

TS-550 evo[®]

Fuel Management System


Installation Guide





Important Safety Messages


Franklin Fueling Systems equipment is designed to be installed in association with volatile hydrocarbon liquids such as gasoline and diesel fuel. Installing or working on this equipment means working in an environment in which these highly flammable liquids may be present. Working in such a hazardous environment presents a risk of severe injury or death if these instructions and standard industry practices are not followed. Read and follow all instructions thoroughly before installing or working on this, or any other related, equipment.


As you read this guide, please be aware of the following symbols and their meanings:


Warning  This symbol identifies a warning. A warning sign will appear in the text of this document when a potentially hazardous situation may arise if the instructions that follow are not adhered to closely. A potentially hazardous situation may involve the possibility of severe bodily harm or even death.


Caution  This is a caution symbol. A caution sign will appear in the text of this document when a potentially hazardous environmental situation may arise if the instructions that follow are not adhered to closely. A potentially hazardous environmental situation may involve the leakage of fuel from equipment that could severely harm the environment.


Danger  This symbol identifies an electrical danger. An electrical danger sign will appear in the text of this document when a potentially hazardous situation involving large amounts of electricity may arise if the instructions that follow are not adhered to closely. A potentially hazardous situation may involve the possibility of electrocution, severe bodily harm, or even death.

Warning  Follow all applicable codes governing the installation and servicing of this product and the entire system. Always lock out and tag electrical circuit breakers while installing or servicing this equipment and any related equipment. A potentially lethal electrical shock hazard and the possibility of an explosion or fire from a spark can result if the electrical circuit breakers are accidentally turned on during installation or servicing. Please refer to the *Installation and Owner's Manual* for this equipment, and the appropriate documentation for any other related equipment, for complete installation and safety information.


Warning  Follow all federal, state and local laws governing the installation of this product and its associated systems. When no other regulations apply, follow NFPA codes 30, 30A and 70 from the National Fire Protection Association. Failure to follow these codes could result in severe injury, death, serious property damage and/or environmental contamination.

Warning  Always secure the work area from moving vehicles. The equipment in this manual is usually mounted underground, so reduced visibility puts service personnel working on this equipment in danger from moving vehicles entering the work area. To help eliminate these unsafe conditions, secure the area by using a service truck to block access to the work environment, or by using any other reasonable means available to ensure the safety of service personnel.

Warning  When the Fuel Management System system is used to monitor tanks containing gasoline or other flammable substances, you may create an explosion hazard if you do not follow the requirements in this manual carefully.

Warning  All wiring must enter the console's enclosure through the designated knockouts. An explosion hazard may result if other openings are used.

Warning  All wiring from probes or sensors to the console must be run in conduit separate from all other wiring. Failure to do so will create an explosion hazard.

Warning  Substituting components could impair intrinsic safety. TS-550 evos are intrinsically safe for sensors installed in – Class I, Division 1, Group D – hazardous locations. Substitution of components could make the energy limiting circuitry in the system ineffective and could cause an explosion hazard. Repairs to a TS-550 evo console or attached components should only be performed by a qualified, factory-trained technician.

Notice

Franklin Fueling Systems reserves the right to change this document and specifications at any time without notice. Franklin Fueling Systems makes no expressed or implied warranty with regard to the contents of this manual. Franklin Fueling Systems assumes no liability for errors or omissions, or for any damages, direct or consequential, that may result from the use of this document or the equipment that it describes.

Trademarks

INCON®, TS-5 Series®, TS-550evo® Series®, System Sentinel®, SCALD®, Brite®, BriteBox®, BriteBus®, and BriteSensors® are registered trademarks of Intelligent Controls. All brand and product names are trademarks or registered trademarks of their respective companies.

Inspection of Materials

Visually inspect all components for defects or damage prior to installation. If any defect or damage is found, do not use the product and contact Franklin Fueling Systems for further assistance.

Return Shipping Charges

Franklin Fueling Systems will not accept shipments of returned products without a Return Material Authorization (RMA) number. RMAs are obtained by contacting Franklin Fueling Systems's Technical Service Division — NO RMAs will be given without the unit's serial number(s). Returned material remains the property of the buyer until replaced or repaired.

Under Warranty

Franklin Fueling Systems will pay all freight and insurance charges for all "Under-Warranty" RMAs.

Non-Warranty

It is the buyer's responsibility to prepay all freight and insurance charges for "Non-Warranty" RMAs.

Refer to the Warranty section at the end of this manual for all warranty issues.

Contacting Franklin Fueling Systems (FFS)

Please feel free to contact us by mail at:

Franklin Fueling Systems
3760 Marsh Rd.
Madison, WI 53718 USA

Or contact us by phone, fax or e-mail:

Tel: 1 608 838 8786

E-mail: sales@franklinfueling.com

Fax: 1 608 838 6433

techserve@franklinfueling.com

Tel: US & Canada 1 800 225 9787

Tel: México 001 800 738 7610

Tel: Europa +49 6571 105 380

Office Hours: 8am to 5pm CST - Monday through Friday

Please visit our web site at www.franklinfueling.com

Contents

Important Safety Messages	2
Notice	3
Trademarks	3
Inspection of Materials	3
Return Shipping Charges	3
Contacting Franklin Fueling Systems (FFS).....	3
Introduction	5
Certified Installer/Service Person	5
Station Owner/Operator	5
Abbreviations & Acronyms	5
Related Documentation.....	5
Product Description	5
Standard Installation Materials	6
Console Installation	7
Console Location.....	7
Mounting the Console	7
TS-550evo Dimensions and Operating Parameters.....	8
Communication Ports	9
RS-232 Communication Connectors.....	9
Wiring the Console & Modules	10
Non-Intrinsically Safe Module Wiring.....	10
Controller Module (CM).....	11
Power Supply Module (PS)	11
Relay Output Wiring (optional)	13
Emergency Generator Applications (optional).....	13
Relay Module (RLY)	15
AC Input Module (ACI)	16
4-20mA EXP Analog Input Module (420EXP)	16
Input/Output Module (IO).....	17
10 Amp Relay Module (10ARLY).....	18
Intrinsically Safe Module Wiring.....	19
Probe Module (PRB)	20
2-Wire Sensor Module (2WSNS)	21
3-Wire Sensor Module (3WSNS)	22
4-20mA Analog Input Module (420IB)	23
Control Drawing	24
Warranty	26
Warranty Registration.....	26
Specifications.....	27

Introduction

This manual contains installation and site preparation instructions for Franklin Fueling Systems's TS-550evo console. Overall safety issues, troubleshooting information, warranty, service, and return policies, as defined in this manual, must be followed.

Please read this entire manual carefully. Failure to follow the instructions in this manual may result in faulty operation, equipment damage, injury or death. This equipment should only be serviced by an Franklin Fueling Systems-certified installer.

Certified Installer/Service Person

Only an Franklin Fueling Systems certified installer or service person is allowed to access both the user interface keypad and areas internal to the TS-550evo console.

Station Owner/Operator

The station owner or operator of the TS-550evo console is only allowed to access the user interface keypad. Access to areas internal to the console is strictly prohibited.

Abbreviations & Acronyms

10ARLY - 10 Amp Relay Module

2WSMS - 2-Wire Sensor Module (Intrinsically Safe)

3WSMS - 3-Wire Sensor Module (Intrinsically Safe)

420EXP - 4-20 mA EXP module

ACI - AC Input Module

420IB - 4-20mA Analog Input Module (Intrinsically Safe)

AST - Aboveground Storage Tank

ATG - Automatic Tank Gauge

CM - Controller Module

DIM - Dispenser Interface Module

FMS - Fuel Management Systems

IQ - Input / Output module

IS - Intrinsically Safe

LIM - LonWorks Interface Module

PC - Personal Computer

PRB - Probe Module (Intrinsically Safe)

PS - Power Supply Module

RLY - Relay Module

SCM - Secondary Containment Monitoring

TPI - Turbine Pump Interface

TS-EXPC - TS-5 Series - Expansion Console

UST - Underground Storage Tank

Related Documentation

The system operation and programming instructions, troubleshooting guide and console maintenance manual are provided for your use in separate documents. Detailed installation and testing instructions for each type of leak detection sensor are present in the relevant manual, and, likewise, the installation, testing, and programming of various upgrade kits and *optional* accessories are also contained in separate manuals, addenda or in one of this document's appendixes.

Product Description

The TS-550 evo is a modular, automatic, continuous monitoring system that uses plug-in modules to perform a wide variety of functions. From fuel management, monitoring, and/or control functions the TS-550 with its plug-in modules allows you to customize the system to meet your needs. Purchase only those functions that you require, and expand your system later for greater capabilities.

The TS-550 evo's enhanced processor and additional memory on the CM (Controller Module) along with the flexibility of the modular design allows for peak performance while monitoring multiple systems. The TS-550 can easily monitor all of your tanks, lines, sumps, and secondary containments.

The TS-550evo console comes standard with a Controller Module (CM), Power Supply Module (PS), and a color LCD display and these features:

- Generates reports automatically in response to preset/programmed conditions and alarm
- Provides audio-visual annunciation when an alarm or warning condition exists
- Performs inventory monitoring
- Is able to print reports on a compatible external Hewlett-Packard Printer
- Can communicate via Ethernet, RS-232, RS-485, or an optional internal fax/modem.

The TS-550 evo console optionally:

- Has six (6) open slot for additional module that can be used to expand its capabilities
- Can support a combination of up to:
 - 36 Probes (or three Probe Modules)
 - 36 2-wire sensors (or three 2-Wire Sensor Modules)
 - 24 3-wire or 2-wire sensors (or three 3-wire Sensor Modules)
 - 24 relay outputs (or three Relay Modules)
 - 24 4-20mA inputs (or three 4-20ma Input Modules)
 - 36 AC inputs (or three AC Input Modules)
 - 12 4-20mA outputs & 24 AC/DC Inputs (or three Input & Output Modules)

Example Station: If your station has 8 Submersible Pumps, 12 Tanks, 8 Lines and 24 Sensors, you could control all of it with your FFS TS-550evo and six plug-in modules: a Relay Module, a Probe Module, an Analog Input Module, an AC Input Module and two Sensor Modules.

Standard Installation Materials

Recommended standard materials should be selected and installed per all applicable local, state and federal codes governing the installation of this product and its associated systems. Please see the corresponding console/module wiring section or the associated devices section of this manual for complete installation details.

Cables Required for Liquid Level Probes, and 4-20 mA Sensors

Use cables and wires compliant with national and local codes. Franklin Fueling Systems recommends using the types of cable shown below up to a recommended length of:

- Belden No. 87760 87760 (0.15" or 3.048 mm OD) to 260 feet (80 m)
- Belden No. 87761* (0.12" or 3.048 mm OD) to 400 feet (120 m)
- Belden No. 88761 88761 (0.12" or 3.048 mm OD) to 400 feet (120 m)
- Belden No. 89182* (0.31" or 7.874 mm OD) to 1500 feet (450 m)

Note: An asterisk (*) denotes a cable that may be ordered from Franklin Fueling Systems.

Note: Conductors of different intrinsically safe (IS) circuits may be run together within the same conduit, and, when they do, they should have at least .01 inches (.25 mm) of insulation.

Cable or Wire for 2-Wire or 3-Wire Sensors

2-wire or 3-wire sensor wire (type THHN, TFFN, or THWN, gas and oil resistant, 18 AWG minimum, 1500 feet max. wire run length) can be used when enclosed within rigid metal conduit from the sensor to the console.

Leak detection sensor cable is required when NOT run through rigid metal conduit. Refer to the *Direct Burial Cable – Installation Manual* (P/N 000-1041) for further information. See below for cable types and descriptions:

Alpha 58411 (Franklin Fueling Systems P/N 600-0062)
--

Two conductor cable for standard, 2 conductor leak detection sensors (0.114 inch (2.9 mm) O.D.)

Wire required for the TS-550evo Console

- 3 conductors: Power – 14 GA to 12 GA Max. – Black, White, and Green
- 1 conductors: Safety Ground – 12 AWG Green (2 may be required in some locations)
- As required conductors: Accessories – Type THHN, TFFN, or THWN, 18 AWG minimum

Circuit Breaker

20 Amp — providing power *only* for the TS-550evo console, one required per console

Weatherproof Junction Boxes

Minimum 16 cubic inch (406.4 cubic mm) weatherproof junction box, cover, and cover gasket for the manholes of: liquid level probes and leak detection sensors. See our sales literature for part numbers for ½ and ¾ inch (12.7 mm and 19.05 mm) conduit junction boxes and recommended manufacturers. Also use ¾ to ½ inch (12.7 mm to 19.05 mm) bushings for probe/sensor compression fittings.

Use a weatherproof metal pull box for combining several circuits that will run into the TS-5 Series console through one or more conduits. Use a separate weatherproof metal pull box to combine intrinsically safe (IS) liquid level probe and leak detection sensor wiring. *Do not run other non-intrinsically safe wiring within the IS pull box.* Run ½ or ¾ inch (12.7 mm or 19.05 mm) IS probe or sensor conduit from the manholes to the IS pull box, and then run up to four ½ or ¾ inch (12.7 mm or 19.05 mm) conduits to the console's IS conduit knockouts.

