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ORMEC

TECHNOLOGY FOR ELECTRONIC MOTION CONTROL



ORION Hardware Overview
Class Notes

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SYSTEM MODULE STATUS DISPLAY INFORMATION:

If Faults exist at power up, the ORION Status Display shows the pertinent Fault "F" codes ..... See page 30

If a user program terminates due to an error and enters direct mode, the program stopped led will turn on and the display shows the pertinent error "E" code. Example: "E", "1" , "9" , "1" , "1" ... for 1911 Axis fault error.
MotionBASIC groups errors into categories by error code numbers. Complete listing found on pages 31-34

1- 999: User Defined Errors are errors generated by the user program with an ERROR statement. It is recommended that unique user generated errors utilize error numbers from 1 to 999 to prevent possible overlap with future releases of MotionBASIC®. ..... Application specific.

1000 - 1099: Syntax Errors are caused by an incorrect, unexpected, or missing keyword, parameter, or delimiter. They can be fixed by editing the program at the line that the error exists. ..... Call your programmer.

1100 - 1199: Program Structure Errors are caused by an unexpected or missing statement. They can be fixed by adding, deleting, or changing a line in the program. ..... Call your programmer.

1200 - 1299: Expression Errors are caused by a numeric or string value out of range, or an incorrect variable type. They can be fixed by changing the value, or type of variable/constant. ..... Call your programmer.
1212: Parameter out of range ..... Data out of design specification.
1221: No such Ormec variable . Install required MotionBASIC extension (MBX) on System card. OR Program typo.

1300 - 1399: I/O Errors Input / Output Errors are caused by an error during an attempted I/O operation. They are not caused by an error in the I/O statement itself.
1307: Cannot open device ..... Check the cables are in the correct port. Check power to your operator interface.
1307: Cannot open file ..... Do you need a second memory disk in the left PC Card slot?
1310: Device write failed ..... With QuickPanel, reload QP Executive Program.
1345: M-Stop configuration conflicts with hardware settings .... Jumpers need to be moved to M-Stop, See page 48
1347: I/O point configured for M-Stop operation ..... Jumpers need to be moved to DIO, See page 48

1400 - 1599: (Reserved)

1600 - 1699: Motion Errors are caused by a situation preventing the completion of a motion as prescribed by the motion statement.
1606: Invalid axis ID ..... See page 50-51
1617: Hardware travel limit Configuration Error ..... See page 58

1700 - 1799: (Reserved)

1800 - 1899: System Errors are caused by a system or hardware limitation, incorrect mode, etc.
1805: Ctrl-C break detected ..... Normal operation, someone stopped the program.
1815: MotionDATA not available ..... See pages 52-53

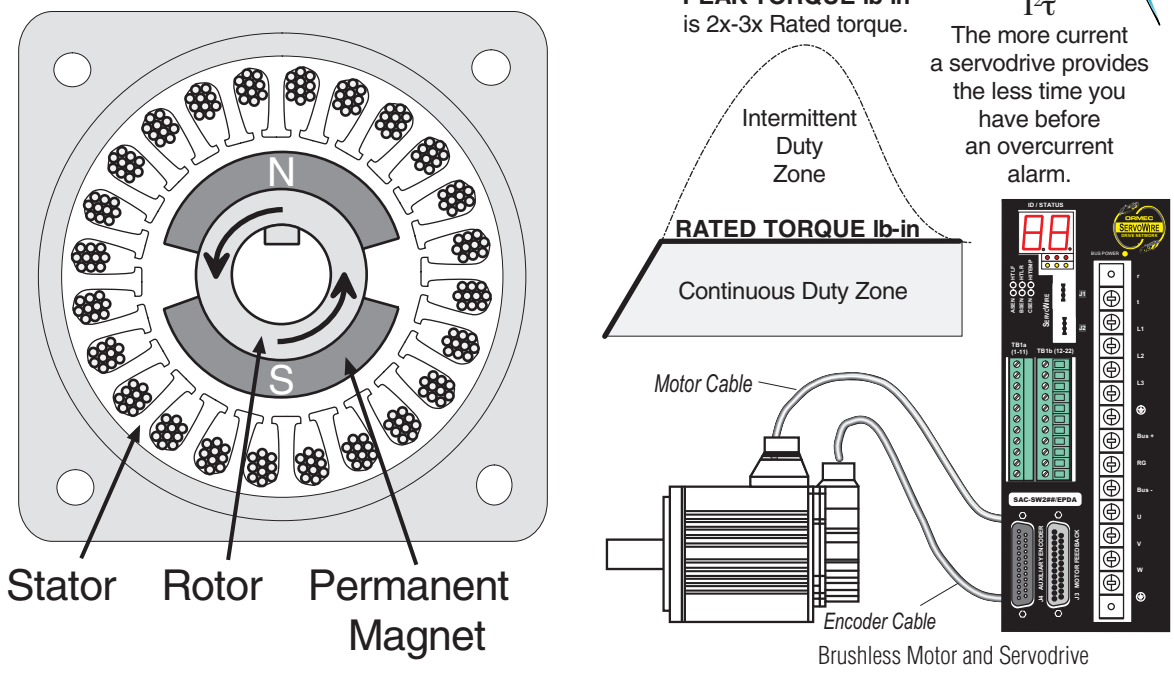
1900 - 1999: Controller Fault Errors ... NO FAULT relay will open.
System errors are Caused by a hardware limitation of the controller.
1900 -1909 are reserved for user generated controller fault errors, which permits the user to issue an error which opens the no-fault relay. The user generated controller fault error is reported in the FAULT@={8} ... Machine Fault.
1900 -1009:User defined errors ..... Application specific.
1911: Axis Fault ..... Look at LED's on both DSP and Servo drives. See pages 37-38
1912: Internal error ..... 1st, check all GROUNDS. Electrical Noise can cause internal errors.
..... 2nd, Do you have the latest MotionBASIC / MBX's software installed?, call your programmer.
..... 3rd, call Ormec Service (716) 385-3520
1920: MotionCredit Verification Failure ..... See page 23

9000 - 9999: MotionBASIC extension (MBX) Errors
Although not strictly a part of MotionBASIC, but rather associated with typical MotionBASIC Extensions, MBX's.

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Brushless Servomotor



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Notes: **Maintainability:** Installing / replacing a servo motor or drive requires no adjustment because the servo parameters and torque limits are set in software. The brushless motor is sealed. **Do not dismantle the motor.**

INERTIA@ is one of the software parameters that represents the total system inertia. This is the motor and machine combined inertia. *When running the machine UNCOUPLED to test a motor, lower INERTIA@ to the value of the motor only. If this is not done, software wound think the machine is attached to the motor and will provide more current to the motor then required to move it. The servo drive may overheat and shut itself down with an overload error.*

Coupling is critical: Always avoid keyways and set screws. Generally, it is best to avoid helical, disc, oldham, split beam and jaw type couplers. Metal bellows will usually provide the best results. Pay careful attention to how it is attached to the shaft. A clamping or taper lock is the best way to go.

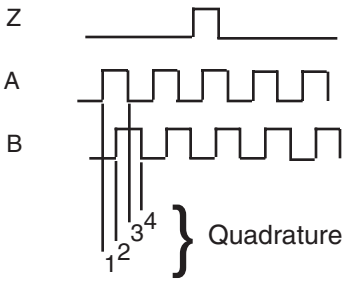
Backlash: The most common symptom of backlash is a "buzz", often very loud, which occurs primarily when the motor is stopped. Often you can eliminate the buzz by applying a torque at the load. The only way to solve the problem is to mechanically eliminate the backlash. If you do not eliminate the buzz, over time it may overheat the motor or ruin the mechanical system. **See the paper on "Coupling High Performance Servos to Mechanical Loads"**

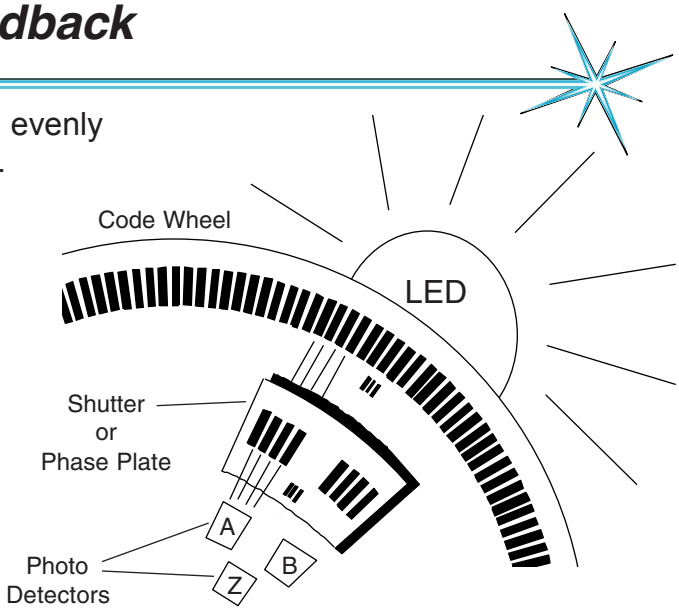
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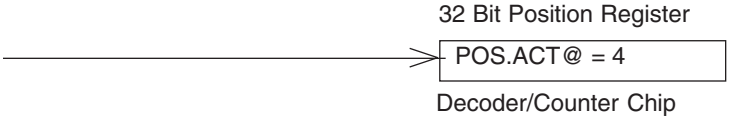
Incremental Encoder Feedback

Resolution in the encoder is based on evenly spaced divisions or lines on a glass disk.

1) Light passes through the encoder's code wheel.
2) The shutter isolates two "flash sequences", shifted in phase.
3) Photo detectors generate electrical pulse trains. Z reference (ZREF@), A channel, & B channel pulse.



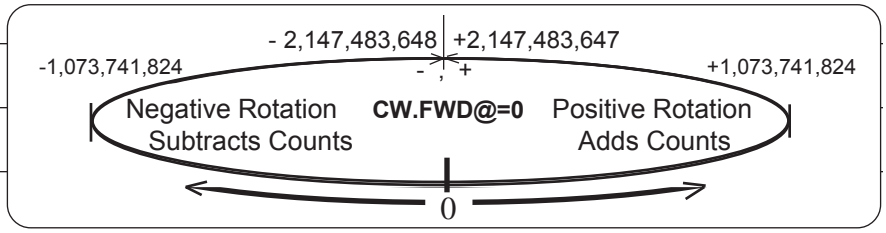




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Notes: These position feedback signals are transmitted to the receiving electronics where a 32-bit register simply increments or decrements an accumulative total for each forward or reverse count edge, (respectively). This roll-over register has a value of ZERO on powerup and range of *-2,147,483,648 to +2,147,483,647* and stored in the Ormec variable**POS.ACT@**. Note: An axis with 6000 $^{cts}/_{rev}$ at 4000 RPM, runs for 1.5 hours will count from 0 to Max count value.

CW.FWD@ Clockwise Forward, when set to TRUE, cause the servomotor's direction of "forward" travel to be "clock-wise", as viewed from the motor shaft end of the motor.

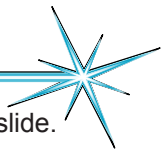


Incremental Encoders do not have the ability to provide their position at powerup. They simply have the ability to send signals which increment or decrement the position register. It is then necessary to "HOME" most incremental encoder applications, to find and establish a known location.
Base Encoder with 8160 linecount * Quadrature feedback, provides 32,640 counts per revolution. **CNT.REV@**=32640
8160 line count, provides 32,640 counts/rev = 90.66 $^{counts}/_{degree}$ Resolution 0.011 Degrees at motor shaft.

ZREF@ Zero Reference, The Input source of ZREF@ above is the "once-per-revolution" reference signal built into the encoder ENCZ.

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Incremental Encoders vs. Absolute Encoders



Incremental and Absolute encoders provide quadrature signals as described in the previous slide.
In some applications it is necessary to know the position of an encoder at powerup.

Incremental Encoders do not have the ability to provide their position at powerup. They simply have the ability to send signals which increment or decrement the position register. It is then necessary to "HOME" most incremental encoder applications, to find and establish a known location. This is done in a variety of ways, a common method is: **1)** a slow motion is started, **2)** WAIT for a hardware signal (prox switch?), **3)** the motion is stopped, and **4)** the position register is overwritten with a desired value (perhaps 0?). Any subsequent motion of the encoder is now relative to this Home reference position..

Absolute Encoders have the ability to report their position at powerup (within ±50,000 revolutions). This is possible due to the following additional encoder hardware: **1)** Super capacitor providing encoder power when disconnected, **2)** Magnetic code wheel pickup to support a **3)** Revolution counter, **4)** A 1 rev Absolute position code wheel, and **5)** Serial communication electronics to send the position value. The revolution counter can be reset to rev 0 by fully discharging the capacitor. After it is recharged, a continuous roll-over rev counter is incremented/decremented based on the magnetic pickup (±50,000). At powerup, the 1 rev absolute code wheel is referenced to find the count location within a revolution. A send request, transmitted to the encoder, causes it to send the sum of (rev counter *counts per rev) + (counts within rev) as serial data. This number is loaded into the position register, and the controller now has the position of the multi-rev absolute encoder. The encoder then switches to operate as an incremental encoder.

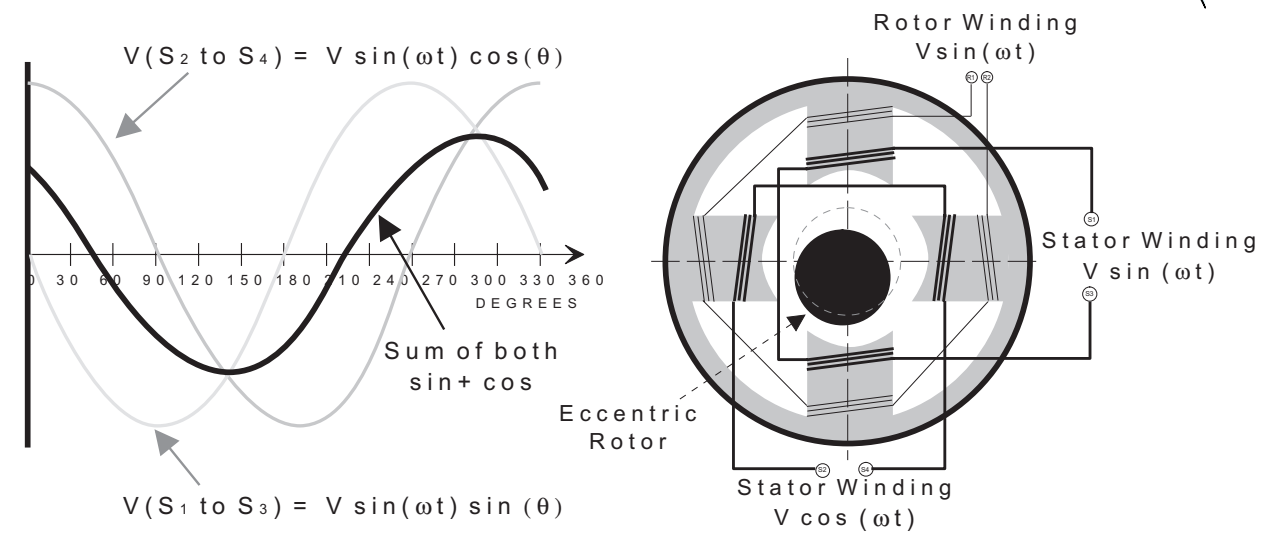
Notes: Absolute Encoder Polling is done via reference to an Ormec Variable, see hypertext on POS.ABS@

Absolute Encoder Support:

The DSP part number uses a "B" for the Battery option that supports the absolute feature.

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Resolver Feedback



Shaft angle= θ, Reference Voltage = Vsin (ωt), ω=(2πf), f=carrier frequency

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Notes: A resolver resembles a small rotary transformer, having two primary windings mounted 90 degrees apart (sin & cos) used to determine the position of a motor. The resolver uses magnetic (analog) coupling to measure absolute shaft position over one revolution. The magnitude between the rotors reference voltage and the two stator voltages (sine and respective cosine) is proportional to the shaft position. 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 (ZREF@) which defines a unique position within a motor revolution. These position feedback signals are transmitted to the receiving electronics where a 32-bit register simply increments or decrements an accumulative total for each forward or reverse count edge, (respectively). This roll-over register has a value of ZERO on powerup and range of *-2,147,483,648 to +2,147,483,647* and stored in the Ormec variable **POS.ACT@**. See page 6, for roll-over information.

The ORION DSP works with quadrature input, so the drive must use a Resolver to Digital (R-to-D) converter to decode the phase information and convert it to digital pulses.

12 bit resolution simulates the equivalent of a 1024 line count encoder

CNT.REV@=4096 Max Speed 7500 $^{Rev}/_{min}$.

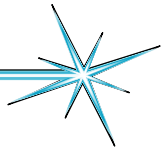
14 bit resolution simulates the equivalent of a 4096 line count encoder

CNT.REV@=16384, Max Speed 3150 $^{Rev}/_{min}$.

Typical R-to-D angular accuracy = 0.32 Degrees, Repeatability 0.088 Degrees

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Encoder vs. Resolver



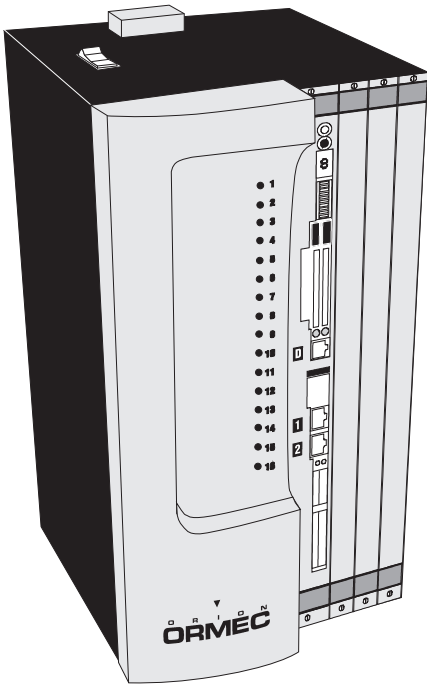
	Encoders	Resolvers	
Standard resolution	32,640	16,384	(counts per revolution)
Maximum Speed	2,448,000	500,000	(counts per second)
Typical/Best Accuracy	1.5 / 1.01	5.0 / 7.0	(arc-minutes)
Typical Tracking Response Time	<1	15	(milliseconds)
Tolerable Shock Level	5	50	(G's)
Operating Temperature Range	0° to 100°	-55° to 175°	(degrees C)

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Notes: See the Encoder vs. Resolver-Based Servo Systems application note. This application note describes the basic operation of resolver and encoder transducers, their related specifications, and issues to consider when applying systems based on either technology.

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ORION Motion Controllers



The model number refers to the number of user slots in each controller.

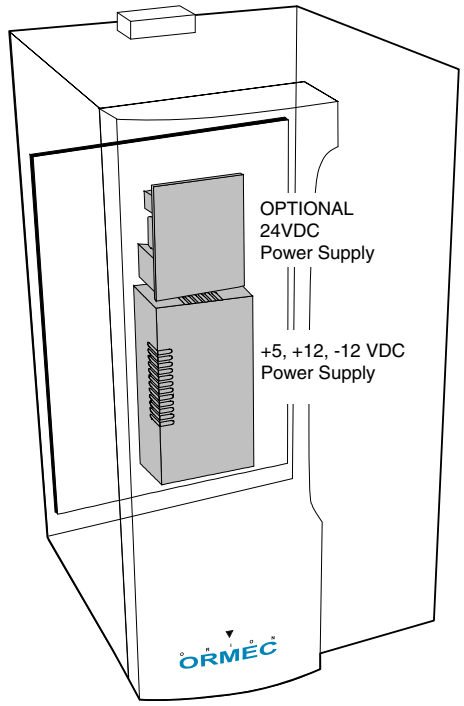
- Model **30** 3 user slots. (shown)
- Model **50** 5 user slots.
- Model **70** 7 user slots.

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Notes: ORMEC's Model 30, 50 & 70 motion controllers are the heart of the ORION™ family of products. Each motion controller features a PC/AT backplane and user expansion slots for a variety of system configurations. The Models 30/50/70 feature three, five and seven expansion slots.

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ORION DC Power



These supplies will auto adjust for the normal AC input voltage range of 115 VAC or 230 VAC. The current output capability of the logic power supply will depend on the ORION model.

- International Power Supplies.
- Automatic input voltage range selection.
  (115 / 230 VAC, 50 / 60 Hz)
- Logic power supply +5, +12, -12 VDC (lower)
- OPTIONAL 24 VDC I/O power supply (upper)
  1.5 Amps Max.

The ORION model number indicates if it has an internal field power supply or not.

"F" - Internal Field supply.
"X" - NO internal supply.

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Notes: **WARNING:** If the ORION controller has an internal 24 VDC power supply, DO NOT CONNECT another external power supply to pins (+24, RTN) on TB2 or TB8.

Connecting External Field Power at TB2

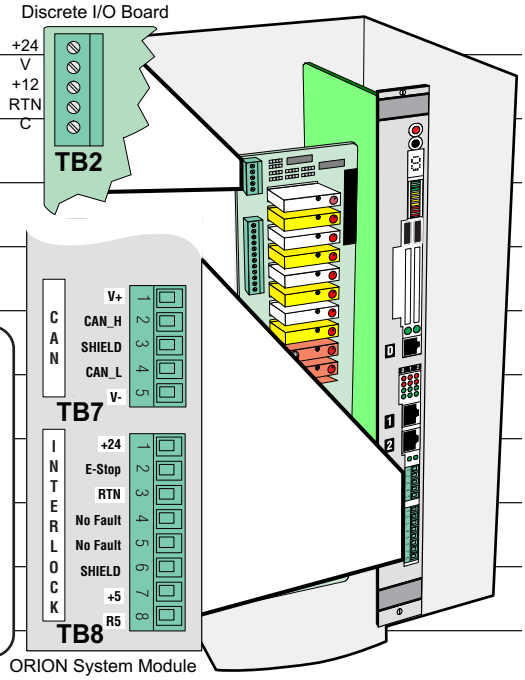
+24	VDC Field power supply from ether the optional internal power supply or a customer supplied external power supply connected to TB8-pin1.
V	Voltage connector for the I/O power Bus, this terminal is connected to all the V pins on TB3, TB4, TB5, and TB6.
+12	VDC power supply derived through a voltage regulator from the 24 VDC field power supply. Intended use with up to eleven G4-IDC-5B modules.
RTN	Return for the 24 Vdc field power supply from ether the optional internal or customer supplied power supply.
C	Common connector for I/O power bus.

OUTPUT POWER

+24 VDC to RTN on TB2 & TB8
V+ to V- on TB7[1]
1.5 Amp Max.

+12 VDC to RTN on TB2
0.5 Amp Max.

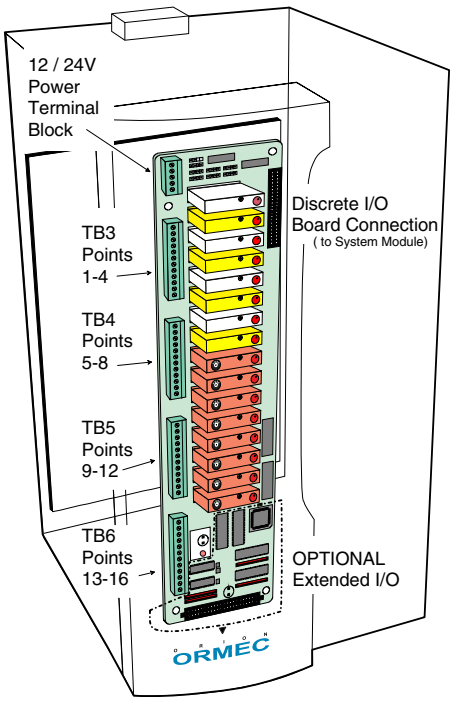
+5 VDC to R5 on TB8
1.0 A Max.



[1] TB7 (V+ / V-) Requires appropriate jumper configuration on the System Module (J47). This output is default configured disabled by jumper J47.

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ORION Discrete Input / Output board



Located behind the ORION front cover is 16 discrete I/O points using OPTO-22 Generation 4 (G4) I/O modules that have a integrated replaceable fuse and status LED.

- 16 Discrete I/O Standard see **DIO@**.
  they can be programmed to be interruptible.
- Removable or Fixed Terminal Blocks.
- Fuse Test Socket and spare holder.
- +12 VDC available at TB2.
  (Derived from optional 24 VDC supply.)

