GE Industrial Systems

Bridge Interface Board IS200BICRH_A_ _

Safety Symbol Legend

Warning

Indicates a procedure or condition that, if not strictly observed, could result in personal injury or death.

Caution

Indicates a procedure or condition that, if not strictly observed, could result in damage to or destruction of equipment.

Note Indicates an essential or important procedure or statement.

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Functional Description

The IS200BICR Bridge Interface Board (BICR) is used in Innovation Series™ Medium Voltage - GP, Type H drives. It provides an interface between the bridge and the drive control. Analog feedback signals from the bridge are connected to TB1 and TB2 on the BICR board's faceplate. These signals are scaled and converted to voltage controlled oscillator (VCO) signals and then passed to the IS200DSPX Digital Signal Processor Control Board (DSPX). Basic bridge cell hardware control, protection, and diagnostics are implemented on the Medium Voltage Ac Drive Fiber-Optic Hub (FOHB) board. The FOHB board functions are interfaced to the control through the IS200BPIR Digital Interface Board (BPIR).

The BPIR and BICR boards are mounted in an Innovation Series board rack and connect to the IS200CABP Cable Assembly Backplane Board (CABP) through their P1 connectors (also P2 connector for BICR board). The logic signals from the BPIR board are interfaced to the BICR board through the CABP board.

The BICR board also provides a panel and system fault string interface, eight optically isolated discrete digital inputs and outputs, two 0–20 mA analog feedback inputs and one 0–10 V analog feedback input. Bridge control, fault string, isolated I/O, and the 0–20 mA connections are made through the P1 connector. The main control board interface and logic power supply connections are made through the P2 connector (see Figure 1 and Table 1).

A serial 1024-bit memory device is provided on the BPIR board. This memory is programmed with board identification and revision information and accessed through a single data line (BRDID) on the P1 connector.

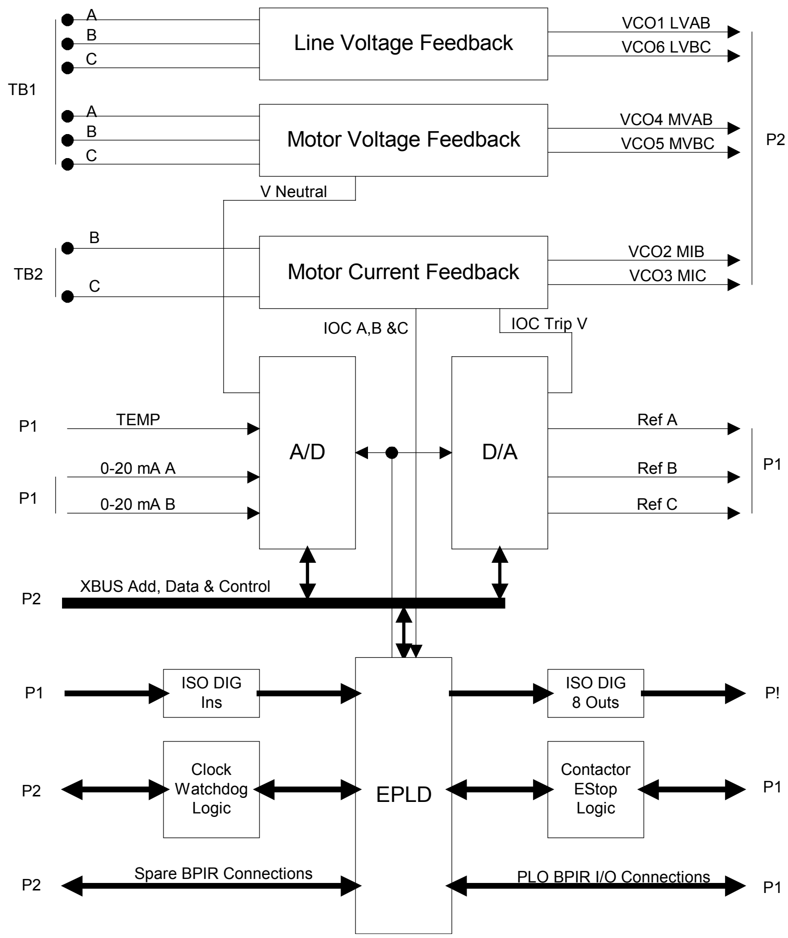


Figure 1. BICR Board Block Diagram

Table 1. BICR Board Typical Power Requirements

Voltage	Current
+05 V dc	300 mA
+15 V dc	150 mA
–15 V dc	150 mA
+24 V dc (Isolated)	50 mA

Line Voltage Feedback

BICR board voltage to frequency gain errors are less than ±1.7%.

Two line-to-line ac input voltages (LVA-B and LVB-C) are derived by resistive attenuated monitoring of the three input phases. Attenuation strings are connected to TB1 and the string resistance (Rx) is varied to scale the feedback (see Figure 2). The two voltages are converted to VCO signals and passed through the P2 connector to VCO counters on the DSPX board. The VCO is biased so that with 0 V input, the output frequency is 1 MHz. Full scale is ±1 MHz from the 0 V bias frequency. Output frequency per peak (pk) input volt can be obtained using the following formula: (also see Table 2)

