GEOKON The World Leader in Vibrating Wire Technology

48 Spencer Street
Lebanon, NH 03766, USA
Tel: 603•448•1562
Fax: 603•448•3216
E-mail: geokon@geokon.com
http://www.geokon.com

INSTRUCTION MANUAL

MODEL 8032

TERMINAL BOARD AND 16/32 CHANNEL MULTIPLEXER

(Doc Rev E, 07/09)

Warranty Statement

Geokon, Inc. warrants its products to be free of defects in materials and workmanship, under normal use and service for a period of 13 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation, freight prepaid. Upon examination by Geokon, if the unit is found to be defective, it will be repaired or replaced at no charge. However, the WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion or current, heat, moisture or vibration, improper specification, misapplication, misuse or other operating conditions outside of Geokon's control. Components which wear or which are damaged by misuse are not warranted. This includes fuses and batteries.

Geokon manufactures scientific instruments whose misuse is potentially dangerous. The instruments are intended to be installed and used only by qualified personnel. There are no warranties except as stated herein. There are no other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and of fitness for a particular purpose. Geokon, Inc. is not responsible for any damages or losses caused to other equipment, whether direct, indirect, incidental, special or consequential which the purchaser may experience as a result of the installation or use of the product. The buyer's sole remedy for any breach of this agreement by Geokon, Inc. or any breach of any warranty by Geokon, Inc. shall not exceed the purchase price paid by the purchaser to Geokon, Inc. for the unit or units, or equipment directly affected by such breach. Under no circumstances will Geokon reimburse the claimant for loss incurred in removing and/or reinstalling equipment.

Every precaution for accuracy has been taken in the preparation of manuals and/or software, however, Geokon, Inc. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages or losses that result from the use of the products in accordance with the information contained in the manual or software.

TABLE of CONTENTS

LIST of FIGURES, TABLES and EQUATIONS

1. THEORY OF OPERATION

The Model 8032 Terminal Board and Multiplexer expands the number of channels that can be read by the MICRO-10 Datalogger or GK-403 Vibrating Wire Readout Box. The system integrates two components, a terminal board for making gage connections and a multiplexer which switches the gage connections, into one circuit board for reliability and ease of use. The channel switching is accomplished by mechanical relays mounted on the underside of the circuit board and the transducer connections are accomplished by friction locking terminals mounted on the top side of the circuit board.

There are three different varieties of 8032 board:

8032-E	Terminal Board only – typically used in conjunction with a 4999 Manual Switch Box
8032-C	Terminal Board with Multiplexer – typically used with Micro-10 Datalogger or GK-403 Readout Box.
8032-A	Terminal Board with Multiplexer and RS-485 Control Lines for extending the distance between the 8032 and the Datalogger or Readout Box

Two switching configurations are supported, 16 channels of 4 conductors or 32 channels of 2 conductors. For the 8032-A and 8032-C, these configurations are set by a DipSwitch on the top side of the circuit board. For the 8032-E, these configurations are determined by the 4999 Manual Switch Box.

To protect against lightning or EMI/RFI induced transients, each channel is protected with 230V tripolar plasma surge arrestors while the shield connections are outfitted with 300V bipolar surge arrestors. See Appendix A for complete specifications on these components.

Note Figures 1 and 2 depicting the supported switching arrangements.

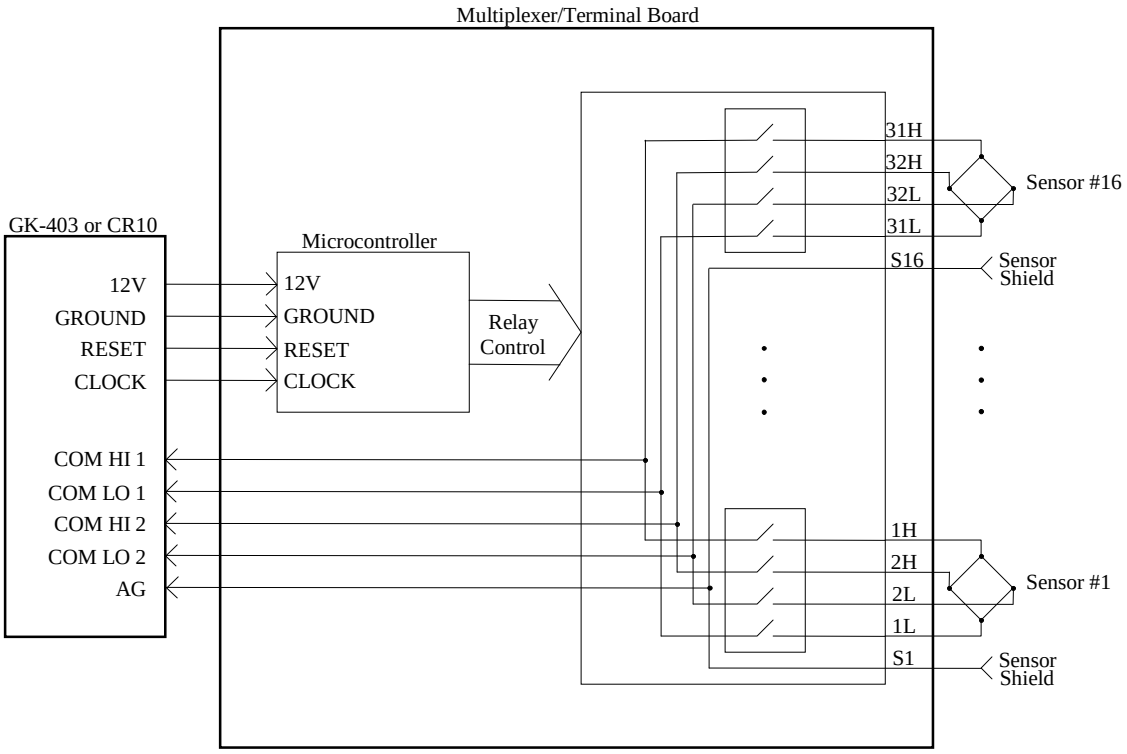


Figure 1 - 16 Channel Switching Block Diagram

The 16 channel 4 wire switching configuration is typically used to multiplex 4 wire sensors such as resistance strain gage load cells. It is also used to switch connections for instruments which have more than one sensor integral to them, such as vibrating wire pressure transducers with an integral thermistor for measuring temperature.