- OPTIONAL Extended I/O see **EIO.MODE@**.
  - ***"U"*** - Fixed Terminal Blocks, ... NO Extended I/O
  - ***"D"*** - Removable Terminal Blocks, NO Extended I/O
  - ***"T"*** - Fixed Terminal Blocks, ... Extended I/O
  - ***"E"*** - Removable Terminal Blocks, Extended I/O

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Notes: ORION offers configurable discrete I/O points that are integral to the controller, and provides for adding additional I/O points when needed. The **IO.MODE@** string defines the configuration of the ORION's I/O points.

Discrete I/O - ORION controllers provide from 8 to 16 Discrete I/O (see **DIO@**) points, integral to the motion controller. Each of the integral I/O points is configurable as an Input (I), an Output (O), a Rising-edge Latched Input (R), or a Falling Edge Latched Input (F).

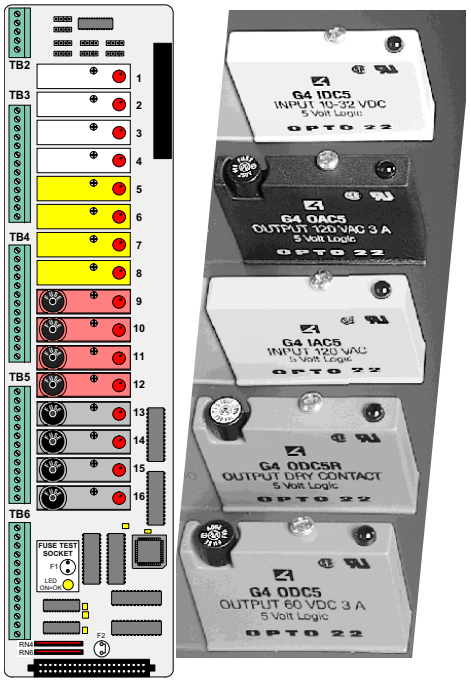
Extended I/O - ORION controllers can access, through the Extended I/O Connector (see **EIO.MODE**), up to 24 additional Discrete I/O points, mounted in an external rack. These I/O points are configurable as Input (I) or Output (O) points. Use the Unit Properties dialog box to include Extended I/O in your project.

Pamux Network - Instead of Extended I/O, the Extended I/O Connector can be used to access up to 512 Pamux Analog (see **AIO@**) or Digital I/O (see **DIO@**) points. Digital I/O points can be configured by IO.MODE@ as Discrete Inputs (I) or Discrete Outputs (O). Analog I/O points can be configured as Bipolar Analog Inputs (B), Bipolar Analog Outputs (C), Single-ended Analog Inputs (S), and Single-ended Analog Outputs (T). Use the Unit Properties dialog box to include Pamux I/O in your project.

Machine Stop and No-Fault I/O - ORION controllers running MotionBASIC 4.x or later, support up to four pairs of Emergency Machine Stop Inputs (see **MSTOP.OK@**) and Machine No-Fault Outputs (see **MFAULT@**). When not used as M-Stop and No-Fault I/O, these 8 I/O points are available as Discrete I/O. Use the MotionDESK Unit Properties dialog box to include M-Stop Inputs and No-Fault Outputs in your project.

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Discrete Input / Output Modules



ORDERING GUIDE

WHITE

G4-IDC-5	DC Input Module, 10-32 VDC & 12-32 VAC
G4-IDC-5B	DC Input Module, Fast Response, 4-16 VDC

BLACK

G4-OAC-5	AC Output Module, 12 to 140 VAC, 3 amps
G4-OAC-5A	AC Output Module, 24 to 280 VAC, 3 amps

YELLOW

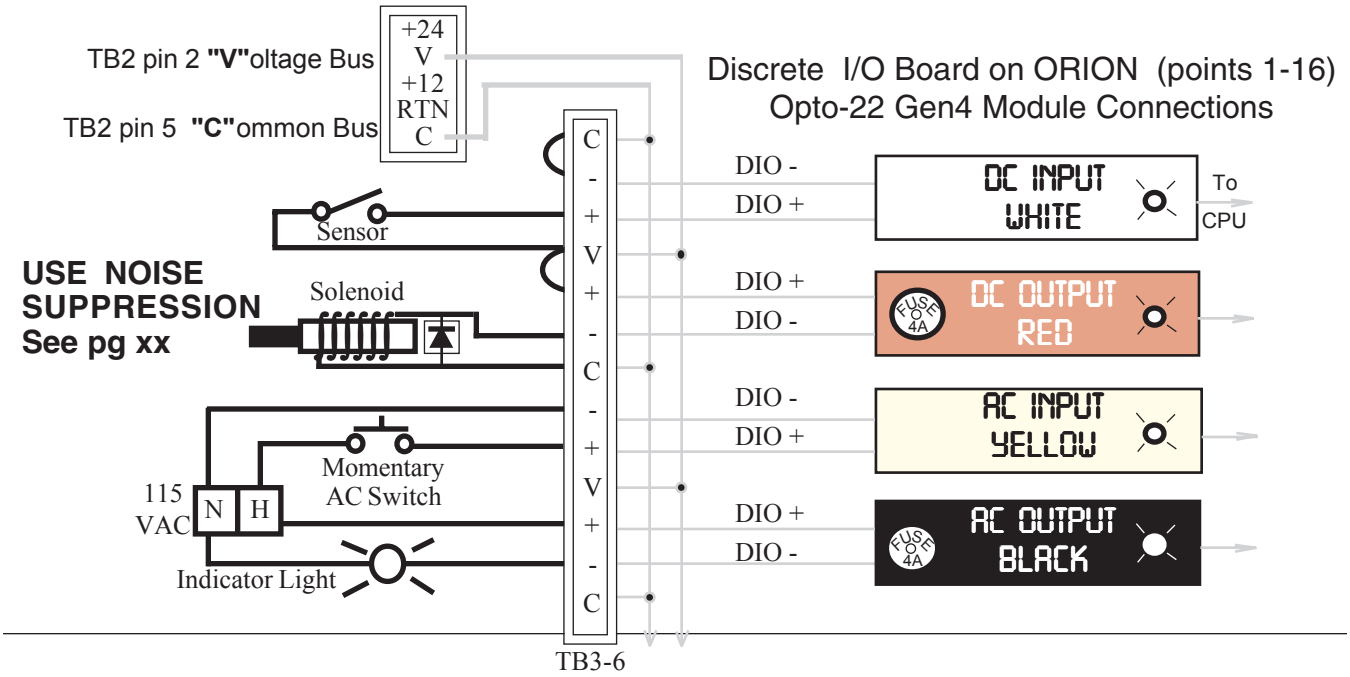
G4-IAC-5	AC Input Module, 90 to 140 VAC/DC
G4-IAC-5A	AC Input Module, 180 to 280 VAC/DC

RED	(WHITE FUSE)
G4-ODC-5R	Relay Module, N.O. contact, 100 VDC / 130 VAC Max, 0.5 amps

RED	(BLACK FUSE)
G4-ODC-5	DC Output Module, 60 VDC Max, 3 amps

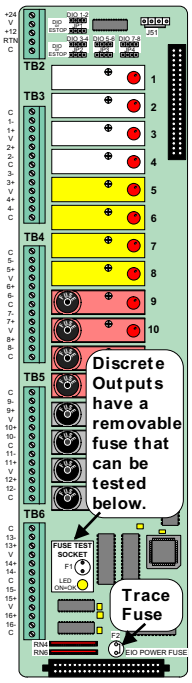
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Notes:



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ORION Trace Fuses



On the Discrete I/O board is a Fuse Test socket "F1" and spare holder.
The below list of fuses are PRE-FUSED by the circuit board trace.

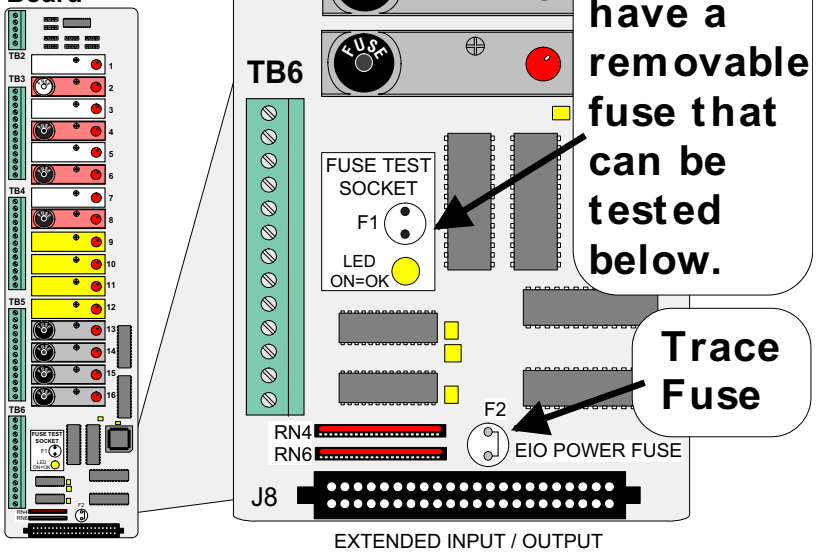
DO NOT USE A REPLACEMENT FUSE UNLESS THE TRACE IS OPENED!

"Fuse"
Discrete I/O board: .... "F2" ... Extended Input /Output , +5VDC power.

System module: ..... "F1" ... +5 VDC test at Interlock TB8 pin 7(+5) and pin 8 (R5).
System module: ..... "F2" ... E-Stop (12 to 24 VAC)or(+12 to +24 VDC) monitor voltage.
System module: ..... "F3" ... +24 VDC test at Interlock TB8 pin 1(+24) and pin 3 (RTN).
System module trace fuses are located on the solder side (back) of board.

The replacement fuse is Wickman 250V, 4 Amps. Part # 19370-062K

Discrete Input / Output Board



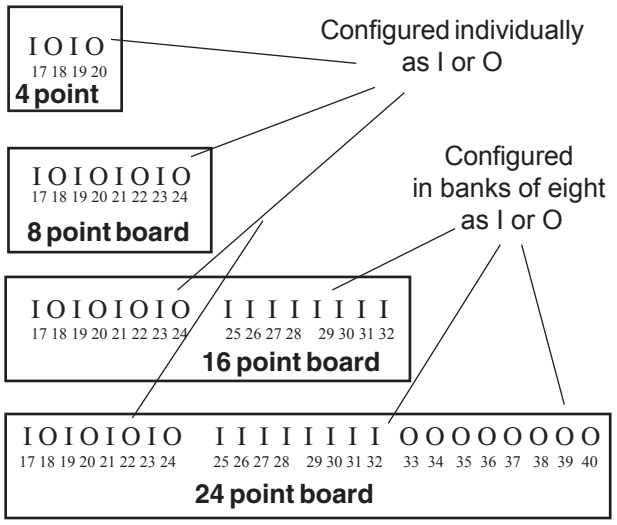
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Extended I/O vs PAMUX I/O

Extended Input / Output

EIO.MODE@=0

Connect one extension board to 24 discrete Points Maximum.

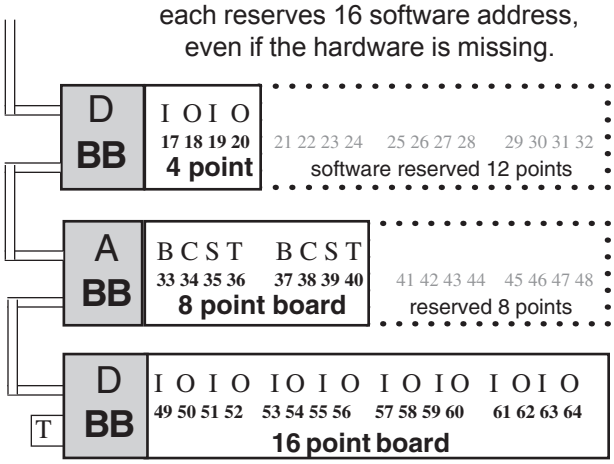


PAMUX Input / Output

EIO.MODE@=1

Connect as many 512 PAMUX Points Maximum.

Analog or Discrete Hardware:
Using Opto 22, Brainboards each reserves 16 software address, even if the hardware is missing.



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Notes: The configuration of any I/O point is done by writing to the ORMEC arrayed variable **IO.MODE@**.

When **EIO.MODE@ = 0** (Digital)

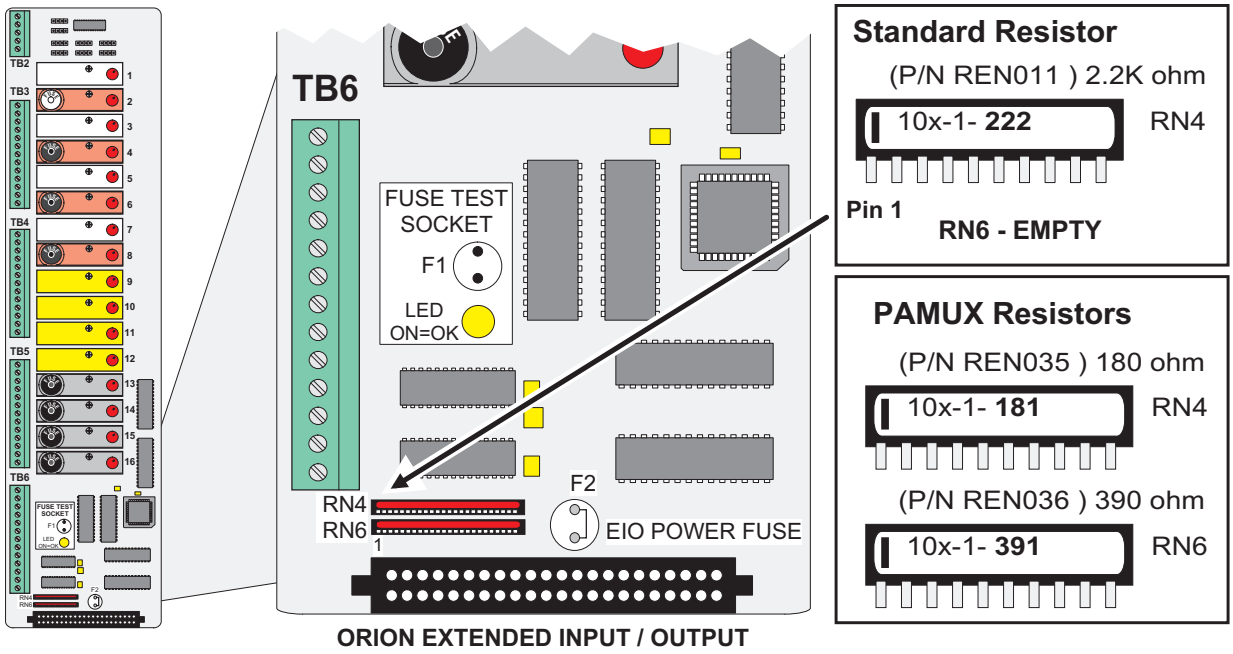
I/O points 17 to 40 provided at the Extended I/O Connector can be configured as follow:
Points 17-24 are individually configured as I or O
Points 25-32 are bank configured as either all I or O
Points 33-40 are bank configured as either all I or O Note that setting the IO.MODE@ of any point within a "bank" will change the mode of all the other points in that bank to that setting.

When **EIO.MODE@ = 1** (Pamux)

I/O points 17 to 528 are configured to align with the addresses of the selected Pamux "Brain-Boards". To calculate the AIO@ or DIO@ point number for the first point associated with a brain-board, multiply its Pamux address by 8 and add 17. e.g. The base I/O point on the Pamux brain-board with address 0 maps to I/O point 17, 2 maps to 33, etc. Subsequent points associated with that particular brain-board occupy subsequent point numbers in the array.

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Extended Input / Output board Resistors



ORION EXTENDED INPUT / OUTPUT

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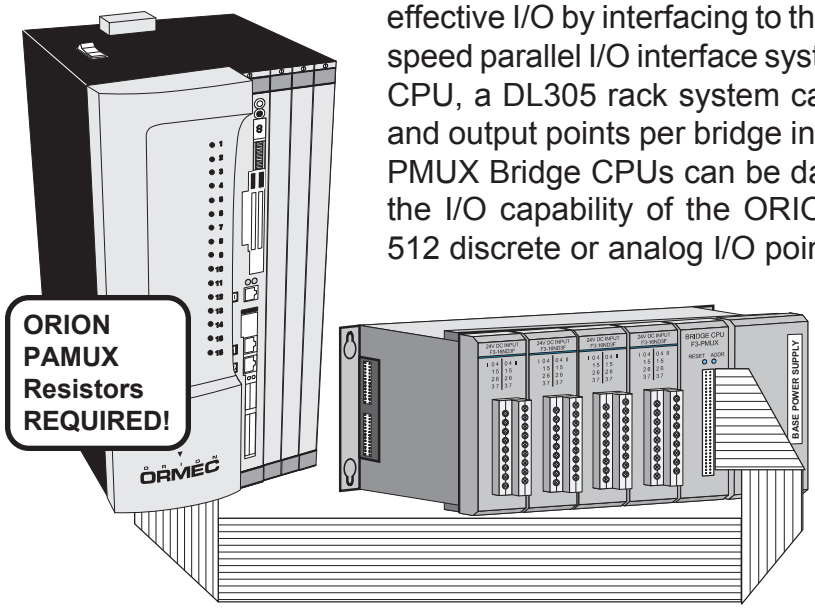
Notes: Factory configuration is for up to 24 Extended I/O points using a standard OPTO-22 I/O rack. In this configuration RN4 is a 2.2K ohm resistor and RN6 is open.

For PAMUX operation remove the 2.2K ohm resistor network (P/N REN011) from RN4 and replace it with a 180 ohm resistor network (P/N REN035). At the same time, a 390 ohm resistor network (P/N REN036) must be installed in location RN6.

Pin 1 of a resistor network being installed should be oriented with there corresponding pin 1 board locations. Pin 1 of a resistor network itself can be identified by a dot or stripe printed next to pin 1.

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Extended I/O using PLC*Direct*™



The ORION™ motion controller can provide compact and cost effective I/O by interfacing to the PLC*Direct*™ Model DL305 high speed parallel I/O interface system. Using one F3-PMUX Bridge CPU, a DL305 rack system can scan up to 128 discrete input and output points per bridge in 1.4 milliseconds. Up to four F3-PMUX Bridge CPUs can be daisy chained together expanding the I/O capability of the ORION™ Controller by an additional 512 discrete or analog I/O points.

Available front loading modules,
ANALOG 4,8 or 16 point (12 bit)
DIGITAL 8 or 16 point.

For more information see application highlights, Product Brief on PLC*Direct*™

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ORION™ Extended I/O addressing using a F3-PMUX™ CPU in a PLC*Direct*™ rack.

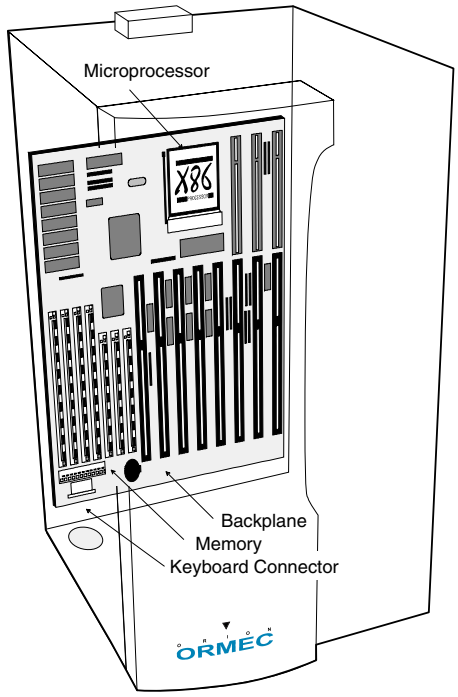
PLC*Direct* ™ TEN SLOT RACK 128 I/O points		EIGHT SLOT RACK 112 I/O points			FIVE SLOT RACK 64 I/O points. Expandable to another 5 slot rack for 128 points.					
Slot 8 I II	**Slot 7** I II	**Slot 6** I II	**Slot 5** I II	**Slot 4** I II	**Slot 3** I II	**Slot 2** I II	**Slot 1** I II	**Slot 0** I II	**Bridge** F3-PMUX CPU	POWER SUPPLY
(14) **129-136** **137-144**	*(12)* **113-120** **121-128**	*(10)* **97-104** **105-112**	*(8)* **81-88** **89-96**	*(6)* **65-72** **73-80**	*(4)* **49-56** **57-64**	*(2)* **33-40** **41-48**	*(0)* **17-24** **25-32**	Base *(address)* **0**		
(30) **257-264** **265-272**	*(28)* **241-248** **249-256**	*(26)* **225-232** **233-240**	*(24)* **209-216** **217-224**	*(22)* **193-200** **201-208**	*(20)* **177-184** **185-192**	*(18)* **161-168** **169-176**	*(16)* **145-152** **153-160**	**16**		
(46) **385-392** **393-400**	*(44)* **369-376** **377-384**	*(42)* **353-360** **361-368**	*(40)* **337-344** **345-352**	*(38)* **321-328** **329-336**	*(36)* **305-312** **313-320**	*(34)* **289-296** **297-304**	*(32)* **273-280** **281-288**	**32**		
(62) **513-520** **521-528**	*(60)* **497-504** **505-512**	*(58)* **481-488** **489-496**	*(56)* **465-472** **473-480**	*(54)* **449-456** **457-464**	*(52)* **433-440** **441-448**	*(50)* **417-424** **425-432**	*(48)* **401-408** **409-416**	**48**		

Opto 22 Pamux™ supports 32 groups of up to sixteen I/O points in each group.
ORMEC ORION™ provide access to these points by referencing the above address.
The 305 Bridge™ F3-PMUX-1 CPU assigns the base address to slot zero using jumper J10.

PLC*Direct* is a trademark of PLC*Direct* by Koyo, Inc.
Pamux is a trademark of Opto-22
Bridge CPU is s trademark of FACTS Engineering, Inc.

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ORION x86 based Motherboard



Typical layout of an ORION controller motherboard, uses industry standard X86 family of microprocessor.

- Microprocessor Selection:
  - ***A*** - 80486, ... 66 MHz
  - ***B*** - 80486, ... 100 MHz.
  - ***C*** - 80586, ... 133 MHz.
  - ***D*** - Pentium ..... 133 MHz.
  - ***E*** - Pentium ..... 233 MHz.

  Pentium available on Model 30 only and requires an ORION-Sys Module version K (or later), and MotionBASIC Ver 4.1 (or later).
- 4 Mbytes DRAM Standard.
- 256 Kilobytes cache memory Standard.
- Real Time Clock and Date.
- Keyboard connector.

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Notes:

ORION™ Motion Controllers

The ORION™ motion controllers feature high performance computing capability. Using the industry standard family of X86, 32-bit processors with five speed options, provides cost-effective power for multi-axis applications.

Intensive math calculations performed in MotionBASIC® take advantage of the DX processor's high-speed integral floating point hardware.

Memory access speed adds to the performance of the controller. The memory bus is 32 bits wide featuring four megabytes of DRAM and 256K byte cache memory to enhance access speed between processor and memory.

Open PC Bus Standard

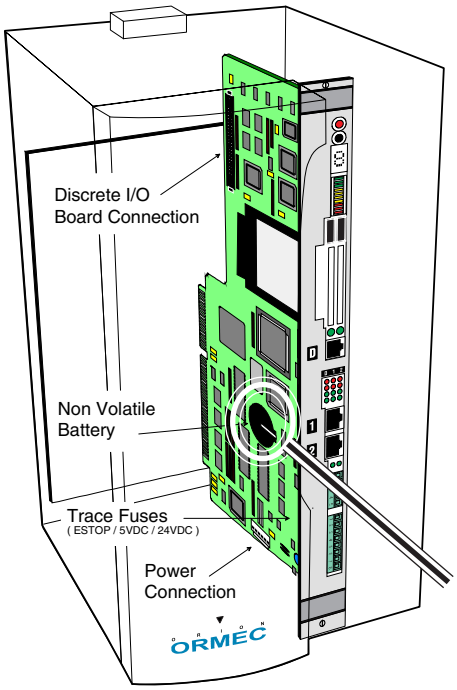
Use of the 16-bit ISA PC bus standard provides an effective platform for building multi-axis motion control systems. PC/AT ISA bus expansion slots interface to Axis Module(s) plus adapters for factory network connectivity.

An industry standard PC BIOS is installed for booting the operating system to RAM from flash memory and performing power-on system testing for the motherboard backplane.

Battery-backed time and date hardware is used to log application events during system operation and for DOS file directory updates.

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ORION System Module



The ORION System Module is what transforms a PC into an industrial-hardened motion controller.

- Safety features:
  Watchdog timer, E-STOP Input, No-Fault Relay Output.
- System Diagnostic LED's.
- Dual PC Card™ drive slots.
- RS-232 Development port.
- RS-485 (2) Serial Communications ports.
- Battery-backed memory (ORN-BAT).
  NOTE: Battery removal will erase...
  MotionBASIC Ver 4.x - Non-Volatile memory.
  MotionBASIC Ver 3.2 - Non-Volatile memory and your application program.

