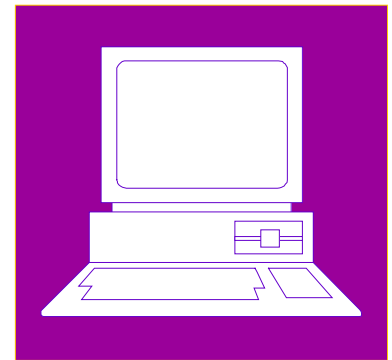
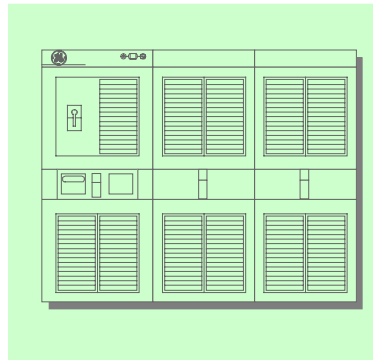
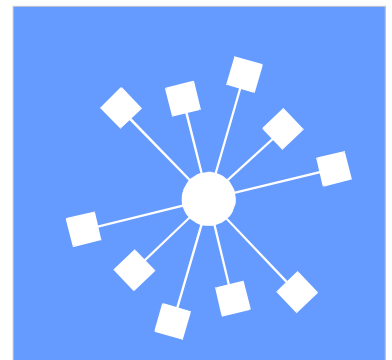




GEH-6396

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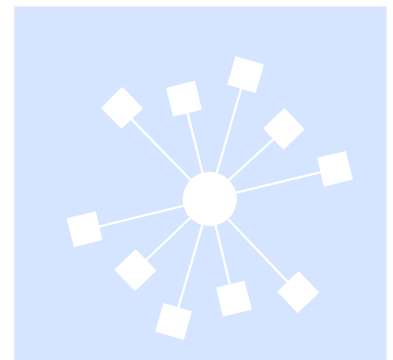


Innovation Series™

Low Voltage Drives – ACCBN-A

Reference and Troubleshooting

Publication: GEH-6396
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Innovation Series™

Low Voltage Drives – ACCBN-A

Reference and Troubleshooting

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These instructions do not purport to cover all details or variations in equipment, nor to provide every possible contingency to be met during installation, operation, and maintenance. If further information is desired or if particular problems arise that are not covered sufficiently for the purchaser's purpose, the matter should be referred to GE Industrial Systems, Salem, Virginia, USA.

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Notes

Chapter 1 Faults and Troubleshooting

Introduction

The drive software includes selftest diagnostics to aid in troubleshooting. When these tests detect an unfavorable condition, they output fault indications to a display. An operator can then examine the fault and clear it, as applicable.

<i>Section</i>	<i>Page</i>
Types of Faults.....	1
Fault Indication.....	2
Fault Descriptions	2

This chapter lists and defines the relevant fault messages for the drive, with troubleshooting suggestions. It is organized as follows:

The table contains a list of the faults with possible causes.

Note When troubleshooting leads to a hardware inspection or component replacement, be sure to follow the procedures described in the drive *User's Guide*, GEH-6392.

 Warning	This equipment contains a potential hazard of electric shock or burn. Only adequately trained persons who are thoroughly familiar with the equipment and the instructions should maintain this equipment.
---	---

Types of Faults

There are currently two types of fault conditions:

- **Trip faults** indicate a more serious condition that needs to be corrected, or it will trip the drive. The condition should be corrected before the drive is restarted.
- **Alarm faults** indicate conditions that should be noted, but that are not serious enough to shut down or trip the drive. Some alarm faults can clear themselves if

the condition goes away. Otherwise, the drive must be stopped for an operator to clear this type of fault.

Most faults can be cleared by selecting *Clear Faults* on the keypad or in the control system toolbox.

Fault Indication

When a fault condition occurs, the drive displays an indicator on the two operator interfaces: the local keypad and a connected PC running the control system toolbox.

On the keypad, a fault symbol  is found on the right side of the display:

- Not flashing (on steady) indicates an alarm.
- Flashing indicates a fault.

The operator can then use the keypad to access the fault/alarm description and clear the fault (see Section 6 for details).

The **control system toolbox** uses a Windows®-based PC display. When a fault occurs, the word *Alarm* or *Trip* appears in the lower right corner of the screen. You can view a description and clear the fault using the toolbox functions. (GE publication GEH-6401 describes these tools and this feature.)

Fault Descriptions

A fault is identified by an assigned **number** and abbreviated **description**. Both of these are displayed when an operator examines a fault using the keypad or the control system toolbox. The figure shows a sample keypad display.

The table lists the drive faults and their probable cause.

Fault No.	Fault Type	Description	Alarm Indicator
ACTIVE FAULT DISPLAY			
50	Trip	HtSink temp low, B	    
108	Brief	DC bus voltage low	
12	Trip	Gnd flt, coarse	
113	Trip	Invalid board set	
--- RESET FAULTS NOW ---			

Fault Display Screen on Keypad

Fault Code Descriptions

No.	Name	Type	Description
2	<i>Illegal seq state</i>	Trip	The <i>Illegal seq state</i> trip fault occurs when the sequencer state (variable <i>Sequencer state</i>) is unrecognized. This trip may occur during system development but should not occur in the field.
3	<i>Phase loss fault</i>	Trip	This permissives for this fault occur when the detected phase imbalance is at a level which is above the threshold that indicates a phase loss. A timer begins when these conditions are met and the alarm, <i>Phase loss alarm</i> begins. If the alarm persists for about 1.0 second, the fault <i>Phase loss fault</i> will occur. The source must be running in order for this fault to occur. The fault can be inhibited by setting <i>Phase loss trip inh</i>. Primary causes: A phase is missing on the input An AC input fuse is blown Possible board failures: DSPX SCNV
4	<i>Phase loss alarm</i>	Alarm	This alarm occurs when the detected phase imbalance is at a level which is above the threshold that indicates a phase loss. A timer begins when this alarm begins and if the alarm persists for about 1.0 second, the fault <i>Phase loss fault</i> will occur. The source must be running in order for this fault to occur. Primary causes: A phase is missing on the input An AC input fuse is blown Possible board failures: DSPX SCNV
6	<i>Run cmd during init</i>	Alarm	The <i>Run cmd during init</i> alarm occurs when a run request is issued during drive initialization. When the alarm occurs, the request to perform a drive action is ignored. Primary causes: The external application layer issues a request to perform a drive action during drive initialization. An external input (i.e. digital input) used to request a drive action was high during drive initialization.
7	<i>TOC pending</i>	Alarm	The <i>TOC pending</i> alarm occurs when one of the squared phase currents (variables <i>Ia² filtered</i> , <i>Ib² filtered</i> , and <i>Ic² filtered</i>) in the timed over current detection model exceeds the timed over current alarm level.
8	<i>Timed over current</i>	Trip	The <i>Timed over current</i> trip fault occurs when one of the squared phase currents (variables <i>Ia² filtered</i> , <i>Ib² filtered</i> , and <i>Ic² filtered</i>) in the timed over current detection model exceeds the timed over current threshold level.
9	<i>EE flash corrupted</i>	Trip	The <i>EE flash corrupted</i> trip fault occurs when the memory containing the drive parameters is determined to be bad during drive initialization. <i>EE flash corrupted</i> requires a hard reset to clear. Possible board failures: DSPX

Fault Code Descriptions

No.	Name	Type	Description
10	<i>Version mismatch</i>	Trip	The <i>Version mismatch</i> trip fault occurs at initialization when the drive pattern detects a product or version mismatch with the parameters stored in non-volatile RAM. Download parameters to fix.
11	<i>AC line failed</i>	Trip	The <i>AC line failed</i> trip fault occurs when the phase lock loop fails to synchronize during the start up sequence. Primary causes: The AC line is missing. There is a large AC line imbalance. There is a blown fuse.
12	<i>AC line transient</i>	Alarm	The <i>AC line transient</i> alarm occurs as a result of significant phase lock loop error or significant phase imbalance. A phase imbalance signal is calculated by subtracting a control calculated threshold from a filtered signal which is formed by filtering the sum of two signals. One of these signals is the phase lock loop error and the other is the error between the demodulated real component of line voltage and the measured magnitude of the line. The calculated threshold phase imbalance level which is computed by the control is based on the magnitude of the input line voltage. This calculated phase imbalance threshold represents a phase imbalance of about 18% or a phase lock loop error of about 6.7 degrees. The phase imbalance signal which is a result of the previously mentioned subtraction is equal to about 18% imbalance when it becomes positive. The phase imbalance signal feeds an integrator designed to cause the <i>AC line transient</i> alarm when the threshold has been exceeded for a very short time. That amount of time is dependent upon the amount of the phase imbalance, but the alarm will occur eventually if the imbalance signal remains positive. Primary causes: AC line disturbances. Transient phase imbalances. Weak control of frequency on diesel generator sets or gas turbine generator sets. Very fast voltage magnitude changes. Damaged reactor or transformer Possible board failures: SCNV BICL DSPX

Fault Code Descriptions

No.	Name	Type	Description
13	<i>AC line watchdog</i>	Trip	The <i>AC line watchdog</i> trip fault will occur when the <i>AC line transient</i> alarm persists for about one second. Both the trip fault and the alarm are a result of significant phase lock loop error or significant phase imbalance. A phase imbalance signal is calculated by subtracting a control calculated threshold from a filtered signal which is formed by filtering the sum of two signals. One of these signals is the phase lock loop error and the other is the error between the demodulated real component of line voltage and the measured magnitude of the line. The calculated threshold phase imbalance level which is computed by the control is based on the magnitude of the input line voltage. This calculated phase imbalance threshold represents a phase imbalance of about 18% or a phase lock loop error of about 6.7 degrees. The phase imbalance signal which is a result of the previously mentioned subtraction is equal to about 18% imbalance when it becomes positive. The phase imbalance signal feeds an integrator designed to cause the <i>AC line transient</i> alarm when the threshold has been exceeded for a very short time. That amount of time is dependent upon the amount of the phase imbalance, but the alarm will occur eventually if the imbalance signal remains positive. If the alarm persists continuously for about one second, the <i>AC line watchdog</i> trip fault will occur. Primary causes: AC line disturbances. Transient phase imbalances. Weak control of frequency on diesel generator sets or gas turbine generator sets. Very fast voltage magnitude changes. Damaged reactor or transformer Possible board failures: SCNV BICL DSPX
14	<i>AC line rev phs seq</i>	Trip	The <i>AC line rev phs seq</i> trip fault occurs when the control senses that the rotation of the AC line is opposite of what is expected. This condition is checked only one time after the control is powered up. When the phase lock loop locks for the first time, just after the charging sequence has begun, the sign of <i>PLL frequency</i> is checked against the expected sign. The expected sign is determined by the setting of <i>Phase rotation</i>. If Forward sequence is selected, the sign of <i>PLL frequency</i> is expected to be positive, otherwise, it must be negative. If the expected sign is not found, the trip fault is given. <i>AC line rev phs seq</i> requires a hard reset to clear. Before changing <i>Phase rotation</i>, review the rotation of any AC cooling pumps or blowers in the drive. Incorrect phase sequence can lead to ineffective air or water flow in the cooling system. Primary causes: Control senses wrong phase sequence. Possible board failures: SCNV BICL DSPX Possible wiring faults: Main AC input lines to source are not in correct phase sequence. Sensing wires to SCNV are in wrong sequence.

Fault Code Descriptions

No.	Name	Type	Description								
15	<i>A-B voltage offset</i>	Trip	The <i>A-B voltage offset</i> trip fault occurs when the A-B line-line voltage offset (variable <i>A-B, Voltage offset</i>) is too large. <i>A-B voltage offset</i> evaluates A-B voltage feedback information collected while the power bridge is turned on. It uses the information to continuously adjust the voltage offset and to detect power bridge and feedback circuitry problems. Primary causes: The wire connection between the phase A or phase B SHCA card and the BPIA/BPIB card is missing or damaged. The A-B voltage feedback VCO on the BPIA/BPIB card is damaged. Two or more shorted IGBTs in separate phases of the power bridge exist. A combination of a shorted IGBT in phase A or phase B and a ground in the load exists. Possible board failures: SHCA BPIA/BPIB HFPA (FU4) DSPX Possible wiring faults: Connection between BPIA/BPIB and SHCA.								
16	<i>Regulator in limit</i>	Alarm	The <i>Regulator in limit</i> alarm occurs when one of the phase lock loop limits is restricted by a clamp. This alarm will occur even if a limit is hit for a very brief period of time. The variable <i>Reg limit summary</i> stores the summary of all regulator limit bits the last time any regulator was in limit. This is a good way to see what limit caused the alarm. A list of the bit numbers for specific regulator limit flags that are part of <i>Reg limit summary</i> is given below. Phase lock loop regulator: Maximum frequency limit -- bit 0 Minimum frequency limit -- bit 1 If a particular limit is suspected, it may be checked by viewing the associated indication variable, as listed in the table below. <table><tr><th>Variable</th><th>Description</th></tr><tr><td><i>PLL positive limit</i></td><td>The pll is in the maximum limit</td></tr><tr><td><i>PLL lower limit</i></td><td>The pll is in the minimum limit</td></tr><tr><td><i>Reg limit summary</i></td><td>Regulator Limit History. This word contains the history of the regulator limit word. At the time of an alarm or fault, the limit word is saved into the history word.</td></tr></table> Primary causes: Frequency out of allowed range (bits 2,3) Poor regulator tune-up due to bad input data Possible board failures: DSPX DSFC/DAMX	Variable	Description	<i>PLL positive limit</i>	The pll is in the maximum limit	<i>PLL lower limit</i>	The pll is in the minimum limit	<i>Reg limit summary</i>	Regulator Limit History. This word contains the history of the regulator limit word. At the time of an alarm or fault, the limit word is saved into the history word.
Variable	Description										
<i>PLL positive limit</i>	The pll is in the maximum limit										
<i>PLL lower limit</i>	The pll is in the minimum limit										
<i>Reg limit summary</i>	Regulator Limit History. This word contains the history of the regulator limit word. At the time of an alarm or fault, the limit word is saved into the history word.										

Fault Code Descriptions

No.	Name	Type	Description
17	<i>IOC setpt over range</i>	Trip	The <i>IOC setpt over range</i> trip fault indicates that the firmware instantaneous over-current threshold request is above the allowed limit. This limit is 2.5 times the rated current for the source. This threshold is a final value that is calculated to be 2.4 times the rated current; therefore, this trip fault should only occur when design personnel over-ride the calculation of the threshold.
18	<i>DB over-temp alarm</i>	Alarm	The dynamic brake resistor thermal model has determined that the resistor is too hot. A trip fault is pending. Over-temperature is determined by the output of a dynamic brake resistor power calculator. A low pass filter which models the allowed impulse time is on the output of the model. This model is driven by user information provided in the commissioning wizard, <i>DB res pwr rating</i>, <i>DB res impulse pwr</i> and <i>DB res impulse time</i>. The power level at which the alarm is given is slightly greater than <i>DB res pwr rating</i>. Primary causes: Wrong commissioning wizard data. The power rating of the resistor is lower than indicated by <i>DB res pwr rating</i>
19	<i>DB over-temp fault</i>	Trip	The dynamic brake resistor thermal model has determined that the resistor is too hot to continue operation. Over-temperature is determined by the output of a dynamic brake resistor power calculator. A low pass filter which models the allowed impulse time is on the output of the model. This model is driven by user information provided in the commissioning wizard, <i>DB res pwr rating</i>, <i>DB res impulse pwr</i> and <i>DB res impulse time</i>. The power level at which the alarm is given is slightly greater than <i>DB res pwr rating</i>. Primary causes: Wrong commissioning wizard data. The power rating of the resistor is lower than indicated by <i>DB res pwr rating</i>
20	<i>B-C voltage offset</i>	Trip	The <i>B-C voltage offset</i> trip fault occurs when the B-C line-line voltage offset (variable <i>B-C, Voltage offset</i>) is too large. <i>B-C voltage offset</i> evaluates B-C voltage feedback information collected while the power bridge is turned on. It uses the information to continuously adjust the voltage offset and to detect power bridge and feedback circuitry problems. Primary causes: The wire connection between the phase B or phase C SHCA card and the BPIA/BPIB card is missing or damaged. The B-C voltage feedback VCO on the BPIA/BPIB card is damaged. Two or more shorted IGBTs in separate phases of the power bridge exist. A combination of a shorted IGBT in phase A or phase B and a ground in the load exists. Possible board failures: SHCA BPIA/BPIB HFP4 (FU4) DSPX Possible wiring faults: Connection between BPIA/BPIB and SHCA.

Fault Code Descriptions

No.	Name	Type	Description
21	<i>Phase A cur offset</i>	Trip	The <i>Phase A cur offset</i> trip fault occurs when the phase A current offset (variable <i>Phs A current offset</i>) is too large. The current offset threshold level is 1 percent of the rated shunt current. <i>Phs A current offset</i> is the output of an automatic current offset calculation. <i>Phase A cur offset</i> evaluates phase A current feedback information collected while the power bridge is turned off, when current feedbacks should be zero. It uses the information to detect power bridge and feedback circuitry problems. Primary causes: The wire connection between the phase A SHCA card and the BPIA/BPIB card is missing or damaged. The phase A current feedback VCO on the BPIA/BPIB card is damaged. Two or more shorted IGBTs in the power bridge exist. A combination of a shorted IGBT in the power bridge and a ground in the load exists.
22	<i>Phase B cur offset</i>	Trip	The <i>Phase B cur offset</i> trip fault occurs when the phase B current offset (variable <i>Phs B current offset</i>) is too large. The current offset threshold level is 1 percent of the rated shunt current. <i>Phs B current offset</i> is the output of an automatic current offset calculation. <i>Phase B cur offset</i> evaluates phase B current feedback information collected while the power bridge is turned off, when current feedbacks should be zero. It uses the information to detect power bridge and feedback circuitry problems. Primary causes: The wire connection between the phase B SHCA card and the BPIA/BPIB card is missing or damaged. The phase B current feedback VCO on the BPIA/BPIB card is damaged. Two or more shorted IGBTs in the power bridge exist. A combination of a shorted IGBT in the power bridge and a ground in the load exists.
23	<i>Phase C cur offset</i>	Trip	The <i>Phase C cur offset</i> trip fault occurs when the phase C current offset (variable <i>Phs C current offset</i>) is too large. The current offset threshold level is 1 percent of the rated shunt current. <i>Phs C current offset</i> is the output of an automatic current offset calculation. <i>Phase C cur offset</i> evaluates phase C current feedback information collected while the power bridge is turned off, when current feedbacks should be zero. It uses the information to detect power bridge and feedback circuitry problems. Primary causes: The wire connection between the phase C SHCA card and the BPIA/BPIB card is missing or damaged. The phase C current feedback VCO on the BPIA/BPIB card is damaged. Two or more shorted IGBTs in the power bridge exist. A combination of a shorted IGBT in the power bridge and a ground in the load exists.

Fault Code Descriptions

No.	Name	Type	Description
24	<i>Bic Watchdog</i>	Trip	The <i>Bic Watchdog</i> trip fault occurs when the BICL stops seeing a watchdog toggle bit from the DSPX. When the drive is running, BICL monitors a toggle bit being manipulated by DSPX. If DSPX does not toggle the bit on BICL within a predefined time interval, the BICL declares a fault and disables the bridge. This indicates that the processor cannot communicate reliably with the bridge interface card. <i>Bic Watchdog</i> requires a hard reset to clear. Possible configuration faults: The connected drive is a simulator but <i>Simulate mode act</i> is equal to <i>False</i>. Set <i>Simulate mode</i> equal to <i>Yes</i> to correct the problem. Possible board failures: BICL DSPX CABP (backplane)
25	<i>Local flt</i>	Trip	The <i>Local flt</i> trip fault occurs when the local permissive circuit is open and a <i>Run request</i> is issued. Possible wiring faults: The connections to ATBA terminal board locations 8 (L115), 10 (L24), and 12 (LCOM) are missing or damaged. The connection to backplane connector J2 is missing or damaged.
26	<i>System flt</i>	Trip	The <i>System flt</i> trip fault occurs when the system permissive circuit is open and a run request is issued. Possible wiring faults: The connections to ATBA terminal board locations 2 (S115), 4 (S24), and 6 (SCOM) are missing or damaged..
27	<i>DC bus under voltage</i>	Trip	The <i>DC bus under voltage</i> trip fault occurs when the dc link voltage feedback (variable <i>DC bus voltage</i>), is too low. The under voltage threshold level is a function of the nominal dc link voltage, which is a function of the input voltage (parameter <i>AC input voltage</i>). The fault is only declared when the source is not in a stopped condition. The main purpose of the trip fault is to detect an excessively low dc link voltage, and to respond by shutting down the bridge. Possible configuration faults: The parameter <i>AC input voltage</i> is not set correctly. Possible board failures: SCNV DSPX

Fault Code Descriptions

No.	Name	Type	Description
28	<i>Ground flt alm, LP</i>	Alarm	The <i>Ground flt alm, LP</i> alarm occurs when a large ground current is detected by the Line Protection (LPPA) Module. The alarm occurs when the LPPA ground current (variable <i>LPPA gnd cur</i>) is greater than the LPPA ground current alarm level (parameter <i>LPPA gnd flt alm</i>). <i>Ground flt alm, LP</i> clears when the LPPA ground current drops below the LPPA ground current alarm turn off level (parameter <i>LPPA gnd flt clr</i>). The alarm can be disabled by inhibiting Line Protection (LPPA) Module functionality. Set parameter <i>LPPA mode</i> equal to <i>LPPA absent</i>. Possible configuration faults: The value of the LPPA ground current alarm level, represented by parameter <i>LPPA gnd flt alm</i>, is too low. Possible board failures: LPPA ATBA BAIA DSPX
29	<i>Ground flt, LP</i>	Trip	The <i>Ground flt, LP</i> trip fault occurs when a large ground current is detected by the Line Protection (LPPA) Module. The trip fault occurs when the LPPA ground current (variable <i>LPPA gnd cur</i>) is greater than the LPPA ground current trip fault level (parameter <i>LPPA gnd flt lvl</i>). <i>Ground flt, LP</i> can be disabled by inhibiting Line Protection (LPPA) Module functionality. Set parameter <i>LPPA mode</i> equal to <i>LPPA absent</i>. Possible configuration faults: The value of the LPPA ground current fault threshold, represented by parameter <i>LPPA gnd flt lvl</i>, is too low. Possible board failures: LPPA ATBA BAIA DSPX
30	<i>AC filter fuse blown</i>	Alarm	The <i>AC filter fuse blown</i> alarm occurs when the Line Protection (LPPA) Module detects that the MOV fuse has blown. The trip fault occurs when the LPPA fuse circuit is open. <i>AC filter fuse blown</i> can be disabled by inhibiting Line Protection (LPPA) Module functionality. Set parameter <i>LPPA mode</i> equal to <i>LPPA absent</i>. Possible board failures: LPPA ATBA BAIA DSPX
31	<i>FW detected IOC</i>	Trip	The <i>FW detected IOC</i> trip fault occurs when a firmware IOC (instantaneous over-current) feature detects a current level on any of the three phases that exceeds 2.4 times the rated value of the source. This trip fault is normally disabled. It is enabled only when the retry time limit for the hardware generated IOC is set to zero. But that retry time is a final value driven by rules. Changing it generates an override. This fault detection scheme is not normally active. Primary causes: excessive current demand on source mis-phasing of phase lock loop

Fault Code Descriptions

No.	Name	Type	Description
35	DB desat	Trip	One of two conditions has occurred. (1) The dynamic brake IGBT has reached a desat condition. In this case, the SCNV has found that Vce, the collector to emitter voltage is greater than 10 volts for at least 4usec while the device is being commanded on. (2) The IGBT driver supply has an under-voltage problem Primary causes: The DB resistor IGBT has failed The IGBT driver supply has failed. Possible board failures: DSPX SCVN BICL
36	DB HS/bridge too hot	Trip	This fault is a result of one of two things. Either the klixon mounted on the dynamic brake IGBT heat sink (1000 frames only) is indicating a temperature too hot for operation, or another klixon whose output is in series with it is indicating that the temperature at the AC feed entry is too hot (1000 and 620 frames) Primary causes: The DB resistor IGBT heat sink is too hot The cooling fan for the AC input feed is not running There is a bad connection from one of the klixons to the DSPX card Possible board failures: DXPX SCVN Possible wiring failures 620 frames: Damaged or missing connection to AC feed entry klixon. DBPL-1 and/or DBPL-2 have bad or missing connection 1000 frames: Damaged or missing connection to converter temp switch Damaged or missing connection on TMPTB (see elementary sheet No 3B) DBPL-1 and/or DBPL-2 have bad or missing connection
37	Bridge over-temp	Trip	This fault will only occur on 620 frames and 1000 frames which have no dynamic brake resistor functionality. It indicates that a klikson in the ac feed entry portion of the bridge has gotten too hot. This klikson monitors temperature at the AC feed entry. The cooling fan for the ac entry of the bridge is not running (AC entry fan) The connection from the bus temperature klikson to DSPX has failed. Possible configuration faults: Wrong frame size selected Possible board failures: DXPX SCVN Possible wiring failures 620 frames: Damaged or missing connection to converter temp switch DBPL-1 and/or DBPL-2 have bad or missing connection 1000 frames: Damaged or missing connection to converter temp switch Damaged or missing connection on TMPTB (see elementary sheet No 3B) DBPL-1 and/or DBPL-2 have bad or missing connection

Fault Code Descriptions

No.	Name	Type	Description
41	<i>DC bus over voltage</i>	Trip	The <i>DC bus over voltage</i> trip fault occurs when the dc link voltage feedback (variable <i>DC bus voltage</i>) is too large. The over voltage threshold level is a function of the nominal dc link voltage; a function of the line-line voltage (parameter <i>AC input voltage</i>). This parameter is populated at commissioning time through user input. When the over voltage condition is detected, the gating to the bridge SCRs is immediately disabled. The main purpose of the trip fault is to detect an excessive and potentially dangerous dc link voltage, and to respond by shutting down the bridge. Possible configuration faults: The parameter, <i>AC input voltage</i>, was set not set correctly. Possible board failures: SCNV DSPX
42	<i>EE erase failed</i>	Alarm	The <i>EE erase failed</i> trip fault occurs when the preparation of memory for the next parameter save operation fails to happen satisfactorily. The next parameter save operation is expected to be invalid, and the integrity of future parameter save operations are in doubt. <i>EE erase failed</i> requires a hard reset to clear. Possible board failures: DSPX
43	<i>Bad short test seq</i>	Trip	The <i>Bad short test seq</i> trip fault occurs when the short test task has been given an illegal command. This should be considered as a code bug, should it occur. It can occur due to improper sequencing of an ACL sequencer design which has not followed sequencer/task rules.
44	<i>Illegal synch seq</i>	Trip	The <i>Illegal synch seq</i> trip fault occurs when the line synchronization task has been given an illegal command. Should this occur, it should be considered a code bug. The error can occur due to improper sequencing of an ACL sequencer design that has not followed sequencer/task rules.
45	<i>Illegal enable seq</i>	Trip	The <i>Illegal enable seq</i> trip fault occurs when the regulator enable task has been given an illegal command. If this occurs, it should be considered a code bug. The error can occur due to improper sequencing of an ACL sequencer design that has not followed sequencer/task rules.
46	<i>Gnd flt, coarse</i>	Trip	The <i>Gnd flt, coarse</i> trip fault occurs when a large ground current is detected. The trip fault occurs when the magnitude of the sum of the three phase currents is too large. Possible board failures: SHCA BPIB/BPIA HFPA (FU4) DSPX Possible wiring faults: Connection between BPIA/BPIB and SHCA.

Fault Code Descriptions

No.	Name	Type	Description
47	<i>Gnd flt, filtered</i>	Trip	The <i>Gnd flt, filtered</i> trip fault occurs when a large ground current is detected. The trip fault occurs when the discriminated ground current (variable <i>Ground current</i>) is greater than the ground current trip fault threshold (parameter <i>Gnd flt trip level</i>). Possible configuration faults: The value of the ground current trip fault threshold, represented by parameter <i>Gnd flt trip level</i>, is too low. Possible board failures: SHCA BPIB/BPIA DSPX Possible wiring faults: Connection between BPIA/BPIB and SHCA.
48	<i>Gnd flt alarm</i>	Alarm	The <i>Gnd flt alarm</i> alarm occurs when a large ground current is detected. The fault occurs when the discriminated ground current (variable <i>Ground current</i>) is greater than the ground current alarm level (parameter <i>Gnd flt alm level</i>). The alarm clears when the discriminated ground current drops below the ground current alarm turn off level (parameter <i>Gnd flt alm clr lvl</i>). Possible configuration faults: The value of the ground current alarm level, represented by parameter <i>Gnd flt alm level</i>, is too low. Possible board failures: SHCA BPIB/BPIA DSPX Possible wiring faults: Connection between BPIA/BPIB and SHCA.
50	<i>HtSink temp low, B</i>	Trip	The <i>HtSink temp low, B</i> trip fault occurs when the heatsink B temperature (variable <i>Heat sink temp, B</i>) is too low. The main purpose of the trip fault is to detect the absence of the heatsink B thermal sensor input. Primary causes: The heatsink B thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is missing or damaged.
51	<i>HtSink A temp low</i>	Trip	The <i>HtSink A temp low</i> trip fault occurs when the phase A heatsink temperature (variable <i>Phase A HtSink temp</i>) is too low. The main purpose of the trip fault is to detect the absence of the phase A heatsink thermal sensor input. Primary causes: The phase A heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is missing or damaged.

Fault Code Descriptions

No.	Name	Type	Description
52	<i>HtSink B temp low</i>	Trip	The <i>HtSink B temp low</i> trip fault occurs when the phase B heatsink temperature (variable <i>Phase B HtSink temp</i>) is too low. The main purpose of the trip fault is to detect the absence of the phase B heatsink thermal sensor input. Primary causes: The phase B heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is missing or damaged.
53	<i>HtSink C temp low</i>	Trip	The <i>HtSink C temp low</i> trip fault occurs when the phase C heatsink temperature (variable <i>Phase C HtSink temp</i>) is too low. The main purpose of the trip fault is to detect the absence of the phase C heatsink thermal sensor input. Primary causes: The phase C heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 5 and 6 is missing or damaged.
54	<i>Ambient temp low</i>	Trip	The <i>Ambient temp low</i> trip fault occurs when the ambient temperature (variable <i>Ambient temp</i>) is too low. The main purpose of the trip fault is to detect the absence of the ambient thermal sensor input. Primary causes: The ambient thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 7 and 8 is missing or damaged.
55	<i>HtSink B miswired</i>	Trip	The <i>HtSink B miswired</i> trip fault occurs when the phase B heatsink temperature (variable <i>Phase B HtSink temp</i>) is high enough to indicate the presence of a thermal sensor input, and the phase B thermal sensor input is expected to be absent. Primary causes: The phase B heatsink thermal sensor input is present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is present or the connector is damaged.

Fault Code Descriptions

No.	Name	Type	Description
56	<i>HtSink C miswired</i>	Trip	The <i>HtSink C miswired</i> trip fault occurs when the phase C heatsink temperature (variable <i>Phase C HtSink temp</i>) is high enough to indicate the presence of a thermal sensor input, and the phase C thermal sensor input is expected to be absent. Primary causes: The phase C heatsink thermal sensor input is present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 5 and 6 is present or the connector is damaged.
57	<i>HtSink sensor bad</i>	Alarm	The <i>HtSink sensor bad</i> alarm occurs when the heatsink temperature (variable <i>Heat sink temp</i>) is too far below the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to detect the absence of the heatsink thermal sensor input. Primary causes: The heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is missing or damaged.
58	<i>HtSink sensor A bad</i>	Alarm	The <i>HtSink sensor A bad</i> alarm occurs when the heatsink A temperature (variable <i>Heat sink temp, A</i>) is too far below the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to detect the absence of the heatsink A thermal sensor input. Primary causes: The heatsink A thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is missing or damaged.
59	<i>HtSink sensor B bad</i>	Alarm	The <i>HtSink sensor B bad</i> alarm occurs when the heatsink B temperature (variable <i>Heat sink temp, B</i>) is too far below the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to detect the absence of the heatsink B thermal sensor input. Primary causes: The heatsink B thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is missing or damaged.

Fault Code Descriptions

No.	Name	Type	Description
60	<i>HtSink A sensor bad</i>	Alarm	The <i>HtSink A sensor bad</i> alarm occurs when the phase A heatsink temperature (variable <i>Phase A HtSink temp</i>) is too far below the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to detect the absence of the phase A heatsink thermal sensor input. Primary causes: The phase A heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is missing or damaged.
61	<i>HtSink B sensor bad</i>	Alarm	The <i>HtSink B sensor bad</i> alarm occurs when the phase B heatsink temperature (variable <i>Phase B HtSink temp</i>) is too far below the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to detect the absence of the phase B heatsink thermal sensor input. Primary causes: The phase B heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is missing or damaged.
62	<i>HtSink C sensor bad</i>	Alarm	The <i>HtSink C sensor bad</i> alarm occurs when the phase C heatsink temperature (variable <i>Phase C HtSink temp</i>) is too far below the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to detect the absence of the phase C heatsink thermal sensor input. Primary causes: The phase C heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 5 and 6 is missing or damaged.
63	<i>HtSink over temp</i>	Trip	The <i>HtSink over temp</i> trip fault occurs when the heatsink temperature (variable <i>Heat sink temp</i>) is too large. The main purpose of the trip fault is to use the heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged.

No.	Name	Type	Description
64	<i>HtSink over temp, A</i>	Trip	The <i>HtSink over temp, A</i> trip fault occurs when the heatsink A temperature (variable <i>Heat sink temp, A</i>) is too large. The main purpose of the trip fault is to use the heatsink A temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink A temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged.
65	<i>HtSink over temp, B</i>	Trip	The <i>HtSink over temp, B</i> trip fault occurs when the heatsink B temperature (variable <i>Heat sink temp, B</i>) is too large. The main purpose of the trip fault is to use the heatsink B temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink B temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is damaged.
66	<i>HtSink A over temp</i>	Trip	The <i>HtSink A over temp</i> trip fault occurs when the phase A heatsink temperature (variable <i>Phase A HtSink temp</i>) is too large. The main purpose of the trip fault is to use the phase A heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase A heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged.
67	<i>HtSink B over temp</i>	Trip	The <i>HtSink B over temp</i> trip fault occurs when the phase B heatsink temperature (variable <i>Phase B HtSink temp</i>) is too large. The main purpose of the trip fault is to use the phase B heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase B heatsink temperature to rise above a safe operating level. Possible board failures: □□□□□ Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is damaged.

Fault Code Descriptions

No.	Name	Type	Description
68	<i>HtSink C over temp</i>	Trip	The <i>HtSink C over temp</i> trip fault occurs when the phase C heatsink temperature (variable <i>Phase C HtSink temp</i>) is too large. The main purpose of the trip fault is to use the phase C heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase C heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 5 and 6 is damaged.
69	<i>HtSink temp hot</i>	Alarm	The <i>HtSink temp hot</i> alarm occurs when the heatsink temperature (variable <i>Heat sink temp</i>) is too large. The main purpose of the alarm is to use the heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged.
70	<i>HtSink temp hot, A</i>	Alarm	The <i>HtSink temp hot, A</i> alarm occurs when the heatsink A temperature (variable <i>Heat sink temp, A</i>) is too large. The main purpose of the alarm is to use the heatsink A temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink A temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged.
71	<i>Htsink temp hot, B</i>	Alarm	The <i>Htsink temp hot, B</i> alarm occurs when the heatsink B temperature (variable <i>Heat sink temp, B</i>) is too large. The main purpose of the alarm is to use the heatsink B temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink B temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is damaged.

Fault Code Descriptions

No.	Name	Type	Description
72	<i>HtSink A temp hot</i>	Alarm	The <i>HtSink A temp hot</i> alarm occurs when the phase A heatsink temperature (variable <i>Phase A HtSink temp</i>) is too large. The main purpose of the alarm is to use the phase A heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase A heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged.
73	<i>HtSink B temp hot</i>	Alarm	The <i>HtSink B temp hot</i> alarm occurs when the phase B heatsink temperature (variable <i>Phase B HtSink temp</i>) is too large. The main purpose of the alarm is to use the phase B heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase B heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is damaged.
74	<i>HtSink C temp hot</i>	Alarm	The <i>HtSink C temp hot</i> alarm occurs when the phase C heatsink temperature (variable <i>Phase C HtSink temp</i>) is too large. The main purpose of the alarm is to use the phase C heatsink temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase C heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 5 and 6 is damaged.
75	<i>HtSink rise high</i>	Alarm	The <i>HtSink rise high</i> alarm occurs when the heatsink temperature (variable <i>Heat sink temp</i>) is too far above the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to use the heatsink and ambient temperature measurements to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged. The thermal sensor input to backplane connector J4 pins 7 and 8 is missing or damaged.

Fault Code Descriptions

No.	Name	Type	Description
76	<i>HtSink rise high, A</i>	Alarm	The <i>HtSink rise high, A</i> alarm occurs when the heatsink A temperature (variable <i>Heat sink temp, A</i>) is too far above the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to use the heatsink A and ambient temperature measurements to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink A temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged. The thermal sensor input to backplane connector J4 pins 7 and 8 is missing or damaged.
77	<i>HtSink rise high, B</i>	Alarm	The <i>HtSink rise high, B</i> alarm occurs when the heatsink B temperature (variable <i>Heat sink temp, B</i>) is too far above the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to use the heatsink B and ambient temperature measurements to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the heatsink B temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is damaged. The thermal sensor input to backplane connector J4 pins 7 and 8 is missing or damaged.
78	<i>HtSink A rise high</i>	Alarm	The <i>HtSink A rise high</i> alarm occurs when the phase A heatsink temperature (variable <i>Phase A HtSink temp</i>) is too far above the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to use the phase A heatsink and ambient temperature measurements to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase A heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is damaged. The thermal sensor input to backplane connector J4 pins 7 and 8 is missing or damaged.

