GE Industrial Control Systems

IGBT Drive Bridge Personality Interface Board IS200BPIAG_A_ _

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 Control Systems.

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Safety Symbol Legend

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

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

Note Indicates an essential or important procedure, practice, condition, or statement.

Contents

Functional Description

The IS200BPIA Bridge Personality Interface Board (BPIA) provides an interface between the control and power electronics of an IGBT 3-phase ac drive. The interface consists of six isolated IGBT gate driver circuits, three isolated shunt voltage controlled oscillator (VCO) feedback circuits, and isolated VCO feedback circuits to monitor the dc link, VAB, and VBC output voltages. Hardware phase overcurrent and IGBT desaturation fault protection are also provided on this board. Bridge control connections are made through the P1 connector. Connections to the phase A, B, and C IGBTs are made through six plug connectors. The BPIA board is mounted in a VME type rack. See Table 1 for board specifications and Figure 1 for a block diagram of the board.

Power Supplies

There are nine isolated power supplies that are derived from the secondaries of three transformers, one per phase. A 17.7 V ac square wave input is supplied to the transformer primaries from the P1 connector. Two of the three secondaries on each transformer are halfwave rectified and filtered to provide the two isolated +15 V (VCC) and –7.5 V (VEE) supplies required by the upper and lower IGBT gate driver circuits. The third secondary is fullwave rectified and filtered to provide the isolated ±12 volts required by the shunt current and phase voltage feedback VCOs and fault detection circuitry. A light 5 V logic supply is also generated by a 5 V linear regulator on the +12 V supply. Control logic referenced +5 V is supplied to the BPIA board through the P1 connector.

Table 1. BPIA Board Specifications

Shunt Current Feedback VCO	
Range	0-2 MHz
Bias	1 MHz
Transfer Function	± 200 mV = ± 800 kHz
Output Offset	± 0.15% typical
Gain Error	± 0.5% typical, 1.5% maximum
All Drift Errors	± 0.0125% per degree C maximum
Phase to Phase Voltage Feedback VCO	
Range	0 – 2 MHz
Bias	976.8 kHz
Transfer Function	± 1.0V = ± 959.58 Hz
Output Offset	± 0.15% typical
Gain Error	± 0.5% typical, 1.5% maximum
All Drift Errors	± 0.0085% per degree C maximum
DC Link Voltage Feedback VCO	
Range	0 – 2 MHz
Bias	0 kHz
Transfer Function	+ 1198 V = 2 MHz
Gain Error	± 0.5% typical, 1.5% maximum
All Drift Errors	± 0.0085% per degree C maximum
IGBT Driver	
Range	–7.5 V to +15 V
Sink/Source	5.0 Amp maximum
On/Off Delay	1.5 microsecond maximum
CE Desaturation Threshold	10.0 V typical
Desaturation Fault Delay	4.2 microsecond typical
(DRVPC) high to DRV Off	1.6 microsecond maximum
Power Requirements	
+5 V dc	1.5 Watts maximum
17.7 V ac	5 W maximum with no driver Amp 18 W maximum with driver Amp

Phase IGBT Gate Drive Circuit

There are two independently isolated IGBT gate drive circuits per phase. One circuit controls the upper IGBT of a phase leg and the other controls the lower. These circuits are comprised of an optically isolated hybrid sip gate drive module and a few discrete components.

The module drives the IGBT gate line between VCC and VEE. Upper and lower module control inputs are anti-parallel connected to prevent simultaneous turn on of both.

The driver circuit can generate two types of faults. When the module is commanded to turn the IGBT ON, the module monitors the voltage drop between the emitter and collector of the IGBT. If this voltage exceeds about 10 V for a period greater than 4.2 microseconds, the module will turn the IGBT OFF and annunciate a desaturation fault. The voltage between VCC and VEE is also monitored. If this voltage drops below 18 V, an undervoltage (UV) fault will occur. These two faults are ORed together and optically coupled back to the control logic.

