GE Industrial Systems

Phase Interface and Control Board
IS200PICHG_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 Systems.

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 IS200PICH Phase Interface and Control Board (PICH) is used in Innovation Series™ drives. It contains all of the gating drivers and feedback signal processing circuits for the four dual IGBT modules of the H-bridge phase assembly and is mounted above the laminated bus. Most of the active circuits are contained on vertically mounted subassemblies soldered into the PICH board. The three types of board subassemblies are:

- IS205TFBH IGBT Temperature Feedback Board (TFBH, quantity of one)
- IS205VCXH VCO Feedback Transmitter Board (VCXH, quantity of four)
- IS205IGDH IGBT Gate Driver Board (IGDH, quantity of eight)

These board subassemblies are described in separate sections in this instruction.

The PICH board assembly has all fiber-optic interfaces with separate fiber-optic isolators for each gating and feedback circuit. Figure 1 shows the PICH board's fiber-optic gating and feedback interfaces. Figure 2 illustrates a single phase of the power converter.

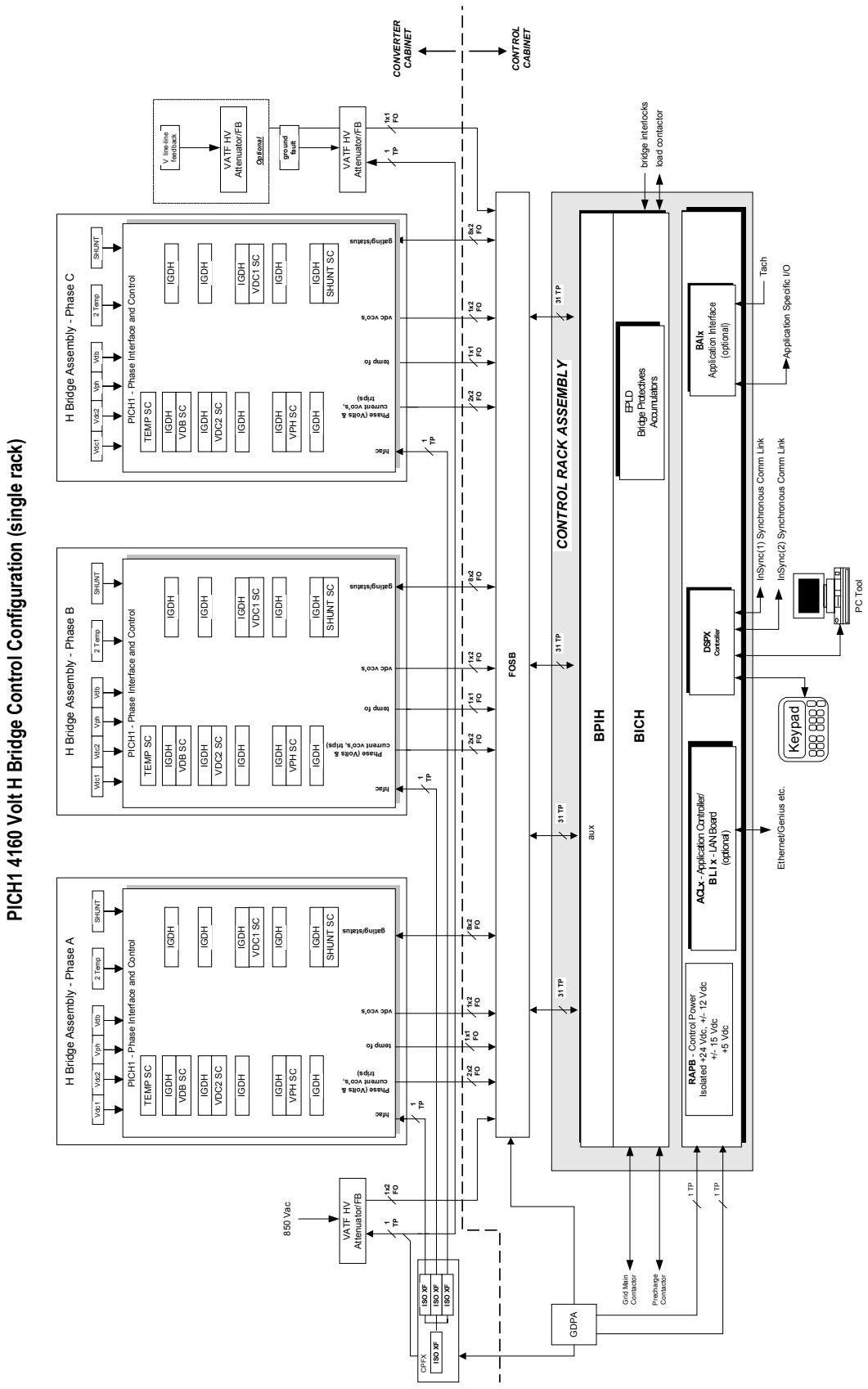


Figure 1. PICH Board Fiber-Optic Gating and Feedback Interface

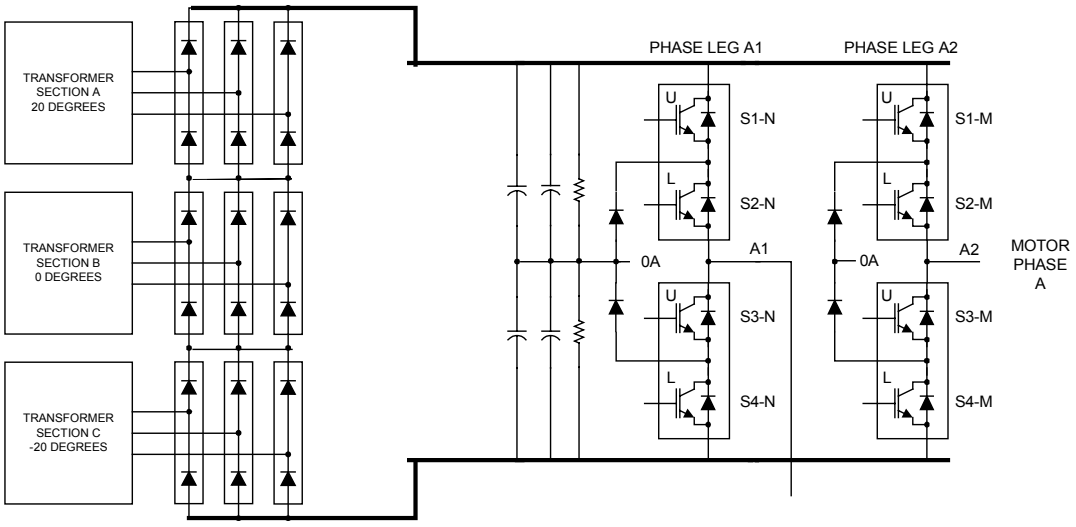


Figure 2. Power Converter Phase Diagram

Electromagnetic Interference (EMI)

The PICH board has two logic area ground planes. The first ground plane (bottom layer, physically closer to the laminated bus) is the power ground (SHCOM). All currents from the power and signal transmission links are diverted to this power ground plane. The second ground plane (top layer) is the signal ground (DCOM). All logic circuits supplied by the +5 V are referenced to this signal ground plane. All signals between the circuits referenced to different grounds are transmitted through a symmetric differential pair link. The two ground planes are star connected via the reference connectors to the laminated bus neutral and heat sink.