$$Hz/Vpk = 2.37\ K * 168492\ Hz / (Rx + .0095\ M)$$

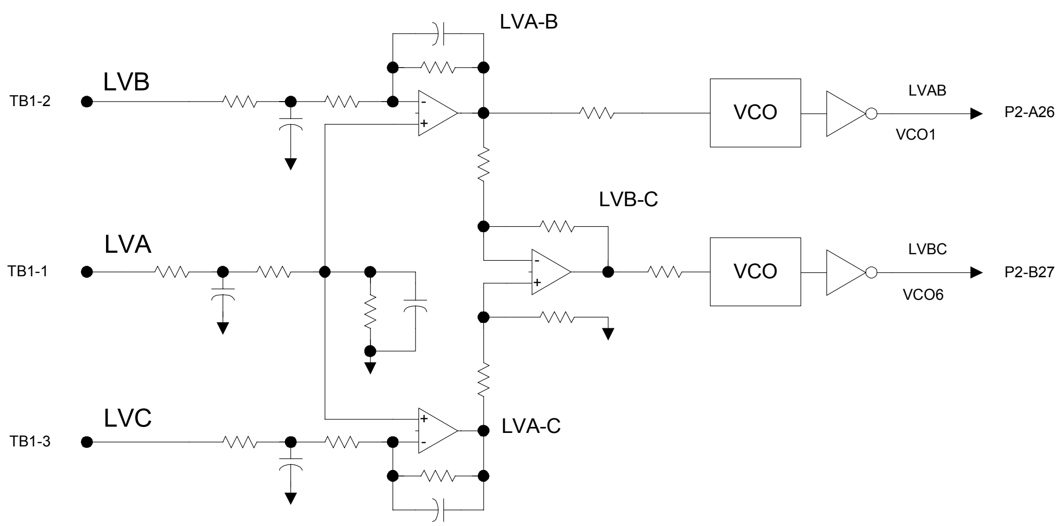


Figure 2. BICR Board Line Voltage Feedback Diagram

Table 2. BICR Board Line Voltage Outputs (per Input Rx)

RMS L-L Voltage	Input Rx Value	Pk L-L Voltage	LVFBK VCO Hz/V	FS LVFBK L-L Pk Voltage	LVAB LVBC TP @ RMS L-L
2400	1800000	3394.1	220.683	4400.8	3.143
3000	2200000	4242.6	180.731	5422.4	3.218
3300	2400000	4666.9	165.730	5913.2	3.246
4160	3000000	5883.1	132.688	7385.7	3.276
4800	3500000	6788.2	113.784	8612.8	3.241
6000	4200000	8485.3	94.863	10330.7	3.378
6600	4800000	9333.8	83.029	11803.1	3.252
6900	5000000	9758.1	79.714	12294.0	3.264
7200	5200000	10182.3	76.653	12784.9	3.276
8400	6000000	11879.4	66.449	14748.2	3.313
10000	7200000	14142.1	55.389	17693.0	3.287
11000	7900000	15556.3	50.487	19410.9	3.296
12000	8600000	16970.6	46.382	21128.9	3.303
12500	9500000	18667.6	41.992	23337.8	3.290
13800	10000000	19516.1	39.895	24564.5	3.267

Motor Voltage Feedback

BICR board voltage to frequency gain errors are less than ± 1.9%.

Two line-to-line motor output voltages (MVA-B and MVB-C) are derived by resistive attenuated monitoring of the three output phases. Attenuation strings are connected to TB2 and the string resistance Rx is varied to scale the feedback. The two voltages are converted to VCO signals and passed through the P2 connector to VCO counters on the DSPX board (see Figure 3). The VCO is biased so that with 0 V input, the output frequency is 1.02 MHz. Full scale is ±1 MHz from the 0 V bias frequency. Output frequency per pk output volt can be obtained using the following formula: (also see Table 3)

Hz/Vpk = 5 K * 80172.6 Hz / (Rx + .005 M)

The motor output neutral voltage (VN) is also monitored. This voltage is scaled and then passed to one of the 10-bit A/D converters that has a ±1 V full scale input (1/2 VN). The VN is scaled through the attenuation strings and the ± full-scale neutral pk voltage can be obtained using the following formula:

±V pk full scale = 2 V * (Rx + .005 M)/ 5 K

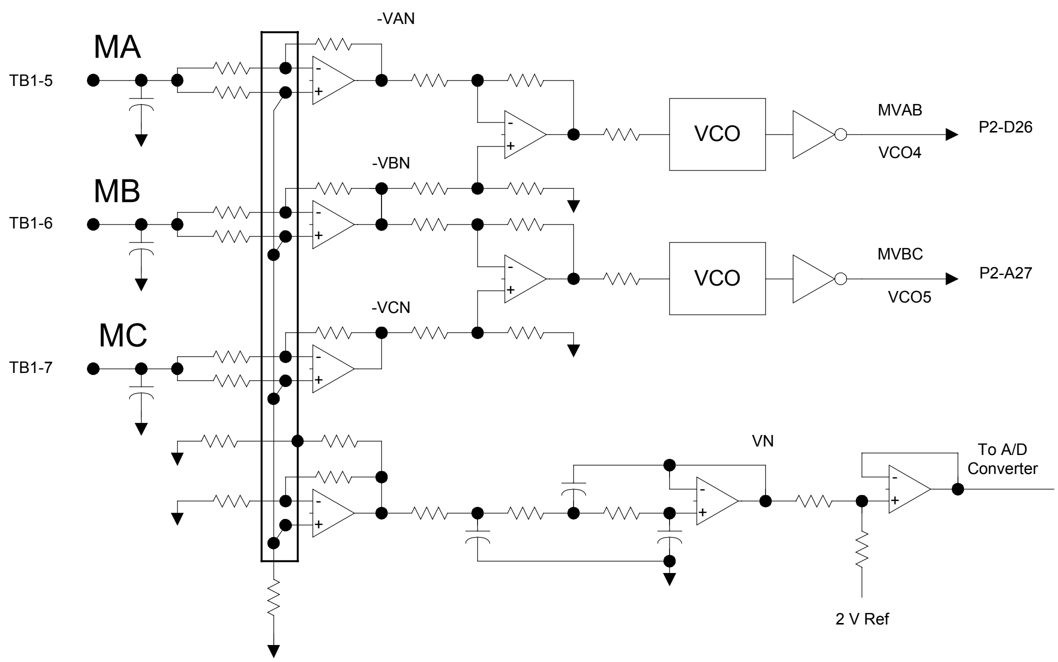


Figure 3. BICR Board Motor Voltage Feedback Diagram

Table 3. BICR Board Motor Voltage Outputs (per Input Rx)

