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Rockwell Automation + Schlumberger

INSTRUCT LIFT CONTROL SYSTEMS

ESP Switchboard Configuration via ESP Controller

Configuration Manual

MODEL: INSTRUCT ESP Intelligent Controller
INSTRUCT ESP Switchboard

Manual No: LCS-ENG-M0004 , Rev. 01

Publisher Notes

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REVISION HISTORY

REVISION	DESCRIPTION OF CHANGE	SENSIA ISSUER	DATE
01	Initial release. Initial conversion to Sensia	Lift Control Systems	15 Apr 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 legislation, including the relevant standards.

All technical data on the instrument is 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 several types of signals 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: Description

This configuration manual describes how to use the INSTRUCT ESP Intelligent Controller to configure the INSTRUCT ESP Switchboard for various artificial lift applications. It is written for users who already understand the physical set up of the well, the characteristics and relationships among flow, pressure, temperature, and signal noise in the well.

This manual shall be read in conjunction with the switchboard and controller manuals.

- INSTRUCT ESP Intelligent Controller Manual (InTouch ID 6128576)
- INSTRUCT ESP Switchboard Manual (InTouch ID 4128912)

1.1 DOCUMENT SCOPE

This document assumes that the Controller is already installed in the INSTRUCT ESP Switchboard and is ready to be started.

This document describes:

- Theory of Operation
- Switchboard settings screens
- Basic Switchboard configuration
- Switchboard commissioning

1.2 SWITCHBOARD PICTURES

Refer to Figure 1.1, Figure 1.2 and Figure 1.3 for the pictures of an INSTRUCT ESP Switchboard with INSTRUCT ESP Intelligent Controller.

Figure 1.1: INSTRUCT ESP Switchboard with INSTRUCT ESP Intelligent Controller

Figure 1.2: INSTRUCT ESP Switchboard Low Voltage Compartment

Figure 1.3: INSTRUCT ESP Switchboard High Voltage Compartment

Section 2: Theory of Operations

2.1 VOLTAGE INPUT

The INSTRUCT Accessory 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:

Table 2.1: Voltage Input Parameters

PARAMETERS	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 apply the deviation to a six-point curve to determine the alarm duration. Used to protect a system from voltage droops and brown outs. The alarm curve is designed to account for the voltage drop during a motor or system start
Rotation	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 switchboard 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 are no-longer matched and apply 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
Low Frequency	Monitor condition where the frequency drops below a specified minimum value. Used to protect a system from low frequency.
High Frequency	Monitor condition where the frequency exceeds a specified maximum value. Used to protect a system from high frequency.

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 measured the voltage values.

The PT input voltage is limited, the maximum voltage should be 120VAC. Additional Potential Transformer exists in Switchboard HV cabinet to interface to high voltage systems as shown in Figure 2.1.

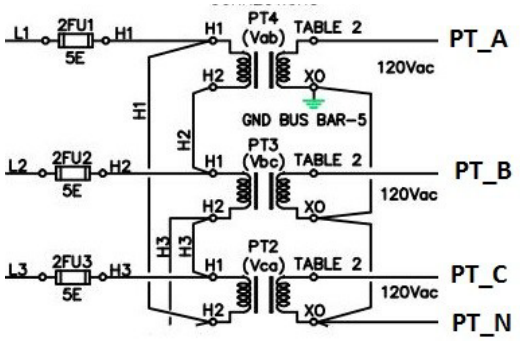


Figure 2.1: PT Inputs Cascade to 4000VAC

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

2.2 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:

Table 2.2: Current Input Parameters

PARAMETERS	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 15-point time curve associated with it. The individual points in this curve can be edited for special applications. The set point 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 set point 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 either voltage mode or current mode. The alarm appears as **ROTATION** on the display.
Unbalance	Monitor condition where current A-B-C magnitude are no-longer matched. The three phase RMS average is compared to the individual phases to calculate unbalance. The set point is typically set to 20%. The alarm appears as **C_UNBAL** on the display

PARAMETERS	OPERATION
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 set point must be set less than the name plate motor start amps and 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 set point 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**.
Power Factor	Monitor condition where the power factor drops below a specified minimum value. Used to protect a system from low power factor.

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.

2.2.1 UNDERLOAD TRACKING

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

NOTE	When the under-load tracking is activated, the normal under load setting is bypassed for the under-load tracking setting.

2.3 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 to the Controller. There exists a unique 1000:1 Burden Module (PN: 100468928, CT BURDEN MODULE).

2.4 CT MODULE

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

2.5 POWER ANALYZER HIGH VOLTAGE MODULE

2.5.1 BACKSPIN / HIGH VOLTAGE INPUTS

The Power Analyzer High Voltage Module contains a 3-phase backspin/HV input 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/HV 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 Power Analyzer HV Module 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 Power Analyzer HV Module. The motor rotation signal pass through the DC blocking filter unaffected.

 WARNING	**Potential Severity: Serious** **Potential Loss: Assets, Personnel** **Hazard Category: Electrical, Machinery equipment hand tools** Starting a motor which is spinning in reverse direction creates a very large current to stop the motor, then start the motor in the correct direction. Damage to motor winding may result.

2.5.2 LEG GROUND

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

The measurements of frequency and voltage can determine motor rotation and line voltage.

Section 3: Switchboard settings screens

3.1 SWITCHBOARD MENUS

The following menus are available for Switchboard when the Power Analyzer Card is inserted into Controller and none of the Controller communication ports, nor the slots' function is configured to VSD.