Conduit

Rigid metal conduit (RMC) - male NPT threaded: use ½ or ¾ inch (12.7 mm or 19.05 mm) for IS probe and sensor wiring to the console (from the manholes, use ½ or ¾ inch conduit), and use ½ or ¾ inch (12.7 mm or 19.05 mm) for non-intrinsically safe accessories and power wiring.

Use conduit hardware that is appropriate for the installation and meets local, state and federal requirements.

Splice Connector Kits Must Be Used — Warranty Requirement

Use the Franklin Fueling Systems-approved, moisture-resistant, no-strip splice connectors for liquid level probe and leak detection sensor wires. You may order the TSP-KW30, which contains 30 of the Franklin Fueling Systems-approved, moisture-resistant connectors.

Using moisture resistant splice connectors will:

- Reduce/eliminate corrosion of the wire connections from repeated exposure to water condensation, which causes eventual signal loss and system failure.
- Reduce/eliminate equipment damage from water flooding around the connectors, which causes short-circuit damage.

Thread Sealant (UL Classified)

Use a non-hardening, "stay-soft," thread sealant, or equivalent, to seal and waterproof all tank riser pipe threads. In addition, the thread sealant (or "pipe dope" as it is commonly known) should also be chemically non-reactive to the product in the tank(s). Apply thread sealant to seal/waterproof all outdoor electrical conduit fitting threads including the hole plugs at the weatherproof junction boxes.

Riser Pipes

ANSI Schedule 40 (or chemically non-reactive) – 4 inch (101.6 mm) (8 NPT) riser pipes for liquid level probes. See the appropriate leak detection sensor manual for information on required riser pipes and riser cap adapters.

Probe Installation Kit(s)

See the TSP-LL2's installation instructions that came with the probe for the items included with the TSP-K4A standard probe installation kit. For chemical applications, see the TSP-LL2C's installation instructions for the TSP-K4AS stainless steel riser cap adapter kit and the TSP-SSP stainless steel product float.

TSP-LL2 Probe Floats

- Floats for 4 inch (101.6 mm) riser pipes, order: TSP-IGF4 for gasoline applications or TSP-IDF4 for diesel and fuel oil
- Floats for 3 inch (76.2 mm) riser pipes, order: TSP-IGF3 for gasoline applications or TSP-IDF3 for diesel and fuel oil
- Floats for 2 inch (50.8 mm) riser pipes, order: TSP-IGF2 for gasoline, TSP-IDF2 for diesel and fuel oils, or TSP-SSP stainless steel float for chemical products

Manufacturer's Tank Chart for Each Tank


The manufacturer's Tank Chart and other documentation will be used for installation and programming, and possibly for future reference. Keep this information — do *not* discard it.


Console Installation

Console Location

The location that you select to install the console must be indoors in an area classified as non-hazardous (see the console specifications table at the beginning of the Wiring the Console & Modules chapter for further information). To get the maximum benefit from this system, install the console where personnel can easily make use of it; mount it at eye level for operator convenience. Mount the console level on a vertical surface between 2 feet (0.6 m) and 6 feet (1.9 m) high using the appropriate fasteners. For European applications, the console must be located in a pollution degree 2 environment per IEC60664.

Mounting the Console

Warning  **The TS-550evo consoles must be mounted in a location where explosive or flammable vapors are not present, otherwise an explosion hazard will be created which can result in severe injury, death, serious property damage and/or environmental contamination.**

Warning  **Leave a minimum of two inches (5.1 cm) of space around the console open to allow for ventilation, communication port connections, conduit and wiring. If the ventilation louvers located on the sides of the TS-550evo are obstructed, the unit may overheat and stop functioning as intended.**

Four mounting tabs are available on the outside corners of the console. Select fasteners that have sufficient load carrying capacity and which are appropriate for wall construction – a fully equipped TS-550evo console can weigh as much as 40 pounds (18 kg), so make sure that your fasteners (and mounting surface) can adequately support that much weight. In addition, plan ahead to make sure that there is enough room around the console for: conduit coming into the unit, communication port connections, possible incoming probe or sensor wiring, and for the console door to fully open for easy access.

Note: For questions concerning standard installation materials to be used for the TS-550evo console, please refer to the Standard Installation Materials section of this manual.

TS-550evo Dimensions and Operating Parameters

The TS-550evo has conduit knockouts and communication ports located on the bottom of the unit. Use the diagram below to help you mount the console appropriately.

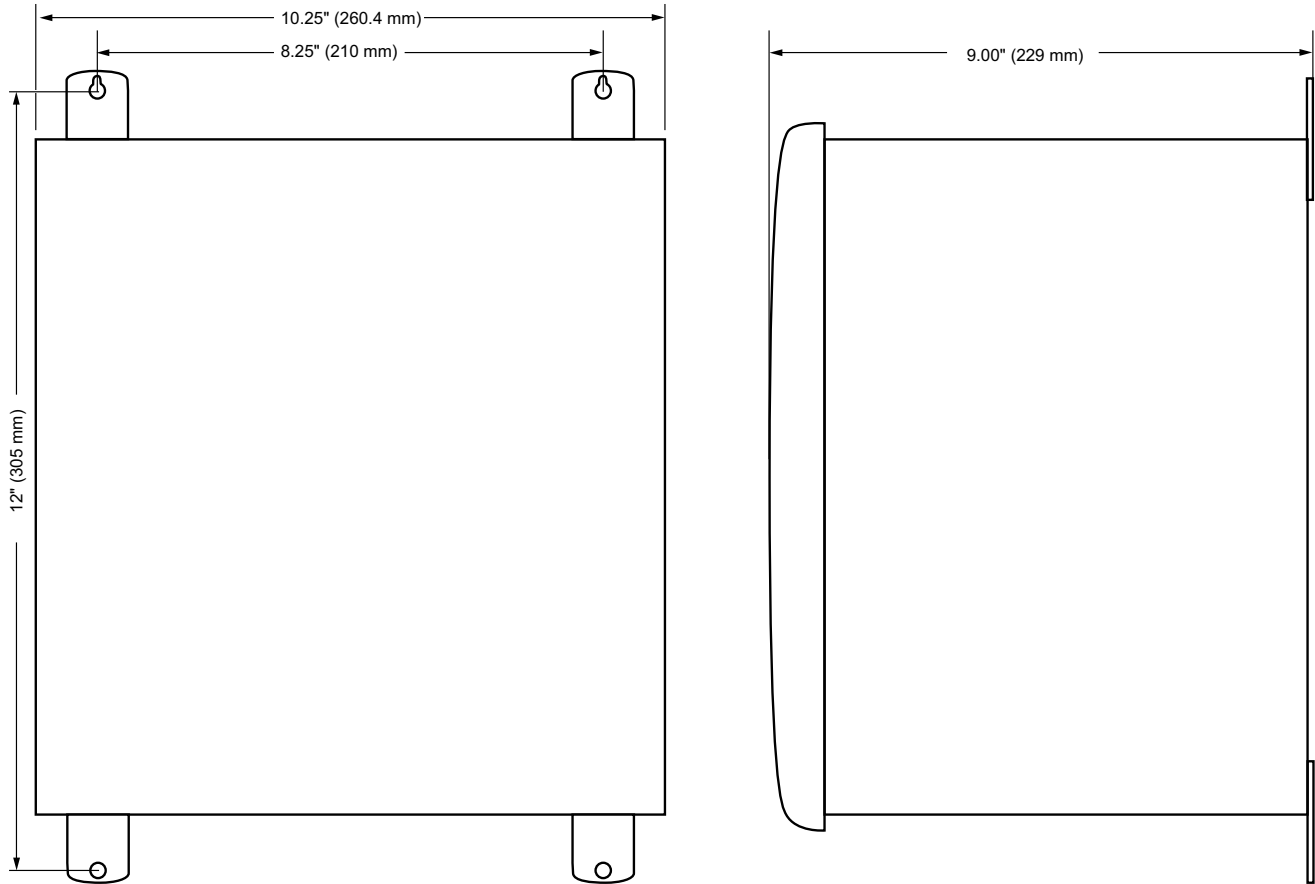


Figure 1: TS-550evo Dimensions

Console Operating Parameters	
Line Voltage:	115/230 V~ +15%, -10%
Frequency & Power:	50/60 Hz, 150 W maximum
Storage Temp.:	-20° to 60° C (-4° to 140° F)
Operating Temp.:	0° to 40° C (32° to 104° F)
Operating Humidity:	0 to 95%, non-condensing
Cleaning:	Cloth or sponge slightly dampened in mild detergent
Splash Resistance:	Not to be exposed to direct spray, splash or drips
Location:	Indoors in an office or in a non-hazardous pollution degree 2 environment per IEC60664

Communication Ports

The TS-550evo console has several communication ports that can be used to communicate with various devices. The communication ports can be used for a wide variety of applications: to connect the console to a computer network, to print reports on an external printer or to fax reports via the optional internal fax/modem. Please refer to the table below for a more complete listing of the ports and their associated devices.

Port	Connector Type	Devices	Module
RS-232 Comm 1	DB9 Female	Local PC (preferred in Comm 1)	Controller
RS-232 Comm 2	DB9 Male	POS Terminal, External Modem, External ATG to TS-EMS or Local PC with a null-modem cable	Power Supply
Ethernet	RJ-45	Local Network	Controller
USB 1	Type A	External Hewlett-Packard Printer	Controller
USB 2	Type A	External Hewlett-Packard Printer	Controller
Fax/Modem	RJ-11	Phone Line (requires an optional fax/modem)	Controller
RS-485/TPI	4 Pin Pluggable Terminal Block, 0.2" (5.08 mm) LS	TS-DIM (external)	Power Supply
Bus Extension (CAN)	3 Pin Pluggable Terminal Block, 0.15" (3.81 mm) LS	TS-EXPC	Power Supply
RS-422/232 & Current Loop	DB9 Male	Dispenser Distribution Box (Dbox)	Dispenser Interface
LON	2 Pin Pluggable Terminal Block, 0.2" (5.08 mm) LS	IFSF Network	LON Interface



Peripheral equipment connected to the T5 series console's communication port must:

1. Be listed by UL or another third-party Nationally Recognized test laboratory when required by the authority having jurisdiction, and:
2. Not be installed over a hazardous location (unless so rated)

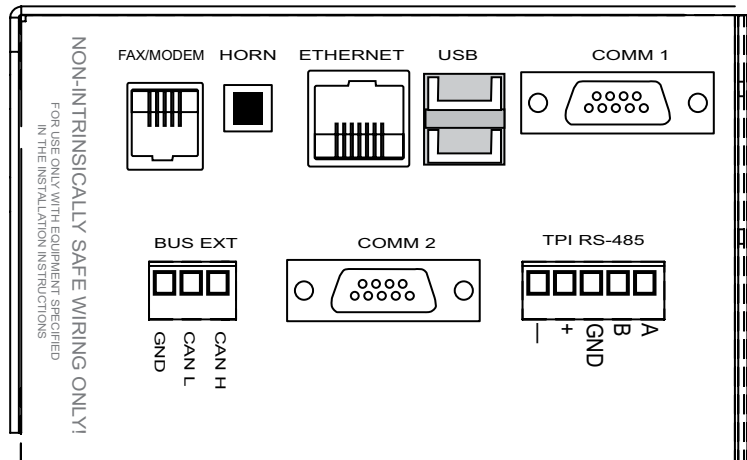


Figure 2: View of Communication Ports

Note: The onboard TS-DIMIB (Dispenser Interface Module) and the TS-LON (IFSF protocol Interface Module) are optional daughterboards that attach to the Power Supply Module. Only one daughterboard can be used in a system.

Note: Either the Current Loop or RS-422/232 connector will be used to connect to a dispenser distribution box (Dbox) depending on the manufacturer's settings.

RS-232 Communication Connectors

Two connectors for RS-232 interfaces are provided on the bottom of the TS-550evo console. The pin designations for the RS-232 connectors are as follows:

Console RS-232 Comm Port 1

DB9 Connector, Female, DCE

Pin No.	Function	Input/Output
2	TXA	O →
3	RXA	I ←
5	Signal GND	
7		
8	CTS	O →

Console RS-232 Comm Port 2

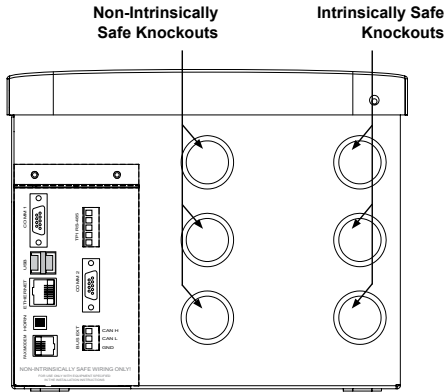
DB9 Connector, Male, DTE

Pin No.	Function	Input/Output
1	DCD	O →
2	RXA	I ←
3	TXA	
4	DTR	I ←
5	Signal GND	O →

Note: Follow the communications setup instructions in the *TS-550evo Programming Guide*.

