Instruction Manual

for

Monroe Electronics, Inc.

Static Monitor

Four Channel Electrostatic Fieldmeter System

Model 177-1

Specifications subject to change without notice.
P/N 0340096

MONROE ELECTRONICS
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WARRANTY

Monroe Electronics, Inc. warrants to the Owners, each instrument and sub-assembly manufactured by them to be free from defects in material and workmanship for a period of one year after shipment from the factory. This warranty is applicable to the original purchaser only.

Liability under this warranty is limited to service, adjustment or replacement of defective parts (other than tubes, fuses or batteries) on any instrument or sub-assembly returned to the factory for this purpose, transportation prepaid.

This warranty does not apply to instruments or sub-assemblies subjected to abuse, abnormal operating conditions, or unauthorized repair or modification.

Since Monroe Electronics, Inc. has no control over conditions of use; no warranty is made or implied as to the suitability of our product for the customer's intended use.

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In the event of a breach of the foregoing warranty, the liability of Monroe Electronics shall be limited to repairing or replacing the non-conforming goods and/or defective work, and in accordance with the foregoing; Monroe Electronics shall not be liable for any other damages, either direct or consequential.

RETURN POLICIES AND PROCEDURES

FACTORY REPAIR:

Return authorization is required for factory repair work. Material being returned to the factory for repair must have a Return *Material Authorization* number. To obtain an RMA number, call 716-585-2254 and ask for Customer Service.

Material returned to the factory for warranty repair must be accompanied by a copy of a dated invoice or bill of sale, which serves as a proof of purchase for the material.

Repairs will be returned promptly. Repairs are normally returned to the customer by UPS within ten working days after receipt by Monroe Electronics, Inc. Return (to the customer) UPS charges will be paid by Monroe Electronics on warranty work. Return (to the customer) UPS charges will be prepaid and added to invoice for out-of-warranty repair work.

EXPEDITED FACTORY REPAIR:

All material returned to the factory by air or by an overnight service will be expedited. Expedited factory repairs will be returned to the customer by the same mode of transportation by which the material was returned to the factory for repair (i.e., material returned to the factory by an overnight service will be returned to the customer by an overnight service).

NOTE: Return (to the customer) transportation expenses for expedited factory repairs will always be at the expense of the customer despite the warranty status of the equipment.

FACTORY REPAIRS TO MODIFIED EQUIPMENT:

Material returned to the factory for repair that has been modified will be not tested unless the nature and purpose of the modification is understood by us and does not render the equipment untestable at our repair facility. We will reserve the right to deny service to any modified equipment returned to the factory for repair regardless of the warranty status of the equipment.

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Section 1

GENERAL

The Monroe Electronics *Static Monitor Four Channel 177-1 Electrostatic Fieldmeter System* measures electrostatic fields (potential gradient) in terms of voltage per unit distance. It may also be used to measure surface voltage using the probe to surface separation as a calibration factor.

As with other models of Monroe Electronics electrostatic fieldmeters, the *Static Monitor 177-1's* primary application is measurement and monitoring of electrostatic charge accumulation. As charge increases on the surface of a material, the electrostatic field in the vicinity increases proportionately. The *Static Monitor 177-1* produces a reliable output signal directly proportional to the surface charge accumulation while making NO PHYSICAL CONTACT with the material being monitored.

This second-generation system features a simplified console for easy installation and operation. Up to four points may be monitored using Monroe Model 1036 probe heads placed at distances up to 1000 feet. Processes can be constantly monitored and recorder outputs utilized for long term, drift free data acquisition. Several units may be ganged for larger applications.

Factory Mutual Research Corp. approves the Model 1036 probes for use in Class I, Division 1, Groups C and D hazardous locations. Approved intrinsic safety (IS) barriers must be used to comply.