1. Summary
2. Backspin
3. Alarms
4. IO
5. Configure
6. Startup Chart

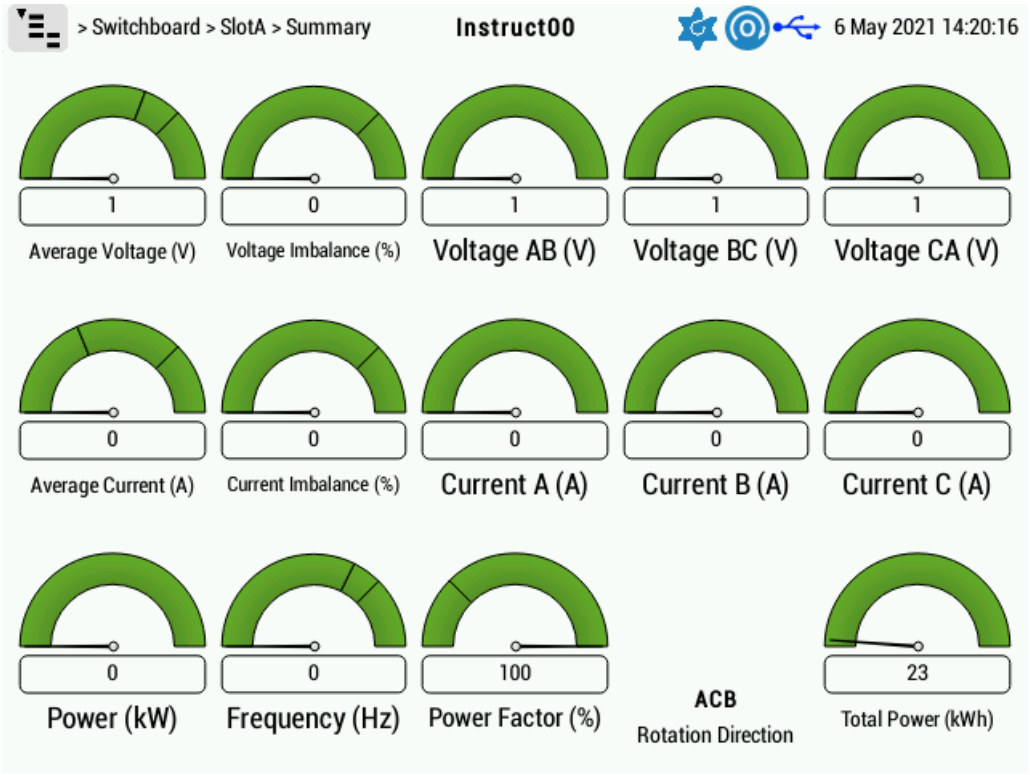


Figure 3.1: Summary Screen

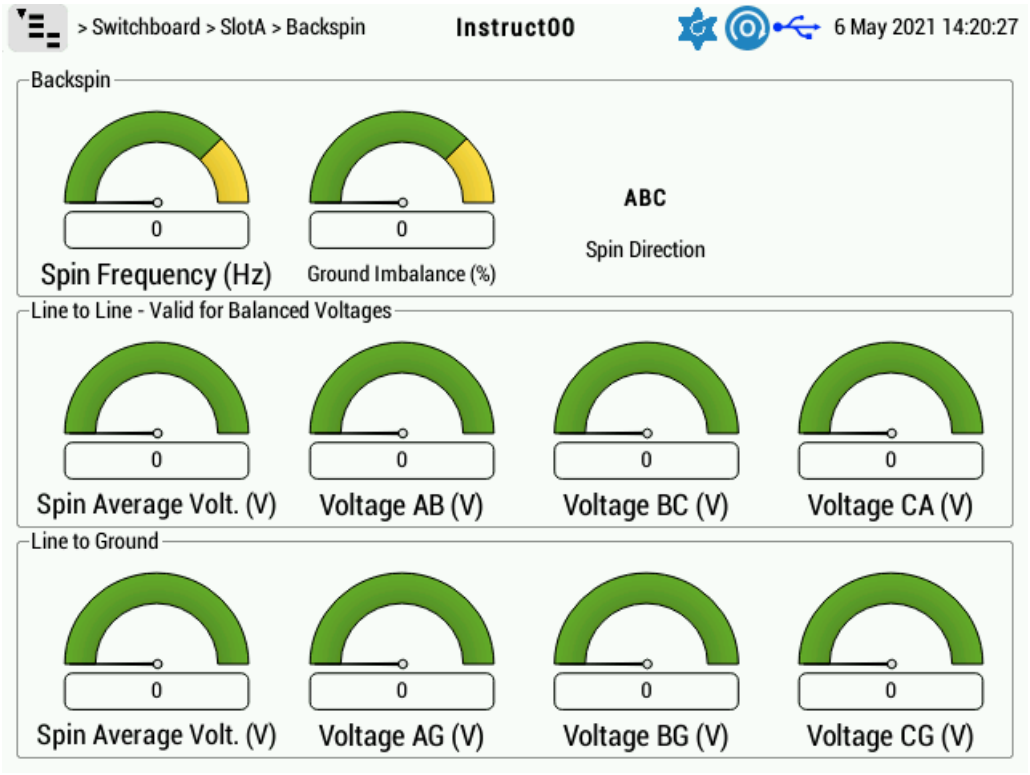


Figure 3.2: Backspin Screen

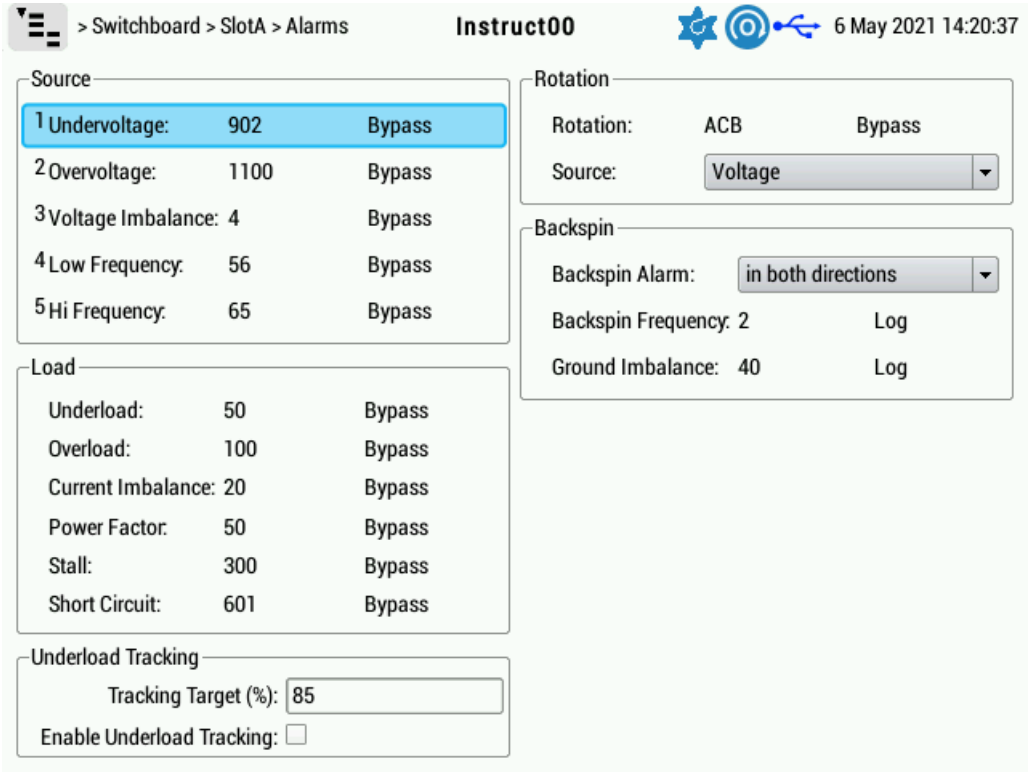


Figure 3.3: Alarms Screen

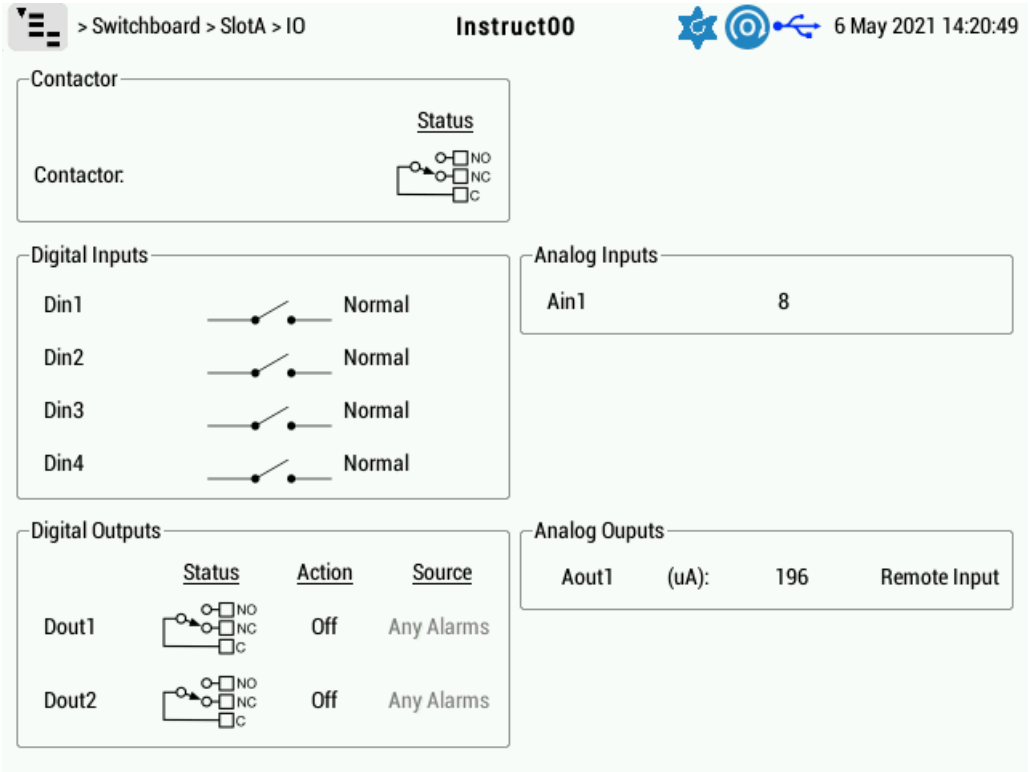


Figure 3.4: IO Screen

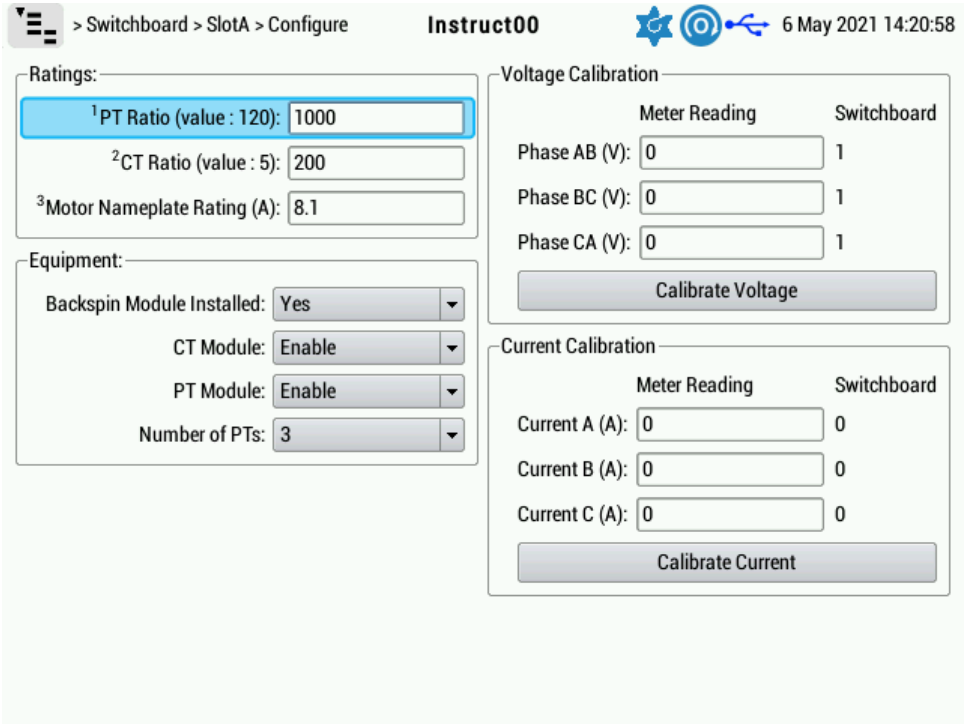


Figure 3.5: Configure Screen

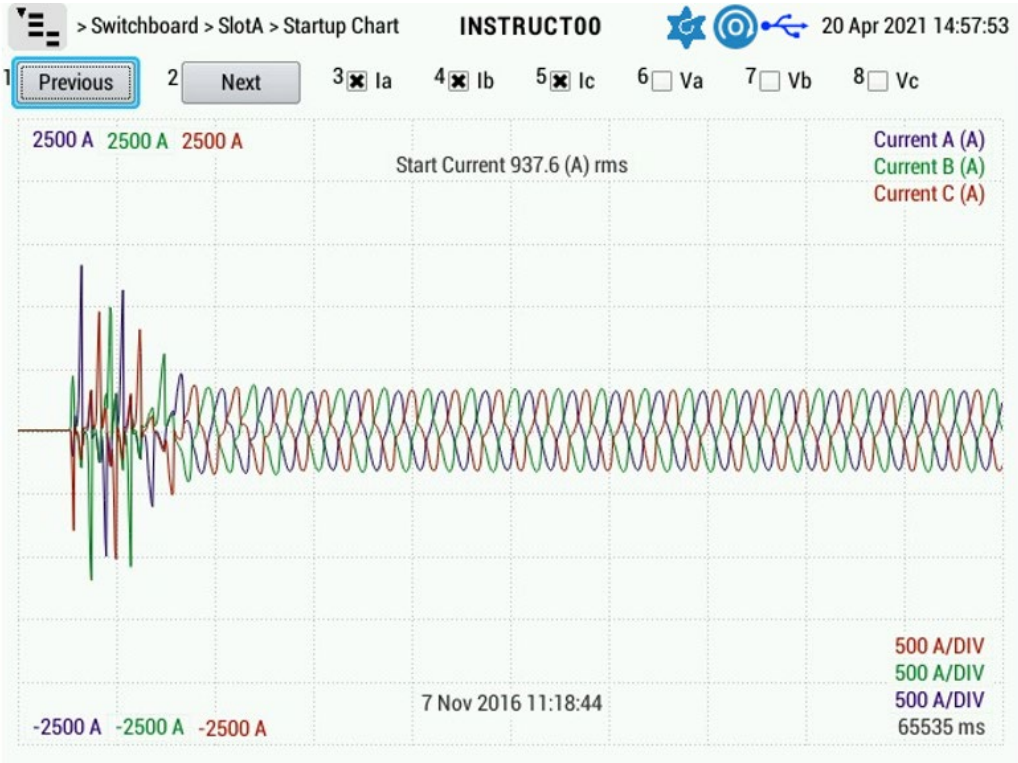


Figure 3.6: Startup Chart Screen

Section 4: Switchboard Setup

The Controller will be configured to Switchboard if a Power Analyzer Card is installed and none