OPERATOR'S MANUAL
FOR THE
DS8020 SERVO AMPLIFIER
(DSHR/DSFR)

PN: EDA100

Patent No. 4,554,512

AEROTECH®

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CHAPTER 1: INTRODUCTION

The Aerotech DS8020 Servo Amplifier marks an advance in brush DC motor power control technology. High output power, small size, and standardized mounting (standard 160 mm, 3U Euro-card) make this Servo Amplifier one of the most versatile on the market today. A photo of the DS8020 Servo Amplifier is shown in Figure 2-1.

The DS8020 utilizes a patented PWM drive scheme allowing it to provide high output power at very high efficency. The DS8020 has a nominal rating of 80 VDC at 20 amps peak (2 seconds), 10 amps continuous (with fan cooling), 5 amps continuous (without fan) at up to a 50 degree C ambient. The patented drive scheme allows operation between 0 and 80 VDC bus levels without component adjustments. A motor output load fuse is provided.

The PWM output switching frequency is 20 KHz, well above the audible frequency range. The PWM output stage utilizes hermetically sealed power MOSFET switching devices, providing very high reliability and long life.

Five potentiometers are provided at the front of the DS8020 for easy access when adjusting the input and tach feedback gain, balance, and current limit. A parameter adjustment module known as the "personality module" provides a means of modifying **all** gain and current limit adjustment parameters usually adjusted with the potentiometers. The user may set predetermined gains and current limits and may match specific DC motors to the DS8020 without adjusting the potentiometers themselves.

The DS8020 is self-contained, except for the user supplied AC voltage source needed to generate the internal DC bus voltage of 0 to 80

VDC, and ±12 VDC control voltages. Motor load short circuit protection is provided internally. A typical interconnection diagram for wiring two or more DS8020 Servo Amplifiers into a system is shown in Figure 2-8.

Aerotech provides two types of integrated power supply mounting racks for the DS8020: the DSFR and the DSHR.

The three-axis mounting rack (DSHR) is shown in Figure 3-1. The six-axis mounting rack (DSFR) is shown in Figure 3-2. Both mounting racks have totally integrated DC bus and control power supplies. Shunt regulators for controlling DC bus motor regeneration and isolation transformers to supply power to the DC bus may be supplied as an option for both mounting racks.

Both mounting racks provide easy termination of control and power connections to the Motion Controller and DC motors. These mounting racks are designed for panel mounting, reversing the mounting flanges on the six-axis DSFR rack, will permit 19" rack mounting.

The major difference between the DSHR rack and DSFR rack is the inherent mounting hardware. The six axis DSFR rack is, in actuality, two three-axis DSHR racks joined together. The six-axis DSFR rack contains two separate three-axis power supplies, each identical to the power supply on the three-axis DSHR mounting rack.

All mounting rack specifications listed in Chapter 3, except those specifying dimensional data, are in reference to the three-axis DSHR mounting rack.

CHAPTER 2: DS8020 SERVO MODULE

The DS8020 Servo Amplifier is shown in Figure 2-1 and Figure 2-2A. Also shown in these figures are the various locations for potentiometer adjustments, the personality module (labeled RCN4), the motor load fuse, and the pin-out specification for the main control and power connector J1 (located at the rear of the unit). Details of the various items are included in this Chapter.

SECTION 2-1 MOUNTING SPECIFICATIONS

The DS8020 is designed to "slide" into any standard 3U or partitioned 6U user-supplied card rack. (Integrated power supply 3U card racks for the DS8020 can be supplied by Aerotech. See Chapter 3 for details.)

A sampling of 3U/6U card rack manufactures are listed below.

BICC-VERO	40 Lindeman Drive Trumbull, CT O6611 (USA)
SCHROFF	179 Commerce Drive Warwilk, R.I. 02886 (USA)
KNURR AG	(USA Representative) Panel Components Corp. 335 Tesconi Circle Santa Rosa, CA 95406