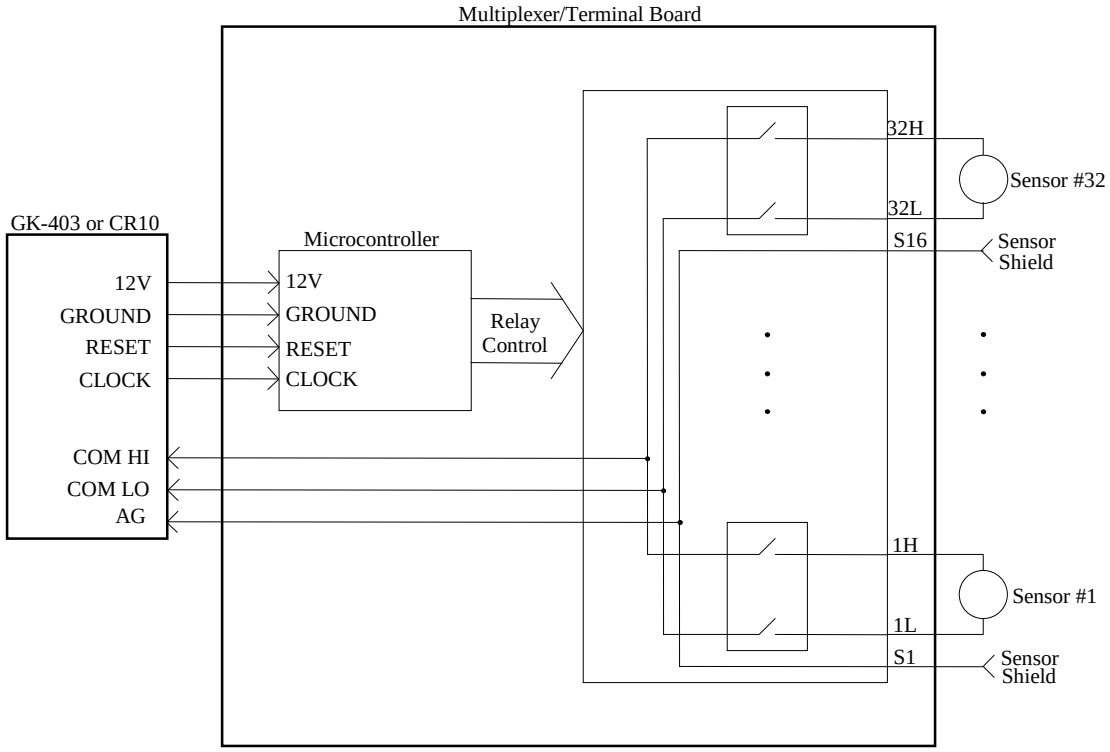


Figure 2 - 32 Channel Switching Block Diagram

The 32 channel 2 wire switching configuration is typically used to multiplex 2 wire sensors such as a vibrating wire pressure transducers, thermistors or thermocouples.

The multiplexer is powered by a nominal 12 VDC supply. Two control lines (RESET and CLOCK) determine how channel selection is accomplished. Two schemes are supported, that used by the GK-403 Vibrating Wire Readout and the MICRO-10 dataloggers. See the following sections explaining how each mode operates.

Figure 3 illustrates the DIP switch SW1 position 1 for switching between 16 and 32 channel operation. SW-1 switch 1 ON = 32 channel, OFF = 16 channel. In Figure 3, 32 channel mode is chosen:

SW1

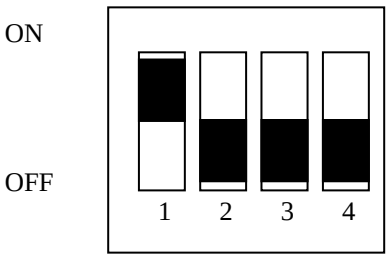


Figure 3 - 16 or 32 Channel Selection

1.1 GK-403 Mode of Operation

The GK-403 mode of operation uses a single control line to select channels. This scheme allows individual channels to be selected without having to sequentially advance through all channels. Multiplexers can also be connected together in a daisy chain fashion using the GK-403 protocol. In 16 channel mode, the number of clock pulses equals 2 times the desired channel number. In 32 channel mode, the number of clock pulses equals the desired channel number plus 1. Note the timing below for 16 and 32 channel switching arrangements.

