

**Micro-Tech 2000
Model 2109
Correlator
Installation & Operation
Manual**

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Chapter 1 Introduction

This chapter introduces you to the Micro-Tech 2000 Model 2109 Correlator. It includes a description of the machine, a list of features and options, and Model 2109 hardware specifications.

The Model 2109 Correlator is a microprocessor-based mass flow meter system that measures the flow of bulk solids through pneumatic lines or in free fall. The system uses two sensors and a transmitter to measure and output of four separate parameters:

- Concentration
- Mean velocity
- Mass flow
- Totalization

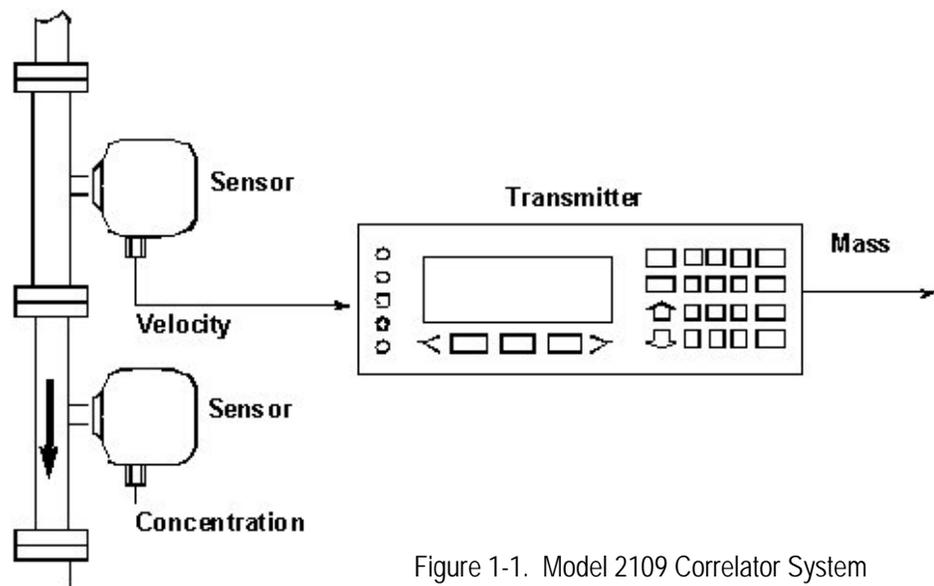


Figure 1-1. Model 2109 Correlator System

System Description

A Model 2109 system is composed of two independent sensors and a single transmitter.

The velocity sensor and the concentration sensor operate using capacitance technology. They are designed for installation directly into the process using DIN or ANSI flanges. These sensors are available in sizes from 0.5-in. (15 mm) to 8-in. (200 mm) nominal ID.

Specifications, installation, and wiring for the DK 13 velocity sensor and DC 13 concentration sensor are detailed in Appendix A.

Signals from the sensors are channeled to the microprocessors in the transmitter for processing. The transmitter generates visual measurement data for the display and electrical output signals representing flow rate, velocity, or concentration. The principal velocity processing technique is based on correlation.

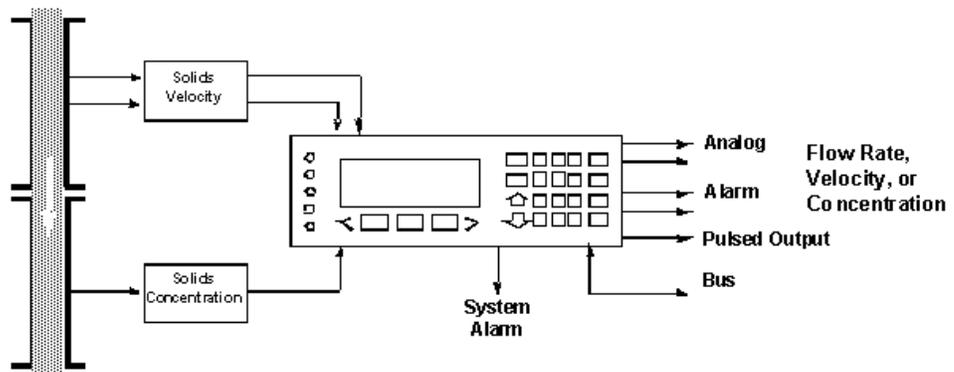


Figure 1-2. Model 2109 Input and Output Signals

Hardware Specifications

This section outlines the specifications for the Model 2109.

Enclosure

Field Mount

- Size 15 X 13 X 7 inches (381 X 330 X 177 mm)
- NEMA 4X, dust and watertight
- Fiberglass reinforced polyester molded
- Door window UVA acrylic UL#E64358
- Stainless steel "Quick" type latch
- 2 position-mounting feet
- Steel chassis providing EMI/RFI shielding
- Provision for 7 solid-state input/output modules (4 output, 3 input)
- Power on/off switch (field terminal board option)

Panel Mount

Size DIN 43700 3.8 X 11.3 in (96 X 288 mm)

Enlarged bezel for field mount and U.S. panel mount to allow "dust seal"

Chromated mild steel

Environmental Conditions

Indoor/Outdoor

Should be mounted as close to the flow meter as possible without being exposed to excessive heat, or moisture.

Altitude

Up to 6,561 feet (2000 M)

Temperature

Storage: -40° to +158° F (-40° to +70° C)

Operating: +14° to +122° F (-10° to +50° C)

Humidity

Maximum relative humidity 80% for temperature up to 31 degree C decreasing linearly to 50% humidity at 40 degree C.

Pollution Degree

Degree 2

Power Requirements

Nominal voltage

110/120/220/240 VAC, selectable

Nominal Frequency

50/60 Hz

Operating Range

Nominal Voltage +10%, -15%

93.5 VAC - 121 VAC (110 VAC Nom)

102.0 VAC - 132 VAC (120 VAC Nom)

187.0 VAC - 242 VAC (220 VAC Nom)

204.0 VAC - 264 VAC (240 VAC Nom)

Fusing

L1 side of line

1.0 Amp Slo-Blo 110/120 VAC, Type T

0.50 Amp Slo-Blo 220/240 VAC, Type T

Operating Current

.50 / .45 / .25 / .23 Amps

Input Voltage

Maximum non-destructive input voltage: 150/300 VAC for 1 minute

Power Switch

Filed mount: switches both L1 and L2

Overvoltage

Category II

AC Power Supply

EMI/RFI protection

110/120/220/240 VAC input selection by means of TWO switches (UL, CSA, VDE approved) mounted internally

50/60 Hz transformer

AC Power Supply

Auxiliary Power Supply Output (Alarm Contacts, etc.)

Output voltage: +24 VDC +27/-21%
(19.0/30.4) (unregulated)

Isolation: Yes, 500 volts

Output ripple: 1.0 V_{peak to peak} typical

Short-circuit protection

Sensor Signal Inputs

DC 13 Pulse Frequency Modulation (PFM)

+14.6V, I Max +35 MA

F in 50-3000 Hz

With shielded signal cable, maximum distance between 2109 and sensor is 2000 ft. (600 m)

DK 13

±1V to ±15V

With shielded signal cable, maximum distance between 2109 and sensor is 2000 ft. (600 m)



Figure 1-3. Model 2109 Field Mount Correlator with Sensors

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Chapter 2 Installation

This chapter provides information about equipment inspection, site preparation, and installation. Be sure to read and follow all safety precautions and warnings in this chapter.

The customer is responsible for initial inspection of the equipment and for site preparation. It is essential that the equipment be placed in accordance with the guidelines set forth in this section.

The customer must ensure that qualified personnel are available to make interconnections with other production equipment and perform work at the installation site. A Thermo Scientific Products Customer Service representative is available to supervise installation and verify operation as well as train personnel assigned to operate and maintain the equipment.

Safety Precautions

Do not connect power to the machine or turn on the unit until you have read and understood this entire manual.

The precautions and procedures presented in this chapter must be followed carefully in order to prevent equipment damage and protect the operator from possible injury.



WARNING. Failure to follow safe installation and servicing procedure could result in death or serious injury.

- Make sure only qualified personnel perform procedures in accordance with the instructions in this manual.
- Allow only qualified electricians to open and work in the electronics cabinets' power supply cabinets, control cabinets, or switch boxes.



WARNING. High voltage that may be present on leads could cause electrical shock.

- All switches (control, motor, power, etc.) must be OFF when checking input AC electrical connections, removing or inserting printed circuit boards, or attaching voltmeters to the system.
- Use extreme caution when testing in, on, or around the electronics cabinet, PC boards, or modules.
- Covers over the electronics should always remain in place during operation. Remove them only for maintenance procedures with the machine's power OFF. Replace all covers before resuming operation.



CAUTION. Do not operate this equipment at more than the specified production rate nor utilize in applications other than those stated in the original order. (To adapt production rates or applications, consult Thermo Scientific for recommendations).

Storing the Model 2109

If you will not be installing the Micro-Tech 2109 electronics system now, it can be safely stored at temperatures from -40° to 158° F (-40° to 70° C). All components should be protected against moisture.

Inspecting and Un-Crating

The Model 2109 has been properly packaged for shipment. Inspect all packages for damage before opening. If there is any evidence of shipping damage, notify the shipping carrier immediately; the carrier may be responsible for damage.



CAUTION. Do not leave insulating material over the machine for any length of time or the machine overheats. The specified maximum ambient temperature is not to be exceeded for more than 5 minutes.

Equipment Location

Give careful consideration to the location of the Micro-Tech 2109 electronics because system performance is affected by location. Follow these guidelines when deciding where to locate the correlator.

Locate the electronics so maintenance personnel can easily perform cleaning and adjustment procedures, and so the control electronics enclosure door is easily accessible. This may require clear space in front of the machine.

There should be a minimum of vibration or air currents in the area. The electronics system is designed to operate in an environment where the temperature ranges no lower than -40° F (-40° C) or higher than 122° F (50° C).

The electronics system is designed to operate in an environment where the humidity (non-condensing) ranges from a maximum relative humidity 80% for temperature up to 31 degree C decreasing linearly to 50% humidity at 40 degree C.

Installation

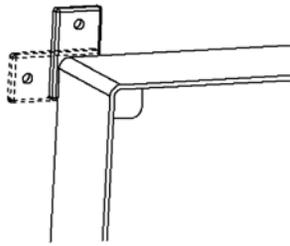
Follow the instructions in this section when installing the Micro-Tech 2190 in your production line.

The Micro-Tech 2109 mounting site should be selected with care in and in an effort to protect the electronics from severe and rapid changes in ambient conditions.

An inside location is recommended. When this is not possible, a mechanical shield should be constructed to protect the feeder controller from direct sunlight, moisture, falling debris and excess weight.

Field Mount Installation

The Model 2109 should not be exposed to excessive vibration, heat, direct sunlight, or moisture. Mount the Model 2109 to a rigid, flat, vertical surface using four mounting holes on the back of the enclosure.



2-Position Mounting Foot

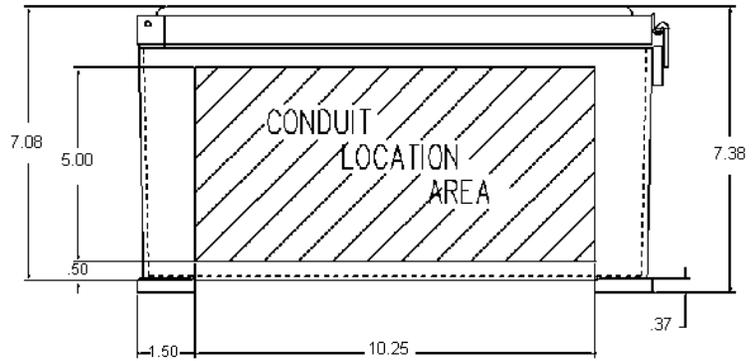
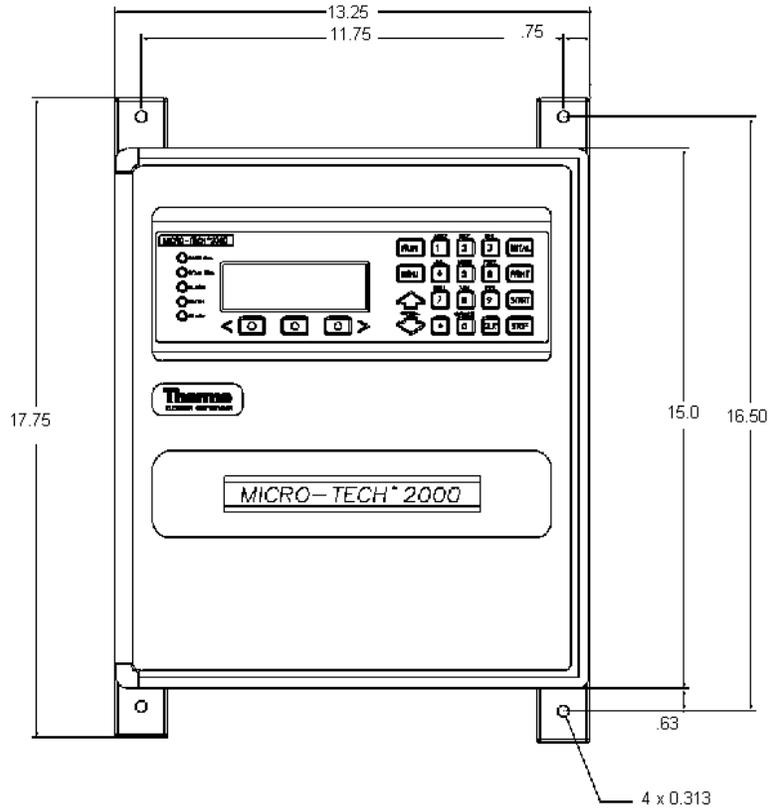


Figure 2-1. Mounting Guidelines for Field Mount
(reference DWG D07257B-B001)

Care should be taken to ensure the mounting surface is flat so as not to twist or warp the fiberglass enclosure when tightening the mounting bolts.

Critical Wiring Conditions

Be sure to observe the following critical wiring conditions to ensure proper connection of your detector:

- Ensure main power is OFF.
- Do not route PFM and signal cables in the same conduit with power cables or any large source of electrical noise.
- Earth ground all enclosures and conduits. A ground connection between all conduits is required.
- Wiring should be long enough to allow the field terminal entry panel to swing down for circuit board access.
- Connect the shields ONLY where shown.
- Check that all wires are tight in their connections.
- Never use a "megger" to check the wiring.
- A readily accessible disconnect device (maximum 20 amps) shall be incorporated in the field wiring. This disconnect should be in easy reach of the operator and it must be marked as the disconnecting device for the equipment.
- All conduits should enter the bottom of the enclosure. Do not run conduit through the top or sides of the enclosure.

Connecting Incoming Power

Use the following steps to connect incoming power (refer to Field Wiring Diagram in Appendix B).



Note All units shipped from the factor are configured for 120 VAC. If another input selection is desired, refer to Switch Configuration. (Table 2-1).

1. Rotate the screw latch mounted on the lower left corner of the front chassis counter clockwise. Open the door.
2. Route incoming power wiring through a conduit hole at the bottom right of the enclosure. Leave enough loose wiring so that if the field terminal board is moved, there will be enough length. Typically, 8 inches (203.0 mm) is sufficient.
3. Wire safety ground terminal located on the side of the chassis.
4. Wire HOT to H on TB7.

5. Wire Neutral to N on TB 7.
6. If additional I/O is required operation at line voltages, these wires should be routed through a conduit hole on the bottom right of the enclosure. Leave enough loose wiring so that if the field terminal board is moved, there will be enough length. Typically, 8 inches (203.0 mm) is sufficient.
7. All additional field-wiring operations at voltages less than 30 V must be located on the left bottom of the enclosure. Leave enough loose wiring so that if the field terminal board is moved, there will be enough length. Typically, 8 inches (203.0 mm) is sufficient.
8. Close the front chassis cover and rotate the screw lock on the lower left corner counter-clockwise until locked. Verify the door is locked.

Panel Mount Installation

The panel-mounted correlator is suitable for mounting in a control panel. The control panel should not be exposed to excessive heat, moisture, or vibration. The front bezel, when properly seated, forms a dust seal.

A two (2) inch clearance around the top and bottom of the Correlator is required for convection cooling. Additional clearances may be required if equipment mounted directly below generates excessive heat.

Clearance in the back is necessary for wiring access and fuse replacement. A clearance on the side is necessary for inserting the chassis holding brackets from the back after insertion of the correlator.

Mounting

Provide a cutout in the panel and insert the controller after removing the holding brackets (see Figure 2-2 and Figure 2-3).

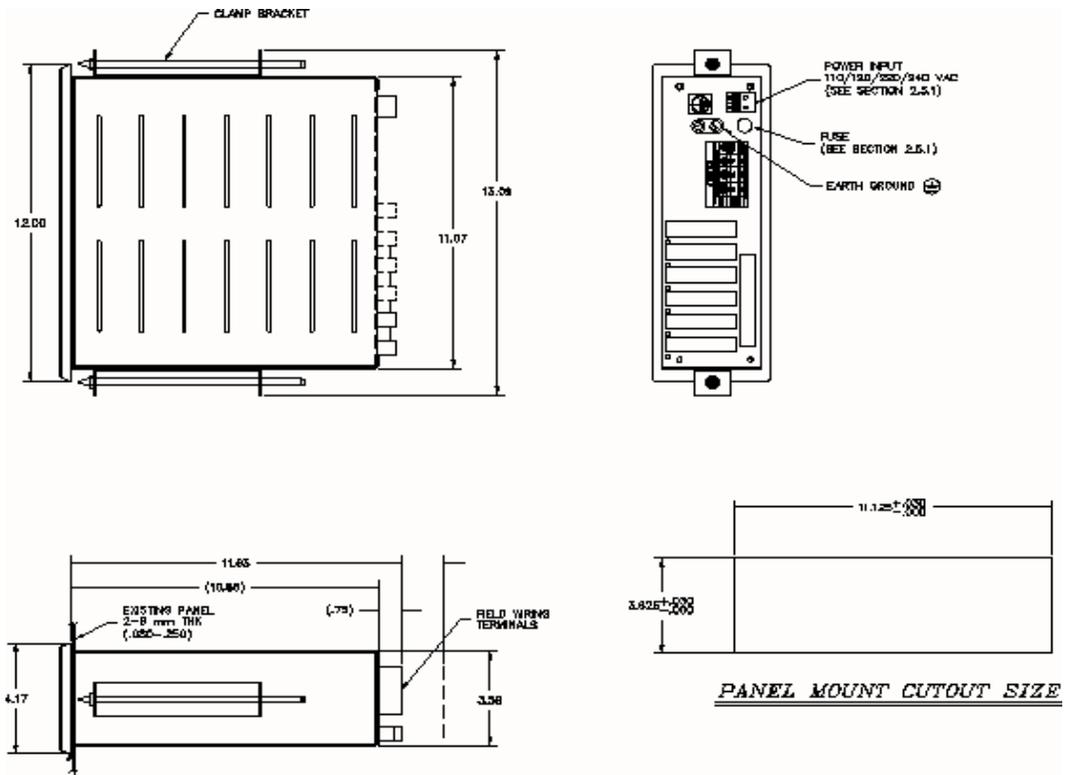


Figure 2-2. Electrical & Mounting Guidelines - Panel Mount Installation

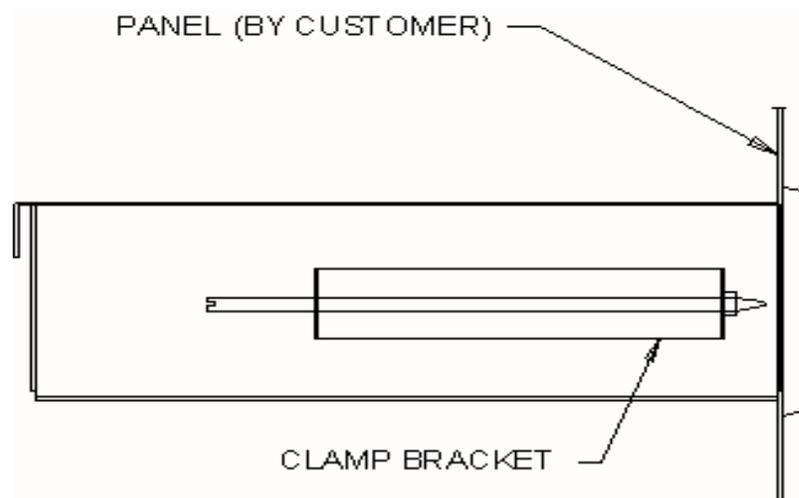


Figure 2-3. Panel Installation

The large rubber band shipped with the unit can be used to hold clamp brackets in place during installation.

Remove the clamp brackets and slide the chassis assembly through the front of the cutout. Re-install the clamp brackets into the chassis and tighten the threaded rods against the back of the panel until unit is secure.

Connecting Incoming Power



To connect incoming power, use the following procedures (refer to the Field Wiring Diagram in Appendix B).

NOTE. All units shipped from the factory are configured for 120 VAC. If another selection is desired refer to Electrical Switches Motherboard Configuration. For input power, use minimum 14 AWG stranded wire (Table 2-1).

To connect incoming power, use the following procedure (refer to the Field Wiring Diagram in Appendix B).

1. For input power, use minimum 14 AWG standard wire.
2. Wire safety ground terminal located on the right back side of the enclosure.
3. Wire the HOT to terminal HOT.
4. Wire the NEUTRAL to terminal labeled NEUTRAL.



NOTE. All units shipped from the factory are configured for 120 VAC. If another input selection is desired, refer to Power Supply.

Electrical Specifications

Electrical specifications for the Model 2109 are:

Voltage

110/120/220/240 VAC

Frequency

50/60 Hz

Power

60 W

Electrical connections to the terminals must be done using minimum 14 AWG (1.5 mm²) wires. Refer to the Field Wiring Diagram in Appendix B if you do not have a specific wiring diagram for your system.



NOTE. Allow only qualified electricians to open and work in the electronics cabinets, power supply cabinets, control cabinets, or switch boxes.

- Do not place the signal wires together with the power cables.
- Connect shields only where indicated in the connection diagrams.
- Connect the ground only as specified by the regulations.
- Never use a megometer to check the signals.

Power Supply

The correlator can be supplied with 110, 120, 220, or 240 VAC. If a certain voltage is not specified, the correlator is preset to work at 120 VAC, 50/60 Hz.

Before connecting supply power, check that the voltage is corresponding to the one preset on the correlator.



CAUTION. Check incoming voltages with a voltmeter before being connected to the machine. Pay special attention to the red tag attached to the machine that stipulates the correct input voltage for your particular unit.

Check the electrical connections and especially that the power cables have not been connected to terminals reserved for signals.

Electrical Switches/Mother Board Configuration

The Micro-Tech 2109 is one of a family of products that is supported by a common hardware platform. Configuration of the hardware platform and additional circuit boards enable the hardware platform to be used for several discrete instruments.

Wire jumpers are installed at the factory for the instrument ordered and should not have to be re-configured in the field. Switches and removable jumpers are described in this section. The default position is noted in each description and, in most cases, not changed.

Mother Board Configuration Jumpers and Switches

TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.

AC voltage input power selection SW 1 and SW2 are located on the right center section of the motherboard (see Figure 2-4). The following table indicates the settings. The shaded cell contains the default settings.

AC Input Voltage	Fuse F1 (SB)	SW1 Setting	SW2 Setting
110	1.0A	110	110/220
120	1.0A	110	120/240
220	0.5A	220	110/220
240	0.5A	220	120/240

Table 2-1. Input Power Selections SW1 and SW2

- First, set SW1 for nominal 110 VAC or 220 VAC
- Set SW2 close to the actual input voltage

Example: Input Voltage = 117 VAC
 SW1 = 110
 SW1 = 120/240

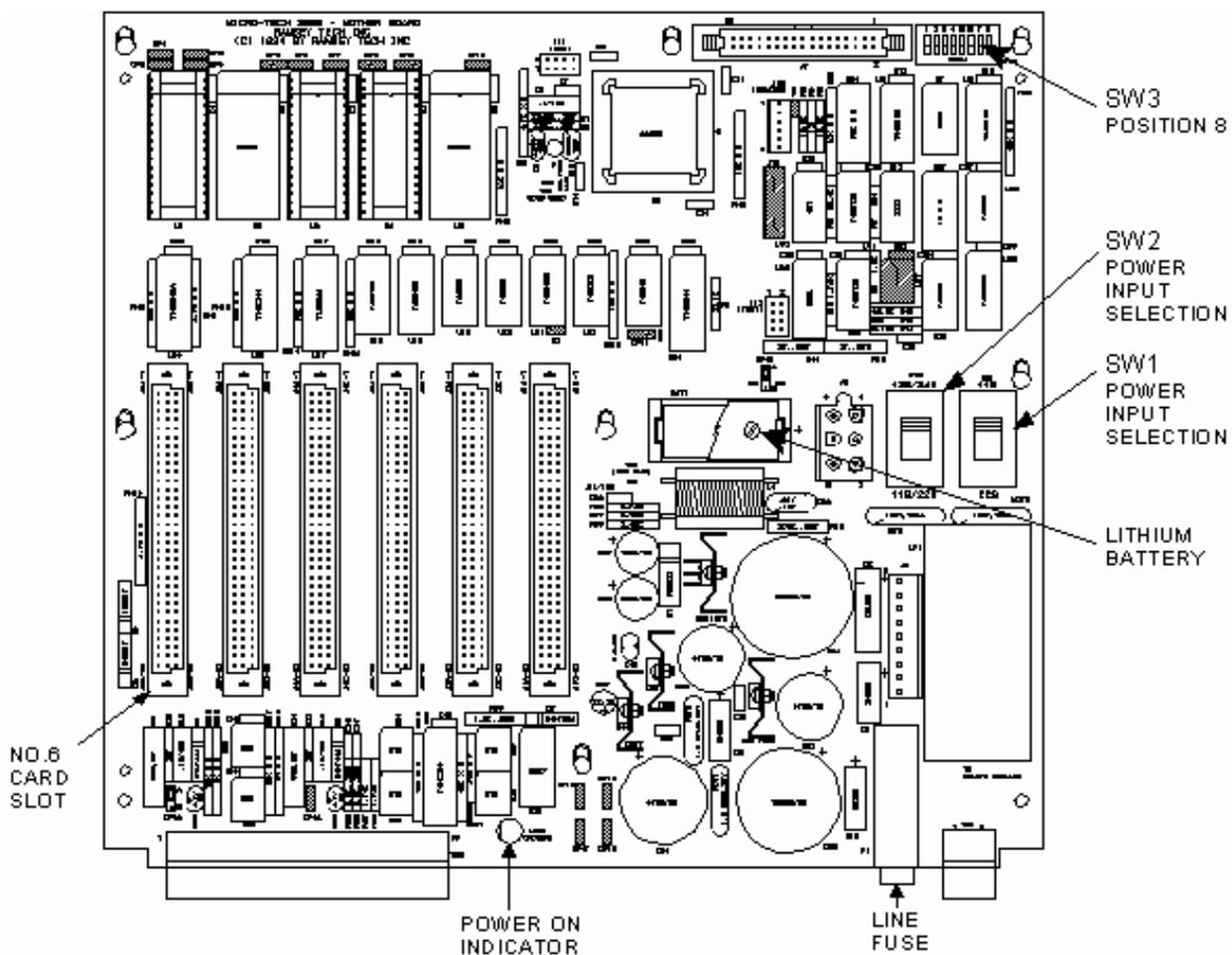


Figure 2-4. Model 2109 Mother Board

Digital Output

Located on the motherboard are provisions for four programmable outputs. Three digital outputs are programmable and the fourth one is permanently assigned as an integrator fault.

The three programmable digital outputs may be configured as normally open or normally closed. The fault output is normally closed and cannot be re-configured or used as a programmable output.

External power is required for all external devices wired to the output.

The programmable output choices are:

- Alarm Cumulative
- Shutdown Cumulative
- Ready
- High Load
- Low Load
- High Rate
- Low Rate
- High Speed
- Low Speed
- Totalization Pulse (Remote Counter)
- Batch Preset Reach
- Batch End
- Print Ready
- Load WTS (Weights)
- Out of Range
- Deviation Alarms

3

Chapter 3 Operations

This chapter provides detailed information about the operator interface to the Model 2109. It describes how to set up and calibrate the Model 2109, how to set up products, and how to perform diagnostic and test functions.

The front panel of the Model 2109 Correlator is designed to simplify setup and machine operation. It provides a vacuum-fluorescent display for viewing system menus and a membrane keyboard for entering data and performing operations. The operator interface is based on a menu structure that guides you through setup and maintenance activities.

Front Panel

The front panel contains the indicators and keys that enable set up of the Model 2109 and to perform calibrations and all required operations after the system has been configured.

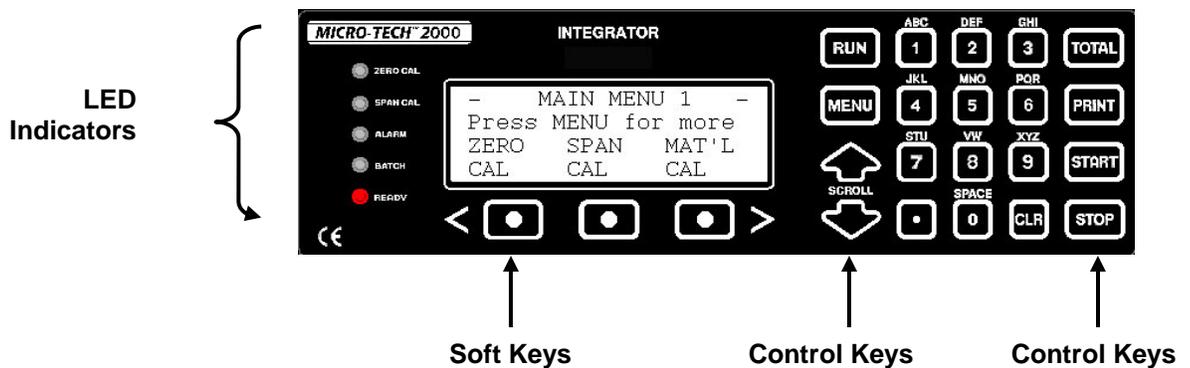


Figure 3-1. Front Panel

LED Indicators

The five red indicators on the left side of the front panel show the operating status of the Model 2109. These indicators are:

ZERO CAL – Zero calibration in progress.