A. Mounting holes as per DIN 41612 specifications
B. .25" quick-connect lugs (typical)

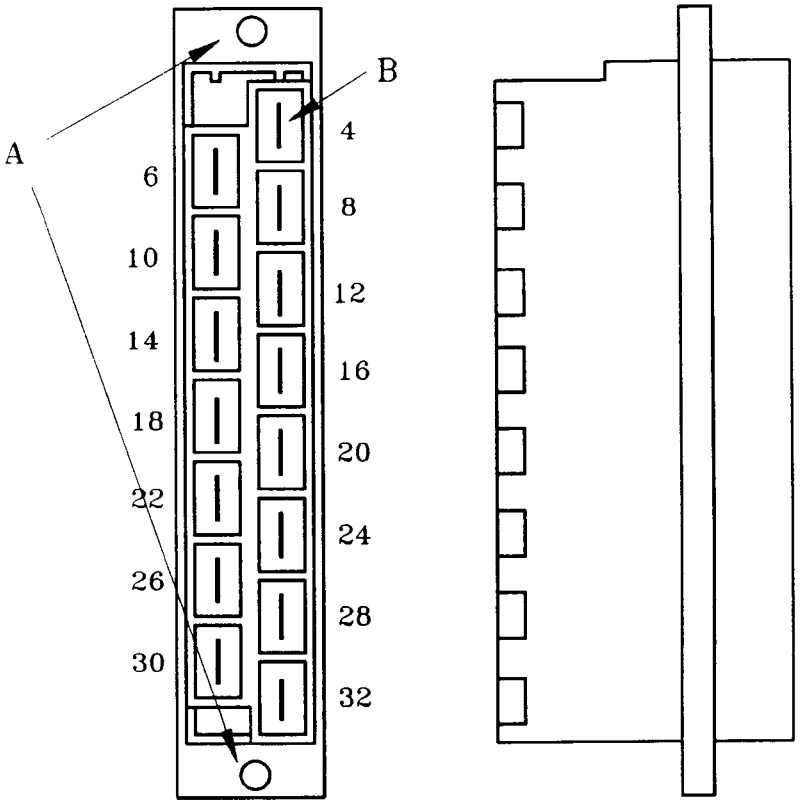


Figure 2-2B: Outline of "Quick-Connect" Mating Connector for Connector J1 of DS8020

If the user desires the DS8020 be integrated into a user designed PC "mother board" (DIN mounting specification 41617), a different connector, designed for PC board mounting, must be used. Aerotech will supply this connector as an option (P/N ECK352), or the user may purchase this connector independantly. One supplier of this mating connector in the U.S.A. is:

SCHROFF
179 Commerce Drive
Warwick, R.I. 02886

SECTION 2-3 ELECTRICAL SPECIFICATIONS

Electrical specifications for the DS8020 are listed in Table 2-1. Each specification refers to corresponding J1connector pin numbers, and to figure numbers containing additional information.

A block diagram of the DS8020 Servo Amplifier module is shown in Figure 2-3. All input and output power and control connections are passed through connector J1 (see also Figure 2-2A).

Two control sections (pre-amplifier and post-amplifier, in dotted lines) are shown in Figure 2-3. Each of these control sections are detailed in subsequent Figures 2-4 and 2-7.

SECTION 2-4 FAULT OUTPUT

The DS8020 Servo Amplifier Module when equipped with the DS Series motherboard is configured with a Fault Output of active low. If the DS8020 Servo Amplifier is not equipped with the DS Series motherboard and the motherboard is to be user supplied the Servo Amplifier Module may be selectivly configured for a Fault Output of active high. This is accomplished by removing the Fault Output Select

jumper (see Figure 2-3) from JP 1-2 and connecting the jumper to JP 2-3.

NOTE: The active high Fault Output must not be used in conjunction with the DS Series motherboard.

SECTION 2-5 PERSONALITY MODULE

The Personality Module pre-amplifier circuit, RCN4, (shown in Figure 2-4) is used to interface input and tach feedback signals (if any exist). Figure 2-2A shows the location of this module.

This module may be reconfigured by the user. An outline of the module is shown in Figure 2-6.

SECTION 2-6 CONTROL MODES

The input speed command, Vcom, (Refer to Figure 2-4) is usually connected to the output command signal of the Motion Controller through J1, pin 16. The motor tachometer feedback connection Vfb is then connected to J1, pin 18. The component values of RCN4 are set to those values depicted in Figure 2-4.

Modern motion controllers often provide tach feedback internally to the control. The result is that the output control signal from the motion controller is usually a current command signal rather than the traditional speed command signal described above.

For this control mode, the tach connection (pin 18 of J1) remains open. The current command signal is brought into pin 16 of J1. In this case, personality module RCN4 is usually reconfigured for unity gain by shorting RCN4 12 to 5, and replacing RCN4 10 to 7 with a 10K ohm resistor. The input and tach potentiometer positions are set full CW.