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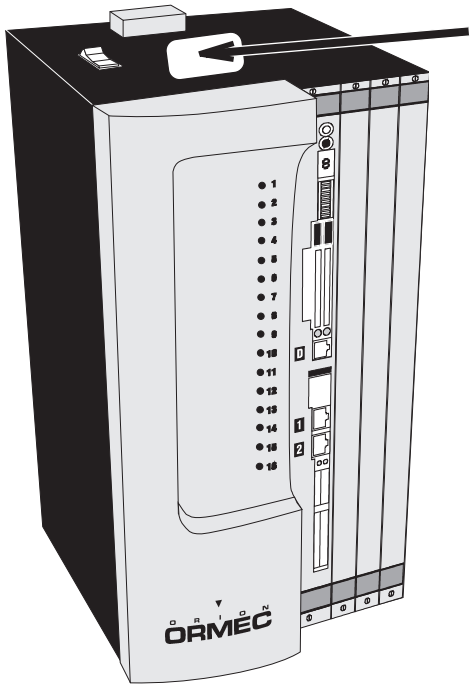
Notes: The System Module integrates a number of important features for industrial control into ORION™.

- **Safety features:** Fail-safe, "Emergency Stop" input and the "No Alarm" output, which is a normally-open, held-closed relay contact. Overall system integrity and safety are preserved by the fact that the No Alarm relay contact is held closed only if there is current in the input circuitry of the Emergency Stop input and the main processor continues to regularly strobe the on-board Watchdog Timer circuitry. System integrity is further insured by individual watchdog timers on each axis module, open-wire detection from each motor's position feedback, and fail-safe, optically-isolated "No Alarm" interfaces to each servodrive.
- **System Diagnostic LED's:** Ten status LEDs and a single-character, alphanumeric display provide diagnostic indication of alarms, faults and operating status. Additionally, four status LEDs for each serial port simplify communications troubleshooting.
- **Dual PC Card™ slots** (ATA-PCMCIA) provides access to memory that is non-volatile, removable, compact and reliable. A Type II slot is provided for the MotionBASIC® System Card using Flash RAM which normally includes all operating system and user software. A Type III slot provides the ability to add a second memory card or hard drive.
- **Development Port** RS-232 is used to communicate with an PC running ORMEC's MotionDesk™ software.
- **Two RS-422/485 serial communication ports** can be used to interface the ORION™ controller to a touchscreen or industrial terminal and/or provide connectivity to a Modbus™ factory network or Allen-Bradley SLC-500 PLCs.
- **Battery-Backed Memory:** 32K bytes can be used for non-volatile MotionBASIC variables, which are kept intact while power is off and available when the system is back on-line.
- **Reset push-button** clears faults and automatically reloads the interrupted program from Flash memory.
- **Push-button one** (PB1) allows the user to control program loading from the front panel.
- **CAN interface** is provided for future connectivity. Consult ORMEC for details.

PRINT HDW.REV@ ... will print to the development port, the hardware revision number. To cross reference the HDW.REV@ code, read the Orion Motion Controller Manual. Example "S:6000" would correspond to Version "G" System Module.

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ORION Model Numbers



ORN - 30 / A F D

- ORION™ Model (Model 30, 50 or 70)
- Microprocessor Selection
  - **A** .... 80486 - 66 **B** .. 80486 -100
  - **C** .... 80586 -133 **D** .. Pentium 133
  - **E** .... Pentium 233
- I/O Power Supply
  - **F** ..... 24 VDC power supply
  - **X** .... No 24 VDC power supply
- Type of Integral Discrete I/O Board
  - **U** ..... Fixed terminal blocks, ... No Extended I/O support
  - **D** ..... Removable TB's, ... No Extended I/O support
  - **T** ..... Fixed terminal blocks, ... Extended I/O support
  - **E** ..... Removable TB's, ... Extended I/O support
- Other options
  - **H** .... Cooling fan, raises max operating temperature
  - **S** .... Delete CAN interface hardware

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Notes: **ORION Factory Upgrades:** Several Factory Upgrade packages are available.

Controller Factory Upgrades:

Upgrade the Unit w/ a new processor, Add a field power supply, Change the I/O board, Add a cooling fan.

Board Level Factory Upgrades:

Upgrade System Modules for use with the Pentium (included w/ unit processor upgrade).
Upgrade DSP Modules for use with the Pentium (included w/ unit processor upgrade).
Add DSP Module analog input option.
Add DSP Module delay counter chip option.
Add DSP Module absolute encoder backup battery support.

ORION Controller Field Upgrade Kits:

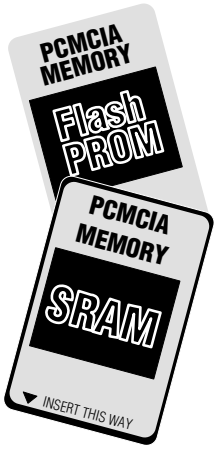
Several Field Upgrade packages are available:

Add a +24 Vdc field power supply.
Change the I/O board.
Add a cooling fan.

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PC CARD Memory

There are two types of optional PCMCIA Memory Cards.
User Programmable Read / Write Storage for programs & data.
Called **PC Cards** on the ORION controller "ATA-PCMCIA" type.



FLASH (inherently nonvolatile)
PCC-FLASH/#
Various sizes available 4,6,10,20,40,85 Mbytes

SRAM (battery nonvolatile)
PCC-SRAM/ #
Various sizes available 1,2,4 Mbytes

PCC-DISK/260 ... Mbytes
PC Card Hard Drive

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Notes: **PC Card Memory** plugs into the front of the motion controller. They provide installation and maintenance of program files, and they support the use of data files.

There are two types of Memory Cards:

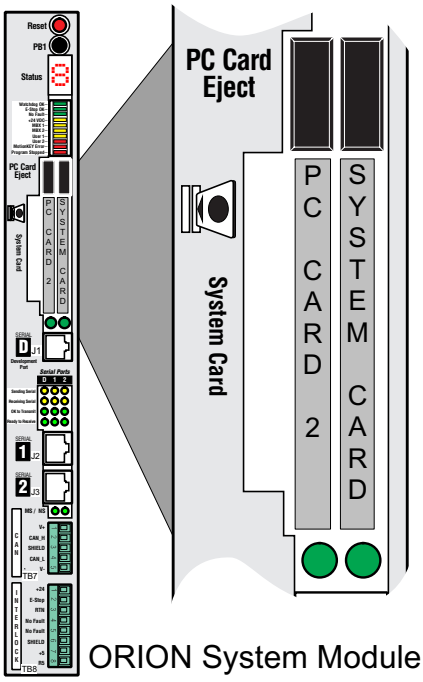
Flash Memory Cards provide Read / Write memory that is inherently nonvolatile. No batteries are required. Write speeds are similar to traditional disk drives; Read speeds are similar to RAM drives.

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

Memory Cards must be formatted with the FORMAT command prior to use.

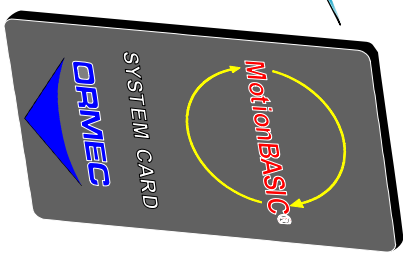
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System Card, part number PCC-SYS/#



ORION System Module

System Card required on right external slot. (Keyed) Standard "ATA-PCMCIA" and contains:



Hidden Files:
- *MS DOS,*
- *MotionBASIC® Operating System*
- *MotionBASIC® Program Buffer and*
- *MotionBASIC® extensions (MBX's)*
  - *add functionality to MotionBASIC®.*
  - *Example: Communications*

User Programmable:
- About 4 Mbytes (standard) are available for storage for programs & data.

Flash Memory compressed and available sizes are
6,9,16,32,64,136 Mbytes

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Notes: When the Green LED is ON or Flashing, it indicates that the controller is accessing the PC Card™. (Disk drive access light.) **Do not remove card when LED is ON.**

MotionBASIC Power up Operation:

MotionBASIC Ver 3.2 If the program contains a line 0, then indirect program execution begins immediately, at line 0.

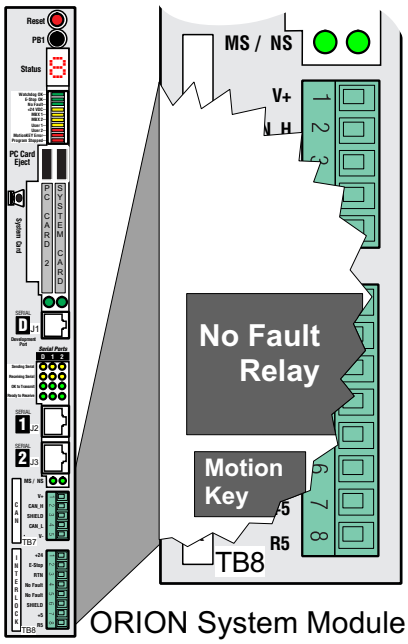
MotionBASIC Ver 4.x If the program contains the subroutine **MAIN:**, program execution begins immediately at MAIN

Important: The Program Buffer is stored on the System Card, and will remain with the System Card if it is moved to another ORION Motion Controller. ***NOTE: A System card running MotionBASIC 3.2, Battery removal will erase your MotionBASIC 3.2 application program.***

MotionBASIC System Card part number PCC-SYS/0006. MotionBASIC System Card, Flash RAM, the part number reflects the size. 0006 Mbytes.

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Security Key & Credits, part number ORN-KEY/#



ORION System Module

WARNING:
Removing or Installing a MotionKEY with power applied to the ORION controller will damage the MotionKEY!

See MotionKEY Installation in the ORION Manual.

Your ORION motion controller will not enable motors if a MotionKEY with less than the required number of MotionCredits is installed on the ORION System Module.

Error #1920: MotionCredit Verification Failure.
Power up Fault@=12 , "F12" on Status LED.

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Notes: Located on the system module is a security key device (black chip). This device is used to store information that regulates the operation of software distributed with ORION Motion Controllers. Each security key is ordered with a certain number of "Motion Credits", depending on customer requirements. MotionBASIC and/or MotionBASIC Extensions, "MBX" will, require a certain number of Motion Credits be available in order to run a motor.

The MotionKEY part number, is the number of installed MotionCredits on the KEY.

Part Number Example: **ORN-KEY/0600,** has six hundred installed.

Your ORION motion controller will not enable motors if a MotionKEY with less than the required number of MotionCredits is installed on the ORION System Module. Error #1920: MotionCredit Verification Failure.

MBX Credits Required for MotionBASIC 5.0 and earlier.

ABE	500	Allen Bradley Ethernet
DF1	300	SLC-500 communication.
DH	500	Datahighway communication
GE	500	GE Genius
MAP	*None*	Mapping for communication.
MDB	300	Modbus communication.
PFB	300	Profibus
QE	400	Quantum Ethernet - (Modbus/TCP)
QP	200	QuickPanel operator display.
S908	500	S908/Modbus communication.

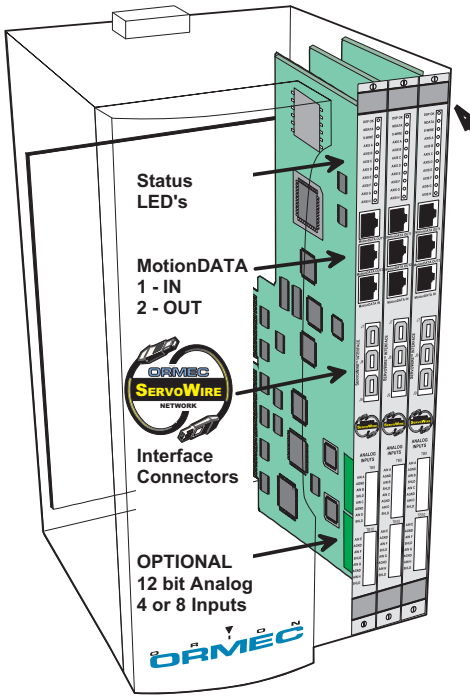
MotionBASIC Credits Required

MB	600	MotionBASIC Ver 3.2 or 4.x
ServoWire Drive	275	Each ServoWire Drive - MotionBASIC Ver 5.x
ServoWire Pacer	*None*	*No MotionCredits required for using a Pacer Encoder.
ServoWire Virtual	*None*	*No MotionCredits required for using MotionDATA generators.

*Note: Pacer Option hardware on ServoWire Drive required.

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ServoWire™ Axis Module



Digital ServoWire™

Used with MotionBASIC Ver 5.x and later.

Model Number Label Location.

- Servomotor Control:
  ORN-SW-AM/x ... ServoWire Axis Module.
- OPTIONAL Selections:
  0 ..... No Analog to Digital Input.
  4 ..... Four channel 12-bit Analog inputs.
  8 ..... Eight channel 12-bit Analog inputs.
- ServoWire™ Cables:
  CBL-SW/ # ..... 1,2,6,14 feet

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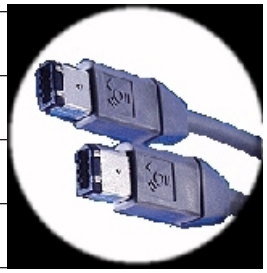


ORMEC's ServoWire Drive Network uses IEEE-1394 communications to bring a new level of performance to networking servodrives. All-digital operation simplifies drive setup and eliminates physical settings (jumpers, potentiometer adjustments, etc.). All motion control & drive parameters are software-driven. No off-line computer setup required—simplifying field replacement of drives.

The ServoWire Axis Module plugs into an ORION Industrial PC-based controller, and supports up to eight servomotors and drives. (An ORION System can support up to 32 axes.) ORMEC's line of ServoWire drives easily connect to ORION utilizing inexpensive, thin serial cables defined by the IEEE-1394 standard. ServoWire drives feature sinusoidal commutation, smart IGBT power blocks and totally software configurable operation. Drive I/O provides high speed sensors, hardware overtravel switches and programmable limit switch outputs.

The ServoWire™ Drive Network provides a high-speed (200 Mbps), real-time, serial communications link between ORION® ServoWire Axis Module and servodrives/motors. This high response, digital control network supports servos, pacer encoders, high speed sensors, I/O and programmable limit switches -- offering performance, flexibility and ease of use.

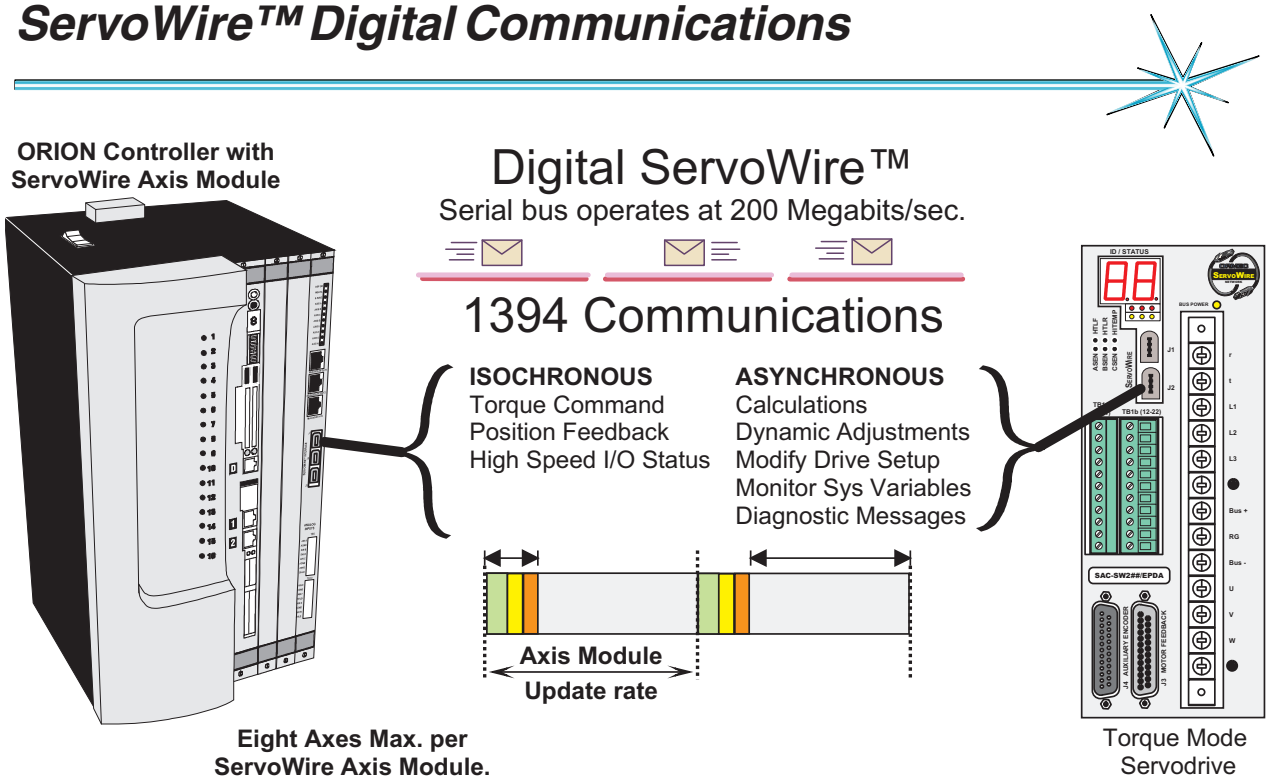
Servo loops are managed in real-time over the bus, implementing a digital torque control network for up to 8 axes. Actual torque commands to the drives are transmitted digitally as 16 bit variables, eliminating the cost and limitations of traditional 12-bit, D-to-A converters and analog torque signals.



The cable and connector design are also part of the IEEE-1394 open standard … and are essential technology to delivering the high-speed serial bus communications. Highly engineered and reliable, the cables and connectors are patterned after those made by Nintendo for their Gameboy units.

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ServoWire™ Digital Communications



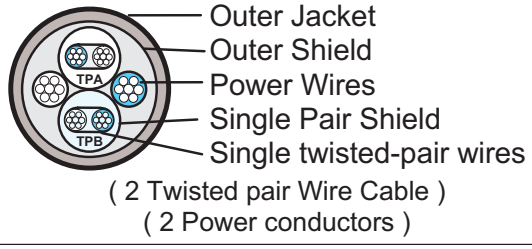
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Notes: First developed under the name FireWire by Apple Computer in 1985, the new network came under the direction of an IEEE Working Group in 1989. IEEE-1394 is an serial bus that offers a high-bandwidth, digital-to-digital interface.

Isochronous transfers guarantee real-time information is "absolutely, positively" delivered at a predetermined rate, especially important for just-in-time delivery of data such as time-critical servo loop updates.
The ServoWire protocol allocates network bandwidth for each servo on the network to guarantee timely transmission of torque commands, position feedback, and high-speed Inputs and Outputs (I/O) status during each loop update for all drives in a ServoWire network. Including high-speed I/O in the isochronous data channel guarantees that the ServoWire Axis Module can always drive or respond to high-speed I/O on the next loop update.

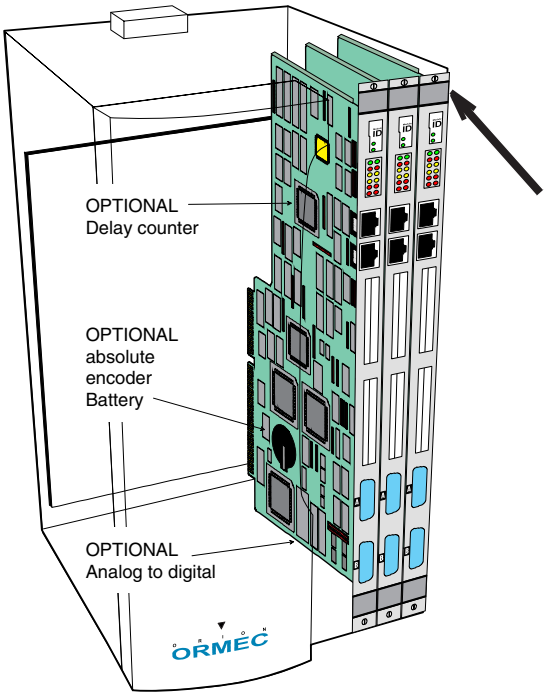
Asynchronous communications, the second type of data transfer supported in 1394, provides a mechanism for flexibly managing real-time command and status communications on the network. Upon completion of all isochronous transfers in each loop update, the remaining bandwidth is available for asynchronous transfers.
Asynchronous communications can be used to:
enable or disable the drive, dynamically adjust tuning parameters , modify drive setup, monitor system variables in real-time, transfer diagnostic messages and reset errors and more.

Standard 1394 cables contain two power conductors, and two twisted pairs (TPA and TPB) for data signaling. Each signal pair is shielded and the entire cable is shielded. Cable power is specified to be from 8 to 40 VDC at up to 1.5 amps and is used to provide interface power for drives connected to the bus.



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DSP Model Numbers



Digital Signal Processor

Used with MotionBASIC Ver 3.2 and 4.x

Model Number Label Location.

- Servomotor Control $1^1/_2$ & 2 axis versions:
  ORN-DSP-AQ/x ... Single Axis with Pacer input.
  ORN-DSP-A2/x ... Dual Axes DSP.
- OPTIONAL Selections:
  0,1,2 ..... Number of Terminal Blocks.
  A ..... Four Analog inputs.
  D ..... Delay counter chip support.
  B ..... Absolute encoder battery backup.

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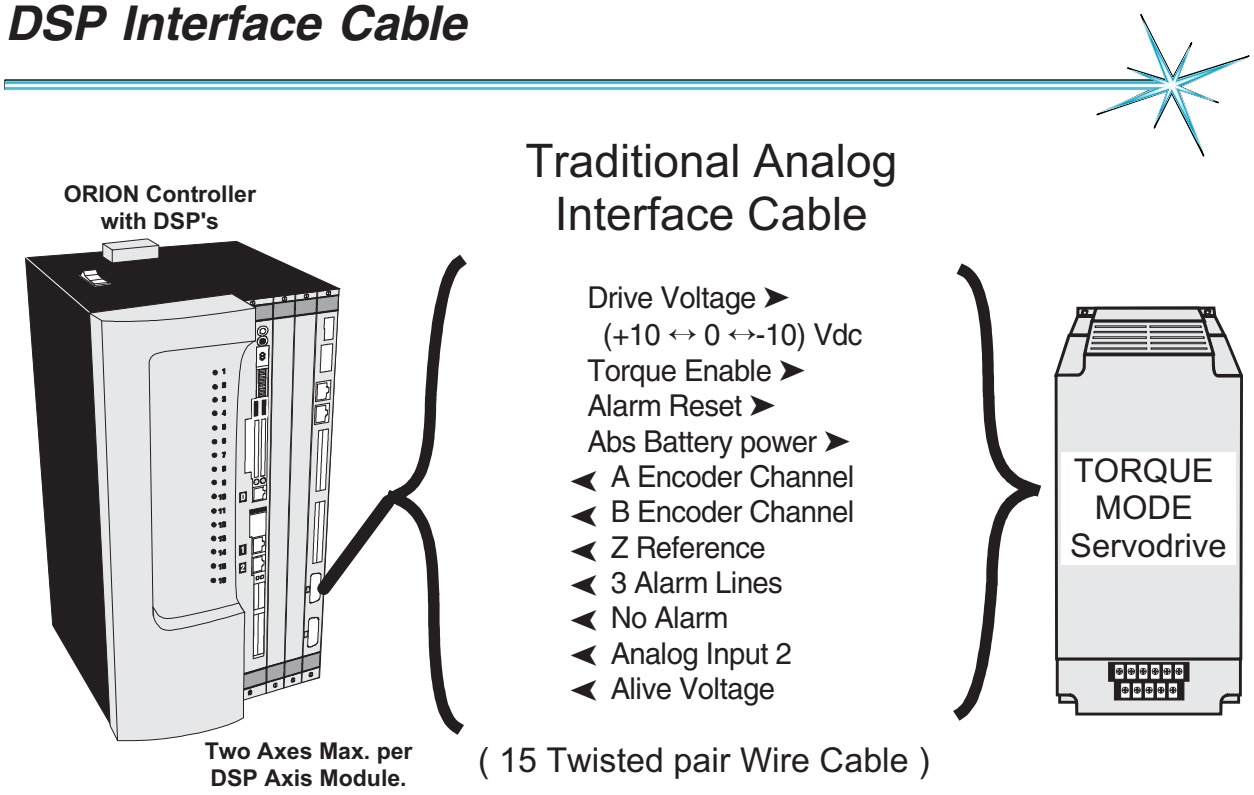
Notes: ORION DSP Axis Modules utilize the Digital Signal Processor (DSP) technology to implement all digital high performance motion control. Each DSP communicates with the main processor through an on-board shared memory interface. It implements servo control loops utilizing discrete signal processing algorithms that eliminates the need for analog circuitry.

