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Target ARS Hardware Manual

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GE Fanuc Automation

Programmable Control Products

***Target®
Automation Rack System***

Hardware Manual

GFK-2200

July 2002

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

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Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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CIMSTAR	Modelmaster	Series 90	VersaPro
Field Control	Motion Mate	Series Five	VuMaster
GEnet	ProLoop	Series One	Workmaster

Content of this Manual

This manual provides installation, configuration, and troubleshooting information for the TARGET Automation Rack System (ARS).

Catalog #	Description
TGT-3X6L-1-0	Target Servo Power Module
78005102	Target Spare Module
TGT-DI0L-32-0	Target Digital DC 16 in, 16 in/out
TGT-000A-4-0	Target 4-Axis Motion Control Module
78004654	Target Power Supply
TGT-AI0V-8-0	Target Analog Module 4 in, 4 out
TGT-S000-1-1	System Module w/ 2MB
78004653	Target Assy
SFW-TGTP-0.85-0	Target Prog Memory Card Rev 0.85
TGT-E000-0-1	Target Rack Exp Mod w/LnkrCbl NAGEL
78004657	Target Axis-Expansion Card Kit
TGT-S000-1-0	Target System Module
TGT-S00N-1-1	Target System Mod w/Network w/2MB
TGT-AI0V-16-0	Target Analog Module 8 in, 8 out
26005592	Target
78004660	Target Digital DC-Expansion Card
TGT-000A-2-0	Target 2-Axis Motion Control Module
78005069	Target Analog-Expansion Card Kit
CMP-26000019	Target Shaded Pole Sleeve Fan
MMR-B00P-1M-0	Target Memory Card BBRAM
SFW-TGTP-1.2	Target Prog Memory Card Rev 1.2
TGT-DI0L-64-0	Target Digital DC 32 in, 32 in/out
TGT-E000-0-0	Target Rack Exp Mod w/2 Linker Cbls
TGT-E00A-2-0	Target Axis Exp Mod w/Rack Lnkr Cbl

Related Publications

Additional information on Motion Solutions is available at <http://www.gefanuc.com/support/plc/m-MotionSolutions.htm>.

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Product Overview

Features

- Up to 8 axes of independent and/or coordinated motion per system
- Complete machine control capabilities including up to 16 analog and 256 digital I/O
- multitasking capabilities allow up to 17 programs to run concurrently plus 1 motion block per axis
- unique integral motor drives plug directly into the rack
- motion based on velocity, position, or time
- user programmable jerk control
- suspend and resume motion
- Digital self-tuning algorithm or user-programmable PIDF

Applications

The TARGET® ARS Automation Rack System can be used in a wide variety of common motion control applications, some examples of which are listed below:

- high speed, accurate indexing operations
- start-stop and continuous conveyors
- part insertion
- drilling
- flexible fixturing
- flying shear
- machining
- pick and place
- position tracking
- rotary index tables
- speed tracking
- web processes
- welding
- wrapping

General Description

The Whedco TARGET® ARS is a complete automation system designed for high performance motion control in conjunction with integrated machine control. It incorporates a unique rack mount package design which minimizes panel and/or rack space for multi-axis systems. The TARGET system communicates over a high speed backplane, and incorporates the latest in high performance computing power including a 32-bit CISC microprocessor and DSP-based motion control. Its multitasking capabilities allow the TARGET to control multiple asynchronous processes for complex automation applications.

Accurate Velocity Control

Servo and stepping motors are necessary in many applications requiring accurate velocity control. Unlike conventional variable speed motors, Whedco motion control systems provide long-term velocity error of less than a tenth of a percent. Tighter process constraints imposed on many system designers make this a mandatory feature in many velocity control applications. In addition, Whedco servo and stepping motor systems operate at higher speeds than typical d.c. motors. Whedco systems are available to operate at speeds in excess of 5000 r.p.m. Finally, Whedco servo and stepping motor systems operate at a constant speed regardless of input line voltage, a critical feature in maintaining accurate velocity control.

Point-to-Point Positioning

Numerous applications require point-to-point position control where a relative or absolute position destination can be specified. The Target Automation Rack System offers many possibilities for this type of move. Position moves can be preprogrammed and executed in response to a discrete input. Alternatively, destination position can be conditional based on program variables or external commands received from a host computer.

Multiple Speed Position Moves

In certain applications, different motor speeds are required when specific positions are achieved. This is common in applications such as drilling, where a rapid infeed is followed by a slower drill-to-depth move. The Target Automation Rack System includes complete capabilities to define this type of move. Motion blocks allow a move to be configured where the exact behavior of the move can be described such that each segment of the move is completed without blending any of the move segments. Such moves can also include outputs which turn on as specific speeds and/or positions are achieved for auxiliary operations such as turning on coolant.

High-Speed Position Capture

The performance of many applications, in particular those requiring conditional indexing, can be improved by obtaining real-time position information. This is often difficult given inherent processing latencies in computer systems. The Target Automation Rack System contains a dedicated high-speed input for a position sensor. This input will capture and store the position of the motor or an auxiliary encoder at the time this input is received in less than 500 nanoseconds.

Torque-Limited Moves

In servo systems, not only can the speed and position of the motor be controlled, but also the output torque. This is useful in applications where excess force can damage parts or where the assembly specification includes a force with which the part must be inserted. The Whedco Target Automation Rack System allows the user to control directly the torque parameter in conjunction with position. This capability is not available in stepping motor systems.

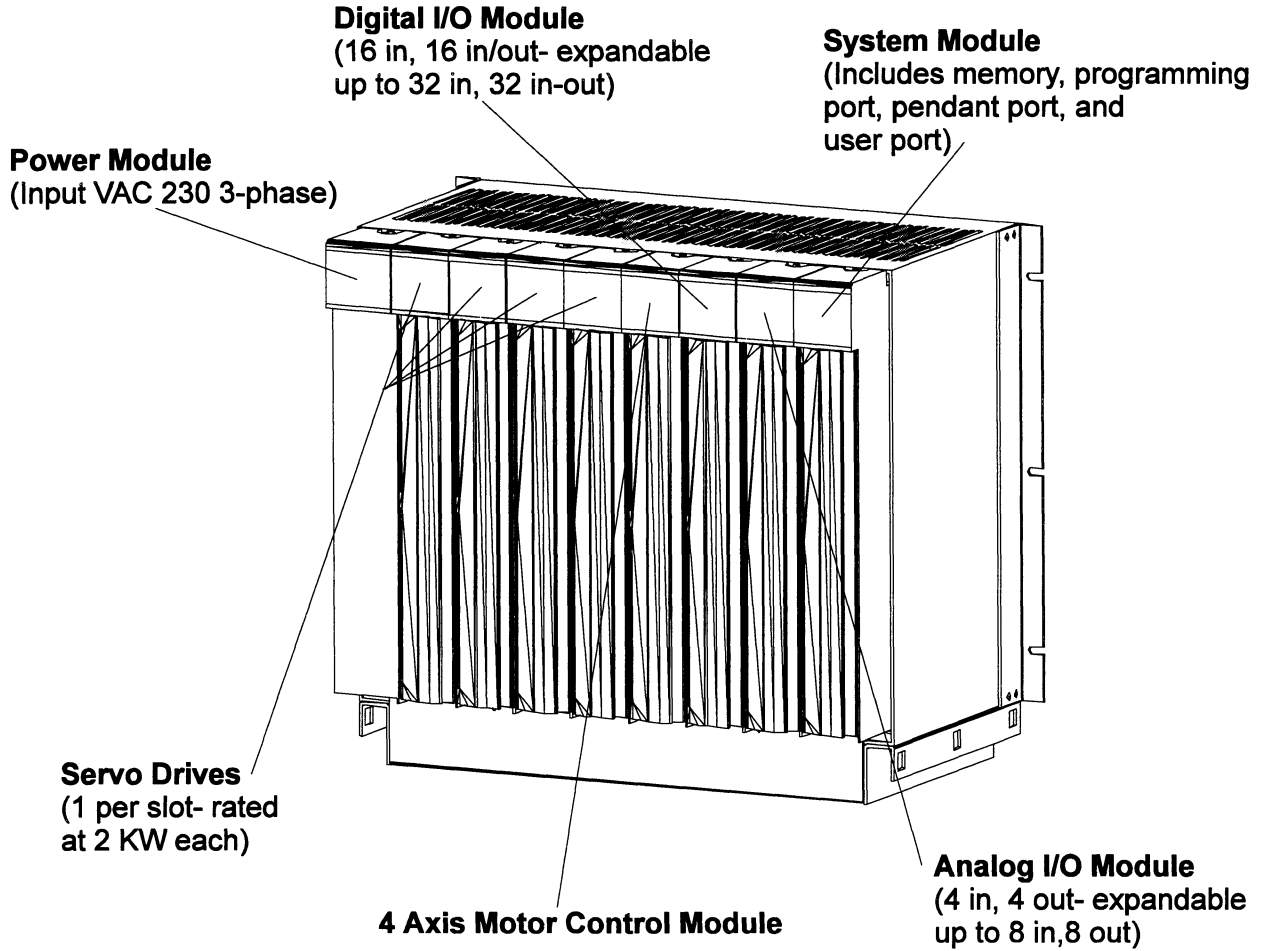
Electronic Gearing

Many applications require the synchronization of one or more axes with an external axis, that is, an axis that will not be controlled by the Target Automation Rack System, so that the controlled motor runs at a ratio which is proportional to the external axis. This is typical in applications such as conveyors. In such applications, an incremental encoder is mounted to the external axis. An axis synchronized to this external incremental encoder input behaves in a manner which is similar to mechanical gearing, hence the term electronic gearing. The Target Automation Rack System has an auxiliary incremental encoder input per axis which can be used to synchronize up to eight separate axes of motion. Each axis can track at the same or at a different rate and can switch in software to track any of the auxiliary incremental encoder inputs.

Phase-Locked-Loop

Certain applications must coordinate the phase of one axis with the phase of another. This type of control is typical in applications such as package wrapping machines. Such an application would, like the electronic gearing case, incorporate an external axis which is monitored by the Target Automation Rack System via an incremental encoder, but it would also include added feedback about the location of the package via a device such as a photocell. The photocell requires a high speed input known as "position capture." The controller provides inputs for both the incremental encoder from the external axis and the high speed input for position capture, and in this manner can synchronize the phase of one axis with another. The Whedco Target Automation Rack System provides a very cost effective solution for such applications.

System Configuration



Note: All module interconnections made via the backplane, none required by user typically
Rack or panel mount, fits in 19" rack with 9U height

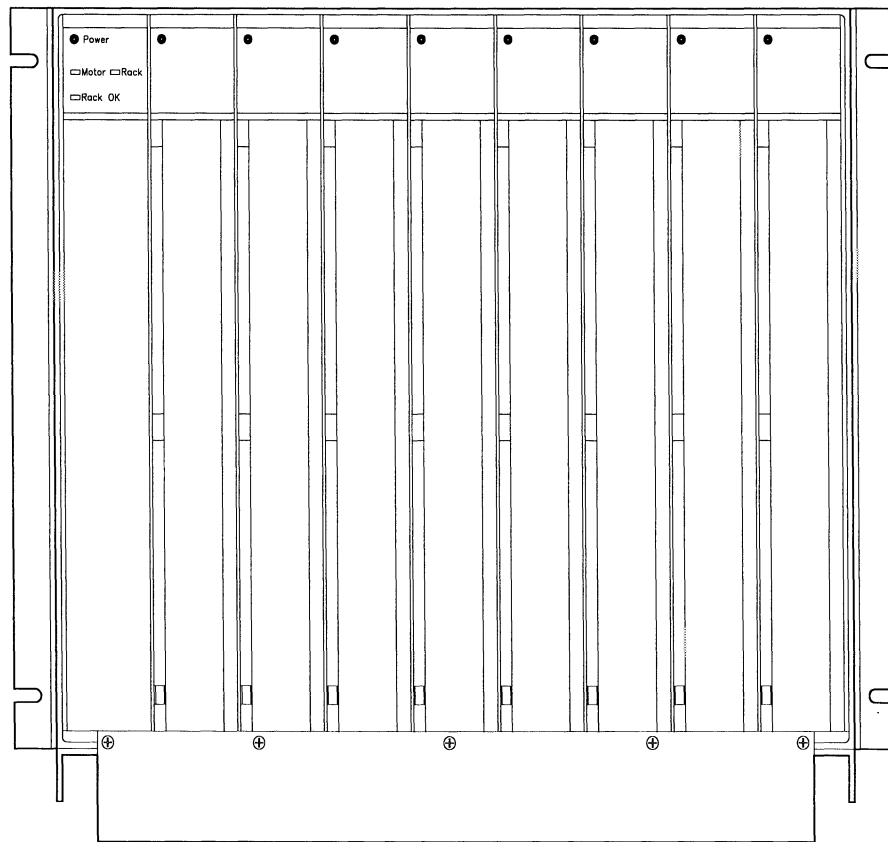
1. Rack & Module Description

1. Rack & Module Description

The Target system incorporates several modules that work together to control servo and stepping motors in conjunction with integrated machine control. The modules are inserted in a rack which houses the main components of the Target system. This chapter will give an overview of the rack structure and describe each of the possible modules that you may have in your Target system, which are as follows:

- | | | | |
|----|----------------|----|------------|
| A. | Power | F. | Servo |
| B. | System | G. | Stepper |
| C. | Expansion | H. | Analog |
| D. | Axis | I. | Digital DC |
| E. | Expansion Axis | | |

For more specific information on the modules, see Appendix E, "Specifications".



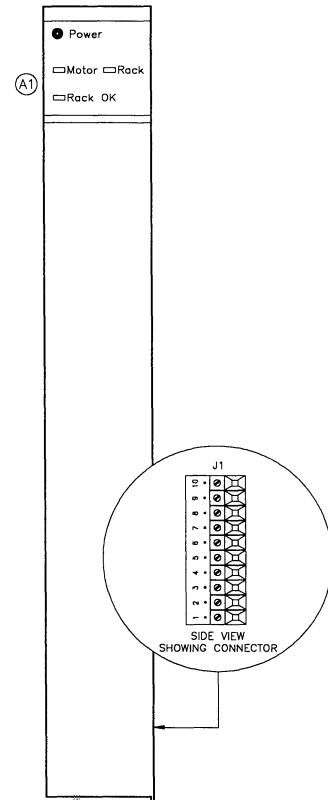
Rack Overview

Each rack can hold up to nine modules, one of which must be the power module, which must be located in the far left slot of the rack. The modules contain the hardware necessary to perform machine control. Each module has a specific function in the Target system, and individually they perform one or more specific tasks. These tasks will be outlined below in the unit descriptions. In order for best performance of the system, the servo modules should be placed next to the power module on the left, and next the axis module, and finally the other modules.

The modules themselves are interconnected via the backplane, so there are typically no interconnections (i.e., connections between any of the modules) required by the user.

A. Power

The power module is located in the far left slot of the rack. It is used as a power supply for the Target system. On the front face of the power module, there are three LEDs (*see A1*) which give information about the status of the module and the rack. The "Motor" LED is on when the motor power is on; the "Rack" LED is on when the rest of the power to the rack is on; and the "Rack OK" LED is on as long as the power to the rack is OK. For example, if the "Rack OK" LED is off, the rack power may be low. There is a connector on the side of the power module whose function is to supply power to the rack, and therefore to other modules.



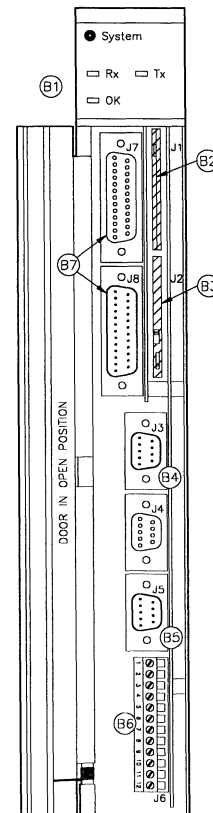
B. System

The system module is the main part of the Target system. It contains the flash and extended memory cards, serial port connections, and connectors that are used to link additional racks to the main rack. Note that the system module is always in the main rack.

On the front face of the system module, there are three LEDs (*see B1*) which give information about the status of the system module. The "Rx" LED is on whenever the program port of the system module is receiving characters; the "Tx" LED is on whenever the program port is transmitting characters; and the "OK" LED is on as long as the system is OK.

The flash memory card (*see B2*) contains the programs necessary to run the system. The extended memory card (*see B3*) contains memory available for variables; this card is optional.

The program port (*see B4*) is used to input commands into the system from a terminal. For example, if you need to enter a diagnostic command when troubleshooting, you would enter it on a terminal (preferably using terminal emulation software such as CCS, described in chapter 2) which has a serial port connection to the program port. The user port (*see B5*) is also a serial connection, but it is used to connect other serial devices to the system. For example, a digital display could be connected to the user port.



The system module also contains the control and status I/O (*see B6*). This is located at the bottom of the system module. The connections are listed below (also see Appendix C & E):

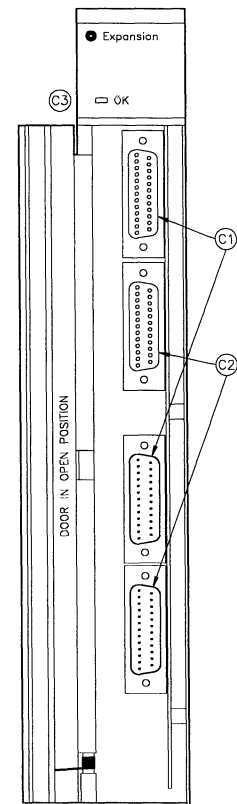
- ▶ Pin 1 is input common.
- ▶ Pin 2 is the suspend input, which is used to tell the system when to suspend all motion.
- ▶ Pin 3 is the resume input, which is used to tell the system when to resume all motion after the motion has been suspended.
- ▶ Pin 4 is the enable input, which is used to enable the system.
- ▶ Pin 5 is the set point input/output.
- ▶ Pin 6 is output common.
- ▶ Pins 7 and 8 are used together as the system ready output.
- ▶ Pins 9 and 10 are used together as the system status OK output.
- ▶ Pins 11 and 12 together is the 24 volt power supply output.

Also, the system module has two 25-pin connectors (*see B7*) that can be used to connect other racks to the main rack. The connection is made from the system module to an expansion module in another rack.

C. Expansion

The sole purpose of the expansion module is to link up to two other racks to the main rack. It is inserted in a second (and possibly third) rack. The system module has two 25-pin connectors to be used to connect the system module in the main rack to the expansion module in the second rack. The connection is made to two of the 25-pin connectors (*see C1*). Also, if a third rack is necessary for your setup, the expansion module in the second rack can be connected to the expansion module in the third rack using the other two connectors (*see C2*).

On the front face of the module is located the "OK" LED (*see C3*). This tells the user if the expansion module is OK.

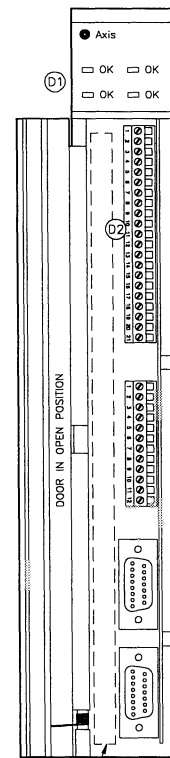


D. Axis

The axis module is used to control axis motion, outside of supplying power to the motor. The axis module contains the I/O used to control axis motion, and also connections for the resolver and auxiliary encoder.

On the front face of the module, there are four "OK" LEDs (see D1). These tell the user if the axes are OK. The I/O is located at the top of the module (see D2). The connections are listed below (also see Appendix C & E):

- ▶ Pins 1 and 2 are the axis 1 and axis 2 user test points, respectively.
- ▶ Pin 3 is the test point common.
- ▶ Pin 4 is input common.
- ▶ Pin 5 is the axis 1 at home input, which is used to tell the system that axis 1 is at home.
- ▶ Pin 6 is the axis 1 at forward overtravel input, which is used to tell the system that axis 1 is at forward overtravel.
- ▶ Pin 7 is the axis 1 at reverse overtravel input, which is used to tell the system that axis 1 is at reverse overtravel.
- ▶ Pin 8 is the axis 1 enable input, which is used to tell the system that axis 1 is enabled.
- ▶ Pin 9 is the axis 1 set point input/output.
- ▶ Pin 10 is the axis 1 OK output.
- ▶ Pins 11 through 16 are the same as 5 through 10, but for axis 2. For example, Pin 11 is the axis 2 at home input.
- ▶ Pin 17 is the output common.
- ▶ Pins 18 and 19 are used as the axis 1 position capture input.
- ▶ Pins 20 and 21 are used as the axis 2 position capture input.



An optional expansion card is available. It duplicates the pin outs shown.

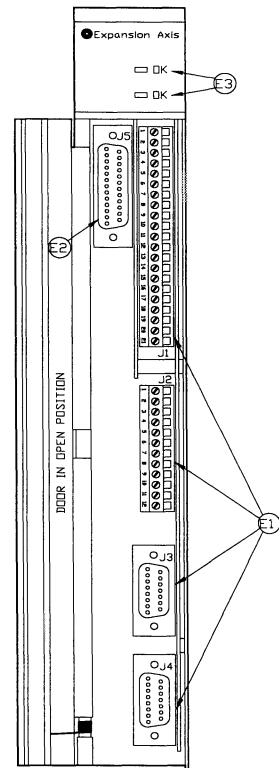
E. Expansion Axis

The expansion axis module can be used in two ways:

- 1) in the first rack, to provide two additional axes that can control external amplifiers (not servo/stepper modules) **or**
- 2) in the second or third rack, to provide two additional axes that can control servo/stepper modules, and also used as an expansion module to connect either the second rack to the first rack, or the third rack to the second rack.

