Model 359 Analog Multiplexer/ Signal Conditioner

Aeon 2
Joerger 19

Model H359
Multiplexing Analog Signal Conditioner

INSTRUCTION MANUAL

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1. INTRODUCTION

1.1 Description

The H359 Multiplexing Analog Signal Conditioner module performs several analog data acquistion functions in one, single-width CAMAC module.

-16-channel analog multiplexer. The H359 has 16 low-level analog inputs and a single analog output. Any single input can be connected to the output by command from the controller.

-Precision amplifier. Amplifier gain is strap selectable from 1 to 1000.

-Low pass filter. A low pass filter with 2 Hz bandwidth is included for use with strain guages, thermocouples or other slowly-varying signals.

-Overvoltage protection. Inputs are protected against overvoltages up to 200 volts.

1.2 Connections

All inputs connect to the H359 at the auxiliary card-edge connector in the free use area at the back of the module. The only connections to the CAMAC dataway are for module power.

The multiplexed analog output and control inputs connect on the front panel. An additional front panel connector allows access to the unmultiplexed analog outputs. Figure 1-1 shows the front panel connectors.

1.3 Indicators

Front panel indicators are also shown in Figure 1-1. The ENABLE indicator, when lit, shows that the controller is currently addressing the module or that the ENABLE switch is ON. This enable mechanism allows a single controller to operate up to 16 H359 modules.

The four, red CHANNEL indicators show the channel number of the analog input currently connected to the output. The four indicators show the channel number in binary. To determine the channel number in decimal, add the digits next to the lit indicators.

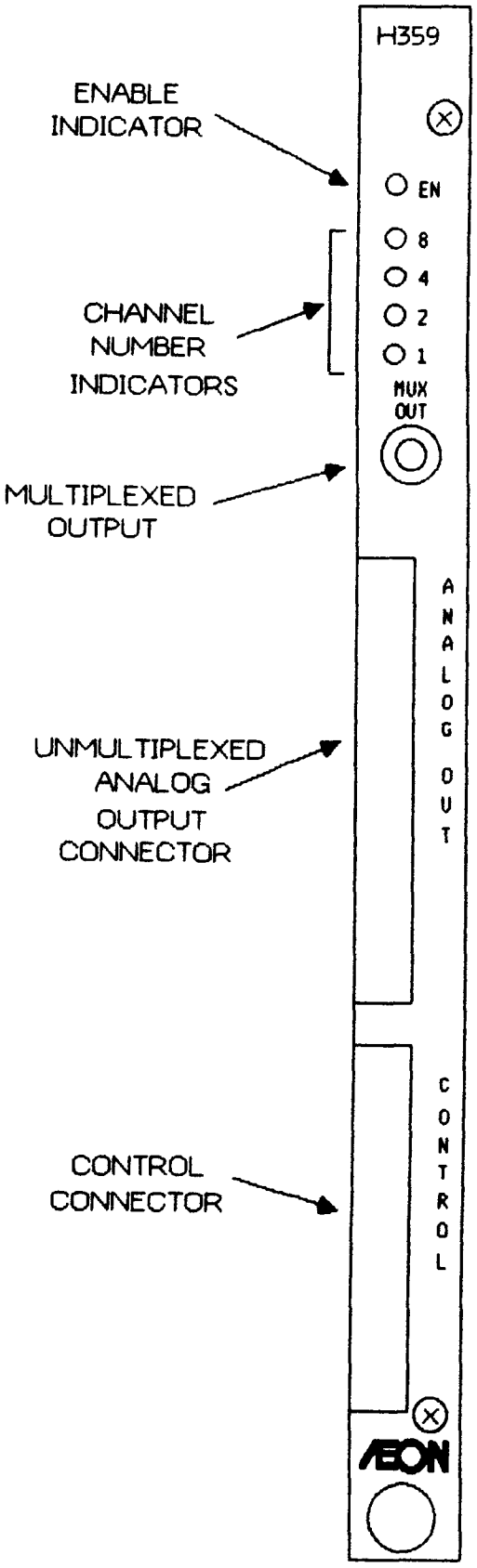

Figure 1-1. H359 Front Panel

2. INSTALLATION

2.1 Unpacking and Inspection

The packing material in which the H359 is shipped is specially designed to protect the module from physical damage and from damage due to electrostatic discharge. Aeon Systems recommends that you save this material in case it becomes necessary to ship the module back for repair.

Upon unpacking, inspect the module closely for shipping damage. This could include broken or missing components, loose screws, etc. If you find such damage, notify the carrier immediately.

2.2 Insertion in the Crate

Inserting the H359 module into a CAMAC crate is not difficult, but should be done with care to avoid damage to the module. Use the following procedure:

Step	Procedure
1	The H359 module can be inserted in any slot except slots 24 or 25, which are reserved for the crate controller.
2	Insert the card edges into the slot and slide the module back until it stops against the connectors at the back of the slot.
3	Press firmly against the front panel of the module to seat the connectors. Press only until the mounting screw on the front panel can be threaded into the hole on the front of the crate.
4	Finish seating the module into its connectors by tightening the mounting screw.