Fault Code Descriptions

No.	Name	Type	Description
79	<i>HtSink B rise high</i>	Alarm	The <i>HtSink B rise high</i> alarm occurs when the phase B heatsink temperature (variable <i>Phase B HtSink temp</i>) is too far above the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to use the phase B heatsink and ambient temperature measurements to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase B heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 3 and 4 is damaged. The thermal sensor input to backplane connector J4 pins 7 and 8 is missing or damaged.
80	<i>HtSink C rise high</i>	Alarm	The <i>HtSink C rise high</i> alarm occurs when the phase C heatsink temperature (variable <i>Phase C HtSink temp</i>) is too far above the ambient temperature (variable <i>Ambient temp</i>). The main purpose of the alarm is to use the phase C heatsink and ambient temperature measurements to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the phase C heatsink temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 5 and 6 is damaged. The thermal sensor input to backplane connector J4 pins 7 and 8 is missing or damaged.
81	<i>HtSink temp imbalanc</i>	Alarm	The <i>HtSink temp imbalanc</i> alarm occurs when the difference between two of the heatsink temperatures differ is too large. In the 250, 375, and 620 frame sizes the heatsink temperatures are contained in variables <i>Heat sink temp, A</i> and <i>Heat sink temp, B</i>. In the 1000 and 1800 frame sizes the heatsink temperatures are contained in variables <i>Phase A HtSink temp</i>, <i>Phase B HtSink temp</i>, and <i>Phase C HtSink temp</i>. Primary causes: The bridge environment and running conditions cause the heatsink temperatures to differ by a large amount. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is missing or damaged. The thermal sensor input to backplane connector J4 pins 3 and 4 is missing or damaged. The thermal sensor input to backplane connector J4 pins 5 and 6 is missing or damaged.
82	<i>HtSink conf invalid</i>	Trip	The <i>HtSink conf invalid</i> trip fault occurs when the specified power bridge heatsink configuration is invalid.

Fault Code Descriptions

No.	Name	Type	Description
83	<i>HtSink temp low</i>	Trip	The <i>HtSink temp low</i> trip fault occurs when the heatsink temperature (variable <i>Heat sink temp</i>) is too low. The main purpose of the trip fault is to detect the absence of the heatsink thermal sensor input. Primary causes: The heatsink thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is missing or damaged.
84	<i>HtSink temp low, A</i>	Trip	The <i>HtSink temp low, A</i> trip fault occurs when the heatsink A temperature (variable <i>Heat sink temp, A</i>) is too low. The main purpose of the trip fault is to detect the absence of the heatsink A thermal sensor input. Primary causes: The heatsink A thermal sensor input is not present. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 1 and 2 is missing or damaged.
86	<i>AC line over voltage</i>	Trip	The <i>AC line over voltage</i> trip fault occurs when the control firmware detects that the magnitude of the AC line is above the value of <i>Line OV fault lvl</i>, which has a suggested value of 117% of nominal. The voltage magnitude used for this comparison is a processed by a low-pass filter. This filter is set to 1.2 rad/sec as a default, so transient over-voltages are allowed above the threshold value without causing this trip fault. Primary causes: AC line voltage is excessive. Possible configuration faults: Source has been applied at a voltage other than that set by the factory. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX

Fault Code Descriptions

No.	Name	Type	Description
87	<i>AC line voltage high</i>	Alarm	The <i>AC line voltage high</i> alarm occurs when the control firmware detects that the magnitude of the AC line is above the value of <i>Line OV alm on lvl</i>, which has a suggested value of 112% of nominal. The voltage magnitude used for this comparison is a low-pass filtered version of the fastest version. The filter is set to 1.2 rad/sec as a default, so transient voltage above the alarm turn-on value can occur without causing this alarm. This alarm will cease once the filtered value of voltage magnitude has decreased to below <i>Line OV alm off lvl</i>, which has a suggested value of 110% of nominal. Primary causes: AC line voltage is marginally excessive. Possible configuration faults: Source has been applied at a voltage other than that set by the factory. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX
88	<i>AC line under volt</i>	Trip	The <i>AC line under volt</i> trip fault occurs when the control firmware detects that the magnitude of the ac line is below the value of <i>Line UV fault lvl</i>, which has a suggested value of 50% of the nominal ac line input. The voltage magnitude used for this comparison is a low-pass filtered version of the signal. The filter is set to 1.2 rad/sec as a default, so transient voltages below the alarm turn-on value can occur without causing this trip fault. Primary causes: AC line voltage too low. Possible configuration faults: Source has been applied at a voltage other than that set by the factory. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX

Fault Code Descriptions

No.	Name	Type	Description
89	<i>AC line volts low</i>	Alarm	The <i>AC line volts low</i> alarm occurs when the control firmware detects that the magnitude of the ac line is below the value of <i>Line UV alm on lvl</i>, which has a suggested value of 88% of nominal. The voltage magnitude used for this comparison is a low-pass filtered version of the fastest version. The filter is set to 1.2 rad/sec as a default, so transient voltage above the alarm turn-on value can occur without causing this alarm. This alarm will cease once the filtered value of voltage magnitude has increased to above the value of <i>Line UV alm off lvl</i>, which has a suggested value of 90% of nominal. Primary causes: AC line voltage is marginally low. Possible configuration faults: Source has been applied at a voltage other than that set by the factory. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX
90	<i>AC line over freq</i>	Trip	The <i>AC line over freq</i> trip fault occurs when the control firmware detects that the frequency of the AC line is above the value of <i>Over freq flt lvl</i>, which has a suggested value of 125% of nominal. The frequency value used for this comparison is a low-pass filtered version of the fastest version. The filter is set to .2 rad/sec as a default, so transient over-frequency values are allowed above the threshold value without causing this trip fault. Primary causes: AC line frequency is excessive. Possible configuration faults: Source has been applied at a 60hz while the fundamental setup value, <i>IPN frq</i> was at 50hz. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX

Fault Code Descriptions

No.	Name	Type	Description
91	AC line freq high	Alarm	The <i>AC line freq high</i> alarm occurs when the control firmware detects that the frequency of the AC line is above the value of <i>Over frq alm on lvl</i>, which has a suggested value of nominal frequency plus 17.3 rad/sec. The frequency value used for this comparison is a low-pass filtered version of the fastest version. The filter is set to .2 rad/sec as a default, so transient over-frequency values are allowed above the threshold value without causing this alarm. This alarm will cease once the filtered value of filtered frequency has decreased to below the value of <i>Over frq alm off lvl</i>, which has a suggested value of nominal frequency plus 15.7rad/sec. Primary causes: AC line frequency is marginally excessive. Possible configuration faults: Source has been applied at 60hz while the commissioning data, <i>IPN frq</i> was set to 50hz. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX
92	AC line under freq	Trip	The <i>AC line under freq</i> trip fault occurs when the control firmware detects that the frequency of the AC line is below the value of <i>Low frq flt lvl</i>, which has a suggested value of nominal of 50% of nominal. The frequency value used for this comparison is a low-pass filtered version of the fastest version. The filter is set to .2 rad/sec as a default, so transient under-frequency values are allowed below the threshold value without causing this trip fault. Primary causes: AC line frequency is low. Possible configuration faults: Source has been applied at 50hz while the commissioning data, <i>IPN frq</i> was set to 60hz. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX

Fault Code Descriptions

No.	Name	Type	Description
93	<i>AC line freq low</i>	Alarm	The <i>AC line freq low</i> alarm occurs when the control firmware detects that the frequency of the AC line is below the value of <i>Low frq alm on lvl</i>, which has a suggested value of nominal minus 17.3rad/sec. The frequency value used for this comparison is a low-pass filtered version of the fastest version. The filter is set to .2 rad/sec as a default, so transient under-frequency values are allowed below the threshold value without causing this alarm. This alarm will cease once the filtered value of filtered frequency has increased to a value above below the value of <i>Low frq alm off lvl</i>, which has a suggested value of nominal frequency minus 15.7rad/sec. Primary causes: AC line frequency is transiently low. Possible configuration faults: Source has been applied at 50hz while the commissioning data, <i>IPN frq</i> was set to 60hz. Factory setting is <i>AC input voltage</i>. Care must be taken when changing this parameter, as the bridge may not be rated for that voltage. Possible board failures: SCNV BICL DSPX
94	<i>SCR 1 over temp</i>	Trip	The SCR thermal model has determined that the junction temperature of SCR 1 is too hot for operation. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>SCR 1 junction temp</i> has been found to exceed the threshold, <i>Jnc over-temp thrsh</i>. Primary causes: Excessive loading of the bridge.
95	<i>SCR 2 over temp</i>	Trip	The SCR thermal model has determined that the junction temperature of SCR 2 is too hot for operation. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>SCR 2 junction temp</i> has been found to exceed the threshold, <i>Jnc over-temp thrsh</i>. Primary causes: Excessive loading of the bridge.
96	<i>SCR 3 over temp</i>	Trip	The SCR thermal model has determined that the junction temperature of SCR 3 is too hot for operation. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>SCR 3 junction temp</i> has been found to exceed the threshold, <i>Jnc over-temp thrsh</i>. Primary causes: Excessive loading of the bridge.
97	<i>Diode 1 over temp</i>	Trip	The diode thermal model has determined that the junction temperature of diode 1 is too hot for operation. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>Diode 1 jnc temp</i> has been found to exceed the threshold, <i>Jnc over-temp thrsh</i>. Primary causes: Excessive loading of the bridge.
98	<i>Diode 2 over temp</i>	Trip	The diode thermal model has determined that the junction temperature of diode 2 is too hot for operation. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>Diode 2 jnc temp</i> has been found to exceed the threshold, <i>Jnc over-temp thrsh</i>. Primary causes: Excessive loading of the bridge.

Fault Code Descriptions

No.	Name	Type	Description
99	<i>Diode 3 over temp</i>	Trip	The diode thermal model has determined that the junction temperature of diode 3 is too hot for operation. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>Diode 3 jnc temp</i> has been found to exceed the threshold, <i>Jnc over-temp thrsh</i>. Primary causes: Excessive loading of the bridge.
100	<i>SCR 1 temp hot</i>	Alarm	The SCR thermal model has determined that the junction temperature of SCR 1 is getting too hot and that a trip fault is pending. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>SCR 1 junction temp</i> has been found to exceed the threshold, <i>Jnc OT alm on thrsh</i>. The alarm will cease when the temperature goes below <i>Jnc OT alm off thrsh</i>. Primary causes: Excessive loading of the bridge.
101	<i>SCR 2 temp hot</i>	Alarm	The SCR thermal model has determined that the junction temperature of SCR 2 is getting too hot and that a trip fault is pending. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>SCR 2 junction temp</i> has been found to exceed the threshold, <i>Jnc OT alm on thrsh</i>. The alarm will cease when the temperature goes below <i>Jnc OT alm off thrsh</i>. Primary causes: Excessive loading of the bridge.
102	<i>SCR 3 temp hot</i>	Alarm	The SCR thermal model has determined that the junction temperature of SCR 3 is getting too hot and that a trip fault is pending. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>SCR 3 junction temp</i> has been found to exceed the threshold, <i>Jnc OT alm on thrsh</i>. The alarm will cease when the temperature goes below <i>Jnc OT alm off thrsh</i>. Primary causes: Excessive loading of the bridge.
103	<i>Diode 1 temp hot</i>	Alarm	The diode thermal model has determined that the junction temperature of Diode 1 is getting too hot and that a trip fault is pending. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>Diode 1 jnc temp</i> has been found to exceed the threshold, <i>Jnc OT alm on thrsh</i>. The alarm will cease when the temperature goes below <i>Jnc OT alm off thrsh</i>. Primary causes: Excessive loading of the bridge.
104	<i>Diode 2 temp hot</i>	Alarm	The diode thermal model has determined that the junction temperature of Diode 2 is getting too hot and that a trip fault is pending. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>Diode 2 jnc temp</i> has been found to exceed the threshold, <i>Jnc OT alm on thrsh</i>. The alarm will cease when the temperature goes below <i>Jnc OT alm off thrsh</i>. Primary causes: Excessive loading of the bridge.
105	<i>Diode 3 temp hot</i>	Alarm	The diode thermal model has determined that the junction temperature of Diode 2 is getting too hot and that a trip fault is pending. See the toolbox diagram, OVR_SCR_THM, for details. The variable, <i>Diode 2 jnc temp</i> has been found to exceed the threshold, <i>Jnc OT alm on thrsh</i>. The alarm will cease when the temperature goes below <i>Jnc OT alm off thrsh</i>. Primary causes: Excessive loading of the bridge.

Fault Code Descriptions

No.	Name	Type	Description
106	<i>Ambient over temp</i>	Trip	The <i>Ambient over temp</i> trip fault occurs when the ambient temperature (variable <i>Ambient temp</i>) is too high. The main purpose of the trip fault is to use the ambient temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the ambient temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 7 and 8 is damaged.
107	<i>Ambient temp hot</i>	Alarm	The <i>Ambient temp hot</i> alarm occurs when the ambient temperature (variable <i>Ambient temp</i>) is too high. The main purpose of the alarm is to use the ambient temperature measurement to detect a condition which could endanger the power bridge. Primary causes: The bridge environment and running conditions cause the ambient temperature to rise above a safe operating level. Possible board failures: BICL Possible wiring faults: The thermal sensor input to backplane connector J4 pins 7 and 8 is damaged.

Fault Code Descriptions

No.	Name	Type	Description
108	<i>Reg in lim time out</i>	Trip	The <i>Reg in lim time out</i> fault occurs when one of the phase lock loop limits is restricted by a clamp. This alarm will occur even if a limit is hit for a very brief period of time. The variable <i>Reg limit summary</i> stores the summary of all regulator limit bits the last time any regulator was in limit. This is a good way to see what limit caused the alarm. A list of the bit numbers for specific regulator limit flags that are part of <i>Reg limit summary</i> is given below. Phase lock loop regulator: Maximum frequency limit -- bit 0 Minimum frequency limit -- bit 1 If a particular limit is suspected, it may be checked by viewing the associated indication variable, as listed in the table below. Variable Description <i>PLL positive limit</i> The pll is in the maximum limit <i>PLL lower limit</i> The pll is in the minimum limit <i>Reg limit summary</i> Regulator Limit History. This word contains the history of the regulator limit word. At the time of an alarm or fault, the limit word is saved into the history word. Primary causes: Frequency out of allowed range (bits 2,3) Poor regulator tune-up due to bad input data Possible board failures: DSPX SCNV
109	<i>Ckt board list fail</i>	Trip	The <i>Ckt board list fail</i> trip fault occurs when the electronic board ID interrogation which happens during drive initialization fails. Each circuit board in the rack has an electronic ID. <i>Ckt board list fail</i> requires a hard reset to clear. Primary causes: A circuit board is not seated properly in its backplane sockets. The electronic ID part on a circuit board has experienced a failure.
110	<i>Task 1 exec overrun</i>	Alarm	The <i>Task 1 exec overrun</i> alarm occurs when Task 1 exceeds its allotted CPU execution time. This alarm may occur during system development but should not occur in the field. Primary causes: Task 1 contains too much functionality to complete in the specified execution time. Possible board failures: DSPX

Fault Code Descriptions

No.	Name	Type	Description
111	<i>Task 2 exec overrun</i>	Alarm	The <i>Task 2 exec overrun</i> alarm occurs when Task 2 exceeds its allotted CPU execution time. This alarm may occur during system development but should not occur in the field. Primary causes: Task 2 contains too much functionality to complete in the specified execution time. Task 1 contains too much functionality. Although it completes in its specified execution time, it does not allow Task 2 to run to completion. Possible board failures: DSPX
112	<i>Task 3 exec overrun</i>	Alarm	The <i>Task 3 exec overrun</i> alarm occurs when Task 3 exceeds its allotted CPU execution time. This alarm may occur during system development but should not occur in the field. Primary causes: Task 3 contains too much functionality to complete in the specified execution time. Task 1 and Task 2 contain too much functionality. Although they complete in their specified execution time, they do not allow Task 3 to run to completion. Possible board failures: DSPX
113	<i>Invalid board set</i>	Trip	The <i>Invalid board set</i> trip fault occurs when the electronic board ID interrogation which happens during initialization does not produce the expected set of circuit boards. Each circuit board in the rack has an electronic ID which contains board type and revision information. Each Innovation Series product has an expected set of circuit boards. If any of the expected boards is missing, or if incorrect boards are present, the drive cannot operate properly. The circuit boards that the drive has identified can be obtained by making the following GE Control System Toolbox menu selections: View, Reports, Drive Version and Hardware Info. Primary causes: A circuit board which is required for the drive to operate properly is not present. A circuit board which should not be used in the drive is present. A circuit board is not seated properly in its backplane socket. The electronic ID part on a circuit board has experienced a failure.

Fault Code Descriptions

No.	Name	Type	Description
114	<i>Ain 1 signal alarm</i>	Alarm	The <i>Ain 1 signal alarm</i> occurs when the level of analog input number 1 (variable <i>Analog input 1</i>) is too low. The alarm level is specified by parameter <i>Analog in 1 flt lev</i>. The alarm can occur only when parameter <i>Analog in 1 flt mode</i> is set equal to Low level alarm. The alarm is disabled for any other setting for parameter <i>Analog in 1 flt mode</i>. The main purpose of <i>Ain 1 signal alarm</i> is to detect a low 4-20 mA signal. The low level may indicate that a signal is missing which is required for the drive to operate properly. Primary causes: The analog input number 1 signal source is absent or unhealthy. Possible configuration faults: The analog input 1 alarm level, represented by parameter <i>Analog in 1 flt lev</i>, is set incorrectly. The analog input number 1 gain, represented by parameter <i>Analog in 1 gain</i>, is set incorrectly. The analog input number 1 offset, represented by parameter <i>Analog in 1 offset</i>, is set incorrectly. The analog input number in 1 flt mode, represented by parameter <i>Analog in 1 flt mode</i>, is set incorrectly. Possible wiring faults: The connections between the analog signal source and ATBA terminal board locations 38 (AI1P) and 40 (AI1N) are missing or damaged.
115	<i>Ain 1 signal trip</i>	Trip	The <i>Ain 1 signal trip</i> fault occurs when the level of analog input number 1 (variable <i>Analog input 1</i>) is too low. The trip fault level is specified by parameter <i>Analog in 1 flt lev</i>. The trip fault can occur only when parameter <i>Analog in 1 flt mode</i> is set equal to Low level trip. The trip fault is disabled for any other setting for parameter <i>Analog in 1 flt mode</i>. The main purpose of <i>Ain 1 signal trip</i> is to detect a low 4-20 mA signal. The low level may indicate that a signal is missing which is required for the drive to operate properly. Primary causes: The analog input number 1 signal source is absent or unhealthy. Possible configuration faults: The analog input 1 trip fault level, represented by parameter <i>Analog in 1 flt lev</i>, is set incorrectly. The analog input number 1 gain, represented by parameter <i>Analog in 1 gain</i>, is set incorrectly. The analog input number 1 offset, represented by parameter <i>Analog in 1 offset</i>, is set incorrectly. The analog input number in 1 flt mode, represented by parameter <i>Analog in 1 flt mode</i>, is set incorrectly. Possible wiring faults: The connections between the analog signal source and ATBA terminal board locations 38 (AI1P) and 40 (AI1N) are missing or damaged.

Fault Code Descriptions

No.	Name	Type	Description
116	<i>Ain 2 signal alarm</i>	Alarm	The <i>Ain 2 signal alarm</i> occurs when the level of analog input number 2 (variable <i>Analog input 2</i>) is too low. The alarm level is specified by parameter <i>Analog in 2 flt lev</i>. The alarm can occur only when parameter <i>Analog in 2 flt mode</i> is set equal to Low level alarm. The fault is disabled for any other setting for parameter <i>Analog in 2 flt mode</i>. The main purpose of <i>Ain 2 signal alarm</i> is to detect a low 4-20 mA signal. The low level may indicate that a signal is missing which is required for the drive to operate properly. Primary causes: The analog input number 2 signal source is absent or unhealthy. Possible configuration faults: The analog input 2 alarm level, represented by parameter <i>Analog in 2 flt lev</i>, is set incorrectly. The analog input number 2 gain, represented by parameter <i>Analog in 2 gain</i>, is set incorrectly. The analog input number 2 offset, represented by parameter <i>Analog in 2 offset</i>, is set incorrectly. The analog input number in 2 flt mode, represented by parameter <i>Analog in 2 flt mode</i>, is set incorrectly. Possible wiring faults: The connections between the analog signal source and ATBA terminal board locations 44 (AI2P) and 46 (AI2N) are missing or damaged.
117	<i>Ain 2 signal trip</i>	Trip	The <i>Ain 2 signal trip</i> fault occurs when the level of analog input number 2 (variable <i>Analog input 2</i>) is too low. The trip fault level is specified by parameter <i>Analog in 2 flt lev</i>. The trip fault can occur only when parameter <i>Analog in 2 flt mode</i> is set equal to Low level trip. The trip fault is disabled for any other setting for parameter <i>Analog in 2 flt mode</i>. The main purpose of <i>Ain 2 signal trip</i> is to detect a low 4-20 mA signal. The low level may indicate that a signal is missing which is required for the drive to operate properly. Primary causes: The analog input number 2 signal source is absent or unhealthy. Possible configuration faults: The analog input 2 trip fault level, represented by parameter <i>Analog in 2 flt lev</i>, is set incorrectly. The analog input number 2 gain, represented by parameter <i>Analog in 2 gain</i>, is set incorrectly. The analog input number 2 offset, represented by parameter <i>Analog in 2 offset</i>, is set incorrectly. The analog input number in 2 flt mode, represented by parameter <i>Analog in 2 flt mode</i>, is set incorrectly. Possible wiring faults: The connections between the analog signal source and ATBA terminal board locations 44 (AI2P) and 46 (AI2N) are missing or damaged.
118	<i>Start with bus high</i>	Trip	An attempt was made to start the source when the voltage was above 85% of that obtainable by full rectification of the ac line. This is an operator error. The purpose of this fault is to prevent the control from firing when a cell is shorted.

Fault Code Descriptions

No.	Name	Type	Description
133	<i>Xfrmr over temp</i>	Trip	The <i>Xfrmr over temp</i> trip occurs when the transformer over temperature circuit is open. The control input which points to the over temperature circuit is selected by parameter <i>Xfrmr OT fault sel</i> . <i>Xfrmr over temp</i> can be disabled by setting parameter <i>Xfrmr OT fault sel</i> equal to <i>Unused</i> .
134	<i>Xfrmr temp hot</i>	Alarm	The <i>Xfrmr temp hot</i> alarm occurs when the transformer over temperature circuit is open. The control input which points to the over temperature circuit is selected by parameter <i>Xfrmr OT fault sel</i> . <i>Xfrmr temp hot</i> can be disabled by setting parameter <i>Xfrmr OT fault sel</i> equal to <i>Unused</i> .
137	<i>Unrecognized IPN</i>	Trip	The <i>Unrecognized IPN</i> trip fault occurs when the specified Intelligent Part Number (IPN) is not a valid combination of fields for the Innovation Series product. The IPN should correspond to the drive nameplate. <i>Unrecognized IPN</i> requires a hard reset to clear.
139	<i>Customer use NC flt</i>	Trip	The <i>Customer use NC flt</i> trip fault occurs when the customer normally closed circuit is open. The state of the normally closed circuit is selected by parameter <i>User NC fault sel</i> .
140	<i>Customer use NC alm</i>	Alarm	The <i>Customer use NC alm</i> alarm occurs when the customer normally closed circuit is open. The state of the normally closed circuit is selected by parameter <i>User NC fault sel</i> .
141	<i>Customer use NO flt</i>	Trip	The <i>Customer use NO flt</i> trip fault occurs when the customer normally open circuit is closed. The state of the normally open circuit is selected by parameter <i>User NO fault sel</i> .
142	<i>Customer use NO alm</i>	Alarm	The <i>Customer use NO alm</i> alarm occurs when the customer normally open circuit is closed. The state of the normally open circuit is selected by parameter <i>User NO fault sel</i> .
143	<i>Bad ramp task</i>	Trip	The <i>Bad ramp task</i> trip fault occurs when the dc link voltage ramp-up task has been given an illegal command. This should be considered as a code bug, should it occur. It can occur due to improper sequencing of an ACL sequencer design which has not followed sequencer/task rules.
144	<i>Bad normal task</i>	Trip	The <i>Bad normal task</i> trip fault occurs when the normal task has been given an illegal command. The normal task is the state in which the control spends almost all of its time once it is running. This should be considered as a code bug, should it occur. It can occur due to improper sequencing of an ACL sequencer design which has not followed sequencer/task rules.
145	<i>Bad bleed task</i>	Trip	The <i>Bad bleed task</i> trip fault occurs when the bleed test task has been given an illegal command. This should be considered as a code bug, should it occur. It can occur due to improper sequencing of an ACL sequencer design which has not followed sequencer/task rules.
146	<i>Bus short</i>	Trip	The control has determined that there is a short on the dc bus. This test is run shortly after the run command is given to the source if the dc link voltage is less than about 25% of nominal.. If the dc link voltage is greater than 25% of nominal at the time the run command is given, the short test is skipped. Possible configuration faults: The transformer data entered via the commissioning wizard was not correct. This will cause a wrong value of inductance to be calculated and can adversely affect the calculation of the ramp rate to be used during the short test, resulting in test failure on an un-shortened bus. Possible board failures: SCNV DSPX

Fault Code Descriptions

No.	Name	Type	Description
147	<i>Bleed test failed</i>	Trip	The bleed test has failed, indicating a problem with the bleed resistor circuit. After the short test is performed, all of the SCRs are turned off and the dc link is allowed to decay. The amount of decay after a few seconds is measured and compared against the expected decay. If that decay was either too little or too much, the <i>Bleed test failed</i> is given. This test is skipped when the parameter, <i>Common transformer</i> is set, indicating that the source is sharing a common transformer with another source. Primary causes: The bleed resistors are absent, disconnected, or the wrong value Possible board failures: SCNV DSPX
148	<i>Link ramp-up timeout</i>	Trip	The dc link voltage has failed to follow the firing commands as the link was being ramped up after a start command was given. If the ramp has not completed within 1 second of the time the command to full voltage was given, this fault will occur. Primary causes: The ac line is well below its nominal value or the SCRs are not gating. Possible board failures: SCNV DSPX
150	<i>Powerdip alarm</i>	Alarm	This alarm can only occur while the source is running. If while the source is running, the dc link voltage drops below 80% of nominal, this alarm will be given. If the link voltage subsequently rises above 85% of nominal, the alarm will go away. The source is said to be in "powerdip" when the alarm is being given. Toolbox diagram OVR_SEQ has a graphical display of the powerdip logic. Powerdip logic has an effect upon recovery from line disturbances. Primary causes: An ac line transient has caused the dc link to temporarily go below the powerdip level.
151	<i>Bad cell test task</i>	Trip	The <i>Bad cell test task</i> trip fault occurs when cell test task has been given an illegal command. This should be considered as a code bug, should it occur. It can occur due to improper sequencing of an ACL sequencer design which has not followed sequencer/task rules.
153	<i>DSPx Watchdog</i>	Trip	The <i>DSPx Watchdog</i> trip fault occurs when the DSPX EPLD stops seeing a watchdog toggle bit from the processor. A hard reset occurs and the fault is declared at initialization. <i>DSPx Watchdog</i> requires a hard reset to clear. Possible board failures: DSPX
154	<i>ADL msg stack fail</i>	Alarm	The <i>ADL msg stack fail</i> alarm occurs when an attempt by autotune or cell test to allocate or free message stack memory fails. The purpose of the alarm is to indicate failure in the use of dynamic memory with asynchronous drive language functionality. This alarm may occur during system development but should not occur in the field. Primary causes: An attempt to allocate or free memory on behalf of the ADL message stack failed.

Fault Code Descriptions

No.	Name	Type	Description
155	<i>DB IGBT over-temp</i>	Trip	The dynamic brake IGBT thermal model has found that the modeled junction temperature of the IGBT, <i>DB IGBT jnc temp</i> is too hot and has tripped the source in order to protect it. See the tool diagram OVR_DB_THM for details. The temperature threshold can be viewed via <i>DB IGBT OT setpoint</i>. The thermal model is driven by a DB current estimator which uses the electrical time constant as given in the commissioning wizard, <i>DB circuit tau</i>. If this value is wrong, improper current modeling can result. Run cell test for a check of this value. Change the value if cell test so suggests. Primary causes: Wrong value of <i>DB circuit tau</i> The DB resistor is not restricting current to a low enough level.
156	<i>DB IGBT too hot</i>	Alarm	The dynamic brake IGBT thermal model has found that the modeled junction temperature of the IGBT, <i>DB IGBT jnc temp</i> is too hot. See the tool diagram OVR_DB_THM for details. The temperature threshold can be viewed via <i>DB IGBT OT alarm on</i>. The alarm will cease if the temperature drops below the value of <i>DB IGBT OT alm off</i>. The thermal model is driven by a DB current estimator which uses the electrical time constant as given in the commissioning wizard, <i>DB circuit tau</i>. If this value is wrong, improper current modeling can result. Run cell test for a check of this value. Change the value if cell test so suggests. Primary causes: Wrong value of <i>DB circuit tau</i> The DB resistor is not restricting current to a low enough level.
157	<i>Bic watchdog echo</i>	Trip	The <i>Bic watchdog echo</i> trip fault occurs when the DSPX stops seeing the echo of the watchdog toggle bit that it writes to the BICL. This indicates that the processor cannot communicate reliably with the bridge interface card. Primary Causes: Bent backplane connector pins or poorly seated cards. Possible board failures: BICL DSPX CABP (backplane)
159	<i>LAN trip request</i>	Trip	The <i>LAN trip request</i> trip fault occurs when a request for a trip fault is received from the LAN by assertion of the reference Boolean signal <i>Trip request, lan</i>.
160	<i>LAN alarm request</i>	Alarm	The <i>LAN alarm request</i> alarm occurs when a request for an alarm is received from the LAN by assertion of the reference Boolean signal <i>Alarm request, lan</i>.
161	<i>LAN watchdog alarm</i>	Alarm	The <i>LAN watchdog alarm</i> occurs when the connection between DSPX and the Application/LAN interface becomes invalid. This includes one of the following conditions, depending upon the selection of <i>Network interface</i>: The Application/LAN interface Dual-Port RAM watchdog stops. The ISBus frames stop. The alarm is declared after the condition persists for several hundred microseconds.
162	<i>Line disturbance alm</i>	Alarm	The low voltage non-regenerative source has on-line protection that will phase back the SCRs in the event of a line disturbance. This is done so as to prevent excessive current in-rush on return of the line to normal and to allow for a graceful recovery. If this event occurs while the source is running, the <i>Line disturbance alm</i> will occur in an attempt to inform the user that the event has occurred. Primary causes: A line disturbance has occurred

Fault Code Descriptions

No.	Name	Type	Description
163	<i>Line disturbance flt</i>	Trip	The low voltage non-regenerative source has on-line protection that will phase back the SCRs in the event of a line disturbance. This is done so as to prevent excessive current in-rush on return of the line to normal and to allow for a graceful recovery. If this event occurs while the source is running, the <i>Line disturbance alm</i> will occur in an attempt to inform the user that the event has occurred. When this occurs, a timer will begin timing. If the time exceeds about 5 seconds, the trip fault, <i>Line disturbance flt</i> will occur. Primary causes: A line disturbance has occurred
165	<i>LAN heartbeat trip</i>	Trip	The <i>LAN heartbeat trip</i> occurs when all of the following conditions are present: Non-zero value is entered in Parameter <i>LAN heartbeat time</i>. The signal (<i>Heartbeat ref, lan</i>) fails to transition within in that time. The trip behavior is enabled by Parameter <i>LAN trips inhibit</i>. The <i>LAN connection ok</i> condition was previously detected.
166	<i>LAN heartbeat alarm</i>	Alarm	The <i>LAN heartbeat alarm</i> occurs when all of the following conditions are present: Non-zero value is entered in Parameter <i>LAN heartbeat time</i>. The signal (<i>Heartbeat ref, lan</i>) fails to transition within in that time. Either the trip behavior is inhibited by Parameter <i>LAN trips inhibit</i>, or the trip behavior is enabled but the <i>LAN connection ok</i> condition was not previously detected.
167	<i>DB reg open loop</i>	Alarm	The parameter, <i>DB open loop cmd</i> is set, allowing a user to connect the signal of his choice as an open loop command to the dynamic brake regulator. Regulation action is bypassed. The regulator is not going to properly control link voltage in this mode. This mode is for test purposes only.
168	<i>System ISBus error</i>	Alarm	The <i>System ISBus error</i> alarm occurs when an ISBus fault is detected in the DSPX control. The variable <i>Sys ISBus error reg</i> contains the bit-coded value of the last ISBus fault detected; each bit indicates a particular ISBus fault seen by the control. The variable <i>Sys ISBus error cnt</i> increments upon fault detection. Record the value of <i>Sys ISBus error reg</i> to assist factory troubleshooting efforts. Monitor the progression of <i>Sys ISBus error cnt</i> to obtain an indication of the rate of occurrence of fault conditions. Transient occurrence of this alarm upon initialization of the interface is expected.
169	<i>Frame PLL not OK</i>	Alarm	The <i>Frame PLL not OK</i> alarm occurs when phase-lock between the DSPX control and the System ISBus or (local ACL) is not assured. Detection of the fault is enabled when the parameter <i>Network interface</i> is configured to select an interface for which synchronized operation is supported. The presence of this alarm indicates that data coherency is compromised. Verify the integrity of ISBus connections and configurations. If this alarm persists in the absence of any other interface faults, then verify that <i>LAN frame time</i> is consistent with that of the host, and confirm the absence of overrides, particularly regarding the Frame phaselock loop and DSPX timebase. Transient occurrence of this alarm upon initialization of the interface is expected.

Chapter 2 Parameters/Functions

Introduction

The following is a list of parameters and functions encountered within the drive. It is organized as follows:

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Diagnostic and Utility Functions

Diagnostic and Utility Overview

The Innovation Series products contain a number of diagnostic functions. More information is available for the following topics.

- *Capture Buffer*
- *General Purpose Constants*
- *General Purpose Filters*
- *Oscillator*
- *Predefined Constants*
- *Signal Level Detector (SLD)*
- *Simulator*

Capture Buffer

The Innovation Series capture buffer is used to collect four channels of coherent data at a specified rate in the drive. The capture buffer is circular, and will collect 512 samples of each data channel before overwriting the oldest data. The capture buffer can be triggered on any available variable signal in the drive by using a Boolean trigger mode or comparison to a value. It is useful for capturing drive variables for troubleshooting field problems and capturing specific drive events. The Trend Recorder can display the capture buffer output.

Function Inputs

The following table specifies the input parameters to the *Capture Buffer* function.

Parameter	Description
<i>Capture trig select</i>	Selects capture buffer trigger variable.
<i>Capture ch1 select</i>	Selects capture buffer channel #1 variable.
<i>Capture ch2 select</i>	Selects capture buffer channel #2 variable.
<i>Capture ch3 select</i>	Selects capture buffer channel #3 variable.
<i>Capture ch4 select</i>	Selects capture buffer channel #4 variable.

The following variable is also an input to the *Capture Buffer* function.

Variable	Description
<i>Capture buffer ready</i>	Enables or disables the capture buffer data collection.

Function Outputs

The following table specifies the output variable of the *Capture Buffer* function.

Variable	Description
<i>Capture buffer stat</i>	Indicates the status of the capture buffer. Possible values are: • <i>Complete</i> - Capture buffer has completed its collection of data and is disabled. • <i>Wait for trigger</i> - The capture buffer is waiting for the evaluation of the trigger condition to go True. • <i>Post trigger capt</i> - Capture buffer has been triggered and is collecting post trigger data.
<i>Capture sample time</i>	Indicates the interval at which the capture buffer collects data based on the values of the parameters <i>Capture period</i> and <i>Capture period gain</i> . Seconds
<i>Capture triggered</i>	Indicates if the capture buffer has been triggered. True/False.

Function Configuration

The following table specifies the parameters that configure the execution rate of the capture buffer.

Parameter	Description
<i>Capture period</i>	Determines the rate at which the capture buffer collects data. Each rate in the enumeration list is based on a particular execution rate in the processor. Actual execution rates vary between each Innovation Series product. Possible values are:

- *Disable* - Disables the capture buffer from collecting data.
- *Task 1 rate* - Collects data at the fastest execution rate of the processor.
- *Task 2 rate* - Collects data at n times slower than Task 1 rate. (n Task 1's are executed every 1 Task 2).
- *Task 3 rate* - Collects data at m times slower than Task 2 rate. (m Task 2's are executed every 1 Task 3).

Note: Whenever this parameter is modified, the capture buffer must be re-enabled to collect data at the new rate.

Capture period gain

Increases the collection period of the capture buffer (data is collected at a slower rate). For an integer value, n (>1), the capture buffer would collect data every nth execution of the *Capture period*.

The following table specifies the parameters that configure the capture buffer.

Parameter	Description
<i>Capture pre trigger</i>	Specifies the number of pre-trigger samples to be collected by the capture buffer.
<i>Capture trigger mode</i>	Specifies the type of comparison against the variable selected in <i>Capture trig select</i> . Note: In level trigger mode, the capture buffer will trigger when the specified comparison is satisfied. If the trigger condition is satisfied when the capture buffer is enabled, it will trigger immediately and collect post-trigger data. Possible values are: • <i>Boolean</i> - Triggers when variable is a 1. Variable in <i>Capture trig select</i> must be of Boolean type. • <i>Inverted Boolean</i> - Triggers when variable is a 0. Variable in <i>Capture trig select</i> must be of Boolean type. • <i>Equal to level</i> - Triggers when variable is equal to value in <i>Capture trig level</i>. • <i>Not equal to level</i> - Triggers when variable is not equal to value in <i>Capture trig level</i>. • <i>Greater than level</i> - Triggers when variable is greater than value in <i>Capture trig level</i>. • <i>Less than level</i> - Triggers when variable is equal to value in <i>Capture trig level</i>.
<i>Capture trigger type</i>	Specifies the type of triggering used in the capture buffer. Possible values are: • <i>Level Triggering</i> - Level trigger mode will trigger when the evaluation of the trigger condition is True. If the trigger condition is satisfied when the capture buffer is enabled, it will trigger immediately and collect post-trigger data. • <i>Edge Triggering</i> - Edge trigger mode will trigger when the evaluation of the trigger condition changes from False to True. An exception is under initialization when the capture buffer will trigger when the evaluation of the trigger condition is True. If the capture buffer is enabled while the trigger condition is True, the capture buffer will wait for the trigger condition to go False and trigger when the evaluation of the trigger condition

changes from False to True.

