

Instruction Manual
for
Monroe Electronics, Inc.
Multi-Point Fieldmeter and
Alarm System
Model 177A

Specifications subject to change without notice.

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Firmware v 1.08

Software v1.04a



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Accessories Included:

Manual
110V Line Cord
220V Line Cord
DB9 M/F Straight-Thru Cable
USB A-Male/B-Male Cable
Mounting Hardware
2 – 2 Position terminal block plugs
4 – 6 Position terminal plugs

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 batteries, fuses or conductive elastomers) 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.

THIS WARRANTY SET FORTH IN THIS ARTICLE IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESSED, IMPLIED OR STATUTORY INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. Except for obligations expressly undertaken by Monroe Electronics, in this Warranty, Owner hereby waives and releases all rights, claims and remedies with respect to any and all guarantees, express, implied, or statutory (including without limitation, the implied warranties of merchantability and fitness), and including but without being limited to any obligation of Monroe Electronics with respect to incidental or consequential damages, or damages for loss of use. No agreement or understanding varying or extending the warranty will be binding upon Monroe Electronics unless in writing signed by a duly authorized representative of Monroe Electronics.

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 585-765-2254 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 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.

FACTORY REPAIRS TO MODIFIED EQUIPMENT:

Material returned to the factory for repair that has been modified will not be 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.

Section 1

GENERAL

Monroe Electronics' Multi-Point Fieldmeter and Alarm System, Model 177A measures electrostatic fields (potential gradient) in terms of voltage per unit distance. Using probe-to-surface separation as a calibration factor enables use of this instrument for measurement of surface voltage as well.

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

The Monroe Electronics Model 177A is an intrinsically safe system, using FM-listed Monroe Electronics Model 1036 sensors, which continuously monitor the critical points in your facility to detect and warn of electrostatic charge buildup before it becomes a problem. In a typical alarm-activated or PLC-connected setup, as static levels in your application surpass a preset value, beyond which there may be a danger to personnel or possible disruption or destruction to the process or product, an initial warning is triggered and the process is allowed to continue. If the problem is rectified, the "warning" returns to a "normal" state. If the condition persists and the static level exceeds a second, more crucial value, an alarm is activated. This second-level alarm can be used to shut down the process until it is brought under control, or to further warn the operator of the more serious condition.

Each Model 177A will monitor up to four locations using Monroe Model 1036 sensors placed at distances up to 1000 feet from the instrument. Processes can be continuously monitored and recorder outputs may be utilized for long term, drift free data acquisition. Cascading of up to 32 units via RS485 permits monitoring of up to 128 sensor locations using a PC and the supplied software.

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

This document provides the user, for hazardous and non-hazardous areas, with operational instructions for Monroe Model 1036 sensors and the corresponding Model 177A Fieldmeter/Alarm System.

Section 2

SPECIFICATIONS

Monitor Console

Temperature Range:	+15° to +45° C
Analog Outputs (user selectable):	±10 V, 0 – 5V, (2.5V ±2.5V full scale); <10 Ω impedance; or simultaneous 4-20mA (optional)
RS232/485 Control:	Channel status, channel disable / enable, group control / setup
Accuracy:	3% of full scale at analog outputs 3% of full-scale ±2 counts +0.3 counts/°C at front panel meters
Displays:	Four 3½-digit LED's, 0.6" (one per input channel)
Power Requirements:	90-260 VAC, 47-60 Hz
Connector Styles:	RS232/RS485 – DB9 Female Probe – DB9 Female Analog Out – BNC Test Connector – Screw Terminals 4-20 mA option – Screw Terminals
Dimensions:	1¾ x 19 x 10 inches (4.45x 48.26 x 25.4 cm) Mounts in a standard 19" rack
Weight:	6 lbs
Relay Contacts:	Switching load 30W 62.5VA; MAX switching voltage 110VDC, 125VAC 0.3A (rms), suggested limit 30VDC 1A MAX. Closed for normal conditions

1036 E & F Sensors

Standard Range	± 10kV/inch
Optional:	± 100V/cm (10kV/m) ± 1kV/cm (100kV/m) ± 10kV/cm (1MV/m) ± 20kV/cm (2MV/m) ± 1kV/inch
Sensitivity:	0.025% of full scale
Drift:	1% of full scale (typical), non-cumulative, long-term when purged according to manufacturer's instructions.
Noise:	<0.05% of full scale, peak-to-peak
Speed of Response:	250 ms, 10%-90% of full scale (typical)
Dimensions	
Model 1036E:	6.0 x 3.0 x 2.063 inches (15.24 x 7.62 x 5.24 cm)
Model 1036F:	1.75dia. x 1.22 inches (4.45 x 3.11 cm)
Maximum Cable Length:	1000 ft. (305 m)
Temperature Range:	-30° C to +100° C

Enclosure (optional)

Capacity:	Two Monitor Consoles
Dimensions:	4.5 x 20 x 14 inches (11.4 x 50.8 x 35.6 cm)

Section 3

ELECTRIC FIELDS AND FIELDMETERS

Electric Field

An electric field is a region in space characterized by the existence of an electric force (F) generated by an electric charge (q). The electric force F acting on a charge q in an electric field is proportional to the charge itself. The relationship of these quantities is expressed by the electrostatic force law [1]:

$$F = qE$$

E is called the electric field strength and is determined by the magnitude and locations of the other charges acting upon charge q

$$E = F/q$$

The electric field strength, E , is usually displayed in the unit of volt/meter (V/m), volt/centimeter (V/cm) or volt/inch (V/in).

Electric Fieldmeters

Charge is often difficult or impossible to measure directly. We rely on detection and measurement of the electric field from the charged object to determine the existence of the charged and to estimate the relative magnitude of the charge. The electrostatic fieldmeter is the instrument that measures electric field strength.

Electric field strength measurements can be difficult to measure and interpret correctly because of several factors that can affect the electric field itself or affect the measurement of the electric field. Guidance is given in this document to help understand or minimize the effects of these factors, and to otherwise correctly interpret electric field measurements.

Fieldmeters measure the electrostatic field (voltage per unit distance) at the aperture of a grounded probe. Ideally, a uniform electric field is established between a charged surface and a grounded surface. The grounded surface may be the grounded surface of the fieldmeter probe, or the fieldmeter probe may also be placed in the plane of a grounded surface (better). The electric field is set up between the grounded surface and the charged surface some distance, D , away. Fieldmeters are calibrated at a particular distance, such as V/inch or V/cm. Therefore, using the manufacturer's calibrated distance (one inch or one centimeter) makes the measurement easier to interpret. Probe-to-surface separation should be carefully controlled for accurate measurement.

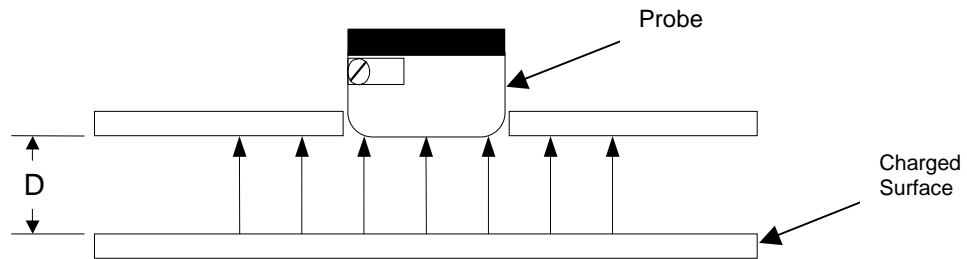


Figure 1: Probe-to-Charged-Surface Separation, D

Monroe Electronics electrostatic fieldmeters use a feedback-driven, null seeking design to assure accurate, drift-free, non-contacting measurements. Accuracy is typically a moderate 3% in a carefully controlled geometry.

Figure 2 illustrates a Monroe Model 1036 fieldmeter probe in simple graphical form. This particular fieldmeter is a chopper-stabilized design that operates reliably in both ionized and non-ionized environments (refer to Appendix II.)

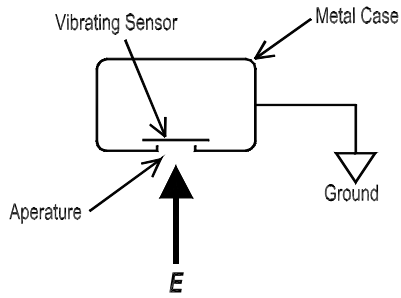


Figure 2: Monroe Model 1036 Fieldmeter Probe

Electrostatic fieldmeters measure electric field strength by non-contacting means. All the charged objects, voltage sources, and grounded conductors (including the fieldmeter probe housing) in the general area affect the electric field strength measurement. The fieldmeter measures the electric field strength only at its aperture. It does not have a viewing angle and it does not see the web or object directly in front of it as a separate entity. This can be demonstrated by measuring the electric field of an insulating sheet with a hole in it.

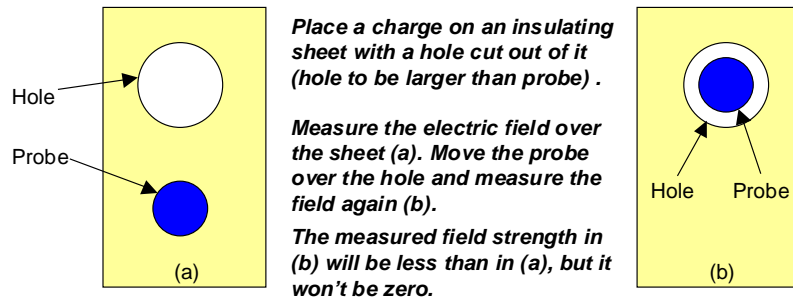


Figure 3: Insulating Sheet Electric Field Demo, Top View

The field over the hole will not be zero, even though there is no charge directly in front of the probe head. This is because the electric field at the probe aperture is a function of each charge on the sheet, and is also a function of the concentration of field due to the grounded probe itself.

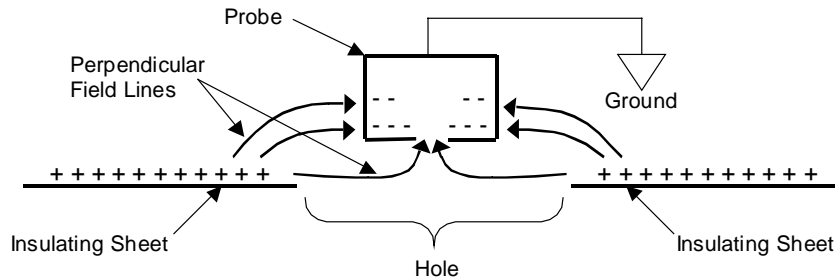


Figure 4: Insulating Sheet Electric Field Demo

Effect of Probe Type on Fieldmeter Readings

For measurement of insulating web surfaces, it is best to maintain the same distance from the fieldmeter to the web as when the fieldmeter was calibrated. Since most fieldmeters are calibrated at one inch, their apertures should be positioned one inch from the web. The Model 1036E probe will give accurate readings (as-is) at a measurement distance of one inch because its large grounded face helps to create a uniform electric field near the aperture of the probe. The Model 1036F probe is significantly smaller than the Model 1036E probe. Unless a grounded shroud is used to enlarge the smaller ground plane of the 1036F probe, the fieldmeter readings will be about 12% high because the electric field will converge on the small probe.

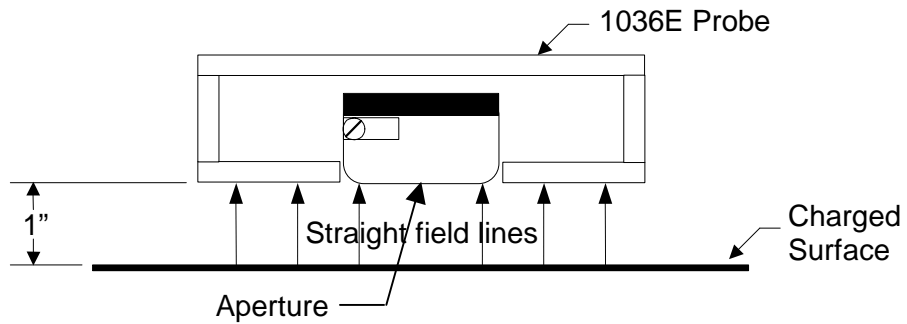


Figure 5: Field Lines Straight to 1036E Probe

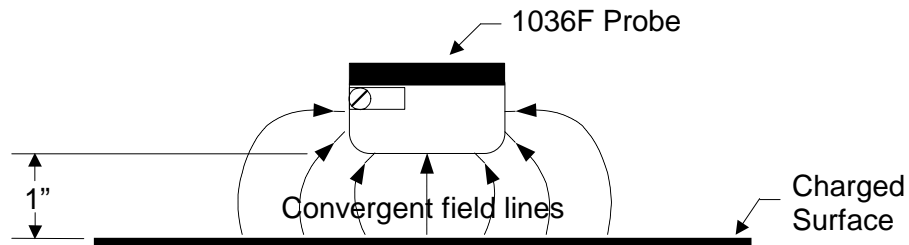


Figure 6: Field Lines Converging to 1036F Probe

Section 4

INSTALLATION

The Model 177A Multi-Point Fieldmeter and Alarm System, 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 177A 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. The chassis of the instrument may be grounded through the line cord, but the chassis must be grounded. A three wire grounded line cord is provided with the unit. 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

Probe Inputs:

Four probe-input connectors are located on the instrument back panel. These are 9-pin subminiature D female 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 for the 177A to operate.

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. Simultaneous 4-channel 4-20 mA current output is optional.

The two possible voltage outputs are: [1] ± 10 volts, [2] 0 – 5 volts (± 2.5 volts full scale).