Section 2

SPECIFICATIONS

Range:	0 to ±10 kV/inch (with standard 1036E-6 probe)
Accuracy:*	3% of full scale at analog outputs 3% of full-scale ±2 counts +0.3 counts/°C at front panel meters
Drift:*	1% (typical) of full scale, non-cumulative, long term when sensors are purged according to manufacturer's instructions
Noise:*	Less than 0.05% of full scale peak to peak below 30Hz
Speed of response:	250ms, 10% to 90% of full scale (typical)
Temperature range:	(a) Probe: -30 to +100°C (b) Mainframe: 0 to 50°C
Outputs:	Any one of three analog outputs may be selected for full scale on any channel: ±10V, ±5V, or +2.5V (±2.5V) offset for use with Monroe Model 178 process controller or equivalent. (Nominal output impedance <10Ω) or 4-20mA Four individual LED panel meters are provided for setup and direct reading of input signal
Power requirements:	90-260VAC, 47-63Hz, Fuse 3AG 1A
Size:	1¾" height fits standard NEMA 19" rack opening Depth is 273mm (10¾")
Weight:	3.6kg (8lbs)
Probe dimensions:	Model 1036E 15.24 x 7.62 x 5.24cm (6.0" x 3.0" x 2.063") Weight 1.53kg (3lbs, 6oz) Model 1036F 4.45cm dia. x 3.11cm high (1.75" dia. x 1.22" high) Weight 0.227kg (8oz)

*These parameters are specified at +25C.

Probe options:

Range is a function of probe selection. Refer to *USERS' MANUAL for Monroe Electronics, Inc. Electrostatic Fieldmeter Probes Models 1036E and 1036F* for further information.

Optional ranges available - ±1kV/cm (100kV/m)
±10kV/cm (1MV/m)
±20kV/cm (2MV/m)
±10kV/inch (standard)
±1kV/inch

Custom ranges are available at an additional charge. Note that some performance may be lost with probes more sensitive than standard.

Probes with higher speed of response, up to 50ms are available. Probe noise will increase in proportion to the increase in speed of response.

Probes are normally furnished with 10-foot cables attached. Extension cables are available to permit total lengths up to 1000 feet.

Accessories included:

This manual
Users' Manual for probes
P-201 RJ11 6-4 to D-sub 9S adapter
4-position and 8-position "pluggable terminal blocks"
RJ11 6-4 line cord
Jumper strip
Mounting kit
AC power cords (Standard and European)

Specifications are subject to change without notice.

Section 3

INSTALLATION

The *Static Monitor 177-1* is designed to occupy a 1¾" space in a standard 19" equipment rack. A minimum of 4" should be left behind the instrument to allow for cable connections to the back panel.

For use in conjunction with central data collection and/or monitoring, the *Static Monitor 177-1* may be placed at any convenient, centralized location provided that the distance to any one probe does not exceed 1000 feet. The probes should be placed at any location requiring the monitoring of charge buildup.

An earth ground is necessary for proper operation. A three wire grounded line cord is provided with the unit. The chassis of the instrument may be grounded through the line cord, but the chassis must be grounded, not floated. The power line connector is located on the rear of the instrument.

NOTE: The wire color code for the line cord provided is:

HIGH SIDE OF LINE — BLACK or BROWN
LOW SIDE OF LINE — WHITE or LIGHT BLUE
SAFETY GROUND — GREEN or GREEN/YELLOW

A. PROBE INPUTS:

Four probe-input connectors are located on the instrument back panel. These are 9-pin subminiature D receptacles for mating to plugs on either the cables attached directly to the probes or extension cables or adapter cables used with them. Two captive screws normally furnished with the plugs may be secured to female thread inserts alongside each receptacle.

At least one probe must be connected to produce a meaningful result from the *Static Monitor 177-1.*

B. OUTPUTS:

Two types of outputs are available on the back panel to represent the inputs. Voltage outputs may be taken at four BNC connectors or 4-20 mA current outputs at screw terminals at JP2. Voltage and current outputs are not simultaneously available for any given channel.

The three possible voltage outputs are: [1] ±10 volts, [2] ±5 volts or [3] +2.5 volts, ±2.5 volts (0 to +5 volts with a +2.5 volt offset so that +2.5 volts at the output represents 0kV at the input).