RMS L-L Voltage	Input Rx Value	Pk L-L Voltage	MVFBK VCO Hz/V	FS MVFBK L-L Pk Voltage	MVAB MVBC TP @ RMS L-L
2400	1800000	3394.1	222.640	4401.7	3.163
3000	2200000	4242.6	182.169	5379.6	3.237
3300	2400000	4666.9	166.991	5868.6	3.264
4160	3000000	5883.1	133.599	7335.4	3.294
4800	3500000	6788.2	114.516	8557.8	3.258
6000	4200000	8485.3	95.432	10269.1	3.395
6600	4800000	9333.8	83.504	11736.0	3.268
6900	5000000	9758.1	80.165	12224.8	3.280
7200	5200000	10182.3	77.082	12713.7	3.291
8400	6000000	11879.4	66.805	14669.6	3.328
10000	7200000	14142.1	55.672	17603.1	3.302
11000	7900000	15556.3	50.739	19314.5	3.311
12000	8600000	16970.6	46.609	21026.0	3.318
12500	9000000	17677.7	44.538	22003.7	3.302
13200	9500000	18667.6	42.194	23226.1	3.304
13800	10000000	19516.1	40.084	24448.7	3.282

Motor Current Feedback

The two motor output current voltage signals, IB and IC, are derived by monitoring the B and C output phase currents using open or closed loop hall effect or LEM™ sensors connected to TB1 and TB2 (see Figure 4). The front end sensor differential amplifier circuits can be configured for multiple inputs and gains of unity (0.5 and 0.25) through various sensor connection schemes to TB1 and TB2. In high current applications requiring two sensors per phase, the sensors should be connected as shown in the parallel sensor connection diagram (see Figure 5).

Note External burden resistors are required when using closed loop sensors. The burden resistor value should be selected to produce ± 10 V across the burden resistor with ± full scale sensor output current.

IB and IC voltages are converted to VCO signals (MIB and MIC) and passed through the P2 connector to the DSPX board VCO counters. The VCO is biased, so that with 0 V at IB and IC the output frequency is 1 MHz. Full scale is ± 1 MHz from the 0 V bias frequency and is produced with a ± 5 V pk at IB or IC. BICR board voltage-to-frequency gain errors are less than ± 1.7%. Peak full scale is also represented as ± 5 V at the MIA, MIB, and MIC test points.

IA voltage is derived from the inverted sum of IB and IC. All three voltages are passed to window compare circuits to detect for an instantaneous overcurrent (IOC) condition. The IOC trip thresholds are programmed from one of the outputs of the D/A converter. Zero to + full scale of the D/A output corresponds to zero full scale of the sensor current.

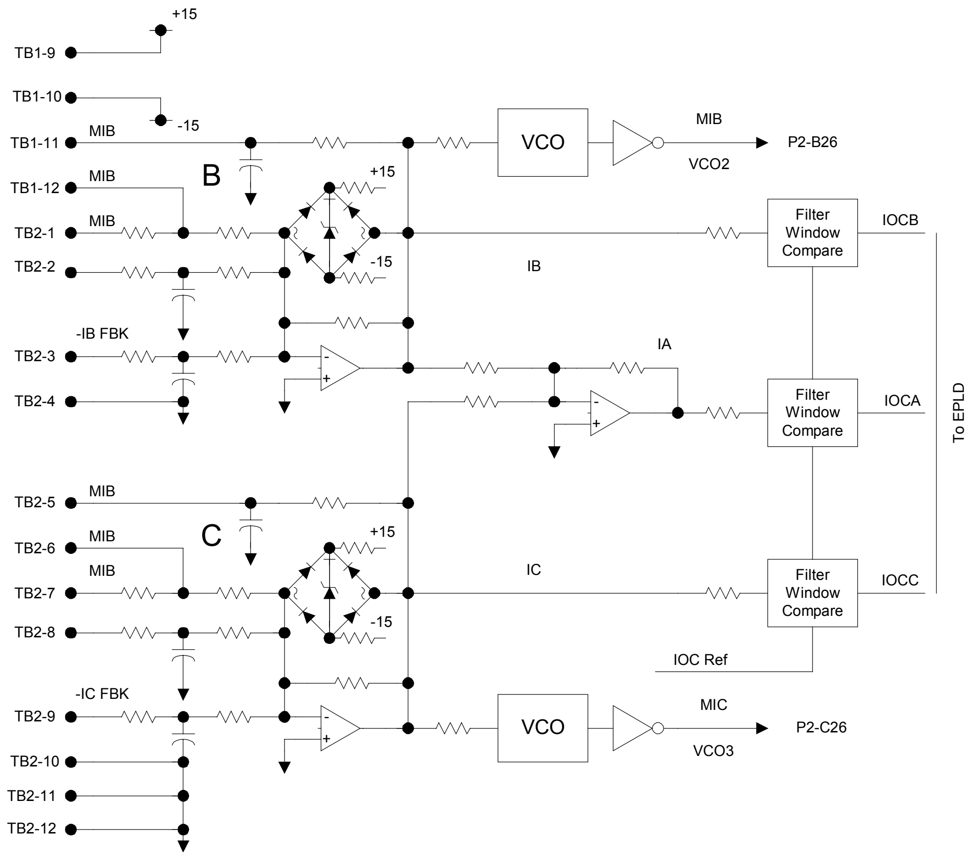
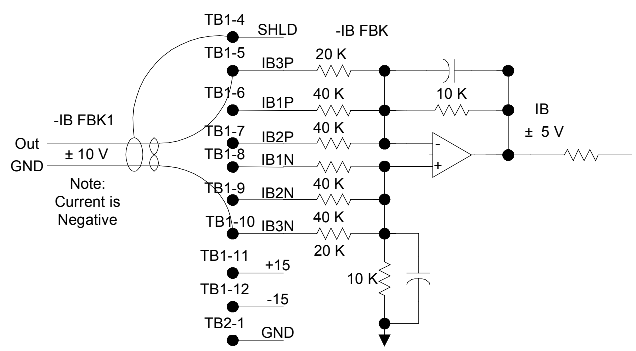
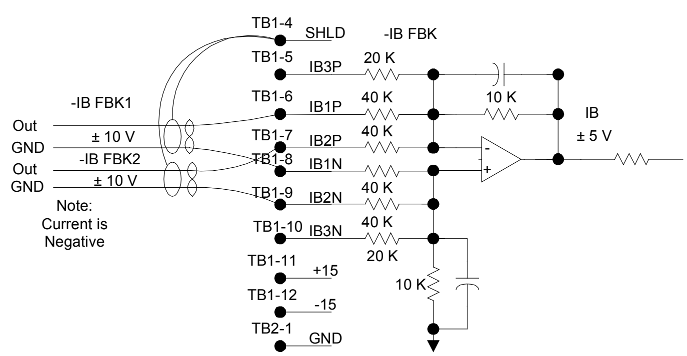