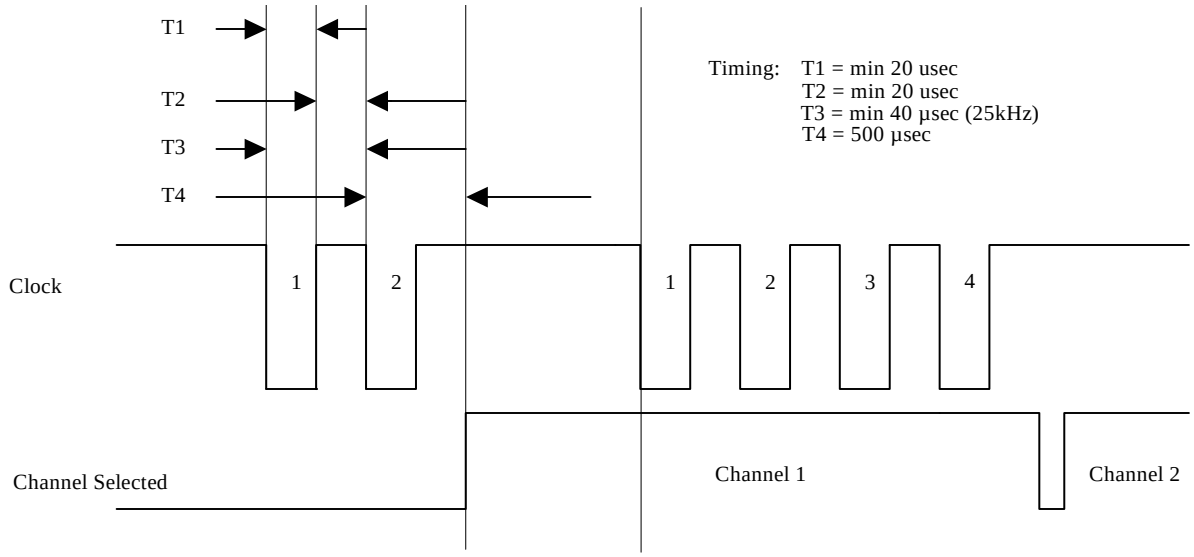


Figure 4 - 16 Channel GK-403 Channel Selection Timing

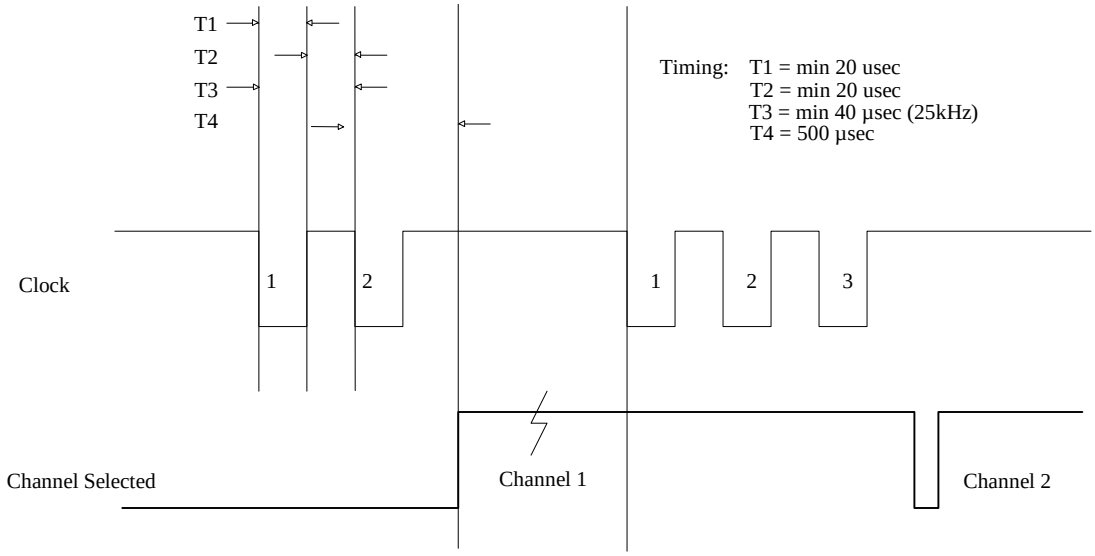


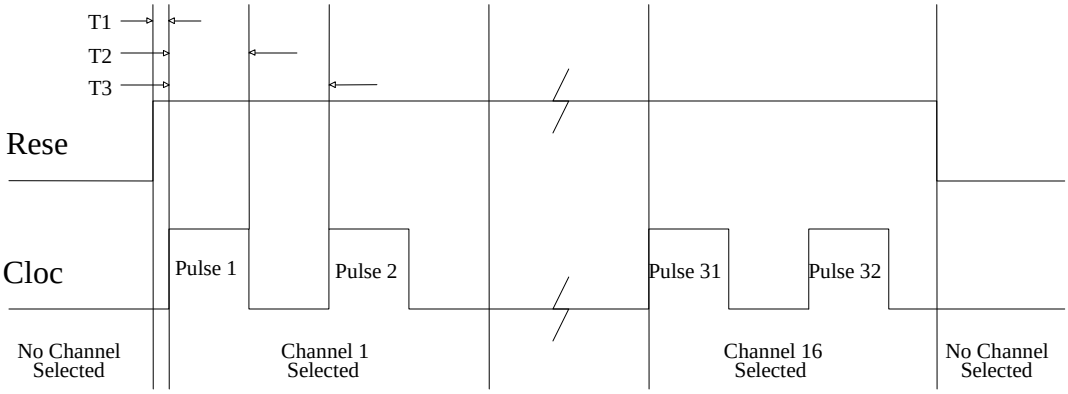
Figure 5 - 32 Channel GK-403 Channel Selection Timing

The GK-403 channel selection scheme is not well suited to long cable lengths. The maximum recommended distance between the GK-403 and multiplexer is 50 feet (15 meters).

1.2 MICRO-10 (CR10) Mode of Operation

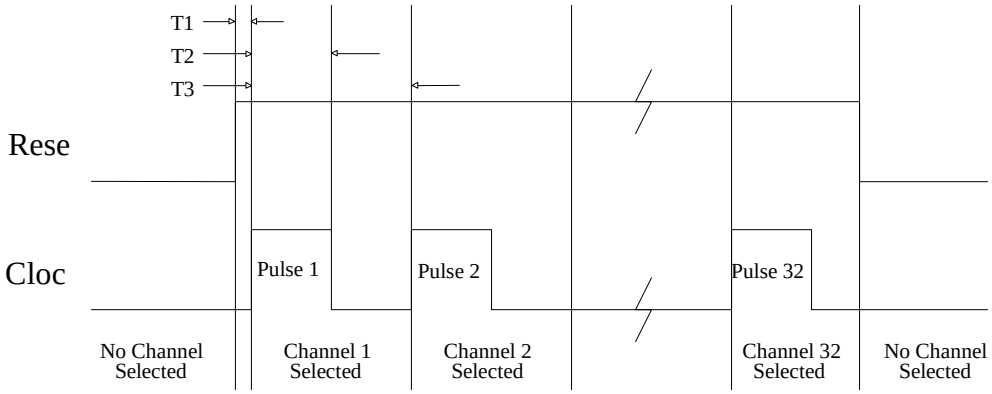
The MICRO-10 (which utilizes a CR10 controller, manufactured by Campbell Scientific, Inc. of Logan, Utah) mode of operation uses two control lines to operate the multiplexer. The RESET line enables the multiplexer and activates the MICRO-10 mode of clocking. Pulses received on the CLOCK line sequentially increment the channels while the RESET line is held high. See the timing diagram below;

The CLOCK line sequentially advances the channels beginning with channel 1. Note the timing diagrams below for 16 and 32 channel switching, respectively.