SPAN CAL – Span calibration in progress.

ALARM – Alarm pending.

BATCH – Batch or load out running.

READY – Powered on, no alarm, no calibration running.

Display

The control keys give you access to various Model 2109 operator functions including menu displays, totalizing, printing, and batch processing. The control keys are:

- RUN - Accesses the Run Menu. Returns the Model 2109 to Run mode whenever pressed.
- MENU - Permits entry to menus.
- SCROLL - The up and down arrow keys scroll up or down the selected menu.
- TOTAL - Displays Master total, Reset total and Operator total. Operator and Reset total may be reset.
- PRINT - Starts printout. COMM option is required.
- START - Starts load out. Restart if interrupted.
- STOP - Interrupts load out. Aborts load out if already interrupted.



NOTE. The START and STOP keys are for the load out option only.

Alphanumeric Keys

The alphanumeric portion of the keypad is set up somewhat like the buttons on a touch-tone telephone. These keys enter numeric values and character strings (letters) when you are string editing.

Each alphanumeric key produces multiple characters if a string entry is required in a field. The first press of a key enters the number on that key. The second press on the same key enters the first letter, and so on. The fourth key press enters the last letter on the key. After the fourth key press, the cycle starts again.

For example, pressing the 5 key once enters a 5; pressing it twice enters the letter M; pressing it three times enters the letter N; pressing it four times enters the letter O.



NOTE. Numbers and letters produced by pressing alphanumeric keys are not actually “entered” into a field until you press the ENTER soft key to confirm.

The dot key (to the left of the 0) enters a decimal point.

The CLR key removes incorrect entries if used before pressing ENTER.

Soft Keys The soft keys select the function displayed directly above the key. They also move the cursor right and left during string editing.

Display The 4-line by 20-character alphanumeric display shows actual running information or shows the menus used for Model 2109 setup, calibration, and testing.

Initial Setup Following mechanical and electrical installation, you need to program field data that is specific to your application into the Model 2109 Correlator memory. The following setup procedures should be completed before you attempt to calibrate your system.

Determining Installation Parameters Before applying power to the Model 2109, complete the following information. Refer to the information provided to you by Thermo Scientific sales or engineering during the quote process or during order processing.

- Diameter of sensors
- Estimated minimum velocity
- Estimated maximum velocity
- Estimated minimum concentration
- Estimated maximum concentration

Programming the Model 2109 When power is first applied to the Model 2109, the system steps you through menus and options that bring the system to a weighing state. Soft keys, alphanumeric keys, and the scroll control keys are used to select choices from the menus. The RUN and MENU control keys are inactive during this procedure.

Programming Mode Programming mode begins after a “cold start.” Information requested by each Model 2109 programming screen should be entered before moving to the next screen. The flow meter is calibrated at the end of this procedure provided the correct information is entered. The ALARM LED on the front panel flashes during the programming procedure and clears when calibration is complete.



NOTE: Cold start your machine only in the event that the software becomes corrupted. To perform a cold start:

- Press and hold the left arrow soft key and the CLR key
- Press Yes in response to “Install Factory Defaults?”

Selecting the Language

The Model 2109 is a dual language instrument. English (or USA) is always the first language. The second can be Italian (ITA), Spanish (SPA), German (GER), or other. Press the down SCROLL key to see choices.

- MEMORY ERASED -
Choose the language
key to continue
ITA USA

Instructional Screens

The instructional screens that appear after the language screen provide general information about moving through the programming screens.

Initial scale setup
and calibration
Press down SCROLL

Press the down SCROLL key.

Press key under HELP
for more information

HELP

HELP is flashing. Press the HELP soft key.

Key with dot (soft
key) performs action
of work above it.
MORE RETURN

Pressing RETURN displays the Help screen. Pressing MORE advances the system to the next screen.

Press the MORE key.

Use down SCROLL key
to advance through
the menus.
MORE RETURN

Pressing MORE displays the previous screen. Pressing RETURN displays the Help screen. Pressing the down SCROLL key on the Help screen enables the system to proceed through the menus needed for system setup.

Press RETURN then press the down SCROLL key.

Selecting Measure Units

Measure units can be individually selected. You need to decide whether to use English units, metric units, or a combination of both.

On the DISPLAY SCROLL 1 screen:

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
OR
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

- DISPLAY SCROLL 1 -
Measure Units
>English<
CHOICE ENTER

Default: English
Selections: English, Metric, Mixed

If English is selected, all units are in English. If metric is selected, all units are in metric. If mixed is selected, units may be a combination of English and metric.

Selecting Totalization Units

Select the units to be used for totalization on the DISPLAY SCROLL 2 screen.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
or
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

- DISPLAY SCROLL 2 -

Totalization Units

>Tons<

CHOICE ENTER

If English: Default: Tons
Selections: Tons, LTons, Pounds

If Metric: Default: tonnes
Selections: tonnes, kg

If Mixed: Default: Tons
Selections: Tons, LTons, Pounds, tonnes, kg

Selecting Rate Units

Select the units to be used for the rate display on the DISPLAY SCROLL 3 screen.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
or
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

- DISPLAY SCROLL 3 -

Rate Units

>Tph<

CHOICE ENTER

If English: Default: Tph
Selections: tph, LTph, LB/h, Percent %, Lb/m, T/m, LT/m

If Metric: Default: kg/h
Selections: t/h, kg/h, kg/m, t/m, Percent %, Tph

If Mixed: Default: Tph
Selections: Tph, LTph, Lb/h, Percent %, T/h, Kg/h, kg/m, t/m, Lb/m, T/m, LT/m

Selecting Weight Units

Select the units to be used for the concentration display on the DISPLAY SCROLL 4 screen.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
or
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

```
- DISPLAY SCROLL 4 -  
Weight Units  
>Pounds<  
CHOICE  ENTER
```

If English: Default: Pounds
If Metric: Default: kg
If Mixed: Default: kg
Selections: Pounds, kg

Selecting Length Units

Select the units to be used for the speed and length display on the DISPLAY SCROLL 5 screen.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
or
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

```
- DISPLAY SCROLL 5 -  
Length Units  
>Feet<  
CHOICE  ENTER
```

If English: Default: Feet
If Metric: Default: meters
If Mixed: Default: meters
Selections: Feet, meters

Defining Scale Capacity and Scale Divisions

Scale capacity is the maximum rate at which the scale is allowed to work. This entry also defines the default number of decimal places used for displaying rate.

Define the scale capacity on the SC DATA SCROLL 1 screen.

1. Use the numeric keys to enter the number.
2. Press ENTER to confirm.
3. SCROLL down to the next screen.

```
- SC DATA SCROLL 1 -  
Max. scale capacity  
10.0 Tph  
ENTER
```

Default: 10.0
Min: 1
Max: 200,000

When you enter the scale capacity, the number of decimal places is also defined. If, for example, you enter 500.0, it sets the Scale Division parameter to 0.1. Advancing to the next scroll displays the scale division corresponding to the just entered scale capacity (SC DATA SCROLL 1). You can change the scale division to any of the available options.



NOTE. Changing the scale division does not affect the value of any other constant or number already entered.

Select the number of decimal places to be used for the display on the SC DATA SCROLL 2 screen.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
or
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen

```
- SC DATA SCROLL 2 -  
Scale Divisions  
0.1 Selected  
CHOICE ENTER
```

Default: 0.1
Selections: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 0.01, 0.02, 0.05, 0.001, 0.002, 0.005

Defining Concentration Parameters

Enter the maximum concentration on SC DATA SCROLL 3.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.

or

1. Use the numeric keys to enter a value.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

- SC DATA SCROLL 3 -

Max Concentration

10 Lbs/ft3

ENTER

If English	Default:	100.0 lb/ft3
or Mixed:	Min:	0.1 lb/ft3
	Max:	200 lb/ft3

If Metric:	Default:	1600.0 kg/m3
	Min:	0.1 kg/m3
	Max:	3200 kg/m3

Enter the concentration sensor diameter on SC DATA SCROLL 4.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.

or

1. Use the numeric keys to enter a value.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

- SC DATA SCROLL 4 -

Concent. sensor

diameter 250 in

ENTER

If English	Default:	1.0 in
or Mixed:	Min:	0.5 in
	Max:	8.0 in

If Metric:	Default:	25.0 mm
	Min:	1.0 mm
	Max:	200.0 mm

Defining Velocity Parameters

Enter the maximum and minimum velocity on SC DATA SCROLL 5 and 6 respectively.

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.

or

1. Use the numeric keys to enter a value.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

- SC DATA SCROLL 5 -

Max velocity

4000 ft/min

ENTER

If English	Default:	4000.0 ft/min
or Mixed:	Min:	2.0 ft/min
	Max:	10,000.0 ft/min

If Metric:	Default:	20.0 m/s
	Min:	0.01 m/s
	Max:	50.0 m/s

- SC DATA SCROLL 6 -

Min velocity

40 ft/min

ENTER

If English	Default:	40.0 ft/min
or Mixed:	Min:	2.0 ft/min
	Max:	10,000.0 ft/min

If Metric:	Default:	0.2 m/s
	Min:	0.01 m/s
	Max:	50.0 m/s



NOTE. With the SC Data Scroll 5 and 6 velocities entered the 2109 defaults to Correlator Speed Scroll 2, Correlator Length. Scroll 3, Sampling Frequency and Scroll 6, Correlation Averaging set to values indicated in Table 3-7.

Leave distance of 0.315 in (8 mm) on SC DATA SCROLL 7 unchanged.

- SC DATA SCROLL 7 -
Velocity sensor
spacing .315 in
ENTER

If English Default: 0.315 in
or Mixed: Min: 0.1 in
 Max: 40.0 in

If Metric: Default: 8.0 mm
 Min: 1.0 mm
 Max: 80.0 mm

Defining the Dead Band Rate

The dead band is a percentage of the scale capacity in which the rate (if any) is ignored and a zero rate is forced. Totalization is frozen when the rate is below the dead band.

Enter the dead band range on SC DATA SCROLL 8 screen. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Service)

- SC DATA SCROLL 8 -
Dead Band Rate
0%
ENTER

Defining the Dead Band Concentration

The dead band is a percentage of the scale capacity in which the concentration (if any) is ignored and a zero concentration is forced. In addition, totalization is frozen when the concentration is below the dead band.

Enter the dead band range on the SC DATA SCROLL 9 screen. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Service)

- SC DATA SCROLL 9 -
Dead Band Concentration
0%
ENTER

Default: 0.1%
Min: 0%
Max: 10%

Automatic Calibration

Follow this procedure to do a quick, automatic calibration of the Model 2109 following initial setup. The Model 2109 is first zeroed (three seconds) and then calibrated using material.

- ZERO CAL -
Stop material flow,
then press START
START

Pressing the START soft key displays the following screen for seven seconds.

AUTO ZEROING
Please wait

During auto zero, no material should be running through the flowmeter. When zero is reached, the system displays the following screen:

AUTO ZERO COMPLETED
Zero # CHANGED
New Zero #XXXXX
CONTINUE

The word COMPLETED is flashing. Press CONTINUE soft key to proceed to the automatic span calibration.

The span calibration must be done using the actual material in a "material test". This test is done by running material through the correlator for a period of time (at least five minutes). Generally, the longer the test, the more accurate the results will be.

All of the material in the material test should be pre-weighed or post-weighed on a high accuracy static scale to obtain the actual weight of the test material. This actual weight is then entered to complete the test. After initial zero calibration is complete and CONTINUE has been pressed, the following screen appears.

Press Start Soft Key
then run material

START ABORT

Press START to advance to the next menu and follow the test procedure.

```
00000.0 Tons
0000.0 Tph
Press done to end
DONE
```

During the automatic span calibration, the resolution of total is 10 times higher than normal.

Wait until all of the material has passed over the scale, then press DONE.

At the end of the test, the system prompts you for the reference weight of the material run during the test.

```
00000.0 Tons
Enter reference
weight: 00.0 Tons
ENTER
```

Using the numeric keys, enter the actual weight of the material passed during the test and confirm by pressing the ENTER soft key. The following screen is displayed:

```
SPAN # CHANGED
New span #000000

CONTINUE
```

Press CONTINUE. The following screen is displayed asking if the reference weight from the test is to be added to the totals.

```
SPAN CALIBRATION
Add reference
weight to totals?
YES      NO
```

If you press YES, the amount of material used for the test is added to the master, reset, and operator's totals. If you press NO, the information is lost.

This is the last screen in the calibration procedure. After the initial zero and span

calibration, the flow meter functions normally. Pressing either YES or NO advances the display to the normal Run Menu.

In case the sensors are not connected or a failure is detected, the following message is displayed:

SCALE NOT CALIBRATED
Press RUN to start
or MENU for scrolls

Manual Span Calibration

Follow this procedure to do a manual calibration of the Model 2109 following initial setup:

1. Place the DC13 on a dry, clean surface and fill with your material.
2. Empty the DC13 and weigh the sample (lbs or kg).

Divide the resulting weight by the volume of your DC13 (see Figure 3-2) and calculate the actual concentration.

3. Connect the empty DC13 to the Micro-Tech 2109 and position it on a dry, clean surface.
4. Run the Zero Calibration procedure if you haven't already done so.
5. Fill the DC13 with the previously weighed material sample.
6. At MAIN MENU 1
7. Select SPAN CAL

- MAIN MENU 1 -
Press MENU for more
ZERO SPAN PROD
CAL CAL SETUP

8. Select MANUAL

Calculate the value of the Span Number using the following formula:

$$\text{New Span Number} = \frac{\text{Actual Concentration}}{\text{Displayed Concentration}}$$

9. Use the numeric keys to change the old span number to the new calculated span number and press ENTER.

The displayed concentration should now be the same as your calculated weight per volume number. The DK 13 is an absolute velocity measurement and does not require calibration.

Install both sensors in your process. The equipment is now ready to provide you with accurate measurement.

Diameter mm	Volume m ³	Diameter Inches	Volume ft ³
15	.0000457	0.6	.001616
20	.0000813	0.75	.002873
25	.0001271	1.0	.004490
32	.0002082	1.25	.007356
40	.0003254	1.5	.011490
50	.0005085	2.0	.017960
65	.0008594	2.5	.030350
80	.0014576	3.0	.051480
100	.0020341	4.0	.071840
125	.0031784	5.0	.11224
150	.0045769	6.0	.161631
200	.0081367	8.0	.287645

Table 3-1. Volume Table

Menu Displays

The Model 2109 Correlator is a menu driven machine that allows you to access all setup, test, and calibration parameters. Main Menu screens 1 through 7 can be accessed at any time by pressing the MENU control key until the desired menu screen is displayed. (See Main Menus for detailed descriptions of these menus.)

Pressing the RUN, TOTAL, and PRINT control keys activate other operator menus.

If the system is password protected, the appropriate password must be entered prior to making changes or performing routine calibration. Menus may be viewed without entering a password, but no entries are allowed unless the password is entered.

Optional menu scrolls are accessible only if the option has been installed.

Normal Power On

When the Model 2109 is powered on after initial programming, the Run Menu is displayed unless the hardware configuration has been changed.

00000000 Tons
00000 Tph
PROD

If the hardware configuration detected at power on differs from the one recorded in memory, the following screen is displayed. (This only happens if a circuit board has been added or removed since power off, or if a board has failed.)

SLOT # n CHANGED
Acquire new
configuration?
YES NO

The screen disappears after ten seconds if the question is not answered. The Model 2109 assumes the answer is NO. The HW CONFIG. CHANGED alarm will be on and cannot be reset. The above screen appears each time power is cycled.

If a board has been removed or added and this is a permanent change in configuration, answer YES.

- A board is removed and is not replaced:
The Model 2109 cancels from memory the setup data of the board that is removed. If the board is added again, the setup data for the board has to be entered again.
- A board is added:
The Model 2109 acquires the new hardware configuration. Setup data for the new board must be entered.



NOTE. Check the setup configuration in the I/O Definition scrolls if an I/O board is removed or added. I/O assignments change when the number of I/O boards changes. Refer to Defining I/O.

Run Menu

When the Model 2109 is powered on after initial programming, the RUN MENU is displayed. Pressing the RUN control key on the front panel at any time can access the Run Menu.

The RUN MENU is made up of several screens that can be scrolled using the up or down SCROLL keys.

Main Run Menu

XX000000000 Tons
Z 0000.00 Tph
PROD

The first line displays the product number followed by the Master Total, which is the number of tons totalized by the Model 2109 since installation.

The third line is blank by default, but can be programmed to show concentration, velocity, or the product name, or the date and time (if the optional COMM board is installed). The selection is made in the Display Menu.

The fourth line displays the soft keys. "XX" in the first line of the menu is the product number. When the PROD key is pressed, the following screen appears if the selection of the product is executed from the remote:

```
In Remote Product
Selection Mode:

                RETURN
```

If product selection isn't executed from the remote, the following screen is displayed:

```
In Remote Product
Selection Mode:

                RETURN
```

If product selection is not executed from the remote, the following screen is displayed:

```
Change the product
Number?

YES          NO
```

If YES is pressed, the following screen appears:

```
Product Name
No Name

ENTER      NEXT      NAME
```

You can enter a different product number (1-99) either by typing in the product number and pressing ENTER, or by using the NEXT key to scroll to the next product.

You can enter a product name by pressing the NAME soft key. The following screen appears:

```
Prod. Number 1
No Name
<ENTER>
```

Type in the product name by pressing the appropriate alphanumeric keys. For example, to type a "C", press the "1" key four times. Use the soft keys under < and > if you need to move the cursor to the proper location in the product name.

After entering the product name, press the ENTER key. Then, press RUN to return to the RUN MENU.

Reset Total Menu

The RESET TOTAL menu is similar to the main RUN menu except that a Reset Total has replaced the Master Total. Press the down SCROLL key for access to the RESET TOTAL menu.

```
RESET000000000 Tons
0000.00 Tph
RESET
```

When the RESET soft key is pressed, the following screen is displayed:

```
Do you wish to clear
RESET total?
YES      NO
```

Press YES to clear the total. Press NO to skip clearing.

Alarm Pending

The message ALARM appears in the Run Menu above the right soft key if an alarm is pending. The ALARM LED indicator is also flashing.

The following menu is displayed after pressing the ALARM soft key.

```
ALARM NEW
XXXXXXXXXXXXXXXXXXXX
NN-DD-YYHH:MM
RESET  NEXT
```

The keyword NEW indicates an alarm that has not yet been acknowledged. When you press the RESET key to clear the alarm, the alarm disappears only if the reason that caused the alarm to occur does not exist anymore. If the alarm is still pending, the keyword ACK is displayed instead of NEW.

The third line shows the date and time only if the optional COMM board is installed.

The NEXT key is used to scroll among the pending alarms. The string xxxxxxxxxxxxxxxxx stands for one of the following alarm conditions:

Alarm	Meaning/Action
CLOCK FAIL	The system has detected a failure on the clock calendar circuit. This alarm can only occur if the optional COMM board is installed. Check the COMM Board to see if it is properly inserted. Replace the COMM board
BAD CONCENTRATION	The system has detected an error on the PFM signal. Check the sensor or PFM connections.
BAD CORRELATION	The system has detected a persistent error on the correlation. Check the correlator connections. Check the correlator parameters.
RAM FAIL	The system has detected an error on the RAM (Random Access Memory) checksum during the internal periodic test. The RAM is used to store variables and set up data. Replace the CPU board.
ROM FAIL	The system has detected an error on the ROM (Read Only Memory) checksum during the internal periodic test. The ROM is used to store the program. Replace the CPU board.
HIGH RATE	The rate has been detected to be higher than the minimum rate entered in the ALARM SETUP MENU.
LOW RATE	The rate has been detected to be lower than the minimum rate entered in the ALARM SETUP MENU.
HIGH CONC	The concentration has been detected to be higher than the maximum rate entered

Alarm	Meaning/Action
	in the ALARM SET UP MENU.
LOW CONC.	The concentration has been detected to be lower than the maximum rate entered in the ALARM SET UP MENU.
HIGH VELOCITY	The velocity has been detected to be higher than the maximum rate entered in the ALARM SETUP MENU.
LOW VELOCITY	The velocity has been detected to be lower than the maximum rate entered in the ALARM SETUP MENU.
WARM START	The system has detected a power loss condition, or power was removed for an undefined period.
COLD START	The system has detected the loss of the setup data after power was removed. The instrument needs to be setup and calibrated. Replace either the motherboard or the battery.
P.D. CALIBRAT	The system was powered off while a calibration sequence was in progress. This means the scale may not be properly calibrated. Check calibration.
CALIB TIME	If a calibration check time period was entered and the time expired this alarm will occur. The purpose is to remind the operator the calibration has not been checked for a long time. Check calibration.
EXT ALARM 1	Digital inputs can be programmed to detect external alarm conditions such as emergency switches, max level switches, or other. This alarm is associated with external alarm #1. Check external alarm #1.
EXT. ALARM 2	Check external alarm #2.
EXT ALARM 3	Check external alarm #3.

Alarm	Meaning/Action
OVERFLOW TOT	This message indicates the output pulse generator for the remote mechanical totalizer has reached an overflow condition. The rate may be too high or the pulse divider has been set to small. Check the rate. Check and eventually increase the pulse divider.
Alarm	Meaning/Action
BATCH DEVIAT	This alarm is only visible if the optional load out board is installed. A batch was run and the error detected at the end of the batch was higher than specified. Check the parameters of the load out. Adjust the Preset value.
COM ERROR	This message is only displayed if the optional COMM board is installed, and indicates that a time out or handshake error was detected during a data transfer on the COM line. Check the COMM line connections. Check the COMM line setup data.
BCD ERROR	This message is only displayed if optional BCD output board is installed. If the variable to be converted in BCD format has more than four digits, the alarm is generated. Check the size of variables and BCD data setup.
MATH ERROR	A divide by zero or overflow error was encountered during internal calculations. This message indicates some abnormal dimensional parameter has been entered in setup. Check setup data.
PRINTER ERROR	This message is displayed if the system has data to print and the printer is disconnected or paper is empty.
HW CONF CHANGED	When a new board is installed or a board that was installed is removed, this message displays. Refer to Normal Power On .

Table 3-2. Alarm Pending Table

Total Key

The TOTAL key on the right side of the front panel access menus that contain detailed information for the three available totalizers: Master, Operator, and Reset.

Master Total cannot be reset; Reset Total can be reset when needed without using a password; Operator Total can be reset when needed, but a password is required.



NOTE. The Operator and Reset totals are stored according to product number.

Press the TOTAL key for access and scroll up or down to find the RESET TOTAL screen. Pressing RUN returns to the RUN menu.

```
RESET TOTAL #1
Since 00-00-0000
00000000 Tons
RESET
```

The first line on the screen shows the totalizer type followed by the product number.

The second line is displayed only if the optional COMM board is installed. It indicates the last date when the Reset Total was cleared.

The RESET soft key allows you to clear the Reset Total. No password is required for this action.

When you press the RESET key, the following screen is displayed.

```
Do you wish to clear
XXXXXX total?

YES      NO
```

XXXXXX can be RESET or OPERATOR. Press YES to clear the total. Press NO to skip clearing.

The Master Total screen is very similar to the Reset Total screen; only the Master Total is displayed instead of the Reset Total. The RESET soft key is not displayed here since the Master Total cannot be cleared.

```
MASTER TOTAL #1
SINCE 00-00-000
00000000 Tons
```

A load out total can also be displayed if the optional load out board is installed.

Print Key

If the optional COMM board is installed, the PRINT control key on the front panel causes the printer to print data.

The following screen is displayed when you press the print key.

```
          - PRINTER SCROLL -  
Com #1 no data  
Start print TOTALS  
PRINT
```

The second line on the screen gives the status of the printer:

- No data - Indicates the printer is idle; no data is being sent to the printer.
- Is running - The system is sending data to the printer.

The third line indicates what kind of data is to be printed. Use the up and down SCROLL keys select among:

- TOTALS - Print totals.
- BATCH - If the load out option is active, print load out information.
- SETUP - Print the setup data of the Model 2109.
- TRAILS - If the audit trails option is active, print audit trails data.

Printing starts after the PRINT soft key is pressed.

The COM soft key allows you to select a specific printer if more than one is installed.

Main Menus

Main Menu screens 1 through 7 can be accessed at any time by pressing the MENU control key on the front panel until the desired menu screen is displayed. Menu scrolls may be selected by pressing the soft key directly below the desired scroll, then using the up or down SCROLL key.

The MENU key activates the following screens.

```
          - MAIN MENU 1 -  
Press MENU for more  
ZERO      SPAN      PROD  
CAL       CAL       SETUP
```

- MAIN MENU 2 -
Press MENU for more
SCALE CALIB
DISPLAY DATA DATA

- MAIN MENU 3 -
Press MENU for more
PROT DIAG TEST

- MAIN MENU 4 -
Press MENU for more
I/O ALARMS LOAD
DEFINE DEFINE OUT

- MAIN MENU 5 -
Press MENU for more
COMM A COMM B PRINT

- MAIN MENU 6 -
Press MENU for more
AUDIT
TRAIL LINEAR

- MAIN MENU 7 -
Press MENU for more
CORRE-
LATOR

Main Menu 1

MAIN MENU 1 contains the calibration menus and the product setup mode menu. Main Menu 1 is selected by pressing the MENU control key on the front panel until it appears. Calibration scrolls are selected by pressing the soft keys directly below the name of the desired scroll.

```
          - MAIN MENU 1 -  
Press MENU for more  
ZERO      SPAN      PROD  
CAL       CAL       SETUP
```

Zero Calibration

The following screen appears when you press the ZERO CAL soft key on MAIN MENU 1 (Password: Operator).

```
          - ZERO CAL -  
Stop material flow  
Then press START  
START     EXIT     MANUAL
```

Pressing the EXIT soft key returns you to Main Menu 1. Pressing MANUAL advances to manual zero, described below. Pressing the start key begins auto zero.

Auto Zero

The following screen is displayed when you press the start soft key.



NOTE. During Auto Zero, resolution of the total is 10 times higher than normal.

The word COMPLETED is flashing. Pressing ADV changes the display from Error % to Total (accumulated weight). The percentage of error is related to full-scale capacity.

Pressing NO returns the screen to Main Menu 1 without changing the zero number.

When you press YES, the zero number is changed and the next screen appears.

```
          - ZERO # CHANGED -  
New zero # 00000  
Old zero # 00000  
RUN      MENU      ADV
```

Pressing ADV changes the display on the third line from Old zero, to Rate, to Total, to Error %. Press MENU to repeat the auto zero calibration. Press RUN to return to the Run Menu.

Manual Zero

The manual zero procedure shows the zero constant and allows you to make a direct change to it using the alphanumeric keys. Use the ENTER key to confirm the new number. (Password: Operator).

```
          - MANUAL ZERO -  
Rate 000.0 Tph  
Zero # 00000  
ENTER      EXIT      RUN
```

Default: 40,000
Min: 0
Max: 120,000

To run the manual zero procedure, press RUN. Pressing the EXIT key returns the screen to Main Menu 1.

Span Calibration

The span calibration must be done using the actual material in a "material test." This test is done by running material through the flow meter for at least five minutes. Generally, the longer the test, the more accurate the results will be.

All of the material in the material test should be pre-weighed or post-weighed on a high accuracy static scale to obtain the actual weight of the test material (the reference weight). Reference weight is then entered to complete the test.

Access the span calibration function by pressing SPAN CAL on MAIN MENU 1.



NOTE. Span calibration should be done at maximum expected flow rate.

```
SPAN CALIBRATION  
Stop material flow  
then press START  
START      MENU      MANUAL
```

Pressing the MENU soft key returns you to MAIN MENU 1. Pressing MANUAL advances to manual span, described below. Pressing the START key begins auto span calibration.

After START is pressed, there is no further totalization.

Auto Span Calibration

The following screen displays when you press the START soft key.

Press START soft key
then run material

START

Press START to go to the next scroll and follow the test procedure.

00000.0 Tons
0000.0 Tph
Press done to end
DONE ABORT



NOTE. During the Auto Span Calibration, the resolution of total is 10 times higher than normal.

Wait until all material has passed through the flow meter, then press DONE. Pressing ABORT returns to the SPAN CALIBRATION screen.

At the end of the test, the following screen is displayed asking if the weight of the material is already known.

00000.0 Tons
Ref. weight known?

YES NO

If you select NO, the system is notified that the reference weight of the material is not known.

When you press NO, the system moves to the Run display where MAT'L is flashing to remind you that the material test is incomplete. The following screen is displayed.

#1000.0 Tons
000 Tph

MAT'L PROD

Press the MAT'L soft key when the reference weight is known.

If you answered YES to "Ref. weight known?" or if the MAT'L key has been pressed after answering NO, the following screen appears.

```
00000.0 Tons
Enter reference
weight: 00.0 Tons
ENTER      ABORT
```

Using the numeric keys, enter the reference (actual) weight of the material passed during the test and confirm by pressing the ENTER key. If you press ABORT, the information acquired during the test is lost and the system goes back to the material calibration menu.

After the reference weight is entered, the following screen is displayed.

```
SPAN CAL COMPLETE
Error ± 000.00%
Change span?
YES      NO      ADV
```

The word COMPLETE is flashing. At this point, the span constant has been updated and the test is finished. Pressing ADV changes the display from Error %, to Total, to PFM average. Pressing YES or NO displays the following screen (the first line will say SPAN UNCHANGED if NO is pressed).

```
SPAN # CHANGED
New zero # 00000
Old zero # 00000
RUN      MENU
```

Press MENU to display a screen asking if the reference weight from the test is to be added to the totals. Press RUN to return to the RUN menu.

```
SPAN CALIBRATION
Add reference
weight to totals?
YES      NO
```

If you press YES, the amount of material used for the test is added to the master, reset, and operator's totals. If you press NO, the information is lost.