Phase A, B, and C Shunt Current Feedback

Output phase current is monitored by deriving a VCO output signal from the voltage dropped across the phase shunt. This voltage is amplified and then passed on to the VCO circuitry. The VCO has a range of 0 – 2 MHz. and the circuit is biased so that at zero current the nominal output is 1 MHz. A ±200 mV shunt voltage is converted into a ±800 kHz change in the VCO output frequency. The output of the VCO is optically coupled to the control logic.

Two faults can be generated by the current feedback circuit, DI/DT and over current (OC). A 100% or greater step change of the rated shunt current will cause a DI/DT fault within 25 microseconds. The OC threshold is set at 250%. These two faults are ORed together and optically coupled back to the control logic.

V A-B and V B-C Phase-to-Phase Voltage Feedback

Output phase-to-phase voltage is monitored by deriving two VCO signals (VAB) and (VBC) from the phase shunt connections. The two VCO circuits share the power supply and oscillator with the phase B and phase C shunt feedback circuits. The VAB circuit is based with the phase B shunt VCO and has a resistive attenuation tie to phase A. The VCB circuit is based with the phase C shunt with a resistive tie to phase B. These VCOs have a range of 0 – 2 MHz and the circuit is biased so that at zero phase-to-phase voltage the nominal output is 976.8 kHz. A ±1.0 V phase-to-phase voltage is converted to a ±959.58 Hz change in the VCO output frequency. The outputs of the VCOs are optically coupled to the control logic.

Vdc Dc Link Voltage Feedback

A third VCO voltage feedback circuit to monitor the dc link voltage is referenced to the phase A lower gate drive circuit with a resistive attenuation tie to the phase A upper collector connection. The VCO has a range of 0 – 2 MHz. The input is scaled so that 0 to 1198 link volts equal 0 to 2 MHz. The output of the VCO is optically coupled to the control logic.

Fault Control and Gate Driver Disable

Gate drive and shunt fault signals are transient and only true during the time the fault condition exists. These signals have to be latched by the fault handling circuit monitoring the faults through P1.

When a fault is detected, control power to all six IGBT driver modules is removed. High speed and fail safe disable lines are provided for this function in the P1 connector.

The DRVPC line should be logic low and have 5 V applied to the DRVP5 line during normal operation. When a fault is detected, taking the DRVPC line high initiates a high-speed driver disable. Removing 5 V power from the DRVP5 through a set of contacts provides a fail-safe disable of the IGBT driver modules.

Serial Board Identification

A serial 1024-bit memory device is present on the BPIA board. This memory is programmed with board identification and revision information.