3. OPERATION

3.1 Connector Pin Designations

A. Analog Inputs

The analog input connector is a card edge connector at the back of the module in the free-use area as shown in Figure 3-1. The inputs and their associated pins are as follows:

Pin	Function	Pin	Function
1A	Channel 0 (-) Input	1B	Channel 0 (+) Input
2A	Channel 1 (-) Input	2B	Channel 1 (+) Input
3A	Channel 2 (-) Input	3B	Channel 2 (+) Input
4A	Channel 3 (-) Input	4B	Channel 3 (+) Input
5A	Channel 4 (-) Input	5B	Channel 4 (+) Input
6A	Channel 5 (-) Input	6B	Channel 5 (+) Input
7A	Channel 6 (-) Input	7B	Channel 6 (+) Input
8A	Channel 7 (-) Input	8B	Channel 7 (+) Input
9A	Channel 8 (-) Input	9B	Channel 8 (+) Input
10A	Channel 9 (-) Input	10B	Channel 9 (+) Input
11A	Channel 10 (-) Input	11B	Channel 10 (+) Input
12A	Channel 11 (-) Input	12B	Channel 11 (+) Input
13A	Channel 12 (-) Input	13B	Channel 12 (+) Input
14A	Channel 13 (-) Input	14B	Channel 13 (+) Input
15A	Channel 14 (-) Input	15B	Channel 14 (+) Input
16A	Channel 15 (-) Input	16B	Channel 15 (+) Input
17A	GROUND	17B	RESET
18A	GROUND	18B	INCREMENT

A-pins (1A - 18A) are on the solder side of the board. B-pins (1B - 18B) are on the component side.

The RESET and INCREMENT lines are discussed in section 3.5, below.

B. Multiplexed Analog Output

The multiplexed analog output is available at a 3-pin LEMO connector on the front panel. This connector is shown in Figure 3-2. The connector pin designations are as follows:

Pin	Function
1	Chassis Ground
2	Multiplexed Output
3	Analog Ground

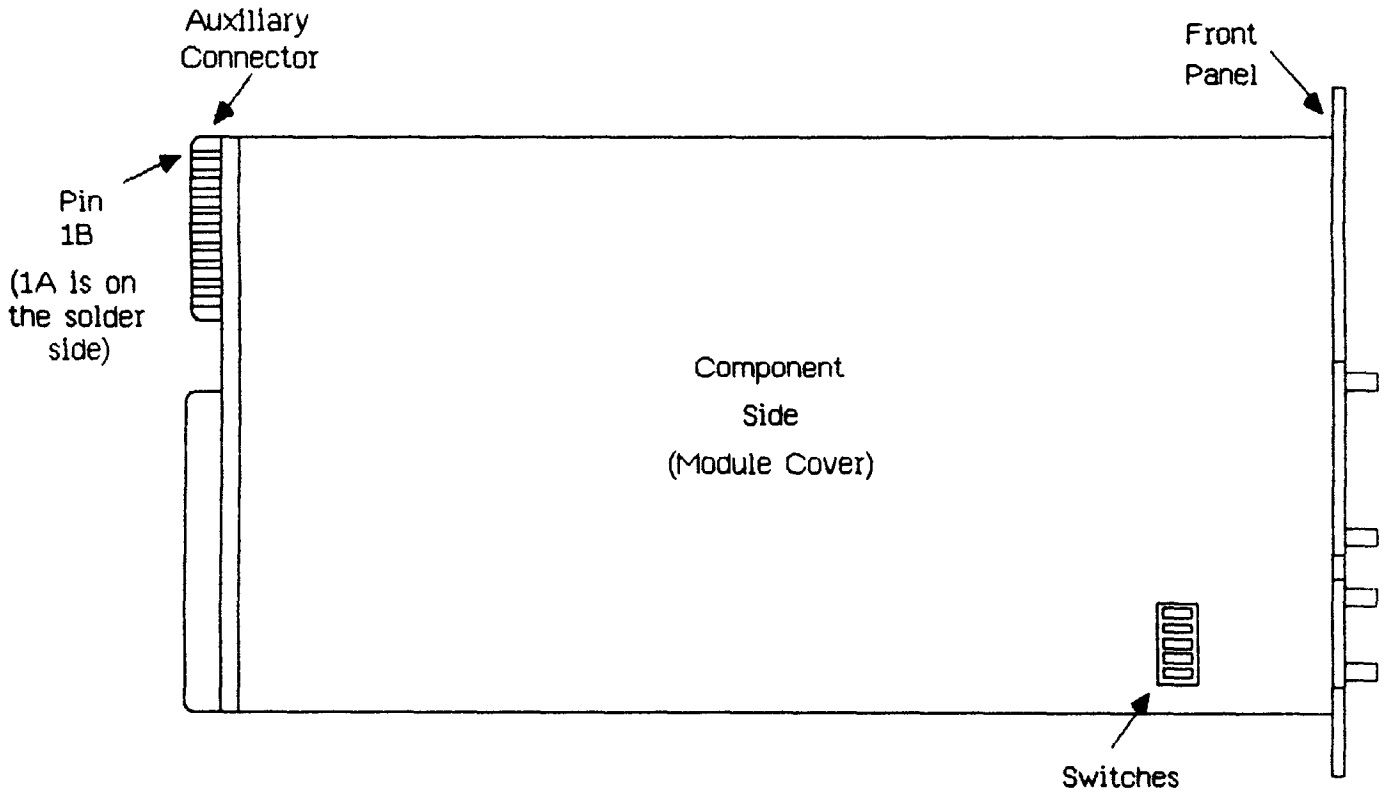

Figure 3-1. Analog Input Connector

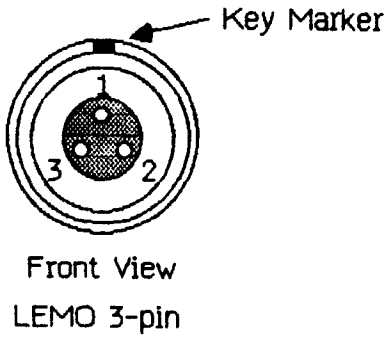

Figure 3-2. Multiplexed Analog Output Connector

C. Control Input Connector

Figure 3-3 shows the front panel control connector. The pin designations of this connector are as follows:

Pin	Function
1	Address line A2
2	Address line A3
3	Address line A1
4	Chassis Ground
5	Address Line A0
6	Chassis Ground
7	INCREMENT
8	Chassis Ground
9	RESET
10	Chassis Ground
11	ENABLE
12	Chassis Ground
13	LOAD
14	Chassis Ground
15	Address Line A7
16	Chassis Ground
17	Address Line A6
18	Chassis Ground
19	Address Line A5
20	Address Line A4