In addition to a wide variety of advanced motion control software features, DSP Axis Modules also provide:

- ◆ individual interfaces to each servodrive and/or axis encoder;
- ◆ electronic gearing via the MotionDATA communications link;
- ◆ an optional delay counter (DELAY@) per axis; and
- ◆ Inputs & Outputs interfaced via a DSP I/O Terminal Block:
  - two optional 12-bit analog inputs (AIN1@ & AIN2@) per axis.
  - two hardware overtravel limit inputs per axis
  - three electronic limit switch outputs per axis (TTL compatible)
  - six high speed inputs (ASEN@, BSEN@, two ZREF@ & two EXTZ)

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DSP Interface Cable



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OUTPUTS:

DRIVE VOLTAGE - 12-bit analog output used to command full-scale servomotor output torque or velocity.

TORQUE ENABLE - This optically isolated output is turned ON (asserted) to enable servodrive output torque.

ALARM RESET - This open collector optically isolated output is turned ON (asserted) to reset servodrive alarms.

ABSOLUTE ENCODER backup battery 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.

INPUTS:

ENCODER CHANNEL A and B - Encoder Channels are differential inputs which provide one of two quadrature square wave signals (A and B) 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.

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.

3 ALARM LINES - provide a "servodrive alarm code" that provides the user with servodrive diagnostic information.

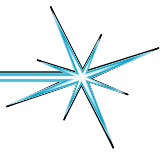
NO ALARM - This input from the servodrive must be asserted, indicating that the servodrive has no alarms. If this input is not asserted, then the ORION controller will detect a servodrive alarm fault, open the *No Fault Relay*, and report the fault through MotionBASIC.

ANALOG INPUT 2 - This is one of two optional 12-bit analog inputs.

ALIVE VOLTAGE - 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.*

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Maintenance LAB 1 Verifying Model Numbers and Voltages

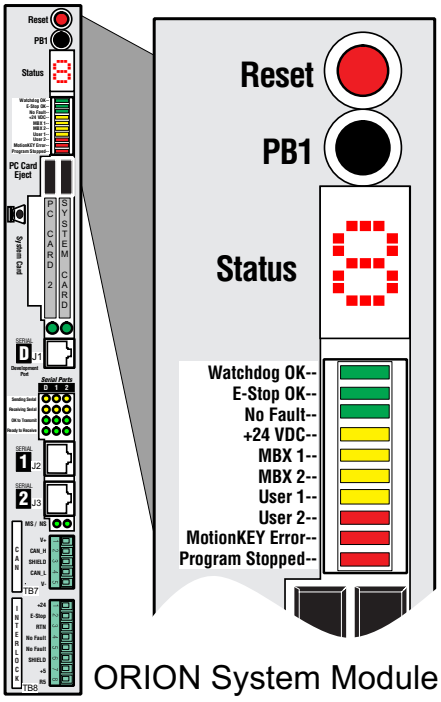


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Notes:

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Status LEDs



ORION System Module

5x7 Status Display

The ORION Status Display is a red, 5x7 alphanumeric status indicator. Once a user program starts execution, the display will be blank.

Status LEDs when lit indicates the following:

Watchdog OK	Green	Motherboard Processor is alive, flashes 1/sec.
E-Stop OK	Green	24 Volts is present at Terminal Block TB8 E-Stop.
No-Fault	Green	The controller has no faults. FAULT@=0
+24 VDC	Yellow	Power is present at TB8 +24 and referenced to RTN.
MBX1	Yellow	MotionBASIC® Extensions, Under MBX control.
MBX2	Yellow	MotionBASIC® Extensions, Under MBX control.
User 1	Yellow	User LED's indication, Under program control.
User 2	Red	User LED's indication, Under program control.
MotionKEY Error	Red	MotionKEY is missing or insufficient credits.
Program Stopped	Red	MotionBASIC® program not running. In Direct Mode.

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Notes: **5x7 Status Display** After initialization, (boot-up about 20-30 seconds) all of the above status LEDs will turn on, then one by one they will turn off, then the ORION Status display will print the MotionBASIC® Version and any installed MBX's.

Example: "M", "B" , "3" , "." , "2", "a" ..... for MotionBASIC Ver 3.2a

Example: "M", "B" , "4" , "." , "0", ".", "1" ... for MotionBASIC Ver 4.0.1

ORION running **MotionBASIC** will work with **MotionDESK:**

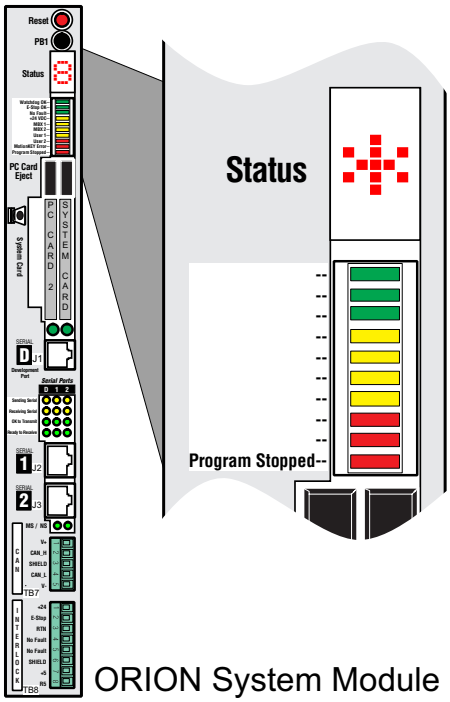
	Ver #	Ver #
May 2000	5.1	3.1
June 1999	5.0	3.1 3.0
Aug 1998	4.1	3.1 3.0, 2.1
July 1997	4.0	3.1 3.0, 2.1, 2.0

ORION running **MotionBASIC** will work with **MotionPRO**:

	Ver #	*Ver #*
Jan 96	3.2	2.2

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Status Display E and F codes



ORION System Module

When a user program terminates normally, the program stopped LED will turn on and the status display will revert back to the Direct Mode starburst.

If a user program terminates due to an error and enters direct mode, the program stopped led will turn on and the display shows the pertinent error code.

Example: "E", "1" , "8" , "0" , "5" ... for

Error # 1805 Ctrl-Break Detected .

This error occurs when the MotionDESK "Abort icon" is pressed or CTRL-Break keystroke is read from the Serial Development port. MotionBASIC reacts differently to this Error, depending on whether a program is running or not.

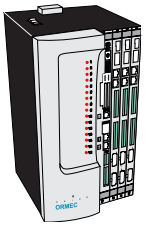
ORMEC SYSTEMS CORP *INSTITUTE FOR ADVANCED MOTION CONTROL TECHNOLOGY*

Notes:

If Faults exist at power up, the ORION Status Display shows the pertinent Fault codes, in the form "Fn Fn ...", where Fn represents each FAULT@ bit that is set.

Example: "F" , "2" , "F" , "1", "2" ... for FAULT@={2,12} see below list.

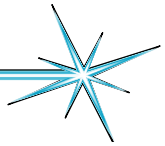
FAULT@ ... Unit Fault Code. Set of current fault(s) with a motion controller.



Code	Fault Condition	Code	Fault Condition
1	RAM Checksum Error	9	String Space Fault
2	Battery Failure	10	MotionCARD Fault
3	Not used	11	Not used
4	Internal Error	12	Security Key Fault
5	Axis Module Failure	13	DSP not Pentium Compatible
6	E-Stop Input Open	14	ServoWire network fault (MBv5)
7	Axis Fault	15	Incompatible Project File (MBv5)
8	Machine Fault		

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Status Display Error Codes



1- 999: User Defined Errors

User defined errors are errors generated by the user program with an ERROR statement. It is recommended that unique user generated errors utilize error numbers from 1 to 999 to prevent possible overlap with future releases of MotionBASIC®.

1000 - 1099: Syntax Errors

Syntax errors are caused by an incorrect, unexpected, or missing keyword, parameter, or delimiter. They can be fixed by editing the program at the line that the error exists.

1000: Syntax error
1001: Invalid line number
1002: Missing subscript
1003: Read-only variable
1004: MOVE syntax error
1005: Error in data
1006: Expected command
1007: Garbage after statement
1008: Too many parameters
1009: Not enough parameters
1010: Expected expression
1011: Expected user variable name
1012: Expected variable name

1014: Expected a number
1015: Expected a line number or label

1017: Expected comma
1018: Expected comma or semicolon
1019: Expected semicolon
1020: Expected left paren
1021: Expected right paren
1022: Expected equal sign
1023: Expected GOTO
1024: Expected THEN
1025: Expected TO
1026: Expected ON, OFF or STOP
1027: Expected a numeric variable
1028: Expected an EVENT input signal
1029: GEAR syntax error

1031: Expected IN or AT to specify gear ratio
1032: Expected a string variable
1033: Invalid user variable or resource

1100 - 1199: Program Structure Errors

Program structure errors are caused by an unexpected or missing statement. They can be fixed by adding, deleting, or changing a line in the program.

1101: Missing equal sign or undefined line number/label
1102: FOR without NEXT
1103: NEXT without FOR
1104: GOSUB without RETURN
1105: RETURN without GOSUB
1106: WHILE without WEND
1107: WEND without WHILE
1108: ELSE/ELSEIF without IF-THEN block
1109: Missing ENDIF
1110: RESUME without error
1111: Out of data
1112: Excess data
1113: Function not found
1114: Duplicate definition
1115: Block structure must be the first statement
1116: Missing FIELD statement

1117: Statement cannot be nested
1118: Statement not allowed inside a FOR loop
1119: Statement not allowed
*1120: Unexpected end of module
*1121: RESUME without thread
*1122: CANNOT END AN ERROR THREAD
*1123: RETURN from EVENT cannot specify a label

*1199 Statement not allowed during SEIZE with time-out

*Indicates an Error neither present nor relevant in MotionBASIC prior to version 4.x

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Status Display Error Codes

1200 - 1299: Expression Errors

Expression errors are caused by a numeric or string value out of range, or an incorrect variable type. They can be fixed by changing the value, or type of variable/constant.

1201: Illegal function call
1202: Numeric overflow
1203: Subscript out of range
1204: Division by zero
1205: Type mismatch
1206: String too long
1207: String formula too complex
1208: Numeric underflow
1209: Invalid numeric operation
1210: Precision error
1211: Integer division by zero
1212: Parameter out of range
1213: Expected string
1214: Expected integer
1215: Expected long
1216: Empty string
1217: Function evaluation error
1218: Range error from INPUT@ high limit
1219: Range error from INPUT@ low limit
1220: Expected a positive number
1221: No such Ormec variable
1222: Array not dimensioned

1224: Expected set
1225: Invalid set element
1226: Record length exceeded
1227: Invalid FIELD variable
1228: NV prefix too long
1229: Cannot change NV prefix
1230: Illegal NV variable type
*1231: Invalid thread ID
*1232: Uninitialized Variable

1300 - 1399: I/O Errors

I/O Errors are caused by an error during an attempted I/O operation. They are not caused by an error in the I/O statement itself.

1301: File not found
1302: Cannot create file
1303: Input past end
1304: Bad filename
1305: Direct statement in file
1306: Invalid baud rate
1307: Cannot open device/file
1308: Device/File already open
1309: Device not open
1310: Device write failed
1311: Cannot close device
1312: Device read failed
1313: Illegal discrete I/O statement
1314: Device not opened for writing
1315: Device not opened for reading
1316: EIO.MODE@ not set for Pamux
1317: Time-out during AIO access
1318: Illegal analog I/O statement
1319: Invalid IO.MODE@ configuration
1320: IO.MODE@ for Pamux write only
1321: Too many timed DIO@ pts active
1322: No PC Card installed

1324: PC Card is write protected
1325: Invalid path
1326: Disk full

1329: File save failed
1330: PC Card may contain data
1331: Unable to FORMAT PC Card

1334: Bad file mode
1335: Device seek failed
1336: ITM-270 Communications Failure
1337: Path/File Access Error
1338: Cannot open protected file
1339: Disk is full
1340: Cannot format a system card
1341: Invalid drive specified
1342: System card not found
*1343: Changing baud not allowed with TCP/IP
*1344: Cannot configure I/O for M-Stop operation
*1345: M-Stop configuration conflicts with hdw
*1346: I/O pair not configured M-Stop operation
*1347: I/O point configured for M-Stop operation

1400 - 1599: (Reserved)

*Indicates an Error neither present nor relevant in MotionBASIC prior to version 4.x

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Status Display Error Codes

1600 - 1699: Motion Errors

Motion errors are caused by a situation preventing the completion of a motion as prescribed by the motion statement.

1601: Velocity out of range
1602: Accel or decel out of range
1604: Illegal motion sequence
1606: Invalid axis ID
1607: Axis mode is incorrect
1608: Fwd software travel limit
1609: Rev software travel limit
1610: Illegal while DSP busy
1612: Specified gear ratio is out of range
1614: Fwd hardware travel limit
1615: Rev hardware travel limit
1616: DSP queue too full for REPEAT
1617: Hardware travel limit Configuration Error
*1618: Project file contains non-existent axis id
*1619: Invalid Motion ID
*1620: Duplicate Motion ID was specified
*1621: Cannot Prepare Motion
*1622: Out of Motion Memory on Axis
*1623: Incompatible Prepared Motion
*1624: Unprepared Motion ID
*1625: Specified axis ID not in project file
*1626: Blend would exceed last target distance
*1627: Blending distance illegal during final decel
**1628: Over temperature condition exists
**1629: Temperature sensor configuration error
**1630: Brake mode is incorrect"
**1631: Not supported for auxiliary axis"

1700 - 1799: (Reserved)

1800 - 1899: System Errors

System errors are caused by a system or hardware limitation, incorrect mode, etc.

1801: Out of memory
1802: Illegal direct
1803: Out of string space'
1804: Cannot continue
1805: ABORT or Ctrl-Break detected
1806: Input buffer overflow
1807: Too many levels of nesting
1808: Illegal indirect
1810: Program buffer write protected
1811: Token buffer overflow
1812: Illegal while FAULT@ is non-zero
1813: Illegal while ESTOP.OK@ is False
1814: Illegal while AFAULT@ is non-zero
1815: MotionDATA not available
1816: Program buffer read protected
1817: Out of NV memory
1818: No NV memory installed
1819: Out of program memory
*1820: Function/Command Not Supported
*1821: Too many HOLDs without a RELEASE
*1822: RELEASE without HOLD
*1824: HOLD.CNT@ is non-zero when SEIZEing
*1825: Could not create a thread
*1826: Illegal Operation using D-Mode Thread ID
*1827: Thread state must be STOPPED
*1828: Illegal while MSTOP.OK@ is FALSE
*1829: Illegal while MFAULT@ is non-zero
*1830: No Type change from EVENT to ERROR
*1831: No Type change from ERROR to EVENT
*1832: Thread already assigned another EVENT
**1833: MotionData Configuration Error (MB 5.1)
**1834: ServoWire Communications Time-out
**1835: Unsupported Option Error
**1836: MotionDesk/MotionBASIC Incompatibility. No FTP Allowed.

*Indicates an Error neither present nor relevant in MotionBASIC prior to version 4.x
**Indicates an Error neither present nor relevant in MotionBASIC prior to version 5.x

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Status Display Error Codes

1900 - 1999: Controller Fault Errors ... NO FAULT relay will open.

System errors are Caused by a hardware limitation of the controller. 1900-1909 are reserved for user generated controller fault errors, which permits the user to issue an error which opens the no-fault relay. The user generated controller fault error is reported in the FAULT@ variable bit 8... Machine Fault.

1910: E-Stop OK input open
1911: Axis fault
1912: Internal error
1913: DSP axis module failure
1914: String space corrupted!
1915: Incompatible MBX version
1916: MBX out of memory

1918: MBX not installed
1919: Checksum Error
1920: MotionCREDIT Verification Failure
*1921: M-Stop OK input open
**1922: ServoWire network fault

1998: Watchdog time-out
1999: Temporary power loss

9000 - 9999: MBX Errors

Although not strictly a part of MotionBASIC, but rather associated with typical MotionBASIC Extensions, MBX's, the following errors are also listed.

9001: Register not mapped
9002: Invalid map
9003: Time-out accessing variable
9004: Register modified
9005: DH communications card error
9006: DH card or driver not installed
9007: Invalid PLC5 file address
9008: Driver not installed
9009: Not allowed as Modbus slave
9010: Not allowed as MotionNET slave
9011: DIO point already mapped
9012: Illegal while communications are enabled
9013: Invalid configuration
9014: Lost remote communications
9015: Task already active
9016: Time-out waiting for reply
9017: Error in reply message
9018: Incompatible remote I/O configuration
9019: Remote I/O not configured
9020: Communications are disabled
9021: RTU Mode requires 8 data bits
9021: RTU Mode requires 8 data bits
9022: Dancer at limit

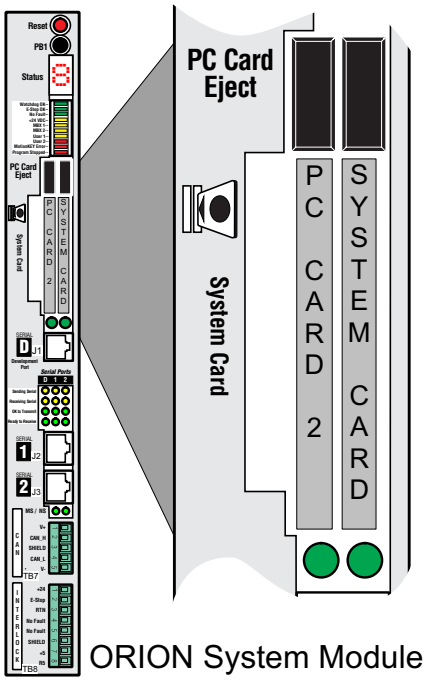
9027: Requested MD.MODE@ value incompatible with other axis

9030: Requested values for MODE@ and MD.MODE@ are incompatible
9031: Minimum Tension Limit
9032: Maximum Tension Limit

*Indicates an Error neither present nor relevant in MotionBASIC prior to version 4.x
**Indicates an Error neither present nor relevant in MotionBASIC prior to version 5.x

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PC Card LEDs



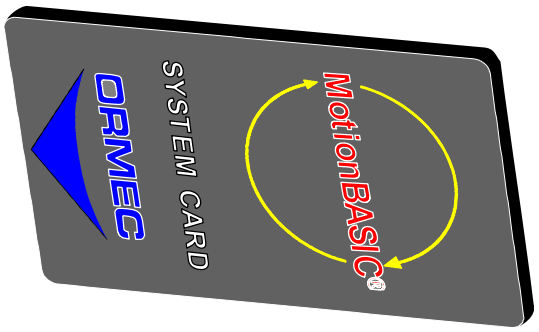
ORION System Module

PC Card™ ATA

The required system card (right slot) can contain all the system executable programs, MotionBASIC® Extensions (MBX), user MotionBASIC® program, and data files. Optional PC Card™ #2 (left slot) is used for storing user MotionBASIC® program & data files.

When the Green LED is ON or Flashing, it indicates that the controller is accessing the PC Card™. (Disk drive access light.)

Do not remove card when LED is ON.



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Notes: PC Cards are credit card sized modules which plug into ORION motion controllers. Support is standard on the ORION for three types of PC Cards: SRAM, ATA FLASH or Hard Drives.

PC Cards plug into the front of the ORION motion controller and use either SRAM or ATA FLASH Memory read/write memory for storing user program files & data files.

Right Slot, the MotionBASIC System Card slot holds MotionBASIC and all Extensions loaded into the ORION.

Left Slot, SRAM, ATA FLASH or Hard Drive that offer large amounts of additional data storage. PC Cards are removable. They can be used to transfer programs and data between controllers in the field without additional hardware such as laptop computers, programming terminals, or data cartridge recorders.

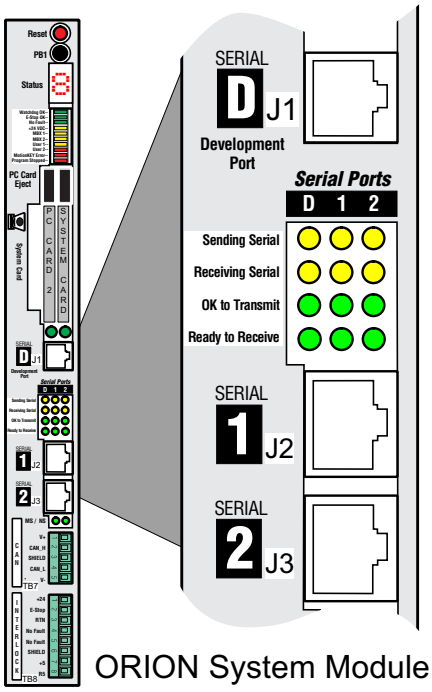
Do not remove card when LED is ON, data may be lost.

FILES ..... Display names of files currently stored on the SYSTEM Card™.

MotionBASIC Ver 4.x - 5.x	MotionBASIC Ver 3.2	
FILES "D:*.*"	FILES "1:*.*"	.... Display files stored in the root dir on **RIGHT PC Card™**.
FILES "E:*.*"	FILES "2:*.*"	.... Display files stored in the root dir on **LEFT PC Card™.**

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Serial Port LEDs



ORION System Module

Serial Ports

One RS-232 **D= Development,**

Two RS-485 **1**= SRL1, **2**= SRL2

WARNING:
Do not connect the communications cable to J2 or J3 serial ports. This can cause damage to the ORION or your computer serial port.

Serial Port LEDs

Sending Serial ..... Yellow .... Transmitting a character on serial port.
Receiving Serial ..... Yellow .... Receiving a character on serial port.
OK to Transmit ..... Green .... Handshake established from other devices.
Ready to Receive ... Green .... Handshake from ORION.

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Notes: ORION controllers provide development communications through an RS-232 serial port. To communicate using the development port, an IBM-PC or clone, must run ORMEC development software.

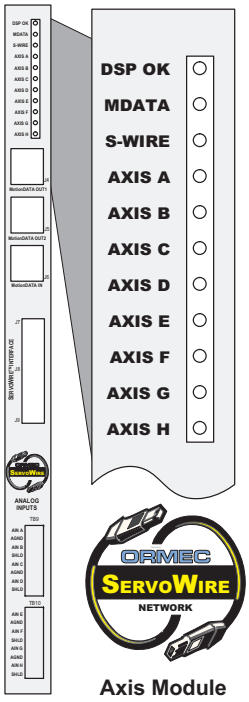
ORION also provides two RS-485 communications ports for interfacing operator interface, Modbus factory communications or other uses.

LED's

Four Serial Port Status LEDs are provided to simplify troubleshooting these communications. Communications with a PC are full-duplex and use hardware handshaking.

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ServoWire™ LED's (ORN-SW-AM)



Axis Module

ServoWire Axis Module LED's
when lit, indicates the following:

LED Name ..... color(s) ..... Action

DSP OK .. Green ..... Axis Module is operating properly. No internal faults.

MDATA .... Green ..... Receiving MotionDATA communications.

S-WIRE .....Red ..... ServoWire Network configuration error.
Example: Two ServoWire Axis Module's cabled together.
Network connected in a ring. Too many drives on network.

AXIS .... Red/Green... Axis A-H LED's are a dual color Red & Green

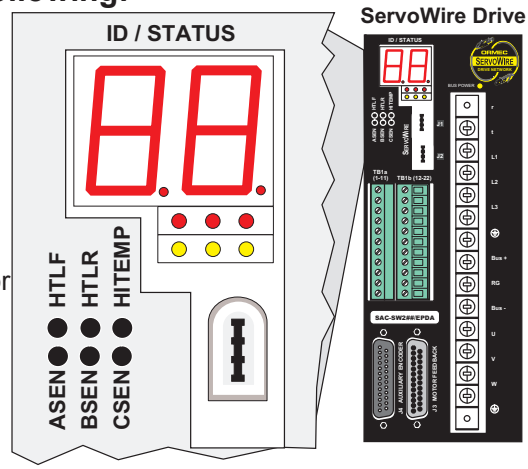
Green ..... Axis OK, AFAULT@=0

Red ..... Axis fault, see AFAULT@(AXIS.FLT1@)

Red/Green... Alternating (flashing) both Green and Red indicates mismatch in project vs Drive ID's setup.

