ALSTOM

iVPI

Integrated Vital Processor Interlocking Control System

Vital Subsystem

Vital Subsystem Manual
P2521B, Volume 3

ALSTOM

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Integrated Vital Processor Interlocking Control System

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Vital Subsystem Manual
Alstom Signaling Inc.

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PREFACE

NOTICE OF CONFIDENTIAL INFORMATION

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ABOUT THE MANUAL

This manual is intended to describe the Alstom Integrated Vital Processor Interlocking Control System, (iVPI) Vital subsystem (Vital boards). This manual is part of a 5 volume set of manuals. The set is summarized in Section 1.

The information in this manual is arranged into sections. The title and a brief description of each section follow:

Section 1 – VITAL PRINTED CIRCUIT BOARDS: This section summarizes the iVPI Vital subsystem boards.

Section 2 – VSP (VITAL SYSTEM PROCESSOR) BOARD, P/N 31166-427-XX: This section provides VSP board detail.

Section 3 – DI (DIRECT INPUT) BOARD, P/N 31166-429-XX: This section provides DI board detail.

Section 4 – VITAL DC OUTPUT BOARDS, P/N 31166-430-XX, -431-XX, -433-XX: This section provides Vital DC output board detail.

Section 5 – ACO (AC OUTPUT) BOARD, P/N 31166-432-XX: This section provides Vital ACO board detail.

Section 6 – CRG (CODE RATE GENERATOR) BOARD, P/N 31166-459-XX: This section provides CRG board detail.

Section 7 – GTP (GENRAKODE TRACK PROCESSOR) BOARD, P/N 31166-434-XX: This section provides GTP board detail.

Section 8 – BEX (BUS EXPANSION) BOARD, P/N 31166-460-XX: This section provides BEX board detail.

Section 9 – SYSTEM ID BOARD, P/N 31166-472-XX AND VITAL INTERFACE BOARDS, P/N 31166-473-XX AND 31166-485-XX: This Section provides the System ID and Vital Interface board detail.

Appendix A – VITAL BOARD LAYOUT DRAWINGS: This section provides the layout drawings for each Vital board type.

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MANUAL SPECIAL NOTATIONS

In the Alstom manuals, there are three methods used to convey special informational notations to the reader. These notations are warnings, cautions, and notes. Both warnings and cautions are readily noticeable by boldface type two lines beneath the caption.

Warning

A warning is the most important notation to heed. A warning is used to tell the reader that special attention needs to be paid to the message because if the instructions or advice is not followed when working on the equipment then the result could be either serious harm or death. The sudden, unexpected operation of a switch machine, for example, or the technician contacting the third rail could lead to personal injury or death. An example of a typical warning notice follows:

WARNING

DISCONNECT MOTOR ENERGY WHENEVER WORKING ON SWITCH LAYOUT OR SWITCH MACHINE. UNEXPECTED OPERATION OF MACHINE COULD CAUSE INJURY FROM OPEN GEARS, ELECTRICAL SHOCK, OR MOVING SWITCH POINTS.

Caution

A caution statement is used when an operating or maintenance procedure, practice, condition, or statement, which if not strictly adhered to, could result in damage to or destruction of equipment. A typical caution found in a manual is as follows:

CAUTION

Turn power off before attempting to remove or insert circuit boards into a module. Boards can be damaged if power is not turned off.

Note

A note is normally used to provide minor additional information to the reader to explain the reason for a given step in a test procedure or to just provide a background detail. An example of the use of a note follows:

NOTE

A capacitor may be mounted on the circuit board with a RTV adhesive. Use the same color RTV.

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1. SECTION 1 – VITAL PRINTED CIRCUIT BOARDS

1.1. INTRODUCTION

This manual describes the Printed Circuit Boards used to provide Vital functionality in the iVPI System.

See P2521B, Volume 2, Table 2–1, for the Vital and Non-Vital PC Board Keying.

1.2. MANUAL SET ORGANIZATION

This manual is part of a 5 volume set supporting the iVPI system. The set is organized as follows:

- Volume 1, Installation, Operation, and Theory Manual, includes general overview of the field installation and setup of the iVPI system; including theory of operation.
- Volume 2, Subrack Configuration, describes the subrack configuration including power supplies.
- Volume 3, Vital Subsystem, is this document. It includes the Vital subsystem board drawings and board reference data.
- Volume 4, Non-Vital Subsystem, includes non-vital subsystem board drawings and board reference data.
- Volume 5, Maintenance and Troubleshooting, describes system maintenance and troubleshooting, including discussion of diagnostics and references for the applicable software and hardware manuals.

1.3. SUBRACK TERMS

The iVPI System is highly modular in design, implemented in a 19 inch rack mounted card cage (Subrack) with a set of plug-in printed circuit boards (boards) that are applied in varying quantities to meet the needs of specific applications.

The terminology used to define the Subrack and its components is as follows:

- A Subrack is a Chassis with Motherboard
- A System is one or more Subracks filled with the appropriate boards for the application
- When a System is configured with more than one Subrack populated with boards, the individual populated Subracks are Subsystems

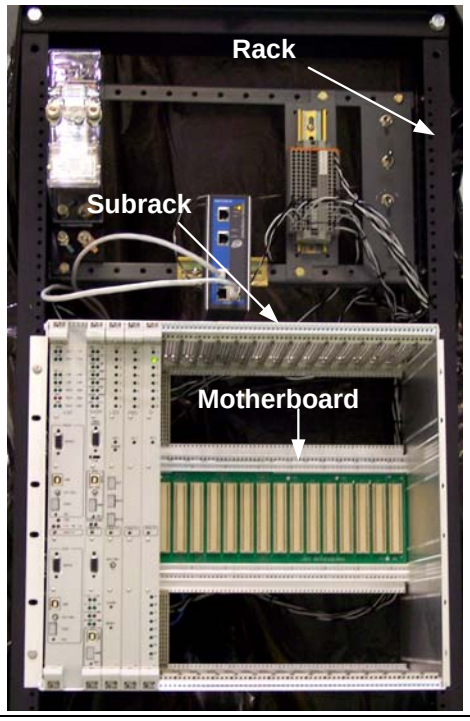

Figure 1–1. iVPI Rack and Subrack

1.4. VITAL SUBSYSTEM

iVPI systems are explicitly designed for operation in the extremely harsh environments seen in railroad and transit properties. The iVPI product line is designed, validated and verified for operation per the AREMA Communication and Signal Manual, Part 11.5.1 for Class C (Wayside Signal Enclosures) and Class D (Wayside Control Rooms) environments without the need for any special environmental conditioning. In practice, each iVPI system for Vital application is comprised of system boards and the appropriate quantity and type of input and output boards required for the particular location.

iVPI system board for a typical North American Rail application is:

- Vital System Processor (VSP) board

The iVPI Vital input and output boards are:

- Direct Input (DI) board
- Single Break Output (SBO) board
- Double Break Output (DBO) board
- Lamp Driver Output (LDO) board
- AC Output (ACO) board

For typical Freight Rail, Commuter Rail, and Light Rail applications, these boards are also available:

- Code Rate Generator (CRG) board
- Genrakode Track Processor (GTP) board

In addition to the system boards listed above, the Vital system may be configured with one or more optional VSP Interface boards to simplify the physical and electrical connections to the VSP board:

- VSP P2 System ID board
- VSP and BEX P1 Interface board
- VSP P3 Interface board

In addition, the Bus Expansion (BEX) board is used in each expansion Chassis configuration. This allows a single VSP board to control both Vital and non-vital boards in up to three external iVPI expansion Chassis.

Figure 1–2 is a block diagram of the boards in the Vital and non-vital subsystems.

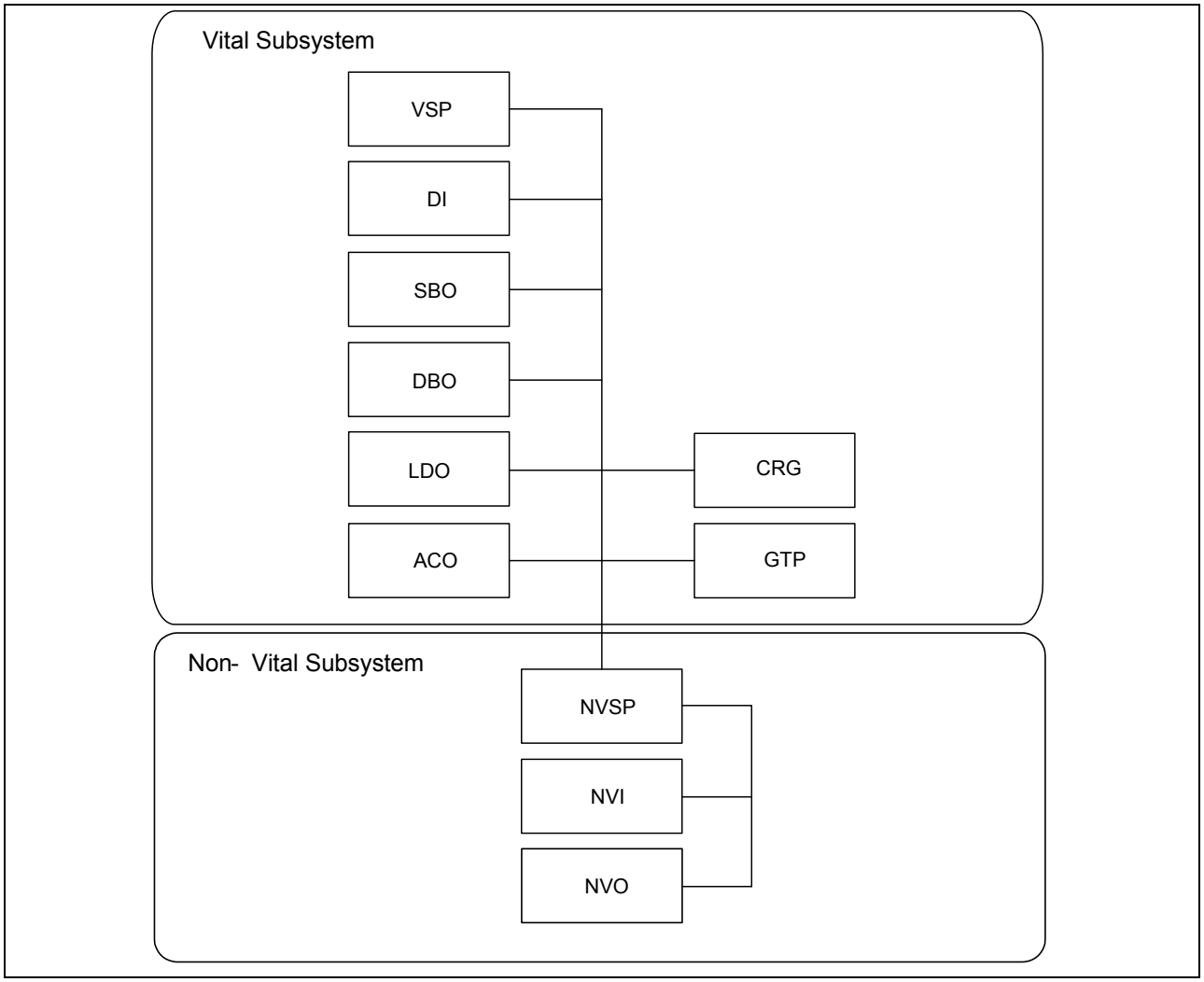

Figure 1–2. Vital and Non-Vital Subsystems

Table 1–1 lists the Vital printed circuit boards in the order that they are discussed. A board's 10 digit drawing number is also the part number use for ordering the board.

Table 1–1. Vital PC Boards Index

Board Type	Drawing Number	Comments
Vital System Processor (VSP)	31166-427-01	386 Processor, 2 Ethernet, I-O Bus Interf, Vital Relay Driver Operate 9-16 VDC, Vital Sftw 40025-413-00/ Boot 40025-426-00, Comm Sftw 40025-416-00/Boot 40025-417-00
Direct Input (DI)	31166-429-01	16 inputs, In 9-16 VDC, Differential
Direct Input (DI)	31166-429-02	16 inputs, In 19-32 VDC, Differential
Single Break Output (SBO)	31166-430-01	Supply 9-30 VDC, 8-Ports
Double Break Output (DBO)	31166-433-01	Supply 9-16 VDC, 8-Ports
Lamp Driver Output (LDO)	31166-431-01	Supply 9-16 VDC, Hot & Cold Check, Cable Integrity Chk, Over/Low Current Monitor, 8-Ports
Vital AC Output (ACO)	31166-432-01	Supply 90-130 VAC, 40-150Hz, 8-Ports, High Current output
Vital AC Output (ACO)	31166-432-02	Supply 90-130 VAC, 40-150Hz, 8-Ports, Low Current Output
Code Rate Generator (CRG)	31166-459-01	Sftw 40025-438-01, Code Rates: 0, 50, 75, 120, 180, 270, 420, Steady-On, Solid State Driver
Code Rate Generator (CRG)	31166-459-02	Sftw 40025-438-01, Code Rates: 0, 50, 75, 120, 180, 270, 420, Steady-On, Relay Driver
Bus Expansion (BEX)	31166-460-01	BEX, Bus Expansion Board
Genrakode Track Processor (GTP)	31166-434-01	Sftw 40025-XXX-00, 2-Genrakode DC Track Circuits w/o Ethernet Software, CAA -0XX, up to 24,000 feet @ 3 ohms per 1,000 feet ballast non-electrified territory

Table 1–1. Vital PC Boards Index (Cont.)

Board Type	Drawing Number	Comments
System ID	31166-472-01	Application Revision and Site ID
VSP and BEX P1 Interface	31166-485-01	Expansion Chassis connections
VSP P3 Interface	31166-473-01	Ethernet and Maintenance ports, VRD Relay connections

Figure 1–3 is block diagram of an example iVPI application using every board type available for the iVPI System. Figure 1–4 is an example iVPI using the expansion system.

NOTE

For descriptions of how to troubleshoot the boards using the LEDs and/or Diagnostic displays visible from the board fronts, see Alstom manual P2521B, Volume 5.

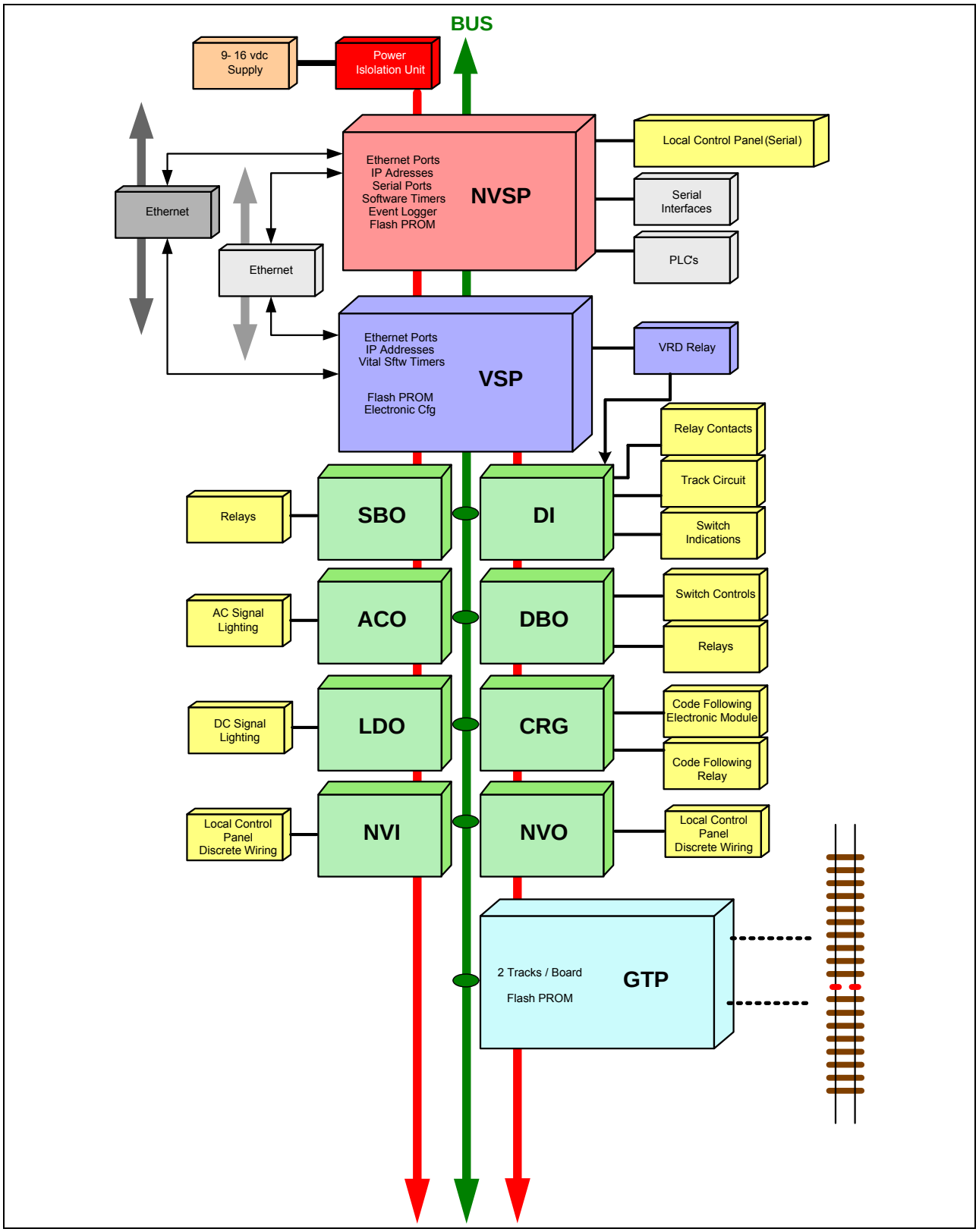

Figure 1–3. Example iVPI Vital / Non-Vital System Application

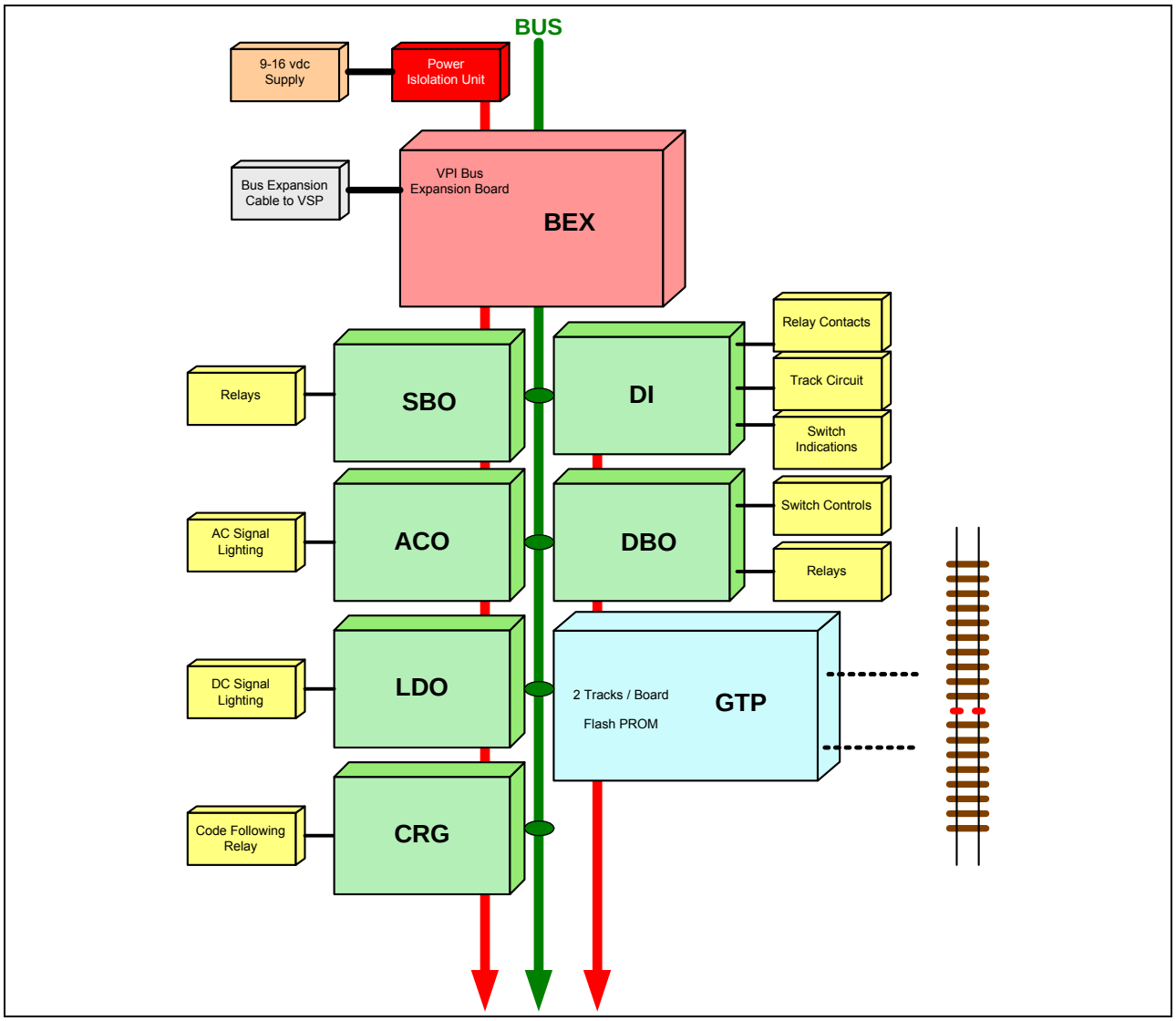

Figure 1–4. Example iVPI Expansion System Application

2. SECTION 2 – VSP (VITAL SYSTEM PROCESSOR) BOARD, P/N 31166-427-XX

2.1. GENERAL

This Section describes the Vital System Processor (VSP) board used in the iVPI system. See Figure A–1 for a board layout drawing.

