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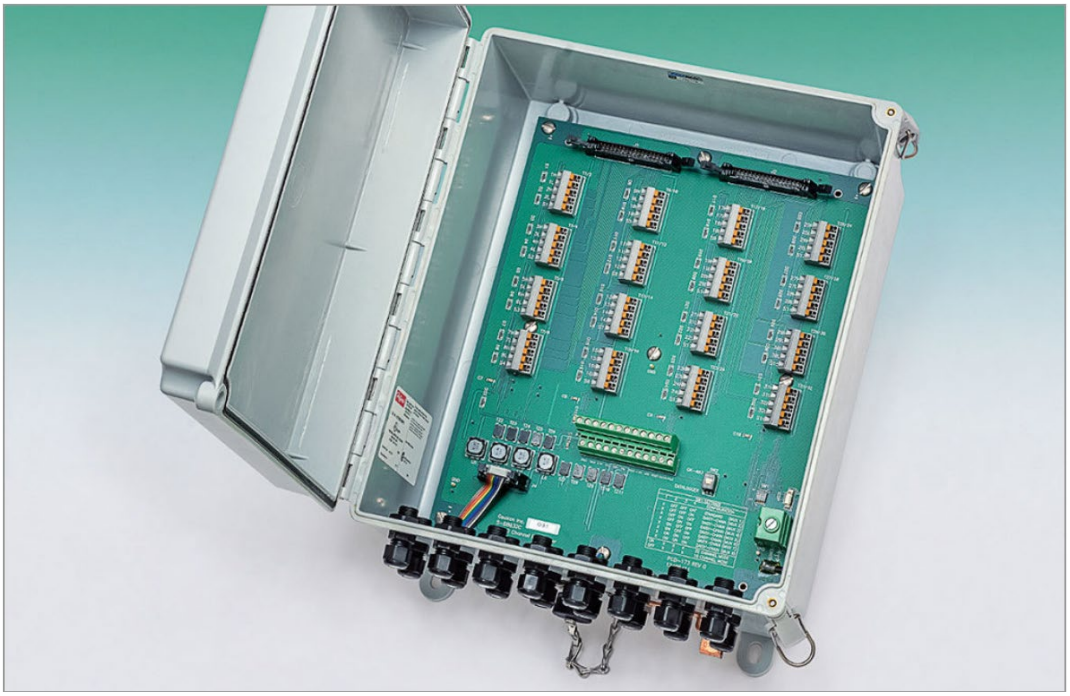
Instruction Manual

Model 8032

Terminal Board and
16/32-channel Multiplexer



(Doc Rev K, 1/22/20)

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1. THEORY OF OPERATION

The Model 8032 Terminal Board and Multiplexer expands the number of channels that can be read by the 8600 Datalogger. Channel switching is accomplished by mechanical relays mounted on the underside of the circuit board and the transducer connections are accomplished by friction locking spring-loaded terminals mounted on the top side of the circuit board.

There are two 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 the 8600 Datalogger.

Two switching configurations are supported, 16-channels of four conductors or 32-channels of two conductors. For the 8032-C, these configurations are set by a DIP Switch on the top side of the circuit board. A second DIP Switch selects whether the 8032-C is being used with a datalogger or GK-403 Readout Box (obsolete model). 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 by an integrated lightning protection system, incorporating 230V tripolar plasma surge arrestors, 150V bipolar plasma surge arrestors, 10uH inductors and 16V transient voltage protection diodes. See Appendix A for complete specifications on these components.

1.1 Channel Switching

Figure 1 illustrates the DIP switch marked “SW1” on the top side of the multiplexer circuit board. Switch position 1 is used for switching between 16 and 32-channel operation. If position 1 is set to **OFF**, the multiplexer is in **16-channel** mode. If position 1 is set to **ON**, the multiplexer is in **32-channel** mode. In Figure 1, 32-channel mode is chosen:

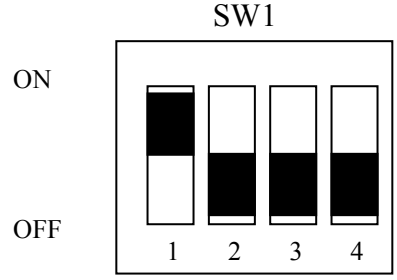


Figure 1 - Channel Selection Switch (Position 1 on SW1)

The 16-channel four-wire switching configuration (Figure 2) is typically used to multiplex four-wire sensors such as resistance strain gauge 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.