Wiring the Console & Modules

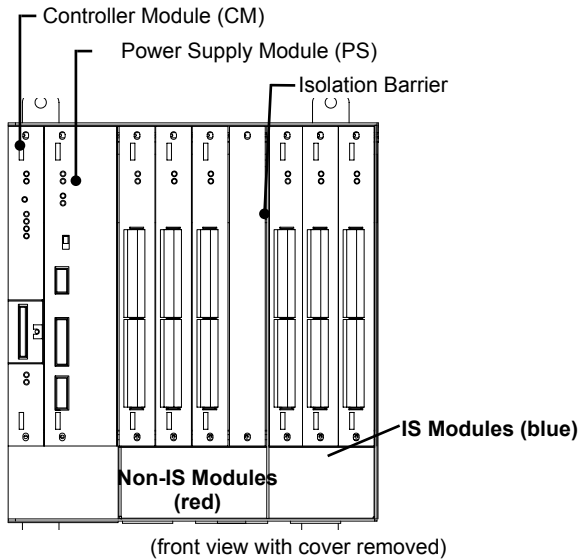
Conduit must only enter the console enclosure through the designated knockouts as shown below in Figure 4.



(bottom view)

Figure 3: TS-550evo Conduit Knockouts

When installing additional modules, Franklin Fueling Systems recommends installing non-IS modules from left to right (from the open slot closest to the power supply) and IS modules from right to left. In this scenario, all unused slots will be concentrated in the middle of the enclosure. This lets the IS barrier be easily moved and allows for the possibility of adding future modules to the system without needing to rewire those devices already in place. It's also a good idea to always start wiring your module at the bottom-most set of channels (usually Channel 1) to further future-proof your installation and avoid any unnecessary confusion.




(front view with cover removed)

Figure 4: TS-550evo Module Connections

It is important that intrinsically safe wiring only enter the console through IS knockouts, and non-intrinsically safe conduit only enter through non-IS knockouts. Maintain the integrity of the intrinsically safe modules by keeping probe and sensor wiring in conduit separate from all other wiring. Probe and sensor wiring may be run in the same conduit as long as they are both receiving power from the same console and the wire complies with NEC 504.30 or applicable local codes.

Non-Intrinsically Safe Module Wiring

Danger  Always lock out and tag electrical circuit breakers while installing or servicing this equipment and any related equipment. A potentially lethal electrical shock hazard and the possibility of an explosion or fire from a spark can result if the electrical circuit breakers are accidentally turned on during installation or servicing.

Important: Non-intrinsically safe wiring cannot be run in the same conduit as intrinsically safe wiring. Conduit knockouts for IS and non-IS module wiring are clearly identified in Figure 7 for your reference. Non-IS modules can be identified by their red faceplates and should always be installed to the left of the moveable isolation barrier.

Non-Intrinsically Safe modules include:

- Controller module
- Power Supply Module
- Relay Module
- AC Input Module
- Input/Output Module
- 10 Amp Relay Module
- 4-20mA EXP Analog Input Module

Controller Module (CM)

The Controller Module (CM) is a non-intrinsically safe module that acts like the brain of your console. The CM handles all of the communication between the modules and then sends that information to your output devices. You can use the LCD touch screen LCD or external printer (depending on model and configuration) as output devices to communicate with your system. The CM links to the status lights on the front of the console and the LCD via flexible cables.

Flexible Cable Connectors

The flexible cables are installed at the factory and is just long enough to allow the door to fully open. They are protected from high power wiring by the metal shroud attached to the CM. The cables should not be deformed, but should rather be freely folded back into the shroud so that they do not get pinched when the door is closed. If the flexible cables do become detached though, they can easily be reattached.

To reattach the flexible cables to the connectors, identify the two sides of each end on both cables: there are metal bands on one side and no metals bands on the other. The flexible cables connect to the CM by inserting one end of each cable into the LCD connector with the cables' metal bands facing to the left so that a metal to metal connection is made with the LCD's connector pins.

After the flexible cables have been correctly inserted all the way into each of the LCD connectors there will be no metal showing above the connection. Once the flexible cable connector is properly attached to the CM's LCD connector, hook it up to the corresponding connector on the inside of your console's door by making the same kind of metal-to-metal connection that you made while inserting it into the CM's faceplate.

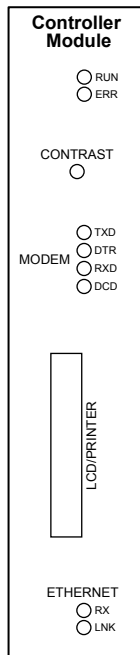


Figure 5: Controller Module

Power Supply Module (PS)


The PS is a non-intrinsically safe module that provides power to the TS-550 evo console from line voltage rated 110 - 240 VAC. The PS is two inches wide, occupies two slots and is located immediately to the right of the CM. The PS consists of two AC /DC switching power supplies - one switching power supply is +5V and the other is +24V.


The PS also has two relay outputs for use with remote annunciators and two low voltage inputs for emergency generator applications.

Line Power Wiring

At the electrical power panel, use or install a 20 amp circuit breaker — this breaker should be dedicated to only supplying power to the TS-550 evo console. Mark this circuit “TS-550 evo console [power] - ONLY” on the circuit label (at the back of the electrical power panel door). Refer to Figure B-1 and the 110/240 VAC Line Power Wire Connection List that precedes it for line power wiring information.

Note: Avoid connecting other equipment to this circuit. If other equipment is connected to this dedicated circuit, the resulting electrical noise could cause faulty system operation.

Danger  **Make sure that the TS-550 evo console's power circuit breaker is turned off during any installation. Lethal voltages are present inside the console which could kill or injure you. Also, secure the TS-550 evo console's circuit breaker in the off position and attach a “lockout” to it, which is dated and signed by you, to prevent accidental closure, injury or death.**

Danger  **The ground bus in the electrical panel must be connected to an earth ground as required by the National Electrical Code (or Canadian Electrical Code) when applicable. If the ground bus is not properly connected to an earth ground or if the IS safety ground is not properly connected at the console, a dangerous condition will be created which could result in an explosion.**

Check Electrical Resistance to Earth Ground

After wiring the IS safety grounds, check the resistance between the IS safety ground terminals at the console and the earth ground – this resistance must be less than 1 ohm.

110/240 VAC Line Power Wire Connection List

Electrical Panel	No. Conductors, Color (Gauge)	Circuit
20 Amp Circuit Breaker	1 Black wire, 14 AWG (1.6 mm) min.	110/240 VAC Power
Neutral	1 White Wire, 14 AWG (1.6 mm) min.	Neutral
Ground Bus	1 Green wire, 14 AWG (1.6 mm) min.	Ground
Ground Bus	1 Green wire, 12 AWG (2.1 mm) min.	Safety Ground

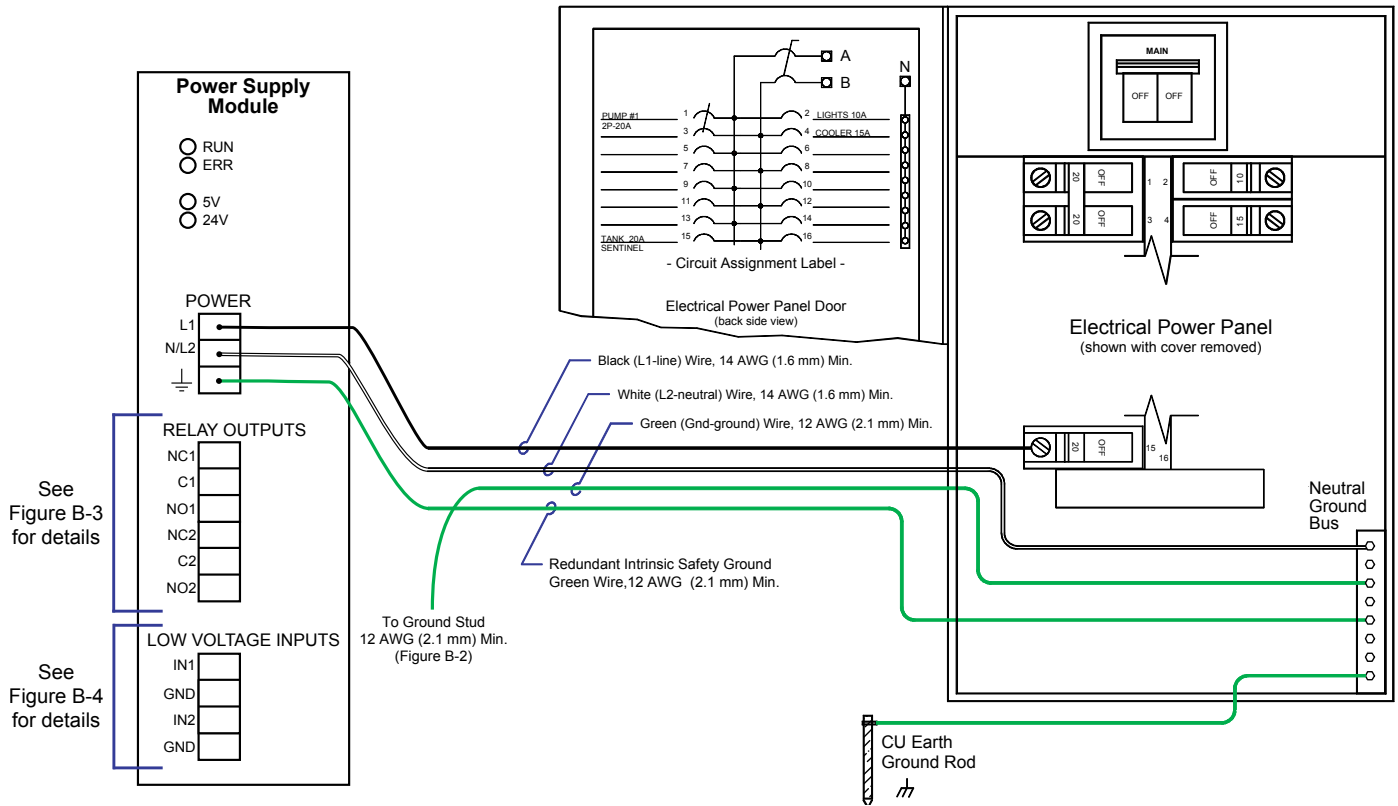


Figure 6 – 110/240 VAC Power and IS Ground Wiring

Note: The installer must connect the earth ground conductor to the most convenient ground terminal as long as it meets local and national codes. The earth ground conductor must be 12 AWG (2.1 mm) or larger.

Stud: #8 threaded post

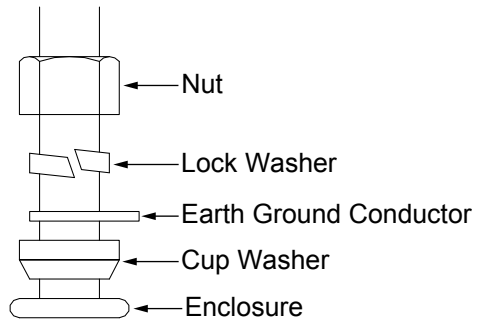


Figure 7 – Ground Stud

Relay Output Wiring (optional)

As illustrated in the diagram below, the Power Supply Module's two relay outputs can be used to activate an external alarm (TS-RA2) and the two inputs can be used to silence that alarm remotely (TS-RK).

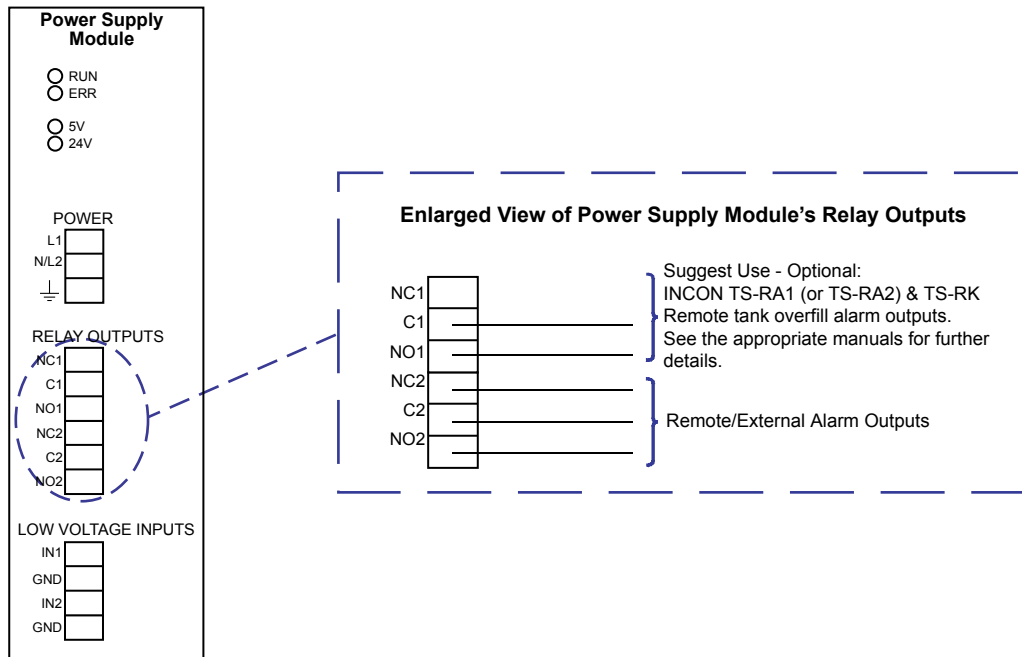


Figure 8: Alarm Output Wiring Schematic

Note: The TS-RA2, TS-RA1 and TS-RK are not part of the UL certification of this system.