2.2. INTRODUCTION

The VSP board is the Vital processing unit of the iVPI system. It provides Vital logic processing, Vital I/O control and monitoring, on-board programming, and extended capacity for larger interlockings.

2.3. FUNCTION

The VSP board can process thousands of Vital expressions, read up to 320 Vital inputs (20 DI boards), set up to 320 Vital outputs (40 Vital output boards, such as SBO, DBO, LDO, ACO), interface to up to 10 GTP boards (20 GENRAKODE III Track Circuits) and 3 CRG boards (8 coded outputs per board), process up to 300 Vital timers, receive and transmit Vital network data, and receive and transmit non-vital controls and indications, all within iVPI's fixed Vital 1-second cycle time.

The board includes a real-time clock and battery-backed RAM for data logging, USB, and Ethernet connectivity.

Through the use of VPI application tools, an engineer defines the logic, I/O functionalities, and communications to implement the interlocking control functions. Application software is compiled using tools downloaded directly to the VSP via a USB type connection interface.

Within iVPI's fixed Vital 1-second cycle time, the VSP:

- Processes up to 3000 Vital expressions
- Reads up to 320 Vital inputs (20 DI boards)
- Sets up to 320 Vital outputs (40 Vital output boards, such as SBO, DBO, LDO, ACO)
- Interfaces to up to 10 GTP boards (20 GENRAKODE III Track Circuits)
- Interfaces to up to 3 CRG boards (8 coded outputs per board)
- Processes up to 300 Vital timers
- Receives and transmits Vital network data (40 VSOE links, application dependant)

A diagnostic program is incorporated in the Logic Processor program memory and tests the different operations from the CPU and peripheral boards. These checks are available through an external monitor or Alstom Maintenance System (MMS).

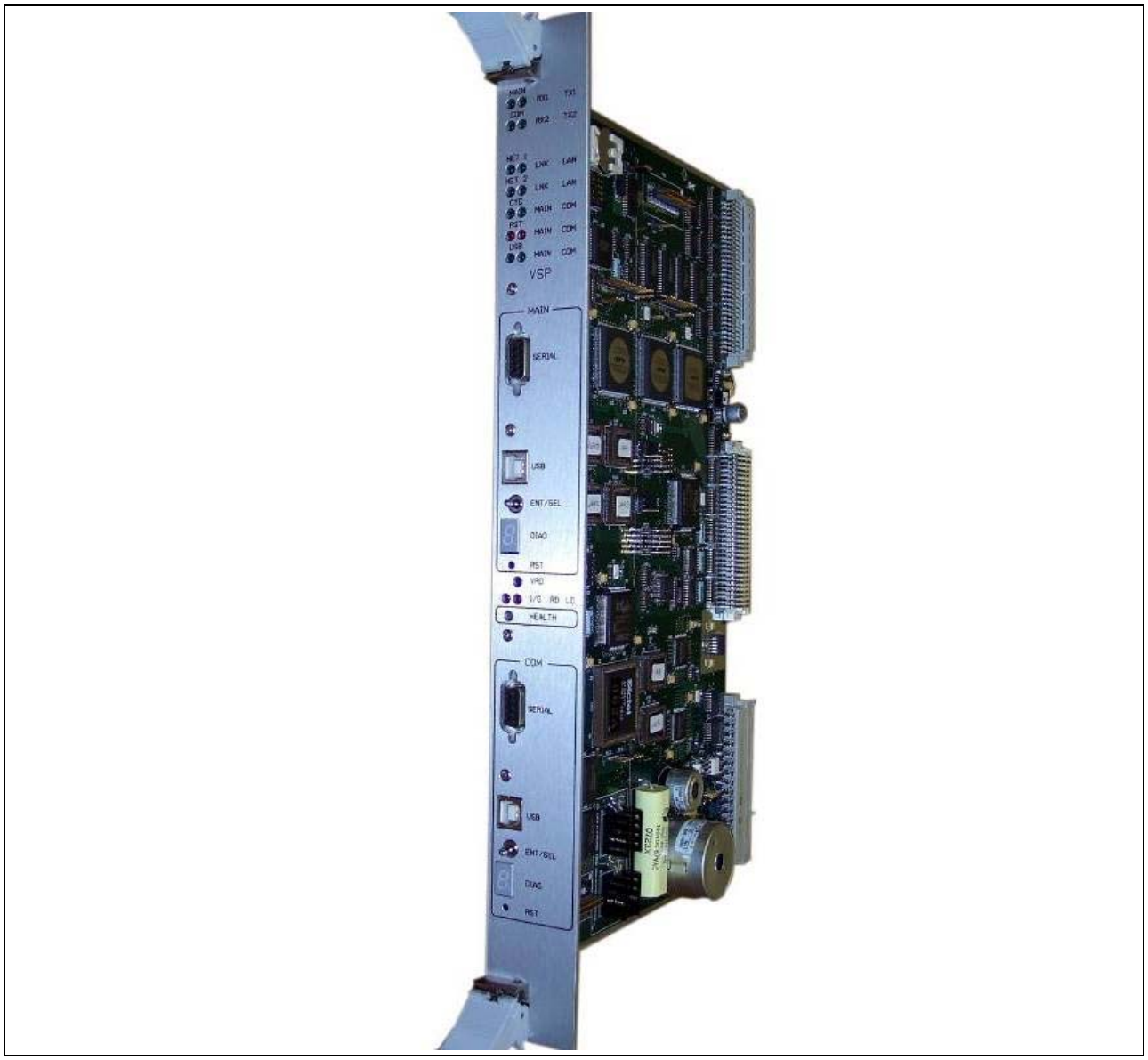

Figure 2–1. VSP Board

2.4. INDICATIONS

The VSP board has LED indications that provide a visual indication of the status of the board, the processors, serial channels, and network links. A Health LED is used to indicate board health status. See Figure 2–2 for an illustration of the board edge, including LEDs, ports, push buttons and 7-segment displays.

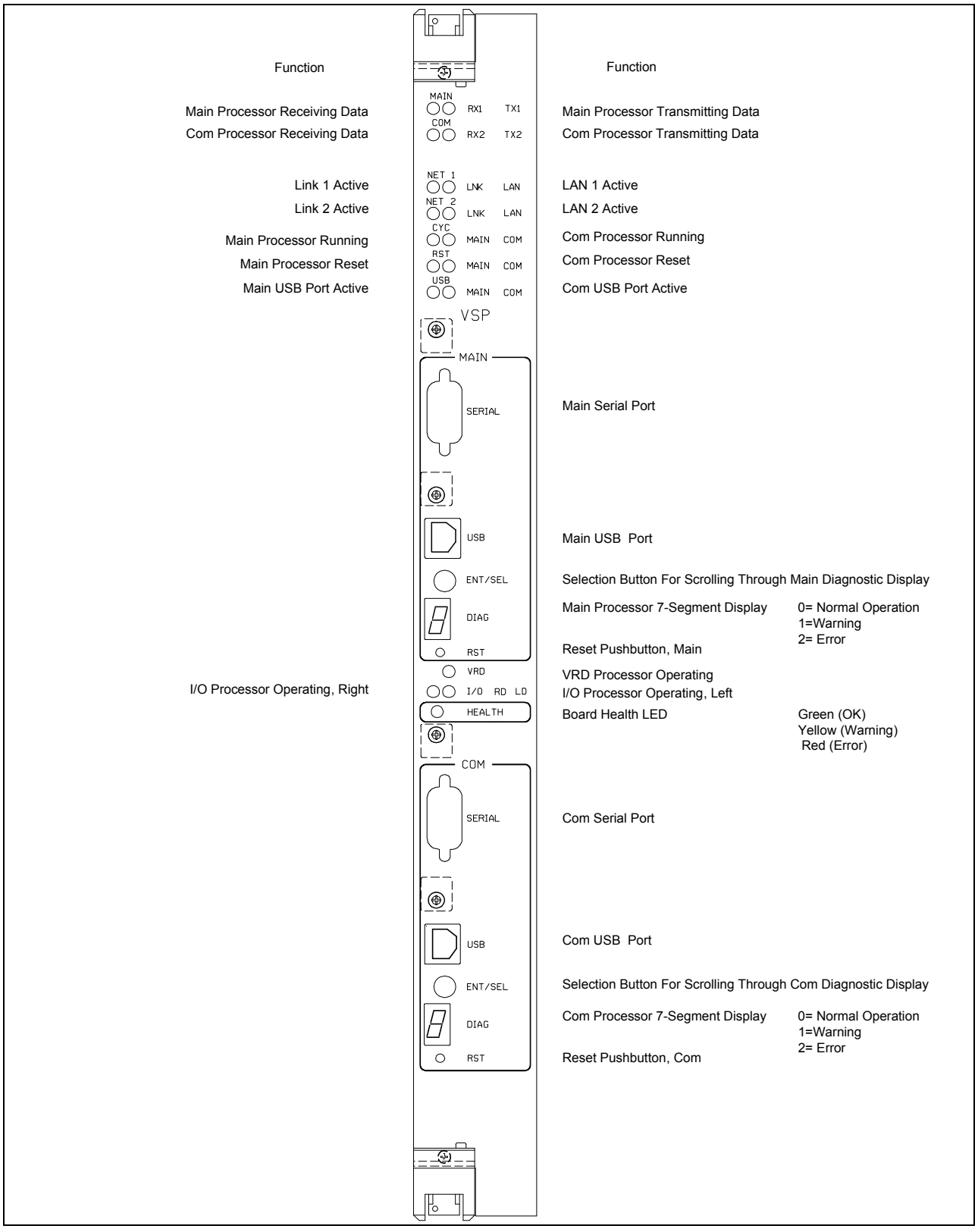

Figure 2–2. VSP Board Edge

2.5. CARD EDGE CONNECTORS

The VSP Board has three card edge connectors:

- P1, the upper connector, is a 96-pin connector (48 pins populated) wired to the expansion bus and used for network connections.
- P2, the middle connector, is a 160-pin connector used to interface with the VSP System Bus, determine the application revision identification of the board, and determine the site identification.
- P3, the lower connector, is a 96-pin connector (48 pins populated) wired with the I/O Bus signals, MMS RS-232 to Serial Data channel 0, Network 1 and 2 and VRD voltage output.

NOTE

For the user defined inputs and outputs, refer to the .lvc output file generated by the system software CAAPE program.

Table 2–1. VSP Board P2 Connector Rev. or Site ID Configuration

System ID Name	Rev or Site ID Name	P2 Connection
ID0	Rev ID0	P2-B14
ID1	Rev ID1	P2-C14
ID2	Rev ID2	P2-A15
ID3	Rev ID3	P2-B15
ID4	Rev ID4	P2-C15
ID5	Rev ID5	P2-A16
ID6	Site ID0	P2-B16
ID7	Site ID1	P2-C16
ID8	Site ID2	P2-A18
ID9	Site ID3	P2-B18
ID10	Site ID4	P2-C18
ID11	Site ID5	P2-A19
ID12	Site ID6	P2-B19
ID13	Site ID7	P2-C19
ID14	Site ID8	P2-A20
ID15	Site ID9	P2-B20

2.6. USER SETTINGS

There are no user/field settings on this board.

2.7. SPECIFICATIONS/ASSEMBLY DIFFERENCES

Table 2–2. VSP Board Specifications/Assembly Differences

Specification	
Maximum Number of Boards Per iVPI System	1
Board Slots Required	2
Maximum Board Logic Current with a 12 VDC Power Supply	1.5A
VPI CAA Version	31746-XXX-XX
Communications Software	40025-413-01, -02
Communications Bootloader	40025-393-01, -02

3. SECTION 3 – DI (DIRECT INPUT) BOARD, P/N 31166-429-XX

3.1. GENERAL

This Section describes the Direct Input (DI) board used in the iVPI system. See Figure A–2 for a board layout drawing.

3.2. INTRODUCTION

Direct Input (DI) boards are used to vitally input the status of devices such as switch machines, track circuits, line circuits and a multitude of other Vital signal apparatus. The DI boards contain sixteen isolated Vital inputs for DC input current sensing. Each input port has two connections to the field equipment (+IN and –IN), and two inputs may be connected in parallel with opposite polarity to form a bipolar input circuit. Each input circuit is vitally isolated from each other, from ground, and from power using techniques that meet or exceed AREMA isolation requirements. Using a unique Vital time interval sampling technique, Vital inputs are immune from false readings due to induced AC frequencies in the range of 25 to 360 Hz. Appropriate transient protection devices are included in the input circuit on the PC board.

The DI board:

- Contains sixteen isolated Vital inputs for DC input current sensing, typical input voltage range is between 9-16vdc
- Includes two connections to the field equipment (+IN and –IN) for each input
- Allows two inputs to be connected in parallel with opposite polarity to form a bipolar input circuit
- Has vitally isolated input circuits, isolated from ground and from power using techniques that meet AREMA isolation requirements (2000VDC)
- Includes induced AC frequencies in the range of 25 to 360 Hz to provide immunity from false readings
- Contains appropriate transient protection devices in the input circuit on the PC board

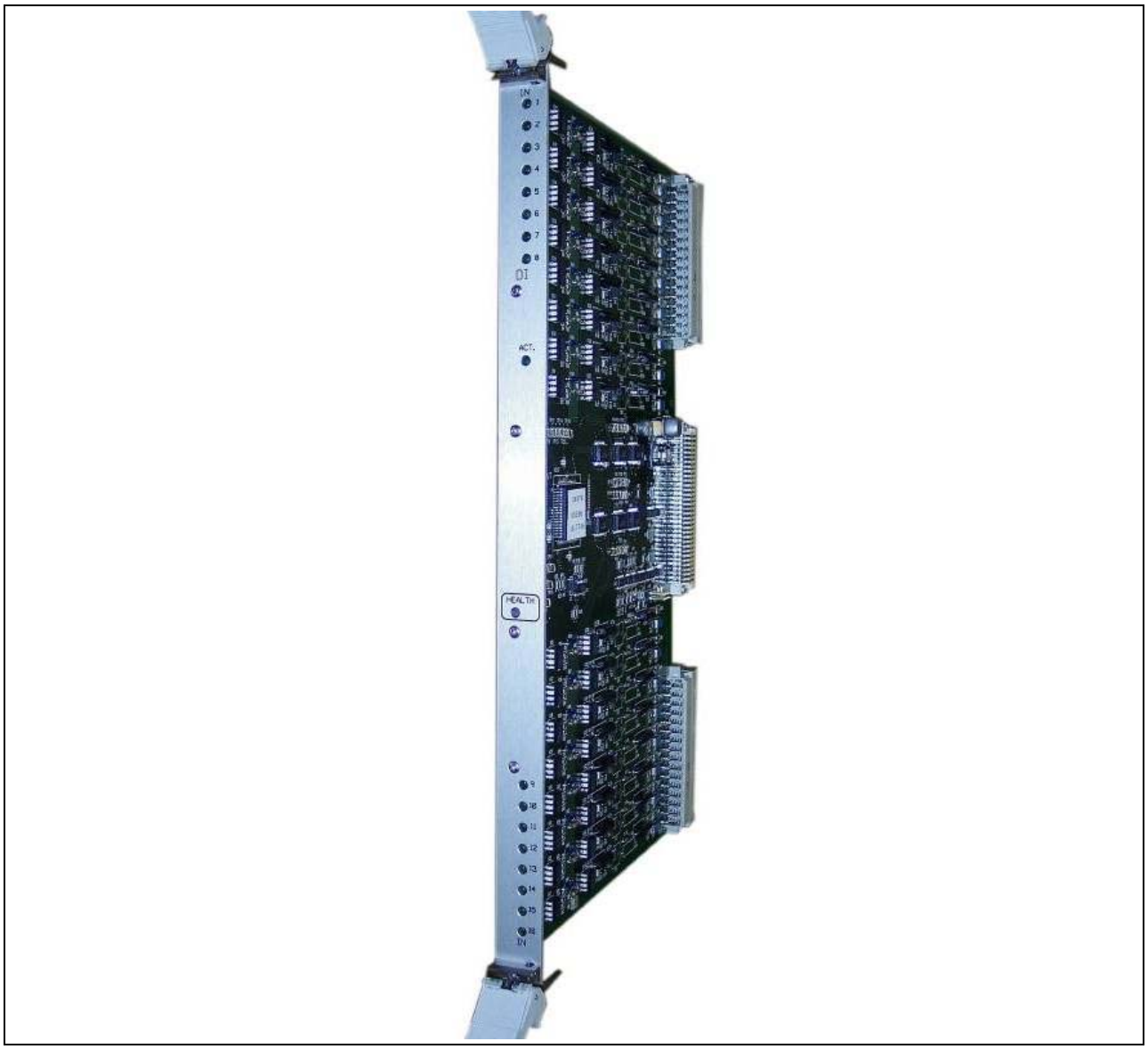

Figure 3–1. DI Board

3.3. OPERATION

Each DI board contains 16 isolated inputs. Each input requires two (2) connections to the field (IN+, IN-). The inputs are DC current sensing and require a minimum of 12.8mA. The maximum input current is 33.0mA. Two (2) inputs may be connected in parallel with opposite polarity (for example, input a+ connected to input b- and input a- connected to input b+) to form a bipolar input.

Each input has an indication that is 'ON' when the input is 'ON' (for example, current flow from IN+ to IN- terminals). The input circuit indications are placed in sequence from 1 to 16 corresponding to inputs 1 to 16 (counting from the top of the board down). The board has an activity indication which is 'ON' for approximately 50ms whenever data is written to the board. When the system is operating normally the activity indication flashes once each second. The board also has a health indication. It can be green, red or orange.

3.4. INDICATIONS

The DI board has LED indications that provide a visual indication of the status of the board and inputs. A Health LED is used to indicate board health status. See Figure 3–2 for an illustration of the board edge.

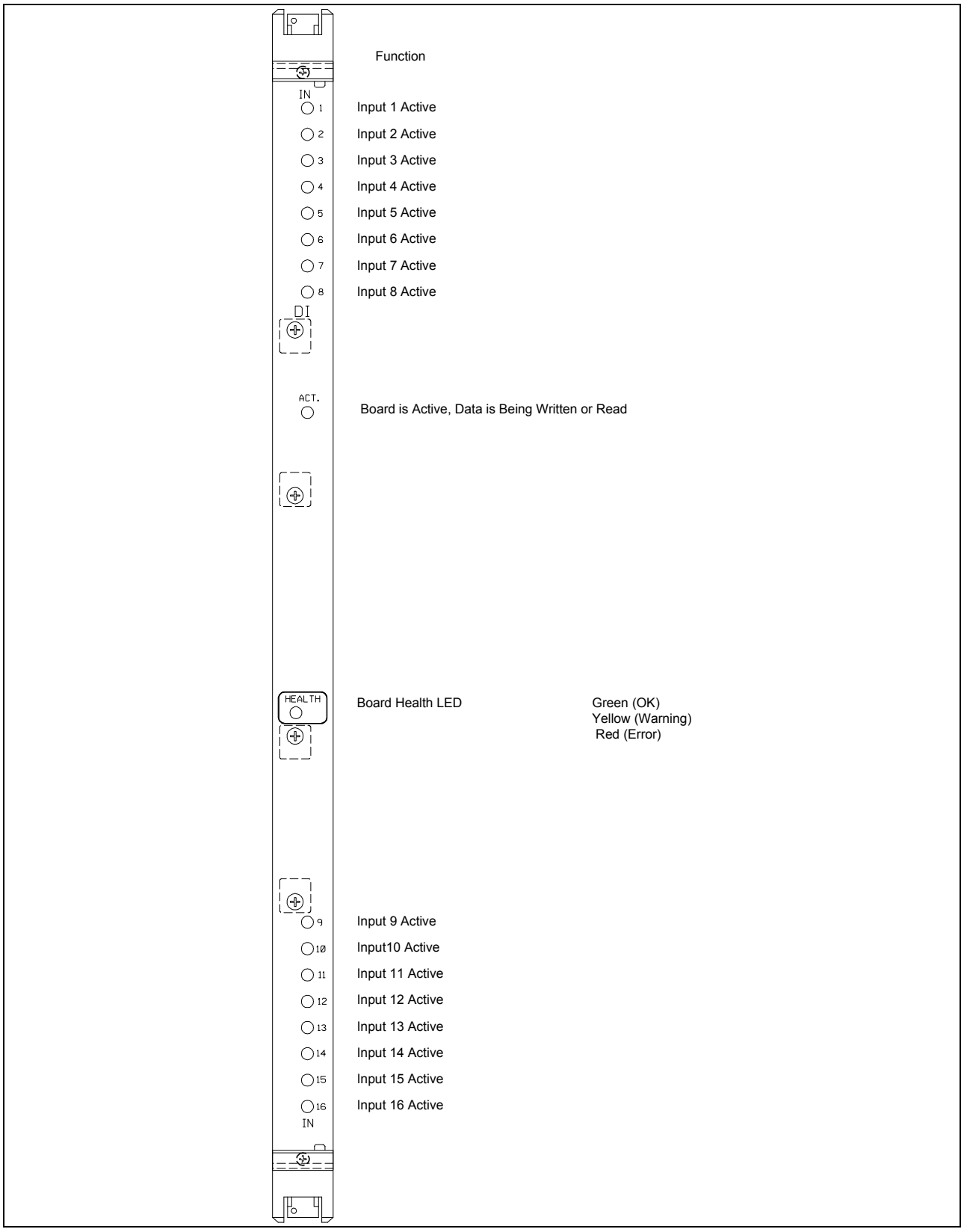

Figure 3–2. DI Board Edge

3.5. CARD EDGE CONNECTORS

The DI Board has three card edge connectors:

- P1, the upper connector, is a 32-pin connector that provides a connection for eight input circuits.
- P2, the middle connector, is a 160-pin connector used to interface with the VSP Vital Bus.
- P3, the lower connector, is a 32-pin connector that provides a connection for eight input circuits.

