ORION
Model 30/50/70
Motion Controller

Installation & Operation Manual
ORN-001j

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Trademark Notices

Warranty

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Terms and Conditions

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UL Recognized Component

ORION motion controllers (ORN-30/___, ORN-50/___ & ORN-70/___) are recognized under the Component Program of Underwriters Laboratories Inc., and are distinguished by the UL trademark symbols shown below.

CE Mark

ORION motion controllers (ORN-30/___, ORN-50/___ & ORN-70/___) carry the CE Mark, as shown below.

Agency Approvals

The ORION motion controller has been tested, and is in compliance with, safety standards in the United States, Canada and the European Union.

Country	**Standard**	**Marking**
United States	UL 508C	UR (Recognized component)
Canada	CSA22.2	C-UR
European Union	EMC Directive Low Voltage Directive	CE CE

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Chapter 1
Welcome

1 Welcome

This manual tells you about ORMEC's ORION Motion Controllers and accessories---providing a detailed description of the ORION hardware and information for installing, operating and "getting started" with your new ORION Motion Control system.

The manual is divided into the following chapters:

Chapter 1	**Welcome** introduces you to this manual and its organization.
Chapter 2	**General Description** provides an overview of the ORION product family. It includes descriptions of the ORION Model 30, 50 & 70 Motion Controllers, the ServoWire and DSP Axis Modules, and compatible servomotors and servodrives.
Chapter 3	**ORION Controller** provides instructions for installing the ORION and detailed descriptions of all the hardware interfaces. It explains the power up and initial configuration operation as well as the LED status indicators. This chapter also provides detailed environmental, mechanical, and electrical interface specifications for the ORION Controller.
Chapter 4	**ServoWire Axis Module** provides instructions for installing the ServoWire Axis Module and detailed descriptions of all the hardware interfaces, as well as an explanation of the LED status indicators. This chapter also provides detailed specifications for the electrical interface specifications for the ServoWire Axis Module.
Chapter 5	**DSP Axis Module** provides instructions for installing the DSP Axis Module and detailed descriptions of all the hardware interfaces, as well as an explanation of the LED status indicators. This chapter also provides detailed specifications for the electrical interface specifications for the ServoWire Axis Module.
Chapter 6	Getting Started provides detailed instructions on how to run your ORION unit for the first time.

Chapter 7	**Product History** provides a chronological revision history for the ORION Motion Controllers, DSP Axis Modules and ServoWire Axis Modules.
Chapter 8	**Maintenance & Troubleshooting** provides tips for maintaining and troubleshooting your ORION system.
Chapter 9	**Terms & Mnemonics** provides definitions for terms specific to Motion Control and/or ORMEC's Motion Control products.
Appendixes	**Appendixes** contain detailed drawings which document the ORION dimensions, system interface, *DSP Axis Module* interface, *ServoWire Axis Module* interface as well as associated interface cables and accessories. See the Table of Contents for details.

This manual concentrates on providing ORION Motion Controller hardware and cabling documentation. Detailed information on ORMEC's MotionBASIC programming language is found in the on-line **MotionBASIC Hypertext Software Manual** (for MB 3.x) or the **MotionBASIC Help** (for MB 4.x and higher). To obtain the latest version of the MotionBASIC Hypertext Software Manual and/or the MotionBASIC Help visit ORMEC's site on the World Wide Web at *http://www.ormec.com*, or call the ORMEC Service Department at (585) 385-3520.

The functionality of certain portions of the ORION hardware is dependent on the version of MotionBASIC used. In these cases, an MB 3.x, MB 4.x, MB 4.x and higher, or MB 5.x note will indicate to which version of MotionBASIC the described functionality of the ORION hardware applies.

Chapter 2
General Description

2 General Description

The ORMEC ORION Motion Controllers are industrially hardened IBM compatible PCs designed specifically for high performance control of automation using servomotors. They are fully compatible with ORMEC's lines of brushless servomotors, servodrives, and operator interface devices.

At the heart of the ORION is an 80x86 main processor. It is interfaced though dual-port RAM "shared memory" to *ServoWire or DSP Axis Modules* which are controlled by Texas Instruments Digital Signal Processors operating at 80 MHz and 50 MHz respectively. This powerful architecture provides the foundation for general purpose motion control programmed in ORMEC's industrialized superset of Microsoft GW-BASIC called MotionBASIC. The combination of a main processor from the proven 80x86 family of microprocessors and Digital Signal Processors for axis control provides speed and performance while maintaining the ease-of-use associated with interpreted BASIC.

- The Model 30 provides three PC-AT I/O slots and is designed for systems which have up to 24 or 6 axes of motion control, using *ServoWire or DSP Axis Modules* respectively.
- The Model 50 provides five PC-AT I/O slots and is designed for systems which have up to 32 or 10 axes of motion control, using *ServoWire or DSP Axis Modules* respectively.
- The Model 70 provides seven PC-AT I/O slots and is designed for systems which have up to 32 or 14 axes of motion control, using *ServoWire or DSP Axis Modules* respectively.

For systems consisting of fewer than the maximum number of axes, the additional slots can be used for various communications options such as a PLC network interface or an additional serial interface.

ORION Motion Controllers provide electronic gearing for a virtually unlimited number of servomotors using ORMEC's proprietary MotionDATA communications network. This feature can be used to either closely

coordinate the motion of multiple servomotors with each other, or coordinate some number of servomotors with the motion of an external pacer encoder.

2.1 Model 30/50/70 Features

- 80x86, 32-bit CMOS high integration microprocessor operating at clock frequencies up to 1.6 GHz
- Powerful MotionBASIC programming with on-line Hypertext Software Manual (for MB 3.x) or Windows[1] Help (for MB 4.x and higher)
- Powerful and easy to use ORMEC Motion Programming environment including:
  MotionDesk, a suite of MotionBASIC 4.x and higher development tools for use on an IBM PC or compatible operating Windows 95/98 and Windows NT (4.0 and higher).
  MotionPRO, a MotionBASIC 3.x development tool for use on an IBM PC or compatible operating Windows version 3.1 or later
- 16-bit IBM PC-AT backplane for *ServoWire and DSP Axis Modules* and expansion boards; Model 30, 50, and 70 have 3, 5 and 7 slots respectively
- RS-232 Development Serial Port for program development and troubleshooting
- Two RS-422/485 serial communications ports for programmable serial communications, PLC network communications, or operator interface communications (QuickPanel[2] or MMI-840)
- Integral Watchdog and Emergency Stop circuitry
- 27 built-in diagnostic LEDs and a single character alphanumeric display for system status indication
- Two PC Card[3] (PCMCIA) standard card slots
- 16 integral discrete I/O points (configured for Opto-22 Generation 4 I/O modules) for machine control
- Optional 24 TTL level I/O points which are compatible with Opto-22 I/O racks or the Opto-22 Pamux[4] system
- IBM PC-AT compatible keyboard interface
- Optional single or dual-channel RS-422 Serial Interface boards

[1]Windows® is a registered trademark of the Microsoft® corporation.

[2]QuickPanel is a trademark of Total Control, Inc.

[3]PC Card™ is a trademark of the Personal Computer Memory Card International Association (PCMCIA)

[4]Pamux™ is a trademark of Opto-22, Inc.

- Support for 4 hardware interlocked Machine Stop/No Fault pairs configured using DIO inputs and outputs
- Future support for an optional CAN based serial communications network

2.1.1 MotionBASIC

ORMEC's ORION motion controllers are programmed using the world's most widely used programming language, BASIC... now enhanced with concurrent programming features (MB 4.x and higher) for high performance motion control.

MotionBASIC is an industrial strength programming language with all the simplicity and power of BASIC, yet designed and built from the ground up for motion control. It incorporates BASIC's strengths... the simplicity of using an interpreter, its powerful string handling, the richness of the language, plus English like keywords and syntax... into a multi-faceted software solution for industrial servo control.

MotionBASIC was designed to be highly compatible with Microsoft GW-BASIC, but it incorporates a number of enhancements for industrial control:

- Powerful, English-like motion statements for multi-axis servo control;
- More than 100 pre-defined ORMEC variables for motion & I/O control;
- MotionBASIC includes program labels and block control structures for structured programming, allowing you to create programs that are more easily written and maintained, and also run faster;
- MotionBASIC is an interpreted programming language. Motion control, I/O, timing functions, event processing and error processing are fully serviced.
- The set data-type and a number of set operators have been added to allow powerful and easy-to-use multi-axis motion programming;
- The user program can automatically execute on powerup in addition to operating in debug mode.
- User program variables (except string variables) can be declared non-volatile and maintained through power-down in non-volatile memory. Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) Non-Volatile Variables chapter for further information.
- MotionBASIC functionality can be extended with special device drivers or with additional statements and functions via field upgradable MotionBASIC Extensions. The latest versions of the MotionBASIC Extensions are available for download from the ORMEC site on the World Wide Web at *http://www.ormec.com*.

2.1.2 ORION Model Number Description

ORN-##/$O_1O_2O_3O_4O_5$

Model

= 30 (3 slots)
= 50 (5 slots)
= 70 (7 slots)

Standard Controller Example: ORN-30/CFDS - ORION Model 30 with 133 MHz 80586 microprocessor, internal 24 VDC Field Power supply, *DIO Board* with pluggable connectors without EIO support, and without CAN interface hardware.

Options:

Processor (must be specified)

O_1 = A (80486, 66 MHz)
= B (80486, 100 MHz)
= C (80586, 133 MHz)
= D (Pentium, 133 MHz) - *for Model 30 only*[5]
= E (Pentium MMX, 233 MHz) - *for Model 30 only*[5]
= F (Atom, 1.6 GHz) - **replaces all other obsolete processor options (A-E)**

Field Wiring Power Supply (must be specified)

O_2 = F (24 VDC, 40 W)
= X (none, external customer supplied power supply)

DIO Board (must be specified)

O_3 = D (*DIO Board* w/ pluggable connectors, without EIO support)
= E (*DIO Board* w/ pluggable connectors, with EIO support)
= U (*DIO Board* w/ fixed connectors, without EIO support)
= T (*DIO Board* w/ fixed connectors, with EIO support)

Other Options (only desired options must be specified)

O_4 = H (integral cooling fan, refer to the Mechanical and Environmental Specifications section, page 73, for operating temperature information). **NOTE: This is a requirement (not an option) when processor option O_1 = F is selected.**

O_5 = S (delete CAN interface hardware)

2.2 Modular Construction

- Compact panel mountable steel enclosure
  Model 30 - 16.3" h x 9.3" w x 7.6"d
  Model 50 - 16.3"h x 10.9"w x 7.6"d
  Model 70 - 16.3"h x 12.5"w x 7.6"d

[5]ORION's with the Pentium option require MotionBASIC 4.1.0 (or later), ORION System Module verion K (or later), and ORION DSP Axis Module, ORN-DSP-A_, version 1.0i (or later).

- Industrially hardened switching power supplies for controller logic power use either 115 or 230 VAC (+10%, -15%) power (auto-selecting) 50/60 Hz and include built-in logic power switch/circuit breaker as well as a line filter for noise immunity.
- Optional 24 VDC Field Power supply (separate from the ORION logic power supply), referenced to the ORION frame ground, for optically coupled discrete I/O

2.3 Axis Modules

There are two types of Axis Modules:

ServoWire Axis Modules are part of an all-digital control network using open-standard IEEE-1394 (FireWire™[6]). Each *ServoWire Axis Module* can be connected to up to 8 **ServoWire Drives**, for control of up to 8 axes of motors and/or pacer encoders. Both the *ServoWire Axis Modules* and *ServoWire Drives* are DSP-based.

DSP Axis Modules come in two varieties, a dual axis unit and a single axis unit with an auxiliary pacer encoder interface. These DSP-based modules provide an analog output voltage to interface with torque-mode or velocity-mode drives.

The two types of Axis Modules require different versions of MotionBASIC:

MotionBASIC 5.x supports only **ServoWire Axis Modules**, and **MotionBASIC 3.x & 4.x** support only **DSP Axis Modules**.

For this reason, the two types of Axis Modules cannot be used together in a single ORION controller.

2.3.1 ServoWire Axis Modules

ServoWire Axis Modules are used with *ServoWire Drives* to provide a totally digital control system, which considerably reduces total installed system cost by reducing system wiring and setup.

The wiring between the *ServoWire Axis Module* and the *ServoWire Drives* consists of a single thin cable, connected in a daisy-chain manner from drive to drive, forming a "tree" topology. All *ServoWire Drive* configuration parameters are stored in the *ORION Motion Controller* and transferred as needed to the Drives via ServoWire.

ServoWire Axis Module features include:

- Texas Instruments TMS-320C50 DSP operating at 80 MHz
- Dual-port RAM between the DSP and the main processor for maximum speed and flexibility

[6] FireWire is a trademark of Apple Computer

- Three ServoWire ports per Axis Module for connection to ORMEC's *ServoWire Drives*
- 1-8 axes per Axis Module, including motors being controlled as well as pacer encoders and virtual axes used as motion references
- Direct digital loop control with servo update rates up to 5 KHz (up to 4KHz for 4 axes, up to 2 KHz for 8 axes) provide wide loop bandwidth for high positioning accuracy and response
- Total elimination of hardware adjustments (no jumpers, switches, or potentiometers)
- All setup parameters are determined by the application program—no extra terminals or special off-line setup procedure required
- Position, velocity, and torque mode control
- Total elimination of analog drift errors and extremely quiet loop operation using direct digital processing of both position and velocity loops with 32 bit intermediate calculation accuracy
- Axis Module, ServoWire and MotionDATA status LEDs, as well as 8 bi-color axis status LEDs
- Software controlled limits on position error, speed, and drive output current
- Velocity and acceleration feedforward for minimum tracking errors and response times
- Proprietary MotionDATA communications between Axis Modules allows tightly coordinated multi-axis motion (no external MotionDATA connection is required between axes on a single ServoWire Axis Module)
- 4 or 8 optional 12-bit, +/- 10 V analog inputs available per ServoWire Axis Module for field wiring.
- Front loading module with integral connector support for all ServoWire and MotionDATA connections, and terminal blocks for all analog input wiring

In order to simplify wiring and reduce overall system cost, many of the traditional features and functions of the *DSP Axis Module* are now part of the **ServoWire Drives**. The highlights of these features include:

- Quadrature feedback 4X decoding, with position rates to 4M bits per second after decode
- Open feedback wire detect provided on all differential quadrature feedback inputs
- Servodrive alarm indication
- Three high speed single-ended 24 VDC sensor inputs plus one encoder reference input per drive for position capture and coordination of axis motion

- Three optically isolated programmable electronic limit switch outputs per axis which indicate axis position
- One optional axis position delay counter per axis
- One optically isolated encoder reference signal output and optional delay counter output per Drive
- Integral terminal blocks and connector support for all interface signals (no external terminal strips required)
- Forward and reverse hardware overtravel limit inputs

2.3.1.1 ServoWire Axis Module Model Number Description

ORN-SW-AM/O_1

Options :

Analog Inputs (must be specified)[7]

O_1 = 0, 4 or 8 (indicates the number of analog inputs supplied)

Examples: ORN-SW-AM/0 has no analog inputs, an ORN-SW-AM/8 has 8 analog inputs.

2.3.2 DSP Axis Modules

These axis modules use a Texas Instruments Digital Signal Processor (DSP) operating at 50 MHz to provide axis control algorithms. *DSP Axis Module* features include:

- Axis control algorithms provided by Texas Instruments TMS-320C52 DSP operating at 50 MHz
- Dual-port RAM between the DSP and the main processor for maximum speed and flexibility.
- Direct digital loop control with up to 8 KHz servo update rates (with MB 4.x and higher) provide wide loop bandwidth for high positioning accuracy and response
- Quadrature feedback 4X decoding, with position rates to 4M bits per second after decode (MotionBASIC 4)
- Position, velocity, and torque mode control
- Total elimination of analog drift errors and extremely quiet loop operation using direct digital processing of both position and velocity loops with 32 bit intermediate calculation accuracy

[7] The total number of analog inputs that can be used is limited to the total number of axes configured on the *ServoWire Axis Module*.

- Software controlled limits on position error, speed, and drive output current
- Velocity and acceleration feedforward for minimum tracking errors and response times
- Fully compatible with ORMEC torque mode servodrives through individual Axis Interface Connectors
- Proprietary MotionDATA communications from DSP to DSP allows tightly coordinated multi-axis motion
- Servodrive remote enable and alarm reset functions are provided by optically coupled outputs
- Open feedback wire detect provided on all differential quadrature feedback inputs
- Fail-safe servodrive alarm detection using optically isolated input
- Servodrive alarm decoding is provided by three optically isolated inputs
- Shared memory data interface to main processor
- Two high speed single-ended 24 VDC sensor inputs per DSP for position capture and coordination of axis motion
- One high speed input selectable as either the motor encoder reference or high speed single ended 24 VDC sensor input per axis
- Three optically isolated programmable electronic limit switch outputs per axis which indicate axis position
- One optional axis position delay counter per axis (MotionBASIC Extension required for use with MB 3.x)
- One optically isolated encoder reference signal output per axis, with future support for configuration as either an encoder reference signal or optional delay counter output
- One optional 12-bit, +/- 10 VDC analog input available per axis for field wiring
- Writable control store for DSP program storage is loaded from the main processor at powerup
- Front loading module with integral terminal blocks and connector support for all interface signals (no external terminal strips required)

2.3.2.1 DSP Axis Module Model Number Description

ORN-DSP-A2/$O_1O_2O_3O_4$ (dual axis)
ORN-DSP-AQ/$O_1O_2O_3O_4$ (single axis w/ pacer encoder interface)

Options (see note):

DSP I/O Terminal Block Connectors
O_1 = 0, 1, or 2 (indicates the number of connector plugs provided)

Analog Input included
O_2 = A (analog input A-D converter included)

Delay Counter included
O_3 = D (delay counter chip included)

Absolute Encoder Backup Battery Support Included[8]
O_4 = B (absolute encoder battery support included)

Example: ORN-DSP-A2/2ADB - *DSP Axis Module*, has 2 DSP I/O terminal block connectors, analog input support, delay counter hardware, and absolute encoder backup battery.

NOTE: After the DSP I/O Terminal Block Connectors option, only the desired options in the DSP Axis Module model number are specified

Contact your ORMEC Sales and Applications Engineer for upgrading the options on your existing DSP Axis Modules.

[8] Absolute encoder backup battery support includes the battery socket, controller chip, and battery. If this option is not ordered, an absolute encoder backup battery cannot be added on-site; the unit must be returned to ORMEC for upgrade (ORMEC p/n ORN-UPG/DSPB).

2.4 European Low Voltage Directive Compliance

The equipment listed in **Table 1** has been tested to and met the requirements of the European Low Voltage Directive by meeting the EN61131-2 standard.

ORMEC Model Number	Description
ORN-30/ ORN-50/ ORN-70/	ORION Model 30 motion controller ORION Model 50 motion controller ORION Model 70 motion controller
ORN-DSP-AQ/ ORN-DSP-A2/	Single Axis DSP Axis Module with pacer encoder interface Dual Axis DSP Axis Module
PCC-SYS/ PCC-SYS4/	MotionBASIC System Card w/ MotionBASIC 3.x MotionBASIC System Card w/ MotionBASIC 4.x
PCC-FLASH/ PCC-SRAM/	PC Card Flash RAM memory card PC Card SRAM memory card
G4-IDC-5 G4-IDC-5B G4-IAC-5 G4-IAC-5A G4-ODC-5 G4-OAC-5 G4-OAC-5A	DC Input Module, 12-32 VDC DC Input Module, Fast Response, 4-16 VDC AC Input Module, 90-140 VAC AC Input Module, 180-280 VAC DC Output Module, 60 VDC max. AC Output Module, 12-140 VAC AC Output Module, 24-280 VAC

***Table 1**, Equipment tested to EN61131-2 standard*

The equipment listed in **Table 2** are sold as components and meet the requirements of some European standards, but have not been tested to the EN61131-2 standard.

ORMEC Model Number	Description
G4-MIO-PB24	Machine I/O Module Mounting Rack, 24 position
G4-MIO-PB16H	Machine I/O Module Mounting Rack, 16 position
G4-MIO-PB8H	Machine I/O Module Mounting Rack, 8 position
MIO-PB4AH	Analog I/O Mounting Rack, 4 position
MIO-PB8AH	Analog I/O Mounting Rack, 8 position
MIO-PB16AH	Analog I/O Mounting Rack, 16 position
G4-ODC-5R	DC Output Module, relay contact
MIO-AD3	4 to 20 mA Current Input Module
MIO-AD6HS	0 to 5 VDC Analog Input Module
MIO-AD7	0 to 10 VDC Analog Input Module
MIO-AD11	-5 to +5 VDC Analog Input Module
MIO-AD12	-10 to +10 VDC Analog Input Module
MIO-DA3	4 to 20 mA Current Output Module
MIO-DA4	0 to 5 VDC Analog Output Module
MIO-DA5	0 to 10 VAC Analog Output Module
MIO-DA6	-5 to +5 VDC Analog Output Module
MIO-DA7	-10 to +10 Analog Output Module

***Table 2**, Equipment not tested to EN61131-2 standard*

Chapter 3
ORION Controller

3 ORION Controller

3.1 ORION Controller Installation

3.1.1 Safety Related Guidelines for Installation in the European Union

General
ORMEC product manuals are written to provide information required for the proper use of the equipment in the intended operation. They are written for technically qualified personnel such as engineers, programmers and maintenance specialists who have been trained in the application of automation control systems.

Proper Use
The equipment and/or system or components may only be used as described in the product manuals.

Guidelines
ORMEC motion control products generally form a part of a larger system or installation. These guidelines are intended to help integrate ORMEC products into the system.

- Since these products are component devices, overall automated system safety is beyond the scope of the product manuals and is the responsibility of the integrator.
- Compliance with EN292-1 and EN292-2 (Safety of Machinery) as well as EN60204 (Electrical Equipment of Industrial Machines) must be observed during the design phase.
- Only qualified personnel should be allowed access to the equipment.
- Opening the housing or protective covers may expose dangerous voltages.
- Emergency tripping devices in accordance with EN60204 must be effective in all operating modes of the automation equipment.

- Measures must be taken when interfacing the inputs and outputs of the automation equipment to prevent an undefined state from being assumed in the case of a wire break in the signal lines.
- The motion controller is a programmable device with the application program being written by the person integrating it into the machine. This program should only be written by a qualified person. Measures must be taken to verify that the program written does not cause dangerous and unwanted machine operation.
- These systems are of rugged design and intended for general purpose service. However, as with any equipment, the more stressing the service conditions the worse is the reliability and some benefit may be expected when real service conditions are better than the worst-case service conditions specified in the product manual and Standards. Some applications may require consideration of special packaging, cooling, electrical noise protection, etc. for reliable operation.

3.1.2 Receiving and Inspection

ORMEC ORION Motion Controllers and their associated accessories are put through rigorous tests at the factory before shipment. After unpacking, however, check for damage which may have been sustained in transit. Check the controller and any of the accessories for bent or broken components, loose bolts or screws, and any other physical damage before installing.

NOTE: Use the original ORION packaging material for shipping units.

Included with your ORION is an MS-DOS[9] package, which contains: a set of MS-DOS installation disks, Users Guide, license agreement, and registration card. Please open this package, read the license agreement, and fill out and return the registration card. MotionBASIC operates on the MS-DOS operating system, which is pre-installed on your MotionBASIC System Card (PCC-SYS/NNNN, PCC-SYS4/NNNN or PCC-SYS5/NNNN). Your ORION includes a license to operate MS-DOS on the ORION system only (the MS-DOS package is provided to you as part of this license agreement).

3.1.3 Panel Mounting and Environment

Panel Mounting data is available in the Mechanical and Environmental Specifications section of this chapter (page 73) and Appendix A. The controller's environment should be maintained as follows:

- Maximum operating temperature should be between 0 and 55C[10] (32°F to 131°F).
- The ORION should be mounted in a grounded metal enclosure. Additional wiring guidelines are included in the "Shielding and

[9]MS-DOS® is a registered trademark of Microsoft, Inc.

[10]Temperature range may be reduced depending on Orion processor option and fan combination. See table **Table 31** for more detail.

Grounding Electrical Panels" Application Note, which is included at the end of this manual.

- If the electrical panel is subject to vibration, mount the unit on shock absorbing material.
- Avoid use in corrosive atmospheres, which may cause damage over time.
- Select a location with minimum exposure to oil, water, hot air, high humidity, excessive dust or metallic particles.
- The proper mounting orientation for the controller is vertical on a panel using the mounting holes (4) provided on the base plate.

3.1.4 ORION System Components

An ORION Motion Controller system consists of the following components:

1) Controller Motherboard
2) ORION System Module
3) Discrete I/O (DIO) Board
4) MotionBASIC System Card containing MotionBASIC Programming Language and optional MotionBASIC® Extensions (MBXs)
5) MotionKey with MotionCredits (600 minimum for MotionBASIC 3.x and 4.x only)

Refer to Appendix A, C-1, and C-2 for diagrams indicating the location of the various ORION system components.

WARNING: DO NOT INSTALL OR REMOVE ANY ORION SYSTEM COMPONENTS WITH POWER APPLIED TO THE SYSTEM (except for the MotionBASIC System Card, which can be installed/removed with the ORION under power).

3.1.5 Terminal Block Wiring Guidelines

All ORION terminal block wiring should be UL Listed copper wire with an 80C temperature rating. The maximum recommended wire gauges are indicated in **Table 3**, which follows. Wiring for TB2 - TB10 should be twisted pair cable, shielded with drain wire connected to earth ground (NOTE: the SHIELD connections at various points on the ORION are connected to the frame ground).

Component	Terminal Block	Max Wire Gauge (AWG) [mm²]	Max Screw Torque (in-lb) [N-m]
ORION Chassis	TB1 (AC Power)	10 [2.9]	5 [0.8]
ORION System Module & DIO Board	TB2-8 (I/O & I/O Power)	12 [2.4]	5 [0.8]
DSP Axis Module	TB9-10 (DSP I/O)	16 [1.3]	3 [0.4]
ServoWire Axis Module	TB9-10 (Analog I/O)	16 [1.3]	3 [0.4]

***Table 3**, Terminal Block Wire Gauges and Max. Screw Torque*

NOTE: **Install all power wiring (including ground wiring) according to NEC (National Electric Code) or UL (Underwriters Laboratories) specifications and in compliance with local ordinances.**

Additional wiring guidelines are included in the "Shielding and Grounding Electrical Panels" Application Note, which is included at the end of this manual.

3.1.6 Input Power - TB1

ORION Motion Controllers operate on either 115 VAC or 230 VAC (+10%, -15%) power (50/60 Hz), without the need to configure the unit for the desired input power. Servodrive control power is available from the Motion Controller at terminals **r** and **t**, which are interlocked with the integral switch/circuit-breaker on the top of the unit. Use of this feature as illustrated in Appendix B eliminates the need for additional switches and/or circuit breakers, and assures that servodrive power will be disabled whenever power is removed from the Motion Controller.

ORMEC servodrives are available with either 115 VAC or 230 VAC control power, depending on the servodrive type and model.

- *ServoWire Drives* operate on 110 – 240 VAC (55 watts/axis max) control power.
- SAC-D servodrives operate on 230 VAC (115 watts/axis max.) control power only.
- SAC-DE servodrives operate on either 115 VAC (50 watts/axis max.) or 230 VAC (50 watts/axis max.) control power. Refer to the part number to determine which control power is required.
- PAC-F power supplies (and therefore SAC-F servodrives) operate on 115 VAC (for PAC-F12 & F20 175 watts/power supply max., for PAC-F50R & F75R 350 watts/power supply max.) control power only.

Input power connections are made on terminal block TB1, located on the top of the unit (refer to Appendix A-1 and D-1). Refer to the Terminal Block Wiring Guidelines section (page 17) for further terminal block wiring information, and the Power Specifications section of this chapter (page 74) for input and output power information.

Terminal	Name	Description
L1, L2	Input Power	Single phase 115 VAC or 230 VAC (+10%, -15%), 50/60 Hz, automatic input voltage range selection.
	Frame Ground	Connect to enclosure chassis and earth ground, preferably with 1/4" braided copper wire.
r,t	Servodrive Control Power	Single phase 115 VAC or 230 VAC (+10%, -15%), 50/60 Hz. This power is switched by the power switch and circuit breakers in the Model 30/50/70.

Table 4, *Terminal Block TB1 Interface Description*

3.1.7 DIO Board Power Terminal Block - TB2 (DIO Board)

There are terminals for +24 VDC, +12 VDC (for high speed Opto modules, such as the G4-IDC-5B), and common on the *DIO Board*. Refer to the Terminal Block Wiring Guidelines section (page 17) for further terminal block wiring information. Refer to Appendix A-4 for the location of terminal block TB2, and Appendix C-4 and C-5 for DIO Board schematic diagrams.

Signal	Pin #	Function	Description
+24	1	+24 VDC Power	24 VDC Field Power supply from either the optional internal power supply or a customer supplied external power supply connected to TB8-1. If the ORION has an internal 24 VDC power supply, do not connect another 24 VDC power supply to the +24 pins on TB2 or TB8.
V	2	I/O Power Bus Power	Voltage connection for the I/O Power Bus, this terminal is connected to all the V pins on TB3 – TB6.
+12	3	+12 VDC Power	+12 VDC power supply derived through a voltage regulator from the 24 VDC Field Power supply. This power supply is intended for use with up to eleven G4-IDC-5B high speed Opto modules.
RTN	4	+24 & +12 VDC Return	Return for the 24 VDC Field Power supply from either the optional internal power supply common or a customer supplied external power supply common connected to TB8-3.
C	5	I/O Power Bus Common	Common connection for I/O Power Bus, this terminal is connected to all the C pins on TB3 – TB6.

Table 5*, Terminal Block TB2 Interface Description*

3.1.8 Integral Discrete I/O (DIO Board)

Sixteen integral discrete I/O points are standard on each ORION controller. These I/O points are located under the front cover of the unit. Connections to them are made through four screw connection terminal blocks, which are located on the left side of the unit. These terminals also provide multiple tie points to the selected *I/O Power Bus* for convenient wiring (refer to I/O Power Bus Wiring (DIO Board) section, page 20). A cable-tray is provided down the left side of the unit with the wiring designed to exit at the lower left (when looking at the unit mounted on a panel).

Mounting sites are provided for Opto-22 Generation 4 I/O Modules, allowing for a variety of I/O choices, and output modules with replaceable fuses. The I/O circuit board features 90 mil thickness and multiple standoffs for ruggedness.

All of these I/O points are individually configurable as either inputs or outputs **(NOTE: At power up all 16 integral I/O points are configured as inputs)** using the MotionBASIC IO.MODE@ variable, or the MotionDesk Project Navigator I/O Properties Configurator (MB 4.x and higher). In addition, any input I/O points can be configured to be asserted for either "high" or "low" voltage levels, or "latched" asserted for either "high" (rising) or "low" (falling) transitions of the input voltage. Any integral I/O point can also be used as an "interrupt" using the ON EVENT DIO@ statement provided in MotionBASIC. Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding the IO.MODE@ variable, and the ON EVENT DIO@ statement. Refer to the MotionDesk Help for further information regarding the Project Navigator I/O Properties Configurator.

Support for configuring as many as four pairs of I/O points to operate as Machine-Stop input and Machine-No Fault output pairs is provided in MotionBASIC version 4.x. Refer to the Machine-Stop/No Fault Configuration - JP1, JP2, JP3, & JP4 section (page 23) of this chapter for further information.

Refer to the Terminal Block Wiring Guidelines section (page 17) for further terminal block wiring information. Refer to Appendix C-2 for *DIO Board* fuse locations, Appendixes C-4 through C-6 for *DIO Board* schematics, and Appendixes E-8 and E-9 for I/O module schematics. Refer to the Fuses section (page 130) of the Maintenance and Troubleshooting chapter for descriptions and part numbers for fuses F1 and F2 on the *DIO Board*.

WARNING: Do not insert or remove I/O modules from the *DIO Board* while the ORION and/or field I/O power is on.

WARNING: Commutating diodes must be used in parallel with inductive loads switched using a G4-ODC-5 output module.

3.1.8.1 I/O Power Bus Wiring (DIO Board)

The ORION DIO Board allows for distribution of a common I/O power supply for more convenient wiring using the I/O Power Bus. NOTE: Use of the I/O

Power Bus is not required. Refer to the following instructions for connecting a power supply to the I/O Power Bus, refer to **Figure 1**, and the DIO Board Power Terminal Block - TB2 section of the Specifications section of this chapter (page 78) for further information.

1) Connect the high side of the power supply (AC or DC) to be used for I/O wiring to the V input on TB2. This terminal is connected to all the V pins on TB3 - TB6. If you are using the ORION Field Power supply, simply place a jumper wire between the +24 and V pins on TB2 (as shown in **Figure 1**).

2) Connect the common of the power supply (either AC or DC) to be used for I/O wiring to the C input on TB2. This terminal is connected to all the C pins on TB3 - TB6. If you are using the ORION Field Power supply, simply pace a jumper wire between the RTN and C pins on TB2 (as shown in **Figure 1**).

3) For any I/O module using the I/O Power Bus power supply, connect the V and C pins to the modules " +" or " -" pins as appropriate for proper circuit operation.

4) For any I/O module not using the I/O Power Bus power supply, do not connect the V or C pins to the module. Connect the desired power supply directly to the " +" and " -" pins as appropriate for proper circuit operation.

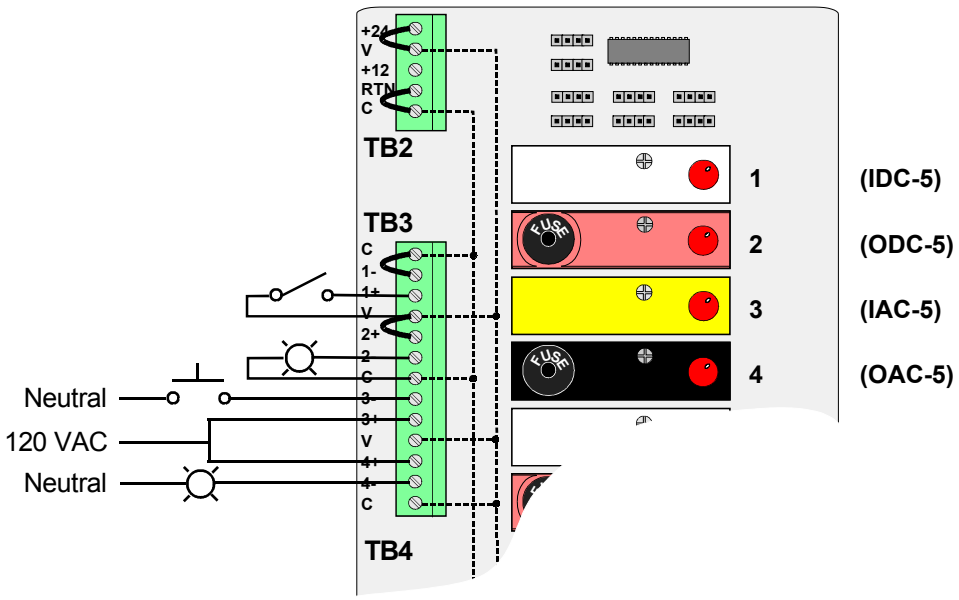


***Figure 1**, I/O Power Bus Wiring Example*

Signal	Location	Function	Description
C	TB3-1	I/O Power Bus Common	Common connection for I/O Power Bus
1-	TB3-2	DIO@(1)-	The output ("low") side of the I/O module for DIO@(1)
1+	TB3-3	DIO@(1)+	The input ("high") side of the I/O module for DIO@(1)
V	TB3-4	I/O Power Bus Power	Voltage connection for the I/O Power Bus
2+	TB3-5	DIO@(2)+	The input ("high") side of the I/O module for DIO@(2)
2-	TB3-6	DIO@(2)-	The output ("low") side of the I/O module for DIO@(2)
C	TB3-7	I/O Power Bus Common	Common connection for I/O Power Bus
3-	TB3-8	DIO@(3)-	The output ("low") side of the I/O module for DIO@(3)
3+	TB3-9	DIO@(3)+	The input ("high") side of the I/O module for DIO@(3)
V	TB3-10	I/O Power Bus Power	Voltage connection for the I/O Power Bus
4+	TB3-11	DIO@(4)+	The input ("high") side of the I/O module for DIO@(4)
4-	TB3-12	DIO@(4)-	The output ("low") side of the I/O module for DIO@(4)
C	TB3-13	I/O Power Bus Common	Common connection for I/O Power Bus
C	TB4-1	I/O Power Bus Common	Common connection for I/O Power Bus
5-	TB4-2	DIO@(5)-	The output ("low") side of the I/O module for DIO@(5)
5+	TB4-3	DIO@(5)+	The input ("high") side of the I/O module for DIO@(5)
V	TB4-4	I/O Power Bus Power	Voltage connection for the I/O Power Bus
6+	TB4-5	DIO@(6)+	The input ("high") side of the I/O module for DIO@(6)
6-	TB4-6	DIO@(6)-	The output ("low") side of the I/O module for DIO@(6)
C	TB4-7	I/O Power Bus Common	Common connection for I/O Power Bus
7-	TB4-8	DIO@(7)-	The output ("low") side of the I/O module for DIO@(7)
7+	TB4-9	DIO@(7)+	The input ("high") side of the I/O module for DIO@(7)
V	TB4-10	I/O Power Bus Power	Voltage connection for the I/O Power Bus
8+	TB4-11	DIO@(8)+	The input ("high") side of the I/O module for DIO@(8)
8-	TB4-12	DIO@(8)-	The output ("low") side of the I/O module for DIO@(8)
C	TB4-13	I/O Power Bus Common	Common connection for I/O Power Bus
C	TB5-1	I/O Power Bus Common	Common connection for I/O Power Bus
9-	TB5-2	DIO@(9)-	The output ("low") side of the I/O module for DIO@(9)
9+	TB5-3	DIO@(9)+	The input ("high") side of the I/O module for DIO@(9)
V	TB5-4	I/O Power Bus Power	Voltage connection for the I/O Power Bus
10+	TB5-5	DIO@(10)+	The input ("high") side of the I/O module for DIO@(10)
10-	TB5-6	DIO@(10)-	The output ("low") side of the I/O module for DIO@(10)
C	TB5-7	I/O Power Bus Common	Common connection for I/O Power Bus
11-	TB5-8	DIO@(11)-	The output ("low") side of the I/O module for DIO@(11)
11+	TB5-9	DIO@(11)+	The input ("high") side of the I/O module for DIO@(11)
V	TB5-10	I/O Power Bus Power	Voltage connection for the I/O Power Bus
12+	TB5-11	DIO@(12)+	The input ("high") side of the I/O module for DIO@(12)
12-	TB5-12	DIO@(12)-	The output ("low") side of the I/O module for DIO@(12)
C	TB5-13	I/O Power Bus Common	Common connection for I/O Power Bus
C	TB6-1	I/O Power Bus Common	Common connection for I/O Power Bus
13-	TB6-2	DIO@(13)-	The output ("low") side of the I/O module for DIO@(13)
13+	TB6-3	DIO@(13)+	The input ("high") side of the I/O module for DIO@(13)
V	TB6-4	I/O Power Bus Power	Voltage connection for the I/O Power Bus
14+	TB6-5	DIO@(14)+	The input ("high") side of the I/O module for DIO@(14)
14-	TB6-6	DIO@(14)-	The output ("low") side of the I/O module for DIO@(14)
C	TB6-7	I/O Power Bus Common	Common connection for I/O Power Bus
15-	TB6-8	DIO@(15)-	The output ("low") side of the I/O module for DIO@(15)
15+	TB6-9	DIO@(15)+	The input ("high") side of the I/O module for DIO@(15)
V	TB6-10	I/O Power Bus Power	Voltage connection for the I/O Power Bus
16+	TB6-11	DIO@(16)+	The input ("high") side of the I/O module for DIO@(16)
16-	TB6-12	DIO@(16)-	The output ("low") side of the I/O module for DIO@(16)
C	TB6-13	I/O Power Bus Common	Common connection for I/O Power Bus

***Table 6**, Terminal Blocks TB3 - TB6 Interface Description*

3.1.8.2 Machine-Stop/No Fault Configuration - JP1, JP2, JP3, & JP4

MotionBASIC 4 (and higher) supports multiple Machine-Stop input (MSTOP.OK@) and Machine-No Fault output (MFAULT@) pairs, allowing fail-safe control of several independent machines or sections of a machine, with a single ORION controller. Up to four pairs of Discrete I/O points are configurable to operate as Machine-Stop/No Fault pairs using jumpers JP1, JP2, JP3, and JP4. Refer to Appendix A-4 and C-2 for the location of the Machine-Stop/No Fault pair configuration jumper headers.

There are two rows of pins for each Machine-Stop/No Fault pair, labeled DIO (upper row) and MSTOP (lower row), refer to Appendix C-2. To configure a pair of I/O points for Machine-Stop/No Fault operation, place the corresponding four position jumper on the MSTOP row of pins. When configuring Discrete I/O points to operate as Machine-Stop/No Fault pairs, the functionality of the I/O points used is dedicated as shown in **Table 7**.

WARNING: With MotionBASIC 3.x, jumpers JP1 - JP4 must be configured for standard DIO operation by placing the four position jumper on the DIO row of pins.

NOTE: The functionality of the C and V pins (I/O Power Bus Power and Common) on TB3 and TB4 does not change when using the Discrete I/O points as Machine-Stop/No Fault pairs.

Signal	Location	Function	Description
1-	TB3-2	MSTOP.OK@(1)-	The output ("low") side of the input module for Machine-Stop #1
1+	TB3-3	MSTOP.OK@(1)+	The input ("low") side of the input module for Machine-Stop #1
2+	TB3-5	MFAULT@(1)+	The input ("high") side of the output module for Machine-No Fault #1
2-	TB3-6	MFAULT@(1)-	The output ("low") side of the output module for Machine-No Fault #1
3-	TB3-8	MSTOP.OK@(2)-	The output ("low") side of the input module for Machine-Stop #2
3+	TB3-9	MSTOP.OK@(2)+	The input ("low") side of the input module for Machine-Stop #2
4+	TB3-11	MFAULT@(2)+	The input ("high") side of the output module for Machine-No Fault #2
4-	TB3-12	MFAULT@(2)-	The output ("low") side of the output module for Machine-No Fault #2
5-	TB4-2	MSTOP.OK@(3)-	The output ("low") side of the input module for Machine-Stop #3
5+	TB4-3	MSTOP.OK@(3)+	The input ("low") side of the input module for Machine-Stop #3
6+	TB4-5	MFAULT@(3)+	The input ("high") side of the output module for Machine-No Fault #3
6-	TB4-6	MFAULT@(3)-	The output ("low") side of the output module for Machine-No Fault #3
7-	TB4-8	MSTOP.OK@(4)-	The output ("low") side of the input module for Machine-Stop #3
7+	TB4-9	MSTOP.OK@(4)+	The input ("low") side of the input module for Machine-Stop #3
8+	TB4-11	MFAULT@(4)+	The input ("high") side of the output module for Machine-No Fault #3
8-	TB4-12	MFAULT@(4)-	The output ("low") side of the output module for Machine-No Fault #3

***Table 7**, Machine-Stop/No Fault Interface Description*

Refer to the Machine-Stop/No Fault Interlocks (TB3 & TB4) section of this chapter (page 29) for information regarding the implementation of a multiple machine interlock system.

3.1.9 CAN Terminal Block - TB7 (ORION System Module)

This optional terminal block is provided standard for future MotionBASIC support of a CAN based serial communications network, and is unused at this time. If the ORION controller has the *delete CAN interface hardware* option (Refer to the ORION Model Number Description section of the General Description chapter, page 6) the CAN Terminal Block (TB7) is not present. Refer to the Terminal Block Wiring Guidelines section (page 17) for further terminal block wiring information. Refer to Appendixes A-3 and C-1 for the location of terminal block TB7.

Signal	Location	Function	Description
V+	TB7-1	+24 VDC Power	The terminal can be jumper configured (J47) to be a +24 VDC power supply, or to be unused. Refer to the CAN Terminal Block Power Configuration - J47 (ORION System Module) section (page 25) for further information. This +24 VDC power supply output terminal is not fused (the internal ORION Field I/O Power Supply has short circuit protection). NOTE: The optional ORION 24 VDC Field I/O Power Supply is separate from the ORION logic power supply and is single point referenced to the ORION frame ground. Refer to Appendix D-1 for further power supply wiring information.
CAN_H	TB7-2		
SHIELD	TB7-3	Shield	Connection to chassis frame for cable shield drain wires.
CAN_L	TB7-4		
V-	TB7-5	+24 VDC Return	The terminal can be jumper configured (J47) to be a +24 VDC return, or to be unused. Refer to the CAN Terminal Block Power Configuration - J47 (ORION System Module) section (page 25) for further information. NOTE: If the ORION has the optional 24 VDC Field I/O Power Supply, the V- terminal is single point referenced to the ORION frame ground, otherwise the V- terminal is not referenced to frame ground. The optional ORION 24 VDC Field I/O Power Supply is separate from the ORION logic power supply. Refer to Appendix D-1 for further power supply wiring information.

***Table 8**, CAN Serial I/O Terminal Block TB7 Interface Description*

3.1.9.1 CAN Terminal Block Power Configuration - J47 (ORION System Module)

The CAN terminal block (TB7) can be configured to provide +24 VDC (and COMMON) for devices connected to the serial I/O bus. With no jumpers on header J47 (factory default), +24 VDC is not supplied through the serial I/O terminal block. With the jumper configuration shown in **Figure 2**, +24 VDC and COMMON are supplied on the V+ and V- pins, respectively, of TB7.

If the ORION controller has the *delete CAN interface hardware* option (Refer to the ORION Model Number Description section of the General Description chapter, page 6) the CAN Terminal Block (TB7) and Power Configuration jumper (J47) are not present, and +24 VDC power cannot be supplied through the CAN Terminal Block (TB7).

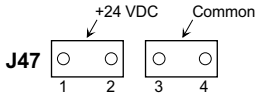


***Figure 2**, CAN terminal block power configuration, J47*

WARNING: If an external power supply is being used to supply 24 VDC to the devices connected to the serial I/O bus, do not place any jumpers on J47.

3.1.10 System Power Wiring & Interlocks - TB8 (ORION System Module)

ORION Motion Controllers provide integrated emergency stop and fault interlocks through terminal block TB8. Also provided on TB8 are terminals for a 24 VDC Field Power supply (either the optional internal power supply or an external customer supplied power supply) and the internal +5 VDC logic power supply. This terminal block is located on the *Orion System Module,* refer to Appendixes A-3 and C-1 for the location of TB8.

System wiring diagrams for standard ORMEC servodrives, which include the recommended safety and fault interlocks for a typical system, are provided in Appendix B. The primary features of these system wiring diagrams are:

- Servomotor power, called *Main Power*, is switched by the *Main Power Contactor*.
- For the *Main Power Contactor* to be enabled, both the *E-Stop Push-button* and the *No Fault* relay must be closed.
- For the *No Fault* relay to be closed, three conditions must be satisfied:
    1. There must be no controller diagnostic faults, including powerup diagnostics and the watchdog timer function;
    2. There must be power (either +12 to +35 VDC or 12 to 30 VAC referenced to RTN on TB8) applied to the E-Stop input at TB8;
    3. There must be no drive faults from any standby or active servodrives, and no open encoder signal wires on axes in pacer, standby, or active mode.

There are many acceptable variations of these System Wiring Diagrams, which can provide different features such as 24 VDC or 115 VAC operation of the *E-Stop Push-button*; 115 or 230 VAC operation of the *Main Power Contactor* coil for motor power. If using a variation, it should incorporate the primary features as described above and as shown in Appendix B. Contact the ORMEC Service Department with any questions you may have in this area.

Refer to the Machine-Stop/No Fault Interlocks (TB3 & TB4) section (page 29) of this chapter for further information regarding the implementation of a multiple machine interlock system.

Refer to the Terminal Block Wiring Guidelines section (page 17) for further terminal block wiring information.

Additional wiring guidelines are included in the "Shielding and Grounding Electrical Panels" Application Note, which is included at the end of this manual.

Signal	Location	Function	Description
24	TB8-1	+24 VDC Power	This terminal is either the output from the optional internal 24 VDC Field Power supply or the input for a customer supplied external 24 VDC power supply. **If the ORION has an internal 24 VDC power supply, do not connect another 24 VDC power supply to the +24 pins on TB2 or TB8**. The optional internal 24 VDC Field Power supply (1.5 A rated output) is provided for Emergency Stop and Servodrive Interlocks, as well as field I/O circuit wiring. NOTE: The optional ORION 24 VDC Field I/O Power Supply is separate from the ORION logic power supply and is single point referenced to the ORION frame ground. Refer to Appendix D-1 for further power supply wiring information. This power supply would normally be used to: 1) power the Emergency Stop Reset Push-button; 2) power +24 VDC discrete inputs for operator actuators, limit switches, PLC interfaces, etc.; and 3) power an MMI-840 (5 watts) or MMI-QP/5_ Operator Interface Terminal (15 watts max.). 4) power hardware overtravel limit switches. This power supply would not normally be used to power 24 VDC coil outputs. If intending to use it for this purpose, the user should watch power requirements carefully and use noise prevention measures such as flyback diodes across each coil.
E-Stop	TB8-2	Emergency Stop Monitor Input	The E-Stop input must have +12 to +35 VDC or 12 to 30 VAC applied to it for full operation. If removed, the No Fault relay contacts will open. When using the recommended interlock system (Appendix B), removal of power from the E-STOP input will cause an emergency stop of all motors. This interlock system provides an E-STOP RESET push-button to initially establish the voltage, allowing the No Fault relay contacts to close. The +24 VDC is then maintained by the MP-AUX auxiliary contact of the Main Power Contactor. Refer to the System Power Wiring & Interlocks - TB8 (ORION System Module) section (page 25) of this chapter for further information.
RTN	TB8-3	+24 VDC Return	Return connection for either the optional internal 24 VDC Field Power supply or the customer supplied external 24 VDC Field Power supply. This terminal is also the return connection for the E-STOP input. NOTE: If the ORION has the optional 24 VDC Field I/O Power Supply, the RTN terminal is single point referenced to the ORION frame ground, otherwise the RTN terminal is not referenced to frame ground. Refer to Appendix D-1 for further power supply wiring information.

Signal	Location	Function	Description
No Fault	TB8-4 TB8-5	No Fault Relay Contact	This fully isolated, normally-open held-closed, relay contact is held closed as long as there is power to the unit, there are no controller faults, the *E-STOP* input is asserted, and all Machine-Stop inputs (if any are used) are asserted. When using the recommended interlock system (Appendix B), this contact is part of the servodrive *Main Power Contactor circuit*, which controls the electromotive power to the servodrive. For a system with multiple motion controllers, the No Fault relay contacts may be wired in series. Refer to the Interlock Terminal Block - TB8 section (page 79) of the ORION Controller chapter for No Fault contact specifications.
Shield	TB8-6	Shield	Connection to chassis frame for cable shield drain wires.
5	TB8-7	+5 VDC Power	Connection to the +5 VDC (1.0 A max.) controller logic power supply. Connections to this power supply should always be made with a shielded twisted pair cable to maintain the integrity of the +5 VDC controller logic power supply. This power supply is intended for use with low voltage sensors and operator interface devices. **DO NOT USE THIS POWER SUPPLY FOR INDUCTIVE LOADS!!!** NOTE: The ORION logic power supply is single point referenced to the ORION frame ground. Refer to Appendix D-1 for further power supply wiring information.
R5	TB8-8	+ 5 VDC Common	Common of the +5 VDC controller logic power supply. NOTE: The R5 terminal is single point referenced to the ORION frame ground. Refer to Appendix D-1 for further power supply wiring information.

Table 9, *Terminal Block TB8 Interface Description*

3.1.11 Connecting an External Field Wiring Power Supply to ORION

The ORION model number indicates whether or not the unit has an internal 24 VDC field wiring power supply. An ORN-KIT/xF label on or near the ORION model number label indicates that an internal 24 VDC field wiring power supply was installed after the unit was shipped. Refer to the ORION Model Number Description section (page 6) of the General Description chapter for further ORION model number information, and Appendix A-2 for the location of the ORION model number label.

If the ORION does not contain an internal 24 VDC power supply, an external 24 VDC power supply can be connected for use as the ORION field wiring power supply. The external 24 VDC field wiring power supply can be connected to the +24 (+24 VDC) and RTN (common) pins on TB2 or TB8

WARNING: If the ORION has an internal 24 VDC power supply, do not connect another 24 VDC power supply to the +24 pins on TB2 or TB8.

When connecting an external 24 VDC power supply to the ORION for field wiring:

1) External power supply voltage range: +15 VDC (min.) to +30 VDC (max.).

2) The external power supply must be protected with 4 amp fuses (customer supplied). The fusible traces on the *ORION System Module* will not fully protect an external power supply.

3) The external 24 VDC power supply load must not exceed 4 amps, or the 24 VDC fusible trace on the *ORION System Module* will blow. Refer to the Fuses section (page 130) of the Maintenance and Troubleshooting chapter for further information.

4) Connecting the external field wiring power supply to either TB2 or TB8 provides power to other terminal block (e.g. if +24 VDC is connected to the +24 pin on TB8 then +24 VDC is available from +24 on TB2).

5) The external 24 VDC power supply must be referenced to the ORION frame ground. **NOTE: If the optional internal 24 VDC Power Supply is not installed in the ORION, the RTN on terminals TB2 and TB8 and the V- terminal on TB7 are not internally referenced to the ORION frame ground.**

6) If an external +24 VDC field wiring power supply is connected to either TB2 or TB8, +12 VDC (1.5 amps maximum) is available from the +12 pin on TB2.

7) The +24 VDC System Status LED on the ORION System Module is lit whenever power is supplied to the +24 pin on TB2 or TB8, even if the ORION power is off.

3.1.11.1 Machine-Stop/No Fault Interlocks (TB3 & TB4)

MotionBASIC 4.x (and higher) supports multiple Machine-Stop input and Machine No Fault output pairs allowing fail-safe control of several independent machines, or sections of a machine, with a single ORION controller.

NOTE: **DIO Board jumper configuration, MotionBASIC variable configuration, and installation of the appropriate I/O module types are required for the proper operation of the Machine-Stop/No Fault pairs.**

Refer to the Machine-Stop/No Fault Configuration - JP1, JP2, JP3, & JP4 section (page 23) of this chapter for further information regarding DIO Board jumper configuration. Refer to the MotionBASIC Help IO.MODE@ section for further information regarding the required software configuration.

An example system wiring diagram for an ORION system utilizing a Machine-Stop/No Fault pair for the interlock wiring is provided in Appendix B-5. The example Machine-Stop/No Fault interlock wiring (Appendix B-5) is based on the ORION System Wiring Diagram with SAC-D & SAC-S Series Servodrives in Appendix B-2. This example can also be similarly applied for use with the other standard servodrives and motors (i.e. ServoWire Drives, DE-Series and F-Series).

The primary features of a system utilizing the recommended Machine-Stop/No Fault pair interlock wiring is as follows:

- Servomotor power, called *Main Power*, is switched by the *Main Power Contactor*.
- For the *Main Power Contactor* to be enabled, both the *M-Stop Push-button* and the *Machine No Fault* relay (MFAULT@) must be closed.
- For the *Machine No Fault* relay (MFAULT@) to be closed, three conditions must be satisfied:
  1) There must be no controller diagnostic faults, including powerup diagnostics and the watchdog timer function;
  2) There must be power applied across the Machine-Stop (MSTOP.OK@) input;
  3) There must be no drive faults from any standby or active servodrives, and no open encoder signal wires on axes in pacer, standby, or active mode that are associated with the corresponding Machine-Stop/No Fault pair.

The recommended system wiring for each individual Machine-Stop/No Fault interlock is exactly the same as for the corresponding servodrives System Wiring Diagram shown in Appendixes B-1 through B-4, except that no connections are made to the Interlock terminal block (TB8). Refer to **Table 9** for a description of the Interlock terminal block (TB8) connections and the corresponding Machine-Stop/No Fault pairs.

<u>For proper Machine-Stop/No Fault interlock operation:</u>

- The Machine-Stop inputs (MSTOP.OK@), DIO points 1, 3, 5, and 7 require installation of an input module with the appropriate voltage rating (G4-IDC-5, G4-IAC-5, or G4-IAC-5A).
- The Machine-No Fault (MFAULT@) outputs, DIO points 2, 4, 6, and 8 require the installation of an output module with the appropriate voltage rating (G4-ODC-5[11], G4-ODC-5R, G4-OAC-5, G4-OAC-5A). For Machine-No Fault circuits using 120 VAC or 24 VDC power, use of a G4-ODC-5R dry contact output module is recommended.

[11]Commutating diodes must be used in parallel with inductive loads switched using a G4-ODC-5 output module.

Machine-Stop/No Fault Interlock				E-Stop/No Fault Interlock		
Signal	**Location**	**Function**	**I/O Type**	**Signal**	**Location**	**Function**
24	TB2-1	+24 VDC	n.a.	24	TB8-1	+24 VDC
1+	TB3-3	Machine-Stop #1	Input	ES	TB8-2	E-Stop
2+	TB3-5	Machine-No Fault #1	Output	NF	TB8-4	No Fault
2-	TB3-6	Machine-No Fault #1	Output	NF	TB8-5	No Fault
24	TB2-1	+24 VDC	n.a.	24	TB8-1	+24 VDC
3+	TB3-9	Machine-Stop #2	Input	ES	TB8-2	E-Stop
4+	TB3-11	Machine-No Fault #2	Output	NF	TB8-4	No Fault
4-	TB3-12	Machine-No Fault #2	Output	NF	TB8-5	No Fault
24	TB2-1	+24 VDC	n.a.	24	TB8-1	+24 VDC
5+	TB4-3	Machine-Stop #3	Input	ES	TB8-2	E-Stop
6+	TB4-5	Machine-No Fault #3	Output	NF	TB8-4	No Fault
6-	TB4-6	Machine-No Fault #3	Output	NF	TB8-5	No Fault
24	TB2-1	+24 VDC	n.a.	24	TB8-1	+24 VDC
7+	TB4-9	Machine-Stop #4	Input	ES	TB8-2	E-Stop
8+	TB4-11	Machine-No Fault #4	Output	NF	TB8-4	No Fault
8-	TB4-12	Machine-No Fault #4	Output	NF	TB8-5	No Fault
NOTE: The 1-, 3-, 5-, and 7- terminals must be connected to RTN in order for the Machine-Stop circuitry to function similarly to the E-Stop circuitry. Also, the I/O Power Bus (V and C) can be used to supply +24 and RTN to the Machine-Stop circuits.						

***Table 10**, Machine-Stop/No Fault Interface - Terminal Block TB8 Comparison*

There are many acceptable variations of the Machine-Stop/No Fault System Wiring Diagram, which can provide different features such as 24 VDC or 115 VAC operation of the *E-Stop Push-button*; 115 or 230 VAC operation of the *Main Power Contactor* coil for motor power. If using a variation, it should incorporate the primary features as described above and in Appendix B. Contact the ORMEC Service Department with any questions you may have in this area.

Additional wiring guidelines are included in the "Shielding and Grounding Electrical Panels" Application Note, which is included at the end of this manual.

3.1.12 Development Serial Port Connector - J1 (ORION System Module)

MotionBASIC programming, system development, and monitoring are accomplished by using an IBM-PC or compatible attached to the Development Serial Port connector, which is located in the middle of the *ORION System Module* (refer to Appendixes A-3 and C-1). The Development Serial Port is an asynchronous RS-232 device. It is handled internally by a 16554 serial communications controller, and interfaced through a 6-pin modular connector (Refer to Appendix C-7). Connection of the development computer to the ORION Development Serial Port can be made while power is applied to the ORION. Refer to **Figure 3** and **Table 11** for a description of the Development Serial Port Connector pinout.

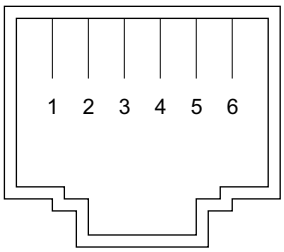


***Figure 3**, Development Serial Port Connector, J1*

Pin # (ORION)	Source	Status LED	RS-232 Name	Pin # (PC[12])	Pin # (AT[13])	Description
1	----	----	DGND	7	5	Signal Ground
2	ORION	Sending Serial	RxD	3	2	Received Data
3	User-PC	Receiving Serial	TxD	2	3	Transmitted Data
4	ORION	OK to Transmit	CTS	5	8	Clear to Send
5	User-PC	Ready to Receive	RTS	4	7	Request to Send
6	ORION	----	SHIELD			Protective Ground
----	----	----	DCD[14]	1	8	Data Carrier Detect
----	----	----	DTR[13]	4	200	Data Terminal Ready
----	----	----	DSR[13]	6	6	Data Set Ready

***Table 11**, Connector J1 Interface Description*

ORMEC provides versions of coil-cord style cables for the Development Serial Port which are compatible with IBM PC-AT style 9 pin D-Sub connectors (CBL-SER-AT) and with IBM PC 25 pin D-Sub connectors (CBL-SER-PC). Refer to Appendixes E-1 and E-2 for further information.