Emergency Generator Applications (optional)

The wiring or use of discrete inputs is optional — skip this section if you don't plan to use this interface. Discrete inputs may be wired to a TS-550 evo console with 18 AWG, type TFFN or THWN wire. You may also use THHN wire in sizes larger than 18 AWG.

Emergency backup power generator run-relay(s) are wired to the discrete input interface terminals at the TS-550 evo console. A run-relay closure will stop a leak test on the associated generator fuel tank. When the generator run-relay opens (generator stops running), a run report is produced at the console, which shows the total and hourly fuel consumption rate during the run cycle.

Note: You must use dry run-relay contacts for this interface because the TS-550 evo series supplies +5 VDC digital logic power at the IN (input) terminals.

Note: It is recommended that you use: IN 1 & GND for Generator 1 /fuel supply Tank #X, and IN 2 & GND for Generator 2 /fuel supply Tank #Y. The specific fuel tank(s) assigned are “programmable.” See Figure 9 for wiring details.

Non-Standard Power Requirements

The console's power must be maintained on a power transfer supply for emergency backup generator applications. In addition, the TS-550 evo series' line power must be supplied through a UPS (Uninterruptible Power Supply). See Figure 9 for emergency generator applications.

Programming & Testing Discrete Inputs

Program the tank gauge and test the discrete inputs for proper operation after installation. See the *TS-550 evo Programming Guide* for reports and programming issues.

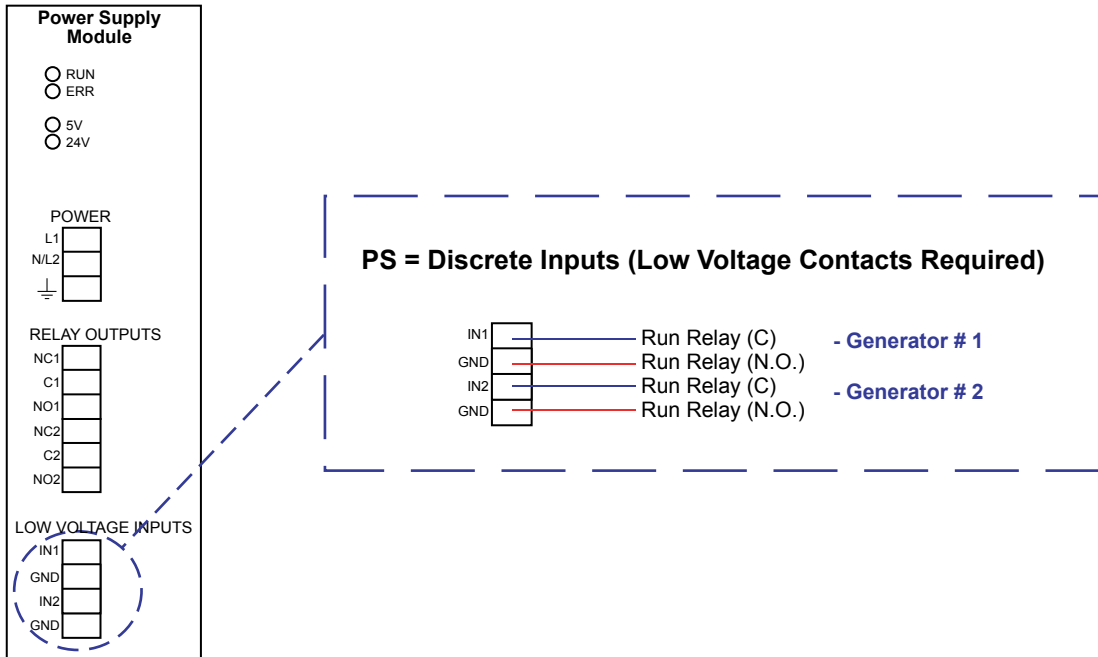


Figure 9 – Emergency Generator Wiring

Relay Module (RLY)

The RLY is a non-intrinsically safe module that has 8 identical Form C output channels. Each channel has a fuse and three terminals. Each channel can be configured as NO or NC with the power off by wiring to the appropriate terminals. A TS-550 evo console can accommodate up to 24 outputs (8 outputs on up to 3 modules) as space allows. The diagrams below illustrate two examples of positive shutdown upon alarm conditions.

Relay Module Specifications	
Number of Channels:	8 Form C
Contact Rating:	2A @ 250 VAC 2A @ 30 VDC

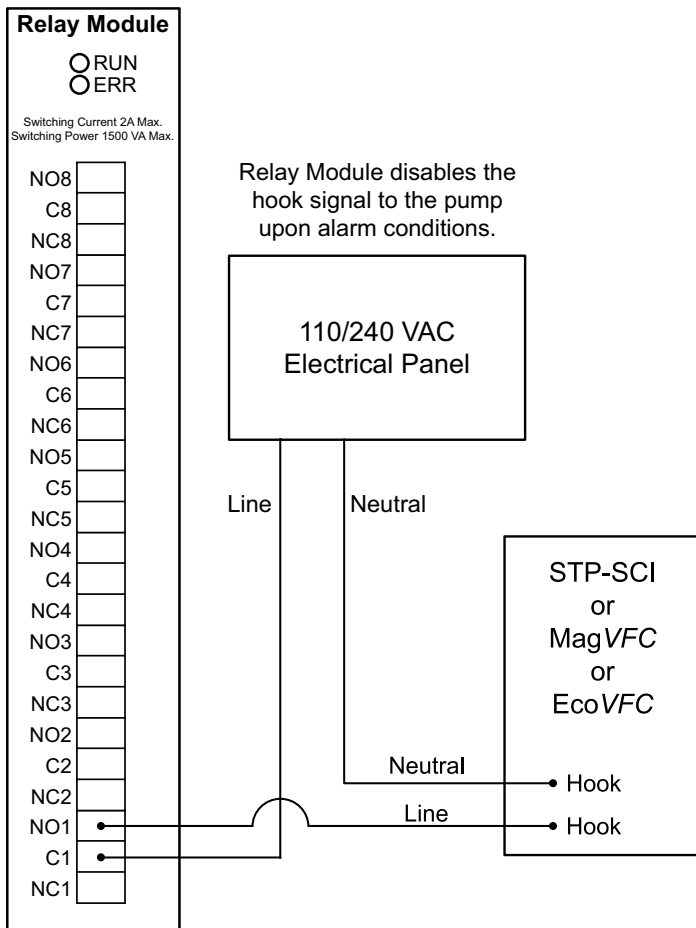


Figure 10: Positive Submersible Control Box Shutdown

Note: A valid dispenser hook signal coming from the AC Input Module (shown in Figure 12) is required for these diagrams to function as shown.

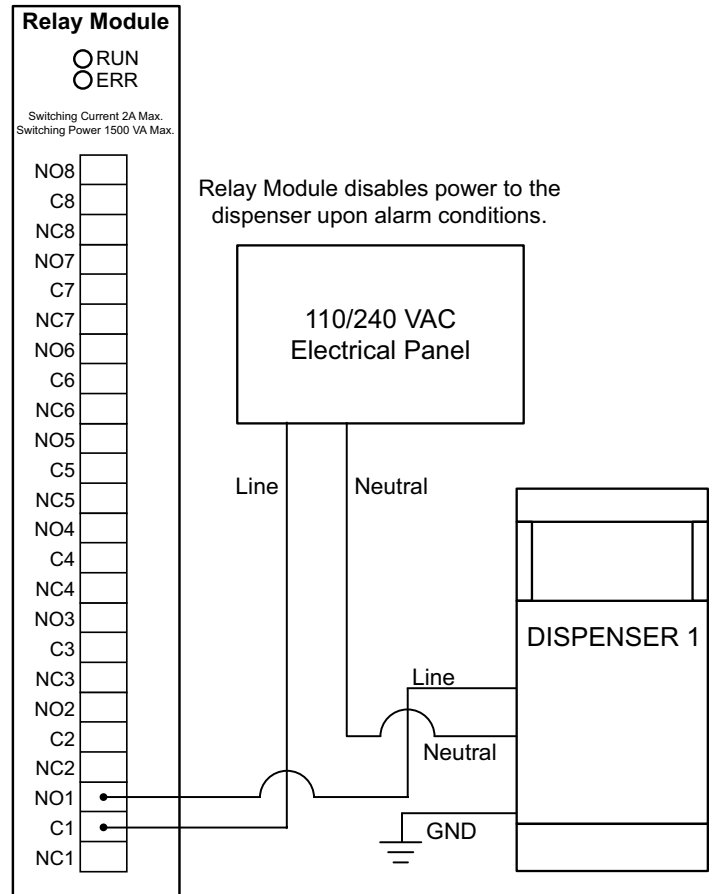


Figure 11: Positive Dispenser Shutdown

Note: If a dispenser's current rating is between 2 and 10 amps, use a 10 amp relay module. If the current rating is higher than 10 Amps, use an appropriate extension relay.

AC Input Module (ACI)

The ACI is a non-intrinsically safe module that has 12 identical optically isolated AC input channels that can be used for dispenser hook isolation, vapor processor input, or as generic AC inputs. The TS-550 evo consoles can handle a total of 36 AC inputs or up to three AC Input Modules in one system.

AC Input Module Specifications	
Number of Channels:	12 optically isolated
Input Voltage Rating:	110 – 240 VAC
Input Current:	7 mA RMS

Dispenser Hook Signals

The TS-550 evo system requires that the dispenser hook signal from every dispenser on site be wired into the console's AC Input Module. When making the connection for the hook signals to the AC Input Module, refer to the following diagram and use these guidelines:

- If there are two hooks per dispenser: wire the two hooks from Dispenser 1 to AC input channels 1 & 2, the hooks from Dispenser 2 to AC channels 3 & 4, etc..
- If there are three hooks per dispenser, then wire the three hooks of Dispenser 1 to the AC input channels 1, 2, 3 and so forth.

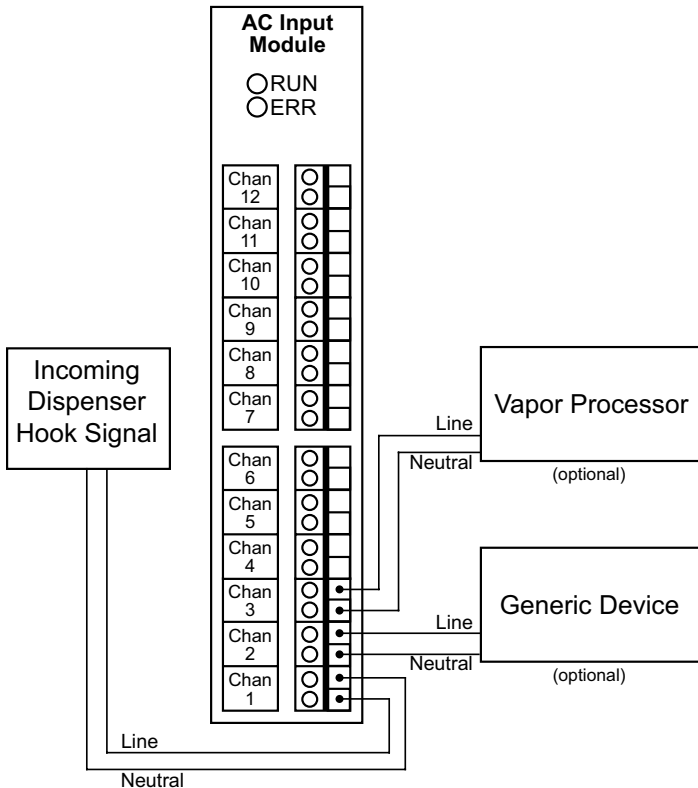


Figure 12: Dispenser Hook Signal

4-20mA EXP Analog Input Module (420EXP)

The 420EXP has 8 identical channels for loop powered non-IS sensors with a 4-20 mA interface. The TS-550 evo series can support up to 24 inputs (3 modules total including 420IB models with 8 inputs each) depending on available space in your console. The 420EXP will most likely be used with explosion proof version of the line leak pressure transducers at the sites where IS wiring is not available. It can also be used with other 4-20 mA sensors located in non-hazardous area.

EXP Analog Input Module Specifications	
Number of Channels:	8
Loop Power	24 Volts
Internal Resistance	350 ohms

Note: Components located in the hazardous area must be an explosion proof version and wiring must be enclosed in explosion proof conduits.