The pins on these connectors are not user configurable.

Table 3–1. DI Board P1 Connections

P1 Pin	INPUT	P1 Pin	INPUT
Z2	IN -1	Z18	IN -5
D2	IN +1	D18	IN +5
Z4		Z20	
D4		D20	
Z6	IN +2	Z22	IN +6
D6	IN -2	D22	IN -6
Z8		Z24	
D8		D24	
Z10	IN -3	Z26	IN -7
D10	IN +3	D26	IN +7
Z12		Z28	
D12		D28	
Z14	IN +4	Z30	IN +8
D14	IN -4	D30	IN -8
Z16		Z32	
D16		D32	

Table 3–2. DI Board P3 Connections

P3 Pin	P3 Pin	INPUT		P3 Pin	P3 Pin	INPUT
Z2	1	IN -9		D16	16	
D2	2	IN +9		Z18	17	IN -13
Z4	3			D18	18	IN +13
D4	4			Z20	19	
Z6	5	IN +10		D20	20	
D6	6	IN -10		Z22	21	IN +14
Z8	7			D22	22	IN -14
D8	8			Z24	23	
Z10	9	IN -11		D24	24	
D10	10	IN +11		Z26	25	IN -15
Z12	11			D26	26	IN +15
D12	12			Z28	27	
Z14	13	IN +12		D28	28	
D14	14	IN -12		Z30	29	IN +16
Z16	15			D30	30	IN -16

NOTE

For the user defined inputs and outputs, refer to the .lvc output file generated by the system software CAAPE program.

3.6. USER SETTINGS

There are no user/field settings on this board.

3.7. SPECIFICATIONS/ASSEMBLY DIFFERENCES

Table 3–3. DI Board Specifications/ Assembly Differences

Specification	31166-429	
	-01	-02
Maximum Number of Boards Per iVPI System	20	20
Board Slots Required	1	1
Nominal Board Logic Current Supply	100 mA	100 mA
Minimum Input Voltage/Port	9.0 VDC	9.0 VDC
Maximum Input Voltage/Port	16.0 VDC	16.0 VDC
Input Current	12.8-33.0 mA	12.8-33.0 mA
Isolation Between Inputs	> 3000 Vrms	> 3000 Vrms
Input Transient Protection Voltage (Max Voltage)	1700 Vrms	1700 Vrms
Input Transient Protection Energy (Max Energy)	3.6 Joules (3.6 watt-seconds)	3.6 Joules (3.6 watt-seconds)
Equipped with Low-Pass Filter	Yes	Yes
Momentary Input Hold (Contains circuitry to cover up momentary losses of the input signal.)	No	Yes

WARNING

THE 31166-429-02 ASSEMBLY INPUT CIRCUIT POSSESSES THE ABILITY TO RECTIFY AC SIGNALS AND IS INTENDED FOR SPECIAL SITUATIONS ONLY. CONSULT ALSTOM ON ITS USE.

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4. SECTION 4 – VITAL DC OUTPUT BOARDS, P/N 31166-430-XX, -431-XX, -433-XX

4.1. GENERAL

This Section describes the Vital DC Output boards used in the iVPI system. See Figures A–3 through A–5 for board layout drawings.

4.2. INTRODUCTION

The Vital DC Output boards are used to output to a wide variety of Vital devices such as switch machines, line circuits, signal lamps and a multitude of other Vital signal apparatus. There are three Vital output boards for the iVPI system:

- Single Break Output, SBO (P/N 31166-430-XX)
- Double Break Output, DBO (P/N 31166-433-XX)
- Lamp Drive Outputs, LDO (P/N 31166-431-XX)

All are configured with 8 Vital outputs per board. The single break output is analogous to a single relay contact placed in the positive or feed side of the circuit. The equivalent to the relay contact in the solid state circuit is the FET switch. The double break output is analogous to a relay circuit with the contacts in both the feed and return sides of the circuit. With the solid-state equivalent, however, each output is completely isolated from all other outputs and/or power supplies.

4.3. OPERATION

LED indications are on each output board. Each indication lights only when the system requests the associated output to turn on.

Eight outputs on each board are divided into two groups of four. Outputs 1-4 are connected to one power supply input, while outputs 5-8 are connected to a second power supply input. These power supply inputs may be connected to different power supplies or they may be tied together external to the iVPI system. If the outputs are being used in a Vital application, the power supply must come from a source that can be vitally turned off (usually a contact of the iVPI Vital relay or one of its repeaters).

4.4. INDICATIONS

The output boards have LED indications that provide a visual indication of the status of the board and output status. A Health LED is used to indicate board health status. See Figures 4–1 through 4–3 for illustrations of the board edges, including LEDs and for the LDO board the push buttons and 7-segment displays.

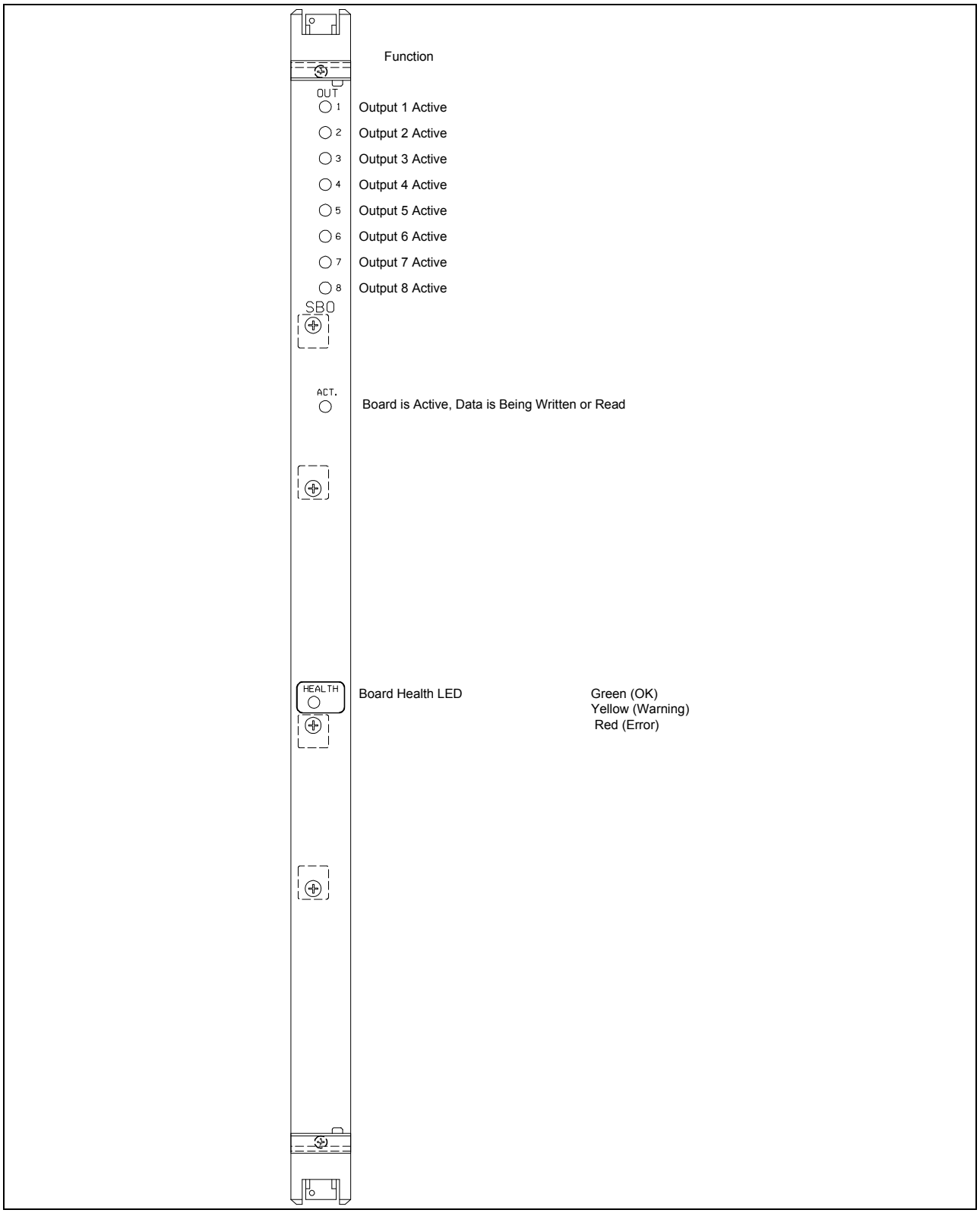

Figure 4–1. SBO Board Edge

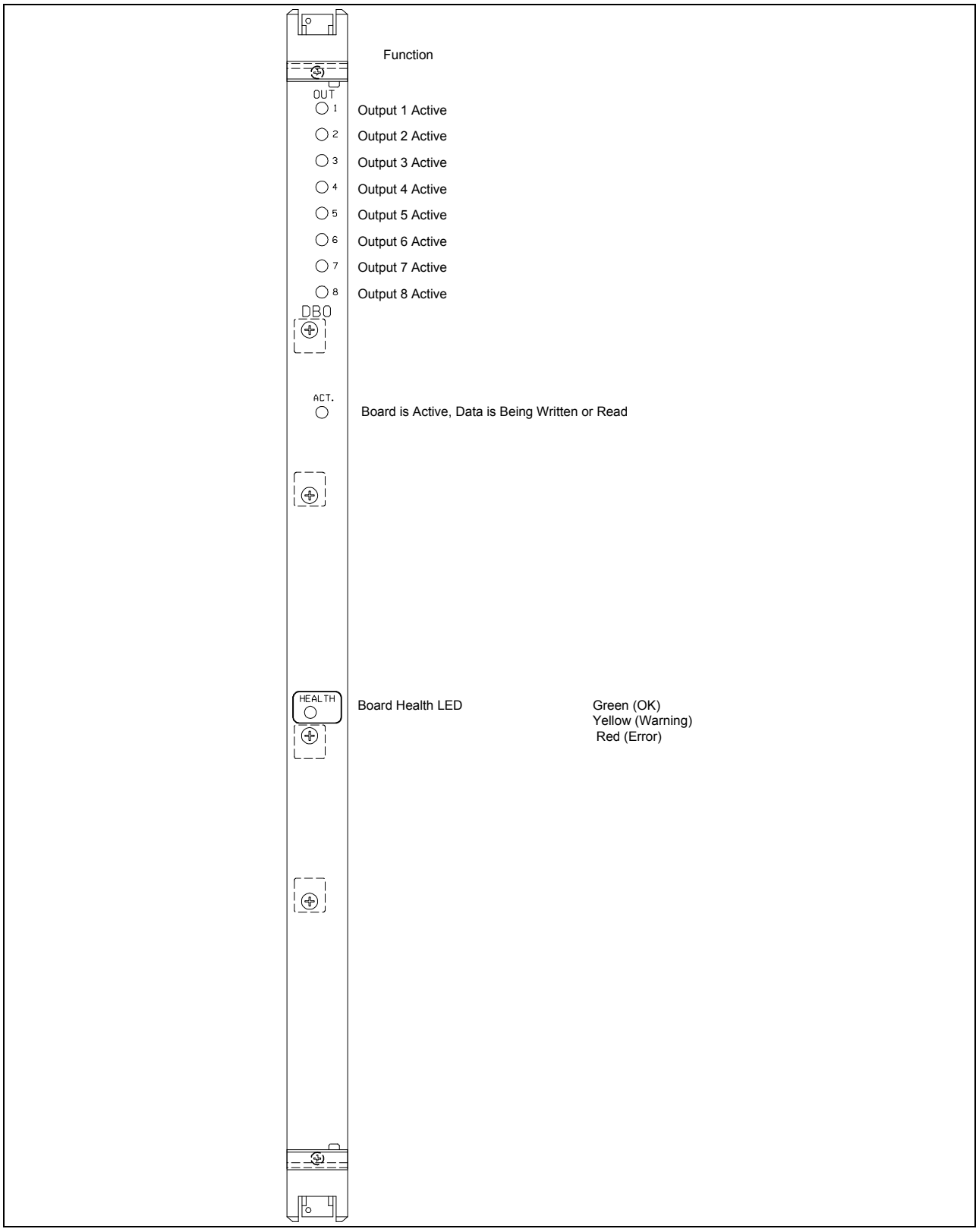

Figure 4–2. DBO Board Edge

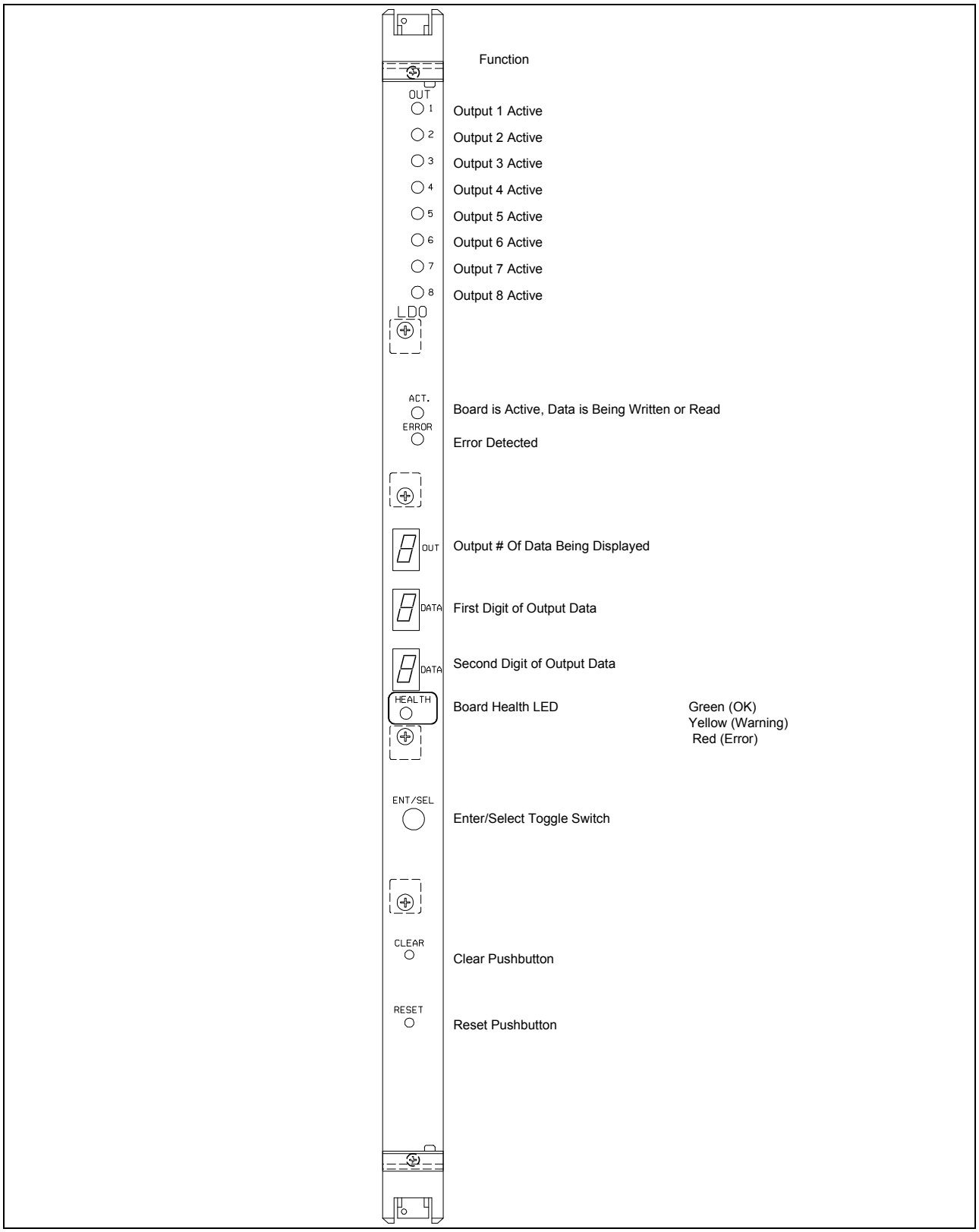

Figure 4–3. LDO Board Edge

4.5. SBO DETAILS

Single Break Output (SBO) boards contain eight vitally isolated outputs per board. Each output has one connection to field equipment (+OUT). The negative side of each group of four outputs is connected to common. This group reference is available at the board connector and each group of four outputs may be connected to a different reference. The output port on a SBO board is analogous to a relay circuit with a contact in the feed side of a circuit only. Supply voltage to the output board can be in the range of 9 to 30 VDC with loads up to 0.5 amps.

Appropriate points in the Vital output circuit have RF Bypass capacitors to ground to eliminate RF interference. Appropriate transient protection devices are also included in the output circuits on each PC board.

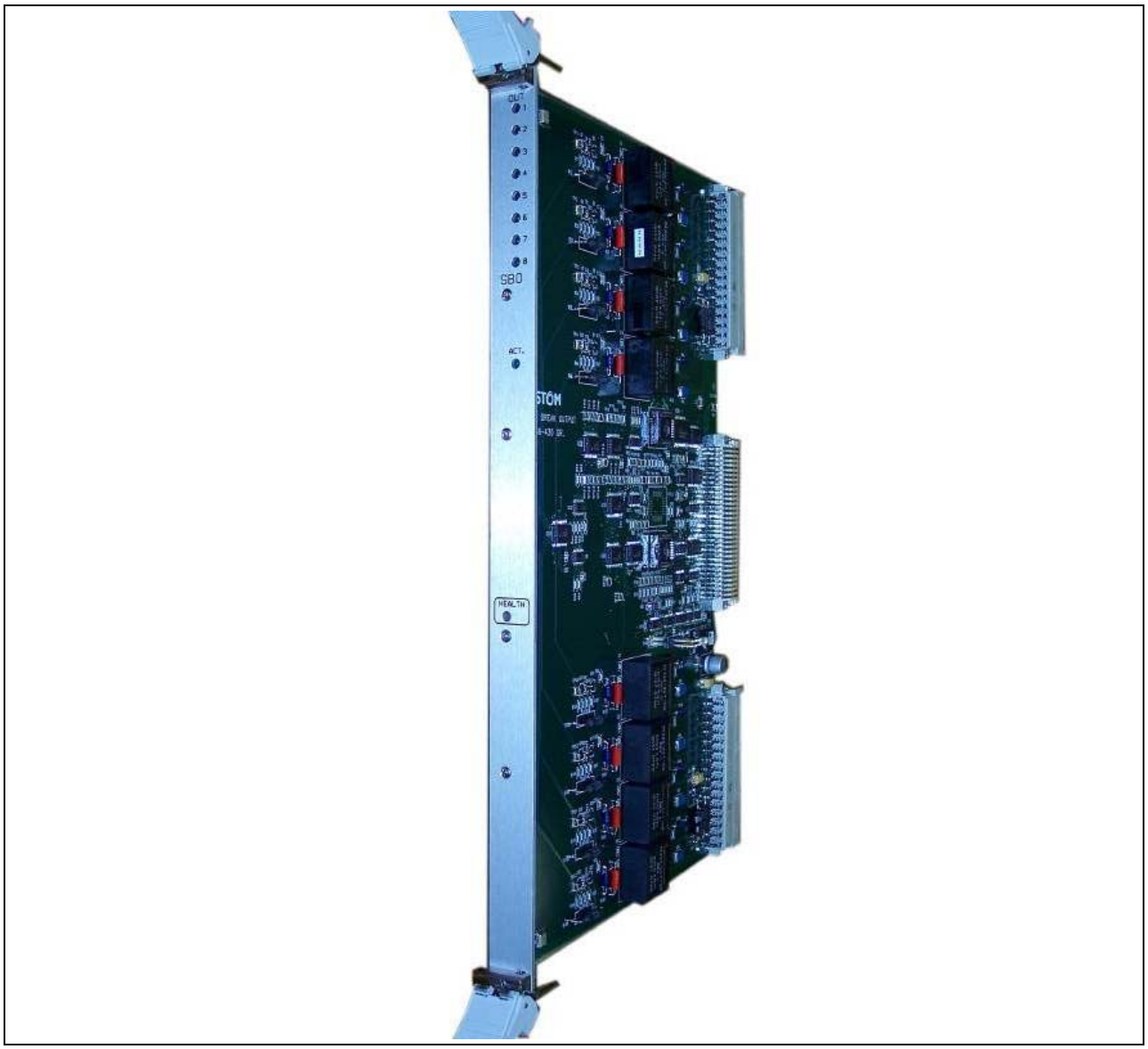

Figure 4–4. SBO Board

The single break output is analogous to a single relay contact placed in the positive or feed side of the circuit. The equivalent of the relay contact in the solid-state circuit is the FET switch. Figure 4–5 shows the SBO board block diagram.