The positive 4-20mA loop outputs are at terminals 2, 4, 6 and 8 of JP2 for Channels 1-4, respectively. The returns are at terminals 1, 3, 5 and 7, which are

connected to common. The user must supply sources for the 4-20mA outputs. A minimum of +2.5 volts must be maintained across the output circuit to insure correct operation. The maximum voltage should not exceed +15 volts for power dissipation reasons.[1]

These outputs are programmed by internal jumpers and are normally set at the factory for sensors with sensitivities of ±10kV/inch and a full scale output voltage of ±10 volts unless otherwise specified.

See APPENDIX I for further information.

C. (REMOTE) TEST:

Two screw terminals are provided at JP2A on the back panel for the purpose of testing the operation of those channels that are actually in operation. Employing this test requires a switch or transistor closure between terminals 1 and 2 of JP2A. Terminal 1 is positive and terminal 2 is ground. Maximum voltage available is approximately 5 volts and maximum current is approximately 10mA.

D. REMOTE ENA (Master/Slave):

Two screw terminals are provided at JP2A on the back panel for Master/Slave operation of up to ten slave instruments from one master or a virtually unlimited number of slaves from an external switch closure. The external switch contact rating must be greater than n x 10mA where n is the number of slaves. Terminals 3 and 4 of JP2A should be wired in parallel between units in the controlled system with external switch or relay contacts (if used) across the two. Terminal 3 is positive and terminal 4 is ground.

The master unit controls the slave unit(s). The slave(s) must have the power switch ON and the front panel switch in STANDBY for remote operation. The master OPERATE/STANDBY switch will then put all slaves in OPERATE when the master is put in OPERATE.

Internal jumpers J5 (Master) and J6 (Slave) configure Master/Slave operation.

E. RS232-C:

Provides for remote group and channel enable/disable function and status check through an RJ11 6-4 modular jack on the instrument back panel. RS232-C implementation is addressed in APPENDIX II.

[1] The screw terminals at JP2 and JP2A are “pluggable terminal blocks”. If for some reason, it becomes necessary to remove the instrument without disturbing the wiring to these terminals, the blocks will pull straight out from their sockets, which are secured to the PC board in the instrument.

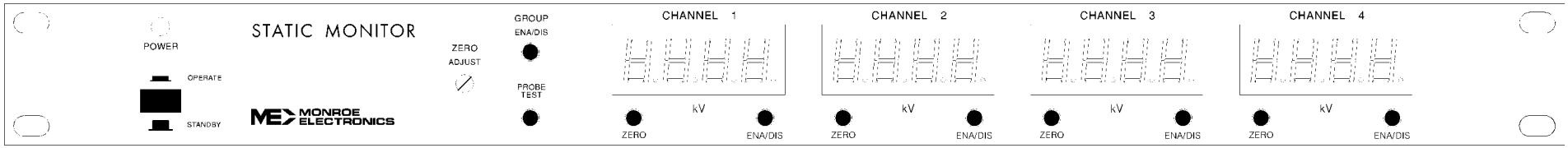


Figure 3-1
Static Monitor Front Panel

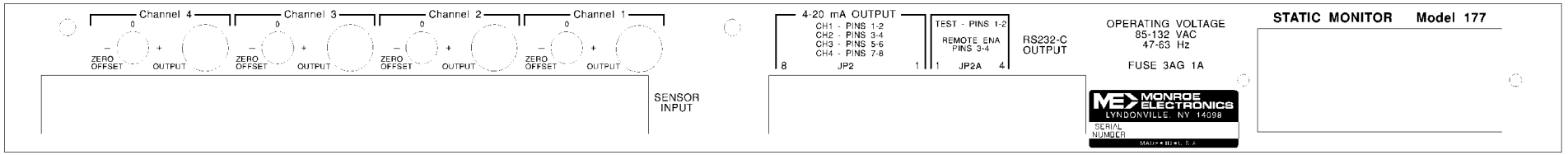


Figure 3-2
Static Monitor Rear Panel

Section 4

PRINCIPLE OF OPERATION

A vibrating sense electrode "looks" at the surface under measurement through a sized hole in the gradient cap. An AC signal is induced on the vibrating electrode that is capacitively coupled to the surface under measurement; thus, not requiring contact. The magnitude and polarity of the DC voltage on the surface dictate this signal's amplitude and phase.

