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Rockwell Automation + Schlumberger

Lift Control Systems

INSTRUCT LIFT CONTROL SYSTEMS

INSTRUCT ESP Intelligent Controller

Installation, Operation & Maintenance Manual

MODELS: 100840400, 101434409, 101683563, 50374306

Manual No. LCS-ENG-M0009 (InTouch ref #6128576), Rev. 02

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Important Safety Information

Terms Used in This Manual

Caution	**Caution, risk of electric shock**
Attention	**Attention, risque d'électrocution**

WARNING	**A warning identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.**
AVERTISSEMENT	**Un avertissement identifie des informations sur des pratiques ou des circonstances pouvant entraîner des blessures corporelles ou la mort, des dommages matériels ou des pertes économiques.**

Caution	Caution statements Indicate actions or procedures which, if not performed correctly, may lead to personal injury or incorrect function of the instrument or connected equipment.
Attention	Indiquez les actions ou les procédures qui, si elles ne sont pas effectuées correctement, peuvent entraîner des blessures ou un mauvais fonctionnement de l'instrument ou de l'équipement connecté.

Note	Indicates additional information about specific conditions or circumstances that may affect instrument operation.
Remarque	Indique des informations supplémentaires sur des conditions ou des circonstances spécifiques pouvant affecter le fonctionnement de l'instrument.

REVISION HISTORY

REVISION	DESCRIPTION OF CHANGE	SENSIA ISSUER	DATE
1	Initial release. Added slot A/B alarm and watchdog function for expansion cards.	Lift Control Systems	30-June-2021
2	Add kits part numbers under MODELS	Lift Control Systems	28-Aug-2022

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GENERAL

WARNING!

To avoid the risk of electric shock and fire, the following safety instructions must be observed and the guidelines followed.

The specifications must not be exceeded, and the device must only be applied as described in the following.

Prior to the installation and commissioning of the unit, the installation guide must be examined carefully.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

GENERAL

AVERTISSEMENT !

Pour éviter tout risque de choc électrique et d'incendie, les consignes de sécurité de ce manuel doivent être observées, et les instructions suivies.

Les spécifications ne doivent pas être dépassées, et l'unité ne doit être appliquée que comme décrit dans le texte suivant.

Ce manuel doit être examiné avec soin, avant l'installation et la mise en service de l'unité.

Si l'équipement est utilisé d'une manière non spécifiée par le fabricant, la protection assurée par l'équipement peut être altérée.

INSTALLATION

WARNING!

Installation may only be carried out by electrically skilled and instructed personnel in accordance with national leg-isolation, including the relevant standards.

All technical data on the instrument are to be observed.

Changes to the design and modifications to the equipment are not permitted.

The equipment shall only be operated as intended and only in undamaged and perfect condition.

Sufficient segregation must exist between different cables and wires carrying different types of signal or power and all other circuits.

All wires must be terminated, complete with crimping lugs. Unused cores should be terminated to the earth bus bar.

INSTALLATION

AVERTISSEMENT !

L'installation ne peut être effectuée que par un électricien qualifié, conformément à la législation nationale, y compris les normes pertinentes.

Toutes les données techniques sur l'instrument doivent être observées.

Modifications de l'équipement ne sont pas autorisés.

L'équipement ne doit être utilisé comme prévu par le fabriquant et uniquement si il est en parfait état.

Une séparation suffisante doit exister entre les différents câbles et les fils transportant différents types de signaux ou de puissance et tous les autres circuits.

Tous les fils doivent être terminés, avec pattes de sertissage. Les noyaux non-utilisés doivent être terminés au jeu de barres de la terre.

Section 1: **Product Description**

1.1 OVERVIEW

The INSTRUCT* ESP Intelligent Controller provides a single, expandable, plug-and-play platform for all electric submersible pump (ESP) motor controller applications. The controller interfaces with three-phase induction motor systems—either fixed speed or variable speed. In addition to gathering data, the controller monitors, controls, and protects the system. It can automatically shut down the motor and drive under adverse conditions and then safely restart the system.

The INSTRUCT ESP Intelligent Controller has an integrated keypad and display for local control and operation. The integrated keypad and display incorporate full Hand-Off-Auto (HOA) and Start control for the motor, eliminating the need for externally wired switches. The control wiring for the controller is connected to removable terminal assemblies on the unit. These terminal assemblies snap in and out for easy connection or removal. The terminal assemblies are organized logically according to the function they perform.

Users can expand the controller platform by inserting expansion cards and option cards. Depending on how the controller expansion slots are configured, users can monitor

- Variable Speed Drive (VSD) parameters
- Control supply voltage
- Motor currents and voltages
- External switch contacts
- Process analog signals
- Data from downhole tool systems/gauges
- Remote SCADA I/O channels

Using option cards, users can connect external annunciation lamps to the outputs on optional I/O cards to improve visibility for on-site personnel. The INSTRUCT ESP Intelligent Controller is especially suited for controlling oilfield production pump motors on ESP systems that use INSTRUCT ESP variable speed drives or switchboards.

Figure 1-1 : INSTRUCT ESP Intelligent Controller

1.2 FEATURES AND BENEFITS

- Intuitive, user-friendly color graphic display and menu system
- Plain-language, multilingual alarms and prompts, at-a-glance wellsite assessment, and dedicated function keys
- Centralized data gathering and storage for troubleshooting and engineering analysis, eliminating multiple surface components
- PC-based StarView* Wellsite Display Software for device configuration, operation, and troubleshooting
- Modular design that increases reliability, expandability, and serviceability
- 1 GB of internal memory with a removable USB drive option and multiprocessor architecture ensuring smooth performance data logging and trending for millions of data points
- Remote access and control capability from multiple SCADA systems and Sensia's surveillance and control system in parallel
- Schlumberger Gauges support: utilizes the Phoenix† Interface Card to provide an acquisition platform for Phoenix artificial lift downhole monitoring equipment and cable-to-surface (CTS) gauges

1.3 LIMITATIONS

Refer to the INSTRUCT ESP Intelligent Controller firmware page (InTouch ID 6145281) for the latest release notes and firmware upgrades.

Section 2: **QHSE**

2.1 DANGER TO PERSONNEL

Potential Severity: Serious
Potential Loss: Personnel
Hazard Category: Electrical

Lethal voltages are present when equipment is running. Do not adjust wire connections until equipment is powered down.

Qualified personnel should take the following precautions when working on or around the controller:

- Do not touch the power connections on the AC power terminals while the controller is in operation. High voltages, 110VAC to 240VAC, exist on these terminals.
- Do not touch the power connections on the DC power terminals while the controller is in operation. Low voltage (24VDC) exists on these terminals, but the potential for high current exists. These voltages may exist even when the system is powered down, due to capacitor charge.
- Do not touch the connections on the INSTRUCT ESP I/O Card relay terminals 1, 2, 3, 4, 5, 6, 7, 8, 9 while the controller is in operation. These relay connections may be switching high voltages. These voltages may exist even when the controller is powered down as these switched voltages may not be part of the controller power. Check all externally connected device power supplies.
- Do not touch the connections on the INSTRUCT Power Analyzer Card relay terminals 1, 2, 3, 4, 5, 6, 7, 8, 9 while the controller is in operation. These relay connections may be switching high voltages. These voltages may exist even when the controller is powered down as these switched voltages may not be part of the controller power. Check all externally connected device power supplies.

2.2 DANGER TO EQUIPMENT

Potential Severity: Light
Potential Loss: Assets
Hazard Category: Electrical

Failure to observe the following precautions can result in damage or destruction of equipment.

Observe the following precautions when working on or around the controller:

- Ensure that the operating facility is dry and dust-free. Incoming air flow must not contain any gases, vapors, or dusts that are electrically conductive or detrimental to functioning. Air containing dust must be filtered.
- The controller should be stored in its transportation packaging to prevent damage during handling.

2.3 DANGER TO THE ENVIRONMENT

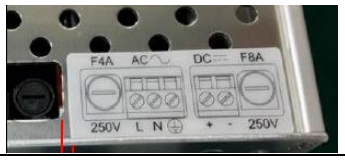
Potential Severity: Light
Potential Loss: Environmental
Hazard Category: Electrical, Fire Flammable

The controller uses a lithium battery and capacitors that may be damaging to the environment if not properly handled.

Observe the following when working with the controller and replacement parts:

- The controller uses a lithium battery. Ensure battery replacement is of the identical type as issued by Sensia or this may void the warranty.
- Do not puncture or incinerate the battery.
- The battery is safe for disposal. Follow local safety practices for the proper disposal of lithium batteries.
- Do not incinerate to dispose of the controller as the electrical components inside may give off harmful gasses. Follow local safety practices for the proper disposal of electronic equipment.

2.4 SAFETY SYMBOLS

Symbol	Summary	Description	Location
	Potential hazard	The area near this symbol may contain a hazard. Consult the User Manual for more information.	
	Protective earth	This terminal is connected to protective earth.	
	Direct current	The signal is a direct current signal.	
	Alternating current	The signal is an alternating current signal.	

2.5 RADIO FREQUENCY REGULATORY COMPLIANCE

2.5.1 CANADA

This product complies with Industry Canada radio frequency regulations CAN ICES-3 (A)/NMB-3(A).

2.5.2 UNITED STATES OF AMERICA — FEDERAL COMMUNICATIONS COMMISSION (FCC)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and radiates radio frequency energy and, if not installed and used in accordance with this manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Section 3: **Specifications**

3.1 OPERATION SPECIFICATIONS

Table 3-1: INSTRUCT ESP Intelligent Controller Operating Environment

Humidity % (Percent)	Maximum relative humidity (RH) of 80 percent (non-condensing) at 31 degC decreasing linearly to 50 percent at 40 degC
Altitude (Meters)	10,000 ft (3,000 m)
Environmental Pollution Degree	Pollution degree 2 according to IEC/CSA /UL 61010-1
Temperature Operating CE/CSA Compliant	-40 degF (-40 degC) to 158 degF (70 degC)
Temperature Operating Absolute Maximum	-40 degF (-40 degC) to 158 degF (70 degC)
Temperature Storage	-40 degF (-40 degC) to 158 degF (70 degC)
Installation	Non-hazardous locations
Enclosure	CSA Type 3R*

* PN 100840400 (INSTRUCT ESP Intelligent Controller) is indoor rated. PN 101434409 (INSTRUCT ESP Type 3R Standalone) is CSA type 3R rated.

Table 3-2: INSTRUCT ESP Intelligent Controller Operating Specifications

Power Supply Rated Input (AC)	100 to 240 volts AC, 50/60 Hz, 75W
Power Supply AC Typical	100 to 240 volts AC, 50/60 Hz, 3W
24 Volt DC Power	Up to 120W at 24 VDC +/- 10% can be externally supplied
Protection	Ingress protection rating of IP20 (no special protection)
StarView Maintenance Port	USB-B
USB Flash Drive Port	USB-A
Expansion Chassis	24 volts DC

Table 3-3: Optional INSTRUCT ESP I/O Card Operating Specifications

Digital Outputs (Relays)	1 – 250 volts AC, 8 A maximum 1 – 30 volts DC, 5 A maximum
Digital Inputs	Power for the digital inputs comes from the 24 VDC terminal DPWR. Only dry contacts such as relays or mechanical switches are to be connected to these inputs.
Analog Outputs	0 to 20 mA
Analog Inputs	0 to 10 volts DC (maximum 12 VDC), 0 to 20 mA (maximum 24mA)

Table 3-4: Optional INSTRUCT Power Analyzer Card Operating Specifications

Digital Outputs (Relays)	1 – 250 volts AC, 8 A maximum 1 – 30 volts DC, 5 A maximum
Digital Inputs	Power for the digital inputs comes from the 24 VDC terminal DPWR. Only dry contacts such as relays or mechanical switches are to be connected to these inputs.
Analog Outputs	0 to 20 mA
Analog Inputs	0 to 10 volts DC (maximum 12 VDC), 0 to 20 mA (maximum 24mA)
PT Inputs	120 volts AC CATIII

Table 3-5: Optional INSTRUCT Power Analyzer 5kV Voltage Sensor Operating Specifications

High Voltage Inputs	5000 volts AC CATIII

3.2 EQUIPMENT SPECIFICATIONS

Table 3-6: INSTRUCT ESP Intelligent Controller Equipment Specifications

Dimensions Box	7.1 in (180 mm) H x 8.5 in (215.8 mm) W x 7.37 in (187.2 mm) D
Dimensions Faceplate	7.64 in (194 mm) H x 10.59 in (269 mm) W x 0.71 in (18 mm) D
Mounting	Indoor use only External applications must be mounted in NEMA 3R or NEMA 4X rated enclosure.
Shipping Weight	9.5 lb (4.3 kg) but subject to change

Table 3-7: Optional INSTRUCT Power Analyzer 5kV Voltage Sensor Specifications

Dimensions Box	4.25 in (108 mm) H x 8.5 in (216 mm) W x 1.75 in (44.5 mm) D
Mounting	Indoor use only. External applications must be mounted in NEMA 3R or NEMA 4X rated enclosure.
Shipping Weight	1 lb (0.454 kg) but subject to change

Section 4: **Theory of Operations**

4.1 OVERVIEW

The INSTRUCT ESP Intelligent Controller is a unified, expandable platform for all artificial lift controller and data acquisition requirements. Users can customize and expand the functionality of the controller by inserting one or more of the two option cards and/or six expansion cards in the available slots.

Figure 4-1 shows the available slots in the INSTRUCT ESP Intelligent Controller.

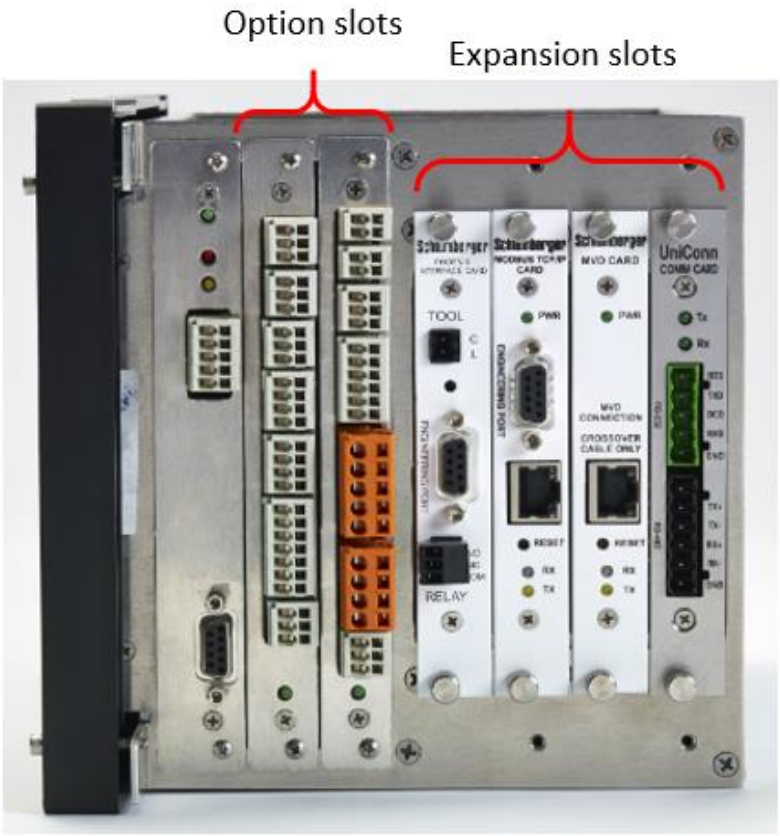


Figure 4-1: INSTRUCT ESP Intelligent Controller Slots

Table 4-1 shows the available option and expansion cards that can be used with the controller. For detailed descriptions, please refer to 4.1.3.

Table 4-1: Option and expansion slot cards

Name	Part Number	Type	Owner
INSTRUCT ESP I/O Card	100848430	Option	Sensia
INSTRUCT Power Analyzer Card	100840440	Option	Sensia
INSTRUCT ESP Modbus TCP/IP Communications Card	100419643	Expansion	Sensia
INSTRUCT ESP RS232/RS485 Communications Card	101120028	Expansion	Sensia
INSTRUCT ESP MVD Card	100357924	Expansion	Sensia

Name	Part Number	Type	Owner
INSTRUCT ESP Gateway Card	103381133	Expansion	Sensia
Phoenix Interface Card	101095702	Expansion	Schlumberger
Extreme Card	100408570	Expansion	Schlumberger

4.1.1 ESP CONTROL

The universal design allows the controller to use the same hardware platform for ESP control and downhole monitoring applications.

4.1.1.1 Logging and Trending

The controller can maintain a record of alarms and events in internal memory, a valuable tool in the troubleshooting process. The logging system retains the last 50,000 events, including setpoint changes, starts, stops, and alarms. The trending system collects data on the following 93 critical channels at sample rates varying from 1 sample per second to 1 sample per 300 seconds (sample rate depends on the channel).

Active Current Leakage	IO Din5 Input	SWB BSM VOLTS UNB LIVEVAL
AnalogIn1	IO Din6 Input	SWB CURRENT A LIVEVAL
AnalogIn2	IO B Din1 Input	SWB CURRENT B LIVEVAL
AnalogIn3	IO B Din2 Input	SWB CURRENT C LIVEVAL
AnalogIn4	IO B Din3 Input	SWB CURRENT AVERAGE LIVEVAL
AnalogBIn1	IO B Din4 Input	SWB CURRENT UNB LIVEVAL
AnalogBIn2	IO B Din5 Input	SWB FREQ LIVEVAL
AnalogBIn3	IO B Din6 Input	SWB LEG GROUND LIVEVAL
AnalogBIn4	MBM FLOAT 0	SWB LIVE POWER LIVEVAL
DH Cf	MBM FLOAT 1	SWB POWER CONSUMPTION LIVEVAL
DH Cz	MBM FLOAT 2	SWB POWER FACTOR LIVEVAL
DHDifferentialPressure	MBM FLOAT 3	SWB ROTATION IDIR LIVE
DHDischargePressure	MBM FLOAT 4	SWB ROTATION VDIR LIVE
DHDischargeTemperature	MBM FLOAT 5	SWB STALL TIME LIVEVAL
DHFlow	MBM FLOAT 6	SWB START CURRENT LIVEVAL
DHIntakePressure	MBM FLOAT 7	SWB VOLTS AB LIVEVAL
DHIntakePressure2	MBM FLOAT 8	SWB VOLTS BC LIVEVAL
DHIntakeTemp	MBM FLOAT 9	SWB VOLTS CA LIVEVAL
DHMotorTemp	Mono-to-UTC Offset	SWB VOLTS AVERAGE LIVEVAL
DHMotorYpoint	Motor Load	SWB VOLTS UNB LIVEVAL
DHVibration	Passive Current Leakage	Temperature
DHVibrationAX1	PIC1 Status Live	VsdAmps
DHVibrationAY1	PIC1 Tr2 Live	VsdFreqOut

DHVibrationY	RTC Battery Live	VSDG7 Excite Amps
DHVibrationZ	Starts	VSDG7 Load
FW Rel Code	SupplyVolts	VsdMotAmps
FW Ver Code	SWB BACKSPIN FREQ LIVEVAL	VSD Power In
IO Din1 Input	SWB BSM VOLTS AB LIVEVAL	VSD Power Out
IO Din2 Input	SWB BSM VOLTS BC LIVEVAL	VsdTorqueAmps
IO Din3 Input	SWB BSM VOLTS CA LIVEVAL	VSD Volts In
IO Din4 Input	SWB BSM VOLTS AVERAGE LIVEVAL	VSD Volts Out

Trend capacity in the controller varies based on many factors, but typical durations for the standard trend configuration are between two to four months of data.

The StarView Wellsite Display Software offers enhanced onsite data viewing, downloading, and controller programming capabilities.

4.1.1.2 Asset Protection

The controller can monitor multiple wells and pump operating data points. It helps protect the total pump system from fault conditions on any of the monitored signals. The controller can be configured to send alarms, await user intervention, or shut down the system to prevent restart until the alarm or fault situations have been rectified.

4.1.1.3 Gas Lock Protection

Gas lock is a condition in which a pump is no longer able to move any fluid due to the build-up of gas in the pump itself. Since fluid is no longer being moved, the well's production becomes minimal. If left in this condition long enough, equipment damage could result.

The controller has a gas lock protection feature, which can automatically detect and deal with this condition. For details about the gas lock protection feature and operational guide, refer to *Gas Lock Protection (GLP) - User Guide* (InTouch 6923767).

4.1.2 USER INTERFACE

The controller display and interface provide user-friendly access for data display, parameter setpoint adjustment, and FSD or VSD control functionality. The backlit liquid crystal screen has an enhanced data display. In addition to fixed-function and multifunction keys, there is a numerical keypad provided to facilitate simple control and configuration. Standard FSD and VSD instrumentation, including status lights, mode selection, and start-stop controls, have been incorporated into the interface. The display, diagnostics, and alarms are in plain language rather than codes, eliminating the need for cross-reference tables or manuals.

4.1.3 OPTION CARDS

4.1.3.1 INSTRUCT ESP I/O Card

The optional I/O card (PN 100840430) provides digital and analog connectivity for interfacing with external devices.

- Digital Output (Relays): The digital outputs on the controller are relay outputs capable of switching either AC (1-250 V) at loads of up to 8 A or DC (1-30V Extra Low Voltage) at loads of up to 5 A. The outputs are dry contacts, meaning the switching voltage is not supplied from the controller and must be supplied as part of the drive wiring. All digital outputs have the relay normally open (Relay x NO), common (Relay x COM), and normally closed (Relay x NC) contacts brought out to terminals.

Potential Severity: Serious

Warning

Potential Loss: Assets

Hazard Category: Electrical

Hazardous voltages can exist on the digital output terminals.

- Analog Output: The controller contains two analog outputs with a 12-bit digital to analog converter. Each of these outputs operates independently to control the 0–20mA loop current. The controller can optionally provide power for the loop current.
- Digital Input: Digital inputs are designed to provide logic information in the form of Open / Close, On / Off, High / Low, 1 / 0, etc. The controller contains six digital inputs that are designed to be switched with dry contacts. The switching voltage, 24 V, is supplied internally from the controller via the Digital Power terminal. These inputs can be independently configured to respond to either an Open or a Close condition.

Caution

Potential Severity: Light

Potential Loss: Assets

Hazard Category: Electrical

The Digital Power terminal is current limited and is not intended for powering external devices. Only use this terminal for dry contacts connecting to Digital Inputs.

- Analog Input: The controller contains four differential analog inputs with a 12-bit analog to digital converter. Each of these inputs can independently operate in voltage or current mode.

Note:

Unlike UniConn, the IO card analog inputs do not provide power for the loop current. The user must have an external power supply.

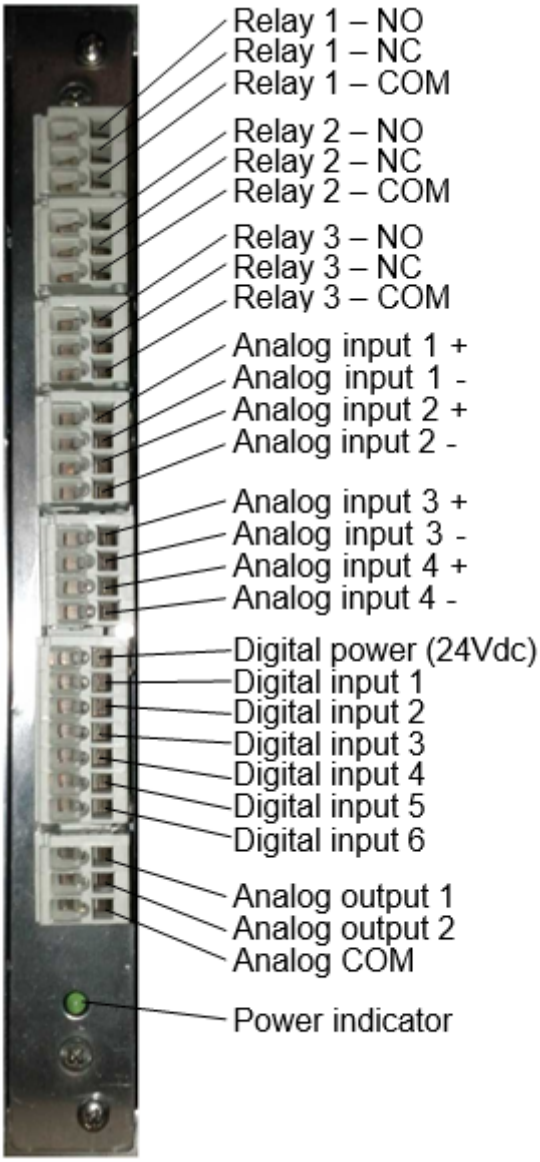


Figure 4-2: INSTRUCT ESP I/O Card (optional)

4.1.3.2 INSTRUCT Power Analyzer Card

The Power Analyzer Card (P/N 100840440) provides 3-phase power monitoring (including 3-phase voltage measurement and 3-phase current measurement), digital and analog connectivity for interfacing with external devices, and interfaces with PA 5kV Voltage Sensor (P/N 100840441).

- I/O:
  - Digital Output (Relays): The digital outputs on the controller are relay outputs capable of switching either AC (1–250V, 8 A maximum) or DC (1 – 30V, 5 A maximum). The outputs are dry contacts meaning the switching voltage is not supplied from the controller. All digital outputs have normally open (Relay x NO), common (Relay x COM), and normally closed (Relay x NC) contacts.
  - Relay 1 is dedicated for switchboard contactor control.
  - Relay 2 and Relay 3 are configurable digital outputs, named Dout1 and Dout2.
  - Analog Output: The Power Analyzer Card has one analog output, which can provide 0–20mA loop current output.
  - Analog Input: The Power Analyzer Card contains one differential analog input. It can operate in voltage or current mode. In voltage mode, the input voltage can vary between 0V to 10VDC. In current mode, the input current can vary between 0mA to 20mA DC.

- Digital Inputs: Digital inputs are designed to provide logic information in the form of Open/Close, On/Off, High/Low, 1/0, etc. The controller contains 4 digital inputs which are typically interfaced with dry contacts.
- The switching voltage, 24 V, is supplied internally from the controller via the Digital Power terminal. These inputs can be independently configured to respond to either an Open or Close condition.

Caution

Potential Severity: Light
Potential Loss: Assets
Hazard Category: Electrical

The Digital Power terminal is current limited and is not intended for powering external devices. Only use this terminal for dry contacts connecting to Digital Inputs.

- Interface with the PA 5kV Voltage Sensor: The Power Analyzer Card can read the High Voltage measurement information and backspin information through this interface. Pin 10 to Pin 21 is for PA 5kV Voltage Sensor connection. The PA 5kV Voltage Sensor is an optional module located in the high voltage compartment of the switchboard, or inside the step-up transformer for a VSD system. Note that no field wiring of these pins is necessary as a cable is provided with the Module.
- Current Input: The Power Analyzer Card contains three AC current transformer (CT) inputs for the purpose of measuring and monitoring 3-phase motor current via the CT Burden Module.
- Voltage Input: The Power Analyzer Card contains three AC potential transformer (PT) voltage inputs for the purpose of measuring and monitoring 3-phase motor voltage.

Figure 4-3: INSTRUCT Power Analyzer Card Connection Pin Assignment shows the Power Analyzer Card connector pin assignment. This illustration can be used as a reference for wiring.

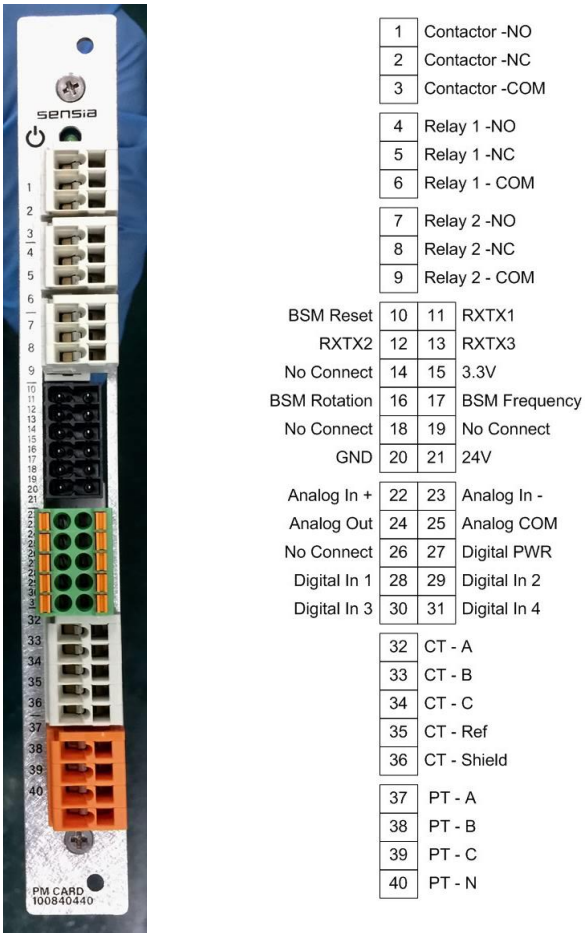


Figure 4-3: INSTRUCT Power Analyzer Card Connection Pin Assignment

4.1.4 EXPANSION CARDS

4.1.4.1 INSTRUCT ESP RS232/RS485 Communications Card (101120028)

The Comm card interfaces the controller with landline and satellite-based SCADA systems. Individually configurable expansion card slots allow the controller to support up to four independent communication systems simultaneously. Standard Modbus® protocol over an RS-232 or RS-485 connector is used. The Comm card provides the connection to the Site Communication Box (SCB) used for data transmission to facilitate Sensia's surveillance and control system. For the *INSTRUCT ESP RS232/RS485 Communications Card Installation Manual*, refer to InTouch Content 6238940.

4.1.4.2 INSTRUCT ESP Modbus TCP/IP Communications Card (100419643)

The Modbus TCP/IP card interfaces the controller with Ethernet-based TCP/IP networks for expanded client SCADA applications. It uses transmission control protocol (TCP) in accordance with standard RFC 793 and Internet protocol in accordance with standard RFC 791. Modbus protocol is encapsulated within the TCP/ IP protocol; therefore, the end device must be capable of decoding Modbus. For the *INSTRUCT ESP Modbus TCP/IP Communications Card Installation Manual*, refer to InTouch Content 6470145.

4.1.4.3 INSTRUCT ESP MVD Card (100357924)

The Medium Voltage Drive Card (MVD Card) is designed to interface with INSTRUCT M21 Intelligent MVDs using the standard User Datagram Protocol (UDP). The MVD Card is factory configured for the EMVT MVDs and no field configuration is possible. The Ethernet communication interface is isolated for enhanced noise immunity. For the *INSTRUCT ESP MVD Card Installation Manual*, refer to InTouch Content 4461916.

4.1.4.4 INSTRUCT ESP Gateway Card (103381133)

INSTRUCT ESP Gateway Cards a standalone communication card that re-uses the INSTRUCT SCB3 CPU board. It can be slotted into any one of the expansion slots of the controller. With an external cellular modem, the gateway card can be used to connect wellsite equipment to Sensia's real-time infrastructure servers and allows for remote monitoring, control, and surveillance of the reservoir, pump, motor, and surface equipment. For the *INSTRUCT ESP Gateway Card Installation Manual*, refer to InTouch Content TBD.

4.2 BASIC CONTROLLER FUNCTIONS

4.2.1 AUTOMATIC START

Automatic start is a function that will permit a start after the processing of a trip or alarm condition. This provides some autonomous control to the controller to start systems with user-defined conditions.

These menu parameters define the criteria for shutdowns and represent global default settings. There is some overlap in functionality of each global parameter and specific alarm options. Most of the controller operating parameters have a user setting for a restart.

The automatic start controls are:

- Shutdown cause
- Starts
- Progressive time delay

4.2.2 EVENT LOG

The event log is designed to maintain a record of recent controller activity. These events can be user parameter changes, user activity, analog I/O changes, alarms, starts, shutdowns, etc. The log is stored in internal memory and will wrap to the start of memory once the log space is full. Optionally, the event log can be manually cleared. Each event is logged with a date and time-stamp accurate to 1/100th of a second to capture the order of the events that occur. Logs can be viewed on the controller under the Logs/Trends menu.

Only alarms with the alarm action parameter set to LOG or LOG+STOP are logged. An alarm that is set to STOP will be logged if it is the cause of a shutdown. Alarm logging events occur when the alarm condition is entered (a setpoint is violated). The length of time the alarm condition was active and the magnitude of the violation are logged as part of the event for certain alarms. If the alarm did not clear before the alarm time parameter timed out, the alarm will cause a shutdown that will be logged immediately following the alarm condition log entry.

