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Summit ESP A
Halliburton Service

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SUMMIT ESP ACS-15 OPERATORS MANUAL

Installation, Set-up and Operation of the Summit ESP ACS-15 Variable Speed Drive. Rev. 1

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The information contained in this manual is subject to change without notice.

Table of Contents

1 SAFETY

Definitions and Symbols

WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment.
Read the message and follow the instructions carefully.

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

WARNING

This symbol indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION

This Symbol indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous High Voltage

WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

CAUTION

Remove any External Start signals or permissives before resetting the fault to prevent an unintentional restart of the Summit ESP VSD, which could result in personal injury or equipment damage.

WARNING

1. **Before startup, observe the warnings and safety instructions provided throughout this manual.**
2. **Internal components and circuit boards (except the isolated I/O terminals) are at utility potential when the Summit ESP VSD is connected to the line. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it.**
3. **When the Summit ESP VSD is connected to the utility, the motor connections U (T1), V (T2), W (T3) and DC bus/brake resistor connections B–, B+, R– and output bus bars / terminal blocks are live even if the motor is not running.**
4. **Do not make any connections when the drive is connected to the utility line.**
5. **Do not open the cover of the AFE drive immediately after disconnecting power to the unit, because components within the drive remain at a dangerous voltage potential for some time. Wait at least five minutes after the cooling fan has stopped and the keypad or cover indicators are dark before opening the Summit ESP VSD cover.**
6. **The control I/O terminals are isolated from the utility potential, but relay outputs and other I/O's may have dangerous external voltages connected even if power is disconnected from the SUMMIT ESP VSD.**
7. **Before connecting to the utility, make sure that the cover of the drive is closed**

2 SHIPPING AND STORAGE

Short Term Storage

The drive can be stored outside unwrapped for short periods of time (1 month or less) without fear of damaging the drive.

Long Term Storage

For long term storage it is recommended that the drive remain in its original packaging. This is sealed from the elements and contains desiccants to prevent moisture build up. *If drive is equipped with space heaters they should be energized.*

In the field

If the VSD is going to be left inoperable in the field, for example during a work-over, or for any other reason, it is HIGHLY recommended power be left on the drive until work actually begins. This provides the drive with heating and reduces moisture build up in the drive reducing the likelihood of faults or damage during the reapplication of power or start-up. Note: When the drive has been shut down in extreme cold weather for an extended amount of time, keep in mind it may take a while to return to operational temperatures.

Shipping

The drive should be properly wrapped for shipping. Short distances without wrapping will not harm the drive; however some thought should be put into the time of year and general weather.

The drive should be properly strapped to the truck bed for shipping. No external boxes should be used for strapping. Two straps should be used between the two lifting tabs on the main enclosure and properly tightened.

The *drives should be shipped in a vertical position* with proper constraints to prevent damage to the units. Cabinets are a "Uni-Body" style (they do not have a metal frame) and extreme care should be taken to not over tighten the straps or chain winches when securing the load. Otherwise damage will occur. Drives that must be shipped in a horizontal position contact factory personnel prior to shipment for further instructions. Contact information is 918-392-7820, and ask for Controls. *Non-compliance with these instructions will make the freight forwarder or transporter responsible for all damages and charges associated with the equipment including repair costs.*

Receipt of Product

This Summit AC variable speed drive has met a stringent series of factory quality requirements before shipment. It is possible that packaging or equipment damage may have occurred during shipment. After receiving your Summit Variable drive, please check for the following:

- Check to make sure that the package(s) includes the proper drive.
- Inspect the unit to ensure it was not damaged during shipment

- Make sure that the part number indicated on the drive nameplate corresponds with the Summit ESP part number on your order.
- If shipping damage has occurred, or the delivery does not correspond to your order, please contact your Summit representative immediately.

3 INSTALLATION

ENCLOSURE PLACEMENT

The drive enclosure should be placed on a solid “substantial” base that is level and not subject to settling due to moisture. The preferred base is concrete but substitutions can be accepted by consulting your Summit representative.

INITIAL CHECKS

Check the drive enclosure for any damage, if any damage is discovered contact the Summit representative.

If the enclosure has a “Shockwatch” impact sensor check condition of its red flags. If it has been tripped make sure to report to Tulsa Controls. The sensors will be located on the lower right hand section of the door and will be yellow and black.

Before connecting to power go through the wiring connections and verify secure connections and check all fuses and safety devices are intact.

Check that the drive is free of moisture and there is not excessive dirt or debris.

It is recommended you perform the static checks described in the “Static checks” section of this manual.

4 POWER WIRING –

General Guidelines

To ensure proper wiring, use the following guidelines:

- Use heat-resistant copper cables only, 75°C or higher
- The input line cable and line fuses must be sized in accordance with the rated input current of the unit. See Table 1-1.
- Provide a ground wire with both input power and output motor leads
- The control should be installed in accordance with all applicable codes. In accordance with NEC 430 Part IV, a protective device is required in the installation of the control.
- This protective device can be either a fuse or a circuit breaker. An RK fuse is an acceptable component. For maximum protection, Summit recommends a Class T fuse.
- Input line cable and line fuses must be sized in accordance with table on Table 1-1
- If the motor temperature sensing is used for overload protection, the output cable size may be selected based on the motor specifications
- If three or more shielded cables are used in parallel for the output on the larger units, every cable must have its own overload protection
- Avoid placing the motor cables in long parallel lines with other cables
- If the motor cables run in parallel with other cables, note the minimum distances between the motor cables and other cables given in the following table

Cable Spacing

Note: The cable spacing also applies between the motor cables and signal cables of other systems.

- The motor cables should cross other cables at an angle of 90 degrees
- If conduit is being used for wiring, use separate conduits for the input power wiring, the output power wiring, the signal wiring, and the control wiring

Summit ACS-15 Variable Speed Drive Short-Circuit Current Rating

The Summit ACS-15 Variable Speed Drive has a maximum symmetrical short-circuit current (ISC) rating of 100 kA rms. The ISC Ampere rating is in accordance with the requirements of UL 508C “Standard for Power Conversion Equipment”.

These requirements cover “open or enclosed equipment that supplies power to control a motor or motors operating at a frequency or voltage different than that of the input supply” including devices rated 1500 volts or less. The Summit Variable Speed Drive series uses an electronic overcurrent protection feature for compliance with the UL 508C requirement. Branch circuit protection must be provided in accordance with local codes.

Table 1-1

kVA	Frame Size	NEC I(A)	I (A)	Fuse Qty	Fuse (A)	Wire Size AWG Power	Wire Size Ground	Terminal Size Power	Terminal Size Ground
72	FR7	77	87	3	110	1	6	14–1/0	10–2/0
87		96	105	3	125	1/0	4	14–1/0	10–2/0
116		124	140	3	175	3/0	2	4–3/0	4–3/0
141	FR8	156	170	3	200	4/0	I/0	3/0–350 kcmil	4–3/0
170		180	205	3	250	300	2/0	3/0–350 kcmil	4–3/0
217	FR9	240	261	3	350	2 x 4/0	3/0	2 x 3/0–350 kcmil	4–000
249		302	300	3	400	2 x 250	300	2 x 3/0–350 kcmil	4–000
320		361	385	3	450	2 x 250	300	600 kcmil	300 kcmil
382	FR10	414	460	3	500	2 x 300	300	600 kcmil	300 kcmil
432		477	520	3	600	2 x 400	350	600 kcmil	300 kcmil
491		590	590	6	350	2 x 500	500	Bus bar (2X 3/8" Studs)	Bus bar
540	FR11	NS	650	6	400	4 x 4/0	500	Bus bar	Bus bar
607		NS	730	6	450	4 x 250	600	Bus bar	Bus bar
682		NS	820	6	500	4 x 300	600	Bus bar	Bus bar
765	FR12	NS	920	6	500	4 x 300	600	Bus bar	Bus bar
856		NS	1030	6	600	4 x 350	—	Bus bar	Bus bar

Table 1-2

HP	Frame Size	FLA	Breaker Current	Wire Size @ AWG Power	Ground	Terminal Size Power	Ground
50	FR8	72	100	2	6	1/0–14	2/0–10
60		87	100	1/0	4	1/0–14	2/0–10
75		105	125	2/0	2	3/0–4	3/0–4
100	FR8	140	150	4/0	1/0	350 kcmil–3/0	3/0–4
125		170	200	300	2/0	350 kcmil–3/0	3/0–4
150		205	250	350	3/0	350 kcmil–2 x 3/0	3/0–4
200	FR9	261	300	2 x 250	3/0	350 kcmil–2 x 3/0	3/0–4
250		300	400	2 x 250	300 kcmil	600 kcmil	600 kcmil
300	FR10	385	500	2 x 300	300 kcmil	600 kcmil	600 kcmil
350		460	600	2 x 400	300 kcmil	600 kcmil	600 kcmil
400	FR11	520	700	2 x 500	500	Bus bar	Bus bar
500		590	800	4 x 4/0	500	Bus bar	Bus bar
550		650	900	4 x 250	600	Bus bar	Bus bar
600		750	1000	4 x 300	600	Bus bar	Bus bar
650	FR12	820	1000	4 x 300	600	Bus bar	Bus bar
700		920	1200	4 x 400	—	Bus bar	Bus bar

6-PULSE/AFE SYSTEM INSTALLATION

Standard 6-pulse and Active Front End (AFE) drives are three wires in, three wires out. No special installation is required.

12/18 PULSE SYSTEM INSTALLATION

12- and 18-pulse drives require phase shift transformers ahead of the drive to provide additional phases of input voltage. The number of conductors required between phase-shift transformer and drive input is always half the number of pulses, i.e., 6 for the 12-pulse system and 9 for the 18-pulse system.

I/O WIRING

Input and output power wiring should enter and leave the junction box on the right side of the drive via weatherproof bushings. External wiring to/from the drive's digital or analog inputs or outputs should not be routed alongside high voltage wiring, both for reasons of safety and electrical noise reduction.

DIGITAL INPUTS

Six digital inputs, DI1 through DI6, are available. They are found on terminals near the bottom of the terminal board. Digital inputs DI1-4 operate on 120 VAC. Digital inputs DI5&6 operate on 24 VDC. Caution: The Summit drive comes with black jumpers connecting these inputs to 120 VAC at terminals labeled DI1-DI4 A&B. You must remove a jumper to connect your field wiring. **Do not make your connections while power is applied to the drive!** These digital inputs are in series with and will "make" the "hot" connection to relay coils.

These relays' contacts activate digital inputs on the Main Drive chassis. The Main Drive's digital inputs are thus protected from direct voltage coming from inside or outside the Summit drive's enclosure.

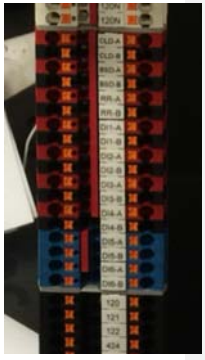


Figure 01 – Black jumpers connect Digital Inputs to 120VAC

On the Summit drive the 120VAC digital inputs are on terminals DI1A&B (DI1), DI2A&B (DI-2), DI3A&B (DI-3), DI4A&B (DI-4) –figure 01, and the 24VDC digital inputs are on terminals 215 & 24- (DI-5) and 216 & 24- (DI-6)- figure-01A

4-1-2016: Where is figure 01A??

To set up a digital input you must first access the Main Menu, then the I/O Menu, then the Dig Input Setup menu. Choices are available for Trip State (NO/NC) and Alarm Action (None, Alarm or Fault). In addition, timers may be programmed for Start Delay (seconds), Trip Delay (seconds), Maximum Restarts (number of) and Restart Delay (minutes).

The green status windows at the left side of the Digital Input setup screen indicate whether the digital input is "true" or not. With the factory yellow jumpers in place and the Trip State set to "closed" the status would be "OK" or "true". Note: The status indicator will only change if the alarm action is set to warning or fault.

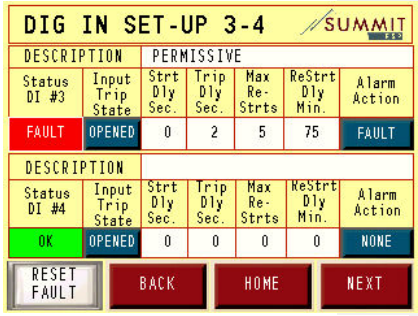


Figure 02– Digital Inputs Screen. Press the Next buttons to set up Digital Inputs 3 through 6.

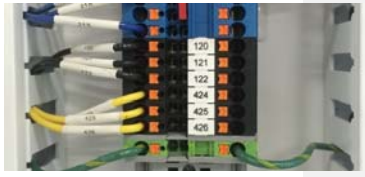


Figure 03– The upper 3 black wires shown are run status and the 3 lowest yellow wires of terminal strip are Digital Output wires.

DIGITAL OUTPUT

The Summit drive has two digital outputs whose wiring is found on the lower right of the terminal block, as shown in the figure. It consists of a common (COM) connection that can be wired to either 120 VAC or 24 VDC. Field wiring should be connected to the left side of the terminal board.

On the Summit drive the digital output #1(run status) connections are 120 NC, 121 COM, 122 NO and switches on run. It is a dry contact and is not programmable.

Digital output #2 is programmable from the Digital output setup screen. On the Summit drive the 424 terminal is NC, 425 is com, and 426 is NO.

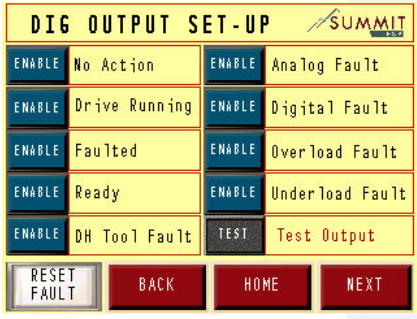


Figure 04 – Digital Output Setup screen

The Digital Output #2's function can be selected by choosing Main Menu, then the Dig Output Setup menu. The drive's Digital Output relay can be set to switch on these occurrences: Drive Running, Drive Faulted, Drive Ready, Downhole Tool Fault, Analog Fault, Digital Fault, Overload Fault, or Underload Fault. It can also be set so that it never switches (No Action). In addition, the relay can be forced to switch states for test purposes by pressing the Test Output button.

ANALOG INPUTS

Two analog inputs are available on the stock Summit drive. Figure 05 shows the drive's internal analog shielded wiring terminated on the right side of the terminal board. The black terminal block is positive, the orange terminal block is the negative, and the grey terminal block is for the shield. Connections to these analog inputs should be made on the left side of the terminal blocks. It is preferred that the shield wire be landed both at the terminal blocks and at the device providing the analog signal. This is done to reduce interference or "noise". The two analog inputs are protected by surge protectors.

Figure 05 – Analog input /output terminal blocks black terminal block +, orange block- , gray block shield

On the Summit drive the Analog Input 1 connections are on terminals 302+, 302- and an adjacent shield (SHLD) terminal. The Analog Input 2 connections are on terminals 304+, 304- and an adjacent shield (SHLD) terminal. Note: analog input terminals do not supply power. 24VDC power is available on the blue and white terminal blocks labeled 24+ and 24- directly below the analog I/O terminals.

The two analog inputs can accept 0-20 mA, 0-10 VDC or -10 to +10 VDC, ground-referenced or differential. These options are set via jumpers X1 and X2 on the drive's OPTA9 circuit board, which is found under the cover on the internal drive module. Reference figure 06 for the location of the OPTA9 circuit board jumpers, and figure 07 for location of OPTA9 board

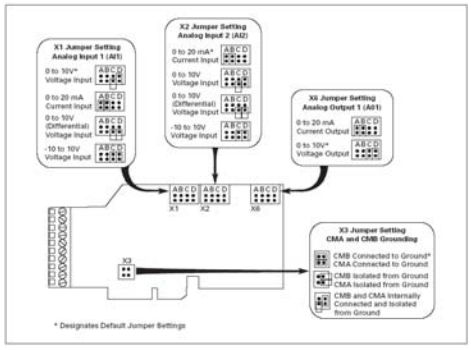


Figure 06 – OPTA9 Board. Jumpers X1 and X2 set the input signal type for Analogs 1 and 2. Jumper X6 sets output signal type for Analog Output 1. X3 jumpers are related to Digital Inputs and do not need to be changed.

The red circle in Figure 07 below shows the cover that must be opened to access the Option A9 circuit board. Caution: Make sure drive power is off! The red circle in Figure 07-A shows the location of OPTA9 board . The board may be removed to gain access to jumpers. Note: When installing or reinstalling boards be sure board is properly seated in slot.

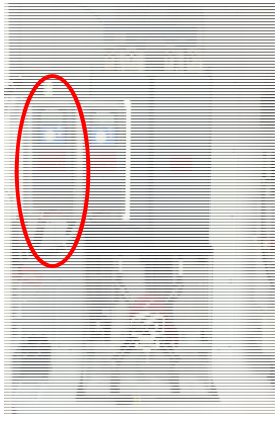
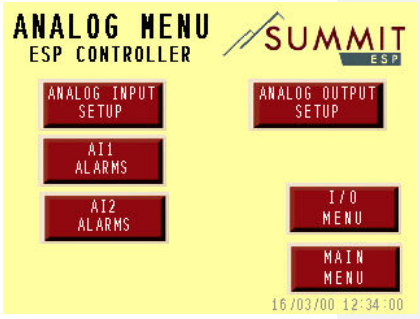


Figure 07 – Open this cover to access the Option A9 Board.

Figure 07-A location of OPTA9 board

The Analog Setup screen allows scaling of the two analog inputs. They can also be named by clicking on the larger white rectangle. Touch this rectangle to bring up an alphanumeric screen where the analog's desired name can be entered. By clicking on the upper blue button at right you can designate the linear or volumetric units of the analog. Choice include FEET, METERS, PSI, BARS, ATMOSPHERES, GALLONS/DAY, BARRELS/DAY, $FEET^3$/DAY, $YARDS^3$/DAY, $METERS^3$/DAY, DEGREES F, DEGREES C, MILLIAMPS, AMPS, VOLTS, KILOVOLTS, INCH-POUNDS, FOOT-POUNDS, NEWTON-METERS, KILOWATT-HOURS or HZ. Clicking on the lower blue button selects either 0-20 mA or 4-20 mA signal format.

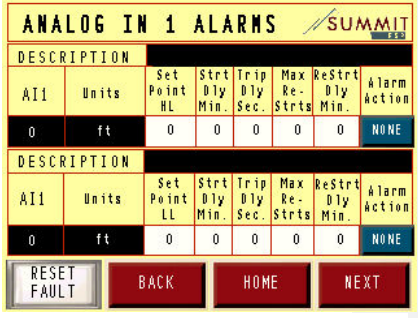


The present numerical value of the Analog Inputs may be observed in the black windows at the left.

Figure 08 – Analog Setup screen

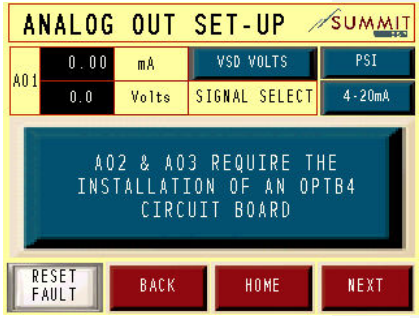
ANALOG ALARMS

If it is desired to have an analog input trigger an action on the part of the drive you can enter settings in the Analog In 1 and/or Analog In 2 Alarm screens. Available limits and timers are shown in picture to the right. To choose what happens when a limit is reached for the set amount of time you can press the blue Alarm Action button, where your choices are None, Warning or Fault. From the Analog In 1 screen you can press the Next button to reach the Analog In 2 Alarms screen.



Analog Input 1 Alarms screen

ANALOG OUTPUT



Analog output set-up screen

The Summit drive has one configurable analog output (Analog Out 1). Its wiring is shown in Figure 05 above, grouped closely with the drive's internal analog inputs wiring. This analog output is protected by a surge protector.

On the standard Summit drive the Analog Output 1 connections are on terminals 318+, 318- and an adjacent shield (SHLD) terminal. . It is preferred that the shield wire be landed both at the terminal blocks and at the device receiving the analog signal. This is done to reduce interference or "noise". Note: The analog output terminals do not supply power. . 24VDC power is available on the blue and white terminal blocks labeled 24+ and 24- directly below the analog I/O terminals.

To configure Analog Output 1 select the Analog Setup screen, shown above. Press the blue button in the lower left to select what is represented by Analog Output 1. Selections are: VSD AMPS, VSD VOLTS, VSD FREQUENCY, ANALOG INUT 1 VALUE, ANALOG INPUT 2 VALUE, MOTOR SPEED, INTAKE PRESSURE, INTAKE TEMPERATURE, MOTOR WINDING TEMPERATURE AND DISCHARGE PRESSURE.

The present numerical value of Analog Output 1 may be observed in the black window near the left side of the screen.

5 COMMISSIONING A PUMPING SYSTEM (INDUCTION MOTOR)

Read and follow all safety warnings and cautions in this manual.

2. During installation ensure:

- That the Summit ESP Drive and motor are properly connected to ground. (Per NEC, API or other appropriate code document.
- That the utility and motor cables are in accordance with the installation and connection instructions.
- That the control cables are located as far as possible from the power cables.

- That control cable shields are connected to protective ground. That no wires make contact with any electrical components in the NXP5 Variable Speed Drive. That the common wire of each digital input group is connected to 120VAC neutral or -24VDC of the I/O terminal supply or an external supply as detailed here.

3. Check that all cooling air vents and passages are clear of debris. Ensure all fans operate at the appropriate time.

4. Check that moisture has not condensed inside the drive cabinet.

5. Check that all START/STOP switches connected to the I/O terminals are in the STOP state.

6. Connect the NXP5 to the utility and switch the power on.

7. Ensure that the parameters on the Quick Start 1, Quick Start 2 and Limits screens match the application by setting, at minimum, the following parameters to match the motor nameplate:

- Nominal voltage of the motor.
- Nominal nameplate frequency of the motor.
- Nominal nameplate full load speed of the motor.
- Motor nominal current.
- Motor power factor.
- Motor type (select PM motor in Group 6 of special app)

8. Perform No-load Test A –or- Test A & B (without the motor connected).

A. Control from the SummitView Set Frequency (Frequency Control)

- Apply input power to the drive.
- Change the Set Frequency to 40 Hz.
- Move the HOA switch to either Hand or Auto.
- Check that the output frequency climbs to and remains at 40 Hz
- Change the Set Frequency to 60 Hz.
- Check that the output frequency climbs to and remains at 60 Hz
- Return the HOA switch to the Off Position.

B. Control from an Analog Source: (PID Mode)

- Apply input power to the drive.
- Select the appropriate Analog Source. This can be Analog Input 1, Analog Input 2, Motor Amps, VSD amps, or the pressure from a Down-Hole Sensor.
- Set up the Analog Source on the Analog Set-Up Page.
- Set-up up the appropriate parameters on the PID set-up Screen.

  - If the actual Analog source is not available a 0-20 mA current source can be used to test operation.
- Set the source to minimum, 0 or 4 mA.
- Move the HOA switch to either Hand or Auto.
- Check that the output frequency climbs to and remains at the Minimum Frequency set on the Quick Start 1 Screen of the SummitView.
- Set the source to maximum, 20 mA.
- Confirm that the drive's output climbs to and remains at the Maximum Frequency set on the Quick Start 1 Screen of the SummitView.
- Return the HOA switch to the Off Position.

9. Disconnect power to the drive. Wait until the cooling fan on the unit stops and the indicators on the panel of the VSD Chassis are not lit. Wait at least five more minutes for the DC bus to discharge. Check the DC bus with a Fluke meter for any residual voltages. Connect the motor to the drive.

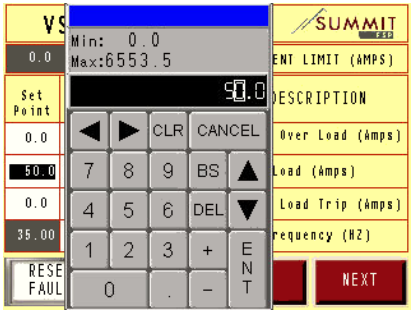
6 SUMMT VIEW BASICS

COLOR, TOUCH SCREEN DISPLAY OVERVIEW

The Summit ESP variable speed drive's display is easy to read. Touchscreen technology makes an external keypad unnecessary. External keypads are prone to failure and/or intermittent operation, since their buttons are mechanical in nature.

DISPLAYING A MENU, READING OR SET POINT

Simply press the button for the screen you would like to display. The software takes you directly to that screen. White fields are settable parameters. Simply press the field you wish to change and the appropriate keypad will be displayed.



EDITING A SET POINT OR PARAMETER

Press the set point or parameter value field. A pop-up menu will appear and the field being adjusted will be highlighted. Enter the desired setting, including decimal if desired. Press ENTER. Note: It is not possible to enter a value outside of the parameter's range. If a value is entered that is out of range, pressing "Enter" will have no effect. Clear the entry and enter a valid value. Minimum and maximum values are displayed in the upper portion of the pop-up menu.

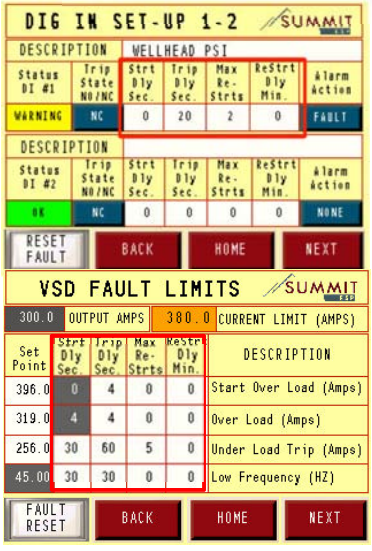
7 BASIC OPERATION

START / STOP

The drive is started by turning the Hand-Off-Auto (HOA) switch to either its Hand position or its Auto position, and pressing the green start button. Turn the HOA switch to OFF to stop the drive.

HAND/OFF/AUTO SWITCH AND RUN SELECTION

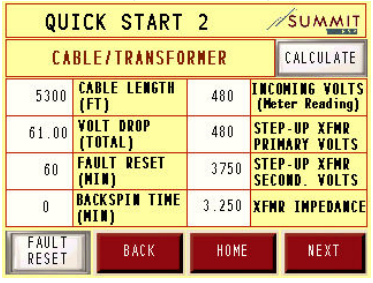
The drive will run and will perform automatic restarts with the HOA switch in Auto position. With the HOA switch set in the Hand position the drive will not perform automatic restarts. A jumper on the terminal block may be removed and external wiring connected to provide a remote run input while in HOA switch is in either position.



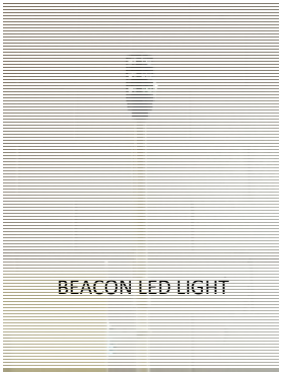
RESTART PARAMETERS

The Summit VSD has automatic restart capability for many of its fault shutdowns, including Overload, Underload, Low Speed, Digital/Analog Inputs, Down Hole Sensor Faults and many others. Some of these restarting faults have customizable parameters associated with them:

- Set Point – The point at which the protective parameter will trip
- Start Delay – The length of time the fault will be ignored to allow the unit to start and stabilize before becoming an active fault.
- Trip Delay – The Length of time the fault will need to be active before the fault trip occurs.
- Maximum Restarts (maximum number of automatic restarts)
- Restart Delay (time after trip before auto restart)



- Backspin Time – Other restarting faults, like Power Loss, have default settings in drive firmware; their trip parameters are fixed for drive or personnel safety reasons, but automatic restarts will occur after the time set in Backspin Time, which is settable by the operator in the Quick Start 2 menu.