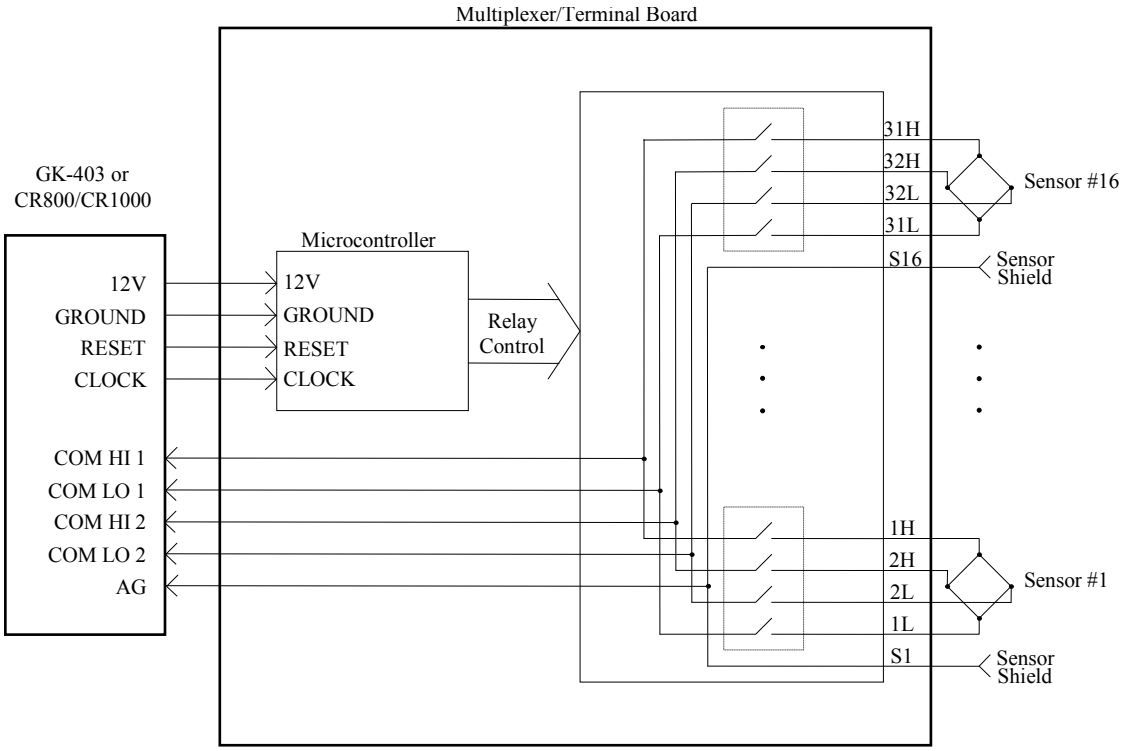


Figure 2 - 16-Channel Switching Block Diagram

The 32-channel two-wire switching configuration (Figure 3) is typically used to multiplex two-wire sensors such as a vibrating wire pressure transducers, thermistors or thermocouples.

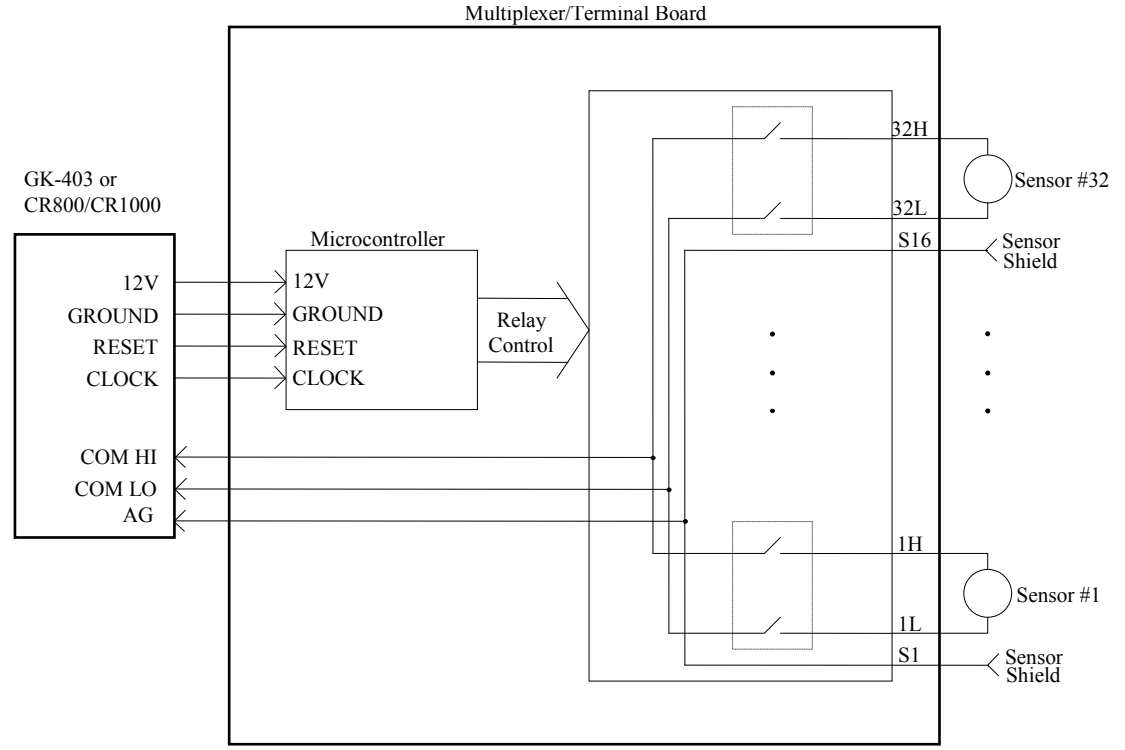


Figure 3 - 32-Channel Switching Block Diagram

1.2 Modes of Operation

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 - one when connected when connected to Model 8600 dataloggers, and the other for the GK-403 Vibrating Wire Readout Box (obsolete model). See the following sections explaining how each mode operates.