Parameter changes by the user are also recorded in the event log. However, since it is not possible to store a descriptive tag name with every parameter, the telemetry location is used to identify the parameter. Telemetry locations are identified by [ ] brackets.

4.2.3 STATISTICS

The controller contains statistics on the health and cycle operation of the system. These parameters represent the present state of operation of the controller. They are available under the **Controller -> Settings/Info** menu.

4.2.4 ALARMS

Alarms are associated with all measured and monitored values. These alarms have parameters that define when and what they do when they become active.

Alarms with the Hi or Lo label are the alarms associated with the high and low limits on the metered variable. If the alarm condition is currently active, it will appear on the **Home** screen and on the **Alarms** screen. Navigate to the associated function's **Alarm** screen to edit the alarm setpoints and actions.

Each alarm has the following settings associated with it:

<table>
<tr><th>Term</th><th colspan="2">Definition</th></tr>
<tr><td>NAME</td><td colspan="2">A user-editable name associated with the alarm. This is the label that will be displayed on the screen when the alarm is active and that will be entered into the log.</td></tr>
<tr><td rowspan="5">ACTION</td><td colspan="2">The action that the alarm performs. Selectable alarm actions are:</td></tr>
<tr><td>Term</td><td>Definition</td></tr>
<tr><td>BYPASS</td><td>Performs no action. Nothing is logged and a shutdown will not occur.</td></tr>
<tr><td>LOG</td><td>Logs the occurrence of the alarm condition in the Event Log</td></tr>
<tr><td>STOP</td><td>Performs a shutdown of the motor. Automatic restarts can occur in Auto mode.</td></tr>
<tr><td>LOG+STOP</td><td>Performs a shutdown of the motor and logs the shutdown and alarm occurrence in the Event Log. Automatic restarts can occur in Auto mode.</td></tr>
<tr><td>SETPOINT</td><td colspan="2">The alarm becomes active when the metered live value violates this setpoint value. The setpoint has the same units as the metered value. For analog variables there are two types of setpoints: high and low. High setpoints trigger an alarm when the metered value exceeds the value of the setpoint. Low setpoints trigger an alarm when the metered value falls below the setpoint. For digital inputs, the setpoint is the digital state the controller will alarm on either OPEN or CLOSE.</td></tr>
<tr><td>TRIP TIME (seconds)</td><td colspan="2">The time duration that the alarm must be active before STOP actions occur. Timing begins each time the metered value violates the setpoint. This value can be used to reduce nuisance trips in metered variables that are noisy or have a lot of variation in the live reading.</td></tr>
</table>

Term	Definition
RESTARTS	The maximum number of restarts allowed for shutdowns by this alarm before a lockout condition is generated to prevent automatic restarts. This feature is provided to limit the number of manual and automatic starts of a motor to a safe level. It prevents excessive cycling that could lead to equipment damage.
RESTART DELAY (minutes)	The countdown time that must elapse before an automatic restart can occur. All alarms must also be clear before the restart occurs. The restart countdown can be manually bypassed by pressing the **Start** key from the **Control Screen** during the countdown.
START BYPASS (seconds)	A temporary bypass time delay added to the Trip Time for starting only. A setting of 0.0 seconds disables this function. Any other number bypasses the alarm to allow a start and keeps it bypassed for the time set. A temporarily bypassed alarm will be displayed on the **Status Screen** when active but will not cause a shutdown. When Start Bypass is enabled, starting can occur when an active alarm is present.
MAINTENANCE BYPASS (minutes)	Maintenance Bypass allows for the temporary bypass of a specific alarm, during operation, for on-the-fly wiring changes or maintenance procedure such as chemical injection. This bypass timer is available for Digital Input Alarms, Underload Alarm, and VSD Underload Alarm. To activate a Maintenance Bypass for an alarm, enter the Maintenance Bypass timer value. While the motor is running, the **Maint. Bypass** button will be enabled on the **Start** screen pop-up indicating that this feature is available but not active. This button must be pressed to activate. The controller will display the message “MaintBypass” in the marquee area during Maintenance Bypass. Once the timer has expired, the bypassed alarm will become active. The Maintenance Bypass function must be reset and activated each time it is to be used as the controller clears the timer value and deactivates this function after each use.

4.2.5 RESET TO FACTORY DEFAULTS

The controller has the Reset to Factory Defaults function. It is available under the **Controller -> Expert/Updates**. This function restores the controller to the setpoint values it shipped with. Consequently, all user edits and configuration changes are lost. However, the Modbus Master, Modbus Slave, Custom Screen configuration functions are not affected.

4.2.6 SLOT A/B ALARM

The controller has two dedicated slots—Slot A and Slot B—for either INSTRUCT Power Analyser Card or INSTRUCT ESP IO card. When any of these cards are installed, the controller detects the cards automatically. A new feature is introduced in the firmware revision v2.115r002 (or later), which allows for an alarm, in case either the Slot A or Slot B card malfunctions.

Note:
The Slot A and Slot B alarms are disabled by default. Therefore, users who do not wish to use a Slot A or Slot B alarm are NOT required to follow the configuration steps described in this document.

Potential Severity: Serious
Potential Loss: Assets
Hazard Category: Electrical

The INSTRUCT expansion cards, for all the slots (including Slot A and Slot B), are NOT hot-swappable. Make sure that the power to the controller is switched off, before insertion or removal of an expansion card.

4.2.7 SLOT WATCHDOG

The Slot Watchdog is a feature that was introduced in the firmware version v2.121r015 (or later). It monitors the serial communication between the controller and an installed card. If the communications between the card and the controller stalls, then the watchdog will cycle the power to that slot—this reboots the card.

The watchdog's primary purpose is to cycle power on a previously working card, which has now stalled in communications.

The communications traffic must be bi-directional for the watchdog to arm itself. If for example, the controller is constantly sending commands to a card, but the card never responds then this does not count. In this situation, the watchdog will remain inactive, even if it was enabled in the settings.

The installed card must be able to communicate with the controller for at least a short period of time before the watchdog will arm itself. This prevents the watchdog from continually cycling power to a damaged card or an empty slot.

Potential Severity: Serious
Potential Loss: Assets
Hazard Category: Electrical

Please exercise caution when using the slot watchdog and power control features. The entire system may be affected by the reboot of an installed card. For example, the output relay on a Phoenix Interface Card (PIC) will be de-energized during the reboot. Also, any firmware upgrade operations will be interrupted by the removal of power. If the PIC or SCB has a firmware upgrade interrupted, it may not operate correctly afterwards, requiring a recovery procedure.

Finally, the slot watchdog and power control features work independently of all other existing functions on the controller. There is nothing preventing the operator from removing power to a slot during a frame test. For example, this would obviously interrupt the frame test.

4.3 CONTROLLER COMPONNETS

4.3.1 POWER SUPPLY

The controller has an internal 75W AC to DC power supply. Alternatively, it can be powered by an external 24 VDC supply. The controller can be powered by both AC and DC at the same time.

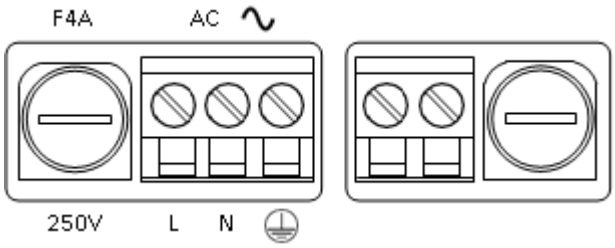


Figure 4-4: Power Supply Inputs

4.3.2 CONTROL CARD

The control card performs all processing, logging, and communications in the controller. The Control Card has two external communication interfaces: RS-232 and RS-485. The RS-232 port uses a DB-9 connector and is primarily intended for maintenance and diagnostics. The RS-485 port is implemented in a 4-wire configuration and uses a terminal block connector. The RS-485 port is primarily intended for connections to VSDs or SCADA systems.

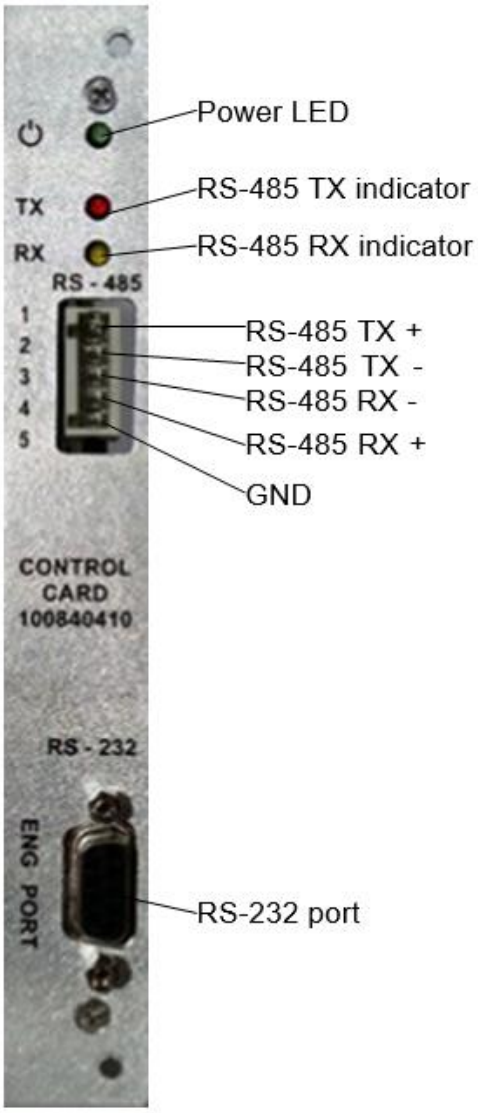


Figure 4-5: Control Card

4.3.3 DISPLAY CARD

The display card provides the user interface for the controller. It has a 5.7-in color VGA LCD display, a keypad interface, a USB maintenance port, and a USB flash drive port. The USB ports are the only ports accessible once the controller is installed in a cabinet. They serve as the interface for optional connection with a PC or USB flash drive for maintenance, data retrieval, or software configuration.

- Maintenance Port: The USB-B connector is located on the front of the controller. This port is designed for configuration and commissioning and works best with the configuration software (StarView).
- USB Flash Drive Port: The USB-A connector is located on the front of the connector. This port will accept most USB flash drives compatible with USB 2.0 and is formatted as FAT32.

4.3.4 EXPANSION SLOTS

There are four expansion ports for use with proprietary expansion cards. These cards provide added functionality for communications and downhole tool (DHT) interface. Each port operates independently.

4.3.5 ENCLOSURE

The enclosure provides the facility to mount the controller inside the cabinet and provides a protective earth terminal for connecting the ground strap to the cabinet.

4.4 USER INTERFACE

4.4.1 OVERVIEW

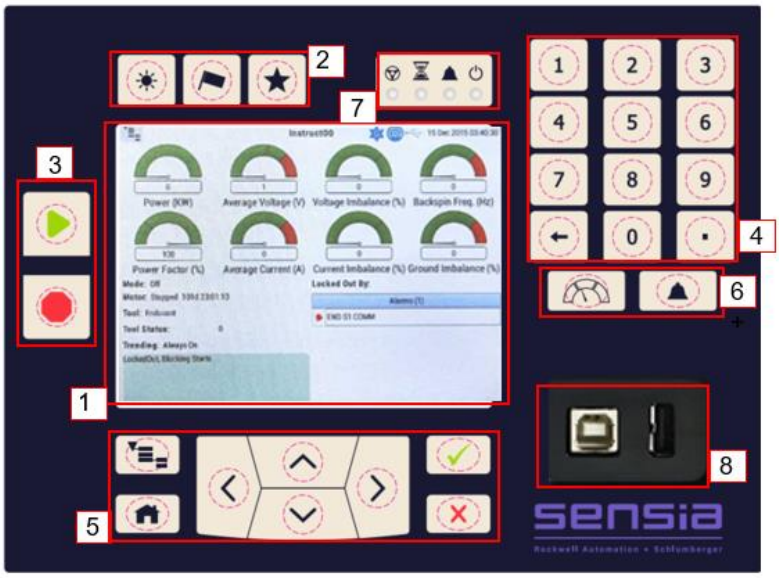


Figure 4-6: Controller Interface

Item	Name
1	Graphical Display
2	Utilities Keys
3	Start/Stop Keys
4	Numeric Keypad
5	Navigation Keys
6	Live/Alarm Keys
7	Status Indication
8	USB Connectors

4.4.2 GRAPHICAL DISPLAY

The Graphical Display is a color liquid crystal display that provides graphical representation of different states, parameters, and alarms. It also provides menu structures which give access to different settings and controls in the controller.

The Home screen displays the key information on the status of the wellsite.

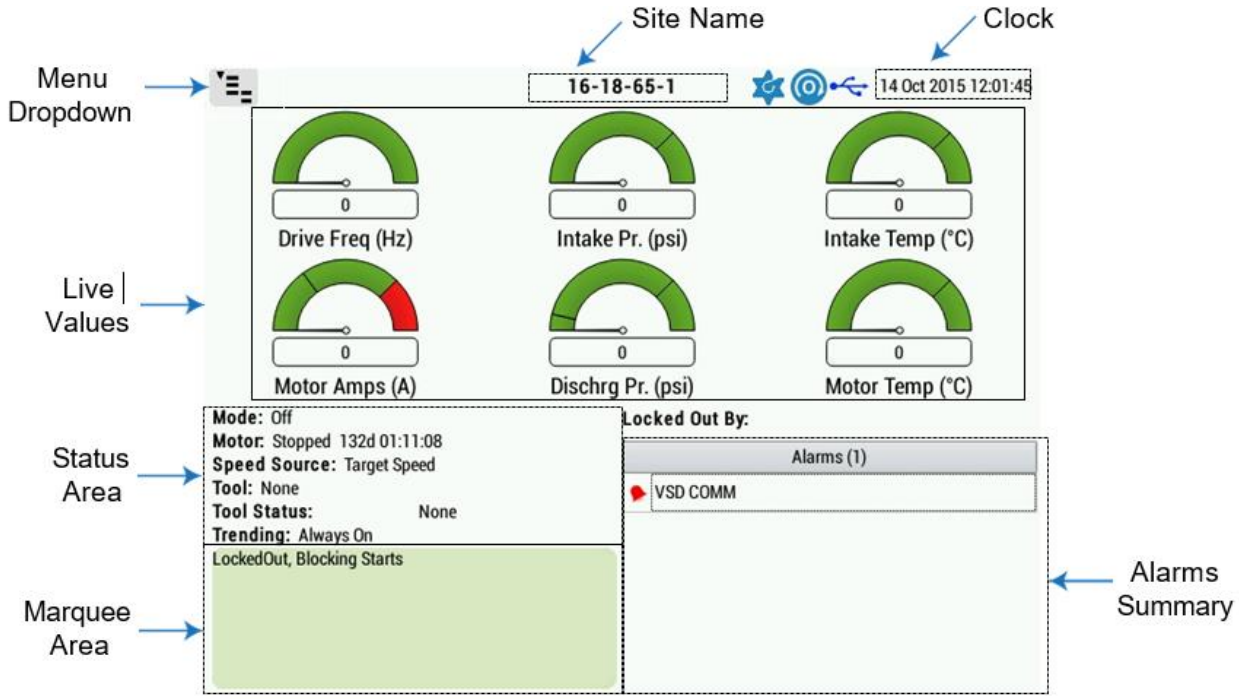


Figure 4-7: Home Screen

Term	Definition
Menu Dropdown	The location from which the menu is displayed when the Menu button is pressed
Site Name	The name of the wellsite
Clock	The current date and time
Live Values	Six key live values are shown in this area.
Status Area	The status of the motor and downhole tool (if applicable), operating mode, and trending status are shown in this area.
Marquee Area	Specific conditions that the operator needs to be aware of are shown here.
Alarms Summary	A summary of active alarms is shown in this area.

The display changes as the operator navigates through the controller.

4.4.3 UTILITIES KEYS

Key	Name	Function
	Backlight	Enables/disables display backlight

Key	Name	Function
	Language	Changes language on Graphical Display
	Favorites	Reserved for Favorites function Screenshot: with the controller fully booted, insert the removable USB Drive into the controller. The USB symbol on the display will turn blue when the controller recognizes the USB drive. Press the key for 3 seconds, it will save the current controller screen as a picture to the USB drive.

4.4.4 START/STOP KEYS

These **Start** and **Stop** keys are fixed-function and will achieve their intended function regardless of which menu screen the user has currently navigated to on the Graphical Display.

Key	Name	Function
	Start	Starts Controller
	Stop	Stops Controller

4.4.4.1 Start Keys

When the **Start** key is pressed, the **Start** screen pop-up is displayed at the bottom of the Graphical Display.

Figure 4-8: Start Screen Pop-up

For the **Start** key to start the pump, there must be no alarms present, and the **HOA** (hand-off-auto) switch must be in either the Hand or Auto Positions Operating Modes. Table 4-2: Operating Modes explains the different HOA switch modes (operating modes).

Table 4-2: Operating Modes

HAND	The motor can only be started by pressing the **Start** key.
AUTO	The motor will start automatically when all alarms are clear and when the restart timer completes its countdown cycle. If all alarms are clear, the **Start** key in the **Control Menu** can also be used to bypass the restart timer countdown. Remote Start/Stop commands from SCADA communication systems are only allowed in Auto mode.
OFF	The motor is OFF, and all starts (local, remote, and automatic) are prevented.

When the controller is OFF (with no alarms latched from the last shutdown), the **Control Screen** appears, with three keys labeled for actions (**Hand**, **Off** and **Auto**). The **Menu** key will take the user into the **Main Menu Screen**.

Pressing either the **1** key or **Left Arrow** key puts the controller into Hand mode. The **HOA** switch points to Hand to indicate that the controller is in Hand mode. Pressing either the **2** key or **Right Arrow** key puts the controller into Auto mode. The **HOA** switch points to Auto to indicate that the controller is in Auto mode. The controller can be placed in Auto mode from either Hand or Off mode, even while the motor is running in Hand mode. Pressing the **Stop** key will place the controller into Off mode and the **Start** screen pop-up will close. The OFF time of the controller will be indicated in the lower left section of the **Home** screen.

When the mode is switched from Off to Auto, the controller will automatically restart when the restart timer countdown has completed.

Latched alarms are listed in the Alarms area and are indicated with an asterisk. If latched alarms exist, they can be cleared by selecting **Unlatch Alarms**. This is performed by pressing the **3** key (Figure 4-8: Start Screen Pop-up).

During a Lockout condition, the **Home** screen will have the words ”Locked Out” in the marquee area. On the **Start** screen pop-up, the Unlock graphic will have a **Start** key icon underneath. This indicates that the **Start** key must be pressed to clear the Lockout condition. The Lockout condition must be cleared to enable the **Start** key in both Hand and Auto mode. Lockout prevents automatic restarting of the motor. Once the **Start** key is pressed, the Lockout condition will be cleared and the **Start** key icon will move to underneath the Start graphic, indicating that the **Start** key can now start the motor.

Pressing the **Start** key will start the motor. The lower left section of the **Home** screen will change to indicate that the motor is running along with an animation. The run time of the motor is also indicated. In the same section of the **Home** screen the controller mode (Hand or Auto) is also indicated.

4.4.4.2 Stop Key

Pressing this key will stop the ESP. It should be noted that once this key is pressed, it is not possible to remote start the ESP unless it is manually placed in auto mode using the keypad.

4.4.5 NUMERICAL KEYPAD

The number keys allow the user to enter numbers or alphabetical characters in certain setting areas of the controller that require user input.

The keys can also be used as shortcuts for quick access to certain parameters and settings displayed on the Graphical Display. For example, when the **2** key is pressed, the Graphical Display will display the **Alarms** menu.

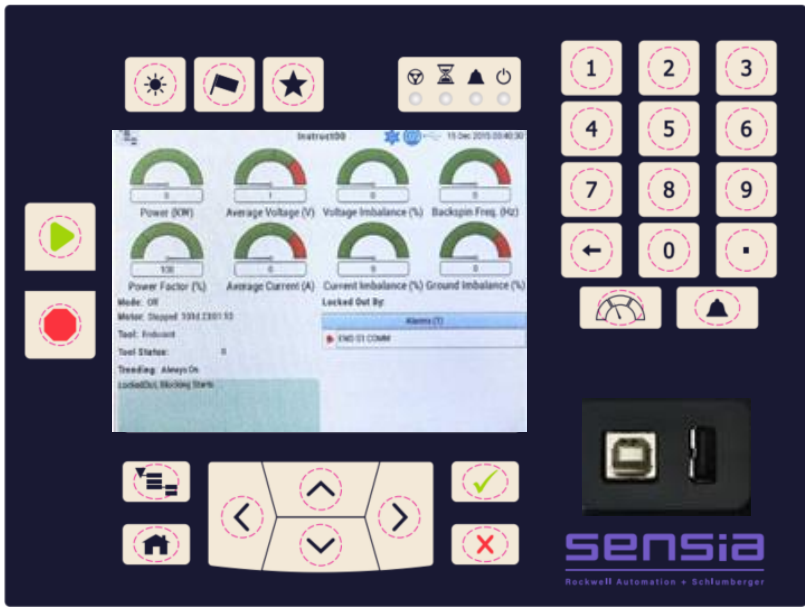
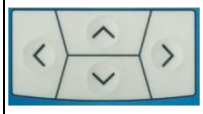


Figure 4-9: Numerical Keypad Menu Shortcut

4.4.6 NAVIGATION KEYS

These keys allow the user to navigate through the menu-driven interface of the controller. Most of these keys, except the **Home** and **Menu** keys, are multi-function and perform different functions depending on the current display on the Graphical Display.

Key	Name	Function
	Home	Changes the display on Graphical Display to the **Home** screen
	Menu	Displays the currently-navigated-to menu on the Graphical Display. If a sub-menu is open, pressing this key will close the sub-menu and show the higher-level menu. Pressing this key when the main menu is displayed will close the main menu.
	Accept	This multi-function key will select an option depending on the current content displayed on the Graphical Display.
	Reject	This multi-function key will de-select an option depending on the current content displayed on the Graphical Display.
	Arrow	These multi-function keys allow the user to select different options on the menu screen and other areas of the Graphical Display. In places that only vertical movements are possible (i.e., it is only possible to use the **Up Arrow** and **Down Arrow** keys to make selections), the **Right Arrow** key can be used to select an option, and the **Left Arrow** key can be used to de-select an option.

4.4.7 LIVE/ALARM KEYS

Key	Name	Function
	Live	Displays graphical representation of different parameters and the status of the controller on graphical display
	Alarm	Display alarms on graphical display

4.4.8 STATUS INDICATORS

Indicator	Name	Function
	Run Status	Green if the controller is running. Unlit if the controller is stopped
	Automatic Restart Status	Light is on when the controller is counting down to an auto-restart. Light is off if the controller is not counting towards an auto-restart.
	Alarm Status	Red if the controller is in an alarm state. Unlit if there are no alarms
	Controller Power	Green if the controller power is ON and the screen is OFF

4.4.9 USB CONNECTORS

These connectors are used to connect the controller to a PC or a storage device. The USB A-to-B cable is required to connect a PC to the controller front panel.

To improve the USB connection reliability during a VSD operation, the USB active extension cable or USB isolators are recommended. These devices can help reduce the noise and improve the connection reliability. Refer to INSTRUCT ESP Intelligent Controller Connection Issues (InTouch ID 6925630) for a detailed solution.

Potential Severity: Light
Potential Loss: Assets
Hazard Category: Electrical

Do not connect the USB cable or a USB drive to the controller before it fully boots up. Otherwise, the controller may not be able to boot up successfully, detect USB drives, or communicate with StarView.

4.5 POWER MONITORING FUNCTIONS

The Power Monitoring System consists of three key components: INSTRUCT ESP Intelligent Controller, Power Analyser Card, and Power Analyzer (PA) 5kV Voltage Sensor. This system can be used for power system measurement in a switchboard (fixed speed system) and for fixed speed motor control. It can also be used in a variable speed system for voltage and current measurements.

4.5.1 VOLTAGE INPUT

The Power Analyzer Card contains three AC potential transformer (PT) voltage inputs for the purpose of measuring and monitoring 3-phase motor voltage. The monitored parameters are described in Table 4-3: Voltage Input Parameters.

Table 4-3: Voltage Input Parameters

Parameter	Operation
Overvolts	Monitor condition where voltage exceeds a specified maximum value. The three-phase RMS average or each individual phase RMS voltage is monitored for overload. Used to protect a system from voltage surges
Undervolts	Monitor condition where voltage drops below a specified minimum value and applies the deviation to a six-point curve to determine the alarm duration. Used to protect a system from voltage droops and brownouts The alarm curve is designed to account for the voltage drop during a motor or system start.
Rotation Live Values Status Area	Monitor the phase voltage sequence A-B-C to ensure the motor is powered in the correct sequence. This prevents the motor from running backwards if the power supply to the motor is reversed.
	Note The detection of rotation change will not work if the cable phases were reversed beyond the PT or CT sensing connections.
	Rotation can be detected from either the current or voltage and thus appears in both the **Load** and **Volts** screens.
Unbalance	Monitor condition where voltage A-B-C magnitude is no longer matched and applies the deviation to a six-point curve to determine the alarm duration. The three-phase RMS average is compared to the individual phases to calculate unbalance. The unbalance is displayed as a percent of line voltage. The alarm curve is designed to account for the voltage unbalance during a motor or system start.

The results of these measurements can be combined with the current inputs to determine the system power and power factor.

The potential transformer (PT) inputs are located on terminals PT-A, PT-B, PT-C and PT-N (PIN 37 - 40) and operate in a WYE “Y” configuration.

Term	Definition
PT-A, B, C	PT inputs for phase voltage A, B, C
PT-N	The neutral point connection for the three-phase voltage.

The front-end voltage divider circuitry in the Power Analyzer Card converts the 120V to small signals, and the 3-phase measuring chip on the Power Analyzer Card measures the voltage values.

The PT input voltage is limited. The maximum voltage should be 120VAC. An additional Potential Transformer exists in the switchboard HV cabinet to interface with the high voltage systems as shown in Figure 4-10.

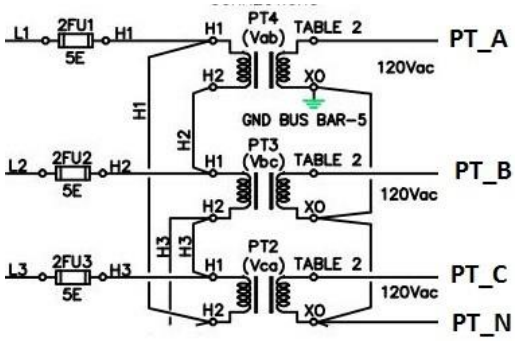


Figure 4-10: PT inputs cascade to 5000VAC

The PT inputs can be scaled to match external PTs and calibrated to account for transformer tolerance.

4.5.2 CURRENT INPUT

The Power Analyzer Card contains three AC current transformer (CT) inputs for the purpose of measuring and monitoring 3-phase motor current. A proprietary current transformer burden module is required to connect the external CT to the Power Analyzer Card. The monitored parameters are described in Table 4-4: Current Input Parameters.

Table 4-4: Current Input Parameters

Parameter	Operation
OVERLOAD	Monitor condition where current exceeds a specified maximum value. The three-phase RMS average or each individual phase RMS current is monitored for overload. Used to protect a system from a failing motor or motor cable while still permitting a motor start. The overload alarm has a 16-point time curve associated with it. The individual points in this curve can be edited for special applications. The setpoint is typically set to 15% higher than the motor running current. The alarm appears as **OVERLOAD** on the display.
UNDERLOAD	Monitor condition where current drops below a specified minimum value. Used to indicate a motor is not efficiently pumping fluid or has air locked The setpoint is typically set to 20% below the motor running current. The alarm appears as **UNDERLOAD** on the display.
ROTATION	This feature is shared with the voltage inputs. Monitoring of rotation can be in either voltage mode or current mode. **Note** When the system is stopped, the current is zero and therefore rotation direction cannot be determined using the CT input. If the rotation detection source is set to CT, then the rotation alarm is automatically bypassed whenever the system is stopped. The alarm appears as **ROTATION** on the display.
Rotation Live Values Status Area	Monitor the phase voltage sequence A-B-C to ensure the motor is powered in the correct sequence. This prevents the motor from running backwards if the power supply to the motor is reversed. **Note** The detection of rotation change will not work if the cable phases were reversed beyond the PT or CT sensing connections. Rotation can be detected from either the current or voltage and thus appears in both the **Load** and **Volts** screens.

Parameter	Operation
Unbalance	Monitor condition where voltage A-B-C magnitude is no longer matched and applies the deviation to a six-point curve to determine the alarm duration. The three-phase RMS average is compared to the individual phases to calculate unbalance. The unbalance is displayed as a percent of line voltage. The alarm curve is designed to account for the voltage unbalance during a motor or system start.
STALL	Stall is a condition where the motor stops rotating. The impedance of the power cables and motor winding create a scenario where the power requirements are high, but this is not a short circuit. The criteria used to define a stall condition must consider the OVERLOAD current required during a motor start. The setpoint must be set less than the name plate motor start amps. It is typically set to three times the motor-rated current. The alarm appears as **STALL** on the display.
SHORT CIRCUIT	This is a condition where a short circuit occurs. This indicates a serious fault has occurred in the cable to the motor or within the motor. The criteria used to define a short circuit must consider the current used in a STALL condition. The setpoint is typically set to six times the *motor-rated current*. The alarm appears as **SHORT_CCT** on the display.
Motor Amps	This is the nameplate rating of the maximum continuous motor amps. This value is used to calculate STALL and SHORT_CCT.

The results of these measurements can be combined with the voltage inputs to determine the system power and power factor.

The CT inputs are located on terminals CT-A, CT-B, CT-C, CT-REF and CT-SHIELD (PIN 32 - 36).

Term	Definition
CT-A, B, C	CT inputs for phase current A, B, C
CT-REF	Reference signal point for the three-phase current measurement
CT_SHIELD	A ground shield to protect the current signals from electrical noise

Warning

Potential Severity: Serious
Potential Loss: Assets, Information
Hazard Category: Electrical

These inputs are designed for the burden module only. Do not directly connect the CT leads to the controller.

The CT inputs can be scaled to match external CTs and calibrated to account for transformer tolerances.

4.5.3 UNDERLOAD TRACKING

The controller can optionally use the underload tracking feature to characterize over time an acceptable underload value up to a minimum setting. This characterized value becomes the reference point for the underload alarm. This accounts for motor current drift over time due to changing well characteristics and permits the controller to not alarm on a set underload value, but to follow the drift and alarm based on the drift point value.

Note

When the underload tracking is activated, the normal underload setting is bypassed for the underload tracking setting

4.5.4 INSTRUCT ESP CT BURDEN MODULE

The CT inputs measure voltage. A burden module is required to convert the current from the CT into a voltage prior to interfacing with the controller. There exists a unique 1000:1 CT Burden Module (PN: 100468928).

4.5.5 CT MODULE

This current transformer is designed to only operate with the standard 200A Switchboards. The CT module consists of three individual 200:5 Current Transformers (PN: 100667780).

4.5.6 INSTRUCT POWER ANALYZER 5KV VOLTAGE SENSOR

4.5.6.1 High Voltage / Backspin Inputs

The INSTRUCT Power Analyzer (PA) 5kV Voltage Sensor (PN 100840441) contains 3-phase high voltage inputs for the purpose of voltage and frequency measurement of a motor. The voltage measurement range is 400-5000Vrms.

The 3-phase voltage inputs can also serve as backspin inputs, for the purpose of detecting motor rotation while the motor is not powered. The motor rotation may be the result of well characteristics continuing to flow or fluid in the pipe draining back into the formation. Depending on the requirement, the controller can be configured to not start the motor while rotation is present or start only if below a rotation threshold.

The backspin input measures the frequency of the motor rotation and has alarm parameters associated with the frequency detection setting. There is a configurable time delay that the controller must wait before starting once the alarm has cleared. This timer will not start during a spin condition, and the controller will remain in the alarm state until the rotation drops below threshold, at which point the timer will start.

Backspin detection is designed to detect very small signals and functions with the system off. During system operation, system harmonics can create false triggers on frequency measurement.