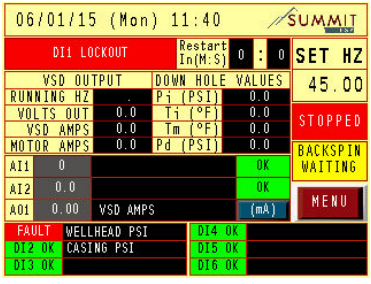


HIGH INTENSITY LED STATUS LAMP

The High Intensity Status Lamp is mounted at the top of the Summit VSD's front door, for visibility to a wide area. It consists of bright red, green and amber LED's that quickly and intuitively indicates the drive's present condition state, in accordance with conventional oilfield usage. Red indicates the drive is stopped, green indicates the drive is running, and flashing amber indicates there is an automatic restart pending. Flashing amber with a steady green LED indicates that the drive is operating in an Alarm condition and will soon trip, if the operator does not intervene.

ALARM AND SHUTDOWN INDICATIONS

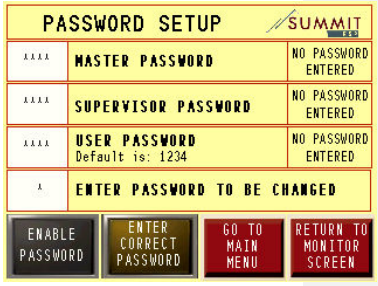
The red, green and yellow areas of the SummitView Home or Default screen provide indications regarding present drive status, alarms and faults. Other screens also provide the same or similar information.



LOCKOUT CONDITION

When the drive is in a lockout condition it has stopped due to a fault, and that particular fault has been configured by the user to keep the drive stopped. The user is does this by entering a zero (0) in the Max Restarts field for that fault. The fault can be cleared by pressing the white Fault Reset button found on any number of screens, by turning the HAND/OFF/AUTO (HOA) switch to OFF and then back to HAND or Auto, or by turning drive power OFF, waiting 5 minutes for DC bus discharge, and reapplying power. If a lockout fault has occurred there can be no starts, manual or automatic, until an operator intervenes.

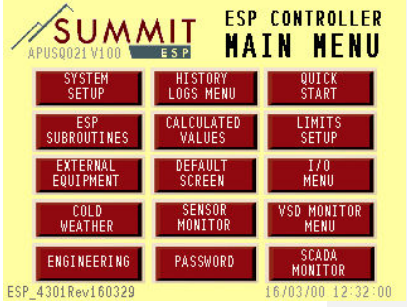
SYSTEM SECURITY



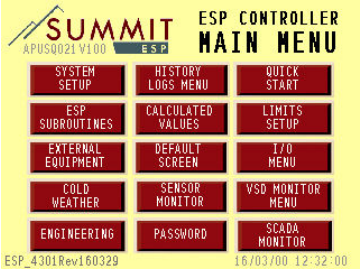
The SummitView has the capability of administering security protection to guard against unauthorized set point editing. The security is initiated by entering a numeric password into the Level 1 and/or 2 set point. If a password code number is entered into either security level set point, then an operator must enter the same password into the User Password variable before any changes to set points or readings will be allowed. Without any security level achieved, the operator may view most display screens but will be unable to edit or change them. Level one of security will grant access to the most commonly used or changed set points, such as modifying alarm thresholds of protection set points. Level 2 security grants access to most of the other set points. The controller is shipped from the factory with all security protection disabled, so if an operator is unable to change set points in the field, a security code will have been entered in the field by local personnel. These local personnel should then be contacted to learn the security code required. The user password is found under the Password screen.

SOFTWARE REVS

The revision number of the Summit VSD's software is displayed in the lower left of the Main Menu, just underneath the Summit logo (see Figure XX). It appears in this format: 4301_ESP_Rev160329, which in this case would signify this revision was released on March, 03 2016.



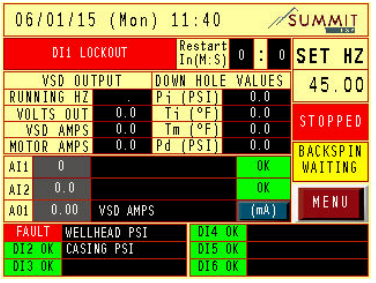
8 THE SUMMITVIEW MENUS

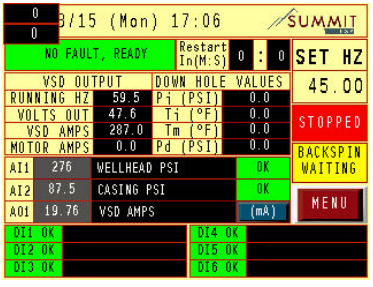


OVERVIEW OF SUMMITVIEW MENU STRUCTURE

The SummitView menu structure is simple and intuitive. Simply press the item or page you wish to view and the system will take you there. Simply press the settable parameter you would like to change and the appropriate keypad will be displayed.

All items are color coded as follows:





- 867.5 Black – Read Only Parameter
- 250 White – Settable *Protective* Parameter
- 200.0 Orange – Settable Parameter
- OK Green – Status Color – Normal/No Attention Required
- WARNING Yellow – Status Color – Warning/Drive is timing out to shut down/May need attention
- FAULT Red – Status Color – Fault/Requires attention to determine the problem
- Blue – Status of sub-routine

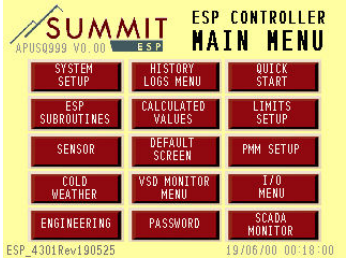
MONITOR SCREEN

The default or Monitoring Screen will be displayed when first starting or arriving at the drive. This screen contains all of the necessary information a pumper will need for daily reports. The SummitView system defaults to the Monitor page 10 Minutes after the last use of the system. Seen above left.

The Monitor Screen has all the information an operator should need for monitoring the operation of the well.

- Drive Status
- Restart Time (if waiting)
- VSD output Parameters Note: Motor amps are calculated based on VSD output amps and transformer ratio.
- Down-Hole Sensor Basic Parameters
- Analog Input Status
- Analog Output Status
- Discrete (or Digital) Input status
- Set Frequency
- Run Status
- Restart Status
-

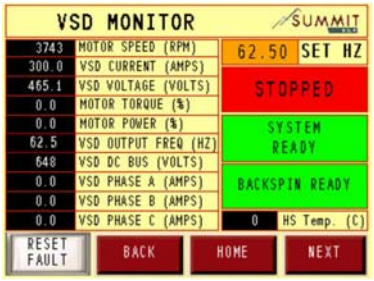
MAIN MENU (HOME SCREEN)



The main menu provides access to all major areas of the SummitView structure. All menus are written in English. Simply press the button for the screen you wish to view and the SummitView software will take you there.
The software revision number is displayed in the lower left-hand corner below the Summit Logo. When calling engineering for support, ensure you note this revision number.

SYSTEM SET-UP

The system Set-up screen provides adjustment to the display Contrast and Brightness, Date and Time settings, as well as Enable/Disable of the down-hole sensor and the External PLC functions of the drive. The Pilot LED, and down hole sensor (if used) can be connected through either Modbus RS-485 or Ethernet, by selecting the desired connection. Comm update times will populate and begin to change when proper connection is selected. The times shown here typical.



VSD MONITOR

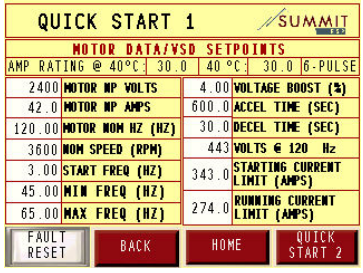
The VSD Monitor screen provides a more detailed status of the VSD status. Three-phase current is displayed along with Motor RPM, Motor Torque and Motor Power. The VSD Heat Sink Temperature is also displayed. It is also possible to set the operating frequency from the VSD Monitor screen.

QUICK START 1 & 2

By completing the Quick Start 1, Quick Start 2 and Limits Screens, you can safely operate the driven equipment. Basic calculations are performed when you press the "Calculate" button on the Quick Start 2 Screen.

QUICK START 1

The drive will automatically input its amp rating into the amp rating slot. It will also indicate if it is a 6-pulse or AFE.



Start Frequency:

The Start Frequency is normally set between 5-10 Hz. Its range is 3-30 Hz. During hard starts it can be helpful to increase the start frequency to help push current to the motor and provide a faster start. The start frequency should be set to the lowest setting that still allows reliable starting.

Minimum Frequency (MIN FREQ (HZ)):

The pumping system Minimum Frequency is determined by the application engineer or salesman during the sizing process. Several things can limit the minimum frequency. The most frequent limitation of an ESP is fluid past the motor. Particularly on heavily loaded systems, it is important to ensure enough Fluid flow past the motor for cooling. The amount of flow required is also determined during the sizing process. The minimum frequency prevents the operator from setting a frequency that's too low for proper operation and limits automated operation during PID control. The drive will do what is necessary to stay above this frequency. The drive will only go below the minimum frequency if the load (current) increases enough that the drive must reduce the frequency to stay below the Current Limit. This can occur if the pump ingests solids or a cable/motor short circuit

occurs. During start, this will display itself as very low running frequency and current at or near the current limit setting.

Maximum Frequency (MAX FREQ (HZ)):

The pumping system Maximum Frequency is determined by the application engineer or salesman during the sizing process and is usually limited by the Motor/VSD/System load capacity or possibly to simply prevent operation at excessive RPM. Pump wear increases with increases in speed. For this reason, ESP's are seldom operated above 70 Hz, but there are exceptions. Normally, the Maximum Frequency should be set to prevent the drive from entering current limit. If the drive enters current limit at 63 Hz, this or a slightly lower setting should be entered as the Maximum Hz, unless the application engineer or salesman has specified a different setting.

Nominal Speed (NOM SPEED (RPM):

The nominal speed is the rated RPM of the motor at 60 Hz. Two-pole, AC induction, ESP motors are theoretically rated at 3600 RPM, but when loaded they will "slip" and run at more like 3450 to 3550 RPM. Surface motors can be 2-, 4- or 6-pole motors, with corresponding theoretical speed ratings of 3600, 1800 and 1200 RPM.

Motor Nameplate Volts (MOTOR NP VOLTS):

The Motor Nameplate Volts is the voltage rating on the motor nameplate. This will be used during "Calculate" to determine the proper Volts @ 60 Hz and the calculated secondary voltage at the transformer.

Motor Nameplate Amps (MOTOR NP AMPS):

The Motor Nameplate Amps is the current rating listed on the motor nameplate. This will be used during "Calculate" to determine the proper calculated motor current on the transformer secondary.

Motor Nameplate Frequency (MOTOR Nom Hz):

The Motor Nameplate Frequency is the frequency rating listed on the motor nameplate. This will be used during "Calculate" to determine the proper calculated motor current and voltage on the transformer secondary.

Accel Time (ACCEL TIME (SEC)):

The Accel Time is the time the drive references to go from the starting Frequency to the Set Frequency. This is normally set between 5-10 seconds. During Hard Starts, it can be helpful to set the Accel Time to a lower Value to provide a harder start to the motor. At very low settings (<3 Sec.) this can saturate the transformer and may cause IGBT Over-Temp Faults. (Instantaneous Over Current Faults) This

parameter should be set to 5 seconds unless required for hard starting which will change automatically when controlled by Locked Pump sub-routine

Decel Time (DECEL TIME (SEC)):

The Decel time is referenced whenever the drive is required to make a change in frequency, EXCEPT during shut-down. The VSD is programmed to ignore the Decel time and Coast during any stop or shutdown.

General Notes on setting the Accel/Decel Times:

- 3 seconds is a very soft start for an ESP. 10 seconds is an eternity.
- Normally, Accel and Decel times should be equal. It is critical if operating in PID mode. When in PID mode, try to set Accel and Decel times at or below 5 seconds AND TO EQUAL VALUES.
- Other than transformer saturation there should not be concern about starting an ESP too fast. In the (Locked Pump) routine, you are allowed to go as low as 2 seconds. Beware of IGBT Over-Temp Faults which can be caused by saturating the transformer at low frequencies. Although UNLIKELY, if you are starting a hard to start unit with a VSD, you do risk breaking a shaft. For this reason, adjustments should be made slowly while monitoring motor temperature or allowing for cool down periods.

Volts @ 60 Hz (VOLTS @ 60 HZ (V)):

The Volts at 60 Hz is the drive's output voltage when operating at 60 Hz. This will be calculated when the "Calculate" button (Quick Start #2) is pressed, but can also be adjusted to compensate for voltage drop across the PWM output filter.

Starting Current Limit (STARTING CURRENT LIMIT (AMPS)):

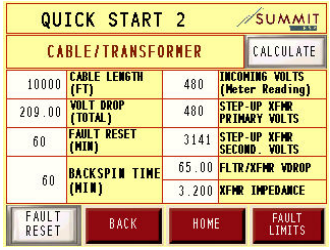
Starting Current Limit governs the drive's maximum output current during the "Start Delay" time period, which is set in Trip Delay Sec, next to the "Start over Load (Amps)" section of the VSD Fault Limits Screen. If, for example, Trip Delay Sec is set to 4 seconds, the drive will provide up to this amount of current for 4 seconds, during a start. After 4 seconds, the drive's output current will be limited to the Running Current Limit value. This will automatically be set by the "Calculate" button based on Motor current and voltage ratings entered into the Quick Start 1 Screen but can be adjusted if necessary for the application.

Starting Current Limit should be set to **NO MORE** than (1.5 x Motor Rated Current) * XFMR Ratio.

Running Current Limit (RUNNING CURRENT LIMIT (AMPS)):

Running Current Limit governs the drive's maximum output current AFTER the Start Delay time (Strt Dly Sec) has elapsed, i.e., during normal operation. Strt Dly Sec is set in the Trip delay section of the Starting over load (Amps) section of the VSD Fault Limits screen. This will automatically be set by the "Calculate" button based on Motor current and voltage ratings entered into the Quick Start 1 Screen but can be adjusted if necessary for the application.

Running Current Limit should be set to no more than XFMR Ratio * Motor Rated Current.



QUICK START 2

Cable Length (CABLE LENGTH (FT)):
This is the total length of cable, including surface cable, from the step-up transformer's secondary side to the ESP motor pothead.

Cable Voltage Drop:
Cable voltage drop is the amount of voltage that is "dropped" in the cable between the step-up transformer and the down-hole motor(s).– This voltage is not available to the motor. It must be compensated for by tapping the step-up transformer to provide motor nameplate voltage plus the expected cable voltage drop. See chart in appendix C.

Fault Reset Time (FAULT RESET (MIN)):
The Fault Reset Time is the time the drive is required to run before the Fault Count in the number of restarts is cleared to "0".

Backspin Time (BACKSPIN TIME (MIN)):
Backspin Time is the drive's restart timer for all faults that do not have their own specific timer. An automatic restart will occur after the elapse of this time. Note that Backspin Time OVERRIDES ALL OTHER Restart Timers. Backspin time for a particular well may be determined by the Field Service Technician by turning off a pump that has already surfaced fluid and observing the small voltage generated by the residual magnetism of the motor(s), using a Fluke or similar meter. The producer might also know this approximate time from knowledge of nearby wells of similar depth.

Actual Incoming Volts (INCOMING VOLTS (Meter Reading)):
This value helps the calculate functions accuracy and needs to be entered before function is used.

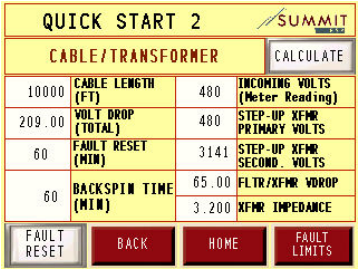
Step-Up Transformer Primary Volts (STEP-UP XFMR PRIMARY VOLTS):
This is the step-up transformer's designed primary voltage found on the transformer's nameplate, typically 480 volts.

Step-Up Transformer Secondary Volts (STEP-UP XFMR SECONDARY VOLTS):

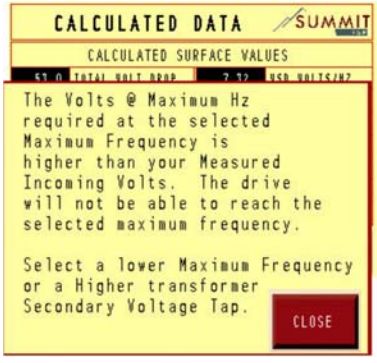
This is the secondary voltage of the step-up transformer, as determined by the settings of the tap switches and its wye or delta secondary-side configuration. This can be found on the Rating and Diagram plate that is attached to the door or tank of the transformer.

Filter/Transformer VDrop:
This setting is particularly important for PM Motors. It is critical that ALL losses are accounted for as a PMM will not operate with a low voltage supply. These values can be estimated or measured on site. This value is added to the Cable drop when calculating the voltage supplied to the motor.

Transformer Impedance (XFMR IMPEDANCE):
This value should be obtained from the transformer's nameplate.



Calculate Button
The Calculate button provides an automated method of calculating the basic operational settings for the drive. These are basic parameters settings and are populated to automatically provide basic protection of an ESP system. The serviceman may change these values to suite specific application requirements. These parameters can be viewed on the Calculated Values Screen.



The following parameters are calculated during the process

- **Total Voltage Drop**

Entered Value on the Quick Start 2 Screen.

- **Voltage Drop per 1000'**

Calculated as: (Total Cable Length / 1000) * Total Voltage Drop.

- **Surface Volts at Max Hz**

Calculated as: (Motor Rated Voltage + Total Cable Drop) * XFMR Ratio Surface Volts @ 60 Hz

- **Ideal XFMR Ratio**

Calculated as: Calculated Secondary Volts / XFMR Primary Voltage Rating

- **Actual XFMR Ratio**

Calculated as: Selected XFMR Secondary Voltage Tap / XFMR Primary Voltage Rating.

- Volts @ 60 Hz

Calculated as Surface Volts @ 60Hz/XFMR Ratio

- **VSD Volts Per Hz**

Calculated as: Volts @ 60Hz / 60

- **VSD Volts @ Max Hz**

If the Volts at Max Hz exceeds the Input Voltage of the Drive (Incoming Volts - Meter Reading) a warning will appear that it will not be possible to reach the selected Maximum Hz based on the present transformer tap. (Right)

- **Current Limit** (Running)

Initially calculated as Motor Rated Current * Transformer Ratio. This can be changed as needed

- **Starting Current Limit**

Initially calculated as Motor Rated Current *125%* Transformer Ratio. This can be changed as needed

- **Overload** (Running)

Initially calculated as Motor Rated Current *105%*Transformer Ratio. This can be changed as needed.

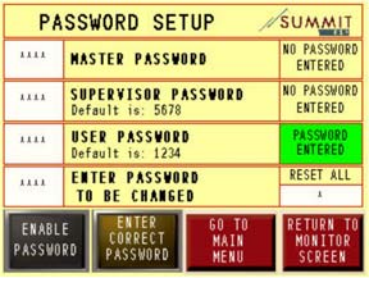
- **Starting Overload**

Initially calculated as Motor Rated Current *105%*Transformer Ratio. This can be changed as needed.

SUMMITVIEW ENGINEERING SCREENS

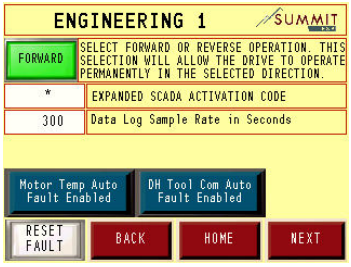
The SummitView Engineering screens are special-purpose screens for enabling/disabling certain functions, for troubleshooting purposes, or if new firmware must be loaded in the field. These screens may be accessed by entering the correct password.

NOTE: It is NOT NECESSARY To "Enable" THE PASSWORD. See left.

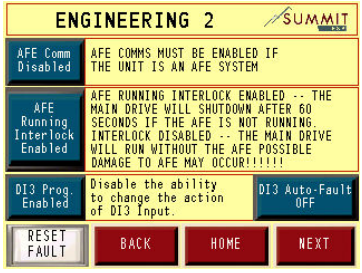


To do so, press the PASSWORD Menu button on the SummitView Main Menu screen. The screen at right appears. Press the white box at lower left, next to ENTER PASSWORD TO BE CHANGED. A numeric keypad will pop up. Enter the Engineering Password and press "ENT" on the Password keypad. The second box from left at the bottom will change from "ENTER CORRECT PASSWORD" to "CORRECT PASSWORD ENTERED".

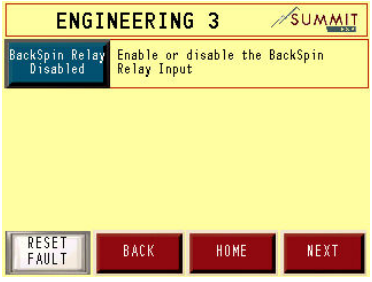
You may now press GO TO MAIN MENU, and from the Main Menu screen you can press the Engineering button. Upon



pressing the Engineering button, the Engineering 1 screen will appear. The green button controls the output direction of the VSD. The data log sample rate may be changed from this screen. However the faster the sample rate the more data is stored in a shorter period of time limiting the amount of days stored. The motor temp auto fault and DH tool auto fault functons may also be turned on and off from this screen. These functions when enabled will not allow the motor temp and DH tool com faults to be disabled without entering the enginering menu.



Pressing the NEXT button at the bottom of the Engineering 1 screen will bring up the Engineering 2 screen.



The two blue buttons on the Engineering 2 screen merit special explanation. AFE COMM Disabled is for drives that do not have Active Front End (AFE) technology. If enabled on a conventional drive it will cause a fault. AFE Running Interlock Enabled button is included to allow override of AFE-specific faults. It will allow the Main Drive to run off of bus voltage developed via rectification of the incoming voltage by the free-wheel diodes, which are in parallel with the AFE's IGBT's. THIS IS FOR TEMPORARY TROUBLESHOOTING USE ONLY! **LONG TERM OPERATION IN THIS MODE WILL PERMANENTLY DAMAGE TO THE AFE DRIVE**!!!!

DI3 Prog. Enabled button will allow you to lock the DI3 setup so only someone with a password can change how it was set up.

Pressing the NEXT button at the bottom of the Engineering 2 screen will bring up the Engineering 3 screen.

In this screen you have the ability to enable and disable the backspin relay. This function is used with drive equipped with a backspin detector.

9 HISTORY & LOGS

EVENT HISTORY

Drive faults are stored in Fault History and appear on the screen of the same name. When the drive has tripped on a fault, this screen will be automatically displayed. The keys at the bottom allow you to reset the last fault, scroll through the list, using the up and down arrow keys, or to move to other screens. If further analysis of particular fault is required you can note its date and time and reference the Last Fault Data Log screen, which is described next.

FAULT DATA LOG

The Last Fault Data Log allows the user to examine the values of many numerical drive values captured at the time of a fault's occurrence. Use the up and down arrow keys to select the fault of interest, then scroll to the right to see the associated values. The other keys at the bottom of this screen perform the same functions described immediately above for the Event History screen.

DATA LOGGING

The data log sample rate is adjustable from 30-600sec. At 600sec the drive stores approximately 30 days of data. The faster the sample rate the fewer days will be recorded. This can be downloaded to a USB pen drive as a .csv file and opened in Microsoft Excel.

Logged Parameters are:

- VSD Output Amps
- VSD Output Volts
- VSD Output Frequency
- Analog 1 Value
- Analog 2 Value
- VSD DC Bus Volts
- Intake Pressure
- Intake Temperature
- Motor Temperature
- VSD Heat Sink Temperature

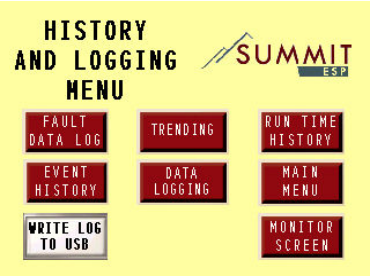
In order to view the most recent data logged press the end button, from here you may scroll up and down to select date and time. As well as right and left to find the parameter desired.

TRENDING

It is often useful to view a graphical presentation of drive, control or downhole sensor parameters. The Trending screen allows this. Upon drive startup the parameters above will begin to log automatically. Of course, not all of these parameters will be available in all pumping equipment configurations. Press the blue button to toggle between viewable parameters. There are default values for Low Scaling and High Scaling, which the user can reset for more relevant viewing, for example, to expand the viewed parameter vertically, for more detail. Sometimes, it is desirable to view a parameter in greater detail timewise. The "**+**" button lets you expand the horizontal (time) scale and the "**–**" button allows you to compress it. This could be useful to (for example) observe drive output current during a hard start condition.

RUN TIME HISTORY

The Runtime History screen allows you to view the hours and minutes that the drive has been running each day for the past thirty days.

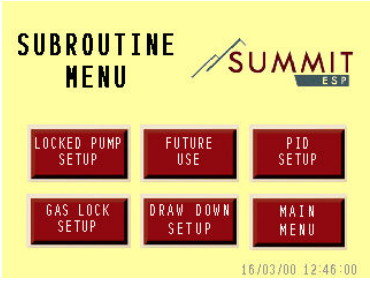


SAVING DATA TO USB THUMB DRIVE

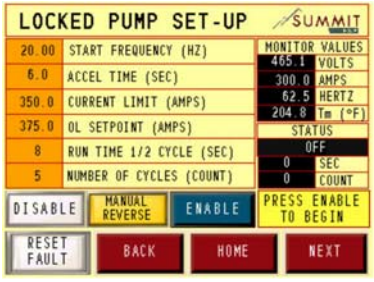
To copy the Data Log for portability purposes you may plug a USB thumb drive into the USB port below the SummitView panel and press the WRITE LOG button on either the Data Logging Screen or History and Logs Menu screen. Leave the thumb drive in the USB port for several minutes to allow all files to be transferred. Log data will be saved in *.csv format that can be viewed in Microsoft's Excel program.

If no USB pen drive is inserted the "Write to Log" button will not function. Wait for the confirmation that the data has been written BEFORE removing the USB pen drive. Removing the pen drive before the confirmation MAY corrupt the data. The data is NOT LOST!!! If this should occur, erase the corrupted files from the USB drive, reinsert and download again.

10 EXTENDED FEATURES



The Summit variable speed drive provides several Extended Sub-routines to aid in operating ESP's. These provide operational improvements to improve ESP operation under certain circumstances.



LOCKED PUMP MODE

Locked Pump mode provides a reasonably safe and easy way to free a unit that is locked down hole due to sand or other solids ingested into the pump.

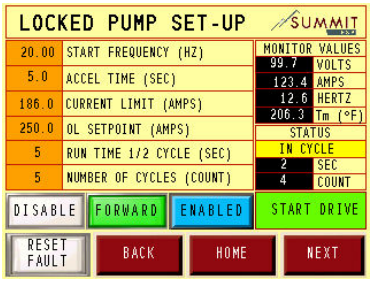
The parameters stored in the Locked Pump setup screen are utilized ONLY during the Locked Pump Routine operation. These parameters are stored separately and when you are finished using the routine, the original "normal" parameters are automatically re-entered into the drive for normal operation.

The Locked Pump setup screen provides several monitoring parameters so the operator can keep an eye on the drive functions and motor temperature. Remember that there is generally a 30 second delay in delivery of the actual Motor Temperature from the down-hole sensor.
There are several methods of utilizing the Locked Pump sub-routine. Follow the instructions below to achieve a start with as little stress to the motor as possible.