This AC signal, conditioned by the preamplifier, filter and signal amplifier, is fed into a phase sensitive demodulator. The signal from the demodulator feeds an integrator. A fraction of the integrator's output voltage is then fed back to the sense electrode to null the field. When the field becomes null, the integrator output stabilizes. The voltage out of the integrator is thus directly proportional to the field intensity at the probe. This makes it possible to couple to a meter for direct readout. The operation of this instrument is such that a low voltage level is used to null the field at the probe to make it intrinsically safe.

The instrument gives a reading of the field intensity at any spacing. However, if the spacing is known, the voltage on the surface under measurement can be determined.

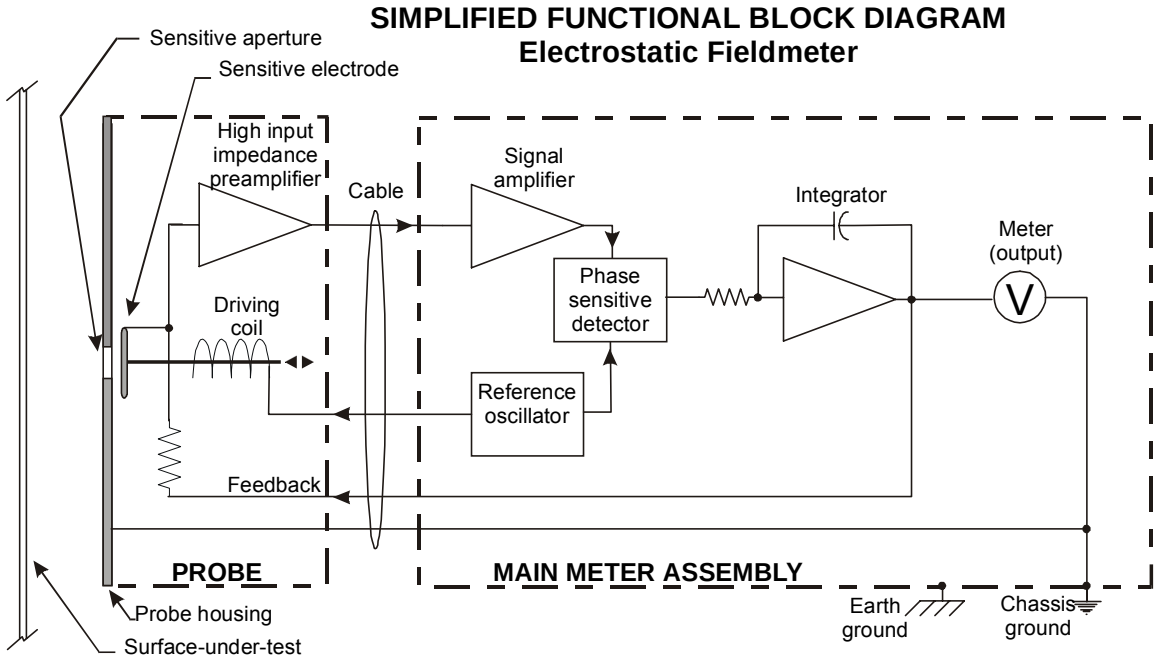


Figure 4-1

Section 5

OPERATION

The POWER LED is tri-color. When no power is applied, it is out. With power applied via the back panel switch and the front panel power switch in the STANDBY position, the LED will normally be amber. When the power switch is shifted to the OPERATE position, the LED will normally turn green. If the LED shows red or no colors are displayed, there is a problem with one or more of the power supplies in the unit. This "POWER GOOD" analysis circuit is provided as a safety feature.

All channels in the group (of four) are enabled on power-up and may be immediately and simultaneously disabled regardless of their current status by pressing the GROUP ENA/DIS pushbutton switch. A disabled channel will display " **.0.0.0**" and the output for that channel will go to the specified value for zero[2]. With the group enabled, any or all channels may be individually toggled between enabled or disabled state by means of the ENA/DIS pushbutton switch under the respective channel display. If the group is disabled and then later enabled the individual channels will revert to the previous status unless the unit has been powered down. Disabled channels may be zeroed. Those channels without probes or cables connected at the back panel will always exhibit a blank display.