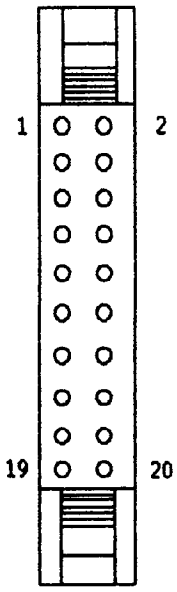

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Figure 3-3. Control Connector

D. Front Panel Unmultiplexed Analog Outputs

The analog output signals for each channel are available at the front panel connector shown in Figure 3-4. These signals are the outputs of the signal conditioning circuitry (precision amplifier and low-pass filter), but are not multiplexed. The output of each channel is always available at the corresponding pins of this connector. Note that these signals are intended mostly for testing and calibration uses. Since they are not buffered (as is the multiplexed output), they are not suitable for driving long cables or significant loads.

The pin designations of this connector are as follows:

Pin	Function
1	Channel 1
2	Chassis Ground
3	Channel 2
4	Chassis Ground
5	Channel 3
6	Chassis Ground
7	Channel 4
8	Chassis Ground
9	Channel 5
10	Chassis Ground
11	Channel 6
12	Chassis Ground
13	Channel 7
14	Chassis Ground
15	Channel 8
16	Chassis Ground
17	Channel 9
18	Chassis Ground
19	Channel 10
20	Chassis Ground
21	Channel 11
22	Chassis Ground
23	Channel 12
24	Chassis Ground
25	Channel 13
26	Chassis Ground
27	Channel 14
28	Chassis Ground
29	Channel 15
30	Chassis Ground
31	Channel 16
32	Chassis Ground
33	No Connection
34	Chassis Ground

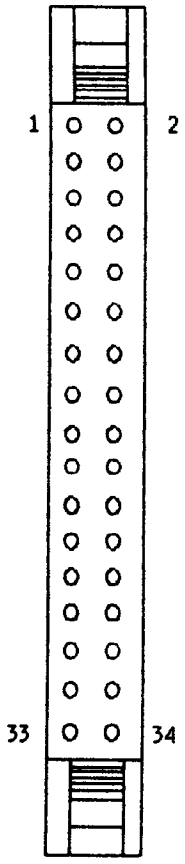

Figure 3-4. Unmultiplexed Analog Output Connector

3.2 Switches

The address and enable switches are located on the left side of the module as viewed from the front (component side). An opening in the module cover allows access to these switches.

A. Address Switches

Switches 1 through 4 set the base address of the module. When this base address appears on address lines A4 through A7 and the LOAD line is asserted on the control input, the module is enabled and the rest of the address lines decoded to select an input channel. The base address can be set to any integral multiple of 16 by means of the base address switches, as follows:

Base Address	Switch			
	1	2	3	4
0	ON	ON	ON	ON
16	ON	ON	ON	OFF
32	ON	ON	OFF	ON
48	ON	ON	OFF	OFF
64	ON	OFF	ON	ON
80	ON	OFF	ON	OFF
96	ON	OFF	OFF	ON
112	ON	OFF	OFF	OFF
128	OFF	ON	ON	ON
144	OFF	ON	ON	OFF
160	OFF	ON	OFF	ON
176	OFF	ON	OFF	OFF
192	OFF	OFF	ON	ON
208	OFF	OFF	ON	OFF
224	OFF	OFF	OFF	ON
240	OFF	OFF	OFF	OFF

To set a switch to ON, use a pen or stylus to move the switch slider in the direction of the arrow on the switch body.

B. Enable Switch

When switch 5 is ON, the module is enabled. In this condition, address lines 4 through 7 are ignored and address lines 0 through 3 are always decoded. This is especially useful in systems with only 1 H359 module.

Make sure that the enable switch is OFF, if the module addressing mechanism is required.

3.3 Gain Jumpers

For each channel, the gain of the precision amplifier can be set by means of user-installed jumpers. Figure 3-5 shows the location of these jumpers. Unless otherwise specified, all channels are set for unity gain (no jumper) at the factory. To change the gain, install a jumper as follows:

Gain	PPL Gain	Install Jumper from Pin 1 to
1000	1024	Pin 2
500	512	Pin 3
250	256	Pin 4
100	128	Pin 5
10		Pin 6

The easiest way to make the jumpers is with a wire-wrap tool and 30 gauge wire-wrap wire.

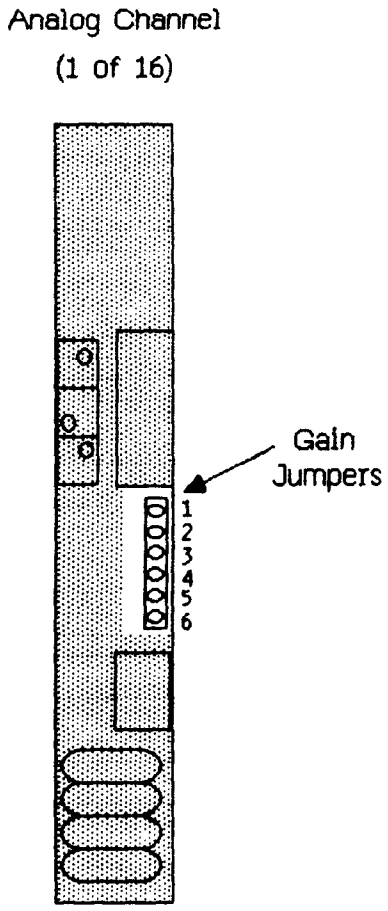

Figure 3-5. Gain Jumpers

3.4 Control

The front panel control input connector accomodates all signals necessary to operate the H359 module. The module accepts active LOW, TTL-compatible signals.