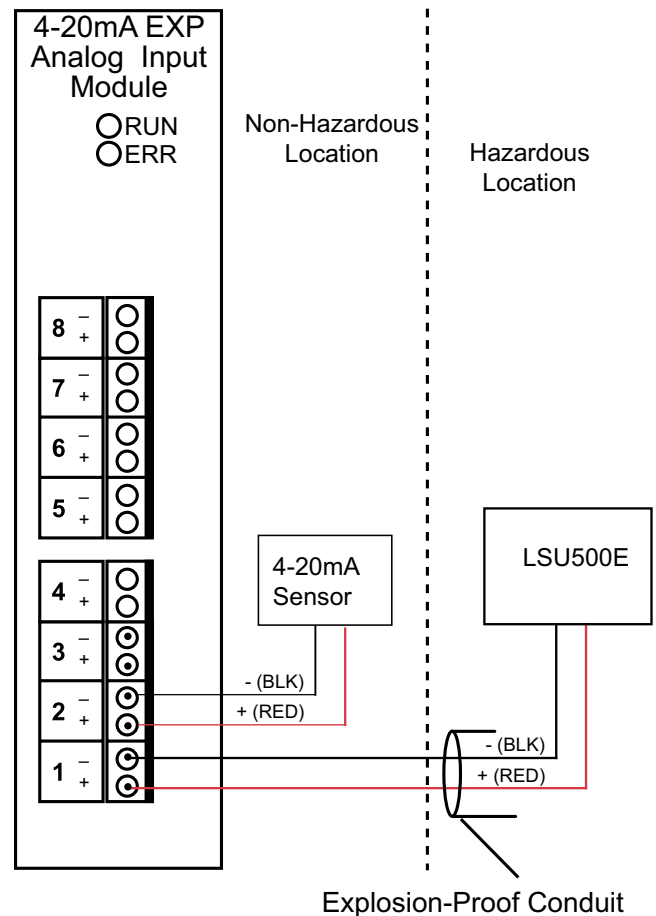


Figure 13: EXP Analog Input Module Connections

Input/Output Module (IO)

The Low Voltage Input/Output Module is a non-intrinsically safe module that provides eight separate AC or DC voltage inputs that can range from 0 to 240 volts. In addition to the AC/DC inputs, the IO module also includes four 4-20mA signal outputs.

IO Module Specifications	
Number of Channels:	8 optically isolated inputs 4 analog outputs
Input Voltage Rating:	3 – 240 Volts AC or DC (AC is rms value)
Input Current (each):	2 mA RMS

The AC/DC inputs are NOT dry contact inputs (there are 2 dry contact inputs on the power supply). Even though the IO Module can accept AC line voltage levels, it is not intended to be used as a substitute for the AC Input Module for dispenser hook inputs. Dispenser hook signals often have leakage currents that could cause false 'on' signals when used with the IO Module.

Important: Use caution if both low voltage and high voltage signals are used simultaneously for the voltage inputs. Use agency approved wire rated at 600V for safety and always make sure terminal connections are tight and that no loose wire strands exist.

The IO Module's four 4-20mA signal outputs can be used to interface to an external device such as a SCADA (Supervisory Control And Data Acquisition) system or a building monitoring system. Typically, data such as tank levels or line pressures can be sent via the 4-20 outputs.

Important: The IO Module supplies 4-20mA loop power. Do NOT connect it to an external device that supplies loop power or use an external power supply for the loop. Doing so may damage the IO and/or the external device. For similar reasons DO NOT connect the IO Module's 4-20mA outputs to the 4-20mA inputs of the 4-20mA Input Module. The 4-20mA Input Module is intrinsically safe and cannot be used with the non-intrinsically safe IO Module; connecting the two together may damage either or both modules.

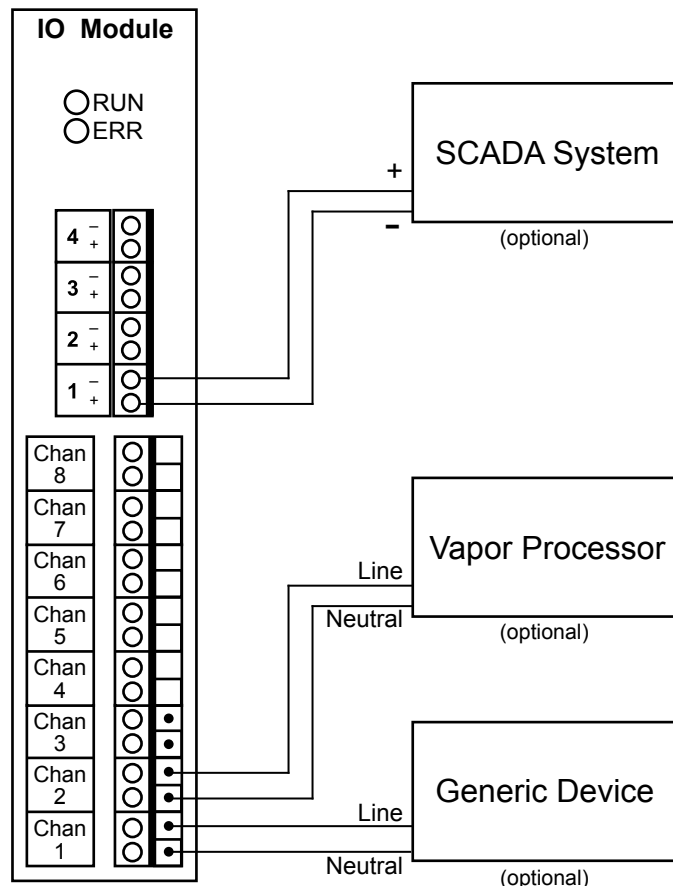


Figure 14: IO Module Wiring Schematic

10 Amp Relay Module (10ARLY)

The 10 Amp Relay Module is a non-intrinsically safe module that has 6 identical Form C output channels. Each channel has a fuse and three terminals. Each channel can be configured as NO or NC with the power off by wiring to the appropriate terminals. A TS-550evo console can accommodate up to 18 outputs (6 outputs on up to 3 modules) as space allows. The diagrams below illustrate two examples of positive shutdown upon alarm conditions.

10 Amp Relay Module Specifications	
Number of Channels:	6 Form C
Contact Rating:	10A @ 250 VAC or ½ hp @ 240 VAC ¼ hp @ 120 VAC

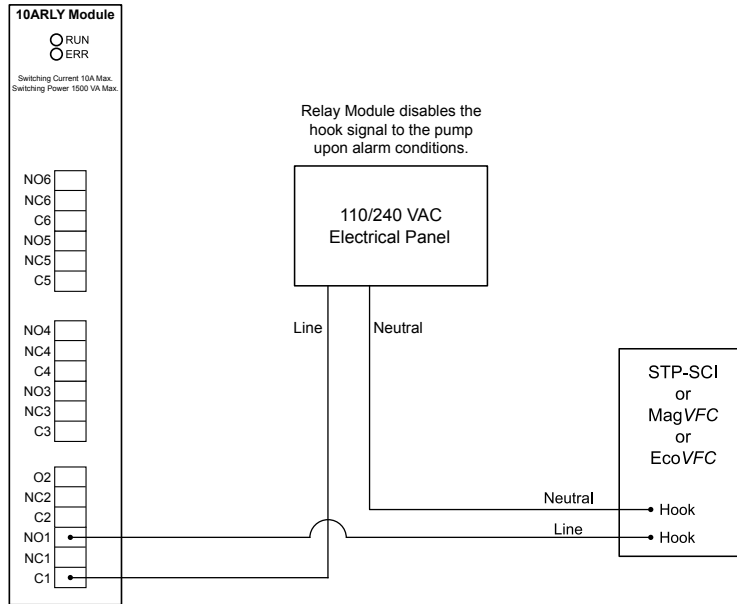


Figure 15: Positive Submersible Control Box Shutdown

Note: A valid dispenser hook signal coming from the AC Input Module (shown in Figure 12) is required for these diagrams to function as shown.

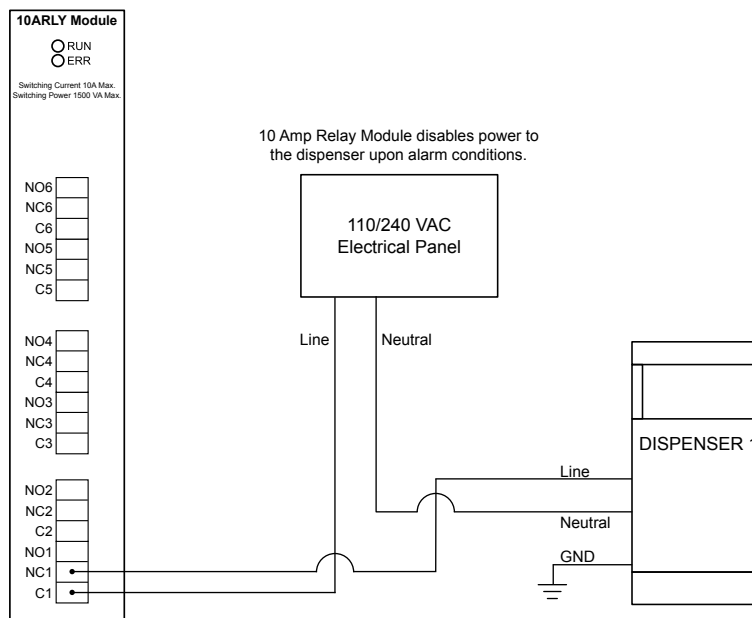


Figure 16: Positive Dispenser Shutdown

Note: If a dispenser's current rating is higher than 10 Amps, use an appropriate extension relay.

Intrinsically Safe Module Wiring

Danger



Always lock out and tag electrical circuit breakers while installing or servicing this equipment and any related equipment. A potentially lethal electrical shock hazard and the possibility of an explosion or fire from a spark can result if the electrical circuit breakers are accidentally turned on during installation or servicing.

Important: Intrinsically safe wiring **cannot** be run in the same conduit as non-intrinsically safe wiring. Conduit knockouts for IS and non-IS module wiring are clearly identified in Figure 6 on page 10 for your reference. IS modules can be identified by their blue faceplates and should always be installed to the right of the moveable isolation barrier.

If local codes do not require the use of conduit, cable glands must be used at all enclosure knock-outs.

Gaps larger than 0.06 inch (1.5 mm) will violate safety approvals. Be certain to provide adequate IS and non-IS wire separation.

Franklin Fueling Systems recommends that each run of IS wiring not exceed 1500 feet (450 m) using any 2-conductor shielded cable or the cables/wires recommended in the Standard Installation Materials chapter. If you are not using the recommended cables/wires as set out in the Standard Installation Materials chapter or need to run wiring beyond 1500 feet (450 m), then please contact Technical Support.

The IS modules in the TS-550 evo console were certified as associated apparatuses using the “Entity Concept.” Under this concept, the IS apparatus (field device) has assigned parameters which, when properly matched to those of an associated apparatus, will constitute an intrinsically safe system. If there are none available however, values of 60 pF/foot (200 pF/m) for capacitance per wire pair and 0.2 uH/foot (0.7 uH/m) for inductance may be used. Refer to the associated apparatus’s control drawing for acceptable cable run length calculations.

The 3WSNS has also been evaluated using the “System Concept” for the specific sensors indicated on page 21. When these sensors are used, cable must be limited to 1500 feet.

Associated apparatus parameter types and how they can be compared to IS apparatus parameter values are shown in the table below.

Parameter	Associated Apparatus	Comparison	IS Device
Maximum Voltage	Uo	<	Ui
Maximum Current	Io	<	Ii
Maximum Power	Po	<	Pi
Total unprotected capacitance	Co	>	Ci + Cc
Total unprotected inductance	Lo	>	Li + Lc

Standard Terms

Term	Definition
Uo	Maximum Output Voltage
Ui	Maximum Input Voltage
Io	Maximum Output Current
Ii	Maximum Input Current
Po	Maximum Output Power
Pi	Maximum Input Power
Co	Maximum External Capacitance
Ci	Maximum Internal Capacitance
Cc	Cable Capacitance
Lo	Maximum External Inductance
Li	Maximum Internal Inductance
Lc	Cable Inductance

Probe Module (PRB)

The Probe Module (PRB) gathers data from probes and presents that information to the Controller Module (CM) for use in inventory reconciliation and reports. Each PRB can accommodate 12 probes and the system as a whole can accept a total of 36 probes (3 modules with 12 inputs each) if space allows. Besides working with LL2 mag probes, the PRB also works with the TSP-DMS sensors for containment sump monitoring.

Note: There are 8 inputs in the TS-608's Probe Module.

Note: All components located in the hazardous area must be Third Party Certified and have appropriate Entity Parameters (see Control Drawing 000-1722 in the back of this manual for further information).

Probe Module Specifications	
Number of Channels:	12
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA <u>Entity Parameters</u>
	Uo = 28.35 V
	Io = 157.5 mA
	Co = 1.04 uF
	Lo = 1.4 mH
	Po = 1.1 W

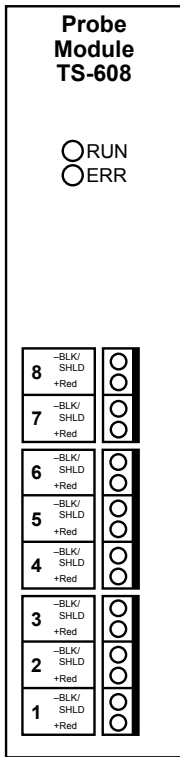


Figure 17: TS-608 PRB Connections

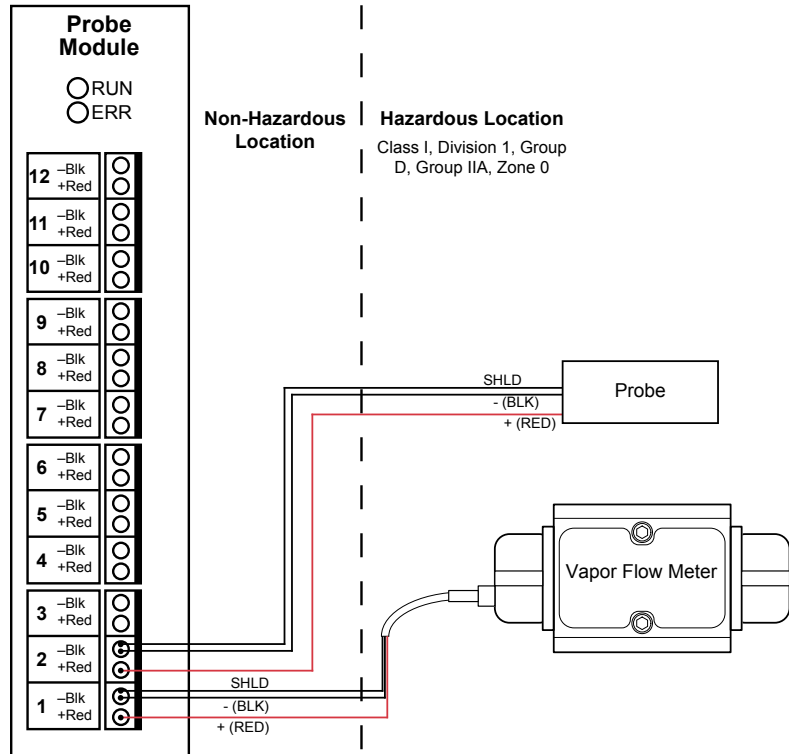


Figure 18: PRB Connections

2-Wire Sensor Module (2WSNS)

The 2-Wire Sensor Module (2WSNS) is designed to accept 12 sensor inputs per module, and the system as a whole can accept a total of 36 sensors (3 modules with 12 inputs each). The 2WSNS only supports standard sensors, and does not accept inputs from BriteSensors. Refer to the diagram below to identify some of the standard sensors that can be used with this module.