Easy Start:

START FREQUENCY – The start frequency should be set as low as possible while STILL providing full amps to the downhole motor. This is generally between 10-20 Hz.

ACCEL TIME – Reducing the acceleration time can aid in starting the pump. Reducing the Accel time TOO much may result in IGBT Over-Temperature Faults. This is a sign that the step-up transformer or motor (In surface applications) is being saturated. 5 seconds is usually sufficient but this can be lowered to as little as 2 seconds.
NOTE: The Acceleration Time must be set to a time FASTER than the Run Time ½ Cycle Time. The software uses the Minimum Frequency set-point to recognize a good start. The drive must reach Minimum Frequency set-point before the Half-Cycle completes in order for the software to recognize a start.



CURRENT LIMIT – Setting the current limit to the motor rating (Motor Rated current * XFMR Ratio) will provide protection for the motor while allowing 100% current to the motor at a reduced frequency. (Increased Torque)

OVERLOAD – Set the Overload to 125% percent of the Current Limit to prevent an Overload shut-down.

RUN TIME 1/2 CYCLE TIME – Set this parameter to 8-10 seconds

NUMBER OF CYCLES – Set the number of cycles between 8-10 cycles.

Monitor the motor temperature carefully and run this routine several times. If the unit breaks loose, the software will reset all parameters to normal operation for you and continue running.

Maximum Torque Start:

NOTE: This method of hard starting will apply a great deal of mechanical NAD electrical stress on the entire system. Although it is unusual to break a shaft using a variable speed drive, it CAN HAPPEN and CAUTION should be used!!!!

NOTE: This method of hard starting will apply a great deal of electrical stress on the entire system. Excessive re-starts can heat the motor or cable beyond specification and a motor or cable burn can occur. Motor Temperature should be carefully monitored!!! CAUTION should be used!!!!

Monitor the motor temperature carefully!!!! If this routine is run multiple times, Ensure the motor temperature does not exceed manufacturer's specifications. Allow proper cool down times!!!! If the unit breaks loose, the software will reset all parameters to normal operation for you and continue running.

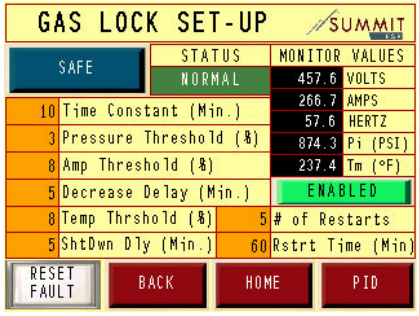
Easy Start:

START FREQUENCY – The start frequency should be set as low as possible while STILL providing full amps to the downhole motor. This is generally between 10-20 Hz.

ACCEL TIME – Reducing the acceleration time can aid in starting the pump. Reducing the Accel time TOO much may result in IGBT Over-Temperature Faults. This is a sign that the step-up transformer or motor (In surface applications) is saturated. 5 seconds is usually sufficient but this can be lowered to as little as 2 seconds transformer permitting

GAS LOCK MODE

The Gas Lock Mode provides a method for operating in Gassy wells. The operator sets thresholds at which he has confirmed the unit is in a Gas Lock condition at the normal operating frequency. The software will automatically detect if the pump is in gas lock and run the routines selected by the operator. The software will unit will monitor changes in values to determine of the Gas Lock condition has been resolved.



Operation Selections:

Safe – Will attempt to break Gas Lock conditions by reducing operating frequency without damaging equipment. Monitors Current and Motor Temperature to determine Gaslock condition. Upon sensing a Gaslock condition the algorithm will slow the motor to minimum speed for the time selected. If the unit does not recover the drive will shut down. If # of Restarts parameters is greater than zero, the unit will restart after them time entered in Rstrt Time.

Intermediate – Will attempt to break Gas Lock conditions by reducing operating frequency without damaging equipment. Monitors Current and Motor Temperature to determine Gaslock condition. Upon sensing a Gaslock condition the algorithm will slow the motor to minimum speed for the time selected. If the unit does not recover the drive will shut down. If # of Restarts parameters is greater than zero, the unit will restart after them time entered in Rstrt Time.

Aggressive – Will attempt to break Gas Lock conditions by reducing operating frequency without damaging equipment. Monitors Current and Motor Temperature to determine Gaslock condition. Upon sensing a Gaslock condition the algorithm will slow the motor to minimum speed.. If the unit does not recover the drive will continue to operate until shut down by Motor over temperature or other fault.. If # of Restarts parameters is greater than zero, the unit will restart after them time entered in Rstrt Time.

Maximum –

Time Constant – This is the amount of time the software algorithm uses to determine changes incurred during Gas Lock conditions. As motor temperature lags current drop during Gas Lock, it may be necessary to extend the Time Constant to allow it to catch the increasing temperature of the motor.

Pressure Threshold – The amount of change (in percentage) required for the Pressure change to impact Gas Lock operation.

Amp Threshold – The amount of change (in percentage) required for the VSD Output Current to change to impact Gas Lock operation.

Decrease Delay – In Aggressive and Maximum Modes, the amount of time the Software will remain at Maximum Frequency during the Attempt to break Gas Lock.

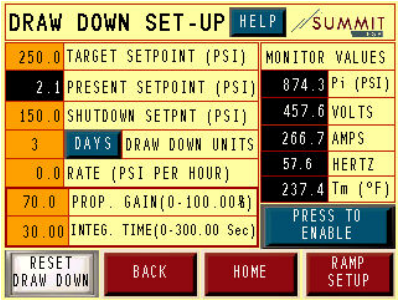
Temp. Threshold – The amount of change (in percentage) required for the VSD Output Current to change to impact Gas Lock operation.

ShtDwn Delay – The number of operating minutes under Gas Lock conditions before the unit will shut down. The range is 5 to 65535 minutes

# of Restarts – The number of attempted Restarts after shutting down due to continued Gas Lock operation

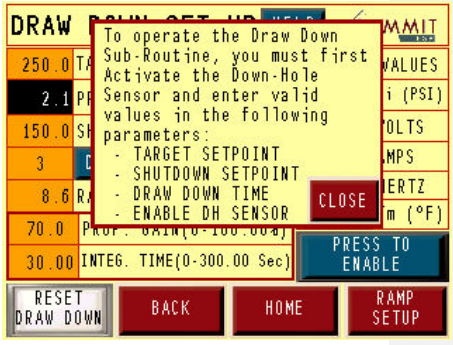
Rstrt Time – The amount of time the Software will wait after shut down before attempting to restart if # of Restart parameter is greater than zero.

DRAW DOWN MODE



Draw Down Mode provides the operator with a method of controlling the draw-down rate of the well. Draw Down Mode requires a functioning down hole sensor with valid Intake Pressure data. When Draw Down Mode is enabled, default parameters are set into the software. PID mode, Intake Pressure, Reverse operation is automatically selected. A Proportional Gain of 10% and an Integral Time of 3 Seconds are default settings and may be adjusted as needed. The sub-routine, once enabled, will remain enabled until it is disabled. The software calculates the Rate as a PSI/Hr value. (Days will be converted to hours by the software.) It memorizes the draw down rate and applies that draw down rate any time the well stops and restarts. When the well reaches the correct operational pressure level as set in the Target Set point, the Draw Down software will automatically disengage while remaining in PID Mode operation maintaining the selected Target Set point. Should the level rise for any reason, the software will sense the change and reenter Draw Down operation to reach the Target Set point.

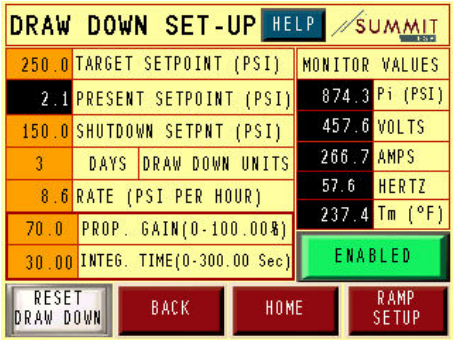
If you attempt to enable Draw Down Mode without all the necessary parameters properly set, you will receive the warning at left.



TARGET SET POINT – Set this to the desired operating pressure of the well. Ensure this is above the bubble point.

PRESENT SET POINT – This displays the operating set point the software is trying to reach for the present 1 hour time period.

SHUTDOWN SET POINT – As in normal PID mode operation, if for some reason the level is drawn below this level, the unit will stop. Restarts can be set up on the PID Setup Screen.



DAYS/HOURS – Select the number of Hours or Days in which to draw down the well. Days will be converted to hours by the software when the sub-routine is enabled.

RATE – The rate of draw down will be calculated based on the difference between present fluid level and the setpoint. It can also be manually entered after Enabling the mode.

The “Help” Button provides information about Draw Down Operation.

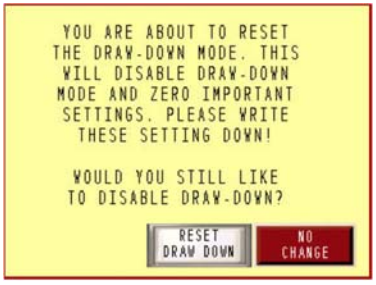
Press this button to enable Draw Down Operation.

This is displayed until Draw Down reaches the desired set point pressure.

Once the well reaches the desired operating pressure, this message will be display.

If the well continues draws down faster than the desired calculated rate while at minimum frequency, the warning to the right will be displayed.

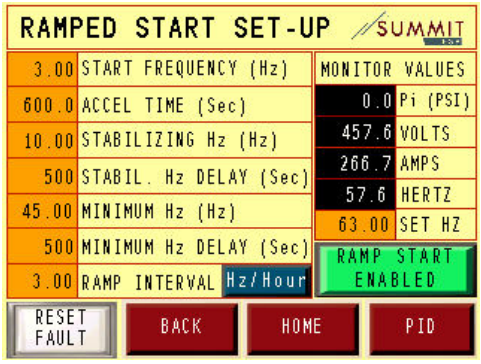
Resetting the Draw Down Mode will erase your settings. You will receive the warning to the right.



PID SETUP (While in Draw Down Mode)– Proportional Gain and Integral Time are provided on the Draw Down Page. If further adjustments are desired they can still be carried out on the PID Setup screen.
However, changing the operational Mode, Input Selection or PID direction are disabled while in Draw Down Mode as shown at right.

RAMP START MODE

Ramp Start Mode provides the operator with a method of controlling the flow during a startup. This can be particularly helpful when filling an empty system, such as an injection well or other system that empty during shutdown. This mode will prevent water hammer that occurs during normal start up conditions at Minimum Speed.



START FREQUENCY – Standard Start Frequency as on Quick Start 1 screen

ACCEL TIME – Standard Accel Time as on Quick Start 1 screen

STABILIZING Hz – This is a temporary Minimum Frequency for the purpose of slowly filling an empty system or for other needs.

STABILIZING Hz DELAY - The amount of time in seconds that the program will wait before beginning to ramp to Minimum Hz.

MINIMUM Hz – Standard Minimum Hz as on Quick Start 1 screen.

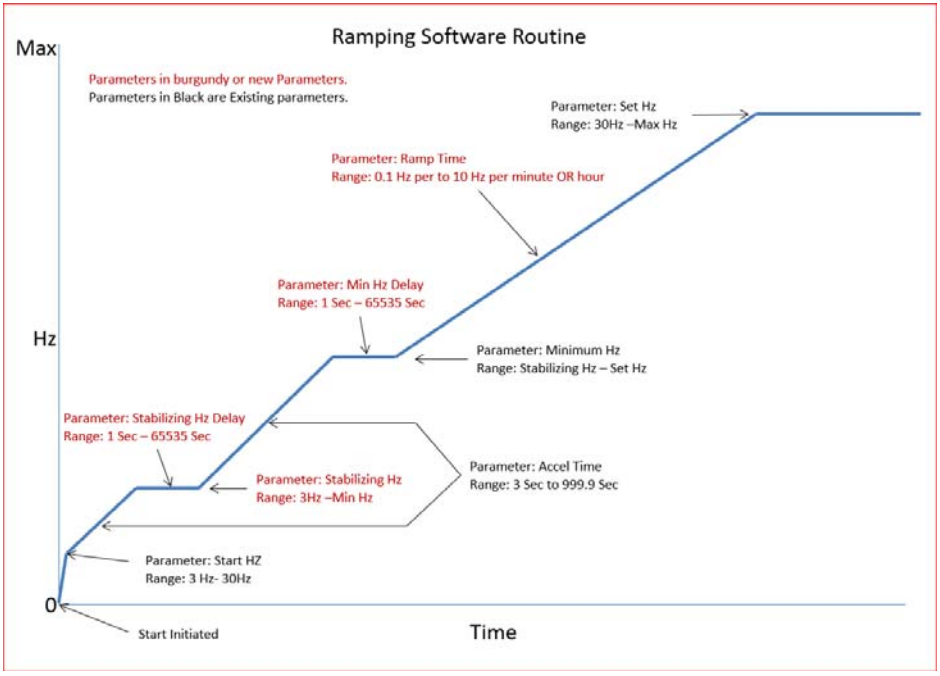
MINIMUM Hz DELAY – The time the program will remain at minimum frequency before ramping up to operating frequency.

RAMP INTERVAL – The number of Hz increase per Minute or Hour. This allows the slow ramping of the drive over long periods of time.

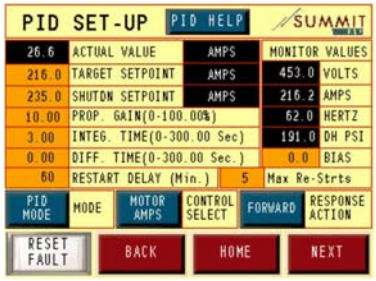
RAMP INTERVAL SELECTION – Select either Minutes or hours as the ratio of acceleration.

SET Hz – Standard Set Hz as on other pages.

On the next page is a visual representation of the operation of Ramp Start routine.


Ramping Software Routine
Max
Parameters in burgundy or new Parameters.
Parameters in Black are Existing parameters.
Parameter: Set Hz
Range: 30Hz –Max Hz
Parameter: Ramp Time
Range: 0.1 Hz per to 10 Hz per minute OR hour
Parameter: Min Hz Delay
Range: 1 Sec – 65535 Sec
Hz
Parameter: Minimum Hz
Range: Stabilizing Hz – Set Hz
Parameter: Stabilizing Hz Delay
Range: 1 Sec – 65535 Sec
Parameter: Accel Time
Range: 3 Sec to 999.9 Sec
Parameter: Stabilizing Hz
Range: 3Hz –Min Hz
Parameter: Start HZ
Range: 3 Hz- 30Hz
0
Start Initiated
Time

PID MODE



Proportional, **I**ntegral, **D**ifferential (or **D**erivative) control. Start with Proportional Gain until you get the response from the drive that you want. If oscillation occurs once the set point is reached, you may need to enter Integral Time. If after setting the Proportional Gain and Integral Time the system is slow to react to changes in the Process Variable, Differential Time can used to Improve response time once at the set point.

ACTUAL VALUE – This displays the operating value of the input selected with the Control Select button. This is the "process Variable. i.e. Intake Pressure, Analog Input, VSD/Motor Current.

TARGET SET POINT – This displays the set point entered by the operator. This is the target the PID will try to maintain.

SHUTDOWN SET POINT – This displays the value that will cause the PID Mode sub-routine to shut down. If the PID Mode control cannot maintain this value and continues to drop (if in Reverse Operation) or climb (if in Forward Operation) and reaches this set point, the unit will stop.

PROPORTIONAL GAIN – This parameter sets the speed with which the PID controller will attempt to reach the set point. A higher Proportional gain provides a faster response time. The negative impact of this is increased oscillation at the set point.

- For Intake pressure control start with a proportional gain of 10-15%.
- For VSD or Motor Current Control start with a Proportional Gain of 8-15%.

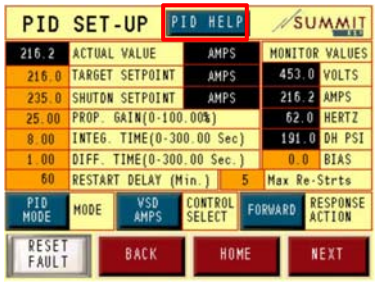
INTEGRAL TIME – This parameter is used to help reduce oscillations once the set point is reached. Too much Integral Time can slow the arrival to the set point.

- For Intake pressure control, a high integral time is best. Start at 45-60 Sec.
- For VSD or Motor Current Control start with low integral time. 1-5 seconds.

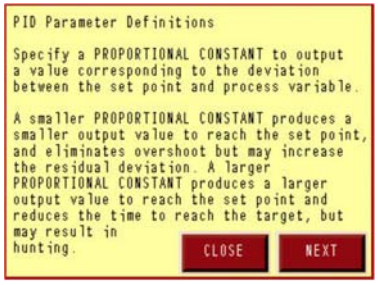
DERIVATIVE TIME – This parameter is used to help improve response time once the set point is reached. Derivative Time that is set too high may increase overshoot and hunting. Use this parameter ONLY if proper operation cannot be achieved with Proportional Gain and Integral Time.

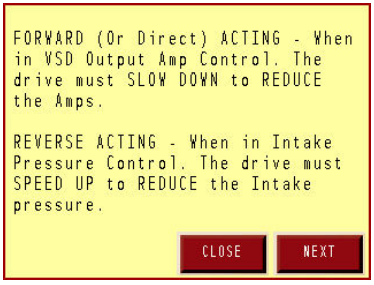
- Derivative time should only be increased if needed

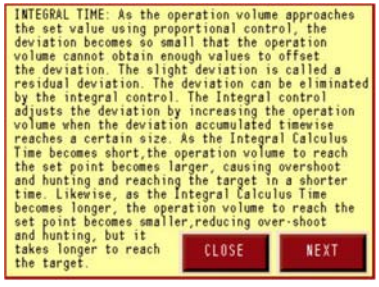
Note: The set points listed above may differ by region; as well conditions vary dramatically by location and formation.

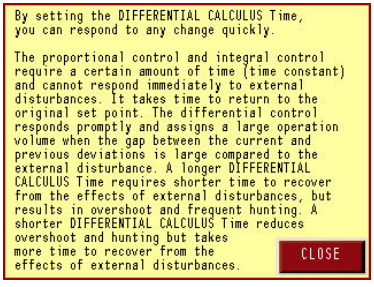


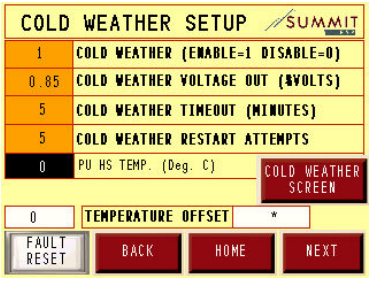
PID HELP SCREENS – Help screens are provided to help you during PID setup. These are available by pressing the PID Help button at the top of the PID Setup Screen.











COLD WEATHER SOFTWARE

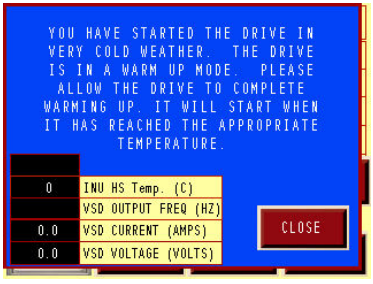
Cold Weather Software is an automated way of warming the drive up in extremely cold weather. When temperatures are Below -20°C (-4°F)or below, this software will provide a DC power output at very low voltage that will warm the IGBT's of the drive preparing them for full operation.

COLD WEATHER ENABLE – Enter "1" to enable the Cold Weather software.

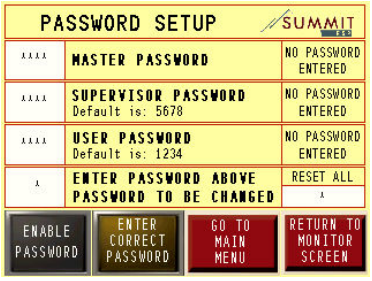
COLD WEATHER VOLTAGE OUT – Enter the percentage of voltage the drive will output to develop the necessary current to warm the IGBT's. Start VERY LOW. 0.5%-1.0%. If you receive IGBT over temp or Over Current Fault, Reduce the % of Voltage.

COLD WEATHER TIMEOUT – Enter the number of minutes the drive should attempt to warm up. Enter the minimum time required to warm the drive under you coldest operating temperature.

NUMBER OF RESTART ATTEMPTS – Enter the maximum Number of Restarts up to 5. If the drive does not warm up on the initial attempt, other attempts can be made automatically. The drive will automatically reset and make another attempt.



COLD WEATHER OPERATION – DURING THE WARM UP PERIOD, THE SCREEN AT RIGHT WILL BE DISPLAYED. YOU CAN MONITOR THE DRIVE'S OPERATION AND HEAT SINK TEMPERATURE.

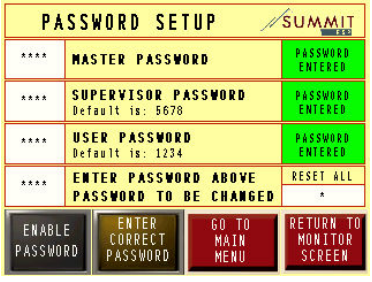


PASSWORD OPERATION

Passwords are provided to limit access to certain personnel.

MASTER PASSWORD – the master password is for use by Summit ESP personnel ONLY for access to the Engineering Pages. If not set correctly, parameters available on these pages can cause serious damage to the drive and endanger personnel. Making changes to these parameters will void your warranty.

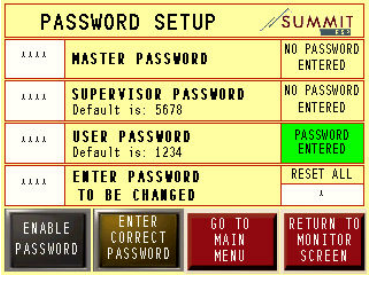
SUPERVISOR PASSWORD – This password provides supervisors with a method of changing the User Password.



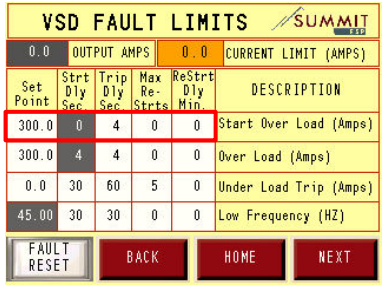
USER PASSWORD - With User password active, personnel are limited to Set Frequency, the Monitor and History & Log screens and Downloading of Logs. When the user password is Entered, the operator has access to the remaining drive parameters. The default is 1234.

ENTER PASSWORD TO BE CHANGED – Use this to enter the appropriate password.

NOTE: Each password grants the rights of that password and the ones below it.

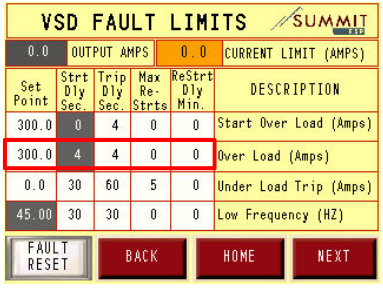


11 FAULTS & ALARMS



START OVERLOAD

During start-up the motor may pull a higher amp load due to various reasons. This set point allows for the higher amp draw at start up. The Trip Delay Sec. set point determines the amount of time the motor will be allowed to draw the higher load. This set point should be set to 5% over the starting current limit entered in page one of the quick start set-up screen.



OVERLOAD

The Summit VSD's Overload routine guards against conditions that could cause motor, drive and/or step-up transformer damage. It does this by comparing running amps to a user-settable number of amps. The settings that allow the drive to protect the motor from the overload condition are found on the VSD FAULT LIMITS screen, adjacent to the designation "Over Load (Amps)".

An Overload fault will occur when the drive's output amps rise to the number of amps in the Overload amps set point (Set Point) for the number of seconds entered by the operator into the Overload Trip Delay setting (Trip Dly Sec.). This condition can occur because the pump is locked (e.g., sand, scale, paraffin, mechanical problem), or because there is an electrical fault in the step-up transformer, in surface or subsurface wiring, or in the motor. Overload trip delay is normally set to 2 to 5 seconds.

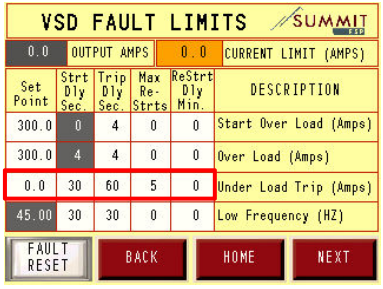
Overload is an automatically restarting fault, though many operators choose to make it a lockout fault – equipment damage can accumulate with repeated starts. The maximum number of automatic restarts is governed by the Maximum Restarts setting (Max Restrts): Set it to 0 (zero) if Overload is to be a lockout fault. If restarts are to be allowed they will occur upon elapse of the number of minutes set by the user in the Overload Restart Delay setting (ReStrt Dly Min.).

Sometimes, it is desirable to disable the Overload fault routine for a very short period of time (no more than 1 second) at pump startup, for example, with a hard starting pump. Use the Overload Start Delay setting (Strt Dly Sec.) to accomplish this. The Overload routine will not come into effect until this time elapses.

Note that upon start the overall Overload trip time is cumulative. That is, it is the sum of Start Delay and Trip Delay. After Start Delay has elapsed trip time will be equal to Trip Delay only.

The Overload amps setting is typically set one of three ways: 1) The drive's rated amps, 2) 125% of the drive's output amps at the present operating frequency, or, 3) 125% of the amps observed while the pump is temporarily operated at its maximum RPM. Method number 3 allows for overload protection when the pump is to be operated over a range of speeds.

UNDERLOAD



An ESP motor is cooled by the fluid that flows past it on the way to the pump. It must, therefore, be protected against conditions that could cause it to overheat while running. The drive's Underload routine does this by comparing running amps to a user-settable number of amps. The settings that allow the drive to protect the motor from the Under-load condition are found on the VSD FAULT LIMITS screen, adjacent to the designation "Under Load Trip (Amps)".

An Underload fault will occur when the drive's output amps fall to less than the Underload amps set point (Set Point) for the number of seconds entered by the operator in the Underload Trip Delay setting (Trip Dly Sec.). This condition could occur because the well is pumped off (insufficient fluid), because there is gas in the pump, or because a shaft is broken in one of the components of the down-hole pumping system. Underload Trip Delay is commonly set to a value between 30 seconds and 180 seconds. A higher setting is typically used for wells with gas interference, to prevent nuisance trips. Note that if drive amps rise back above the Underload amps set point before a trip has occurred the trip timer resets to zero.

Underload is an automatically Re-Starting fault. The maximum number of automatic restarts is governed by the Maximum Restarts setting (Max Restrts). This setting may be set to 0 (zero), if Underload is to be a lockout fault. If restarts are to be allowed they will occur upon elapse of the number of minutes set by the user in the Underload Restart Delay setting (ReStrt Dly Min.).

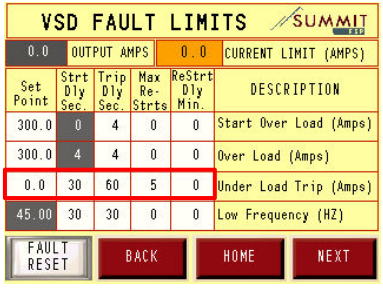
Sometimes, it is desirable to disable the Underload fault routine for a period of time at pump startup due to accumulated gas, which can cause repeated Under-load shutdowns such that the pump never runs long enough to begin producing fluid. Use the Underload Start Delay setting (Strt Dly Sec.) to accomplish this. The Underload routine will not come into effect until this number of seconds elapses. Note that upon start the overall Underload trip time is cumulative. That is, it is the sum of Start Delay and Trip Delay. After Start Delay has elapsed trip time will be equal to Trip Delay only.