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 unit provides a 12V nominal supply which gives a compliance range of 7 volts. An external supply may be connected which will be used by all 4 channels. The external supply must be less than 25 volts. Output compliance is external supply minus 5 volts. Note that this supply will be referenced to chassis and Analog ground. These outputs are in addition to the four voltage outputs. See the overview of the 4-20mA module in Section 10 on page 30 for more information.

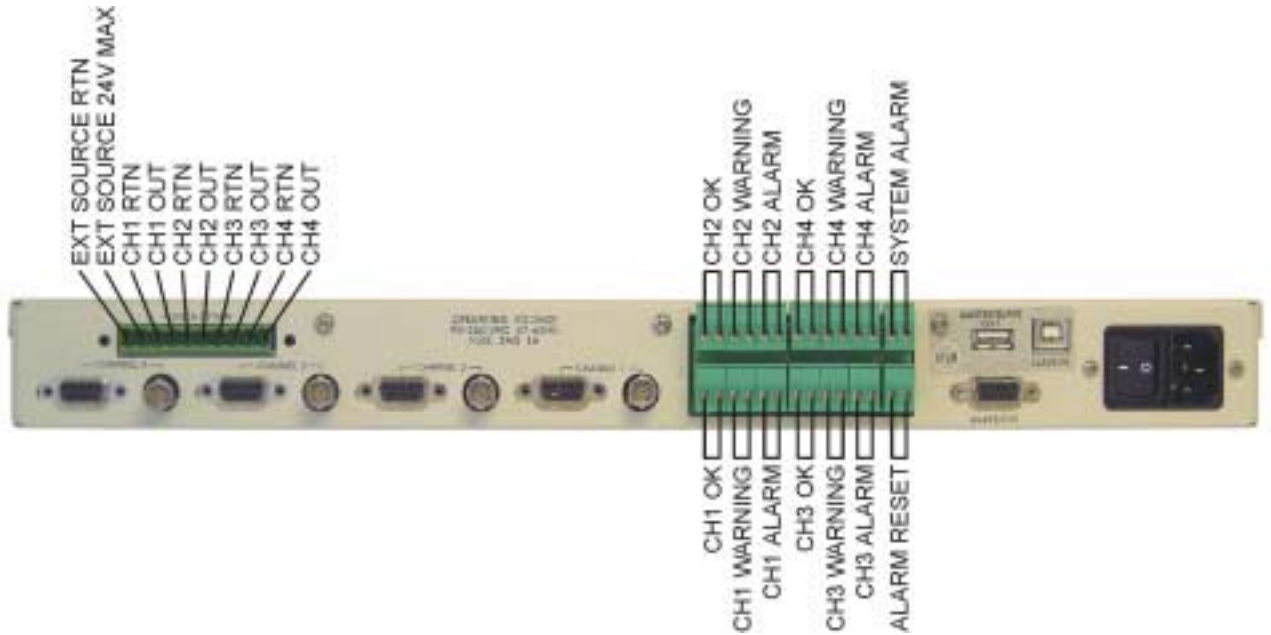


Figure 7: Rear panel relay hookups

Rear panel alarm relay connections:

Three status LEDs and relays are assigned to each channel. These LEDs and relays are referenced as **OK**, **WARNING**, and **ALARM**. External monitoring equipment can be connected to these relays and indicator LEDs via screw terminals located on the rear panel of the instrument and assigned as specified on the instruments cover.

Connections should be made using the following diagram as a guide. For operational information refer to the Rear Panel Relay Connection segment in Section 8 of this manual.

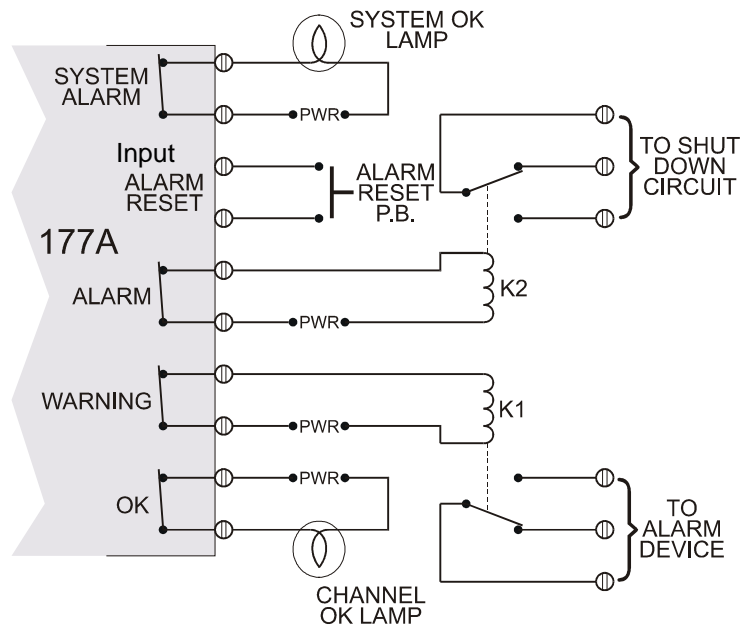


Figure 8: Rear Panel Relay Connections

Section 5

PRINCIPLE OF OPERATION

Refer to Figure 9 for the following discussion.

The probe is placed to “view” the target surface, which is assumed to be charged. In this instance, the gradient cap containing the aperture faces the target surface.

A sensitive electrode behind the aperture is vibrated perpendicular to the electric field by means of a drive coil (vibrated toward and away from the target surface). An A.C. signal is induced onto the sensitive electrode due to the motion of the vibrating electrode in the electric field, which is created by the charges on the target surface. The modulation amplitude of the A.C. signal, relative to the drive coil signal, is related to the polarity of the charge on the target surface.

This A.C. signal, conditioned by a preamplifier, filter, and signal amplifier, is fed into a phase-sensitive demodulator. This signal from this demodulator feeds an integrating amplifier. A fraction of the integrator’s output signal is fed back to the sensing electrode to null the signal from the external electric field.

The voltage signal from the integrator is thus directly proportional to the field intensity at the sensing electrode of the probe. The output signal from the integrator drives a meter for direct readout.

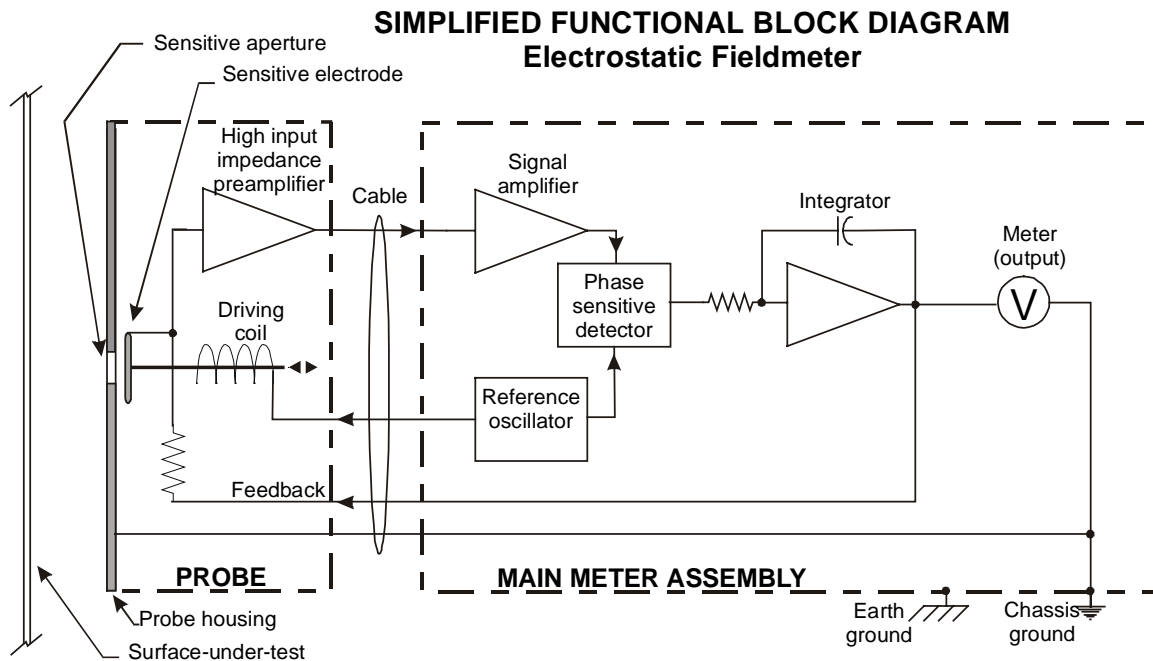


Figure 9

Section 6

USING 1036E AND 1036F SENSORS

General

Models 1036E and 1036F electrostatic fieldmeter probes are electrically identical and interchangeable. The major differences are physical. Model 1036F is a small (1.75" dia. x 1.25" H), lightweight version for general-purpose applications, or where available space is a problem. Model 1036E, for most industrial applications, is a 1036F probe built into a standard Crouse-Hinds ½"-FS1 electrical box with a stainless steel cover.

Both probes utilize the same vibrating capacitor modulator, and both have built-in provisions for purging with filtered air to prevent contamination and long-term drift. Inert gas may also be used for purging in hazardous areas where the probe will be used in an inert gas atmosphere. Purge gas flow in the Model 1036F exits through the sensitive aperture only. Gas flow in Model 1036E is directed across the face of the probe as well as through the sensitive aperture. Both probes are designed to be used with Monroe Electronics Model 177A Static Monitor 4 Channel Electrostatic Fieldmeter/Alarm System.

Static electricity is a natural occurrence resulting from common converting, laminating, and printing applications. At times static electricity is little more than an annoyance. However, in applications where significant electrostatic charges accumulate, the effects can be very serious. Typical probe applications include static level safety monitoring in explosive environments and static level quality monitoring in sensitive machine areas.



Figure 10: Model 1036E Fieldmeter Probe



Figure 11: Model 1036F Fieldmeter Probe

Installation

Sensitivity:

Full-scale sensitivity for any properly standardized and calibrated probe/instrument combination is dependent upon the gradient cap (containing the aperture) on each probe. Full-scale sensitivity for any given system or channel (in the case of a multi-channel system such as the Model 177A) can be determined by inspecting the gradient cap on the probe. Each gradient cap is stamped on its face with a number, which represents a different size aperture. This number relates to the sensitivity of the probe as shown in the table below. Probes are standardized at the factory in a uniform electric field between two relatively large metal plates (see Figure 12). Once standardized in this manner, they may be interchanged at will.

Probe Model	Full Scale Sensitivity	
1036_-3	±1 kV/cm	(±100 kV/M)
1036_-4	±10 kV/cm	(±1 MV/M)
1036_-5	±20 kV/cm	(±2 MV/M)
1036_-6	±10 kV/in	Standard
1036_-7	±1 kV/in	

Table 1: Probe Model vs. Full Scale Sensitivity

Mounting:

Probe mounting requirements for electrostatic field determinations will vary somewhat with the nature of the desired measurement. In general, it is best to mount the probe as near as practical to the surface being monitored, as long as the input signal remains less than the full-scale sensitivity of the probe. For example, mount the metric unit reading probes from Table 1 at one centimeter and the English unit reading probes at one inch, if feasible. It is strongly recommended that, where possible, the probe be mounted "looking" downward in order to minimize the probability of contaminants entering the aperture in the face.

Model 1036E is provided with two mounting flanges. The case should be electrically connected to ground. The gradient cap (containing the aperture) of the probe is a reference surface with its own ground connection. Do not make a separate ground connection to this surface.

Model 1036F may be held by hand to make rough measurements, or mounted by means of two threaded inserts installed in the mounting block. Care must be exercised when selecting screw length. Other temporary mounting options are friction clamps, adhesives or double-sided tape. The metal body of the probe is internally connected to instrument ground and should not normally be connected to any other ground.

Geometry:

A shroud is not necessary on 1036E probes mounted at 1in/1cm or less from the web because the large faceplate provides the same function as a shroud (creates a uniform field in front of the probe at one inch or less).

As a truly uniform field does not usually occur in most practical measurement situations using the 1036F probes, partly due to the introduction of the grounded probe itself, one must either:

- Improve the geometry by establishing a grounded plane (shroud) through which the fieldmeter probe can view the field under consideration. Refer to figure 6 on page 9. (see also Application Note –0003 in Appendix.)
- Establish a correction factor for the data, or
- Accept relative data. In many cases, this is acceptable practice once a fixed geometry is established and related to the real electric field.

Cables:

Both types of probes are normally equipped with 10-foot-long cables and subminiature D connectors that mate with Monroe Electronics Model 177A. This is Option 1 of 6 available wiring options – see Appendix A – Probe Connection Options for details. The first 3 options are for non-hazardous (non-classified) locations where there are no Intrinsic Safety (IS) considerations. The last 3 options are for hazardous (classified) locations where IS must be considered as part of the installation and barriers are in use.

Extension cables are available from Monroe in lengths up to 1000 feet, which is the maximum permissible length. These extension cables may be ordered in any length (up to 1000 feet) by part number 1036/12-nnnn, where nnnn is the length in feet.

The cable exit on Model 1036E is supplied through a packing gland which is screwed into a ½"-14 NPT tapped hole in a boss on one end of the housing. Inside the housing, the probe is plugged into a terminal block to which the cable attaches. Where it is desirable or necessary to connect Model 1036E probes to Model 177 Static Monitors with conduit, the original cable and packing gland can be removed and the cable replaced by any length (up to 1000 feet) pulled through the conduit with a connector on only the Model 177 end. Refer to Appendix A – Probe Connection Options, Options 3, 4 or 6 (depending on whether IS must be considered) for details.

Purging:

Any "contamination" present in the probe or near the measurement will have an adverse affect on performance. When insulative particles or liquid becomes charged and enters the probe or attaches near the aperture of the probe, it becomes a source of measurement error and drift. Less obvious is the influence of gaseous atmospheric constituents, including aerosols, which contaminate the probe by altering the contact potentials between critical surfaces.