NOTE. The moisture compensation option is inhibited during material calibration. This is done to make the check of the totalized quantity easier. The static scale provides the weight of the material, including moisture. The weight of the water is removed immediately before adding to total at the end of the procedure so the master, reset, and operator's totals remain correct.

Manual Span Calibration

If the span constant is known, (refer to Manual Span Calibration to determine the constant) this procedure allows you to make a direct change to span using the numeric keys. Use the enter key to confirm the new number. (Password: Operator.)

```
          - MANUAL SPAN -  
Rate 000.0 Tph  
Span # 0000000  
ENTER      EXIT      RUN
```

Default: 20,000
Min: 500
Max: 1,500,000

To run the manual span procedure, press RUN. Pressing the EXIT key returns the screen to MAIN MENU 1.

Product Setup

Product setup consists of one screen for local or remote product selection. Access product setup by pressing the PROD SETUP soft key on MAIN MENU 1. In local mode, product selection can be entered through the keypad. In remote mode, up to ten products can be selected. (Password: Operator.)

Physical digital input assignments for each product are made in the I/O DEFINE scroll after remote has been enabled. There are three general-purpose digital inputs available on the motherboard. Additional digital inputs are available by adding an optional DIO board.

```
Enter product  
Selection mode:  
  
EXIT      LOCAL
```

Pressing the EXIT key returns the screen to MAIN MENU 1. Pressing the center soft key toggles between LOCAL and REMOTE.

Main Menu 2

MAIN MENU 2 contains display message options, scale data selections relating to the physical characteristics of the carriage, and choices of parameters for the calibration of the scale system. MAIN MENU 2 can be selected by pressing the MENU control key on the front panel until MAIN MENU 2 displays.

```
- MAIN MENU 2 -  
Press MENU for mor  
SCALE      CALIB  
DISPLAY    DATA    DATA
```

You perform operations on the scrolls available from Main Menu 2 in a similar manner. The basic procedure is as follows:

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
Or
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.

```
START UP SCROLL  
Use SCROLL keys to view  
selections
```

Selecting Weight Units

Measure units can be individually selected. You need to decide whether to use English units, metric units, or a combination of both. Select the measure units to be used on the DISPLAY SCROLL 1 screen. (Password: Service.)

```
- DISPLAY SCROLL 1 -  
Measure Units  
>English<  
CHOICE    ENTER
```

Default: English
Selections: English, Mixed, Metric

If English is selected, all units are in English. If metric is selected, all units are in metric. If mixed is selected, units may be a combination of English and metric.

Selecting Totalization Units

Select the units to be used for totalization on the DISPLAY SCROLL 2 screen. (Password: Service.)

```
          - DISPLAY SCROLL 2 -  
Totalization Units  
>Tons<  
CHOICE   ENTER
```

If English: Default: Tons
Selections: Tons, LTons, Pounds

If Metric: Default: tonnes
Selections: tonnes, kg

If Mixed: Default: Tons
Selections: Tons, LTons, Pounds, tonnes, kg

Selecting Rate Units

Select the units to be used for the rate display on the DISPLAY SCROLL 3 screen. (Password: Operator.)

```
          - DISPLAY SCROLL 3 -  
Rate Units  
>Tph<  
CHOICE   ENTER
```

If English: Default: Tph
Selections: Tph, LTph, Lb/h, Percent %, Lb/m, T/m, LT/m

If Metric: Default: kg/h
Selections: t/h, kg/h, kg/m, t/m, Percent %

If Mixed: Default: Tph
Selections: Tph, LTph, Lb/h, Percent %, t/h, kg/h,kg/m, t/m, Lb/m, T/m, LT/m

Selecting Concentration Units

Select the units to be used for the concentration display on the DISPLAY SCROLL 4 screen. (Password: Operator.)

```
                - DISPLAY SCROLL 4 -  
Weight Units  
>Pounds<  
CHOICE   ENTER
```

If English: Default: Pounds
If Metric: Default: kg
If Mixed: Default: kg
Selections: Pounds, kg

Selecting Length Units

Select the units to be used for the speed and length display on the DISPLAY SCROLL 5 screen. (Password: Operator.)

```
                - DISPLAY SCROLL 5 -  
Length Units  
>Feet<  
CHOICE   ENTER
```

If English: Default: Feet
If Metric: Default: meters
If Mixed: Default: meters
Selections: Feet, meters

Selecting the Language

The Model 2109 is a dual-language instrument. English (USA) is always the first language; the second can be chosen from the list on the DISPLAY SCROLL 6 screen. (Password: Operator.)

```
                - DISPLAY SCROLL 6 -  
Language  
>USA<  
CHOICE   ENTER
```

Default: USA
Selections: USA, ITALIAN

Setting Time and Date Format

These screens apply only if the optional COMM board is installed.

Define the format for displaying and printing the time and date on DISPLAY SCROLLS 7 and 8. The defaults on these screens depend on the language selected. (Password: Service.)

```
                - DISPLAY SCROLL 7 -  
Time  
>am/pm<  
CHOICE      ENTER
```

If USA or English: Default: am/pm
If other language: Default: 24 h
Selections: am/pm, 24 h

```
                - DISPLAY SCROLL 8 -  
Date  
>MM-DD-YY<  
CHOICE      ENTER
```

If USA: Default: MM-DD-YY
If other language: Default: DD-MM-YY
Selections: DD-MM-YY, MM-DD-YY,YY-MM-DD

Setting Line 3 of the Run Menu

The RUN menu can be configured to display the date and time (if COMM board is installed), product, process variable, or nothing on line 3. Set the display for line 3 of the RUN menu on the DISPLAY SCROLL 9 screen. (Password: Operator.)

```
                - DISPLAY SCROLL 9 -  
Run display line 3  
>No display<  
CHOICE      ENTER
```

Default: No Display
Selections: No Display, Product, Date/Time
 (if COMM board is installed), Concent. Velocity

Setting Damping Factors for the Display

When process variables are displayed on the screen, they can be damped by a programmable factor to filter out variations that can be introduced by mechanical vibrations. To tune a damping filter, enter the number of seconds corresponding to the desired time constant.

For example, if 10 seconds is entered, the process variable will reach stability after a step change in 10 seconds. These damping factors only affect the display, not the

current output variable.

Enter the damping time for the rate display on the DISPLAY SCROLL 10 screen. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Operator.)

```
- DISPLAY SCROLL 10 -  
Damping Display RATE  
Damping = 0 sec  
ENTER
```

Default: 10 seconds
Min: 0 seconds
Max: 400 seconds

Enter the damping time for the concentration display on the DISPLAY SCROLL 11 screen. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Operator.)

```
- DISPLAY SCROLL 11 -  
Damping Display CONC, VEL  
Damping = 0 sec  
ENTER
```

Default: 10 seconds
Min: 0 seconds
Max: 400 seconds

Scale Data

Scale data defines specific parameters of the scale such as its mechanical dimensions, sensor size, and others. (Refer to Section on Determining Installation Parameters for the values.) Access these menus by pressing the SCALE DATA soft key on Main Menu 2.

Defining Scale Capacity and Scale Divisions

Scale capacity is the maximum rate (maximum mass flow) at which the scale is allowed to work. This entry also defines the default number of decimal places that are used for displaying rate.

Define the scale capacity on the SC DATA SCROLL 1 screen. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Service).

```
- SC DATA SCROLL 1 -  
Max scale capacity  
10.0 T/h  
ENTER
```

Default: 10.0
Min: 1
Max: 200,000

When you enter the scale capacity, the number of decimal places is also defined. If, for example, you enter 500.0, it sets the "Scale Division" parameter to 0.1. Advancing to the next scroll displays the scale division corresponding to the just entered scale capacity (SC DATA SCROLL 1). You can change the scale division to any of the available options.



NOTE. Changing the scale division does not affect the value of any other constant or number already entered.

Select the number of decimal places to be used for the rate display on the SC DATA SCROLL 2 screen. (Password: Service.)

```
- SC DATA SCROLL 2 -  
Scale division  
>0.1<  
CHOICE   ENTER
```

Default: 0.1
Selections: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 0.01, 0.02, 0.05, 0.001, 0.002, 0.005

Defining Concentration Parameters

Enter the maximum concentration on the SC DATA SCROLL 3 screen. Use the numeric keys to enter the number. Press enter to confirm. (Password: Service.)

```
- SC DATA SCROLL 3 -  
Max concentration  
100.0 lbs/ft3  
ENTER
```

If English or Mixed: Default: 100.0 lb/ft³
Min: 0.1 lb/ft³
Max: 200 lb/ft³

If Metric: Default: 1600.0 kg/m³
Min: 0.1 kg/m³
Max: 3200 kg/m³

Enter the concentration sensor diameter on the SC DATA SCROLL 4 screen. Press enter to confirm. Use the numeric keys to enter the number. (Password: Service.)

- SC DATA SCROLL 4 -
Concent. sensor
Diameter 1.0 in
ENTER

If English	Default:	1.0 in
or Mixed:	Min:	0.5 in
	Max:	8.0 in

If Metric:	Default:	25.0 mm
	Min:	1.0 mm
	Max:	200 mm

Defining Velocity Parameters

Enter the maximum and minimum velocity on SC DATA SCROLLS 5 and 6 respectively. Use the numeric keys to enter the numbers. Press enter to confirm. (Password: Service.)

- SC DATA SCROLL 5 -
Max velocity
4000 fpm
ENTER

If English	Default:	4000.0 ft/min
or Mixed:	Min:	2.0 ft/min
	Max:	10,000.0 ft/min

If Metric:	Default:	20.0 m/s
	Min:	0.01 m/s
	Max:	50.0 m/s

- SC DATA SCROLL 6 -
Min velocity
40 fpm
ENTER

If English or Mixed: Default: 40.0 ft/min
Min: 2.0 ft/min
Max: 10,000.0 ft/min

If Metric: Default: 20.0 m/s
Min: 0.01 m/s
Max: 50.0 m/s

Leave distance of 0.315 in (8mm) on SC DATA SCROLLS 7 unchanged.



NOTE. This parameter is crucial to correct velocity calculation.

- SC DATA SCROLL 7 -
Velocity sensor
Spacing .315 in
ENTER

If English or Mixed: Default: 0.315 in
Min: 0.1 in
Max: 40.0 in

If Metric: Default: 8.0 mm
Min: 1.0 mm
Max: 80.0 mm

Setting the Dead Band

The dead band is a percentage of the scale rate capacity in which the rate (if any) is ignored and a zero rate is forced. In addition, totalization is frozen when the rate is below the dead band.

Enter the dead band range on the SC DATA SCROLL 8 screen. Use the numeric keys to enter the number. Press enter to confirm. (Password: Service.)

- SC DATA SCROLL 8 -
Dead Band Rate
0%
ENTER

Default: 0.1%
Min: 0%
Max: 10%

Setting the Dead Band Concentration

The dead band is a percentage of the scale concentration capacity in which the concentration (if any) is ignored and a zero concentration is forced. In addition, totalization is frozen when the concentration is below the dead band.

Enter the dead band range on the SC DATA SCROLL 9 screen. Use the numeric keys to enter the number. Press enter to confirm. (Password: Service.)

```
- SC DATA SCROLL 9 -  
Dead Band Concentration  
0%  
ENTER
```

Default: 0.1%
Min: 0%
Max: 10%

Calibration Data

Calibration data allows you to enter or set parameters relating to the calibration of the Model 2109. Access these menus by pressing the CALIBRATION DATA soft key on MAIN MENU 2.

Enter a Calibration Interval

If an optional COMM board is installed, the system can be programmed to prompt you when the next calibration is due. If you do not want this option, confirm the default 0 days interval; otherwise enter the number of days.

The calibration date displayed in CAL DATA SCROLL 2 is automatically updated whenever a calibration is performed. If a non-zero value is entered, an alarm appears after the time is elapsed. The alarm can only be cleared after a calibration check is executed.

Enter the calibration interval on the CAL DATA SCROLL 1 screen. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Operator.)

```
- CAL DATA SCROLL 1 -  
Calibration Interval  
0 Days  
ENTER
```

Default: 0 days
Min: 0 days
Max: 365 days

This scroll displays the date of the last calibration and the expected date of the next

one, based on the entry in the previous screen.

- CAL DATA SCROLL 2 -
Calibration date
Last: MM-DD-YY
Next: MM-DD-YY

Main Menu 3

Main Menu 3 allows you to protect and “unprotected” the system using passwords, and to perform diagnostic and test functions. The diagnostic functions can be only operated after removing all password protection, and should be only used by experienced Thermo Scientific personnel. The test functions are allowed to normal users.

Main Menu 3 can be reached by pressing the MENU control key on the front panel until Main Menu 3 appears.

- MAIN MENU 3 -
Press MENU for more

PROT DIAG TEST

Changing the Protection Level

The Model 2109 has three protection levels with specific related passwords.

The protection levels and passwords are defined as follows in Table 3-3.

PROTECTION	PASSWORD	STATUS
None	Service	The system is completely unprotected; all data can be read or changed.
Limited	Operator	Operator functions and data re protected. All setup and calibration data are protected except zero calibrate.
Protected		The system is totally protected; process data can be read, but no changes are allowed.

Table 3-3. Passwords

A Service password is required to access the None level of protection. An Operator or

a Service password is required to access the Limited level of protection. (A Service password supersedes an Operator password.)

Define the protection level on the screen below.

```
- PROTECTION LEVEL -  
>NONE<  
NONE      LTD      PROT
```

Default:	None	
Selections:	None, Limited, Protected	
Password:	from NONE to LTD or PROT:	not required
	from LTD to prot	not required
	from ltd to none:	Service
	from prot to none:	Service
	from prot to ltd:	Operator or Service

On-Line Procedure for Changing Protection Level

The protection level can be temporarily changed by entering a password “on the fly” during normal operation. When you try to enter a variable or select a function that is password protected, and the password is installed, the following screen is displayed.

```
- SYSTEM PROTECTED -  
PLEASE ENTER  
PASSWORD _____  
ENTER
```

You can enter either the Operator or the Service password. However, if you enter the Operator password and the variable or function requires the Service password instead, access is denied and the following screen is displayed.

```
- SYSTEM PROTECTED -  
PLEASE ENTER SERVICE  
PASSWORD _____  
ENTER
```

If you do not enter the correct password, the following screen appears.

```

- SYSTEM PROTECTED -
INVALID PASSWORD
ACCESS DENIED
RETURN

```

Pressing RETURN returns the system to the previous function. If you enter the correct password, the previous screen appears and access is allowed.

When the protection level is changed using the on line procedure, the system automatically returns to protected status if no keyboard entries are made within 60 seconds.

Diagnostics

Access these functions by pressing the DIAG soft key on MAIN MENU 3. Use the SCROLL control keys to view the menu selections.

Concentration Diagnostics

DIAGNOST. SCROLL 1 shows the raw data from the concentration sensor and the net value after the zero constant has been subtracted.

```

- DIAGNOST SCROLL 1 -
PFM GROSS: 00000
PFM NET: 0000

```

Correlator Diagnostics

DIAGNOST. SCROLL 2 shows the data obtained from the correlator board at the end of each correlation. Each time you press the NEXT soft key, the type of data displayed changes. Correlation data includes:

```

- DIAGNOST SCROLL 2 -
PFM GROSS: 00000
PFM NET: 0000

```

- Delay – The computed time in milliseconds for material to move from the first sensor to the second sensor in the DK13. This value is computed from the correlation of the signals from the two sensors. (Velocity is computed from this value and the distance between the sensors.)

$$\frac{60 \text{ sec} \times 1000 \text{ m s}}{\text{Delay Reading in M sec} \times .315 \text{ In Spacing} / 12 \text{ in}} = \text{Delay}$$

Example: 1.199 ms delay = 1313 FPM velocity.

Typically stable, fluctuations in readings indicate changing flow rate.

- Size – The amount of data used for the correlation. This should be the same as the entry in Menu 7, Length.
- Time – The time required to compute the correlation between the signals. This indicates the update rate for the velocity. This changes with Menu 7, correlation length, sampling frequency, and correlation averaging.
- Level – The signal level of the signals from the DK13 in volts. The correlation calculation is not sensitive to the size of the signal, but if the signal level is very low, it could indicate that something is wrong with the DK13 or the wiring. No flow = 0.2 volts (noise); Running 1 volt. Set Menu 7 correlator signal threshold above noise.
- Zeros – The number of times the signal crosses zero volts in the sample being used for computation. This gives an indication of the amount of “structure” in the signal. Higher is better unless it is just noise. At no flow, noise oscillates across the zero giving lots of counts. While running crossover may be less.
- Readings – A running count of the number of correlations computed. Observing this value gives an indication that the correlation software is working.
- Warnings – The number of times the software could not compute the correlation. If more than a couple, this indicates some kind of abnormal condition. Look at Peak to see % quality of correlations.
- Peak – The value of the highest peak found in the correlation. The time of the peak is indicated in the DELAY diagnostic. This number indicates the quality of the correlation. 80% is great, 40% is bad. Low readings mean an incorrect setup or bad sensor. No flow typically 0-10% running >50%. Affected by material speed, flow rate, Correlator Menu 7.

Changing Passwords

The Service password can be defined or changed by entering a new one on the DIAGNOST. SCROLL 3 screen. You can enter up to eight characters using the alphanumeric keys. Press the enter key to confirm. The entered numbers are not echoed on the screen. To remove a password, just press the ENTER key. (Password: Service.)



NOTE. It is strongly recommended you write down the password(s) and keep a copy in a safe place.

```

- DIAGNOST SCROLL 3 -
ENTER SERVICE
PASSWORD *****
  
```

Default: No password

After the password has been entered, the system asks for confirmation. This prevents losing access control due to a typing mistake while entering passwords.

```
- DIAGNOST SCROLL 3 -  
ENTER SERVICE  
PASSWORD *****  
ENTER
```

If the password entered the second time matches the first, the following message confirms the entry.

```
- DIAGNOST SCROLL 3 -  
NEW PASSWORD  
ACQUIRED  
RETURN
```

If the two passwords do not match, the system does not accept the new password.

```
- DIAGNOST SCROLL 3 -  
INVALID PASSWORD  
  
RETURN
```

The Operator (limited protection) password can be changed by entering a new one on the DIAGNOST. SCROLL 4 screen. You can enter up to eight characters using the numeric keys. Press the enter key to confirm. The entered numbers are not echoed on the screen. To remove a password, just press the ENTER key. (Password: Operator.)

```
- DIAGNOST SCROLL 4 -  
ENTER OPERATOR  
PASSWORD *****  
MENU ENTER
```

Default: No password

The Operator password checking and confirmation is the same as that for the Service password.

Displaying the Software Version

The software version is displayed for reference only.

- DIAGNOST SCROLL 5 -
Software version:
51.00.00.00

Setting Up Date and Time (Optional)

This function applies only if a COMM board is installed.

You can set the current date and time on the DAIGNOST. SCROLL 6 and 7 screens. A battery operated clock calendar then maintains time and date even if power is removed. Use the numeric keys to enter the numbers. Press ENTER to confirm. Day, Month, and Year are entered in sequence. (Password: Service.)

- DIAGNOST SCROLL 6 -
Date: DD-MM-YYYY
Day: DD
ENTER

Time is entered in a similar way. The AM/PM key is used when time is in USA or English mode.

- DIAGNOST SCROLL 7 -
Time: HH:MM
Hours: HH
ENTER AM/PM

Checking Hardware Configuration

The system automatically recognizes when optional boards are installed. The following scrolls are used to show the configuration.

Remember that when a board is acknowledged, the related information stays in memory even if the board is removed, until the operator deletes it by responding YES to the message shown at power on.

The following screen (DIAGNOST. SCROLL 8-13) is displayed for each board installed in each slot (slots #1-#6).

- DIAGNOST SCROLL X -
Board type slot #X
BOARD TYPE

Correlator Board	The correlator board
PFM Board	The Pulse Frequency Modulation board for connecting to the DE10, DC13, and DE 20.
Dig I/O 16 in/4 out	Optional digital input output board #16 Optocoupled Digital Inputs #4 Optocoupled Digital Outputs
Dig I/O 16 out/4 in	Optional digital input output board #4 Optocoupled Digital Inputs #16 Optocoupled Digital Outputs
Load Out 16 in/4 in	Optional digital input output board dedicated to the load out. #16 Optocoupled Digital Inputs #4 Optocoupled Digital Inputs
Load Out 16out/4 in	Optional digital input output board dedicated to the load out. #4 Optocoupled Digital inputs #16 Optocoupled Digital Inputs
Analog I/O	Optional analog input output board #2 Current outputs #2 Voltage inputs
Current Out	Optional current output board #1 current output
Communication A	Serial communication board (RS-232, RS-485)
Communication B	Field Bus Board

Table 3-4. Board Type

Tests Access these functions by press the TEST soft key on MAIN MENU 3. Use the SCROLL control keys to view the menu selections.

Lamp Test

- TEST SCROLL 1 -

LAMP TEST

START

Press START to begin a lamp test of the Model 2109. All LEDs and digits of the display blink for a number of seconds.

Self Test of the Unit

The system can perform some internal test functions, which can be used to detect malfunctions of the hardware devices. (Password: Service.)

After START is pressed, the following screens are displayed in sequence.

- TEST SCROLL 2 -
Internal test of
microprocessor
START

- TEST SCROLL 2A -
Testing ROM
Test PASSED

- TEST SCROLL 2B -
Testing RAM
Test PASSED

- TEST SCROLL 2C -
Testing E2PROM
Test PASSED

The message Test PASSED is displayed if the test runs correctly. If something wrong is detected, the message Test FAILED is displayed, and the soft key CONTINUE is shown. You must press the key to go on to the next test.



NOTE. Test 2C requires a hardware jumper to be installed between the serial in the serial out pins of the motherboard. Since the jumper is not normally in place, a TEST FAILED message at the end of Test 2C is normally displayed.

Testing Digital Inputs

This test shows the status of each digital output and allows the operator to force the output for testing purposes. The output, when forced, stays on until the CLEAR soft key is pressed or the Run Menu is entered.

If an output is forced and the scroll key is used for reaching some other menu, the output stays in the forced status until RUN is pressed. This allows you to check inputs while outputs are still in the forced status.

```
- TEST SCROLL 3 -  
Dig input test  
Slot #0: ----0000
```

Slots are numbered 1 to 6; slot 0 is the motherboard. Inputs are shown from right to left. If a board has 16 inputs, two screens are used to show the first and the second half; the lower half is shown first.

Testing Digital Outputs

This test shows the status of each digital output and allows the operator to force the output for testing purposes. The output, when forced, stays on until the CLEAR soft key is pressed or the Run Menu is entered.

If an output is forced and the scroll key is used for reaching some other menu, the output stays in the forced status until RUN is pressed. This allows you to check inputs while outputs are still in the forced status.

```
- TEST SCROLL 4 -  
Dig output test  
Output #1: ON  
ENTER      ON/OFF
```

To force an output, use the numeric keys to enter the desired number.

Confirm by pressing ENTER. Then use the ON/OFF key to force it to the ON or OFF status. After the output has been forced, the CLEAR soft key appears in the middle position.

(Password: Service)

Slots are numbered 1 to 6; slot 0 is the motherboard.



NOTE. Forcing the digital outputs may cause machinery to start. After you try to force an output, the following message screen is displayed.

```
WARNING  
EQUIPMENT MAY START  
  
CONTINUE  ABORT
```

If you press the CONTINUE soft key, be aware that the action may cause damage or injury. If you press ABORT, the system will return to the previous scroll.

Testing Current Outputs

This function applies only if a current output board is detected. The board can have one or two current output channels. To force the output, use the numeric keys to enter the desired number of mill amperes. Press ENTER to confirm. Press CLEAR to free the mA channel. (Password: Service.)

```
- TEST SCROLL 5 -  
Current output #1  
Should be 00.0 mA  
ENTER    CLEAR
```

Default: 0.0 mA
Min: 0.0 mA
Max: 20.0 mA

If the board has two channels, the following screen is shown.

```
- TEST SCROLL 6 -  
Current output #2  
Should be 00.0 mA  
ENTER    CLEAR
```

Testing Current Inputs

The following screen is displayed only if an analog input board is detected. It shows the status of each analog input channel.

```
- TEST SCROLL 7 -  
Voltage input  
#100.0 V  
#200.0 V
```

Testing Communication A

If a communication board is detected, the following screen is shown. (The PORT2 soft key is shown only if two boards are detected.) Press PORT1 or PORT2 to initiate the test. (Password: Service.)

```
- TEST SCROLL 8 -  
Test communication A  
  
PORT1    PORT2
```

A test pattern is sent out on the TX output and read on the RX input. If the test fails, the message Test Failed is shown; otherwise, the message TEST PASSED is displayed.



NOTE. This test requires a hardware jumper to be installed between terminals TB5-8 (RX) and TB5-9 (TX) on the communication board.

```
- TEST SCROLL 9 -  
Test communication B  
  
START
```

Testing Communication B

This test is similar to the previous one, but is used for the field bus version of the communication board. Press START to run the test (Password: Service)

```
- TEST SCROLL 9 -  
Test communication B  
  
START
```

Testing the BCD Input Board

If an optional load out board is detected, the following screen appears. The test is similar to the digital input test. (Password: Service.)

```
- TEST SCROLL 10 -  
BCD Input test  
  
0000
```

Testing the BCD Output Board

The following test can be run if an optional load out board is detected. To force the output, use the numeric keys to enter the number. Press ENTER to confirm. The CLEAR soft key appears indicating that the output is being forced to a value. Press CLEAR to free the output. (Password: Service.)

```
- TEST SCROLL 11 -  
BCD Output test  
0000  
ENTER    CLEAR
```

Default: 0
Min: 0
Max: 9999 or 7999 (if parity check is enabled)

Testing the CPU Serial Line

Press START to perform a test of the serial line of the CPU. (Password: Service.)

```
- TEST SCROLL 12 -  
Test CPU Serial Line  
  
START
```

Testing the Keyboard and Switches

This screen allows you to run a test of the Model 2109 keyboard and switches. You indicate which key you want to test by pressing it (its image will appear on the display).

```
- TEST SCROLL 13 -  
Keyboard + switches  
Key  
Switches 00000000
```

You must press the RUN control key to exit. All other keys, including the menu key, are interpreted as input.

Main Menu 4

Main Menu 4 is used to define the Model 2109 input and output (I/O), alarms, and, if the optional hardware exists, the load out (batch) controller.

Main Menu 4 can be reached by pressing the MENU control key on the front panel until Main Menu 4 appears.

```
- MAIN MENU 4 -  
Press MENU for more  
I/O          Load  
DEFINE  ALARMS  DEFINE OUT
```

Defining I/O

The I/O section of the system can be fully configured. All inputs and outputs are conventionally numbered and can be assigned to physical input and output terminals depending on specific needs.

However, the standard Model 2109 configuration as provided by the factory is normally satisfactory for most users.



WARNING. Changing the definitions of digital inputs and/or outputs may cause machinery to start. After you try to change a definition, the following message screen will be displayed.

```
WARNING
EQUIPMENT MAY START

CONTINUE  ABORT
```

If you press the CONTINUE soft key, be aware that the action may cause damage or injury. If you press ABORT, the system will return to the previous scroll.

Defining Current Outputs

If a current output board is installed, the following menus are shown. Use the CHOICE key to change the variable and the ENTER key to confirm. The NEXT key allows you to setup additional current outputs, if installed. (Password: Service)

```
          - I/O DEF SCROLL 1 -
Current Output define
#1 >Rate<
CHOICE  ENTER  NEXT
```

Default: Rate
Selections: Off, Rate

For the next three screens, the up and down SCROLL keys move between range definition, delay definition, and damping definition for a current output. The NEXT soft key moves to the next current output.

If the selection on I/O DEF SCROLL 1 is not OFF, you can set up the range, delay, and damping of the current output. The range is selectable between the standard 0–20 mA and 4–20 mA, both in direct and reverse mode.

Select 0–20 or 4–20 for an increase in current for any increase of the variable. Select 20–0 or 20–4 for a decrease in current for any increase of the variable. (Password: Service.)

```
          - I/O DEF SCROLL 1A -
Current Out range
#1 >4-20 mA<
CHOICE  ENTER  NEXT
```

Default: 4–20 mA
Selections: 0–20 mA, 4–20 mA, 20–0 mA, 20–4 mA

Each current output can be delayed. This is typically needed in blending systems, to correct transport time differences. The delay is set in seconds. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Service.)

```
- I/O DEF SCROLL 1B -  
Current Out delay  
#1 >10 sec<  
ENTER    NEXT
```

Default: 10 seconds
Min: 0 seconds
Max: 300 seconds

A damping factor can also be selected for each current channel. This damping only affects the current output, not the displayed variable, which has a separate damping factor selectable in Main Menu 2. Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Operator.)

```
- I/O DEF SCROLL 1C -  
Current Out damping  
#1 >2<  
ENTER    NEXT
```

Default: 2 seconds
Min: 0 seconds
Max: 400 seconds

Defining Analog Inputs



NOTE. The analog input hardware is factory configured for current (0-20 mA) in utilizing a shunt (W3 or W4) and 250 ohm resistor (R-21 and R-22 or R-28 and R-29) across the input. To use with a voltage input (0-5 VDC), the corresponding shunt (W3 for Input #1 or W4 for Input #2) must be cut.

If an analog board is installed, the following screens are displayed. Analog inputs can be used to compensate for the moisture of the material.

Moisture compensation is performed on the concentration and affects both rate and totals. Moisture compensation is suspended only during calibration with material so

that the totalized quantity can be directly compared to the weight obtained on a static scale. The moisture compensation is executed before adding to total. (Password: Service.)

The moisture scroll decreases rate and total by the same percentage as the number entered into the moisture scroll. To reduce the rate and total by one percent, enter one percent into the scroll.



WARNING. Because the materials dielectric constant is lower than water, a one percent moisture change affects the material's capacitance more than 1%.

```
- I/O DEF SCROLL 2 -  
Analog Input #1 def  
>Moisture<  
CHOICE   ENTER   CALIB
```

Default: Off
Selections: Off, Moisture

If an analog input has been programmed for reading the moisture signal and CALIB was pressed on I/O DEF SCROLL 2, the following screens appear.