There are two prevalent theories for setting Underload amps. If the pump is to be operated at a consistent speed the drive's output amps should be recorded after the well stabilizes at that pump speed. Set the Underload set point to 85% of that number of amps. If the pump is to be operated over a range of speeds the Underload set point may be set at 85% of the number of drive output amps observed at the lowest allowed operating speed. Note, though, that if pump speed is later increased the second method may not provide adequate motor protection.

General Notes on setting Underload:

If your motor horsepower is well matched to your load your Underload amps setting can be somewhat "looser," i.e., perhaps 80% of running amps, rather than 85%. If your motor is big for the application, which can be the case when used equipment is re-run, consider setting Underload amps on the "tight" side, like 90%. The reason for this is that motor current is composed of two parts, idle amps and load amps. With a motor that is big for the application, when the load falls off the amperage reduction that is observed will be mostly load amps. Another way to say this is, the remaining current will have a higher proportion of idle current to total current. As such, it might not fall enough to trip the drive on Underload.

LOW SPEED TRIP



The Low Speed Trip fault stops the pump if the drive's output frequency is below a designated value. The drive might, under certain circumstances, be unable to bring the motor up to the RPM corresponding to the Hz set by the operator. This can happen if the pump becomes "sticky" and the drive reaches its Running Current Limit before the set Hz is achieved. If allowed to run at too low a speed the pump can "deadhead" (fluid may be pushed up the tubing, but not all the way to surface). The stationary fluid around the motor will absorb only so much motor heat, then the motor will overheat and may become damaged.

Note that upon start the overall Low Speed Trip time is cumulative. That is, it is the sum of Start Delay and Trip Delay. After Start Delay has elapsed trip time will be equal to Trip Delay only.

If you wish this fault routine to be completely inactive you can set its Set Point Hz higher than your desired operating Hz.

INPUT OVERVOLTAGE

Maximum input voltage is 550 VAC or 850VDC on the bus. The drive will trip off on an Overvoltage fault if input voltage exceeds 550 VAC. This is factory set and cannot be adjusted.

INPUT UNDERVOLTAGE

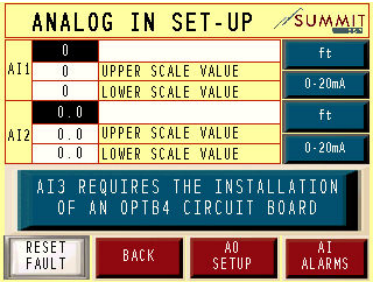
Minimum input voltage is 323 VAC. The drive will trip off on an Undervoltage fault if input voltage falls below 323 VAC. This is factory set and cannot be adjusted. The drive will lower the output frequency to lower the output load and will try to continue operating the load. Should the load overcome the available power of the VSD, the VSD will perform on orderly shutdown prior to complete loss of power.

Note: The drive will stop operating the load at 323 Volts. The drive control circuitry will stay on until a much lower voltage, approximately 150VDC on the DC Bus.

HEAT SINK

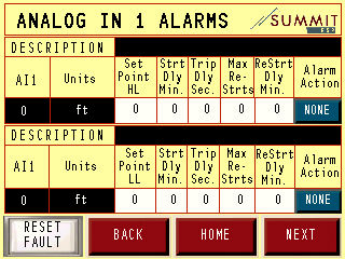
Heat sink temperatures are limited to
-20° to +90°C.(-4 to 194°F)

12 ANALOG SETUP



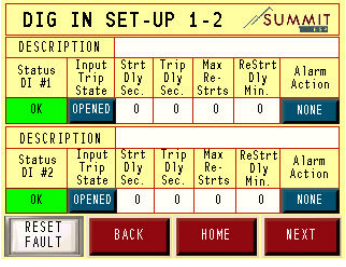
In the Analog Set-up screen is accessed from the I/O Menu under Analog Menu. Here you can set up your analog Input 1 &2. The ft button on AI1 & AI2 can be pressed and changed to: (ft, meters, PSI, BAR, ATM, GPM, GPD, BBL/D, FT3/D, YD3/D, M3/D, FEHERENHEIT, CELSIUS, mA, AMPS, VOLTS, KV, IN^LB, FT^LB, NM, kWHr). 0-20 mA can also be changed to 4-20mA depending on what is needed. Upper and lower scale value must be entered as it is listed on device suppling the analog signal.

13 ANALOG ALARMS



In the analog alarms page you can Set the High and Low level shutdown set points, as well as fault delay's and restart parameters. You may also choose the alarms action (NONE, WARNING, OR FAULT).

14 DIGITAL SETUP



In the Digital In Set-Up screen you can choose which input trip state you would like (OPEN or CLOSED)

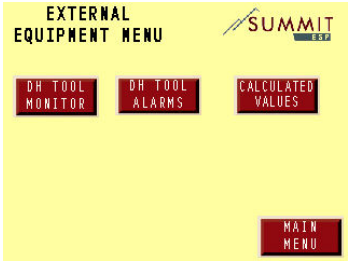
As well as the Alarm Action (NONE, WARNING, OR FAULT)

The Restart delay seconds is the delay for when the drive is to restart after the fault has been cleared.

The trip delay is the amount of seconds before the fault will turn the drive off on a DI Fault.

Max restarts are the amount of restarts you want the drive to restart after the faults have been given.

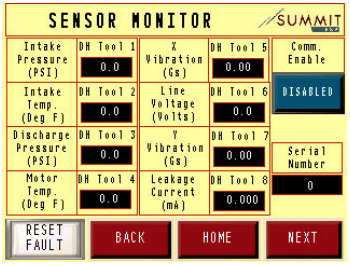
15 SENSOR INTEGRATION



SummitView external equipment menu

External Equipment Menu

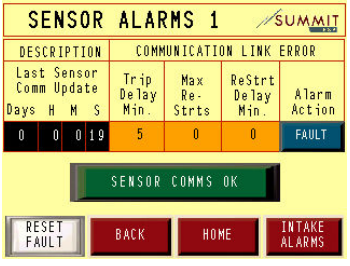
The external equipment menu gives access to the down hole tool monitor screen, down hole alarms screens, as well as the calculated values screen.



SummitView Sensor Monitor screen.

Sensor Monitor Screen

The sensor monitor screen will display all sensor values and serial number for the downhole tool. Sensor communication may also be adjusted and disabled from this screen.



Sensor Alarms 1 screen communication faults

Sensor Alarms Screens

In the sensor alarms screen 1 the downhole communication fault can be set. This alarm is set to fault automatically unless downhole communications are disabled or the auto fault is turned off in the engineering 1 screen. Three additional Sensor Alarms screens (2, 3, 4) may be accessed by using the button in the lower right corner . Under the Sensor Alarms 2 screen you can set your Intake Pressure Faults or Alarms. Under the Sensor Alarms 3 screen you can set your Intake Temperature Alarms. Under the Sensor Alarms 4 screen you can set up your Vibration alarms for X and Y. All sensor alarms may be set-up with restart parameters, and can be set for fault, warning, or none (no action).

16 MAINTENANCE

Maintenance interval

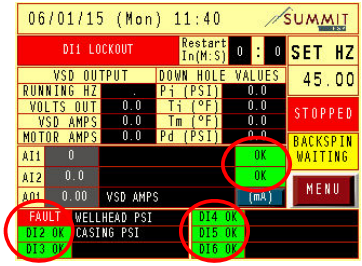
Table 9-14-1

12 months (if the unit is stored)	Capacitor reforming, see separate instructions
6 - 24 months (depending on the environment)	• Check the input and output terminals and control I/O-terminals. • Clean the cooling tunnel • Check the operation of the cooling fan, check for corrosion on the terminals, bus-bars and other surfaces • Check the door filters in the case of cabin installation
5 - 7 years	Replace the cooling fans: • Main fan • Internal IP54 fan • Cabinet cooling fan/filter
5 - 10 years	Change the DC bus capacitors

17 TROUBLESHOOTING

Recognizing Faults

Faults will be displayed in the upper left hand corner of the default screen as a red box, and the fault description will be listed in this box. Digital input and Analog input faults will also show as a red box or boxes lower on the screen (see circled areas in picture to the left). Next to the red box with fault in it should be a description of the fault. Descriptions of other common faults are listed below.



Common Faults

F1 Overcurrent-The drive current has exceeded set Overload. Check the load and all electrical equipment.

F2 Overvoltage-The DC voltage has exceeded the parameters in the drive module-Check the input voltage or if it occurs on decel it may require lengthening the decel time.

F3 Ground Fault-The sum of all three phase output is not 0. This means an unbalance in the output current one leg is pulling current out of range with the others. This is most likely a hardware issue. Perform static checks on drive. It could also be a measurement issue. Most likely require component replacement from qualified technician.

F7 Saturation-The drive has detected a failure of a component current exceeded drive capabilities. Do not restart without performing diagnostics or drive components. This is most likely caused by a hardware component failure of output of drive. Perform static checks by qualified technician.

F9 Under voltage-The DC bus has detected a low voltage situation and dropped below 450 VDC. Check input voltage to be above 323VAC if in normal range check fuses, and perform static no power checks.

F10 Input Supervision- The drive has detected a missing input line phase. Check incoming power and input fuses.

F11 Output Supervision- The drive has detected a loss of current in an output phase check output of drive and perform static no power checks.

F13 Heat sink Under Temp- The Heat sink temperature is below -14 degrees Fahrenheit (-10c). Enable cold weather package or allow the drive to warm itself with its heaters.

F14 Overtemp-The drive heat sink has reached 194 degrees F. Verify cooling fans are operational and the drive has been set up to operate at the optimum settings. Also verify load is not exceeding the drive rated capacity. You will receive a warning at 185 degrees.

F17 Underload-The drive has detected a load below the manually entered set point. Check the load.

F32 Fan Cooling- Indicates a cooling fan on drive module did not start when asked. Check to make sure fans are running in many cases the fans starting and stopping will cause this erroneously. You can change the settings to make the fans operate –continuously, temperature, and on run in most situations “on run” works the best to mitigate this fault or adding the newer versions of software.

F41 IGBT temp-The drive has detected a high current at the IGBT. This can be caused by transformer saturation or a hardware failure but it is not a true temperature related problem. In some cases the drive will display a F31 IGBT temp which has the same root causes.

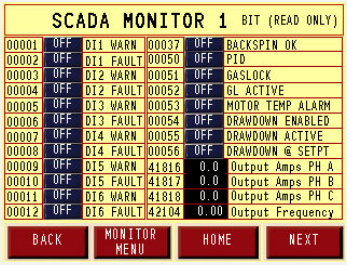
F51 External Fault- It is actually a sine wave filter alarm or a loss of control power to relays and terminal strip. Verify terminal strip has 120vac then verify that the wire returning from Filter monitor board has 120vac. This wire will be numbered according to drive size.

F53 DC Bus Comm-This fault indicates that the drive has lost communication with the SummitView touch screen. Check cabling and sometimes if the unit has suffered a power bump you will get this code. The SummitView powers down quicker than the drive so the drive sees this as a loss of communications.

Low Frequency-The drive output frequency has dropped below the minimum frequency. This is usually caused by the drive reaching current limit set point and being slowed down to the point of motor stall. Check current limit and make sure well is operating correctly.

Drive Comms Loss-The SummitView has lost communication with drive module. Check connections and power to the Ethernet switch.

18 SCADA



The SCADA monitor screens display the values being sent out through the communication connections for the customer. These screens can be used to verify numbers being received by the customers systems. They also provide the addresses for the registers.

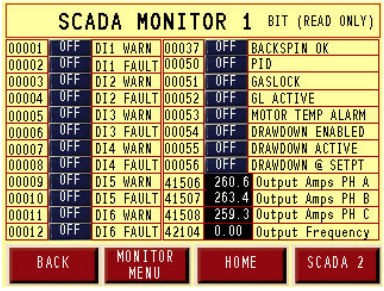
REGISTERS

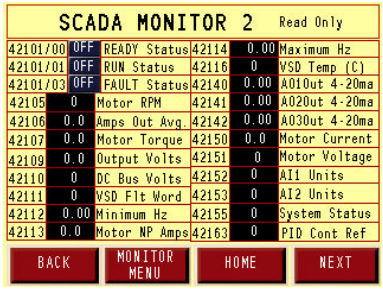
Monitored Variables	Integer Value	0	1
	ModBus ID		
AI1UnitsIndication(Integer)	42152	Integer Value 0-22 See Table to Right	
AI2UnitsIndication(Integer)	42153		
DriveStatusIndication(Integer)	42155	SystemDisabled	SystemReady
PIDControlReference(Integer)	42163	AI1	AI2
CombinedOperating Mode(Integer)	42164	Set Hz	PID
DigitalInput1Warning	1	Off	On
DigitalInput1Fault	2	Off	On
DigitalInput2Warning	3	Off	On
DigitalInput2Fault	4	Off	On
DigitalInput3Warning	5	Off	On
DigitalInput3Fault	6	Off	On
DigitalInput4Warning	7	Off	On
DigitalInput4Fault	8	Off	On
DigitalInput5Warning	9	Off	On
DigitalInput5Fault	10	Off	On
DigitalInput6Warning	11	Off	On
DigitalInput6Fault	12	Off	On
DigitalInput1Lockout	13	Off	On
DigitalInput2Lockout	14	Off	On
DigitalInput3Lockout	15	Off	On
DigitalInput4Lockout	16	Off	On
DigitalInput5Lockout	17	Off	On
DigitalInput6Lockout	18	Off	On
BackSpinTimerDone	37	Off	On
OperationMode	50	Set Hz	PID
GasLockMode	51	Off	On
GasLockPresentlyActive	52	Inactive	Active
MotorTemperauteAlarm (>310°F {154°C})	53	OK	Alarm
DrawDownModeEnabled	54	Off	On

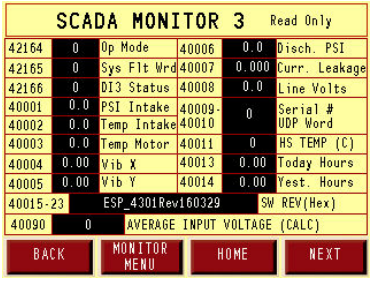
DrawDownModeActive	55	Inactive	Active
DrawDownModeAtSet point	56	Off	On
PIDForward/Reverse	57	FWD	REV
DriveReadyStatus	42101/00	NotReady	Ready
DriveRunningStatus	42101/01	Stopped	Running
DriveFaultStatus	42101/03	NotFaulted	Faulted
Control Set Point & Variables	**Integer Value**	**0**	**1**
	ModBus ID		
VFDDisable	40200/04		Disable
VFDEnable	40200/05		Enable
VFDResetButton	42001/02		Reset
PIDMode ON/OFF	40201	KEYPAD	PID
PIDControlSelect	40202/00-04	AI1	AI2
PIDControlFWDREV	40203	Forward	Reverse
ExpandedSCADAAccess (Integer)	40024	0DP	
DriveFreq.Set point (Integer)	40025	1DP/2DP	
ULSet point (Integer)	40027	1DP	
OLSet point (Integer)	40028	1DP	
IntakeTempMaxSet point (Integer)	40029	1DP	
MotorTempMaxSet point (Integer)	40030	1DP	
IntakePressMinSet point (Integer)	40031	1DP	
IntakePressMaxSet point (Integer)	40032	1DP	
PIDSet point (Integer)	40033	1DP	
PIDShutDownSet point (Integer)	40034	1DP	
PIDPropGain(Integer)	40035	2DP	
PIDIntegralTime(Integer)	40036	2DP	
PIDDifferentialTime(Integer)	40037	2DP	
PIDRestartMinutes(Integer)	40038	0DP	
PID#OfRestarts(Integer)	40039	0DP	
Reserved	40040	N/A	
AI1LowLevelSet point (Integer)	40041	0DP	
AI1HighLevelSet point (Integer)	40042	0DP	
AI1LowLevelAction(Integer)	40043	None	
AI1LowLevelTripDelayTime(Integer)	40044	0DP	
AI1HighLevelAction(Integer)	40045	None	
AI1HighLevelTripDelayTime(Integer)	40046	0DP	
AI1LowLevelRestartTime(Integer)	40047	0DP	
AI1HighLevelRestartTime(Integer)	40048	0DP	
AI2LowLevelSet point (Integer)	40049	1DP	

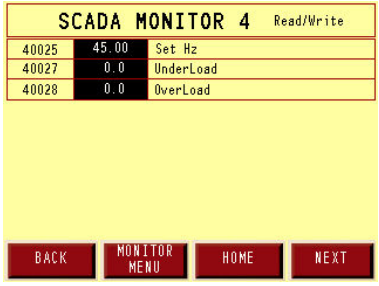
AI2HighLevelSet point (Integer)	40050	1DP
AI2LowLevelAction(Integer)	40051	None
AI2LowLevelTripDelayTime(Integer)	40052	0DP
AI2HighLevelAction(Integer)	40053	None
AI2HighLevelTripDelayTime(Integer)	40054	0DP
AI2LowLevelRestartTime(Integer)	40055	0DP
AI2HighLevelRestartTime(Integer)	40056	0DP
Run Time Data		
Today Hours (Integer)	40013	2DP
Yesterday Hours(Integer)	40014	2DP
VFD Monitored Varibles		
IntakePressure(Integer)	40001	1DP
IntakeTemperature(Integer)	40002	1DP
WindingTemperature(Integer)	40003	1DP
XAxisViberation(Integer)	40004	2DP
YAxisViberation(Integer)	40005	2DP
DischargePressure(Integer)	40006	1DP
LeakageCurrent(Integer)	40007	3DP
LineVoltage(Integer)	40008	1DP
ToolSerialNumber(Integer*2)	40009/UDWord	0DP
VSDHeatsinkTempC	40011	0DP
SoftwareRevision(ES)	40015	0xXXXX (Hex)
SoftwareRevision(P_)	40016	0xXXXX (Hex)
SoftwareRevision(43)	40017	0xXXXX (Hex)
SoftwareRevision(01)	40018	0xXXXX (Hex)
SoftwareRevision(Re)	40019	0xXXXX (Hex)
SoftwareRevision(vY)	40020	0xXXXX (Hex)
SoftwareRevision(YM)	40021	0xXXXX (Hex)
SoftwareRevision(MD)	40022	0xXXXX (Hex)
SoftwareRevision(D)	40023	0xXXXX (Hex)
SoftwareRevisionDateOnly(Integer) (YYMMDD)	40106/DWord	0DP
AVGInputVolts(Calculated)(Integer)	40090	0DP
DriveOutputCurrentA(Integer)	41506	1DP
DriveOutputCurrentB(Integer)	41507	1DP
DriveOutputCurrentC(Integer)	41508	1DP
DriveOutputFrequency(Integer)	42104	2DP
MotorSpeedRPM(Integer)	42105	0DP
DriveOutputCurrentAvg(Integer)	42106	1DP
MotorTorque%(Integer)	42107	1DP
DriveOutputVoltage(Integer)	42109	1DP

DCBusVoltage(Integer)	42110	0DP
DriveFaultWord(Integer)	42111	N/A
MinimumFrequency(Integer)	42112	1DP
MotorNameplateAmps(Integer)	42113	1DP
MaximumFrequency(Integer)	42114	1DP
DriveHeatSinkTemp°C(Integer)	42116	0DP
MotorCurrent(Integer)	42150	1DP
MotorVoltage(Integer)	42151	0DP
AnalogInput1(Integer)	42156	0DP
AnalogInput2(Integer)	42158	0DP
UnderloadSetting(Integer)	42160	1DP
OverloadSetting(Integer)	42162	1DP
SystemFaultWord(Integer)	42165	
AFE_A Monitored Varibles		
AFE_A Line Volts	42200	1DP
AFE_A Heat Sink Temp	42201	0DP
AFE_A Total Current	42202	1DP
AFE_A U Phase Current	42203	1DP
AFE_A V Phase Current	42204	1DP
AFE_A W Phase Current	42205	1DP
AFE_A Run Status	42206	
	0	Stopped
	1	Running
AFE_A Ready Status	42207	
	0	Ready
	1	Alarm
	2	Faulted
AFE_B Monitored Varibles		
AFE_B Line Volts	42250	1DP
AFE_B Heat Sink Temp	42251	0DP
AFE_B Total Current	42252	1DP
AFE_B U Phase Current	42253	1DP
AFE_B V Phase Current	42254	1DP
AFE_B W Phase Current	42255	1DP
AFE_B Run Status	42256	
	0	Stopped
	1	Running
AFE_B Ready Status	42257	
	0	Ready
	1	Alarm
	2	Faulted


SCADA MONITOR 1 BIT (READ ONLY)
00001 OFF DI1 WARN
00002 OFF DI1 FAULT
00003 OFF DI2 WARN
00004 OFF DI2 FAULT
00005 OFF DI3 WARN
00006 OFF DI3 FAULT
00007 OFF DI4 WARN
00008 OFF DI4 FAULT
00009 OFF DI5 WARN
00010 OFF DI5 FAULT
00011 OFF DI6 WARN
00012 OFF DI6 FAULT
00037 OFF BACKSPIN OK
00050 OFF PID
00051 OFF GASLOCK
00052 OFF GL ACTIVE
00053 OFF MOTOR TEMP ALARM
00054 OFF DRAWDOWN ENABLED
00055 OFF DRAWDOWN ACTIVE
00056 OFF DRAWDOWN @ SETPT
41506 260.6 Output Amps PH A
41507 263.4 Output Amps PH B
41508 259.3 Output Amps PH C
42104 0.00 Output Frequency
BACK
MONITOR MENU
HOME
SCADA 2


SCADA MONITOR 2 Read Only
42101/00 OFF READY Status
42101/01 OFF RUN Status
42101/03 OFF FAULT Status
42105 0 Motor RPM
42106 0.0 Amps Out Avg.
42107 0.0 Motor Torque
42109 0.0 Output Volts
42110 0 DC Bus Volts
42111 0 VSD Flt Word
42112 0.00 Minimum Hz
42113 0.0 Motor NP Amps
42114 0.00 Maximum Hz
42116 0 VSD Temp (C)
42140 0.00 AO1Out 4-20ma
42141 0.00 AO2Out 4-20ma
42142 0.00 AO3Out 4-20ma
42150 0.0 Motor Current
42151 0 Motor Voltage
42152 0 AI1 Units
42153 0 AI2 Units
42155 0 System Status
42163 0 PID Cont Ref
BACK
MONITOR MENU
HOME
NEXT


SCADA MONITOR 3 Read Only
42164 0 Op Mode
42165 0 Sys Flt Wrd
42166 0 DI3 Status
40001 0.0 PSI Intake
40002 0.0 Temp Intake
40003 0.0 Temp Motor
40004 0.00 Vib X
40005 0.00 Vib Y
40006 0.0 Disch. PSI
40007 0.000 Curr. Leakage
40008 0.0 Line Volts
40009-40010 0 Serial # UDP Word
40011 0 HS TEMP (C)
40013 0.00 Today Hours
40014 0.00 Yest. Hours
40015-23 ESP_4301Rev160329 SW REV(Hex)
40090 0 AVERAGE INPUT VOLTAGE (CALC)
BACK
MONITOR MENU
HOME
NEXT


SCADA MONITOR 4 Read/Write
40025 45.00 Set Hz
40027 0.0 UnderLoad
40028 0.0 OverLoad
BACK
MONITOR MENU
HOME
NEXT

19 Main Drive Power Unit Parameters

BASIC PARAMETERS (CONTROL KEYPAD: MENU M2 -> G2.1)

Table 5: Basic parameters G2.1

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.1.1	**Min frequency**	0.00	P2.1.2	Hz	**45.00**		101	
P2.1.2	**Max frequency**	P2.1.1	320.00	Hz	**60.00**		102	If fmax > than the motor synchro- nous speed, check suitability for motor and drive system.
P2.1.3	**Accel time**	0.1	3000.0	s	**5.0**		103	Gives the time that is necessary for the output frequency to increase from zero frequency to maxi- mum frequency.
P2.1.4	**Decel time**	0.1	3000.0	s	**5.0**		104	Gives the time that is necessary for the output frequency to decrease from maximum frequency to zero frequency.
P2.1.5	**Current limit**	0.1 x IH	2 x IH	A	**Rating of Drive**		107	Minimum, maximum, and default parameters are calculated off of motor name plate amps when calculate function is used in the FB
P2.1.6	**Nominal voltage of the motor**	180	690	V	**460**		110	Find the value Un on the rating plate of the motor. Find out if the motor connection is Delta or Star.

P2.1.7	**Nominal frequency of the motor**	8.00	320.00	Hz	**60.00**		111	Find the value fn on the rating plate of the motor.
Index	**Parameter**	**Min**	**Max**	**Unit**	**Default**	**Cust**	**ID**	**Description**
P2.1.8	**Nominal speed of the motor**	24	20 000	rpm	**3600**		112	Find the value on the rating plate of the motor.
P2.1.9	**Nominal current of the motor**	0.1 x IH	2 X IH	A	**XXX**		113	Find the value In on the rating plate of the motor.
P2.1.10	**Motor cos phi**	0.30	1.00		**0.85**		120	Find the value on the rating plate of the motor.
P2.1.11	**I/O reference**	0	3		**3**		117	0 = AI1 1 = AI2 2 = Keypad 3 = Fieldbus
P2.1.12	**Keypad control reference**	0	3		**2**		121	0 = AI1 1 = AI2 2 = Keypad 3 = Fieldbus
P2.1.13	**Fieldbus control reference**	0	3		**3**		122	0 = AI1 1 = AI2 2 = Keypad 3 = Fieldbus
P2.1.14	**Preset speed 1**	0.00	P2.1.2	Hz	**20.00**		105	Speeds preset by operator.
P2.1.15	**Control place**	1	3		**1**		125	1 = I/0 terminal 2 = Keypad 3 = Fieldbus

INPUT SIGNALS (CONTROL KEYPAD: MENU M2 -> G2.2)

Table 6: Input signals, G2.2

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.2.1	**Start/Stop logic**	0	6		**6**		300	**Logic = 0** Ctrl sgn 1 = Start forward Ctrl sgn 2 = Start reverse **Logic = 1** Ctrl sgn 1 = Start/ Stop Ctrl sgn 2 = Reverse **Logic = 2** Ctrl sgn 1 = Start/ Stop Ctrl sgn 2 = Run enable **Logic = 3** Ctrl sgn 1 = Start pulse (edge) Ctrl sgn 2 = Stop pulse **Logic = 4** Ctrl sgn 1 = Forward pulse (edge) Ctrl sgn 2 = Reverse pulse (edge) **Logic = 5** Ctrl sgn 1 = Start pulse (edge) Ctrl sgn 2 = Reverse pulse **Logic = 6** Ctrl sgn 1 = Start pulse (edge) Ctrl sgn 2 = Enable pulse

Table 6: Input signals, G2.2

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.2.2	**DIN5 function**	0	8		**0**		301	0 = Not used 1 = Ext. fault, closing cont. 2 = Ext. fault, open- ing cont. 3 = Run enable 4 = Acc./Dec. time select. 5 = Force cp. to IO 6 = Force cp. to key- pad 7 = Force cp. to field- bus 8 = Reverse
P2.2.3	**DI6 function**	0	8		**0**		301	0 = Not used 1 = Ext. fault, closing cont. 2 = Ext. fault, open- ing cont. 3 = Run enable 4 = Acc./Dec. time select. 5 = Force cp. to IO 6 = Force cp. to key- pad 7 = Force cp. to field- bus 8 = Reverse
P2.2.4	**Reference scaling minimum value**	0.00	320.00	Hz	**20.00**		303	Selects the fre- quency that corre- sponds to the min. reference signal 0.00= No scaling
P2.2.5	**Reference scaling maximum value**	0.00	320.00	Hz	**50.00**		304	Selects the fre- quency that corre- sponds to the max. reference signal 0.00= No scaling
P2.2.6	**Reference filter time**	0.00	10.00	s	**0.10**		306	0 = No filtering
P2.2.7 **	**AI1 signal selection**				**AnIN:A.1**		377	TTF programming method used. See *8.9 "Terminal to function" (TTF) programming principle*.
P2.2.8 **	**AI2 signal selection**				**AnIN:A.2**		388	TTF programming method used. See *8.9 "Terminal to function" (TTF) programming principle*.

