Intrinsically Safe Duplexer

instruction manual

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Intrinsically Safe Duplexer

APPLICATIONS

- Duplex Pumping Stations that Control Liquid Level
- Pump Down (Empty a Tank) or Pump Up (Fill a Tank)
- Where Intrinsically Safe Operation is Required
- Where Connection to a SCADA System is Required

STANDARD FEATURES

- Float or Conductance Probe Level Inputs
- Duplex Alternation
- Level Input Indication
- Pump Call Indication
- High Alarm Indication with Latch Feature
- Low Alarm Indication
- Power On Indication
- Level Input Out of Sequence Indication
- Level Simulation Push-Button
- HOA and Lead Select Switches
- Pump Call and High & Low Level Alarm Relays
- Intrinsically Safe Level Inputs
- 10 second Power Up Delay
- Adjustable Lag Pump Delay
- Low Level Input Acts as a Redundant Off
- RS232 Serial Port with Modbus RTU Protocol
- Setup and Troubleshooting Features Available using a Separately Supplied Touch Screen Interface Device

OPTIONAL FEATURES

- Three Enclosure Options: Surface Mount, Din Rail Mount, or Panel Mount
- Ethernet Port Option with Modbus TCP

This Associated Apparatus Provides Intrinsically Safe Level Input Circuits For use in:

Class I, Groups A, B, C, D
Class II, Groups E, F, G and
Class III – Hazardous Locations

When Connected in Accordance with UL Control Drawing No. 0302.

SPECIFICATIONS

Input Power:	120 VAC ±10 %, 7.7 VA max
Relay Outputs:	6 A Resistive @ 120 VAC
Agency Approval:	UL 913, CAN/CSA UL FILE #: E189808
Operating Temp:	-20 °C to +60 °C
Storage Temp:	-45 °C to +85 °C
Indicators:	LED
Sensor Output Voltage:	±8 V Square wave
Sensor Output Current:	±0.8 mA max (per sensor)
Color:	White with Blue Lettering
Enclosure Material:	Aluminum

ORDERING INFORMATION

Part Number: **ISD** - **X** **X**

Product Type
Case Options
Communications Option

Enclosure Options: **S** = Surface Mount
D = Din Rail Mount
P = Panel Mount

Communications Option: Blank = Standard Unit
E = Ethernet Port

Touch Screen Interface Device

The Touch Screen Interface Device (TSID) is a optional piece of equipment that is used to perform troubleshooting and customization of the ISD for specific applications. It provides full access to all the setup and diagnostic parameters. It also has a screen designed to demo the SCADA capabilities of the ISD.

TSID FUNCTIONS

- View Status of Float Switch / Level Probe Inputs
- View Level Input Out of Sequence Data
- Setup of the Following Parameters:
  - Level Status High Reset Mode
  - Lag Pump Delay
  - Out-Of-Sequence Alarm Reset Mode
  - Pump Up / Down Mode
  - Remote Control Command Cancel Delay
  - Level Input Sensitivity
  - Communication Setup for use in SCADA System
- View and Reset Fault Codes
- Demo SCADA features

TSID COMMUNICATION WITH ISD

The **Touch Screen Interface Device** communicates with the ISD through its RS232 serial port. The serial port setup of both devices must match the following:

Baud Rate = 9600 bps Parity Mode = 0 Stop Bits = 2 Slave Address = 1

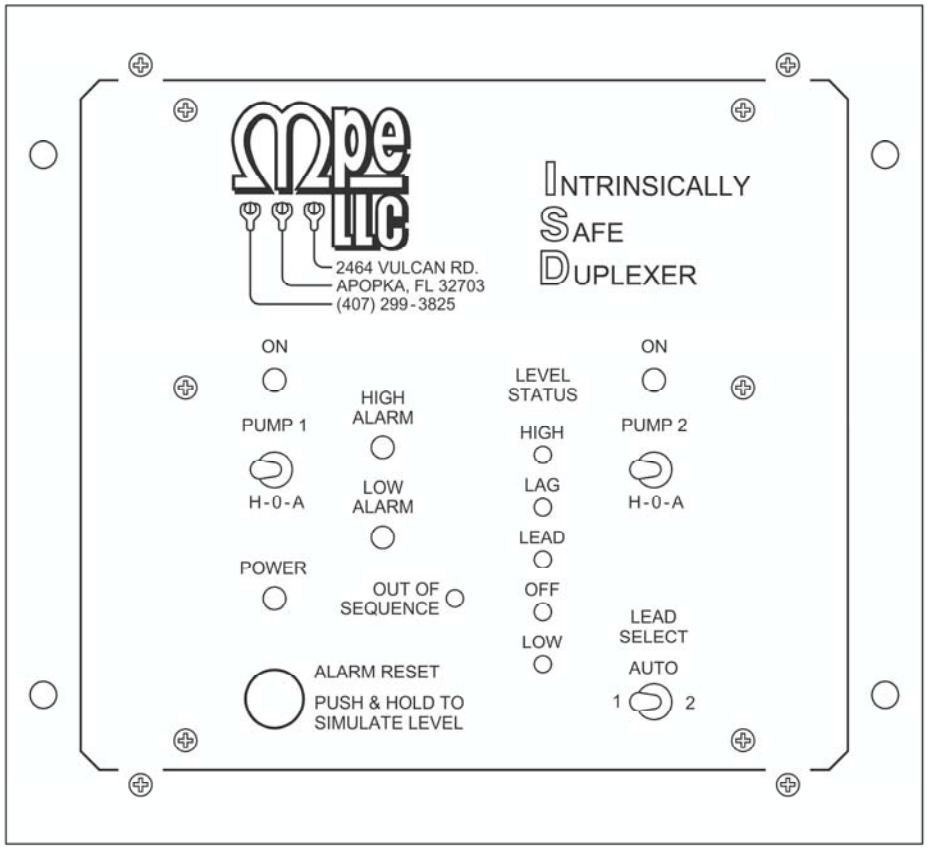
To make the ISD's serial port settings match the TSID's serial port settings, hold down the push-button on the controller for 22 seconds. (This will also temporarily make the Register Access Mode = 1.)

When all the work using the TSID is done and the TSID is disconnected from the controller, you must wait 5 seconds before connecting the controller to a SCADA system. The 5 seconds of no communication is required to signal the controller that it is time to start using the serial port settings you programmed into it for the custom application.

The Touch Screen Interface Device (TSID) consists of a 6 inch Touch Screen panel made by Automation Direct, housed in a durable carrying case with a power cord and an interface cable for connection to the serial port. It is programmed as a Modbus Master that continually polls the ISD.

ORDERING INFORMATION

Part Number: **TSID**



H-O-A TOGGLE SWITCHES

The H-O-A (HAND-OFF-AUTO) toggle switches provide control over the pumps for maintenance or testing purposes. When a pump's H-O-A switch is placed in the "HAND" position the pump will be called to run. When placed in the "Auto" position the respective pump will be turned on and off as needed to maintain the wet well level, based on the level inputs. Placing a pump's H-O-A in the "Off" position disables the pump from operating.

LEAD SELECT TOGGLE SWITCH

For normal automatic alternation of the pumps set the Lead Select toggle switch to the "AUTO" position. In cases where one of the two pumps is not available for service or has maintenance issues, the other pump may be selected as lead by setting the Lead Select toggle switch to either "1" or "2" .

LEVEL SIMULATION

Entering the Level Simulation Mode

To enter the Level Simulation mode press and hold the push-button, on the front of the unit, for three seconds or until one or more of the level indicators are turned on.

Increasing the Simulated Level

To increase the simulated level, hold the push-button until the desired level is indicated on the level status indicators. There is a three second delay between levels. With the H-O-A's in the "Auto" position, the pumps will be called to run as the level is increased to the Lead and Lag levels.

Decreasing the Simulated Level

To decrease the simulated level, release the push-button. The level will decrease by one level every three seconds.

Exiting the Level Simulation Mode

To exit the Level Simulation mode, release the push-button and wait until all the level indicators are turned off. Three seconds after the last level indicator is turned off, the unit exits the Level Simulation mode.

PUMP ON INDICATORS

The Pump ON indicators are turned on when the respective pump call relay is energized, in either "HAND" or "AUTO" mode.

POWER INDICATOR

The controller monitors the internal power supply and turns on the "POWER" indicator whenever there is sufficient electrical power for the unit to function. When the "POWER" indicator is off, the power supply voltage is too low for the unit to function.

HIGH LEVEL ALARM

High Alarm & Relay

The indicator labeled "HIGH ALARM" is turned on whenever the HIGH input is closed or covered. The HIGH ALARM relay contact will also be closed. As soon as the HIGH input is opened or uncovered the HIGH ALARM indicator will be turned off and the HIGH ALARM relay contact will open. This indicator and the HIGH ALARM relay does not latch on and is not effected by the alarm latch/reset feature discussed below. The High Level Input also provides a redundant pump Off, when in the Pump Up Mode.

Level Status - High

The indicator under "LEVEL STATUS" labeled "HIGH" is turned on whenever the HIGH input is closed or covered. It is part of the row of indicators that provides level indication. The alarm indication will remain latched on to provide a record of the condition, provided the Alarm Reset Mode is set for manual reset.

Level Status - High - Reset

To reset the latched "HIGH" indication, press the push-button on the front of the unit. To reset the alarm indication remotely through the SCADA system, momentarily set Coil 7 in register 40001.