Timing: T1 = 250 µsec(min.)
T2 = 10 µsec(min)
T3 = 20 µsec(min) (50 kHz)

Figure 6 - 16 Channel MICRO-10 Channel Selection Timing



Timing: T1 = 250 µsec
T2 = 10 µsec
T3 = 20 µsec (50 kHz)

Figure 7 - 32 Channel MICRO-10 Channel Selection Timing

The MICRO-10 channel selection scheme can be used with fairly long cable lengths. The maximum recommended distance between the MICRO-10 and multiplexer is 1000 feet (300 meters). For longer cable lengths up to 9000 feet (2743 meters), the 8032A (with RS485 option) is recommended.

2. INSTALLATION AND WIRING

2.1 Installation

The multiplexer and (or terminal board alone) are housed in a Nema 4 weatherproof enclosure. However, it is recommended that additional measures be taken to ensure that water or other contaminants are prevented from entering and subsequently disrupting operation of the equipment. For example, in field environments, it could be installed inside an equipment trailer or shed. The enclosure should be mounted in an upright fashion, i.e. on a wall. The holes located in the tabs at the top and bottom of the enclosure are used for mounting. Note Figure 8 for mounting dimensions.

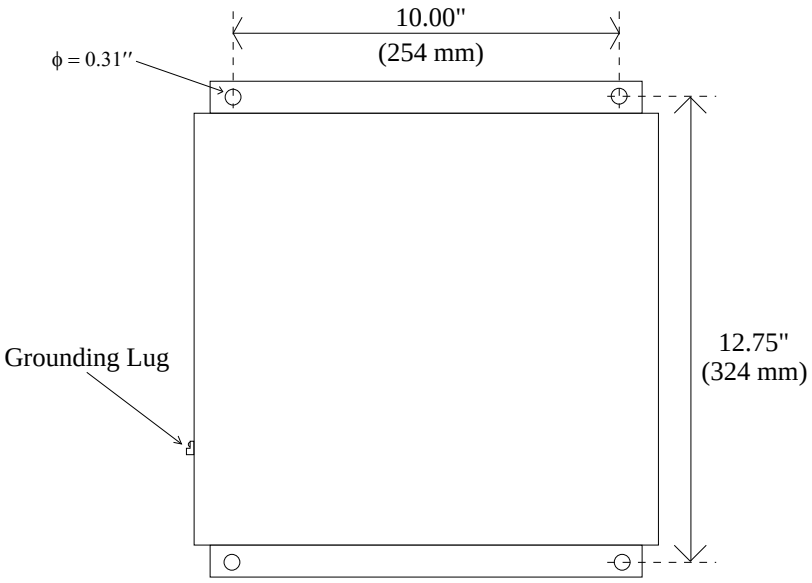


Figure 8 - Multiplexer Enclosure Mounting Dimensions

The enclosure should have an earth ground installed. This must be installed if the terminal board is equipped with optional lightning protection components. Drive a copper stake into the ground or use an existing grounded metal structure for this connection. Attach a large gauge copper wire (>12 AWG) from ground to a mounting lug of the enclosure (grind the paint off for a good connection) or, if so equipped, the ground connection screw terminal located on the side of the enclosure.

2.2 Wiring

The enclosure has cable entries for passing the instrument cables to the terminal board. These entries have seals for specific cable sizes which will minimize the possibility of water or other contaminants entering the box and causing problems.

If the unit is equipped with manual switching the switch panel must be removed to access the terminal board. See Appendix C for additional information.

Actual gage connections to the terminal board will vary depending on the instrument type and cable used. Note the following tables to get the general idea.

Terminal Board	Vibrating Wire with Thermistor	Resistance Strain Gage Bridge	Linear Potentiometer (with Remote Sense)
1H	VW Sensor #1	S+ from Bridge #1	Excitation Pot #1
1L	VW Sensor #1	S- from Bridge #1	Wiper Output Pot #1
2H	Thermistor #1	P+ to Bridge #1	Remote Sense Pot #1
2L	Thermistor #1	P- to Bridge #1	Ground Pot #1
S1	Shield Drain Wire from Sensor #1	Shield Drain Wire from Bridge #1	Shield Drain Wire from Pot #1
3H	VW Sensor #2	S+ from Bridge #2	Excitation Pot #2
3L	VW Sensor #2	S- from Bridge #2	Wiper Output Pot #2
4H	Thermistor #2	P+ to Bridge #2	Remote Sense Pot #2
4L	Thermistor #2	P- to Bridge #2	Ground Pot #2
S2	Shield Drain Wire from Sensor #2	Shield Drain Wire from Bridge #2	Shield Drain Wire from Pot #2
•	•	•	•
•	•	•	•
•	•	•	•
31H	VW Sensor #16	S+ from Bridge #16	Excitation Pot #16
31L	VW Sensor #16	S- from Bridge #16	Wiper Output Pot #16
32H	Thermistor #16	P+ to Bridge #16	Remote Sense Pot #16
32L	Thermistor #16	P- to Bridge #16	Ground Pot #16
S16	Shield Drain Wire from Sensor #16	Shield Drain Wire from Bridge #16	Shield Drain Wire from Pot #16

Table 1 - 16 Channel Multiplexer/Terminal Board Wiring

Terminal Board	Vibrating Wire	Thermistor	Thermocouple
1H	VW Sensor #1	Thermistor #1	Thermocouple #1
1L	VW Sensor #1	Thermistor #1	Thermocouple #1
2H	VW Sensor #2	Thermistor #2	Thermocouple #2
2L	VW Sensor #2	Thermistor #2	Thermocouple #2
S1	Shield Drain Wires from Sensors 1&2	Shield Drain Wires from Thermistors 1&2	
3H	VW Sensor #3	Thermistor #3	Thermocouple #3
3L	VW Sensor #3	Thermistor #3	Thermocouple #3
4H	VW Sensor #4	Thermistor #4	Thermocouple #4
4L	VW Sensor #4	Thermistor #4	Thermocouple #4
S2	Shield Drain Wires from Sensors 3&4	Shield Drain Wires from Thermistors 3&4	
•	•	•	•
•	•	•	•
•	•	•	•
31H	VW Sensor #31	Thermistor #31	Thermocouple #31
31L	VW Sensor #31	Thermistor #31	Thermocouple #31
32H	VW Sensor #32	Thermistor #32	Thermocouple #32
32L	VW Sensor #32	Thermistor #32	Thermocouple #32
S16	Shield Drain Wires from Sensors 31&32	Shield Drain Wires from Thermistors 31&32	