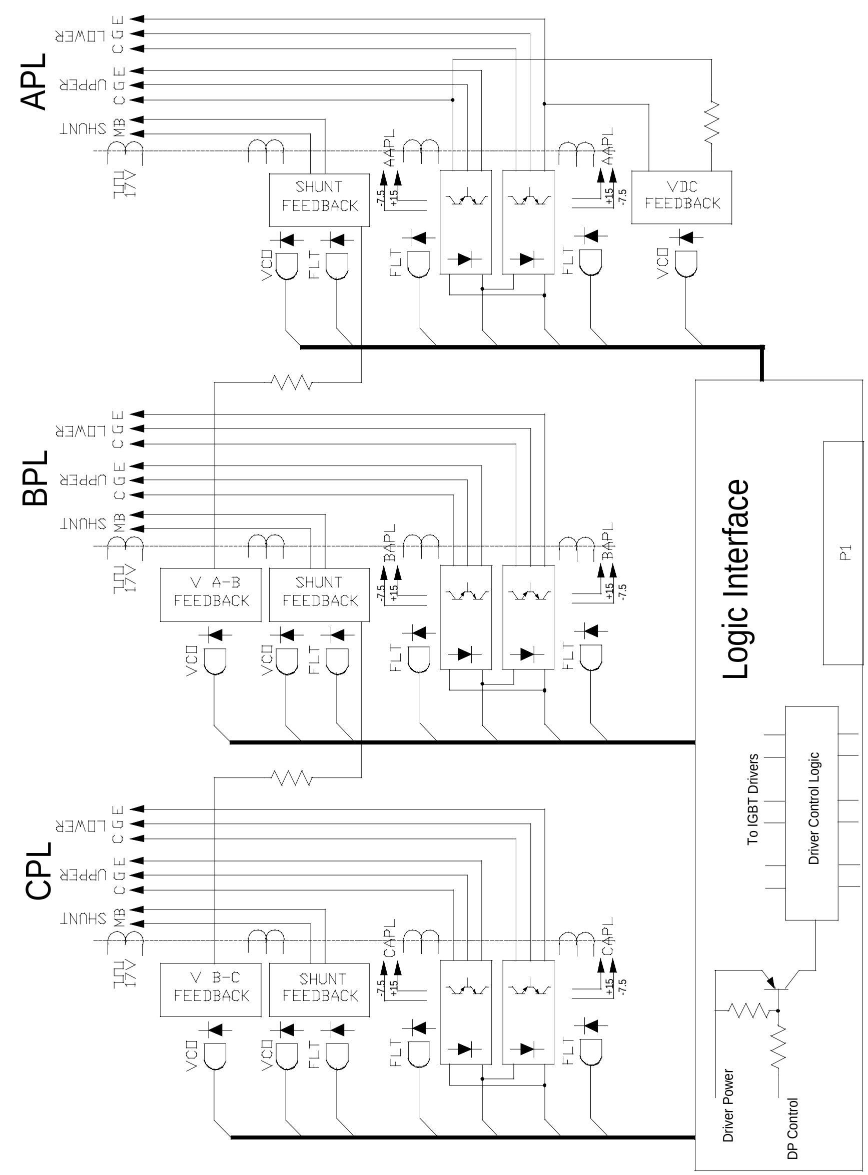

Figure 1. BPIA Board Block Diagram

Application Data

The BPIA board plugs into in a VME type rack via the P1 connector. Connections to the phase A, phase B, and phase C IGBTs are made through six plug connectors included on the board as follows:

- Table 3. APL, Phase A Connector
- Table 4. BPL, Phase B Connector
- Table 5. CPL, Phase C Connector
- Table 6. AAPL, Phase A Upper Amplifier Supply
- Table 7. BAPL, Phase B Upper Amplifier Supply
- Table 8. CAPL, Phase C Upper Amplifier Supply

The BPIA board does not include any adjustable hardware, testpoints, LED indicators, or fuses. See Figure 2 for a board faceplate illustration and Figure 3 for a board layout diagram.