You can calibrate the input signal by entering the equivalence between percent of moisture and mA on two points.

Press the %MOIST soft key to enter the percent of moisture; press the MA soft key to enter the corresponding number of mill amperes. Use the numeric keys to enter the numbers. Press ENTER to confirm.

```
- I/O DEF SCROLL 2A -  
Moisture input calibr  
0.0% M = 0.0 mA  
ENTER   %MOIST   mA
```

Default: 0.0% 0.0 mA
Min: 0.0% 0.0 mA
Max: 20.0% 10.0 mA

Follow the same procedure for the second point, shown below.

```

- I/O DEF SCROLL 2B -
Moisture input calibr
10.0% M = 20.0 mA
ENTER   %MOIST      mA

```

```

Default:    10.0%  20.0 mA
Min:        1.0%   5.0 mA
Max:        20.0%  20.0 mA

```

Defining Digital Inputs

Digital inputs can be programmed. The following screen shows one logical function per time, and allows you to assign it to a physical input. The NEXT soft key scrolls between the logical functions. The NC/NO soft key selects the Normally Open (NO) or Normally Closed (NC) status of the input. (Normally Open means the input is inactive when disconnected.)

To program a function, scroll with NEXT until the function is displayed, then use the numeric keys to enter the physical input number and confirm with ENTER. Press the NC/NO soft key until the desired mode is displayed. By assigning a function to 0, the function is disabled. (Password: Service.)

Logical selections should not be reassigned after the physical inputs have been terminated.

```

- I/O DEF SCROLL 4 -
Moisture input calibr
10.0% M = 20.0 mA
ENTER   %MOIST      mA

```

The following table shows the available logical selections that can be assigned to any available physical input. Default inputs can be reassigned to any physical output if desired. External alarms 1, 2 and 3 can be assigned to logical functions not on the list.



CAUTION. Logical Inputs return to the default if the Model 2109 is cold started.

Selection	Default		
External alarm 1	0	NO	0 = function disabled
External alarm 2	0	NO	
External alarm 3	0	NO	
Print	0	NO	Only if COMM is installed
Reset Totals	0	NO	
Reset Alarms	0	NO	
Product #1	0	NO	Only if Product Select is Remote
Product #2	0	NO	Only if Product Select is Remote
Product #3	0	NO	Only if Product Select is Remote
Product #4	0	NO	Only if Product Select is Remote
Product #5	0	NO	Only if Product Select is Remote
Product #6	0	NO	Only if Product Select is Remote
Product #7	0	NO	Only if Product Select is Remote
Product #8	0	NO	Only if Product Select is Remote
Product #9	0	NO	Only if Product Select is Remote
Product #10	0	NO	Only if Product Select is Remote
Auto Zero	0	NO	Only if AZT enabled
Batch Start	0	NO	Only if Load Out installed
Batch Stop	0	NO	Only if Load Out installed
Batch Standby	0	NO	Only if Load Out installed

Table 3-5. Available Logical Selections

Three assignable inputs are standard on the motherboard. Additional assignable logical inputs from the above table can be selected by adding optional I/O boards. Available options are 4in/16out, 16in/4out or 20in/20out by adding both boards.



WARNING. Changing the definitions of digital inputs may cause machinery to start. After you try to change a definition, the following message screen is displayed.

WARNING
EQUIPMENT MAY START

CONTINUE ABORT

If you press the CONTINUE soft key, be aware that the action may cause damage or injury. If you press ABORT, the system will return to the previous scroll.

Defining Digital Outputs

Digital outputs can be programmed. The following screen shows one logical function per time, and allows you to assign it to a physical output. The NEXT soft key scrolls between the logical functions. The NC/NO soft key selects the Normally Open (NO) or Normally Closed (NC) status of the output. (Normally Open means the output is not energized in normal conditions.)

To program a function, scroll with NEXT until the function is displayed, then use the numeric keys to enter the number of the physical output and confirm with ENTER. Press the NC/NO soft key until the desired mode is displayed. By assigning a function to 0, the function is disabled. (Password: Service.)

Logical selections should not be reassigned after the physical outputs have been terminated.

```

      - I/O DEF SCROLL 5 -
Dig. Output def
Alarm0          NC
ENTER          NC/NO      NEXT
    
```



CAUTION. Logical selections return to the default if the Model 2109 is cold started.

Selection	Default		
Alarm	2	NC	
Shut Down	0	NO	
Ready	1	NC	
High Rate	0	NO	Only if Rate Alarm enabled
Low Rate	0	NO	Only if Rate Alarm enabled
Totalizer	3	NO	
Batch Preset	0	NO	Only if Load Out installed
Batch End	0	NO	Only if Load Out installed
Air Purge	0	NO	

Table 3-6. Available Logical Selections

One non-assignable Fault output and three assignable outputs are standard on the motherboard. Additional assignable logical selections from the above table can be selected by adding optional I/O boards. Available options are 4in/16out, 16in/4out or 20in/20out by adding both boards.



WARNING. Changing the definitions of digital inputs may cause machinery to start. After you try to change a definition, the following message screen is displayed.

```
WARNING
EQUIPMENT MAY START

CONTINUE  ABORT
```

If you press the CONTINUE soft key, be aware that the action may cause damage or injury. If you press ABORT, the system will return to the previous scroll.

Defining Remote Totalizer Output

If the Totalizer output function is assigned to an output, the following screens allow you to set up related parameters.

Set the divider according to the maximum rate the scale will run. The divider is entered in totalization units (T.U.). The pulse frequency generated in normal conditions should not exceed 10 Hz. Higher frequencies are possible, however they do not improve accuracy.

Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Service.)

```
- I/O DEF SCROLL 6 -
Remote counter div.
1.0 Tons
ENTER
```

Default: 1
Min: 0.01
Max: 100

Enter the pulse width in seconds of the totalizer. A higher pulse width limits the maximum frequency. The default 0.1 seconds is recommended for frequencies lower than 5 Hz.

Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Service.)

```
- I/O DEF SCROLL 7 -
Remote counter pulse
Width 0.100 Sec
ENTER
```

Default: 0.1 seconds
Min: 0.005 seconds
Max: 1 second

Defining Air Purge Timing

If an output is assigned to the Air Purge function, a time interval and duration are defined on the next two screens.

Use the numeric keys to enter the number. Press ENTER to confirm. (Password: Operator.)

```
- I/O DEF SCROLL 8 -  
Air purge interval  
120 Sec  
ENTER
```

Default: 120 seconds
Min: 0 seconds
Max: 3,600 seconds

```
- I/O DEF SCROLL 9 -  
Air purge duration  
2 Sec  
ENTER
```

Default: 2 seconds
Min: 0 seconds
Max: 30 seconds

Defining BCD Output Data

If a load out output board is installed, you can select the related variable. (Password: Service.)

```
- I/O DEF SCROLL 10 -  
BCD Output variable  
Rate  
CHOICE ENTER
```

Default: None
Selections: None, Rate

If a selection other than None is made on I/O DEF SCROLL 10, the following screens allow you to define the polarity and the parity check of the BCD output.

The polarity selection reverses the signals from NO to NC and vice versa. If a parity criterion is selected, the most significant bit of the BCD output is used for parity check. (Password: Service.)

```

- I/O DEF SCROLL 10A -
BCD Output Polarity
Positive
CHOICE   ENTER
```

Default: Negative
Selections: Positive, Negative

```

- I/O DEF SCROLL 10B -
BCD Output Parity
Positive
CHOICE   ENTER
```

Default: No
Selections: No, Yes

Defining BCD Input Data

If an optional load out input board is installed, the following screens allow you to define the related variable and the polarity of the signals. (Password: Service.)

```

- I/O DEF SCROLL 11 -
BCD Input Variable
Batch set pt
CHOICE   ENTER
```

Default: None
Selections: None, Batch set pt, Batch pre-act

The next screen appears only if BCD input is not set to None.

```

- I/O DEF SCROLL 11A -
BCD Input polarity
Positive
CHOICE   ENTER
```

Default: Negative
Selections: Negative, Positive

Defining Alarms

Model 2109 alarms can be programmed. Process alarms such as low and high rate can be set to a desired range. In addition, all alarms can be defined to be one of the following modes:

- Alarm - Generate a warning message when active.
- Shut Down - Generate a warning message, turn off the READY LED on the front panel, and produce fault output when active.
- None - No action.

Access the alarm definition screens by pressing the ALARMS DEFINE soft key on Main Menu 4. Use the SCROLL control keys to view the menu selections.

Defining Rate Alarm

Press the CHOICE soft key to turn on or off the rate alarm. Confirm by pressing ENTER. (Password: Operator.)

- ALARM SCROLL 1 -	
Rate alarm	
>NO<	
CHOICE	ENTER

Default: No
Selections: No, Yes

If the selection in the previous screen was YES, the screens for entering the low and high setpoint for the alarm will appear.

Use the numeric keys to enter the setpoint. Enter the desired delay time before the alarm is monitored.

The UNITS key allows you to specify the set points in engineering units. This soft key toggles to %, which selects set points in percent. The SET/DELAY key toggles between the set point and the delay time. The ENTER key confirms your entries. (Password: Operator.)

- ALARM SCROLL 1A -	
Low rate set	
_____ % _____ sec	
ENTER	DELAY/SET %UNITS

Default: 10% 10 seconds
Min: 0% 0 seconds
Max: 103% 90 seconds

```

- ALARM SCROLL 1B -
High rate set
_____ % _____ sec
ENTER   DELAY/SET   %UNITS

```

Default: 10% 10 seconds
 Min: 0% 0 seconds
 Max: 103% 90 seconds

Defining Concentration Alarm

Press the CHOICE key to turn on or off the concentration alarm. Confirm by pressing ENTER. (Password: Operator.)

```

- ALARM SCROLL 2 -
Concent. alarm
>No<
CHOICE   ENTER

```

Default: No
 Selections: No, Yes

If the selection in the previous screen was YES, the screens for entering the low and high setpoint for the alarm will appear.

Use the numeric keys to enter the setpoint. Enter the desired delay time before the alarm is monitored.

The UNITS key allows you to specify the set points in engineering units. This soft key toggles to %, which selects set points in percent. The SET/DELAY key toggles between the set point and the delay time. The ENTER key confirms your entries. (Password: Operator.)

```

- ALARM SCROLL 2A -
Low conc. set
_____ % _____ sec
ENTER   DELAY/SET I/O UNITS

```

Default: 10% 10 seconds
 Min: 0% 0 seconds
 Max: 103% 90 seconds

```

- ALARM SCROLL 2B -
High conc set
_____ % _____ sec
ENTER   DELAY/SET   I/O UNITS

```

Default: 0% 10 seconds
 Min: 0% 0 seconds
 Max: 103% 90 seconds

Defining Velocity Alarm

Press the CHOICE key to turn on or off the velocity alarm. Confirm by pressing ENTER. (Password: Operator.)

```

- ALARM SCROLL 3 -
Velocity alarm
>No<
CHOICE   ENTER

```

Default: No
 Selections: No, Yes

If the selection in the previous screen was YES, the screens for entering the low and high setpoint for the alarm will appear. Use the numeric keys to enter the setpoint. Enter the desired delay time before the alarm is monitored.

The UNITS key allows you to specify the set points in engineering units. This soft key toggles to %, which selects set points in percent. The SET/DELAY key toggles between the set point and the delay time. The ENTER key confirms your entries. (Password: Operator.)

```

- ALARM SCROLL 3A -
Low velocity set
_____ % _____ sec
ENTER   DELAY/SET I/O UNITS

```

Default: 10% 10 seconds
 Min: 0% 0 seconds
 Max: 103% 90 seconds

```

- ALARM SCROLL 3B -
High velocity set
_____ % _____ sec
ENTER    DELAY/SET    I/O UNITS

```

Default: 10% 10 seconds
Min: 0% 0 seconds
Max: 103% 90 seconds

Setup Alarm Modes

The following screen is displayed for three seconds.

```

- ALARM SCROLL 4 -
- ALARM DEFINITION -
Use NEXT key or
enter alarm number

```

After three seconds, the following screen is displayed. Use this screen to set the mode for each alarm. (Password: Operator.)

The CHOICE soft key toggles among ALARM (warning message), SHUT DOWN (message plus fault output), or NONE (no action). Press ENTER to confirm your selection.

Press the NEXT soft key to display the next alarm in sequence. You can also use the numeric keys to enter a specific alarm number and press ENTER to confirm.

Refer to Section Alarm Pending (Table 3-2) for a list of all alarms.

Load Out

The load out menus (and the LOAD OUT soft key on Main Menu 4) display only if the optional load out board is installed. The load out option is described in another manual

Main Menu 5

Main Menu 5 is use to define the serial options for the Model 2109. COMM A is used to set up the serial line of the optional Communication A board, and PRINT is used for setting up the printer output.

```

- MAIN MENU 5 -
Press MENU for more

COMM A    PRINT

```

Defining COMM A

The COMM A board has one serial channel that can be configured using jumpers as an RS-232 or an RS-485 channel. The serial channel can be used for printing or for serial communication with an intelligent device such as a PLC or a PC. Two boards can be installed and programmed, typically one for the printer and one for the supervisor.

The following screens define the communication parameters for the first and the second channel. Press the COMM A soft key on Main Menu 5, then use the SCROLL control keys to view the menu selections. (Password: Service.)

```
          - COMM A SCROLL 1 -  
Baud Rate port #1  
>9600<  
CHOICE  ENTER
```

Default: 9600
Selections: 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600

```
          - COMM A SCROLL 2 -  
Set parity port #1  
>no parity<  
CHOICE  ENTER
```

Default: No parity
Selections: No parity, even parity, odd parity

```
          - COMM A SCROLL 3 -  
Stop bits port #1  
>1<  
CHOICE  ENTER
```

Default: 1 stop bit
Selections: 1 stop bit, 2 stop bits

```
          - COMM A SCROLL 4 -  
Word length port #1  
>8<  
CHOICE  ENTER
```

The next screen is used to specify the protocol for port #1. Some commonly used protocols are implemented in the system. Possible selections are:

- PC-MASTER - Thermo Scientific proprietary protocol: Multi Drop, Master Slave.
- SIEMENS 3964R - A proprietary protocol of Siemens: Point to point, Multi Master.
- ALLEN BRADLEY DF1 - A proprietary protocol of Allen Bradley: Multi Drop, Master Slave.
- MODBUS - A proprietary protocol of AEG: Multi Drop, Master Slave.
- PRINTER - Not a protocol; selects printer output.

```
          - COMM A SCROLL 5 -  
Protocol port #1  
>Printer<  
CHOICE   ENTER
```

Default: Printer
Selections: Printer, PC-Master, Siemens 3964R, Allen Bradley DF1, MODBUS

If the selected protocol is not Printer, the following screens define the address of the device on the multi drop line and the access permission from the remote supervisor.

If None is selected, the supervisor has full access to the device. If Limited is selected the supervisor only accesses those variables that are accessible with the Operator password. If Protected is selected, the unit is ready only to the supervisor.

```
          - COMM A SCROLL 5A -  
Clear to send #1  
>disabled<  
CHOICE   ENTER
```

Default: Disabled
Selections: Disabled, enabled

```
          - COMM A SCROLL 6 -  
Address port #1  
>1<  
CHOICE   ENTER
```

Default: 1
Min: 1
Max: 256

```
          - COMM A SCROLL 7 -  
Access prot port #1  
>1<  
CHOICE   ENTER
```

Default: None
Selections: None, limited, protected

If a second communication board is installed, the following screens appear. These screens operate exactly as the ones dedicated to the communication board 1.

```
          - COMM A SCROLL 8 -  
Baud rate port #2  
>9600<  
CHOICE   ENTER
```

Default: 9600
Selections: 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600

```
          - COMM A SCROLL 9 -  
Set parity port #2  
>no parity<  
CHOICE   ENTER
```

Default: No parity
Selections: No parity, even parity, odd parity

```
          - COMM A SCROLL 10 -  
Stop bits port #2  
>1<  
CHOICE   ENTER
```

Default: 1 stop bit
Selections: 1 stop bit, 2 stop bits

```
          - COMM A SCROLL 11 -  
Word length port #2  
>8<  
CHOICE   ENTER
```

Default: 8 bits
Selections: 8 bits, 7 bits

```
- COMM A SCROLL 12 -  
Protocol port #1  
>Printer<  
CHOICE ENTER
```

Default: Printer
Selections: Printer, PC-Master, Siemens 3964R, Allen Bradley DF1, MODBUS

```
- COMM A SCROLL 12A -  
Protocol port #1  
>disabled<  
CHOICE ENTER
```

Default: Disabled
Selections: Disabled, enabled

Defining Printing

The Micro-Tech 2109 has a fully programmable printer format. This section explains how to program it according to your specific needs. Access these menus by pressing the PRINT soft key on Main Menu 5.

Defining Handshaking

The system can be configured to operate without any handshake (None), or to use the Clear to Send signal (CTS) or the XON-XOFF sequence. (Refer to the printer instruction manual to define which selection is required.)

The selection None is only used for testing purposes. It is not recommended for normal use. If None is selected, the system is not able to recognize whether or not the printer is on line, or if the paper is empty.

The most commonly used protocol is CTS, which is a signal generated by the printer to indicate whether it is ready to receive data. (Password: Service.)

```
          - PRINTER SCROLL 1 -  
Handshaking  
>None<  
CHOICE   ENTER
```

Default: None
Selections: None, CTS, Xon-Xoff

Different printers use different end of line patterns. Select the one you need for your printer. (Password: Service.)

```
          - PRINTER SCROLL 2 -  
End of line  
>CR<  
CHOICE   ENTER
```

Default: CR
Selections: CR, LF, CR+LF

Some printers cannot accept characters while they are printing. In some cases, the handshake is not well controlled by the printer, so a delay at end of line is helpful. Use the numeric keys to enter the number in seconds. Press ENTER to confirm. (Password: Service.)

```
          - PRINTER SCROLL 3 -  
Delay end of line  
>0< sec  
ENTER
```

Default: 0 seconds
Min: 0 seconds
Max: 5 seconds

A form feed character can be sent to the printer after each report to force the printer to eject the paper. If NO is selected, a normal End of Line character(s) is printed at the end of the report. (Password: Service.)

```

- PRINTER SCROLL 4 -
Form Feed
>NO<
CHOICE    ENTER

```

Default: No
 Selections: No, Yes

Periodic Printing

If you want to generate periodical printing, enter the number of minutes, hours, or days in the following screen. Entering 0 prevents periodic printing.

Use the numeric keys to enter the numbers. Press ENTER to confirm.

Use the INTV key to switch from minutes to hours to days. (Password: Operator.)

```

- PRINTER SCROLL 5 -
Print Interval
>0< min
ENTER    NEXT

```

Default: 0 min
 Min: 0 min, 0 hour, 0 day
 Max: 59 min, 23 hour, 365 day

The system can print at specific times during the day. Use the numeric keys to enter the time you want to obtain the printing. Press ENTER to confirm.

Use the NEXT key to scroll between the print times (maximum 4).

The ON/OFF key enables or disables the displayed print time. (Password: Operator.)

```

- PRINTER SCROLL 6 -
Print time #1
Time HH:MM
ENTER    ON/OFF    NEXT

```

	If 24 hrs.	If am/pm
Default:	Off	Off
Min:	00:00	01:00
Max:	23:59	12:59

The following screens specify whether to print alarms and what the format for the report is to be. (Password: Service.)

```
          - PRINTER SCROLL 7 -  
Printer alarms  
>NO<  
CHOICE   ENTER
```

Default: No
Selections: No, Yes

```
          - PRINTER SCROLL 8 -  
Total report format  
>Default 1<  
CHOICE   ENTER
```

Default: Default 1
Selections: Default 1, Default 2

Print Key

If the optional COMM board is installed, pressing the print control key on the front panel causes the printer to print data. (Refer to Print Key.)

Main Menu 6

Main Menu 6 is used to define Audit Trails and Linearization. Main Menu 6 can be reached by pressing the MENU control key on the front panel until Main Menu 6 appears.

```
          - MAIN MENU 6 -  
Press MENU for more  
AUDIT  
TRAIL           LINEAR
```

Audit Trails

These screens are only displayed if the Audit Trails option is installed. Press the AUDIT TRAIL soft key on Main Menu 6 to access the function.

The Audit Trails function is a method for recording all changes in setup and calibration data. Any time you change a value that affects weighing, the new parameter is recorded with time and date of the change. All changes can be printed when required.

Specify whether the Audit Trails function is enabled on the AUDIT TRAILS 1 screen.

- AUDIT TRAILS -
Use scroll keys or
enter trails number

After three seconds, the next screen is shown.

TRAIL EVENT No. 0000
Hh:mmdd-mm-yyyy
nnnnnn = vvvvvv / old
nnnnnn = vvvvvv / new

hh:mm	Time of change
dd-mm-yyyy	Date of change (the format may vary depending on the country)
nnnnnn	Parameter's name
vvvvvv	Parameter's values, before change (old) and after change (new)

Time and date are shown only if an optional communication board is installed.

You can scroll between events that are displayed in order of date and time. You can also enter a number to display a specific event.

Linearization

Select YES or NO to enable or disable linearization. Once enabled, no linearization is done until you perform an Auto Multipoint material calibration or manually enter the linearization factors. (Password: Service.)

- LINEARIZATION 1 -
Linearization
>NO<
CHOICE ENTER

Default: No
Selections: No, Yes

Use the following scrolls to set linearization factors. If you enter 0.000000 (default value), the rate is not corrected in that portion of range. A number lower than 1.000 reduces the span, while a number larger than 1.000 increases the span.

Use the numeric keys to enter numbers. Press ENTER to confirm after typing in a frequency or a factor. The **FREQ/FACT** soft key toggles between a Freq or Factor entry. **ACQ** automatically acquires the frequency at present flow rate. (Password: Service.)

- LINEARIZATION 2A -	
Freq	Factor 1
000000	0.000000
ENTER	FREQ/FACT

	<u>Freq</u>	<u>Factor</u>
Min:	0	0.000000
Max:	131070	1.500000

The LINEARIZATION 2A scroll is for flow rate under 20%. There are up to five additional scrolls for accommodating other flow rates.

- LINEARIZATION 2B - Flow rate under 40%.
- LINEARIZATION 2C - Flow rate under 60%.
- LINEARIZATION 2D - Flow rate under 80%.
- LINEARIZATION 2E - Flow rate under 100%.
- LINEARIZATION 2F - This point is the flow rate at which the span was set during span calibration (see Span Calibration). Do not change it unless you perform a new span calibration.

Main Menu 7

Main Menu 7 is used to set up the Model 2109 Correlator.

Main Menu 7 can be reached by pressing the MENU control key on the front panel until Main Menu 7 appears.

<p>- MAIN MENU 7 -</p> <p>Press MENU for more</p> <p>CORRELATOR</p>

You perform operations on the scrolls available from Main Menu 7 in a similar manner. The basic procedure is as follows:

1. Press the down SCROLL key to accept the default value and scroll down to the next screen.
- or**
1. Press the CHOICE soft key to scroll selections.
2. Press ENTER to confirm your selection.
3. SCROLL down to the next screen.
4. Press the CORRELATOR soft key to access the screens.
5. Enter the direction of the material flow. S1 is sensor 1, S2 sensor 2. (Password: Service.)

**Correlation Scroll 1
Direction**

The DC13 sensors are inside the welded pipe between the mounting flanges. DC or DK Sensor 1 is located under the weld where the two pipe sections are connected. Sensor 2 is located under the large pipe section.

- CORREL. SCROLL 1 -

Direction
> Forward (S1 ->S2) <
CHOICE ENTER

Default: Forward (S1->S2)
Selections: Forward (S1->S2), Reverse (S2->S1)

The Correlation length and sampling frequency must be set to allow the correlator time to correlate the minimum speed. As an example if the maximum delay time was set for 7 seconds and it took 8 seconds for the material to move from sensor S1 to S2, the correlator would restart its sweeps every 7 seconds and would not correlate or display speed.

MAX Delay time is calculated by Correlation length/sample frequency.

Example: 3.5 K (correlator length)/.5 KZ Sample Frequency = the max delay between DK sensors S1 and S2 of 7.0 seconds

Minimum Speed is calculated by sample frequency/correlation length x 60 seconds x .315 in (S1 to S2 length/12 inches

Example: .5/3.5 x 60 sec x .315 inches/12 inches per 1 foot = .225 FPM

Setting the parameters too low causes the speed update time to be extremely slow.

Example: 3.5 K (correlator length)/.5 KZ Sample Frequency x correlator averaging of 1 equals a 7 second update time. Moving the correlator averaging to 4 would cause a 28 second speed update time.

Speeds	Correlation Length	Sampling Frequency	Correlation Averaging
SCROLL	2	3	6
Speeds Less than 50 FPM	3.5 Default 3.5	.5 - 10 Default 5	1,2,4 Default 2
Speeds More than 50 FPM Less than 200 FPM	3.5 - 2.0 Default 2.0	5 – 50 Default 6	4,8 Default 4
Speeds More than 200 FPM Less than 1000 FPM	3.0 – 1.0 Default 1.0	10 – 100 Default 40	4,8 Default 4
Speeds More than 1000 FPM Less than 100000 FPM	1.0 Default 1.0	10 – 100 Default 80	4,8 Default 4

Table 3-7. Typical Speed Related Correlator Setup Parameters

Correlation Scroll 2

Define the length of the correlation in kilobytes (k). (Password: Service.)

Correlation scroll 2 Correlation Length is the amount of data used in the correlation calculation (.5 to 3.5 thousand data readings). More data gives higher quality readings but takes longer to compute and has smaller velocity range. More data is also needed on slow speeds to provide enough delay transport time between the two sensors inside the DK13.

Slow material speeds change the data more slowly so use longer correlation lengths to collect more changes. Fast material speeds provide many changes so use shorter correlation lengths.

```
- CORREL. SCROLL 2 -  
Correlation Length  
>1 kByte<  
CHOICE  ENTER
```

Default: 1
Selections: 1, 1.5, 2, 2.5, 3, 3.5, 0.5

Correlation Scroll 3 Sampling Frequency

Define the sampling frequency in kHz. Use the numeric keys to enter the number. Press enter to confirm. (Password: Service.)

Correlation Scroll 3 Sampling Frequency is the rate at which the A/D converter reads the signals from the DK13 (.5K to 160K samples per second). The software uses the nearest obtainable setting.

Slow material speeds change the data more slowly and use slower sampling frequency rates to collect more data. The .5 sampling frequency makes the velocity display and speed update rate very slow. Faster material speeds provide many changes so use faster sampling frequency rates.

```
- CORREL. SCROLL 3 -  
Sampling frequency  
(SF) >100 kHz<  
ENTER
```

Default: 100
Min: 1
Max: 160

Correlation Scroll 4 Filter Cut-Off

Define the Cut-off frequency of the filter as fraction of the sampling frequency (SF). (Password: Service).

Correlation Scroll 4, Correlation Filter Cut-off (1/5 – 1/640) is the setting of the low pass filter. It is relative to the Sampling Frequency. For example, if the setting is 1/10 and the Sampling Frequency is set to 20000, the low pass filter is set to 2000 Hz. 1/10 is usually good.

Higher cut-off frequencies let in more data and produce better correlations unless there is too much noise.

```
          - CORREL. SCROLL 4 -  
Filter cut-off  
>1/10<  
CHOICE   ENTER
```

Default: 1/10

Selections: 1/5, 1/10, 1/20, 1/40, 1/80, 1/160, 1/320, 1/640

Correlation Scroll 5 Auto Gain

Defines if the correlator gain is auto set or manually set through the keyboard. Select if Gain is Auto (YES) or Manual (OFF). In Auto DK13 signals are monitored and gain is set. In Manual gain is set in Scroll 5A.

```
          - CORREL. SCROLL 5 -  
Auto Gain  
>NO<  
CHOICE   ENTER
```

Default: NO

Selections: NO, YES

Correlation Scroll 5A Pre-Amp Gain

Define the gain of the pre-amplifier. (Password: Service.)

Correlation Scroll 5A, Pre-amp Gain is self-explanatory. (Displays only if Correlation Scroll 5 is set to NO.) The correlation computation is not sensitive to the amount of signal as long as it is above the noise (1 to 8). Low flow rates may not have enough signal. Check voltage level in the Diagnostics Scroll 3. Too much gain and the noise is amplified.

```
- CORREL. SCROLL 5A -  
Pre-Amp Gain  
>1<  
CHOICE ENTER
```

Default: 1
Selections: 1, 2, 4, 8

Correlation Scroll 6 Correlation Averaging

Define how many correlations to use to compute the average final value. Use the numeric keys to enter the number. Press enter to confirm. (Password: Service.)