Table 2 - 32 Channel Multiplexer/Terminal Board Wiring

Figure 9 depicts the terminal board to which gage connections are made. If the terminal board is equipped with manual switches connectors J3 and J4 will have ribbon cables attached connected to switch boards.

The components labeled "SA" are Tripolar Surge Arrestors (optional, see Appendix A.3 for specifications). Components labeled "SG" are Bipolar Surge Arrestors (optional, see Appendix A.4 for specifications).

Terminal strips T1 to T16 are for the gage connections.

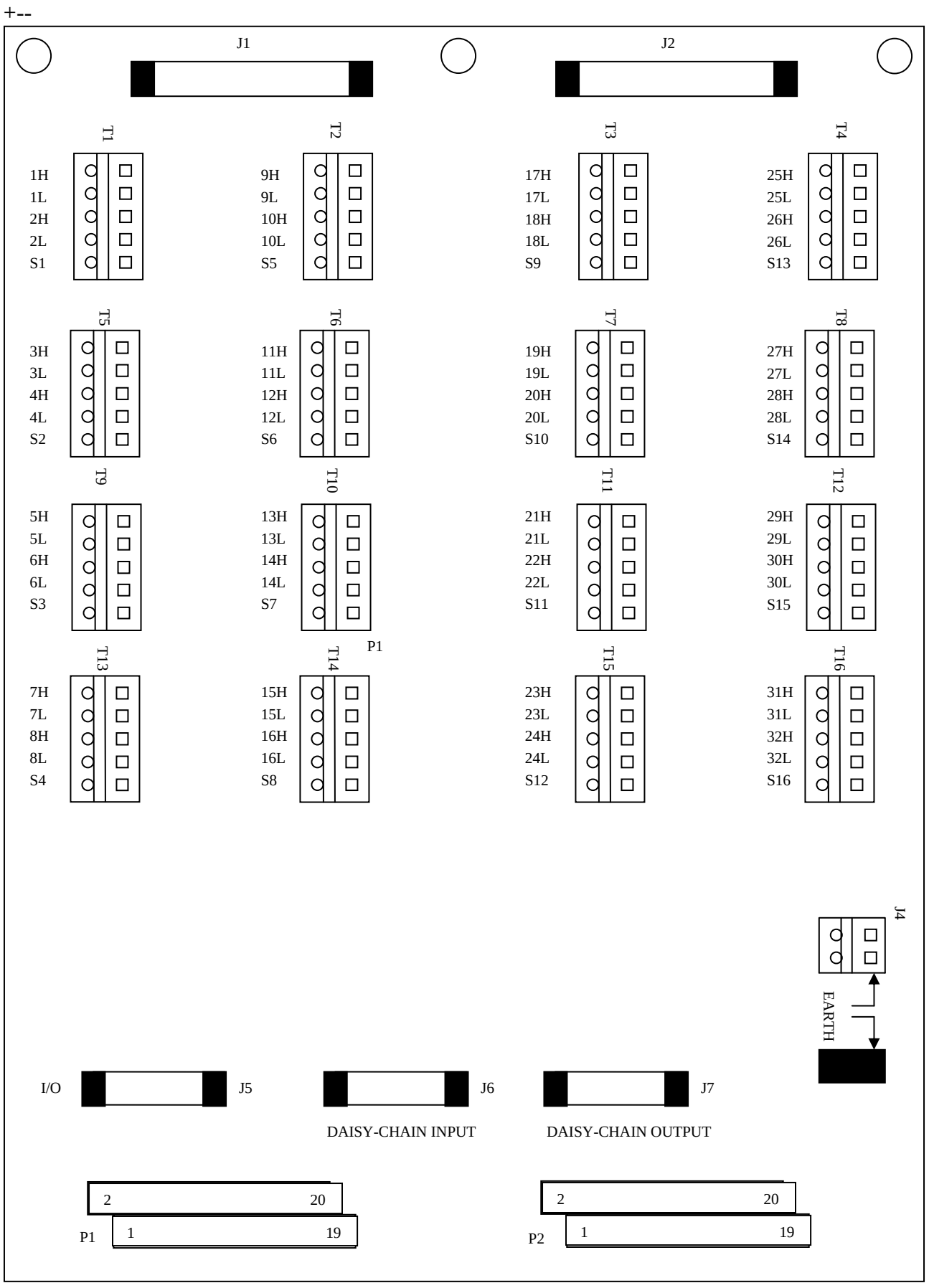


Figure 9- Terminal Board Layout

3. MAINTENANCE

Maintenance for the Model 8032 Multiplexer/Terminal Board is minimal. The following checks should be performed periodically though;

- ✓ Is there water or other contaminants intruding into the enclosure? At times water can wick through the sensor cables onto the terminal board. This will at some point cause problems with the system. Water or other contaminants can also enter through improper use of the cable entries. Additional sealing of the entries can be done with various sealing compounds such as RTV. If moisture is condensing inside desiccant can be used to keep this to a minimum. Desiccant is available from the factory.

- ✓ Are connections corroding? If the unit is installed near salt water for example, salts may form on the terminals inside the enclosure and cause malfunctions. In this event check that the enclosure is properly sealed. Use sealing compounds if necessary. Desiccant may also help prevent this buildup. Sealing sprays such as HumiSeal may also help protect the connections.

- ✓ Is the earth ground connection acceptable? Check that corrosion has not built up around the connection to the enclosure (outside or in). Disassemble, sand the connection location to remove rust or corrosion, and reattach if necessary.