of the Controller ports and slot's function is configured to VSD. The Controller will then add the Switchboard menu to the top-level menu structure.

NOTE	The Controller begins to support dual Power Analyzer Card from firmware version v2.122r005. Two Power Analyzer Cards can be installed to Controller, at slot A and slot B, respectively. The Controller can then be configured for two different switchboards setup.

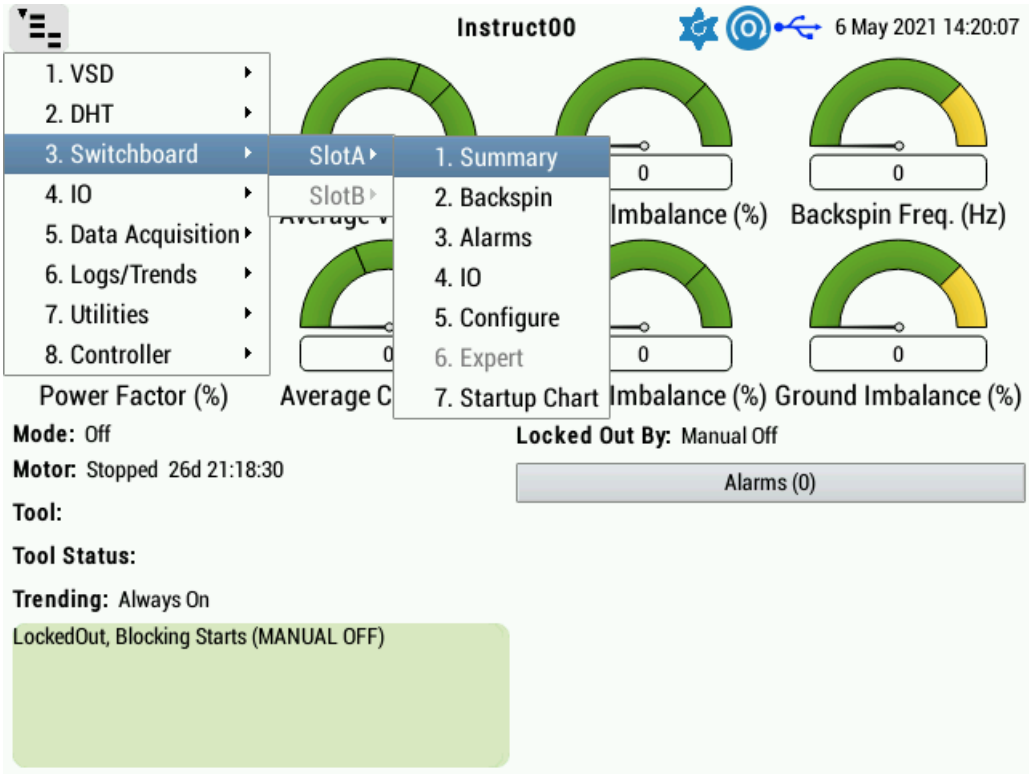


Figure 4.1: Switchboard Menu Tree

The home screen shows the fixed speed-specific parameters (as opposed to VSD parameters) if a Power Analyzer Card is installed.