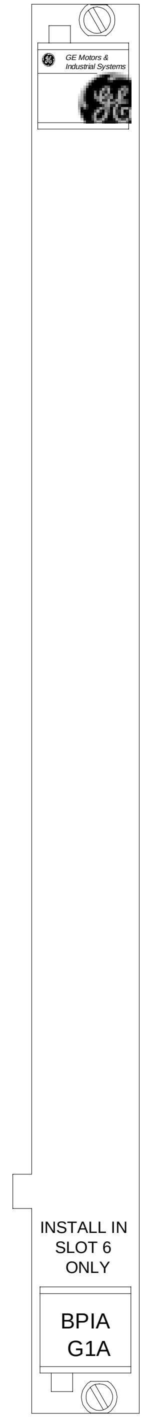

Figure 2. BPIA Board Faceplate

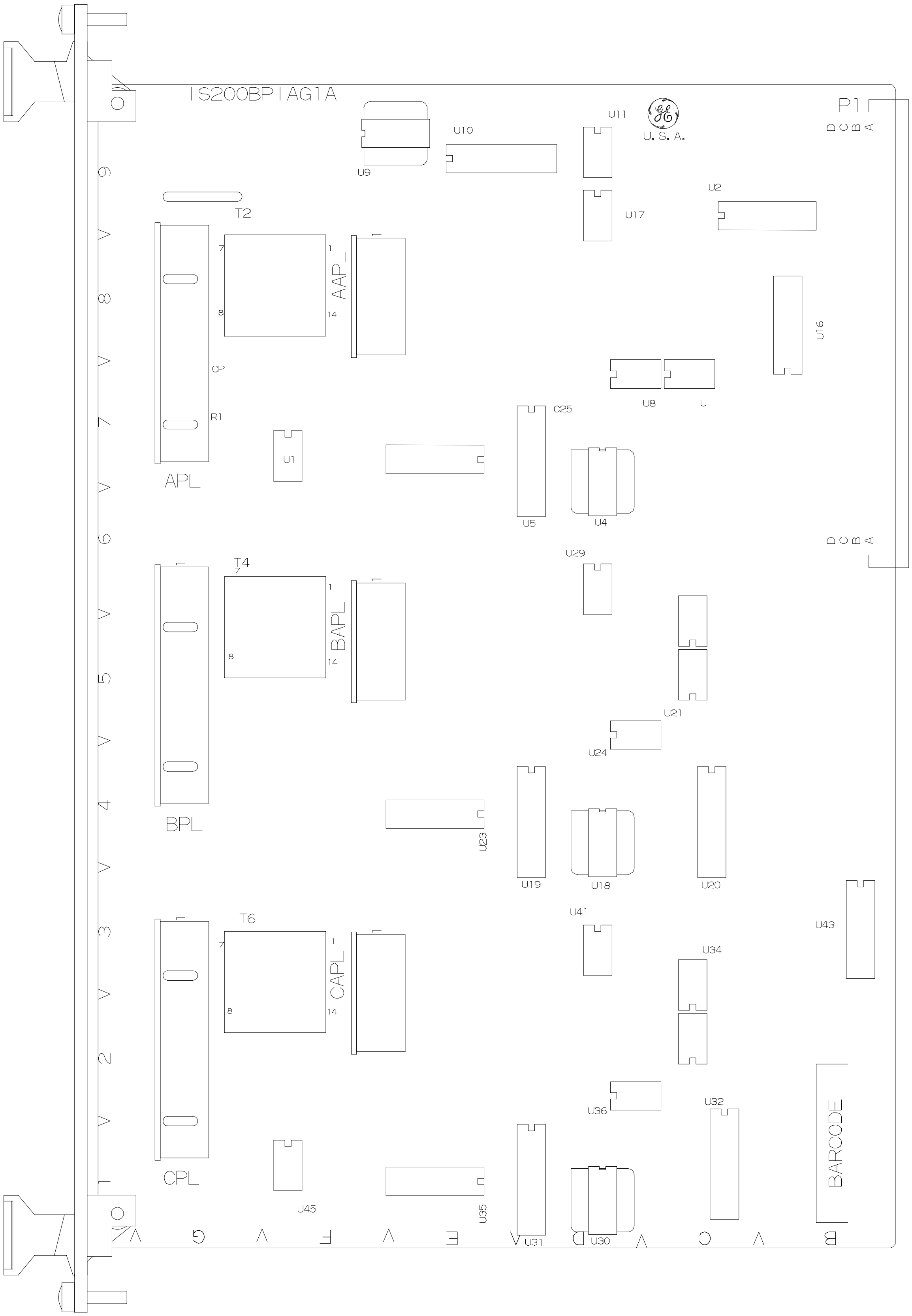

Figure 3. BPIA Board Layout Diagram

Table 2A. Bridge Control Connector

P1 Pin	Nomenclature	Description
A1	NC	No Connect, Voltage Clearance
A2	NC	No Connect, Voltage Clearance
A3	NC	No Connect, Voltage Clearance
A4	NC	No Connect, Voltage Clearance
A5	NC	No Connect
A6	NC	No Connect
A7	NC	No Connect
A8	NC	No Connect
A9	NC	No Connect
A10	NC	No Connect
A11	NC	No Connect
A12	NC	No Connect
A13	NC	No Connect
A14	NC	No Connect
A15	P5	+5 V Supply
A16	P5	+5 V Supply
A17	NC	No Connect
A18	NC	No Connect
A19	NC	No Connect
A20	NC	No Connect
A21	NC	No Connect
A22	NC	No Connect
A23	P5	+5 V Supply
A24	P5	+5 V Supply
A25	NC	No Connect
A26	NC	No Connect
A27	NC	No Connect
A28	NC	No Connect
A29	NC	No Connect
A30	NC	No Connect
A31	P5	+5 V Supply
A32	P5	+5 V Supply