The configuration of the expansion axis module is basically the same as a two-axis axis module (*see E1*), along with a 25-pin connector (*see E2*) that can connect either the expansion axis module in the second rack to the system module (in the main rack), or the expansion axis module in the third rack to the expansion module in the second rack.

On the front face of the module, there are two "OK" LEDs (*see E3*). These tell the user if the axes are OK.

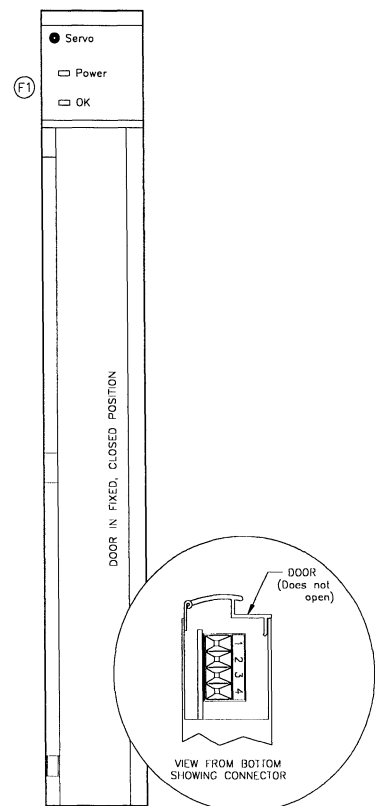


F. Servo

The servo module is used to supply power to a servo motor.

On the front face of the module, there are two LEDs (*see F1*) which give information about the status of the module. The "Power" LED is on when the internal capacitors are charged; the "OK" LED is on when the servo module is OK.

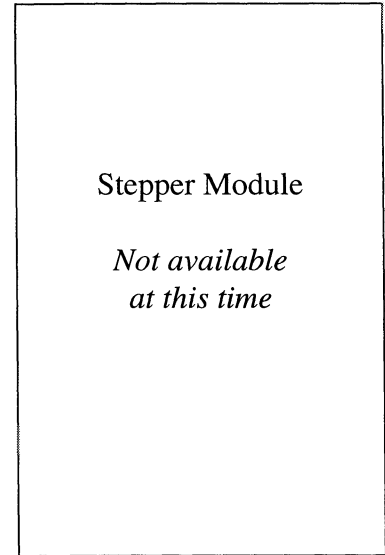
Note that, unlike the other modules, the servo module is wired from the bottom, not the front. Also, unlike the other modules, the door does not open.



G. Stepper

The stepper module is used to supply power to a stepper motor.

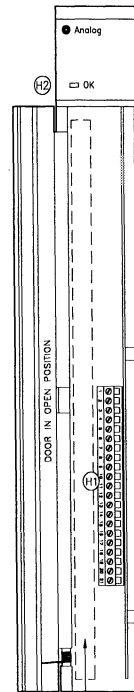
On the front face of the module, there are two LEDs which give information about the status of the module. The "Power" LED is on when the internal capacitors are charged; the "OK" LED is on when the stepper module is OK.



H. Analog

The analog I/O module contains the general purpose analog inputs and outputs of the system. Specifically, it has either 4 inputs and 4 outputs (*see H1*) or 8 inputs and 8 outputs, depending on whether the module has an expansion card or not.

On the front face of the module is an "OK" LED (*see H2*). This is on whenever the analog I/O module is OK.

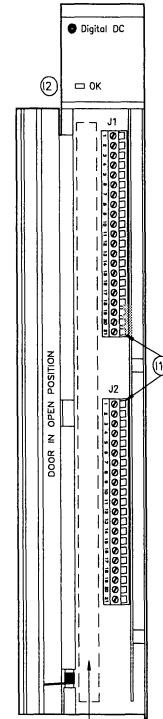


An optional expansion card is available. It duplicates the pin outs shown.

I. Digital DC

The digital I/O module contains the general purpose digital inputs and outputs of the system. Specifically, it has either 16 inputs and 16 input/outputs (*see I1*) or 32 inputs and 32 input/outputs, depending on whether the module has an expansion card or not.

At the top of the module is an "OK" LED (*see I2*). This is on whenever the digital I/O module is OK.



An optional expansion card is available. It duplicates the pin outs shown.

2. Installation and Expansion

2. Installation & Expansion

The purpose of this chapter is to give you an idea of how the different components of the Target system are installed. It shows how the different parts of the system fit together to make a working unit. This chapter, along with Chapter 5, will show you how to install and replace system components, which will be needed to correct some of the possible system problems. Also, this chapter will show you how to expand the axis, analog I/O and digital I/O modules; for example, how to expand a two axis module to a four axis module. Specifically, this section will show you

- A. how modules are placed in the rack (including how to insert the memory card),
- B. how the modules should be wired,
- C. how the rack is mounted (mounting ears, leaving room for airflow), and
- D. how to expand the axis, analog I/O and digital I/O modules.

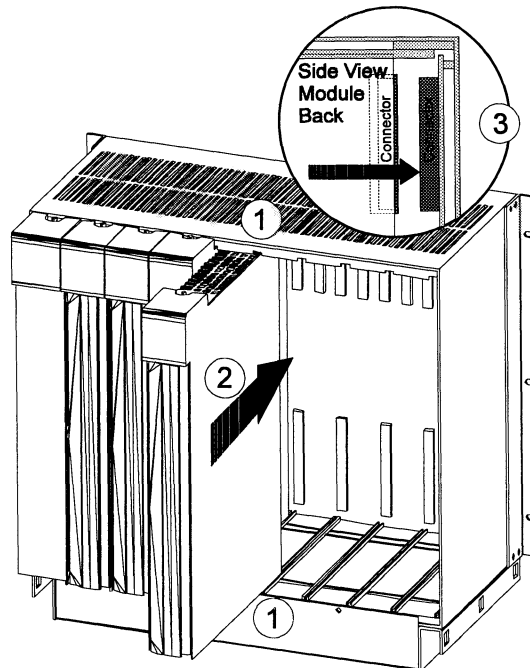
A. Module Installation

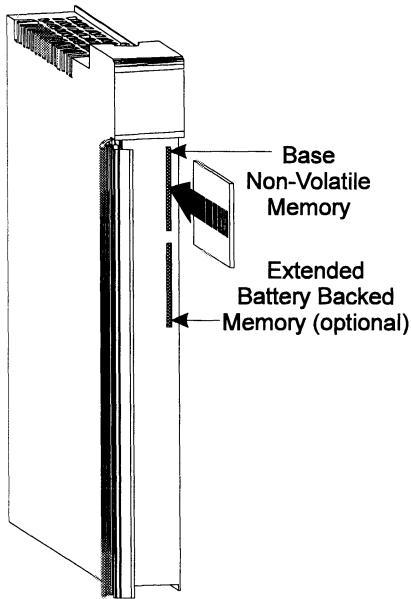
In this section, we will show you how to install the modules into the rack, and how to insert the memory card(s) into the system module. As we have said at the beginning of chapter 1, each rack can hold up to nine Target modules. The power module must be inserted in the far left slot of the rack, leaving room for up to eight additional modules. The modules are inserted all in the same way; but note that for the power module, you will need a screwdriver to attach the connector on the right side of the power module. This must be done before inserting the module into the rack. Most of the other modules have the quick disconnect connectors that can be easily connected after inserting the module into the rack.

Here are the steps that you should take to insert the modules:

1. Line the module up with the slot. Make sure that the bottom edges of the module are lined up with the guides before pushing it in.
2. Slide the module in. Make sure to handle it with care; don't force it in.
3. Keep sliding the module in until the connectors come together, as shown in the diagram. Make sure that the connectors are lined up correctly before pushing the module all the way in. You should feel the module click into place.

At this point, you should attach all the connectors to the module to complete the installment process.





To insert a memory card into the system module, use the diagram shown. First, make sure that you are putting the memory card into the correct slot. For example, if you are inserting a new flash memory card, insert it into the upper slot, NOT the lower slot, which is reserved for the expanded memory card.

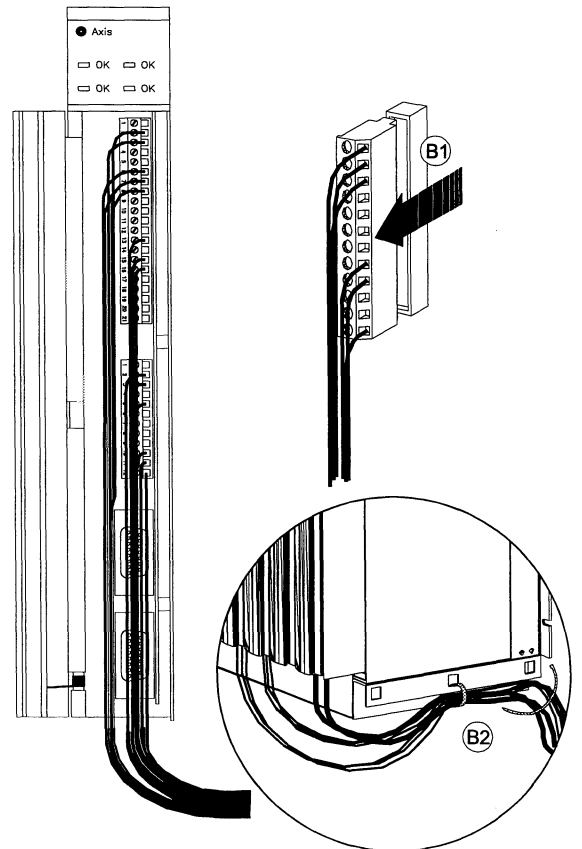
Make sure that the pins on the memory card line up correctly before pushing the card all the way in. Also, after you have inserted the card, make sure that it is firmly seated.

B. Module Wiring

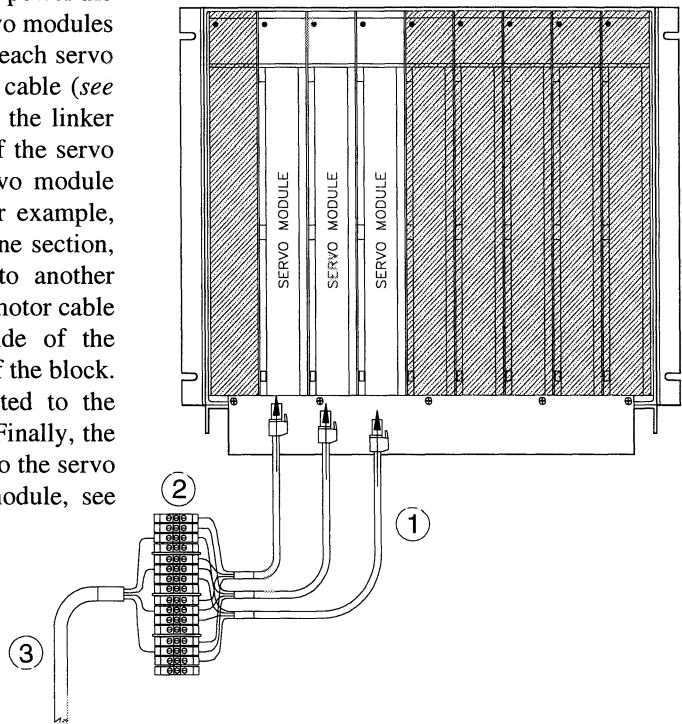
In this section, we will show you how the modules are wired. The wiring should be done in a certain way so that you can save time if you have to diagnose system problems later on.

In the diagram at right, we see the connectors that are used to attach to the modules (*see B1*). These are quick disconnect connectors, which are easily attached and removed. Note that not all modules have these. For example, the power module has a connector that is not quick disconnect; it needs to be disconnected using a screwdriver.

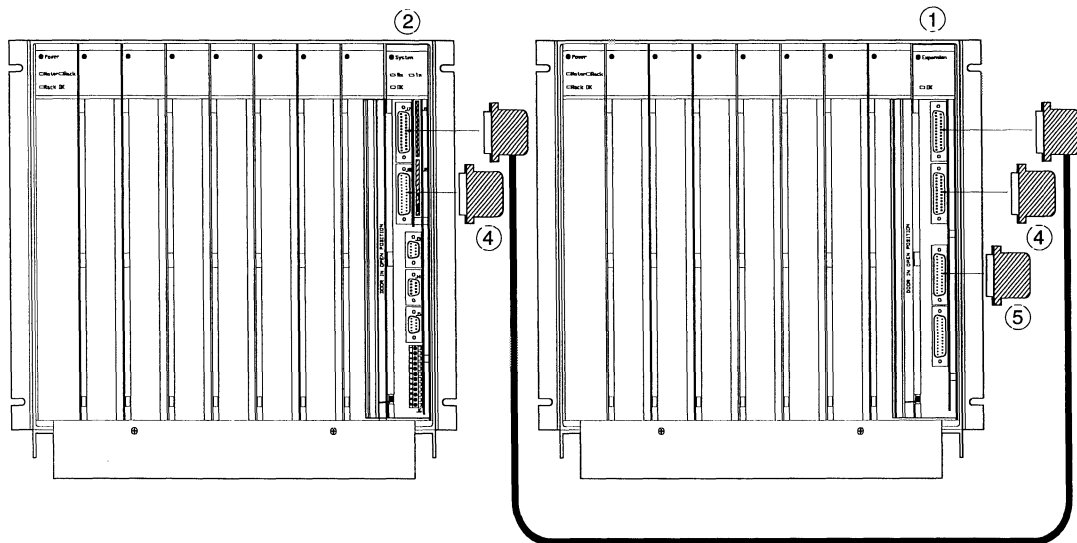
The wires that come out from the connectors should go down to the bottom of the rack. The wires of all the modules should then be grouped together using a wire tie as shown (*see B2*). This is done so that if the fan tray (which is on the bottom of the module) needs to be removed, the wires will not be in the way. Also, the air flow through the bottom of the module will not be blocked.



It is possible to have more than one servo module power the same servo motor if needed. In this case, the servo modules are linked as shown in the diagram at right. To each servo module, you should attach a servo motor linker cable (see 1). Then, the corresponding wire from each of the linker cables should be attached to the same section of the servo motor linker block (see 2). (Note that the servo module linker block is divided into four sections.) For example, each of the "R" wires should be connected to one section, each of the "S" wires should be connected to another section, and so on. Then, the wires of the servo motor cable (see 3) should be connected to the other side of the connector, corresponding to the correct section of the block. For example, the "R" wire should be connected to the section where all the "R" wires are, and so on. Finally, the other end of the servo motor cable is connected to the servo motor. For more information on the servo module, see Chapter 1, section E, "Servo".



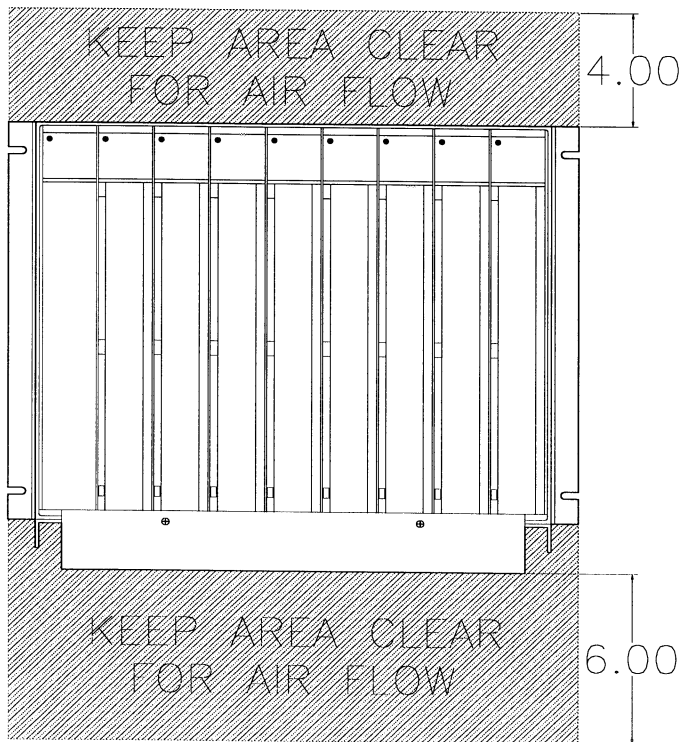
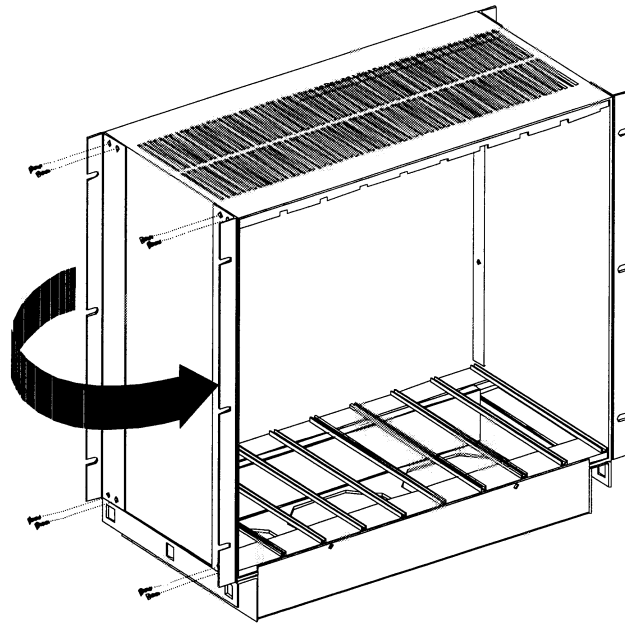
You can have up to three racks connected in a Target system. One potential way of connecting two racks is shown below. The expansion module (see 1), which is used to link additional racks to the main rack, is connected to the system module (see 2) as shown. Note that only the first cable, called the rack linker cable (see 3), is used to link the two racks. The second cable, called the servo/stepper module linker cable, is not used here, so terminating plugs are inserted where the connection should be (see 4). This setup occurs when you have an axis module in both racks. If you had an axis module only in the first rack, and you wanted this axis module to control servo modules in the second rack as well as the first rack, you would then use the servo/stepper module linker cable as well as the rack linker cable to link the two racks. Also note that a terminating plug (see 5) is inserted at the place where there would otherwise be a connection to a third rack. For other information on the expansion module, see Chapter 1, section C, "Expansion".



C. Rack Installation

In this section, we will show you how the rack should be installed. It is assumed that the rack has already been installed, therefore the purpose of this section is to give you a picture of how this is done, not necessarily to show you how to install a rack.

As you can see in the diagram at right, the rack is mounted using mounting ears. They are either placed in the rear of the rack for panel mounting, or they are placed in the front for rack mounting.



If you have multiple racks mounted on the same panel, the racks are mounted such that there is a minimum distance between them as shown in the diagram at left. There should be at least 4 inches of space on the top of the rack and 6 inches of space on the bottom so that each rack will receive an adequate amount of air flow.

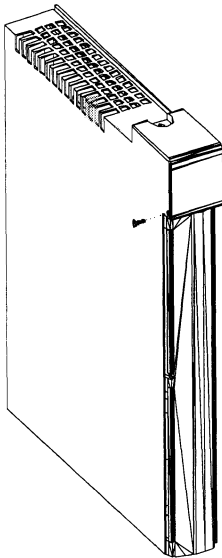
D. Module Expansion

In this section, we will show you how to expand the axis, analog I/O and digital I/O modules. Specifically, we will show you how to

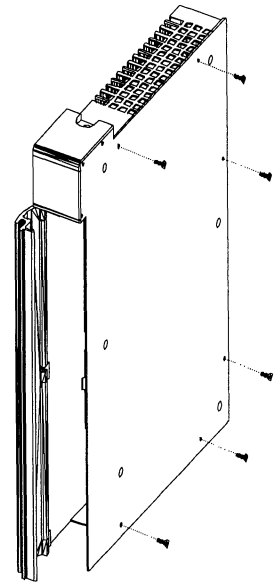
- expand a two axis module to a four axis module
- expand an analog I/O module from 4 inputs, 4 outputs to 8 inputs, 8 outputs
- expand a digital I/O module from 16 inputs, 16 input/outputs to 32 inputs, 32 input/outputs

The steps to expand each of the modules are very much the same. Basically, you will need to take the module apart, put in the expansion card, and put the module back together.

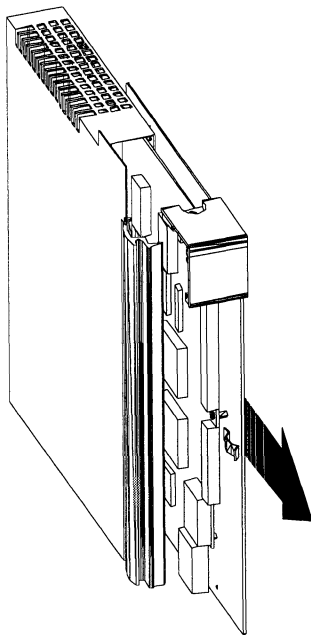
Before starting, you will have to remove the module from the rack if you have not done it already. After the module has been removed, follow these steps to expand the module:



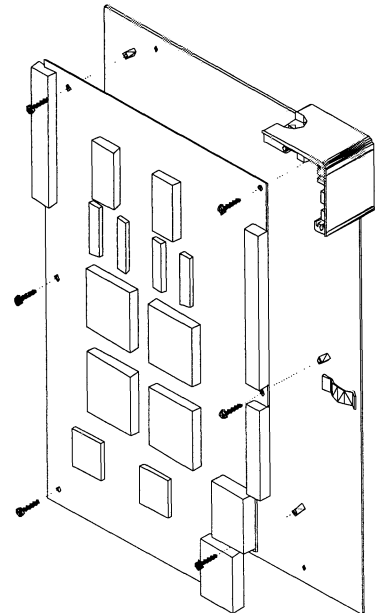
1. Remove the screw in the upper right hand corner of the module housing using a Phillips screwdriver.