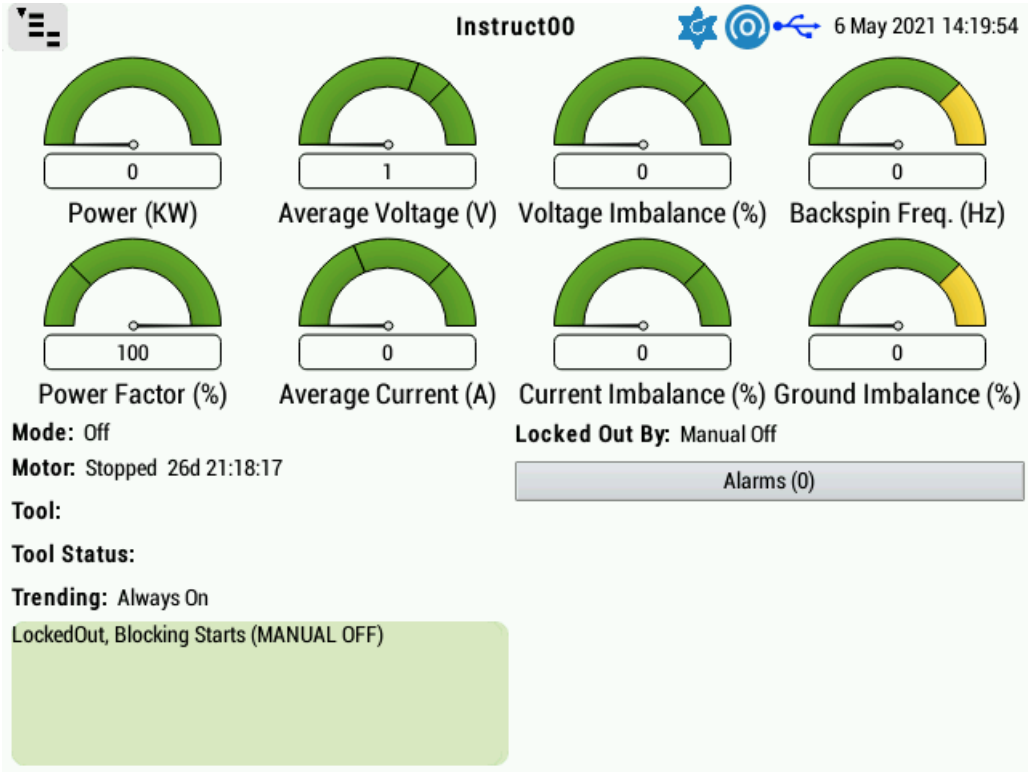


Figure 4.2: Switchboard Home Screen

4.1 SWITCHBOARD I/O

The switchboard I/O menu can be accessed with the navigation sequence **Switchboard → Slot A/B → IO**.

There are some minor differences between the I/O Card and Power Analyzer Card with respect to the available I/O. The Power Analyzer Card has 4 Digital Inputs, 3 Digital Outputs, 1 Analog Input and 1 Analog Output compared to the I/O Card's 6 Digital Inputs, 3 Digital Outputs, 4 Analog Inputs and 2 Analog Outputs. Configuration of the Power Analyzer Card I/O is like the configuration of the standard I/O expansion card.

The first Power Analyzer Card relay output is for Contactor, and its status is displayed on the I/O screen. Control of the contactor is provided by the Start and Stop buttons on the Controller keypad. The normal pump start HOA pop-up will appear when you press Start.

HOA operation can also be configured externally. Refer to the Digital Input HOA instructions in the Installation section of INSTRUCT ESP Intelligent Controller Manual (InTouch ID 6128576) for wiring examples. Refer to the Digital Input HOA instructions in the Configuration section of INSTRUCT ESP Intelligent Controller Manual (InTouch ID 6128576) for configure examples.

For the other digital outputs (relays), analog and digital inputs, the configuration is the same as the controller I/O card. Refer to the Digital I/O and Analog I/O instructions in the Configuration section of INSTRUCT ESP Intelligent Controller Manual (InTouch ID 6128576) for details.

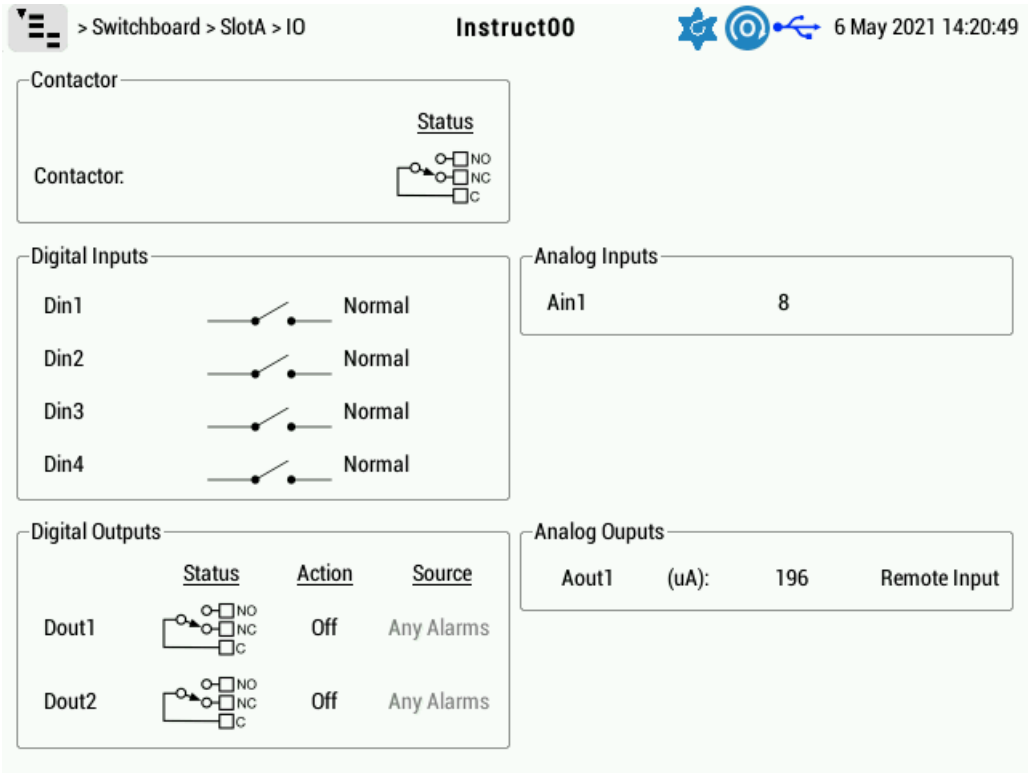


Figure 4.3: Switchboard I/O Screen

4.2 SWITCHBOARD ALARMS

The switchboard alarms menu can be accessed with the navigation sequence **Switchboard → Slot A/B → Alarms**.

The Source section allows the configuration of the 3-phase voltage input alarms (Undervoltage, Overvoltage, Voltage Imbalance, Low Frequency and Hi Frequency).

The Load Section allows the configuration of the 3-phase current alarms (Underload, Overload, Current Imbalance, Power Factor, Stall and Short Circuit).

NOTE	There is a known issue for the SWB Rotation Alarm on Current. This issue exists in firmware version 2.110r010 or earlier. If the user has set a rotation alarm and the alarm happens to be active due to the last read rotation value, the user cannot start the SWB. To work around the issue, the user needs to bypass the alarm, start the SWB and re-enable the alarm.

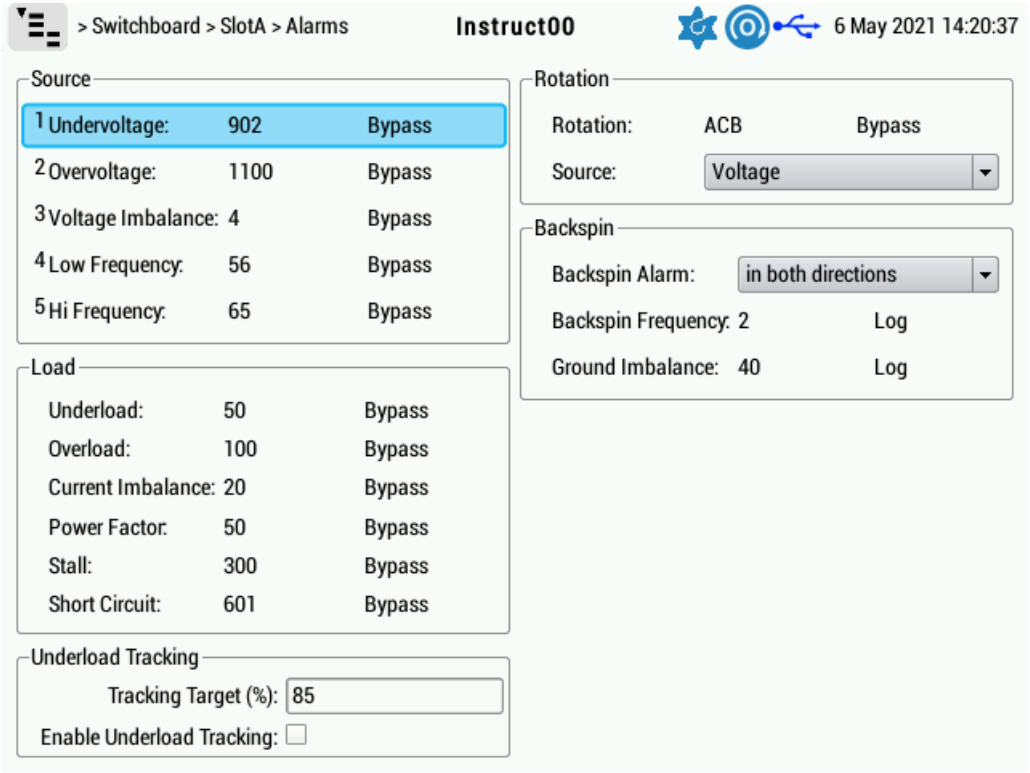


Figure 4.4: Switchboard Alarms Screen

To edit an alarm, use the navigation or numerical keys to choose the alarm you wish to edit. A configuration menu will be displayed to allow the user to enter configuration parameters