Table 6: Input signals, G2.2

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.2.9 ***	**AI3 signal selection**				**AnIN:D.1**		**377**	TTF programming method used. See8.9 "Terminal to function" (TTF) programming principle. Only available with OPTB4 card installed
P2.2.10	**AI1 reference offset**	0	1		**0**		1844	0 = 0-20 mA (0-10 V) ** 1 = 4-20 mA (2-10 V) **
P2.2.12	**AI2 reference offset**	0	1		**0**		302	0 = 0-20 mA (0-10 V) ** 1 = 4-20 mA (2-10 V) **
P2.2.12	**AI3 reference offset**	0	1		**0**		1843	0 = 0-20 mA (0-10 V) ** 1 = 4-20 mA (2-10 V) ** Only available with OPTB4 card installed
P2.2.13	**AI1 Reference inversion**	0	1		**0**		305	0 = Not inverted 1 = Inverted
P2.2.14	**AI2 Reference inversion**	0	1		**0**		1846	0 = Not inverted 1 = Inverted
P2.2.15	**AI3 Reference inversion**	0	1		**0**		1847	0 = Not inverted 1 = Inverted Only available with OPTB4 card installed

** = Remember to place jumpers of block X1and X2 accordingly. See figure 6 on page 12.

****= OPTB4 card must be installed see Appendix xx on page xx for jumper locations*

Table 7: Output signals, G2.3

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.3.1	**Analogue output 1 function**	0	9		**4**		307	0 = Not used (20 mA/10V) 1 = Output freq. (0- fmax) 2 = Freq. reference (0-fmax) 3 = Motor speed (0-Motor nominal speed) 4 = Motor current (0-InMotor) 5 = Motor torque (0-TnMotor) 6 = Motor power (0-PnMotor) 7 = Motor voltage (0-UnMotor) 8 = DC-link volt (0-1000V) 9=AI1
P2.3.2	**Analogue output 1 filter time**	0.00	10.00	S	**1.00**		308	0 = No filtering
P2.3.3	**Analogue output 1 inversion**	0	1		**0**		309	0 = Not inverted 1 = Inverted
P2.3.4	**Analogue output 1 minimum**	0	1		**0**		310	0 = 0 mA (0 V) 1 = 4 mA (2 V)
P2.3.5	**Analogue output 1 scale**	10	1000	%	**100**		311	
P2.3.6	**Analogue output 1 signal selection**	AnOUT:0.1	AnOOUT:E.10		**AnOUT: A.1**		464	TTF programming method used. See*8.9 "Terminal to function" (TTF) programming principle*.

Table 7: Output signals, G2.3

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.3.7	***Analogue output 2 function***	*0*	*8*		***4***		*307*	*0 = Not used (20 mA/10V)1 = Output freq. (0-fmax)* *2 = Freq. reference (0-fmax)* *3 = Motor speed (0-Motor nominal speed)* *4 = Motor current (0-InMotor)* *5 = Motor torque (0-TnMotor)* *6 = Motor power (0-PnMotor)* *7 = Motor voltage (0-UnMotor)* *8 = DC-link volt (0-1000V)*
P2.3.8	***Analogue output 2 filter time***	*0.00*	*10.00*	*s*	***1.00***		*308*	*0 = No filtering*
P2.3.9	***Analogue output 2 inversion***	*0*	*1*		***0***		*309*	*0 = Not inverted 1 = Inverted*
P2.3.10	***Analogue output 2 scale***	*10*	*1000*	*%*	***100***		*311*	
P2.3.11	**Analogue output 2 minimum**	0	1		**0**		310	0 = 0 mA (0 V)
P2.3.12	***Analogue output 2 signal selection***	*0*			***AnOUT:D.1***		*464*	*TTF programming method used. See* *8.9 "Terminal to function" (TTF) programming principle.*

Note: parameters in italics are only used when OPTB4 card is installed

Table 7: Output signals, G2.3

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.3.13	***Analogue output 3 function***	*0*	*8*		***4***		*307*	*0 = Not used (20 mA/10V)* *1 = Output freq. (0- fmax)* *2 = Freq. refer- ence (0-fmax)* *3 = Motor speed (0-Motor nominal speed)* *4 = Motor current (0-InMotor)* *5 = Motor torque (0-TnMotor)* *6 = Motor power (0-PnMotor)* *7 = Motor voltage (0-UnMotor)* *8 = DC-link volt (0-1000V)*
P2.3.14	***Analogue output 3 filter time***	*0.00*	*10.00*	*s*	***1.00***		*308*	*0 = No filtering*
P2.3.15	***Analogue output 3 inversion***	*0*	*1*		***0***		*309*	*0 = Not inverted 1 = Inverted*
P2.3.16	***Analogue output 3 minimum***	*0*	*1*		***0***		*310*	*0 = 0 mA (0 V)* *1 = 4 mA (2 V)*
P2.3.17	***Analogue output 3 scale***	*10*	*1000*	*%*	***100***		*311*	
P2.3.18	***Analogue output 3 signal selection***	*0*			***AnOUT:D2***		*464*	*TTF programming method used. See* *8.9 "Terminal to function" (TTF) programming principle.*
P2.3.19	**Output frequency supervision limit 1**	0	2		**0**		315	0 = No limit
P2.3.20	**Output frequency limit 1; Supervised value**	0.00	320.00	Hz	**0.00**		316	

Note: parameters in italics are only used when OPTB4 card is installed

Table 7: Output signals, G2.3

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.4.1	**Digital output 1 function**	0	16		**2**		312	0 = Not used 1 = Ready 2 = Run 3 = Fault 4 = Fault inverted 5 = FC overheat warning 6 = Ext. fault or warning 7 = Ref. fault or warning 8 = Warning 9 = Reversed 10 = Preset speed 1 11 = At speed 12 = Mot. regulator active 13 = OP freq. limit 1 superv. 14 = Control place: IO 15 = Thermistor fault/warning 16 = Fieldbus DIN1
P2.4.2	**DO1 ON Delay**	*0*	320.0	s	**0.0**		487	
P2.4.3	***DO1 OFF Delay***	*0*	320.0	S	**0.0**		488	
P2.4.4	**RO1 function**	0	18		**9 / AFE Run**		313	
P2.4.5	**RO1 ON Delay**	*0*	320.0	s	**0.0**		489	
P2.4.6	***RO1 OFF Delay***	*0*	320.0	S	**0.0**		490	
P2.4.7	**RO2 function**	0	18		**17/ FB DI2**		314	
P2.4.8	**RO2 ON Delay**	*0*	320.0	s	**0.0**		491	
P2.4.9	***RO2 OFF Delay***	*0*	320.0	S	**0.0**		492	

Table 8: Drive control parameters, G2.4

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.5.1	**Ramp 1 shape**	0.0	10.0	s	**0.1**		500	Smooth ratio for S- curves. 0 = Linear 10 = full acc/dec inc/dec tmes
P2.5.2	**Ramp 2 shape**	0.0	10.0	s	**0.0**		501	Smooth ratio for S- curves. 0 = Linear 10 = full acc/dec inc/dec tmes
P2.5.3	**Acceleration time 2**	0.1	3000.0	s	**5.0**		502	
P2.5.4	**Deceleration time 2**	0.1	3000.0	s	**5.0**		503	
P2.5.5	**Brake chopper**	0	4		**0**		504	0 = Disabled 1 = Used when running 2 = External brake chopper 3 = Used when stopped/running 4 = used when running (no testing)
P2.5.6	**Start function**	0	2		**0**		505	0 = Ramp 1 = Flying start 2 = Conditional flying start

Table 8: Drive control parameters, G2.4

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.5.7	**Stop function**	0	3		**0**		506	0 = Coasting 1 = Ramp 2 = Ramp+Run enable coast 3 = Coast+Run enable ramp
P2.5.8	**DC braking current**	0.00	IL	A	**Drive Size**		507	Auto populated by drive size
P2.5.9	**DC braking time at stop**	0.00	600.00	s	**0.00**		508	0 = DC brake is off at stop
P2.5.10	**Frequency to start DC braking during ramp stop**	0.10	10.00	Hz	**1.50**		515	
P2.5.11	**DC braking time at start**	0.00	600.00	s	**0.00**		516	0 = DC brake is off at start
P2.5.12	**Flux brake**	0	1		**0**		520	0 = Off 1 = On
P2.5.13	**Flux braking current**	0.00	IL	A	**Drive Size**		519	Auto populated by drive size

Table 9: Motor control parameters, G2.5

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.6.1	**Motor control mode**	0	3		**0**		600	0 = Frequency control 1 = Speed control 2 = Open loop torque control 3 = Closed loop speed ctrl 4 = Closed loop torque control
P2.6.2	**U/f optimization**	0	1		**0**		109	0 = Not used 1 = Automatic torque boost
P2.6.3	**U/f ratio selection**	0	3		**0**		108	0 = Linear 1 = Squared 2 = Programmable 3 = Linear with flux optim.
P2.6.4	**Field weakening point**	8.00	320.00	Hz	**60.00**		602	The field weakening point is the output frequency at which the output voltage reaches the field weakening point
P2.6.5	**Voltage at field weakening point**	10.00	200.00	%	**100.00**		603	The voltage at the field weakening point as a percent-age of the motor nominal voltage.

Table 9: Motor control parameters, G2.5

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.6.6	**U/f midpoint frequency**	0.00	P2.5.4	Hz	**50.00**		604	If the value of P2.6.3 is programmable, this parameter gives the middle point frequency of the curve.
P2.6.7	**U/f midpoint voltage**	0.00	100.00	%	**100.00**		605	If the value of P2.6.3 is programmable, this parameter gives the middle point frequency of the curve.
P2.6.8	**Output voltage at zero frequency**	0.00	40.00	%	***0.04***		606	This parameter gives the zero frequency voltage of the U/f curve. The default value is different for different unit sizes.
P2.6.9	**Switching frequency**	2.0	6.0	kHz	***3.6***		601	If you increase the switching frequency, the capacity of the AC drive reduces. To reduce capacitive currents in the motor cable, when the cable is long, we recommend that you use a low switching frequency. To reduce the motor noise, use a high switching frequency.
P2.6.10	**Overvoltage control**	0	2		**2**		607	0 = Not used 1 = Used (no ramping) 2 = Used (ramping)
P2.6.11	**Undervoltage control**	0	1		**1**		608	0 = Not used 1 = Used

Table 9: Motor control parameters, G2.5

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.6.12	**Load drooping**	0.00	100.00	%	**0.00**		620	The function enables a speed drop as a function of load. The load drooping is given as a percentage of the nominal speed at a nominal load.
P2.6.13	**Identification**	0	2		**0**		631	0 = No action 1 = Identification w/o run 2 = Identification with run 3 = Encoder ID run 4 = No action 5 = ID Run Failed
P2.6.14.1	**Magnetizing current**	0.00	2 x IH	A	**0.00**		612	The magnetizing current (no-load current) of the motor. The magnetizing current identifies the values of the U/f parameters if they are given before the identification run. If the value is set to 0, the magnetizing current is calculated internally.
P2.6.14.2	**Speed control P gain**	1	1000		**30**		613	
P2.6.14.3	**Speed control I time**	0.0	3200.0	ms	**30.0**		614	
P2.6.14.4	**Reserved**	-320.00	320	X	**0.00**		1499	
P2.6.14.5	**Acceleration compensation**	0.00	300.00	s	**0.00**		626	
P2.6.14.6	**Slip adjust**	0	500	%	**100**		619	
P2.6.14.7	**Magnetizing current at start**	0	IL	A	**0**		627	Parameter is calculated internally

Table 9: Motor control parameters, G2.5

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.6.14.8	**Magnetizing time at start**	0	60000	ms	**0**		628	
P2.6.14.9	**0-speed time at start**	0	32000	ms	**100**		615	
P2.6.14.10	**0-speed time at stop**	0	32000	ms	**100**		616	
P2.6.14.11	**Startup Torque**	0	3		**0**		621	0 Not Used 1 TorqMemory Motor will be started at the same torque as it was stopped at 2 Torque Ref Torque reference is used at start for the startup torque 3 Torque forward/Torque reverse See ID633 and 634
P2.6.14.12	**Startup torque FWD**	-300.0	300.0	%	**0.0**		633	
P2.6.14.13	**Startup torque REV**	-300.0	300.0	%	**0.0**		634	
P2.6.14.14	**Reserved**	-320.0	320.0	X	**0.00**		1499	
P2.6.14.15	**Encoder 1 Filter time**	0.0	100.0	ms	**0.0**		618	
P2.6.14.16	**Reserved**	-320.0	320.0	X	**0.00**		1499	
P2.6.14.17	**Current control Kp**	100	0.00	%	**20.00**		617	
P2.6.14.18	**Reserved**	-320.0	320.0	X	**0.00**		1499	

Table 10: Prohibit frequency parametersG2.6

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.7.1	**Range 1 Low frequency**	0.00	320.00	Hz	**0.00**		509	
P2.7.2	**Range 1 High frequency**	0.00	320.00	Hz	**5.00**		510	
P2.7.3	**Prohibit acc./dec. ramp**	0.1	10.0	X	**0.1**		518	

Table 11: Protections, G2.7

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.8.1	**4 mA Input fault**	0	5		**0**		700	0 = No response 1 = Warning 2 = Warning+Previous Freq. 3 = Warning+PresetFreq 2.7.2 4 = Fault, stop acc. to 2.4.7 5 = Fault, stop by coasting
P2.8.2	**4 mA fault frequency**	0.00	P2.1.2	Hz	**0.00**		728	
P2.8.3	**Response to external fault**	0	3		**3**		701	0 = No response 1 = Warning 2 = Fault, stop acc. to 2.4.7 3 = Fault, stop by coasting
P2.8.4	**Input phase supervision**	0	3		**3**		730	

Table 11: Protections, G2.7

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.8.5	**Undervoltage fault response**	0	1		**0**		727	0 = Fault stored in history Fault not stored
P2.8.6	**Output phase supervision**	0	3		**3**		702	0 = No response 1 = Warning
P2.8.7	**Earth fault protection**	0	3		**3**		703	2 = Fault, stop acc. to 2.4.7
P2.8.8	**Thermal protection of the motor**	0	3		**0**		704	3 = Fault, stop by coasting
P2.8.9	**Motor ambient temperature factor**	-100.0	100.0	%	**0.0**		705	
P2.8.10	**Motor cooling factor at zero speed**	0.0	150.0	%	**40.0**		706	
P2.8.11	**Motor thermal time constant**	1	200	min	**80**		707	
P2.8.12	**Motor duty cycle**	0	150	%	**100**		708	
P2.8.13	**Stall protection**	0	3		**0**		709	0 = No response 1 = Warning 2 = Fault, stop acc. to 2.4.7 3 = Fault, stop by coasting
P2.8.14	**Stall Current limit**	0	2 x IH	A	**.7 x IH**		710	Parameter is auto calculated
P2.8.15	**Stall time limit**	1.00	120.00	S	**15.00**		711	
P2.8.16	**Stall frequency limit**	1.00	P2.1.2	Hz	**25.00**		712	
P2.8.17	**Underload protection**	O	3		**0**		713	0 = No response 1 = Warning 2 = Fault, stop acc. to 2.4.7 3 = Fault, stop by coasting

Table 11: Protections, G2.7

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.8.18	**UP from torque**	10	150.0	%	**50.0**		714	
P2.8.19	**UP zero frequency torque**	5.0	150.0	%	**10.0**		715	
P2.8.20	**UP time limit**	2.00	600.00	S	**20.00**		716	
P2.8.21	**Thermistor fault response**	0	3		**0**		732	0 = No response 1 = Warning 2 = Fault, stop acc. to 2.4.7 3 = Fault, stop by coasting
P2.8.22	**FBcomm. Fault response**	0	3		**0**		733	0 = No response 1 = Warning 2 = Fault, stop acc. to 2.4.7 3 = Fault, stop by coasting
P2.8.23	**Slot comm fault response**	0	3		**3**		734	0 = No response 1 = Warning 2 = Fault, stop acc. to 2.4.7 3 = Fault, stop by coasting

Table 12: Autorestart parameters, G2.8

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.9.1	**Wait time**	0.10	10.00	s	**2.00**		717	The wait time before the first reset is done.
P2.9.2	**Trial time**	0.00	60.00	s	**30.00**		718	When the trial time is over, and the fault is still active, the drive will trip.
P2.9.3	**Start function**	0	2		**0**		719	The selection of the start mode for Automatic reset. 0 = Ramp 1 = Flying start 2 = According to P2.4.6
P2.9.4	**Number of tries after undervoltage trip**	0	10		**1**		720	
P2.9.5	**Number of tries after overvoltage trip**	0	10		**0**		721	
P2.9.6	**Number of tries after overcurrent trip**	0	3		**1**		722	
P2.9.7	**Number of tries after 4mA reference trip**	0	10		**0**		723	
P2.9.8	**Number of tries after motor temperature fault trip**	0	10		**0**		726	
P2.9.9	**Number of tries after external fault trip**	0	10		**0**		725	
P2.9.10	**Number of tries after underload fault trip**	0	10		**0**		738	
P2.9.11	**FB fault tries**	0	10		**1**		739	

Table 13: Cold weather parameters G2.9

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.10.1	**Mode state**	0	1		**1**		1554	0=disabled 1=Enabled
P2.10.2	**CW volt output**	0.00	20.00	%	**0.85**		1555	
P2.10.3	**Active time**	0	10	Min	**5**		1556	

Table 14: Backspin parameters G2.10

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.11.1	**Backspin Timer**	0	32767	S	**0**		1811	
P2.11.2	**Backspin timeout**	0	32767	S	**0**		1810	

Table 15: Fan control parameters G2.11

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.12.1	**Fan control mode**	1	10		**1**		1572	
P2.12.2	**IGBT start temp**	0	50	°C	**50**		1573	
P2.12.3	**IGBT stop temp**	-10	45	°C	**45**		1574	

Table 15: kWh meter parameters G2.12

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
2.13.1	**Counter unit**	1	10		**1/ 0.01kWh**		1829	
2.13.2	**Trip counter unit**	1	10		**1/ 0.01kWh**		1830	
2.13.3	**Reset trip counter**	0	1		**0**		1831	0=no 1=yes

Table 16: Keypad control parameters, M3

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P3.1	**Control place**	1	3		**1**		125	1 = I/0 terminal 2 = Keypad 3 = Fieldbus
P3.3	**Direction (on key-pad)**	0	1		**0**		123	You can adjust the frequency reference on the keypad with this parameter.
P3.4	**Stop button**	0	1		**1**		114	0 = Limited function of Stop button 1 = Stop button always enabled

System menu M6

Table 17: Copy parameters P6.3

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P6.3.4	**Automatic backup**	0	1		**1**		820	0=Yes 1=No

Table 18: Security parameters P6.5

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P6.5.2	**Parameter lock**	0	1		**0**		819	0=Chang enable 1=Change disable
P6.5.3	**Startup wizard**	0	1		**0**		826	0=No 1=Yes
P6.5.4	**Multi monitor items**	0	1		**0**		822	0=Change enable 1= Change disable
P6.5.5	**OPTAF remove**	0	1		**0**		832	

Table 19: Keypad settings P6.6

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P6.6.1	**Default page**	0	99.99.99.99.99		**0.**			
P6.6.2	**Default page / operating menu**	0	99		**1**			
P6.6.3	**Time out time**	0	65535	S	**600**		804	
P6.6.4	**Contrast**	0	31		**18**		805	
P6.6.5	**Backlight time**	0	65535	M	**10**		818	

Table 20: Hardware Setting P6.7

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P6.7.1	**Internal Brake Resistor**	0	1		**0**		821	0= not connected 1=connected
P6.7.2	**Fan control**	0	3		**1**		825	0=continuous 1=Temperature 2= First start 3= Calc temp
P6.7.3	**HMI ACK timeout**	0	5000	ms	**200**		823	
P6.7.4	**HMI retry**	1	10		**5**		824	
P6.7.5	**Sine filter connected**	0	1		**1**			0=not connected 1=connected
P6.7.6	**Pre-Charge Mode**	0	1		**0**			0=Normal FC

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Table 21: OPTA9 parameters P7.1

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P7.1.1.1	**AI1 mode**	1	5		**1**			1 = 0...20mA 2 = 4...20mA 3 = 0...10V 4 = 2...10V 5 = -10...+10V
7.1.1.2	**AI2 mode**	1	5		**1**			1 = 0...20mA 2 = 4...20mA 3 = 0...10V 4 = 2...10V 5 = -10...+10V
7.1.1.3	**AO1 mode**	1	4		**2**			1 = 0...20mA 2 = 4...20mA 3 = 0...10V 4 = 2...10V

Table 22: Communications parameters

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
7.5.1.1	**Communication Time out**	0	255	S	**60**			
7.5.1.2	**IP part 1**	1	223		**192**			
7.5.1.3	**IP part 2**	0	255		**168**			
7.5.1.4	**IP part 3**	0	255		**1**			
7.5.1.5	**IP part 4**	0	255		**2**			
7.5.1.6	**Sub net mask P1**	0	255		**255**			
7.5.1.7	**Sub net mask P2**	0	255		**255**			
7.5.1.8	**Sub net mask P3**	0	255		**255**			
7.5.1.9	**Sub net mask P4**	0	255		**0**			
7.5.1.10	**Default gateway P1**	0	255		**192**			
7.5.1.11	**Default gateway P2**	0	255		**168**			
7.5.1.12	**Default gateway P3**	0	255		**1**			
7.5.1.13	**Default gateway P4**	0	255		**5**			

- If the number of running auxiliary drives is smaller than the value of parameter 2.9.27 the autochange function can take place.
- If the number of running auxiliary drives is equal to the value of parameter 2.9.27 and the frequency of the controlled drive is below the value of parameter 2.9.28 the autochange can take place.
- If the value of parameter 2.9.28 is 0.0 Hz, the autochange can take place only in rest position (Stop and Sleep) regardless of the value of parameter 2.9.27.

8.10 INTERLOCK SELECTION(P2.9.23)

This parameter is used to activate the interlock inputs. The interlocking signals come from the motor switches. The signals (functions) are connected to digital inputs which are programmed as interlock inputs using the corresponding parameters. The pump and fan control automatics only control the motors with active interlock data.

- The interlock data can be used even when the Autochange function is not activated
- If the interlock of an auxiliary drive is inactivated and another unused auxiliary drive available, the latter will be put to use without stopping the AC drive.
- If the interlock of the controlled drive is inactivated, all motors will be stopped and restarted with the new set-up.
- If the interlock is re-activated in Run status, the automatics functions according to parameter 2.9.23, Interlock selection:

Table217:SelectionsforInterlockselection

Selection number	Selection name	Description
0	Not used	
1	Update in stop	Interlocks are used. The new drive will be placed last in the autochange line without stopping the system. However, if the autochange order now becomes, for example, [P1 -> P3 -> P4 -> P2], it will be updated in the next Stop (autochange, sleep, stop, etc.). EXAMPLE: [P1 -> P3 -> P4] -> [P2 LOCKED] ->[P1 -> P3 -> P4 -> P2] -> [SLEEP] -> [P1 -> P2 -> P3 -> P4]

20 AFE Parameters

Header needs formatting to be consistent with other pages.

Table1. Monitoring 1

Code	Signal	Unit	ID	Description
V1.1.1	DC Voltage	V	1108	Measured DC Link voltage in Volts
V1.1.2	Used DC Voltage Reference	%	1200	Used DC voltage reference by the regenerative unit in percentage of Nominal DC Voltage. Nominal DC voltage = 1.35 * Supply voltage
V1.1.3	Total Current	A	1104	Total current of the regenerative unit in Amperes.
V1.1.4	Active Current	%	1125	Reactive current of the regenerative drive in percentage of Rated Line Current. > 0 power from AC side to DC side < 0 power from DC side to AC side
V1.1.5	Reactive Current	%	1157	Reactive current of the regenerative drive in percentage of Rated Line Current. > 0 Inductive current < 0 Capacitive current
V1.1.6	Active Power	kW	1511	> 0 power from AC side to DC side < 0 power from DC side to AC side
V1.1.7	Power %	%	5	> 0 power from AC side to DC side < 0 power from DC side to AC side
V1.1.8	Status Word		43	
V1.1.9	Supply Frequency	Hz	1101	Supply frequency in ##.## Hz. The sign indicates the phase order.
V1.1.10	Supply Voltage	V	1107	Input AC voltage, RMS line to line Volts.
V1.1.11	Line Frequency D7	Hz	1654	Measured line frequency by OPT- D7
V1.1.12	Line Voltage D7	V	1650	Measured line voltage by OPT-D7

Table2. Monitoring values 2

Code	Signal	Unit	ID	Description
V1.2.1	Unit Temperature	°C	1109	Heat **sink** temperature
V1.2.2	Current	A	1113	Unfiltered current

V1.2.3	DC Voltage	V	44	Unfiltered DC Voltge
V1.2.4	Operation Hours	h	1856	Operation hours in format of #,##
V1.2.5	Reactive Current Reference	%	1389	Used reactive current reference 100.0 = Rated Line Current

Table3. FieldBus Monitoring values

Code	Signal	Unit	ID	Description
V1.3.1	Main Control Word		1160	Control word from fieldbus
V1.3.2	Main Status Word		1162	Status word to fieldbus
V1.3.3	Fault Word 1		1172	
V1.3.4	Fault Word 2		1173	
V1.3.5	Warning Word 1		1174	
V1.3.6	Last Active Warning		74	
V1.3.7	Last Active Fault		37	
V1.3.8	Aux Control Word		1161	
V1.3.9	Aux Status Word		1163	

Table4. IO Monitoring values

Code	Signal	Unit	ID	Description
V1.4.1	DIN1, DIN2, DIN3		15	Digital Inputs A1, A2 and A3 Status (sum)
V1.4.2	DIN4, DIN5, DIN6		16	Digital Inputs B4, B5 and B6 Status (sum)
V1.4.3	DIN Status 1		56	
V1.4.4	DIN Status 2		57	
V1.4.5	Analogue Input 1	%	13	
V1.4.6	Analogue Input 2	%	14	
V1.4.7	Analogue Out 1	%	26	
V1.4.8	PT100 Temp. 1	°C	50	
V1.4.9	PT100 Temp. 2	°C	51	
V1.4.10	PT100 Temp. 3	°C	52	
V1.4.11	DO1, RO1, RO2		17	Digital Output and Relay 1&2 Status (sum)

Table5. Unit Monitoring Values

Code	Signal	Unit	ID	Description
V1.5.1	Unit Nominal Voltage	V	1117	Unit rated AC Voltage
V1.5.2	Unit Nominal Current	A	1118	
V1.5.3	U Phase Current	A	1149	U Phase RMS current
V1.5.4	V Phase Current	A	1150	V Phase RMS current
V1.5.5	W Phase Current	A	1151	W Phase RMS current

Table6. Basic parameters

Code	Parameter	Min	Max	Unit	Default	ID	Note
P2.1.1	Rated Line Voltage	400V : 323V 690V : 446V	400V : 550V 690V : 758V	V	480	1201	Set here the nominal voltage of the grid.
P2.1.2	Supply frequency	50	60	*Hz*	*60*	*1532*	
P2.1.2	Rated Line Current	0.0	Varies	A	I_H	113	Parameter will auto populate.
P2.1.3	System Rated Power	0	32000	kW	0	116	
P2.1.4	Parallel AFE	0	1		0	1501	**0** = single AFE **1** = parallel AFE Activation will set DC Drooping to 4%.