Figure 4 illustrates the DIP switch SW2 for switching between a GK-403 or Datalogger application. "DATALOGGER" is the default SW2 position:

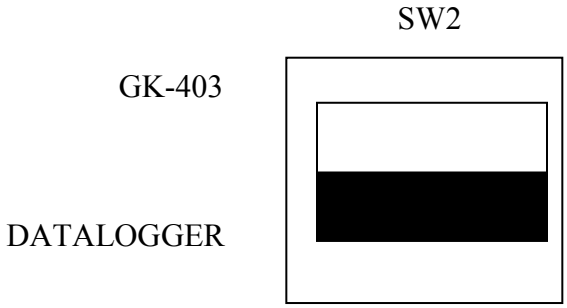
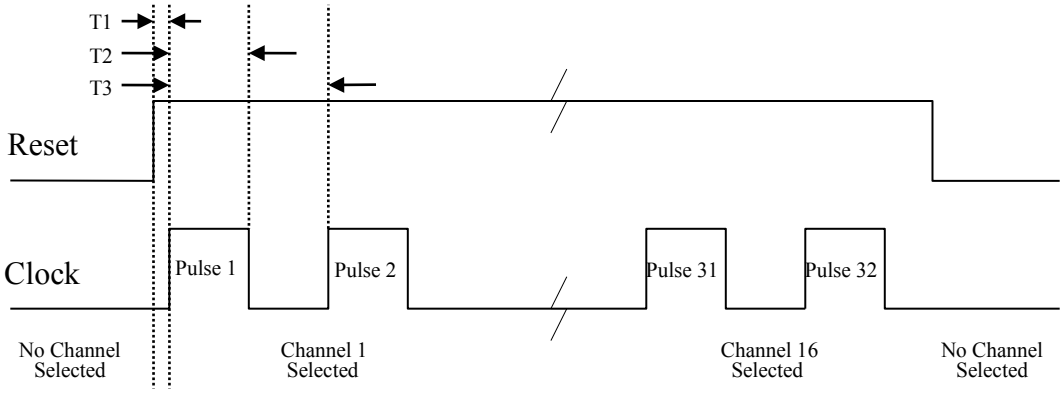


Figure 4 - GK-403/DATALOGGER Selection

1.2.1 Datalogger Mode of Operation

The Datalogger mode of operation uses two control lines to operate the multiplexer. The RESET line enables the multiplexer and activates the Datalogger mode of clocking. Pulses received on the CLOCK line sequentially increment the channels while the RESET line is held high. See the timing diagrams below (Figure 5 and Figure 6)

The CLOCK line sequentially advances the channels beginning with Channel 1. Note the timing diagrams for 16-channel (shown in Figure 5) and 32-channel (shown in Figure 6) channel switching arrangements.



Timing: T1 = 50 mSec(min.)
T2 = 2 mSsec(min)
T3 = 4 mSsec(min)

Figure 5 - 16-Channel Datalogger Channel Selection Timing

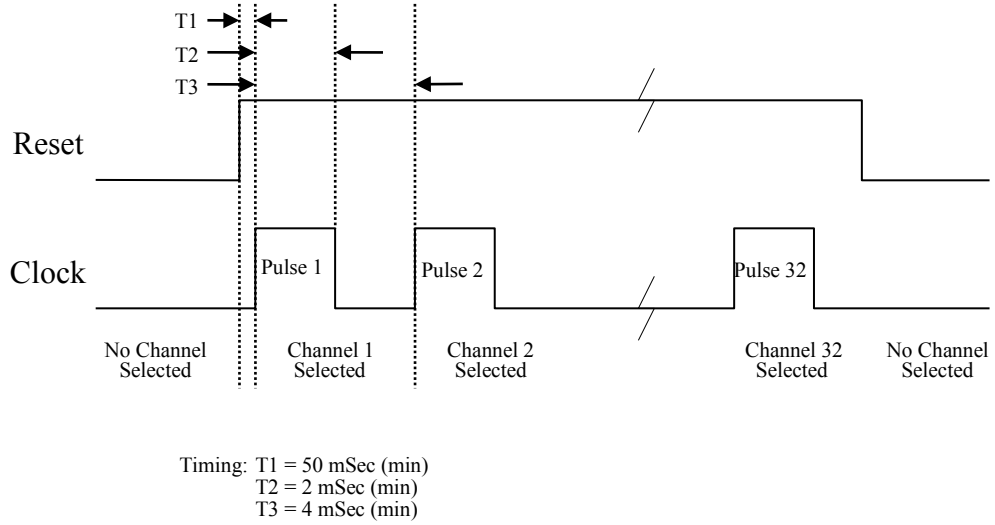


Figure 6 - 32-Channel Datalogger Channel Selection Timing

1.2.2 GK-403 Mode of Operation

(**Please note:** The GK-403 is an obsolete model. This mode of operation has been retained for legacy purposes.)

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 two times the desired channel number. In 32-channel mode, the number of clock pulses equals the desired channel number plus one. Note the timing for 16-channel (shown in Figure 7) and 32-channel (shown in Figure 8) switching arrangements.

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).