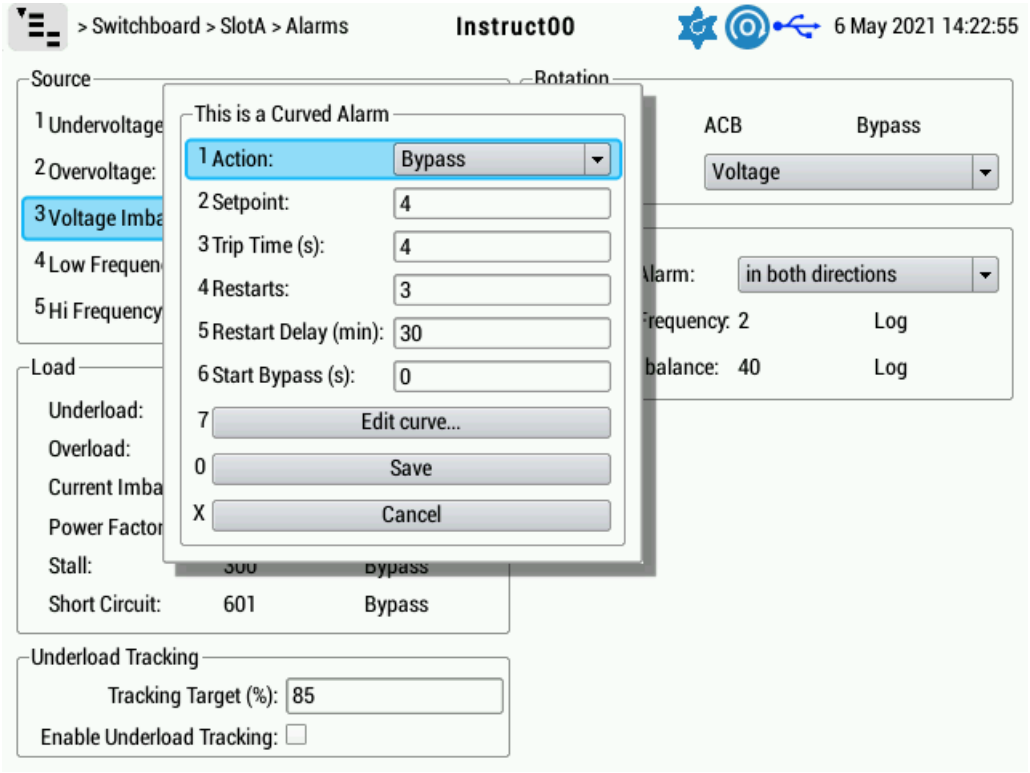


Figure 4.5: Switchboard Alarms Configuration Screen

TERM	DEFINITION
Underload Tracking	The Switchboard has underload tracking features. Users can enable and disable it by selecting the Enable Underload Tracking check box. The Tracking Target can be set anywhere from 1% to 100%.
Rotation	The Switchboard has a Current and Voltage rotation direction detection feature. In the Rotation section, users can choose the source as either Current or Voltage, and choose to alarm on a specific direction, ABC or ACB

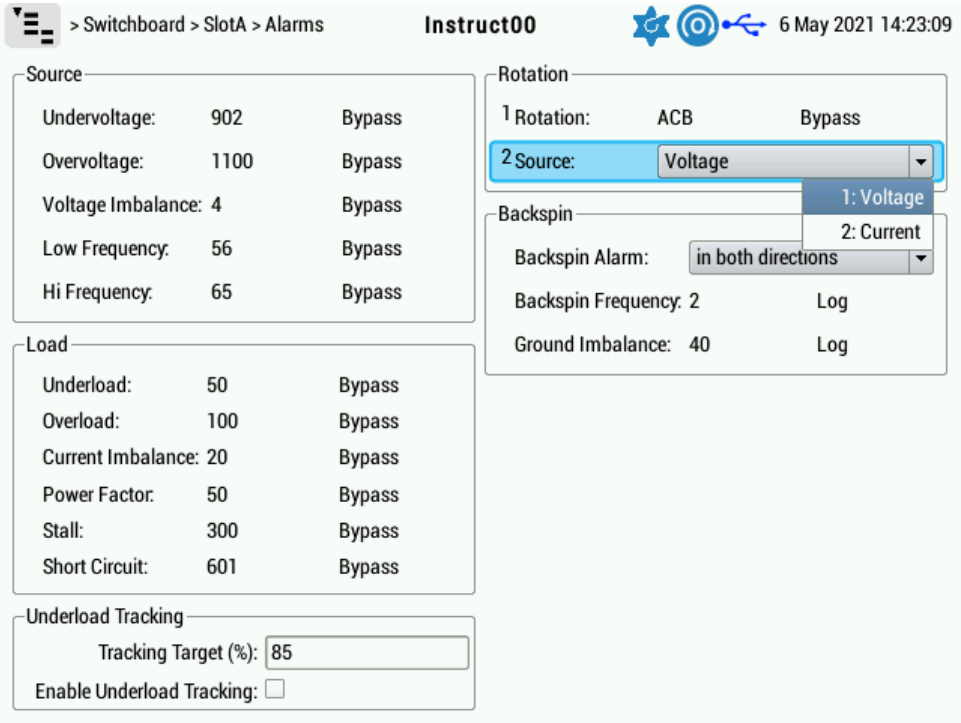


Figure 4.6: Switchboard Rotation Source Configuration

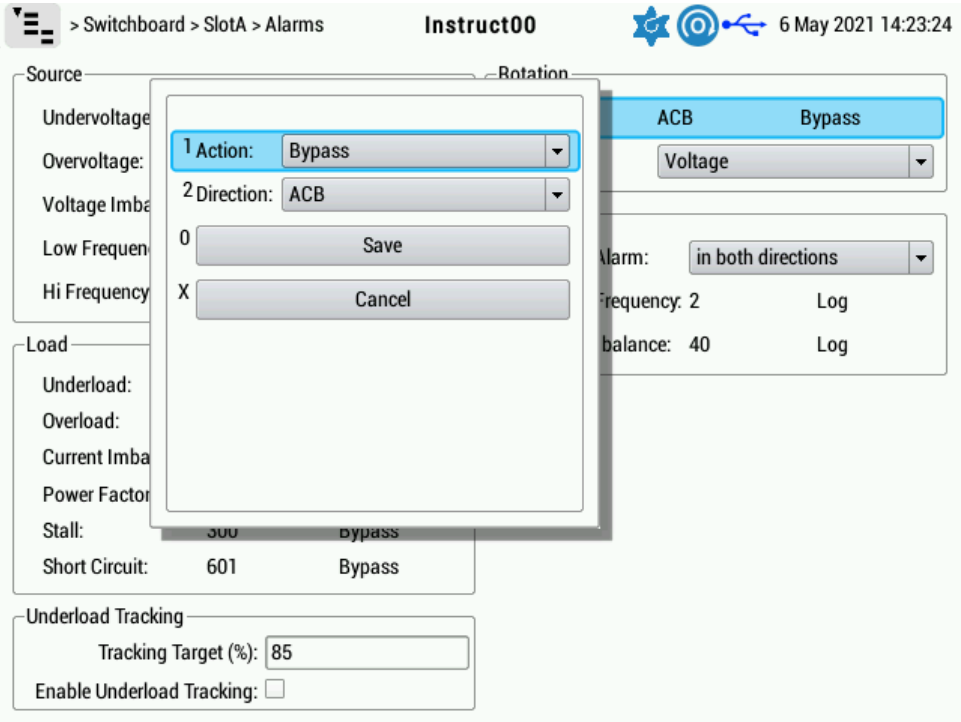


Figure 4.7: Switchboard Rotation Action Configuration

TERM	DEFINITION
Backspin Alarms	The Switchboard also provides a Backspin detection alarm. In the Backspin section, the user can configure the Backspin Alarm direction, Backspin Frequency alarm and Ground Imbalance alarm