Figure 4. BICR Board Motor Current Feedback Diagram



Typical single sensor connections. Phase B



Typical Dual Sensor Connections. Phase B

Figure 5. Motor Current Feedback Sensor Connection Diagram

Fault String and MA/MB Contactor Control

There are two fault sting inputs to the BICR board: (see Figure 6)

- One input dedicated to the panel series string of interlock contacts
- One input dedicated to the system string of interlock contacts

The input terminals for these fault strings are 24 V, 115 V, and common and each fault string is fuse protected. Typical connections are between the common and one of the voltage terminals. The inputs are isolated so one string can be operated at 24 V while the other is operated at 115 V. Loading of the inputs is 20 mA maximum. One of the specified voltages must be applied to both inputs for normal operation. Current ratings for the MA and MB contactors are as follows:

- MA Form C: 6 A @ 125 V ac
  .6 A @ 110 V dc
  2 A @ 30 V dc
- MB Form A: .6 A @ 125 V ac
  .6 A @ 110 V dc
  2 A @ 30 V dc

The states of the inputs are reported back to the DSPX board. Both inputs are hardware *ANDed* to provide a master enable for the MA and MB contactor pilot relays. Dropping out either or both of these inputs while the drive is running will sequence a controlled shutdown.

The MA contactor pilot relay has two functions:

- Providing a set of Form C contacts to control the main contactor
- Control of the bridge RUN signal to the FOHB board through the HR1/HR2 contact

To pick up this relay, the C Disable and NMAC lines must be low, and the fault string must be satisfied. An MA sense input is provided and should be used with an interlock on the MA contactor to inhibit bridge firing if the main contactor does not pick up. To pick up the MB relay, the C Disable and NMBC lines must be low and the fault string satisfied. Both the MA and MB pilot relays are dropped out on a WD fault.

Note Sense input for the MA contactor is 24 – 115 V ac/dc with a loading of 4 – 10 mA peak. No dedicated sense input is provided for the MB contactor.

The hardware configuration assures that if a fault string is broken while the drive is running, bridge firing will be disabled before the MA or MB contactors drop out. Sequencing of the contactors and the FOHB board RUN signal is done in software using the NMAC, NMBC, RUN, and BICDABL control outputs and the MASEN, LOCFLT, SYSFLT, and bridge feedback fault lines. The BICDABL line is asserted high during power-up or hard reset configuration of the BICR board's electronically programmable logic device (EPLD). Taking this line high assures the MA and MB contactors do not pick up until commanded.

A watchdog circuit in the EPLD monitors the 20 MHz (clk0) and 16 MHz (clk16) clock signals. If the 20 MHz or 16 MHz clock is not present, bridge firing will be disabled, and the MA and MB contactors and discrete digital outputs will drop out. If a clock failure occurs while the bridge is firing, the RUN signal will also be removed. In addition to the clk0 and clk16 watchdog, two additional watchdogs are implemented in the EPLD. If bridge firing power is enabled through the power electronics enable bit, the watchdog toggle bit must be written to an alternate state within a clkt1 period. The clkt1 period must be less than 20,000 clk0 periods, or a watchdog fault will be generated.