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Notes: **ServoWire Drive LED's when lit, indicates the following:**



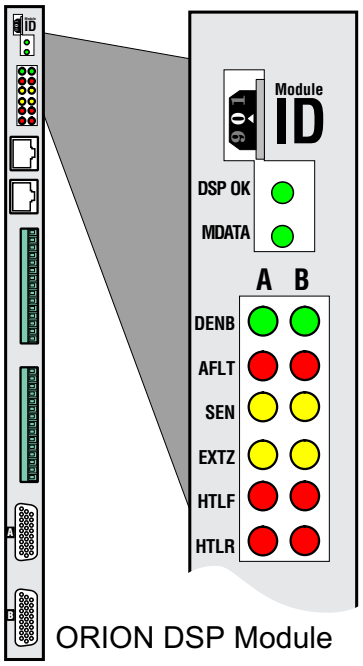
Hardware Travel Limit Forward / Reverse:
HTLF .... Red..... **LED ON when there is an error,**
HTLR .... Red..... **axis motion is prohibited.**
Project is ENABLED and NOT conducting current at SW Drive TB.
Error #1614 Fwd hardware travel limit
Error #1615 Rev hardware travel limit
Project is DISABLED and conducting current at SW Drive TB.
Error #1617 Hardware travel limit Configuration Error

High Temp:
HITEMP. Red..... Error 1628 The thermal contact in the motor is open.
.... Red..... Error 1629 Configuration conflict.

Input Sensors A, B, C:
ASEN .. Yellow... Sensor ASEN is conducting current.
BSEN .. Yellow... Sensor BSEN is conducting current.
CSEN .. Yellow... Sensor CSEN is conducting current.

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DSP LEDs (ORN-DSP-A2 or AQ)



ORION DSP Module

Digital Signal Processor LED's

when lit, indicates the following:

DSP OK ... Green .... DSP card is operating properly. No internal faults.
MDATA ... Green .... DSP is receiving MotionDATA communications.

DENB ... Green .... Drive Enabled - Torque is enabled for the respective axis.
AFLT ..... Red..... Axis Fault on the respective axis.
SEN ... Yellow ... Sensor ASEN or BSEN is conducting current.
EXTZ ... Yellow ... External ZREF sensor is conducting current on the respective axis.

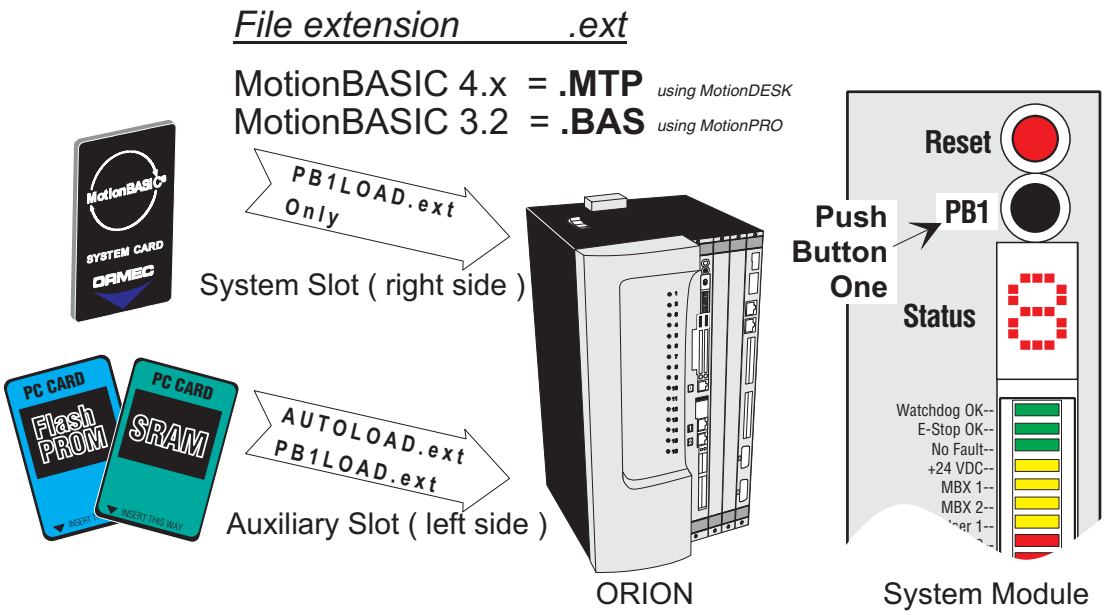
***H**ardware **T**ravel **L**imit **F**orward / **R**everse.*
HTLF ..... Red **LED ON when there is an error,**
HTLR ..... Red **axis motion is prohibited.**
when Jumper "J17" is ENABLED and NOT conducting current at TB9 or TB10.
Error #1614 Fwd hardware travel limit
Error #1615 Rev hardware travel limit
when Jumper "J17" is DISABLED and conducting current at TB9 or TB10.
Error #1617 Hardware travel limit Configuration Error

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Notes:

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PB1LOAD and AUTOLOAD



PB1 will inhibit a program from automatically executing at powerup.

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Notes: The project names AUTOLOAD.*ext* and PB1LOAD.*ext* have special functionality in that they are means to load an alternate program into the power up default, without the use of a computer.

At power up, if the Black push-button **PB1 is not pressed,**

the operating system looks for the file named AUTOLOAD.*ext* in the root directory (LEFT PC Card Only), it loads that project into memory. It then will "kickoff" program execution if the (MotionBASIC v4.x label "MAIN") or (MotionBASIC v3.2 "line zero") exists.

At power up, the Black push-button **PB1 is pressed and the file PB1LOAD.*ext* is present,**

Load a MotionBASIC® project. The operating system looks for the file named PB1LOAD.*ext* in the root directory, it loads that project into the Program Buffer. It then goes to direct mode (program stopped), which is always the case with PB1 pressed at power up, regardless of any program loading that might be done.
PB1LOAD.*ext* on PC Card 2 will always OVERWRITE any existing PB1LOAD.*ext* on the System Card.

At power up, the Black push-button **PB1 is pressed and the file PB1LOAD.*ext* is NOT present,**

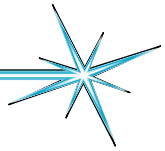
This will **Inhibit** a MotionBASIC® program from running at boot-up.

PROCEDURE FOR USING A PC CARD TO PERFORM A PB1 LOAD:

1) INSERT PC CARD
2) "HOLD IN" the PB1 BUTTON and turn POWER ON.
3) Hold PB1 in for about 5 seconds.
4) Wait until the controller has booted-up
5) Cycle POWER OFF then ON. Program runs if (MB Ver 4.x - 5.x "MAIN") or (MB Ver 3.2 "Line Zero") exists.

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Lab: Status LED's

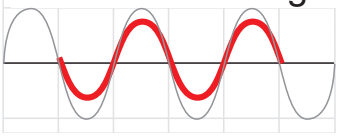


Notes:

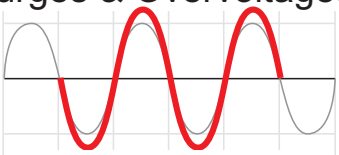
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Poor Power Quality can cause 1912 Errors

Brownouts or Sags



Surges & Overvoltages



Transients *(Spikes)*



Outages (Blackouts)



The majority of electrical noise or inductive kicks, can be generated inside your plant by any device with a large load current when turned on or off.
Example: Motors, Drives, Elevators, Copy machines, Printers, Air conditioners, Fluorescent lights, Induction Heaters.

Electro-Magnetic Interference EMI (radio signals) or Electrical disturbance can be generated when lighting strikes a power line or by using an arc-welder.

Symptoms:
All of the above "invisible" power disturbances can cause flicker or waver on a computer's monitor or machine indicator light. Stop or slow communications on a network or modem (transmission errors). Cause a PLC or Motion controller to shut down (System lockup Error 1912), and lead to premature failure of part or all of an unprotected electronic system.

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Quality of the power being delivered to a piece of equipment can be effected by many types of power problems. The equipment life expectancy can be shortened. The operation of the machine can behave unpredictable with each different types of power problem. The more common types of Power disturbances are listed with some of the causes.

UNDER-VOLTAGE called BROWNOUT or SAGS: is a decrease in line voltage of at least 10% of the average line voltage for half a cycle or longer. Often caused by large inductive equipment being applied on the same AC line. The source of the power drain can come form other buildings attached to the same power grid. The equipment often continues to operate. Permanent failure rarely occurs, but there is the potential problem of logic circuit corruption.

SURGE or OVERVOLTAGE - A power surge is the opposite of a sag. A surge is defined as a 10% increase (or greater) in line voltage for a half cycle or longer. A power surge is often caused by large inductive loads being applied on the same AC line. Power surges shorten the equipments life expectancy and cause random shut downs.

TRANSIENTS or SPIKES - Relatively short duration and usually high energy content, a spike is a surge of energy superimposed on the AC power line. Transients are caused by lightning bolts hitting a power line, switching inductive loads on and off, a power utility grid being switched, or by Silicon Control Rectifier (SCR). Integrated Circuits used in personal computers, PLC, and Motion controller do not have ability to absorb this high energy forever. Repeated high energy spikes can eventually render built-in spike protection components useless. Equipment ages prematurely.

OUTAGE and BLACKOUT - A condition where a portion of the sine wave is missing or has a lower than expected value. These types of problems can be caused when large motors are started, lightning arresters are employed (during a lightning hit), or when electrical equipment fails. They can lead to failures in computers and electronic equipment. When the duration of a outage exceeds 1 cycle it is called a Power failure or Blackout.

HIGH FREQUENCY NOISE - can be caused by electronic equipment feeding internal noise back onto the power line, like induced noise from switching power supplies or servo drives. This noise is transferred (superimposed) onto the AC line causing disturbances. This noise can cause internal component degradation and eventual system failure. System reset or lockups, and/or data transfer errors will increase.

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Protect your equipment



Power Line Filters reduce high frequency noise and voltage impulses above 3 kHz. It is strongly recommended that a power line filter be installed to eliminate electromagnetic interference coming into the electrical system from the AC power lines, as well as blocking switching noise from being transmitted back out to the power grid from the servodrives. See the servodrive manual for recommend filters.

Read the ORMEC Application note on "Shielding & Grounding Electrical Panels".

Surge protectors (Diverter) extend the lifetime of electronic equipment by protecting it against harmful high intensity power spikes and overvoltage problems.

Isolation Transformers - These protect equipment from high and low frequency noise found on the ground line. This is accomplished through basic transformer action and a neutral to ground bond.

Voltage Regulators - This component corrects high or low input voltages. Equipment utilizing switchmode power supplies rarely require external regulation.

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Notes: **If the noise filter connection or wiring methods are improper, it's effectiveness is significantly reduced. The following is the recommended approach:**

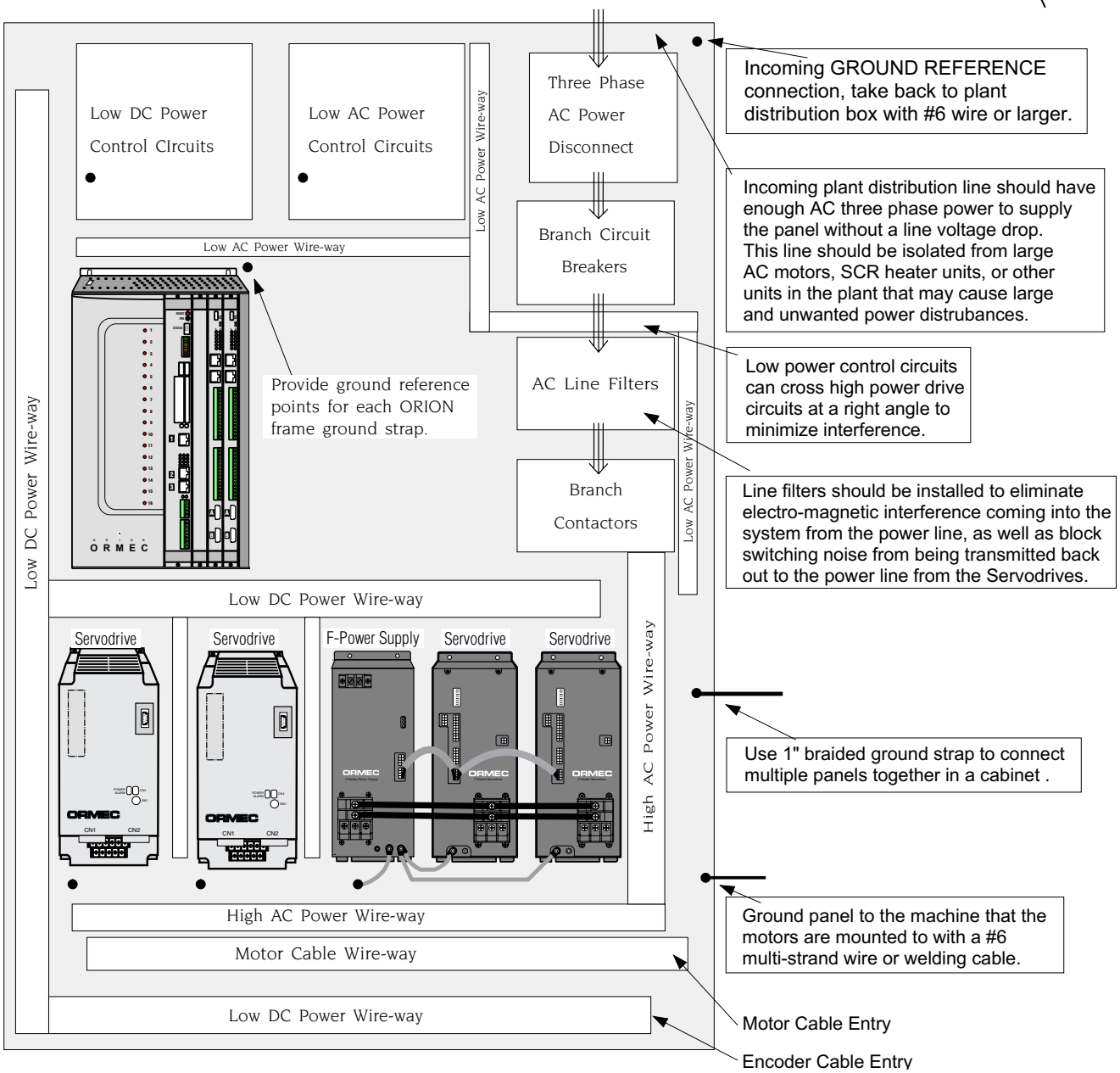
1) Separate the input and output leads by a minimum of 10 inches (25.4 cm). Do not bundle them in the same duct or wireway.
2) Do not bundle the ground lead with the filter output line or other signal lines, and do not run them in the same duct.
3) Connect the filter ground lead with a single wire (preferably braid) to the enclosure or the control panel frame grounding terminal.

Recommended Motor and Servodrive Wiring Methods:

1) When the motor is mounted to the machine and grounded through the machine frame, $^{dv}/_{dt}$ current flows from the PWM power through the floating capacitance of the motor. To prevent noise effects from this current, and also for safety, the motor housing should be connected to the frame of the servodrive, which should be directly grounded to the control panel frame ground terminal.
2) Wire the frame ground (FG) connection directly to the servodrive case, and connect to the control panel.
3) When motor wiring is contained in metal conduits, the conduits and boxes must be grounded. Use wires of 12 AWG or heavier for grounding to the case (preferably flat woven silver plated copper braid).
4) Route signal and power leads (including motor power) in separate conduits or wireways, separated by a minimum of 10 inches (25 cm).

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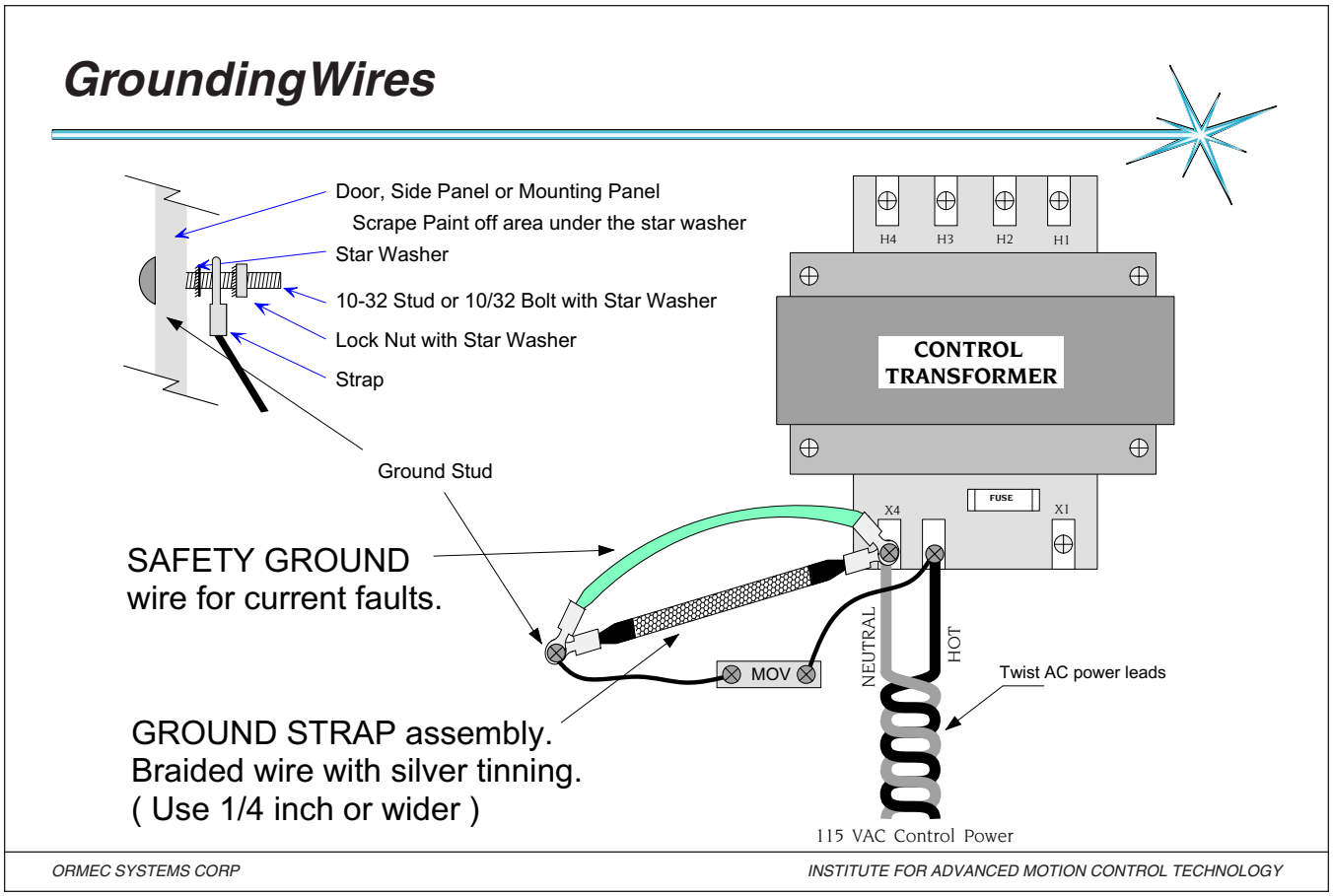
Grounding & Panel Layout



Power Line Filtering:

The Servodrive uses high voltage switching power transistors in the main circuit. When these transistors are switched, the $^{di}/_{dt}$ or $^{dv}/_{dt}$ switching noise may sometimes prove objectionable depending on the wiring and/or grounding method. The servodrive also utilizes a microprocessor, which can be susceptible to power line interference caused either by the output switching transistors or other equipment on the power line, such as welders, electrical discharge machines, induction heating equipment, etc. Careful layout of wiring and power line filtering will help prevent noise interference.

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Notes: Keep all signal common return points at the same potential. With the high frequency harmonics (300 MHz.) generated by switching amplifiers, this is not always easy. At these frequencies, the typical 12 gauge safety ground wire looks more like a series of inductors and capacitors instead of a low resistance path to ground. Use of a ground strap made with silver tinned flat braid and the steel sub-panel itself provide a much better return path than conventional wire.

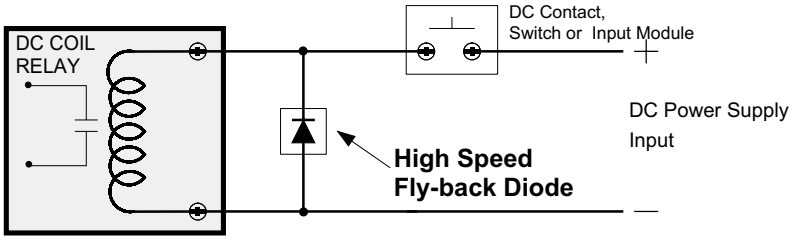
A second, equally important, goal is to minimize the magnetic coupling between circuits. This is generally achieved by minimum separations and wire routing. Radio Frequency coupling is a problem primarily tackled with appropriate shielding and grounding techniques. Protection from and elimination of transient spikes, is achieved with power line filters and appropriate suppressors like Metal Oxide Varistors (MOV).

See the ORMEC Application note on "Shielding and Grounding Electrical Panels"

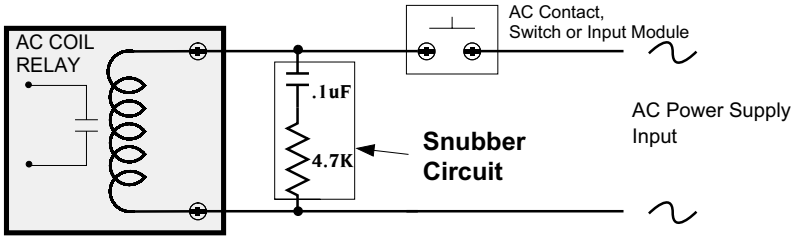
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Noise Suppression

Noise Suppression for DC electromagnetic relay.



Noise Suppression for AC electromagnetic relay.



Locate the noise suppresser as close to the coil as possible.

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Notes: When the load or coil is switched off and its magnetic field collapses, high energy spikes are produced. Any connection to an inductive load, should be terminated with a noise suppressor to absorb these noise spikes. Locate the suppressor as close to the noise source (coil) as possible. The amount of energy which needs to be absorbed can be considerable and it is important the device be rated accordingly.

DC electromagnetic relay coils should use high speed flyback diode .

AC electromagnetic relay coils should use "Snubber", typically a 4.7K ohm resistor in series with a 0.1uF capacitor wired across the load or coil.

See the ORMEC Application note on "Shielding and Grounding Electrical Panels"

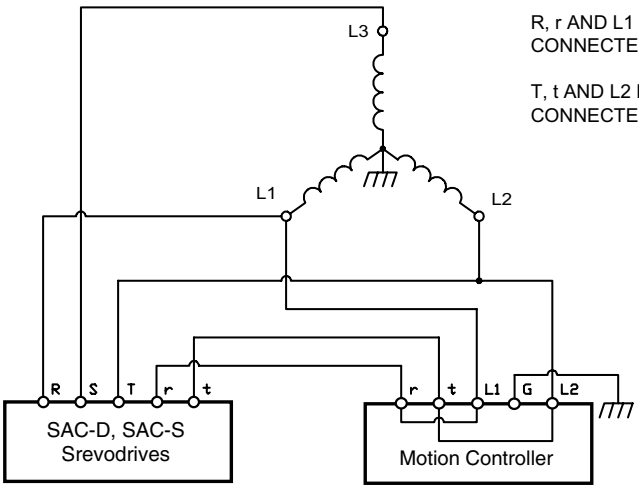
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Three Phase Power Distribution

The logic power supply connections to SAC-D & SAC-S series servodrives are connected to terminals “r” and “t”. For proper operation, these must be connected to the same lines of the incoming 3 phase power supply as the main drive power connections on terminals “R” and “T”. “R”, “r” and L1 (on the motion controller) must be connected to one incoming line. Likewise, “T”, “t” and L2 must be connected to a second incoming line. The third incoming line is connected to “S” only. This wiring arrangement is shown in the motion controller manual appendix and the SAC-D & SAC-S Series Servodrive manual appendix.

Failure to comply with the above can prevent the drive from enabling, make the motor unable to run at maximum speed and may cause permanent damage to the drive.

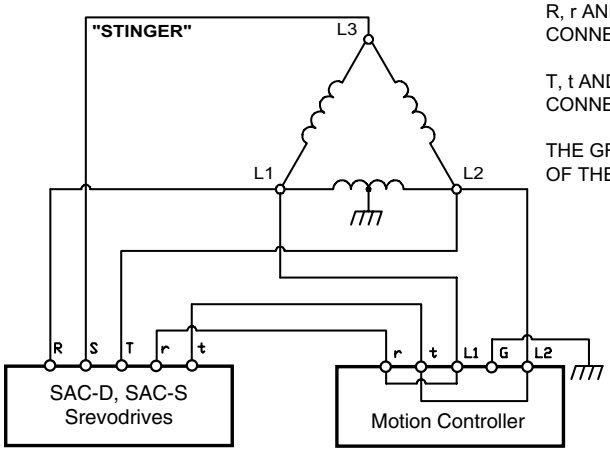
Y CONNECTED



R, r AND L1 MUST ALL BE CONNECTED TO THE SAME PHASE.