In the function descriptions that follow, the word "enabled" refers to the state in which the module is capable of receiving a module address and channel number from the control lines. It indicates this state by turning the ENABLE light on the front panel on. The H359 can be enabled in several ways:

1. Turning the enable switch ON enables the module until the switch is turned OFF. The RESET line has no effect as long as the enable switch is on.

2. Making the ENABLE line active, enables the module until the line is released. The RESET line has no effect as long as the ENABLE line is active.

3. Pulsing the LOAD line when the address on control lines A4 - A7 matches the module's base addresses, enables the module. It remains enabled until one of the following events takes place:

   a pulse on the RESET line or
   a pulse on the LOAD line when A4 - A7 do not match the module's base address.

Signal Name	Function
A0 - A3	Channel number. If the H359 module is enabled, it connects the channel whose number corresponds to the binary address on A0 - A3 to the multiplexed output. A3 is the most significant bit of the channel number.
A4 - A7	Module address. If the binary address on A4 - A7 (A7 is the most significant bit) matches the base address set on the address switches, pulsing the LOAD line enables the H359. The module remains in the enabled state until it is reset (by asserting the RESET line) or until a different module address appears on A4 - A7. If the enable switch is ON, or if the ENABLE line is active, these signals are ignored.
INCREMENT	If the H359 is enabled, pulsing INCREMENT disconnects the current input from the multiplexed output and connects the next input (new channel number = current channel number + 1) regardless of the channel number on A0 - A3. If the current channel number is 15, pulsing INCREMENT changes the channel number to 0.

RESET — Pulsing RESET changes the currently selected channel number to 0 and disables the H359 module. The RESET line has no effect if the module is enabled by means of the enable switch, or if the ENABLE line is active.

ENABLE — Activating the ENABLE line is equivalent to turning ON the enable switch. That is, while ENABLE is LOW, the module ignores the module address on A4 - A7 and connects the input channel designated by A0 - A3 to the multiplexed output. The module remains enabled until the ENABLE line is released.

LOAD — When LOAD goes LOW, the H359 compares the module address to its base address. If the addresses match, it selects the channel number designated by A0 - A3 and connects that input to the multiplexed output. The output remains connected until a new address is loaded or until the module no longer enabled. If the module is enabled by means of the enable switch or if the ENABLE line is being held low, the H359 selects the channel designated by A0 - A3 regardless of A4 - A7.

The INCREMENT and RESET inputs are also available on the auxiliary connector along with the analog inputs.

4. CALIBRATION PROCEDURE

Before calibrating the H359 module, turn off crate power and remove the module from the crate. Take the cover off the left (component) side of the module by removing six screws. Each analog channel is represented by a section on the circuit board. These sections are labeled at the top with CHANNEL A through CHANNEL S. The CHANNEL A section corresponds to analog input channel 0 and the CHANNEL S section to input channel 15. Most calibration steps are repeated for each channel before moving on to the next step.

To calibrate the H359 module, install the module in the crate in a slot that allows room for a screwdriver to turn the calibration potentiometers. An alignment tool or other insulated screwdriver is strongly recommended. Calibration potentiometers R6, R7 and R8 are shown in Figure 4-1. The alignment procedure is as follows:

Step	Procedure
1.	Set the input voltage to 0V. The easiest way to do this is with a special input connector that has all of the inputs shorted together and to ground. Set gain to 1 by removing all gain jumpers.
2.	Connect a voltmeter to the unmultiplexed output of channel 0.
3.	With the gain set to 1, adjust the output offset potentiometer (R7) for an output of 0V.
4.	Set gain to the required final value by installing the gain jumper according to the procedure in Section 3.3.
5.	Adjust the input offset potentiometer (R6) for 0V output.
6.	Repeat steps 2 - 5 for each channel. Remove the shorting connector.
7.	Connect the voltmeter again to the unmultiplexed output for channel 0. Apply full scale voltage to input 0.
8.	Adjust the gain potentiometer (R8) for positive full scale output.
9.	Apply negative full scale voltage to the input.
10.	Measure the output voltage. It should be close to minus full scale. If not, adjust the output offset potentiometer to bring the output closer to full scale and repeat steps 7 through 10.

11. Repeat steps 7 - 10 for each input.

12. After calibrating all channels, connect the voltmeter to the multiplexed output. Turn ON the enable switch to select channel 0.

13. Apply positive full-scale voltage to input 0. Adjust the gain potentiometer R29 (shown in Figure 4-2) for full scale output.

14. Apply negative full-scale voltage to input 0. The output voltage should be close to minus full-scale. If not, adjust the offset potentiometer (R28) to bring the output closer to full scale and repeat steps 13 and 14.

15. Disconnect signal sources and the voltmeter. Turn off the crate power and remove the module from the crate. Replace the cover.

16. Install the module in the correct slot. Connect the analog input, multiplexed output and control cables to the corresponding connectors.