Correlation Scroll 6, Corr Averaging is the number of correlations computations to average together for each velocity calculation. Averaging correlations together produces a higher quality correlation with a more distinct peak. Velocity display is more active at 1 and updates more slowly at 8.

```
- CORREL. SCROLL 6 -  
Corr. averaging  
>4<  
ENTER
```

Default: 4
Min: 1
Max: 8

Correlation Scroll 7 Peak Cutoff

Define the Peak Cut-off, Correlation Scroll 7. [Peak Cut-off calculation = (new speed – old speed/max speed x 100% (should be greater than Correlation Scroll 7B, Deviation %)] (Password: Service.)

```
- CORREL. SCROLL 7 -  
Peak Cutoff  
>YES<  
CHOICE ENTER
```

Default: 20%
Selections: YES, NO

**Correlation Scroll 7A
Delay**

```
- CORREL. SCROLL 7A -  
Delay  
>.25 SEC<  
ENTER
```

Default: .25 Sec
Min: .01 Sec
Max: 25 Sec

**Correlation 7B
Deviation**

Correlation Scroll 7B, Deviation – if the peak is active and the new speed exceeds the change limit entered in this scroll, the 2109 keeps the old speed value for the time.

```
- CORREL. SCROLL 7B -  
Deviation  
>50.0<  
ENTER
```

Default: 50.0%
Min: .01%
Max: 50.0%

**Correlation Scroll 8
Correlation Threshold**

Correlation Scroll 8, Correlation Threshold is the minimum allowable “quality” for the correlation. If the quality is below this value, the data is discarded and the previous value is used for the velocity.

```
- CORREL. SCROLL 8 -  
Correl Threshold  
>20%<  
ENTER
```

Default: 20%
Min: 20%
Max: 100%

Correlation Scroll 8A Correlation Threshold Time

Correlation Scroll 8A, Correlation Threshold time is the amount of time the correlation must be above the Correlation Threshold before the readings are accepted.

```
- CORREL. SCROLL 8A -  
Correl. Threshold Time  
>1< Sec  
ENTER
```

Default: 1 sec
Min: 1 sec
Max: 10 sec

Correlation Scroll 9 Signal Threshold

Correlation Scroll 9, Signal Threshold is the minimum amount of signal allowed. Correlations with signal levels below this value are discarded. This can be used to prevent the correlator from computing a velocity when there is no usable signal.

```
- CORREL. SCROLL 9 -  
Signal Threshold  
>0< Volts  
ENTER
```

Default: 0.0 Volts
Min: 0.0 Volts
Max: 50.0 Volts

Correlation Scroll 10 Auto Tune

Correlation Scroll 10, Auto Tune is an automatic function of the instrument. The purpose is to automatically change the correlator sampling frequency in order to find the best condition. A condition is good if the number of zero crossing is above a defined limit.

The number of zero crossing gives an indication of the amount of features and structure in the signal. The number of zero crossings should be monitored and kept, on average, above the minimum level.

If the number is too low, the sample rate should be reduced which will increase the time length of the records and should increase the number of zero crossings in the data.

```
- CORREL. SCROLL 10 -  
Auto Tune  
>NO<  
CHOICE ENTER
```

Default: NO
Selection: NO, OFF

**Correlation Scroll 10A
Number Zero Crossings**

- CORREL. SCROLL 10A -
Num zero crossings
>500<
ENTER

Default: 500
Min: 5
Max: 5000

**Correlation Scroll 10B
Delta Zero Crossings**

- CORREL. SCROLL 10B -
Delta zero crossings
>10< %
ENTER

Default: 10%
Min: 10%
Max: 100%

**Correlation Scroll 10C
Time Auto Tuning**

- CORREL. SCROLL 10C -
Time Auto Tuning
>10< Sec
ENTER

Default: 10 sec
Min: 1 sec
Max: 3600 sec

**Correlation Scroll 10D
Initial Sample
Frequency**

- CORREL. SCROLL 10D -
Init Sampling Freq
>12.8< KHZ
ENTER

Default: 1 KHZ
Min: 1 KHZ
Max: 160 KHZ

Correlation Scroll 10E
Delay Auto Tuning

- CORREL. SCROLL 10E -
Delay Auto Tuning
>10< Sec
ENTER

Default: 10 sec
Min: 1 sec
Max: 60 sec

4

Chapter 4 Maintenance & Troubleshooting

This chapter provides information about 2109 maintenance and troubleshooting. It includes pointers for routine maintenance and suggestions for diagnosing operational problems.

The maintenance information in this chapter should be sufficient to meet your service needs. If you encounter a problem that requires technical assistance, please call your service representative (refer to Service and Repair Information for telephone numbers).

Your Model 2109 Correlator is capable of efficient and reliable operation when it is properly set up and maintained.

The Model 2109 Correlator control unit is a solid-state device, and as such, required minimal maintenance.

Routine Maintenance

The set up and maintenance information in this manual is designed to meet your service needs. However, if you run into problems requiring technical assistance, please call Thermo Scientific at (800) 445-3503. In addition, Thermo Scientific Products Field Service Representatives are fully trained and available from regional offices.

Minimize vibration and air currents in the area around the 2109 Correlator.

The control unit enclosure can be wiped clean with a damp cloth, and if necessary, a mild detergent. Never use abrasive cleaners, especially on the display windows. Keep the enclosure door tightly closed to prevent dirt infiltration.

As a preventive measure, check all wires, plugs, and integrated circuits in the control unit to make sure they are tight in their connectors. Also, keep the enclosure door tightly closed to prevent dirt infiltration.

If your 2109 Correlator is not working reliably or your calibrations are providing unexpected results, there are several things you can do to determine the cause of the problem.

Always begin with a visual inspection of the sensors and 2109 transmitters. If you are experiencing operational problems with the 2109, a quick visual inspection may reveal the source of the problem. Check the following items before proceeding to more specific troubleshooting procedures.

1. Check power
 - Check that the two (2) Line voltage Selector Switches are set to the correct line voltage (see Chapter 2 section on Electrical Switches/Mother Board Configuration)
 - Check the fuses.
 - Check that the power switch is ON and that power is supplied to the unit.

2. Check connections
 - Make sure all terminations are secure.
 - Check that the Display Module and Keyboard connectors are firmly seated in their connectors
 - Check that the Remote Counter and optional input/output modules are secure in their sockets.
 - Check that all jumpers are in their correct position.

Troubleshooting

This unit has built-in trouble shooting capabilities. A number of possible problems are automatically detected and screen messages are displayed. Refer to "Main Menu 3" on page 37 for diagnostics and test scrolls.

Alarm Messages

The ALARM message is assigned to the right hand soft key when an alarm is pending. The ALARM message and its LED flash at the same time.

5

Chapter 5 Service, Repair & Replacement Parts

This chapter provides information about service, repair, and replacement parts for your Thermo Scientific product. It includes the telephone numbers for various departments at Thermo Scientific, the procedure for ordering replacement parts, a Return Material Authorization Form, and the parts list for the product are also included in this chapter.

The maintenance information in this manual is designed to meet your service needs. If you should encounter a problem that requires technical assistance, you may call Thermo Scientific Product Service at (800) 445-3503.

Thermo Scientific also provides on-site service technicians to assist customers with installation, setup, initial calibration, customer training, maintenance, and repair. Contact the Thermo Scientific Field Service department at the number given below for current rates and scheduling.

Thermo Scientific has repair centers located at the plant in Minneapolis, Minnesota. Products that need system checkout or repair can be returned to the plant with the Return Material Authorization (RMA) Form. Contact our Repair and Return department (800) 445-3503 to get a form.



NOTE: Have your machine model number and serial number available when you call.

Main Switchboard	(800) 445-3503
FAX	(763) 783-2525
Service	(800) 445-3503
Return Material Authorization & Repair	(800) 445-3503
Or any local Thermo Scientific office.	

Parts Ordering Information

For the fastest service when ordering parts, telephone or FAX the Thermo Scientific Parts Department at the numbers given below. Your regional field service representative can also assist you with parts orders.

The recommended procedure for ordering parts is:

Determine the broken or faulty part.

1. Locate the part in the Parts List.
2. Find the part number(s) for the item(s) you need.
3. Before you contact Thermo Scientific for your parts, make sure you have the following information:
 - Machine model and serial number
 - Purchase Order number
 - Date Required
 - Preferred shipping method
 - Part number(s), description, and quantity needed.
 - Telephone or FAX:

Thermo Fisher Scientific
Customer Service Department
501 90th Ave. NW
Minneapolis, MN 55433
FAX: (763) 783-2525
Phone: (800) 445-3503
Return Material Authorization
and Repair: (800) 445-3503

Table 5-1. Spare Parts List for Model 2109 Granucor Correlator

Equipment	Part No.
2109 Complete - includes enclosure & I-out	58080
Chassis Assembly, Panel Mount, includes 1 Analog Output	058075
Chassis Assembly, Field Mount, includes 1 Analog Output (no enclosure)	058536
PCBA, Mother Board	051324
PCBA, Correlator	057727
PCBA, PFM Input	050831
PCBA, Analog Output (1 out)	071637
PCBA, Analog Output (2 in/2 out)	071636
PCBA, DIO (4 in/16 out)	046841
PCBA, DIO (16 in/4 out)	046844
PCBA, Comm AA@ Select one only:	068053
RS-232C	
RS-485, std (point to point)	
RS-485, multi-drop	
20 mA (digital) current loop	
PCBA, Comm Aprofibus@	056713
Connector, HSG, AD@ Aprofibus@	057416
PCBA, Comm, DeviceNet	068147
PCBA Field Marshall	058842
PCBA DeviceNet	067097
PCBA, Comm, Ethernet (TCP/IP)	084727
PCBA, LED Assembly	046847
PCBA, Display Assembly	046860
PCBA, Field Terminal Entry	047572
Touch Panel Model 2109	058173
Fuse, Slo-Blo, .5 Amp (F1 220V)	001366
Fuse, Slo-Blo, 1.0 Amp (F1 110V)	002443
Fuse, Fast-Blo, 4.0 Amp (FT Board)	037287
Battery, Lithium, 3.0 V	037188
Transformer, Power	046863
Module, Power Input 180-240 VAC	047646
Module, Power Input 90-120 VAC	047575
Module, Power Input 10-32 VDC	048162
Module, Power Output 24-240 VAC	046814
Module, Power Output 5-60 VDC	046815

Table 5-2. Spare Parts List for Granucor DC13 Concentration Sensor

Equipment	Part No.
DC13 Sensor Assembly	
Must specify the following:	
A) Diameter/flange Size	
B) Material (carbon steel or stainless steel)	
C) Pressure	
D) Area Classification	
PCBA, AMP, DC13, 220 VAC	051784
PCBA, AMP, DC13, 115 VAC	051786
PCBA, AMP, DC13, 42 VAC	051787
PCBA, AMP, DC13, 24 VAC	051788
PCBA, AMP, DC13, 16-32 VDC	051789
PCBA, AMP, DC13, 110 VAC	051790
PCBA, AMP, DC13, 127 VAC	051791
PCBA, AMP, DC13, 230 VAC	051792
PCBA, AMP, DC13, 240 VAC	051793
PCBA, AMP, DC13, 48 VAC	051794

Table 5-3. Spare Parts List for Granucor DK13 Velocity Sensor

Equipment	Part No.
DK13 Sensor Assembly	
Must specify the following:	
A) Diameter/flange Size	
B) Material (carbon steel or stainless steel)	
C) Pressure	
D) Area Classification	
<u>DK13 AMP PCBA, non-hazardous area, 0.5" - 2"</u>	
PCBA, AMP, DC13, ACTIVE, 220 VAC	051796
PCBA, AMP, DC13, ACTIVE, 115 VAC	051798
PCBA, AMP, DC13, ACTIVE, 42 VAC	051799
PCBA, AMP, DC13, ACTIVE, 24 VAC	051800
PCBA, AMP, DC13, ACTIVE, 16-32 VDC	051801
PCBA, AMP, DC13, ACTIVE, 110 VAC	051802
PCBA, AMP, DC13, ACTIVE, 127 VAC	051803
PCBA, AMP, DC13, ACTIVE, 230 VAC	051804
PCBA, AMP, DC13, ACTIVE, 240 VAC	051805
PCBA, AMP, DC13, ACTIVE, 48 VAC	051805
<u>DK13 AMP PCBA, hazardous area, 0.5" - 2"</u>	
PCBA, AMP, DK13, ACT, 220V, CLASS I	086365
PCBA, AMP, DK13, ACT, 115V, CLASS I	086366
PCBA, AMP, DK13, ACT, 42V, CLASS I	086367
PCBA, AMP, DK13, ACT, 24V, CLASS I	086368
PCBA, AMP, DK13, ACT, 110V, CLASS I	086369
PCBA, AMP, DK13, ACT, 127V, CLASS I	086370
PCBA, AMP, DK13, ACT, 230V, CLASS I	086371
PCBA, AMP, DK13, ACT, 240V, CLASS I	086372
PCBA, AMP, DK13, ACT, 48V, CLASS I	086373
<u>DK13 AMP PCBA, ALL AREAS, 2.5" - 8.00"</u>	
PCBA, AMP, DK22, 24 VAC	051814
PCBA, AMP, DK22, 42 VAC	051815
PCBA, AMP, DK22, 48 VAC	051816
PCBA, AMP, DK22, 110/115 VAC	051817
PCBA, AMP, DK22, 127 VAC	051818
PCBA, AMP, DK22, 220 VAC	051819
PCBA, AMP, DK22, 230 VAC	051820
PCBA, AMP, DK22, 240 VAC	051821
PCBA, AMP, DK22, 24 VDC	051823

**Phone/Fax
Contacts for
Thermo Fisher
Scientific Offices**

Australia

+61 (0) 8 8208-8200
+61 (0) 8 8234-3772 fax
service.auadl@thermofisher.com

Brazil

+55-11-2367-2192
+55-11-2367-2192 fax

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(See United States)

Chile

+56 (2) 2378 5080
+56 (2) 2370 1082 fax
ventas.Bulk.LA@thermofisher.com

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+86 10-8419-3588
+86 10-8419-3580 fax

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+27 (0) 11-776-0000
+27 (0) 11-822-3982 fax
sales@thermo.co.za

Spain

+34 91-484-5965
+34 91-484-3597 fax
commercial.pid.esmad@thermofisher.com

United States & Canada

+1 (800) 445-3503
+1 (763) 783-2525 fax
service.bulk.us@thermofisher.com
parts.bulk.us@thermofisher.com
sales.bulk.us@thermofisher.com

Disposal of Hazardous Waste

Disposal of lithium batteries and soldered printed circuit boards must be in accordance with your local Hazardous Waste Policy.

As an alternative product supplied by Thermo Scientific may be returned freight pre-paid, for disposal. Contact the Repair Department for a Return Material Authorization Number before shipping any product for disposal.

A

Appendix A DC13 / DK13 Sensors

The DC 13 and DK 13 are sensors used in a correlator system for the measurement of bulk solids flowing through pneumatic lines. This system can be applied to most pneumatic conveying systems, which have typical solids loading of five pounds of solids to every pound of conveying gas.

System Description

Each complete system is composed of two independent sensors and a single transmitter (Figure A-1). The DK 13 velocity sensor and the DC 13 concentration sensor operate using capacitance technology and are designed for direct installation into the process using ANSI Tongue and Groove, or DIN flanges.

These sensors are available non-hazardous or hazardous area configurations and in various sizes from 0.5 in (15mm) to 8 in (200mm) nominal ID. Three parameters are measured and output by the 2109 system: solids, concentration, mean solids velocity, and solids mass flow.

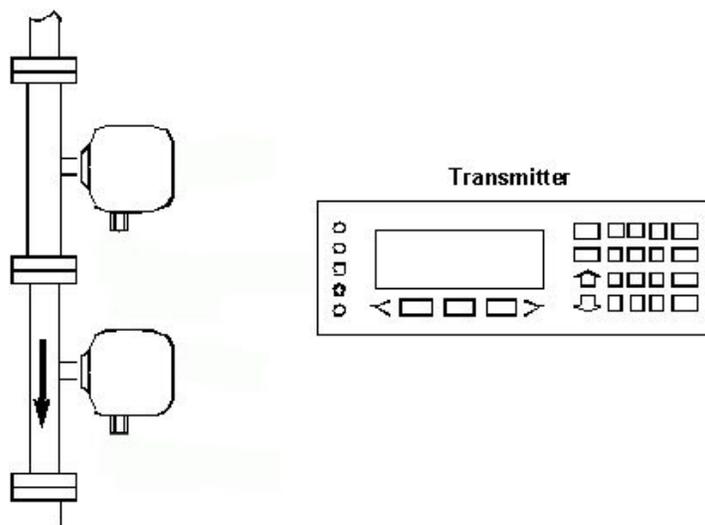


Figure A-1. 2109 System

The DK 13 contains two capacitance sensors and the DC 13 contains a single capacitance sensor (Appendix Figure A-2).

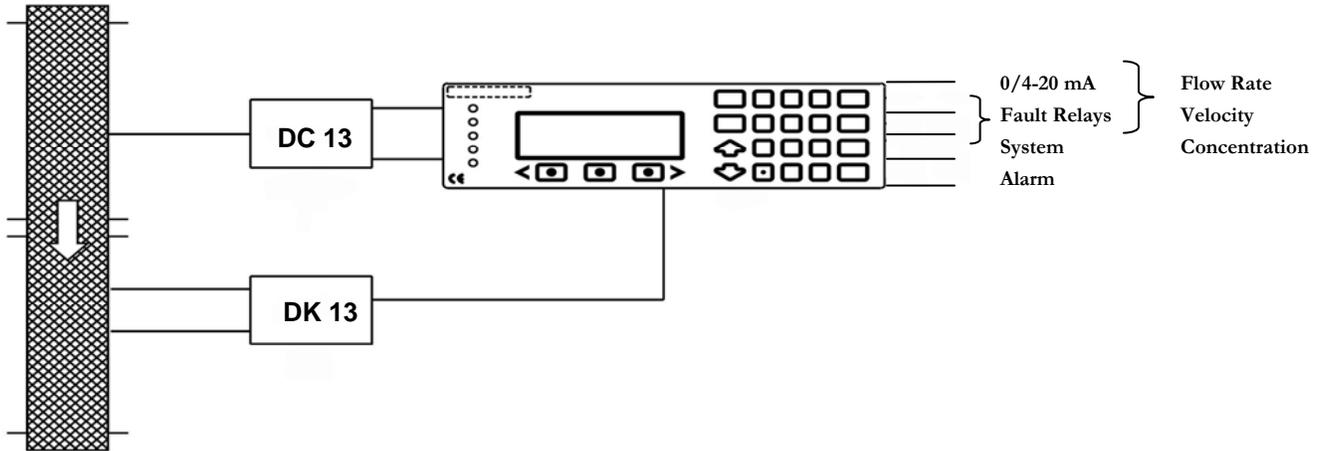


Figure A-2. Capacitance Sensors

DK 13, DC 13 Capacitance Sensors

Particles in two phase, flowing streams, such as solid particles in a carrier gas, statistically exhibit fluctuations in their concentration and orientation to each other. The Model 2109 system evaluates the particle velocities and concentration in order to calculate mass flow. By knowing density, velocity, and concentration of the solids, mass flow can be calculated (Appendix Figure A-3).

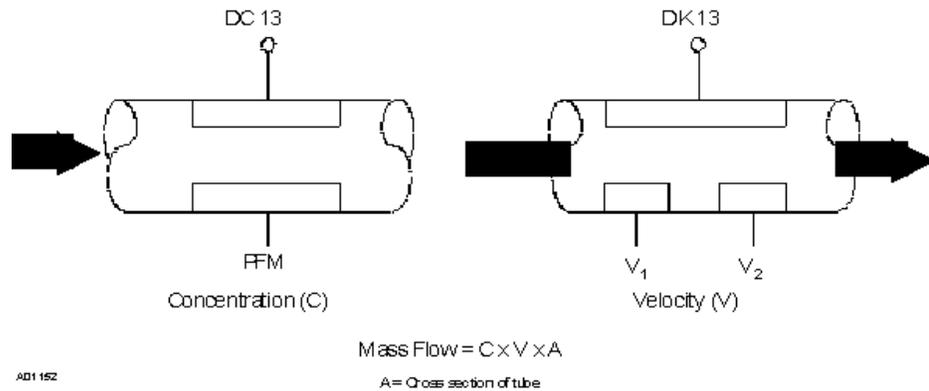


Figure A-3. Calculate Mass Flow

The DK 13 velocity sensor is comprised of two capacitance sensors configured such that the stream of particles passes by sensor number 1 first (Figure A-3). The second sensor is oriented a known distance away from sensor number 1 (Figure A-4) Ideally, if the particle distribution in the stream did not change, sensor 2 would generate the exact signal as sensor number 1. The only difference between the two

signals would be a function of time (T). This corresponds to the time it took the particles to travel the distance (d) between sensor 1 and 2. In real applications, the orientations of the particles change as they pass through the sensor, colliding with the sensor walls and each other.

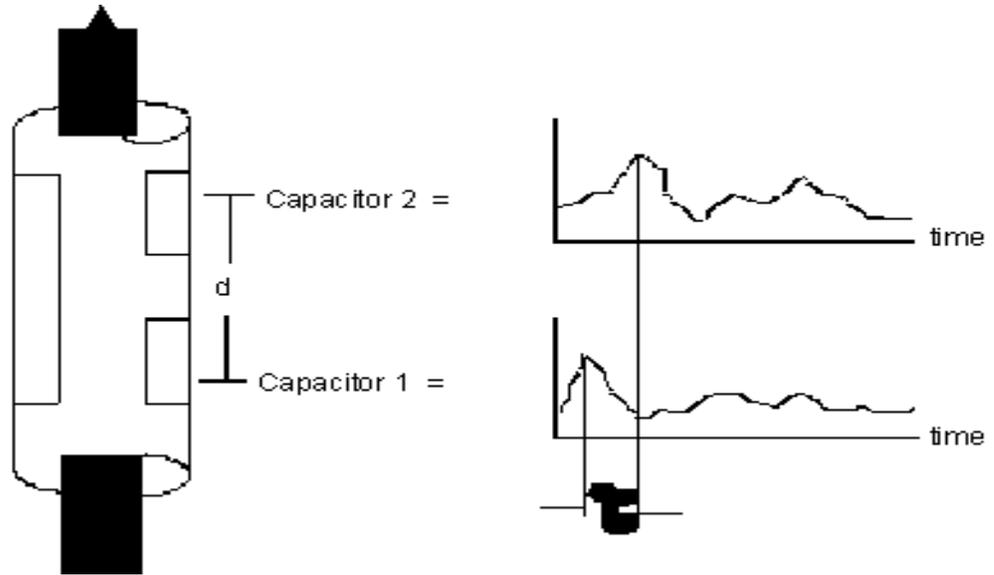


Figure A-4. Flow Direction

The Model 2109 velocity transmitter correlates these two signals from the sensor and finds the closest similarity between them. From this cross-correlation function, the Model 2109 Correlator determines the transit time (τ). By knowing the distance (d) between the two sensors and the transit time, the 2109 Correlator calculates the mean solids velocity.

The DC 13 concentration sensor also employs the capacitive measuring principle. Although visibly similar to the DK 13 velocity sensor, it has only one capacitance sensor.

The change in capacitance (in relation to an empty sensor) is proportional to the solids concentration. The capacitance measurement yields a voltage, which is changed to a frequency signal and transmitted to the 2109 Correlator.

DK 13 Velocity Sensor

The DK 13 sensor consists of an inner liner made of a woven epoxy resin to which the electrodes of the capacitance sensor are mounted. The counter electrode, slightly more than one quarter of the diameter, runs the entire length of the liner. The electrodes are fixed at a distance of 0.315 in (8mm) apart (Appendix Figure A-5).

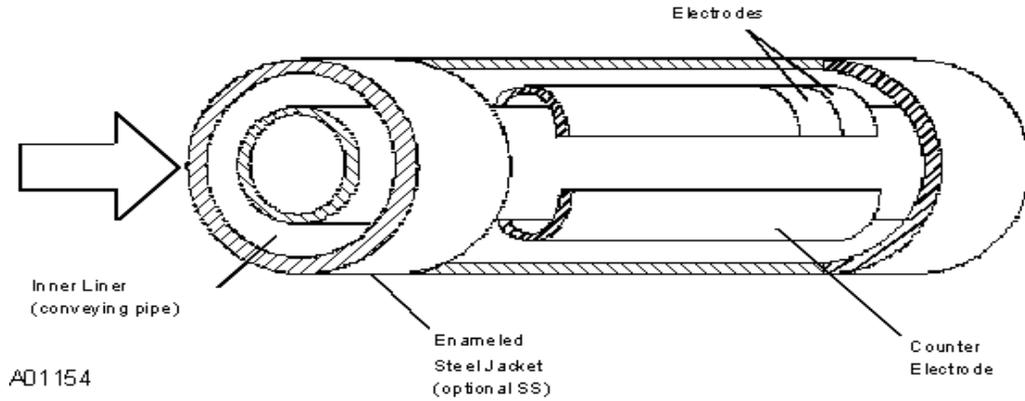


Figure A-5. DK 13 Velocity Sensor

DC 13 Concentration Sensor

The DC 13 Sensor has the same dimensions, materials of construction and external appearance as the DK 13. The main difference is the plate configuration of the capacitor.

In the DC 13, there is only one pair of electrodes, which run the length of the sensor (Appendix Figure A-6). The signal produced by the DC 13 is a pulsed frequency output connected to the 2109 Correlator transmitter using a two-wire cable. Internal adjustments are not required on the DC 13 sensor during calibration.

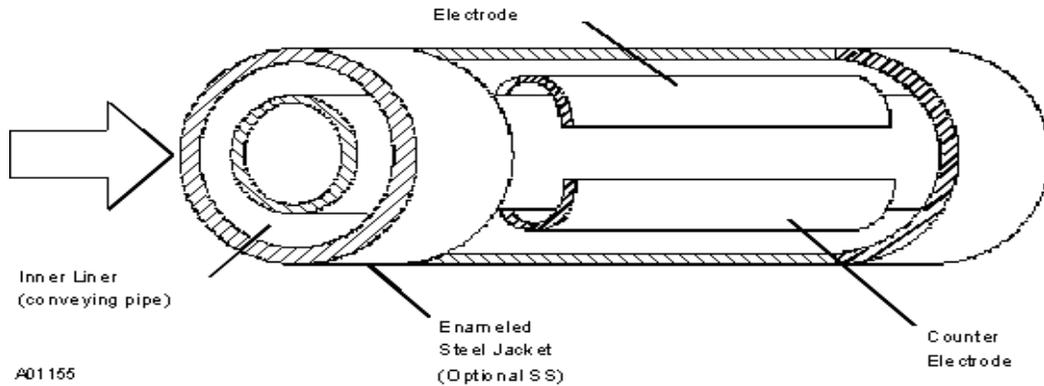


Figure A-6. DC 13 Concentration Sensor

DK 13 Sensor Specifications

Material

Tube: Steel, painted (stainless steel optional)

Electronics Housing: Cast aluminum (hazardous Class I optional)

Fittings

Flanges, ANSI, tongue and groove or DIN

Installed height (H) as per dimensions table

Environmental

Permissible temperature range:

In measuring tube <300° F

Ambient temperature -4° to +140° F

Storage temperature -40° to +165° F

Voltage supply

Must be specified when ordering system

Alternating voltage

10 V, 115 V, 220 V, 230 V; +15 to -10%, 50/60 Hz

Direct voltage

24 V (non-hazardous housings only)

Power consumption

Maximum 4.5 VA

Outputs

2 x ± 10 V, protected against short circuit

Sensitivity

1: 10

Empty pipe capacitance

Approximately 40 pF

Capacitance in full pipe

Depends on solids

Bandwidth of output signal

Up to 5 kHz

Solids loading

Minimum 3 to 1 lb/lb (mass ratio solids/gas)

Signal transmission cable

3-wire shielded, 25 ohms per wire max. resistance, 2000 ft. max. length

DC 13 Sensor Specifications

Installation position

Vertical, with material flow downward if possible

Upstream distance

20 diameters of straight pipe is required

Downstream distance

10 diameters of straight pipe is required

Material

Tube: Steel, painted (stainless steel optional)

Electronics Housing: Cast aluminum (hazardous Class I optional)

Fittings

Flanges, ANSI, tongue and groove or DIN

Nominal pressure and installed height (H) as per Table A-1

Environmental

Permissible temperature range:

In measuring tube <300° F

Ambient temperature -4° to +140° F

Storage temperature -40° to +165° F

Voltage supply

Must be specified when ordering system

Alternating voltage

10 V, 115 V, 220 V, 230 V; +15 to -10%, 50/60 Hz

Direct voltage

24 V (non-hazardous housings only)

Power consumption

Maximum 4.5 VA

Output

Basic current of approximately 4.4 mA superimposed by pulses of approximately 6.2 mA. Pulse duration 100 μ S \pm 5%

Frequency

56 to 2600 Hz

Solids loading, m

Minimum 3 to 1 lb/lb (mass ratio solids/gas mass)

Sensitivity

1024 Hz (of two-phase-flow)

Response value

<10⁻³

<4 x 10⁻³

Empty pipe capacitance

Approximately 0.75 pF

Response time

<1 second

Signal Transmission Cable

2-wire, shielded, 25 ohms per wire max. Resistance, 2000 ft. max. length

Installation position

Vertical, with material flow downward, if possible

Upstream Length

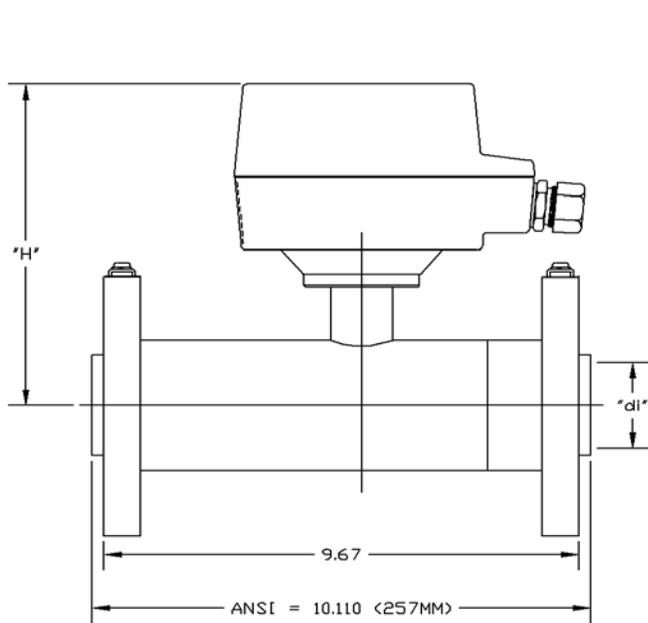
20 diameters of straight pipe required

Downstream Length

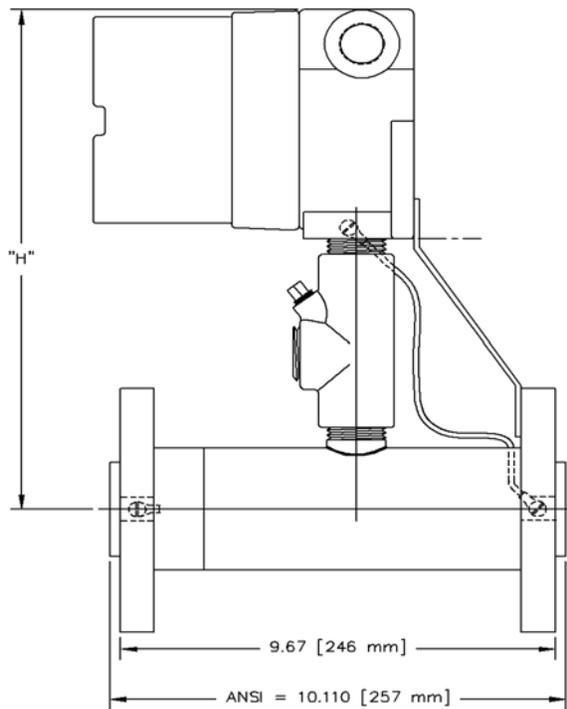
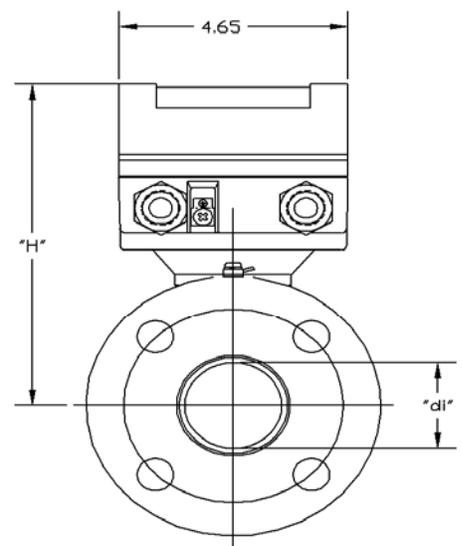
10 diameters of straight pipe required



NOTE. Please compare local nominal voltage and ordered options with data on the labels before connecting the system.