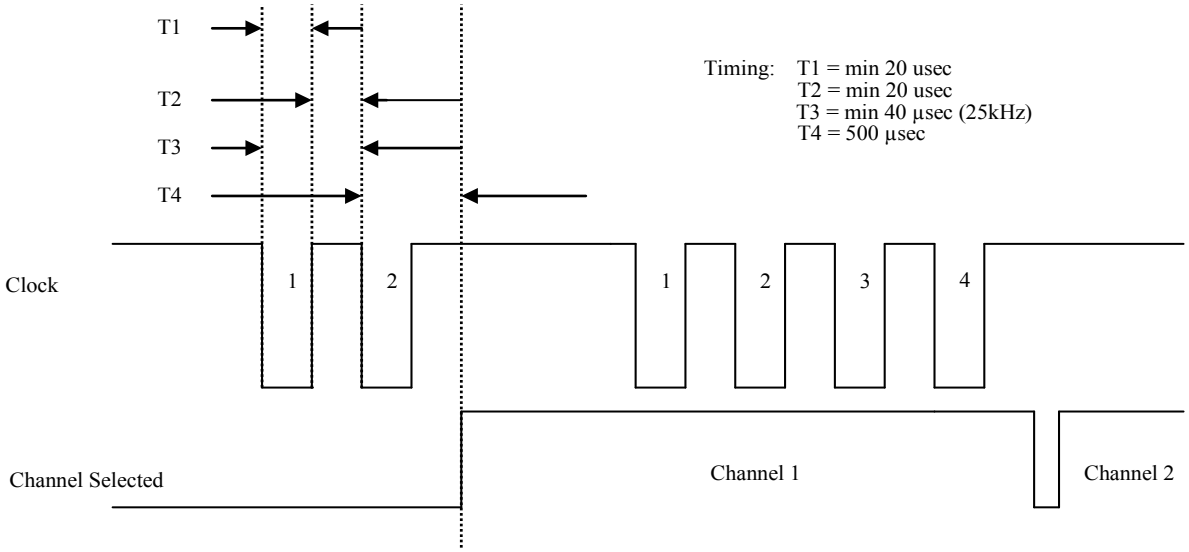


Figure 7 - 16-Channel GK-403 Channel Selection Timing

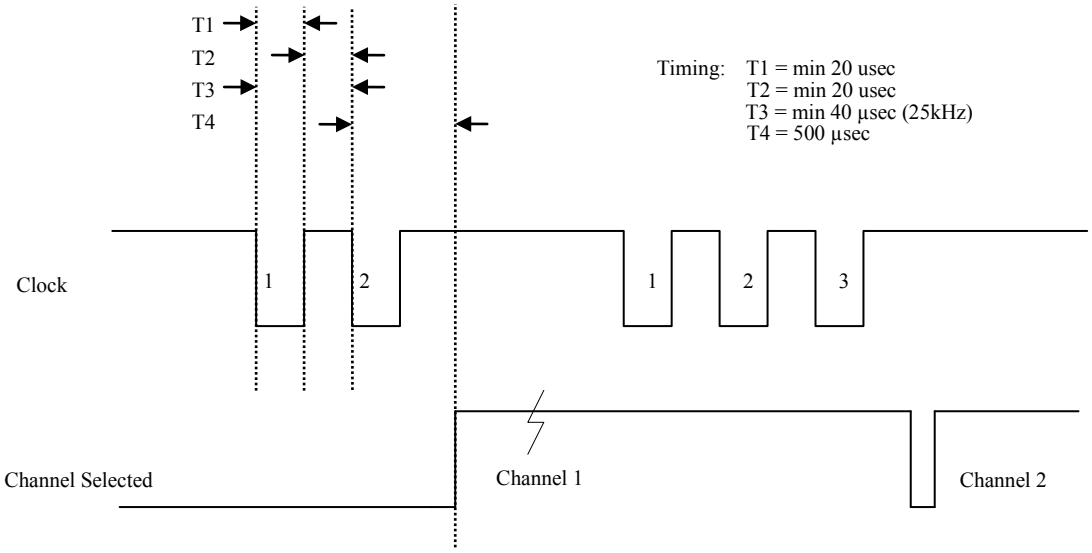


Figure 8 - 32-Channel GK-403 Channel Selection Timing

2. INSTALLATION AND WIRING

2.1 Installation

The multiplexer (or terminal board alone) is housed in a Nema 4/4X 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 9 for mounting dimensions.

Figure 9 - Multiplexer Enclosure Mounting Dimensions

An earth ground lug is installed on the bottom of the enclosure. Drive a copper stake into the ground (or use an existing grounded metal structure) and attach a large gauge copper wire (>12 AWG) from earth ground to the earth ground lug 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. Plastic dowels are provided for unused cable entries to prevent moisture and contaminants from entering the enclosure.

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 gauge 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 Gauge 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 10 depicts the terminal board to which gauge connections are made. If the terminal board is equipped with manual switches, connectors J1 and J2 will have ribbon cables that are connected to the switch boards.

Terminal Blocks T1/2 to T31/32 are for the gauge connections.