Constant purging of the Model 1036 probe with clean dry air or an inert gas is recommended whenever practical to prevent airborne contaminants from entering the aperture in the gradient cap and being deposited on the electrode.

The air supply should meet standard ANSI/ISA-S7.0.01-1996 - Quality Standard for Instrument Air. A Koby "Junior" filter available from Koby, Inc., 297 Lincoln Street, Marlboro, MA 01752 should meet this standard and will provide sufficient mechanical and chemical filtration for one to four probes under most conditions.

A complete probe purge kit, Model 1017/22G, is available for Model 1036F from Monroe Electronics. It includes a low volume, long-life air pump, mechanical and chemical filters, and a supply of tubing. The pump is fully capable of 24-hour per day operation, thus keeping the probe ready for immediate use. A purge gas inlet tube supplied with each 1036F probe may be installed in either of two positions, the choice of which is primarily a matter of convenience in routing of the hose carrying the purge gas. These consist of tapped holes that exit at 90° to each other near the probe cable. If it is desired to move the purge tube to the other location, simply switch it with the Allen set screw plugging the other hole.

Purge the Model 1036E probe through a ¼"-18 NPT tapped hole in the end of the housing near the cable exit using common plumbing or tubing components.

Gas pressure to either probe type should be sufficient to produce a slight positive flow out of the probe and in no event should exceed a pressure of ½ psi.

Servicing

General:

It must be emphasized that the critical elements of these probes (gradient cap and sensing electrode) must be kept free from contaminants, e.g., dust, fumes, mists or any foreign material. The materials of which these probe elements are made were very carefully chosen to minimize contact potential. Any foreign matter which will cause relative electrical activity when combined with relative motion will tend to cause drift and measurement errors.

Therefore, it is recommended that:

- Probes be constantly purged even when not in use, if this is practical.
- Probes be kept tightly covered when not in use and are not being purged to prevent contamination. A covering such as a plastic bag or aluminum foil may be used. DO NOT cover the sensitive aperture with adhesive tape.
- Probes be cleaned only to the degree and frequency necessary to achieve the required stability.
- Gradient caps NOT be removed for cleaning unless absolutely essential.
- Major cleaning and reconditioning be should performed by the factory.

Cleaning:

The recommended cleaning solvent is instrument grade 70-100% isopropyl alcohol applied with a suitable soft, lint-free applicator. Use of a non-approved solvent may degrade performance permanently, requiring factory service.

Outside surfaces of the probe should first be wiped clean with a lint-free wiping tissue saturated in solvent. Then the interior surfaces should be flushed with solvent, using a plastic squeeze bottle through the aperture until no dirt or dust may be seen. The probe should then be allowed to drain and dry thoroughly. A 15-minute bake-out at 75°C is recommended to remove residual solvent.

Disassembly/Assembly, Model 1036E:

In order to rewire the cable terminal block, replace or standardize the probe assembly and, in most cases, to calibrate Model 1036E, it must first be removed from its housing. This is done by loosening the four cross point screws around the outer edge of the cover 1-1½ turns each, in turn, several times while lifting the cover and probe straight out of the housing until it is completely removed. DO NOT attempt to remove the screws completely one at a time. These four screws have circular

"E-rings" installed on them under the cover plate to make the screws captive and prevent their falling into machinery below.

The probe assembly will need to be removed from the cover plate, for standardizing, calibration, or to replace the gradient cap. This is done by removing the four cross point screws which secure the phenolic mounting block to the hex standoffs, leaving the standoffs attached to the cover plate.

To reassemble the probe unit, reverse the above procedure. After the phenolic mounting block has been re-secured to the four hex standoffs, the probe unit should be inspected to assure that an even air gap exists completely around the gradient cap between the cap and the cover plate. If not, loosen the two cross point screws which secure the probe body to the phenolic mounting block, and adjust the probe body so that it is centered and completely surrounded by an even air gap.

Partially mate the card-edge fingers into the terminal block connector in the housing and tighten the four outer screws in the cover plate 1-1½ turns at a time until the assembly is secured in the housing.

Standardization:

A simple accurate means of standardizing Model 1036 probes using any channel of the Model 177A Static Monitor as a test vehicle is given here.

The primary reason for standardization of type 1036 probes is to assure interchangeability of probes. The procedure is not suggested as routine, but is presented here in the event it becomes necessary to re-standardize following replacement of a gradient cap or major probe overhaul. It should be performed only under controlled conditions in a suitably equipped electronics laboratory. Monroe Electronics recommends that all probe standardization be performed at its facility.

All type 1036 probes are shipped from the factory standardized in a uniform (parallel) electric field using a fixture similar to that shown in Figure 12. The fixture consists of two flat rigid metal plates, which are parallel and separated with insulators by a distance "d" of one inch and have side dimensions of at least 5d (the bigger, the better; within practical limitations). The ground plate has a hole in its center just large enough to provide clearance around the probe so that the probe does not make contact with the plate. A calibrating voltage is applied to the gradient plate to establish a reference field in the volume between the plates. This fixture is available from Monroe Electronics, Inc. as part number 96102A.

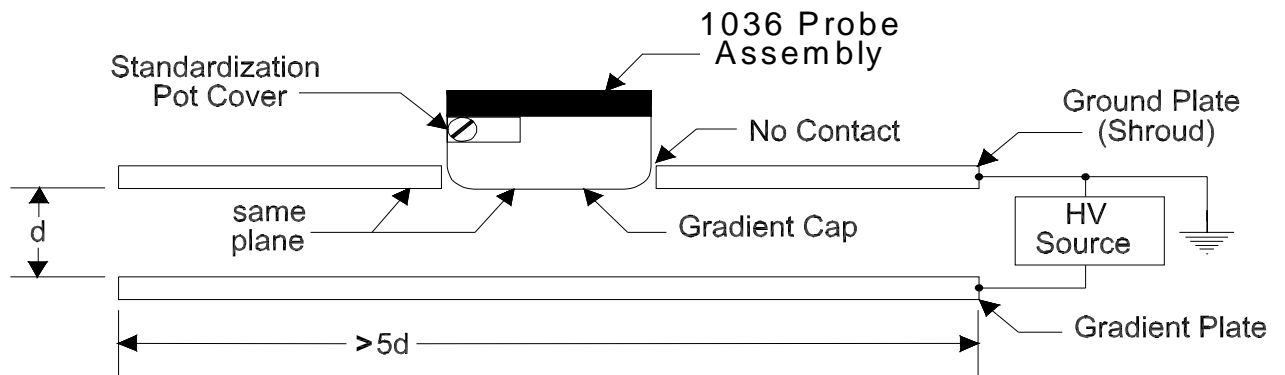


Figure 12: Standardization Fixture (P.N. 96102) Setup for 1036 Probes

A Probe Standardization/Test Cable, Model number 1036/22C shown in Figure 13 below is required to standardize or bench-test type 1036E-X probes. No special cable is required for type 1036F-X probes. This cable is included with Monroe's 96102A test fixture and is available for purchase.

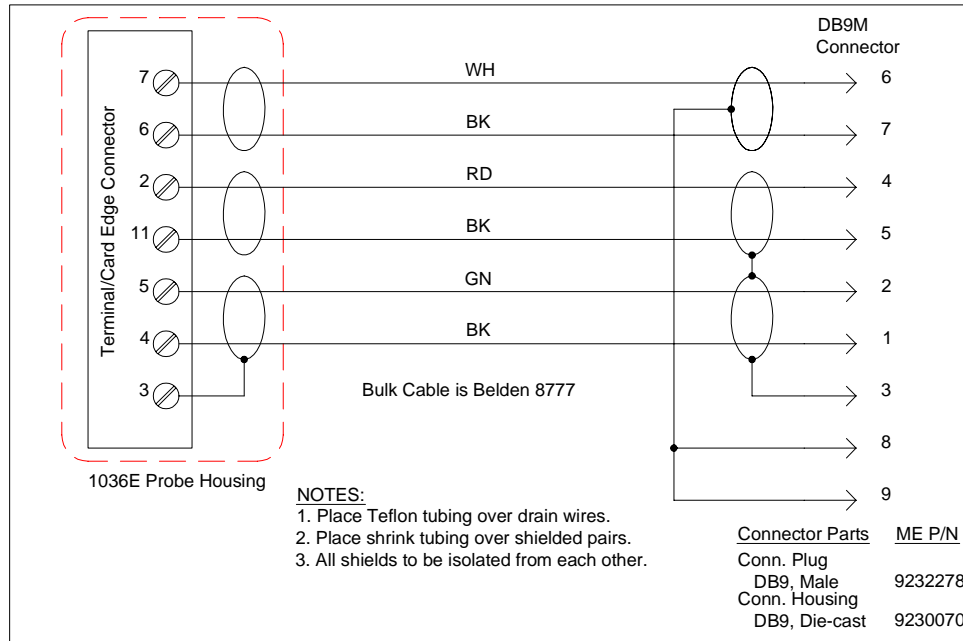


Figure 13: 1036E Standardization/Test Cable, Model No. 1036/22C

The standardization procedure is as follows:

- Set up apparatus as outlined above. Set a precision calibrating voltage source to zero volts.
- Set the Model 177A Static Monitor zero control of the selected channel to read a value of 0.000 at its $\pm 10V$ analog output using a high quality, $4\frac{1}{2}$ digit digital multimeter (DMM).
- Apply calibrating source voltage (V_{HV}) shown in Table 2 for the probe model being standardized.
- Adjust the standardization potentiometer in the probe to produce value (V_{IND}), as shown in Table 2, at the analog output of the selected channel using the same DMM as above.

Probe Model	Sensitivity	V_{HV}	V_{IND}
1036_-2	± 100 V/cm	200.0 V	100.0 V
1036_-3	± 1 kV/cm	2000 V	1.000 kV
1036_-4	± 10 kV/cm	2000 V	1.00 kV
1036_-5	± 20 kV/cm	2000 V	0.50 kV
1036_-6	± 10 kV/in	787.4 V	1.000 kV
1036_-7	± 1 kV/in	787.4 V	1.00 kV

Table 2: HV Source and Meter Reading for Probe Standardization

Full Scale Range* Maximum Surface Voltage	Probe	Probe to Surface Spacing	
		inches	cm.
20.0 kV	20 kV/cm (-5)	0.4 in	1.0 cm
	10 kV/cm (-4)	0.8 in	2.0 cm
	10 kV/in (-6)	2.0 in	5.1 cm
	1.0 kV/cm (-3)	7.9 in	20 cm
10.0 kV	10 kV/cm (-4)	0.4 in	1.0 cm
	10 kV/in (-6)	1.0 in	2.5 cm
	1.0 kV/cm (-3)	3.9 in	10 cm.
1.0 kV	1.0 kV/cm (-3)	0.4 in	1.0 cm
	100 V/cm (-2)	3.9 in	10 cm

*Called "Probe type" in Software

Table 2A: Probe Selection/Sensitivity Chart

Intrinsic Safety (IS) 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. To comply, approved safety barriers must be used as shown in the drawings. These drawings are included in Appendix B – Intrinsic Safety Barriers or are available from Monroe Electronics. Copies of the Factory Mutual Research Corporation report 1Q3A9.AX specific to these probes are also available on request.

Section 7

Typical Setup

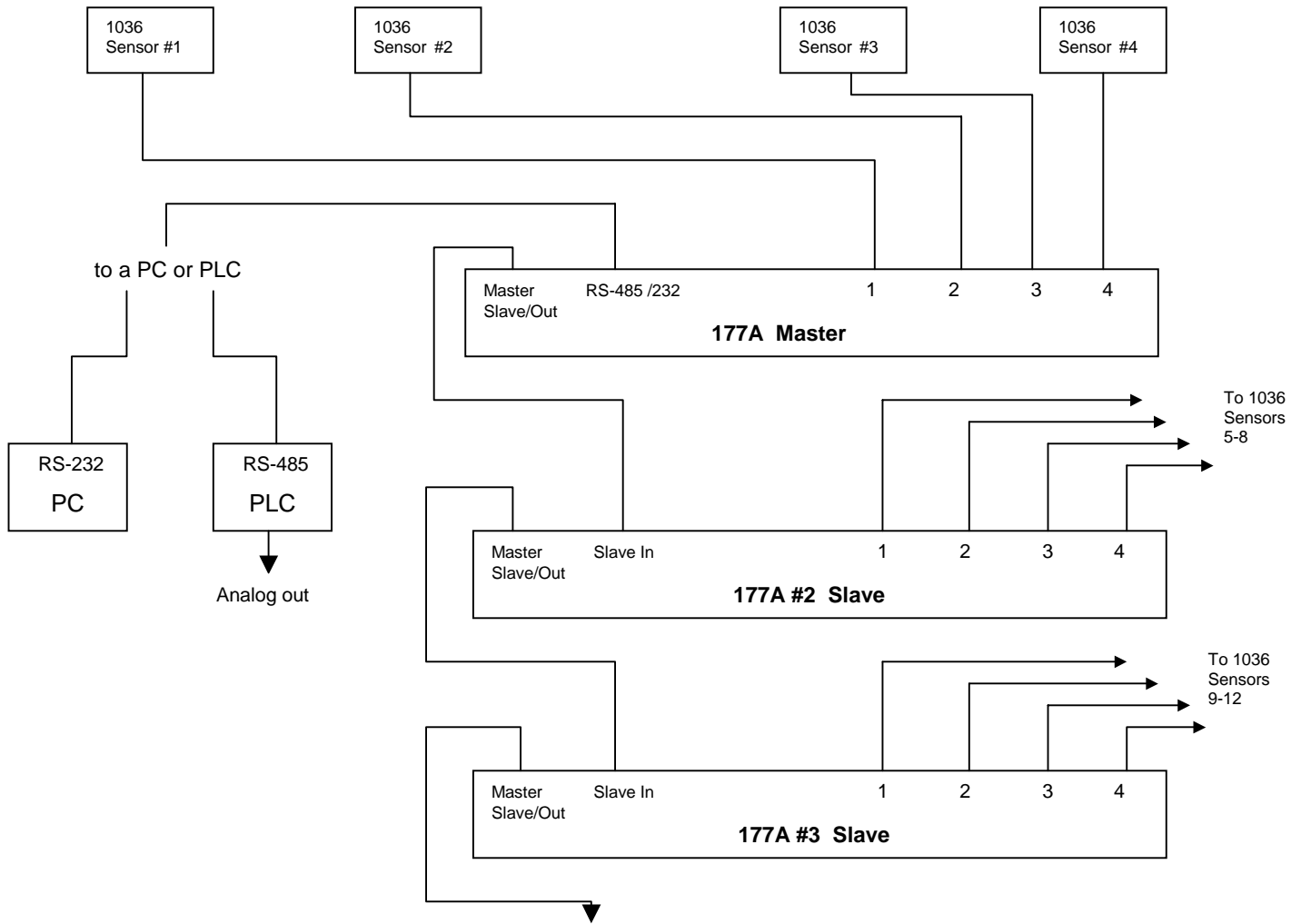


Figure 14 – Block Diagram of a typical set up

Analog Inputs

Monitoring equipment for voltage levels may be connected to any or all of the four channels via the BNC connectors located adjacent to each channel probe connector on the rear panel on the instrument.