Control power distribution to each individual IGBT gate power supply employs shunt capacitors to the power ground plane. This provides a low impedance return path to the heat sink for the parasitic currents forced by the IGBT switching. To minimize the H-field coupling, all signal lines are routed on board layers between the power and signal ground planes to minimize signal line loop areas. In addition, all balanced differential signal lines are routed on two adjacent layers on top of each other.

Each signal and power transmission transformer has a shield around the secondary winding. The shield is connected to the emitter of the respective IGBT through the IGDH subassembly cable shield. The DCOM of each respective IGDH subassembly is also referenced to the IGBT emitter.

Current Feedback

The PICH board interfaces standard (75 – 250 amp) 100 mV shunts to the converter bridge. The PICH board supplies a lag compensation for the L/R time constant of the shunts. The shunt feedback wires are physically balanced and the shunt feedback signal processing circuits are provided by a VCXH board subassembly located at the bottom of the PICH board (to minimize shunt wire length).

Hardware overcurrent trips (both magnitude and rate) are provided. The magnitude trip is set at a nominal 2.4 pu current (for example, 600 amps for the 400 amp IGBT module with a 250 amp shunt). The rate trip is set at 1 pu at 8 microseconds (for example, 31.25 A/microsecond for the 400 amp IGBT module). For the fiber-optic interface, light means OK and the absence of light represents a fault.