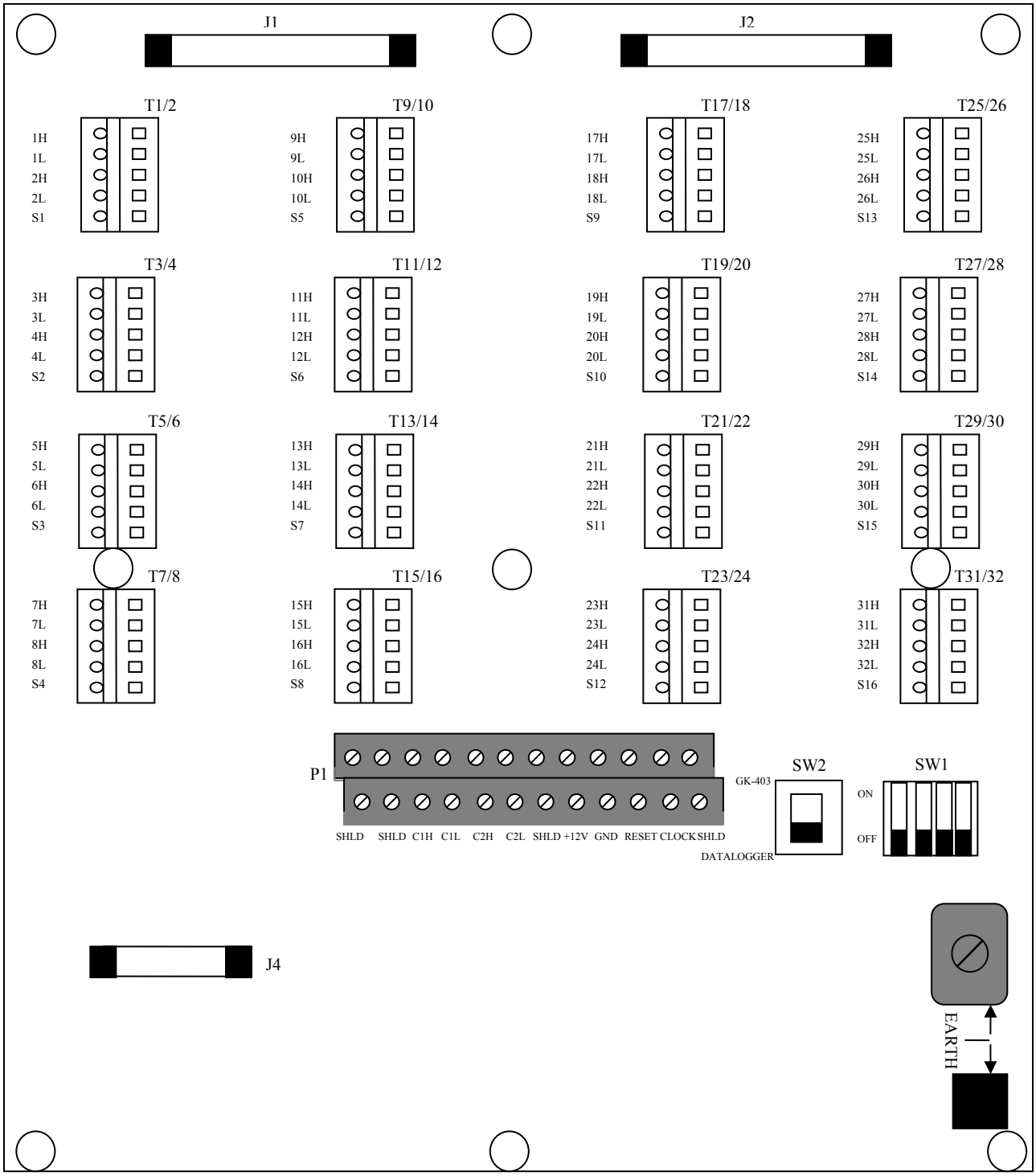


Figure 10 - Terminal Board Layout

2.2.1 Model 8032-27 and Load Cell Wiring

Connect the "common" VW- conductor from the load cell to the 8032-27 by lifting up the orange tab located on the opposite side of the six black conductors, inserting the common conductor fully into the 8032-27 (Figure 11), and then pushing down on the orange tab until it snaps into place. Refer to Table 3 to identify which conductor carries the common VW- signal.

Figure 11 - Model 8032-27 Jumper Wire Assembly

10 pin Bendix PT06A-12-10P	**Function**	**3 Gauge VW Load Cell, Purple Cable**	**4 Gauge VW Load Cell, Purple Cable**	**6 Gauge VW Load Cell, Orange Cable**
H	Common	White's Black*	Green	Blue

Table 3 - Common Conductor Chart

*White's black and Green wires are switched on GEOKON 3-gauge VW load cells prior to serial number 3313.

The following wiring chart details the connections between the load cell and 8032-27 with the terminal board:

Terminal Board	**Vibrating Wire with Thermistor**
1H	VW Sensor #1
1L	8032-27
2H	Thermistor
2L	Thermistor
S1	Shield Drain Wire
3H	VW Sensor #2
3L	8032-27
4H	-
4L	-
S2	-
5H	VW Sensor #3
5L	8032-27
6H	-
6L	-
S3	-
•	•
•	•
11H	VW Sensor #6
11L	8032-7
12H	-
12L	-
S6	-

Table 4 - Standard VW Load Cell Wiring When Using 8032-27

2.3 Datalogger Connection

Following sensor and installation, connections between a Datalogger and Multiplexer(s) can be made using the model 8032-5 interconnect cable. Each Multiplexer employed is connected to the appropriate weather tight 10-pin Bendix connector mounted on the enclosure. Each connector on a standard Datalogger is pre-wired to control and read the external Multiplexers.

3. MAINTENANCE AND TROUBLESHOOTING

3.1 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 can 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 can also help prevent this buildup. Sealing sprays such as HumiSeal can 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.

3.2 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.

Symptom: 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).

Symptom: 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.

Symptom: 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

GENERAL:	
Power Requirements	10-16 VDC (unregulated)
Quiescent Current (Datalogger mode)	80 µA (16CH mode), 130µA (32CH mode)
Quiescent Current (GK-403 mode)	12 mA
Channel Activated Current	30 mA
Control Line Input Impedance	100 kΩ (CLOCK), 100 kΩ (RESET)
Control Line Input Levels	TTL or RS-232 (±9 VDC)
Transient Protection	16 VDC Transzorbs
Operating Temperature	–40 to +60° C
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	Mechanical: 5 x 10^7 operations Electrical @ 30W: 2 x 10^5 operations
Ambient Temperature	–40 to +70°C
TRIPOLAR PLASMA SURGE ARRESTOR:	
Nominal DC Breakdown Voltage	230V
Surge Life	100 (10/1000 ms pulse @ 200 A)
Maximum Surge Current	5 kA per side (8/20 µs pulse)
Insulation Resistance	10^9 Ω
Operating Temperature	–65 to +125° C
BIPOLAR PLASMA SURGE ARRESTOR:	
Nominal DC Breakdown Voltage	150V
Maximum Surge Current	1 kA (8/20 µs pulse)
Insulation Resistance	10^{10} Ω
Operating Temperature	–65 to +125° C