Monitoring equipment for current levels may be connected to the optional 4-20mA pcb via screw terminals located on the rear panel of the instrument.

Section 8

OPERATION

Front Panel Features



Figure 15: Front Panel View

Console Switches

PWR – Switches unit ON or OFF (There is a main power switch on the rear panel that supplies DC power. The front panel console push button switches the power to the to the unit's power supply.) If line power is lost, the 177A will return to operational status when power is restored.

GROUP ENA/DIS - All channels in the group (of four) are enabled on power-up. These channels may be immediately and simultaneously disabled by pressing the **GROUP ENA/DIS** button on the front panel or clicking the **GROUP ENA/DIS** button on the program monitor screen.

SETUP – Initiates programming via the front panel. Yellow Program LED lights when **SETUP** button is pressed and remains lit for duration that instrument is in program mode.

TEST – Initiates testing of all connected and enabled probes. Pressing and holding down the **TEST** button causes a shift in the probe reading to the minus direction, the reading should return to normal when the button is released, indicating a good probe.

ENTER – Press **ENTER** to accept changes during programming or to perform a function.

EXIT – Press **EXIT** to escape the changes or exit the program mode.

Console LEDs

POWER – Green LED lights when power is applied to the instrument. A flashing power LED indicates a problem with the instrument's power supplies. If this occurs refer to the Return Policy on page 3 for servicing.

PROGRAM – Yellow LED lights when the SETUP switch is depressed and remains lit until the program mode is exited. If master/slave units are utilized the program light will pulse on the master unit which drives probe oscillation. If it is a slave unit the program light will not be lit.

The program LED does not pulse when the unit is in program mode.

The program light flashes (pulses at a slower rate) when the unit is receiving a firmware update. If the update is interrupted either, by the user or power failure, the light will flash and remain flashing until the update is completed successfully.

FP LOCK – Red LED indicates that the front panels controls have been locked. When locked the front panel buttons do not function except for **Power**, **Setup** and **Exit**. FP lock can be enabled or disabled via the front panel controls or the pc software supplied.

REMOTE – Lights when the PC program is in use.

Rear Panel Relay Connections

Three status LEDs and relays are assigned to each channel. These LEDs and relays are referenced as **OK**, **WARNING**, and **ALARM**. External monitoring equipment can be connected to these via screw terminals located on the rear panel of the instrument. Connections are specified in Figure 7 on page 10 and on the instrument's cover.

Three modes of operation are available:

Alarm Mode - Latching

Under normal operating conditions (i.e. the monitored static level is less than the preset warning and alarm levels) all three relays are energized initiating a contact closure. The green or **OK** status LED is blinking while the yellow or **WARNING** and red or **ALARM** status LEDs are not lit.

When static levels reach the preset Warning level and the preset Alarm Delay has expired (refer to Program Setup in Section 9 for details) the Warning relay will open and the Warning LED will light. The OK LED will continue to blink. Whenever the instrument achieves Warning mode it will stay in that condition until the problem is corrected or the static level falls to less than the preset warning.

When static levels reach the preset Alarm level and the preset Alarm Delay has expired (refer to Program Setup in Section 9 for details) the Alarm relay will open and the Alarm LED will light. The OK LED will continue to blink and the Warning LED remains lit as well.

System Alarm - Upon realization of an alarm condition the System Alarm relay will open. Upon opening the System button on the Monitor screen on your pc will flash red.

Whenever the instrument achieves Alarm mode it will stay in that condition until the problem is corrected and the instrument is manually reset by toggling the channel's **EN/DIS** button on the instrument console or via the pc program provided or by momentarily shorting the Alarm Reset terminals on the back panel.

Alarm Mode – Non-Latching

Under normal operating conditions (i.e. the monitored static level is less than the preset warning and alarm levels) all three relays are energized initiating a contact closure. The green or **OK** status LED is blinking while the yellow or **WARNING** and red or **ALARM** status LEDs are not lit.

When static levels reach the preset Warning level and the preset Alarm Delay has expired (refer to Program Setup in Section 9 for details) the Warning relay will open and the Warning LED will light. The OK LED will continue to blink. Whenever the instrument achieves Warning mode it will stay in that condition until the problem is corrected or the static level falls to less than the preset warning level.

When static levels reach the preset Alarm level and the preset Alarm Delay has expired (refer to Program Setup in Section 9 for details) the Alarm relay will open and the Alarm LED will light. The OK LED will continue to blink and the Warning LED remains lit as well.

System Alarm - Upon realization of an alarm condition the System Alarm relay will open. Upon opening the System button on the Monitor screen on your pc will flash red.

Whenever the instrument achieves Alarm mode it will stay in that condition until the static level falls to less than the preset warning level resetting to normal operation.

Non-Alarm Mode

In non-alarm mode the alarms are disabled, the green or **OK** remains lit continuously. Warning and Alarm are not triggered. The instrument continues to monitor static levels regardless of operating conditions.

Channel Switches

ENA/DIS – Toggles the channel status between Disable / Enable / Alarm

ZERO – Press and release the **ZERO** button to zero the channel. Display will return to pre-set zero level. The channel display to the immediate right of the channel display being zeroed will count down the pre-set zero time out. (For Channel 4 the channel display immediately to the left will count down the zero time out.) If zero level is reached within the pre-set time the channel display will read **don** for “done.” If the zero level is not reached within the pre-set time the display will read **err** for “error.”

Auto-Zero – Press and release the Zero button (< 1sec)

Manual Zero – Press and hold the zero button then push the up or down arrow buttons to adjust the zero reading

Channel LEDs

Green (left) LED – Lights and remains lit when a probe is connected and the channel is enabled (Non-Alarm mode). Lights and flashes when a probe is connected and the channel alarm is enabled. (Alarm Mode: Latching and non-latching.) LED remains flashing even as the Yellow, Warning and Red, Alarm LEDs light during warning and alarm conditions.

Yellow (center) LED – Lights when the pre-set voltage warning level is reached. Remains lit until voltage level drops below warning level (non-latching) or until the condition corrected and the channel is reset (Latching).

Red (right) LED - Lights when the pre-set voltage alarm level is reached. Remains lit until voltage level drops below warning level (non-latching) or until the condition corrected and the channel is reset (Latching).

177A Relay and LED Functions

Initially all Ok, warning, alarm relays are closed (shorted or activated). The Ok LED is on; warning and alarm LEDs are off.

Channel Ok relay is open (the green LED off) when:

- The channel is enabled and has no probe.
- The channel is disabled.

Channel Warning relay is open (the amber LED on) when:

The channel is enabled and the reading is on or above the warning level.

Channel Alarm relay is open (the red LED on) when:

- The channel is enabled and has no probe.
 - The channel is enable and the reading is on or above the alarm level.
- If the unit is in alarm latching mode and the reading comes back down, the relay will not close until the [Ena/Dis] or [GRP] button is depressed.

System relay is normally closed. It is open when:

- One or more of the alarm relay is open.
- One or more of the enabled channel has no probe.
- Power supplies have failed.

Power LED:

On when the unit is powered up. Slow blink if power supply has failed.

Program LED:

Normally off. It is on when doing front panel setup.

Pulses on when the unit is a master. See section on master/slave operation in the User Manual. Note: if USB cable A & B are connected to the same unit, oscillator is disabled.

FP Lock LED:

Normally off. On when the front panel is locked.

When the front panel is locked, only the [Setup] and arrow buttons work. You can unlock the unit, or browse the program setup but cannot change it.

Remote LED

Normally off. Blinks when serial port is receiving.

Section 9

177A Software

Connecting the instrument to a PC (via RS232 serial port)

Connect the 177A to your PC using the DB9-M/F straight through cable in your accessories. Plug the male end of the cable into the RS-485/232 receptacle on the rear of the instrument. Plug the female end of the cable into the appropriate connector on your PC.

Connecting via RS485

Refer to Appendix III for RS-485 connections details.

Installing the Software

Insert the supplied disk into the appropriate drive. A Launch program should automatically begin running. Follow the instructions for the desired action. (i.e. to install the software click the Installation button.) If the Launch program does not automatically start refer to the following instructions:

Click on **Start** on your task bar and then select **Run –**

Type the appropriate drive letter for the disk and setup.exe (i.e. - a:\setup.exe) on the disk and follow the subsequent instructions.

Upon completion, the program icon will be displayed in a window. Click on and drag the icon to your desktop to place a short cut there. Close the window.

Programming via PC

The software included with the 177A is designed to program, monitor and test the instrument via RS-232 or RS-485 connections using the toolbar on the program's main screen.

Connect – Select the appropriate comport and baud rate to be used for the monitor from the drop-down menus. The baud rate should reflect the current Windows setting for this comport.

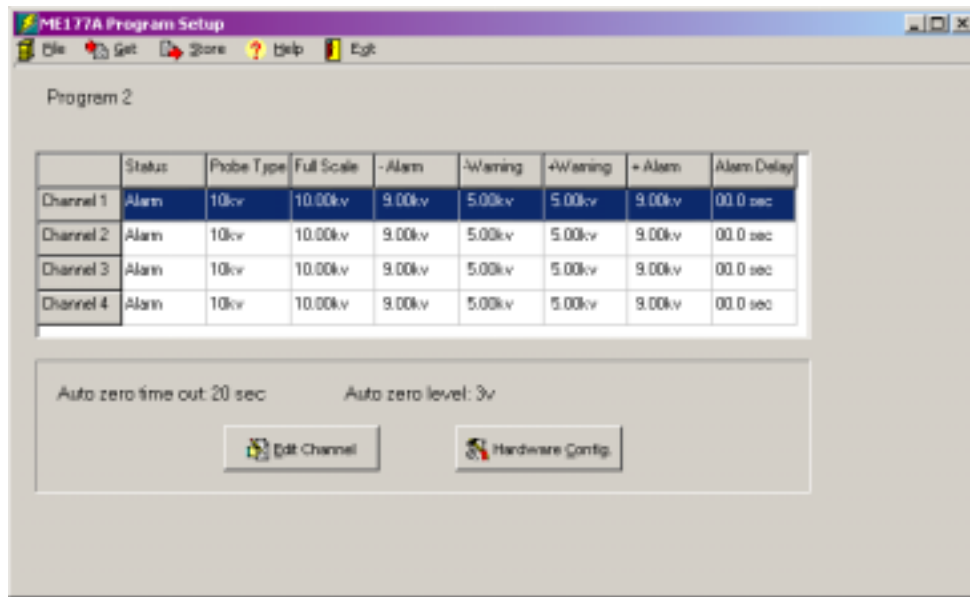
Program Setup – Permits enable/disable of alarms; setting of warning and alarm levels; full scale; alarm delay; auto zero time and level; and decimal position. Four user-defined programs are available which can be set up and stored. The instrument is set to P0, the default setup program. P1 – P4 are initialized to the default settings, resetting these four programs is accomplished via the ME177A program.

From the **Program Setup** drop-down menu:

Click on **Read Setup from 177A** to select program 1 – 4, or retrieve the active program.

Click on **Open Program on disk** to retrieve a program (*.prg) from a file.

Upon retrieving a program the following window will open:



From the **File** drop-down menu:

Select **Open** to retrieve a stored program filename.prg

Select **Save** to save a program

Select **Restore Defaults** to restore the default settings to all channels

Click on **Get** to select program 1 - 4, or retrieve the active program

Edit Channel- Each channel has its own alarm and warning levels, full-scale setting and decimal setting. The auto zero time out and level are the same for all 4 channels.



Disable Disables the channel display (three dashes across display)

Enable Enables the channel display (display is active with green LED lit)

Alarm Enables the channel and alarm (display is active with green LED flashing)

Full-scale Sets the full scale range for the channel display.
Default is 1000v.

± Alarm Level – When value exceeds this setting the alarm, if set, will activate. Default is 9000v.

± Warning Level - When value exceeds this setting the alarm, if set, will activate. Default is 500v.

Note: Alarm level must be greater than the Warning level. Full scale setting must be greater than or equal to the alarm levels.

Alarm Delay – Delay time for the alarm/warning relay to open after the value exceeds the set level. Default is 0 seconds. Setting an alarm delay can prevent erroneous alarms.

Auto zero – Time and Level – When the **Zero** button is pressed auto-zero begins. If the channel reading reaches the level within the time period, the process stops and shows done. If it times out without reaching the level, it will show error and exit out of the auto-zero process. Default time for Auto-Zero time is 20 seconds. Default for Auto-Zero level is $\pm 3v$.