NOTE: **Revision B of the CBL-SER-PC and CBL-SER-AT Development Serial Port communications cables are required for proper MotionDesk 2.0 (and later) operation.**

The development serial port provides hardware handshaking signals Clear to Send (CTS) and Request to Send (RTS). The status of these signals, as well as Transmitted Data (TxD) and Received Data (RxD) signals are displayed by the vertical row of LEDs labeled "D" on the *Orion System Module* (located between J1 and J2). Refer to Appendix A-3 for the location of the Serial Port Status LEDs. The green OK to Transmit and Ready to Receive LEDs should be lit after the ORION has executed its powerup sequence. The yellow Sending Serial and Receiving Serial LEDs flash whenever data is transmitted or received by the controller.

[12] Pinout for the connector on the PC end of a CBL-SER-PC (includes an RJ11 to 25 Pin adapter).

[13] Pinout for the connector on the PC end of a CBL-SER-AT (includes an RJ11 to 9 Pin adapter).

[14] The DCD, DTR, and DSR signals are connected together

3.1.13 ORION Serial Ports SERIAL 1 and SERIAL 2 - J2 & J3 (ORION System Module)

Connections to the ORION Serial Ports are made through connectors J2 and J3, which are located on the *Orion System Module* (labeled SERIAL 1 and SERIAL 2). Refer to Appendixes A-3 and C-1 for the location of J2 and J3, and Appendix E for further cable and accessories information.

MotionBASIC supports the ORION Serial ports as general purpose serial communications devices. MotionBASIC provides device driver support for the:

- MMI-840 Industrial Terminal with an 8-line by 40 character display;
- QuickPanel man-machine interface terminal with a 5" or 9.5" diagonal flat panel touchscreen LCD graphic display. (MotionBASIC Extension software is required when using the QuickPanel);

The pinouts of the ORION Serial Ports are shown in **Figure 4** and **Table 12**, which follow. Note that signals are in pairs due to the balanced-pair differential configuration of the RS-422/485 communications standard. A CBL-MOD8 is intended for use with the ORION Serial Ports. Refer to the CBL-MOD8 drawing included in Appendix E-3 for further information. Appendix E also documents other CBL-MOD8 accessories.

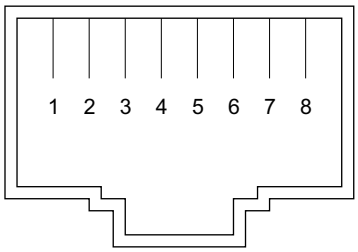


***Figure 4**, ORION Serial Port Connectors, J2 & J3*

Pin #	Signal Name	S1 & S2 Status LEDs	Description
1	TxD	Sending Serial	Transmit (Send) Data
2	TxD'		
3	RxD	Receiving Serial	Receive Data
4	RxD'		
5	RTS	Ready to Receive	Request to Send
6	RTS'		
7	CTS	OK to Transmit	Clear to Send
8	CTS'		

***Table 12**, Connectors J2 & J3 Interface Description*

Note that these serial ports provide hardware handshaking signals CTS and RTS. The status of these signals, as well as TxD and RxD, are displayed by the Serial Ports 1 and 2 LEDs on the *Orion System Module* (located between J1 and J2).

- The green 'OK to Transmit' and 'Ready to Receive' LEDs should be lit when the ORION Serial Ports are enabled, and the serial cable is properly connected between the ORION controller and the remote device.
- The yellow 'Sending Serial' and 'Receiving Serial' LEDs flash whenever data is transmitted or received by the controller.

3.1.13.1 RS-422/485 Serial Communications with the ORION Serial Port

MotionBASIC uses the "OPEN" statement to provide access to asynchronous serial communications via one of the ORION Serial Ports, "SRL1:" or SRL2:". These ports are commonly used as interfaces to the ORMEC MMI-840 Industrial Terminal or the ORMEC QuickPanel MMI flatpanel touchscreen. They can also be used for serial communications with terminals, computers or programmable controllers, or for background communications using the Modbus and QuickPanel Communications MotionBASIC Extensions (MBX).

3.1.13.2 Modbus[15] Communications

The Modbus Communications MotionBASIC Extension (MBX) allows an ORION Motion Controller to provide **background** Modbus communications as either a Master or a Slave. This factory communications link provides a convenient method for data communications between ORION Motion Controllers, programmable logic controllers, and other intelligent devices. A number of configurations are supported using either the ORION Serial Ports or an additional serial card.

The Modbus Communications MotionBASIC Extension (MBX) swaps the SERIAL 1 (J2) and SERIAL 2 (J3) serial port Transmitted Data and Receive Data pins when configured as a Modbus Slave. This allows direct cable connection between ORION units using Modbus Communications. Refer to the Modbus Communications Hypertext Software Manual (for MB 3.x) or the Modbus Help (for MB 4.x and higher) for further information.

3.1.13.3 QuickPanel Communications

The QuickPanel Communications MotionBASIC Extension (MBX) allows an ORION Motion Controller to provide **background** communications with a QuickPanel Man Machine Interface. This factory communications link provides a convenient method for data communications between a QuickPanel and one or more ORION Motion Controllers using either the ORION Serial Ports or an additional serial card. The QuickPanel Communications MBX also provides the ability to download a QuickPanel application program through the ORION Serial Ports eliminating the need for special download cables when making changes to the MMI panels.

The QuickPanel Communications MBX swaps the SERIAL 1 (J2) and SERIAL 2 (J3) serial port Transmitted Data and Receive Data pins. Refer to the QuickPanel Communications Help for further information.

[15]Modbus® is a registered trademark of Modicon, Inc.

3.1.14 Extended I/O Connector - J8 (DIO Board)

The Extended I/O Option provides a 50-pin connector at the bottom of the *DIO Board*. It can be configured as either a **discrete** or **Pamux** I/O interface using the MotionBASIC **EIO.MODE@** variable, or the MotionDesk Project Navigator Unit Properties configurator (MB 4 & higher).

The Extended I/O interface can be further configured using the MotionBASIC **IO.MODE@** variable, or the MotionDesk Project Navigator I/O Properties configurator (MB 4 & higher):

- If the Extended I/O interface is configured to provide 24 **discrete I/O** points, the I/O points can be configured as either **inputs** or **outputs**, similar to the 16 Integral I/O points.
- If the Extended I/O interface is configured for **Pamux** operation, the I/O points can be configured as **discrete** or **analog**.

NOTE: At power up, all discrete and extended I/O points are configured as discrete inputs.

For more info on:	Refer to:
EIO as discrete I/O	Section 3.1.14.1, Discrete EIO Configuration
EIO as Pamux I/O	Section 3.1.14.2, Pamux EIO Configuration
IO.MODE@ and EIO.MODE@	MotionBASIC Help (for MB 4 & higher) , or MotionBASIC Hypertext Software Manual (MB 3)
J8 & DIO schematic	Appendix A-4 & Appendix C-2
Cables and accessories	Appendix E
Project Navigator I/O & Unit Properties	MotionDesk Help

3.1.14.1 Discrete EIO Configuration

The *DIO Board* is shipped with the EIO configured for use as discrete I/O (EIO.MODE@=0), I/O points DIO@(17) through DIO@(40) are arranged in three groups of eight as shown in **Table 13,** Connector J8 Interface Description. They are software configurable as inputs or outputs using the MotionBASIC IO.MODE@ variable, or the MotionDesk Project Navigator I/O Properties configurator (MB 4.x and higher). Group A I/O points are individually selectable; Group B & C I/O points may be selected as inputs or outputs only as a group.

The EIO interface schematic is found in Appendix C-6. The connector pin assignments are compatible with Opto-22 I/O Module Racks.

Extended I/O Point Groups								
Group A			**Group B**			**Group C**		
DIO@(#)	Opto #	Pin #	DIO@(#)	Opto #	Pin #	DIO@(#)	Opto #	Pin #
17	0	47	25	8	31	33	16	15
18	1	45	26	9	29	34	17	13
19	2	43	27	10	27	35	18	11
20	3	41	28	11	25	36	19	9
21	4	39	29	12	23	37	20	7
22	5	37	30	13	21	38	21	5
23	6	35	31	14	19	39	22	3
24	7	33	32	15	17	40	23	1

Table 13, *Connector J8 Interface Description*

All even numbered pins on connector J8 are +5 VDC common. +5 VDC is provided on pin 49 of J8 through fuse F2. Refer to Appendix C-6 for a description of fuse F2 on the *DIO Board* as well as the ORMEC and Wickman part numbers.

ORMEC provides a 24 position I/O rack (G4-MIO-PB24) and cable (CBL-EIO) for use with the EIO Option interface to provide an additional 24 discrete I/O points.

NOTE: There is no 5 VDC supplied to the 24 position I/O rack through the CBL-EIO ribbon cable:

I/O Rack	**+5 V available through ribbon cable CBL-EIO**
G4-MIO-PB8	Yes
G4-MIO-PB16H	Yes
G4-MIO-PB24	**No, connect +5 and R5 on the Orion System Module to "+" and "-" on rack. Also see Appendix E for further information on CBL-EIO.**

3.1.14.2 Pamux I/O Configuration

When used as a Pamux I/O interface (EIO.MODE@=1), the EIO Connector provides access to 512 digital and/or analog I/O points using the Opto-22 Pamux standard. These I/O points are accessed from MotionBASIC as DIO@(n) and AIO@(n) array variables, numbered from 17 to 528. Refer to the Pamux I/O System section (page 56) of this chapter for further information.

The *DIO Board* is shipped with the EIO configured for use as discrete I/O (EIO.MODE@=0). For use with Pamux I/O it is necessary to change the configuration of the termination resistor networks on the *DIO Board*. The EIO Pamux I/O termination resistors required are included with each ORION

Motion Controller[16]; refer to **Table 14** for resistor network information. Refer to Appendix C-2 for the location of the EIO Pamux I/O termination resistors and the resistor orientation information.

Configuration	**RN4** (ohms)	**RN5** (ohms)
EIO (default)	2.2K	open
Pamux I/O	180.00	390.00

Table 14, *EIO/Pamux Termination Resistors*

3.1.15 Keyboard Interface Connector

The Keyboard Interface, standard on all ORION controllers, is a 5 pin DIN connector located on the bottom of the unit. It is compatible with all IBM PC-AT compatible keyboards. Refer to Appendix A-2 for the location of the Keyboard Interface Connector.

WARNING: Do not connect a keyboard to the ORION controller with power on.

3.1.16 I/O Address and PC Card Configuration - J40 (ORION System Module ORN004/043)

WARNING: The ORION System Module I/O address and PC Card configuration jumper header, J40, for ORN004 and ORN043 is configured at the factory and must not be changed (refer to Figure 5).

Refer to Appendix C-1 for the location of the I/O Address and PC Card Configuration header, J40.

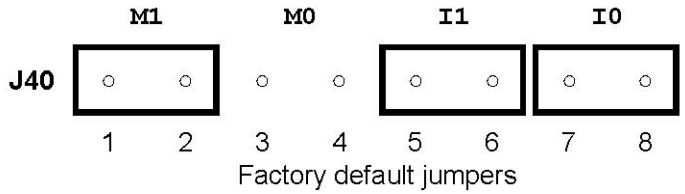


Figure 5*, I/O Address and PC Card Configuration (ORN004/043), J40*

3.1.17 I/O Address and PC Card Configuration - J40 (ORION System Module ORN098/099)

WARNING: The ORION System Module I/O address and PC Card configuration jumper header, J40, for ORN098 and ORN099 is configured at the factory and must not be changed (refer to Figure 6).

Refer to Appendix C-1 for the location of the I/O Address and PC Card

[16]Contact your ORMEC Sales and Applications Engineer if you need additional Pamux termination resistor networks (ORMEC part number: ORN-PMXTRM).

Configuration header, J40.

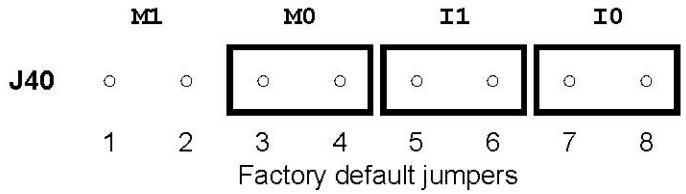


***Figure 6**, I/O Address and PC Card Configuration (ORN098/099), J40*

3.1.18 EIO Clock Configuration - J53 (ORION System Module)

A jumper is required on header J53 of the ORION System Module only when using a revision G or later ORION System Module in a controller with a revision C or earlier DIO Board with the EIO Option. Refer to Appendix C-1 for the location of the EIO Clock Configuration header, J53.

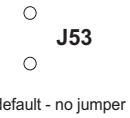


***Figure 7**, EIO Clock Configuration, J53*

Note the following:

A Revision D or later DIO Board with EIO option will operate properly with any revision ORION System Module (no jumper on header J53 required on rev. G and later ORION System Modules).

A Revision C or earlier DIO Board with EIO Option will operate properly with a revision F or earlier ORION System Module.

DIO Boards without the EIO option will operate properly with any revision ORION System Module (no jumper on header J53 required).

3.1.19 PC Cards

ORION Motion Controllers support the use of credit card sized memory modules which conform to the international PC Card ATA (PCMCIA) standard. These plug-in modules are used for storing:

- MotionBASIC and ORION system executable programs
- MotionBASIC Extensions (MBX)
- MotionBASIC application programs
- Random access and sequential data files
- QuickPanel application programs

WARNING: DO NOT REMOVE A PC CARD, OR TURN OFF THE ORION POWER, WHILE THE GREEN PC CARD ACCESS LED IS LIT.

NOTE: If you are using a PC Card Flash memory card not supplied by ORMEC, be sure that the card is ATA compatible (ATA compatibility does not apply to SRAM memory cards). ORMEC has tested and recommends SanDisk PC Card ATA Flash memory cards. Refer to the MotionBASIC Hypertext Software Manual (for MB 3) or the MotionBASIC Help (for MB 4 & higher), FORMAT statement section for instructions on how to prepare a PC Card for use with ORION. The FORMAT statement is not allowed for PC Card 1 slot; you must use the PC Card 2 slot for formatting.

Two PC Card slots are provided on the *Orion System Module*, PC Card 1 (Type II) & PC Card 2 (Type II). ORMEC provides PC Card ATA Flash memory cards, and SRAM memory cards.

Refer to Appendixes A-3 and C-1 for the location of the PC Card slots on the *Orion System Module*. Refer to the MotionBASIC Hypertext Software Manual (for MB 3) or the MotionBASIC Help (for MB 4 & higher) for an overview of the commands related to the use of PC Cards (e.g. FILES, LOAD, KILL, etc.).

Name	Location	MotionBASIC 3 Drive Name	MotionBASIC 4 & above Drive Name
PC Card 1	Right-hand slot	1:	D:
PC Card 2	Left-hand slot	2:	E:

***Table 15**, PC Card Locations and Drive Designations*

3.1.19.1 PC Card 1 - System Card (ORION System Module)

PC Card 1 (Type II) is usually the System Card, which contains all the MotionBASIC, ORION system executable programs, and MotionBASIC Extensions (MBX). Refer to the Powerup (ORION System Module) section (page 64) of the ORION Controller chapter for further information. PC Card 1 can also be used to store MotionBASIC application programs, QuickPanel application programs, and random access and sequential data files.

There are several different memory size System Cards available. The amount of memory required on the System Card depends on the amount of data to be stored on it. For example: A PCC-SYS/0006 (a 6M byte PC Card preloaded with MB 3.x) or PCC-SYS4/0006 (a 6M byte PC Card preloaded with MB 4.x and higher) has approximately 5M bytes of MotionBASIC Extension and application program (MotionBASIC programs, QuickPanel program, data files, etc.) storage capacity[17]. If you anticipate needing more than 5M bytes of program memory you should purchase an 8M byte MotionBASIC System Card (PCC-SYS/0009 or PCC-SYS4/0009) or larger.

[17]MotionBASIC System Cards utilize disk compression technology which increases the PC Card memory capacity above the physical memory size indicated by the card's part number.

Call your ORMEC Sales and Applications Engineer for assistance selecting the appropriate size MotionBASIC System Card.

NOTE: **PC Card 1 cannot be formatted using the MotionBASIC FORMAT statement, only PC Card 2 can be formatted.**

3.1.19.2 PC Card 2 - Application Card (ORION System Module)

PC Card 2 (Type I) is usually used to store additional MotionBASIC application programs, QuickPanel application programs, and random access and sequential data files. Refer to the Powerup (ORION System Module) section (page 64) of the ORION Controller chapter for further information.

3.1.20 MotionKeys and MotionCredits

The ORION MotionKey is a hardware key programmed with a number of MotionCredits, which are required for the operation of MotionBASIC and MotionBASIC Extensions. Refer to the Powerup (ORION System Module) section (page 64) of the ORION Controller chapter for further information regarding MotionCredits.

On 1/20/2005 a replacement was released to replace the original MotionKey that became obsolete. The new MotionKey is a small PCB that is functionally and fit compatible with the original.

3.1.20.1 MotionKey Installation

The MotionKey is located on the *ORION System Module* near the *DIO Board* EIO connector, when looking at the *ORION System Module* installed in the motion controller. Refer to Appendix C-1 for the location of the MotionKey on the *ORION System Module*, and **Figure 8** for a MotionKey installation diagram. When looking at the *ORION System Module* not installed in an ORION, the MotionKey is in the upper right hand corner.

To replace a MotionKey on the *ORION System Module*:

1) Disable power to the ORION**. REMOVING OR INSTALLING A MotionKey WITH POWER APPLIED TO THE ORION WILL DAMAGE THE MotionKey!!!**

2) The MotionKey is held in place by a washer with a flat side. Loosen the screw holding the washer a half turn, turn the washer to allow removal of the currently installed key, and remove the key. It may be necessary to partially remove the *ORION System Module* from the controller chassis to perform this procedure.

3) Insert the new MotionKey into the socket (U36). Be sure the label on the MotionKey is facing the edge of the *ORION System Module* PC board. DO NOT FORCE THE MotionKey INTO THE SOCKET, IMPROPER INSERTION OF THE MotionKey WILL RESULT IN DAMAGE TO THE MotionKey.

4) Turn the washer so that the key is held in place, and tighten the screw holding the washer.

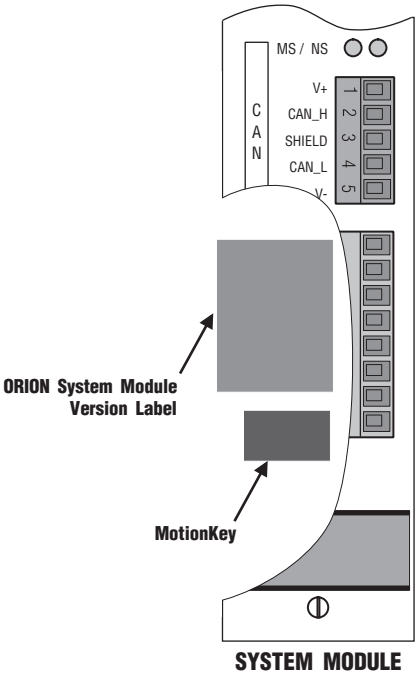


***Figure 8**, MotionKey Installation Diagram*

Figure 9, New Version MotionKey Installed

3.1.20.2 MotionCredit Requirements

During the powerup sequence, ORION determines the number of MotionCredits installed.

For MotionBASIC 4.x: There must be sufficient MotionCredits for MotionBASIC and all the MBXs on the *MotionBASIC System Card.*

For MotionBASIC 5.x: There must be sufficient MotionCredits for all the drives attached to the system and all the MBXs on the *MotionBASIC System Card*.

If there are insufficient MotionCredits installed, the ORION will not enable motor motion (MODE@>0). All other MotionBASIC and MBX functionality will be allowed in this case so that the application program can properly maintain the machine I/O, and so an operator interface (if used) can indicate the machine status.

The number of MotionCredits required is dependent on the version of MotionBASIC installed on the System Card. Refer to **Table 16** for a description of the MotionCredits required.

	For use with MotionBASIC version…	ORMEC p/n	MotionCredits Required
MotionBASIC	3 4 5	PCC-SYS PCC-SYS4 PCC-SYS5	600 600 0
Modbus Communications	3 4 5	MBX-MDB MBX-MDB-4 MBX-MDB-5	300
S908 Communications	3 4 5	MBX-S908 MBX-S908-4 MBX-S908-5	500
Data Highway/Plus Communications	3 4 5	MBX-DH MBX-DH-4 MBX-DH-5	500
SLC-500 DF1 Connectivity	3 4 5	MBX-DF1 MBX-DF1-4 MBX-DF1-5	300
QuickPanel Communications	3 4 5	MBX-QP MBX-QP-4 MBX-QP-5	200
GE Genius Communications	4 5	MBX-GE-4 MBX-GE-5	500
Profibus DP (Slave only) Communications	4 5	MBX-PFB-4 MBX-PFB-5	300
Modbus TCP (Quantum Ethernet) Communications	4 5	MBX-QE-4 MBX-QE-5	400
Allen-Bradley Ethernet	4 5	MBX-ABE-4 MBX-ABE-5	500
ServoWire Drive *(Pacer Encoder and Virtual Axes do not require MotionCredits)*	3 4 5		N/A N/A 275/Drive

***Table 16**, MotionCredit requirements for MotionBASIC and MBXs*

To determine the total number of MotionCredits required for your application add the number of MotionCredits for MotionBASIC, each MBX and each ServoWire Drive installed.

Examples

An ORION with a MotionBASIC 4 System Card (PCC-SYS4/####) and the QuickPanel MBX (MBX-QP-4).

Software	MotionCredits
PCC-SYS4/### (MotionBASIC 4.x.x)	600
MBX-QP-4	200
Total	800

An ORION with a MotionBASIC 5 System Card (PCC-SYS5/#####), Allen-Bradley Ethernet MBX (MBX-ABE-5) and 4 ServoWire Drives.

Software	**MotionCredits**
PCC-SYS5/### (MotionBASIC 5.x.x)	0
MBX-ABE-5	500
ServoWire Drives	1100
Total	1600

Contact your ORMEC Sales and Application Engineer if you need a MotionKey with more MotionCredits, or if you need assistance determining the number of MotionCredits required by your application.

3.1.20.3 Determining the Number of MotionCredits on a MotionKey

The number of MotionCredits on a MotionKey can be determined three ways:

1) The MotionKey part number, as follows:
   ORN-KEY/0600
   In the MotionKey part number, shown above, the 0600 is the number of MotionCredits installed on the KEY.

2) The number printed on the top of the key (Refer to **Figure 10** and **Figure 11**). This can be read without having to remove the MotionKey from the ORION, by simply opening the DIO cover and looking at the key.

   For a Rev A label (numbering across the width of the key):
   MotionCredits = [number on top of key] * 100
   For example: 1300 MotionCredits = 13

   For a Rev B label (numbering along the length of the key), the number of MotionCredits can be read directly.
   For example: 1300 MotionCredits = 1300

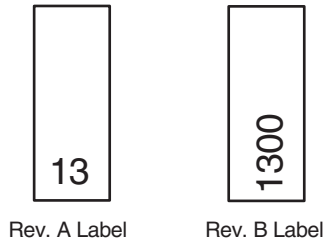


***Figure 10**, MotionKey Labels*

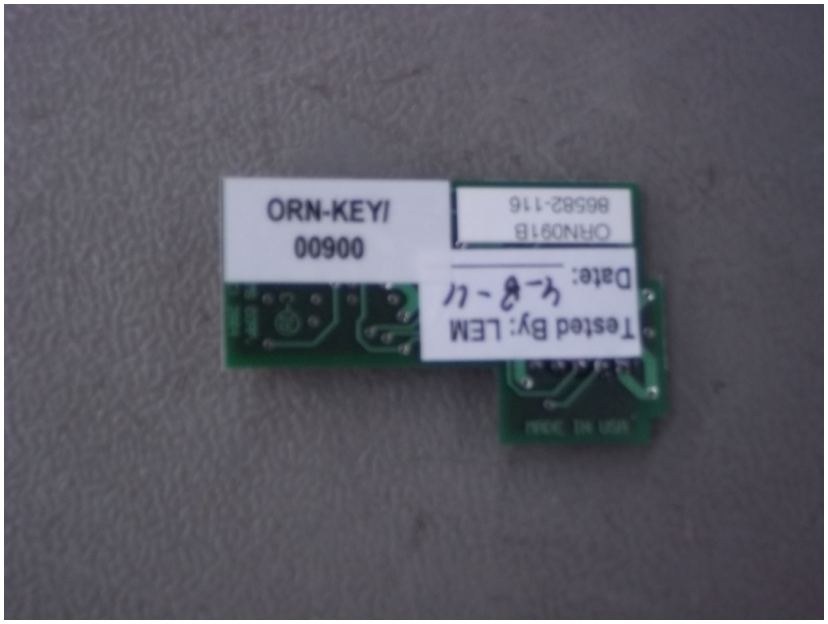


Figure 11, New MotionKey Label

3) The MotionBASIC sign-on message (refer to **Figure 12,** MotionBASIC Sign-On Message / Direct Mode Window) prints out the number of MotionCredits required by MotionBASIC and any installed MotionBASIC Extensions, and the number of MotionCredits installed. You can view the MotionBASIC sign-on message using MotionPRO or the MotionDesk Direct Mode window. Refer to the MotionPRO Installation and Operation manual or the MotionDesk Help for further information.

4) The MotionDesk SysInfo display (refer to **Figure 13,** MotionDesk SysInfo Display) indicates the number of MotionCredits required by MotionBASIC (MB 4.x and higher) and any installed MotionBASIC Extensions, and the number of MotionCredits installed. Refer to the MotionDesk Help for further information.

WARNING: Your ORION motion controller will not enable motor motion if a MotionKey with less than the required number of MotionCredits is installed on the *ORION System Module*.

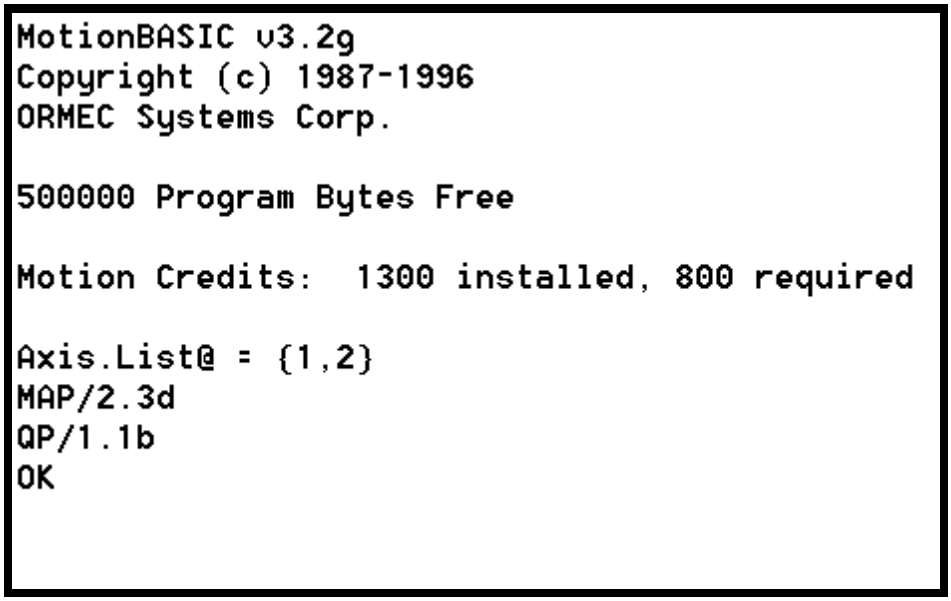


***Figure 12**, MotionBASIC Sign-On Message / Direct Mode Window*

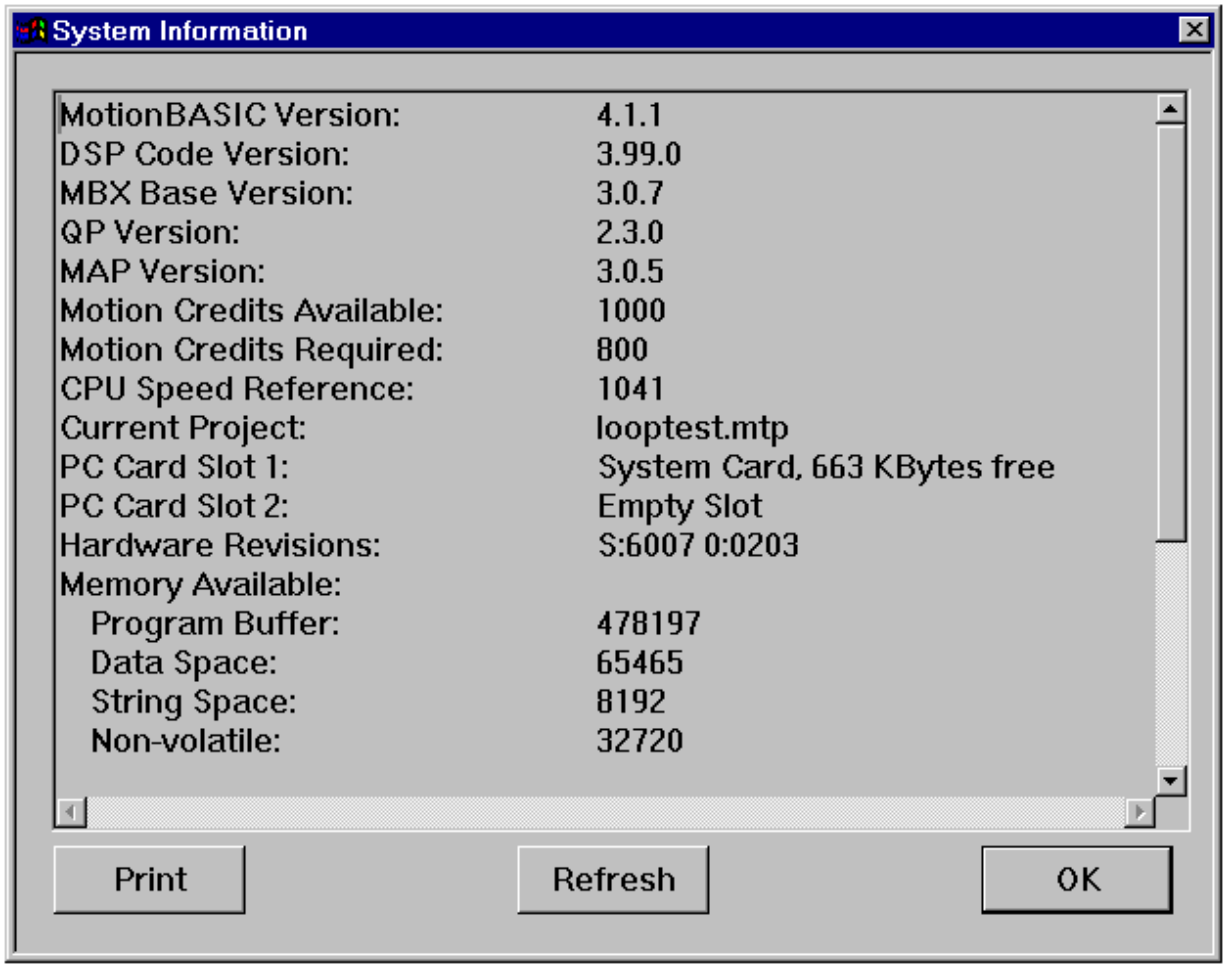


***Figure 13**, MotionDesk SysInfo Display*

3.1.21 ORN-422 Serial Communications Adapter

The serial communications adapter is a half length IBM PC card which has two serial ports that can be configured as RS-232 or RS-422/485. There is a DB-9 serial connector for each port. An ORION controller supports only one dual-port *Serial Communications Interface* at a time.

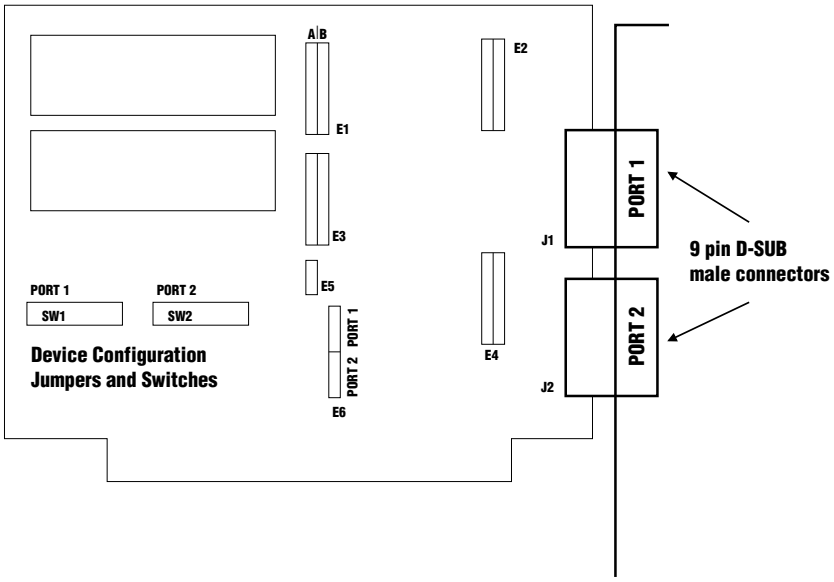


***Figure 14**, ORN-422 Layout*

3.1.21.1 Factory Default Configuration

The factory default settings configure the *Serial Communications Adapter* for the following mode of operation:

Port 1: RS-232 (standard)
COM1, port enabled, RS-232, IRQ4, flow control enabled

Port 2: RS-422/485 for use with MMI-840
COM2, port enabled, RS-422/485, drive ON, flow control disabled

	Switch Settings							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Port 1:	Off	Off	Off	Off	Off	Off	Off	On
Port 2:	Off	On	Off	Off	Off	Off	Off	On

***Table 17**, ORN-422 Default Switch Configuration*

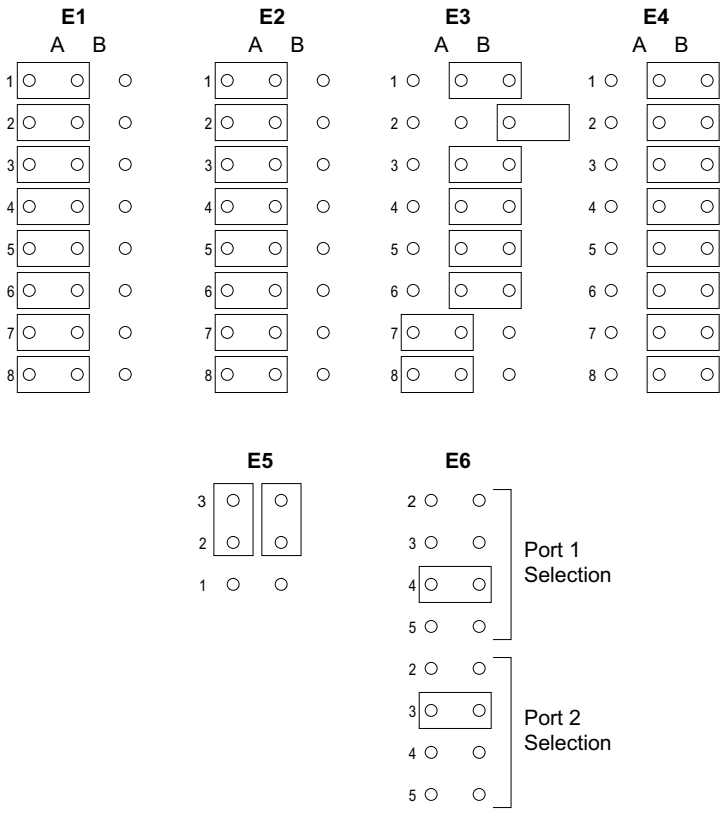


***Figure 15**, ORN-422 Factory Default Configuration*

3.1.21.2 Device Configuration

Table 18 shows the settings for Port 1 & Port 2 which determine the I/O address of each serial port. The Port 1 switches determine the address of the Port 1 connector and the Port 2 switches determine the address of the Port 2 connector.

	Switch Settings							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**Address**
COM1:	Off	Off	Off	Off	Off	Off	Off	3F8-3FF
COM2:	Off	On	Off	Off	Off	Off	Off	2F8-2FF
COM3:	Off	Off	Off	Off	Off	On	Off	3E8-3EF
COM4:	Off	On	Off	Off	Off	On	Off	2E8-2EF

***Table 18**, ORN-422 General Switch Configuration*

3.1.21.3 Port Enable/Disable

Port 1 can be disabled by setting switch 8 for Port 1 to Off. Port 2 can be disabled by setting switch 8 for Port 2 to Off. When a port is disabled, the corresponding IRQ jumper (jumper header E6) should also be removed. The factory default setting for Port 1 and Port 2 is On.

3.1.21.4 Interrupt Request

The interrupt request (IRQ) is configured using jumper header E6. The upper half of E6 is used to select the IRQ for Port 1, and the lower half is used for Port 2. The number to the left of the header (2, 3, 4, or 5) indicates the IRQ level.

NOTE: IRQ3 (COM2 & COM4) and IRQ4 (COM1 & COM3) are the only IRQs supported by MotionBASIC for serial communication ports.

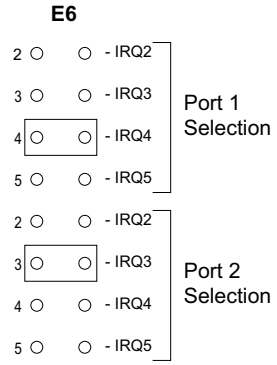


***Figure 16**, ORN-422 Interrupt Level configuration, E6*

Jumper header E5 selects the (normal) single interrupt per port mode or the multiple interrupt mode, which allows you to share the interrupt on the ports. The multiple interrupt mode also allows you to share the IRQ signals

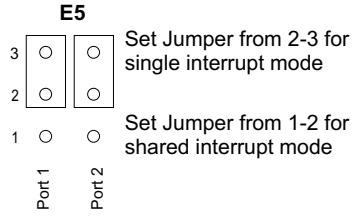


***Figure 17**, ORN-422 Interrupt Mode configuration, E5*

3.1.21.5 Driver Enable

When using a RS-422/485 port as "master only" the RS-485 driver should always be enabled. This is the default with jumper headers E1 and E3 position 7 set to "A". Refer to ORN-422 Serial Communications Adapter, Factory Default Configuration section (page 48) for further information.

If a port is to be used for rotating master RS-485 communications, the driver disable signal can be connected to the RTS signal from the appropriate port by moving jumper 7 on headers E1 and E3 to position "B".

3.1.21.6 RS-232 and RS-422/485 Configuration

Each port can be independently configured for RS-232 or RS-422/485 communications. The configuration is made using jumper headers E1, E2, E3, and E4. **Table 19** shows the two configurations for each port.

Port	Interface	Jumper Positions	
Port 1	RS-232	E2 - "A"	E1 - "A"
	RS-422/485	E2 - "B"	E1 - "B"
Port 2	RS-232	E4 - "A"	E3 - "A"
	RS-422/485	E4 - "B"	E3 - "B"

***Table 19**, ORN-422 Jumper Configuration*

Note that on jumper headers E2 and E4 you must remove all eight push-on jumpers. This is required to fully isolate the RS-232 and RS-422/485 signals. However, on jumper headers E1 and E3 there are some options as described in **Figure 18** and **Figure 19**.

If a serial port is configured for RS-232 operation, you have the option of using the modem control signals or forcing them to their RS-232 TRUE level.

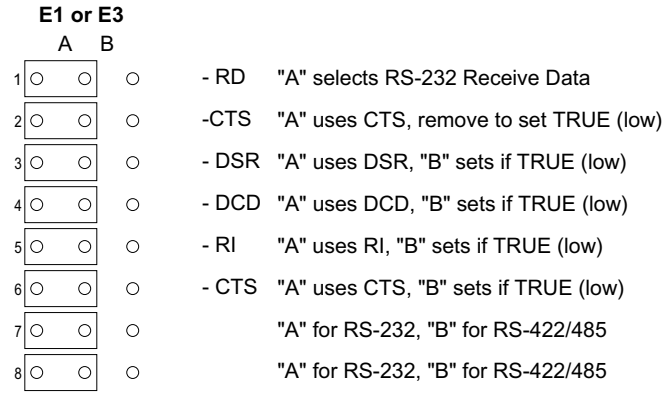


***Figure 18**, ORN-422 RS-232 Serial Port configuration*

If a serial port is configured for RS-422 operation, you have the option of using the modem control signals or forcing them to their RS-232 TRUE levels.

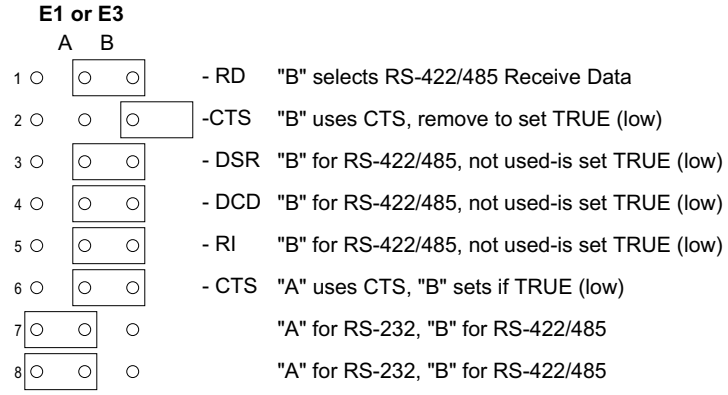


***Figure 19**, ORN-422 RS-422/485 Serial Port configuration*

NOTE: If CTS signals are required, install jumper 2 in the "B" position and 6 in the "A" positions. If CTS is to be ignored, remove jumper 2 and install jumper 6 in the "B" position.

3.1.21.7 DB-9 Pin Description

Pin	RS-232 Signal		RS-422/485 Signal	
1	DCD	Carrier Detect	RxD+	Receive Data +
2	RxD	Receive Data	RxD-	Receive Data -
3	TxD	Transmit Data	TxD-	Transmit Data -
4	DTR	Data Terminal Ready	TxD+	Transmit Data +
5	GND	Ground	GND	Ground
6	DSR	Data Set Ready	RTS+	Ready to Send +
7	RTS	Request to Send	RTS-	Ready to Send -
8	CTS	Clear to Send	CTS-	Clear to Send -
9	RI	Ring Indicator	CTS+	Clear to Send +

***Table 20**, ORN-422 Connector Description*

3.1.22 ORN-232 Serial Communications Adapter

The ORN-232 Serial Communications Adapters are half length IBM PC cards which have two integral RS-232 serial ports. A DB-9 serial connector (Port 1) is provided for use as the COM1: port and a DB-25 serial connector (Port 2) is provided for the COM2: port. ORION controllers support only one dual-port *Serial Communications Interface* at a time.

3.1.22.1 ORN-232 Revision G Hardware*

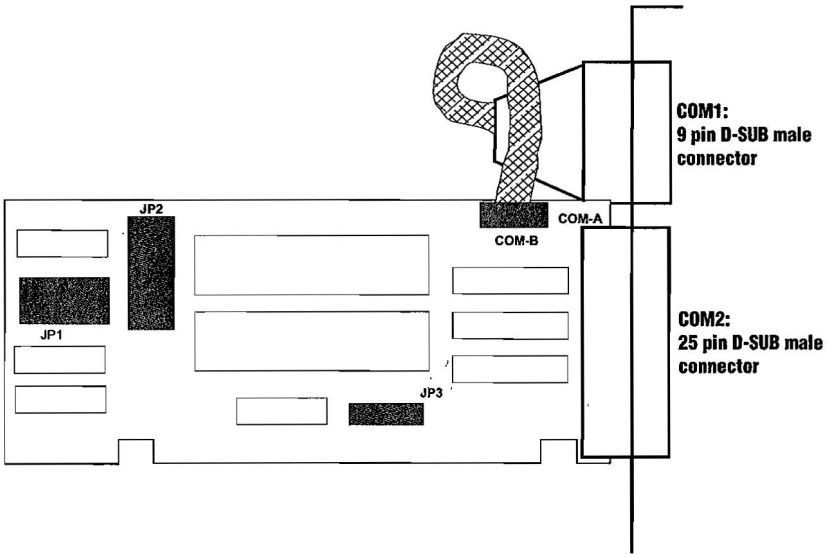


***Figure 20** , ORN-232 Rev. G Layout*

3.1.22.2 ORN-232 Revision G Device Configuration – JP1, JP2 & JP3

This communications card is configured using jumper header JP3 as follows:

COM1: address 3F8H with IRQ4 (9 pin male D-Sub connector)

COM2: address 2F8H with IRQ3 (25 pin male D-Sub connector)

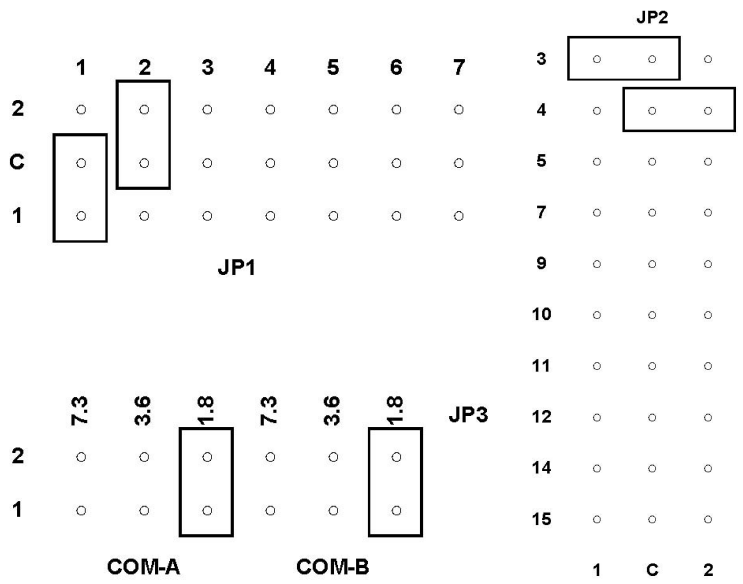


***Figure 21**, ORN-232 Rev. G configuration, JP1, JP2 & JP3*

3.1.22.3 ORN-232 Revision F Hardware

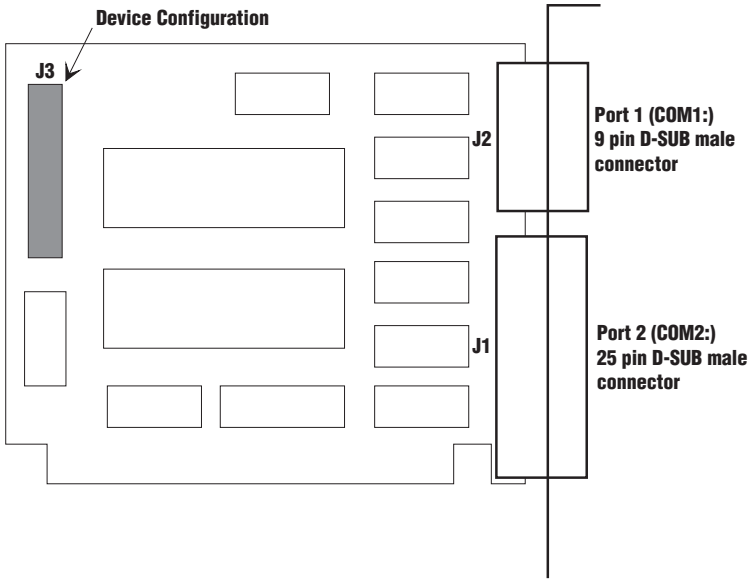


***Figure 22**, ORN-232 Rev. F Layout*

3.1.22.3.1 ORN-232 Revision F Device Configuration - J3

This communications card is configured using jumper header J3 as follows:

COM1: address 3F8H with IRQ4 (9 pin male D-Sub connector)

COM2: address 2F8H with IRQ3 (25 pin male D-Sub connector)

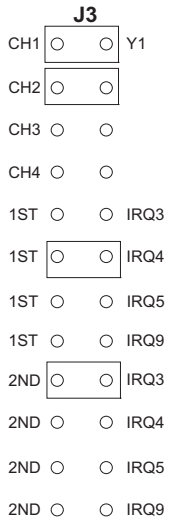


***Figure 23**, ORN-232 Rev. F configuration, J3*

3.1.22.4 ORN-232 Revision E Hardware

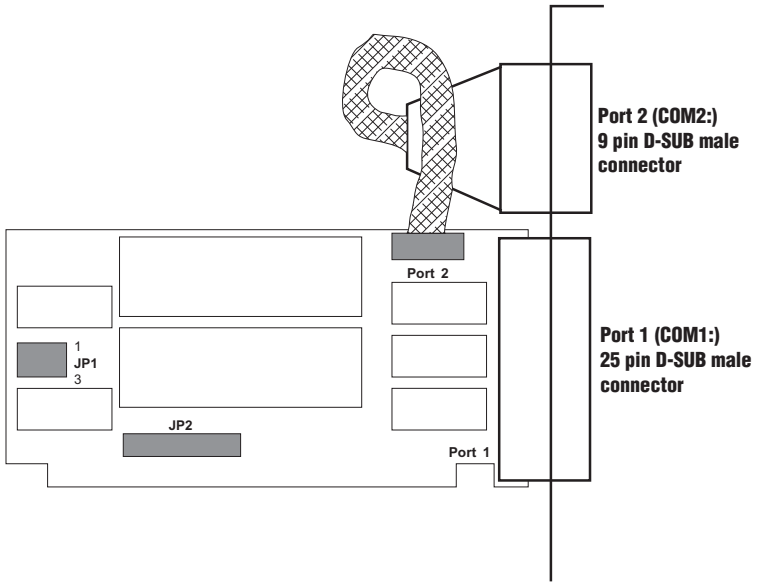


***Figure 24**, ORN-232 Rev. E Layout*

3.1.22.4.1 Device Configuration - JP1 & JP2

This communications card is configured using jumper headers JP1 and JP2 as follows:

COM1: address 3F8H with IRQ4 (25 pin male D-Sub connector)

COM2: address 2F8H with IRQ3 (9 pin male D-Sub connector)

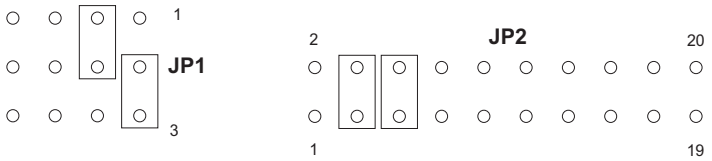


***Figure 25**, ORN-232 Rev. E configuration, JP1 & JP2*

3.1.22.5 Connector Pin Descriptions (ORN-232 Rev. E and F)

The pin assignments for both connectors are shown in **Table 21**.

Port 1 (25 pin)	**Port 2** (9 pin)	**RS-232 Signal**	**Description**
2	3	TxD	Transmit Data
3	2	RxD	Receive Data
4	7	RTS	Request to Send
5	8	CTS	Clear to Send
6	6	DSR	Data Set Ready
7	5	GND	Ground
8	1	CD	Carrier Detect
20	4	DTR	Data Terminal Ready
22.	9	RI	Ring Indicator

***Table 21,** ORN-232 Connector Descriptions for Rev. E & F*

3.1.23 Pamux I/O System

Pamux is an open standard for high speed I/O communications. It features 24-signal parallel multiplexed communications allowing access of up to 512 analog and discrete optically isolated I/O points. When the MotionBASIC EIO.MODE@ variable (EIO.MODE@=1) or the MotionDesk Unit Settings configurator (MB 4.x and higher) configures the ORION EIO interface for Pamux operation, discrete and analog I/O array variables (DIO@ and AIO@) are indexed from point 17 to 528.

ORMEC's Pamux implementation (utilizing the Opto-22 system) is based on the use of 4, 8, and 16 position I/O module racks with Brain Boards. The Brain Boards are the Pamux interface between the I/O module racks and

ORION. This section details the jumper configurations for the digital and analog Brain Boards (MIO-B5 and MIO-B6 respectively). For further information refer to the "Brain Board User's Guide" included with each Opto-22 Brain Board.

Additional wiring guidelines are included in the “Shielding and Grounding Electrical Panels” Application Note, which is included at the end of this manual.

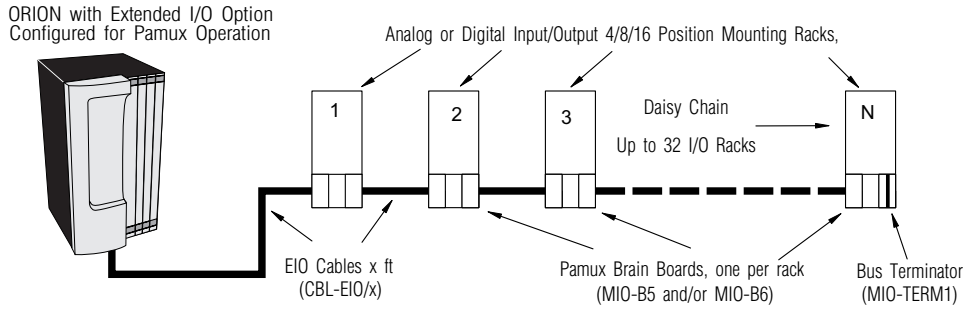


***Figure 26**, Example Pamux System Connection Diagram*

3.1.23.1 Pamux I/O Power Supplies

The Pamux Digital Brain Board (MIO-B5) and Analog Brain Board (MIO-B6) require a +5 VDC and +/-15 VDC (MIO-B6 only) power supply. The PSU-PAMUX/A and PSU-PAMUX/B power supplies are available for use with the Pamux Brain Boards. The Pamux I/O power supply should be mounted in close proximity to the Brain Boards to minimize the line voltage drop at the load. Shielded cable with the drain wire connected to earth ground should be used to minimize the possibility of interference due to electrical noise. Refer to the Opto-22 Pamux Users Guide for further Pamux Brain Board and I/O Rack power supply information.

NOTE: **Due to the tolerance on the Pamux Brain Board +5 VDC power supply (5 VDC +/-0.1 VDC), the ORION +5 VDC logic power supply is not recommended for use with Pamux Brain Boards.**

3.1.23.2 Digital Brain Board (MIO-B5) Jumper Configuration

The Pamux Digital Brain Board (MIO-B5) has 9 configuration jumpers, jumpers 0 through 4 are used to configure the board's address (refer to the Brain Board Address Jumper Configuration section, page 58). Jumpers 5 through 8 are for configuring the Pamux watchdog and reset. These jumpers must be configured as shown in **Table 22** for use with ORION. For further information refer to the "B5 Brain Board User's Guide" included with each unit.

Setting	**Description**
Jumper 5 present	Watchdog disable
Jumper 6 present	Watchdog disable
Jumper 7 removed	Active low reset
Jumper 8 removed	Reset - watchdog disable

***Table 22**, Digital Brain Board (MIO-B5) Jumper Configuration*

3.1.23.3 Analog Brain Board (MIO-B6) Jumper Configuration

The Pamux Analog Brain Board (MIO-B6) has 8 configuration jumpers, jumpers 1 through 5 are used to configure the board's address (refer to the Brain Board Address Jumper Configuration section, page 58). Jumpers 6 through 8 are for configuring the Pamux watchdog and reset. These jumpers must be configured as shown in **Table 23** for use with ORION. For further information refer to the "B6 Brain Board User's Guide" included with each unit.

Setting	**Description**
Jumper 6 removed	Unused
Jumper 7 removed	Active low reset
Jumper 8 present	Watchdog disable

***Table 23**, Digital Brain Board (MIO-B6) Jumper Configuration*

3.1.23.4 Brain Board Address Jumper Configuration

To allow the Pamux protocol to properly access each I/O point, Brain Boards have an address associated them. This address is dependent on the desired first I/O point number on the module rack, and is configured using the first 5 jumpers on the Brain Board jumper header (0-4 for an MIO-B5, and 1-5 for a MIO-B6). Refer to **Table 24** for an overview of the Brain Board addresses and the corresponding jumper configurations.

		Jumper							Jumper				
Digital Brain Board		4	3	2	1	0	Digital Brain Board		4	3	2	1	0
Analog Brain Board		5	4	3	2	1	Analog Brain Board		5	4	3	2	1
Brain Board Address	Starting DIO@	MSB				LSB	Brain Board Address	Starting DIO@	MSB				LSB
0	17	0	0	0	0	0	32	273	0	0	0	0	0
2	33	0	0	0	0	1	34	289	1	0	0	0	1
4	49	0	0	0	1	0	36	305	1	0	0	1	0
6	65	0	0	0	1	1	38	321	1	0	0	1	1
8	81	0	0	1	0	0	40	337	1	0	1	0	0
10	97	0	0	1	0	1	42	353	1	0	1	0	1
12	113	0	0	1	1	0	44	369	1	0	1	1	0
14	129	0	0	1	1	1	46	385	1	0	1	1	1
16	145	0	1	0	0	0	48	401	1	1	0	0	0
18	161	0	1	0	0	1	50	417	1	1	0	0	1
20	177	0	1	0	1	0	52	433	1	1	0	1	0
22	193	0	1	0	1	1	54	449	1	1	0	1	1
24	209	0	1	1	0	0	56	465	1	1	1	0	0
26	225	0	1	1	0	1	58	481	1	1	1	0	1
28	241	0	1	1	1	0	60	497	1	1	1	1	0
30	257	0	1	1	1	1	62	513	1	1	1	1	1
1 = jumper present, 0 = jumper not present													

***Table 24**, Brain Board Address Jumper Configuration*

3.1.23.5 Pamux Bus Terminator Board (MIO-TERM1)

The Pamux Bus Terminator Board (MIO-TB) must be plugged into the bus connector (J1 or J2) on the last Brain Board on the bus (Refer **Figure 26**). The red wire attached to the Bus Terminator Boards must be connected to the +5 VDC supply on the I/O module rack. For further information refer to the "Brain Board User's Guide" included with each Brain Board.

NOTE: **The +5 VDC terminal is under the Brain Board when the Brain Board is mounted to an I/O module rack. The red wire on the Bus Terminator Board must be connected prior to connecting the Brain Board to the I/O module rack.**

3.1.24 Ethernet Communications Adapters

Three Ethernet communications adapters are available for use in an ORION controller, one PC Card based and two half-length IBM PC cards (ISA). All three support RJ45 and BNC connectors, and the 3C509 contains an AUI connector as well.

The ORION controller supports the use of up to two Ethernet adapters in an ORION. The two adapters can consist of any combination of ORN-E3C509 and ORN-ENE2000 adapters, and up to one PCC-E3C589.

NOTE: **Prior to MotionBASIC 5.0.3, no more than one adapter of each type could be used in a single ORION. For example: An ORN-ENE2000 and an ORN-E3C509 could be used together in the same ORION, but two ORN-ENE2000 adapters could not.**

NOTE: **MotionBASIC 4 or higher is required for using the Ethernet Communications Adapters.**

Use of ORMEC's Ethernet Communications Adapters requires a working knowledge of TCP/IP network addressing.