A "PROBE TEST" pushbutton provides a system operational check on all channels in use. When this button is pressed, the displayed values will increase by some positive amount and when it is released, normal channels will again indicate the correct value. This test is useful for troubleshooting.

To properly zero a given channel, its probe must first be subjected to or immersed in a "zero field". The ideal method of creating a zero field is to suspend the probe in a completely enclosed grounded Faraday cage. A more practical approach is to restrict the electrostatic view of the probe to the inside of a grounded metallic container (such as a coffee can) or point the probe at a relatively large grounded conductive surface at a relatively close probe to surface spacing. Press the "ZERO" button corresponding to that channel and adjust "ZERO ADJUST" for a zero indication on the display.

Notice that there is only one "ZERO ADJUST" control. The setting for each channel is stored in non-volatile electronic memory.

In the event that a zero reading is not attainable, there is a ZERO OFFSET switch for each channel located on the back panel. The switch corresponding to the offending channel may be set to a position, which will allow zeroing that channel.

[2] The specified value for zero is zero in the case of a ±5 volt or ±10 volt, +2.5 volts where a +2.5 volt offset is used and 12 mA in the case of a 4-20mA output.

Section 6

ADJUSTMENTS

A. REFERENCE ADJUSTMENT:

There is only one adjustment in this instrument. A high quality, 5½ digit or better DVM such as Fluke Model 8840A or equivalent should be used to set the reference voltage at TP-1. (Refer to drawing 177/1, sheet 1 of 5, location B-2)

1. Check power supply voltages to assure that they are within the tolerances shown on the schematics.

2. Adjust R-72 to produce a nominal reference voltage of -4.489 volts at TP-1 *relative to Pin 3 of A-29*.

3. Check the positive reference to assure that it is within the specified limits.

B. PROBE STANDARDIZATION:

Each type 1036 probe as received new from the factory or returned from the factory as a repaired item has been "standardized" in a prescribed manner to assure interchangeability. The procedure for standardizing probes is detailed in the *USERS' MANUAL for Monroe Electronics, Inc. Electrostatic Fieldmeter Probes Models 1036E and 1036F*.

Any channel of *Static Monitor 177-1* may be converted into a null detector as required by the procedure by shunting the integrator (pins 13 and 14 of A-35, A-31, A-26 or A-22, depending on which channel is selected) with a 10 meg-ohm resistor.

APPENDIX I

OUTPUT REFERENCES

The full-scale output of any given channel is dependent upon the sensitivity of the probe associated with that channel. Each probe is standardized at the factory prior to shipment according to a number which is permanently stamped into the face of the gradient cap and is also noted in the model number following a dash (-). A table of probe sensitivities is given below.

Dash #	Full Scale Sensitivity
-3	±1 kV/cm (±100 kV/M)
-4	±10 kV/cm (±1 MV/M)
-5	±20 kV/cm (±2 MV/M)
-6 •	±10 kV/in (**Standard**)
-7	±1 kV/in

Table A-I-1
Probe Sensitivities

Jumpers on the main PC (Model 3530) may be configured to accommodate any of these probes and to produce meaningful meter displays and outputs. Standard jumper configurations are denoted with a bullet (•) in the tables above and below. Instruments are shipped from the factory with standard probes and standard jumper configurations unless otherwise specified.