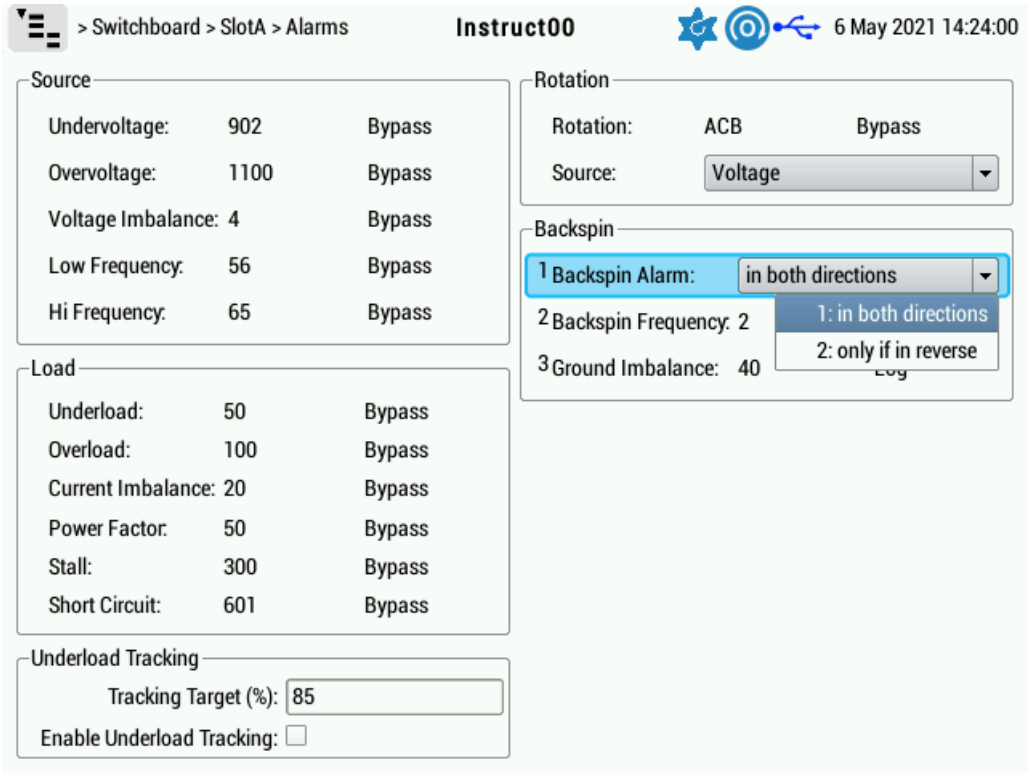


Figure 4.8: Backspin Direction Alarm Configuration

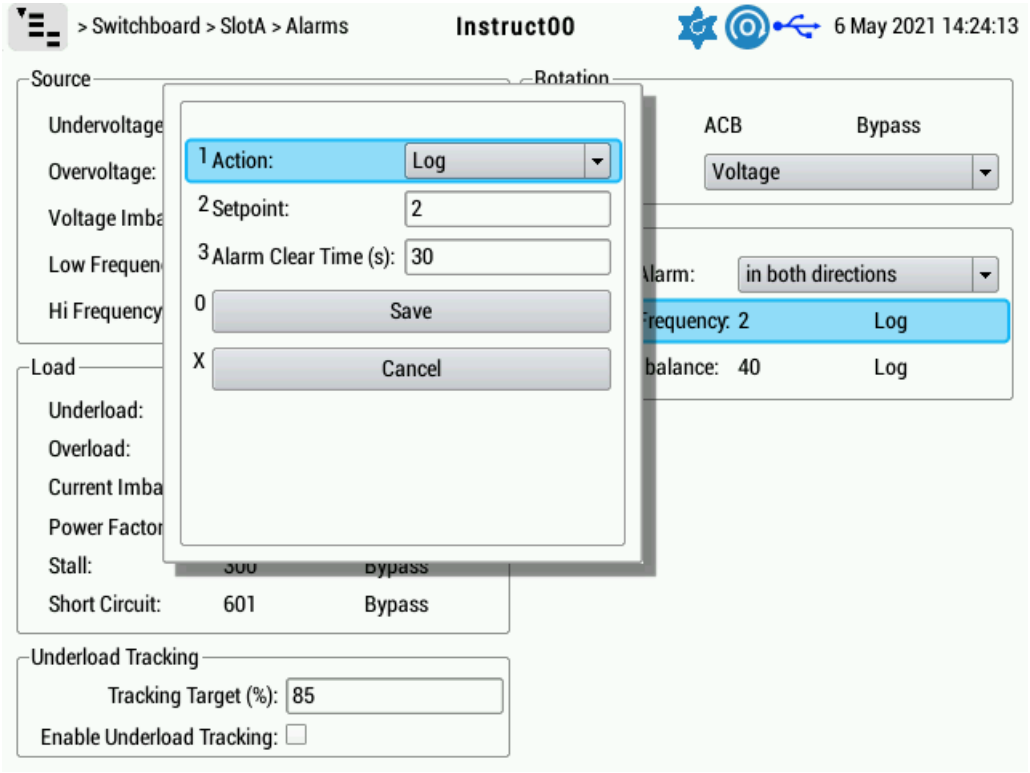


Figure 4.9: Backspin Frequency Alarm

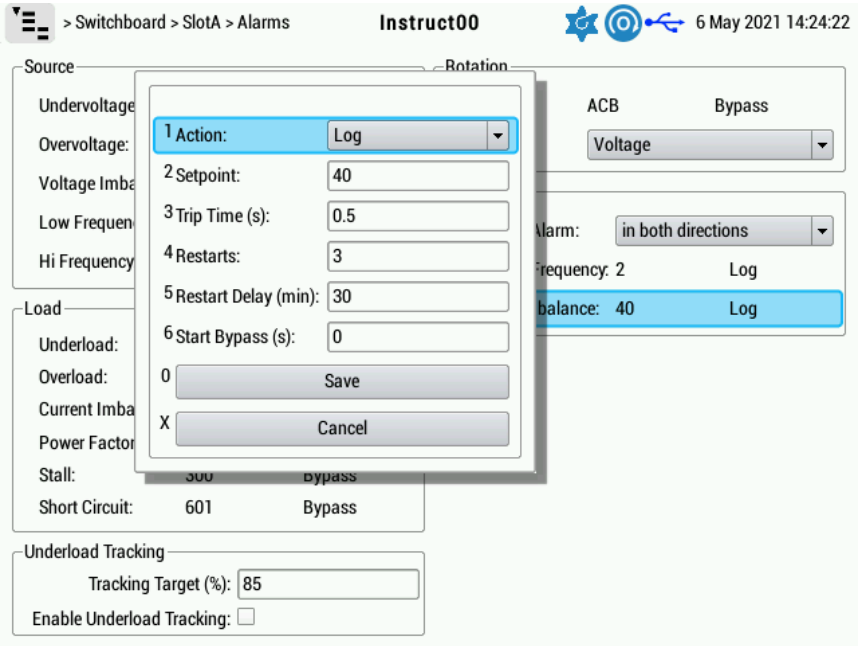


Figure 4.10: Backspin Leg Ground Imbalance Alarm

4.3 SWITCHBOARD CONFIGURATION AND CALIBRATION

The switchboard configuration menu can be accessed with the navigation sequence **Switchboard → Slot A/B → Configure**.

The Switchboard Configure screen allows the user to set the PT and CT ratios and motor nameplate rating. The PT ratio and CT ratio should correspond to the CTs, and PTs used in the switchboard. The motor nameplate rating should correspond with the actual motor used in the ESP.