Level Status - High - Reset Mode

The **Level Status High Reset Mode** may be changed using the **Touch Screen Interface Device**.

Parameter	Default Value	Setting Definitions
Level Status High Reset Mode	1	1 = Manual Reset - Reset by Pressing the Push-Button 2 = Auto Reset - Resets When Level Drops Below High Level

LOW LEVEL ALARM

The Low Level Alarm Input Provides indication and relay contact closure of a low level condition. The Low Level Input also provides a redundant pump Off, when in the Pump Down Mode. If the Low Level Alarm is not use, a jumper wire should be placed between terminals 1 and C.

Low Alarm & Relay

The indicator labeled "LOW ALARM" is turned on whenever the LOW input is opened or uncovered. The LOW ALARM relay contact will also be closed. As soon as the LOW input is closed or covered the LOW ALARM indicator will be turned off and the LOW ALARM relay contact will open.

Level Status - Low

The indicator under "LEVEL STATUS" labeled "LOW" is turned on whenever the LOW input is opened or uncovered. It is part of the row of indicators that provides level indication.

PUMP DELAYS

Power Up Delay

Whenever electrical power is lost and then restored, immediate pump operation is prevented by a fixed ten second "Power Up Delay" which must first expire before a pump is called to run.

Lag Pump Delay

Any time one of the pumps is called to run, the Lag Pump Delay must first expire before the other pump may be called to run.

The **Lag Pump Delay** setting may be changed using the **Touch Screen Interface Device**.

Parameter	Default Value	Setting Definitions
Lag Pump Delay	5 Seconds	Range: 1 - 255 Seconds.

OUT OF SEQUENCE - Alarm Indication

The out-of-sequence logic detects when the inputs fail to close in the correct order and provides indication of the condition. Some out-of sequences conditions are allowed to exist without turning on the alarm indication, while the logic waits for additional level inputs to close.

Out-Of-Sequence Alarm Indication Reset Mode

The Out-Of-Sequence Alarm indication may be set to either “Auto Reset” or Manual Reset” mode.

While in the “Auto Reset” mode, the alarm indication will turn off automatically if the sequence is correct during a subsequent pumping cycle.

While in the “Manual Reset” mode, the operator must press the Push-Button to turn off the indication.

Out-Of-Sequence Alarm Reset Mode may be changed using the **Touch Screen Interface Device**.

Parameter	Default Value	Setting Definitions
Out-Of-Sequence Alarm Reset Mode	1	1 = Auto Reset - Resets when the Sequence is Correct 2 = Manual Reset - Resets by Pressing the Push-Button

OUT OF SEQUENCE - Pump Operation - Pump Down Mode

Out-Of-Sequence Condition	Pump Operation
LOW INPUT - Out-Of-Sequence **Any three higher** Inputs Close Before the **Low**	Normally the **Low** level input operates as a redundant Off. However, if it fails to close as the level rises, it will prevent pump operation until it is proven faulty. When the Low input failure is first determined the logic turns on the 1st and 2nd pumps, with the lag pump delay in between, and pumps down to the Off level. In the next pumping cycle the Low input is ignored and not used as a redundant Off. If the Low input begins to function normally again, then it will be restored as the redundant Off.
OFF INPUT - Out-Of-Sequence **Lead** and **Lag** Inputs Close Before the **Off**	Turns on 1st pump when the **Lead** and **Lag** inputs close. Turns on 2nd pump when **High** input closes.
LEAD INPUT - Out-Of-Sequence **Off** and **Lag** Inputs Close Before the **Lead**	Turns on 1st pump when the **Off** and **Lag** inputs close. Turns on 2nd pump when **High** input closes.
LAG INPUT - Out-Of-Sequence **Off**, **Lead**, and **High** Inputs Close Before the **Lag**	Turns on 1st pump when the **Off** and **Lead** inputs close. Turns on 2nd pump when **High** input closes.
OFF and LEAD INPUTS - Out-Of-Sequence **Lag**, and **High** Inputs Close Before the **Off** and **Lead**	Turns on 1st and 2nd pumps when the **Lag** and the **High** inputs close, with lag pump delay.
OFF and LAG INPUTS - Out-Of-Sequence **Lead**, and **High** Inputs Close Before the **Off** and **Lag**	Turns on 1st and 2nd pumps when the **Lead** and the **High** inputs close, with lag pump delay.
LEAD and LAG INPUTS - Out-Of-Sequence **Off**, and **High** Inputs Close Before the **Lead** and **Lag**	Turns on 1st and 2nd pumps when the **Off** and the **High** inputs close, with lag pump delay.
HIGH INPUT - Out-Of-Sequence **High** Input Closed with **Any three lower** Inputs Open	Prevents **High** input from calling second pump when **Off**, **Lead**, or **Lag** inputs fail.

OUT OF SEQUENCE - Pump Operation - Pump Up Mode

Out-Of-Sequence Condition	Pump Operation
HIGH INPUT - Out-Of-Sequence **Any three lower** Inputs Open Before the **High** Opens	Normally the **High** level input operates as a redundant Off. However, if it fails to open as the level drops, it will prevent pump operation until it is proven faulty. When the High input failure is first determined the logic turns on the 1st and 2nd pumps, with the lag pump delay in between, and pumps up to the Off level. In the next pumping cycle the High input is ignored and not used as a redundant Off. If the High input begins to function normally again, then it will be restored as the redundant Off.
OFF INPUT - Out-Of-Sequence **Lead** and **Lag** Inputs Open Before the **Off**	Turns on 1st pump when the **Lead** and **Lag** inputs open. Turns on 2nd pump when **Low** input open.
LEAD INPUT - Out-Of-Sequence **Off** and **Lag** Inputs Open Before the **Lead**	Turns on 1st pump when the **Off** and **Lag** inputs open. Turns on 2nd pump when **Low** input open.
LAG INPUT - Out-Of-Sequence **Lag** Input fails to Opens Before the **Low**	Turns on 1st pump when the **Off** and **Lead** inputs open. Turns on 2nd pump when **Low** input opens.
OFF and LEAD INPUTS - Out-Of-Sequence **Lag**, and **Low** Inputs Open Before the **Off** and **Lead**	Turns on 1st and 2nd pumps when the **Lag** and the **Low** inputs open, with lag pump delay.
OFF and LAG INPUTS - Out-Of-Sequence **Lead**, and **Low** Inputs Open Before the **Off** and **Lag**	Turns on 1st and 2nd pumps when the **Lead** and the **Low** inputs open, with lag pump delay.
LEAD and LAG INPUTS - Out-Of-Sequence **Off**, and **Low** Inputs Open Before the **Lead** and **Lag**	Turns on 1st and 2nd pumps when the **Off** and the **Low** inputs open, with lag pump delay.
LOW INPUT - Out-Of-Sequence **Low** Input Open with **Any three higher** Inputs Closed	Prevents **Low** input from calling second pump when **Off**, **Lead**, or **Lag** inputs fail.

OUT OF SEQUENCE - Trouble Shooting

By using the **Touch Screen Interface Device** an operator may view which input the controller determined was out-of-sequence, even if the out-of-sequence indicator on the front of the unit was manually or automatically reset. However, if the power had been cycled since the event, the data is lost.

The out-of-sequence data may be viewed using Touch Screen Interface Device which shows which inputs are “Currently Out Of Sequence” from SCADA register 40005, Coils 65, 66, 67, and 68.

Also, the currently-out-of-sequence data is copied so that later an operator may view which inputs were previously out-of-sequence. The data is labeled “Latched Out Of Sequence” and may be viewed using the Touch Screen Interface Device which reads the data from SCADA register 40005, Coils 69, 70, 71, and 72.

Whenever there is an input with a “Latched Out Of Sequence” condition a “Fault Code” of 21 will also be present in the “Fault Code” SCADA register 40004.

The “Latched Out Of Sequence” data may be erased by pressing the “Fault Reset” button on the Touch Screen Interface Device, which toggles the “Fault Code - Reset” SCADA register 40001, Coil 8.

PUMP UP / DOWN MODE

The controller may be used in either a Pump Down (empty a tank) or Pump Up (fill a tank) level control application. The level inputs may be connected to either float switches, single point conductance probes, or selected points on a ten point conductance probe. Use of the Low level input is optional. If used, it functions as a redundant pump off in the Pump Down mode, and as a redundant pump call in the Pump Up mode.

Where float switches are used, all the float switch contacts must be the Normally Open type that close as the liquid level rises to cover or tilt the float switch.

Where a conductance probe is used, care must be taken to ensure that the liquid is grounded to the control panel ground, and that the Level Input Sensitivity setting is correct for the liquid being pumped. See the section in this manual on the “Level Inputs”.

Note: When operated in the Pump Up mode, the Off, Lead, and Lag level status indicators will turn on as the level drops below the respective level input points.

The **Pump Up / Down Mode** may be changed using the **Touch Screen Interface Device**.

Parameter	Default Value	Setting Definitions
Pump Up / Down Mode	1	1 = Pump Down - Empty a Tank 2 = Pump Up - Fill a Tank

REMOTE PUMP CONTROL

Disable Pumps

The pumps may be disabled through the SCADA system by setting Coil 1 or 2 in register 40001.
To return a pump to normal control clear Coil 1 or 2 in register 40001.

Force On Pumps

The pumps may be forced on through the SCADA system by setting Coil 3 or 4 in register 40001.
To return a pump to normal control clear Coil 3 or 4 in register 40001.