Note: Standard sensors do not use digital data. They operate like ON-OFF switches, which are closed when no liquid is present and open when a liquid is detected.

2-Wire Sensor Module	
Number of Channels:	12
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA <u>Entity Parameters</u>
	Uo = 6.51 V
	Io = 2.04 mA
	Co = 500 uF
	Lo = 100 mH
	Po = 3.3 mW

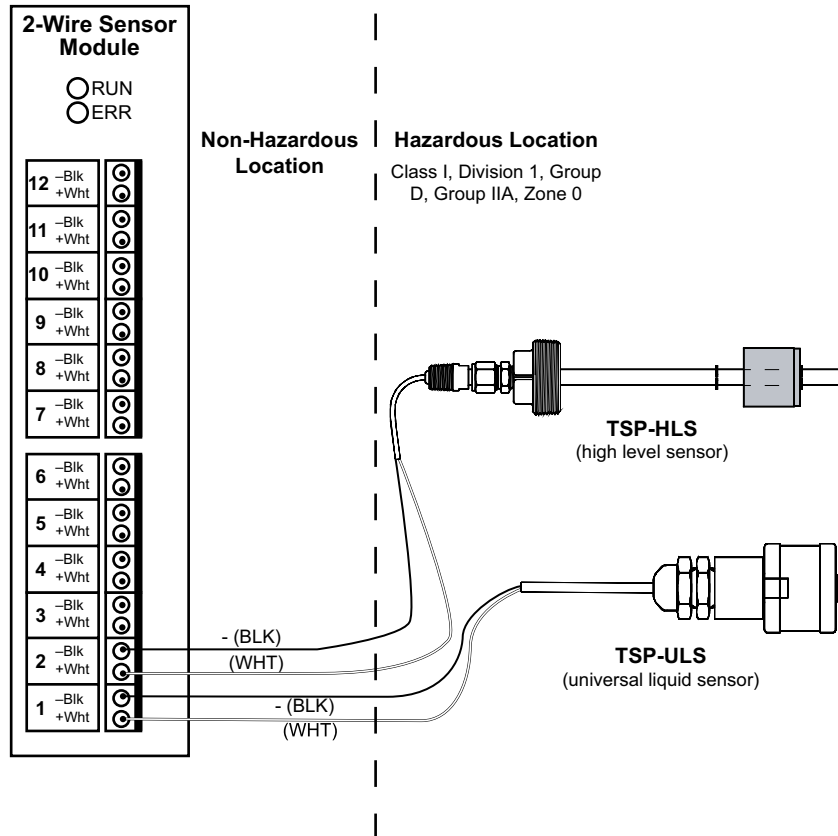


Figure 19: 2-Wire Sensor Connections

Note: All components located in the hazardous area must be Third Party Certified and have appropriate Entity Parameters (see Control Drawing 000-1722 in the back of this manual for further information).

3-Wire Sensor Module (3WSNS)

The 3-Wire Sensor Module (3WSNS) is designed to accept 8 sensor inputs per module, and the system as a whole can accept a total of 24 sensors (3 modules with 8 inputs each). The 3WSNS can support standard sensors and BriteSensors®. BriteSensors are powered sensors that digitally communicate the sensor-type and alarm status of the sensor to the console. Most BriteSensors can discriminate between water and hydrocarbon products and produce different alarm codes for each. Refer to the diagram below to identify the types of sensors that should be used with this module.

3-Wire Sensor Module	
Number of Channels:	8
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA
<u>Entity Parameters</u>	
	Uo = 7.71 V
	Io = 573 mA
	Co = 500 uF
	Lo = 433 uH
	Po = 932 mW

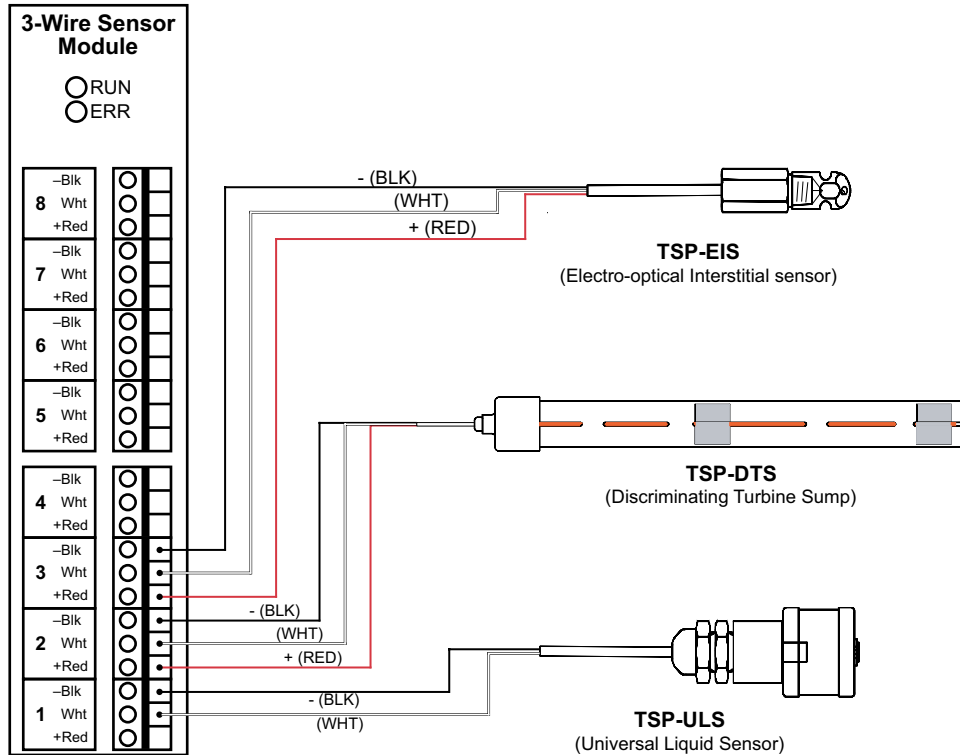


Figure 20 3-Wire Sensor Wiring

Important: Brite Sensors are not approved for use in European Union markets where ATEX approved devices are required.

The Brite Sensors shown in this table are part of the UL & C-UL System Listing.

Model	Description
TSP-EIS	Electro-optical Interstitial liquid – Standard sensor
TSP-ULS	Universal Liquid – Standard sensor
TSP-HLS-15	High product Level, 15" – Standard sensor
TSP-HLS-30	High product Level, 30" – Standard sensor
TSP-HIS	Hydrostatic Interstitial reservoir – BriteSensor
TSP-DIS	Discriminating Interstitial liquid – BriteSensor
TSP-DDS	Discriminating Dispenser Sump – BriteSensor
TSP-DTS	Discriminating Turbine Sump – BriteSensor
TSP-MWS	Discriminating Monitoring Well – BriteSensor
The following sensors are not covered by UL / cUL approval	
TSP-HIS-XL	Hydrostatic Interstitial reservoir, extra long – BriteSensor
TSP-DVS	Discriminating Vapor – BriteSensor

Note: Alternate sensors may be provided. All components located in the hazardous area must be Third Party Certified and have appropriate Entity Parameters (see Control Drawing 000-1722 in the back of this manual for further information).

4-20mA Analog Input Module (420IB)

The Analog Input Module has 8 identical channels for loop powered IS sensors with a 4-20 mA interface. The TS-550 evo series can support up to 24 inputs (3 modules with 8 inputs each) depending on available space in your console. The Analog Input Module will most likely be used with: line leak pressure transducers, tank pressure sensors and vacuum sensors.

Analog Input Module Specifications	
Number of Channels:	8
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA
<u>Entity Parameters</u>	
	U _o = 26.25 V
	I _o = 98.2 mA
	C _o = 1.25 uF
	L _o = 14.7 mH
	P _o = 0.64 W

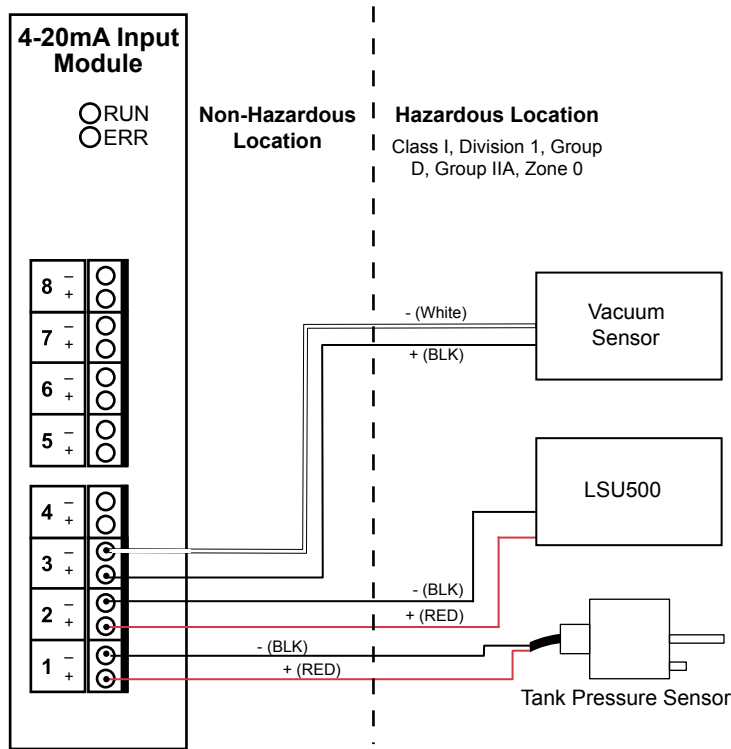


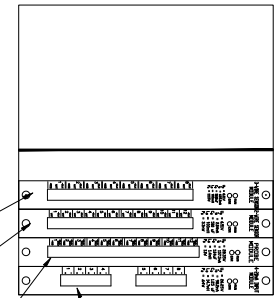
Figure 21: 420IB Connections

Note: All components located in the hazardous area must be Third Party Certified and have appropriate Entity Parameters (see Control Drawing 000-1722 in the back of this manual for further information).