The user can also choose to enable or disable the equipment according to different installations. They can choose if the Power Analyzer HV Module is installed and enable/disable the CT or PT readings. For K095 retrofits where only two PTs are installed, select “2” under the Number of PTs. For all other standard systems with three PTs, select “3”.

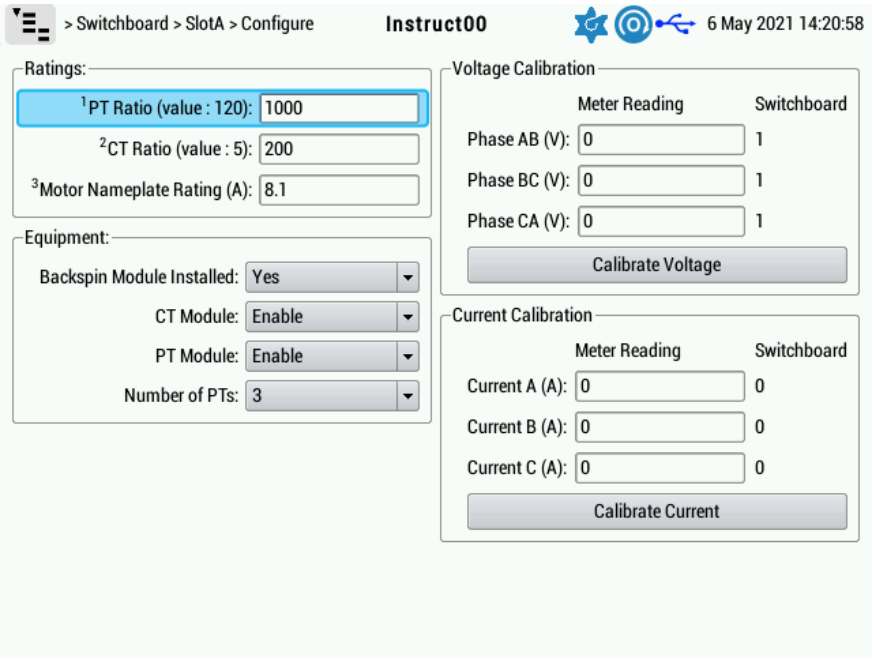


Figure 4.11: Switchboard Configuration Screen

The voltage and current inputs are pre-calibrated during the manufacturing process. However, the user can still recalibrate them according to their own needs to account for instrumentation tolerance.

 WARNING	**Potential Severity: Serious** **Potential Loss: Personnel** **Hazard Category: Electrical** The calibration procedure involves live measurements on a high voltage system. Only to be performed by qualified personnel with the appropriate PPE.

NOTE	**PT Calibration Procedure** 1. Ensure that the PTs are correctly wired to the Power Analyzer Card and that the system voltage is stable. 2. Measure the voltage with a calibrated voltmeter. Record the values for each line-line measurement. 3. Enter the recorded values in the Meter Reading fields. 4. Press the Calibrate Voltage button. 5. Confirm that the Power Analyzer Card readings match the entered values, they are shown to the right.

NOTE	**CT Calibration Procedure** 1. Ensure that the CTs are correctly wired to the CT Burden Module, and the low-voltage cable from the CT Burden Module is correctly wired to the Power Analyzer Card. 2. Ensure that the load is stable so that the current will not significantly fluctuate during the calibration process. 3. Measure the current with a calibrated clamp-on ammeter. Record the values for each phase measurement. 4. Enter the recorded values in the Meter Reading fields. 5. Press the Calibrate Current button. 6. Confirm that the Power Analyzer Card readings match the entered values, they are shown to the right.

4.4 SWITCHBOARD STARTUP CHART

The start-up chart can be accessed with the navigation sequence **Switchboard → Slot A/B → Startup Chart**.

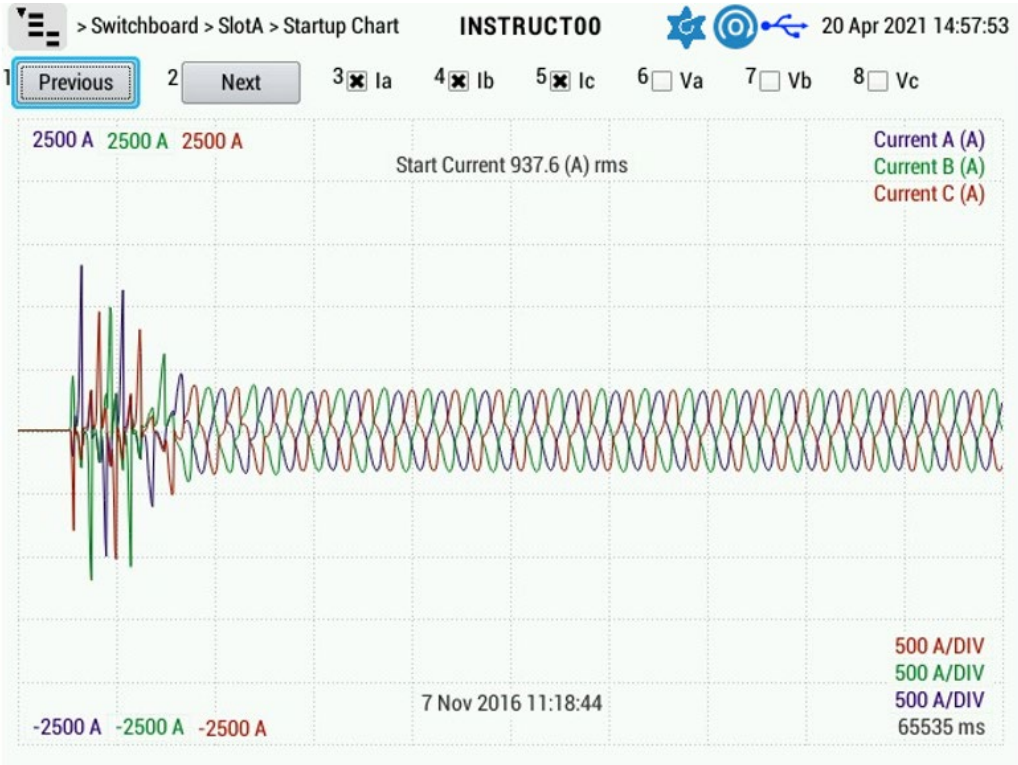


Figure 4.12: Switchboard Startup Chart Screen

Startup Chart can also be viewed through Instruct Viewer from an exported H5 file. For details, refer to Instruct Viewer user manual embedded inside the software

Section 5: Switchboard Commissioning

Fixed speed represents controller operation configured for switchboards or non-variable speed drive applications.

5.1 CONTROLLER/SWITCHBOARD VERIFICATION

For the safety of the ESP equipment and operating personnel it is important to perform a series of routine checks before startup.

 WARNING	**Potential Severity: Serious** **Potential Loss: Personnel** **Hazard Category: Electrical** Ensure that lockout/tagout procedures (refer to SENS-HSE-S027) are always followed.

1. Once the switchboard is installed at the site it is necessary to check all wiring connections, including the grounding connection between the switchboard and earth ground. A ‘tug and pull’ test will locate any loose connections.
2. The PT settings must be verified against the *Controller Commissioning Record*. Refer to drawing located on the inside door of the high-voltage compartment of the switchboard.
3. The CT Burden Module rating must be consistent with the motor current rating in the *Controller Commissioning Record*. The CT Burden Module is connected to the controller CT Inputs and is mounted with the controller inside the switchboard low-voltage compartment. The ampere rating of the switchboard must not exceed the range of the CT Burden Module.
4. Ensure that the main disconnect and breaker CB-1 are all OPEN.
5. Verify the phase wiring is correct: Phase A on the left, Phase B in the center, and Phase C on the right. It is important to ensure that the phase wiring is correct at the main disconnect, vacuum contactor, transformer primary inputs, transformer secondary inputs, wellhead junction box, and motor lead connections.
6. With power applied to the switchboard, a qualified electrician should verify the incoming voltage at the main disconnect.
7. With the disconnect closed, the voltages on the PT primaries should be verified to be within the controller input range (0-120 volts AC).