Remote Control Command Cancel Delay

If communication is lost while the pumps are being controlled remotely, the remote control commands will be automatically canceled upon the expiration of the Remote Control Command Cancel Delay. Momentarily turning off the electrical power to the controller will also cancel the remote control commands.

The **Remote Control Command Cancel Delay** may be changed using the **Touch Screen Interface Device**.

Parameter	Default Value	Setting Definitions
Remote Control Command Cancel Delay	1 Minute	Delay Range: 1 - 254 Minutes To Prevent Remote Control Commands From Being Canceled - Set On: 255

ELAPSED TIME METERS

The Elapsed Time Meters may be read through the SCADA system at registers 40006 and 40007. The values read from these registers are intended for use in comparing the pump run time of one pump with the run time of the other pump, for the purpose of checking for uneven run times. (Uneven run times is an indication of a maintenance problem with one of the pumps.) Periodically the comparison of run times should be made and the registers should reset to zero. The ETM data is stored in non-volatile memory registers at the end of each pump run cycle. Only the latest addition to the run time will be lost if a power outage occurs while a pump is called to run. To reset one of the ETMs to zero, momentarily set Coil 5 or 6 in register 40001. The Elapsed Time Meter registers have a range of 0.0 - 6553.5 hours, where the decimal point must be inserted by the HMI.

LEVEL INPUTS

The Low, Off, Lead, Lag, and High level inputs allow the controller to determine the level of the liquid in the wet well. The inputs may be connected to either float switches, single point conductance probes, or selected points on a ten point conductance probe.

The controller sends a ±8V square wave signal to each of the float switches or probe electrodes and monitors the signals. For applications that use float switches, the common side of all the float switches is connected to ground. In applications that use a conductance probe (Level Probe), the liquid must be grounded to the same ground as the controller. When a float switch is closed or liquid covers one of the probe electrodes, the square wave signal is partially or fully diverted to ground, and the respective input's Level Input Status Value changes from a high number to a lower number. The Level Input Status Value associated with the input is then compared to the Level Input Sensitivity setting. When the input's Level Input Status Value is determined to be below the Level Input Sensitivity setting, the input is considered to be closed or covered.

Float Switch Applications

Where float switches are used, the float switch contacts must all be the Normally Open type that close as the liquid level rises to cover or tilt the float switch (this also applies to the Low float switch). The Normally Open type float switches are required for both the Pump Down (empty a tank) mode, and for the Pump Up (fill a tank) mode. When the controller is operated in the Pump Up mode, the state of the Off, Lead, and Lag inputs is inverted by the logic inside the controller, again allowing the use of the Normally Open type float switch.

Conductance Probe Applications

For applications that use a conductance probe, the liquid in the wet well must contain ions which allow the water to conduct electrical current. Sewage contains a lot of ions and is a very good conductor of electricity. However, clean water has a low number of ions, and can be difficult to detect. Using a conductance probe to detect storm water is not recommended. While storm water may start out with enough ions to detect, it becomes more difficult to detect the longer it rains, as the run off becomes cleaner.

Grounding The Liquid

When used with a conductance probe, the liquid in the wet well must have an electrical connection to the control panel ground. Where a submersible pump is present, the grounded housing of the pump is sufficient. In the absence of any other path to ground, a single point probe, or the bottom electrode of a ten point probe may be placed low in the wet well and connected to the control panel ground.

Level Input Sensitivity

The **Level Input Sensitivity** may be changed using the **Touch Screen Interface Device**.

Parameter	Default Value	Recommended Setting
Level Input Sensitivity	100	Float Switch - 100 Typical Sewage - 100 Light Sewage - 150

To determine the best setting for your application perform the following procedure:

1. Ensure that the "Off" electrode is covered with liquid.
2. Use the **TSID** to read the Level Input Status Value for the "Off" level input.
3. Add about 40 to the Level Input Status Value of the covered input. (For example typical sewage will produce a value of around 60 or less. When you add 40 to that value, you have a recommended setting of 100, which is the default setting for typical sewage.)

FAULT CODES

When the controller detects a fault condition, a Fault Code is generated and placed into register 40004. The **Fault Code** may be viewed using the **Touch Screen Interface Device**. See the Fault Code Table below for a description of the condition.

Fault Code Table

Fault Code	Description of Condition
0	Normal
1	Communication Fault – Overrun Error reading incoming message.
2	Communication Fault – Time out error reading incoming message.
3	Communication Fault – Time out error responding to message.
4	Communication Fault – Incoming message failed Checksum Test.
5	Communication Fault – Invalid Modbus Function Code.
6	Communication Fault – Trying to preset more than 35 registers using Function Code No. 16.
7	Communication Fault – Trying to force to more than 100 Coils using Function Code No. 15.
8	Communication Fault – Write Attempt to Register Not Marked for “Write” using Function Code No. 05.
9	Communication Fault – Write Attempt to Register Not Marked for “Write” using Function Code No. 06.
10	Communication Fault – Write Attempt to Register Not Marked for “Write” using Function Code No. 15.
11	Communication Fault – Write Attempt to Register Not Marked for “Write” using Function Code No. 16.
12	Communication Fault – Write Attempt made with Register Access Mode Parameter set for Read Only.
13	Communication Fault – The UART detected a Framing Error reading the incoming message. It did not find Stop Bit where expected.
14	Communication Fault – Noise Detected on incoming message.
21	Level Input Out of Sequence.

COMMUNICATION WITH A SCADA SYSTEM

A SCADA system may communicate with the controller through either the RS232 Serial Port or through the Optional Ethernet Port. The ISD operates as a MODBUS slave, where all communication is initiated by the MODBUS master.

MODBUS Functions Supported

Function Code	Function Description	Notes
01	Read Coil Status	
02	Read Input Status	
03	Read Holding Registers	
04	Read Input Registers	
05	Force Single Coil	
06	Preset Single Register	
08	Diagnostics - Sub-function 00 (Return Query Data)	
15	Force Multiple Coils	Limited to 100 Coils
16	Preset Multiple Registers	Limited to 35 Registers

Setup for Connection to a SCADA System

Each controller in a SCADA system using the Modbus protocol is assigned a unique Slave Address so that it can be polled by the SCADA system Master using that unique Slave Address. However, if communication is through the optional Ethernet Port, each controller will already have a unique IP Address. In this case, the Slave Address Parameter may be set to 0. When set to 0 the controller will ignore the value of the incoming Slave Address, except that it will make a copy to be sent back in the response.

The Register Access Mode parameter is provided to prevent (when set on Read Only) malicious attempts to remotely control the pumps, or change setup parameter values. Unless greatly needed, the Register Access Mode should be left on Read & Write.

The following parameters must be setup using the **Touch Screen Interface Device**:

Parameter	Default Value	Setting Definitions
Slave Address	1	Range: 0 - 247
Register Access Mode	1	1 = Read & Write 2 = Read Only

NOTE: If the Register Access Mode is changed to “Read Only” the ISD will not allow any other changes to the parameter values. The controller can be temporally placed into the “Read & Write” mode by holding down the push-button on the controller for 22 seconds. It will automatically return to the “Read Only” mode, 5 seconds after being disconnected from the **Touch Screen Interface Device.**

RS232 SERIAL PORT

The RS232 serial port allows a SCADA system to communicate with the ISD using the Modbus RTU protocol.

Setup of RS232 Serial Port

The controller's RS232 serial port must be setup to communicate with the device it is connected to. The Baud Rate, Parity Mode and Stop Bits parameter values of the two devices must be set to match.

The Delay Before Response parameter is provided for cases where the modem needs additional time to prepare itself before receiving a response back from the controller.

The following parameters must be setup using the **Touch Screen Interface Device**:

Parameter	Default Value	Setting Definitions
Baud Rate	4	1 = 1200 bps 2 = 2400 bps 3 = 4800 bps 4 = 9600 bps
Parity Mode	0	0 = No Parity 1 = Odd Parity 2 = Even Parity
Stop Bits	2	1 = 1 Stop Bit 2 = 2 Stop Bits (The 2nd Stop Bit is available only when No Parity is selected)
Delay Before Response	3 ms	Range: 1 – 100 ms

ETHERNET PORT - Option

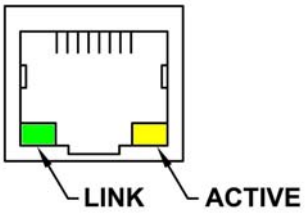
Features

The Ethernet Port has the following features:

- Protocol Supported: Modbus TCP
- IEEE 802.3 Compliant
- Auto-negotiation of Communication Speed: 10 or 100 Mbps
- Auto-negotiation of Duplex Mode: Half or Full Duplex
- Link, and Active status LED indicators

LED Indicator	OFF	ON
LINK (Green)	Not Linked	Linked
ACTIVE (Yellow)	Idle	Active Communication

RJ45 Connector



Setup of Ethernet Port

Before connecting the controller to a SCADA system the following parameters must be setup using the **Touch Screen Interface Device**:

Parameter	Default Value	Setting Definitions
Protocol	2	2 = Modbus TCP
IP Address	192 . 168 . 80 . 12 (IP4 . IP3 . IP2 . IP1)	Identifier for the device on an IP network. Range: 0 - 255
Subnet Mask	255 . 255 . 255 . 0 (SM4 . SM3 . SM2 . SM1)	Range of IP addresses that can be directly connected in the network. Range: 0 - 255
Default Gateway	192 . 168 . 80 . 1 (DG4 . DG3 . DG2 . DG1)	A node on the network that serves as an entrance to another network when no direct connection exists. Range: 0 - 255
Port Number	502	Range: 1 - 65,535

NOTE: The Ethernet Port reads the setup values upon power up; any changes require the power to be cycled before the new values are used.

