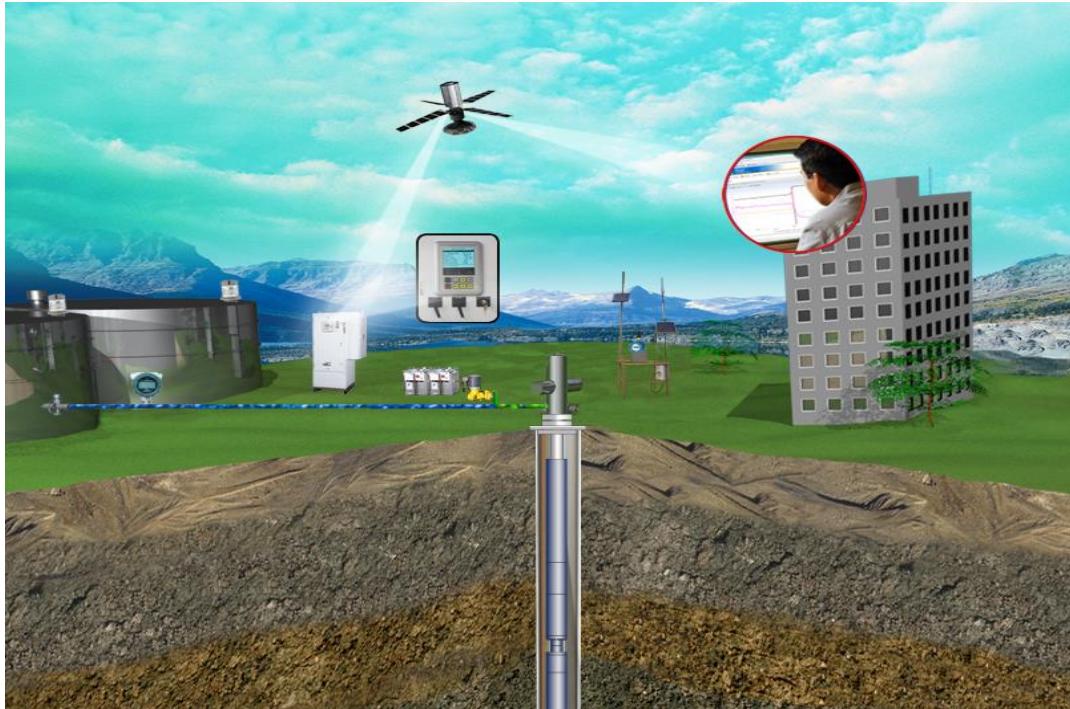


Electrospeed Advantage Variable Speed Drive

Installation and Operations Manual



2000 / 4000 / 8000 Series Drives
6-, 12-, and 24- Pulse
ESP (6-Step) and FPWM
NEMA 1 & 4 Enclosure



Revision History						
Rev.	ECM	Amendment Detail	Reviewer	Approver	Approval Date	
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B	C110627	Updated PS Fuse values, Cable Charts and Flash Card Section	J. Hillshafer	B. Haapanen	9 Feb 2012	
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E	C112619	Updated to Add Nema 1 Drive	J. Hillshafer	R. Dubuc	29 May 2014	
F	C113981	Updated Electrospeed Input Electrical Filter support, User configured datalogging, Current Unbalance, EtherNet & Sealed drive drawings	R. Dubuc	S. Plitt	19 Oct 2015	

Contact your local Baker Hughes representative for current information regarding this product

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Electrospeed Advantage™ Variable Speed Drive Installation and Operations Manual



INTRODUCTION

The Baker Hughes Electrospeed Advantage™ variable speed drive (VSD) is classified as a variable voltage inverter (VVI). It uses a six-pulse silicon controlled rectifier (SCR) front end to convert incoming AC power into variable voltage DC power. This DC power is inverted to variable voltage variable frequency AC power and is used to drive an electrical submersible pump (ESP) or a surface motor. Drives with higher pulse count front ends (converters) identified as 12- or 24-pulse drives can be configured where harmonic reduction is required. An inductor connected in series and capacitors connected in parallel across the DC bus are used to filter the AC ripple. The inverter section uses power insulated gate bipolar transistors (IGBT) to synthesize a 3-phase quasi-sinusoidal output voltage using Baker Hughes' SelectWave™ inverter algorithm. This modern AC variable voltage inverter is designed to meet all the requirements of installations requiring a variable frequency source. It operates directly from 380 to 480 VAC 3-phase 50/60 Hertz power.

Use of the latest microprocessor technology allows for ease of setup, operation and diagnostics. Microprocessor control also reduces the number of circuit boards required, thus

enhancing the reliability and versatility of the drive. The graphical operator interface provides ease of use and programming of special applications.

The Advantage drive is programmable for many types of loads such as variable torque, constant torque and constant voltage with extended speed range. The Advantage drive is available in a weatherproof (NEMA 4, IP56) and a general purpose (NEMA1, IP30) enclosure. The weatherproof units use a patented cooling system that eliminates the inefficiencies and reliability problems associated with heat pumps. Currently, three NEMA 4 enclosure sizes referred to as 2000, 4000 and 8000 series are being offered. At this time, the NEMA 1 enclosure is offered in the 2000 series size only. The Advantage drive can communicate with SCADA or telemetry systems, using the included Modbus RTU protocol with the onboard RS-232 and RS-485 hardware interface or via Modbus TCP with either of two included Ethernet ports. The Advantage drive also provides a high-speed interface (CITIBus™) that simplifies control system expansion and customization. Using the CITIBus interface, input/output expansion modules can be added to the system, thus providing a single point of control and monitoring for a wide range of sensor types.

FEATURES/FUNCTIONS

Connectivity, telemetry ready	Allows networking or remote operation
Downloadable configuration Files	Ease of multiple drive setup
Control system expandability via I/O modules	Flexibility in system design and configuration
Advantage operator interface identical for all Advantage products and similar to GCS products	Maintenance and operations personnel need to learn interface only once
Surface mount electronics technology	Smaller circuit boards with fewer connections lead to higher reliability
Field upgradeable software	Drive does not have to be removed from location to modify or upgrade software
Automatic and continuous data log function	Over one year of recorded data without user configuration or intervention
Supplied converter utility generates Excel compatible data files from binary	Data can be analyzed using familiar PC software tools
Electronic chart recorder built-in	Allows paperless recording of motor current
Redundant backup of data and operating due to failure	Reduces chance of data and protection loss parameters
Date/time stamp of event and shutdown history	Helps identify problems or trends
Diagnostic/alarm windows automatically pop up	Automatic display of problems without operator security clearance
Programmable I/O	I/O can be programmed to function independently of drive operation, similar to an independent PLC
Compatible with entire Advantage and GCS product line	Configuring and interfacing with other Baker Hughes products is made easier
Enclosures comply with industrial standards NEMA 4 (IP56) or NEMA 1 (IP30)	Reliable operation in any environment
Six-step or Pulse Width Modulation (PWM) or Filtered PWM (FPWM)	Operator selectable output waveforms yield application flexibility

BENEFITS

COMMISSIONING CHECKLIST

The following steps describe a sequence of tests and/or settings that should occur when first commissioning a drive.

- Confirm the correct voltage levels are present on the incoming power lines to the drive.
- Confirm the phase sequence wiring of any phase shift transformers for multi-pulse converter configurations are correctly sequenced.
- Check the torque on all power cable connections, any phase shift transformers, incoming power connections, output power connections, and the step-up transformer connections.
- Check the step-up transformer ratio is correct.
- Confirm an accurate Personality Module (USB flash drive) is in one of the available USB ports on the Advantage System Base Board (ASBB) or Basic System Base Board (BSBB).
- Program and confirm all motor parameters (use nameplate ratings or use information from an AutographPC™ software file developed for that well and the installed equipment).
- Program the overcurrent values, undervoltage values, voltages, I limit, overload set point, and motor rotation.
- Program and confirm the frequency set point.
- Start the unit into an open circuit output to test the converter section.
- Start the unit into a shorted output to test the inverter section.
- Connect the drive output back to the step-up transformer and start the downhole equipment.
- Monitor the drive output power currents and/or the output step-up transformer currents and discharge pressures to confirm correct motor rotation.
- Measure the drive's incoming power currents with a clamp on meter to evaluate the percentage of drive load to the predicted values and assess the accuracy of the current sharing algorithms if any phase shift transformers are used.
- Measure the drive output power currents with a clamp on meter and compare them to the displayed current data to confirm the right drive model is contained on the personality module.
- Measure the step-up transformer output power currents with a clamp on meter, and using the drive output power currents (these should be equal to the step-up transformer input power currents); evaluate the actual step-up transformer ratio to the calculated/desired value.
- Measure all the phase shift transformer input voltages, phase shift transformer output voltages, drive input voltages, drive output voltages and step-up transformer input voltages to confirm minimal voltage drop under loaded conditions. **Do not measure the step-up transformer's output voltages unless the proper equipment is available and medium voltage electrical system training has been completed.**
- Evaluate the measured motor load to predicted values at the particular operating frequency.

SAFETY AND INSTALLATION

Safety Recommendation

The drive should be installed, adjusted and serviced by qualified electrical maintenance personnel. Improper installation or operation of the drive may cause injury to personnel or damage to equipment. The drive must be installed and grounded in accordance with local and national electrical codes. Potentially lethal voltages exist within the cabinet. Extreme care must be taken to ensure all power sources are disconnected before starting installation, maintenance and repair jobs.

Whenever a drive containing a SCADA or telemetry connection is to be repaired or serviced, the service man must disconnect any communication devices attached to the drive to prevent unexpected start commands from the remote control system. Service men must be aware that there could be more than one remote telemetry connection and that all of them must be disabled or disconnected for the duration of the repair period. Once repairs are completed, the telemetry connections should be reestablished.

Personal Protective Equipment (PPE)

The basic personal protection equipment (PPE) required for field service includes, but is not limited to, steel toe shoes, safety glasses and a hard hat. If electrical configuration or maintenance is performed on potentially energized circuits, personal protective equipment is required to minimize the danger of electrical shock, arc flash and/or arc blast. The level of PPE required can vary based upon the available electrical energy available at the installation site. If any doubt exists, consult and employ the recommendations published in the National Fire Protection Code, NFPA-70E.

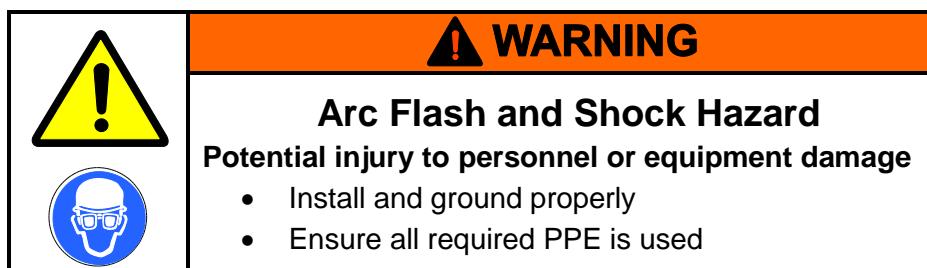
Always be aware of and conform to the applicable local fire and electrical safety regulations.

Drive-specific Configuration

The Electrospeed Advantage drive series comes in a NEMA 4 (IP56) enclosure. The 2000 series model size is also available in a NEMA 1 (IP30) configuration .

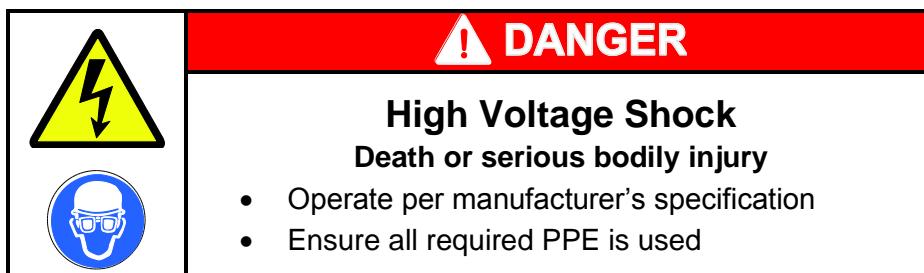
Electrical Disconnect Handle with Interlock and Override

The electrical disconnect has an interlock feature which will not allow it to be turned on unless the cabinet door is closed. The technician can temporarily override this safety feature by turning the interlock with a slot screwdriver. This allows the cabinet door to be opened while the drive continues to operate and power is still applied.



Safety Procedures

Work inside the cabinets should be performed with the power off. Isolate energy source(s) and use proper Lock Out/Tag Out (LOTO) procedures and Personal Protective Equipment (PPE) to ensure personnel safety. The drive also contains stored sources of energy in the form of capacitors. Allow sufficient time after power is removed for those capacitors to discharge to a safe level below 50VDC. The bleed resistors attached to the capacitors will reduce the voltage to safe levels within five minutes of power down. Confirm removal of energy source using a proven voltage indicator device.



Shipping and Handling

The Advantage drive enclosure should be securely fastened to any vehicle used to transport the unit. Use tie-down ropes or straps to immobilize the unit during shipping and prevent shipping damage. To prevent damage during transportation, the unit must not be shipped in corrosive atmospheres. The cabinets are specially designed for safe handling using a spreader bar placed through the lifting lugs at the top of the unit. Lift capacity should be checked prior to moving the unit into place. Check Appendix J for size and weight of specific unit being installed.

Storage

To prevent damage during storage, the unit must not be stored in corrosive atmospheres and should be kept between the temperature range of -58°F to 158°F (-50°C to 70°C).

INSTALLATION

Location

NEMA 1: The general purpose enclosure (NEMA 1, IP30) is suitable for most factory or control room installations, however, care should be taken in choosing the location. The area must be well ventilated to allow unrestricted air flow through the controller's filtered intake. Cooling air entry and exit is located on the front of the controller, therefore, no side, back, or top clearance is required. A minimum of 36 in. (1 m) clearance in front of the enclosure is recommended for servicing, which is also adequate for cooling airflow. Areas with oil vapors or mists, excessive moisture, or with fumes or vapors that are corrosive or flammable should be avoided.

NEMA 4: The weatherproof enclosure NEMA 4 (IP56) is suitable for outdoor installations in non-classified/nonhazardous locations. Allow a minimum of 48 in. (1.22 m) clearance in the front and the rear of the enclosure for servicing and air flow requirements. Never install the drive close to heat generating sources such as transformers or other drives. It is necessary to have an unrestricted supply of cooling air (55°C maximum) to the cooling fan(s) mounted to the back of the enclosure.

Initial Checks

Before installing the drive, check the unit for:

- * Physical damage to drive and visual damage to the shipping container or cabinet.
- * Remove all packing materials such as tape, foam, shipping restraints and padding.
- * Correct application. The drive nameplate data, transformers and load must be compatible.
- * Internal connections. Ensure all circuit boards, cables, components and connectors are secure.

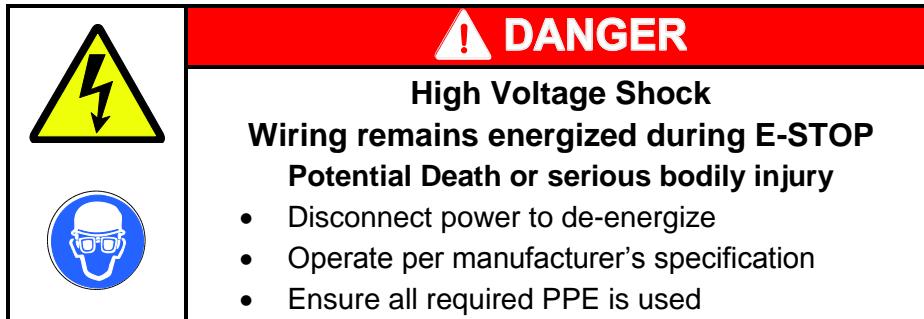
Power and Customer Interface Wiring

Gland plates are provided for power cable entry into the bottom of the J-box on the NEMA 4 drives and the top of the cabinet on the NEMA1 models. See the tables in the appendices for glands, lugs, cable sizes and for the locations for cable entry glands. The drive itself must be grounded by connecting earth ground to the drive's ground bus bar inside the input disconnect switch or the junction box. See the tables in the appendices for the ground conductor sizes. Power wiring must be sized to meet local and national electrical codes based on the maximum ambient temperatures. Connect the input power cable to the terminals of the junction box (NEMA 4 2000 and 4000 series drives) or input switch. (NEMA1 series). This drive is not phase sensitive to input power rotation. The output power cable is connected from the output terminals to the input terminals of the step-up transformer when used or the input terminals of the electric motor.

When factory installed options are used, control inputs and outputs are wired directly to MOLEX headers mounted on the Advantage System Base Board (ASBB) or Basic System Base Board (BSBB). When wiring is field installed, the AC control wiring should be a minimum of 14 awg and run in conduit separate from DC control wiring. Analog inputs (Analog 1 and 2 and any auxiliary or optional analog inputs) should be connected with a shielded, grounded, twisted pair cable, minimum 20 awg. When installing cables not rated for 600 V such as communication cables, those cables must be routed with the low voltage wiring (not in contact with the 600 V rated wiring).

Emergency Stop (Category Zero) Option Wiring

The Electrospeed Advantage drive can be configured to provide a category zero emergency stop option. When this option is installed, the control power transformer and 480 V bus tap wiring associated with this function will remain energized when the E-STOP switch is activated. To completely de-energize the drive, disconnect it from the 3-phase input power source via an upstream switch or circuit breaker.



Motor Temperature Sensing

If a motor temperature sensing device is utilized in the Motor installation, the VSD must be set for Motor Over-Temperature shut-down.

IEEE Compliant Systems

When needed to minimize harmonic distortion on the utility power line, the Advantage drive can be configured to use a 12 or 24-pulse converter configuration. In these configurations, additional transformers are used to create phase shifted inputs of the incoming power. The outputs of the phase shifting transformer are connected to the additional converter input sections of the drive. Using a 24 pulse converter drive configuration will usually reduce the total harmonic distortion (THD) on the power system to below IEEE 519 requirements.

System Control Circuit Boards

The Baker Hughes Advantage Series of variable speed drives use one of two different system control circuit boards, based upon drive size and complexity.

Advantage drives of the 2000/4000 series 6 /12 pulse inputs use the “Basic System Base Board” (BSBB). The BSBB hosts two processing boards, the Advantage Power Converter Board (APC) and the Advantage System Controller Board (ASC). With both of these boards installed the assembly is known as the “Basic System Control Board” (BSCB). These boards can be ordered and replaced individually, or as an assembly. The BSCB contains all of the advanced processing power and connectivity enhancements found in Advantage series drives, but uses power transistor and SCR driver cards and mounting similar to that on the GCS.

Advantage drives of the 4000-24p / 8000 series use a different style of system base board called the “Advantage System Base Board” (ASBB). Like the BSSB, the ASBB hosts two processing boards, the Advantage Power Converter Board (APC) and the Advantage System Controller Board (ASC). With both of these boards installed the assembly is known as the “Advantage System Control Board” (ASCB). These boards can be ordered and replaced individually, or as an assembly.

The ASCB is used in 24 pulse drives as well as multi-cabinet drives, such as the 8000 series.

The ASCB uses a new style of SCR and Transistor driver cards, connectors, cabling and mounting compared to previous drive series. The converter and inverter cards are connected via a wiring harness rather than being directly connected to the system control board. This allows the driver cards to be located much closer to their devices. The ASCB supports up to four different inverter and converter sections, each with its own plug on the ASCB, labeled J5 through J8 for the converter section and J9 through J12 for the inverter section.

These connectors differ from the previous style in two significant ways:

- The harness/ connectors between the system control board and the driver cards must not be disconnected while the system control board is powered. This can cause permanent damage to the driver cards and/ or the ASBB.
- If any of the inverter plugs on the ASBB is not plugged into the wiring harness the connector must be terminated using an Advantage Inverter Termination Plug (AITP, “dummy plug”). An empty (unterminated) inverter plug will be interpreted as a constant IOT and may cause the drive to lock up or the APC to stop communicating with the rest of the hardware.



Graphic Display Basics

This portion of the Electrospeed Advantage™ Variable Speed Drive's Installation and Operations manual describes the basic principles of the Graphic Control Operating System, the operation of the keypad, and the liquid crystal display (LCD) screen. The Advantage drive uses an LCD panel as its primary operator interface.

The LCD has a resolution of 320x240 pixels and supports colored graphics. Using this display, the operator can view and/or modify all set points contained in the drive. Whenever the Advantage drive is first powered up and is ready to operate, the LCD will show the Main Menu screen, similar to the one shown at left.

Keypad Switches

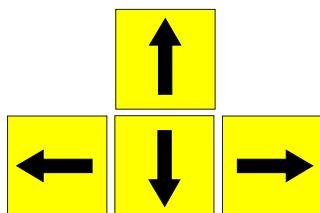
The interface has several keypad switches whose functions are defined as follows:



The green START key is pressed to manually start the motor.



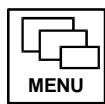
The red STOP key manually stops the motor and is also used to clear or acknowledge a lockout condition.



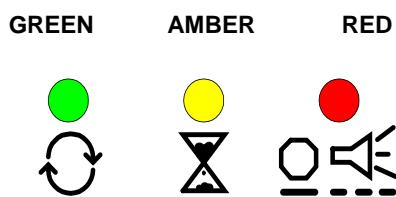
The arrow-keys are used to move the cursor on the screen or to increment and decrement numbers when calibrating or editing a set point.



The ENTER key is used to select highlighted menu items or to program or finalize a set point or value entry.



The MENU key is used as a backup or cancel key to abort any adjustment in progress. Press MENU repeatedly to access the Main Menu screen.



Keypad LEDs

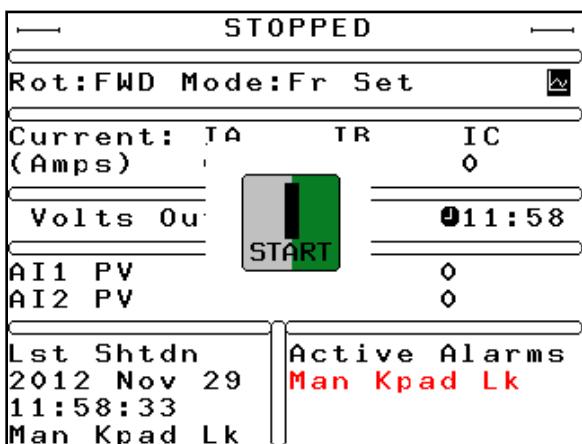
The green, amber and red panel light emitting diodes (LEDs) indicate the present status of the motor. Green indicates the system is running. Green with flashing amber indicates the drive is currently timing an active alarm for a shutdown. Amber only denotes the system is stopped but all alarms are clear and it is timing down for an automatic restart. Red indicates the system is shut down and that automatic restarts are disabled and/or active alarms exist so that the drive will not restart by itself.

Capacitive Keypad

The Advantage display uses a capacitive touch keypad, which eliminates the mechanical switches previously used. It is useful to think of key presses as taps on (or near) the glass. The Advantage LCD display is not touch sensitive, only the keypad.

To prevent unintended start and stop operations, a delay of approximately two seconds is implemented on the start and stop keys. The user must maintain contact with the key during this delay to activate the start or stop function. If the user releases contact with the key during the delay before it completes, no action will be initiated. The display shows a visual representation of this with a pop-up dialog that progresses from grey to green in quarter second steps as shown at left.

The Advantage display can be used over a wide range of ambient temperature from -58°F up to 176°F (-50°C up to 80°C).





Key Pad Lockout Switch

The key switch mounted below the display is intended to replace the function of the lockable display unit door on the drive. The two switch settings correspond to:

OFF: All the keys are disabled except for the STOP button.

ON: The display functions normally.

Weatherproof Design

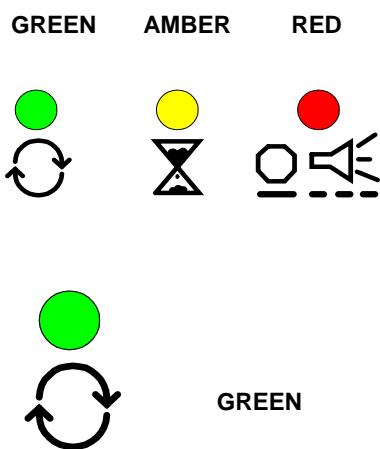
The display is flush mounted on the door, which will prevent any sand, water, dust or corrosives from causing circuit board damage.

Display LEDs and Panel Lights

There are two sets of indicator lights on the front cabinet of the Advantage drive. One set is contained inside the bezel of the TFT LCD (the display LEDs). The other set is attached to the front panel of the cabinet (the panel lights). The operation of the display LEDs is as follows:

Green, Amber and Red Display LEDs

The Advantage drive display unit has red, amber and green LEDs built into it. These lights function slightly differently from any external optional panel lights and are not affected by the panel light mode selection. These lights can be used in combinations so that the combined states indicate the following.



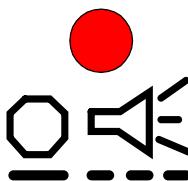
Green light on steady: The motor is running with no alarms.

Green light on with amber flashing: The motor is running, but an alarm is active and its associated time delay is counting down to expire.

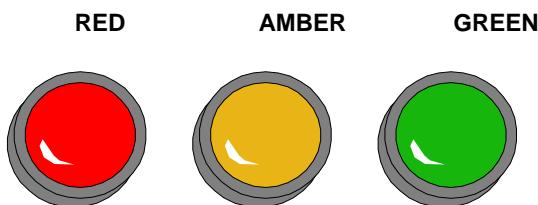
If the alarm persists past the associated time delay, the motor will shut down.



AMBER



RED



RED



AMBER



GREEN

Amber light on alone: The motor is stopped, but there are no active alarms and the motor will automatically restart when the restart time delay has expired. If the parameter Wait for Restart Timer is disabled, the motor can be started at any time by pressing the START button.

Red light on steady: The motor is stopped because of a manual or operator stop or a central computer shutdown command.

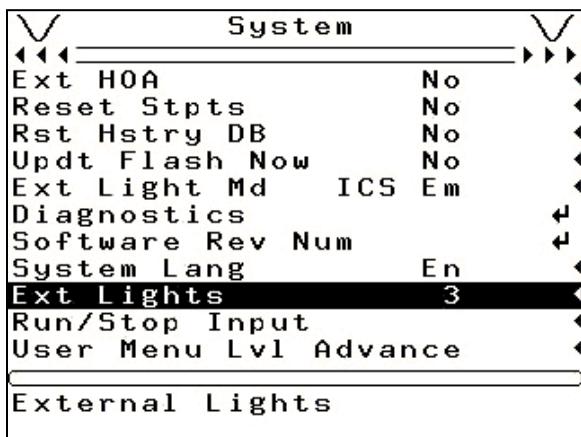
Red light on flashing: The motor is stopped because of one of the enabled alarms. Restart will not occur without operator intervention

Red light on flashing with amber: The motor is stopped because of one of the enabled alarms. Restart will occur when restart time delay has expired.

Optional External Red, Amber and Green Panel Lights

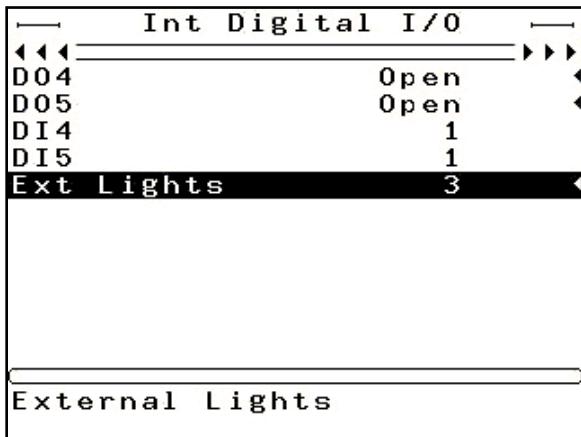
Optional external panel lights can be connected to three of the five digital outputs provided on the ASBB or the BSBB. The three Digital outputs corresponding to the Red, Amber and Green lights are located on the ASBB or BSBB connector labeled J20. Digital Output 1 corresponds to the Green light; Digital Output 2 to the Amber light; and Digital Output 3 to the Red light. Digital Outputs 4 and 5 are extra onboard Digital outputs. All five outputs are dry contact, Normally Open (NO) relay contacts rated for 12A at 250 VAC, 30 VDC.

If the red, amber and green lights are installed on the enclosure, and wired to the corresponding digital output terminals, the Advantage drive will operate the lights in the following modes if the Ext Lights parameter described in the next section is set to 3. The operator can choose these modes of operation from the SCADA & Security & System menu, Ext Light Md page or the Internal & External Modules menu Onboard I/O selection, Int Digital I/O page. In all modes, the green light indicates the motor is running.

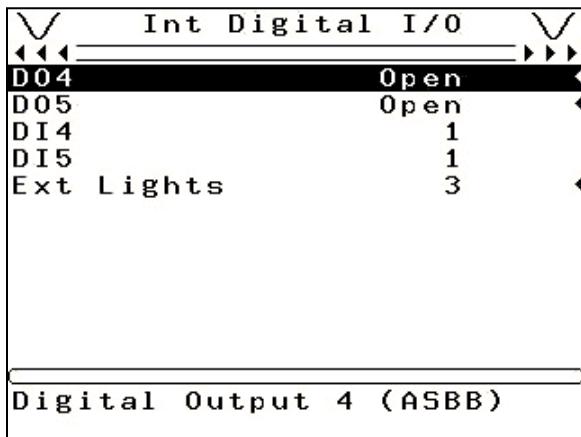


External Lights

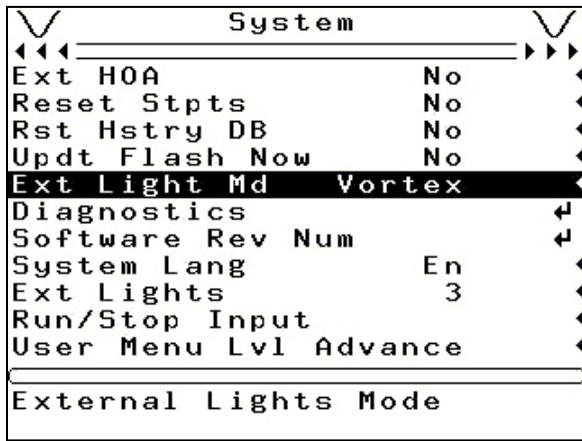
Relays one, two and three of the five digital output relays on the Advantage drive can be reassigned as general purpose outputs if the panel lamp function is not required. In this case, the parameter Ext Lights (external lights) can be set to control how many of the outputs are used in the External Light mode explained below.



This parameter is accessed from the SCADA & Security & System menu, System page, Ext Lights parameter or the Internal & External Modules menu, Onboard I/O page, Ext Lights parameter. The possible settings are 3, 1 or none. If set to 3, all three relays are used in the Ext Lights mode and none are available for general purpose events. If set to 1, only the green light's relay is used and the other two relays are available for general purpose outputs. If set to none, all three relays are available for general purpose outputs.



These general purpose outputs can be programmed to change state based on various system events via the User Config Function menu, Digital Output Control selection. Digital Output Relay 4 and 5 are currently only configurable for an Open or Closed status when system power is applied. They will not switch based on system events. They are accessed from the Internal & External Modules menu, Onboard I/O selection and Int Digital I/O page.

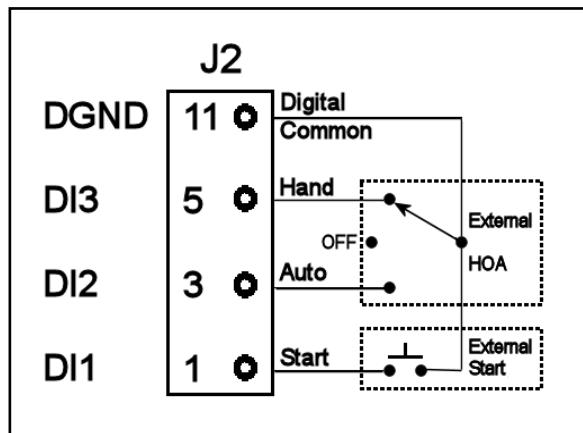


External Light Mode: Vortex

The red light indicates that the motor is stopped and that no automatic restart will occur. This may be because:

- 1: An alarm is still active,
- 2: The last shutdown caused a lockout condition,
- 3: The Hand/Off/Auto switch is in the OFF or Hand position, or
- 4: The drive has received a valid shutdown command from a central computer.

The amber light indicates that the motor is stopped, but all alarms are clear and the drive is counting down the Restart Time Delay. When this delay has expired the Advantage drive will automatically restart. The green panel light indicates that the motor is running.



External Light Mode: Kratos

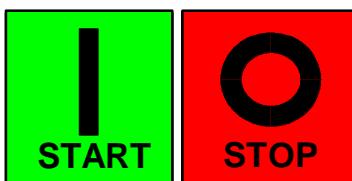
In this mode, the red and amber lights operate in the same way as a Kratos or Centrigard™ Controller. The red light indicates an Overload shutdown has occurred and an amber light indicates all other shutdowns.

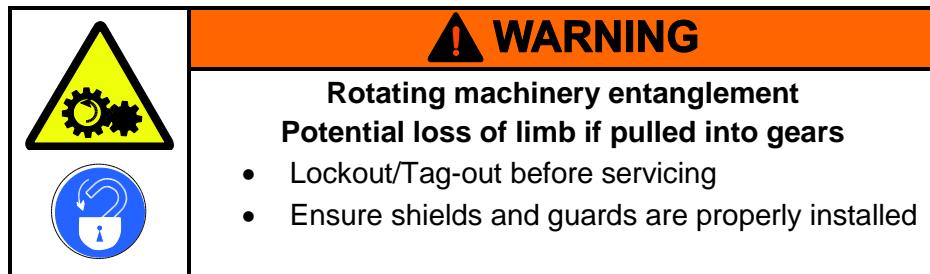
External Light Mode: ICS EM

In this mode, the panel lamps operate in the same way as an ICS Electrospeed variable speed drive. The red light indicates an Overload shutdown; an amber light indicates an Underload shutdown. If the shutdown is caused by any other reason, no panel lights will be illuminated.

Start/Stop Display Unit Switches

The Advantage drive's display unit keypad provides a capacitive touch keypad switch for START and STOP functions. To start a motor manually, press the START button on the display unit for approximately two seconds. To shut down a running motor, or to clear a lockout condition, press the STOP button for approximately two seconds. See the section called **Capacitive Keypad** for further information on the capacitive touch keypad switch.





Internal Hand/Internal Auto Mode Selection

The following description for the Internal Hand/Internal Auto mode selection assumes that an optional external Hand/Off/Auto (HOA) switch is **not** installed.

The Internal Hand or Internal Auto operational mode is determined by the status of the Int Auto Rstrt (internal automatic restart enable) parameter that is found on the Starts page of the Basic Setup menu. When the Int Auto Rstrt parameter is set to NO, the Internal Hand mode of operation is selected. When the Internal Hand mode is selected the motor can only be started manually by pressing the display START button. In no case will a start be allowed if any alarms are active.

Starts	
Int Auto Rstrt	Yes
Strts Counter	0
Total Starts	77
Max Allowd Strt	4
Strts Cntr Rst	10 min
Prog Rstrt Tm	0 min
Restart Delay	20 min
Tm Til Rstrt	00:00 M:S
Stagrd Strt Tm	0 min
Wait Fr Rstrt	No
Rstrt On Ovld	Yes
Internal Automatic Restart Enable	

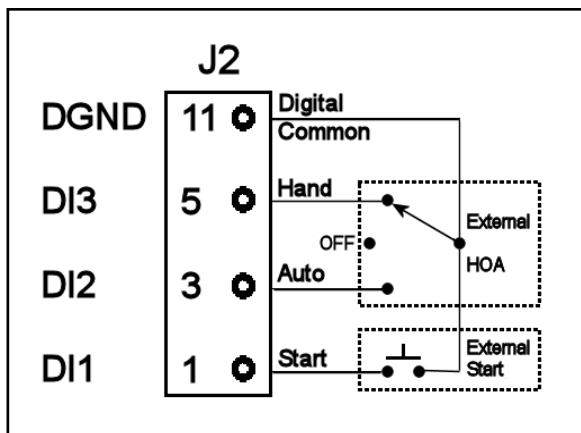
When this parameter is set to YES and the Ext HOA parameter on the System page of the SCADA & Security & System menu is set to NO, an Internal Auto automatic restart mode is selected. The drive will automatically attempt to start the motor after the restart time delay has expired, if there are no active alarms and a lockout condition does not exist.

The motor can be started manually at any time by pressing the display START button unless the Wait Fr Rstrt (wait for restart time) set point is set to YES on the Starts page of the Basic Setup menu and the Tm Til Rstrt (time until restart) countdown has not expired. In this case, the motor cannot be started until the restart time delay has expired. In no case will a start be allowed if any alarms are active. If a shutdown that causes a lockout condition has occurred, the lockout must be cleared and the restart delay time must expire if the Wait Fr Rstrt set point is set to

YES on the Starts page of the Basic Setup menu before the drive will allow a manual start attempt from the display start button.

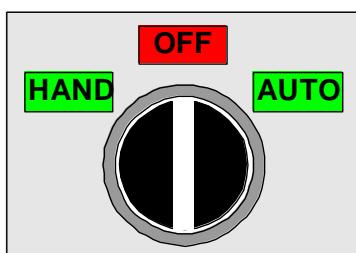
A lockout condition can be cleared by pressing the STOP button switch on the display keypad. As noted earlier the above described operating mode infers the optional HOA panel mounted switch is not installed (optional HOA switch described below).

Hand/Off/Auto and Start Panel Mounted Switches (External HOA)



The drive's mode of operation can also be determined by the status of optional externally mounted HOA mode and START switches. A running motor can be shut down, or a lockout condition can be cleared manually by changing the position of the HOA switch to the OFF position and then back to the desired mode of operation, HAND or AUTO. If external, panel mounted switches are used, be sure to enable them by setting the Ext HOA parameter to YES. This parameter is found under the menu SCADA & Security & System on the System page.

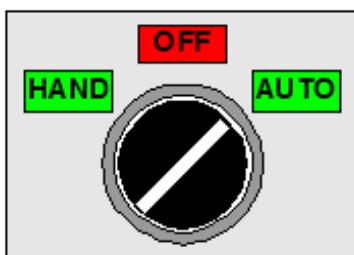
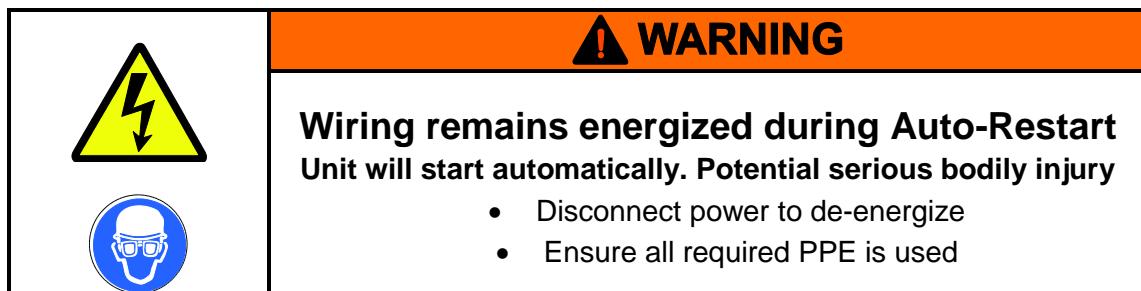
The HOA enable parameter configures the three digital inputs for use with an external HOA switch and an External Start button (momentary switch). This External Start momentary switch is in addition to the display unit's keypad start button.



If the HOA enable parameter is set to YES and the HOA switch is in the AUTO position, it will override the Int Auto Rstrt parameter. In this mode the drive will automatically start depending on the delay times set and the cause of the last shutdown.

The drive operation varies depending on the position of the HOA switch. With the HOA switch in the OFF mode, the unit cannot be started locally by the capacitive touch start button on the display, by the External Start momentary switch on the cabinet face, or remotely by a SCADA system. It will not attempt to automatically start either. The Tm Til Rstrt parameter on the Starts page of the Basic Setup menu will still count down from the time of last shutdown depending on the

cause of the shutdown, but the drive will not automatically attempt to start when the time has elapsed. If the Wait Fr Rstrt parameter is set to NO and the HOA switch is in the HAND position, the drive will start without any delay when the START button is pressed if there are no active alarms and no lockout condition exist. If the Wait Fr Rstrt parameter is set to YES and the HOA switch is in the HAND position, the drive will start only after any restart delay time has expired (either the Global Restart Delay or the Auxiliary Restart Parameter Restart Delay, whichever applies to that particular shutdown event). When in the HAND position the automatic restart function is disabled as is any SCADA requested starts.



When the HOA switch is in the Auto mode, there are no active alarms and a lockout condition does not exist, the drive will automatically attempt to start based on whether the Tm Til Rstrt timer has expired and the incremental value of the global parameter Max Alowd Strt has not been exceeded (or the incremental value of the Auto Restarts on the Auxiliary Restart Parameter, ARP, when auxiliary restart is enabled). To clear a lockout condition either press the capacitive touch STOP button or move the HOA switch to the OFF position and back to the desired mode of operation.

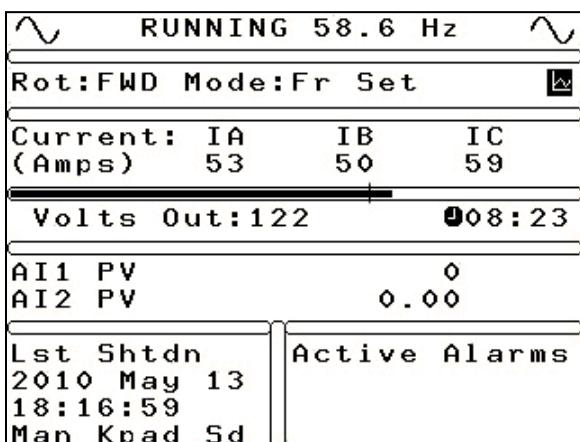
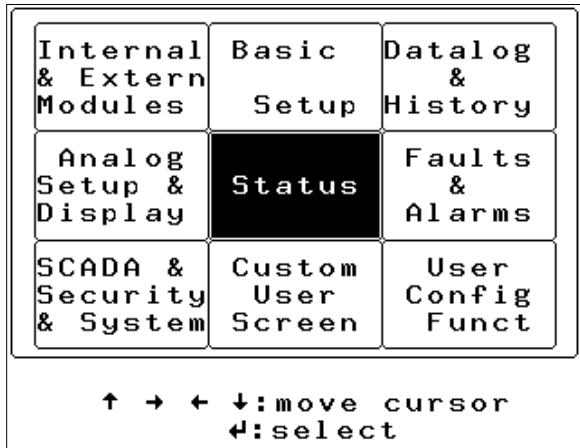
Manual Keypad Lockout (Man Kpad Lk)

When the drive is shutdown by pressing the STOP button on the keypad, it will annunciate a manual keypad lockout shutdown. This lockout will prevent all start attempts except for the keypad START or the optional external START switch. To clear the lockout and start, press the

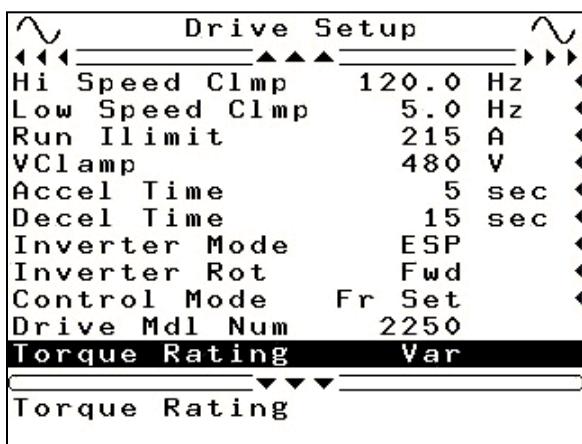
keypad start or external start switch. To clear this lockout without causing a start, press and hold the keypad STOP key for about 5 seconds. This shutdown/lockout is treated differently from all others due to the possibility of control conflicts when an external HOA switch is utilized.

Displaying a Menu, Reading or Setpoint

The operator interacts with the Advantage drive by pressing the keypad switches below the LCD screen. Use the arrow-keys to move the highlighting pointer to the desired menu item and then press the ENTER button to select that item (although the highlighting pointer changes in appearance depending on the information displayed on the screen, it is always implemented in reverse color compared to other text on screen). As an example, to display the current operational status of the motor, use the arrow-keys to move the highlight to the center Status position of the Main Menu (at left) and press the ENTER key.



The Advantage drive will display the status screen and show the running status information similar to the screen shown at left. To return to the previous menu, press the MENU key and the display will change back to the Main Menu screen.

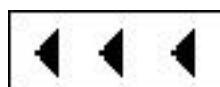


Advantage Drive Display Conventions

All Advantage drive menus and screens use common symbols to convey information. For example, when a menu screen contains more information than can fit onto one page of display, the graphic  will appear at the bottom of the screen. This graphic indicates that using the arrow-keys to move the cursor to the bottom of the page will cause the screen text to scroll upward until the bottom line of the menu is displayed. Several menu screens can also be linked together by the LEFT and RIGHT arrow-keys. This is indicated by the  and  graphics appearing on the left and right ends of the bar at the top of the screen. When a parameter can be modified, the small arrow pointer  appears at the right edge of the parameter's line. Note that only some of the parameters on the example screen shown at left can be edited.



This pointer at the end of the line indicates that the parameter can be edited.



This symbol indicates that additional menus can be accessed by pressing the LEFT arrow-key.



This symbol indicates that additional menus can be accessed by pressing the RIGHT arrow-key.



More information or additional menu items can be reached by pressing the UP or DOWN arrow-key and moving the cursor to the top or bottom of the screen.



Editing a Reading or Setpoint

Hi Thld Setup	
High Threshold	300 A
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	5 sec
Aux Rstrt Parm	No
Analog Input 1 High Threshold	

Any parameter within the Advantage drive that can be edited or changed will display a small arrowhead pointer on the right side of the cursor bar. To edit any of these parameters, use the UP and DOWN arrow-keys to highlight the desired parameter with the cursor. When there, press the ENTER key to activate the Edit mode for that parameter. The present value of that parameter will appear in reverse color, with a cursor box surrounding the alpha numeric character being modified. In the illustration at left, the cursor surrounds the 0 in the value of 300. To change characters to the left or right of the highlighted character press the LEFT or RIGHT arrow-keys while in the edit mode. When the correct character is highlighted, pressing the UP/DOWN arrow-keys will cause that value to increase or decrease. When the parameter reaches the desired value, release the arrow-key then press and release the ENTER key to save the newly modified setting. If the user wishes to abort the modification, simply press the MENU key instead of the ENTER key to cancel the changes. If a large number change is required, the user can use the LEFT/RIGHT arrow-keys to shift the cursor to the appropriate digit location and then use the UP/DOWN arrow-keys to change that digit. As an example, the illustrations at left show the cursor in the fourth digit position, ready to change the value from zero to one through nine.

Hi Thld Setup	
High Threshold	300 A
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	5 sec
Aux Rstrt Parm	No
Analog Input 1 High Threshold	

Notice that if the drive does not allow the user to edit any parameter even though the edit arrowhead is displayed, it is possible that system security has been enabled and the user must first enter a valid password. Read the **System Security** section to learn about working with security levels. Read-only parameters or menu selections do not display the small triangular graphic symbol at the right side of the display line. If there are read-only parameters, editable parameters and menu selections on the same page, the read-only parameters will not show any symbol to the far right of the display. Any editable parameters will show the small arrowhead to the far right of the display and any menu selections will show an Enter symbol to the far right of the display. If only menu selections exist on a page, no symbol will be shown to the far right of the

display. The example screens at left show the Present Value as read-only, three editable parameters and two menu selections.

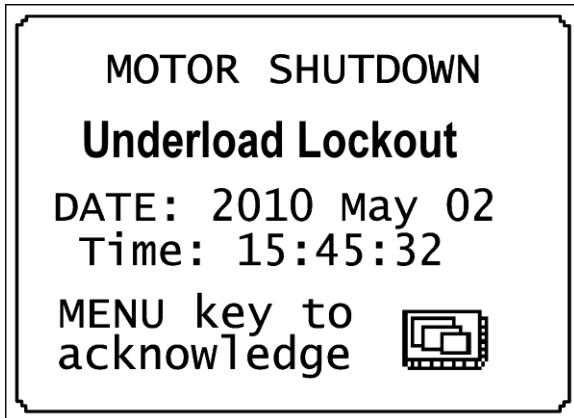
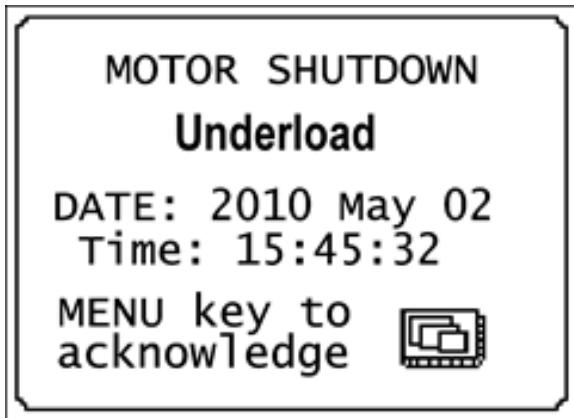
Auxiliary Restarts Parameter Enable

When the Advantage drive has been configured to restart automatically (Int Auto Rstrt set to YES), it normally uses two global parameters: Max Alowd Strt (Maximum Allowed Starts) and Restart Delay (Restart Delay) found in the Basic Setup menu on the Starts page (shown at left), to determine how many starts are allowed and how long to wait before attempting the start. However, under some circumstances it can be desirable to configure a particular fault's restart parameters differently based upon what the cause of the shutdown was. Most shut down alarms in the Advantage drive have an associated set of Auxiliary Restart Parameters (ARPs) connected with them. When the ARPs are enabled, and the drive shuts down because of that specific condition, it will use the ARP Auto Restarts and Restart Delay parameters to control the restart attempt. Conversely, if the Auxiliary Restarts Enable parameter for a specific fault and alarm is set to NO, but automatic restarts are allowed, the drive will use the global maximum allowed start attempts and the restart time delay set on the Starts page of the Basic Setup menu.

As an example, the Telemetry Fail Auxiliary Restart Parameters enable parameter in the screen shown on the left is set to YES, which causes the ARP Auto Restarts and the ARP Restart Delay parameters to appear in the Faults & Alarms menu on the Telemetry Fail page.

Starts	
Int Auto Rstrt	Yes
Strts Counter	0
Total Starts	57
Max Alowd Strt	4
Strts Cntr Rst	60 min
Prog Rstrt Tm	0 min
Restart Delay	60 min
Tm Til Rstrt	00:00 M:S
Stagrd Strt Tm	0 min
Wait Fr Rstrt	Yes
Rstrt On Ovld	No
Maximum Allowed Starts	

Telemetry Fail	
Present Value	No
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	10 sec
Alm HldOf Dly	1 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
Telemetry Fail Auxiliary Restart Parameters	



Drive Setup	
Set Frequency	60.0 Hz
Hi Speed Clmp	120.0 Hz
Low Speed Clmp	5.0 Hz
Run Ilimit	215 A
VClamp	480 V
Accel Time	5 sec
Decel Time	15 sec
Inverter Mode	ESP
Inverter Rot	Fwd
Control Mode	Fr Set
Drive Mdl Num	2250
Torque Rating	Var
Freq Avoid Cfg	
Pwm Filtr Cfg	
User Password	0
Advanced Setup	
User Password	

Alarm and Shutdown Indication

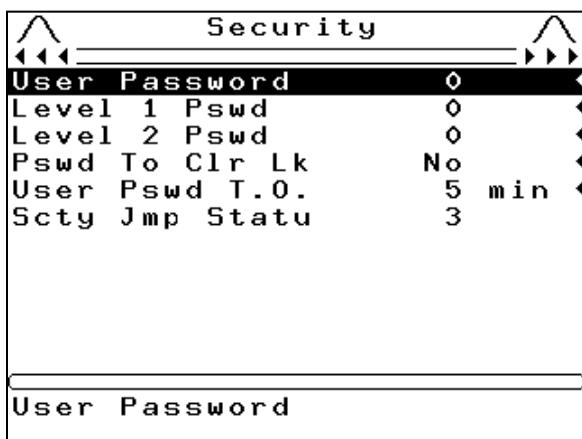
The Advantage drive always annunciates live alarm and shutdown information on the status screen of the display unit. The drive will also display an alarm alert screen after any shutdown occurs. This pop-up alert screen is displayed on top of all other screens and shows the time and cause of the motor shutdown. Press the MENU button to acknowledge and clear this screen and return to the previously displayed screen.

Lockout Condition

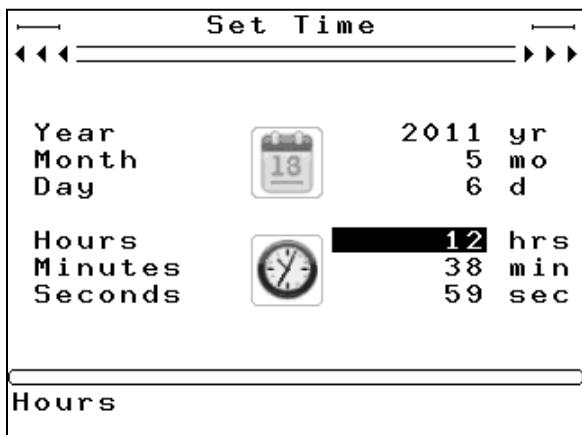
Any of the protective shutdown alarms can be configured to cause a lockout condition and this situation is indicated by LK or LKout accompanying the cause of shutdown. If such a lockout condition has occurred, no starts of any kind, manual, automatic or remote will be allowed until the lockout has been cleared. A lockout can be cleared by pressing the STOP keypad switch on the Display unit or changing the position of the HOA Mode switch, if installed, to OFF and back to HAND or AUTO.

System Security

The Advantage drive has the capability of administering security protection to guard against unauthorized set point editing. The security is initiated by entering a code number or 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 1 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.

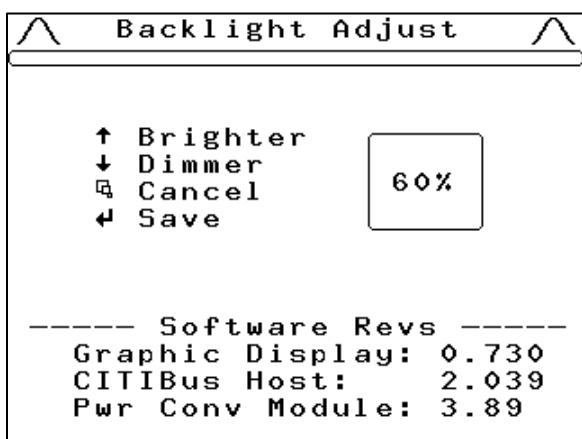


The drive is shipped from the factory with all security protection disabled, so if an operator is unable to change set points in the field, a security code may have been entered in the field by local personnel. These local personnel should then be contacted to learn the security code required. The Security page can be found under the SCADA & Security & System menu.



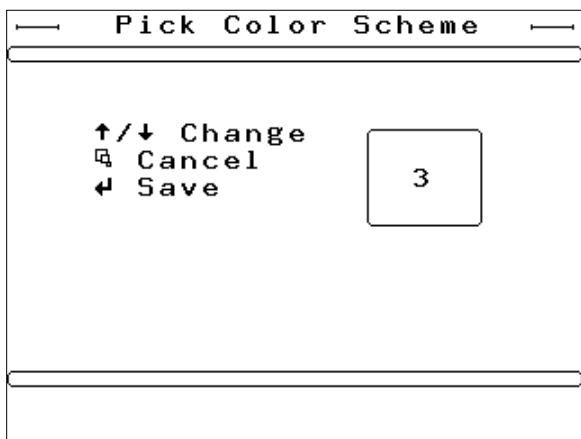
System Time Clock

The Advantage drive uses a battery backed real-time clock circuit for time keeping functions. All events and shutdowns recorded are time stamped with the date and time of occurrence. A battery is supplied with the system that will keep the clock up to date in the event of a power failure or shutdown. The system clock can be set to the current date and time by entering the desired data into the Set Time menu screen found as a submenu of the SCADA & Security & System. This time keeping device is year 2000 compliant.



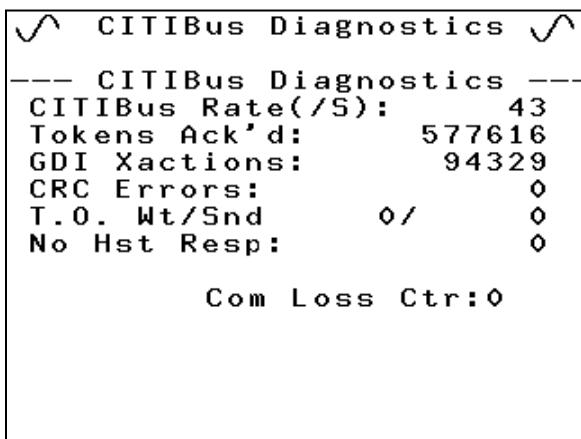
Backlight Adjust (Brightness)/Software Revs

To activate the Backlight Adjust (brightness adjustment) screen, press both the LEFT and RIGHT arrow-keys simultaneously, hold for a half second and then release both keys. A screen similar to the one at left will appear. At this point, use the UP and DOWN arrow-keys to adjust the brightness higher or lower as required. This screen also displays the Software Revision levels loaded in the modules connected to this unit. Software upgrades can provide access to new, additional features and resolve operating issues. Contact Baker Hughes personnel for software upgrades if required.



Pick Color Scheme

Press the RIGHT arrow-key and the Pick Color Scheme screen is displayed. Use the UP and Down arrow-keys to toggle through the available color schemes. Once adjustments are complete, press the ENTER or MENU key to return to the Advantage drive menu system.



Citibus Diagnostics

Press the RIGHT arrow-key again and the CITIBus Diagnostics information is displayed. CITIBus is the trademark name of the hardware/software connection and communication between modules connected together in an Advantage drive system. This information can be used to diagnose problems if they arise.



— Utility Menu —

AI1 Prsnt Val ,42

Add Parm to status 1
Add to Custom User 1
Screen Capture 0
Rename this Parameter
Log this Parameter

RePlaces one of the two STATUS menu Parameters with the Parameter above.

— Utility Menu —

AI1 Prsnt Val ,42

Add Parm to status 1
Add to Custom User 1
Screen Capture 0
Rename this Parameter
Log this Parameter

RePlaces one of 11 Custom User menu Parameters with the Parameter above.

— Utility Menu —

AI1 Prsnt Val ,42

Add Parm to status 1
Add to Custom User 1
Screen Capture 0
Rename this Parameter
Log this Parameter

Save the image of the Previous menu to a disk file as screapxx.bmp

Utility Menu

The Utility menu is activated by depressing the UP and DOWN arrow-keys at the same time. A menu screen similar to the one at left will appear.

Add Parm to Status

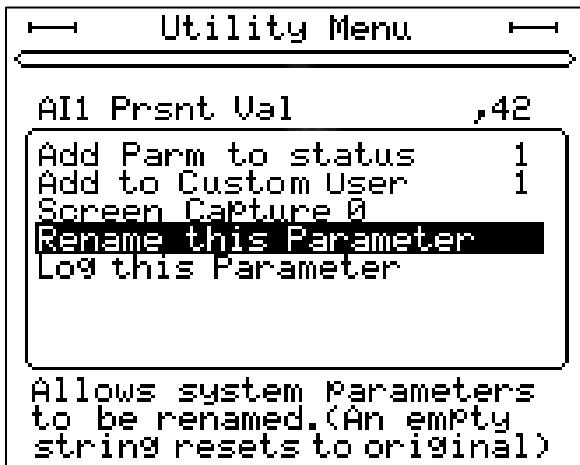
This function allows the user to replace one or both of the analog parameters on the Status screen. The factory default setting is for the Status screen to display the present value of Onboard Analog Inputs 1 and 2. To replace these parameters, first use the arrow-keys to move the cursor to highlight the parameter that will be copied. Next, activate the Utility Menu by depressing the UP and DOWN arrow-keys at the same time. Then, move the cursor to highlight Add Parm to Status and press ENTER. The cursor will highlight the number 1 at the right side of the screen. Press the UP or DOWN arrow-key to select between status line 1 or 2. Press ENTER again to replace the selected status line with the new selection.

Add to Custom User

This function allows the user to place up to 11 parameters onto the Custom User screen. First, use the cursor keys to highlight the desired parameter. Next, activate the Utility Menu by pressing the UP and DOWN arrow-keys at the same time. Move the cursor bar to highlight the Add to Custom User line and press ENTER. Use the UP or DOWN arrow-keys to select which line (1 to 11) of the Custom User screen this parameter will be placed on. Lastly, press the ENTER key again to execute the function. In the illustration, the present value of Analog Input 1 will be placed on line 1 of the Custom User screen. Note that the parameter can also be renamed to a more descriptive label.

Screen Capture

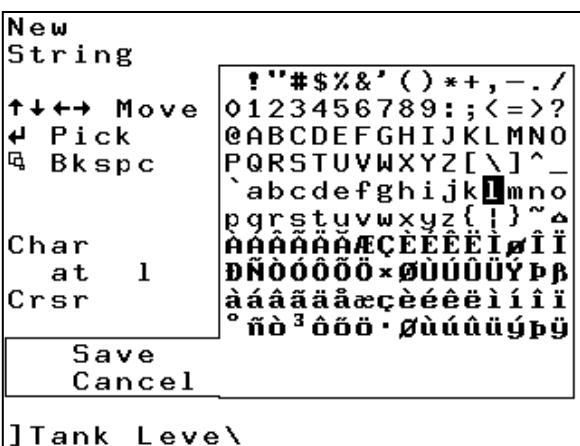
The Screen Capture function is used to store a copy of the presently displayed screen onto the Compact Flash Memory Card. A valid memory card must be installed to use this function. Use the cursor keys to display the desired screen and activate the Utility Menu. Move the cursor to the Screen Capture menu line and press ENTER. The



number 0 will change to reflect the file name created. All of the files are of a two-color bitmap variety with automatically assigned filenames of scrcap01.bmp through scrcap99.bmp. The capture function will automatically increment the number in the file name when it encounters an existing file.

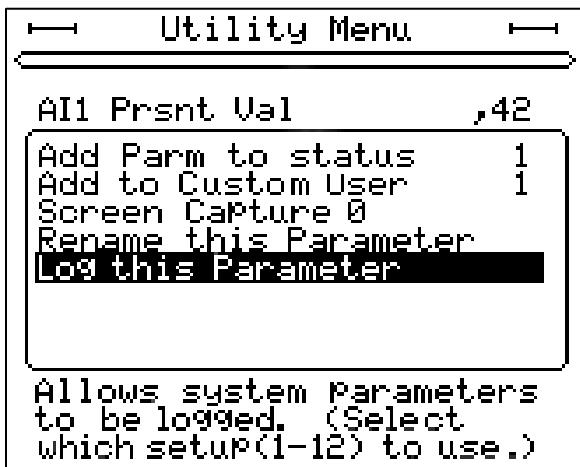
Rename This Parameter

This function allows the user to rename any valid data point. For example, Analog Input 1 could be renamed to Tank Level. Up to 15 characters can be used in the descriptor. The first step is to use the cursor keys to highlight the parameter that will be renamed. Next, activate the Utility Menu, highlight the Rename this Parameter line and press ENTER. The screen will change to one resembling the one at left below. Use the arrow-keys to move the cursor to the desired letter and press ENTER. Repeat this procedure until all the desired letters are selected, then move the cursor to the SAVE area on the screen. Press ENTER and the new name will be preserved while the screen reverts back to the original menu. If the name must be reset to default values, erase all of the custom characters in the string (by pressing the MENU key) and save it as an empty string. The parameter's name will revert to the default value. As shown in the illustration at left, the cursor is currently resting on the lower case L character and the newly created string will be Tank Level. The backslash character “\” after the “e” indicates where the next letter or character will be placed.



Log This Parameter

This function can be used to add any database point to the list of points being logged or recorded to the CF memory card on the display unit. To use this feature, first move the cursor to highlight the desired parameter, then press the UP and DOWN arrow-keys simultaneously to activate this Utility Menu. Then select the Log this Parameter menu item and press ENTER. The cursor at this line will change to display the number 1. This number indicates which of the twelve possible datalog slots this parameter will be configured into. If slot number 1 is already allocated, select another slot. Once that is selected, press ENTER and the



STOPPED & Rdg		
Rot:FWD	Mode:Fr	Set ↴
Current: IA (Amps)	IB 0	IC 0
Volts Out: 0	16:48	
Tank Level DI2 State	8 1	
Lst Shtdn 2010 Jul 9 16:36:04 Tank Level	Active Alarms Tank Level Lo DI2 Alm	
Lo Thld Setup		
Low Threshold	10	
Alarm Enable	Yes	
Lockout Enable	No	
Bypass Delay	0 sec	
Shutdown Delay	4 sec	
ARP Enable	No	
Tank Level Low Threshold Alarm Enable		
Internal AI1		
Tank Level	8	
Maximum & Cfg	5000	
Instrument Typ	0-10 VDC	
Minimum Rdng	4	
Hi Thld Setup	4	
Lo Thld Setup	4	
Tank Level		

screen will revert back to the original location before entering the Utility Menu mode. The highlighted data point will be added to the list of logged points with a sample interval time of 1 second and a dead band value of 1. If those parameters are not acceptable, change them by using the Datalog Setup menu discussed later in this manual.

Active Alarm Screen

As shown to the left, the lower right hand corner of the Status screen displays the currently active alarms. If this list is longer than three entries, the additional alarms are not visible on the screen. To view those alarms, move the cursor to Active Alarms area and scroll down. If there are further alarms to view, they will become visible. As shown, the Tank Level Lo Threshold and Digital Input 2 Alarm (DI2 Alm) are active. If the user wishes to view or edit the alarm's configuration screen, press the ENTER key while the cursor is highlighting the desired active alarm. By pressing the ENTER key in the example, the screen will change to show the Internal Analog Input 1, Lo Thld Setup configuration screen as shown at left (note the Internal AI1 parameter has been renamed to Tank Level in this example as depicted in the graphic at left). This feature can help to identify which physical input is in alarm when the data point has been user renamed. In the example, since the Digital Input had been renamed to Tank Level, the user may not be able to easily determine which configuration screen (Internal AI 1 Lo Threshold Setup) was associated with this active alarm input. This feature allows the user to navigate directly to the configuration screen associated with any active alarm.

Recording and Restoring a Drive's Configuration

The Advantage drive uses mass storage devices such as USB flash drives to record system critical information. The VSD automatically records the setup configuration to one of these flash drives called the personality module.(PM) The set point file is updated with the newest information every 15 minutes. In the event of a circuit board failure and subsequent replacement, the drive will use

the most recent copy of the set point file and transfer those settings into the new circuit board automatically. No user intervention is required. If a user wishes to copy the settings from one drive to another, he/she should use the Compact Flash memory card.

EASYSTART SETUP

The Advantage drive software has a configuration assist feature called EasyStart. This algorithm is designed to lead a user, step by step, through the required, critical parameter settings needed prior to starting and running a motor. The EasyStart algorithm will execute automatically when power is applied, if the drive has not yet been configured or run. After the setup has executed once, it will record that fact and will not run again until the Advantage set points and database have been reset to factory defaults. When the Advantage drive is powered up for the first time, the following screen will be displayed.

Set Time

Year	2012	yr
Month	2	mo
Day	2	d
Hours	13	hrs
Minutes	34	min
Seconds	41	sec

Hours

Set Time

This first screen provides a way to verify and if necessary, adjust the battery backed, real-time clock. If required, enter the correct values into the clock variables. When finished, press the RIGHT arrow key to proceed to the next screen.

Set Language & Units

System Lang	En
Units	Imp

System Language

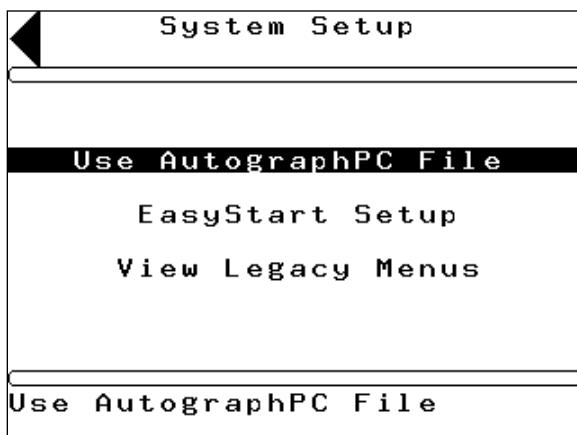
Note: At the top of the screen, a black arrowhead is pointing to the right, indicating that there are more menus/screens accessible in that direction. If visible, a left arrowhead indicates that pressing the left arrow key will return to the previous menu screen.

Set Language and Units

The next visible screen allows the user to select the system language of English, Spanish or Russian.

The measurement units can be set to either metric or imperial.

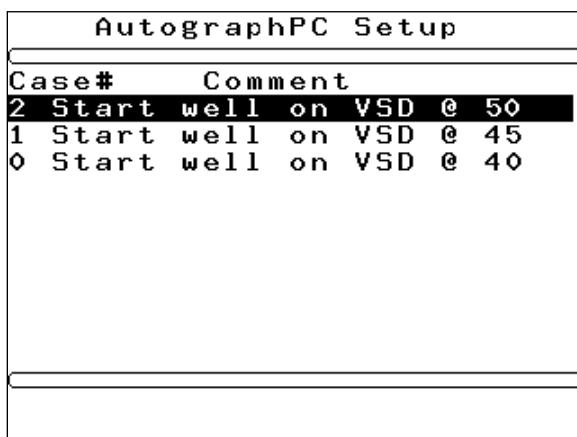
When finished with this screen, press the RIGHT arrow key to proceed to select the type of set up information and the method of data entry.



System Setup

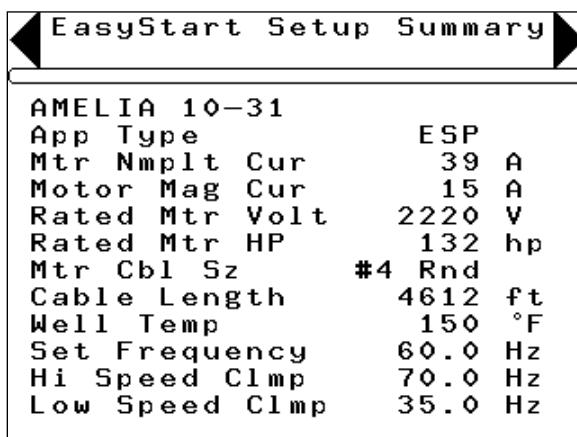
This screen allows the user to select the input method used to configure the Advantage drive.

The graphic at left depicts the screen highlighting the “Use AutographPC File” menu line. Use this method when you have a valid Autograph PC*.APX file or a saved configuration text file. Press ENTER at this menu line to display the next phase of configuration.



Autograph_Pc Setup

When the user selects “Use AutographPC File” from the previous screen, the Advantage drives retrieves the setup files from the personality module and if several cases exist on file, it presents them in a list format similar to the graphic at left. Move the cursor to highlight the desired configuration and press ENTER.



EasyStart Setup Summary

Once the user has selected a configuration file, the drive will parse the settings out of the file and program the appropriate system variables. After completion, the drive will display several linked summary screens showing the parameter settings used. The first example screen is shown at left.

Transformer Parameters

Select an available transformer tap voltage closest to the calculated tap voltage.

SUT Rated Vlts	480 V
SUT Voltage @	60 Hz
Calc Xfmr Tap	3323
Act Xfmr Tap	2039

Actual Transformer Tap

Transformer Parameters

Press the RIGHT arrow key to proceed to the next screen, a summary of the transformer parameters.

Press the RIGHT arrow key again to display the final summary screen. Note that if any of these parameters need to be changed, the user is allowed to edit values on these screens.

EasyStart Final Summary

Ovld Setpoint	181 A
Undrlnd Setpoint	123 A
Run Ilimit	165 A
Sync Ilimit	214 A
Accel Time	10 sec
Decel Time	10 sec
Lo Speed Bp D1	30 sec

Overload Setpoint

EasyStart Final Summary

The final summary screen shows the last few pertinent setup parameters.

Complete EasyStart

Enter the Main Menu

Go to EasyI/O Setup

Complete EasyStart

Press the RIGHT arrow key once more and the screen at left will be displayed. At this point in the sequence, the user may select the Complete Setup -> Main Menu item and will be directed to the Main Menu screen.

If there are site specific inputs and outputs to be defined and configured, the user can select Complete Setup -> Easy I/O and the drive will proceed to an assisted I/O configuration algorithm.



System Setup	
Use AutographPC File	
EasyStart Setup	
View Legacy Menus	
EasyStart Setup	

Easy Start Setup

The EasyStart Setup assists in configuring a drive by presenting the user with a series of screens with questions and entry spaces for the answers. Using the answers provided, the drive will set up the necessary parameters automatically. Press ENTER at this screen to proceed to the EasyStart Setup.

Site Information	
[Site Name]	AMELIA 10-31
[Notes(5 lines)]	
Press for System Setup	

Site Information

The site information screen is the first of the series of the setup sequence. These user entered parameters can be used to identify the location or well. Up to five lines of additional information can be entered if desired.

Press the RIGHT arrow key to proceed to the next screen.

Application Type	
Select the well application to assist EasyStart in the menu setup.	
App Type	ESP
Application Type	

Application Type

Set the application type to be an ESP (electrical submersible pump) or an HPS (horizontal pumping system). The setup wizard presets some parameters depending upon the type of application. For example, selecting ESP will set the torque limit = 150%, Motor Mag Current = 40% of nameplate. Selecting HPS will set the Motor Mag Current = 25% and Decel time delay is set to 30 seconds.

Press the RIGHT arrow key to proceed.

Power System Voltage	
Verify that the detected power system voltage is correct.	
Pwr Sys Volts	480 V
Inpt Freq Prsnt	60.0 Hz
Power System Voltage	

Power System Voltage

The Advantage drive automatically detects the voltage and frequency of the power system it is connected to. If it miscalculates, the user can enter the correct value here, by selecting the value closest to the electricity supplier's nominal voltage and frequency.

Press the RIGHT arrow key to proceed.