2. Remove the six screws, which are on the perimeter of the plate of the module, using a Phillips screwdriver. Do not remove the three screws in the upper left hand corner of the plate.

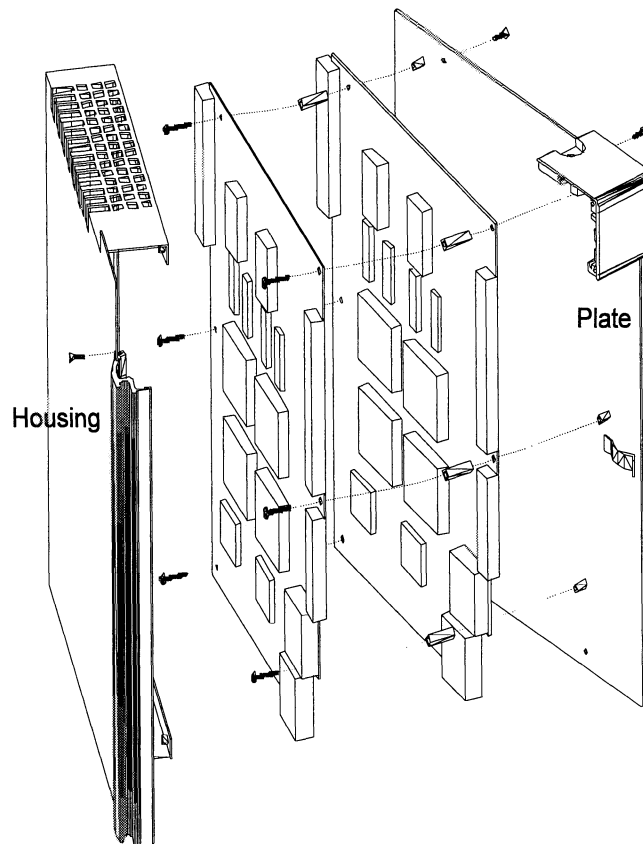


3. Carefully slide the plate (which has the circuit board attached to it) out of the module. Set the housing aside.



4. Remove the six screws on the perimeter of the circuit board using a flathead screwdriver. Set these screws aside -- they are no longer needed.

5. If you are expanding the axis module, you will need to remove jumper plugs JP1 and JP2 on the axis board. If you are expanding the digital I/O module, you will need to remove jumper JP1 on the digital board.
6. Now, install the expansion card. Take first the spacers, then the expansion card, and then the new (longer) screws, and assemble them as shown. Tighten the screws using a flathead screwdriver.
7. Carefully slide the plate back into the module housing, making sure that everything but the plate itself goes inside the housing.
8. Fasten the Phillips screws back into the module. Make sure that you put the longest of these screws into the upper right hand corner of the housing, and the rest into the plate.



3. Diagnostic Tools

3. Diagnostic Tools

In order to diagnose potential problems of the Target system, you will need a working knowledge of the diagnostic tools needed to do this. This chapter will describe what these tools are and how they are to be used. Some of the tools, such as the voltmeter and the oscilloscope, should be at your disposal. Other tools are already part of the Target system, such as the diagnostic commands. In these and other cases, this section will show how to use these tools to help identify system problems clearly.

The three main topics of this section are as follows:

- A. Hardware (e.g., voltmeter, ohmmeter, scope, PC)
- B. Diagnostic Commands
- C. CCS (Controller Communication Software)

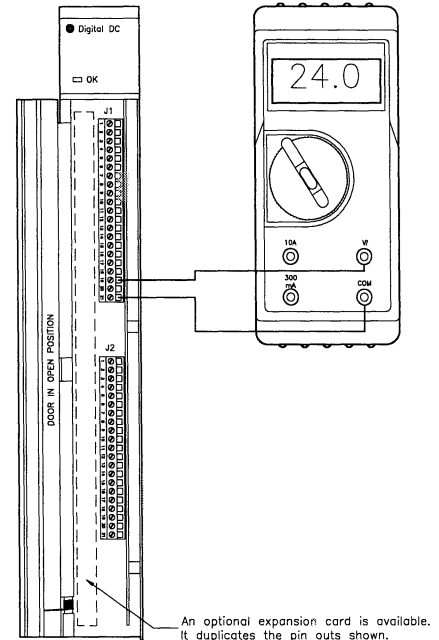
A. Hardware

These are the four different types of hardware that are needed to diagnose any system problem:

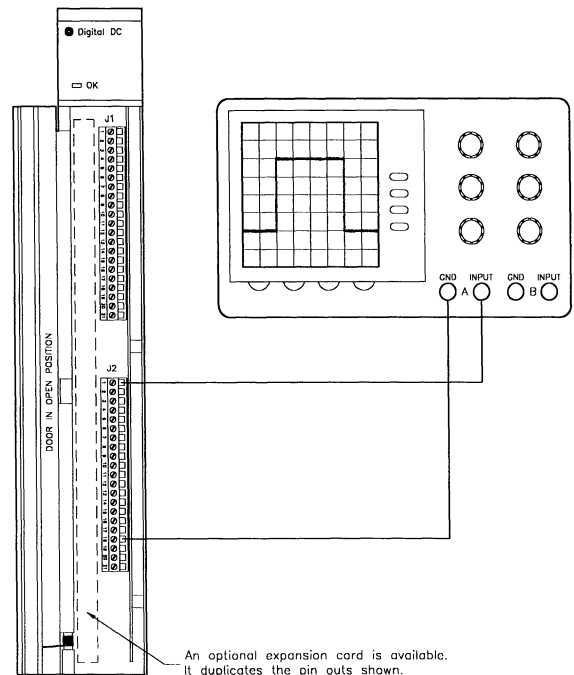
1. Voltmeters are used to check voltages on digital and analog inputs and outputs, AC power and individual power supplies.
2. Ohmmeters are used to check for shorts, opens, and bad resistors.

NOTE: Normally, these first two hardware tools are combined into what is called a digital multimeter.

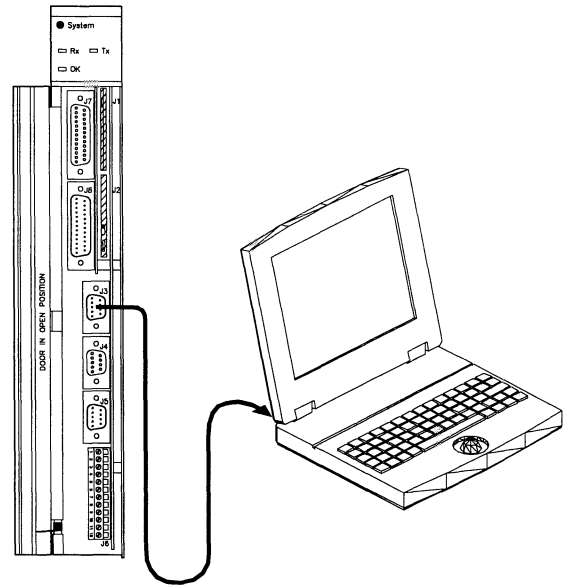
An example of a digital multimeter is shown at right.



3. Oscilloscopes are used to check voltages on inputs and outputs and power supplies, but NOT AC power. The voltages that occur on an AC power line are much too large to be handled by an oscilloscope, and can be adequately checked by a voltmeter. Scopes can also be used to check encoder outputs and pulse information. Since oscilloscopes can display the actual signal of interest (as opposed to a multimeter, which can only give a numerical voltage reading), they can be used to check not only voltage levels, but noise levels as well.



4. Finally, a PC (personal computer) is used to run CCS (Controller Communication Software) or some other terminal emulation software. This is so that you can enter diagnostic commands into the system. To use your PC to enter commands, you must first connect one of the available serial ports of the PC to the program port of the system module. This is shown in the diagram below. Then, using the terminal program, you should make the proper settings so that your computer will be able to communicate with the Target system. These settings are things such as baud rate and the port name. For more help on making the proper settings, refer to your computer manuals.



B. Diagnostic Commands

This section describes what the diagnostic commands of the Target system are and how to use them. First, a summary of the commands are given, then they are explained in detail, and a few examples of how the commands are used are given. Specifically, this section is divided up as follows:

1. Reporting Register Values (?)
2. Diagnostic Conditions and Items (DGC, DGI; DGE, DGL)
3. Examples

For further information on diagnostic commands, see Appendix A, "Diagnostic Command and Register Summary".

Diagnostic Command Summary

<i>mnemonic</i>	<i>description</i>
?	reports value of register
DGC	assigns diagnostic condition for printing
DGE	enables diagnostics
DGI	assigns diagnostic item to be printed
DGL	prints diagnostic line of items
DGO	outputs diagnostic register value to program port
DGP	prints diagnostic message to terminal
DGS	sets program to single step mode
DGT	sets program to trace mode
REVISION	reports firmware revision

1. Reporting Register Values (?)

When diagnosing the system, it will be necessary to check things such as the status of the system, any faults or errors that may have occurred, position & velocity of the axes, or others. All you need to know is which register you need to report, and then type this in followed by a question mark (?). This will give you the current value of the register. Some examples of registers you may want to check are:

- ▶ Fault, Status and Assignment Error Registers (AXE, AME, DME, SME, SRC, SRAM, SRDM, SRSM, SRP, SRS, SRA, IOS, IOA, FCS, FCA). When you type in one of these registers followed by "?", the system will output a message from the program port to the terminal you are using. These messages describe the status and/or fault condition of the system or part of the system (e.g. analog I/O module, servo module), or an assignment error for one of the modules. When the system is faulted, you should type in "FCS?" to check for the specific fault. If the axis is faulted, use "FCAa?", where *a* is the number of the axis. Further explanation of the messages that result from entering these commands can be found in Appendix B.
- ▶ Registers that contain position or velocity data for one of the axes, such as PSA, PSC, PSO, PSX, PSR, PCA, PCX, VLA, and VLX.
- ▶ Registers that contain information about the phase locked loop, such as PHP, PHR and PHM.
- ▶ I/O Registers (CTR, TMI, TMP, DI, DID, DIT, DIA, EG, DO, DOD, DOP, DOE, AI, AIO, AIB, AIF, AO, AOP, SPA, SPS). These registers are used to determine the values of the inputs and outputs of the system, and to store parameters related to the inputs and outputs of the system. For example, DI1 contains the values of the digital inputs of digital I/O module one, and DIA1 contains information about which digital inputs of digital I/O module one are to be filtered.

For a complete listing and description of the registers, see Appendix A, "Diagnostic Command and Register Summary".

2. Diagnostic Conditions and Items (DGC, DGI; DGE, DGL)

Diagnostic conditions and items are used to help distinguish certain events in the system that may be causing problems. Diagnostic items are simply expression operands that are used in the context of the diagnostic mode, which is enabled by the DGE command. (The diagnostic mode is enabled by entering "DGE=1" on the terminal you are using.) Up to eight diagnostic items can be defined using the DGI command. Diagnostic items, for example, can be things like the axis position (PSA a), axis velocity (VLA a), control output (CMD a), or variable values (VB n , VI n , etc.). A line of diagnostic items can be printed to the terminal using the DGL command. See the command summary for more information.

Alternatively, you can tell the controller when to print a diagnostic line of items to the terminal by setting diagnostic conditions. When a diagnostic condition is met, then a diagnostic line items will be printed to the terminal. The DGC command can be used to define up to eight diagnostic conditions. Diagnostic conditions can be set to any boolean expression; for example, you can set DGC1 to program n executing (PROG n), timer n timed out (TM n) or axis n motion generator enabled (SRA n .0). Note that only one of the eight diagnostic conditions needs to be satisfied for the controller to output the diagnostic line of items.

3. Examples

Here are two examples which show you how to use some of the diagnostic commands above to troubleshoot the system. The examples follow directly from the troubleshooting chart in Chapter 4.

a. Example of an Axis Module Check

Let's say that, in diagnosing the Target system, you find out that on the axis module, the OK LED for axis one is off, and therefore axis one is faulted. Then, using a PC running a terminal program, you would type

FCA1?

to check for the type of fault that has occurred on axis one. Now, let's say that you get the message

Motor Over-Temperature

Then, by looking this fault code message up in Appendix B, Chart 3, "Axis Fault Code Messages", you find the following, which tells you the possible cause(s) (in the third column) and solution(s) (in the fourth column) for the above fault code message:

15	Motor Over-Temperature	The temperature sensor in the motor sensed the motor going over its maximum allowed temperature.	<ul style="list-style-type: none"> ▶ Check for a broken wire in the motor feedback cable. ▶ If motor is hot, it is improperly sized.
----	------------------------	--	--

You would then go ahead and try the above solutions to see if one of them solves the problem.

b. Example of a System Module Check

Let's say that, in diagnosing the Target system, you find out that the OK LED of the system module is off, and therefore the module is faulted. Then, using a PC running a terminal program, you would type

FCS?

to check for the type of system fault that has occurred. For example, let's say you get the message

Axis Communication Error

Then, by looking this fault code message up in Appendix B, Chart 2, "System Fault Code Messages", you find the following, which tells you the possible cause(s) (in the third column) and solution(s) (in the fourth column) for the above fault code message:

24	Axis Communication Error	The system module is not communicating properly with one of the axes.	▶ Type "SRC?" to determine the specific axis that is causing the error.
----	--------------------------	---	---

You would then go ahead and type

SRC?

and get a message such as the following

Axis one communication is bad

If you look this up in Appendix B, Chart 6, "Communication Status Messages", you will find the following entry:

0	Axis one communication is bad	The system module is not communicating properly with axis one.	► Replace system module and/or axis module if fault will not go away with the RSFALL command.
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You would then proceed with the possible solution given.

C. **CCS (Controller Communication Software)**

CCS is a program that can be used to easily interface with the Target system. It is a terminal emulation program with added features that make it simple to enter commands into the Target system. The purpose of this section is to give a general description of CCS and how to use it. The Whedco model number for CCS is: SFW-CCSW-5-0. The software is available only in a Windows format.

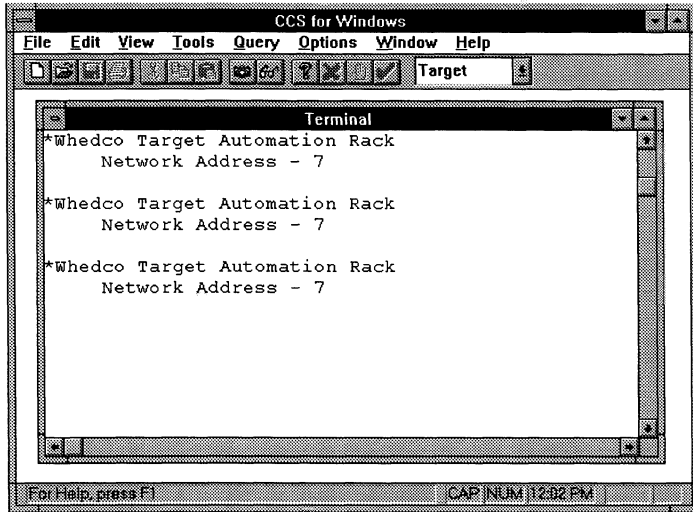
To install CCS:

1. Insert diskette in appropriate drive
2. Go to Program Manager
3. Select File
4. Select Run ...
5. At Command Line specify appropriate drive followed by :setup
6. Follow instructions on screen
7. When installation is complete, a Program Manager Group will be created for CCS for Windows

To run CCS:

1. Double click on CCS for Windows icon (or hit enter)
2. The first time you run the program, a message will appear indicating no Com Port has been specified. Go to the Options pull-down menu and select Settings. Under settings, select the appropriate Com Port. The baud rate should be set to the default of 9600. Under Controller Address, select Target. If the Target has just been powered up, a message will appear indicating the controller address is not valid or baud rate is not correct. Indicate OK. Each time the Target is powered up, the software must be initialized by sending several carriage returns. Hit the enter key five (5) times to complete this initialization.
3. Once initialized, the system will respond with Whedco Target Automation Rack and Network Address.

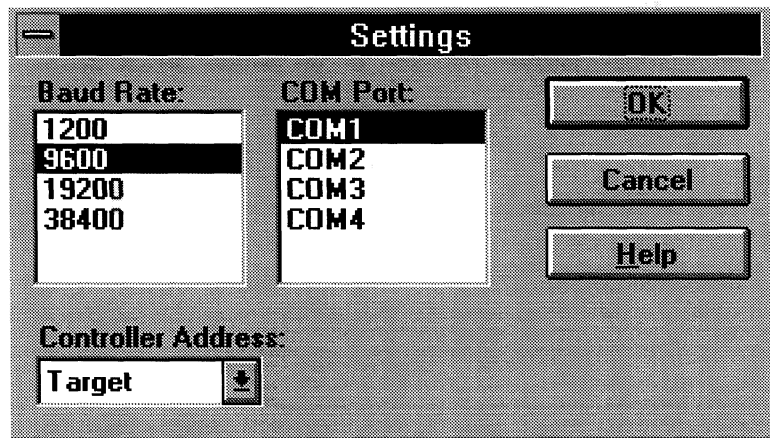
If the system fails to initialize, check the Troubleshooting Checklist for possible solutions.



Terminal Mode

CCS software allows easy communication with the Target from a PC/AT compatible computer providing a terminal emulator for direct communication.

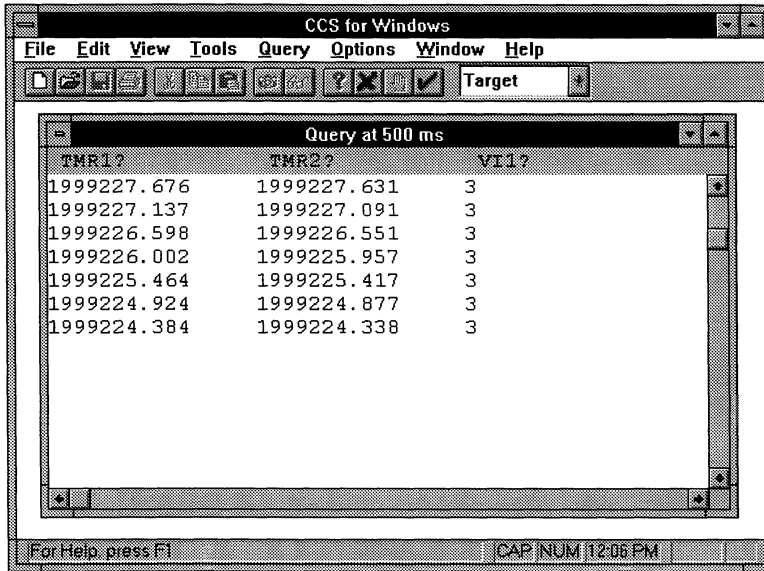
To initialize CCS, the Com Port, Controller Address (Target) and Baud Rate (default 9600) must be specified.



Troubleshooting Checklist

If CCS fails to initialize, check the following:

1. Be sure the Target is connected to the power source.
2. Be sure the serial cable is connected to the System module at program port J3 (see page Rack & Module Description 1 - 2 for location) and to Com Port on PC. Be sure to note which Com Port is used so correct Com Port can be specified in Settings in CCS.
3. Be sure correct Controller Address is specified. This must be Target.
4. Be sure the default baud rate of 9600 is specified. Target will automatically set the correct baud rate after the system is initialized.
5. The Rx LED on the System module should flicker when typing characters to the terminal. If the LED does not flicker, the System module is not receiving characters from the terminal. If the Rx LED is working but the Tx LED does not flicker, the System module is not transmitting back to the terminal and no characters will appear on the screen.
6. CCS also has a Help menu which includes on-line troubleshooting tips.



Query Mode

A query function provides on-screen, real-time reporting on machine parameters.

Queries can be performed in the Terminal Mode by typing the mnemonic command followed by ? and a carriage return. (i.e., SRS?)

Queries may also be performed by selecting "Start" from the Query Menu. You may specify up to five different queries which will all be reported simultaneously as well as a query rate in milliseconds. Enter the desired queries, the query rate and then select OK. CCS will send all queries to the Target if all are valid. If any query is invalid, an error message will appear.

The tool bar is another way to access Query mode in CCS. The "?" button can be used to start a query. The "X" button ends a query currently running. The "hand" button pauses a query currently running and the "check" button resumes the running of a query.