The MAC Address is unique to each field device and is set at the factory. It can not be changed in the field, but may be viewed using the **Touch Screen Interface Device**.

Parameter	Fixed Value
MAC Address	0 : 80 : 194 : 219 : XXX : XXX (MA6 : MA5 : MA4 : MA3 : MA2 : MA1)

SCADA REGISTERS

<table>
<tr><th>Register Address</th><th>Read</th><th>Write</th><th>Description of SCADA Registers</th></tr>
<tr><td>40001</td><td>√</td><td>√</td><td>
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<tr><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>Coil</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Fault Code - Reset</td><td>Level Status - High Latched On - Reset</td><td>ETM 2 - Reset</td><td>ETM 1 - Reset</td><td>Pump 2 - Force On</td><td>Pump 1 - Force On</td><td>Pump 2 - Disable</td><td>Pump 1 - Disable</td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Level Status - Low</td><td>Level Status - High Latched On</td><td>Pump 2 - Called</td><td>Pump 1 - Called</td><td>Level Status - High</td><td>Level Status - Lag</td><td>Level Status - Lead</td><td>Level Status - Off</td><td></td></tr>
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<tr><td>40005</td><td>√</td><td></td><td>
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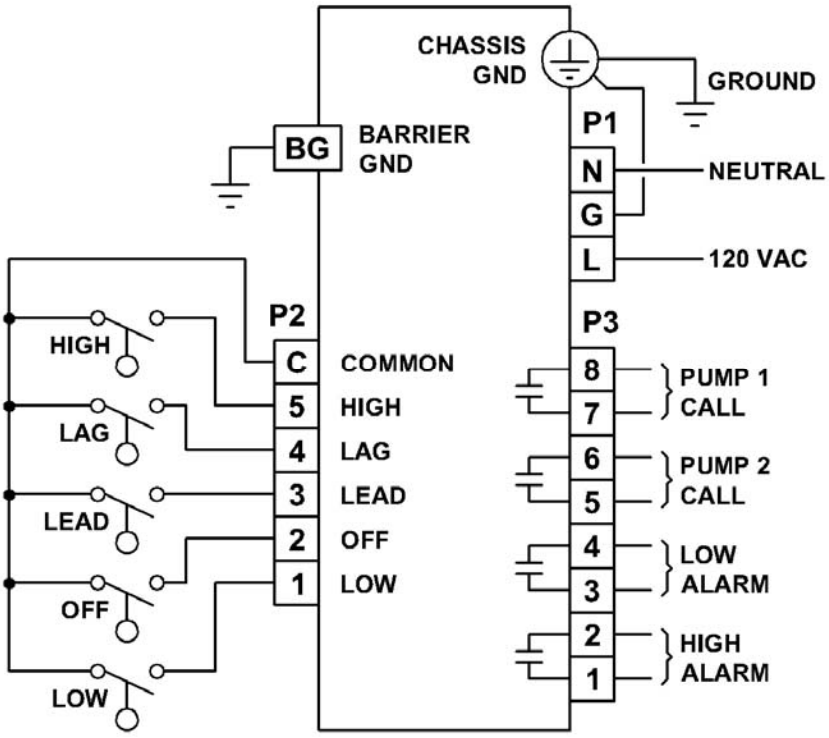
<tr><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td><td>Coil</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Level Input - Low Latched Out of Sequence</td><td>Level Input - Low Currently Out of Sequence</td><td>Level Input - High Latched Out of Sequence</td><td>Level Input - Lag Latched Out of Sequence</td><td>Level Input - Lead Latched Out of Sequence</td><td>Level Input - Off Latched Out of Sequence</td><td>Level Input - High Currently Out of Sequence</td><td>Level Input - Lag Currently Out of Sequence</td><td>Level Input - Lead Currently Out of Sequence</td><td>Level Input - Off Currently Out of Sequence</td><td></td></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td>Bit</td></tr>
</table>
</td></tr>
<tr><td>40006</td><td>√</td><td></td><td>Pump 1 Elapsed Time Meter (hours and 1/10 hours) 0.0 - 6553.5 hours</td></tr>
<tr><td>40007</td><td>√</td><td></td><td>Pump 2 Elapsed Time Meter (hours and 1/10 hours) 0.0 - 6553.5 hours</td></tr>
<tr><td>40042</td><td>√</td><td></td><td>Power Supply Voltage (Volts and 1/10 Volts) Normal Range: 12.4V - 17.4V</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

SETUP PARAMETER REGISTERS

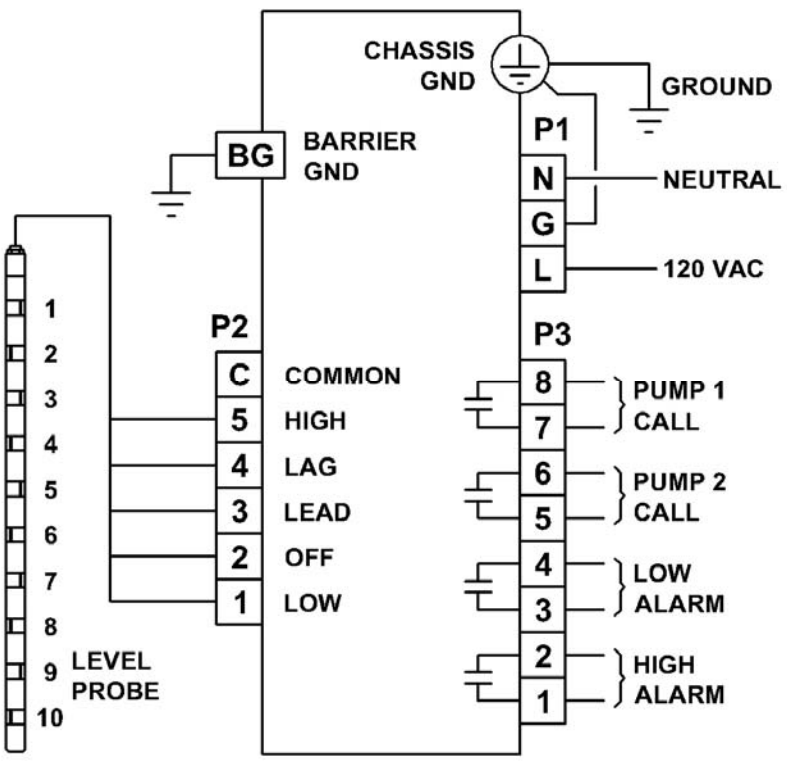
Register Address	Read	Write	Description of Setup Parameter Registers
40015	√	√	Out of Sequence Indication Reset Mode
40016	√	√	Pump Up / Down Mode
40017	√	√	Lag Pump Delay
40018	√	√	Level Input Sensitivity
40019	√	√	Alarm Reset Mode
40020	√	√	SCADA Setup - Register Access Mode
40022	√	√	RS232 Serial Port Setup - Slave Address
40023	√	√	RS232 Serial Port Setup - Baud Rate
40024	√	√	RS232 Serial Port Setup - Parity Mode
40025	√	√	RS232 Serial Port Setup - Stop Bits
40026	√	√	RS232 Serial Port Setup - Delay Before Response
40027	√	√	SCADA Setup - Remote Control Command Cancel Delay
40200	√	√	Ethernet Port Setup - Protocol
40201	√	√	Ethernet Port Setup - IP Address - IP1 IP4 . IP3 . IP2 . IP1
40202	√	√	Ethernet Port Setup - IP Address - IP2
40203	√	√	Ethernet Port Setup - IP Address - IP3
40204	√	√	Ethernet Port Setup - IP Address - IP4
40217	√		Ethernet Port Setup - MAC Address - MA1 MA6 : MA5 : MA4 : MA3 : MA2 : MA1
40218	√		Ethernet Port Setup - MAC Address - MA2
40219	√		Ethernet Port Setup - MAC Address - MA3
40220	√		Ethernet Port Setup - MAC Address - MA4
40221	√		Ethernet Port Setup - MAC Address - MA5
40222	√		Ethernet Port Setup - MAC Address - MA6
40223	√	√	Ethernet Port Setup - Subnet Mask - SM1 SM4 . SM3 . SM2 . SM1
40224	√	√	Ethernet Port Setup - Subnet Mask - SM2
40225	√	√	Ethernet Port Setup - Subnet Mask - SM3
40226	√	√	Ethernet Port Setup - Subnet Mask - SM4
40227	√	√	Ethernet Port Setup - Default Gateway - DG1 DG4 . DG3 . DG2 . DG1
40228	√	√	Ethernet Port Setup - Default Gateway - DG2
40229	√	√	Ethernet Port Setup - Default Gateway - DG3
40230	√	√	Ethernet Port Setup - Default Gateway - DG4
40232	√	√	Ethernet Port Setup - Port Number

CONNECTION DIAGRAMS

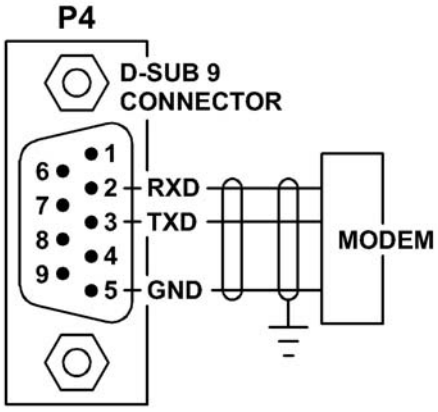
Note:
If the Low Level Alarm is not required place a jumper wire between terminals 1 and C on connector P2.