The PA 5kV Voltage Sensor contains a DC blocking filter. For applications where a downhole tool (DHT) is used with an electric submersible pump (ESP), the DC power for the DHT will not affect the PA 5kV Voltage Sensor. The motor rotation signal passes through the DC blocking filter unaffected.

Warning

Potential Severity: Serious

Potential Loss: Assets, Process

Hazard Category: Electrical, Machinery equipment hand tools

Starting a motor which is spinning in reverse direction creates a very large current in order to stop the motor and then start the motor in the correct direction. Damage to motor winding may result.

4.5.6.2 Leg Ground

The Power Analyzer Card performs leg ground measurement using the PA 5kV Voltage Sensor. Leg ground measures the phase-ground voltage and unbalance indicates insulation degradation and ground fault problems. A single-phase dead short will show a 100% reading.

4.6 I/O FUNCTIONS

4.6.1 DIGITAL OUTPUTS

The digital outputs on the Power Analyzer Card or I/O Card are relay outputs capable of switching either AC (120/240 V Hazardous Circuits) at load up to 8A or DC (0-30 V Extra Low Voltage) at load up to 5A. The outputs are dry contacts meaning the switching voltage is not supplied from the card and must be supplied as part of the switchboard wiring. All digital outputs have the relay normally open (RLYx NO), common (RLYx COM), and normally closed (RLYx NC) contacts brought out to terminals.

Potential Severity: Light
Potential Loss: Personnel
Hazard Category: Electrical

Digital outputs must be connected to 120/240 VAC Hazardous Circuits OR 1–30 VDC Extra Low Voltage circuits exclusively. **Do not mix control voltage types**. In order to operate the controller within the CE certification, the digital outputs must not be connected to more than 240 volts AC.

The first digital output on the Power Analyzer Card is reserved for switchboard contactor control. This relay has additional hardware to prevent contactor dropout in brownout or low power conditions. This output is also tied to the motor shutdown event from alarms and the **Off** key. The green LED displays the status of this relay. In VSD applications this relay still operates as a contactor that can be used to indicate VSD run status (i.e., if power is applied to the motor).

Term	Definition
Off	Relay operation is disabled and left in the OFF position. The normally open terminal is electrically opened, and the normally closed terminal is closed.
On	The relay is held in the ON position. The normally open terminal is closed, and the normally closed terminal is open. This can be used for an external device to detect power failure to the controller as the relay will go OFF when power is removed.
Blink	The relay turns ON and OFF at a one-second interval.
Coil	The relay behaves as a SCADA output coil for remote control applications. The SCADA system writes to a telemetry register as a bit value 0 or 1 to control this output.
Contactor	The relay follows the motor contactor relay status (i.e., ON when the contactor is ON). This also follows the green LED on the controller faceplate. This function is often used to control an external lamp for improved visibility of the controller run status.
Restart	The relay is ON when the controller restart timer is counting down for an automatic restart. This follows the flashing red LED status. This function is often used to control an external lamp for improved visibility of the controller status.
On Alarm	The relay is ON when the controller is in an alarm condition. This function follows the solid red LED status. This function is often used to control an external lamp for improved visibility of the controller status.
Blocking	The relay is ON when something (alarm, hold start, etc.) is blocking an automatic restart and also when the motor is running. The relay is OFF when the contactor is OFF and no alarms are present.
SoftStart_Done	The relay turns ON when the soft-start Delay has expired. During a soft-start application, Relay1 (CONTACTOR) is connected to the soft-start relay and turns ON when a start occurs. This parameter is used to turn on a second relay to control the full operation. This relay will drop out when Relay1 drops out to stop the motor.

4.6.2 ANALOG INPUT

The Power Analyzer Card or I/O Card Analog input contains differential analog inputs. Each of these inputs can independently operate in voltage or current mode.

The analog input channels are used to interface with external analog devices or Remote Telemetry Devices (RTD) like pressure or temperature units. The range and scale settings for the analog inputs operate in a similar manner to the analog outputs.

The analog inputs operate in the range of 0–10V or 0–22mA current loop measurement. These operating ranges can be scaled to function as 0–5V, 2–8V, 4–20mA, etc.

For voltage measurements the inputs are differential with an operating range up to 10V. Each input contains over-voltage protection which activates in the 20 to 24 VDC range. Therefore, the differential data of 10V can swing up to the 20V without data corruption.

Each analog input can be configured with parameters as shown in Table 4-5: Analog Input Settings.

Table 4-5: Analog Input Settings

Parameter	Description
Name	Name of the data type, i.e. Pressure, temperature, Temp1, etc.
Input type	Voltage or current mode, i.e. 0-10 V or 0-20 mA
Raw Maximum	Configuration setting on controller to map to Scaled Maximum
Raw Minimum	Configuration setting on controller to map to Scaled Minimum
Scaled Maximum	Maximum reading of device in engineering units, i.e., 200 psi
Scaled Minimum	Minimum reading of device in engineering units, i.e., 0 psi

The Name parameter can be used to change the name of the analog input channel to something more descriptive on the display. For example, a wellhead pressure sensor might be labeled ”WH Press.” The maximum number of characters permitted is ten.

The Input Type parameter determines whether the analog input channel operates as a voltage input or current loop input. This parameter can be set to either 0–10V for voltage mode or 0-20 mA for current mode.

The Raw Maximum and Raw Minimum parameters are used to set the 0-10 volts and 0-20 mA ranges to other ranges. The raw values are expressed as a percentage of the maximum input voltage or current. This is used to interface with devices that have ranges like 0-1 volts, 1-5 volts, or 4-20 mA.

The Scaled Maximum and Scaled Minimum parameters are used to set the Engineering units that the user wishes to see within the bounds of 0% and 100%. These Engineering units may represent pressure, temperature, voltage, current, etc.

The configuration of these inputs can be performed using the controller interface or the StarView program utility.

4.6.2.1 Voltage Mode

The analog inputs configured for voltage inputs have a basic circuit topology shown in Figure 4-11: Analog input voltage mode single device.

Note

The end device would typically require a power supply, which is not shown in Figure 4-11.

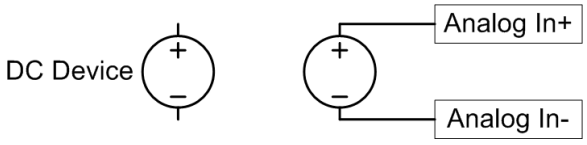


Figure 4-11: Analog input voltage mode single device

Figure 4-12: Analog input voltage mode DC powered device shows an external power supply which provides power to the device.

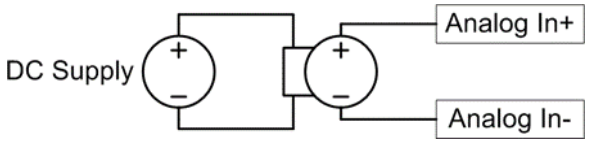


Figure 4-12: Analog input voltage mode DC powered device

4.6.2.2 Current Mode

The analog inputs configured for current inputs have a basic circuit topology shown in Figure 4-13. For the current loop to function a power supply is required to drive it.

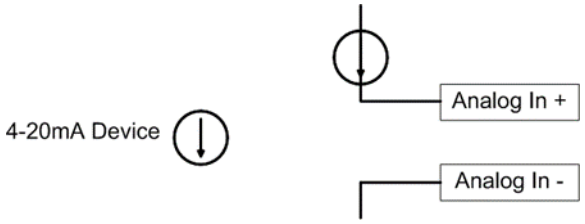


Figure 4-13: Analog input current mode single device

4.6.3 DIGITAL INPUT

Digital inputs are designed to provide logic information in the form of Open / Close, On / Off, High / Low, 1 / 0, etc. The digital inputs are designed to be switched with dry contacts. The switching voltage, 24 volts DC available on DPWR pin, is supplied internally from the card via the DIGITAL PWR terminal. These inputs can be independently configured to respond to either an Open or a Close condition. A sample digital input circuit is shown in Figure 4-14.

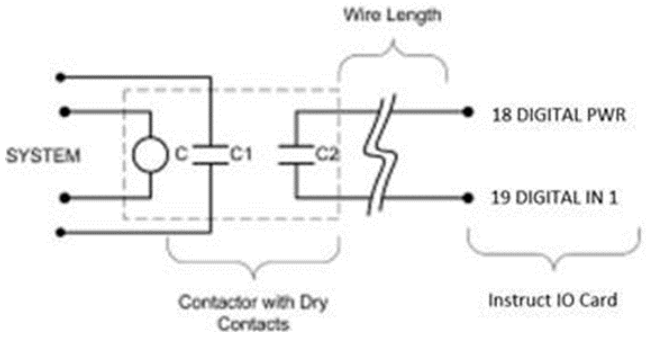


Figure 4-14: Digital input dry contacts

The digital inputs contain internal alarms to indicate power and voltage faults.

If the length of the digital input wiring is very long, the DC switching power can be subject to significant voltage droop. The recommendation is to use an additional relay to provide the switched signal to the card. The power to drive the relay would be according to the client's discretion. The placement of the relay would be near to the controller as shown in Figure 4-15.

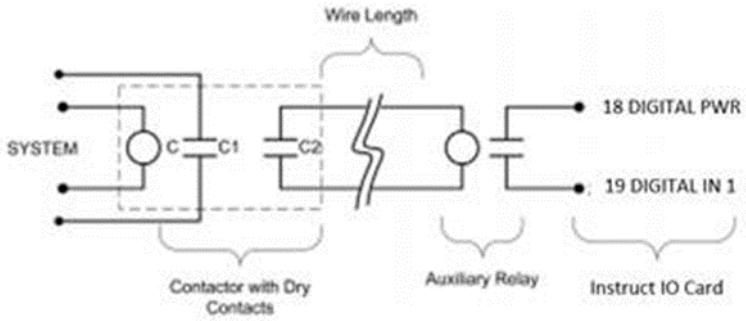


Figure 4-15: Digital input with auxiliary relay

The digital inputs should always be wired in a fail-safe connection so that loss of power or a break in the digital input wiring will trigger the input. The controller should be set to alarm on a switch open condition, and the external switch set to hold the switch closed during normal operation. In addition to catching a fault condition from the external device, the controller will also receive an alarm condition in the case of external device power failure or a break in the signal wires.

The controller configuration can accept both types of inputs, normally open and normally closed.

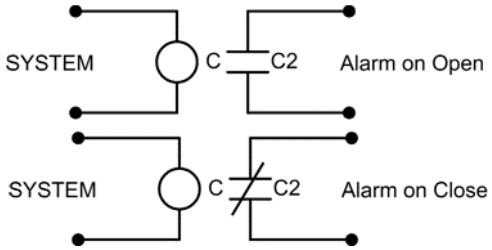


Figure 4-16: Digital input fail-safe considerations

4.6.3.1 Digital Input HOA

Hand, Off, Auto (HOA) represents a traditional mechanical switch to ensure that only one of the three modes functions at one time. The HOA functions on the keypad already emulate this operation. Alternately the digital input may be configured to operate as a HOA permitting the use of traditional mechanical switches.

The digital input Hand, Off, Auto operational features are summarized in Table 4-6: Digital input HOA Details.

Table 4-6: Digital input HOA Details

HOA Function	Description
NORMAL	The digital input is configured for normal operation. HOA mode is disabled.
START	Momentary closure on any digital input configured for START will place the controller in START mode provided the controller is in HAND or AUTO mode and no alarms are present. If the controller is in a lockout condition, activating a START will first clear the lockout. A subsequent START will place the controller in START mode. Latched alarms are automatically cleared during a START. Maintenance Bypass mode can be activated if START is held closed more than five seconds. If digital inputs are used for HAND and AUTO mode selection and there is a requirement to toggle between these modes, this can be done by holding in START while switching modes. **Note** Recommendation is to not configure more than one input for START. Once a digital input is configured for START, normal digital operation (Alarming and Restarting) for that input will be disabled. START from the controller's keypad will function normally when using START from digital input. START from digital input is activated by closing the circuit and cannot be configured to START on open circuit.

HOA Function	Description
HAND	Closing the circuit will place the controller in HAND mode and override HAND/AUTO control from the controller's keypad. Once a digital input is configured for HAND, normal digital operation (Alarming and Restarting) for that input will be disabled. HAND mode can only be activated by closing the circuit and cannot be configured to activate on open circuit. **Note** Only one digital input should be configured for HAND mode. When HAND is not activated (open circuit) and AUTO mode is not activated, the controller will be placed in MANUAL OFF mode.
AUTO	Closing the circuit will place the controller in AUTO mode and override HAND/AUTO control from the controller's keypad. Once a digital input is configured for AUTO, normal digital operation (Alarming and Restarting) for that input will be disabled. AUTO mode can only be activated by closing the circuit and cannot be configured to activate on open circuit. **Note** Only one digital input should be configured for AUTO mode. When AUTO mode is not activated (open circuit) and HAND mode is not activated, the controller will be placed in MANUAL OFF mode.

4.6.3.2 Digital Input Alarm

The digital inputs have been designed to survive wiring faults and high voltage transients. There are two digital alarms:

Alarm Label	Description
U_IO_PFail	Indicates that a short to ground has occurred somewhere on the digital inputs (DIGITAL IN pin 22 to 27). With this alarm active, the entire digital input system may be affected as the digital power (DIGITAL PWR pin 21) is shared among all inputs.
U_IO_V_HI	Indicates that a high voltage fault exists somewhere on the digital inputs (DIGITAL IN pin 22 to 27). This may be due to a wiring fault where high voltage or AC voltage has been connected to the digital input.

4.6.4 ANALOG OUTPUT

The analog outputs operate to control the 0–20mA loop current. The analog output cannot provide power for the loop current.

The analog output channels can be used for external control of devices such as an electronic valve or meter. The range and scale settings for the analog outputs operate in a similar manner to the analog inputs.

The analog outputs operate in the range of 0-22mA and can be configured to operate in 4–20mA, 10–15mA, etc. An external power supply may be used to power the current loop. Each output contains over-voltage protection that activates in the 20 to 24 VDC range, so the external power supply must operate below this value.

Each analog output can be configured with the parameters shown in Table 4-7: Analog Output Settings.

Table 4-7: Analog Output Settings

Parameter	Description
Name	Name of the data type, i.e. Pressure, Temperature, Temp1, etc.
Source	Parameter that drives the analog output value, i.e., Analog In 1, Power Factor, etc. See Table 4 8: Analog Output Source Settings.
Scaled Maximum	Maximum reading of the device in engineering units, i.e. 200 PSI
Scaled Minimum	Minimum reading of the device in engineering units, i.e. 0 PSI
Raw Maximum	Configuration setting on the controller to map to Scaled Maximum
Raw Minimum	Configuration setting on the controller to map to Scaled Minimum

The Name parameter can be used to change the name of the analog output channel to something more descriptive on the display. For example, average voltage might be labeled ”Avg Volts.” The maximum number of characters possible is ten.

The Source parameter represents analog outputs that may be bound to the parameters shown in Table 4-8: Analog Output Source Settings. In this manner, live data may be mapped to auxiliary displays or other devices.

Table 4-8: Analog Output Source Settings

Remote input	Manual setting of the analog output using the setpoint. This can be performed using the keypad, StarView, or remote SCADA.
Analog 1 to 4	Analog output can be mapped to the controller analog inputs.
Fixed-Speed parameters	Power factor, Average Volts, Average Amps, etc.
VSD parameters	Variable speed drive parameters such as Run frequency, etc.
DHT	Downhole tool interface card parameters such as Pump intake pressure, Bottom hole temperature, Vibration, etc.

Section 5: **Installation**

5.1 CONTROLLER MOUNTING

This section applies to all activities related to retrofitting drives and switchboards, using UniConn controllers, with the INSTRUCT ESP Intelligent Controllers.

The controller must be installed in an enclosure to be used. Typically, this is done at the factory or by qualified personnel in the field.

Caution

Potential Severity: Light

Potential Loss: Assets, Reputation

Hazard Category: Machinery equipment hand tools

If the PCB on the controller bezel is not attached properly due to a gluing issue, apply the adhesive hot melt glue (PN: 100213270, 3M 3779TC or 3M 3779) to attach the PCB to the bezel.

Figure 5-1: Keypad Inspection

Warning

Potential Severity: Serious

Potential Loss: Personnel

Hazard Category: Electrical, Machinery equipment hand tools

Do NOT install the controller in 200 kVA or smaller 12-pulse SineWave/Non SineWave VSDs, as the spacing between live components inside the VSD is not adequate to ensure safe operation.

Caution

Potential Severity: Light

Potential Loss: Assets

Hazard Category: Machinery equipment hand tools

Installation can only be performed by authorized factory or service personnel. Operators only have access to the front panel of the controller. No installation or retrofit can be carried out by the operator.

5.1.1 REQUIRED EQUIPMENT

Caution

Potential Severity: Light
Potential Loss: Assets
Hazard Category: Electrical

All wiring to the controller must use copper wires rated for minimum 90 degC.

Part Number	Description	Qty
101224847	INSTRUCT ES7 VSD Retrofit Drill Template, 18 Ga Steel, Galvanized	1
101224844	Drill Bit, 5/32-in X 2-1/16-in L, Black Oxide	1
101206590	Operating Tool for WAGO 3.5mm Terminals ROHS	1
AC21259	MS Binding 10-32 x 1/2-in Slot Drive	4
AC21063	Locknut Hex 10-32-in Steel Zinc KEPS	4

The following tools/equipment are required for the procedure.

- Voltmeter
- 3/8-in nut driver
- Drill
- Vacuum
- 5/16-in slotted screwdriver
- 7/64-in hex key
- 0.4 x 2.5-mm slotted screwdriver
- Electrical tape

5.1.2 MOUNTING

The controller is mounted into the Drive/Switchboard enclosure with the following procedure. It is recommended that two people perform this procedure.

1. Using the appropriate procedures, ensure the Drive/Switchboard is stopped and that input power supplies are OFF before proceeding with the procedure.
2. Using the appropriate procedures, open cabinet door and use a voltmeter to verify all power is OFF on the Drive/Switchboard prior to proceeding with remaining procedure.
3. Remove all connectors from bottom and sides of UniConn, including any connectors on option cards.
4. Ensure the door on the UniConn front panel is closed.
5. Using an 11/32-in nut driver, remove the four (4) nuts that secure the UniConn to the enclosure.
6. Open the door for the UniConn front panel and remove the UniConn.
7. Using 5/16-in slotted screwdriver, insert 10-32 x 5/8-in screws into the existing mounting holes. Ensure the screws are inserted from the exterior.
8. Place from the inside the drill template over the four screws, ensuring that the notch in the template is in the top left corner.
9. Using a 3/8-in nut driver, secure the drill template with 10-32 locknuts.
10. Using a drill and 4-mm drill bit, drill four holes through the enclosure using the holes in the drill template as a guide.
11. Vacuum up any metal shavings from the inside and outside of enclosure.
12. Using a 3/8-in nut driver, remove locknuts and then remove the drilling template, leaving the 10-32 screws in place.

13. Using a 3/8-in nut driver, install the controller with bezel removed from the inside of the enclosure using the locknuts.

Caution

Potential Severity: Light
Potential Loss: Assets, Personnel
Hazard Category: Electrical

Ensure there is enough clearance between the controller and any live components inside the Drive/Switchboard, prior to energizing the Drive/Switchboard.

14. Using a 7/64-in hex key, install controller bezel from the front using the provided 4-40 x 1-1/8-in screws.

5.2 CONTROLLER WIRING

1. Using a 0.4 x 2.5-mm slotted screwdriver, remove wires from UniConn connector.
2. Using the Wago connector tool, re-install wires on controller I/O card connector.

Note

- Relay 1 NO/NC/COM – The INSTRUCT ESP Intelligent Controller will need to be configured to have the same function as the UniConn Relay 1 terminals.
- Analog Pwr/Out1/Out2 – The function of the analog output is different from the UniConn analog output. If using these connections, refer to 6.9: Analog Output.

Table 5-1: INSTRUCT ESP I/O Card Wiring Reference

INSTRUCT ESP Intelligent Controller I/O Card	
Description	**Pin**
Relay 1 – NO	1
Relay 1 – NC	2
Relay 1 – COM	3
Relay 2 – NO	4
Relay 2 – NC	5
Relay 2 – COM	6
Relay 3 – NO	7
Relay 3 – NC	8
Relay 3 – COM	9
Analog input 1 +	10
Analog input 1 –	11
Analog input 2 +	12
Analog input 2 –	13
Analog input 3 +	14
Analog input 3 –	15
Analog input 4 +	16
Analog input 4 –	17
Digital power	18
Digital input 1	19

INSTRUCT ESP Intelligent Controller I/O Card	
Description	**Pin**
Digital input 2	20
Digital input 3	21
Digital input 4	22
Digital input 5	23
Digital input 6	24
ANALOG OUT1	25
ANALOG OUT2	26
ANALOG GND	27

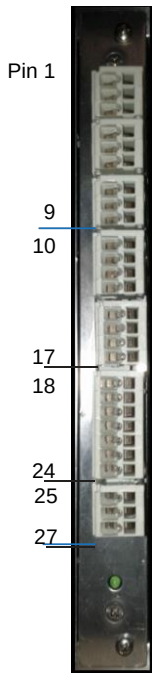


Figure 5-2: INSTRUCT ESP I/O Card Wiring Diagram

Note
For Analog Out connections, ensure that the shield wire is connected to the Analog GND pin (pin 27) of the I/O card. Do not connect the shield to Chassis GND.

3. Using a 0.4 x 2.5-mm slotted screwdriver, remove wires from UniConn Comm Card connector.
4. Using the Wago connector tool, re-install wires on the Control Card.

Table 5-2: RS-485 Wiring Cross Reference

Description	Cable Color Code		
	CAT 5	**CAT 6**	**Pin**
RS-485 TX	Blue	Blue	1
RS-485 TX-	Orange	Blue/White	2
RS-485 RX-	White/Orange	Green	3
RS-485 RX+	White/Blue	Green/White	4

Description	Cable Color Code		
	CAT 5	CAT 6	Pin
GND	Green	Brown	5
Shield Wire			5

Figure 5-3: RS-485 Wiring Diagram

Note
The RX+ and RX- terminals are reversed as compared to the Communication Card (101120028).

Note
For RS-485 connections, ensure that the shield wire is connected to the RS-485 GND pin (pin 5) of the INSTRUCT ESP Intelligent Controller Control card. Do not connect the shield to Chassis GND.

5. Using a 0.6 x 3.5-mm slotted screwdriver, remove wires from UniConn AC power supply terminals 46, 47 and 48.
6. Using a 0.6 x 3.5-mm slotted screwdriver, re-install the wires on the INSTRUCT ESP Intelligent Controller power supply inputs.

Table 5-3: AC Input Wiring Cross Reference

INSTRUCT ESP Intelligent Controller	
Description	**Pin**
GND	GND
AC-N	N
AC-L	L

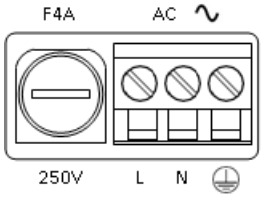


Figure 5-4: AC Input Wiring Diagram

5.3 SWITCHBOARD / POWER MONITORING SYSTEM WIRING

This section applies to all activities related to retrofitting the INSTRUCT ESP Intelligent Controller into a switchboard with a UniConn Controller. It is similar to retrofitting a VSD, except for the wiring process. The user should refer to the following wiring procedure for retrofitting a INSTRUCT ESP Intelligent Controller into a switchboard.

The Power Analyzer Card can be used inside a VSD system for the purpose of voltage and current measurements.

Note
For the K095 retrofit kit, refer to the INSTRUCT ESP Intelligent Controller Reference Page (InTouch ID 6023027).

5.3.1 WIRING

1. Using a 0.4 x 2.5-mm slotted screwdriver, remove wires from UniConn connector.
2. Using the Wago connector tool, re-install wires on the INSTRUCT ESP Intelligent Controller Power Analyzer card connector.

Note
- Relay 1 NO/NC/COM – This relay can only be used for Contactor control.
- Analog Pwr/Out1/Out2 – The function of the analog output is different from the UniConn analog output. If using these connections, refer to 6.9: Analog Output.

Table 5-4: Digital Outputs – Wiring Cross Reference

UniConn		INSTRUCT Power Analyzer Card	
Description	**Pin**	**Description**	**Pin**
RLY1 NO	1	RLY1 NO	1
RLY1 NC	2	RLY1 NC	2
RLY1 COM	3	RLY1 COM	3
RLY2 NO	4	RLY2 NO	4
RLY2 NC	5	RLY2 NC	5
RLY2 COM	6	RLY2 COM	6

UniConn		INSTRUCT Power Analyzer Card	
Description	**Pin**	**Description**	**Pin**
RLY3 NO	7	RLY3 NO	7
RLY3 NC	8	RLY3 NC	8
RLY3 COM	9	RLY3 COM	9
RLY4 NO	10	N/A	
RLY4 NC	11	N/A	
RLY4 COM	12	N/A	

Table 5-5: Analog/Digital – Wiring Cross Reference

This table shows the analog inputs and outputs, together with the digital inputs.

UniConn		INSTRUCT Power Analyzer Card	
Description	**Pin**	**Description**	**Pin**
Analog in 1+	13	Analog In+	22
Analog in 1-	14	Analog In-	23
Analog PWR	28	Analog Out	24
Analog Out1	29	Analog COM	25
DIGITAL PWR	21	DIGITAL PWR	27
DIGITAL IN 1	22	DIGITAL IN 1	28
DIGITAL IN 2	23	DIGITAL IN 2	29
DIGITAL IN 3	24	DIGITAL IN 3	30
DIGITAL IN 4	25	DIGITAL IN 4	31
DIGITAL IN 5	26	N/A	
DIGITAL IN 6	27	N/A	

Table 5-6: PT/CT and Backspin Connections – Wiring Cross Reference

UniConn		INSTRUCT Power Analyzer Card	
Description	**Pin**	**Description**	**Pin**
SPIN-A	31	N/A	
SPIN-B	32	N/A	
SPIN-C	33	N/A	
CT-A	34	CT_A	32
CT-B	35	CT_B	33
CT-C	36	CT_C	34
CT-PWR	37	N/A	
CT-REF	38	CT_REF	35
CT-SHIELD	39	SHIELD	36
PT-N	40	PT-N	40
PT-A	41	PT-A	37
PT-B	42	PT-B	38
PT-C	43	PT-C	39

Figure 5-5: INSTRUCT Power Analyzer Card

5.3.2 CURRENT TRANSFORMERS AND BURDEN MODULE

The Power Analyzer Card interfaces with conventional 0-5 A current transformers (CTs) using the INSTRUCT ESP CT Burden Module (PN 100468928). The motor leads must pass through the CTs, which are installed in the high voltage compartment, for measurement of motor currents. The CT outputs must be connected to the input terminals of the CT Burden Module. The measurement connection to the controller is brought back on a low-voltage signal cable. This cable must be wired to the CT input plug (pins 32-36) of the Power Analyzer Card. The CT ratio must be correctly configured for the controller readings to be valid.

Figure 5-6: INSTRUCT ESP CT Burden Module 5A input type

5.3.3 POTENTIAL TRANSFORMERS

The PT outputs are connected to the Power Analyzer Card PT inputs, pin 36 through pin 40.

The voltage inputs on the Power Analyzer Card accept 120 volts AC nominal voltage levels for monitoring the three-phase supply voltages. Since switchboard voltages are typically much higher than this, external potential transformers (PTs) are used to provide voltage level translation from the high-voltage signals. Three individual PTs are required for full high-speed three-phase monitoring applicable with both switchboards and VSDs.

The PT secondary windings must be connected to the controller in a Wye configuration with the neutral point terminated at the instrumentation transformer secondary winding common point.

The connection to the motor cables should be a Delta configuration to allow the controller to read line-to-line voltages. Refer to the following figure for the normal 3 PT configuration wiring diagram.

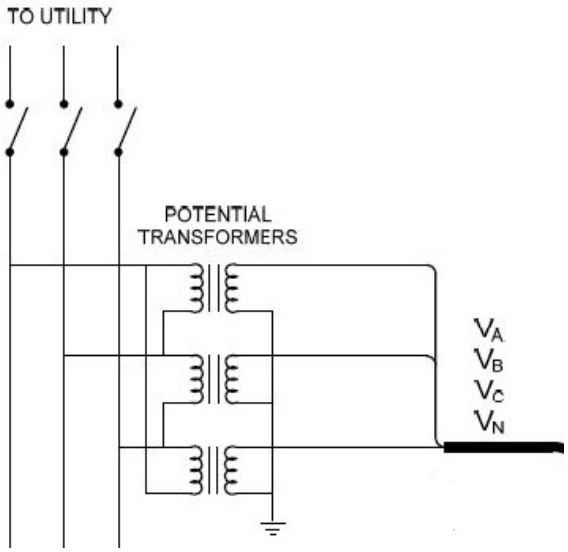


Figure 5-7: PT Configuration

For K095 backward compatibility, the controller has a 2 PT configuration option, which allows the user to use only 2 PTs. Refer to the following figure for the 2 PT configuration wiring diagram.

Note
In a two PT system the third reading (Vbc) is extrapolated from the other two. If there is significant voltage imbalance, this reading may not be accurate within specification.

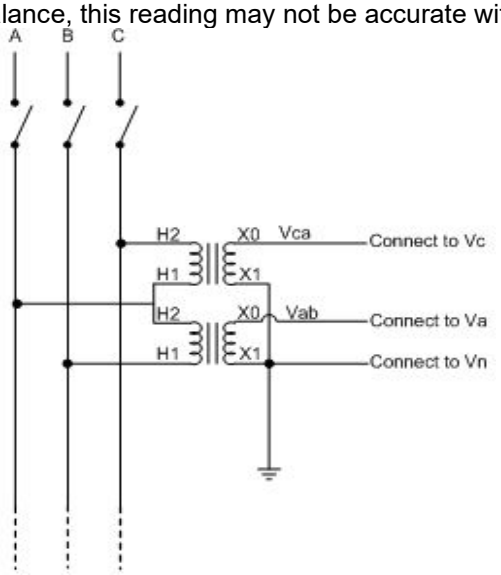


Figure 5-8: 2 PT Configuration (for K095 retrofit kit)

5.3.4 INSTRUCT POWER ANALYZER 5KV VOLTAGE SENSOR

The INSTRUCT Power Analyzer 5kV Voltage Sensor (PN100840441) can be installed in the high-voltage compartment of a switchboard or step-up transformer output of a VSD system. The three high-voltage input cables are connected to the motor leads, and the ground line is connected to the star-point transformer, switchboard, or system ground.

The PA 5kV Voltage Sensor is connected to the Power Analyzer Card via the PA 5kV Voltage Sensor Signal Cable. The PA 5kV Voltage Sensor Signal Cable is available in lengths of 4m and 8m. The cable is NOT reversible. The end that connects to the PA 5kV Voltage Sensor is labelled “Sensor,” (previously labelled “BSM”), and the end that connects to the Power Analyzer Card (which has the cable shielding connection) is labelled “PA” (previously labelled “SWB”). Connector pins 10 to 21 of the Power Analyzer Card are for the PA 5kV Voltage Sensor connection.

Note
The PA 5kV Voltage Sensor completely replaces the A095 Backspin Shunt. The A095 is not compatible with the INSTRUCT ESP Intelligent Controller. There is only one model of the new PA 5kV Voltage Sensor: it covers the entire 400V-5000V range.
For UniConn Compatibility use, the voltage range is 800V – 5000V

Caution

Potential Severity: Light
Potential Loss: Assets, Personnel
Hazard Category: Electrical

The 3-pin black connector is for UniConn compatibility use. The output signals (BS-A, BS-B & BS-C) are hazardous voltage (40VAC) circuit and are not used in this actual switchboard application. The J2 connector removable part shall always be fully inserted before use, in order to prevent access to the hazardous voltage circuit.