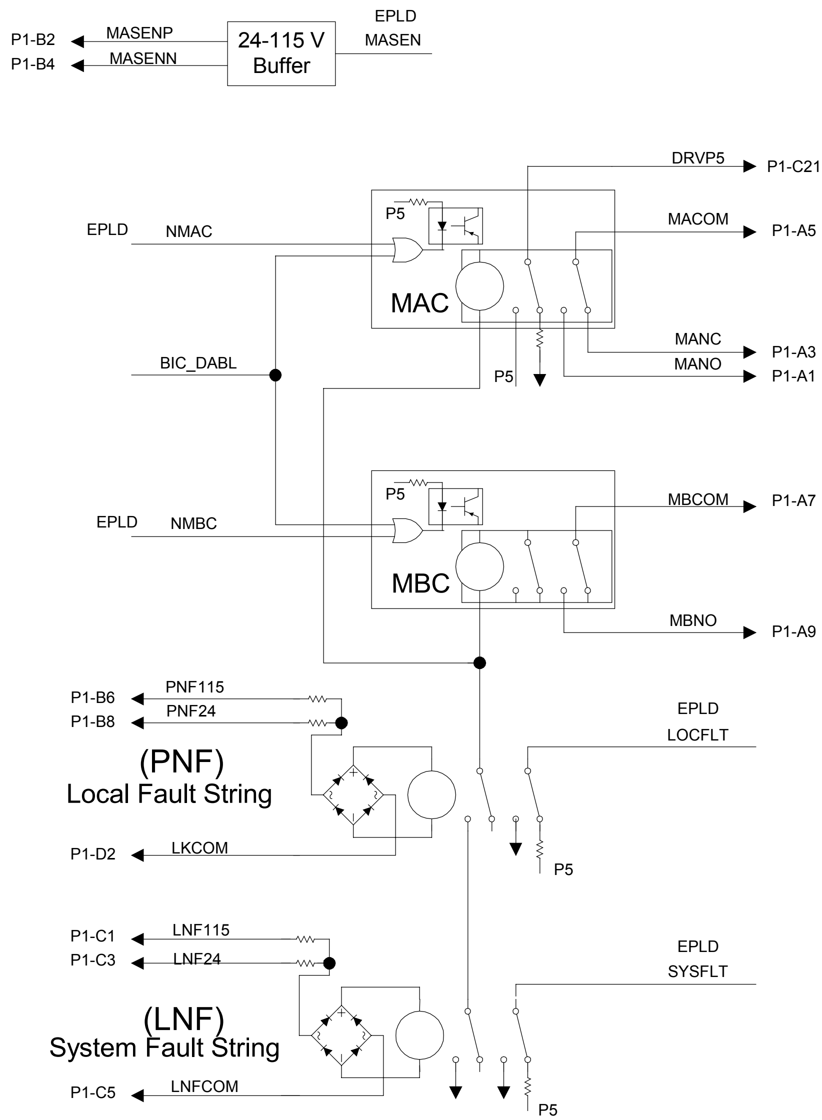


Figure 6. Fault String and MA/MB Contactor Control Block Diagram

Analog/Digital Converter Inputs

There are four analog/digital (A/D) converter input channels as shown in Table 5 and Figure 7. Channel one of the A/D converter monitors the motor neutral voltage (VN). VN is a bipolar voltage that is biased at 1 V for a neutral voltage of 0 V. Full scale voltage for this input into the A/D converter is ±1 V. Channel two of the A/D converter monitors a temperature signal sent from the FOHB board and represents the peak temperature of the cells during normal operation. Full scale at the input terminals (P1-TEMP and P1-TEMPC) is 10 V. This voltage is used for temperature fault indication as shown in Table 4.

Table 4. Temperature Fault Inputs

Voltage	Indication
10 V – 8 V	OK
8 V – 2 V	Over Temp Warning
2 V – 0 V	Over Temp Trip

Channels three and four are externally multiplexed to provide two additional analog inputs. The *auxan* line is used to select the two additional inputs. With an *auxan* logic low, channels three and four are assigned to the 0–20 mA input circuits. There are two 0–20 mA inputs that are scaled for zero to full scale on two of the A/D converter outputs. Channels three and four are assigned to the 0–10 V and board temperature circuit outputs when the *auxan* line is asserted high.

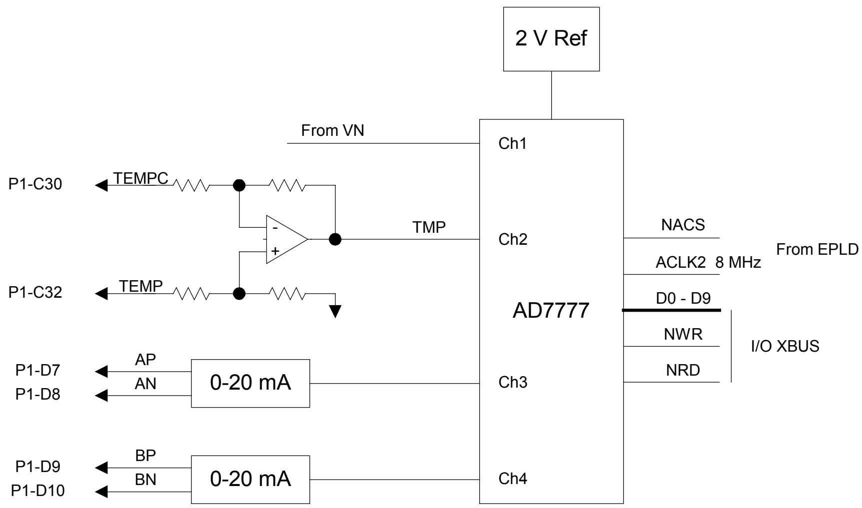


Figure 7. A/D Converter Interface

Table 5. Analog/Digital Converter Input Specifications

Input	Range	A/D Chnl.	Auxan Bit	A/D Count	Tolerance
VN Neutral	± 2 V	1	NA	256 Cnt./V	± 2.5%
Cell Temp	0 – 10 V	2	NA	102.4 Cnt./V	± 2.5%
mA Input - B	0 – 20 mA	3	0	48.9 Cnt./mA	± 3.5%
V Input - C	0 – 10 V	3	1	99.9 Cnt./V	± 3.5%
mA Input - A	0 – 20 mA	4	0	48.9 Cnt./mA	± 3.5%
Board Temp	0 – 5 V @ RTD	4	1	204.8 Cnt./V	± 5.0%

Digital/Analog Converter Outputs

There are four 12-bit digital/analog (D/A) converters on the BICR board (see Figure 8). Three of these outputs are scaled and buffered to provide the bipolar phase reference required by the bridge PWM modulator located on the FOHB board. The forth converter is set between 0 to + full scale to set the motor IOC trip reference level. All four converter data registers are double buffered. The R/W data register are loaded, and the new values transferred to the analog outputs, at the same time as the /LD line is asserted low. All registers are set to the midpoint (0 V) when the DARST line is set high.