After editing a program you may save it to your hard drive or send it to the 177A as it's active program. First exit the Edit Channel window by clicking on O.K., then from the **Store drop**-down menu:

Click on **Active Program** or **Program 1, 2, 3, or 4** to store your program into permanent memory. If program 1, 2, 3, or 4 is set as your active program those changes will also be applied.

Hardware Config – Permits selection of the station (unit) number, system type, active program, probe type, outputs, serial port, and baud rate.



Station Number – Each 177A should be assigned a unique number for identification, especially when more than one unit is connected to the RS-485 bus. Station numbers may range from 1 to 255.

Active Program – Selects the program P0 (default) or P1 – P4 to be activated.

System Type – Selects the alarm mode for the instrument

Non-Alarm – Alarms are disabled

Alarm Latching – When the probe reading exceeds the alarm level the alarm relay latches causing the alarm LED for that channel to light. Alarm remains in latched or in Alarm mode until the corresponding channel ENA/DIS button is pressed on the instrument's front panel, reset from the PC or by external reset connection.

Alarm Unlatching - When the probe reading exceeds the alarm level the alarm relay latches causing the alarm LED for that channel to light.

Alarm remains in latched or in Alarm mode until the probe reading falls back under the alarm level at which point the relay unlatches.

Probe Type – Must be set from the front panel set-up mode. Please refer to the Front Panel Programming Tree included on your disk.

Output Voltage - Click in a specific channel's probe type box to set the output voltage to either 0-5V or $\pm 10V$.

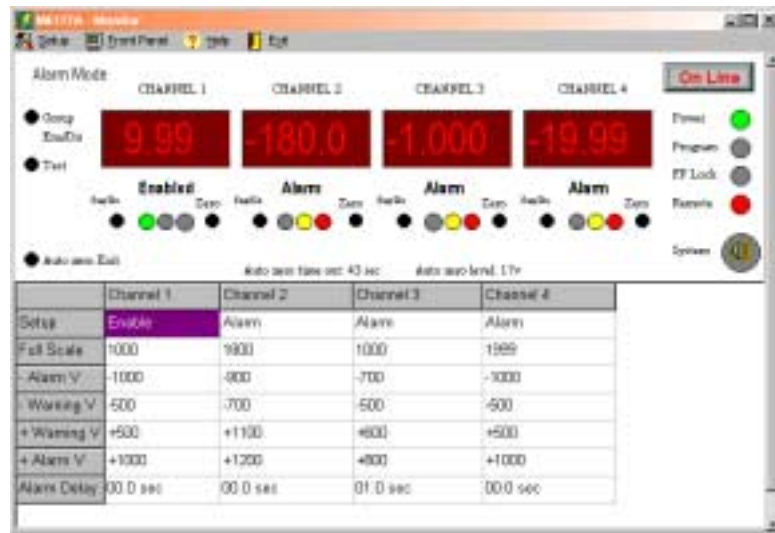
Serial Type – Set serial connection type: RS-232 RS-485Half, or RS-485Full. If RS-485Full is selected and there are more than two units connected, the RS-485 Terminator should be enabled on the first and last units on the bus. **Note: If the serial configuration is not properly set up the instrument will lock up. If this happens turn off the unit, disconnect the plug, reset the firmware to the correct type, restart and reconfigure the software.**

Baud Rate – Set the appropriate baud rate for your system. Should be the setting used under "Connect."

Monitor

The monitor screen enables you to observe the 177A console in real time. It reads data from the 177A console and updates the screen at approximately 3 times per second. The top half of the Monitor screen mimics the instrument's front panel, while the bottom half of the Monitor screen displays the active program from the 177A.

From the Monitor drop-down menu select **Monitor**, the following window will open:



Use the pc mouse to activate the instrument controls via the monitor screen.

Group ENA/DIS – All channels in the group (of four) are enabled on power-up. These channels may be immediately and simultaneously disabled by pressing the **GROUP ENA/DIS** button on the front panel or clicking the **GROUP ENA/DIS** button on the program monitor screen.

Test Button – Tests the probe. Click on and hold causing an output and display shift in the minus direction. Release the button, the reading will return to normal if the probe is functioning properly.

On Line – Click on to set the instrument for continuous monitoring

Off Line – Click off to end continuous monitoring

Ena/Dis – Toggles channel status Disable / Enable / Alarm for the corresponding channel

Zero – Initiates Auto Zeroing for the corresponding channel

Auto Zero Exit – Stops ongoing auto zeroing

FP Lock – Click on the button on the monitor screen or select **FP**

From the **Front panel** drop-down menu:

Lock/Unlock – Select to toggle the front panel between lock / unlock. Red LED indicates that the front panels controls have been locked. When locked the front panel buttons do not function except for **Power, Setup** and **Exit**. FP lock can be enabled or disabled via the front panel controls or the pc software supplied.

Alarm/Non-Alarm –Select to set the Alarm mode. In Alarm mode channels can be set to enable / disable / alarm. In Non-Alarm mode channels can be set to enable / disable only.

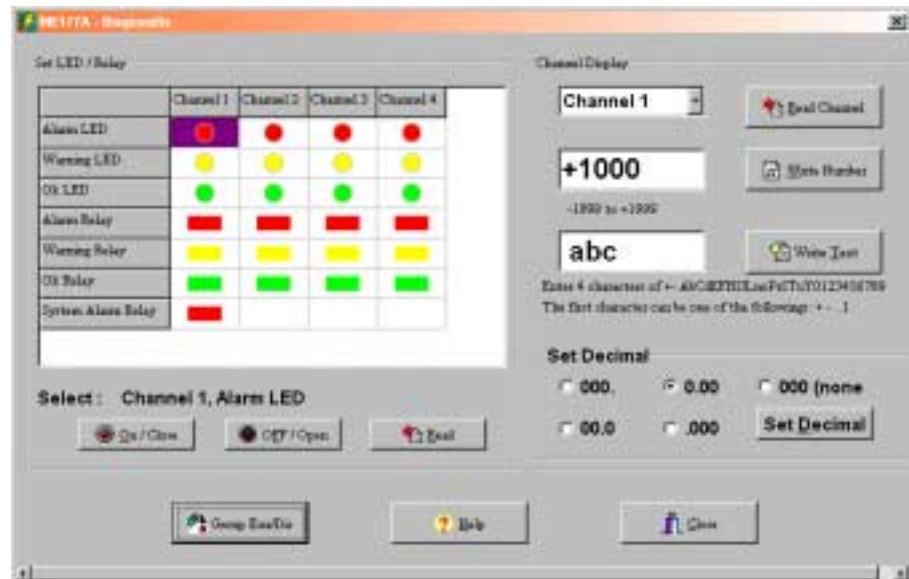
System Diagnostic – Indicates if a system error exists. Select to test the system. If the System icon is blinking it may be due to one or more of the following:

- A channel is enabled, the alarm is set but no probe is connected.
Fix: Disable the channel or connect a probe to the channel.
- A channel, with its alarm activated, has reached the alarm level.
Fix: When the level has returned to its normal range toggle the channel's ENA/DIS button to clear the alarm.
- System power supply is below normal. Check power supply.

Change Password – Select to change the password. Enter the default password (Default password is 1 9 5 3) as prompted. Enter the new password as prompted. Upon completion, the system will confirm the password change if accepted.

Diagnostic

From the Monitor drop-down menu select **Diagnostic**, the following window will open:



Selecting this window from the **MONITOR** drop-down menu on the main screen permits reading and writing to the front panel displays, LEDs, and exercising the system relay contacts. Before using this feature, the 177A must be connected and set to **Group-Disable** to permit control of these items. This feature is helpful in testing all external relay contact wiring to external devices.

To turn an LED or relay contact on or off or to obtain its status, click on the appropriate box on the Set LED/Relay grid, then click the **On**, **Off**, or **Read** button. Remember that the relay contacts are set to be “fail safe” meaning that when conditions are O.K. in normal operation, these contacts are closed. They will then open under caution or alarm conditions or system failures. See Figure 8, on page 10, for examples of connecting external devices.

To read a register (channel display), select the channel in the Channel Display box in the right of the Diagnostic window, and then click the **Read** button. The selected channel display data is shown in the window below the channel display pull-down.

Numerical or text data can be written to any channel display by first selecting the channel in the Channel Display pull-down in the right of the Diagnostic window, entering the data to be written in the boxes below and then clicking the **Write Number** or **Write Text** button.

Display decimal points can be checked by using the **Set Decimal** box. Select the decimal position to be written and then click the **Set Decimal** button. The display should show the correct decimal point with associated zeros. This only checks the functionality of the decimal point and does not alter the setting used in the **Edit Channel** screen of the **Program Setup**.

Any settings written to the unit during diagnostic checks are automatically canceled when the unit is cycled back to **Group Enable**.

The Read / Write commands use MODBUS protocol. The addresses for the relays, LEDs, and displays are listed below and in the Coil Address Table in the help menu of the Read / Write Coils window.

Register (Channel) addresses for MODBUS communications:

Channel 1 Display =Register 0
Channel 2 Display =Register 1
Channel 3 Display =Register 2
Channel 4 Display =Register 3

Coil (LED and Relays) addresses:

Channel 1 Alarm LED (red) = Coil 0 ---- Alarm Relay = Coil 12
Channel 2 Alarm LED (red) = Coil 1 ---- Alarm Relay = Coil 13
Channel 3 Alarm LED (red) = Coil 2 ---- Alarm Relay = Coil 14
Channel 4 Alarm LED (red) = Coil 3 ---- Alarm Relay = Coil 15
Channel 1 Warning (amber LED) = Coil 0 ---- Warning Relay = Coil 16
Channel 2 Warning (amber LED) = Coil 1 ---- Warning Relay = Coil 17
Channel 3 Warning (amber LED) = Coil 2 ---- Warning Relay = Coil 18
Channel 4 Warning (amber LED) = Coil 3 ---- Warning Relay = Coil 19
Channel 1 OK LED (green) = Coil 8 ---- OK Relay = Coil 20
Channel 2 OK LED (green) = Coil 9 ---- OK Relay = Coil 21
Channel 3 OK LED (green) = Coil 10 ---- OK Relay = Coil 22
Channel 4 OK LED (green) = Coil 11 ---- OK Relay = Coil 23
System Alarm Relay = Coil 24

To exit the **Diagnostic** window, click on the **Close** button.

To close the program software click on **Exit** on the main program window.

Section 10

Programming via the Front Panel

A programming tree is supplied to facilitate instrument programming via the front panel. Use the programming tree in conjunction with the front panel features detailed at the beginning of Section 9 to work your way through the programming sequences.

To enter the programming mode via the front panel press the **SETUP** button.

Use the Up / Down / Left / Right arrow buttons to move between the displays.

Press the **ENTER** button to accept changes or perform the function.

Press the **EXIT** button to escape the changes or to exit **SETUP** mode.

Section 11

Optional 4 – 20 mA Module

General

The optional 4-20 mA module provides 4 separate channel outputs in addition to the normal voltage outputs. All channels have a common ground. The instrument provides a 12-volt nominal supply which gives a compliance range of 7-volts. No external supply is required provided the 7-volt compliance is observed.

An external supply may be connected which would be used by all four channels. The external supply must be less than 25-volts. Output compliance of the is the external supply minus 5-volts. Note that this supply will be referenced to chassis and analog ground.

A termination resistor must be installed on the 4-20 mA receiving equipment and must be less than the compliance voltage, or

$$V_{\text{compliance}} > .020 * R_{\text{in}} \text{ where } R_{\text{in}} \text{ is the receiver input resistance}$$

Specifications

Internal Supply:	11.5 volts min
External Supply:	25 volts max
Compliance:	Supply – 5 volts 7-volts with internal supply
Accuracy:	Error less than 1% of reading or $\text{Error}\% = (((\text{RDG} \times 0.005) + 40 \mu\text{A})/\text{RDG}) * 100$ Zero error < 40 μA
Operating Temperature:	0 – 50 ⁰ C
Temperature Coefficient:	< 0.1% 0-50 ⁰ C temperature range

Section 12

Upgrading the Firmware

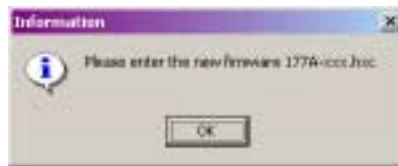
From time to time firmware upgrades may be available. With units version 1.03 or higher this upgrade can be accomplished using the 177A software and obtained via download from our website, e mail, or CD. Units that are version 1.02 require reprogramming of the processor and cannot be upgraded via the 177A software. To check the version of your unit read the Channel 2 display at power up. **Note:** For the duration of the firmware upgrade (approximately 6 minutes) the instrument is not functional and the system is not monitoring. If you have any questions regarding firmware upgrades please contact Monroe Electronics.

To initiate firmware upgrade, click on Update Firmware in the Program Setup drop-down menu. The following window will appear:



Diagram 1

Clicking on Yes will present the following window:



Clicking on OK will present the following window:

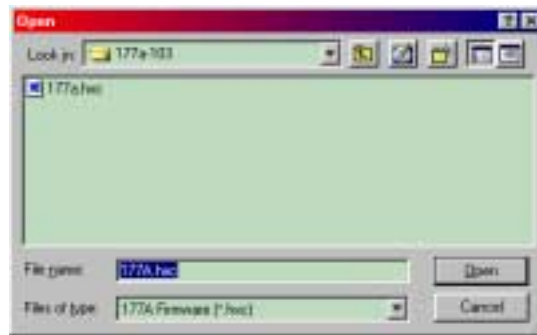


Diagram 2

The source file may be on a CD or downloaded from the Internet. If not available via our web site please contact Monroe Electronics to obtain to receive firmware updates. Upon selecting the appropriate upgrade file the instrument will “check” the update file and display the following if it is O.K. for use. Or, if the file is not ok, “**Invalid file format. File not loaded**” will be displayed.