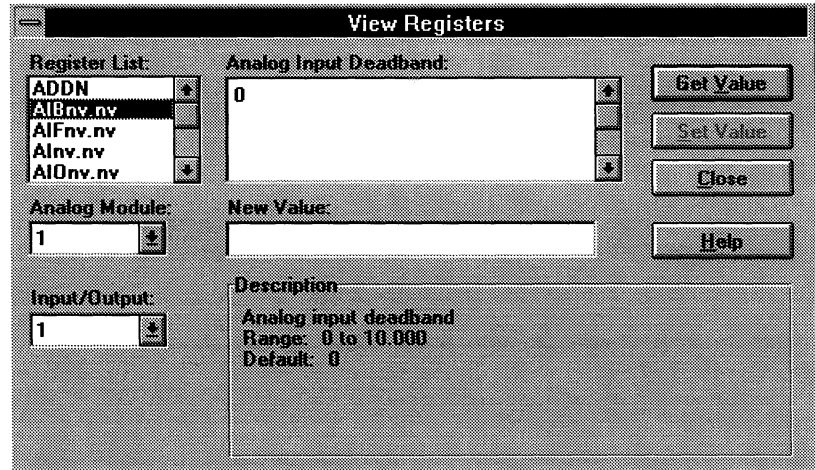
The "Query" dialog box contains the following fields and buttons:

- Query 1: TMR1?
- Query 2: TMR2?
- Query 3: VI1?
- Query 4: (empty)
- Query 5: (empty)
- Query Rate (in milliseconds): 500
- Buttons: OK, Cancel, Help

View Registers

On-line help provides a complete explanation of user parameter settings and complete descriptions of program commands.

View Registers can be accessed through the Tools pull-down menu. To query the value of a register, select the register name from the register list. The value will be displayed in the text box along with a description in the dialog box. If the register requires a parameter, the parameter may be selected from a list appearing below the register list.



Select "Set Value" to change the value for that parameter. Some values are read only and cannot be changed. To set the value of the register, use the New Value text box, type in the new value, and hit Enter or select " Set Value" to produce the new value.

The View Registers screen can also be accessed through the "eyeglasses" icon on the tool bar.

If you wish to write incoming characters to a file, you can open a Capture File through the Tools pull-down menu or by using the "Camera" icon on the tool bar. Choose Open Capture File and name the file. This will save all settings for communication and all queries and rate. When you want to stop capturing characters,, choose Close CaptureFile.

All visual settings for CCS such as the color of the screen, type fonts and scroll bars can be changed through the Options pull-down menu.

Upon exiting CCS, all settings are saved. The next time you start CCS, all settings will be restored.

Diagnostic Commands

In the Terminal Mode, you may review Diagnostic Commands by first setting DGE=1 which enables the diagnostics. You may also check the firmware revision level by typing REVISION. Reg? reports the value of a register.

5. How to Replace Parts

5. How To Replace Parts

Now that you have determined the specific problem, it is possible that you will have to replace one of the components of the Target system. The purpose of this chapter is to show you how to replace the part that is needed. This, along with Chapter 2, will show you how to install and replace system components, which will be needed to correct some of the possible system problems. Specifically, this chapter will show you

- A. how to replace modules (including how to replace memory cards) and
- B. how to replace the fans.

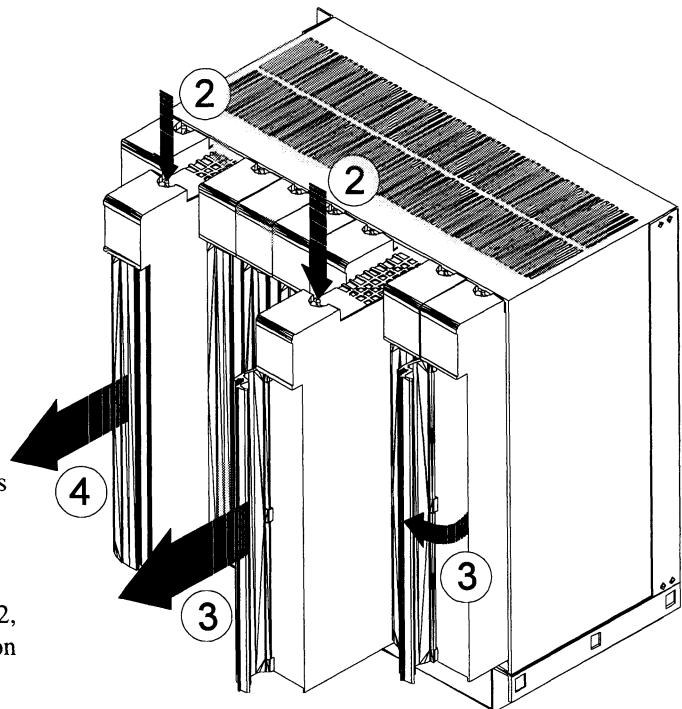
NOTE: Before replacing any of the components of the Target system, MAKE SURE THAT ALL POWER IS TURNED OFF.

A. Module Replacement

The purpose of this section is to show you how to replace a faulty module. For all the available modules, the steps that you will take to replace the modules are mostly the same except for the power and servo modules. These two modules are constructed differently than the other ones, and so have to be replaced in slightly different ways.

First, make sure that all power is off, and then follow these steps to replace the modules (for steps 2, 3 and 4, use the diagram below):

1. (Not applicable to power module) Remove all connectors from the module. Note that the servo module is wired from the bottom, and the rest (except for the power module) are wired from the front. Having done this, make sure that the connectors and wires are out of the way so that you can take out the module.
2. Push the release button down and hold it down with one hand.
3. (Not applicable to power or servo module) Open the door with your other hand and pull on it outward to remove the module.
4. (For power and servo module ONLY) Hold the bottom of the module with your other hand and pull on it outward to remove the module.
5. (For power module ONLY) Remove the wires from the connector from the bottom of the right side of the module using a screwdriver.



To insert a new module, see Chapter 2, section A, "Module Installment", for details on how to do this.

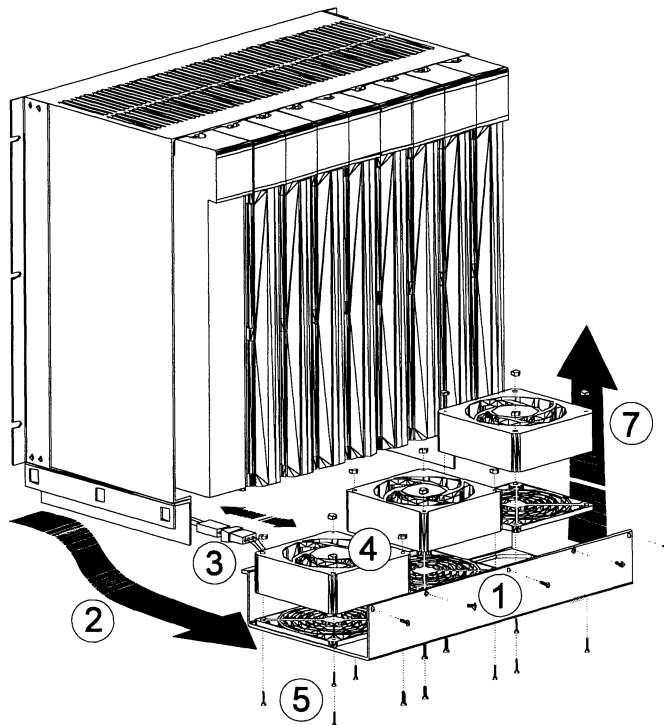
In order to replace a memory card, you must first pull the memory card out carefully. To insert a new memory card, see Chapter 2, section A, "Module Installment" for details.

B. Fan Replacement

This section will show you how to replace the fans, which are mounted on the bottom of the Target module. Here are the steps that you should take to replace one of the fans:

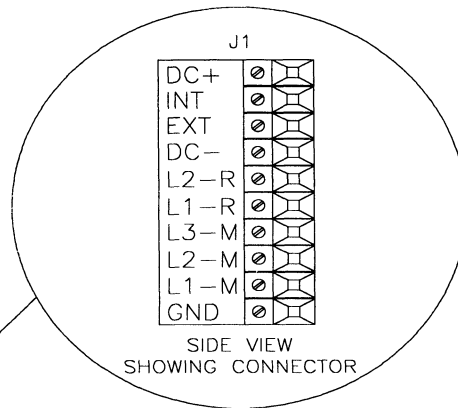
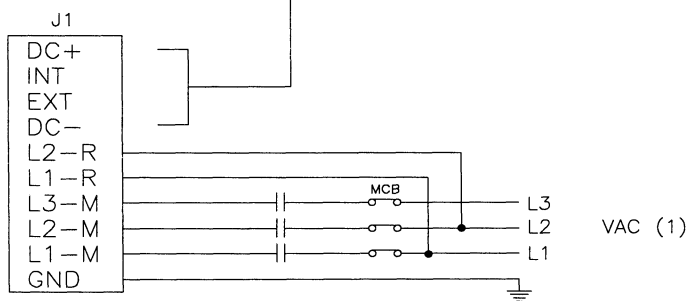
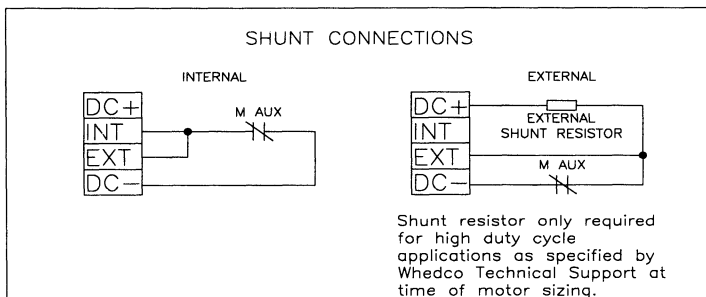
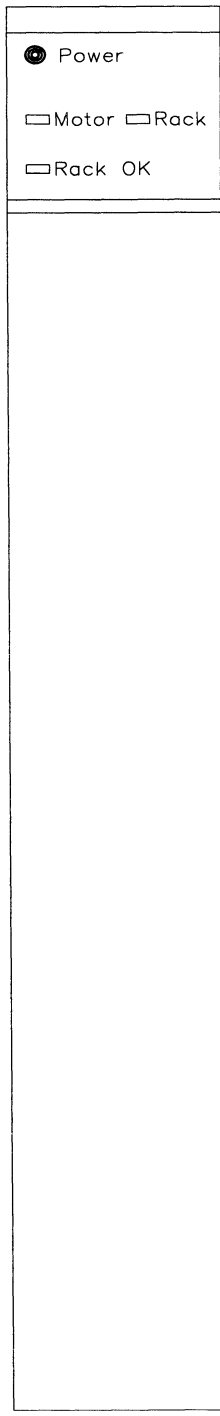
1. Remove the five screws on the front of the fan tray.
2. Slide the fan tray out as shown.
3. Disconnect the connector for the backplane.
4. Remove the four nuts from the top side of the fan.
5. Remove the four bolts from the bottom side of the fan.
6. Remove the wires from the back of the fan. Note that there are two (or four) red wires and one green wire. To remove the green wire, simply unscrew and remove the forked connection. To remove the red wires, you will have to desolder the connection. Take special care in doing this if there are two red wires joined together at one connection point.
7. Take the fan off.

To put the fan back in, just back track the steps that you took to remove it. In other words, take the new fan, resolder the red wires, reconnect the green wire, screw in the bolts, etc.



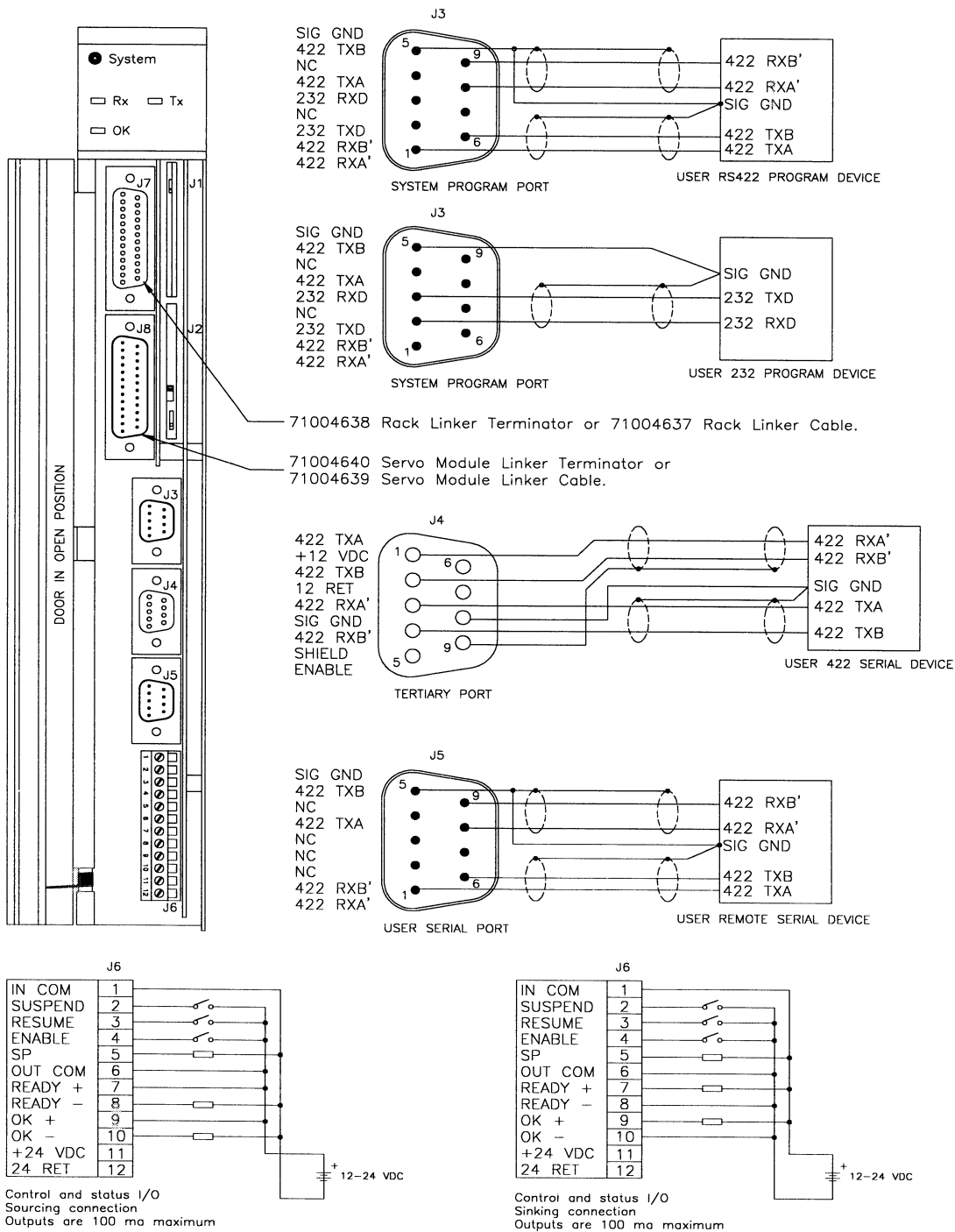
Appendix A
Wiring Diagrams

Power Module

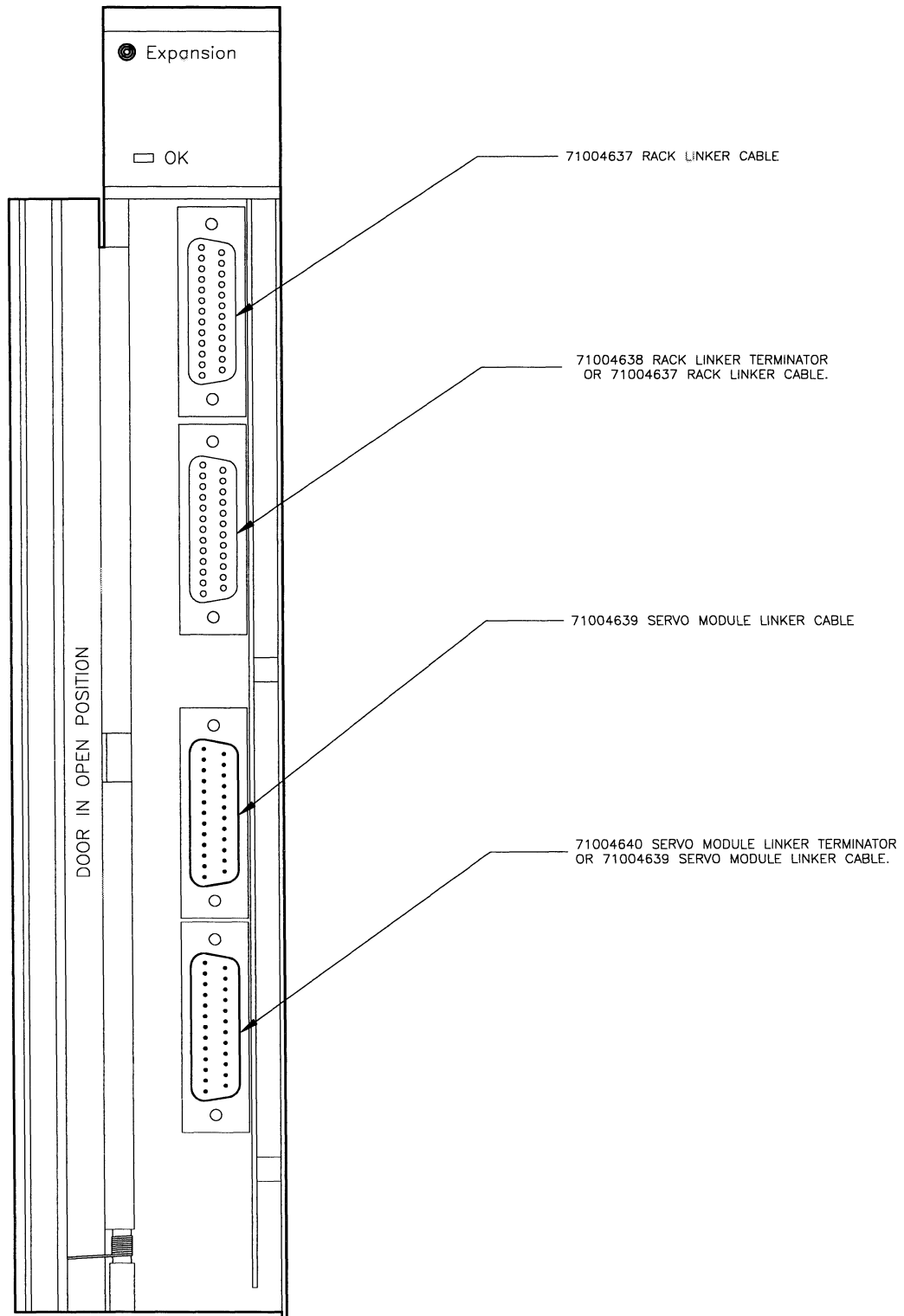


- Notes:
- (1) Rack input power: 180-250 VAC, 50-440 Hz
1 phase @ 2 Amps
 - (2) Motor input power: 180-250 VAC, 50-440 Hz
1 phase @ 14 Amps, 3 phase @ 7 Amps per Servo Module
 - (3) The power module must be positioned in the far left slot of the rack.