Non-hazardous
(A97010 – reference dwg C07298L-B006)



Hazardous
(A97011 – reference dwg C07298T-B008)

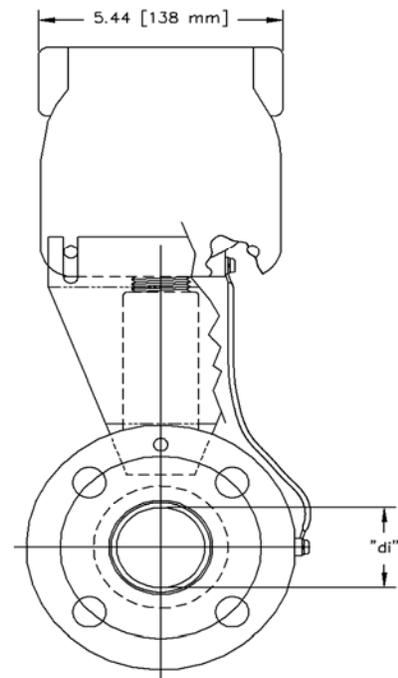


Figure A-7. Typical DK 13 and DC 13 Dimensions

General Installation Guidelines

Installation procedures should be a combination of the end user's best engineering practices in compliance with local codes and the manufacturer's recommendations. To achieve maximum performance within the parameters designed into the system, certain precautions should be observed.

1. Care should be taken to avoid ingress of moisture through the conduit. Drip loops or conduit runs which slope down from instrument enclosures are suggested, in conjunction with sealing of conduit entries.
2. Ensure adequate grounding for proper instrumentation operation. This is accomplished by connecting the third wire power ground when wiring the system. The sensor housing ground should be connected to the adjacent flange-grounding lug.
3. Process line size should be the same as the sensor mounting size to minimize sensor liner wear during operation.
4. A vertical installation is preferred, with the process flow either up or down to eliminate settling of solids in the sensors when the process is not running.
5. Minimize vibration by rigidly securing the process pipeline as close to the sensors as possible.
6. To maintain proper sensor-to-process pipeline alignment, a flange mounting kit is available. Ensure proper alignment to avoid excessive sensor wear.

Sensor Mounting

The DK 13 and DC 13 sensors are mounted as shown in Figure A-8. Vertical mounting is recommended, with the process flowing upwards or downwards during normal flow.

This also allows solids to drop out of the measuring sensors during a no flow condition, preventing false zero point measurements. The orientation of the sensor with conduit entries facing down prevents ingress of moisture into the electronics housing.

The recommended inlet and outlet straight pipe runs are shown in Figure A-8 whenever sensor must be mounted between on-straight pipe runs.

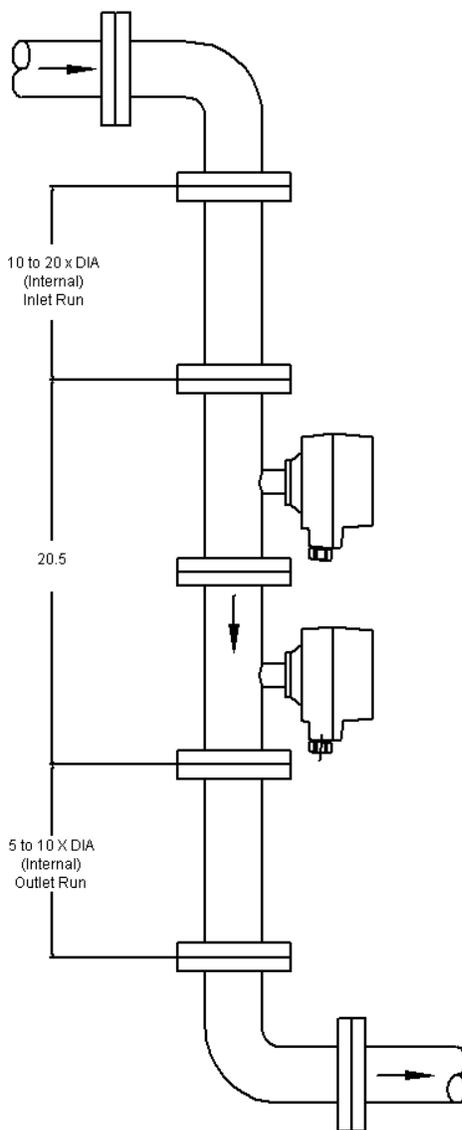


Figure A-8. Vertical Sensor Mounting
(reference drawing B7298L-Y006)

Sensor Wiring

All wiring of the Micro-Tech 2109 system should be made in accordance with local codes. Sensors include 1/2" NPT conduit entries on non-hazardous units and 3/4" NPT on Hazardous units. The following recommendations are for conduit installation:

1. Fish wires through conduit to sensor housing.
2. Remove conduit adapter from cable entry and slide back over wires.
3. Fish wires through rubber seal fitting into electronic enclosure.
4. Connect wires to terminals according to wiring diagrams.
5. Reattach conduit adapters and tighten to activate seals.
6. Connect and tighten conduit into adapter while holding conduit adapter.



WARNING. The Micro-Tech 2109 system contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation, or other handling of internal boards or devices.



NOTE. This system is not unique in its content of ESD (Electrostatic Discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, CMOS, etc). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

When wiring or working with internal components, a static discharge wristband, or other appropriate static discharge device should be worn.

Power input and signal output wiring should be installed through separate conduit entries. Wiring blocks are located inside the housing with captive barrier screw terminals.



NOTE. For proper system operation, connect a wire between each housing external grounding lug and the sensor flange-grounding lug.

1. Loosen four housing cover screws or unscrew Class I cover.
2. Remove housing cover; locate terminal blocks on PC board.
3. Wire according to Figure A-9, tighten terminal screws.



NOTE. DK 13 requires 3-conductor shielded cable for signal output; the DC 13 requires 2- conductor shielded cable.

4. Install housing cover and tighten screws.

Sensor Calibration

Sensors are factory calibrated for PFM output. Any further calibration is performed through the Micro-Tech 2109.

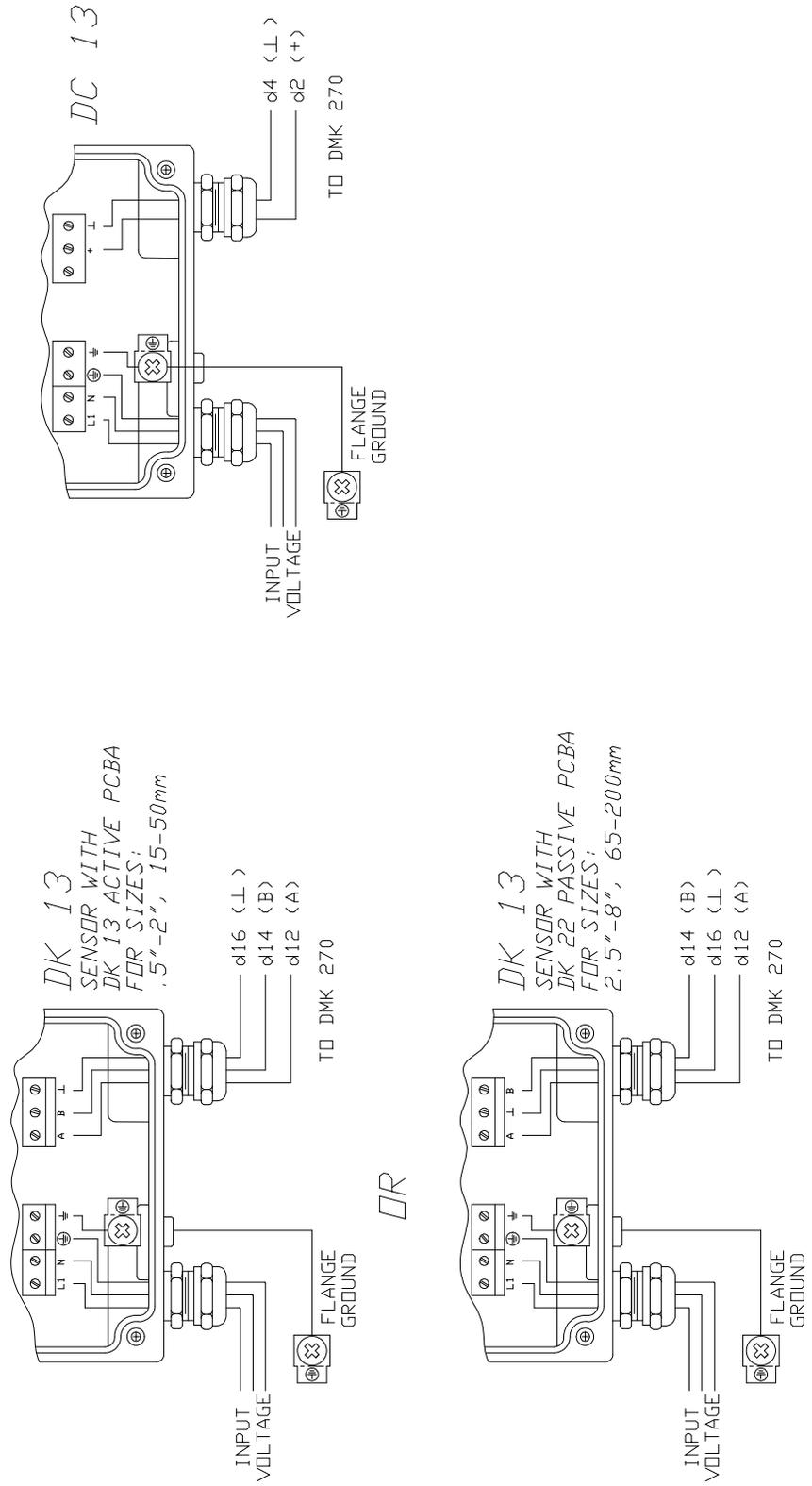
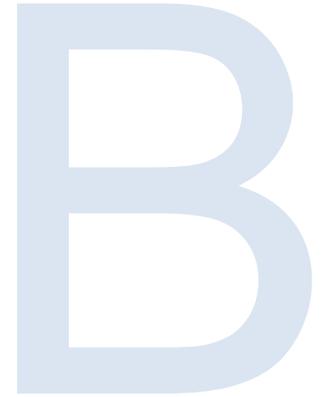


Figure A-9. Sensor Wiring

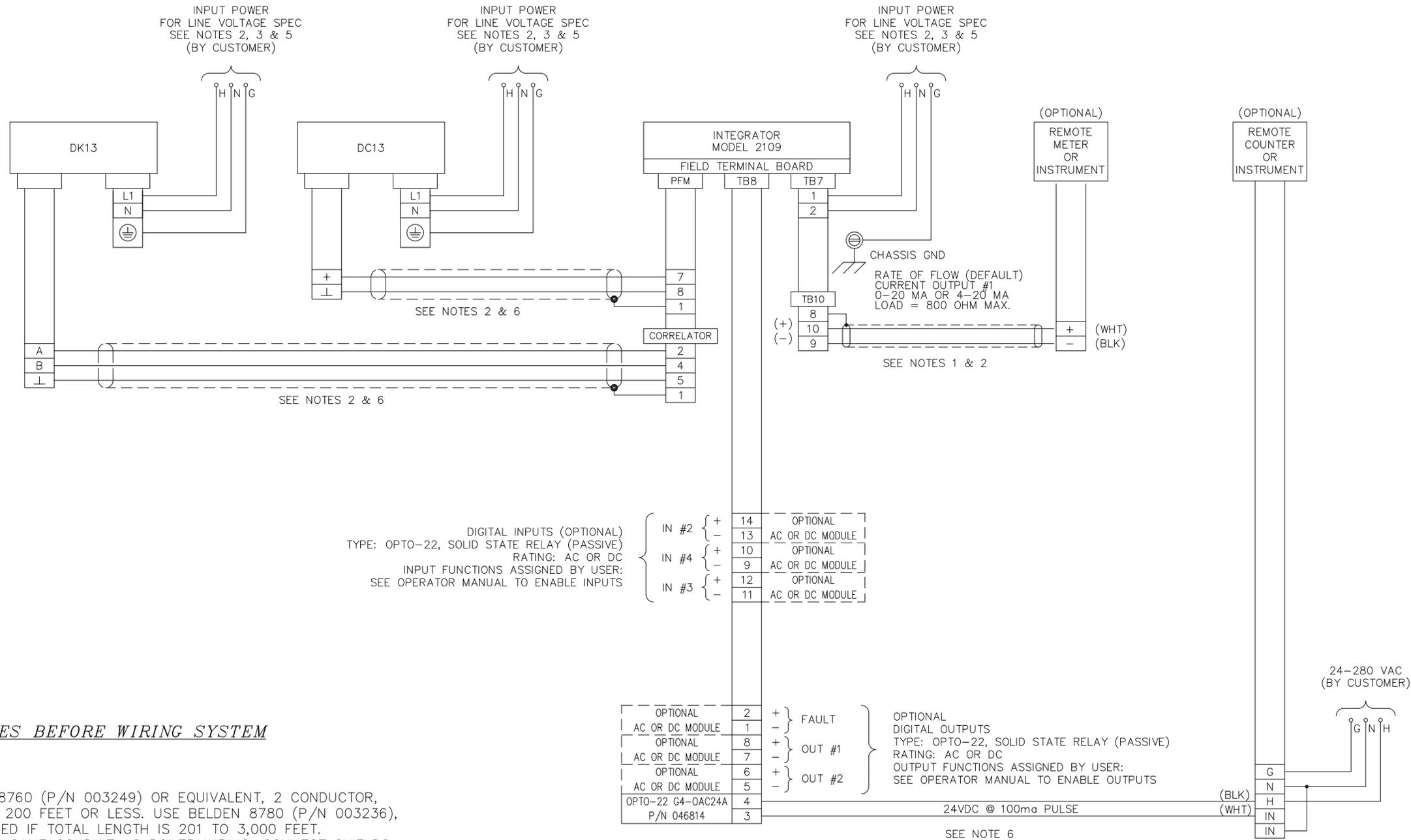
A01158



Appendix B Engineering Drawings

This appendix contains the engineering drawings pertaining to the Micro-Tech 2109 Correlator field and panel mount options.

- Field Wiring Diagram, 2109 Field Mount and DC 13, DK 13
D07280N-A001
- Field Wiring Diagram, 2109 Field Mount and DC 13, DK 13, Dual I Out
D07280N-A011
- Field Wiring Diagram, 2109 Panel Mount and DC 13, DK 13
D07280N-B001
- Field Wiring Diagram, 2109 Panel Mount and DC 13, DK 13, DK13, Dual I Out
D07280N-B011
- Outline and Mounting 2000 Series Field Mount
D07257B-B001
- Outline and Mounting 2000 Series Panel Mount
D07257B-B002
- Outline and Mounting DC 13/DK 13 DIN
C07298L-B001
- Outline and Mounting DC 13/DK 13 ANSI 150 Lb.
C07298L-B003
- Outline and Mounting DC13, DK13, ANSI 300 lb.
C07298L-B006
- Outline and Mounting, DC13, DK13, ANSI 600 lb.
C07298L-B015
- Outline & Mounting, DC13, DK13, ANSI 300 lb, Class I
C07298T-B006
- Outline and Mounting, DC13, DK13, ANSI 600 lb, Class I
C07298T-B015



IMPORTANT: READ ALL NOTES BEFORE WIRING SYSTEM

NOTES:

- ANALOG OUTPUT: USE BELDEN 8760 (P/N 003249) OR EQUIVALENT, 2 CONDUCTOR, 18 AWG, SHIELDED IF TOTAL IS 200 FEET OR LESS. USE BELDEN 8780 (P/N 003236), 2 CONDUCTOR, 16 AWG, SHIELDED IF TOTAL LENGTH IS 201 TO 3,000 FEET.
- DO NOT RUN SIGNAL CABLES IN SAME CONDUIT AS POWER WIRING. CONNECT SHIELDS ONLY WHERE SHOWN.
- INPUT POWER REQUIREMENTS (FACTORY SET AT 120 VAC)
FOR DC/DK 13 VOLTAGE CHANGE, SEE MANUAL.
FOR 2109 VOLTAGE CHANGE, SEE MANUAL PLUS 2109 SELECTOR SWITCHES.
A. 110 VAC +10%/-15% 1/2 AMP 50 VA, 50/60 HZ
B. 120 VAC +10%/-15% 1/2 AMP 50 VA, 50/60 HZ
C. 220 VAC +10%/-15% 1/4 AMP 50 VA, 50/60 HZ
D. 240 VAC +10%/-15% 1/4 AMP 50 VA, 50/60 HZ
- EARTH GROUND ALL ELECTRICAL ENCLOSURES.
- ALL WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE AND ALL LOCAL CODES. ALL WIRING, EXCEPT AS NOTED, IS THE RESPONSIBILITY OF THE CUSTOMER.
- DIGITAL INPUTS AND OUTPUTS: USE BELDEN 8760 (P/N 003249) OR EQUIVALENT, 2 CONDUCTOR, 18 AWG SHIELDED CABLE OR USE BELDEN 8772 (P/N 002346) OR EQUIVALENT, 3 CONDUCTOR, 20 AWG SHIELDED CABLE MAXIMUM DC/DK 13 SIGNAL CABLE LENGTH 1000 FT. MAXIMUM 2109 INPUTS/OUTPUTS SIGNAL CABLE LENGTH 400 FT.

DIGITAL INPUTS (OPTIONAL)
TYPE: OPTO-22, SOLID STATE RELAY (PASSIVE)
RATING: AC OR DC
INPUT FUNCTIONS ASSIGNED BY USER:
SEE OPERATOR MANUAL TO ENABLE INPUTS

IN #2	+	14	OPTIONAL
	-	13	AC OR DC MODULE
IN #4	+	10	OPTIONAL
	-	9	AC OR DC MODULE
IN #3	+	12	OPTIONAL
	-	11	AC OR DC MODULE

OPTIONAL	2	+	FAULT	OPTIONAL
AC OR DC MODULE	1	-		
OPTIONAL	8	+	OUT #1	OPTIONAL
AC OR DC MODULE	7	-		
OPTIONAL	6	+	OUT #2	OPTIONAL
AC OR DC MODULE	5	-		
OPTO-22 G4-OAC24A P/N 046814	4			
	3			24VDC @ 100ma PULSE

SEE NOTE 6

CADD DATABASE: AUTOCAD

DO NOT SCALE DWG	SCALE	N/A
REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	JOB NO	
TOLERANCE UNLESS SPECIFIED	ENG	JEF
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.XX ± .03	DWN	KIM
.XXX ± .01	DATE	1/24/01
FRACT ± 1/16	CHK	JEF
ANGLES ± 1/2°	DATE	1/25/01

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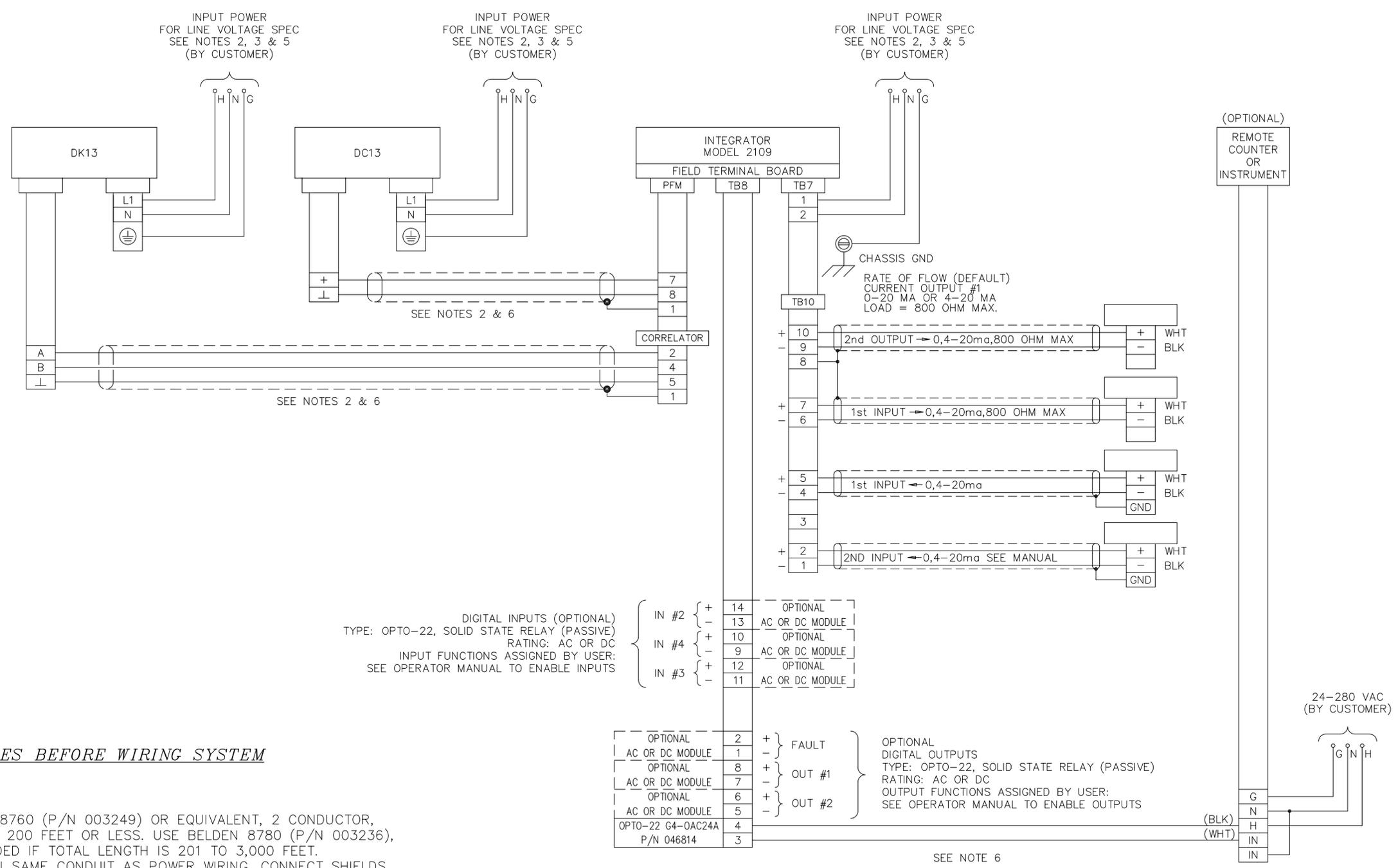
Thermo
ELECTRON CORPORATION

FIELD WIRING DIAGRAM
GRANUCOR SYSTEM WITH
2109 FIELD MOUNT AND
DK13, DK13

PART NO	DRAWING NUMBER	REV
	D07280N-A001	D

REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD
D	3228		DC WAS WIRED TO TB9	7/22/03	KIM	RWT
C	2967		UPDATE TO THERMO	1/29/02	KIM	WMR
B	2670		ADDED WIRING NOTES	4/30/01	KIM	RWT
A	1256		RELEASED	1/25/01	KIM	JEF

ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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IMPORTANT: READ ALL NOTES BEFORE WIRING SYSTEM

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- DO NOT RUN SIGNAL CABLES IN SAME CONDUIT AS POWER WIRING. CONNECT SHIELDS ONLY WHERE SHOWN.
- INPUT POWER REQUIREMENTS (FACTORY SET AT 120 VAC)
FOR DC/DK 13 VOLTAGE CHANGE, SEE MANUAL.
FOR 2109 VOLTAGE CHANGE, SEE MANUAL PLUS 2109 SELECTOR SWITCHES.
A. 110 VAC +10%/-15% 1/2 AMP 50 VA, 50/60 HZ
B. 120 VAC +10%/-15% 1/2 AMP 50 VA, 50/60 HZ
C. 220 VAC +10%/-15% 1/4 AMP 50 VA, 50/60 HZ
D. 240 VAC +10%/-15% 1/4 AMP 50 VA, 50/60 HZ
- EARTH GROUND ALL ELECTRICAL ENCLOSURES.
- ALL WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE AND ALL LOCAL CODES. ALL WIRING, EXCEPT AS NOTED, IS THE RESPONSIBILITY OF THE CUSTOMER.
- DIGITAL INPUTS AND OUTPUTS: USE BELDEN 8760 (P/N 003249) OR EQUIVALENT, 2 CONDUCTOR, 18 AWG SHIELDED CABLE OR USE BELDEN 8772 (P/N 002346) OR EQUIVALENT, 3 CONDUCTOR, 20 AWG SHIELDED CABLE MAXIMUM DC/DK 13 SIGNAL CABLE LENGTH 1000 FT. MAXIMUM 2109 INPUTS/OUTPUTS SIGNAL CABLE LENGTH 400 FT.