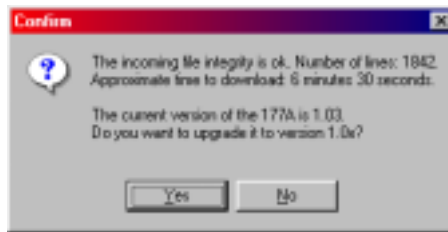


Diagram 3

Click on Yes to begin the download.

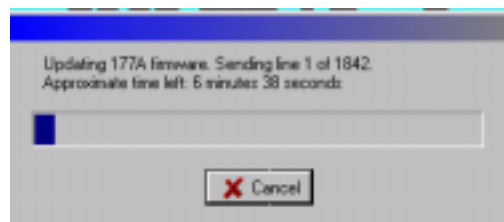


Diagram 4

If the unit is powered up in Load Program mode (caused by a previously incomplete loading process due to power or user interruption) and Update Firmware is selected on the Main screen drop-down menu the following window will be displayed:

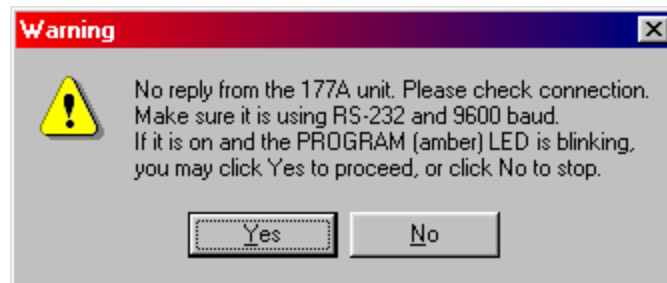


Diagram 5

If your connections are good and power is supplied to the unit click on Yes and proceed to open the source file (Diagram 2.)

During the download, if the chip is bad (doesn't accept data), show:
"The program chip is defective."
"Please contact the manufacturer for replacement."

When the upgrade is completed successfully “**Firmware Upgrade Success!**” will be displayed:

APPENDIX I

PROBE CONNECTION OPTIONS

There are at least six wiring options for the Model 177A with regards to the Model 1036E or 1036F probes. The first three options are for non-hazardous (non-classified) locations where there are no Intrinsic Safety (IS) considerations. The last three options are for hazardous (classified) locations where Intrinsic Safety (IS) must be considered as part of the installation.

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-long cables. 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-I-1)

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

Note: 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 may 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 each connector are $\frac{5}{8}$ " x $1\frac{1}{4}$ ". The minimum conduit ID through which this can be pulled is $1\frac{3}{8}$ ", although, it would be 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-I-1.
- b.
 1. Buy bulk cable and pull as above. Cable construction details are provided in Figure A-I-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-I-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-I-1 and Figure A-I-2 for cable construction details.

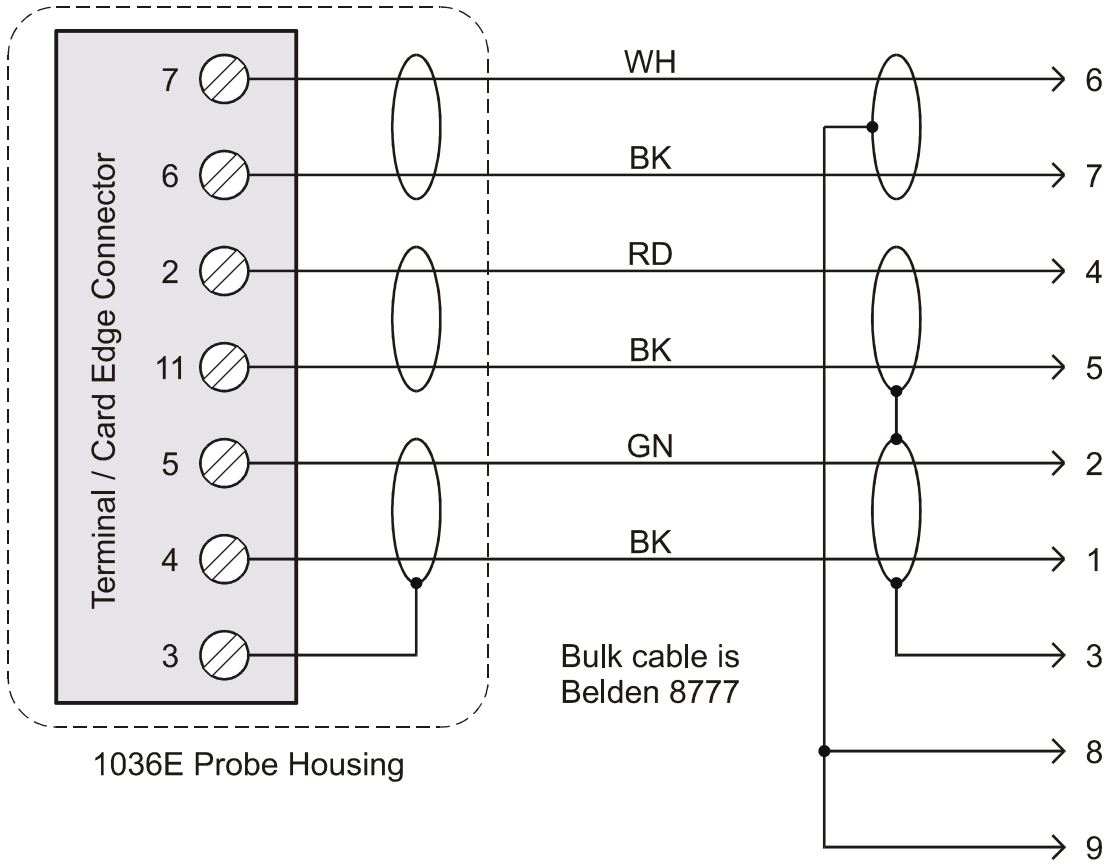


Figure A-I-1

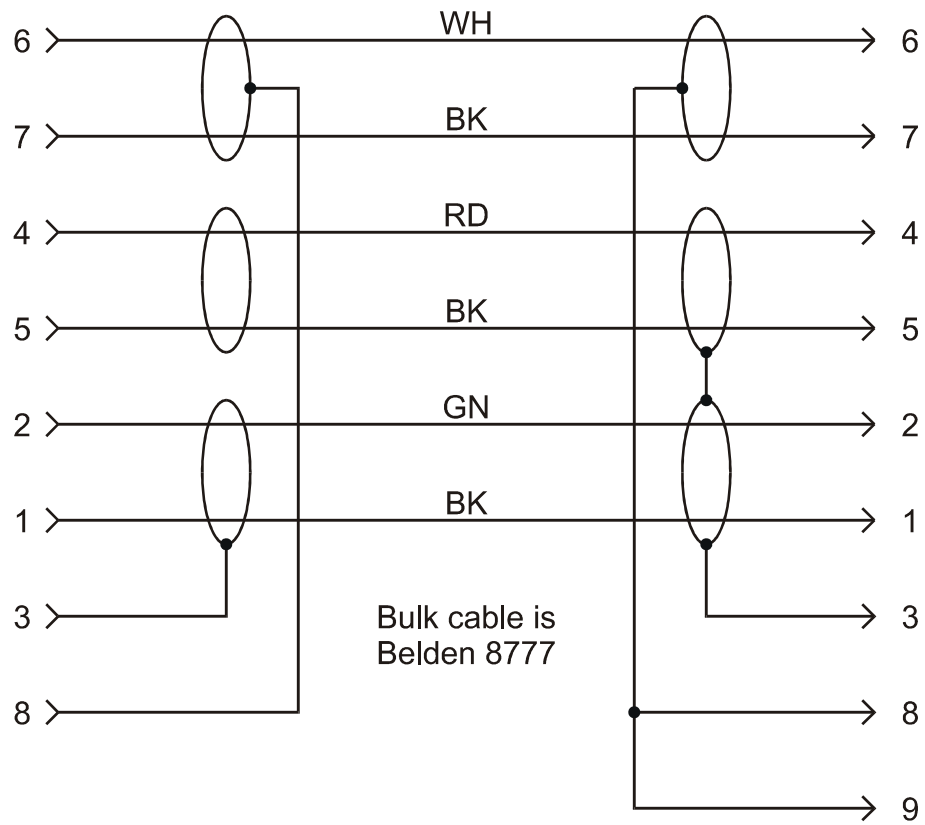
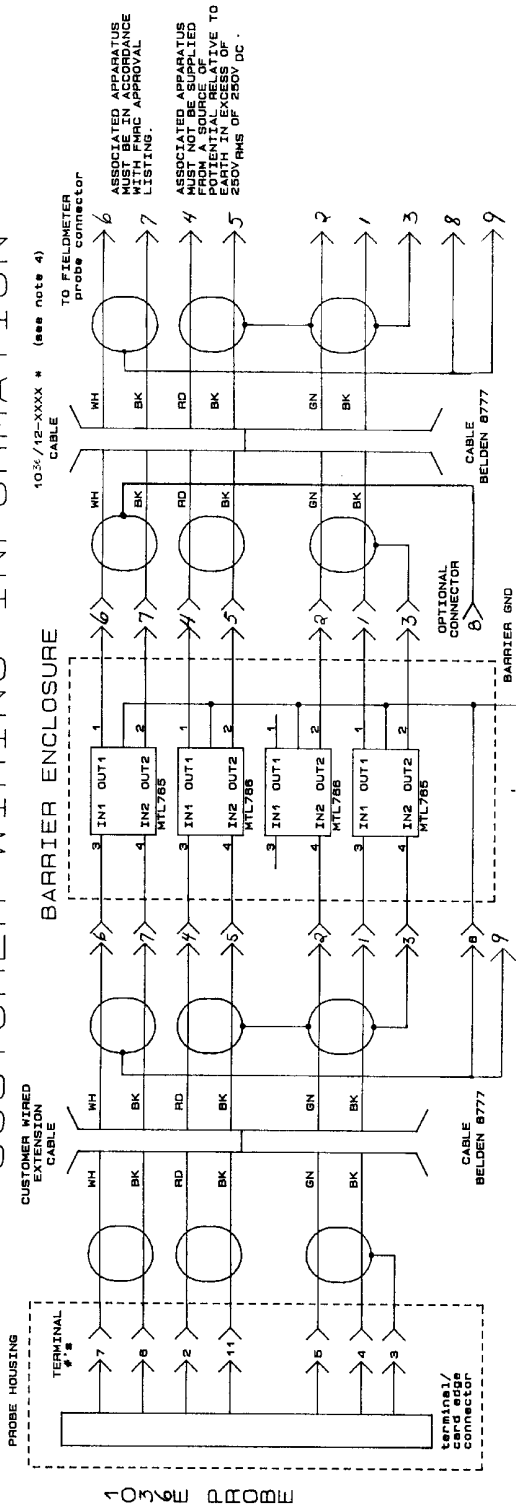
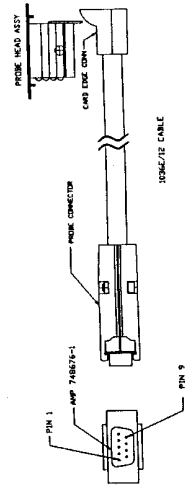


Figure A-I-2

CUSTOMER WIRING INFORMATION



- NOTES:
- 1) WIRE COLORS ARE FOR REFERENCE ONLY AND APPLY ONLY TO BELDEN 8777 CABLE.
 - 2) THE PHRC APPROVAL LISTING FOR THE CUSTOMER EXTENSION CABLES WHEN USING A BARRIER AND CUSTOMER SUPPLIED EXTENSION CABLE FROM PROBE.
 - 3) THE CONNECTORS AT THE BARRIER ARE OPTIONAL.
 - 4) THE -XXXX INDICATES THE CABLE LENGTH IN FEET.
 - 5) MTL SHUNT DIODE SAFETY BARRIERS MUST NOT BE USED IN THE HAZARDOUS AREA.
 - 6) MAXIMUM CABLE LENGTH IS 1000 FEET.
 - 7) CAPACITANCE - 80 PICOFARADS PER FOOT.
 - 8) REFER TO INDUSTRY - 0250 MICRO HENRIES PER FOOT FOR WIRING CONNECTIONS.
 - 9) THE PROBE AND MOUNTING MUST BE CONNECTED TO EARTH GROUND. A NEW GROUND MUST BE INTRODUCED INTO THE HAZARDOUS AREA.



NO REVISIONS CAN BE RELEASED
WITHOUT APPROVAL FROM FACTORY MUTUAL.