Voltage Feedbacks

The dc bus voltages are fed back to the PICH board relative to common (tied to the dc link midpoint). Two VCXH board subassemblies measure each half of the dc bus voltage.

A comparator on these VCXH board subassemblies monitors for an overvoltage (OV) condition and the OV trip comparators are OR'd together. A fourth VCXH subassembly is configured for bipolar operation and monitors the phase output to neutral voltage.

The voltage feedbacks (DCP, DCN, and VFBK) employ high impedance attenuators to the VCXH subassembly. The two dc bus voltage measurements (DCP and DCN) are single-ended relative to the PICH board's DCOM (dc bus neutral). The phase to neutral voltage (VFBK) is measured differentially relative to neutral/DCOM, employing a pair of the attenuation resistors.

Overvoltage Trips

Dc bus overvoltage (OV) trip signals are generated on the PICH board. The single OV signal is generated as a logical OR of overvoltage comparators monitoring each half of the dc bus. The OV signal also includes a PICH board control power undervoltage signal. A hardware jumper (JP1) is provided to reduce the OV trip point.

Control Power Supplies

The 27 kHz control power to the PICH board is isolated by an isolation transformer mounted on the IS200CPFX Phase Leg Flash Protection Boards (CPFX, one per phase). This control power is referenced to the dc bus midpoint at the PICH board, and thus requires individual isolation transformers for the three phase assemblies. Transient voltage suppression is provided using an MOV on the PICH board control power input. Estimated control power requirements are shown in Table 4.

The ±15 V and 5 V control power supplies are monitored for an undervoltage (UV) condition. The control power supply undervoltage fault is OR'd with the OV fault feedback. When power is applied, the undervoltage fault is asserted until all three power supplies are above their trip levels and the 5 V power-on reset timer has expired. These trip levels are shown in Table 1.

The PICH board distributes the 27 kHz control power to the eight gate drivers, two unused external gate drivers, and the current feedback VCXH subassembly via individual isolation transformers.

Table 1. PICH Board Control Power Supply Voltages and UV Trip Levels

Power Supply	Minimum	Maximum	Typical	UV Min.	UV Max.
P15	+14.82 V	+15.18 V	80 mA	+13.0 V	+13.6 V
N15	–14.25 V	–15.75 V	300 mA	–13.0 V	–13.6 V
P5	+4.75	+5.25	120 mA	+4.500 V	+4.657 V
Power-On / Reset	--------	--------	1.4 ms	--------	--------

IS205TFBHG_A_ _ IGBT Temperature Feedback Board

The IS205TFBH IGBT Temperature Feedback Board subassembly (TFBH) provides two thermistor temperature feedback channels for monitoring IGBT cold-plate temperature. It is mounted to the PICH board in a 39-pin connector and soldered in place (one TFBH subassembly per PICH board). The two temperature signals are converted and multiplexed by the TFBH subassembly into a serial data stream. The IGBT cooling plate temperature is monitored at two locations with 100 kilohm thermistors. The measured voltages are converted by a quad-channel 8-bit analog/digital converter (ADC) configured for a –40 to 100 °C measurement range. Thermistor linearization is accomplished by digital signal processor (DSP) control software.

The temperature information is continuously transmitted at a 250 kHz data rate, alternating between the two temperature channels. The serial data is transmitted to the BICH board via fiber-optic cable. The PICH board provides the required ±15 V and +5 V power supplies to the TFBH subassembly.

IS205VCXHG_A_ _ VCO Feedback Transmitter Board

A total of four IS205VCXH VCO Feedback Transmitter Board subassemblies (VCXH) are mounted on the PICH board:

- Two are used for Dc Capacitor Bus Voltages
- One is used for Phase to Neutral Voltage
- One is used for Phase Current

The VCXH subassemblies, except the phase current feedback one, receive power from the PICH board's control power supply (referenced to the dc bus midpoint). The phase current feedback VCXH subassembly receives PICH board generated isolated power.

The VCXH subassemblies are mounted to the PICH board in 43-pin connectors and soldered in place.

The VCXH subassemblies contain a single voltage controlled oscillator (VCO) transmitter circuit and are setup to drive a fiber optic transmitter.

The subassemblies also include two window comparators with individual references. The window comparators can be configured for overcurrent, di/dt, and overvoltage trips. The output signals from the VCXH subassemblies are transmitted through PICH board supplied fiber-optic transmitters.