3.1.24.1 Ethernet Communications Adapter Hardware

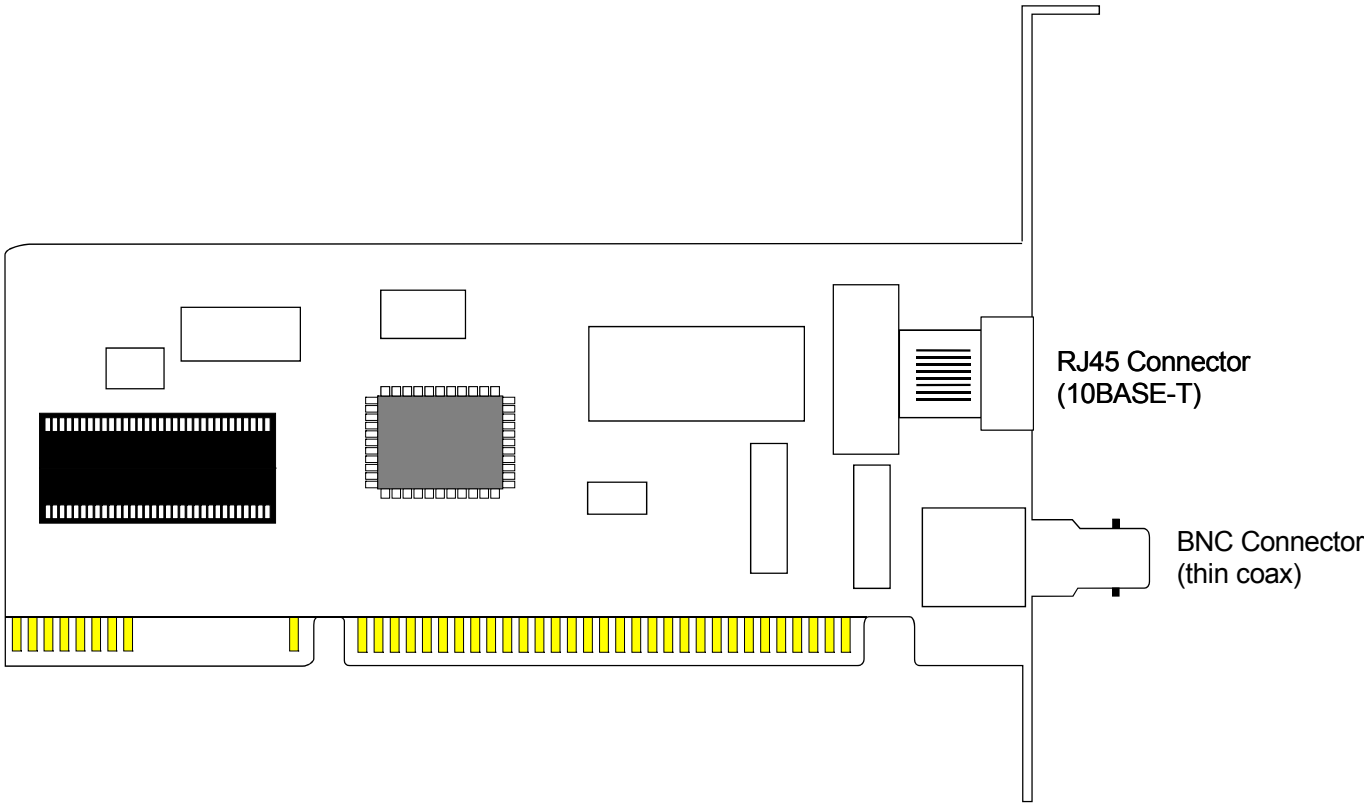


Figure 27, ORN-ENE2000 Layout

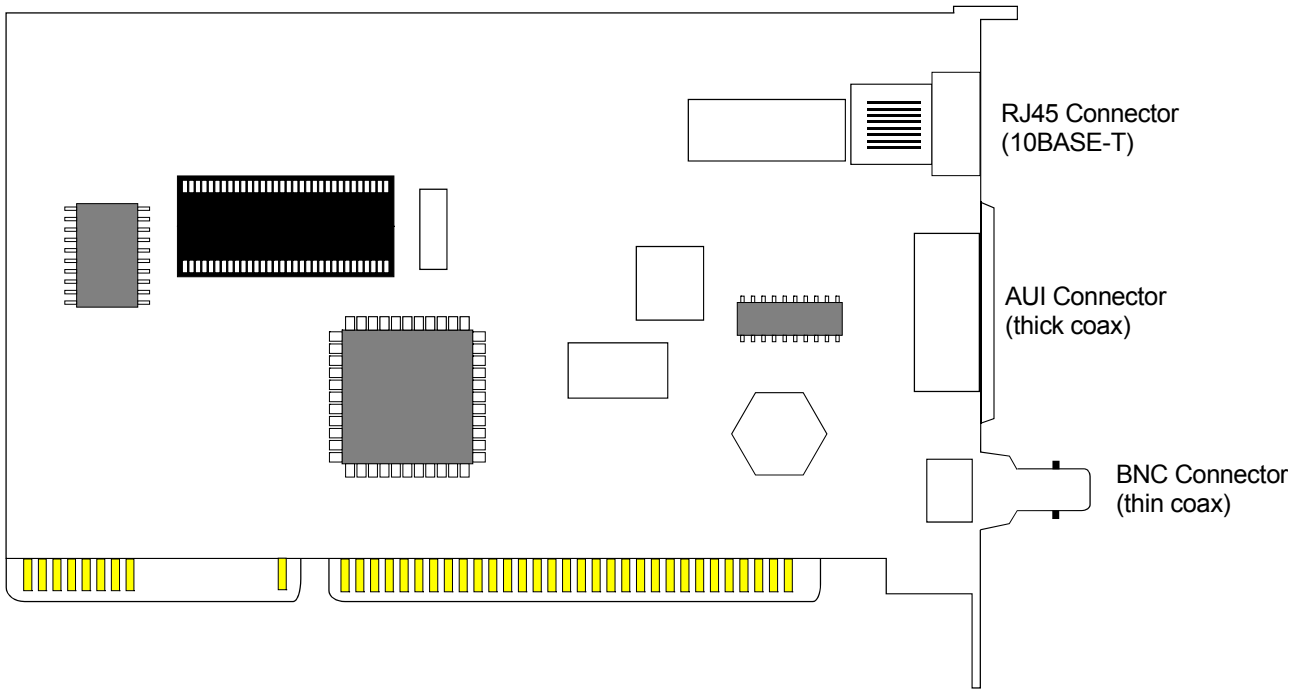


Figure 28, ORN-E3C509 Layout

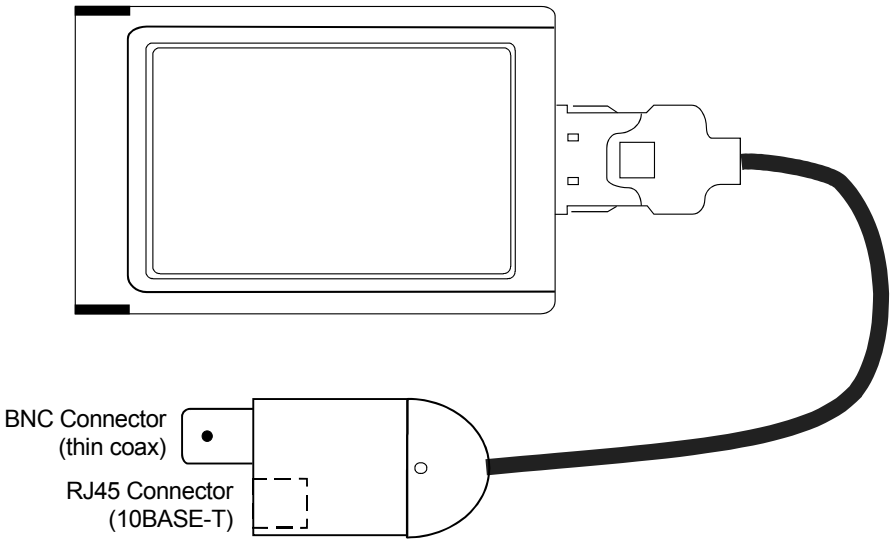


***Figure 29**, PCC-E3C589 Layout*

3.1.24.2 Ethernet Communications: Adapter Configuration

Ethernet communications adapters used in ORIONs have no hardware configuration jumpers; they are configured with a software setup utility supplied by the manufacturer along with the card.

ORMEC-supplied Ethernet Adapters: ORN-ENE2000 & ORN-E3C509
All Ethernet adapters supplied by ORMEC are configured and tested at the factory to use the correct I/O address and IRQ as shown in **Table 25**. They are also configured by default to use the RJ45 connector.

- If you want to use the **RJ45** connector, the card is already configured correctly. You do not need to run the software setup utility.
- If you want to use the **BNC** or **AUI** connector, you will need to run the software setup utility to change the connector type. This requires temporarily installing the card into the computer you will use to run the setup utility. See the manufacturer's installation manual for details.
- **Non-ORMEC-supplied Ethernet Adapters**
  You will need to run the software setup utility to set I/O address and IRQ settings as shown in **Table 25** below, as well as the connector type. This requires temporarily installing the card into the computer you will use, in order to run the software setup utility. See the manufacturer's installation manual for details.

NOTE: **Ethernet adapters used in an ORION controller must have Plug -N-Play support disabled using the software setup utility, prior to installation in the ORION.**

Ethernet Adapter	I/O Address	IRQ
ORN-ENE2000	0x300	10
ORN-E3C509	0x320	11
PCC-E3C589	0x360	5

***Table 25**, Ethernet adapter ORMEC **required** settings*

WARNING: **Due to the potential for resource conflicts, DO NOT CHANGE THE ETHERNET ADAPTER I/O ADDRESS OR IRQ SETTINGS FROM THE VALUES SHOWN IN Table 25.**

3.1.24.3 Ethernet Communications: ORION Configuration

1) **Determine the proper IP Address and SubNet mask**
Consult your Network Administrator to obtain an IP address and SubNet mask that is compatible with your existing network**. If you are adding the ORION to an existing network, it is likely that the default values shown below will have to be changed.**

Ethernet Adapter	IP Address	SubNet Mask
ORN-ENE2000	192.168.64.40	255.255.224.0
ORN-E3C509	192.168.64.42	255.255.224.0
PCC-E3C589	192.168.64.41	255.255.224.0

***Table 26**, ORION Ethernet adapter IP address & SubNet Mask default values*

2) **Change the ORION Ethernet Configuration in MotionDesk**

For MotionDesk 2.0.x:

- The ORION Ethernet configuration is in file ORION.INI, located in subdirectory library in the MotionDesk installation directory. (Default: \Program Files\Ormec\MotionDesk\library)
- Use MotionPad to open the ORION.INI file, and change the IP Address and SubNet Mask to the values determined in Step 1 above. Edit the section with the label that matches your adapter model.

For MotionDesk 2.1.x and higher:

- In Project Navigator, right-click on *Unit Properties*, select *Insert Device*, and choose the appropriate Ethernet Adapter model.
- Select the *IP Address* tab, and configure the *IP Address* and *SubNet Mask* to the values determined in Step 1 above.
- Select the *Hardware Settings* tab, and select the connector type you will be using. The connector type selected should match what you specified in the Ethernet adapter card setup in the Ethernet Communications Adapter Hardware section (page 60).
- If you want to use an Ethernet network for MotionDesk development communications (instead of the normal Dial Up Networking), select the *Security* tab to enter a password. This ensures that the ORION will not accept command channel communications (*Sync, Direct Mode*, *Console,* etc.) unless the correct password is transmitted. The password has no effect for normal factory network communications, such as Quantum Ethernet or AB Ethernet.

3) **Transfer the settings to the ORION**

- Establish development communications (normally Dial Up Networking) between your development PC and the ORION.

For MotionDesk 2.0.x:

- Copy your newly-edited ORION.INI file to the root directory of the MotionBASIC System Card, using MotionDesk Filer. Refer to MotionDesk Help for more information on using MotionDesk Filer.

For MotionDesk 2.1.x & higher:

- Sync the project, and then reboot the ORION.

3.1.24.4 Ethernet Communications: MotionDesk Development Communications using Ethernet

The following is an overview of the steps to follow for installing an ORMEC supported Ethernet adapter in an ORION controller for MotionDesk development communications. The details for some of the steps are included in the Sections 3.1.24.2 and 3.1.24.3, above.

NOTE: This section pertains only to the use of an ORION Ethernet adapter for MotionDesk development communications. Use of the Ethernet adapter for factory network run-time communications such as Quantum Ethernet or AB Ethernet do not require this outline to be followed.

1) Install and configure an Ethernet card in your development computer, consult your Network Administrator for assistance.
2) Make sure the Ethernet adapter to be installed in the ORION is properly configured according to section 3.1.24.2 Ethernet Communications: Adapter Configuration. With ORION power disabled, install it in the ORION controller.
3) Turn on the ORION power and establish communications using MotionDesk and the ORION Serial Development Port. Refer to the MotionDesk Help for further information.
4) Sync the MotionDesk project with the Ethernet Communications ORION configuration (done in section 3.1.24.3, Step 2)
5) Exit MotionDesk, and disconnect the cable from the ORION Serial Development Communications port.
6) Cycle power to the ORION.
7) Connect the Ethernet card in your development computer to the Ethernet card in the ORION.
8) Run MotionDesk, and use the MotionDesk View\Preferences\General menu to change the Unit Name to match the IP address of the Ethernet adapter installed in the ORION, as you configured in section 3.1.24.2.
9) Establish Ethernet communications with the ORION.

3.2 ORION Controller Operation

3.2.1 Powerup (ORION System Module)

ORION Motion Controllers are user-programmable devices and operation is dependent on the MotionBASIC program loaded on the System Card Flash memory.

Whenever AC power is applied to the controller, or the red Reset push-button on the *Orion System Module* is pressed, the motion controller executes the following powerup sequence, which can last 30 to 60 seconds. A vertical line scrolls across the System Status Display, at varying speeds, during the powerup sequence.

NOTE: Until MotionBASIC is initialized the state of the Status LEDs on the *ORION System Module* do not properly indicate the system status.

- The ORION checks for a MotionBASIC System Card in PC Card 1. If PC Card 1 is empty (no PC Card of any type), the ORION checks for a MotionBASIC System Card in PC Card 2. The ORION will not complete the power sequence if it cannot find a MotionBASIC System Card in either PC Card Slot.
- On-line diagnostics are performed which verify *motherboard, ORION System Module, ServoWire Axis Module* and *DSP Axis Module* operation.
- The number of MotionCredits installed on the *ORION System Module* is determined (refer to the MotionKeys and MotionCredits section, page 40, of the ORION Controller chapter).
- MotionBASIC and any installed MotionBASIC Extensions are initialized and the total number of MotionCredits required for operation is calculated.
- If the PCC/SYS card has been updated for compatibility with an Orion O_1 = F option, the system display will flash "SYS2.0". This indicates the card will work with all processor options of the Orion controller.
- All the segments of the System Status LEDs are lit at once, and then turned off one at a time, except for the No Fault LED and possibly the +24 VDC and E-Stop OK LEDs. The +24 VDC and E-Stop OK LEDs will be lit throughout the sequence, if there is power supplied to them (+24 VDC supply and E-Stop input on TB8), otherwise they will be off.
- The Watchdog OK LED begins to flash, if no System Faults (FAULT@=0) are detected the No Fault LED is illuminated, and the MotionBASIC version (e.g. MB 3.2a) and the versions of any installed MotionBASIC Extensions (e.g. QP 1.0c - QuickPanel MBX) are displayed one character at a time on the System Status Display.
- The number of MotionCredits required to operate MotionBASIC and any installed MotionBASIC Extensions is compared with the number installed. If the number of MotionCredits installed is insufficient, the System Status Display shows "F12" (FAULT@=12) and the MotionKey Fault LED is lit. The ORION sign-on message in MotionDesk shows the number of MotionCredits installed on the *ORION System Module* and the number required to operate MotionBASIC and any installed MotionBASIC Extensions. Checking the MotionCredits is performed only once at powerup.
- At this point the application software is loaded into the program memory based on the status of push-button PB1 on the *ORION System Module*.

3.2.1.1 MotionBASIC version 3.x Powerup (ORION System Module)

IF PB1 IS NOT HELD PRESSED during the powerup sequence:[18]

- If an AUTOLOAD.BAS program is stored on PC Card 2 (left slot), and has a line 0, it is loaded into the program memory and executed.
- If an AUTOLOAD.BAS program is not available the last program saved from program memory is reloaded, if this program has a line 0, then it is executed and the motion controller enters indirect mode (program execution) operation, the Program Stopped LED is not illuminated, and the System Status Display is blank.

IF PB1 IS HELD PRESSED during the powerup sequence:

NOTE: It is necessary to hold the PB1 push-button only until the ORION starts its Powerup on-line diagnostics (indicated by the vertical bar scrolling across the Status display).

- The ORION checks for one of the following programs in the order shown:

  PB1LOAD.BAS stored on PC Card 2 (left slot)
  PB1LOAD.BAS stored on PC Card 1 (right slot)

  The first program found is loaded into program memory. If neither one is found, the last program saved from the program memory is reloaded.

- While a program is being loaded into program memory, the corresponding PC Card LED will flash indicating the card is being accessed.
- After the project loading is complete, program execution is inhibited and the motion controller enters direct mode operation, the Program Stopped LED is illuminated, and a pulsing "starburst" pattern is displayed on the System Status Display.

It is important to note that:

- Non-volatile variables are stored in 32K bytes of battery backed RAM on the *ORION System Module*. Variable values are retained through power cycles and pressing the controller Reset button.
- All ORMEC variables are volatile, program variables must be declared non-volatile. Refer to the MotionBASIC Hypertext Software Manual NONVOL section for further information.

3.2.1.2 MotionBASIC version 4.x Powerup (ORION System Module)

IF PB1 IS NOT HELD PRESSED during the powerup sequence:[19]

[18]The MotionBASIC System Card must be in PC Card 1 (right slot) in order for the program loading sequence for PB1LOAD.BAS and AUTOLOAD.BAS to execute properly.

- If an AUTOLOAD.MTP project file is stored on PC Card 2 (left slot), and has a label MAIN:, it is loaded into the program memory and executed. NOTE: An AUTOLOAD.MTP project file on the MotionBASIC System Card is ignored.

- If an AUTOLOAD.MTP project file is not available, the last project loaded into program memory is reloaded; if this program has a label MAIN:, then it is executed and the ORION enters indirect mode (program execution) operation, the Program Stopped LED is not lit, and the System Status Display is blank.

IF PB1 IS HELD PRESSED during the powerup sequence:

NOTE: It is necessary to hold the PB1 push-button until the ORION starts its Powerup on-line diagnostics (indicated by the vertical bar scrolling across the Status display).

- The ORION checks for one of the following project files in the order shown:

  PB1LOAD.MTP stored on PC Card 2 (left slot)
  PB1LOAD.MTP stored on PC Card 1 (right slot)

The first PB1LOAD project file found is loaded into program memory. If neither file is found, the last project loaded into program memory is reloaded.

- While a program is being loaded into program memory, the corresponding PC Card LED will flash indicating the card is being accessed.

- After the project loading is complete, program execution is inhibited and the motion controller enters direct mode operation, the Program Stopped LED is illuminated, and a pulsing "starburst" pattern is displayed on the System Status Display.

It is important to note that:

- Non-volatile variables are stored in 32K bytes of battery backed RAM on the *ORION System Module*. Variable values are retained through power cycles and pressing the controller Reset button.

- All ORMEC variables are volatile, program variables must be declared non-volatile. Refer to the MotionBASIC Help NONVOL section for further information.

3.2.2 Power Fault (ORION System Module)

ORION controllers have circuitry which senses loss of incoming AC power before the +5 VDC controller power goes below specification (1/2 cycle power loss acceptable, 1 cycle power loss will result in a Power Fault condition). When a Power Fault condition is detected:

[19]The MotionBASIC System Card must be in PC Card Slot 1 (right slot) in order for the program loading sequence for PB1LOAD.MTP and AUTOLOAD.MTP to execute properly.

- All outputs are unasserted.
- The No-Fault relay contacts open (TB8 - No Fault).
- If used, the Machine-No Fault outputs are unasserted (DIO@(2), DIO@(4), DIO@(6) & DIO@(8)).
- All DSP axis enable outputs (T-ENABLE') are unasserted.
- The Watchdog OK light is OFF (not flashing).
- The System Status Display shows "E1999 ".
- All processing by the main CPU is suspended.

If the +5 VDC controller power supply goes below specification, or power is cycled off and back on, then the CPU will be reset normally (as described in the Powerup (ORION System Module) section, page 64, of this chapter) when +5 VDC power is restored, and ERR will retain the value of the last error that occurred before the power fault.

If AC power is restored before the +5 VDC controller power supply goes out of specification, the unit will be inoperative with the System Status Display showing "E1999 ", the Watchdog OK light not blinking and ERR=1999.

This Temporary Power Loss fault may be cleared by pressing the red RESET pushbutton on the front of the unit, or by cycling the ORION power. After pressing the red RESET button operation should proceed normally, with the exception that the ERR variable will be initially set to 1999. After cycling the ORION power, operation should proceed normally, and the ERR variable will be reset.

3.2.3 System Status Display (ORION System Module)

The System Status Display, found on the *ORION System Module*, is a red, 5x7 single character alphanumeric indicator. Refer to Appendix A-3 for the location of the System Status Display on the *ORION System Module*. The System Status Display provides the functionality shown in **Table 27**.

System State	**Display State**
Powerup: On-line diagnostics	A Vertical bar scrolls across the display with varying frequency.
Powerup: PCC-SYS identification	If the PCC-SYS card has been updated for use with Orion O_1=F controller. “SYS2.0” will be displayed one character at a time.
Powerup: MotionBASIC initialization	When MotionBASIC initialization, and the initialization of any installed MotionBASIC Extensions is complete, the versions of each are displayed one character at a time. If a System Fault (FAULT@>0) is found then the display shows F## where ## corresponds to the MotionBASIC System Fault bit that is set. If more than one System Fault is detected then the display will show an F## message for each bit set. Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the

	MotionBASIC Help (for MB 4.x and higher) for further information regarding the FAULT@ variable.
Direct mode operation	A pulsing "starburst" is displayed (Program Stopped LED is illuminated). After a MotionBASIC error an "E" followed by the appropriate MotionBASIC error code is displayed until the next valid MotionBASIC statement is executed.
Indirect mode operation (program running)	Blank (Program Stopped LED is not illuminated)
Watchdog fault	E1998 (MotionBASIC Error Code 1998)
Power Fault	E1999 (MotionBASIC Error Code 1999)

***Table 27**, System Status Display functionality*

3.2.4 System Status LEDs (ORION System Module)

Ten *System Status LEDs* (one 10-segment LED) are provided on the *Orion System Module* to aid in system troubleshooting and status monitoring. Refer to **Table 28** for a list of the LEDs and descriptions of what they indicate. For further information regarding the *System Status LEDs* refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher).

Name	Color	Description
Watchdog	Green	During normal operation this LED flashes approximately once per second (twice per second for MB 4.x and higher with MotionDesk connected). If this LED is not flashing it indicates that a **Watchdog Time-out** or **Temporary Power Loss** has occurred, the *No Fault Relay* will be opened and all local DIO outputs will be disabled.
E-Stop OK	Green	Assertion indicates that power (+12 to 35 VDC or 12 to 30 VAC) is supplied to the *Emergency Stop* (E-Stop) input. Refer to the system wiring diagrams in Appendix B for further information regarding the recommended E-Stop circuit wiring.
No Fault	Green	Assertion indicates that the *No-Fault* (No Fault) relay contact is held closed. Closure of the *No-Fault* (No Fault) relay is conditional provided that there is power to the controller, no internal faults, and power is applied to the *Emergency Stop* (E-Stop) input. Refer to the system wiring diagrams in Appendix B for further information regarding the recommended E-Stop circuit wiring.
+24 VDC	Yellow	Assertion indicates that +24 VDC is present at TB8 +24 pin on the *ORION System Module*. If the controller does not have an internal 24 VDC Field Power supply, this LED indicates that an external power supply is providing the +12 to +35 VDC power.
MBX 1 MBX 2	Yellow Yellow	Reserved for use by MotionBASIC Extensions.
User 1 User 2	Yellow Red	Provided for user program status indication. These LEDs are controlled by the value of the MotionBASIC USER1.LED@ and USER2.LED@ variables.
MotionKey Fault	Red	Assertion indicates that either no MotionKey is installed on the ORION System Module; or that the MotionKey does not have enough MotionCredits for MotionBASIC and any installed MotionBASIC Extensions.
Program Stopped	Red	Assertion indicates that no MotionBASIC application program is being executed.

***Table 28**, System Status LEDs*

3.2.5 PC Card Status LEDs (ORION System Module)

A pair of green LEDs is provided under the PC Card slots on the *ORION System Module*. These LEDs are lit when the controller is accessing (reading or writing data) the corresponding PC Card.

WARNING: DO NOT REMOVE A PC CARD, OR TURN OFF THE ORION POWER, WHILE THE GREEN PC CARD ACCESS LED IS LIT.

3.2.6 Serial Port Status LEDs (ORION System Module)

Twelve *Serial Port Status LEDs* (4 LEDs for each Serial Port) are provided on the *ORION System Module* to aid in troubleshooting and status monitoring of Development and ORION Serial Ports (Serial 1 and Serial 2) communications. Refer to **Table 29** for a list of the LEDs and what they indicate.

Name	Color	Description
Sending Serial	Yellow	Indicates that the ORION controller is transmitting data through the corresponding serial port.
Receiving Serial	Yellow	Indicates that the ORION controller is receiving data through the corresponding serial port.
OK to Transmit	Green	Indicates that the corresponding serial port "handshake" signal is properly configured to allow the ORION controller to transmit data.
Ready to Receive	Green	Indicates that the corresponding serial port "handshake" signal is properly configured to allow transmission of data to the ORION controller from the transmitting device.

***Table 29**, Serial Port Status LEDs*

3.2.7 CAN Status Indicator LEDs (ORION System Module)

Two LEDs, labeled MS and NS, are provided on the *ORION System Module* between J3 and TB7 for indicating CAN communications status. Refer to Appendix A-3 for the location of the CAN Status Indicator LEDs on the *ORION System Module*. These LEDs are reserved for use with future MotionBASIC CAN serial communications network support.

NOTE: If your ORION includes the CAN interface delete option, these LEDs will not be present. Refer to the ORION Model Number Description section (page 16)of the General Description chapter for further ORION part number information.

3.2.8 Initial Configuration (MotionBASIC 3.x Systems Only)

All ORION motion control systems are configured and tested at ORMEC as a complete system. As part of that procedure, a MotionBASIC program named SETUP.BAS is installed in the unit.

In addition, if a "lot system test" (integrated system test) has been performed, the specification parameters for the motors purchased with the system are selected using MotionPRO and this configuration is loaded into the CONFIG.BAS data file for the unit. This file, along with the associated documentation about the system configuration provided is designed to facilitate setting up your motion control system and checking it out for the first time.

3.3 ORION Controller Specifications

3.3.1 General Specifications

CPU Processor types	80486-DX2 66 MHz 80486-DX4 100 MHz 80586 133 MHz Pentium 133 MHz Pentium MMX 233 MHz Atom 1.6 GHz
Total controller memory[20]	4M bytes (DRAM)
MotionBASIC program memory[20]	500K bytes
Non-volatile variable memory[20]	32K bytes (battery backed SRAM)
Memory Cards	Interface Format: ATA System Cards: 6, 9, 16, 32, 64, 136 Mbytes ATA Flash Card: 4, 6, 10, 20, 40, 85 Mbytes SRAM Memory Card: 1, 2, 4 Mbytes ATA Hard Drive: 170, 260 Mbytes

***Table 30**, ORION Controller General Specifications*

[20] Refer to the Orion Memory chapter of the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding memory utilization.

3.3.2 Mechanical and Environmental Specifications

Dimensions	
Model 30	16.3"h x 9.3"w x 7.6"d maximum (414h x 236w x 193d mm)
Model 50	16.3"h x 10.9"w x 7.6"d maximum (414h x 277w x 193d mm)
Model 70	6.3"h x 12.5"w x 7.6"d maximum (414h x 318w x 193d mm)
Weight	
Model 30	17.2 lb. (7.8 kg), without I/O modules
Model 50	18.2 lb. (8.3 kg), without I/O modules
Model 70	19.9 lb. (9.0 kg), without I/O modules
DSP Axis Module	1.2 lb. (0.55 kg)
/F Processor Option	+.4 lb. (0.18 kg), additional Model 30, 50, 70 weight
Operating Temperature	
80x86 Processor:	
with cooling fan option	0C to 55C (32°F to 131°F)
without cooling fan option	0C to 40C (32°F to 104°F)
Pentium Processor:	
with cooling fan option	0C to 50C (32°F to 122°F)
without cooling fan option	0C to 40C (32°F to 104°F)
Atom Processor:	
with cooling fan only	0C to 50C (32°F to 122°F)
Storage Temperature	-25C to 70C (-13°F to 158°F)
Relative Humidity	5 to 95% non-condensing (RH-2)
EN61131-2 ESD Severity Level	ESD-4
Mounting & Airflow	Mounting must be vertical; Airflow must be unrestricted.
Altitude	6,562 ft. (2000 M)
EN61131-2 Pollution Rating	Degree 3

***Table 31**, ORION Controller Mechanical and Environmental Specifications*

3.3.3 Power Specifications

3.3.3.1 Input Power

Motion Controller (L1 to L2)	115 VAC (90 - 127 VAC), 47 - 63 Hz – or – 230 VAC[21] (190 - 253 VAC), 47 - 63 Hz Model 30: 208 W max Model 50: 283 W max Model 70: 283 W max (not including control power to servodrives) Isolation: Class 1, 240 VAC, 20 amp (incl. ORION and all subassemblies).
ServoWire Drive Control Power	115 or 230 VAC, 50/60 Hz SAC-SW203, 205, 210 & 217 20 W typical (45 W max.) SAC-SW220 30 W typical (55 W max.)
SAC-DE Servodrive Control Power	115 VAC or 230 VAC, 50 W (+10%, -15%), 50/60Hz, depending on model
SAC-D Servodrive Control Power	230 VAC, 115 watts (+10%, -15%), 50/60Hz
F-Series Servodrive Control Power	95 to 132 VAC, 350 watts max., 50/60 Hz
ServoWire Axis Module	5 VDC @ 1 A +12 VDC @ 70 mA/Axis Module @ 60 mA/Drive connected 11.6 W total (w/ 8 drives connected)
DSP Axis Module	5 VDC @ 1.9 A typ. (3.57 A max.) +12 VDC @ 22.3 mA -12 VDC @ 51.6 mA 9.9 W total
Lineshaft Pacer Encoders EDR-25_/_nnnn	5 VDC @ 245 mA maximum, 1.23 watts
MMI-840	9 to 30 VDC, 5 watts total (1.3 A in-rush)
QuickPanel	24 VDC MMI-QP2/5M: 500 mA, 12 watts max. MMI-QP2/5C: 625 mA, 15 watts max.
G4-IDC-5B	12 VDC, 45 mA max.

[21] Once the input voltage passes the threshold of 132VAC, it has 1/4th of the power cycle (4-5mS) to enter the high voltage range (190-253VAC). Failure to do this can cause failure of the line fuse.

***Table 32**, ORION Controller and Accessories Input Power*

3.3.3.2 Output Power

AC Power TB1, r & t	VAC output phases same as VAC input phases at L1 and L2 Model 30: 8.3 amps RMS maximum Model 50: 12.5 amps RMS maximum Model 70: 17.5 amps RMS maximum
+24 VDC (optional power supply) +24 to RTN on TB2 & TB8 V+ to V- on TB7[22]	24 VDC, +/-7% (separate from ORION logic power supply), referenced to the ORION frame ground 1.5 A total maximum
+12 VDC +12V to RTN on TB2	12 VDC, +/-5% 0.5 A maximum
+5 VDC +5 to R5 on TB8 +5 VDC to DGND on J6 & J7 per motherboard slot	5 VDC, +/-5% 1.0 A maximum 500 mA maximum 2.5 A maximum
-5 VDC per motherboard slot	5 VDC, +/-5% 500 mA maximum
+/-12 VDC (internal) per motherboard slot	+/-12 VDC, +/-5% 500 mA maximum

***Table 33**, ORION Controller Connector Output Power Ratings*

Note: The Output Power Specifications shown in **Table 33** are the maximum current available per output pin. The additional aggregate limits below must also be met at a temperature less than the maximum operating temperature.

	Model 30	**Model 50**	**Model 70**
Total +24/+12 VDC (I/O P.S.)	1.5 A max.	1.5 A max.	1.5 A max.
Total +5 VDC	10 A max.	16 A max.	16 A max.
Total -5 VDC	0.75 A max.	0.75 A max.	0.75 A max.
Total +12 VDC (internal)	2 A max.	3 A max.	3 A max.
Total -12 VDC (internal)	0.65 A max.	0.65 A max.	0.65 A max.
Total DC Power[123]	85 watts max.	127 watts max.	127 watts max.

***Table 34**, ORION Controller Total Output Power*

[22] Requires appropriate jumper configuration (J47), refer to the CAN Terminal Block Power Configuration - J47 (ORION System Module) section (page 25) of the ORION Controller chapter.

[23] Total DC Power value does not include +24/+12 VDC I/O power supply output.

The values in **Table 34** are the total current and power available for DSPs, motherboard cards, and external field wiring.

Example:

A system with 2 DSPs, one EDR-25S/A pacer encoder, and eight G4-IDC-5 DC input modules using 24 VDC provided at TB2. To analyze power requirements, first ascertain that each voltage/current requirement is within specifications. Then ascertain that the total wattage requirements are within specifications.

Calculate +5 VDC usage:

Two DSP Axis Modules	2 * 1.9 A	= 3.8 A
One EDR-25S/A	0.245A	= 0.245 A
	Total	= 4.045 A

This is less than the available 10 A of +5 VDC and so is acceptable.

Calculate +24 VDC usage:

Eight G4-IDC-5 Modules	8 * 20 mA	= 0.16 A

This is less than the available 1.5 A of +24 VDC and so is acceptable.

Calculate the total power usage:

Two DSP Axis Modules	2 * 9.9 W	= 19.8 W
One EDR-25S/A	1.23 W	= 1.23 W
Eight G4-IDC-5 Modules	8 * 0.48	= 3.84 W
	Total	= 24.9 W

This is less than the available 85 W and so is acceptable.

3.3.4 Non-Volatile Memory Battery Specifications

The non-volatile variable memory battery is a Lithium battery used to preserve non-volatile variables while the ORION input power is off.

Shelf Life	10 years
Working Life[1]	10 years
Capacity	1000 milliamp hours
Output Voltage	3.0 to 3.1 VDC when new 2.75 VDC with 10% life remaining 2.50 VDC with 1% life remaining
Manufacturer P/N	Renata, CR2477-N

***Table 35**, ORION Non-Volatile Memory Battery*

3.3.5 PC Card Slot Specifications

Slot 1 Type I or II, PCMCIA
Slot 2 Type I or II, PCMCIA

3.3.6 Interface Specifications

3.3.6.1 Development Serial Port - J1

Connector	RJ11 Modular Jack
Standards	EIA RS-232C
Default Config.	8 data bits 1 stop bit no parity
Baud Rates	38400, 19200, 9600, 4800, 2400 Unit will autobaud to one of the above baud rates upon receipt of two "carriage return" characters after "powerup" or "reset". See the MotionBASIC manual for details

***Table 36**, ORION Development Serial Port – J1*

3.3.6.2 ORION Serial Ports - J2 & J3

Connector	RJ45 Modular Jack
Standards	EIA RS-422/485
Default Config.	8 data bits 1 stop bits no parity
Baud Rates	115.2K, 57.6K, 38.4K, 19.2K, 9600, 4800, 2400, 1200

***Table 37**, ORION Serial Ports – J2 & J3*

3.3.6.3 DIO Board Power Terminal Block - TB2

Connector	5 pin pluggable terminal block
+24, RTN (optional power supply) (pins 1, 4)	24 VDC Power and Return Appendix C-5
Voltage from +24 to RTN Current Output	+24 VDC +/-7% 1.5A maximum (incl. +12 VDC output)
+12 (pin 3)	+12 VDC Power (derived from +24 VDC) Appendix C-5
Voltage from +12 to RTN Current Output	+12 VDC +/-5% 0.5A maximum
V, C (pins 2, 5)	I/O Power Bus Power and Common Appendix C-4
Voltage rating Current rating	60 VDC or 280 VAC maximum 3 amps maximum

***Table 38**, DIO Board Power Terminal Block – TB2*

3.3.6.4 CAN Terminal Block - TB7 (Optional)

Connector	5 pin pluggable terminal block
V+, V- (pins 1, 5)	24 VDC Power and Return
Voltage from V+ to V- Current Output	+24 VDC 1.5A maximum
Power supply available for use by devices connected to CAN interface. These outputs are default configured disabled by jumper header J47, refer to the CAN Terminal Block Power Configuration - J47 (ORION System Module) section (page 25) for further information. NOTE: The V+ +24 VDC power supply output terminal is not fused (the internal ORION Field I/O Power Supply has short circuit protection).	

***Table 39**, CAN Terminal Block – TB7*

3.3.6.5 Interlock Terminal Block - TB8

Connector	8 pin pluggable terminal block
+24, RTN (optional power supply) (pins 1, 3)	24 VDC Power and Return Appendix C-3
Voltage from +24 to RTN Current Output	+24 VDC +/-7% 1.5A maximum
E-Stop (pin 2)	Emergency Stop Input Appendix C-3
Voltage input range Turn-On Current Input Resistance	+12 to +35 VDC or 12 to 30 VAC 1.0 mA minimum 3.3K ohms
No Fault (pins 4, 5)	No Fault Relay Appendix C-3
Voltage Current	24 VDC or 240 VAC maximum (nominal) 2 A maximum
+5, R5 (pin 7, 8)	5 VDC Power and Return Appendix C-3
Voltage from +5 to R5 Current Output	+5 VDC +/-5% 1.0 A maximum

***Table 40**, Interlock Terminal Block – TB8*

3.3.7 Discrete Input/Output Module Specifications

General I/O Module Specifications	
Isolation (Input to Output)	4000 Volts RMS
Storage Temperature	-40 to 85C
Operating Temperature	-30 to 70C
Overall Dimensions	1.6" x 1.9" x 0.48" (41 x 49 x 12 mm)
Approximate Weight	1.2 oz (165 g)
Visual Indicator	LED indicator on module lit to indicate the ON state in MotionBASIC.
Monitoring Point	On MPU (logic) side of isolation
Output Module Circuit Protection	Fused, 250 V, 4 amps rated
	(Wickman Part Number: 19370-062-K)
Output Module Types	1 contact per module, solid state (except for G4-ODC-5R which is N.O.), individually isolated

DC Input Modules	Units	G4-IDC-5	G4-IDC-5B
Input Voltage	VDC	10-32	4-16
Reverse Voltage Protection	volts	32.00	16.00
Operate Voltage (ON)	volts	10.00	3.00
Release Voltage (OFF)	volts	3.00	1.00
Input Current at Maximum Input Voltage	mA max.	25.00	45.00
Input Current at Rated Release Voltage	mA max.	1.00	0.70
Turn On Time	msec max.	5.00	0.05
Turn Off Time	msec max.	5.00	0.10
EN 61131-2 Input Type		Type 1 (U_n = 20 VDC)	Type 1 (U_n = 12 VDC)

DC Output Modules	Units	G4-ODC-5	G4-ODC-5R
Load Voltage, maximum	VDC	60.00	100 (130 VAC)
Load Voltage, range	VDC	5-60	0 to max.
Current Rating at 45C	amps	3.00	0.50
Current Rating at 70C	amps	2.00	0.50
Output Voltage Drop	VDC max.	1.60	0.30
Off State Current Leakage	mA max (60 VDC)	1.00	0.00
Turn On Time	msec max.	0.50	0.50
Turn Off Time	msec max.	0.50	0.50
Mechanical Life	cycles	n/a	5×10^6
Contact Bounce	msec max.	n/a	0.25
EN 61131-2 Output Type		Short-circuit proof	

AC Input Modules	Units	G4-IAC-5	G4-IAC-5A
Input Voltage	VAC	90-140	180-280
Operate Voltage (ON)	VAC min.	90.00	180.00
Release Voltage (OFF)	VAC max.	45.00	45.00
Input Current at Max. Input Voltage	mA max.	11.00	11.00
Input Current at Rated Release Voltage	mA max.	3.00	3.00
Turn On Time	msec max.	20.00	20.00
Turn Off Time	msec max.	20.00	20.00
EN 61131-2 Input Type		Type 1	Type 1
		(U_n = 100 VAC)	(U_n = 200 VAC)

AC Output Modules	Units	G4-OAC-5	G4-OAC-5A
Load Voltage, nominal	VAC (25 to 65 Hz)	120.00	240.00
Load Voltage, range	VAC	12-140	24-280
Repetitive Blocking Voltages	volts peak	500.00	500.00
Current Rating at 45C	amps	3.00	3.00
Current Rating at 70C	amps	2.00	2.00
One Cycle Surge Current	amps max.	80.00	80.00
Output Voltage Drop	VAC max.	1.60	1.60
Off State Current Leakage	mA max. RMS @ 60 Hz	5.00	2.50
Turn On Time	cycle max. (0 volts)	1/2	1/2
Turn Off Time	cycle max. (0 volts)	1/2	1/2
DV/DT - Off-State		200 volts/microsecond	
DV/DT - Commutating		Snubbed for rated 0.5 power factor load.	
EN 61131-2 Output Type		Short-circuit proof	

***Table 41**, Discrete I/O Module Specifications*

Chapter 4
ServoWire Axis Module Installation & Operation

4 ServoWire Axis Modules

4.1 ServoWire Axis Module Installation

4.1.1 MotionDATA Interface Connectors – J4, J5 & J6

The pinout of the MotionDATA connectors is shown in **Figure 30**. Note that the signals are in pairs due to the balanced-pair differential configuration of MotionDATA. A CBL-MOD8/0.7 is supplied with every *ServoWire Axis Module* (ORN-SW-AM). Appendix E-3 details the CBL-MOD8/NNN cable compatible with this connector. Appendix E also documents other CBL-MOD8 accessories.

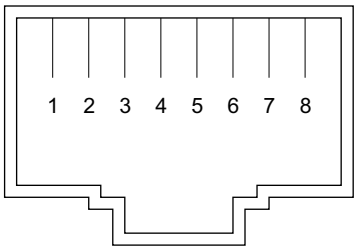


Figure 30, *MotionDATA Connectors, J4, J5 & J6*

NOTE: The metal case, which provides a termination of the cable shield, is connected to the shield point on the DSP Axis Module for the MotionDATA OUT connectors (J4 & J5) only.

4.1.2 ServoWire Interface Connectors – J7, J8 & J9

The ServoWire interface connectors, J7, J8 and J9, are standard 6 pin IEEE 1394 connectors (Molex p/n 53462-0611), as shown in **Figure 31**. Connections from the *ServoWire Axis Module* to the ServoWire Drives are made using prefabricated ServoWire cables (CBL-SW/##). The *ServoWire Axis Module* connector layout is shown in Appendix A-1.

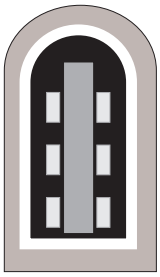


***Figure 31**, IEEE 1394 Modular Connector*

4.1.3 ServoWire Axis Module Analog Input Terminal Block – TB9 & TB10

Two 8-pin terminal blocks (Phoenix p/ns socket - 1803332 and plug - 1827185), TB9 and TB10, are provided on *ServoWire Axis Modules* with the analog input option. These terminal blocks provide for a convenient field interface to four or eight 12-bit analog inputs (AIN1) per *ServoWire Axis Module*, depending on the analog input option purchased. Refer to the ServoWire Axis Modules section (page 7) of the General Description chapter to determine whether your *ServoWire Axis Module* includes the analog input option.

The number of analog inputs available for use by an application program is limited to the number of axes connected to that ServoWire Axis Module.

NOTE: **Wiring to the analog inputs should be twisted pair cable, with a foil shield and drain wire.**

Refer to the ServoWire Axis Module Analog Input Terminal Blocks - TB9 & TB10 section (page 87) of this chapter for analog input specifications, and Appendix F-4 for further information.

Additional wiring guidelines are included in the "Shielding and Grounding Electrical Panels" Applications Note, which is included at t6he end of this manual.

Terminal	Function	Description
AIN1(a)	Analog Input a	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the first axis defined on this Axis Module, and is accessible for use in its DSP control loops.
AGND	Analog Ground	Ground reference for AIN1.

AIN(b)	Analog Input b	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the second axis defined on this Axis Module, and is accessible for use in its DSP control loops.
SH	Shield	
AIN1(c)	Analog Input c	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the third axis defined on this Axis Module, and is accessible for use in its DSP control loops.
AGND	Analog Ground	Ground reference for AIN1.
AIN(d)	Analog Input d	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the fourth axis defined on this Axis Module, and is accessible for use in its DSP control loops.
SH	Shield	
AIN1(e)	Analog Input e	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the fifth axis defined on this Axis Module, and is accessible for use in its DSP control loops.
AGND	Analog Ground	Ground reference for AIN1.
AIN(f)	Analog Input f	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the sixth axis defined on this Axis Module, and is accessible for use in its DSP control loops.
SH	Shield	
AIN1(g)	Analog Input g	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the seventh axis defined on this Axis Module, and is accessible for use in its DSP control loops.
AGND	Analog Ground	Ground reference for AIN1.
AIN(h)	Analog Input h	Optional 12-bit, +/-10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC AIN1@ variable for the eighth axis defined on this Axis Module, and is accessible for use in its DSP control loops.
SH	Shield	

***Table 42**, ServoWire Axis Module Analog Input Terminal Blocks – TB9 & TB10*

4.2 ServoWire Axis Module Operation

4.2.1 ServoWire Axis Module Status LEDs

Three LEDs, two green and one red, are provided at the top of the ServoWire Axis Module for indicating *ServoWire Axis Module* status. Refer to the following table for a list of the LEDs and what they indicate.

Name	Color	Description
DSP OK	Green	Indicates that the *ServoWire Axis Module* does not have any module faults (DSP watchdog time-out, etc.).
MDATA	Green	Indicates that the *ServoWire Axis Module* is receiving the MotionDATA Synchronous Clock signal.
S-WIRE	Red	Indicates that there is a ServoWire network configuration error.

***Table 43**, ServoWire Axis Module Status LEDs*

4.2.2 ServoWire Axis Status LEDs

Eight bi-color LEDs (one per axis) are provided on the ServoWire Axis Module, below the ServoWire Axis Module Status LEDs, for indicating the axis status. The LEDs are assigned in ascending order based on the Ids of the Drives attached to the Axis Module. In other words, LED (a) corresponds to the lowest axis ID attached to the ServoWire Axis Module, LED (b) corresponds to the next higher axis ID attached to the ServoWire Axis Module, and so on. Pacer and Virtual axes are also assigned ServoWire Axis Status LEDs.

Refer to the following table for a list of the LEDs and what they indicate.

Name	Description
Axis A	Green – Indicates that the corresponding axis has no axis faults (AFAULT@ = 0). Red – Indicates that the corresponding axis has an axis fault (AFAULT@ > 0). Green/Red (Alternating) – Indicates a mismatch between the axes defined in the MotionDesk Project file and those actually connected to the ORION.
Axis B	
Axis C	
Axis D	
Axis E	
Axis F	
Axis G	
Axis H	

***Table 44**, ServoWire DSP Axis Module Axis Status LEDs*

4.3 ServoWire Axis Module Specifications

4.3.1 ServoWire Axis Module Interface Specifications

4.3.1.1 ServoWire Axis Module MotionDATA Interface - J4 & J5

Connector	RJ45 Modular Jack
Standards	EIA RS-422/485

***Table 45**, ServoWire Axis Module MotionDATA Interface – J4 & J5*

4.3.1.2 ServoWire Axis Module ServoWire Interface – J7, J8 & J9

Connector	Modular Jack
Standards	IEEE 1394

***Table 46**, ServoWire Axis Module ServoWire Interface – J7, J8 & J9*

4.3.2 ServoWire Axis Module Analog Input Terminal Blocks - TB9 & TB10

Connector	8 pin pluggable terminal block
AIN A – AIN H(optional), **AGND** (pins 1, 2)	Analog Input and Analog Ground Appendix F-4
Input range	+/-10 VDC
Max. input	+/-15 VDC maximum
Input protection	RC network
Input impedance	>10K ohms
Type of input	single ended
Digital Resolution	12 bits (monotonic w/ no missing codes)
Value of LSB	4.88 mV
Data format	Binary
Digital output reading under overload	wrap
Sample duration time (including settling time)	8 usec
Sample repetition time	Based on LOOP.RATE@ (333 usec typ.)
Input filter	Passive filter, 1 kHz cutoff typical
Conversion Method	Successive approximation
Operating Mode	Self-scan
Cabling	Twisted pair, shielded with drain wire

***Table 47**, ServoWire Axis Module Analog Input Terminal Blocks – TB9 & TB10*

Chapter 5
DSP Axis Module
Installation & Operation

5 DSP Axis Modules

5.1 DSP Axis Module Installation

There are two types of DSP Axis Modules:

- ORN-DSP-AQ - for single axis (Axis B) control with a pacer encoder (Axis A) interface, and
- ORN-DSP-A2 - for dual axis control.

The interface circuitry schematics and component layout diagram for the *DSP Axis Modules* is documented in Appendix G. Refer to Appendix A-2 for the location of a DSP Axis Module in an ORION system. Refer to the DSP Axis Module Model Number Description section (page 11) of the General Description chapter for a complete description of the *DSP Axis Module* part numbers and options.

5.1.1 DSP Axis Modules: Axis IDs

ORION Motion Controllers identify each "axis" of control in the system with an *Axis-ID* from 1 to 20. A "pacer encoder" used in "electronic gearing" applications is also assigned an *Axis-ID* in the system. This allows the pacer encoder to simply plug into the standard *Axis Interface Connector* of any *DSP Axis Module* and be referenced by MotionBASIC using standard pre-defined variables. e.g. *POS.ACT@(Axis-ID)* is used to reference or set the actual encoder position. The "Axis Control Mode" variable, MODE@(*Axis-ID*), can configure an axis as a "Pacer Encoder", instead of a "Servo Axis".

5.1.2 DSP Axis Modules: Setting DSP Axis Module ID

Each ORION *DSP Axis Module* in a system has a unique *Module ID,* 0 through 9, which is configured by the DSP Axis Module ID switch on the module. Refer to Appendix A-6 for the location of the DSP Axis Module ID switch. To determine the *Axis-ID* of each axis in the system use the following equations:

***Axis-A ID* = (2 * *Module ID*) + 1**

***Axis-B ID* = (2 * *Module ID*) + 2**

Examples:

1) If the *DSP Axis Module* ID is 0, the *Axis-A* of that module is Axis 1 and *Axis-B* is Axis 2.

2) If the *DSP Axis Module* ID is 6, the *Axis-A* of that module is Axis 13 and *Axis-B* is Axis 14.

The MotionBASIC AXIS.LIST@ variable indicates all the installed axes (axes found at powerup) in the ORION. Type PRINT AXIS.LIST@ to review the installed axes. The MotionDesk SysInfo display (refer to **Figure 13**) also indicates all the installed axes (axes found at powerup) in the ORION.

5.1.3 DSP Axis Modules: Installation

The diagram in Appendix A-2 indicates the *ORMEC standard installation* of *DSP Axis Modules* in the ORION unit. The diagram shows the 7 slot version of the ORION controller, however, the same order of module placement applies for the 3 and 5 slot versions. The *DSP Axis Module ID*s start with 0, in the slot next to the *Orion System Module*, and are in ascending order to the right, ending with ID 6.

5.1.4 DSP Axis Modules: MotionDATA Interface Connectors - J4 & J5

The pinout of the MotionDATA connectors is shown in **Figure 32**. Note that the signals are in pairs due to the balanced-pair differential configuration of MotionDATA. A CBL-MOD8/0.7 is supplied with every *DSP Axis Module* (ORN-DSP). Appendix E-3 details the CBL-MOD8/NNN cable compatible with this connector. Appendix E also documents other CBL-MOD8 accessories.

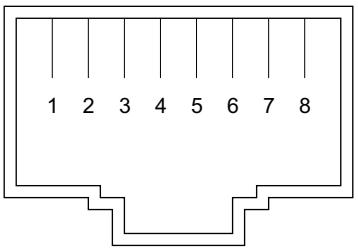


***Figure 32**, MotionDATA Connectors, J4 & J5*

NOTE: The metal case, which provides a termination of the cable shield, is connected to the shield point on the DSP Axis Module for the MotionDATA OUT connector (J4) only.

5.1.5 DSP Axis Modules: Axis Interface Connectors - J6 & J7

Axis Interface Connectors J6 and J7 are 26 pin female HDP-22 style connectors (compatible with AMP p/n 748365-1). Connections from the *DSP Axis Module* to servodrives or pacer encoders are normally made using prefabricated cables shown in Appendix H. DSP Axis Interface wiring should be 22 AWG, twisted pair cable, shielded with drain wire connected to earth ground (NOTE: the SHIELD connections at various points on the ORION are connected to the frame ground). The *DSP Axis Module* connector layout is shown in Appendix A-6, and interface schematics are shown in Appendix G. Refer to **Figure 33** and **Table 48** for further connector pinout information.

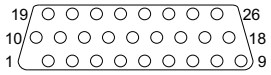


***Figure 33**, DSP Axis Module, Axis Interface Connector (J6 & J7)*

WARNING: The DSP Axis Module jumpers J13 and J14 must be properly configured for the servodrive type. If these jumpers are not properly configured the Servodrive and/or ORION can be damaged. Refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) for further information.

Signal	Pin #	Function	Description
ENCA ENCA'	1 2	Encoder Channel A Encoder Channel A'	Encoder Channel A and A' are differential inputs which provide one of two quadrature square wave signals used by the *DSP Axis Module* to determine encoder direction and travel. For axes controlling a servomotor, these signals are used for feedback. For axes used to interface to a pacer encoder, these signals are used to determine only the direction and travel of the external encoder. Forward travel (reversible in software through MotionBASIC) is defined as the direction for which ENCA leads ENCB by 90 degrees.
		Open Wire Detection	Both quadrature feedback channels are monitored by open wire detection circuitry, and if any open wire or short circuit is detected, servo operation is interrupted, the *No Fault Relay* is disabled, and the T-ENABLE' output is turned OFF.
DRV-CMD	3	Output Command	This +/-10 VDC 12-bit analog output is used to command +/- full-scale servomotor output torque (current) or velocity.
AGND	4	Analog Signal Ground	This pin is a ground reference point for DRV-CMD. NOTE: AGND is an isolated ground plane on the DSP Axis Module. AGND is isolated from DGND to reduce noise in the analog circuitry, and is connected to DGND at only one point on the DSP Axis Module board.
V- or -12V	5 7 8	Servodrive Interlock Voltage Common	Jumper (J13 and J14) configurable as either an input for the negative terminal of an external 5 to 24 VDC power supply, or an output for -12V supplied by ORION, which is used to drive the servodrive interlock opto-isolators. - When configured as an input from an external power supply, the power supply is connected to pin 5 and pins 7 and 8 are connected to pin 5 on the DSP (SAC-D, E, F and S servodrives). - When configured as an output supply, pins 7 and 8 provide -12V from the ORION power supply, pin 5 is unused (SAC-DE servodrives). Refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) for further information. **WARNING: Improper jumper J13 and J14 configuration can result in damage to the servodrive and/or the ORION!!!.**
ALM-RESET'	6	Servodrive Alarm Reset	This open collector optically isolated output is turned ON (asserted) to reset servodrive alarms. It is rated for 24 VDC operation and can sink 25 mA to the *V- Servodrive Interlock Voltage Common*.

Signal	Pin #	Function	Description
T-ENABLE'	9	Torque Enable	This optically isolated output is turned ON (asserted) to enable servodrive output torque. It is rated for 24 VDC operation and can sink 25 mA. With default jumper strapping, this output sinks current to the *V- Servodrive Interlock Voltage Common*. Alternatively, the emitter of this optically isolated transistor (T-ENABLE2', pin 15) can be isolated from *V-* to allow "active high" operation for torque enable function.
SHIELD	10	Cable Shield	This pin is internally connected to frame ground and provided for termination of a shield for the Axis Interface Cable.
ENCB ENCB'	11 12	Encoder Channel B Encoder Channel B'	Encoder Channel B and B' are differential inputs which provide one of two quadrature square wave signals used by the *DSP Axis Module* to determine encoder direction and travel. Refer to the ENCA ENCA' description at the beginning of this table.
+5V	13	+5 VDC	This pin is internally connected to the main +5 VDC power supply of the *DSP Axis Module* and provided for external use (500 mA maximum). **NOTE: This +5VDC supply is not fused.**
AIN2	14	Axis Analog Input 2	This is one of two optional 12-bit analog inputs.
T-ENABLE2' or +12V	15	Torque Enable (Active High)	Jumper (J13 and J14) configurable as either the emitter of an optically isolated transistor, or an output for +12V supplied by ORION. - When configured as the emitter of an optically isolated transistor, this signal is turned on to enable servodrive output torque. See T-ENABLE' above. By default it is strapped to V- (pins 5, 7, & 8) by removable jumpers between pins 5 and 6 of header J11 (J10) (SAC-D, E, F, and S servodrives), but, for servodrives which require an "active high" Torque Enable input, the jumper(s) may be removed, DC. power attached to T-ENABLE', and this output attached to the servodrive. - When configured as an output supply, pin 15 provides +12V from the ORION power supply SAC-DE servodrives). Refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) for further information. **WARNING: Improper jumper J13 and J14 configuration can result in damage to the servodrive and/or the ORION!!!.**
BAT- (DGND)	16	Battery Common (Digital Ground)	Used as the negative terminal of the absolute encoder backup power supply. This pin is connected to the ORION +5 VDC common. Refer to the BAT+ description later in this table for further information.

Signal	Pin #	Function	Description
ABS	17	Absolute Encoder Read Command	This TTL-level signal is asserted (high level) by the motion controller when either the MotionBASIC POS.ACT@=POS.ABS@, or ABS@ =ON statements are executed. This causes absolute encoder position information to be sent; and normal operation initiated for D-Series multi-revolution absolute encoders only.
BAT+	18	Battery Voltage or Servodrive Alarm	The positive terminal of the absolute encoder backup power supply. This is connected to a +4.3 VDC power supply while the controller has control power, or to an optional 3 VDC lithium battery when controller power is off. This power is required for backup of absolute encoder circuitry associated with D-Series servodrives and motors which support multi-revolution absolute encoders. For servodrives which provide an "active high" No-Alarm interlock, this terminal may be jumper strapped to the NO-ALARM opto-isolator input.
ENCZ ENCZ'	19 20	Encoder Channel Z Encoder Channel Z'	Encoder Channel Z and Z' are differential inputs which produce a reference pulse for use by the *DSP Axis Module*. This reference pulse is normally asserted by the feedback or pacer encoder once per revolution of that device. In some cases, however, these signals can come from another device such as a registration sensor or an external home position sensor. *DSP I/O Terminal Blocks* (TB9 & TB10) are provided for convenient field wiring of these signals when they are not obtained from the standard position encoder (EXTZ). Refer to the DSP Axis Modules: DSP I/O Terminal Block - TB9 & TB10 section (page 101) of this chapter for further information.
DGND	21	Digital Signal Ground	This pin is a ground reference point for the +5 VDC output.
V+	22	Servodrive Interlock Voltage	The positive terminal of an external 5 to 24 VDC power supply which is used to drive the *servodrive interlock opto-isolators*.
NO-ALARM'	23	Servodrive Alarm	This input from the servodrive must be between 4 and 25 VDC lower than the *DC Servodrive Interlock Voltage* provided on pin 22 to be asserted, indicating that the servodrive has no alarms. If this input is not asserted, then the ORION controller will detect a servodrive alarm fault, open the *No Fault Relay*, and report the fault through MotionBASIC. The servodrive output circuitry must be able to sink 0.7 to 7 mA of current for this input to operate, depending on the value of the *DC Servodrive Interface Voltage*.

Signal	Pin #	Function	Description
AL03' AL02' AL01'	24 25 26	Alarm Code Input 3 Alarm Code Input 2 Alarm Code Input 1	These three inputs provide a "servodrive alarm code" which is used by MotionBASIC to provide user servodrive diagnostic information. Depending on the value of the DC Servodrive Interlock Voltage, the servodrive output circuitry driving these inputs must be capable of sinking 0.7 to 7 mA of current.

***Table 48**, Connectors J6 & J7 Interface Description*

5.1.5.1 DSP Axis Modules: D-Series (SAC-D) Axis Interface

A CBL-AD is used to connect a SAC-D servodrive to a *DSP Axis Module*. Refer to the CBL-AD/NN drawing in Appendix H-1 for further information regarding this cable. The following interface description assumes that the default jumpers are in place on the *DSP Axis Module*, refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) and Appendix G-1 for further information. **NOTE: The interface features described are at the pins of the DSP Axis Module.**

Signal	Pin #	Description
DRV-CMD	3	This +/- 10 VDC analog output from the DSP D/A converter is provided to command torque (current) in the D-Series servodrives.
AGND	4	Analog signal ground is a ground reference point for the *DRV-CMD* signal.
DGND	21	Digital signal ground is a ground reference point for the *+5 VDC* output.
ENCA ENCA'	1 2	These differential signals provide one of the quadrature feedback channels for the axis.
ENCB ENCB'	11 12	These differential signals provide one of the quadrature feedback channels for the axis.
ENCZ ENCZ'	19 20	These differential signals provide the "once per revolution" marker signal for the feedback encoder.
T-ENABLE'	9	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to enable torque in the servodrive.
ALM-RESET'	6	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to clear alarm conditions in the D-Series servodrive. It is asserted by the motion controller when the *AFAULT@* variable is cleared (set to 0).
AL01' AL02' AL03'	26 25 24	For the D-Series servodrives these three signals form a coded alarm with values 0 - 7. This code makes up the second digit of the *ALARM@* variable whenever there is an alarm condition.
NO-ALARM'	23	This optically coupled input must be ON (asserted), sinking current from the *V+* terminal for the servo axis to operate in standby, output, velocity, or position mode. If it is not sinking current, the *ALARM@* variable will have a value of 10 or more, with the second digit dependent on the state of *AL01' - AL03'*.
V+ V-	22 5	Power supply point and common for the *Servodrive Interlock Voltage* **provided by the servodrive** to operate the *DSP Axis Module's NO-ALARM' and AL01' – AL03'* opto-isolated interlock inputs.
SPD MON	14	Servodrive velocity monitor signal for use in distributed feedback systems. (+/-1 VDC per +/-1000 RPM for MAC-DA, and DE motors) (+/-2 VDC per +/-1000 RPM for MAC-DB motors)
SHIELD	10	*Axis Interface Cable* shield termination point, internally connected to frame ground.