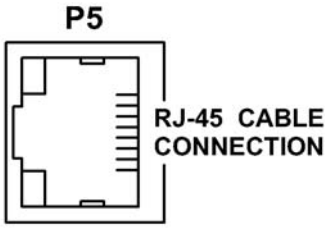
CONNECTION DIAGRAM - FLOAT SWITCH



CONNECTION DIAGRAM - LEVEL PROBE



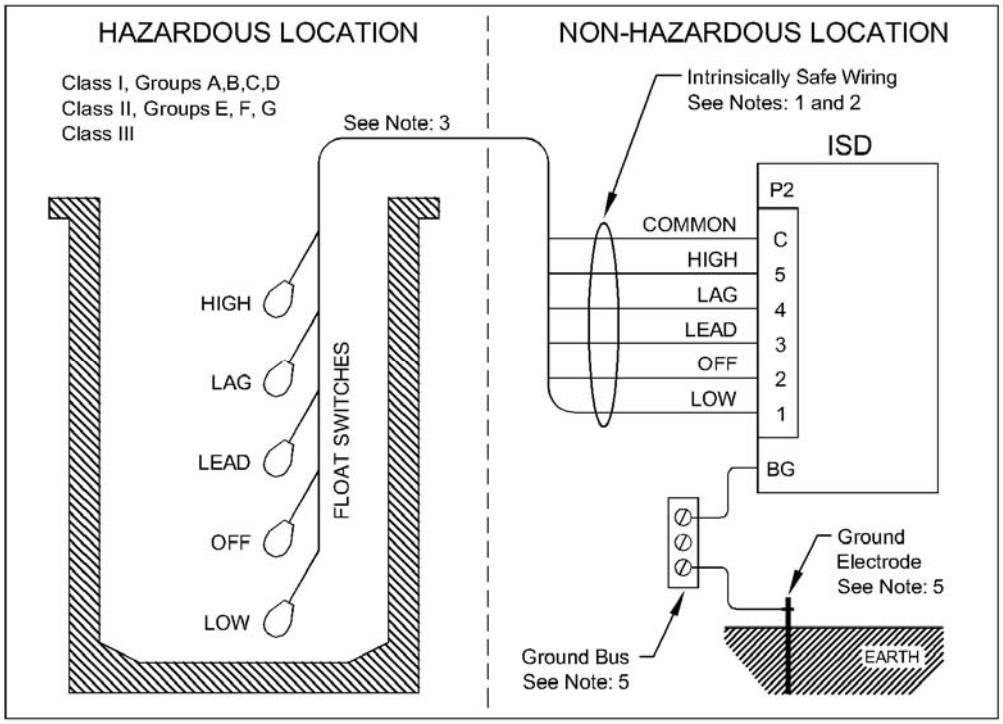
RS-232 SERIAL PORT



Optional ETHERNET PORT

INTRINSICALLY SAFE DUPLEXER ISD

Control Drawing No. 0302 Page 1 of 3 FLOAT SWITCH APPLICATION



Notes for Control Drawing 0302 Page 1 of 3:

1. All intrinsically safe wiring shall be separated from non-intrinsically safe wiring. Refer to article 504.2 of the National Electric Code (ANSI/NFPA 70) or other local codes, as applicable.
2. Maximum distance between ISD and Float Switches is 1000 feet.
3. The Float Switches used with the ISD shall be any non-energy storing or generating switch type device containing no capacitance or inductance. The Float Switch's cable capacitance plus it's equipment capacitance (Ci) must be less than the capacitance (Ca) marked on the ISD. Also, the Float Switch's cable inductance plus its equipment Inductance (Li) must be less than the inductance (La) marked on the ISD. If the electrical parameters of the cable are unknown, then a capacitance value of 60 pF/ft – and an inductance of 0.20 µH/ft are to be used. Cable capacitance and cable inductance are calculated as follows: 60 pF/ft x 1000 ft = 60 nF 0.2 µH/ft x 1000 ft = 0.20 mH
4. The ISD must be installed in an enclosure suitable for the application in accordance with the National Electric Code (ANSI/NFPA 70) for installation in the United States, the Canadian Electrical Code for installations in Canada, or other local codes, as applicable.
5. The ISD barrier ground must be connected to the ground bus in the power distribution panel. The ground bus must be connected to a suitable ground electrode per the National Electric Code (ANSI/NFPA 70) or other local codes, as applicable. The resistance of the ground path from the ISD barrier ground to the ground electrode must be less than 1 Ohm.
6. The ISD must not be connected to devices that use or generate more than 250 Vrms or dc with respect to earth.
7. This associated apparatus (ISD) has not been evaluated for use in combination with another associated apparatus.
8. A. For installations in which both the Ci and Li of the intrinsically safe apparatus exceeds 1% of the Co and Lo parameters of the associated apparatus (excluding the cable), then 50% of Co and Lo parameters are applicable and shall not be exceeded.

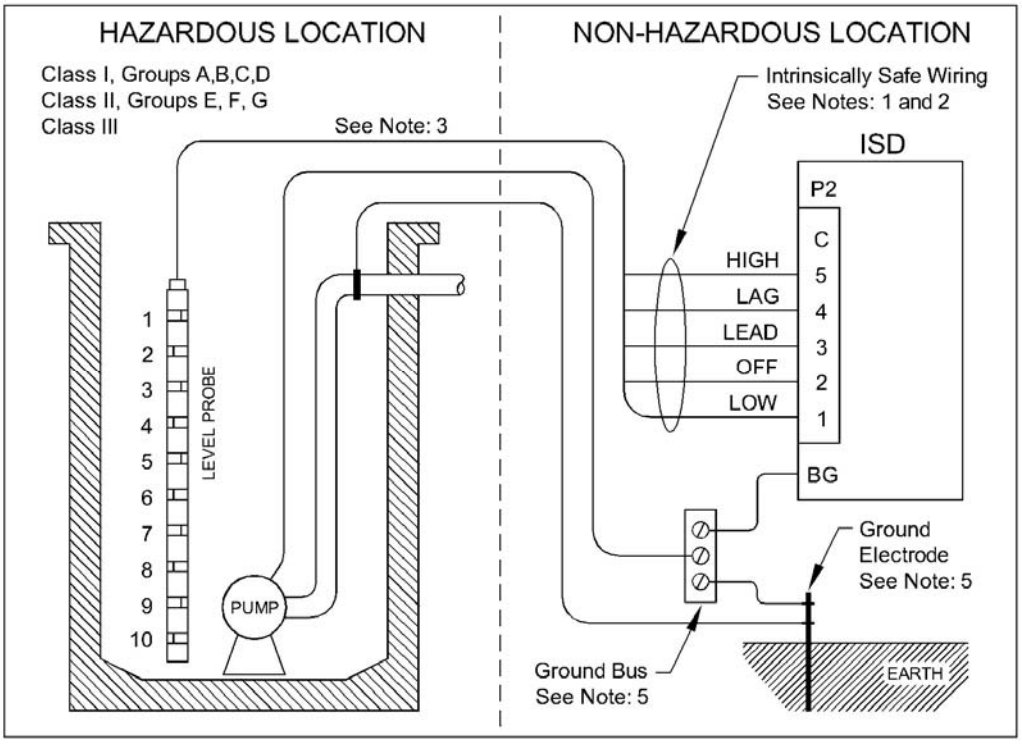
   B. The output current of this associated apparatus is limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

ISD Entity Parameters: Vt = 27.6 V It = 40.5 mA Ca = 86 nF La = 216.7 uH Po = 279 mW Um = 250 Vrms

Revision Date: 9-23-10

INTRINSICALLY SAFE DUPLEXER ISD

Control Drawing No. 0302 Page 2 of 3 GROUNDED TANK APPLICATION



Notes for Control Drawing 0302 Page 2 of 3:

1. All intrinsically safe wiring shall be separated from non-intrinsically safe wiring. Refer to article 504.2 of the National Electric Code (ANSI/NFPA 70) or other local codes, as applicable.
2. Maximum distance between ISD and Probe is 1000 feet.
3. The Probe's cable capacitance plus the Probe's intrinsically safe equipment capacitance (Ci) must be less than the capacitance (Ca) marked on the ISD. Also, the Probe's cable inductance plus the Probe's intrinsically safe equipment Inductance (Li) must be less than the inductance (La) marked on the ISD. If the electrical parameters of the cable are unknown, then a capacitance value of 60 pF/ft – and an inductance of 0.20 µH/ft are to be used. Cable capacitance and cable inductance are calculated as follows: 60 pF/ft x 1000 ft = 60 nF
   0.2 µH/ft x 1000 ft = 0.20 mH
4. The ISD must be installed in an enclosure suitable for the application in accordance with the National Electric Code (ANSI/NFPA 70) for installation in the United States, the Canadian Electrical Code for installations in Canada, or other local codes, as applicable.
5. The hazardous location ground and the ISD barrier ground must be connected to the ground bus in the power distribution panel. The ground bus must be connected to a suitable ground electrode per the National Electric Code (ANSI/NFPA 70) or other local codes, as applicable. The resistance of the ground path from the ISD barrier ground to the ground electrode must be less than 1 Ohm.
6. The ISD must not be connected to devices that use or generate more than 250 Vrms or dc with respect to earth.
7. This associated apparatus (ISD) has not been evaluated for use in combination with another associated apparatus.
8. A. For installations in which both the Ci and Li of the intrinsically safe apparatus exceeds 1% of the Co and Lo parameters of the associated apparatus (excluding the cable), then 50% of Co and Lo parameters are applicable and shall not be exceeded.