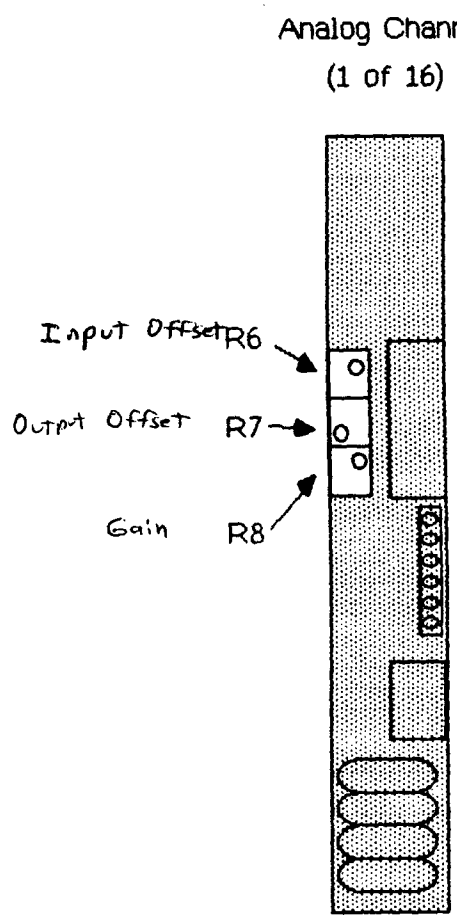

Figure 4-1. Calibrating Potentiometers

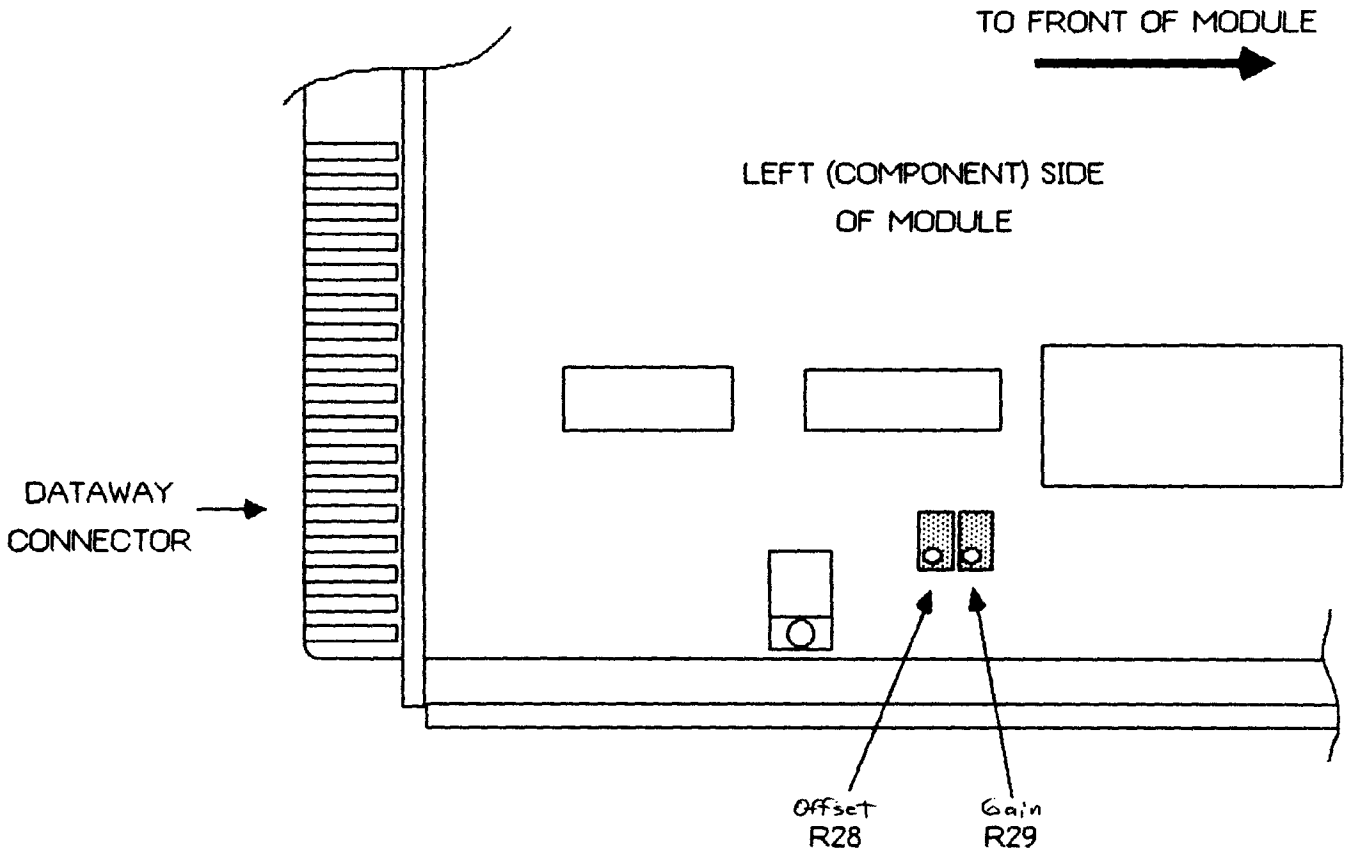

Figure 4-2. Output Buffer Calibrating Potentiometers

JOERGER ENTERPRISES, INC.

MODEL ISO-AMP

16 CHANNEL ISOLATED AMPLIFIER AND MULTIPLEXER

FEATURES:

- *INDIVIDUALLY ISOLATED INPUTS*
- *COMMON MODE VOLTAGE ±1000 VOLTS*
- *COMMON MODE REJECTION 156db @ 60Hz*
- *NORMAL MODE REJECTION 55db @ 60Hz*
- *5mv INPUT RANGE (OTHER RANGES AVAILABLE)*
- *COLD JUNCTION COMPENSATION FOR THERMOCOUPLE APPLICATIONS*

The Joerger Enterprises, Inc. Model ISO-AMP has been designed to handle low level signals in a high noise environment where isolation and filtering are required for operation. It contains individual isolation amplifiers for each input which can accept common mode voltages of up to 1000 volts. In addition, each amplifier has a low pass filter which provides 55db of normal mode rejection at 60Hz.