***Table 49**, Connectors J6 & J7 Interface for SAC-D Series Servodrives*

5.1.5.2 DSP Axis Modules: DE-Series (SAC-DE) Servodrive Interface

A CBL-ADE is used to connect a SAC-DE servodrive to a *DSP Axis Module*. Refer to the CBL-ADE/NN drawing in Appendix H-2 for further information regarding this cable. The following interface description assumes that the jumpers on the *DSP Axis Module* have been configured appropriately for use with a SAC-DE servodrive, refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) and Appendix G-1 for further information. **NOTE: The interface features described are at the pins of the DSP Axis Module.**

Signal	Pin #	Description
DRV-CMD	3	This +/- 10 VDC analog output from the DSP D/A converter is provided to command torque (current) in the DE-Series servodrives.
AGND	4	Analog signal ground is a ground reference point for the *DRV-CMD* signal.
DGND	21	Digital signal ground is a ground reference point for the *+5 VDC* output.
ENCA ENCA'	1 2	These differential signals provide one of the quadrature feedback channels for the axis.
ENCB ENCB'	11 12	These differential signals provide one of the quadrature feedback channels for the axis.
ENCZ ENCZ'	19 20	These differential signals provide the "once per revolution" marker signal for the feedback encoder.
T-ENABLE'	9	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to enable torque in the servodrive.
ALM-RESET'	6	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to clear alarm conditions in the D-Series servodrive. It is asserted by the motion controller when the *AFAULT@* variable is cleared (set to 0).
AL01' AL02' AL03'	26 25 24	For the D-Series servodrives these three signals form a coded alarm with values 0 - 7. This code makes up the second digit of the *ALARM@* variable whenever there is an alarm condition.
NO-ALARM'	23	This optically coupled input must be ON (asserted), sinking current from the *V+* terminal for the servo axis to operate in standby, output, velocity, or position mode. If it is not sinking current, the *ALARM@* variable will have a value of 10 or more, with the second digit dependent on the state of *AL01' - AL03'*.
V- V+	7,8 15	Power supply point and common for the *Servodrive Interlock Voltage* provided by ORION to operate the *DSP Axis Module's NO-ALARM' and AL01' - AL03'* opto-isolated interlock inputs.
SPD MON	14	Servodrive velocity monitor signal for use in distributed feedback systems. (+/-1 VDC per +/-1000 RPM for MAC-DE motors)
SHIELD	10	*Axis Interface Cable* shield termination point, internally connected to frame ground.

***Table 50**, Connectors J6 & J7 Interface Description for SAC-DE Series Servodrives*

5.1.5.3 DSP Axis Modules: E-Series (SAC-E) Axis Interface

A CBL-AE is used to connect a SAC-E servodrive to a *DSP Axis Module*. Refer to the CBL-AE/NN drawing in Appendix H-3 for further information regarding this cable. The following interface description assumes that the default jumpers are in place on the *DSP Axis Module*, refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) and Appendix G-1 for further information. **NOTE: The interface features described are at the pins of the DSP Axis Module.**

Signal	Pin #	Description
DRV-CMD	3	This +/- 10 VDC analog output from the DSP D/A converter is provided to command torque (current) in the E-Series servodrives.
AGND	4	Analog signal ground is a ground reference point for the *DRV-CMD* signal.
DGND	21	Digital signal ground is a ground reference point for the *+5 VDC* output.
ENCA ENCA'	1 2	These differential signals provide one of the quadrature feedback channels for the axis.
ENCB ENCB'	11 12	These differential signals provide one of the quadrature feedback channels for the axis.
ENCZ ENCZ'	19 20	These differential signals provide the "once per revolution" marker signal for the feedback encoder.
T-ENABLE'	9	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to enable torque in the servodrive.
F-ENABLE' (V-)	8	This *V-* terminal point enables forward torque in the servodrive.
R-ENABLE' (V-)	7	This *V-* terminal point enables reverse torque in the servodrive.
ALM-RESET"	6	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to clear alarm conditions in the E-Series servodrive. It is asserted by the motion controller when the *AFAULT@* variable is cleared (set to 0).
AL01' AL02' AL03'	26 25 24	For the E-Series servodrives these three signals form a coded alarm with values 0 - 7. This code makes up the second digit of the *ALARM@* variable whenever there is an alarm condition.
NO-ALARM'	23	This optically coupled input must be ON (asserted), sinking current from the *V+* terminal for the servo axis to operate in standby, output, velocity, or position mode. If it is not sinking current, the *ALARM@* variable will have a value of 10 or more, with the second digit dependent on the state of *AL01' - AL03'*.
V+ V-	22 5	Power supply point and common for the *Servodrive Interlock Voltage* **provided by the servodrive** to operate the *DSP Axis Module's NO-ALARM' and AL01' - AL03'* opto-isolated interlock inputs.
SPD MON	14	Servodrive velocity monitor signal for use in distributed feedback systems. (+/-2 VDC per +/-1000 RPM for MAC-E motors,).
SHIELD	10	*Axis Interface Cable* shield termination point, internally connected to frame ground.

***Table 51**, Connectors J6 & J7 Interface Description for E-Series Servodrives*

5.1.5.4 DSP Axis Modules: F-Series (SAC-F) Axis Interface

A CBL-AF is used to connect a SAC-F servodrive to a *DSP Axis Module*. Refer to the CBL-AF/NN drawing in Appendix H-4 for further information regarding this cable. The following interface description assumes that the default jumpers are in place on the *DSP Axis Module*, refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) and Appendix G-1 for further information. **NOTE: The interface features described are at the pins of the DSP Axis Module.**

Signal	Pin #	Description
DRV-CMD	3	This +/- 10 VDC analog output from the DSP D/A converter is provided to command torque (current) in the F-Series servodrives.
AGND	4	Analog signal ground is a ground reference point for the *DRV-CMD* signal.
DGND	21	Digital signal ground is a ground reference point for the *+5 VDC* output.
ENCA ENCA'	1 2	These differential signals provide one of the quadrature feedback channels for the axis.
ENCB ENCB'	11 12	These differential signals provide one of the quadrature feedback channels for the axis.
ENCZ ENCZ'	19 20	These differential signals provide the "once per revolution" marker signal for the feedback encoder.
T-ENABLE'	9	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to enable torque in the servodrive.
ALM-RESET'	6	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to clear alarm conditions in the D-Series servodrive. It is asserted by the motion controller when the *AFAULT@* variable is cleared (set to 0).
OVERVOLTS'	26	Assertion indicates that the F-Series servodrive has a *High Bus Voltage* or *Current Fault* alarm condition. The status of this input is indicated by bit 1 of the *ALARM@* variable.
OUTPUT FAULT'	25	Assertion indicates that the F-Series servodrive has a *High Bus Voltage* alarm condition. The status of this input is indicated by bit 2 of the *ALARM@* variable.
OVERTEMP'	24	Assertion indicates that the F-Series servodrive has an *Over Temperature* or *RMS Current Limit Fault* alarm condition. The status of this input is indicated by bit 3 of the *ALARM@* variable.
DRV-RDY'	23	This optically coupled input must be ON (asserted), sinking current from the *V+* terminal for the servo axis to operate in standby, output, velocity, or position mode. If it is not sinking current, the *ALARM@* variable will have a value of 10 or more, with the second digit dependent on the state of *OVERVOLTS', OUTPUT FAULT, & OVERTEMP'*.
V+ V-	22 5	Power supply point and common for the *Servodrive Interlock Voltage* **provided by the servodrive** to operate the *DSP Axis Module's DRV-RDY', OVERVOLTS', OUTPUT FAULT',* and *OVERTEMP'* opto-isolated interlock inputs.
SPD MON	14	Servodrive velocity monitor signal for use in distributed feedback systems. (+/- 8 VDC per +/- max. speed for MAC-F motors)
SHIELD	10	*Axis Interface Cable* shield termination point, internally connected to frame ground.

***Table 52**, Connectors J6 & J7 Interface Description for F-Series Servodrives*

5.1.5.5 DSP Axis Modules: S-Series (SAC-S) Axis Interface

A CBL-AS is used to connect a SAC-S servodrive to a *DSP Axis Module*. Refer to the CBL-AS/NN drawing in Appendix H-5 for further information regarding this cable. The following interface description assumes that the default jumpers are in place on the *DSP Axis Module*, refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) and Appendix G-1 for further information. **NOTE: The interface features described are at the pins of the DSP Axis Module.**

Signal	Pin #	Description
DRV-CMD	3	This +/- 10 VDC analog output from the DSP D/A converter is provided to command torque (current) in the S-Series servodrives.
AGND	4	Analog signal ground is a ground reference point for the *DRV-CMD* signal.
DGND	21	Digital signal ground is a ground reference point for the *+5 VDC* output.
ENCA ENCA'	1 2	These differential signals provide one of the quadrature feedback channels for the axis.
ENCB ENCB'	11 12	These differential signals provide one of the quadrature feedback channels for the axis.
ENCZ ENCZ'	19 20	These differential signals provide the "once per revolution" marker signal for the feedback encoder.
T-ENABLE'	9	This optically coupled output must be ON (asserted), providing a low resistance path to the *V-* terminal to enable torque in the servodrive.
F-ENABLE' (V-)	8	This *V-* terminal point enables forward torque in the servodrive.
R-ENABLE' (V-)	7	This *V-* terminal point enables reverse torque in the servodrive.
AL01' AL02' AL03'	26 25 24	For the S-Series servodrives these three signals form a coded alarm with values 0 - 7. This code makes up the second digit of the *ALARM@* variable whenever there is an alarm condition.
NO-ALARM'	23	This optically coupled input must be ON (asserted), sinking current from the *V+* terminal for the servo axis to operate in standby, output, velocity, or position mode. If it is not sinking current, the *ALARM@* variable will have a value of 10 or more, with the second digit dependent on the state of *AL01' - AL03'*.
V+ V-	22 5	Power supply point and common for the *Servodrive Interlock Voltage* **provided by the servodrive** to operate the *DSP Axis Module's NO-ALARM' and AL01' - AL03'* opto-isolated interlock inputs.
SPD MON	14	Servodrive velocity monitor signal for use in distributed feedback systems. (+/-2 VDC per +/-1000 RPM for MAC-A motors) (+/-4 VDC per +/-1000 RPM for MAC-B and C motors)
SHIELD	10	*Axis Interface Cable* shield termination point, internally connected to frame ground.

***Table 53**, Connectors J6 & J7 Interface Description for S-Series Servodrives*

5.1.5.6 DSP Axis Modules: Pacer Encoder (EDR-25) Axis Interface

A CBL-QE25 or CBL-QEV25 is used to connect a EDR-25 Series Pacer Encoder to a *DSP Axis Module*. Refer to the CBL-QE25/NN drawing in Appendix H-14 for further information regarding this cable. The following interface description assumes that the default jumpers are in place on the *DSP Axis Module*, refer to the *DSP Axis Module*, refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) and Appendix G-1 for further information. **NOTE: The interface features described are at the pins of the DSP Axis Module.**

Signal	Pin #	Description
+5V	13	The DSP Axis Module supplies +5 VDC to power the pacer encoder (500 mA maximum).
DGND	21	Digital signal ground is a ground reference point for the *+5 VDC* output.
ENCA ENCA'	1 2	These differential signals provide one of the quadrature feedback channels from the Pacer Encoder.
ENCB ENCB'	11 12	These differential signals provide one of the quadrature feedback channels from the Pacer Encoder.
ENCZ ENCZ'	19 20	These differential signals provide the "once per revolution" marker signal for the Pacer Encoder.
SHIELD	10	Axis Interface Cable shield termination point, internally connected to frame ground. The cable to the Pacer Encoder should always be shielded to protect the encoder signals as well as the +5 VDC power.

***Table 54**, Connectors J6 & J7 Interface Description for Pacer Encoders*

5.1.6 DSP Axis Modules: DSP I/O Terminal Block - TB9 & TB10

Two 15-pin terminal blocks (TB9 & TB10), one per axis, are provided on the *DSP Axis Module*[24] for a convenient field interface to:

- four high speed sensor inputs (1 microsecond response), two per terminal block (ASEN, BSEN, EXTZ(A,B)),
- six programmable limit switch outputs (OUT1', OUT2', & OUT3'), three per axis
- two encoder reference outputs, one per axis (SOUT')
- two 12-bit analog inputs (AIN1) per DSP Axis Module (optional feature - extra cost per *DSP Axis Module*[25]), and

[24]The plugs for terminal blocks TB9 and TB10 are optional, refer to the DSP Axis Module Module Number Description section of the General Description chapter for further information. If you need to order a plug for TB9 and/or TB10 (ORMEC part number: CON500) contact your ORMEC Sales and Application Engineer.

[25]The analog input option also provides two analog inputs (4 total) at the servodrive interface connectors (J6 & J7).

- four overtravel limit switch inputs (HTLR' & HTLF'), two per axis.
- future support for two delay counter (optional feature - extra cost per *DSP Axis Module*) outputs (SOUT'), one per axis,

Refer to Appendix G for interface schematics for the *DSP I/O Terminal Blocks*. Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding the MotionBASIC variables and statements related to the DSP I/O signals.

Signal	Pin #	Function	Description
AIN1(A,B)	1	Analog Input 1	An optional 12-bit, +/- 10 VDC, analog input with 1 kHz low pass filter. This input is monitored via the MotionBASIC *AIN1@(n)* variable, which is indexed on Axis-ID. A second analog input, *AIN2@(n)* is available through the *Axis Interface Connector*.
AGND	2	Analog Ground	This pin is a ground reference point for *AIN1*. NOTE: AGND is an isolated ground plane on the DSP Axis Module. AGND is isolated from DGND to reduce noise in the analog circuitry, and is connected to DGND at only one point on the DSP Axis Module board.
SH	3	Cable Shield	Connection for *DSP Axis Module I/O Terminal Block* cabling.
ASEN(A,B) [TB9] BSEN(A,B) [TB10]	4 4	High Speed Sensor High Speed Sensor	Single-ended, high-speed digital sensor inputs to the *DSP Axis Module* that can be used to capture axis position in one microsecond; or synchronize a motion change within one position loop update (normally 125 to 333 microseconds). The operation of these inputs (rising/falling edge latched or high/low level) is configurable through the MotionBASIC SENS.MODE@ variable or the MotionDesk Axis Settings configurator (MB 4.x and higher). ASEN and BSEN can also be internally gated by the Programmable Limit Switch Outputs. Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding the SENS.MODE@ variable. Refer to the MotionDesk Help for further information regarding the Axis Settings configurator. V+S and V-S must be connected to a DC Power Supply (5 - 24 VDC) to use these inputs.
EXTZ(A,B)	5	High Speed Sensor	An additional single-ended, high-speed digital sensor input to the *DSP Axis Module* that can be used to capture axis position in one microsecond; or synchronize a motion change within one position loop update (normally 125 to 333 microseconds). This input must be enabled by the MotionBASIC SENS.MODE@ variable or the MotionDesk Axis Settings configurator. Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding the SENS.MODE@ variable. Refer to the MotionDesk Help for further information regarding the Axis Settings configurator. V+S and V-S must be connected to a DC Power Supply (5 - 24 VDC) to use this input.

Signal	Pin #	Function	Description
V+S V-S V-S	6 7 8	Sensor Power Supply Sensor Power Common Sensor Power Common	Connections for DC power supply (often ORION's 24 VDC Field Power supply) used to operate high speed sensors attached to *ASEN* (*BSEN*) and *EXTZ*. This power supply is also used to "pull up" the *Programmable Axis Outputs* (OUT1' - OUT4') and source current for the hardware overtravel limit (HTLF' & HTLR') circuits. **Must be connected to a DC Power Supply (5 - 24 VDC) to enable use of ASEN, BSEN, EXTZ, HTLR, HTLF, and SOUT'. The V+S and V-S DC Power Supply must be referenced to ORION +5 VDC common (R5) on the Interlock Terminal Block (TB8) for proper operation of the ASEN, BSEN and EXTZ inputs.**
SOUT'(A,B)	9	Delay Counter Encoder Reference Output (default)	Encoder reference signal or future support for a software configurable output providing access to the Delay Counter output. This output is "active low", "pulled up" to V+S with a 1.6 usec minimum pulse width. **V+S and V-S must be connected to a DC Power Supply (5 - 24 VDC) to use this output.**
OUT1'(A,B) OUT2'(A,B) OUT3'(A,B) OUT4'(A,B)	10 11 12 13	Programmable Limit Switch Outputs (OUT4' is not currently supported))	Each axis has three Electronic Programmable Limit Switch Outputs which are automatically controlled by the DSP based on axis position (OUT4' support will be provided in future versions of MotionBASIC). These outputs are configured through MotionBASIC, and updated at each servo loop update (normally 3000 to 5000 times per second for MB 3.x, and 5000 to 8000 times per second for MB 4.x and higher). These outputs are "active low", "pulled up" to V+S.
HTLR'(A,B) HTLF'(A,B)	14 15	Reverse Overtravel Limit Forward Overtravel Limit	If enabled, the Hardware overtravel inputs must be sinking current in opto-isolators U34 and U35 or else an overtravel limit condition will exist, disabling the axis. Jumper J17 can be configured to override these inputs, allowing axis motion without the need to wire to these inputs. **V+S and V-S must be connected to a DC Power Supply (5 - 24 VDC) to use these inputs.**

***Table 55**, Terminal Blocks TB9 & TB10 Interface Description*

5.1.6.1.1 DSP Axis Modules: Analog Input Wiring (AIN1)

An optional general purpose analog input is provided on each DSP I/O Terminal Block (TB9 & TB10).

NOTE: **Wiring to the analog inputs should be shielded twisted pair cable, with a foil shield and drain wire.**

Refer to the DSP I/O Terminal Blocks - TB9 & TB10 section (page 114) of the DSP Axis Modules chapter, and Appendix G-2 and G-4 for further information.

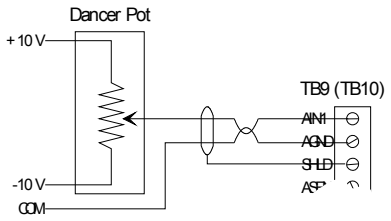


***Figure 34**, Example Analog Input Wiring, TB9 & TB10*

5.1.7 DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14

The default configuration (shown in **Figure 35**, also refer to **Figure 36**) for a DSP Axis Module when using SAC-D, SAC-E, SAC-F, and SAC-S servodrives is that the axis interlock circuit power is provided by Servodrive through pins 5 (V-) and 22 (V+). The configuration for a DSP Module when using a SAC-DE servodrive (refer to **Figure 35**) is that the axis interlock power is supplied by the DSP through pins 7 & 8 (-12V) and 15 (+12V)

WARNING: The DSP Axis Module jumpers J13 and J14 must be properly configured for the servodrive type. If these jumpers are not properly configured the Servodrive and/or ORION can be damaged. Refer to Appendix G-1 for the location of the Servodrive Interface Configuration Jumpers on the DSP Axis Module.

Default Configuration (ORN-DSP 1.01B and later)
FOR USE WITH E, F, D and S-SERIES SERVODRIVES
(Factory Default Jumpers Shown)

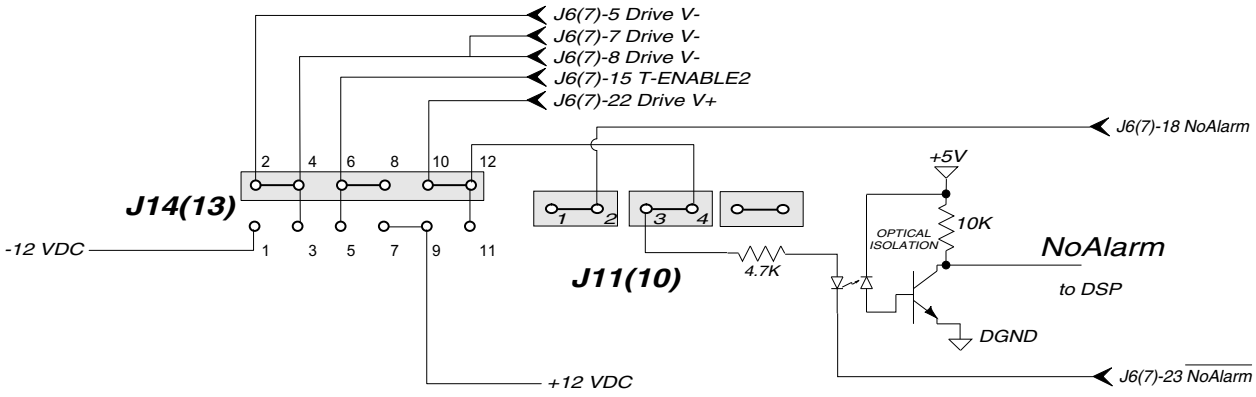


***Figure 35**, DSP Servodrive Interface default jumper configuration, Axis A (Axis B)*

To allow a more flexible interface for implementing systems with various servodrives, the *No-Alarm* (NO-ALARM') input from the servodrive and the *Torque-Enable* (T-ENABLE') output to the servodrive can both be configured for "active high" or "active low" (standard configuration) operation.

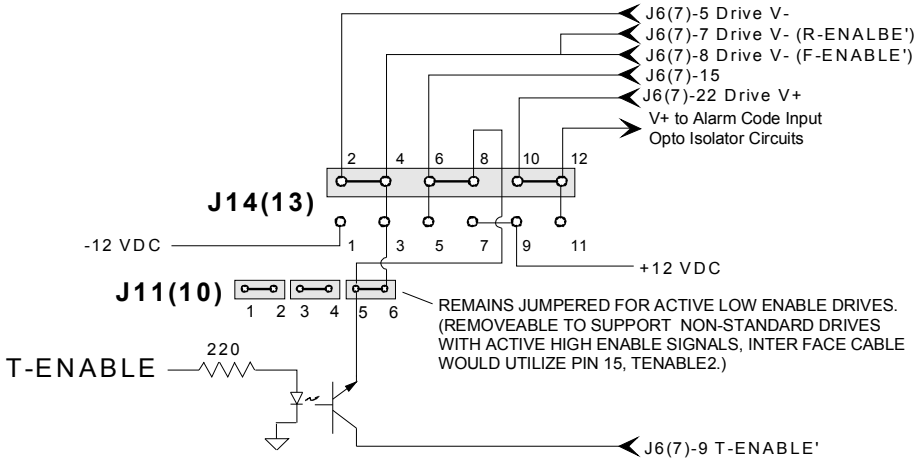
- To allow "active high" operation of the *No-Alarm* input, remove the two jumpers on header J11 for Axis-A, or header J10 for Axis-B, from pins 1-2 and 3-4, and place a single jumper between pins 2-3 of the same header. Refer to **Figure 35** for further information.

- To provide an "active high" *Torque Enable* output, remove the jumper between pins 5-6 of header J11 for Axis-A, or header J10 for Axis-B. See the description of the T-ENABLE' and T-ENABLE2' outputs in the DSP Axis Modules: Axis Interface Connectors - J6 & J7 section (page 91). Refer to **Figure 35** and Appendix G for further information.

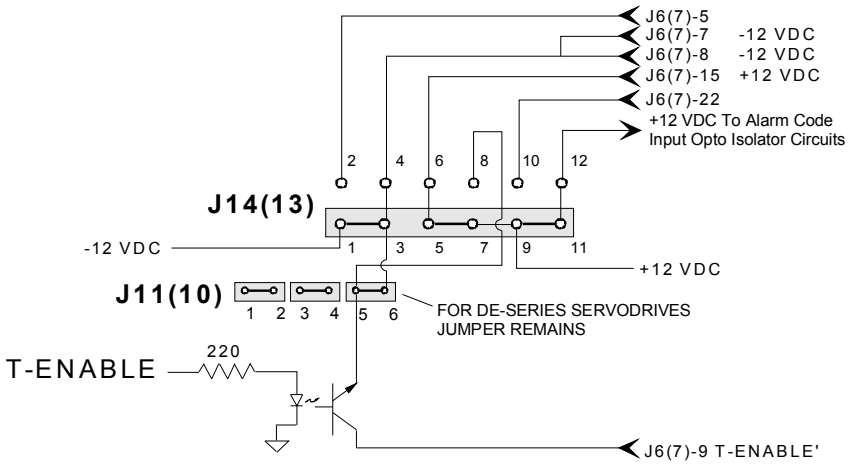
- To provide a *Torque Enable* using an external power supply while also using the DSP +/-12 VDC for the alarm code input circuitry: For Axis-A, place the 3 position jumper bar on the odd pins of header J14, remove the jumper between pins 5-6 of header J11 and replace it between pins 8-10 on J14; For Axis-B, place the 3 position jumper bar on the odd pins of header J13, remove the jumper between pins 5-6 of header J10 and replace it between pins 8-10 on J13. Refer to **Figure 35** and Appendix G for further information.

When using a DSP Axis Module with a servodrive that does not supply +/-12 VDC, contact the ORMEC Service department for assistance.

DRIVE ENABLE/ JUMPER INSTALLATION
FOR USE WITH E, F, D, and S-SERIES SERVODRIVES (ORN-DSP 1.08 or later)



DRIVE ENABLE/ JUMPER INSTALLATION
FOR USE WITH DE-SERIES SERVODRIVES (ORN-DSP 1.08 or later)



USING DSP ±12VDC, AND INDEPENDENT TORQUE ENABLE (ORN-DSP 1.0B or later)

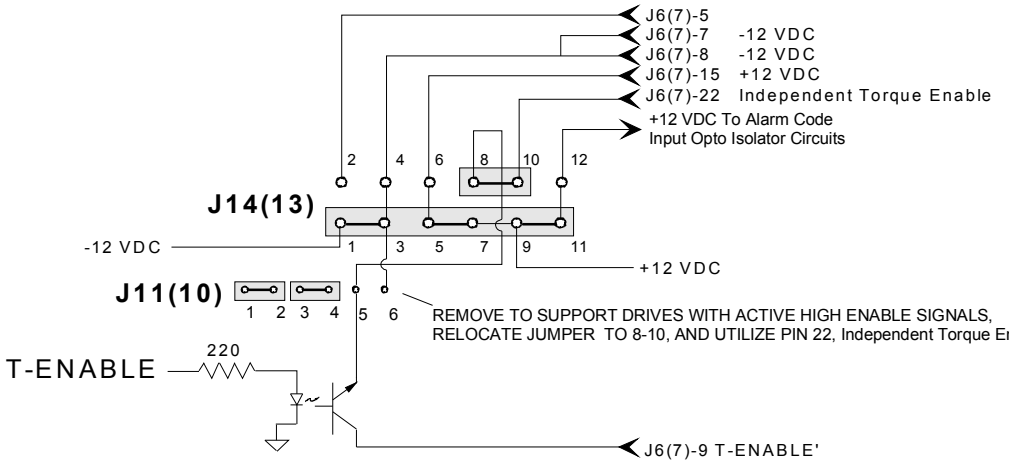


***Figure 36**, DSP Servodrive Interface T-ENABLE Configuration, Axis A (Axis B)*

5.1.8 DSP Axis Modules: High Speed Sensor Input Configuration - J9 & J12

The High Speed Sensor Inputs (ASEN, BSEN, & EXTZ) are default configured for operation with sensors which have NPN type output transistors. The default positions of the jumpers on headers J9 and J12 for Axis-A and Axis-B respectively is to connect pins 1,3,5,7 . This provides an input pull-up resistance of 2.5K ohms to the *Sensor Power Supply* (V+S). For use with sensors which have less current drive capability, the jumper can be moved "to the right" one or two positions as shown in **Table 56**.

	Jumper Position			
ASEN	J9: 1,3,5,7	J9: 3,5,7	J9: 5,7	J9: 1,3,5
EXTZ(A)	J9: 2,4,6,8	J9: 4,6,8	J9: 6,8	J9: 2,4,6
BSEN	J12: 1,3,5,7	J12: 3,5,7	J12: 5,7	J12: 1,3,5
EXTZ(B)	J12: 2,4,6,8	J12: 4,6,8	J12: 6,8	J12: 2,4,6
Pull-Up Resistance	2.5K ohms	4.4K ohms	20K ohms	None (for PNP-type)
Current @ 24 VDC	9.1 mA	5.2 mA	1.1 mA	1.6 mA

***Table 56**, Jumper Headers J9 & J12 Configuration Description*

Moving the jumper one position "to the left", across the pins indicated in the right column of **Table 56**, eliminates the pull-up resistance for compatibility with sensors which have PNP-type output transistors. The input impedance in this mode is approximately 15K ohms. Refer to **Figure 36** and Appendix G for further information.

NOTE: **Wiring to the high speed sensor inputs should be shielded twisted pair cable, with a foil shield. The DC Power Supply connected to V+S and V-S must be connected to the ORION frame ground for proper operation of the ASEN, BSEN, and EXTZ inputs.**

The MotionBASIC SENS.MODE@ variable or the MotionDesk Project Navigator Axis Settings configurator (MB 4.x and higher) can be used to configure the high speed sensor inputs for edge or level sensitive triggering. **Using the high speed sensor inputs configured for level sensitive triggering (SENS.MODE@="H" or "L") increases the susceptibility of your sensor inputs to noise.** Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding the SENS.MODE@ variable. Refer to the MotionDesk Help for further information regarding the MotionDesk Project Navigator Axis Settings configurator.

The EXTZ(A,B) inputs must be enabled by the MotionBASIC SENS.MODE@ variable or through the MotionDesk Project Navigator Axis Setting configurator (MB 4.x and higher). Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding the SENS.MODE@ variable. Refer

to the MotionDesk Help for further information regarding the MotionDesk Project Navigator Axis Settings configurator.

Refer to Appendix G-1 for the location of the High Speed Sensor Input Configuration jumpers on the *DSP Axis Module*.

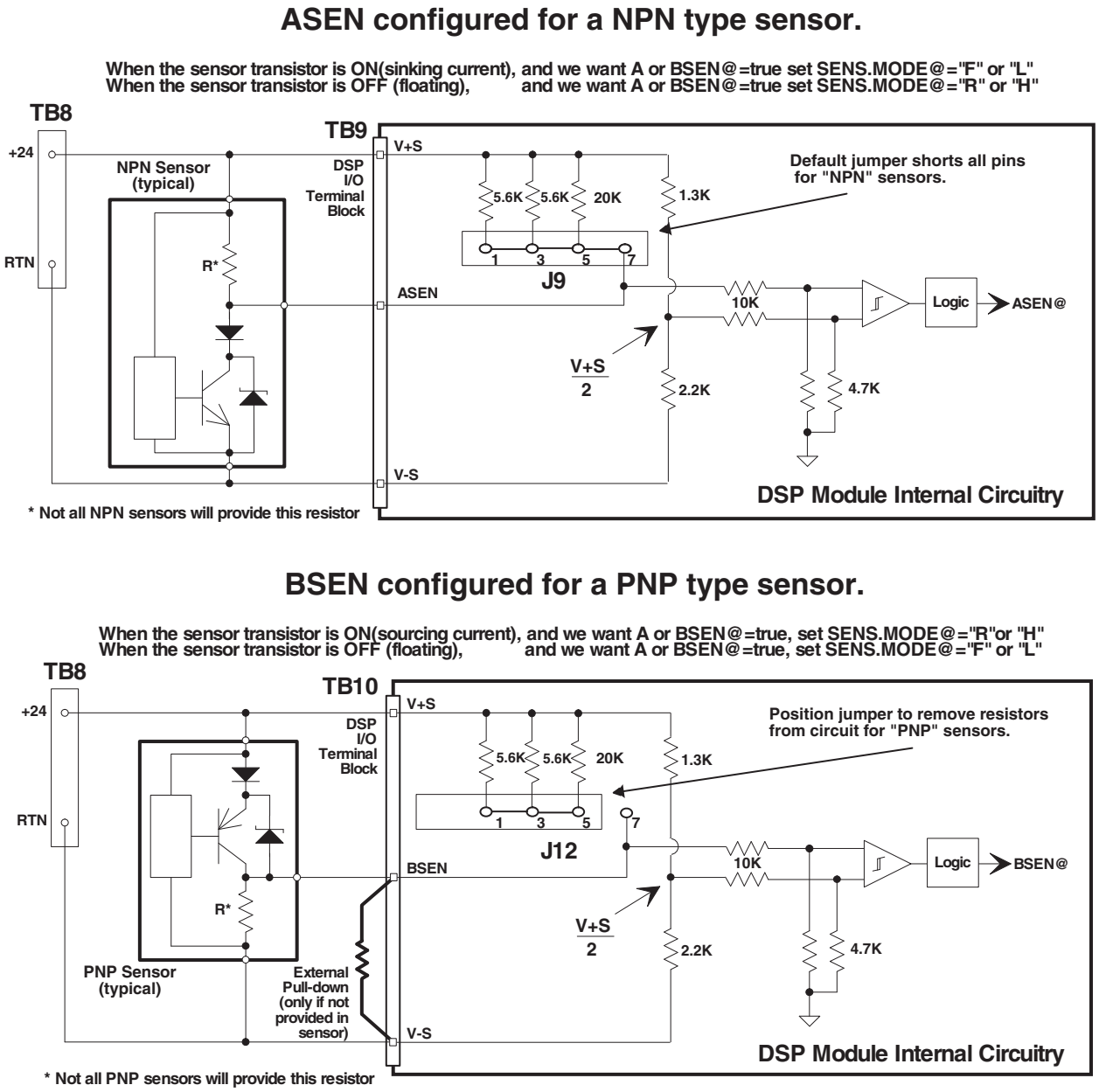


***Figure 37**, Example High Speed Sensor Input configurations, J9 & J12*

5.1.9 DSP Axis Modules: Base DSP Address - J15 & J16

WARNING: The base DSP address is fixed, do not change the configuration of jumpers J15 and J16!!!

The proper jumper configuration for the base DSP address is J15 pins 1 and 2, J16 pins 2 and 3. Refer to **Figure 38** and Appendix G-1 for the location of the BASE DSP Address jumpers on the *DSP Axis Module*.

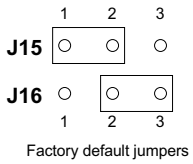


***Figure 38**, Base DSP Address configuration, J15& J16*

5.1.10 DSP Axis Modules: Hardware Overtravel Limits Enable/Disable - J17

A jumper between pins 1 and 3 of J17 enables the hardware overtravel limit inputs for Axis A. Similarly, a jumper between pins 2 and 4 of J17 enables the hardware overtravel limit inputs for Axis B. With the hardware overtravel limit inputs enabled the hardware overtravel limit switches connected to the HTLF' and HTLR' DSP I/O inputs must sink current to enable motor motion. Refer to the Axis Status LEDs section (page110) for information regarding the HTLF and HTLR status LEDs.

A jumper between pins 3 and 5 of J17 disables the hardware overtravel limit inputs for Axis A. Similarly, a jumper between pins 4 and 6 of J17 disables the hardware overtravel limit inputs for Axis B. If the HTLF' and HTLR' DSP I/O inputs are connected to a limit switch that sinks current a "1617 - Hardware Travel Limit Configuration Error" will result. This error message is intended to warn people that a hardware overtravel limit switch that was intended to be used is being overridden in hardware by the configuration of header J17.

Refer to **Figure 39** and Appendix G for the location of jumper header J17 and the interface schematics.

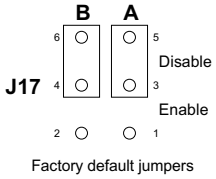


***Figure 39**, Hardware Overtravel Limits Enable/Disable, J17*

5.2 DSP Axis Module Operation

5.2.1 DSP Axis Module Status LEDs

Two green LEDs are provided on the *DSP Axis Module* below the Module ID Switch for indicating *DSP Axis Module* status. Refer to **Table 57** for a list of the LEDs and what they indicate.

Name	Color	Description
DSP OK	Green	Indicates that the *DSP Axis Module* does not have any module faults (DSP watchdog time-out, etc.).
MDATA	Green	Indicates that the *DSP Axis Module* is receiving the MotionDATA Synchronous Clock signal.

***Table 57**, DSP Axis Module Status LEDs*

5.2.2 Axis Status LEDs

Twelve LEDs (6 per axis) are provided on the DSP Axis Module below the DSP Axis Module Status LEDs for indicating axis status. Refer to **Table 58** for a list of the LEDs and what they indicate.

Name	Color	Description
DENB	Green	Indicates that the corresponding axis is enabled (position tracking, open wire detect, etc. enabled), the MODE@ variable for the corresponding axis is greater than two, and the T-ENABLE' output is active (either active high or low depending on DSP jumper configuration).
AFLT	Red	Indicates that the corresponding axis has an Axis Fault condition, AFAULT@ >0.
SEN	Yellow	Indicates that the corresponding axis sensor hardware (ASEN or BSEN) is asserted (conducting current).
EXTZ	Yellow	Indicates that the corresponding axis external sensor hardware is asserted (conducting current).

HTLF HTLR	Red Red	Assertion indicates one of the two following error conditions: Indicates that the corresponding axis hardware overtravel limit switch input (HTLF' and HTLR') is unasserted (not conducting current), and not disabled by hardware jumper configuration, and that axis motion <u>is inhibited</u> by the corresponding input signal. - OR - Indicates that the corresponding axis hardware overtravel limit switch input (HTLF' and HTLR') is asserted (conducting current), and is overridden by hardware jumper configuration, and that axis motion <u>is inhibited</u> due to the conflict between the hardware overtravel limit switch and the override hardware jumper.

***Table 58**, Axis Status LEDs*

5.3 DSP Axis Module Specifications

5.3.1 Absolute Encoder Battery

The absolute encoder battery is a lithium battery used to power optional absolute encoders on MAC-DA, MAC-DB, and MAC-DE servomotors.

Shelf Life	10 years
Working Life[1]	9 years (one absolute encoder) 4 years (two absolute encoders)
Capacity	1000 milliamp hours
Output Voltage	3.0 to 3.1 VDC when new 2.75[2] VDC with 10% life remaining 2.52 VDC with 1% life remaining
Manufacturer P/N	Renata, CR2477-N
[1] Refers to the amount of battery life based on having the ORION and D-Series servodrive control power and the ORION control power turned off 24 hours per day, 365 days per year. The absolute encoder battery is not used when an ORION or D-Series servodrive has control power.	
[2] This is below the minimum voltage required for the absolute encoder backup power (2.8 VDC).	

***Table 59**, Absolute Encoder Battery*

5.3.2 DSP Axis Interface Connector - J6 & J7

ENCA, ENCA', ENCB, ENCB' (pins 1, 2, 11, 12)	Differential Digital Inputs Appendix G-2, G-4
Common mode input	-15 VDC to +15 VDC maximum
Absolute max. input voltage	+/-25 VDC
Maximum frequency MotionBASIC 3.x Motion BASIC 4.x & above	 1.7 MHz (after 4x quad decode) 4.0 MHz (after 4x quad decode)
Quadrature specification	90º +/-45º
Differential turn on voltage ENCA-ENCA', ENCB-ENCB' $V_{ID} > 0.7$ V -0.7 V > V_{ID} > 0.7 V $V_{ID} < -0.7$ V *Where V_{ID}= (ENCx) - (ENCx')*	 Receiver Output H ? L

DRV-CMD (pin 3)	Analog Output Appendix G-3, G-5
Voltage output range	+/- 10 VDC
Current Output	5 mA maximum
Load Resistance	2K ohms minimum

SAC-D, SAC-E, SAC-F and SAC-S Configuration (J13 & J14)

V+,V- (pins 5,7,8,22)	Servodrive Interlock Power Supply Appendix G-3,G-5
Externally supplied voltage for driving opto-coupled servodrive interface.	
Voltage from V+ to V-	30 VDC maximum 4.5 VDC minimum
T-ENABLE2' (pin 15)	Optically Coupled Digital Output Appendix G-3, G-5
Opto-coupler which sinks current to V- when on. T-ENABLE2' can be optionally jumpered to source current at pin 15.	
Max. current Max. voltage Voltage when on (V_{sat}) Power dissipation	35 mA maximum 35 VDC maximum 0.4 VDC maximum (I_c = 2.5 mA) 100 mW absolute maximum

SAC-DE Configuration (J13 & J14)

-12V, +12V (pins 7, 8, 15)	Servodrive Interlock Power Supply Appendix G-3, G-5
ORION power supply for driving opto-coupled servodrive interface. This configuration is used for servodrives which do not have a power supply available for use by the interlock circuitry.	
Voltage from +12 to -12	24 VDC +/-10 % 35 mA maximum
ALM-RESET', T-ENABLE' (pins 6, 9)	Optically Coupled Digital Output Appendix G-3, G-5
Opto-couplers which sink current to V- when on.	
Max. current Max. voltage Voltage when on (V_{sat}) Power dissipation	35 mA maximum 35 VDC maximum 0.4 VDC maximum (I_c = 2.5 mA) 100 mW absolute maximum

AIN2 (optional) (pin 14)	Analog Input Appendix G-2, G-4
Input range Max. input Passive filter	+/-10 VDC +/- 15 VDC maximum 1 kHz cutoff typical
AIN1 and AIN2 use identical circuitry, refer to the DSP Axis Interface Connector - J6 & J7 section (page 112) of this chapter for additional AIN2 specifications.	

ENCZ, ENCZ' (pins 19, 20)	Differential Digital Inputs Appendix G-2, G-4
Common mode input	-12 VDC to +12 VDC maximum
Absolute max. input voltage	+/-25 VDC
Differential turn on voltage	
ENCZ-ENCZ'	Receiver Output
V_{ID} > 0.2 V	H
-0.2 V > V_{ID} > 0.2 V	?
V_{ID} < -0.2 V	L

NO-ALARM', AL01', AL02', AL03' (pins 23, 24, 25, 26)	Optically Coupled Digital Inputs Appendix G-2, G-4
Must sink current from V+ to change opto-coupler output state. Active-high fail-safe NO-ALARM interlocks can be accommodated with an optional jumper which connects NO-ALARM' to pin 18.	
Current to turn on	0.7 mA minimum 7.0 mA maximum
Input Voltage	5V + V+ maximum

***Table 60**, DSP Axis Module Axis Interface Connector – J6 & J7*

5.3.3 DSP I/O Terminal Blocks - TB9 & TB10

Connector	15 pin pluggable terminal block
AIN1 (optional), **AGND** (pins 1, 2)	Analog Input and Analog Ground Appendix G-2, G-4
Input range	+/-10 VDC
Max. input	+/-15 VDC maximum
Input protection	RC network
Input impedance	>10K ohms
Type of input	single ended
Digital Resolution	12 bits (monotonic w/ no missing codes)
Value of LSB	4.88 mV
Data format	Binary
Digital output reading under overload	wrap
Sample duration time (including settling time)	8 usec
Sample repetition time	Based on LOOP.RATE@ (333 usec typ.)
Input filter	Passive filter, 1 kHz cutoff typical
Conversion Method	Successive approximation
Operating Mode	Self-scan
Cabling	Twisted pair, shielded with drain wire

ASEN (BSEN), EXTZ (pins 4, 5)	Digital Inputs Appendix G-2, G-4
Max. voltage any input Minimum acceptance time	V+S 1 microsecond
Turn-on voltage ASEN or BSEN V_{IN} > 0.5 * (V+S) + 0.4 VDC V_{IN} < 0.5 * (V+S) + 0.1 VDC	 Receiver Output H L

V+S, V-S (pins 6, 7, 8)	DSP I/O Power and Return Appendix G-2 through G-6
Externally supplied voltage for driving sensor and/or DSP output interface.	
max. voltage between V+S and V-S	+/- 27 VDC maximum
SOUT' (pin 9)	Optically Coupled Digital Outputs Appendix G-6
max. sink current low level voltage high level voltage absolute maximum	40 mA 0.4 VDC maximum (I_{OL} = 16 mA) 0.7 VDC maximum (I_{OL} = 40 mA) V+S VDC 30 VDC
OUT1', OUT2', OUT3', OUT4' (pins 10, 11, 12, 13)	Optically Coupled Digital Outputs Appendix G-3, G-5
max. sink current low level voltage high level voltage absolute maximum	33 mA 0.7 VDC maximum (I_c = 33 mA) V+S - 0.5 VDC 27 VDC
HTLR', HTLF' (pins 14, 15)	Optically Coupled Digital Inputs Appendix G-2, G-4
Must sink current from V+S to change opto-coupler output state.	

Current to turn on	0.7 mA minimum 7.0 mA maximum
Voltage max.	5V + V+S maximum

The reverse breakdown voltage of the input diode is 5 VDC. Therefore the input must not exceed the V+S input by more than 5 VDC.

***Table 61**, DSP Axis Module I/O Terminal Blocks – TB9 & TB10*

Chapter 6
Getting Started

6 Getting Started

6.1 Preparation for Test Run

For the test run, you need to configure your system according to the ORION Controller chapter and with the appropriate System Wiring Diagram in Appendix B.

DO NOT connect the motor shafts to the driven machine until after the test run is complete! Before the test run, do the following checks of the servomotor and Motion Controller and their installation. Correct any problems before proceeding.

6.1.1 Motion Controller Checklist

Verify that the power is fused properly and that the system power wiring and grounding are correct. See the System Power Wiring & Interlocks - TB8 (ORION System Module) section (page 25) of the ORION Controller chapter and Appendix B of this manual, as well as the *Servodrive Manual*.

1) For MotionBASIC 3.x Systems Only: If a "lot system test" (integrated system test) was performed at ORMEC, the Axis Interface Cables **must be** installed the same as they were at the factory. Servodrives and motors must be connected in the same order because the servo loop configuration parameters are stored in the MP.CONFIG configuration routine by *Axis-ID*. Refer to the DSP Axis Modules chapter (page 89) and Appendix B.
2) Verify that the DSP Axis Module Servodrive Interface Configuration jumpers are properly configured for each servodrive. Refer to the DSP Axis Modules: Servodrive Interface Configuration Jumpers - J10, J11, J13 & J14 section (page 104) of the ORION Controller chapter for further information.
3) Verify that the encoder cables are properly installed. Refer to Appendix B.

4) Verify that the motor wiring and grounding are correct. Refer to Appendix B and the appropriate *Servodrive Manual*.

5) Check for compatible voltage ratings on all servodrives obtaining control power from terminals r and t on TB1.

6) Verify that all wiring leads are firmly connected to their terminals

7) Attach an IBM-PC or compatible computer operating either the MotionPRO (MB 3.x) or the MotionDesk (MB 4.x and higher) communications utility to the ORION Development Port.

8) Verify incoming line voltage (115 VAC or 230 VAC (+10%, -15%), 50/60 Hz) **CHECK POWER BEFORE APPLYING IT TO THE MOTION CONTROLLER!**

6.1.2 Servomotor Checklist

1) Verify proper motor mounting and that the **shaft is not connected to the load.**

2) Check that mounting bolts and nuts are tight.

3) Verify that motor shaft rotates freely by hand (NOTE: If your motor has an integral fail-safe brake you must apply power to the brake coil in order to allow the motor shaft to rotate).

4) For motors with oil seals, (standard on IP-67 rated motors) the seals should be in good condition and properly lubricated.

5) Verify that the key is removed from the shaft keyway, or that it is securely taped down, for test.

6) Verify that the Motor and Encoder Cables are properly attached.

6.1.3 Applying Control Power

1) Refer to the Powerup (ORION System Module) section (page 64) of the ORION Motion Control chapter for further information regarding the ORION powerup sequence.

2) After checking the items above, apply control power (L1 and L2 and toggle on the switch on the top of the controller).

3) The ORION will execute it's Powerup sequence as detailed in the Powerup (ORION System Module) section (page 64) of the ORION Controller chapter.

4) After the Powerup sequence is complete, the green watchdog timer light should flash at a rate of approximately once per second. At this point, the system is operating correctly.

6.2 MotionDesk & MotionPro Development Software

Once power has been applied to the system, you should run either MotionPRO for MB 3.x or MotionDesk for MB 4.x and higher to communicate

with the unit. Consult the MotionPRO or MotionDesk manual as appropriate for installation, startup, and communications details.

6.2.1 Test Running Your MotionBASIC 3.x System

Once communications is established between the development computer and the unit, type RUN and press the Enter key to execute the SETUP program installed in the unit at the factory. SETUP.BAS allows a user to exercise an ORION controller, and is included with MotionDesk (1:\ORMEC\BAS\SETUP.BAS). Before shipment, this program is loaded into the controller program memory, along with a configuration file named CONFIG.BAS.

The SETUP program is menu-driven and will allow you to:

1) Home, Index, and Run all the motors, one at a time;

2) Configure, observe, and manipulate the Integral I/O, Extended I/O, and DSP I/O; and

3) Interactively adjust servo loop parameters after the motors are connected to their respective loads, if required.

After setting up your system, you may save the system's loop and I/O configuration using the *Configuration* menu in MotionPRO.

When the system is configured for your application, you should proceed to develop your application software. The MotionDesk Developer's Kit includes a number of application software development tools called MotionBASIC Tools. These programs and documentation are designed to make applications program development much easier by providing working program modules for accomplishing functions for most Motion Control applications, such as an Error Handler. The ORION training class provides instruction in the use of these tools, contact your ORMEC Sales Representative for further information regarding ORMEC Training classes.

6.2.2 Test Running Your MotionBASIC 4.x System

Once communications is established between the development computer and the ORION controller, the MotionDesk Project Navigator can be used to configure the ORION hardware.

The MotionDesk Project Navigator provides the ability to:

- Select the ORION controller and DSP Axis Module models.
- Configure the general purpose analog and digital I/O using the I/O Properties configurator.
- Select the appropriate motors and drives and configure the DSP Axis Module I/O using the Axis Settings configurator.

After the ORION hardware has been configured for your application, the MotionDesk Axis Tune utility can be used to index and tune the axes.

The MotionDesk Axis Tune utility is a Windows based program that allows you to:

- Index all the motors, one at a time
- Interactively adjust servo loop parameters after the motors are connected to their respective loads, if required
- View graphical display of the commanded and actual motor velocity, commanded motor torque, and the position following error.

When the system hardware is configured for your application and the axes are tuned, you should proceed to develop your application software. ORMEC training classes are available which provide instruction in writing application programs using MotionBASIC, contact your ORMEC Sales Representative for further information.

Chapter 7
Product History

7 Product History

7.1 Determining Hardware Revision Numbers and HDW.REV@

The following is a description of the locations for the hardware revision numbers for the ORION motion controller and its components:

- ORION motion controller - Shown on the part number label (top of the unit above the input power terminal block, next to the power switch/ciruit breaker). Refer to Appendix A-1 for the location of the ORION part number label.
- *ORION System Module* - Written in the REV field on the PC board (below the PC Card slots and on top U26 next to the battery - which may not require board removal to read). Refer to Appendix C-1 for the location of the *ORION System Module* REV field.
- *DIO Board with EIO Option* - Written in the REV field on the PC board (next to connector J52). Refer to Appendix C-2 for the location of the *DIO Board* REV field.
- *DIO Board without EIO Option* - Written in the REV field on the PC board (next to connector J52). Refer to Appendix C-2 for the location of the *DIO Board* REV field.
- *DSP Axis Module* - Shown on the part number label, located on the upper board handle. Refer to Appendix A-5 for the location of the *DSP Axis Module* part number label.

The hardware revision numbers of the ORION System Module and the installed DSP Axis Modules can also be determined using MotionPRO (for MB 3.x) and the HDW.REV@ MotionBASIC variable or the MotionDesk SysInfo display (MB 4.x and higher). Refer to the MotionBASIC Hypertext Software Manual (for MB 3.x) or the MotionBASIC Help (for MB 4.x and higher) for further information regarding the HDW.REV@ variable. Refer to the MotionDesk Help for further information regarding the SysInfo display.

7.2 ORION Model 30/50/70 (ORN-30, ORN-50 & ORN-70)

Version 1.0d - February, 1996 (initial ORION release)

1) ORION System Module revision C released, refer to the ORION System Module (ORN004 & ORN043) section (page 124) of this chapter for further information.

Version 1.0e - February, 1996

1) ORION System Module revision D released, refer to the ORION System Module (ORN004 & ORN043) section (page 124) of this chapter for further information.

Version 1.0f - February, 1996

1) ORION System Module revision E released, refer to the ORION System Module (ORN004 & ORN043) section (page 124) of this chapter for further information.

Version 1.0g - April, 1996

1) Capacitors added to ORION Motherboard to improve elevated temperature operation.

Version 1.0h - April, 1996

1) DIO Board (with EIO Option) revision C released, refer to the DIO Board with EIO Option (ORN005 and ORN020) section (page 126) of this chapter for further information.

Version 1.1a - April, 1996

1) ORION's marked as UL Recognized Components released.

2) ORION System Module revision F released, refer to the ORION System Module (ORN004 & ORN043) section (page 124) of this chapter for further information.

3) RTV applied to DIO Board to meet UL requirements.

Version 1.1b - April, 1996

1) DIO Board revision D released, refer to the DIO Board with EIO Option (ORN005 and ORN020) section (page 126) of this chapter for further information.

Version 1.1c - September, 1996

1) ORION Motherboard power supply connector changed to provide better fit.

Version 1.2a - September, 1996

1) ORION with CE Mark released. Prior to this point, ORION's with the CE Mark required special handling.

2) ORION System Module revision G released, refer to the ORION System Module (ORN004 & ORN043) section (page 124) of this

chapter for further information.

3) DIO Board without EIO Option released, refer to the DIO Board with EIO Option (ORN005 and ORN020) section (page 126) of this chapter for further information.

Version 1.2b - October, 1996

1) ORION System Module revision H released, refer to the ORION System Module (ORN004 & ORN043) section (page 124) of this chapter for further information.

Version 1.2c - January, 1997

1) Internal ORION heat dissipation improved.

2) Internal ORION wiring modified to meet European Low Voltage Directive and CE Mark requirements.

Version 1.2d - February, 1997

1) ORION System Module Revision I released, refer to the ORION System Module (ORN004 & ORN043) section (page 124) of this chapter for further information.

Version 1.3a - April, 1997

1) Integral cooling fan option added.

2) 80586 processor option added.

3) Delete CAN interface option added.

Version 1.3b - October, 1997

1) Added ORION power up progress indication on MBX 1, MBX2, User1 and User2 LEDs (MotionBASIC 3.2j or later).

Version 1.3c - January, 1997

1) Modified the ORION transient protection, increasing the clamp and standoff voltages so EU insulation testing can be performed without the need to disconnect the transient protection.

Version 1.3d – June/July, 1998

1) Initial release of Pentium versions of the Orion controller.

2) ORION System Module Revision K released, refer to the Orion System Module (ORN004) section (page 124) of this chapter for further information.

3) Modified the DRAM timing.

4) Requires ORN-DSP/x v1.1a, refer to the DSP Axis Module (ORN-DSP-AQ & ORNDSP-A2) section (page 127) of this chapter for further information.

Version 1.3e - January, 1999

1) Updated ORN-DSP/x to v1.1b which corrects sensor clearing and false triggering issues.

Version 1.3f - June, 1999

1) ORION System Module Revision L released, refer to the Orion System Module (ORN004) section (page 124) of this chapter for further information.

Version 1.3g - August, 1999

1) ORION System Module Revision M released, refer to the Orion System Module (ORN004) section (page 124) of this chapter for further information.

Version 1.3h - March, 2000

1) New BIOS is being used for 486 & 586 based controllers however all controller versions were bumped.

Version 1.4a - January, 2003

1) A new motherboard is qualified for 486 & 586 based controllers to replace previous board due to obsolescence.

Version 1.5a - June, 2006

1) A new motherboard is qualified for Pentium based controllers to replace previous board due to obsolescence.

Version 1.5a - August, 2007

1) ORION System Module Revision O released, refer to the Orion System Module (ORN004) section (page 124) of this chapter for further information.

Version 1.5b - June, 2008

1) The processor voltage for 586 based controllers was adjusted to the middle of the tolerance range to insure proper operation in all temperature conditions.

Version 1.5c - June, 2008

1) UL Approval to use a different power supply for ORN-70 controllers.

Version 2.0a - May, 2012

2) New backplane and processor replaces all previous processor options due to obsolescence.

7.2.1 ORION System Module (ORN004 & ORN043)

Version C - February, 1996
HDW.REV@ = S:2003

Version D - February, 1996
HDW.REV@ = S:2007

1) Improved No Fault relay operation

2) Modified termination resistor configuration of Serial 1

(SRL1:) and Serial 2 (SRL2:) to improve multi-drop communications performance.

Version E - February, 1996
HDW.REV@ = S:4000

1). Spacing of No Fault relay PCB traces to meet UL requirements

Version F - April, 1996
HDW.REV@ = S:4001

1) RTV applied to Interlock Terminal Block (TB8) to meet UL requirements.

Version G - September, 1996
HDW.REV@ = S:6000

1) PCB artwork modified to meet UL requirements without RTV applied to Interlock Terminal Block (TB8).

2) PCB artwork modified to meet European EMC Directive and CE Mark requirements.

Version H - October, 1996
HDW.REV@ = S:6001

1) PC Card slot insulation improved.

Version I - February, 1997
HDW.REV@ = S:6003

1) PCB artwork modified to meet European Low Voltage Directive ESD and CE Mark requirements.

2) PCB artwork modified to improve the CAN bus interface.

Version J - October, 1997
HDW.REV@ = S:6007

1) Added ORION power up progress indication on MBX 1, MBX2, User1 and User2 LEDs (MotionBASIC 3.2j or later).

Version K - June, 1998
HDW.REV@ = S:600F

1) Introduces the Pentium option on the ORION Model 30.

Version L - June, 1999
HDW.REV@ = S:601F

1) Update PC Card socket interface to improve power-up boot performance.

Version M - August, 1999
HDW.REV@ = S:603F

1) Further update PC Card socket interface to improve power-up boot performance. This supersedes Version L.

Version N - August, 2006

HDW.REV@ = S:603F

1) Removed CAN interface chips to reduce cost. CAN interface was never supported by software.

Version O - August, 2007
HDW.REV@ = S:607F

1) Watchdog timeout on System Module was extended from 40 ms to 320 ms to prevent system hang during boot with Pentium based controllers and pacer interfaces on drives. **NOTE: These are not interchangeable with ORN098/099 boards in Orion O_1 = F systems.**

7.2.2 ORION System Module (ORN098 & ORN099)

Version O - May, 2012
HDW.REV@ = S:607F

1) Same circuitry and modifications as ORN004/043 with jumper and PROM change for Orion option O_1 = F processor compatibility. **NOTE: These are not interchangeable with ORN004/043 boards in Orion non-O_1 = F systems.**

7.2.3 DIO Board with EIO Option (ORN005 and ORN020)

Version B - January, 1996 (initial ORION release)

Version C - April, 1996

1) Modifications made to improve the Pamux interface noise immunity.

Version D - April, 1996

1) PCB artwork modified to meet UL requirements without the use of RTV.
2) Clock circuit modified to meet European EMC Directive and CE Mark requirements.

7.2.4 DIO Board without EIO Option (ORN017 and ORN021)

Version A - September, 1996 (initial release)

1) DIO Boards without the EIO Option provided prior to this release were DIO Boards with EIO Option, but, without the EIO Option chips installed.

Version B - January, 1996

1) Revision letter changed for tracking purposes to reflect the same version as the DIO Board with EIO Option, no functional changes

were made.

Version C - May, 1996

1) Separate design for the DIO Board without EIO Option release. No functional changes were made to the board, but all unused EIO Option support was removed.

7.3 ServoWire Axis Module (ORN-SW-AM)

Version 1.0.0 – June 1999 (initial ServoWire release)
HDW.REV@ = #:2000

Version 1.0.1 – June 1999
HDW.REV@ = #:2001

1) Removed component to enhance startup of DSP at power-up.

Version 1.0.2 – April 2000 (initial ServoWire release)
HDW.REV@ = #:2003

1) Changed frequency components that control the ServoWire bus frequency to be in the center of the allowable range.

Version 1.0.3 – August 2003
HDW.REV@ = #:2003

1) Modified bus access timing between ORN-SW-AM and motherboard.

Version 1.1.0 – September 2003
HDW.REV@ = #:4000

1) New printed circuit board to deal with chip obsolecense in ServoWire circuits.

7.4 DSP Axis Module (ORN-DSP-AQ & ORN-DSP- A2)

Version 1.0b - January, 1996 (initial ORION release)
HDW.REV@ = #:0103

Version 1.0c - March, 1996
HDW.REV@ = #:0107

1) Modifications made to improve ELS1 and ELS2 (OUT1 and OUT2) gating operation with ASEN and BSEN.

Version 1.0d - March, 1996
HDW.REV@ = #:0200

1) PCB artwork corrections.

Version 1.0e - May, 1996
HDW.REV@ = #:0201

1) Delay counter signal debounce circuitry improved.

Version 1.0f - June, 1996
HDW.REV@ = #:0203

1) Analog input noise immunity improved.

Version 1.0g - March, 1997
HDW.REV@ = #:0207

1) Support for delay counter (optional) triggering on the motor encoder reference input added.

Version 1.0h - October, 1997
HDW.REV@ = #:020F

1) Shield connection removed from the MotionDATA IN connector (J5).