Table7. Reference handling

Code	Parameter	Min	Max	Unit	Default	ID	Note
P2.2.1	DC Voltage Ref.	400V: 105% 690V: 105%	400V: 130% 690V: 115%	%	105.00	1462	DC Voltage reference as percentage of Nominal DC Voltage Nominal DC voltage = 1.35 * Supply voltage
P 2.2.2	DC Voltage Drooping	0.00	100.00		0.00	620	AFE drooping DC-voltage. Set to 4.00% when parallel AFE operation is selected
P 2.2.3	Reactive Current Reference Selector	0	2		0	1384	Reactive current reference source: **0** = Panel **1** = Analogue Input 1 **2** = Analogue Input 2
P2.2.4	ReactiveCurr.Ref	-100.0	100.0	%	0.0	1459	Regenerative reactive current reference 100.0 = nominal current. Positive = Inductive Negative = Capacitive

Table8. Digital input parameters

Table9. Analog input parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.3.1.1	Run Request	0	6		1	1206	**0** = Not used **1** = DIN1 **2** = DIN2 **3** = DIN3 **4** = DIN4 **5** = DIN5 **6** = DIN6
P2.3.1.2	Contactor Open (Forced Open)	0	12		0	1508	**0** = Not used **1** = DIN1 **2** = DIN2 **3** = DIN3 **4** = DIN4 **5** = DIN5 **6** = DIN6 **7** = DIN1 (inverted) **8** = DIN2 (inverted) **9** = DIN3 (inverted) **10** = DIN4 (inverted) **11** = DIN5 (inverted) **12** = DIN6 (inverted)
P2.3.1.3	LCL Temperature monitoring X52	0	12		0	1179	As par. P2.3.1.2
P2.3.1.4	Main contactor Acknowledge	1	6		4	1453	**1** = DIN1 **2** = DIN2 **3** = DIN3 **4** = DIN4 **5** = DIN5 **6** = DIN6
P2.3.1.5	LCL Fan Monitoring (X51)	0	12		0	1178	As par. P2.3.1.2
P2.3.1.6	Fault Reset	0	6		6	1208	As par. P2.3.1.1
P2.3.1.7	External fault	0	12		0	1214	As par. P2.3.1.2
P2.3.1.8	Run Enable	0	6		0	1212	As par. P2.3.1.1
P2.3.1.9	Cooling Monitor	0	6		0	750	OK input from the cooling unit
P2.3.1.10	LCL Temperature monitoring X51	0	12		0	1180	As par. P2.3.1.2

Formatting issue – parameters goes after…input

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.3.2.1	Analogue Input1 Minimum	0	1		0	1227	Minimum voltage or Current at AI1. **0** = 0 V / 0 A **1** = 2 V / 4 mA

P2.3.2.2	Analogue Input 1 Filter Time	0.00	10.00	s	1.00	1228	Filter time for AI1 in ###.## sec. **0** = No filtering
P2.3.2.3	Analogue Input2 Minimum	0	1		0	1231	Minimum voltage or Current at AI2 in. **0** = 0 V / 0 A **1** = 2 V / 4 mA
P2.3.2.4	Analogue Input 2 Filter Time	0.00	10.00	s	1.00	1232	Filter time for AI2 ###.## sec. **0** = No filtering

Table10. Digital output parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.1.1	Digital output 1 function	0	11		9	1216	Signal selection for DO1. **0** = DO Control from FB (AuxControlWord, bit 13) **1** = Ready **2** = Running **3** = Fault **4** = No Fault **5** = Warning **6** = At Reference **7** = Regen Active **8** = Charge DC **9** = Ready / Warning (blink). **10** = Temperature Warning. **11** = DC Voltage Above Limit
P2.4.1.2	Relay Output 1 function	0	11		2	1217	Signal selection for the digital indication through RO1.
P2.4.1.3	Relay Output 2 function MMC	**0**	**0**		**0**	1218	Main Contactor Control Slot B, Output 2 **This parameter cannot be changed.**
P2.4.1.4	Digital output 4 function	0	11		3	1385	Signal selection for the digital indication through ROE1 (Option card OPT-B5).
P2.4.1.5	Digital output 5 function	0	11		5	1386	Signal selection for the digital indication through ROE2 (Option card OPT-B5).
P2.4.1.6	Digital output 6 function	0	11		10	1390	Signal selection for the digital indication through ROE3 (Option card OPT-B5).
P2.4.1.7	Digital output 7 function	0			0	1391	0=control from FB
P2.4.1.8	Digital output 8 function	0			0	1395	0=control from FB
P2.4.1.9	Digital output 9 function	0			0	1396	0=control from FB
P2.4.1.10	Digital output 10 function	0			0	1423	0=control from FB
P2.4.1.11	Digital output 11 function	0			0	1427	0=control from FB
P2.4.1.12	Digital output 12 function	0			0	1428	0=control from FB
P2.4.1.13	Digital output 13 function	0			0	1429	0=control from FB

Table11. Analog Output 1 parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.2.1	AO1 SignalID	0	2000		0	1233	Set the ID no. of a signal to be connected to AO1.
P2.4.2.2	AO1 Offset	0	1		0	1234	Minimum voltage or current at AO1. **0** = 0V/0mA. **1** = 2V/4mA
P2.4.2.3	AO1 Filter	0.02	10.00	s	10.00	1235	Filter time for AO1 in ##.## sec.
P2.4.2.4	AO1 Max Value	-30000	30000		1500	1236	Maximum value of a signal connected to AO1. This will correspond to +10V/20mA.
P2.4.2.5	AO1 Min Value	-30000	30000		0	1237	Minimum value of a signal connected to AO1. This will correspond to 0V/0mA or 2V/4mA depending on the AO1 Offset

Table12. Current Limit

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.1.1	Current Limit	0	Varies	A	I_L	107	Total current limit

Table13. Power Limit

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.2.2	InputPowerLim	0	300	%	300	1289	Motoring power limit in AFE mode to DC-link.
P 2.5.2.1	OutputPowerLim	0	300	%	300	1290	Generating power limit in AFE mode to grid.

5.1.1 Auto

Table14. Auto Start Stop

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.3.1	Start Function	0	1		0	1274	**0** = Normal **1** = Auto
P2.5.3.2	Auto Stop Level	-100.0	100.0	%	-3.0	1099	
P2.5.3.4	Minimum Run Time	0	32000	ms	100	1281	
P2.5.3.5	Stop delay	0	32000	ms	1000	1282	

5.1.2 DC Vol

Table15. DC Voltage

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.4.1	DC Voltage Supervision Limit	0	1100	V	600	1454	

Table16. Drive control parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.1	Switching frequency	3.6	Varies	kHz	3.6	601	Switching frequency
P2.6.2	Regen Options 1	0	65535		288	1463	This packed bit word is made for enabling/ disabling different control options for regeneration control.
P2.6.3	Start Up Delay	0.00	320.00	s	0.00	1500	Starting delay when run command is given. When you program different delays to the paralleled units, the units will start in sequence.
P2.6.4	Modulator Type	0	4		0	1516	**0** = Hardware **1** = Software 1 **2** = Software 2 **3** = Software 3 **4** = Software 4
P2.6.5	Control Options	0	65536		0	1798	Control word for activating special features.
P2.6.6	Control Options	0	65536		0	1707	Control word for activating special features.
P2.6.7	Operation Time	0	2^32		20	1855	Stored AFE Running time

Table17. Control parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.8.1	Voltage Controller Kp	0	32000		200	1451	Gain for the DC voltage controller of the unit
P2.6.8.2	Voltage Controller Ti	0	1000	ms	50	1452	Integral time for the DC Voltage controller of the regenerative unit
P2.6.8.3	Active current Kp	0	4000		400	1455	Active current controller gain.
P2.6.8.4	Active current Ti	0.0	100.0	ms	1.5	1456	Active current controller integral time
P2.6.8.5	Sync Kp	0	32000		2000	1457	Synchronization gain
P2.6.8.6	Sync Ti	0	1000		50	1458	Synchronisation integral time (15 = 7ms).
P2.6.8.7	Modulator Index Limit	0	200	%	110	655	Lower value may improve current waveform, but causes the DC voltage to increase when the line voltage is high.
P2.6.8.8	Main Contactor On Delay	0.00	10.00	s	0.40	1519	Start delay from Main Contactor Acknowledge
P2.6.8.9	Capacitor Size	0.00	10.00	%	5.0	1460	
P2.6.8.10	Inductor Size	0.00	10.00	%	6.0	1461	

Table18. Fieldbus parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.7.1	Fieldbus data out 1 selection	0	65535		1149	1490	Choose monitoring data with parameter ID. Default Total Current.
P2.7.2	Fieldbus data out 2 selection	0	65535		1150	1491	Choose monitoring data with parameter ID. Warning Word 1.
P2.7.3	Fieldbus data out 3 selection	0	65535		1151	1492	Choose monitoring data with parameter ID. Fault Word 1.
P2.7.4	Fieldbus data out 4 selection	0	65535		1118	1493	Choose monitoring data with parameter ID. Fault Word 2.
P2.7.5	Fieldbus data out 5 selection	0	65535		1109	1494	Choose monitoring data with parameter ID. Din Status 1.
P2.7.6	Fieldbus data out 6 selection	0	65535		1107	1495	Choose monitoring data with parameter ID. Din Status 2.
P2.7.7	Fieldbus data out 7 selection	0	65535		1104	1496	Choose monitoring data with parameter ID
P2.7.8	Fieldbus data out 8 selection	0	65535		1162	1497	Choose monitoring data with parameter ID. Supply Voltage.
P2.7.9	Fieldbus data in 1 selection	0	65535		1032	876	Choose monitoring data with parameter ID
P2.7.10	Fieldbus data in 2 selection	0	65535		1172	877	Choose monitoring data with parameter ID. Aux Control Word.
P2.7.11	Fieldbus data in 3 selection	0	65535		1173	878	Choose monitoring data with parameter ID
P2.7.12	Fieldbus data in 4 selection	0	65535		1174	879	Choose monitoring data with parameter ID
P2.7.13	Fieldbus data in 5 selection	0	65535		0	880	Choose monitoring data with parameter ID
P2.7.14	Fieldbus data in 6 selection	0	65535		0	881	Choose monitoring data with parameter ID
P2.7.15	Fieldbus data in 7 selection	0	65535		0	882	Choose monitoring data with parameter ID
P2.7.16	Fieldbus data in 8 selection	0	65535		0	883	Choose monitoring data with parameter ID
P2.7.18	Control Slot Selector	0	8		0	1440	**0**=All **4**=Slot D **5**=Slot E

Table19. Protections parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
2.8.1.1	Response to Thermistor fault	0	3		0	732	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.2	Drive Over Temperature Fault Response	2	3		2	1517	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.3	Over Voltage Fault Response	2	3		2	1507	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.4	Reserved	0	0		0	1990	
2.8.1.5	Input Filter Over Temperature Response	0	3		0	1505	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.6	Max Charge Time	0.00	10.00	s	5.00	1522	Charging time limit when the drive charging options are used.
2.8.1.7	Main Contactor on Fault	1	0		0	1510	**0** = Keep closed **1** = Open
2.8.1.8	Main Contactor Fault Delay	0.00	10.00	s	3.50	1521	Delay for (F64) MCC Open Fault. Defines the max delay time between the main contactor close command and the acknowledge signal.
2.8.1.9	Input Phase supervision Fault Response	0	3		2	1518	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.10	Response to external fault	0	3		2	701	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.11	Fan Fault Response	3	2		2	1524	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.12	Input Filter Fan Fault Response	3	1		2	1509	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DCOFF
2.8.1.13	Cooling Flt. Delay	0.00	10.00	s	10.00	751	

Table20. PT-100

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.8.2.1	PT100 Inputs	0	6		0	1221	**0** = Not used **1** = Analogue Input 1 **2** = PT100 input 1 **3** = PT100 input 1 & 2 **4** = PT100 input 1 & 2 & 3 **5** = PT100 input 2 & 3 **6** = PT100 input 3
P2.8.2.2	PT100 FaultResponse	0	3		0	740	**0**=No response **1**=Warning **2**=Fault **3**=Fault, DC OFF
P2.8.2.3	PT100 Warn.Limit	-30	200	°C	100	741	
P2.8.2.4	PT100 Fault Lim.	-30	200	°C	130	742	

Table21. Earth fault

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.8.3.1	EarthFlt Response	2	5		1	1332	**0**=No response **1**=Fault
P2.8.3.2	EarthFaultLevel	0	100	%	50	1333	
P2.8.3.3	Earth Fault Delay	0	30000	ms	800	774	

Table22. Fieldbus

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.8.4.1	FB Communication fault response	0	2		2	733	**0**=No response **1**=Warning **2**=Fault
P2.8.4.2	FB Watchdog delay	0	5.00	s	2.00	1354	Watchdog fault delay for FB master. The function can be disabled if set to zero.

Table23. Auto reset parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.1	Wait time	0.10	10.00	s	0.20	717	
P2.9.2	Trial time	0.00	60.00	s	30.00	718	
P2.9.3	Number of tries after overvoltage trip	0	10		0	721	
P2.9.4	Number of tries after over current trip	0	3		0	722	
P2.9.5	Number of tries after external fault trip	0	10		0	725	
P2.9.6	Fault Simulation	0	65535		0	1569	

Table24. DIN ID Control parameters

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.10.1	ID Control DIN	0.1	E.10		0.1		1570	Slot. Board input No.
P2.10.2	Controlled ID	0	10000	ID	0		1571	Select ID that is controlled by digital input
P2.10.3	False value	-32000	32000		0		1572	Value when DI is low
P2.10.4	True value	-32000	32000		0		1573	Value when DI is high

Table25. Keypad control parameters

Code	Parameter	Min	Max	Unit	Default	ID	Description
P3.1	Control place	2	0	2		1403	**0**=Fieldbus **1**=I/O terminal **2**=Keypad (Default)

Basic System Diagram and Test Points

System Components

- Converter Section
  - Consists of Diodes or SCRs depending on the model of drive
  - Converts 3 Phase AC incoming voltage to DC voltage
- DC Bus
  - Consists of DC Bus Inductors and Capacitors
- Inverter Section
  - Consists of IGBT transistors
  - Converts DC voltage to 3 Phase AC output voltage

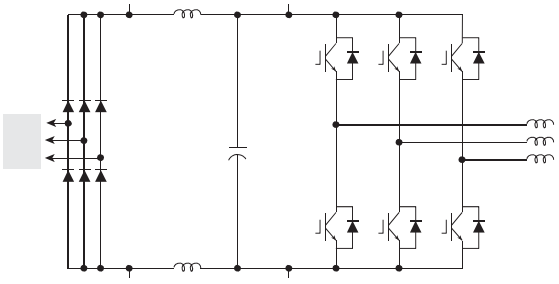
Test Points

Category	Test Point	Description
Input Voltage (Drive Input)	R	L1 - Drive Input, Output of Circuit Breaker
	S	L2 - Drive Input, Output of Circuit Breaker
	T	L3 - Drive Input, Output of Circuit Breaker
DC Bus	DC+	Positive DC Bus Terminal, Pre-Link Inductor/Capacitors
	DC–	Negative DC Bus Terminal, Pre-Link
	INV+	Positive DC Bus Terminal, Post-Link
	INV-	Negative DC Bus Terminal, Post-Link
Output Voltage	U	M1 - Drive Output Pre-sine Wave Filter
	V	M2 - Drive Output Pre-Sine Wave Filter
	W	M3 - Drive Output Pre-Sine Wave Filter
	TB12	Output Terminal Block

Static Checks for Power Devices

Refer to Figure 4.1 for system diagram and test point designations.

Figure 4.1 System Diagram



Note: The following tests were conducted on 6 Pulse Models only. A Fluke 87 Multi-Meter was used with the selector switch set to "Diode Check."

Input Devices

Failure Mode: If a short is present between two of the test points, replace the associated input diode or SCR.

Input Power Device Checks (SCR) 180..600 Amp

Meter + Lead on Test Point:	Meter – Lead on Test Point:	Nominal Reading
DC+	R (L1)	OL (Infinite)
DC+	S (L2)	OL (Infinite)
DC+	T (L3)	OL (Infinite)
DC-	R (L1)	OL (Infinite)
DC-	S (L2)	OL (Infinite)

DC-	T (L3)	OL (Infinite)

Input Power Device Checks (Diode) 744..900 Amp

Meter + Lead on Test Point:	Meter – Lead on Test Point:	Nominal Reading .
R (L1)	DC+	0.383 +/-10%
S (L2)	DC+	0.383 +/-10%
T (L3)	DC+	0.383 +/-10%
DC-	R (L1)	0.383 +/-10%
DC-	S (L2)	0.383 +/-10%
DC-	T (L3)	0.383 +/-10%

Input Power Device Checks (Diode) 1115..1650 Amp

Meter + Lead on Test Point:	Meter – Lead on Test Point:	Nominal Reading .
R (L1)	CNV+ (DC+)	0.410 +/-10%
S (L2)	CNV+ (DC+)	0.410 +/-10%
T (L3)	CNV+ (DC+)	0.410 +/-10%
CNV– (DC–)	R (L1)	0.410 +/-10%
CNV– (DC–)	S (L2)	0.410 +/-10%
CNV– (DC–)	T (L3)	0.410 +/-10%

Output Devices

Failure Mode: If a short is present between two of the test points, replace the associated output IGBT.

Output Power Device Checks (IGBT) 180..325 Amp

Meter + Lead on Test Point:	Meter – Lead on Test Point:	Nominal Reading
U (M1)	INV+	0.345+/-10%
V (M2)	INV+	0.345+/-10%
W (M3)	INV+	0.345+/-10%
U (M1)	INV-	Charge/Inf
V (M2)	INV-	Charge/Inf
W (M3)	INV-	Charge/Inf
INV+ (DC+)	U (M1)	Charge/Inf
INV+ (DC+)	V (M2)	Charge/Inf
INV+ (DC+)	W (M3)	Charge/Inf
INV– (DC–)	U (M1)	0.345+/-10%
INV– (DC–)	V (M2)	0.345+/-10%
INV– (DC–)	W (M3)	0.345+/-10%

Output Power Device Checks (IGBT) 475..1650 Amp

Meter + Lead on Test Point:	Meter – Lead on Test Point:	Nominal Reading
U (M1)	INV+	0.340+/-10%
V (M2)	INV+	0.340+/-10%
W (M3)	INV+	0.340+/-10%
U (M1)	INV-	Charge/Inf
V (M2)	INV-	Charge/Inf
W (M3)	INV-	Charge/Inf
INV+ (DC+)	U (M1)	Charge/Inf
INV+ (DC+)	V (M2)	Charge/Inf
INV+ (DC+)	W (M3)	Charge/Inf
INV– (DC–)	U (M1)	0.340+/-10%
INV– (DC–)	V (M2)	0.340+/-10%
INV– (DC–)	W (M3)	0.340+/-10%

Drive Component Identification

The photos that follow are annotated to help the Summit drive user identify drive components for reasons of maintenance or troubleshooting. The drive components shown can be easily correlated with their symbolic representations on the schematic diagrams found in Section XX. Many of the drive components will be found in both AFE and standard drives. Typically, these components are noted in the photo captions.

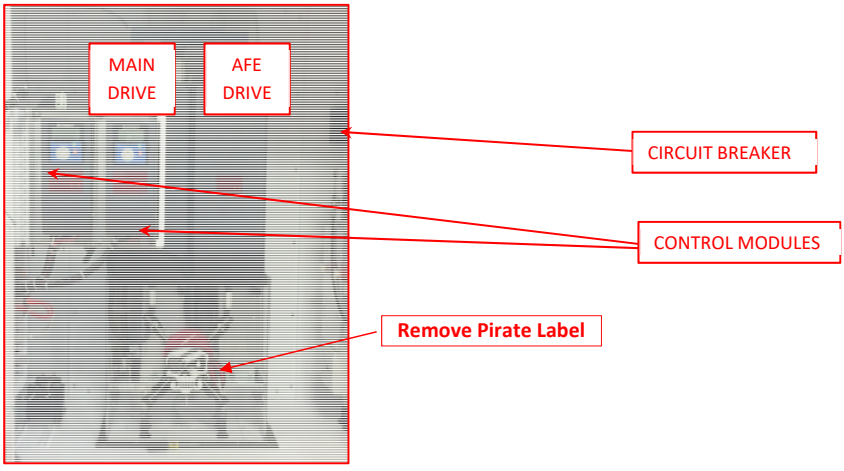


Figure XX – Some components in an AFE drive system. The breaker and transformer shown here are found in all drives.

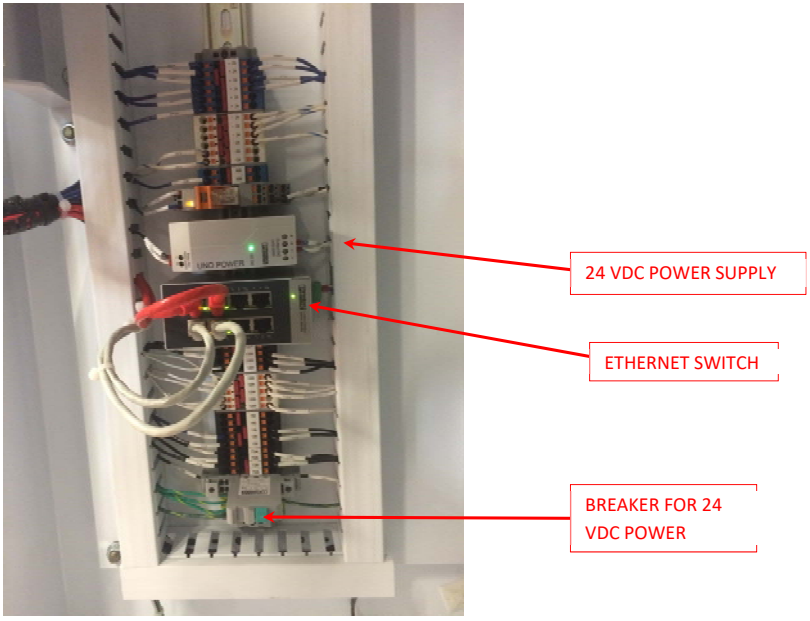


Fig XX – Components at top end of terminal board.
Some components may not be present in all drives.

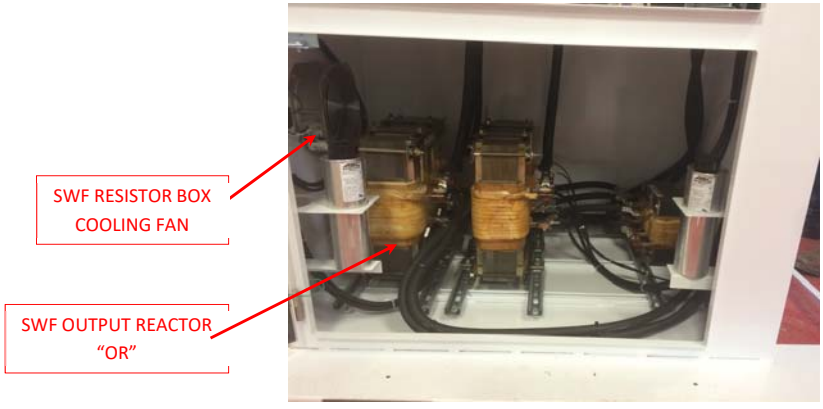


Fig XX – Some sine wave filter (SWF) components.

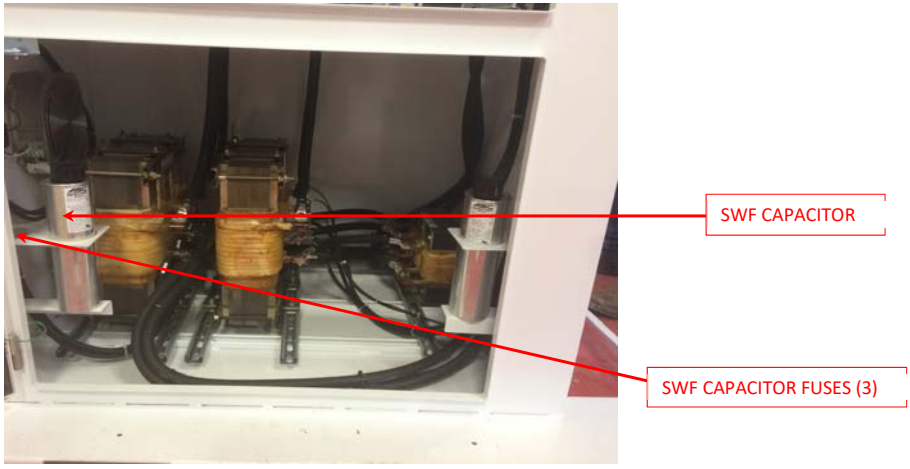


Fig XX – Sine wave filter components. Standard drive.

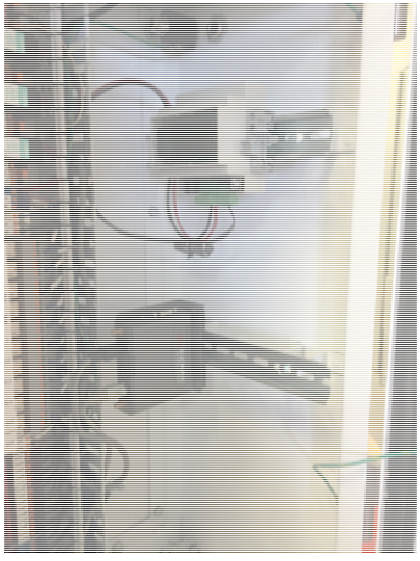


Fig XX – SCADA radio (cell phone modem) And SPS1500

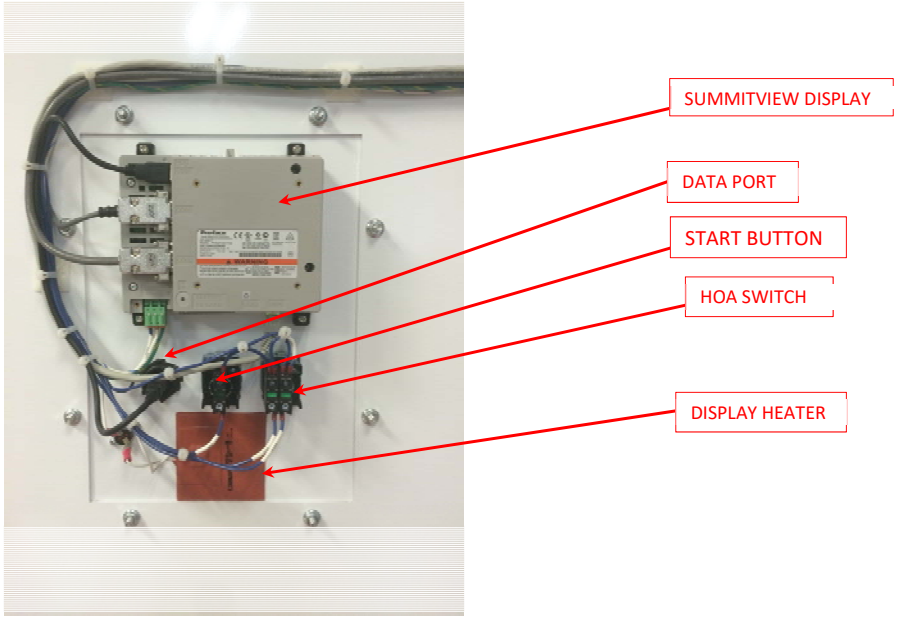


Fig XX – Rear view of components mounted on drive enclosure door. Note: SummitView Display may be called "Wiseguy" on some schematics.