Capture trig level Specifies the threshold level for level-based trigger comparisons.

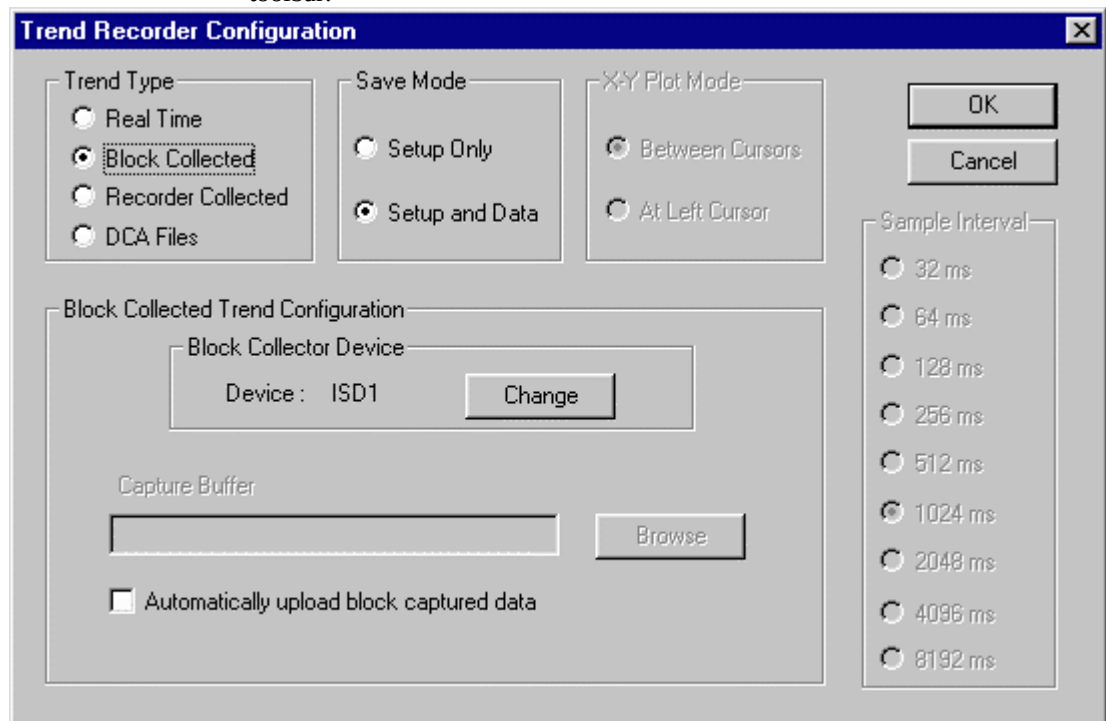
Function description

The capture buffer can be accessed from the Trend Recorder in the Control System Toolbox. To enable the Trend Recorder:

- From the *View* menu, select *Trend Recorder* OR select the Trend Recorder button on the toolbar: .

To enable the Innovation Series capture buffer from the Trend Recorder:

- From the *Edit* menu, select *Configure* OR select the *Configure* button from the Trend Recorder toolbar: .
- Select *Block Collected* as the *Trend Type* in the dialog box and click *OK*. This enables the *Upload*  and *Edit Block*  buttons on the Trend Recorder toolbar.



- Select the *Edit Block* button from the toolbar, which brings up a block diagram that allows you to configure the capture buffer parameters described in the *Function Input* and *Function Configuration* sections. All of the parameter values must be sent to the drive for the capture buffer to work correctly.
- Go back to the Trend Recorder and select the *Record*  button to enable the capture buffer. The toolbox status bar should change from a “Stopped” indication:



to a “Waiting” indication:



This indicates that the capture buffer is collecting data and waiting for the trigger.

To upload the capture buffer data into the Trend Recorder, select the Upload button from the Trend Recorder toolbar.

Related diagrams

- Capture Buffer Configuration (Capture)

General Purpose Constants

Each Innovation Series product provides three general purpose constants. The general purpose constants allow users to place constant values in device variables. The general purpose constants are particularly useful in configuring diagnostic functions.

Function inputs

The following table specifies the input parameters of the *General Purpose Constants* function.

<i>Parameter</i>	<i>Description</i>
<i>GP Constant 1</i>	User defined constant 1
<i>GP Constant 2</i>	User defined constant 2
<i>GP Constant 3</i>	User defined constant 3

Function outputs

The following table specifies the output variables of the *General Purpose Constants* function.

<i>Variable</i>	<i>Description</i>
<i>GP Constant 1</i>	User defined constant 1
<i>GP Constant 2</i>	User defined constant 2
<i>GP Constant 3</i>	User defined constant 3

Function description

The *General Purpose Constants* function sets the general purpose constant output variables equal to the general purpose constant input parameters:

GP Constant 1 = *GP Constant 1*

GP Constant 2 = *GP Constant 2*

GP Constant 3 = *GP Constant 3*

The units of the general purpose constants are determined by their use. For example, if one of the constants is used as a comparison level in a diagnostic function such as an SLD, the implied units of the constant are the internal control units of the signal against which the comparison is made. The units of the general purpose constant are not necessarily the display units of the comparison signal. For more information on the difference between display units and internal control units, see the *Language and Units Presentation* function help.

Related diagrams

- Diagnostic & Utility Functions (Diag_Util)

General Purpose Filters

Each Innovation Series product contains four general purpose filters. The general purpose filters allow users to filter signals with a specified bandwidth.

Function inputs

The following table specifies the input parameters of the *General Purpose Filters* function.

<i>Parameter</i>	<i>Description</i>
<i>GP filter 1 sel</i>	Selects input to general purpose filter 1
<i>GP filter 2 sel</i>	Selects input to general purpose filter 2
<i>GP filter 3 sel</i>	Selects input to general purpose filter 3
<i>GP filter 4 sel</i>	Selects input to general purpose filter 4

Function outputs

The following table specifies the output variables of the *General Purpose Filters* function.

<i>Variable</i>	<i>Description</i>
<i>GP filter 1 output</i>	General purpose filter 1 output
<i>GP filter 2 output</i>	General purpose filter 2 output
<i>GP filter 3 output</i>	General purpose filter 3 output
<i>GP filter 4 output</i>	General purpose filter 4 output

Function configuration

The following table specifies the configuration parameters of the *General Purpose Filters* function.

<i>Parameter</i>	<i>Description</i>
<i>GP filter 1 bndwth</i>	General purpose filter 1 bandwidth
<i>GP filter 2 bndwth</i>	General purpose filter 2 bandwidth
<i>GP filter 3 bndwth</i>	General purpose filter 3 bandwidth
<i>GP filter 4 bndwth</i>	General purpose filter 4 bandwidth

Function description

The operation of general purpose filter 1 is described here. Each of the four general purpose filters behaves in the same manner.

The input, output, and bandwidth of general purpose filter 1 are defined as follows:
Input = Variable selected by *GP filter 1 sel*

Output = *GP filter 1 output*

Bandwidth = *GP filter 1 bndwth*

The transfer functions for general purpose filter 1 is defined as follows:

$$\text{Output} = \frac{\text{Bandwidth}}{s + \text{Bandwidth}} \times \text{Input}$$

The general purpose filters run at the fastest execution rate available in the product. This is the same rate at which bridge feedbacks are collected, the fastest regulators are operated, and hardware commands are issued. The filter execution rate is generally faster than the 1-millisecond rate at which the application functions and the LAN communications occur.

Related diagrams

- Diagnostic & Utility Functions (Diag_Util)

Oscillator

Each Innovation Series product contains a diagnostic oscillator. The oscillator for the non-regenerative source switches between adjustable positive and negative values. Also, up and down times are independently adjustable. The oscillator can be used as a reference signal source for test purposes.

Function outputs

The following table specifies the output variables of the *Oscillator* function.

<i>Variable</i>	<i>Description</i>
<i>Sqr wave osc output</i>	Oscillator square wave output

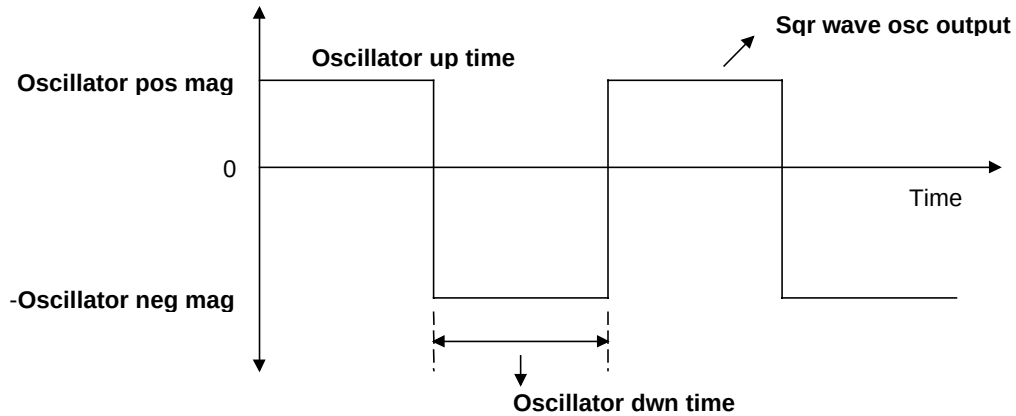
Function configuration

The following table specifies the configuration parameters of the *Oscillator* function.

<i>Parameter</i>	<i>Description</i>
<i>Oscillator neg mag</i>	Magnitude of the negative portion of oscillator output
<i>Oscillator pos mag</i>	Magnitude of the positive portion of oscillator output
<i>Oscillator up time</i>	The amount of time that the square wave stays at the upper value
<i>Oscillator down time</i>	The amount of time that the square wave stays at the lower value
<i>Oscillator enable</i>	Enable oscillator

Function description

The *Oscillator* function produces a square wave output that switches between a positive value and a negative value. The function can be enabled or disabled via the parameter, *Oscillator enable*. The output levels and the period of the square wave are configurable. The diagram below shows how the oscillator output is generated from the configuration parameters.



Related diagrams

- Diagnostic & Utility Functions (Diag_Util)

Signal Level Detector (SLD)

Each Innovation Series product supplies three SLD channels. Each SLD does a level comparison on two inputs. The Boolean output of the SLD represents the status of the comparison. The nature of the comparison is configurable.

Function inputs

The following table specifies the input parameters of the *Signal Level Detector (SLD)* function.

Parameter	Description
<i>SLD1 input 1 select</i>	Selects SLD1 input 1 value
<i>SLD1 input 2 select</i>	Selects SLD1 input 2 value
<i>SLD2 input 1 select</i>	Selects SLD2 input 1 value
<i>SLD2 input 2 select</i>	Selects SLD2 input 2 value
<i>SLD3 input 1 select</i>	Selects SLD3 input 1 value
<i>SLD3 input 2 select</i>	Selects SLD3 input 2 value

Function outputs

The following table specifies the output variables of the *Signal Level Detector (SLD)* function.

Variable	Description
<i>SLD1 status</i>	Status of SLD1 comparison
<i>SLD2 status</i>	Status of SLD2 comparison
<i>SLD3 status</i>	Status of SLD3 comparison

Function configuration

The following table specifies the configuration parameters of the *Signal Level Detector (SLD)* function:

Parameter	Description
<i>SLD1 compare mode</i>	Type of comparison that the SLD1 function

	performs
<i>SLD1 sensitivity</i>	SLD1 comparison level
<i>SLD1 hysteresis</i>	SLD1 turn off deadband
<i>SLD1 pick up delay</i>	SLD1 turn on time delay, Seconds
<i>SLD1 drop out delay</i>	SLD1 turn off time delay, Seconds
<i>SLD1 input 1 abs val</i>	SLD1 input 1 mode (allows the absolute value to be used)
<i>SLD2 compare mode</i>	Type of comparison that the SLD2 function performs
<i>SLD2 sensitivity</i>	SLD2 comparison level
<i>SLD2 hysteresis</i>	SLD2 turn off deadband
<i>SLD2 pick up delay</i>	SLD2 turn on time delay, Seconds
<i>SLD2 drop out delay</i>	SLD2 turn off time delay, Seconds
<i>SLD2 input 1 abs val</i>	SLD2 input 1 mode (allows the absolute value to be used)
<i>SLD3 compare mode</i>	Type of comparison that the SLD3 function performs
<i>SLD3 sensitivity</i>	SLD3 comparison level
<i>SLD3 hysteresis</i>	SLD3 turn off deadband
<i>SLD3 pick up delay</i>	SLD3 turn on time delay, Seconds
<i>SLD3 drop out delay</i>	SLD3 turn off time delay, Seconds
<i>SLD3 input 1 abs val</i>	SLD3 input 1 mode (allows the absolute value to be used)

Function description

The following description explains the operation of SLD1. It also applies to SLD2 and SLD3.

Parameters *SLD1 input 1 select* and *SLD1 input 2 select* select device variables. They define the inputs for SLD1. The following table specifies how the inputs are formed based on the value of parameter *SLD1 input 1 abs val*.

<i>SLD1 input 1 abs val</i>	<i>SLD1 Input Values</i>
<i>False</i>	Input 1 = <i>SLD1 input 1 select</i> pointer value Input 2 = <i>SLD1 input 2 select</i> pointer value
<i>True</i>	Input 1 = Absolute value of <i>SLD1 input 1 select</i> pointer value Input 2 = <i>SLD1 input 2 select</i> pointer value

The parameter *SLD1 compare mode* determines the type of comparison that is performed on the two inputs. It determines how the configuration parameters *SLD1 sensitivity*, *SLD1 hysteresis*, *SLD1 pick up delay*, and *SLD1 drop out delay* are interpreted. It determines how the output *SLD1 status* is formed. The following tables specify the behavior of SLD1 for the different enumerations of *SLD1 compare mode*.

SLD1 compare mode = In1-In2>Sen

Turn on condition	$(\text{Input 1} - \text{Input 2}) > \text{SLD1 sensitivity}$
Turn on delay time	Turn on condition must remain valid for <i>SLD1 pick up delay</i> . After the delay <i>SLD1 status</i> = True.
Turn off condition	$(\text{Input 1} - \text{Input 2}) \leq (\text{SLD1 sensitivity} - \text{SLD1 hysteresis})$
Turn off delay time	Turn off condition must remain valid for <i>SLD1 drop out delay</i> . After the delay <i>SLD1 status</i> = False.
<i>SLD1 compare mode = In1-In2<Sen</i>	
Turn on condition	$(\text{Input 1} - \text{Input 2}) < \text{SLD1 sensitivity}$
Turn on delay time	Turn on condition must remain valid for <i>SLD1 pick up delay</i> . After the delay <i>SLD1 status</i> = True.
Turn off condition	$(\text{Input 1} - \text{Input 2}) \geq (\text{SLD1 sensitivity} + \text{SLD1 hysteresis})$
Turn off delay time	Turn off condition must remain valid for <i>SLD1 drop out delay</i> . After the delay <i>SLD1 status</i> = False.
<i>SLD1 compare mode = In1<>In2</i>	
Turn on condition	Absolute value of $(\text{Input 1} - \text{Input 2}) > \text{SLD1 sensitivity}$
Turn on delay time	Turn on condition must remain valid for <i>SLD1 pick up delay</i> . After the delay <i>SLD1 status</i> = True.
Turn off condition	Absolute value of $(\text{Input 1} - \text{Input 2}) \leq (\text{SLD1 sensitivity} - \text{SLD1 hysteresis})$
Turn off delay time	Turn off condition must remain valid for <i>SLD1 drop out delay</i> . After the delay <i>SLD1 status</i> = False.
<i>SLD1 compare mode = In1=In2</i>	
Turn on condition	Absolute value of $(\text{Input 1} - \text{Input 2}) \leq \text{SLD1 sensitivity}$
Turn on delay time	Turn on condition must remain valid for <i>SLD1 pick up delay</i> . After the delay <i>SLD1 status</i> = True.
Turn off condition	Absolute value of $(\text{Input 1} - \text{Input 2}) > (\text{SLD1 sensitivity} + \text{SLD1 hysteresis})$
Turn off delay time	Turn off condition must remain valid for <i>SLD1 drop out delay</i> . After the delay <i>SLD1 status</i> = False.
<i>SLD1 compare mode = In1-In2>Sen one shot</i>	
Turn on condition	$(\text{Input 1} - \text{Input 2}) > \text{SLD1 sensitivity}$

Turn on delay time	After the turn on condition is met a timer begins. The turn on condition does not need to remain valid while the timer runs. After <i>SLD1 pick up delay</i> expires <i>SLD1 status</i> = True.
Turn off condition	After <i>SLD1 status</i> goes True a timer begins. After <i>SLD1 drop out delay</i> expires <i>SLD1 status</i> = False. The minimum time <i>SLD1 status</i> is True is approximately 1 millisecond.
Reset condition	SLD 1 becomes active again when $(\text{Input 1} - \text{Input 2}) \leq (\text{SLD1 sensitivity} - \text{SLD1 hysteresis})$ <i>SLD1 compare mode = In1-In2<Sen one shot</i>
Turn on condition	$(\text{Input 1} - \text{Input 2}) < \text{SLD1 sensitivity}$
Turn on delay time	After the turn on condition is met a timer begins. The turn on condition does not need to remain valid while the timer runs. After <i>SLD1 pick up delay</i> expires <i>SLD1 status</i> = True.
Turn off condition	After <i>SLD1 status</i> goes True a timer begins. After <i>SLD1 drop out delay</i> expires <i>SLD1 status</i> = False. The minimum time <i>SLD1 status</i> is True is approximately 1 millisecond.
Reset condition	SLD 1 becomes active again when $(\text{Input 1} - \text{Input 2}) \geq (\text{SLD1 sensitivity} + \text{SLD1 hysteresis})$

Related diagrams

- Signal Level Detection (SLD)

Predefined Constants

Each Innovation Series product contains a number of predefined constants. These constants are available for use in a variety of functions. They are generally found on the selection lists for parameters that select control signals.

Floating point constants

The following floating point constants are available.

- *Constant float 0.0*
- *Constant float -1.0*
- *Constant float 1.0*

Integer constants

The following integer constants are available.

- *Constant integer0*
- *Constant integer -1*
- *Constant integer1*

Boolean constants

The following Boolean constants are available.

- *Force True*
- *Force False*

Unused constants

The Unused category of constants can be used to turn off certain product behaviors. See individual functional helps for information on how the Unused constants affect those functions.

The following Unused constants are available.

- *Unused float*
- *Unused integer*
- *Unused Boolean*

Simulator

The *Simulator* function allows the user to simulate the operation of the regenerative source and the ac line without applying power to the bridge, and other equipment.

Function inputs

The following table specifies the input parameters of the *Simulator* function.

Parameter	Description
<i>Simulate mode</i>	Request to run in simulation mode (yes or no). The actual change from one mode to the other will not be made unless the source is stopped.
<i>Sim line inductance</i>	Allows changing of the simulated plant inductance so that mis-matches between control settings and actual plant values can be made..
<i>Sim capacitance</i>	Allows changing of the simulated plant capacitance so that mis-matches between control settings and actual plant values can be made..
<i>Sim line frequency</i>	AC line frequency in simulator mode. Note that this can be set for other than 50 or 60 hz, but should normally be set to one or the other.
<i>Sim freq slew rate</i>	Simulator frequency slew in rads/sec/sec. Setting this value to a something other than zero causes the frequency to slew continuously from nominal - .5*nominal to nominal+..25*nominal and back. This exercises the entire transient frequency range covered by the specification.
<i>Sim line voltage</i>	Simulator line to line voltage magnitude. This value determines the magnitude of the ac line in simulator mode. It can be adjusted to simulate a low or high line condition.
<i>Sim A-N volt scale</i>	<i>Sim A-N volt scale</i> can be used to attenuate phase A line to neutral voltage in order to simulate transient line

conditions. The line to neutral voltage for phase A will attenuated according to *Sim A-N volt scale* every 2.70046seconds. The duration of the transient is specified by the parameter *Volt short time*. The 2.70046sec. time was chosen so that the transient condition gradually walks through the sin wave. In order to simulate an open on phase A, set *Sim A-N volt scale* and *Sim B-N volt scale* to 1.0 and set *Sim C-N volt scale* to 0.5.

<i>Sim B-N volt scale</i>	<i>Sim B-N volt scale</i> behave identically to <i>Sim A-N volt scale</i> except that it effects phase B instead of phase A.
<i>Sim C-N volt scale</i>	<i>Sim C-N volt scale</i> behave identically to <i>Sim A-N volt scale</i> except that it effects phase C instead of phase A.
<i>A-B volt fault scale</i>	<i>A-B volt fault scale</i> simulates a line to line fault between phases A and B. The default for <i>A-B volt fault scale</i> is 0, providing no attenuation.

Function outputs

The following table specifies the output variables of the *Simulator* function.

<i>Variable</i>	<i>Description</i>
<i>Simulate mode act</i>	Simulator mode
<i>Sim A-B line voltage</i>	Simulator line to line voltage A-B
<i>Sim B-C line voltage</i>	Simulator line to line voltage B-C
<i>Sim A-N line voltage</i>	Simulator line to neutral voltage A
<i>Sim B-N line voltage</i>	Simulator line to neutral voltage B
<i>Sim C-N line voltage</i>	Simulator line to neutral voltage C
<i>Sim DC bus current</i>	Simulator dc load current
<i>Sim DC bus power</i>	Simulator dc power

Diagnostic Variables

The *Diagnostic Variables* function allows the user to examine critical control signals for the low voltage non-regenerative source. The following variables are among those available.

Function outputs

The following table specifies the output variables of the *Simulator* function.

<i>Variable</i>	<i>Description</i>
------------------------	---------------------------

<i>Phase A current</i>	Filtered phase A current, amps
<i>Phase B current</i>	Filtered phase B current, amps
<i>Phase C current</i>	Filtered phase C current, amps
<i>Output volts, A-B</i>	Filtered A-B line-line voltage, volts
<i>Output volts, B-C</i>	Filtered B-C line-line voltage, volts
<i>DC bus voltage</i>	Filtered DC link voltage, DC volts
<i>Real pwr cur</i>	Filtered <i>Real current fbk</i>
<i>Reactive cur</i>	Filtered <i>Reactive current fbk</i>
<i>Vx, X-axis voltage</i>	Filtered version of <i>X-axis volt fbk</i>
<i>Vy, Y-axis voltage</i>	Filtered version of <i>Y-axis volt fbk</i>
<i>Real current fbk</i>	X-component of phase currents – sampled at fast rate
<i>Reactive current fbk</i>	Y-component of phase currents – sampled at fast rate
<i>X-axis volt fbk</i>	X-component of ac line voltages - sampled at fast rate
<i>Y-axis volt fbk</i>	Y-component of ac line voltages – sampled at fast rate

General Setup Functions

Keypad Overview

The Drive Diagnostic Interface (DDI; also known as the keypad) is mounted on the door of an Innovation Series drive. The DDI provides a simple, easily accessible means for a user to set, monitor, and maintain the drive locally.

The DDI provides both analog and digital representations of drive functions and values. Its keypad is logically organized into two functional groups: navigation keys and drive control keys. The Run and Stop keys are set to the side for easy access.

The operator can use the DDI to perform the following common tasks:

- Monitor dc link voltage / ac line current / ac line voltage / dc bus power
- Start/Stop the drive
- Adjust a configuration parameter
- Reset a fault condition
- Commission the drive through a wizard

Each drive has its own DDI for local control.

For the source, the Remote/Local button can only enable or disable the start button on the keypad. This button will toggle the status of *Local mode active* within the control, but has no other effect.

Related functions

Following are the DDI functions that can be modified from the toolbox:

- *Keypad Contrast Adjustment*
- *Keypad Meter Configuration*
- *Keypad Security Configuration*
- *Language Display*

Keypad Contrast Adjustment

Normally the LCD contrast of the Drive Diagnostic Interface (DDI) should be adjusted at the DDI or keypad. The user can select a Screen Contrast Adjustment under one of the menus on the Menu screen.

However, there may be situations where the DDI contrast is too light or too dark for the user to navigate through the menus. If this occurs, the *Keypad contrast adj* parameter may be adjusted from the toolbox.

Function configuration

<i>Parameter</i>	<i>Description</i>
<i>Keypad contrast adj</i>	Adjusts the contrast of the DDI LCD screen. Values are from 0 to 63 where 63 is the darkest contrast. Setting <i>Keypad contrast adj</i> to 0 will cause the DDI to adjust the contrast to a middle value. Note: Once <i>Keypad contrast adj</i> has been modified in the toolbox and then saved in the drive, a hard reset must be performed for the user to see their modification to the contrast reflected in the DDI.

Keypad Meter Configuration

The DDI Status screen has four animated meters and associated text that display drive performance information.

The variables displayed by the meters and the meter ranges can be modified by configuring the following parameters:

Function configuration

<i>Parameter</i>	<i>Description</i>
<i>Keypad meter 1 sel</i>	Selects a floating-point variable that is displayed in Meter #1 on the DDI Status screen.
<i>Keypad meter 2 sel</i>	Selects a floating-point variable that is displayed in Meter #2 on the DDI Status screen.
<i>Keypad meter 3 sel</i>	Selects a floating-point variable that is displayed in Meter #3 on the DDI Status screen.
<i>Keypad meter 4 sel</i>	Selects a floating-point variable that is displayed in Meter #4 on the DDI Status screen.
<i>Keypad meter 1 range</i>	Selects the bar graph meter scaling for Meter #1. Possible values are as follows (note that all bar graphs are scaled in percent (%)): • <i>0 to +100</i> • <i>-100 to +100</i>

- 0 to +150
- -150 to +150
- 0 to +200
- -200 to +200
- 0 to +300
- -300 to +300

Keypad meter 2 range Selects the bar graph meter scaling for Meter #2. See *Keypad meter 1 range* for possible values.

Keypad meter 3 range Selects the bar graph meter scaling for Meter #3. See *Keypad meter 1 range* for possible values.

Keypad meter 4 range Selects the bar graph meter scaling for Meter #4. See *Keypad meter 1 range* for possible values.

Note: When changing DDI meter configuration from the toolbox, first save the modified parameters to the drive. Press the Menu button and then the Status button on the DDI. This will cause the meters on the Status screen to update.

Keypad Security Configuration

The DDI contains security controls to keep unauthorized personnel from operating or reconfiguring the drive. These security controls can be modified from the toolbox or from the DDI. The controls are password protected in the DDI.

Function configuration

<i>Parameter</i>	<i>Description</i>
<i>Keypad privilege</i>	Selects the privilege level in the DDI. Possible levels are: • <i>Read only</i> - Disables both drive controls and configuration functions. Allows user to view but not edit parameters. • <i>Operate & read only</i> - Enables drive controls, but disables configuration functions. Allows user to view but not edit parameters. • <i>Configure & operate</i> - Enables both drive controls and configuration functions. See below for full list of enabled functions for each level.
<i>Keypad password</i>	Sets the 5-digit password value for the DDI. When a user attempts to modify the Keypad security configuration from the DDI, he will be prompted to enter a password. If the entered password does not match the value in <i>Keypad password</i>, the user will not be permitted to modify the security configuration (i.e. <i>Keypad privilege</i> and <i>Keypad password</i>).

Function description

The following table displays a list of all DDI functions. Available functions for each privilege level are marked with a check mark (✓).

Note that for regenerative and non-regenerative sources, the following functions are not meaningful and therefore the associated keypad buttons are non-functional: Change direction, Jog, Speed Increment and Speed Decrement.

Keypad Function	Privilege Level		
	Read Only	Operate & read only	Cofigure & operate
Drive control functions			
Stop	✓	✓	✓
Start		✓	✓
Reset faults	✓	✓	✓
Change direction		✓	✓
Remote/Local		✓	✓
Jog		✓	✓
Speed Increment		✓	✓
Speed Decrement		✓	✓
Menu functions			
Status button	✓	✓	✓
Menu button	✓	✓	✓
Navigation buttons (Arrows, Esc, Enter)	✓	✓	✓
Display Active Faults	✓	✓	✓
Display Fault History	✓	✓	✓
View Parameters	✓	✓	✓
Edit Parameters			✓
View Variables	✓	✓	✓
Wizards			✓
Adjust Screen Contrast	✓	✓	✓
Display Firmware Version	✓	✓	✓
Display Hardware Information	✓	✓	✓
Save Parameters to Backup			✓
Restore Parameters from Backup			✓
Compare Current Parameters to Backup	✓	✓	✓
View Overrides	✓	✓	✓

Note: When changing DDI security configuration from the toolbox, first save the modified parameters to the drive. Then switch between the Menu and Status screens for the password and privilege level to update.

Language and Units Presentation

The presentation of the Innovation Series product in the Control System Toolbox and DDI (keypad) can be customized. The presentation can be configured using the following parameters:

- *Language*
- *Display units*

In regions in which English is not the primary language, the Innovation Series product provides a choice of two languages: English and the indigenous language. The presentation is in English if parameter *Language* is set to *English*. The presentation is in the indigenous language if *Language* is set to *Native*.

Parameters and variables in the Innovation Series product can be displayed in different unit systems. The display units are chosen by parameter *Display units*. Three different unit systems are available:

- *Imperial (English)*
- *Metric (SI)*

- *Native (Platform)*

If *Display units* is set to *Native (Platform)*, then values are displayed in the same units that the internal control uses. The following table specifies some of the unit system differences.

Display units	Length	Power	Torque	Flux
<i>Imperial (English)</i>	Feet	Horsepower	Foot-pounds	Volts/hertz
<i>Metric (SI)</i>	Meters	Kilowatts	Newton-meters	Volts/hertz
<i>Native (Platform)</i>	Meters	Watts	Newton-meters	Webers

Language Display

As long as the keypad has been configured correctly, the DDI can display its menu and status information in an alternate language.

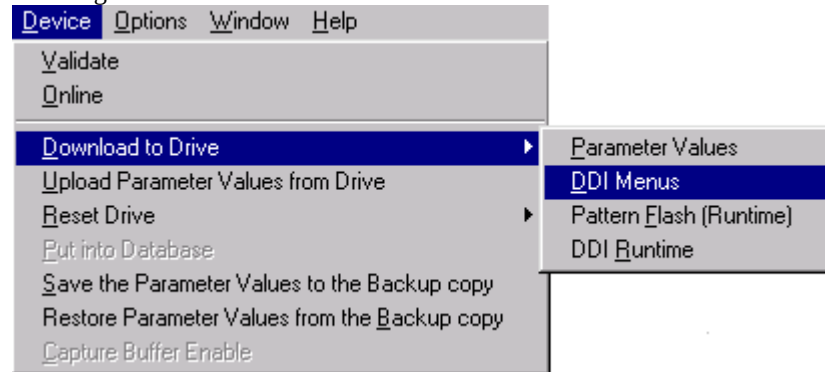
Note: *Presently this function is not yet operational.*

Function configuration

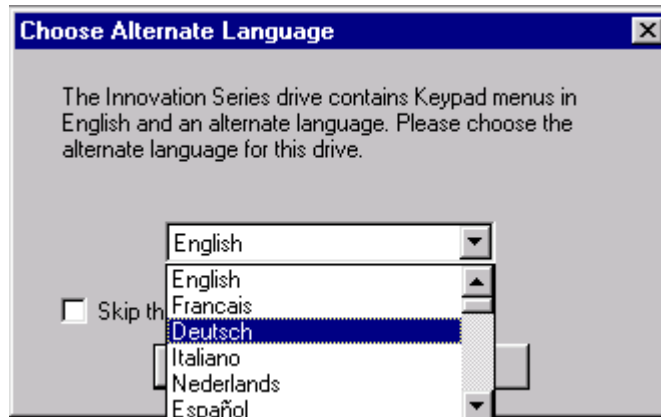
Parameter	Description
<i>Language</i>	Selects the language in which to display all information in the DDI. Possible selections are: • <i>English</i> - Displays DDI text in English. • <i>Native</i> - Displays DDI text in the native language that is specified when DDI Menus are downloaded from the toolbox (see below).

Function description

To display the DDI text in a non-English language, the user must first download the appropriate DDI Menus. The user can perform this operation from the toolbox by selecting from the menu bar: Device > Download > DDI Menus.



The user will then be prompted to select an alternate language to download to the DDI.



The toolbox will then build the DDI Menu file and can be downloaded to the DDI. Once the download is completed, the user can then modify the *Language* parameter to the desired value. The DDI will display its text in the selected language the next time its screen is updated.

I/O Functions

Analog and Digital I/O Testing

The *Analog and Digital I/O Testing* function is intended for factory use only.

Function configuration

The following table specifies the configuration parameters for the *Analog and Digital I/O Testing* function.

Parameter	Description
<i>I/O test mode req</i>	Hardware I/O test request.
<i>Simulate mode</i>	Simulator mode request.

Both *I/O test mode req* and *Simulate mode* must be True for the *Analog and Digital I/O Testing* function to be active. *I/O test mode* is True when the function is active.

Analog inputs

The following table specifies the signals available for testing the analog inputs.

Variable	Description
<i>Analog input 1 volts</i>	Voltage of analog input 1 source. DC volts
<i>Analog input 2 volts</i>	Voltage of analog input 2 source. DC volts

Digital inputs

The following table specifies the signals available for testing the digital inputs.

Variable	Description
<i>Digital input 1 test</i>	Unfiltered value of digital input 1.
<i>Digital input 2 test</i>	Unfiltered value of digital input 2.
<i>Digital input 3 test</i>	Unfiltered value of digital input 3.

<i>Digital input 4 test</i>	Unfiltered value of digital input 4.
<i>Digital input 5 test</i>	Unfiltered value of digital input 5.
<i>Digital input 6 test</i>	Unfiltered value of digital input 6.

Hi-fi counters

The following table specifies the signals available for testing the high fidelity VCO counters.

<i>Variable</i>	<i>Description</i>
<i>VCO 1 unfiltered</i>	VCO 1 counter value.
<i>VCO 2 unfiltered</i>	VCO 1 counter value.
<i>VCO 3 unfiltered</i>	VCO 1 counter value.

Local and system fault strings

The following table specifies the signals available for testing the local and system fault strings.

<i>Variable</i>	<i>Description</i>
<i>Local fault test</i>	Unfiltered value of local fault string.
<i>System fault test</i>	Unfiltered value of system fault string.

Contactor status

The following table specifies the signals available for testing the main contactor status input.

<i>Variable</i>	<i>Description</i>
<i>MA cont test mode</i>	Unfiltered value of main contactor status.

DAC and meter outputs

The following table specifies the parameters that configure the analog output (DAC) and meter output tests.

<i>Parameter</i>	<i>Description</i>
<i>Analog out 1 test</i>	DAC 1 output voltage. DC volts
<i>Analog out 1 test</i>	DAC 2 output voltage. DC volts
<i>Analog out 1 test</i>	DAC 3 / Meter 1 output voltage. DC volts
<i>Analog out 1 test</i>	DAC 4 / Meter 2 output voltage. DC volts
<i>Analog meter 3 test</i>	Meter 3 output voltage. DC volts
<i>Analog meter 4 test</i>	Meter 4 output voltage. DC volts

Relay outputs

The following table specifies the parameters that configure the relay output test.

<i>Parameter</i>	<i>Description</i>
<i>Relay 1 test</i>	Relay 1 output.
<i>Relay 2 test</i>	Relay 2 output.
<i>Relay 3 test</i>	Relay 3 output.
<i>SS relay driver test</i>	Relay 4 output.

Related diagrams

- Analog and Digital I/O Testing (HWIO_Tst)

Analog Inputs/Outputs and Mapping

Analog Inputs

Two bipolar (+/- 10 volts) analog inputs are available at the terminal board (ATB). Jumpers on the BAIA board connect a burden resistor that allow these inputs to be used for 4-20 ma references.

Analog in 1 offset and *Analog in 2 offset* provide a voltage offset adjustment. *Analog in 1 gain* and *Analog in 2 gain* can be used to scale the inputs from volts to appropriate application units. *Analog in 1 filter* and *Analog in 2 filter* provide first-order signal softening at *Analog input 1* and *Analog input 2*.

Loss of 4-20 ma signal can be configured by selecting a lower threshold *Analog in 1 flt lev* and *Analog in 2 flt lev* and then selecting the appropriate fault type, *Analog in 1 flt mode* and *Analog in 2 flt mode*.

Analog Outputs

Two bipolar (+/- 10 volts) DAC outputs are available at the terminal board (ATB). The signal to be output is selected by *Analog out 1 select*. This signal can be offset by *Analog out 1 offset* using the same units as the signal to be output. The signal is scaled for output by setting *Analog out 1 scale* to the value that will produce +10 volts. The second DAC is configured in a similar manner.

Meters:

Four bipolar (+/- 10 volts) meter drivers are available for use with the optional meter assembly. This assembly is connected to the drive at connector J8 on the backplane.

The signal to be metered is selected by *Analog meter 1 sel*. This signal can be offset by *Meter 1 offset* using the same units as the signal to be metered. The signal is scaled for output by setting *Analog meter 1 scale* to the value which shall produce +10 volts. *Meter 1 mode* is used to accommodate both 0 - +10 volt meters and -10 - +10 volt meters. *Analog meter 1 scale* is unaffected by *Meter 1 mode*. The remaining three meters are configured similarly.

Related diagrams

- Analog Inputs / Outputs & Mapping (HWIO_Ana)

Digital Inputs/Outputs and Mapping

Digital inputs and outputs provide an interface between the outside world and the control. The ATB (terminal board) provides six general purpose digital inputs. Three dry contact relays and one solid state relay driver are provided as outputs. System and Local fault strings provide start and trip interlocks to the control.

Isolated digital inputs are listed with their associated terminal board points. A filter debounces a noisy input signal. The filter should be set to zero in most instances, since the hardware provides a level of debounce conditioning. The variables *Digital input 1* through *Digital input 6* indicate the logical state of each digital input and are used to interface to functions in the drive that require a Boolean signal.

Each relay output may be used by setting the parameters *Relay 1 select* through *Relay 3 select* to the variables whose logical states are desired to drive the corresponding relay. The associated terminal board points are shown for output terminals of each relay. The variables *Relay 1 state*, *Relay 2 state*, and *Relay 3 state* indicates whether the relay coils are energized.