IS205IGDHG_A_ _ IGBT Gate Driver Board

The IS205IGDH IGBT Gate Driver Board subassembly (IGDH) provides the majority of the circuitry required to interface an IGBT module to the control logic. Each IGDH subassembly interfaces with an IGEH board mounted on an IGBT module via a 6-pin connector on the PICH board (J1 – J8). Each PICH board includes eight IGDH subassemblies and the associated isolated power supplies. These subassemblies are mounted to the PICH board in 57-pin connectors and soldered in place. Each IGDH subassembly accepts and decodes gate ON, gate OFF, and Soft Shutdown logic level commands at the command input, and outputs the appropriate IGBT gate signals. A logic level status output signal reports the status of the control power supplies and the IGBT collector-emitter voltage when the IGBT is commanded ON. Power is provided from an isolated transformer winding and the command and status signals are optically isolated from the control logic. Each IGDH subassembly is referenced to the emitter of the IGBT module that it provides an interface to. See Figure 3 for a block diagram of IGDH subassembly operation.

Voltage Monitors, and Power Supply Faults

The ±15 V monitor returns an IGDH fault when +15 is less than +13.5 to +12.9 V or –15 V is greater than –13.5 to –12.9 V. The +5 V monitor returns an IGDH fault and places the gate driver logic in a RESET state when +5 < 4.5 to 4.7 V. The RESET state overrides all external inputs and places the IGBT gate in a soft shutdown fault mode.

An IGDH fault causes the status feedback to be turned OFF and a soft shutdown fault inhibits the gate drive. The +5 V monitor circuit and all of its functions are active when +5 is greater than +1.5 V. This inhibits the gate drive during power up to prevent false turn-ons of the IGBT.

Gate Drive

The gate drive circuit receives a logic level ON, OFF, or soft shutdown command signal input. A gate deglitch filter is implemented that ignores any gate command signals less than the gate deglitch time.

Desaturation Detection

IGBT desaturation is detected by sensing the collector-emitter voltage (Vce). Each IGDH subassembly returns a desaturation fault by taking the IGDH Fault Status Output (FOUT) low. The IGDH will not override the command input during a desaturation fault. External logic monitors the FOUT and commands the IGBT OFF with a Soft Shutdown command before excessive damage to the IGBT device occurs (given a sensed V collector-emitter). Desaturation detection is enabled when the IGBT is turned ON and the blanking time has expired. A desaturation fault is reported if the collector-emitter voltage is above the desaturation trip threshold while desaturation detection is enabled.

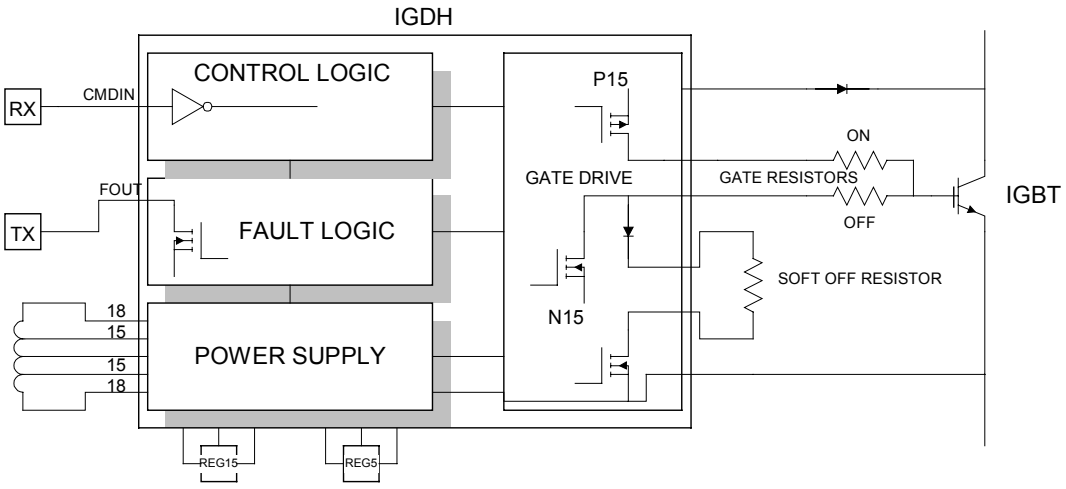


Figure 3. IGDH Subassembly Functional Block Diagram

Application Data

The PICH board assembly (with its TFBH, VCXH, and IGDH board subassemblies) includes one adjustable jumper, 15 testpoints, and three LED indicators as part of the board assembly.