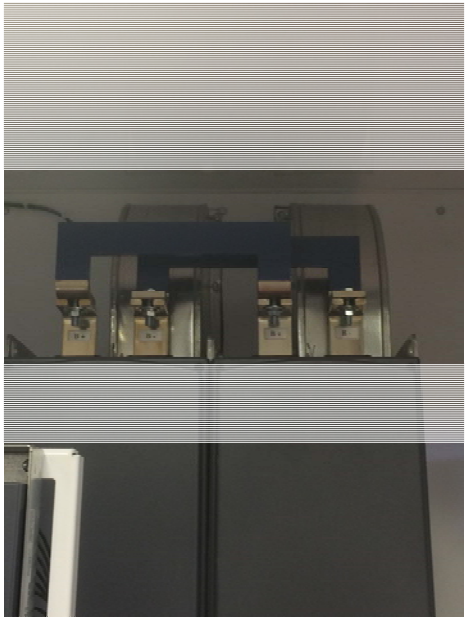


Fig XX – DC Bus conductors between Main and AFE Drives. AFE drive systems only.

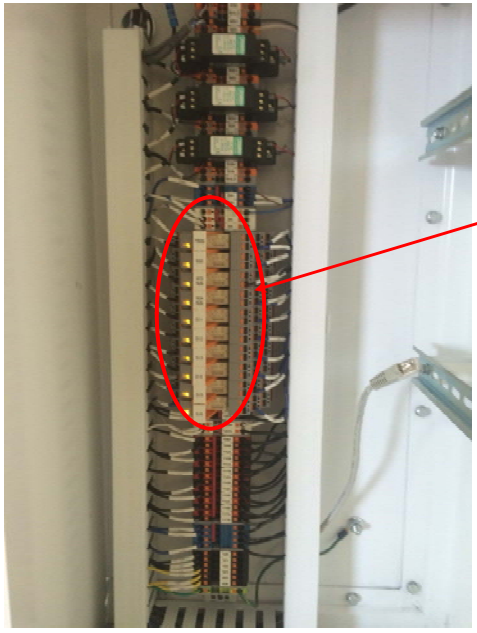


Fig XX – 120 VAC relays for Digital Inputs and other field kill circuits.

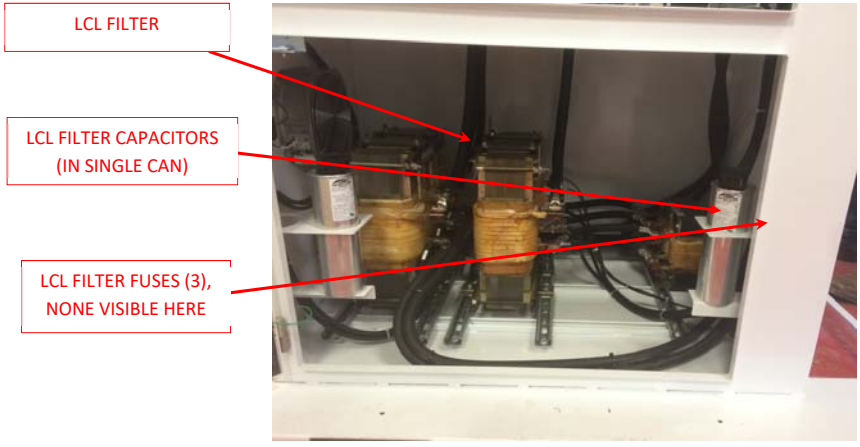


Fig XX – AFE input filter (LCL) components. Enclosure heater not specific to AFE drive systems - may be found in any drive.

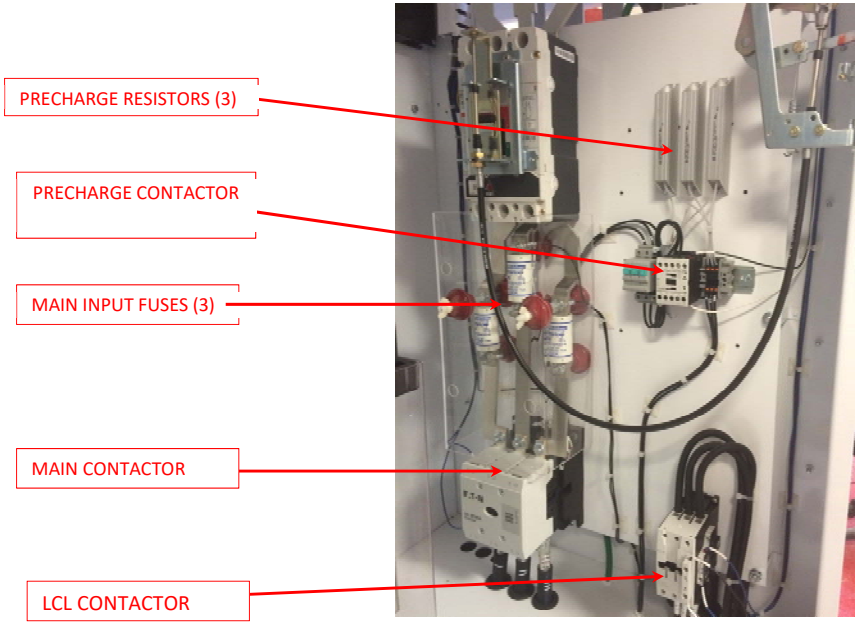


Fig XX – AFE system components mounted on right wall of drive enclosure. Main input fuses, 120 VAC convenience receptacle

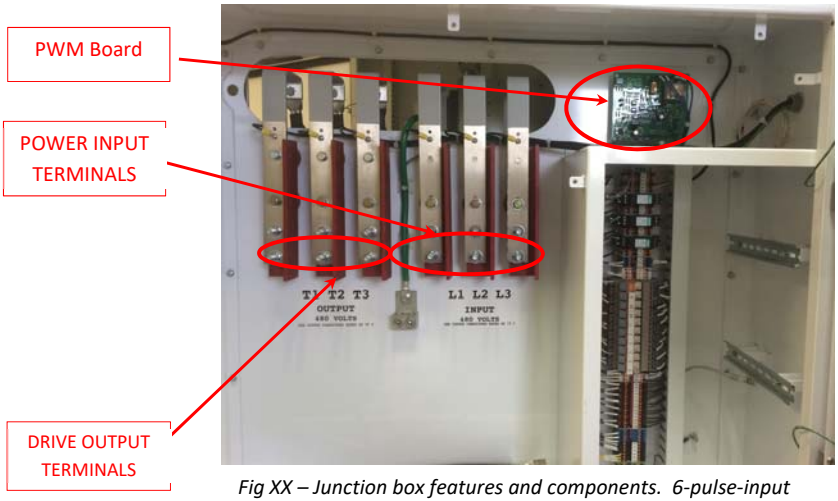


Fig XX – Junction box features and components. 6-pulse-input drive.

OPTA9			
Terminal		Signal	Technical information
1	+10 Vref	Reference voltage	Maximum current 10 mA
2	AI1+	Analogue input, voltage or current	Selection V or mA with jumper block X1 (see Page 83): Default: 0– +10 V (Ri = 200 kΩ) (-10 V…+10 V Joy-stick control, selected with a jumper) 0– 20 mA (Ri = 250 Ω)
3	GND/AI1–	Analogue input common	Differential input if not connected to ground; Allows ±20 V differential mode voltage to GND
4	AI2+	Analogue input, voltage or current	Selection V or mA with jumper block X2 (see Page 83): Default: 0– 20 mA (Ri = 250 Ω) 0– +10 V (Ri = 200 kΩ) (-10 V…+10 V Joy-stick control, selected with a jumper)
5	GND/AI2–	Analogue input common	Differential input if not connected to ground; Allows ±20 V differential mode voltage to GND
6	24 Vout (bidirectional)	24 V auxiliary voltage	±15%, maximum current 250 mA (all boards total);150 mA (from single board); Can also be used as external power backup for the control unit (and fieldbus)
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Digital input 1	R_i = min. 5 kΩ 18…30 V = "1"
9	DIN2	Digital input 2	
10	DIN3	Digital input 3	
11	CMA	Digital input common A for DIN1, DIN2 and DIN3.	Must be connected to GND or 24 V of I/O terminal or to external 24 V or GND Selection with jumper block X3 (see Page 83):
12	24 Vout (bidirectional)	24 V auxiliary voltage	Same as terminal #6
13	GND	I/O ground	Same as terminal #7
14	DIN4	Digital input 4	R_i = min. 5kΩ 18…30 V = "1"
15	DIN5	Digital input 5	
16	DIN6	Digital input 6	
17	CMB	Digital input common B for DIN4, DIN5 and DIN6	Must be connected to GND or 24 V of I/O terminal or to external 24 V or GND Selection with jumper block X3 (see Page 83):
18	AO1+	Analogue signal (+output)	Output signal range: Current 0(4)–20 mA, R_L max 500 Ω or Voltage 0–10 V, R_L >1kΩ Selection with jumper block X6 (see Page 83):
19	AO1–	Analogue output common	
20	DO1	Open collector output	Maximum U_{in} = 48 VDC Maximum current = 50 mA

Control terminal signals

Control I/O terminal signals on I/O board OPTA9

Control unit

The control unit of the frequency converter consists roughly of the control board and additional boards (see Figure 6-25 and Figure 6-26) connected to the five slot connectors (A to E) of the control board.

The control board is connected to the power unit through a D-connector (1) or fibre optic cables (FR9).

Figure 6-25. NX control board

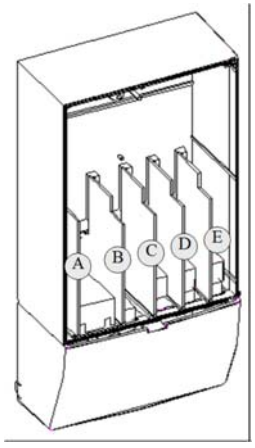
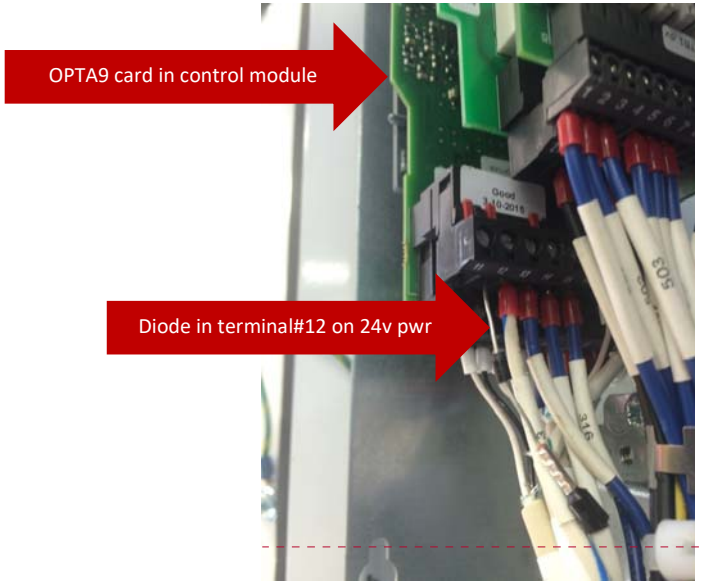


Figure 6-26. Basic and option board connections on the control board

Usually, when the frequency converter is delivered from the factory, the control unit includes at least the standard compilation of two basic boards (I/O board and relay board) which are normally installed in slots A and B. On the next pages you will find the arrangement of the control I/O and the relay terminals of the two basic boards, the general wiring diagram and the control signal descriptions. The I/O boards mounted at the factory are indicated in the type code. For more information on the option boards, see *Summit* NX option board manual (DPD00884).The control board can be powered externally (+24 V, ±10%) by connecting the external power source to either of the bidirectional terminal #6 or #12, see page 80. This voltage is sufficient for parameter setting and for keeping the fieldbus active. Note however that the analogue inputs and outputs as well as the measurements of the main circuit (e.g. DC-link voltage, unit temperature) are not available when the mains is not connected (with the exception of frame size FR9 and bigger).

NOTE! If the 24 V inputs of several frequency converters are connected in parallel we recommend to

Use a diode in terminal #6 (or #12) in order to avoid reverse current to. This might damage the control board. See picture below.



Commented [RBA1]: Leave Diode note and add info regarding new terminal block.

Fan Troubleshooting Procedures

1. Fan power supply measurements
   • Power up the fan power supply (see the instructions in Chapter 3.5).
   • Check that the power supply and fan are running. See the three LED's on the fan power supply.
2. The LED's are explained in the table below.
   • If the power supply and fan are working properly, turn off the external power supply and proceed to the next step.
   • If the fan power supply doesn't run, check that the fan power supply fuses are not burned.
3. The fuse base is located on the driver board assembly (see Chapter 4.6).
   • If the fuses are OK, remove the fan power supply assembly (see the instructions in Chapter 4.3).
   • Measure the resistance from fan power supply board connector X2 (Figure 3.8), between pin (DC-) and pin 3 (DC+). If the pins are in short circuit, the board is broken and needs to be replaced (see the instructions in Chapter 4.3).

Color	Component	Meaning
Green	H6	Power ON
Yellow	H8	Fan Control Enable (Run Request)
Red	H9	Alarm, If Minimum rotation Speed is not reached

Table 3.7. LED's on the fan power supply

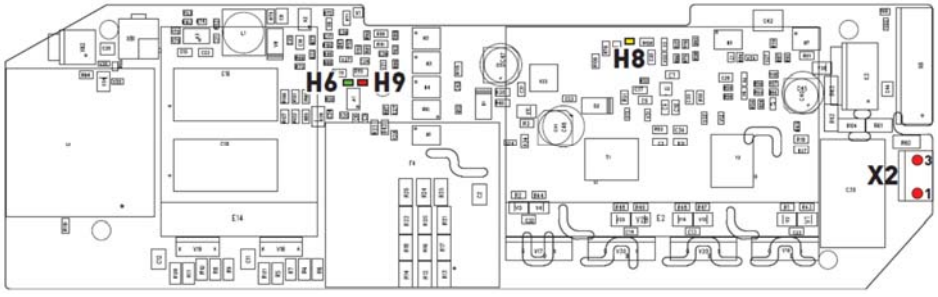


Figure 3.8. Fan power supply (spare part code: 60S00581, ID: 70CVB00411, V.B) top side layout 3.9 DC voltage measurements

4. Check the control panel monitoring page for the unit measuring voltages. If the unit is not measuring anything, the problem might be in:
   - ASIC board -> Change and program the ASIC board (see the instructions in Chapter 4.5)
   - Fiber adapter board (in FR10)-> Replace the board (see the instructions in Chapter 4.4)
   - If the monitoring value is too small, check the ASIC board programming.
   - If the problem was not in the monitoring value, go back to ASIC board programming.

ACTIVE FRONT END (AFE) DRIVE POWER-UP AND RUN SEQUENCE

Power Up

An AFE drive system is comprised of an AFE Drive, a Main Drive, and many ancillary components. Interactions between the two Drives and the ancillary components can be better understood by referring to the AFE drive system schematic in Section XXX while reading this Section.

1. Human operator closes main breaker.
2. Incoming power phases A and B supply 480 VAC to the control power transformer, which develops 120 VAC. 120 VAC hot goes to the AFE Drive's OPTA9 card's terminal 25 (common), which is connected internally to both NC and NO contacts.
3. The OPTA9's onboard NC contacts are already closed, causing 120 VAC hot to be output on the OPTA9's terminal 24.
4. The 120 VAC hot from the AFE Drive's OPTA9's terminal 24 pulls in the pre charge contactor via wire 424
5. Pre charge contactor supplies "soft" 3-phase voltage to the AFE Drive's U, V, and W input terminals via three pre charge resistors.
6. When the AFE Drive receives "soft" 3-phase input voltage its OPTA9's contacts switch states. This causes the pre charge contactor to drop out, and the main contactor is pulled in by 120 VAC hot from the AFE Drive's OPTA9's terminal 26 via wire 626. Full bus voltage is now developed in the AFE Drive and supplied to the Main Drive via the heavy B+ and B- DC bus bars between the two Drives.
7. At the same time that the main contactor is pulled in, one set of auxillary relays of main contactor, NO contacts close and supply 24 VDC to the AFE Drive's Main Contactor Acknowledge input, DIN4.

Run Logic

8. When the human operator turns the HOA switch to either Hand or Auto +24 VDC is sent to the INU "Ready" Status Input, DIN2 and 24VDC is supplied to the "Start" Button circuit. When the HOA switch is turned to "AUTO", 24 VDC is also sent to the INU "AUTO" input, DIN3. When the start button is pushed 24VDC goes to the main drives Opt A9 card digital input 1. This then tells the Main drives Opt A2 card to close one of its relay outputs and sends 120VAC to the LCL contactor. When the LCL contactor closes this closes a set of auxillary contacts that send 24VDC to AFE Opt A9 digital input 1 which tells it to run.

Note that all of the actions in steps 1 through 7 occur simply when power is applied to the drive. Actions in steps 8 and 9 occur upon drive startup, as initiated by the operator turning the HOA switch to either Hand or Auto, or by SCADA command, with the HOA switch already being in a run-ready position.)

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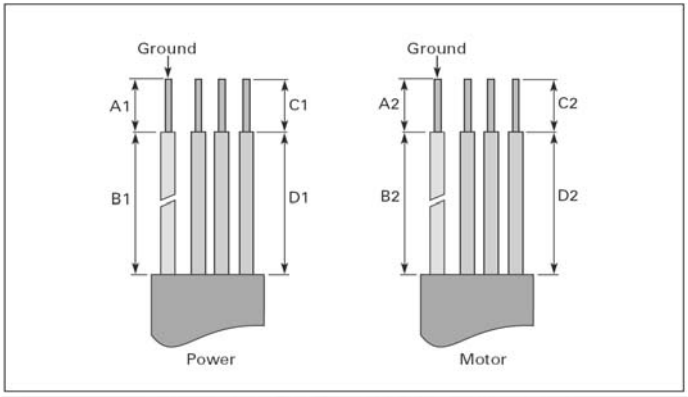
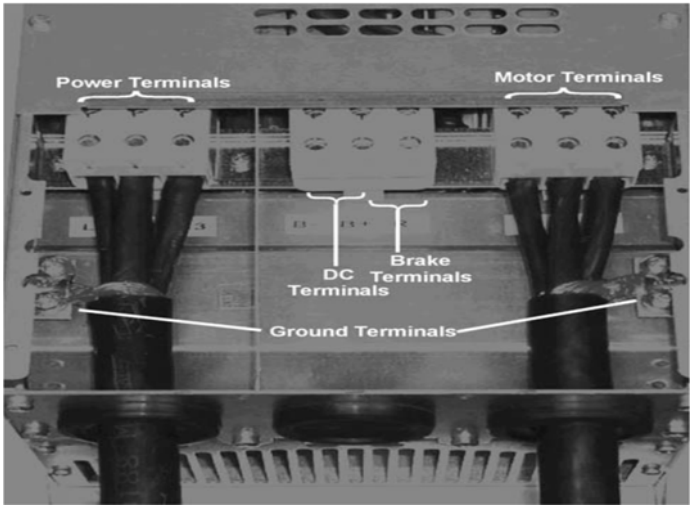
APPENDIX A: INSTALLATION/SERVICE RECORD





APPENDIX B: UL CABLE SIZING

Frame	Type	I_L [A]	Fuse [A]	Power and motor cable Cu [mm2]	Terminal cable size	
					Main terminal [mm2]	Earth terminal [mm2]
FR4	NXP0003 2—0008 2 NXP0003 5—0009 5	3–8 3–9	10	3*1.5+1.5	1–4	1–4
	NXP0011 2—0012 2 NXP0012 5	11–12 12	16	3*2.5+2.5	1–4	1–4
FR5	NXP0017 2 NXP0016 5	17 16	20	3*4+4	1–10	1–10
	NXP0025 2 NXP0022 5	25 22	25	3*6+6	1–10	1–10
	NXP0031 2 NXP0031 5	32 31	35	3*10+10	1–10	1–10
FR6	NXP0048 2 NXP0038 5—0045 5	48 38–45	50	3*10+10	2.5–50 Cu 6–50 Al	2.5–35
	NXP0061 2 NXP0061 5	61	63	3*16+16	2.5–50 Cu 6–50 Al	2.5–35
FR7	NXP0075 2 NXP0072 5	75 72	80	3*25+16	2.5–50 Cu 6–50 Al	6–70
	NXP0088 2 NXP0087 5	88 87	100	3*35+16	2.5–50 Cu 6–50 Al	6–70
	NXP0114 2 NXP0105 5	114 105	125	3*50+25	2.5–50 Cu 6–50 Al	6–70
FR8	NXP0140 2 NXP0140 5	140	160	3*70+35	25–95 Cu/Al	25–95
	NXP0170 2* NXP0168 5*	168	200	3*95+50	95–185 Cu/Al	25–95
	NXP0205 2 NXP0205 5	205	250	3*150+70	95–185 Cu/Al	25–95
FR9	NXP0261 2* NXP0261 5*	261	315	3*185+95 or 2*(3*120+70)	95–185 Cu/Al 2	5–95
	NXP0300 2* NXP0300 5*	300	315	2*(3*120+70)	95–185 Cu/Al 2	5–95
FR10	NXP0385 5	385	400 (3 pcs)	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NXP0460 5	460	500 (3 pcs)	Cu: 2*(3*150+70) Al: 2*(3*240Al+72Cu)	Even/Odd	Even/Odd
	NXP0520 5	520	630 (3 pcs)	Cu: 2*(3*185+95) Al: 2*(3*300Al+88Cu)	Even/Odd	Even/Odd
FR11	NXP0590 5	590	315 (6 pcs)	Cu: 2*(3*240+120) Al: 4*(3*120Al+41Cu)		Even/Odd
	NXP0650 5	650	400 (6 pcs)	Cu: 4*(3*95+50) Al: 4*(3*150Al+41Cu)	Even	Even/Odd
	NXP0730 5	730	400 (6 pcs)	Cu: 4*(3*120+70) Al: 4*(3*185Al+57Cu)	Even	Even/Odd
	NXP0820 5	820	500 (6 pcs)	Cu: 4*(3*150+70) Al: 4*(3*185Al+57Cu)	Even	Even
	NXP0920 5	920	500 (6 pcs)	Cu: 4*(3*150+70) Al: 4*(3*240Al+72Cu)	Even	Even
	NXP1030 5	1030	630 (6 pcs)	Cu: 4*(3*185+95) Al: 4*(3*300Al+88Cu)	Even	Even

APPENDIX D: SPECIFICATIONS & RATINGS

Table 20-1

High overload = Max current IS, 2 sec/20 sec, 150% overloadability, 1 min/10 min following continuous operation at rated output current, 150% rated output current (IH) for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (I_H)

Low overload = Max current IS, 2 sec/20 sec, 110% overloadability, 1 min/10 min following continuous operation at rated output current, 110% rated output current (IL) for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (I_L)

380–500V Power Ratings

480V, 50/60 Hz, 3 Phase Input Ratings

	Variable Torque Ratings (ESP)			Constant Torque Ratings						
	kVA (I_L)	kW (I_L)	Current (I_L)	hp (I_H)	kW (I_H)	Current (I_H)	Switching Frequency (kHz)			Heat Losses
Frame Size	Horsepower	Variable Torque kW	Variable Torque Full Load Amps at 40°C	Horsepower	Constant Torque kW	Constant Torque Full Load Amps at 40°C	Min	Max	Default	Watts at Rated Output and Default SF
FR7	50	37	72	40	30	61	1	6	3.6	925
	60	45	87	50	37	72	1	6	3.6	1125
	75	55	105	60	45	87	1	6	3.6	1375
FR8	100	75	140	75	55	105	1	6	3.6	1875
	125	90	170	100	75	140	1	6	3.6	2250
	150	110	205	125	90	170	1	6	3.6	2750
FR9	200	132	261	150	110	205	1	6	3.6	3300
	249	160	300	200	132	245	1	6	3.6	4000
FR10	300	200	385	250	160	300	1	6	3.6	5000
	350	250	460	300	200	385	1	6	3.6	6250
	400	250	520	350	250	460	1	6	3.6	6250
FR11	500	315	590	400	250	520	1	6	3.6	7875
	—	355	650	500	315	590	1	6	3.6	8875
	600	400	730	—	355	650	1	6	3.6	10,000
FR12	—	450	820	600	400	730	1	6	3.6	11,250
	700	500	920	—	450	820	1	6	3.6	12,500
	800	560	1030	700	500	920	1	6	3.6	14,000
FR13	900	630	1150	800	560	1030	1	6	3.6	15,750
	1000	710	1300	900	630	1150	1	6	3.6	17,750
	1200	800	1450	1000	710	1300	1	6	3.6	20,000
FR14	1500	1000	1770	1200	900	1600	1	6	3.6	25,000
	1800	1200	2150	1600	1100	1940	1	6	3.6	30,000
	2200	1400	2700	1900	1300	2300	1	6	3.6	35,000

APPENDIX E: VARIABLE TORQUE VSD RATINGS

	Variable Torque Ratings (ESP)		
	kVA (I_L)	kW (I_L)	Current (I_L)
Frame Size	**Horsepower**	**Variable Torque kW**	**Variable Torque Full Load Amps at 40°C**
FR7	50	37	72
	60	45	87
	75	55	105
FR8	100	75	140
	125	90	170
	150	110	205
FR9	200	132	261
	249	160	300
FR10	300	200	385
	350	250	460
	400	250	520
FR11	500	315	590
	—	355	650
	600	400	730
FR12	—	450	820
	700	500	920
	800	560	1030
FR13	900	630	1150
	1000	710	1300
	1200	800	1450
FR14	1500	1000	1770
	1800	1200	2150
	2200	1400	2700

APPENDIX G: START UP

START-UP

1. Read and follow all safety warnings and cautions in this manual.

2. At installation, ensure: That the NXP5 and motor are connected to ground.
That the control cables are located as far as possible from the power cables. That control cable shields are connected to protective ground. Be sure that no wires make contact with any electrical components in the NXP5. That the common input of each digital input group is connected to ground or +24V of the I/O terminal supply or an external supply as detailed here.

3. Check the quality of the cooling air.

4. Check that moisture has not condensed inside the NXP5.

5. Check that all START/STOP switches connected to the I/O terminals are in the STOP state.

6. Ensure that the Group 1 parameters match the application by setting, at minimum, the following parameters to match the motor nameplate: Nominal voltage of the motor. Nominal nameplate frequency of the motor. Nominal nameplate full load speed of the motor. Motor nominal current. Motor power factor. Motor type (select PM motor in Group 6 of special app)

NO LOAD SETUP

7. Perform either Test A or Test B without the motor connected to the NXP5.

Test A—Control from the Control Panel
Apply input power to the NXP5. Press the keypad START button.
If not in the Operate Menu, go to the Monitoring Menu and check that the output frequency follows the keypad reference. Press the keypad STOP button.