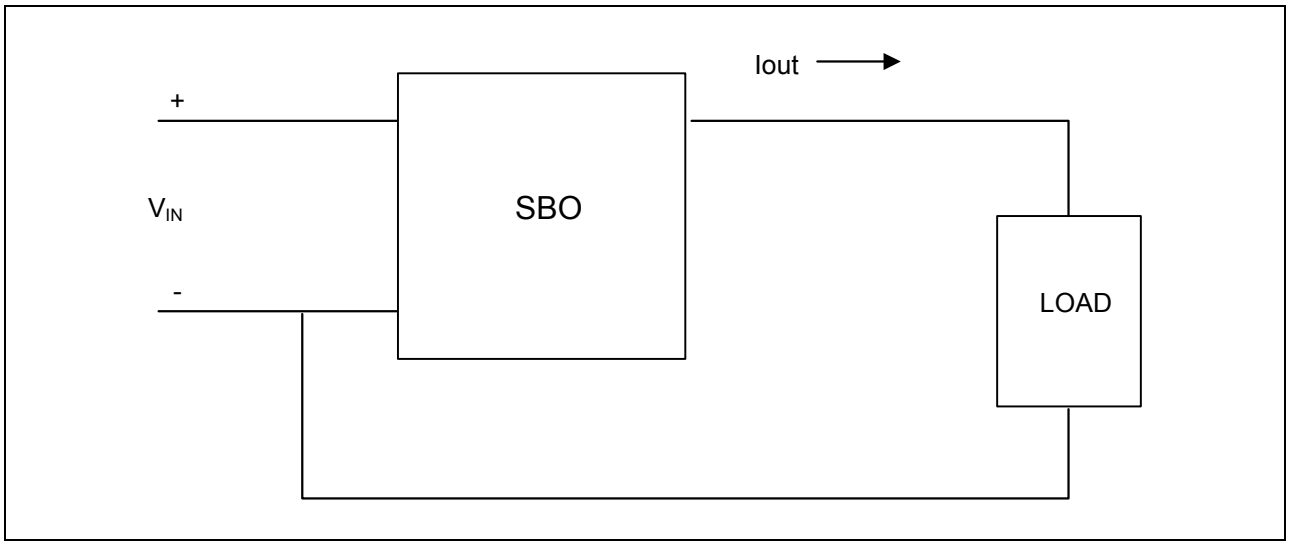

Figure 4–5. SBO Block Diagram

4.5.1. Card Edge Connectors

The SBO Board has three card edge connectors.

- P1, the top connector, is a 32-pin connector for Channels 1 through 4
- P2, the middle connector, is a 160 -pin connector used to interface with the VSP System Bus (part of the Motherboard)
- P3, the lower connector, is a 32-pin connector for Channels 5 through 8

The pins on these connectors are not user configurable.

Table 4–1. SBO Board P1 Connections

P1 Pin	SBO
Z2	OUT V1 COM
D2	OUT V1 COM
Z4	
D4	
Z6	+V1
D6	+V1
Z8	
D8	
Z10	+OUT1
D10	OUT V1 COM
Z12	
D12	
Z14	OUT V1 COM
D14	+OUT2
Z16	

P1 Pin	SBO
D16	
Z18	+OUT3
D18	OUT V1 COM
Z20	
D20	
Z22	OUT V1 COM
D22	+OUT4
Z24	
D24	
Z26	OUT V1 COM
D26	OUT V1 COM
Z28	
D28	
Z30	+V1
D30	+V1

Table 4–2. SBO Board P3 Connections

P1 Pin	SBO
Z2	OUT V2 COM
D2	OUT V2 COM
Z4	
D4	
Z6	+V2
D6	+V2
Z8	
D8	
Z10	+OUT5
D10	OUT V2 COM
Z12	
D12	
Z14	OUT V2 COM
D14	+OUT6
Z16	

P1 Pin	SBO
D16	
Z18	+OUT7
D18	OUT V2 COM
Z20	
D20	
Z22	OUT V2 COM
D22	+OUT8
Z24	
D24	
Z26	OUT V2 COM
D26	OUT V2 COM
Z28	
D28	
Z30	+V2
D30	+V2

4.5.2. User Settings

There are no user/field settings on this board.

4.5.3. Specifications

Table 4–3. SBO Board Specifications

Specification	31166-430-01
Maximum Number of Boards Per iVPI System	40
Board Slots Required	1
Number of Ports per Board	8
Maximum Board Logic Current Supply	500 mA
Minimum Switched Output Supply Voltage (Vin)	9.0 VDC
Maximum Switched Output Supply Voltage (Vin)	30.0 VDC
AOCD Current Threshold	3 mA max
Typical Output Voltage Drop	1.0 VDC
Maximum Switched Power	15 watts
Maximum Output Current Per Port (Iout)	500 mA
Isolation Between Outputs and 5 Volt Logic	> 3000 Vrms
Coded Energy Switching	No
Group Energy Filtered	Yes
Coded Type Switching	Yes

WARNING

THE SBO BOARD MAY FAIL WITH UP TO 3 MILLIAMPERES OF OUTPUT LEAKAGE CURRENT WITH THE SYSTEM REQUESTING THE OUTPUT TO BE IN THE DE-ENERGIZED STATE. TO PREVENT A POTENTIAL UNSAFE CONDITION, ANY LOAD DEVICE ATTACHED TO A LOW CURRENT VITAL OUTPUT CIRCUIT BOARD MUST NOT OPERATE AND MUST DE-ACTIVATE ABOVE 3 MILLIAMPERES. THIS INCLUDES ALL ENVIRONMENTAL OPERATING CONDITIONS AND ALL OPERATING VALUES OF THE LOAD DEVICE OVER ITS SERVICE LIFE. FAILURE TO FOLLOW THIS REQUIREMENT MAY LEAD TO UNEXPECTED OPERATION OF THE LOAD DEVICE.

4.6. DBO DETAILS

Double Break Output (DBO) boards contain eight vitally isolated outputs per board. Each output has two connections to field equipment (+OUT and –OUT) and two outputs may be connected with opposite polarity to form a Bipolar output circuit without requiring a separate external isolator interface for either the Double Break or the Bipolar mode of field connection. The output port on a DBO board is analogous to a relay circuit with contacts in both the feed and return sides of the circuit.

Each output circuit is vitally isolated from each other, from power and from ground. Supply voltage to the board can be in the range of 9 to 16 VDC with loads up to 0.6 amps. Additional board voltages are to be supported as required by specific applications. Being a fully isolated double break output circuit arrangement, this output can tolerate a single point failure to ground or to power without any damage.

Appropriate points in the Vital output circuit have RF Bypass capacitors to ground to eliminate RF interference. Appropriate transient protection devices are also included in the output circuits on each PC board.

Figure 4–6. DBO Board

The double break output is analogous to a relay circuit with the contacts in both the feed and return sides of the circuit. With the solid-state equivalent, however, each output is completely isolated from all other outputs and/or power supplies. Each output is isolated. Figure 4–7 shows the DBO board block diagram.

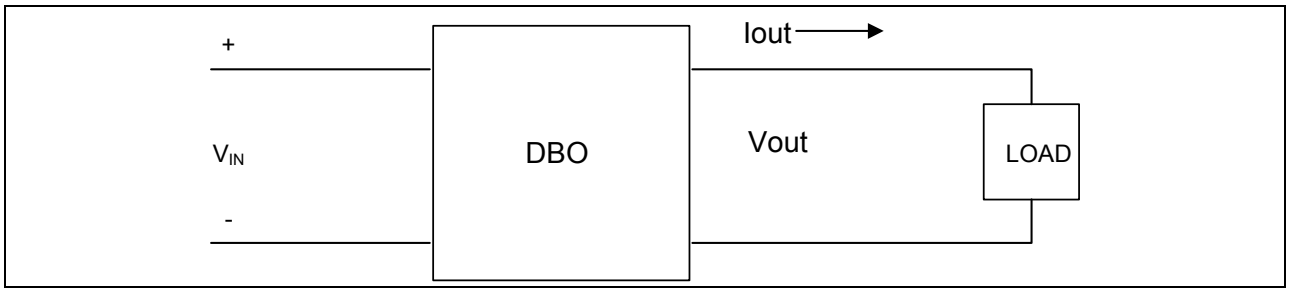

Figure 4–7. DBO Board Block Diagram

4.6.1. Card Edge Connectors

The DBO board has three card edge connectors.

- P1, the top connector, is a 32-pin connector for Channels 1 through 4.
- P2, the middle connector, is a 160-pin connector used to interface with the VSP System Bus (part of the Motherboard).
- P3, the lower connector, is a 32-pin connector for Channels 5 through 8.

The pins on these connectors are not user configurable.

Table 4–4. DBO Board P1 Connections

P1 Pin	DBO
Z2	OUT V1 COM
D2	OUT V1 COM
Z4	
D4	
Z6	+V1
D6	+V1
Z8	
D8	
Z10	+OUT1
D10	OUT 1 COM
Z12	
D12	
Z14	OUT 2 COM
D14	+OUT2
Z16	

P1 Pin	DBO
D16	
Z18	+OUT3
D18	OUT 3 COM
Z20	
D20	
Z22	OUT 4 COM
D22	+OUT4
Z24	
D24	
Z26	OUT V1 COM
D26	OUT V1 COM
Z28	
D28	
Z30	+V1
D30	+V1

Table 4–5. DBO Board P3 Connections

P3 Pin	DBO
Z2	OUT V2 COM
D2	OUT V2 COM
Z4	
D4	
Z6	+V2
D6	+V2
Z8	
D8	
Z10	+OUT5
D10	OUT 5 COM
Z12	
D12	
Z14	OUT 6 COM
D14	+OUT6
Z16	
D16	

P3 Pin	DBO
Z18	+OUT7
D18	OUT 7 COM
Z20	
D20	
Z22	OUT 8 COM
D22	+OUT8
Z24	
D24	
Z26	OUT V2 COM
D26	OUT V2 COM
Z28	
D28	
Z30	+V2
D30	+V2
Z32	
D32	

4.6.2. User Settings

There are no user/field settings on this board.

4.6.3. Specifications

Table 4–6. DBO Board Specifications

Specification	31166-433-01
Maximum Number of Output Boards Per iVPI System	40
Board Slots Required	1
Number of Ports Per Board	8
Minimum Input Voltage (Vin)	9.0 VDC
Maximum Input Voltage (Vin)	16.0 VDC
Maximum Output Current	600 mA
Output Voltage	= Vsupply – 5 x Iout
Isolation Between Outputs	> 3000 Vrms
AOCD Current Threshold	3 mA max
Maximum Board Logic Current Supply	500 mA
Maximum Output Current Per Port (Iout)	300 mA
Maximum Output Power Per Port	9 W

WARNING

THE DBO BOARD MAY FAIL WITH UP TO 3 MILLIAMPERES OF OUTPUT LEAKAGE CURRENT WITH THE SYSTEM REQUESTING THE OUTPUT TO BE IN THE DE-ENERGIZED STATE. TO PREVENT A POTENTIAL UNSAFE CONDITION, ANY LOAD DEVICE ATTACHED TO A LOW CURRENT VITAL OUTPUT CIRCUIT BOARD MUST NOT OPERATE AND MUST DE-ACTIVATE ABOVE 3 MILLIAMPERES. THIS INCLUDES ALL ENVIRONMENTAL OPERATING CONDITIONS AND ALL OPERATING VALUES OF THE LOAD DEVICE OVER ITS SERVICE LIFE. FAILURE TO FOLLOW THIS REQUIREMENT MAY LEAD TO UNEXPECTED OPERATION OF THE LOAD DEVICE.

4.7. LDO DETAILS

Lamp Drive Output (LDO) boards contain eight Vital outputs per board to directly drive incandescent signal lamps or to directly drive signal lamp LED assemblies. Each output has a Sourcing Drive (positive side switch) capable of providing a maximum output current of 3.3 amps per port. The supply voltage to the board can be adjusted externally to account for line losses to the bulb/LED signal assembly in order to get the desired voltage at the bulb/LED Signal Assembly (provided the 3.3 amps per port is not exceeded). Each port has over-current protection and over-current detection with an appropriate diagnostic.

The LDO board includes hot and cold filament check for incandescent bulbs and for Alstom approved LED Signal Assemblies as well as an adjustable low level current detection threshold range for LED signal assemblies. Each group of four output ports shares a common reference signal. The positive side of each output circuit is vitally isolated from each other, from power and as a group of four outputs from ground.

Appropriate points in the Vital output circuit have RF Bypass capacitors to ground to eliminate RF interference. Appropriate transient protection devices are included in the output circuits on each PC board.

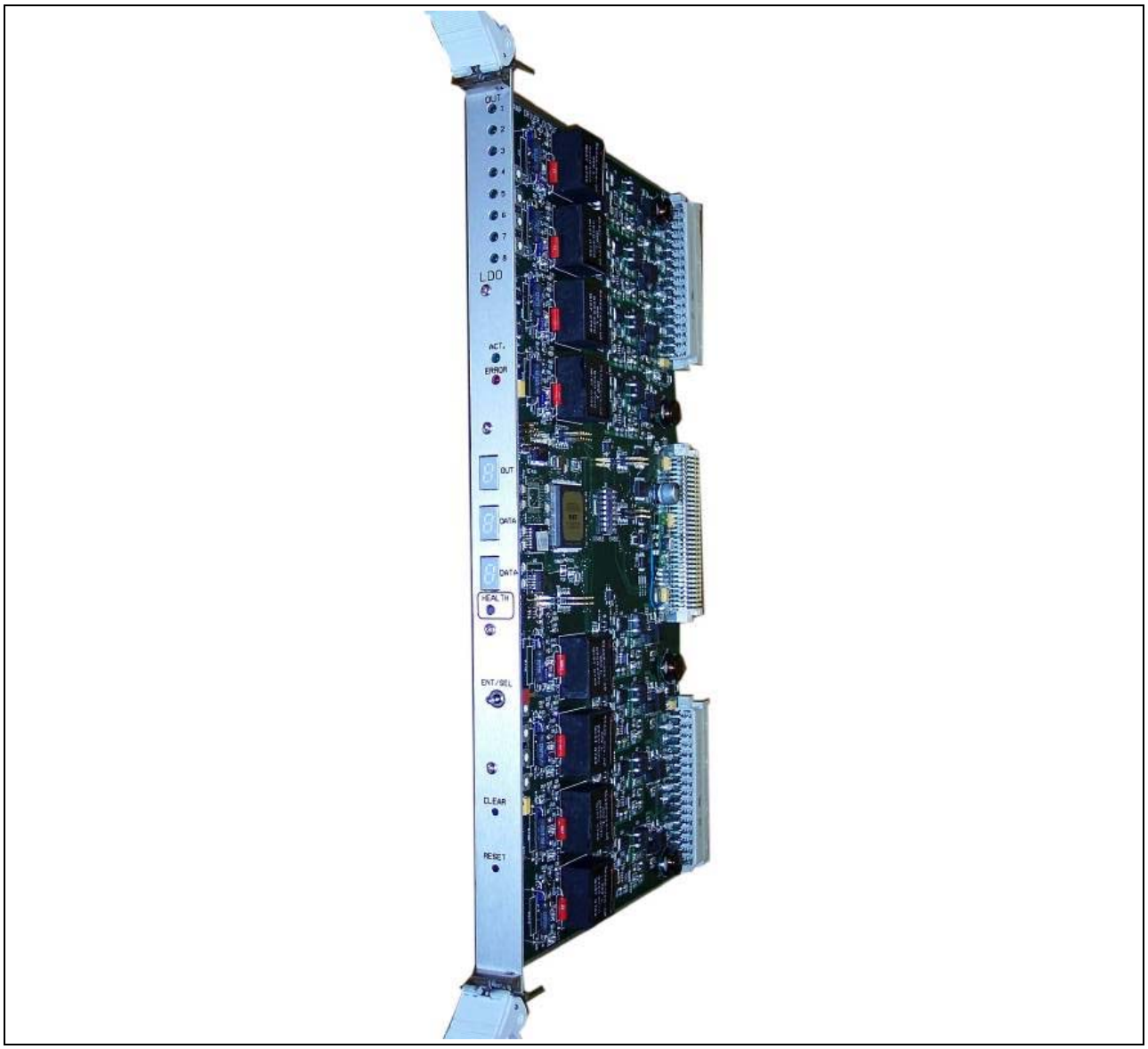

Figure 4–8. LDO Board

The lamp drive output circuit handles high current to light signal lamps. Each output circuit can accommodate hot and cold filament checks. This output uses a FET switch in the "high side" of the circuit. Therefore, it is necessary to supply the common side of the battery or signal lighting supply to the signal lamps. Figure 4–9 shows the LDO board port interface block diagram.

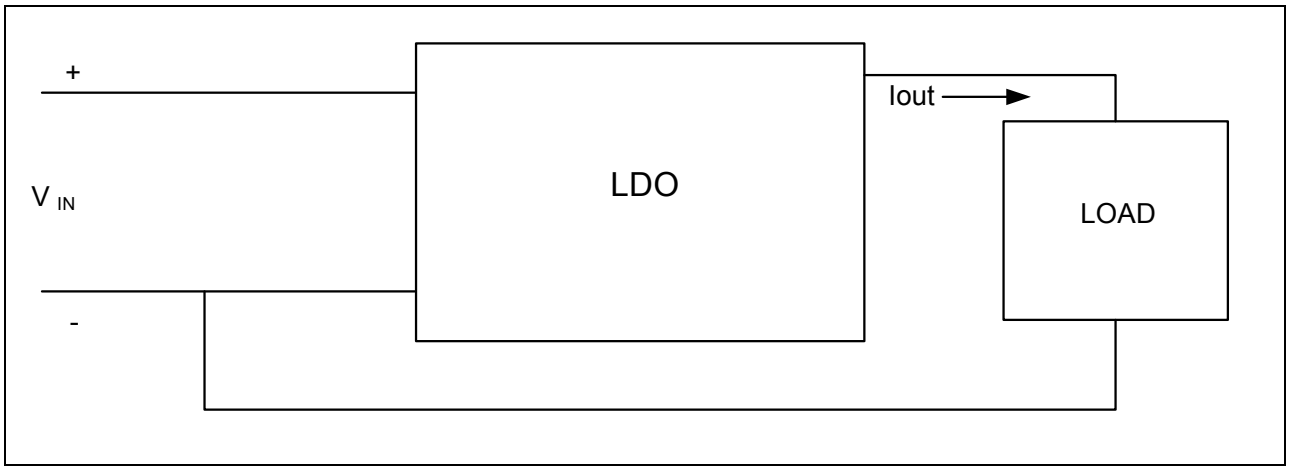

Figure 4–9. LDO Board Port Interface

The LDO board includes:

- A Diagnostic Interface to iVPI VSP Board that registers all current readings and error conditions and can be read or cleared via the iVPI VSP Board.
- A Board Edge User Interface that registers all current readings and error conditions and can be read or cleared via a Board Edge User interface.
- A Current Monitor (LCTH) that reads the current through the output approximately every 200 milliseconds. This current can be compared to one of 8 different threshold levels (0.0, 0.55, 0.75, 0.95, 1.25, 1.55, 2.05, or 3.25 Amps) to turn the output off if it is not drawing the minimum required current. The use of the iVPI filament checking routines enables downgrading and prevents upgrading to signals that are not drawing the required current. The outputs are protected from overcurrent and short protection.
- A Cable Integrity Check that uses isolated voltage sensing at the output to determine if a potential exists across the output when the output is off. A separate switch for each output can be used to select the system reaction to this event (log the error or drop the iVPI Vital Relay).

4.7.1.1. Enable/Disable VRD Drop Switches

This is an eight position DIP switch, one switch per output. When Enabled a CIC error causes the removal of Vital Power. When Disabled the error is still stored on the board until cleared (see Clear Switch below).

4.7.1.2. Low Current Threshold Switches

This is a series of 10-position rotary switches, one per output, that allow eight selections for the Low Current Threshold of the Current Monitoring function. One setting disables the Low Current Shutdown and is intended for incandescent bulb signals. Five settings indicate a possible decrease in luminance for LED signals. The 2.05 setting could be used with a 25W load to indicate a Low Vital Power Indication. The 3.25A Setting may be used in future designs that drive two 25W loads to indicate "One Filament Out".

4.7.1.3. Toggle Switch

This switch enables maintenance personnel to monitor various functions on the LDO board. It is used to select which output to monitor and whether to display Current or Errors for the particular output.

4.7.1.4. Clear Switch

This switch enables maintenance personnel to clear out the Error Registers, Current Reading Registers and resets all board states.

4.7.2. Indications

4.7.2.1. Output LEDs

These LEDs indicate which outputs are on or off (1 at top through 8 at bottom)

4.7.2.2. 7-Segment Displays

This display is used in conjunction with the toggle switch and shows the Output number of the data being displayed and the value of the parameter.

- Which output has an error (Decimal Point of Output Number 7-Segment)
- Which error on a particular output (Toggle Down, 1=CIC, 2=LCTH, 3=OverCurrent-Off, 4=OverCurrent-On)
- Current readings (Toggle Up)

4.7.2.3. Error LED

This LED is used so railroad maintainers can quickly determine where to start diagnosing problems (particularly when a diagnostic port device is not being used).

4.7.3. LDO Board Switches

Table 4–7 shows the switches for the LDO Board. See Figure 4–10 for a board layout drawing identifying the LDO switch locations and see Figure A–5 for a complete board layout drawing.