Table 2B. Bridge Control Connector

P1 Pin	Nomenclature	Description
B1	VAC1	17.7 V ac Connection 1
B2	VAC2	17.7 V ac Connection 2
B3	NC	No Connect, Voltage Clearance
B4	NC	No Connect, Voltage Clearance
B5	NC	No Connect, Voltage Clearance
B6	NC	No Connect
B7	NC	No Connect
B8	NC	No Connect
B9	NC	No Connect
B10	NC	No Connect
B11	NC	No Connect
B12	NC	No Connect
B13	BR2EN	Bridge 2 Enable
B14	BR1EN	Bridge 1 Enable
B15	NDRPC	Driver power control; Low = Power ON
B16	DCOM	Digital Common
B17	NFLTRST	Bridge fault reset; Low = Reset (BPIB)
B18	AUF	Phase A Upper Desaturation/UV fault; High = Fault
B19	DCOM	Digital Common
B20	NVDC	Link V dc VCO; 0 – 1198VDC = 0 – 2 MHz
B21	DCOM	Digital Common
B22	ALF	Phase A Lower Desaturation/UV fault; High = Fault
B23	ASF	Phase A Shunt fault; High = Fault
B24	NAUD	Phase A Upper driver; Low = ON
B25	DCOM	Digital Common
B26	NASFB	IA VCO; 1 MHz ±200 mV = ±800 kHz
B27	DCOM	Digital Common
B28	NALD	Phase A Lower driver; Low = ON
B29	BUF	Phase B Upper Desaturation/UV fault; High = Fault
B30	DCOM	Digital Common
B31	NVAB	VA – VB VCO; 976.8 kHz ±959.58 Hz/1 V
B32	DCOM	Digital Common

Table 2C. Bridge Control Connector

P1 Pin	Nomenclature	Description
C1	VAC1	17.7 V ac Connection 1
C2	VAC2	17.7 V ac Connection 2
C3	NC	No Connect, Voltage Clearance
C4	NC	No Connect, Voltage Clearance
C5	NC	No Connect, Voltage Clearance
C6	NC	No Connect, Voltage Clearance
C7	NC	No Connect
C8	NC	No Connect
C9	NC	No Connect
C10	NC	No Connect
C11	NC	No Connect
C12	NC	No Connect
C13	NC	No Connect
C14	BLF	Phase B Lower Desaturation/UV fault; High = Fault
C15	BSF	Phase B Shunt fault; High = Fault
C16	NBUD	Phase B Upper driver; Low = ON
C17	DCOM	Digital Common
C18	NBSFB	IB VCO; 1 MHz ±200 mV = ±800 kHz
C19	BRDID	Serial Board ID Line
C20	NBLD	Phase B Lower driver; Low = ON
C21	DRVP5	Driver Switched 5 V power output
C22	CUF	Phase C Upper Desaturation/UV fault; High = Fault
C23	DCOM	Digital Common
C24	NVBC	VB – VC VCO; 976.8 kHz ±959.58 Hz/1 V
C25	DCOM	Digital Common
C26	CLF	Phase C Lower Desaturation/UV fault; High = Fault
C27	CSF	Phase C Shunt fault; High = Fault
C28	NCUD	Phase C Upper driver; Low = ON
C29	DCOM	Digital Common
C30	NCSFB	IC VCO; 1 MHz ±200 mV = ±800 Khz
C31	DCOM	Digital Common
C32	NCLD	Phase C Lower driver; Low = ON