Motor Parameters	
Enter nameplate values based on 50 or 60 Hz operation.	
Mtr Nmplt Cur	39 A
Rated Mtr Volt	2220 V
Rated Mtr HP	132 hp
MotorParms @	60 Hz
Motor Eff.	85 %
Motor Nameplate Current	

Motor Parameters

Enter the motor's parameters using the manufacturer's nameplate ratings

Press the RIGHT arrow key to proceed.

Cable Parameters	
Select the well depth and temp based on the displayed units. The default motor cable size is based on the motor current.	
Mtr Cbl Sz	#4 Rnd
Cable Length	4612 ft
Well Temp	150 °F
Motor Cable Size	

Cable Parameters

Enter the size, type and length of downhole cable as well as the reservoir/well temperature.

Press the RIGHT arrow key to proceed.



Frequency Parameters	
Set Frequency	60.0 Hz
Hi Speed Clmp	70.0 Hz
Low Speed Clmp	35.0 Hz
Set Frequency	

Frequency Parameters

Set the desired operating frequency as well as the upper (high speed clamp) and lower (low speed clamp) limits allowed.

Press the RIGHT arrow key to proceed.

EasyStart Setup Summary	
AMELIA 10-31	
App Type	ESP
Mtr Nmplt Cur	39 A
Motor Mag Cur	15 A
Rated Mtr Volt	2220 V
Rated Mtr HP	132 hp
Mtr Cbl Sz	#4 Rnd
Cable Length	4612 ft
Well Temp	150 °F
Set Frequency	60.0 Hz
Hi Speed Clmp	70.0 Hz
Low Speed Clmp	35.0 Hz

EasyStart Setup Summary

This screen displays a summary of the parameter settings up to this point.

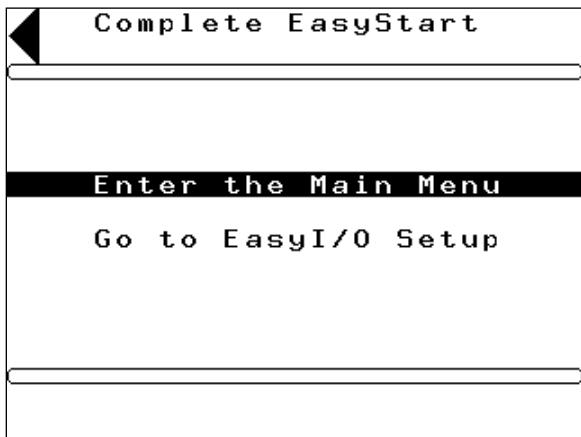
Press the RIGHT arrow key to proceed.

Transformer Parameters	
Select an available transformer tap voltage closest to the calculated tap voltage.	
SUT Rated Vlts	380 V
SUT Voltage @	60 Hz
Calc Xfmr Tap	2127
Act Xfmr Tap	2039
Actual Transformer Tap	

Transformer parameters

If a step-up transformer is connected between the drive and the motor, enter the input voltage and frequency ratings here. The Advantage will calculate a transformer tap setting from the available settings and suggest a voltage tap. The user should select a transformer tap that is as close as possible to the suggested one, and then enter the actual voltage tap utilized.

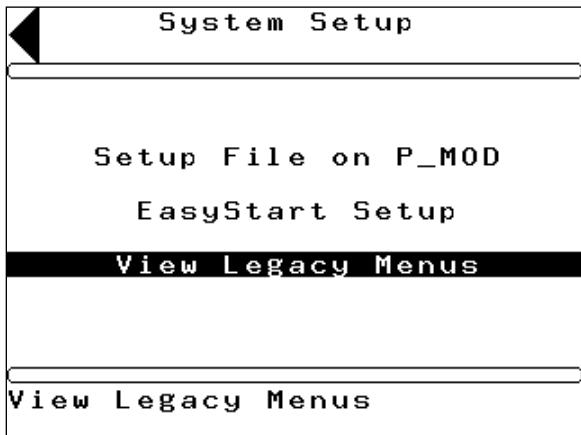
Press the RIGHT arrow key to proceed to the EasyStart Final Summary screen.



Complete EasyStart

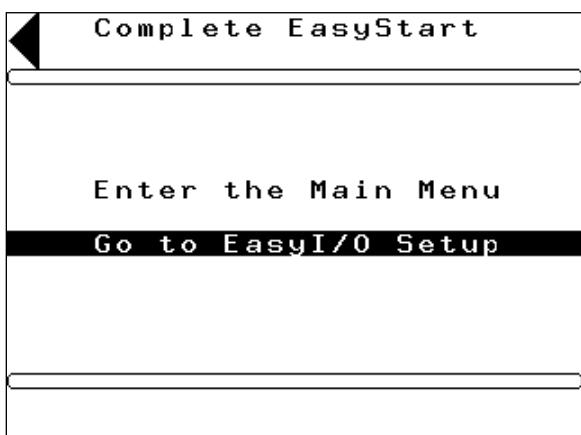
This screen marks the end of the setup sequence. At this point, the user may select the Enter the Main Menu item and will be directed to the Main Menu screen.

If there are site specific inputs and outputs to be defined and configured, the user can select "Go to Easy I/O Setup and the drive will proceed to an assisted I/O configuration algorithm.



View Legacy Menus

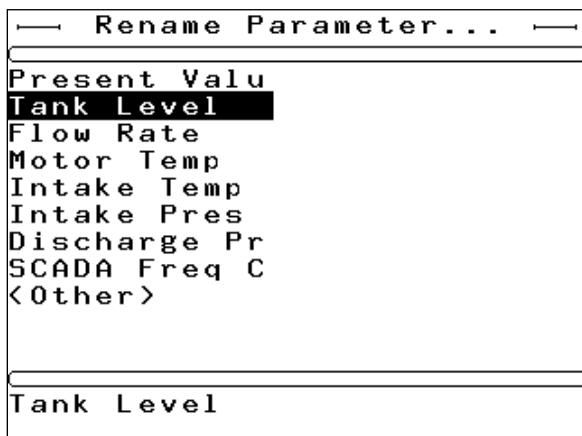
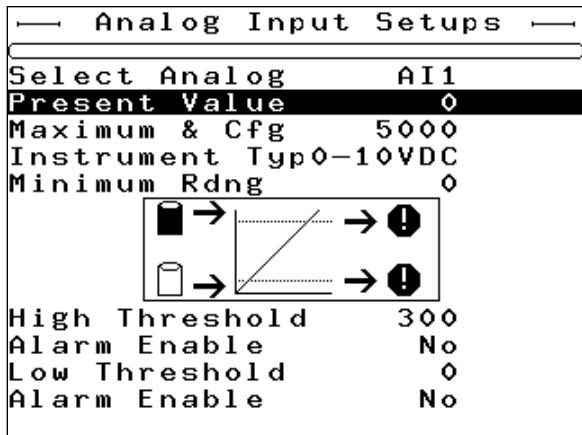
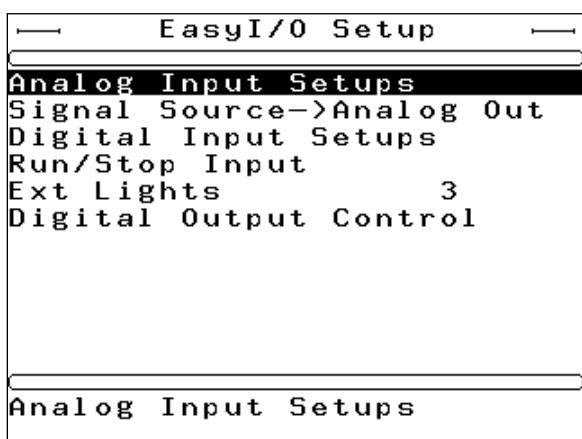
The Legacy Menus provide the experienced user with the same menu structure and parameters as used on the previous generation of Baker Hughes variable speed drives called GCS. If one is familiar with these menus, this may be a more efficient way of configuring a drive.



EASY I/O SETUP

The Easy I/O Setup screens assist the user to configure additional inputs and outputs connected to the Advantage drive. The drive supports several types of expansion modules and their associated data. Use this routine to select the I/O and setup the alarm thresholds, time delays and signal sources and routings. The setup routine can be started via this menu item immediately after completing the EasyStart routine, or by using the menu item from the Features screen.

The following provides a detailed explanation of usage.



Easy I/O Setup

This feature offers a streamlined way to configure the variables required when commissioning input / output sensors connected to the drive. The setup screens for each different type of I/O device are also accessible through their related menus found under the Internal and External Modules screens. Some of those input screens do contain variables, such as time delays, that are not repeated here. Changes performed in either location will take effect immediately.

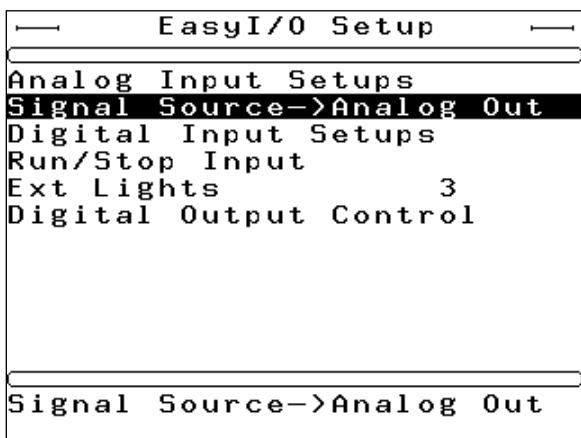
Analog Input Setups This first menu item aids with configuring analog inputs. Press ENTER to proceed to the following screen to select the input.

Select Analog allows the user to select which analog input device to configure. This screen initially opens with the Select Analog variable set to None. With the cursor on this point, press ENTER, then UP or DOWN arrow to scroll through the available input. The screen shown at left depicts Onboard Analog Input 1 as the signal being configured.

These configuration screens are also accessible via the Internal and External Modules menu screens and a detailed explanation of the variables is available there.

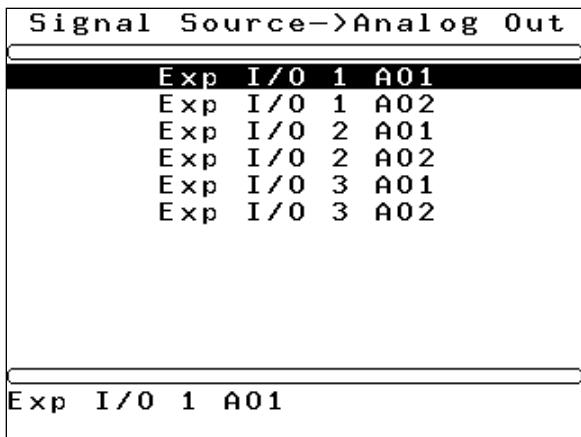
If desired, the selected input parameter can be automatically renamed by moving the cursor to the present value position and pressing ENTER. A screen will appear that allows the user to select one from a list of existing names or create a new one as shown in the graphic.

Rename Parameter This menu screen allows the user to select an existing name or create a new one by selecting "Other". The selected name will be applied to the Analog input previously selected.

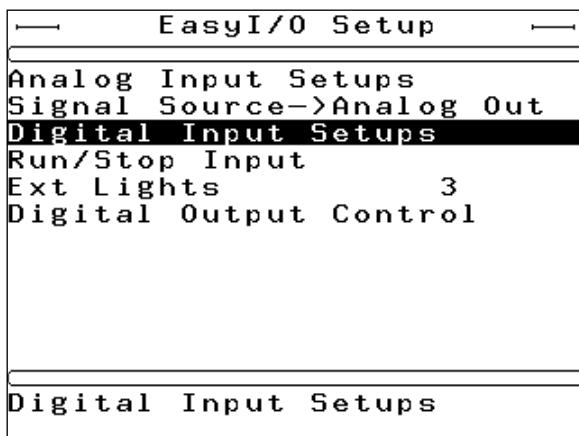


Signal Source -> Analog Out This menu choice configures one of the available analog output signals to generate an analog signal out based upon a user selected analog input signal.

This configuration screen is also accessible via the Internal & External Modules menu screens and a detailed explanation of the variables is available there.



Signal Source-->Analog Out Move the cursor to the required analog output and press enter. The screen will change to the configuration menu for the selected output. Selection of the source for the analog output is configured there. The screen is also accessible via the User Config Func\Analog Output Control screen and further information is found in that portion of this manual.



Digital Input Setups This menu choice will assist the user in configuring digital or status inputs to the drive.

— Digital Input Setups —

Select Digital	DI1
Present State	1
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	1 sec

The diagram shows a digital input logic path. It starts with a '1' at the top left, followed by a horizontal line with a square junction point. From this junction, one branch goes down to a '0' at the bottom left, and the other branch continues straight to a circle containing a question mark at the bottom right.

The Digital Input Setup configuration menu will initially display none in the cursor/selection box. Press ENTER then UP or DOWN arrow to scroll through the available input signals.

These input screens are also accessible via the Main Menu, Internal and External Modules menu screens. A detailed explanation of the variables is available there.

— Digital Input Setups —

Select Digital	DI1
Present State	1
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	1 sec

The diagram shows a digital input logic path. It starts with a '1' at the top left, followed by a horizontal line with a square junction point. From this junction, one branch goes down to a '0' at the bottom left, and the other branch continues straight to a circle containing a question mark at the bottom right.

If desired, the selected input parameter can be automatically renamed by moving the cursor to the present state position and pressing ENTER. A screen will appear that allows the user to select one from a list of existing ones or create a new one as shown in the graphic.

Rename Parameter This menu screen allows the user to select an existing name or create a new one by selecting "Other". The selected name will be applied to the Digital input previously selected.

— Rename Parameter... —

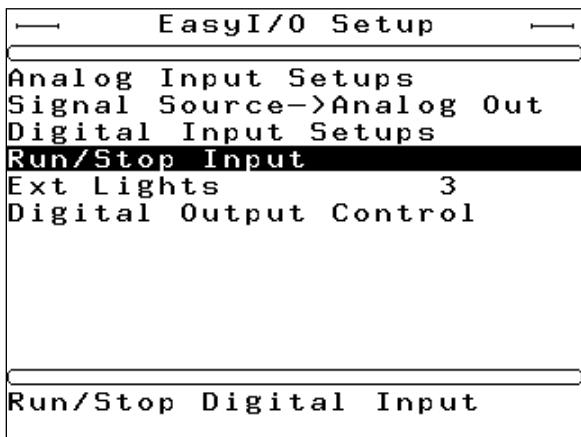
Present Stat	Remote Stop
WH Pres 1 Hi	Remote Stop
WH Pres 2 Hi	Backspin
WH Pres Low	Groundfault
FL Pres 1 Hi	ThrChm Oil
FL Pres 2 Hi	ThrChm Oil
FL Pres Low	ThrChm Vib
Casing Hd Pr	ThrChm Temp
Hi Tank Leve	Intake Pres
Lo Tank Leve	Intake Pres
Run Permissi	Dischg Pres

Hi Tank Level , 97

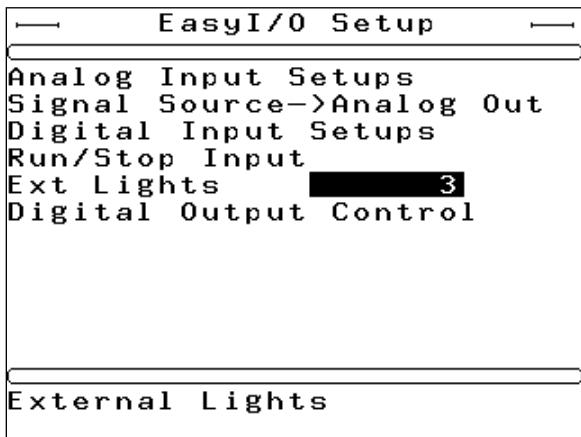
— Digital Input Setups —

Select Digital	DI1
Hi Tank Level	1
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	1 sec

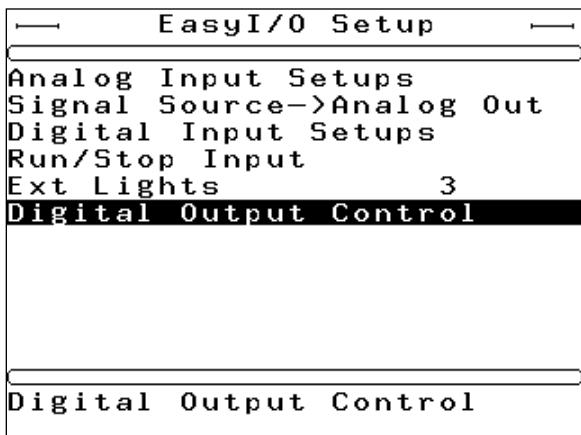
The diagram shows a digital input logic path. It starts with a '1' at the top left, followed by a horizontal line with a square junction point. From this junction, one branch goes down to a '0' at the bottom left, and the other branch continues straight to a circle containing a question mark at the bottom right.



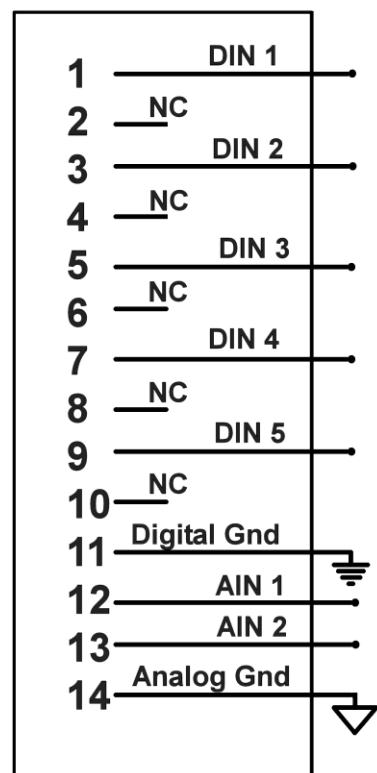
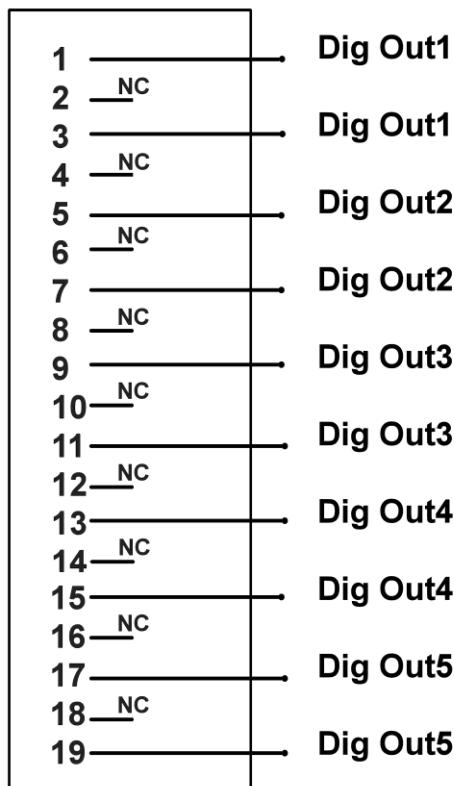
Run /Stop Input allows the user to select any available digital input to act as a permission to run signal to the drive. This menu is also accessible via the Main Menu, SCADA and Security and System, System menu. A thorough explanation of this feature can be found in the manual section pertaining to the System menu.



Ext Lights sets how many external beacon lights the drive will use to annunciate its status. A comprehensive explanation is found in the manual section Main Menu, SCADA and Security and System, System menu.



Digital Output Control is used to configure internal signals or events so that they annunciate their status to available digital outputs on the drive. The explanation for this feature is found under the Main Menu, User Config Funct, Digital Output Control screens.

J2
Digital Inputs

Analog Inputs
J20


Onboard Digital I/O

Onboard Digital Inputs

The Advantage System Base Boards (ASBB) and the Basic System Base Boards (BSBB) provide five status, or digital inputs, defined as a switch closure to ground. Inputs are terminated on J2 of the ASBB or BSBB, on odd numbered pins 1 through 11. These digital inputs are designed to be used with field-installed dry-contact closure switches. These inputs must not have active external voltages applied to the switch contacts attached to the ASBB/BSBB Digital Common or Digital Input terminals. ASBB/BSBB board damage or failure may result if these requirements are not observed. The pin-out definitions are as follows:

Pin 1 = Digital Input 1 (or START push-button switch)

Pin 3 = Digital Input 2 (or Auto-ReStart mode switch)

Pin 5 = Digital Input 3 (or Hand mode switch)

Pin 7 = Digital Input 4

Pin 9 = Digital Input 5

Pin 11 = Digital Common (DGND)

Note: Pins numbered 2, 4, 6, 8 and 10 have no connections.

Onboard Digital Outputs

The ASBB/BSBB provides five digital outputs, the first three of which are usually used to switch external Green, Amber and Red panel lights. The terminations are located on the connector labeled J20 on the ASBB or the BSBB. All five outputs are dry-contact, Normally Open (NO) relay contacts, rated for 10 amps at 250 Volts AC, 30 VDC.

The pin-out definitions for J20 are:

Digital Output 1 = Pin 1 and 3 (green RUN light)

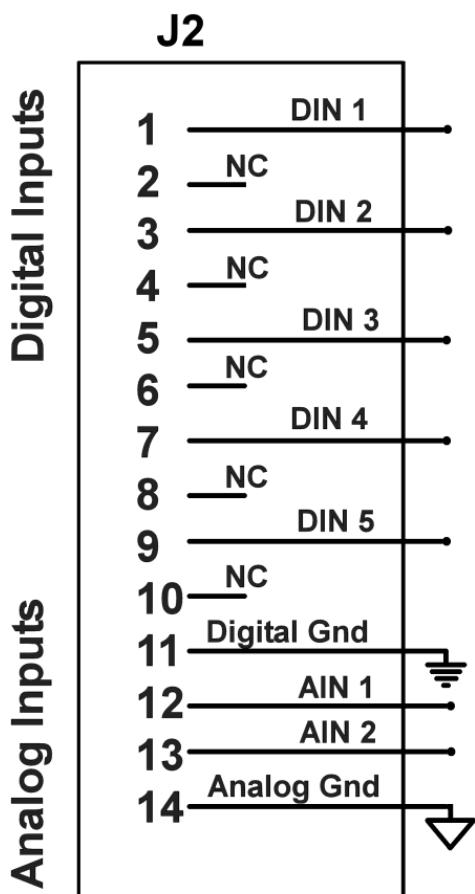
Digital Output 2 = Pin 5 and 7 (amber light)

Digital Output 3 = Pin 9 and 11 (red light)

Digital Output 4 = Pin 13 and 15 (spare output)

Digital Output 5 = Pin 17 and 19 (spare output)

Note: Pins numbered 2, 4, 6, 8, 10, 12, 14, 16 and 18 have no connections.



Onboard Analog Inputs

The ASBB provides for two analog inputs rated for 0-10 VDC terminated on the connector labeled J2 on the ASBB or the BSBB. Interfacing to 4-20 mA signals requires moving the dip switches next to the AI1 and AI2 pins on the J2 connector from the 0-10 V position to the 4-20 mA position on the ASBB or the BSBB. This connects a 500 ohm resistor across the Analog Input and Analog Ground pins for the respective input on the PC board. Calibration of the offset and span parameters on the Internal AI1 or Internal AI2 pages in the Internal & Extern Modules menu on the Onboard I/O selection screen is also required.

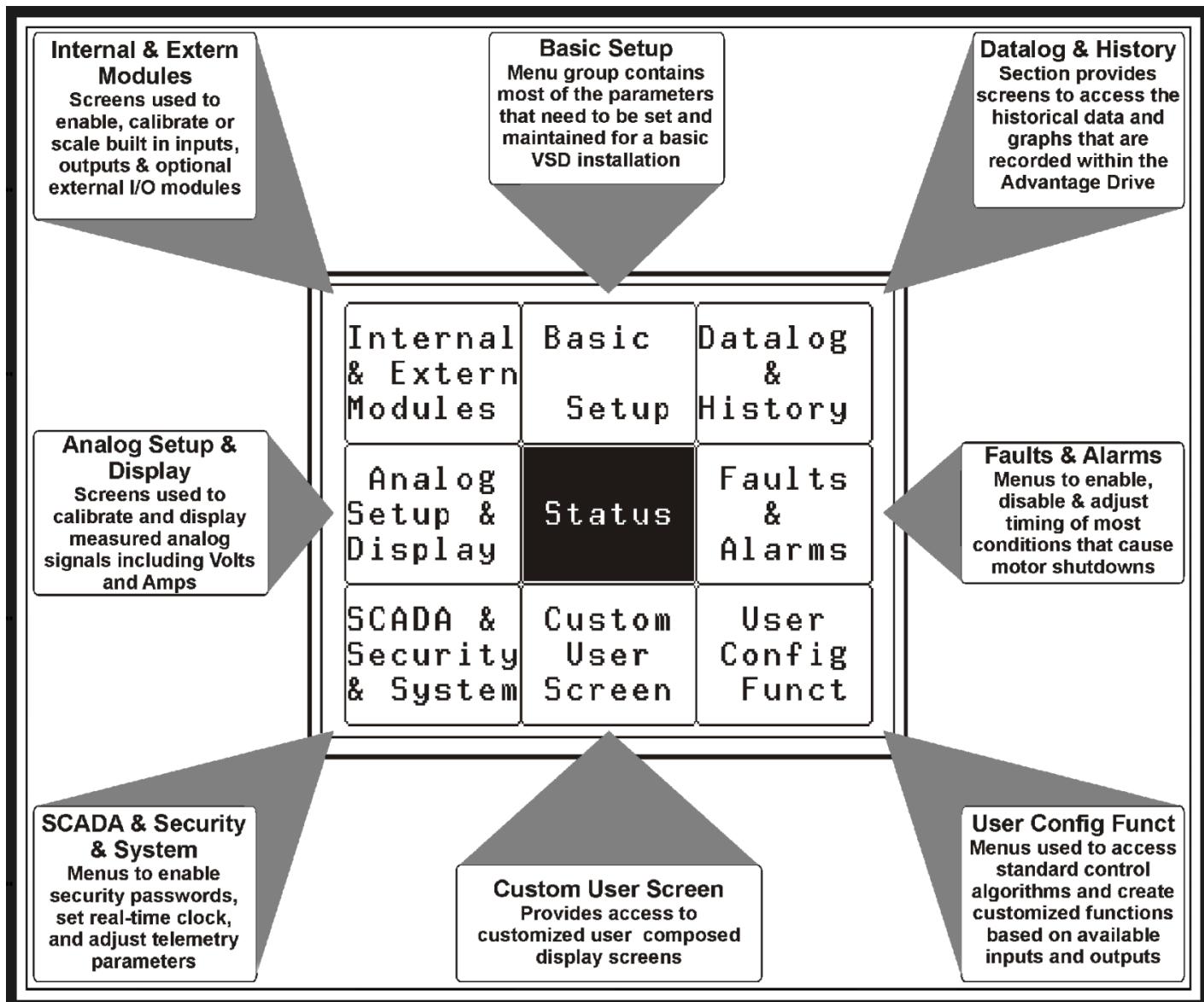
The pin-out definitions are as follows:

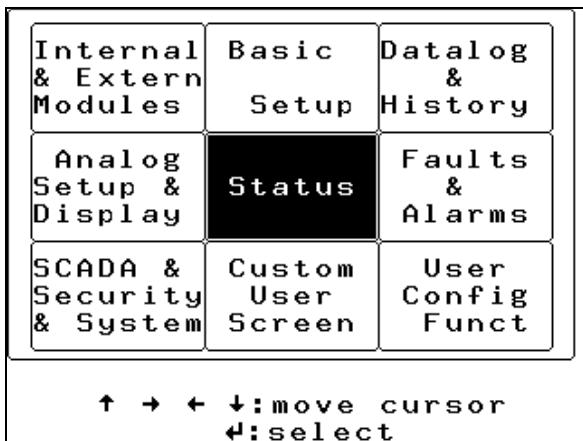
- Pin 12 = Analog Input 1
- Pin 13 = Analog Input 2
- Pin 14 = Analog Common Ground

THE ADVANTAGE DRIVE MENUS

The following section will list and provide explanations of all the menus and parameters that are available to the user. The order in which the parameters are listed is based on starting with the Main Menu screen of the display, as shown below, then proceeding clockwise from Basic Setup around the perimeter. Some of the display screens are too long to fit onto the 11 lines of text available on one screen. For clarity within this manual, some of those screens may be illustrated longer than normal to show all of the parameters available. To locate information pertaining to any specific parameter, use the index at the end of this manual to locate a keyword, and then view the information on the page(s) indicated.

Overview of Menu Structure





Status Screen

The Status screen is the primary operator's display. Access this screen by moving the cursor to the center position as shown and press the ENTER key. From here, the operator can view most of the parameters needed when determining the run status of the drive. From this screen, the user can move the cursor to highlight and edit the Set Frequency, Rotation, Output Mode, access the Amp Cart graph, set the time and scroll through the list of Active Alarms. While the cursor is highlighting an active alarm, pressing the ENTER key will immediately display the active alarm's configuration screen without having to navigate through the menu structure.

Use the right and left arrow keys to access all the available parameters on this screen. Highlight the desired parameter then press the ENTER key to edit it. The available parameters are: Set Frequency, Rotation, Mode, view the Ampchart, or change the Set time. If any active alarm is shown, you can highlight it and press the enter key to navigate directly to its menu.

The motor is running at 58.6 Hz. This will also indicate Stop or Stopping. If acceleration is being limited by Current or Torque demand, it will display ILIM or TLIM.

Output phase rotation = Forward
Speed Control = Frequency Setpoint
The Amp Chart graph is highlighted in reverse graphics in this screen shot and can be accessed by pressing the ENTER key.

The output currents are 52, 50, & 59 amps, output voltage is 461 VAC.

Analog input #1 measures bottom hole pressure.
Analog input #2 measures barrels per day of fluid produced.

The controller is detecting an Underload alarm condition and is waiting for the time delay to expire before it shuts down the motor.

Use the Utility Menu to assign two different parameters to this area of the screen and/or to rename them.

The most recent shutdown (Lst Shtdn) was caused by an Overload Lockout condition on May 14, 2010 at 8:35:53 AM local time.

RUNNING 58.6 Hz

Rot:FWD Mode:Fr Set

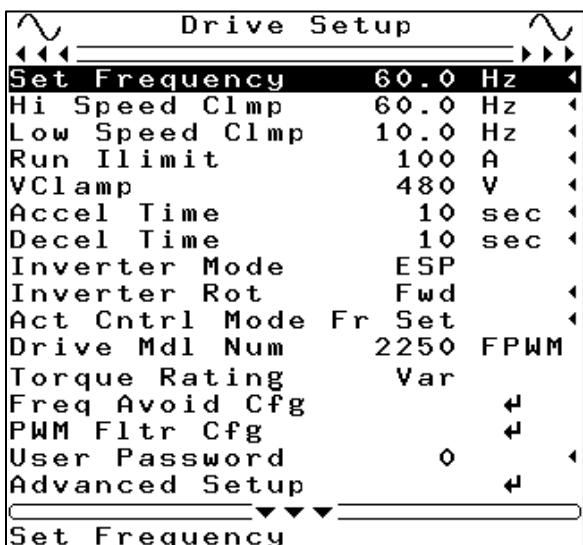
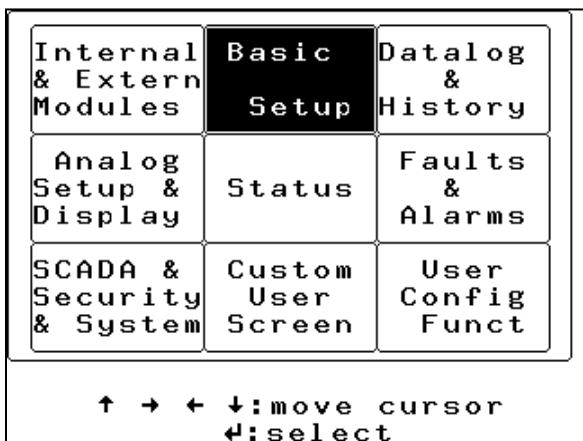
Current: IA IB IC
(Amps) 52 50 59

Volts Out: 461

Bottom Hole PSI 1638 PSIG
Flow Rate 942 bpd

Lst Shtdn 2010 May 14 08:35:53
Ovld Shtdn

Active Alarms Undrlnd Alm



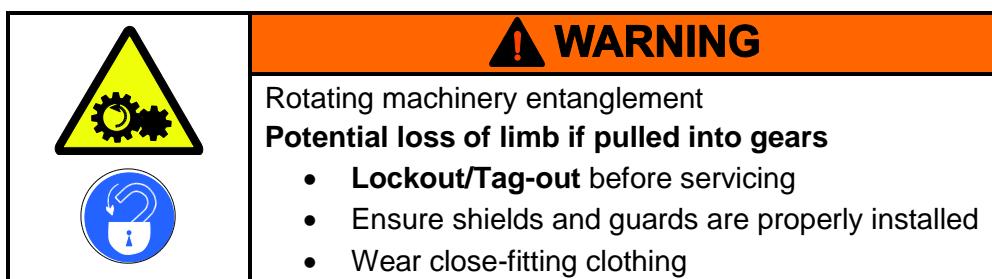
Basic Setup

When the cursor is moved to the top center position of the Main Menu screen, and the ENTER key is pressed, the first of five Advantage drive Setup screens is displayed. These screens gather together most of the parameters needed to start up and run the Advantage drive. To display another screen, press the LEFT or RIGHT arrow-key. To edit any parameter, use the arrow-keys to move the cursor bar over any menu item as shown at left below and press the ENTER key. The display will enter the edit mode and allow changes to the value of that parameter. The five screens available within this group are Drive Setup, Load Setup, Site Setup, Features and Starts. Each is reviewed below.

Drive Setup

Set Frequency Controls the output frequency of the variable speed drive while operating in Frequency Set Point Control mode. The output frequency is adjustable in 0.1 Hertz increments between the Low Speed Clamp and High Speed Clamp set points. Operating speed is also limited by the current limiting set point, Run ILimit and Torque Limit.

High Speed Clamp Sets the maximum frequency at which the Advantage drive is permitted to operate and is programmable between 5 and 120 Hertz or the equivalent rpm if set into the rpm operating mode. **WARNING!** The maximum operating frequency should not be allowed to exceed the maximum operating speed for the equipment operated, as recommended by the manufacturer. Operating rotating equipment above maximum rated speed may result in damage to equipment and injury to personnel.



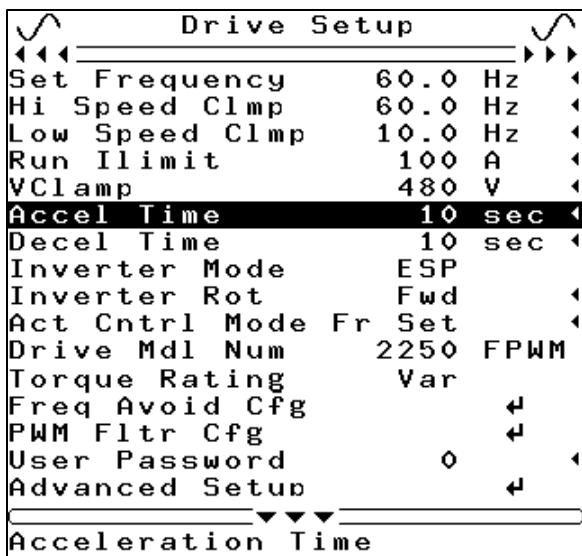
Low Speed Clamp Low Speed Clamp sets the minimum allowed operating frequency, and is programmable from 5 to 120 Hertz or the equivalent rpm values. For submersible motors, the Low Speed Clamp set point should not be set below the speed that provides adequate fluid flow rate past the motor for proper cooling. The flow of cooling air for conventional motors also decreases with speed creating potential cooling problems, especially in constant torque applications where high input currents are needed at low speeds. The minimum operating speed should be based on the motor manufacturer's recommendations.

Drive Setup	
Set Frequency	60.0 Hz
Hi Speed Clmp	60.0 Hz
Low Speed Clmp	10.0 Hz
Run ILimit	100 A
VClamp	480 V
Accel Time	10 sec
Decel Time	10 sec
Inverter Mode	ESP
Inverter Rot	Fwd
Act Cntrl Mode Fr	Set
Drive Mdl Num	2250 FPWM
Torque Rating	Var
Freq Avoid Cfg	↔
PWM Fltr Cfg	↔
User Password	0
Advanced Setup	↔
Run ILimit	

Run ILimit Running Current Limit controls the maximum output current that the drive will deliver to the motor or load during normal operation. Run ILimit is adjustable from 0% to 150% of the drive's output current rating. Run ILimit is in effect during all times except Sync Delay. If the drive is operating in Run ILimit, the output frequency will change within the High Speed Clamp and minimum speed range to maintain the output current at the Run ILimit value.

Run ILimit is frequently used in submersible pump applications to limit the motor input current to its nameplate rating. When gas is ingested into the pump, the load will decrease, allowing for higher frequency operation at the Run ILimit current. The higher speeds will help force the gas on through the pump, at which time the load will increase, and the frequency will drop.

VClamp Voltage Clamp sets the maximum output voltage that will be produced by the drive at any frequency and determines when the drive begins constant horsepower operation. VClamp is adjustable from 100 to 550 VAC. Typical settings would be 480 VAC for 460/480 VAC input or 400 VAC for 380/400 VAC input. The maximum obtainable output voltage in ESP mode will be approximately 5% higher than the input voltage, but cannot exceed 550 VAC.



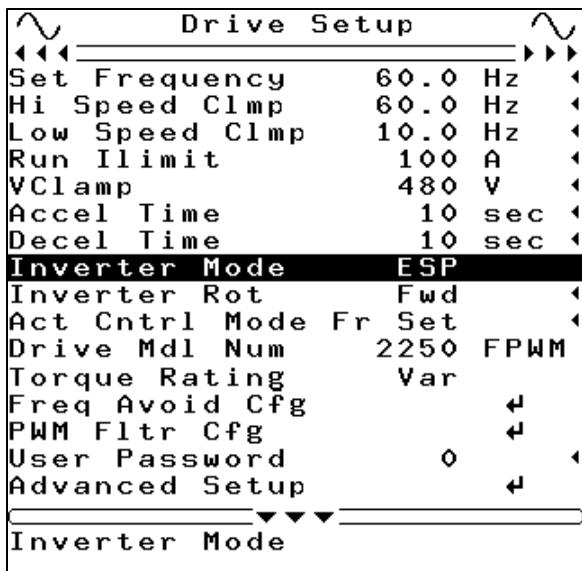
Accel Time Sets the time required for the drive to increase its output frequency by 60 Hertz and is adjustable from 2 to 200 seconds. Acceleration does not commence until the sync delay has expired. To determine actual rate (Hertz/sec), divide 60 by the set time in seconds. The motor acceleration will be limited by this setting if the drive is allowed to provide sufficient current to maintain the rate. Otherwise, the acceleration rate will be limited by available current (ILimit). When operating in the proportional/integral/derivative (PID) control mode, the Accel Time should be set to the minimum value, 2 seconds, to allow the response of the drive to be regulated by the PID control algorithm.

Decel Time Deceleration Time sets the time required for the drive to reduce its output frequency by 60 Hertz and is adjustable from 2 to 200 seconds. To determine the actual rate (Hertz/sec), divide 60 by the set time in seconds. If the drive is operating a high inertia load, the deceleration rate may be limited by the inertia of the motor and load. Under these conditions, the deceleration rate will follow the coast time of the motor. When operating in the PID control mode, the Decel Time should be set to the minimum value, 2 seconds, to allow the response of the drive to be regulated by the PID control algorithm.

Inverter Mode Sets the type of output wave form that will be produced by the Advantage drive. There are three possible inverter output modes:

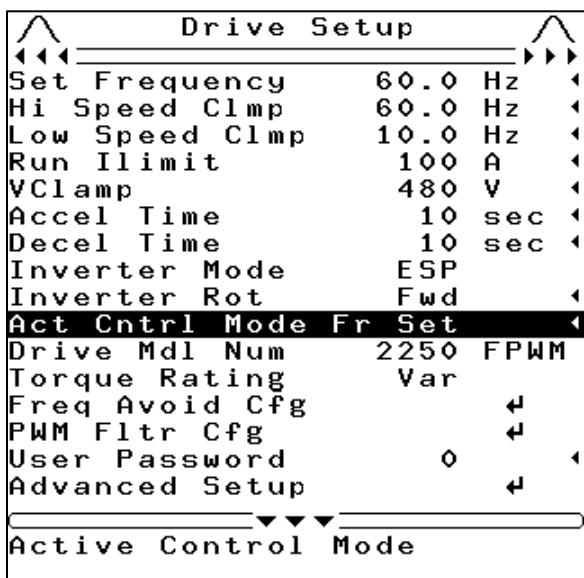
ESP The ESP mode produces a pseudo-sinusoidal wave form that has six voltage transitions (6-step output) in the recreated output signal.

HYB Hybrid PWM creates a variable voltage, pulse width modulated output wave form that can be useful in some applications to reduce the current harmonics to the motor. Hybrid PWM can also reduce peak cable voltage-stresses under some conditions.



NOTICE

When HYB or PWM output will be used with submersible pumps it is necessary to use a PWM output filter to prevent damage to connected equipment. Refer to the PWM Filter configuration section of this manual for additional information.



PWM PWM mode is a standard, full bus voltage, pulse width modulated wave form. This output has its best applications in surface motors where a step-up transformer is not used and the power cable from the drive to the motor is relatively short.

Inverter Rotation Controls the direction of output phase rotation of the drive. The choices are FWD (forward) and REV (reverse). This rotation is defined by the phase rotation sequence of the three output voltages or currents, ABC (forward) or CBA (reverse).

Act Cntrl Mode Active Control Mode selects which type of control algorithm will govern the output of the drive. There are multiple modes available:

FR SET Frequency Set point mode causes the Electrospeed Advantage drive to attempt to operate at the user programmed Set Frequency, accessed in the Drive Setup menu group. Note that several factors may affect the drive's ability to achieve this frequency, including ILimit, High Speed Clamp and Low Speed Clamp.

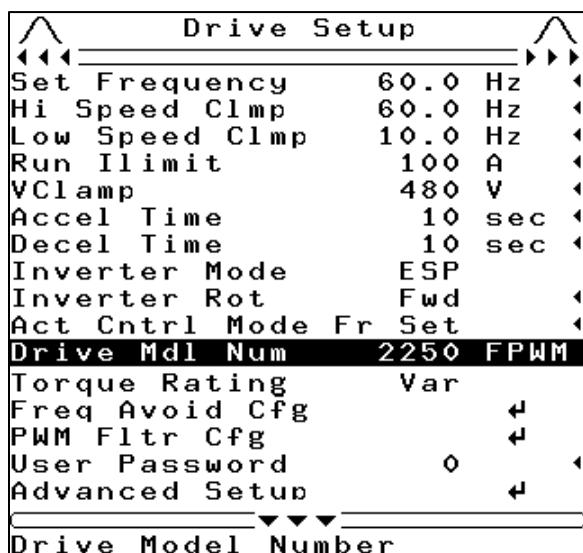
AN FOL In Analog Follower mode, the drive will attempt to vary its output frequency between the Low Speed Clamp and High Speed Clamp in proportion to 0% to 100% of the analog input signal selected. The parameters affecting this control method are found in the Prog Logic Funct menu group.

PID In PID mode, the drive will attempt to vary its output frequency in order to maintain a given analog input signal. The parameters affecting this closed loop control algorithm are found in the Prog Logic Funct menu group.

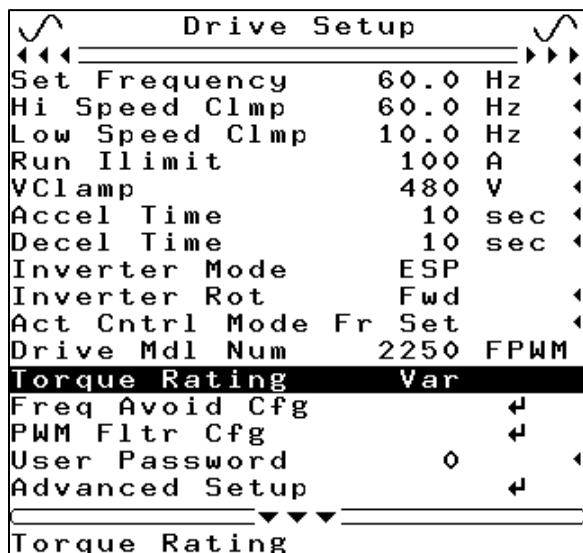
MAXPnt (Maximum Point™) This frequency control mode is used to cause the Advantage drive to automatically adjust or sweep its output power frequency up or down within the High Speed and Low Speed Clamps settings, in steps of 0.1 to 15.0 Hertz over a period of time from 1 minute to 96 hours. At the end of the programmed frequency change, the Advantage drive will automatically revert to its Frequency Set point mode. It will then

maintain the output at the last achieved frequency. The parameters affecting this control method are found in the User Config Funct menu on the Output Frequency Control selection.

GasCtl (MaxRate™ Gas Mitigation Software) This optional, software based control mode is used to minimize pump-off and gas locking issues in wells with variable gas content. The parameters affecting this control method are found in the User Config Funct menu on the Output Frequency Control selection.



Drive Mdl Num Drive Model Number displays the model number of the drive. The base model number for each Advantage drive is stored in memory on the System Control Board, along with upper and lower limits for parameters affected by the ratings of the drive. Every time the drive is powered on, it will retrieve the model number and associated limits from memory. This model number should agree with the model number stamped onto the nameplate riveted onto the outside of the drive enclosure. If the drive has been configured to produce a Filtered PWM output, the Drive Model Number parameter will also include the indicator FPWM as shown in the next graphic below. When so configured, an additional menu selection used to configure the PWM filter control algorithm will appear below the model number.



Torque Rating Torque Rating indicates the type of output torque that the drive will produce: either CT (constant torque) or VT (variable torque). The basic Advantage drive models are set up for variable torque loads. Contact Baker Hughes personnel to convert to a constant torque setting. This will de-rate the output current and KVA ratings by 20%, but the overload and start currents will remain the same.

Freq Avoid Cfg Frequency Avoidance Configuration provides access to a user programmable table of five output frequencies at which the drive is not permitted to operate. Press the ENTER button while highlighting this menu item to access the table of values.

Freq Avoidance			
Frequency Dedbnd			
1	9.5	1.0	Hz
2	0.0	0.5	Hz
3	0.0	0.5	Hz
4	0.0	0.5	Hz
5	0.0	0.5	Hz

Frequency

Freq Avoidance This table allows the user to specify five individual frequencies that the drive will not produce. Each frequency entered has an associated dead band value. This dead band value instructs the drive as to how close to the disallowed output frequency it can run. As illustrated at left, the first frequency to avoid has been set to 9.5 Hertz with a dead band of 1.0 Hertz. This means that the Advantage drive will not allow steady state operation within the range of 8.5 to 10.5 Hertz. The drive will produce those frequencies only while it is ramping its output from one side of the prohibited range to the other side. These settings can be used to prevent unwanted vibrations that may be generated as a result of equipment resonance at specific frequencies.

Drive Setup	
Set Frequency	60.0 Hz
Hi Speed Clmp	60.0 Hz
Low Speed Clmp	10.0 Hz
Run Ilimit	100 A
VClamp	480 V
Accel Time	10 sec
Decel Time	10 sec
Inverter Mode	ESP
Inverter Rot	Fwd
Act Cntrl Mode Fr	Set
Drive Mdl Num	2250 FPWM
Torque Rating	Var
Freq Avoid Cfg	↔
PWM Fltr Cfg	↔
User Password	0
Advanced Setup	↔
PWM Fltr Cfg	

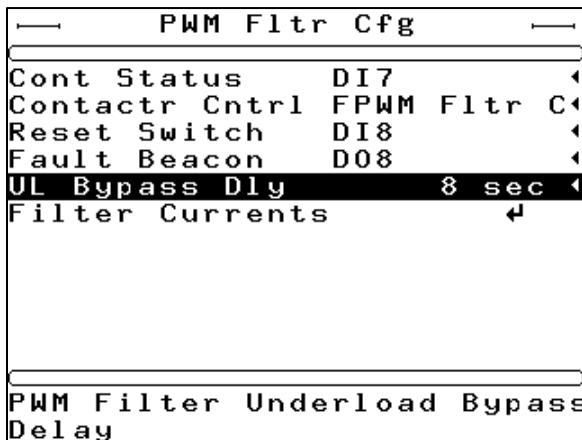
Pwm Fltr Cfg

When utilizing an Advantage filtered PWM (FPWM™) drive model, this additional "PWM Filter Configuration" menu will appear. It allows the user to configure the interface between the Advantage drive and the PWM Filter controller. This PWM filter controller monitors the status of the filter, and if a malfunction occurs, signals the Advantage drive to switch over to operate in the ESP mode. On submersible pumping systems, this can be very important since unfiltered PWM drives can produce very high voltage transient signals that can damage or destroy downhole motors and cables in a short period of time. An Advantage drive not configured as an FPWM model can still operate in PWM output mode by changing the Inverter Mode parameter to PWM. When used on submersible systems, it is the user responsibility to properly connect and configure an output filter suitable for the load ratings to prevent damage to the motor or cable.

PWM Fltr Cfg	
Cont Status	DI7
Contactr Cntrl	FPWM Fltr C
Reset Switch	DI8
Fault Beacon	D08
UL Bypass Dly	8 sec
Filter Currents	↔
PWM Filter Contactor Status	

Cont Status This input to the drive represents the filter's contactor status. When the filter contactor is open, the filter is disengaged and the Advantage LV drive will switch to the ESP mode of operation.

Contactor Cntrl The PWM filter controller uses an output from the drive to control whether the input filter is engaged. This causes the filter algorithm to begin monitoring for an underload condition that can happen if any two phases of filter capacitors have failed. Since the motor draws a small load at start

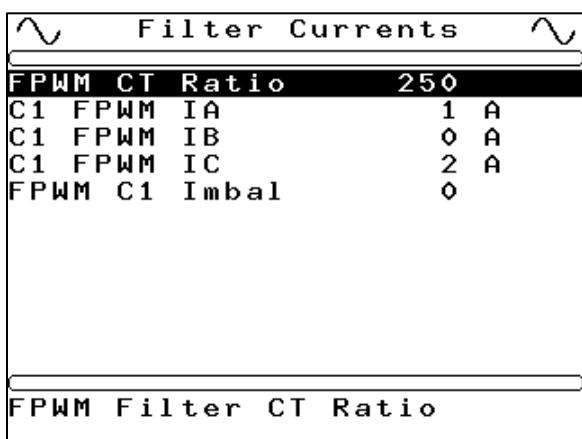


up, it can appear that an underload is occurring. For this reason, the controller incorporates an underload bypass delay, explained below.

Reset Switch When a filter problem has occurred, the drive will operate in ESP (6-step) mode until the filter is repaired. Once the filter is repaired, activate this input signal and it will cause the drive to begin operation in PWM mode once again.

Fault Beacon The fault beacon output is used for connecting and controlling an output beacon indicator used to signal that the PWM filter has experienced a fault and must be attended to.

UL Bypass Dly This user set parameter controls the length of time that the controller ignores an underload condition in the PWM filter immediately after a start up.



Filter Currents This menu item accesses the current signal inputs used by the drive to determine if the PWM filter is operating properly. Move the cursor to this menu item and press ENTER to enter the display screen shown next.

Filter Currents

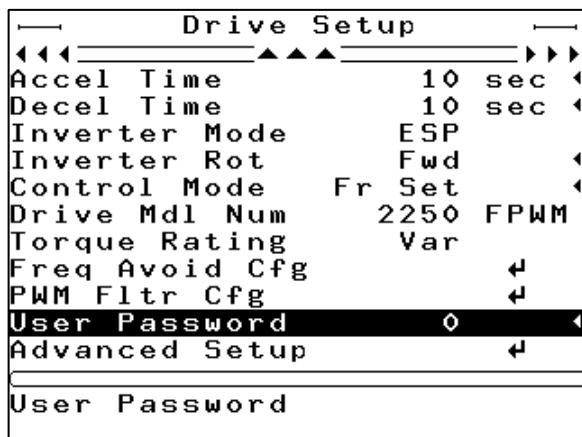
FPWM CT Ratio This parameter represents the current transformer ratio used to measure current in the PWM filter.

C1 FPWM IA

C1 FPWM IB

C1 FPWM IC These three parameters show the amount of current to each of the three delta wired capacitors in the filter.

FPWM C1 Imbal This parameter shows the present current imbalance in percentage.



User Password This parameter permits entry of the operator's password. When system security has been enabled, the operator must enter the correct password in this location before being allowed to modify any other set points or parameters. Read the **System Security** section for more information about working with security passwords.

Advanced Setup

This menu provides access to a number of the legacy parameters that were used to optimize motor starting.

The Advantage system is designed to automate many of the requirements necessary to achieve maximum starting torque and these parameters should not be required except under unusual or extreme situations/

Advanced Setup	
VBoost Sync	0 V
VBoost	0 V
Sync Ilimit	308 A
Sync Frequency	12.0 Hz
Sync Delay	6 sec

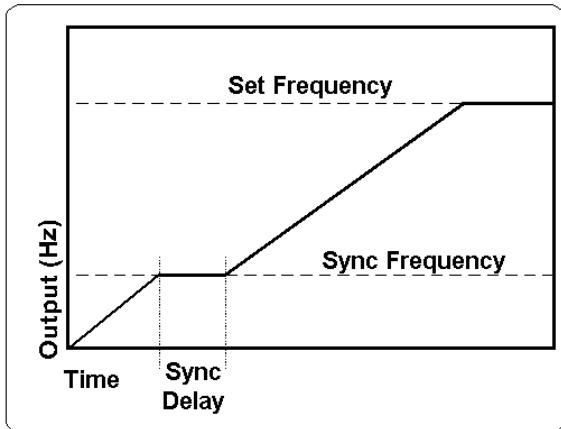
VBoost Sync

VBoost Sync Voltage Boost during Synchronization Delay controls the amount of voltage increase added to the base voltage at the starting frequency. VBoost Sync performs the same basic function as VBoost, but is present only during starting to properly compensate for the higher voltage drop in the cable associated with starting currents. VBoost Sync should be set to zero for the initial startup, and increased only if difficulties in starting are encountered. The output current should be monitored during the initial start attempts to determine the maximum output current delivered in the event the start is unsuccessful. The output current not reaching the ILimit Sync value is an indication that increasing VBoost Sync could increase output current. VBoost Sync is adjustable from 0 to 200 VAC.

VBoost Voltage Boost controls the amount of offset voltage added to the zero-speed voltage level which is otherwise zero volts. At low frequencies it is sometimes desirable to increase the output voltage above the normal base voltage since the resistive portion of the motor impedance becomes more significant when compared to the reactive portion. This can limit the motor excitation current, reducing available torque at low speeds. By adding VBoost, low speed performance can be improved and it can also compensate for the effect of output cable and/or transformer voltage drop, which will also be more pronounced at low frequencies. The volts-per-hertz ratio is then automatically adjusted to decrease the effect of VBoost linearly with speed so that at maximum speed the effect is zero. VBoost is not active during Sync Delay. Initial setup should typically be done without any VBoost, and should then be increased if and when necessary.

Generally, VBoost is not used with variable torque loads, since the motor load decreases so dramatically with speed. The effective decrease in voltage that is experienced may even improve the efficiency of the underloaded motor. Constant torque loads, however, require full torque even at low speeds, making the use of VBoost necessary in those applications. One way to determine the proper amount of voltage boost in a constant torque application would be to operate the controller at minimum speed, and adjust VBoost up or down to obtain minimum current.

Sync ILimit Synchronization Time Delay Current Limit sets the maximum output current produced during Sync Delay, and is adjustable from 0% to 150% of the drive's output current rating. A good initial setting for Sync ILimit would be 150% of motor nameplate current. If an output transformer is used, as with submersible pumps, set this parameter to 150% of the motor current multiplied by the transformer ratio (output voltage divided by input voltage).



Sync Frequency Synchronization Frequency sets the output frequency in Hertz that the drive will use to start the motor. As illustrated at left, when the system is started, the drive will ramp up to the set Sync Frequency. The output will be held at the Sync Frequency for a period of time referred to as Sync Delay. The Sync Delay time allows the motor to accelerate to the starting frequency. At the end of the Sync Delay time, the drive will accelerate the motor to the preset operating frequency. The Sync Frequency should be set as low as practical for the application. Typical settings would be 10 to 12 Hertz for submersible motors and 3 to 5 Hertz for surface motors. The available motor starting torque is directly proportional to the square of the starting current, and inversely proportional to the starting frequency. This shows the first criterion for successful starting is to be able to deliver the maximum current available to the motor, and the second criterion is to start at the lowest possible frequency.

Sync Delay Synchronization Time Delay sets the amount of time in seconds that the drive will allow for the motor to accelerate to the starting speed

established by Sync Frequency. Sync Delay is adjustable from 0 to 60 seconds. Typical settings for submersible installations would be 2 to 5 seconds. Surface motors require more time due to higher inertia and are typically set at 5 to 10 seconds. At the end of Sync Delay, the drive will accelerate the motor at the Accel Time rate, or follow the motor's acceleration limited by Run ILimit to the set frequency. If Sync Delay is too short, the motor may not start. If this happens, the drive will typically shut down in overload. As additional protection, the Electrospeed Advantage drive will shut down on a Low Speed trip if it is operating in Run ILimit, below Low Speed Clamp, and the output frequency is not increasing. This provides a positive means for detecting a stalled motor.

Load Setup

The parameters on the Load Setup page allow the drive to calculate the necessary parameters so as to operate in the Torque Control mode. In this mode, the drive continually calculates actual developed motor torque and shaft rpm based on the parameters set by the operator and will display these values as well as the pump shaft torque and rpm if different. Additionally, it will limit the output frequency, voltage and current based on either the ILimit setting (Advantage drive Setup screen) or TLimit (Torque Limit) depending on which it encounters first. The items on this screen are described below.

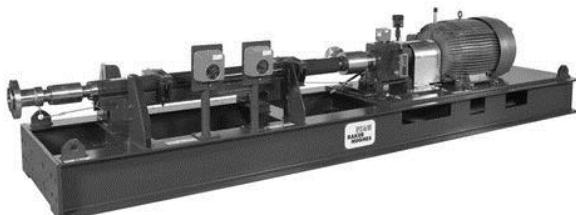
Load Setup		
Motor RPM	3503	RPM
Motor Torque	62	%
Pump RPM	3504	RPM
Pump Torque	434	lbft
Torque Limit	150	%
Mtr Nmplt Cur	71	A
Motor Mag Cur	21	A
Rated Mtr Volt	120	V
Rated Mtr HP	30	hp
Mtr Rated RPM	3450	
Rated Motor Tr	700	lbft
Num Of Mtr Pls	2	
Gear Ratio	1.00	
Speed In RPM	No	
Motor Revolutions Per Minute		

Motor RPM Actual motor shaft rpm. This item cannot be edited.

Motor Torque Actual developed motor shaft torque as a percentage of maximum total rated Motor Torque. This item cannot be edited. The rated Motor Torque is a user entered value further down this same screen.

Pump RPM Pump Shaft rpm. This number is calculated based on the Gear Ratio set as another parameter on this screen. If the Gear Ratio is 1:1, this rpm will equal the Motor rpm. This item cannot be edited.

Load Setup	
Motor RPM	0 RPM
Motor Torque	0 %
Pump RPM	0 RPM
Pump Torque	0 lbft
Torque Limit	150 %
Mtr Nmplt Cur	313 A
Motor Mag Cur	125 A
Rated Mtr Volt	480 V
Rated Mtr HP	279 hp
Motor Parms @	60 Hz
Motor Rated RP	3470 RPM
Motor Eff.	85 %
Rated Motor Tr	497 lbft
Num Of Mtr Pls	2
Gear Ratio	1.00
Speed In RPM	No
Torque Limit	



Pump Torque Pump Shaft Torque is a calculated value dependent on the Gear Ratio and may or may not be different than the Motor Torque. This item cannot be edited.

Torque Limit This is the limiting torque percentage allowed by the drive. Its range is from 0% to 150% and is a dominant limit similar to ILimit. In other words, this limit will take precedence over all other operating parameters and will not be exceeded. The drive continuously compares the actual torque with the Torque Limit setting and the actual output current with the ILimit setting. Once either limit is reached, the drive will adjust the output voltage and frequency as necessary so as not to exceed the limits.

Mtr Nmplt Cur Motor Nameplate Current. This parameter should be set to the current drawn when the motor is operating at rated load, speed, and voltage. This value is usually referred to as the rated motor nameplate current. If the drive is connected to an output transformer, the actual drive or panel current can be different than the motor current. However, in every case, this parameter must hold the actual rated motor current.

Motor Mag Cur Motor Magnetizing Current. This parameter is the expected no load current of the motor. The factory default is 30% of the drive rating. The actual value of Motor Magnetizing Current used can be determined from the motor manufacturer specifications, or measured with the motor shaft decoupled from the load. If either of these options is not available, using 40% (40%=ESP, 25%=Surface Motor/HPS) of the Motor Nameplate Current entered in the previous setpoint will yield approximately correct torque and rpm values. In the example screen at left, the Motor Nameplate Current is 313 amps and the magnetization current

NOTICE

This software can be used without torque control parameters. However, to do this, the Motor Nameplate, Current and the Motor Magnetizing Current must be set correctly and the Torque Limit must be set to Maximum.

is set to 40% of 313 amps which equals 125 amps.

Rated Mtr Volt Rated Motor Voltage. The rated motor voltage should be set to match the nameplate data.

Rated Motor HP Rated Motor Horsepower is the Motor Nameplate rated horsepower.

Mtr Rated RPM Motor Rated rpm. This number is determined directly from the motor nameplate and represents the maximum motor revolutions per minute.

NOTICE

Number of motor poles and gear ratio **must be set before** the speed in rpm parameter is set to YES.

Rated Motor Tr Rated Motor Torque. The value in this parameter is calculated by the Advantage using the previously entered motor horsepower and rated RPM. Available torque, in lb/ft, is derived from the equation shown at left.

$$\text{Torque (ft-lb)} = (\text{HP} \times 5252) / \text{Rated RPM}$$

Num Of Mtr PIs Number of motor poles. The user should set this parameter to 2, 4 or 6 depending on the manufacturer's information found on the motor nameplate.

Gear Ratio Gear (or pulley) reducer ratio. In some installations, a gear box is used to reduce the motor speed into a lower rpm for the pump. The default value of 1.00 indicates that no speed reduction is used.

Speed in RPM When this parameter is set to YES, all speed control settings will subsequently be made and displayed in Pump rpm. This includes High/Low Speed Clamp and Set Frequency (rpm). The ratio of Pump rpm to Motor rpm is controlled by the two parameters: number of Motor Poles and Gear Ratio.

Expressed mathematically, the ratio is represented by the equation shown below.

$$\text{Pump RPM} = \left(\frac{\text{PowerFrequency} \times 120}{\# \text{ of Motor Poles}} \right) \div \text{GearRatio}$$

Load Setup		
Motor RPM	0	RPM
Motor Torque	0	%
Pump RPM	0	RPM
Pump Torque	0	lb ft
Torque Limit	150	%
Mtr Nmplt Cur	313	A
Motor Mag Cur	125	A
Rated Mtr Volt	480	V
Rated Mtr HP	279	hp
Motor Parms @	60	Hz
Motor Rated RP	3470	RPM
Motor Eff.	85	%
Rated Motor Tr	497	lb ft
Num Of Mtr PIs	2	
Gear Ratio	1.00	
Speed In RPM	No	
<hr/>		
Speed In RPM		

Site Setup		
Units	Imp	
App Type	ESP	
Pwr Sys Volts	480 V	
Mtr Cbl Sz	#2 Flt	
Cable Length	5280 ft	
Well Temp	150 °F	
Cbl V Drop per	45	
SUT Rated Vlts	480 V	
SUT Voltage @	60 Hz	
SUT Saturation	30 %	
Calc Xfmr Tap	4401	
Units of Measure		

Site Setup

The site setup screen holds information pertaining to the equipment installed at this location. This data is used by the drive to configure some of its protection settings.

Units The Units selection indicates whether measurements are displayed in imperial or metric units.

App Type The Application Type variable determines the type of equipment installed, either an ESP (electric submersible pump) or an HPS (horizontal pumping system)

Pwr Sys Volts The Power System Volts parameter displays the nominal voltage level applied to the power terminals of the drive.

Mtr Cbl Sz This variable represents the downhole power cable size in standard gauge classifications, and whether the cable is a flat or round style.

Cable Length The cable length parameter holds the value of installed cable length.

Well Temp The downhole or reservoir temperature is user set into this parameter.

Cbl V Drop per This parameter holds the value of the downhole cable's voltage drop per thousand feet. This value is determined by the motor cable size setting and is used to calculate the voltage required at the surface to produce rated motor voltage at the end of the cable.

SUT Rated Volts The input voltage rating of the step-up transformer, which is usually connected to the drive's output terminals.

SUT Voltage @ This variable represents frequency specification of the step-up transformer. The frequency rating of the transformer affects the selection of transformer taps.

SUT Saturation This variable is set to the voltage level, in percentage of full rated voltage, that the step up transformer can accept and function normally. When the applied voltage exceeds

Site Setup		
Units	Imp	
App Type	ESP	
Pwr Sys Volts	480 V	
Mtr Cbl Sz	#2 Flt	
Cable Length	5280 ft	
Well Temp	150 °F	
Cbl V Drop per	45	
SUT Rated Vlts	480 V	
SUT Voltage @	60 Hz	
SUT Saturation	30 %	
Calc Xfmr Tap	4401	
Cable Voltage Drop per 1000 ft		

Site Setup	
Pwr Sys Volts	480 V
Mtr Cbl Sz	#2 Flt
Cable Length	5280 ft
Well Temp	150 °F
Cbl V Drop per	45
SUT Rated Vlts	480 V
SUT Voltage @	60 Hz
SUT Saturation	30 %
Calc Xfmr Tap	4401
Act Xfmr Tap	4400
Input Filter Setup	
Calculated Transformer Tap	

transformer rating plus saturation voltage, (130% in this example) additional input voltage will not produce additional output voltage. The Advantage drive calculates this voltage level and if exceeded, triggers an algorithm that reduces its output voltage to keep it within limits. When this function is active, the system will display "XLIM" at the top of the STATUS screen to indicate that the system is limiting the output voltage. This parameter is normally restricted to field service access.

Calc Xfmr Tap This value represents the ideal voltage tap value of the step-up transformer. This number is calculated by the Advantage drive based on the other user entered settings. Since the ideal tap setting may not exist, the user should select the transformer tap closest to the suggested level.

Act Xfmr Tap The calculated tap may not always be available on the tap selectors of the transformer. This variable allows the user to tell the Advantage which tap setting was actually selected on site.

Input Filter Setup

This menu provides access to the screens used to configure the optional input filter, called the Electrospeed Input Electrical Filter.

Input Filter Control Algorithm

The input filter provides harmonic filtering to the Drive input to reduce the total harmonic distortion to a low level. When the Drive is started and the output currents start to increase, the control software will read all three output currents and calculate the average. When the average current exceeds a user preset high threshold, a user defined digital output relay will engage the input harmonic filter. (Note: one unused form C relay must be reserved for this function) The filter will stay engaged until the Drive is stopped or if the average output current drops to a value below the preset low threshold.

Site Setup	
Pwr Sys Volts	480 V
Mtr Cbl Sz	#2 Flt
Cable Length	5280 ft
Well Temp	150 °F
Cbl V Drop per	45
SUT Rated Vlts	480 V
SUT Voltage @	60 Hz
SUT Saturation	30 %
Calc Xfmr Tap	4401
Act Xfmr Tap	4400
Input Filter Setup	
Input Filter Setup	

Input Filter Setup	
Filter Cntl En	No
Hi Threshold	30 %
Lo Threshold	20 %
Contactor Src	X1 D01 PV
Contactor Stat	Open
Start Byp Dly	0 sec
Avg Drive Amps	0 A
Input Filter Control Enable	

Filter Cntl En This parameter controls whether the input filter is enabled or disabled. Set it to "YES" to enable the filter.

Input Filter Setup			
Filter Cntl En	No		
Hi Threshold	30	%	
Lo Threshold	20	%	
Contactor Src	X1	D01	PV
Contactor Stat	Open		
Start Byp Dly	0	sec	
Avg Drive Amps	0	A	

Input Filter Contactor
Source

Hi Threshold The high threshold is user set and represents the level of current, in percentage of full scale, at which the filter will be engaged. The value can range from 25% up to 35%

Lo Threshold The low threshold is user set and represents the level of current, in percentage of full scale, at which the filter will be disengaged. The value can range from 15% up to 25%

Contactor Src This variable controls which output is used to control the input filter's contactor. It can be user set to any status relay output available in the local system. The illustrations shows the selected output is on Expansion Input/Ouput Module One, Digital Output One and follows the present value (PV), either open or closed.

Contactor Stat This parameter displays the present state of the input filter contactor. When the status shows "open" the input filter is disengaged.

Start Byp Dly The Start Bypass Delay can be set in seconds, and will keep the filter contactor disabled for that amount of time at startup. This prevents the filter from prematurely engaging in some horizontal applications.

Avg Drive Amps This variable displays the present average value of output current

Features	
Single Phase Vo	No
Current Sharing	No
Backspin Detect	No
Backspin Start	No
MaxStart Enable	No
RideThru Enable	No

Single Phase Volts

Features

The Features page contains a list of the available software algorithms that can be enabled and utilized..

Single Phase Volts This parameter configures the Electrospeed Advantage series drive to operate from a single phase source of input power as opposed to the usual three phase source. Set this parameter to yes if the incoming voltage to the drive is single phase. The single input power phase wire should be connected to L1 and the Neutral connected on L2 of the input terminals. The input voltage monitoring alarms are reconfigured to monitor the single phase of voltage only, and the Voltage Unbalance alarm must be disabled. The three phase power output of the drive is de-rated by two thirds (66.7%) to reflect the lower input power available. This configuration can be very useful to drive small three phase motors when only single phase power is present.

Features	
Single Phase Vo	No
Current Sharing	No
Backspin Detect	No
Backspin Start	No
MaxStart Enable	No
RideThru Enable	No

Current Sharing

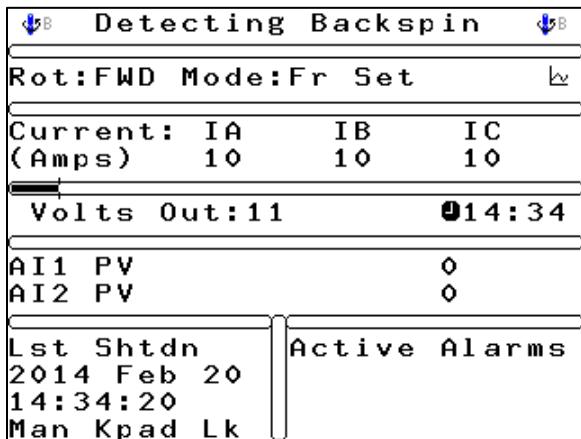
Current Sharing This feature is used to enable or disable the current sharing mode on dual/multiple converter variable speed drives. When this feature is enabled, the drive will force all available converter sections to equally divide the total current between sections. This function works in both ESP and PWM mode.

Features	
Single Phase Vo	No
Current Sharing	No
Backspin Detect	No
Backspin Start	No
MaxStart Enable	No
RideThru Enable	No

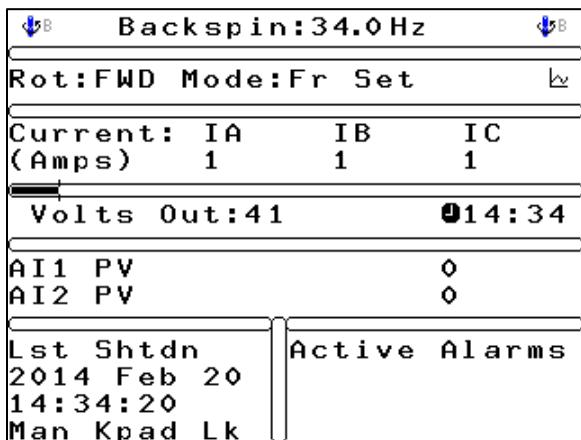
Backspin Detect

Backspin Detect When this feature is enabled, it begins to operate when the START key is pressed or a start command is issued.

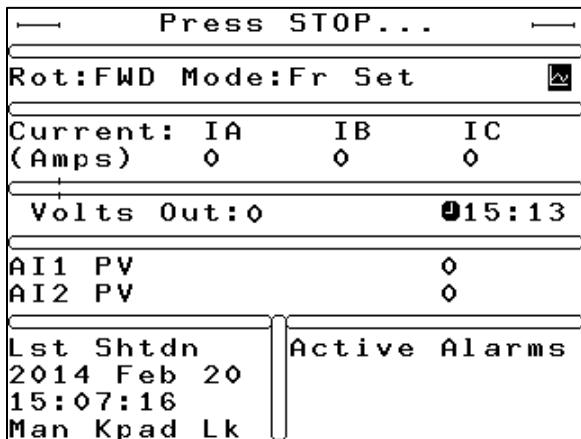
The backspin detect algorithm works by sweeping the drive's output frequency from 60 Hz to 5 Hz while maintaining a small but constant flux on the stator. While sweeping, if the produced frequency is higher than the backspin frequency, then drive will be driving energy into the system. When the swept frequency is below the backspin frequency, the motor will be driving energy into the drive. The Advantage's output control system operates as a bus follower, therefore, as soon as the swept frequency goes below the backspin frequency, the control system will slave to the backspin frequency, follow the coasting motor and display the backspin frequency as it decelerates to a stop.



While the algorithm is working to detect the presence of a backspin condition, the drive will display a message and icons on the top line of the main screen as shown in the screen shown at left.



When a backspin condition is detected, the screen will display the current spinning frequency. This backspin frequency will tend to decrease over time as the fluid in the production pipe drains back into the reservoir. However, if the frequency does not change even after a long delay, there could be other circumstances at play. For example, if the well is being back fed from a common production manifold, it can appear to be back spinning indefinitely.



When the backspin condition has ended, the screen will display the message “Press Stop...” as illustrated in the screen capture graphic at left.