Table 4–7. LDO Board Switches

Switches	
S1	Low Current Threshold setting for output 4 (LCTH-4)
S2	Low Current Threshold setting for output 3 (LCTH-3)
S3	Low Current Threshold setting for output 2 (LCTH-2)
S4	Low Current Threshold setting for output 1 (LCTH-1)
S5	CIC VRD Drop, when set to OFF causes the VRD to drop if a cable fault is detected
S6	Low Current Threshold setting for output 8 (LCTH-9)
S7	Enter/Select Toggle Switch
S8	Low Current Threshold setting for output 7 (LCTH-7)
S9	Low Current Threshold setting for output 6 (LCTH-6)
S10	Low Current Threshold setting for output 5 (LCTH-5)
S11	Pushbutton, Clear
S12	Pushbutton, Reset

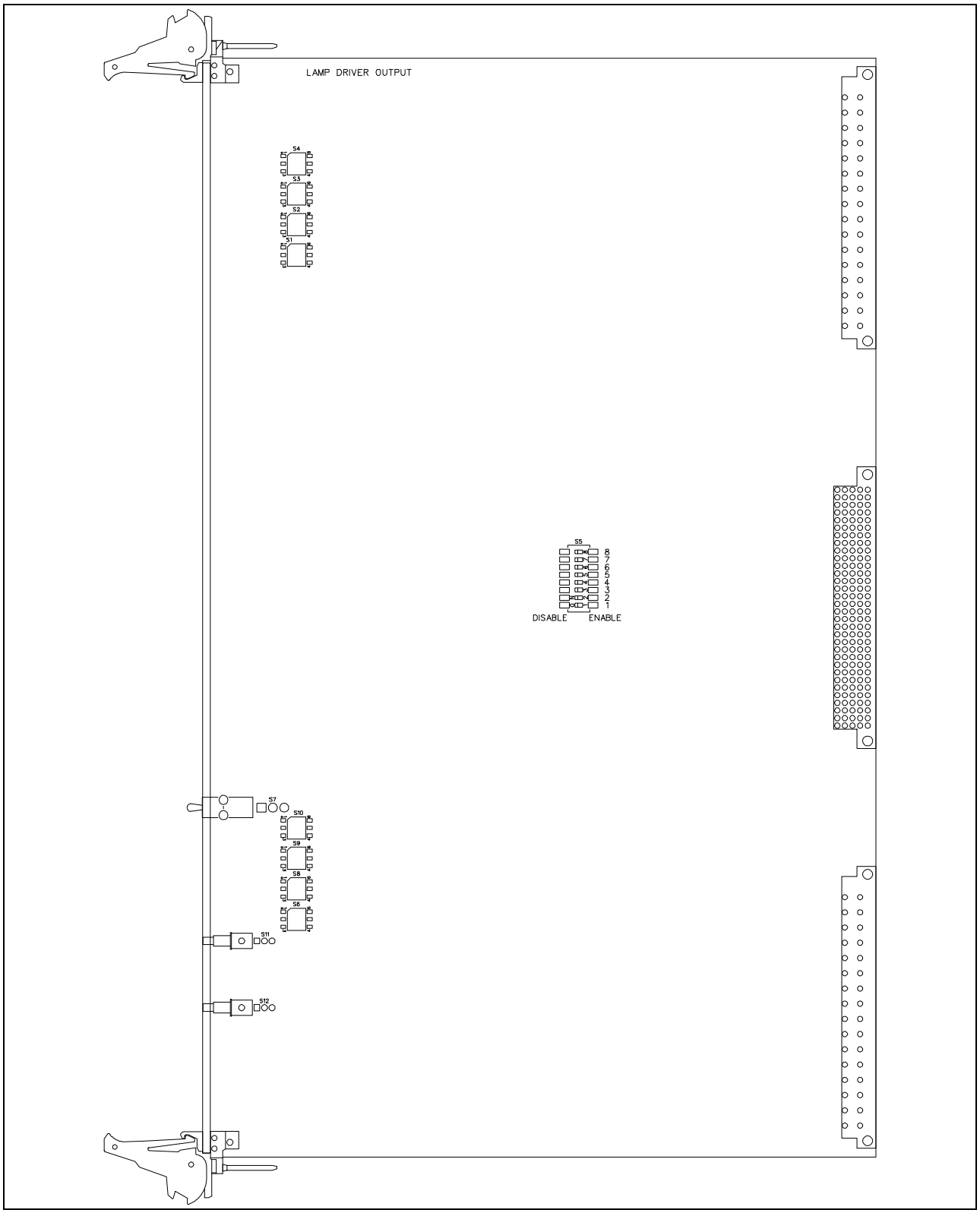

Figure 4–10. LDO Board Switches

Switches LCTH-1 through LCTH-8, Located on S1-S4, S6, and S8-S10) are used to select the Low Current Threshold (LCTH). An example selection dial is shown in Figure 4–10. Table 4–8 summarizes the switch settings.

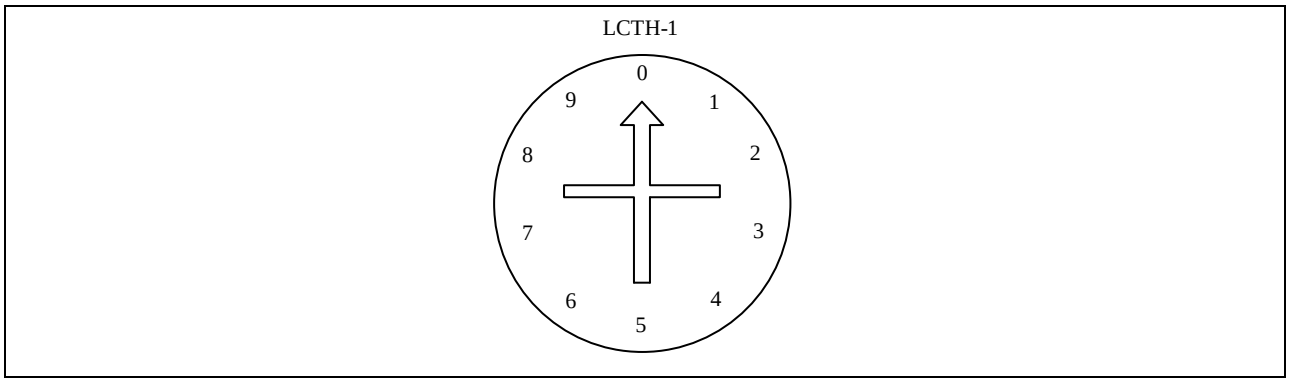

Figure 4–11. LCTH Selection Dial

Table 4–8. LCTH Switch Settings

Threshold	Switch Setting
0.0A	SW=0 Low Current Detection Disabled
0.55A	SW=1
0.75A	SW=2
0.95A	SW=3
1.25A	SW=4
1.55A	SW=5
2.05A	SW=6
3.25A	SW=7
0.0A	SW=8 Low Current Detection Disabled
0.55A	SW=9 (same as SW=1)

4.7.4. Card Edge Connectors

The LDO Board has three card edge connectors.

- P3, the top connector, is a 32-pin connector for Channels 1 through 4.
- P2, the middle connector, is a 160-pin connector used to interface with the VSP System Bus (part of the Motherboard).
- P1, the lower connector, is a 32-pin connector for Channels 5 through 8.

Table 4–9. LDO Board P1 Connections

Pin P1	Vital Output Function
P1-Z10	-V1OUT
P1-D10	OUT1
P1-D14	-V1OUT
P1-Z14	OUT2
P1-Z18	-V1OUT
P1-D18	OUT3
P1-D22	-V1OUT
P1-Z22	OUT4
P1-D2	-V1OUT
P1-Z2	-V1OUT
P1-D30	-V1OUT
P1-Z30	-V1OUT
P1-D6	+V1OUT
P1-Z6	+V1OUT
P1-D30	+V1OUT
P1-Z30	+V1OUT

Table 4–10. LDO Board P3 Connections

Pin P3	Vital Output Function
P3-Z10	-V2OUT
P3-D10	OUT5
P3-D14	-V2OUT
P3-Z14	OUT6
P3-Z18	-V2OUT
P3-D18	OUT7
P3-D22	-V2OUT
P3-Z22	OUT8
P3-D2	-V2OUT
P3-Z2	-V2OUT
P3-D30	-V2OUT
P3-Z30	-V2OUT
P3-D6	+V2OUT
P3-Z6	+V2OUT
P3-D30	+V2OUT
P3-Z30	+V2OUT

The pins on these connectors are not user configurable.

4.7.5. Specifications

Table 4–11. LDO Board Specifications

Specification	31166-431-01
Maximum Number of Output Boards Per iVPI System	40
Board Slots Required	1
Number of Ports Per Board	8
Minimum Switched Output Supply Voltage (Vin)	8.0 VDC
Maximum Switched Output Supply Voltage (Vin)	16.0 VDC
AOCD Current Threshold	65mA max
Hot/Cold Filament Check	Yes, 100 mA
Maximum Board Logic Current Supply	350 mA
Maximum Output Current Per Port (Iout)	3.3 A
Maximum Output Current Per 4-Port Group	7.5 A
Typical Output Voltage Drop	1.0 VDC
Over Current Shutdown Threshold (t = 200 to 400 ms)	4.0 A
Low Level Current Detection Threshold Range	0.55 to 3.25 A in 7 steps
Isolation Between Outputs and 5 Volt Logic	> 3000 Vrms

WARNING

THE LDO BOARD MAY FAIL WITH UP TO 65 MILLIAMPERES OF OUTPUT LEAKAGE CURRENT WITH THE SYSTEM REQUESTING THE OUTPUT TO BE IN THE DE-ENERGIZED STATE. TO PREVENT A POTENTIAL UNSAFE CONDITION, ANY LOAD DEVICE ATTACHED TO A HIGH CURRENT VITAL OUTPUT CIRCUIT BOARD MUST NOT OPERATE AND MUST DE-ACTIVATE ABOVE 65 MILLIAMPERES. THIS INCLUDES ALL ENVIRONMENTAL OPERATING CONDITIONS AND ALL OPERATING VALUES OF THE LOAD DEVICE OVER ITS SERVICE LIFE. FAILURE TO FOLLOW THIS REQUIREMENT MAY LEAD TO UNEXPECTED OPERATION OF THE LOAD DEVICE.

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5. SECTION 5 – ACO (AC OUTPUT) BOARD, P/N 31166-432-XX

5.1. GENERAL

The Vital AC Output (ACO) Board operates in a manner similar to Vital Output Boards. See Figure A–6 for a board layout drawing.

5.2. INTRODUCTION

The ACO board is used for lighting signal lamps or for operating other AC loads. The board has 8 outputs divided into two groups of four. Outputs 1 through 4 are connected to one power supply input while outputs 5 through 8 are connected to a second power supply input. In Vital applications, these power supply inputs are connected to a source that can be vitally turned off (usually a contact of a Vital relay or one of its repeaters).

Two versions of the ACO board are available:

- P/N 31166-431-01 is capable of driving loads up to 0.8 amperes and provides a high output current threshold.
- P/N 31166-431-02 is capable of driving loads up to 0.6 amperes and provides a low output current threshold.

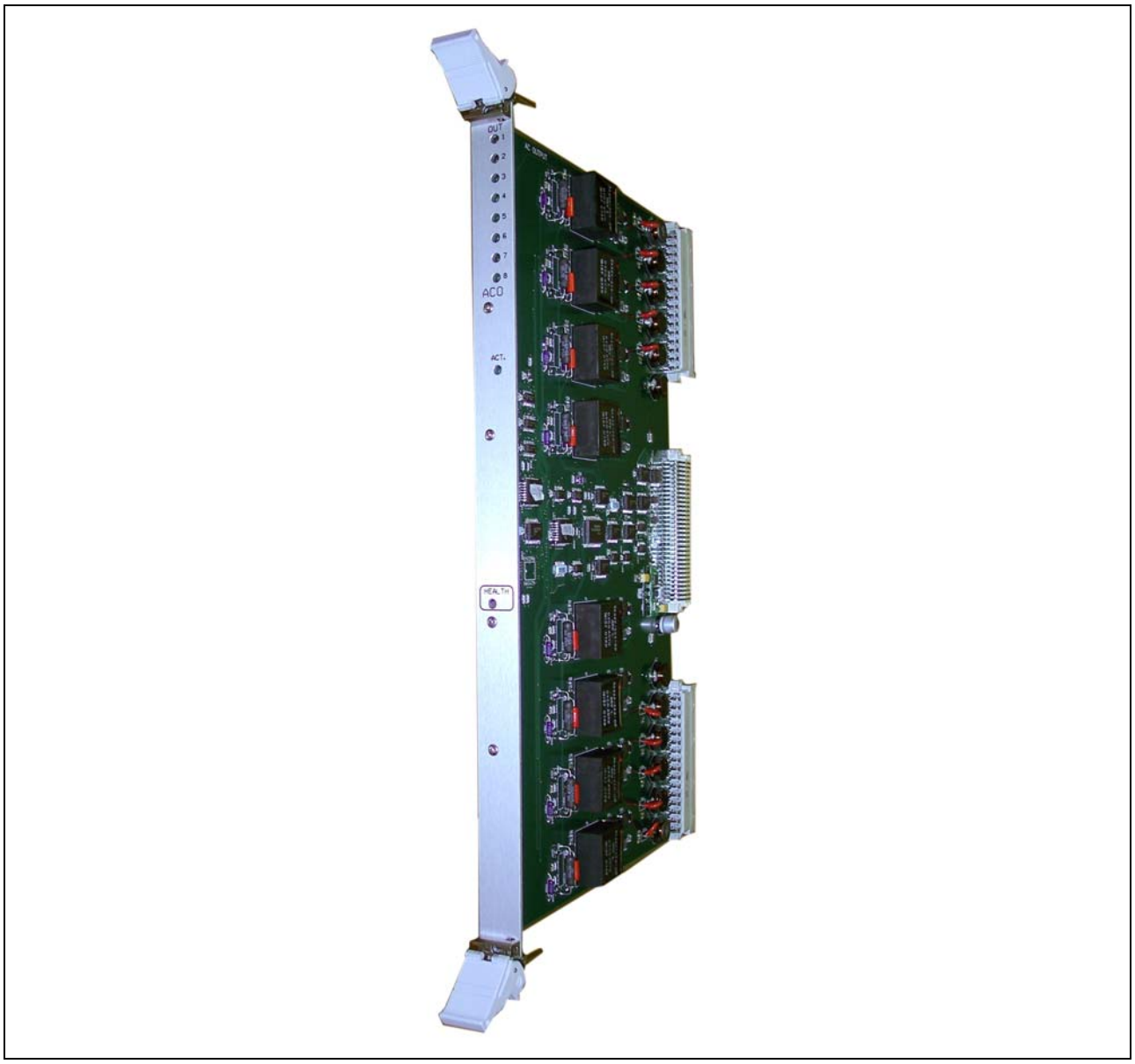

Figure 5–1. ACO Board

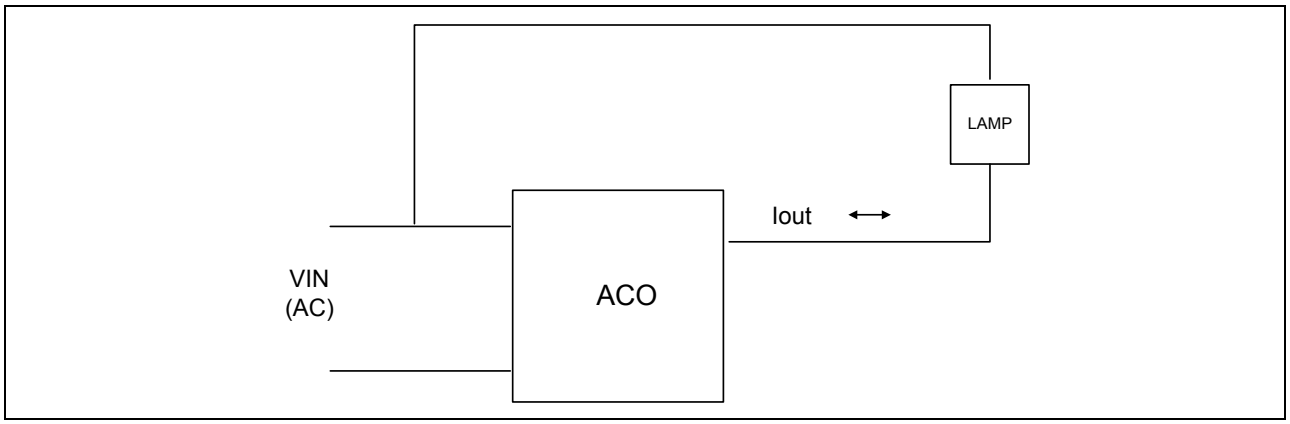

Figure 5–2. ACO Board Port Interface

5.3. INDICATIONS

The ACO board has LED indications that provide a visual indication of the status of the board and output status. A Health LED is used to indicate board health status. See Figures 5–3 for an illustration of the board edge.

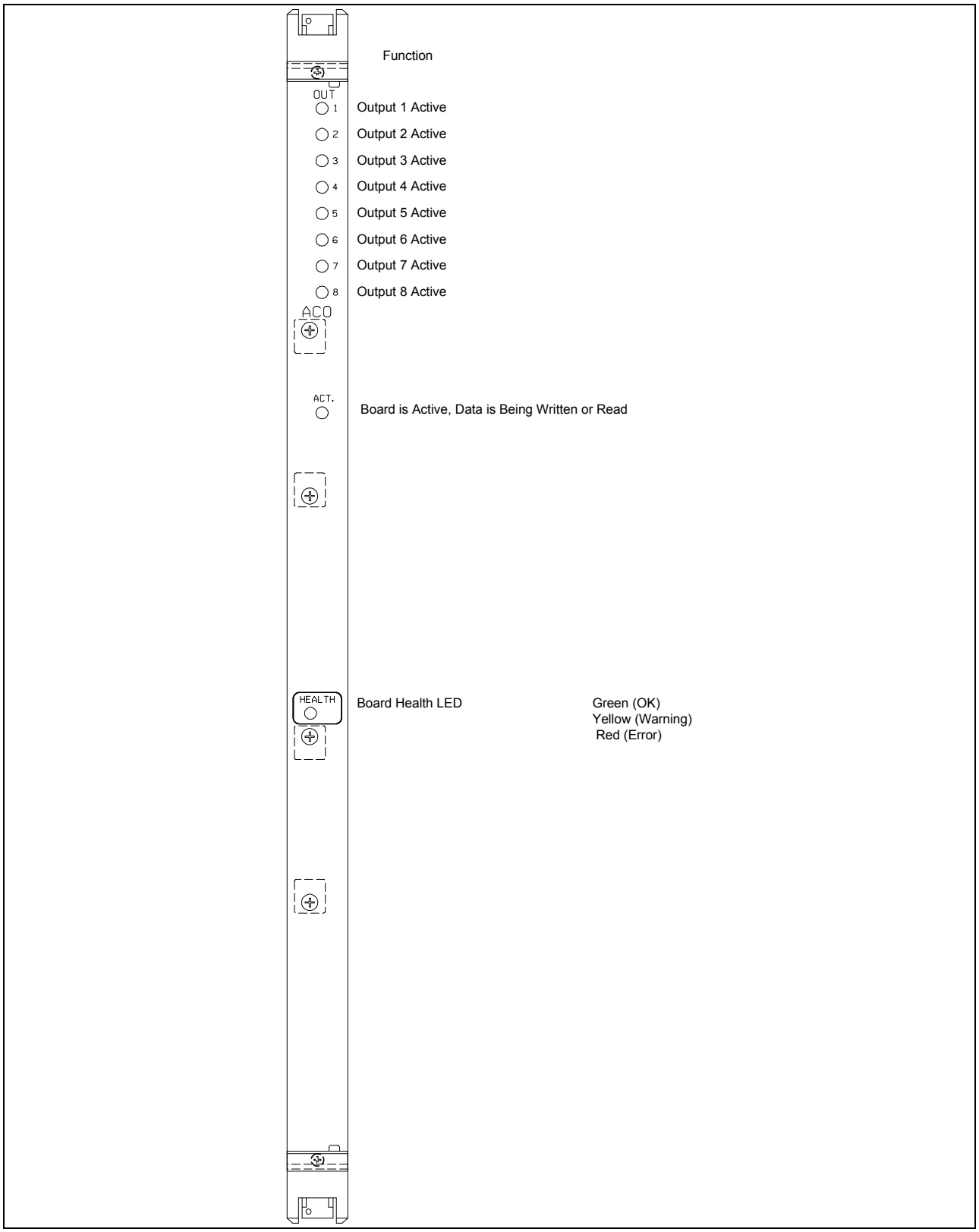

Figure 5–3. ACO Board Edge

5.4. CARD EDGE CONNECTORS

The ACO board has three card edge connectors:

- P1, the top connector, is a 32-pin connector which contains wiring for Vital power connections.
- P2, the middle connector, is a 160-pin connector used for connections to the motherboard which supplies 5 Volt power and common.
- P3, the lower connector, is a 32-pin connector which contains wiring for check ids, serial links, and Vital power.

The pins on these connectors are not user configurable.

Table 5–1. ACO Board P1 Connections

P1 Pin	ACO	P1 Pin	ACO
Z2	OUT V1 COM	D16	
D2	OUT V1 COM	Z18	+OUT3
Z4		D18	
D4		Z20	
Z6	+V1	D20	
D6	+V1	Z22	
Z8		D22	+OUT4
D8		Z24	
Z10	+OUT1	D24	
D10		Z26	OUT V1 COM
Z12		D26	OUT V1 COM
D12		Z28	
Z14		D28	
D14	+OUT2	Z30	+V1
Z16		D30	+V1

Table 5–2. ACO Board P3 Connections

P3 Pin	ACO
Z2	OUT V2 COM
D2	OUT V2 COM
Z4	
D4	
Z6	+V2
D6	+V2
Z8	
D8	
Z10	+OUT5
D10	
Z12	
D12	
Z14	
D14	+OUT6
Z16	

P3 Pin	ACO
D16	
Z18	+OUT7
D18	
Z20	
D20	
Z22	
D22	+OUT8
Z24	
D24	
Z26	OUT V2 COM
D26	OUT V2 COM
Z28	
D28	
Z30	+V2
D30	+V2

5.5. USER SETTINGS

There are no user/field settings on this board.

5.6. SPECIFICATIONS/ASSEMBLY DIFFERENCES

WARNING

LOW CURRENT VITAL AC OUTPUT BOARDS MAY FAIL WITH UP TO 3 MILLIAMPERES OF OUTPUT LEAKAGE CURRENT WITH THE SYSTEM REQUESTING THE OUTPUT TO BE IN THE DE-ENERGIZED STATE. TO PREVENT A POTENTIAL UNSAFE CONDITION, ANY LOAD DEVICE ATTACHED TO A LOW CURRENT VITAL OUTPUT CIRCUIT BOARD MUST NOT OPERATE AND MUST DE-ACTIVATE ABOVE 3 MILLIAMPERES. THIS INCLUDES ALL ENVIRONMENTAL OPERATING CONDITIONS AND ALL OPERATING VALUES OF THE LOAD DEVICE OVER ITS SERVICE LIFE. FAILURE TO FOLLOW THIS REQUIREMENT MAY LEAD TO UNEXPECTED OPERATION OF THE LOAD DEVICE.