Relay four is a solid-state relay driver that should be used for driving a 24 Vdc, 10mA relay. The relay driver output may be used by setting the parameter *SS relay driver sel* to the variable whose logical state is desired to drive the relay. *Solid state relay* indicates the status of the relay driver.

A pilot relay is provided for controlling a main contactor. This contactor is controlled through source sequencing.

Contactor status feedback is available *MA contactor closed*.

Related diagrams

- Digital Inputs / Outputs & Mapping (HWIO_Dig)

LAN Functions

LAN Overview

Information is available for the following LAN topics:

- *Frame Phaselock Loop*
- *LAN Configuration and Health*
- *LAN Signal Map*

Frame Phaselock Loop

The *Frame Phaselock Loop* function can synchronize the execution of the Innovation Series drive control firmware with the communication frame of the product application interface. This feature is available only for those interface which support synchronous communications, such as ISBus.

Function outputs

The following table specifies the published output variables of the *Frame Phaselock Loop* function.

Variable	Description
<i>Frame PLL OK status</i>	Boolean signal indicating the lock status of the <i>Frame Phaselock Loop</i> .
<i>FPLL Phase error</i>	Phase error signal for the <i>Frame Phaselock Loop</i> . Scaling is per-unitized such that unity corresponds to the full frame period; signal values range from minus one-half to plus one-half.
<i>FPLL Freq Output</i>	Frequency adjustment output signal for the <i>Frame Phaselock Loop</i> . Scaling is per-unitized such that unity corresponds to the full frame period; signal values range from minus output limit to plus output limit.

Function configuration

The following table specifies configuration parameters related to the *Frame Phaselock Loop* function.

Parameter	Description
<i>Network interface</i>	Network interface type. Specifies one of the following interface types: • No interface • ACL dual port memory (synchronous operation supported) • ISBus (synchronous operation supported) • DRIVENET - Optional LAN modules such as Genius & Profibus
<i>LAN frame time</i>	Expected communication frame period. Allowed frame periods are 1, 2, 4, and 8 milliseconds.

Function description

The product completely handles configuration of the *Frame Phaselock Loop* function. Appropriate user selections of *Network interface* activate the function, and user specification of *LAN frame time* sets the nominal period.

The Boolean variable *Frame PLL OK status* indicates the status of the *Frame Phaselock Loop*. The asserted state indicates that the function has been activated and that lock status has been validated. The unasserted state indicates that the function is not activated or that lock status is not validated.

The *FPLL Phase error* signal reflects the phase error when valid phase information has been extracted from the interface. A signal value of zero indicates either zero phase error or invalid phase information. Scaling is such that one per-unit phase error represents a full communication frame period.

The *FPLL Freq Output* signal is the frequency adjustment output of the function; the authority of the function to modify away from nominal frequency is strictly limited. When the function is not activated, the *FPLL Freq Output* signal is zero. When the function is activated but no valid phase information is detected, then *FPLL Freq Output* maintains its last valid calculated value.

When phaselock is achieved, *Frame PLL OK status* is asserted, *FPLL Phase error* is at a zero-mean steady-state value, and *FPLL Freq Output* is at a non-zero, but very small, steady-state value. When the *Frame Phaselock Loop* has been requested by configuration but phaselock is not achieved, then *Frame PLL not OK* is shown.

LAN Configuration and Health

The following information describes the configuration of the primary signal interface between the Innovation Series device and the application layer interface. The application layer may consist of an embedded ACL card, a direct LAN interface card, or an application-level ISBus serial bus.

Configuration parameters

The following table specifies the configuration parameters of the *LAN Configuration and Health* function.

Parameter	Description
<i>Network</i>	Network interface type. Specifies one of the following interface types:

<i>interface</i>	• No interface • ACL dual port memory • ISBus • DRIVENET - Other optional LAN modules such as Genius and Profibus
<i>LAN frame time</i>	Expected communication frame period. Allowed frame periods are 1, 2, 4, and 8 milliseconds.
<i>LAN fbk avg time</i>	Period over which feedback signals are sequentially averaged. The <i>LAN Signal Map</i> help topic describes which feedback signals are averaged. If <i>LAN fbk avg time</i> is zero, no averaging occurs.
<i>LAN cmds inhibit</i>	Disables LAN references, forcing the signal interface to operate in feedback-only mode. Local images of reference signals are set to zero (0.0) or False.
<i>LAN trips inhibit</i>	Disables LAN heartbeat trip fault (<i>LAN heartbeat trip</i>), and enable the corresponding alarm (<i>LAN heartbeat alarm</i>).
<i>LAN heartbeat time</i>	Period within which transition must be detected in the LAN heartbeat signal (<i>Heartbeat ref, lan</i>) to satisfy the local heartbeat timeout check.
<i>Sys ISBus node #</i>	ISBus node for the Innovation Series Drive device. Each device on the ISBus bus should be assigned a unique node between 1 and 31.
<i>LAN parameter 1 through LAN parameter 16</i>	These parameters are used only by optional LAN modules and are specific to those modules. Such items as baud rate and device number are configured via these parameters. Please see the documentation for the specific LAN module for detailed information.

Diagnostic variables

The following table specifies variables that indicate the LAN health and status for the *LAN Configuration and Health* function.

<i>Variable</i>	<i>Description</i>
<i>LAN connection ok</i>	Indicates that the health of the LAN connection is good, such that the LAN watchdog function is satisfied.
<i>LAN commands OK</i>	Indicates that the health of the LAN references is good, based upon detection of two successive <i>LAN connection ok</i> indications.
<i>Heartbeat ref, lan</i>	LAN heartbeat signal that proceeds from the application layer to the local device, used locally for <i>LAN heartbeat trip</i>) and <i>LAN heartbeat alarm</i>) detection, and as the source of the reflected <i>Heartbeat fbk, lan</i> signal.
<i>Heartbeat fbk, lan</i>	Local device reflection of the <i>Heartbeat ref, lan</i> signal that is sent back to the application layer.
<i>Sys ISBus error cnt</i>	Counter signal which provides an indication of the rate of occurrence of ISBus fault conditions.
<i>Sys ISBus error reg</i>	Bit-coded value of the last ISBus fault detected; each bit indicates a particular ISBus fault seen by the control.

<i>Frame PLL OK status</i>	Boolean signal indicating the lock status of the <i>Frame Phaselock Loop</i> .
<i>FPLL Phase error</i>	Phase error signal for the <i>Frame Phaselock Loop</i> . Scaling is per-unitized such that unity corresponds to the full frame period; signal values range from minus one-half to plus one-half.
<i>FPLL Freq Output</i>	Frequency adjustment output signal for the <i>Frame Phaselock Loop</i> . Scaling is per-unitized such that unity corresponds to the full frame period; signal values range from minus output limit to plus output limit.

Function description

Determining the integrity of the LAN interface involves several communication layers, and may vary depending upon the specific communication options in use. The Innovation Series Drive has two levels of validation available: LAN watchdog and LAN heartbeat. Status information is conveyed to the user and/or application by status signals and fault declarations.

The LAN watchdog function describes the set of mechanisms the drive uses to determine the status of the connection between DSPX and the module immediately “above” the drive in the LAN hierarchy. For Dual-Port RAM interfaces, such as that used for an embedded ACLA controller and for a direct LAN interface, the watchdog takes the form of a handshake protocol. In this handshake protocol, the drive determines the presence of a minimum level of intelligence on the host on the LAN side of the shared memory. For ISBus interfaces, such as that used by a remote or embedded ACLA controller, the watchdog reflects the reception of ISBus frame synchronization codes. The watchdog function’s immediate authority is limited to alarms and status variables, although the status information does play a functional role in the interface management. Note that the watchdog does not offer information about the LAN connection’s status which may be supported beyond the immediate interface to DSPX. In fact, many device networks offer no means of determining basic network health.

The LAN heartbeat function is visible to the user. The heartbeat function uses published signal map channels, and is available for use by the application. It provides a means to “loop back” a signal between the drive and any level in the LAN hierarchy so a higher-level controller can validate the entire connection pathway, including the drive itself. Locally, the drive can be configured to trigger a trip or alarm if the heartbeat reference signal fails to transition within a configurable period of time. The heartbeat offers the most robust validation options from a system perspective, although it offers the least information about the detected problem’s location.

The *System ISBus error* alarm occurs when an ISBus fault is detected in the DSPX control. The variable *Sys ISBus error reg* contains the bit-coded value of the last ISBus fault detected; each bit indicates a particular ISBus fault seen by the control. The variable *Sys ISBus error cnt* increments upon fault detection. When initializing the interface, the user should expect the alarm to signal intermittently.

The *Frame PLL not OK* alarm occurs when phase-lock between the DSPX control and the System ISBus or (local ACL) is not assured. Detection of the fault is enabled when the parameter *Network interface* is configured to select an interface for which synchronized operation is supported. This alarm indicates that data coherency is compromised. Status of the *Frame Phaselock Loop* function can be observed via the signals *Frame PLL OK status*, *FPLL Phase error*, and *FPLL Freq Output*.

LAN Signal Map

The information below describes the primary signal interface between the Innovation Series Drive and the product application layer interface. The application layer may consist of an embedded ACL card, a direct LAN interface card, or an application-level ISBus serial bus.

The *LAN Signal Map* is a fixed signal map which defines dedicated registered communication channels for specific signals. It is defined in terms of paired reference and feedback pages which are of the same physical size. The internal data organization of the reference and feedback pages may differ. The standard Innovation Series signal map page consists of eight 32-bit elements.

Each 32-bit element in the *LAN Signal Map* is assigned a data type. The following data types are used.

- Single precision floating point, IEEE 754 format (23-bit mantissa, 8-bit exponent, 1-bit sign).
- Two's complement integer.
- Individual 1-bit Boolean signals.

LAN References

The following table specifies the *LAN Signal Map* reference signals.

<i>Page</i>	<i>Element</i>	<i>Signal</i>	<i>Data Type</i>	<i>Description</i>
1	1		Boolean bits	Boolean requests. See table below for definition of request bits.
1	2-6	Unused		
1	7	<i>GP lan ref 1</i>	Floating point	General purpose reference that can be used by a number of functions.
1	8	<i>GP lan ref 2</i>	Floating point	General purpose reference that can be used by a number of functions.
2	1-6	Unused		
2	7	<i>GP lan ref 3</i>	Floating point	General purpose reference that can be used by a number of functions.
2	8	<i>GP lan ref 4</i>	Floating point	General purpose reference that can be used by a number of functions.

The following table specifies the *LAN Signal Map* request bits that appear in Page 1, Element 1 of the reference signal map.

<i>Bit</i>	<i>Signal</i>	<i>Description</i>
0	<i>Heartbeat ref, lan</i>	Heartbeat signal to validate LAN health.
1	<i>Fault reset req, lan</i>	Request to reset drive faults. Functionality is always enabled.

2	<i>Trip request, lan</i>	Request to trip the drive. Functionality is always enabled.
3	<i>Alarm request, lan</i>	Request to declare an alarm in the drive. Functionality is always enabled.
4-9	Unused	
10	<i>X stop request, lan</i>	Request to perform an X stop in the drive. Functionality is always enabled.
11-23	Unused	
24	<i>GP lan req bit 1</i>	General purpose request that can be used by a number of functions.
25	<i>GP lan req bit 2</i>	General purpose request that can be used by a number of functions.
26	<i>GP lan req bit 3</i>	General purpose request that can be used by a number of functions.
27	<i>GP lan req bit 4</i>	General purpose request that can be used by a number of functions.
28	<i>GP lan req bit 5</i>	General purpose request that can be used by a number of functions.
29	<i>GP lan req bit 6</i>	General purpose request that can be used by a number of functions.
30	<i>GP lan req bit 7</i>	General purpose request that can be used by a number of functions.
31	<i>GP lan req bit 8</i>	General purpose request that can be used by a number of functions.

LAN Feedbacks

Several LAN feedback signals are averaged versions of internal drive signals. The signals that fall in this category appear in dedicated floating point feedback channels. The averaging is sequential (not rolling) and the averaging time is specified by parameter *LAN fbk avg time*.

The following table specifies the *LAN Signal Map* feedback signals.

<i>Page</i>	<i>Element</i>	<i>Signal</i>	<i>Data Type</i>	<i>Description</i>
1	1		Boolean bits	Boolean feedbacks. See table below for definition of feedback bits.
1	2	<i>Fault number</i>	Integer	Number of active fault. Priority is given to trip faults over alarms, and to the earliest detected fault.
1	3	<i>AC line current, lan</i>	Floating point	Averaged <i>AC line current</i> .

1	4	<i>AC line voltage, lan</i>	Floating point	Averaged <i>Avg line voltage mag.</i>
1	5	<i>DC bus voltage, lan</i>	Floating point	Averaged <i>DC bus voltage.</i>
1	6	<i>DC bus power, lan</i>	Floating point	Averaged <i>DC bus power</i>
1	7	<i>GP lan fbk reg 1</i>	Floating point	General purpose feedback selected by <i>GP lan fbk reg 1 sel.</i>
1	8	<i>GP lan fbk reg 2</i>	Floating point	General purpose feedback selected by <i>GP lan fbk reg 2 sel.</i>
2	1	<i>AC line freq, lan</i>	Floating point	Averaged line frequency <i>AC line frequency.</i>
2	2	<i>AC line vars, lan</i>	Floating point	Averaged line VARs , <i>Volt amps reactive</i>
2	3-6	Unused		
2	7	<i>GP lan fbk reg 3</i>	Floating point	General purpose feedback selected by <i>GP lan fbk reg 3 sel.</i>
2	8	<i>GP lan fbk reg 4</i>	Floating point	General purpose feedback selected by <i>GP lan fbk reg 4 sel.</i>

The general purpose feedback signals *GP lan fbk reg 1*, ..., *GP lan fbk reg 4* are not averaged. The following parameters are used to select the general purpose feedbacks.

- *GP lan fbk reg 1 sel*
- *GP lan fbk reg 2 sel*
- *GP lan fbk reg 3 sel*
- *GP lan fbk reg 4 sel*

The following table specifies the *LAN Signal Map* feedback bits that appear in Page 1, Element 1 of the feedback signal map.

Bit	Signal	Description
0	<i>Heartbeat fbk, lan</i>	Heartbeat signal to validate LAN health.
1	<i>No faults active</i>	No trip faults or alarms are active in the drive.
2	<i>Trip fault active</i>	Trip fault is active in the drive.
3	<i>Local fault string</i>	Local hardware permissive fault is active in the drive.
4	<i>System fault string</i>	System hardware permissive fault is active in the drive.
5	<i>Ready to run</i>	Drive is ready and will respond to a run request.

6	<i>Bridge is on</i>	Bridge power is enabled.
7	<i>Running</i>	Drive is running; References and regulators are enabled.
8-9	Unused	
10	<i>X stop active</i>	Result of X stop requests.
11-22	Unused	
23	<i>Lan diag fbk bit 1</i>	Drive has diagnostic information for the diagnostic master.
24	<i>GP lan fbk bit 1</i>	General purpose feedback selected by <i>GP lan fbk bit 1 sel</i> .
25	<i>GP lan fbk bit 2</i>	General purpose feedback selected by <i>GP lan fbk bit 2 sel</i> .
26	<i>GP lan fbk bit 3</i>	General purpose feedback selected by <i>GP lan fbk bit 3 sel</i> .
27	<i>GP lan fbk bit 4</i>	General purpose feedback selected by <i>GP lan fbk bit 4 sel</i> .
28	<i>GP lan fbk bit 5</i>	General purpose feedback selected by <i>GP lan fbk bit 5 sel</i> .
29	<i>GP lan fbk bit 6</i>	General purpose feedback selected by <i>GP lan fbk bit 6 sel</i> .
30	<i>GP lan fbk bit 7</i>	General purpose feedback selected by <i>GP lan fbk bit 7 sel</i> .
31	<i>GP lan fbk bit 8</i>	General purpose feedback selected by <i>GP lan fbk bit 8 sel</i> .

The following parameters are used to select the general purpose feedback bits.

- *GP lan fbk bit 1 sel*
- *GP lan fbk bit 2 sel*
- *GP lan fbk bit 3 sel*
- *GP lan fbk bit 4 sel*
- *GP lan fbk bit 5 sel*
- *GP lan fbk bit 6 sel*
- *GP lan fbk bit 7 sel*
- *GP lan fbk bit 8 sel*

Source Protective Functions

Protective Functions

The PWM Source provides many standard Innovation Series platform protective functions, as well as source specific protections. Protective conditions cause the source to annunciate specific *faults*, which can be used to guide diagnosis and repair

as applicable. Faults can be either *trip faults*, which cause the source to trip, or *alarm faults*, which do not trip the source, but annunciate the abnormal condition for warning or diagnostic record reasons.

There are literally hundreds of possible faults in the extensively monitored source. For orientation purposes, note that generally faults fall into the following classes:

- AC Line Faults
- Bridge Feedback Faults
- Bridge Hardware Faults
- Bridge Thermal Faults
- I/O Faults
- LAN Communications Faults
- Platform Execution Faults
- Sequencer Faults
- Source Control Faults

Some of the classes consist only of standard Innovation Control faults or source specific faults, but many classes include both types. Details are provided in the specific fault code help documentation.

Custom User Faults

Each Innovation Series product provides the capability to configure two fault circuits. The trip faults *Customer use NC flt* and *Customer use NO flt* trigger on input signals that are the states of the fault circuits. *Customer use NC flt* occurs when the normally closed circuit is open. *Customer use NO flt* occurs when the normally open circuit is closed.

Function inputs

The following table specifies the input parameters of the *Custom User Faults* function.

<i>Parameter</i>	<i>Description</i>
<i>User NC fault sel</i>	Selects the source of the normally closed circuit input.
<i>User NO fault sel</i>	Selects the source of the normally open circuit input.

Faults and alarms

The following table specifies the faults and alarms declared by the *Custom User Faults* function.

<i>Fault/Alarm</i>	<i>Description</i>
<i>Customer use NC flt</i>	Trip fault that occurs when the normally closed circuit input is False, indicating that the circuit is open
<i>Customer use NO flt</i>	Trip fault the occurs when the normally open circuit input is True, indicating that the circuit is closed

Function description

The parameters *User NC fault sel* and *User NO fault sel* generally select digital inputs (variables *Digital input 1*, ..., *Digital input 6*) or general purpose LAN

requests (variables *GP lan req bit 1*, ..., *GP lan req bit 8*). The custom user faults may be disabled by selecting Unused for the input parameters.

Ground Fault Protection (Fast)

The *Ground Fault Protection (Fast)* tests the phase currents to verify that there is no ground current in the system.

Function inputs

The following table specifies the input parameters of the *Ground Fault Protection (Fast)* function.

Parameter	Description
<i>Phase A current</i>	Phase A current feedback. Amps
<i>Phase B current</i>	Phase B current feedback. Amps
<i>Phase C current</i>	Phase C current feedback. Amps

Function outputs

The following table specifies the output variables of the *Ground Fault Protection (Fast)* function.

Variable	Description
<i>Gnd current, coarse</i>	Ground current, filtered. Amps

Function configuration

The following table specifies the configuration parameters for the *Ground Fault Protection (Fast)* function.

Parameter	Description
<i>Gnd flt coarse trip</i>	Current level at which the <i>Gnd flt, coarse</i> trip fault occurs. Amps

Faults and alarms

The following faults and alarms are declared by the *Ground Fault Protection (Fast)* function.

Fault / Alarm	Description
<i>Gnd flt, coarse</i>	Occurs when <i>Gnd current, coarse</i> > <i>Gnd flt coarse trip</i> .

Function description

Gnd current, coarse is determined by summing and filtering the three phase currents *Phase A current*, *Phase B current*, and *Phase C current*.

The configuration parameter *Gnd flt coarse trip* can be set to a default value by running the *Ground Fault Setup*.

Ground Fault Protection (Slow)

The *Ground Fault Protection (Slow)* tests the phase currents to verify that there is no ground current in the system.

Function inputs

The following table specifies the input parameters of the *Ground Fault Protection (Slow)* function.

Parameter	Description
<i>Phase A current</i>	Phase A current feedback. Amps
<i>Phase B current</i>	Phase B current feedback. Amps
<i>Phase C current</i>	Phase C current feedback. Amps

Function outputs

The following table specifies the output variables of the *Ground Fault Protection (Slow)* function.

Variable	Description
<i>Ground current</i>	Ground current, averaged and filtered. RMS amps

Function configuration

The following table specifies the configuration parameters for the *Ground Fault Protection (Slow)* function.

Parameter	Description
<i>Gnd flt trip level</i>	Current level at which the <i>Gnd flt, filtered</i> trip fault occurs. RMS amps
<i>Gnd flt alm level</i>	Current level at which the <i>Gnd flt alarm</i> alarm occurs. RMS amps
<i>Gnd flt alm clr lvl</i>	Current level at which the <i>Gnd flt alarm</i> alarm clears. RMS amps

Faults and alarms

The following faults and alarms are declared by the *Ground Fault Protection (Slow)* function.

Fault / Alarm	Description
<i>Gnd flt, filtered</i>	Occurs when <i>Ground current</i> > <i>Gnd flt trip level</i> .
<i>Gnd flt alarm</i>	Occurs when <i>Ground current</i> > <i>Gnd flt alm level</i> . Clears when <i>Ground current</i> < <i>Gnd flt alm clr lvl</i> .

Function description

Ground current is determined by summing, averaging, and filtering the phase currents *Phase A current*, *Phase B current*, and *Phase C current*.

The configuration parameters *Gnd flt trip level*, *Gnd flt alm level*, and *Gnd flt alm clr lvl* can be set to default values by running the *Ground Fault Setup*.

Hardware Fault Strings

Each Innovation Series product provides a hardwired, fail-safe circuit to turn off bridge power and to shut down its control. The circuit consists of two independent isolated inputs designated the local and system fault strings. The loss of either input results in the shutdown of the power bridge and control.

Diagnostic variables

The following table specifies the *Hardware Fault Strings* diagnostic variables.

<i>Variable</i>	<i>Description</i>
<i>Local fault string</i>	State of the local fault string circuit.
<i>System fault string</i>	State of the system fault string circuit.

Function configuration

The following table specifies the *Hardware Fault Strings* configuration parameters.

<i>Parameter</i>	<i>Description</i>
<i>Inh sim Loc/Sys flt</i>	Disables the hardware fault string validation in simulation mode only.

Faults and alarms

The following table specifies the faults and alarms associated with the *Hardware Fault Strings*.

<i>Fault/Alarm</i>	<i>Description</i>
<i>Local flt</i>	Trip fault that occurs when the local fault string circuit is open.
<i>System flt</i>	Trip fault that occurs when the system fault string circuit is open.

Function description

The hardware fault string circuits are capable of operating with either 24 volts DC or 115 volts AC. The inputs are isolated so the system and local fault string circuits are not required to operate at the same voltage level. Both circuits must be closed for normal product operation.

The local fault string circuit is closed when the following connections are made through appropriate circuitry:

- Terminal board (ATBA): Connector L115 or L24 to connector LCOM.
- Backplane: Jumper J2 pin 1 to pin 2.

The system fault string circuit is closed when the following connection is made through appropriate circuitry:

- Terminal board (ATBA): Connector S115 or S24 to connector SCOM.

The local and system fault strings are evaluated by the hardware. If one of the strings opens during product operation, then the hardware implements a controlled shutdown of the power bridge and dropout of the contactors.

The state of the hardware fault string inputs are reported to the control and contained in variables *Local fault string* and *System fault string*. The variables contain the actual state of the hardware circuits whether or not the product is running. The trip faults associated with the fault strings, *Local flt* and *System flt*, are reported when the fault string opens only when the product is running or commanded to run.

Line-Line Voltage Protection

The drive contains several diagnostic and protective features involving the *Line-Line Voltage Protection*.

Function configuration

The following table specifies the *Line-Line Voltage Protection* configuration parameters.

Parameter	Description
<i>Line OV fault lvl</i>	AC line over-voltage trip threshold
<i>Line OV alm on lvl</i>	AC line over-voltage alarm on threshold
<i>Line OV alm off lvl</i>	AC line over-voltage alarm off threshold
<i>Line UV fault lvl</i>	AC line under-voltage trip threshold
<i>Line UV alm on lvl</i>	AC line under-voltage alarm on threshold
<i>Line UV alm off lvl</i>	AC line under-voltage alarm off threshold
<i>Over frq flt lvl</i>	AC line over-frequency trip threshold
<i>Over frq alm on lvl</i>	AC line over-frequency alarm on threshold
<i>Over frq alm off lvl</i>	AC line over-frequency alarm off threshold
<i>Low frq flt lvl</i>	AC line under-frequency trip threshold
<i>Low frq alm on lvl</i>	AC line under-frequency alarm on threshold
<i>Low frq alm off lvl</i>	AC line under-frequency alarm off threshold

Diagnostic variables

The following table specifies the *Line-Line Voltage Protection* diagnostic variables.

Variable	Description
<i>Output volts, A-B</i>	Filtered A-B line-line voltage, volts
<i>Output volts, B-C</i>	Filtered B-C line-line voltage, volts
<i>A-B, Voltage offset</i>	Calculated A-B voltage offset, volts
<i>X-axis volt fbk</i>	X-component of ac line voltages - sampled at fast rate
<i>Y-axis volt fbk</i>	Y-component of ac line voltages – sampled at fast rate
<i>Vx, X-axis voltage</i>	Filtered version of <i>X-axis volt fbk</i>
<i>Vy, Y-axis voltage</i>	Filtered version of <i>Y-axis volt fbk</i>
<i>B-C, Voltage offset</i>	Calculated B-C voltage offset, volts
<i>Line monitor volt</i>	AC line voltage magnitude – filtered
<i>Line monitor frq</i>	AC line frequency – filtered
<i>Stopped</i>	The source is stopped
<i>PLL proven</i>	PLL is proven

Faults and alarms

The following table specifies the faults and alarms associated with the *Line-Line Voltage Protection*.

Fault/Alarm	Description
<i>.A-B voltage offset</i>	Trip fault that occurs when the A-B line-line voltage offset is too high.

<i>B-C voltage offset</i>	Trip fault that occurs when the B-C line-line voltage offset is too high.
<i>AC line over voltage</i>	Trip fault that occurs when the line to line voltage magnitude is too high.
<i>AC line voltage high</i>	Brief fault that occurs when the line to line voltage magnitude is too high, and is approaching the trip level.
<i>AC line under volt</i>	Trip fault that occurs when the line to line voltage magnitude is too low.
<i>AC line volts low</i>	Brief fault that occurs when the line to line voltage magnitude is too low, and is approaching the trip level.
<i>AC line over freq</i>	Trip fault that occurs when the calculated ac line frequency is too high
<i>AC line freq high</i>	Brief fault that occurs when the ac line frequency is too high, and is approaching the trip level.

Function description

Voltage Offset Detection

The variables *Output volts, A-B* and *Output volts, B-C* are filtered versions of the measured line-line voltage feedbacks. The default filter frequency is 1000 rad/sec.

The source performs an automatic voltage offset calculation only when it is running. Any appreciable offset voltage that is detected during the calculation indicates a potential power bridge or feedback circuitry problem. The *A-B voltage offset* and *B-C voltage offset* trip faults are reported when excessive offsets are calculated. The calculated offsets *A-B, Voltage offset* and *B-C, Voltage offset* are used by the control to calculate feedbacks once the drive starts running. The threshold for the offset faults is calculated by the control.

The following faults are only active if *PLL proven* and *Stopped* are both true.

AC Line Overvoltage Detection

The regenerative source cannot operate effectively if the ac line voltage remains too high. This condition presents hazard to the power devices, as well as to the control algorithm. The *AC line voltage high* will indicate an over-voltage condition of the line when the filtered line magnitude, *Line monitor volt*, exceeds the user parameter, *Line OV alm on lvl*. This alarm will persist until *Line monitor volt* drops below the level, *Line OV alm off lvl*. If the voltage exceeds the level *Line OV fault lvl*, the source will trip with the fault, *AC line over voltage*. The settings for these user level parameters are calculated by the control during the commissioning exercise using the following rules:

Line OV alm on lvl = 112% of nominal ac line voltage

Line OV alm off lvl = 110% of nominal ac line voltage

Line OV fault lvl = 117% of nominal ac line voltage

AC Line Undervoltage Detection

The source will alarm and/or trip if the ac line magnitude dips too low. The alarm, *AC line volts low*, will indicate an under-voltage condition of the line when the

filtered line magnitude, *Line monitor volt*, dips below the value of the user parameter, *Line UV alm on lvl*. This alarm will persist until *Line monitor volt* exceeds the level, *Line UV alm off lvl*. If the voltage dips below the level *Line UV fault lvl*, the source will trip with the fault, *AC line under volt*. The settings for these user level parameters are calculated by the control during the commissioning exercise using the following rules:

Line UV alm on lvl = 88% of nominal ac line voltage

Line UV alm off lvl = 90% of nominal ac line voltage

Line UV fault lvl = 50% of nominal ac line voltage

AC Line Overfrequency Detection

The source will alarm and/or trip if the ac line frequency is too high. The alarm, *AC line freq high* will indicate an over-frequency condition of the line when the filtered line magnitude, *Line monitor frq*, goes above the value of the user parameter, *Over frq alm on lvl*. This alarm will persist until *Line monitor frq* goes below the level, *Over frq alm off lvl*. If the frequency goes above the level *Over frq flt lvl*, the source will trip with the fault, *AC line over freq*. The settings for these user level parameters are calculated by the control during the commissioning exercise using the following rules:

Over frq alm on lvl = nominal frequency + 17.28rad/sec

Over frq alm off lvl = nominal frequency + 15.71rad/sec

Over frq flt lvl = 125% of nominal frequency

AC Line Underfrequency Detection

The source will alarm and/or trip if the ac line frequency is too low. The alarm, *AC line freq low* will indicate an under-frequency condition of the line when the filtered line magnitude, *Line monitor frq*, goes below the value of the user parameter, *Low frq alm on lvl*. This alarm will persist until *Line monitor frq* goes above the level, *Low frq alm off lvl*. If the frequency goes above the level *Low frq flt lvl*, the source will trip with the fault, *AC line under freq*. The settings for these user level parameters are calculated by the control during the commissioning exercise using the following rules:

Low frq alm on lvl = nominal frequency - 17.28rad/sec

Low frq alm off lvl = nominal frequency - 15.71rad/sec

Low frq flt lvl = 50% of nominal frequency

Phase Current Protection

The drive contains several diagnostic and protective features involving *Phase Current Protection*.

Diagnostic variables

The following table specifies the *Phase Current Protection* diagnostic variables.

Variable	Description
<i>Phase A current</i>	Filtered phase A current, amps
<i>Phase B current</i>	Filtered phase B current, amps
<i>Phase C current</i>	Filtered phase C current, amps
<i>Phs A current offset</i>	Calculated phase A current offset, amps

<i>Phs B current offset</i>	Calculated phase B current offset, amps
<i>Phs C current offset</i>	Calculated phase C current offset, amps
<i>Ia^2 filtered</i>	Squared phase A current, RMS amps ²
<i>Ib^2 filtered</i>	Squared phase B current, RMS amps ²
<i>Ic^2 filtered</i>	Squared phase C current, RMS amps ²
<i>Real current fbk</i>	X-component of phase currents – sampled at fast rate
<i>Reactive current fbk</i>	Y-component of phase currents – sampled at fast rate
<i>Real pwr cur</i>	Filtered <i>Real current fbk</i>
<i>Reactive cur</i>	Filtered <i>Reactive current fbk</i>

Function configuration

The following table specifies the *Phase Current Protection* configuration parameters.

Parameter	Description
<i>Disable TOC profile</i>	Disables the application of the timed over current profile to the squared phase currents.

Faults and alarms

The following table specifies the faults and alarms associated with the *Phase Current Protection*.

Fault/Alarm	Description
<i>Phase A cur offset</i>	Trip fault that occurs when the phase A current offset is too high.
<i>Phase B cur offset</i>	Trip fault that occurs when the phase B current offset is too high.
<i>Phase C cur offset</i>	Trip fault that occurs when the phase C current offset is too high.
<i>Timed over current</i>	Trip fault that occurs when one of the squared phase currents is too high.
<i>TOC pending</i>	Alarm that occurs when one of the squared phase currents is too high.

Function description

The variables *Phase A current*, *Phase B current*, and *Phase C current* are filtered versions of the measured phase current feedbacks. The default filter frequency is 1000 rad/sec. These three signals are used for diagnostics only.

The source performs an automatic current offset calculation when it is stopped. During the calculation, the power bridge is turned off, and the phase currents should be zero. Any appreciable phase current that is detected during the calculation indicates a potential power bridge or feedback circuitry problem. The *Phase A cur offset*, *Phase B cur offset*, and *Phase C cur offset* trip faults are reported when excessive offsets are calculated. The calculated offsets *Phs A current offset*, *Phs B*

current offset, and *Phs C current offset* are used by the control to null the feedbacks once the drive starts running.

The source performs a timed over current (TOC) detection. The TOC detection filters the squared phase currents, applying a TOC cooling profile to the filter. The TOC cooling profile is turned off if parameter *Disable TOC profile* is set to *True* (the default value). If any of the squared phase currents are high enough to warrant caution, the *TOC pending* alarm is reported. If any of the squared phase currents is excessively high, the *Timed over current* trip fault is reported. The alarm and fault thresholds are calculated so that the alarm occurs when the source exceeds its rated current, and trips when it is applied at 150% of rated current for over 60 seconds.

DC Link Protection

The drive contains several diagnostic and protective features involving the *DC Link Protection*.

Diagnostic variables

The following table specifies the *DC Link Protection* diagnostic variables.

<i>Variable</i>	<i>Description</i>
<i>DC bus feedback</i>	Unfiltered dc link voltage, dc volts
<i>DC voltage feedback</i>	FIR filtered <i>DC bus feedback</i> used for voltage regulator.
<i>AC line input power</i>	Filtered AC line power at source terminals
<i>DC bus current</i>	Filtered, estimated source dc current
<i>DC bus voltage</i>	Filtered dc link voltage, dc volts
<i>Running</i>	Indicates whether the source is ready to accept load, and therefore whether the dc link voltage is within regulation.

Function configuration

All dc link protection settings are final values calculated by the control.

Faults and alarms

The following table specifies the faults and alarms associated with the *DC Link Protection*.

<i>Fault/Alarm</i>	<i>Description</i>
<i>DC bus over voltage</i>	Trip fault that occurs when the dc link voltage is too high.
<i>DC bus under voltage</i>	Trip fault that occurs when the dc link voltage is too low.

Function description

The signal *DC bus feedback* is an unfiltered representation of the dc link voltage. *DC bus voltage* is a filtered version of the dc link voltage. The default filter frequency is 90 rad/sec.

The *DC bus over voltage* trip fault occurs when the dc link voltage exceeds a maximum safe operating voltage defined as

Transformer Overtemperature Detection

Those Innovation Series products that are part of a system containing a transformer provide the capability to detect transformer overtemperature condition. The *Xfrmr over temp* trip fault and the *Xfrmr temp hot* alarm trigger on a signal that is a digital input from the transformer overtemperature fault circuit. Either the fault or alarm occurs when the transformer overtemperature circuit is open.

Function inputs

The following table specifies the input parameters of the *Transformer Overtemperature Detection* function.

Parameter	Description
<i>Xfrmr OT fault sel</i>	Selects the source of the transformer overtemperature circuit.

Function configuration

The following table specifies the configuration parameters of the *Transformer Overtemperature Detection* function.

Parameter	Description
<i>Xfrmr OT fault mode</i>	Specifies whether the overtemperature condition triggers a fault or an alarm.

Faults and alarms

The following table specifies the faults and alarms that the *Transformer Overtemperature Detection* function declares.

Fault/Alarm	Description
<i>Xfrmr over temp</i>	Occurs when the state of the transformer overtemperature circuit is False, indicating that the circuit is open, and parameter <i>Xfrmr OT fault mode</i> is set to <i>Trip flt</i> .
<i>Xfrmr temp hot</i>	Occurs when the state of the transformer overtemperature circuit is False, indicating that the circuit is open, and parameter <i>Xfrmr OT fault mode</i> is set to <i>Alarm fault</i> .

Function description

The parameter *Xfrmr OT fault sel* generally selects digital inputs (*Digital input 1*, ..., *Digital input 6*). The *Transformer Overtemperature Detection* may be disabled by setting *Xfrmr OT fault sel* equal to *Unused*.

Line Protection Module

The LPPA is the line protection module. This is an optional hardware module used by the source to determine ground faults. Source firmware reads two inputs from the LPPA to determine the presence of ground faults, and the status of the MOV fuse. Those using this function should refer to the LPPA manuals for proper application and scaling information.

The ground fault detection portion of this protective is a pointer, *LPP gnd signal sel*, normally aimed towards one of the configurable analog inputs, *Analog input 1*

unfil(default). This is a voltage signal representing ground fault current, but the default configuration for this protection function leaves the signal in volts, and sets the alarm and trip thresholds as a voltage. A low pass filter is applied to the scaled input signal, and the output of the filter, *LPPA gnd cur*, is tested against thresholds that are described below. If *LPPA gnd cur* rises above *LPPA gnd flt alm*, the alarm *Ground flt alm, LP* will be given. If it falls back below *LPPA gnd flt clr*, the alarm will cease after the source has stopped. If the signal surpasses *LPPA gnd flt lvl*, the source will trip with (<<Lp_Gnd_Trip)>>.

The MOV fuse part of this function uses a pointer input, *LPP fuse blown sel*. As a default, this pointer is directed to *Digital input 2*. A low pass filter is applied to each digital input. Once read in the fuse, sense signal becomes *LPPA fuse stat*. If it is False, the alarm *AC filter fuse blown* will be given. The alarm will only clear if *LPPA fuse stat* becomes True again (by replacing the fuse).

The following tables show the parameters and variables for this function.