INDUCTOR	
Rated Current	4A
Inductance	10µH (±20%)
D.C.R.	25mΩ MAX (at 20°C)
TRANSIENT VOLTAGE SUPPRESSOR (TRANSORB):	
Rated Power	1500W
Peak forward Surge Current	200A
Reverse Standoff Voltage	16.0V
TRANSDUCER CONNECTION MAXIMUM OPERATING VOLTAGE LEVELS:	
Common mode Voltage/Earth Ground	16V(max)
Differential mode Voltage (Channel # 'H' – Channel # 'L')	16V(max)
RESET AND CLOCK MAXIMUM OPERATING VOLTAGE LEVELS:	
Single ended Control Voltage/System Ground	16V(max)

Table 5 - Specifications

APPENDIX B. CONNECTOR AND CABLE WIRING

J4	Inside Color	10 Pin Bendix	Description	8032-5 (TAN) Cable Wire Color
1	Brown	A	COM HI 1	White
2	Red	B	COM LO 1	White's Black
3	Orange	C	COM HI 2 (16-channel)	Red
4	Yellow	D	COM LO 2 (16-channel)	Red's Black
5	Green	K	Analog Ground	Shield Drain Wires – all pairs plus overall
6	Blue	F	+12 Volt Power	Yellow
7	Purple	G	Power Ground	Yellow's Black
8	Grey	H	RESET (DATALOGGER) SENSE (GK-403)	Green
9	White	J	CLOCK	Green's Black
10		E	No Connection	Blue & Blue's Black (unused)

Table 6 - J4 (I/O) Connector

P1 Terminal	Label	Description	8032-5 (TAN) Cable Wire Color
1,2	SHLD	SHIELD	Shield Drain Wires – all pairs plus overall
3,4	SHLD	SHIELD	Shield Drain Wires – all pairs plus overall
5,6	C1H	COM HI 1	White
7,8	C1L	COM LO 1	White's Black
9,10	C2H	COM HI 2 (16-channel)	Red
11,12	C2L	COM LO 2 (16-channel)	Red's Black
13,14	SHLD	SHIELD	Shield Drain Wires – all pairs plus overall
15,16	+12V	+12 Volt Power	Yellow
17,18	GND	Power Ground	Yellow's Black
19,20	RESET	RESET	Green
21,22	CLOCK	CLOCK	Green's Black
23,24	SHLD	SHIELD	Shield Drain Wires – all pairs plus overall
-	-	No Connection	Blue & Blue's Black (unused)

Table 7 - P1 (I/O) Connector

Note: P1 is a "stacking" type connector. Odd number terminals are read left to right on the bottom row. Even numbered terminals are read left to right on the top row.

J1	Terminal Blocks	Label	J2	Terminal Blocks	Label
1	T1/2	1H	1	T17/18	17H
2	T1/2	1L	2	T17/18	17L
3	T1/2	2H	3	T17/18	18H
4	T1/2	2L	4	T17/18	18L
5	T3/4	3H	5	T19/20	19H
6	T3/4	3L	6	T19/20	19L
7	T3/4	4H	7	T19/20	20H
8	T3/4	4L	8	T19/20	20L
9	T5/6	5H	9	T21/22	21H
10	T5/6	5L	10	T21/22	21L
11	T5/6	6H	11	T21/22	22H
12	T5/6	6L	12	T21/22	22L
13	T7/8	7H	13	T23/24	23H
14	T7/8	7L	14	T23/24	23L
15	T7/8	8H	15	T23/24	24H
16	T7/8	8L	16	T23/24	24L
17	T15/16	16L	17	T31/32	32L
18	T15/16	16H	18	T31/32	32H
19	T15/16	15L	19	T31/32	31L
20	T15/16	15H	20	T31/32	31H
21	T13/14	14L	21	T29/30	30L
22	T13/14	14H	22	T29/30	30H
23	T13/14	13L	23	T29/30	29L
24	T13/14	13H	24	T29/30	29H
25	T11/12	12L	25	T27/28	28L
26	T11/12	12H	26	T27/28	28H
27	T11/12	11L	27	T27/28	27L
28	T11/12	11H	28	T27/28	27H
29	T9/10	10L	29	T25/26	26L
30	T9/10	10H	30	T25/26	26H
31	T9/10	9L	31	T25/26	25L
32	T9/10	9H	32	T25/26	25H
33	Shield	S1-S16	33	Shield	S1-S16
34	Shield	S1-S16	34	Shield	S1-S16

Table 8 - 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 four-channel switching. To wire the terminal board remove the four panel mounting screws and lift out the panel. The terminal board for making gauge connections is underneath the switch panel.