DIGITAL INPUTS (OPTIONAL)
TYPE: OPTO-22, SOLID STATE RELAY (PASSIVE)
RATING: AC OR DC
INPUT FUNCTIONS ASSIGNED BY USER:
SEE OPERATOR MANUAL TO ENABLE INPUTS

IN #2	+	14	OPTIONAL
	-	13	AC OR DC MODULE
IN #4	+	10	OPTIONAL
	-	9	AC OR DC MODULE
IN #3	+	12	OPTIONAL
	-	11	AC OR DC MODULE

OPTIONAL	2	+	FAULT	OPTIONAL DIGITAL OUTPUTS TYPE: OPTO-22, SOLID STATE RELAY (PASSIVE) RATING: AC OR DC OUTPUT FUNCTIONS ASSIGNED BY USER: SEE OPERATOR MANUAL TO ENABLE OUTPUTS
AC OR DC MODULE	1	-		
OPTIONAL	8	+	OUT #1	
AC OR DC MODULE	7	-		
OPTIONAL	6	+	OUT #2	
AC OR DC MODULE	5	-		
OPTO-22 G4-OAC24A P/N 046814	4			
	3			

SEE NOTE 6

CADD DATABASE: AUTOCAD

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.XXX ± .01	KIM	2/12/03
FRACT ± 1/16	CHK	DATE
ANGLES ± 1/2°	RWT	2/12/03

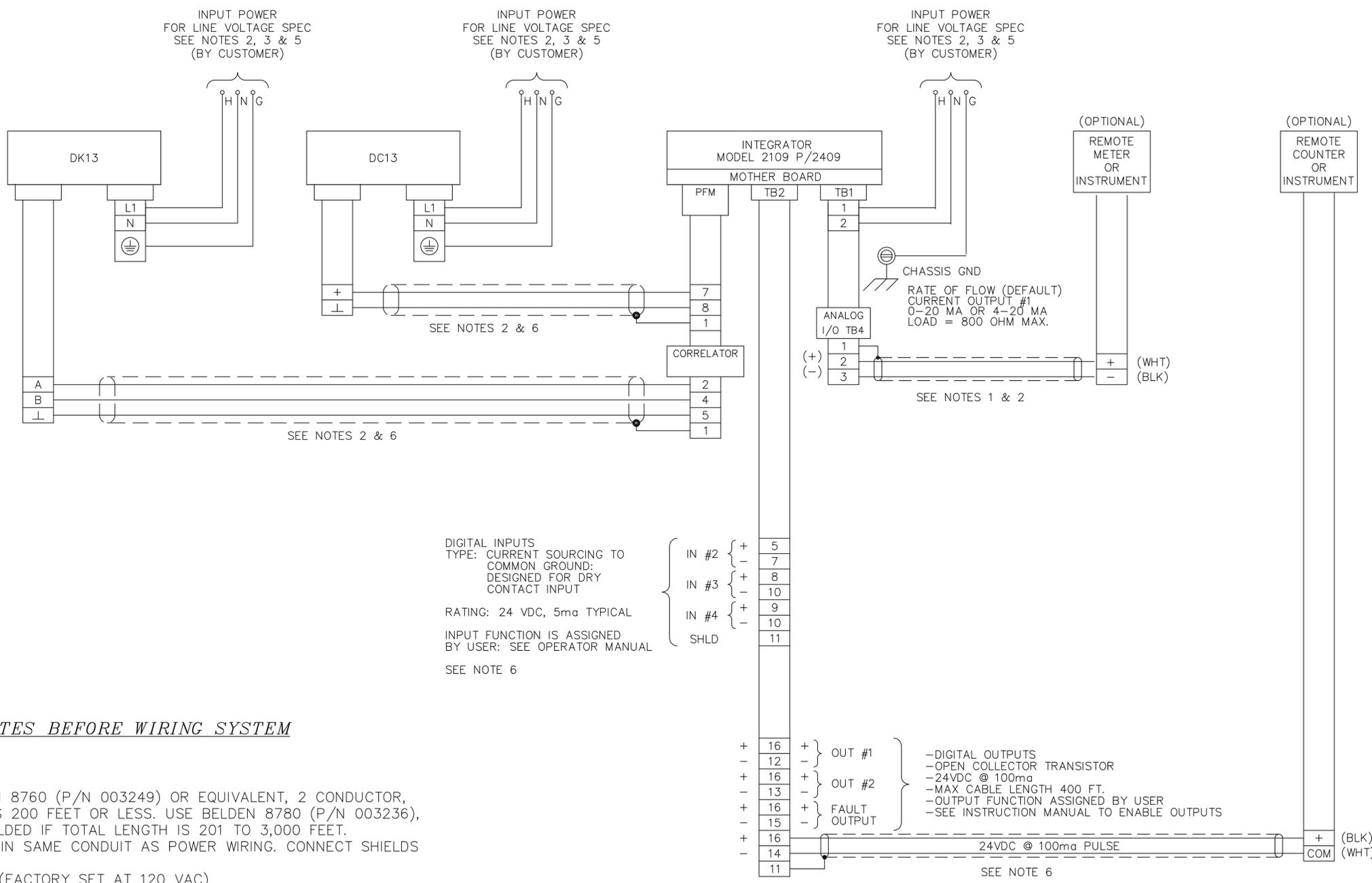
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FIELD WIRING DIAGRAM
GRANUCOR SYSTEM WITH
2109 FIELD MOUNT DUAL I-OUT/IN
AND DC13, DK13

B	3228	DC WAS WIRED TO TB9	7/22/03	KIM	RWT
A	3332	RELEASED	2/12/03	KIM	RWT
REV	ECO NO	MICRO	DATE	BY	APPD

CUSTOMER LOCATION	CUST ORDER NO	USER LOCATION
PART NO	DRAWING NUMBER	REV
	D07280N-A011	B



IMPORTANT: READ ALL NOTES BEFORE WIRING SYSTEM

NOTES:

- ANALOG OUTPUT: USE BELDEN 8760 (P/N 003249) OR EQUIVALENT, 2 CONDUCTOR, 8 AWG, SHIELDED IF TOTAL IS 200 FEET OR LESS. USE BELDEN 8780 (P/N 003236), 2 CONDUCTOR, 16 AWG, SHIELDED IF TOTAL LENGTH IS 201 TO 3,000 FEET.
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A. 110 VAC +10%/-15% 1/2 AMP 50 VA, 50/60 HZ
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C	2967	UPDATE TO THERMO	1/29/02	KIM	WMR
B	2670	ADDED WIRING NOTES	4/26/01	KIM	RWT
A	1256	RELEASED	1/25/01	KIM	JEF
REV	ECO NO	MICRO	DESCRIPTION	DATE	BY APPD

CADD DATABASE: AUTOCAD

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.XXX ± .01	KIM	1/24/01
FRACT ± 1/16	CHK	DATE
ANGLES ± 1/2°	JEF	1/25/01

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CUSTOMER LOCATION

USER LOCATION

Derived From

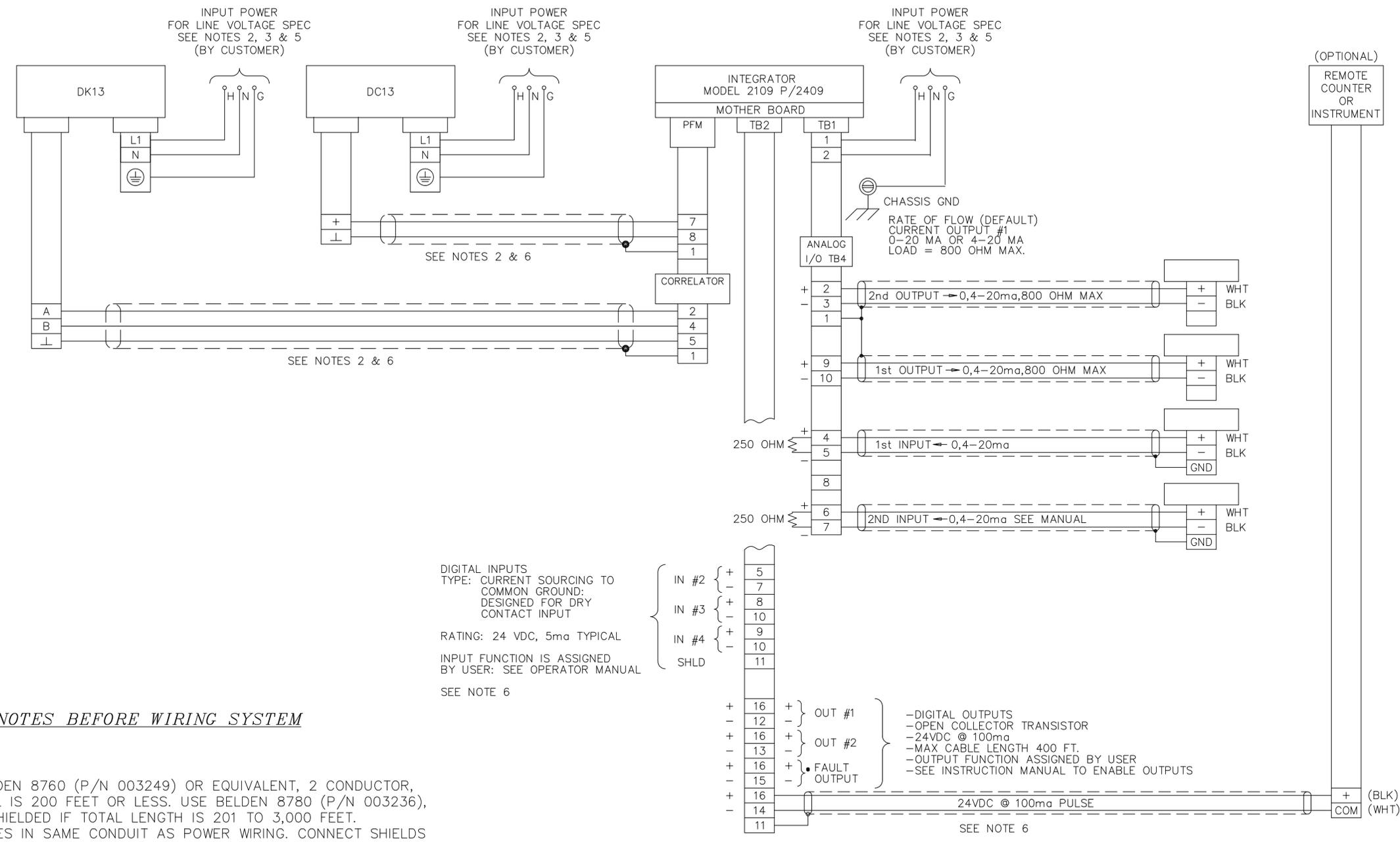
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FIELD WIRING DIAGRAM
GRANUCOR SYSTEM WITH
2109 PANEL MOUNT AND
DC13, DK13

PART NO	DRAWING NUMBER	REV
	D07280N-B001	C



IMPORTANT: READ ALL NOTES BEFORE WIRING SYSTEM

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C. 220 VAC +10%/-15% 1/4 AMP 50 VA, 50/60 HZ
D. 240 VAC +10%/-15% 1/4 AMP 50 VA, 50/60 HZ
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REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	JOB NO	ENG RWT	DATE 2/12/03
TOLERANCE UNLESS SPECIFIED		DWN	DATE 2/12/03
.X ± .06		CHK	DATE 2/12/03
.XX ± .03		RWT	
.XXX ± .01			
FRACT ± 1/16			
ANGLES ± 1/2°			
NEXT ASS'Y			
CUST ORDER NO			
CUSTOMER LOCATION			
USER LOCATION			

Thermo
ELECTRON CORPORATION

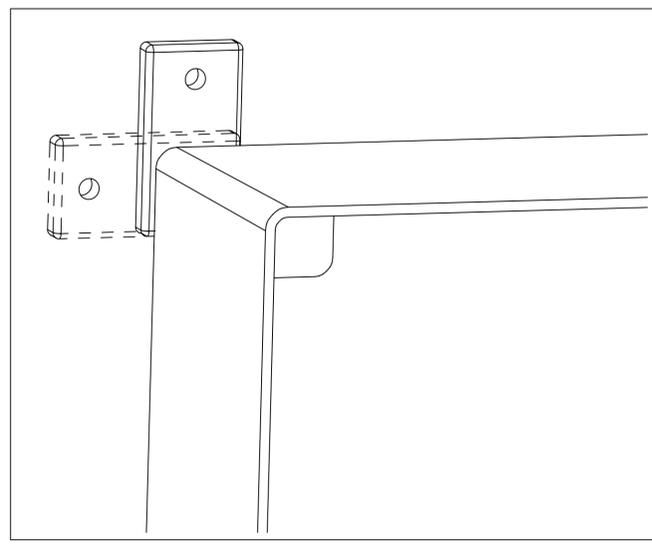
FIELD WIRING DIAGRAM
GRANUCOR SYSTEM WITH
2109 PANEL MOUNT DUAL I-OUT/IN
AND DC13, DK13

PART NO	DRAWING NUMBER	REV
D07280N-B011		A

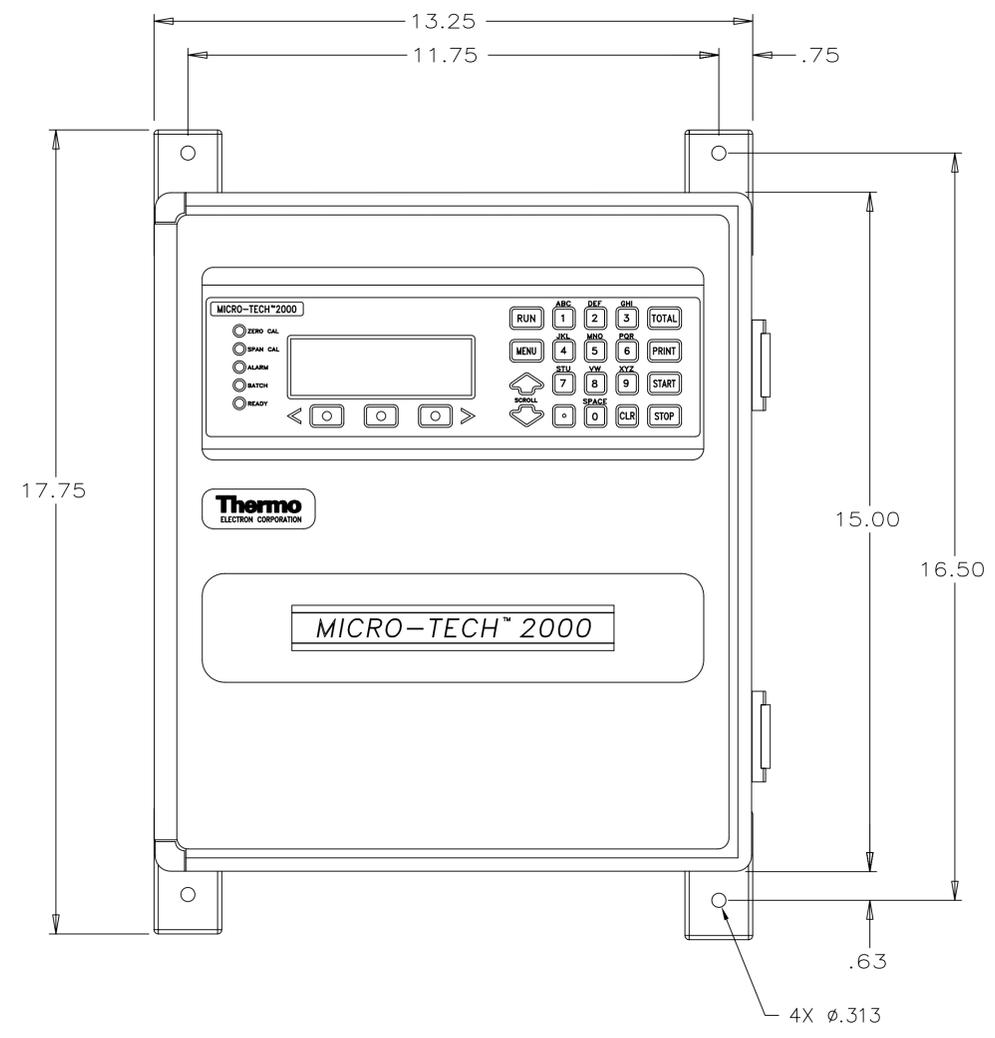
Derived From: D07280N-B001 © 2003 by Thermo Electron

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REV	ECO NO	MICRO	DESCRIPTION	DATE BY APPD

ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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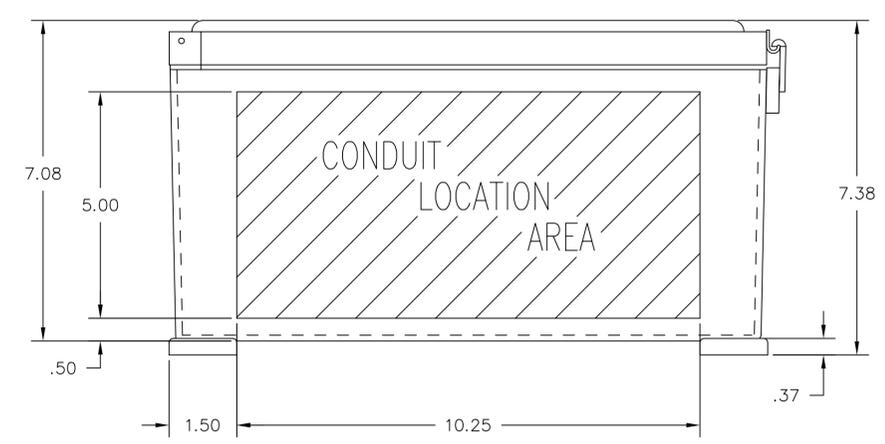


2-POSITION MOUNTING FOOT



NOTES:

- ENCLOSURE:
 - BLUE FIBERGLASS
 - NEMA-3,4X AND 12
 - IP 61 THROUGH 65
 - TWO LOCKABLE, QUICK RELEASE STAINLESS STEEL LATCHES
 - UL TYPE 4X CLEAR ACRYLIC WINDOW
- ALL CONDUIT ENTRANCES TO BE MADE THROUGH BOTTOM OF ENCLOSURE.
- NON-METALLIC ENCLOSURE DOES NOT PROVIDE GROUND BONDING BETWEEN CONDUIT ENTRIES. SUITABLE GROUND BONDING MUST BE PROVIDED AT INSTALLATION.



CADD DATABASE: AUTOCAD

DO NOT SCALE DWG	SCALE	NONE
REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	JOB NO	
TOLERANCE UNLESS SPECIFIED	ENG	DATE
.x ± .06	IEG	2-23-95
.xx ± .03	DWN	TP
.xxx ± .01	TP	2-23-95
FRACT ± 1/16	CHK	IEG
ANGLES ± 1/2°	IEG	4-7-95

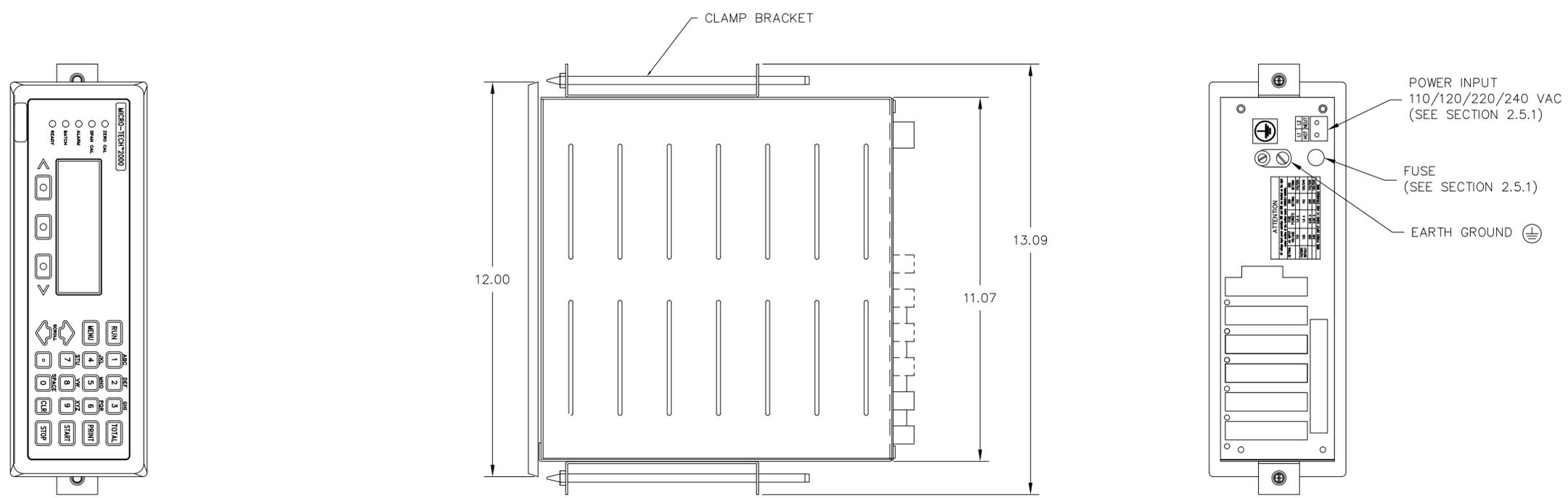
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REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD
G	0554		CHANGE LABELING	2/7/05	SJL	SJL
F	2548		CHANGE LABELING	2/15/01	KIM	WMR

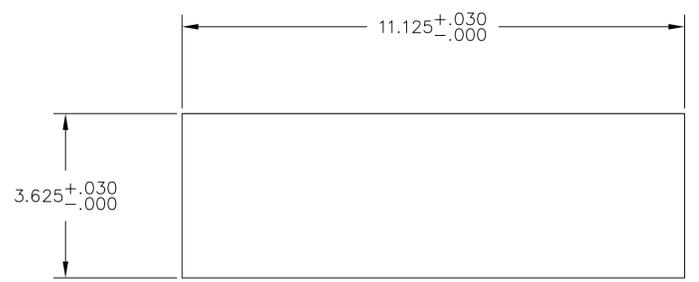
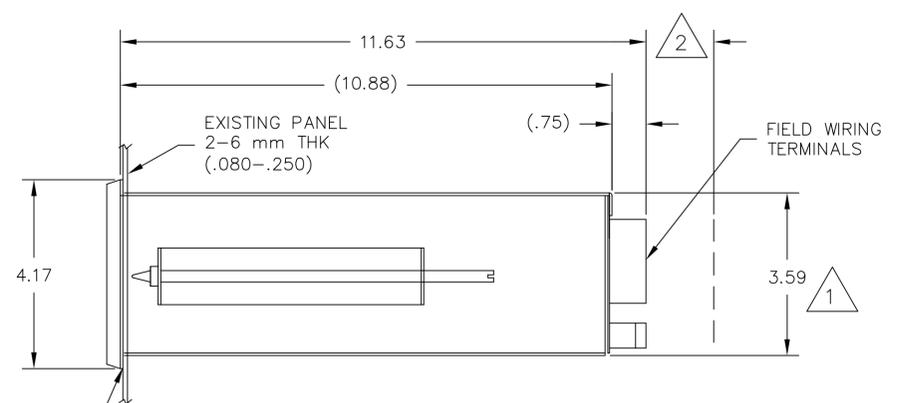
NEXT ASS'Y	
CUST ORDER NO	
CUSTOMER LOCATION	
USER LOCATION	

PART NO	DRAWING NUMBER	REV
048691	D07257B-B001	G



NOTES:

1. TWO INCH MINIMUM CLEARANCE REQUIRED ABOVE AND BELOW INTEGRATOR TO PROVIDE FOR CONVECTION COOLING.
2. ADDITIONAL CLEARANCE REQUIRED AT REAR OF INTEGRATOR FOR WIRING ACCESS.
3. REFER TO DRAWING FOR PANEL CUTOUT DIMENSIONS. USE CAUTION WHEN CUTTING PANEL. DIMENSIONAL CLEARANCE TOLERANCES ARE MINIMAL. DO NOT OVERSIZE CUTOUT.
4. REMOVE "KNOCK-OUT" MATERIAL FROM GASKET. ATTACH GASKET TO PANEL. AVOIDING WRINKLES OR TEARS.
5. REMOVE CLAMP BRACKETS FROM INTEGRATOR AND SLIDE CHASSIS THROUGH FRONT OF CUTOUT. RE-INSTALL CLAMP BRACKETS AND TIGHTEN THREADED RODS AGAINST BACK OF PANEL. SLIGHTLY COMPRESSING GASKET TO FORM DUST SEAL. DO NOT OVERTIGHTEN.



PANEL MOUNT CUTOUT SIZE

RUBBER GASKET
.06" THICK

REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD
E	1164		REVISED BEZEL, ADDED NAMETAG	8/15/06	KIM	KIM
D	2548		CHANGE BEZEL	2/15/01	KIM	WMR
C	0918		ADD END VIEW AND LABELS	3/17/98	KIM	WMR
B	9742	CMA	ADD NOTES TO DRAWING	4/19/96	EBJ	WMR
A	9053	CMA	RELEASED	10/27/95	SBG	WMR

DO NOT SCALE DWG		SCALE 1/2	
REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES		JOB NO	
TOLERANCE UNLESS SPECIFIED		ENG	DATE 4/4/95
.x	± .06	OWN	DATE 4/4/95
.xx	± .03	TP	DATE 4/4/95
.xxx	± .01	CHK	DATE 4/4/95
FRACT	± 1/16		
ANGLES	± 1/2°		
NEXT ASS'Y			
CUST ORDER NO			
CUSTOMER LOCATION			
USER LOCATION			

CADD DATABASE: AUTOCAD

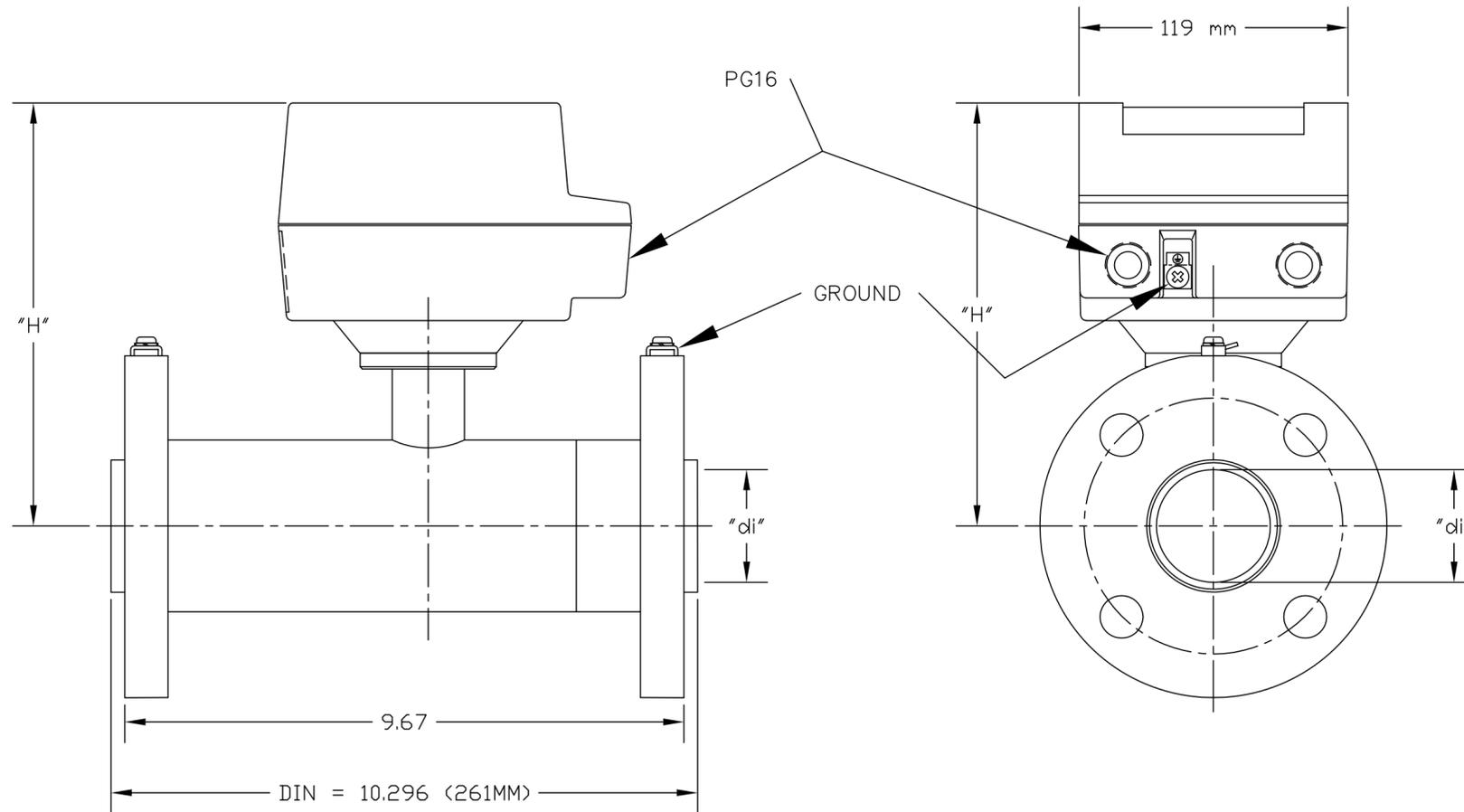
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OUTLINE & MOUNTING
PANEL MOUNT
MICRO-TECH 2000

PART NO	DRAWING NUMBER	REV
048690	D07257B-B002	E

ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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NOTES:

1. SEE MANUAL FOR INSTALLATION.
2. BOLT HOLES ARE 2 mm LARGER THAN BOLT DIAMETER.
3. MATERIAL:
 FLANGE FACE - SS 316
 FLANGE BODY - CS, PAINTED
 SENSOR BODY - CS, PAINTED
 ENCLOSURE - CAST ALUMINUM
4. RECOMMENDED FLANGE MATE IS PER DRAWING C07298L-B100 OR C07298L-B101. FLANGE STYLED AFTER DIN 2501/2513 BUT WITH CENTERING RING AND TIGHTER TOLERANCE TO PREVENT MISALIGNMENT.
5. RECOMMENDED GASKETS PER B07298L-B201
6. MAXIMUM PRESSURE IS 6 BAR, 87 PSI.