Features	
Single Phase Vo	No
Current Sharing	No
Backspin Detect	Yes
Backspin Start	Yes
MaxStart Enable	No
RideThru Enable	No

Backspin Start

Backspin Start This feature first performs the function of “Backspin Detect” and then attempts to re-start the motor once it has stopped spinning or the backspin condition has been resolved. When this feature is enabled and the backspin has ended, the display will not show the “Press Stop...” indicator, but briefly displays the message “STOPPED”, then proceeds directly to a motor start.

Features	
Single Phase Vo	No
Current Sharing	No
Backspin Detect	No
Backspin Start	No
MaxStart Enable	No
RideThru Enable	No

MaxStart Enabled

MaxStart™ Enable This parameter enables the Maximum Torque Start (MaxStart™) algorithm. When the MaxStart™ mode is selected, the drive applies an algorithm for starting a stuck or hard-starting motor by quickly applying forward and reverse rotation at start-up. The power conversion module (PCM) of the drive will automatically detect when the motor begins to turn and will terminate the forward/reverse switching of directions so as to prevent damage to the motor. Under normal circumstances, this parameter can be set to normal to generate a regular start up. Note that for this algorithm to function properly, the motor current and torque parameters in the Load and Site setup screen must be correctly configured. For additional information regarding the operation of this feature please contact Centrilift Control Technologies.

Features	
Single Phase Vo	No
Current Sharing	No
Backspin Detect	No
Backspin Start	No
MaxStart Enable	No
RideThru Enable	No

RideThru Enabled

RideThru Enable When set to YES, the Ride Through Enable parameter allows the drive to continue operating through voltage events such as sags and surges. When the input voltage experiences transient level changes, the controller modifies drive operation in an attempt to continue running (ride through) for the duration of the voltage event. However, if the voltage sag/surge exceeds the safe limits of operation, the drive will shut down the motor to prevent equipment damage.

Note: Both voltage sags and surges are measured and annunciated.

Starts

The Starts menu is accessed from the Drive Setup, the Load Setup or the Site Setup screen by pressing the RIGHT or LEFT arrow-key until the screen shown at left is displayed.

Starts	
Int Auto Rstrt	Yes
Strts Counter	0
Total Starts	34
Max Alowd Strt	5
Strts Cntr Rst	60 min
Prog Rstrt Tm	0 min
Restart Delay	30 min
Tm Til Rstrt	29:37 M:S
Stagrd Strt Tm	0 min
Wait Fr Rstrt	Yes
Rstrt On Ovld	No
Internal Automatic Restart Enable	

Int Auto Rstrt The Internal Auto Restart parameter controls whether the drive will automatically restart the motor after it has shut down and is not locked out. This parameter is used in the absence of an externally mounted HOA switch and is overridden by the position of the HOA switch when one is installed and enabled.

Strts Counter Starts Counter displays the number of times that the drive has automatically restarted the motor. This counter is used in conjunction with the following Maximum Allowed Starts and Starts Counter Reset Delay set points to limit and control the number of times the drive will restart the motor before assuming a lockout condition and preventing additional start attempts. A lockout condition can be cleared by pressing the STOP keypad switch or moving the optional HOA switch to OFF and back to AUTO or HAND.

Total Starts Total Starts records the number of times the drive and motor have been started since the last reset to factory defaults command.

Max Alowd Strts Maximum Allowed Starts controls the number of automatic restarts that will be attempted by the drive before generating a lockout. If the drive attempts this many restarts and the motor does not run for a minimum of the time set in the Starts Counter Reset Delay parameter, the drive will then assume a lockout condition and prevent further restart attempts until the lockout is cleared. A lockout condition can be cleared by pressing the STOP keypad switch or moving the HOA switch to OFF and back to AUTO or HAND. This maximum starts parameter is used for all restart attempts unless the Auxiliary Restart Parameters are enabled for that specific cause of shutdown.

Strts Cntr Rst Starts Counter Reset delay controls the length of time, in minutes, that the drive/motor must run before the drive resets the

automatic starts counter and allows the full number of restart attempts to occur. When this time delay has expired and Starts Counter is reset to zero, the drive can again attempt as many automatic restarts as allowed by the Max Alowd Strts parameter. For example, if the motor has been started and has shut down before the factory default delay of 60 minutes have elapsed, the drive will record 1 automatic start. If the motor is started again and shuts down again before 60 minutes of running time, the drive will then show 2 automatic start attempts. If this situation is repeated once again, the drive will record the third automatic start attempt and generate a lockout condition. This lockout condition will prevent any subsequent start attempts until the lockout has been cleared. This time delay is also used by the following Progressive Restart Time parameter.

Starts	
Int Auto Rstrt	Yes
Strts Counter	0
Total Starts	34
Max Alowd Strt	5
Strts Cntr Rst	60 min
Prog Rstrt Tm	0 min
Restart Delay	30 min
Tm Til Rstrt	29:24 M:S
Stagrd Strt Tm	0 min
Wait Fr Rstrt	Yes
Rstrt On Ovld	No
Progressive Restart Time	

Prog Rstrt Tm Progressive Restart Time Delay provides a method of automatically increasing the amount of restart time delay that the drive waits for before restarting the motor. When this parameter is set to a non-zero value, the specified number of minutes will be added to the Restart Time Delay used to postpone an automatic restart. In this situation, the drive will use the standard Restart Time delay for the first restart period and then add the Progressive Restart Time Delay to the second and subsequent restart attempts. To prevent an ever increasing Restart Time Delay, the amount of Progressive Restart Time added will revert to zero when the motor runtime has exceeded the previously discussed Starts Counter Reset delay.

Restart Delay Restart Delay sets the amount of time, in minutes, that the drive will wait after a shutdown before attempting an automatic restart of the motor. If necessary, the motor can be started immediately by pressing the START keypad button or the panel mounted START switch if the panel is equipped with one. In all cases, the drive will attempt to restart the pump only if there are no active alarms and the Wait for Restart Timer set point is disabled. Restart Delay can be automatically affected by the Progressive Restart Time Delay set point previously discussed. If the Auxiliary Restart Parameters are enabled for the cause of the last shutdown, the drive will use those

specific settings for restart time delay and number of start attempts.

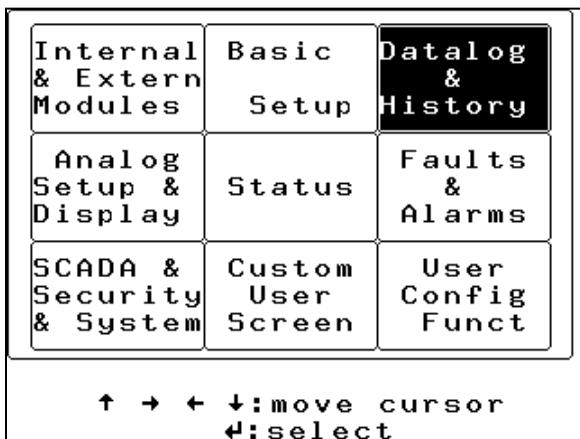
Tm Til Rstrt Time until Restart displays the number of minutes and seconds left before the drive will attempt to restart the motor. If this set point reads zero and the drive is not running, there could be active alarms, or restarting is prevented because the keypad STOP button was pressed, the external HOA mode switch is in HAND or OFF position, a telemetry shutdown control command is active or the Int Auto Rstrt parameter is set to NO.

Stagrd Strt Tm Staggered Start Time provides a means of setting a unique restart time delay for each drive. After a power failure, all drives will wait for a time delay equal to the Restart Delay plus this staggered start time delay. Offsetting individual restart times this way can help to prevent voltage sag on the power system caused when many motors start at once.

Wait Fr Rstrt T Wait for Restart Time Delay forces the drive to wait until the restart time delay expires before allowing any type of restart, either manual or automatic. To restart immediately in case of emergency, change this set point to NO and then start the drive. Be sure to set it back to YES if restarts are to be prevented during the restart time delay. The drive will never attempt to restart the motor if there are active alarms.

Rstrt on Ovld Restart on Overload programs the Overload Auxiliary Restart Parameters (ARPs) to allow the drive one automatic motor restart attempt after an Overload shutdown. Refer to the **Overload Fault and Alarm** sections of this manual for further details.

Starts	
Int Auto Rstrt	Yes
Strts Counter	0
Total Starts	34
Max Allowd Strt	5
Strts Cntr Rst	60 min
Prog Rstrt Tm	0 min
Restart Delay	30 min
Tm Til Rstrt	29:04 M:S
Stagrd Strt Tm	0 min
Wait Fr Rstrt	Yes
Rstrt On Ovld	No
Staggered Start Time	



DATALOG AND HISTORY

The Datalog and History group of screens provide access to the recorded history stored within the Advantage drive. This group of screens includes the Shutdown History, Event Records, Run History, Status (for the ATA USB memory drive), Site Information and Graphing. The Status (for the **USB Flash Drive** section) also includes the Enable Data Logging, Setup Datalogging, Save Historical Data, Save/Load System Setups, Directory/File Functions and Advanced Information screens.

Shutdown History					
1: Man Kpad Sd	05/20	13:47			
2: Undrlld Shtd	05/20	13:34			
3: Man Kpad Sd	05/20	10:26			
4: Man Kpad Sd	05/19	18:08			
5: Man Kpad Sd	05/19	18:06			
6: Man Kpad Sd	05/19	18:04			
7: Man Kpad Sd	05/19	18:02			
8: Man Kpad Sd	05/19	17:58			
Underload Shutdown					

Shutdown History

Shutdown History displays the cause, time and date of the last ninety-nine shutdowns. The screen holds eleven records at once. To view any other shutdown histories, press the DOWN arrow-key to move the cursor to the bottom of the screen and beyond, scrolling through all available records. The names of the causes of shutdown are often abbreviated, so if an explanation is required, the area at the bottom of the screen displays an expanded version of the cause.

Shutdown Detail	
Underload Shutdown	
20 May 2010	13:34:29
Voltage AB:	119
Voltage BC:	119
Voltage CA:	119
Phase A Amps:	96
Phase B Amps:	97
Phase C Amps:	98
Analog I/P 1:	0
Analog I/P 2:	0
Data recorded @ shutdown MENU to return to overview	

Shutdown Detail

The Shutdown Detail screen is displayed when the ENTER key is pressed while the cursor highlights a shutdown history record. This record contains the value of the three output current and output voltage readings and the two analog input readings at the time this corresponding shutdown occurred. This data can be useful for diagnosing troublesome applications.

Event Records	
1:SPC Control Mode	✓
2:Startup	█
3:SPC Motor Mag Cur	
4:SPC Mtr Nmplt Cur	
5:RST Ext Rst	
6:Initial program load	
7:SPC Control Mode	
8:Startup	
9:RTN PCM ⚡ Lock	
10:SDE PCM Sys Err	
Startup	
2010/06/11 14:58:30	

Event Records

The Event Records screen displays the 254 most recent events that have occurred since the drive has been installed and powered up. When the event buffer has been filled, the drive will begin to overwrite the oldest records with the latest event information. Each numbered entry in the list of events is followed by a three letter abbreviation indicating the type of event, which is in turn followed by the data base point description that caused or was affected by the event. At the bottom of the screen, three lines of information are displayed that show: the type of event (non-abbreviated), the time and date of occurrence and, in the case of a set point change, the before and after values of that set point. Use the UP/DOWN arrow-keys to move the cursor up and down to highlight different events and view their information at the bottom of the screen. To quickly move the cursor from one end of the list to the other end of the list, press the ENTER key. If a valid Compact Flash memory card is connected to the system, the user can copy these records to the memory card on demand via the Datalog screen. The Advantage drive automatically stores a copy of these records on the system's Personality module each day at midnight.

Run History	
Run Time Dys	0 d
Run Time Min	00:02:34 HMS
Rstbl Run Time	0 d
Rstbl Run Tm	01:23:56 HMS
Reset Run Time	
Ttl Run Time D	0 d
Ttl Run Time	00:32:41 HMS
Down Time Dys	0 d
Down Time Min	00:00:00 HMS
Ttl Dn Tm Dys	0 d
Ttl Dn Tm Min	18:07:37 HMS
Strts Counter	2
Max Allowd Strt	3
Strts Cntr Rst	60 min
Run Time Days	

Run History

The Run History screen displays counters and timers that record various operating information about the installation. To access Run History press the RIGHT arrow-key from the Events Record screen.

Run Time (days) This timer records the total number of 24-hour days that the motor has run since the last time it was started up.

Run Time Min (Run Time Minutes) This timer records the hours, minutes and seconds (HMS) that the motor has run since the last start. When this timer reaches 24 hours, it will start again from zero, and Run Time (days) will be incremented by one day.

Rstbl Run Time (days) This user Resettable Run Timer records the number of 24-hour days that the motor has run since the last user reset.

Rstbl Run Tm (HMS) This user Resettable Run Timer records the number of hours, minutes and seconds (HMS) the motor has run since the last user reset. When this timer reaches 24 hours, it will revert to zero and the Rstbl Run Time (days) timer will be incremented by one day.

Reset Run Time Use this display point to reset the Rstbl Run Time counters back to zero. Move the cursor until it highlights this point, then press the ENTER key. The two resettable counters will reset to zero, and, if the motor is running, immediately begin to accumulate run time.

Ttl Run Time Dys Total Run Time (days) records the total number of days the motor has run since it was first installed and commissioned.

Ttl Run Time (HMS) This timer records the hours, minutes and seconds (HMS) that the motor has run since it was first installed and commissioned. When this timer reaches 24 hours, it will start again from zero, and Ttl Run Time (days) will be incremented by one day.

Down Time Dys Down Time (days) records the total number of days that the motor has been off since the last time it was shut down.

Down Time Min Down Time counter records the hours, minutes and seconds (HMS) that the motor has been off since the last time it was shut down. When this timer reaches 24 hours, it will start again from zero, and Down Tm (days) will be incremented by one day.

Ttl Dn Tm Dys Total Down Time (days) records and accumulates the total number of days that the motor has been shut off since it was first commissioned and started.

Ttl Dn Tm Min The Total Down Time counter records and accumulates the hours, minutes and seconds (HMS) that the motor has been off since it was first commissioned and started. When this timer reaches 24 hours, it will start again from zero, and Ttl Dn Tm (days) will be incremented by one day.

Run History		
Run Time Dys	0	d
Run Time Min	00:02:34	HMS
Rstbl Run Time	0	d
Rstbl Run Tm	01:23:56	HMS
Reset Run Time		
Ttl Run Time D	0	d
Ttl Run Time	00:32:41	HMS
Down Time Dys	0	d
Down Time Min	00:00:00	HMS
Ttl Dn Tm Dys	0	d
Ttl Dn Tm Min	18:07:37	HMS
Strts Counter	2	
Max Allowd Strt	3	
Strts Cntr Rst	60	min
Run Time Days		

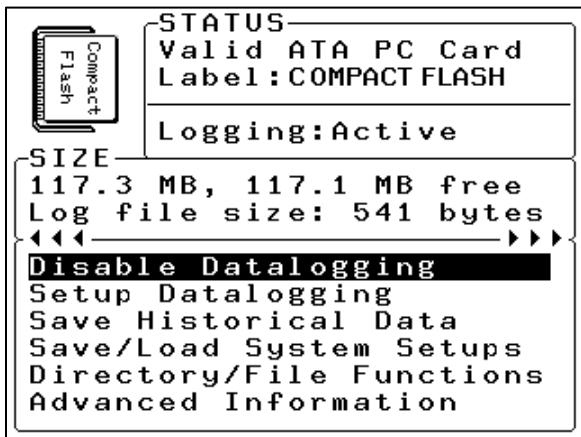
Strts Counter Starts Counter displays the number of automatic restarts that have occurred, during which the motor did not run long enough to expire the Starts Counter Reset delay. If this starts counter reaches the value that is programmed into the Max Alowd Strts, the drive will enter a lockout state and will not allow further restart attempts until the lockout is cleared. This parameter is also accessible in the Basic Setup menu on the Starts page and is duplicated here for operator convenience only.

Max Alowd Strts The maximum allowed starts parameter controls how many automatic restart attempts will be allowed before the drive locks out and prevents any further starts.

Strts Cntr Rst Starts Counter Reset delay controls the length of time, in minutes, that the motor must run before the automatic Starts Counter is reset to zero. When this time delay has expired and Starts Counter is reset to zero, the drive can again attempt as many automatic restarts as allowed by the Max Alowd Strts parameter. This parameter is also accessible in the Basic Setup menu on the Starts page and is duplicated here for operator convenience only.

If a valid Compact Flash memory card is connected to the system, the user can copy these records to the memory card on demand via the Datalog screen. The Advantage drive automatically stores a copy of these records on the system Personality module each day at midnight.

Run History		
Run Time Dys	0	d
Run Time Min	00:02:34	HMS
Rsttbl Run Time	0	d
Rsttbl Run Tm	01:23:56	HMS
Reset Run Time		
Ttl Run Time D	0	d
Ttl Run Time	00:32:41	HMS
Down Time Dys	0	d
Down Time Min	00:00:00	HMS
Ttl Dn Tm Dys	0	d
Ttl Dn Tm Min	18:07:37	HMS
Strts Counter	2	
Max Alowd Strt	3	
Strts Cntr Rst	60	min
Starts Counter Reset Time		

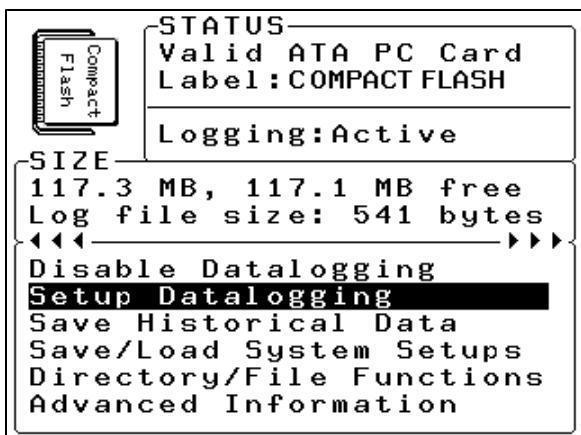


Compact Flash Card Datalogging

The Status page under the Datalog and History menu provides access to the GCS legacy data logging functions provided with the Advantage controller. The data recorded is stored onto a non-volatile memory card inserted into the provided socket on the Advantage display unit. The system will monitor the amount of unused capacity on the Compact Flash memory card and when free space falls below 10 megabytes, it will erase the oldest datalog records to make room for the new data. In this method, the newest data will always be recorded and the data logging function will not become suspended. The CF cards are formatted and structured with a DOS file format. When plugged into a personal computer, the CF card should appear as a disk drive and the logged data will appear as a normal DOS type of file upon that CF card. To use, view or manipulate the logged data, the user can open the file using MS Excel, MS Word or any other PC software that can import a comma separated variable (CSV) file type. As can be seen in the next graphic below, the Status and Size portions of the screen are filled with appropriate information when a valid CF card is inserted.

Enable/Disable Datalogging Use this menu item to start or stop the data logging function. Move the cursor over this item and press the ENTER key to toggle between Enable and Disable. If this item is toggled to Enable Datalogging, the Advantage controller will commence logging the data as configured within the next menu item, Setup Datalogging. Permission to enable or disable datalogging is dependent upon security level clearance. If security is enabled, the user must enter a valid password to be allowed to enable/disable datalogging. Refer to the next section for instructions on configuring the datalogging setup.

Setup Datalogging To access the setup screens for datalogging, move the cursor to this location and press ENTER. Note that the logging function must be disabled before access to the datalogging setup screen is allowed. The screens illustrated below are used to configure datalogging options. After the setup is completed, the configuration is stored



Datalog Setup		
	Description	Enable
1	Output IA	►►►
2	Output IB	
3	Output IC	
4	Pump Torque	
5	Motor Torque	
6	AI1 PV	
7	AI2 PV	
8	▼	
9	▼	
	Description	
	Output Current A	

within non-volatile memory and is retained even in the event of a power failure. In such a case, the user need not re-enter the setup, because the Advantage will re-configure itself using this stored configuration.

Datalog Setup

This screen provides the user with the ability to configure the type of data to be logged. Up to twenty four data variables can be logged at a user set interval and deadband. Each of the logged data variables requires the user to select a data point identification (PID) from the Select Item menu list or a valid numerical PID number. Once the datalog setup is complete, press the MENU key to exit.

Select Item...		
<none>	Gigawatt Hrs	►►►
Output Freq	IA Scaled	
Output IA	Inpt Frq Prs	
Output IB	IB Scaled	
Output IC	IC Scaled	
Output Volts	Iunbal	
Bus Vlts	Kilowatt Hrs	
AI1 PV	Inst Power	
AI2 PV	Megawatt Hrs	
DI1 State	Highest Cur	
DI2 State	Power Factor	
Output Current A		

Description Move the cursor to highlight one of the rows (1 through 24) in this column and press ENTER. At that point, a Select Item screen will appear. Use the arrow keys to move the highlight cursor to the item to be logged and press ENTER. The selected data point is then added to the Description field for data logging.

Description (Select Item) This illustration shows the first screen of the selection list. Move the cursor to the right to display additional, selectable items. Note that if the desired item is not on this list, the Utility Menu provides an alternative method to select points for data logging. If any parameter currently selected for data logging needs to be removed, first place the cursor on that position, press ENTER to open this screen, select the blank line at the top of the first screen and press ENTER again. That will cause the datalog entry for that line to be reset to inactive.

Itvl

Set this Interval parameter to the length of time to wait between consecutive samples. The value can range from 00:00:01 seconds to 99:59:59 hours:minutes:seconds. Each logged parameter can have a different interval time setting.

Datalog Setup			
	Itvl	Dedbnd	Enable
1	1	1	✓
2	1	1	✓
3	1	1	✓
4	1	1	✓
5	1	1	✓
6	3	3	✓
7	3	3	✓
8	0	0	X
9	0	0	X
	Itvl		
	01 sec ,		

Datalog Setup				
	Itvl	Dedbnd	Enable	
1	1	1	✓	
2	1	1	✓	
3	1	1	✓	
4	1	1	✓	
5	1	1	✓	
6	3	3	✓	
7	3	3	✓	
8	0	0	X	
9	0	0	X	

Dedbnd

Dedbnd This parameter controls the size of deadband used when decided whether to record a new value of the logged data point. If set to 0, every new reading will be recorded. When set to any other number, the new readings will only be recorded if the value has changed by an amount equal to or greater than the deadband value.

Datalog Setup				
	Itvl	Dedbnd	Enable	
1	1	1	✓	
2	1	1	✓	
3	1	1	✓	
4	1	1	✓	
5	1	1	✓	
6	3	3	✓	
7	3	3	✓	
8	0	0	X	
9	0	0	X	

Enable

Enbl

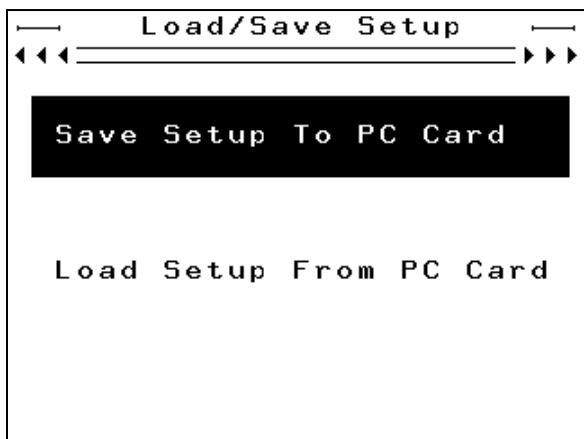
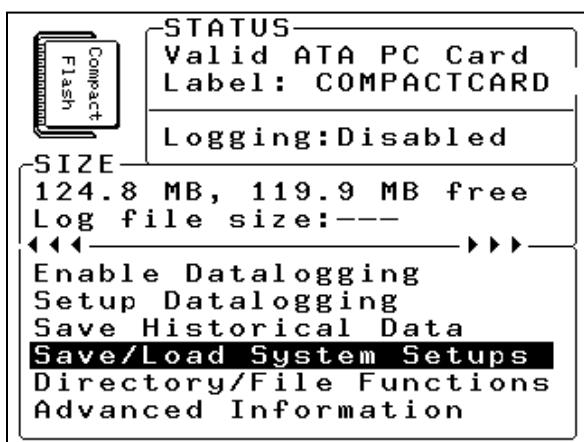
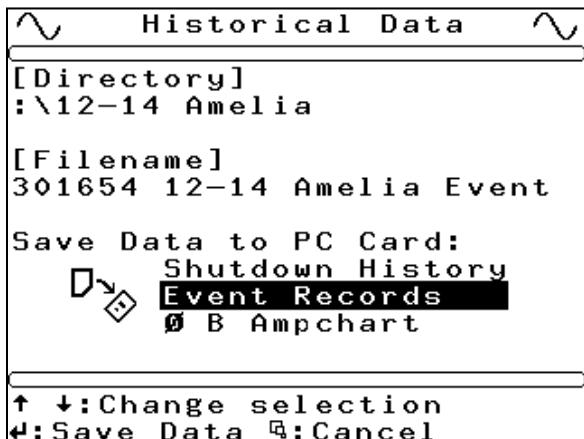
Enable This point controls whether the Advantage controller will record (log) the data associated with the description field. If this point displays a check mark, ✓, the data will be recorded, if it displays an X, the data will not be logged. Move the cursor to this variable and press ENTER, then, press the UP or DOWN arrow keys to toggle the value between enabled and disabled.

	STATUS
	Valid ATA PC Card Label: COMPACTCARD
Logging: Disabled	
SIZE	124.8 MB, 120.1 MB free
Log file size:---	
Enable Datalogging Setup Datalogging Save Historical Data Save/Load System Setups Directory/File Functions Advanced Information	

Save Historical Data

This group of functions allows the user to copy the internal history databases to the CF card. Most CF card enabled computers can read this card and the data contained therein. All the following data files are written to the CF card in a comma separated variable (*.csv) format. The data will be written to a Windows/DOS type file named according to the following conventions:

The file name will begin with the day of the month (1 thru 31) and the current hour and minute. If a site name has been entered, it is appended to the file name and lastly the file type identifier is added. In the example shown, the file name of the Event Records will be 301654 12-14 Amelia Event Rec.csv. In this case, because a site name has been entered, all the historical files will be written to a sub-directory on the CF card named 12-14 Amelia. When no site name is supplied, the files are stored in the root directory of the CF card.



Shutdown History This function will copy the internal shutdown history database from the Advantage drive to the CF card.

Event Records (History) This function will copy the internal Event History database from the Advantage drive to the CF card.

Phase B Ampchart This function will copy the internal phase B Ampchart data from the Advantage drive to the CF card.

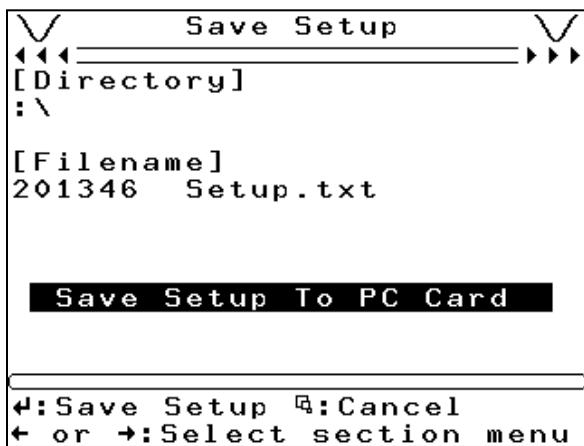
Save/Load System Setups

The Advantage drive uses the system's personality module to automatically record user changes to the drive's settings. In addition to the automatic and transparent configuration recording, the Advantage allows the user to save the drive's setup to a Compact Flash memory card inserted into the display's connector.

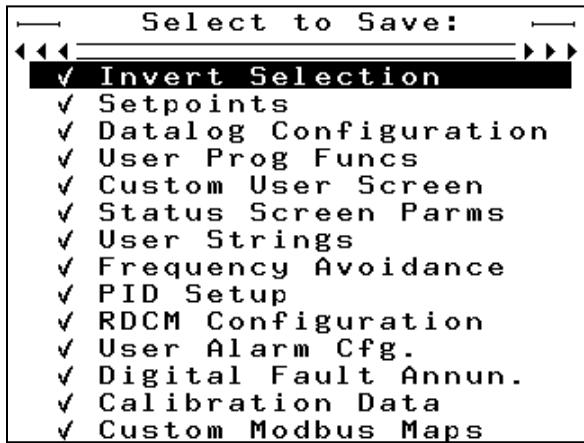
This configuration can be used to archive the settings, or used to recreate these settings on another controller. Move the cursor to this location and press ENTER to access the screen shown below.

Save Setup to PC Card

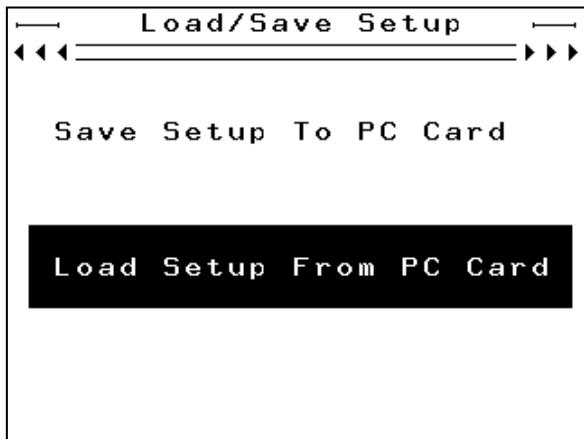
To save all of the settings in an Advantage controller, move the cursor to this location and press ENTER. The screen displayed next will show the site name under the directory heading if it has been entered on the Site Information page.



Save Setup This screen is displayed as a confirmation after the user has selected Save Setup to PC Card from the previous menu. If all of the set points are to be saved, simply press the ENTER key at this screen and the unit will begin saving the set points to the CF card. While this function is in progress, the screen will show various progress indicators. Once the save is complete, the screen will revert to the main Datalog menu. From this menu, the user can press the RIGHT or LEFT arrow keys to access another screen that allows them to specify which of the internal set points will be saved. A screen similar to the next one will be displayed.

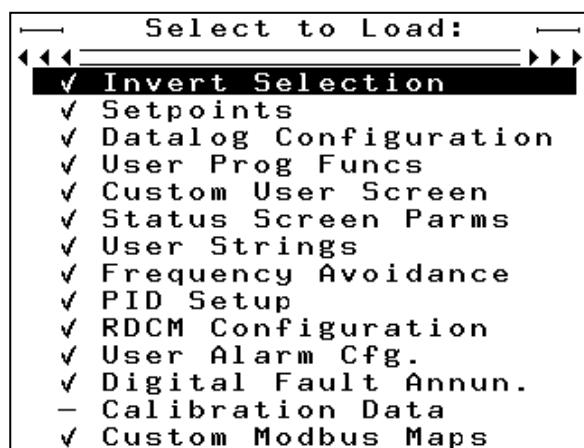
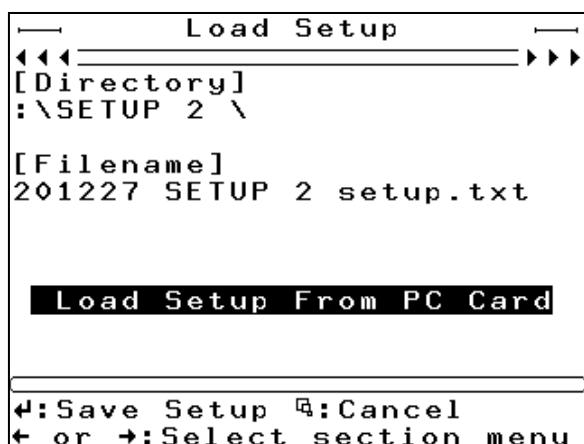
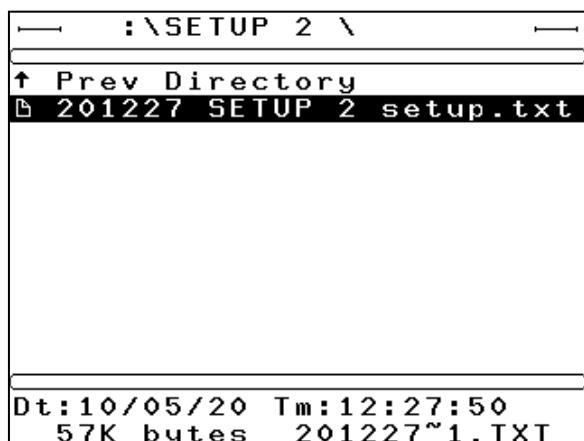


Save Setup (Select to Save) This screen allows the user to select which type of set points will be saved to the CF Card. If left untouched, all the set points will be saved. To prevent any category from being saved to the CF Card, use the arrow keys to move the cursor to that line and press ENTER. The check mark at the beginning of the line will change to an X, indicating that category will not be saved. To quickly select or deselect all the categories, toggle the Select All / Invert Selection menu item. When all desired sections have been selected, press the RIGHT or LEFT arrow again to return the cursor to the Save Setup to PC Card menu and press ENTER.



Load Setup From PC Card

This function is used to restore a previously saved setup or configuration from the CF Card. First save a valid setup by using the Save Setup function previously explained. With a valid saved setup on a CF Card inserted into an Advantage controller, move the cursor to this position and press ENTER to proceed to the next screen shown below.



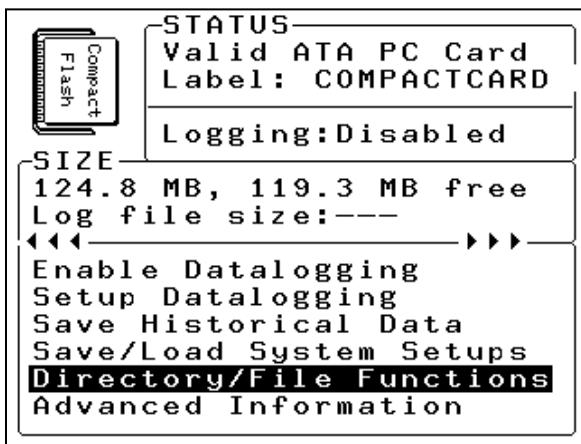
Load Setup From PC Card (Select File)

This screen is used to navigate the CF Card's directory structure to select a specific setup file to load. In the illustration, the cursor is highlighting the file called 201227 SETUP 2 setup.txt. Press ENTER to select this file and proceed to the next screen shown below.

Load Setup from PC Card The Advantage controller is ready to load the selected setup from the CF Card. If the complete setup is to be reloaded, press ENTER to proceed with the load. The motor must be stopped for a complete setup load. Progress indicators will show the steps taken. Once the load is complete, the screen will revert to the main DATALOG menu.

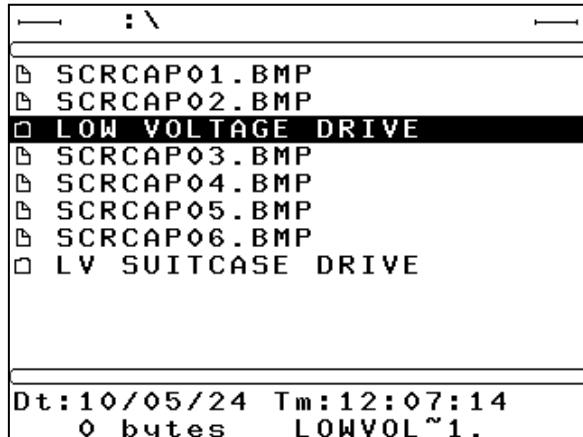
If only specific sections of the file will be loaded, press the LEFT or RIGHT arrow keys to access the section selection screen shown next.

Load Setup (Select info to Load) Use this screen to select from the available sections of the saved setup file. Move the cursor with the arrow keys to highlight an available section and press ENTER to check it. The example shown at left has only one section not selected to load, Calibration Data, while all other sections are selected for loading. To quickly select or deselect all the categories, toggle the Select All / Invert Selection menu item. When all desired sections have been selected, press the RIGHT or LEFT arrow again to return the cursor to the Load Setup to PC Card menu and press ENTER. Loading of set points is not allowed while the motor is running.

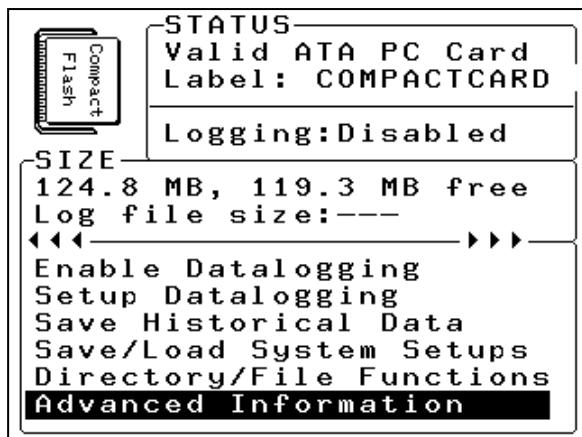


Directory/File Functions

This menu item provides access to a basic directory and file manager. Press the ENTER key to display a screen similar to the next illustration.



When the Directory/File Functions menu item is selected, a screen similar to the one at left will display. It shows the cursor highlighting the sub-directory called Low Voltage Drive. Press the ENTER key to view the contents of that directory. The file/directory creation time, date and size are displayed at the bottom of the screen. When the cursor is highlighting a file, press the RIGHT arrow key to delete it. To confirm the delete file command, press ENTER again at the prompt or press the MENU key to cancel.



Advanced Information

This menu item provides access to a screen displaying technical information regarding the inserted CF Card. An example screen is shown on the left.

Advanced PCC Info		
Mnfct:	Hypersto	
Vol Id:	COMPACTCARD	
Vol S/N:	28DA3487	
System:	MSD055.0 FAT16	
Size:	124.8 MB	
Media:	248	
	Sector	Cluster
Sz(B)	512	4 secs
Ttl#:	256224	63922
Rsvrd:	1	
Root:	503	
Data:	535	

USB FEATURES		
◀◀◀	No USB Drive Inserted	▶▶▶

USB FEATURES		
◀◀◀	Scanning USB Drive	▶▶▶

This is an example of the type of information available regarding the file system structure of the CF Card.

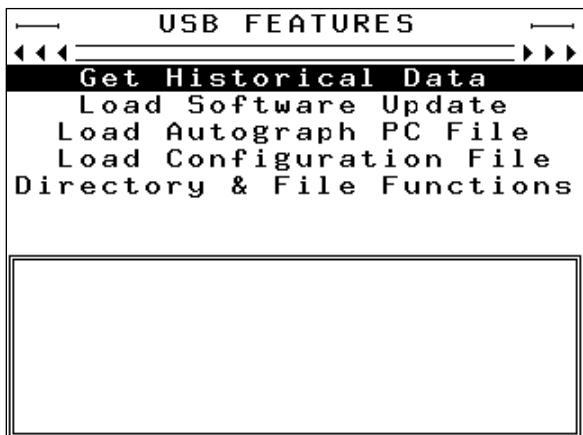
USB Features

The USB Features page allows the user to transfer software updates and historical data to and from the USB port accessible on the front door of the VSD. The internal USB port is dedicated for use as the system configuration and storage device. The terms personality module, P_MODULE, and pmod all refer to that internal USB system configuration and storage device. The Advantage drive will not operate without a personality module; therefore it is secured inside the drive and is not user accessible or serviceable.

If an additional solid state USB mass storage device (MSD) is not inserted in the external USB port on the front door of the cabinet, a screen similar to the one at left should appear on the Datalog & History\USB Features page. You will also see this screen if the system controller cannot read the USB device or when it is removed.

When a USB MSD is inserted in the USB port on the front of the drive cabinet, a message will appear which indicates that it is scanning the USB drives for files and the presence of pre-existing data... The larger the solid state disk drive is, the longer this could take.

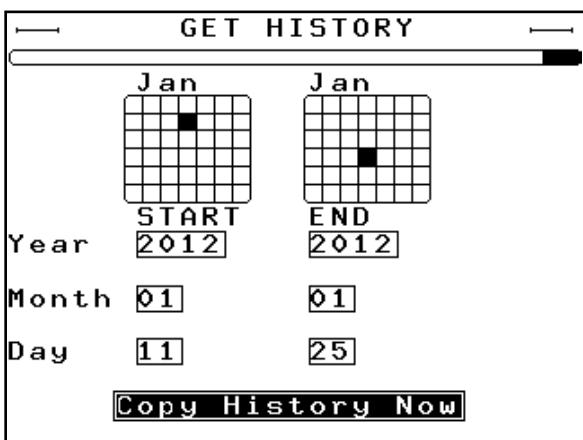
After the scan is complete a screen similar to the one shown at left should appear. The example screen shows five menu lines in this instance. The number of menu options on this screen is dependent upon the information held on the inserted USB drive. The example shows the screen as it would appear when all of the USB Features are available.



Get History

The first feature on the USB Features screen is the Get Historical Data. Pressing enter when this line is highlighted will take you to the Get History screen.

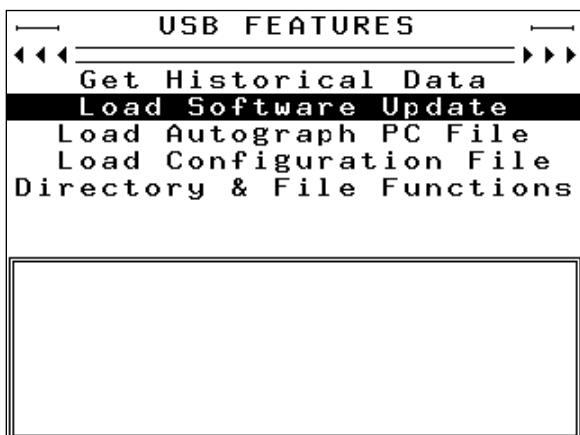
The Get History screen is used to select the span or length of historical information that the user wishes to copy from the personality module to the externally connected USB drive. By default the last two weeks of historical data will be selected. The bar at the top of the screen indicates how much of the available data is selected with the left side of the bar representing the oldest data, the right side of the bar representing the newest data.



The user may select more or less data for transfer by editing the START year/month/day and the END year/month/day.

Several limits apply to the selection process. First, the user can not set a start date earlier than the oldest timestamp on the personality module. The user can not set a start date that is later than the end date. The user can not set an end date that is earlier than the start date. The user can not set an end date that is later than the newest time stamped file on the personality module.

Pressing ENTER when Copy History Now is selected will send the user back to the USB Features screen and start the copy process. The files will be placed in a folder called WellData in the root directory of the external solid state drive. A subdirectory with the same name as the [Site Name] on the Site Information screen will be created in the WellData directory. If the [Site Name] is blank then the history files will be saved to a folder call GenericSite on the door drive. For an explanation of the data recorded onto the personality module, consult Appendix C: Data Logging Specifications.



Load Software Update

Another feature available via the USB Features screen is the Load Software Update. There are three different sections of software in the Advantage low voltage (LV) drive capable of being upgraded in the field. These are:

- 1: Advantage Power Conversion (APC)
- 2: Advantage Graphics Display (AGD)
- 3: Advantage System Control (ASC)

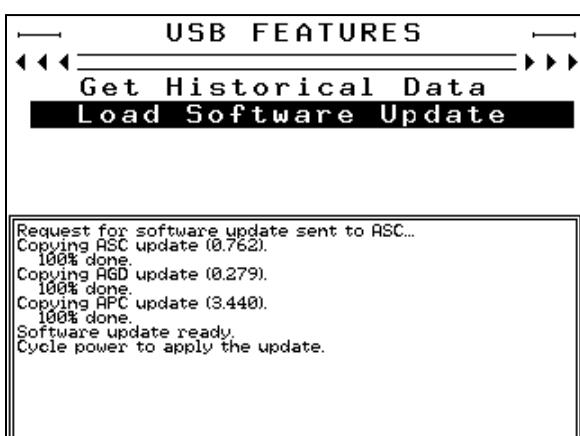
A USB flash drive will be required to store and transport the software upgrades to the Advantage LV drive in the field. These software upgrades will be available to download from the Baker Hughes internet portal when an upgrade is released. The directory structure of the USB flash drive must adhere to the guidelines listed below. Note the flash drive can be named anything except P_Module (the flash drive in the example is named Door Drive) and, at a minimum, a subdirectory named SW_Upgrd must exist with a corresponding hardware target subdirectory (either AGD, APC, OR ASC). Other directories/subdirectories may exist without interfering with the software upgrade procedures. The subdirectory location of the particular software upgrade depends on the desired hardware target as follows:

APC upgrade must be placed in a subdirectory named \\SW_UPGRD\APC

AGD upgrade must be placed in a subdirectory named \\SW_UPGRD\AGD

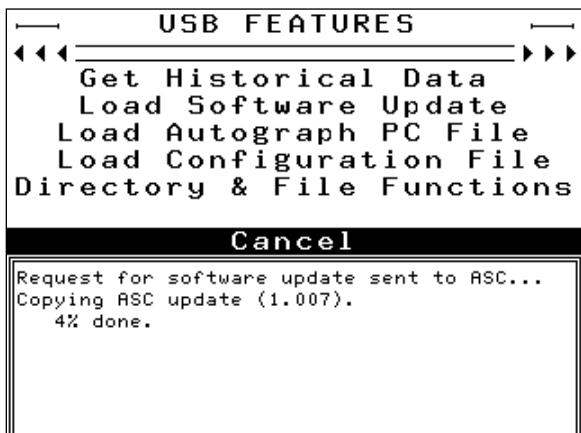
ASC upgrade must be placed in a subdirectory named \\SW_UPGRD\ASC

Each software upgrade will be composed of two files with the following naming convention. The upgrade target is identified in the name by a three letter acronym (APC, AGD or ASC and a numeric sequence representing the software revision level. The file with the file-type suffix of *.ELF contains the software while the file suffixed *.MD5 contains the error detection code used to verify that the software is intact and is not corrupted.



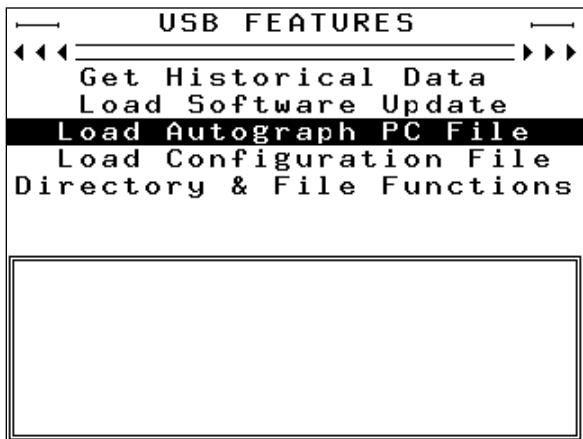
For example, files named ASC_CodeFlash_1007.ELF and ASC_CodeFlash_1007.MD5 are the pair of files containing the system controller software version 1.007 and the MD5 error detection checksum value.

Insert a USB flash drive into the weather proof USB port on the front of the drive with the software upgrades in the correct subdirectories. The LV drive must be powered up and may be in a running, stopped, or alarmed mode when the flash drive is inserted. To automatically update the software installed on the drive, these files must have a later (larger) version number than the current operating software located in the flash.



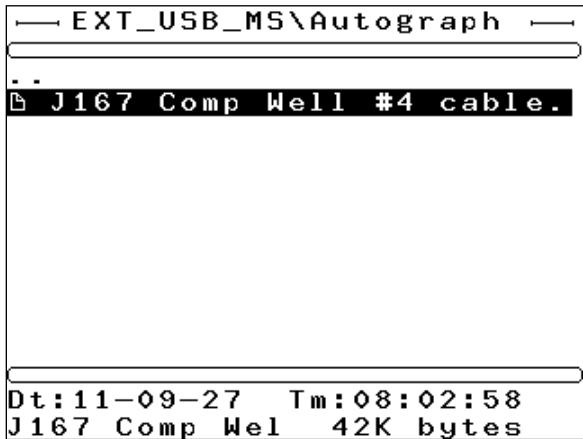
Pressing ENTER when Load Software Update is selected will cause the ASC to check the external USB drive(s) for available software updates.

If the ASC does find an update it will copy the necessary files from the external USB drive to the personality module. At the next drive power on cycle, the ASC will compare the revision numbers and dates of the update with the currently loaded software. If the software version stored on the personality module is newer than the existing version, the ASC will burn that version into ASC flash memory or will initiate a transfer from the ASC to the module that the new software is meant for. After the necessary firmware files have been copied to the drive, the user must cycle power to the drive to cause it to load and run the new software. During this upgrade, the drives set points are saved to a configuration file on the P_MOD and restored after the upgrade. This means the drive will automatically restore its own set points after an upgrade without user intervention.



Load Autograph PC File

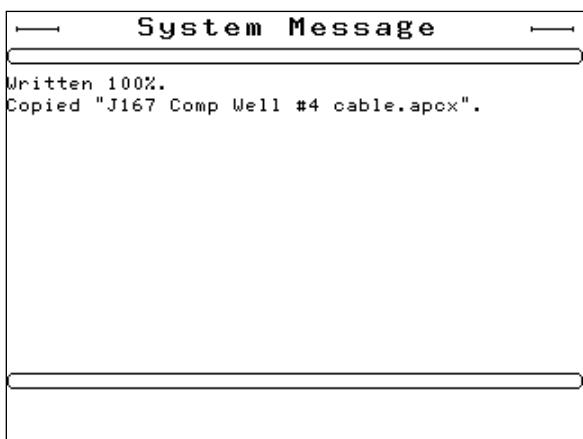
The Advantage drive can retrieve and utilize configuration settings from a file created by Baker Hughes' pump sizing software package called Autograph PC. Using that software, a designer can preset many of the variables required to properly commission an ESP pump installation. Once satisfied with the configuration, the Autograph PC program can create a disk file containing the required settings. When this file is placed into a root directory called Autograph_PC on a USB Mass Storage Device (MSD) memory device, the Advantage drive can use the contained information to configure its settings. If the sub-directory and files are not placed on the USB MSD, the related menu item will not be displayed.



To use an Autograph PC generated configuration, copy the configuration file to the AUTOGRAPH_PC sub-directory on the root directory of a USB MSD. Insert the USB MSD into the free port on the drive. If the correct directory exists and a valid Autograph PC file exists, the Advantage will show a screen similar to the one at left and allow the user to copy the configuration file to the personality module memory space. Press the ENTER key to initiate the copy.

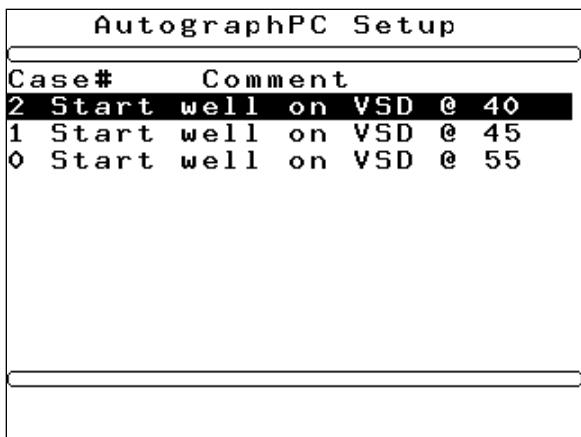
Note: the file extension of the Autograph configuration must be *.apcx.

For example: J167 Comp Well #4 cable.apcx

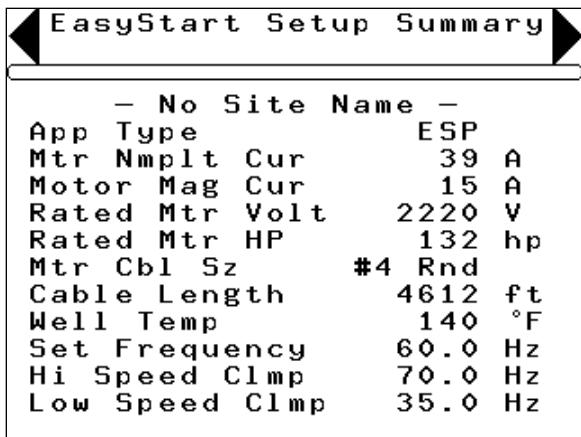


As the system copies the setpoint file to the personality module, it will post update messages on the display unit announcing the success (or failure) of the copy.

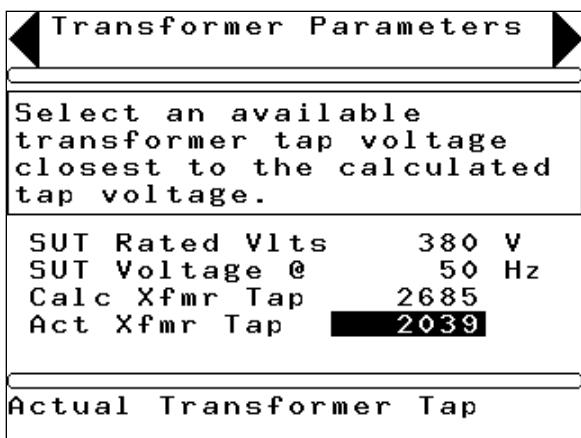
Once the file has been successfully copied to the personality module, the Advantage will parse the contents of the file and determine if there are more than one configurations held in the same file. If so, the system will display the choices on screen and allow the user to choose one of them as shown on the next screen capture.



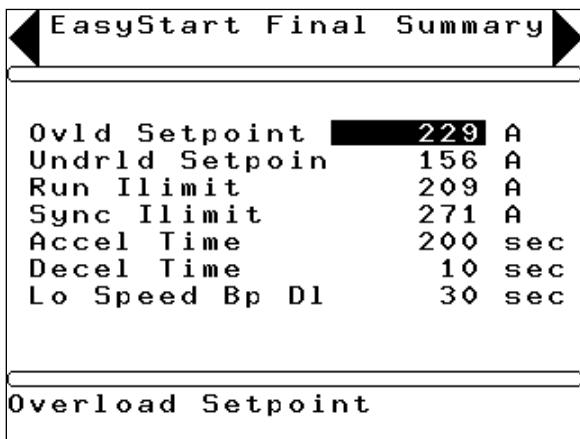
The Autograph PC file used in the example at left has three separate configurations held within it. The user can choose any one of the configurations by moving the cursor over their choice and pressing ENTER.



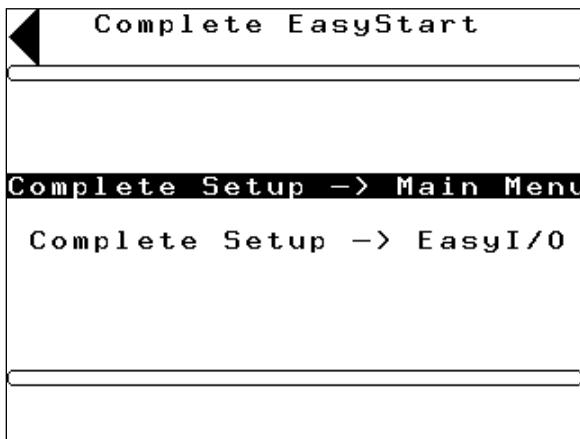
Once the user selects a configuration file and presses ENTER, the system will copy the set points from the file into the database. Once completed, it will display summary screens showing the value of the critical set points.



Press the RIGHT arrow to cycle through the three summary screens.

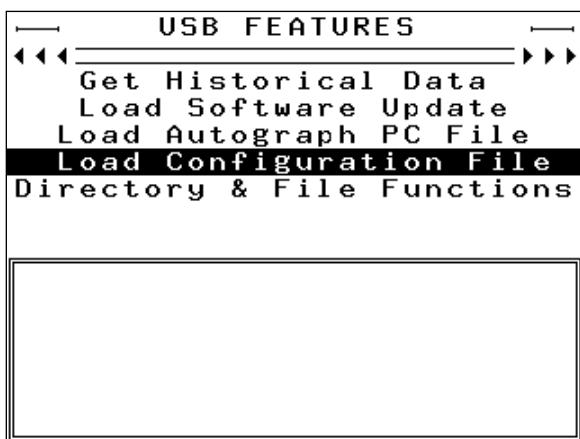


EasyStart Final Summary Screen



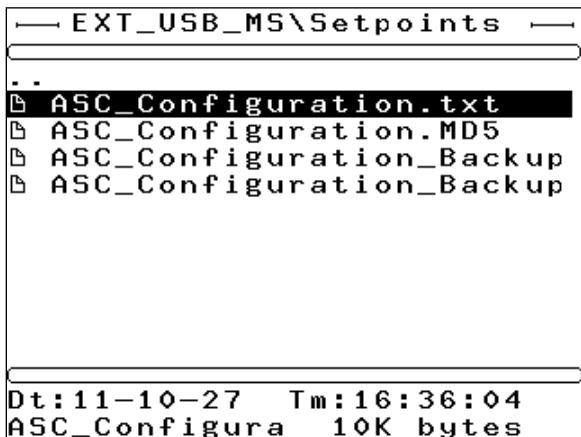
Complete Setup

If the settings are acceptable, the final screen allows the user to complete the setup and display the main menu.



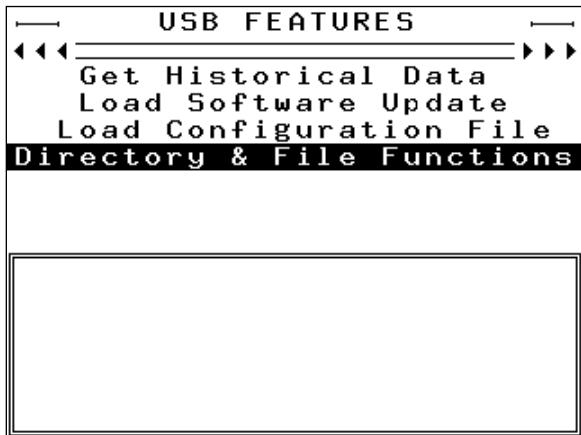
Load Configuration File

The Load Configuration File feature allows the user to re-program the drive's operating parameters using settings in the file stored on the USB mass storage device (MSD). The Advantage drive automatically creates the file on the USB MSD in a directory labeled Setpoints. Within this directory, the system stores two files per saved configuration. The example screen capture at left/below shows an example whereby two sets of configuration files called ASC_Configuration and ASC_Configuration_Backup are stored on the USB device.



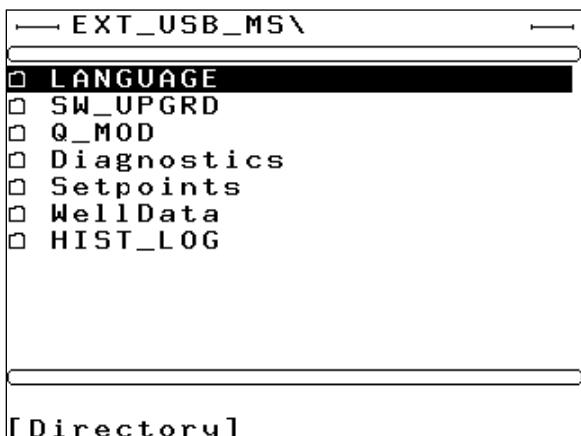
A set of configuration files consist of the one containing the data that has a file type suffix of *.txt. The other file with a *.MD5 suffix, contains the error detection code used to verify that the setpoint file is intact and not corrupted.

To load a configuration file into the drive, move the cursor to highlight the desired file and press the ENTER key. If the file holds valid configuration information and the error detection algorithm finds no faults, the set points contained in that file are loaded into the Advantages database. Once the setpoint file load has completed, the display unit will show a message stating the file copy was done.



Directory and File Functions

The Directory and File Function menu provides the user with a way to view the contents of the USB MSD (mass storage device). This feature does not allow the user to delete, move or rename any of the files or directories.



To navigate through the directory structure, use the arrow keys to move the cursor until it highlights the desired directory/file, then press ENTER

Site Information	
[Site Name] ADVANTAGE TEST WELL	
[Notes(5 lines)] User Notes can hold any type of data : INSTALL\REWORK DATE LEGAL SITE DESCRIPTOR EQUIPMENT SERIAL NOS.	
Drive Model:2250-6-VT	

Site Information

This screen is used to enter a descriptive site names and optional notes. The factory default for these entries is blank or empty. If a site name is entered, it is used to create a sub-directory of the same name on a CF card inserted into the display unit. Any historical or saved data will be stored into that sub-directory. Move the cursor to one of these items and press ENTER to access the screen for data entry. The Notes section contains five lines capable of holding 20 characters each and hold required data. Info describing how to use the text entry screen can be found in the Utility Menu section of this manual.

Graphing	
Phase B Ampchart	
Phase B Ampchart	

Graphing

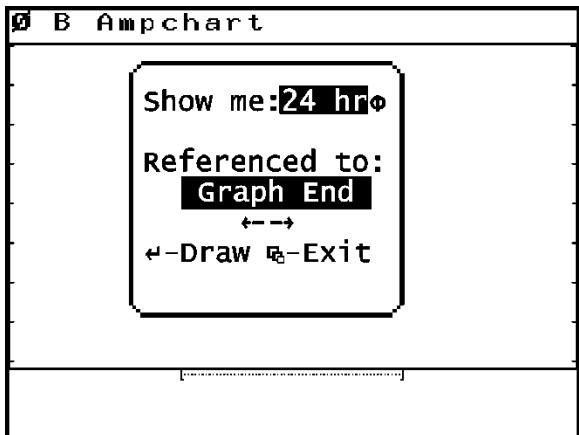
The Graphing group of screens gather together available graphing functions.

Phase B Amp Chart This time vs. current graphing function serves the same purpose as the standard circular amp chart recorder commonly found in motor control applications.

The Advantage drive samples the phase B motor current and records the minimum and maximum values during each one minute period and an average value every four minutes. The maximum, minimum and average values are used to create this graph.

The drive records this data whenever the motor is running. When seven days of data have been captured, the amp chart function will begin to overwrite the oldest data with newest values. In this way, the drive will always retain the data from the most recent seven-day run period. The amp chart only contains the last seven days of operational data.

The following convenience feature has been added to the Advantage drive functions. If a valid compact flash memory card, with sufficient free memory space, is inserted and left in the card slot of the Advantage display unit, the amp chart file will automatically be written to it every Sunday at midnight. The amp chart file will contain up to 300 Kilobytes per week. Therefore, an 8-megabyte memory device will be capable of recording a minimum of 26 weeks (6 months) of data.

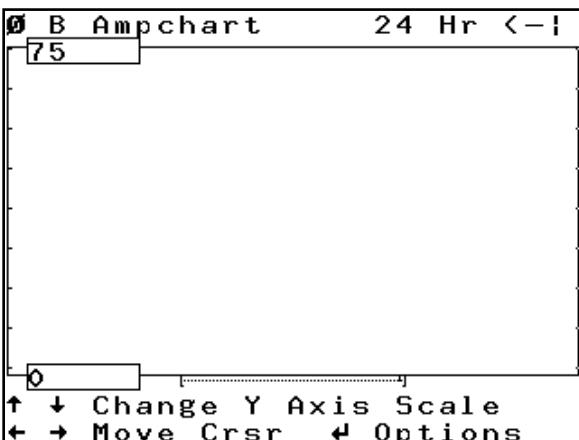


The data format of the amp chart file on the compact flash card will be in a *.csv file. The CSV (comma separated variable) files can be opened and read by most word processors or spreadsheet programs.

Note: the ampchart data is also automatically stored in the USB personality module internally connected to the drive. These files are of a *.DAT format. The DAT files will first require conversion to CSV using the Advantage DAT converter before they can be viewed by word processors and spreadsheet programs.

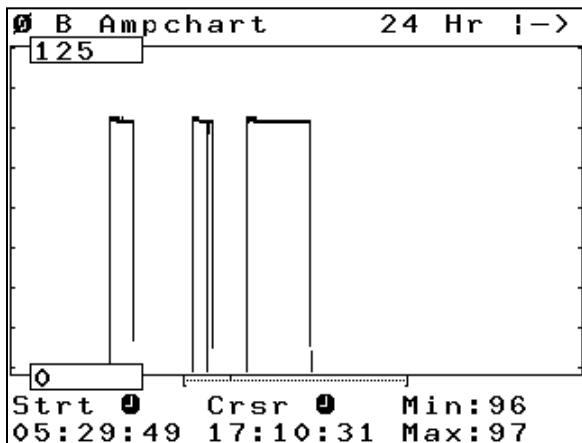
Ø B Amp Chart

This graph screen displays the recorded amp chart data described in the previous section. Use the UP/DOWN arrow-keys to select the graph duration of 3, 6, 12, 24, 48 hours or 1 week. Use the LEFT/RIGHT arrow-keys to select the graph's starting location reference. The Referenced to: Graph Start selection causes the graph's left side axis to be set to the beginning of the data and extend forward in time for the amount set by the UP/DOWN arrow-keys. The Referenced to: Graph End selection sets the graph's right hand axis to the present time/date. The Referenced to: Csr selection creates a graph centered on the present cursor line position, extending forward and backward in time for the time duration selected in the Show me: selection. Once these options are set, press the ENTER key to display the graph.

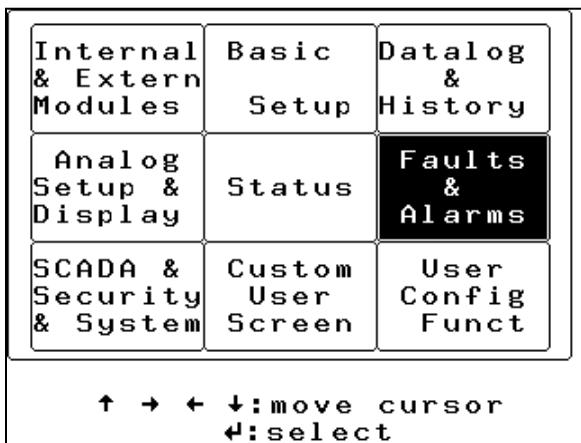


The next illustration shows a 24-hour amp chart referenced to the beginning of the data at 05:29:49 am. The cursor is presently at the time representing 17:10:31 pm. After the ENTER key is pressed, the Drive will draw the graph and show the new key

options at the bottom of the screen as shown at left. Whenever the graph is being displayed, pressing the UP/DOWN arrow-keys will change the Y-axis scale up or down. Pressing the LEFT/RIGHT arrow-keys will move the cursor left or right on the screen. To display the Options (duration and reference) screen again, press the ENTER key. Press the LEFT or RIGHT arrow-key to display the time, date and current Minimum/Maximum values.



The graph screen will change to display the start time of the graph, the time of the present cursor position and the minimum and maximum recorded values at the cursor position. While the graph is being displayed, the Strt Time displayed represents the time/date at the left-hand axis, while the Crsr Time shows the time/date of the current cursor position. Both of these date displays will alternate between time and date at approximately one cycle per second. If desired, the data collected to create this graph can be transferred on demand to a USB flash drive inserted into the card slot on the graphic display unit. The command to copy the data to this card is found on the menu structure of Datalog&History>Status\GetHistoricalData\Ø B Ampchart. This is automatically stored in the personality module every midnight.



FAULTS AND ALARMS

The Faults and Alarms group of screens provide access to the motor and drive protection features within the Advantage drive. This menu group includes a setup screen for each of the alarm conditions providing the user with complete control over the response of the VSD to these occurrences. The first screen viewed after pressing ENTER at this Main Menu selection will usually be Overload.

Overload

This screen contains the parameters concerned with protecting the motor from excessive current draw.

Overload	
Setpoint	100 A
Highest Cur Ø	82 A
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	0.3 sec
Shutdown Delay	8 sec
Rstrt On Ovld	Yes
Aux Rstrt Parm	Yes
Auto Restarts	1
Restart Delay	30 min
Max Load I Thd	600 A
Overload Setpoint	

Setpoint The Overload Setpoint determines the maximum output current that can be delivered to the motor without engaging the Overload routine and subsequently causing a motor shutdown. The drive uses the highest current drawn by any single set of motor leads to calculate the magnitude of Overload. The typical setting for the Overload setpoint is the motor nameplate full load amps or motor nameplate current. Both the Overload setpoint and Overload shutdown time delay should be set as low as practical for the application. In cases where an output step-up/step-down transformer is connected between the drive and motor/cable, be sure to include the transformer ratio in calculations of overload settings.

Highest Cur Ø This parameter displays the highest current drawn by any single phase of motor leads. The Overload condition is calculated upon the highest single current measured. This point is not adjustable.

Alarm Enable This set point normally controls whether the drive will shut down the motor because of an Overload condition. In the case of the Advantage drive, this parameter cannot be disabled and Overload protection is permanently enabled.

Lockout Enable This parameter determines if the drive will enter a lockout condition after the first shutdown when it has shut down the motor due to an Overload. If this point is enabled and the motor

Overload	
Setpoint	100 A
Highest Cur Ø	82 A
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	0.3 sec
Shutdown Delay	8 sec
Rstrt On Ovld	Yes
Aux Rstrt Parm	Yes
Auto Restarts	1
Restart Delay	30 min
Max Load I Thd	600 A
Overload Shutdown Delay	

is shut down due to Overload, the drive will lock out and prevent any further restart attempts until the lockout is cleared. The factory default setting is YES, Overload shutdowns will lock out automatic restarts.

Bypass Delay Sets the number of seconds that the Advantage drive will ignore an Overload alarm condition that is present at startup or that occurs during this bypass period. This timer has a resolution of one tenth of a second.

Shutdown Delay Sets the number of seconds that the drive will ignore an Overload alarm condition that exists while the motor is running, but only after the Overload Bypass Delay timer has expired. The shutdown delay is defined as the delay, in seconds, before the drive shuts the motor off when the current draw exceeds 150% or 1.5 times the Overload current set point. If the motor current exceeds the overload set point, but is either greater than or less than 150% or 1.5 times the set point, the drive will either lengthen or shorten the time delay by a mathematical function that simulates motor heating effects. The relationship between current and time delay is established by the constant I^2T , and simply stated, the greater the Overload current is, the shorter the time delay will be. The actual time delay before shutdown can be derived by the following formula:

$$\text{Seconds_to_shutdown} = \frac{(Overload_Setting / 2)^2 * Shutdown_Delay}{(Running_Amps - Overload_Setting)^2}$$

However, if the drive is heavily loaded, it will protect itself by causing an IOT or Instantaneous Overload Trip shutdown before 200% current is reached. The Overload time should be set between two and eight seconds for a submersible motor and 30 to 45 seconds for conventional motors.

Overload	
Setpoint	100 A
Highest Cur Ø	82 A
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	0.3 sec
Shutdown Delay	8 sec
Rstrt On Ovld	Yes
Aux Rstrt Parm	Yes
Auto Restarts	1
Restart Delay	30 min
Max Load I Thd	600 A
Restart On Overload	

Rstrt on Ovld Restart on Overload programs the Overload Auxiliary Restart Parameters (ARPs) to allow the drive one automatic motor restart attempt after an Overload shutdown. All ARPs are accessible from each individual Fault and Alarm Setup screen. However, the case of Overload is unique. When Rstrt on Ovld is set to YES, the ARP for Overload is automatically activated and the restarts set to 1. The illustration at left depicts the ARP settings when this parameter is active.

Aux Rstrt Parm Overload Auxiliary Restart Parameters Enable, when set to YES, forces the Advantage drive to use the Auto Restarts and Restart Delay parameters listed below when it shuts down due to an Overload alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

Auto Restarts Number of Overload Auto Restarts allowed. Controls how many automatic restarts will be allowed when the drive has shut down due to an Overload alarm and the Aux Rstrt Parm has been set to YES.

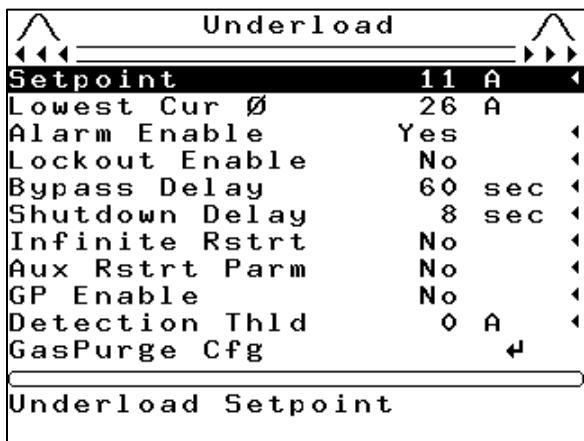
Restart Delay Overload Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to Overload alarm and the Aux Rstrt Parm has been set to YES.

Overload	
Setpoint	100 A
Highest Cur Ø	82 A
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	0.3 sec
Shutdown Delay	8 sec
Rstrt On Ovld	Yes
Aux Rstrt Parm	Yes
Auto Restarts	1
Restart Delay	30 min
Max Load I Thd	600 A
Maximum Load Current Threshold	

Max Load I Thd This parameter is used to set the threshold of allowed load current. Since a step up transformer is typically used, the calculated load current must use the transformer ratio to derive the motor /load current. When the current on any one output phase exceeds this limit, an instantaneous shutdown will occur. The user must enter the value in Amps RMS which is internally converted to the peak value. ($\text{PEAK_AMPS} = \text{AMPS_RMS} * \sqrt{2}$) The drive uses the calculated peak value as the limit and will annunciate the shutdown as a **High Load Current** trip with an indication of which phase of current exceeded the threshold. The factory default value is set to 5000 amps to prevent an unintentional shutdown when this feature is not used.

Underload

This screen groups the parameters concerning Underload protection. Underload alarms protect the motor from insufficient current draw. In submersible pump applications, Underload often indicates that there is a low volume of fluid being pumped. Since the submersible pump's motor is cooled by this flow of fluid, an Underload will usually cause the motor to overheat.



Setpoint The Underload Setpoint parameter must be set to the value of motor current below which the drive will shut down the motor. The typical setting is 15% to 20% below the lowest current phase at minimum output frequency. In cases where an output step-up/step-down transformer is connected between the drive and motor/cable, be sure to include the transformer ratio in calculations of underload settings.

Lowest Cur Ø This parameter displays the lowest current drawn by any one phase. The Underload alarm condition is calculated upon this lowest phase motor current. This point is not adjustable.

Alarm Enable This setpoint controls whether the drive will shut down the motor because of an Underload condition or will ignore it. The factory default setting is YES, Underload protection enabled.

Lockout Enable This parameter determines if the drive will enter a lockout condition after the first shutdown when it has shut down the motor due to an Underload. If this point is enabled and the motor is shut down due to an Underload, the drive will lock out and prevent any further restart attempts until the lockout is cleared. The factory default setting is NO; do not lock out upon shutdown.

Bypass Delay Sets the number of seconds that the Advantage drive will ignore an Underload alarm condition that is present at startup or that occurs during this bypass period. The factory default setting is 60 seconds.