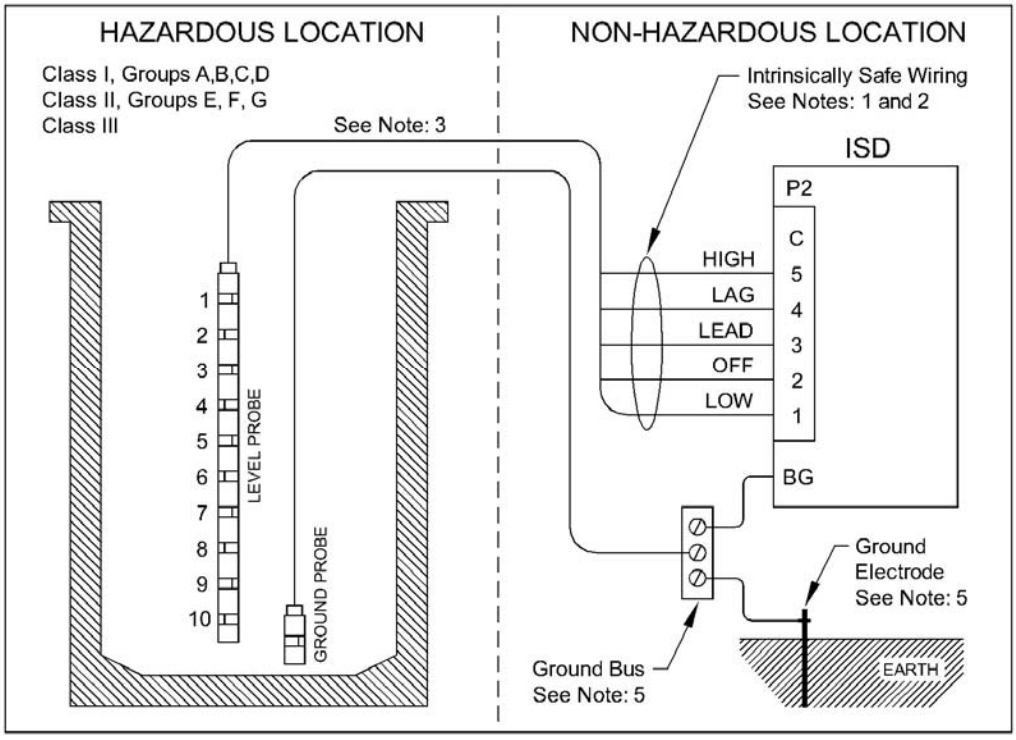
   B. The output current of this associated apparatus is limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

ISD Entity Parameters: Vt = 27.6 V It = 40.5 mA Ca = 86 nF La = 216.7 uH Po = 279 mW Um = 250 Vrms

Revision Date: 9-23-10

INTRINSICALLY SAFE DUPLEXER ISD

Control Drawing No. 0302 Page 3 of 3 UNGROUNDED TANK APPLICATION



Notes for Control Drawing 0302 Page 3 of 3:

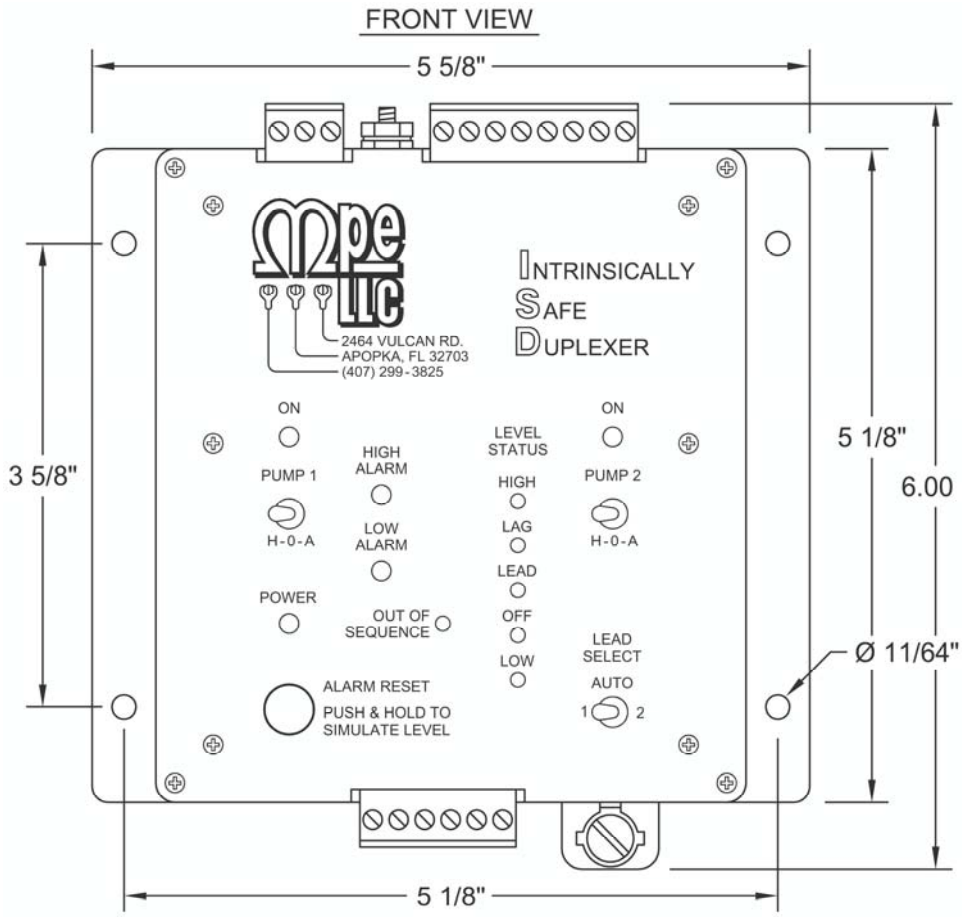
1. All intrinsically safe wiring shall be separated from non-intrinsically safe wiring. Refer to article 504.2 of the National Electric Code (ANSI/NFPA 70) or other local codes, as applicable.
2. Maximum distance between ISD and Probe is 1000 feet.
3. The Probe's cable capacitance plus the Probe's intrinsically safe equipment capacitance (Ci) must be less than the capacitance (Ca) marked on the ISD. Also, the Probe's cable inductance plus the Probe's intrinsically safe equipment Inductance (Li) must be less than the inductance (La) marked on the ISD. If the electrical parameters of the cable are unknown, then a capacitance value of 60 pF/ft – and an inductance of 0.20 µH/ft are to be used. Cable capacitance and cable inductance are calculated as follows: 60 pF/ft x 1000 ft = 60 nF
   0.2 µH/ft x 1000 ft = 0.20 mH
4. The ISD must be installed in an enclosure suitable for the application in accordance with the National Electric Code (ANSI/NFPA 70) for installation in the United States, the Canadian Electrical Code for installations in Canada, or other local codes, as applicable.
5. The hazardous location ground and the ISD barrier ground must be connected to the ground bus in the power distribution panel. The ground bus must be connected to a suitable ground electrode per the National Electric Code (ANSI/NFPA 70) or other local codes, as applicable. The resistance of the ground path from the ISD barrier ground to the ground electrode must be less than 1 Ohm.
6. The ISD must not be connected to devices that use or generate more than 250 Vrms or dc with respect to earth.
7. This associated apparatus (ISD) has not been evaluated for use in combination with another associated apparatus.
8. A. For installations in which both the Ci and Li of the intrinsically safe apparatus exceeds 1% of the Co and Lo parameters of the associated apparatus (excluding the cable), then 50% of Co and Lo parameters are applicable and shall not be exceeded.