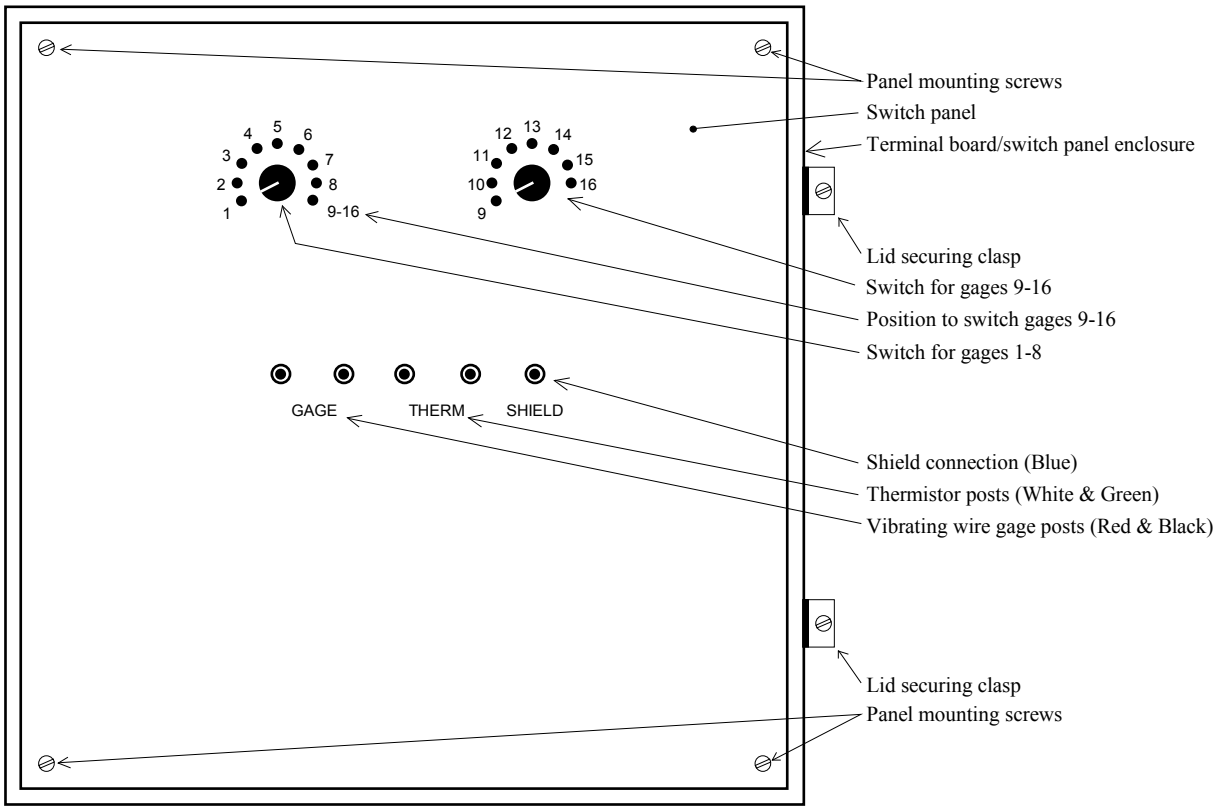


Figure 12 - Manual Switch Panel and Enclosure

To obtain readings with the manual switching follow these steps:

1) Open the terminal box/multiplexer enclosure by opening the quick-release 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. "DAISY-CHAIN" OPERATION

Up to eight 8032's can be "daisy-chained" together using a common RESET and CLOCK control line. This can be advantageous in situations where either there are not enough control ports available on the 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 Block 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 four-conductor channels can 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 9 - "Daisy-Chain" Operation/Channels Accessed

Figure 13 is a schematic representation of the "daisy-chain" configuration with multiplexers configured for 32-channels. Figure 13 shows three multiplexers sharing the same control ports, and a single cable is used to interconnect them.