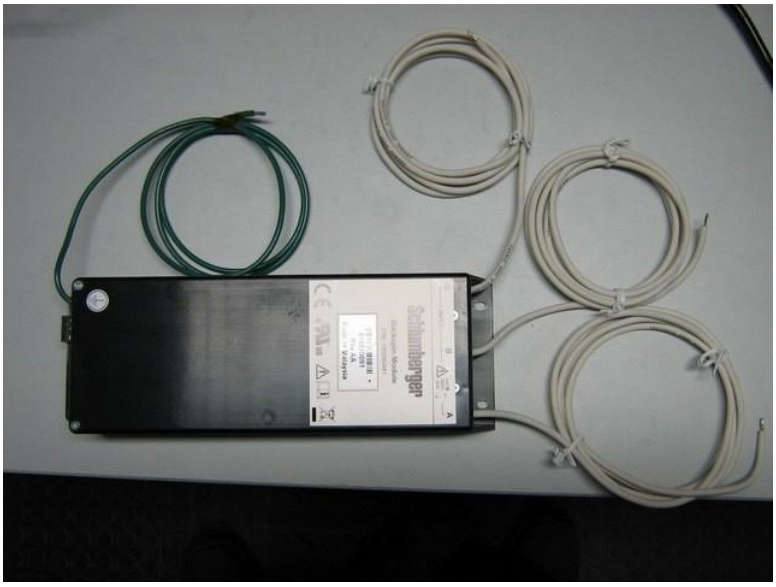


Figure 5-9: INSTRUCT Power Analyzer 5kV Voltage Sensor

Figure 5-10: INSTRUCT Power Analyzer 5kV Voltage SensorSignal Cable

5.4 CONTROLLER CONNECTION

5.4.1 PROTECTIVE EARTH AND POWER CONNECTIONS

The controller must have its protective earth terminal connected to the cabinet earth terminal. The protective earth terminal is marked on the chassis, located on the left side of the unit.

The controller is typically installed in a drive enclosure, and the protective earth terminal must be securely connected to a terminal block that is solidly connected to the system earth ground. Proper connection from the controller's protective earth terminal to system earth ground must be through 14 AWG green/yellow wire terminated with a #8 ring lug. The provided pressure ring washer (lock washer) must be installed along with the #6-32 machine screw to secure the ring lug to the protective earth terminal.

Connection of the controller to the supply source (power) is made to the power supply input on the bottom of the controller. If the controller is supplied with AC voltage (the typical scenario for VSD applications), the supply is connected to the AC inputs. For ELVT VSDs, the AC supply is labelled Control Voltage; if required, consult the Figure 5-12: INSTRUCT ES7 Intelligent VSD Three-line Diagram for details. For special applications where the controller is supplied with DC voltage, the supply is connected to the DC inputs. The controller AC and DC supply voltage can be supplied simultaneously.

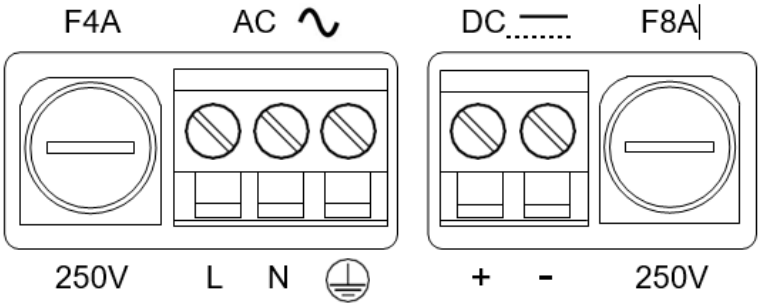


Figure 5-11: Power Supply Inputs

Wiring to the power supply input terminal blocks must be made using 14-18 AWG stranded wire. A means of disconnecting the controller from the supply must be provided. In an ELVT application, the supply source can be disconnected via MCCB1. Refer to Figure 5-12: INSTRUCT ES7 Intelligent VSD Three-line Diagram for details. If the controller is being installed in a special or standalone application, a switch or circuit breaker must be included in the installation, and it must be easily accessed and marked as a disconnecting device.

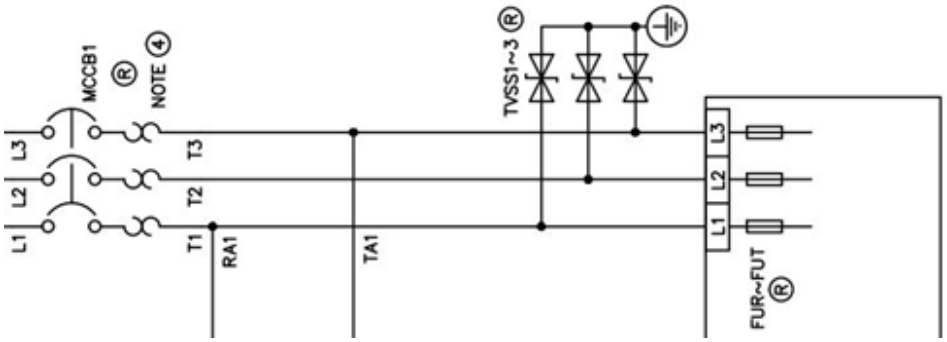


Figure 5-12: INSTRUCT ES7 Intelligent VSD Three-line Diagram

5.4.2 ANALOG SIGNAL CONNECTIONS

Special consideration is needed when using the analog input and output connections (pins 10 to 17 and 25 to 27) on the I/O card to interface with other equipment at the wellsite.

- Analog inputs are differential.
- Analog outputs must use the Analog Common (pin 27).
- Interface cables typically use a shield and must be grounded.

Note
When shielded cables are used, the shield must be grounded at one point only. For Analog Inputs, this point is close to the source device. For Analog Outputs, this point is Analog GND (pin 27).

5.4.2.1 Electrical Noise and Shields

Electrical noise, either radiated or conducted as electromagnetic interference (EMI), can often cause issues retrieving data from sensors. The cable can either conduct noise to other equipment or act as an antenna radiating noise. It can also pick up EMI radiated from other sources. A twisted pair wire with a shield is used to protect against these sources.

The shield can reflect energy or conduct it to ground. Shields typically come in two types, foil and braid. Foil shielding uses a thin layer of aluminium with a carrier such as polyester for added strength and ruggedness. This offers 100% coverage, however difficult to terminate. A braid is a woven mesh of bare or tinned copper wires, providing a coverage typically 70-95% coverage of the signal cable depending on the tightness of the weaves. A braid allows for easier termination. Some cable manufacturers even offer a combination of both foil and braid.

Cable routing is another important aspect of reducing crosstalk and interference. Placing signal cables next to power cables can allow power-line noise to couple onto the signal lines causing interference.

Ground loops are another potential cause of noise. To avoid creating ground loops, only ground the signal cable at one end. At the other end of the cable, the shield is considered “floating,” i.e., not tied to anything.

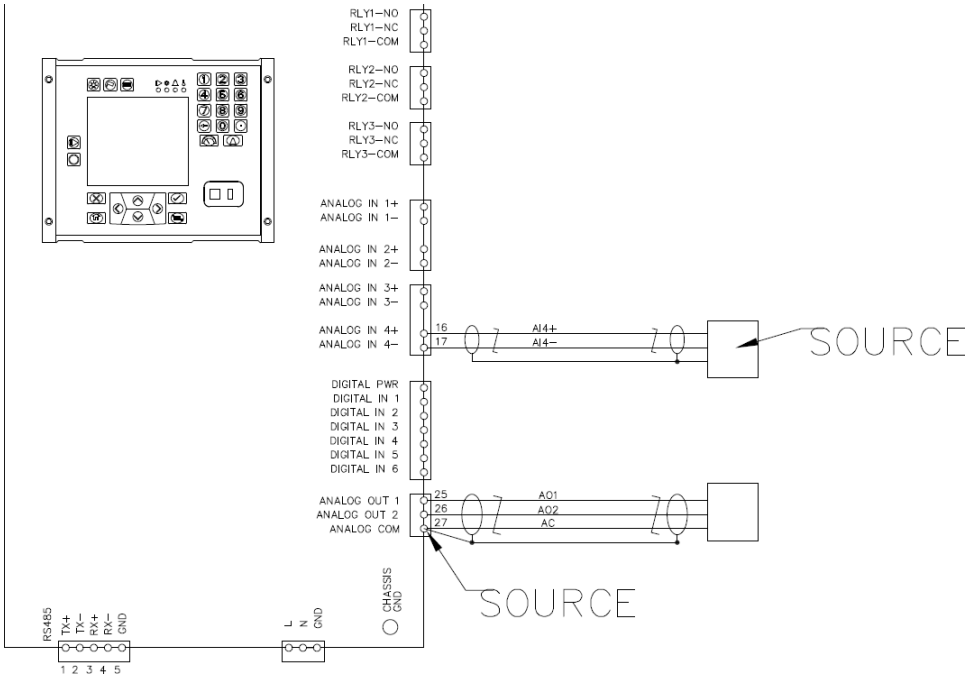


Figure 5-13: Analog In/Out Wiring

5.4.3 ANALOG INPUT

The controller employs full-differential inputs on the front end of the analog inputs. The negative input should not be connected to the controller earth ground when used with single-ended output devices. These devices should be grounded to earth at their location and their ground signal connected to the controller analog input negative terminal only. This will help to avoid ground loop currents that can potentially affect the operation of the equipment.

Note
For analog inputs the shield should be terminated at the source and left floating at the controller side. It is advised that heat shrink is applied to the shield at the controller side in order not to be left exposed.

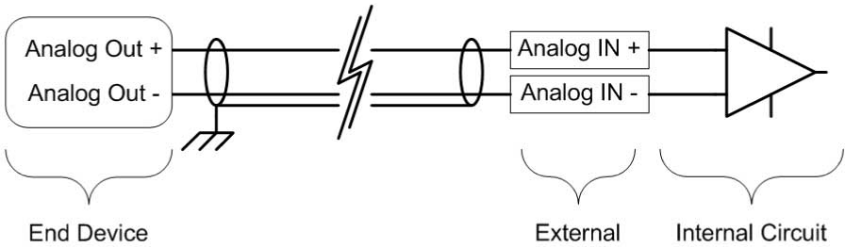


Figure 5-14: Differential inputs on differential devices

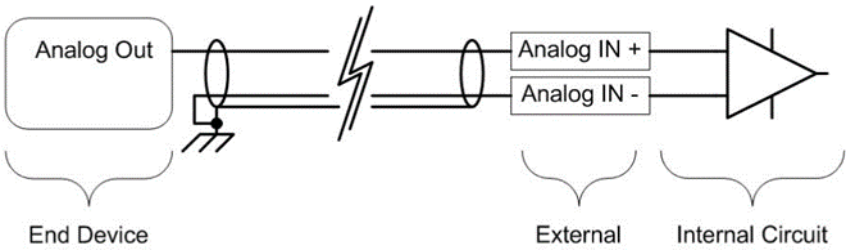


Figure 5-15: Differential inputs on single end device

5.4.4 ANALOG OUTPUT

The controller employs a single-ended output for both analog outputs. The Analog Common (pin 27) must be used as the return path for both outputs. The shield must be connected to the Analog Common pin at the controller and be left floating at the device end. The shield must not be used as the return path.

Note
For analog outputs the shield should be terminated to the analog com of the controller and left floating at the receiving end. It is advised that heat shrink be applied to the shield at the receiving side in order for it not to be left exposed.

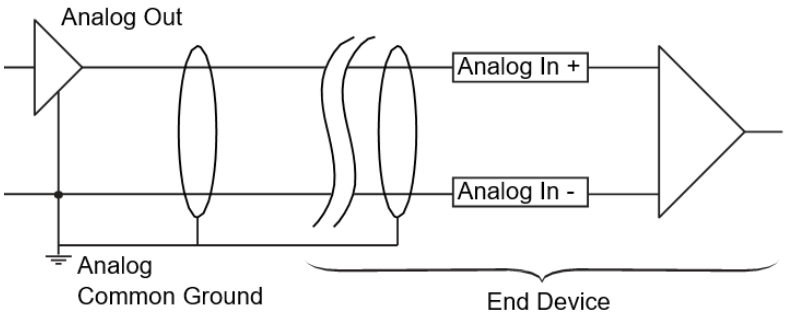


Figure 5-16: Analog Output

5.4.5 DIGITAL SIGNAL CONNECTIONS

5.4.5.1 Digital Input

The digital inputs operate with external dry contacts using the controller's digital power to drive the logic. A shielded cable must be grounded at one point either near the end device or on the controller's system ground.

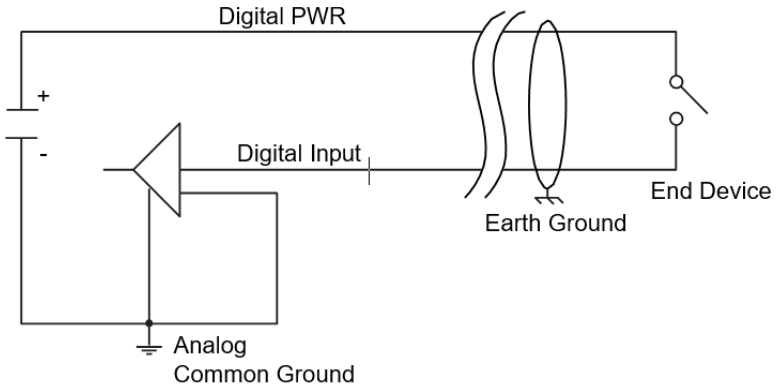


Figure 5-17: Digital Input

5.4.5.2 Digital Input HOA

The following is an example of a wiring connection for digital input Hand, Off, Auto connection.

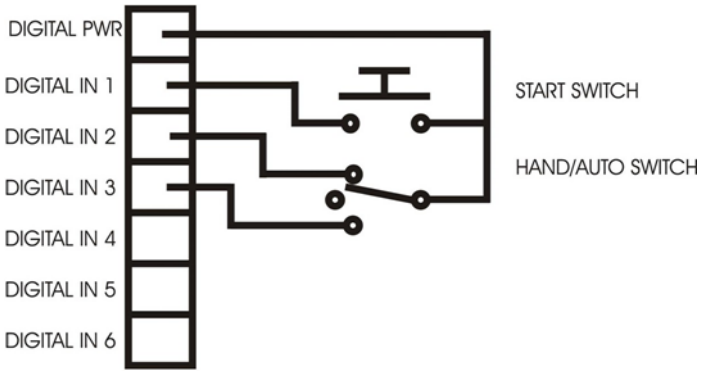


Figure 5-18: Digital Input HOA Wiring Connection

5.4.6 CONTROL CARD RS-485 WIRING CONNECTION

The control card has two external communication interfaces: RS-232 and RS-485. The RS-485 port is implemented in a 4-wire configuration and uses a terminal block connector. The RS-485 port is primarily intended for connections to VSDs or SCADA systems.

Table 5-7: Control Card Pin Assignment

PIN Number (top to bottom)	PIN NAME	FUNCTION
1	TX+	RS-485 Transmit Positive
2	TX-	RS-485 Transmit Negative
3	RX-	RS-485 Receive Negative
4	RX+	RS-485 Receive Positive
5	GND	Isolated Signal Ground (Connect the cable shield to this pin at the controller end only).

5.5 INSTRUCT EXPANSION CARDS INSTALLATION

Caution

Potential Severity: Light
Potential Loss: Assets
Hazard Category: Electrical

The INSTRUCT expansion cards are not hot-swappable. Power to the controller must be turned off prior to insertion of the card into an expansion card slot.

The INSTRUCT expansion cards are installed in the controller by removing the cover plate on one of the card slots and sliding the card firmly into the slot. The card should slide freely along the guides and be seated so that the faceplate is flush with the controller enclosure. The card thumbscrews should be tightened to hold the card in place but should not be used to seat the card.

Expansion card wiring should be performed in accordance with the specific requirements of that card.

For detailed installation procedures of the INSTRUCT ESP RS232/RS485 Communications Card, refer to the *Comm Card Installation Manual* (InTouch ID 6238940).

For detailed installation procedures of the INSTRUCT ESP Modbus TCP/IP Communications Card, refer to the *Modbus TCP Card Installation Manual* (InTouch ID 6470145).

For detailed installation procedures of the INSTRUCT ESP MVD Card, refer to the *MVD Card Installation Manual* (InTouch Content 4461916).

5.6 USB SERIAL DRIVER INSTALLATION

The following procedure describes how to install the USB-Serial driver required to communicate with the controller and StarView on a Windows machine (PC).

Caution

Potential Severity: Light
Potential Loss: Assets, Reputation
Hazard Category: Electrical

Do not connect the USB cable to the controller before it fully boots up. Otherwise, the controller may not be able to boot up successfully.
This is applicable to the installation of the USB Serial Driver and connection to the controller using StarView slot.

1. Power up the controller.
2. Using a USB 2.0 A-Male to B-Male, connect the PC to the controller port.

Note
After a few seconds, “Device driver software was not successfully installed” will be displayed.

Figure 5-19: Device Driver

3. Open the **Device Manager**. In the **Device Manager** under **Other Devices**, right-click on **CDC Serial** and select **Update Driver Software**. Click on “Browse my computer for driver software.”

Note
The controller should be recognized as a USB mass-storage device under My Computer. In the following figure the computer assigned the controller to disk “F.”

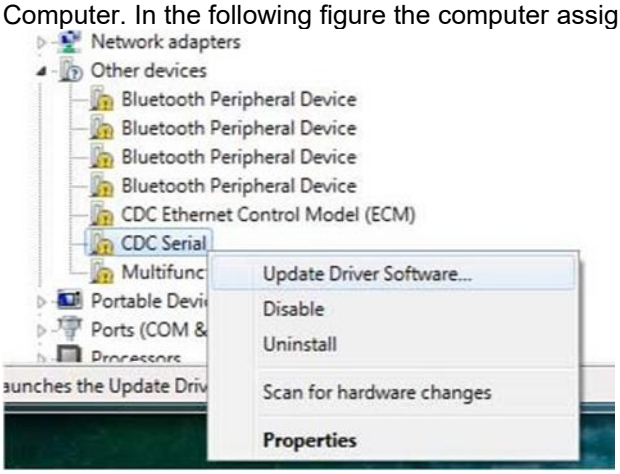


Figure 5-20: Update Driver Software

4. Select the appropriate disk to install the driver on the controller.

Figure 5-21: Select Appropriate Disk

Note
Windows will not be able to verify the publisher.

5. Select “Install this driver software anyway.”

Figure 5-22: Install Driver Software

6. Upon successful driver installation, in the **Device Manager**, a Gadget Serial (COMx) device will appear under the **Ports (COM & LPT)** section.

Figure 5-23: Gadget Serial (COMx)

7. Record the COM number before exiting the **Device Manager**.
8. If required, open StarView and use the COM number to configure a connection.

Note
Windows will request a new installation of the serial driver if using a new USB port on the same computer.

5.7 UPGRADING THE CONTROLLER EMBEDDED SOFTWARE (FIRMWARE)

5.7.1 UPDATING THE FIRMWARE WITH USB FLASH DRIVE

1. Download the latest Embedded Software Image (firmware) from InTouch Content ID 6145281.
2. Copy the **.fw** file onto a FAT32–formatted removable USB drive.

Note
The file cannot be renamed or it will not be recognized by the controller.

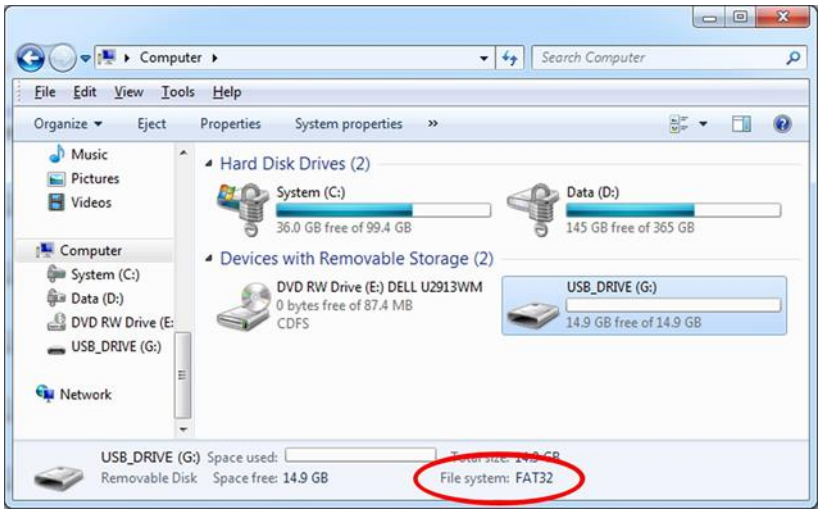


Figure 5-24: Removable USB Drive with FAT32 File System

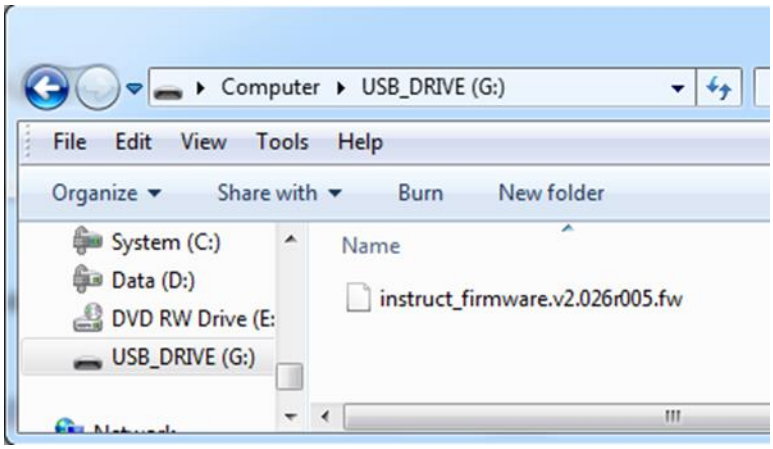


Figure 5-25: Firmware on Removable USB Drive

3. After the file has been copied to the removable USB drive, safely remove the USB drive.

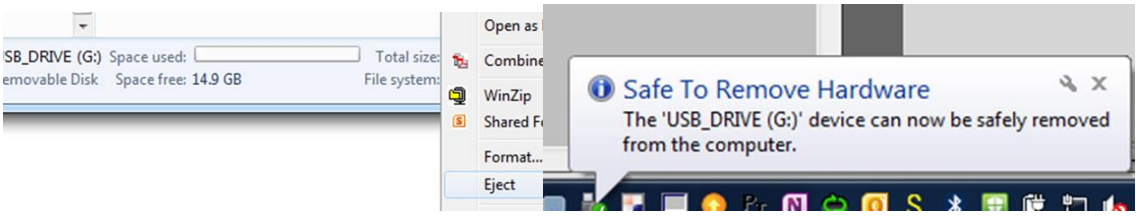


Figure 5-26: Safely Ejecting a Removable USB Drive

4. Insert the removable USB Drive into the controller.

5. Navigate to **Controller > Expert/Updates**.
6. Check the existing firmware version number. If it is below 2.103, you will need to prepare trending after the upgrade.

   After a few seconds the controller will display the latest available firmware on the USB drive.
7. Decide if the firmware upgrade should be applied on the next power cycle (default, no selection needed), or immediately after the file transfer progress has completed (check the box with **Reboot after image has updated**).
8. Once the selection has been made, select the **Update to USB Image** button. This process will take approximately 18 minutes. The controller will continue to protect a running drive during the firmware loading process and will only reboot and trip the drive if the **Reboot after image has updated** option has been selected.
9. Once the upgrade is complete and the controller has been rebooted, verify the new firmware version from the **Controller > Settings** screen.
10. If you have upgraded from a version lower than 2.103, you will need to prepare trends. This copies trend files from the old trend system and prepares the controller for the new trend system. Open StarView (version 5.2.62.r1972 or higher) and navigate to **Utilities -> Prepare Trending**.
11. Download the trend data by clicking **Read From Instruct**. Save the file on your computer.
12. Open the downloaded file by clicking **Open in Viewer** and check that the trend data is available.

5.7.2 UPDATING THE FIRMWARE WITH STARVIEW

1. Ensure that you have the latest version of the StarView installed. This can be found on InTouch Content 6031798. The earliest version that supports controller firmware upgrades is 5.2.181.2135.
2. With the controller fully booted (gauges visible on the Home screen), insert the USB A-B cable between your computer and the controller. Do not insert the USB cable before the controller is fully booted.
3. Open StarView and connect to the controller. See the **Quick Start Help** in the **Help** menu of StarView if you are not familiar with this process.
4. If this is the first time connecting a controller to the computer for firmware upgrades or downloading trends, you will need to configure the network. Under the **Utilities** menu, select **Instruct – Download** Trends. A window will appear for downloading data from the controller. Select **Utilities -> Configure Instruct Network**. When it is complete, you can close this window.

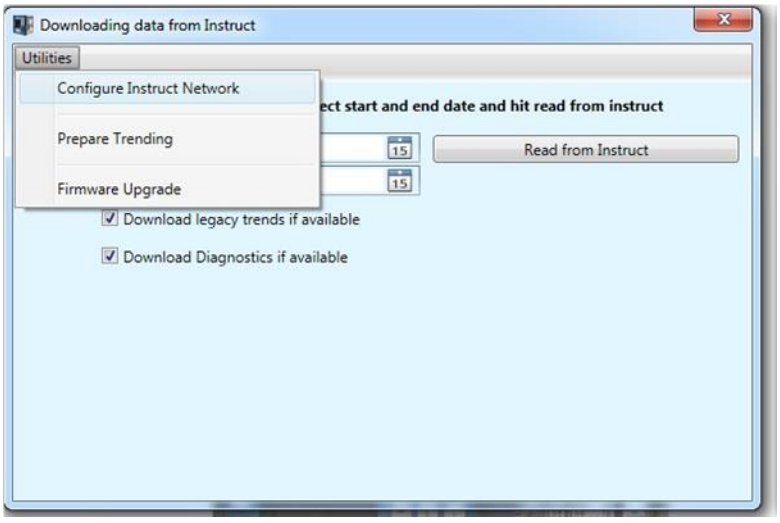


Figure 5-27: Configuring the Instruct Network

5. Click on the **Configuration** menu on the left-hand side of the screen and then click **Controller**. Check the existing firmware version number. If it is below 2.103, you will need to prepare trending after the upgrade. On the right-hand side of the screen, you will see **Upgrade Firmware** under the **Special Features** panel.

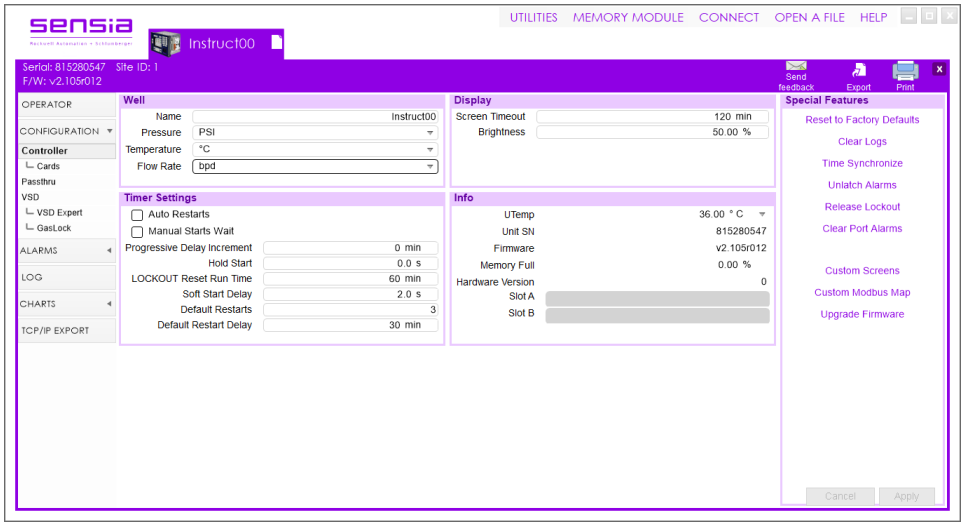


Figure 5-28: Configuration -> Controller Screen

6. Click on **Select FW** file. Choose the firmware file that you wish to apply to the controller.
7. Click **Start FW Upload**. The status of the upgrade is shown with the latest message at the top of the window.

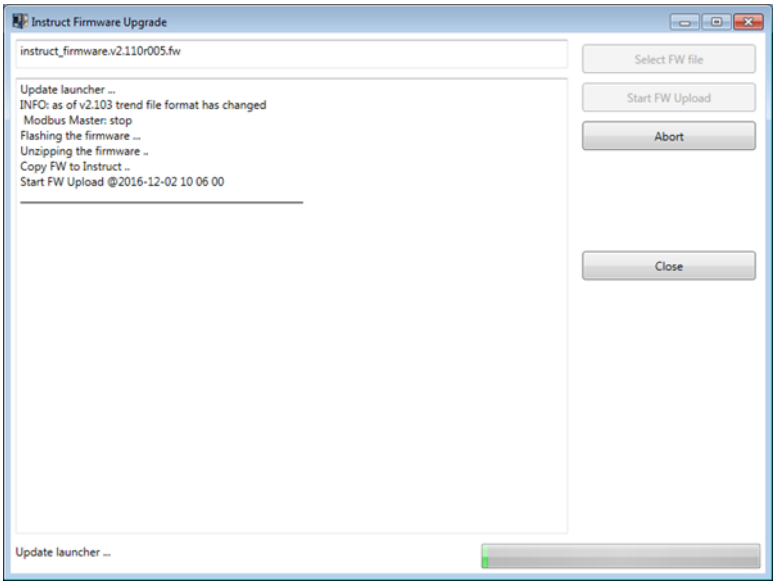


Figure 5-29: Firmware update in progress

8. The upload takes about 18 minutes. If you wish to abort the upgrade, click the **Abort** button.
9. Once finished, a pop-up window will appear indicating that the firmware upload is complete. Remove the USB cable from the controller and reboot the controller to apply the update.
10. If you have upgraded from a version lower than 2.103, you will need to prepare trends. This copies trend files from the old trend system and prepares the controller for the new trend system. Open StarView (version 5.2.62.r1972 or higher) and navigate to **Utilities -> Prepare Trending**.
11. Download the trend data by clicking **Read From Instruct**. Save the file on your computer.
12. Open the downloaded file by clicking **Open in Viewer** and check that the trend data are available

5.8 WORKING WITH WINDOWS 10

There is a known issue that StarView only partially works on Windows 10. The reason was the lack of a USB driver for the controller that works on Windows 10. A new USB driver that works on both Windows 7 and Windows 10 was implemented in the controller's firmware, known as the "new USB driver."

To comply with best practices, the USB device identifier of the controller had to be changed since the controller gets the USB device identifier from the firmware. controllers flashed with firmware v2.119r012 or later will advertise the new identifier. The significance is that the old USB driver that had been previously installed will fail to detect controllers flashed with firmware v2.119r012 or later, and StarView will not work correctly.

Please follow the installation guide described in InTouch Content 7424371. If you encounter any errors, refer to the troubleshooting guide.

Section 6: **Configuration**

This section contains configuration information and instructions for the controller systems, using the controller interface. For configuration instructions using a PC refer to the *StarView User Guide*. StarView is the software program used to interface the PC with the controller for configuration and diagnostics. This section assumes that the controller, expansion card(s), and latest firmware have been installed.

Tip
The menu dropdown can be navigated using either the numerical keypad or the navigation keys.

Caution

Potential Severity: Light
Potential Loss: Assets, Reputation
Hazard Category: Electrical

Do not connect the USB cable to the controller before it fully boots up. Otherwise, the controller may not be able to boot up successfully or the USB port will not be functional.

6.1 CONTROLLER SETTINGS

The controller settings screen displays the well settings, display settings, rating of unit, serial number, firmware version, hardware version, memory usage, etc.

To navigate to the controller settings screen using the controller:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **Controller** menu item, using either the numeric keypad or the up/down/left/right navigation keys on the keypad.

Figure 6-1: Controller Menu Tree

4. Select the **Settings** menu item.
5. Select the parameter using navigation keys. Press the **Enter** button to confirm selection.

