not Connected
22	PERCENT_PWR_ISO1	Isolated analog output 1, 0-10V, 4-20mA Current mode: 8V compliance voltage minimum Voltage mode: Connected device must have input impedance > 50kΩ, otherwise read error will be >1%
23	PERCENT_PWR_ISO1_RET	Isolated analog output 1 return
24	PERCENT_PWR_ISO2	Isolated analog output 2, 0-10V, 4-20mA Current mode: 8V compliance voltage minimum Voltage mode: Connected device must have input impedance > 50kΩ, otherwise read error will be > 1%
25	PERCENT_PWR_ISO2_RET	Isolated analog output 2 return
26	NC	Not Connected
27	GND	Ground

Remote DB-37 connector J5, pin (male)		
Pin	**Name**	**Function**
28, 29	+15V	+15 Vdc Source 100mA maximum
30, 31	+24V	+24 Vdc Source 250mA maximum
32, 33, 34, 35, 36, 37	NC	Not connected

Table 6-4 DB-37 (J6)

Remote DB-37 connector J6, socket (female)		
Pin	**Name**	**Function**
1	1E-4_IND_1	Switch contact 1 for 1E-4 range indication Imax = 100mA, Vmax = 30 Vdc
2	1E-4_IND_2	Switch contact 2 for 1E-4 range indication
3	1E-3_IND_1	Switch contact 1 for 1E-3 range indication Imax = 100mA, Vmax = 30 Vdc
4	1E-3_IND_2	Switch contact 2 for 1E-3 range indication
5	AUTO_IND_1	Switch contact 1 for autorange indication Imax = 100mA, Vmax = 30 Vdc
6	AUTO_IND_2	Switch contact 2 for autorange indication
7	1E-11_IND_1	Switch contact 1 for 1E-11 range indication Imax = 100mA, Vmax = 30 Vdc
8	1E-11_IND_2	Switch contact 2 for 1E-11 range indication
9	1E-10_IND_1	Switch contact 1 for 1E-10 range indication Imax = 100mA, Vmax = 30 Vdc
10	1E-10_IND_2	Switch contact 2 for 1E-10 range indication
11	1E-5_IND_1	Switch contact 1 for 1E-5 range indication Imax = 100mA, Vmax = 30 Vdc
12	1E-5_IND_2	Switch contact 2 for 1E-5 range indication
13	1E-6_IND_1	Switch contact 1 for 1E-6 range indication Imax = 100mA, Vmax = 30 Vdc
14	1E-6_IND_2	Switch contact 2 for 1E-6 range indication
15	1E-7_IND_1	Switch contact 1 for 1E-7 range indication Imax = 100mA, Vmax = 30 Vdc
16	1E-9_IND_1	Switch contact 1 for 1E-9 range indication Imax = 100mA, Vmax = 30 Vdc
17	1E-9_IND_2	Switch contact 2 for 1E-9 range indication
18	1E-8_IND_1	Switch contact 1 for 1E-8 range indication Imax = 100mA, Vmax = 30 Vdc
19	1E-8_IND_2	Switch contact 2 for 1E-8 range indication
20	REM_1E-4	Remote select for 1E-4 range Active low (0 to 1V), Zout = 100kΩ, Vhigh = 15V

Remote DB-37 connector J6, socket (female)		
Pin	**Name**	**Function**
21	REM_1E-3	Remote select for 1E-3 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
22	REM_1E-6	Remote select for 1E-6 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
23	REM_1E-7	Remote select for 1E-7 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
24	REM_1E-8	Remote select for 1E-8 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
25	REM_1E-9	Remote select for 1E-9 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
26	REM_AUTO	Remote select for autorange Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
27	REM_1E-10	Remote select for 1E-10 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
28	REM_1E-11	Remote select for 1E-11 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
29	REM_1E-5	Remote select for 1E-5 range Active low (0 to 1V); Zout = 100kΩ; Vhigh = 15V
30, 31, 32	NC	Not connected
33, 34, 35, 36	GND	Ground
37	1E-7_IND_2	Switch contact 2 for 1E-7 range indication

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