Shutdown Delay Sets the number of seconds that the drive will ignore an Underload alarm condition that exists while the motor is running, but only after

Underload	
Setpoint	11 A
Lowest Cur Ø	26 A
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	60 sec
Shutdown Delay	8 sec
Infinite Rstrt	No
Aux Rstrt Parm	No
GP Enable	No
Detection Thld	0 A
GasPurge Cfg	
Underload Infinite Restarts	

the Underload Bypass Delay timer has expired. The factory default setting is 8 seconds.

Infinite Rstrt Underload Infinite Restarts, if set to YES, will cause the drive to allow an infinite number of Underload shutdowns and restarts. The Advantage drive will normally use the Underload Lockout Enable or the Maximum Allowed Restarts parameters to lock out and disallow excessive automatic starts, thereby protecting the motor from repetitive failed start attempts. There are some situations, however, that require the ability to restart the pump an indefinite number of times when the shutdown cause is Underload. The factory default setting is NO.

Aux Rstrt Parm Underload Auxiliary Restart Parameters, when set to YES, forces the Advantage drive to use the restart parameters listed below when it shuts down due to an Underload alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

Auto Restarts This parameter controls how many Automatic Restarts will be allowed when the drive has shut down due to Underload and the Aux Rstrt Parm has been set to YES.

Restart Delay Underload Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to Underload and the Aux Rstrt Parm has been set to YES.

GP Enable the GasPurge Enable feature parameters are only available when the optional **MaxRate™** software is installed. If enabled, by setting this menu parameter to YES, the controller will attempt to clear any occurring gas locks and keep the pump running.

GP Detect Thld This parameter sets the GasPurge routine's detection threshold. Depending upon which trigger mode is selected, this value can be in units of amps, torque, or output frequency. When the system output falls below this value, a

Underload	
Setpoint	11 A
Lowest Cur Ø	25 A
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	60 sec
Shutdown Delay	8 sec
Infinite Rstrt	No
Aux Rstrt Parm	No
GP Enable	No
Detection Thld	0 A
GasPurge Cfg	
GasPurge Enable	

Underload	
Setpoint	11 A
Lowest Cur Ø	25 A
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	60 sec
Shutdown Delay	8 sec
Infinite Rstrt	No
Aux Rstrt Parm	No
GP Enable	No
Detection Thld	0 A
GasPurge Cfg	
GasPurge Cfg	

gas-lock condition may be occurring and if so, the controller will attempt to clear the gas lock. The trigger mode is selected in the following GasPurge Config menu.

GasPurge Config When the gas purging algorithm is required, configure the required parameters via this menu selection.

The GasPurge functionality is designed to provide a way to initiate changes in pump speed to mitigate gas or pump off events in the well. This system allows the user to configure a trigger condition which will indicate that a gas lock or pump off condition has occurred. If the trigger condition exists for a long enough period of time, the system will respond by decreasing the output frequency of the drive through various cycles. The intent is to vary the conditions at the intake of the pump in order to clear the gas lock condition or allow the well to recover within a prescribed period of time before initiating a shutdown of the motor.

GP Trigger Mode This parameter selects the method used to detect a gas lock and to trigger remedial action. The three choices are:

GasPurge Config	
Trigger Mode	Amps
Bypass Delay	0 min
Bypass Ø Rem	0 min
Num Attempts	0
Max Attempts	0
Detection Time	0 sec
Low Speed Ø	0 sec
Detection Thld	0 A
Lowest Cur Ø	26 A
GasPurge Trigger Mode	

Amps: When the system amperage draw drops below the threshold set in the **GP Detect Thld** parameter, the GasPurge operation will commence.

Torque: When the system torque produced drops below the threshold set in the **GP Detect Thld** parameter, the algorithm will initiate.

HS Clmp: When the drive's output frequency reaches within 0.5Hz (**GP HSC Offset**) of the High Speed clamp parameter, set in the **GP Detect Thld** parameter, the GasPurge routine will begin to operate.

Bypass Delay This parameter is used to force the GasPurge routine to ignore the user-set thresholds while the pump is starting up. Set the value of time in this parameter to a level sufficient to allow the pump to start and accelerate up to the desired speed.

Bypass Time Rem The variable displays the length of time remaining in the bypass delay

Num Attempts This parameter displays the current number of GasPurge attempts the system has tried.

Max Attempts This parameter controls the number of consecutive gas lock purge attempts that will be made before the system stops trying and shuts down, preventing further attempts.

Detection Time The detection time parameter specifies the length of time that the drive must exceed the selected threshold before it will begin to take steps to purge the gas from the pump.

Lo Speed Time The low speed time variable controls the length of time that the motor will spend running at the low speed trip setpoint during the first portion of the gas purge cycle. During the first two purge attempts, the drive reduces the output frequency to the low speed clamp value and holds it there for the GP Lo Sped Time delay. If unsuccessful after two attempts, the drive begins to reduce the output frequency to lower levels with each iteration. On the first attempt (third overall) where the output frequency is reduced to below the low speed clamp, it will be held for the GP Lo Sped Time delay period. During any subsequent attempts, the low speed time delay is automatically changed to 10 seconds and maintained for any remaining cycles. At that point, the delay is not user adjustable. These purge cycles continue until the maximum number of allowed attempts has been attempted, or the gas is purged from the system.

GasPurge Config	
Trigger Mode	Amps
Bypass Delay	0 min
Bypass Rem	0 min
Num Attempts	0
Max Attempts	0
Detection Time	0 sec
Low Speed	0 sec
Detection Thld	0 A
Lowest Cur	26 A

GasPurge Detect Threshold

Note: The last two lines of this screen are dependent upon which of the three trigger modes is selected

If **AMPS** trigger mode is active, the last two lines will show the following:

Detection Thld In Amps trigger mode, this parameter holds the detection trigger threshold. When the current drops below this value, the Gas Purge algorithm will run.

GasPurge Config

Trigger Mode	Torque
Bypass Delay	3 min
Bypass 0 Rem	0 min
Num Attempts	0
Max Attempts	2
Detection Time	0 sec
Low Speed 0	5 min
Torque Thld	0 %
Motor Torque	0 %

GasPurge Torque Threshold

Lowest Current Phase This parameter displays the lowest current available at the drive output.

If the **Torque** trigger mode is selected, the last two lines of the screen will display the following:

GP Trq Thld This parameter holds the torque threshold value in percent. When the output torque drops below this value, the GasPurge routine will operate.

Motor Torque This variable displays the current value of motor torque in a percentage of maximum set torque.

GasPurge Config

Trigger Mode	HS Clmp
Bypass Delay	3 min
Bypass 0 Rem	0 min
Num Attempts	0
Max Attempts	2
Detection Time	0 sec
Low Speed 0	5 min
GP HSC Offset	0.5 Hz
Output Freq	0.0 Hz

GasPurge High Speed Clamp Offset

If the **High Speed Clamp** trigger mode is selected, the last two lines will show the following:

GP HSC Offset This parameter controls how close the output frequency must be to High Speed Clamp before the GasPurge algorithm will run.

Output Frequency This parameter displays the current output frequency generated by the drive and is shown on this screen as a convenience.

Current Unbalance

Setpoint	25.00 %
Iunbal	0.00 %
Alarm Enable	Yes
Lockout Enable	Yes
Bypass Delay	0 sec
Shutdown Delay	2 sec
Aux Rstrt Parm	No

Current Unbalance Setpoint

Current Unbalance

The current unbalance alarm function monitors the three output currents and causes a shutdown if the output unbalance exceeds the user set threshold.

Setpoint Set this variable to the percentage level of current unbalance allowed before a shutdown will occur.

Iunbal This parameter displays the present value of current unbalance in percent.

Current Unbalance	
Setpoint	25.00 %
Iunbal	0.00 %
Alarm Enable	Yes
Lockout Enable	Yes
Bypass Delay	0 sec
Shutdown Delay	2 sec
Aux Rstrt Parm	No

Current Unbalance Bypass Delay

Alarm Enable This setpoint controls whether the drive will shut down the motor because of an unbalanced current condition or will ignore it.

Lockout Enable This parameter determines if the drive will enter a lockout condition after the first shutdown when it has shut down the motor due to an unbalance. If this point is enabled and the motor is shut down due to an Current Unbalance, the drive will lock out and prevent any further restart attempts until the lockout is cleared.

Bypass Delay Sets the number of seconds that the Advantage drive will ignore a Current Unbalance alarm condition that is present at startup or that occurs during this bypass period. The factory default setting is 60 seconds.

Shutdown Delay Sets the number of seconds that the drive will ignore an a Current Unbalance alarm condition that exists while the motor is running, but only after the Underload Bypass Delay timer has expired. The factory default setting is 8 seconds.

Current Unbalance	
Setpoint	25.00 %
Iunbal	0.00 %
Alarm Enable	Yes
Lockout Enable	Yes
Bypass Delay	0 sec
Shutdown Delay	2 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min

Current Unbalance Auxiliary Restart Parameters

Aux Rstart Parm Current Unbalance Auxiliary Restarts Enable, when set to YES, forces the Advantage drive to use the Auto Restarts and Restart Delay parameters listed below when it shuts down due to an Unbalance alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

Auto Restarts Auto Restarts controls how many Automatic Restarts will be allowed when the drive has shut down due to Current Unbalance and the Aux Rstrt Parm Enable has been set to YES.

Restart Delay Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to an Current Unbalance and the Aux Rstrt Parm Enable has been set to YES.

Input Ovrvl t

Setpoint	530 V
Highest Vlts Ø	109V
Alarm Enable	No
Lockout Enable	No
Bypass Delay	4 sec
Shutdown Delay	4 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min

OverVoltage Setpoint

Input Ovrvl t

This screen contains the parameters concerning Input overvoltage protection into one group.

Overvoltage alarms protect the Advantage drive from the stresses that will result from excessive input voltage and provide an indication to the operator that power supply problems exist.

Setpoint The input Overvoltage Setpoint parameter must be set to the value of input voltage above which the drive will shut down the motor. The factory default setting is 530 Volts.

Highest Vlts Ø The Highest Volts phase parameter displays the highest measured incoming voltage of all three phases. The Overvoltage alarm condition is calculated upon this value. This point is not user adjustable.

Alarm Enable This set point controls whether the drive will shut down the motor because of an Overvoltage condition or will ignore it.

Lockout Enable This parameter determines if the drive will enter a lockout condition when it has shut down the motor due to Overvoltage. If this point is enabled and the motor is shut down due to Overvoltage, the drive will lock out and prevent any further restart attempts until the condition is cleared. The factory default setting is NO; do not lock out automatic restarts upon shut down.

Bypass Delay Sets the number of seconds that the Advantage drive will ignore an Overvoltage alarm condition that is present at startup or that occurs during this bypass period. The factory default setting is 4 seconds.

Shutdown Delay Sets the number of seconds that the drive will ignore an Overvoltage alarm condition that exists while the motor is running, but only after the Overvoltage Bypass Delay timer has expired. The factory default setting is 4 seconds.

Aux Rstrt Parm Overvoltage Auxiliary Restarts Enable, when set to YES, forces the Advantage drive to use the Auto Restarts and Restart Delay parameters listed below when it shuts down due to an Overvoltage alarm. If this parameter is set to

Input Ovrvl t

Setpoint	530 V
Highest Vlts Ø	109V
Alarm Enable	No
Lockout Enable	No
Bypass Delay	4 sec
Shutdown Delay	4 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min

OverVoltage Bypass Delay

NO, the drive will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

Auto Restarts Auto Restarts controls how many Automatic Restarts will be allowed when the drive has shut down due to Overvoltage and the Aux Rstrt Parm Enable has been set to YES.

Restart Delay Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to an Overvoltage and the Aux Rstrt Parm Enable has been set to YES.

Input Undvlt	
Setpoint	300 V
Lowest Vlts Ø	109V
Alarm Enable	No
Lockout Enable	No
Bypass Delay	4 sec
Shutdown Delay	1 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
UnderVoltage Setpoint	

Input Undvlt

This screen contains the parameters concerning Input Undervoltage protection into one group. This alarm helps to detect and annunciate power supply problems.

Setpoint The Undervoltage Setpoint parameter must be set to the value of input voltage below which the drive will shut down the motor. The factory default setting is 20% below drive nameplate voltage rating.

Lowest Vlts Ø This parameter displays the value of the lowest phase voltage of all three input phases. The Undervoltage alarm condition is calculated upon this lowest value. This point is not user adjustable.

Alarm Enable This set point controls whether the drive will shut down the motor because of an Undervoltage condition or will ignore it.

Lockout Enable This parameter determines if the drive will enter a lockout condition when it has shut down the motor due to Undervoltage. If this point is enabled and the drive is shut down due to Undervoltage, the drive will lock out and prevent any further restart attempts until the condition is cleared. The factory default setting is NO; do not lock out automatic restarts upon shut down.

Input Undvlt	
Setpoint	300 V
Lowest Vlts	109V
Alarm Enable	No
Lockout Enable	No
Bypass Delay	4 sec
Shutdown Delay	1 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
UnderVoltage Shutdown Delay	

Bypass Delay Sets the number of seconds that the Advantage drive will ignore an Undervoltage alarm condition that is present at startup or that occurs during this bypass period. The factory default setting is 0 seconds.

Shutdown Delay Sets the number of seconds that the drive will ignore an Undervoltage alarm condition that exists while the motor is running, but only after the Undervoltage Bypass Delay timer has expired. The factory default setting is 4 seconds. This time delay is further shortened by a mathematical function that simulates motor heating effects and is established by the constant T/V^2 . Simply stated, the lower the input voltage is, the shorter the time delay will be. In a typical submersible installation the Undervoltage time delay might be set to 4 seconds when the voltage falls below the set point (1 time under voltage set point).

Since the Undervoltage setpoint equals 1 times the Undervoltage level, the T/V^2 constant would be $4/(1)^2 = 4$. The time delay before shutdown would then be:

DelayInSeconds	$== (T/V^2 \text{ CONSTANT}) / [(\text{multiple of undervoltage setpoint})^2]$ $== 4/1^2 == 4 \text{ seconds.}$
----------------	--

If the Undervoltage was to reach 200%, or 2 times the Undervoltage setpoint, the time delay to shutdown would be $4/(2.0)^2 = 4/4$ or 1.00 seconds. The Undervoltage time is typically set between 2 and 8 seconds for a submersible motor and 30 to 45 seconds for conventional motors.

Aux Rstrt Parm Auxiliary Restart parameters, when set to YES, forces the Advantage drive to use the restart parameters listed below when it shuts down due to an Undervoltage alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

Auto Restarts Auto Restarts controls how many Automatic Restarts will be allowed when the drive has shut down due to Undervoltage and the Aux Rstrt Parm has been set to YES.

Restart Delay Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to Undervoltage and the Aux Rstrt Parm has been set to YES.

Input Vunbal

Input Voltage Unbalance alarms are used to detect and annunciate problems with incoming power.

Input Vunbal	
Setpoint	4.00 %
Present Value	2.29 %
Alarm Enable	No
Lockout Enable	No
Bypass Delay	4 sec
Shutdown Delay	1 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
<hr/> Voltage Unbalance Setpoint	

Setpoint The Voltage Unbalance Setpoint parameter must be set to the percentage value of input voltage unbalance above which the drive will shut down the motor. The factory default setting is 4%.

Present Value This parameter displays the present percentage value of Voltage Unbalance. This percentage is defined as the maximum deviation of any one-phase voltage from the average value of all three phases. The Voltage Unbalance alarm condition is calculated upon this percentage of deviation. This point is not user adjustable.

Alarm Enable This set point controls whether the drive will shut down the motor because of a Voltage Unbalance condition or will ignore it.

Lockout Enable This parameter determines if the drive will enter a lockout condition when it has shut down the motor due to Voltage Unbalance. If this point is enabled and the motor is shut down due to Voltage Unbalance, the drive will lock out and prevent any further restart attempts until the condition is cleared. The factory default setting is NO; do not lock out automatic restarts upon shutdown.

Bypass Delay Sets the number of seconds that the Advantage drive will ignore a Voltage Unbalance alarm condition that is present at startup or that occurs during this bypass period. The factory default setting is 4 seconds.

Shutdown Delay Sets the number of seconds that the drive will ignore a Voltage Unbalance alarm condition that exists while the motor is running, but

Input Vunbal	
Setpoint	4.00 %
Present Value	2.29 %
Alarm Enable	No
Lockout Enable	No
Bypass Delay	4 sec
Shutdown Delay	1 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
<hr/> Voltage Unbalance Shutdown Delay	

only after the Voltage Unbalance Bypass Delay timer has expired. The factory default setting is 1 second.

Aux Rstrt Parm Auxiliary Restart Parameters, when set to YES, forces the Advantage drive to use the restart parameters listed below when it shuts down due to an input voltage unbalance alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

Auto Restarts Auto Restarts controls how many automatic restarts will be allowed when the drive has shut down due to an input voltage unbalance and the Aux Rstrt Parm has been set to YES.

Restart Delay Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to an input voltage unbalance and the Aux Rstrt Parm has been set to YES.

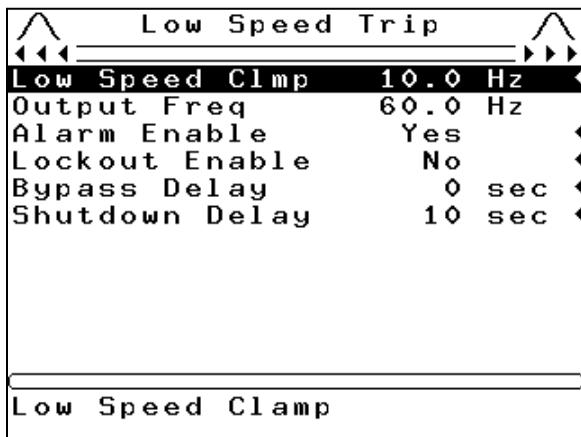
Low Speed Trip

The Low Speed Trip (LST) setpoint protects the motor from operating below a user selected frequency for longer than the specified time delay. Note: if the parameter Speed in RPM is set to YES, this screen will display Pump RPM in place of Motor Hz.

Low Speed Clmp Low Speed Clamp represents the lower limit to the demanded speed. The actual output frequency can drop below this set point. When it falls to 0.5 Hertz below this parameter, the drive will begin to process a Low Speed Trip shutdown if this alarm is on.

Output Freq Output Frequency displays the present operating frequency of the drive. Output Frequency is not adjustable from this set point, although it can be set from the Advantage Basic Setup menu on the Drive Setup page.

Alarm Enable Low Speed Trip Alarm Enable set point controls whether the drive will cause a shutdown due to low output speed. The factory

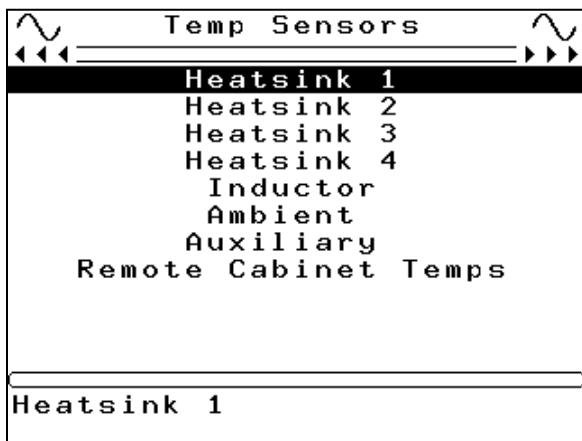


default setting is YES, Low Speed Trip Alarm is enabled.

Lockout Enable Low Speed Trip Lockout Enable controls whether the drive will enter a lockout condition when it has shut down due to a Low Speed Trip alarm condition. If this point is enabled and the motor is shut down due to Low Speed Trip, the drive will lock out and prevent any further restart attempts until the condition is cleared. The factory default setting is NO; do not lock out upon shutdown.

Bypass Delay Low Speed Trip Bypass Delay sets the number of seconds the Advantage drive will ignore a Low Speed Trip alarm condition at startup or occurs during this bypass period. The factory default setting is the sum of the Sync Delay plus the Accel Time delays.

Shutdown Delay Low Speed Trip Shutdown Delay sets the number of seconds the drive will ignore a Low Speed Trip Alarm condition that exists while the motor is running, but only after the Low Speed Trip Bypass Delay timer has expired. The factory default setting is 10 seconds.



Temp Sensors

This menu group provides access to the parameters concerning the temperature sensors built into the Advantage drive. Each heat sensor has a setup screen that gathers all the parameters related to that specific sensor. Highlight the desired menu entry with the cursor bar and press enter to access that screen. Note, not all sensors are installed in all drive models. If not installed, the alarm for that sensor will be disabled at the factory. If a temperature sensor fails in open circuit mode, it will typically exhibit a full-scale reading of 572°F (300°C).

Heatsink 1

This screen displays the parameters pertaining to Heatsink 1. Only the Lockout Enable parameter is user adjustable.

Heatsink 1 Temp	
HS1 Raw	586
Present Value	22 °C
HS1 Thld	85 °C
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	30 sec
Heatsink 1 Present Value	

Present Value This value indicates the scaled temperature reading measured on Heatsink 1.

HS1 Thld Heat Sink 1 over Temperature Threshold is the set point that contains the highest temperature allowed to occur before the drive will cause a shutdown.

Alarm Enable Alarm Enable setpoint controls whether the drive will cause a shutdown due to a temperature reading over the threshold on Heatsink 1.

Lockout Enable Lockout Enable controls whether the drive will enter a lockout condition when it has shut down due to a Heatsink 1 Over Temperature alarm condition. If the motor is shut down due to Heatsink 1 Over Temperature, the drive will lock out and prevent any further restart attempts until the condition is cleared. The factory default setting is NO; do not lock out upon shutdown.

Bypass Delay Bypass Delay sets the number of seconds that the drive will ignore a Heatsink 1 Over Temperature alarm condition that is present at startup or that occurs during this bypass period.

Shutdown Delay Shutdown Delay determines the number of seconds that the drive will ignore a Heatsink 1 Over Temperature alarm condition which exists while the motor is running, but only after the Heatsink 1 Over Temperature Bypass Delay timer has expired.

Heatsink 2

This screen displays the parameters pertaining to Heatsink 2. All parameters are used in the same fashion as those parameters for Heatsink 1. Refer to that section of the manual for further explanation of the parameters. The set point value shown in the graphic represents the factory setting for this heat sensor. With the exception of Lockout Enable, none of the values are user adjustable.

Heatsink 2 Temp	
HS2 Raw	592
Present Value	24 °C
HS2 Thld	85 °C
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	30 sec
Heatsink 2 Present Value	

Heatsink 3 Temp	
HS3 Raw	0
Present Value	0 °C
HS3 Thld	85 °C
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	30 sec
Heatsink 3 Present Value	

Heatsink 3

This screen displays the parameters pertaining to Heatsink 3. All parameters are used in the same fashion as those parameters for Heatsink 1. Refer to that section of the manual for further explanation of the parameters. The set point value shown in the graphic represents the factory setting for this heat sensor. With the exception of Lockout Enable, none of the values are user adjustable.

Heatsink 4 Temp	
HS4 Raw	841
Present Value	105 °C
HS4 Thld	85 °C
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	30 sec
Heatsink 4 Present Value	

Heatsink 4

This screen displays the parameters pertaining to Heatsink 4. All parameters are used in the same fashion as those parameters for Heatsink 1. Refer to that section of the manual for further explanation of the parameters. The set point value shown in the graphic represents the factory setting for this heat sensor. With the exception of Lockout Enable, none of the values are user adjustable.

Inductor Temp	
Ind TmpRaw	595
Present Value	25 °C
Ind TmpThld	180 °C
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	30 sec
Inductor Temp Present Value	

Inductor Temp

This screen displays the parameters pertaining to Inductor Temperature. In the Advantage family of variable speed drives, the inductor, or link reactor, is mounted below the capacitor deck in the air plenum. The actual temperature sensor is mounted near the windings to provide an accurate temperature measurement. All parameters are used in the same fashion as those parameters for Heatsink 1. Refer to that section of the manual for further explanation of the set points. The set point value shown in the graphic represents the factory setting for this heat sensor. With the exception of Lockout Enable, none of the values are user adjustable.

Ambient Temp	
Amb TmpRaw	611
Present Value	30 °C
Amb TmpThld	85 °C
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	30 sec
Ambient Temp Present Value	

Ambient Temp

This screen displays the parameters pertaining to Ambient Temperature. The Ambient Temperature sensor is mounted on the main printed circuit board of the Advantage drive (the ASBB or BSBB) and, in this position, measures the interior temperature of the drive enclosure. All parameters are used and set in the same fashion as those parameters for Heatsink 1. Refer to that section of the manual for further explanation of user set points. The set point value shown in the graphic represents the factory setting for this heat sensor. With the exception of Lockout Enable, none of the values are user adjustable.

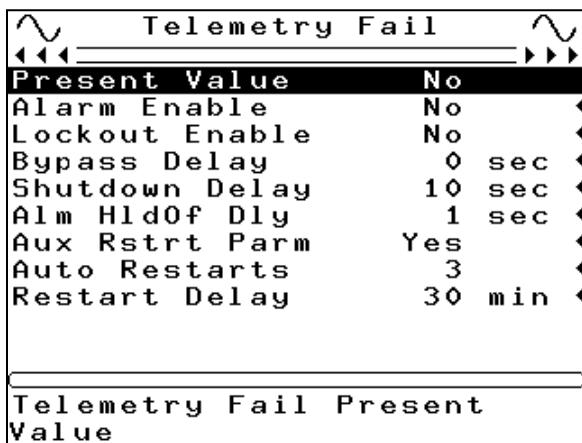
Auxiliary Temp	
Aux TmpRaw	593
Present Value	24 °C
Aux TmpThld	85 °C
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	30 sec
Auxiliary Temp Present Value	

Auxiliary Temp

This screen displays the parameters pertaining to Auxiliary Temperature. All parameters are used and set in the same fashion as those parameters for Heatsink 1. Refer to that section of the manual for further explanation of user set points. The Auxiliary Temperature input can be used for application specific temperature monitoring such as step-up transformer oil temperature. The Auxiliary Temperature input differs from the others in that the parameters are user adjustable.

Telemetry Fail

This alarm screen allows access to the parameters associated with a telemetry failure alarm. A Telemetry Failure alarm is defined as existing when a valid message destined for this drive is not received within the associated time delays. This type of alarm can be useful when the Advantage is connected to a telemetry or SCADA system and the pump must not be allowed to operate during a communications failure. For example, this alarm could be used to shut down a water source well used to feed a process facility when the communication and/or control system in that facility fails.



Present Value This data variable displays the current status of the Telemetry Failure alarm. If this point reads YES and the alarm is enabled, the drive will shut down the motor after the associated time delays have expired. An alarm is considered to be active when the drive is not actively receiving a message for this unit or transmitting a reply to a valid message. Therefore, when enabled, the present value will change from YES to NO when actively communicating. The time delays discussed below allow the user to adjust the length of time before any action is taken due to this alarm.

Alarm Enable This set point controls whether this Telemetry Alarm will cause the drive to shut down the motor when a communications alarm occurs.

Lockout Enable This set point controls whether the drive will or will not attempt an automatic restart when the motor has been shut down because of a Telemetry alarm. If it is set to YES and a Telemetry alarm shutdown occurs, the drive will lock out and prevent any further start attempts.

Bypass Delay This set point represents the amount of time in seconds that the drive will ignore an existing Telemetry Alarm after a start. If a non-zero value is entered into this parameter, the drive will start the motor even while the alarm exists. If the communications system is indeed not operating, this is not desirable because the motor will shut down again as soon as the associated delays expire. Instead, use the Alarm Hold Off Delay timer to control whether the drive restarts while a communications alarm exists.

Shutdown Delay This parameter represents the amount of time in seconds the drive will allow a Telemetry Alarm to exist before shutting down. This alarm time should be set to slightly longer than the total cycle time of the host SCADA computer. For example, if the SCADA host scans this particular drive every nine minutes, the alarm could be set to 10 minutes. If the host SCADA system does not communicate with this drive within that time delay, its motor will be shut down automatically.

Telemetry Fail	
Present Value	No
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	600 sec
Alm HldOf Dly	30 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min

Telemetry Fail Alarm
Holdoff Delay

Alarm HldOf Dly The Alarm Hold Off Delay parameter controls whether the drive will allow the motor to be started while the telemetry alarm exists. If a Bypass Delay is entered into this parameter and the communications system is not operating, the drive will start the motor and probably only run until the Bypass and Shutdown delays expire. This situation will repeat and can result in numerous unnecessary motor starts and even damage. This unique Hold Off Delay lets the drive listen for and determine whether any communications traffic exists on the telemetry system. If valid communications messages exist, it is assumed that a telemetry system is in place and functioning and the motor is allowed to start. In this case, the central SCADA computer must then communicate to this specific Advantage drive within the Bypass plus the Shutdown Delay to prevent a shutdown.

Note: unlike the Bypass and Lockout time delays, this Alarm Hold Off Delay timer is re-triggered by any data traffic, not only messages destined for this unit.

Telemetry Fail	
Present Value	No
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	600 sec
Alm HldOf Dly	30 sec
Aux Rstrt Parm	No

Telemetry Fail Auxiliary
Restart Parameters

Aux Rstrt Parm When set to YES, the Auxiliary Restart Parameter setpoint causes the Advantage to use the restart parameters listed below when it shuts down due to a Telemetry Fail alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart.

Auto Restarts Auto Restarts controls how many automatic restarts will be allowed when the drive has shut down due to Telemetry Fail and the Aux Rstrt Parm has been set to YES.

Restart Delay Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to Telemetry Fail and the Aux Rstrt Parm has been set to YES.

Alarm Setup		
Undrld Alm Enb	Yes	
Ovld Alm Enbl	Yes	
OvrVlt Alm Enb	Yes	
UndrVlt Alm En	No	
VUnbal Alm En	No	
Lo Spd TrpAlm	No	
Aux TmpAlm Enb	No	
DI1 Alm Enbl	No	
DI2 Alm Enbl	No	
DI3 Alm Enbl	No	
AI1 Hi Alm En	No	
AI1 Lo Alm	No	
AI2 Hi Alm En	No	
AI2 Lo Alm	No	
Tel Fail Alm E	No	
Invld ⚡ Alm En	No	
Underload Alarm Enable		

Alarm Setup

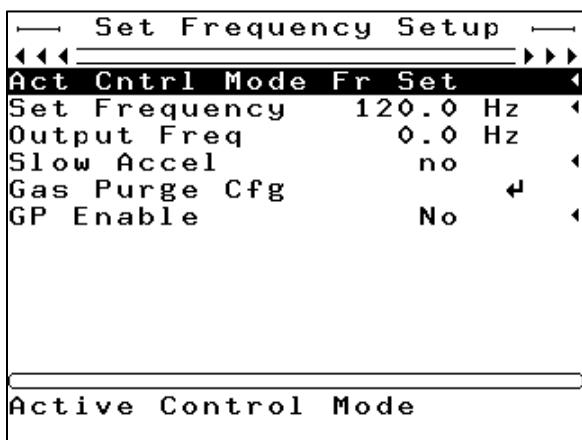
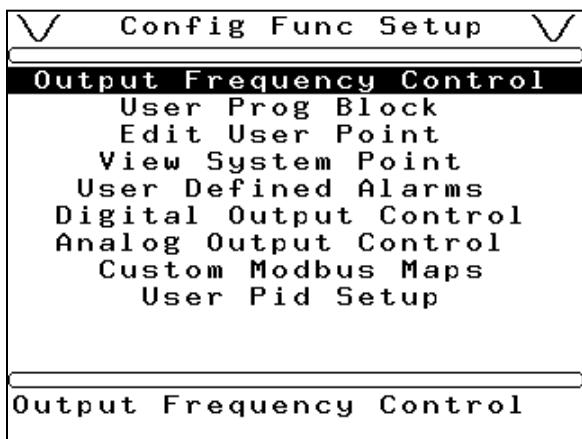
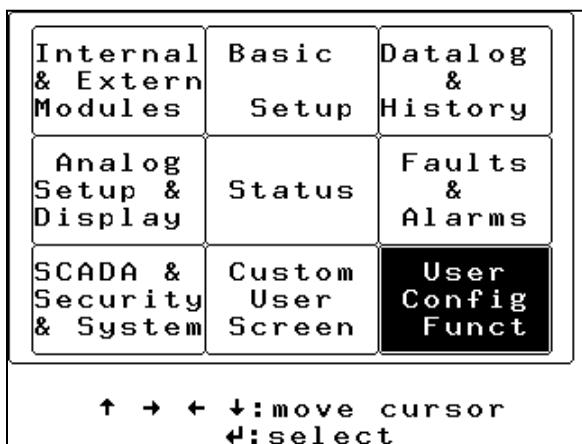
The alarm setup screen is provided as a convenience to the user so that many of the alarm conditions can be enabled or disabled within one screen.

These alarm configuration screens are also accessible from the Faults and Alarms menu screens.

Undrld Alm Enb	Underload Alarm Enable
Ovld Alm Enbl	Overload Alarm Enable
OvrVlt Alm Enb	Input Overvoltage Alarm Enable
UndrVlt Alm En	Undervoltage Alarm Enable
Vunbal Alm Enbl	Voltage Unbalance Alarm Enable
Lo Spd TrpAlm	Low Speed Alarm Enable
Aux TmpAlm Enb	Auxiliary Temp Alarm Enable
DI1 Alm Enbl	Digital Input 1 Alarm Enable
DI2 Alm Enbl	Digital Input 2 Alarm Enable
DI3 Alm Enbl	Digital Input 3 Alarm Enable
AI1 Hi Alm En	Analog Input 1 High Threshold Trip Enable
AI1 Lo Alm	Analog Input 1 Low Threshold Alarm Enable
AI2 Hi Alm En	Analog Input 2 High Threshold Trip Enable
AI2 Lo Alm	Analog Input 2 Low Threshold Alarm Enable
Tel Fail Alm E	Telemetry Fail Alarm Enable
Invld Clock Alm En	Invalid Clock Alarm Enable

These alarm configuration screens are also accessible from the Internal&External Module/ Onboard I/O selection screens.

DI1 Alm Enbl	Digital Input 1 Alarm Enable
DI2 Alm Enbl	Digital Input 2 Alarm Enable
DI3 Alm Enbl	Digital Input 3 Alarm Enable
AI1 Hi Alm En	Analog Input 1 High Threshold Trip Enable
AI1 Lo Alm	Analog Input 1 Low Threshold Alarm Enable
AI2 Hi Alm En	Analog Input 2 High Threshold Trip Enable
AI2 Lo Alm	Analog Input 2 Low Threshold Alarm Enable



USER CONFIG FUNCTION

The User Config Funct (User Configuration Function) group of screens provides access to the programmable functions of the Advantage drive. Several different types of functions are available via this screen, including built-in control algorithms and user configured and defined protection alarms.

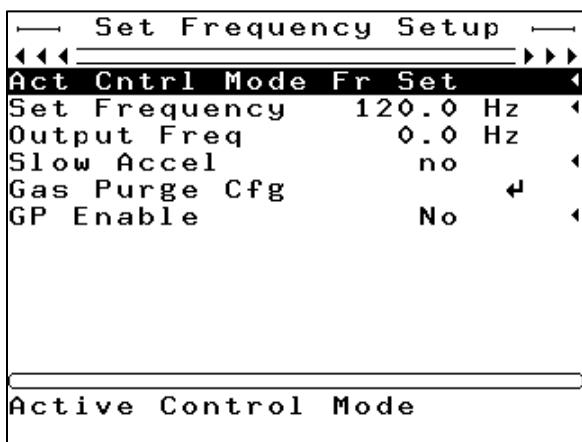
Config Function Setup

The Config Function Setup screen provides access to the available functions.

Output Frequency Control

The output frequency control setup screen provides the user with multiple modes of output speed control. When the user selects one of the modes, the bottom portion of the screen will change to display the parameters pertaining to that type of control algorithm.

Active Control Mode The Active Control Mode determines which algorithm will control the output speed of the drive. Each of the four algorithms uses a set of variables that control its operation. Select the operating mode first, and the rest of the screen will change to display the parameters associated with that control method. The user can now pre-configure a different control mode than presently selected. While viewing the currently selected mode, press the left or right arrow keys to access the configuration screens for the other control modes. The pre-configured control mode will only become active when the user selects that mode from the top line (Act Cntrl Mode) of the mode screen.

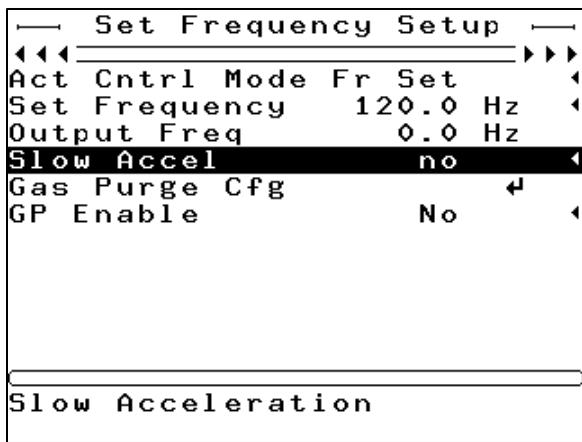


Frequency Setpoint Mode

Active Control Mode: FR SET (Frequency Set point) When the Advantage drive is operating in Frequency Setpoint mode, it will attempt to operate at the user programmed set frequency. Several factors may affect the drive's ability to achieve this frequency, including ILimit, TLimit, High Speed Clamp and Low Speed Clamp.

Set Frequency This user set parameter is the requested operating frequency of the drive. This setpoint can also be entered via the Basic Setup/Drive Setup screen as well as the status screen.

Output Freq This parameter shows the current operating output frequency of the drive.

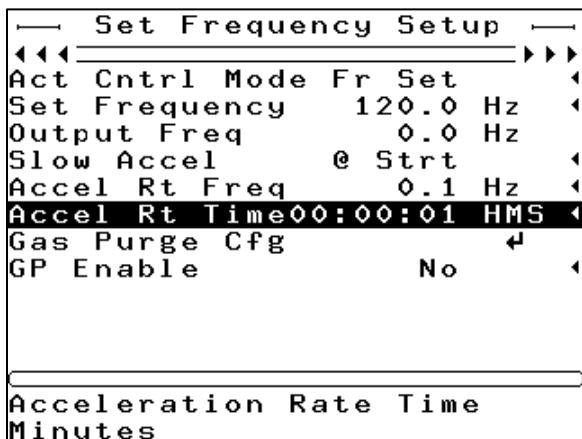


Slow Accel This parameter is used to configure the drive for exceptionally long acceleration times. When activated, the drive will perform a normal start sequence and accelerate to the Low Speed Clamp frequency using the normal Accel Time rate. Once the low speed clamp frequency has been achieved, the Slow Accel parameters become active. The slowest acceleration rate allowed is 0.1 Hertz increase every 99 hours.

Slow Accel (never) When set to Never, the drive will accelerate according to the Accel Time parameter from the Advantage drive Setup menu. Accel Time has a maximum time setting of 200 seconds for 60 Hertz of frequency change or 1 Hertz in 3.3 seconds.

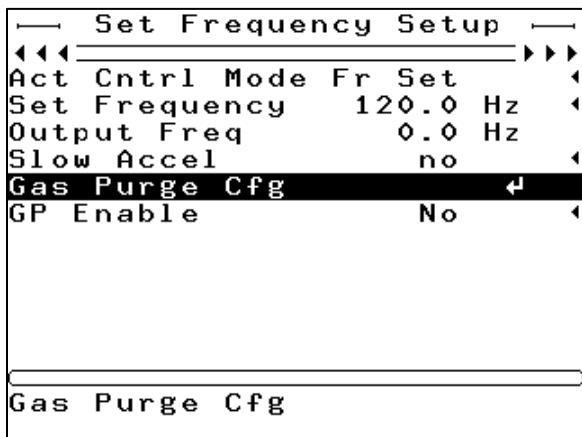
Slow Accel (@ strt) When set to @ Strt, the drive will use the Slow Accel parameters only when the motor is being started. Once the set frequency has been achieved, any subsequent acceleration will occur at the Accel Time rate set in the Advantage drive Setup menu.

Slow Accel (always) When set to Always, the drive will use the slow Accel parameters whenever it needs to accelerate. Deceleration will still occur at the Decel Time rate.



Accel Rt Freq This parameter controls the frequency step size used in the slow acceleration algorithm. It can be set to any value between 0.1 Hertz to 120.0 Hertz.

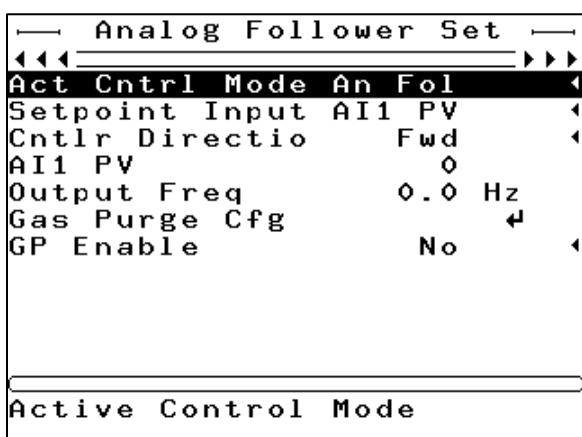
Accel Rt Time This parameter controls the time delay used in the slow acceleration algorithm. It can be set to any value between 1 second and 99 hours. Using the parameters shown in the illustrations at left, the drive will accelerate by 1.0 Hertz every hour.



GasPurge Cfg When the gas purging algorithm is required, configure the required parameters via this menu selection. A full description of the variables utilized in GasPurge are listed and explained in UNDERLOAD section of the manual.

GP Enable This parameter allows the user to enable or disable the Gas Purging Algorithm.

Note: Configuration information pertaining to GasPurge is provided in the Underload section of this manual.

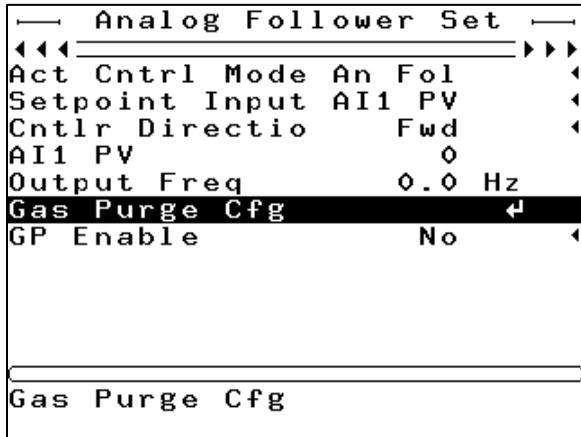


Analog Follower Mode

Act Cntrl Mode: An Fol (Acting Control Mode: Analog Follower) When operating in analog Follower Control mode, the drive will attempt to vary its output frequency between the Low Speed Clamp and High Speed Clamp in proportion to 0% to 100% of the analog input signal selected.

Setpoint Input The Setpoint input dictates which input signal the Advantage drive will attempt to follow. The available inputs are the same as listed for the PID Control Mode Setpoint, but exclude the Manual Setpoint.

Cntlr Direction The Drive Direction parameter selects whether the drive speeds up or slows down in response to a rise (or fall) in the value of the set point. In forward mode, the drive speed increases when the set point input increases. The opposite happens when the direction is set to reverse.



AI1 PV This parameter displays the present value of whichever analog input is selected as the set point. In this example, it will show the present value of Analog Input 1.

Output Freq Output Frequency displays the present output frequency that the Advantage drive is currently producing.

GasPurge Cfg When the gas purging algorithm is required, configure the required parameters via this menu selection. A full description of the variables utilized in GasPurge are listed and explained in UNDERLOAD section of the manual.

GP Enable This parameter allows the user to enable or disable the Gas Purging Algorithm.

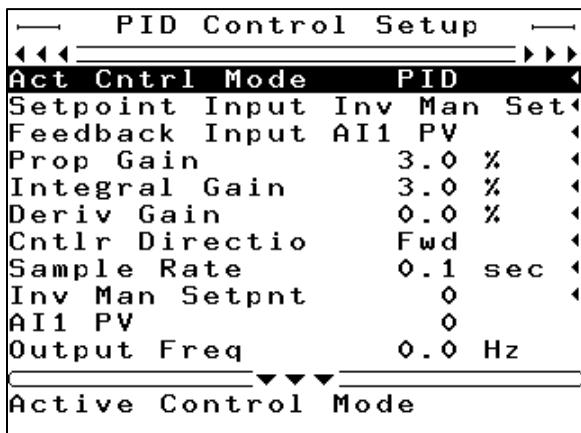
Note: Configuration information pertaining to GasPurge is provided in the Underload section of this manual.

Proportional/ Integral/ Derivative Mode

Active Control Mode: PID When operating in PID mode, the controller will attempt to vary its output frequency in order to maintain a given feedback (analog input signal).

Setpoint Input The setpoint input dictates which control value or input signal will be used as the target that the controller will attempt to reach and maintain. When the cursor is on this point and the user presses ENTER, a Select Item screen will appear as shown at left below. Use the arrow keys to highlight the desired input point and press ENTER. Available inputs are:

Inv Man Setup (Inverter Manual Setpoint) The controller will vary its output frequency to achieve this value of feedback signal. The engineering units entered here must match the units of the selected feedback input.



Available settings include:

AI1 PV (Analog Input 1 Present Value)

The current calibrated and scaled value of the analog signal present on Analog Input 1.

AI2 PV (Analog Input 2 Present Value)

The current calibrated and scaled value of the analog signal present on Analog Input 2.

X1 AI1 PV, X1 AI2 PV (Expansion I/O

Module 1, Analog Input 1 Or 2) The calibrated value of the analog signal present on Analog Input 1 or 2 Of Expansion I/O Module 1.

X2 AI1 PV, X2 AI2 PV (Expansion I/O

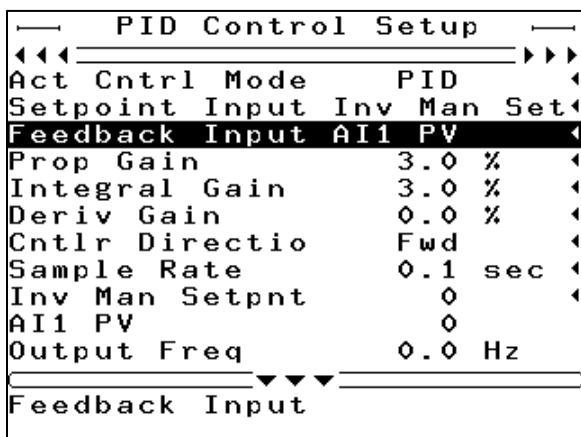
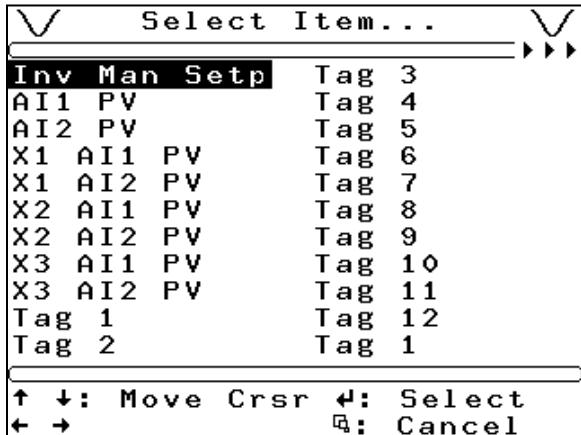
Module 2, Analog Input 1 Or 2) The calibrated value of the analog signal present On Analog Input 1 or 2 Of Expansion I/O Module 2.

X3 AI1 PV, X3 AI2 PV (Expansion I/O

module 3, Analog Input 1 or 2) The calibrated value of the analog signal present on Analog Input 1 or 2 of Expansion I/O Module 3.

Remote Device 1 thru Remote Device 3 (RDCM Device 1 thru Device 3) with data points (Tags) 1 thru 12 on each device. These values are accessed from the RDCM which retrieves the data from connected third party sensors/devices.

Feedback Input The feedback input determines which signal will be used as feedback to the PID control algorithm. Note that the algorithm will not function properly if the setpoint input and the feedback input are set to the same analog input. When this menu item is activated, a select item screen will appear similar to the one displayed above for setpoint input. Use the arrow keys to highlight the desired input point and press ENTER.



Outpt Freq Cntrl	
Control Mode	PID
Setpoint Input	Inv Man Set
Feedback Input	INTAKE PRES
Prop Gain	5.0 %
Integral Gain	1.0 %
Deriv Gain	0.5 %
Cntlr Directio	Rev
Sample Rate	0.1 sec
Inv Man Set PV	124 kPa
INTAKE PRES PV	117 kPa
Output Freq	36.1 Hz
Feedback Input	

Available inputs are:

AI1 PV (Analog Input 1 Present Value)

The current value of the analog signal present on Analog Input 1.

AI2 PV (Analog Input 2 Present Value)

The current value of the analog signal present on Analog Input 2.

X1 AI1 PV, X1 AI2 PV (Expansion I/O

module 1, Analog Input 1 or 2) The calibrated value of the analog signal present on Analog Input 1 or 2 of Expansion I/O Module 1.

X2 AI1 PV, X2 AI2 PV (Expansion I/O

module 2, Analog Input 1 or 2) The calibrated value of the analog signal present On Analog Input 1 or 2 of Expansion I/O Module 2.

X3 AI1 PV, X3 AI2 PV (Expansion I/O

module 3, Analog Input 1 or 2) The calibrated value of the analog signal present on Analog Input 1 or 2 of Expansion I/O Module 3.

Intake Press (Centinel Module Intake Pressure) The Centinel measured intake pressure.

Intake Temp (Centinel Module Intake Temperature) The Centinel measured intake temperature.

Cntl Mtr Tmp (Centinel Motor

Temperature) The Centinel measured motor temperature.

Remote Device 1 thru Remote Device 3

(RDCM Device 1 thru Device 3) with data points (tags) 1 thru 12 on each device. These values are accessed from the RDCM which retrieves the data from connected third party sensors/devices.

Prop Gain Proportional Gain is set as a percentage value (0 to 100%) and represents the proportional gain component of the PID control

PID Control Setup	
Act Cntrl Mode	PID
Setpoint Input	Inv Man Set
Feedback Input	AI1 PV
Prop Gain	3.0 %
Integral Gain	3.0 %
Deriv Gain	0.0 %
Cntlr Directio	Fwd
Sample Rate	0.1 sec
Inv Man Setpnt	0
AI1 PV	0
Output Freq	0.0 Hz
Prop Gain	

algorithm. The factory default setting is 3%. Each time the PID control algorithm is recalculated; an amount proportional to the product of the "error" and the proportional gain is added or subtracted from the output speed demand. The proportional gain component of the algorithm modifies the speed demand to speed up the response of the system since its value is based on the instantaneous error term.

Integ Gain Integral Gain is set as a percentage value (0 to 100%) and represents the integral gain component of the PID control algorithm. The factory default setting is 3%. Every time the control algorithm is updated, the controlling analog input value is compared to the setpoint. The difference between the two represents the error. The output speed demand is increased or decreased by an amount proportional to the product of the error and the Integral Gain. Simply put, the greater the error value, or the higher the gain is set, the greater the change will be.

Deriv Gain Derivative Gain is set as a percentage value (0 to 100%) and represents the derivative gain component of the PID control algorithm. The factory default setting is 0%. The derivative gain component is calculated as the product of the difference between the last two analog input readings (the feedback). This component will decrease the speed demand if the difference is negative and will increase the speed demand if the difference is positive. The derivative gain, therefore, is either added or subtracted from the speed demand which tends to limit the overshoot in systems where a fast response is necessary.

PID Control Setup	
Act Cntrl Mode	PID
Setpoint Input	Inv Man Set
Feedback Input	AI1 PV
Prop Gain	3.0 %
Integral Gain	3.0 %
Deriv Gain	0.0 %
Cntlr Directio	Fwd
Sample Rate	0.1 sec
Inv Man Setpnt	0
AI1 PV	0
Output Freq	0.0 Hz
Deriv Gain	

Cntlr Directio Controller Direction controls the polarity [Direct Acting (FWD) or Reverse Acting (REV)] in which the PID algorithm will apply the speed adjustments. In direct acting, the drive will increase its output frequency in response to an increase in the setpoint. Reverse acting decreases the output frequency in response to an increasing setpoint.

PID Control Setup					
Act Cntrl Mode	PID				
Setpoint Input	Inv	Man	Set		
Feedback Input	AI1	PV			
Prop Gain	3.0	%			
Integral Gain	3.0	%			
Deriv Gain	0.0	%			
Cntlr Directio	Fwd				
Sample Rate	0.1	sec			
Inv Man Setpnt	0				
AI1 PV	0				
Output Freq	0.0	Hz			
PID Sample Rate					

Sample Rate The sample rate parameter allows the user to regulate how often the PID algorithm re-evaluates and re-calculates a new speed demand. If left at the default minimum value of 0.1 seconds, the PID routine will execute ten times per second or every 100mS. Some gauges used as feedback to the PID can have sample periods of up to 30 seconds. If the PID sample rate is much shorter than the feedback update rate, it can lead to unstable control loops with poor response characteristics. The sample Rate variable should always be set to equal or slightly longer than the response time of the device used as the feedback input. This parameter has a resolution of 100 milliseconds.

Inv Man Setpnt (Setpoint Input Present Value)

This variable displays the present value of the setpoint parameter. The Advantage drive will increase or decrease the output frequency so that the value of the feedback sensor equals this setpoint input. If the manual setpoint is selected, the user must enter the value of that point in this parameter. If any analog input is selected as the setpoint, then the value of that input is displayed here instead.

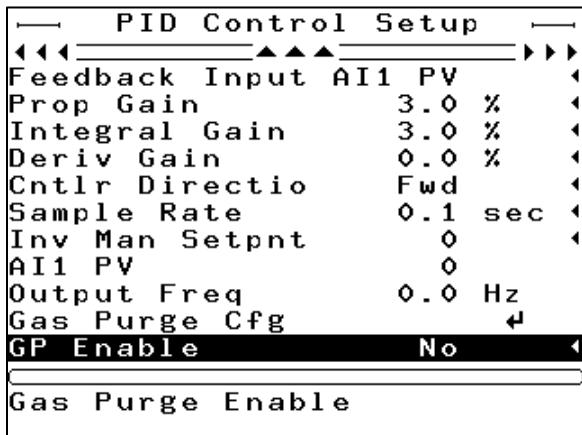
Intake Pres PV (Feedback Input =Intake Pressure Present Value) This variable displays the present value of the selected feedback signal sensor. The sensor input is selected in this screen on the line above called Feedback input.

Inv Man Stpnt (Inverter Manual Setpoint)

Displays the value of the user entered manual set point that the Advantage drive will try to cause the feedback input to match. The drive will increase (or decrease) its output frequency to attempt to accomplish this. If any analog input is selected as the set point, then the value of that input is displayed here instead.

AI1 Prsnt Val (Analog Input 1, Present Value)

Displays the current value of the signal selected as the feedback signal to the drive's PID control loop. If any other analog input is selected as the setpoint, then the value of that input is displayed here instead.



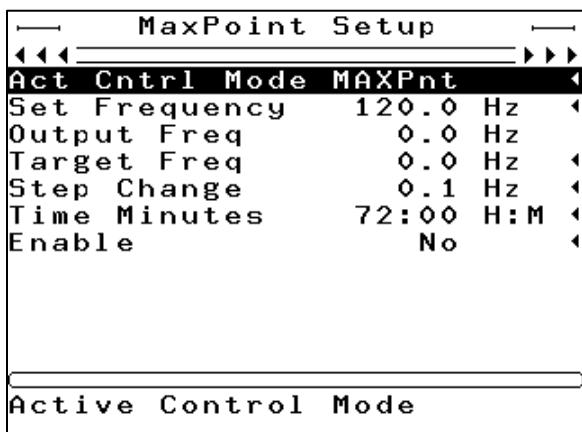
GasPurge Cfg When the gas purging algorithm is required, configure the required parameters via this menu selection. A full description of the variables utilized in GasPurge are listed and explained in UNDERLOAD section of the manual.

GP Enable This parameter allows the user to enable or disable the Gas Purging algorithm.

Note: Configuration information pertaining to GasPurge is provided in the Underload section of this manual.

MaxPoint™ Control Mode

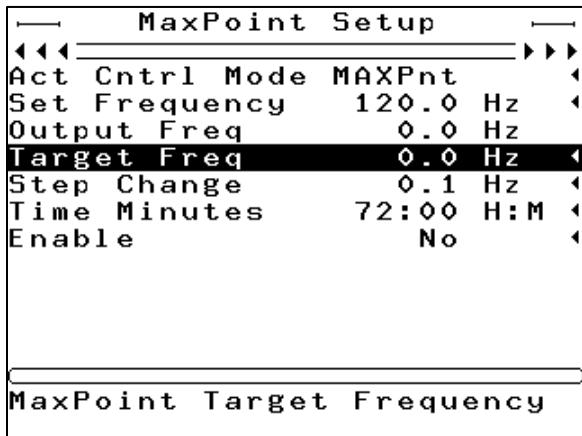
Act Cntrl Mode MAXPnt This frequency control mode is used to cause the Advantage VSD to automatically adjust or sweep its output power frequency up or down within the High Speed and Low Speed Clamps settings, in steps of 0.1 to 15.0 Hertz over a period of time from 1 minute to 96 hours. At the end of the programmed frequency change, the Advantage drive will automatically revert to its Frequency Setpoint mode, and then maintain its output at the last achieved frequency.



If any disruption occurs during a frequency sweep process that causes the motor to shut down, the Advantage drive will disable the MAXPnt™ mode and revert to a frequency set point type of mode. If the drive is subsequently restarted, the Set Frequency will be equal to the last frequency attained while in MAXPnt™ mode.

The MAXPnt™ mode cannot be enabled while the motor is stopped. If the user enables the MAXPnt™ mode while the motor is off, the system will immediately disable it.

To select MAXPnt™ mode, move the cursor to the Control Mode position, press ENTER, then press the UP or DOWN arrow-key to scroll through the available control modes. When MAXPnt™ is displayed, press ENTER again.



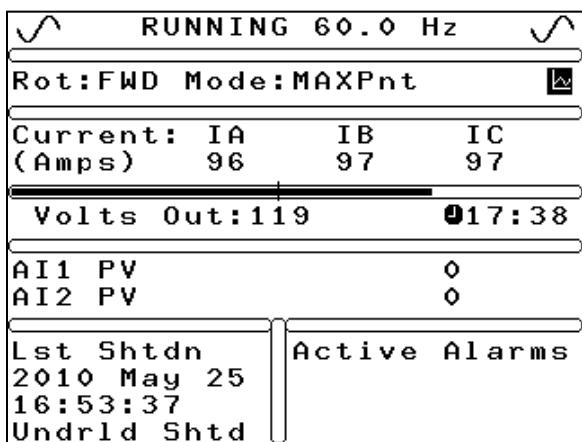
Set Frequency This parameter displays the Output Frequency currently being requested by the system controller.

Output Frequency The parameter displays the present Output Frequency. This can differ momentarily from the Set Frequency above because the drive has a user selectable acceleration and deceleration time delay function and does not change its output instantaneously.

Target Frequency This displays the final frequency that the drive will produce when the sweep function has been completed. This target can be higher or lower than the present Set Frequency.

Step Change The Step Change parameter allows the user to control the size of frequency change. If left at the default value, the step size will be 0.1 Hertz. To force a larger step change in frequency, adjust this parameter up to a maximum of 15.0 Hertz.

Time The Time parameter is used to control the total length of the sweep period, from 1 minute up to 96 hours.



MAXPnt™ Enable When the parameters have been set, start the drive and then change this parameter to YES. At that point, the drive will begin to calculate and execute a series of output frequency changes. If this parameter is set to YES while the drive is stopped, the system will change it back to NO. When MAXPnt™ mode is selected, the Status screen of the Advantage will indicate MAXPnt™ on the MODE parameter. When the function is enabled, the MODE indicator will flash on and off at approximately once per second. If the indicator is not flashing, the MAXPnt™ mode has been selected, but is not currently activated.

MaxRate™ Gas Mitigation Software

MaxRate™ gas mitigation software is an optional software algorithm designed to clear gas locks and manage drawdowns in challenging wells.

Act Cntrl Mode Gas Control

This optional feature is designed to maximize the run time and minimize the shutdown/start-up cycles associated with producing fluids from a well with highly variable gas content. These types of wells can cause a gas-lock in the pump which will stop production or if left unchecked, damage the pump and motor.

Wellbore Type Use this parameter to identify the type of wellbore present in this application. The choices are:

Vertical: This setting is for standard/traditional vertically drilled wells.

Horizontal: Choose this for horizontally drilled/completed wells

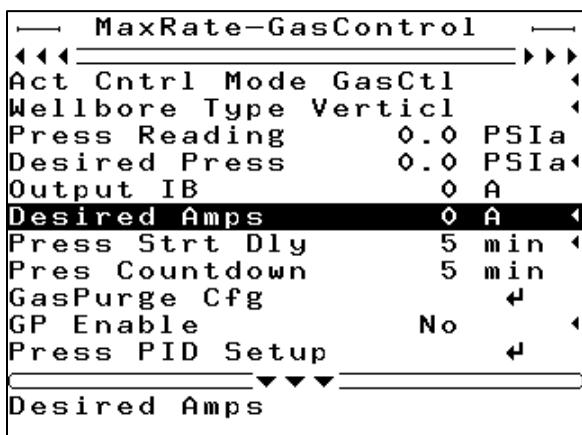
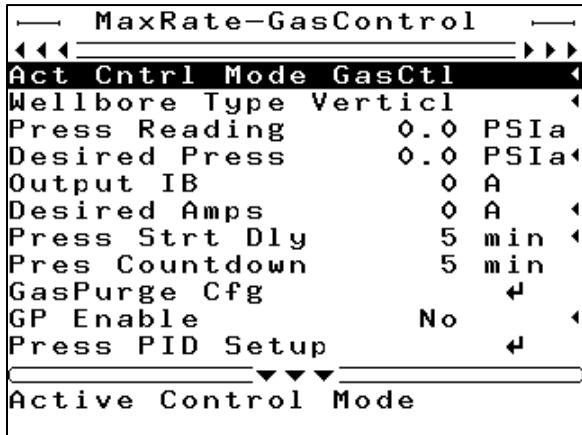
Extreme: Any type of well that exhibits large fluctuations in the frequency and volume of gas produced.

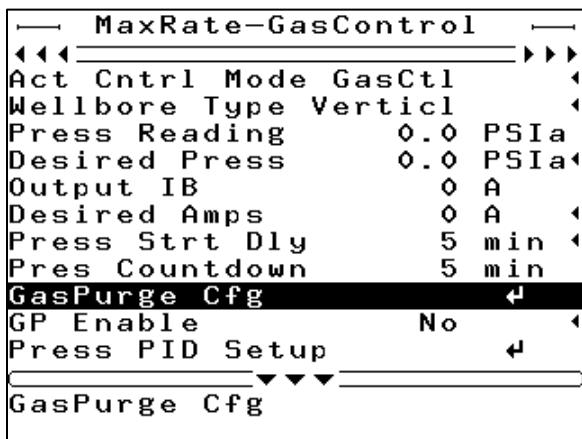
Press Reading This variable displays the currently measured pressure reading from the selected downhole gauge.

Desired Press This parameter holds the desired intake pressure as entered by the user.

Output IB The presently measured output current of phase B is displayed.

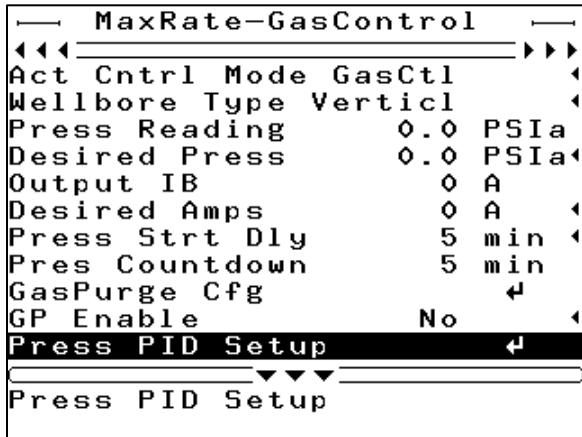
Desired Amps This parameter holds the user entered desired value of amperage output from the drive.





Press Strt Dly This value represents the length of time that the system will wait after a start-up before measuring and reacting to the intake pressure signal by modifying the Desired Amps setpoint described above. The delay value of 5 minutes is used for initial startup only and will be replaced by a new value as demanded by the pressure control loop after the pressure start delay has expired. The most recent stable value of current demanded by the pressure control loop will be retained and used during the next start attempt.

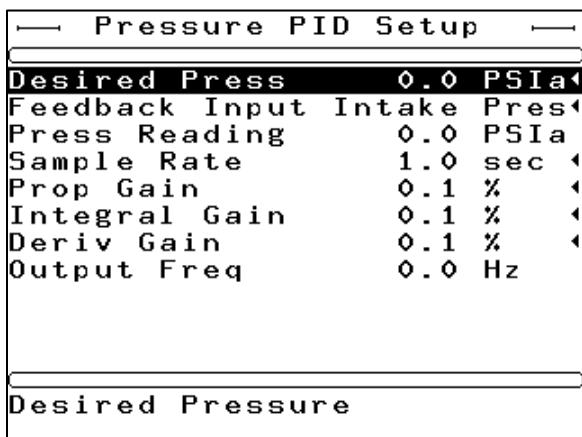
Pres Countdown This variable displays the length of time remaining in the Pressure Start Delay before the GasControl algorithm begins monitoring pressure and reacting to it.



GasPurge Cfg This menu is available when the optional MaxRate™ Gas Mitigation software is installed. Use this menu to configure the parameters used during an automated attempt to break a gas lock condition and purge the gas from the system. The explanation for each of the GasPurge Parameters is provided in the UNDERLOAD section of this manual.

GP Enable This parameter allows the user to enable or disable the GasPurge Algorithm.

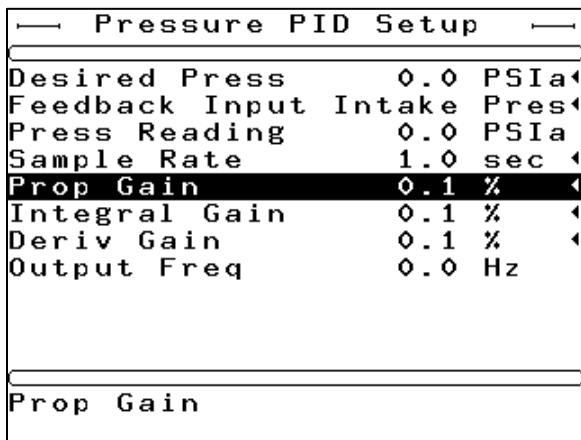
Press PID setup Pressure PID Setup. This menu item provides access to the Proportional /Integral /Derivative control algorithm settings related to the intake pressure. These are utilized within the MaxRate™ Gas Mitigation routine.



Desired Press Desired Pressure holds the user set value of pressure that the drive will attempt to maintain.

Feedback Input This variable is used to specify which input signal will be used by the Pressure PID routine as feedback to the control loop.

Press Reading The present value of pressure reading is displayed in this parameter.



Sample Rate This variable allows the user to specify at which intervals the pressure control PID algorithm runs. This user set value should be equal to or slightly longer than the typical pressure gauge update rate. Additionally, this parameter can be increased to slow the operation of the pressure control loop when long durations between evaluating and acting on the control loop error are desired.

Prop Gain This variable contains the user set value of Proportional Gain. This is used within the PID algorithm to calculate the desired output. Proportional Gain helps to accelerate the change in output when the error term is large.

Integral Gain Integral Gain holds the value of integral gain, used by the PID portion to generate the required output. The integral term is used to resolve all differences between desired output and actual output over time.

Deriv Gain The Derivative Gain portion of a PID control loop is used to minimize or eliminate the over/undershoot of the output when rapid changes in the feedback signals occur.

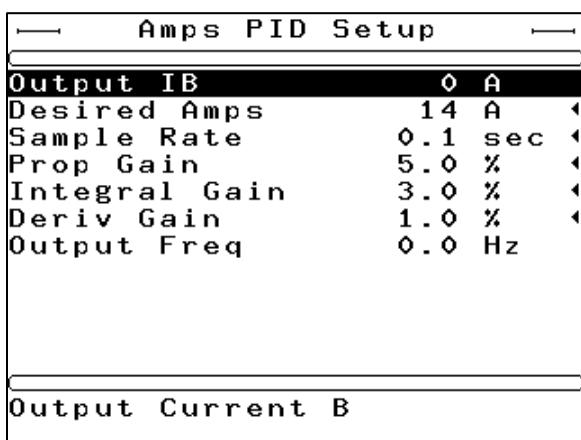
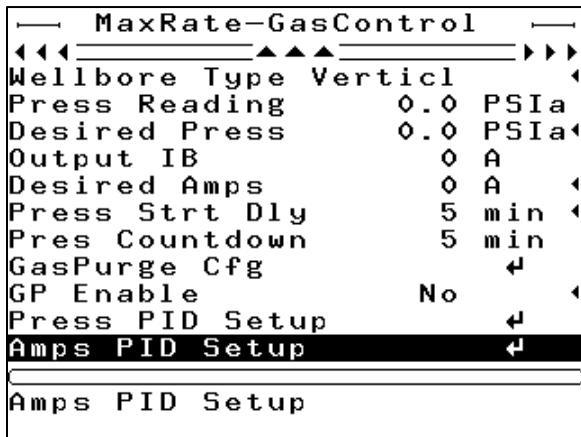
Output Freq This variable displays the present value of output frequency.

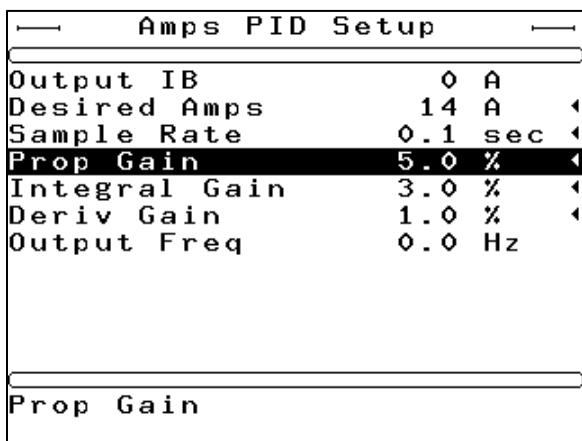
Amps PID Setup This menu item provides access to the Proportional /Integral /Derivative control algorithm settings related to the output amps control loop. These are utilized within the MaxRate™ Gas Mitigation routine.

Output IB This displays the present value of current being produced on Phase B of the drive output.

Desired Amps This parameter holds the user set value of current that the drive is required to produce. Note that when the Pressure PID is operating (following the bypass delay), the system will begin writing new values into this parameter.

Sample Rate The sample rate parameter controls how often this Amps PID routine operates. This parameter can be increased to slow the operation of

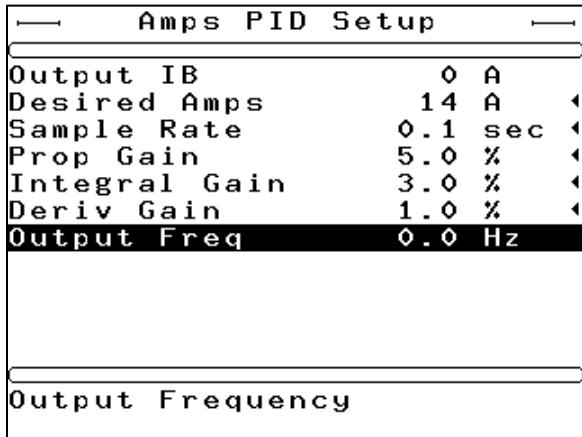




the Amps control loop when long durations between evaluating and acting on the control loop error are desired.

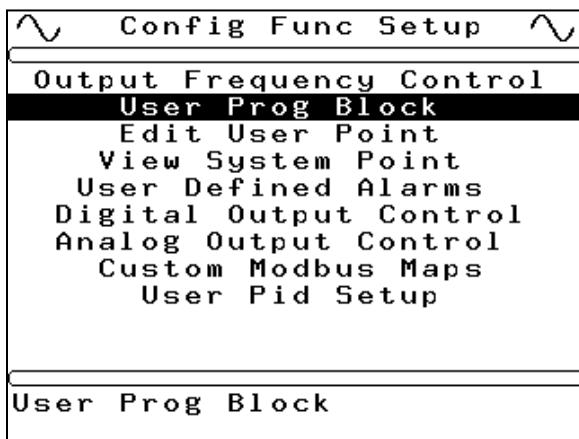
Prop Gain This variable contains the user set value of Proportional Gain. This is used within the PID algorithm to calculate the desired output. Proportional Gain helps to accelerate the change in output when the error term is large.

Integral Gain Integral Gain holds the value of integral gain, used by the PID algorithm to generate the required output. The integral term is used to resolve all differences between desired output and actual output over time.



Deriv Gain The Derivative Gain portion of a PID control loop is used to minimize or eliminate the over/undershoot of the output when rapid changes in the feedback signals occur.

Output Freq This variable displays the present value of output frequency.



User Prog Block

The User Program Block menu provides user access to the execution control block that drives the programmable logic function controller. Using the functions provided, the user can create custom, unique-control algorithms that are not available within the standard controller. The information and description provided in this manual is brief. However, the document titled *Electrospeed Programmable Functions Application Guide* provides more detail.

Edit Prog Block

The Edit Program Block screen allows the user to enter or edit any of the Prog Block variables. There are 48 User Prog Blocks available numbered 0 through 47. When referenced within a User PLC point, the blocks are identified by their database address number with block number zero equaling address 99, block number 1 equaling address 98 and so on. The last Prog Block available is block number 47 at address 52.

Block ID The Block ID variable indicates which Prog Block is presently shown on the screen. The illustration shows User Prog Block number 00 displayed. Move the cursor to highlight this item and press the LEFT/RIGHT arrow-keys to show the last/next block.

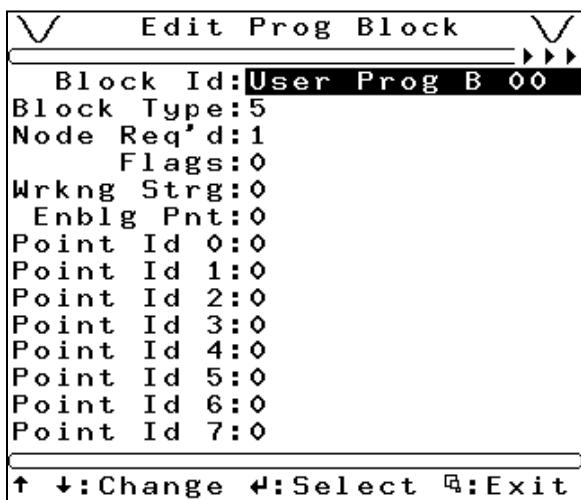
Block Type The User Prog Block type determines what type of function this block will perform. Block Type 5 is general purpose.