6. Enter the parameter value. Press the **Enter** button to confirm value.

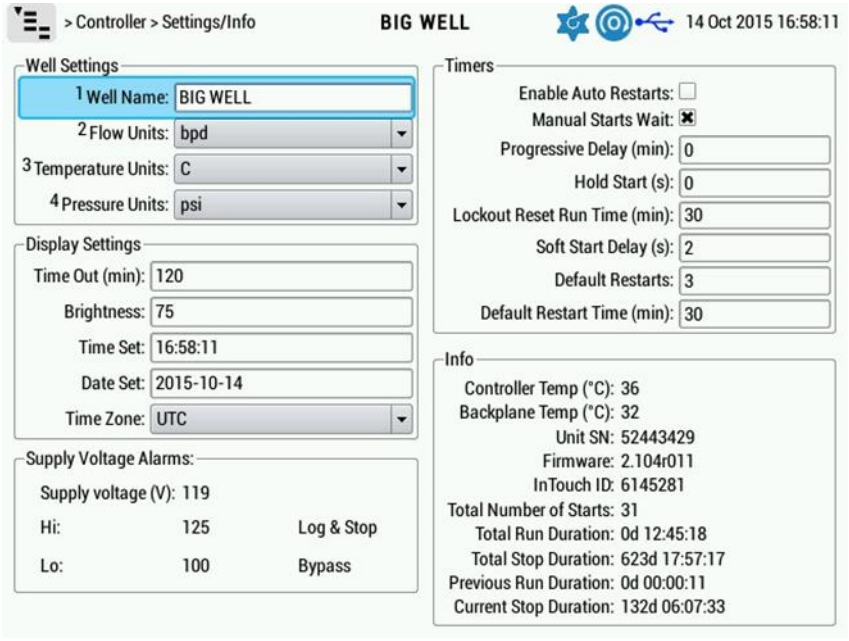


Figure 6-2: Controller Settings Screen

7. Repeat steps 5 to 6 for each required parameter.

The following are some of the settings that can be configured in the controller settings menu:

- Automatic start
- Well Settings (Well name, Flow Units, Temperature Units, and Pressure Units)
- Display-related settings
- Enable/Disable Auto Restarts
- Enable/Disable Manual Starts Wait
- Progressive Delay
- Hold Start
- Lockout Restart (Reset Run Time)
- Soft Start Delay
- Default Restarts

6.2 AUTOMATIC START

Automatic start is a controller function that will permit a start after the processing of a trip or alarm condition.

These parameters can be configured using the controller keypad or StarView. To configure the auto restart settings:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **Controller** menu item, using either the numeric keypad or the up/down/left/right navigation keys on the keypad.
4. Select the **Settings** menu item.

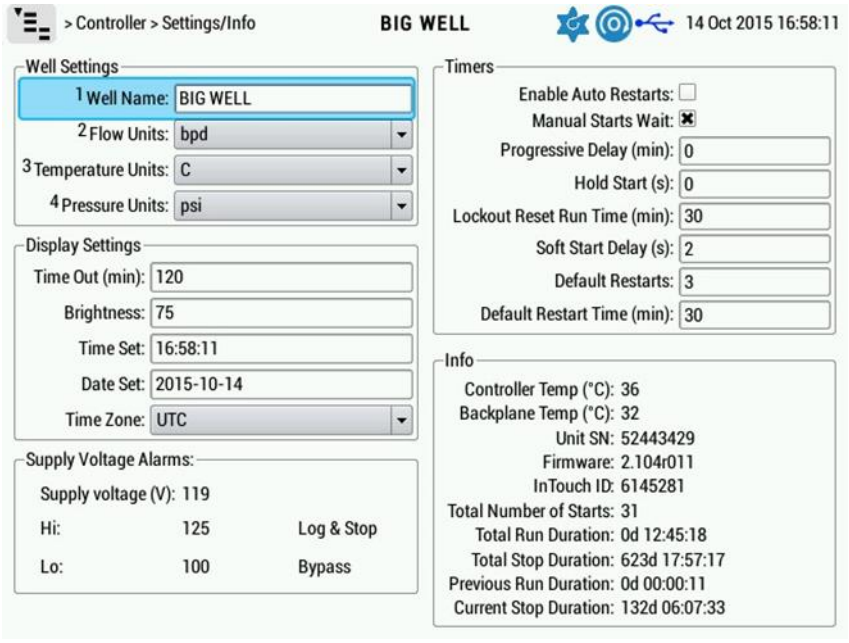


Figure 6-3: Controller Setting Screen

5. Select **Enable Auto Restarts**. Select the parameter using navigation keys. Press the **Enter** (√) button to confirm selection.
6. Select the auto restart parameters using navigation keys. Press the **Enter** (√) button to confirm selection.
7. Enter the auto restart parameters. Press the **Enter** (√) button to confirm value.

Note
For the Soft-start delay, one of the I/O Card's digital relay outputs (RL1, RL2, or RL3) must be configured to use this feature. Refer to the *6.6: Digital Output* section for details.

6.3 RELEASE LOCKOUT

This function is currently unavailable.

6.4 MOTOR AMPS

The controller displays motor load as a percent of rated motor current. This is on the motor name plate. To configure the motor rating:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **VSD** menu item, using either the numeric keypad or the up/down/left/right navigation keys on the keypad.
4. Select the **Configure** menu item.

Figure 6-4: VSD Menu Tree

5. Select the **Motor Rating** option using navigation keys. Press the **Enter** (√) button to confirm selection.
6. Enter the name plate rating. Press the **Enter** (√) button to confirm value.

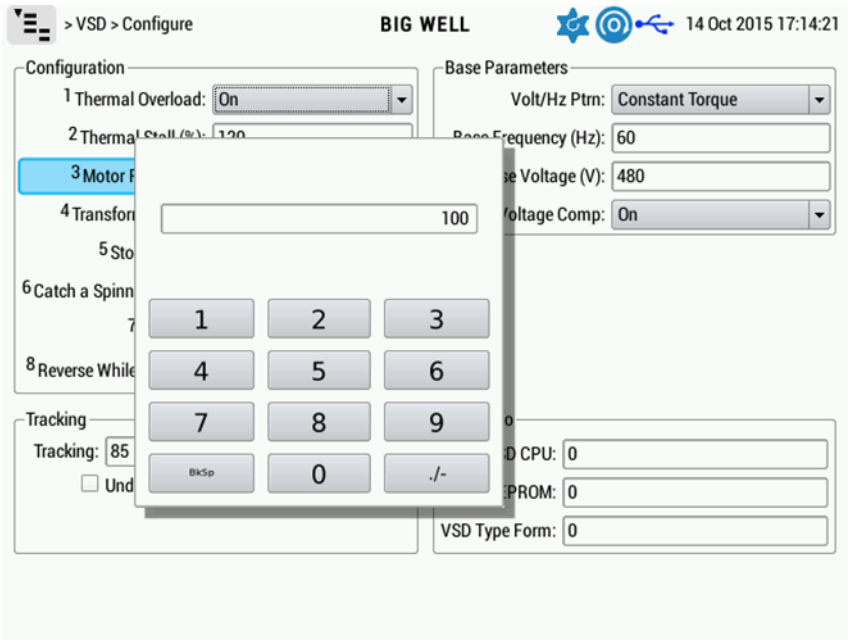


Figure 6-5: VSD Configure Screen

6.5 TREND SAMPLING TIME

The controller automatically logs data from a pre-defined list of I/Os. The default logging rates depend on the channel being logged, but these rates may be modified through the StarView software by setting a new value in the Sampling Time field presented on the **Charts > Live Trend > Change Rate** panel. Refer to the *StarView User Guide* (accessible by clicking **Quick Start Help** within the **StarView** menu bar) for details.

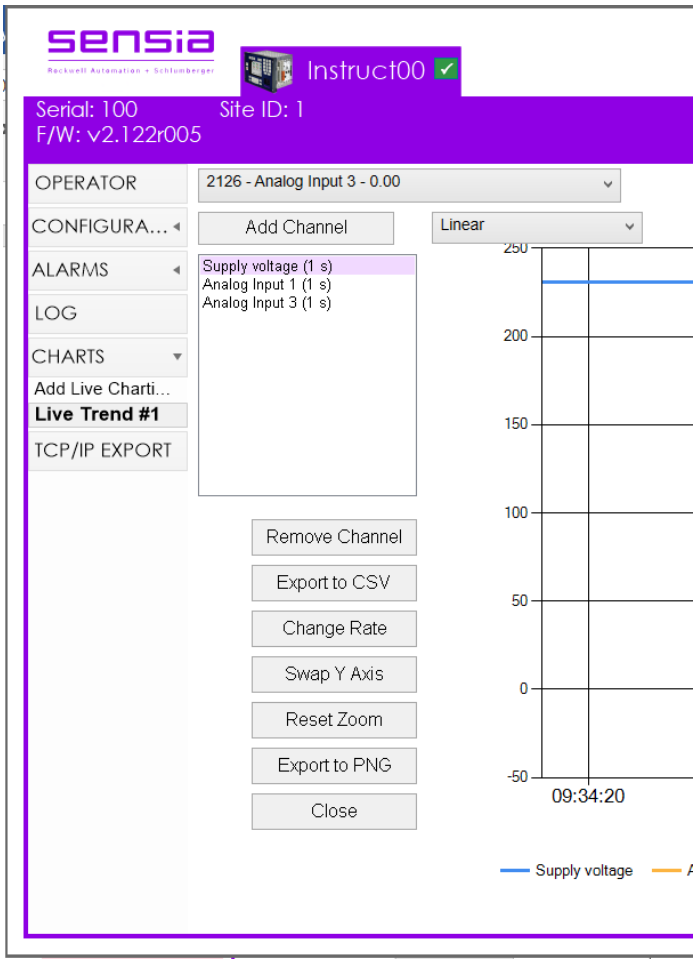


Figure 6-6: Configure Sampling Time in StarView

6.6 DIGITAL OUTPUT

All three digital outputs on the I/O card (RELAY1, RELAY2, and RELAY3) are configurable. The relays all have normally open and normally closed terminals.

To configure digital outputs:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **IO** menu item, using the keypad or navigation keys.
4. Select the appropriate **Slot** (Slot A or Slot B) menu item.

Figure 6-7: IO Menu Tree

5. Select the appropriate digital output using the navigation keys.

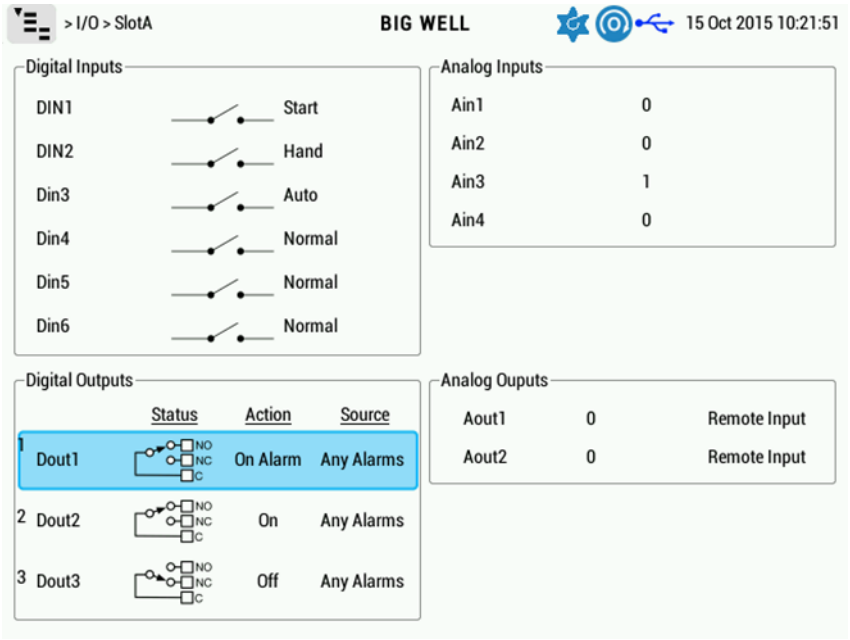


Figure 6-8: IO Screen (Digital Outputs)

6. Press the **Enter** (√) button to confirm selection and access the parameters.
7. Enter the parameter values using numerical keypad. Press the **Enter** (√) button to confirm each value.
8. Press the **Exit** (X) button to exit parameters screen.
9. Repeat steps 5 to 8 for each digital output.

6.7 ANALOG INPUT

The analog inputs are 0–10 VDC or 4-20 mA current loops that can be used to monitor external sensors and RTDs. The parameters can be configured using the controller keypad or StarView.

To configure analog inputs:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the IO menu item, using the keypad or navigation keys.
4. Select the appropriate **Slot** (Slot A or Slot B) menu item.

Figure 6-9: IO Menu Tree

5. Select the appropriate analog input using the navigation keys.

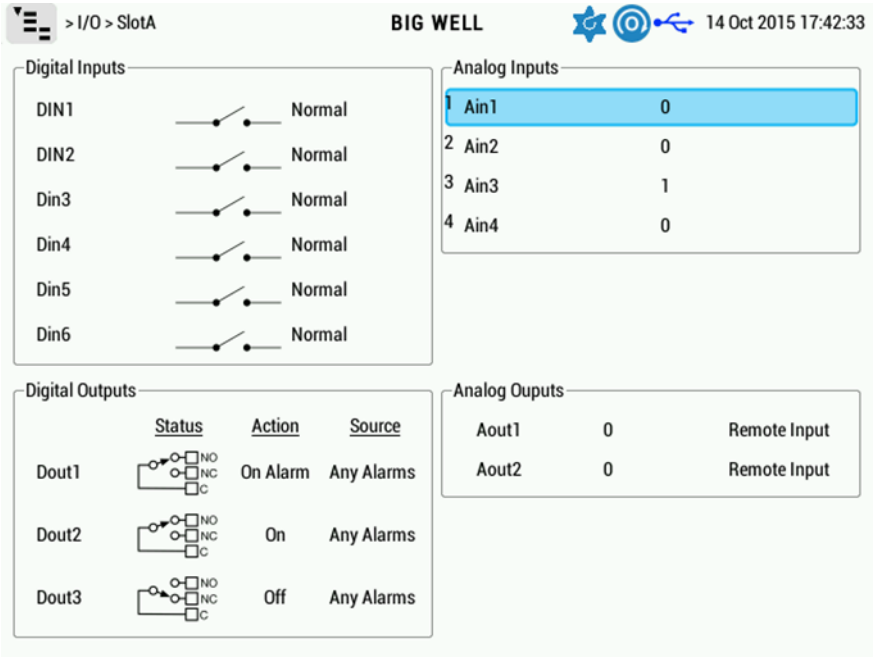


Figure 6-10: IO Screen (Analog Inputs)

6. Press the **Enter** (√) button to confirm selection and access the parameters.

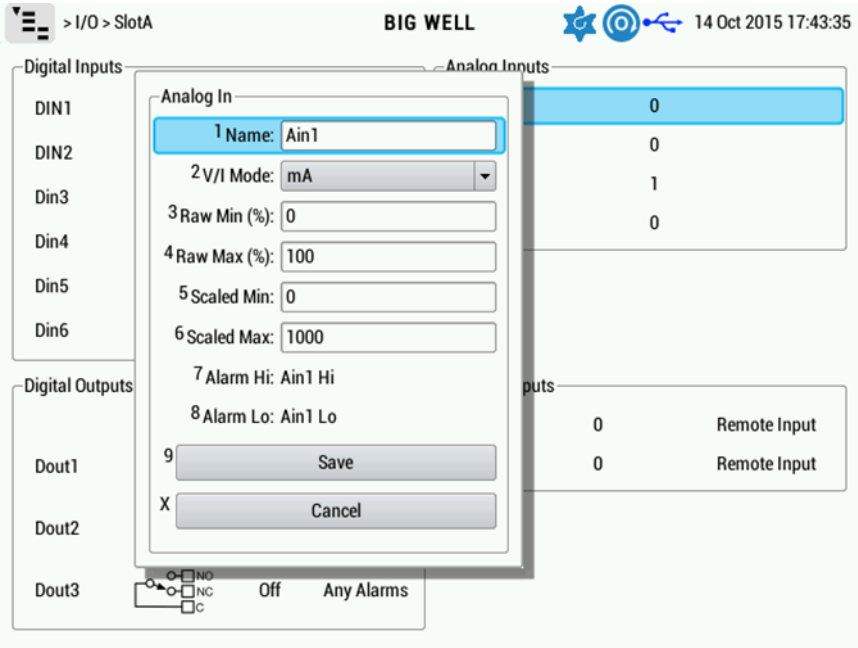


Figure 6-11: Analog Inputs

7. Enter the parameter values using numerical keypad. Press the **Enter** (√) button to confirm each value.
8. Press the **Exit** (X) button to exit parameters screen.
9. Repeat steps 5 to 8 for each analog input.

6.7.1 DECIMAL PLACES

Special care must be applied when using numbers and decimal places on the controller. The numbers are arbitrarily stored in the Modbus table / memory map based on the specific data type requirements.

The decimal point "." is not incorporated into the controller and values are displayed as determined from the data type in memory.

Example 1
Data type for frequency is XX.X. This is stored in memory as XXX with a type parameter to indicate a decimal place.

Example 2
For values expected to be XX.XX, the user settings on the controller would be XXXX.

To incorporate a decimal in the analog readings the user must perform the scaling. For analog data that become incorporated into additional controller controls as feedback parameters, i.e. surface pressure, speed settings, etc., the decimal values must be carefully evaluated to ensure that the analog data provided are in the expected scaling of the controller's feedback system.

6.7.2 ALARMS

Each analog channel has two alarms associated with it:

- the high setpoint alarm
- the low setpoint alarm

Each setpoint can be configured for an alarm action. Each of these alarms may be bypassed if not required.

Note
ESP mode supports alarming on the analog inputs.

Examples

Configuration of the analog input parameters using the controller can best be explained with the following examples.

Example 1: Sensor with 0 V reference
A pressure sensor measures 0-1000 psi and sends out a proportional 0-10 V signal.
Pressure gauge specification:

- 0 psi at 0 V
- 1000 psi at 10 V

There is a direct relationship to the controller analog input voltage and the Raw % range.

$$\frac{0V}{10V} \equiv \frac{0\%}{100\%}$$

Applying these two relationships results in:

$$\frac{0\%}{100\%} \equiv \frac{0\,psi}{1000\,psi}$$

These values correspond to the Scaled analog settings (Scaled Min and Scale Max).

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 0%
Scaled Maximum = 1000
Scaled Minimum = 0

Example 2: Sensor with 0mA reference
A temperature probe measures a 25-150 degC (77 to 302 degF) range on a 0-20 mA loop.
Temperature probe specifications:

- 25 degC at 0 mA
- 150 degC at 20 mA

There is a direct relationship to the controller analog input current and the Raw % range.

$$\frac{0mA}{20mA} \equiv \frac{0\%}{100\%}$$

Applying these two relationships results in:

$$\frac{25°C}{150°C} \equiv \frac{0\%}{100\%}$$

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 0%
Scaled Maximum = 150
Scaled Minimum = 25

Example 3: Sensor with two points, voltage mode
A pressure sensor measures 3000-12000 psi and sends out a proportional 1-5 V signal.
Pressure gauge specification:

- 3000 psi at 1 V

- 12000 psi at 5 V

Controller analog input specification:

- 0 to 10 V, 4096 discrete data points
- 1% accuracy

There is a direct relationship to the controller analog input voltage and the Raw % range:

$$\frac{0V}{10V} \equiv \frac{0\%}{100\%}$$

To restrict the display range to match that of the pressure sensor, the following ratio must be maintained.

$$\frac{1V}{5V} \equiv \frac{10\%}{50\%}$$

The 10% and 50% values are entered for the Raw % values.

$$\frac{10\%}{50\%} \equiv \frac{3000\,psi}{12000\,psi}$$

These values correspond to the Scaled analog settings.

Setting Summary:
Raw Maximum = 50%
Raw Minimum = 10%
Scaled Maximum = 12000
Scaled Minimum = 3000

A chart representing the data points is shown in Figure 6-12. The data are linear but do not equal zero at 0% full scale.

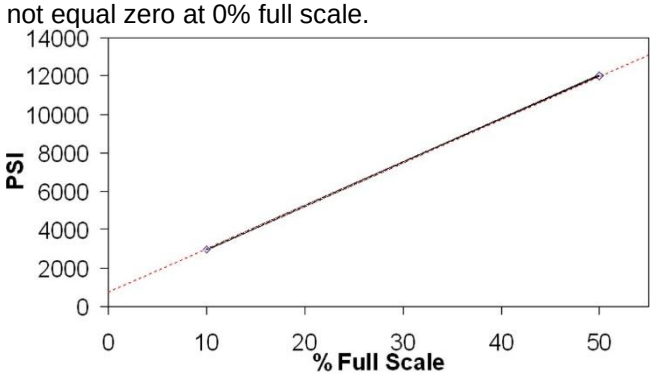


Figure 6-12: 10-50% vs 3000-12000psi

The resolution for this configuration follows this relationship:

$$\frac{100\%}{4096\,points} \equiv \frac{50\%}{x} \rightarrow x = 2048\,points$$

$$\frac{100\%}{4096\,points} \equiv \frac{10\%}{x} \rightarrow x = 409.6\,points \approx 410\,points$$

$$\therefore \frac{12000\,psi}{2048\,points} \Leftrightarrow \frac{3000\,psi}{410\,points} \rightarrow \frac{9000\,psi}{(2048-410)\,points}$$

$$\rightarrow \frac{9000\,psi}{1638\,points} = 5.49\,{}^{psi}\!/_{point}$$

The engineering units for this pressure transducer on the controller will have a resolution of approximately 5 psi.

Alarm trigger points can be set to client requirements.

Example 4: Sensor with two points, current mode

A temperature sensor generates a 4-15 mA signal to measure a 10-200 degC (50 to 392 degF) signal.

Temperature Sensor specifications:

- 10 degC at 4 mA
- 200 degC at 15 mA

Controller analog input specification:

- 4 to 20 mA (26 mA over-range or 130%), 4096 discrete data points. Determine how many points available within the 100% range.

$$\frac{20mA}{100\%} \equiv \frac{26}{130\%} \rightarrow \frac{130\%}{4096\text{points}} \equiv \frac{100\%}{3151\text{points}}$$

- 5% accuracy.

There is a direct relationship to the controller analog input current and the Raw % range.

$$\frac{0mA}{20mA} \equiv \frac{0\%}{100\%}$$

To relate 4 mA to the Raw % range:

$$4mA \rightarrow \frac{4mA}{20mA} \equiv \frac{x}{100\%} \rightarrow x = 20\%$$

To relate the 15 mA to the Raw % range:

$$15mA \rightarrow \frac{15mA}{20mA} \equiv \frac{x}{100\%} \rightarrow x = 75\%$$

For a loop current of 4 mA the temperature is 10 degC. For a loop current of 15 mA the temperature is 200 degC. This results in:

$$\frac{10°C}{200°C} \equiv \frac{20\%}{75\%}$$

Setting Summary:

Raw Maximum = 75%
Raw Minimum = 20%
Scaled Maximum = 200
Scaled Minimum = 10

The measurement resolution for this configuration follows the relationship:

$$\frac{130\%}{4096\,points} \equiv \frac{75\%}{x} \rightarrow x = 2363\,points$$

$$\frac{130\%}{4096\,points} \equiv \frac{20\%}{x} \rightarrow x = 630.15 = 630\,points$$

$$\frac{200°C}{2363\,points} \Leftrightarrow \frac{10°C}{630\,points} \rightarrow \frac{(200-10)°C}{(2363-630)\,points}$$

$$\rightarrow \frac{190°C}{1733\,points} = 0.109\,°C/point$$

The engineering units for this temperature transducer on the controller will have a resolution of approximately 0.11 degC.

6.8 DIGITAL INPUTS

The six digital inputs on the I/O card are used to monitor external switches for a status change. These status changes can be used to activate alarms. The following describes the basic alarm features of the controller. The digital input alarm has an additional parameter called Alarm On and can be configured either as open or closed.

OPEN	The alarm occurs when the switching power, from the DIGITAL PWR terminal, is not detected on the input terminal, i.e., the switch is open.
CLOSE	The alarm occurs when switching power, from the DIGITAL PWR terminal, is detected on the input terminal, i.e., the external switch has closed.

To configure digital inputs:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **IO** menu item, using the keypad or navigation keys.
4. Select the appropriate **Slot** (Slot A or Slot B) menu item.

Figure 6-13: IO Menu Tree

5. Select the appropriate digital input using the navigation keys.

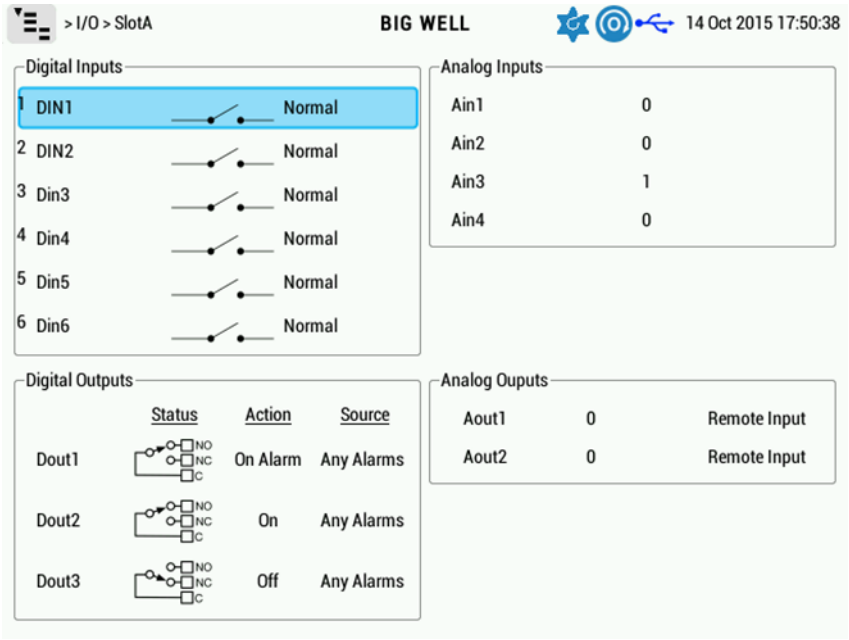


Figure 6-14: IO Screen (Digital Inputs)

6. Press the **Enter** (√) button to confirm selection and access the parameters.
7. Enter the parameter values using the numerical keypad. Press the **Enter** (√) button to confirm each value.
8. Press the **Exit** (X) button to exit the parameters screen.
9. Repeat steps 5 to 8 for each digital input.

6.8.1 DIGITAL INPUT HOA

The HOA (Hand, Off, Auto) parameters can be configured using the controller or StarView. The HOA parameters should correspond with the digital input HOA wiring installation.

To configure the digital inputs for HOA, select the digital input switch setting.

Note
Ensure the digital location of the HOA functions matches the wire connections to the switches.

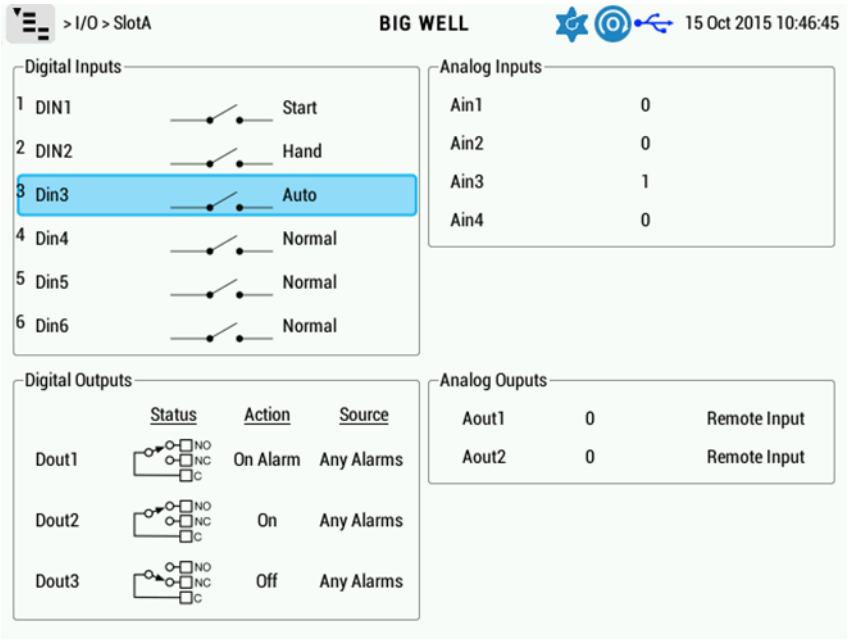


Figure 6-15: HOA Settings Example

6.9 ANALOG OUTPUT

The user analog outputs are 4-20 mA current loops that can be used by a SCADA system for external control of other devices like an electronic valve or meter. The output value may also be set from the controller keypad.

Caution

Potential Severity: Light
Potential Loss: Assets
Hazard Category: Machinery equipment hand tools

Failure to observe the following precautions may result in damage to the controller and connected equipment.

The controller provides current sourced analog outputs. The 4-20mA current loop must be referenced to Analog Common (I/O card pin 27).

The range and scale settings for the analog outputs operate in a similar manner to the analog inputs. The controller analog output currents are capable of 1 to 20 mA full scale.

To configure the analog outputs using the controller keypad:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **IO** menu item, using the keypad or navigation keys.
4. Select the appropriate **Slot** (Slot A or Slot B) menu item.

Figure 6-16: IO Menu Tree

5. Select the appropriate analog output using the navigation keys.

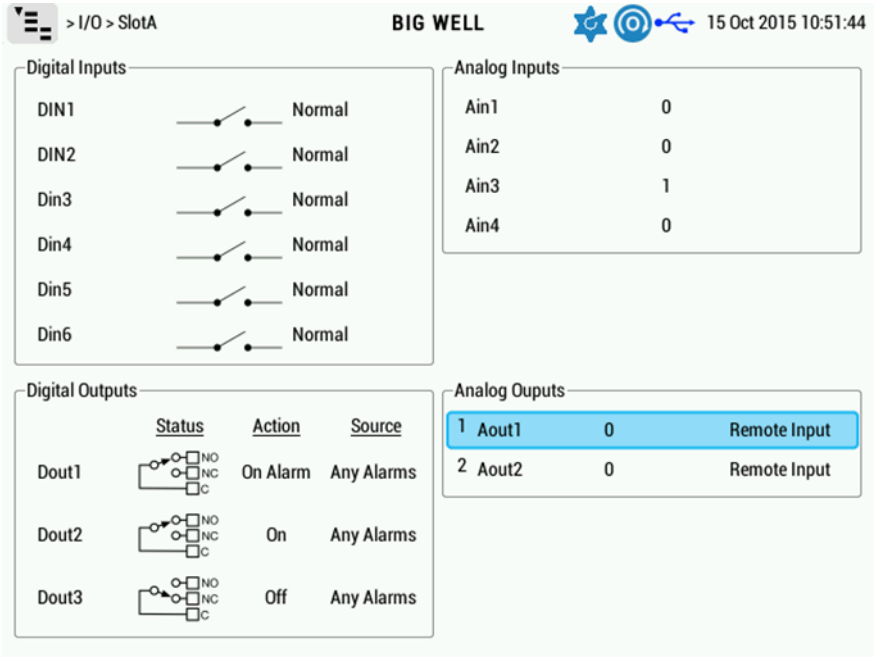


Figure 6-17: IO Screen (Analog Outputs)

6. Press the **Enter** (√) button to confirm selection and access the parameters.
7. Enter the parameter values using the numerical keypad. Press the **Enter** (√) button to confirm each value.

Note
The Source options only function when the application supports it. For example, Pump Intake Pressure is functional when a Schlumberger Phoenix Interface Card is installed.

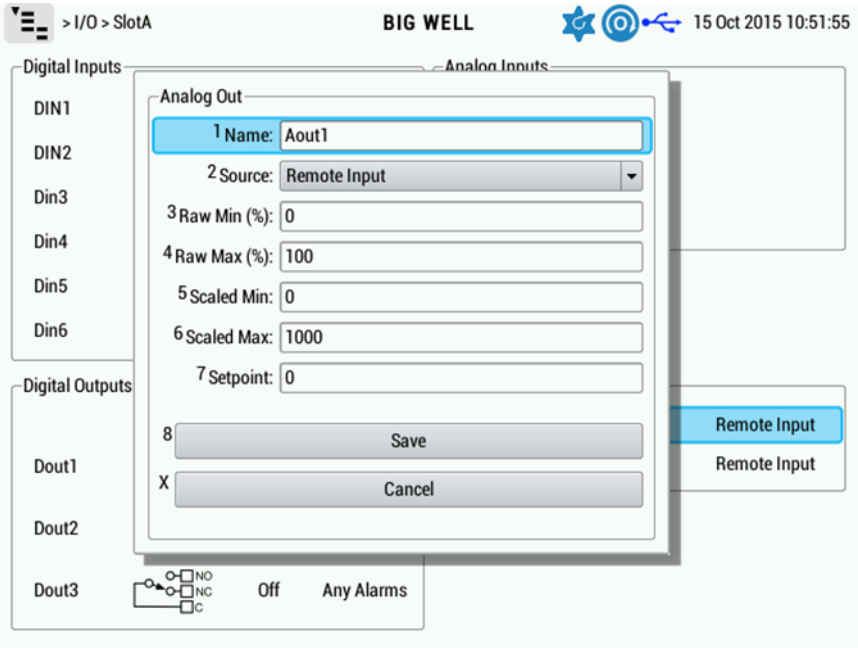


Figure 6-18: Analog Outputs Screen

8. Press the **Exit** (X) button to exit the parameters screen.
9. Repeat steps 5 to 8 for each analog output.

6.9.1 ALARMS

There are no alarm points associated with the analog outputs. These values are generated by the controller, not monitored like the input parameters, and therefore have no alarms.