WARNING

HIGH CURRENT VITAL AC OUTPUT BOARDS MAY FAIL WITH UP TO 65 MILLIAMPERES OF OUTPUT LEAKAGE CURRENT WITH THE SYSTEM REQUESTING THE OUTPUT TO BE IN THE DE-ENERGIZED STATE. TO PREVENT A POTENTIAL UNSAFE CONDITION, ANY LOAD DEVICE ATTACHED TO A HIGH CURRENT VITAL OUTPUT CIRCUIT BOARD MUST NOT OPERATE AND MUST DE-ACTIVATE ABOVE 65 MILLIAMPERES. THIS INCLUDES ALL ENVIRONMENTAL OPERATING CONDITIONS AND ALL OPERATING VALUES OF THE LOAD DEVICE OVER ITS SERVICE LIFE. FAILURE TO FOLLOW THIS REQUIREMENT MAY LEAD TO UNEXPECTED OPERATION OF THE LOAD DEVICE.

Table 5–3. ACO Board Specifications/Assembly Differences

Specification	31166-432-01	31166-432-02
Maximum Number of Boards Per iVPI System	40	40
Board Slots Required	1	1
Number of Ports Per Board	8	8
Minimum Switched Output Supply Voltage	90 VAC rms	90 VAC rms
Maximum Switched Output Supply Voltage	130 VAC rms	130 VAC rms
Maximum Output Current Per Port	0.8 A rms	0.5 A rms
Isolation Between Outputs	> 3000 Vrms	> 3000 Vrms
Frequency Range	40 - 150 Hz	40 - 150 Hz
AOCD Operating Threshold	65 mA max	3 mA max
Special EMI Suppression	Yes	Yes
Maximum Board Logic Current Supply	500mA	500mA
Switched Power (max resistive)	104 W	104 W
Vital Output Flashing	No	No

6. SECTION 6 – CRG (CODE RATE GENERATOR) BOARD, P/N 31166-459-XX

6.1. GENERAL

The Code Rate Generator (CRG) board is a Vital iVPI board that generates coded outputs. See Figure A–7 for a board layout drawing.

6.2. INTRODUCTION

The Code Rate Generator (CRG) board contains eight vitally isolated outputs per board. The CRG board has its own Vital processor engine for generating and proving the pulsed outputs typically used to generate cab signal outputs. Each output has two connections to field equipment (+OUT and –OUT). The output port on a CRG board is analogous to a relay circuit with contacts in both the feed and return sides of the circuit.

Each output circuit is vitally isolated from each other, from power and from ground. Appropriate points in the Vital output circuit have RF Bypass capacitors to ground to eliminate RF interference.

Figure 6–1. CRG Board

6.3. OUTPUT CONFIGURATIONS

All outputs are generated using a Double Break Output (DBO) DC-DC converter and as such, are isolated from each other by >3000Vrms.

6.3.1. Solid State Relay Driver

The output circuit on a solid state driver drives a CRYDOM D241xx type Solid State Relay.

Nominal Operating Conditions (load 1500Ω):

- Output Voltage: ~4.64V
- Output Current: ~3.1mA

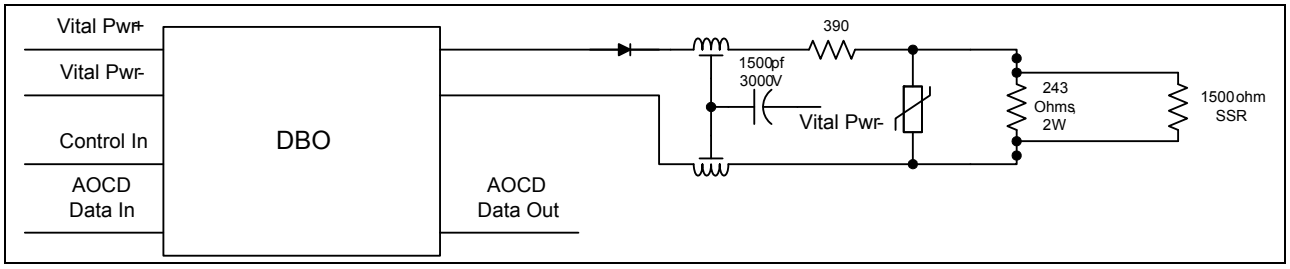

Figure 6–2. Solid State Relay Load Output Circuit

Load Short-Circuit:

- Max Current (16V into board): ~50mA
- Min Current (8V into board): ~24mA

Load Open-Circuit:

- Max Voltage (16V into board): ~7.38V
- Min Voltage (8V into board): ~3.29V

6.3.2. B-Relay Driver

The output circuit on a B-relay driver drives a typical B-style code following relay. The equations allow for the computation of the output voltage and current as a function of Vital power supply voltage and relay coil impedance.

Nominal Operating Conditions (VS = Vital Power Supply Voltage; RL = Coil Impedance):

- Output Voltage: VOUT = VS*(1.2) - (~0.7)
- Output Current: IOUT = VOUT/RL

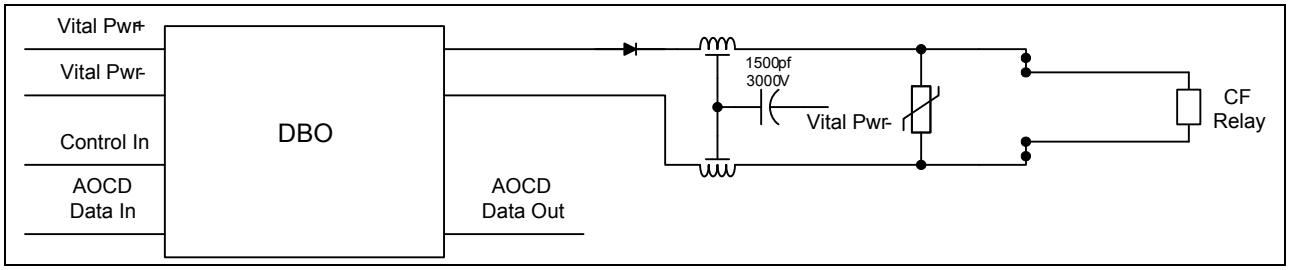

Figure 6–3. Code-Following Load Relay Output Circuit

6.4. INDICATIONS

6.4.1. Output LEDs

The CRG board has LED indications that provide a visual indication of the status of the board and output status. A Health LED is used to indicate board health status. See Figures 6–4 for an illustration of the board edge.

6.4.2. 7-Segment Displays

Two seven segment displays, along with the action of a two position toggle switch, provide the means to read out various code rate parameters for each of the eight outputs.

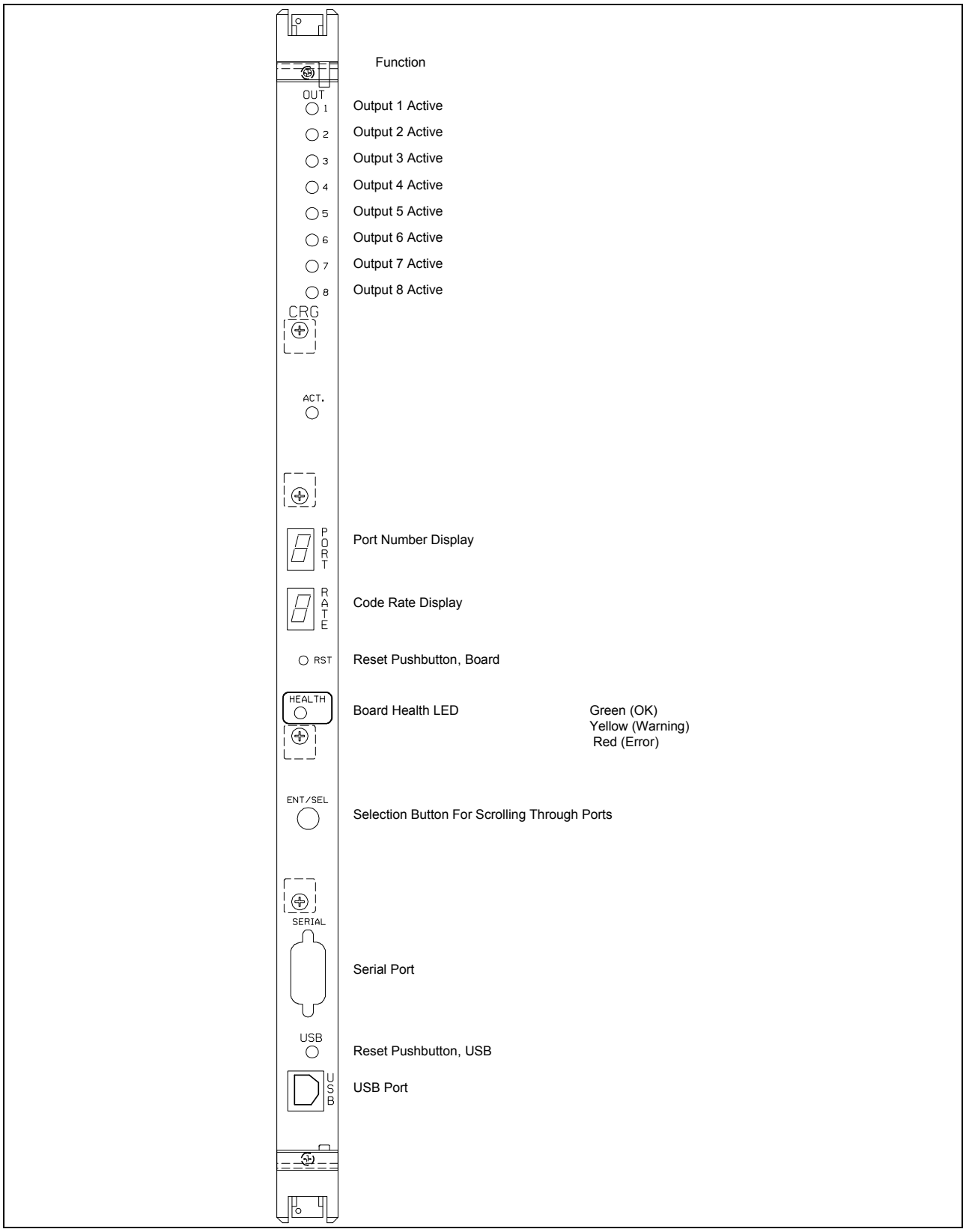

Figure 6–4. CRG Board Edge

6.5. CARD EDGE CONNECTORS

The CRG board has three card edge connectors:

- P1 (upper connector) is a 48-pin connector used for vital power and Outputs 1-4.
- P2 (middle connector) is a 160-pin connector used to interface with the VSP System Bus, NV I/O. Power is supplied on the P2 connector.
- P3 (lower connector) is a 48-pin connector used for vital power and Outputs 5-8.

Table 6–1. CRG Board P1 Connections

P1-	Name	Function
Z6	V1+	Vital Power 1 +
D6	V1+	Vital Power 1 +
Z30	V1+	Vital Power 1 +
D30	V1+	Vital Power 1 +
Z2	V1COM	Vital Power 1 Common
D2	V1COM	Vital Power 1 Common
Z26	V1COM	Vital Power 1 Common
D26	V1COM	Vital Power 1 Common
Z10	OUT1+	Vital Output 1 +
D10	OUT1-	Vital Output 1 -
Z14	OUT2+	Vital Output 2 +
D14	OUT2-	Vital Output 2 -
Z18	OUT3+	Vital Output 3 +
D18	OUT3-	Vital Output 3 -
Z22	OUT4+	Vital Output 4 +
D22	OUT4-	Vital Output 4 -

Table 6–2. CRG Board P3 Connections

P3-	Name	Function
Z6	V2+	Vital Power 2 +
D6	V2+	Vital Power 2 +
Z30	V2+	Vital Power 2 +
D30	V2+	Vital Power 2 +
Z2	V2COM	Vital Power 2 Common
D2	V2COM	Vital Power 2 Common
Z26	V2COM	Vital Power 2 Common
D26	V2COM	Vital Power 2 Common
Z10	OUT5+	Vital Output 5 +
D10	OUT5-	Vital Output 5 -
Z14	OUT6+	Vital Output 6 +
D14	OUT6-	Vital Output 6 -
Z18	OUT7+	Vital Output 7 +
D18	OUT7-	Vital Output 7 -
Z22	OUT8+	Vital Output 8 +
D22	OUT8-	Vital Output 8 -

The pins on these connectors are not user configurable.

6.6. USER SETTINGS

There are no user/field settings on this board.

6.7. SPECIFICATIONS/ ASSEMBLY DIFFERENCES

Table 6–3. CRG Board Specifications/Assembly Differences

Specification	**31166-459**	
	-01	**-02**
Maximum Number of Boards Per iVPI System	3	
Board Slots Required	1	
Typical Board Logic Current Supply	1500 mA	
Input Power Supply Range	8V to 16V	
Power Supply Operating Current	0.5A	
AOCD Operating Threshold	3 mA max	
Output	Solid State	Mechanical Relay
Code Rates Supported (Pulses Per Minute)	0, 50, 75, 120, 180, 270, 420, Steady On	

7. SECTION 7 – GTP (GENRAKODE TRACK PROCESSOR) BOARD, P/N 31166-434-XX

7.1. GENERAL

This Section describes the Genrakode Track Processor (GTP) board. See Figure A–8 for a board layout drawing.

7.2. INTRODUCTION

The GTP board is for Commuter, Freight and LRT applications.

This board plugs into the iVPI system in any slot, except 1 and 2, and is typically used for driving DC Coded Approach Track Circuits. The board front edge includes connections for downloading the Genrakode programs as well as indications for Codes In/Codes Out, and other maintenance indications. Track leads connect to the rear of the subrack and to track filtering devices to prevent surges and other transient inputs from affecting the track circuit function.

Refer to the Genrakode 3 manual P2524 for complete details of the operation of the GTP board.

Figure 7–1. GTP Board

7.3. OPERATION

The Genrakode Track Processor (GTP) provides track control circuitry for two separate tracks hereby designated as East and West.

7.4. INDICATIONS

The GTP board has LED indications that provide a visual indication of the status of the board, the tracks, and the signals. A Health LED is used to indicate board health status. See Figure 7–3 for an illustration of the board edge, including LEDs, ports, push buttons and 7-segment displays.

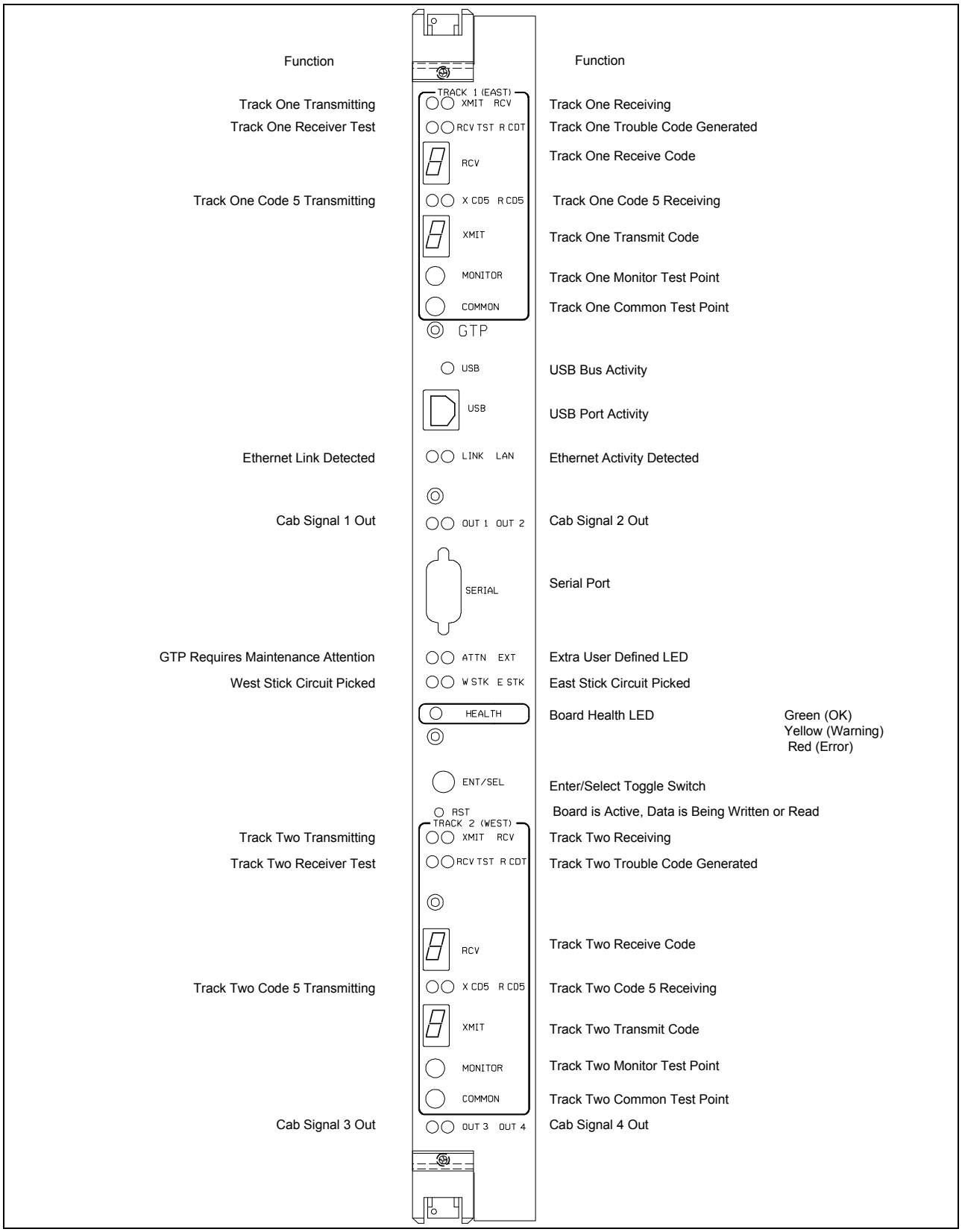

Figure 7–2. GTP Board Edge

7.5. CARD EDGE CONNECTORS

The GTP board has three card edge connectors:

- P1, the top connector, is a 48-pin connector which contains wiring for TRACK 1/EAST track circuit and power connections.
- P2, the middle connector, is a 160-pin connector used for connections to the motherboard which supplies 5 Volt power and common.
- P3, the lower connector, is a 48-pin connector which contains wiring for TRACK 2/WEST track circuit and power connections.

The pins on these connectors are not user configurable.

7.6. USER SETTINGS

There are no user/field settings on this board.

7.7. SPECIFICATIONS

Table 7–1. GTP Board Specifications

Specification	31166-434-01
Maximum Number of Boards Per iVPI System	10
Board Slots Required	2
Number of Track Circuits Per Board	2
Maximum Board Logic Current Supply	600mA
Isolation Between Outputs	> 3000 Vrms

8. SECTION 8 – BEX (BUS EXPANSION) BOARD, P/N 31166-460-XX

8.1. GENERAL

This Section describes the Bus Expansion (BEX) board. See Figure A–9 for a board layout drawing.

8.2. INTRODUCTION

The BEX board serves two purposes; to replicate the P2 backplane I/O Bus, System Bus and I^2C Bus of each IVPI expansion chassis, and to provide a buffered continuation of the System Expansion Bus and I^2C Bus to a successive IVPI expansion chassis in the System.

8.3. OPERATION

The BEX board is used to enable a single VSP board to control both Vital and non-vital boards in up to three external iVPI expansion Chassis. This board allows vital I/O circuit boards to properly operate in the expansion module when connected to an iVPI main module.

Each expansion chassis can contain up to 20 boards in addition to the Bus Expansion board. The BEX board resides in slot 1 of each iVPI expansion chassis in place of the VSP board.

8.4. INDICATIONS

Status LED's on the front panel provide a visual indication of onboard and I/O bus activity as well as the presence of chassis power.

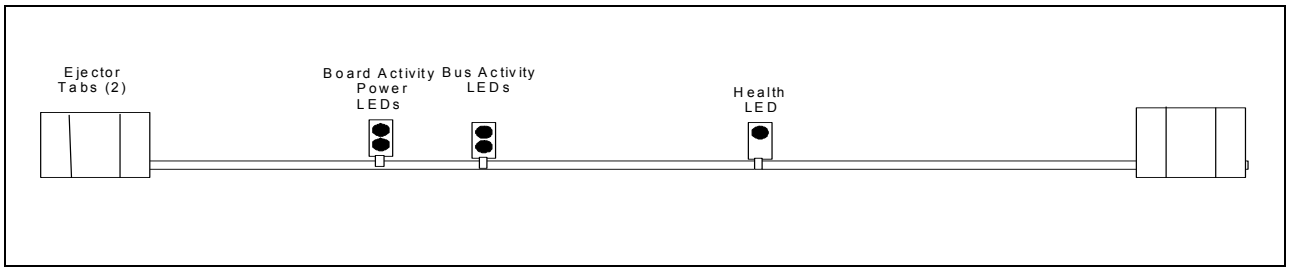

Figure 8–1. BEX Board Edge

8.5. CARD EDGE CONNECTORS

The BEX Board has three card edge connectors:

- P1, the upper connector, is a 96-pin connector; this connector is not used.
- P2, the middle connector, is a 160-pin connector used to interface with the VSP System Bus; it contains the backplane power, I/O Bus, System Bus and the I^2C signals that originate at the VSP.
- P3, the lower connector, is a 96-pin connector that receives the inputs from the VSP board in the main chassis.

NOTE

For the user defined inputs and outputs, refer to the .lvc output file generated by the system software CAAPE program.

8.6. USER SETTINGS

There are no user/field settings on this board.