4. TROUBLESHOOTING

Below are some commonly experienced problems along with possible remedial action. Contact the factory if any problem remains unresolved or additional help is required.

A particular channel on the multiplexer appears to be malfunctioning.

- Check sensor connections on the terminal board. Clean if corrosion exists.
- Try moving the sensor wired to the suspect channel to another channel to verify the malfunctioning of the channel (as opposed to the sensor).

No channels are working.

- Inspect circuit board for shorts, opens, or other damage.
- Is moisture present on circuit board? If so, install desiccant to absorb.

Channel selection appears to be random.

- Has corrosion built up on the circuit board? Clean if necessary.
- Is there a source of electrical noise nearby? Move multiplexer or noise source if possible.

APPENDIX A - SPECIFICATIONS

A.1 General

Power Requirements: 10-16 VDC (unregulated)
Quiescent Current (MICRO-10 mode): 80 μA (16CH mode), 130μA (32CH mode)
Quiescent Current (GK-403 mode): 12 mA
Channel Activated Current: 30 mA
Control Line Input Impedance: 26 kΩ (CLOCK), 13.9 kΩ (RESET)
Control Line Input Levels: TTL, 5V CMOS or RS-232 (±9 VDC)
Transient Protection: 6 VDC Transzorbs
Operating Temperature: –40 to +60° C

A.2 Relays

Type: NAIS TXS2SA-4.5V DPDT non-latching
Power: 11.1 mA @ 5VDC (55.5 mW)
Contact Type: Gold clad silver alloy
On Resistance: 100 mΩ
Coil Resistance: 405 Ω
Maximum Switching Power: 30W (resistive)
Maximum Switching Voltage: 110 VDC
Maximum Switching Current: 1 A
Operate Time: ≈5 msec Max.
Release Time: ≈5 msec
Switching Life: 5×10^7 operations (mechanical)
2×10^5 operations (electrical @ 30W)
Ambient Temperature: –40 to +70°C

A.3 Tripolar Plasma Surge Arrestor

Nominal DC Breakdown Voltage: 230V
Surge Life: 400 (10/1000 ms pulse @ 500 A)
Maximum Surge Current: 10 kA per side (8/20 μs pulse)
Insulation Resistance: 10000 MΩ
Operating Temperature: –65 to +125° C

A.4 Bipolar Plasma Surge Arrestor

Nominal DC Breakdown Voltage: 300V
Surge Life: 1000 (10/1000 μs pulse @ 500 A)
Maximum Surge Current: 20 kA (8/20 μs pulse)
Insulation Resistance: 10000 MΩ
Operating Temperature: –65 to +125° C

A.5 Transducer Connection Maximum Operating Voltage Levels:
Common-mode Voltage/Earth Ground: 16V(max)
Differential-mode Voltage (Channel # ‘H’ – Channel # ‘L’): 16V(max)

A.6 Reset and Clock Maximum Operating Voltage Levels:
Single-ended Control Voltage/System Ground: 16V(max)

A.7 RS-485 Maximum Operating Voltage Levels:

RESET:	Common-mode Voltage/Earth Ground: 16V(max) Differential-mode Voltage: 6V(max)
CLOCK:	Common-mode Voltage/Earth Ground: 16V(max) Differential-mode Voltage: 6V(max)
RS-485 +12V:	Common-mode Voltage/Earth Ground: 16V(max) Power Supply Voltage/System Ground: 16V(max)

APPENDIX B - CONNECTOR AND CABLE WIRING

J5	Inside Color	10 Pin Bendix	Description	Grey or Orange Cable Wire Color	Tan Cable Wire Color
1	Brown	A	COM HI 1	Brown	White
2	Red	B	COM LO 1	Brown's Black	White's Black
3	Orange	C	COM HI 2 (16 channel)	Red	Red
4	Yellow	D	COM LO 2 (16 channel)	Red's Black	Red's Black
5	Green	E	Analog Ground	Blue & Blue's Black	Blue & Blue's Black
6	Blue	F	+12 Volt Power	Yellow	Yellow
7	Purple	G	Power Ground	Yellow's Black	Yellow's Black
8	Grey	H	RESET (CR10) SENSE (GK-403)	Green	Green
9	White	J	CLOCK	Green's Black	Green's Black
10		K	No Connection	Shield Drain Wires from Brown & Red's pair plus Overall	Shield Drain Wires from White & Red's pair plus Overall

Table B.1 – J5 (I/O) Connector

J6/J7	Inside Color	Description	Grey or Orange Cable Wire Color
1	Brown	COM HI 1	White
2	Red	COM LO 1	White's Black
3	Orange	COM HI 2 (16 channel)	Green
4	Yellow	COM LO 2 (16 channel)	Green's Black
5	Green	RS-485 +12 Volt Power	Red
6	Blue	RS-485 Power Ground	Red's Black
7	Purple	RS-485 RESET	Blue
8	Grey	RS-485 /RESET	Blue's Black
9	White	RS-485 CLOCK	Yellow
10	Black	RS-485 /CLOCK	Yellow's Black

Table B.2 – J6/J7 (Daisy-chain) Connectors

P1	Description
1,2	SHIELD
3,4	SHIELD
5,6	COM HI 1
7,8	COM LO 1
9,10	COM HI 2 (16 channel)
11,12	COM LO 2 (16 channel)
13,14	SHIELD
15,16	RS-485 +12 Volt Power
17,18	RS-485 Power Ground
19,20	RESET
21,22	CLOCK
23,24	SHIELD

Table B.3 – P1 (I/O) Connector

P2	Description
1,2	COM HI 1
3,4	COM LO 1
5,6	COM HI 2
7,8	COM LO 2
9,10	RS-485 +12 Volt Power
11,12	RS-485 Power Ground
13,14	RS-485 RESET
15,16	RS-485 /RESET
17,18	RS-485 CLOCK
19,20	RS-485 /CLOCK
21,22	SHIELD
23,24	SHIELD