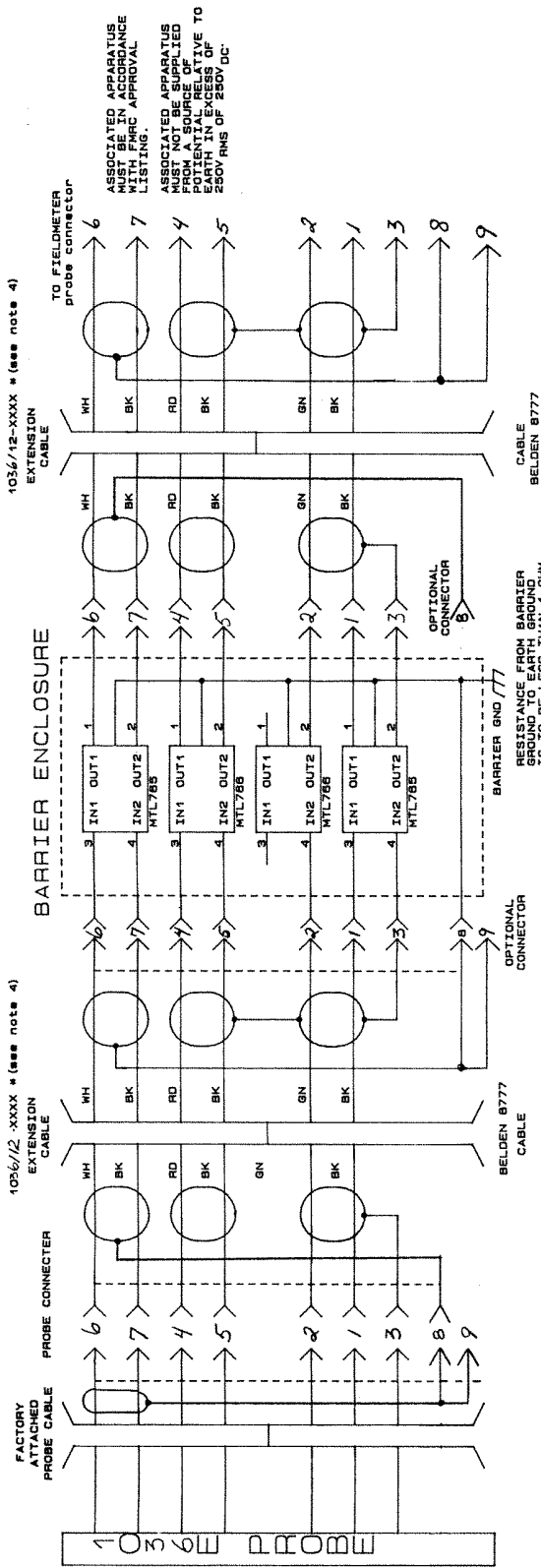
A RELEASED		DATE	11-15-93
LOC. LET.	SCALE	DATE	11/15/93
DRAWN	CHK'D.	NO. APP'D.	1036/12
NEXT ASSEMBLY	REG.	TOLERANCE UNLESS OTHERWISE SPECIFIED:	
		TWO PLACE DECIMAL ± .020	FRACTIONAL ± 1/64
		THREE PLACE DECIMAL ± .008	ANGULAR ± 1'
MATERIAL			

MONROE ELECTRONICS, INC.
 LYNDENHILL, NEW YORK
 MODEL 1036E/17
 CUSTOMER WIRING OUTLINE
 DRAWING NO. 1036/12
 SHEET 2 OF 3

MTL 765
 MTL 766
 MTL
 EQUIPMENT SAFETY BARRIER
 1036/12-388-00
 1036/12-40-00
 R. STAPILL, JR.

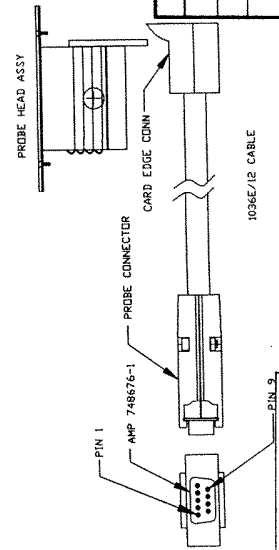
020
PH-100185

CUSTOMER WIRING INFORMATION



- NOTES:
- 1) WIRE COLORS ARE FOR REFERENCE ONLY AND THE ABOVE DRAWING SHOWS THE CABLE WIRING FOR EXTENSION CABLES WHEN USING A BARRIER AND THE CONNECTORS AT THE BARRIER ARE OPTIONAL.
 - 2) THE -XXXX INDICATES THE CABLE LENGTH IN FEET (EX. 1036/12-0500 IS A 500 FOOT CABLE).
 - 3) MIL SHUNT DIODE SAFETY BARRIERS MUST NOT BE USED IN EXCESS OF 1000 FT OR 250V DC.
 - 4) MAXIMUM CABLE LENGTH IS 1000 FEET.
 - 5) CAPACITANCE - 60 PICOFARADS PER FOOT.
 - 6) REFER TO OPERATING AND INSTRUCTION MANUALS FOR WIRING CONNECTIONS.
 - 7) THE PROBE AND MOUNTING MUST BE CONNECTED TO A NEW GROUND INTO THE HAZARDOUS AREA.

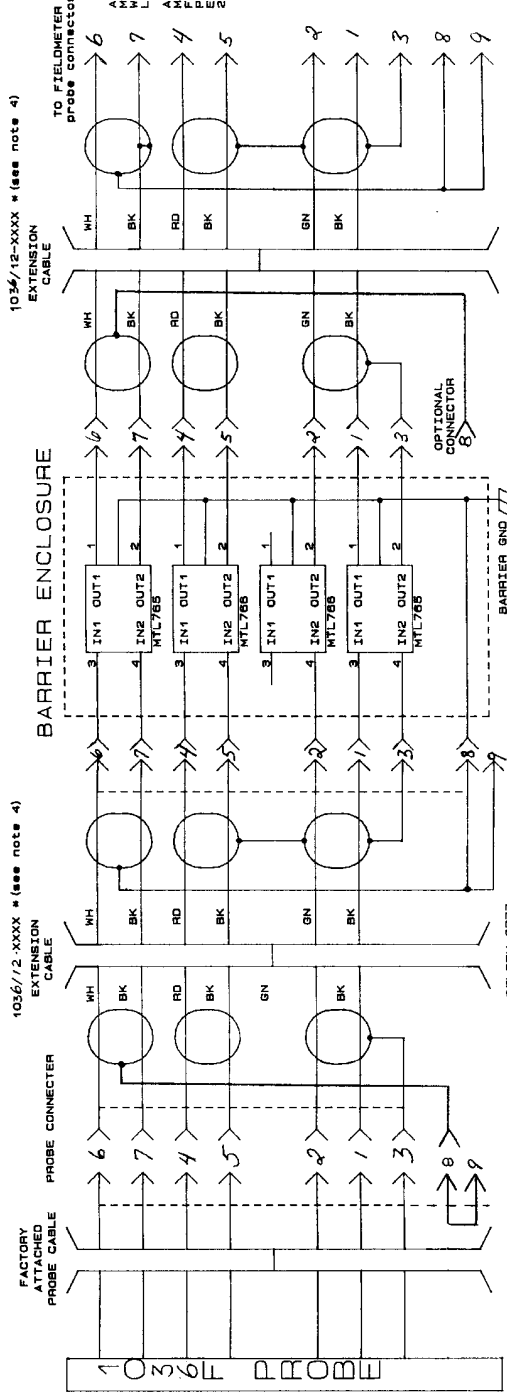
NO REVISIONS CAN BE RELEASED WITHOUT APPROVAL FROM FACTORY MUTUAL.



1036/12		DATE	
A RELEASED		11-15-93	
LOC. LET.	SCALE	DATE	REVISIONS
		MG	10/21/93
DRAWN	CHKD.	APP'D.	NO. REC.
MG	VRS	CHP	10/21/93
ASSEMBLY	NO. REC.	TOLERANCE UNLESS OTHERWISE SPECIFIED:	
		TWO PLACE DECIMAL ± .020	
		THREE PLACE DECIMAL ± .008	
MATERIAL		DRAWING NO. REV	
EQUIVALENT SAFETY BARRIER		1036/12 A	
		SHT 80F3	

1036/12

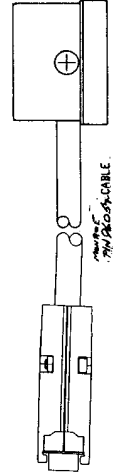
CUSTOMER WIRING INFORMATION



ASSOCIATED APPARATUS MUST BE IN ACCORDANCE WITH FMRC APPROVAL LISTING.

ASSOCIATED APPARATUS FROM A SOURCE OF LIVED POTENTIAL RELATIVE TO EARTH IN EXCESS OF 250V RMS OR 250V DC.

- NOTES:
- 1) WIRE COLORS ARE FOR REFERENCE ONLY AND APPLY ONLY TO BELDEN 8777 CABLE.
 - 2) EXTENSION CABLES MUST BE USED FOR ALL EXTENSION CABLES WHEN USING A BARRIER AND THE CABLE FACTORY SUPPLIED WITH PROBE.
 - 3) THE CONX. INDICATES THE CABLE LENGTH IN FEET WITH MAX. LENGTH 1000 FEET. (FOOT CABLE)
 - 4) MAX. LENGTH 1000 FEET. (FOOT CABLE)
 - 5) MAX. LENGTH 1000 FEET. (FOOT CABLE)
 - 6) THE PROBE AND MOUNTING MUST BE CONNECTED TO GROUNDED EQUIPMENT AND MUST NOT INTRODUCE A NEW GROUND INTO THE HAZARDOUS AREA.
 - 7) MAXIMUM CABLE LENGTH IS 1000 FEET.
 - 8) REFER TO APPARATUS INSTRUCTION MANUALS FOR INDUCTANCE - 0.20 MICRO HENRIES PER FOOT.
 - 9) THE PROBE AND MOUNTING MUST BE CONNECTED TO GROUNDED EQUIPMENT AND MUST NOT INTRODUCE A NEW GROUND INTO THE HAZARDOUS AREA.



NO REVISIONS CAN BE RELEASED WITHOUT APPROVAL FROM FACTORY MUTUAL.

A RELEASED		DATE	11-15-93
LOC. LET.	SCALE	DRAWN	DATE
		VRS	11/13
NO. REQ.	CH'KD.	APPD.	DATE
		RHP	10/14/93
TOLERANCE UNLESS OTHERWISE SPECIFIED:			
TWO PLACE DECIMAL ± .020		FRACTIONAL ± 1/64	
THREE PLACE DECIMAL ± .005		ANGULAR ± 1'	
MATERIAL			
MORRIS ELECTRONICS, INC. LYONSVILLE, NEW YORK			
MODEL 1036F/18 CUSTOMER WIRING OUTLINE			
DRAWING NO.		REV	
1036/10		A	
SMT 3.0.3			

APPENDIX II

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

and

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

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

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 3 — 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 4 - 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:

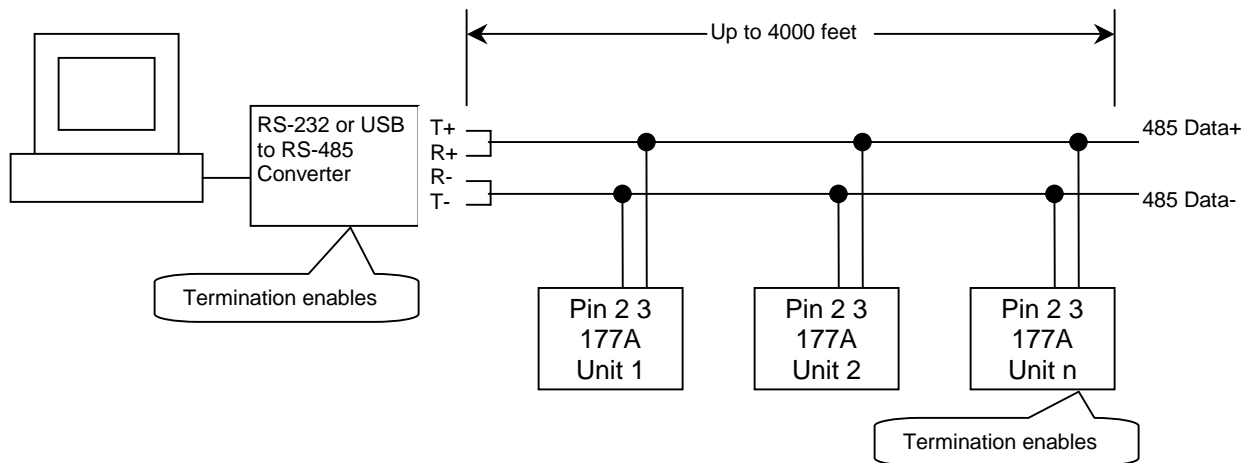
National Fire Protection Association
1 Batterymarch Park
PO Box 9101
Quincy, MA 02269-9101
Tel. (800) 344-3555

APPENDIX III

RS-485 Half Duplex / Full (RS-422) Connection To 177A

RS-485 is a specialized interface that is very common in the data acquisition world. An RS-485 network can be connected in a 2 or 4-wire mode (bi-directional - half duplex - multi-drop Communications over a single or dual twisted pair cable). All the devices in the same network should be connected in daisy chain (see diagram below). Maximum cable length can be as much as 4000 feet.

RS-485 Half Duplex



Tools and procedures to setup the 177A units for RS-485 communication:

- Station ID, RS-485 and Terminator setup.
- RS-232 to RS-485 Converter.
- Cable

Station ID, RS-485 and Terminator setup: Each 177A on the same RS-485 bus must have its own unique ID (1-255). This can be set via ME177A software or from the front panel Setup. Baud rate is 9600 by default.

Setup RS-485 from the 177A front panel:

Press Key	Display(blinking)	Display Description
Setup	Lo	Front panel Lock
Up	SS	System Setup
Right	bAu	Baud rate
Down	IT	Interface Type
Right	+232	RS-232
Down	485 - HAF	RS-485 Half duplex
Enter		

Setup Terminator (continue from above):

Press Key	Display(blinking)	Display Description
Left	+485	
Down	TEr	Terminator
Right	on	Press up/down to select terminator on / oFF
Enter		

Setup Station ID (continue from above):

Press Key	Display(blinking)	Display Description
Left	IT	Interface Type
Down	Sn	Station number
Right	001	Enter station ID
Enter		

Setup RS-485 from ME177A software: Connect the 177A unit to the PC's comport. On the main entries screen, click on Get – Active Program. This leads to Program Setup screen. Click on [Hardware Config] button to go to the System Setup Screen. Enter the Station ID, Select Serial Type and Terminator. Click the [Send & Exit]

RS-232 To RS-485 Converters:

When connecting to the PC's comport, an RS-232 to RS-485 converter may be needed (see Diagram above).

When connecting to the PC's USB port, an USB to RS-485 converter is needed (see Diagram above). The following device has been tested to use with 177A: VScom USB-COMi Adapter.