Node Req'd The Node Required variable is reserved for future use.

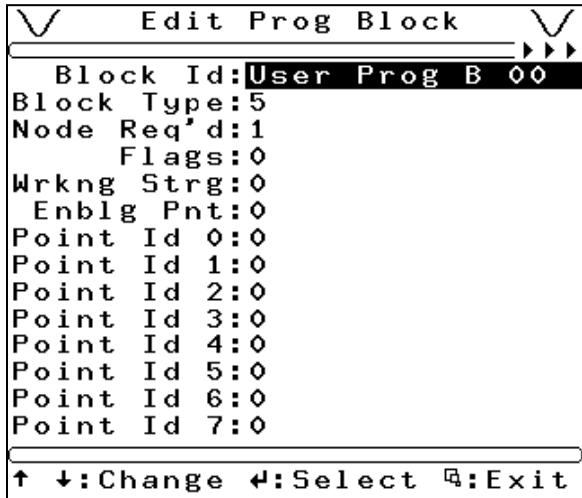
Flags The Flags variable controls execution of the PLC Block.

Wrkng Strg Working Storage is a variable used internally by the Advantage drive.

Enblg Pnt Enabling Point is used to allow/disallow execution of User Prog Block that is configured as a user alarm control block. Enter the Point ID number of a built-in, enabled alarm chain to activate this



Prog Block. When the named alarm chain is enabled, this User Prog Block will also be enabled and processed.



Point ID 0 Point ID 0 holds the user database point number of the first point to execute. Valid entries are point ID 4095 through point ID 3840. The User Prog routine will execute any points listed before the point ID with a zero value. If valid point IDs exist in any subsequent point IDs, they will not be executed.

Point ID 1 Point ID 1 holds the user database point number of the second point to execute. Valid entries are Point ID 4095 through Point ID 3840.

Point ID 2 Point ID 2 holds the user database point number of the third point to execute. Valid entries are Point ID 4095 through Point ID 3840.

Point ID 3 Point ID 3 holds the user database point number of the fourth point to execute. Valid entries are Point ID 4095 through Point ID 3840.

Point ID 4 Point ID 4 holds the user database point number of the fifth point to execute. Valid entries are Point ID 4095 through Point ID 3840.

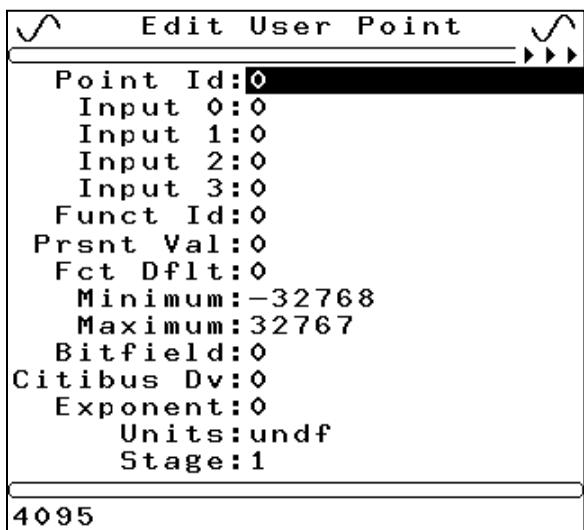
Point ID 5 Point ID 5 holds the user database point number of the sixth point to execute. Valid entries are Point ID 4095 through Point ID 3840.

Point ID 6 Point ID 6 holds the user database point number of the seventh point to execute. Valid entries are Point ID 4095 through Point ID 3840.

Point ID 7 Point ID 7 holds the user database point number of the eighth point to execute. Valid entries are Point ID 4095 through Point ID 3840.

Edit User Point

The Edit User Point menu, in conjunction with the User Prog Block menus, provides access to the user database points used to perform calculations and logical functions. The possible value of a user data point extends the full 16-bit signed and unsigned range. In other words, the data points can range from -32768 to +32767 for signed integers and 0 to 65535 for unsigned integers. All arithmetic operators will function correctly; however, the user/programmer bears the responsibility of testing for calculation overflows.



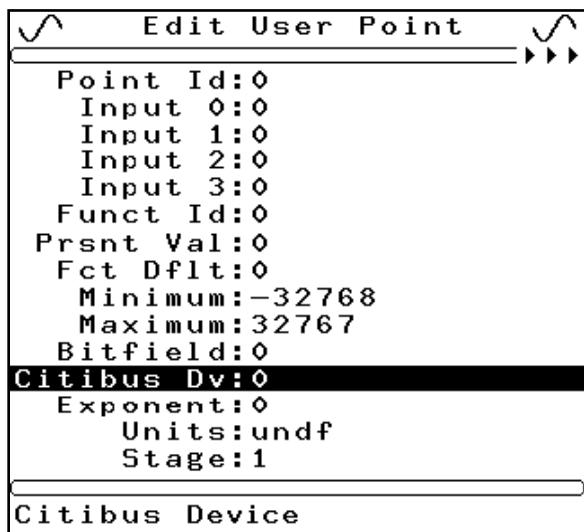
Point ID The Point ID variable is used to identify which database point is being displayed or edited. Move the cursor to this location and press the LEFT/RIGHT arrow-keys to display the previous/next user database point. Press the ENTER key to be allowed to enter the actual point number of any User point. The Advantage drive has 256 User Database points available.

Input 0 This variable is used to indicate the first Point ID that will be used by this User Prog function. This point can be set to the number of any of the available database points in the Advantage drive and is not limited to the 256 user database point addresses. A complete list of addressable database points is available in the *Applications and Troubleshooting Manual*.

Input 1 This variable is used to indicate the second Point ID that will be used by this User Prog function. This point can be set to the number of any of the available database points in the Advantage drive and is not limited to the 256 user database point addresses.

Input 2 This variable is used to indicate the third Point ID that will be used by this User Prog function. This point can be set to the number of any of the available database points in the Advantage drive and is not limited to the 256 user database point addresses.

Input 3 This variable is used to indicate the fourth Point ID that will be used by this User Prog function. This point can be set to the number of any of the available database points in the Advantage drive and is not limited to the 256 user database point addresses.



Funct ID The Function ID variable holds the number identifier of the required function. These functions are listed in the *Advantage Programmable Functions Application Guide*.

Prsnt Val The Present Value parameter contains the current numerical value of this point.

Fct Dflt The Factory Default of the present value for this user database point is held in this variable.

Minimum The Minimum value of this user database point. The default minimum is -32768 (signed 16-bit integer). If this point is declared an unsigned integer, the minimum is limited to zero.

Maximum The Maximum value of this user database point. The default maximum value is 32767 (signed 16-bit integer). If this point is declared an unsigned integer, the maximum value is limited to 65535.

Bitfield The Bitfield variable contains a bit-coded value that classifies the database point according to the value contained. These settings are listed in the *Advantage Programmable Functions Application Guide*.

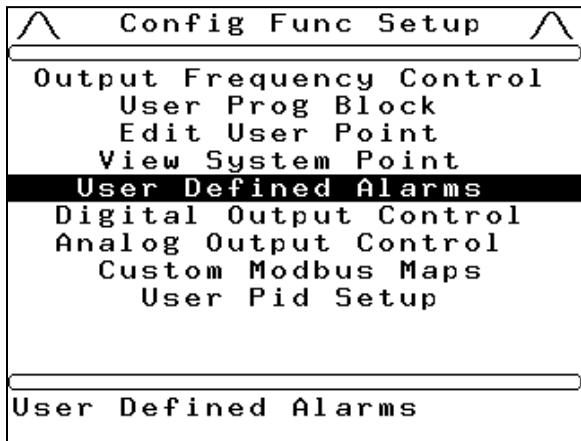
Wrkng Strg Working Storage is a variable used internally by the Advantage drive.

CITIBus Dv Not implemented at this time.

Exponent The Exponent variable defines the location of the decimal point in the present value of this point. A -1 means the value is divided by 10, -2 means the value is divided by 100.

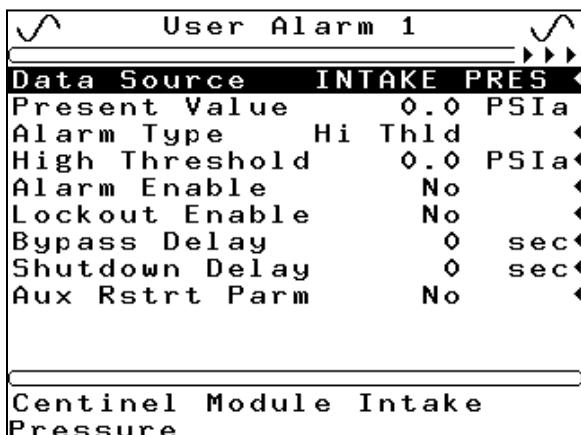
Units The Units variable can be used to assign a label to the value represented by the point.

Stage The Stage variable allows the user to declare this database point to be a signed (stage = 1) or unsigned (stage = 2) 16-bit integer. The range of an unsigned 16-bit integer is -32768 to +32767. An unsigned integer ranges from 0 to +65535.



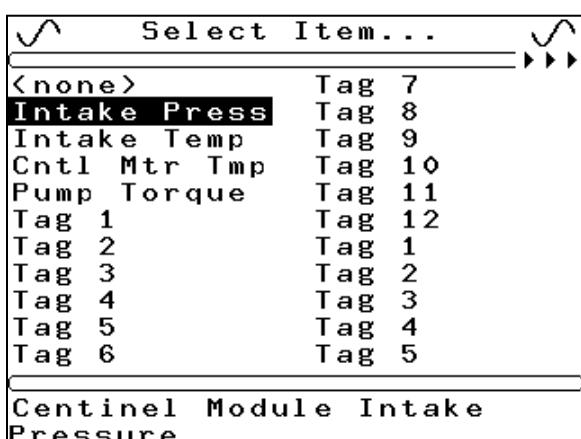
User Defined Alarms

The User Defined Alarms menu provides access to eight configurable alarms. Any number of these alarms can be activated and used to cause a motor shutdown if the defined conditions exist.



User Alarm 1

This menu screen accesses all of the data controlling User Alarm 1. Eight identical, assignable, alarm processing chains exist in the Advantage drive. Only User Alarm 1 is explained in detail since all eight alarms are configured in the same fashion as this one. The data source inputs available include the Centinel Downhole Gauge and the Remote Data Communication Module (RDCM) unit's readings.



Data Source This parameter selects the source of the signal, which will be used in the alarm processing. The example shown has selected Intake Press as the data source. This channel is defined as Centinel Module Intake Pressure, hence that label appears at the bottom of the screen. When selecting a source for the alarm input, an item select screen similar to the one at left will appear.

Present Value The current value of the data source is displayed in this location.

Alarm Type The type of alarm is chosen in this parameter. If High Threshold is chosen, the Advantage drive will consider the alarm condition active when the present value exceeds the set threshold. When Low Threshold is chosen, the alarm will be active when the present value is less than the threshold parameter.

User Alarm 1	
Data Source	INTAKE PRES
Present Value	0.0 PSIA
Alarm Type	Hi Thld
High Threshold	0.0 PSIA
Alarm Enable	Yes
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	0 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
Alarm Enable	

High Threshold This parameter holds the threshold value at which the alarm will become active. If a Low Threshold alarm is selected, this parameter label will read Low Threshold.

Alarm Enable This set point controls if the VSD will shut down the motor because of a User Alarm condition or will ignore it.

Lockout Enable This parameter determines if the VSD will enter a lockout condition when it has shut down the motor. If this point is enabled and the motor is shut down due to User Alarm 1, the VSD will lock out and prevent any further restart attempts until the condition is cleared.

Bypass Delay Sets the number of seconds that the VSD will ignore a User Alarm 1 condition that is present at startup or that occurs during this bypass period.

Shutdown Delay Sets seconds that the VSD will ignore a User Alarm 1 condition that exists while the motor is running, but only after the User Alarm 1 Bypass Delay timer has expired.

Aux Rstrt Parm Auxiliary Restart Parameters forces the Advantage drive to use the restart parameters listed below when it shuts down due to a User Alarm 1 condition. If this is set to NO, the VSD will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

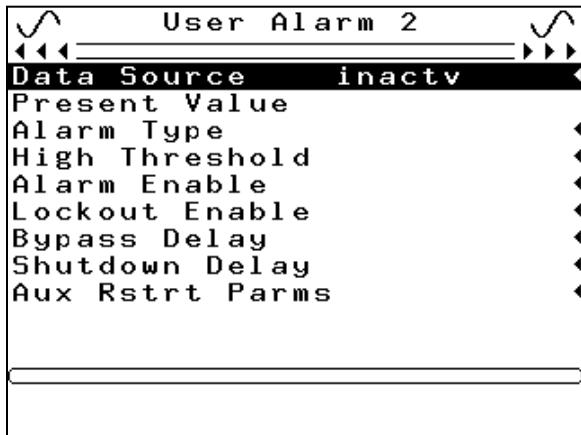
Auto Restarts Auto Restarts controls how many automatic restarts will be allowed when the VSD

has shut down due to a User Alarm 1 condition and the Aux Rstrt Parm has been set to YES.

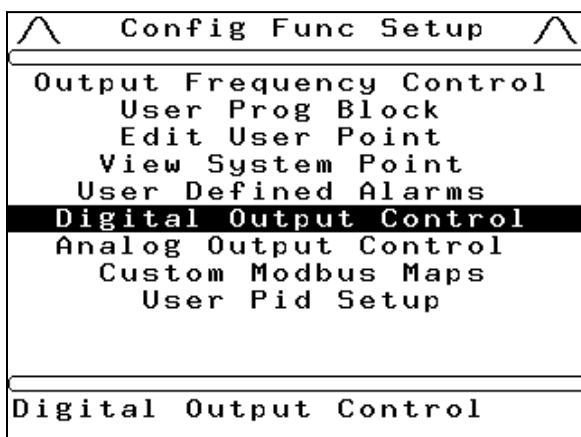
Allowed Starts Allowed starts controls how many automatic restarts will be allowed when the VSD has shut down due to a User Alarm 1 condition and the Aux Rstrt Parm has been set to YES.

Restart Delay Restart Delay controls the length of time the VSD will wait before attempting to restart the motor when it was shut down due to a User Alarm 1 condition and the Aux Rstrt Parm has been set to YES.

User Alarm 2 Through 8



All eight User Alarms are configured in the same fashion. The factory default setting for alarms is to be disabled or inactive as depicted on the graphic at left. Refer to the preceding section, **User Alarm 1**, for setup instructions. If a User Alarm must be deactivated, simply set the Data Source parameter to the blank selection and the variable will read inactv.



Digital Output Control

The Advantage drive software allows the user to use available output relays to annunciate alarms or shutdowns. The relays can be connected to control systems or beacon lamps.

Dig Output Setup					
	Alrms	Sdns	List	Reset	
D01	◀	◀	X	none	
D02	◀	◀	X	none	
D03	◀	◀	X	none	
X1D01	◀	◀	X	none	
X1D02	◀	◀	X	none	
X1D03	◀	◀	X	none	
X2D01	◀	◀	X	none	
X2D02	◀	◀	X	none	
X2D03	◀	◀	X	none	

Digital Output Setup (Alarms)

This column provides a method to select and assign alarms to the digital output listed to the left of the cursor. In the illustration at left, Digital Output 1 (onboard) is going to be configured. Move the cursor to the row containing the desired output and press ENTER to display the screen illustrated next.

Alrms					
Select	All				
X	AI1	Hi	Thld		
X	AI1	Lo	Thld		
X	AI2	Hi	Thld		
X	AI2	Lo	Thld		
X	DI1	Alm			
X	DI2	Alm			
X	DI3	Alm			
X	Iunbal	Alm			
X	VUnbal	Alm			
X	Ovld	Alm			

Select Alarms

This screen allows the user to select which alarms will cause the associated digital output to activate. All available digital output relays on the ASBB are Normally Open relays. One relay on each Auxiliary I/O Module offers both a Normally Open and a Normally Closed contact. The other two relays on the Auxiliary I/O Module have Normally Open (NO) contacts only. The user can select the appropriate switching action desired. When the digital output activates a Normally Open relay it will close the output contacts. If the cursor is highlighting the Select All item as shown at left and the ENTER key is pressed, all available alarms will cause the digital output to activate.

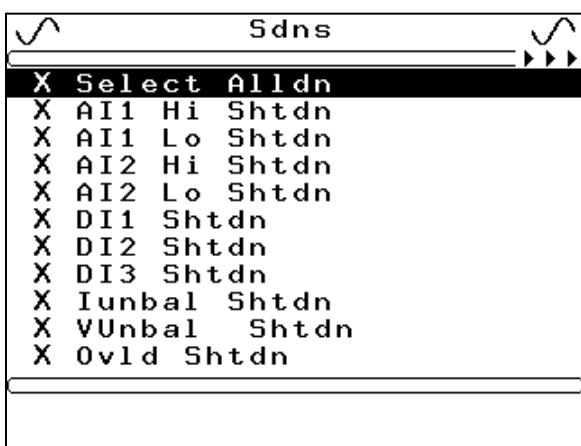
Note, in the case of alarms, the digital output will switch on when the alarm activates and off when it deactivates. In other words, the digital output does not latch the alarm condition. If only individual alarms must be annunciated, move the cursor to highlight that specific alarm, and then press ENTER. The X next to the alarm name will change to a check mark.

Once finished selecting alarms, press MENU to return to the previous screen.

Dig Output Setup					
	Alrms	Sdns	List	Reset	
D01	◀	◀	X	none	
D02	◀	◀	X	none	
D03	◀	◀	X	none	
X1D01	◀	◀	X	none	
X1D02	◀	◀	X	none	
X1D03	◀	◀	X	none	
X2D01	◀	◀	X	none	
X2D02	◀	◀	X	none	
X2D03	◀	◀	X	none	

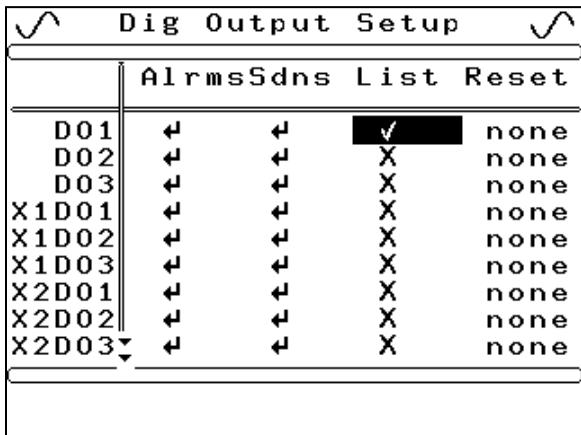
Digital Output Setup (Shutdowns)

This menu item provides a way to assign shutdown events to a specific digital output. Both alarms and shutdowns or any combination thereof can be assigned any specific digital output.



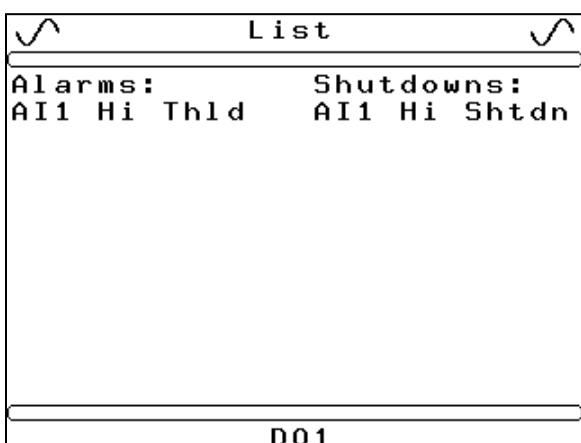
Select Shutdowns

This screen allows the user to select which shutdowns will cause the associated digital output to activate. If the cursor is highlighting the Select All item as shown at left and the ENTER key is pressed, all available shutdowns will cause the digital output to activate. In the case of shutdowns, the digital output will switch on and latch in that state until the user resets it or the motor is restarted. If only select shutdowns are to be annunciated, move the cursor to highlight that specific alarm, then press ENTER. The X next to the shutdown name will change to a check mark. Once finished selecting shutdowns, press MENU to return to the previous screen.



Digital Output Setup (List)

This option provides a list of all alarms and shutdowns associated with the particular digital output. This yields a simple method of checking the status of the configuration. Move the cursor to the row of the digital output in question and press the ENTER key. In the example illustration at left, the list shown will pertain to Digital Output 1. The example list generated will resemble the illustration below.



Digital Output Setup (View List)

This screen shows a list of Alarms and Shutdowns assigned to the associated digital output. The illustration at left depicts that Analog Input 1, High Threshold alarm and Shutdown (AI1 Hi), annunciated on Digital Output 1 (DO1). Each of the available digital outputs will have a screen similar to this one.

Dig Output Setup				
	Alrms	Sdns	List	Reset
D01	◀	◀	X	none
D02	◀	◀	X	none
D03	◀	◀	X	none
X1D01	◀	◀	X	none
X1D02	◀	◀	X	none
X1D03	◀	◀	X	none
X2D01	◀	◀	X	none
X2D02	◀	◀	X	none
X2D03	◀	◀	X	none

Digital Output Setup (Reset)

This option allows the user to designate a digital input to be used as the reset or acknowledge signal for the shutdown annunciations. When an Advantage drive is integrated into a process control system, it is common to require all alarm and shutdown annunciations to be cleared before a start is allowed. If this parameter is left in the default state of None, the output annunciation will only be reset when the motor is started. If a specific reset/acknowledge input is desired, move the cursor to the correct row in the Reset column, press ENTER, then select the appropriate input from the list shown in the subsequent screen.

Config Func Setup	
Output Frequency Control	
User Prog Block	
Edit User Point	
View System Point	
User Defined Alarms	
Digital Output Control	
Analog Output Control	
Custom Modbus Maps	
User Pid Setup	

Analog Output Control	
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Analog Output Control

This function allows the user to select an analog input signal or source and use it to drive an analog Output on the Expansion I/O Modules. This function is useful when interfacing Advantage drive units with an external control system as is commonly implemented with standalone Programmable Logic Controllers (PLC).

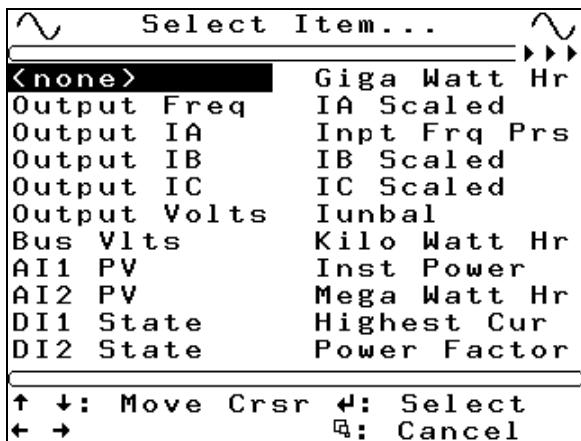
Analog Out Setup	
X1	A01 Sig Src
X1	A02 Sig Src
X2	A01 Sig Src
X2	A02 Sig Src
X3	A01 Sig Src
X3	A02 Sig Src

Exp I/O 1 A01 Signal Source	
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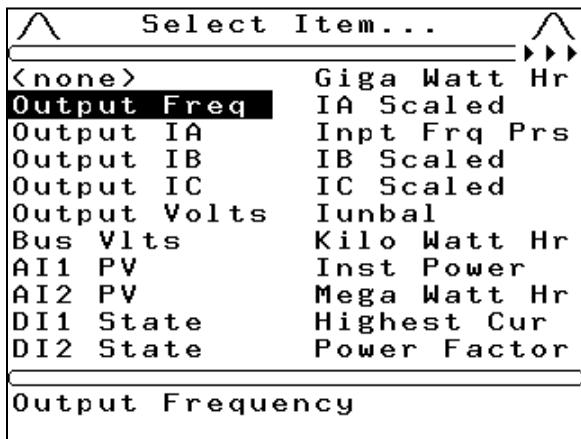
Analog Out Setup

From this screen, the user selects one of the available analog Output channels. Once a channel is chosen, the following menu screens provide a means to select the signal that will be driven out of that channel.

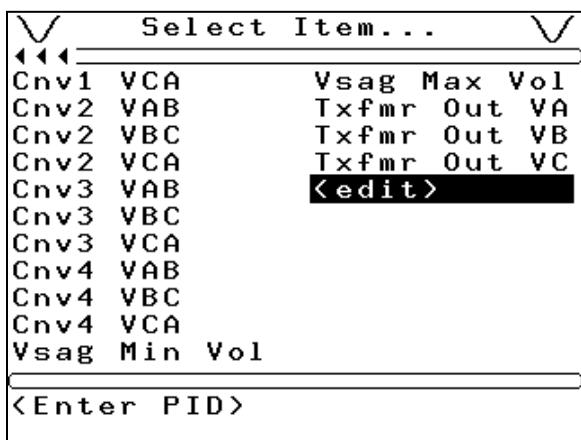
In the example at left, pressing the ENTER key will allow the user to select a signal source to drive analog Output 1 on Expansion I/O Module 1.



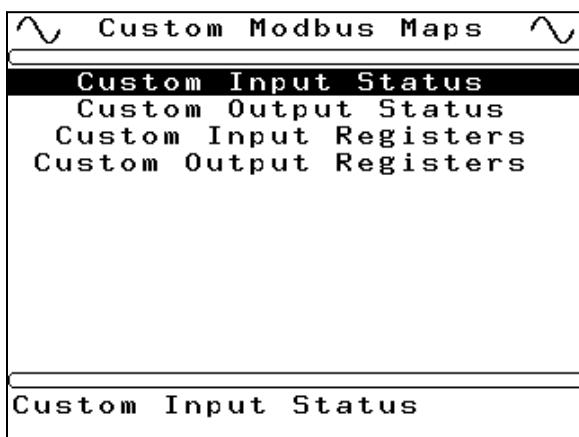
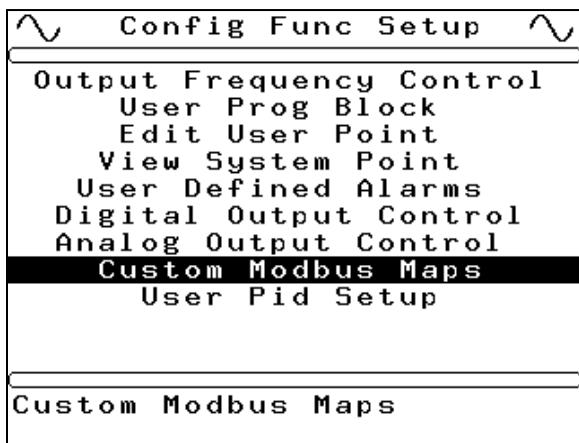
Select Item (None) The default state of the analog Output Control is for each analog output to have no signals driving it. To return to this state, move the cursor to highlight the <none> menu item and press ENTER.



Select Item (Output Freq) In the case of an Advantage drive, the user can use the present value of the output frequency to drive a 4-20 mA analog Output signal. When the signal source is selected, the Advantage drive will configure the analog Output parameters to match the units and the span of that source. In most cases those values will be sufficient, but they can be user modified if necessary.



Select Item (Edit) If the desired signal source is not listed in the list of available data points, the user can select any valid Point Identifier (Point ID) number via the <edit> menu item. Move the cursor to highlight this item and press ENTER. Then use the arrow-keys to enter the desired Point ID number.



Cstm Input Status	
Custom Adrs	System Adrs
10001	10257
10002	10294
10003	10297
10004	10300
10005	0
10006	0
10007	0
10008	0
10009	0

System Adrs ID = 18

Custom Modbus Maps

The Custom Modbus Map function can be useful for users configuring a SCADA or monitoring system using Modbus Protocol. The user can reorganize data contained in widely separated address locations within the Advantage drive into a single contiguous block of addresses. This means the SCADA system can retrieve up to 125 data and/or parameter values with a single function call instead of several. This will minimize the transmission time required to retrieve the data and enhance throughput of the SCADA system. A separate block of 250 user-assigned addresses is available for each of the data types in this VSD. In keeping with Modbus conventions these blocks are named input Status, Output Status, input Registers and Output Registers.

Custom Input Status

Input Status registers represent digital inputs or parameters that can have a value of only 0 or 1. Input Status registers cannot be written to, or modified by, the SCADA system. Their value is dependent on their input signals or values. Input Status registers are read using Modbus function code 2.

Custom Input Status Configuration

This screen allows the user to remap up to 250 input status (read only) registers. The column on the left of the screen represents the user-defined address while the column on the right is used to enter the existing system address of the desired database point. In the example at left, the four addresses represent Onboard Digital Input 1 Shutdown alarm (10257), Expansion I/O 1, Digital Input 1 Present Value (10294), Expansion I/O 2, Digital Input 1 Present Value (10297) and Expansion I/O 3 Digital Input 1 Present Value (10300). The SCADA system retrieves the value of those four widely-separated parameters with one Read Status request with a starting address of 10001 and a register count of 4. Attempting to read a custom address that has no corresponding system address assigned (Custom Adrs 10005 at left, for instance) will result in an error message indicating an invalid address. Consult a Modbus Protocol specification for an explanation of

exception and error code messages. This information can also be found in the *ADV_GCS Modbus Protocol Support Guide* available from Baker Hughes.

Custom Output Status Configuration

This screen allows the user to remap up to 250 output status (read and write) registers. The column on the left of the screen represents the user-defined custom address while the column on the right is used to enter the existing system address of the desired database point. In the example shown at left, three output status registers have been remapped to custom addresses 00001, 00002 and 00003. The data formerly available only at addresses 00513 (Central Shutdown Request), 00539 (SCADA Stop) and 00538 (SCADA Start) can now be read and written to at the custom addresses. Attempting to read a custom address that has no corresponding system address assigned (Custom Adrs 00004 at left, for instance) will result in an error message indicating an invalid address. Consult a Modbus Protocol specification for an explanation of exception and error code messages. This information can also be found in the *ADV_GCS Modbus Protocol Support Guide* available from Baker Hughes.

Custom Input Registers

The Custom input Registers screen allows the user to remap up to 250 existing input registers (read-only analog values). The column on the left of the screen represents the user-defined custom address while the column on the right is used to enter the existing system address of the desired database point. In the example shown at left, five input registers have been remapped to custom addresses 30001 through 30005. The data formerly available only at addresses 30258 (Current phase A), 30259 (Current phase B), 30260 (Current phase C), 30266 (Value of Analog Input 1) and 30377 (Motor rpm) can now be read at the custom addresses. Attempting to read a custom address that has no corresponding system address assigned (Custom Adrs 30006 at left, for instance) will result in an error message indicating an invalid address. Consult a Modbus Protocol specification for an explanation of exception and error code messages. This information can also be found in the *ADV_GCS*

Cstm Output Status	
Custom Adrs	System Adrs
00001	513
00002	539
00003	538
00004	0
00005	0
00006	0
00007	0
00008	0
00009	0
System Adrs	ID = 19

Cstm Input Regs	
Custom Adrs	System Adrs
30001	30258
30002	30259
30003	30260
30004	30266
30005	30377
30006	0
30007	0
30008	0
30009	0
System Adrs	ID = 16

Modbus Protocol Support Guide available from Baker Hughes.

Custom Output Registers

Cstm Output Regs	
Custom Adrs	System Adrs
40001	40514
40002	41068
40003	0
40004	0
40005	0
40006	0
40007	0
40008	0
40009	0

System Adrs ID=17

The Custom Output Registers screen allows the user to remap up to 250 existing output registers (read and write analog values). The column on the left of the screen represents the user-defined custom address, while the column on the right is used to enter the existing system address of the desired database point. In the example shown at left, two output registers have been remapped to custom addresses 40001 and 40002. The data formerly available only at addresses 40514 (Restart Delay Minutes) and 41068 (RDCM Device 3 Tag 12) can now be read at the custom addresses.

Attempting to read a custom address that has no corresponding system address assigned (Custom Adrs 40003 at left, for instance) will result in an error message indicating an invalid address.

Consult a Modbus Protocol specification for an explanation of exception and error code messages. This information can also be found in the *ADV_GCS Modbus Protocol Support Guide* available from Baker Hughes.

User PID Setup

The User PID screen permits a user to configure a closed-loop control system utilizing the analog inputs and outputs available within the Advantage controllers. Note that this PID control algorithm is independent of the existing PID output frequency control function used to control the drive's output. To learn more about the theory behind this proportional, integral, derivative (PID) control method consult any of the engineering texts that explain the concepts in detail.

Config Func Setup	
Output Frequency Control	
User Prog Block	
Edit User Point	
View System Point	
User Defined Alarms	
Digital Output Control	
Analog Output Control	
Custom Modbus Maps	
User Pid Setup	

User Pid Setup

User PID Setup	
Usr PID Enbl	No
Setpoint Input	User PID Se
Feedback Input	AI1 PV
Output Point	X1 A01 PV
Prop Gain	0.3 %
Integral Gain	0.3 %
Deriv Gain	0.0 %
Cntlr Directio	Fwd
Sample Rate	0.5 sec
Setpoint Input	OPSIa
Feedback Input	OPSIa
▼▼▼	
User PID Enable	

User PID Enbl After the required parameters have been configured, use this variable to engage the PID control loop by setting it to YES. To disengage the PID control loop, set this variable to NO.

Setpoint Input This parameter is used to hold the value that the user wishes the system to achieve in its feedback input. Use the arrow keys to move the highlight cursor to this point and press the ENTER

key. A screen similar to the Select Item one shown below will appear. In the example shown at left, the setpoint will be a User PID Manual setting. Thus the value of the setpoint will be entered manually by the user in the parameter further down this screen labeled Usr PID Man St.

Select Item (Setpoint Input) This screen presents the user with a list of available inputs that can be used as setpoint input parameters for the User PID control loop. The illustration at left shows the USR PID Manual setpoint highlighted. Press the ENTER key to select this variable or the arrow keys to highlight and select another input.

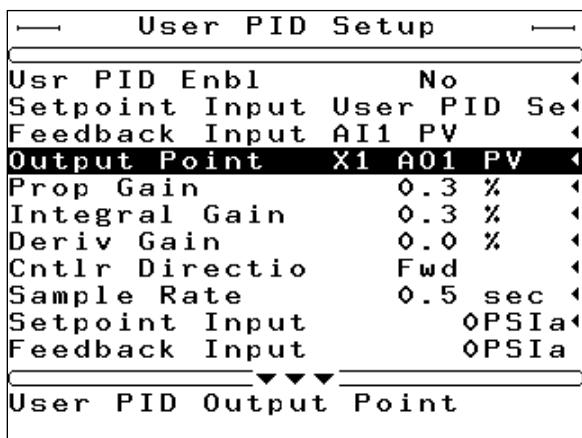
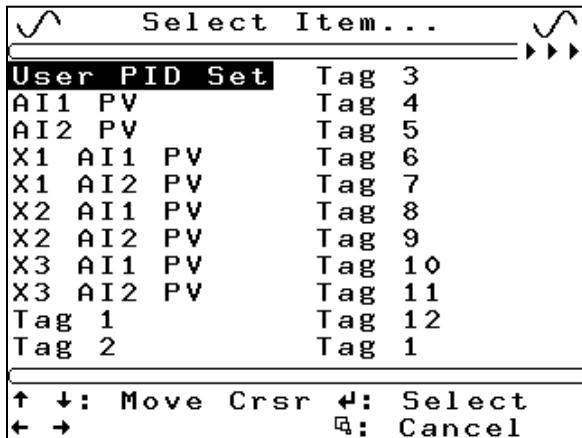
Setpoint inputs are frequently configured to be physical analog signals wired to analog inputs of the controller. The example above uses a manually entered value for the setpoint to illustrate that possibility.

Feedback Input This parameter is used to configure the analog input point used to measure the present value of the system being controlled. The example shows onboard Analog Input 1 as the feedback. In this case the analog input is measuring a pressure in pounds per square inch (PSI).

Output Point This parameter is used to select the output point that the PID control loop will adjust up or down in value. In such a closed-loop system, it is assumed that when the value of the output point is modified, it will affect the process and cause a corresponding change in the feedback input. To select an output point, move the cursor to highlight this line and press the ENTER key. The example shows Expansion I/O module 1's Analog Output 1 as the controllers output. A Select Item screen will be displayed that is similar to the one previously described for the setpoint input.

Prop Gain This variable is used to set the percentage of proportional gain used within the PID control algorithm.

Integral Gain This variable is used to set the percentage of integral gain used in the PID control loop.



User PID Setup		
Usr PID Enbl	No	
Setpoint Input	User	PID Set
Feedback Input	AI1	PV
Output Point	X1	A01 PV
Prop Gain	0.3	%
Integral Gain	0.3	%
Deriv Gain	0.0	%
Cntlr Directio	Fwd	
Sample Rate	0.5	sec
Setpoint Input	0	PSIa
Feedback Input	0	PSIa
User PID Sample Rate		

Deriv Gain This variable is used to set the percentage of derivative gain used in the PID loop.

Cntlr Direction The Controller Direction parameter is used to define the PID control loop as forward acting or reverse acting. For this controller the definitions of forward or reverse are as follows:

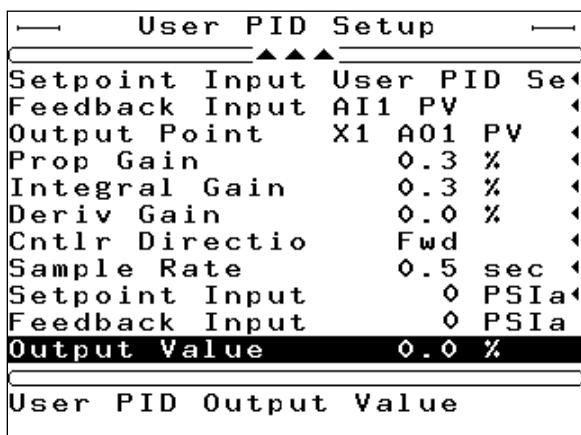
Sample Rate The sample rate parameter allows the user to regulate how often the PID algorithm re-evaluates and re-calculates a new output demand. If left at the default minimum value of 0.5 seconds, the PID routine will execute two times per second or every 500 mS. The sample Rate variable should always be set to equal or slightly longer than the response time of the device used as the feedback input. This parameter has a resolution of 0.5 Seconds.

Forward acting: when the value of the feedback input is less than the value of the setpoint, the value of the output point will increase.

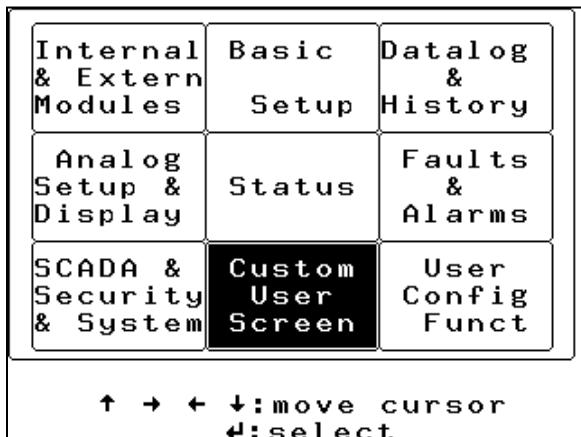
Reverse acting: when the value of the feedback input is less than the value of the setpoint, the value of the output point will decrease.

User PID Setpo User PID Manual Setpoint This parameter is used to display the value of, or accept entry of the PID setpoint. In the example shown, the system is configured to use the manually entered PID setpoint. Therefore to enter the desired value of this manual setpoint, move the cursor to this line and press the ENTER key. Use the arrow keys to enter the desired value and when finished press the ENTER key again. If the setpoint input selected is an analog input, this parameter will not be editable, but the present value of the selected analog input will be displayed.

Feedback Input This menu line displays the present value of the feedback input. In the example shown, the feedback input is set to AI1 PV (Onboard Analog Input 1, Present Value). Therefore this line displays the present value of that analog input.

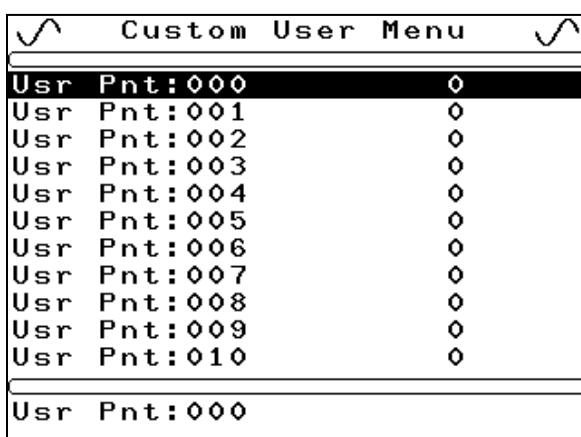


Output Value This parameter displays the output value in percentage of full scale that the User PID control routine is presently demanding. Once the feedback input and the setpoint input are equal in value, the output will stabilize at the value that produces that equality. The output value can also be monitored by the user to ensure that the User PID control is working properly



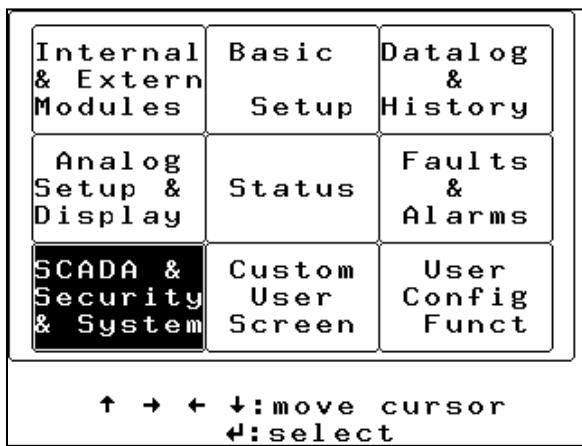
CUSTOM USER SCREEN

The Custom User Screen provides a user configurable display screen. Parameters from other display screens can be copied to this one, allowing the user to create a customized screen of data.



Custom User Menu

As shown in the graphic at left, the Custom User Menu displays eleven data variables. Each of the eleven lines of data can be configured to display any data found in the drive. The factory default configuration shows the value of the first eleven User Data Points. To replace these data points with others, use the Utility Menu option Add to Custom User. Refer to the section titled **Utility Menu** for further information regarding this function.



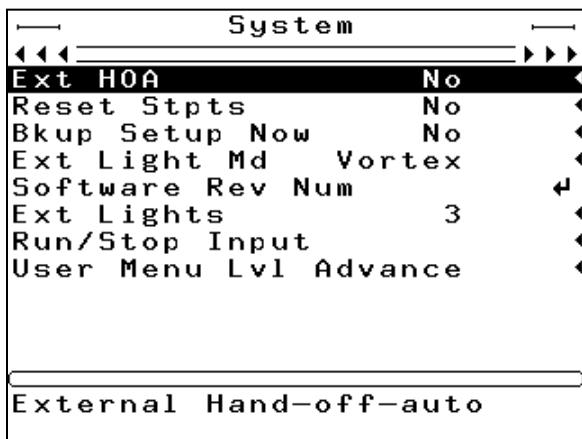
SCADA AND SECURITY AND SYSTEM

The SCADA & Security & System group of screens provide access to several system maintenance, security, and communication options within the Advantage drive.

NOTE: Whenever a drive containing a SCADA or telemetry connection is to be repaired or serviced, the service man must disconnect any communication devices attached to the drive to prevent unexpected start commands from the remote control system. Service men must be aware that there could be more than one remote telemetry connection and that all of them must be disabled or disconnected for the duration of the repair period.

System

This screen provides access to several parameters concerning overall system operation and maintenance.



Ext HOA This parameter, External Hand/Off/Auto (HOA) switch, controls whether the Advantage drive uses its onboard digital inputs as control inputs for an externally or remotely mounted HOA switch. When this parameter is enabled, Digital Inputs 1 through 3 are dedicated to this HOA function and cannot be used for general-purpose status inputs. If the Ext HOA enable parameter is set to YES and the HOA switch is in the AUTO position, it will override the Int Auto Rstrt parameter on the Basic Setup menu on the Starts page. In this mode the drive will automatically start depending on the delay times set and the cause of the last shutdown. The state of the digital inputs dictates whether the Advantage drive will operate in an External Auto Restarts mode (automatic restarts) or an External Hand mode (manual restarts only). The CENTER or OFF position of this switch is interpreted as a manual shutdown command. See the section titled **Internal Hand/Internal Auto Mode Selection** and the section titled **Hand/Off/Auto and Start Panel Mounted Switches** for further information regarding operating modes.

Reset Setpoints This control set point will cause the Advantage drive to reprogram all of its parameter and set point values back to the factory default settings. The function will also reset all running/downtime accumulators and start counters back to the zeroed state. This is typically used when a drive is being moved or re-deployed into another location or installation. It provides a known, conservative starting point for user setup.

Rst Hstry DB (Reset History Database) Setting this parameter to YES erases the Shutdown History, the Event Records, the Run History and the phase B Ampchart Data in the Datalog & History menu.

Bkup Setup Now (Backup Drive Setup Now) Setting this parameter to YES overwrites the ASC_Configuration.md5 file and the ASC_Configuration.txt file in the setpoint's subdirectory on the P_MODULE USB drive. The system uses this information on power-up.

Ext Light Md External Light Mode controls how external panel lights are used. Available settings are:

Vortex

Red Light = Shutdown, no restart without operator intervention.
Amber Light = Shutdown, no active alarms, down counting to automatic restart.
Green Light = Running

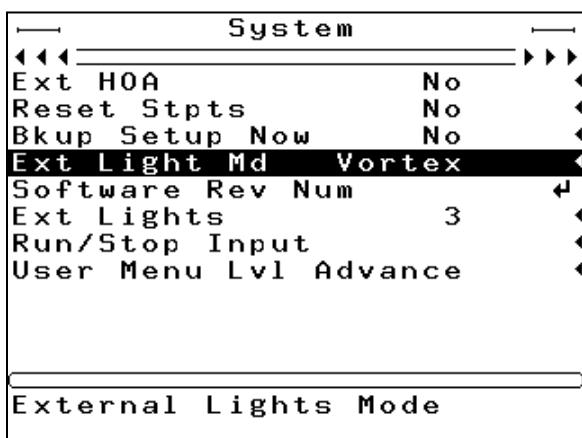
Kratos

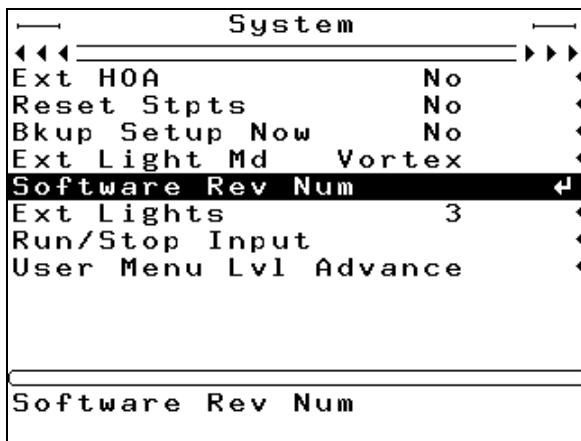
Red Light = Overload shutdown
Amber Light = All other shutdowns
Green Light = Running

ICS Emulation

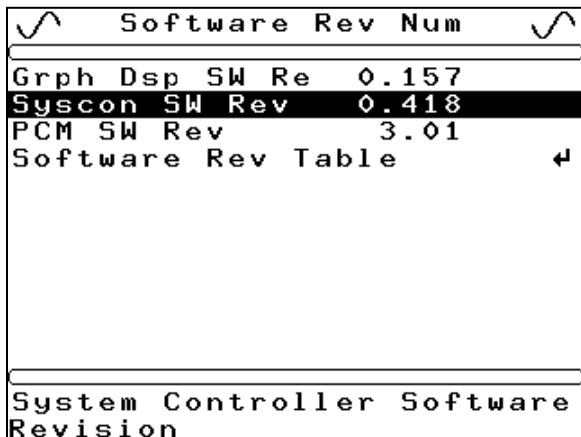
Red Light = Overload shutdown
Amber Light = Underload shutdown
Green Light = Running

In ICS emulation mode, if motor is shutdown, but the cause is neither overload nor Underload, no lights will be illuminated.



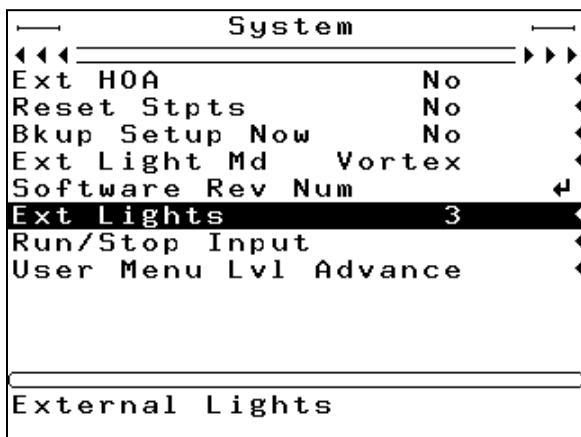


Software Rev Num The software revision levels of the Advantage modules connected together in this control system are listed in this menu screen. Highlight this item and press ENTER to access the subsequent menu.



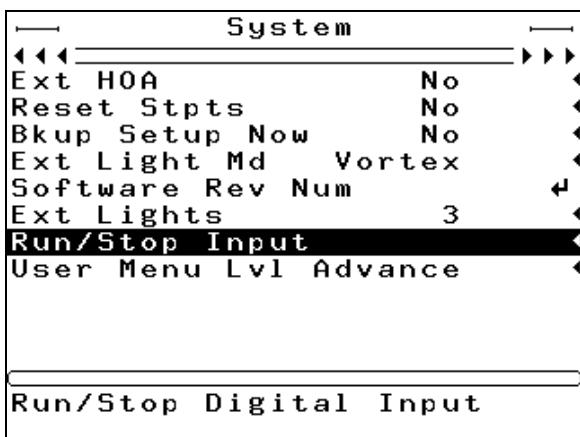
Software Rev Num

The revision levels of all the modules installed in this Advantage drive are listed on this screen.

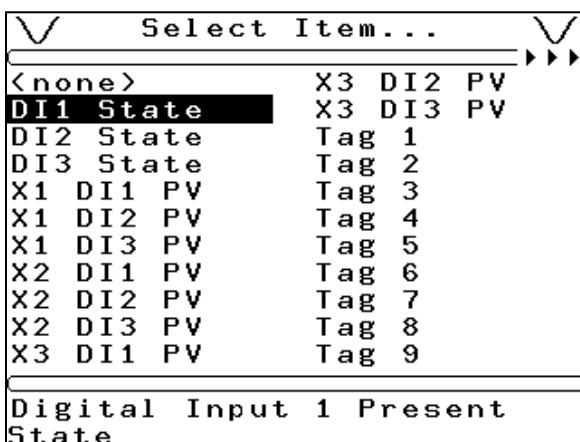


Ext Lights The external lights parameter controls how many of the onboard digital output relays are used with the external light mode. If set to three, all of the relays are used to annunciate the status of the attached motor according to the rules set out in the section of this manual: **Red, Amber and Green Panel Lights**.

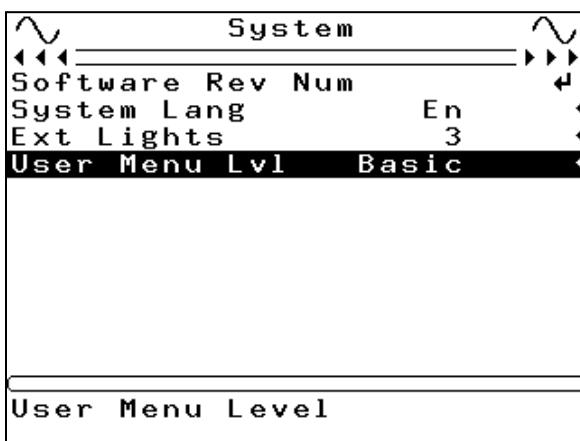
The other possible settings are 1 (green light only) and none. When set to 1 or none, the unused relays can be used as general purpose output relays for annunciation.



Run/Stop Input Allows the user to select any available digital input to serve as a controlling point to start and stop the drive/motor. When the selected input contacts close, the drive will RUN; when the contacts open, the drive will STOP. Similar to other inputs, such as Keypad Start, if any active, on-bypassed alarms exist, the drive will not start the motor.

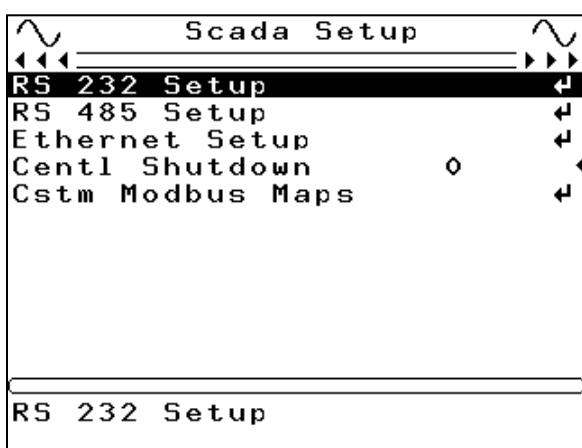


Run/Stop Input – Select Item This screen allows the user to select which digital input will be used to control the motor. Selecting NONE will clear any previous selections and disable the Run/Stop feature.



User Menu Lvl This menu item will allow the user to select Advanced or Basic menus. The normal default setting is Advanced. When Basic menus are selected, many of the menu items will not be displayed. This can be used to limit access to certain points or to avoid confusing casual users. The Basic menu version of the system screen is illustrated at left.

Setting the Menu Level to Basic does not disable any features or settings whose menu screens are no longer visible.



SCADA Setup

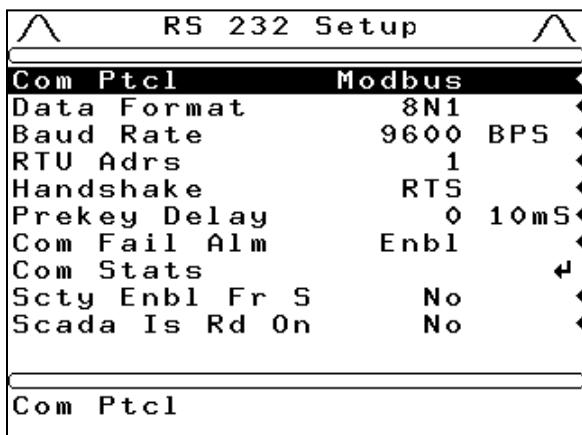
The SCADA Setup menu groups together the related parameters controlling communications to external computer systems and telemetry devices. Press the RIGHT arrow-key from the System menu to access this menu.

RS 232 Setup

This menu accesses the configuration menu for the RS-232 communications port. The TX and RX indicator lights for the port are located on the ASBB or the BSBB near J16, the RS-232 port.

Com Ptcl Communication Protocol allows the user to select the communication language that the drive will use to electronically communicate to telemetry and computer systems. Two settings are possible: Modbus and ICM Em. Selecting ICM Em will cause the Advantage drive to support the Modbus address map found in the previous generation variable speed drive ICS when equipped with the ICM communication module. Refer to the *ICM Manual* for detailed information. Selecting Modbus instructs the drive to support the standard GCS Modbus register address table. The document *ADV_GCS Modbus Protocol Support Guide* contains the address map for all standard GCS modules. The Advantage drive contains a superset of these addresses since it holds all of the standard data points and adds new points valid only for Advantage VSDs.

Data Format The Data Format variable allows the user to control the output format of the serial transceiver. The available choices are:



Data Bits	Parity	Stop Bits
8	None	1
8	Even	1
8	Odd	1
8	None	2
8	Even	2
8	Odd	2

Baud Rate Baud rate sets the speed of serial communication with telemetry and computer systems. Supported rates are 1,200 to 115,000 kbps.

Factory Default Serial settings are:
 9,600 baud, 8 Data Bits, No Parity, 1 Stop, 1 Start.

RTU Adrs Remote Terminal Unit Address is the variable that assigns a number from 1 to 255 to this drive for the purpose of identifying itself within a communication network.

RS 232 Setup	
Com Ptcl	Modbus
Data Format	8N1
Baud Rate	9600 BPS
RTU Adrs	1
Handshake	RTS
Prekey Delay	0 10ms
Com Fail Alm	Enbl
Com Stats	
Scty Enbl Fr S	No
Scada Is Rd On	No
Handshake	

Handshake Hardware Handshake is a three-state variable that controls the type of communication synchronization that is used on the RS-232 port.

Possible settings are: none, RTS or R/CTS.

None selects a 3-wire serial communication port setting (RX, TX, and GND).

RTS Request to Send selects a 4-wire serial communication port setting (RX, TX, RTS and GND). When RTS is selected and a transmission is occurring, the drive will assert the RTS signal line for a time period equal to the value set into the PreKey Delay parameter discussed in this section. After this time delay has expired, the data is transmitted.

R/CTS Selects a 5-wire serial communication port setting (RX, TX, RTS, CTS and GND). When RTS/CTS is selected, when transmitting, the drive will assert the RTS signal line and wait until the CTS line is also asserted by the external modem. Once the CTS line is asserted, then the Advantage drive will transmit its data.

RTS State When the Hardware Handshake parameter is set to None, this menu line appears and allows the user to force the RTS signal line to either the Mark or Space state. This RTS signal line can then be used to supply port-powered communication devices such as infrared transmitters or RS-485/422 interfaces. The Space state will produce approximately +7.75 VDC at up to 20 mA. The Mark state is -8.5 VDC with the same current rating as the Space state.

RS 232 Setup	
Com Ptcl	Modbus
Data Format	8N1
Baud Rate	9600 BPS
RTU Adrs	1
Handshake	RTS
Prekey Delay	0 10ms
Com Fail Alm	Enbl
Com Stats	•
Scty Enbl Fr S	No
Scada Is Rd On	No
Prekey Delay	

PreKey Delay When the Hardware Handshake parameter is set to RTS, this line appears on the screen. PreKey Delay implements a Push-to-Talk or Request-to-Send delay timer that is used to assert the RTS output at the RS-232 Communication Port for a user specified time before commencing serial data transmitting. This signal and/or delay is commonly used to handshake, or synchronize, two communication devices. In two-way radio systems, this RTS can be used as the Microphone/Transmit signal to enable the radio transmitter prior to serial data output.

CTS T.O. When the Hardware Handshake parameter is set to R/CTS, this line appears on the screen. This menu item, Clear to Send Time Out, sets the amount of time that the Advantage drive waits for the Clear to Send line to become asserted. If the line is not asserted within this time delay, the drive resets its communication buffers and aborts transmission of the pending message. It then begins listening for a new message.

Com Stats Move the cursor to this menu item and press ENTER to view the communications statistics screen. Refer to the section **SCI Com Stats** below for a sample screen and description.

Scty Enbl Fr S This parameter, Security Enabled for SCADA, controls whether a valid password must be entered before allowing a SCADA system to modify parameters or start the motor. If set to NO, SCADA system messages are acted upon regardless of Security status. If set to YES, a valid Level 2 password must be entered before the SCADA system can make any changes to the system. The password can be entered manually from the display unit or via the SCADA system.

SCADA Is Rd On This parameter is used to control whether the SCADA system will be allowed to modify (write) parameters. When it is set to YES, the SCADA system is allowed to read parameter values, but it cannot modify any of the values. Read Only SCADA mode is not affected by system security passwords.

RS 232 Setup	
Com Ptcl	Modbus
Data Format	8N1
Baud Rate	9600 BPS
RTU Adrs	1
Handshake	RTS
Prekey Delay	0 10ms
Com Fail Alm	Enbl
Com Stats	•
Scty Enbl Fr S	No
Scada Is Rd On	No
Scada Is Rd Only	

RS 232 Com Stats									
R	00	00	00	00	00	00	00	00	00
X	00	00	00	00	00	00	00	00	00
	00	00	00	00	00	00	00	00	00
T	00	00	00	00	00	00	00	00	00
X	00	00	00	00	00	00	00	00	00
	00	00	00	00	00	00	00	00	00
Receive Overrun:	0								
Noise Flag Errs:	0								
Framing Errors:	0								
Parity Errors:	0								
CRC Errors:	0								
Successful Reads:	0								
Successful Writes:	0								

RS 232 Com Stats

This screen displays information pertaining to the operation of the RS-232 communication-control registers and memory buffers. It is useful for diagnosing serial communications problems with telemetry equipment. It displays accumulators for several error and message counters as well as the first 24 bytes of the transmit and receive memory buffers. The contents of the buffers can be temporarily frozen/released by pressing the ENTER key. This allows the user to examine a single message exchange. By pressing the DOWN arrow-key, the user can also filter incoming messages based on the Modbus function code. Repeatedly pressing the DOWN arrow-key will cycle through the available function codes that will be displayed on the top line of this screen.

RS 485 Setup

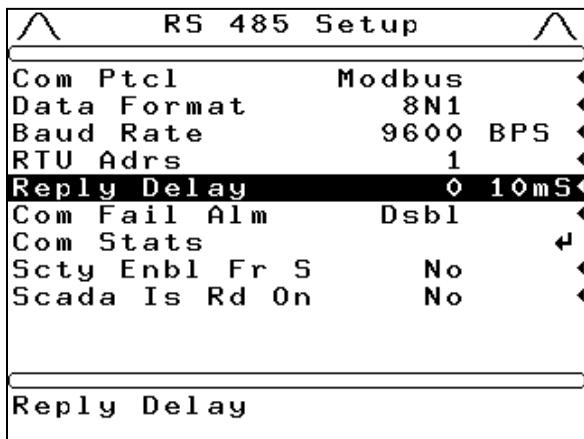
The Advantage drive provides two individual serial communication ports. The additional port is designated as an RS-485 type useful for multidrop communications networks on twisted pair cables.

RS 485 Setup	
Com Ptcl	Modbus
Data Format	8N1
Baud Rate	9600 BPS
RTU Adrs	1
Reply Delay	0 10ms
Com Fail Alm	Dsbl
Com Stats	
Scty Enbl Fr S	No
Scada Is Rd On	No
Com Ptcl	

Com Protocol Communication Protocol allows the user to select the communication language that the drive will use to electronically communicate to telemetry and computer systems. Two settings are possible: Modbus and ICM Em. Selecting ICM Em will cause the Advantage drive to support the Modbus address map found in the previous generation variable speed drive ICS when equipped with the ICM communication module. Refer to the *ICM Manual* for detailed information. Selecting Modbus instructs the drive to support the standard GCS Modbus register address table. The document *ADV_GCS Modbus Protocol Support Guide* contains the address map for all standard GCS modules. The Advantage drive contains a super set of these addresses since it holds all of the standard data points and adds new points valid for Advantage drive only.

Data Format The Data Format variable allows the user to control the output format of the serial transceiver. The available choices are:

Data Bits	Parity	Stop Bits
8	None	1
8	Even	1
8	Odd	1
8	None	2
8	Even	2
8	Odd	2



Baud Rate Baud rate sets the speed of serial communication with telemetry and computer systems. Supported rates are 1,200 to 115,000 baud.

Factory Default Serial settings are:
9,600 baud, 8 Data Bits, No Parity, 1 Stop, 1 Start.

RTU Adrs Remote Terminal Unit Address is the variable that assigns a number from 1 to 255 to this drive for the purpose of identifying itself within a communication network.

Reply Delay This parameter allows the user to specify a time delay controlling how long the drive will delay before sending its reply to a SCADA system. Some systems require a few milliseconds of turn-around delay or they will cut off the first portion of a reply message.

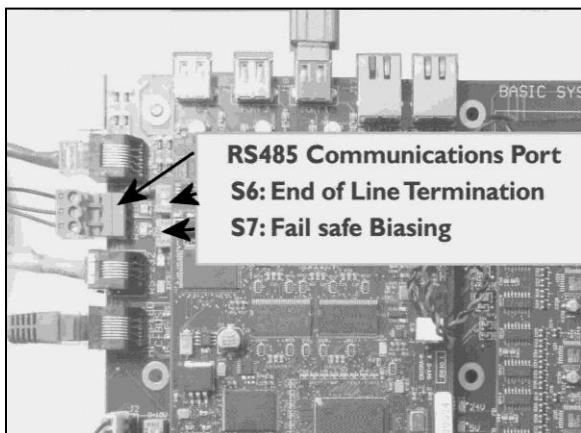
Com Fail Alm This parameter controls whether the telemetry failure alarm will apply to this port if it is enabled. More information regarding this Telemetry Failure alarm is found in the **Faults and Alarms** section of this manual

Com Stats Move the cursor to this menu item and press ENTER to view the communications statistics screen. Refer to the section **SCI Com Stats** below for a sample screen and description.

Scty Enbl Fr S This parameter, Security Enabled for SCADA, controls whether a valid password must be entered before allowing a SCADA system to modify parameters or start/stop the motor. If set to NO, SCADA system messages are acted upon regardless of Security status. If set to YES a valid Level 2 password must be entered before the SCADA system can make any changes to the

system. The password can be entered manually from the display unit or via the SCADA system.

SCADA Is Rd On This parameter is used to control whether the SCADA system will be allowed to modify (write) parameters. When it is set to YES, the SCADA system is allowed to read parameter values, but it cannot modify any of the values. Read Only SCADA mode is not affected by system security passwords.



RS 485 Terminations and Fail Safe Biasing

Several programming jumpers are added to the board to allow selection of End of Line (EOL) termination and fail-safe biasing. Refer to the illustration at left that shows the circuit board connector and jumper locations.

The RS-485 connection point is a 3-terminal screw-down style connector. The RS-485 port is configured to use a single pair of transmission wire connections and a ground.

The connections are labeled:

- B - RS-485 data connection
- A - RS-485 data connection
- IGND – Isolated Ground

For a typical RS-485 connection simply connect A to A and B to B in the RS-485 loop. Due to differences in interpretation of the RS-485 standard, it is often necessary to cross the A and B connections when interfacing to third-party devices (A to B, B to A). This operation will not damage the equipment and if A-B signals are connected backwards, the result will simply be a lack of communication until properly connected.

The TX and RX indicator lights for the RS-485 port are located on the ASBB or the BSBB near the RS-485 port.

There are three switches on the BSBB circuit board that have the following functions:

S6 120 ohm Termination Resistor. This switch should be turned ON **only** if the drive is the last device on the RS-485 Bus.

S7 Fail-safe Biasing Resistors. Fail-safe biasing jumpers may be required in electrically noisy conditions. Fail-safe biasing should only be installed on **one** device on the RS-485 bus. Before setting this switch to ON ensure that the central or any other unit does not already have fail-safe biasing capability enabled.

RS 485 Com Stats

485 Com Stats							
R	00	00	00	00	00	00	00
X	00	00	00	00	00	00	00
	00	00	00	00	00	00	00
T	00	00	00	00	00	00	00
X	00	00	00	00	00	00	00
	00	00	00	00	00	00	00
Receive Overrun:	0						
Noise Flag Errs:	0						
Framing Errors:	0						
Parity Errors:	0						
CRC Errors:	0						
Successful Reads:	0						
Successful Writes:	0						

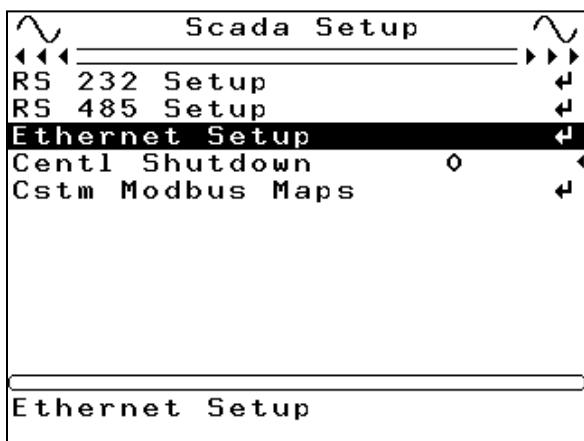
This screen displays info pertaining to the operation of the RS-485 communication control registers and memory buffers. It is useful for diagnosing serial communications problems with telemetry equipment. It displays accumulators for several error and message counters as well as the first 24 bytes of the transmit and receive memory buffers. The contents of the buffers can be temporarily frozen/released by pressing the ENTER key. This allows the user to examine a single message exchange. By pressing the DOWN arrow-key the user can also filter incoming messages based on the Modbus function code. Repeatedly pressing the DOWN arrow-key will cycle through the available function codes displayed on the top line of this screen.

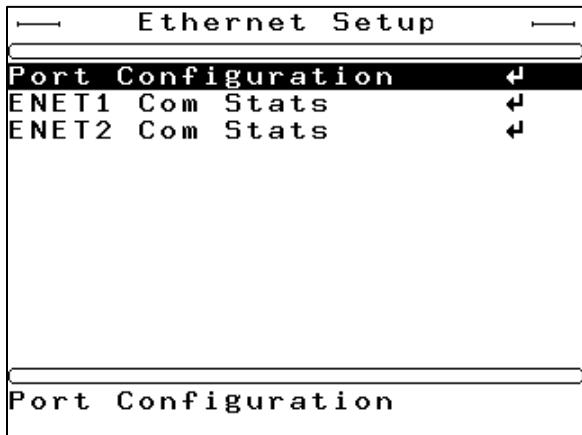
Ethernet Setup

This menu line provides access to the configuration screens for the two Ethernet ports available on the Electrospeed Advantage drive. Port 1 is connected to the weatherproof Ethernet port on the face of the cabinet door. Port 2 is accessible on the system control board when the cabinet door is open. Both of the Ethernet ports support Modbus TCP/IP protocol and are programmed to respond to ModbusTCP messages as a ModbusTCP slave device.

ModbusTCP is a version of the original ModbusRTU protocol developed by Gould Modicon and is now available as an open standard for data exchange between industrial control systems.

The full specification along with details for implementation of the ModbusTCP/IP protocol can





be found on the Modbus website at
<http://www.modbus.org/specs.php>.

The Advantage VSD has been programmed to adhere to the *MODBUS Messaging on TCP/IP Implementation Guide V1.0b*, and has also been tested using verification tools from the Modbus organization. The system is automatically configured to use TCP port 502 for ModbusTCP traffic as per the above specification.

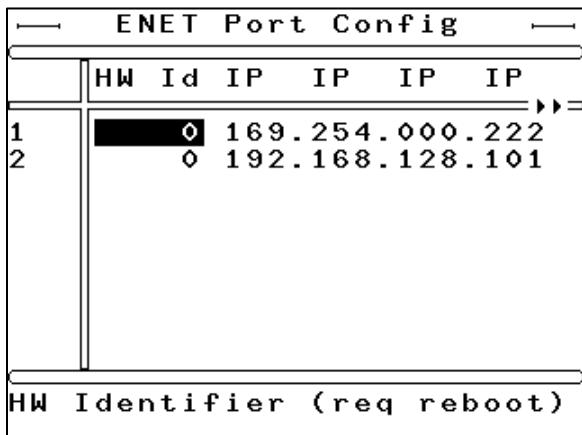
The only setup required to establish communication with a ModbusTCP master is the configuration of the Ethernet port settings on the Ethernet Setup menu as discussed in the following section.

The registers available to read and write are the same as those offered in the standard ModbusRTU address map, detailed in the *ADV_GCS Modbus Protocol Support Guide* document.

Port Configuration This screen provides access to the Ethernet port configuration screens for both ports.

By factory default, the two Ethernet ports are configured with the IP addresses shown at left. If required, the ports can be configured with different IP, SUB NET and Gateway addresses.

Pressing the ENTER key when the Ethernet Setup option is highlighted will take you to the Ethernet Setup page where you can set port one or two's MAC address, IP address and subnet mask and gateway variables.

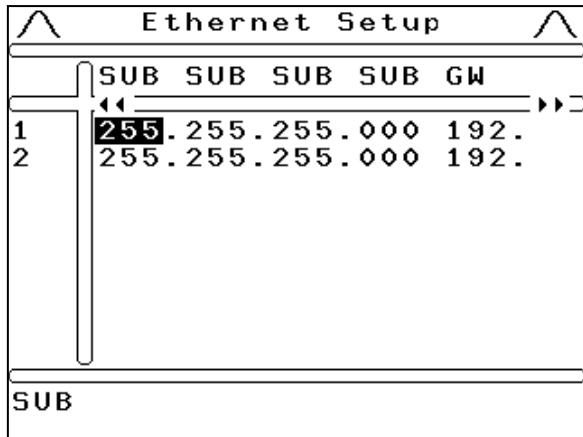


HW Id The Hardware ID number is analogous to the Media Access Controller (MAC) address. It is useful when several drives share a single network and must all have the same IP address. In this case, the Hardware ID number can be set to a different value on each device. This is similar to setting a unique RTU address in a serial Modbus network and can range from 0 to 1023.

The three settings required for an Ethernet / TCP device are: IP Address, Subnet and Gateway.

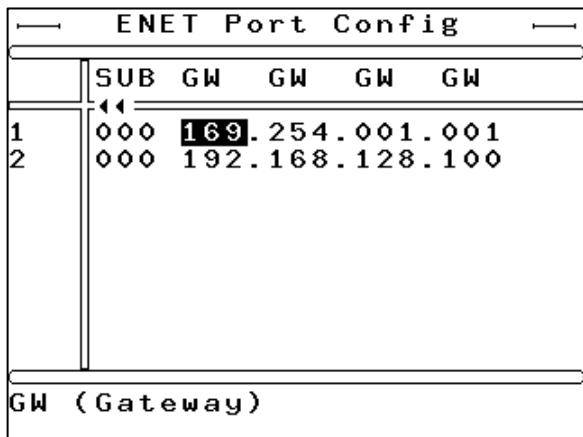
IP Address (IP) Default Port 1=169.254.000.222

Default Port 2=192.168.128.101



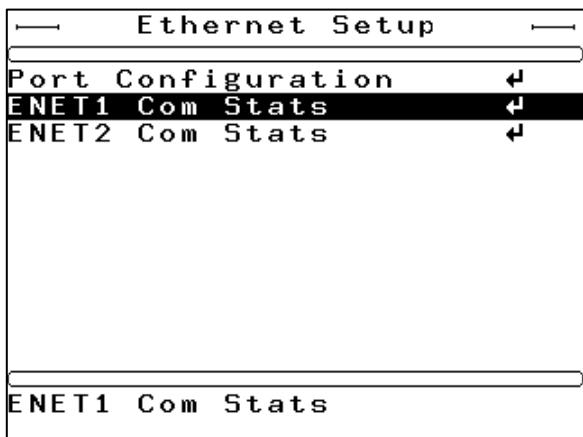
Pressing the RIGHT arrow-key several times will take you to the Subnet mask parameters.