T, t AND L2 MUST ALL BE CONNECTED TO THE SAME PHASE.

DELTA CONNECTED



R, r AND L1 MUST ALL BE CONNECTED TO THE SAME PHASE.

T, t AND L2 MUST ALL BE CONNECTED TO THE SAME PHASE.

THE GROUND MUST BE IN THE CENTER OF THE PHASE CONNECTED TO L1 & L2

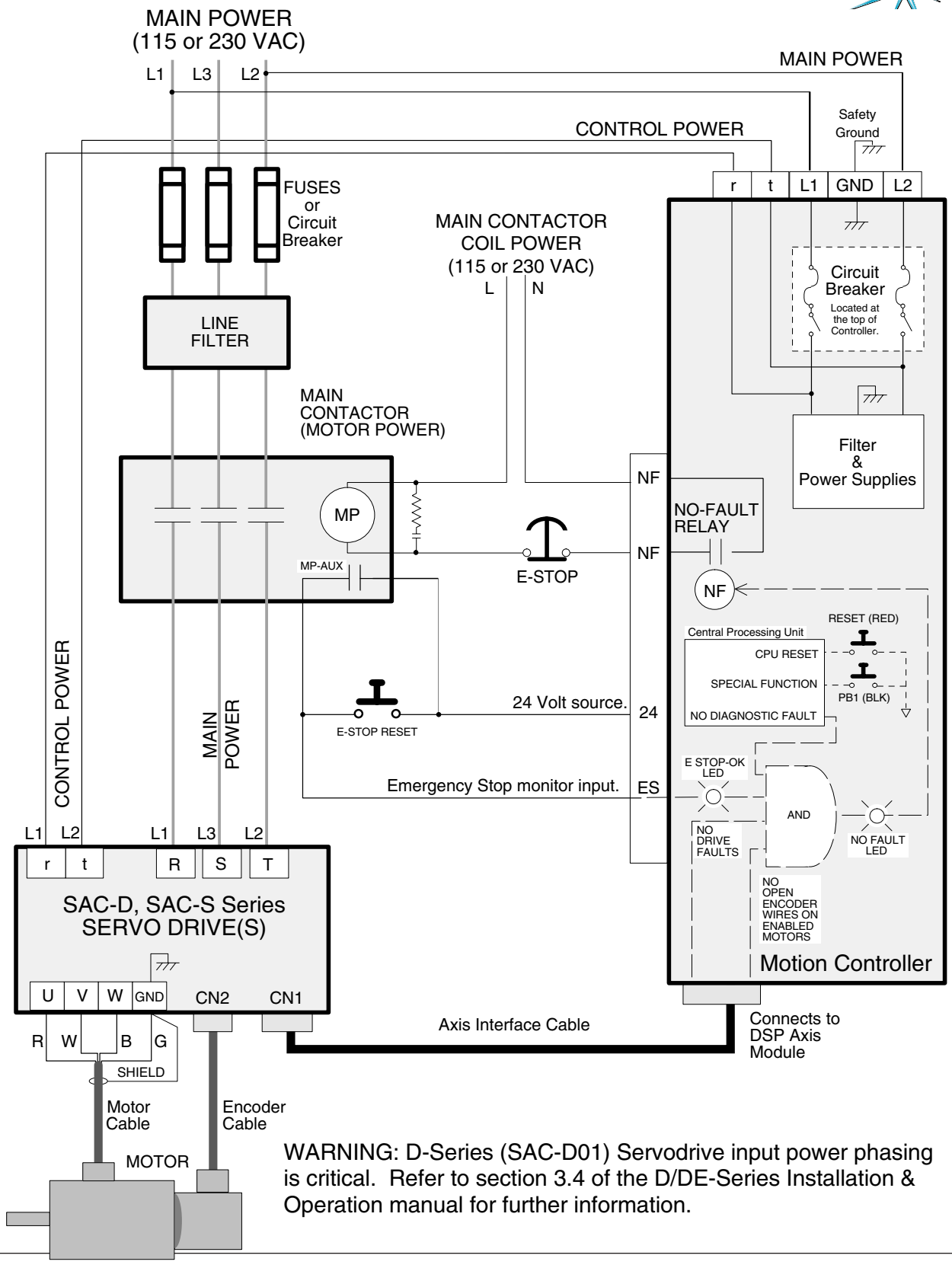
On many delta connected power systems, a center tap on one of the phases is connected to ground. This results in a line-to-ground voltage of 120VAC on two of the lines and 212VAC on the third. This 212VAC line, sometimes referred to as a "stinger", must be connected toterminal S on the drive.

Connection of the stinger to R, T, r, t, L1 or L2 may cause catastrophic drive failure.

NOTE: CIRCUIT BREAKERS, FUSES, CONTACTORS. ETC, ARE OMITTED FOR CLARITY. REFER TO THE MOTION CONTROLLER MANUAL APPENDIX OR THE SERVODRIVE MANUAL APPENDEX FOR DETAILED WIRING DIAGRAMS.

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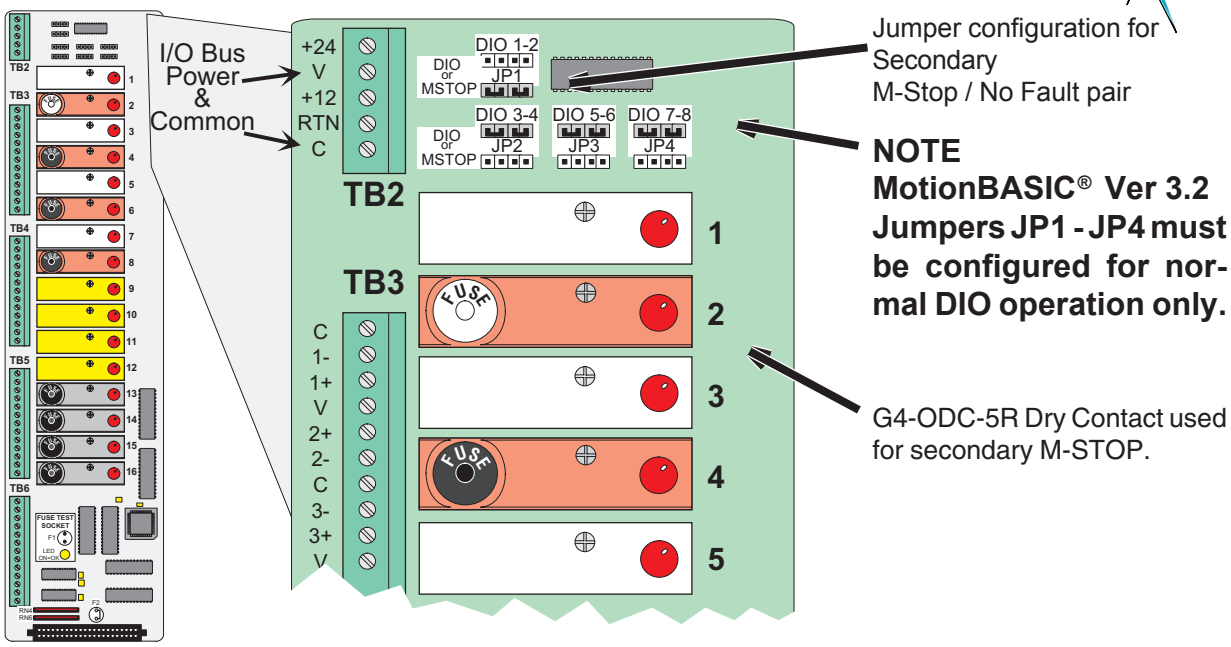
E-Stop System Wiring



WARNING: D-Series (SAC-D01) Servodrive input power phasing is critical. Refer to section 3.4 of the D/DE-Series Installation & Operation manual for further information.

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Secondary Machine - STOP Jumpers



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Notes: **MotionBASIC Ver 3.2 NOTE: Jumpers JP1 - JP4 must be configured for normal DIO operation only.**

Secondary M-Stop/No Fault Configuration - JP1, JP2, JP3, & JP4

MotionBASIC V4.0 and later, enables ORION Motion Controllers to support multiple secondary M-Stop input and No Fault output pairs allowing fail-safe control of several independent machines, or sections of a machine, with a single controller. Up to four pairs of Discrete I/O points will be configurated to operate as secondary M-Stop/No Fault pairs using jumpers JP1, JP2, JP3, and JP4.

There are two rows of pins for each Machine-Stop/No Fault pair, labeled DIO (upper row) and MSTOP (lower row). 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.

For proper Machine-Stop/No Fault interlock operation:

• **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).

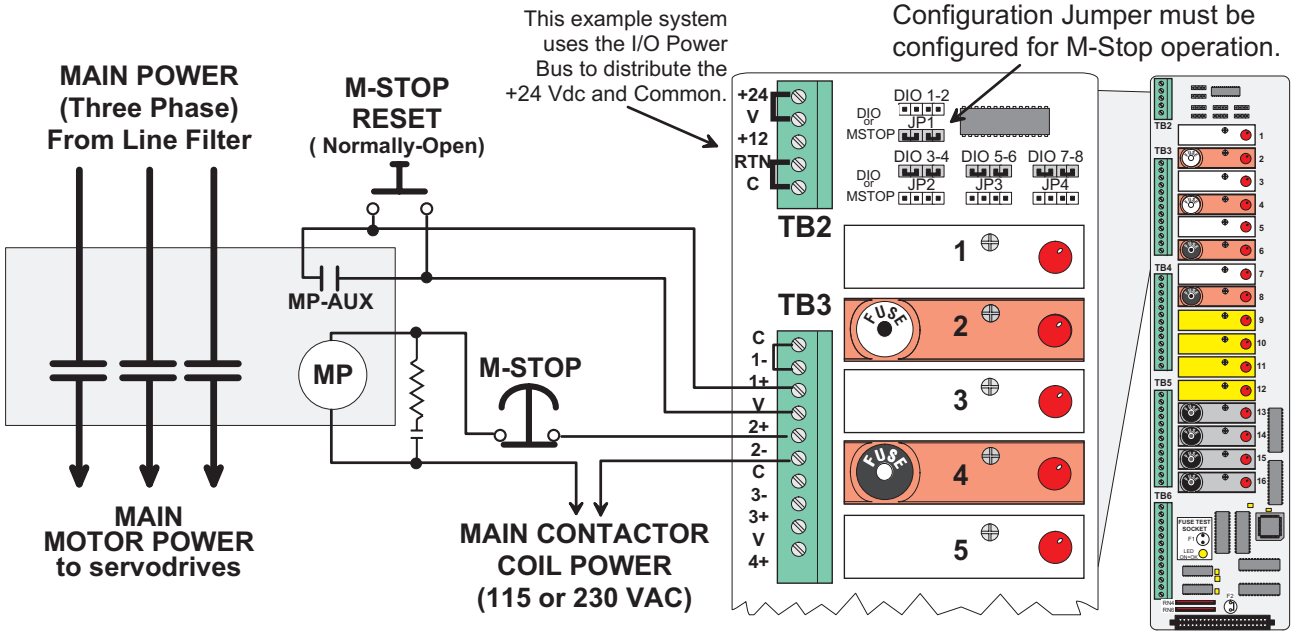
• **The Machine-No Fault outputs** (MFAULT@), DIO points 2, 4, 6, and 8 require the installation of an output module with the appropriate voltage rating (G4-ODC-5[1] , G4-ODC-5R, G4-OAC-5, G4-OAC-5A). For Machine-No Fault circuits using 120 VAC or 24 VDC power, use of a G4-ODC-5R dry contact output module is recommended.
1 Commutating diodes must be used in parallel with inductive loads switched using a G4-ODC-5 output module.

Error codes:

1345: M-Stop configuration conflicts with hardware settings.....Jumpers need to be moved to M-Stop position.
1347: I/O point configured for M-Stop operation .....Jumpers need to be moved to DIO position.

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Secondary Machine-Stop / No Fault Wiring



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Notes: This example Machine-Stop/No Fault interlock wiring is based on the ORION System Wiring Diagram with SAC-D & SAC-S Series Servodrives. This example can also be similarly applied for use with the other standard servodrives and motors (i.e. DE-Series and F-Series). Refer to the Orion Motion Controller Manual for other examples.

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.

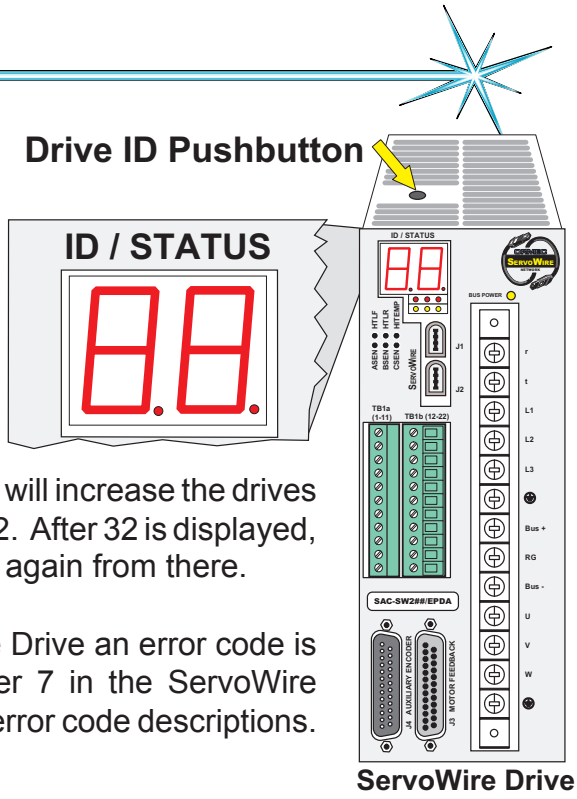
The recommended system wiring for each individual Machine-Stop/No Fault interlock is exactly the same as for the corresponding servodrives System Wiring Diagram shown in Orion Motion Controller Manual ORN-001f, Appendixes B-1 through B-3, except that no connections are made to the Interlock terminal block (TB8).

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 the Orion Motion Controller Manual, Appendix B.
Contact the ORMEC Service Department with any questions you may have in this area.

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ServoWire™ Axis assignment

ServoWire Drives have a 2 digit Drive Identity (ID) status display. The Drive ID Status display is important because it displays the axis identification number used to control the drive by the ServoWire Axis Module. Valid axes numbers are in the range 1-32 and are shipped from the factory with a Drive ID set to 1.



ServoWire Drive

A recessed push-button located on top of the drive will increase the drives ID by 1 when pressed, up to a maximum value of 32. After 32 is displayed, it will roll over back to 1, and continue increasing again from there.

If an alarm condition is present on the ServoWire Drive an error code is displayed on the ID/Status display. See Chapter 7 in the ServoWire Operation Manual or the quick reference card for error code descriptions.

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Drive SETUP: When changing drive ID's, a ServoWire Bus Reset will occur, and generate a controller error #1922 ServoWire network fault. This is normal operation. For ServoWire Drives with the "/P" pacer option, if the auxiliary axis (connector J4) is used, this auxiliary axis ID is **one less** than the Drive ID. *Ex: The pacer axis ID will be 1, Motor ID will be 2 and displayed on the status display.*

Flashing AXIS ID: indicates two ServoWire Drives have duplicate axis ID's on the same Orion controller. The flashing duplicate axis ID 1, may belong to a pacer axis (Pacer ID = one less than the displayed Drive ID).

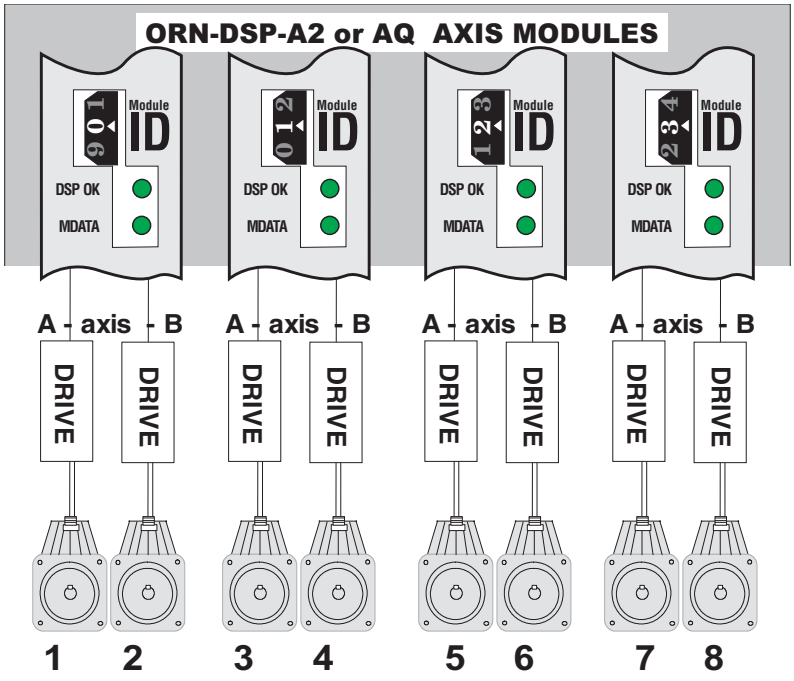
Flashing both AXIS ID and ALARM ID: If an alarm condition is present on the ServoWire Drive, an error code (HEX value) is displayed on the ID/STATUS display. See alarm code table to right or chapter 7 in the ServoWire Drives Manual for more detail display code descriptions. The decimal equivalent error code can be obtained by the ORION controller by accessing the ORMEC variable ALARM@. See Orion HELP System - ALARM@ for error code description.

MotionBASIC 5.x - The ServoWire Drive ID's must match the settings in "*Project Navigator \ Axis Settings*".



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DSP Axis assignment



The axis number used for

Axis A = (2 * Module ID) +1

Axis B = Axis A + 1

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DSP Axis Module IDs

Notes:

The DSP Axis Module identification code (Module ID) is set by a rotary DIP switch on the DSP panel. This code can be set in the range 0 to 9. When two or more DSP Axis Modules are installed in an ORION, they MUST be assigned different Module IDs. The Module ID is used to determine the axis numbers of servos interfaced to the controller.

The axis number used for **Axis A is (2 * Module ID) +1**

The number for **Axis B is (2 * Module ID) +2**

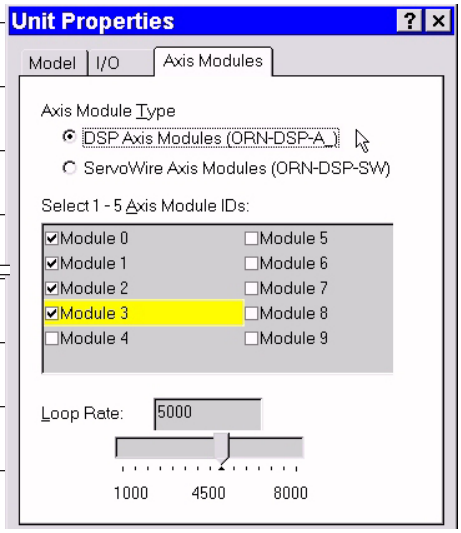
These settings are used on powerup to determine AXIS.LIST@.

ERROR # 1606 Invalid axis ID, is caused when your program is attempting to access an axis number that is missing.

MotionBASIC 3.2 - To find the axes numbers used in your program, select MotionPRO's Application menu to "View MP.CONFIG". The DSP Module rotary switch settings must match the axes used in MP.CONFIG.

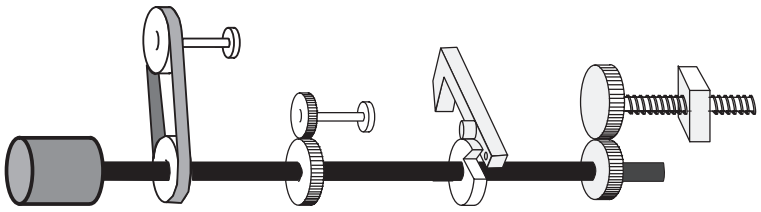
MotionBASIC 4.x - The DSP Module rotary switch setting must match the settings in "*Unit Properties \ DSP Modules*".

Use System Info to verify the "Axes installed", that were assigned at power up.



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Electronic Gearing



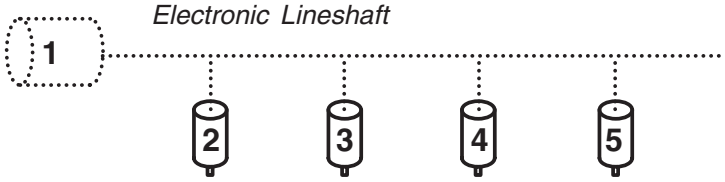
Main Machine Drive Motor

Mechanical Lineshaft

- ❑ Torsional Windup
- ❑ Mechanical Adjustments/Phasing
- ❑ Mechanical Changeovers
- ❑ Mechanical Clutches & Disconnects

Virtual Main Machine Drive Motor

Electronic Lineshaft



- ❑ GEARED or INDEPENDENT Axes of Motion
- ❑ Instantaneous Changeovers
- ❑ Programmatic Coupling/Decoupling from Lineshaft

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Notes:

With an ORMEC system the above main machine example can be replaced by using one of two GEAR formats.

The two left mechanical examples are Gear Follower (output) Axis Relative to Pacer (input) speed.

Move a follower motor in synchronism with its pacer.

GEAR Axis.2 AT 1 TO 1 ratio

GEAR Axis.3 AT -2 TO 1 ratio (The negative sign changes direction.)

The two right mechanical examples are Gear Follower Axis for a Specified Distance Relative to Pacer Speed,

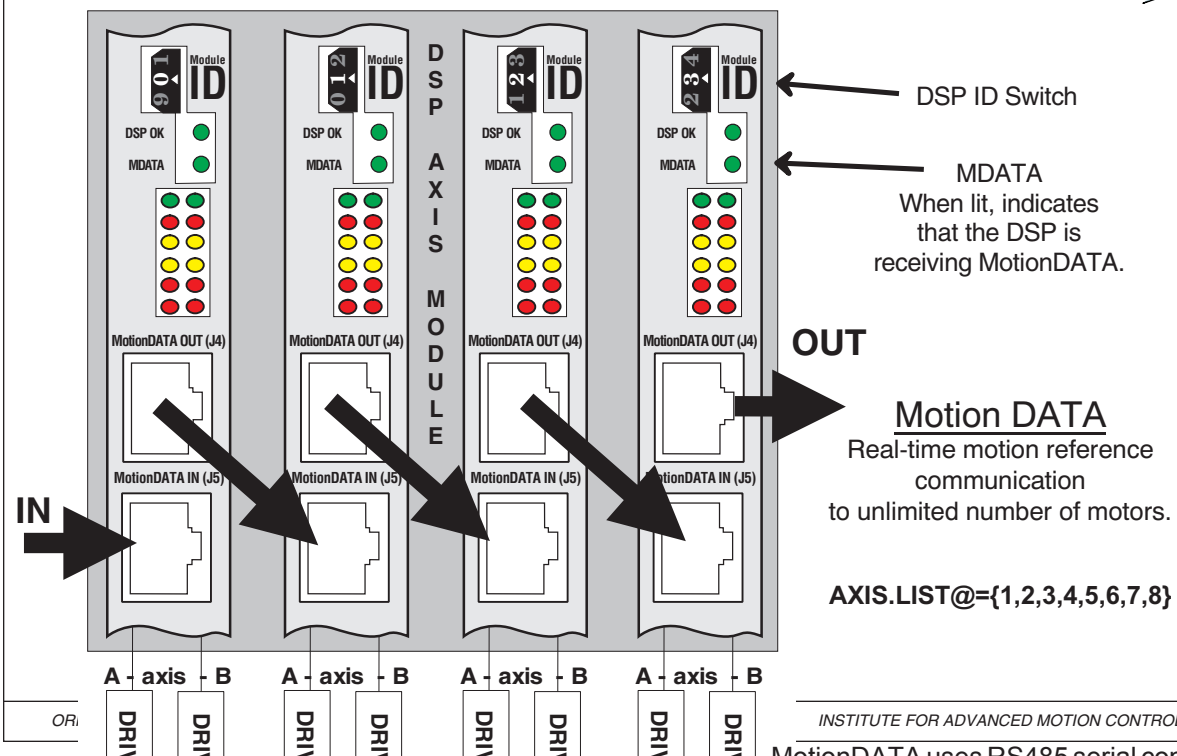
Move a follower motor for a given distance from its current position in synchronism with its pacer, specifying a gear ratio.