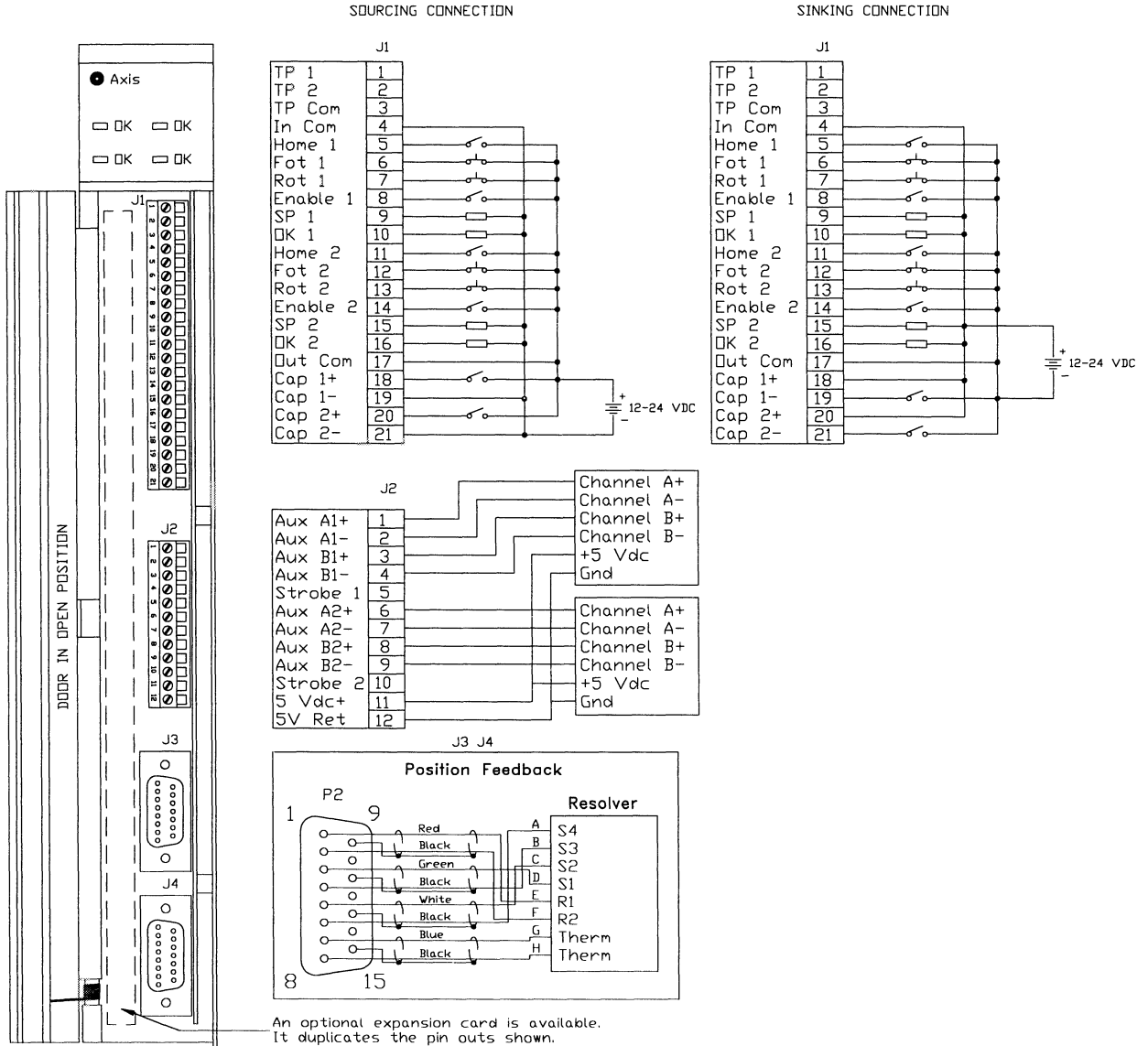
System Module



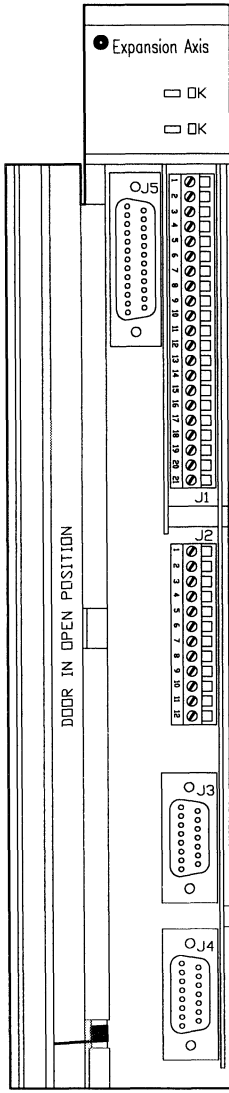
Expansion Module



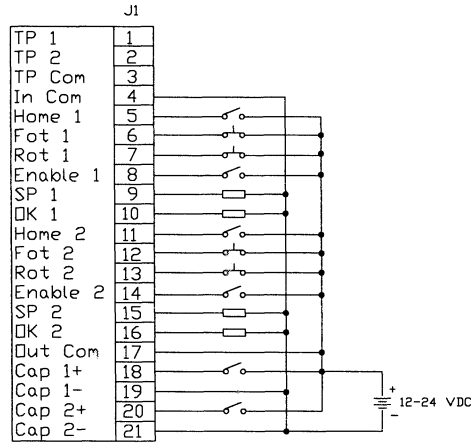
Axis Module



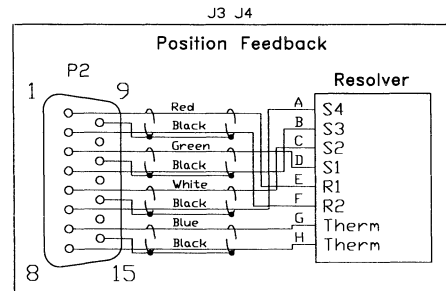
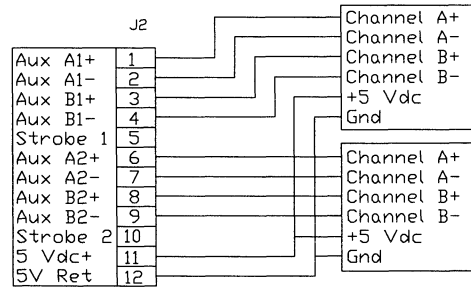
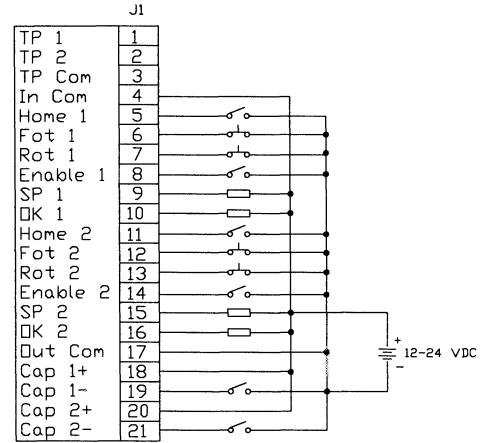
Expansion Axis Module



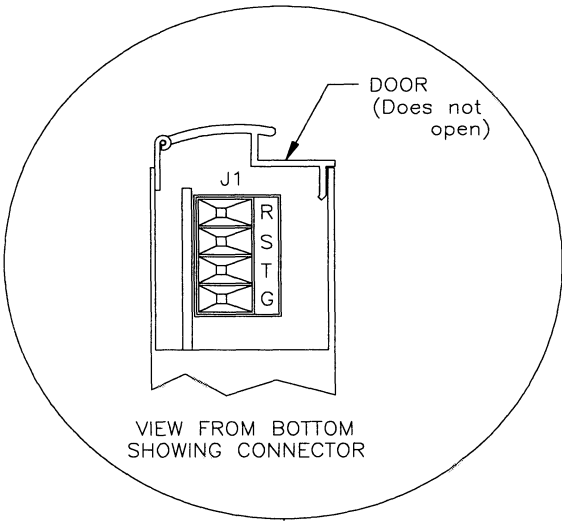
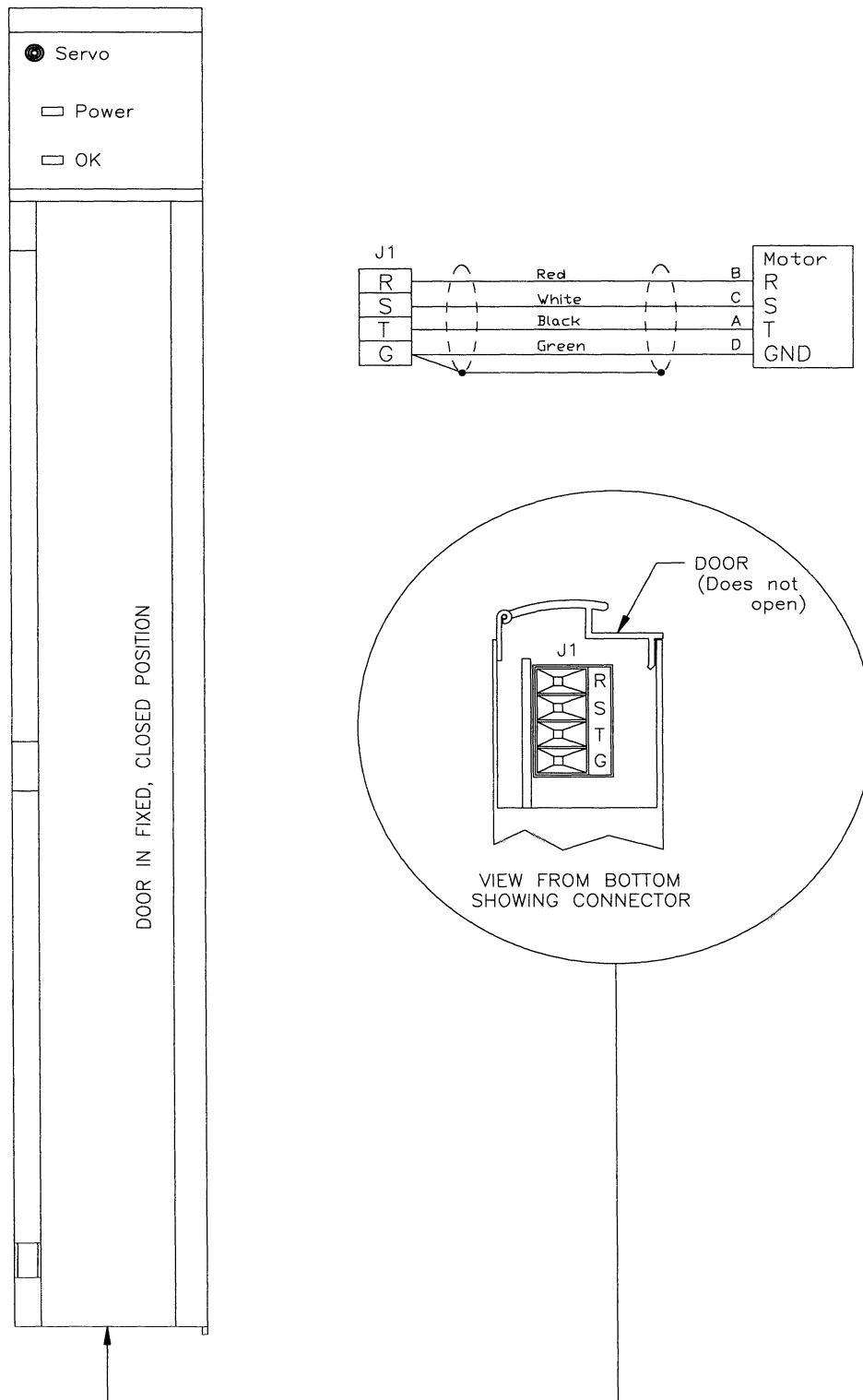
SOURCING CONNECTION



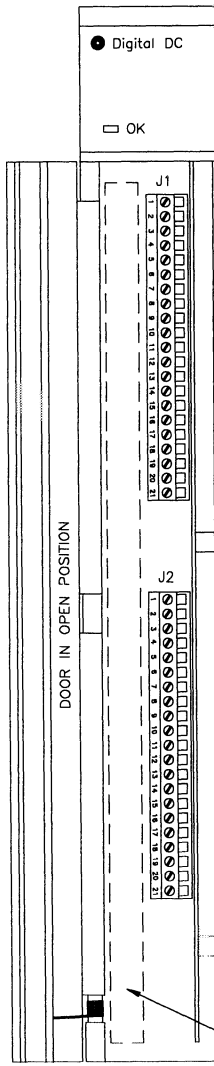
SINKING CONNECTION



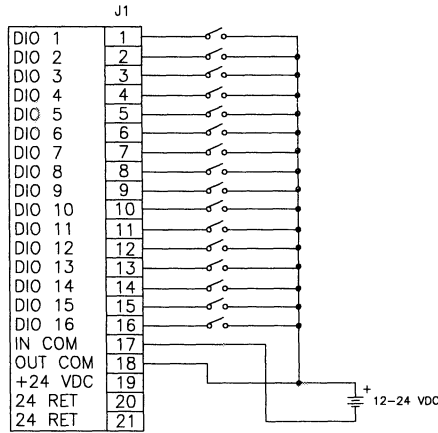
Servo Module



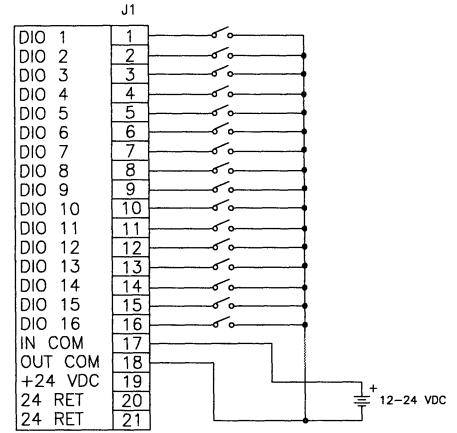
Digital Input/Output Module



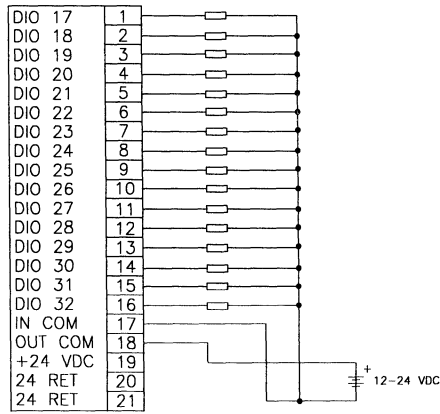
SOURCING CONNECTION



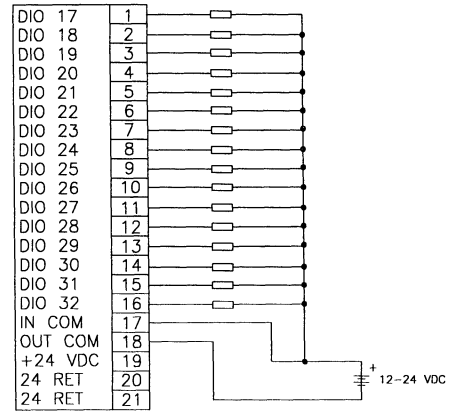
SINKING CONNECTION



J2



J2

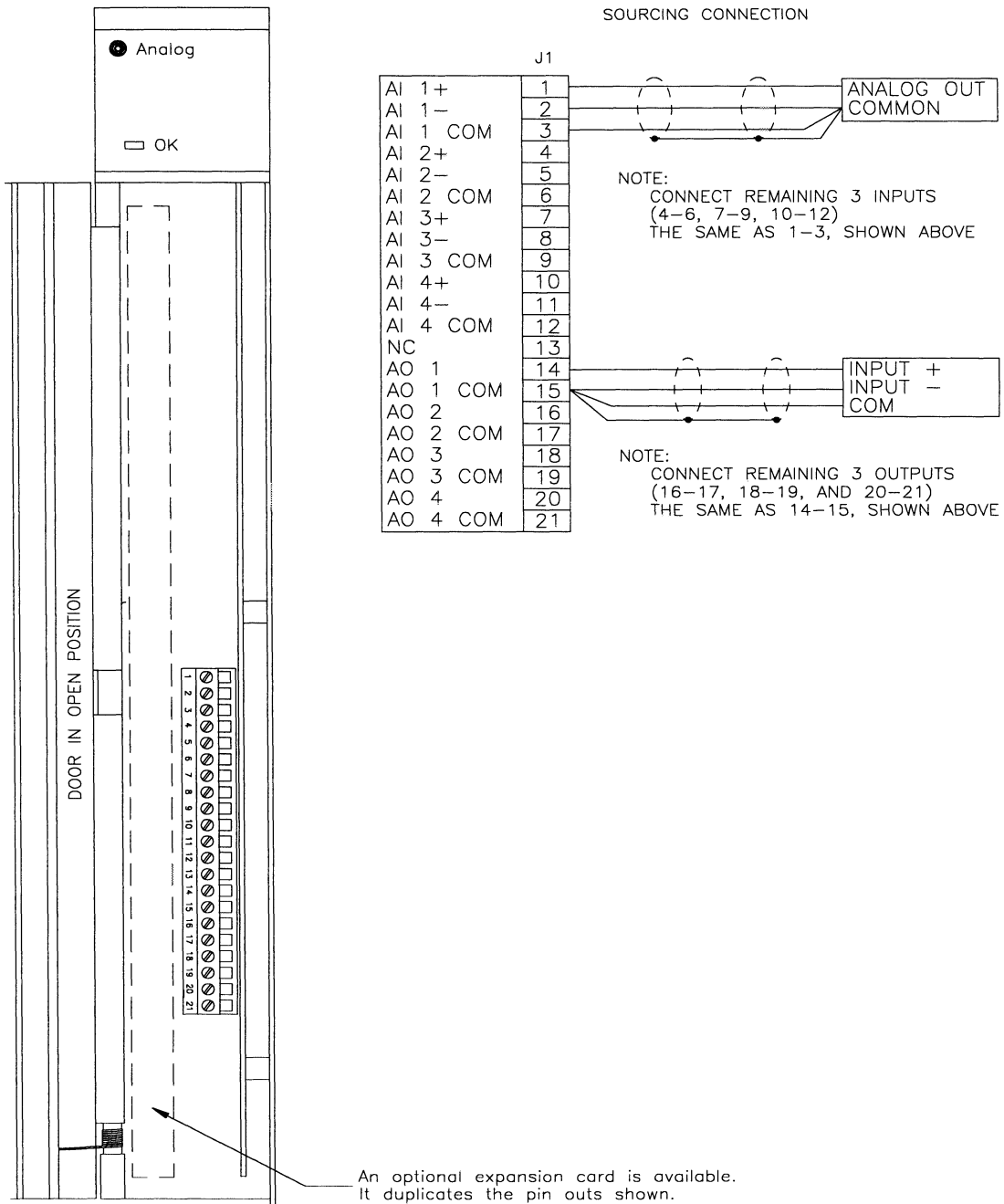


An optional expansion card is available. It duplicates the pin outs shown.

NOTES

1. Outputs are 100 ma maximum.

Analog Input/Output Module



Appendix B

Spare Parts

Spare Parts List

Spare Part Type	Model Description	Whedco Part Number
Rack Hardware	Rack with Power Supply Module (includes two spare modules and fans)	78005068
	Door assembly kit (door, hinge, spring)	28255208
	Mounting ear	14004597
	Fan	26000019
	Fan Guard	28000023
	Spare Module	78005102
Modules	System	78004655
	Analog	78004661
	Digital DC	78004659
	Axis	78004656
	Servo	78004658
	Stepper	not available at this time
	Expansion Axis	78005196
	Expansion Rack	78004662
	Power Supply (only)	78004654
Expansion Kits	Axis - Expansion Card Kit	78004657
	Analog - Expansion Card Kit	78005069
	Digital DC - Expansion Card Kit	78004660
PCMCIA Memory Cards	Flash: Stores User Application Program	31430139
	BBRAM: Stores Variables	31430069
Cables and Connectors	Rack Linker Cable	71004637
	Servo/Stepper Module Linker Cable	71004639
	Rack Linker Terminator	71004638
	Servo/Stepper Module Linker Terminator	71004640
	Quick Disconnect Terminal Connector: 21 pin	21000408
	Quick Disconnect Terminal Connector: 12 pin	21000409
	Quick Disconnect Terminal Connector: 4 pin	21000372
	Servo Motor Linker Block	21005268
	Servo Motor Cable - 6 Amp (direct linkage without Servo Motor Linker Block)	71004712
	Servo Motor Cable - 12 Amp (used with Servo Motor Linker Block)	71004713
	Servo Motor Linker Cable	71005267
Software	SFW-CCSP-6-0	20506199

Appendix C
Specifications

Specifications

Motion Parameters

Description	Minimum	Maximum	Resolution	Units
Absolute Position Register	-2,000,000,000	+2,000,000,000	1	pulses
Absolute Move Distance	-2,000,000,000	+2,000,000,000	1	pulses
Incremental Move Distance	-2,000,000,000	+2,000,000,000	1	pulses
Offset Move Position	-2,000,000,000	+2,000,000,000	1	pulses
Acceleration/Deceleration	100	1,000,000,000	2	pulses/second ²
Velocity	1	16,000,000	1	pulses/second
Acceleration/Deceleration Percent	1	99	1	percent
Move Time	0.005	10,000.000	0.001	seconds
Jerk Percent	0	100	1	percent
Unit Ratio ^(a)	1	1,000,000	1	pulses/unit

(a) The unit ratio is used to convert to engineering units. To determine the range of permissible values for each parameter in engineering units, divide the parameter minimum and maximums by the number assigned to the unit ratio.

Memory

Type	Size/Range	Standard	Optional
Programs	224 Kbytes	17	n/a
Motion Blocks	224 Kbytes	400	n/a
Integer	+/-2,147,483,647	4,096 ^(a)	262,144 ^(a)
Floating Point Variables ^(b)	+/-1.7X10 ^{+/-38}	2,048 ^(a)	131,072 ^(a)
Boolean Variables	1-bit	256	n/a
String Variables	127 characters	16	144
Countdown Timers	2,000,000.000 seconds	16	n/a
Interval/Pulse Timer	200,000.0000 seconds	0	32
Total User Program Storage	n/a	256 Kbytes BBRAM or EPROM	
Total Variable Storage	n/a	16.5 Kbytes BBRAM	1 Megabyte BBRAM

(a) Integer and Floating Point Variable space is shared. There can be a maximum of 4096 integer variables or 2048 floating point variables, but not both. Integer and Floating Point Variables can be mixed with memory space shared (for example, if 1024 Floating Point Variables are used, 2048 integer variables are possible). The same ratio of integer and floating point memory applies if the optional memory is purchased.

(b) Floating point variables utilize a 32-bit mantissa and are precise to 9 decimal digits.

Timing

Inputs

Type	Speed
Digital Inputs	1.5 milliseconds
Analog Inputs	2.0 millisecond
Position Capture Update Rate	400 nanoseconds

Outputs

Type	Speed
Digital Outputs	2.5 milliseconds
Analog Outputs	1.0 millisecond
Setpoint Outputs	300 microseconds

Axis

Type	Speed
Servo Update	122 microseconds
Position Capture	400 nanoseconds

Timers

Countdown Update Rate	1.0 millisecond
Interval/Pulse Update Rate	100 microseconds

Mathematical Operands

add, subtract, multiply, divide, square root, absolute value, exponential, natural log, sine, cosine, tangent, arc tangent (trigonometric functions are in degrees)

Communication

Format	RS - 232	RS - 422
Programming Port	1	1
User Port	n/a	1
Baud Rate	1200, 9600 or 19200	

Discrete Inputs and Outputs

Inputs

Number Available	256
Operating Range	12-24 Vdc, 30 Vdc maximum
Maximum Off Input Voltage	4 Vdc
Minimum On Input Voltage	10 Vdc
Load	2K Ohms
Interface Format	source/sink user configurable

Outputs

Number Available	256
Operating Range	12-24 Vdc, 30 Vdc maximum
Maximum On Resistance	35 Ohms
Maximum Load Current	100 mA
Maximum Off Leakage Current	200 nA
Interface Format	source/sink user configurable

Analog Inputs and Outputs

Inputs

Maximum Number Available	8
Voltage	+/- 10 Vdc
Input Impedance	50K Ohms
Resolution	12-bits

Outputs

Maximum Number Available	8
Voltage	+/- 10 Vdc
Current	10 mA
Resolution	12-bits

Position and Velocity Feedback

Incremental Encoder

Maximum Number Available	1 per axis
Input Format	single-ended or differential, quadrature sine or square wave or pulse/direction
Input Voltage	5 to 24 Vdc
Maximum Line Count Frequency	2.5 MHz (1X) or 10 MHz (4X)

Resolver

Maximum Input Available	1 per axis
Type	control transmitter
Phase Shift	+/- 5.0 degrees at 5 KHz
Primary Impedance	$(R+jI) > 150 \text{ Ohms @ } 5 \text{ KHz}$
Null Voltage	<20 mV rms @ 5 KHz
Maximum Speed	15,000 rpm
Resolution	12-bits
Transformation Ratio	0.50 to 2.0

D C Power Supplies

Logic Input	180 to 265 VAC 47-63 Hz single phase
Drive Input	180 to 265 VAC 47-63 Hz single or three phase
User Output	+ 5 Vdc @ 1.0 Amps, + 24 Vdc @ 1.75 Amps

Environmental

Operating Temperature	0 to 40 degrees C. free air ambient
Storage and Shipping Temperature	0 to 80 degrees C.