Warning

Bridge cabinet doors should not be opened when drive power is ON. Testpoints are for factory/bench test use only.

There are no fuses as part of the assembly. The PICH board assembly also includes 12 plug connectors, three stab-on connectors, and 24 fiber-optic connectors. See Figure 4 for a PICH board layout diagram that shows the locations of these components and the following tables for descriptions:

Table	Description
2	Values with JP1 in 4160 position
3	Values with JP1 in 3300 position
4	Testpoints
5	LED indicators
6	IGDH , plug connector, and IGBT switch
7	Plug connectors J1 – J8
8	Plug connectors J13 and J14
9	Plug connector J15
10	Plug connector J16
11	Stab-on connectors
12	Fiber-optic connectors

Table 2. PICH Board Jumper JP1, Values In the 4160 Position

Function	Trip Pt or Level	Hysteresis	VCXH Comparator V
V dc Link Setpoints	(1/2 dc bus)	--------	--------
V dc OV	1999 V, ±1.9%	0%	8.975 V, ±1.4%

Table 3. PICH Board Jumper JP1, Values In the 3300 Position

Function	Trip Pt or Level	Hysteresis	VCXH Comparator V
V dc Link Setpoints	(1/2 dc bus)	--------	--------
V dc OV	1865 V, ±2.1%	0%	8.372 V, ±1.6%