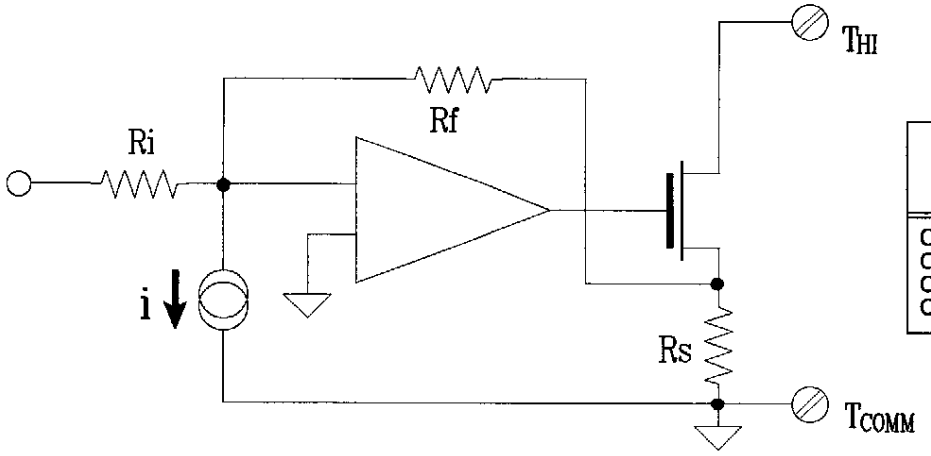
Channel	Meter		Decimal Point			Output			
	1000	1999	1.000	10.00	100.0	±10V	±5V	+5V	4-20mA
Ch1	J47•	J48	J41	J42•	J43	J45•	J50	J44,49,50	J44,46,51
Ch2	J36•	J37	J30	J31•	J32	J34•	J39	J33,38,39	J33,35,40
Ch3	J25•	J26	J19	J20•	J21	J23•	J28	J22,27,28	J22,24,29
Ch4	J14•	J15	J8	J9•	J10	J12•	J17	J11,16,17	J11,13,18

Table A-I-2
Jumper Configurations for Meters and Outputs

When the outputs of the *Static Monitor 177-1* are interfaced to other devices such as computer equipment, best results will be realized using the voltage outputs (e.g., ±10V, ±5V or +5V). Keep equipment ground paths short by grouping the equipment together in one cabinet and using a common power ground, particularly where single-ended inputs are the only option.

The 4-20mA outputs are most useful where a device such as a repeater must be located at some considerable distance from the console. An example would be a remote display in a Division 1 or Division 2 hazardous area where long wires and Intrinsic Safety (IS) barriers are necessary.

An equivalent circuit for the 4-20mA output stages is shown in Figure A-I-1.



	JP2 Terminal #	
	T_{HI}	T_{COMM}
Ch 1	2	1
Ch 2	4	3
Ch 3	6	5
Ch 4	8	7

Figure A-I-1
4-20mA Transmitter Equivalent Circuit

T_{COMM} terminals are connected together and to equipment ground in the *Static Monitor* making all four 4-20mA outputs essentially single-ended transmitters requiring floating receiver equipment.

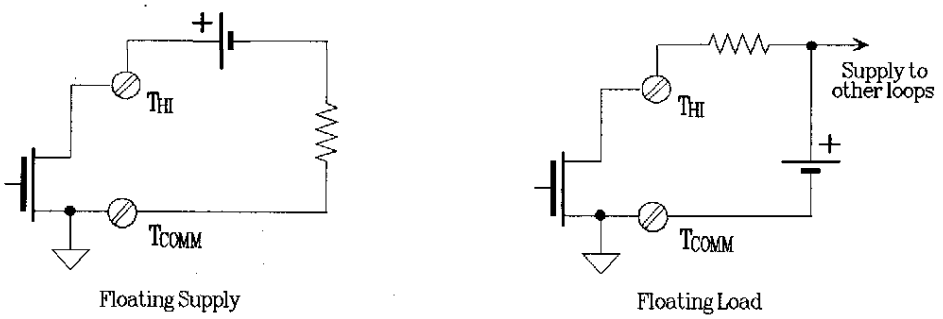


Figure A-I-2
Two Methods of Receiver Wiring

Compliance range between T_{COMM} and T_{HI} is 2.5 volts minimum to 15 volts maximum.

APPENDIX II

RS-232 Implementation

The RS-232 receive line allows up to 3 sec between characters. The return responses are initiated after <CR>. <LF>'s are ignored. When the front panel buttons are depressed the busy line (CTS) goes true. The busy line goes false when the buttons are released.

Baud rate=1200, no parity, 8 bits, 1 stop bit.