Rack Configuration

Number of Modules Per Rack	8 maximum plus power supply
Racks Per System	3 maximum
Number of Addressable Systems	64 maximum

Performance

Drives

Motor Type	Drive Type	Rating
Brushless Servo	integral*	up to 24 Amps continuous per axis @ 310 Vdc, 2X peak
Servo	user supplied	any amplifier accepting +/- 10 Vdc analog velocity or current input

*maximum 10 horsepower continuous per rack

Consult factory for performance curves

Target Power Module

J1 MAINS AND DC POWER			
PIN	SIGNAL	DIRECTION	FUNCTION
1	DC+	Out	DC Bus+
2	INT	Out	Internal Clamp Resistor
3	EXT	In	To Clamp Resistor
4	DC-	RETURN	DC Bus Return
5	L2-R	In	AC Rack Power Mains
6	L1-R	In	AC Rack Power Mains
7	L3-M	In	AC Motor Mains
8	L2-M	In	AC Motor Mains
9	L1-M	In	AC Motor Mains
10	G	Frame	Frame Ground Connection Point

Target Axis Module

J1 DIGITAL INPUTS AND OUTPUTS			
PIN	SIGNAL	DIRECTION	FUNCTION
1	TP1	Out	Axis 1 User Test Point
2	TP2	Out	Axis 2 User Test Point
3	TP COM	Common	Test Points Common
4	IN COM	Common	Inputs Common
5	HOME 1	In	Axis 1 Home
6	FOT 1	In	Axis 1 Forward Overtravel
7	ROT 1	In	Axis 1 Reverse Overtravel
8	ENABLE 1	In	Axis 1 Enable
9	SP 1	I/O	Axis 1 Set Point
10	OK 1	Out	Axis 1 Status OK
11	HOME 2	In	Axis 2 Home
12	FOT 2	In	Axis 2 Forward Overtravel
13	ROT 2	In	Axis 2 Reverse Overtravel
14	ENABLE 2	In	Axis 2 Enable
15	SP 2	I/O	Axis 2 Set Point
16	OK 2	Out	Axis 2 Status OK
17	OUT COM	Common	Outputs Common
18	CAP 1+	In	Axis 1 Position Capture +
19	CAP 1-	In	Axis 1 Position Capture -
20	CAP 2+	In	Axis 2 Position Capture +
21	CAP 2-	In	Axis 2 Position Capture -

Target Axis Module

J2 AUXILIARY ENCODER			
PIN	SIGNAL	DIRECTION	FUNCTION
1	A1+	In	Axis 1 Auxiliary Channel A+
2	A1-	In	Axis 1 Auxiliary Channel A-
3	B1+	In	Axis 1 Auxiliary Channel B+
4	B1-	In	Axis 1 Auxiliary Channel B-
5	STROBE 1	Out	Axis 1 Auxiliary Position Request Strobe
6	A2+	In	Axis 2 Auxiliary Channel A+
7	A2-	In	Axis 2 Auxiliary Channel A-
8	B2+	In	Axis 2 Auxiliary Channel B+
9	B2-	In	Axis 2 Auxiliary Channel B-
10	STROBE 2	Out	Axis 2 Position Request Strobe
11	5 VDC+	Out	5 Volt Encoder Power Supply
12	5V RET	Return	5 Volt Power Supply Return

J3, J4 RESOLVER			
PIN	SIGNAL	DIRECTION	FUNCTION
1	R1	Out	Rotor Pin 1
2	R2	Out	Rotor Pin 2
3	S1	In	Stator Pin 1
4	S3	In	Stator Pin 3
5	S2	In	Stator Pin 2
6	S4	In	Stator Pin 4
7	THERM +	In	Thermistor Input +
8	THERM -	In	Thermistor Input -
9	SHIELD	Return	Shield
10	SHIELD	Return	Shield
11	SHIELD	Return	Shield
12	SHIELD	Return	Shield
13	SHIELD	Return	Shield
14	SHIELD	Return	Shield
15	SHIELD	Return	Shield

Target Digital I/O Module

J1 USER DIGITAL INPUTS AND OUTPUTS			
PIN	SIGNAL	DIRECTION	FUNCTION
1	DIO 1	In/Out	Input/Output 1
2	DIO 2	In/Out	Input/Output 2
3	DIO 3	In/Out	Input/Output 3
4	DIO 4	In/Out	Input/Output 4
5	DIO 5	In/Out	Input/Output 5
6	DIO 6	In/Out	Input/Output 6
7	DIO 7	In/Out	Input/Output 7
8	DIO 8	In/Out	Input/Output 8
9	DIO 9	In/Out	Input/Output 9
10	DIO 10	In/Out	Input/Output 10
11	DIO 11	In/Out	Input/Output 11
12	DIO 12	In/Out	Input/Output 12
13	DIO 13	In/Out	Input/Output 13
14	DIO 14	In/Out	Input/Output 14
15	DIO 15	In/Out	Input/Output 15
16	DIO 16	In/Out	Input/Output 16
17	IN COM	Common	Input Common
18	OUT COM	Common	Output Common
19	24 VDC +	Out	24 Volt Power Supply
20	24 RET	Return	24 Volt Power Supply Return
21	24 RET	Return	24 Volt Power Supply Return

Target Digital I/O Module

J2 USER DIGITAL INPUTS AND OUTPUTS			
PIN	SIGNAL	DIRECTION	FUNCTION
1	DIO 17	In/Out	Input/Output 17
2	DIO 18	In/Out	Input/Output 18
3	DIO 19	In/Out	Input/Output 19
4	DIO 20	In/Out	Input/Output 20
5	DIO 21	In/Out	Input/Output 21
6	DIO 22	In/Out	Input/Output 22
7	DIO 23	In/Out	Input/Output 23
8	DIO 24	In/Out	Input/Output 24
9	DIO 25	In/Out	Input/Output 25
10	DIO 26	In/Out	Input/Output 26
11	DIO 27	In/Out	Input/Output 27
12	DIO 28	In/Out	Input/Output 28
13	DIO 29	In/Out	Input/Output 29
14	DIO 30	In/Out	Input/Output 30
15	DIO 31	In/Out	Input/Output 31
16	DIO 32	In/Out	Input/Output 32
17	IN COM	Common	Input Common
18	OUT COM	Common	Output Common
19	24 VDC +	Out	24 Volt Power Supply
20	24 RET	Return	24 Volt Power Supply Return
21	24 RET	Return	24 Volt Power Supply Return

Target Analog I/O Module

J1 USER ANALOG INPUTS AND OUTPUTS			
PIN	SIGNAL	DIRECTION	FUNCTION
1	AI 1+	In	Analog Input 1+
2	AI 1-	In	Analog Input 1-
3	AI 1 COM	Common	Analog Input 1 Common
4	AI 2+	In	Analog Input 2+
5	AI 2-	In	Analog Input 2-
6	AI 2 COM	Common	Analog Input 2 Common
7	AI 3+	In	Analog Input 3+
8	AI 3-	In	Analog Input 3-
9	AI 3 COM	Common	Analog Input 3 Common
10	AI 4+	In	Analog Input 4+
11	AI 4-	In	Analog Input 4-
12	AI 4 COM	Common	Analog Input 4 Common
13	NC	NC	No Connection
14	AO 1	Out	Analog Output 1
15	AO 1 COM	Common	Analog Output 1 Common
16	AO 2	Out	Analog Output 2
17	AO 2 COM	Common	Analog Output 2 Common
18	AO 3	Out	Analog Output 3
19	AO 3 COM	Common	Analog Output 3 Common
20	AO 4	Out	Analog Output 4
21	AO 4 COM	Common	Analog Output 4 Common

Target System Module

J3 SYSTEM PROGRAM PORT			
PIN	SIGNAL	DIRECTION	FUNCTION
1	422RXA'	In	RS422 Receive A'
2	232TXD	Out	RS232 Transmit
3	232RXD	In	RS232 Receive
4	NC	NC	No Connection
5	COM	Common	Signal Common
6	422RXB'	In	RS422 Receive B'
7	NC	NC	No Connection
8	422TXA	Out	RS422 Transmit A
9	422TXB	Out	RS422 Transmit B

J4 TEACH PENDANT PORT			
PIN	SIGNAL	DIRECTION	FUNCTION
1	TXA	Out	Transmit A
2	TXB	Out	Transmit B
3	RXA'	In	Receive A'
4	RXB'	In	Receive B'
5	ENABLE	In	Teach Pendant Enable
6	12 VDC +	Out	12 Volt Power Supply
7	12 RET	Return	12 Volt Return
8	COM	Common	Signal Common
9	SHIELD	Common	Signal Common

Target System Module

J5 USER SERIAL PORT			
PIN	SIGNAL	DIRECTION	FUNCTION
1	422RXA'	In	RS422 Receive A'
2	NC	NC	No Connection
3	NC	NC	No Connection
4	NC	NC	No Connection
5	COM	Common	Signal Common
6	422RXB'	In	RS422 Receive B'
7	NC	NC	No Connection
8	422TXA	Out	RS422 Transmit A
9	422TXB	Out	RS422 Transmit B

J6 CONTROL & STATUS I/O			
PIN	SIGNAL	DIRECTION	FUNCTION
1	IN COM	Common	Input Common
2	SUSPEND	In	Suspend
3	RESUME	In	Resume
4	ENABLE	In	Enable
5	SP	I/O	Set Point
6	OUT COM	Common	Output Common
7	READY +	Out	System Ready +
8	READY -	Out	System Ready -
9	OK+	Out	System Status OK+
10	OK-	Out	System Status OK-
11	24 VDC +	Out	24 Volt Power Supply
12	24 RET	Return	24 Volt Power Supply Return

Target Servo Module

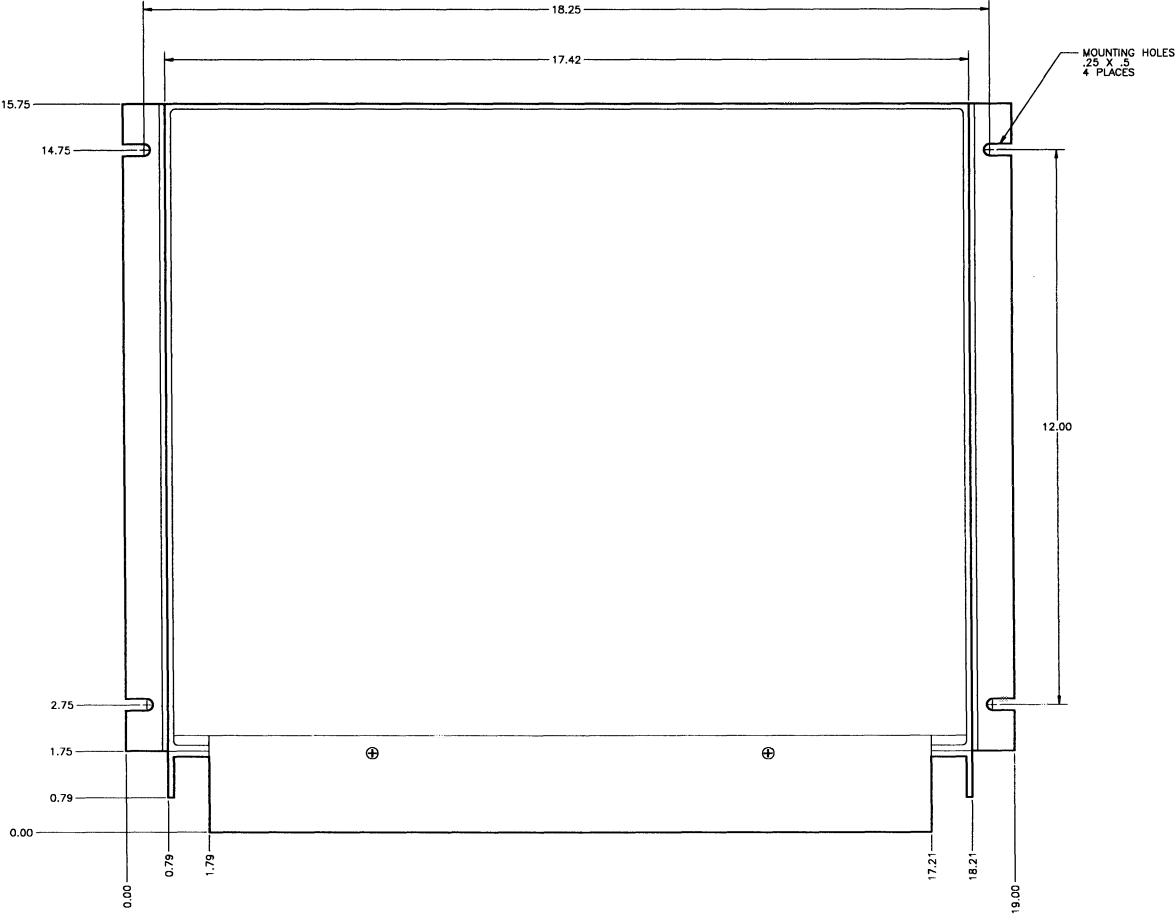
J1 BRUSHLESS SERVO MOTOR			
PIN	SIGNAL	DIRECTION	FUNCTION
R	R	Out	Phase R Motor Power Out
S	S	Out	Phase S Motor Power Out
T	T	Out	Phase T Motor Power Out
G	G	Ground	Motor Frame Ground/Cable Shield

Appendix D

Rack Mounting Dimensions

Target® ARS Rack Mounting Dimensions

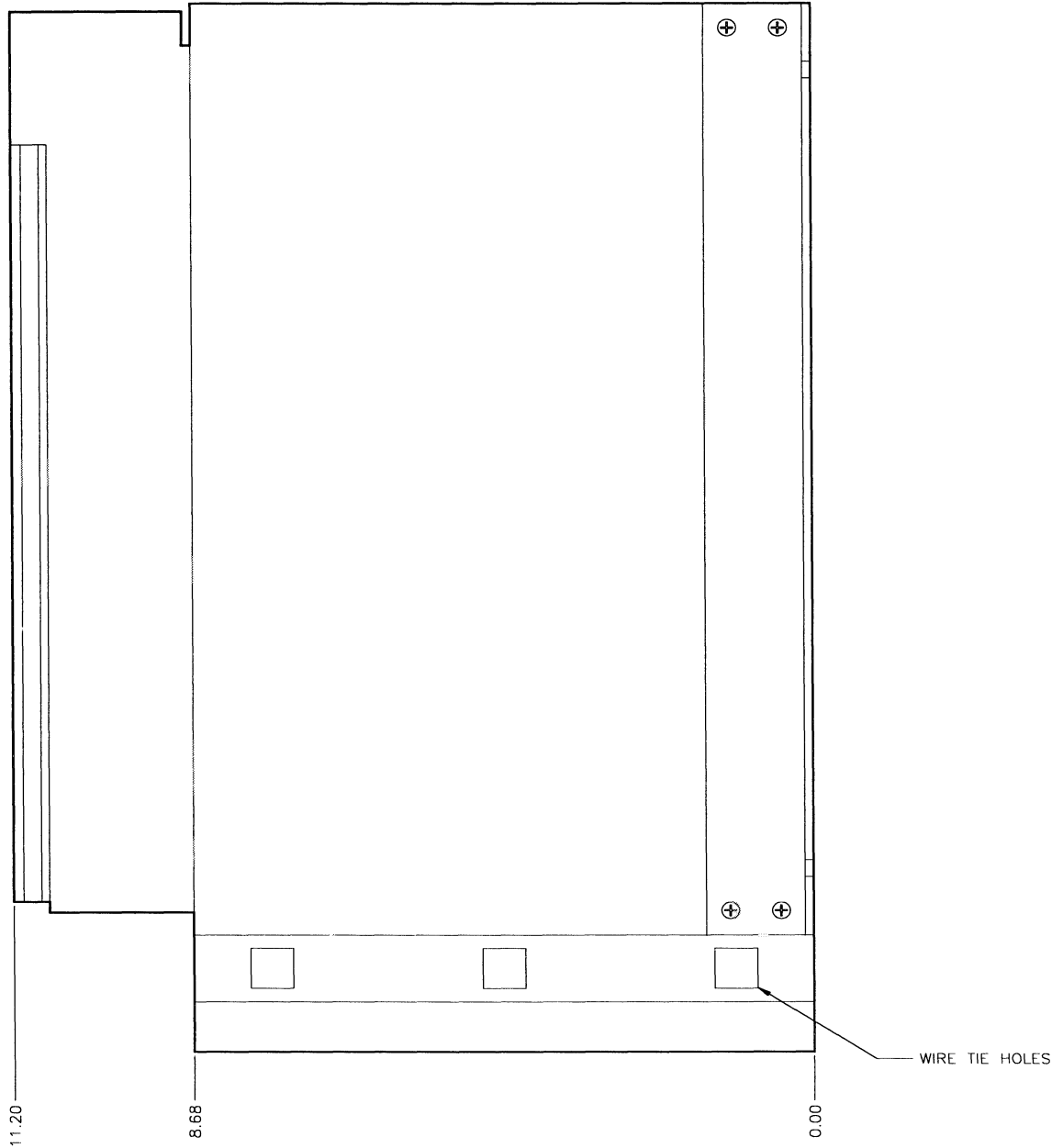
Dimensions are shown in inches



Panel Mounting Dimensions

Target® ARS Rack Mounting Dimensions

Dimensions are shown in inches



Side View

Section

2

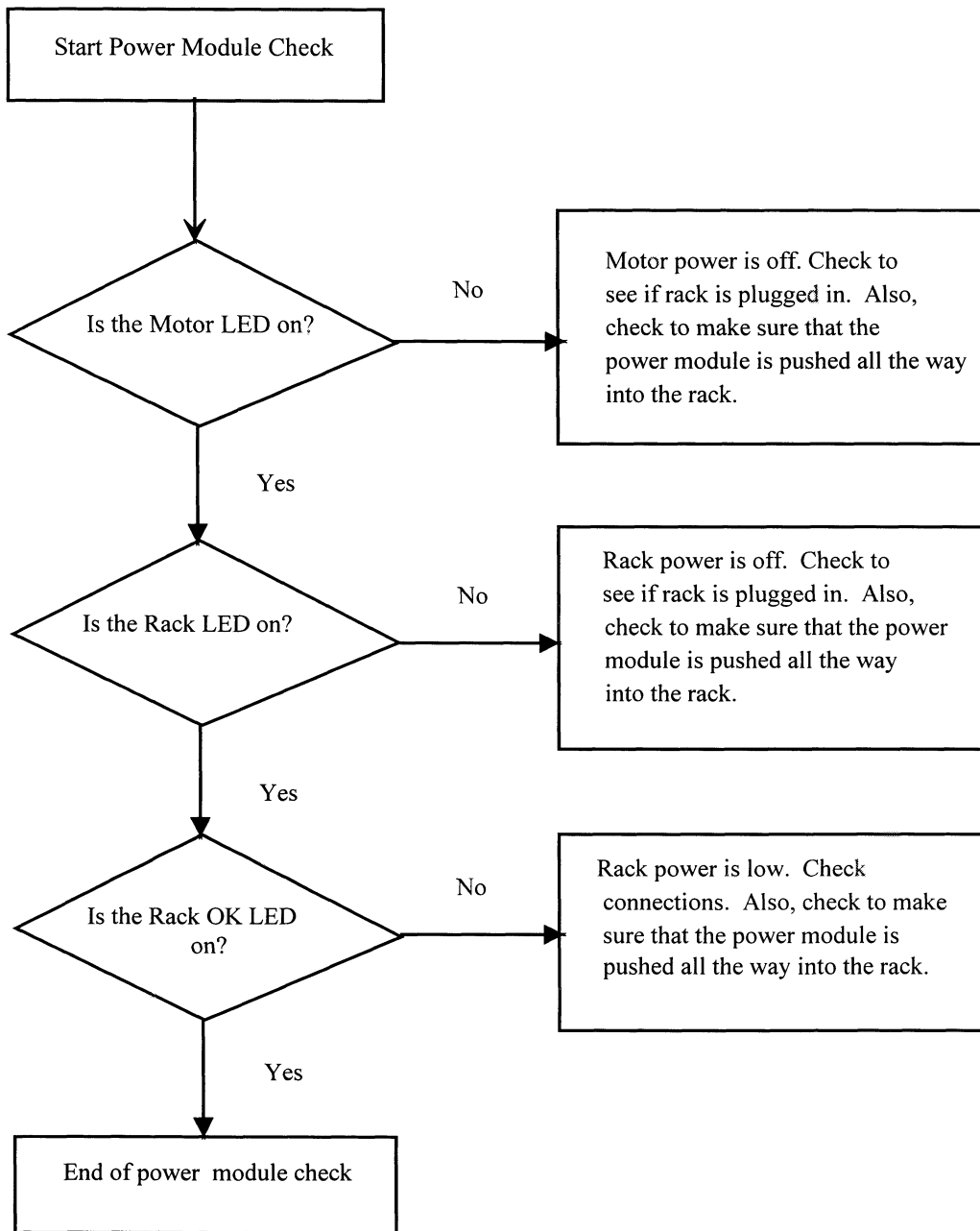
Target ARS Troubleshooting Guide

1. Target Troubleshooting Approach
2. Troubleshooting Flowcharts
3. Module Drawings
4. Fault and Status Registers
5. Complete List of Registers and Commands
6. Flash Memory: Save and Retrieve
7. Target Memory: Uploading to a File
8. Target Memory: Downloading Files