8.7. SPECIFICATIONS

Table 8–1. BEX Board Specifications

Specification	31166-434-01
Maximum Number of Boards Per iVPI System	3
Board Slots Required	1
Number of Subracks Per Board	3
Maximum Board Logic Current with a 12 VDC Power Supply	0.5A

9. SECTION 9 – SYSTEM ID BOARD, P/N 31166-472-XX AND VITAL INTERFACE BOARDS, P/N 31166-473-XX AND 31166-485-XX

9.1. GENERAL

This Section provides the System ID and Vital Interface board detail.

9.2. INTRODUCTION

An iVPI may be configured to use various types of optional Interface boards to provide additional connectivity to the VSP board:

- VSP P2 System ID Board P/N 31166-472-01
- VSP and BEX P1 Expansion Interface Board P/N 31166-485-01
- VSP P3 Interface Board P/N 31166-473-01

9.3. VSP P2 SYSTEM ID BOARD OPERATION

The VSP P2 System ID board (P/N 31166-472-01) is located at P2 on the VSP board.

This board assembly provides a means to set the System ID (revision and site ID) for the VSP board assembly in an iVPI subrack. Four thumbwheel switches are rotated into position to match the revision and site ID produced by the application tool, CAAPE, when the application is compiled. Each thumbwheel switch has 16 positions that are marked 0 – 9 and A – F. The iVPI Main Subrack System ID Configuration Procedure located in Section 2 of P2521B, Volume 1 describes how to configure the System ID Interface board.

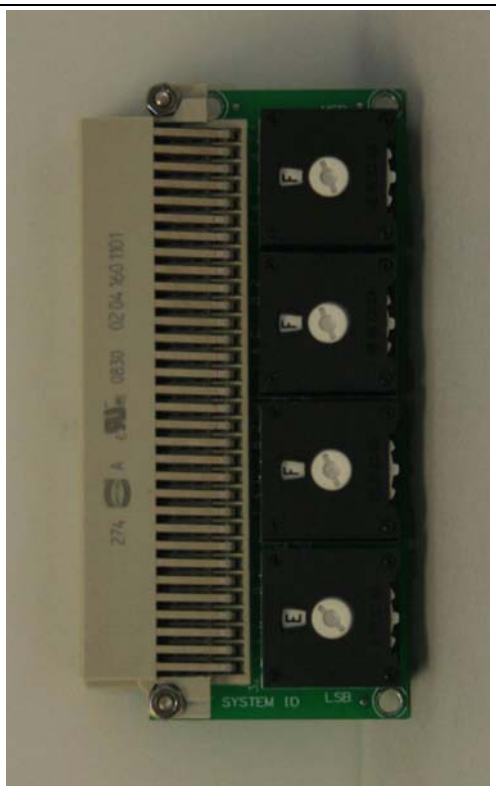

Figure 9–1. VSP P2 System ID Interface Board

9.4. VSP AND BEX P1 MOTHERBOARD EXPANSION BUS INTERFACE BOARD OPERATION

The VSP and BEX P1 Motherboard Expansion Bus Interface board (P/N 31166-485-01) is located at P1 on the VSP board or BEX board. It provides a method to connect one, two, or three expansion chassis to the main chassis.

9.5. VSP P3 INTERFACE BOARD OPERATION

The VSP P3 Interface board (P/N 31166-473-01) is located at P3 on the VSP board to provide additional connectivity to the VSP board:

- Two RJ45 modular jacks connect to the VSP board's Ethernet Ports
- One RJ45 modular jack connect to the VSP board's MAC Port
- One RJ12 modular jack connects to the VSP board's Health Monitor Interface
- Four cage clamp type terminals (that accept wire sizes from #14 AWG to #20 AWG) to support loose wire connections for the VSP board's VRD relay interface:
  - Two terminals are used for battery power ("B12" and "N12")
  - Two terminals are used for VRD coil connections ("COIL+" and "COIL-")

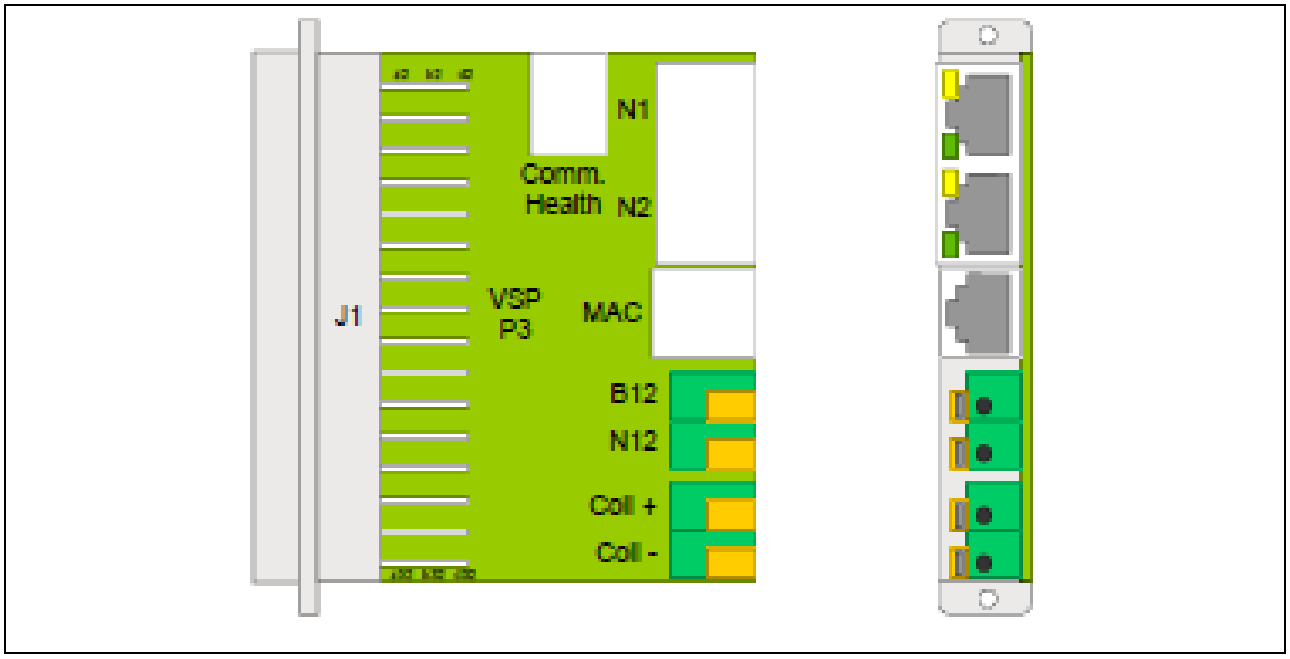

Figure 9–2. VSP P3 Interface Board

A. APPENDIX A – VITAL BOARD LAYOUT DRAWINGS

A.1. GENERAL

This appendix contains layout drawings of the boards discussed in this manual.