RS-232 commands:

Individual channel control -

#N<cr><lf> where # = channel number
enables channel

#F<cr><lf> where # = channel number
disables channel

Group control -

E<cr><lf>
enables group

D<cr><lf>
disables group

Status -

S<cr><lf>

Response Examples:

1 = Ch enabled
0 = Ch disabled
E =Grp enabled
D = Grp disabled

Group Status ↓

D1111 <cr> <lf> [1]
E0101 <cr> <lf> [2]

Unit returns ***OK<cr><lf>*** for valid commands
Unit returns ***ER<cr><lf>*** for invalid commands
Unit returns ***TO<cr><lf>*** for RS-232 time-out (˜3 sec)

Valid commands - 1N, 2N, 3N, 4N, 1F, 2F, 3F, 4F, E, D, S
With a trailing <cr><lf>

[1] Group is disabled. All channels in the group will be enabled when the group is enabled.
[2] Group is enabled. Channels 2 and 4 are enabled and channels 1 and 3 are disabled.

APPENDIX III

PROBE CONNECTION OPTIONS

There are at least six wiring options for the Model 177 as regards the Model 1036E or 1036F probes. These are, progressing from the most basic through the more complex system installation where Intrinsic Safety (IS) is a consideration:

OPTION 1: All probes (1036E or 1036F) use factory installed cables, no extension cables, no IS considerations

Probes are normally factory equipped with ten foot cables, although longer or shorter cables are available on special order. To use or test this system, simply plug the probes into the appropriate connectors on the back of the instrument.

OPTION 2: Probes use factory installed cables and factory supplied extension cables, no IS considerations

Extension cables are available in lengths up to 1000 feet. The extension cable order number is *1036/12-XXXX* where *"XXXX"* denotes the length of the cable in feet. Factory supplied extension cables will be labeled with this part number near one end.

The connector at one end mates with the connector on the end of the cable attached to the probe and the one on the other end mates with the appropriate connector on the back of the instrument. Although it is virtually impossible to err, it is advisable to test the system "on the bench" in a confined area before permanently installing long cable runs.

OPTION 3: 1036E probes with long customer installed cables with or without extension cables, no IS considerations (see Figure A-III-1)

Wiring connections for customer installed 1036E probe cables <u>for use in a non-IS installation</u> are shown in Figure A-III-1. Model 1036E probes have terminal blocks inside their housings to which the cable wires are directly attached.

Please note that 1036F probes have permanently attached cables and that this option does not apply.

As in OPTION 2, it is advisable to "bench test" the system before removing the factory attached cables.

There are a couple of valid reasons for constructing your own cables:

a. You <u>may</u> be able to save money, although, in the long run, troubleshooting may prove to be more costly than using factory supplied cables.

   or

b. It is necessary to pull the cable through a fairly long run of conduit and the connector won't fit. The largest rectangular cross sectional dimensions of <u>each connector</u> are $^{5}/_{8}$" x $1^{1}/_{4}$". The <u>minimum</u> conduit ID through which this can be

pulled is $1^3/_8$", although, it would be theoretically possible, with a great deal of care, to pull up to five cables simultaneously through that ID in a smooth straight run by staggering the connectors.

There are a couple of ways to approach (b. [above]):

a. 1. Buy factory fabricated *1036/12-XXXX* extension cables (where *"XXXX"* is the length of the cable in feet) that are long enough to reach from the console location, through the conduit to the probe location with a few feet extra for measurement error.

2. Remove and discard the factory supplied (usually ten foot) cable from the probe and mount the probe housing.

3. Cut the female DB9 connector plug off of the extension cable.

4. Pull the cable from the instrument end of the conduit to the probe end.

5. Connect the wires to the terminal block in the probe housing as shown in Figure A-III-1.

b. 1. Buy bulk cable and pull as above. Cable construction details are provided in Figure A-III-1.

OPTION 4: 1036E probes with factory attached cables, extension cables (factory or customer supplied) and IS barriers (see drawing 1036/10 [SHT. 2 of 3])

Please refer to drawing 1036/10 [SHT. 2 of 3]. This drawing shows wiring for one channel. Generally, all channels would be wired alike. All barriers (four per channel) may be located in a single barrier enclosure.