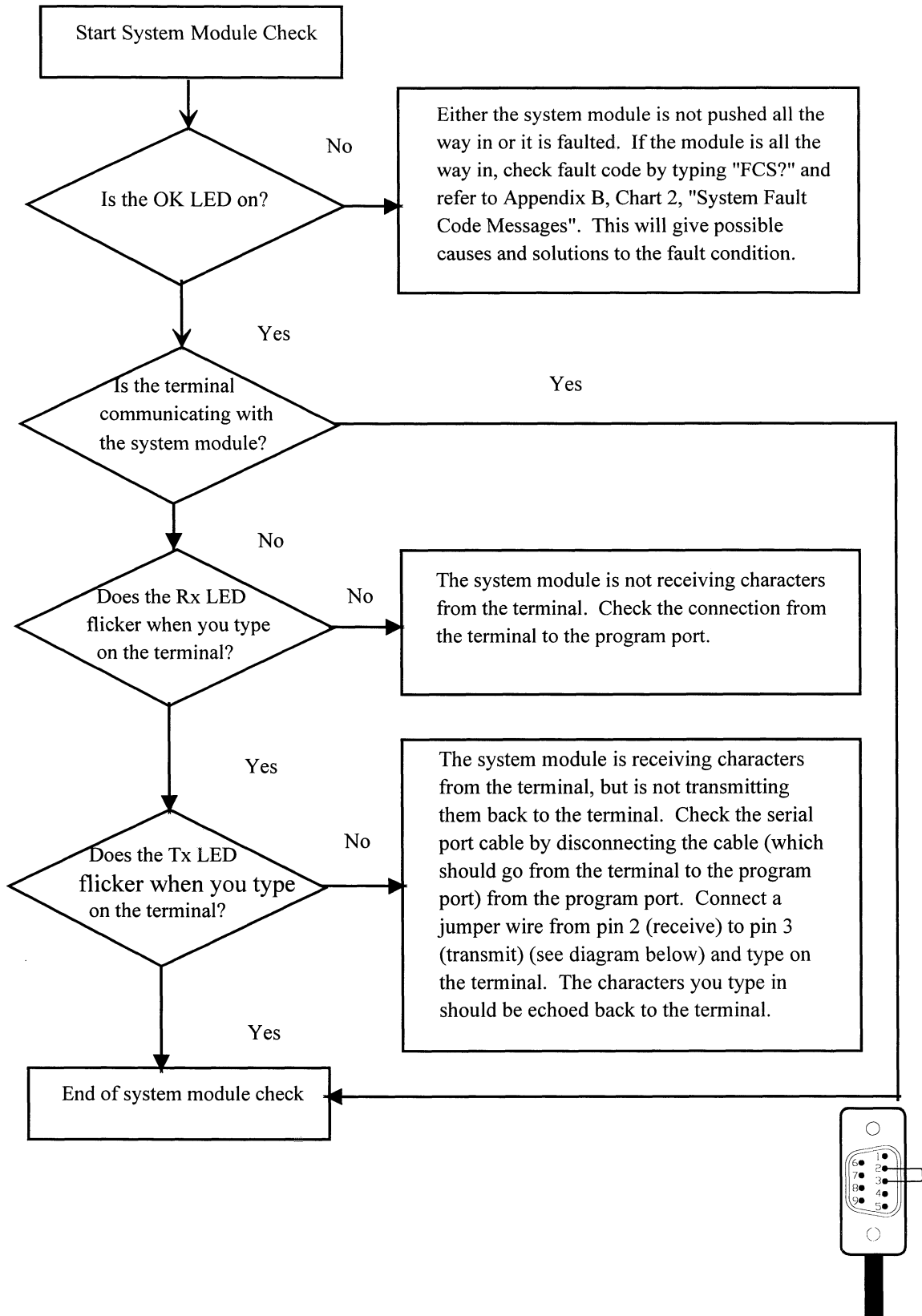
Target Troubleshooting Approach

- 1. Identify module with no OK lamp.**
- 2. Check hardware and wiring associated with module.**
- 3. If problem is not resolved, connect computer with CCS.
Connect serial cable to Target Program Port.**
- 4. Examine system fault code FCS? and system status SRS?**
- 5. Examine fault code and status of module reporting a problem.**
- 6. Identify and correct problem.**