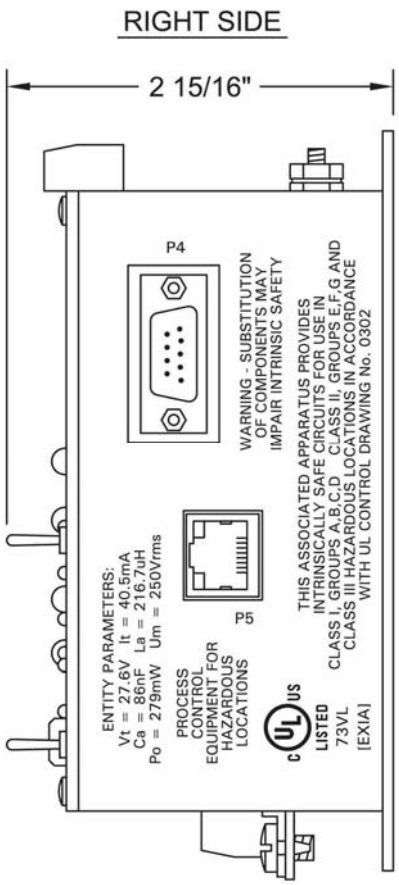
   B. The output current of this associated apparatus is limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

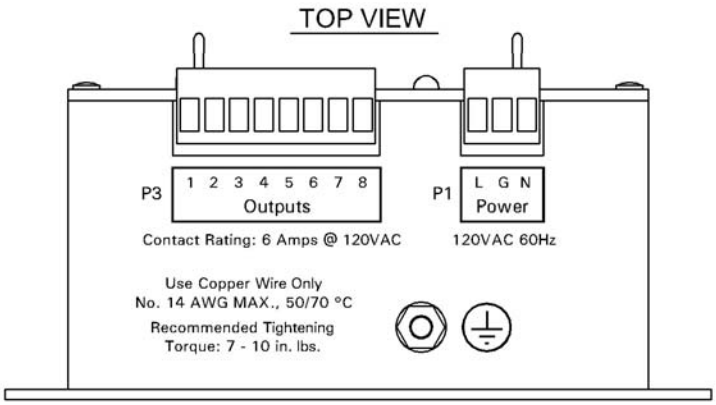
ISD Entity Parameters: Vt = 27.6 V It = 40.5 mA Ca = 86 nF La = 216.7 uH Po = 279 mW Um = 250 Vrms