Table 2D. Bridge Control Connector

P1 Pin	Nomenclature	Description
D1	NC	No Connect, Voltage Clearance
D2	NC	No Connect, Voltage Clearance
D3	NC	No Connect, Voltage Clearance
D4	NC	No Connect
D5	NC	No Connect
D6	NC	No Connect
D7	NC	No Connect
D8	NC	No Connect
D9	NC	No Connect
D10	NC	No Connect
D11	NC	No Connect
D12	NC	No Connect
D13	NC	No Connect
D14	NC	No Connect
D15	NC	No Connect
D16	NC	No Connect
D17	NC	No Connect
D18	NC	No Connect
D19	NC	No Connect
D20	NC	No Connect
D21	NC	No Connect
D22	NC	No Connect
D23	NC	No Connect
D24	NC	No Connect
D25	NC	No Connect
D26	NC	No Connect
D27	NC	No Connect
D28	NC	No Connect
D29	NC	No Connect
D30	NC	No Connect
D31	NC	No Connect
D32	NC	No Connect

Table 3. APL, Phase A Connector

Pin	Nomenclature	Description
1	AGL	Phase A Gate Lower IGBT
2	AEL	Phase A Emitter Lower IGBT
3	NC	Not Connected
4	NC	Not Connected
5	ACL	Phase A Collector Lower IGBT
6	AEU	Phase A Emitter Upper IGBT
7	AGU	Phase A Gate Upper IGBT
8	ASHM	Phase A Shunt Motor Side
9	ASHB	Phase A Shunt Bridge Side
10	NC	Not Connected
11	NC	Not Connected
12	ACU	Phase A Collector Upper IGBT

Table 4. BPL, Phase B Connector

Pin	Nomenclature	Description
1	BGL	Phase B Gate Lower IGBT
2	BEL	Phase B Emitter Lower IGBT
3	NC	Not Connected
4	NC	Not Connected
5	BCL	Phase B Collector Lower IGBT
6	BEU	Phase B Emitter Upper IGBT
7	BGU	Phase B Gate Upper IGBT
8	BSHM	Phase B Shunt Motor Side
9	BSHB	Phase B Shunt Bridge Side
10	NC	Not Connected
11	NC	Not Connected
12	BCU	Phase B Collector Upper IGBT

Table 5. CPL, Phase C Connector

Pin	Nomenclature	Description
1	CGL	Phase C Gate Lower IGBT
2	CEL	Phase C Emitter Lower IGBT
3	NC	Not Connected
4	NC	Not Connected
5	CCL	Phase C Collector Lower IGBT
6	CEU	Phase C Emitter Upper IGBT
7	CGU	Phase C Gate Upper IGBT
8	CSHM	Phase C Shunt Motor Side
9	CSHB	Phase C Shunt Bridge Side
10	NC	Not Connected
11	NC	Not Connected
12	CCU	Phase C Collector Upper IGBT

Table 6. AAPL, Phase A Upper Amplifier Supply

Pin	Nomenclature	Description
1	ALP15	Phase A Lower +15 V Supply
2	ALN7	Phase A Lower –7.5 V Supply
3	NC	Not Connected
4	NC	Not Connected
5	AUP15	Phase A Upper +15 V Supply
6	AUN7	Phase A Upper –7.5 V Supply

Table 7. BAPL, Phase B Upper Amplifier Supply

Pin	Nomenclature	Description
1	BLP15	Phase B Lower +15 V Supply
2	BLN7	Phase B Lower –7.5 V Supply
3	NC	Not Connected
4	NC	Not Connected
5	BUP15	Phase B Upper +15 V Supply
6	BUN7	Phase B Upper –7.5 V Supply

Table 8. CAPL, Phase C Upper Amplifier Supply

Pin	Nomenclature	Description
1	CLP15	Phase C Lower +15 V Supply
2	CLN7	Phase C Lower –7.5 V Supply
3	NC	Not Connected
4	NC	Not Connected
5	CUP15	Phase C Upper +15 V Supply
6	CUN7	Phase C Upper –7.5 V Supply

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 4 explains the structure of the part number.