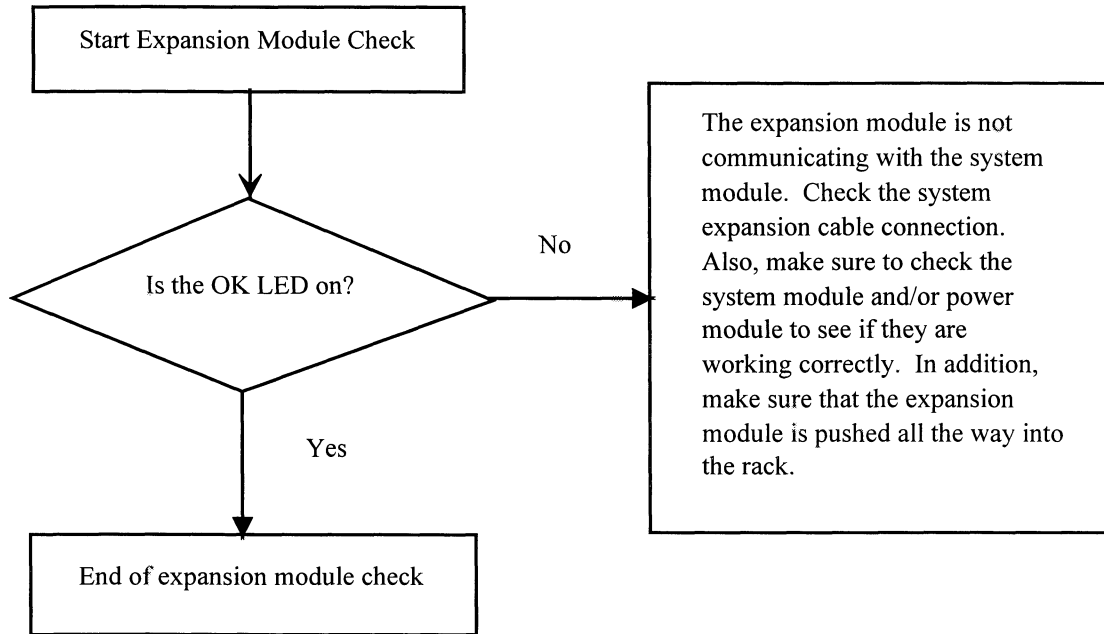
A. Power Module Check



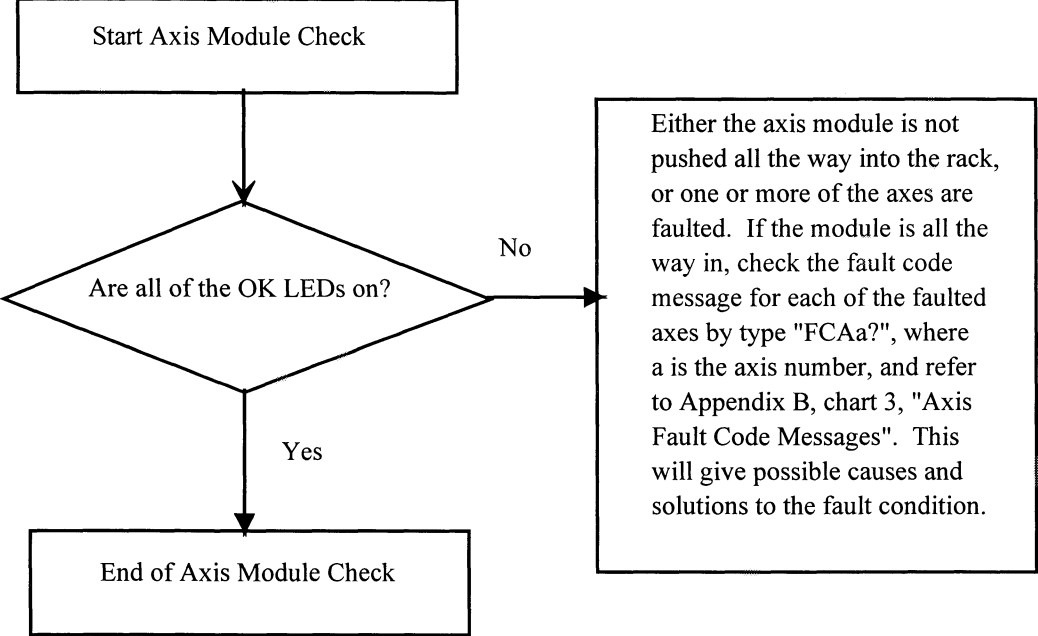
B. System Module Check



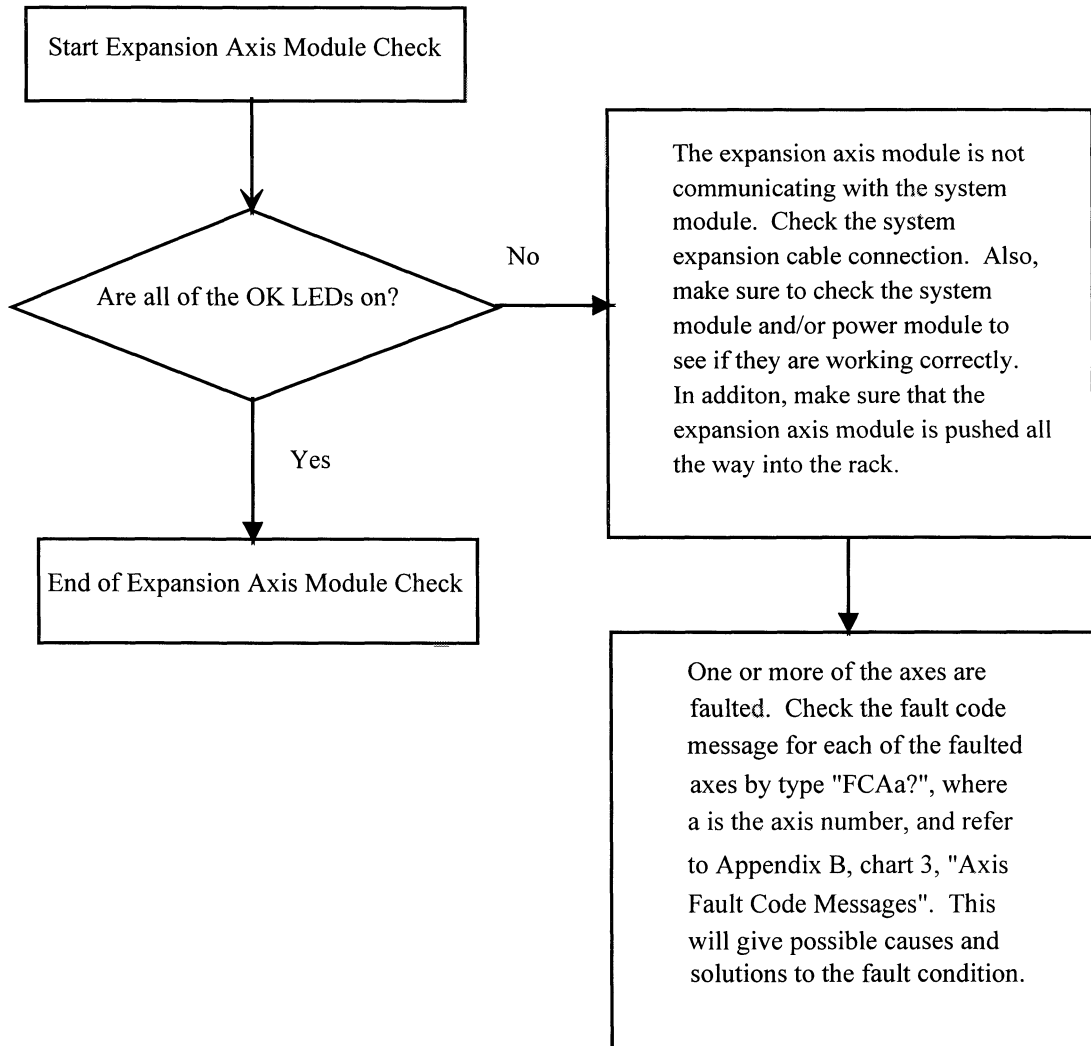
C. Expansion Module Check



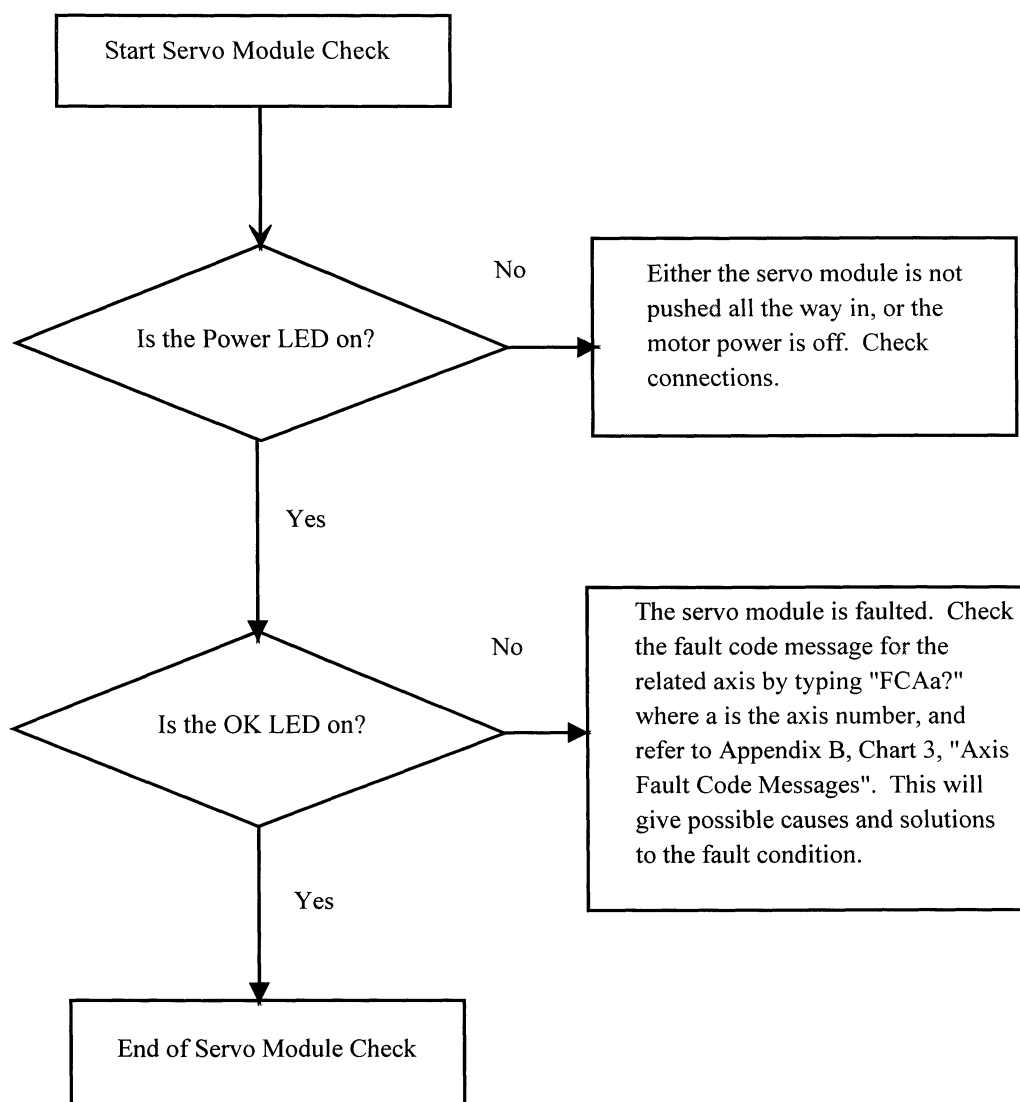
D. Axis Module Check



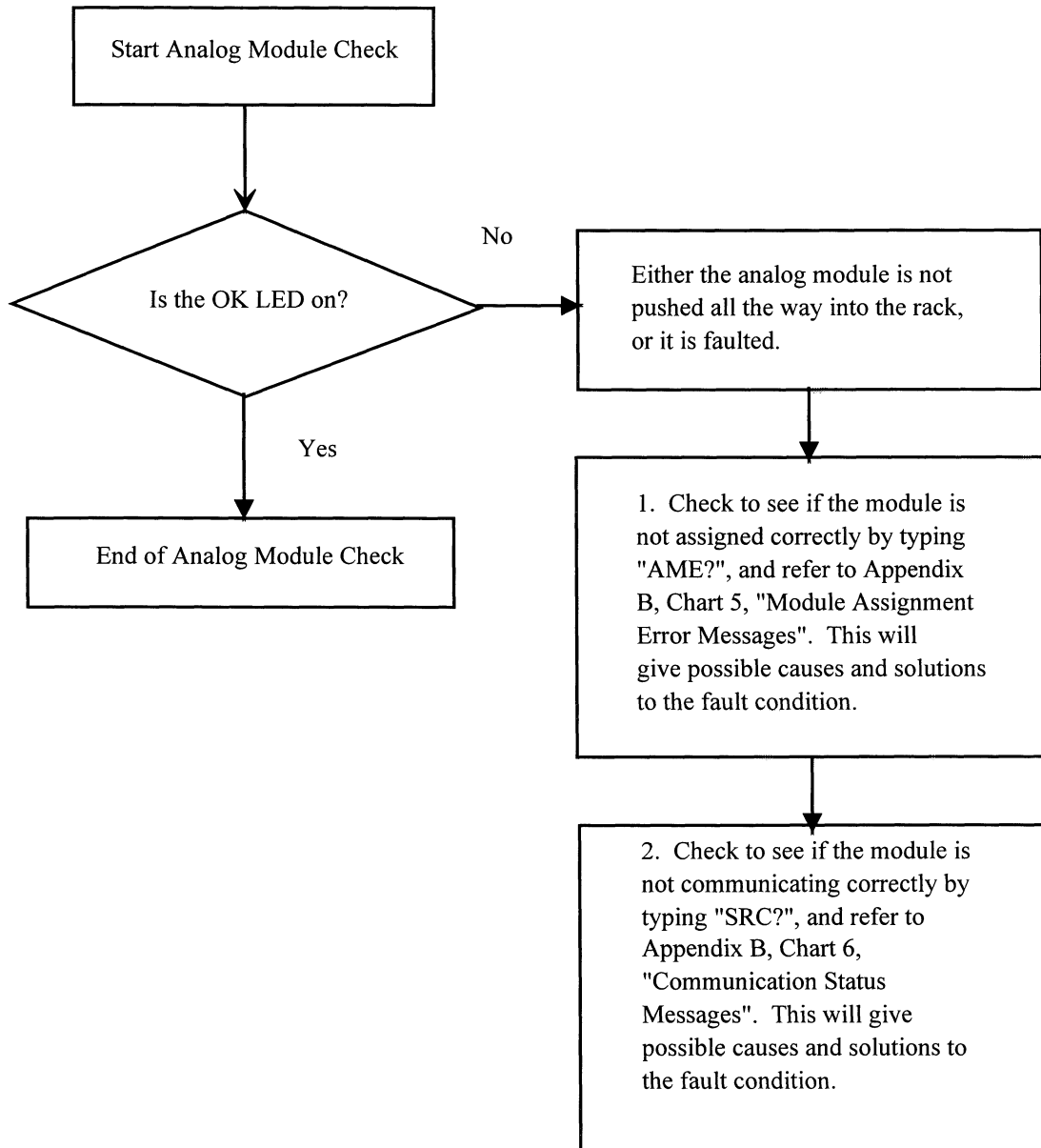
E. Expansion Axis Module Check



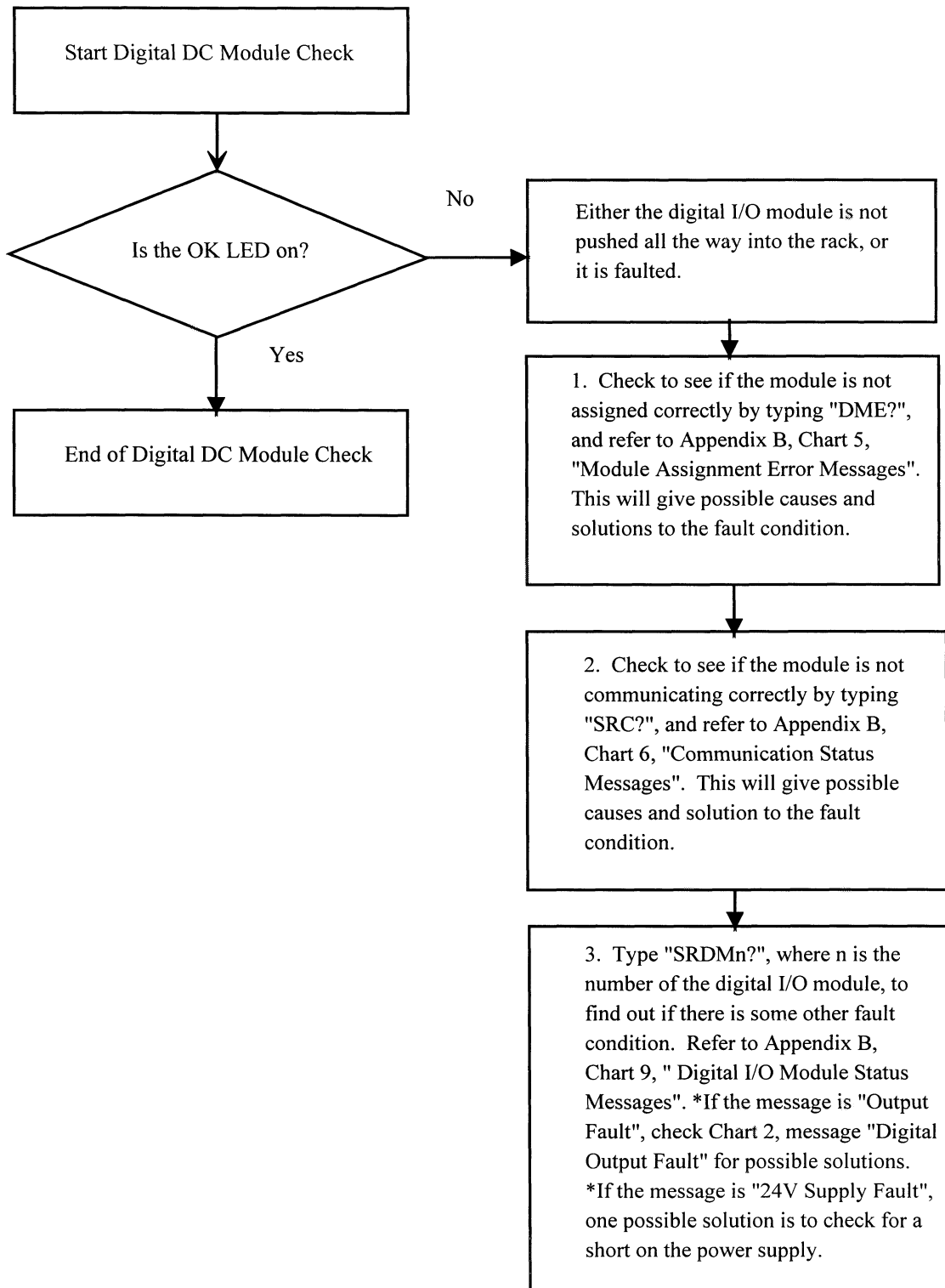
F. Servo Module Check



G. Analog Module Check



H. Digital DC Module Check



Field Service: Fault and Status Registers

Use CCS to query the Fault and Status registers.

Register	Name	Pages
FCS	System Fault Code	B6 - B9
FCAa	Axis a Fault Code	B9 - B11
AXE	Axis Assignment Errors	B11 - B12
AME	Analog Module Assignment Errors	B12 - B15
DME	Digital Module Assignment Errors	B12 - B15
SME	Servo Module Assignment Errors	B12 - B15
SRC	Communication Status Register	B16 - B17
SRM	Motion Status Register	B18 - B19
SRAMm	Analog I/O Module m Status Register	B19
SRDMm	Digital I/O Module m Status Register	B19 - B20
SRSMa.m	Servo Module Status Register	B20
IOS	System I/O Status	B21
IOAa	Axis a I/O Status	B21 - B22
SRPn	Program Status Register	B22
SRS	System Status	B23
SRAa	Axis a Status	B23 -B24

Register List

<i>Class</i>	<i>mnemonic</i>	<i>description</i>
<u>System</u>	ADDN	address of network port
	AM	analog I/O module rack slot assignment
	AME	analog module assignment error register
	AXE	axis assignment error register
	AXIS	axis assignment
	BAUDP	baud rate of program port
	BAUDU	baud rate of user serial port
	BITP	databits of program port
	BITU	databits of user serial port
	CE	conversion error
	CIE	computer interface format on program port enable
	DATE	date
	DM	digital I/O module rack slot assignment
	DME	digital module assignment error register
	FCA	axis fault code register
	FCS	system fault code register
	HSE	XON, XOFF handshake protocol on program port enable
	IP	axis in position
	IPALL	all axes in position
	KEY	character in user receive buffer
	MB	axis motion block executing
	MBANY	any motion block executing
	PARP	parity of program port
	PARU	parity of user serial port
	PROG	program executing
	SM	axis servo/stepper module assignment
	SME	servo/stepper module assignment error register
	SRA	axis status register
	SRAM	analog I/O module status register
	SRC	communication status register
	SRDM	digital I/O module status register
	SRM	motion status register
	SRP	program status register
	SRS	system status register
	SRSM	servo/stepper module status register
	STM	start time of timer
	TIME	time of day
	TL	axis at torque limit
	TLANY	any axis at torque limit
	TM	timer timed out flag
	TMR	timer
	VFA	floating point variable allocation
	VFEA	floating point variable extended allocation

<i>Class</i>	<i>mnemonic</i>	<i>description</i>
<u>Axis</u>	AR	amplitude of resolver excitation
	CMA	commutation angle advance
	CMD	position controller command output
	CMO	commutation angle offset
	CMR	motor poles to resolver poles commutation ratio
	CURC	continuous current in percent of maximum
	CURP	peak current in percent of maximum
	CURS	power save current in percent of continuous
	DIR	direction of motor for forward moves
	FE	axis following error
	FEB	following error bound
	FR	axis feedback resolution
	IPB	in-position band
	KA	acceleration feedforward
	KD	derivative control gain
	KI	integral control gain
	KP	proportional control gain
	KT	filter time constant
	OFA	axis position offset
	OFX	auxiliary position offset
	OTF	forward software overtravel
	OTR	reverse software overtravel
	PCA	axis position capture
	PCX	auxiliary position capture
	PFB	position feedback deadband
	PFD	position feedback denominator
	PFE	position feedback enable
	PFL	position feedback backlash
	PFN	position feedback numerator
	PFT	position feedback correction time
	PLA	axis position length
	PLX	auxiliary position length
	POE	power output stage enable
	PSA	axis position
	PSC	command position
	PSO	offset position
	PSR	resolver position
	PSX	auxiliary position
	PWE	position register wrap enable
	PZA	axis position synchronized
	PZX	auxiliary position synchronized
	QTX	auxiliary quadrature type
	TLC	torque limit current in percent of continuous
	TLE	torque limit enable
	TP	test point output
	URA	axis unit ratio
	URX	auxiliary unit ratio
	VLA	axis velocity
	VLAT	axis velocity filter time constant
	VLX	auxiliary velocity
	VLXT	auxiliary velocity filter time constant

<i>Class</i>	<i>mnemonic</i>	<i>description</i>
<u>Motion</u>	CAE	cam enable
	CAF	cam filter constant
	CAI	cam position register increment
	CAM	cam point
	CAO	cam offset
	CAP	cam shaft position
	CAR	cam position
	CAS	cam scale factor
	CAT	cam shaft position type
	CCB	cam compile beginning point
	CCE	cam compile ending point
	CCP	cam compile starting position
	GRB	gearing bound
	GRD	gearing denominator
	GRE	gearing enable
	GRF	gearing filter constant
	GRI	gearing input
	GRN	gearing numerator
	MAC	axis motion acceleration/deceleration
	MAP	axis motion acceleration/deceleration percent
	MDC	axis motion deceleration
	MDP	axis motion deceleration percent
	MJK	axis motion jerk percent
	MPA	absolute move position
	MPI	incremental move position
	MPO	offset move position
	MT	axis motion type
	MTM	axis move time
	MVL	axis motion velocity
	MVM	axis motion velocity for run to marker
	PHB	phase error bound
	PHE	phase locked loop enable
	PHG	phase gain
	PHL	phase length
	PHM	phase multiplier
	PHO	phase offset
	PHP	phase position
	PHR	phase error
	PHT	phase lockout time
PHZ	phase zero	
<u>Input/Output</u>	AI	analog input
	AIB	analog input deadband
	AIF	analog input filter frequency
	AIO	analog input offset
	AO	analog output
	AOP	power-up state of analog output
	CTR	counter
	DI	digital input register
	DIA	digital input filter assignment
	DID	digital input digit
	DIT	digital input filter time

<i>Class</i>	<i>mnemonic</i>	<i>description</i>
<u>Input/Output</u>	DO	digital output register
	DOD	digital output digit
	DOE	fault on digital output fault enable
	DOP	power-up state of digital outputs
	EG	positive edge sensitive digital input register
	IOA	axis I/O register
	IOS	system I/O register
	SPA	axis set point
	SPIA	axis set point input
	SPIS	system set point input
	SPOA	axis set point output
	SPOS	system set point output
	SPS	system set point
	TMI	interval timer
	TMP	pulse timer
<i>Variable</i>	VB	boolean variable
	VF	floating point variable
	VI	integer variable
	VS	string variable

Command List

<i>Class</i>	<i>mnemonic</i>	<i>description</i>
<u>System</u>	AUTORET	enables auto retrieving of user memory from the flash memory card on power up
	AUTOTUNE	automatically sets up control constants
	CHANGEPW	prompts for change of password
	CLM	clears all user memory and resets registers to factory defaults
	COPYFLASH	copies extended memory card to flash memory card in firmware slot
	COPYRAM	copies extended memory card to RAM memory card in firmware slot
	FIRMWARE	downloads firmware and saves in the flash memory card
	MEMORY	reports memory remaining
	MOTORSET	automatically sets up motor constants
	PASSWORD	prompts for password
	RETRIEVE	retrieves user memory from the flash memory card to BBRAM
	RSFA	resets axis faults
	RSFALL	resets system and all axes faults
	RSFS	resets system faults
	RTF	retrieves firmware from the flash memory card and puts it in code memory- disables all other commands except SVF
	SAVE	saves user memory from BBRAM to the flash memory card
	SECURE	secures user memory space
	STFA	sets axis fault
	STFALL	sets system and all axes fault
	STFS	sets system fault
	SVF	saves firmware in the flash memory card from code memory- can only be used after RTF - enables all command
<u>Program</u>	!	exits editor
	DEL	deletes current statement in editor
	END	ends program or motion block and exits editor
	EXM	executes motion block
	EXP	executes program
	EXVS	executes command stored in string variable
	FAULT	enters editor and makes statement which faulted system current statement
	GOSUB	unconditionally "gosubs" label
	GOTO	unconditionally "gotos" label
	IF...GOSUB	conditionally "gosubs" label
	IF...GOTO	conditionally "gotos" label
	KLALL	kills all programs
	KLP	kills program
	L	makes statement the current statement in editor
	LABEL	makes statement at label the current statement in editor
	LOCK	locks interpreter to program
	MBA	assigns axes to motion block
	MOTION	edits motion block
	POP	pops "gosub" address from top of "gosub" stack
	PROGRAM	edits program
	REM	comment
	REPEAT	repeats motion from beginning of block
	RETURN	returns from "gosub"
	RSM	resumes motion of axis
	RSMALL	resumes motion of all axes

<i>Class</i>	<i>mnemonic</i>	<i>description</i>
<u>Program</u>	RSTSTK	resets "gosub" stack to empty
	STVB...GOTO	sets boolean variable and if variable wasn't set "gotos" label
	SUP	suspends motion of axis
	SUPALL	suspends motion of all axes
	UNLOCK	unlocks interpreter from program
	WAIT	waits for expression to be true
	WAIT...WHEN...	
	GOTO	waits for expression to be true or when expression becomes true "gotos" label
X	makes next statement the current statement in editor or single	
<u>Motion</u>	CAZ	zeros cam table
	CCM	compiles cam motion
	HT	halts motion
	RHF	runs forward to home input
	RHR	runs reverse to home input
	RMF	runs forward to marker
	RMR	runs reverse to marker
	ROF	runs forward to overtravel input
	ROR	runs reverse to overtravel input
	RPA	runs to absolute position
	RPI	runs to incremental position
	RPO	runs to offset position
	RVF	runs to velocity forward
	RVR	runs to velocity reverse
	ST	stops motion
STEP	step input	
<u>Input/Output</u>	EUB	empties user port buffer
	GET	gets one character from user serial port
	IN	inputs register value from user serial port
	OUT	outputs string expression to user port
	PUT	puts one character to user serial port
<u>Diagnostic</u>	?	reports value of register
	DGC	loads diagnostic condition for printing
	DGE	enables diagnostics
	DGI	loads diagnostic item to print
	DGL	prints diagnostic line of items
	DGO	outputs diagnostic register value to program port
	DGP	prints diagnostic message to program port
	DGS	sets program to single step mode
	DGT	sets program to trace mode
	Q	reports value of register
	REVISION	reports firmware revision

Target Memory: Uploading to a File

Use the following sequence to upload the Target memory to a PC file.

- 1. Connect a PC running CCS to the Target using serial cable CBL-H1IC-10. Plug the cable end labeled RS-232 Port into the 9 pin COM port on the PC. Plug the cable end labeled IMC or OIP into the Target System Module Program port.**
- 2. Set the CCS address to Target. Press the PC Enter key several times until the Target "signs on".**
- 3. Disable the system and kill any executing programs by typing STFALL followed by KLALL.**
- 4. On the PC click on Tools. From the Tools menu select receive all. From the Receive All menu, select Registers, Programs, and Motion Blocks. Do not select Variables. Click on OK.**
- 5. Wait until the upload is complete.**
- 6. CCS loads an image of the Target memory into the PC memory and opens the editor on the memory image. Click on File and select Save As. Enter the file name you wish to save the memory to.**
- 7. Close the editor.**
- 8. Restart the system by cycling the power or by typing EXP17.**

Target Memory: Save and Retrieve

The Target user programs, registers, and variables are stored in battery backed up static RAM. The user programs and registers can be saved to FLASH memory.

- 1. Connect a PC running CCS to the Target using serial cable CBL-H1IC-10. Plug the cable end labeled RS-232 Port into the 9 pin COM port on the PC. Plug the cable end labeled IMC or OIP into the Target System Module Program port.**
- 2. Set the CCS address to Target. Press the PC Enter key several times until the Target "signs on".**
- 3. Disable the system and kill any executing programs by typing STFALL followed by KLALL.**
- 4. Type AUTORET to enable the FLASH memory autoretrieve on power cycle.**
- 5. Type SAVE to copy the programs and registers into the FLASH memory card.**
- 6. Restart the system by cycling the power or by typing EXP17.**

Target Memory: Downloading Files

Use the following sequence to download files from a PC to a Target.

- 1. Connect a PC running CCS to the Target using serial cable CBL-H11C-10. Plug the cable end labeled RS-232 Port into the 9 pin COM port on the PC. Plug the cable end labeled IMC or OIP into the Target System Module Program port.**
- 2. Set the CCS address to Target. Press the PC Enter key several times until the Target "signs on".**
- 3. Disable the system and kill any executing programs by typing STFALL followed by KLALL.**
- 4. On the PC click on Tools and Send File(s). Select the file you wish to send and click on OK.**
- 5. Wait until the file transmission is complete. If no error occurs, skip ahead to step 8.**
- 6. If an error occurs, CCS will stop the transmission and open the editor with the cursor at the line containing the offending command or character.**
- 7. Fix the offending line, save the file, and click on Tools and Send File(s) again to retransmit the corrected file.**
- 8. Restart the system by cycling the power or by typing EXP17.**

Section

3

Target Connector Key Installation Procedure

You Will Need

- 1 - Connector
part number 21000480 or 21000481;
see attached chart to determine the appropriate connector
- 4 - Keys
part number 21000498

To Install the Keys

1. Turn the connector so that the screws and key grooves are facing upward. The key grooves are located on top of the connector mating surface.
2. Insert the key into the appropriate numbered groove. The two dots on the key surface should face upward when inserted into the groove.
After insertion, tear the key from the cluster.

Connectors

Module	Module Number	Connector Part Number	Designator	Key Positions
System	78004655	21000480	J6	2,5,8,11
2 Axis Motion Control	78004656	21000481	J1	2,5,17,20
		21000480	J2	2,5,8,11
2 Axis Motion Control Expansion Card	78004657	21000481	J1	2,5,16,19
		21000480	J2	2,5,7,10
4 Axis Motion Control	78005682	SAME AS ABOVE for 2 Axis Module & Expansion Card		
Digital I/O (16 in, 16 in/out)	78004659	21000481	J1	2,5,17,20
		21000481	J2	2,5,16,19
Digital I/O Expansion Card	78004660	21000481	J1	3,6,17,20
		21000481	J2	3,6,16,19
Digital I/O (32 in, 32 in/out)	78005778	SAME AS ABOVE for Digital I/O Module & Expansion Card		
Analog I/O (4 in, 4 out)	78004661	21000481	J1	2,5,17,20
Analog I/O Expansion Card	78005069	21000481	J1	2,5,16,19
Analog I/O (8 in, 8 out)	78005721	SAME AS ABOVE for Analog I/O Module & Expansion Card		
Axis Expansion	78005196	21000481	J1	2,5,17,20
		21000480	J2	2,5,8,11

Section
4

Installing Backplane Jumpers on the Axis Expansion Module

The following instructions explain how to install back plane jumpers on the TARGET ARS Axis Expansion Module.

This process is required if there is more than one rack connected in the system and the Axis Expansion Module is not located in the main rack, the one containing the System Module.

Basically, you will need to take the module apart, put in the back plane jumpers, and put the module back together. Before starting, remove the Axis Expansion Module from the rack. After the module has been removed, follow these steps to install the jumpers:

1. **Remove Retaining Screw.**

Remove and save the screw in the upper right corner of the module housing using a Phillips screwdriver. See Figure 1 for proper orientation and location of screw.

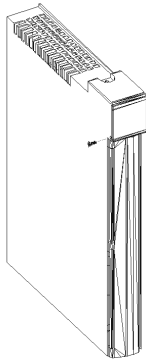


Figure 1. Remove Retaining Screw

2. **Disassemble Module.** Remove and save the six screws on the perimeter of the module plate using a Phillips screwdriver. Do not remove the three screws in the upper left corner of the plate. See Figure 2 for proper orientation of the plate.

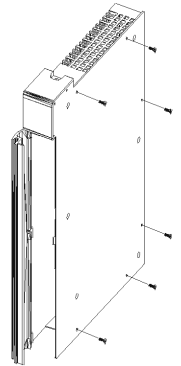


Figure 2. Disassemble Module

3. **Remove Plate from Module.** Carefully slide the plate (which has the circuit board attached to it) out of the module. See Figure 3 for plate location. Set the housing aside.

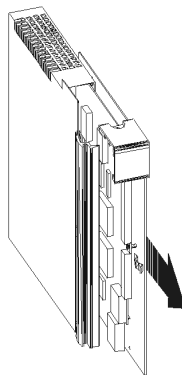


Figure 3. Remove Plate from Module

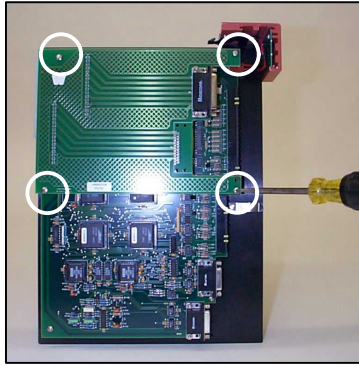


Figure 4. Removing Connector Board

4. **Remove circuit board.** Remove the four screws and standoffs on the perimeter of the 70005272 circuit board using a flathead screwdriver. (See Figure 4) Save these screws -- you will need them later. Remove the 70005272 board from the 70005190 board.

5. **Locate J5 Connector.** Make sure the 70005190 board is facing you so that the logo and the LED bracket are in the upper left corner. Notice the gray J5 connector (Figure 5) on the lower left corner of the board.



Figure 5. J5 Connector Location



Figure 6. JP2 Connector and Jumpers

6. **Install Jumpers.** Install each of the 12 jumpers on the gold JP2 connector pins located directly above the Grey J5 connector on the lower-left corner of the board. Insert each jumper vertically from left to right on each pair of connector pins located at the JP2 site on the board, as shown in Figure 6.

7. **Reassemble Module.** Mount circuit board 70005272 back onto board 70005190, with both the logo and the 25-pin DB connector facing up. (See Figure 4) Find the row of interconnect pins on the bottom of board 70005272 and insert them into the orange J6 connector located on board 70005190. Finally, replace the four standoffs and screws between the two boards at the four corners of board 70005190.
8. **Reinsert Plate.** Carefully slide the plate back into the module housing, making sure that everything but the plate itself goes inside the housing. (See Figure 3)
9. **Reattach Plate.** Fasten the Phillips screws back into the module. Make sure that you put the longest of these screws into the upper right corner of the housing and the rest into the plate.