NOMINAL PIPE SIZE				APPROX. WEIGHT (Kgs)*	FLANGE (mm)				FLANGE RATING T < 300°F (BAR)
in	mm	H (mm)	di (mm)		FLANGE OD	# OF HOLES	BOLT DIA. SEE NOTE #2	BOLT CIRCLE DIAMETER	
.5	15	185	15	3.7	95	4	M12	65	40
.75	20	190	20	4.6	105	4	M12	75	40
1.0	25	193	25	5.2	115	4	M12	85	40
1.25	32	197	32	5.7	140	4	M16	100	40
1.5	40	201	40	5.9	150	4	M16	110	25
2.0	50	207	50	8.9	165	4	M16	125	16
2.50	65	215	65	11.5	185	8	M16	145	16
3.0	80	225	80	13.1	200	8	M16	160	16
4.0	100	237	100	13.5	220	8	M16	180	10
5.0	125	255	125	18	250	8	M16	210	10
6.0	150	267	150	23	285	8	M20	240	10
8.0	200	295	200	36	340	8	M20	295	6

CADD DATABASE: AUTOCAD

DO NOT SCALE DWG REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	SCALE 1/2	JOB NO
TOLERANCE UNLESS SPECIFIED	ENG RWT DATE 12/3/97	DWN KIM DATE 12/3/97
.X ± .06	CHK RWT DATE 12/9/97	
.XX ± .03		
.XXX ± .01		
FRACT. ± 1/16		
ANGLES ± 1/2°		

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OUTLINE AND MOUNTING
 DC 13 AND DK 13
 DIN CS/SS
 GRANUCOR

REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD
E	1562		FLANGE RATING ON 1.25 PIPE WAS: 25	8-24-07	GDK	RWT
D	1363		REVISED CHART	2/15/07	GDK	RWT
C	0863		CHANGE FORMAT	6/15/05	LB	RWT
B	2579		ADD NOTES 4, 5, 6 & FLG RATING, CHG "H" DIM	2/20/01	KIM	RWT
A	0716	JKM	RELEASED	12/9/97	KIM	RWT

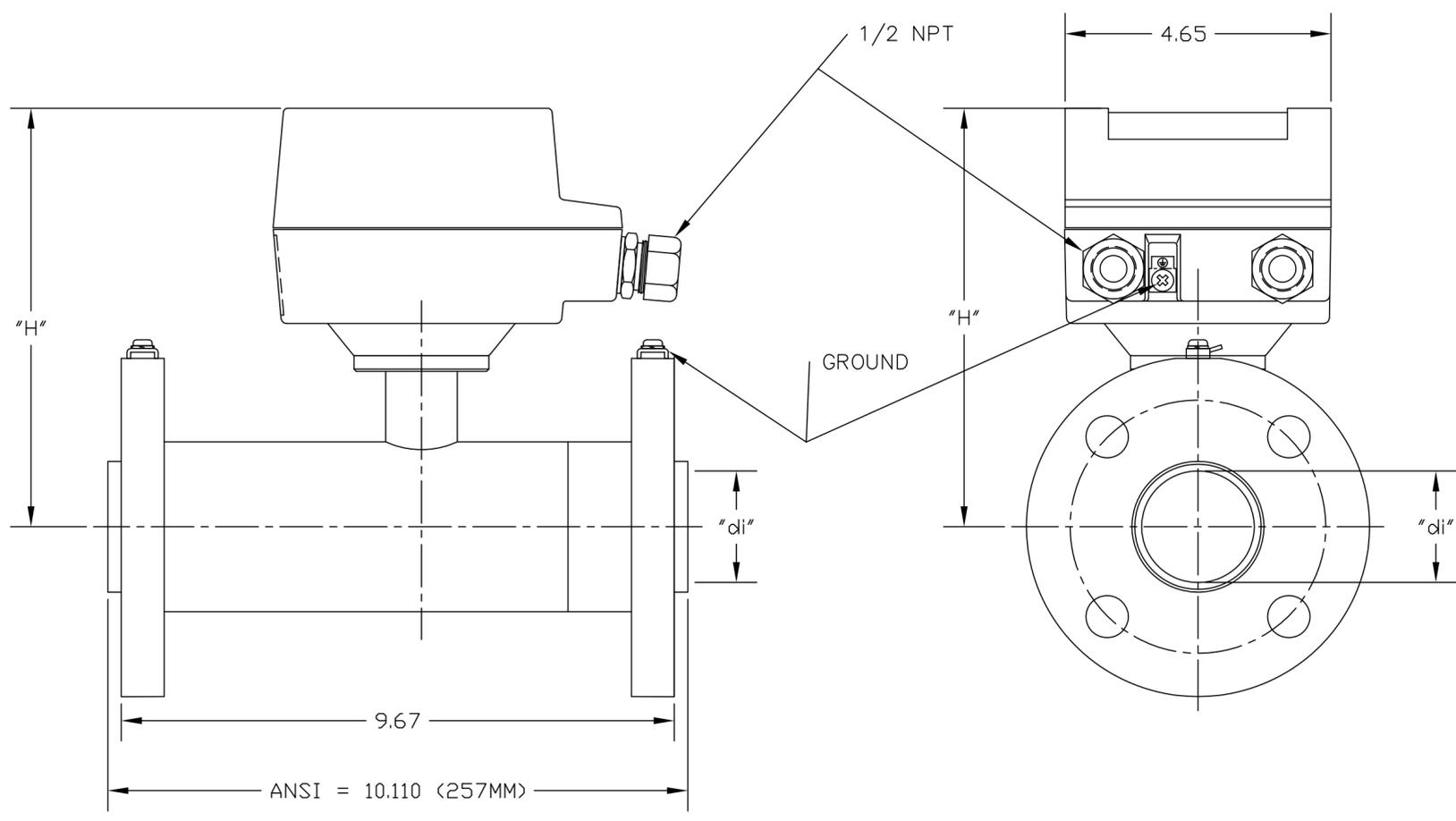
NEXT ASS'Y	
CUSTOMER LOCATION	
USER LOCATION	

PART NO	DRAWING NUMBER	REV
	C07298L-B001	E

Derived From C07298L-Y007

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ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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NOTES:

1. SEE MANUAL FOR INSTALLATION.
2. BOLT HOLES ARE 1/8" LARGER THAN BOLT DIAMETER.
3. MATERIAL:
FLANGE/BODY - CS, PAINTED
ENCLOSURE - CAST ALUMINUM
4. RECOMMENDED FLANGE MATE IS PER DRAWING C07298L-B103

NOMINAL PIPE SIZE				APPROX. WEIGHT (LBS)*	FLANGE (in)				FLANGE RATING T < 300°F (PSI)
in	mm	H (in)	di (in)		FLANGE O.D.	# OF BOLTS	BOLT DIA. SEE NOTE #2	BOLT CIRCLE DIAMETER	
.5	15	7.29	.591	7.5	3.50	4	1/2	2.38	230
.75	20	7.49	.794	10	3.88	4	1/2	2.75	230
1.0	25	7.61	.984	11.5	4.25	4	1/2	3.13	230
1.25	32	7.87	1.26	12.5	4.63	4	1/2	3.50	230
1.5	40	7.92	1.575	13	5.00	4	1/2	3.88	230
2.0	50	8.16	1.969	19.5	6.00	4	5/8	4.75	230
2.50	65	8.75	2.559	25.4	7.00	4	5/8	5.50	230
3.0	80	8.87	3.150	29	7.50	4	5/8	6.00	230
4.0	100	9.34	3.937	29.5	9.00	8	5/8	7.50	230
5.0	125	10.12	4.921	39.7	10.00	8	3/4	8.50	230
6.0	150	10.52	5.906	51	11.00	8	3/4	9.50	230
8.0	200	11.62	7.874	79.5	13.50	8	3/4	11.75	230

CADD DATABASE: AUTOCAD

DO NOT SCALE DWG REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	SCALE 1/2	JOB NO
TOLERANCE UNLESS SPECIFIED	ENG RWT	DATE 12/3/97
.X ± .06	DWN	DATE 12/3/97
.XX ± .03	KIM	
.XXX ± .01	CHK	DATE 12/9/97
FRACT. ± 1/16	RWT	
ANGLES ± 1/2°		

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OUTLINE AND MOUNTING
DC13 AND DK13
ANSI CS 150 LB SMALL TONGUE
AND GROOVE, GRANUCOR

D	1605		REVISED FLANGE RATINGS	9-18-07	GDK	RWT
C	0863		CHANGE FORMAT	6/15/05	LB	RWT
B	2579		ADD NOTE 4, 5 & FLG RATING, CHG "H" DIM	2/20/01	KIM	RWT
A	0716	JKM	RELEASED	12/9/97	KIM	RWT
REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD

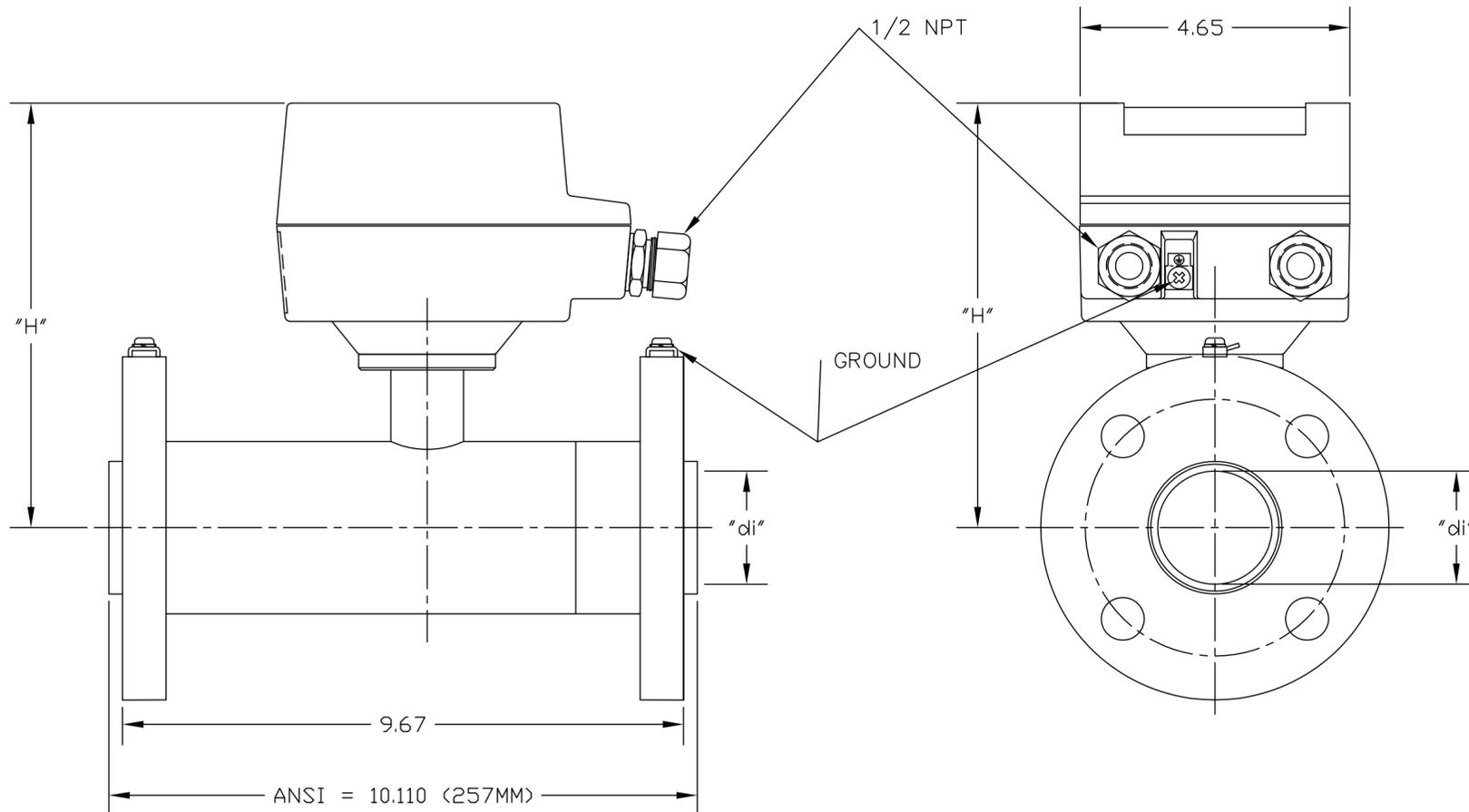
NEXT ASS'Y	
CUST ORDER NO	
CUSTOMER LOCATION	
USER LOCATION	

PART NO	DRAWING NUMBER	REV
	C07298L-B003	D

Derived From C07298L-Y007

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ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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NOTES:

1. SEE MANUAL FOR INSTALLATION.
2. BOLT HOLES ARE 1/8" LARGER THAN BOLT DIAMETER.
3. MATERIAL:
FLANGE/BODY - CS, PAINTED
ENCLOSURE - CAST ALUMINUM
4. RECOMMENDED FLANGE MATE IS PER DRAWING C07298L-B106

NOMINAL PIPE SIZE				APPROX. WEIGHT (LBS)*	FLANGE (in)				FLANGE RATING T < 300°F (PSI)
in	mm	H (in)	di (in)		FLANGE O.D.	# OF BOLTS	BOLT DIA. SEE NOTE #2	BOLT CIRCLE DIAMETER	
.5	15	7.29	.591	8	3.75	4	1/2	2.625	655
.75	20	7.49	.794	12	4.63	4	5/8	3.125	655
1.0	25	7.61	.984	15	4.88	4	5/8	3.50	655
1.25	32	7.87	1.26	17	5.25	4	5/8	3.875	655
1.5	40	7.92	1.575	21	6.13	4	3/4	4.50	655
2.0	50	8.16	1.969	28	6.50	8	5/8	5.00	655
2.50	65	8.75	2.559	36	7.25	8	3/4	5.875	655
3.0	80	8.87	3.150	43	8.25	8	3/4	6.625	655
4.0	100	9.34	3.937	48	10.00	8	3/4	7.875	655
5.0	125	10.12	4.921	76	11.00	8	3/4	9.25	655
6.0	150	10.52	5.906	89	12.50	12	3/4	10.625	655
8.0	200	11.62	7.874	122	15.00	12	7/8	13.00	655

CADD DATABASE: AUTOCAD

DO NOT SCALE DWG REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	SCALE N/A	JOB NO
TOLERANCE UNLESS SPECIFIED	ENG RWT	DATE 12/3/97
.X ± .06	DWN	DATE 12/3/97
.XX ± .03	KIM	
.XXX ± .01	CHK	DATE 12/9/97
FRACT. ± 1/16	RWT	
ANGLES ± 1/2°		

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OUTLINE AND MOUNTING
DC 13 & DK 13, ANSI CS
300 LB SMALL TONGUE &
GROOVE, GRANUCOR

REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD
D	1605		REVISED FLANGE RATINGS	9-18-07	GDK	RWT
C	0863		CHANGED FORMAT	6/15/05	LB	RWT
B	2579		ADDED NOTE 4, 5 & FLG RATING; CHG "H" DIM	2/20/01	KIM	RWT
A	0716	JKM	RELEASED	12/9/97	KIM	RWT

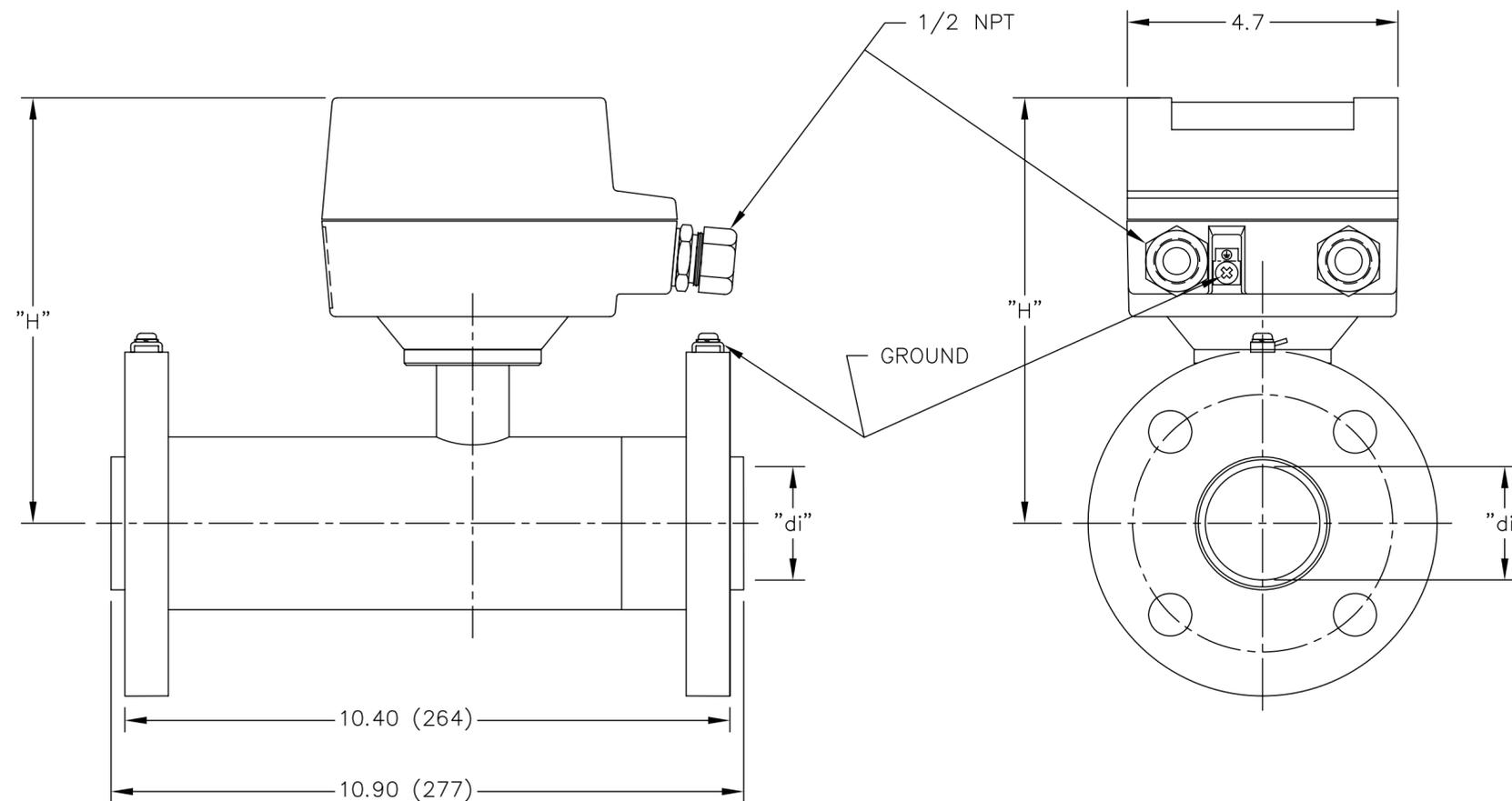
NEXT ASS'Y	
CUST ORDER NO	
CUSTOMER LOCATION	
USER LOCATION	

PART NO	DRAWING NUMBER	REV
	C07298L-B006	D

Derived From C07298L-B003

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ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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NOTES:

1. SEE MANUAL FOR INSTALLATION.
2. BOLT HOLES ARE 1/8" LARGER THAN BOLT DIAMETER.
3. MATERIAL:
FLANGE/BODY - CS, PAINTED
ENCLOSURE - CAST ALUMINUM
4. RECOMMENDED FLANGE MATE IS PER DRAWING C07298L-B115

TABULATION

NOMINAL PIPE SIZE inches	NOMINAL PIPE SIZE mm	H (IN)	di (IN)	FLANGE O.D.	NO. OF BOLTS	BOLT DIA SEE NOTE 2	BOLT CIRCLE DIA	FLANGE RATING T<300° F (PSI)
.50	15	7.60	.591	3.75	4	1/2	2.63	1315
.75	20	7.70	.794	4.63	4	5/8	3.25	1315
1.00	25	7.90	.984	4.88	4	5/8	3.50	1315
1.25	32	8.00	1.260	5.25	4	5/8	3.88	1315
1.50	40	8.20	1.575	6.13	4	3/4	4.50	1315
2.00	50	8.50	1.969	6.50	8	5/8	5.00	1315
2.50	65	8.90	2.559	7.50	8	3/4	5.88	1315
3.00	80	9.20	3.150	8.25	8	3/4	6.63	1315
4.00	100	9.80	3.937	10.75	8	7/8	8.50	1315
5.00	125	10.60	4.921	13.00	8	1	10.50	1315
6.00	150	11.00	5.906	14.00	12	1	11.50	1315
8.00	200	11.90	7.874	16.50	12	1 1/8	13.75	1315

CADD DATABASE: AUTOCAD

DO NOT SCALE DWG REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	SCALE N/A	JOB NO
TOLERANCE UNLESS SPECIFIED	ENG RWT	DATE 4/13/04
.X ± .06	DWN	DATE 4/13/04
.XX ± .03	NAJ	DATE 4/13/04
.XXX ± .01	CHK RWT	DATE 4/13/04
FRACT. ± 1/16		
ANGLES ± 1/2°		
NEXT ASS'Y		
CUST ORDER NO		
CUSTOMER LOCATION		
USER LOCATION		

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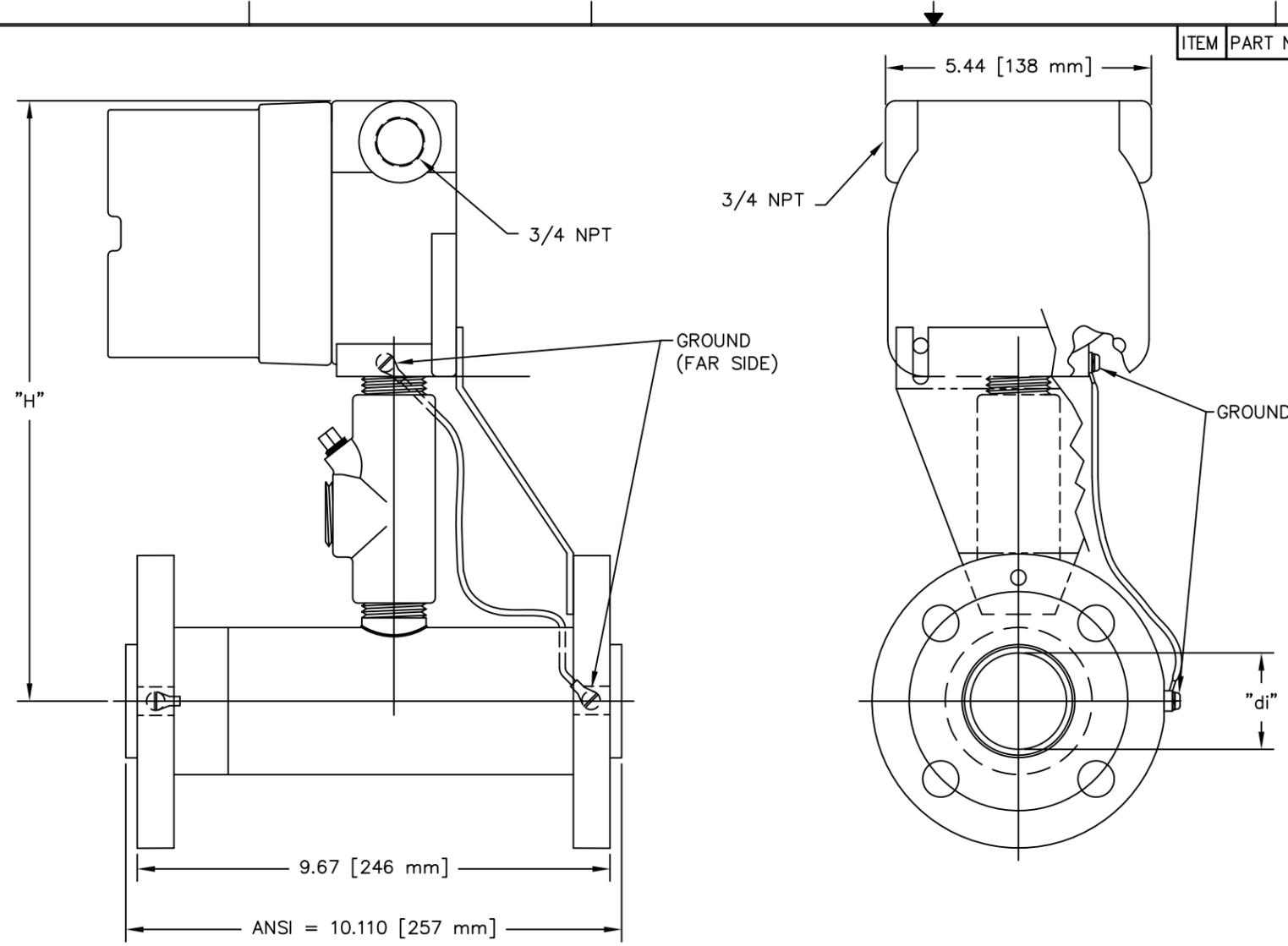
OUTLINE AND MOUNTING
DC 13 & DK 13
ANSI CS 600 LB SMALL TONGUE & GROOVE, GRANUCOR

PART NO	DRAWING NUMBER	REV
	C07298L-B015	C

REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD
C	1071		REVISE FLANGE O.D. ON 4.00 PIPE SIZE	7/12/06	GDK	RWT
B	0931		REVISE TABULATION & GRAPHICS	12/7/05	LB	RWT

Derived From C07298L-B012

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ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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NOTES:

1. SEE MANUAL FOR INSTALLATION.
2. BOLT HOLES ARE 1/8" LARGER THAN BOLT DIAMETER.
3. MATERIAL:
FLANGE/BODY - CS, PAINTED
ENCLOSURE - CAST ALUMINUM
4. RECOMMENDED FLANGE MATE IS PER DRAWING C07298L-B106

NOMINAL PIPE SIZE				APPROX. WEIGHT (LBS)*	FLANGE (in)				FLANGE RATING T < 300°F (PSI)
in	mm	H (in)	di (in)		FLANGE O.D.	# OF BOLTS	BOLT DIA. SEE NOTE #2	BOLT CIRCLE DIAMETER	
.5	15	12.16	.591	8	3.75	4	1/2	2.625	655
.75	20	12.36	.794	12	4.63	4	5/8	3.125	655
1.0	25	12.48	.984	15	4.88	4	5/8	3.50	655
1.25	32	12.74	1.26	17	5.25	4	5/8	3.875	655
1.5	40	12.79	1.575	21	6.13	4	3/4	4.50	655
2.0	50	13.03	1.969	28	6.50	8	5/8	5.00	655
2.50	65	13.62	2.559	36	7.25	8	3/4	5.875	655
3.0	80	13.74	3.150	43	8.25	8	3/4	6.625	655
4.0	100	14.21	3.937	48	10.00	8	3/4	7.875	655
5.0	125	14.99	4.921	76	11.00	8	3/4	9.25	655
6.0	150	15.39	5.906	89	12.50	12	3/4	10.625	655
8.0	200	16.49	7.874	122	15.00	12	7/8	13.00	655

CADD DATABASE: AUTOCAD

DO NOT SCALE DWG	SCALE N/A
REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES	JOB NO
TOLERANCE UNLESS SPECIFIED OTHERWISE DIMENSIONS ARE IN INCHES AND (mm)	ENG RWT DATE 1-27-05
X.X [X] ± .06 ± 1.5 mm	DWN RAE DATE 1-27-05
X.XX [X.X] ± .03 ± .8 mm	CHK RWT DATE 1-27-05
X.XXX [X.XX] ± .01 ± .3 mm	
FRACT. ± 1/16 ± N/A	
ANGLES ± 1/2° ± 1/2°	
NEXT ASS'Y	
CUST ORDER NO	

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OUTLINE AND MOUNTING, CLASS I
DC 13 & DK 13, ANSI CS
300 LB SMALL TONGUE &
GROOVE, GRANUCOR

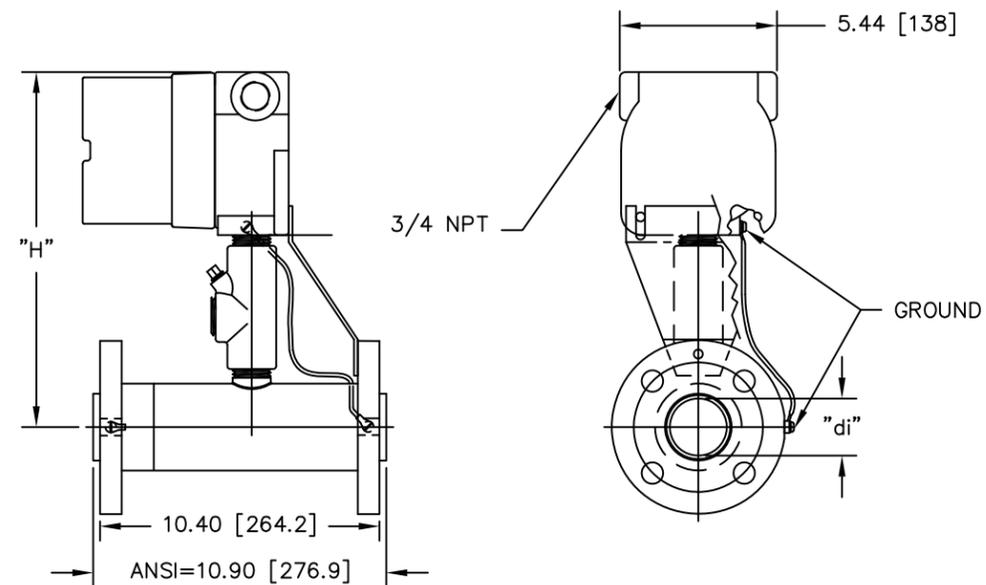
NO CHANGES WITHOUT REGULATORY APPROVAL

D	3323	ADDED REGULATORY STAMP	9-9-13	PMR	AJW
C	1605	REVISED FLANGE RATINGS	9-18-07	GDK	RWT
B	0735	ADDED BRKT	6/01/05	LB	RWT
A	0547	RELEASED	2-3-05	RAE	RWT
REV	ECO NO	MICRO	DESCRIPTION	DATE	BY APPD

CUSTOMER LOCATION	
USER LOCATION	

PART NO	DRAWING NUMBER	REV
	C07298T-B006	D

ITEM	PART NO	QTY	DESCRIPTION	DWG NO/SPEC
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NOTES:

1. SEE MANUAL FOR INSTALLATION.
2. BOLT HOLES ARE 1/8" LARGER THAN BOLT DIAMETER.
3. MATERIAL:
FLANGE/BODY - CS, PAINTED
ENCLOSURE - CAST ALUMINUM
4. RECOMMENDED FLANGE MATE IS PER DRAWING C07298L-B115

NOMINAL PIPE SIZE				APPROX. WEIGHT (LBS)*	FLANGE (in)				PRESSURE RATING T < 300°F (PSI)
in	mm	H (in)	di (in)		FLANGE O.D.	# OF BOLTS	BOLT DIA. SEE NOTE #2	BOLT CIRCLE DIAMETER	
.5	15	12.16	.591	--	3.75	4	1/2	2.63	1315
.75	20	12.36	.794	--	4.63	4	5/8	3.25	1315
1.0	25	12.48	.984	--	4.88	4	5/8	3.50	1315
1.25	32	12.74	1.26	--	5.25	4	5/8	3.88	1315
1.5	40	12.79	1.575	--	6.13	4	3/4	4.50	1315
2.0	50	13.03	1.969	--	6.50	8	5/8	5.00	1315
2.50	65	13.62	2.559	----	7.50	8	3/4	5.88	1315
3.0	80	13.74	3.150	--	8.25	8	3/4	6.63	1315
4.0	100	14.21	3.937	--	10.75	8	7/8	8.50	1315
5.0	125	14.99	4.921	--	13.00	8	1	10.50	1315
6.0	150	15.39	5.906	--	14.00	12	1	11.50	1315
8.0	200	16.49	7.874	--	16.50	12	1 1/8	13.75	1315

CADD DATABASE: AUTOCAD

NO CHANGES WITHOUT REGULATORY APPROVAL

REV	ECO NO	MICRO	DESCRIPTION	DATE	BY	APPD
C	3323		ADDED REGULATORY STAMP	10/03/13	PMR	AJW
B	0889		REVISED FLG RATING	10/31/05	LB	RWT
A	--		RELEASED	9/16/05	LB	RWT

DO NOT SCALE DWG		SCALE N/A	
REMOVE ALL BURRS AND UNNECESSARY SHARP EDGES		JOB NO	
UNLESS SPECIFIED OTHERWISE DIMENSIONS ARE IN INCHES AND (mm)		ENG RWT	DATE 9/16/05
x.x [x]	± .06 ± 1.5 mm	DWN LB	DATE 9/16/05
x.xx [x.x]	± .03 ± .8 mm	CHK RWT	DATE 9/16/05
x.xxx [x.xx]	± .01 ± .3 mm		
FRACT.	± 1/16 ± N/A		
ANGLES	± 1/2° ± 1/2°		
NEXT ASS'Y			
CUST ORDER NO			
CUSTOMER LOCATION			
USER LOCATION			

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OUTLINE AND MOUNTING, CLASS I
DC13 AND DK13
ANSI CS 600 LB SMALL TONGUE
AND GROOVE, GRANUCOR

PART NO	DRAWING NUMBER	REV
	C07298T-B015	C