Examples

The following examples demonstrate the use of scaling and manipulating raw values.

Example 1:
Average voltage mapped to 0-20 mA
The controller is operating with 120 VAC rated PT inputs. Map the 3-phase average voltage within a range of 0-200 VAC to represent 0-20 mA. Analog output requirement:

- 0 mA at 0 V
- 20 mA at 200 V

There is a direct relationship to the controller analog output current and the Raw % range.

$$\frac{0mA}{20mA} \equiv \frac{0\%}{100\%}$$

Applying these two relationships results in:

$$\frac{0\%}{100\%} \equiv \frac{0V}{200V}$$

These values correspond to the Scaled analog settings as shown below.

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 0%
Scaled Maximum = 200
Scaled Minimum = 0

Example 2:
Analog input mapped to analog output
The controller is operating with 120 VAC rated PT inputs. Map the 3 phase average voltage within a range of 0-200 VAC to represent 0-20 mA. Analog output requirement:

- 0 mA at 0 analog input
- 20 mA at 1000 analog input.

There is a direct relationship to the controller analog output current and the Raw % range.

$$\frac{0mA}{20mA} \equiv \frac{0\%}{100\%}$$

Applying these two relationships results in:

$$\frac{0mA}{20mA} \equiv \frac{0}{1000}$$

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 0%
Scaled Maximum = 1000
Scaled Minimum = 0

Example 3: Intake pressure mapped to analog output
Require a 4–20mA signal for a pressure range of 0 to 5000psi. Review of the Modbus register for the DHT tool indicates a decimal placement of X.X.

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 20%
Scaled Maximum = 50000
Scaled Minimum = 0

Example 4: Motor temperature mapped to analog output
Require a 4–20mA signal for a temperature range of 0 to 400F. Review of the Modbus register for the DHT tool indicates a decimal placement of X.X.

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 20%
Scaled Maximum = 4000
Scaled Minimum = 0

Example 5: Vibration mapped to analog output
Require a 4–20mA signal for a vibration range of 0 to 5G. Review of the Modbus register for the DHT tool indicates a decimal placement of X.XXX.

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 20%
Scaled Maximum = 5000
Scaled Minimum = 0

Example 6: VSD Running Frequency mapped to analog output
Require a 4–20mA signal for a frequency range of 0 to 90Hz. Review of the Modbus register for the DHT tool indicates a decimal placement of X.XX.

Setting Summary:
Raw Maximum = 100%
Raw Minimum = 20%
Scaled Maximum = 9000
Scaled Minimum = 0

6.10 INSTRUCT LIFT CONTROL SYSTEMS

INSTRUCT ESP Intelligent Controller supports INSTRUCT Lift Control Systems, including variable speed drives and fixed speed systems. The INSTRUCT Lift Control Systems and the INSTRUCT ESP Intelligent Controller should be configured and set up for operations according to the respective user manuals listed below:

1. *INSTRUCT E20P Intelligent VSD Manual* and *INSTRUCT ESP Intelligent Controller-E20P Intelligent VSD Configuration Manual* (InTouch 7275535)
2. *INSTRUCT ESP Switchboard Manual* and *INSTRUCT ESP Intelligent Controller-ESP Switchboard Configuration Manual* (InTouch 4128912)
3. *INSTRUCT ES7 Intelligent VSD and INSTRUCT ESP Intelligent Controller-ES7 Intelligent VSD Configuration Manual* (InTouch 4197006 and 4933237)
4. *INSTRUCT E30 Intelligent VSD Manual* and *INSTRUCT ESP Intelligent Controller-E30 Intelligent VSD Configuration Manual* (InTouch 7743254)
5. *INSTRUCT M21 Intelligent MVD Manual* and *INSTRUCT ESP Intelligent Controller-M21 Intelligent MVD Configuration Manual* (InTouch 4027643)

6.11 POWER MONITORING

The controller can also be used for INSTRUCT Lift Control Systems power monitoring. For details, please refer to: Power Analyzer Card for VSD Power Monitoring (InTouch 7700594).

6.12 EXPANSION PORT

The expansion port parameters can be configured using the controller or StarView. Detailed configuration requirements can be found in each expansion card section.

To configure the expansion port:

1. Press the **Menu** key.
2. Select **Controller**, using the keypad or navigation keys.
3. Select the **Slot**. Select **Slot 1–4** depending on which slot contains the card.

Figure 6-19: Configure Menu Tree

4. Enter the slot/card parameters. The communications configuration screens are generic for all communications settings.

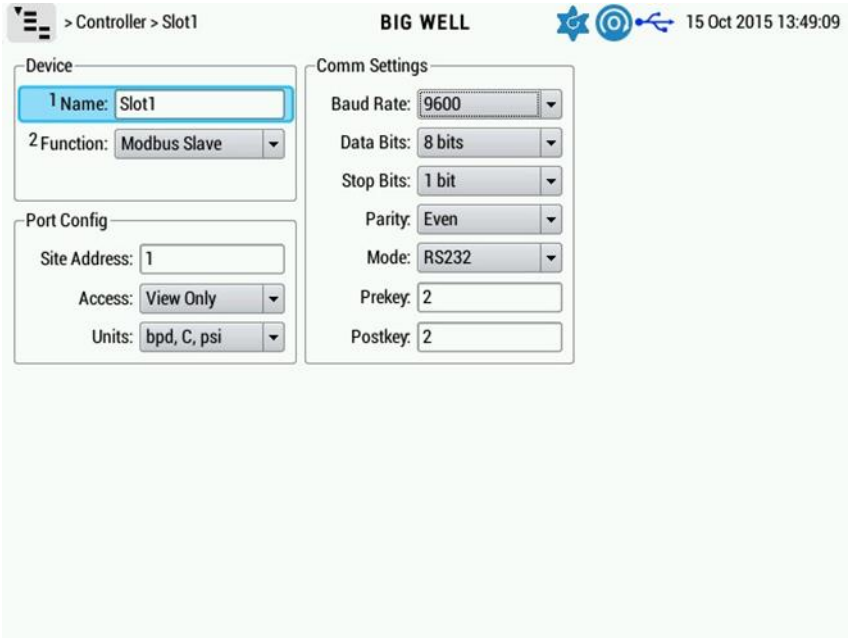


Figure 6-20: Slot Configuration Screen

6.13 SLOT A/B

The Slot A/B alarms can be configured with the following steps:

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **Controller** menu item.
4. Select the **Slot A/B** menu item.

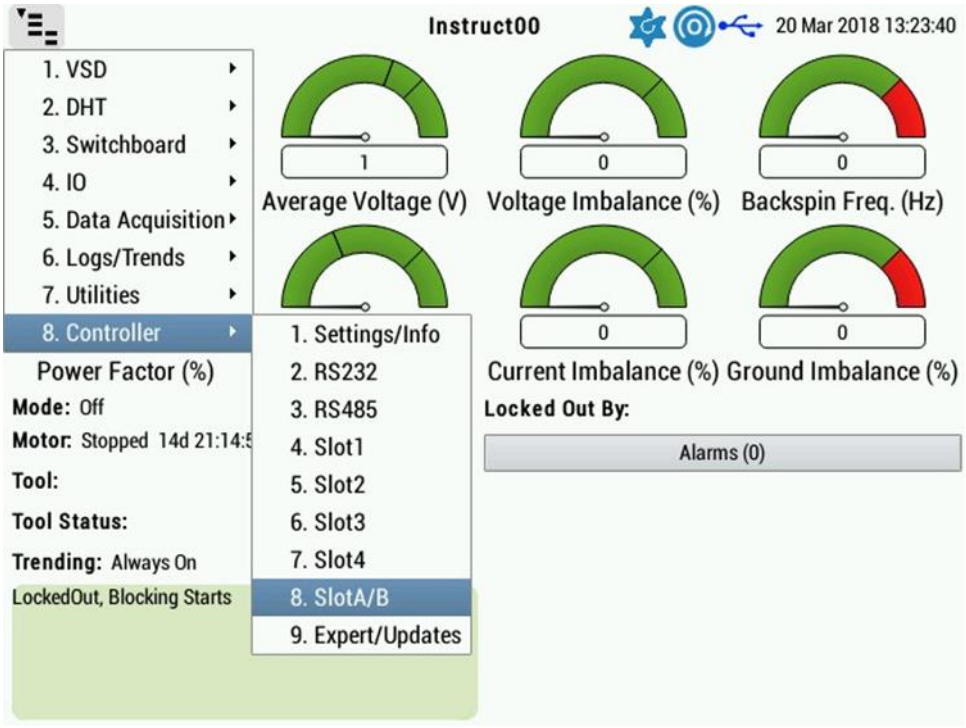


Figure 6-21: SlotA/B Menu Tree

Figure 6-22: SlotA/B Screen

5. Set the **Action** field as the intended action to be taken, when the **Expected HW** field setting is different from the HW detected by the controller. It can be individually configured for both Slot A and Slot B, as Bypass, Log, Stop, Stop & Log.

Figure 6-23: SlotA/B Action

Note
If the **Action** field is set to Bypass, Slot A/B alarm will not be triggered in any case. It should be set to Bypass, only if the application does not require Slot A/B alarm under any situation.

6. Set the **Expected HW** field to comply with the type of card physically inserted into the respective Slot. It can be individually configured for both Slot A and Slot B, as None, Any, IO Card, SWB card. If the **Expected HW** field setting does not match with the card detected by the controller, or if the card in Slot A or Slot B malfunctions, an alarm is raised for the respective slot. The action taken by the controller for this alarm will depend on the setting in the **Action** field.

Figure 6-24: SlotA/B Expected HW

Table 6-1: Expected HW Options

S. No.	Option	Description
1.	None	No card shall be inserted

S. No.	Option	Description
2.	Any	Either of the cards can be inserted.
3.	IO Card	IO card shall be inserted.
4.	SWB Card	SWB card shall be inserted.

7. Set the Trip Time (s) to define a definite delay (in seconds) before stopping the drive. In case of a Slot A/B alarm, the time delay can provide a window for an application-specific corrective action (e.g., manual intervention) before stopping the drive. The delay holds a significance only if the **Action** field is either set to Stop or Stop & Log, as the drive will not be stopped in other cases.

6.14 CONTROLLER STATISTICS

The Controller Statistics features are available in FW 2.117r002 and later versions. The **Statistics** screen is under Controller **Menu-> Controller-> Statistics**.

Figure 6-25: Controller Statistics

The following functions are available.

- Clear All Statistics: resets all the historical statistics to zero including all the data in the Totals group, together with the resettable start counter and all four daily run timers in the Other group. This function can only be used when the controller is set to Manual Off mode. Please note that the statistics displayed in the Totals group is the same information that is available in the Controller **Menu -> Controller -> Settings/Info** screen, which would also be reset.
- Clear Resettable Start Count: resets the Resettable Start Counter in the Other group to zero. Note the Total Number of Starts in the Totals group will be unaffected by this reset. This function can only be used if the controller is set to Manual Off mode.

The following setting is available:

- Daily Timer Start Hour: specifies the hour when all four daily timers will roll over, and today's timer will start again at zero; note that the valid range is 0 – 23. For example, if the setting is 7 then every day at 07:00:00 the Daily Run Time – Today will start again at zero. The value previously displayed in Daily Run Time – Today will roll over to Daily Run Time – Yesterday.

The following statistics are available:

- Total Number Of Starts: the total number of start commands issued from the controller since the last time this statistic was cleared.
- Total Run Duration: the total amount of time the VSD/SWB has been running

- Total Stop Duration: the total amount of time the VSD/SWB has been stopped. Please note that any time the controller is powered down will be included as stop time.
- Previous/Current Run Duration: the amount of time that the VSD/SWB was or has been continually running since the most recent start attempt. The controller display will show Current or Previous depending on whether the VSD/SWB is currently running or not.
- Previous/Current Stop Duration: the amount of time that the VSD/SWB was or has been continually stopped, since the most recent stoppage. Note that the period when the controller is powered down will be included as stop time. The controller display will show Current or Previous depending on whether the VSD/SWB is currently stopped or not.
- Resettable Start Counter: the number of start attempts since this statistic was last cleared
- Daily Run Time – Today: the amount of time the VSD/SWB has run in the last 24 hours, as defined by the Daily Timer Start Hour setting
- Daily Run Time – Yesterday: the amount of time the VSD/SWB ran yesterday
- Daily Run Time – 2 Days Previous: the amount of time the VSD/SWB ran two days ago
- Daily Run Time – 3 Days Previous: the amount of time the VSD/SWB ran three days ago

Example

When the Daily Timer Start Hour is adjusted, the daily timers are not immediately affected. Daily Run Time – Today will continue to accumulate until the newly set start hour is reached, at which time all the timers will roll over as usual.

This could, therefore, cause the daily timer to count either less or more than a full 24 hours even if the system were running uninterrupted the entire time, depending on the setting change and when it occurred.

- Suppose the controller was set to roll over at 7:00 am and at 7:30 am the Daily Timer Start Hour was changed to 8:00 am. At 8:00 am, the timers would roll over as usual, thereby resulting in a daily run time of 1 hour.
- Suppose the controller was set to roll over at 7:00 am, and at 6:30 am the Daily Timer Start Hour was changed to 6:00 am. If the controller runs uninterrupted the entire time, the timers would roll over at 6:00 am the next morning. The result would be a daily run time of 47 hours.

Note

In a similar fashion, when the controller system time is adjusted, or if the controller was reset to factory defaults, the timers are not immediately affected. After a factory reset, the Daily Timer Start Hour is set to default, which is 0 (i.e., midnight).

Example

The controller will count time even when it is powered off, and therefore will roll the timers.
If the controller was powered off for one full day, the timers will all roll over once, with Daily Run Time – Today becoming zero. If the controller is powered off continuously for more than four days, all the timers would be zero.

6.15 SLOT WATCHDOG

The Slot Watchdog is configured in the **Slot x** configuration screens **Menu > Controller > Slot X**, as shown in Figure 6-26: Configuring Watchdog.

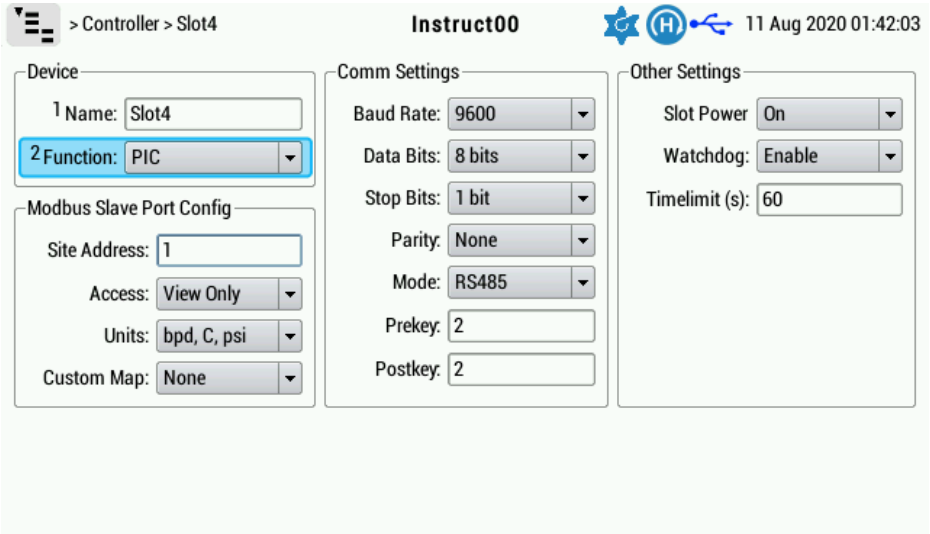


Figure 6-26: Configuring Watchdog

Note

The watchdog feature only supports the slot functions PIC and ICD1. If the slot is assigned to a non-supported function, the watchdog will remain inactive even if it was enabled. However, the manual slot power control is available for all slot functions and can be changed by the operator at any time.

6.15.1 WATCHDOG PARAMETERS

The following parameters are available for operator configuration:

- **Slot Power**
  - *On* means that the slot power will available.
  - *Off* means that the slot power will be removed.
  - *Cycle* means that the slot will have its power removed for a short period of time, and then automatically re-enabled. It is the equivalent of manually turning the power off and then back on.
- **Watchdog**
  - *Enable* means that the watchdog will be enabled for this slot.
  - *Disabled* means that the watchdog will be deactivated.

Note

Note the watchdog must detect communication traffic in both directions before it actually becomes active.

- **Timelimit**
  - The amount of time in seconds that the watchdog will allow communications to stall before cycling power. For PIC, it is recommended to use a short period like 30 – 60 seconds. For ICD1, it is recommended to use a longer period of 120 – 180 seconds.

6.15.2 USER INDICATIONS

When the Slot Watchdog cycles the power to a slot, it will generate a latch (as indicated in Figure 6-27: Watchdog Alarm Latch below with the yellow icon).

Figure 6-27: Watchdog Alarm Latch

The latch can be cleared by the usual methods for unlatching alarms in the controller. The simplest way is to press the green **Start** button once to bring up the **Start** popup at the bottom of the screen. Then press the **4** key, which is the **Unlatch** shortcut key.

When the watchdog is armed, it means that it is actively monitoring the serial communication traffic and will cycle the slot power if the time limit is exceeded. This is indicated in the green marquee area in the lower left corner of the controller's home screen, shown in Figure 6-28: Watchdog Arm Indication.

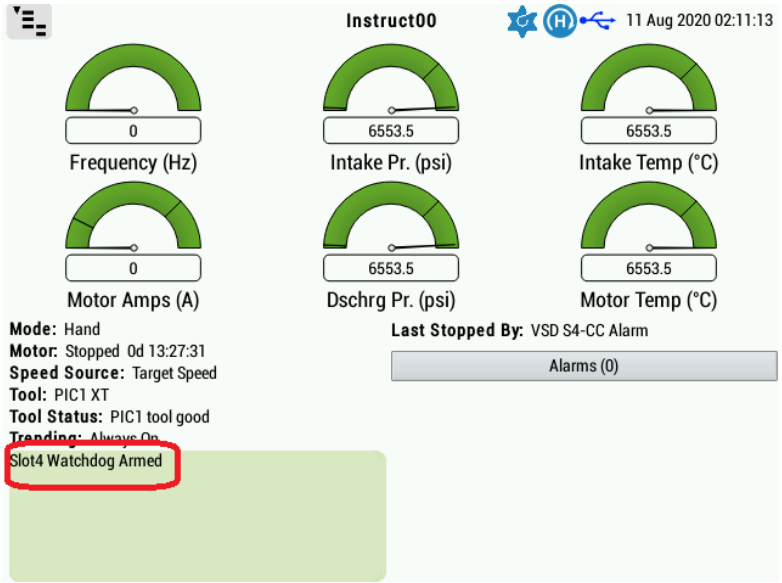


Figure 6-28: Watchdog Arm Indication

If this message does not appear, it means that the slot watchdog is disarmed, i.e.: not monitoring the serial traffic. When in a disarmed state, the watchdog will never cycle the slot power. Please check the configuration and ensure that the installed card is functioning and communicating, if the intent is to have the watchdog monitoring the system.

In the case of a PIC card, it takes about 15 seconds for it to be able to respond to the controller after a power cycle (this is when the PIC COMM alarm should clear). Since the controller is always attempting to communicate with the PIC, it is expected that the watchdog should be able to arm itself within this time.

If a slot has been manually powered down, this will be indicated in the green marquee area in the lower left corner of the controller's home screen, shown in Figure 6-29: Slot Power Down.

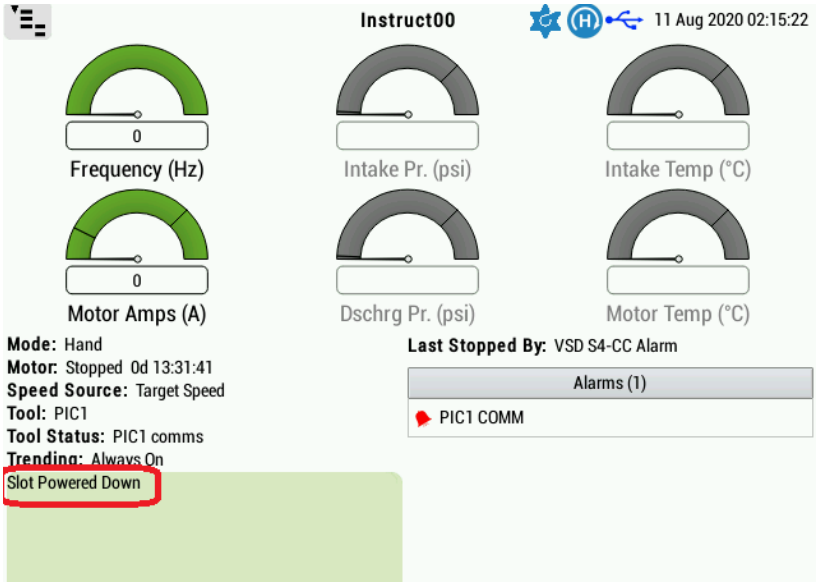


Figure 6-29: Slot Power Down

If this message does not appear, it means that all slots are currently powered up.

Section 7: **Operations**

7.1 STARVIEW-ENABLED AND STARVIEW-CONIGURED FEATURES

Several controller features require the StarView PC software for configuration or viewing. Users should familiarize themselves with the list of features that require StarView for configuration or viewing and ensure a PC with StarView is available for any cases where these features must be utilized.

Table 7-1: StarView-Enabled and StarView-Configured Features

Feature Name	Feature Function	StarView Implementation
Log & Site File Retrieval	Enables users to download and save the site logs and site configurations to their local PC	Required to initiate log and site file download. Site file saved with Export option in StarView; logs exported using Export to CSV option
Applying StarView STE File	Allows a saved site file to be applied to a controller. This will apply the saved configuration/settings to the controller.	Required to apply site (STE) file
Shutdown Curves	Enables a shutdown curve to be configured so that trip times may be more precisely controlled based on the magnitude of the high current alarm	Required to view and adjust shutdown curves in the **Alarms>VSD>Motor Current HI** screen
VSD Underload Tracking	Enables the VSD to adjust the underload trip point over time based on nominal operating parameters	Required to enable this option in the **Alarms > VSD > Tracking** screen
Runtime Statistics	Indicates runtime statistics such as total runtime, total of time, and number of starts	Statistics are shown in the **Operator** screen
Schlumberger Phoenix Gauge Diagnostics Screen	Lists diagnostic parameters from the Schlumberger DHT board. The parameters include supply voltage, regulated and unregulated voltages, and remote sensor currents.	Available in the **Configuration > Phoenix DHT > Gauge Diagnostics** screen

7.2 BEHAVIOR AND FEATURE DIFFERENCES BETWEEN UNICONN AND INSTRUCT ESP INTELLIGENT CONTROLLER

Refer to the latest *Firmware Release Notes* (InTouch ID 6145281) for the latest differences between the UniConn and the INSTRUCT ESP Intelligent Controller.

7.3 CHARTING AND TRENDING

7.3.1 CHART TRENDS

The **Charting** screen allows up to eight channels of data to be displayed simultaneously, in real time.

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.

3. Select the **Logs/Trends** menu item using either the numeric keypad or the up/down/left/right navigation keys on the keypad.
4. Select the appropriate **Chart Trends** menu item.

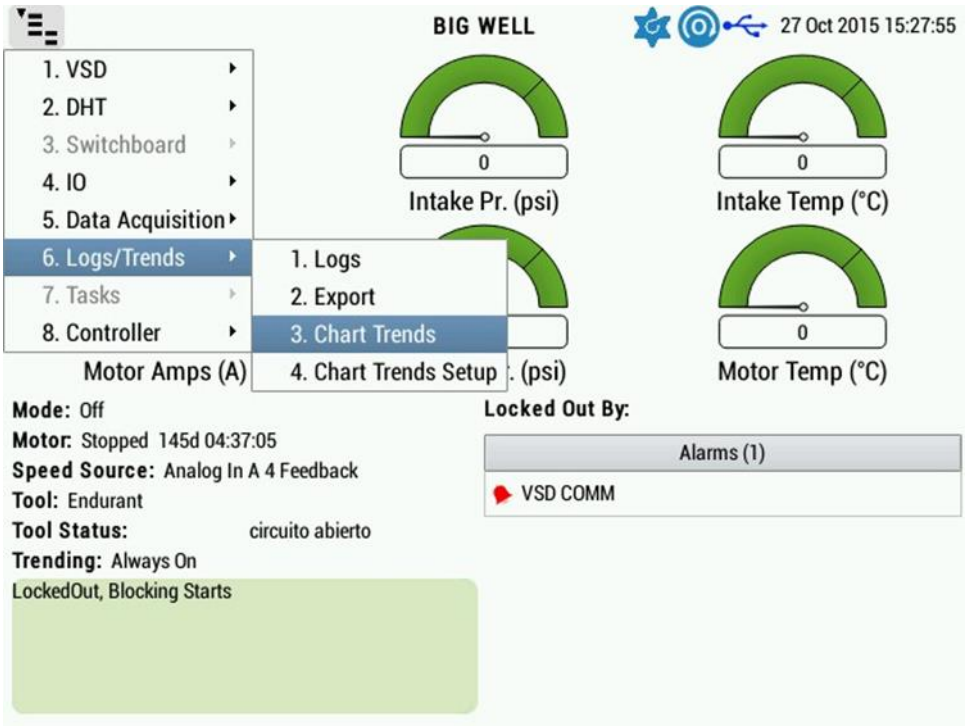


Figure 7-1: Chart Trends Menu Tree

7.3.1.1 Real Time Charting

By default, real-time charting is enabled. The user can pause and resume the chart. The chart can be reconfigured by selecting the **Configure** button to go to the **Chart Trends Setup** screen.

In the top-right corner are the channel names and their current values. In the bottom right-hand corner are the value ranges, per division, for each channel. The chart display has 10 divisions both across and up and down. The minimum and maximum range displayed on the chart, for each channel, is shown on the left-hand side at the bottom and top.

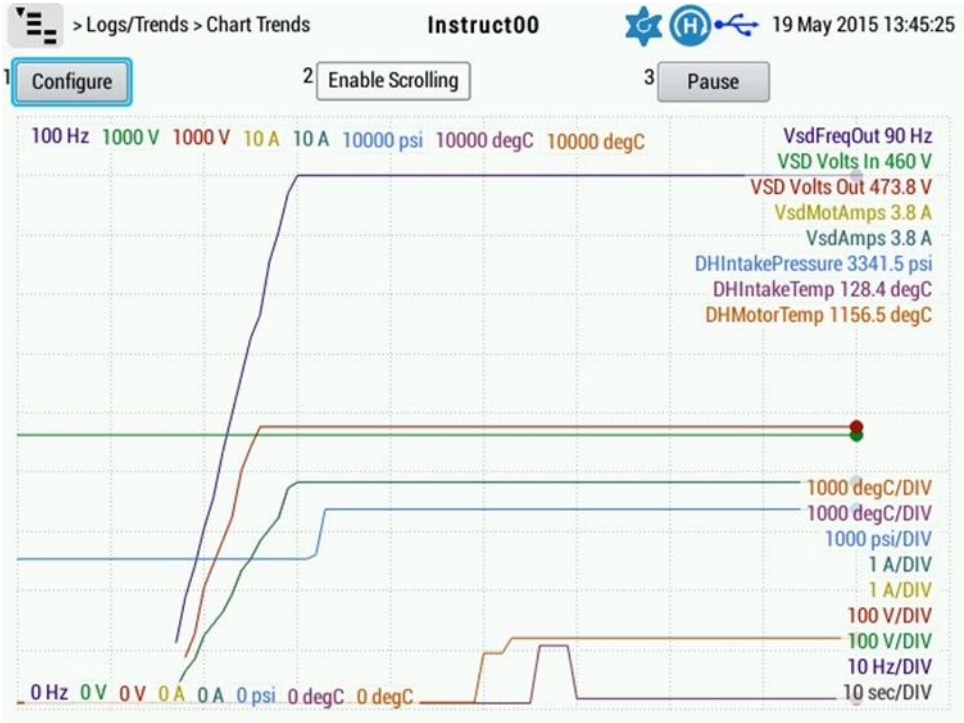


Figure 7-2: Charting Screen

7.3.1.2 Chart Scrolling

Select the **Enable Scrolling** button to change the input mode and allow the chart to be scrolled using the left and right arrow keys. You can zoom in and out of the chart using the up and down arrow keys. As the image is scrolled, the values of the cursors on the center line are displayed in the top right corner of the chart.

Disable scrolling by selecting the **Enable Scrolling** button again.

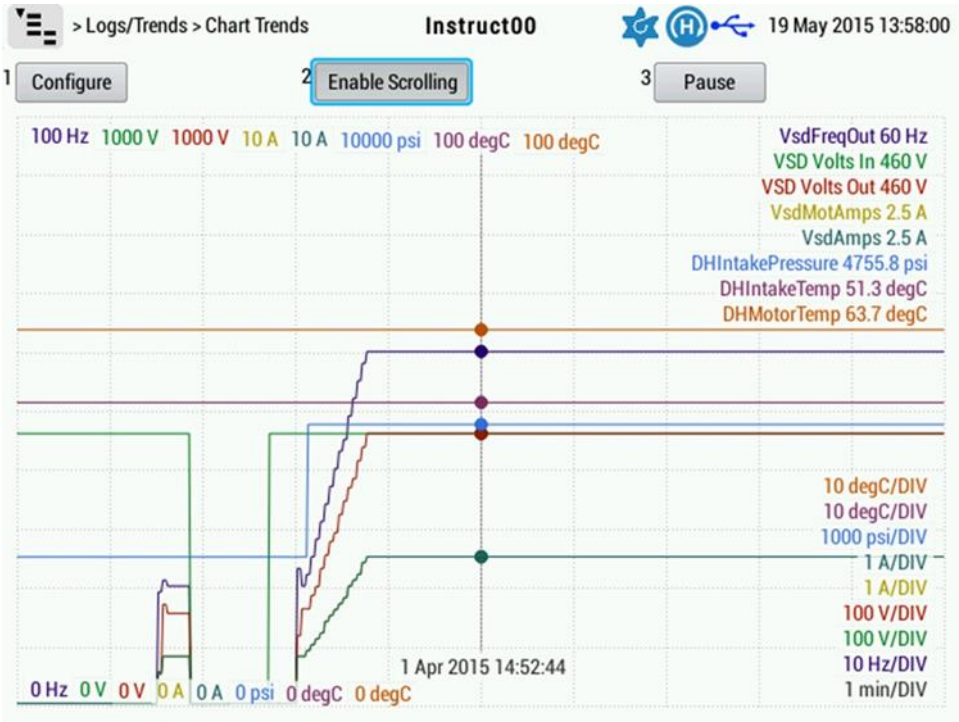


Figure 7-3: Chart Scrolling

Charting can be paused by selecting the **Pause** button. Select the **Pause** button again to resume charting.

Note
When the **Pause** button is selected to pause charting, it changes to a **Resume** button.

7.3.2 CHART TRENDS SETUP

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **Logs/Trends** menu item using either the numeric keypad or the up/down/left/right navigation keys on the keypad.
4. Select the appropriate **Chart Trends** menu item.