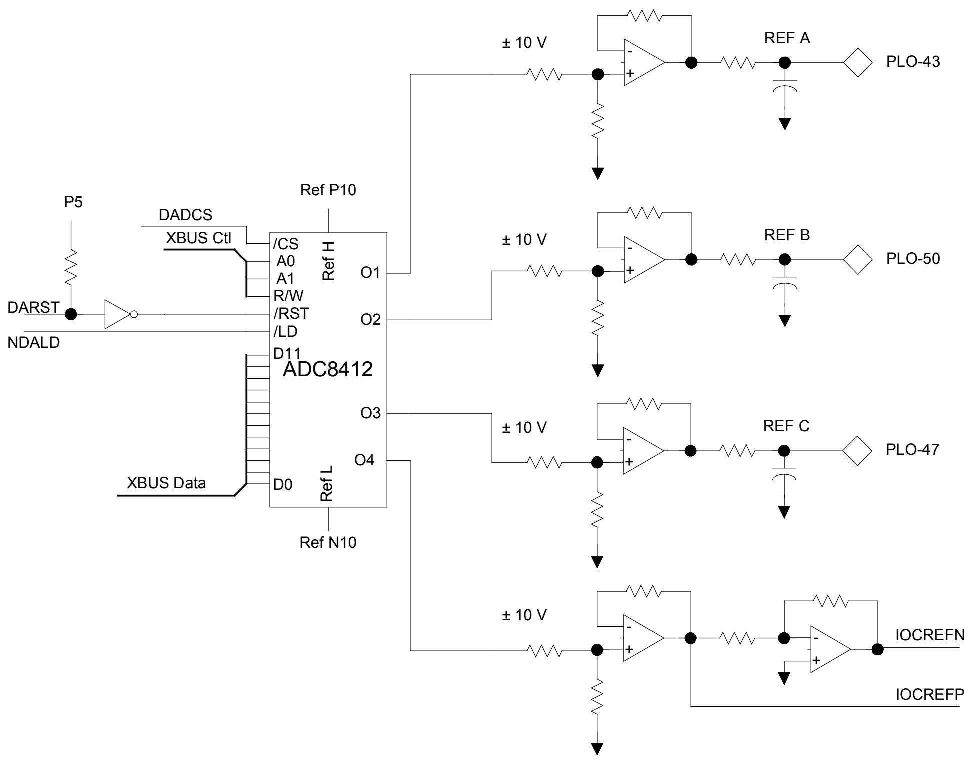


Figure 8. Reference D/A Converter Interface Block Diagram

Discrete Digital Inputs

There are eight differential discrete inputs routed to the BICR board from the CTBC terminal board through the CABP board. The sense of the inputs is such that a high input on the CTBC results in a high input to the BICR board's EPLD. The discrete inputs are optically coupled to the control logic. Each input has a yellow LED to indicate its state. Overvoltage protection up to 60 V is provided.

Note Input voltages above 60 V cause the 7.5 V zener diode to sink to 30+ mA, causing it to dissipate more than its rated power (250 mW). The zener diode can handle non repetitive pulses of 10 W for 1 ms.

Table 6. Discrete Input Specifications

Specification	Conditions	Min / Typ / Max (Units)
Input Range		0 to +30 V dc
Loading	Vin = +30 V dc	Max = 20 mA
Positive Threshold	Vin Increasing	Max = +20 V
Negative Threshold	Vin Decreasing	Min = +5 V
Hysteresis		Min = 4.5 V
Turn-On Time		Typ = 3 µs
Turn-Off Time		Typ = 2.8 µs
Rise Time		Typ = 1.6 µs
Fall Time		Typ = 2.2 µs
Isolation Voltage		Min = 2500 V ac rms

Solid State Relay Digital Outputs

There are eight solid state relay outputs routed from the BICR board to the CTBC terminal board through the CABP board. A high output from the BICR board's EPLD results in the output relay being closed and a low output from the EPLD results in the output relay being opened. The default relay output state is open (EPLD output pulled low). The relay outputs are optically isolated from the control. Each output has a yellow LED to indicate its state. Transient voltage suppression is provided to clamp the output voltage at 32 V.

Note When clamping at 32 V, the zener diodes can withstand up to 30 mA of current before they exceed their power rating (500 mW). The zeners can handle non-repetitive pulses of 10 W for 10 ms.

Table 7. Solid State Relay Output Specifications

Specification	Conditions	Min / Typ / Max (Units)
Output Voltage Rating		Max = 28 V dc
Output Current Rating		Max = 0.7 A dc
Turn-On Time	Photovoltaic Relay	Typ = 2.0 ms
Turn-Off Time	Photovoltaic Relay	Typ = 0.5 ms
Isolation Voltage		Min = 4000 V ac rms

Application Data

The BICR board includes two terminal boards, two backplane connectors, eight user testpoints, eighteen LED indicators, and two fuses. There are no adjustable hardware devices on the board. Refer to Figure 9 for component locations and the following tables for descriptions.

Note There are additional testpoints and an additional connector (JTAG) on the BICR board surface. These are for development use only and not described in this publication.

Table	Description
8	TB1 Terminal Board
9	TB2 Terminal Board
10	User Testpoints
11	LED Indicators
12	Fuses

Note Backplane connectors P1 and P2 require a custom extender board to access individual pin signals. Checking of these signals is not a part of standard in-service testing/troubleshooting procedures and these signals are not described in this publication.