Table B.4 – P2 (I/O) Connector

J1	Terminal Strips	J2	Terminal Strips
1	T1 - 1H	1	T3 - 17H
2	T1 - 1L	2	T3 - 17L
3	T1 - 2H	3	T3 - 18H
4	T1 - 2L	4	T3 - 18L
5	T5 - 3H	5	T7 - 19H
6	T5 - 3L	6	T7 - 19L
7	T5 - 4H	7	T7 - 20H
8	T5 - 4L	8	T7 - 20L
9	T9 - 5H	9	T11 - 21H
10	T9 - 5L	10	T11 - 21L
11	T9 - 6H	11	T11 - 22H
12	T9 - 6L	12	T11 - 22L
13	T13 - 7H	13	T15 - 23H
14	T13 - 7L	14	T15 - 23L
15	T13 - 8H	15	T15 - 24H
16	T13 - 8L	16	T15 - 24L
17	T14 - 16L	17	T16 - 32L
18	T14 - 16H	18	T16 - 32H
19	T14 - 15L	19	T16 - 31L
20	T14 - 15H	20	T16 - 31H
21	T10 - 14L	21	T12 - 30L
22	T10 - 14H	22	T12 - 30H
23	T10 - 13L	23	T12 - 29L
24	T10 - 13H	24	T12- 29H
25	T6 - 12L	25	T8 - 28L
26	T6 - 12H	26	T8 - 28H
27	T6 - 11L	27	T8 - 27L
28	T6 - 11H	28	T8 - 27H
29	T2 - 10L	29	T4 - 26L
30	T2 - 10H	30	T4 - 26H
31	T2 - 9L	31	T4 - 25L
32	T2 - 9H	32	T4 - 25H
33	Shield	33	Shield
34	Shield	34	Shield

Table B.5 – J1/J2 (Terminal Board) Connectors

APPENDIX C - MANUAL SWITCH INSTRUCTIONS

The Model 8032 16/32 Channel Multiplexer directly supports manual switching of the sensor leads. This feature allows the user to easily connect a manual readout and obtain measurements in tandem with the automatic system. The manual switching components are optional and must be specified at time of order. A number of switching configurations are supported, consult the factory for additional information.

Depicted below is a manual switch arrangement for use with 16 vibrating wire sensors and their respective thermistors. The multiplexer is configured for 4 channel switching. To wire the terminal board remove the 4 panel mounting screws and lift out the panel. The terminal board for making gage connections is underneath the switch panel.

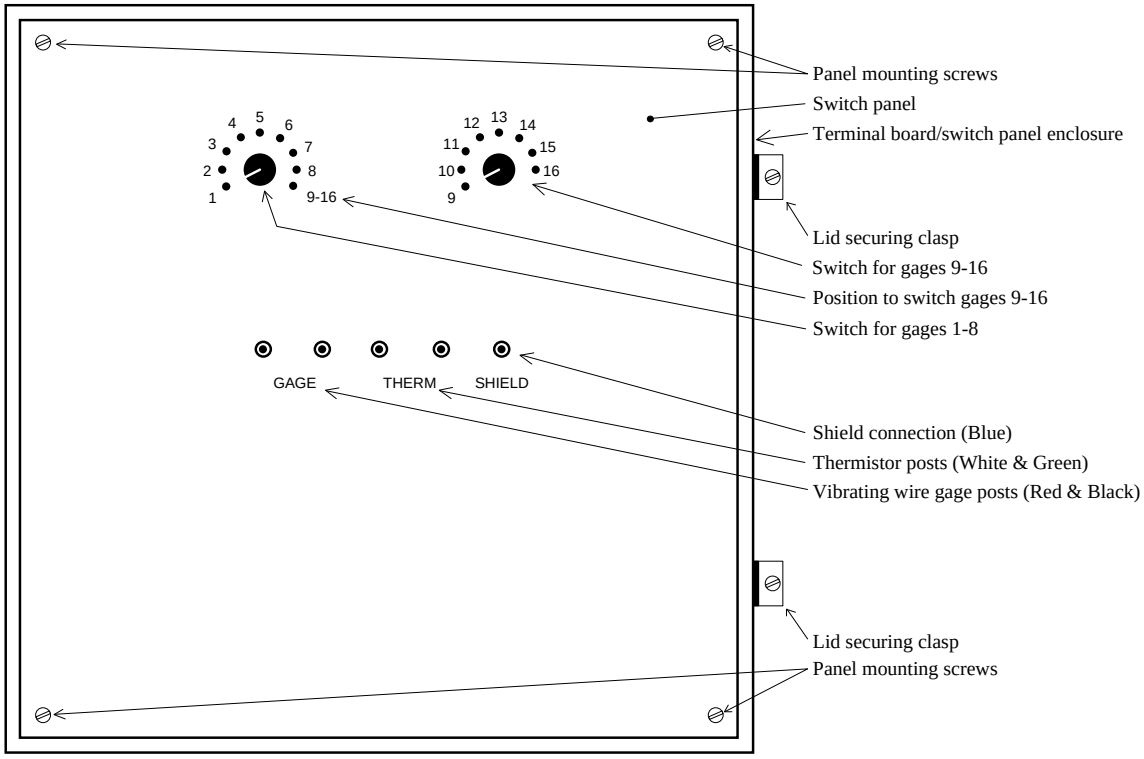


Figure 10 - Manual Switch Panel & Enclosure

To obtain readings with the manual switching follow these steps;

1. Open the terminal box/multiplexer enclosure by loosening the clasps which secure the lid.
2. Connect the alligator clip leads of the readout to the respective posts on the front panel. In the event the switch panel is equipped with a connector, plug in the cable from the readout.
3. Switch to position 1 on the left switch. Sensor 1 is now connected to the posts and will be read by the readout. Switch through all positions until 9-16 is reached. The right switch will now control which sensor is connected to the clip lead posts. Switch through positions 9-16.
4. When complete disconnect the clip leads, close the lid and fasten tightly with the two clasps.

APPENDIX D – MICRO-10 DAISYCHAIN OPERATION

Up to (8) 8032's may be "daisychained" together using a common RESET and CLOCK control line. This may be advantageous in situations where either there are not enough control ports available on the Micro-10 datalogger for the number of multiplexers desired, or to reduce the number of cables required to implement a large multi-channel system.