- NOTES:
- THE MODEL TS-5000, 550, 5, 608, TS-ENS, TS-EXPC, AND TS-EXPC2 SHALL NOT BE CONNECTED TO ANY EQUIPMENT WHICH USES OR GENERATES GREATER THAN 250V.
 - EACH GROUND TERMINAL SHALL BE CONNECTED TO A SUITABLE SYSTEM EARTH GROUND. THE DC RESISTANCE BETWEEN GROUND TERMINALS AND EARTH GROUND SHALL BE LESS THAN 1 OHM.
 - THE MODEL TS-5000, 550, 5, 608, TS-ENS, TS-EXPC, AND TS-EXPC2 WIRING SHALL BE INSTALLED IN DIFFERENT INTRINSICALLY SAFE CIRCUITS RUN IN THE SAME CABLE/CONDUIT MUST HAVE AT LEAST 0.25mm OF INSULATION.
 - CAPACITANCE AND INDUCTANCE OF THE FIELD WIRING FROM THE INTRINSICALLY SAFE EQUIPMENT TO THE BARRIER SHALL BE CALCULATED AND MUST BE INCLUDED IN THE SYSTEM SAFETY CALCULATIONS AS EQUIPMENT CAPACITANCE (C) MUST BE LESS THAN THE MARKED CAPACITANCE (C₀) SHOWN ON ANY BARRIER USED. THE SAME APPLIES FOR INDUCTANCE (L), L₀ AND L_a, RESPECTIVELY, WHERE THE MARKED INDUCTANCE (L) IS UNKNOWN. THE FOLLOWING VALUES SHALL BE USED: C=86pF/(1200V/m), L=0.24mH/(6.03V/m).
 - WIRING CABLES AND SEALTS MUST BE INSTALLED IN ACCORDANCE WITH THE NEC, CEC, OR OTHER APPLICABLE NATIONAL OR LOCAL CODES.
 - USE ONLY CABLE THAT IS SPECIFIED IN THE USER INSTALLATION MANUAL OR LISTED EQUIVALENT FOR THE INSTALLATION OF LIQUID LEVEL PROBES.
 - USE THE FOLLOWING WIRE TYPES ONLY. 18 AWG MINIMUM. TO CONNECT SENSORS TO THE TS-5000, TS-550, TS-608, TS-ENS, TS-EXPC, AND TS-EXPC2, RESISTANT TYPES TFN, THHN AND THHN CABLES.
 - USE ONLY GRIP TYPE CONNECTORS FOR ELECTRICAL CONNECTIONS (DO NOT USE WIRE NUTS OR OTHER TYPE CONNECTORS).
 - SEAL ALL FIELD WIRING CONNECTIONS FROM MOISTURE WITH EPOXY SEAL - PAKOS.
 - SEE INSTALLATION MANUAL FOR MORE DETAIL.
 - THE GENERAL CONTRACTOR MUST SUPPLY THE SPECIFIED WIRE, CONDUITS AND ELECTRICAL ACCESSORIES.
 - THE ENTRY CONCEPT ALLOWS THE USER TO IDENTIFY ACCEPTABLE COMBINATIONS OF INTRINSICALLY SAFE EQUIPMENT FROM THE LISTED EQUIPMENT. THE USER MUST REFER TO THE USER INSTALLATION MANUAL ASSIGNED A SET OF PARAMETERS CALLED ENTRY PARAMETERS. THE ENTRY PARAMETERS FOR TS-5000, 550, 5, 608, TS-ENS, TS-EXPC, AND TS-EXPC2 (ASSOCIATED APPARATUS) CAN BE OBTAINED FROM THE USER INSTALLATION MANUAL. THESE ENTRY PARAMETERS MUST BE INCLUDED IN THE CONTROL DRAWING FOR THE INTRINSICALLY SAFE APPARATUS SHALL BE USED. THE COMBINATION OF THE INTRINSICALLY SAFE APPARATUS AND ASSOCIATED APPARATUS MUST COMPLY WITH THE FOLLOWING:
 - (a) $U_0 \leq U_0$ (Vrms)
 - (b) $I_0 \leq I_0$ (Arms)
 - (c) $P_0 \leq P_0$ (Wmax) (SEE NOTE 4)
 - (d) $C_0 \leq C_0 + C_{add}$
 - (e) $L_0 \leq L_0 + L_{add}$ (SEE NOTE 4)
 - THE OUTPUT CURRENT OF THE ASSOCIATED APPARATUS IS LIMITED BY A RESISTOR SUCH THAT THE OUTPUT VOLTAGE-CURRENT CURVE IS A STRAIGHT LINE DRAWN BETWEEN OPEN-CIRCUIT VOLTAGE AND SHORT-CIRCUIT CURRENT.
 - ASSOCIATED APPARATUS MUST BE INSTALLED IN AN ENCLOSURE SUITABLE FOR THE APPLICATION IN THE USER INSTALLATION MANUAL. IF THE ASSOCIATED APPARATUS IS IN THE UNITED STATES, CANADA, OR OTHER LOCAL COUNTRIES, THE NATIONAL ELECTRICAL CODE FOR INSTALLATIONS IN CANADA, OR OTHER LOCAL CODES, AS APPLICABLE.
 - INTRINSICALLY SAFE CIRCUITS MUST BE WIRED AND SEPARATED IN ACCORDANCE WITH ARTICLE 504.20 OF THE NATIONAL ELECTRICAL CODE (NEC/NFPA 70) OR OTHER LOCAL CODES, AS APPLICABLE.
 - THIS ASSOCIATED APPARATUS HAS NOT BEEN EVALUATED FOR USE IN COMBINATION WITH ANOTHER ASSOCIATED APPARATUS.
 - INSTALLATIONS IN WHICH BOTH THE C₀ AND L₀ OF THE INTRINSICALLY SAFE APPARATUS EXCEEDS 1% OF THE C₀ AND L₀ PARAMETERS OF THE ASSOCIATED APPARATUS (EXCLUDING THE CABLE), THEN SOME OF C₀ AND L₀ PARAMETERS ARE APPLICABLE AND SHALL NOT BE EXCEEDED.

NON-INTRINSICALLY SAFE COMPARTMENT

INTRINSICALLY SAFE COMPARTMENT



NON HAZARDOUS LOCATION
MODELS
TS-5000
TS-550
TS-608
TS-ENS
TS-EXPC
TS-EXPC2
ASSOCIATED APPARATUS

HAZARDOUS LOCATION
GROUP 1IA, ZONE 0

TABLE 1 - ENTRY PARAMETERS 4-WIRE MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2, 3, 4	ES25VDC	0.075A	1E30F	1.87MH	10.84W

TABLE 1A - ENTRY PARAMETERS PROBE MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2, 3, 4	ES35VDC	0.075A	1E30F	1.4MH	11W

TABLE 1B - ENTRY PARAMETERS 2-WIRE SENSOR MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2	ES1VDC	2.04A	500P	1.00MH	2.33W

TABLE 2B - ENTRY PARAMETERS 3-WIRE SENSOR MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2, 3, 4	ES1.7VDC	1.7A	500P	1.43MH	2.33W

NOTE: ADDITIONALLY, THE 3-WIRE SENSOR MODULE HAS BEEN EVALUATED AS A SYSTEM DTS, U.S. ETS, HIS, HS-15 (P, -30, DR MW-15, -20, DR -25)

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

REV	DATE	DESCRIPTION	DATE	APPROVED
N		ADD TS-EXPC2 AND SPECIAL CONDUIT TO 204-43		
M				
K				

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

19) ONLY THIS PAGE REPRESENTS THE CONTROL DRAWING FOR THE UNITED STATES AND CANADA. ADDITIONAL PAGES OF THIS DOCUMENT REPRESENT SIMILAR INFORMATION FOR ALTERNATE COUNTRIES OR CERTIFICATIONS.

18) UL LISTED 6779

17) INSTALLATIONS IN WHICH BOTH THE C₀ AND L₀ OF THE INTRINSICALLY SAFE APPARATUS EXCEEDS 1% OF THE C₀ AND L₀ PARAMETERS OF THE ASSOCIATED APPARATUS (EXCLUDING THE CABLE), THEN SOME OF C₀ AND L₀ PARAMETERS ARE APPLICABLE AND SHALL NOT BE EXCEEDED.

16) THIS ASSOCIATED APPARATUS HAS NOT BEEN EVALUATED FOR USE IN COMBINATION WITH ANOTHER ASSOCIATED APPARATUS.

15) INTRINSICALLY SAFE CIRCUITS MUST BE WIRED AND SEPARATED IN ACCORDANCE WITH ARTICLE 504.20 OF THE NATIONAL ELECTRICAL CODE (NEC/NFPA 70) OR OTHER LOCAL CODES, AS APPLICABLE.

14) ASSOCIATED APPARATUS MUST BE INSTALLED IN AN ENCLOSURE SUITABLE FOR THE APPLICATION IN THE USER INSTALLATION MANUAL. IF THE ASSOCIATED APPARATUS IS IN THE UNITED STATES, CANADA, OR OTHER LOCAL COUNTRIES, THE NATIONAL ELECTRICAL CODE FOR INSTALLATIONS IN CANADA, OR OTHER LOCAL CODES, AS APPLICABLE.

13) THE OUTPUT CURRENT OF THE ASSOCIATED APPARATUS IS LIMITED BY A RESISTOR SUCH THAT THE OUTPUT VOLTAGE-CURRENT CURVE IS A STRAIGHT LINE DRAWN BETWEEN OPEN-CIRCUIT VOLTAGE AND SHORT-CIRCUIT CURRENT.

12) THE ENTRY CONCEPT ALLOWS THE USER TO IDENTIFY ACCEPTABLE COMBINATIONS OF INTRINSICALLY SAFE EQUIPMENT FROM THE LISTED EQUIPMENT. THE USER MUST REFER TO THE USER INSTALLATION MANUAL ASSIGNED A SET OF PARAMETERS CALLED ENTRY PARAMETERS. THE ENTRY PARAMETERS FOR TS-5000, 550, 5, 608, TS-ENS, TS-EXPC, AND TS-EXPC2 (ASSOCIATED APPARATUS) CAN BE OBTAINED FROM THE USER INSTALLATION MANUAL. THESE ENTRY PARAMETERS MUST BE INCLUDED IN THE CONTROL DRAWING FOR THE INTRINSICALLY SAFE APPARATUS SHALL BE USED. THE COMBINATION OF THE INTRINSICALLY SAFE APPARATUS AND ASSOCIATED APPARATUS MUST COMPLY WITH THE FOLLOWING:

- (a) $U_0 \leq U_0$ (Vrms)
- (b) $I_0 \leq I_0$ (Arms)
- (c) $P_0 \leq P_0$ (Wmax) (SEE NOTE 4)
- (d) $C_0 \leq C_0 + C_{add}$
- (e) $L_0 \leq L_0 + L_{add}$ (SEE NOTE 4)

11) THE GENERAL CONTRACTOR MUST SUPPLY THE SPECIFIED WIRE, CONDUITS AND ELECTRICAL ACCESSORIES.

10) SEE INSTALLATION MANUAL FOR MORE DETAIL.

9) SEAL ALL FIELD WIRING CONNECTIONS FROM MOISTURE WITH EPOXY SEAL - PAKOS.

8) USE ONLY GRIP TYPE CONNECTORS FOR ELECTRICAL CONNECTIONS (DO NOT USE WIRE NUTS OR OTHER TYPE CONNECTORS).

7) USE THE FOLLOWING WIRE TYPES ONLY. 18 AWG MINIMUM. TO CONNECT SENSORS TO THE TS-5000, TS-550, TS-608, TS-ENS, TS-EXPC, AND TS-EXPC2, RESISTANT TYPES TFN, THHN AND THHN CABLES.

6) USE ONLY CABLE THAT IS SPECIFIED IN THE USER INSTALLATION MANUAL OR LISTED EQUIVALENT FOR THE INSTALLATION OF LIQUID LEVEL PROBES.

5) WIRING CABLES AND SEALTS MUST BE INSTALLED IN ACCORDANCE WITH THE NEC, CEC, OR OTHER APPLICABLE NATIONAL OR LOCAL CODES.

4) CAPACITANCE AND INDUCTANCE OF THE FIELD WIRING FROM THE INTRINSICALLY SAFE EQUIPMENT TO THE BARRIER SHALL BE CALCULATED AND MUST BE INCLUDED IN THE SYSTEM SAFETY CALCULATIONS AS EQUIPMENT CAPACITANCE (C) MUST BE LESS THAN THE MARKED CAPACITANCE (C₀) SHOWN ON ANY BARRIER USED. THE SAME APPLIES FOR INDUCTANCE (L), L₀ AND L_a, RESPECTIVELY, WHERE THE MARKED INDUCTANCE (L) IS UNKNOWN. THE FOLLOWING VALUES SHALL BE USED: C=86pF/(1200V/m), L=0.24mH/(6.03V/m).

3) THE MODEL TS-5000, 550, 5, 608, TS-ENS, TS-EXPC, AND TS-EXPC2 WIRING SHALL BE INSTALLED IN DIFFERENT INTRINSICALLY SAFE CIRCUITS RUN IN THE SAME CABLE/CONDUIT MUST HAVE AT LEAST 0.25mm OF INSULATION.

2) EACH GROUND TERMINAL SHALL BE CONNECTED TO A SUITABLE SYSTEM EARTH GROUND. THE DC RESISTANCE BETWEEN GROUND TERMINALS AND EARTH GROUND SHALL BE LESS THAN 1 OHM.

1) THE MODEL TS-5000, 550, 5, 608, TS-ENS, TS-EXPC, AND TS-EXPC2 SHALL NOT BE CONNECTED TO ANY EQUIPMENT WHICH USES OR GENERATES GREATER THAN 250V.

HAZARDOUS LOCATION
GROUP 1IA, ZONE 0

TABLE 1 - ENTRY PARAMETERS 4-WIRE MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2, 3, 4	ES25VDC	0.075A	1E30F	1.87MH	10.84W

TABLE 1A - ENTRY PARAMETERS PROBE MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2, 3, 4	ES35VDC	0.075A	1E30F	1.4MH	11W

TABLE 1B - ENTRY PARAMETERS 2-WIRE SENSOR MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2	ES1VDC	2.04A	500P	1.00MH	2.33W

TABLE 2B - ENTRY PARAMETERS 3-WIRE SENSOR MODULE

TERMINAL	U ₀ /VDC	I ₀ /I/SEC	C ₀ /C ₀	L ₀ /L ₀	P ₀
1, 2, 3, 4	ES1.7VDC	1.7A	500P	1.43MH	2.33W

NOTE: ADDITIONALLY, THE 3-WIRE SENSOR MODULE HAS BEEN EVALUATED AS A SYSTEM DTS, U.S. ETS, HIS, HS-15 (P, -30, DR MW-15, -20, DR -25)

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

UL LISTED 6779

19) ONLY THIS PAGE REPRESENTS THE CONTROL DRAWING FOR THE UNITED STATES AND CANADA. ADDITIONAL PAGES OF THIS DOCUMENT REPRESENT SIMILAR INFORMATION FOR ALTERNATE COUNTRIES OR CERTIFICATIONS.