Parameter	Description
<i>LPP gnd signal sel</i>	LPPA ground fault signal pointer
<i>LPPA gnd flt scl</i>	Voltage to current scale factor - applied to the input analog signal. This parameter is set to 1.0 as default, leaving the scaled signal output as a voltage.
<i>LPPA gnd flt fil</i>	The bandwidth of the low pass filter (rad/sec) - applied to the analog input signal. The default is set to the reciprocal of the execution rate of task2.
<i>LPPA gnd flt alm</i>	The level at that the alarm, <i>Ground flt alm, LP</i> , is set.
<i>LPPA gnd flt clr</i>	The level at which the alarm, <i>Ground flt alm, LP</i> , is cleared.
<i>LPPA gnd flt lvl</i>	The level at which the trip f
<i>LPP fuse blown sel</i>	LPPA MOV fuse sense signal pointer
<i>LPPA mode</i>	LPPA Absent/Present selection - populated during commissioning
Variable	Description
<i>LPPA gnd cur</i>	Ground current indication (filtered). Note that this value may actually be scaled as the voltage sensed from the LPPA, not a current. If <i>LPPA gnd flt scl</i> is 1.0, this is the sensed voltage.
<i>LPPA gnd warning</i>	This variable is for external use to indicate that the alarm <i>Ground flt alm, LP</i> is present.
<i>LPPA gnd trip</i>	This variable is for external use to indicate that the fault <i>LPPA gnd trip</i> is present.
<i>LPPA fuse stat</i>	This signal, when True, indicates that the MOV fuse is working properly. When <i>LPPA mode</i> indicates that the LPPA module is not present, this variable will always be True.

Phase Imbalance Function

The source phase imbalance function is responsible for monitoring the condition of the phase imbalance on the ac line, as well as the status of the phase lock loop. Pertinent variables and are listed below.

Variables	Description
<i>Y axis line voltage</i>	The demodulated , y-component of the ac line voltage. This is the component that phase lock loops regulates to zero.
<i>PLL error</i>	This is the error signal of the phase lock loop.
<i>X axis line voltage</i>	The demodulated, x-component of the ac line voltage.
<i>Ac line magnitude</i>	This is the magnitude of <i>X axis line voltage</i> and <i>Y axis line voltage</i> (square root of squared sums). It represents the magnitude of the ac line..
<i>Phase imbalance sqr</i>	This signal is basic in the determination of phase imbalance or phase lock loop goodness for the source. It is the filtered sum of two squared signals. The first is <i>PLL error</i> , and the second is the difference between <i>X axis line voltage</i> and <i>Ac line magnitude</i> .
<i>Phase imbalance ref</i>	This signal represents the allowed amount of imbalance for the source. It has units of volts squared. It includes an allowance for noise, and is compensated by the magnitude of the ac line.
<i>Phase imbalance avg</i>	This signal is the amount by which <i>Phase imbalance sqr</i> exceeds the allowed threshold, <i>Phase imbalance ref</i> .
<i>Phase imbalance int</i>	When <i>Phase imbalance avg</i> is greater than zero, it accumulates with dt compensation into this integrator. If the integrator exceeds the a clamp threshold, <i>Phs imbalance limit</i> , an alarm, <i>AC line transient</i> , will occur. If this condition persists for <i>Phs imbalance time</i> , the trip fault, <i>AC line watchdog</i> will occur.
<i>Phs imbalance limit</i>	This is the clamp for <i>Phase imbalance int</i> . When <i>Phase imbalance int</i> is in this clamp, the alarm, <i>AC line transient</i> , will occur. If this condition persists for <i>Phs imbalance time</i> , the trip fault, <i>AC line watchdog</i> will occur.
<i>PLL proven</i>	This Boolean indicates the status of the phase lock loop. It is directly affected by the phase imbalance detection circuit. When the ac line appears to the control after charging begins, there will a significant, transient error until the loop locks. <i>Phase imbalance avg</i> will thus be significant, but will begin to decay as the loop locks. After <i>Phase imbalance int</i> is less than zero for about 120 msec., <i>PLL proven</i> will be set true and the phase lock loop will be declared ready for use. In order for <i>PLL proven</i> to be set False after it is set True, <i>AC line loss</i> must be true for

	1sec. or <i>Phase imbalance int</i> must be non-zero for 1sec.
<i>AC line loss</i>	If the ac line drops below 10% of nominal for 5 msec, <i>AC line loss</i> will be set True, declaring that the ac line has been lost. This will immediately cause the <i>AC line transient</i> alarm. If the condition persists for 1 second, the source will trip if it hasn't already. <i>AC line loss</i> will be set False again as soon as the ac line rises back above 15% of nominal.
Parameters	Description
<i>Phase loss trip time</i>	The low voltage non-regenerative source has a phase loss detection function. It uses <i>Phase imbalance sqr</i> , but compares it against a dedicated threshold that is set to a level that will indicate a phase loss. If <i>Phase imbalance sqr</i> exceeds that threshold for <i>Phase loss trip time</i> seconds, the trip fault, <i>Phase loss fault</i> , will occur. Prior to the time exceeded, the alarm, <i>Phase loss alarm</i> , will occur. The source must be running for either to occur.
<i>Phase loss trip inh</i>	When <i>Phase loss trip inh</i> is set, the trip fault <i>Phase loss fault</i> will not occur. However, this parameter has no effect on the phase loss alarm.
The Ovr_Line_Mon diagram, as seen through the toolbox, shows one line of the phase imbalance scheme.	

Thermal models

Non-regen source thermal model functions

The Non-Regenerative Source has three thermal models. One model for the power bridge SCRs and diode, the main power devices. Another is for the IGBT, which is the power switching device for the optional dynamic brake function. The third is for the optional dynamic brake resistor. In all three cases, parameters from the particular bridge being used and the currents and voltages pertaining to the device make it possible to closely follow the device temperature. If the temperature reaches a danger point, an alarm is given. A trip fault is given if that trend continues.

The following functions will further describe the thermal models of the Innovation Series Non-Regenerative Source:

- *Heatsink Thermal Protection*
- *SCR/Diode thermal model*
- *Dynamic brake IGBT thermal model*
- *Dynamic brake resistor thermal model*

Heatsink Thermal Protection

The *Heatsink Thermal Protection* function measures the power bridge heatsink and ambient temperatures and verifies that they are at a safe operating level.

Different bridge frame sizes require different sets of hardware thermal inputs and generate different sets of temperature variables and faults. Click on one of the frame sizes below for more information on the *Heatsink Thermal Protection* function.

Frame sizes 620, 1000

The *Heatsink Thermal Protection* function measures two power bridge heatsink temperatures and two ambient temperatures for frame sizes 620 and 1000.

Function inputs

The inputs to the *Heatsink Thermal Protection* function are hardware thermal sensor connections. The following table specifies the required thermal sensor connections to backplane connector J4.

J4 pins	Required connection
1 & 2	Heatsink A thermal sensor
3 & 4	Heatsink B thermal sensor
5 & 6	Open
7 & 8	Ambient thermal sensor

Function outputs

The following table specifies the output variables of the *Heatsink Thermal Protection* function.

Variable	Description
<i>Heat sink temp, A</i>	Measured heatsink A temperature. Degrees C or Degrees F
<i>Heat sink temp, B</i>	Measured heatsink B temperature. Degrees C or Degrees F
<i>Ambient temp</i>	Measured bridge ambient temperature. Degrees C or Degrees F
<i>Htsink configuration</i>	Heatsink configuration number is 2 for 620 and 1000 frame and 3 for 1800 frame sources
<i>SCR 1 heat sink temp</i>	For 620 and 1000 frame non-regen sources, the three SCR temperatures are modeled from one temperature sensor, which is equal to <i>Heat sink temp, A</i>
<i>SCR 2 heat sink temp</i>	For 620 and 1000 frame non-regen sources, the three SCR temperatures are modeled from one temperature sensor, which is equal to <i>Heat sink temp, A</i>
<i>SCR 3 heat sink temp</i>	For 620 and 1000 frame non-regen sources, the three SCR temperatures are modeled from one temperature sensor, which is equal to <i>Heat sink temp, A</i>
<i>Diode 1 htsink temp</i>	For 620 and 1000 frame non-regen source, the three diode temperatures are modeled from one temperature sensor, which is equal to <i>Heat sink temp, B</i>

In simulator mode, the output variables are set to constant values which are the maximum expected operating temperatures.

Related faults and alarms

The following faults and alarms are declared by the *Heatsink Thermal Protection* function.

- *HtSink over temp, A*
- *HtSink over temp, B*
- *Ambient over temp*
- *HtSink temp hot, A*
- *Htsink temp hot, B*
- *Ambient temp hot*
- *HtSink temp low, A*
- *HtSink temp low, B*
- *Ambient temp low*
- *HtSink sensor A bad*
- *HtSink sensor B bad*
- *HtSink rise high, A*
- *HtSink rise high, B*
- *HtSink temp imbalanc*
- *HtSink C miswired*

Frame size 1800

The *Heatsink Thermal Protection* function measures three power bridge heatsink temperatures and one ambient temperature for frame sizes 1000 and 1800.

Function inputs

The inputs to the *Heatsink Thermal Protection* function are hardware thermal sensor connections. The following table specifies the required thermal sensor connections to backplane connector J4.

<i>J4 pins</i>	<i>Required connection</i>
1 & 2	Heatsink A thermal sensor
3 & 4	Heatsink B thermal sensor
5 & 6	Heatsink C thermal sensor
7 & 8	Ambient thermal sensor

Function outputs

The following table specifies the output variables of the *Heatsink Thermal Protection* function.

<i>Variable</i>	<i>Description</i>
<i>Phase A HtSink temp</i>	Measured heatsink A temperature. Degrees C

	or Degrees F
<i>Phase B HtSink temp</i>	Measured heatsink B temperature. Degrees C or Degrees F
<i>Phase C HtSink temp</i>	Measured heatsink C temperature. Degrees C or Degrees F
<i>Ambient temp</i>	Measured bridge ambient temperature. Degrees C or Degrees F
<i>Htsink configuration</i>	Heatsink configuration number is 2 for 620 and 1000 frame and 3 for 1800 frame sources

In simulator mode, the output variables are set to constant values which are the maximum expected operating temperatures.

Related faults and alarms

The following faults and alarms are declared by the *Heatsink Thermal Protection* function.

- *HtSink A over temp*
- *HtSink B over temp*
- *HtSink C over temp*
- *Ambient over temp*
- *HtSink A temp hot*
- *HtSink B temp hot*
- *HtSink C temp hot*
- *Ambient temp hot*
- *HtSink A temp low*
- *HtSink B temp low*
- *HtSink C temp low*
- *Ambient temp low*
- *HtSink A sensor bad*
- *HtSink B sensor bad*
- *HtSink C sensor bad*
- *HtSink A rise high*
- *HtSink B rise high*
- *HtSink C rise high*
- *HtSink temp imbalanc*

SCR/Diode thermal model

The Non-Regenerative Source has a thermal mode for the SCR/diode bridge. It uses heat sink temperatures read in by thermistors as the starting point for this model, then uses current feedbacks and cell thermal characteristics based on frame size to determine the temperature rise across the various components of the cells. Finally, a

junction temperature is derived for each cell. A peak junction temperature is found among the three SCRs and another peak temperature is found for the diodes. If either of those peak junction temperatures exceeds the maximum allowed temperature, the source will fault and cease to gate cells.

The table below represents the user variables of the SCR/Diode thermal mode.

Variable	Description
<i>Htsink configuration</i>	This variable indicates the type of heat sink configuration of the given bridge. This number varies according to frame size. 620 and 1000 frame non-regen sources use type 2, which allows for one reading for the SCR heat sinks, <i>Heat sink temp, A</i> and one reading for the diode heat sinks, <i>Heat sink temp, B</i> 1800 frame sources use type 3 configuration, which allows for three heat sink readings, one for each phase(SCR/Diode pair). <i>Phase A HtSink temp</i> monitor phase A devices, <i>Phase B HtSink temp</i> monitors phase B devices, and <i>Phase C HtSink temp</i> monitors phase C devices. For clarity to the user, these temperatures are copied over into six different device temperatures. These device temperature names are listed below. They always have the same meaning. See OVR_SCR_THM for a pictorial view.
<i>SCR 1 heat sink temp</i>	This is the measured heat sink temperature for SCR 1.
<i>SCR 2 heat sink temp</i>	This is the measured heat sink temperature for SCR 2.
<i>SCR 3 heat sink temp</i>	This is the measured heat sink temperature for SCR 3.
<i>Diode 1 htsink temp</i>	This is the measured heat sink temperature for diode 1
<i>Diode 2 htsink temp</i>	This is the measured heat sink temperature for diode 2
<i>Diode 3 htsink temp</i>	This is the measured heat sink temperature for diode 3
<i>SCR 1 junction temp</i>	The calculated temperature for SCR 1
<i>SCR 2 junction temp</i>	The calculated temperature for SCR 2
<i>SCR 3 junction temp</i>	The calculated temperature for SCR 3
<i>Max SCR jnc temp</i>	The maximum of SCR 1, SCR 2 , and SCR 3 junction temperature.
<i>Diode 1 jnc temp</i>	The calculated temperature for diode 1
<i>Diode 2 jnc</i>	The calculated temperature for diode 2

temp

<i>Diode 3 jnc temp</i>	The calculated temperature for diode 3
<i>Max diode jnc temp</i>	The maximum of diode 1, Diode2 , and diode 3 junction temperatres.
<i>Jnc OT alm on thrsh</i>	The SCR or diode temperature at which any given device will begin to alarm..
<i>Jnc OT alm off thrsh</i>	The SCR or diode temperature above which any given device that is giving the over-temperature warning alarm will cease to do so.

Dynamic brake resistor thermal model

The following list of variables help explain the optional dynamic brake resistor thermal model. The intent of this model is to protect the dynamic brake resistor.

<i>Variable</i>	<i>Description</i>
<i>DB estimated power</i>	This is the estimated power being dissipated by the dynamic brake resistor. Accuracy of this calculation relies on an accurate inductance value of the dynamic brake circuit.
<i>Modeled DB res power</i>	This is the low pass filtered value of <i>DB estimated power</i>)
<i>DB OT alarm on thrs</i>	This is the level of dynamic brake resistor power at which the brief fault, <i>DB over-temp alarm</i> begins annunciating.
<i>DB OT alarm off thrs</i>	This is the level of dynamic brake power below which the brief alarm, <i>DB over-temp alarm</i> will cease to announce.
<i>DB OT trip thrs</i>	When the dynamic brake resistor reaches a power dissipation level that is dangerous to the resistor and maintains or exceeds that temperature for a pre-determined amount of time.

Dynamic brake IGBT thermal model

The optional dynamic brake function uses an IGBT for its switching device. There is a thermal model for the IGBT to protect it from over-heating. This IGBT is the same device used in some of the Innovation Series low voltage pwm products. It also uses the same thermal model as those products.

For information pertaining to the dynamic brake resistor thermal model, see *Dynamic brake resistor thermal model*

The following list of variables help explain the IGBT thermal model. The intent of this model is to protect the dynamic IGBT.

<i>Variable</i>	<i>Description</i>
<i>DB IGBT htsink temp</i>	The IGBT heat sink temperature. This temperature is modeled from the ambient temperature and the ambient to heat sink thermal impedence.
<i>DB IGBT jnc</i>	The IGBT estimated junction temperature, derived from

<i>temp</i>	ambient temperature, total IGBT power dissipation, and modeled IGBT losses.
<i>DB IGBT peak temp</i>	This is the peak detected version of <i>DB IGBT peak temp</i> . It attempts to remove the ripple from the signal and represent the peak amount of that ripple.
<i>DB IGBT OT alarm on</i>	This is the level of IGBT estimated temperature above which the brief alarm, <i>DB IGBT too hot</i> will begin to annunciate.
<i>DB IGBT OT alm off</i>	This is the level of IGBT estimated temperature below which the brief alarm, <i>DB IGBT too hot</i> will quit annunciating once it has begun.

Sequencer Functions

Sequencer Overview

Sequencing is a key function of the Innovation Series Low Voltage Non-Regen Source. The sequencer oversees the starting and stopping of the source. It protects from the mis-operation of the source during fault or diagnostic conditions. The sequencer also provides source status information that can be used by various source and application functions.

The Ovr_Seq diagram, as viewed from the Toolbox, gives the user an over-view of the sequencer in a state diagram manner. When the toolbox is connected to the source, the highlighted circle indicates the present sequencer state. A brief summary of each of the names associated with a given state is shown below.

Variable	Description
<i>Stopped</i>	This variable indicates that the source is in the stopped state. No sequencer task is running
<i>Sync check</i>	This state is used to briefly check that the phase lock loop is locked to the ac line. A fault will occur if the phase lock loop is not synchronized with the line.
<i>Short test</i>	The short test is in progress. This purpose of this test is to insure that there is not a short on the dc link before the control attempts to ramp up the link voltage. Cells are fired at a very retarded angle so that if a short is present, fuses will not be blown.
<i>Bleed test</i>	The bleed test is in progress. The SCRs are not firing during this test, but the dc link is allowed to decay and a check is made to ensure that the decay rate is reasonable.
<i>Ramp up</i>	This is the ramp-up state. The control is bringing the dc link up. The dc link is ramped up from the bleed test level to full on during this state. The ramp-up is done at a controlled rate so as to stay out of continuous current.
<i>Normal</i>	This is the normal state. The control will spend almost all of its life here once the run command has been given. The SCRs are fired full on here so that the maximum voltage is developed here.
<i>Fire All</i>	All three SCRs are fired all the time in this state. When

the control transfers to this state, it is making an attempt to survive a transient ac line condition. If the dc link voltage becomes too low, control will transfer to the *SCRs Off* state. If a timeout occurs while in this state, a fault will occur and the source will stop. Bridge and gate drive limitations prevent continuous operation in this state.

<i>SCRs Off</i>	This is the SCR off state. Entry to this state occurred when the dc link voltage dipped to a level too low for recovery to the normal state with “full on firing” of the SCRs. Control will transfer back out of this state to recovery when the ac line will support a phase-controlled ramp-up of the voltage.
<i>Recovery</i>	This is the recovery state. The control attempts to re-gain control to the normal (full on firing) state by safely ramping up the dc link voltage and controlling current magnitude so as not to allow fuses to blow.
<i>Cell test in running</i>	This is the cell test in progress state. It control the sequencing of the cell test. It may be entered only from the stopped state.
<i>Powerdip inactive</i>	This is the power-dip inactive state. The two power-dip states are independent of the main state machine. The will spend most of its time in this state.
<i>Powerdip active</i>	This is the power-dip state. The control enters this state when the dc link voltage dips below a specified level. It will recover back to the <i>Powerdip inactive</i> state when the dc link voltage exceeds another level.
<i>Pwr dip action lvl</i>	The level below which the control goes into the power-dip state.
<i>Pwr dip recovery lvl</i>	The level above which the source is no longer in the power-dip state.
<i>Bridge test skip lvl</i>	This is the level of dc link voltage above which the short test and the bleed test will both be skipped. The reasoning here is that in order for the voltage to have reached this level, there could not have been a short and the bleed test has already been performed. This is a means of speeding up the dc link initialization process.

The following functions will further describe the sequencing of the Innovation Series Non-Regenerative Source:

- *Fault Reset Logic*
- *Sequencer Permissives*
- *Stopping Commands*
- *Sequencer Commands*
- *Sequencer Status*

Fault Reset Logic

The sequencer oversees the shutdown of a source under a fault condition. It insures that the contactors are opened and the regulators are disabled in a timely manner.

Faults can be reset in several different ways. They can be reset from the source Diagnostic Interface (DDI), also called the keypad. They can be reset by a selected variable, or through the LAN, if enabled.

Function inputs

<i>Parameter</i>	<i>Description</i>
<i>Fault reset select</i>	Specifies a Boolean variable that requests a fault reset, when the variable transitions from a 0 to a 1 (Positive edge detected).
Variable	Description
<i>Fault reset req, lan</i>	Requests a fault reset when the LAN is active and variable transitions from a 0 to a 1 (positive edge detected). Refer to <i>LAN Signal Map</i> . This variable must be selected in <i>Fault reset select</i> to be active.
DDI “Reset Faults” Push Button	Requests a fault reset when pressed.

Function outputs

<i>Variable</i>	<i>Description</i>
<i>Trip fault active</i>	Indicates when a Trip fault is present. <i>Trip fault active</i> is True when a Trip fault exists. It is a NC contact in the <i>Ready to run</i> permissive string. Refer to <i>Sequencer Permissives</i> .
<i>No trip fault</i>	Indicates when a Trip fault is NOT present. Is True when there is no Trip fault. (Alarm may exist).
<i>No faults active</i>	Indicates when no Trip faults or Alarms are present. Is True when no faults or alarms exist in the source.

Function description

When the source is running and a Trip fault is generated, the sequencer will perform the following actions in order:

- Disables the bridge power enable, *Bridge is on*.
- Disables the voltage and current regulators via *Inner reg enable*.
- Returns sequencing control to the stopped state.

The sequencer also removes any type of run request to the source because the *Ready to run* permissive string drops out due to the Trip fault. This will also prevent the source from trying to run while a Trip fault is present.

When a trip fault occurs, the bridge is turned off quickly without a ramp down of any kind. The source cannot control the loading on the dc link.

To reset a Trip fault or Alarm, request a Fault reset using one of the **Function inputs** described above.

Note: Performing a Fault reset may not clear the fault if the fault condition still exists, or if the fault is Locked.

Sequencer Permissives

Sequencer permissives are used to either prevent or allow the source to run if the permissive condition exists in the source. There are two types of permissives: internal permissives and application permissives.

Internal permissives are internal source conditions that must be satisfied before the source will run. The current offsets must be valid, that is, the offset calculation must have run for 1.0second after power-up or after a stop.

Application permissives allow the user to connect application specific permissive logic that must be satisfied before the source will run.

The main permissive string used by the sequencer is *Ready to run*. This permissive must be **True** for the source to run and the details of this permissive are displayed in the Sequencing diagrams in the source.

Function inputs

Application Permissive Inputs

Variable	Description
<i>X stop active</i>	If True , this permissive will prevent the source from starting or will perform an X-Stop if the source is running.

Internal Permissive Inputs

Variable	Description
<i>Local fault string</i>	Local hardware permissive. When <i>Local fault string</i> is True , it will prevent the source from starting or running. If a run is requested while <i>Local fault string</i> is True , a Trip fault, <i>Local flt</i> , will be generated.
<i>System fault string</i>	System hardware permissive. When <i>System fault string</i> is True , it will prevent the source from starting or running. If a run is requested while <i>System fault string</i> is True a Trip fault, <i>System flt</i> , will be generated. See also <i>Hardware Fault Strings</i> .

Function outputs

Variable	Description
<i>Ready to run</i>	The main run permissive and primary indication that the source is ready to run. If False , this permissive will cause all run requests and commands to drop out. The source cannot be started unless <i>Ready to run</i> is True .

Related faults and alarms

The following faults and alarms may be generated when the *Ready to run* permissive is not satisfied.

- *Local flt*
- *System flt*

Stopping Commands

The sequencer provides two mechanisms for issuing a controlled stop of the source: a Normal stop and an X-stop.

A Normal stop can be issued in several ways:

- Removing a run request
- Pressing the Stop pushbutton on the DDI (also called the keypad),
- Causing a downward transition to the variable or input to which *Hardware run ptr* is pointed.

An X-Stop is issued through only via ISBus for the source. The stop mechanism is no different than the others for the case of the source.

A third mechanism for stopping the source is to generate a Trip fault. In this case, the shutdown is essentially the same as the others described here.

Normal Stop

The Normal stop is the typical way to stop the source in a controlled manner. A Normal stop can be configured as Ramp stop, Coast stop, or Quick stop.

Function inputs

The following parameters source the function input variables:

Parameter	Description
<i>Hardware run ptr</i>	See <i>Sequencer Commands</i> for a description of this parameter.
<i>X stop active</i>	If True , this permissive will prevent the source from starting or will perform an X-Stop if the source is running.
<i>Link down fast</i>	If True , and the bridge is equipped with a dynamic brake, the control will use the dynamic brake to bleed the voltage from the dc link very quickly as its stops. No faults will result.

The following variables are inputs that are used to stop the source.

Variable	Description
<i>Run request</i>	A normal stop is generated when <i>Run request</i> is false.
DDI Stop Pushbutton	A normal stop is generated when the Stop pushbutton is pressed on the DDI.

X-Stop

The X-stop is an alternate way to stop the source in a controlled manner. An X-stop can only be issued via ISBus for the source.

Function inputs

Variable	Description
<i>X stop request, lan</i>	Is used to source <i>X stop active</i> from the LAN when <i>LAN commands OK</i> is True .

Once the source is stopped, *X stop active* must be set **False** before the source is re-started.

Sequencer Commands

A sequencer **request** is generated from various user inputs to direct the sequencer to either run. A sequencer **command** is the internal “go ahead” to sequencer once the permissive logic has been satisfied (see *Sequencer Permissives*).

The variable *Run request* is associated with **Run Commands** and direct the sequencer to run the source

Run Commands

A run command (initiated by *Run request*) will:

- Enable bridge power
- Cause the dc link to charge by closing the MB contactor
- After appropriate timing and the link is charged, command the MA contactor to close and open the MB contactor.
- Verify that the pll is locked
- Begin controlling link voltage by ramping the dc link reference.

Function inputs

<i>Parameter</i>	<i>Description</i>
<i>Hardware run ptr</i>	Selects an external input that can source <i>Run request</i> . This input is active in both “Remote mode” and “Local Mode”. This pointer was designed to point to one of the digital inputs. The sequencer behavior enables an automatic run request to be generated to the source after a power-up reset if the input to which <i>Hardware run ptr</i> is pointed is high. After power-up, this signal is transition detected. A low to high transition will attempt to issue a run command and a high to low transition will stop the source if it is running.

<i>Variable</i>	<i>Description</i>
<i>Hardware run request</i>	Sets/clears <i>Run request</i> when <i>Hardware run ptr</i> is used
DDI Run pushbutton	Sets <i>Run request</i> to True if the source is in Local mode (<i>Local mode active</i> is True).

Function outputs

<i>Variable</i>	<i>Description</i>
<i>Run request</i>	The request to run the source. The details of the logic which forms this signal is shown in the sequencer diagrams.
<i>Run command</i>	Internal sequencer command formed from <i>Run request</i> , and the <i>Ready to run</i> permissive string.

Sequencer Status

The sequencer provides source status information that can be used by various application functions and is also used for internal sequencing functions. The status information is divided into 2 types:

- source status variables
- Sequencer status variables

Source status variables

Source status variables provide general information about the status of the source (e.g. whether it is running, stopped, etc.) These variables are used by the toolbox and by the DDI (also called keypad) to provide source status information to the user. source status information is provided to the LAN as well. (See *LAN Signal Map*.)

Variable	Description
<i>Bridge is on</i>	Bridge power is enabled.
<i>Inner reg enable</i>	The inner regulators have been enabled and the control is in the mod to provide power.
<i>Normal</i>	This is the normal state. The control will spend almost all of its life here once the run command has been given. The SCRs are fired full on here so that the maximum voltage is developed here.
<i>No faults active</i>	No faults or alarms exist in the source.
<i>Ready to run</i>	The source is ready to run and will start if a run is requested. (See <i>Sequencer Permissives</i> .)
<i>Running</i>	The source is running (i.e. the regulators are enabled).
<i>Stopped</i>	The source is stopped (i.e. bridge power is off).
<i>Trip fault active</i>	A Trip fault exists in the source.
<i>PLL proven</i>	The phase lock loop has been proven and is ready to be used for phase controlled cell gating.
<i>Bleed test</i>	The bleed test is in progress. It is attempting to verify that the dc link will bleed down when cell gating ceases.
<i>Sequencer state</i>	Internal sequencer state variable that indicates what mode the sequencer is in. Possible values include: • Stopped • PLL sync • Short test • Bleed test • Ramp Up • Running
<i>Bridge test skip lvl</i>	This is the level of dc link voltage above which the short test and the bleed test will both be skipped. The reasoning here is that in order for the voltage to have reached this level, there could not have been a short and the bleed test has already been

	preformed. This is a means of speeding up the dc link initialization process.
<i>Fire All</i>	Indication that all scrs are being fired all the time – not phase controlled. This is done for very brief periods of time if ability to fire in a phase controlled manner is lost. The total time is limited by <i>Maximum fireall time</i> .
<i>Maximum fireall time</i>	This is the maximum amount of time that the SCRs can be fired in the <i>Fire All</i> mode. If this time is exceeded, the SCR gating will shut off and the control will wait for the ac line conditions and phase lock loop status to allow phase controlled firing before it ramps up the dc link voltage again. The control will trip out on an under-voltage trip eventually if these conditions are not met.
<i>Min run voltage</i>	The voltage which must be maintained or exceeded for a short period of time before the ramp-up state is complete and the control is allowed to progress to the “Normal” state.
<i>Powerdip inactive</i>	This is the power-dip inactive state. The two power-dip states are independent of the main state machine. The will spend most of its time in this state.
<i>Powerdip active</i>	This is the power-dip state. The control enters this state when the dc link voltage dips below a specified level. It will recover back to the <i>Powerdip inactive</i> state when the dc link voltage exceeds another level.
<i>Pwr dip action lvl</i>	The level below which the control goes into the power-dip state.
<i>Pwr dip recovery lvl</i>	The level above which the source is no longer in the power-dip state.
<i>SCRs Off</i>	This is the SCR off state. Entry to this state occurred when the dc link voltage dipped to a level too low for recovery to the normal state with “full on firing” of the SCRs. Control will transfer back out of this state to recovery when the ac line will support a phase-controlled ramp-up of the voltage.
<i>Short test</i>	The short test is in progress. This purpose of this test is to insure that there is not a short on the dc link before the control attempts to ramp up the link voltage. Cells are fired a a very retarded angle so that if a short is present, fuses will not be blown.
<i>Sync check</i>	This state is used to briefly check that the phase lock loop is locked to the ac line. A fault will occur if the phase lock loop is not synchronized with the line.
<i>Ramp up</i>	This is the ramp-up state. The control is bringing the dc link up. The dc link is ramped up from the bleed test level to full on during this state. The

	ramp-up is done at a controlled rate so as to stay out of continuous current.
<i>Recovery</i>	This is the recovery state. The control attempts to re-gain control to the normal (full on firing) state by safely ramping up the dc link voltage and controlling current magnitude so as not to allow fuses to blow.
<i>Cell test request</i>	Cell test is in progress. This is a “for display only” variable
<i>Cell test in running</i>	Cell test is in progress. This variable is used for diagram display and also for control where knowledge of cell test status is important.

Source request variables

Sequencer status variables are used to request and report status of internal regulator sequencing. These variables normally come in pairs of a **Request** and a **Status**. The **Request** is a command to either enable or disable the appropriate function. The **Status** is a feedback that indicates the command has been successfully executed (i.e. enabled or disabled) and the sequencer can proceed to its next state.

<i>Variable</i>	<i>Description</i>
<i>Seq sync request</i>	Request to check that the pll is proven <i>PLL proven</i> .
<i>Seq sync status</i>	The pll was seen proven when checked.
<i>Short test request</i>	Request from outer sequencer to perform the short test
<i>Short test status</i>	Short test has completed
<i>Bleed test request</i>	Request from outer sequencer to perform bleed test
<i>Bleed test status</i>	Bleed test has completed
<i>Ramp up request</i>	Request from outer sequencer to perform dc link ramp up
<i>Ramp up status</i>	Ramp up is complete
<i>Reg enable request</i>	Request to enable (disable) all regulators.
<i>Reg enable status</i>	Status that all regulators are enabled (disabled).
<i>Cell run test req</i>	Request from outer sequencer to run cell test
<i>Cell test status</i>	Cell test has completed
<i>Hardware run request</i>	Sets/clears <i>Run request</i> when <i>Hardware run ptr</i> is used

Source Configuration Functions

Intelligent Part Number (IPN)

The Intelligent Part Number (IPN) specifies the Innovation Series product and the basic configuration of the product. The IPN is the catalog number for the Innovation Series product. It can be found on the inside of the cabinet door.

The IPN for the Innovation Series non-regenerative source with general application pattern takes the following form:

ACCBN-A-FRAM-VOLT-FREQ-VERS-xxx-xxxx-x

The IPN contains eight fields separated by dashes. The fields shown in italics are user configurable.

Product field

The product field is designated by the characters ACCBR. The characters have the following meaning:

AC	AC line input
CB	Common bus
N	Non-Regenerative

Pattern field

The pattern field is designated by the character A. The character has the following meaning:

A	General application firmware pattern
---	--------------------------------------

The following table specifies the configuration parameters associated with this function.

<i>Parameter</i>	<i>Description</i>
<i>IPN frame size</i>	(FRAM) – Frame size of the product.
<i>IPN volt rat</i>	(VOLT) – Maximum input voltage and device rating.
<i>IPN frq</i>	(FREQ) – Nominal AC line frequency.
<i>IPN frame version</i>	(V) – Bridge frame version size

Frame size field

The frame size field is designated by the characters *FRAM*. The designation has the following meaning:

<i>FRAM</i>	Bridge frame size
-------------	-------------------

The following regenerative source frame sizes are supported:

0620, 1000, 1800

System voltage field

The system voltage field is designated by the characters *VOLT*. The designation has the following meaning:

<i>VOLT</i>	Maximum input voltage and device rating
-------------	---

The non-regenerative source supports the following system voltages:

0575

AC Line Frequency (FREQ) field

FREQ Nominal AC line frequency (FREQ)

The FREQ selection is set according to the frequency of the ac line being used, but bridges are made for a specific frequency since the inductor changes based on frequency. The non-regenerative source supports the following FREQ selections:

THD selection	Shunt ratings
50hz	All 50 hz nominal ac lines
60hz	All 60 hz nominal ac lines

Bridge Version field (Vers) field

The version is designated by the character V. The designation has the following meaning:

V Bridge version

The bridge version selection must correspond with the nameplate version number of the bridge. This is critical. Bridge version changes when a bridge component changes which effects configuration of the control. Failure to select the correct bridge version can prevent proper operation of the source, disable needed protections, or cause feedback mis-scalings.

Primary Source & Application Data

User entered parameters

Several primary values define the ac line characteristics for the Innovation Series low voltage non-regenerative source. The primary values include ac line frequency and voltage

The primary values are used to determine control and protective settings for the drive.

The following table lists the user entered parameters that specify the primary data:

Parameter	Description
<i>AC input voltage</i>	AC line voltage(rms) at bridge terminals
<i>Phase rotation</i>	Ac line phase sequence rotation request

This product is designed to require very few user inputs. It essentially acts a power supply and is expected to provide a stable and dependable dc link with very little user information. Many calculated final values are derived from these few user inputs.

Display meter scaling parameters

The Innovation Series Low Voltage Non-Regenerative Source contains a set of parameters which specify the scaling for the DDI and toolbox display meters. These parameters are calculated from the primary source bridge and application parameters. They are calculated within either the *Source Commissioning* wizard or the *Per Unit Setup* wizard. If any of the primary data parameters is modified outside the *Source Commissioning* wizard, the *Per Unit Setup* wizard should be performed to update the display meter scaling parameters.

Source Control Functions

Non-Regen Source Overview

The Non-Regen Source is a simple hybrid bridge converter connected to the customer power grid, typically used to provide a dc power source for multiple DC-Fed drives. The bridge has three SCRs and three diodes

This product has an optional dynamic brake package to provide for regeneration from the connected drives in a limited manner.

For all applications, the Non-Regen Source's basic control strategy is to ramp up the dc link upon receiving the "start" command and then to fully rectify the ac line. Protection of the bridge in the face of ac line transients is performed by phase-back of the SCRs when needed.

An extensive self-test is provided by the control. This test verifies performance of each of the each SCR and the dynamic brake, if present. Current feedback validity is also checked, and the total link capacitance is measured.

As with the other Innovation Series Products, there are numerous protectives provided, including thermal models for the SCRs, diodes, and the dynamic brake IGBT.

Some of the basic bridge diagnostics are listed below and can be seen in the bridge over-view diagram in the toolbox.

Variable	Description
<i>AC line current</i>	Filtered current magnitude. A true magnitude calculation of demodulated Ia and Ib which is then filtered.
<i>AC line voltage</i>	Filtered ac line magnitude. A true magnitude calculation of Vab and Vbc which is then filtered.
<i>Avg line voltage mag</i>	This is the task 2 representation of ac line magnitude. It is the average of the last four task 1 values. This signal is used in LAN communications for ac line magnitude display.
<i>AC line frequency</i>	The filtered ac line frequency produced by the phase lock loop.
<i>AC line input power</i>	The filtered ac line real power.
<i>DC bus voltage</i>	The filtered dc link voltage

The bridge over-view diagram also shows whether or not the dynamic brake option is available, and, if so, the value of the dynamic brake resistor.

Parameter	Description
<i>Enable dynamic brake</i>	Dynamic brake enable. Set true only if a dynamic brake package is present.
<i>Dynamic brake res</i>	The value of the dynamic brake resistor, if present.

Phase Lock Loop Function

The source phase lock loop function is the heart of the source control. The pll outputs phase and frequency information to the rest of the control, which is critical to the regulators and to gating. As with the other source regulation functions, there are

no user parameters which directly effect the regulator, but there are some commissioning wizard parameters that are critical.

In order for the source phase lock loop to accurately lock to the ac line under all types of loading conditions, information about line stiffness, inductance, and resistance must be known. The most vital information needed for the source phase lock loop conditioning and current regulator gains is ac line inductance. The control can calculate inductance from user-provided transformer information and know bridge inductance information, or the user may enter the inductance, and bypass those calculations. The most fundamental user parameters are listed below.

Parameter	Description
<i>Transformer KVA base</i>	The KVA rating of the transformer feeding the source - used in the control's inductance calculation.
<i>Common transformer</i>	This parameter is set to prevent the bleed test from running on non-regen sources when they share a transformer with another source. The common mode voltage generated by drives attached to other sources on a common transformer will cause the bleed test to fail unless this parameter is set.
<i>Xfrmr per cent imped</i>	The per cent impedance of the transformer feeding the source. This value can be increased from name-plate data if feeder lines are very long.
<i>AC feeder source</i>	Determines the bandwidth of the phase lock loop. If the "utility" selection is used, the bandwidth is set to obtain an amount of "sluggishness" appropriate for a utility feed. The pll will be more robust and less sensitive to un-real disturbances. The setting should be "isolated generator" only if the line is a diesel-generator or other spongy line source. The bandwidth ratio of "utility" versus "isolated generator" is 4:1.
<i>Phase rotation</i>	The phase lock loop can lock to either "forward-ABC" or reverse phase sequence. The fault <i>AC line rev phs seq</i> will occur if the wrong sequence is seen by the control.