Subnet (SUB) Default Port1 =255.255.000.000
Default Port2 =255.255.255.000



Pressing the RIGHT arrow-key several more times will take you to the Gateway parameters.

Gateway (GW) Default Port1=169.254.001.001
Default Port2=192.168.128.100



ENET1 / ENET2 Com Stats These two screens display the communication statistics pertaining to the two Ethernet ports. Both screens show the same information, but dedicated to port one or two.

ENET1 Com Stats

ENET1 Com Stats								
R	00	00	00	00	00	00	00	00
X	00	00	00	00	00	00	00	00
	00	00	00	00	00	00	00	00
T	00	00	00	00	00	00	00	00
X	00	00	00	00	00	00	00	00
	00	00	00	00	00	00	00	00
Receive Overrun:	0							
Noise Flag Errs:	0							
Framing Errors:	0							
Parity Errors:	0							
CRC Errors:	0							
Successful Reads:	0							
Successful Writes:	0							

This screen and the ENET2 screen display the status of the two Ethernet ports. The most recent received and transmitted message are displayed in the top portion of the screen. The lower half of the screen displays the number of errors experienced as well as the number of successful reads and writes.

ENET2 Com Stats

This screen displays statistics pertaining to Ethernet port 2.

Centl Shutdown

Central Shutdown is a system status variable that is dedicated to annunciating the presence of a SCADA or User PLC motor shutdown command. When this variable is set to any non-zero value, the drive will stop the motor, if running, and disallow further restart attempts until cleared. Although this variable can be cleared locally, be cautious if doing so since other control personnel or processes may require and depend on this system to remain stopped. For example, it can be set by a broadcast mode shutdown command that is transmitted to all drives on a SCADA control system.

Cstm Modbus Maps The Custom Modbus Maps selection is duplicated here for operator convenience. See the Custom Modbus Maps selection under the User Config Funct menu for a complete description.

Security

This menu accesses the system security features of the Advantage drive. Press the RIGHT arrow-key from the SCADA Setup menu to reach this screen.

User Password The User Password parameter contains the user's security password. It can be entered here or via the Basic Setup menu on the Drive Setup page.

Scada Setup	
RS 232 Setup	◀ ▶
RS 485 Setup	◀ ▶
Ethernet Setup	◀ ▶
Centl Shutdown	0
Cstm Modbus Maps	◀ ▶

Central Shutdown

Security	
User Password	0
Level 1 Pswd	0
Level 2 Pswd	0
Pswd To Clr Lk	No
User Pswd T.O.	5 min
Scty Jmp Status	3

User Password

Security	
User Password	0
Level 1 Pswd	0
Level 2 Pswd	0
Pswd To Clr Lk	No
User Pswd T.O.	5 min
Scty Jmp Status	2

Password To Clear Lockout

Level 1 Pswd Level One Password is the value that must be entered into the user password parameter to gain edit access to most set points. If the user password does not equal this one, this variable will display XXXXX.

Level 2 Pswd Level Two Password is the value that must be entered into the User Password parameter to gain edit access to all set points and system configuration variables. If the user password does not equal this one, this variable will display XXXXX.

Pswd To Clr Lk Password to Clear Lockout controls whether a valid password must be entered before the user is allowed to clear a lockout condition and restart the motor.

User Pswd T.O. User Password Time Out sets the length of time delay after any key press before the Advantage drive sets the user password back to zero.

Scty Jmp Status Security Jumper Status shows what security level the drive is in.

Set Time

This screen displays the present settings of the battery backed, real time clock operating in the Advantage system and allows the user to reset the clock's time and date if necessary. The primary purpose of the clock is to be able to record the dates and times for the Shutdown History and the data logging functions.

If the clock becomes invalid for any reason, the user should use this screen to enter the correct values.

The input range for the parameters are:

Year The current year, ranges from 1996 to 2035

Month The current month, ranges from 1 to 12

Day The current day, ranges from 1 to 31

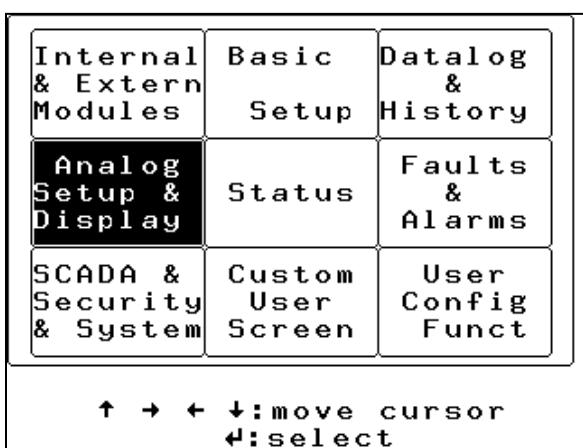
Hours The current time in hours, ranges 0 to 23

Minutes The current time in minutes, 0 to 59

Seconds The current time in seconds, 0 to 59

Set Time	
Year	2012 yr
Month	1 mo
Day	30 d
Hours	13 hrs
Minutes	38 min
Seconds	47 sec

Hours



Drive Input Current	
Cnv1 B Amps	156 A
Cnv2 B Amps	0 A
Cnv3 B Amps	0 A
Cnv4 B Amps	0 A
Input IA	164 A
Input IB	166 A
Input IC	164 A
Inpt CT Ratio	500

Converter 1, Phase B Amps

ANALOG SETUP AND DISPLAY

The Analog Setup screen display the input and output current, voltage, power readings and accumulated power consumption.

Drive Input Current

The Advantage drive can utilize up to four individual converter sections to minimize the harmonic distortion reflected back into the utility power supply system. To ensure all the converters are providing balanced current amounts the phase B current is measured on each converter.

Cnv1 B Amps Converter 1, phase B Amps displays the present value of input current on converter 1, phase B.

Cnv2 B Amps Converter 2, phase B Amps displays the present value of input current on converter 2, phase B.

Cnv3 and Cnv4 Amps These amps are only displayed when they actually exist in the specific drive model selected or field service level security is achieved.

Cnv3 B Amps Converter 3, phase B Amps displays the present value of input current on converter 3, phase B.

Cnv4 B Amps Converter 4, phase B Amps displays the present value of input current on converter 4, phase B.

The number of input current values shown is dependent on drive configuration and model. More information is available in the section Multiple Converter / 24 Pulse Drives.

Input IA This parameter displays the value of input current on phase A of converter 1.

Input IB This parameter displays the value of input current on phase B of converter 1.

Input IC This parameter displays the value of input current on phase C of converter 1.

Inpt CT Ratio This parameter displays the transformer ratio used in the CTs measuring the input current. The factory default CT ratio is

automatically selected by the Advantage based on model number specifications.

Drive Input Volts	
Filter Cntl En	Yes
Cnv1 VAB	485 V
Cnv1 VBC	481 V
Cnv1 VCA	487 V
Pwr Sys Volts	480 V
Input Filter Control Enable	

Drive Input Volts

This screen displays the input voltage measurements.

Filter Cntl En This variable represents the present status of the input filter and acts as a reminder that the filter exists and due to its nature, can affect the voltage measurements displayed.

The number of converter inputs (CNV1, 2, 3 or 4) shown is dependent upon the drive configuration and model. More information is available in the appendix Multiple Converter / 24 Pulse Drives.

Cnv1 VAB Converter 1 A-B Voltage displays the phase to phase AC, RMS voltage level present across converter 1 A and B phase input terminals of the drive.

Cnv1 VBC Converter 1 B-C Voltage displays the phase to phase AC, RMS voltage level present across converter 1 B and C phase input terminals of the drive.

Cnv1 VCA Converter 1 C-A Voltage displays the phase to phase AC, RMS voltage level present across converter 1 C and A phase input terminals of the drive.

Cnv2, Cnv3 and Cnv4 These voltage readings will appear only if the drive model actually contains the additional converters sections or field service level security is achieved

Pwr Sys Volts This parameter displays the user set nominal input voltage level. If this does not agree with the actual input voltage, the user can select from the following ranges: 480, 460, 430, 415 and 380 Volts.

Drive Input Power

Inst Power This parameter displays the instantaneous power consumption of the drive in kilowatts.

Drive Input Power	
Inst Power	100 kW
Inpt KVA	172 KVA
Power Factor	58 %
Kilo Watt Hrs	675 kWh
Mega Watt Hrs	0 MWh
Giga Watt Hrs	0 GWh
Inpt CT Ratio	500
Instantaneous Power	

Input KVA Input Kilovolt Amps displays the drive's total current consumption of volt amps.

Power Factor This parameter displays the drive's present input power factor in percent. This calculated value represents the ratio of the input watts divided by input volt amps times 100.

Kilo Watt Hrs This parameter represents the accumulated power consumed by the drive in watt hours times 1,000.

Mega Watt Hrs This parameter accumulates consumed power in megawatt hours, or 1,000 kilowatt hours. When the kilowatt hours reach 1,000, the Advantage will reset the kilowatt hours to zero and increment megawatt hours by 1.

Giga Watt Hrs This parameter records the accumulated power consumed in gigawatt hours. When the megawatt hours reach 1,000, the Advantage will reset megawatt hours to zero and increment the gigawatt hours by 1.

Input CT Ratio This parameter holds the input current transformer ratio used in the power calculations to scale the analog to digital converter readings into engineering units of amps.

Drive Output

Output Volts This parameter displays the present value of the AC voltage produced phase-to-phase at the output terminals of the drive.

Output IA Output IA displays the present value of the AC current on the drive's phase A output terminal.

Output IB Output IB displays the present value of the AC current on the drive's phase B output terminal.

Output IC Output IC displays the present value of the AC current on the drive's phase C output terminal.

Output KW Output Kilowatts displays the output of the drive in kilowatts.

Drive Output	
Output Volts	0 V
Output IA	0 A
Output IB	0 A
Output IC	0 A
Output KW	0 kW
Output KVA	0 KVA
Output PF	0.00
<hr/>	
Output Volts	

Transformer / Motor		
Txfmr	Out	VAB
Txfmr	Out	VBC
Txfmr	Out	VCA
Motor	VAB	0 V
Motor	VBC	0 V
Motor	VCA	0 V
Motor	IA	0 A
Motor	IB	0 A
Motor	IC	0 A
DH Xmer Rat		1.000
Mtr CT Ratio		0
Txfmr Output Voltage A-B		

Output KVA Output KVA represents the total output of the drive in kilovolt amps.

Output PF Output Power Factor displays the power factor calculated as the ratio of Output KW/Output KVA.

Transformer/Motor

Txfmr Out VAB Transformer Output Voltage A-B is the calculated voltage available across the phase A and B outputs. The drive output voltage is multiplied by the DH Xmer Ratio parameter (also on this page) to derive this voltage.

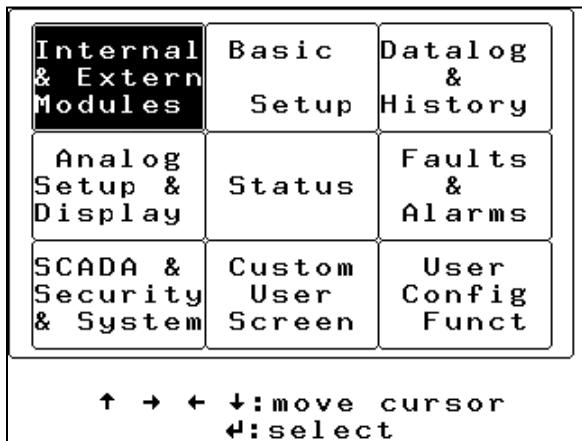
Txfmr Out VBC Transformer Output Voltage B-C is the calculated voltage available across the phase B and C outputs. The drive output voltage is multiplied by the DH Xmer Ratio parameter (also on this page) to derive this voltage.

Txfmr Out VCA Transformer Output Voltage C-A is the calculated voltage available across the phase C and A outputs. The drive output voltage is multiplied by the DH Xmer Ratio parameter (also on this page) to derive this voltage.

Motor VAB Motor Voltage A-B. This parameter represents the downhole or ESP motor voltage between phase A and B. The Advantage LV controller calculates this value based on the drive output volts, the Act Xfmr Tap parameter entered on the Site Setup page of the Basic Setup menu, and the Cable Length parameter entered on the Site Setup page of the Basic Setup menu.

Motor VBC Motor Voltage B-C. This parameter represents the downhole or ESP motor voltage between phase B and C. The Advantage LV controller calculates this value based on the drive output volts, the Act Xfmr Tap parameter entered on the Site Setup page of the Basic Setup menu, and the Cable Length parameter entered on the Site Setup page of the Basic Setup menu.

Motor VCA Motor Voltage C-A. This parameter represents the downhole or ESP motor voltage between phase C and A. The Advantage LV controller calculates this value based on the drive output volts, the Act Xfmr Tap parameter entered on



the Site Setup page of the Basic Setup menu, and the Cable Length parameter entered on the Site Setup page of the Basic Setup menu.

Motor IA Motor Current A This parameter represents the downhole or ESP motor current on the phase A output of the step-up transformer. Optional current transformers must be installed on the downhole cable and the correct CT ratio must be entered in the Mtr CT Ratio parameter below.

Motor IB Motor Current B This parameter represents the downhole or ESP motor current on the phase B output of the step-up transformer. Optional current transformers must be installed on the downhole cable and the correct CT ratio must be entered in the Mtr CT Ratio parameter below.

Motor IC Motor Current C This parameter represents the downhole or ESP motor current on the phase C output of the step-up transformer. Optional current transformers must be installed on the downhole cable and the correct CT ratio must be entered in the Mtr CT Ratio parameter below.

DH Xmer Rat Downhole Transformer Ratio. This parameter represents the step-up ratio of the output transformer. The Advantage LV drive uses the drive +output voltage/current and this transformer ratio to calculate the transformer's output voltage.

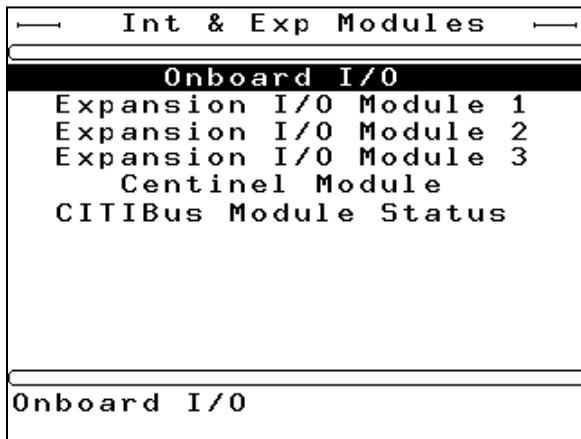
Mtr CT Ratio Motor Current Xfmr Ratio. Motor Current Transformer Ratio is the ratio of the optional CT's installed on the motor conductors. Accurate motor phase currents will be displayed in the Motor IA, Motor IB, and Motor IC parameters above when this ratio is correctly entered and the optional CT's are installed.

Transformer / Motor			
Txfmr	Out	VAB	1 V
Txfmr	Out	VBC	1 V
Txfmr	Out	VCA	1 V
Motor	VAB		0 V
Motor	VBC		0 V
Motor	VCA		0 V
Motor	IA		0 A
Motor	IB		0 A
Motor	IC		0 A
DH Xmer Rat		1.000	
Mtr CT Ratio		0	
DH Xmer Ratio			

INTERNAL AND EXTERNAL MODULES

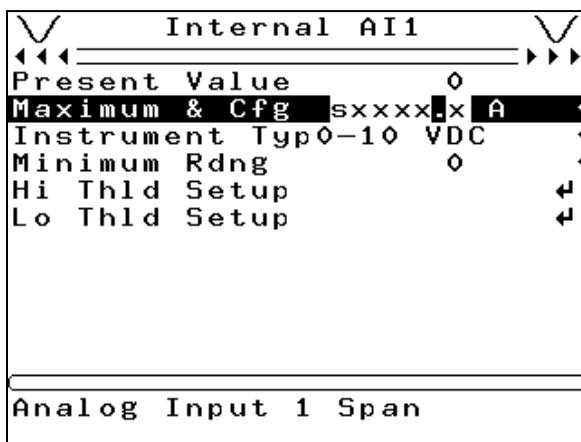
The Internal and Extern Modules screen allows access to the submenus providing control of the setup parameters dealing with all Input/Output Modules, both built-in (onboard) and optional, externally mounted expansion cards. To select the onboard I/O Setup and Configuration screens, use the arrow-keys to move the cursor bar over the

onboard I/O menu item as shown below and press the ENTER key. The Advantage drive will display the first of the configuration screens for the onboard I/O. To access the other setup screens, move the cursor over the menu item desired and press ENTER to display that screen.



Onboard I/O

The Onboard Input/Output menu provides access to the setup screens for the built-in I/O. These consist of two 0-10 Volt/4-20 mA DC analog inputs, five digital (status) inputs and five digital outputs (switch closures). The first screen shown will normally be the Internal AI1, as shown in the next illustration.



Internal Analog Input 1

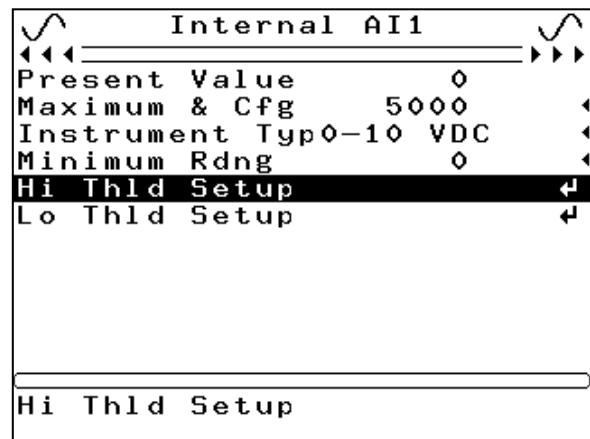
This menu screen accesses all the parameters related to the 0-10 VDC or 4-20 mA signal applied to Analog Input Terminal 1.

Present Value The number displayed represents the current scaled value of the analog signal present on Analog Input Terminal 1.

Maximum & Cfg This parameter is used to select the analog input's maximum (displayed reading at maximum input), the location of the decimal point (divide by 10, 100 or 1,000) and the engineering units (psi, amps, volts, etc.). Move the cursor to highlight this parameter and press the ENTER key. The highlight cursor will change to appear like the illustration at left. At this point, use the LEFT/RIGHT arrow-keys to move the decimal point left or right as required, and then press ENTER again. The cursor will change to highlight the maximum value of the analog input. Use the UP/DOWN or LEFT/RIGHT arrow-keys to adjust it to the required value, then press ENTER again. The cursor will change once more and allow the user to select engineering units applicable to the analog input. At this point use the UP/DOWN arrow-keys to scroll through the available engineering units until the desired one

NOTICE

To configure a 10-50 mA signal input, set S1-2 to ON and connect a 331 ohm 1/2 watt resistor to pins 12 and 14 on J2.



appears, then press ENTER to finalize the configuration.

Instrument Typ Allows selection of the type of signal connected to the analog input. The user selectable instrument types are 0-10 VDC, 0-5 VDC, 4-20 mA and 10-50 mA. To use the 0-10 VDC or 0-5 VDC signal type, set switch S1-2 to the OFF, or 0-10 V position, and select the instrument type via this parameter (the S1-2 switch is next to the J2 connector on the system control board). To use the 4-20 mA current loop type, set S1-2 to the ON (4-20 mA) position. Set the instrument type to 4-20 mA type, and the drive will apply the offset calculations required.

To use a 10-50mA signal, connect an external 331 ohm resistor parallel to the internal 500 ohm resistor, creating a 200 ohm input impedance. The 10-50 mA input signal wires are connected to the same pins in parallel with the resistor, with positive connected to J2-pin 12, negative to J2-pin 14. Set the instrument type to 10-50 mA and the drive will calculate the present value of input signal.

Minimum Rdng Use this parameter to set the minimum reading value shown when the analog input signal is at the minimum amplitude.

Hi Thld Setup This option allows access to the parameters associated with a high threshold alarm on Analog Input 1. Highlight this item and press ENTER to access the subsequent menu.

Lo Thld Setup This option allows access to the parameters associated with a low threshold alarm on Analog Input 1. Highlight this item and press ENTER to access the subsequent menu.

High Threshold Setup

High Threshold Analog Input 1 High Threshold sets the upper threshold of Analog Input 1 value that, if exceeded, will cause the motor to shut down.

Alarm Enable Analog Input 1 High Threshold Trip Enable controls whether the Advantage drive will shut down the motor when the Present Value of Analog Input 1 exceeds the High Threshold value.

Hi Thld Setup	
High Threshold	300
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	5 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
Analog Input 1 High Threshold	

Lockout Enable Analog Input 1 High Threshold Lockout Enable determines if the drive will enter a lockout condition after the first shutdown when it has shut down the motor due to a High Threshold alarm.

Bypass Delay Analog Input 1 High Threshold Bypass Delay sets the number of seconds the Advantage drive will ignore a High Threshold alarm condition present at startup.

Shutdown Delay Analog Input 1 High Threshold Shutdown Delay sets the number of seconds the drive will ignore a High Threshold alarm condition that exists while the motor is running, but only after the High Threshold Bypass Delay time has expired.

Aux Rstrt Parm When set to YES, the Auxiliary Restart Parameters setpoint causes the Advantage drive to use the restart parameters listed below when it shuts down due to an Analog Input 1 High Threshold alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart.

Auto Restarts Auto Restarts Allowed (for Analog Input 1) controls how many automatic restarts will be allowed when the drive has shut down due to an Analog Input 1 High Threshold alarm and the Aux Rstrt Parm has been set to YES.

Restart Delay Analog Input 1 High Threshold Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to an Analog Input 1 High Threshold alarm and the Aux Rstrt Parm has been set to YES.

Low Threshold Setup

Low Threshold Analog Input 1 Low Threshold sets the lower threshold of analog input value that, if exceeded, will cause the motor to shut down.

Alarm Enable Analog Input 1 Low Threshold Alarm Enable controls if the Advantage drive will shut down the motor when the present value falls below the Low Threshold value.

Lo Thld Setup	
Low Threshold	0
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	4 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
Analog Input 1 Low Threshold	

Lockout Enable Analog Input 1 Low Threshold Lockout Enable determines if the drive will enter a lockout condition after the first shutdown when it has shut down the motor due to a Low Threshold alarm.

Bypass Delay Analog Input 1 Low Threshold Bypass Delay sets the number of seconds the Advantage drive will ignore a Low Threshold alarm condition at startup.

Shutdown Delay Analog Input 1 Low Threshold Shutdown Delay sets the number of seconds the drive will ignore a Low Threshold alarm condition that exists anytime the motor is running, but only after the Low Threshold Bypass Delay has expired.

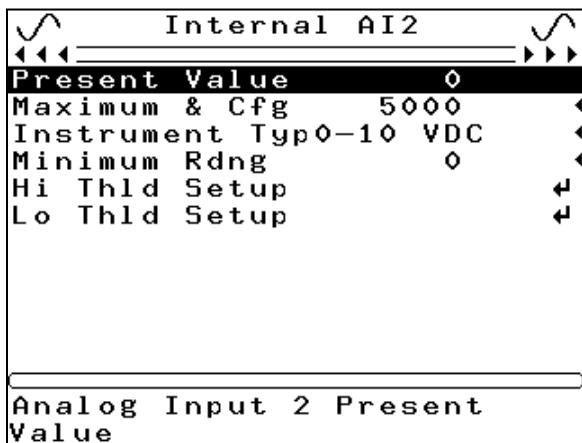
Aux Rstrt Parm Analog Input 1 Low Threshold Aux Restart Parm. When set to YES, the Auxiliary Restart Parameters setpoint causes the Advantage drive to use the restart parameters listed below when it shuts down due to an Analog Input 1 Low Threshold Alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart.

Auto Restarts Number of Analog Input 1 Low Threshold Auto Restarts controls how many automatic restarts will be allowed when the drive has shut down due to an Analog Input 1 Low Threshold Alarm and the Aux Rstrt Parm has been set to YES.

Restart Delay Analog Input 1 Low Threshold Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to an Analog Input 1 Low Threshold Alarm and the Aux Rstrt Parm has been set to YES.

Internal Analog Input 2

This setup and configuration screen is accessed by pressing the RIGHT arrow-key while displaying the screen for Internal Analog Input 1. This second analog input is calibrated and operates in exactly the same way as Internal Analog Input 1; however, all of the readings and set points are based on the analog signal connected to the Analog 2 Input Terminal. The configuration of the settings is more



thoroughly explained in the preceding section
Internal Analog Input 1.

Internal Digital Input 1, 2, 3, 4 and 5

This menu screen provides access to all the parameters related to the digital status (ON/OFF) signal applied to Digital Input Terminal 1 (J2-Pin 1). The digital inputs are activated by shorting the input terminal to the Digital Common Ground Terminal provided on the same terminal block.

If the External HOA parameter is enabled, Digital Input 1 is dedicated to function as a START push-button switch and is unavailable for general-purpose use.

Internal DI1	
Present State	1
Actv Alm State	1
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	1 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min
<hr/>	
Digital Input 1 Present State	

Present State The number displayed to the right of this label represents the current condition of the status signal present on Digital Input Terminal 1. An open circuit on Terminal 1 produces a status value of 1 (one). If the switch or sensor connected between the input and Common Ground is closed, the status value of digital input becomes 0 (zero).

Actv Alm State The Active Alarm State parameter allows the user to select whether this digital input is considered in the alarm state when the input is 1 or 0 (zero). Whichever digital input state (one or zero) this variable is set to will be considered the alarm state. When the Present Value of the digital input matches the value of this set point, the alarm is activated and, if enabled, will cause a shut down.

Alarm Enable Controls whether the drive will shut down the motor when the Present Status of the digital input equals the Active Alarm State.

Lockout Enable Controls whether the drive will lock out and prevent further automatic restart attempts when the drive shuts down the motor because of a Digital Input 1 alarm.

Bypass Delay Sets the number of seconds that the Advantage drive will ignore a Digital Input 1 alarm condition that is present at startup time.

Internal DI1	
Present State	1
Actv Alm State	1
Alarm Enable	No
Lockout Enable	No
Bypass Delay	0 sec
Shutdown Delay	1 sec
Aux Rstrt Parm	Yes
Auto Restarts	3
Restart Delay	30 min

Digital Input 1 Shutdown Delay

Shutdown Delay Sets the number of seconds that the drive will ignore a Digital Input 1 alarm condition that exists while the motor is running, but only after the Digital Input 1 Bypass Delay time has expired.

Aux Rstrt Parm When set to YES, the Auxiliary Restart Parameters set point causes the Advantage drive to use the restart parameters listed below when it shuts down due to an Internal Digital Input 1 alarm. If this parameter is set to NO, the drive will use the Global Restart parameters when performing an automatic restart. The Global Restart parameters are set from the Basic Setup menu on the Starts page.

Auto Restarts Auto Restarts controls how many automatic restarts will be allowed when the drive has shut down due to an Internal Digital Input 1 alarm and the Aux Rstrt Parm has been set to YES.

Restart Delay Restart Delay controls the length of time the drive will wait before attempting to restart the motor when it was shut down due to an Internal Digital Input 1 alarm and the Aux Rstrt Parm has been set to YES.

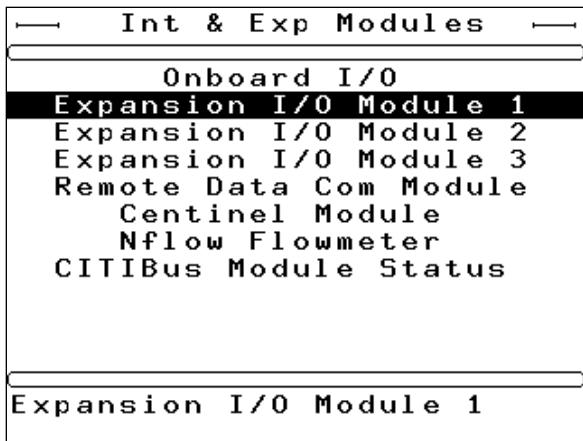
Internal Digital Output 1, 2, 3, 4 and 5

If the set point External Lights found in the System menu is set to less than three, then this menu will be visible. It permits direct user access to the digital output relays, when they are configured as general purpose outputs. When configured as such, these relays can be used by User PLC programs.

Auxiliary I/O	
DIG6	1
DI7	1
DI8	1
D06	Open
D07	Open
D08	Open
AI3	1
AI4	1
AI5	0
AI6	1

Auxiliary I/O

This screen shows the status of the additional input/output ports available on the Advantage drive.

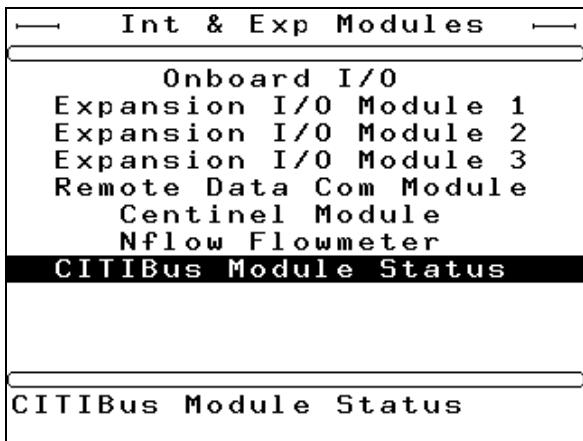


Expansion I/O Module 1

Expansion I/O Module 2

Expansion I/O Module 3

These menus provide access to the parameters related to installed devices such as expansion input/output module. Please view menu and parameter descriptions in the operator's manual provided with the applicable module.



CITIBus Module Status

The CITIBus Module Status screen allows the user to enable expansion modules connected to the CITIBus communication bus and to monitor the CITIBus communication success rate.

Module Status	
System Cntlr	Enbl
PCM	Enbl
Centinel Module	Dsbl
Remote Data Com	Dsbl
EIO1	Dsbl
EIO2	Dsbl
EIO3	Dsbl
Nflow Flowmeter	Dsbl

↑ ↓ : Move Cursor
 ← → : To Enable GCS Module

Module Status

This menu screen shows which of the available expansion modules are enabled to communicate on the CITIBus network. Move the highlighting cursor to the available items and press ENTER to enable that module.

System Cntlr System Controller drive is always enabled.

PCM Power Conversion Module is enabled when configured as Variable Speed Drive.

Centinel Module Enabled if a Centinel GCS Downhole Measurement module is attached. For further information refer to the *Centinel Operator's manual*.

Remote Data Com Enabled if an RDCM is connected. For further information refer to the *Remote Data Communication Module Operator's manual*.

EIO1, EIO2, EIO3 Expansion Input/Output modules 1, 2 and 3 can be added and enabled.

Nflow Flowmeter Nflow Flowmeter is enabled if a NeuraFlow module is installed.

Module Status				
Nod	%Error	Tmot	CRC	
CIM	100.00	9	0	XR
RDC	100.00	5	0	XR
EX1	100.00	5	0	XR
EX2	100.00	5	0	XR
EX3	100.00	5	0	XR
NFL	100.00	7	0	XR
PCM	0.18	174	0	✓
GDI	0.00	3	0	✓
NUL	0.00	0	0	

✓-Onlin X-Offlin ?-Missng
 0-Rescan R-R1d Pnd W-wrmhol

Modules Status CITIBus Success Rate

This screen is accessible when field service security level access has been achieved and the LEFT or RIGHT arrow-key is pressed while displaying the previous Module Status screen. In an Advantage LV drive, that level is achieved when a CF card with field service level access is inserted into the display unit (Security Jumper Status = 2). This screen displays the percentage of error, time out count and CRC error rates for all modules installed. If modules are not installed, their % of Error will be displayed as 100%.

APPENDIX A: SPECIFICATIONS AND RATINGS

Specifications

Output frequency:	10 to 120 Hertz at 480 V AC
Output voltage at maximum Hz:	40 to 480 V AC
Start frequency:	3 to 20 Hertz
Sync delay time:	0 to 60 sec
High speed clamp:	10 to 120 Hertz
Frequency resolution:	± 0.1 Hertz
Volts/Hertz:	0.7 - 10 V
Low speed clamp:	10 to 120 Hertz
Voltage boost:	0 to 200 V AC
Voltage boost sync:	0 to 200 V AC
Instantaneous over current (IOT):	170% of full load rating
Current limit:	0 to 150% of VSC rating
Current limit sync:	0 to 150% of VSC rating
Maximum overload current:	0 to 150% of VSC rating for variable torque 0 to 200% of VSC rating for constant torque
Voltage clamp:	100 to 550 V AC
Acceleration time:	2 to 200 sec
Deceleration time:	2 to 200 sec
Control power:	24 V DC
Efficiency:	≥ 98% at rated load
Power factor:	0.96 at full speed

Ratings

Input voltage

(standard): 380 to 480 V AC (3-phase) + 5%, -15%, 50/60 Hertz

Frequency

Input current:

± 2 Hertz

Output ratings: See Appendix G: Variable Torque VSC Ratings

See Appendix G : Variable Torque VSC Ratings

Operating temperature

NEMA 1 (IP30):

0 to 45° C (32 to 113° F)

NEMA 4 (IP56):

0°C to 55°C (32°F to 131°F)

With heater: -40°C to 55°C (-40°F to 131°F)

Storage temperature

-50°C to 70°C (-58°F to 158°F)

Humidity:

NEMA 4 (IP56):

Suitable for use outdoors in all climatic conditions.

NEMA 1 (IP30):

95% Non-Condensing

Elevation:

To 5,000 ft without de-rating

Weight:

Dependent on model number – consult Appendix K

Dimensions:

Dependent on model number – consult Appendix K



APPENDIX B: INSTALLATION/SERVICE RECORD

Area _____ District _____
Startup _____ Service _____ Restart _____ Report

Customer _____	County / Province _____	State / Country _____
Facility /Field _____	Unit / Lease _____	No _____ City _____
VSC S/N: _____	Model _____	Amps _____ KVA _____ Software Rev:APC _____
Motor Mfg _____	Volts _____	Amps _____ Hp _____ Service _____ ASC _____
Cable Size _____	Ft _____	Volts/Ft _____ Temp Factor _____ Cable _____ AGD _____
Pump Mfg _____	Model _____	Series _____ Stages _____
Intake (Rotary, Rev-Flow, Std)	Min Hz _____	BPD _____ Max Hz _____ BPD _____
Check Valve _____	Jap Setting _____	Ft Bottom Hole Temp _____ F. deg
Xfrm S/N _____	Voltage _____	Ratio _____ Taps 1 _____ 2 _____ Delta WYE _____

Drive Input Volts Unloaded
a/b _____ a/c _____ b/c _____

Drive Input Amps
@ Hz _____ a) _____ b) _____ c) _____
@ Hz _____ a) _____ b) _____ c) _____

Drive Input Volts to Ground
a _____ b _____ c _____

Drive Output Amps
@ Hz _____ a) _____ b) _____ c) _____
@ Hz _____ a) _____ b) _____ c) _____

Drive Input Volts Loaded
a/b _____ a/c _____ b/c _____

Down Hole Motor Amps
@ Hz _____ a) _____ b) _____ c) _____
@ Hz _____ a) _____ b) _____ c) _____

Drive Output Volts
@ Hz _____ a/b _____ a/c _____
@ Hz _____ a/b _____ a/c _____

Motor & Cable Ohms Phase to Ground
a _____ b _____ c _____

Surface Voltage Phase to Ground
a) _____ b) _____ c) _____

Motor & Cable Ohms Phase to Phase
a/b _____ a/c _____ b/c _____

Setup or Operating Parameters			
Overload Amps	Start Frequency	Sync Delay	Low Speed Clamp
Overload Time	V Boost Sync	Hi Speed Clamp	VBoost
I Limit	V Clamp	Accel Time	
I Limit Sync	Underload Amps	Decel Time	
Fault Restarts	Jog Frequency	Control Setpoint	Aux. Restart
Restart Delay	Underload Restarts		
Fault Reset	UL Trip Delay		Frequency Avoid
Set Speed(Hz)	Mode	Output Rotation	
Run Speed(Hz)	LSTrip Delay	Control Signal	Analog 1 or 2
Bypass LSTrip Delay	UL Delay	LSTrip Enable	LSTrip Lockout
UL Bypass Delay	DI1 Delay	UL Enable	UL Lockout
DI1 Bypass Delay	DI2 Delay	DI1 Enable	DI1 Lockout
DI2 Bypass Delay	OL Delay	DI2 Enable	DI2 Lockout
OL Bypass Delay		OL Enable	OL Lockout
Wait for Restart Delay			

Comments / Observations : _____

Job Started:

Job Completed:

Serviced

APPENDIX C: DATA LOGGING SPECIFICATIONS

Historical Logging on Advantage Series of VSDs

The Advantage Electrospeed has the following historical logging capabilities in common with the GCS Electrospeed series of VFDs.

- 254 Most recent System events
 - o Including startup, shutdown, power up, parameter change, alarm condition etc.
 - o Stored in battery backed memory
 - o Saved to PC Card on demand
 - o Visible on Display menu
- 99 Most recent shutdowns
 - o Included shutdown cause, volts, amps and analog inputs @ shutdown
 - o Stored in battery backed memory
 - o Saved to PC Card on demand
 - o Visible on Display menu
- Digital Ampchart
 - o Emulated 7 day Bristol amp chart
 - o Stored in battery backed memory
 - o Saved to PC Card on demand
 - o Visible on Display menu
- User Configurable Logging
 - o Stored directly to PC Card (required PC Card to be enabled)
 - o User selectable 24 items from list of ~200 system parameters
 - o User selectable duration / deadband
 - o Logging stopped when PC Card filled up (no endless logging)
- Drive setup can be saved or loaded via the PC Card slot

Advantage Historical Logging:

The Advantage LV products are equipped with an internal “personality module” (PM) designed for storage of all drive configuration, setup and historical data. It has 750MB of flash storage dedicated for historical recording, allowing the drive to retain setup, configuration and historical information. The drive also has a compact flash memory card connector. The flash card can be used for user defined data logging, history as well as configuration and setup files.

The Advantage LV drive provides a weatherproof, user accessible USB slot located on the door allowing historical data to be retrieved from the drive without access to high voltage.



Advantage LV Series of drives provide the following additional features.

- **Drive configuration / setup**
 - o Drive setup automatically saved to PM within 15 minutes of parameter change, does not require drive to be shut down.
 - o Drive configuration retained in PM and will automatically reload set points when software is upgraded or system board is replaced.
- **Firmware Updates**
 - o Firmware updates can be loaded via the door mounted USB stick by following the software upgrade procedure.
 - o Updates can be loaded while the drive is running. Will be applied the next time the system cycles power. Recommend someone on-site to apply the upgrades.
- **254 Most recent System events**
 - o Events for the day are recorded to the PM every midnight.
 - o Copied to USB Door drive during a 'Get Historical Data' operation.
- **99 Most recent shutdowns**
 - o Shutdowns for the day are recorded to the PM every midnight.
 - o Copied to USB Door drive during a 'Get Historical Data' operation.
- **Digital Ampchart**
 - o Ampchart is copied each Sunday night at midnight to the PM.
- **Endless Data logging**
 - o 61 system parameters automatically configured
 - o Duration is once per second
 - o Dead band requires sample to change by 2% of previous value before being recorded to disk.
 - o Evaluated and sampled once each second.
 - o Data compressed and stored to PM in real time (.dat file type)
 - o Retains all data up to moment of power failure
 - o No user setup required
 - o Up to one year of recorded
 - o 'Endless' logging with oldest data removed each week to make room for new data

The organization of the Historical data that is copied to the USB stick inserted in the drive door is detailed in the USB FEATURES SCREEN portion of this document.

A PC Application is available to decompress the .DAT files generated by the Advantage endless logging.

Appendix D: Product Certification

General

The Electrospeed Advantage™ Variable Speed Drive (ADV VSD) has been designed and evaluated to the following standards:

- UL508C "Power Conversion Equipment"
- CSA22.2 No. 14 "Industrial Control Equipment"
- IEC 61800-5-1 "Adjustable Speed Electrical Power Drive Systems-Part 5-1: Safety Requirements-Electrical, thermal and energy"
- IEC 61800-3 "Adjustable Speed Electrical Power Drive Systems-Part 3: EMC requirements and specific test methods".

The evaluation of the ADV VSD was performed by the Notified Body, TUV Rheinland of North America to all of the above standards. Consequently, the standard offering product bears the cTUV_{US} certification mark. The cTUV_{US} mark serves as a declaration by TUV Rheinland of North America that:

- 1) The ADV VSD meets all of the United States and Canadian safety design requirements for Industrial Machinery as defined in UL508C and CSA 22.2 No. 14;
- 2) Baker Hughes has a management of change system in place that takes into account the certification requirements and;
- 3) The manufacture of the product follows the design requirements as specified during the initial investigation.

Baker Hughes CE marks the ADV VSD to the Electromagnetic Compatibility (EMC) Directive 2004/108/EC and the Low Voltage Directive (LVD) 2006/95/EC. The Declaration of Conformity is available upon request.

EMC Considerations

The Electrospeed Advantage™ Variable Speed Drive has been designed and tested for use in industrial applications. An industrial environment is defined as an installation where the product is not connected directly to power sources that feed a public main. In the terms as defined in IEC 61800-3, the product is for use in a Category C4, second Environment. Voltage dips or short interruptions greater than 50% of input power will cause the drive to shut-down in fault conditions.

During installation, Power cabling is to be segregated from signal cabling to avoid ECM interference concerns.

Warning: In a domestic environment this product may cause radio frequency interference in which case supplementary mitigations may be required.

Factors that affect certification

Installation

Installation of the Electrospeed Advantage™ Variable Speed Drive that is contrary to the documentation provided here in will invalidate the factory certification.



Repair/Servicing

The TUV certification shall remain valid at the conclusion of routine repairs and servicing provided that the following conditions are met:

- The parts used in any repair/servicing activity have been received from a certified factory location and have been designated for the particular usage.
- The end result of the repair/service is a product that is identical to the form, fit and function of the model number stamped on the nameplate of the VSD and as received from the factory.

APPENDIX E: MULTIPLE CONVERTER / 24 PULSE DRIVES

The Advantage variable speed drive can be configured with a 24 pulse input converter to minimize the level of current harmonic distortion generated on the power system. Using this configuration will usually reduce the total harmonic distortion (THD) on the power system to a level below the IEEE-519 requirements.

Overview: The main components of the 24-pulse drive are:

1. Input transformer with four phase shifted secondary windings, 15 degrees apart.
2. Four input disconnect switches, one for each transformer winding/converter input
3. Advantage system base board with four converter control outputs (ASCB)
4. Four, three phase SCR converter sections
5. Four current sharing CTs, one for each converter

Please refer to drawings 908182 / 908166 for the system level schematics of the 24 pulse drive.

General Description:

An Advantage 24-pulse drive uses four converter input terminal sets connected to four separate phase shifted power transformer windings. The four converters are all used to charge the drive's DC Bus while dividing the total power load between the sections. This configuration results in a minimum of current harmonic distortion. Since optimizing for minimum harmonic distortion may not yield the best input power factor, the current sharing feature can be user enabled/disabled. When current sharing is enabled, the Advantage drive will equalize the levels of current drawn between the available converters thereby minimizing the amount of harmonic distortion imposed upon the utility power supply. Conversely, disabling current sharing will result in the best input power factor, but possibly higher harmonic distortion.

Hardware:

The 24 pulse and 8000 series Advantage drives use the Advantage System Control Board (ASCB). This circuit board can control up to four converter and four inverter modules.

The ASCB uses different driver cards and connectors than those found on previous drives. The converter and inverter cards are connected via a wiring harness rather than being directly connected to the system control board. This allows the driver cards to be located much closer to their devices. The ASCB supports up to four different inverter and converter sections, each with its own plug on the ASCB, labeled J5 through J8 for the converter section and J9 through J12 for the inverter section. These connectors differ from the previous style in two significant ways:

- The harness/ connectors between the system control board and the driver cards must not be disconnected while the system control board is powered. This can cause permanent damage to the driver cards and/ or the ASBB.
- If any of the inverter plugs on the ASBB is not plugged into the wiring harness the connector must be terminated using an Advantage Inverter Termination Plug (AITP, "dummy plug"). An empty inverter plug will be interpreted as a constant IOT and may cause the drive to lock up or the APC to stop communicating with the rest of the hardware, depending on software.

Software:

All of the circuit boards used in the Advantage system should be running the latest versions of software. Contact Centrilift for information regarding the current software revision levels.

Operation:

Current sharing can be turned on or off in the Advantage Features menu by enabling or disabling Current Sharing. The Analog Setup and Display / Drive Input Current screen shows the input current on B phase of each converter section. If current sharing is enabled, but the

currents are shown to be imbalanced, it might indicate a problem with one or more converters.

Features	
EasyStart Setup	No
EasyI/O Setup	No
Single Phase Vo	No
Current Sharing	Yes
Backspin Detect	No
Backspin Start	No
MaxStart Enable	No
RideThru Enable	No

Drive Input Current	
Cnv1 B Amps	152 A
Cnv2 B Amps	152 A
Cnv3 B Amps	154 A
Cnv4 B Amps	150 A
Input IA	582 A
Input IB	584 A
Input IC	580 A
Inpt CT Ratio	500

The graphic shown at left shows that there are four converters and that the phase B current from each converter is relatively well balanced.

The drive's input power factor and power consumption is calculated using the three current readings from converter one. Those three currents are shown as Input IA, IB and IC

APPENDIX F: FILTERED PWM OPERATION

Setup of Advantage variable speed drives with FPWM™ capability applied on Electrical Submersible Pumps

This information applies to Advantage variable speed drives configured to operate in filtered pulse width modulation (FPWM) mode. The following provides a brief overview of the system.

FILTERED PWM (FPWM™) SYSTEM OVERVIEW

- In addition to the standard drive's power and control electronics, the FPWM configured drive incorporates series connected Filter Inductors, delta connected capacitors and contactors.
- The carrier frequency of the Advantage PWM waveform is 2 kHz. This frequency is fixed and will not need adjustments for different loads.
- Electrical Submersible Pump (ESP) systems can be damaged by an unfiltered PWM waveform. The Advantage FPWM™ design prevents this damage by creating a nearly sinusoidal waveform for the ESP system.
- In case of a failure in the Filter section the Advantage FPWM™ will automatically switch the output waveform to 6-step (ESP Inverter mode) without stopping the motor. This not only prevents a loss of production from the well but also protects the ESP components downstream of the Advantage from unfiltered PWM waveforms..

SETUP:

There are particular operating characteristics that occur while operating in this mode that need to be explained.

Due to the design of the FPWM system, the maximum voltage attainable at the output will be approximately 6.25% lower than a drive without the option. At the same time the output current to the step-up transformer will be seen to have increased capacity by the same amount (ratio).

This is neither a design flaw nor a problem but rather a characteristic common to every drive system that uses a form of filter to change the output PWM waveform into a “cleaner” (more sinusoidal) power source.

The setup of the drive and surface equipment needs to be handled differently when FPWM mode is used. The system must be calibrated to operate at a lower maximum output voltage as illustrated in the example below.

For example: an 8900 model drive rated 1000kVA, 480 volts input and set up for max volts out (480) in ESP mode (standard 6-step operation) will have a full load output current of 1203 Amps. When operating in FPWM mode the same drive with 480 volts in and set for maximum output (now 450VAC) will have a full load output current rating of 1283 Amps. The point is that the same full load system capability of 1000kVA is still available.

To ensure the proper, required voltage is delivered to the motor, review and, if necessary, change the step-up transformer tap selections.

The difference in output voltage may prevent a system from attaining a specific maximum output voltage in FPWM versus ESP modes. It's important to check applications that may have a voltage limit on the transformer.

OPERATION:

ADVANTAGE FPWM™ drives are designed to run in PWM Inverter mode which, when properly filtered, will produce a nearly sinusoidal waveform. However if the filter or one of its components fails, the drive detects the problem and de-energizes the filter. At the same time it changes the Inverter mode from PWM to ESP mode while still running.

There are two main conditions that can cause the controller to disengage the filter contactor. One of these is Current Unbalance, which is usually a result of one phase of filter capacitors failing to an open circuit. This causes zero current on that phase and high current on the other two generating a current unbalance which in turn causes a switch to ESP mode.. The other possibility is Underload which can happen if two or three phases of the filter capacitors fail to an open circuit. The event history recorded in the drive will help to identify and rectify problems. The example event record below indicates that the filter was disengaged due to a C-Phase current imbalance.

Event Records	
1:Startup	
2:SPC PWM Fltr Flt Alrm	
3:SPC Inverter Mode	
4:SDE Man Kpad Lk	
5:RTN FPWM C1 Imbal	
6:SPC PWM Fltr Flt Alrm	
7:SPC Inverter Mode	
8:CFN FPWM C1 Imbal	
9:Startup	
10:SPC PWM Fltr Flt Alrm	
<hr/>	
Setpoint change	
2013/09/10 11:28:27	
Bef:	0
Aft:	2

The ADVANTAGE FPWM™ decides which Inverter mode is used. The choices are PWM and ESP, the Hybrid mode is not available. When the filter is operating normally, the Inverter mode is PWM (mode 2). If the filter has a problem and disengages, the Inverter mode is ESP (mode 0). The operator cannot change Inverter mode with the keypad or SCADA system.

Pwm Fltr Cfg	
Cont Status	DI8
Cntlr DI1	FPWM FLTR C
Reset Switch	DI7
Fault Beacon	DO8
Filter Currents	
<hr/>	
PWM Filter Contactor Status	

Filter test:

To test the FPWM™ system it is sometimes desirable to mimic a failure in the Filter. One way to do this is to start the drive in PWM mode and wait for it to ramp up. Once the drive is up to speed change the Contactor status input from DI8 to an unused input such as DI4, DI5 or DI6. Soon after that the filter will disengage and though the drive will continue to run, the Inverter mode will change from PWM to ESP and the "Check Filter" light will illuminate.

To re-engage FPWM™ operation after a filter failure, stop the drive, rectify the cause of the

failure and push the “Reset Filter” pushbutton. The “Check Filter” light will go out. The display will indicate PWM Inverter mode but the filter contactor will not energize until the drive is started again.

Soon after starting the ADVANTAGE in PWM inverter mode, the DC bus voltage goes to maximum regardless what the Output voltage and frequency are. Therefore if the functional test “Form the DC bus capacitors” is performed it must be done in ESP mode. Forcing the drive to run in ESP mode can be accomplished in the same way as just previously explained for the FPWM system test. This ensures the drive will run in ESP mode and not FPWM™. When the drive is started, it does not read a normal, contactor engaged signal from the digital input,

assumes there has been a “filter failure”, and will switch automatically to ESP mode.

Filter Currents			
FPWM	CT	Ratio	250
C1	FPWM	IA	1 A
C1	FPWM	IB	0 A
C1	FPWM	IC	2 A
FPWM	C1	Imbal	0

FPWM Filter CT Ratio			
----------------------	--	--	--

Shorted-Output tests must also be done in ESP mode.

Once finished forming capacitors or performing the Shorted-Output test, reverse whatever method was used to simulate a filter fault. Apply power to the drive and push the Filter Reset button to reengage FPWM™ operation.

Filter Currents The individual filter capacitor currents are displayed in this screen accessed from the bottom line of the PWM Flt Cfg screen. Also displayed is the current transformer ratio and the present amount of current imbalance.

APPENDIX G: MODEL DESIGNATION & VARIABLE TORQUE VSD RATINGS

Model Designation: Series 2xxx-4-ADV-yp-FPWM
Series 4xxx-4-ADV-yp-FPWM
Series 8xxx-4-ADV-yp-FPWM

(xxx = KVA = 060, 125,200,250,300,350,400,500, 600, 700, 800, 900)
(y= 6, 12, 24; z= FPWM, Blank)

Rated Voltage: 3 AC 380-480V, 50-60Hz

Rated Current:

xxx=	60	125	200	250	300	350	400	500	600	700	800	900	(KVA)
y=6:	83	164	253	329	411	492	573	655	788	945	1102	1263	(Amps)
y=12:(2x)		82	26.5	64.5	205.5	246	286.5	327.5	394	427.5	551	631.5	(Amps)
y=24:(4x)								197	236.5	275.5		315.5	(Amps)

Protection Class: I **Enclosure type:** NEMA 4

Output Ratings: 480VMax, 10-120Hz.

Output at 380 - 480V:	52-66 kVa	(xxx=060)
	103-130 kVa	(xxx=125)
	159-200 kVa	(xxx=200)
	206-260 kVa	(xxx=250)
	257-325 kVa	(xxx=300)
	308-390 kVa	(xxx=350)
	359-454 kVa	(xxx=400)
	411-518 kVa	(xxx=500)
	494-624 kVa	(xxx=600)
	592-748 kVa	(xxx=700)
	691-873 kVa	(xxx=800)
	792-1000 kVa	(xxx=900)

NOTE: When applying variable speed drives to constant torque loads, the continuous output current and output kVA are de-rated by 20%. The overload and start currents remain the same.

Recommended input fuse sizes are shown in the appendix named Fuse and Cable Sizing

Variable Torque VSD Ratings

Output Ratings at 480 VAC/400 VAC					Input Ratings	
Model	KVA 380/480	Continuous Current RMS Amps	Overload Current 60 Sec	Start Current 7 Sec	Amps	
					Fuse Rating	Input Current
2060-4-ADV-6	52/66	79	95	119	100	83
2125-4-ADV-6	103/130	156	187	234	200	164
2200-4-ADV-6	159/200	241	289	362	300	253
2250-4-ADV-6	206/260	313	376	470	400	329
2125-4-ADV-12	103/130	156	187	234	2x100	2x82
2250-4-ADV-12	206/260	313	376	470	2x200	2x165
4300-4-ADV-6	257/325	391	469	587	500	411
4300-4-ADV-12	257/325	391	469	587	2x250	2x206
4350-4-ADV-6	308/390	469	563	704	600	492
4350-4-ADV-12	308/390	469	563	704	2x300	2x246
4400-4-ADV-6	359/454	546	655	819	700	573
4400-4-ADV-12	359/454	546	655	819	2x350	2x287
4500-4-ADV-6	411/518	624	749	936	800	655
4500-4-ADV-12	411/518	624	749	936	2x400	2x328
8600-4-ADV-24	494/624	750	900	1125	500x2	788
8700-4-ADV-24	592/748	900	1080	1350	600x2	945
8800-4-ADV-24	691/873	1050	1260	1575	700x2	1102
8900-4-ADV-24	792/1000	1203	1444	1805	800x2	1263

Fuse
24 Pulse

250x4

300x4

350x4

400x4

APPENDIX H: FUSE AND CABLE SIZING

Recommended Cable Sized for NEMA 4/IP56 Drive, 131°F (55°C) Ambient

All power cabling must be 167°F (75°C) rated per UL 508C. The cable sizes below are based on 131°F (55°C) ambient temperature and will work under all circumstances. Cable sizes may be calculated based on your local maximum ambient. Higher temperature rating cables may be used, but must be sized for 75°C rating.

VSD Model	Input Fuse Rating	Input Current	Cable Size (AWG) (x) = Conductors per phase	Ground Conductor Size (Included in Cable) (x) = No. of Conductors	Cable P/N	Cable Gland P/N	Lug P/N	Torque Rating (in./lb)	Lug Kit P/N
					Input/Out	Input/Out	Input/Out	Input/Out	
2060-4-ADV-6	100A	83	1, (1)	#6 AWG	902158	902169	901358	228/228	902182
2125-4-ADV-6	200A	164	250MCM, (1)	#4 AWG	902163	902174	902177	496/496	902193
2200-4-ADV-6	300A	253	3/0, (2)	#4 AWG	902161	902172	88152	496/496	902187
2250-4-ADV-6	400A	329	250MCM, (2)	#4 AWG	902163	902174	902177	496/496	902194
4300-4-ADV-6	500A	411	4/0, (3)	#4 AWG	902162	902173	48455	252/252	902191
4350-4-ADV-6	600A	492	250MCM, (3)	#4 AWG	902163	902174	902177	252/252	902195
4400-4-ADV-6	700A	573	350MCM, (3)	#3 AWG	902164	902175	902178	252/252	902198
4500-4-ADV-6	800A	655	500MCM, (3)	#2 AWG	902165	902176	86659	252/252	902200

Note: for 2000 / 4000 6-Pulse Drives, Cables are copper, 3 conductor with ground conductor and aluminum armor, XLP, 90°C (sized as 75°C),

2125-4-ADV-12	2-100A	2x82	1/0, (1) per input, (2) output	#6 AWG	902159	902169	51145	228/496	902183
2250-4-ADV-12	2-200A	2x164.5	250MCM, (1) per input, (2) output	#4 AWG	902163	902174	902177	496/496	902194
4300-4-ADV-12	2-250A	2x205.5	2/0, (2) per input, (4) output	#6 AWG	902160	902171	88160	252/252	902186
4350-4-ADV-12	2-300A	2x246	3/0, (2) per input, (4) output	#4 AWG	902161	902172	88152	252/252	902188
4400-4-ADV-12	2-350A	2x286.5	4/0, (2) per input, (4) output	#4 AWG	902162	902173	48455	252/252	902192
4500-4-ADV-12	2-400A	2x327.5	250MCM, (2) per input, 500MCM (3) output	#4 AWG	902163	902174	902177	252/252	902196

Recommended Cable Sized for NEMA 4/IP56 Drive, 131°F (55°C) Ambient

All power cabling must be 167°F (75°C) rated per UL 508C. The cable sizes below are based on 131°F (55°C) ambient temperature and will work under all circumstances.

Cable sizes may be calculated based on your local maximum ambient. Higher temperature rating cables may be used, but must be sized for 75°C rating.

VSD Model	Input Fuse Rating	Input Current	Cable Size (AWG) (x) = Conductors per phase	Ground Conductor Size (Included in Cable) (x) = No. of Conductors	Cable P/N	Cable Gland P/N	Lug P/N	Torque Rating (in./lb)	Lug Kit P/N
					Input/Out	Input/Out	Input/Out	Input/Out	
12-12 pulse									
24-24 pulse									
8600-4-ADV-12	2-500A	2x 788	3/0, (3) per input, (6) Output	#4 AWG (6)	902161	902172	88152	78/78	902189
8700-4-ADV-12	2-600A	2x 945	250MCM, (3) per Input, (6) Output	#4 AWG (6)	902163	902174	902177	78/78	902197
8800-4-ADV-12	2-700A	2x 1103	350MCM, (3) per Input, (6) Output	#3 AWG (6)	902164	902175	902178	78/78	902199
8900-4-ADV-12	2-800A	2x 1263	500MCM, (3) per Input, (6) Output	#2 AWG (6)	902165	902176	86659	78/78	902201
8600-4-ADV-24	4-250A	4x 788	2/0, (4) per Input, (8) Output	#6 AWG (4)	902160	902171	88160	78/78	902186
8700-4-ADV-24	4-300A	4x 945	3/0, (4) per Input, (8) Output	#4 AWG (4)	902161	902172	88152	78/78	902188
8800-4-ADV-24	4-350A	4x 1103	4/0, (4) per Input, (8) Output	#4 AWG (4)	902162	902173	48455	78/78	902192
8900-4-ADV-24	4-400A	4x 1263	250MCM, (2) per Input, (8) Output	#4 AWG (4)	902163	902174	902177	78/78	902196

Power Supply Fuses

Designator	Description	Baker Hughes P/N	Manufacturer	Manf. P/N
F1, F2	Fuse, 2A 600 V time delay	53369	BUSS	FNQ-R-2
F3, F4	Fuse, 5A 600 V time delay	54184	BUSS	FNQ-R-5
F5, F6	Fuse, 3.15A,250v,5x20MM,SLO-BLO	901266	LITTLEFUSE	02183.15
F7	Fuse, 6.3A,250v,5x20MM, FAST ACTING	C908171	LITTLEFUSE	021706.3*P
Secondary. Fuse for Control Transformer, CPT1				
FU7	Fuse, 2 amp, 250 V, time delay	900967	BUSSMANN	#MDL-2
FU13 & 14	Fuse, 10 amp, 600V Time delay (8000 series)	C85507	BUSSMANN	FNQ-R-10

APPENDIX I: CONTROL SCHEMATIC DIAGRAMS

Series 2000/4000 – 6 / 12 Pulse Nema1

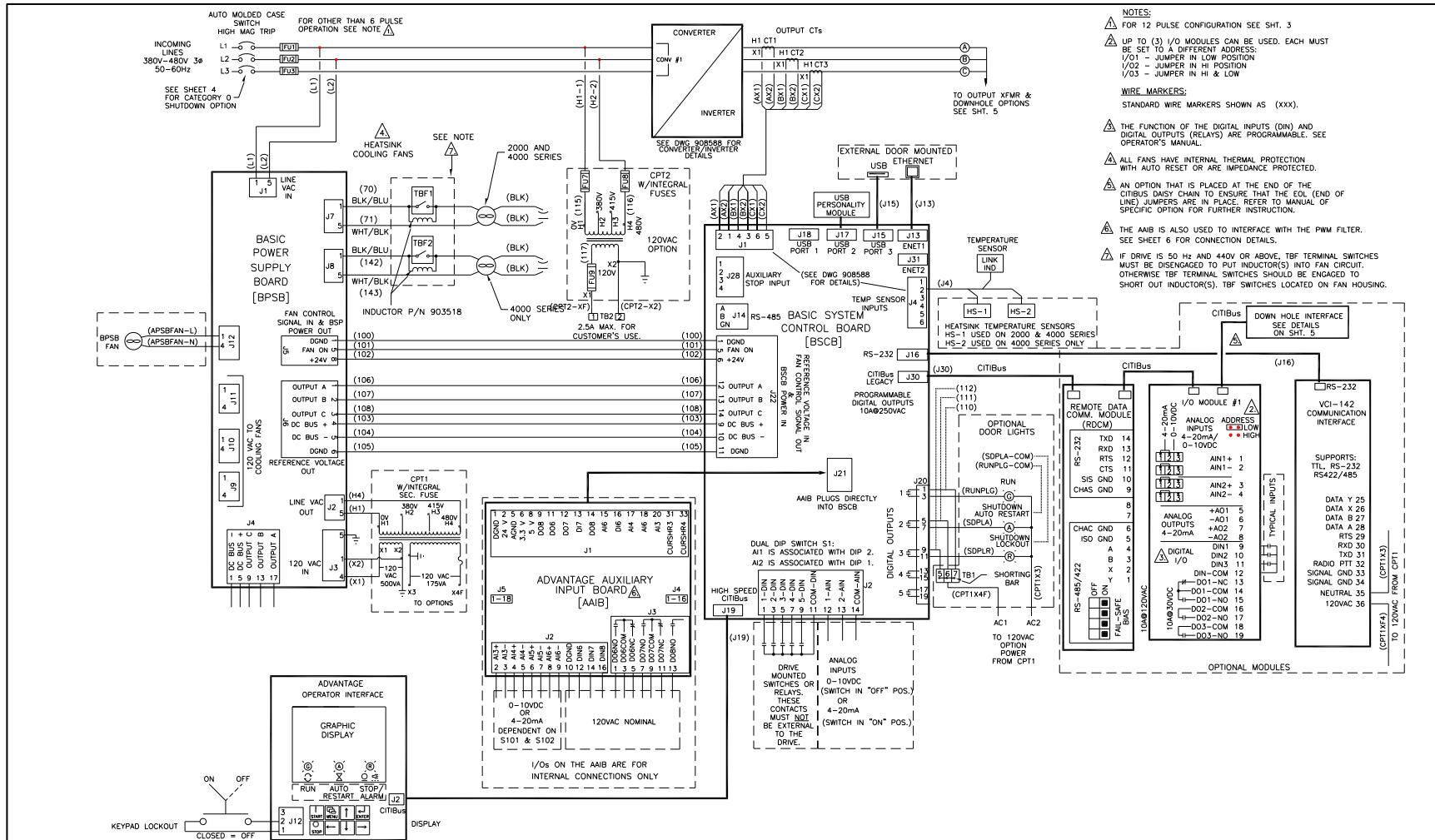


Figure 1: ADVANTAGE 2000/4000 NEMA 1 6-PULSE, 12-PULSE ALL STANDARD OPTIONS

Drawing reference number-908587, sheet number-2, revision-A, revision date: 12 June 13

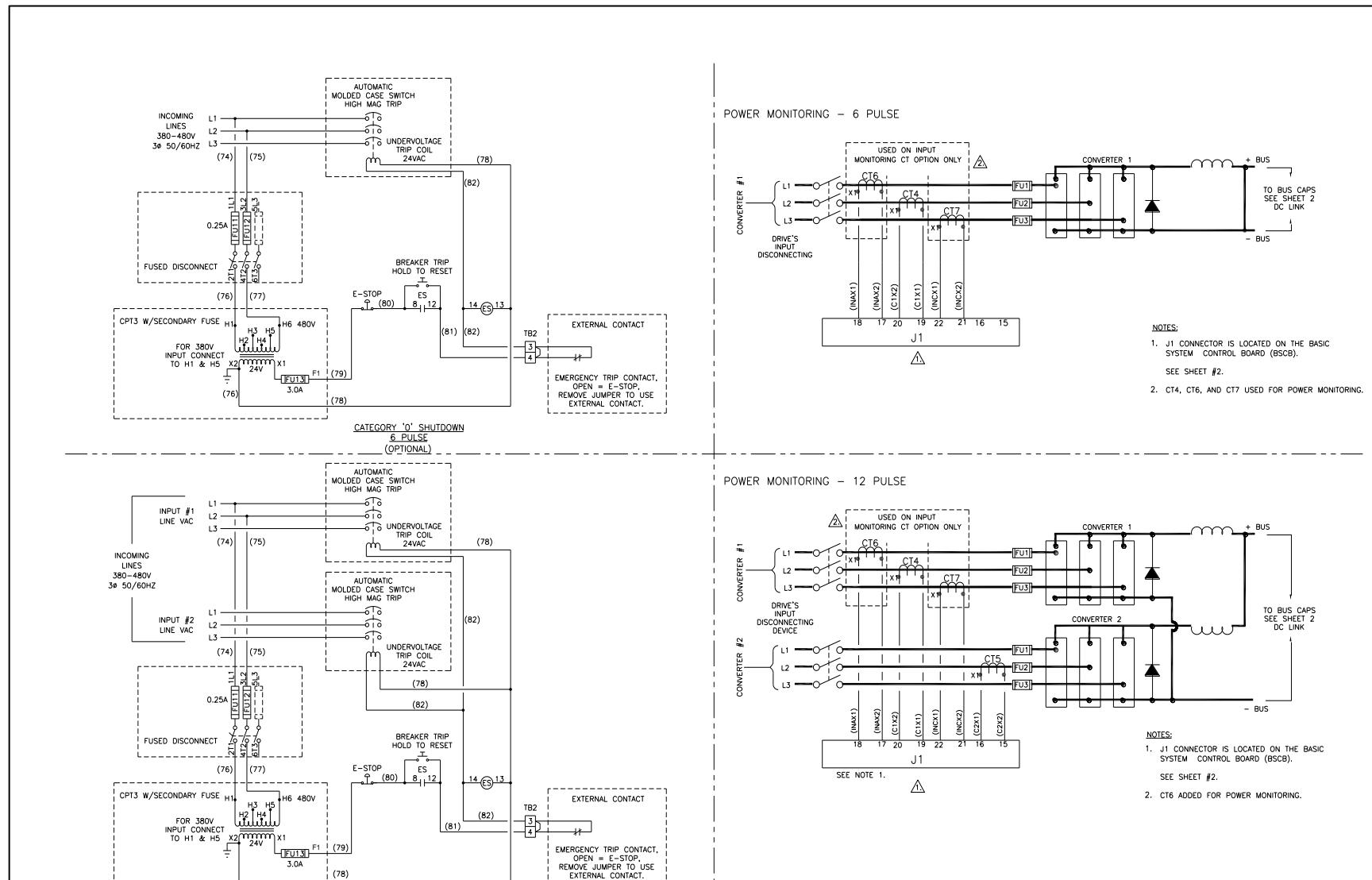


Figure 2: ADVANTAGE 2000/4000 NEMA-1 6&12-PULSE CATEGORY 0 SHUT DOWN & INPUT POWER MONITORING

Drawing reference number-908587, sheet number-4, revision-A, revision date: 12 June 13

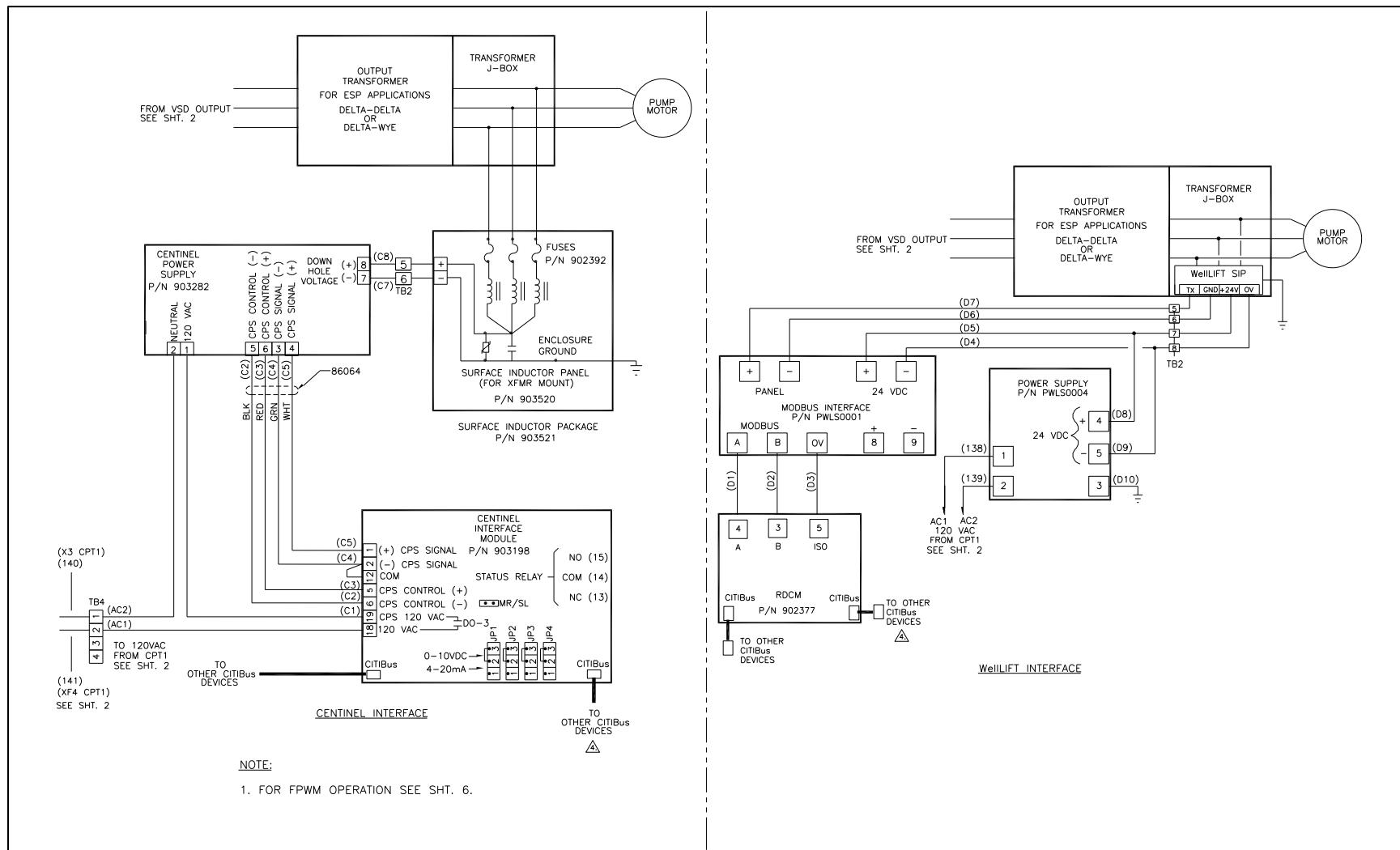


Figure 3: ADVANTAGE 2000/4000 NEMA 1 6-PULSE, 12-PULSE CENTINEL AND WELL LIFT INTERFACE
Drawing reference number-908587, sheet number-4, revision-A, revision date: 12 June 13