Version 1.1a - July, 1998
HDW.REV@ = #:021F

1) DSP changes to support Orion Pentium ISA bus speed improvements.

Version 1.1b - Januray, 1999
HDW.REV@ = #:023F

1) Modifications to correct false triggering and clearing of sensors.

Version 1.2a - July, 2000
HDW.REV@ = #:0300

1) New printed circuit board to enhance manufacturing process.

Version 1.2b - October, 2000
HDW.REV@ = #:0301

1) Correct power to A/D converter circuitry.

Chapter 8
Maintenance & Troubleshooting

8 Maintenance & Troubleshooting

8.1 Fan

For ORION controllers equipped with the cooling fan option, fan should be checked periodically to insure proper operation. Refer to Appendix A-2 for the location of the optional ORION fan.

With the ORION power off, verify that the fan grill is clear of obstructions

With the ORION power on, verify that the fan is spinning and drawing air out of the unit.

If the fan is unobstructed and is not spinning properly, contact ORMEC to obtain a replacement fan kit (ORN-KIT/xxxH, includes fan and installation instructions).

8.2 Batteries

8.2.1 Measuring Non-Volatile Battery Voltage

To measure the voltage of the Non-volatile memory battery:

Turn off power to the ORION and remove the ORION System Module from the controller.

To measure battery voltage, place the positive lead of a voltmeter on the top (positive side as indicated by the "+" symbol) of the battery, and the negative lead of the voltmeter on the R5 terminal of TB8. Be sure that the voltmeter display range is accurate to at least 1 decimal place. Refer to the Non-Volatile Memory Battery Specifications section (page 76) of the ORION Controller chapter for battery voltage level information, Appendix C-1 for the location of the Non-volatile memory battery.

NOTE: **Removing the non-volatile memory battery results in the loss of all MotionBASIC program the non-volatile variable values.**

8.2.2 Replacing the Non-volatile Memory Battery (ORN-BAT)

With the power off, remove the *ORION System Module* from the chassis. Refer to Appendix C-1 for the location of the non-volatile memory battery. Remove the old battery from the socket and insert the new battery (ORN-BAT). ***Removal of the Non-volatile memory battery will result in the loss of all MotionBASIC program Non-volatile variable values, and loss of the MotionBASIC application program for MB 3.x systems.*** **Be sure that the positive side of the battery (indicated by the "+" symbol) is facing up while inserting it into the socket!!!**

8.2.3 Measuring Absolute Encoder Backup Battery Voltage

To measure the voltage of the absolute encoder backup battery:

Turn off power to the ORION and remove the appropriate DSP Axis Module from the controller.

NOTE: *Disconnecting the Axis Interface cable (J6 or J7) disconnects the absolute encoder battery from the servodrive. Leaving the Axis Interface cable disconnected for longer than 48 hours may result in the loss of the absolute encoder data.*

To measure battery voltage, place the positive lead of a voltmeter on the top (positive side as indicated by the "+" symbol) of the battery (indicated by the "+' symbol), and the negative lead of the voltmeter on the AGND terminal of either TB9 or TB10. Be sure that the voltmeter display range is accurate to at least 1 decimal place. Refer to the Absolute Encoder Battery section (page 111) of the DSP Axis Module chapter for battery voltage level information, Appendix G-1 for the location of the absolute encoder backup battery.

8.2.4 Replacing the Absolute Encoder Battery (ORN-BAT)

With the power off, remove the DSP Axis Module from the chassis. Refer to Appendix G-1 for the location of the absolute encoder battery. Remove the old battery from the socket and insert the new battery (ORN-BAT). The motor's absolute encoder data is retained for up to 96 hours without power applied to the ORION or the servodrive logic power inputs, and without the absolute encoder backup battery. Refer to the D-Series AC Servodrives Installation and Operation manual for further information. **Be sure that the positive side of the battery (indicated by the "+" symbol) is facing up while inserting it into the socket!!!**

8.3 Fuses

8.3.1 Fusible Traces

All fuses on the *ORION System Module* and *DIO Board* are fusible traces. Refer to Appendix C-1 and C-2 for the location of the *ORION System Module* and *DIO Board* fusible traces. Refer to **Table 62** for a list of the fuses, their

locators, and description.

Locator	Location	Description
F1	DIO Board	Fuse test socket
F2	DIO Board	EIO power (+5 VDC)
F1	System Module	+5 VDC power
F2	System Module	E-Stop input
F3	System Module	+24 VDC power

***Table 62**, Fuse information*

To verify the status of a fusible trace you must visually inspect it. Look for burnt and/or broken traces, these indicate a "blown fuse". A "blown" fusible trace has a pair of socket pins for the insertion of a replacement fuse. A spare fuse is provided on the DIO Board in the Fuse Test Socket (F2), this fuse should fit any of the fuse sockets on the *ORION System Module* and *DIO Board*.

NOTE: The fusible traces on the ORION System Module are on the opposite side of the PC board from the replacement fuse sockets.

Fuse
Manufacturer: Wickman
Rating: 250V, 4A
Part Number: 19370-062-K

8.3.2 G4 Output Module Fuses

The G4 output modules (G4-ODC-5, G4-ODC-5B, OAC-5, & OAC-5A) have integral fuses. A blown fuse does not prevent the integral LED in the output module from being lit when the output is asserted, even though the output circuit is not closed. A spare fuse is provided in the Fuse Test Socket on the *DIO Board.* Refer to the Fuse Test Socket (F1) section (page 131) of this chapter for fuse testing information.

Fuse
Manufacturer: Wickman
Rating: 250V, 4A
Part Number: 19370-062-K

8.3.3 Fuse Test Socket (F1)

A Fuse Tester (F1) is provided on the *DIO Board.* To test a fuse insert it into the Fuse Test Socket, if the LED is illuminated the fuse is good. This Fuse Test Socket will work for the replacement fuses for the G4 I/O modules, *ORION System Module,* and *DIO Board* fuses.

When testing a fuse, first insert a "known good" fuse into the socket to verify the socket's operation.

NOTE: The Fuse Test Socket requires the +5 VDC power supply be connected to the *DIO Board* for proper operation.

8.4 ORION System Module Troubleshooting

8.4.1 No LEDs Lit on ORION System Module

If no LEDs are lit on the *ORION System Module*:

1) Verify that there is power to the unit, and the power switch/circuit breaker is on. Verify that the voltage between L1 and L2 on the input power terminal block is the appropriate level (either 115 or 230 VAC), and verify that the 5 VDC is present between +5 and R5 on TB8 (refer to the No +5 VDC at Interlock Terminal Block section, page 135). If there is power to the unit and the power switch/circuit breaker is on, there are no LEDs lit on either the *ORION System Module* or the *DSP Axis Modules,* and 5 VDC is not present on TB8, call the ORMEC Service Department.
2) If there are LEDs lit on the *DSP Axis Modules*, but not on the *ORION System Module*, verify that the power supply cable is properly connected to the *ORION System Module*. Turn power off to the unit, and remove the *ORION System Module*. The power supply cable should be connected to header J46. If the power cable is not connected, connect it and re-install the *ORION System Module*, before applying power.
3) If there are LEDs lit on the *DSP Axis Module*, but not on the *ORION System Module*, and the power supply cable is properly connected to header J46, call the ORMEC Service Department.

8.4.2 ORION Dot Matrix Status Indicator Remains Completely Lit

If the ORION doesn't complete the power up sequence, and all the dots in the 5x7 dot matrix Status display are lit on the *ORION System Module*, the MotionBASIC System Card may be missing or corrupted. If the MotionBASIC System Card is missing, install one and press the RESET button. If there is a card already installed, replace it with another MotionBASIC System Card and press the RESET button.

If your ORION has the Pentium Processor Option: Verify that your ORION System Module is version K (or later). Refer to Figure 7 for the location of the ORION System Module version label. If your ORION System Module is not version K (or later) contact the ORMEC Service Department.

8.4.3 ORION Does Not Complete the Power Up Sequence

If the ORION doesn't complete the power up sequence, gather the information listed below and call the ORMEC Service Department.

1) ORION model number, serial number, and the numbers on any mod labels. Refer to Appendix A-2 for the location of the ORION model number, serial number and mods label.

2) System Module version number, serial number, and the numbers on any mod labels. Refer to Figure 7 for the ORION System Module version label location, and Appendix A-3 for the location of the serial number and labels.

3) If you have a Rev. J (or later) System Module, with the ORION in the incomplete power up sequence state, note the status of the MBX1, MBX2, User1, and User2 LEDs.

4) The MotionBASIC version:
If you are able to communicate with the ORION after resetting the unit or cycling power, the MotionBASIC version can be determined in MB 3.x by typing baud@=0 and pressing enter several times, or by using the MotionDesk Sys Info utility in MB 4.x and higher.
If you are not able to communicate with the ORION after resetting the unit or cycling power, the MotionBASIC version originally installed on the System Card are printed on the back of the System Card.
If your ORION has the Pentium Processor Option MotionBASIC 4.1.0 (or later) is required. Earlier versions of MotionBASIC will not allow the ORION to complete the boot sequence. If you have a version of MotionBASIC earlier than 4.1.0, contact the ORMEC Service Department.

5) The model numbers for any installed MotionBASIC Extensions, and their corresponding versions:
If you are able to communicate with the ORION after resetting the unit or cycling power, the MBX versions can be determined in MB 3.x by typing baud@=0 and pressing enter several times, or by using the MotionDesk Sys Info utility in MB 4.x and higher.
If you are not able to communicate with the ORION after resetting

6) the unit or cycling power, the MBXs and their versions originally installed on the System Card are printed on the back of the System Card

8.4.4 MotionPRO - ORION Communications Problems

After referring to the MotionPRO Operation manuals, follow the steps listed in this section if your development computer with MotionPRO doesn't communicate with your ORION motion controller.

1) Verify that the MotionPRO communications cable (CBL-MOD6-AT or CBL-MOD6-PC) is connected to the appropriate development computer serial port, and to the Development Port (J1) on the *ORION System Module*. **Be certain that the MotionPRO communications cable is not connected to one of the ORION Serial Ports (J2 and J3), this can result in damage to the serial port and/or the development computer.**

2) Verify that the Ready to Receive and OK to transmit LEDs on the *ORION System Module* are asserted, indicating that the Serial Development Port hardware is enabled. If these LEDs are not asserted call the ORMEC Service Department.

3) With MotionPRO running on your development computer, and in "TALK" mode (the MotionPRO mode is indicated in the bottom left-hand corner of the screen, EXECUTE will de displayed until communications are

established), press the ENTER (carriage return) key on the development computer and verify that both the Receiving Serial and Sending Serial LEDs on the *ORION System Module* flash. If the Receiving Serial LED is flashing, the Development Computer is transmitting data to the ORION, and if the Sending Serial LED is flashing the ORION is responding.

4) If the Receiving Serial LED on the *ORION System Module* is not flashing, verify that the MotionPRO communications cable is attached to the correct serial port on your development computer. If it is not, either move the MotionPRO communications cable to the appropriate development computer serial port, or change the serial port specified in MotionPRO (<F2>, <S>, <C>). If this does not solve the problem there may be a problem with the development computer serial port. NOTE: If you are operating MotionPRO on a development computer which is also operating Windows, the mouse is often connected to COM1:.

5) If the Receiving Serial LED on the *ORION System Module* is flashing with each ENTER (carriage return) press, but the Sending Serial LED on the *ORION System Module* is not, the ORION may be executing a MotionBASIC program. If the Program Stopped LED on the *ORION System Module* is unasserted, the ORION is executing a MotionBASIC program. Pressing <Ctrl-C> will break MotionBASIC program execution and put the ORION in direct mode.

6) If the ORION is still not responding to ENTER (carriage return) key presses, try pressing the RESET button on the *ORION System Module* and repeating this test. If this does not resolve the problem call the ORMEC Service Department.

8.4.5 MotionKey Fault LED Lit

If the MotionKey LED is lit:

1) Verify that a MotionKey is installed on the *ORION System Module*. Refer to Appendix A-3 for the location of the MotionKey on the *ORION System Module*.

2) If a MotionKey is installed, you will need to establish communications with the ORION using MotionPRO and verify the number of MotionCredits on the key and the number required by MotionBASIC and any installed MBXs. The number of MotionCredits installed on the MotionKey and the number required by MotionBASIC and any installed MBXs is displayed in the MotionBASIC sign-on message.
   For MotionPRO (MB 3.x)
   At the MotionBASIC direct mode prompt type BAUD@=0, and press ENTER (carriage return) several times.
   For MotionDesk (MB 4.x and higher)
   The SysInfo display can be used to view the number of MotionCredits installed and required in MotionBASIC 4.x.

   If your MotionKey does not have enough MotionCredits contact your ORMEC Sales and Applications Engineer to obtain a key with the appropriate number of MotionCredits.

8.4.6 +24 VDC LED Not Lit

If the +24 VDC LED on the ORION System Module is not lit:

1) Verify that the ORION includes a 24 VDC power supply by an "F" in the unit's part number (e.g. ORN-30/A**F**E) or an ORN-KIT/xF label on or near the ORION part number label. The ORION part number label is on the top of the unit above the input power terminal block, next to the power switch/circuit breaker.

2) If the ORION includes a 24 VDC power supply, measure the voltage between the +24 and RTN pins on the Interlock terminal block (TB8). If 24 VDC is not present between +24 and RTN on TB8 the 24 VDC fuse on the *ORION System Module* may be blown. Turn off power to the motion controller and remove the ORION System Module. Refer to Fusible Traces section (page 130) of this chapter for further information.

3) If there is a 24 VDC power supply in the unit, and the 24 VDC fuse is not blown, call the ORMEC Service Department.

8.4.7 No +5 VDC at Interlock Terminal Block

If voltage between the +5 and R5 pins on the Interlock terminal block (TB8) is less than 4.95 VDC the 5 VDC fuse on the ORION System Module may be blown. Refer to the Fusible Traces section (page 130) of this chapter for further information. If the 5 VDC fuse is not blown, call the ORMEC Service Department.

8.4.8 No Fault Relay Not Closing

For the *No Fault* relay to be closed, four conditions must be satisfied:

1) There must be no controller diagnostic faults, including powerup diagnostics and the watchdog timer function. You can determine the system status using the System Status Indicators (System Status Display and LEDs) on the *ORION System Module*. Refer to the System Status Display (ORION System Module) and System Status LEDs (ORION System Module) sections (pages 68 and 69) of the ORION Controller chapter for further information.

2) There must be power (either +12 to +35 VDC or 12 to 30 VAC) applied to the E-Stop input at TB8. You can verify that the E-Stop input is asserted using the E-Stop OK LED on the *ORION System Module*.

3) If the Machine-Stop inputs (MB 4.x and higher) are used, the appropriate DIO points must be asserted (DIO@(1), DIO@(3), DIO@(5) & DIO@(7)). You can verify that a Machine-Stop input is asserted using the LED on the I/O module. NOTE: If using MotionBASIC 3.x this condition does not apply.

4) There must be no drive faults from any standby or active servodrives, and no open wires on axes in pacer mode. You can determine the axis status using the DSP Axis Module and Axis Status Indicators LEDs on the *DSP*

Axis Module(s). Refer to the DSP Axis Module Operation section (page 110) of the DSP Axis Module chapter for further information.

If these four conditions are satisfied, establish communications with the ORION using MotionPRO or MotionDesk.
For MotionPRO (MB 3.x):
At the MotionBASIC prompt type <Alt-C>, "0", and ENTER (carriage return). This should cause the No Fault Relay to close, if not, type <Alt-F> for further fault information and call the ORMEC Service Department if you are unable to resolve the problem.
For MotionDesk (MB 4.x and higher):
In the Direct Mode window enter the following sequence of MotionBASIC commands AFAULT@=0:MFAULT@=0:FAULT@=0:WAIT 300:MODE@=0<Return>. This should cause the No Fault Relay to close, if not, use the MotionDesk SysInfo display to view further fault information and call the ORMEC Service Department if you are unable to resolve the problem.

8.5 DIO Board Troubleshooting

8.5.1 I/O Modules Not Functioning Properly

For input modules (G4-IDC-5, G4-IDC-5B, G4-IAC-5, and G4-IAC-5A) and output modules (G4-ODC-5, G4-ODC-5R, G4-OAC-5, and G4-OAC-5A) the module's integral LED will be lit when the I/O point is asserted. If the LED is not lit:

1) Verify that the module is completely inserted into the DIO Board and held in place by the mounting screw.
2) For input modules, verify that the appropriate voltage is applied at the modules corresponding input terminals on the DIO Board (TB3 - TB6).
3) With all power to the ORION disabled, verify that the ribbon cable between the *DIO Board* (J52) and the *ORION System Module* (J41) is completely inserted in the connectors at both ends. Refer to Appendixes C-1 and C-2 for the location of connectors J52 and J41.
4) Verify that the Machine-Stop/No Fault Configuration Jumpers are configured for the appropriate mode of operation (either DIO or MSTOP). Refer to the Machine-Stop/No Fault Configuration - JP1, JP2, JP3, & JP4 section (page 23) of the ORION Controller chapter for further configuration information.

If the LED for an output module is lit, but the output circuit is still not closed, the integral module fuse may be blown. Remove the module's fuse and insert it into the Fuse Test Socket (F1) on the *DIO Board* to verify the fuses integrity. Refer to the Fuse Test Socket (F1) section (page 131) of this chapter for further information.

8.5.2 Dim I/O Module LEDs

If the I/O module LEDs appear too dim:

1) Verify that the 5 VDC power supply voltage is correct by measuring the voltage between the +5 and R5 pins of TB8 on the ORION System Module. Refer to the No +5 VDC at Interlock Terminal Block section (page 135) of this chapter for further information. If the +5 VDC is not correct, contact the ORMEC Service Department. NOTE: The +5 VDC power for the *DIO Board* is supplied directly from the ORION logic power supply, and does not pass through the +5 VDC fuse (F1) on the *ORION System Module*.

2) With all power to the ORION disabled, verify that the *DIO Board* power cable is completely inserted into the Input Power Connector (J51). Refer to Appendix A-4 for the location of the *DIO Board* Input Power Connector (J51).

8.5.3 No DIO Board Power Output (TB2)

If there is no +24 VDC and +12 VDC power present on terminal block TB2:

1) Verify that the ORION includes a 24 VDC power supply by an "F" in the unit's part number (e.g. ORN-30/A**F**E) or an ORN-KIT/xF label on or near the ORION part number label. The ORION part number label is on the top of the unit above the input power terminal block, next to the power switch/circuit breaker.

2) *If the ORION includes a 24 VDC power supply*, verify that the *DIO Board* Power Cable is completely inserted into connector J51. Refer to Appendix A-4 for the location of connector J51.

3) *If the ORION does not include a 24 VDC power supply*, an external supply must be connected to the +24 and RTN pins of TB8 on the *ORION System Module* in order for the *DIO Board* to have +24 VDC and +12 VDC power outputs. In this case, with all power to the ORION disabled, also verify that the power supply cable is completely inserted into connector J46 on the *ORION System Module*. Refer to Appendix C-1 for the location of connector J46. Refer to the Connecting an External Field Wiring Power Supply to ORION (page28) section of the ORION Controller chapter for further information.

If there is +24 VDC power, but, no +12 VDC power present on terminal block TB2 call the ORMEC Service Department.

8.5.4 EIO Not Functioning Properly

If an I/O Rack (MIO-PB24, PB16H, or PB8H) or Pamux Brain Board (MIO-B5 and /or MIO-B6) connected to the *DIO Board* is not functioning properly:

1) Verify that the CBL-EIO ribbon cable between the *DIO Board* connector (J8) and the I/O rack or Brain Board connector is completely inserted at both ends.

2) Verify that the EIO Power Fuse (F2) on the *DIO Board* is not blown. If fuse F2 is blown, find and correct the problem which caused the fuse to blow, and then insert a replacement fuse.

3) Verify that the 5 VDC power supply voltage is correct by measuring the voltage between the +5 and R5 pins of TB8 on the *ORION System Module*. Refer to the No +5 VDC at Interlock Terminal Block section (page 135) of this chapter for further information. If this voltage is not correct, contact the ORMEC Service Department.

4) Verify that the +5 and R5 pins on the ORION System Module (TB8) are connected to the "+" and "-" terminals respectively on the I/O rack.

5) With all power to the ORION disabled, verify that the ribbon cable between the *DIO Board* (J52) and the *ORION System Module* (J41) is completely inserted to the connectors at both ends.

6) With all the power to the ORION disabled, remove the ORION System Module and verify that the EIO Clock Configuration header (J53) is properly configured. Refer to the 3.1.18 section (page 38) of the ORION Controller chapter for further information. **NOTE: Only ORION System Module revisions G and later have the EIO Clock Configuration header J53, this step can be skipped for older revision ORION System Modules.**

For a Pamux system connected to DIO Board:

1) Verify that all the CBL-EIO ribbon cables between the Brain Boards are completely inserted into the connectors at both ends.

2) Verify that the Pamux Bus Terminator Board (MIO-TERM1) is properly installed in the last Brain Board on the bus. Refer to the Pamux Bus Terminator Board (MIO-TERM1) section (page 59) of the ORION Controller chapter for further information.

3) Verify that the jumpers on all the Brain Boards are properly configured. Refer to the Pamux I/O System section (page 56) of the ORION Controller chapter for further information.

4) Verify that the power supply for each Brain Board and I/O module rack is properly connected. Refer to the power supply connection diagrams included in the "Brain Board User's Guide", supplied with each Pamux Brain Board.

8.6 ServoWire Axis Module Troubleshooting

8.6.1 DSP OK LED Not Lit

If the DSP OK LED on a ServoWire Axis Module is not lit:

1. Verify the controller input power voltage
2. With controller power off, verify that the Axis Module boards are completely inserted into their controller slots.

If the problem persists, call the ORMEC Service Department.

8.6.2 S-WIRE LED is Lit

If the S-WIRE LED on the ServoWire Axis Module is lit there is a configuration error for that Axis Modules ServoWire network. Examples of ServoWire network configuration errors are: 1) network cable connections form a ring, 2) two or more Axis Modules are connected together via ServoWire cable, 3) more than eight Drives are connected to a single ServoWire Axis Module.

Verify that the ServoWire network cabling between the Axis Module and Drives is correct. If the problem persists, contact the ORMEC Service Department.

8.6.3 Axis Status LED Red (Axis A – Axis H)

If an Axis Status LED is red, indicating an axis fault (AFAULT@>0):

1) Determine if there is an alarm on that axis by checking the Drives 2-digit 7-segment display. If there is a Drive alarm (ALARM@>0), correct the fault and reset the system.

2) Determine which axis has a fault (AFAULT@>0), correct it and reset the system. To help determine which axis has a fault, establish communications with the ORION using MotionDesk. Open the Direct Mode Window, press <Alt><Shift>F and <Enter>. The current system error and fault information will be displayed. *Note: It is not necessary to "break" program execution when performing this operation.* Refer to the MotionBASIC Help for information regarding the various axis fault codes.

Call the ORMEC Service Department if you need additional assistance.

8.6.4 Axis Status LED Alternating Green/Red (Axis A – Axis H)

If an Axis Status LED is alternating green and red, indicating a mismatch between the axes defined in the MotionDesk Project and those connected to the ServoWire Axis Module, verify that all the ServoWire Drives have the axis IDs indicated in the MotionDesk Project file. Use the pushbutton on the top of the Drive to change the Drive ID, if necessary, and reset the system. Refer to the ServoWire Drive ID section of the ServoWire Drive Installation and Operation Manual for further information regarding Drive ID configuration.

Call the ORMEC Service Department if you need additional assistance.

8.6.5 Fewer Lit Axis Status LEDs than Drives (Axis A – Axis H)

If your ServoWire Axis Module has fewer Axis Status LEDs lit (either Green, Red or Alternating Green/Red) than Drives connected to it, indicating that one or more axes are not in AXIS.LIST@:

1. Verify that the ServoWire network cabling between the Axis Module and Drives is correct.

2. Verify that all the Drives have logic power.
3. Verify that no two (or more) Drives connected to that ORION have the same ID. If two (or more) Drives have the same ID, the IDs on the Drives 2-digit 7-segment displays will flash. Change the Drive ID(s) so they match the configuration in the MotionDesk Project file using the pushbutton on the top of the drive, and reset the system. Refer to the ServoWire Drive ID section of the ServoWire Drive Installation and Operation Manual for further information regarding Drive ID configuration.

Call the ORMEC Service Department if you need additional assistance.

8.7 DSP Axis Module Troubleshooting

8.7.1 DSP OK LED Not Lit

If the DSP OK LED on a DSP Axis Module is not lit:

1. Verify the controller input power voltage
2. With controller power off, verify that the Axis Module boards are completely inserted into their controller slots.

If the problem persists, call the ORMEC Service Department.

8.7.2 Sensor Input LEDs Flashing (SEN)

If the A and B SEN LEDs are flashing, when the input signal is not changing state:

1) Verify that +24 VDC and +24 VDC common are connected to V+S and V-S respectively on either of the DSP I/O Terminal Blocks (TB9 and TB10), and that the +24 VDC common is connected to the +5 VDC common (R5) on the Interlock Terminal Block (TB8) on the *ORION System Module*.
2) Verify that the sensor cable is a shielded twisted pair, and that the shield drain is connected to the SHLD input on the DSP I/O Terminal Block (TB9 and TB10).
3) With power to the ORION disabled, verify that the sensor biasing resistor jumper is properly configured for the sensor being used. Refer to the DSP Axis Modules: High Speed Sensor Input Configuration - J9 & J12 section (page 107) of the DSP Axis Module chapter for further information.

8.7.3 Hardware Overtravel Limit Switch LED Lit

If a hardware overtravel limit switch is being used and the corresponding LED (HTLF or HTLR) is lit:

1) Verify that the limit switch is closed to V-S.
2) Verify that DC power supply is connected to V+S, and the DC common is connected to V-S on either DSP I/O Terminal Block (TB9 or TB10) of the

DSP Axis Module. If an external power supply is used, its common should be referenced to the ORION power supply common.

3) Verify that the appropriate axis Hardware Overtravel Limits Enable/Disable jumper (J17) on the *DSP Axis Module* is in the ENABLE position. Refer to Appendix G-1 for the location of the J17, and the DSP Axis Modules: Hardware Overtravel Limits Enable/Disable - J17 section (page 109) of the DSP Axis Module chapter.

If no hardware overtravel limit switch is being used and the corresponding LED (HTLF or HTLR) is lit, with power to the ORION disabled, verify that the appropriate axis Hardware Overtravel Limits Enable/Disable jumper (J17) on the *DSP Axis Module* is in the DISABLE position.

8.7.4 AFLT LED Lit

If the AFLT LED is lit:

3) If both axes connected to the DSP Axis Module are servo axes and the AFLT LED for Axis A is lit, verify that the DSP Axis Module is a dual axis module (ORN-DSP-A2). Two servo axes cannot be controlled with a single axis plus pacer encoder module (ORN-DSP-AQ).

4) Verify that the servodrive interface cable (CBL-AD, ADE, AE, AF, or AS) is connected to the appropriate Servodrive Interface Connector. **DISABLE THE ORION and SERVODRIVE LOGIC POWER PRIOR TO ATTACHING THE SERVODRIVE INTERFACE CABLE.**

5) Determine if there is a servodrive fault, if so, correct the fault and reset the system.

6) Establish communications with the ORION using MotionPRO or MotionDesk
   For MotionPRO: (MB 3.x)
   Type <Alt-F> at the MotionBASIC direct mode prompt (you may have to "break" program execution by typing <Ctrl-C> to exit the application program). This should tell you the current system status and the status of any axes with faults.
   For MotionDesk: (MB 4.x and higher)
   The SysInfo display will indicate the current system status and any axes with faults. It is not necessary to "break" program execution when using the SysInfo display. Refer to the MotionBASIC Help for information regarding the various axis fault codes.

Call the ORMEC Service Department if you need additional assistance.

Chapter 9
Terms & Mnemonics

9 Terms & Mnemonics

There are a number of terms or "buzzwords" which are often used in the Motion Control Industry, some of which have very specific meanings in ORMEC's products and systems. This section attempts to define many of these terms used in this document which may be unfamiliar.

Absolute Encoder **-** a sensing device that provides the position of the shaft relative to a fixed reference point at power up without having move the shaft to determine that point. In the case of a multiple revolution absolute rotary encoder, the current position may be multiple turns away from the reference point.

Axis - In motion control, this term normally refers to one of the servomotors in the system, either by name or *Axis-ID* from 1 to 20. It is also used to refer to any *Pacer Encoders* in the system. Many ORMEC pre-defined variables in MotionBASIC are defined for each axis in the system and are therefore indexed by Axis-ID.

CAN (Controller Area Network) - an open standard, high data rate, broadcast-oriented communications protocol, originally developed for the European automotive market. The CAN protocol has high noise immunity, and is available in a variety of chip packages with high temperature ratings.

Controller Motherboard - IBM PC-AT compatible motherboard which is the backplane of an ORION Motion Controller. ORION controller motherboards are available with 4, 6, and 8 slots. The first slot always contains the *ORION System Module*, therefore the ORION Model number (30, 50 & 70) indicates the number of slots remaining for *DSP Axis Module*s, Network Communications Adapters, etc.

Current Source - The ability for a device to switch and provide current for a circuit.

Current Sink - The ability to for a device to switch and accept the current in a circuit.

Data Highway/Plus - Allen-Bradley's Data Highway and Data Highway Plus are proprietary peer-to-peer message passing factory networks. Data

Highway/Plus is a convenient and powerful method for data communications between ORION Motion Controllers, programmable logic controllers, man-machine interfaces, and host computers.

DIO Board - The *DIO* (Discrete I/O) *Board* is the integral mounting rack for the 16 I/O modules that are supported by an ORION Motion Controller. This board also contains an I/O power terminal block and optional EIO interface connector and circuitry.

DSP - Digital Signal Processors are special purpose micro-controllers used in ORMEC ORION Motion Controllers to perform servomotor loop control.

DSP Axis Module - An IBM-PC/AT compatible printed circuit board which contains a DSP, shared dual-port memory, and two axis interface connectors. It is used to perform the digital control algorithms and interface servo axes in the system, or interface to a pacer encoder.

Electronic Gearing - A means of precisely coordinating the motion of a number of *servo axes* with a *pacer encoder* or a *pacer* servo axes.

Encoder - A digital position transducer used to determine the position of a motor, a rotating shaft on a machine, or a linear position associated with a machine. It has two *quadrature* channels (A & B) which determine incremental movements and a single *encoder reference* channel (Z) which defines a unique position within its travel. Most, but not all, position encoders internally use optical gratings and sensors.

Encoder Reference - A signal generated by the position *encoder* once per revolution which may be used to determine the encoder's overall angular or linear orientation. Also sometimes called an *encoder marker pulse*.

Factory network adapters - A physical layer network interface which plugs into the Controller Motherboard and contains a co-processor for performing factory network communications (e.g. Data Highway Plus and Modbus/S908 require factory network adapter cards).

Follower - A servo axis which is controlling its motion as a function of MotionDATA generated by a *pacer* axis. Follower motions are generated with the GEAR statement in MotionBASIC.

G4 I/O Modules - Opto-22's Generation 4 I/O modules feature a small industry standard footprint with integral LEDs, and integral fuses on the output modules.

GE Genius - General Electric's Genius is a peer to peer data and I/O communications factory network. GE Genius is a convenient and powerful method for data and I/O communications between ORION motion controllers and GE Series 90-30 and 90-70 PLCs.

Home Position - A reference position for either a servo or an encoder *axis*.

Hardware Overtravel Limits - Optically isolated inputs to a *DSP Axis Module* which must be asserted (sinking current), or disabled by hardware jumper, for a servo axis to operate.

Loop Update - *Servo Loops* in ORION Motion Control systems are updated by the *DSP Axis Module* at rates of between 1,500 and 8,000 times per second. At each *Loop Update*, the DSP performs housekeeping operations

such as updating the axis position and the output signals in addition to performing the real-time control algorithm for that servomotor.

Machine Sensor - Any of a number of types of ON-OFF sensors such as various proximity switches or mechanical switches mounted to a machine.

Machine-Stop/No Fault - A Machine-Stop/No Fault pair are a pair of I/O points on the DIO Board (DIO pts. 1-2, 3-4, 5-6, and 7-8) used to control several independent machines, or sections of a machine, using a single ORION controller.
- A Machine-Stop input (DIO pts. 1, 3, 5, and 7) must be asserted for full operation of the axes it controls. If power a Machine-Stop Input is removed, it's corresponding

Machine-No Fault output will be unasserted.
- A Machine-No Fault output (DIO pts. 2, 4, 6, and 8) is asserted as long as there is power to the unit, there are no controller faults, it's corresponding Machine-Stop input is asserted, and there are no axis faults for the axes it monitors.

MMI-840 - The MMI-840 is a compact industrial terminal featuring an 8-line by 40-character backlit display and a 30-key keypad. The front panel is designed to NEMA-4 (washdown) specifications, and the large rubberized keys feature tactile feel. Three color-coded groups of keys are fully supported by MotionBASIC to provide menu selection and editing as well as alphanumeric data entry. It operates on 24 VDC (provided by the Motion Controller) and is interfaced via RS-422 to either an ORION Serial Port (Serial 1 & 2) or a Serial Interface Adapter.

Modbus - A single master, multi-drop network for transferring factory data originally developed by Modicon and supported by many controls vendors. Modbus is a convenient and cost-effective method for data communications between an ORION Motion Controller, programmable logic controllers, man-machine interfaces, and host computers.

Module ID - Refers to the setting of the Module ID rotary switch on a DSP Axis Module. DSP Axis Module ID numbers are normally sequential starting with 0 (0, 1, 2, 3, etc.) from left to right, and are used to calculate the Axis ID.

MotionBASIC - The ORMEC motion programming language which enhances industry standard BASIC with additional built-in statements and pre-defined variables specifically intended for Motion Control applications.

MotionBASIC Extension (MBX) - A dynamic link library (DLL) which is added to the MotionBASIC System Card to provide specialized functionality, such as factory network communications. Once installed, the MBX provides additional statements and variables to MotionBASIC to provide elegant integration of specialized functionality. MBXs require additional MotionCredits in order for proper MotionBASIC operation.

MotionBASIC System Card - PC Card containing the MotionBASIC interpreter and ORION system files. This card is installed in the first PC Card slot on the ORION System Module and contains additional memory space for MotionBASIC application programs.

MotionDATA - ORION high speed motion information used to coordinate motion among multiple *axes* controlled by DSPs.

MotionDesk - A fully integrated, Windows 95/NT compatible "desktop" for motion control. It utilizes drop-down menus, toolbars, and dialog boxes and presents an intuitive and powerful graphical user interface (GUI) to ORION controllers running MotionBASIC 4.x.

MotionKey - A hardware key on the ORION System Module which is programmed with a number of MotionCredits, which are required for the operation of MotionBASIC and the MotionBASIC Extensions.

MotionPRO - Development software used to communicate with ORMEC's Generation III family of motion controllers and ORION controllers running MotionBASIC 3.x.

ORION System Module - The ORION System Module integrates a number of important features for industrial control into ORION, including: PC Card support, non-volatile variable memory, fail-safe optically isolated "Emergency Stop" input, "No Alarm" relay output, Watchdog Timer circuitry, status LEDs, and serial communications ports.

Pacer - A *servo* or *encoder axis* which transmits either its actual or commanded motion to other servo axes through the MotionDATA communication channel to another servo axis.

Pacer Encoder - An incremental encoder or device which generates *quadrature* signals which are used by other servo axes when they operate as *followers*.

Pamux - Opto-22's open standard parallel multiplexed method of accessing up to 512 analog or digital optically isolated I/O points.

PC/AT Bus - Open standard 16-bit ISA bus used as the backplane of IBM-PC/AT compatible computers.

PC Card - Credit card size memory module conforming to the widely accepted PCMCIA open standard. In addition to the MotionBASIC System Card, ORION supports the use of a second Type I or II PC Card through the second PC Card slot on the ORION System Module. Flash RAM, SRAM, and Hard Disk modules are available in the PC Card format, each can be used for additional application program and data file storage space.

PC Card™ Memory Cards - a *PC Card™ Memory Card* is plugged into the PC Card™ slot on the ORION System Module, it provides a removable non-volatile memory disk drive.

- ATA Flash Memory Cards provide read/write memory that is inherently non-volatile and are available in sizes from 2M to 40M bytes. They have limitations with respect to dynamic data storage.

- SRAM Memory Cards provide read/write memory with internal lithium battery backup. Read/write speeds comparable to RAM drives provide ideal dynamic data storage including random access files. They are available in 1M, 2M and 4M byte sizes.

Profibus DP - An "open standard" fieldbus supporting master and slave devices. Profibus DP is a convenient and powerful method for to allow a Profibus DP master device high speed access to ORION motion controller (Profibus DP slave) bit and word I/O data.

Quadrature - Quadrature or "phase quadrature" signals are the most commonly used method of electronically determining or transmitting bi-directional position information. The two quadrature signals are digital square waves which have their cycles displaced 90 degrees (of the 360 electrical degrees in the repeated waveform). All four edges of the two digital signals are normally used for the maximum possible position resolution ("4x").

QuickDesigner - ORMEC's editing and configuration software development tool for building control panels for the QuickPanel operator interface. All QuickPanel object details such as shape, color, size, action, and legend are easily modified using QuickDesigner.

QuickManager - All the QuickPanel panels, alarm messages, status messages, variable mappings, etc. associated with an application make up a project. QuickManager is used to manager multiple operator panel projects. Individual projects can use different screen sizes and display types, which are also stored with each project.

QuickPanel - A flatpanel touchscreen operator interface terminal featuring graphical LCD or electroluminescent displays with NEMA 12 (and optional NEMA 4X) sealing. The QuickPanel provides a variety of controls which can be used to replace traditional operator interface panel (e.g. push-buttons, selector switches, pilot lights, etc.) and data display/entry devices. Communications with an ORION controller use the MotionBASIC Extension (MBX) for QuickPanel Communications to transfer bit and word numeric data, as well as I/O, independent of the MotionBASIC program. The 5" units operate on 24 VDC (supplied by the motion controller), the 9" units operate on 120 VAC, and are interfaced via RS-422 to an ORION Serial Port (Serial 1 & 2) or via RS-422 or RS-232 to a Serial Interface Adapter.

Registration Control - The act of maintaining a fixed position relationship between machine tooling and a product in the machine. Registration is normally measured by capturing the tooling position with respect to the product using a registration sensor of some type. It is controlled by phasing the tooling ahead or behind based on the difference between the actual and desired positional orientation.

Resolver - A position transducer used to determine the position of a motor. Resolvers are rotary transformer devices with analog interfaces. However, in ORMEC Motion Control systems which use resolvers, the servodrive decodes the resolver position digitally and provides two *quadrature* channels (A & B) which determine incremental movement and a single *encoder reference* channel (Z) which defines a unique position within a motor revolution.

Servo (or Servomotor) - A special motor which is controlled positionally by comparing its measured position with its desired position. ORMEC's MAC Series servomotors are considered AC Brushless Servomotors (also sometimes called DC Brushless Servomotors) because of the permanent magnet rotors and the wound stators.

Servodrive - A power unit for amplifying a small-signal ($\pm$10 VDC) drive command to the power necessary to control a servomotor. ORMEC's SAC Series servodrives are matched with the MAC Series servomotors to provide fully integrated control as well as extensive fault diagnostic capabilities.

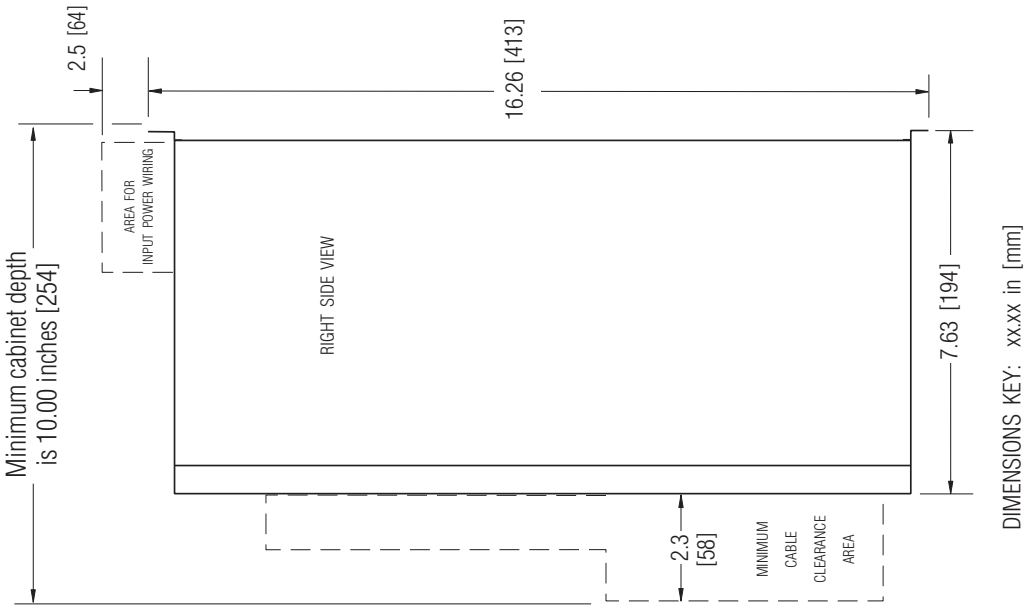
Servo Loop - The act of controlling a servo by repeatedly observing its speed and position and adjusting its torque creates a "servo loop". With ORION Motion Controllers, these digital loops are "closed" by the *DSP Axis Modules* at *loop update* rates of 1,500 to 8,000 times per second.

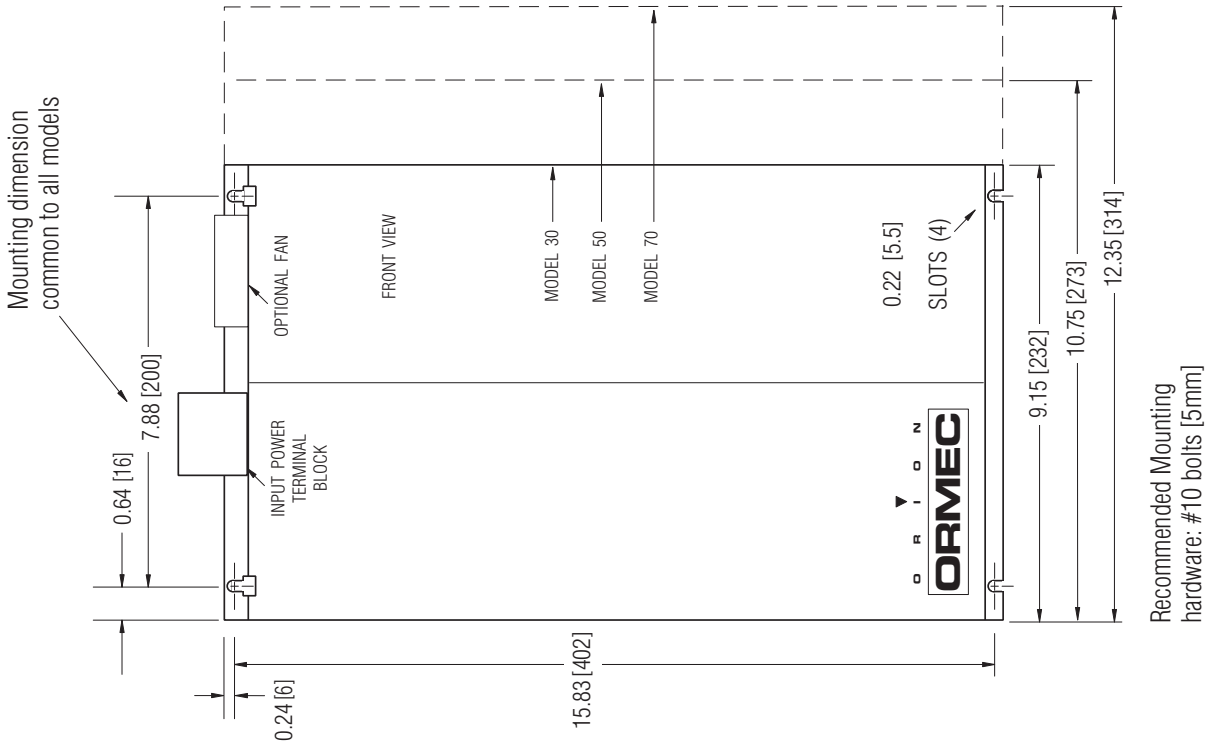
SLC-500 DF1 - A point to point network link providing direct, cost effective connectivity between an ORION motion controller RS-232 port and an Allen-Bradley SLC-500 PLC development port.

Tension - the magnitude of force uniformly distributed through a material as a result an external force on that material which constrains movement.

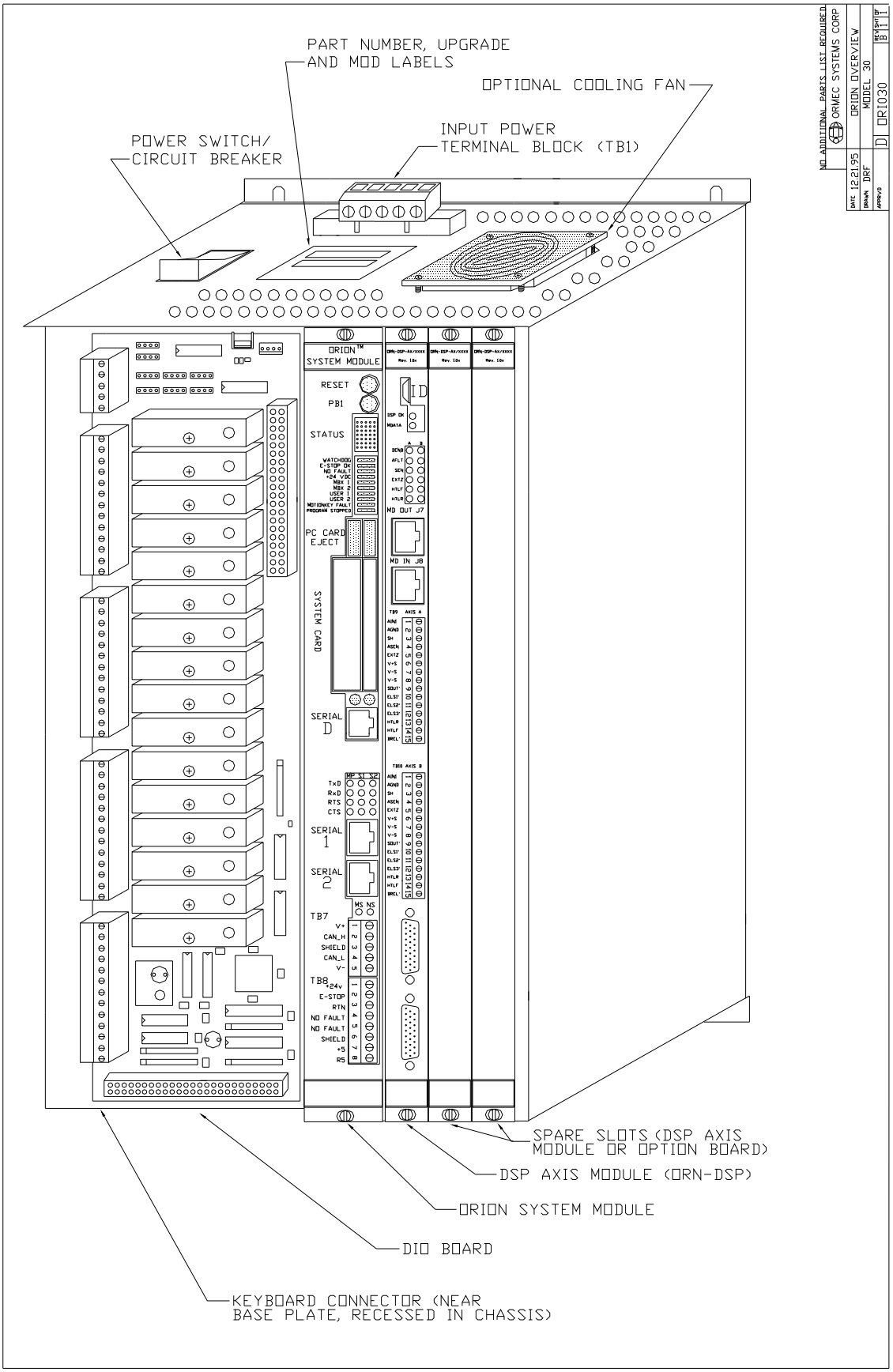
Appendix A - ORION Installation Diagrams