The following table lists and describes several variables associated with the phase lock loop.

Variables	Description
<i>Y axis line voltage</i>	The feedback for the phase lock loop regulator. The reference is zero, since the phase lock loop is attempting to regulate the y-component of the line voltage to zero.
<i>X axis line voltage</i>	The demodulated x-axis component of the ac line voltage. It is not used in the actual phase lock loop regulator, but is used with <i>VyLine</i> to calculate the AC line magnitude, <i>AC line voltage</i> .
<i>PLL error</i>	The phase lock loop regulator error.
<i>Line monitor frq</i>	A low-pass filtered version of the phase lock loop frequency. It is used for frequency fault checking.
<i>PLL frequency</i>	The main un-filtered ac line frequency, as determined by the phase lock loop regulator. This value is used throughout the control's regulators.

<i>AC line angle cmd</i>	This is the angle of the ac line, as determined by the phase lock loop regulator. It is the angle used to determine the phase of the up/down commands to the bridge gating interface.
<i>AC line angle fbk</i>	This is the angle of the ac line, as determined by the phase lock loop regulator. It is the angle used to demodulate the voltage and current feedbacks at the beginning of each fast execution task.
<i>PLL prop gain</i>	The phase lock loop proportional gain. This gain is dynamic. It very hot before the pll is locked, and then changes to a more sluggish gain.
<i>PLL integral gain</i>	The phase lock loop integral gain. This gain is dynamic. It is very hot before the pll is locked, and then changes to a more sluggish gain.
<i>PLL max frequency</i>	Maximum frequency allowed by phase lock loop regulator. This is function of the nominal input frequency.
<i>PLL min frequency</i>	Minimum frequency allowed by phase lock loop regulator. This is function of the nominal input frequency. It is also dynamic. When the pll is not locked, this variable is set to the negative of <i>PLL max frequency</i> .
<i>PLL proven</i>	This Boolean indicates whether the pll is locked. It is used throughout the control as a permissives to run or check various protections.

Regulator Limits

Each regulator has limits which are used to protect against wind-up and excessive demands for the output of the regulator. See *Regulator in limit* or *Reg in lim time out* for details.

Control Diagnostic Variables

Several filtered control diagnostic variables are available to the user. They are listed in the table below.

<i>Variable</i>	<i>Description</i>
<i>AC line current</i>	Filtered current magnitude. A true magnitude calculation of demodulated Ia and Ib which is then filtered.
<i>AC current mag(fast)</i>	Unfiltered ac current magnitude sampled at fastest execution rate.
<i>AC line voltage</i>	Filtered ac line magnitude. A true magnitude calculation of Vab and Vbc which is then filtered.
<i>AC line frequency</i>	The filtered ac line frequency produced by the phase lock loop.
<i>DC bus power</i>	The dc bus power is calculated from the demodulated ac line voltages and currents and is compensated for bridge losses.

<i>DC bus current</i>	The filtered, estimated dc link current. This is calculated from <i>DC bus power</i> divided by the dc link voltage.
<i>AC line input power</i>	Filtered ac line power. This is the power at the terminals of the source. It is calculated from the demodulated currents and voltages sensed at the terminals of the source.
<i>Volt amps reactive</i>	This is the filtered volt-amps reactive seen by the source control via the demodulated voltages and currents measured at the terminals of the source.
<i>Measured capacitance</i>	The total capacitance of the source and all connected drives on the link as measured by cell test.

Dynamic Brake Control

The Low Voltage Non-Regenerative Source has an optional dynamic brake package that will allow for limited regeneration of attached drives into the DC link. The regulator is a proportional plus integral type. The reference is normally a changing value which is a few per cent increase over the value of dc link voltage that can be sustained by the present magnitude of the ac line. The feedback is a FIR filter, the same as used for the voltage regulator on ACCBR-A (regenerative source – low voltage). The output of the regulator is sent to a frequency modulator which accumulates output until a full “packet” can be sent to the firing scheduler.

The output of the regulator can be switched for population by other procedures, such as the test oscillator, or the diesel warming function. Cell test also takes over the output of the dynamic brake regulator.

The user diagram, Ovr_DB_Reg , is very valuable in understanding the behavior and topology of the dynamic brake regulator. Also, Ovr_Dsl_Wrm gives an overview of the diesel warming function.

The following tables of variables and parameters help further describe this function.

<i>Variable</i>	<i>Description</i>
<i>Ac line magnitude</i>	The magnitude of the ac line, obtained by demodulation of input AC signals , then a magnitude calculation at the fastest execution rate.
<i>DB res measured</i>	The dynamic brake resistance found by cell test.
<i>DB electrical tau</i>	The dynamic brake time constant as found by cell test.
<i>DB auto ref max</i>	The clamp which controls the maximum floating reference for the dynamic brake regulator.
<i>DB auto ref min</i>	The clamp which controls the minimum floating reference for the dynamic brake regulator.
<i>DB duty</i>	The clamped and modulated output of the dynamic brake regulator. Because of the modulator, this value is always either zero or one. This value determines the time of the next switch scheduling of the DB IGBT.
<i>Regulation DB duty</i>	The output of the dynamic brake regulator before it goes to the frequency modulator.
<i>DB voltage error</i>	The error signal for the dynamic brake regulator.

<i>DB proportional duty</i>	The proportional signal for the dynamic brake regulator
<i>DB integral duty</i>	The integrator signal for the dynamic brake regulator
<i>DB integrator delta</i>	The integrator delta
<i>DB cell test active</i>	A Boolean which, when set by cell test, allows it to take control of the dynamic brake regulator reference.
<i>DB reg fixed thrsh</i>	The mirror image of a final value which, when set, forces the DB regulator to use a fixed reference, as mirrored by <i>DC link DB threshold</i>
<i>DB open loop cmd</i>	A variable used by cell test to set the dynamic brake regulator duty directly, forcing a bypass of the regulator, but using the modulator.
<i>DB regulator mode</i>	When set true, this variable indicates that the dynamic brake regulator is operating in its “normal” mode, using the floating reference as a maximum allowed voltage.
<i>DB int max limit</i>	The upper limit for the integrator of the dynamic brake regulator
<i>DB int min limit</i>	The lower limit for the integrator of the dynamic brake regulator.
<i>DB integral gain</i>	The integrator gain for the dynamic brake regulator.
<i>DB line scale factor</i>	The scale factor applied to the floating reference for the dynamic brake regulator. When the maximum attainable dc link voltage is multiplied by this number, the reference for the regulator results.
<i>DB modulation max</i>	The minimum dynamic brake modulation limit.
<i>DB modulation min</i>	The minimum dynamic brake modulation limit.
<i>DB prop gain</i>	The proportional gain for the dynamic brake regulator.
<i>DB power filtered</i>	Filtered dynamic brake power.
<i>DB voltage command</i>	The reference for the dynamic brake regulator, regardless of the source.
<i>DB Wo gain</i>	The dynamic brake resonant frequency compensation -- a function of capacitance.
<i>DC link DB threshold</i>	The fixed reference for the dynamic brake regulator, used only when <i>DB reg fixed thrsh</i> is true.
<i>DB open loop duty</i>	A ram copy of the parameter, <i>DB open loop duty</i> . This parameter can be pointed to by <i>DB_Open_Adr</i> , allowing a open loop test controlled by the user. Care must be exercised when using this mode.
<i>DB inhibited</i>	A variable representing the on/off state of the dynamic brake regulator.
<i>Diesel warm-up duty</i>	The output of the diesel warm-up function, which becomes the output of the entire regulator when the

	diesel warm-up mode is invoked.
<i>Diesel warm-up req</i>	This variable is set when the a diesel warm-up is requested. It forces the DB regulator to relinquish its output to the control of the diesel warm-up control.
<i>Lan DB on request</i>	This Boolean variable can be pointed to by <i>Diesel warm select</i> so that the LAN can have control capability of the diesel warm function.
<i>DC voltage feedback</i>	The feedback used for the dynamic brake regulator. This feedback is the output of a FIR filter applied to <i>DC bus feedback</i> .
Parameter	Description
<i>Enable dynamic brake</i>	This parameter is set True in order to enable the dynamic brake function. When it is set False, all dynamic brake functions are disabled.
<i>Dynamic brake res</i>	The resistance of the dynamic brake resistor. This parameter is used in several calculations in the control.
<i>DB circuit tau</i>	The electrical time constant of the dynamic brake circuit. Note that cell test calculates a value of the time constarnt which can be used to update <i>DB circuit tau</i> .
<i>DB res pwr rating</i>	The continuous power rating of the dynamic brake resistor. This parameter is used to calculate settings for the DB resistor thermal model protectives.
<i>DB res impulse pwr</i>	The impulse power rating of the dynamic brake resistor. This parameter is also used to calculate settings for the DB resistor thermal protectives.
<i>DB res impulse time</i>	The amount of time (in seconds) that the dynamic brake resistor can tolerate <i>DB res impulse pwr</i> applied to it.
<i>DB control open loop</i>	The user request to operate the dynamic brake control in an user-controlled open loop manner. The parameter, <i>DB open loop duty</i> can then be used to set the duty cycle when in this mode if it is pointed to by the paramter, <i>DB open loop select</i> . See toolbox drawing, OVR_DB_REG. . Note that some thought should go into the setting of the duty cycle.
<i>DB open loop select</i>	This pointer allows the user to select the reference for the DB duty cycle in open loop mode. Note that <i>DB open loop cmd</i> must be set True.
<i>Diesel warm select</i>	The pointer which points to the source of the diesel warming function on/off Boolean . Normally, this will be one of the digital inputs.
<i>DB Power Request</i>	The real power request for the diesel warming mode. The diesel warming regulator will regulate the DB duty to obtain the desired wattage requested as long as it is within the capability of the circuit.
<i>DB power omega</i>	This parameter adjusts the response (rad/sec) of the low pass filtered variable, <i>DB power filtered</i> .

Diesel Warming

The Low Voltage Non-Regenerative Source has a diesel warming function which can be used to periodically load a diesel with a specified amount of power from the dynamic brake circuit(if provided). A pointer directed at a digital input or other source is used to invoke the regulator. A regulator modifies the duty cycle of the dynamic brake IGBT so as to give the requested power. The requested power must be within the constraints of the dynamic brake circuit. All protectives are in effect when this function is invoked.

<i>Variable</i>	<i>Description</i>
<i>Diesel warm-up duty</i>	The output of the diesel warm-up function, which becomes the output of the entire regulator when the diesel warm-up mode is invoked.
<i>Diesel warm-up req</i>	This variable is set when the a diesel warm-up is requested. It forces the DB regulator to relinquish its output to the control of the diesel warm-up control.
<i>Parameter</i>	<i>Description</i>
<i>DB power filtered</i>	Filtered dynamic brake power.
<i>Diesel warm select</i>	The pointer which points to the source of the diesel warming function on/off Boolean . Normally, this will be one of the digital inputs.
<i>DB Power Request</i>	The real power request for the diesel warming mode. The diesel warming regulator will regulate the DB duty to obtain the desired wattage requested as long as it is within the capability of the circuit.

Firing Angle Ramp Functions

Normally, the low voltage non-regenerative source fires its SCRs at the ‘full on’ angle (fully advanced), so as to produce the maximum voltage. There are transition times, however, when the firing angle is being slewed from a retarded angle to a fully advanced angle. During any transition of the firing angle to a more fully advanced angle, the rate of change of the firing angle, or ramp rate, must be controlled so as to constrain the inrush current to the bridge. This is the primary function of the ramp function.

The ramp function works in the following way. The sequencer sends a request to the ramp function for a specific firing angle. If the ramp freeze logic is requiring that the ramp cease momentarily, there will be no change in firing angle. If the ramp freeze logic allows the angle change, then it will change by an incremental angle determined by preset parameters and final values.

The freeze logic is de-activated if the source is running, that is, after the control has ramped the firing angle to the ‘full on value’. Either of two items can freeze the firing angle. One of those is a current feedback great enough to say that “zero current” has not been achieved. The other item is a comparison between a maximum allowed peak current and an expected peak current based on the firing angle that is scheduled to be used. If the expected peak current is predicted to be greater than the maximum allowed peak current, the freeze logic will prohibit advancement of the firing angle.

This function is described further the the tables below which list the pertinent parameters and variables.

The slew rate controller controls the rate at which the firing angle can advance.

Each Innovation Series product contains a diagnostic oscillator. The oscillator for the non-regenerative source switches between adjustable positive and negative values. The oscillator can be used as a reference signal source for test purposes.

Function variables

The following table specifies the output variables of the *Firing Angle Ramp Functions* function.

Variable	Description
<i>Beta firing command</i>	The output of the slew rate generator which is the firing angle used. When <i>Beta firing command</i> is zero, the output voltage will be near zero
<i>Beta firing request</i>	The requested firing command as set by the sequencer. The value varies depending in the mode of operation. Some of those modes are during short test, cell test, and running.
<i>Firing angle ramping</i>	The variable is true when <i>Beta firing command</i> and <i>Beta firing request</i> are equal, that is, the requested firing command has been achieved.
<i>Freeze cmd beta slew</i>	This Boolean is set true when the ramp rate generator detects that zero current is not present or that implementation of the newly calculated firing angle would result in excessive in-rush current.
<i>Running</i>	The source has ramped <i>Beta firing command</i> to the 'Full on ' value and is ready to accept load..
<i>Zero current flag</i>	The zero current detector sets this Boolean True when current feedbacks indicate that current magnitude is below a rule-calculated zero current threshold.
<i>Peak ramp current OK</i>	This variable is set true when expected peak current threshold detector determines that if the new firing angle is implemented, the resulting current will be below <i>Max ramp current</i> .
<i>Expected peak cur</i>	The predicted current magnitude that will occur if the new firing angle is implemented.
<i>Max ramp current</i>	The ram copy of a final value which is used as the threshold of comparison when determining if the predicted peak current exceeds the maximum. This value if based on rated current of the source.

Function configuration

The following table specifies the configuration parameters of the *Firing Angle Ramp Functions* function.

Parameter	Description
<i>Slew deg per firing</i>	The number is the firing angle slew rate that will result if the zero current detector and the peak current threshold detector do not freeze the firing angle advancement. This parameter is used during link ramp-after bleed test has completed . There are other slew rates used for other times, such as the short test ramp up and cell test ramp-ups.

SCR and DB Firing Mechanics

There are two major types devices two gate for the low voltage non-regenerative source. These are (1) the SCRs, which are always present, and the (2) dynamic brake IGBT, which is option for this product.

The SCR gating uses the phase lock loop output angle, which represents the phase of the ac line. Another very important input is the firing command angle from ramp rate generator. This firing command is transformed into three different firing angles between 0 and 360 degrees, one for each SCR. At any given time, a particular SCR is scheduled to be gated next. For forward sequence of the ac line, the order is SCR-1, SCR-2, SCR-3. When the firing scheduler runs, it checks the angle at which the next SCR is to be fired against the actual angle of the ac line as seen by the phase lock loop. If the difference between these two angles is less than the angle of movement for one execution time, the gating will be scheduled. This is a simplistic view of the gating scheme, but should still provide basic input.

The dynamic brake regulator, when used, outputs a duty signal which is feed to the DB fire scheduler. This scheduler is quite simple. It schedules every fast execution pass, or every 250usec, but schedules the gating to the transistor so that a pulse occurs every 500usec, making the DB frequency 2khz. Each execution time, the scheduler either schedules an 'on' or an 'off' for the transistor so that a transistor "on" pulse is centered around the task 1 execution starting time for every other task1.

Function variables

The following table specifies the output variables of the *SCR and DB Firing Mechanics* function.

Variable	Description
<i>Beta firing command</i>	The output of the slew rate generator which is the firing angle used. When <i>Beta firing command</i> is zero, the output voltage will be near zero
<i>PLL frequency</i>	The main un-filtered ac line frequency, as determined by the phase lock loop regulator. This value is used throughout the control's regulators.
<i>AC line angle cmd</i>	This is the angle of the ac line as determined by the phase lock loop regulator. It is the angle used to determine the angle to gate SCRs relative to the angle at which the gating is scheduled..
<i>Y-axis volt fbk</i>	Y-component of ac line voltages – sampled at fast rate. The phase lock loop regulates a derivative of this signal to zero in order to stay synchronized with the ac line.
<i>X-axis volt fbk</i>	X-component of ac line voltages - sampled at fast rate. This signal is not used in the firing command scheme.
<i>DC bus feedback</i>	Unfiltered DC link voltage, DC volts. A filtered version of this signal is used in the DB voltage control
<i>Real current fbk</i>	<i>X-component of phase currents – sampled at fast rate. This signal is used in ac line re-construction.</i>
<i>Reactive current fbk</i>	Y-component of phase currents – sampled at fast rate. This signal is used in ac line re-construction.
<i>DB duty</i>	This is the duty signal from the dynamic brake regulator. It is used to determine IGBT gating times.

Chapter 3 Wizards

Introduction

This chapter contains descriptions and help items associated with configuring and diagnosing the Innovation Series low voltage-ACCBN-A drives. They are organized in the following manner:

<i>Section</i>	<i>Page</i>
Simulator Setup.....	1
Analog Filter Setup	2
Capture Buffer Setup	2
DAC Setup.....	2
Diagnostic Filter Setup	2
Ground Fault Setup	3
Panel Meter Setup.....	3
Per Unit Setup.....	3
Relay Output Setup	3
Remaining Parameter Setup.....	3
Default Parameter	3
Source Commissioning	3
AC Line Protectives Wizard	8
Line Protection Module Wizard.....	9
Line Data Wizard.....	10
Cell Test Wizard	11

Simulator Setup

Simulator Setup: Introduction

The *Simulator Setup* configures the drive to run in simulator mode.

Simulator Setup: Simulator Mode

If you would like to run the drive in simulator mode, select *Yes*.

If you do not want to run the drive in simulator mode, select *No*.

Related functions

- *Simulator*

Simulator Setup: Hardware Fault String Override

If you would like to disable the *Local flt* and *System flt* trip faults in simulator mode, select *Yes*.

If you would like to continue to check for the *Local flt* and *System flt* trip faults in simulator mode, select *No*.

Related functions

- *Hardware Fault Strings*

Simulator Setup: Conclusion

The *Simulator Setup* has reconfigured the drive with your selections.

Analog Filter Setup

The *Analog Filter Setup* wizard directs configuration of the analog input filters. For more information on the analog input filters, see the *Analog Inputs/Outputs and Mapping* function help.

Capture Buffer Setup

The *Capture Buffer Setup* wizard directs configuration of the capture buffer. For more information on the capture buffer, see the *Capture Buffer* function help.

DAC Setup

The *DAC Setup* wizard directs configuration of the analog outputs (DACs). For more information on the DACs, see the *Analog Inputs/Outputs and Mapping* function help.

Diagnostic Filter Setup

The *Diagnostic Filter Setup* wizard directs configuration of the general purpose diagnostic filters. For more information on the diagnostic filters, see the *General Purpose Filters* function help.

Ground Fault Setup

The *Ground Fault Setup* directs configuration of the ground fault protection. It is recommended that the control be allowed to calculate the default ground fault parameter settings. For more information on the ground fault parameters, see the *Ground Fault Protection (Slow)* and *Ground Fault Protection (Fast)* function helps.

Panel Meter Setup

The *Panel Meter Setup* wizard directs configuration of the panel meters. For more information on the panel meters, see the *Analog Inputs/Outputs and Mapping* function help.

Per Unit Setup

The *Per Unit Setup* wizard directs configuration of the per unit parameters that determine scaling for the DDI. It is recommended that the control be allowed to calculate the default per unit settings.

Relay Output Setup

The *Relay Output Setup* wizard directs configuration of the relay outputs. For more information on the relay outputs, see the *Digital Inputs/Outputs and Mapping* function help.

Remaining Parameter Setup

The *Remaining Parameter Setup* wizard directs configuration of parameters that cannot be assigned default values during the commissioning process. It is recommended that the control be allowed to calculate the default parameter settings.

Default Parameter

A choice may be made between selecting the default parameter calculations to be made by the control or individually picking each of the parameters associated with this function. In general, the best choice is to allow the control to calculate the parameter values. Setting each individual parameter by hand requires the user to be much more familiar with the function. Proceed with care when choosing this path.

Source Commissioning

Source Commissioning: Overview

The *Source Commissioning* wizard guides the user through the process of configuring the regenerative source for a particular application. It asks a series of questions that allow the user to specify important control parameters. It also directs

the control to perform calculations that determine the values of other parameters. At the conclusion of the wizard, the source should have all of the information that it needs to run successfully.

The *Source Commissioning* wizard may be run more than once, with the following note of caution. Some of the parameters that are changed by the rule calculations may be modified after the wizard has finished. If any parameter modifications have been made, they may be lost when the *Source Commissioning* wizard runs. Parameter changes should be reviewed each time the wizard runs. In addition, a parameter backup prior to running the wizard is highly recommended.

Source Commissioning: Unit Systems

Three different unit systems are available for displaying parameters and variables:

- *Imperial (English)*
- *Metric (SI)*
- *Native (Platform)*

The *Native (Platform)* unit system displays parameters and variables in the same units that the internal control uses.

Select one of the three unit systems.

Related functions

- *Language and Units Presentation*

Source Commissioning: Common Transformer Operation

Common transformer should be set True when the non-regen source share a transformer with another source. That other source can be regenerative or non-regenerative. Setting this parameter true will cause the source to skip the bleed test which is performed immediately after the short test after a run command is given to the source. The short test will not work correctly in a common transformer configuration.

Source Commissioning: Transformer Data

The non-regenerative source does not use R/L compensation to lock to the ac line as the regenerative source does. However, the value of inductance calculated by the control from user-provided transformer data is used in other important places. It is used to calculate the angle of gating for short test. This allows the non-regen source to properly restrict the current when there is a short on the bus, but still allows reasonable rapid advancement of the firing angle when there is no short. Improperly entered data can cause this test to malfunction.

Be sure to enter the values in the units specified in the wizard.

The following values are requested::

- *Transformer KVA base*: The KVA of the transformer.
- *Xfrmr per cent imped*: Transformer per cent impedance. Refer to transformer nameplate. 5.0% is typical.

Source Commissioning: AC Line Characteristics

This help covers two items concerning the source commissioning wizard ac line

Utility/Isolated Generator

AC feeder source determines the gain used by the phase lock loop. For almost all applications, this should be set for UTILITY. If the ac line is provided by an isolated generator, then that selection should be made. This will provide for a more robust regulation system for the case where the AC line is sluggish. The isolated generator selection forces hotter gains on the phase lock loop so that it can track the faster moving, less stable AC line.

Forward/Reverse Phase Sequence

Phase rotation allows the user to specify the rotation direction of the AC line. A fault will occur if the requested direction of rotation is not seen by the control when the phase lock loop locks. The forward direction here is defined as A-B-C . See *AC line rev phs seq*

Source Commissioning: AC Line Voltage Input

RMS AC Line Input

AC input voltage is the AC line input voltage. This is the nominal voltage. The AC line can be “high” or “low” relative to nominal. This helps determine that phase lock loop gains as well as the protection thresholds for AC line magnitude.

Source Commissioning: DB Enable Decision

Dynamic Brake Functionality

Enter True if the source has an installed dynamic brake, else enter false. The complete DB capability is dependent upon this answer. If this question is answered as True when no DB is present, several faults will result.

Source Commissioning: Auto Rule Calculation

Dynamic Brake Resistance Value

Enter the ohmic value of the dynamic brake resistor here, *Dynamic brake res*, and the electrical time constant of the circuit, *DB circuit tau*. Note that both of these are important value. Power calculations are dependent upon both of them. If *DB circuit tau* is unknown, estimate it, then update the value after cell test has been run and a better result is found.

Source Commissioning: Dynamic Brake Power Characteristics

Dynamic Brake Resistor Power Characteristics

Enter the continuous power rating of the dynamic brake resistor, *DB res pwr rating*, the impulse power of the resistor, *DB res impulse pwr*, and the impulse time of the resistor, *DB res impulse time*.

These three inputs will allow for adequate protection of the dynamic brake resistor. A model can simulate the heating of the resistor with this information. Good information is critical to protection of the bridge.

See Toolbox diagram **OVR_DB_THM**.

Source Commissioning: LPPA Option

Line Protection Module

The line protection module is optional. See *Line Protection Module*

Source Commissioning: Primary Rule Calculations

Primary Rule Calculation

This step is necessary. It drives all of the user answered questions into the control and forces calculation of all of the rules. It must be done.

Source Commissioning: Control Auto Calculate

Let the control do it for you

A yes is highly recommended for this answer. The alternative will be much harder. It will require the user to run several different wizards and to answer several questions within each of those wizards. Answering yes will allow the control to populate these several user level parameters with values based on the the answers given to the preceeding questions in this wizard. The internal parameter, *Use default settings* is used to activate this path, but actual access to this parameter is not needed

Source Commissioning: Wrap-up

Usually, there will be faults remaining after the commissioning wizard has reached this point. These faults are a result of the control continuing to run its protective functions during the commissioning exercise. The simplest way to clear these faults is to give a hard reset to the control.

Source Commissioning: Capture Buffer Re-arm

Pushing this button will re-arm the capture buffer if the trigger condition is not presently met. If the defaults were used, the capture buffer will be set to trigger on a trip fault. So, if a trip fault still occurs, pushing the button will not actually re-arm the buffer. **It should be re-armed after there are no faults. This may be after the hard reset.** If the capture buffer is set to trigger on a trip fault, it will be armed the first time it powers up after a hard reset without a fault.

Source Commissioning: Simulation Defaults

You may use this wizard to reset all of the simulator user-level parameters to the factory recommended settings or you may use it to examine each simulator parameter, one by one.

Simulator Wizard: Simulator Default Decision

A yes is usually recommended for this answer. However, if you would like to use this wizard to set a simulator parameter to a non-standard value, perhaps in order to explore the result of mis-matches between the control and the plant, answering no to

this question will provide that opportunity. *Default simulator* is used to activate this path, but actual access to this parameter is not needed.

Simulator Wizard: Simulator Enable Decision

A Simulator mode is available in the drive. The simulator mode allows the drive to be “run” while not necessarily attached to an AC line or to a drive. A simulated AC line is produced which gives user capability to cause transients. The user can also request that a dc current be applied to the dc link. See *Simulator*

Simulator Wizard: Simulator Local/System Fault Options

Two protective hardware circuits must be satisfied to allow cell firing and therefore allow the drive to run. They are *Local fault string* and *System fault string*. These protective strings can be ignored for the purpose of running the drive in simulator mode. If they are not ignored, they must be satisfied to make the source run as a simulator.

Simulator Wizard: Simulator Basic Bridge Parameters

These simulator parameters represent the most basic “plant” values. They can be set to a value that is different from the control’s compensation in order to explore the effects of a mis-match between the control and the plant.

- *Sim line inductance* - Represents the plant inductance in inductors, cables, and transformers.
- *Sim capacitance* - Represents the capacitance of the source bridge in addition to the capacitance of all of the simulated attached drive bridges.

Source Sequencer Wizard: Default Sequencer Setup

A yes is usually recommended for this answer. However, if you would like to use this wizard to set up sequencer parameters to non-standard values, you may. This switch may also be used to re-set the sequencer parameters to the factory recommended values

Source Sequencer Wizard: Fault Reset and Hardware Run Address

These two pointers determine where the control looks to get commands for fault reset and hardware run commands. A fault reset can also be done from the keypad.

- *Fault reset select* - Pointing this parameter to an input will allow that input to reset trip faults to the source.
- *Hardware run ptr* - Pointing this parameter to an input will allow that input to control starting and stopping of the source. If the input pointed to by this parameter is high when the source boots up from a hard reset, the source will begin the start sequence. After that time this input will then start/stop the source on rising/falling edges of that signal.

Source Sequencer Wizard: Wizard Completion

You have completed the source sequencer wizard. The source is ready to run again with the new inputs as long as there are no faults

AC Line Protectives Wizard

Line Protection: Introduction

The Line Protection Setup Wizard allows selection or restoration of the control calculated parameters which effect line protection functions concerning over and under frequency as well as over and under voltage. One may also choose to select the value of each parameter.

Line Protection: Default Settings

The Line Protection Setup Wizard defaults are highly recommended. Making the default selection will result in voltage and frequency protection settings that are in line with the specifications of the source and that are proven settings.

Line Protection: Overvoltage

These parameters set the level of protection of the ac line over-voltage protection. It is highly recommended to use the control default values as calculated in the previous steps (you can go backward).

- *Line OV fault lvl* is the ac line voltage above which the source will trip.
- *Line OV alm on lvl* is the ac line voltage above which the source begins to alarm the over-voltage condition.
- *Line OV alm off lvl* is the ac line voltage below which the source quits alarming the over-voltage condition.

For additional information, see *Protective Functions*.

Line Protection: Undervoltage

These parameters set the level of protection of the ac line under-voltage protection. It is highly recommended to use the control default values as calculated in the previous steps (you can go backward).

- *Line UV fault lvl* is the ac line voltage below which the source will trip.
- *Line UV alm on lvl* is the ac line voltage below which the source begins to alarm the under-voltage condition.
- *Line UV alm off lvl* is the ac line voltage above which the source quits alarming the under-voltage condition.

For additional information, see *Protective Functions*.

Line Protection: Overfrequency

These parameters set the level of protection of the ac line over-frequency protection. It is highly recommended to use the control default values as calculated in the previous steps (you can go backward).

- *Over frq flt lvl* is the ac line frequency above which the source will trip.
- *Over frq alm on lvl* is the ac line frequency above which the source begins to alarm the over-frequency condition.
- *Over frq alm off lvl* is the ac line frequency below which the source quits alarming the over-frequency condition.

For additional information, see *Protective Functions*.

Line Protection: Underfrequency

These parameters set the level of protection of the ac line under-frequency protection. It is highly recommended to use the control default values as calculated in the previous steps (you can go backward).

- *Low frq flt lvl* is the ac line frequency below which the source will trip.
- *Low frq alm on lvl* is the ac line frequency below which the source begins to alarm the under-frequency condition.
- *Low frq alm off lvl* is the ac line frequency above which the source quits alarming the under-frequency condition.

For additional information, see *Protective Functions*.

Line Protection: Conclusion

You have completed the wizard. The control is now ready to run with the new values after the parameter upload.

For additional information, see *Protective Functions*.

Line Protection Module Wizard

Line Protection Module: Introduction

The Line Protection Module Wizard allows selection or restoration of the control calculated parameters which effect line protection module functions concerning the levels of current at which ground faults and alarms will be reported. One may also choose to select the value of each parameter.

Line Protection Module: Addresses

The following four parameters configure the “front end” of the Line Protection Module code. They turn the function on/off, determine the input addresses and voltage to current scalings of the ground current indication.

- *LPPA mode* enables/disables the function. If the module is not present, this should be disabled.

- *LPPA gnd flt scl* has potential to scale the input voltage into a current. Default, control calculated settings set this value to 1.0, leaving all internal signals in volts.
- *LPP fuse blown sel* is the control's address of the MOV fuse indicator input.
- *LPP gnd signal sel* is the control's address of the ground current sensing signal.

For additional information, see *Line Protection Module*.

Line Protection Module: Default Selection

Normally, you should use the default settings. If you are sure that you understand what you are doing, and want to change the settings away from defaults, you may choose the other path.

For additional information, see *Protective Functions*.

Line Protection Module: Thresholds

The following four parameters configure the low pass filter for the ground current signal as well as the alarm and trip threshold for that signal.

- *LPPA gnd flt fil* The response in rad/sec of the low pass filter which is applied to the input ground current indication signal.
- *LPPA gnd flt alm* is the ground current indication signal level above which the alarm, *Ground flt alm*, *LP* is given.
- *LPPA gnd flt clr* is the ground current indication signal level below which the alarm, *Ground flt alm*, *LP* ceases.
- *LPPA gnd flt lvl* is the ground current indication signal level above which the trip fault, *Ground flt*, *LP* is given.

For additional information, see *Line Protection Module*.

Line Protection Module: Conclusion

- You have completed the Line Protection Module Wizard. After an upload, the control is ready to run with those new values.

For additional information, see *Line Protection Module*.

Line Data Wizard

Line Data Wizard: Introduction

Data concerning the AC line is important to the non-regen source. This wizard gives opportunity to re-set the parameters associated with the ac line.

Line Data Wizard: Parameter Changes

- *AC input voltage* is the line to line voltage ac input to the bridge. It is normally either 460 volt or 575 volt. Note that this is not the IPN data voltage rating, which is device rating.

- *Phase rotation* allows the user to electronically reverse the expected ac line phase sequence. If during a start-up or re-build the fault, *AC line rev phs seq* is obtained, indicating that the phase sequence of the ac line is reverse compared to what the source expects, the sense of *Phase rotation* can be changed. A hard reset is required, but when the source comes out of the hard reset, it will be ready to run with the new phase sequence. Note that when running in simulation mode, it will be necessary to run the simulator setup wizard and choose defaults or set the sign of simulated line frequency to agree with the new setting of *Phase rotation*.

Line Data Wizard: Wizard Conclusion

You have completed the line data setup wizard for ACCBN-A, the low voltage non-regenerative source. You should now be able to run with the new parameters. If you changed *Phase rotation*, be sure to issue a hard reset to the control upon exit from this wizard.

Cell Test Wizard

Cell Test: Introduction

The low voltage non-regenerative cell test does an extensive test of the bridge. Each power semi-conductor is checked, as well as DB, if present. Current sensing is checked. A measure of total capacitance is calculated. Successful completion of this cell test gives reasonable assurance that the bridge will function properly.

Cell Test: Operation

Cell test can be invoked as long as there is no fault, but if the bridge voltage is above 30% of nominal, the cell test will wait until the dc link voltage has decayed to 30% of nominal. This cell test will last several seconds. Messages initiated by the source control will give updates as to the status of cell test, as well as measured results. Any trip fault will terminate the test.

Cell Test: Results

Cell test has completed. If failures were indicated, these should be resolved before trying to run the bridge.

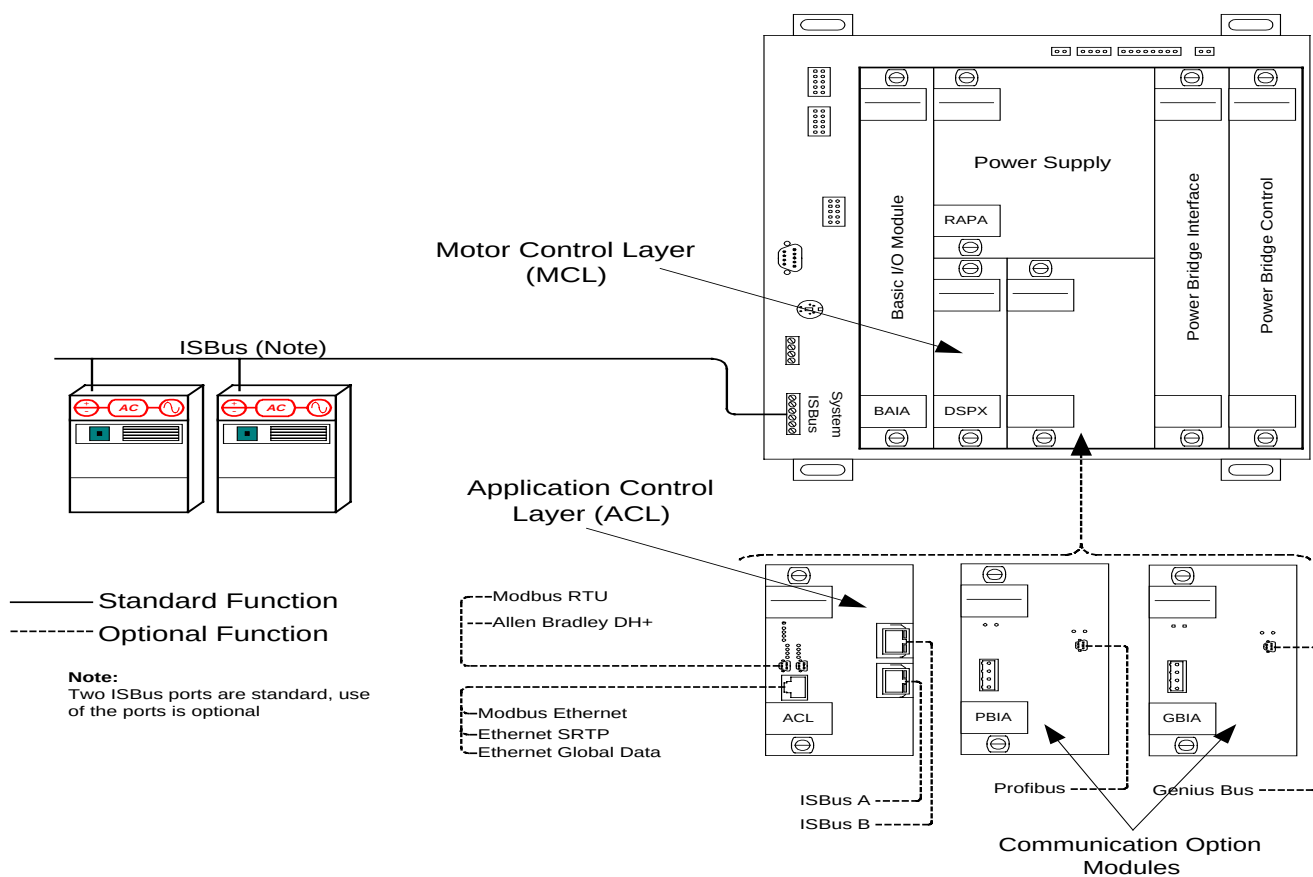
Notes

Chapter 4 Signal Mapping

Introduction

Interfacing with the motor control layer (MCL) of the drive is done through I/O or a standard LAN (local area network) signal map. This chapter describes the standard LAN signal map which is used for several LAN interfaces (refer to the following figure and table).