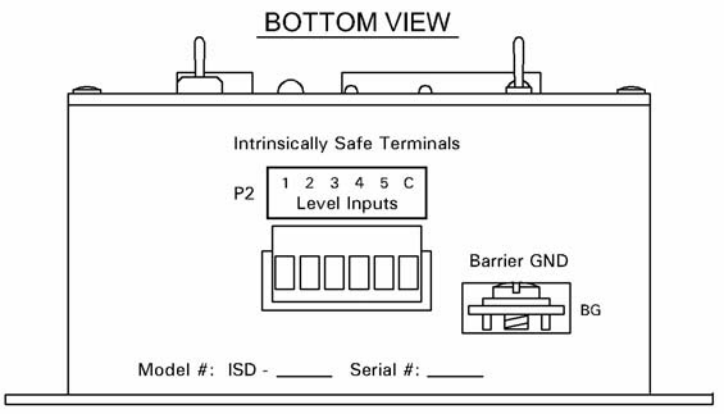
Revision Date: 9-23-10

ENCLOSURE MECHANICAL LAYOUT - SURFACE MOUNT VERSION

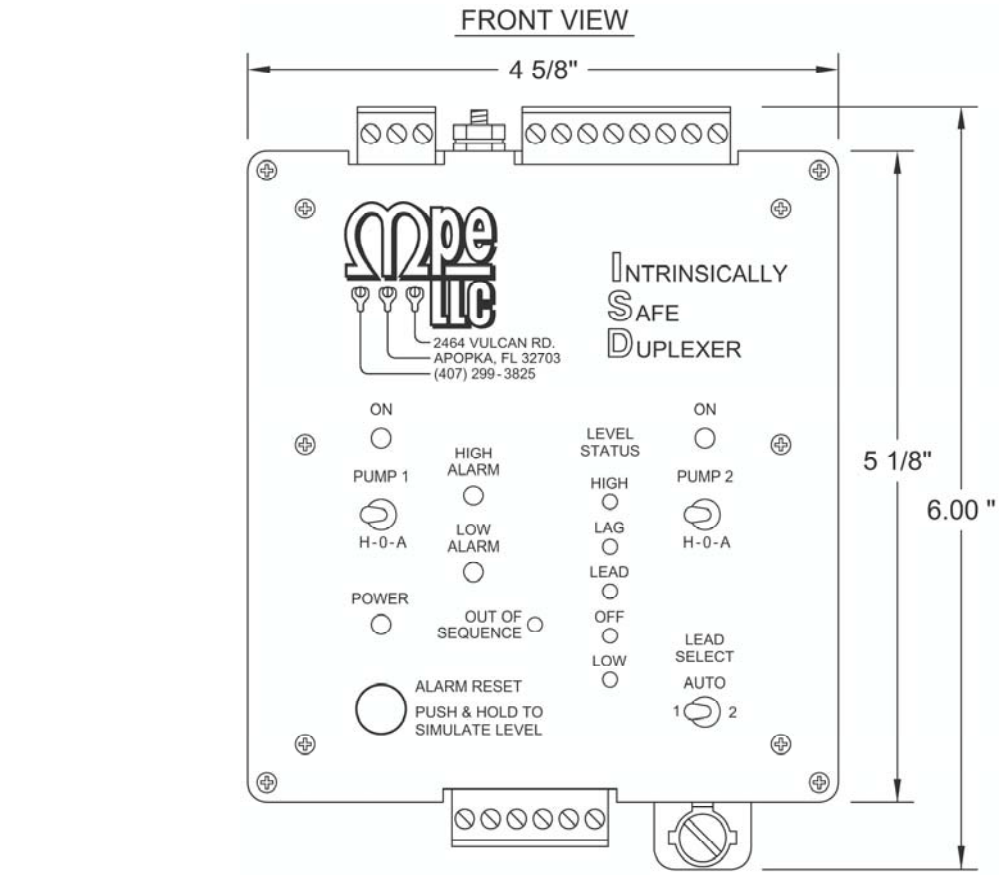


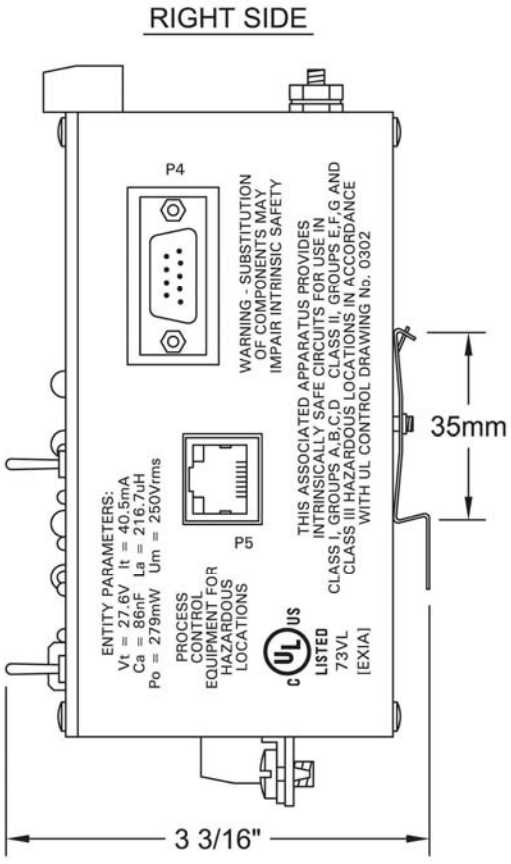


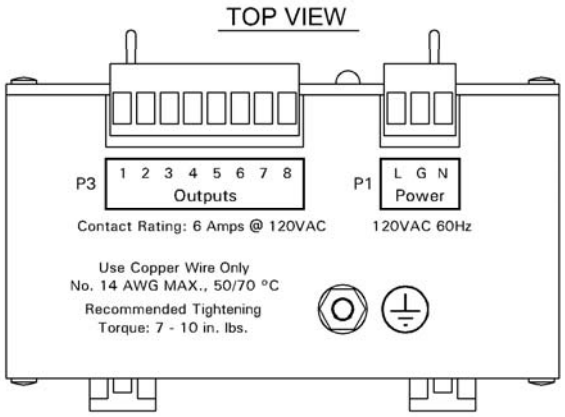


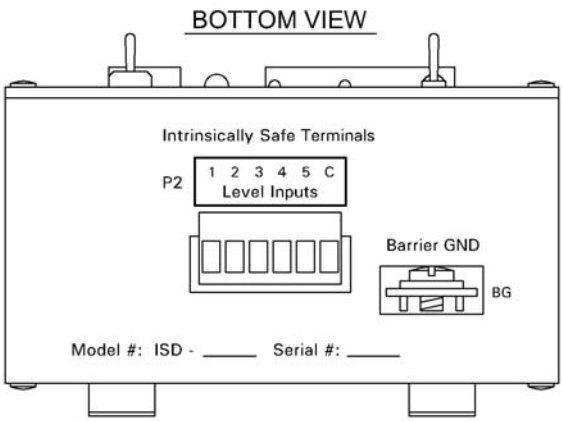


ENCLOSURE MECHANICAL LAYOUT - DIN RAIL MOUNT VERSION

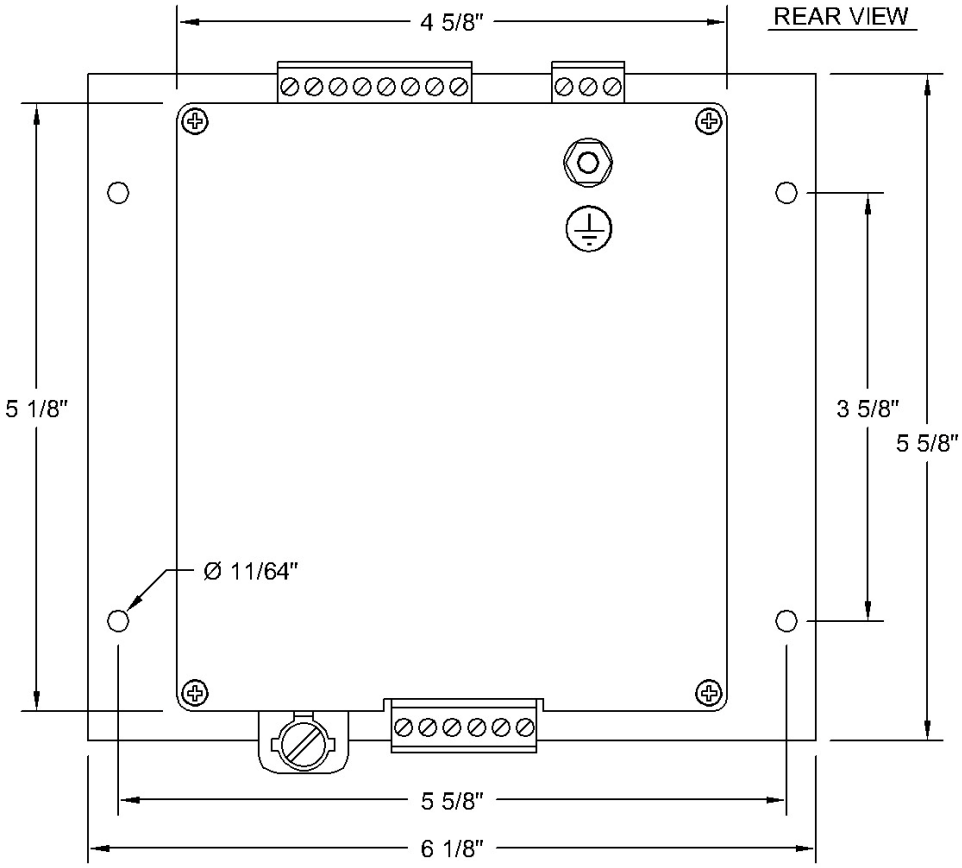


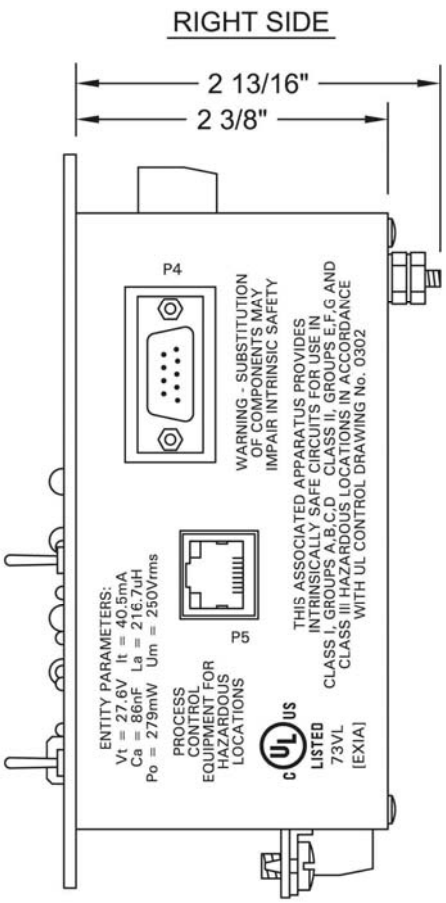


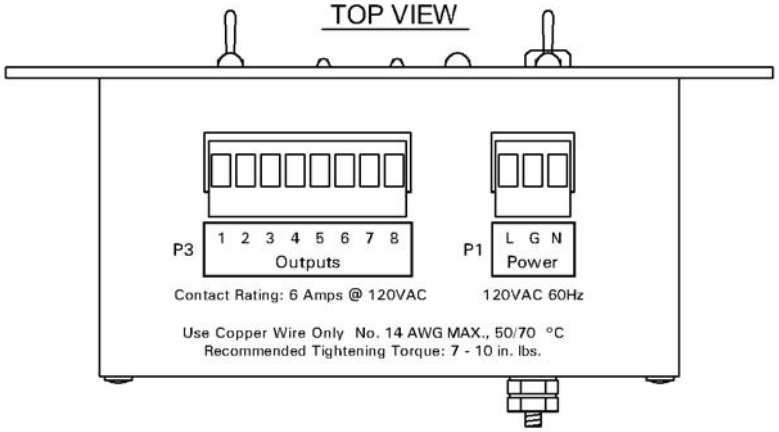


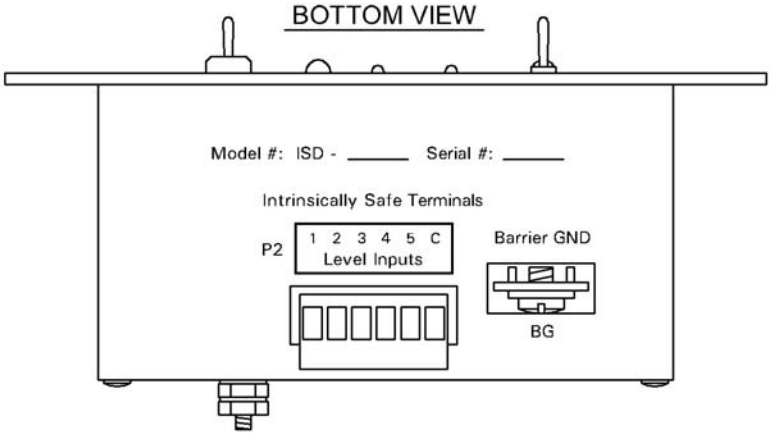


ENCLOSURE MECHANICAL LAYOUT - PANEL MOUNT VERSION

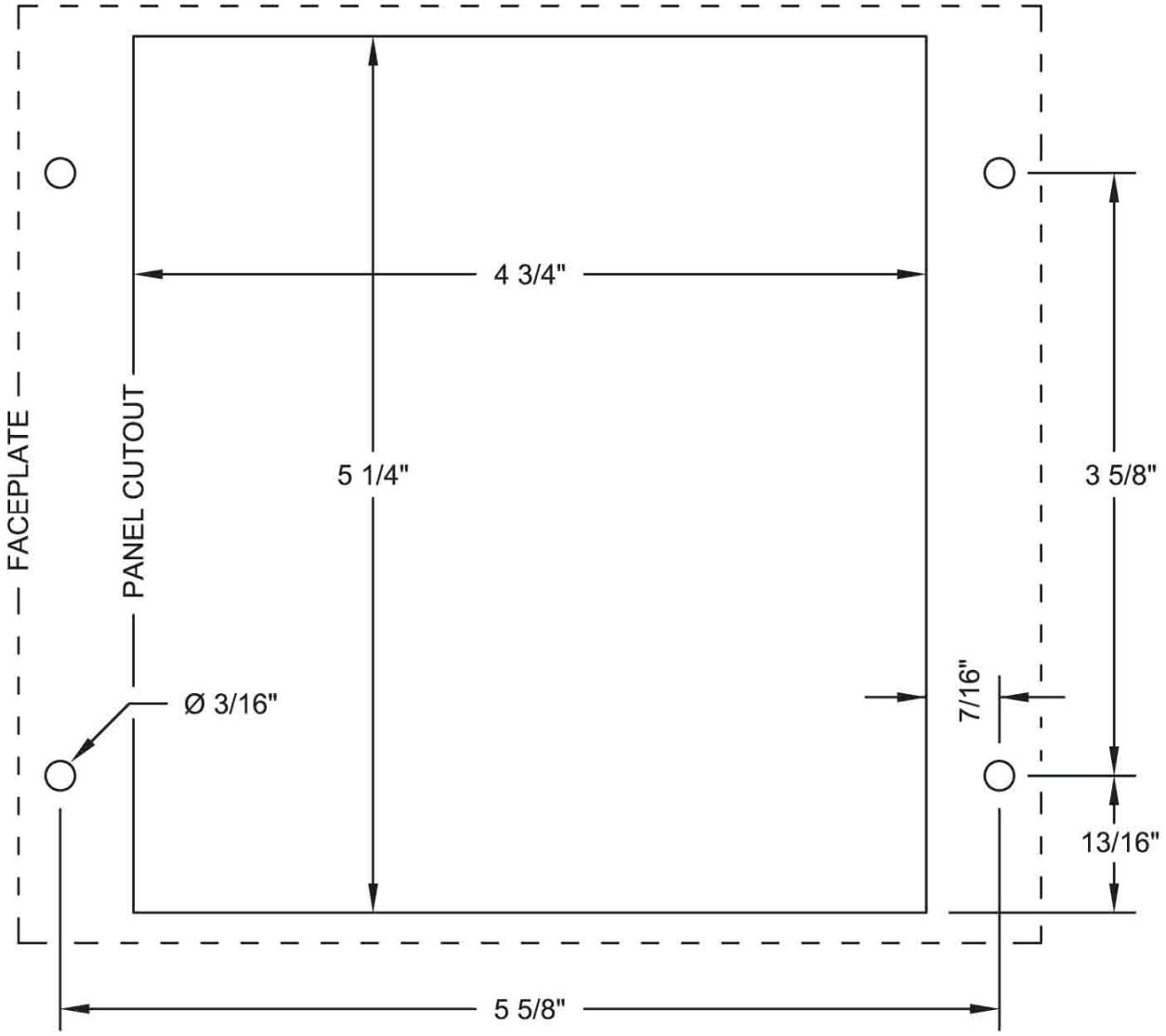








PANEL CUTOUT - PANEL MOUNT VERSION



Not Printed to Scale. **Do Not Use as a Template.**

WIRING NOTES - TO REPLACE ORIGINAL ISD