18) UL LISTED 6779

17) INSTALLATIONS IN WHICH BOTH THE C₀ AND L₀ OF THE INTRINSICALLY SAFE APPARATUS EXCEEDS 1% OF THE C₀ AND L₀ PARAMETERS OF THE ASSOCIATED APPARATUS (EXCLUDING THE CABLE), THEN SOME OF C₀ AND L₀ PARAMETERS ARE APPLICABLE AND SHALL NOT BE EXCEEDED.

REVISED		DATE	APPROVED
NO.	BY		
1	SEE SHEET 1		

NON-HAZARDOUS LOCATION
 MODELS
 TS-5000
 TS-500
 TS-5
 TS-608
 TS-EMS
 TS-EXPC
 TS-EXPC2
 ASSOCIATED APPARATUS

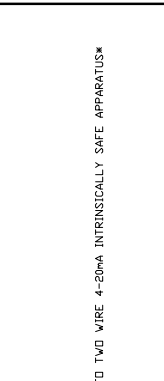


TABLE 1 - ENTITY PARAMETERS 4-20mA MODULE

TERMINAL	Uo	Io	Co	Lo	Po
1	26.25Vdc	0.0982A	1.25uF	14.7mH	0.64V

TABLE 1A - ENTITY PARAMETERS PROBE MODULE

TERMINAL	Uo	Io	Co	Lo	Po
+ (RED), - (BLK) / SHLD	28.35Vdc	0.1575 A	1.04uF	1.4 mH	1.1V

TABLE 1B - ENTITY PARAMETERS 2-WIRE SENSOR MODULE

TERMINAL	Uo	Io	Co	Lo	Po
+ (WHT), - (BLK)	6.51 Vdc	2.04 mA	500 uF	100 mH	3.3 mV

TABLE 2B - ENTITY PARAMETERS 3-WIRE SENSOR MODULE

TERMINAL	Uo	Io	Co	Lo	Po
+ (RED), + (WHT), - (BLK)	7.71 Vdc	573 mA	500 uF	433 uH	932 mV

* NOTE: WITH THE SUITABLE TEMPERATURE CODE.

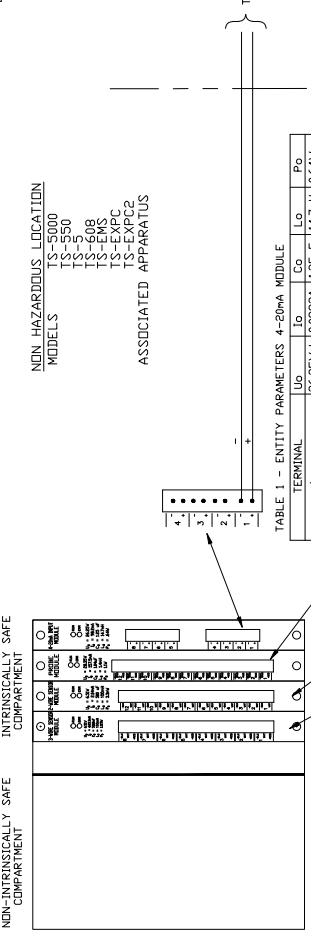


TABLE 1 - ENTITY PARAMETERS 4-20mA MODULE

TERMINAL	Uo	Io	Co	Lo	Po
1	26.25Vdc	0.0982A	1.25uF	14.7mH	0.64V

TABLE 1A - ENTITY PARAMETERS PROBE MODULE

TERMINAL	Uo	Io	Co	Lo	Po
+ (RED), - (BLK) / SHLD	28.35Vdc	0.1575 A	1.04uF	1.4 mH	1.1V

TABLE 1B - ENTITY PARAMETERS 2-WIRE SENSOR MODULE

TERMINAL	Uo	Io	Co	Lo	Po
+ (WHT), - (BLK)	6.51 Vdc	2.04 mA	500 uF	100 mH	3.3 mV

TABLE 2B - ENTITY PARAMETERS 3-WIRE SENSOR MODULE

TERMINAL	Uo	Io	Co	Lo	Po
+ (RED), + (WHT), - (BLK)	7.71 Vdc	573 mA	500 uF	433 uH	932 mV

- THE MODEL TS-5000, 550, 5, 608, TS-EMS, TS-EXPC, AND TS-EXPC2 SHALL NOT BE CONNECTED TO ANY EQUIPMENT WHICH USES OR GENERATES GREATER THAN 250V.
- EACH GROUND TERMINAL SHALL BE CONNECTED TO A SUITABLE SYSTEM EARTH GROUND. THE DC RESISTANCE BETWEEN GROUND TERMINALS AND EARTH GROUND SHALL BE LESS THAN 1 OHM.
- CAPACITANCE AND INDUCTANCE OF THE FIELD WIRING FROM THE INTRINSICALLY SAFE EQUIPMENT TO THE BARRIER SHALL BE CALCULATED AND MUST BE INCLUDED IN THE SYSTEM CALCULATIONS AS PERMITTED BY IEC 60078-1 (5). THE CHARACTERISTICS OF THE FIELD WIRING SHALL BE SHOWN ON ANY EQUIPMENT CAPACITANCE (C) MUST BE LESS THAN THE MARKED CAPACITANCE (CO) SHOWN ON ANY BARRIER USED. THE SAME APPLIES FOR INDUCTANCE (LI, LC AND LO, RESPECTIVELY). WHERE THE CABLE CAPACITANCE AND INDUCTANCE PER FOOT ARE NOT KNOWN, THE FOLLOWING VALUES SHALL BE USED: Cc=60pF/ft(200pF/m), Lc=0.2uH/ft (0.7uH/m).
- WIRING, CABLEING AND SEALS MUST BE INSTALLED IN ACCORDANCE WITH THE APPLICABLE NATIONAL OR LOCAL CODES.
- SEE INSTALLATION MANUAL FOR MORE DETAIL.
- THE ENTITY CONCEPT ALLOWS THE USER TO IDENTIFY ACCEPTABLE COMBINATIONS OF INTRINSICALLY SAFE APPARATUS AND ASSOCIATED APPARATUS THAT HAVE NOT BEEN EXAMINED AS SYSTEM PARAMETERS CALLED ENTITY PARAMETERS. THE ENTITY PARAMETERS FOR TS-5000, 550, 5, 608, TS-EMS, TS-EXPC, AND TS-EXPC2 (ASSOCIATED APPARATUS) CAN BE FOUND IN TABLE 1, 1A, 1B AND 2B. TO DETERMINE THE Uo, Io, Co, Lo, AND Po VALUES THE CONTROL DRAWING FOR THE ASSOCIATED APPARATUS AND ASSOCIATED APPARATUS MUST COMPLY WITH THE FOLLOWING:
 $U_o \leq U_i$
 $I_o \leq I_i$
 $C_o \geq C_i + C_{cable}$ (SEE NOTE 4)
 $L_o \geq L_i + L_{cable}$ (SEE NOTE 4)
- 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.
- ASSOCIATED APPARATUS MUST BE INSTALLED IN AN ENCLOSURE SUITABLE FOR THE APPLICATION IN ACCORDANCE WITH THE NATIONAL AND LOCAL CODES, AS APPLICABLE.
- INTRINSICALLY SAFE CIRCUITS MUST BE WIRED AND SEPARATED IN ACCORDANCE WITH NATIONAL AND LOCAL CODES, AS APPLICABLE.
- ASSOCIATED APPARATUS HAS NOT BEEN EVALUATED FOR USE IN COMBINATION WITH ANOTHER ASSOCIATED APPARATUS.
- DEVICE MUST BE USED AND OPERATED WITHIN AN AMBIENT RANGE OF 0°C TO 40°C.
- ALL OPENINGS (SLOTS) MUST BE PROVIDED WITH A MODULE, PLACE-HOLDING COVER, OR THE PARTITION, WHICH MUST BE FIRMLY SCREWED IN PLACE.
- PARTITION MUST BE INSTALLED BETWEEN THE INTRINSICALLY SAFE MODULES AND ALL OTHER MODULES.
- INSTALLATION EXTRA CARE MUST BE TAKEN TO ENSURE INTRINSICALLY SAFE FIELD WIRING IS PROPERLY ROUTED AND SECURED, AS NECESSARY, SO AS TO NOT BE DAMAGED WHEN THE COVER IS CLOSED.
- ATEX APPROVAL DISPLAYED:
- IECEx APPROVAL DISPLAYED:
- SPECIAL CONDITIONS FOR SAFE USE ARE AS FOLLOWS:
 • DEVICE MUST BE USED AND OPERATED WITHIN AN AMBIENT TEMPERATURE RANGE OF 0°C TO 40°C.
 • OPENINGS (SLOTS) MUST BE PROVIDED WITH A MODULE, PLACE-HOLDING COVER, OR THE PARTITION, WHICH MUST BE FIRMLY SCREWED IN PLACE.
 • THE PARTITION MUST BE INSTALLED BETWEEN THE INTRINSICALLY SAFE MODULES AND ALL OTHER MODULES.
 • DURING INSTALLATION, EXTRA CARE MUST BE TAKEN TO ENSURE INTRINSICALLY SAFE FIELD WIRING IS PROPERLY ROUTED AND SECURED AS NECESSARY, SO AS TO NOT BE DAMAGED WHEN THE COVER IS CLOSED.



UL LISTED
Classified
 -Reduced Fire-Risk
 -Reduced Emission
 -Reduced Maintenance
 -Reduced Installation Time

Franklin Fueling Systems

UNLESS OTHERWISE SPECIFIED:
 DIMENSIONS IN INCHES
 DECIMALS: XX + .015
 FRACTIONS: 1/16
 THIRD ANGLE

DATE: 08/20/2014
 DRAWN BY: JPP
 CHECKED BY: JPP

PROJECT: 000-1722
 SHEET: 2 OF 2

THE INFORMATION CONTAINED IS THE PROPRIETARY PROPERTY OF INTELLIGENT CONTROLS, INC. AND IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PERMISSION OF INTELLIGENT CONTROLS, INC.

AUTOCAD FILE NO. 0001722HDWG

CONTROL DRAWING TS ATG
 ATEX, IECEx SECTION

Warranty

For information concerning Franklin Fueling Systems's warranties, please refer to the *Franklin Fueling Systems Fuel Management Systems Warranty Policy* (P/N 000-1124).

Warranty Registration

After installation, make sure to return the Warranty Registration form to Franklin Fueling Systems. This form validates the warranty as stated in Franklin Fueling Systems document 000-1124.

Specifications

Warning  The TS-550evo console must be mounted in a location where explosive or flammable vapors are not present, otherwise an explosion hazard will be created which can result in severe injury, death, serious property damage and/or environmental contamination.

Console

Line Voltage:	90-250 V~
Frequency & Power:	50/60 Hz, 150 W maximum
Storage Temp.:	-20° to 60° C (-4° to 140° F)
Operating Temp.:	0° to 40° C (32° to 104° F)
Operating Humidity:	0 to 95%, non-condensing
Cleaning:	Cloth or sponge slightly dampened in mild detergent
Splash Resistance:	Not to be exposed to direct spray, splash or drips
Location:	Indoors in an office or in a non-hazardous pollution degree 2 environment per IEC60664

2-Wire Sensor Module

Number of Channels:	12
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA <u>Entity Parameters</u> U _o = 6.51 V I _o = 2.04 mA C _o = 500 uF L _o = 100 mH P _o = 3.3 mW

3-Wire Sensor Module

Number of Channels:	8
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA <u>Entity Parameters</u> U _o = 7.71 V I _o = 573 mA C _o = 500 uF L _o = 433 uH P _o = 932 mW

Low Voltage Input/Output Module

Number of Channels:	8 optically isolated inputs 4 analog outputs
Input Voltage Rating:	3 - 240 Volts AC or DC (AC is rms value)
Input Current Rating:	2 mA

AC Input Module

Number of Channels:	12 optically isolated
Input Voltage Rating:	110 – 240 VAC
Input Current Rating:	7 mA

4-20mA Analog Input Module

Number of Channels:	8
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA <u>Entity Parameters</u> U _o = 26.25 V I _o = 98.2 mA C _o = 1.25 uF L _o = 14.7 mH P _o = 0.64 W

Probe Module

Number of Channels:	12 (8 in the TS-608)
Safety Rating:	Class I, Division 1, Group D, [Ex ia] IIA <u>Entity Parameters</u> U _o = 28.35 V I _o = 157.5 mA C _o = 1.04 uF L _o = 1.4 mH P _o = 1.1 W

Relay Module

Number of Channels:	8 Form C
Contact Rating:	2A @ 250V 2A @ 30 VDC

10 Amp Relay Module

Number of Channels:	6 Form C
Contact Rating:	10A @ 250V or ½ hp @ 240 VAC ¼ hp @ 120 VAC

INCON[®]



Franklin Fueling Systems

www.franklinfueling.com

3760 Marsh Road • Madison, WI 53718, U.S.A.

Tel: +1 608 838 8786 • Fax: +1 608 838 6433

Tel: USA & Canada 1 800 225 9787 • Tel: México 001 800 738 7610

Franklin Fueling Systems GmbH

Rudolf-Diesel-Strasse 20 • 54516 Wittlich, GERMANY

Tel: +49-6571-105-380 • Fax: +49-6571-105-510