Model 30/50/70 – Installation Diagrams

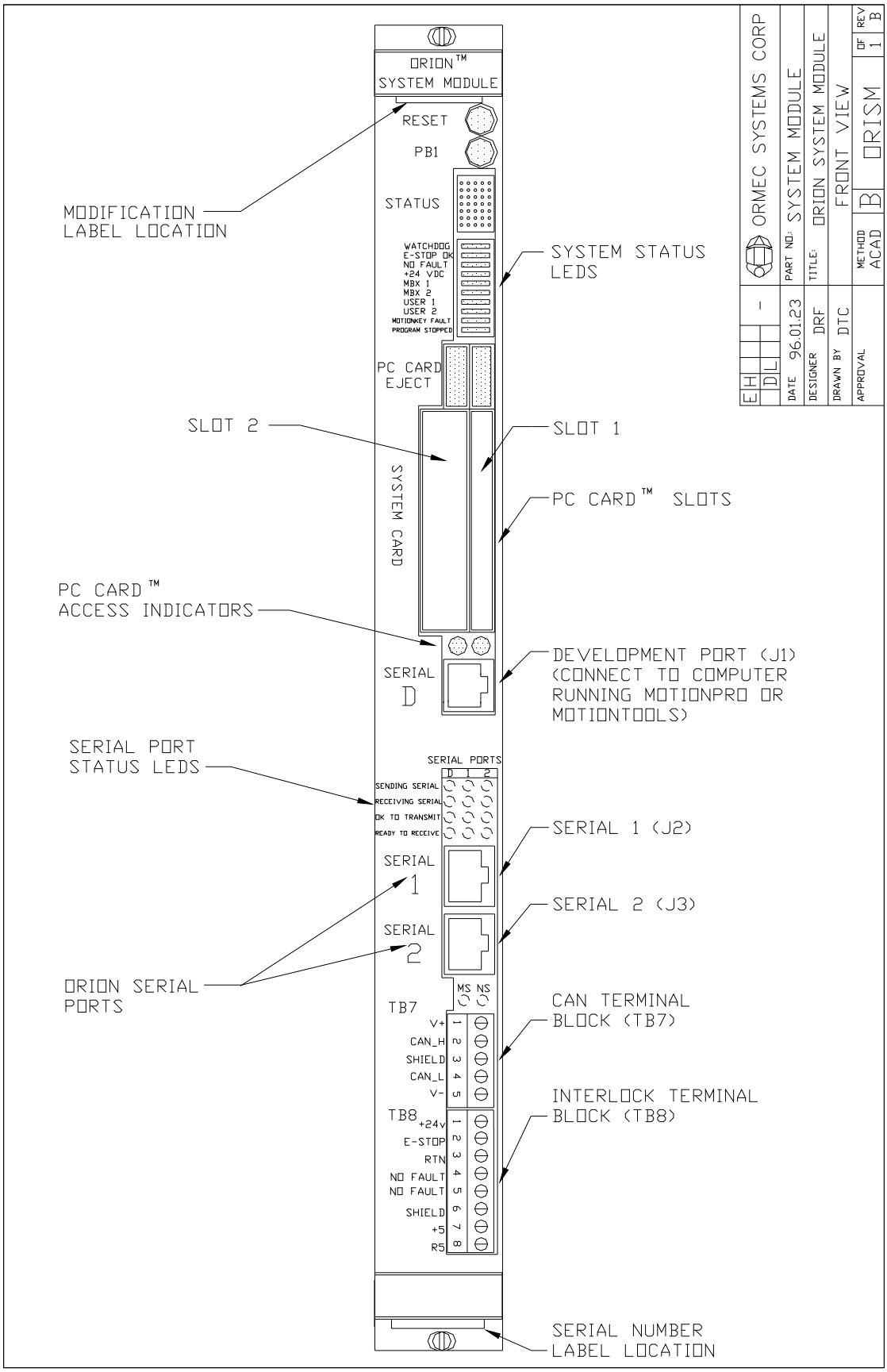




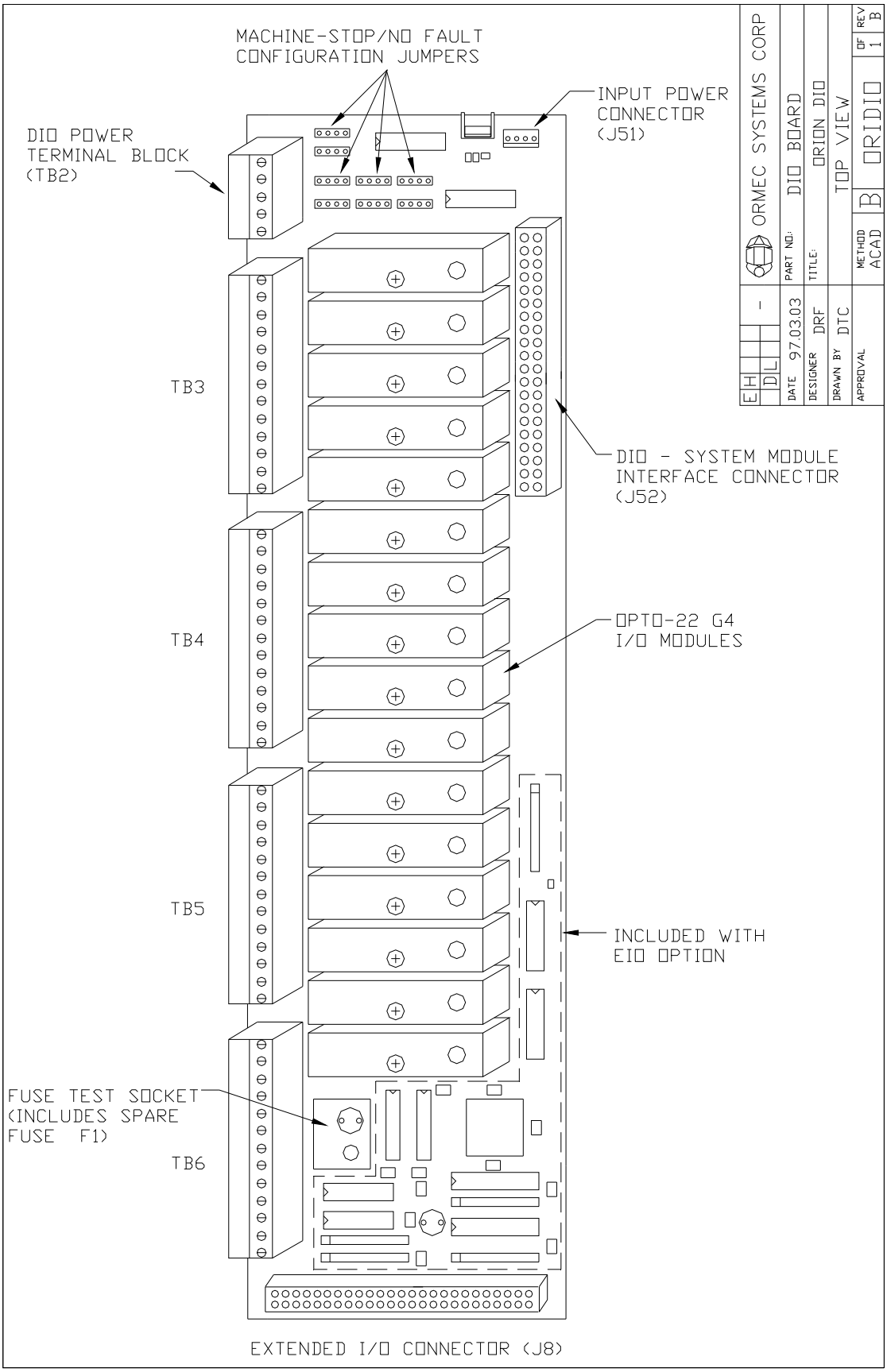
ORION System Overview Drawing



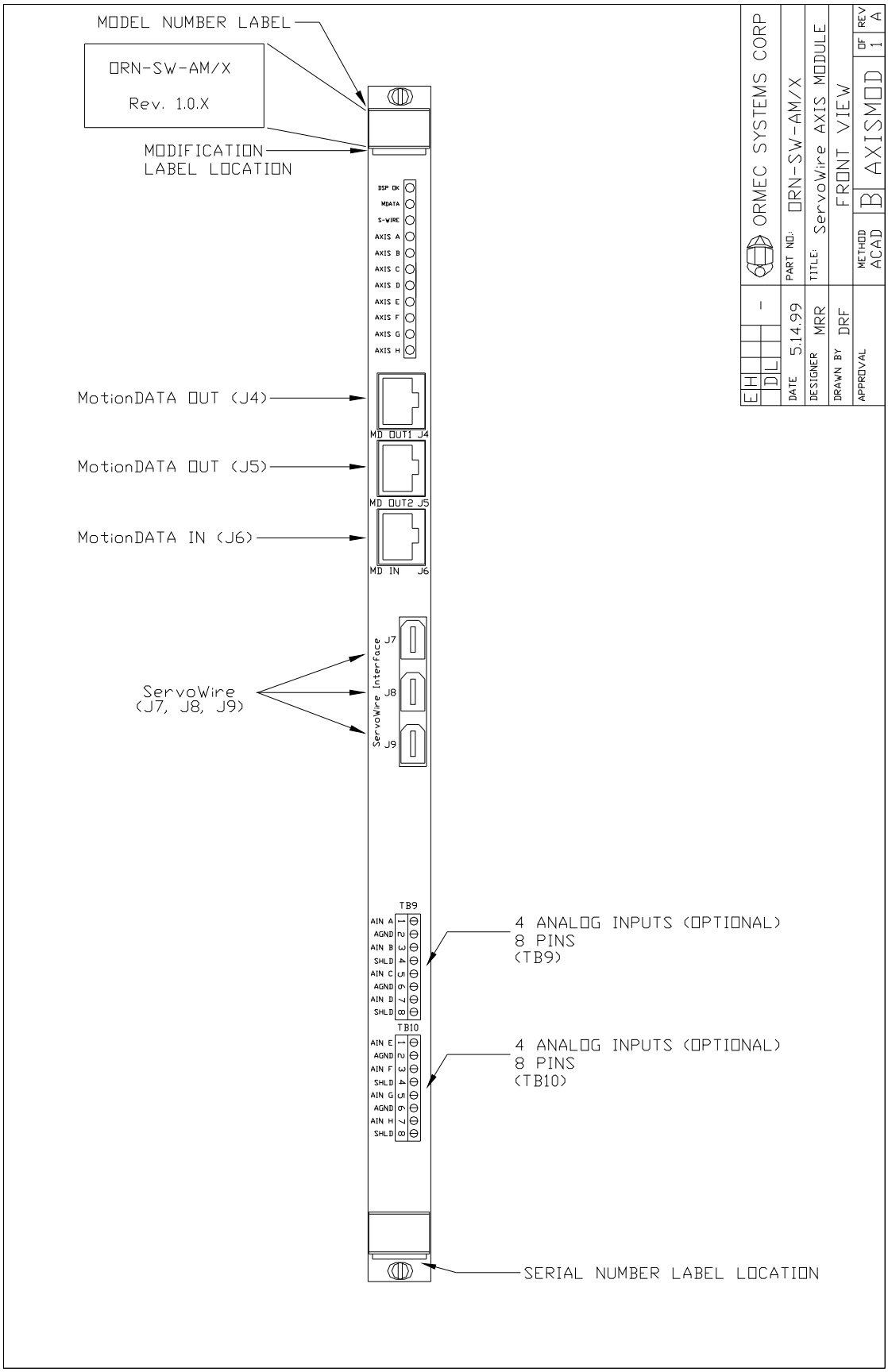
ORION System Module Faceplate



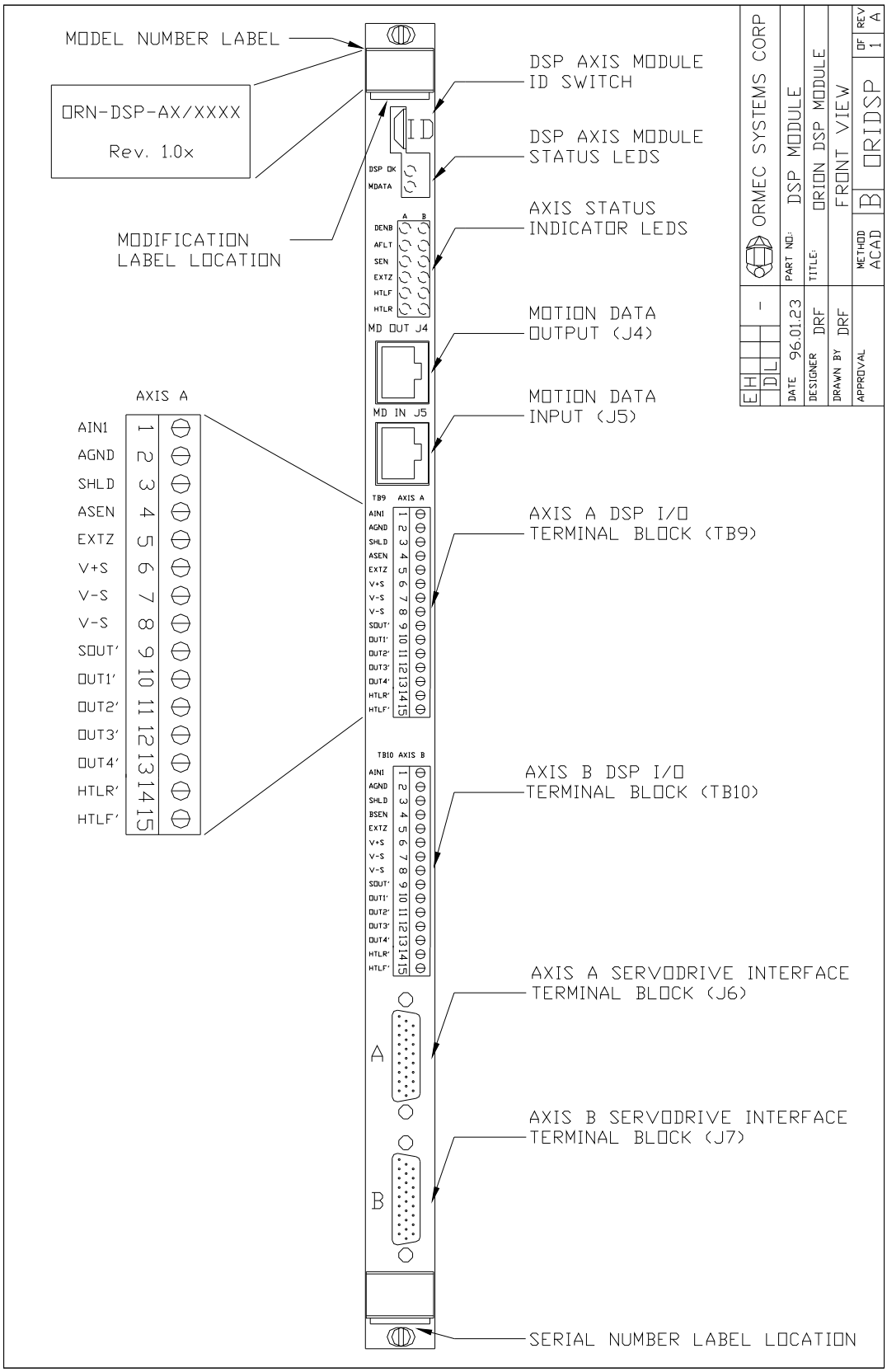
ORION DIO Board



ORION ServoWire Axis Module Faceplate

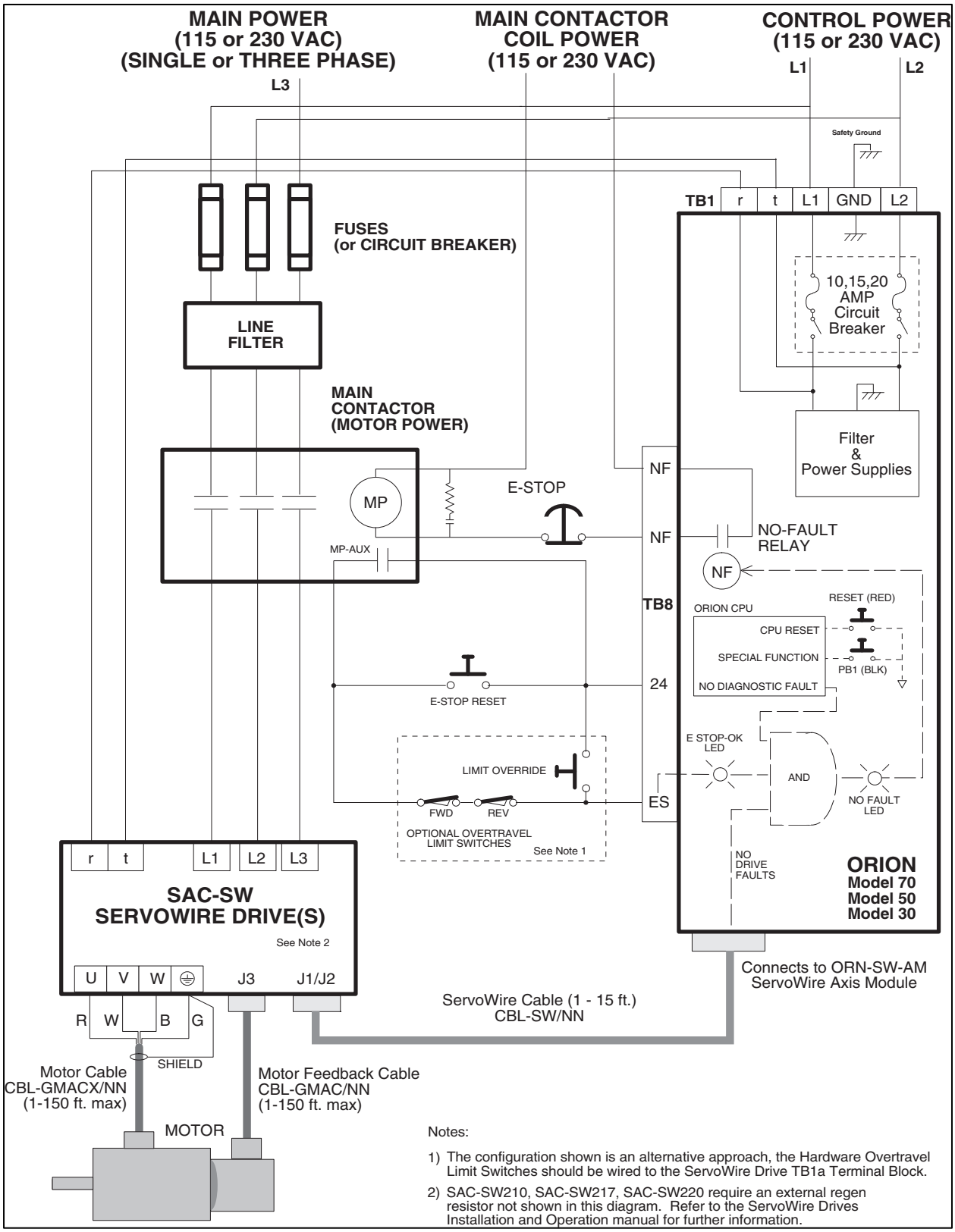


ORION DSP Axis Module Faceplate

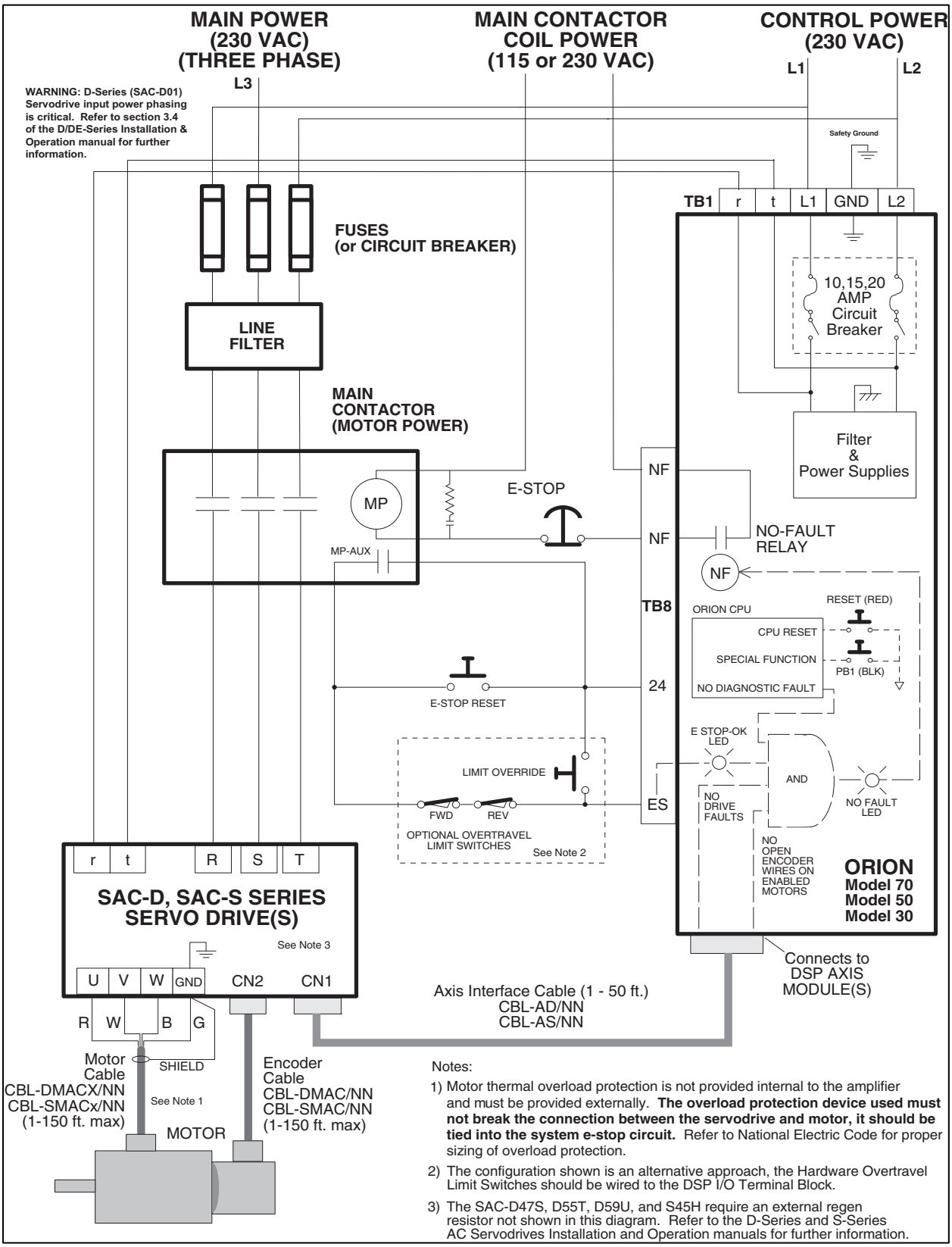


Appendix B – System Wiring Drawings

ORION System Wiring Diagram with ServoWire Drives



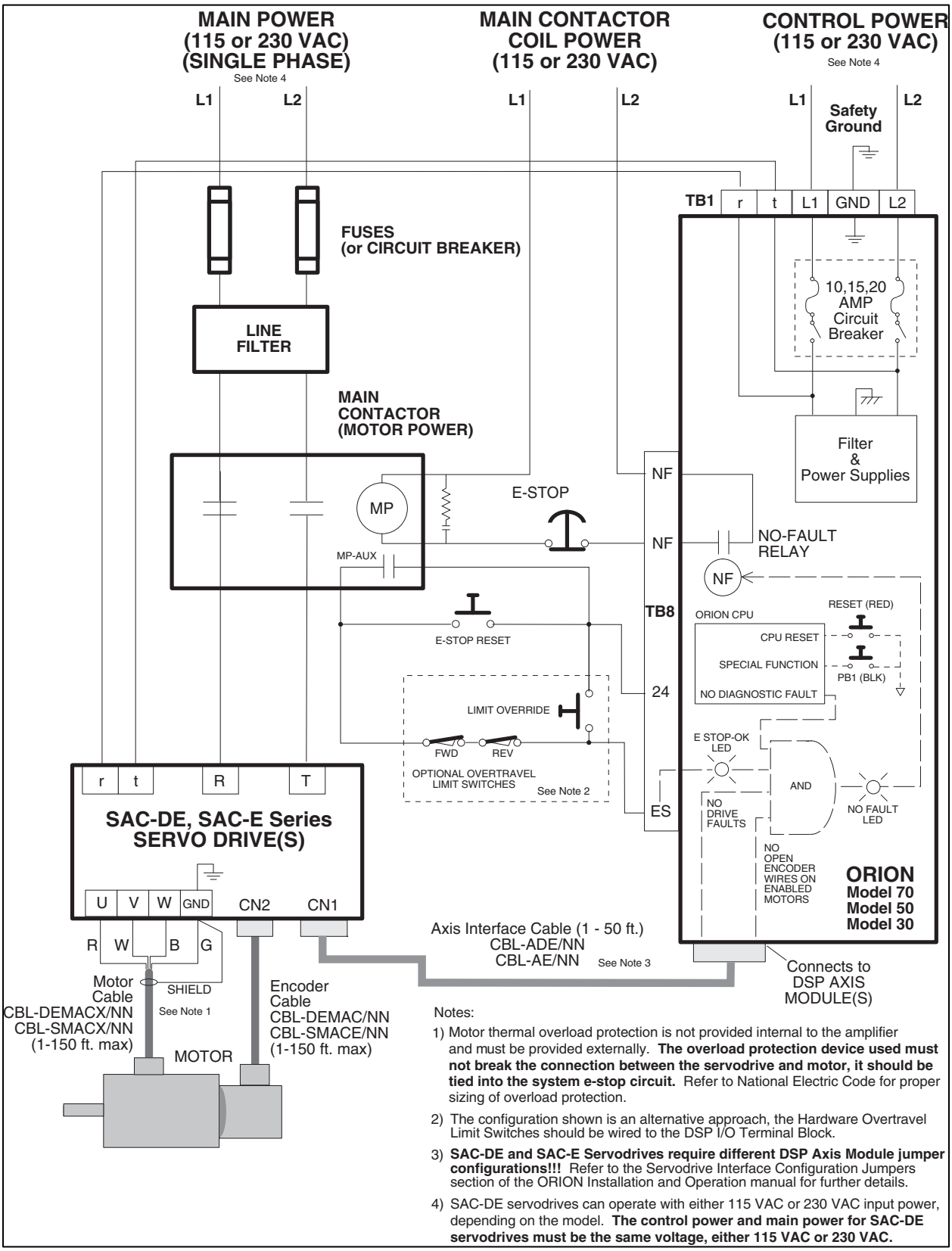
ORION System Wiring Diagram with SAC-D & SAC-S Series Servodrives



Notes:

1) Motor thermal overload protection is not provided internal to the amplifier and must be provided externally. **The overload protection device used must not break the connection between the servodrive and motor, it should be tied into the system e-stop circuit.** Refer to National Electric Code for proper sizing of overload protection.
2) The configuration shown is an alternative approach, the Hardware Overtravel Limit Switches should be wired to the DSP I/O Terminal Block.
3) The SAC-D47S, D55T, D59U, and S45H require an external regen resistor not shown in this diagram. Refer to the D-Series and S-Series AC Servodrives Installation and Operation manuals for further information.

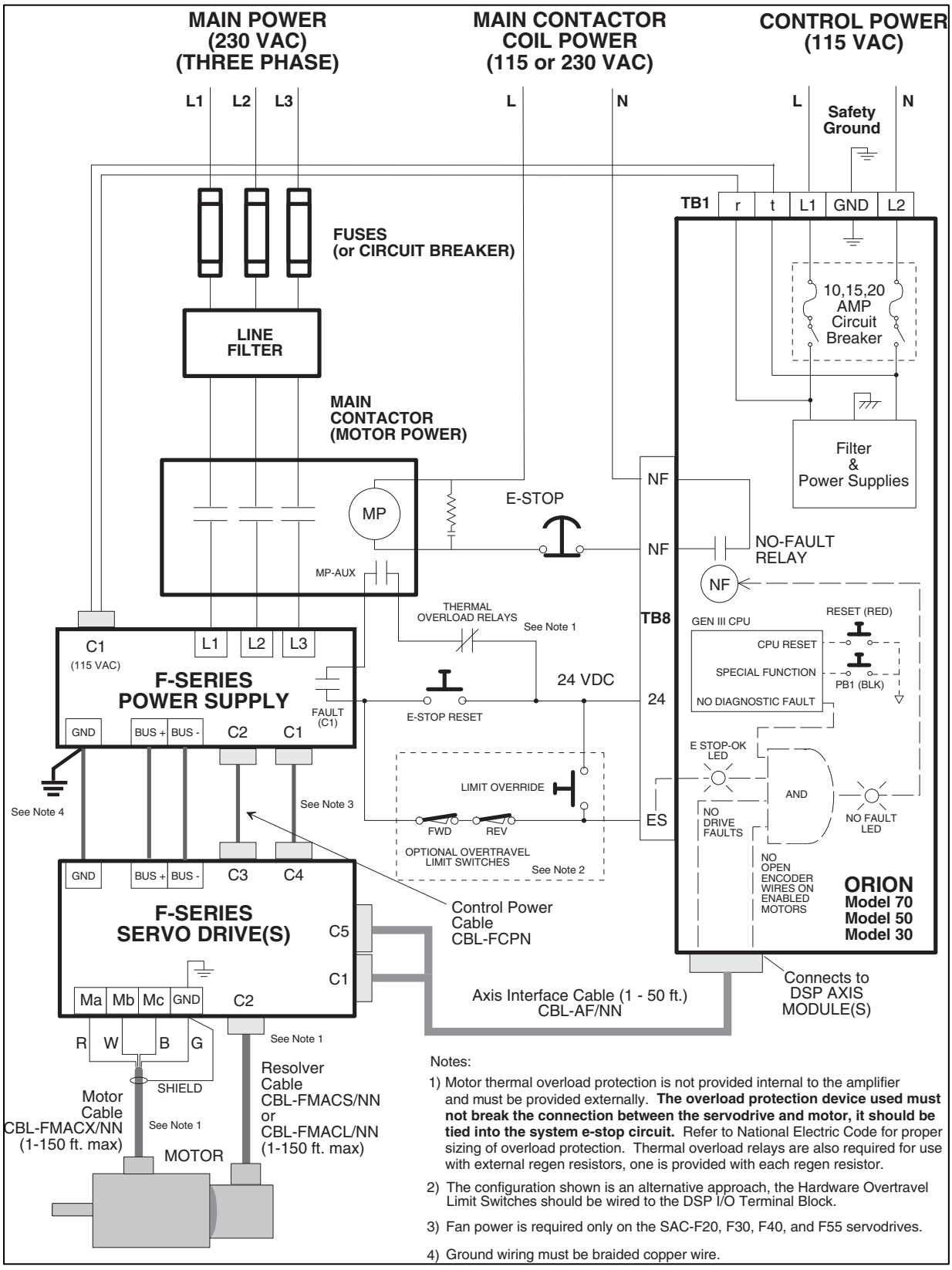
ORION System Wiring Diagram with SAC-DE & SAC-E Series Servodrives



Notes:

1) Motor thermal overload protection is not provided internal to the amplifier and must be provided externally. **The overload protection device used must not break the connection between the servodrive and motor, it should be tied into the system e-stop circuit.** Refer to National Electric Code for proper sizing of overload protection.
2) The configuration shown is an alternative approach, the Hardware Overtravel Limit Switches should be wired to the DSP I/O Terminal Block.
3) **SAC-DE and SAC-E Servodrives require different DSP Axis Module jumper configurations!!!** Refer to the Servodrive Interface Configuration Jumpers section of the ORION Installation and Operation manual for further details.
4) SAC-DE servodrives can operate with either 115 VAC or 230 VAC input power, depending on the model. **The control power and main power for SAC-DE servodrives must be the same voltage, either 115 VAC or 230 VAC.**

ORION System Wiring Diagram with SAC-F Series Servodrives (115V)



Notes:

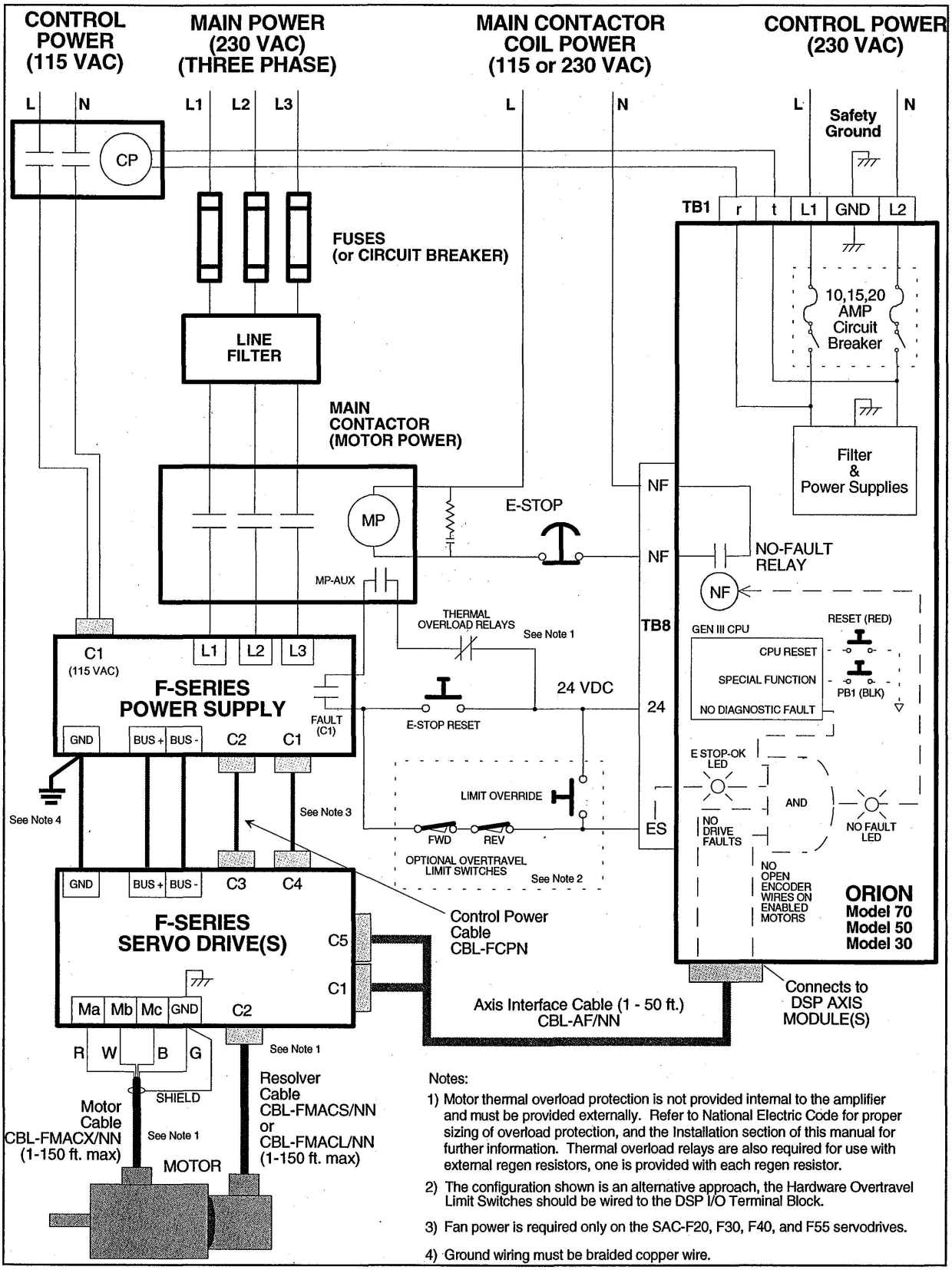
1) Motor thermal overload protection is not provided internal to the amplifier and must be provided externally. **The overload protection device used must not break the connection between the servodrive and motor, it should be tied into the system e-stop circuit.** Refer to National Electric Code for proper sizing of overload protection. Thermal overload relays are also required for use with external regen resistors, one is provided with each regen resistor.

2) The configuration shown is an alternative approach, the Hardware Overtravel Limit Switches should be wired to the DSP I/O Terminal Block.

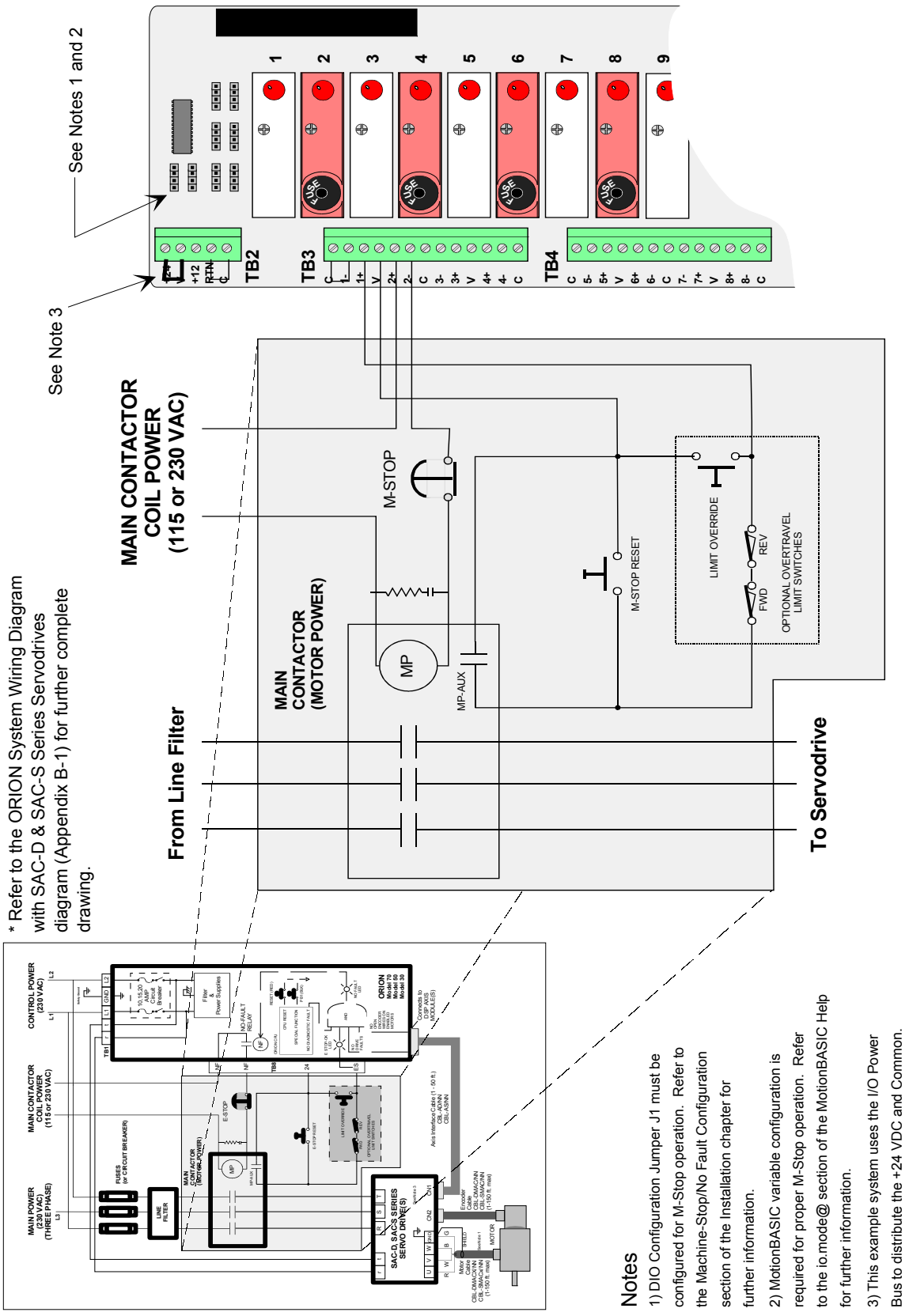
3) Fan power is required only on the SAC-F20, F30, F40, and F55 servodrives.

4) Ground wiring must be braided copper wire.

ORION System Wiring Diagram with SAC-F Series Servodrives (230V)

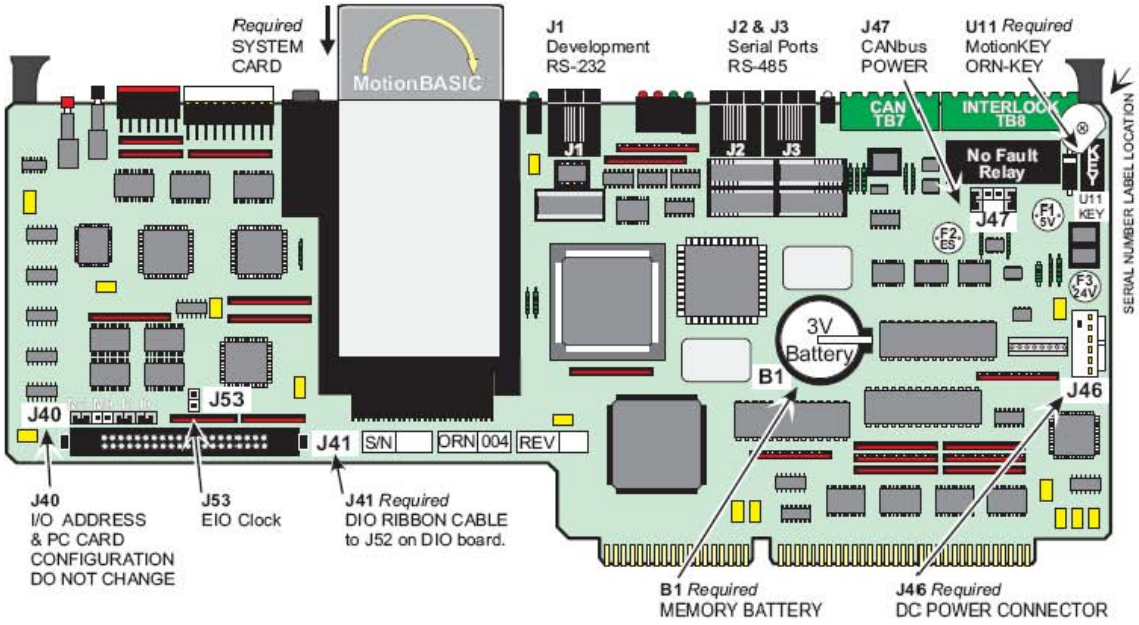


Example Machine-Stop/No Fault Wiring Diagram



Appendix C – ORION Interface Schematics

ORION System Module Jumpers and Component Locations



J47 ... 24 Volt Power Jumpers for CANbus Terminal Block - TB7 Connector
V+, V- TB7 Connector (pins 1, 5) 24 VDC Power and Return. Current Output 1.5A maximum.
WARNING: "NOT FUSED" Power supply available for use by devices connected to CANbus interface.
NOTE: These two jumpers short two pins each. Do not jumper the two middle pins!

J40 ... I/O Address and PC Card Configuration
WARNING:The ORION System Module I/O address and PC Card configuration jumper header, is configured at the factory and must not be changed.

J53 ... Extended Input / Output Clock Jumper (EIOCLK) Only required for Extended I/O Option. On older system modules the EIOCLK signal originated on this board. Newer hardware provides this signal on the Discrete Input/Output board. This jumper is only required when using a newer system module (REV "G" and above) with an older Discrete Input/Output board (REV "C" and below).

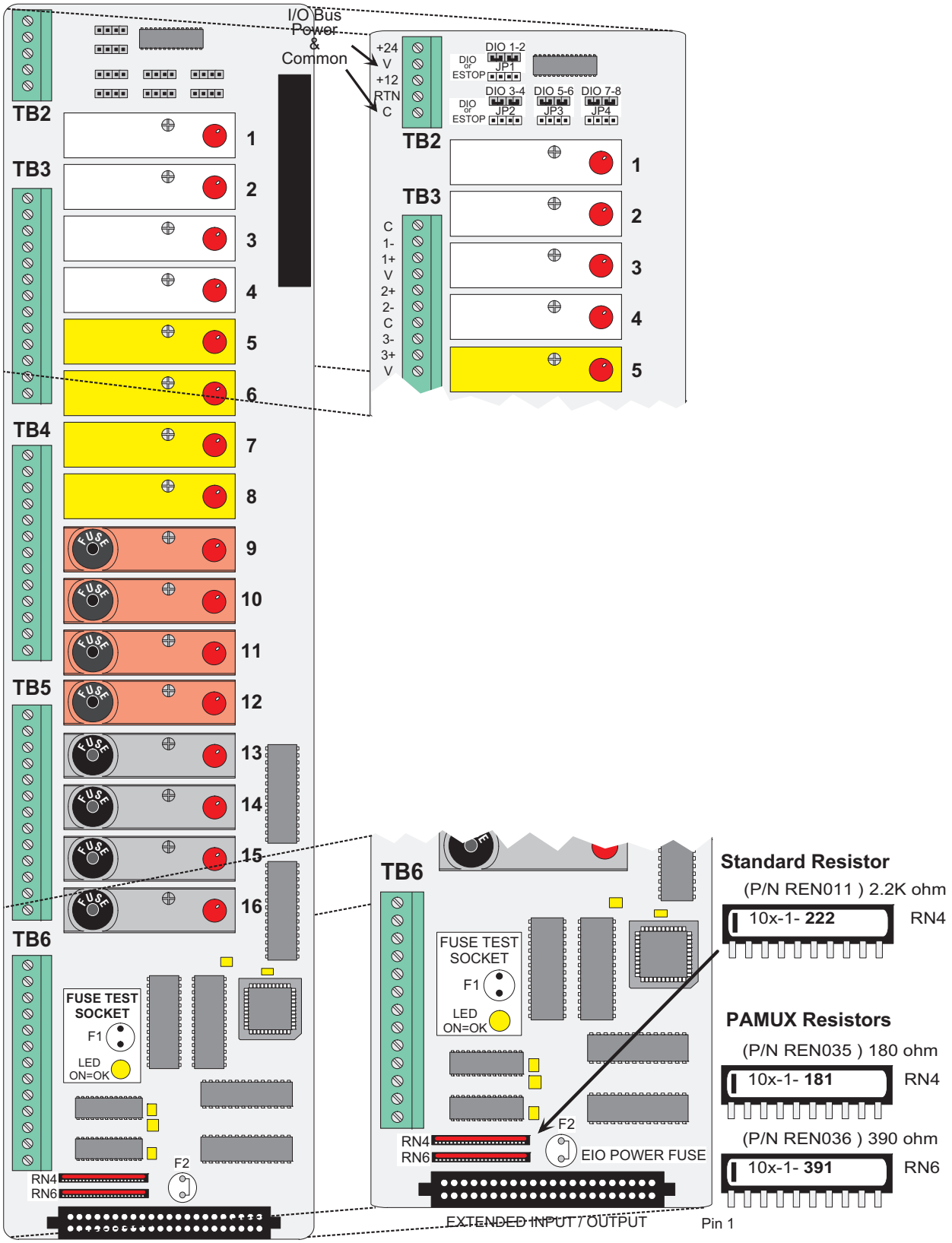
U11 ... ORN-KEY MotionKey Power-up FAULT@=12 ... Status display "F","1","2"
The ORION MotionKey is a hardware key which is programmed with a number of MotionCredits, which are required for the operation of MotionBASIC and MotionBASIC Extensions (MBX's). The MotionKey is located in the upper right hand corner.
Removing or installing a MotionKey with power applied to the ORION will damage the MotionKey! Do not force the MotionKey into the socket!. Improper insertion will result in damage to the MotionKey.
WARNING: Your ORION motion controller will not enable motor motion if a MotionKey with less than the required number of MotionCredits is installed on the ORION System Module.

B1 ... Non-Volatile Memory Battery Power-up FAULT@=2 ... Status display "F","2"
The non-volatile variable memory battery is a Lithium battery used to preserve non-volatile variables while the ORION input power is off. Removal of this battery will erase all Non-Volatile memory.
Output Voltage 3.0 to 3.1 VDC when new , 2.75 VDC with 10% life remaining 2.5 VDC with 1% life.
After replacing the battery, you will need to power cycle the controller twice to clear the FAULT@=2.

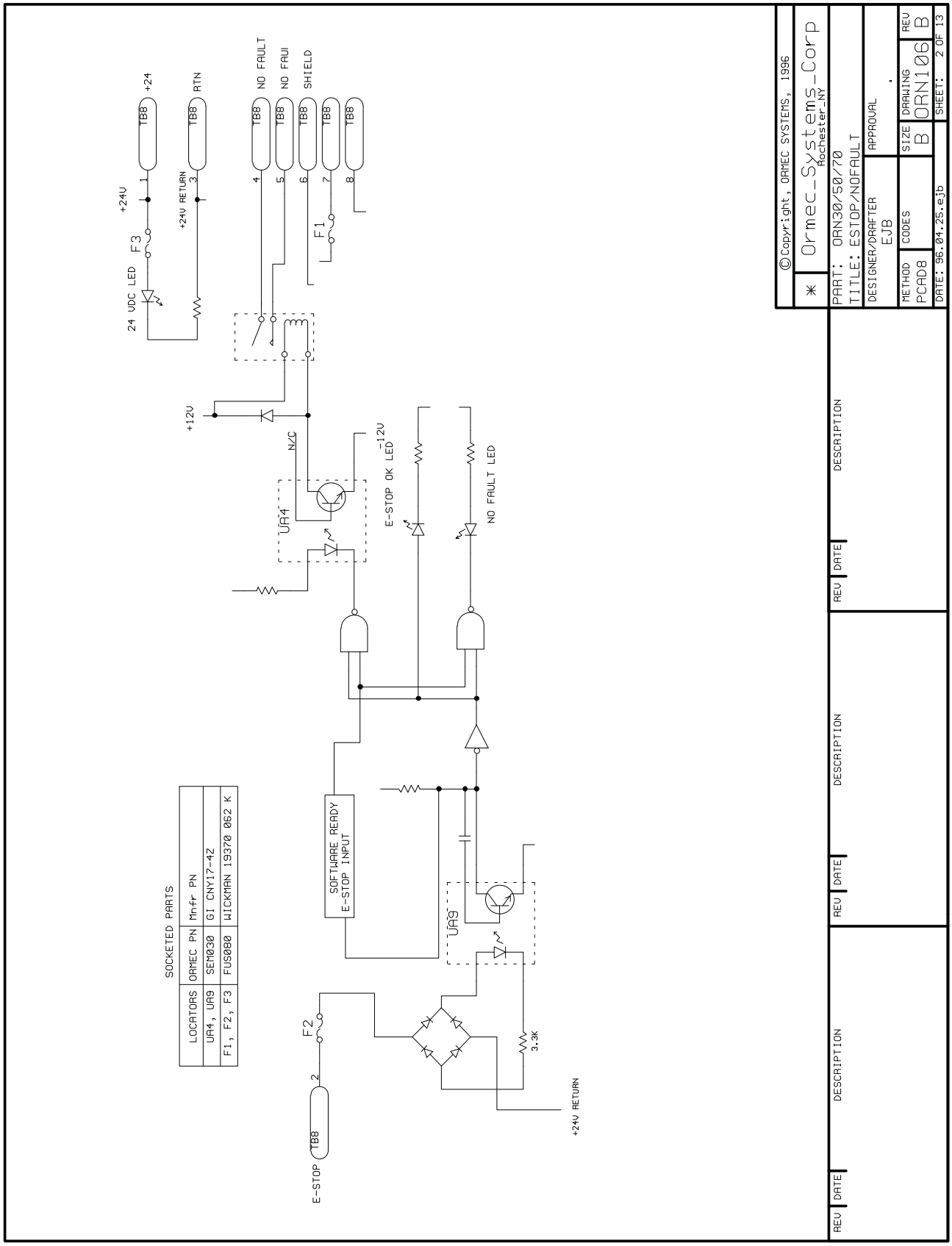
F1, F2, F3 ... Trace Fuses are PRE-FUSED by the circuit board trace.
DO NOT USE A REPLACEMENT FUSE UNLESS THE TRACE IS BLOWN!
System module trace fuses are located on the solder side (back) of board.
F1 ..... +5 VDC test at Interlock TB8 pin 7(+5) and pin 8 (R5)
F2 ..... E-Stop (12 to 24VAC)or(+12 to +24VDC) monitor voltage.
F3 ..... +24 VDC test at Interlock TB8 pin 1(+24) and pin 3 (RTN)
The replacement fuse is Wickman 250V, 4Amps. Part # 19370-062K

The Discrete I/O board has a Fuse Test socket "F1" and spare fuse holder.

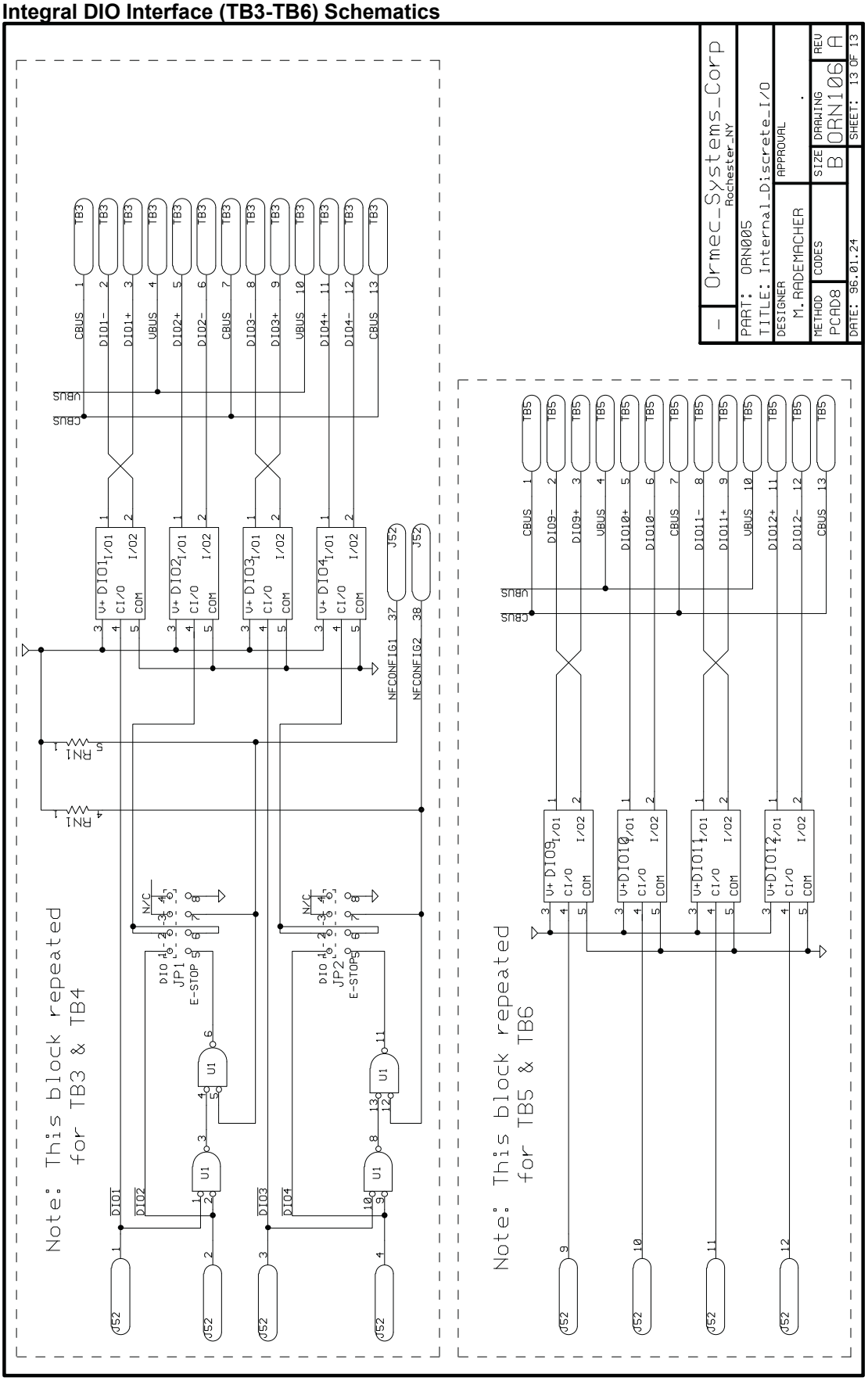
DIO Board Component Location Diagram



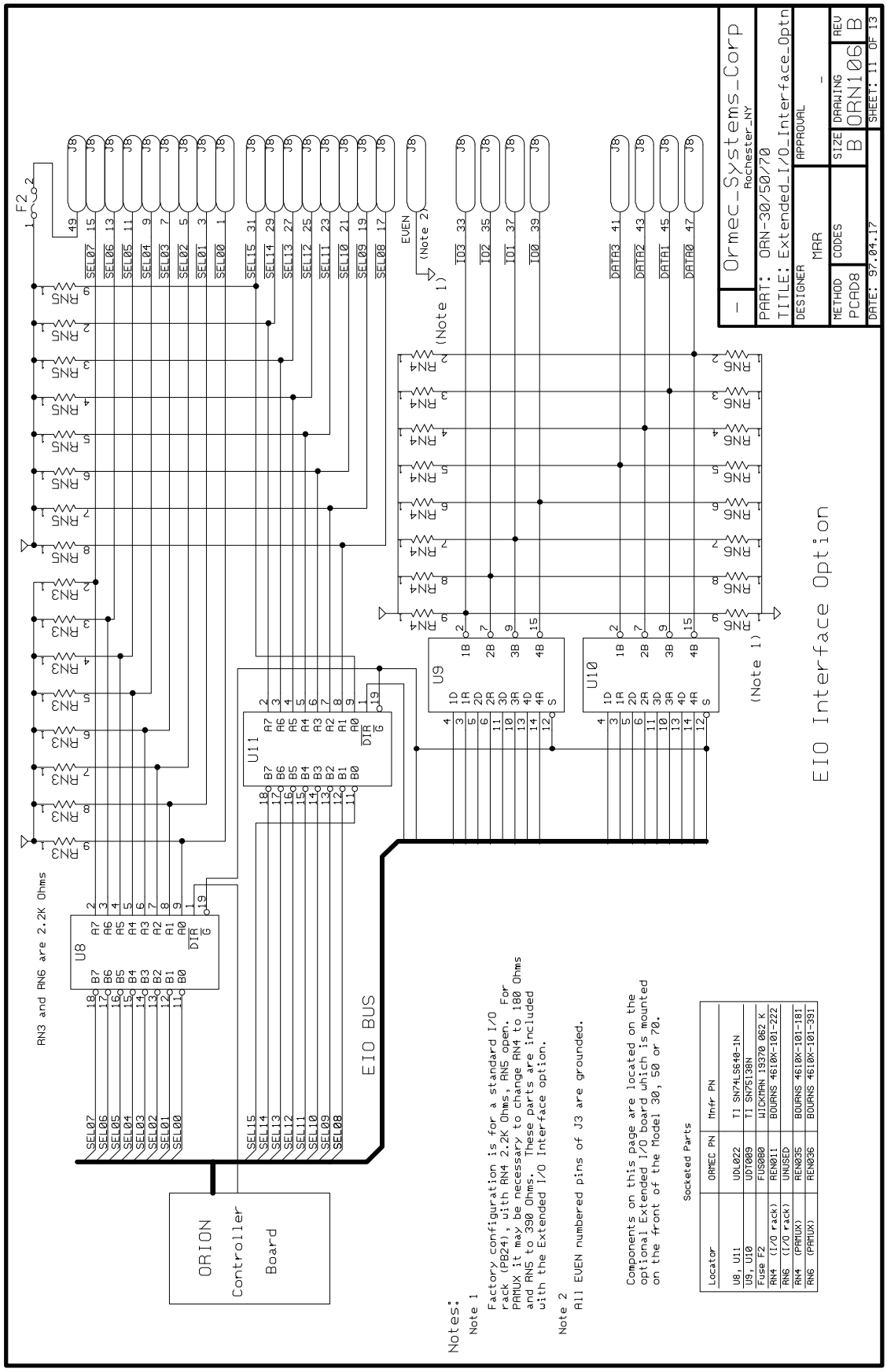
Interlock Terminal Block (TB8) Schematics



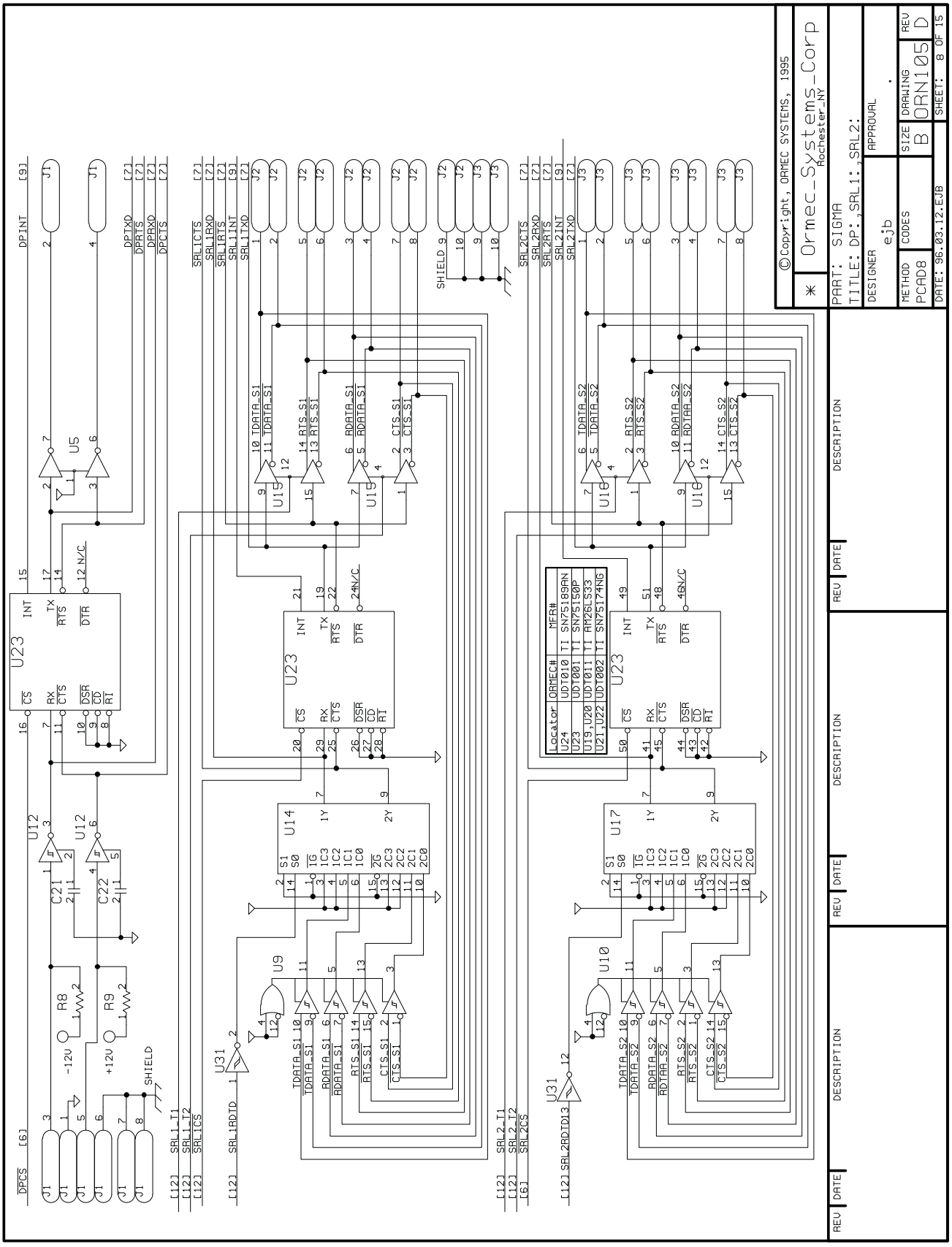
Integral DIO Interface (TB3-TB6) Schematics



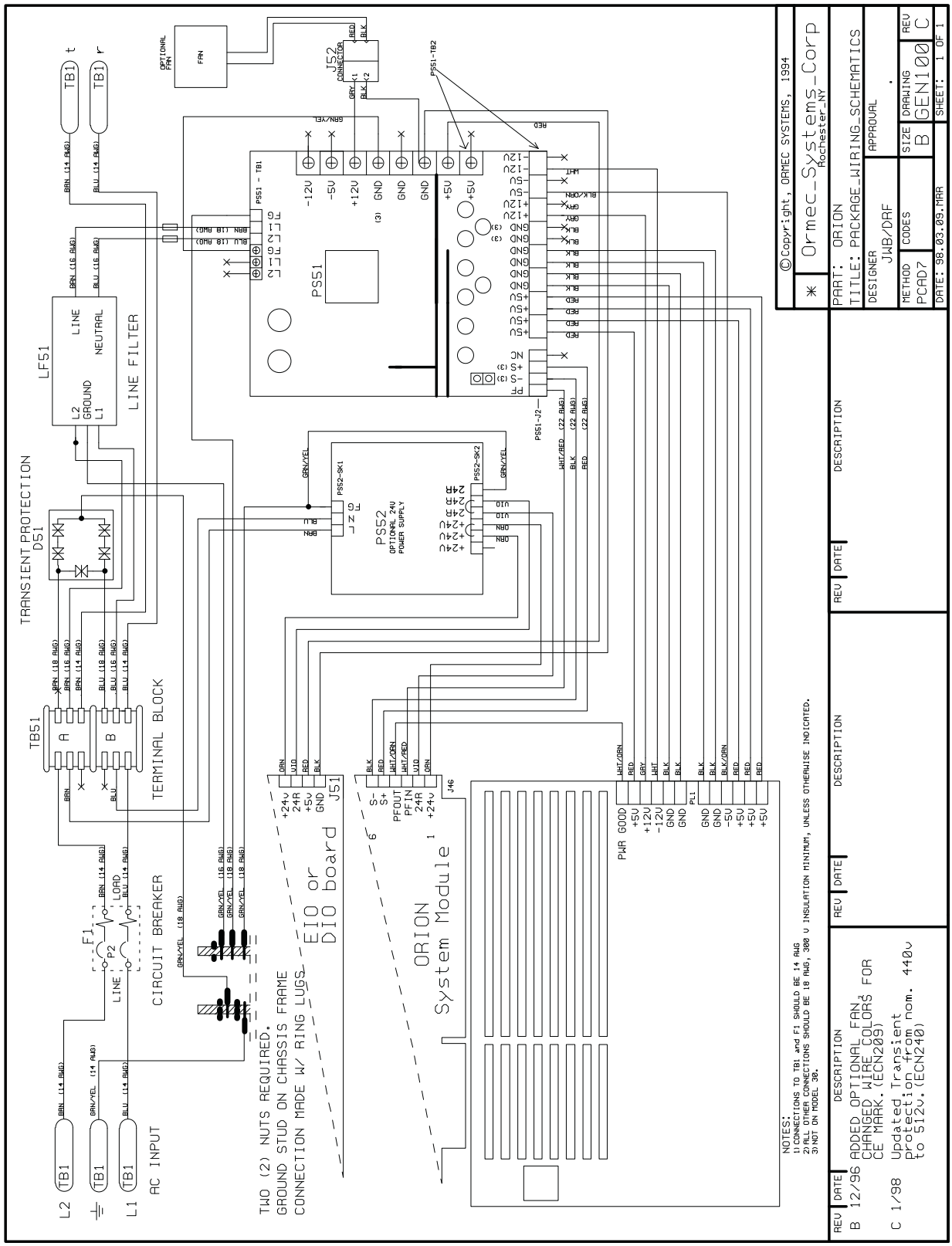
Extended I/O (or Pamux) Interface (J8) Schematics



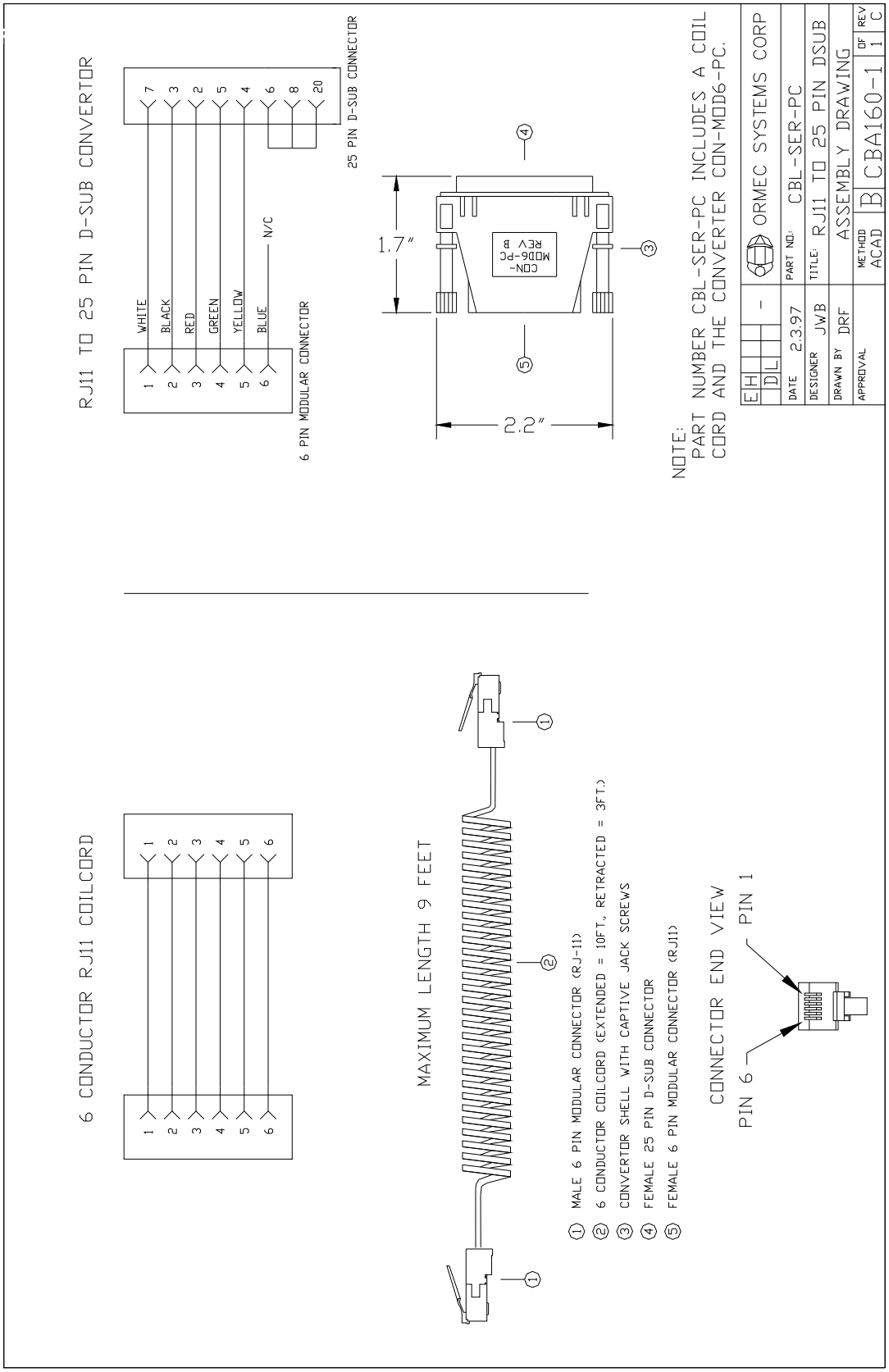
Development & ORION Serial Port Schematics