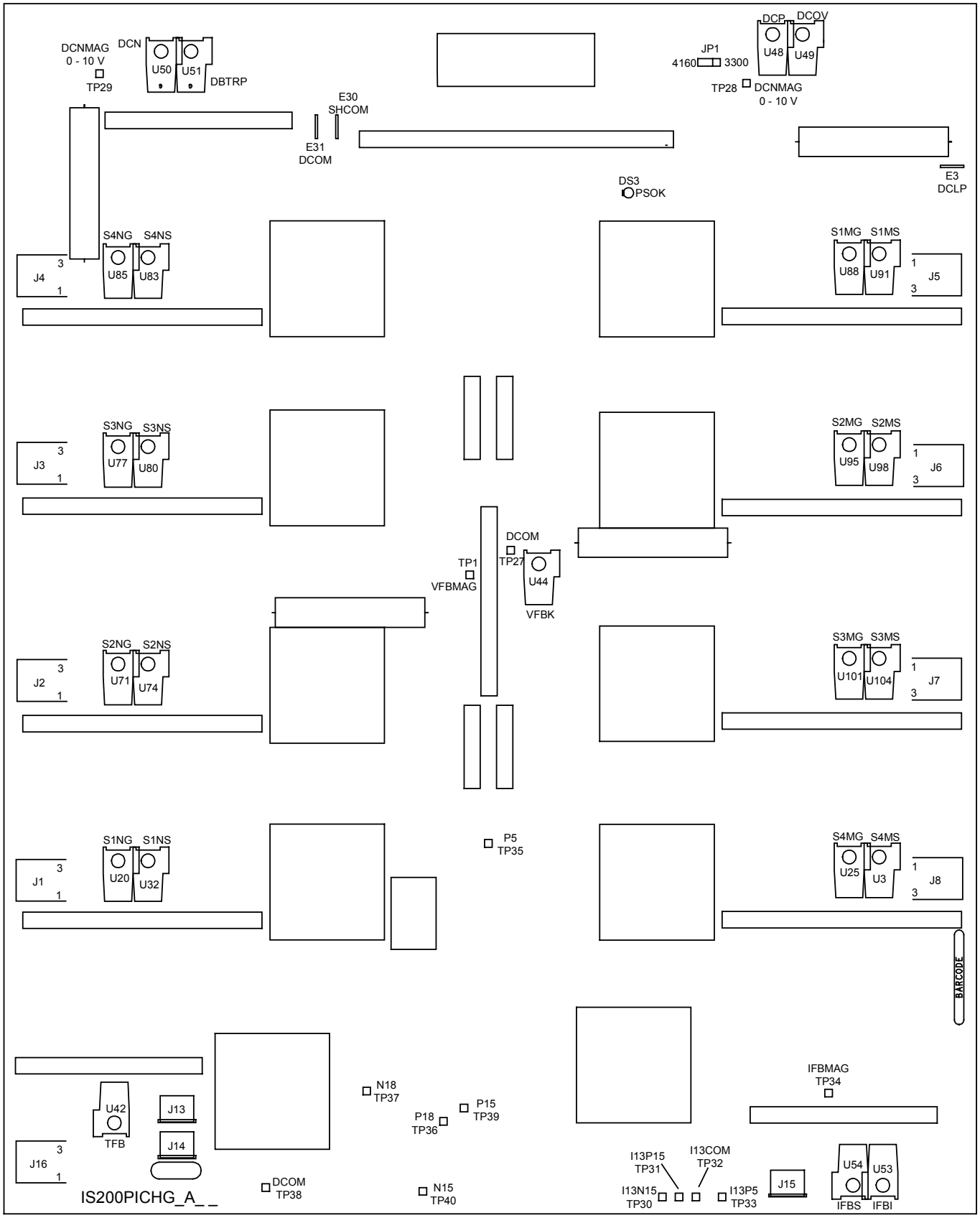


Figure 4. PICH Board Layout Diagram

Warning

Bridge cabinet doors should not be opened when drive power is ON. Testpoints are for factory/bench test use only.

Table 4. PICH Board Testpoint Signal Descriptions

Testpoint	Nomenclature	Description
TP1	VFBMAG	Inverter voltage feedback ±5 V output
TP27	DCOM	Supply digital common
TP28	DCPMAG	Dc link upper voltage feedback 0 – 10 V output
TP29	DCNMAG	Dc link lower voltage feedback 0 – 10 V output
TP30	I13N15	Shunt circuit isolated negative 15 V unregulated power supply
TP31	I13P15	Shunt circuit isolated positive 15 V unregulated power supply
TP32	I13COM	Shunt circuit isolated power supply common
TP33	I13P5	Shunt circuit isolated positive 5 V regulated power supply
TP34	IFBMAG	Shunt circuit isolated current feedback ±5 V output
TP35	P5	Regulated positive 5 V power supply
TP36	P18	Unregulated positive 18 V power supply
TP37	N18	Unregulated negative 18 V power supply
TP38	DCOM	Supply digital common
TP39	P15	Regulated positive 15 V power supply
TP40	N15	Regulated negative 15 V power supply

Table 5. PICH Board LED Indicator Descriptions

LED	Color	Nomenclature	Description
DS1	Green	--------	Not Used
DS2	Red	--------	Not Used
DS3	Green	PSOK	Control power supply is OK

Table 6. PICH Board IGDH Subassemblies, Plug Connectors, and IGBTs

IGDH Daughterboard	Plug	IGBT Switch
U15	J1	S1-N
U16	J2	S2-N
U17	J3	S3-N
U18	J4	S4-N
U19	J5	S1-M
U6	J6	S2-M
U7	J7	S3-M
U8	J8	S4-M

*Table 7. PICH Board Connectors J_ * To IGEH Board Pin Signal Descriptions*

Pin No.	Nomenclature	Description
1	GON_	Gate driver ON command
2	ICOM_	Emitter connection
3	GOFF_	Gate driver OFF command
4	CV_	IGBT collector voltage feedback
5	I_P15	Positive 15 volt clamp
6	ISHCOM_	Transformer/Cable shield connection

* The underscore character (_) signifies the J connector number, 1 – 8.

Table 8. PICH Board Connectors J13 and J14 Interface With CPFX Board Pin Signal Descriptions

Pin No.	Nomenclature	Description
1	HF1	48 V ac, 27 kHz power from CPFX board isolation transformer
2	HFSH	Shield common connected to the SHCOM plane of PICH board
3	HF2	48 V ac, 27 kHz power from CPFX board isolation transformer

Table 9. PICH Board Connector J15 Shunt Circuit Pin Signal Descriptions

Pin No.	Nomenclature	Description
1	SHUNTN	Shunt voltage feedback (motor side)
2	SHUNTP	Shunt reference connected to COM of shunt circuit VCXH daughterboard (bridge side)
3	SHIELD	Shield common referenced to COM of shunt circuit VCXH daughterboard

Table 10. PICH Board Connector J16 Temperature Feedback Pin Signal Descriptions

Pin No.	Nomenclature	Description
1	PT1	Excitation power for thermistor #1
2	SHCOM	Shield common connected to SHCOM plane of PICH board
3	VT1	Thermistor #1 feedback
4	PT2	Excitation power for thermistor #2
5	SHCOM	Shield common connected to SHCOM plane of PICH board
6	VT2	Thermistor #2 feedback