Connection to the 177A: Locate the DB-9 connector on the back of the unit, connect the two wires to the 485 data as follows:

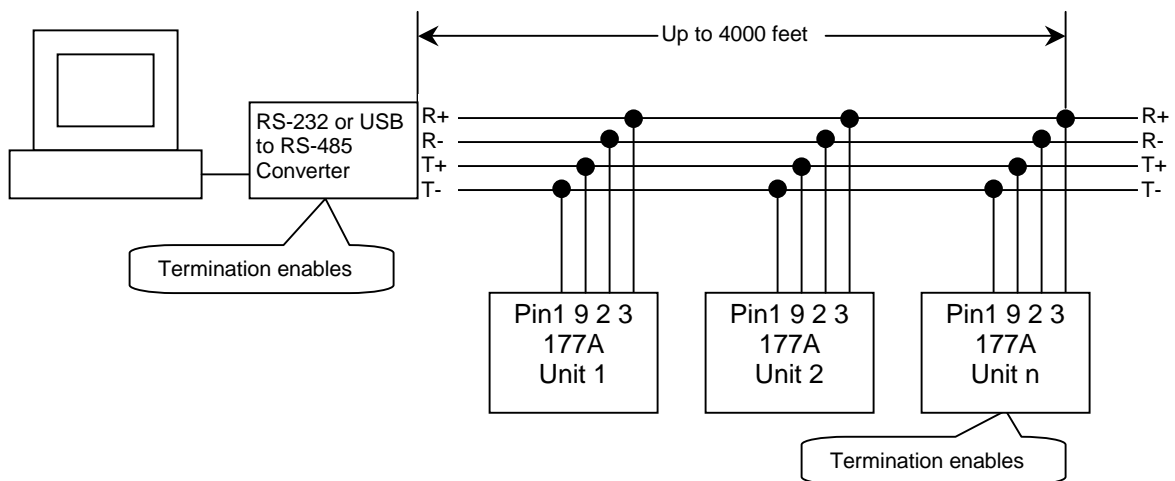
RS-485Bus		177A DB-9
Data+	→	Pin3
Data-	→	Pin2

For correct operation of the transmitter and the receiver, a return signal path between the grounding of individual devices is required. It may be realized either by a third wire, or by grounding each device (third pole in the mains socket).

Cable Selection For RS-485 Systems

Category 5 cable is available as shielded twisted pair (STP) as well as unshielded twisted pair (UTP) and generally exceeds the recommendations for RS-422 making it an excellent choice for RS-485 systems

RS-485 Full Duplex (RS-422)



Setup for the Station ID and Terminator is the same as setup RS-485 Half, see above for details.

Setup RS-485 Full duplex from the 177A front panel:

<u>Press Key</u>	<u>Display(blinking)</u>	<u>Display Description</u>
Program	Lo	Front panel Lock
Up	SS	System Setup
Right	bAu	Baud rate
Down	IT	Interface Type
Right	+232	RS-232
Down	485 - FuL	RS-485 Full duplex
Enter		

Connection to the 177A: Locate the DB-9 connector on the back of the unit; connect the four wires to the 485 bus as follows:

RS-485Bus		177A DB-9
T-	→	Pin1
T+	→	Pin9
R-	→	Pin2
R+	→	Pin3

APPENDIX IV

Communication with ME 177A using MODBUS Protocol

Read Channel LEDs or Relays (read coil)

Write Channel LEDs or Relays (write coil)

Read Channel display (read register)

Write Channel display (write register)

Read Channel LEDs or Relays (read-coil):

From Master (PC software or PLC):

Unit#	Command	CoilAdrH	CoilAdrL	lenHigh	lenLow	crch	crcl
1-255	0x01	0	0-24	0	1		

The request consisted of the unit# and the command code 01 followed by a 2 byte starting address, specifying the variable to be read.

Length high must be 0, length low is 1.

CoilAdrH is 0

CoilAdrL is as follows:

- 0 Channel 1 Alarm (red) LED
- 1 Channel 2 Alarm (red) LED
- 2 Channel 3 Alarm (red) LED
- 3 Channel 4 Alarm (red) LED
- 4 Channel 1 Warning (Amber) LED
- 5 Channel 2 Warning (Amber) LED
- 6 Channel 3 Warning (Amber) LED
- 7 Channel 4 Warning (Amber) LED
- 8 Channel 1 OK (Green) LED
- 9 Channel 2 OK (Green) LED
- 10 Channel 3 OK (Green) LED
- 11 Channel 4 OK (Green) LED
- 12 Channel 1 Alarm Relay
- 13 Channel 2 Alarm Relay
- 14 Channel 3 Alarm Relay
- 15 Channel 4 Alarm Relay
- 16 Channel 1 Warning Relay
- 17 Channel 2 Warning Relay
- 18 Channel 3 Warning Relay
- 19 Channel 4 Warning Relay
- 20 Channel 1 OK Relay
- 21 Channel 2 OK Relay
- 22 Channel 3 OK Relay
- 23 Channel 4 OK Relay
- 24 System Alarm Relay

177A reply to read coil:

Unit#	command	# of data	Coil Value	crch	crcL
1-255	0x01	1	0=Off, 0xff=On		

Write Channel LEDs or Relays (write coil):

From Master (PC software or PLC):

Unit#	Command	CoilAdrH	CoilAdrL	New Value	0	crch	crcL
1-255	0x05	0	0-24	0=Off, 0xff=On			

The request consisted of the Unit address and the command code 05 followed by a 2 byte starting address, specifying the variable to be set, a data byte, specifying the binary value to set (ON = 0xff, OFF = 0) and an additional byte always set to 0.

177A reply to write single coil is identical to the received packet:

Unit#	Command	CoilAdrH	CoilAdrL	New Value	0	crch	crcL
1-255	0x05	0	0-24	0=Off, 0xff=On			

Read Channel display (read register):

From PC or PLC:

Unit#	Command	RegAdrH	RegAdrL	LenH	LenL	crch	crcL
1-255	0x03	0	0-3	0	1		

RegAdrL is as follows:

0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4

177A reply:

Unit#	Command	# of data	dataH	dataL	crch	crcL
1-255	0x03	1	##	##		

Write Channel display (write register):

From PC or PLC:

Unit#	Command	RegAdrH	RegAdrL	dataH	dataL	crch	crcL
1-255	0x06	0	0-3	##	##		

177A reply to write single Register is identical to the received packet:

Unit#	Command	RegAdrH	RegAdrL	dataH	dataL	crch	crcL
1-255	0x06	0	0-3	##	##		

Note:

If the Unit# is 0, the 177A units will execute the Write-Coil and Write-Register commands, but No reply.

Application Note APNE-0003

Monroe Electronics Model 1036 fieldmeter probes are calibrated (or, more correctly, "standardized") in a true uniform or homogeneous field. The calibration fixtures used are designed to produce parallel field lines.

As a true uniform field does not usually occur in most practical measurement situations, partly due to the introduction of the grounded probe itself, one must either:

1. Attempt to better the geometry by establishing a grounded plane, through which the fieldmeter probe can view the field under consideration,
2. Establish a correction factor for the data, or
3. Accept relative data. In many cases, this is perfectly acceptable practice once a fixed geometry is established.

Some guidelines are offered here.

During the standardization procedure, these probes are configured as shown in Figure 15 with the face of the probe flush with the bottom of the upper metal plate or "shroud" which is referenced at ground potential. This shroud effectively increases the area of the face of the probe. It and the surface under test (in this case, gradient plate) can be considered to be infinitely large as long as the size of the plates exceeds 5 or 6 times the distance between the plates.

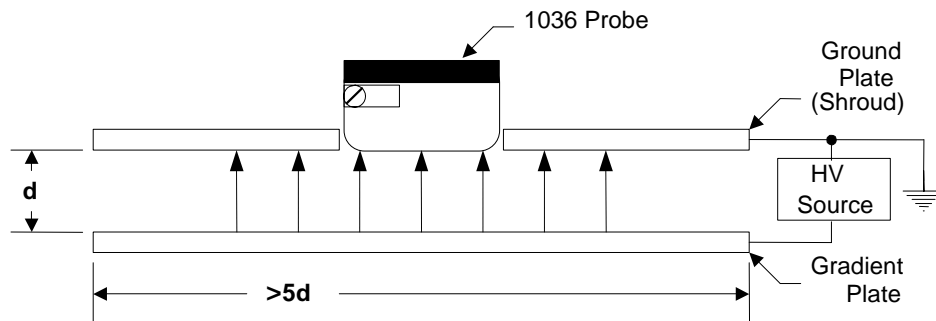


Figure 15

Please note that the diameter of the face of the Model 1036F probe is approximately 1½ inches. The face of the Model 1036E is 4¼ inches by 2¾ inches. Either probe type used on its own without a shroud will tend to perturb a field as shown in Figure 16.

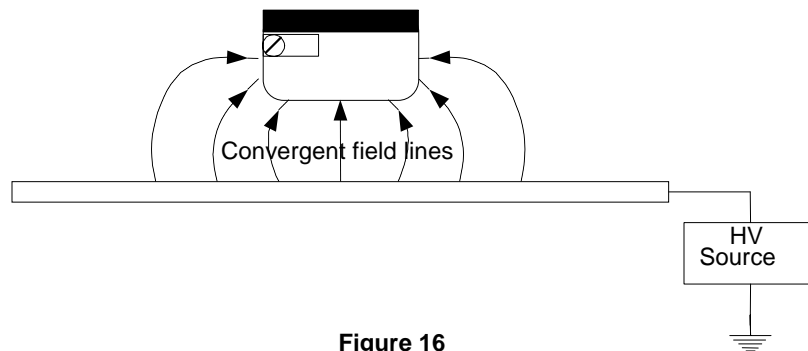


Figure 16

Convergent field lines such, as these tend to "enhance" the measurement and cause the apparent field strength to increase, thus producing a high reading. Although this may be relatively inconsequential where a direct measurement of surface voltage is desired — for example, where a probe whose specified sensitivity is 10kV/cm is being used at 1cm to produce an indicated full scale

value of up to 10,000 volts — given a large enough surface and a properly sized shroud, that same probe could be used to produce a measurement of surface voltage up to 100,000 volts at 10cm with fairly good accuracy.

Tests performed in our laboratory produced the following:

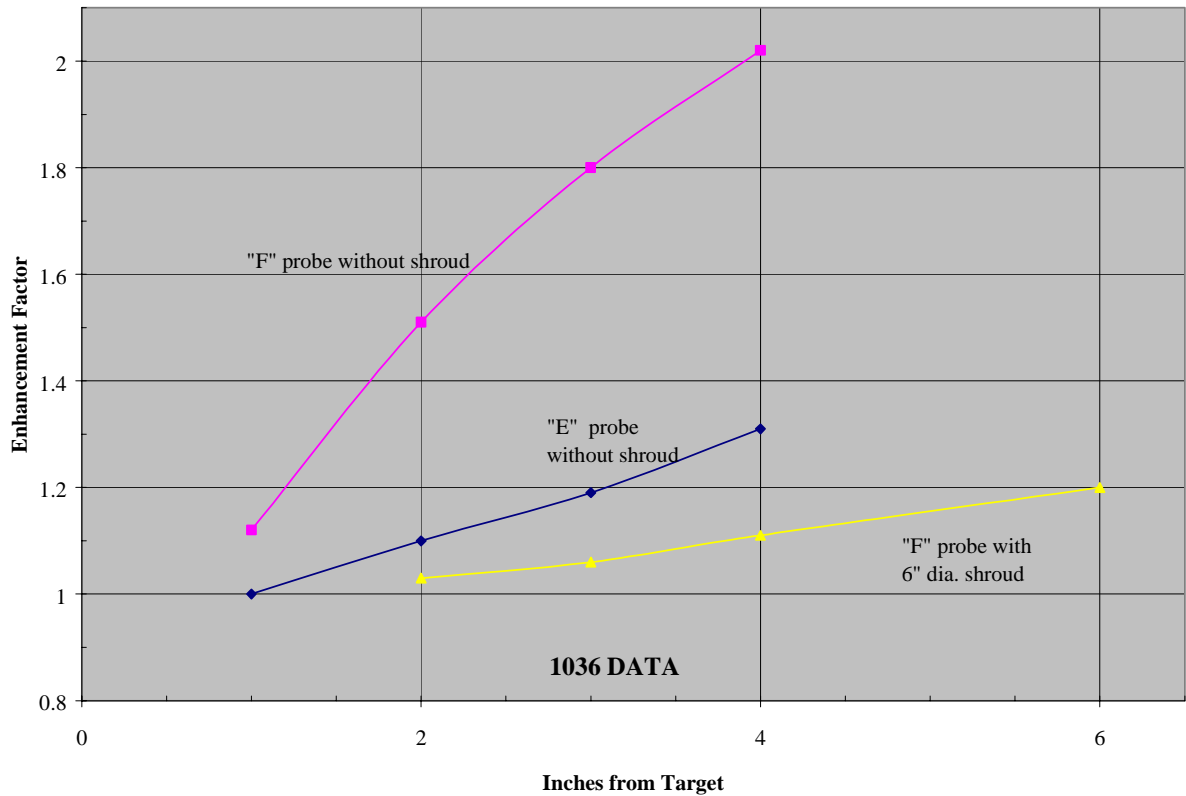


Figure 17

Some conclusions may be drawn from the data shown in Figure 17 :

1. An "F" probe produces a reading about 12% high with no shroud at 1" (25mm) and about double at 4" (100mm).
2. When provided with a 6" diameter shroud, the error drops to fewer than 10% at spacings of up to almost 4".
3. A shroud is unnecessary on an "E" probe at 1" or less and would produce the same improvement as with the "F" probe at greater spacing.
4. As a general rule of thumb, a shroud (or the size of the face of the probe) should be about 1½ times the spacing to keep errors to about 10% or less.