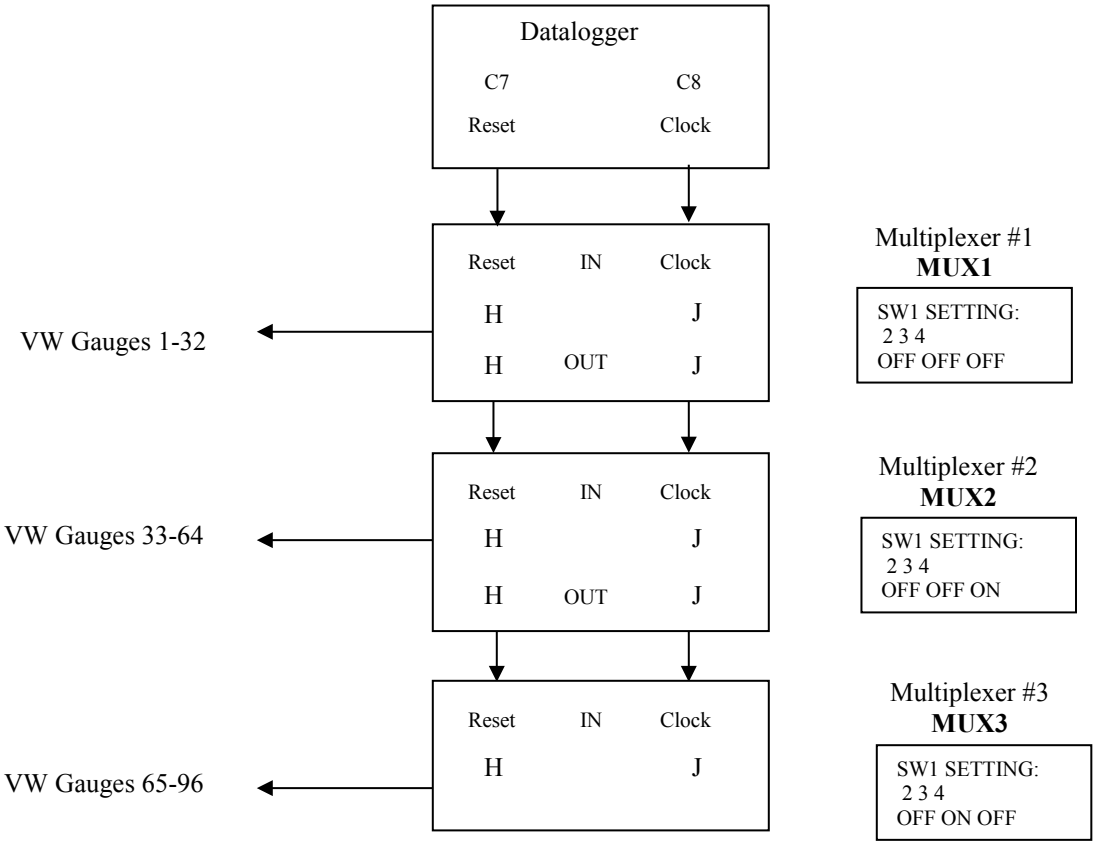


Figure 13 - "Daisy-chain" Configuration

APPENDIX E. MAXIMUM 8032-5 (TAN CABLE) CABLE LENGTHS

The 8032 Multiplexer is a low power device, that can be physically located at a considerable distance from the Datalogger. The limitations to the maximum distance between the 8032 multiplexer and the datalogger are mostly due to the voltage dropped by the 8032-5 MUX cable over its length. Factors such as ambient temperature, number of 8032 Multiplexers ("daisy-chain" configuration) and system battery voltage need to be considered in determining the maximum 8032-5 cable length.

For a single 8032 Multiplexer under normal operating conditions (System Battery = 12V, ambient temperature = 20° C), the maximum recommended cable length from the Datalogger to the 8032 Multiplexer is 4588 feet (≈1400 m). Figure 14 displays the maximum recommended cable length for various Datalogger, Battery Voltage and ambient Temperature combinations.

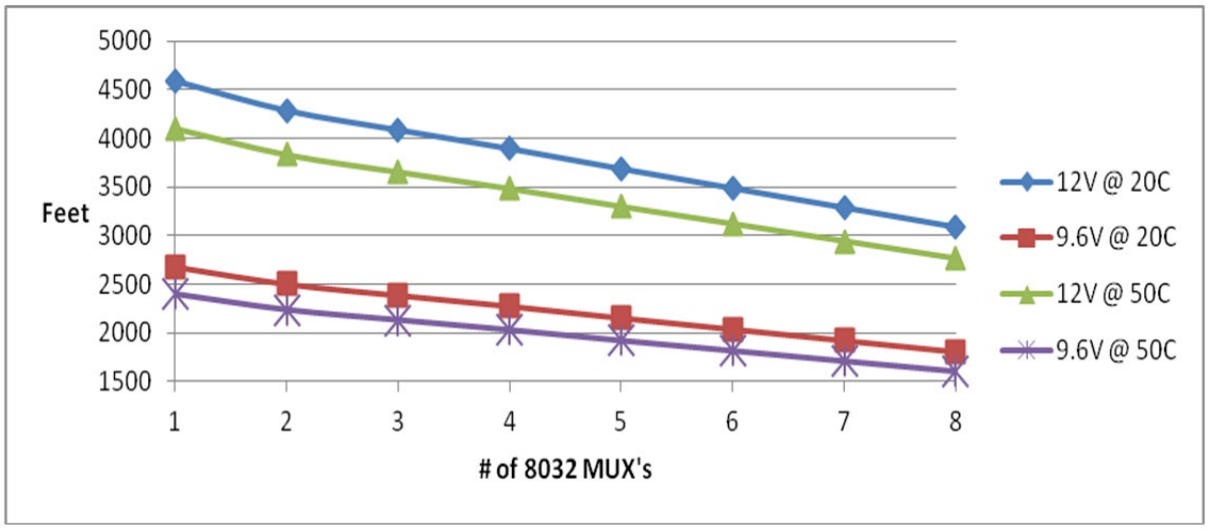


Figure 14 - Recommended Maximum Cable Length

APPENDIX F. MEMS SENSOR TO MULTIPLEXER WIRING

Up to sixteen Uniaxial MEMS sensors are connected to the Canary six-wire Multiplexer through the weather tight strain relief fittings mounted to the Datalogger enclosure; with the final connection made to the terminal blocks mounted on the Multiplexer. Each terminal block, or Multiplexer channel, consists of seven clamp connections. A sample Uniaxial MEMS connection is as follows for terminal block #1

Terminal Block Location	Sensor Wire Color	Description
1H1	White	MEMS Output +
1L1	White's Black	MEMS Output -
1H2	Green	Thermistor Output+
1L2	Green's Black	Thermistor Output-
1H3	Red	+12V Power
1L3	Red's Black	Power Ground
Shield	Bare	Cable Shield

Table 10 - Uniaxial MEMS Wiring

Up to eight Biaxial MEMS sensors are connected to each Canary six-wire Multiplexer through the weather tight strain relief fittings mounted to the Datalogger enclosure; with the final connection made to the terminal blocks mounted on the Multiplexer. Each terminal block, or Multiplexer channel, consists of seven clamp connections. A sample biaxial MEMS connection is as follows for terminal blocks #1 and #2:

Terminal Block Location	Sensor Wire Color	Description
1H1	White	A axis Output +
1L1	White's Black	A axis Output -
1H2	Blue	Thermistor Output+
1L2	Blue's Black	Thermistor Output-
1H3	Red *	+12V Power
1L3	Red's Black *	Power Ground
Shield	Bare	Cable Shield
2H1	Green	B axis Output +
2L1	Green's Black	B axis Output -
2H2	No Connection	--
2L2	No Connection	--
2H3	Red *	+12V Power
2L3	Red's Black *	Power Ground
Shield	Bare	Cable Shield

Table 11 - Biaxial MEMS Wiring

* Jumpers required for Sensor Power and Sensor Ground