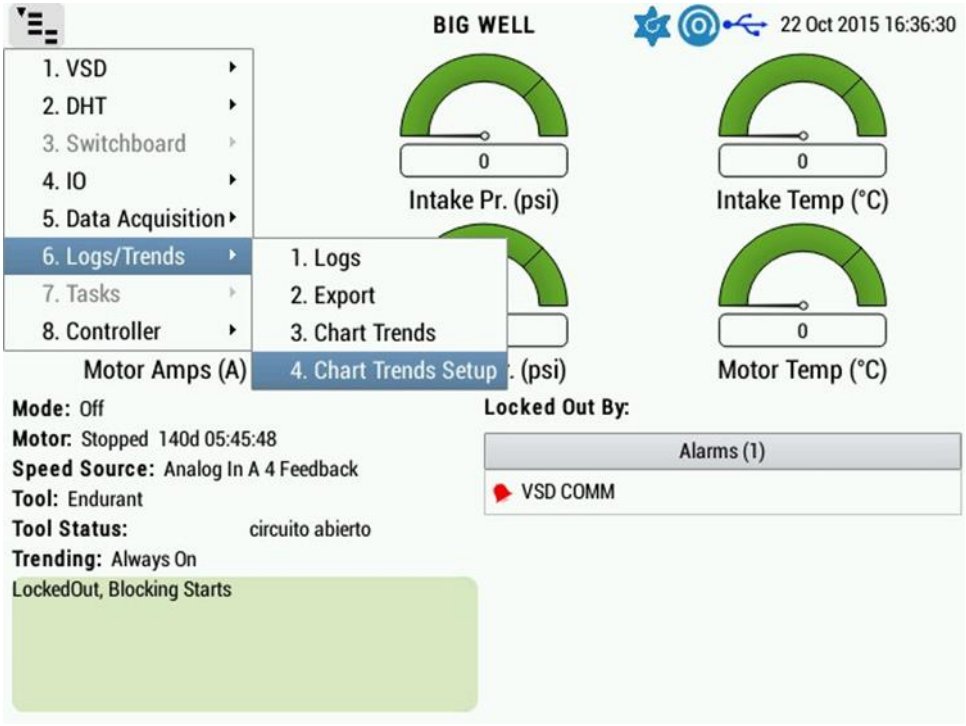


Figure 7-4: Chart Trend Setup Menu Tree

7.3.2.1 Presets

1. Select the **Preset** channel for configuration.

Note
Several presets are provided to allow quick reconfiguration of the channels to be charted. In addition to the five predefined presets, eight user-customizable presets are provided.

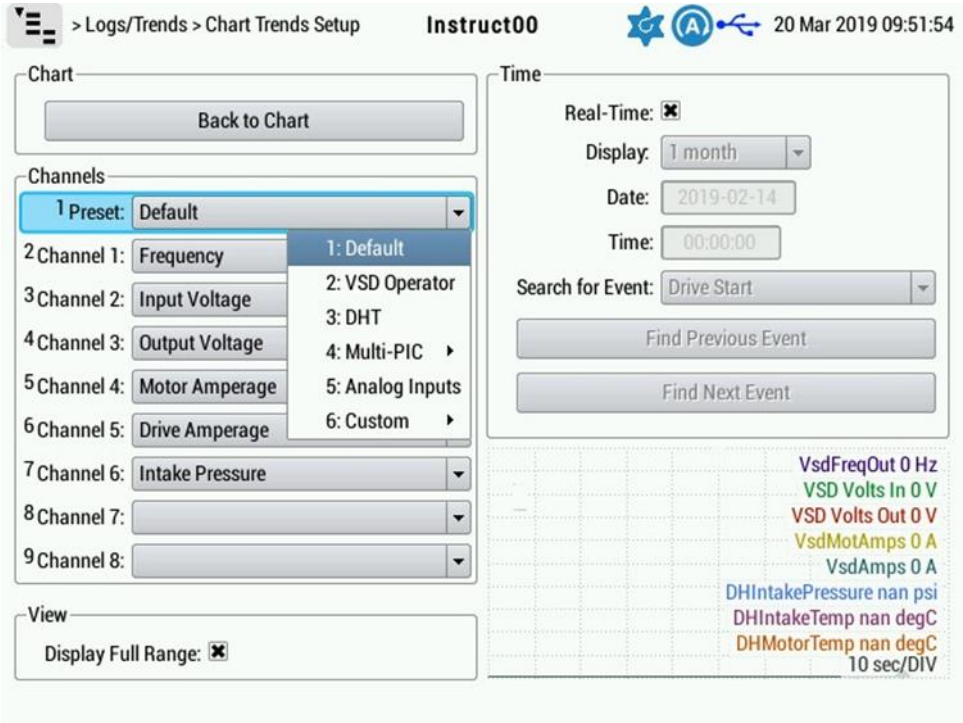


Figure 7-5: Default/Custom Presets Menu Tree

Selecting a preset configures all the channels.

Example

Selecting the Analog Inputs preset configures Channels 1 – 8 to be Analog Inputs.

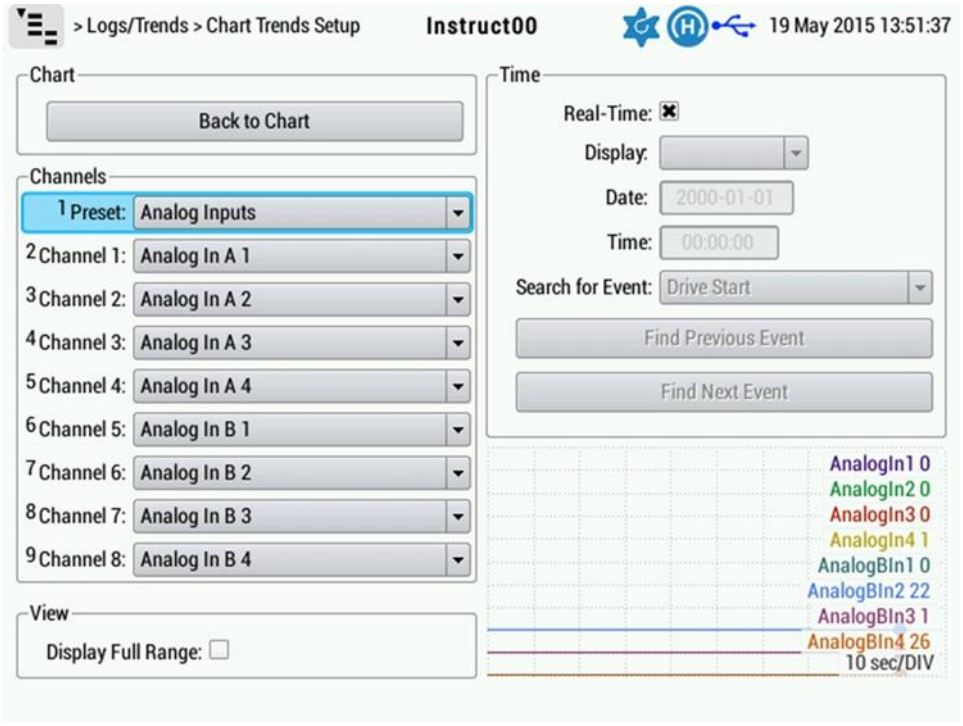


Figure 7-6: Analog Inputs Preset

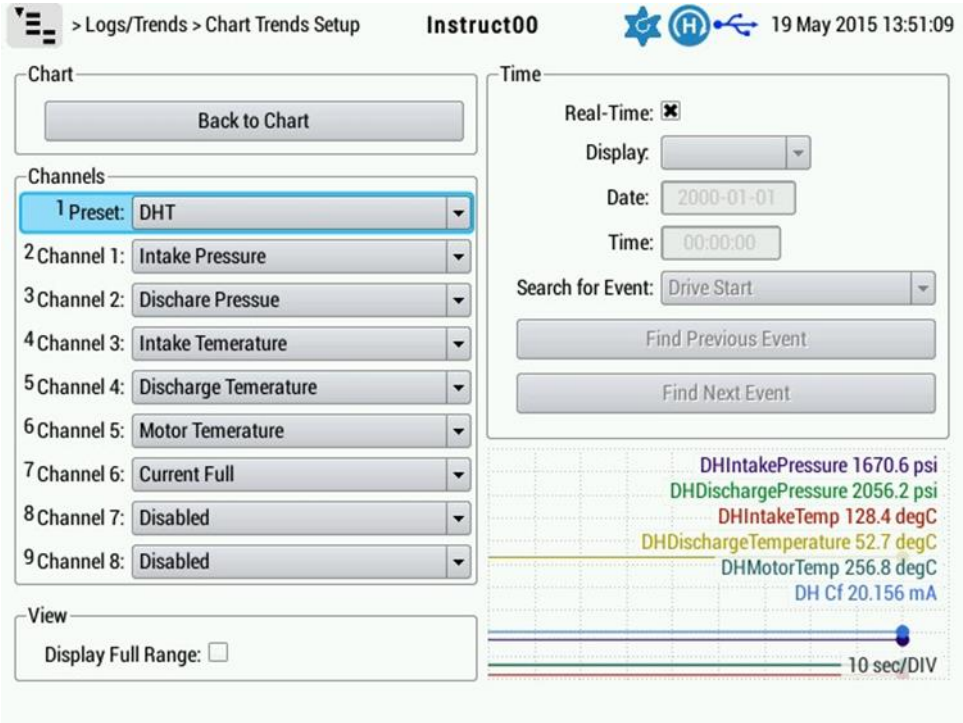


Figure 7-7:DHT Preset

7.3.2.2 Individual Channels

1. Select the appropriate **Channel** for configuration. Each channel can be individually selected. Chartable channels are selectable by categories.

> **Note**
> Each channel can be individually selected. Chartable channels are selectable by categories (i.e., Drive, DHT, IO, and Controller).

2. Select the **Channel Category** to display the parameters that can be charted.

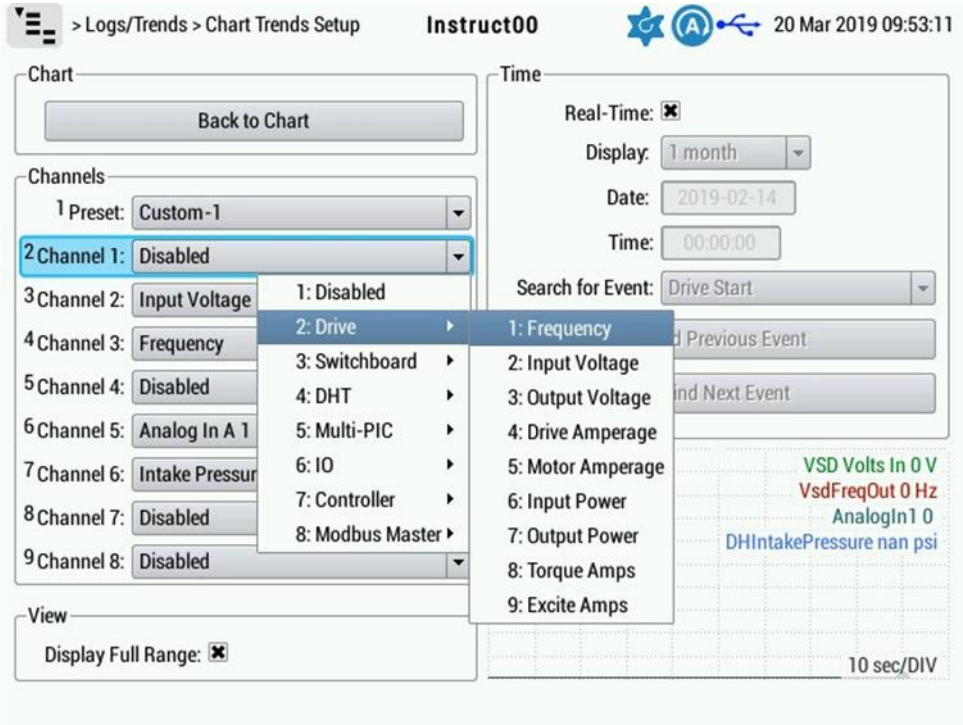


Figure 7-8: Channel Configuration Menu Tree

Note
The Display Full Range option will plot the channels from zero rather than auto scale them.

7.3.2.3 Charting Duration

1. If Real-Time charting is enabled (**X** is displayed in the **Real-Time** option), toggle it off by selecting the **Real-Time** option.
2. Select the **Display** option to specify the duration of the chart. The duration can be 1 minute, 10 minutes, 1 hour, 1 day, 1 week, or 1 month.

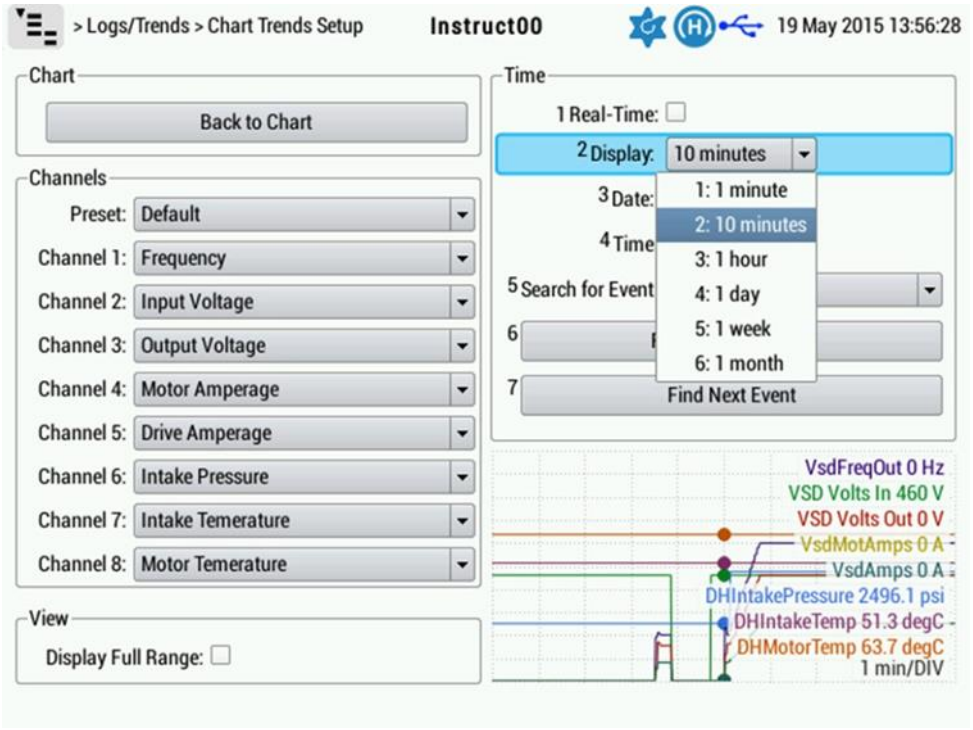


Figure 7-9: Chart Duration Menu Tree

3. Select **Search for Event** option to center the chart on a drive-start or drive-stop event.

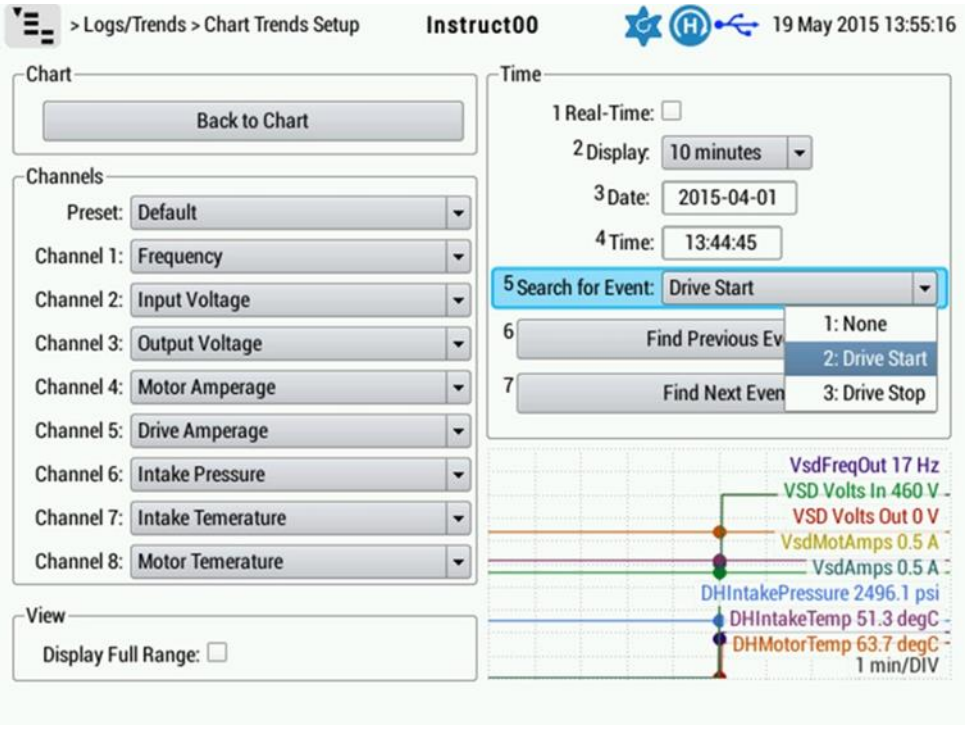


Figure 7-10: Event Trigger Menu Tree

4. Select the **Find Next/Previous Event** buttons to move to the next or previous occurrence of that event.

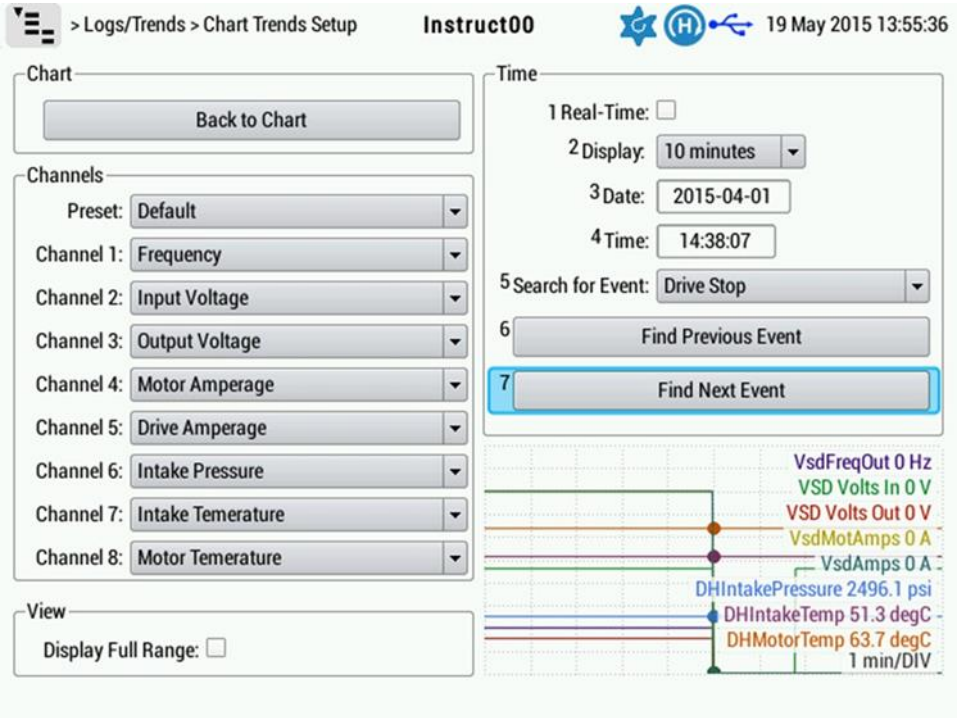


Figure 7-11: Find Previous/Next Event

7.3.3 VIEWING LOGS

1. Press the **Home** button on the keypad.
2. Press the **Menu** button on the keypad to bring up the top-level menu.
3. Select the **Logs/Trends** menu item using either the numeric keypad or the up/down/left/right navigation keys on the keypad.
4. Select the appropriate **Logs** menu item.

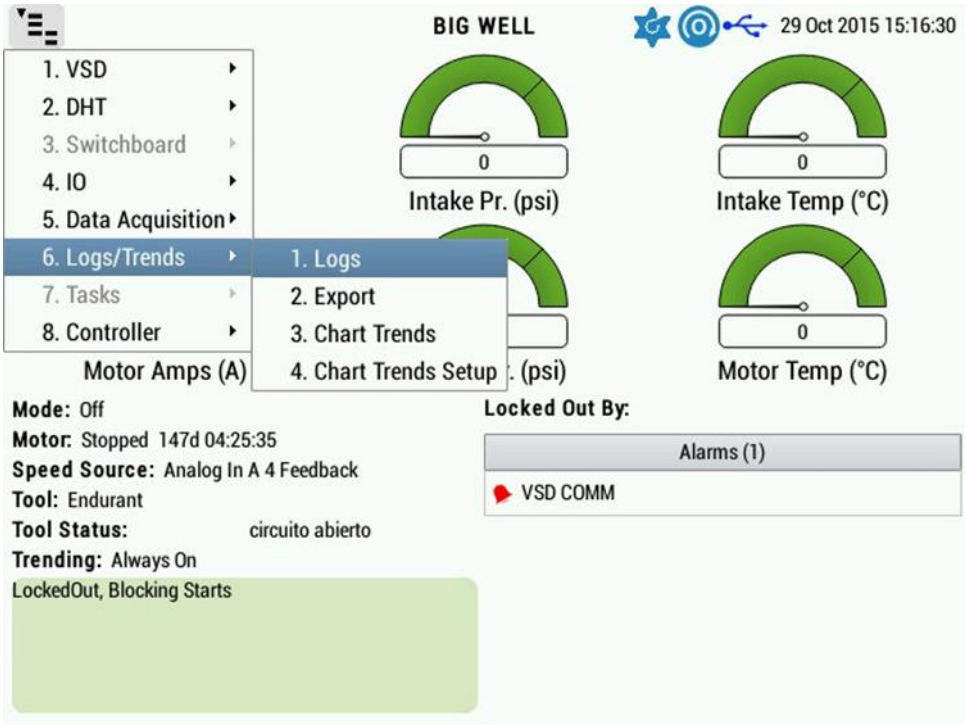


Figure 7-12: Logs Menu Tree

5. All the logs since the last firmware update will be visible. Use the arrow buttons on the right side of the screen to scroll the list up and down.

Figure 7-13: Display Logs Screen

7.4 EXPORTING LOGS AND TRENDS

1. Select a 1GB/1GiB or larger removable USB drive.

2. Ensure the removable USB drive intended for historical data download has been formatted for the FAT32 file system and has at least 600MB of free space. Note that the file export will not affect files already on the USB drive.
3. With the controller fully booted, insert the removable USB Drive into the controller. The USB symbol on the display will turn blue when the controller recognizes the USB drive.
4. Press the **Home** button on the keypad.
5. Press the **Menu** button on the keypad to bring up the top-level menu.
6. Select the **Logs/Trends** menu item using either the numeric keypad or the up/down/left/right navigation keys on the keypad.
7. Select the appropriate **Export** menu item.

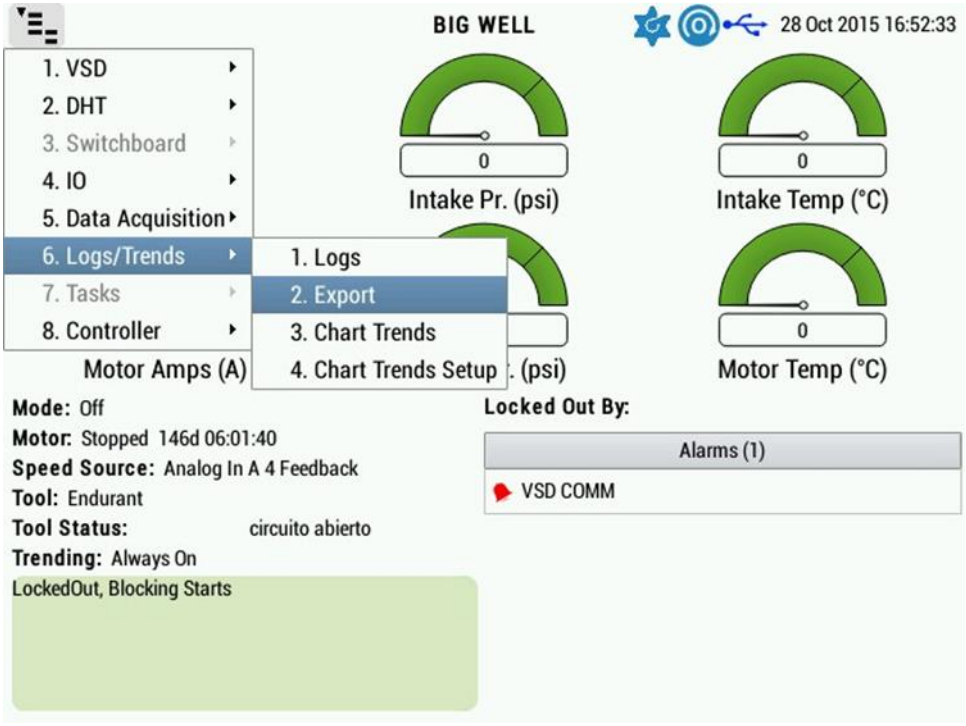


Figure 7-14: Export Log/Trends Menu Tree

8. Enter the **From Date** and **To Date** to select the data to export.

> **Note**
> When entering the **Export** screen, note that the From Date and To Date are set to export all available data by default. The size of the .**h5** file and the length of the export duration can be reduced by exporting only the data for the date range you require.

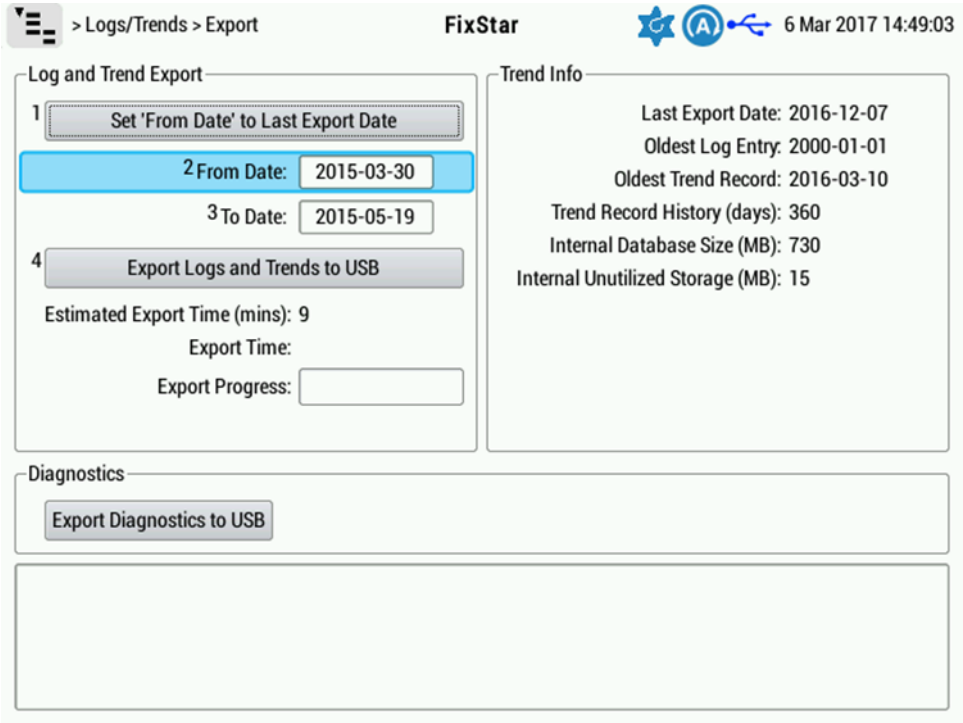


Figure 7-15: Log/Trends Export Screen

9. Select the **Export** menu item to begin the export of the log and channel data. Progress is indicated by a progress bar and export timer.

Note
The **Export Logs and Trends to USB** button is disabled until a USB drive is plugged in.

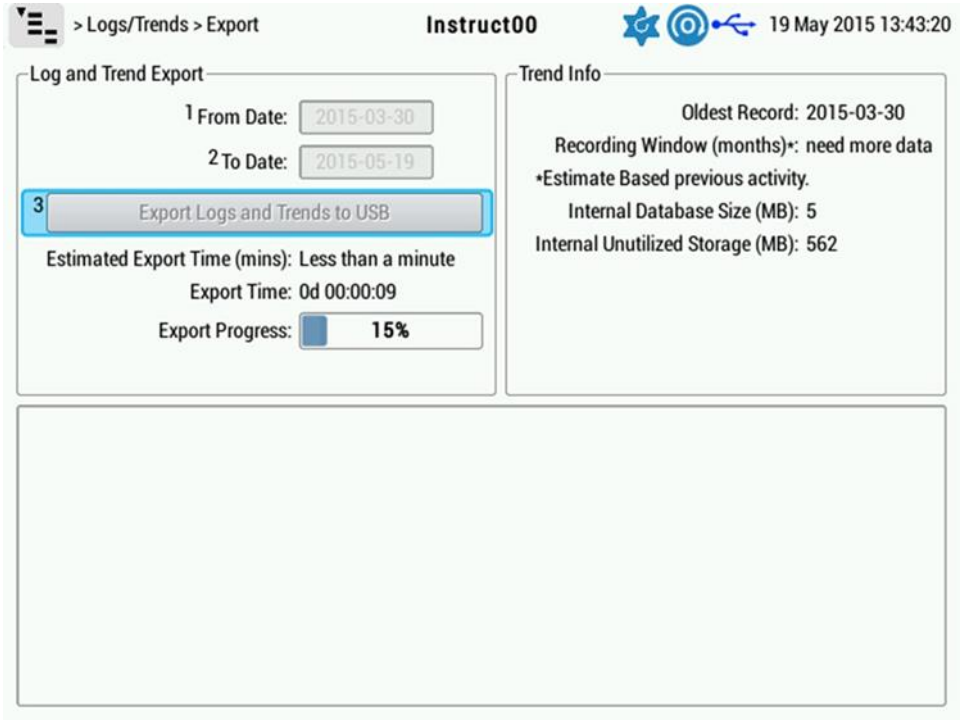


Figure 7-16: Exporting Logs/Trends Screen

When the export is finished, the progress bar remains at 100% until the USB key is removed. The logs and trends are combined into a single file in the format: **Site Name-From Date-To Date.h5**.

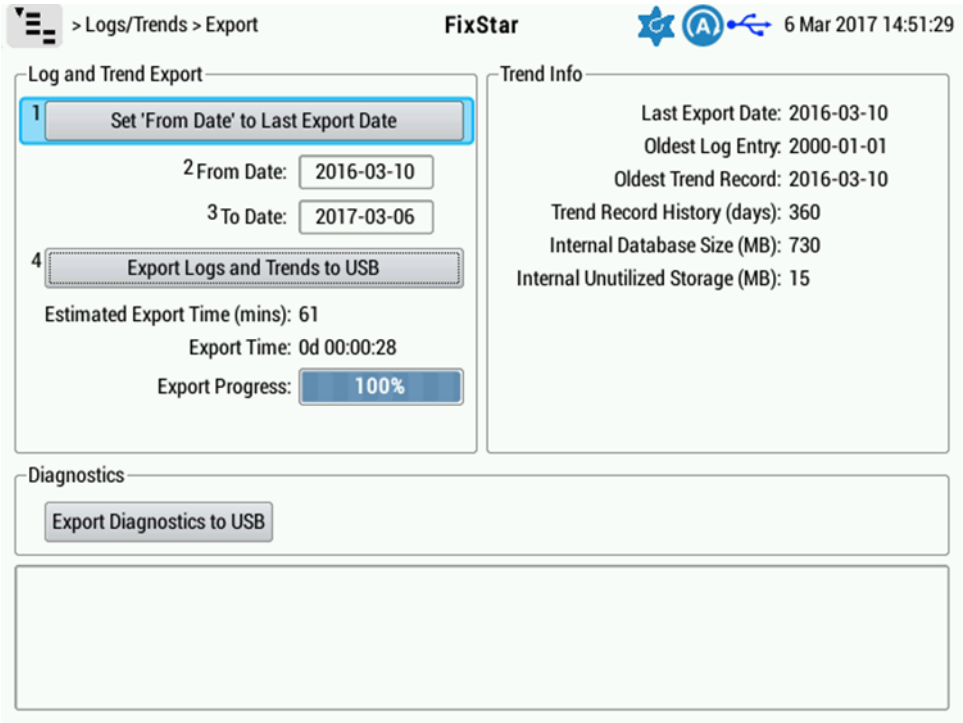


Figure 7-17: Export Complete Screen

10. Insert the USB flash drive into your computer. The **.h5** file will be available on the main directory of the USB flash drive. It can be opened using the Data Viewer software.

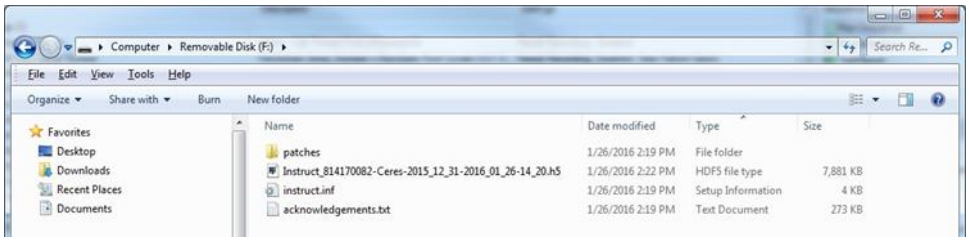


Figure 7-18: Insert USB Flash Drive

Note
In addition to the .**h5 log/trend** file, a few other items will be copied to the USB flash drive. The **patches** directory and **acknowledgements.txt** file are provided as part of software license requirements. The **instruct.inf** file is the device driver that is required for StarView to communicate with the controller. None of these additional files contain wellsite data. They can be safely deleted if desired.