The board's functional acronym, shown in Figure 4, normally is based on the **board description**, or name. For example, the *BPIA* board is described as the *IGBT Drive Bridge Personality Interface* board.

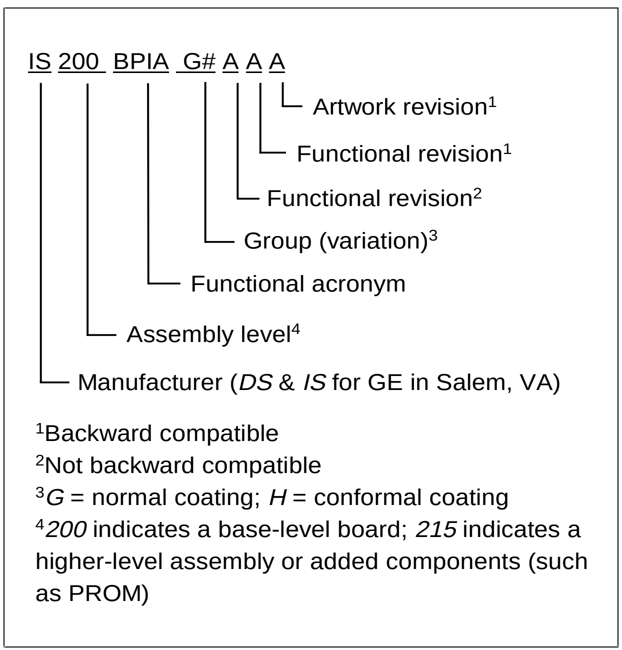

Figure 4. Board Part Number Conventions

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 Control 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:

- 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 Control Systems ensures backward compatibility of replacement boards.

How to Replace the Board

Handling Precautions

CAUTION

To prevent component damage caused by static electricity, treat all boards with static sensitive handling techniques.

Printed wiring boards may contain static-sensitive components. Therefore, GE ships all replacement boards in antistatic bags. Use the following guide-lines when handling boards:

1. Store boards in antistatic bags or boxes.
2. Use a grounding strap when handling boards or board components.

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 re-move, insert, or adjust board connections while power is applied to the equipment.

Remove the board from the VME rack as follows:

1. Make sure that the drive in which the board resides has been deenergized.
2. Open the drive's cabinet door. Using equipment designed for high voltages, test any electrical circuits **before touching them** to ensure that power is off.
3. Remove the protective cover from the right side of the board rack as follows:
   a. Loosen the four screws in the side of the cover. (It is not necessary to remove these screws because the cover is slotted for re-moval.)
   b. Loosen the screws at the top and bottom of the cover. (The screws are captive in the cover front and should not be removed.)
   c. Slide the protective cover forward and then to the right to remove it from the side screws.
4. Carefully disconnect all cables from the BPIA board as follows:
   - Verify cables are labeled with the correct connector name (as marked on the board) to simplify reconnection.
   - For ribbon cables, grasp each side of the cable connector that mates with the board connector and gently pull the cable connector loose.
   - For cables with pull tabs, carefully pull the tab.
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 front and should not be removed.)
   b. Unseat the board by raising the ejector tabs.
   c. Using both hands, gently pull the board from the VMEbus rack.

Install the new (replacement) board in the rack as follows:

1. Slide the board into the **correct slot** in the rack.

CAUTION

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

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.

4. Reconnect all cables to BPIA board as labeled and ensure that cables are properly seated at both ends.

5. Reinstall the protective cover on the right side of the board rack as follows:

   a. Place the protective cover over the four side screws, then slide it towards the rear of the rack (in the four slots).

   b. Tighten the screws at the top and bottom of the cover front. (The screws are captive in the cover front.)

   c. Tighten the four screws in the side of the cover.

6. Close the drive cabinet door.

Notes:

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Issue date: 1998-07-29
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