The standard gain is 1000. However, other gains are available in addition to the ability to handle a 4ma to 20ma input. The full scale input range of 5mv is ideal for thermocouple inputs and as an option for these applications, cold junction compensation is provided for the popular type thermocouples. This will compensate for junction temperature and can be switch selected to handle J, K, or T type thermocouples. It also has the ability to handle B, E, R, and S types by setting two internal resistors. To insure correct operation at low levels each input offset is individually adjusted to zero. The gain of each amplifier is also adjusted independently. Because the gain is individually settable, applications requiring different gains can also be handled. This feature allows the ability to accept different thermocouple inputs into the same module or handle different level signals. The 16 channels are multiplexed and buffered and provide a standard output of ±5 volts. The multiplexer address is controlled externally in either of two modes. A parallel mode is available which accepts a 4 bit address and a load signal which loads the selected address into memory. The second method provides the ability to clock the address counter. A reset input sets the address to channel zero and each clock signal increases the address by one. The single analog output can then be applied to an ADC for conversion.

If an ADC is not already available in your system, you might consider our Model ISO-ADC which has the same front end but in addition contains an ADC and data memory. This unit continuously scans the 16 inputs, converts the analog data to digital in an integrating type ADC for further 60Hz rejection and then stores the converted data in a 16 word memory. Data is read out from this memory thus providing simple operation. The read/write cycle is interlocked so correct data is always read.

SPECIFICATIONS

ANALOG INPUTS

Number of Channels	16
Full Scale Input Ranges Available	±5mv to ±100mv, ±50mv to ±5v, 4ma to 20ma. Units shipped with full scale input of ±5mv unless otherwise specified.
Output Range	±5 volts
Gain Nonlinearity	±.03% Maximum
Gain Drift	±35ppm/°C Maximum
Offset Drift	2.5uv/°C Maximum
Common Mode Voltage	±1000 VDC
Common Mode Rejection	156db @ 60Hz
Normal Mode Rejection	55db @ 60Hz
Input Impedance	100M Ohms
Scanning Speed	400 Channels Per Second

THERMOCOUPLE COMPENSATION OPTION

Thermocouple Types	J, K, and T types are standard; B, E, R, or S can be programmed internally.
Type Selection	An internal switch selects the type used. In the case where different types are being used, the selection is externally programmable.
Accuracy	±.2°C @ 25°C

POWER

+24v, 200ma	Tested JOERGER 1 UNIT	250 mA	AEON 120 ma
-24v, 50ma		30 mA	130 ma.
+6v, 100ma		87 ma	200 ma.

SIZE

#1 CAMAC module — S/N 115 — S/N 67

CONNECTORS

2/20/90

Input	Cannon DD50P
Output	LEMO RA0302

Hi Z ea. 100K in each Log input

TEMPERATURE RANGE

0°C to 50°C

OPTIONS

1. Input Range ±50mv to ±5v, specify range required.
2. Current Input, range 4ma to 20ma standard, others available.
3. Thermocouple cold junction compensation.
4. Analog inputs via rear panel edge connector.

JEI1083

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JOERGER ENTERPRISES, INC. _____

MODEL ISO-AMP

16 CHANNEL ISOLATED AMPLIFIER AND MULTIPLEXER

The Joerger Enterprises, Inc. Model ISO-AMP provides 16 channels of amplification with a high degree of filtering and individual isolation. Each amplifier has its own gain adjustment and gains of up to 1000 are possible with a common mode rejection of 156db at 60HZ are possible. An optional offset adjustment is also available for each channel if the input offset must be set to zero. The 16 channels are multiplexed to a common output amplifier which has a gain of two, providing an output range of ±10 volts. Module addressing and control are optically isolated to preserve overall isolation. Each channel also has an isolated output source of ±12 volts for applications that may require external power, such as two terminal I.C. temperature transducers.

This module offers the ability to amplify low level signals such as thermo couples, filter out noise, multiplex them to a common output, provide input offset control, an external isolated power source, all completely isolated with all channels completely independent.

To provide the ability to set the gain, the board is layed out so that each channel has a potentiometer in series with a resistor as the primary adjustment. To increase the gain further this series combination can be paralleled by an additional resistor as indicated on schematic ISO-202. The gain equation is:

$$GAIN = 1 + \frac{10K}{R_G}$$

R_G is the parallel combination of gain resistors.

The following chart shows resistor values for gains commonly used at PPPL:

Gain	Rg1	Rg2
256	51	Removed
512	51	100
1024	10	100

CIRCUIT DESCRIPTION

The Model ISO-AMP does not use the dataway for anything but power. It uses +6 volts and ±24 volts. The 24 volts is used to run the oscillators and to generate ±15 volts for the output analog sections. The 15 volts is generated using a tracking regulator to insure accurate performance. The module uses a front panel connector for control and an auxiliary rear panel connector for signal inputs and control.

For the module to operate it must be enabled, or addressed somewhat like the "N" line in the dataway. There are a number of ways to enable the module. There is an enable line in the front panel connector that will enable the module with a logic "1" (0 volts) applied. This would be identical to the "N" line operation. The module can also be enabled by an on board DIP switch which will enable the module at all times and override any other address mode. The module may also be addressed by a four bit word. The module address is set by a four pole DIP switch and when the input address matches this address switch, the module will be enabled. The mode of operation can be disabled by an on board DIP switch which disables the address comparator. Whenever the module is enabled a green LED on the front panel will light indicating the module is active.

Once the module is enabled the active channel can be selected. This can be done in two ways, one is a parallel load of the address being sent to the module by a four bit word, or the address can be clocked by a signal from either the front panel or rear panel. This signal will increment the address counter by one each time it is received. The address counter can also be reset to channel zero by a signal from either the front panel or rear auxiliary connector. With the module enabled the selected amplifiers address will be indicated on the front panel by four LED's. All control signals and address signals require an active low for logic "1" and all inputs are biased to a logic "0" with 10K ohm to +5 volts. The counter is incremented on the leading edge of the clock signal. With the parallel address mode the data is loaded while the LOAD signal is down and locked onto that address when it returns high. To improve noise immunity the clock, reset, load and enable signals are buffered by input Schmitt triggers.