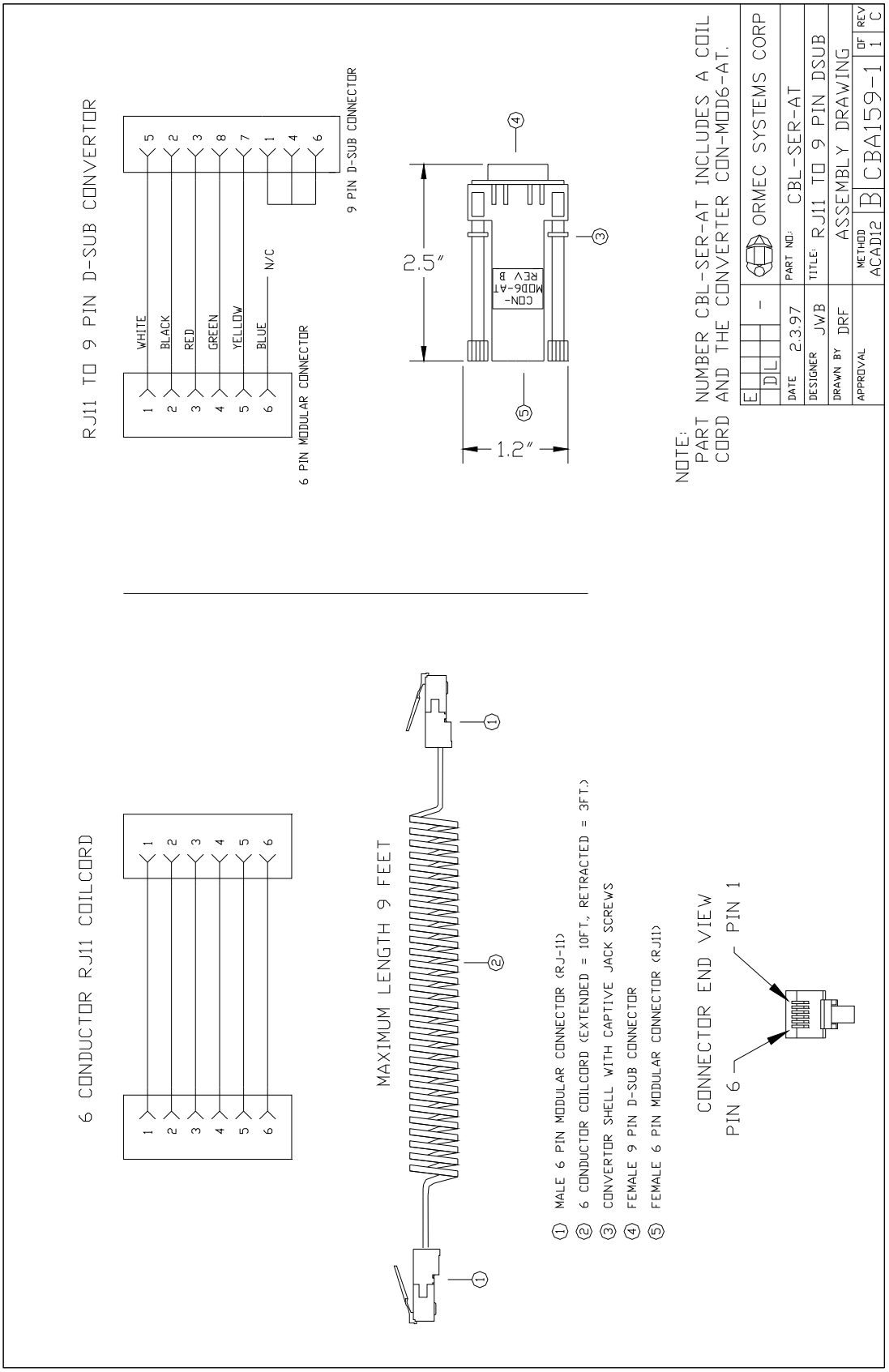
Appendix D – ORION Internal Wiring



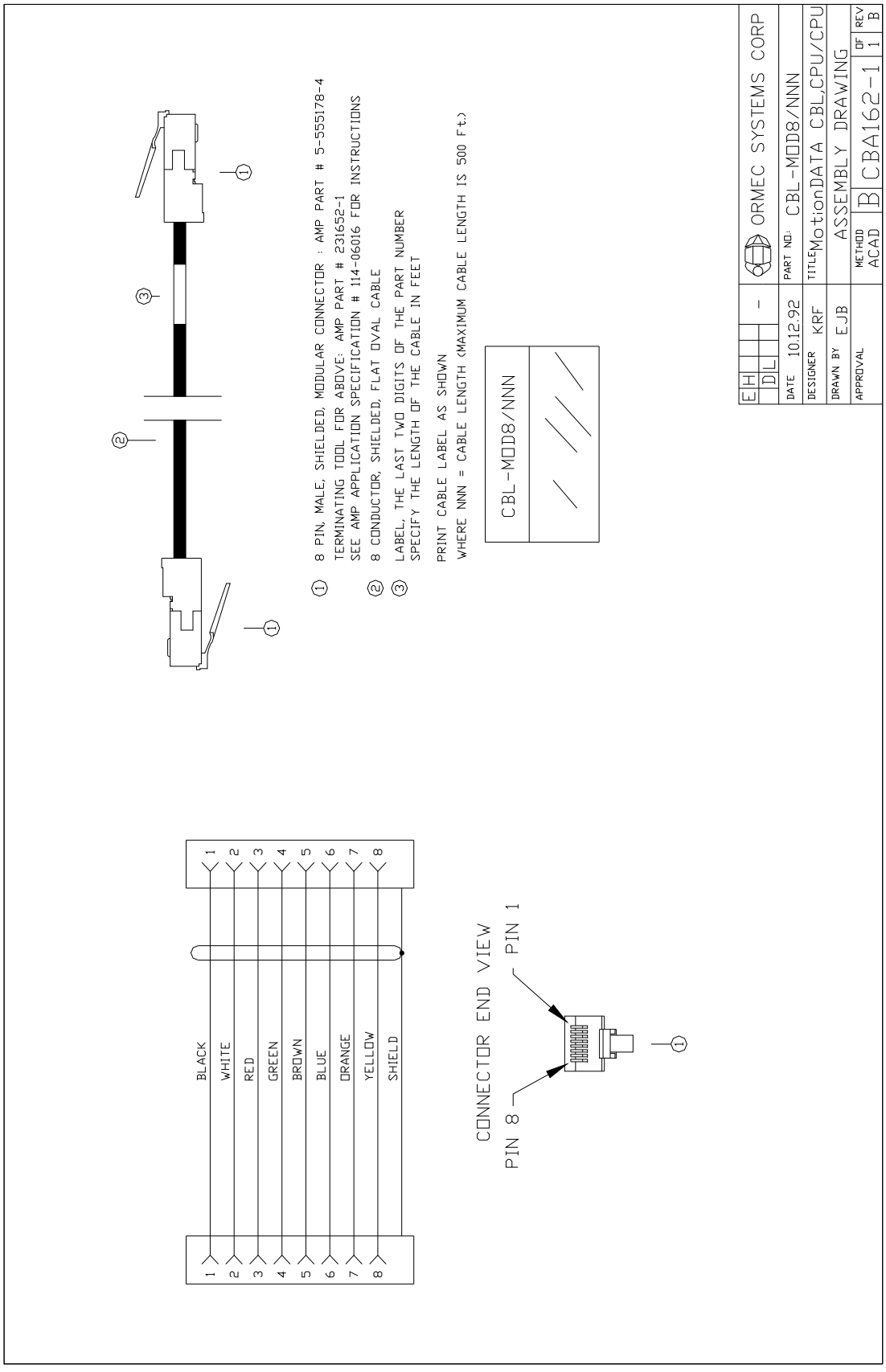
Appendix E – ORION Interface Cables & Accessories



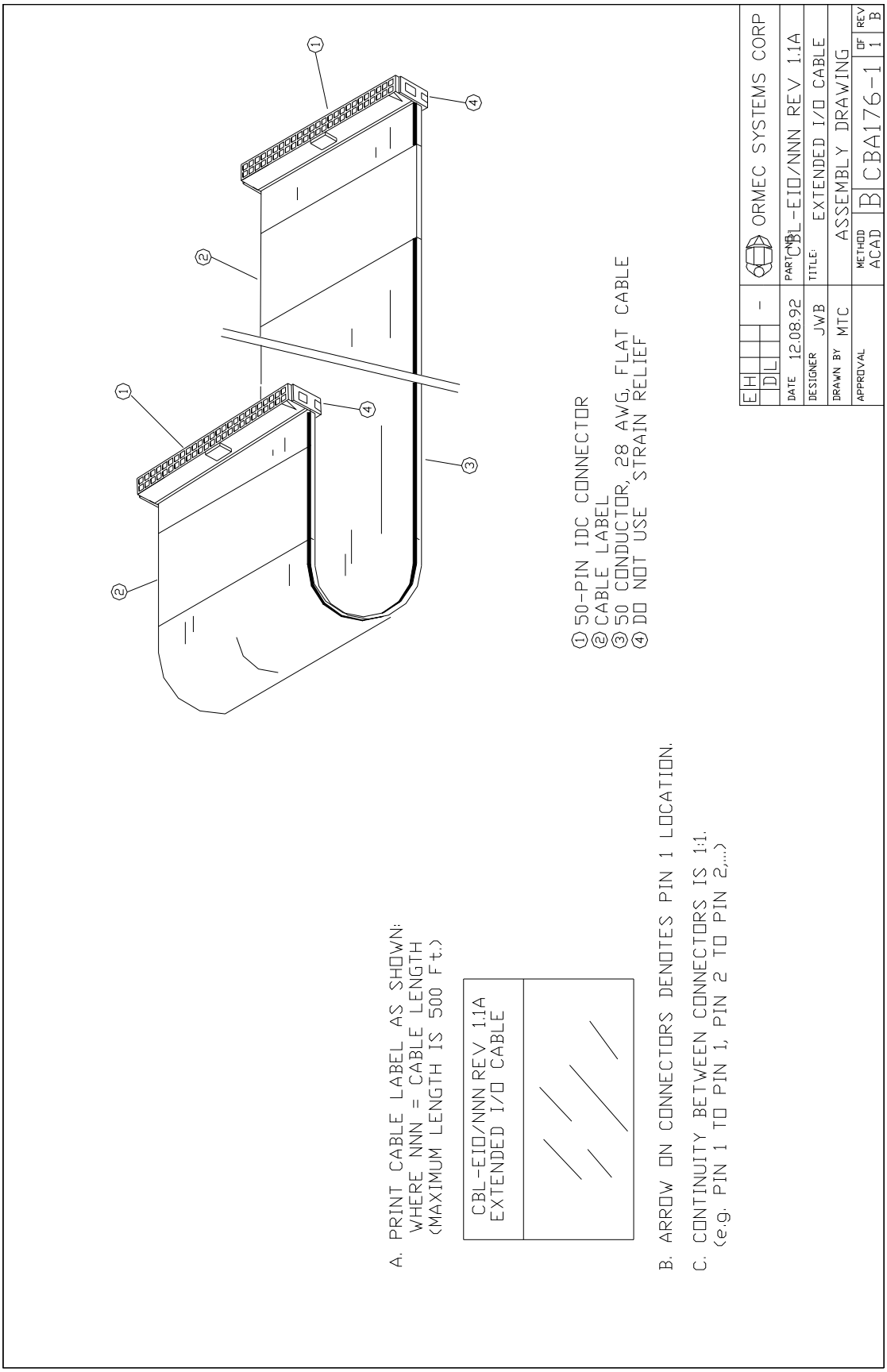
CBL-SER/AT – Serial Coil Cord to IBM-AT



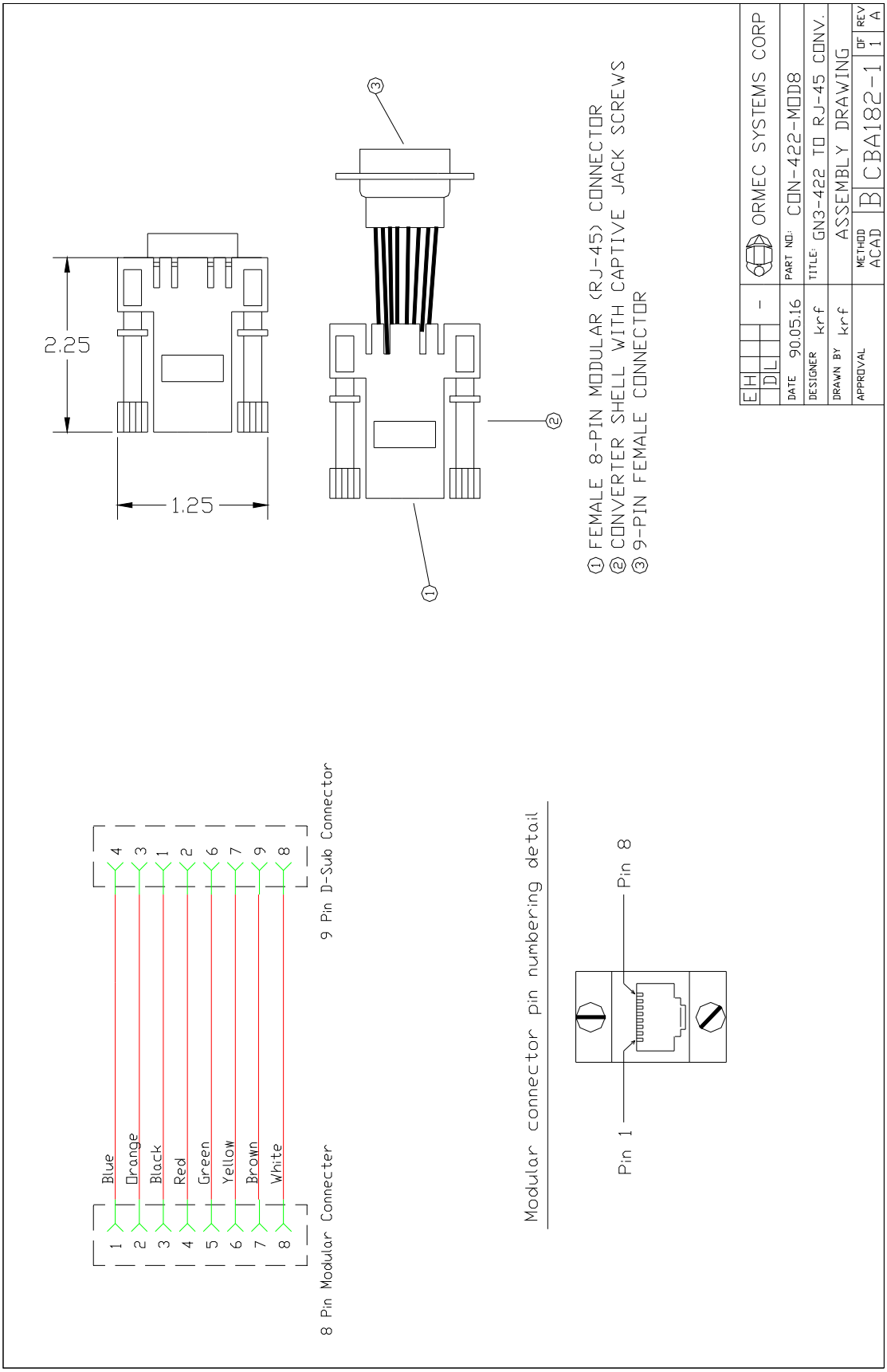
CBL-MOD8/NNN – Shielded 8-wire modular cable



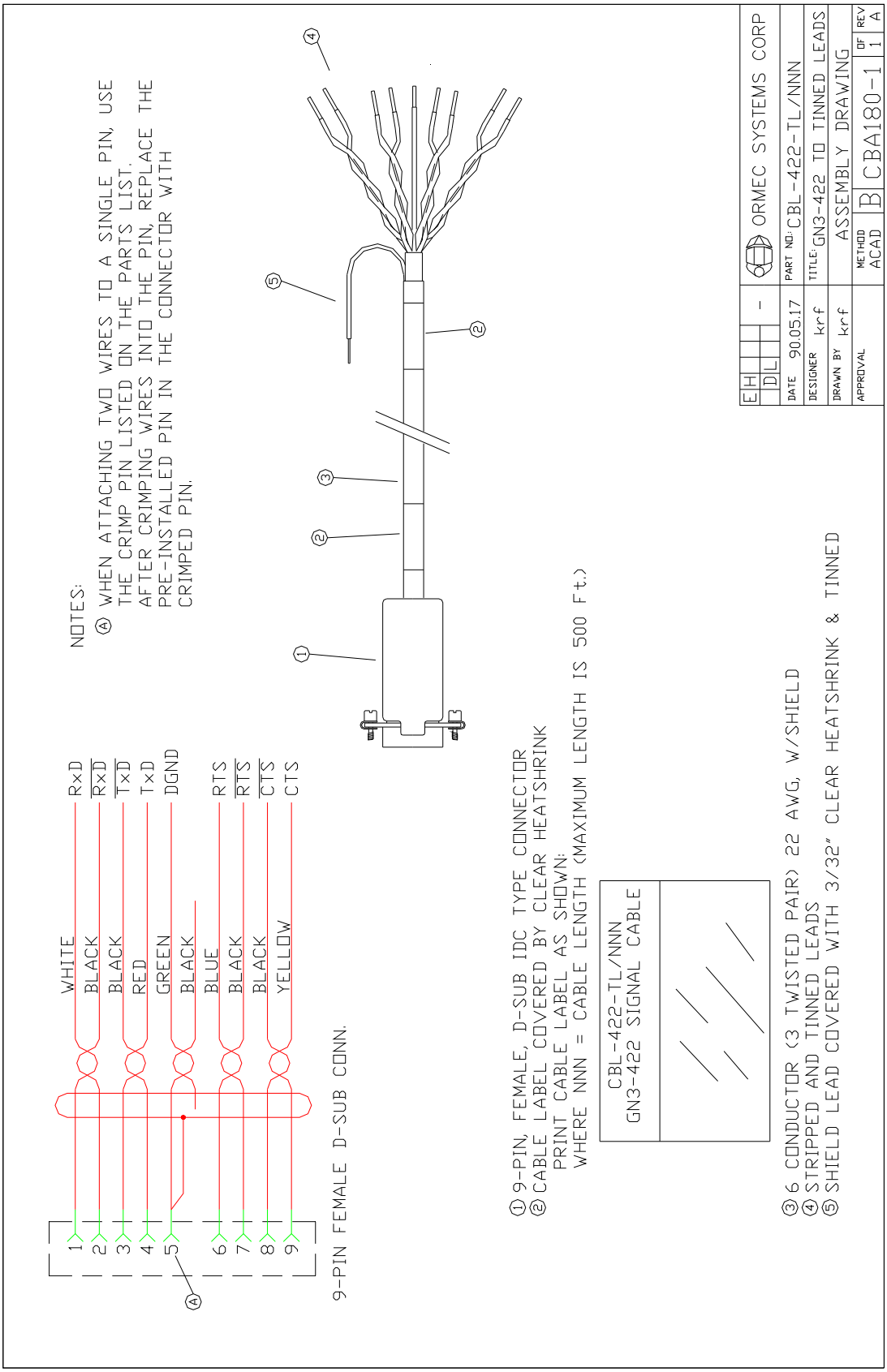
CBL-EIO/NNN – Extended I/O Cable



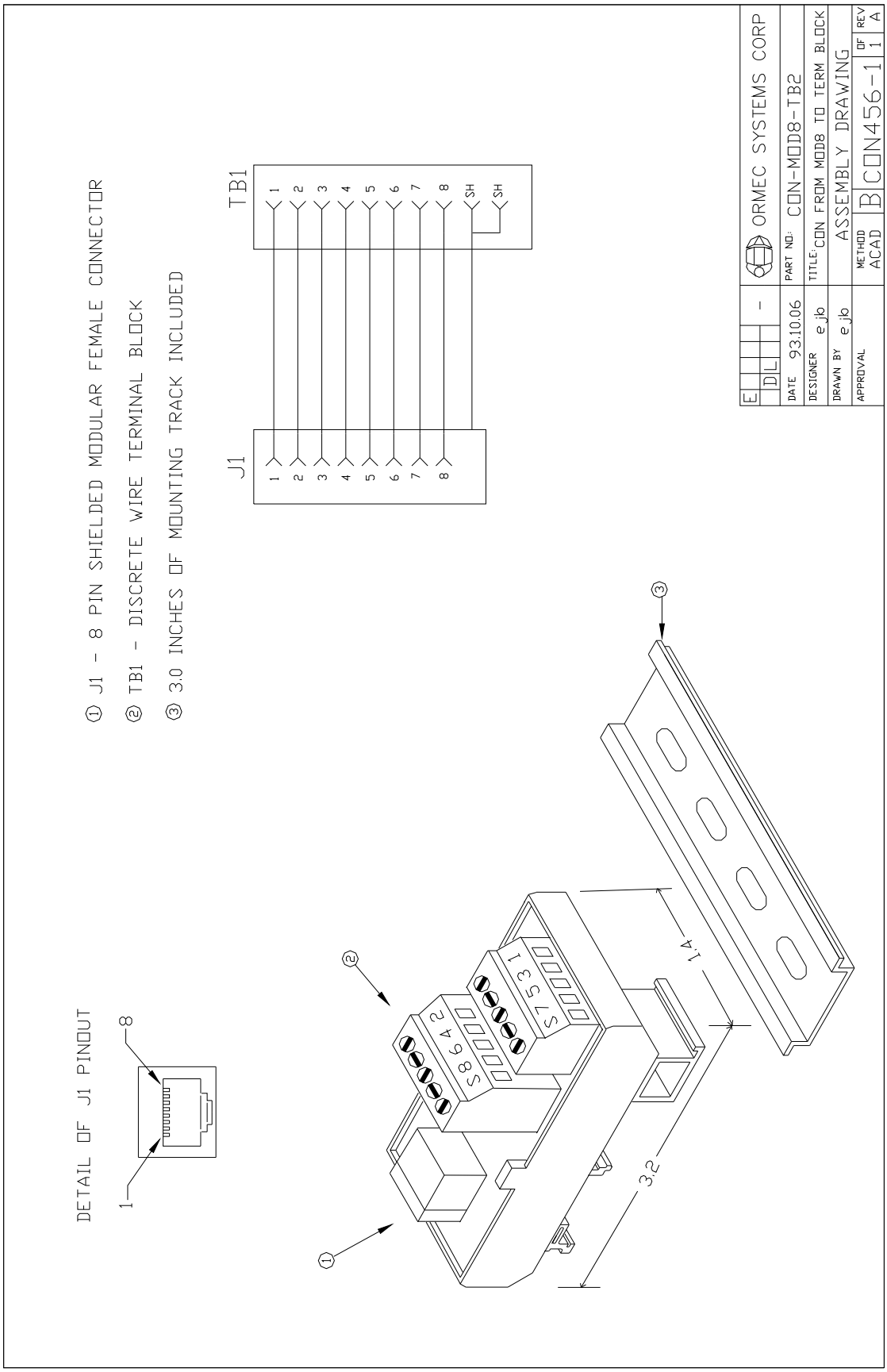
CON-422-MOD8 – Connector from ORN-422 to CBL-MOD8



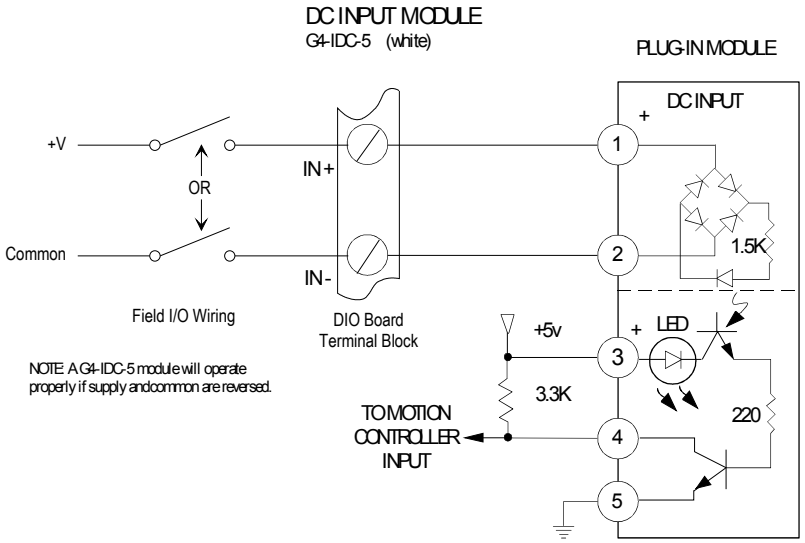
CBL-422-TL/NNN – Cable from ORN-422 to Tinned Leads



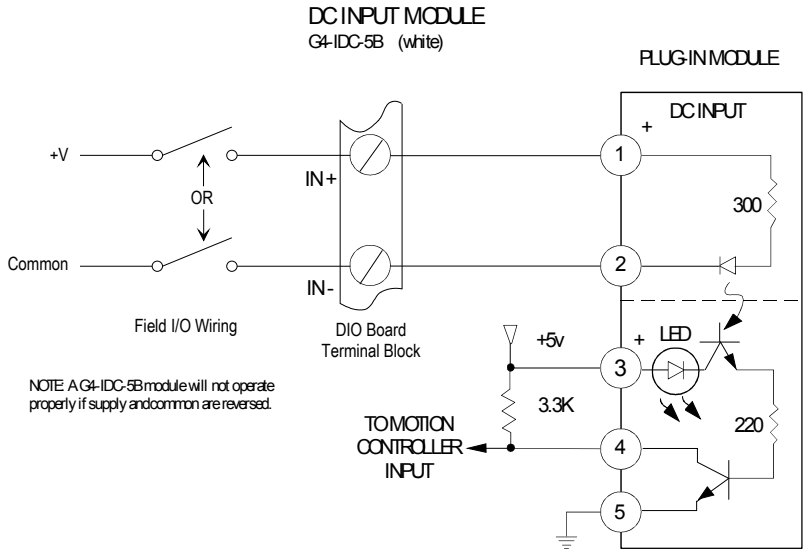
CON-MOD8-TB2 – Connector, CBL-MOD8 to Terminal Block



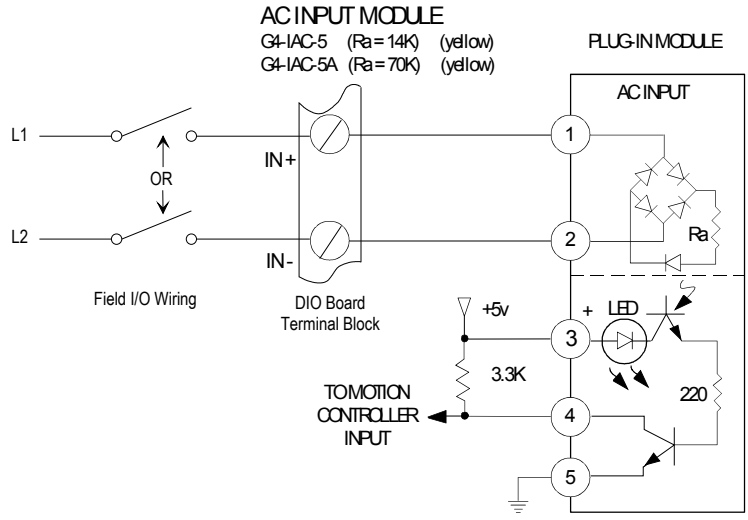
IDC-5, IDC-5B, IAC-5 & IAC-5A – DIO Board Input Modules



CAUTION: Do not remove or install modules with power applied

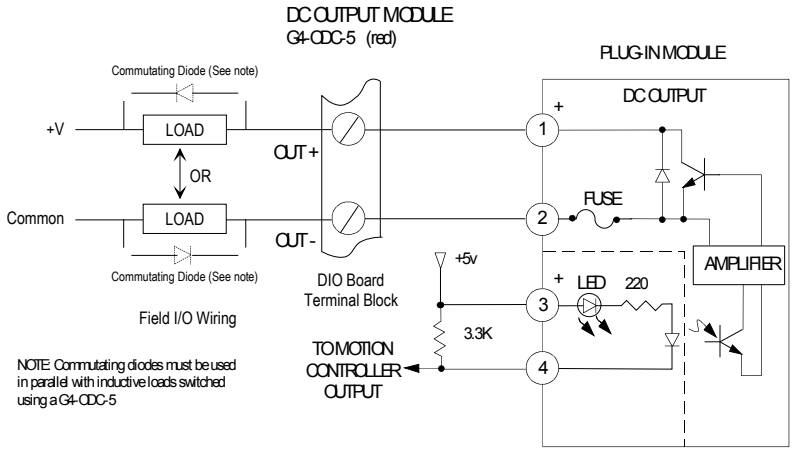


CAUTION: Do not remove or install modules with power applied

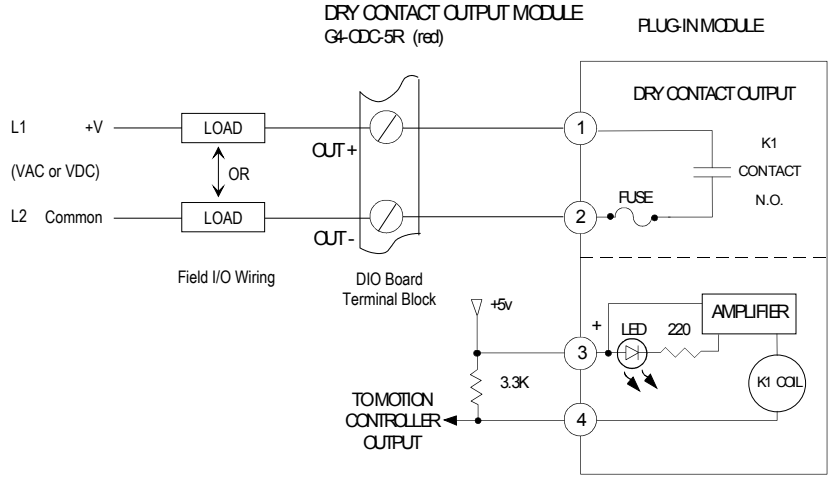


CAUTION: Do not remove or install modules with power applied

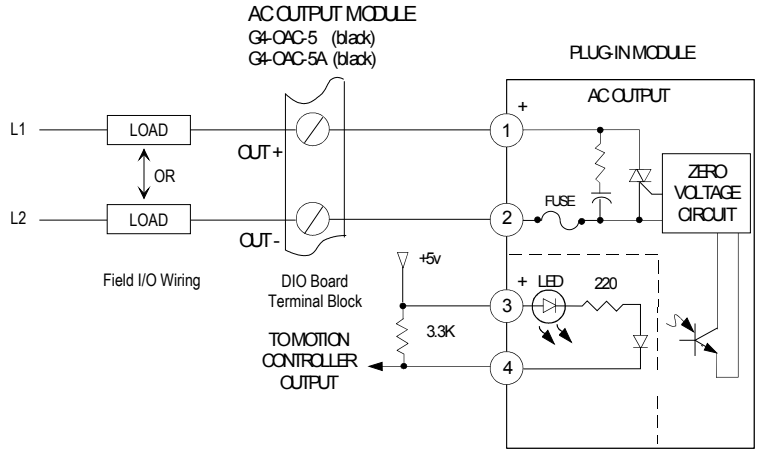
ODC-5, ODC-5R, OAC-5 & OAC-5A – DIO Board Output Modules



CAUTION: Do not remove or install modules or fuses with power applied



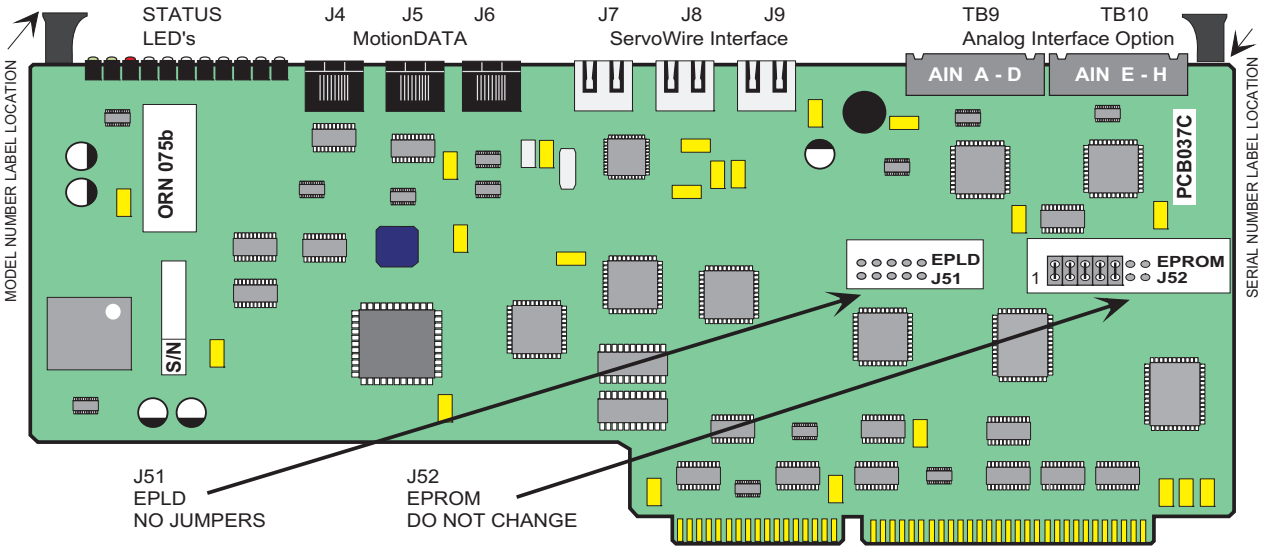
CAUTION: Do not remove or install modules or fuses with power applied



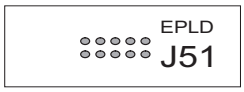
CAUTION: Do not remove or install modules or fuses with power applied

Appendix F – ServoWire Axis Module Interface

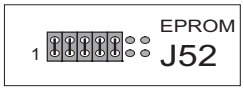
ServoWire Axis Module Component Layout Diagram



Factory Default Jumpers shown below.

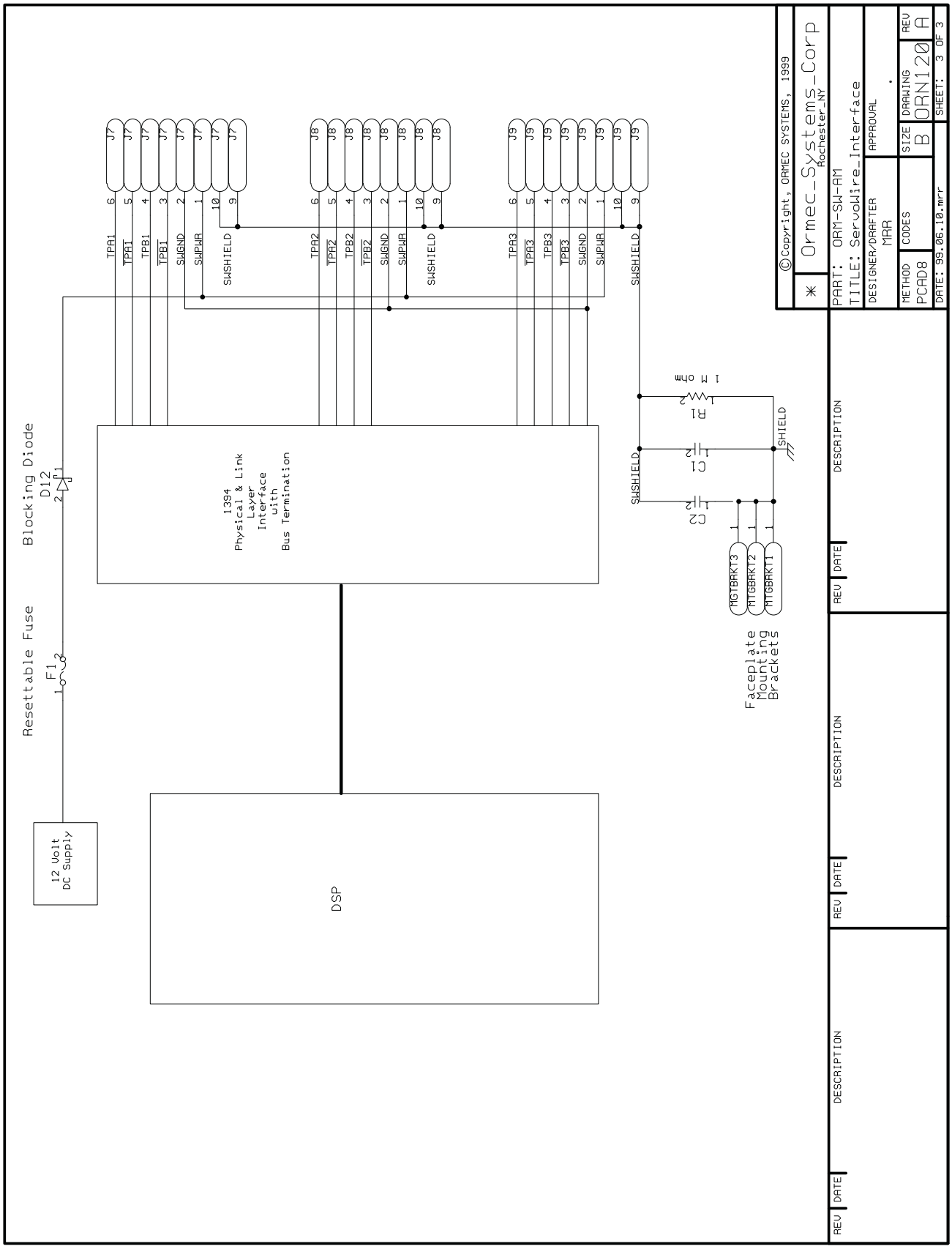


EPLD The ServoWire Axis Module jumper J51 must not have any jumpers installed. EMPTY - NO JUMPERS on J51.

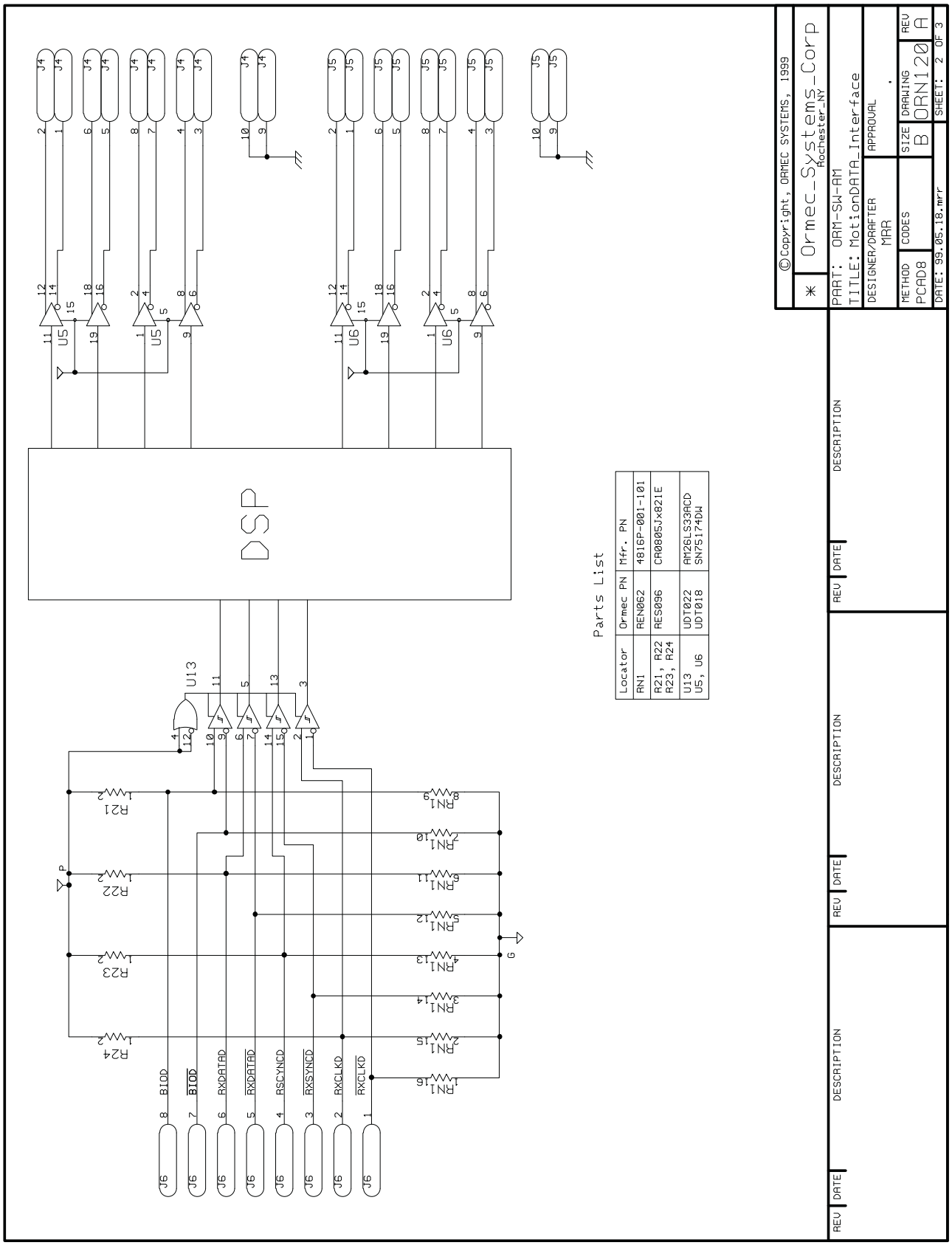


EPROM Configuration Jumpers. ***The ServoWire Axis Module jumper block must be properly configured in the factory setting. If this jumper block is not properly configured the ORION controller will not recognize the servowire axis module.***
Note: J52 uses a jumper block that shorts five pairs of pins. (left side - pin1)

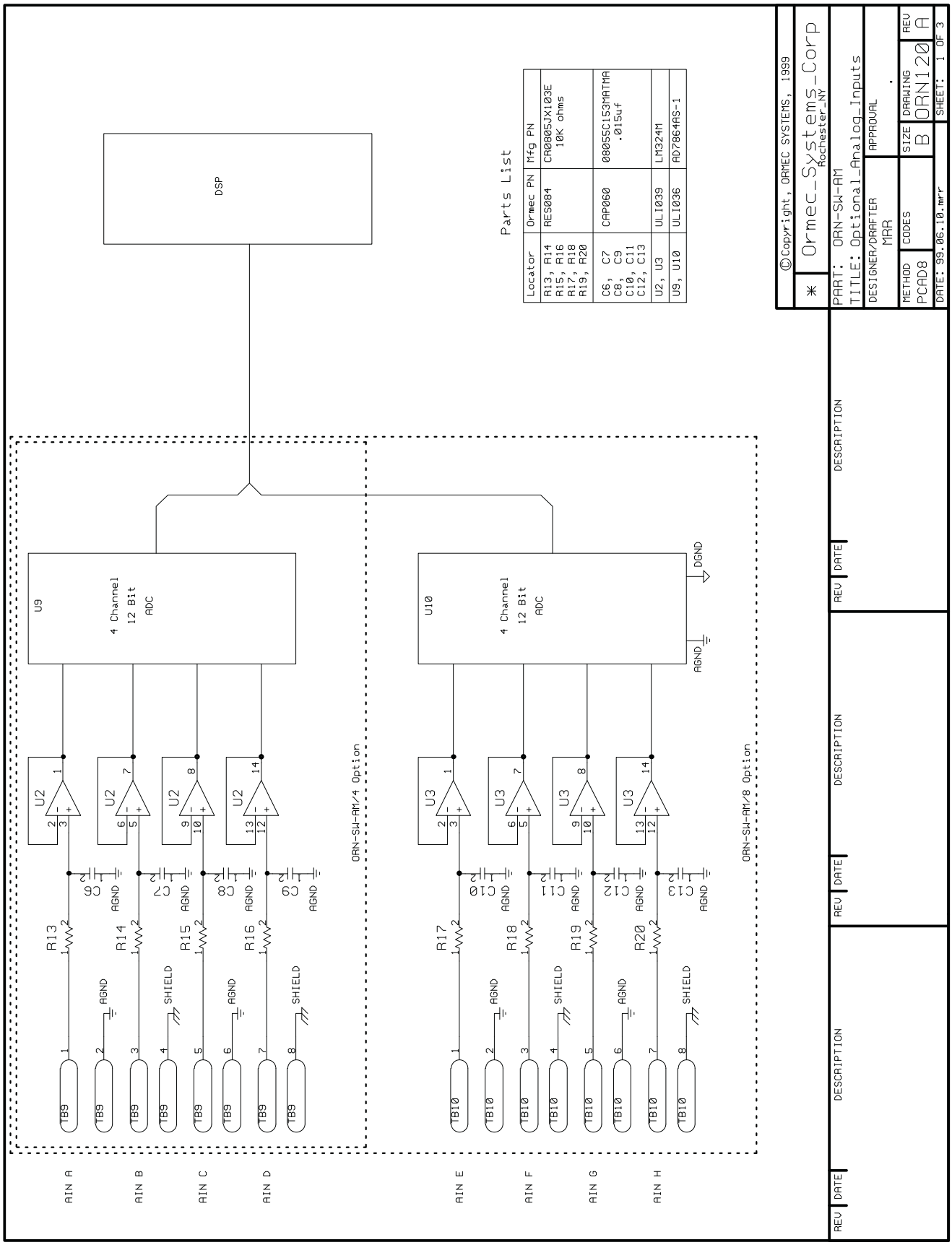
ServoWire Interface Schematics



MotionDATA Interface Schematics

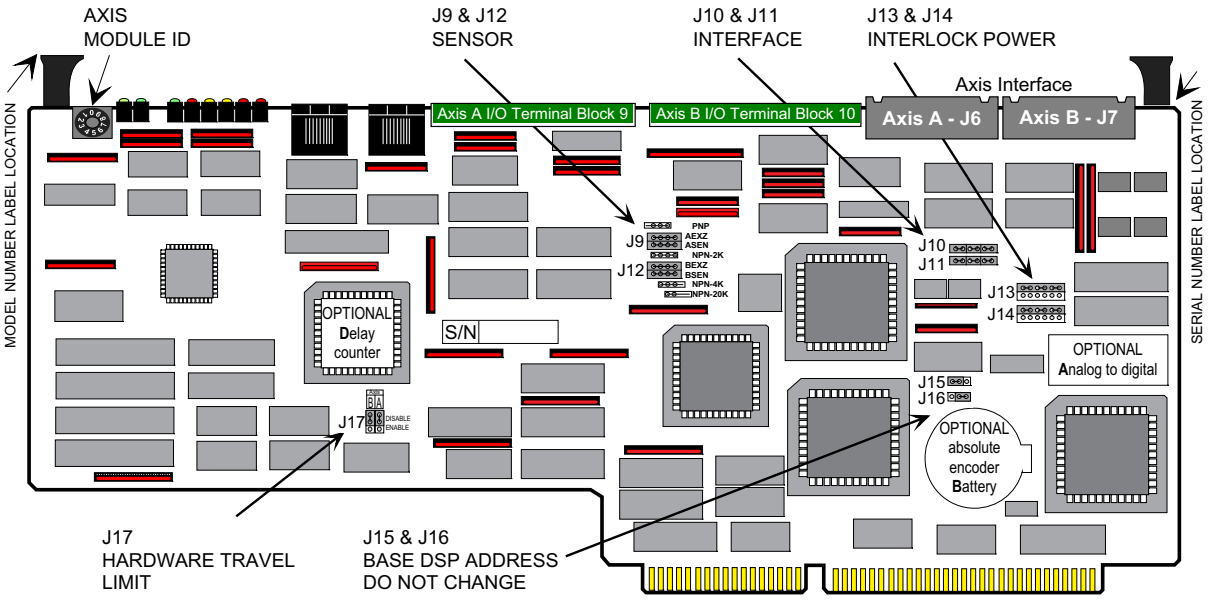


Analog Input Interface Schematics

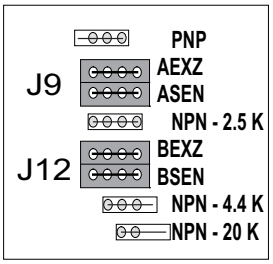


Appendix G – DSP Axis Module Interface

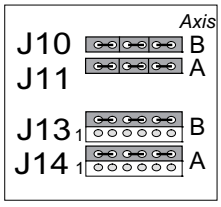
DSP Axis Module Component Location Diagram



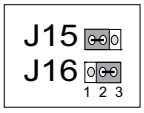
Factory Default Jumpers shown below.



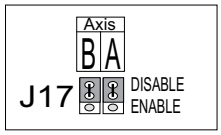
High Speed Sensor Inputs, (ASEN, BSEN, & EXTZ) are default configured for operation with sensors which have NPN type output transistors. The default four pin jumper connects all four pins to provide a 2.5K pull up.
ODD pins are for ASEN & BSEN, EVEN pins are for EXTZ (External Zero Reference).
Wiring to the high speed sensor input should be shielded twisted pair cable, with foil shield. Sensor voltage must be provied at TB9 or TB10, pins (V+S), (V-S).
For proper operation of the sensor inputs, the DC power supply common connected to V-S must also be connected to the Interlock Terminal Block (TB8) common (R5) on the ORION system module.
On the face of the DSP Axis module are status LED's. The sensor LED's will be "ON" when the corresponding axis sensor hardware is conducting current.



Servodrive Interface Configuration Jumpers. ***The DSP Axis Module jumpers must be properly configured for the servodrive type. If these jumpers are not properly configured the servodrive and/or ORION can be damaged.***
The default jumpers are configured for SAC-D, SAC-E, SAC-F, and SAC-S servodrives.
For SAC-DE servodrives move the J13 or J14 jumper, connecting the ODD pins.
For non-standard servodrive, refer to the ORION Motion Control Manual-Sec.(3.4.8)
Note: J10 & J11 use three - two pin jumpers, J13 & J14 use one three-pair jumper.



Base DSP Address Jumpers. The base DSP address is fixed, DO NOT CHANGE the configuration of jumper J15 or J16.

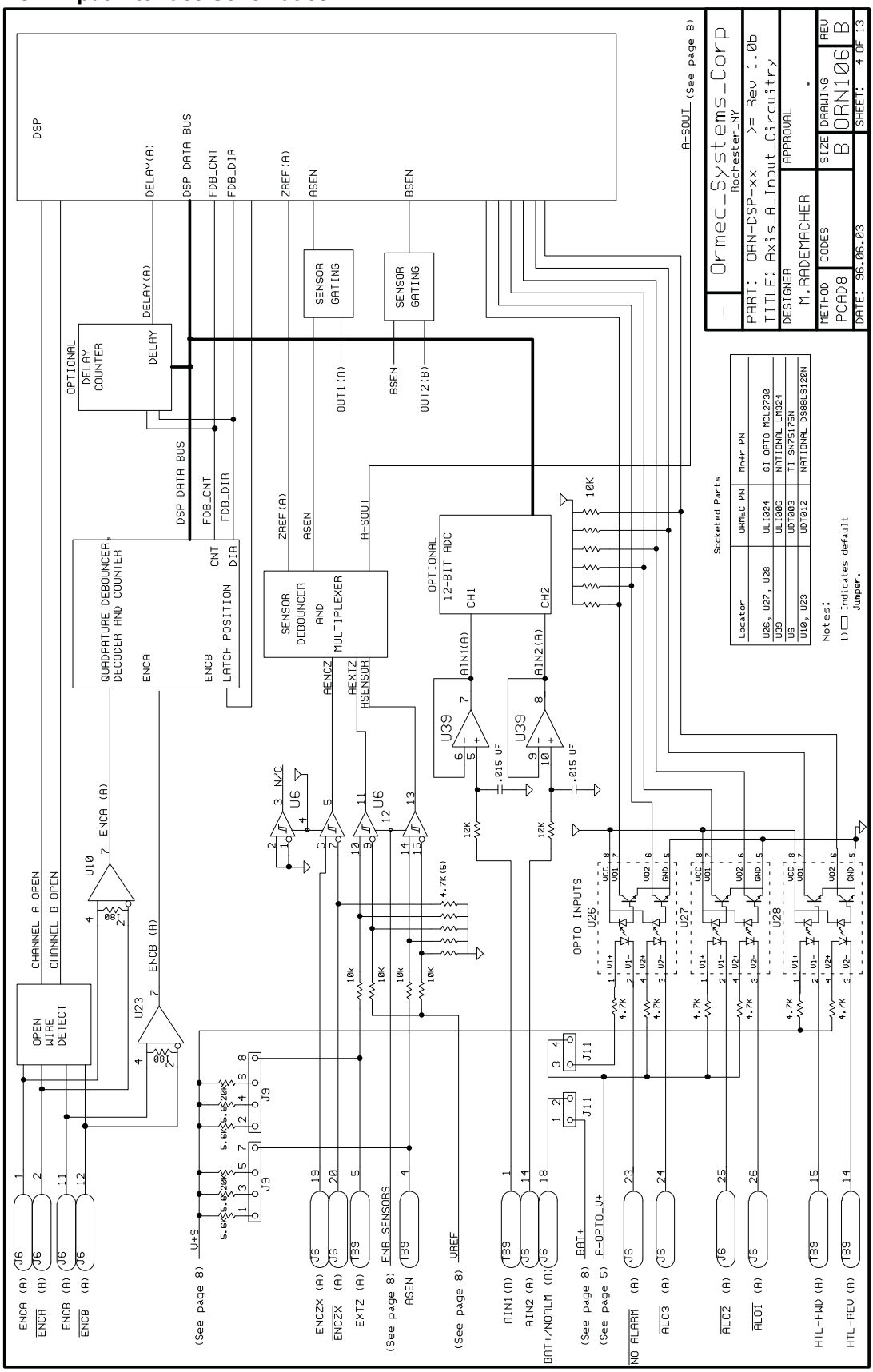


Hardware Travel Limits. The factory default jumpers for J17 disables the **H**ardware **T**ravel **L**imit **F**orward / **R**everse for both axis. The DSP, HTLF & HTLR red LED's will be on when there is an ERROR, axis motion is prohibited,

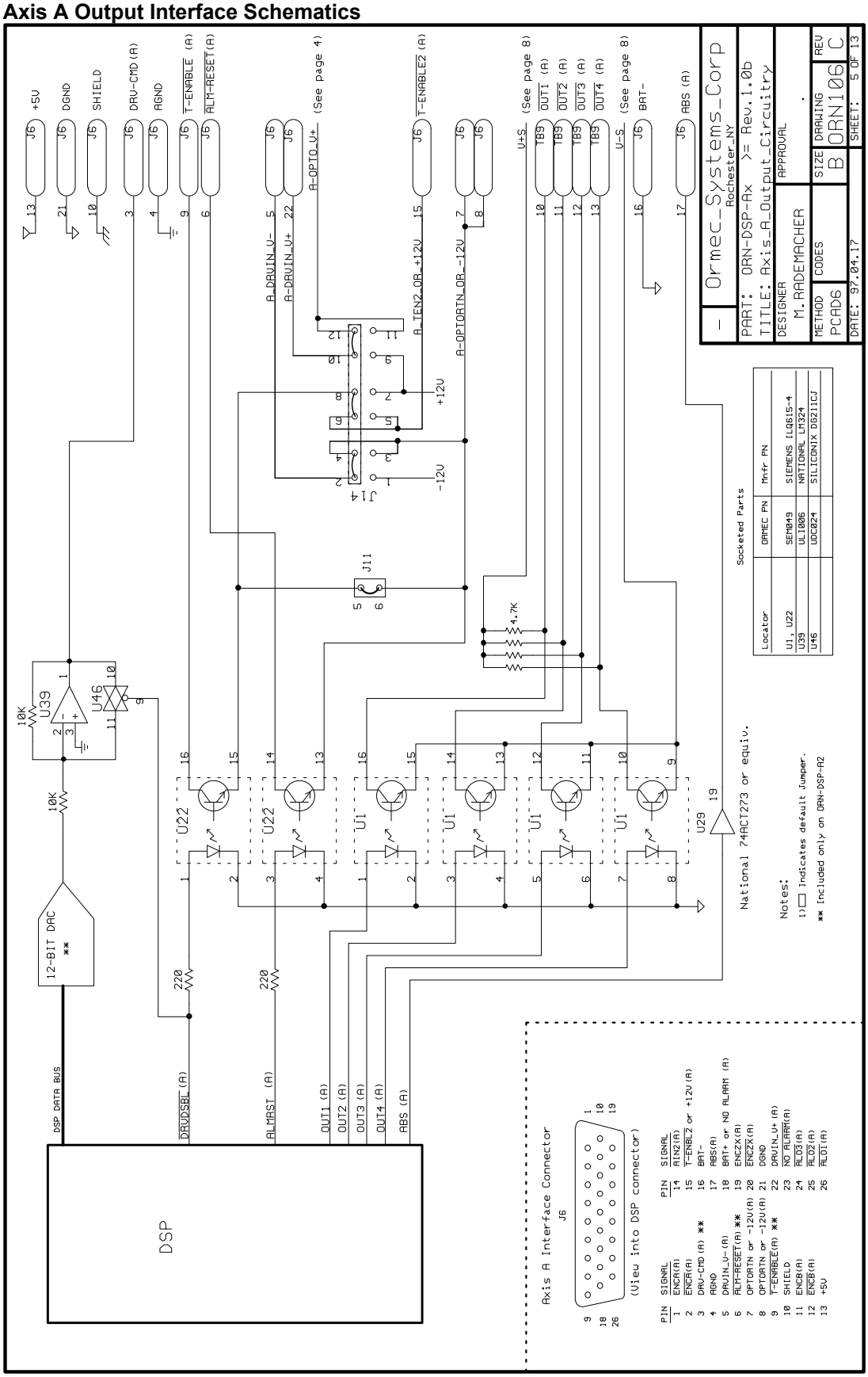
a)------- when Jumper "J17" is ENABLED and HTL inputs are NOT conducting current at TB9 or TB10, a travel limit ERROR will be generated. (ERR=1614, or 1615)

b)------- when Jumper "J17" is DISABLED and HTL inputs are conducting current at TB9 or TB10, configuration ERROR # 1617 will be generated.