Note that on each side of the barrier enclosure, you have the option of using connectors or "hard wiring" the cables directly to terminals on each barrier. Hard wiring, again, allows the cables to be pulled through conduit without interference associated with connectors.

Cable construction details are provided in Figure A-III-1.

OPTION 5: 1036F probes, extension cables (factory or customer supplied) and IS barriers (see drawing 1036/10 [SHT. 3 of 3])

Cables are captive to Model 1036F probes.

OPTION 6: 1036E probes with customer supplied cables and IS barriers

(see drawing 1036/10 [SHT. 1 of 3])

Wiring must be as shown in drawing 1036/10 [SHT. 1 of 3]. Refer to Figure A-III-1 and Figure A-III-2 for cable construction details.

APPENDIX IV

INTRINSIC SAFETY BARRIERS

Model 1036E and 1036F Electrostatic Fieldmeter Probes meet Factory Mutual Research Corporation requirements for Class I, Division 1, Groups C and D hazardous locations when installed in accordance with the appropriate Monroe Electronics, Inc. control drawings included in this manual. Approved safety barriers must be used as shown in the drawings to comply.

Copies of the Factory Mutual Research Corporation report 1Q3A9.AX specific to these probes are available on request from Monroe Electronics, Inc.

Two manufacturers of IS barriers are currently approved:

MTL, Incorporated
8576 Wellington Road
PO Box 1690
Manassas, VA 22110-1690

Tel. (703) 361-0111
Fax. (703) 368-1029

and

R. Stahl, Inc.
150 New Boston St.
Woburn, MA 01801-6204

Tel. (617) 933-1844
(800) 782-4397
(800) 782-7233 in MA
Fax. (617) 933-7896

Barrier requirements and recommended enclosures are shown in the tables below:

Number of Channels →	1	2	4	6	8	10	12	14	16
	Number of Barriers								
MTL 765	2	4	8	12	16	20	24	28	32
MTL 766	2	4	8	12	16	20	24	28	32
	Recommended Enclosures								
MT 5	1								
MT 12		1							
MT 24			1	1		2	2		
MT 32					1			2	2

Table 1— MTL

NOTES for MTL Systems:

- Enclosures include barrier mounting hardware, tagging strips, etc. Labeled wiring ducts are included with MT 32.
- Listed enclosures are glass-filled polycarbonate with transparent lids. They are impact resistant, flame retardant and dustproof to IEC529:IP65.
- MTL will install barriers at no charge if supplied with position (sequence) information.
- "Internals" (everything that normally goes in an enclosure but no enclosure) are available.

Number of Channels →	1	2	4	6	8	10	12	14	16
	Number of Barriers								
9002/77-150-300-00	2	4	8	12	16	20	24	28	32
9002/22-240-160-00	2	4	8	12	16	20	24	28	32
	Recommended Enclosures								
S 806 NF-12	1	1							
S 1412 NF-25			1	1					
S 1412 NF-50					1	1	1		
S24H20BLP-80								1	1

Table 2 - R. Stahl

NOTES for R. Stahl Systems:

- Enclosures include mounting rails, insulating standoffs, ground terminals and labels.
- Listed enclosures are Hoffman NEMA-4.

Some National Fire Prevention Association (NFPA) publications dealing with the subject of Intrinsic Safety (IS) are:

- NFPA 497A - *Classification of Class I (Classified) Locations for Electrical Installations in Chemical Process Areas* (pamphlet)
- NFPA 497M - *Classification of Gases, Vapors and Dusts for Electrical Equipment in Hazardous (Classified) Locations* (pamphlet)
- NFPA 493 - *Intrinsically Safe Apparatus for Use in Division 1 Hazardous Locations* (pamphlet)
- NFPA 325M - *Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids* (pamphlet)
- NFPA 496 - *Purged and Pressurized Enclosures for Electrical Equipment* (pamphlet)
- *Electrical Installations in Hazardous Locations* by Peter J. Schram and Mark W. Earley - ISBN 0-87765-356-9 (book)

The above are available from and are sold by:

National Fire Protection Association
1 Batterymarch Park
PO Box 9101
Quincy, MA 02269-9101
Tel. (800) 344-3555