Table 11. PICH Board Stab-On Connector Signal Descriptions

Stab-On Connector	Nomenclature	Description
E3	DCLP	Positive dc voltage feedback
E30	SHCOM	Power ground connection to neutral bus/heat exchanger
E31	DCOM	Digital common connection to neutral bus/heat exchanger

Table 12. PICH Board Fiber-Optic Connector Descriptions

Connector	Color	Nomenclature	Description
U20	Blue	S1NG	S1N gating command receiver – Light ON = Gate ON
U32	Gray	S1NS	S1N gating status transmitter – Light ON = OK
U71	Blue	S2NG	S2N gating command receiver – Light ON = Gate ON
U74	Gray	S2NS	S2N gating status transmitter – Light ON = OK
U77	Blue	S3NG	S3N gating command receiver – Light ON = Gate ON
U80	Gray	S3NS	S3N gating status transmitter – Light ON = OK
U83	Blue	S4NG	S4N gating command receiver – Light ON = Gate ON
U85	Gray	S4NS	S4N gating status transmitter – Light ON = OK
U88	Blue	S1MG	S1M gating command receiver – Light ON = Gate ON
U91	Gray	S1MS	S1M gating status transmitter – Light ON = OK
U95	Blue	S2MG	S2M gating command receiver – Light ON = Gate ON
U98	Gray	S2MS	S2M gating status transmitter – Light ON = OK
U101	Blue	S3MG	S3M gating command receiver – Light ON = Gate ON
U104	Gray	S3MS	S3M gating status transmitter – Light ON = OK
U25	Blue	S4MG	S4M gating command receiver – Light ON = Gate ON
U3	Gray	S4MS	S4M gating status transmitter – Light ON = OK
U48	Gray	DCP	Transmitter, VCO dc1 upper 1/2 dc link voltage feedback
U50	Gray	DCN	Transmitter, VCO dc2 lower 1/2 dc link voltage feedback
U44	Gray	VFBK	Transmitter, VCO phase voltage feedback
U53	Gray	IFBI	Transmitter, VCO current feedback
U54	Gray	IFBS	Transmitter, IOC / di/dt status – Light ON = OK, Light OFF = Fault
U49	Gray	DCOV	Transmitter, OV & PSUV status – Light ON = OK, Light OFF = Fault
U51	Gray	DBTRP	Transmitter, DB trip status – Light ON = OK, Light OFF = Trip
U42	Gray	TFB	Transmitter, Temperature feedback

Renewal/Warranty Replacement

How to Order a Board

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

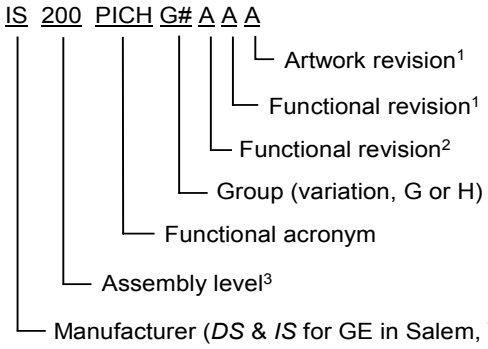
- How to accurately identify the part
- If the part is under warranty
- How to place the order

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 PICH board is described as the Phase Interface and Control 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 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 Systems
Product Service Engineering
1501 Roanoke Blvd.
Salem, VA 24153-6492 USA
Phone: +1 540 387 7595
Fax: +1 540 387 8606
(Replace + with the international access code.)

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 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. 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 above *Caution* criteria).

Replacement Procedures

Warning

Bridge cabinet doors should not be opened when drive power is ON.

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.

Remove the PICH board as follows:

1. Make sure that the drive in which the board resides has been de-energized and follow all local safety practices of Lock-Out/Tag-Out.
2. Open the bridge cabinet doors and verify that the neon lamps on the IS200CVMB Capacitor Voltage Monitoring Board have gone out, indicating that voltage is below 50 V dc.
3. Install safety grounds (see Figure 5) and, using equipment designed for high voltages, test any electrical circuits **before touching them** to ensure that power is OFF and has dissipated.
4. Carefully disconnect all cables from the PICH board to be replaced 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.
   - For fiber-optic cables, depress the latch on the mating connector and remove the fiber-optic cable.

Caution

Avoid dropping mounting hardware into the unit, which could cause damage.