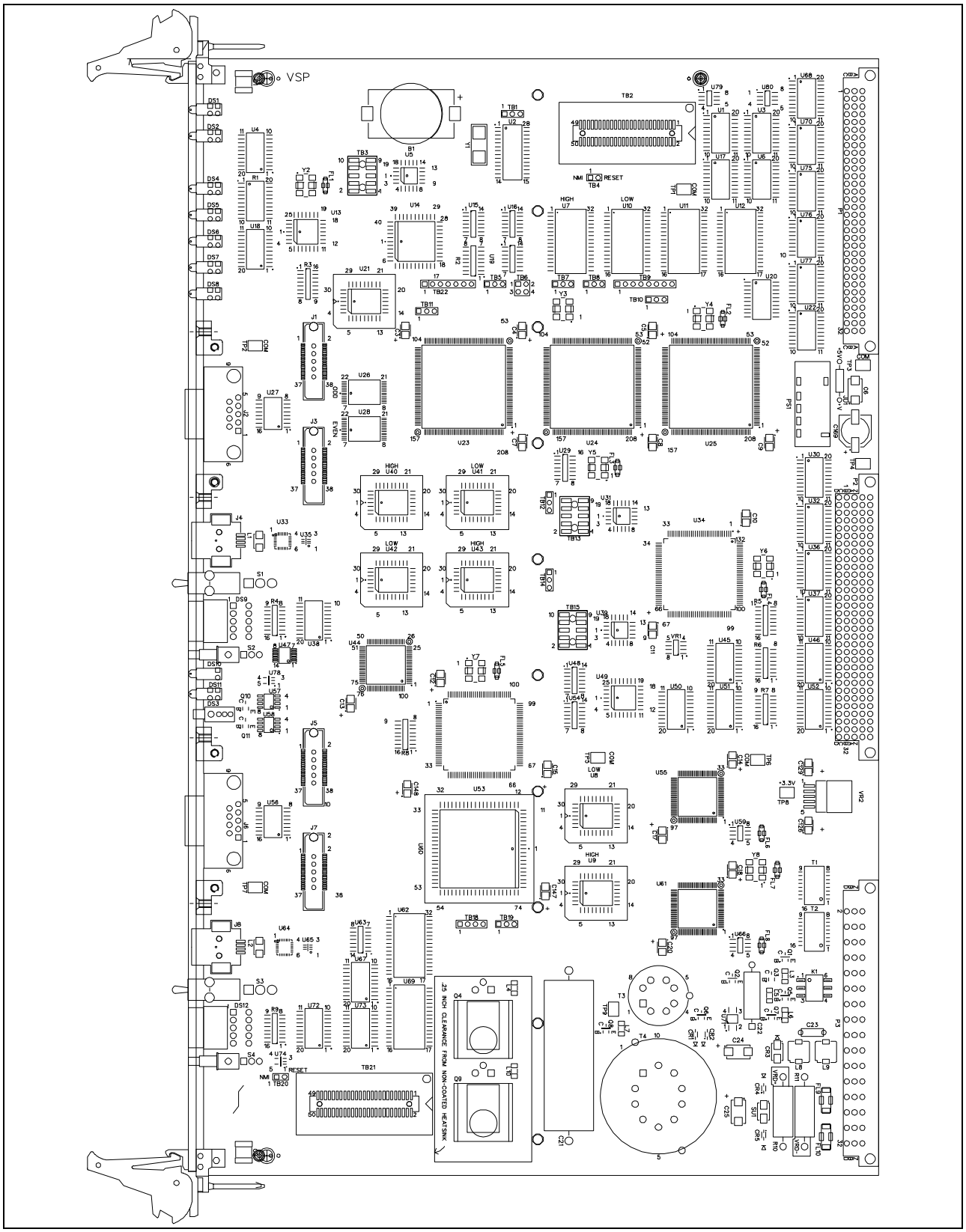

Figure A–1. VSP Board, P/N 31166-428-01

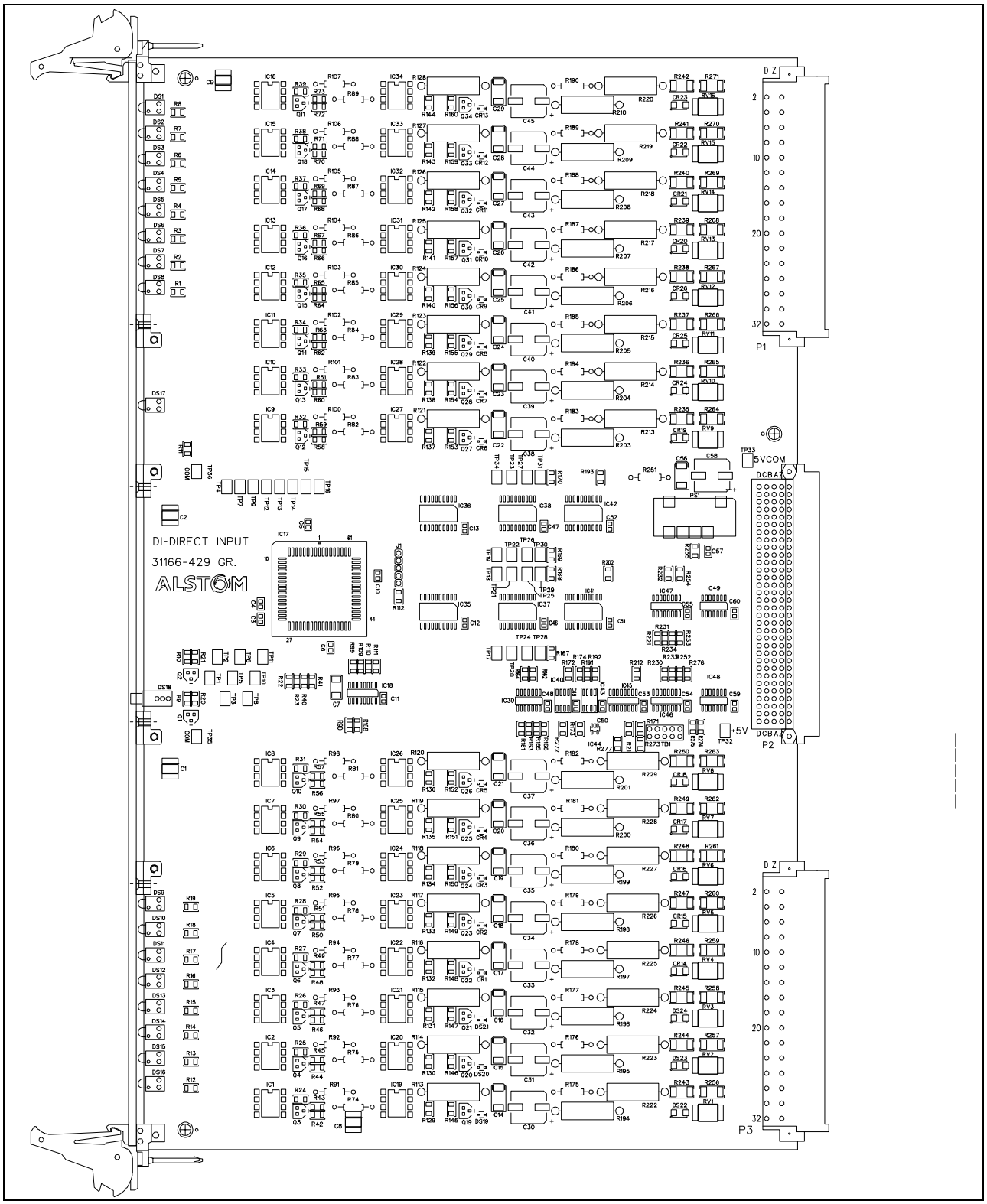

Figure A–2. DI Board, P/N 31166-429-01

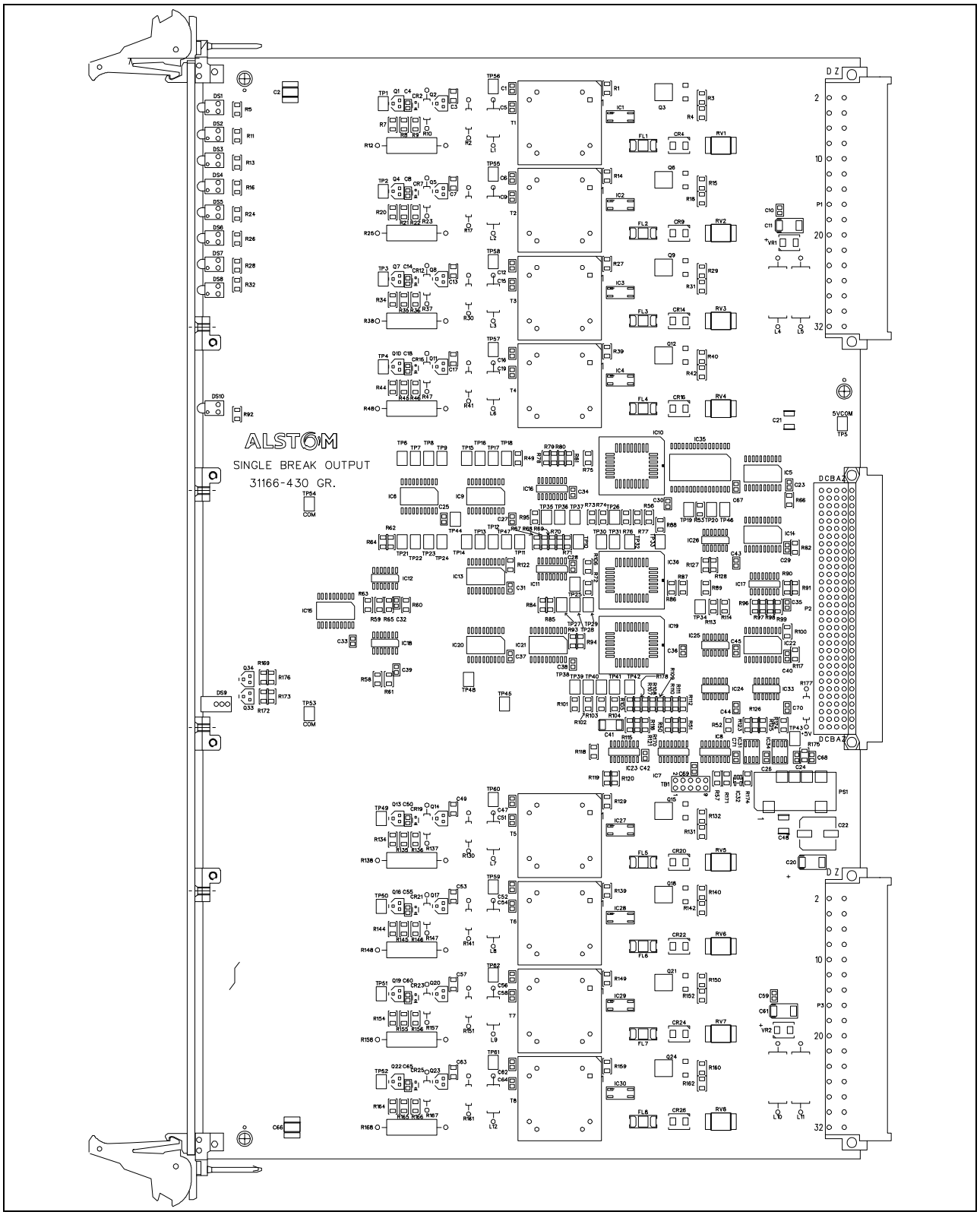

Figure A–3. SBO Board, P/N 31166-430-01

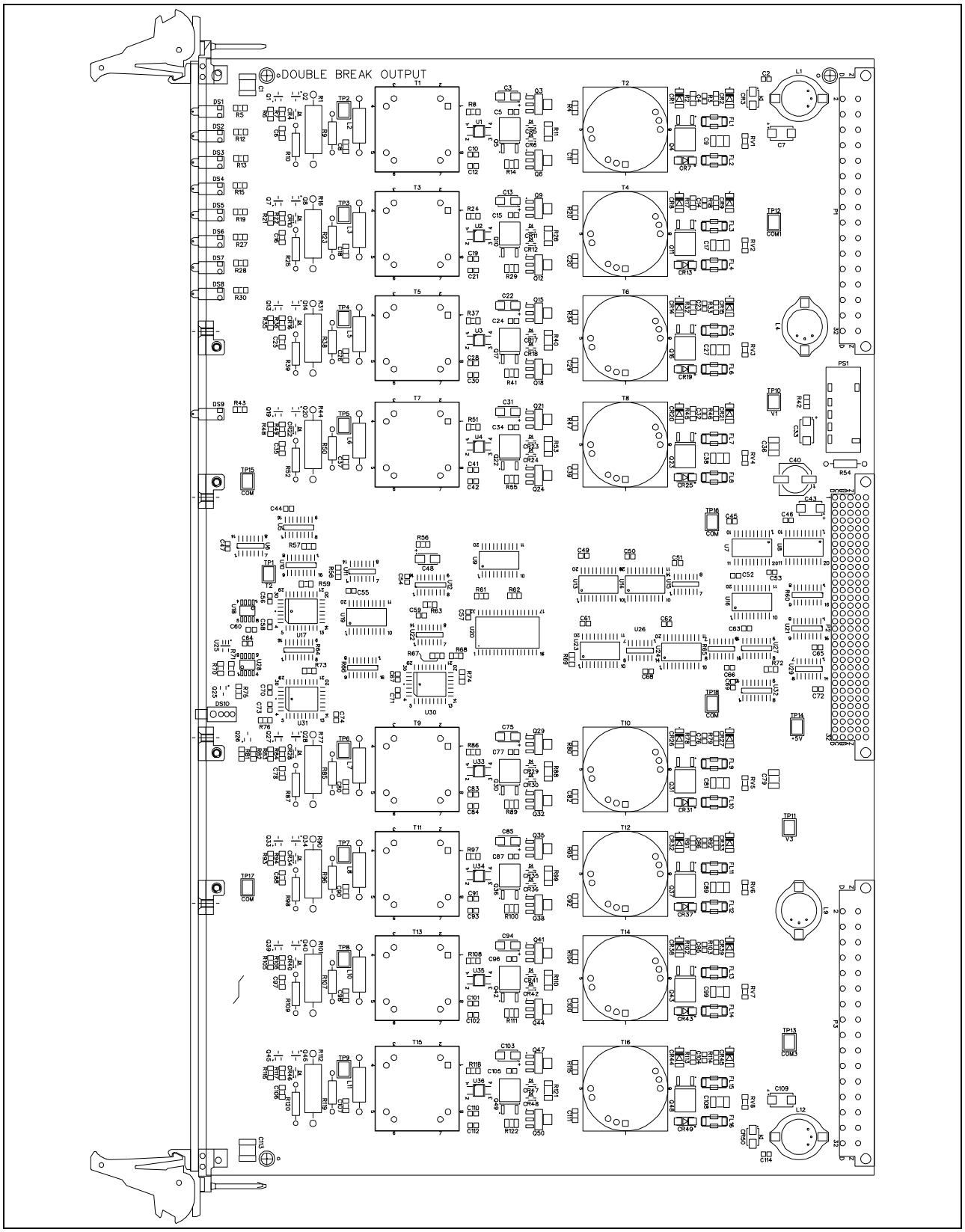

Figure A–4. DBO Board, P/N 31166-433-01

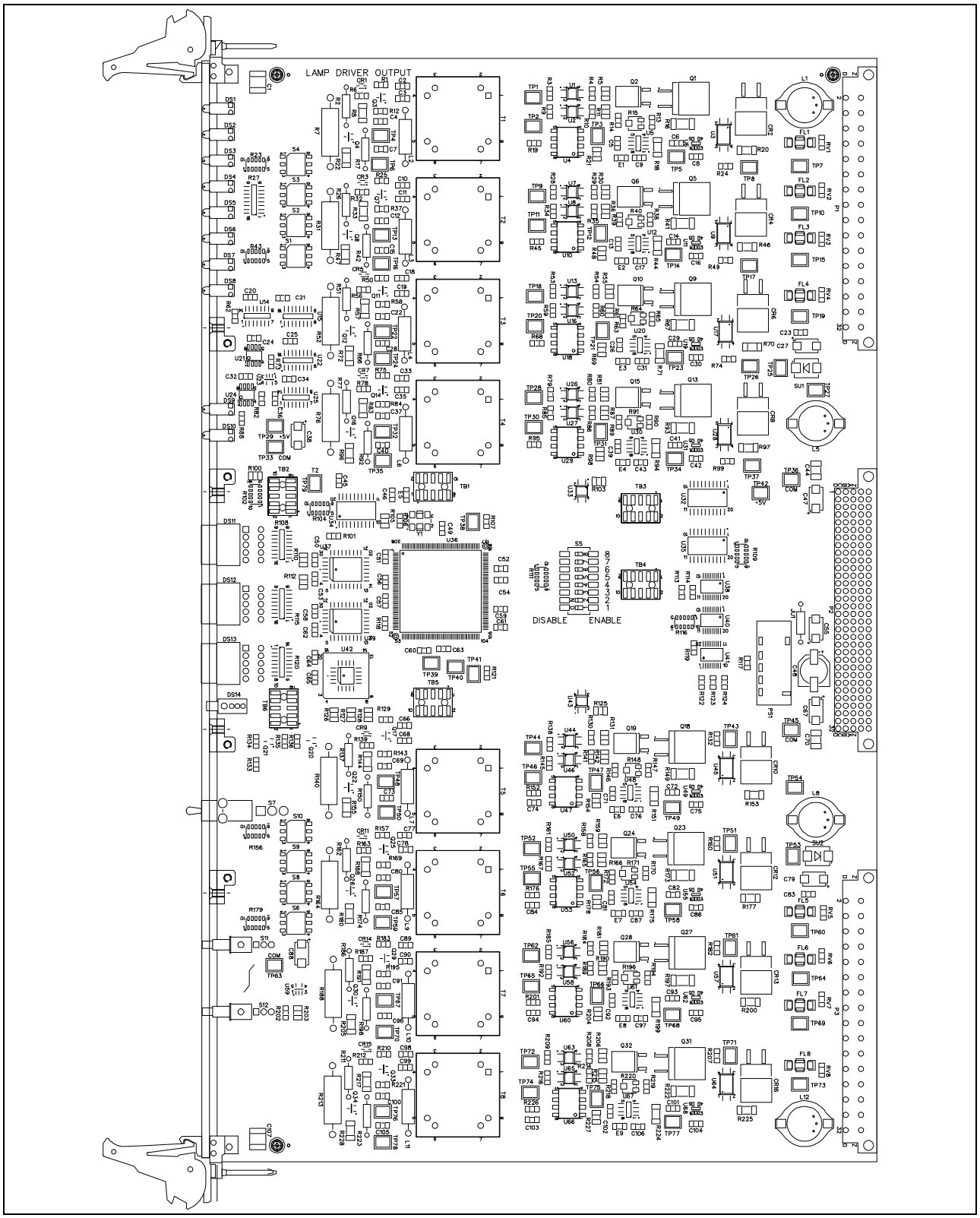

Figure A–5. LDO Board, P/N 31166-431-01

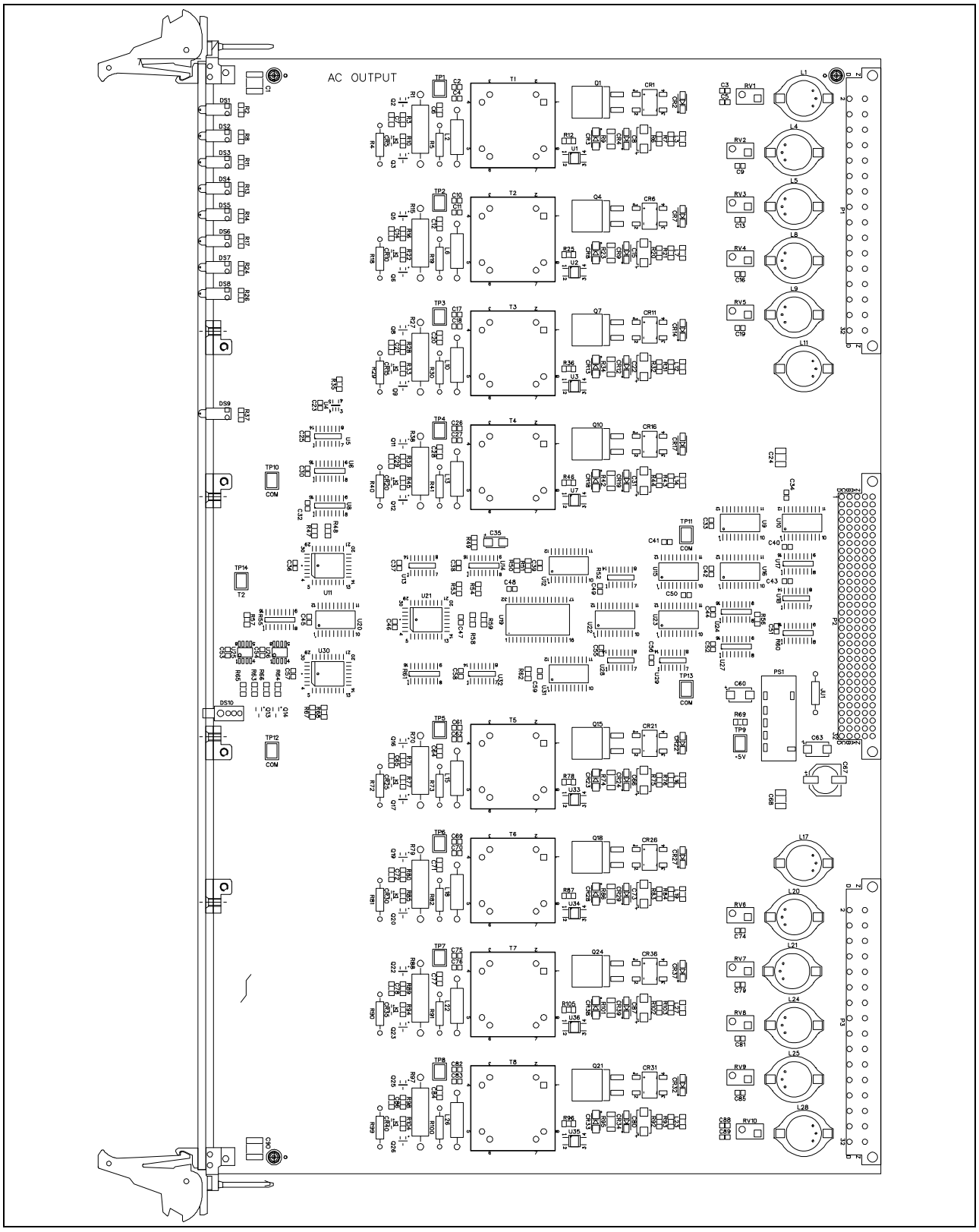

Figure A–6. ACO Board, P/N 31166-432-01 and -02

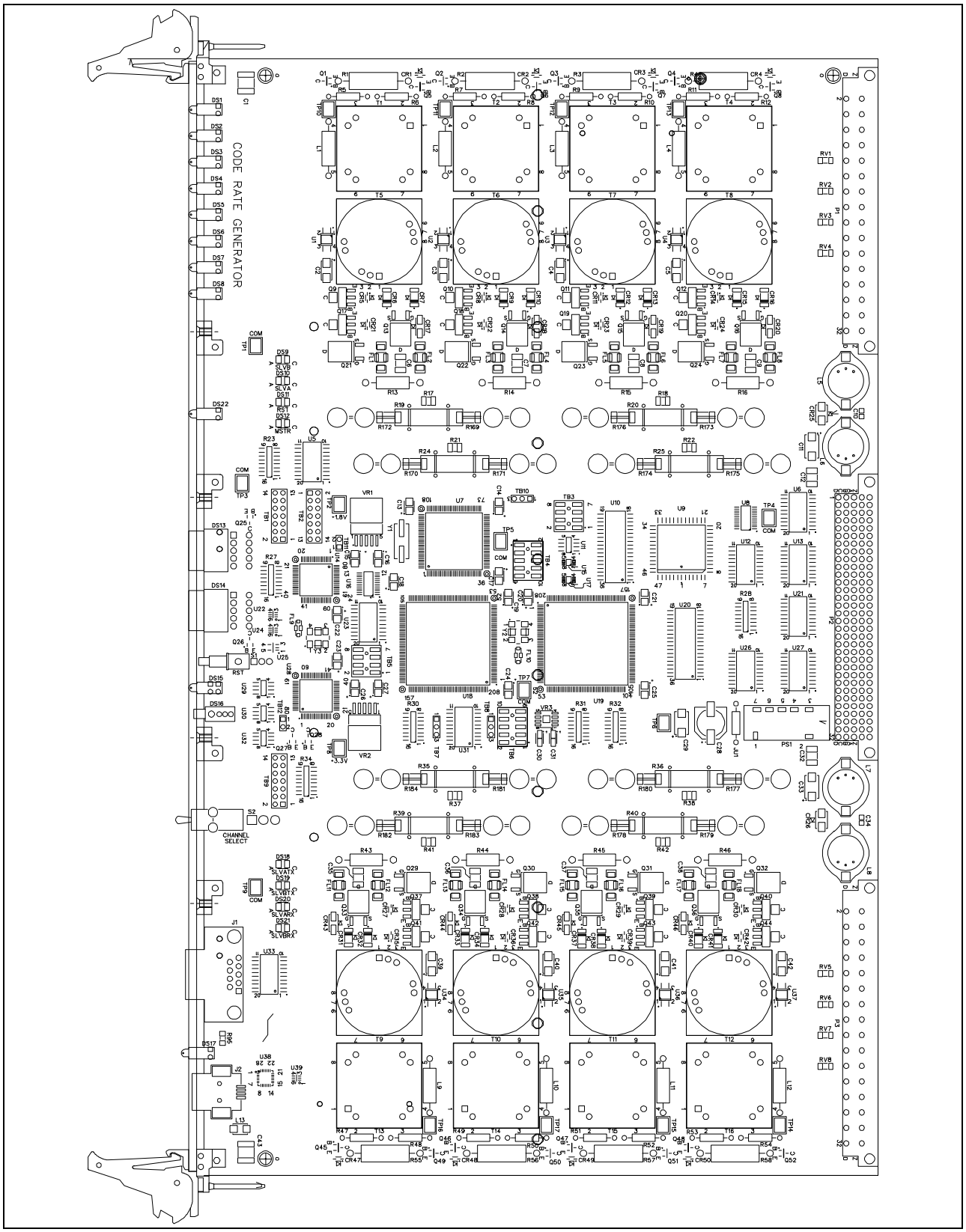

Figure A–7. CRG Board, P/N 31166-459-01

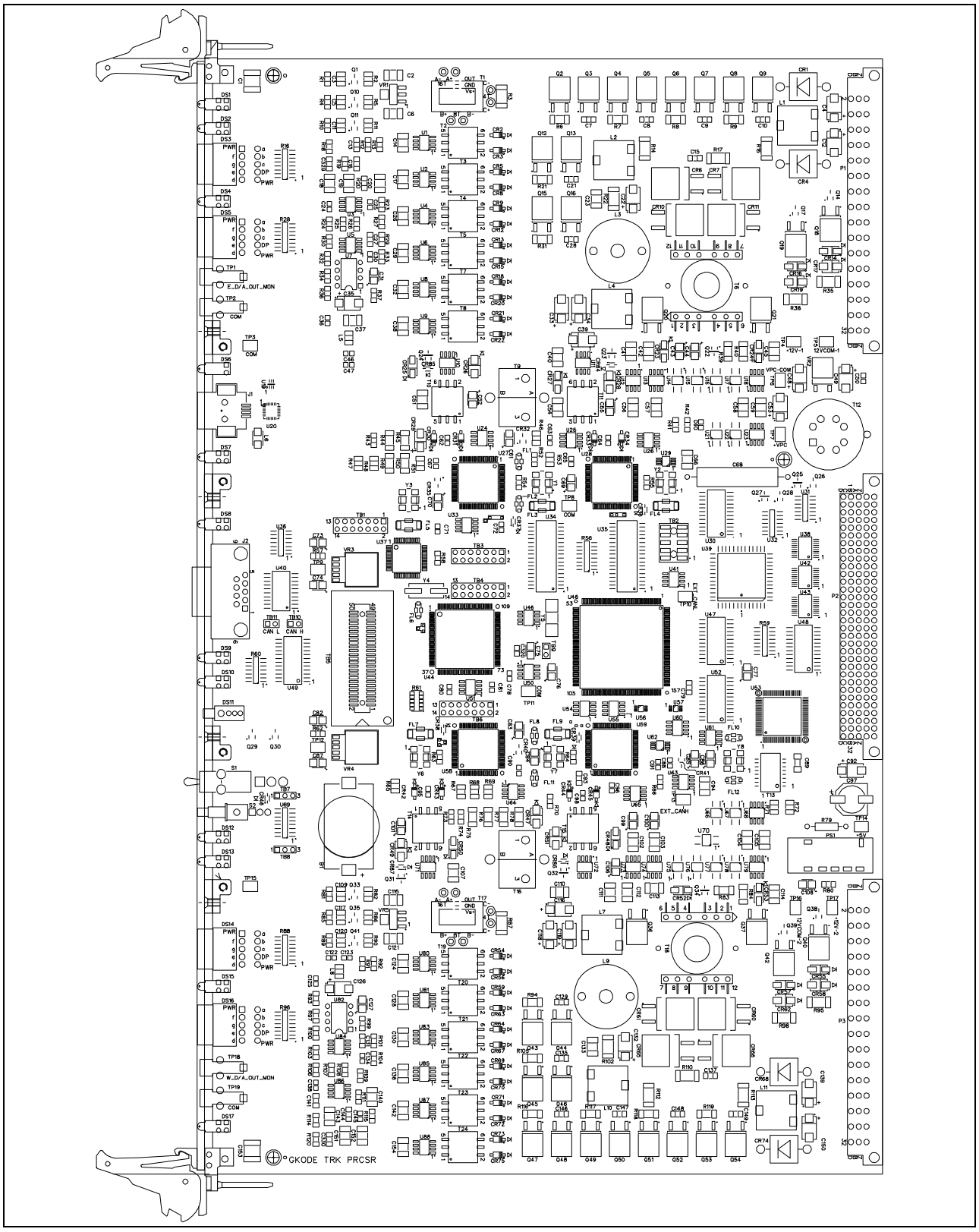

Figure A–8. GTP Board, P/N 31166-434-01

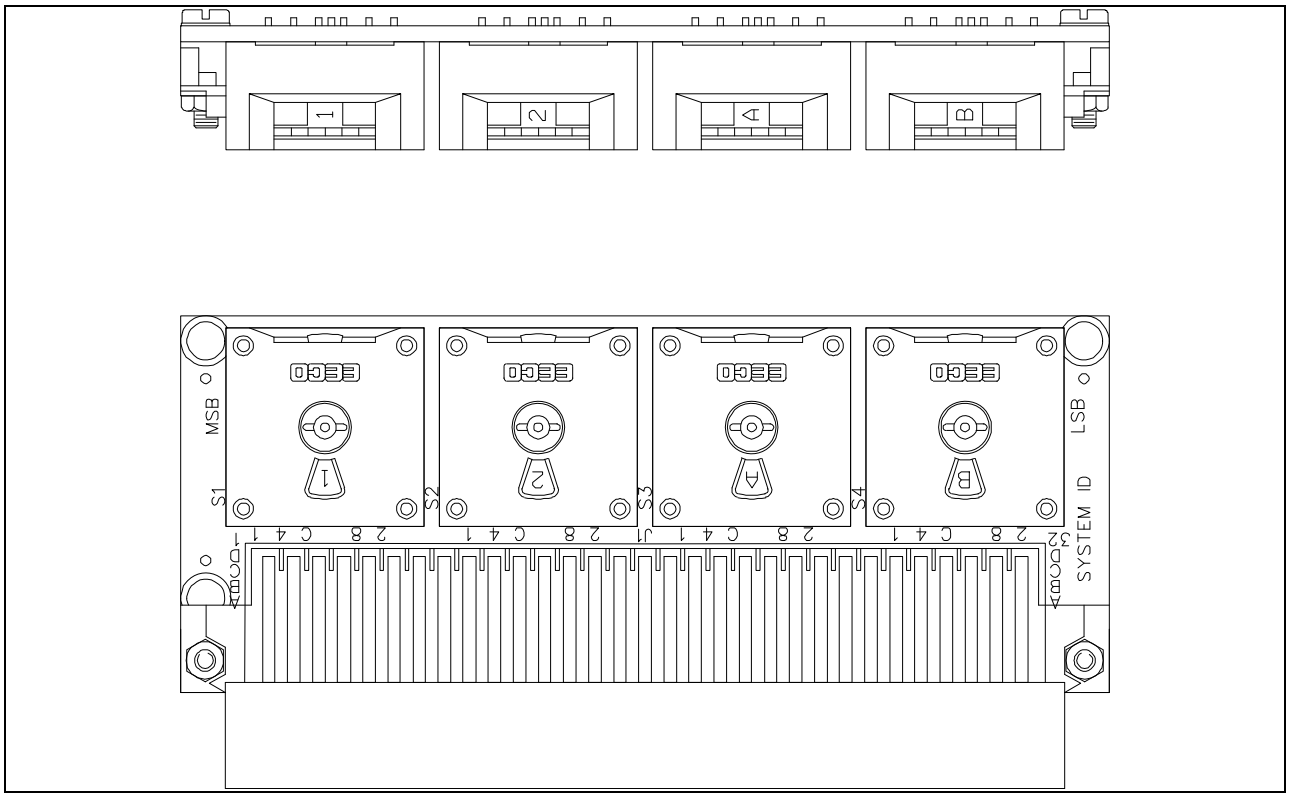

Figure A–9. VSP P2 System ID Board, P/N 31166-472-01

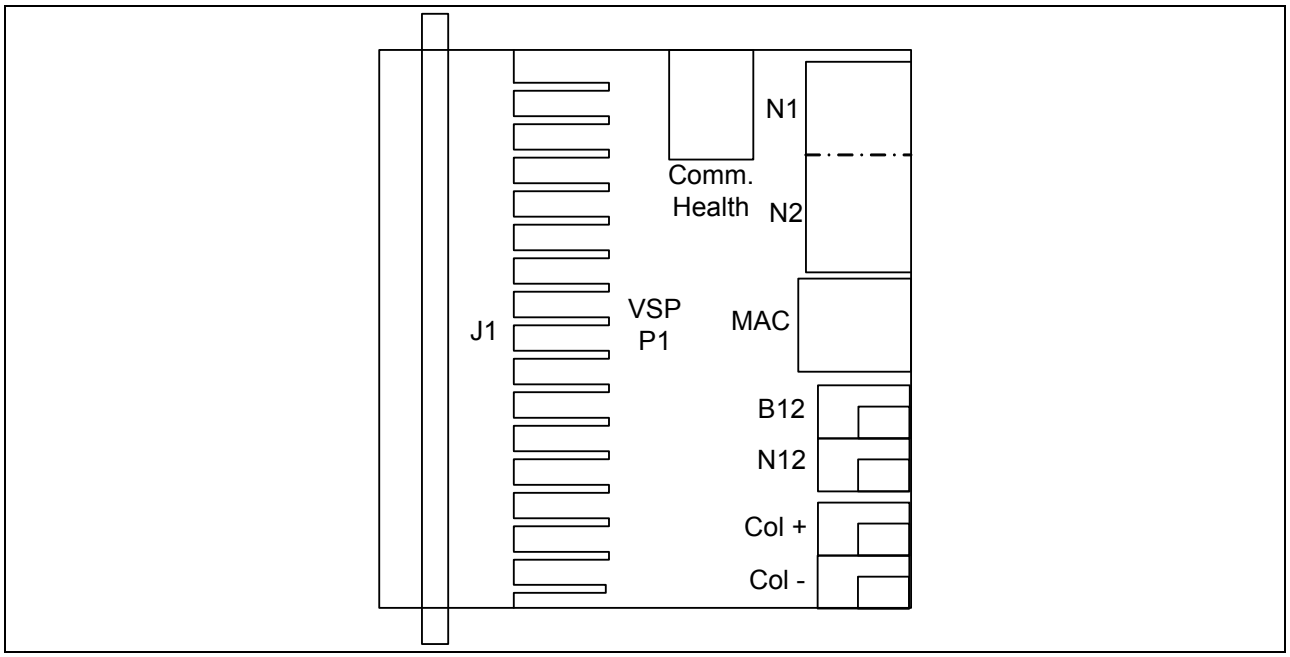

Figure A–10. VSP P3 Interface Board, P/N 31166-473-01

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