SW1 located on the Terminal Strip side of the circuit board determines the address of each multiplexer and the corresponding signal channels. As many as 256 2-conductor channels or 128 4-conductor channels may be accessed per RESET line.

SW1 Setting			Channels Accessed
2	**3**	**4**	
OFF	OFF	OFF	1-32 (32 channel mode) , 1-16 (16 channel mode) **DEFAULT MUX1**
OFF	OFF	ON	33-64 (32 channel mode) , 17-32 (16 channel mode) **MUX2**
OFF	ON	OFF	65-96 (32 channel mode) , 33-48 (16 channel mode) **MUX3**
OFF	ON	ON	97-128 (32 channel mode) , 49-64 (16 channel mode) **MUX4**
ON	OFF	OFF	129-160 (32 channel mode) , 65-80 (16 channel mode) **MUX5**
ON	OFF	ON	161-192 (32 channel mode) , 81-96 (16 channel mode) **MUX6**
ON	ON	OFF	193-224 (32 channel mode) , 97-112 (16 channel mode) **MUX7**
ON	ON	ON	225-256 (32 channel mode) , 113-128 (16 channel mode) **MUX8**

Table D.1 – Daisychain Operation/Channels Accessed

The following example on the next page is a schematic representations of the daisychain configuration with multiplexers configured for 32 channels. The figure D-1 shows 3 multiplexers sharing the same control ports, and a single cable is used to interconnect them.

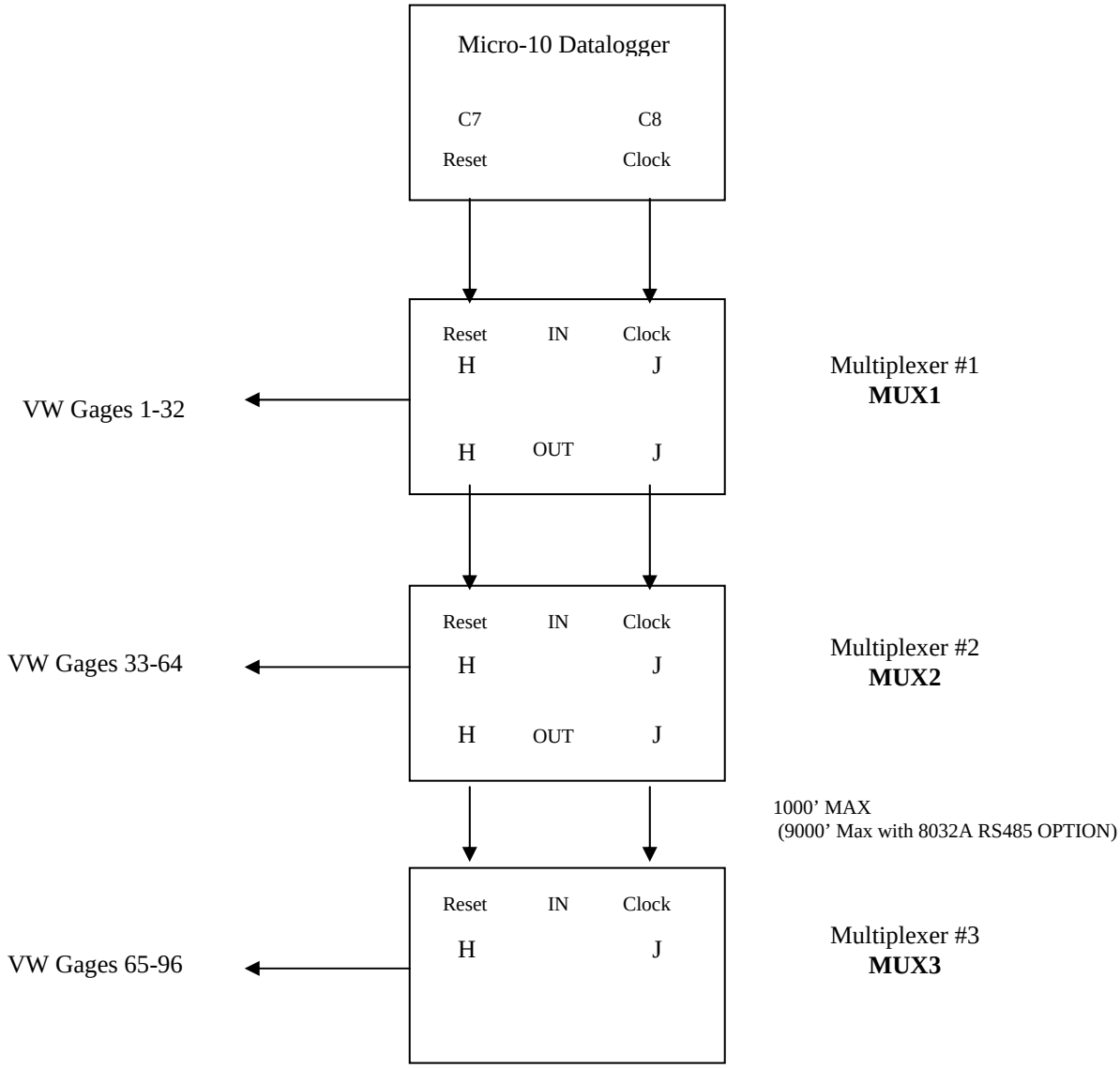


Figure D.1: Daisychain Configuration

NOTE:
By using 8032A multiplexers (with RS485 option), the maximum allowable distance from the Micro-10 datalogger to the most distant multiplexer can extend out to 9000' (2743m). Without the use of the RS-485 option, the greatest recommended distance from the Micro-10 datalogger to the most distant multiplexer is 1000' (305m). This option may be used with both the Star and Daisychain configurations. **The last multiplexer in the chain (or physically furthest from the datalogger) must have jumpers JP1 and JP2 set between pins 1 and 2 (terminated). All other multiplexers should have their JP1 and JP2 jumpers set between pins 2 and 3 (not terminated).**