GEAR Axis.4 FOR 90 degrees IN 360 degrees

GEAR Axis.5 FOR 10 inch AT 1 TO 1 ratio BY 2 inch accl, 3 inch decel

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MotionData Cabling using DSP's



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Notes:

MotionDATA uses RS485 serial communication at 65.2K baud. Each DSP "Tick" (1/loop.rate), three numeric values are received and sent. The GEAR motion command connects multiple servomotors to an axis encoder that provide source position information. This is accomplished with Motion-DATA (MD.MODE@), a communications link which transmits real-time motion information directly between DSPs at each position loop update LOOP.RATE@.

ERROR 1815 MotionDATA Not Available. An attempt was made to turn on pacer input monitoring for an axis when pacer information was not available. This could be due to cabling problems, configuration problems (MD.MODE@), or transmission problems with "up-stream" axes on the MotionDATA bus.

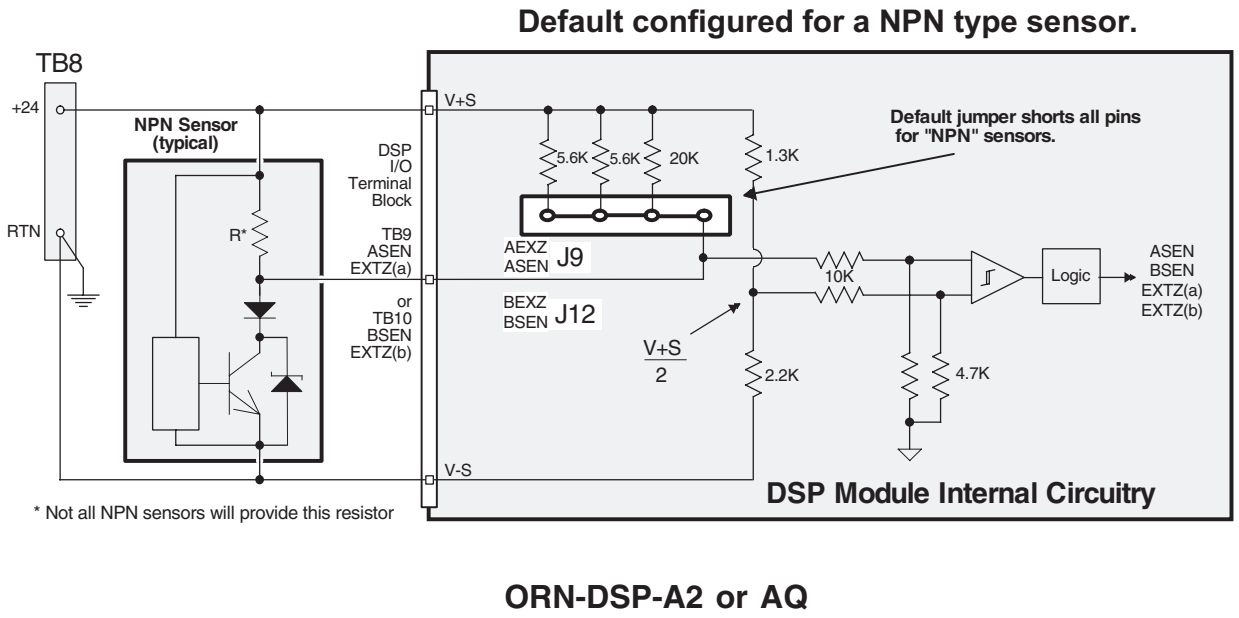
Example:

Dual axis DSP Axis Modules (ORN-DSP-A2) control two axes, "Axis-A" and "Axis-B", which occupy two consecutive ascending axis numbers, e.g. axis 3 and 4. Attempting to set up Axis-B to monitor the MotionDATA input when Axis-A is neither monitoring nor sourcing information, then a MotionDATA not available error will be generated on Axis-B.

```
GEAR.PROGRAM.EXAMPLE:
  MP.CONFIG
  MD.MODE@(1)=2 : MD.MODE@(2)=10
  AFAULT@=0 : FAULT@=0 : WAIT 200 : MODE@=5   ' Clear faults and put the servos in mode 5
  WAIT 200 : MOVE AT 30 UNTIL ZREF@           ' Normalize, MOVE both motors to 12 O'clock.
  GEAR 2 AT 1 TO 1
  MOVE 1 AT 5
RETURN
```


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DSP Sensor NPN / PNP Jumper Configuration



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Notes: The High Speed Sensor Inputs ASEN, BSEN, EXTZ(axis.a), and EXTZ (axis.b) can be individually configured to operation with sensors which have NPN or PNP type output transistors.

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 +5 VDC common (R5) on the Interlock Terminal Block (TB8) for proper operation of the ASEN, BSEN, and EXTZ inputs.

NPN type sensors:
The High Speed Sensor Inputs 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. Refer to the ORION Motion Controller Manual for further information.

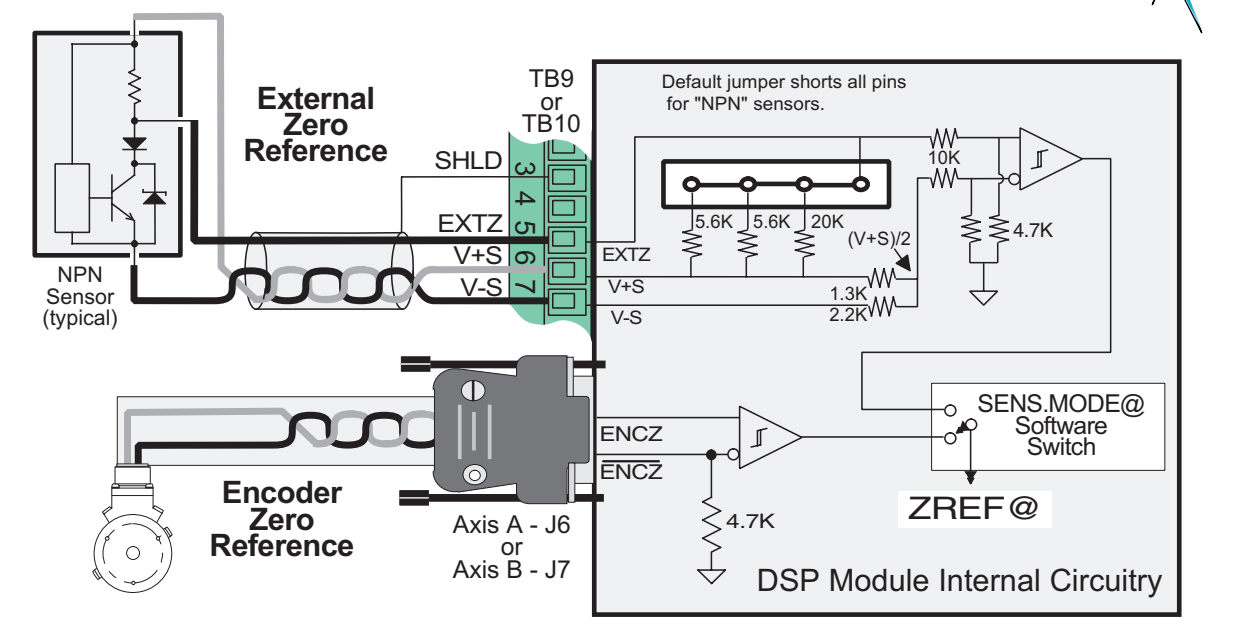
PNP type sensors:
Moving the jumper one position "to the left", across the pins eliminates the pull-up resistance for compatibility with sensors which have PNP-type output transistors. The input impedance in this mode is approximately 15K ohms. Refer to the ORION Motion Controller Manual for further information.

External sensors have a yellow LED that will be lit when conducting current on the respective axis.

Software configuration SENS.MODE@:
MotionBASIC allows you to configure the high speed sensor inputs as edge (R or F) or level (H or L) sensitive triggering using the SENS.MODE@ variable. 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.
External Z reference, EXTZ(a,b) inputs must be enabled by the MotionBASIC SENS.MODE@ variable.
Refer to the MotionBASIC Hypertext manual for further information regarding the SENS.MODE@ variable.

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DSP Encoder / External Zero Reference



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Notes: Zero Reference (ZREF) is a high speed sensor input into an ORION DSP Axis Module. Each axis has two dedicated Zero Reference inputs, located at (TB9, J6) for axis "A" and (TB10, J7) for axis "B".

Encoder Zero reference (ENCZ) is an "once-per-revolution" reference signal from the axis encoder. (is the default)

External Zero reference (EXTZ) signal from the DSP I/O terminal block can be chosen as the source of each Zero Reference input.

Configuration of ZREF is available by the ORMEC Variable SENS.MODE@. ZREF inputs can be independently configured to be level sensitive (Active **L**ow or Active **H**igh) or edge-triggered (**R**ising Edge or **F**alling Edge) by using SENS.MODE@. The default is Rising Edge Triggered (R) **SENS.MODE@(axis)=**"RRRNN**Z**".

External Zero reference inputs (EXTZ) have a yellow LED that will be lit when conducting current on the respective axis.

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 +5 VDC common (R5) on the Interlock Terminal Block (TB8) for proper operation of the ASEN, BSEN, and EXTZ inputs.

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DSP SOUT ... Encoder Reference or Delay Counter

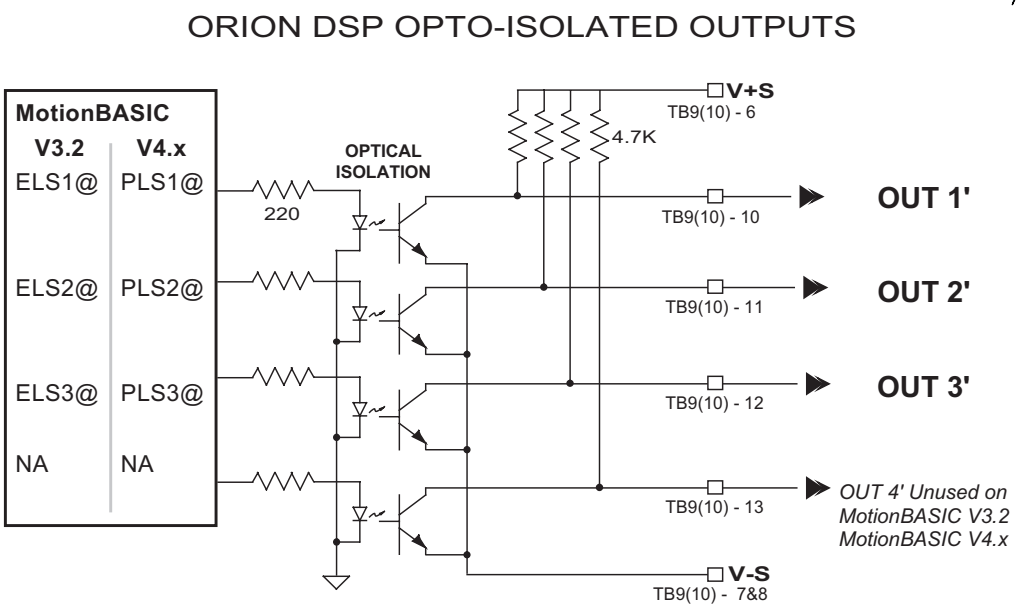
Software configurable output providing access to either the Encoder Zero reference signal (default) or the optional Delay Counter that requires a MotionBASIC Extension. This output is "active low" and is "pulled up" to V+S. Power must be supplied to V+S (5...24VDC) and V-S (Common) to use this output.

ORN-DSP-A2 or AQ

Notes:

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DSP Outputs ... OUT1' to OUT4'



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Notes: Each axis has three outputs which are automatically controlled by the DSP. They turn ON and OFF automatically when an axis position goes "into" or "out of" a specified range.

MotionBASIC® Ver 3.2 ELS-Electronic **L**imit **S**witch using encoder's actual position only.

MotionBASIC® Ver 4.x-5.0 PLS-Programmable **L**imit **S**witch using encoder's actual / commanded / pacer position.

The status variable, ELS#@ or PLS#@, tells you if the output is active. These outputs are "ACTIVE LOW " zero volts out, or "pulled up" to V+ on pin six.

Define the range for which an limit switch will be ON. (Output Voltage is ZERO)

MB Ver 3.2 ELS1.LOW@(axes #) = position 1 in user units. ELS1.HIGH@(axes #) = position 2 in user units.

MB Ver 4.x PLS1.LOW@(axes #) = position 1 in user units. PLS1.HIGH@(axes #) = position 2 in user units.

Example: If you print out the status.

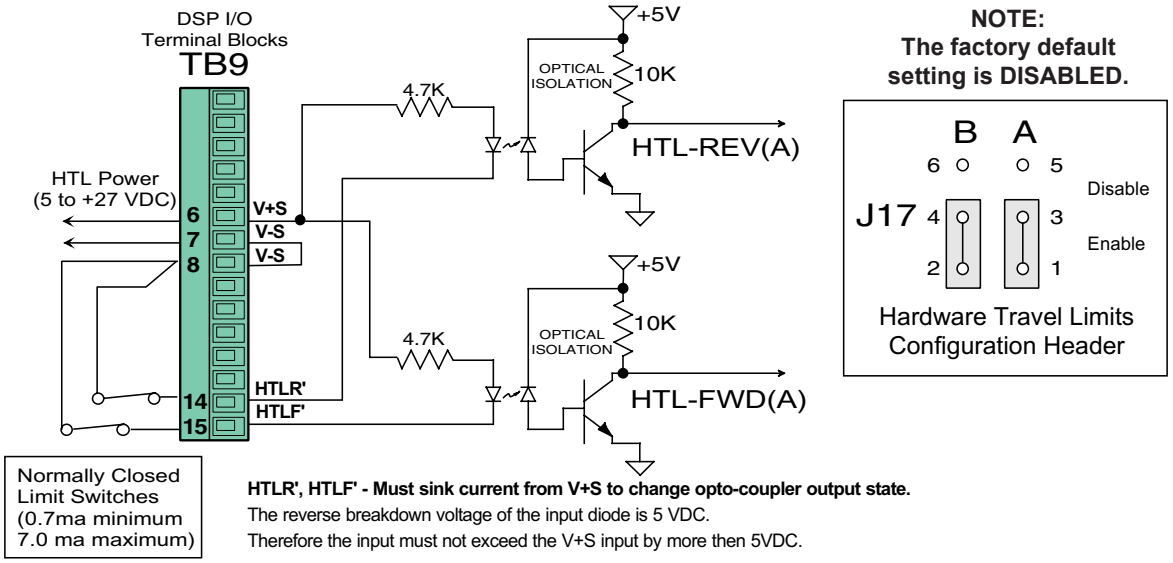
PRINT ELS1@(axis #) or **PRINT PLS@1(axis #)** 'the below example will print out the status for axis number four.

? ELS1@(4) or **?PLS1@(4)** MotionBASIC returns **-1** TRUE output voltage will be about zero (0.7 V).

? ELS2@(4) or **?PLS2@2(4)** MotionBASIC returns **0** FALSE output voltage will be V+ pin six.

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DSP Hardware Travel Limit Jumpers



NOTE:
The factory default setting is DISABLED.

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Notes: The factory default jumpers for J17 disables the **H**ardware **T**ravel **L**imit **F**orward /**R**everse (HTLF)/(HTLR) for both axes. This jumper between pins 3 and 5 of J17 disables the hardware overtravel limit inputs. To enable hardware overtravel limit inputs, the jumper is moved to short pins 1 and 3, the hardware overtravel limit switches connected to the HTLF' and HTLR' DSP I/O inputs must sink current to enable motor motion.

When the jumper is in the disabled position and the HTLF' and/or 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.

DSP LED's ... HTLF and HTLR
Hardware Travel Limit Forward / Reverse **LED is ON** when there is an error, **axis motion is prohibited,**
Red LED ON ..... when Jumper "J17" is ENABLED and NOT conducting current at TB9 or TB10.
ERROR #1614 or #1615 Fwd / Rev hardware travel limit
Red LED ON ..... when Jumper "J17" is DISABLED and conducting current at TB9 or TB10.
ERROR #1617 - Hardware Travel Limit Configuration Error

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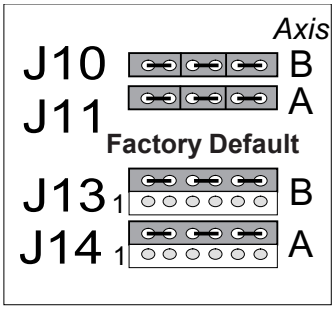
DSP Servo Drive Interface Jumpers

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 nonstandard 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.



NOTE: It is possible to have an ALARM@=10, Drive unplugged error when the jumpers are configured in the default setting and the DSP axis interface cable is connected to a SAC-DE servodrive.

ORN-DSP-A2 or AQ

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Notes: The factory default configuration 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+).

WARNING: The DSP Axis Module jumpers J10 and J11 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

F-1 in the ORION Motion Controller Manual for the location of the Servodrive Interface Configuration Jumpers

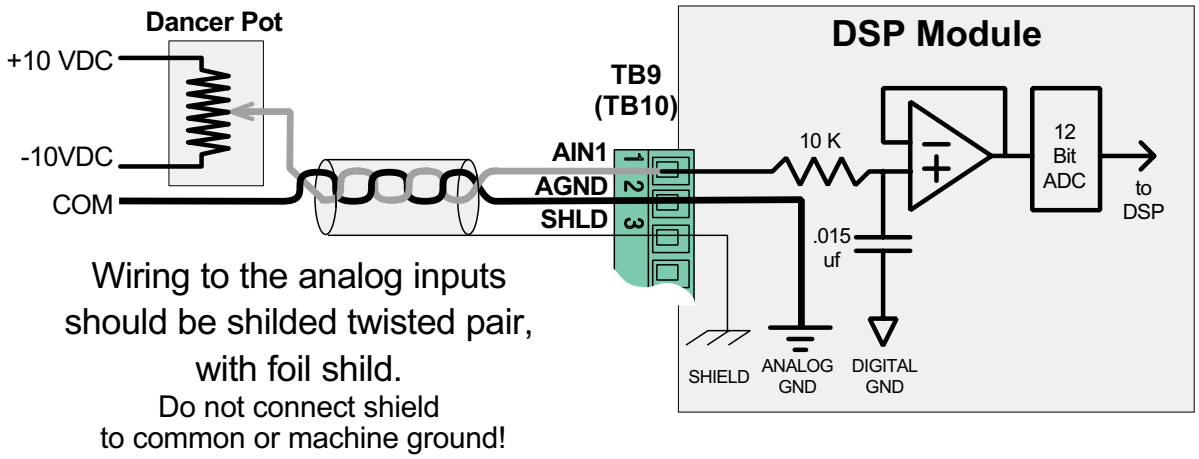
on the *DSP Axis Module*.

SAC-D, SAC-E, SAC-F and SAC-S Configuration (J13 & J14)
Externally supplied voltage for driving opto-coupled servodrive interface.

SAC-DE Configuration (J13 & J14)
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. The axis interlock power is supplied by the DSP through pins 7 & 8 (-12V) and 15 (+12V)

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DSP Analog Option



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Notes: Optional, 12-bit analog input, +/- 10 VDC, two per axis (4 total), with 1 kHz low pass filter.

These inputs are monitored via the MotionBASIC variable AIN1@(n), AIN2@(n) where n=Axis number.

AIN1@ is a general purpose analog input.

AIN1@(axis.a) is available at the DSP terminal block TB9

AIN1@(axis.b) is available at the DSP terminal block TB10

Analog input located at pin 1, ground (AGND) on pin 2, and shield on pin 3.

AIN2@ is provided primarily to accommodate systems using distributed feedback for analog velocity monitor signals.

AIN2@(axis.a) is available through the Axis Interface Connector Axis A

AIN2@(axis.b) is available through the Axis Interface Connector Axis B

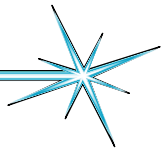
DSP Axis interface connector Analog input (AIN2) pin 14, Ground (AGND) pin 4, shield pin 10

Refer to the ORION Model 30/50/70 Manual:

DSP I/O Terminal Blocks section of the Specifications chapter, and Appendix F-2 and F-4 for further information.

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DSP Absolute Encoder Option



Absolute encoders have capacitors that retain enough charge for 3 days of tracking. Optional batteries on DSP Axis Modules, charge encoders while quadrature feedback is disabled. 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.

ABS@ Absolute Encoder Reset Power
This variable is provided as a means to recover from the complete discharge of an absolute encoder's super-capacitor. Motors with absolute encoders that have undergone a complete discharge will not operate. Their drives return an alarm code to indicate this condition. The recovery is a manual reset of the encoder's revolution counter. This reset procedure requires that a manual charge / discharge cycle be performed on the encoder. ABS@ set to "ON" will charge the encoder's capacitor. THIS VARIABLE SHOULD NOT BE MANIPULATED FOR ANY OTHER PURPOSE.

ORN-DSP-A2 or AQ

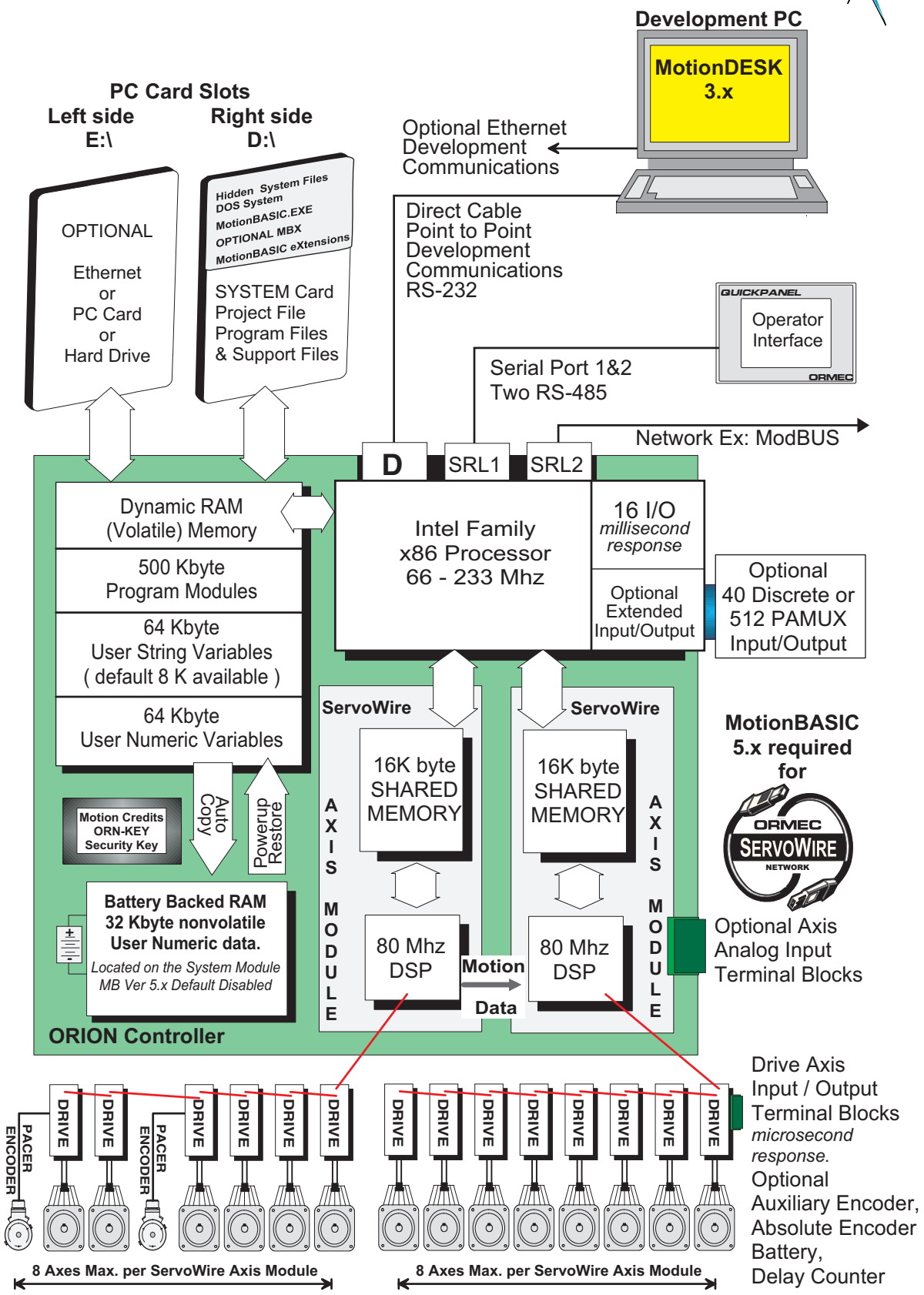
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Notes: Resetting the Absolute encoder revolution counter for Axis 2 after capacitor discharge, SEE ABS@ in Help:

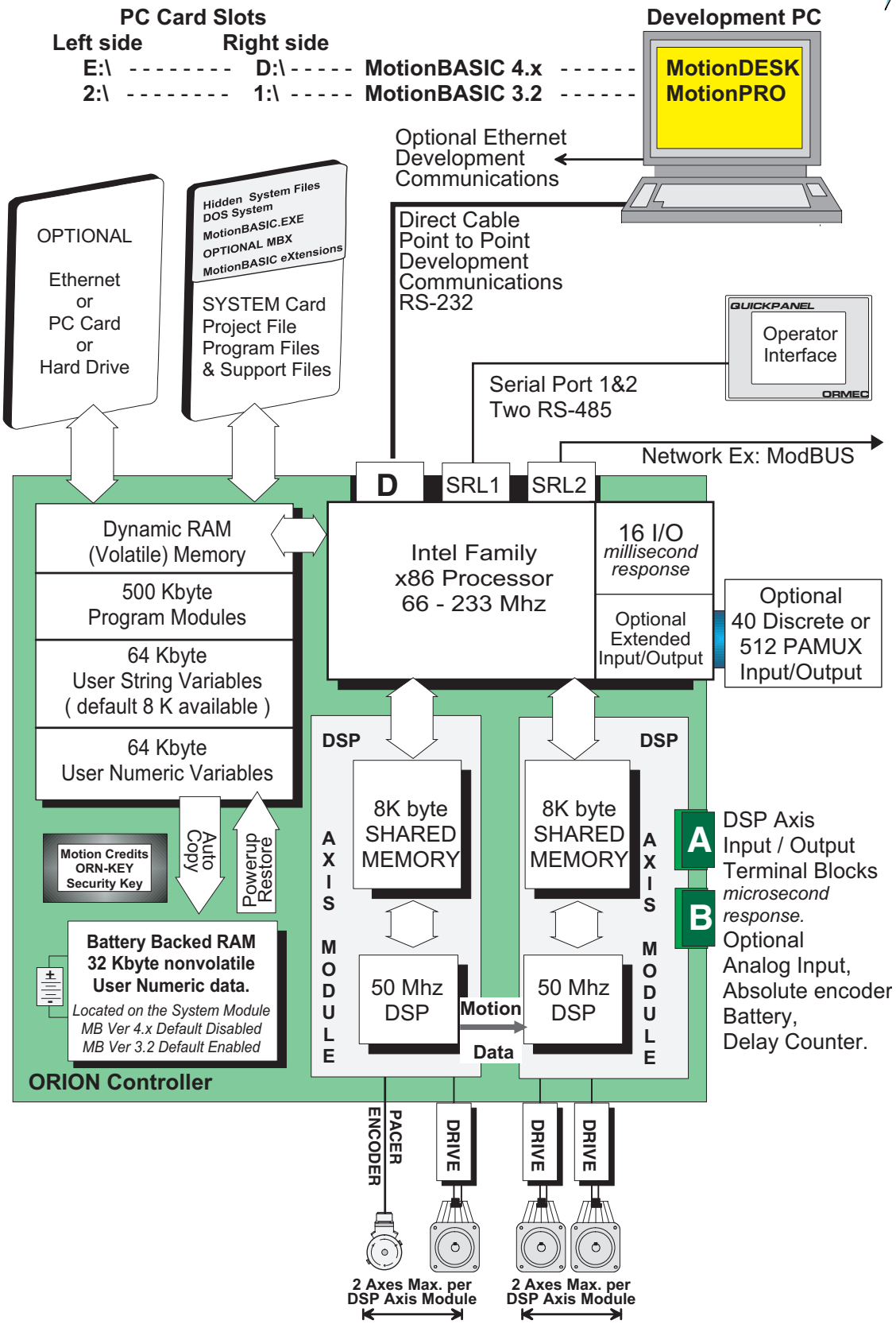
```
RESET.PROCEDURE:
PRINT "1. Connect encoder cable. (Servodrive to Motor)."
PRINT "2. Connect the Axis Interface cable. (Drive to DSP Axis Module)."
PRINT "3. Turn on Drive logic power, Press a key when ready"
WHILE INKEY$="" : WEND
PRINT "4. Applying Power to the Capacitor... Please Wait 3 minutes..."
MD.MODE@(2)=0 : MODE@(2)=0
ABS@(2)=ON
WAIT 3 * 60000  ' three min
ABS@(2)=OFF
PRINT "5. Charge Complete, Turn off Drive power, and disconnect encoder cable"
PRINT "6. Connect Discharge adapter, Press a key when ready."
WHILE INKEY$="":WEND
PRINT "Please wait for 2 minutes..."
WAIT 2 * 60000
PRINT "Step 7.  Remove discharge adapter and reconnect encoder cable to the drive."
PRINT "Step 8.  Apply power and test the axis. (MP.CONFIG and MODE@=5)"
PRINT "If ALARM persists, repeat this procedure."
PRINT "Note: This procedure often needs to be performed twice to succeed."
RETURN
```


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System Architecture with ServoWire™

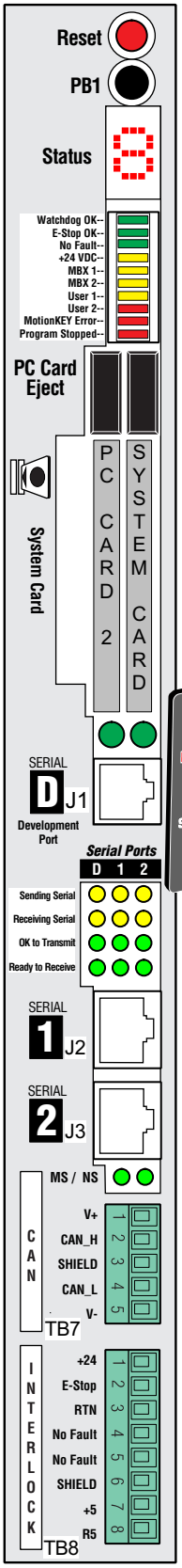


System Architecture with DSP's



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ORION System Module



5x7 Status Display After initialization, the ORION Status display will print the MotionBASIC® Version and installed MBX's. Once a user program starts execution, the display will be blank. When a user program terminates normally, the display will revert back to the Direct Mode starburst. If a user program terminates due to an error and enters direct mode, the program stopped led will be on and the display shows the pertinent error code. Example: "E", "1", "9", "1", "1" ... for ERROR 1911 Axis fault.

Status LEDs when lit indicates the following:

Watchdog OK	Green	Motherboard Processor is alive, flashes 1/sec.
E-Stop OK	Green	24 Volts is present at Terminal Block TB8 E-Stop.
No-Fault	Green	The controller has no faults. FAULT@=0
+24 VDC	Yellow	Power is present at TB8 +24 and referenced to RTN.
MBX1 & MBX2	Yellow / Yellow	MotionBASIC® Extensions, Under MBX control.
User 1 / User 2	Yellow / Red	User LED's indication, Under program control.
MotionKEY Error	Red	MotionKEY is missing or insufficient credits.
Program Stopped	Red	MotionBASIC® program not running. In Direct Mode.

PC Card™ ATA The required system card (right slot) can contain all the system executable programs, MotionBASIC® Extensions (MBX), user MotionBASIC® program, and data files.
An optional PC Card™ is used for storing user MotionBASIC® program & data files. When the Green LED is ON or Flashing, it indicates that the controller is accessing the PC Card™.

DO NOT REMOVE A PC CARD WHEN THE LED IS ON OR FLASHING.

FILES ..... Display names of files currently stored on the booted SYSTEM Card™.

MotionBASIC V4.x	MotionBASIC V3.2	
FILES "D:*.*"	FILES "1:*.*"	Display files stored in the root dir on RIGHT PC Card™.
FILES "E:*.*"	FILES "2:*.*"	Display files stored in the root dir on LEFT PC Card™.
.MTP	.BAS	Filename extension (*.ext*) for below function.

AUTOLOAD.*ext* ..... File name which is designated to automatically load into the controller from the left PC Card™ on power up. Filename allowed in the left PC Card™ slot ONLY.
PB1LOAD.*ext* ..... File loaded into the controller from the PC Card™ if the PB1 button is held pressed during power up. PB1LOAD.*ext* in the left PC Card™ will always OVERWRITE an existing PB1LOAD.*ext* on the System Card located in the right slot.

Serial Ports **D**=Development, **1**= SRL1, **2**= SRL2

WARNING: DO NOT connect the communications cable to J2 or J3 serial ports. This can cause damage to the ORION serial port or your computer port.

Sending Serial	Yellow	Transmitting a character on serial port.
Receiving Serial	Yellow	Receiving a character on serial port.
OK to Transmit	Green	Handshake from other devices has been established.
Ready to Receive	Green	Handshake from ORION.

E-Stop - (TB8 E-Stop) ORION controllers include an E-Stop monitor input, which is indicated by a green "E-Stop OK" LED above. For normal operation, Emergency Stop input power (+12 to +24VDC or 12 to 24VAC, referenced to TB8-RTN) is applied to TB8 E-Stop input. It is recommended that the input be interlocked with the servodrive main power auxiliary contact. Should that current be interrupted, the "E-Stop OK" LED will go off, causing a controller fault error. Error #1910: "E-Stop OK" Input Open.

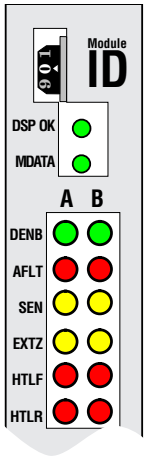
No Fault - INTERLOCK (TB8 - No Fault, pins 4&5) ORION controllers have a "No Fault relay", located on the system module. This relay is an isolated "normally-open" output contact. As long as there are No Fault conditions in the controller (LED is ON), the relay will be energized, holding the output contact closed. The power to the No Fault relay is also hardware interlocked with both the E-Stop monitor input and Watchdog circuitry. It is recommended that the No Fault relay be interlocked in series with the main contactor coil. To reenergize this relay after a fault, "E-Stop OK" and "No Fault" LED's must be ON. The "No Fault" LED is only an indicator and tells you the contact SHOULD be closed.

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ORION Quick Reference

Reset button located on the system module will reboot, like a PC key combination <Ctrl><Alt><Del>. Used to restart the system instead of flipping the power switch. Avoid turning the power on and off frequently.

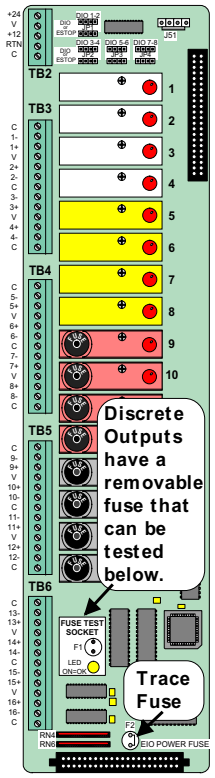
PB1 - Push Button one can be used at power up (boot-up) in two ways:
Inhibits a MotionBASIC® program from running at boot-up.
Loada MotionBASIC® program. If PB1 is held in during boot-up, the controller checks for one of the following program files in this order: PB1LOAD.*ext* on left slot PC Card first, System Card, right slot second.
Filename extension (.*ext*) for MotionBASIC V4.0 is (.MTP) , MotionBASIC V3.2 is (.BAS).
PB1LOAD.*ext* on left PC Card will always OVERWRITE an existing PB1LOAD.*ext* on the System Card.



ORION ... Digital Signal Processor ... ORN-DSP-A2 or AQ

DSP Axis Identification The axis rotary switch determines axes number.
DSP Axis A # = DSP rotary switch # * 2 + 1, DSP Axis B # = Axis A # + 1
You MUST cycle power if you change the DSP axis rotary switch, this will update AXIS.LIST@.
PRINT AXIS.LIST@ - will identify all of the servo axes found in the system at powerup.
Note: axis A number will be ODD, axis B number is EVEN.

DSP LED's - when lit, indicates the following:
DSP OKGreenDSP card is operating properly. No software or internal faults.
MDATAGreenMotionDATA - DSP is receiving MotionDATA communications.
DENB ....Green ....Drive Enabled - Axis torque is enabled for the respective axis.
AFLT ..... Red .....Axis Fault on the respective axis.
SEN ... Yellow ....Sensor hardware (ASEN or BSEN) is asserted (conducting current).
EXTZ ... Yellow ....External ZREF sensor is asserted (conducting current) on the respective axis.
***H**ardware **T**ravel **L**imit **F**orward / **R**everse.* LED ON when there is a error, axis motion is prohibited on MB v3.2,
HTLF ..... Red .....when Jumper "J17" is ENABLED and NOT conducting current at TB9 or TB10.
HTLR ..... Red .....when Jumper "J17" is DISABLED and conducting current at TB9 or TB10.



ORION ... Discrete Input / Output board
Connecting External Field Power Supply at TB2

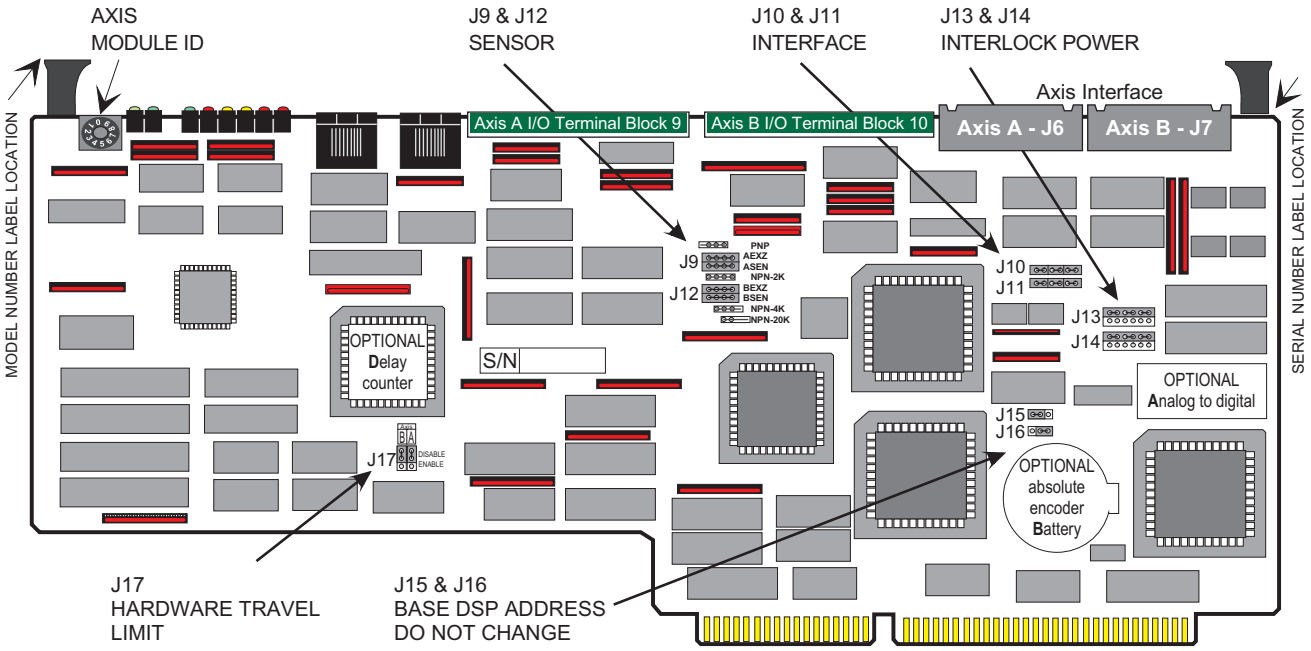
The ORION model number indicates if it has an internal field power supply or not.
The letter "F" = Internal Field supply, The letter "X" = NONE
WARNING: If ORION has an internal 24VDC power supply, DO NOT connect another 24VDC supply to pins (+24, RTN) on TB2 or TB8

Discrete I/O Point - DIO@(*number*) ... number of the I/O point.
Read Input ..... **PRINT DIO@(*number*)** Zero=OFF, minus one (-1)=ON
Clear a Latched Input .. **DIO@(*number*)=OFF**
Write Output ..... **DIO@(*number*)=ON** or OFF or Set time in milliseconds.
Configure I/O point ..... **IO.MODE@(*number*)="*letter*"**
letters are: **I** = input, **O** = output, (I or O used for any point.)
R = rising, **F** = falling (Only the first 16 points use R or F)

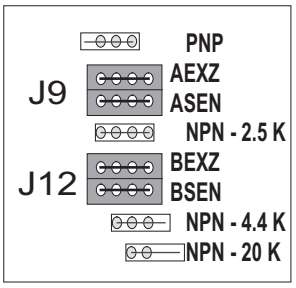
Trace Fuses On the Discrete I/O board is a Fuse Test socket "F1" and spare holder. The below list of fuses are PRE-FUSED by the circuit board trace.
DO NOT USE A REPLACEMENT FUSE UNLESS THE TRACE IS OPENED!
Discrete I/O board: ....."F2" ..... Extended Input /Output , +5VDC power.
System module trace fuses are located on the solder side (back) of board.
System module: ....."F1" ..... +5 VDC test at Interlock TB8 pin 7(+5) and pin 8 (R5)
System module: ....."F2" ..... E-Stop (12 to 24VAC)or(+12 to +24VDC) monitor voltage.
System module: ....."F3" ..... +24 VDC test at Interlock TB8 pin 1(+24) and pin 3 (RTN)
The replacement fuse is Wickman 250V, 4Amps. Part # 19370-062K

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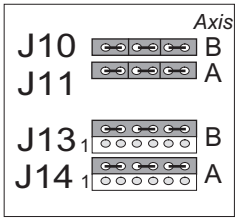
ORION Digital Signal Processor (DSP) Jumpers.



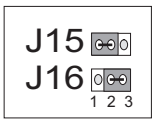
Factory Default Jumpers shown below. **ORN-DSP-A2 or AQ**



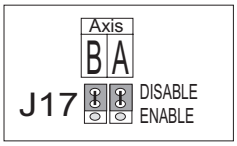
High Speed Sensor Inputs, (ASEN, BSEN, & EXTZ) are default configured for operation with sensors which have NPN type output transistors. The default four pin jumper connects all four pins to provide a 2.5K pull up.
ODD pins are for ASEN & BSEN, EVEN pins are for EXTZ (External Zero Reference).
Wiring 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.



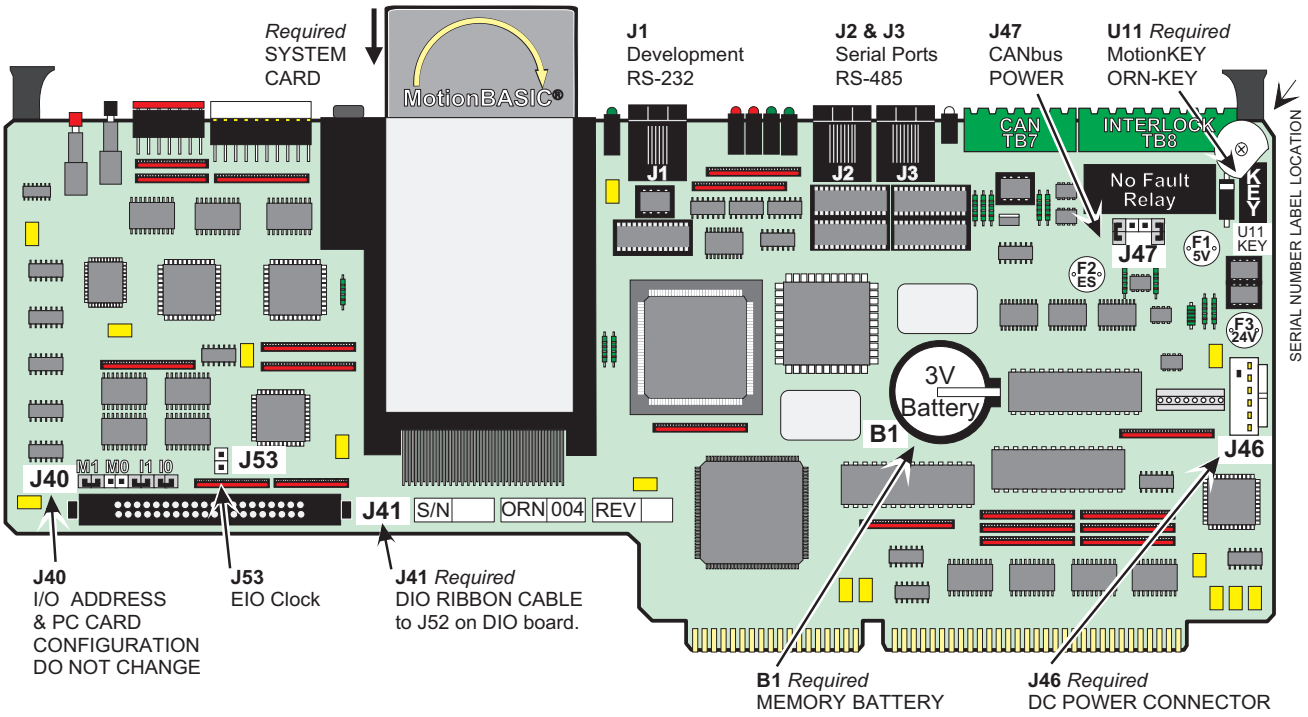
Hardware Travel Limits. The factory default jumpers for J17 disables the **H**ardware **T**ravel **L**imit **F**orward / **R**everse for both axis. The DSP, HTLF & HTLR red LED's will be on when there is an ERROR, axis motion is prohibited,

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.

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ORION System Module Jumpers and component locations.




Default
(No Output)

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!



DO NOT CHANGE!

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.

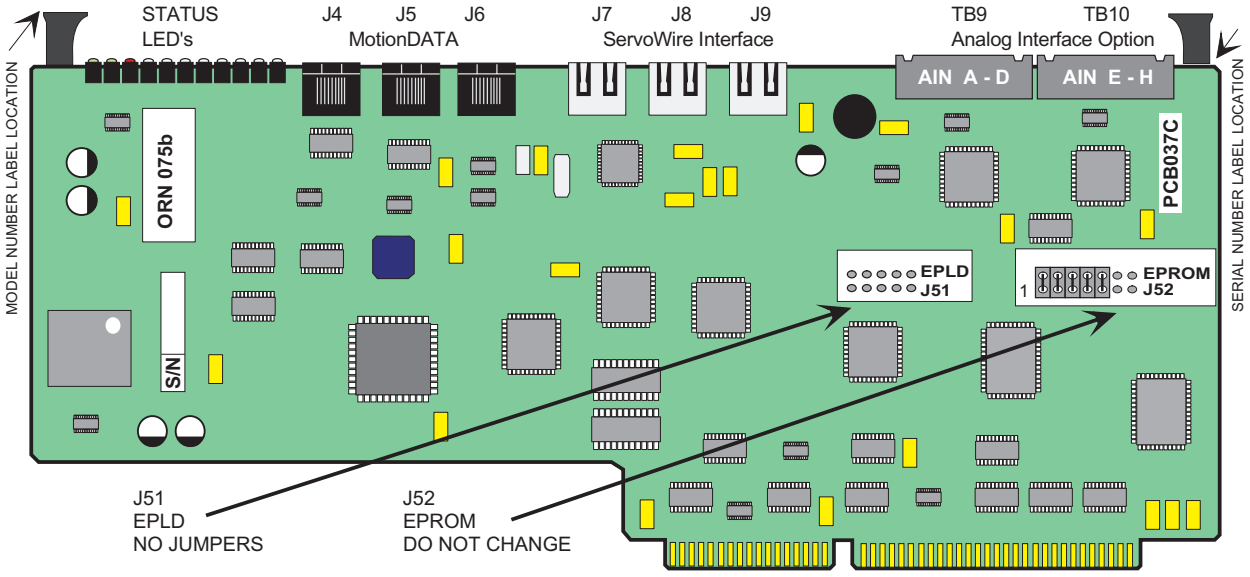


B1 ... Non-Volatile Memory Battery Power-up FAULT@=2 ... Status display "F","2"
The non-volatile variable memory battery is a Lithium battery used to preserve non-volatile variables while the ORION input power is off. Removal of this battery will erase all Non-Volatile memory.
Output Voltage 3.0 to 3.1 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.

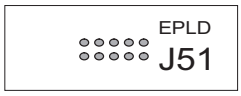
F1, F2, F3 ... Trace Fuses are PRE-FUSED by the circuit board trace.
DO NOT USE A REPLACEMENT FUSE UNLESS THE TRACE IS BLOWN!
System module trace fuses are located on the solder side (back) of board.
F1 ..... +5 VDC test at Interlock TB8 pin 7(+5) and pin 8 (R5)
F2 ..... E-Stop (12 to 24VAC)or(+12 to +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.

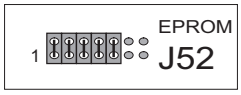
Axis Module Component Location Diagram.



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)

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