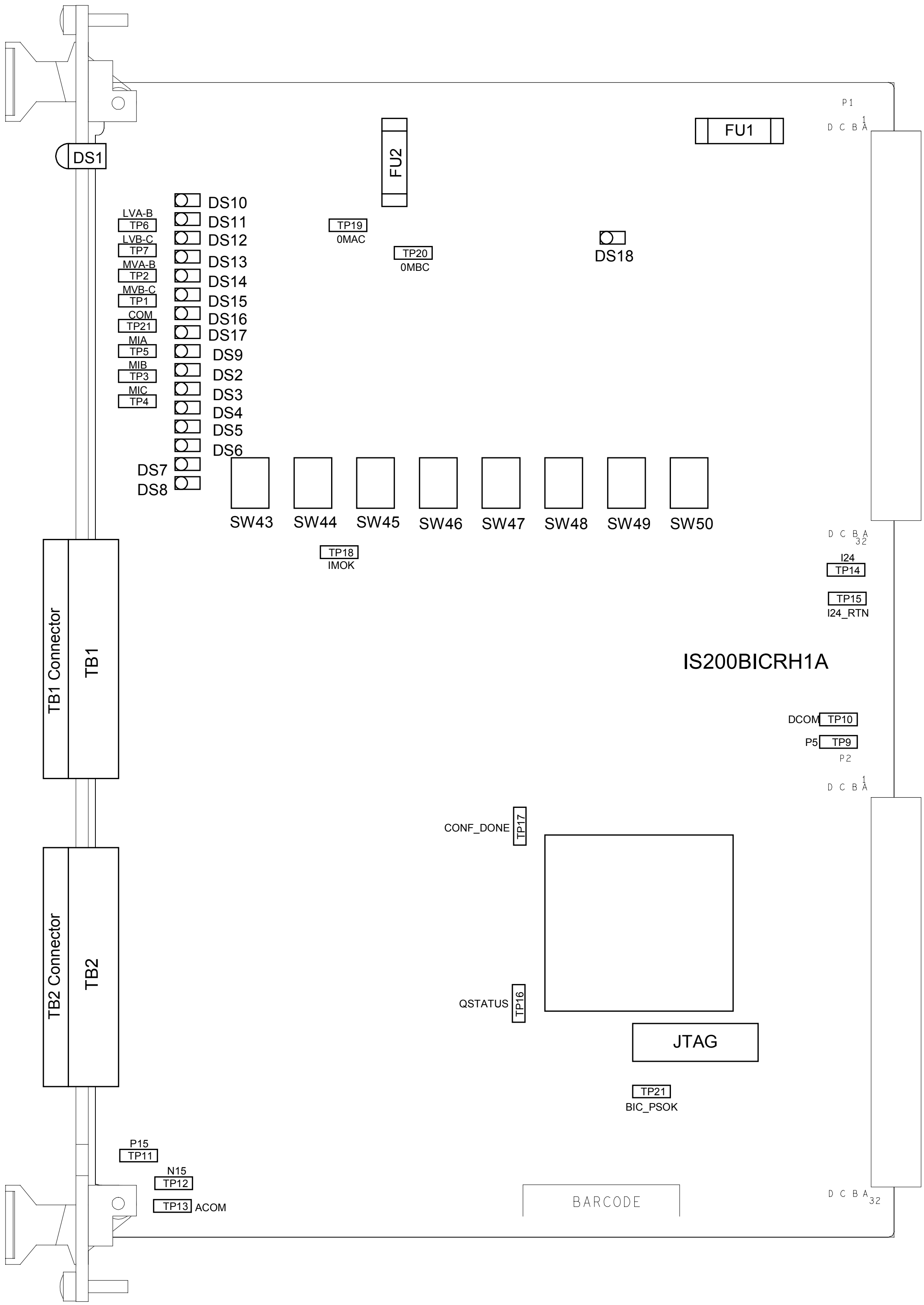


Figure 9. BICR Board Layout Diagram

Table 8. TB1 Bridge Feedback Terminal Board Pin Descriptions

Pin	Name	Description
1	LVA	Line Voltage resistive attenuation Phase A input
2	LVB	Line voltage resistive attenuation Phase B input
3	LVC	Line voltage resistive attenuation Phase C input
4	SHLD	Shield Connection
5	IB3P	Phase B current sensor A = .5 + input 3
6	IB1P	Phase B current sensor A = .25 + input 1
7	IB2P	Phase B current sensor A = .25 + input 2
8	IB1N	Phase B current sensor A = .25 – input 1
9	IB2N	Phase B current sensor A = .25 – input 2
10	IB3N	Phase B current sensor A = .5 – input 2
11	P15	+ 15 V Supply
13	N15	- 15 V Supply

Table 9. TB2 Bridge Feedback Terminal Board Pin Descriptions

Pin	Name	Description
1	ACOM	Analog ± 15 V Common
2	IC3P	Phase C current sensor A = .5 + input 3
3	IC1P	Phase C current sensor A = .25 + input 1
4	IC2P	Phase C current sensor A = .25 + input 2
5	IC1N	Phase C current sensor A = .25 – input 1
6	IC2N	Phase C current sensor A = .25 – input 2
7	IC3N	Phase C current sensor A = .5 – input 3
8	SHLD	Shield Connection
9	MVA	Motor voltage resistive attenuation Phase A input
10	MVB	Motor voltage resistive attenuation Phase B input
11	MVC	Motor voltage resistive attenuation Phase C input
12	SHLD	Shield Connection to Chassis

*Table 10. User Testpoints**

Testpoint	Name	Description
TP6	LVA-B	Line Phase Voltage A-B ±5.94 V pk FS
TP7	LVB-C	Line Phase Voltage B-C ±5.94 V pk FS
TP2	MVA-B	Motor Phase Voltage A-B ±5.94 V pk FS
TP1	MVB-C	Motor Phase Voltage B-C ±5.94 V pk FS
TP21	COM	Signal Common
TP5	MIA	Motor Phase A Current ±5 V pk FS
TP3	MIB	Motor Phase B Current ±5 V pk FS
TP4	MIC	Motor Phase C Current ±5 V pk FS

*These user testpoints are accessible through the opening in the BICR board faceplate and are listed in the order (from top to bottom) that they are arranged on the board.