MODEL ISO-AMP

REAR INPUT PRINTED CIRCUIT CONNECTOR

MATING HALF: VIKING 3V18 OR EQUIV.

VIEWED FROM REAR OF MODULE

SOLDER SIDE					COMPONENT SIDE		
CHANNEL	0	RETURN	1A	1B	CHANNEL	0	SIGNAL
"	1	"	2A	2B	"	1	"
"	2	"	3A	3B	"	2	"
"	3	"	4A	4B	"	3	"
"	4	"	5A	5B	"	4	"
"	5	"	6A	6B	"	5	"
"	6	"	7A	7B	"	6	"
"	7	"	8A	8B	"	7	"
"	8	"	9A	9B	"	8	"
"	9	"	10A	10B	"	9	"
"	10	"	11A	11B	"	10	"
"	11	"	12A	12B	"	11	"
"	12	"	13A	13B	"	12	"
"	13	"	14A	14B	"	13	"
"	14	"	15A	15B	"	14	"
"	15	"	16A	16B	"	15	"
		GROUND	17A	17B	RESET		
		GROUND	18A	18B	INCREMENT		

MODEL ISO-AMP

FRONT PANEL CONTROL CONNECTOR: AMP102159-4

MATING CONNECTOR: AMP499675-4

VIEWED FROM FRONT OF MODULE

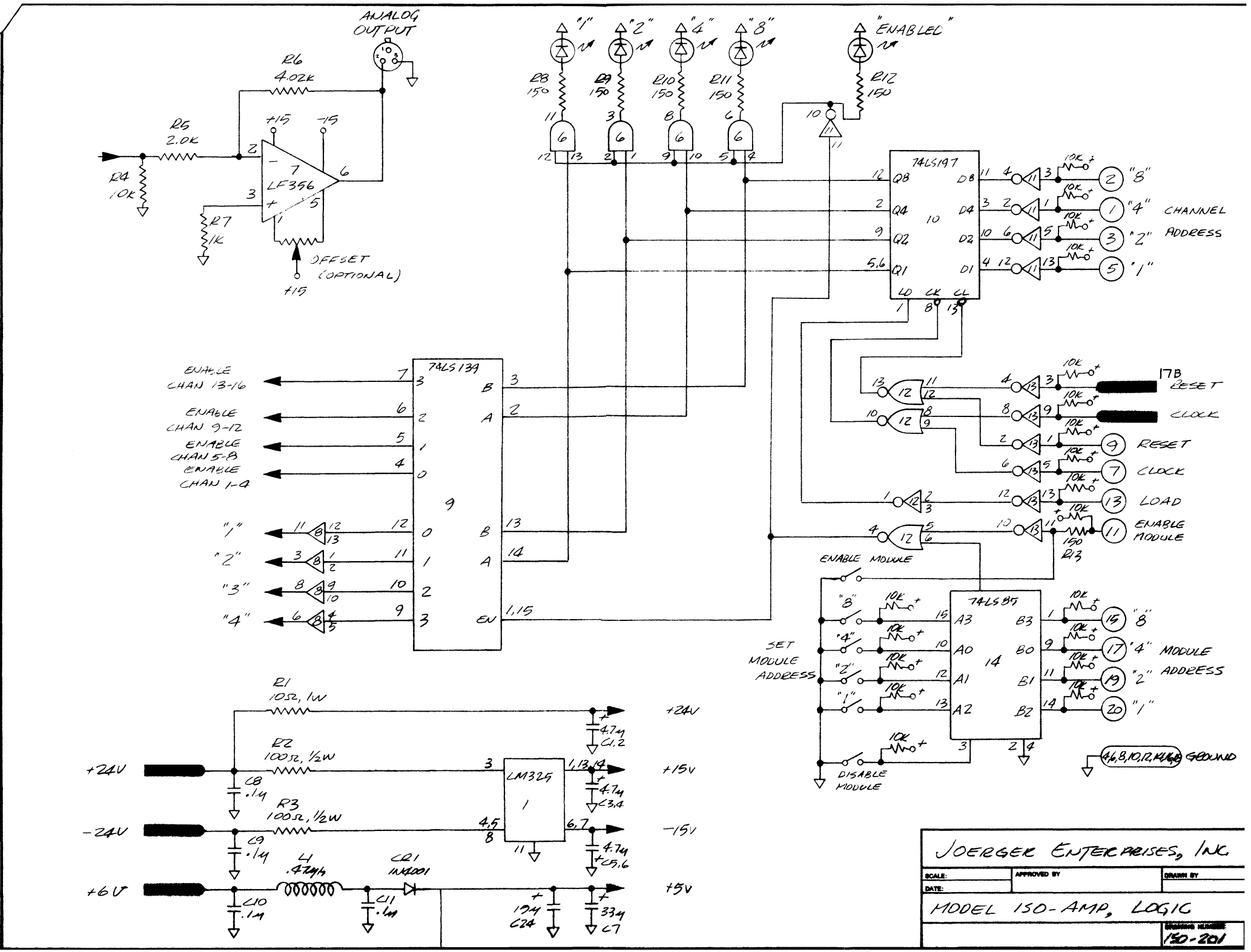
COMPONENT SIDE			SOLDER SIDE
BIT 4 CHANNEL ADDRESS	1	2	BIT 8 CHANNEL ADDRESS
BIT 2 CHANNEL ADDRESS	3	4	GROUND
BIT 1 CHANNEL ADDRESS	5	6	"
INCREMENT ADDRESS	7	8	"
RESET ADDRESS	9	10	"
ENABLE MODULE (Override Module Select)	11	12	"
LOAD CHANNEL ADDRESS	13	14	"
BIT 8 MODULE SELECT	15	16	"
BIT 4 MODULE SELECT	17	18	GROUND
BIT 2 MODULE SELECT	19	20	BIT 1 MODULE SELECT

JOERGER ENTERPRISES, INC.