<i>Section</i>	<i>Page</i>
Parameter Configuration for Signal Mapping.....	3
Variable Mapping	3
Variable Maps (Source Patterns, ACCBN-A & ACCBR-A).....	6



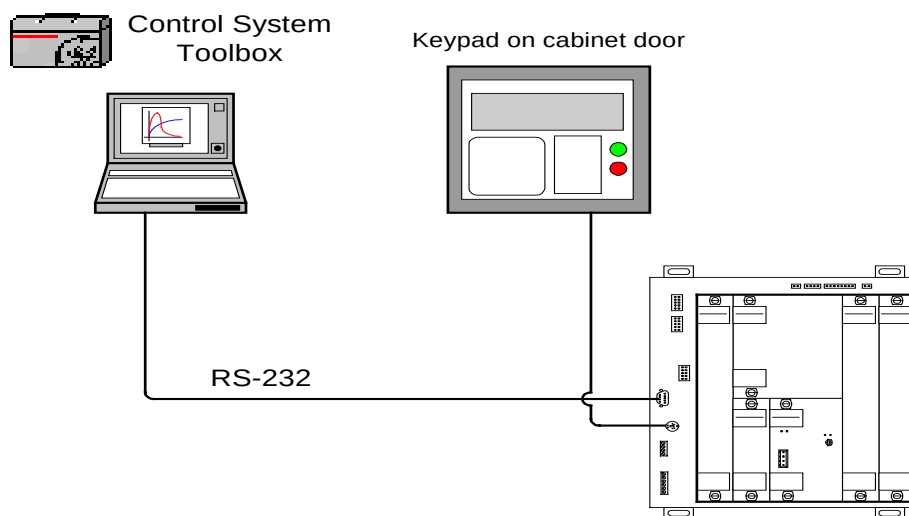
Interface	Associated Module	Notes
Profibus-DP Slave	IS215PBIA	Freeze and sync mode supported Support of 9.6Kb to 12Mb
Genius	IS215GBIA	LAN heartbeat supported
ISBus Slave	IS215DSPX	Supported from motor control layer, no additional modules required
Application Control Layer (ACL)	IS215ACLI	From the ACL, other LANs are supported: - Modbus RTU - Allen Bradley DH+ - Modbus Ethernet - Ethernet SRTP - Ethernet Global Data Configuration is required in the ACL

Parameter Configuration for Signal Mapping

The 64 byte bi-directional signal map is configured with either the keypad or toolbox.

Refer to the data sheets associated with these interface modules for a detailed description of the configuration.

Signals are LAN or I/O based variables that either control the drive or provide feedback data on the status of the drive. For example, an analog input signal provides the speed reference for the drive



Parameters are used in the drive for configuration of functions. For example, six parameters are used to configure the ramp rate function generator in the general industries pattern.

LAN Interface	Description of Configuration
Genius Bus	Auxiliary Genius Bus Interface Module IS215GBIAH_A__ GEI-100269
Profibus-DP	Auxiliary Profibus-DP Interface Module IS215PBIAH_A__ GEI-100419
ISBus	GEH-6417
ACL based LAN Interfaces	GEI-100434

Variable Mapping

Variables are dynamic references for control of the drive or contain feedback on the status of the drive. For example, speed feedback and speed reference are two variables associated with the speed regulator function in the drive

The variable map is defined in terms of paired reference and feedback pages.

Page Type	Direction of Data
Reference Page	Sent from the controller to the drive (speed reference for example)
Feedback Page	Sent from the drive to the controller (speed feedback for example)

Each element in the map is assigned a data type. Standard assignments utilize the two data types, a 32-bit real and 1-bit Boolean.

Data Type	Format
Real	IEEE 754 single format (23-bit mantissa, 8-bit exponent, 1-bit sign)
Boolean	1-bit per signal

The following table specifies variables which indicate the LAN health and status for the LAN Configuration and Health function.

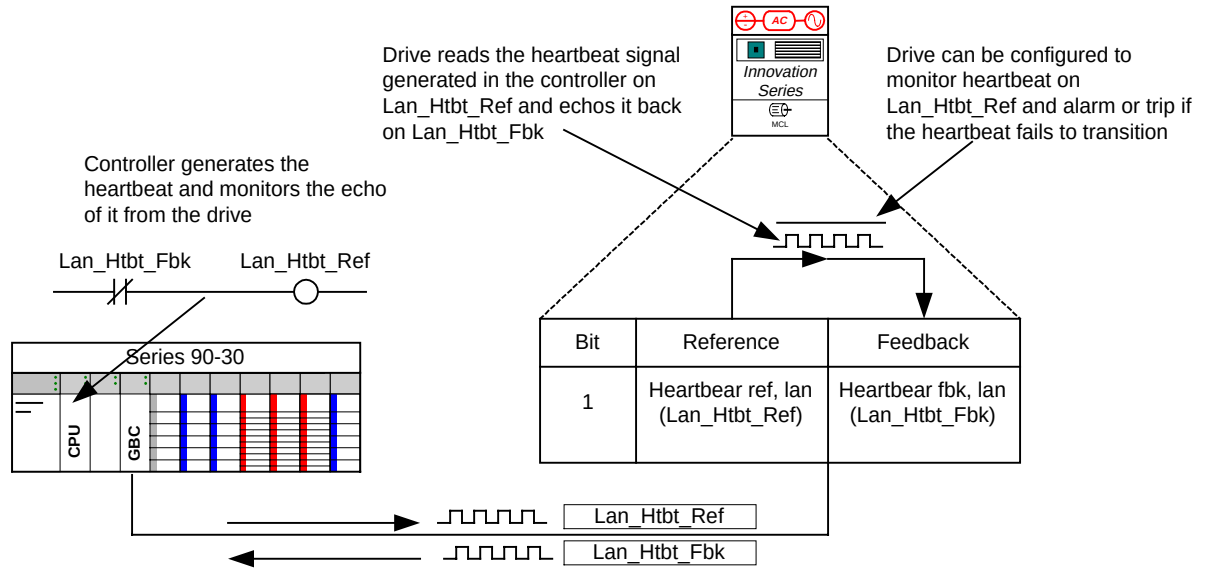
Variable	Description
LAN connection OK	Indicates that the health of the LAN connection is good, such that the LAN watchdog function is satisfied.
LAN commands OK	Indicates that the health of the LAN references are good, based upon the detection of two successive LAN connection ok indications.
Heartbeat ref, LAN	LAN heartbeat signal that is generated by the controller. The drive can be configured to alarm or trip upon the failure of this heartbeat. The drive also echos this signal back out the Heartbeat Fbk LAN variable.
Heartbeat Fbk, LAN	Drive echos the Heartbeat ref variable out on Heartbeat Fbk.
Sys ISBus error Cnt	Not applicable
Sys ISBus error Reg	Not applicable
Frame PLL OK status	Not applicable
FPLL Freq Output	Not applicable

Applying the LAN Heartbeat Echo Feature

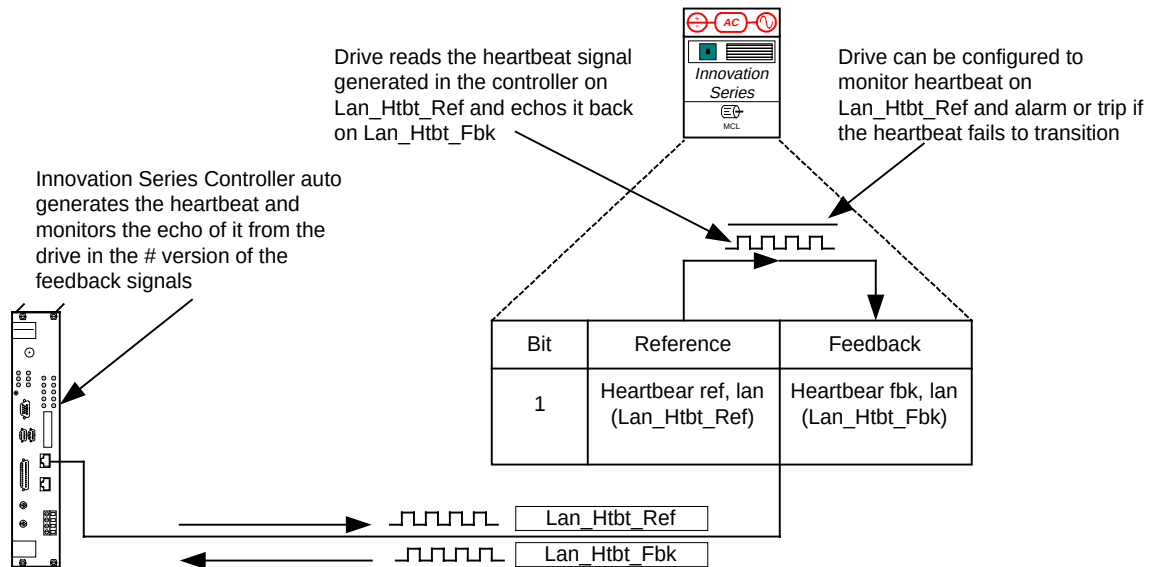
When controlling a drive over a LAN, both the controller and drive need to monitor and react to changes in the status of LAN health. The heartbeat echo feature in the drive provides a mechanism for this function.

The following illustrations of the heartbeat echo function indicate how the drive and controller obtain status on the integrity of the LAN and possible configuration options.

Heartbeat Echo Function With a PLC



Heartbeat Echo Function with an Innovation Series Controller



Application of Feedback Signals

In most control systems the LAN (Genius, Profibus-DP, etc) operates asynchronous with the execution of control logic. Two situations can occur:

- **Under Sampling** - If the control logic sweep rate is slower than the LAN sweep rate, certain samples of feedback signals from the drive are not seen by the control logic.

- **Over Sampling** - If the control logic sweep rate is faster than the LAN sweep rate, certain feedback signal samples from the drive are seen multiple times by the control logic.

To address the under sampling problem, signal conditioning is provided for dedicated *analog* feedback channels in the form of sequential averaging. Feedback signals are comprised of a series of short-term averages of the source signal. The parameter *LAN fbk avg time* configures the averaging period; updates to the feedback signal map are performed coherently.

Note that when an integer relationship exists between *LAN frame time* and *LAN fbk avg time*, then the frame and feedback averaging periods are synchronized to the extent possible. This synchronization is optimal for synchronous LAN interfaces, such as those provided by the ISBus.

Variable Maps (Source Patterns, ACCBN-A & ACCBR-A)

The following tables define the signal map for the ACCBN-A (Non-Regenerative) and ACCBR-A (Regenerative) pattern. The signal map tables provide the following as appropriate:

- 20-character user names and 12-character symbolic names
- Units or scale groups

Real Variable Map

Reference			Feedback	
Byte	Variable	Functionality	Variable	Functionality
1-4	Request bits 1, lan (Lan_Req1_Wrd)	multiple bits, see table below	Feedback bits 1, lan (Lan_Fbk1_Wrd)	multiple bits, see table below
5-8	Iy reference, lan* (Lan_Iy_Ref) Iy_Scl *Regen Sources only	Iy reference select (Iyrf_Cmd_Adr) Behavior 2	Fault number (Lan_Flt_Code) <integer>	number of the active fault with (1) highest severity (trip/alarm) (2) earliest time- stamp
9-12	Iy feedback, lan* (Lan_Iy_Fbk) Iy_Scl *Regen Sources only	Iy feedback select (Iyrf_Fbk_Adr) Behavior 2	AC line current, lan (Lan_I_Mag) "A rms"	=Avg[I_Mag_Fil] sequential averages
13-16	Not Used		AC line voltage, lan (Lan_Line_Mag) "V rms"	=Avg[Line_Mag_T2] sequential averages
17-20	Not Used		DC bus voltage, lan (Lan_Vdc_Fbk) Vdc_Scl	=Avg[Vdc_Fbk_T2] sequential averages

Reference			Feedback	
21-24	Not Used		DC bus power, lan (Lan_Bus_Pwr) Power_Scl	=Avg[Bus_Pwr] sequential averages
25-28	GP lan ref 01 (Lan_R01_Ref)	general purpose real var	GP lan fbk reg 01 (Lan_R01_Fbk)	GP lan fb reg 01 sel (Lan_R01_Adr)
29-32	GP lan ref 02 (Lan_R02_Ref)	general purpose real var	GP lan fbk reg 02 (Lan_R02_Fbk)	GP lan fb reg 02 sel (Lan_R02_Adr)
33-36	Not Used		AC line freq, lan (Lan_Line_Frq) Frequency_Scl	=Avg[PII_W_T2] sequential averages
37-40	Not Used		AC line vars, lan (Lan_Var_Calc) VAR_Scl	=Avg[Var_Calc] sequential averages
41-56	Not Used		Not Used	
57-60	GP lan ref 03 (Lan_R03_Ref)	general purpose real var	GP lan fbk reg 03 (Lan_R03_Fbk)	GP lan fb reg 03 sel (Lan_R03_Adr)
61-64	GP lan ref 04 (Lan_R04_Ref)	general purpose real var	GP lan fbk reg 04 (Lan_R04_Fbk)	GP lan fb reg 04 sel (Lan_R04_Adr)

Boolean Variable Map

Request			Feedback	
Bit	Variable	Functionality	Variable	Functionality
1	Heartbeat ref, lan (Lan_Htbt_Ref)	Heartbeat function: transitions expected	Heartbeat fbk, lan (Lan_Htbt_Fbk)	Heartbeat function: loopback Heartbeat ref, lan
2	Fault reset req, lan (Lan_Flt_Rst)	Fault reset select (Flt_Rst_Adr) Behavior 1, edge	No faults or alarms (No_Flt)	no active (uncleared) faults, "not (trip OR alarm)"
3	Trip request, lan (Lan_Trp_Req)	Fault.Lan trip request (Lan_Trp) Behavior 0	Trip fault active (Trip_Flt)	active trip fault, "trip"

Request			Feedback	
4	Alarm request, lan (Lan_Alm_Req)	Fault.Lan alarm request (Lan_Alm) Behavior 0	Local fault string (Loc_Flt)	local hardware permissive; bridge inhibited
5	Not Used		System fault string (Sys_Flt)	system hardware permissive; bridge inhibited
6	Not Used		Ready to Run (Run_Rdy)	device is ready & will respond to run request
7	Not Used		Bridge is on (Brg_Pwr_Enb)	bridge power is enabled;
8	Not Used		Running (Running)	sequencer task status
9-10	Not Used		<spare>	
11	X stop request, lan (Lan_Xstp_Req)	Behavior 0, level	X stop active (X_Stp_Cmd)	result of Xstop requests
12-24	Not Used		Not Used	
25	GP lan req bit 01 (Lan_B01_Req)	general purpose bool var	GP lan fbk bit 01 (Lan_B01_Fbk)	GP lan fb bit 01 sel (Lan_B01_Adr)
32	GP lan req bit 08 (Lan_B08_Req)	general purpose bool var	GP lan fbk bit 08 (Lan_B08_Fbk)	GP lan fb bit 08 sel (Lan_B08_Adr)

Appendix A

Introduction

Application firmware consists of coordinated blocks of code called **functions**. Each function performs a specific task in controlling the drive.

Parameters are adjustable values within a function that allow you to configure and adjust the drive behavior. For example, some basic parameters and their associated units include *Motor rated current* (Amps), *Motor rated freq* (Hz), *Motor rated voltage* (Volts), and *Regulator type*. Parameters can be set and modified from the keypad and the optional configuration program, the Control System Toolbox.

The drawings in this section are function diagrams for a typical Innovation Series Low Voltage drive. Refer to Chapter 2 for more detailed description of these functions.



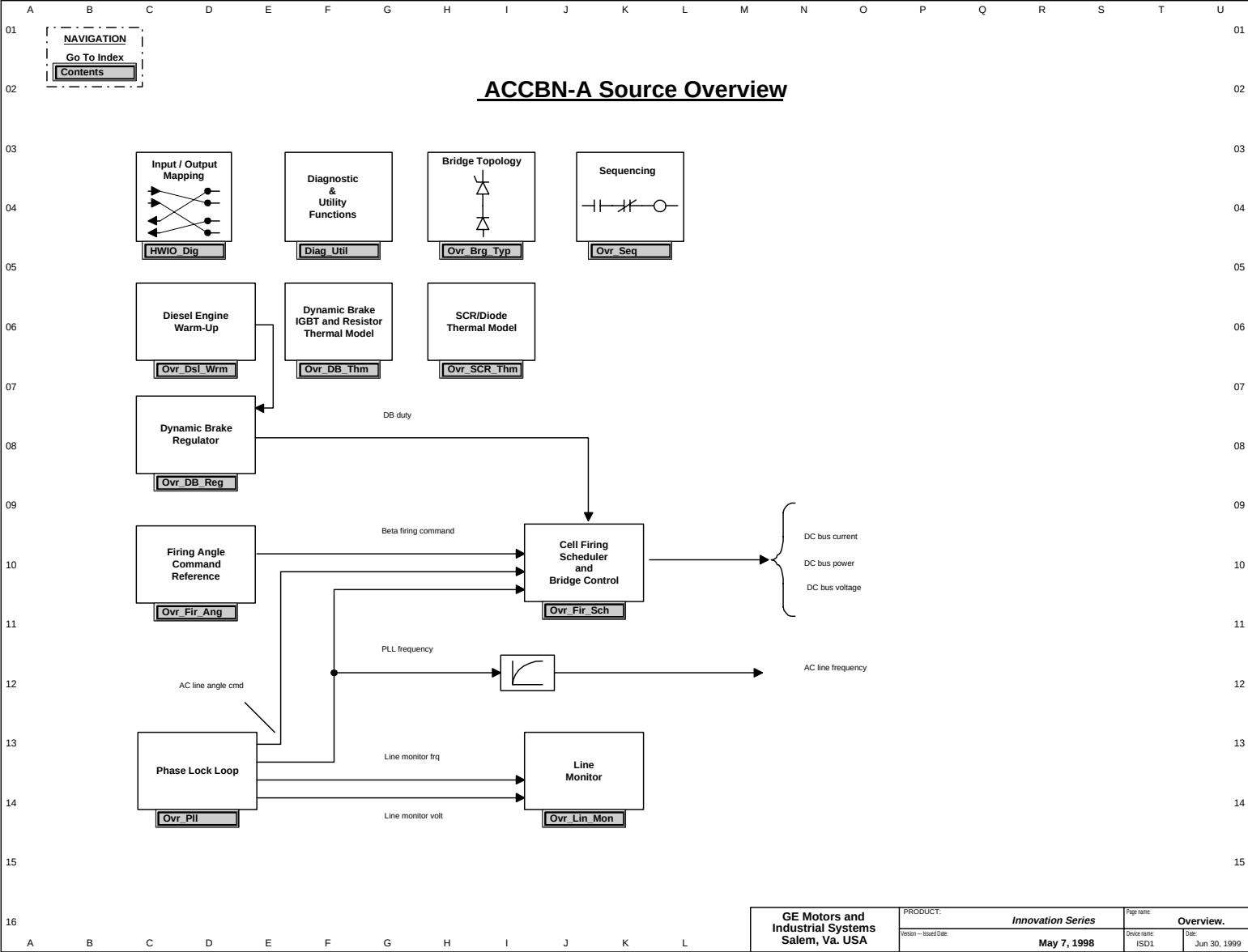
Caution

To prevent personal injury or equipment damage caused by equipment malfunction, only adequately trained personnel should modify any programmable machine.

Note These diagrams are available as navigable, online drawings in the optional Windows®-based drive configuration software, the GE Control System Toolbox.

Diagram Title	Page Name
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ACCBN-A Source Index.....	Contents
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Analog Inputs/Outputs & Mapping.....	HWIO_Ana
Bridge Typology Overview.....	Ovr_Brg_Typ
Sequencing Overview.....	Ovr_Seq
General Sequencing.....	Gen_Seq1
General Sequencing.....	Gen_Seq2
SCR/Diode Thermal Model Overview.....	Ovr_SCR_Thm
Dynamic Brake Thermal Model Overview.....	Ovr__DB_Reg

Diesel Engine Warm-Up With Dynamic Brake Resistor.....	Ovr_Dsl_Wrm
Firing Angle Reference.....	Ovr_Fir_Ang
Phase Lock Loop Regulator.....	Ovr_Pll
Bridge Control SCR & DB Firing.....	Ovr_Fir_sch
Line Monitor Overview.....	Ovr_Lin_Mon
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Signal Level Detection.....	SLD
Capture Buffer Configuration.....	Capture



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11) Dynamic Brake Thermal Model.....	Ovr DB Thm
12) Dynamic Brake Regulator.....	Ovr DB Reg
13) Diesel Warm-Up with Dynamic Brake.....	Ovr Dsl Wrm
14) Firing Angle Command Reference.....	Ovr Fir Ang
15) Phase Lock Loop.....	Ovr Pll
16) Cell Firing Scheduler & Bridge Control.....	Ovr Fir Sch
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Factory Test Only	
Analog and Digital I/O Testing.....	HWIO Tst

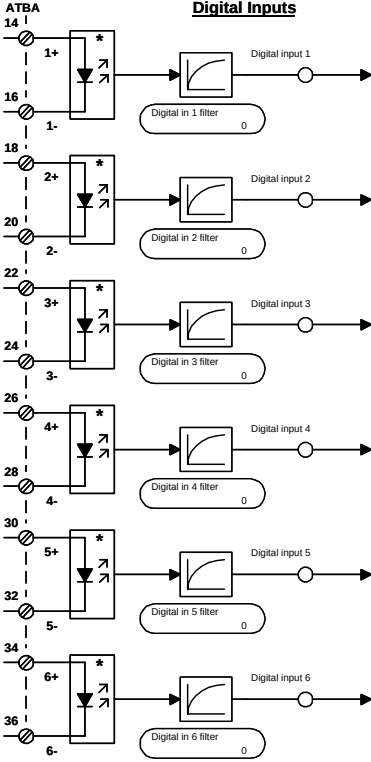
ACCBN-A Source Index									
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		19) Signal Level Detection.....▶	SLD
		20) Capture Buffer Configuration.....▶	Capture
<u>Factory Test Only</u>			
Analog and Digital I/O Testing.....▶	HWIO Tst		

Digital Inputs/Outputs & Mapping



Digital Inputs

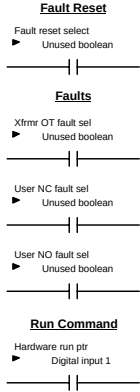


Dedicated Digital Inputs

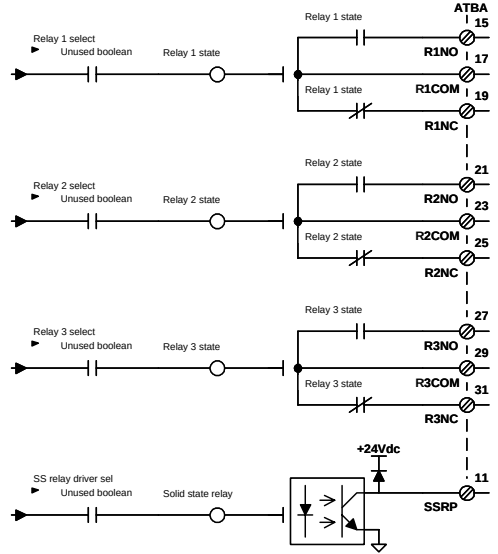


* - 2-5ms HW Filtering

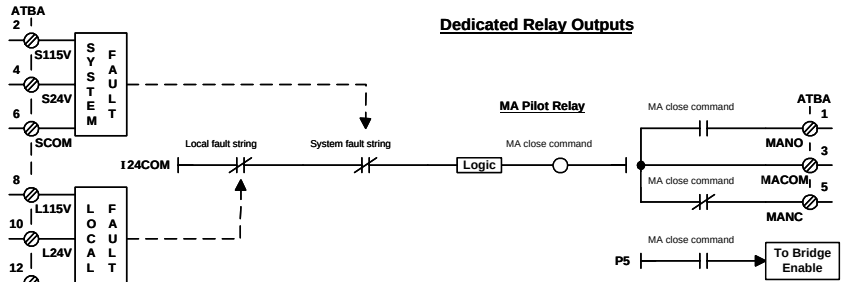
Sequencing Selectors



Relay Outputs



Dedicated Relay Outputs



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PRODUCT:	
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Innovation Control

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HWIO Dig.

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March 4, 1998

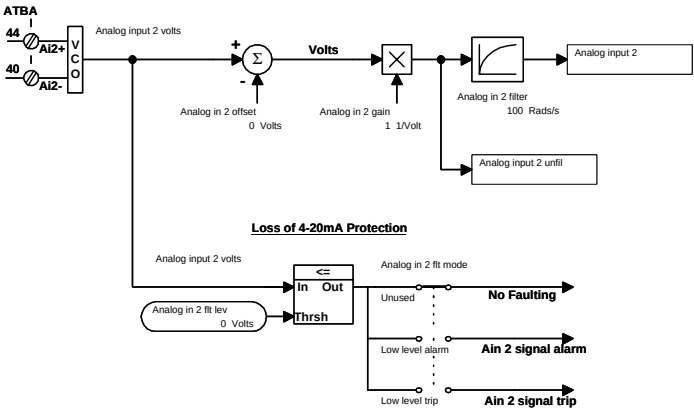
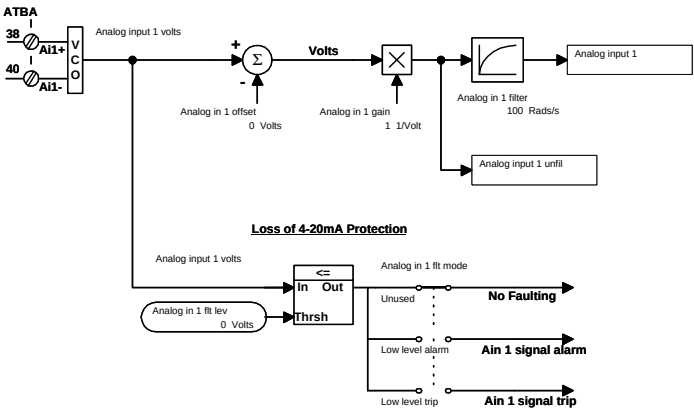
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Date:	Jun 30, 1999
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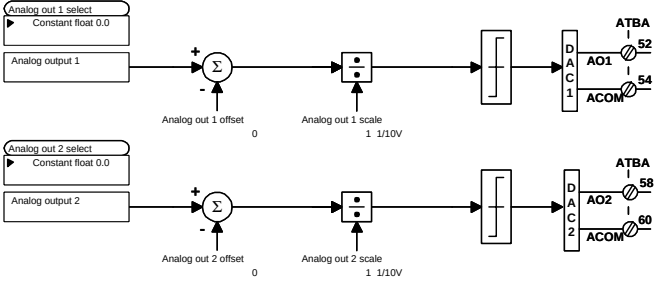
Analog Inputs/Outputs & Mapping

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Overview	Digital I/O
Overview	HWIO Dig

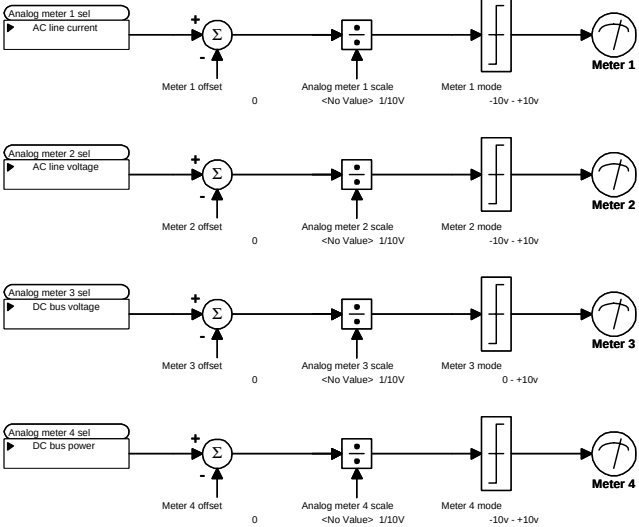
Analog Inputs



Analog Outputs



Meter Outputs

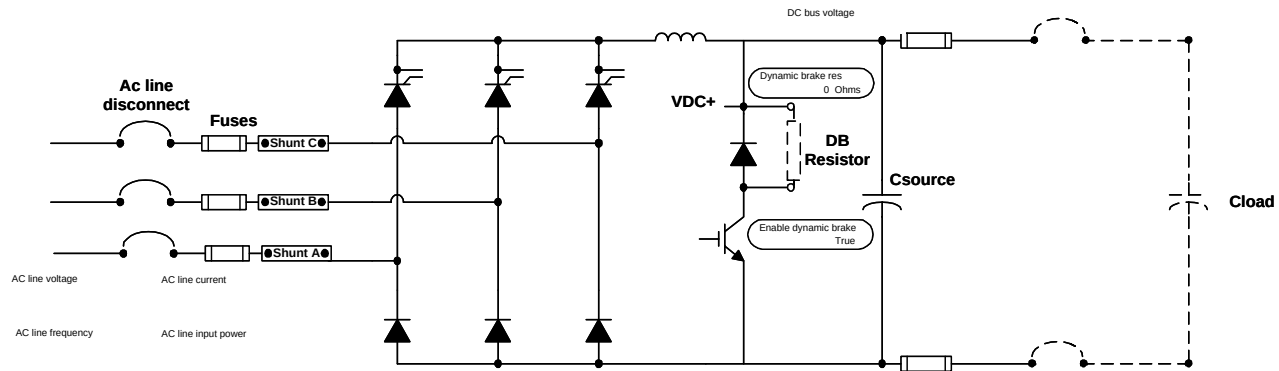


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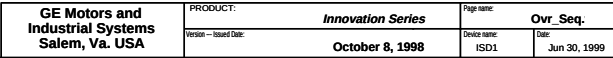
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serial date: March 16, 1998

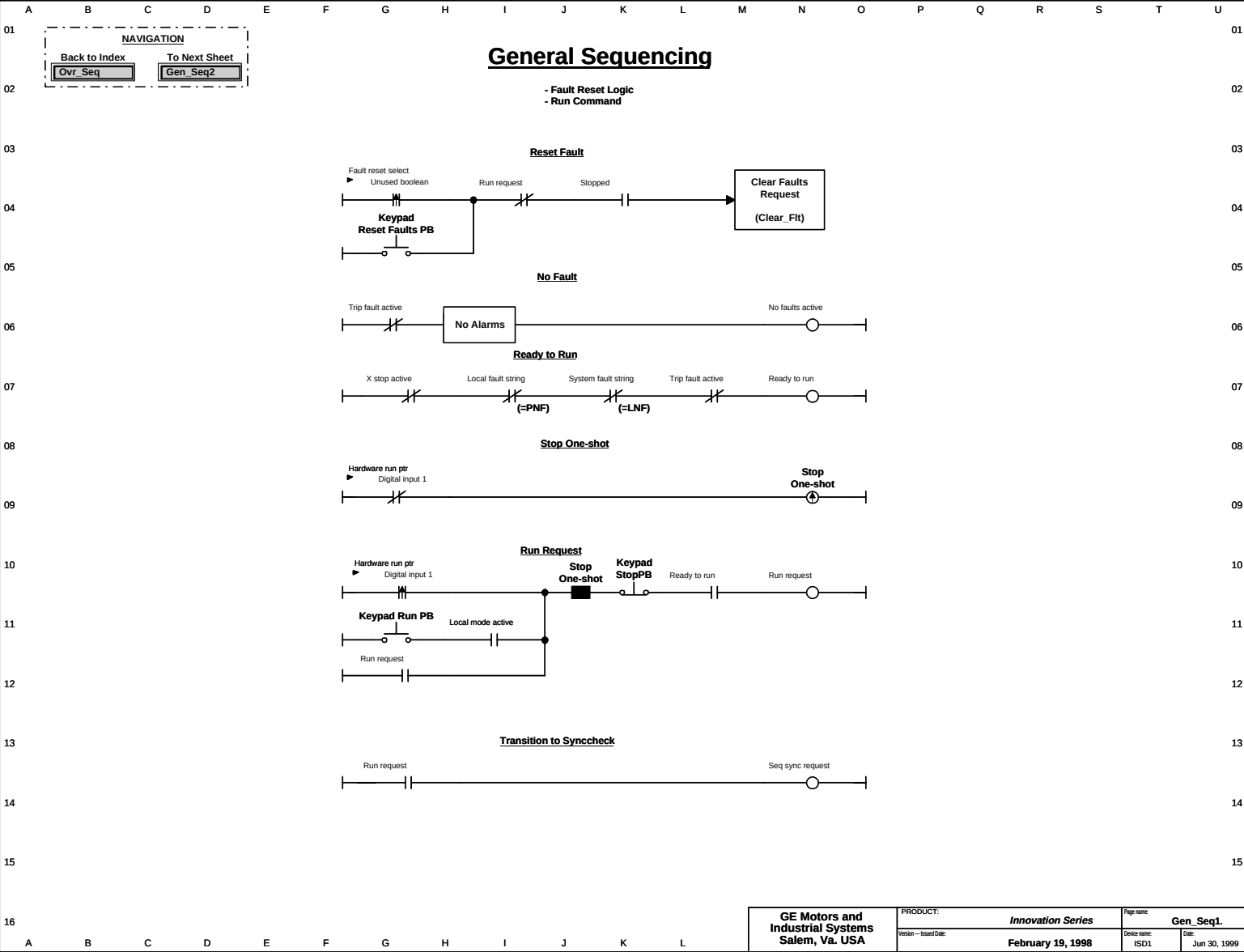
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Device name: ISD1
Date: Jun 30, 1999

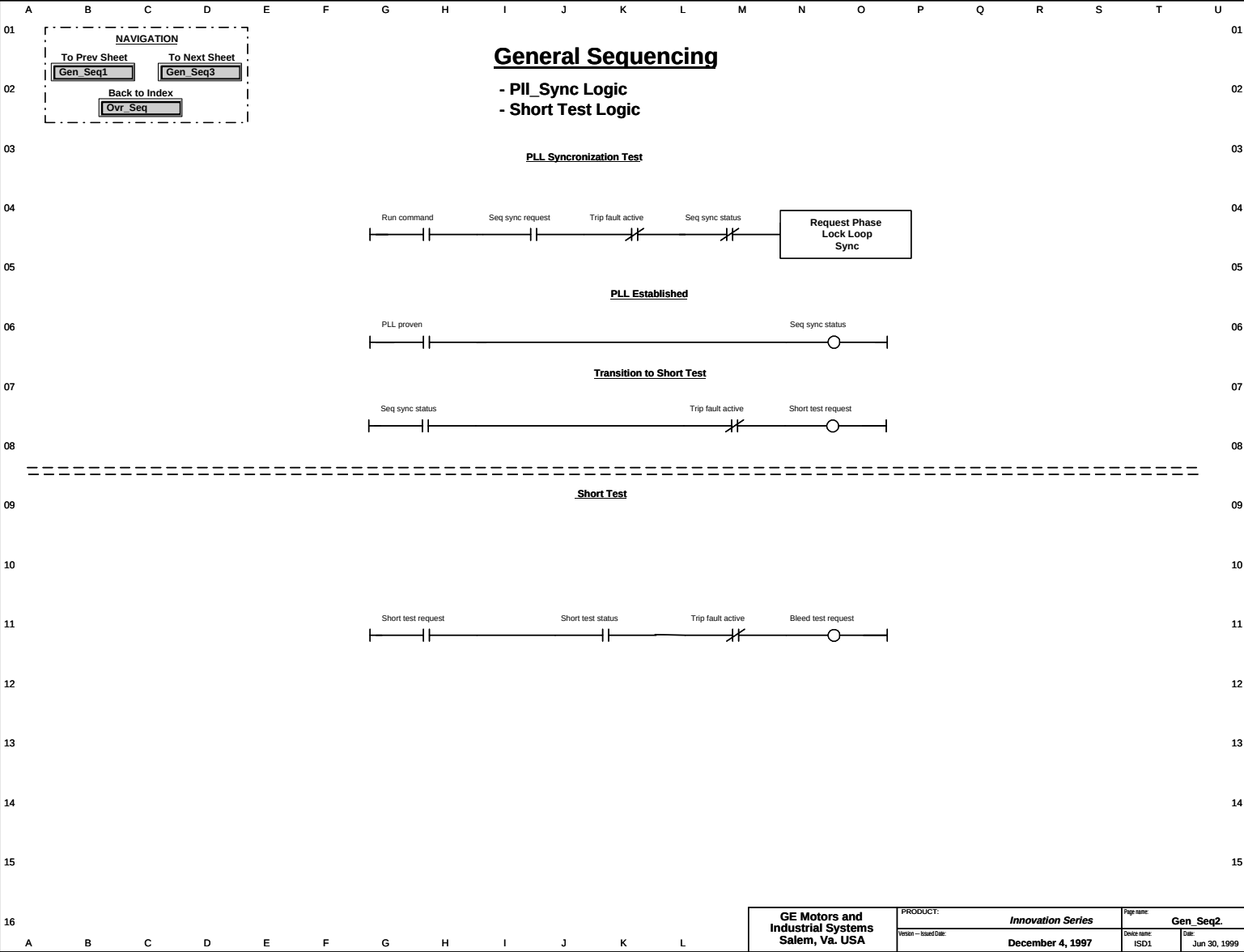
Bridge Typology Overview



Beta_Rmp_Ip -- Firing angle used has reached requested value
Beta_Rtd -- The transient line angle controller has determined that the firing angle should be retarded.
Beta_Cal_Vld-- the transient line angle controller calculation is presently valid.







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Ovr Seq

General Sequencing

- Bleed Test

- Ramp Up

Bleed Test

Bleed test request

Bleed test status

Trip fault active

Ramp up request

Ramp Up

Ramp up request

Ramp up status

Trip fault active

Normal request

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PRODUCT:Innovation Series

version – issued Date:December 4, 1997

Page name:Gen Seq3.

Device name:ISD1

Date:Jun 30, 1999

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Overview

SCR/Diode Thermal Model Overview

Htsink configuration

IPN frame size
1000 frame

Ambient temp

620Frame & 1000 Frame

Htsink Config. = 2

Heat sink temp, A

Heat sink temp, B

1800 Frame

Htsink Config. = 3

Phase A

Phase B

Phase C

Phase A Htsink temp

Phase B Htsink temp

Phase C Htsink temp

(All SCRs are modeled as having the same heat sink temp.)

(All diodes are modeled as having the same heat sink temp.)

(Each SCR/Diode pair or phase is modeled as having one heat sink temperature.)