*Table 11. LED Indicators**

LED	Color	Name	Description
DS1	Green	IMOK	ON when power applied and board functioning properly
DS2	Yellow	DO2	Digital relay number 2 output, ON when closed
DS3	Yellow	DO3	Digital relay number 3 output, ON when closed
DS4	Yellow	DO4	Digital relay number 4 output, ON when closed
DS5	Yellow	DO5	Digital relay number 5 output, ON when closed
DS6	Yellow	DO6	Digital relay number 6 output, ON when closed
DS7	Yellow	DO7	Digital relay number 7 output, ON when closed
DS8	Yellow	DO8	Digital relay number 8 output, ON when closed
DS9	Yellow	DO1	Digital relay number 1 output, ON when closed
DS10	Yellow	DI1	Discrete digital input number 1, ON when active
DS11	Yellow	DI2	Discrete digital input number 2, ON when active
DS12	Yellow	DI3	Discrete digital input number 3, ON when active
DS13	Yellow	DI4	Discrete digital input number 4, ON when active
DS14	Yellow	DI5	Discrete digital input number 5, ON when active
DS15	Yellow	DI6	Discrete digital input number 6, ON when active
DS16	Yellow	DI7	Discrete digital input number 7, ON when active
DS17	Yellow	DI8	Discrete digital input number 8, ON when active
DS18	Yellow	CONF_DONE	ON when contactor control configuration complete

*LEDs DS2 – DS18 that are visible through the faceplate opening are for troubleshooting purposes and do not need to be observed during normal operation.

Table 12. Fuses

Fuse	Path	Description and Part Number
FU1	Local fault string	250 V, 200 mA; 44A725207-004
FU2	System fault string	250 V, 200 mA; 44A725207-004

Renewal/Warranty Replacement

How to Order a Board

When ordering a replacement board for a GE drive, you need to know:

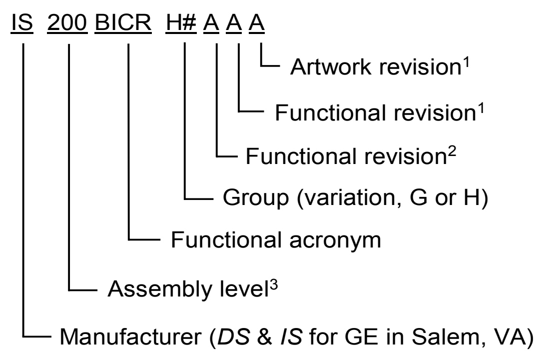
- How to accurately identify the part
- If the part is under warranty
- How to place the order

This information helps ensure that GE can process the order accurately and as soon as possible.

Board Identification

A printed wiring board is identified by an alphanumeric **part (catalog) number** located near its edge. Figure 10 explains the structure of the part number.

The board's functional acronym, shown in Figure 10, is normally based on the **board description**, or name. For example, the BICR board is described as the Bridge Interface board.



[1]Backward compatible
[2]Not backward compatible
[3]*200* indicates a base-level board; *215* indicates a higher-level assembly or added components (such as PROM)

Figure 10. Board Part Number Conventions

Warranty Terms

The GE *Terms and Conditions* brochure details product warranty information, including **warranty period** and **parts and service coverage**. The brochure is included with customer documentation. It may be obtained separately from the nearest GE Sales Office or authorized GE Sales Representative.

Placing the Order

Parts still under **warranty** may be obtained directly from the factory:

GE Industrial Systems
Product Service Engineering
1501 Roanoke Blvd.
Salem, VA 24153-6492 USA
Phone: +1 540 387 7595
Fax: +1 540 387 8606

(“+” *indicates the international access code required when calling from outside of the USA*.)

Renewals (spares or those not under warranty) should be ordered by contacting the nearest GE Sales or Service Office.

Be sure to **include the following** when ordering any warranty or renewal parts:

- Complete part number and description
- Drive serial number
- Drive Material List (ML) number

Note All digits are important when ordering or replacing any board. The factory may substitute later versions of boards based on availability and design enhancements. However, GE Industrial Systems ensures backward compatibility of replacement boards.

Handling Precautions

Caution

To prevent component damage caused by static electricity, treat all boards with static sensitive handling techniques. Wear a wrist grounding strap when handling boards or components, but only after boards or components have been removed from potentially energized equipment and are at a normally grounded workstation.

Printed wiring boards may contain static-sensitive components. Therefore, GE ships all replacement boards in antistatic bags.

Use the following guidelines when handling boards:

- Store boards in antistatic bags or boxes.
- Use a grounding strap when handling boards or board components (per previous *Caution* criteria).

Replacement Procedures

Warning

To prevent electric shock, turn off power to the board, then test to verify that no power exists in the board before touching it or any connected circuits.

Caution

To prevent equipment damage, do not remove, insert, or adjust board connections while power is applied to the equipment.

➢ To remove the BICR board

1. Make sure that the drive in which the board resides has been de-energized. (Refer to the appropriate *User's Manual* for complete de-energizing procedures, *GEH-6131* for air-cooled drives or *GEH-6133* for liquid-cooled drives.)
2. Open the drive’s control cabinet door, and using equipment designed for high voltages, test any electrical circuits **before touching them** to ensure that power is off.
3. Grasp each side of the TB1 connector that joins with the board's TB1 and gently pull the TB1 connector loose. (Individual wires do not have to be removed from the TB1 connector.)
4. Repeat step 3 for TB2.
5. Carefully remove the board from the rack, as follows:

   a. Loosen the screws at the top and bottom of the board, near the board ejector tabs. (The screws are captive in the board faceplate and should not be removed.)

   b. Unseat the board by raising the ejector tabs.

   c. Using both hands, gently pull the board from the board rack.

➢ To install the new replacement BICR board

1. Verify that both fuses are present and good, then slide the board into the **correct slot** in the rack.

Caution

Because boards are keyed for specific rack slots, inserting the BICR into the wrong slot can damage the electronics.

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2. Begin seating the board by firmly pressing the top and bottom of the board at the same time with your thumbs.
3. Finish seating the board in the slot by starting and then tightening the screws at the top and bottom of the board. **Tighten the screws evenly** to ensure that the board is seated squarely (2 – 4 in. lb. torque).
4. Orient the TB1 connector to TB1 in the same position as when removed and reconnect the TB1 connector to TB1 (ensure that it is properly seated).
5. Repeat step 4 for TB2.
6. Close the drive's control cabinet door.

Notes

GE Industrial Systems

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