5. Carefully remove the two plastic wire holders that secure wire bundles to the PICH board.
6. Remove the 12 nylon screws that hold the PICH board in place and remove the board.

Install the new (replacement) PICH board as follows:

1. Orient the board in the same position as the board that was removed.
2. Secure the PICH board to the 12 isolated standoffs with the 12 nylon screws removed in step 6 of *removing the board*, and fully tighten all screws.
3. Reconnect all electrical connections that were disconnected in step 4 of *removing the board*.

4. Reinsert the two plastic wire holders that secured wire bundles to the PICH board that were removed in step 4 (above).

5. Remove the safety grounds that were installed in step 3 of *removing the board*, then close the bridge cabinet doors.

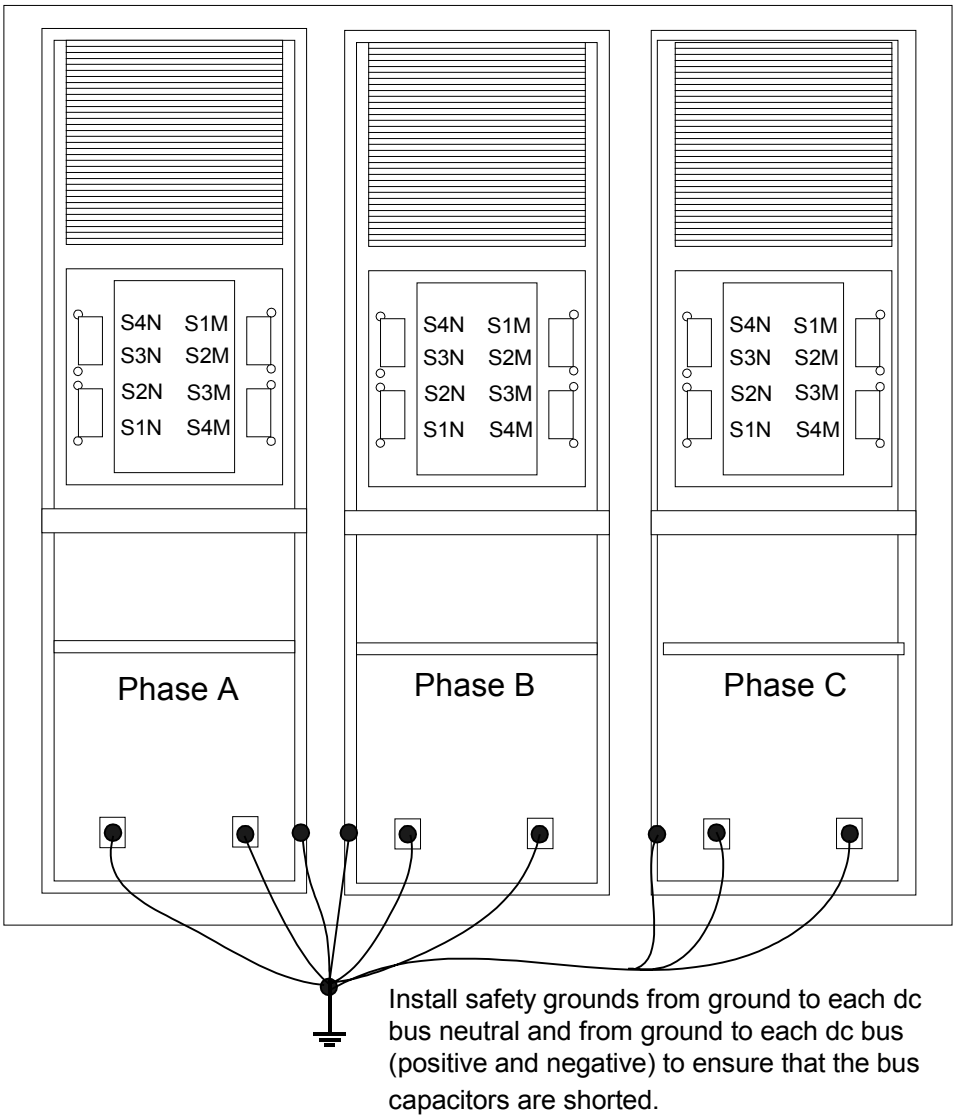


Figure 5. Dc Bus Safety Grounding

GE Industrial Systems

Issue date: 1999-03-29

General Electric Company
1501 Roanoke Blvd.
Salem, VA 24153-6492 USA