MODEL ISO-AMP

P.C. BOARD #ISO-ADC101

	REFERENCE DESIGNATION	DESCRIPTION
INTEGRATED CIRCUITS	IC 1	LM325
	IC 2, 3, 4, 5	SCM100A
	IC 6	74LS08
	IC 7	LF356N
	IC 8	7408
	IC 9	74LS139
	IC 10	74LS197
	IC 11	74LS04
	IC 12	74LS02
	IC 13	74LS14
	IC 14	74LS85
	IC 15	76SB06
	IC 16, 17	4310R-101-103
	IC 18	4306R-101-103
DIODES	CR 1	1N4001
RESISTORS	R 1	10 ohms, 1W, 10%
	R 2, 3	100 ohms, ½W, 10%
	R 4	10K ohms, 1%
	R 5	2.0K ohms 1%
	R 6	4.02K ohms, 1%
	R 7	1K ohms, 1%
	R 8-13	150, ¼W, 10%
	R_G	Determined by Gain Required.
CAPACITORS	C 1-6	4.7uf, 35v
	C 7	33uf, 6v
	C 8-23	.1uf, 50v
	C 24	15uf, 6v
INDUCTORS	L 1	.47uh

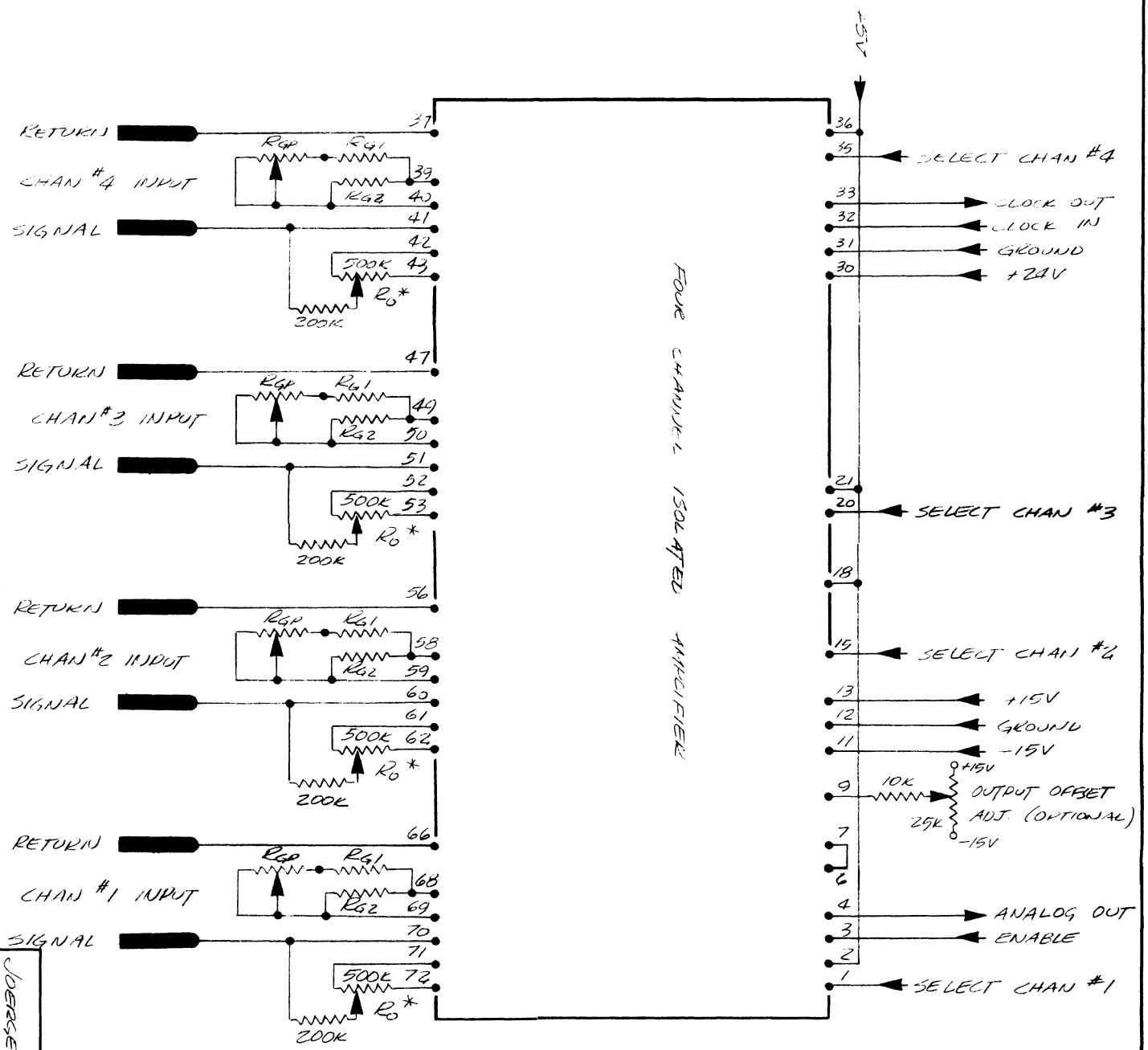


JOERGER ENTERPRISES, INC.

SCALE:	APPROVED BY	DRAWN BY
DATE:		

MODEL 150-AMP, LOGIC

DRAWING NUMBER: 150-201



NOTES: 1) R_S FOR INPUT OFFSET ADJ. OPTIONAL

2) GAIN SET BY R_{G1}, $G = 1 + \frac{10K\Omega}{R_G'}$, $R_G' = R_{GP} + R_{G1} // R_{G2}$

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MODEL 150 AMP, TYPICAL ANAL. INPUT	
DRAWING NUMBER 150-202	