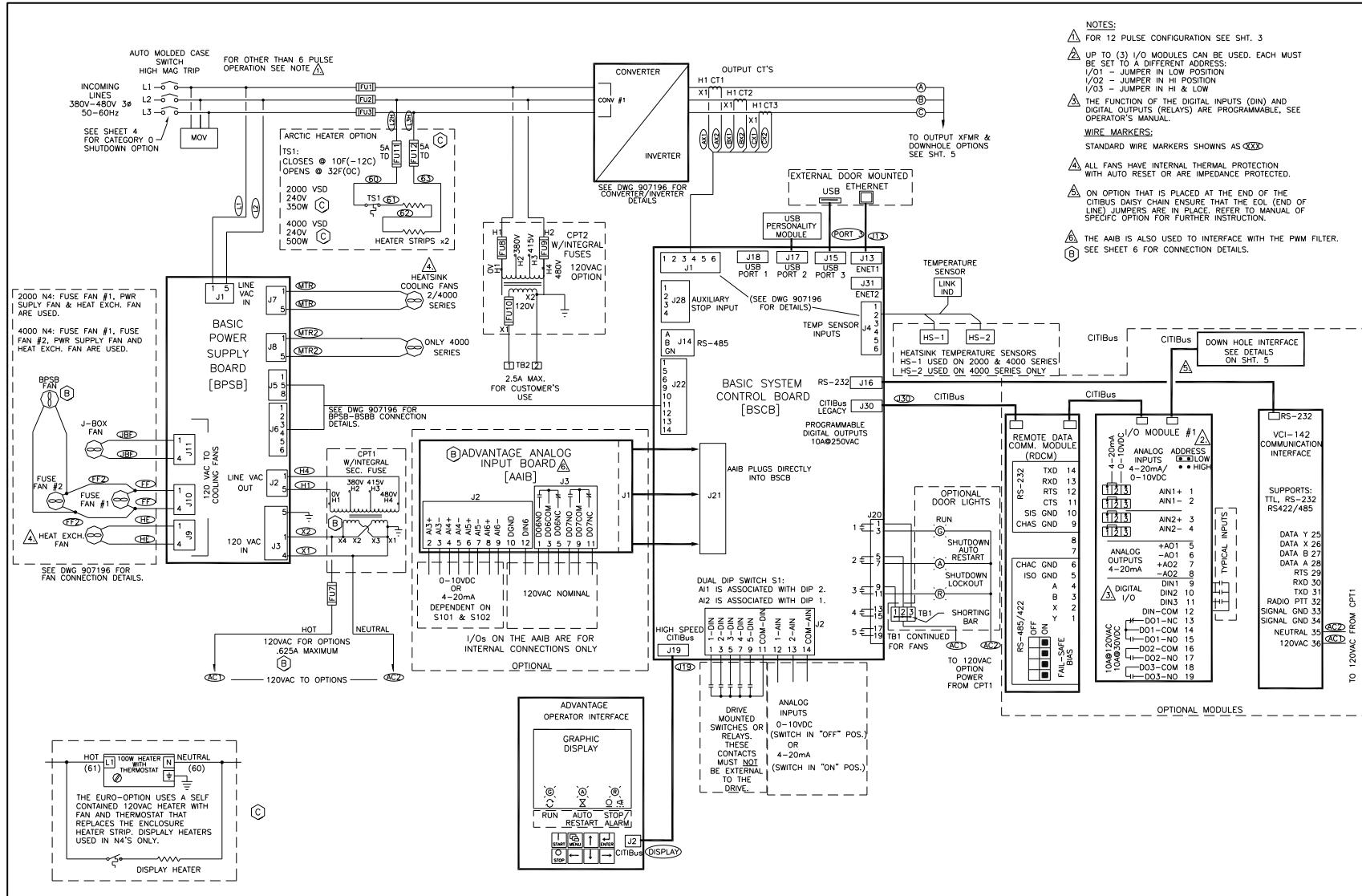


Figure 4: VSD ADVANTAGE SERIES 2000 & 4000 N4 WITH ALL STANDARD OPTIONS

Drawing Number: 907195 - Sheet Number: 2 - Revision: C - Revision Date: 15DEC11

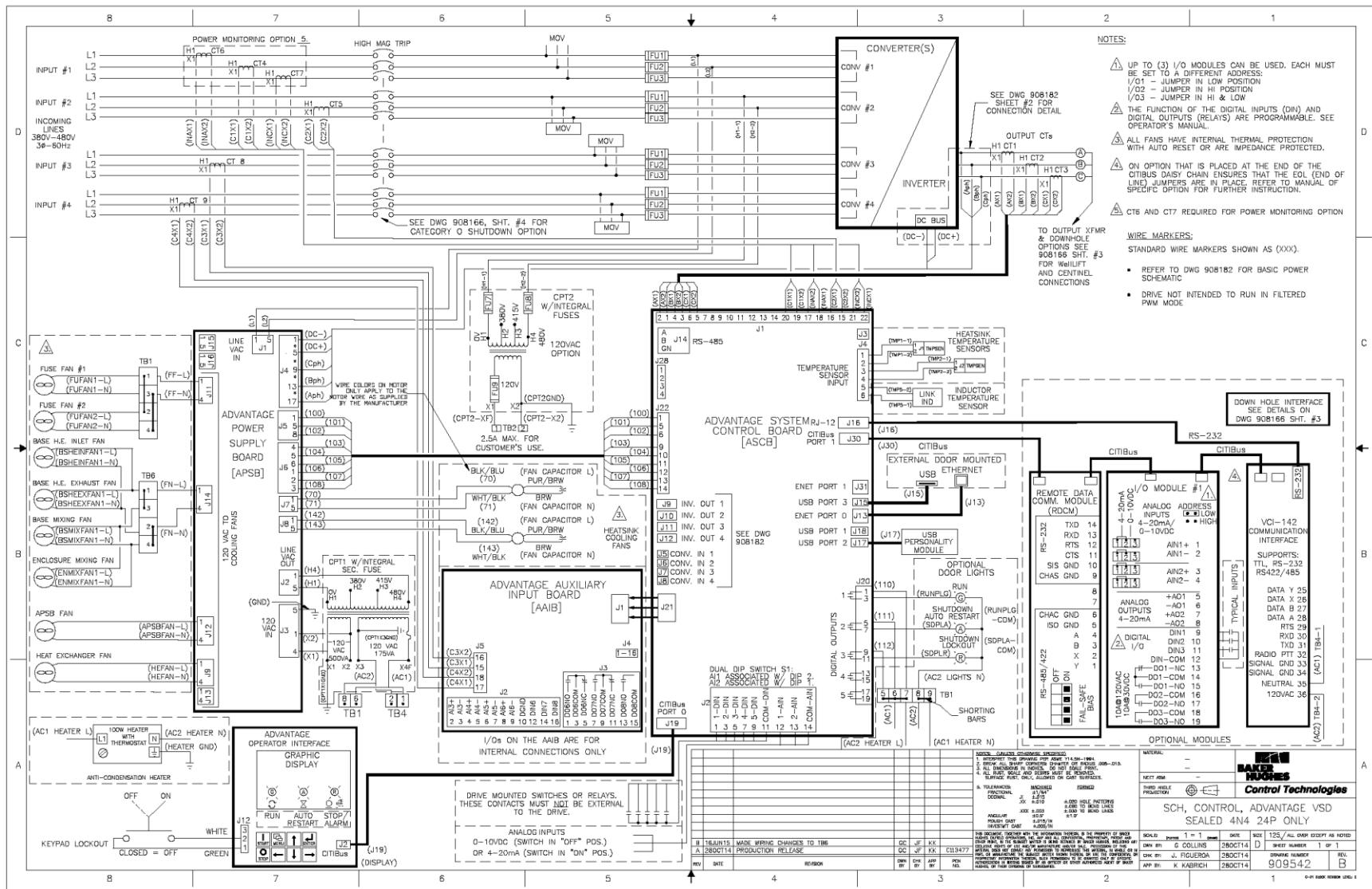


Figure 5: VSD ADVANTAGE SERIES 4000 HARSH ENVIRONMENT NEMA4 24 PULSE WITH ALL STANDARD OPTIONS
Drawing Number: 909542 Revision:B Oct. 2014

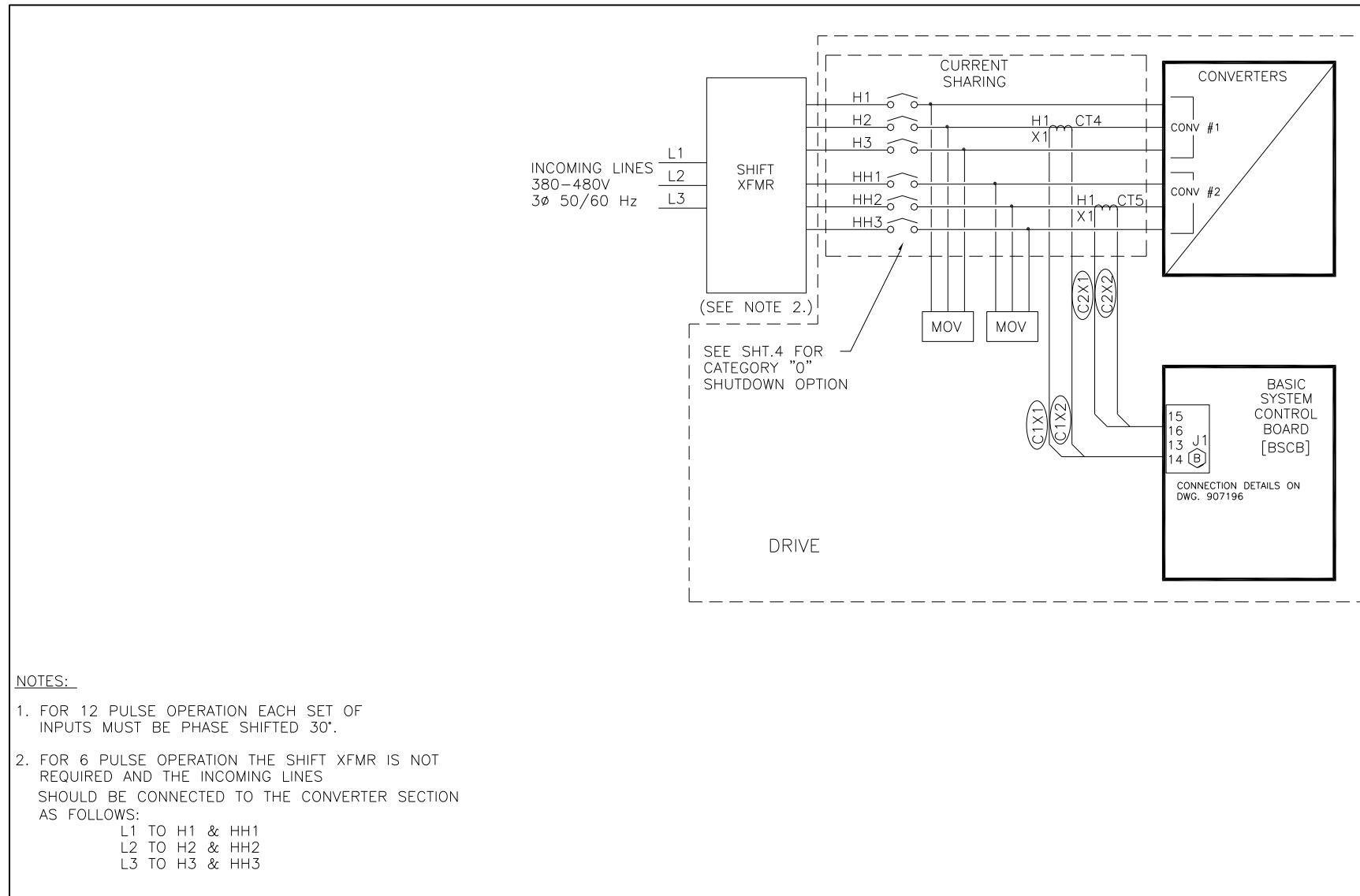


Figure 6: ADVANTAGE SERIES 2000 & 4000 N4 12P CURRENT SHARING
Drawing Number: 907195 -Sheet Number: 3 -Revision: B - Revision Date: 20MAY11

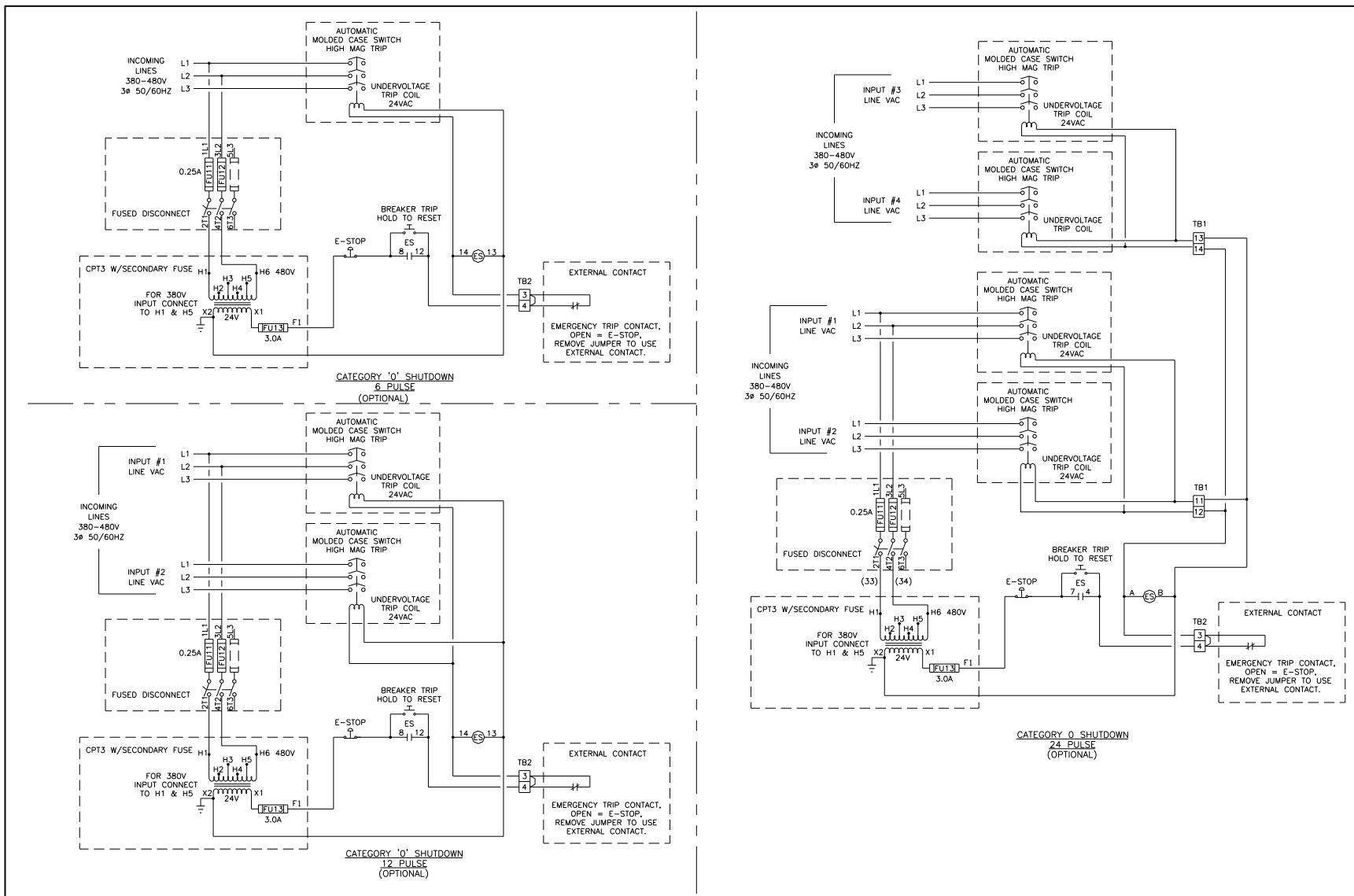


Figure 7: VSD ADVANTAGE SERIES 2000 & 4000 N4 CATEGORY ZERO SHUT DOWN OPTION

Drawing Number: 907195 - Sheet Number: 4 - Revision: C - Revision Date: 15DEC11

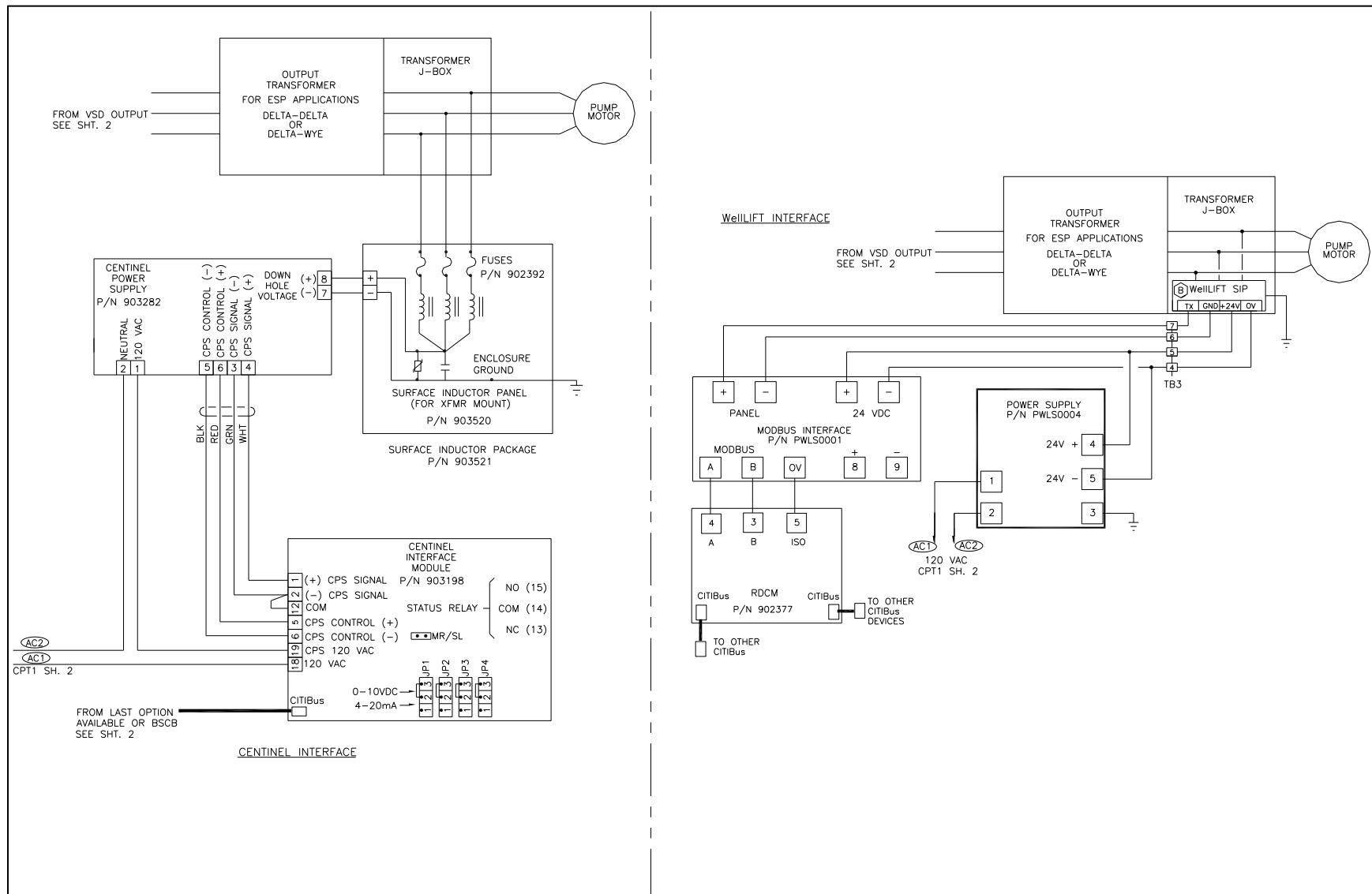


Figure 8: VSD ADVANTAGE SERIES, 2000 & 4000 N4 DOWNHOLE INSTRUMENTATION OPTION
Drawing Number: 907195 - Sheet Number: 5 - Revision: B - Revision Date: 20MAY11

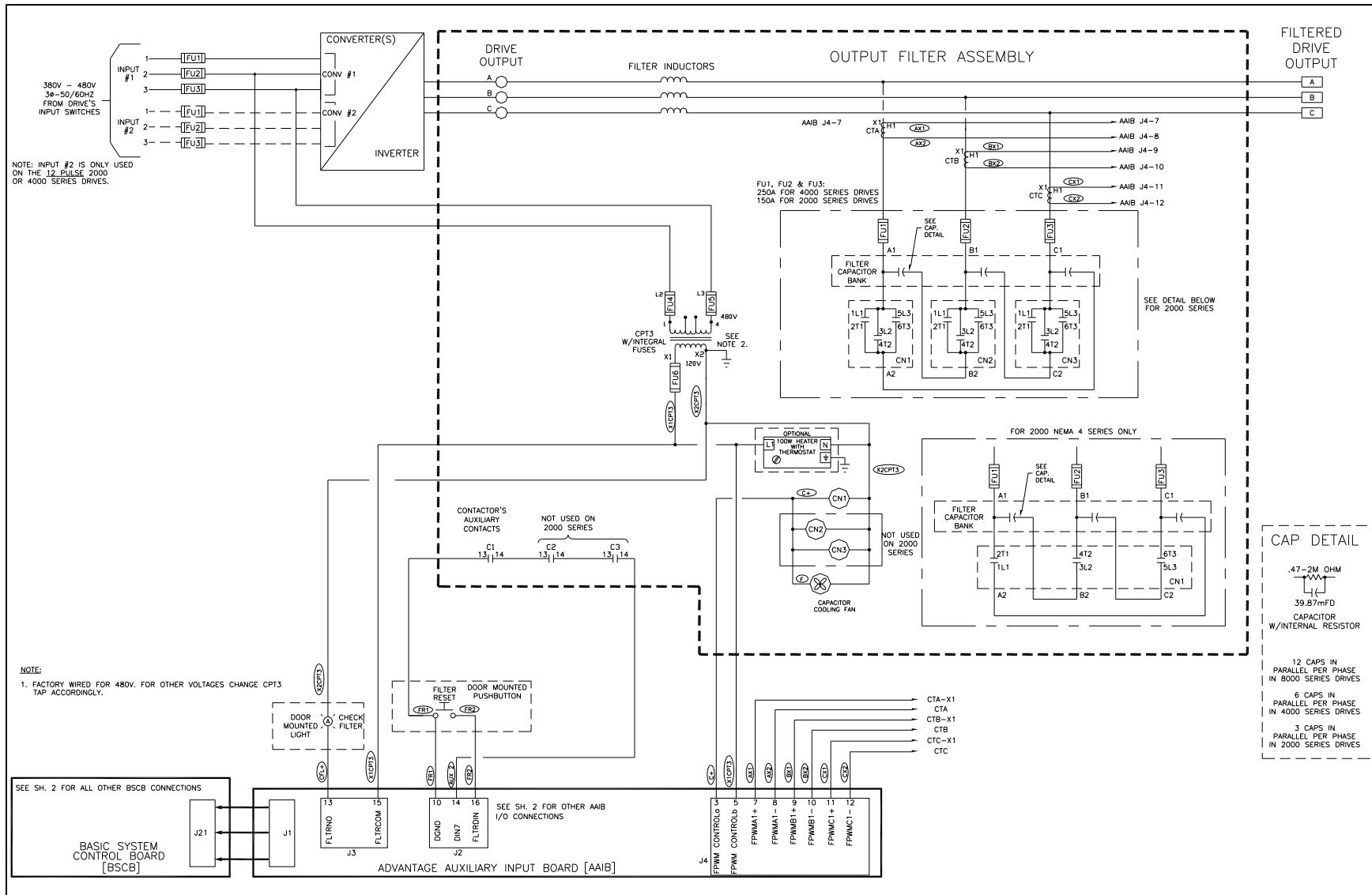


Figure 9: ADVANTAGE SERIES 2000 & 4000 N4 SCH/INTERCONNECT, PWM FILTER TO DRIVE

Drawing Number: 907195 - Sheet Number: 6 - Revision: B - Revision Date: 20MAY11

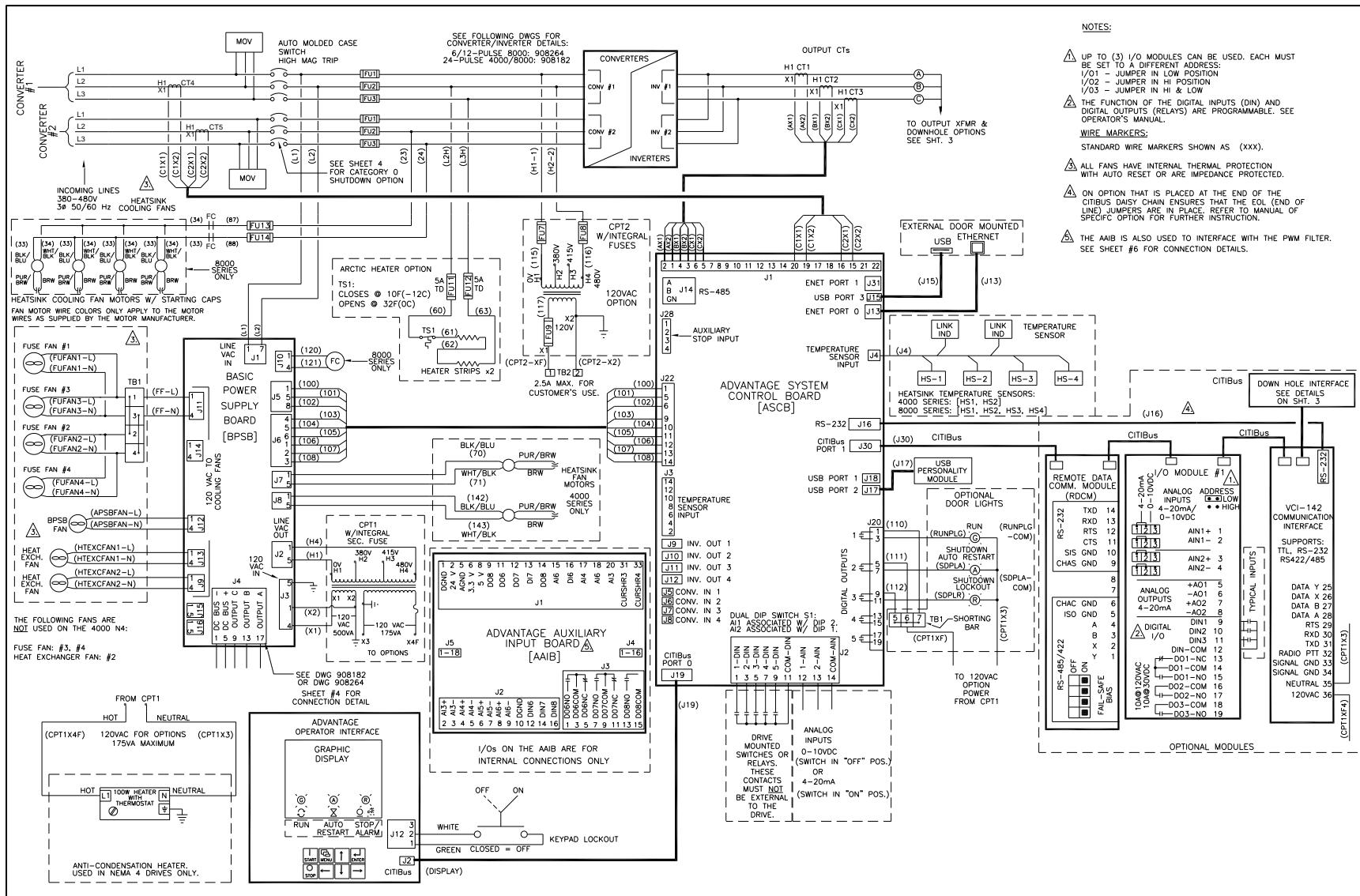


Figure 10: ADVANTAGE VSD 8N4 6/12 & 24P, 4N4 24P ONLY WITH ALL STANDARD OPTIONS
Drawing Number: 908166 - Sheet Number: 2 - Revision: B - Revision Date: 25MAR13

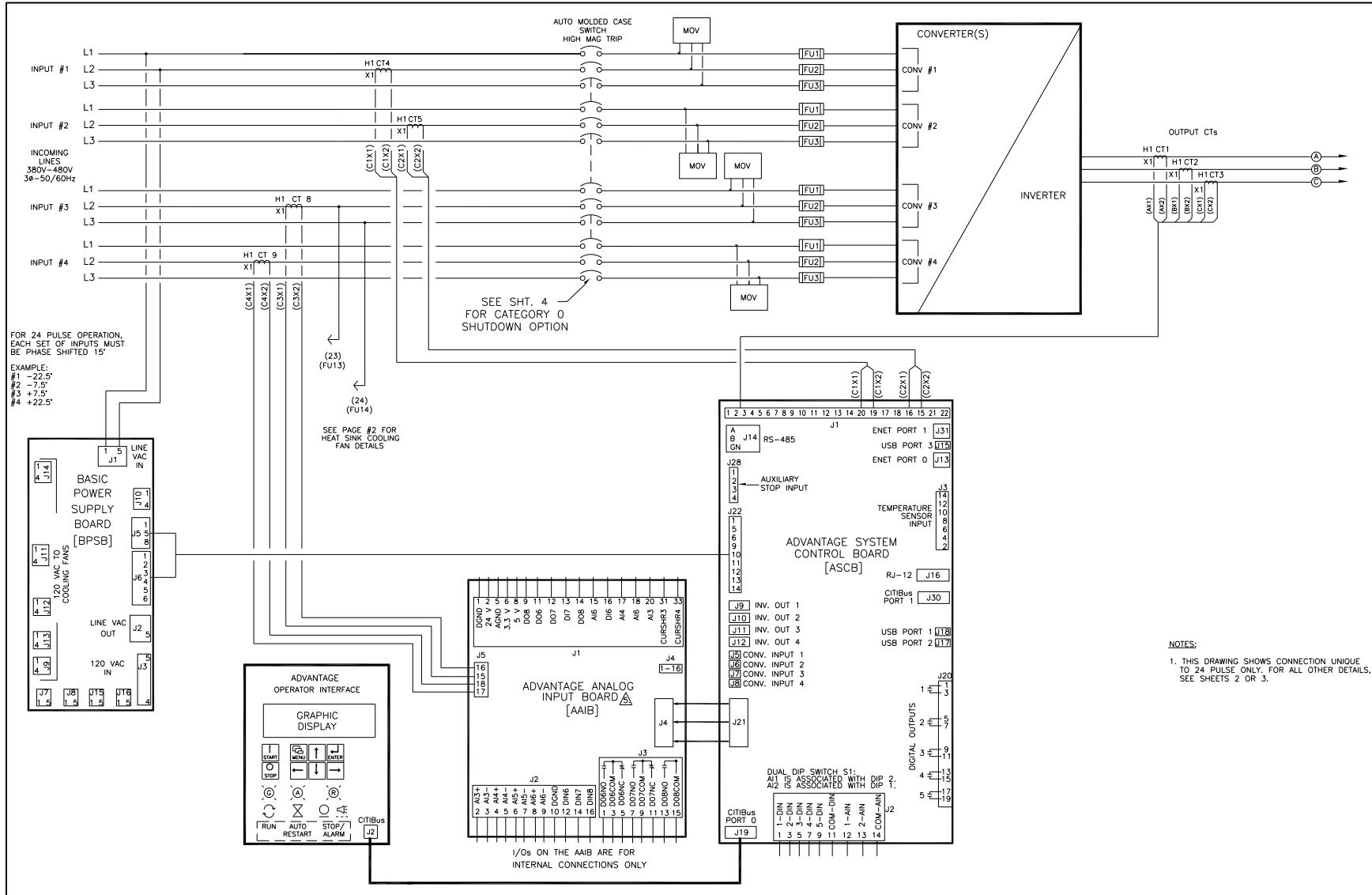


Figure 11: ADVANTAGE 4000-24 PULSE AND SERIES 8000 6/12P, 24 PULSE - CONVERTERS AND CONTROL
Drawing reference number-908166, sheet number-5, revision-A, revision date: 18 Oct 12

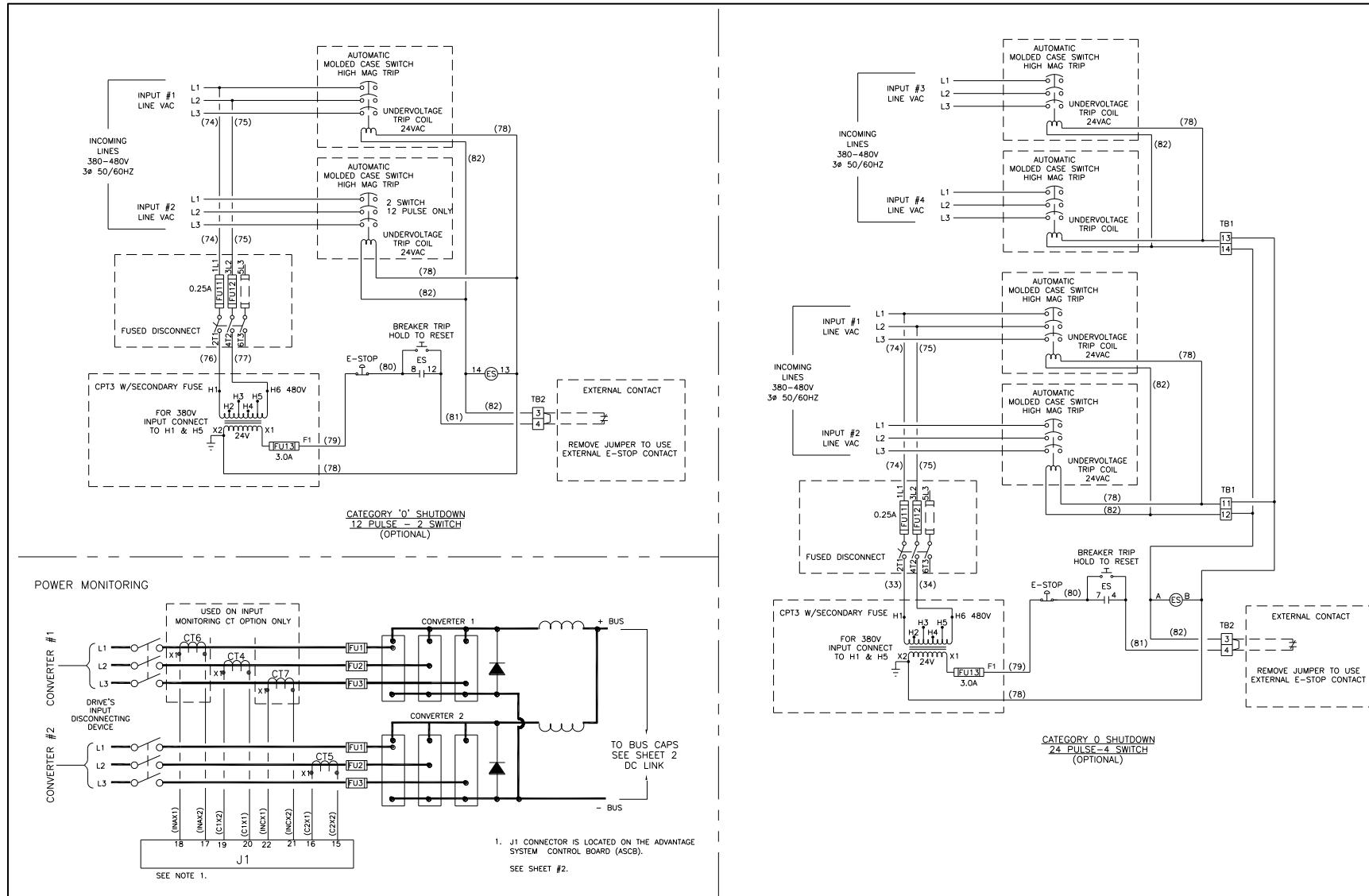


Figure 12: ADVANTAGE 4000-24P & 8000 6/12/24 P CATEGORY '0' SHUTDOWN & POWER MONITORING OPTION
Drawing reference number-908166, sheet number-4, revision-A, revision date: 18 Oct 12

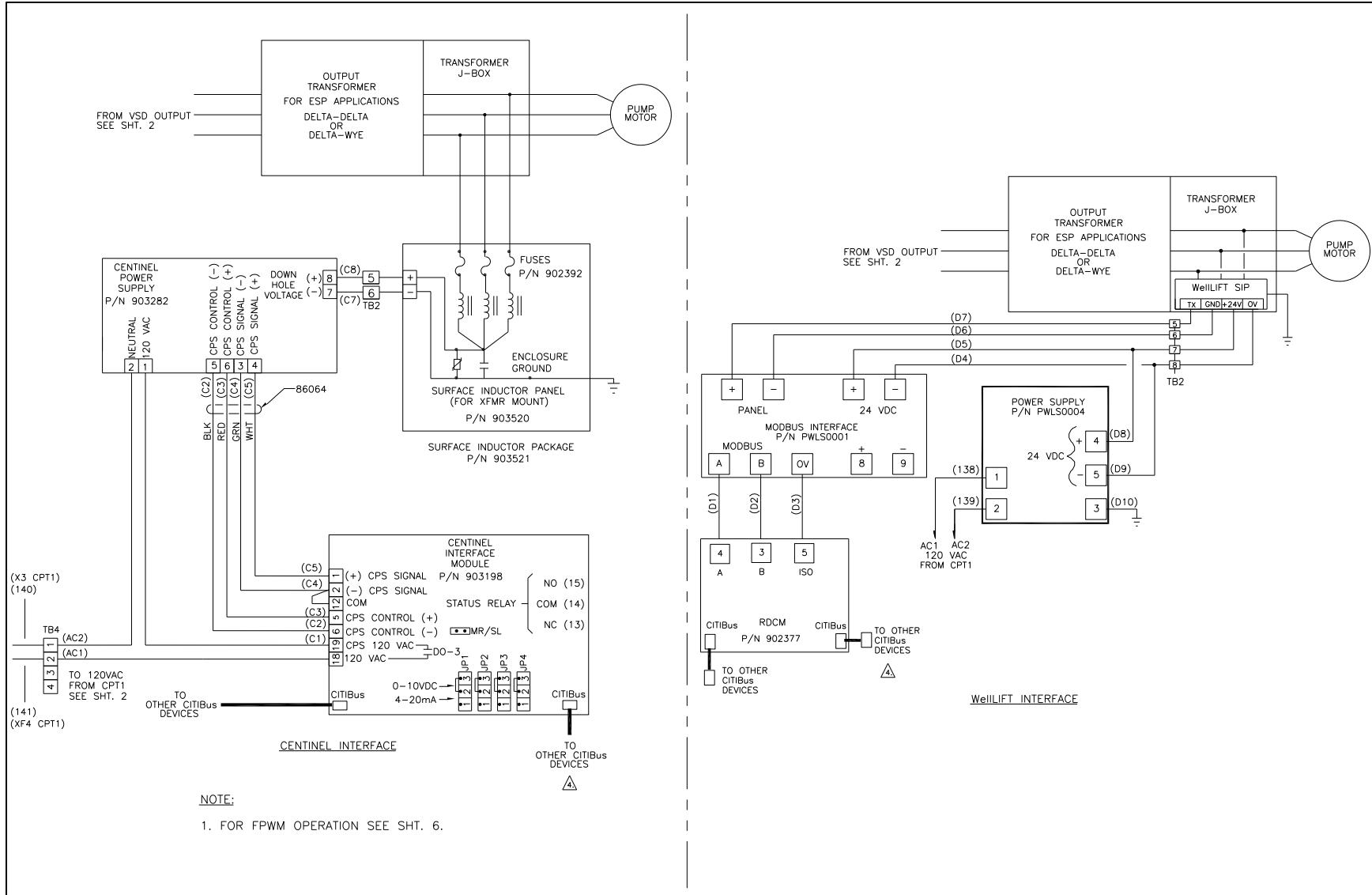


Figure 13: ADVANTAGE 4000-24P & 8000 6/12P, 24P DOWNHOLE INSTRUMENTATION: CENTINEL AND WELL LIFT INTERFACE

Drawing reference number-908166, sheet number-3, revision-A, revision date: 18 Oct 12

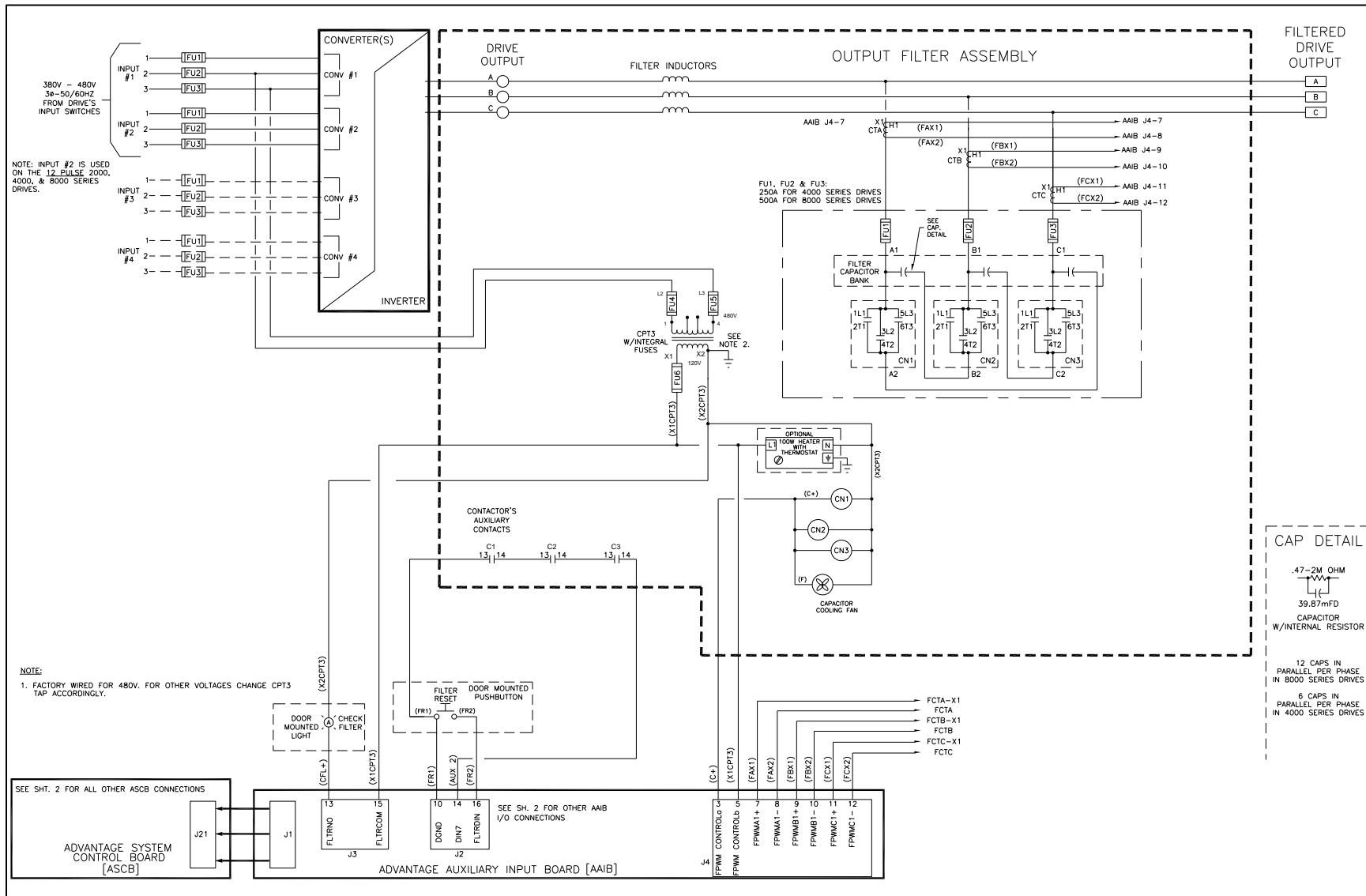


Figure 14: ADVANTAGE 4000-24P AND SERIES 8000 6/12P, 24 P FILTERED PWM OPTION

Drawing reference number-908166, sheet number-6, revision-A, revision date: 18 Oct 12

APPENDIX J: POWER SCHEMATIC DIAGRAMS

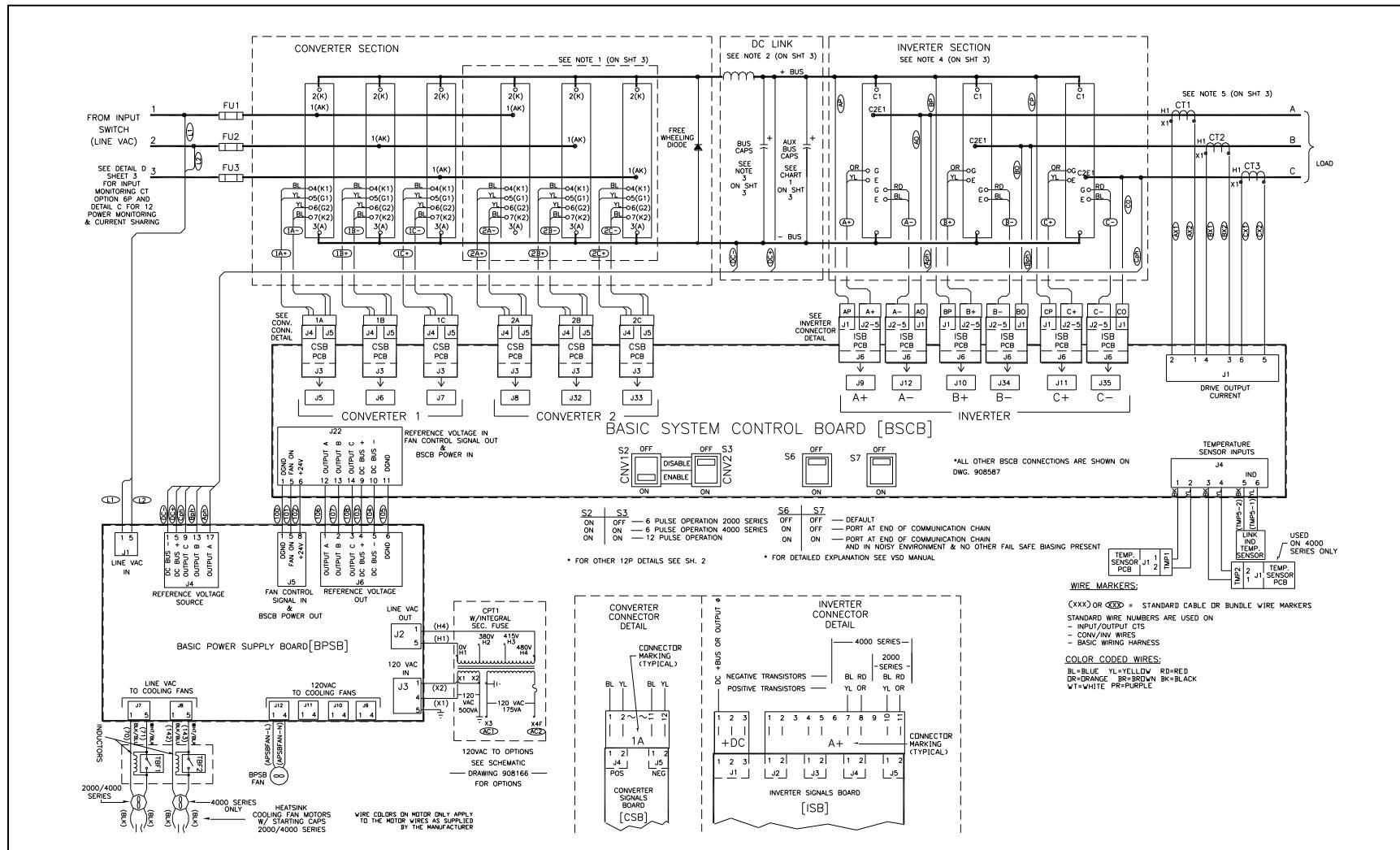


Figure 15: ADVANTAGE 2000/4000 NEMA1 6/12PULSE CONVERTER, CONTROL BOARD, POWER SUPPLY, COOLING FANS, INVERTER

Drawing reference number-908694, sheet number-3, revision-A, revision date: 12 June 13

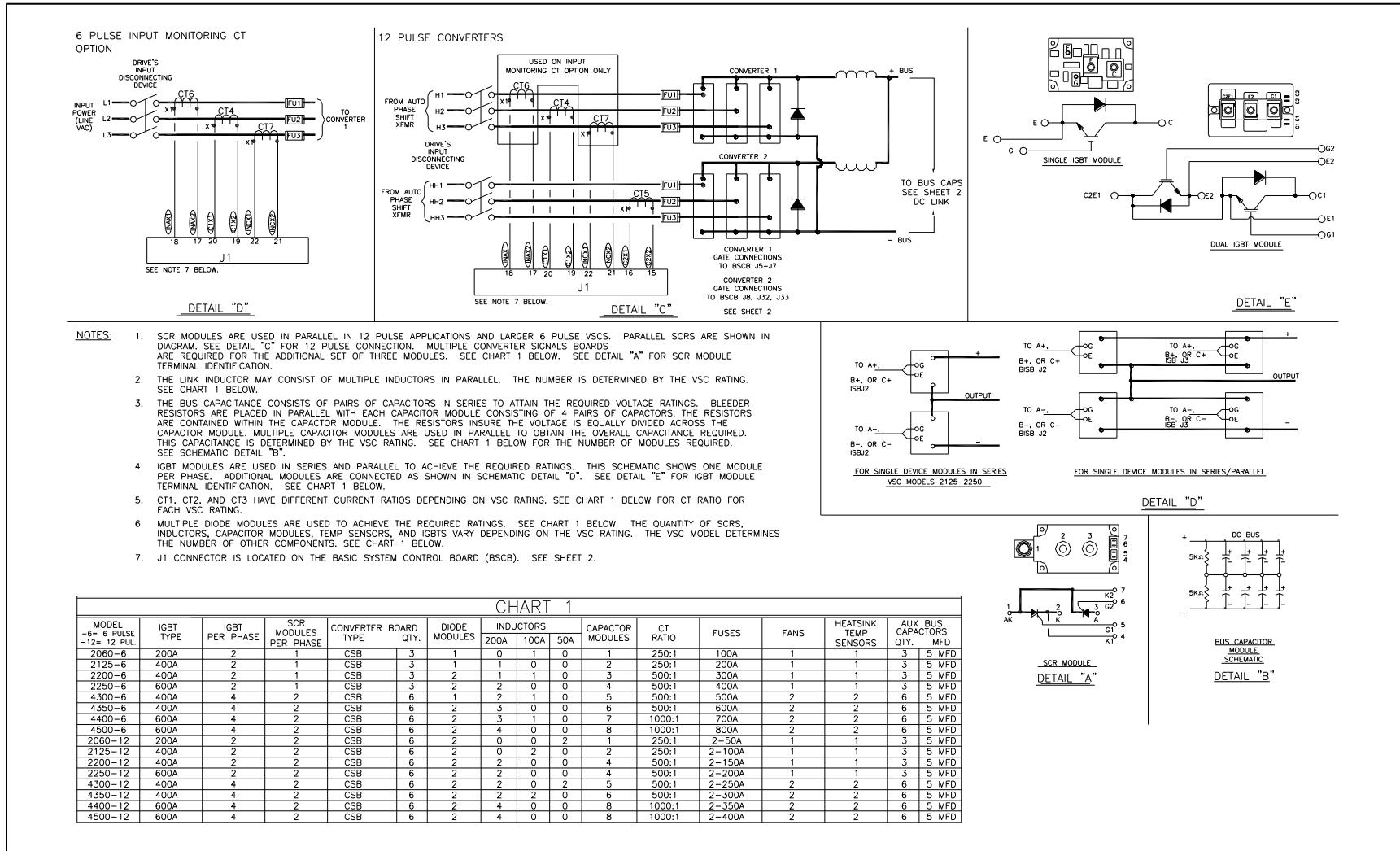


Figure 16: ADVANTAGE 2000/4000 NEMA 1 DETAIL: 12-PULSE CONVERTER, 6/12 INPUT MONITORING, IGBT, SCR DIODE DC BUS

Drawing reference number-908694, sheet number-2, revision-A, revision date: 12 June 13

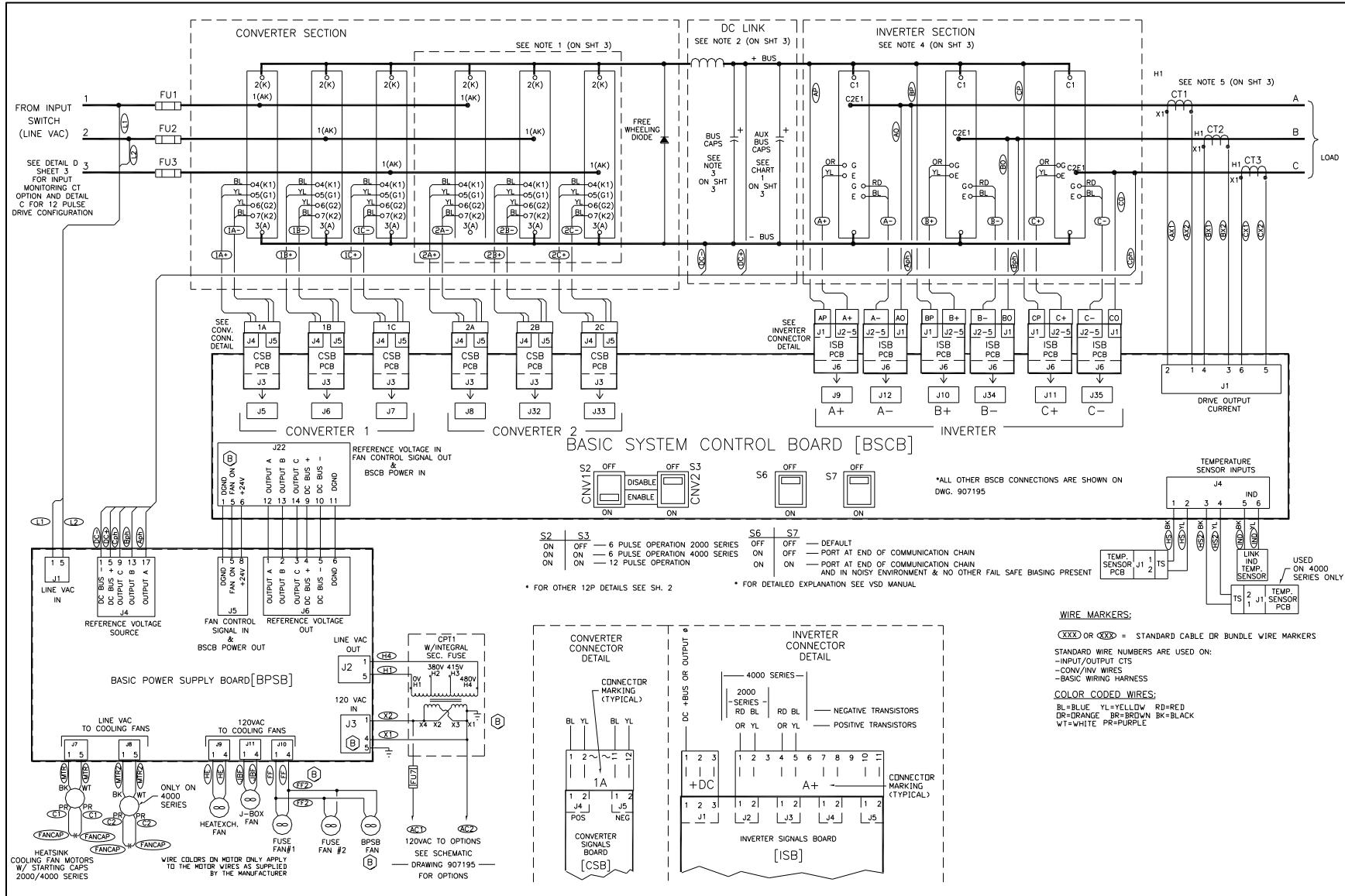
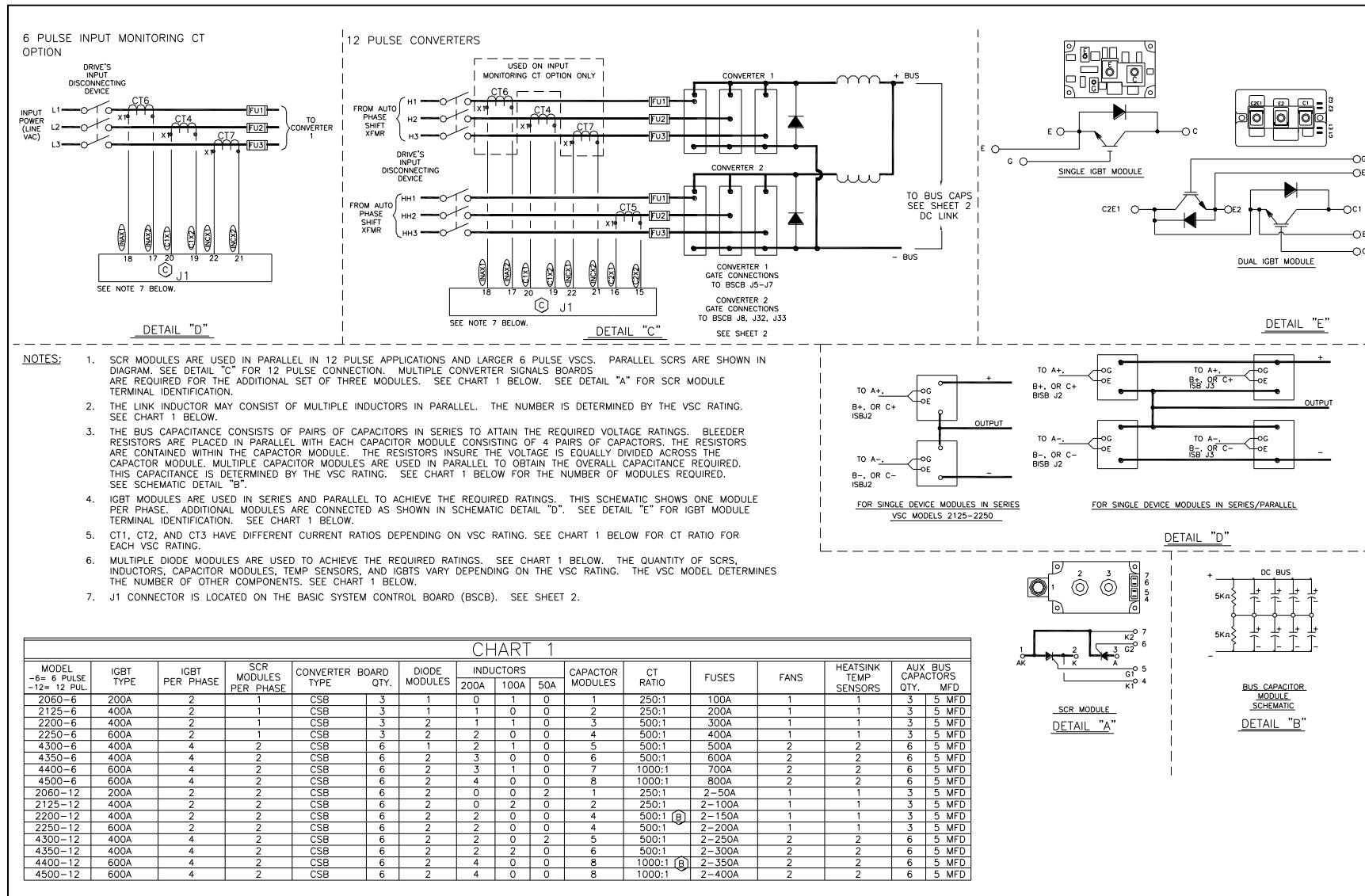


Figure 17: ADVANTAGE 2000/4000 NEMA 4 - 6/12PULSE CONVERTER, CONTROL BOARD, POWER SUPPLY, COOLING FANS, INVERTER

Drawing reference number-907196, sheet number-2, revision-B, revision date: 12 Mar 12



**Figure 18: ADVANTAGE 2000/4000 NEMA4 DETAIL: 12 PULSE CONVERTER, 6 PULSE INPUT MONITORING,
IGBT, SCR, DIODE, DC BUS**

Drawing Number: 907196 - Sheet Number: 3 - Revision: C - Revision Date: 12MAR12

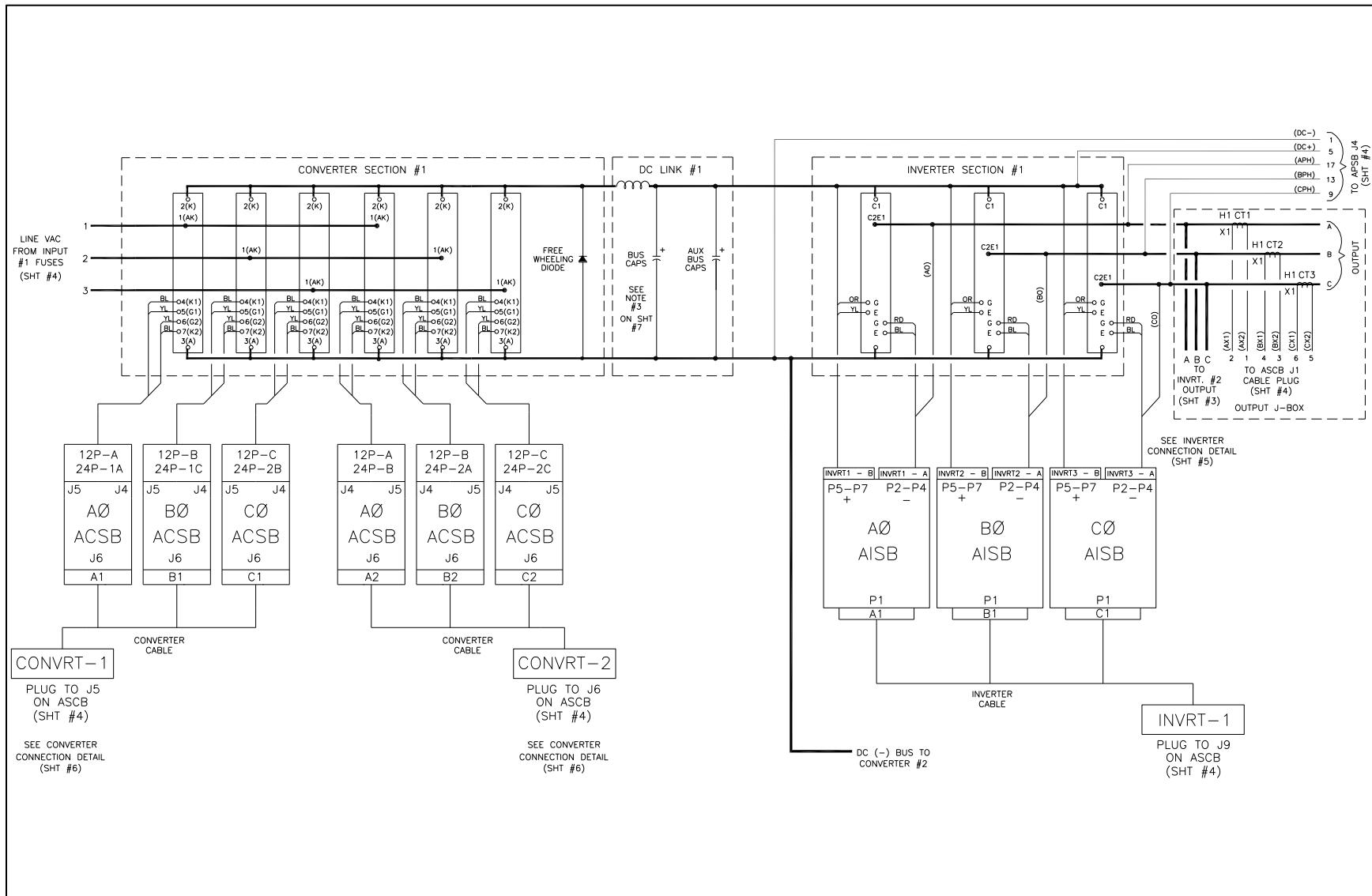


Figure 19: ADVANTAGE 8000 NEMA4 6/12 PULSE DETAIL: CONVERTER 1 AND INVERTER 1

Drawing Number:908264 - Sheet Number:2 - Revision:A - Revision Date:18OCT12

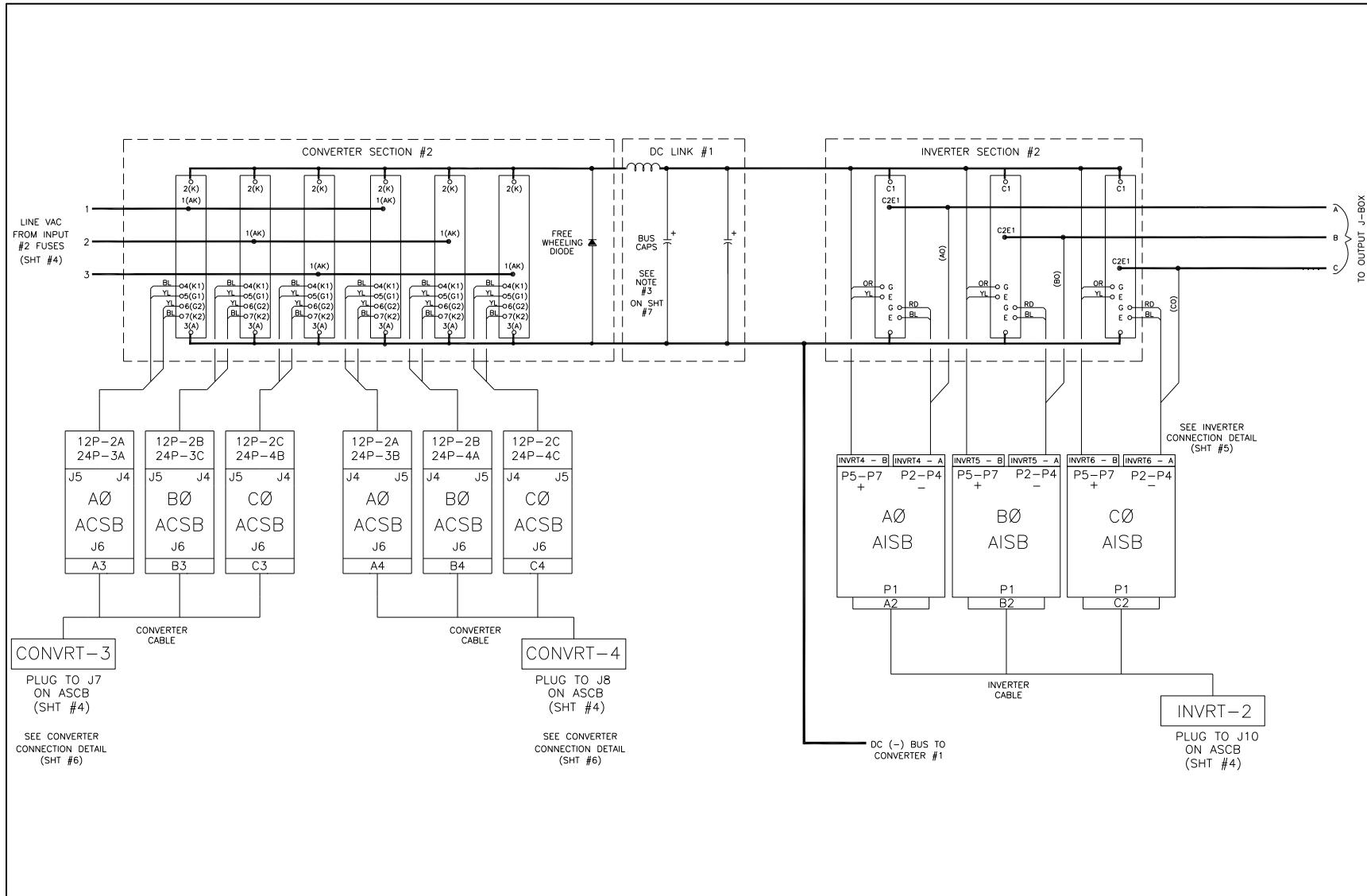


Figure 20: ADVANTAGE 8000 NEMA4 6/12 PULSE DETAIL: CONVERTER 2 AND INVERTER 2

Drawing Number:908264 - Sheet Number:3 - Revision: A - Revision Date:18OCT12

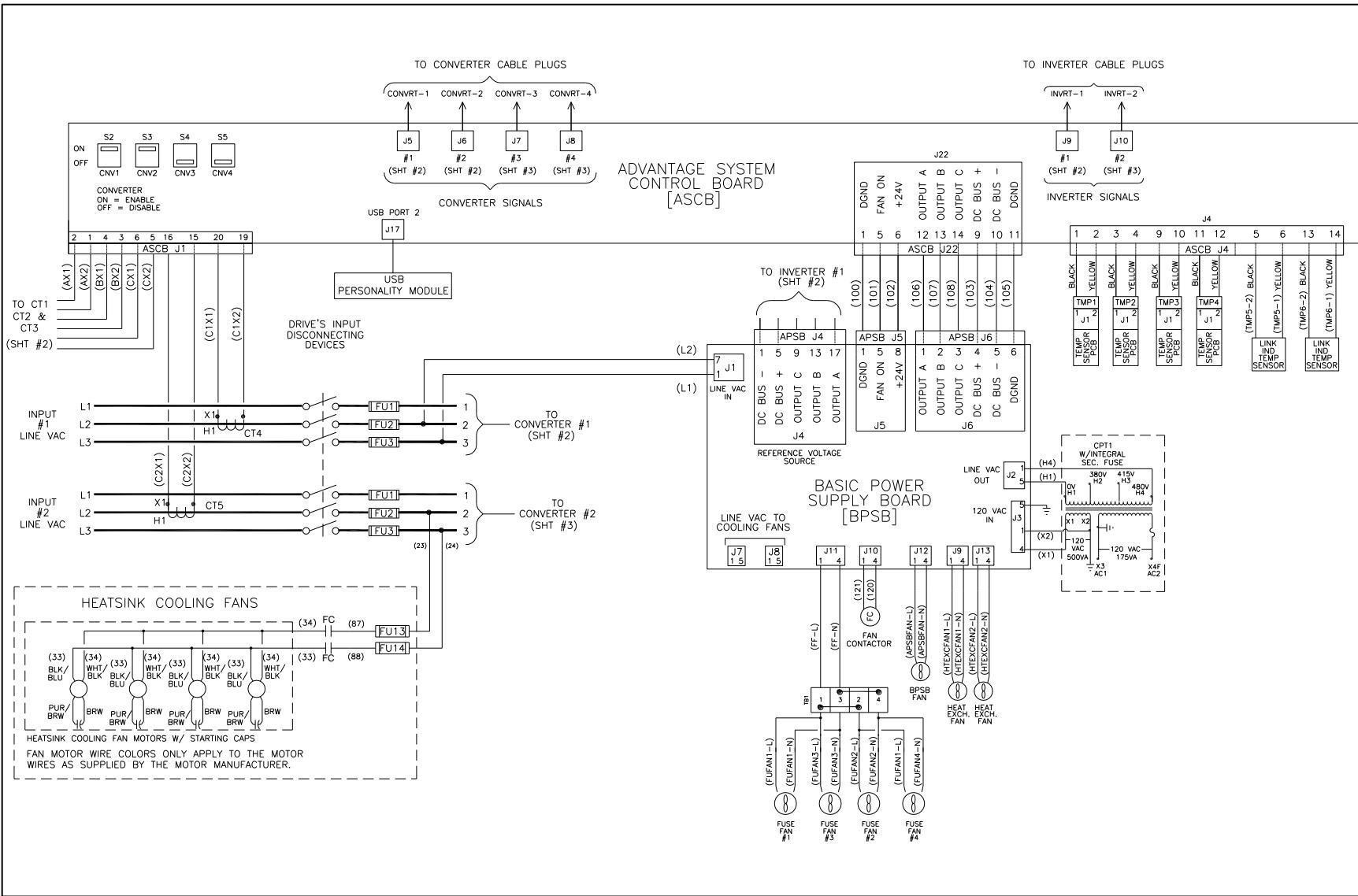


Figure 21: ADVANTAGE 8000 NEMA4 6/12 PULSE DETAIL: CONTROL BOARD, POWER SUPPLY, COOLING FANS

Drawing Number:908264 - Sheet Number:3 - Revision: A - Revision Date:18OCT12

INVERTER CONNECTION DETAIL

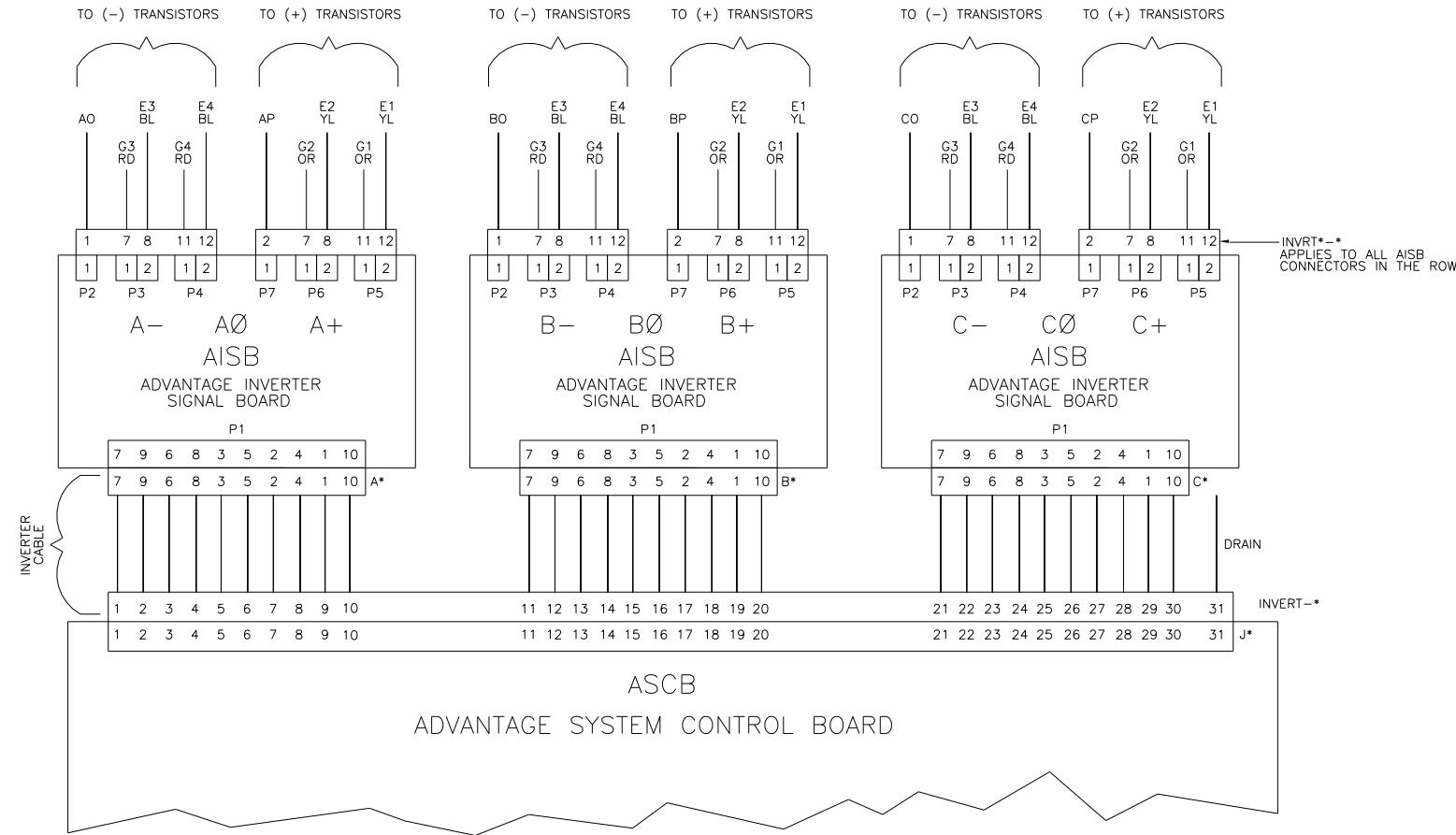
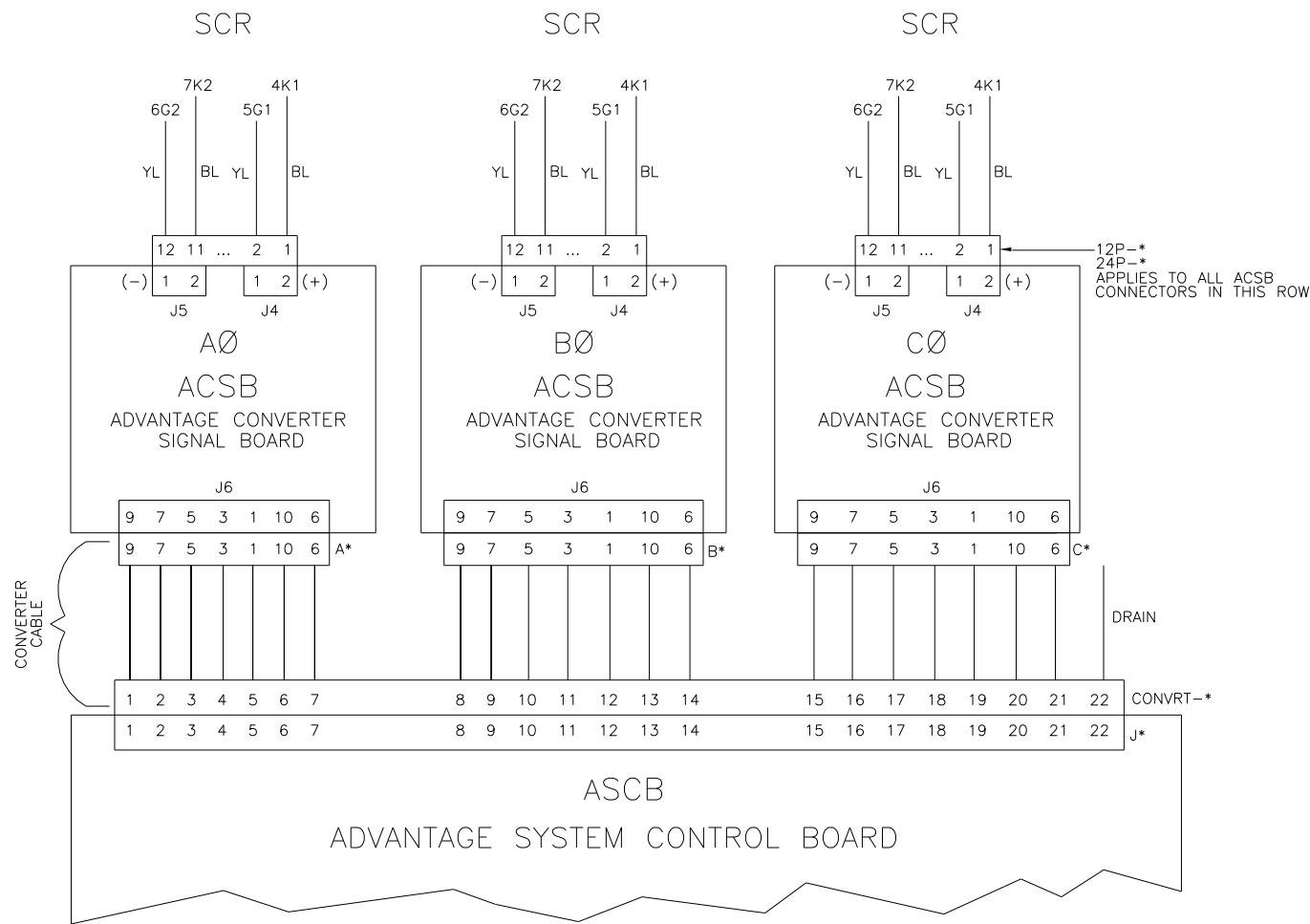


Figure 22: ADVANTAGE 8000 NEMA4 6/12 PULSE DETAIL: INVERTER BOARD CONNECTIONS

Drawing Number: 908264 - Sheet Number:5 - Revision: A - Revision Date: 18OCT12

CONVERTER CONNECTION DETAIL



* INDICATES ADDITIONAL MARKING. SEE PAGES 2 & 3 FOR SPECIFIC CONNECTOR MARKING.