5.2 CONTROLLER PARAMETER SETUP

Perform the following steps to set up controller parameters:

1. After verifying the checks in the 5.1 Controller/Switchboard Verification section, close the CB-1 breaker. The controller will display the Status Screen after the firmware loads. It is common to have active alarms displayed at this time.
2. The parameters in the Motor Table should be set according to the values in the *Controller Commissioning Record.*

NOTE	The PT Ratio should be set to the highest voltage within the range of PT2, PT3, and PT4 taps. Refer to the diagram posted inside the switchboard to find this value.

3. Compare the controller voltage readings with measurements taken with a calibrated voltmeter by a qualified electrician. Adjust the controller configuration and settings as required.
4. The supply voltage should not be within 5% of either the High or Low alarm levels. Adjust these alarm settings if required.
5. The phase rotation must be ABC. Check the phasing if the controller displays ACB for the rotation value.

6. The settings in the Field Table must be set according to the site-specific equipment connected to the analog and digital inputs.

NOTE	After all parameters are set there should be no active alarms.

7. Go into the Switchboard Configure screen (Menu ->Switchboard->Slot A/B ->Configure), and set the following parameters at the minimum, for typical Switchboard applications:

   - **Power Analyzer HV Module Installed**
     Select Yes if a Power Analyzer HV Module is installed and connected to the Power Analyzer Card.
   - **CT Module**
     Select Enable if CTs or a CT Burden Module is installed and connected to the Power Analyzer Card.
   - **PT Module**
     Select Enable if PTs are installed and connected to the Power Analyzer Card.
   - **Number of PTs**
     Select 2 or 3 PTs depending on the installation configuration.
   - **PT Ratio**
     Enter the transformer ratio of the PTs here.
   - **CT Ratio**
     Enter the transformer ratio of the CTs for CT Burden Module here.
   - **Motor Nameplate Rating**
     Enter the current rating found on the motor nameplate

8. Go into the Switchboard IO screen (Menu ->Switchboard->Slot A/B ->IO), and set the following parameters for typical Switchboard applications:

   - **Digital Inputs**
     Configure any Digital Input connected to the Power Analyzer Card. Each input can be given a name and the input's function, action, alarm trip, trip time, number of allowable restarts, restart delay, start bypass and maint. Bypass must all be configured.
   - **Digital Outputs**
     The Power Analyzer Card provides three digital outputs. The first (Relay 1) is preconfigured for contactor operation. The other 2 (if used) must be configured for name, action, and activation source alarm.
   - **Analog Input**
     Configure the Analog Input for name, voltage/current mode, raw input min/max percentage, scaled value min/max and hi/lo protection alarms. The alarms can be configured for action, setpoint, trip time, allowable restarts, restart delay, start bypass and name.
   - **Analog Output**
     Configure the Analog output for name, source, raw value min/max percentage, scaled value min/max and setpoint.

9. Go into the Switchboard Alarms screen (Menu ->Switchboard->Slot A/B ->Alarms), and set the following parameters for typical Switchboard applications:

   - **Source Alarms**
     Set the Undervoltage, Overvoltage, Voltage Imbalance and Hi/Lo Frequency protection set points, along with their associated protection setup – action, trip time, number of allowed auto restarts, auto restart delay, and bypass time during startup.
   - **Load Alarms**
     Set the Underload, Overload, Current Imbalance, Power Factor, Stall and Short Circuit protection set points, along with their associated protection setup – action, trip time, number of allowed auto restarts, auto restart delay, and bypass time during startup.
   - **Underload Tracking**
     Enable Underload Tracking if desired and enter Tracking Target percentage.
   - **Rotation**
     Select the Rotation Direction and Source.
   - **Backspin**

Set the Backspin Alarm, Backspin Frequency, and Ground Imbalance protection set points, along with their associated protection setup – action, trip time, number of allowed auto restarts, auto restart delay, and bypass time during startup.

5.2.1 FIXED SPEED CONTROLLER SETTINGS

Table 5.1: Recommended FSD Controller Settings

SWITCHBOARD CONTROLLER RECOMMENDED SETTINGS			ALARM SETTINGS				
PARAMETER	SETPOINT	ACTION	SETPOINT	TRIP TIME (SEC)	NO. OF AUTO RESTART ALLOWED	RESTART DELAY (MIN)	START BYPASS (SEC)
Current	Current unbalance	Log and Stop	20.00%	2.0	0	30	0.0
	Overload	Log and Stop	1.15* Running Amp	16.0	0	30	0.0
	Underload	Log and Stop	0.80* Running Amp	8.0	3	30	0.0
	Short Circuit	Bypass	6* Motor Nameplate Amps	0.4			
	Stall	Bypass	3* Motor Nameplate Amps	0.5			
Voltage	Voltage Unbalance	Log and Stop	5.00%	4.0	3	30	0.0
	Overvolt	Log and Stop	1.1 * Surface voltage	1.0	3	30	0.0
	Undervolt	Log and Stop	0.9 * Surface voltage	4.0	3	30	0.0
Frequency	High frequency	Log and Stop	Supply frequency + 5Hz	0.2	3	30	0.0
	Low frequency	Log and Stop	Supply frequency - 5Hz	0.2	3	30	0.0
Supply Volt	High supply volt	Log and Stop	Supply volt + 10V	0.5	3	30	0.0
	Low supply volt	Log and Stop	Supply volt - 10V	9.0	3	30	0.0
Others	Power factor	Log and Stop	50%	0.2	0	30	0.0
	Leg Ground	Log and Stop	40.00%	0.5	3	30	0.0
				Clear Time (sec)	Alarm on Reverse Spin Only		
	Spin	Log and Stop	2.0 Hz	30.0	No		
				Detection			
	Rotation	Stop	ACB	Current			

5.3 STARTUP PROCEDURES

Perform the following procedures to start up a controller:

1. Set up the controller with all the minimum parameters described in the controller (Switchboard) Parameter Setup section.
2. Verify that no alarm(s) are active and/or latched and the unit is not locked out. If any of these condition(s) are active, unlock the unit, unlatch the active latched alarm(s), and clear all other active alarm(s) by rectifying their cause(s).
    a. Select HAND/AUTO operation mode, then press START. If the unit is locked out or any alarm is still latched, the START button will not appear in the display when HAND/AUTO mode is selected.
    b. Calibrate the Switchboard Current Amps and Switchboard Phase Voltage readings by adjusting CT Ratio and PT Ratio setpoints. Do this by comparing displayed initial Switchboard current and voltage values to the values obtained using a multimeter. Further refinement of the readings is possible using the calibration feature found on the Switchboard Configure screen (Menu>Switchboard>Slot A/B>Configure). For voltage calibration, enter the meter readings for each phase and select Calibrate Voltage. For current calibration, enter the meter readings for each phase and select Calibrate Current.
    c. Reset the Under/Overload and Under/Overvoltage settings of the Power Analyzer Card accordingly.
    d. Once all external signals and subsystems have been connected to the drive, run the drive for a reasonable period to confirm proper operation and that no faults or shutdowns occur.
    e. Download the configuration/history/data for future reference.

Section 6: Switchboard and Controller Support Resources

6.1 PRODUCT DOCUMENTATION

This manual describes using an INSTRUCT ESP Intelligent Controller to configure the INSTRUCT ESP Switchboard. For the individual product manuals:

LCS-ENG-M0003 INSTRUCT ESP Switchboard Installation, Operation & Maintenance Manual
LCS-ENG-M0009 INSTRUCT ESP Intelligent Controller Installation, Operation & Maintenance Manual

6.2 GUIDES AND RELEASE NOTES

General guides, best practices, technical alerts, and software release notes for:

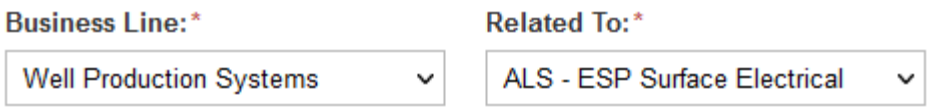
INSTRUCT ESP Switchboard are available at InTouch 3792757 Reference Page.
INSTRUCT ESP Intelligent Controller are available at InTouch 6023027 Reference Page

6.3 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.



6.4 HOW TO REACH US

You can find more information about Sensia, INSTRUCT ESP Switchboard, and 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

- Lift Control Drives Page: https://www.sensiaglobal.com/Sensia-Lift-Control-Systems/Lift-Control-Drives
- ESP Controller Page: https://www.sensiaglobal.com/Sensia-Lift-Control-Systems/Lift-Control-Devices/ESP-controllers

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