Test B—Control from the I/O Terminals
Apply input supply power to the NXP5. Change control from the keypad to the I/O terminals using the LOCAL/REMOTE button. Start the drive by closing the START/STOP input on DIN1. Change the frequency reference setting on AI1. If not in the Operate Menu, go to the Monitoring Menu and check that the output frequency follows the frequency reference. Stop the drive by opening the START/STOP input on DIN1.

8.Disconnect all power to the NXP5. Wait until the cooling fan on the unit stops and the indicators on the panel are not lit. If no keypad is present, check the indicators in the control panel cover. Wait at least five more minutes for the DC bus to discharge. Connect the motor to the NXP5. If possible, perform a startup test or ID run with the motor connected to the NXP5 but not connected to the process

9. Disconnect all power to the NXP5. Wait until the cooling fan on the unit stops and the indicators on the panel are not lit. If no keypad is present, check the indicators in the control panel cover. Wait at least five more minutes for the DC bus to discharge. Connect the motor to the driven load, making sure mechanical system requirements are met. Make sure that the driven load can be run safely and that no hazard exists to any personnel.

START-UP WORKSHEET

Customer: _____ Well Number: _____

Date: _____ Drive Serial Number: _____

1: Motor Voltage: _____

Amps: _____

Cable Size: _____ Length: _____

2: Desired Operating Frequency

Minimum: _____ Maximum: _____

3: Maximum Volts Available (Input Voltage): _____

4: Secondary Voltage @ Maximum Hertz: _____

$$Motor\ Voltage * \frac{Max\ Hz}{60\ Hz} + Cable\ Drop = \text{Secondary Volts @ Max Hz}$$

Motor Voltage_____ X Max. Hz._____

60 Hz. + Cable Drop = _____

5: Secondary Voltage Taps Selected: Tap #1 _____ Tap #2 _____ Tap #3 _____

6: Transformer Ratio: =

Secondary Voltage Taps Selected _____ = _____

Transformer Primary (480)

7: Secondary Voltage @ 60 Hertz: = _____

(from line 4)

Secondary Voltage @ Max. Hertz _____ X 60 = _____

Maximum Hertz _____

8: Drive Volts @ 60 Hertz: = _____

(from line 7)

Secondary Voltage @ 60 Hertz _____ = _____

Transformer Ratio _____

9: Required KVA @ Max. Hertz: =

$$\frac{\text{Surface Voltage} \times \text{Motor Nameplate Amps} \times 1.73}{1000}$$

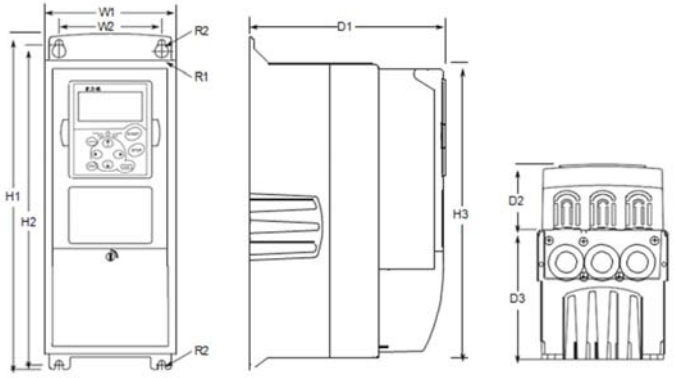
10: Controller sizing: = Motor Nameplate Amps X Transformer Ratio =

(Select a drive Model with a continuous current rating => than this calculation) (Refer to Appendix A: Specification and Sizes)

21 APPENDIX H: WEIGHTS & DIMENSIONS

Table 20-2

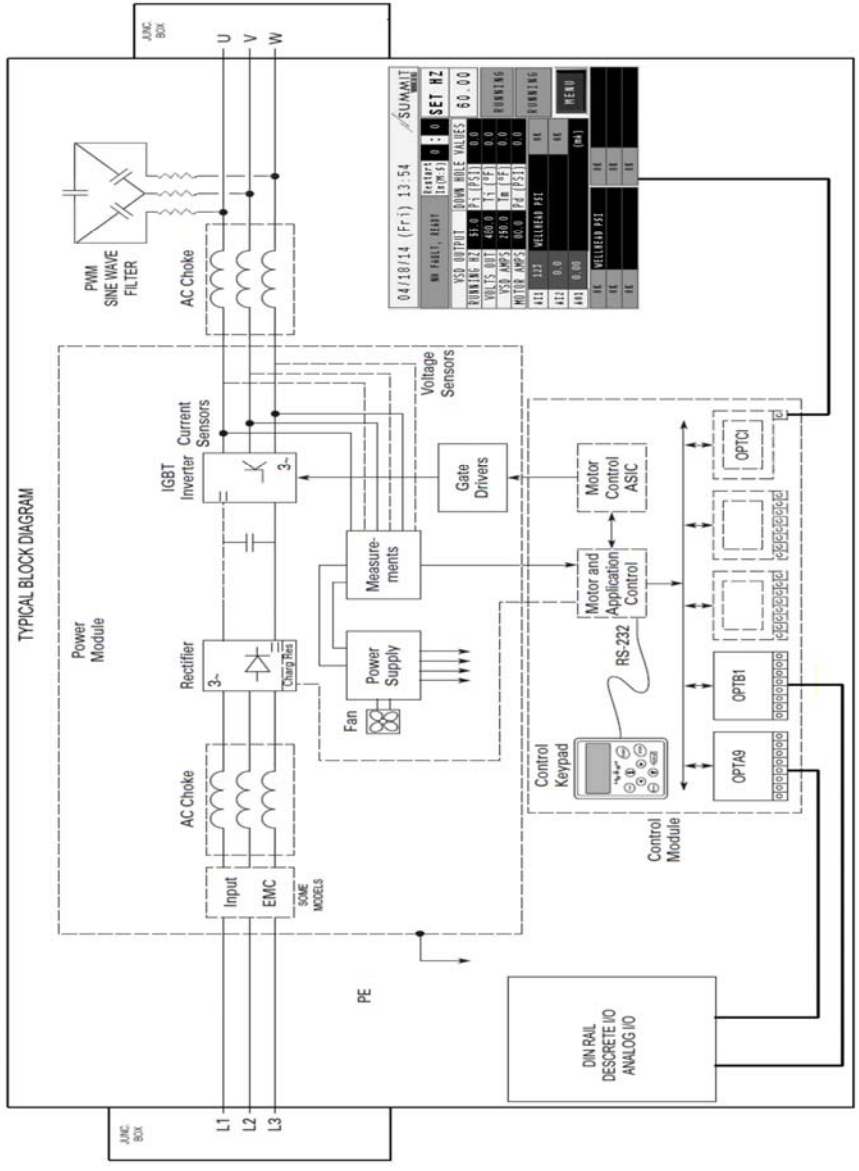
NEMA Type 1 and Type 12 Enclosure Dimensions



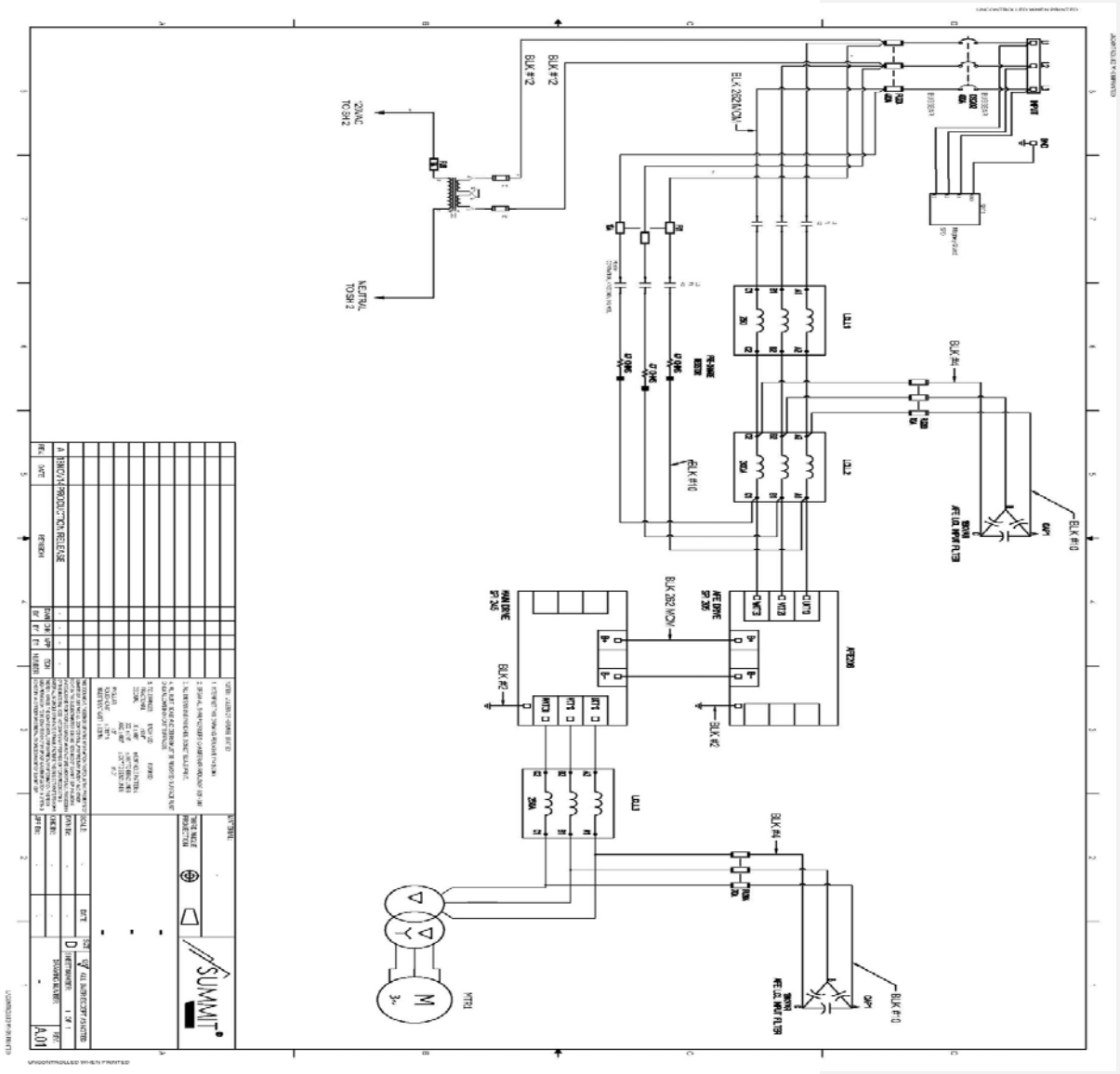
Frame Size	Voltage	hp (I_H)	H1	H2	H3	D1	D2	D3	W1	W2	R1 Dia.	R2 Dia.	Weight Lbs (kg)
FR4	230V	3/4–3	12.9 (327)	12.3 (312)	11.5 (292)	7.5 (190)	2.5 (64)	5.0 (126)	5.0 (126)	3.9 (100)	0.5 (13)	0.3 (7)	11 (5)
	480V	1–5											
FR5	230V	5–7-1/2	16.5 (419)	16.0 (406)	15.3 (389)	8.4 (214)	2.7 (68)	5.8 (148)	5.6 (143)	3.9 (100)	0.5 (13)	0.3 (7)	17.9 (8.1)
	480V	7-1/2–15											
FR6	230V	10–15	22.0 (558)	21.3 (541)	20.4 (519)	9.3 (237)	2.7 (68)	6.7 (171)	7.7 (195)	5.8 (148)	0.7 (18)	0.4 (9)	40.8 (18.5)
	480V	20–30											
	575V	2–25											
FR7	230V	20–30	24.8 (630)	24.2 (614)	23.3 (591)	10.1 (257)	2.7 (68)	7.5 (189)	9.3 (237)	7.5 (190)	0.7 (18)	0.4 (9)	77.2 (35)
	480V	40–60											
	575V	30–40											
FR8	480V	75–125	29.7 (755)	28.8 (732)	28.4 (721)	12.3 (312)	1.3 (34)	11.0 (279)	11.2 (285)	10.0 (255)	0.7 (18)	0.4 (9)	127.8 (58)
	575V	50–75											
FR9	480V	150–200	45.3 (1150)	44.1 (1120)	45.3 (1150)	14.3 (362)	5.4 (137)	8.8 (224)	18.9 (480)	15.7 (400)	0.7 (18)	0.4 (9)	321.9 (146)
	575V	100–150											

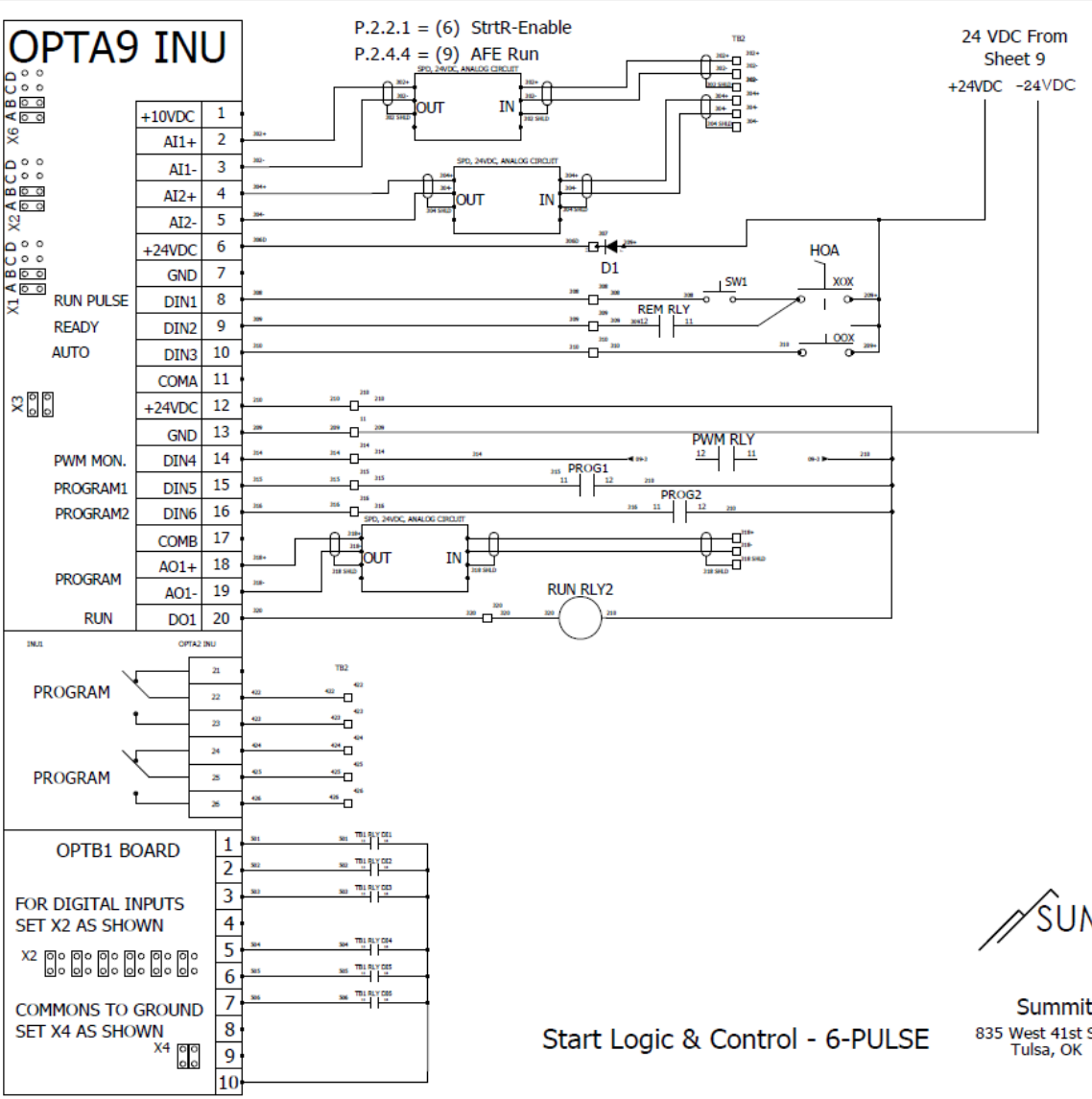
20 APPENDIX I: SCHEMATIC DIAGRAMS

Block diagram



BASIC POWER & AFE CONTROL SCHEMATIC

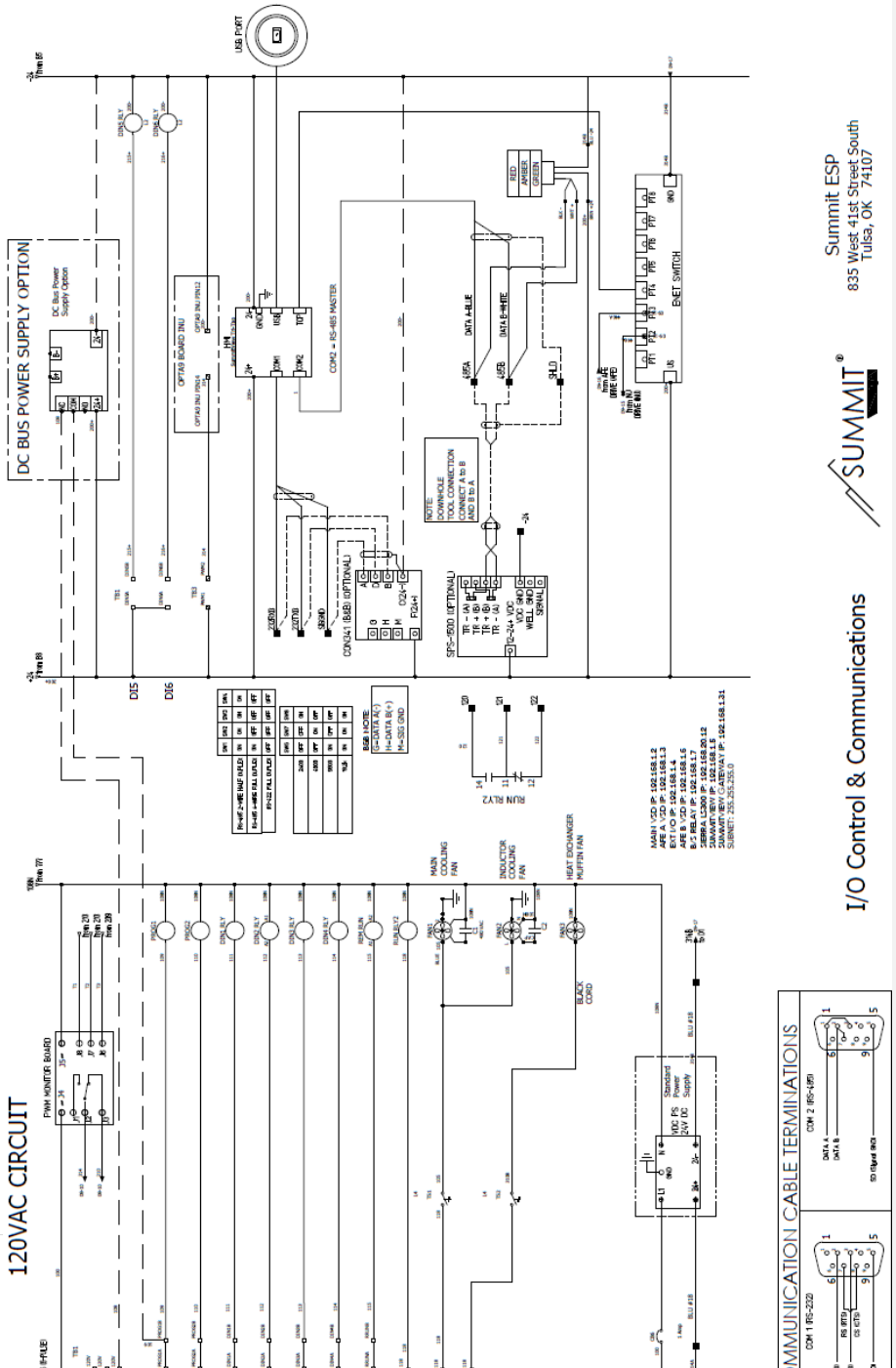




Start Logic & Control - 6-PULSE

Summit ESP
835 West 41st Street South
Tulsa, OK 74107

BASIC CONTROL I/O SCHEMATIC



22 APPENDIX J: SPARE PARTS

AFE FILTER FUSES

Ferraz-Shawmut	Fuse, 700VAC, 60A, Fast Acting, Semiconductor Fuse	
Ferraz-Shawmut	Fuse, 700VAC, 70A, Fast Acting, Semiconductor Fuse	
Ferraz-Shawmut	Fuse, 600VAC, 80A, Fast Acting Semiconductor Fuse	
Ferraz-Shawmut	Fuse, 600VAC, 90A, Fast Acting Semiconductor Fuse	

COOLING FANS

Frame (FR/FI)	Style #	VISTA Description	Notes	SN of First Drive with DC Parts
8	S01016	9000Xe Series DC-DC power board	Requires PP00071 DC Fan	13068696
8	PP00071	9000Xe Series DC-DC fan	Requires S01016 DC-DC Power Board	13068696
9-14	S01017	9000Xe Series DC-DC power board	Requires PP00072 DC Fan	13100567* 91684006*
9-14	PP00072	9000Xe Series DC-DC fan	Requires S01017 DC-DC Power Board	13100567* 91684006*

* due to multiple manufacturing locations

InSpatial LS300 Cellular Modem Troubleshooting Guide

Understanding the

Below is a description of the LEDs where the Network and Signal are

most important.

Network LED Cellular network authentication status

Red—No cellular network is present, or the device is in radio passthru mode. (There is no network coverage at the location.)

Flashing red—The device is attempting to connect to the cellular network.

Yellow—The cellular network is found, and the device is connecting.

Flashing yellow—The cellular network is unavailable. (The device was unable to authenticate on the network. This is a symptom of a modem that hasn't been activated yet)

Green —Connected to the cellular network (Modem is activated and connected to the cellular network).

Flashing Green—The device is roaming (not on the carrier's authentic network).

Signal LED Cellular network's signal indicator

Flashing red—No signal is present. (RSSI < -110 dBm)

Red—A bad signal is present. (RSSI between -100 dBm and -110 dBm)

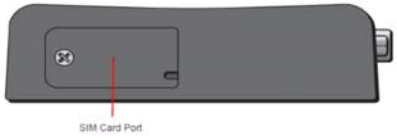
Yellow—A marginal signal is present. (RSSI between -85 dBm and -100 dBm)

Green—A good signal is present. (RSSI ≥ -85 dBm)

Power LED Input power and/or GPS status

Off—No power or input voltage ≥ 36VDC or ≤ 7.5VDC (refer to

Normal operation for the cellular modem.



Normal Sequence (Powerup)

Note for normal operation on the cellular modems, we're looking for the PWR, SAT, NET and STAT lights to be on. The Tx/Rx light should flash about every 10-15 seconds.

Power - Green

Signal - Flash Red (then solid color, red, yellow, or green)

Activity - ON/OFF

Network -Flash yellow (then solid green)

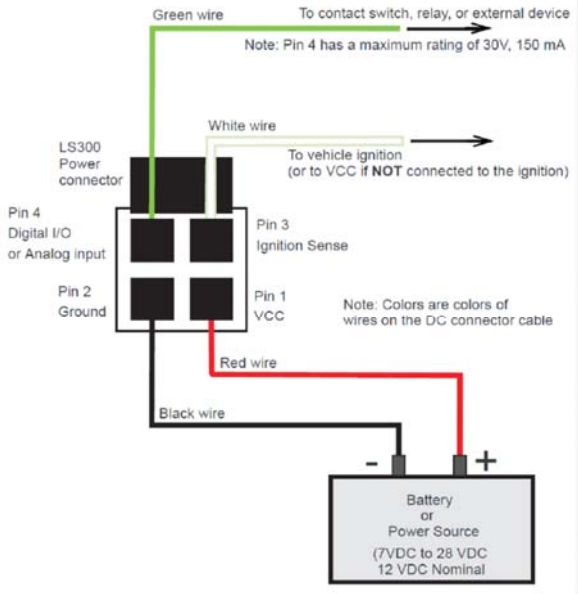
Summi

This section describes what the settings in the SummitView should be set to for proper communications.

SummitView Settings

Non-Smart Gateway setup:

The picture to the right shows the pin-out for the LS300 connector. With a multimeter, check pins 1 (VCC, bottomright) and 2 (ground, bottom-left) to make sure power is making it through the cable.



LS300 Connector Diagram

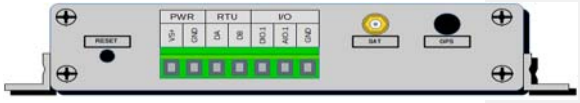
Please have the following items available prior to contacting support:

- ✓ Customer / Well Name
- ✓ Modem ESN Number (Verzion)
- ✓ Modem IMEI Number (AT&T)
- ✓ [Optionally] SIM ID Number (AT&T)

Understanding the Modem Status Lights

Below is a description of the PULSAR status LEDs located on the front plate.

Pulsar/Satellite Modem



PWR

On - Indicates input is within range (9-23VDC)

Off - No power. Please verify power supply and power wiring.

SAT

On - Indicates satellite transceiver is functioning properly

Off - Typically indicates a malfunctioning PULSAR. Cycle power to PULSAR, if SAT remains off, unit will likely need to be replaced.

NET

On - Indicates if it has found the satellite network.

Off - Typically indicates a coverage or RF cable issue. Verify the satellite antenna has a clear view of the sky, and that the RF cable is not damaged.

Note: some models include a separate GPS SMA connector. Please ensure the antenna is NOT connected to this port.

Tx/Rx

Both Flashing/Alternating - The PULSAR is receiving valid send and receive commands.

Tx Only Flashing - PULSAR is attempting to read data from

Normal Sequence (on Power-up)

Note for normal operation on the satellite modems, we're looking for the PWR, SAT, NET and STAT lights to be on. The Tx/Rx light should flash about every 10-15 seconds.

PWR - ON

SAT - ON

NET - ON/OFF

Tx/Rx - flashing 10-20 seconds

Power and Communication Wiring

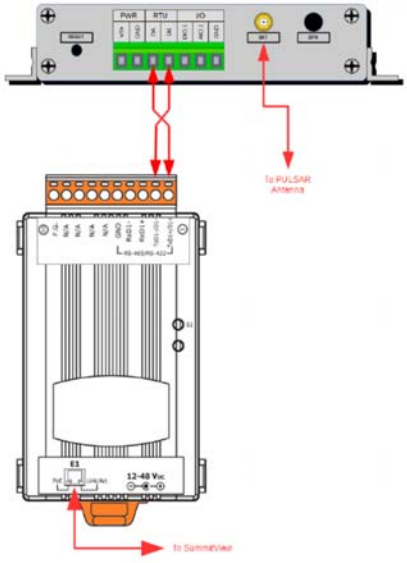
This section describes how the devices should be wired.

To Ethernet Converter

485 Wiring:

TD1+/D1+ → DA

TD1-/D1- → DB



Power

Verify that the power supply is within the specified range of 9-38vdc (9-23vdc for older models)

To SummitView

• Check Ethernet cable

SummitView Communications

Below are the listed setups for the converter based on the unit it is connected to

Non-Smart Gateway setup

• Converter IP address: 192.168.1.31

• Device IP address: 192.168.1.5

Smart Gateway setup

• Converter IP address: 192.168.20.31

Please have the following items available prior to contacting support:

- ✓ Customer / Well Name
- ✓ PULSAR IMEI Number
- ✓ Status of LEDs