Figure 23: ADVANTAGE 8000 NEMA4 6/12 PULSE DETAIL: CONVERTER BOARD CONNECTIONS
 Drawing Number: 908264 - Sheet Number: 6 - Revision: A - Revision Date: 18OCT12

- NOTES:
1. SEE DETAIL "A" FOR SCR MODULE TERMINAL IDENTIFICATION.
 2. THE NUMBER LINK INDUCTOR IS DETERMINED BY THE VSC RATING.
THE 8000 SERIES HAS PAIRS OF PARALLEL INDUCTORS. SEE CHART 1 BELOW.
 3. THE BUS CAPACITANCE CONSISTS OF PAIRS OF CAPACITORS IN SERIES TO ATTAIN THE REQUIRED VOLTAGE RATINGS. BLEEDER RESISTORS ARE PLACED IN PARALLEL WITH EACH CAPACITOR MODULE CONSISTING OF 4 PAIRS OF CAPACITORS. THE RESISTORS ARE CONTAINED WITHIN THE CAPACITOR MODULE. THE RESISTORS INSURE THE VOLTAGE IS EQUALLY DIVIDED ACROSS THE CAPACITOR MODULE. MULTIPLE CAPACITOR MODULES ARE USED IN PARALLEL TO OBTAIN THE OVERALL CAPACITANCE REQUIRED. THIS CAPACITANCE IS DETERMINED BY THE VSC RATING. SEE CHART 1 BELOW FOR THE NUMBER OF MODULES REQUIRED. SEE SCHEMATIC DETAIL "B".
 4. IGBT MODULES ARE USED IN SERIES AND PARALLEL TO ACHIEVE THE REQUIRED RATINGS. THIS SCHEMATIC SHOWS ONE MODULE PER PHASE. MODULES ARE CONNECTED AS SHOWN IN SCHEMATIC DETAIL "D". SEE DETAIL "E" FOR IGBT MODULE TERMINAL IDENTIFICATION. SEE CHART 1 BELOW.

QUANTITIES SHOWN FOR THE 8000 SERIES ARE THE SUM OF THE LEFT AND RIGHT DRIVE SECTIONS
ALL 24 PULSE DRIVES HAVE A TOTAL OF 12 SCRS & ADVANTAGE CONVERTER SIGNAL BOARD (ACSB)
ALL 24 PULSE DRIVES HAVE 4 DIODE MODULES

MODEL	IGBT TYPE	IGBT PER PHASE	INDUCTORS			CAPACITOR MODULES	CT RATIO	FUSES	FANS	HEATSINK TEMP SENSORS	AUX BUS CAPACITORS 5 MFD
			200A	100A	50A						
8600	400A	8	4	2	0	10	2000:1	500A	4	4	24
8700	400A	8	6	0	0	12	2000:1	600A	4	4	24
8800	600A	8	6	0	2	14	2000:1	700A	4	4	24
8900	600A	8	8	0	0	16	2000:1	800A	4	4	24

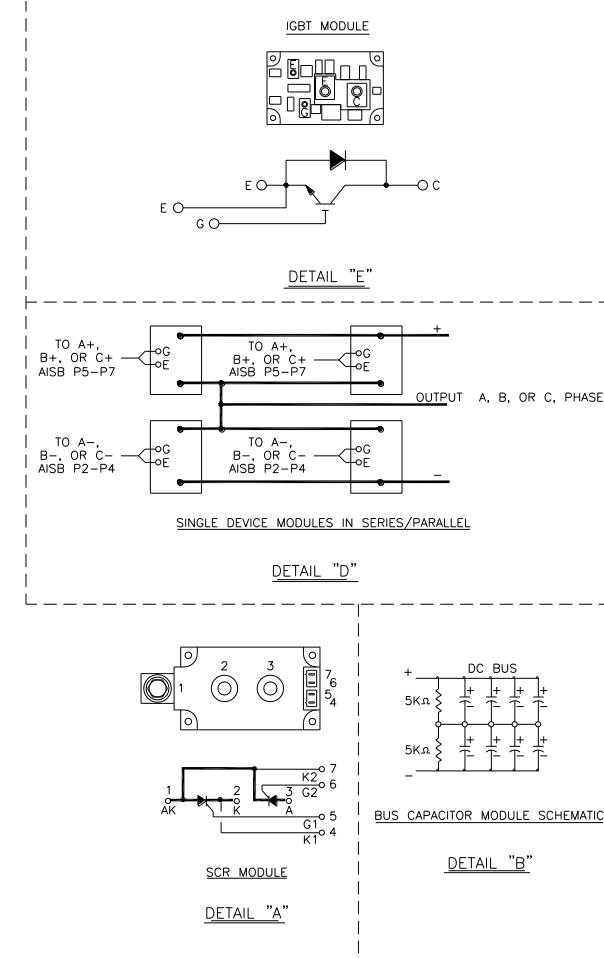


Figure 24: ADVANTAGE 8000 NEMA4 6/12 PULSE DETAIL: IGBT, SCR, DIODE, DC BUS

Drawing Number: 908264 - Sheet Number:7 - Revision: A - Revision Date:18OCT12

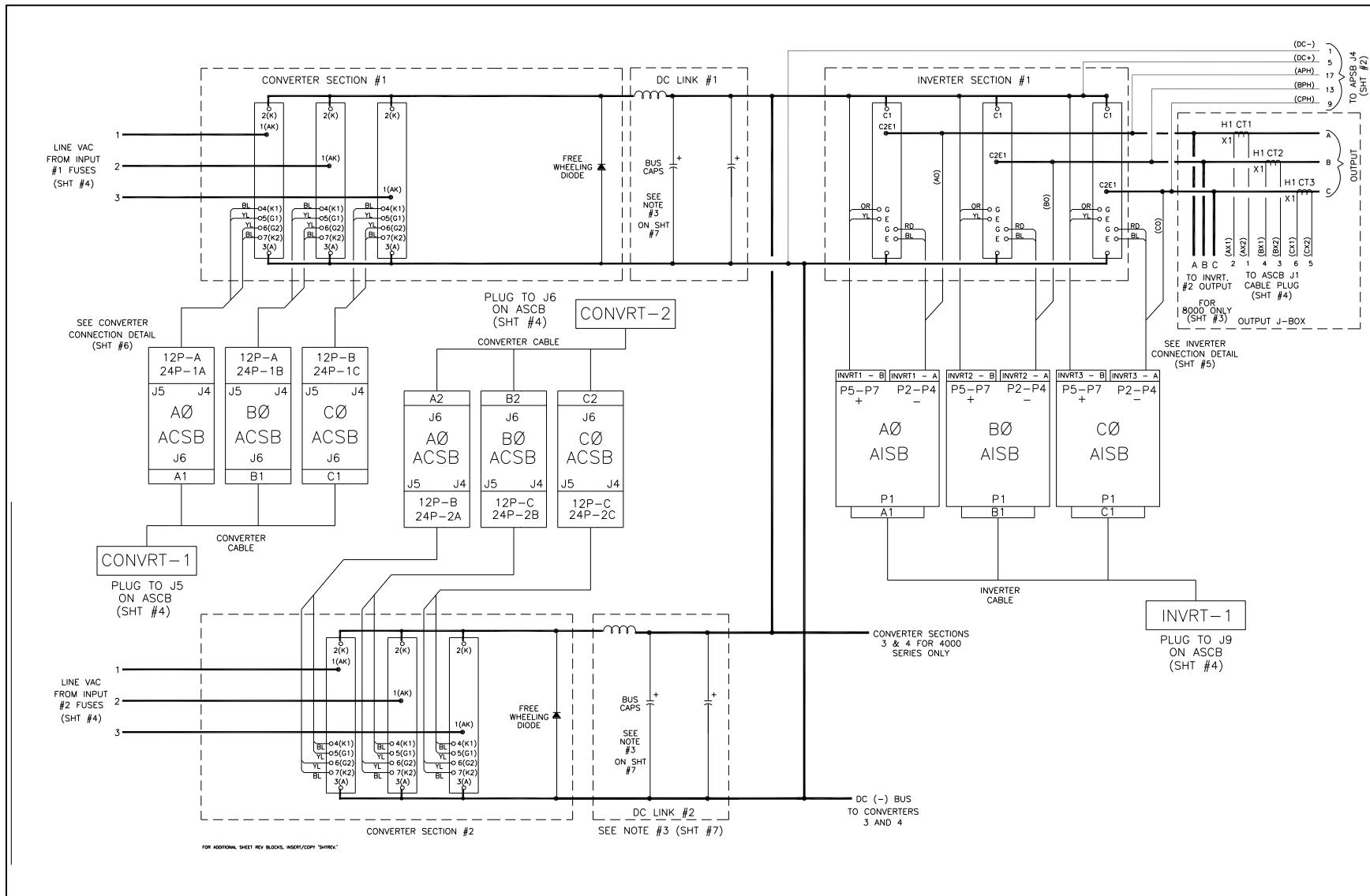


Figure 25 ADVANTAGE 8000 NEMA4 6/12 PULSE DETAIL: CONVERTER 1 & 2 AND INVERTER 1

Drawing Number:908182 - Sheet Number:2 - Revision: A - Revision Date:18OCT12

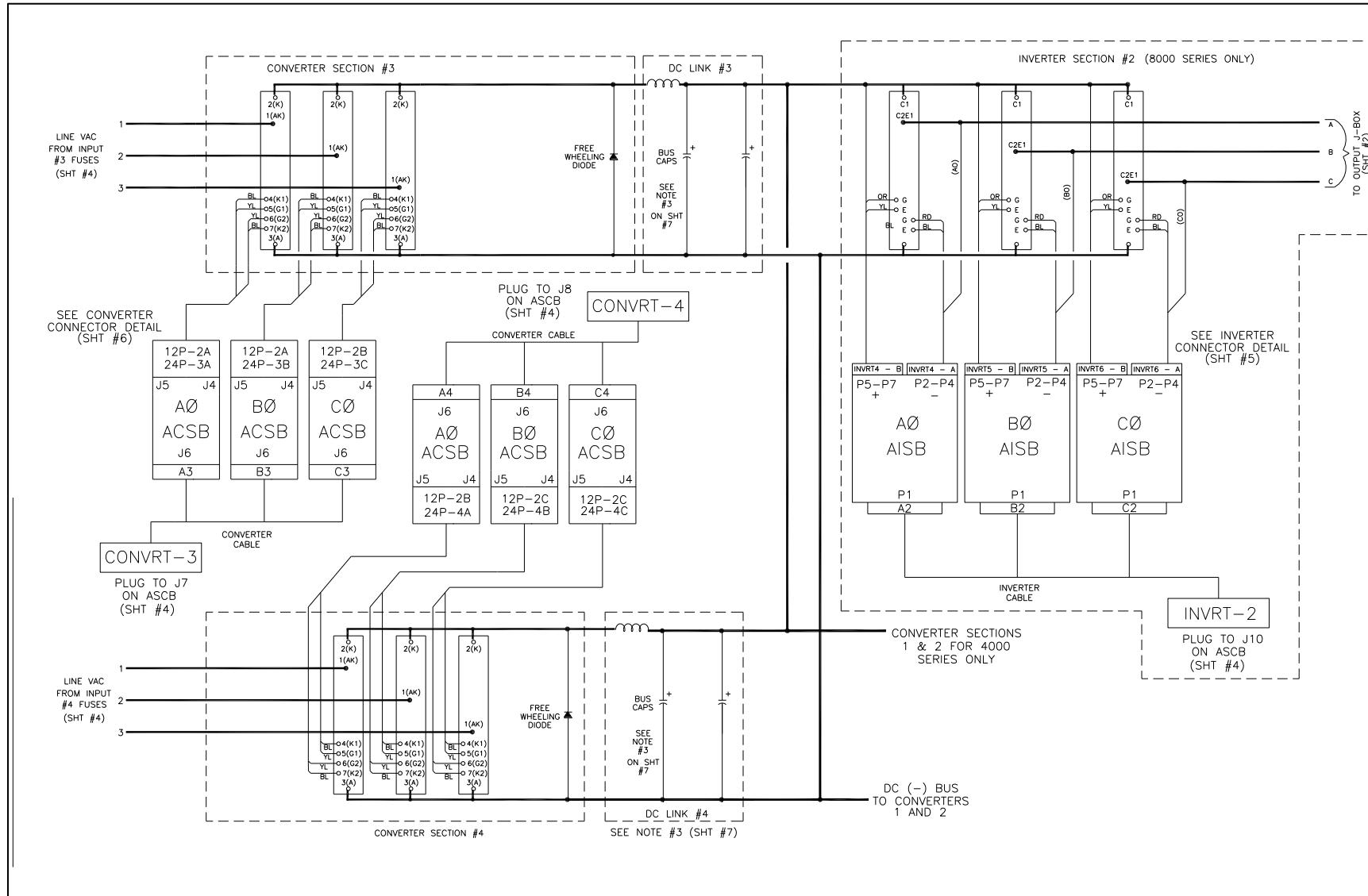


Figure 26 : ADVANTAGE 4000/ 8000 NEMA4 6/12 PULSE DETAIL: CONVERTER 3 & 4 AND INVERTER 2

Drawing Number:908182 - Sheet Number:3 - Revision: A - Revision Date:18OCT12

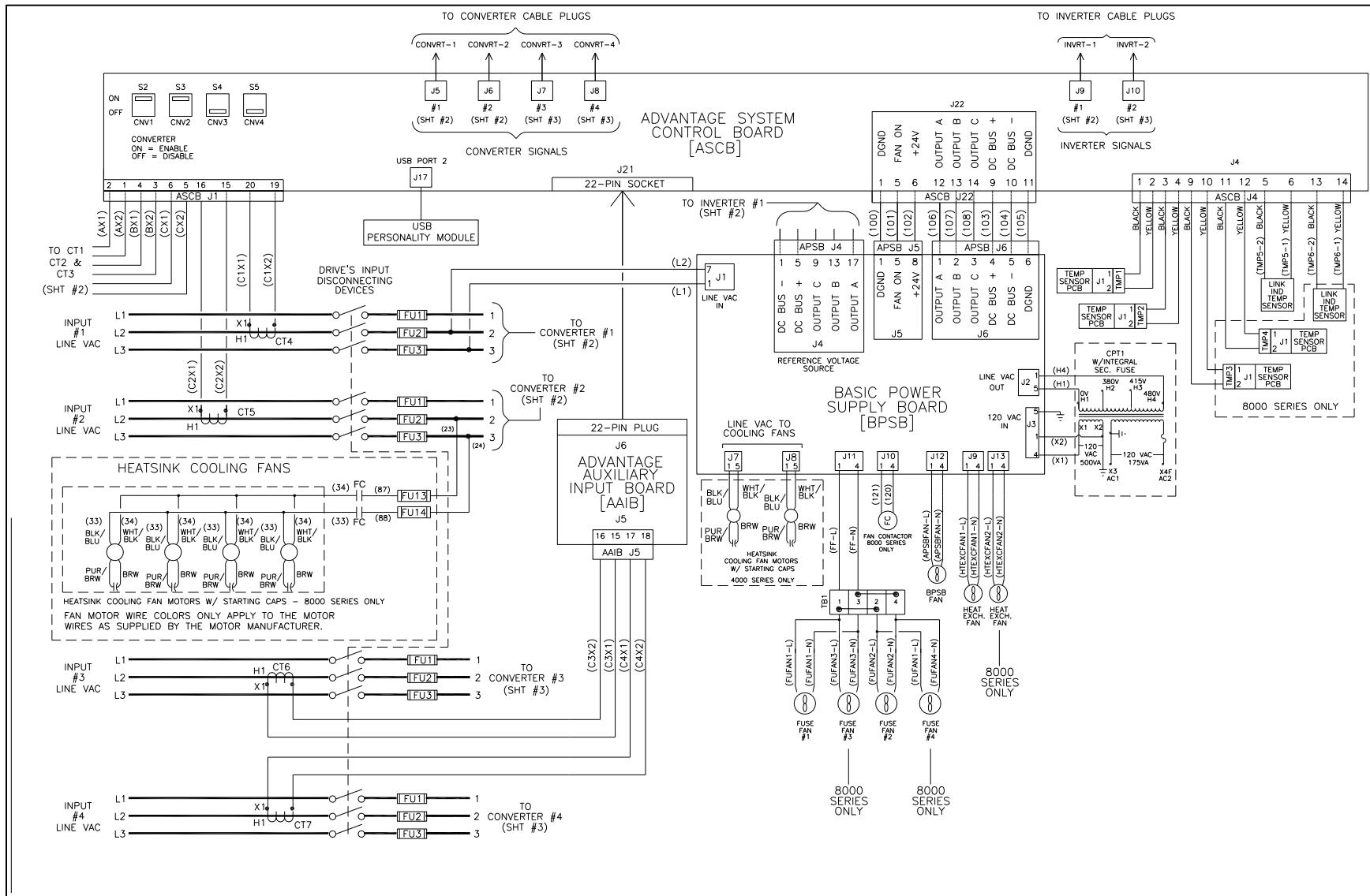


Figure 27: ADVANTAGE 4000/8000 NEMA4 24 PULSE CONTROL BOARD, POWER SUPPLY, COOLING FANS

Drawing Number: 908182 - Sheet Number: 4 - Revision: A - Revision Date: 18OCT12

INVERTER CONNECTION DETAIL

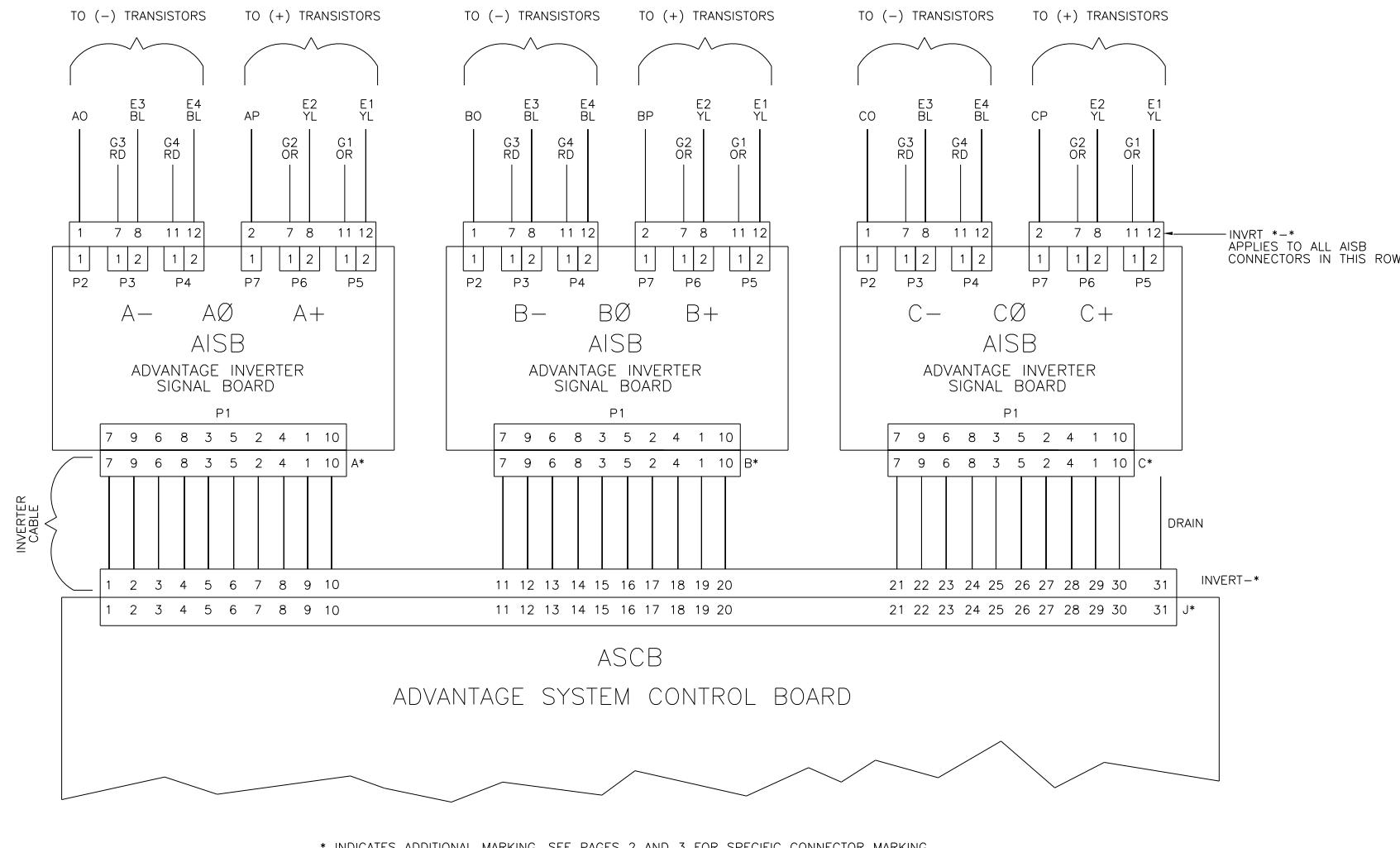
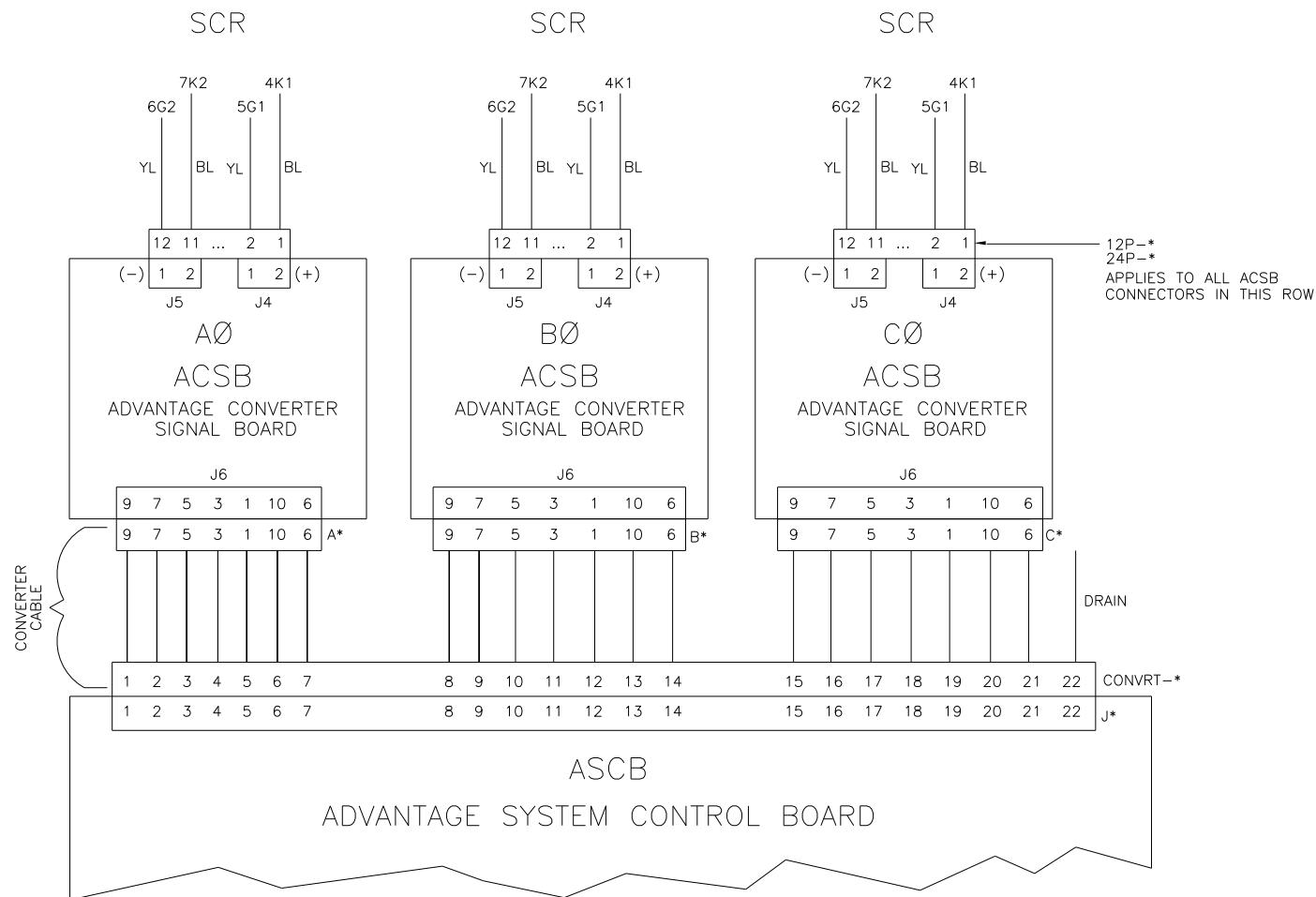


Figure 28: ADVANTAGE 4000/ 8000 NEMA4 24 PULSE Detail: INVERTER BOARD CONNECTIONS

Drawing Number: 908182 - Sheet Number: 5 - Revision: A - Revision Date: 18OCT12

CONVERTER CONNECTION DETAIL



* INDICATES ADDITIONAL MARKING. SEE PAGES 2 AND 3 FOR SPECIFIC CONNECTOR MARKING.

Figure 29: ADVANTAGE 4000/ 8000 NEMA4 24 PULSE DETAIL: CONVERTER BOARD CONNECTIONS

Drawing Number: 908182 - Sheet Number: 6 - Revision: A - Revision Date: 18OCT12

- NOTES:
1. SEE DETAIL "A" FOR SCR MODULE TERMINAL IDENTIFICATION.
 2. THE NUMBER LINK INDUCTOR IS DETERMINED BY THE VSC RATING.
THE 8000 SERIES HAS PAIRS OF PARALLEL INDUCTORS. SEE CHART 1 BELOW.
 3. THE BUS CAPACITANCE CONSISTS OF PAIRS OF CAPACITORS IN SERIES TO ATTAIN THE REQUIRED VOLTAGE RATINGS. BLEEDER RESISTORS ARE PLACED IN PARALLEL WITH EACH CAPACITOR MODULE CONSISTING OF 4 PAIRS OF CAPACITORS. THE RESISTORS ARE CONTAINED WITHIN THE CAPACITOR MODULE. THE RESISTORS INSURE THE VOLTAGE IS EQUALLY DIVIDED ACROSS THE CAPACITOR MODULE. MULTIPLE CAPACITOR MODULES ARE USED IN PARALLEL TO OBTAIN THE OVERALL CAPACITANCE REQUIRED. THIS CAPACITANCE IS DETERMINED BY THE VSC RATING. SEE CHART 1 BELOW FOR THE NUMBER OF MODULES REQUIRED. SEE SCHEMATIC DETAIL "B".
 4. IGBT MODULES ARE USED IN SERIES AND PARALLEL TO ACHIEVE THE REQUIRED RATINGS. THIS SCHEMATIC SHOWS ONE MODULE PER PHASE. MODULES ARE CONNECTED AS SHOWN IN SCHEMATIC DETAIL "D". SEE DETAIL "E" FOR IGBT MODULE TERMINAL IDENTIFICATION. SEE CHART 1 BELOW.

QUANTITIES SHOWN FOR THE 8000 SERIES ARE THE SUM OF THE LEFT AND RIGHT DRIVE SECTIONS
ALL 24 PULSE DRIVES HAVE A TOTAL OF 12 SCRS & ADVANTAGE CONVERTER SIGNAL BOARD (ACSB)
ALL 24 PULSE DRIVES HAVE 4 DIODE MODULES

MODEL	IGBT TYPE	IGBT PER PHASE	INDUCTORS			CAPACITOR MODULES	CT RATIO	FUSES	FANS	HEATSINK TEMP SENSORS	AUX BUS CAPACITORS 5 MFD
			200A	100A	50A						
4300, 4350	400A	4	4	0	0	8	500:1	150A	2	2	12
4400, 4500	400A	4	4	0	0	8	1000:1	200A	2	2	12
8600	400A	8	4	0	4	10	2000:1	250A	4	4	24
8700	400A	8	4	4	0	12	2000:1	300A	4	4	24
8800	600A	8	8	0	0	16	2000:1	350A	4	4	24
8900	600A	8	8	0	0	16	2000:1	400A	4	4	24

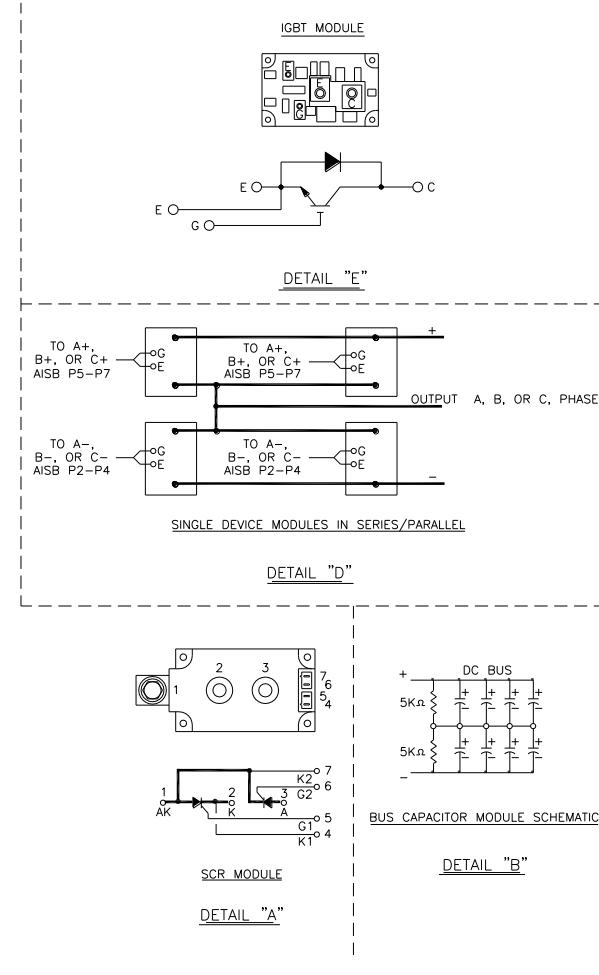


Figure 30: ADVANTAGE 4000/ 8000 NEMA4 24 PULSE DETAIL: IGBT, SCR, DIODE, DC BUS

Drawing Number: 908182 - Sheet Number: 7 - Revision: A - Revision Date: 18OCT12

APPENDIX K: OUTLINE AND ANCHOR DIMENSIONAL DRAWINGS

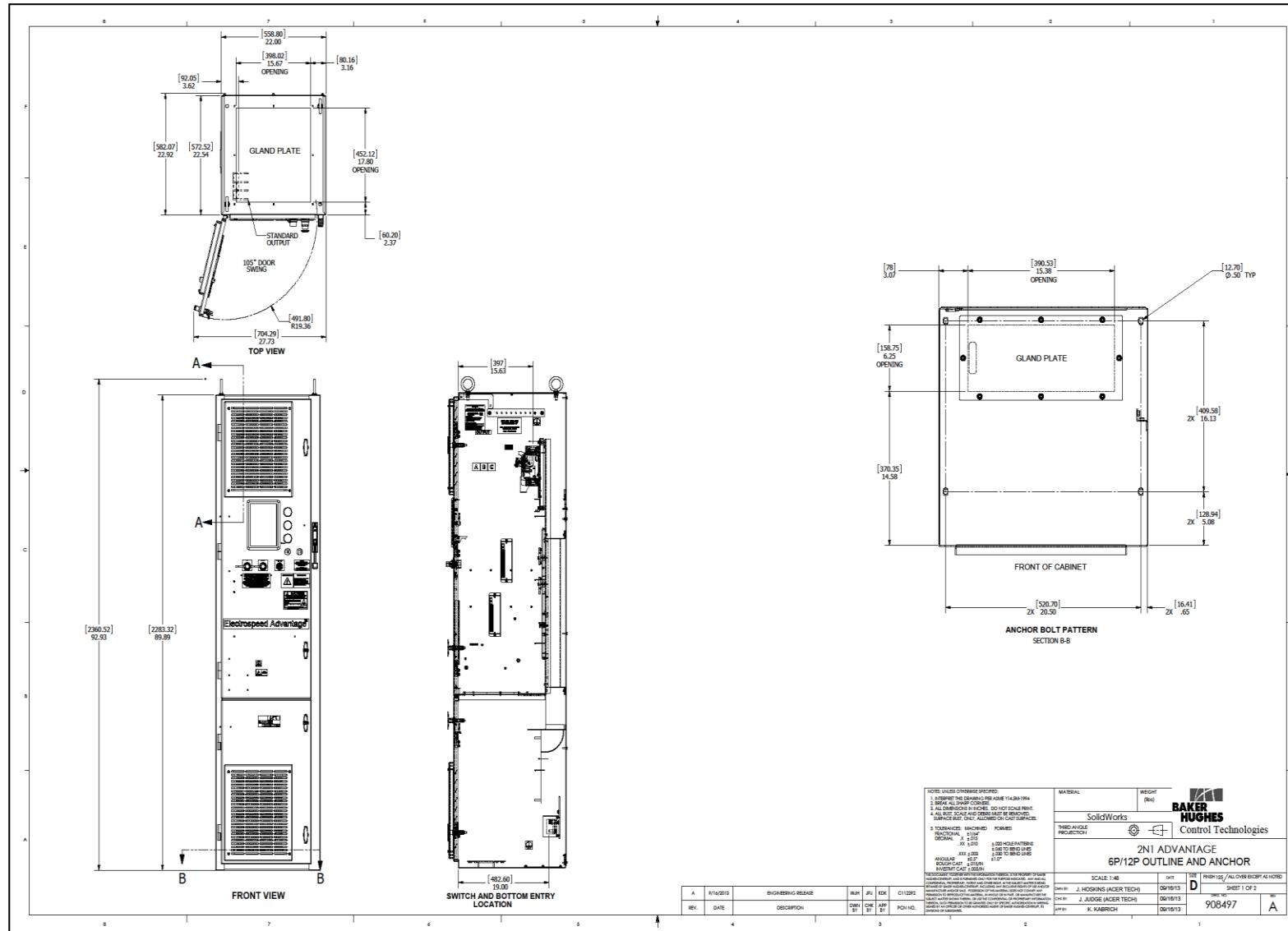


Figure 31: ADVANTAGE 2000 NEMA 1: OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 908497 - Sheet Number: 1 - Revision: A - Revision Date: 16SEP13

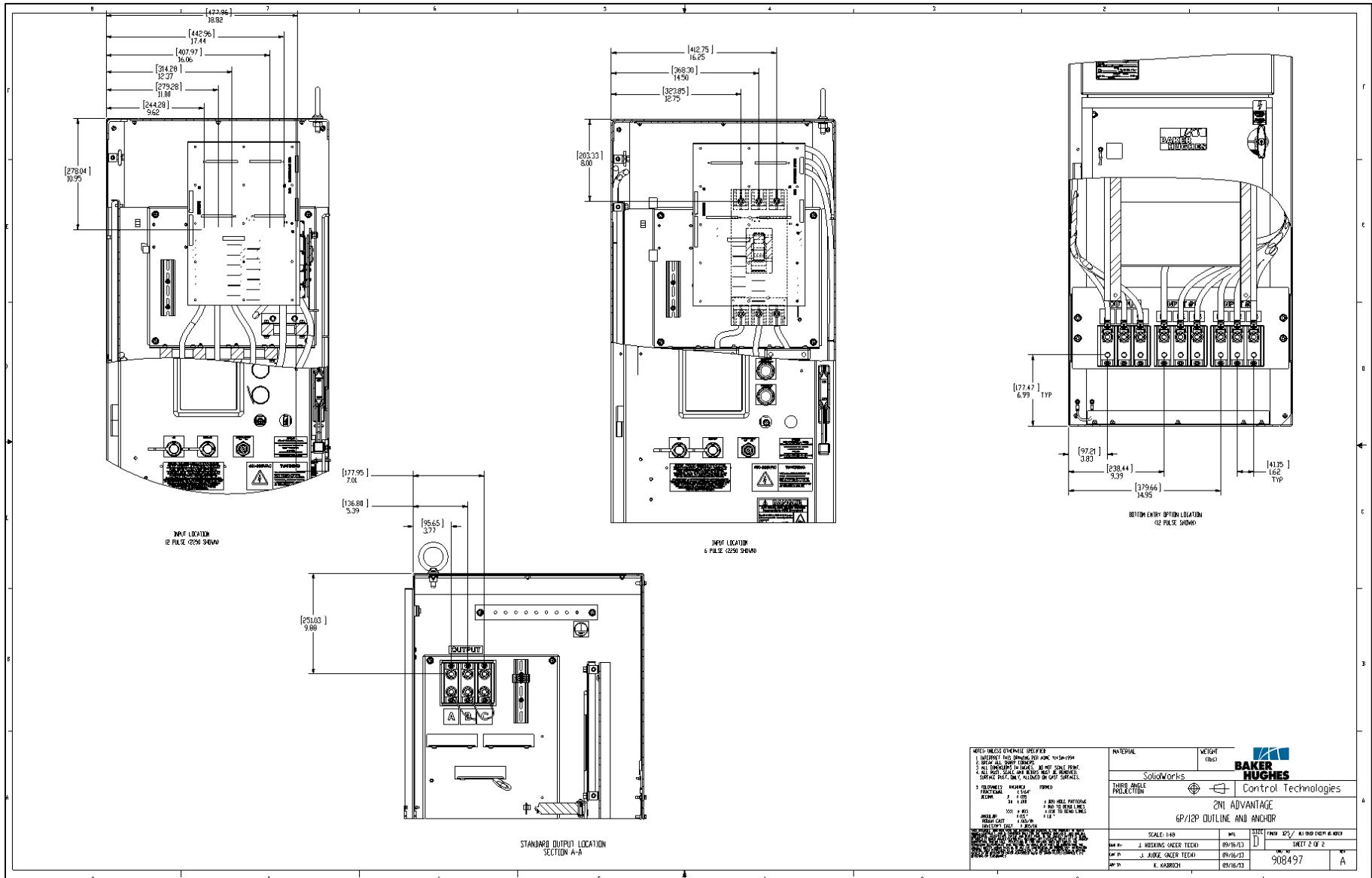


Figure 32: ADVANTAGE 2000 NEMA 1: OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 908497 - Sheet Number: 2 - Revision: A - Revision Date: 16SEP13

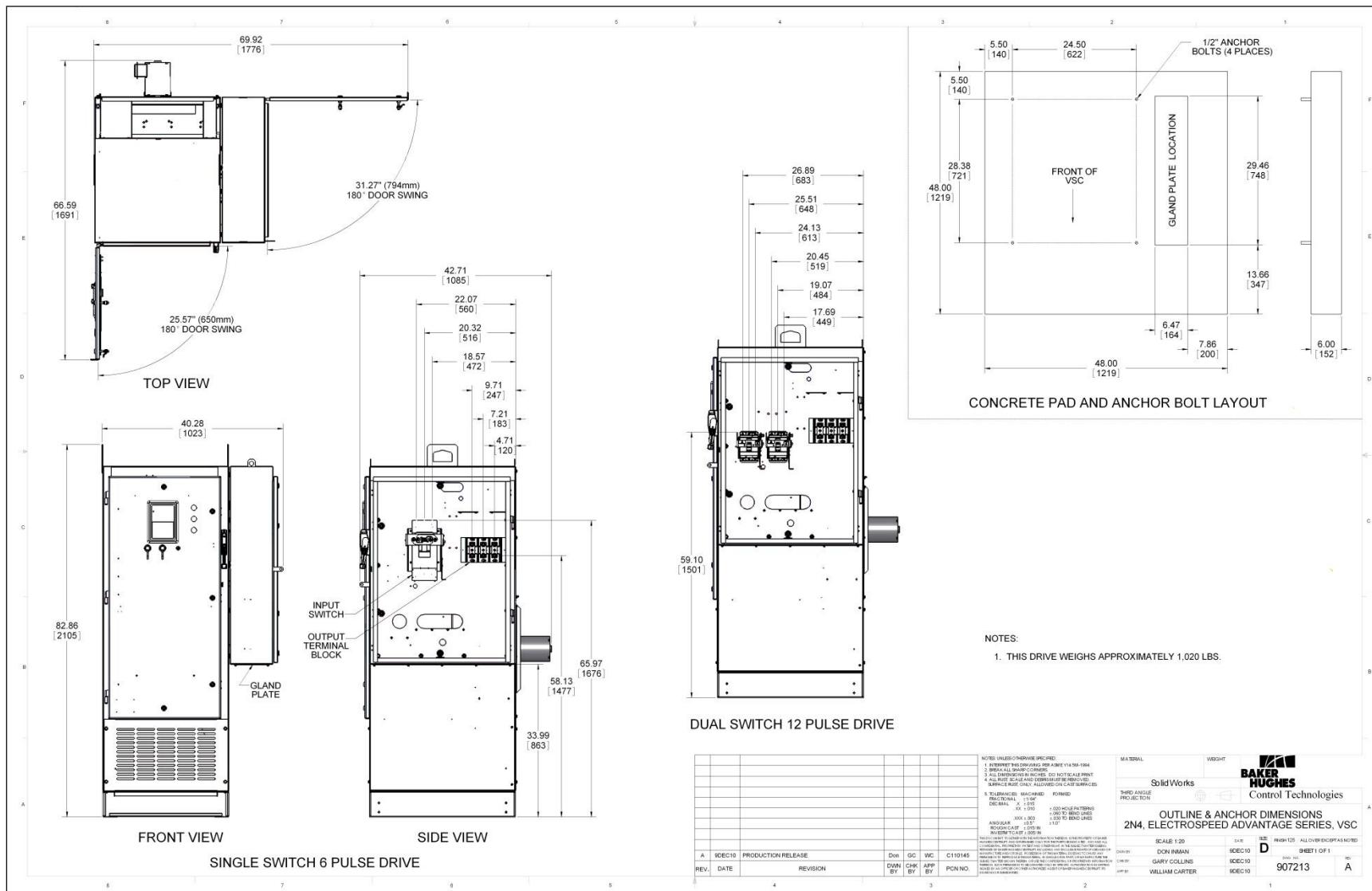


Figure 33: ADVANTAGE 2000 NEMA 4: OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 907213 - Sheet Number: 1 - Revision: A - Revision Date: 9DEC10

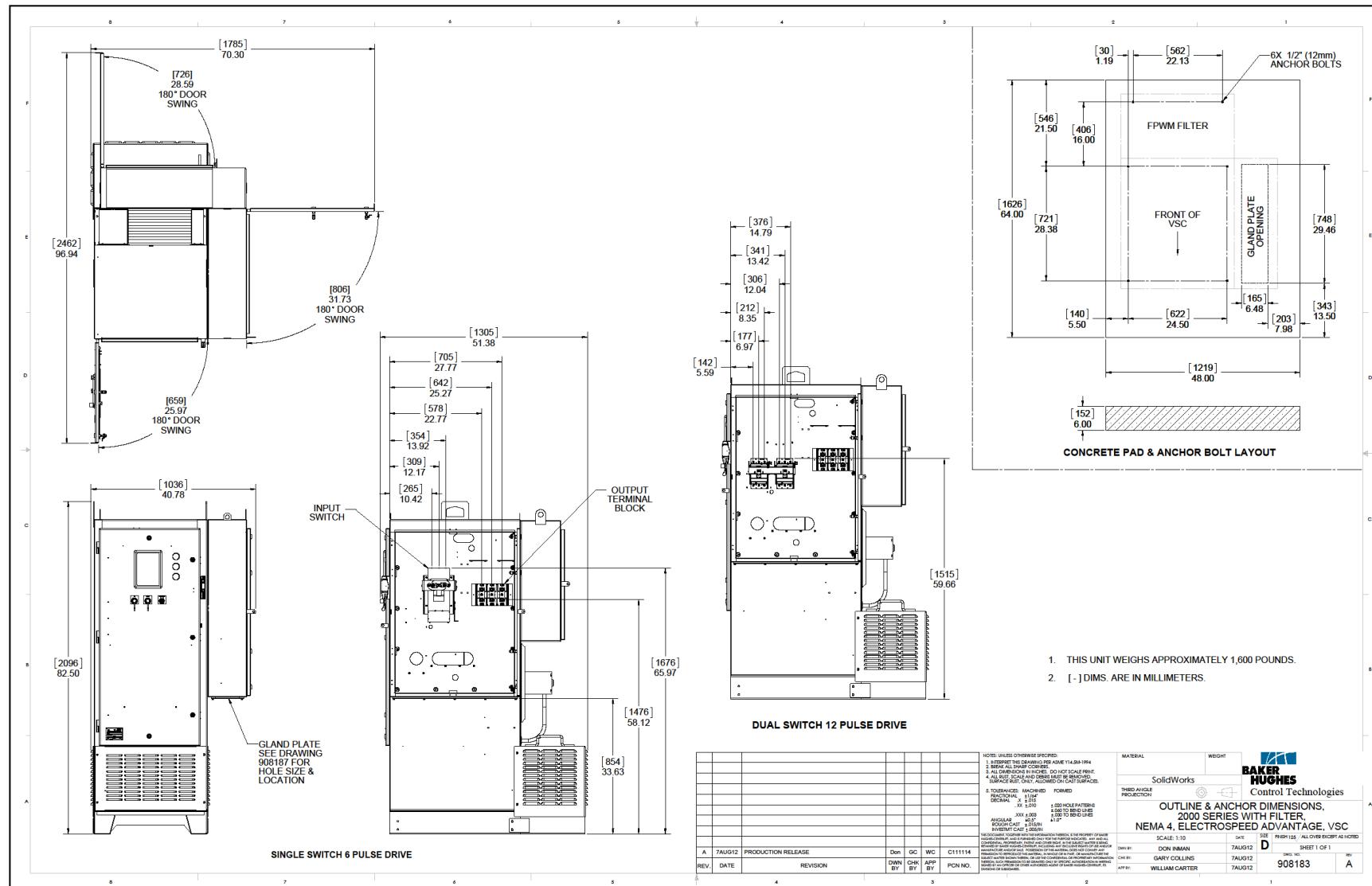


Figure 34: ADVANTAGE 2000 NEMA 4 SERIES- PWM FILTER OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 908183 - Sheet Number: 1 - Revision: A - Revision Date: 7AUG12

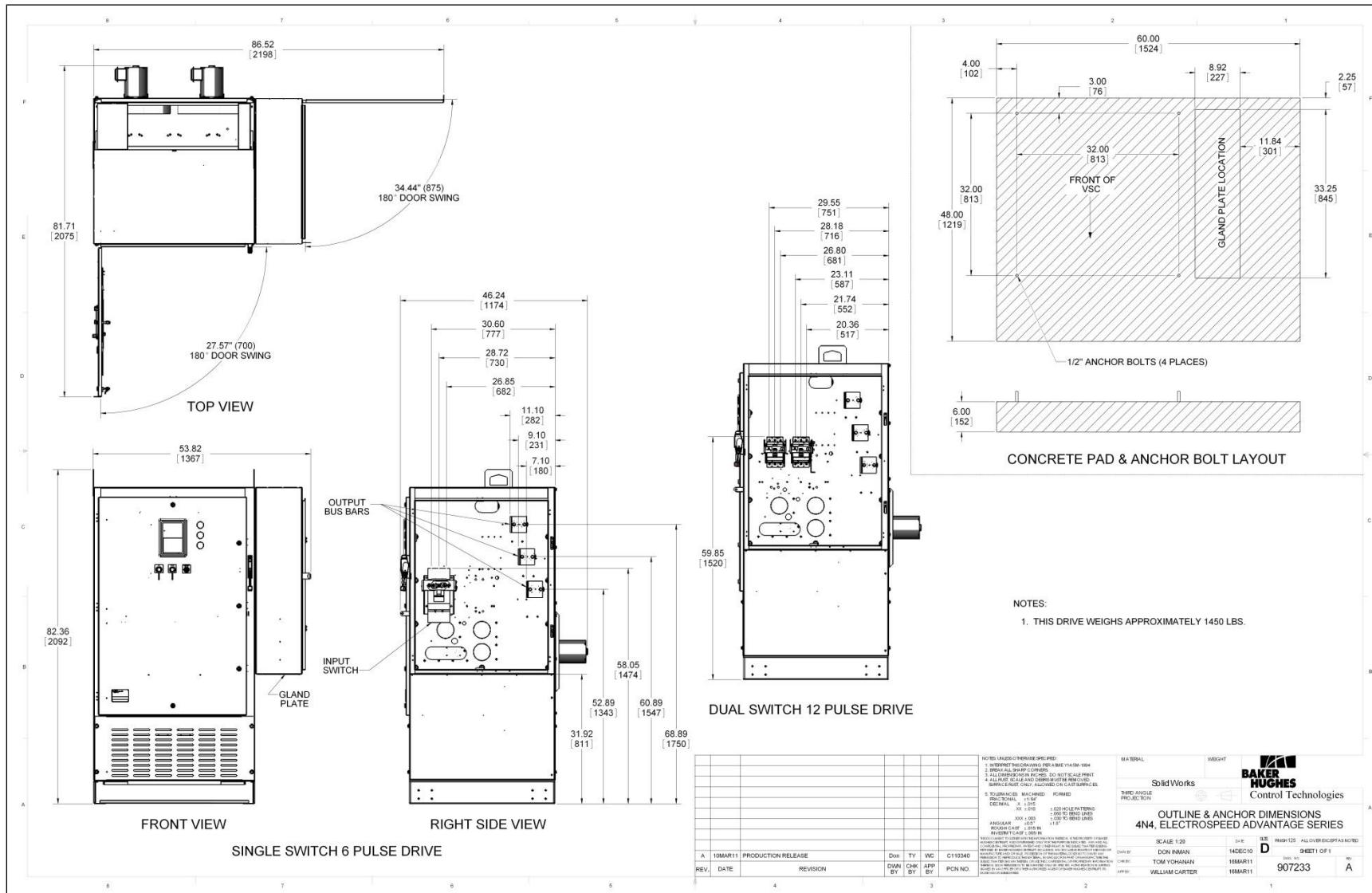


Figure 35: ADVANTAGE 4000 NEMA 4 6/12P SERIES OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 907233 - Sheet Number: 1 - Revision: A - Revision Date: 16MAR11

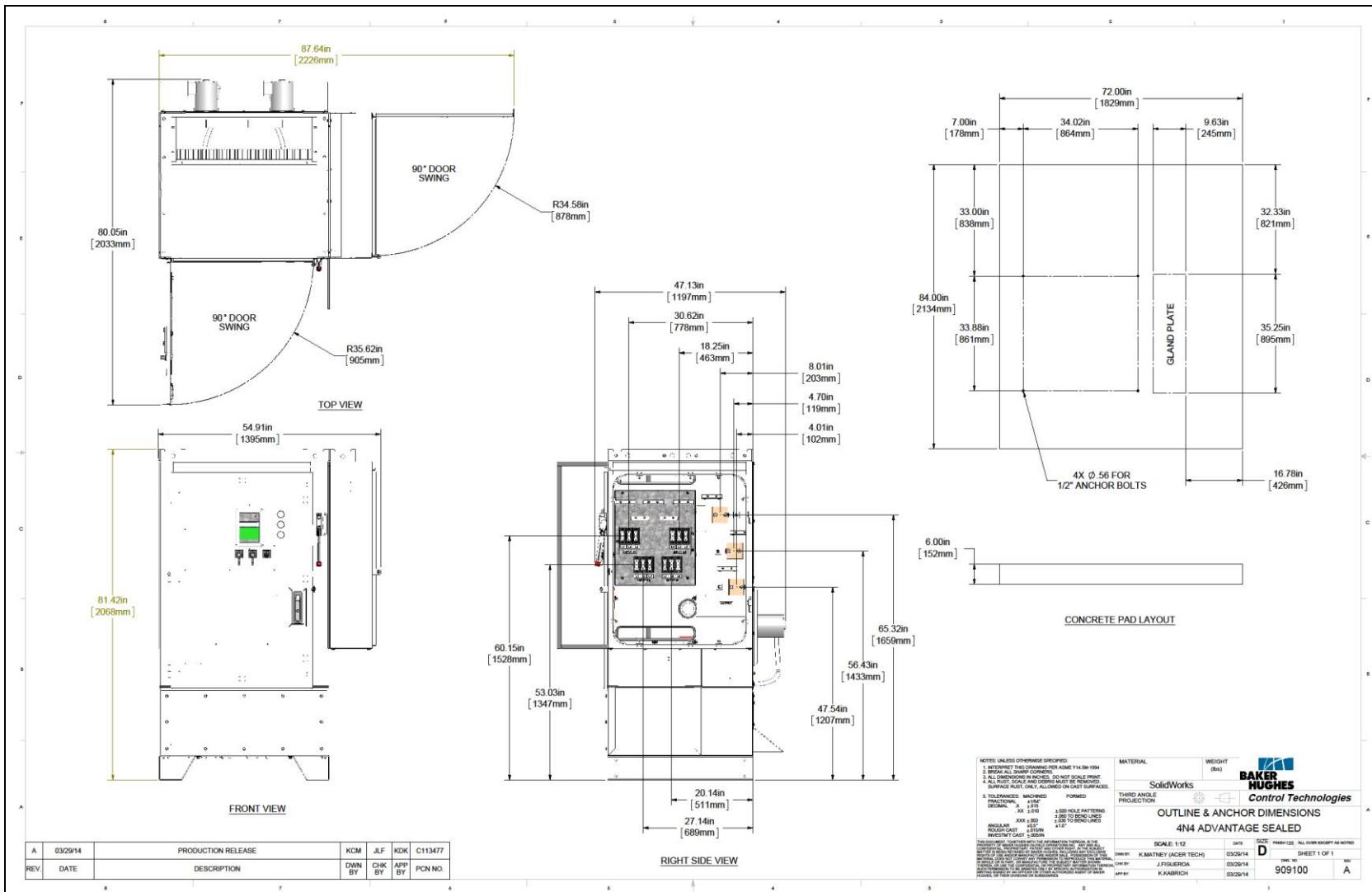


Figure 36: ADVANTAGE 4000 NEMA4 24P SERIES HARSH ENVIRONMENT CABINET - OUTLINE & ANCHOR
Drawing Number: 909100 - Sheet Number: 1 - Revision: A - Revision Date: 29MAR14

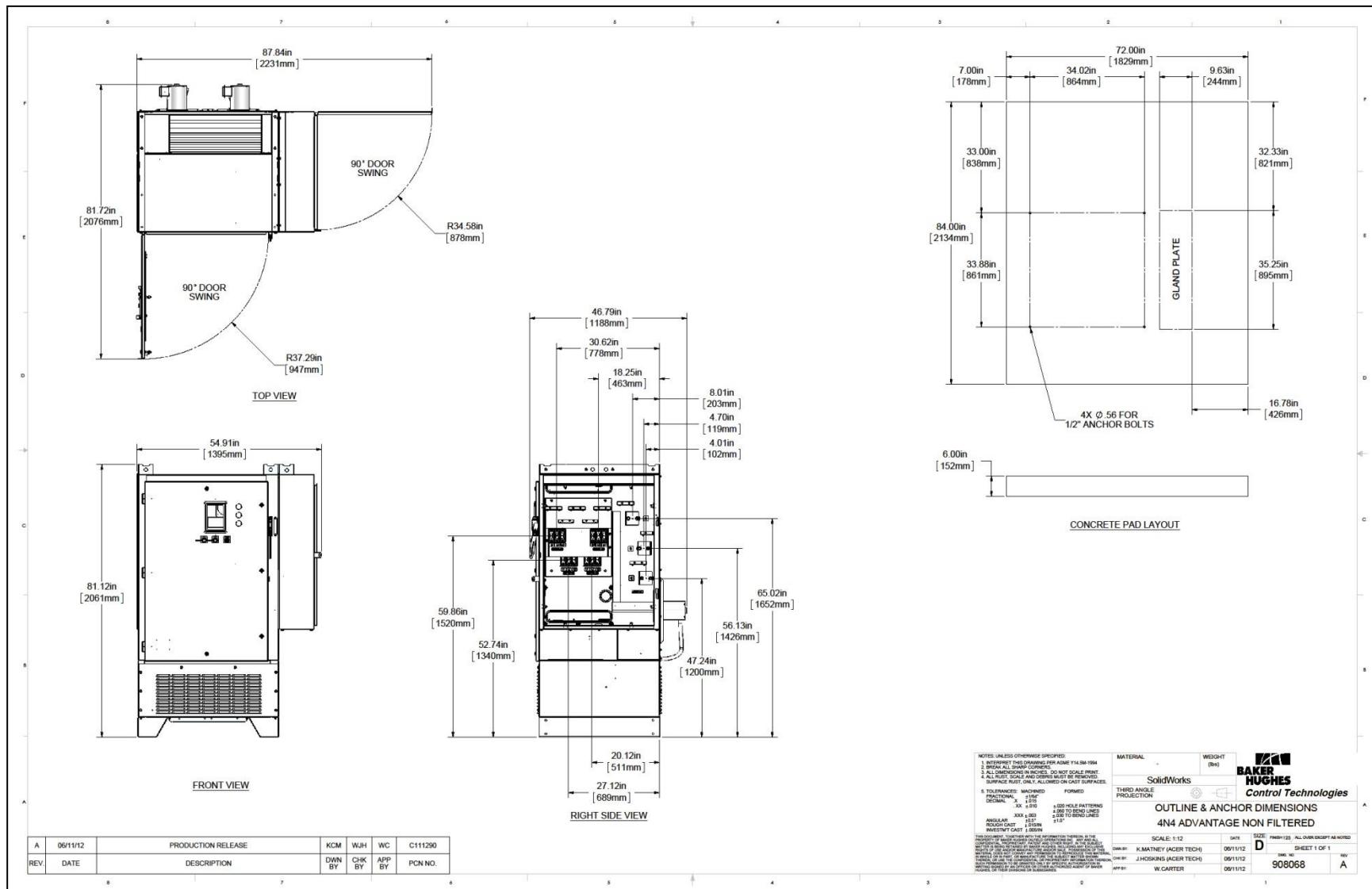


Figure 37: ADVANTAGE 4000 NEMA 4 24P SERIES OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 908068 - Sheet Number: 1 - Revision: A - Revision Date: 11JUN12

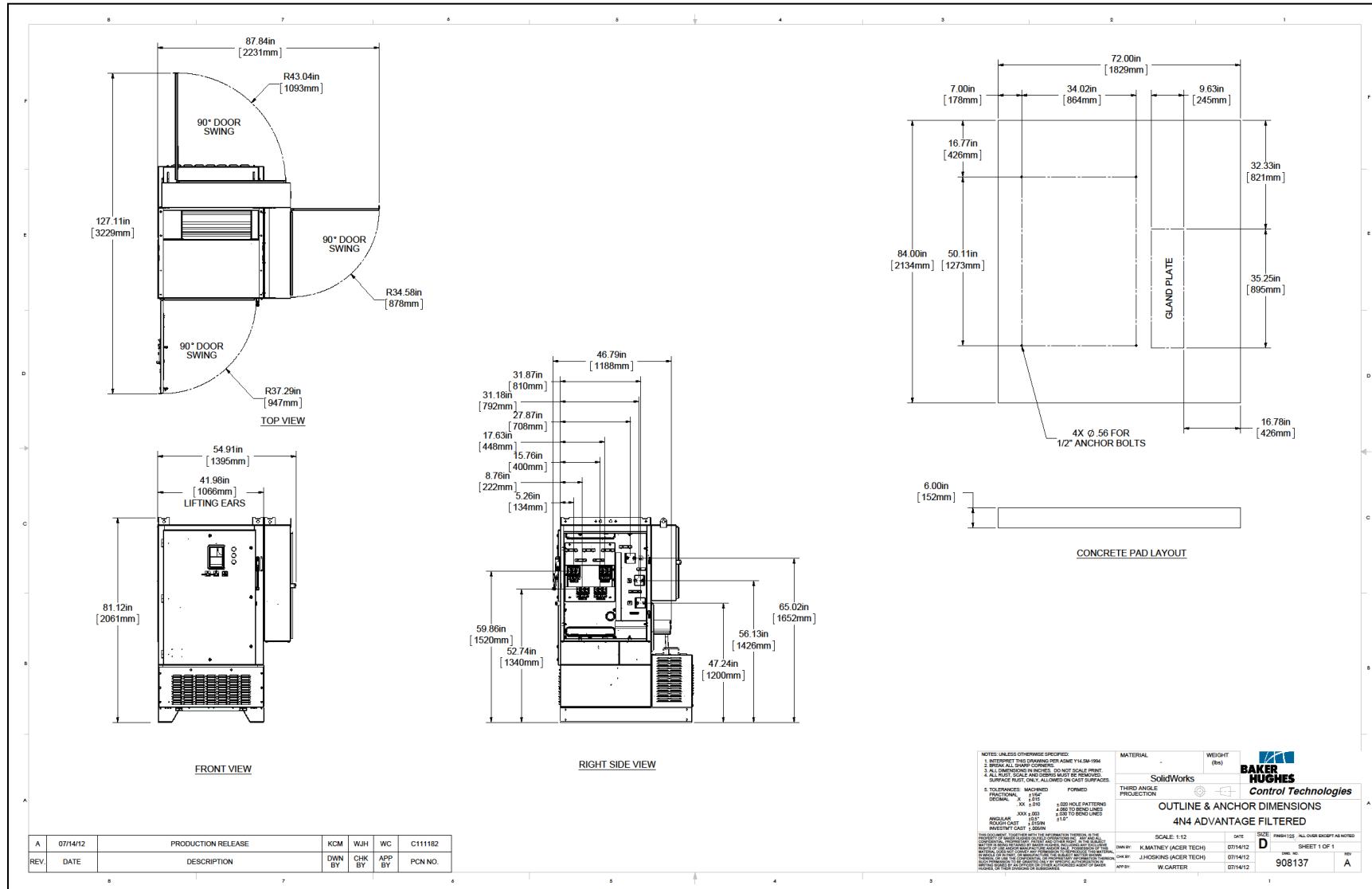


Figure 38: ADVANTAGE 4000 NEMA 4 SERIES-PWM FILTER OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 908137- Sheet Number: 1 - Revision: A - Revision Date: 17JUN12

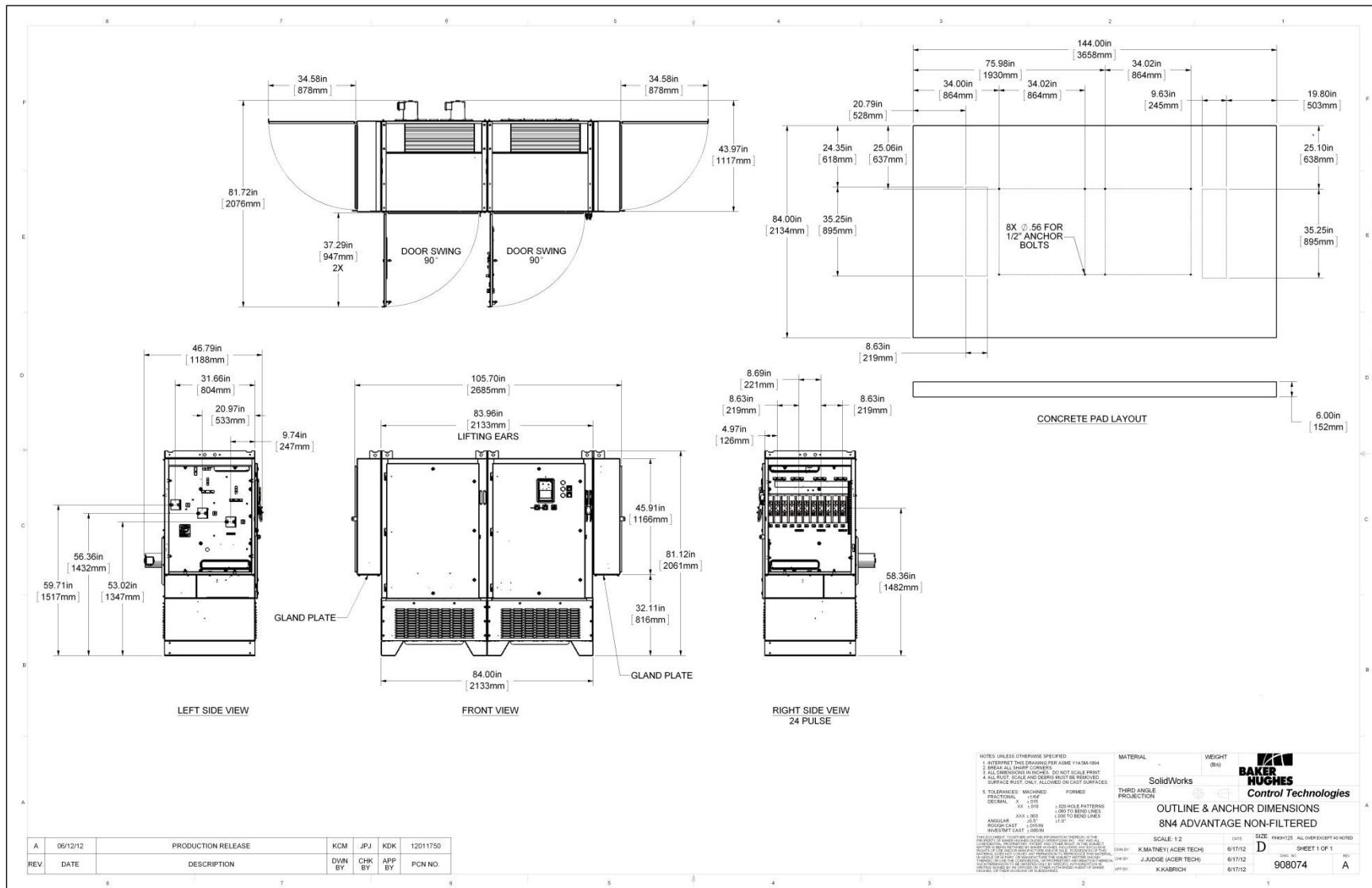


Figure 39: ADVANTAGE 8000 NEMA 4 SERIES OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS

Drawing Number: 908074 - Sheet Number: 1 - Revision: A - Revision Date: 17JUN12

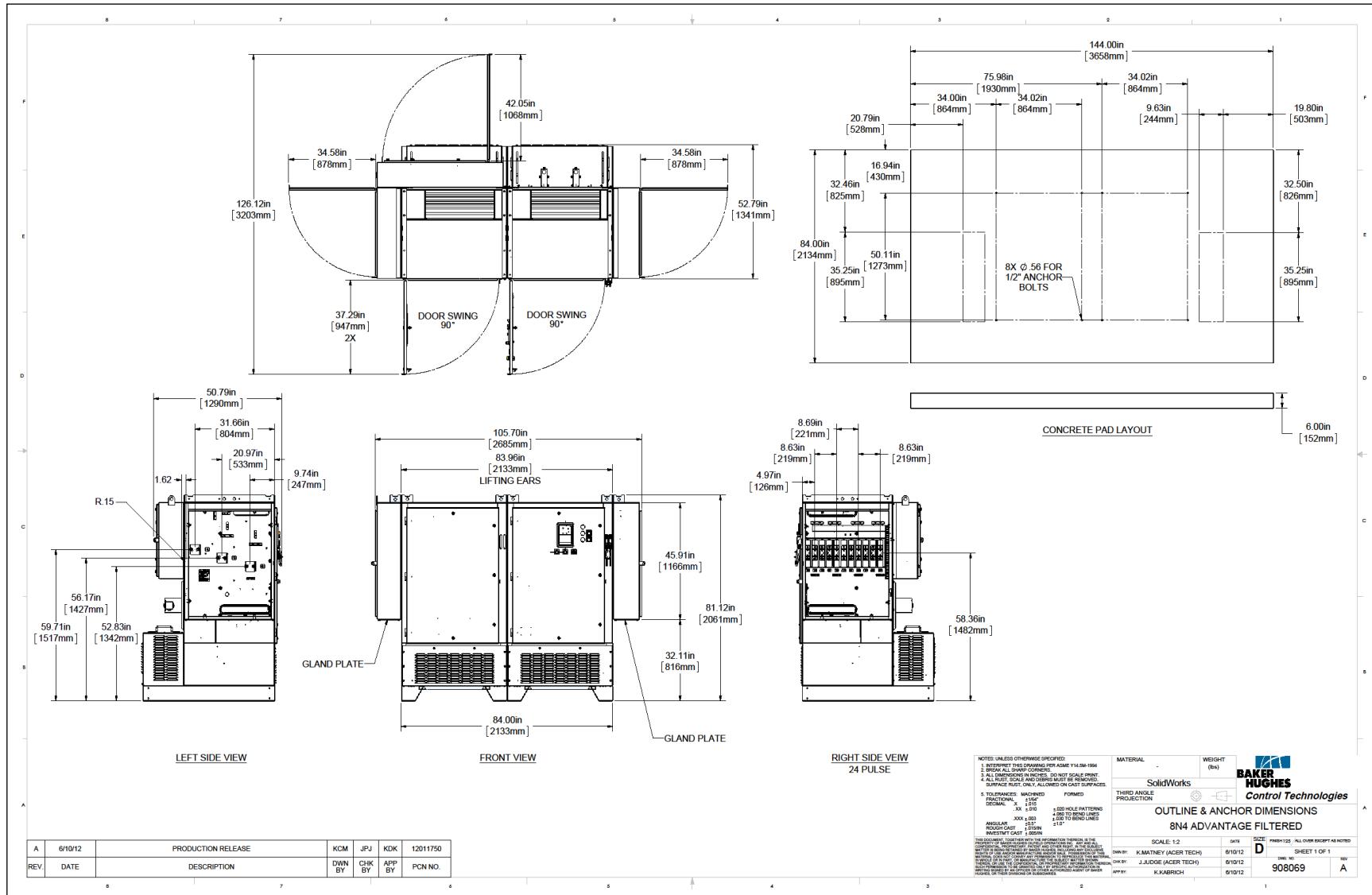


Figure 40: ADVANTAGE 8000 NEMA 4 SERIES-PWM FILTER OUTLINE & ANCHOR DIMENSIONAL DIAGRAMS
Drawing Number: 908069 - Sheet Number: 1 - Revision: A - Revision Date: 10JUN12

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