SCR 1 heat sink temp

SCR 2 heat sink temp

SCR 3 heat sink temp

SCR Thermal Models

SCR 1 junction temp

SCR 2 junction temp

SCR 3 junction temp

Max SCR Temperature Selection

Peak Detector

Max SCR jnc temp

Jnc over-temp thrsh

Jnc OT alm on thrsh

Jnc OT alm off thrsh

Junction Temperature Fault Detection

Diode 1 htsink temp

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Diode 3 htsink temp

Diode Thermal Models

Diode 1 jnc temp

Diode 2 jnc temp

Diode 3 jnc temp

Max SCR Temperature Selection

Peak Detector

Max diode jnc temp

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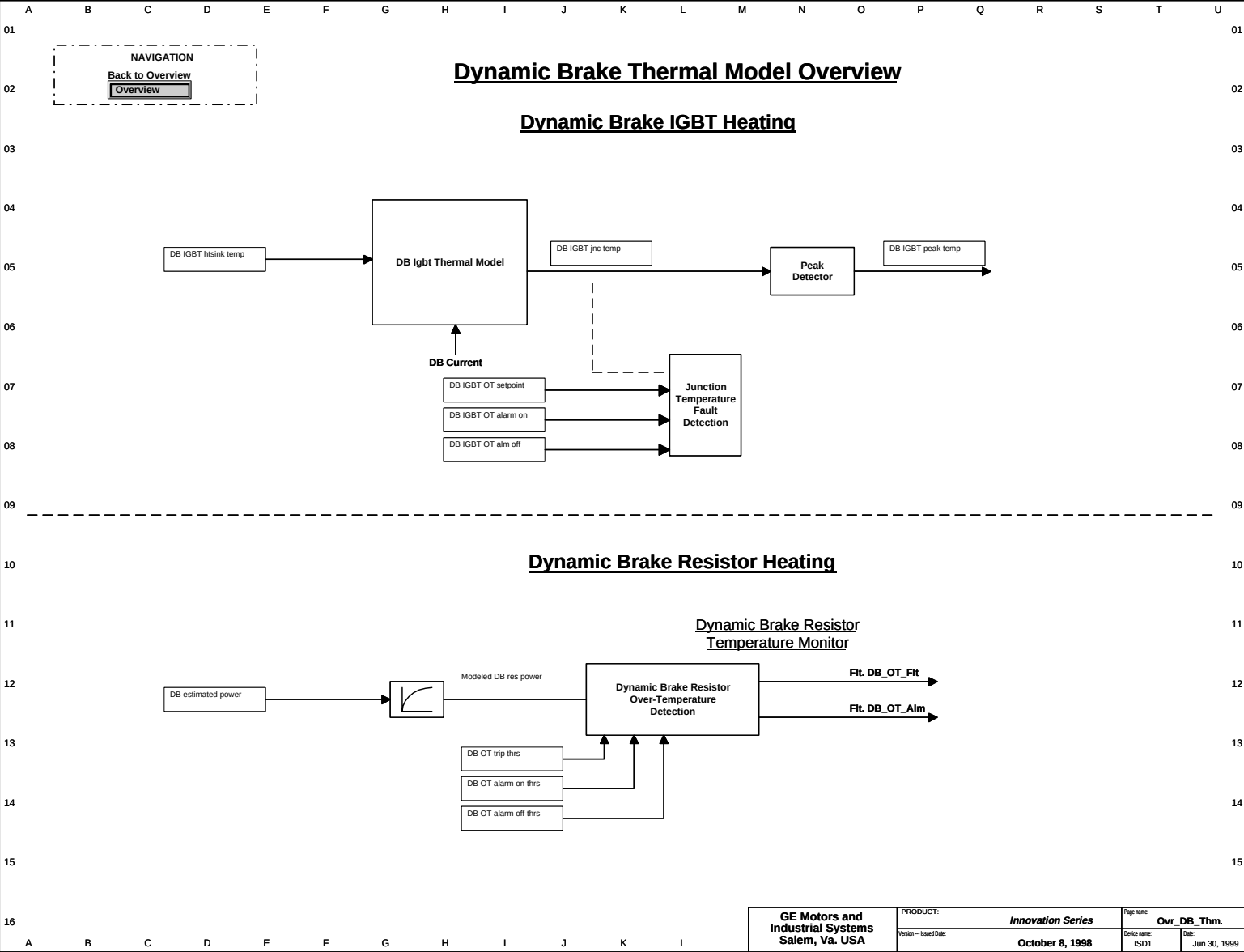
PRODUCT: Innovation Series

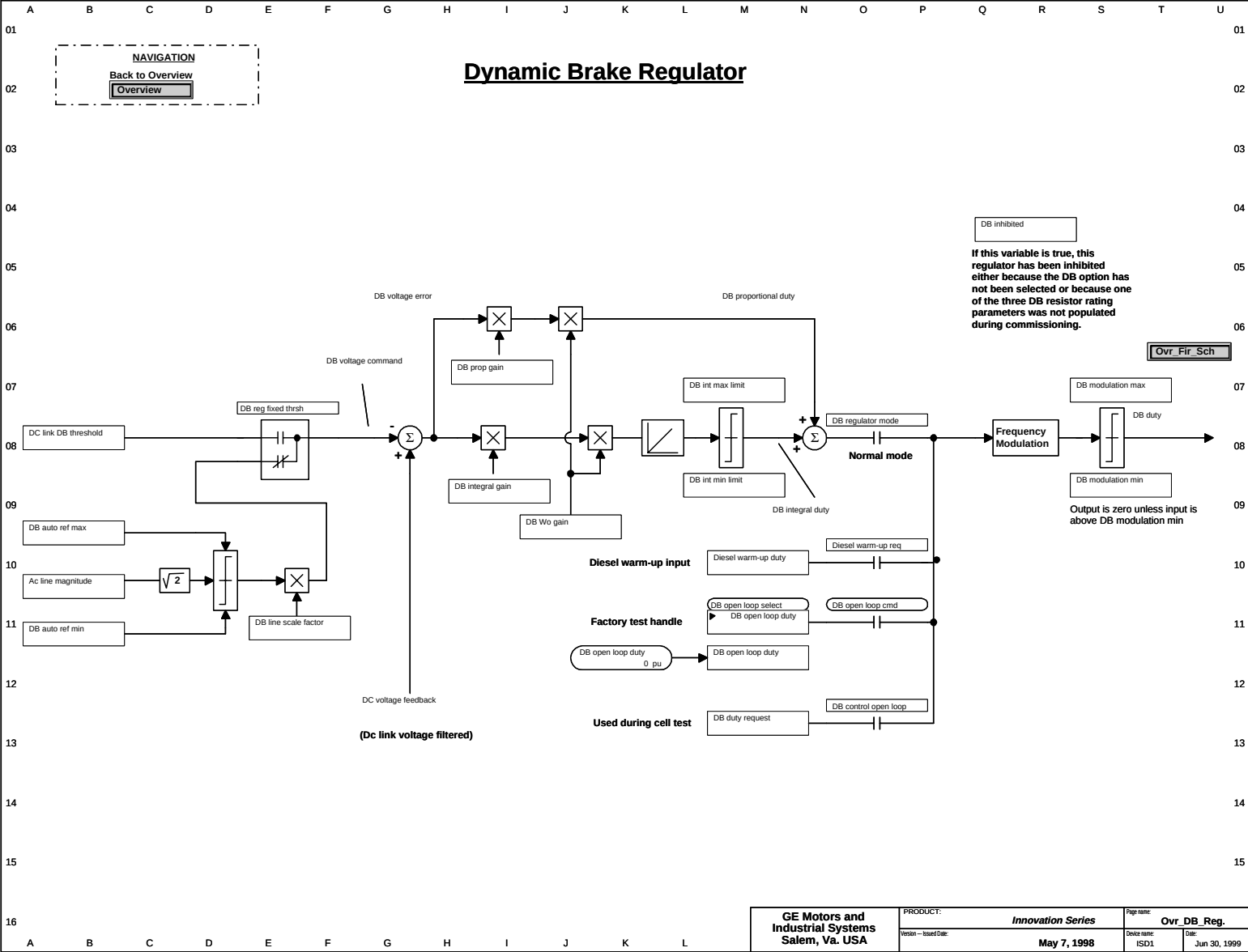
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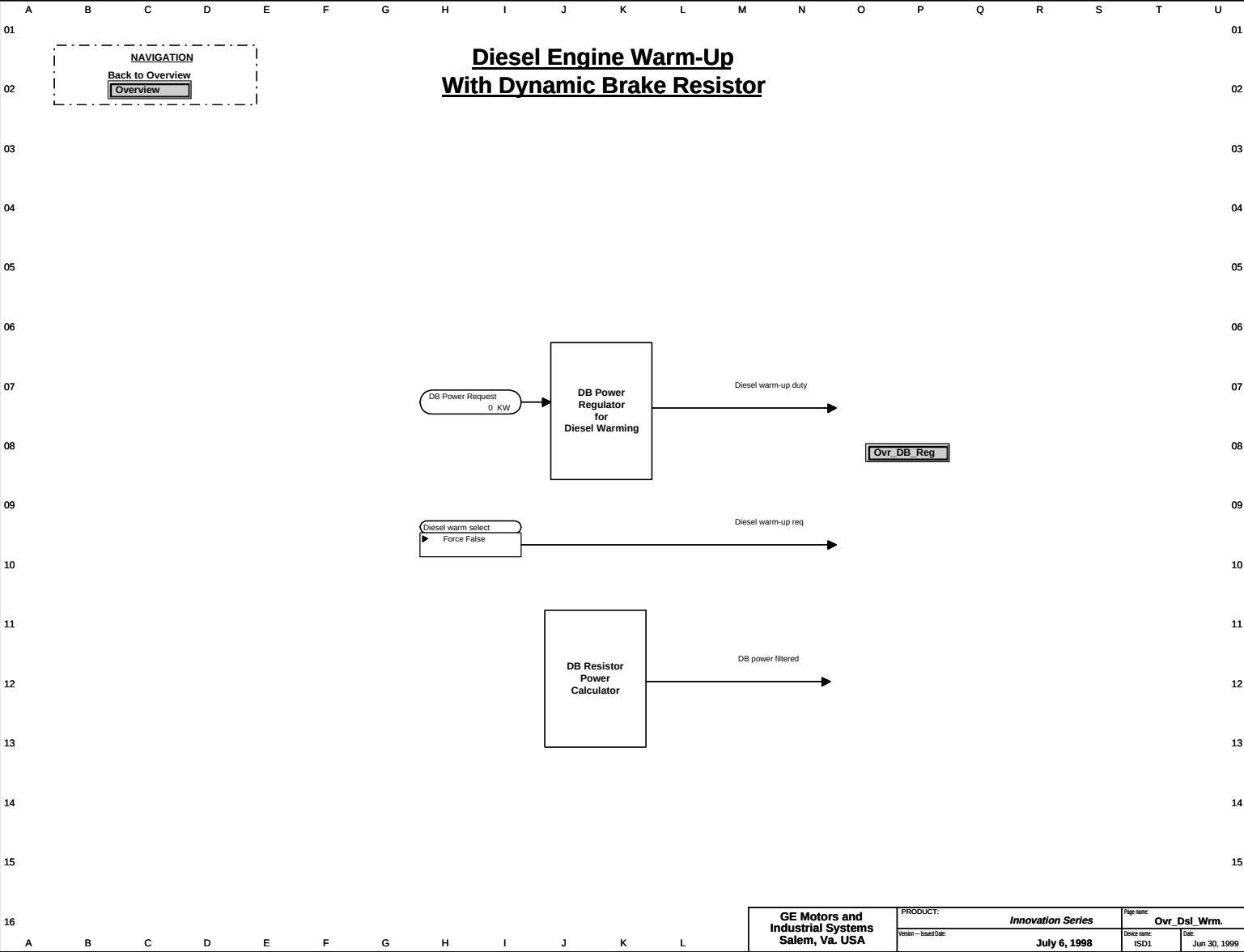
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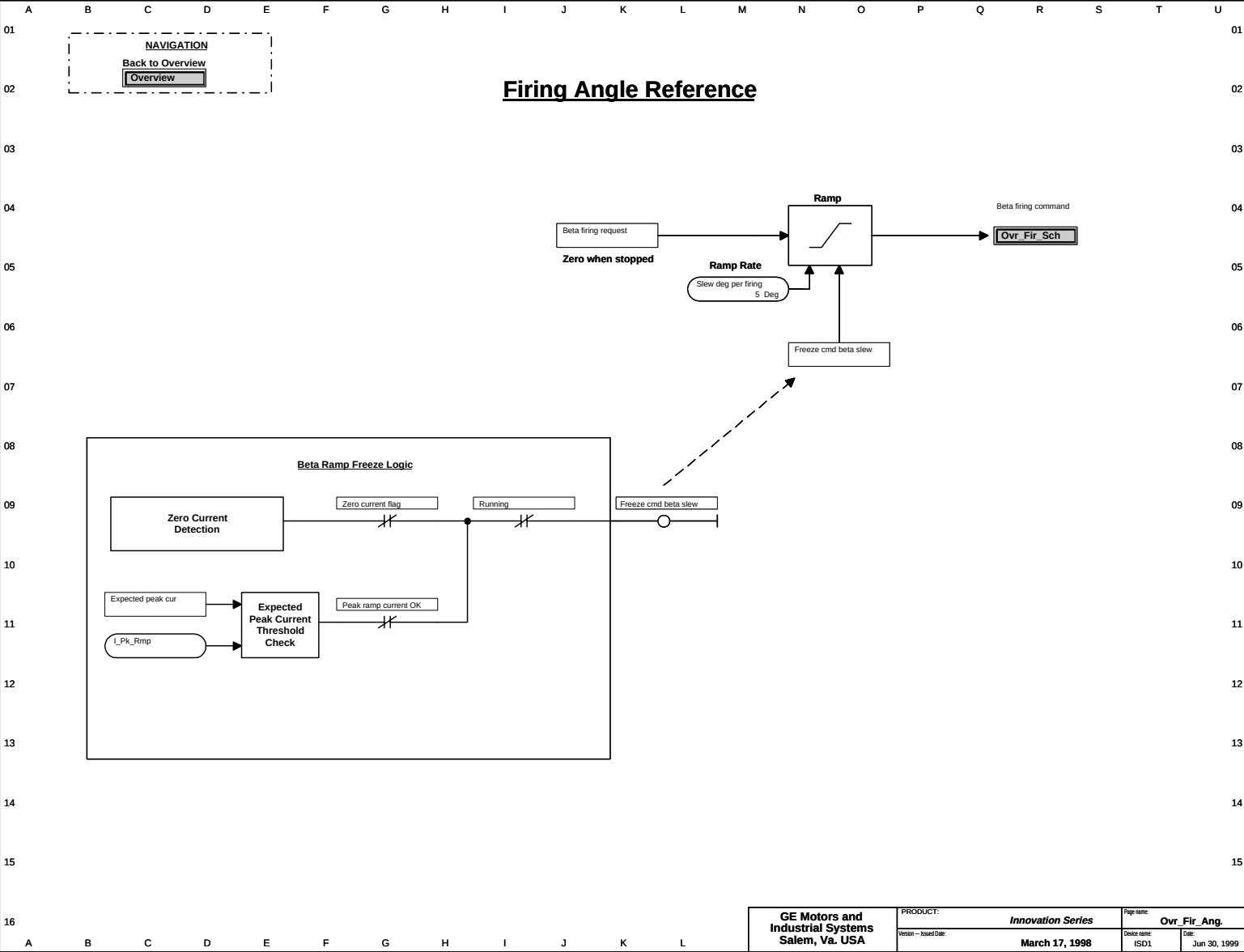
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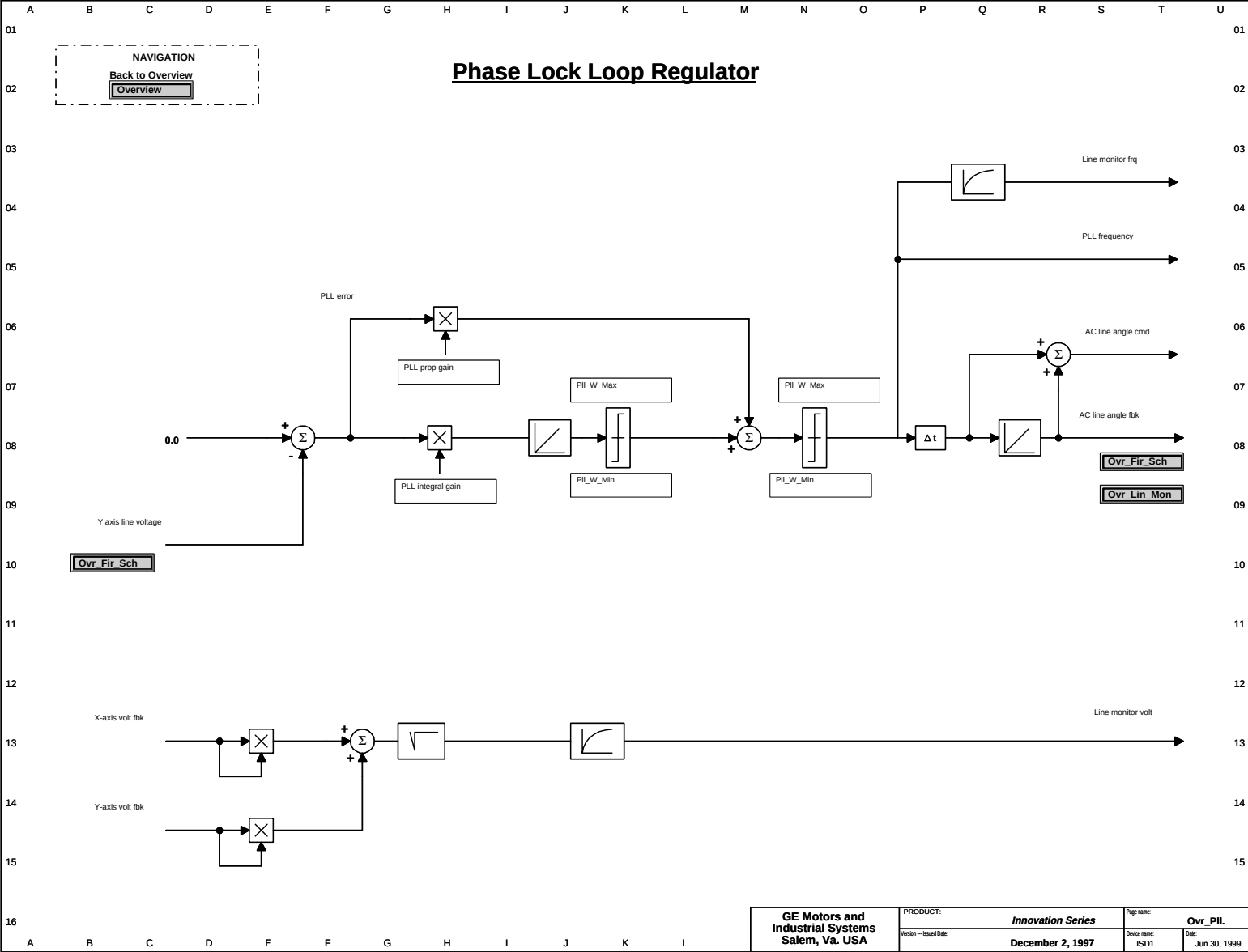
Date: Jun 30, 1999











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PRODUCT:

Innovation Series

version - issued Date:

December 2, 1997

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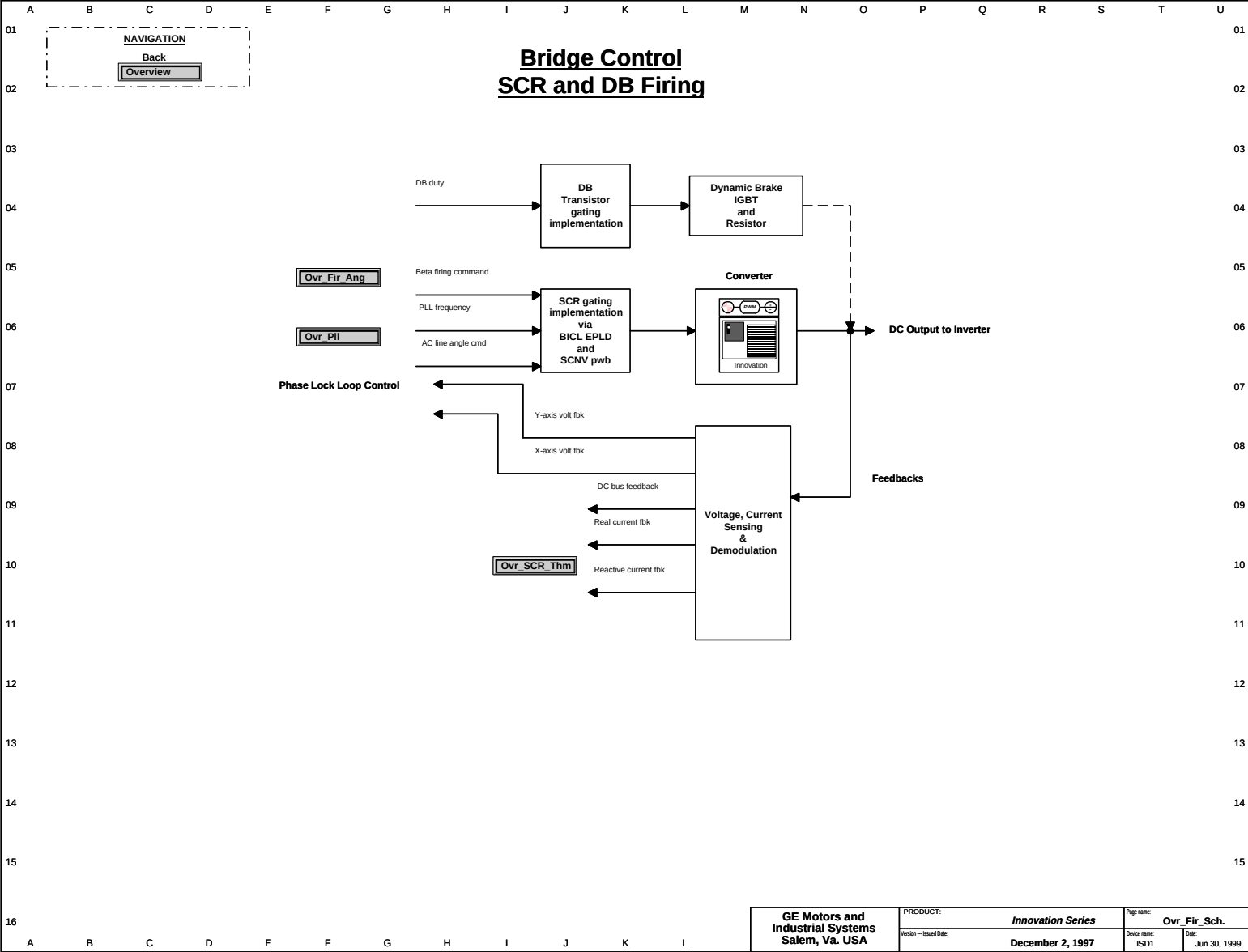
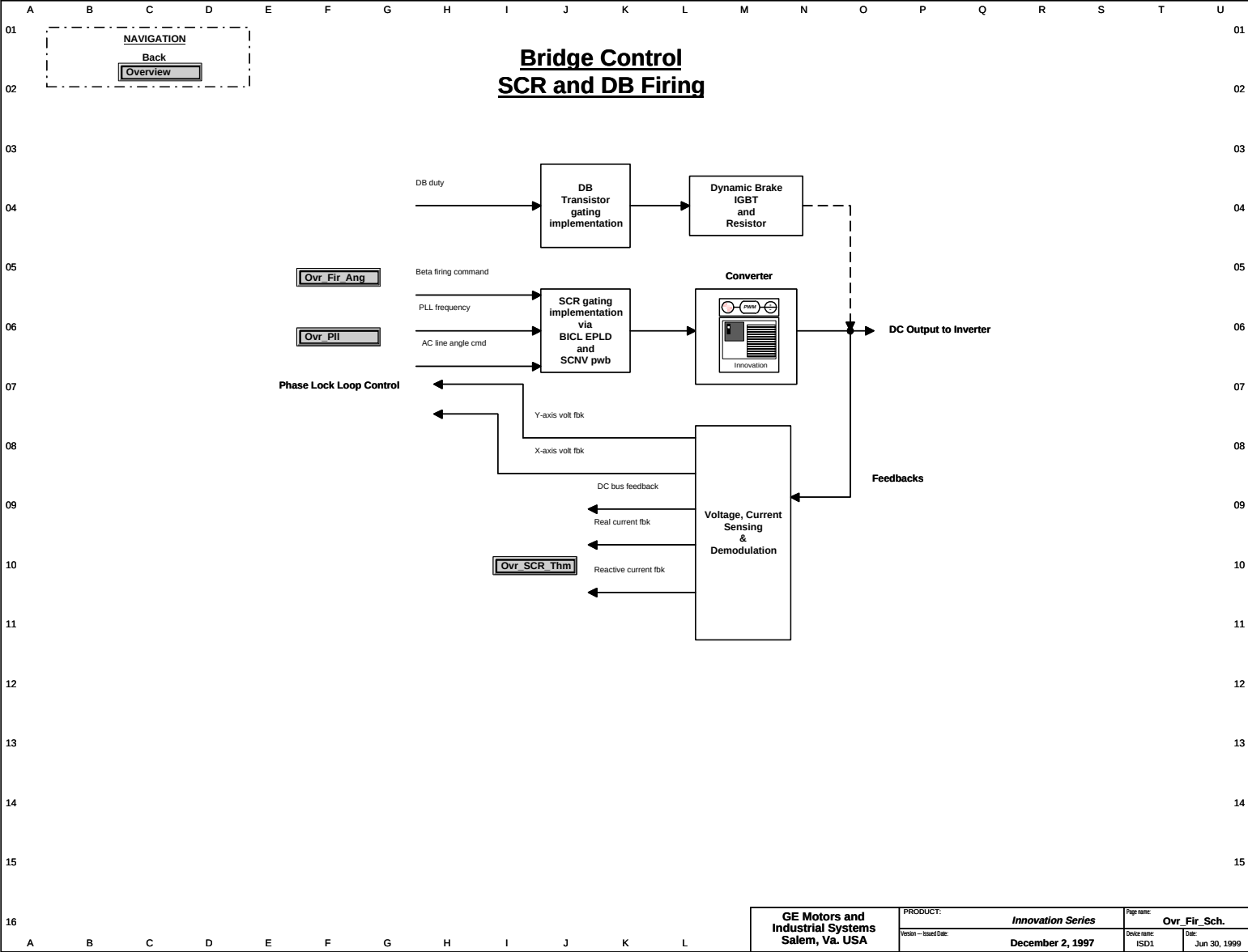
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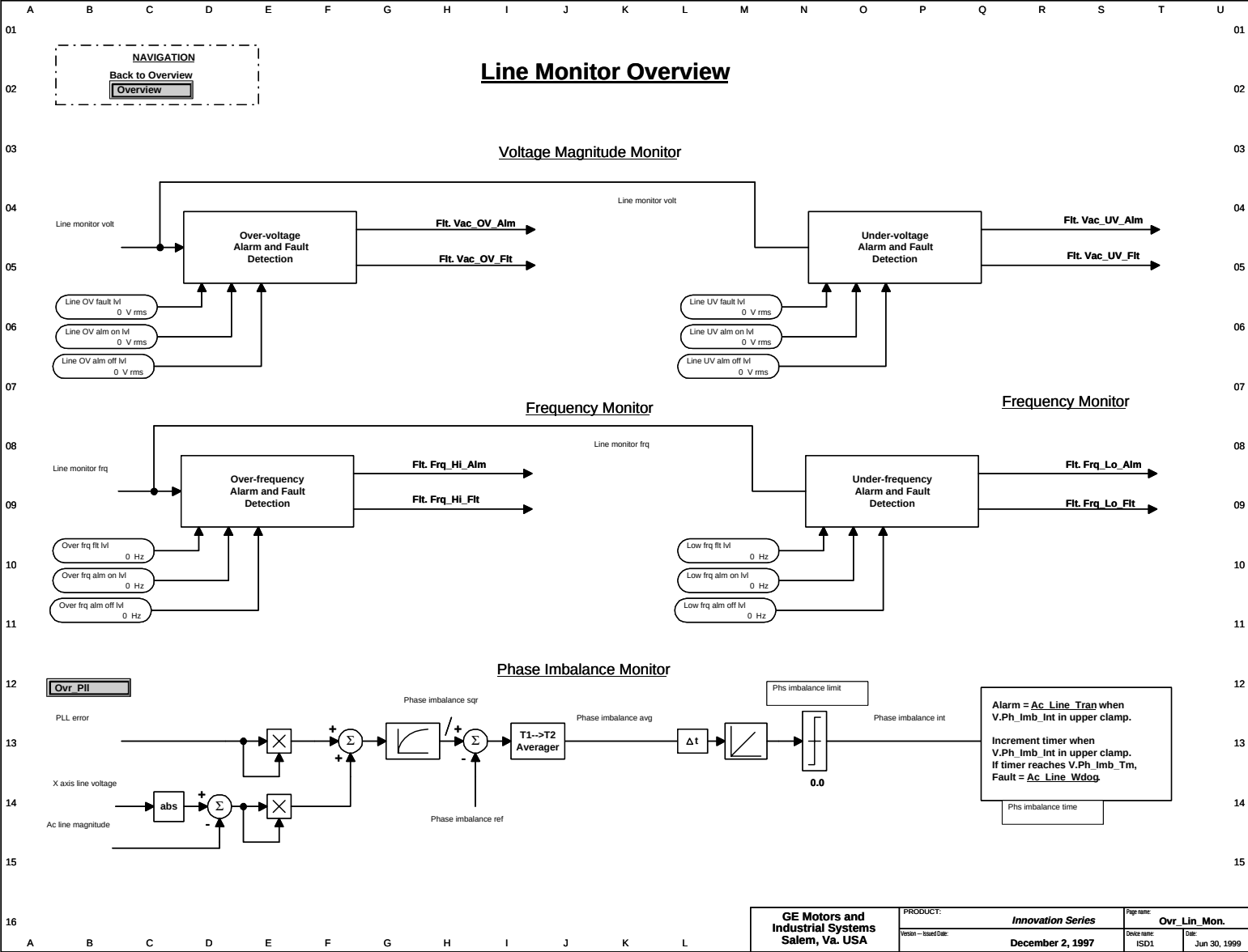
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Oscillator neg mag

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Constant float 0.0

GP filter 1 bndwth

0 rad/s

GP filter 1 output

GP filter 2 sel

Constant float 0.0

GP filter 2 bndwth

0 rad/s

GP filter 2 output

GP filter 3 sel

Constant float 0.0

GP filter 3 bndwth

0 rad/s

GP filter 3 output

GP filter 4 sel

Constant float 0.0

GP filter 4 bndwth

0 rad/s

GP filter 4 output

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PRODUCT:

Innovation Control

serial date:

April 9, 1998

Page name:

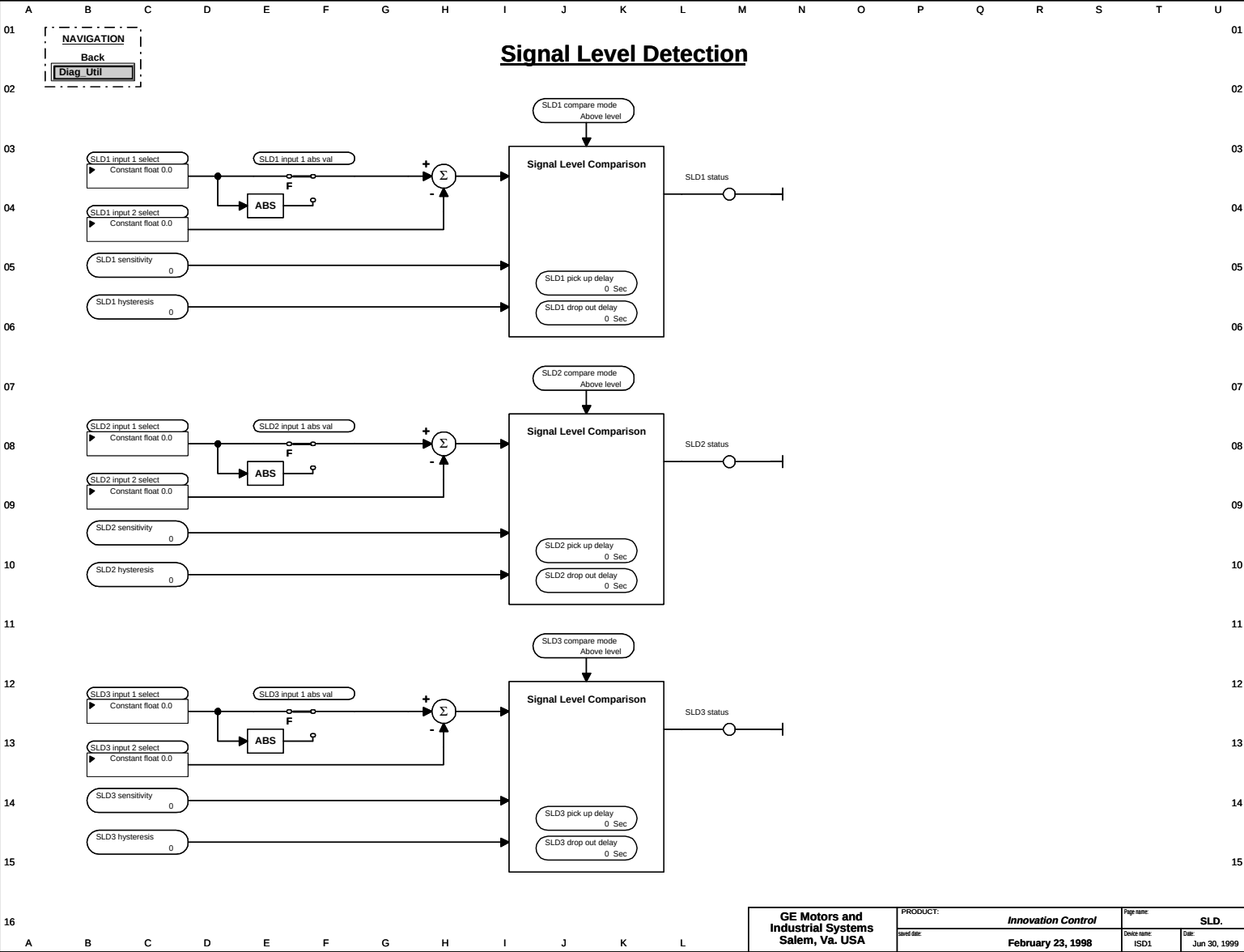
Diag_Util.

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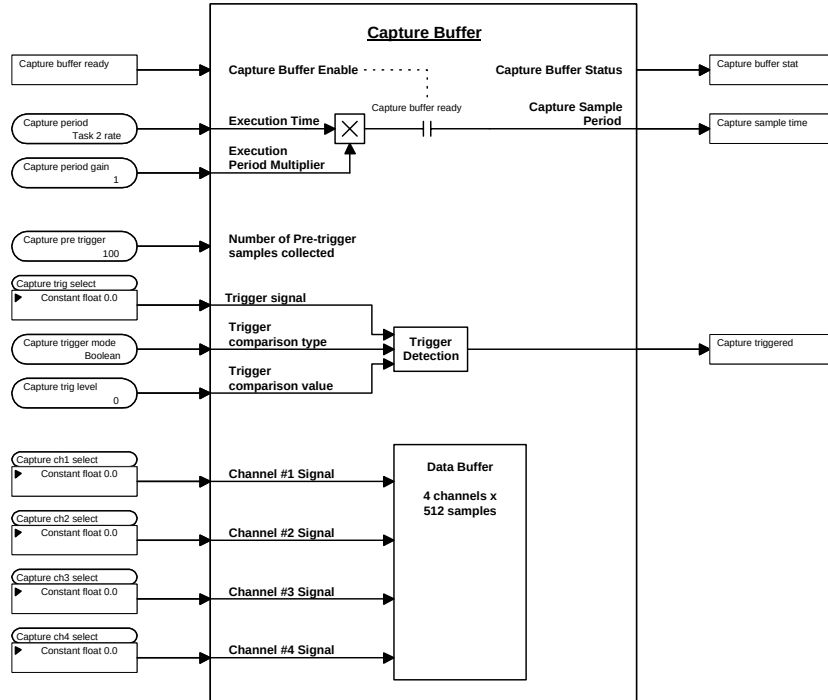
ISD1

Date:

Jun 30, 1999



Capture Buffer Configuration



Glossary of Terms

ACCBN

AC product, Common Bus Non-regenerative source. This source provides dc power to a dc fed, ac product (such as ACDCF), and is not capable of regenerating power to the ac line.

ACCBR

AC product, Common Bus Regenerative source. This source provides dc power to a dc fed, ac product (such as ACDCF), and is capable of regenerating power to the ac line.

ACDCF

AC product, DC Fed inverter. This inverter is powered from a source bridge (such as ACCBN, ACCBR).

drive

(Industrial.) The equipment used for converting available power into mechanical power suitable for operation of a machine.

filter

An electrical circuit that passes frequencies within a specified frequency band and attenuates signals that fall outside of that frequency band. (Also see line filter, ac.)

frame

Size of drive cabinet(s). Determined by hardware components required for power application.

harmonic distortion

Undesired harmonic frequencies that result from irregularities in a transmission line.

layout drawing

A diagram showing the components of a panel, and their location and connections.

line filter

A filter that connects from ac line to ac line at the input of a power converter. The filter consists of a series configuration of resistors and capacitors, which damps out high frequency oscillations on the ac power line.

NEMA

National Electrical Manufacturers Association. An organization that develops standards for the electrical manufacturing industry.

non-regenerative

See regenerative.

outline drawings

A drawing or diagram that shows the dimensions and non-detailed layout of a device or equipment.

parameters

Used in the drive for configuration of functions. For example, six parameters are used to configure the ramp rate function generator in the general industries pattern.

reactor

A device (such as a coil, winding, or conductor of small resistance) used to introduce reactance into an alternating-current circuit.

regenerative

Ability of a drive to return power from the motor armature to the ac line. Creates a braking effect on the motor.

signals

LAN or I/O based variables that either control the drive or provide feedback data on the status of the drive. For example, an analog input signal provides the speed reference for the drive.

variables

Dynamic references for control of the drive or contain feedback on the status of the drive. For example, speed feedback and speed reference are two variables associated with the speed regulator function in the drive.

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