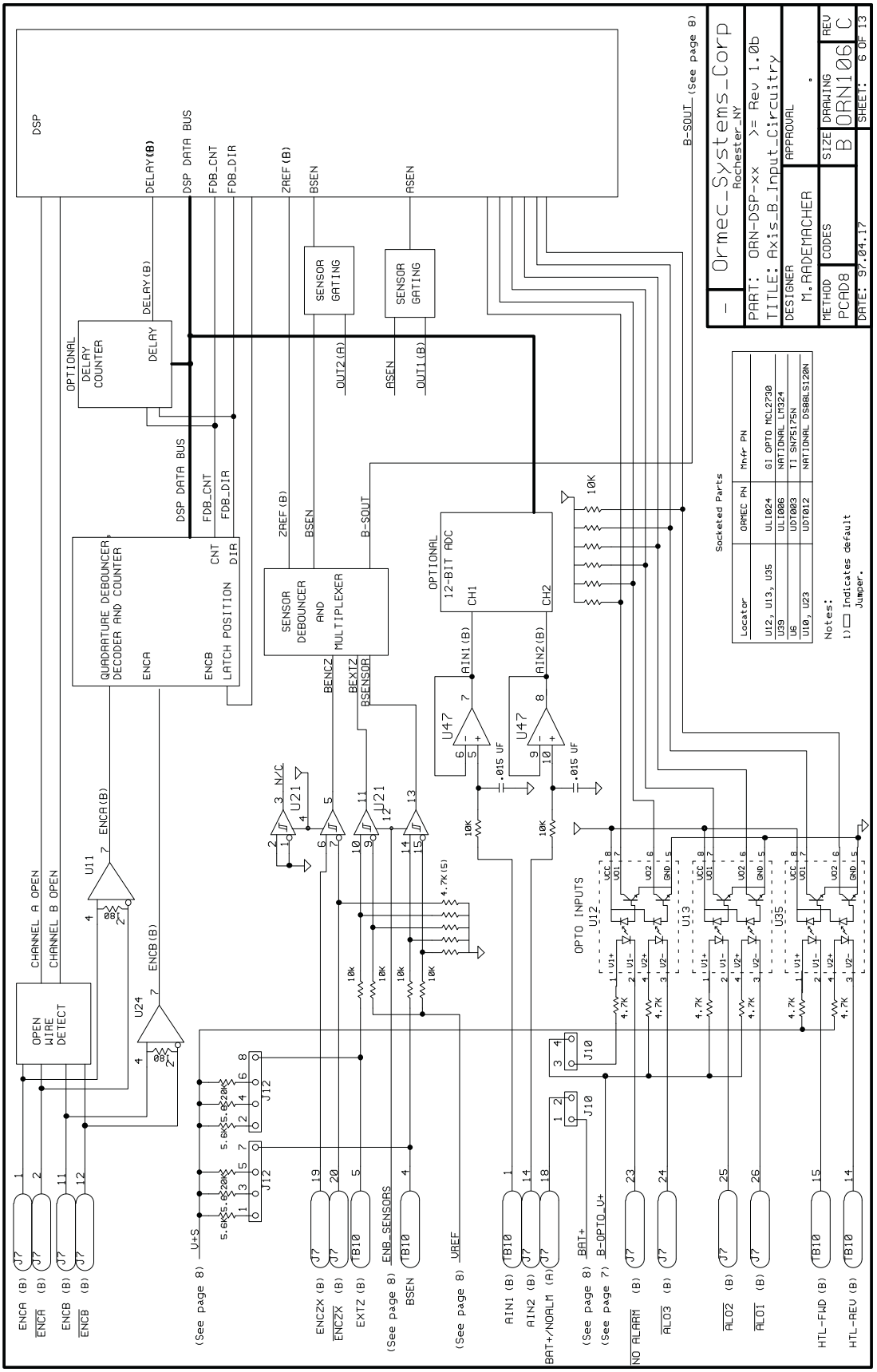
Axis A Input Interface Schematics



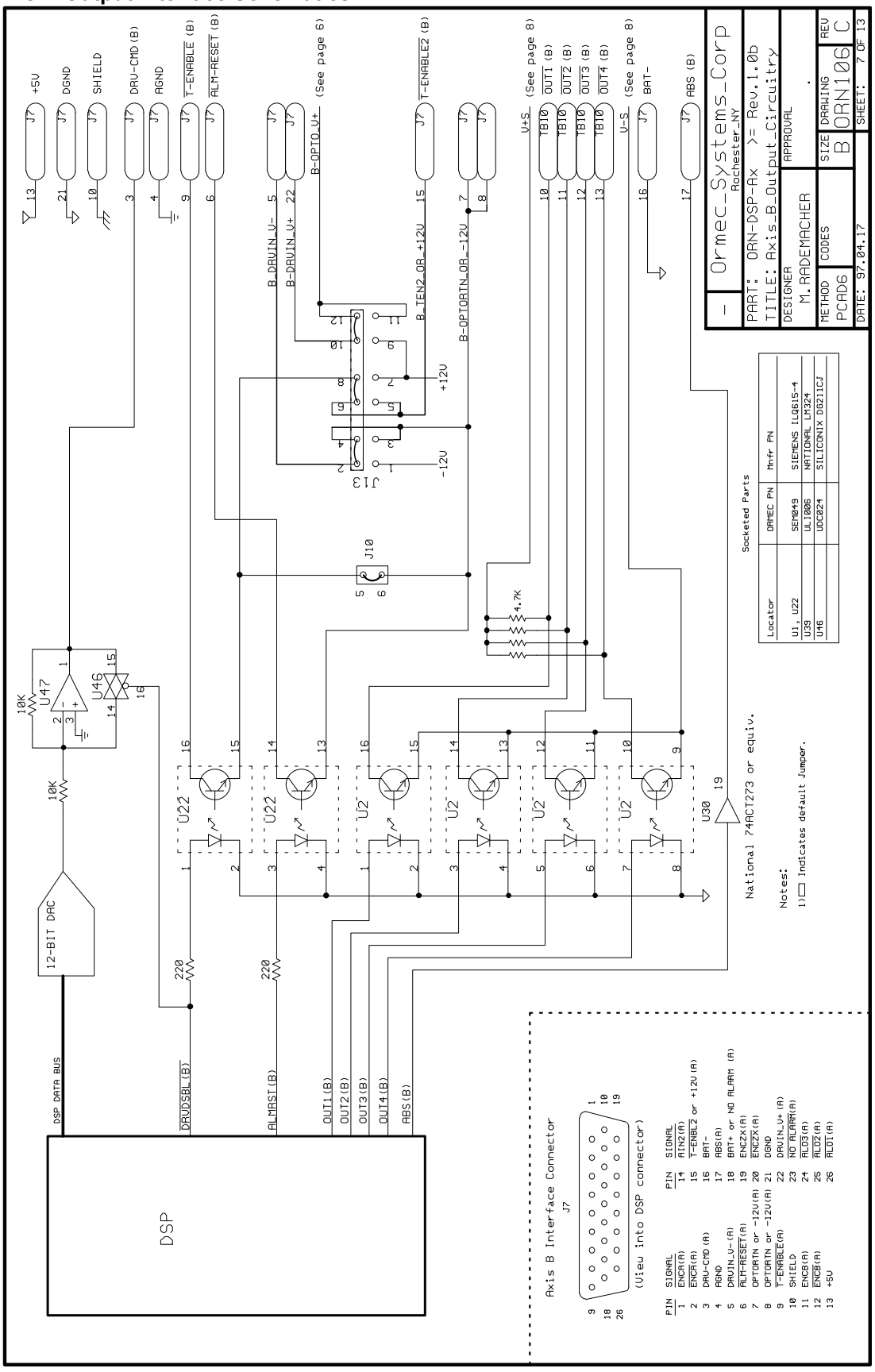
Axis A Output Interface Schematics



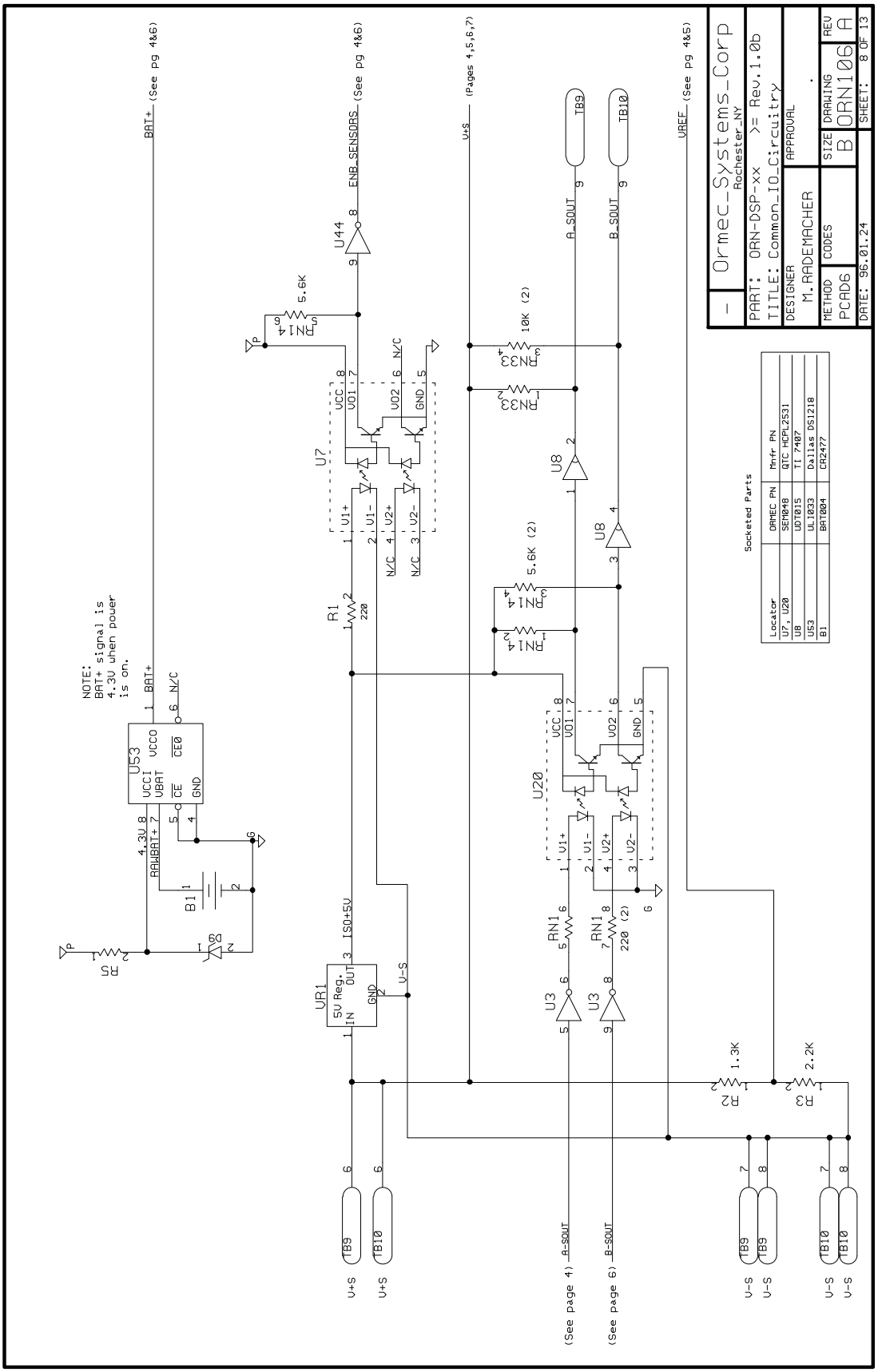
Axis B Input Interface Schematics



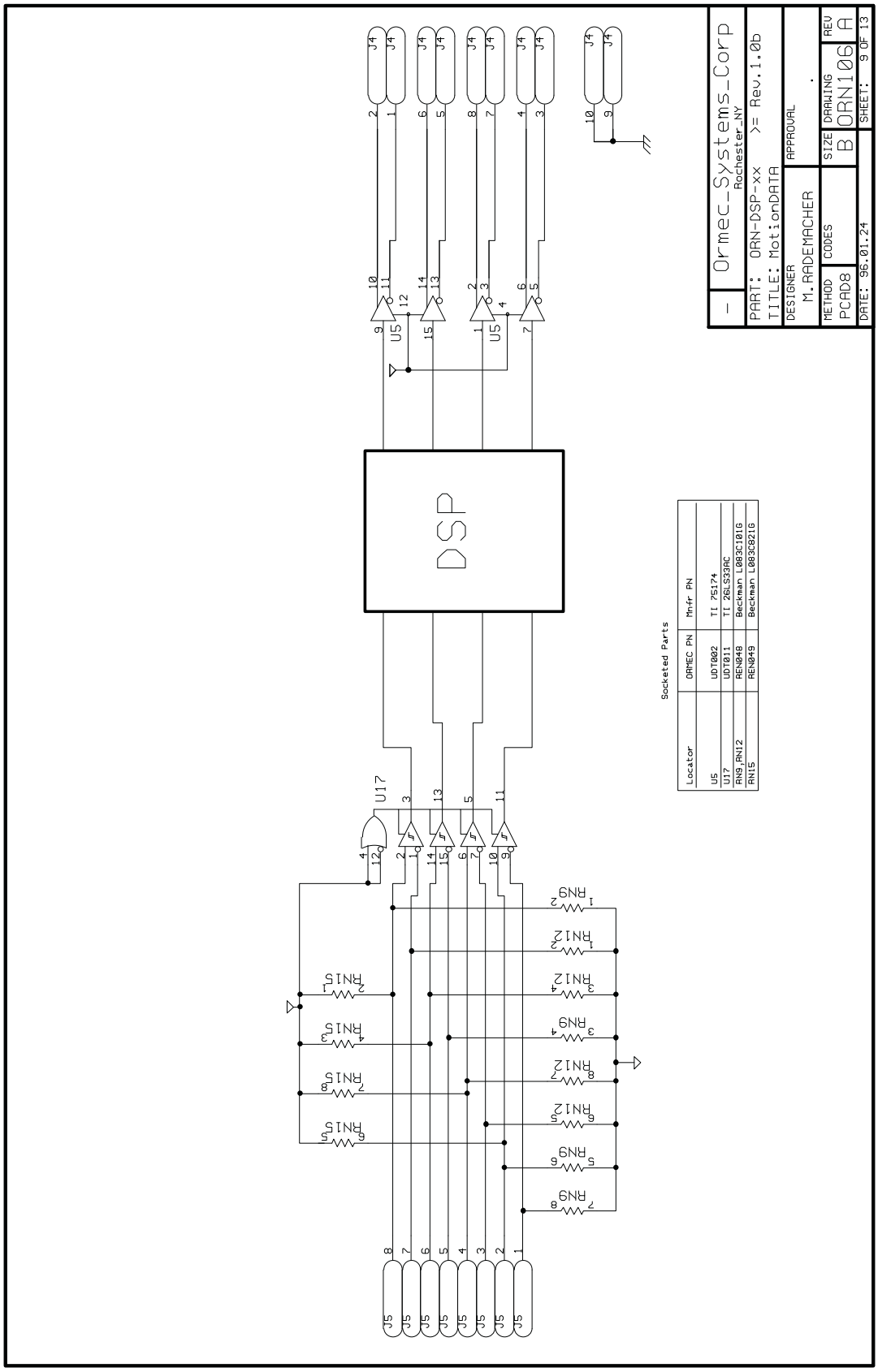
Axis B Output Interface Schematics



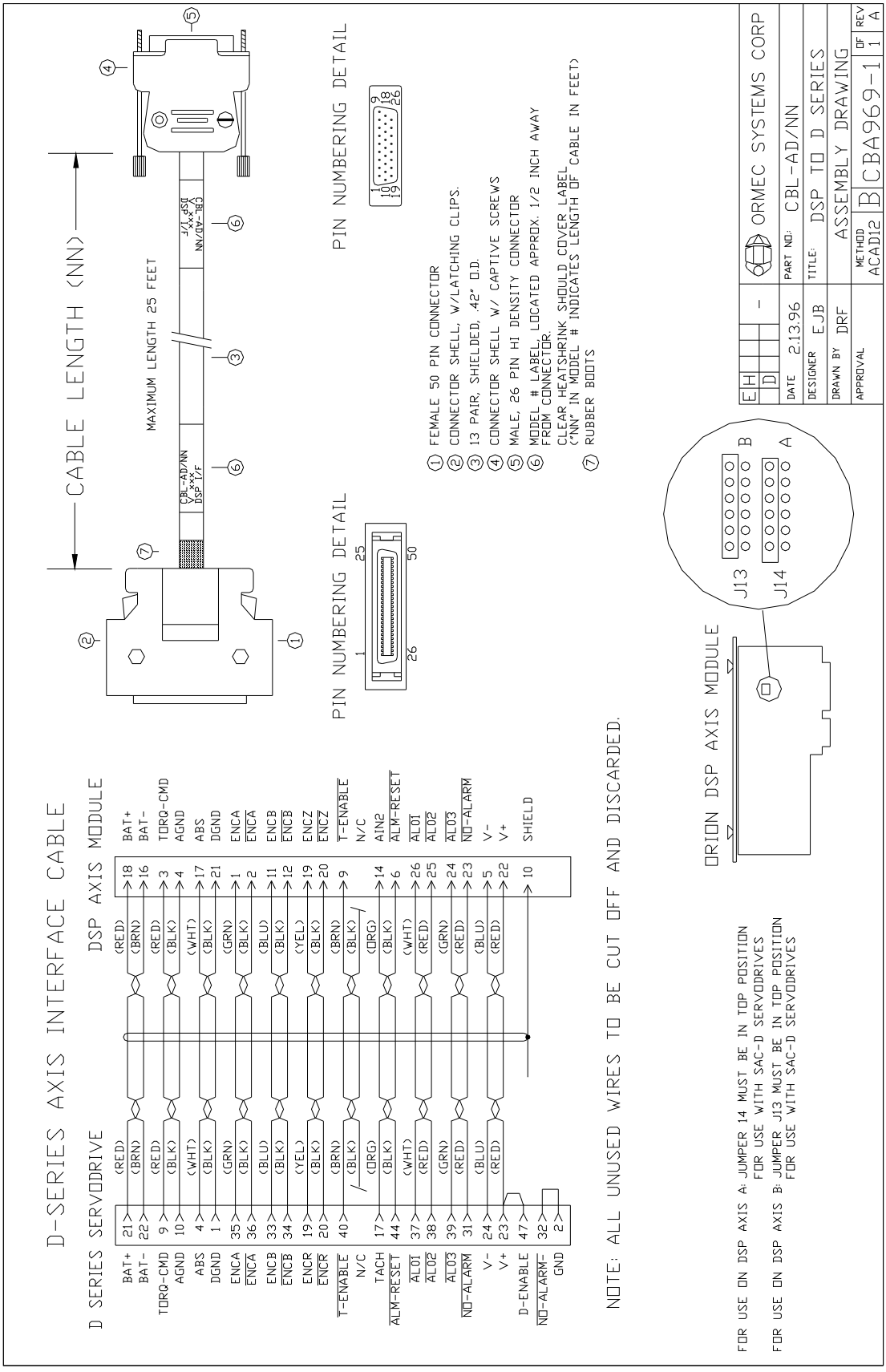
Miscellaneous DSP I/O Circuitry Schematics



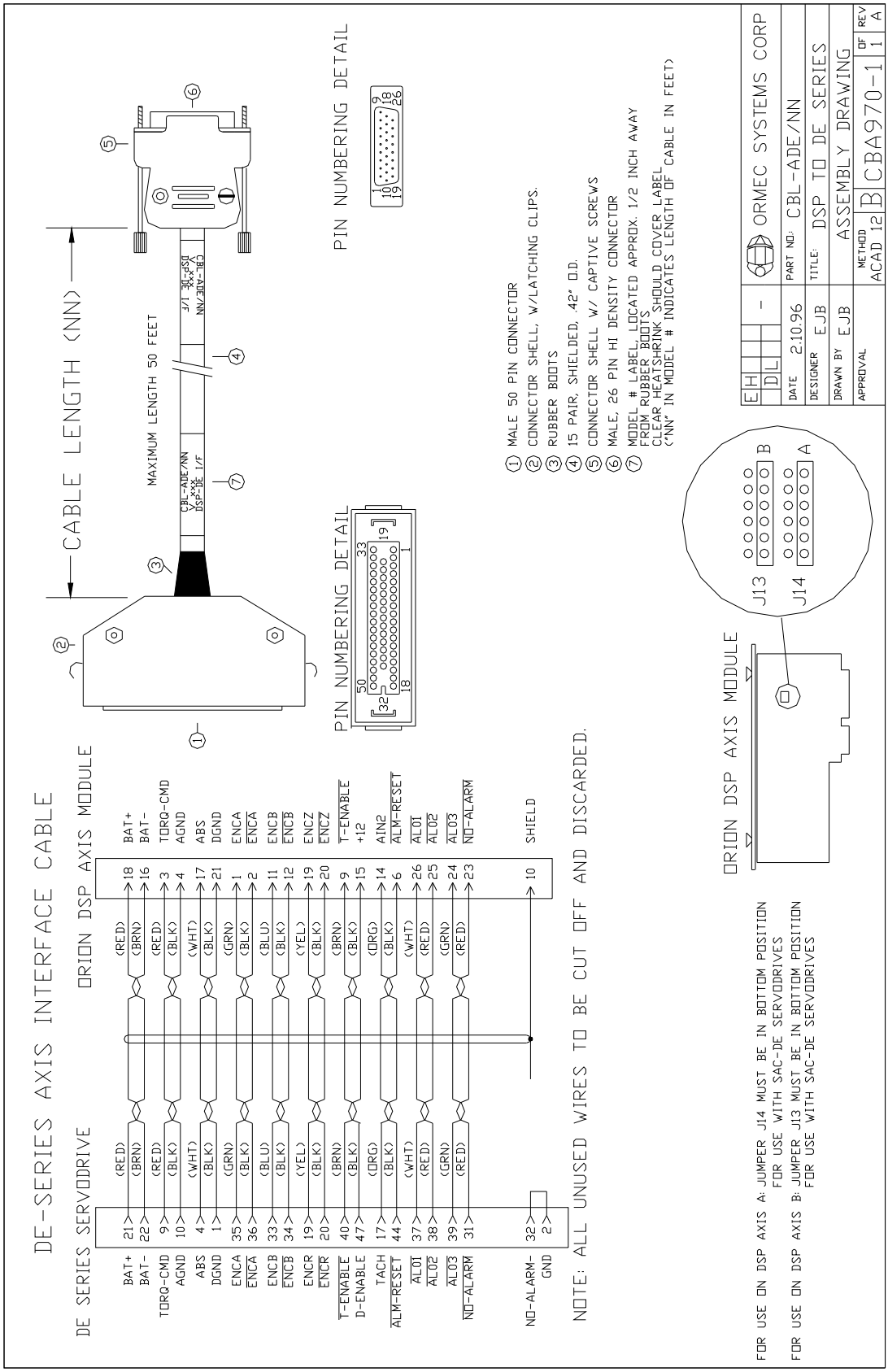
MotionDATA & Analog Input Interface Schematics



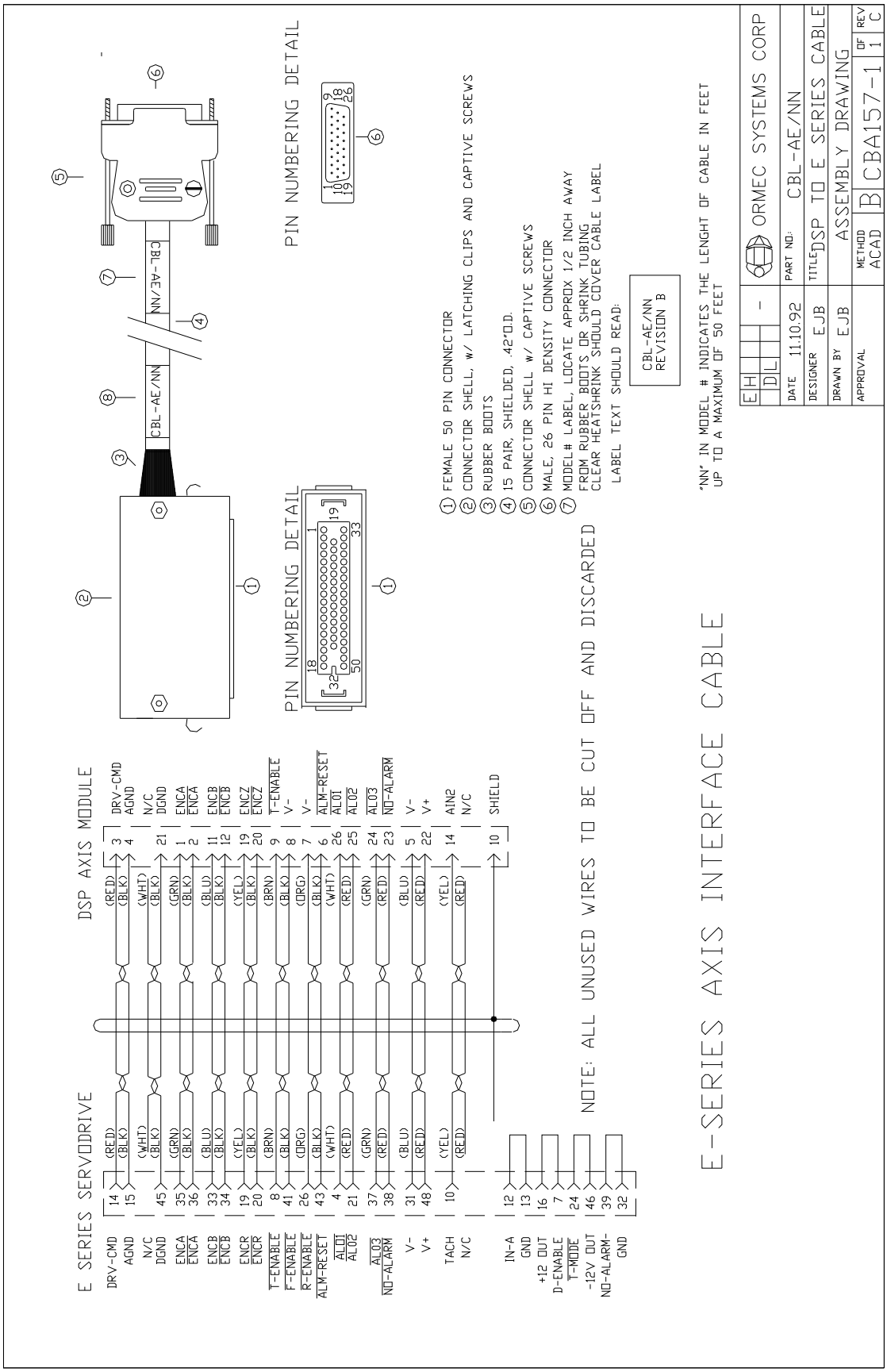
Appendix H - DSP Interface Cables and Accessories



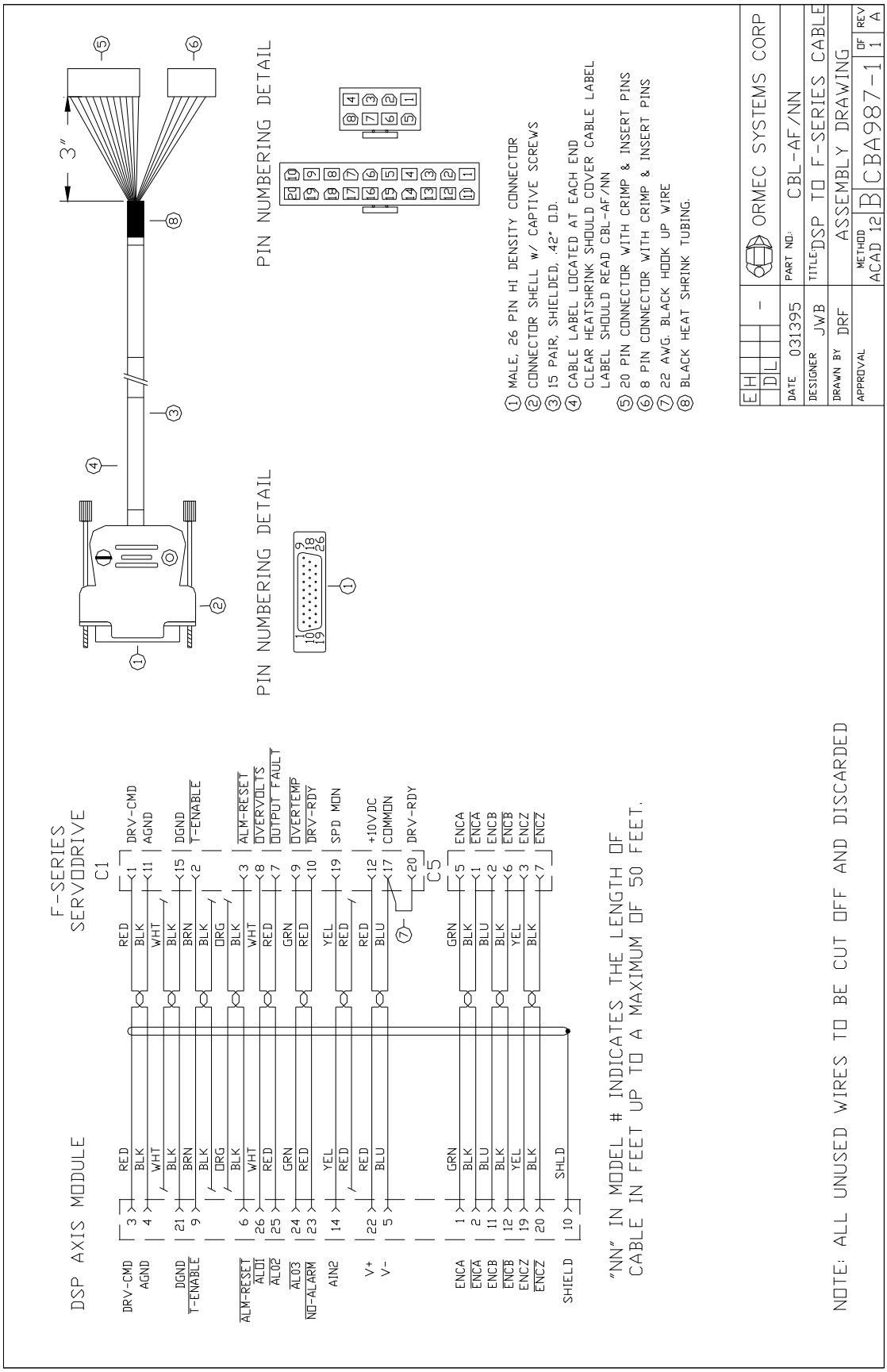
CBL-ADE - DE-Series (SAC-DE) Axis Interface Cable



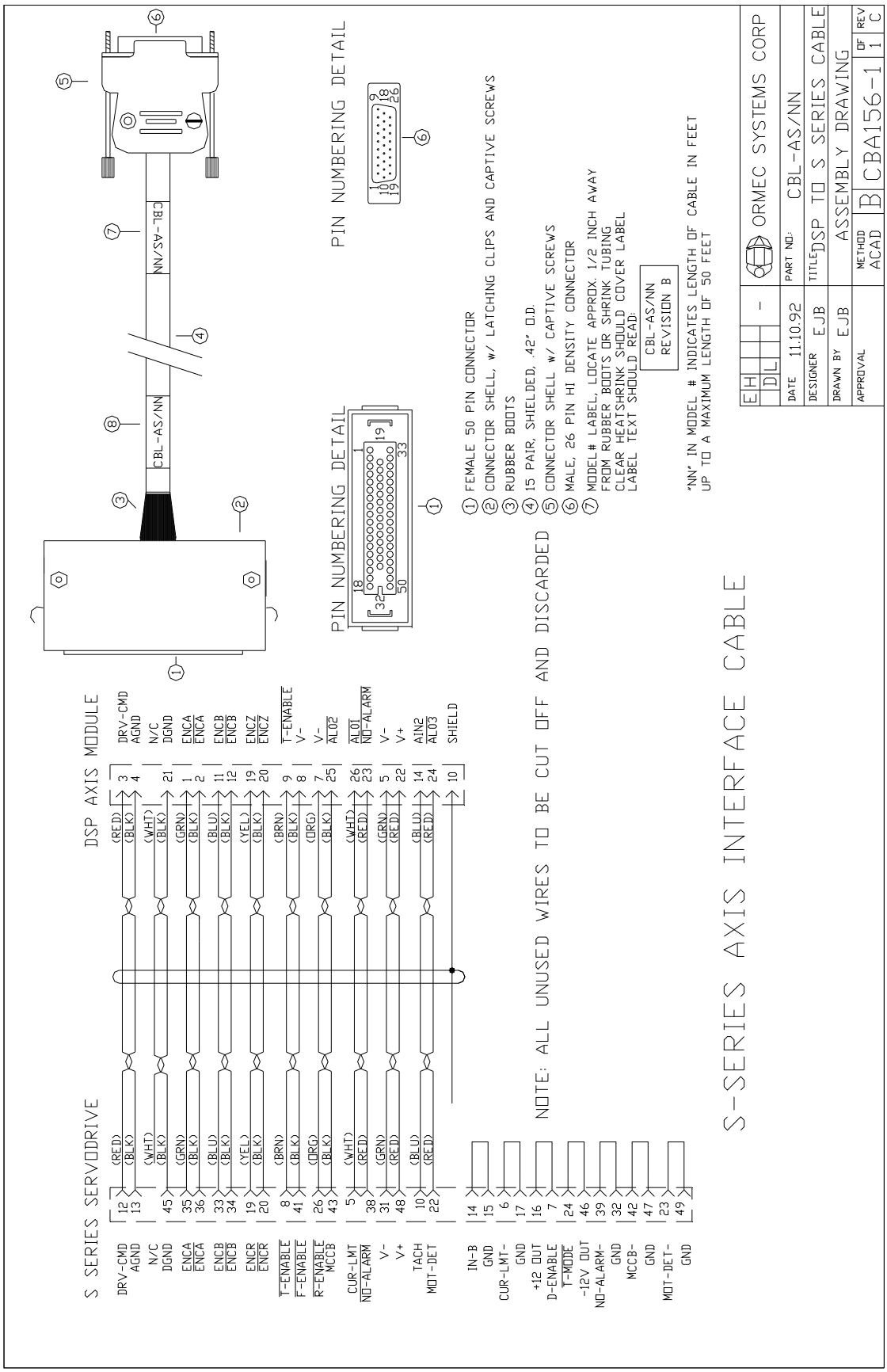
CBL-AE - E-Series (SAC-E) Axis Interface Cable



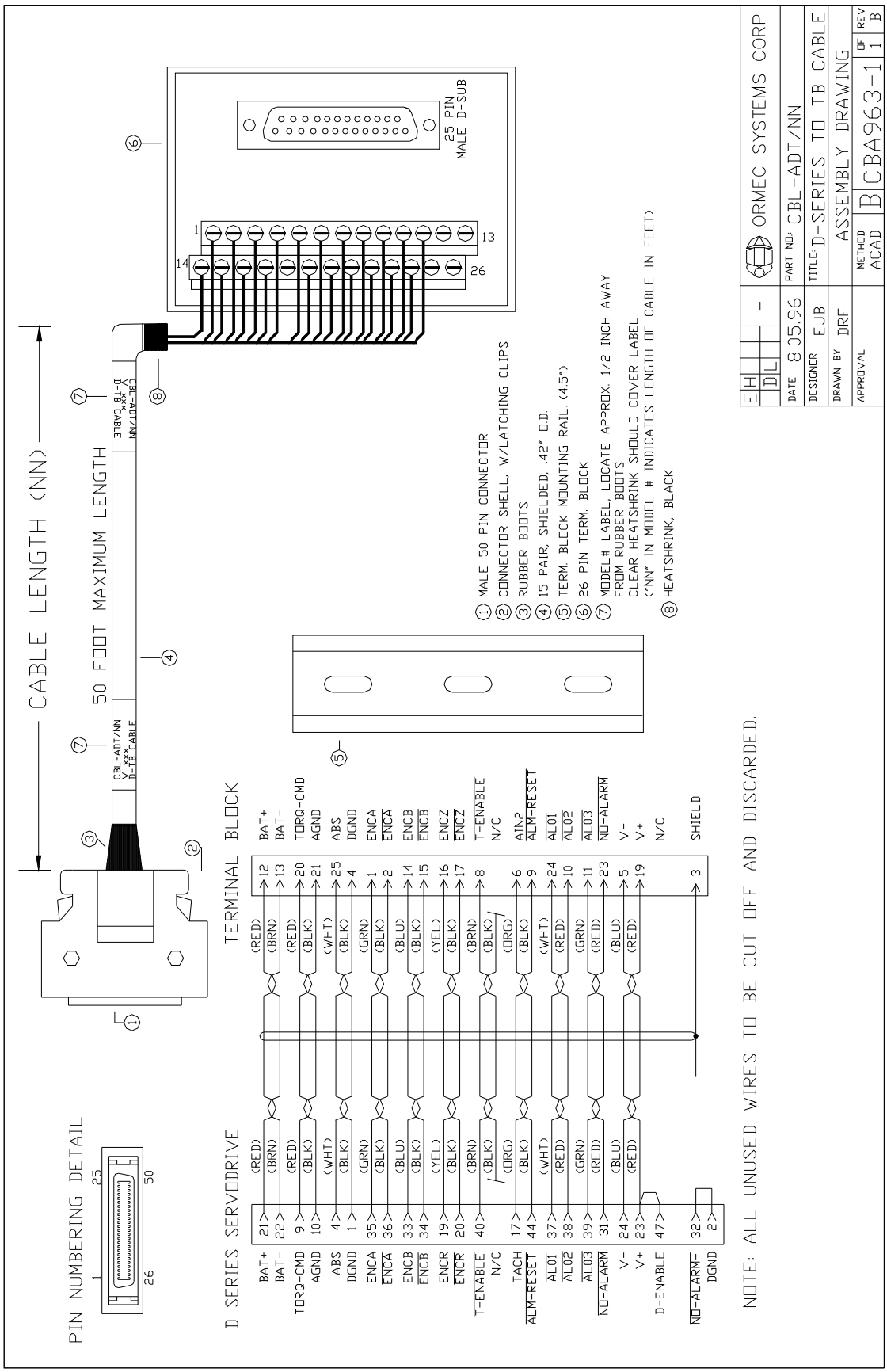
CBL-AF - F-Series (SAC-F) Axis Interface Cable



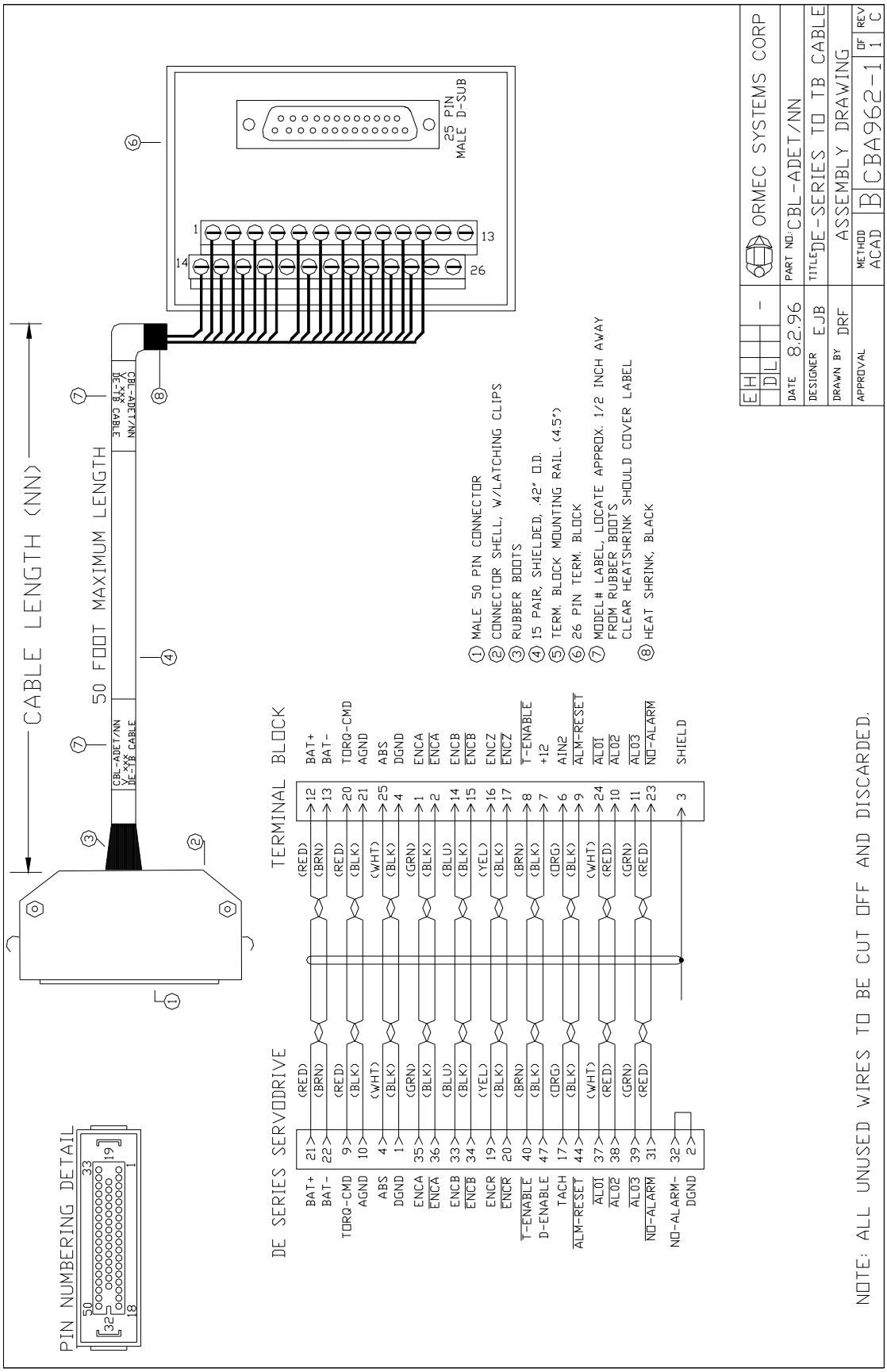
CBL-AS - S-Series (SAC-S) Axis Interface Cable



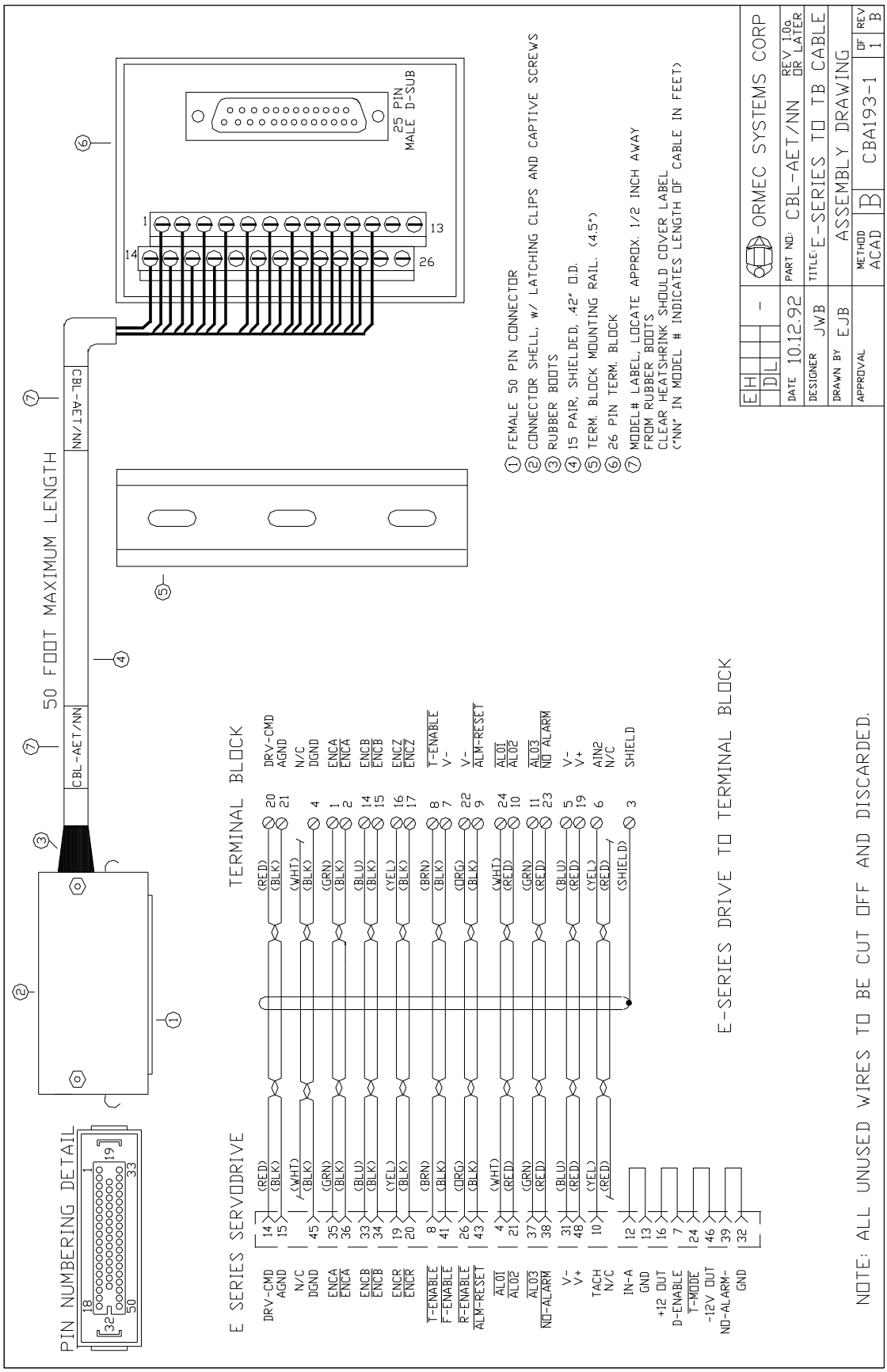
CBL-ADT - D-Series (SAC-D) to Termianl Block Axis Interface Cable



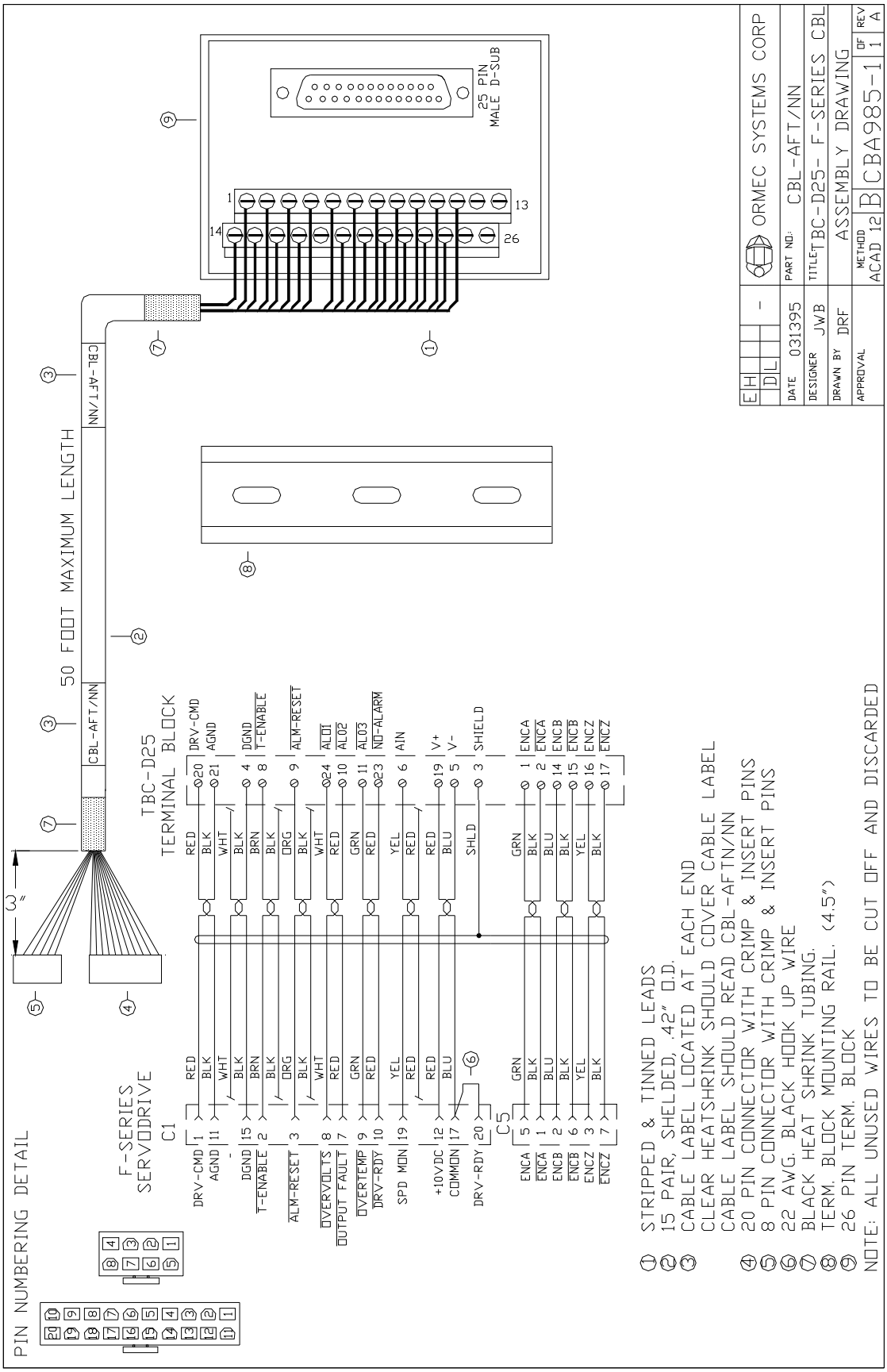
CBL-ADET - DE-Series (SAC-DE) to Termianl Block Axis Interface Cable



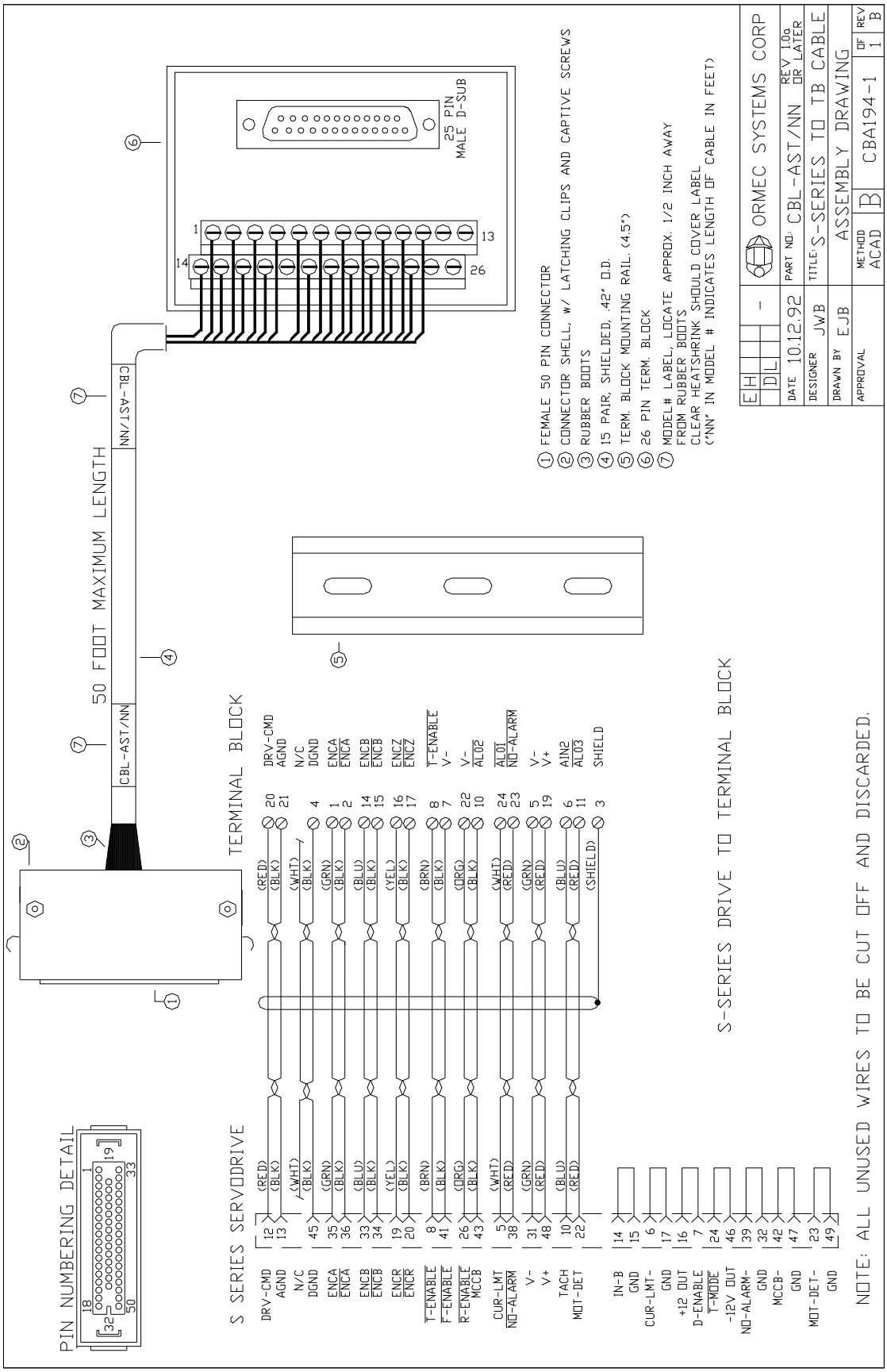
CBL-AET - E-Series (SAC-E) to Termianl Block Axis Interface Cable



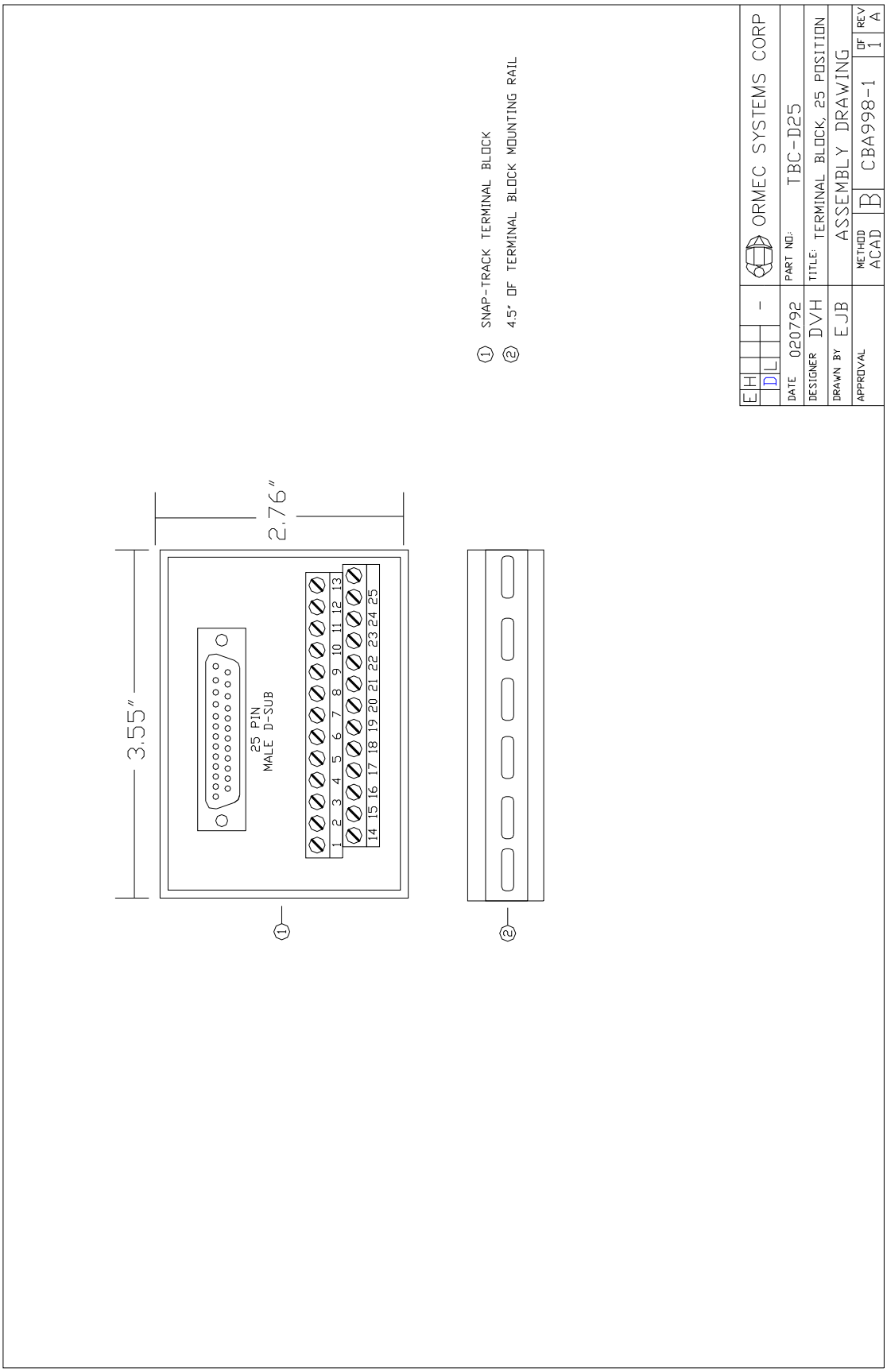
CBL-AFT - F-Series (SAC-F) to Termianl Block Axis Interface Cable



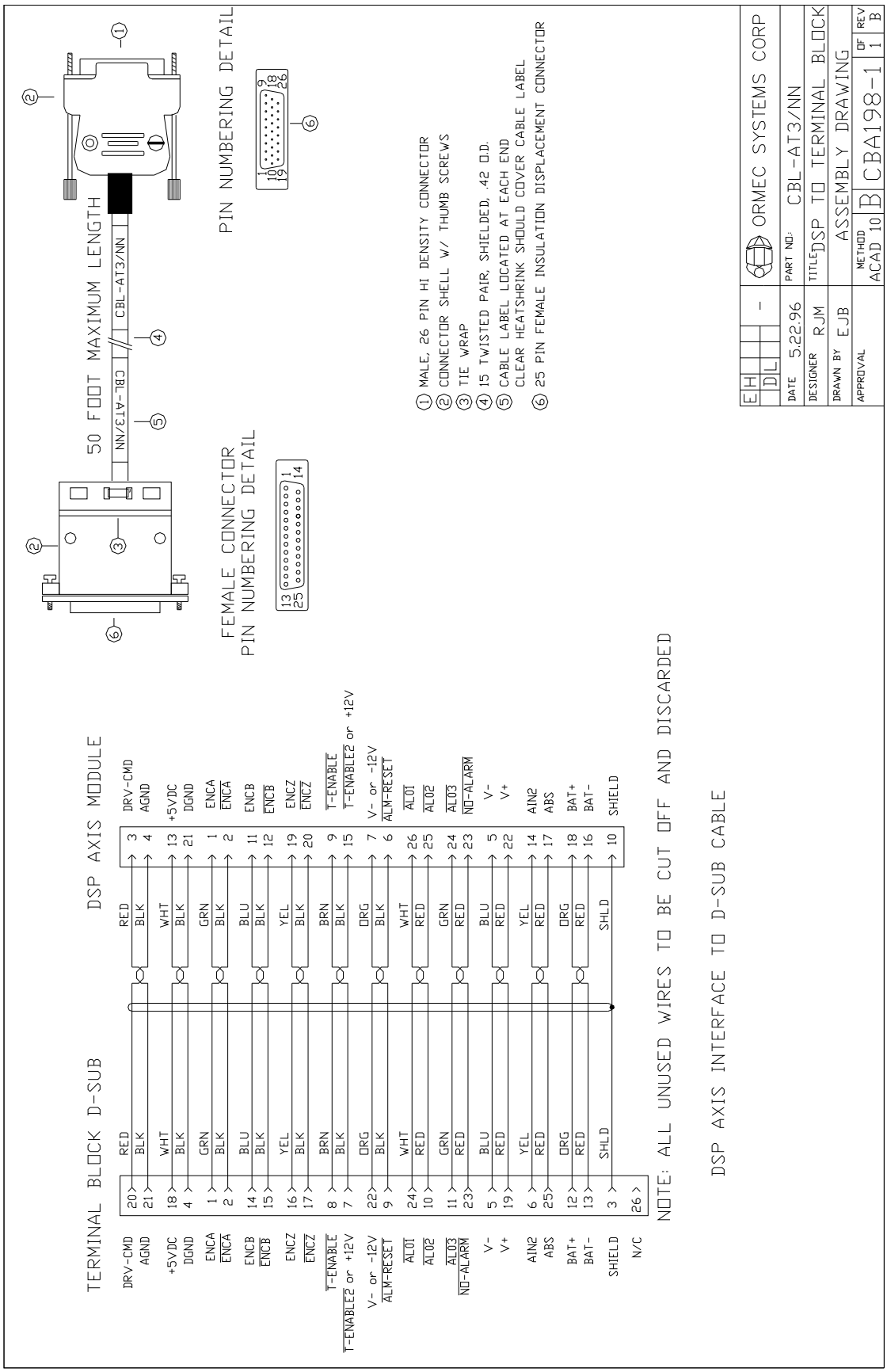
CBL-AST - S-Series (SAC-S) to Termianl Block Axis Interface Cable



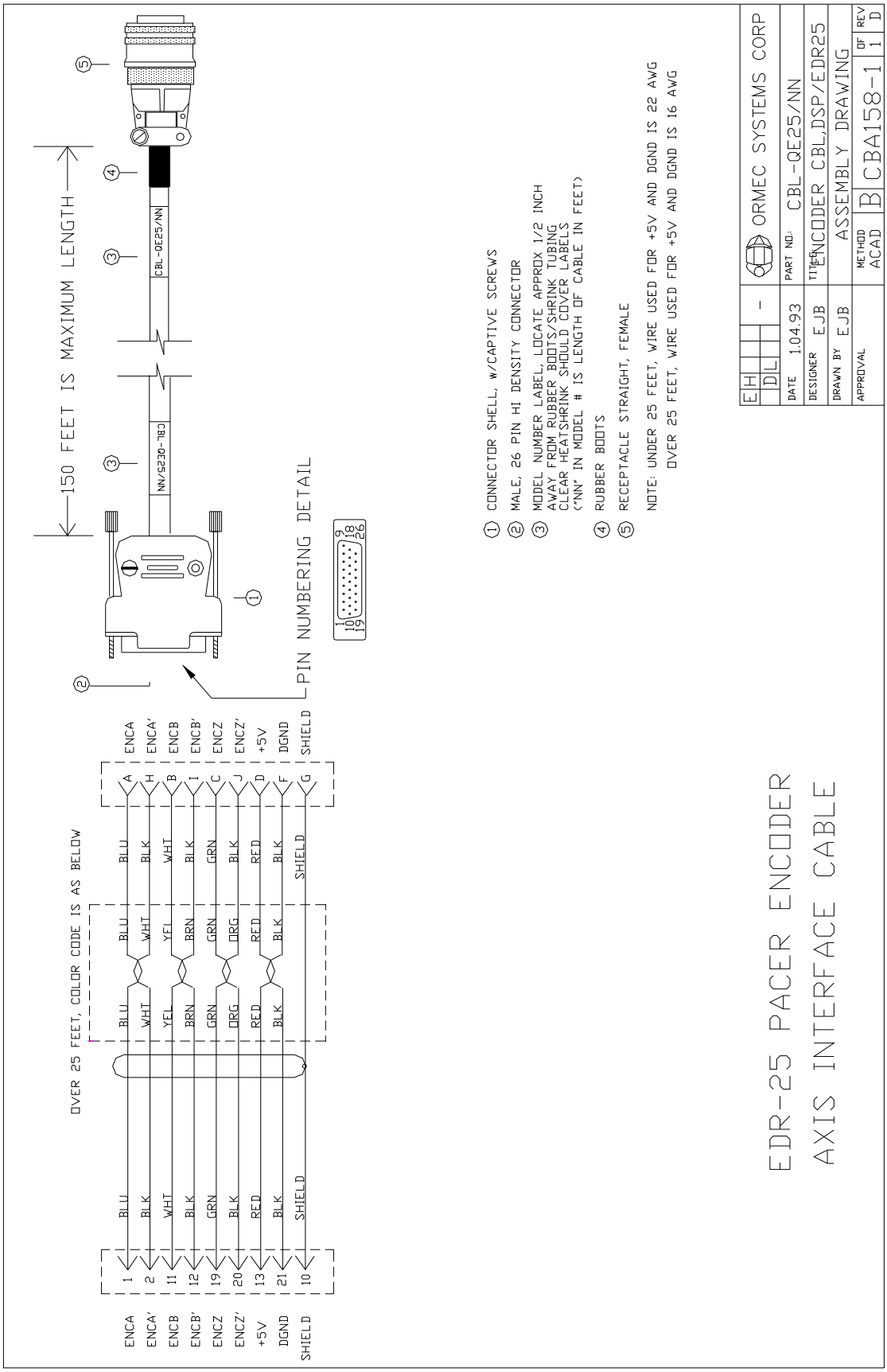
TBC-D25 - Axis Terminal Block



CBL-AT3 - DSP to Axis Termianl Block Cable



CBL-QE25 - EDR-25 Pacer Encoder Axis Interface Cable



CON-2Q - DSP Axis Interface Connector