Note
The Export Diagnostics function is available to troubleshoot firmware version 2.106r012 and later. The user can go to **Logs/Trends -> Export** Screen and click on **Export Diagnostics**. The exported file will be saved on a USB. Then the field user can send the file to the engineering team for analysis.

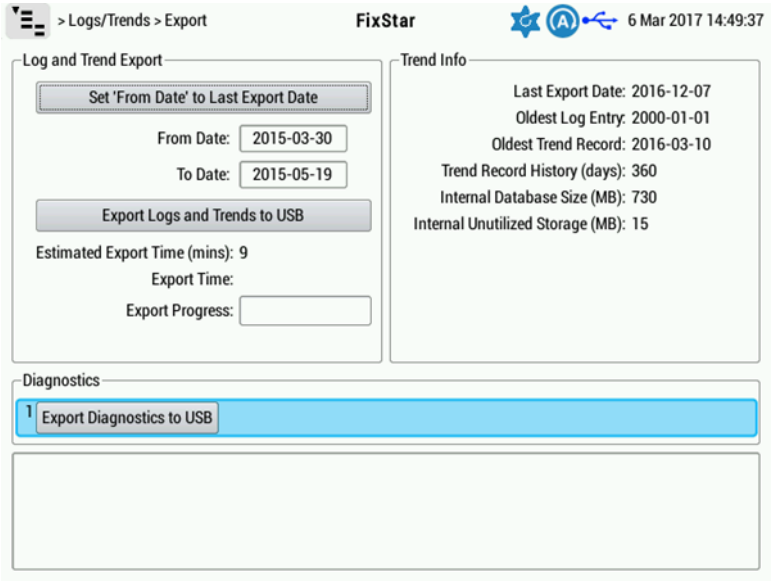


Figure 7-19: Export Diagnostics Screen

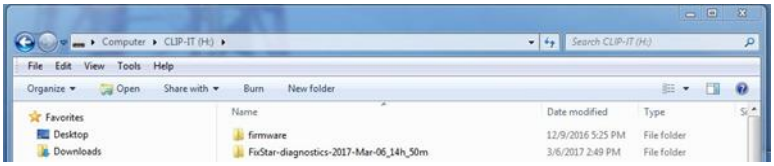


Figure 7-20: Export Diagnostics File

Note
StarView software can also be used to download logs and trends. For details, refer to *StarView User Manual* embedded in the software. See InTouch Content 6031798.

7.5 PASS-THROUGH MODE

Caution

Potential Severity: Light
Potential Loss: Assets
Hazard Category: Electrical

Use this feature with caution. The controller will pass traffic regardless of the configuration while the feature is active.

7.5.1 MODBUS-BASED TRAFFIC

Modbus mode is suitable when Modbus-like traffic is expected: for example, when reading Schlumberger PIC Coefficients. In this mode, the controller will receive an entire Modbus packet on the Source Port from a master (e.g., StarView on the USB port), and then re-transmit this entire packet to the Target Port and on to the slave (e.g., PIC, in a slot). Note that generic pass-through can be used to carry Modbus traffic, but the resulting link will not be 100% stable (resulting in a high number of retransmissions and failed packets).

1. Ensure that the controller is communicating with the target option card. Configure the proper expansion slot and ensure no COMM alarms are present.
2. Start and connect StarView NG to the USB-B port at the front of the controller.
3. On the left **Navigation** pane, select **CONFIGURATION -> Passthru**.
4. In the **Target** field, select the expansion slot that the target option card is installed in.
5. In the **Source** field, select USB PORT. This is the front USB port that the PC running StarView software is connected to.

6. Set the **Timeout** field. This is the amount of time that the pass-through will be active. After this time is up, the controller will drop the pass-through and go back to regular operating mode.
7. Set the **Activity Timeout** field. This is the amount of time the controller will allow the pass-through to be idle (i.e., no serial traffic) before it drops out of the pass-through.
8. Press the **Apply** button in StarView so that the settings are sent to the controller.

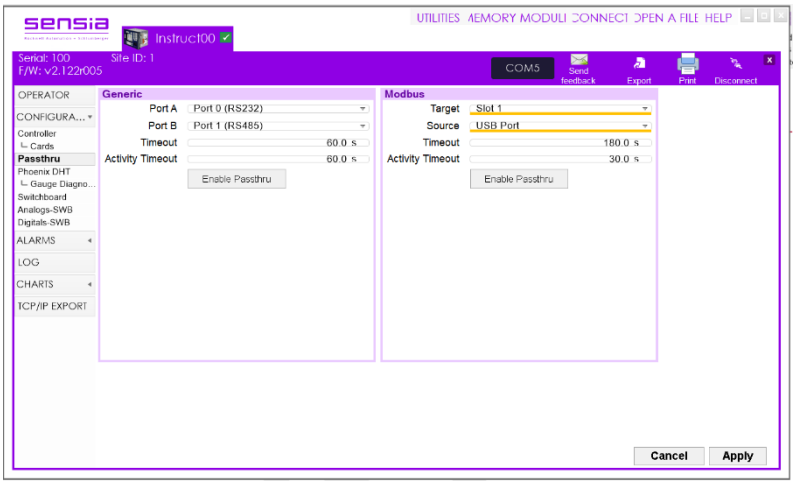


Figure 7-21: Modbus Passthru

9. Click the **Enable Passthru** button in StarView.
10. Note the COM port number at the top of the screen in StarView. Press the **Disconnect** button in StarView.

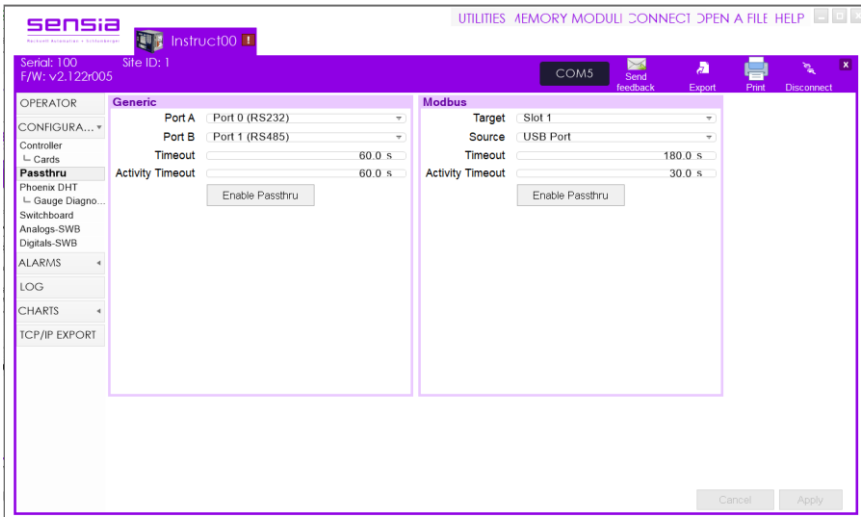


Figure 7-22: Enable Modbus Passthru

11. Open up the Modbus Master application and select the COM port advertised in StarView.

    Pass-through mode is now enabled and the Modbus traffic is now being directed to the target option card.
12. After the pass-through mode expires, disconnect the terminal program, and press the **Connect** button in StarView. The serial connection is now reconnected to the controller.

7.5.2 GENERIC CONSOLE TRAFFIC

Generic mode is best used when a user prompt is expected: for example, when using the Schlumberger PIC engineering prompt. In generic mode, the controller simply listens for serial traffic on the pass-through ports and resends it out the other one.

1. Ensure that the controller is communicating with the target option card. Configure the proper expansion slot and ensure no COMM alarms are present.
2. Start and connect StarView NG to the USB-B port at the front of the controller.
3. On the left **Navigation** pane, select **CONFIGURATION -> Passthru**.
4. In the **PORT A** field, select the expansion slot that the target option card is installed in.
5. In the **PORT B** field, select USB PORT. This is the front USB port that the PC running StarView software is connected to.
6. Set the **Timeout** field. This is the amount of time that the pass-through will be active. After this time is up, the controller will drop the pass-through and go back to regular operating mode.
7. Set the **Activity Timeout** field. This is the amount of time the controller will allow the pass-through to be idle (i.e., no serial traffic) before it drops out of pass-through.
8. Press the **Apply** button in SVNG so that the settings are sent to the controller.

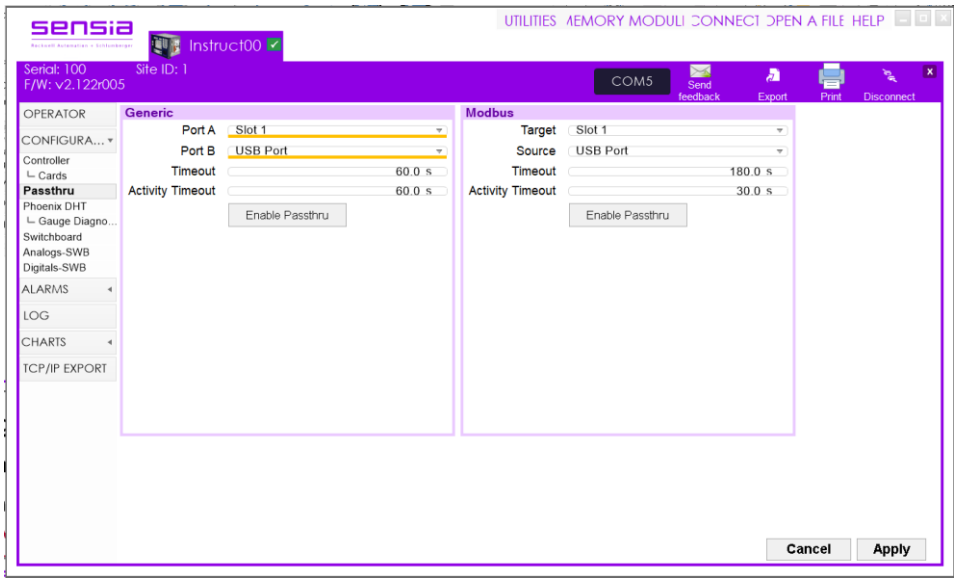


Figure 7-23: Generic Passthru

9. Click the **Enable Passthru** button in StarView.
10. Note the COM port number at the top of the screen in StarView. Press the **Disconnect** button in StarView.

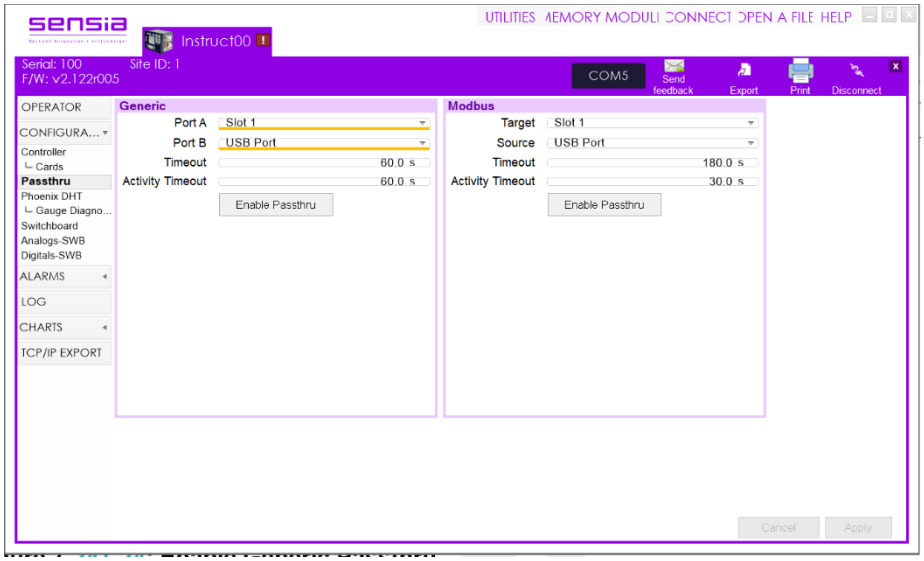


Figure 7-24: Enable Generic Passthru

11. Open your terminal program and select the COM port advertised in StarView.

    Pass-through mode is now enabled and the traffic is now being directed to the target option card.

12. After pass-through mode expires, disconnect the terminal program, and press the **Connect** button in StarView. The serial connection is now reconnected to the controller.

Section 8: **Troubleshooting**

8.1 INSTRUCT ESP INTELLIGENT CONTROLLER

Table 8-1: INSTRUCT ESP Intelligent Controller Troubleshooting Chart.

This table provides guidelines for troubleshooting a controller-installed fixed speed or variable speed drive.

Symptom	Cause and Remedy
The controller has power on the AC or DC terminals, but the display does not turn on and the unit does not operate.	The fuse for the power supply has blown. Check and change the fuse according to Section 9:Maintenance. Test and ensure that the fuse does not blow immediately on power-up. If this happens, the controller must be returned to the factory.
The controller is in Hand Mode, but there is no **START** key.	Two causes: 1) The unit is in a lockout condition. Clear the lockout by pressing the **UNLOCK** button. If the **START** key appears, the controller may be started. 2) There is an active alarm that is preventing a start. The red alarm LED will be ON in this situation and the name of the alarm(s) will be flashing on the status screen. Once the alarm condition clears or is bypassed, the **START** key will appear, and the unit can be started.
The controller can be started locally but cannot be started by SCADA.	Two causes: 1) The controller must be in AUTO mode for remote starts to work. 2) The Access setting on the Option Port the SCADA is connected to must be set to FULL. VIEW-ONLY access will prevent the remote start command from being written to the controller.
The phase voltages read steady but incorrectly.	Check that the PT Ratio in the Motor Table is correct. If the errors are the same for all phases, adjust the PT Ratio. For fine tuning of individual phases, you can use the **Voltage Calibration** screen.
Motor currents read steady but incorrectly.	Check that the CT Ratio is correct in the Motor Table. If the errors are the same for all phases, adjust the CT Ratio. For fine tuning of individual phases, you can use the **Load Calibration** screen.
As motor load increases, the Power Factor decreases. This is opposite of what should occur.	The PTs have not been phased correctly. The Rotation must be ABC for correct power factor readings. If it is ACB, the PT phasing must be changed. Power down and change the phasing.
Analog Input values do not correspond to the actual measured values.	The Engineering min/max and Raw min/max values for the Analog Input channel are not set correctly. Configure the Analog Input using the controller or StarView.
The temperature displays incorrectly.	The temperature measured is the controller internal temperature. This may appear higher than the ambient due to the power dissipated by the controller's electrical systems.
INSTRUCT Accessory Cards are installed but do not operate.	Two causes: 1) The fuse on the expansion card power supply has blown and needs to be replaced. See Section 9: Maintenance for information on how to replace the fuse. 2) The communications settings required by that card are not set properly in the **Options Ports** menus. Refer to the documentation that came with the expansion cards for instructions on the required settings.
A SCADA system can read values from the controller but is unable to write any changes.	The Option Port that the SCADA is connected to has its Access set to VIEW-ONLY. For writes to take effect, this setpoint must be set to FULL.

8.2 INSTRUCT POWER ANALYZER CARD

Problem	Symptoms	Cause	Solution
Controller not detecting Power Analyzer Card	Switchboard/ VSD Monitoring menu item greyed out in **Controller** menu	Power Analyzer Card is not fully inserted into the expansion slot.	Ensure the Power Analyzer Card is fully inserted into the expansion slot.
		Bad Power Analyzer Card	Replace Power Analyzer Card.
Incorrect data or no data displayed on controller	Card Status LED not blinking correctly (0.5 sec on / 0.5 sec off.	Bad Power Analyzer Card	Replace Power Analyzer Card.

8.3 INSTRUCT ESP RS232/RS485 COMMUNICATION CARD

Symptom	Cause	Solution
Card not communicating properly	Incorrect port configuration	Make sure function is set to Modbus slave.
	Incorrect port configured	A system can have multiple Comm Cards. Make sure the port and installed Comm card are properly configured for the connected SCADA system.
	Incorrect wiring	RS-232: Verify wiring, typically a 3- or 4-wire configuration. Refer to master device and/or intermediate device manual. RS-485: Verify wiring, typically a 4- or 2-wire configuration. Refer to master device and/or intermediate device.
SCADA system not communicating properly	SCADA system application problem	Verify that controller/acquisition system and Comm card have been successfully connected to a similar SCADA system. Send Modbus map to SCADA team.
	Incorrect Modbus slave (site) address	Make sure Comm card port and SCADA system are set to the same slave (site) address.
	Incorrect Modbus map	Make sure the correct Modbus map is used by the SCADA system. For example, UniConn and controller have different Modbus maps.
SCADA system not sending remote commands	Cannot stop, clear, and start system remotely.	Make sure the controller/acquisition system port setting is set to FULL Access. Make sure the correct Modbus map is used. Make sure the proper coils are used. Refer to Modbus map. Make sure the SCADA system is using the proper logic sequence.
SCADA system cannot interface with controller/acquisition system	SCADA system does not support Modbus RTU protocol.	Additional hardware is required to connect to non-Modbus systems.
	SCADA system does not support RS-232 or RS-485.	Additional hardware is required to connect to convert the RS-232 or RS-485 connection.

8.4 INSTRUCT ESP MODBUS TCP/IP COMMUNICATIONS CARD

Symptom	Cause	Solution
Card not communicating properly	Incorrect port configuration	Make sure TCP/IP, Gateway, and/or Netmask are valid.
	Incorrect port configured	A system can have multiple cards. Make sure the port and installed card are properly configured for the connected SCADA system.
	Incorrect wiring	Make sure RJ45 Ethernet cable is used.
SCADA system not communicating properly	SCADA system application problem	Verify that controller/acquisition system and card have been successfully connected to a similar SCADA system. Send Modbus map to SCADA team.
	Incorrect Modbus slave (site) address	Make sure card port and SCADA system are set to the same slave (site) address.
	Incorrect Modbus map	Make sure the correct Modbus map is used by the SCADA system. For example, UniConn and INSTRUCT ESP Intelligent Controller have different Modbus maps.
SCADA system not sending remote commands	Cannot stop, clear, and start system remotely	Make sure the controller/acquisition system port setting is set to FULL Access. Make sure the correct Modbus map is used. Make sure the proper coils are used. Refer to Modbus map. Make sure the SCADA system is using the proper logic sequence.
SCADA system cannot interface with controller/acquisition system	SCADA system does not support Modbus RTU protocol.	Additional hardware is required to connect to non-Modbus systems.
	SCADA system does not support RS-232 or RS-485.	Additional hardware is required to connect to convert the RS-232 or RS-485 connection.

Section 9: **Maintenance**

9.1 OVERVIEW

The controller is composed of sensitive electronics as part of an integrated assembly and as such maintenance and service is not intended to be performed onsite. The only maintenance that can be performed is fuse replacement.

Potential Severity: Serious
Potential Loss: Personnel
Hazard Category: Electrical

Fuse replacement can only be performed by authorized service personnel. Operators only have access to the front panel of the controller. No maintenance or service can be carried out by the operator.

9.2 MAINTENANCE SCHEDULE

Details the routine maintenance that should be provided at different time intervals throughout the life of the tool or system.

Fuse Replacement: When required

Real-Time Clock: Once per year

Firmware Upgrade: Per notification and/or prior to troubleshooting

9.3 FUSE REPLACEMENT

The controller fuses can be replaced by authorized service personnel using the following procedure. The following tools/equipment will be required for the procedure.

- Voltmeter
- 5/16-in slotted screwdriver

Potential Severity: Serious
Potential Loss: Personnel
Hazard Category: Electrical

Hazardous voltages can exist on the power supply AC input terminals.

1. Using the appropriate procedures, ensure the VSD is stopped and that input power supplies are OFF before proceeding with the procedure.
2. Using the appropriate procedures, open the cabinet door and use a voltmeter to verify all power is OFF on the VSD prior to proceeding with the following steps.
3. Remove the input connectors to the power supply.
4. Identify the appropriate fuse to be replaced.
    - If the system is powered via AC, the correct fuse is left of the AC input.
    - If the system is powered via DC, the correct fuse is right of the DC input.

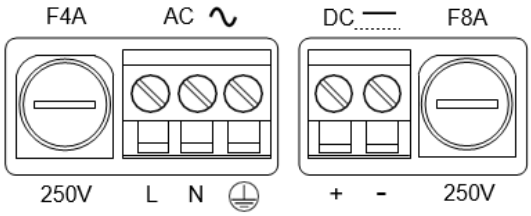


Figure 9-1: Power Supply Inputs

5. Remove the appropriate fuse by using a 5/16-in slotted screwdriver to turn the fuse holder a half-turn counterclockwise.
6. Remove the fuse from the fuse holder.
7. Install a new fuse in the fuse holder. For AC powered applications, install a fast-acting 4A fuse rated for 250V. For DC powered applications, install a fast-acting 8A fuse rated for 250V.
8. Install the fuse holder back into the controller power supply. Use the 5/16-in slotted screwdriver to turn the fuse holder clockwise until the fuse holder will no longer turn.
9. Reconnect the input connectors to the power supply.

Appendix A: **Parts, Spares, Tools, and Supplies**

A.1 INSTRUCT ESP Intelligent Controller

Part Number	Description
100840484	INSTRUCT ESP Intelligent Controller Keypad/Bezel Assembly
101156134	Plug Female 5pin 10A 3.5mm with Cage Clamp RoHS WAGO PN:734-105
101206590	Operating Tool for WAGO 3.5mm Terminals RoHS WAGO PN: 734-231
101216378	MS Socket Cap 6-32x1.125 SS Hex Drive
101216382	Terminal Block Wire Plug 3POS 5.08mm RoHS AMP PN: ELFF03230
101216384	Terminal Block Wire Plug 2POS 5.08mm RoHS AMP PN: ELFF02230
101155848	FUSE 4A 250V FAST ACTING 5 x 20mm RoHS EATON PN: BK1/S500-4-R or equivalent
101155863	FUSE 8A 250V FAST ACTING 5 x 20mm RoHS EATON PN: BK1/S500-8-R or equivalent
102097331	SPARE PARTS KIT Note: This kit contains a complete set of plugs, terminal blocks and fuses needed for the controller.
100840487	USB DRIVE 8GB ROHS
100840488	STARVIEW USB CABLE TYPE A/B 6FT, 1.8M ROHS
102837305	USB TO USB single port isolator 4kV, 12Mbps RoHS B&B Electronics PN: UH401
102844591	Extension cable, USB A Male to Female, USB 2.0, 32.8ft (10m), black
100840400	Instruct ESP Intelligent Controller
101434409	INSTRUCT ESP Type 3R Standalone
101683563	Instruct ESP VSD Kit
50374306	Instruct ESP VSD Kit with PA Card

A.2 INSTRUCT ES7 Intelligent VSD

Part Number	Description
100220873	Comm Cable: UniConn – G7 control board
101227522	VSD Retrofit Toolkit (tools and template)
101458206	Type 3R Retrofit Kit for 12-pulse 200kVA or smaller VSDs
103060241	INSTRUCT M21 Intelligent MVD Retrofit Kit

A.3 INSTRUCT ESP I/O Card

Part Number	Description
100840430	INSTRUCT ESP I/O Card
101017503	Plug Female 3pin 10A 3.5mm with Cage Clamp RoHS WAGO PN:734-103
101017504	Plug Female 4pin 10A 3.5mm with Cage Clamp RoHS WAGO PN:734-104
101156136	Plug Female 7pin 10A 3.5mm with Cage Clamp RoHS WAGO PN:734-107
101206590	Operating Tool for WAGO 3.5mm Terminals RoHS WAGO PN: 734-231
101363245	INSTRUCT ESP I/O Card Connectors Kit Note: this kit contains a complete set of the above plugs needed for the I/O card.

A.4 INSTRUCT ESP RS232/RS485 Communication Card

Part Number	Description
101120028	INSTRUCT ESP RS232/RS485 Communications Card
102941820	Terminal Block Wire Recep 5.08mm 5POS RoHS WEIDMULLER PN: 1943840000
100367386	Terminal Block 300V 10A 5.08mm 6POS RoHS WEIDMULLER PN: 1526810000
100078327	Thumb Screw #3-56 x 1/4" SS Knurled RoHS

A.5 INSTRUCT ESP Modbus TCP/IP Communications Card

Part Number	Description
100419643	INSTRUCT ESP Modbus TCP/IP Communications Card
AC21228	Dust cover for engineering port
100267826	RS232 Serial Cable
100078327	Thumb Screw #3-56 x 1/4" SS Knurled RoHS

A.6 INSTRUCT ESP MVD Card

Part Number	Description
100357924	INSTRUCT ESP MVD Card
100448078	Cross-Wired Ethernet Cable 15 feet
100078327	Thumb Screw #3-56 x 1/4" SS Knurled RoHS

A.7 INSTRUCT ESP Gateway Card

Part Number	Description
103381133	INSTRUCT ESP Gateway Card
101078022	Plug Female 8POS 10A 3.5mm RoHS WAGO PN: 713-1104
101017516	Plug Female 6POS 10A 3.5mm RoHS WAGO PN: 713-1103
100078327	Thumb Screw #3-56 x 1/4" SS Knurled RoHS

A.8 INSTRUCT Power Analyzer Card

Part Number	Description
100840440	INSTRUCT Power Analyzer Card
101017503	Plug Female 3pin 10A 3.5mm with Cage Clamp RoHS WAGO PN: 734-103
101754940	Terminal Block FEM 3.81mm 28-14AWG 4POS RoHS: WAGO PN: 734-204
101156134	Plug Female 5pin 10A 3.5mm with Cage Clamp RoHS WAGO PN: 734-105
101754969	Terminal Block PLUG 3.5mm 24-16AWG 5POS RoHS Phoenix Contact PN: 1790137
101206590	Operating Tool for WAGO 3.5mm Terminals RoHS WAGO PN: 734-231

A.9 INSTRUCT Power Analyzer 5kV Voltage Sensor

Part Number	Description
100840441	INSTRUCT Power Analyzer 5kV Voltage Sensor

Part Number	Description
100367410	TERMINAL BLOCK FEM STRAIGHT 5.08mm 300V 10A 3POS RoHS
101947881	PA 5kV Voltage Sensor Signal Cable, 4m
101947905	PA 5kV Voltage Sensor Signal Cable, 8m
102773500	INSTRUCT Power Analyzer 5kV Voltage Sensor with heavy duty clips

A.10 INSTRUCT Power Analyzer Kit

Part Number	Description
50372042	INSTRUCT Power Analyzer Kit (8m cable)
50371999	INSTRUCT Power Analyzer Kit (4m cable)
100840441	INSTRUCT Power Analyzer 5kV Voltage Sensor
100840440	INSTRUCT Power Analyzer Card

A.11 Switchboard Retrofit Kit Parts

Switchboard UniConn Retrofit Kit Parts:

Part Number	Description
100840400	INSTRUCT ESP Intelligent Controller
100840440	Power Analyzer Card
100840441	INSTRUCT Power Analyzer 5kV Voltage Sensor
101947881	PA 5kV Voltage Sensor Signal Cable, 4m Note: for a standard switchboard, the 4m PA 5kV Voltage Sensor signal cable is recommended. There exists also 8m cable length if needed. 101947905: 8m PA 5kV Voltage Sensor Signal Cable

Note
Check the CT Burden Module in the retrofit system. It should be PN: 100468928. If not, change the CT Burden Module to PN: 100468928.

Part Number	Description
101764633	Retrofit Kit for K095
101943387	Retrofit Kit for K095 sub-assembly
100840440	Power Analyzer Card
100840441	INSTRUCT Power Analyzer 5kV Voltage Sensor
101947905	PA 5kV Voltage Sensor Signal Cable, 8m Note: for a standard K095 retrofit kit, the 8m PA 5kV Voltage Sensor signal cable is recommended. There exists 4m cable length if needed. 101947881: 4m PA 5kV Voltage Sensor Signal Cable

A.12 INSTRUCT Type 3R Standalone

Part Number	Description
101434409	INSTRUCT ESP Type 3R Standalone

A.13 INSTRUCT ESP VSD Kit

Instruct ESP VSD Kit (PN: 101683563) includes below parts:

Part Number	Description
100840400	INSTRUCT ESP Intelligent Controller
100840430	INSTRUCT ESP I/O Card

A.14 INSTRUCT ESP VSD Kit with PA Card

Instruct ESP VSD Kit with PA Card (PN: 50374306) includes below parts:

Part Number	Description
100840400	INSTRUCT ESP Intelligent Controller
100840440	Power Analyzer Card

Appendix B: **Modbus Master Configuration**

The INSTRUCT ESP Intelligent Controller can be configured to read data to external Modbus devices and alarm on those readings. In this configuration, the INSTRUCT ESP Intelligent Controller will be the Modbus master device and the external device will be the slave. To use this function, either use the RS232 port or RS485 port on the Controller Cards or install a Comm Card in the option port. The slave device would then be connected to the configured MBM port.

The StarView built-in utility (Modbus Master Configuration) will be needed for the configuration of Modbus Master. For the instructions about how to configure Modbus Master, please refer to the **Modbus Master Configuration Quick Start Help** inside the software.

Appendix C: **Custom Modbus Slave**

The INSTRUCT ESP Intelligent Controller can also be configured as Modbus Slave to create Custom Modbus Map. Custom Modbus Map provides a flexible Modbus map that adapts to your needs.

This can be helpful to:

- Improve SCADA bandwidth utilization. The data required by the SCADA system can be grouped in one contagious block—thus making it possible to acquire all data with one simple query.
- Provide backward compatibility with some legacy products

> **Note**
> Custom Modbus Slave is supported on INSTRUCT ESP Intelligent Controller starting form firmware release v2.108.

The StarView built-in utility (Custom Modbus Slave) is the software used to configure Custom Modbus Map. For instructions about how to configure Custom Modbus Slave, please refer to **Customer Modbus Slave Quick Start Help** inside the software.

Appendix D: **Custom Screens**

The INSTRUCT ESP Intelligent Controller screen can be customized through the StarView built-in utility (Custom Screens). For instructions about how to use Custom Screens, please refer to the **Custom Screens Quick Start Help** inside the software.

Appendix E: **References**

Manual, INSTRUCT ESP Intelligent Controller (InTouch ID 6128576)

Reference Page, INSTRUCT ESP Intelligent Controller (InTouch ID 6023027)

INSTRUCT ESP Intelligent Controller Firmware and Release Note (Including Telemetry Map) (InTouch ID 6145281)

User Manual, UniConn Controller (InTouch ID 3953183)

User Guide, StarView (access via StarView built-in Quick Start Help)

USB connection Best Practice (InTouch ID 6925630)

User Guide, Gas Lock Protection (InTouch ID 6923767)

General Troubleshooting Guide (InTouch ID 6941816)

Bluetooth Best Practice (InTouch ID 6929547)

Appendix F: **INSTRUCT ESP Intelligent Controller Support Resources**

PRODUCT DOCUMENTATION

This manual is the main product documentation for the INSTRUCT ESP Intelligent Controller.

GUIDES AND RELEASE NOTES

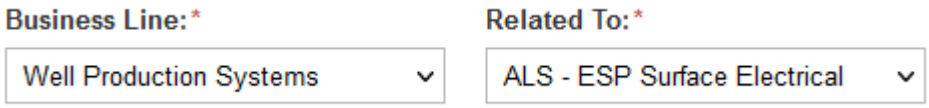
General guides, best practices, technical alerts, firmware, and software release notes are available at InTouch 6023027 reference page for the INSTRUCT ESP Intelligent Controller.

TECHNICAL SUPPORT

You can reach us via the Lift Control Systems Custom Service email:

liftcontrolsystems@sensiaglobal.com

- For Schlumberger customers, an InTouch ticket should be raised to Well Production System – ALS-ESP Surface Electrical helpdesk.



HOW TO REACH US

You can find more information about Sensia and about the INSTRUCT ESP Intelligent Controller information here:

Sensia Home Page: https://www.sensiaglobal.com/

Sensia Lift Control Solutions Page: https://www.sensiaglobal.com/Sensia-Lift-Control-Systems

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