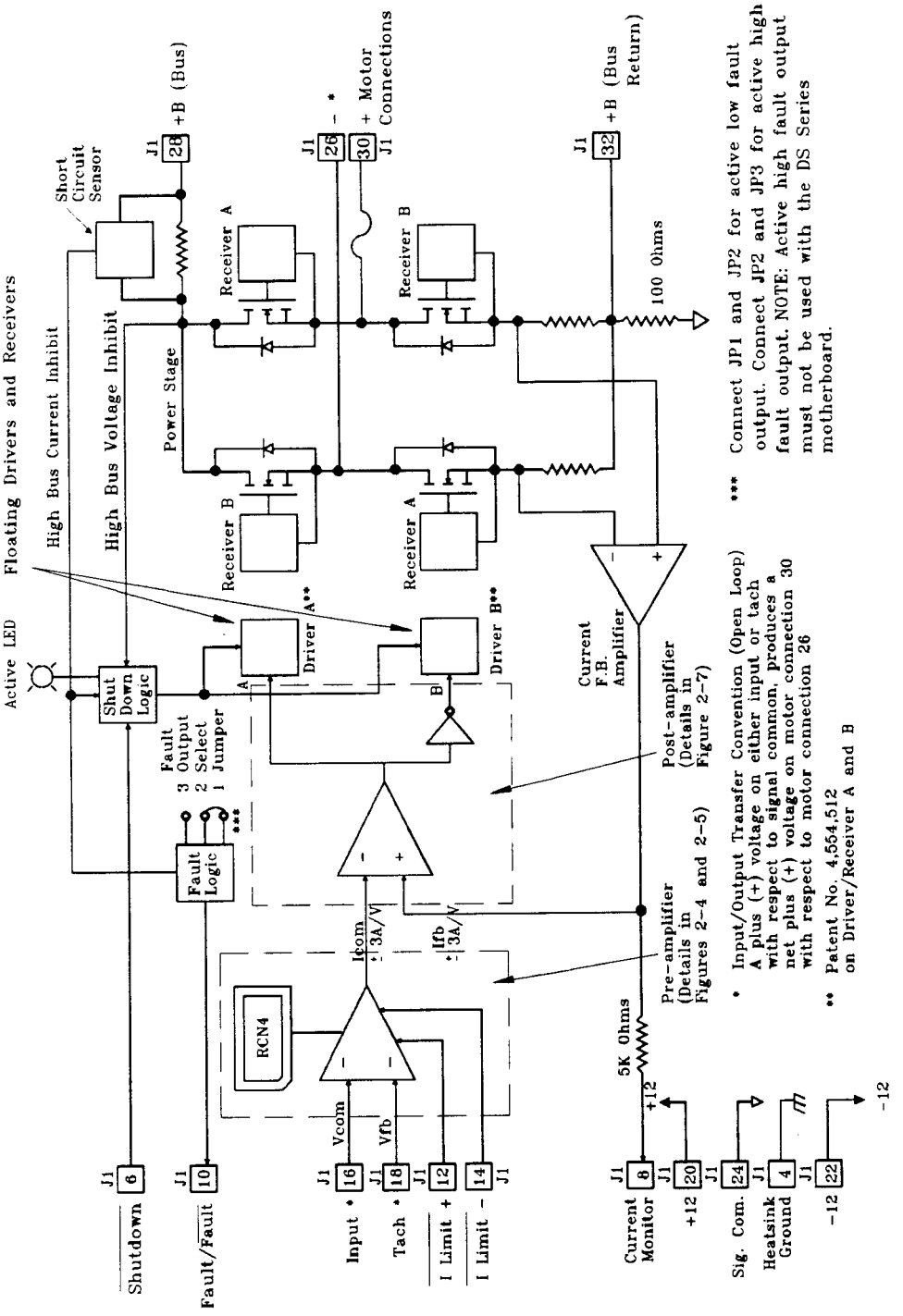


Figure 2-3: Simplified Block Diagram of the DS8020 Servo Amplifier Module

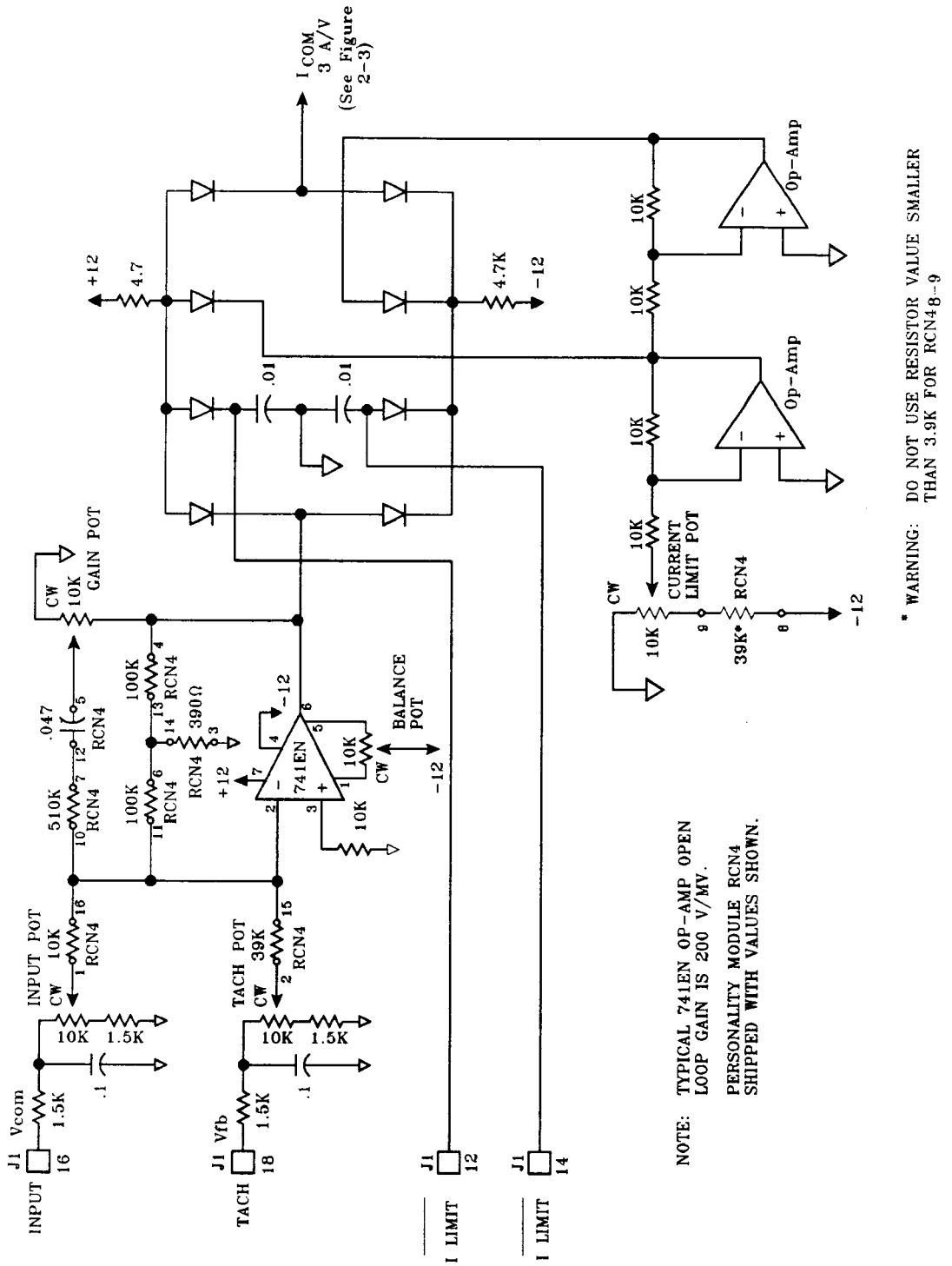


Figure 2-4: Detailed Electrical Diagram of DS8020 Pre-Amplifier Circuit (actual circuit)

SECTION 2-7 SETTING THE CURRENT LIMIT

The RCN4 resistor component 8-9 is used to set the maximum current that can be obtained by the current limit potentiometer (full CW for zero current, full CCW for maximum current). The resistor value for $RCN4_{8-9}$, however, **must not be less than 3.9K ohms** or the maximum clamp level of 20 amps will be exceeded. Alternate maximum current clamp levels less than 20 amps can be selected by using the following equation.

$$\text{MAX. CURRENT CLAMP (Amps) (current limit pot full CCW)} = \frac{180000}{5000 + RCN4_{(8\text{-}9)}}$$

($RCN4_{8-9}$ in ohms)

The resistor is factory set for 3.9K (20 amps maximum).

SECTION 2-8 PRE-AMPLIFIER GAIN CHARACTERISTICS

The open loop transfer function for the input connection Vcom (pin 16, J1) and tach feedback connection Vfb (pin 18, J1) to internal current command signal, Icom, is shown in Figure 2-5. The gain curves shown in Figure 2-5 are in relation to the values of RCN4 shown in Figure 2-4.

SECTION 2-9 THE POST-AMPLIFIER

A detailed circuit description of the post-amplifier (shown by dotted lines in Figure 2-3) is outlined in Figure 2-7.(The circuitry shown in Figure 2-7 is for reference only and is not intended to be altered by the user.)

Figure 2-7 shows the control relationships of the internal current command, Icom, with the internal current feedback signal, Ifb, (see also Figures 2-3 and 2-4). A brief outline of the PWM circuit, used to control the MOSFET switches of the output power stage, is also shown in this figure.

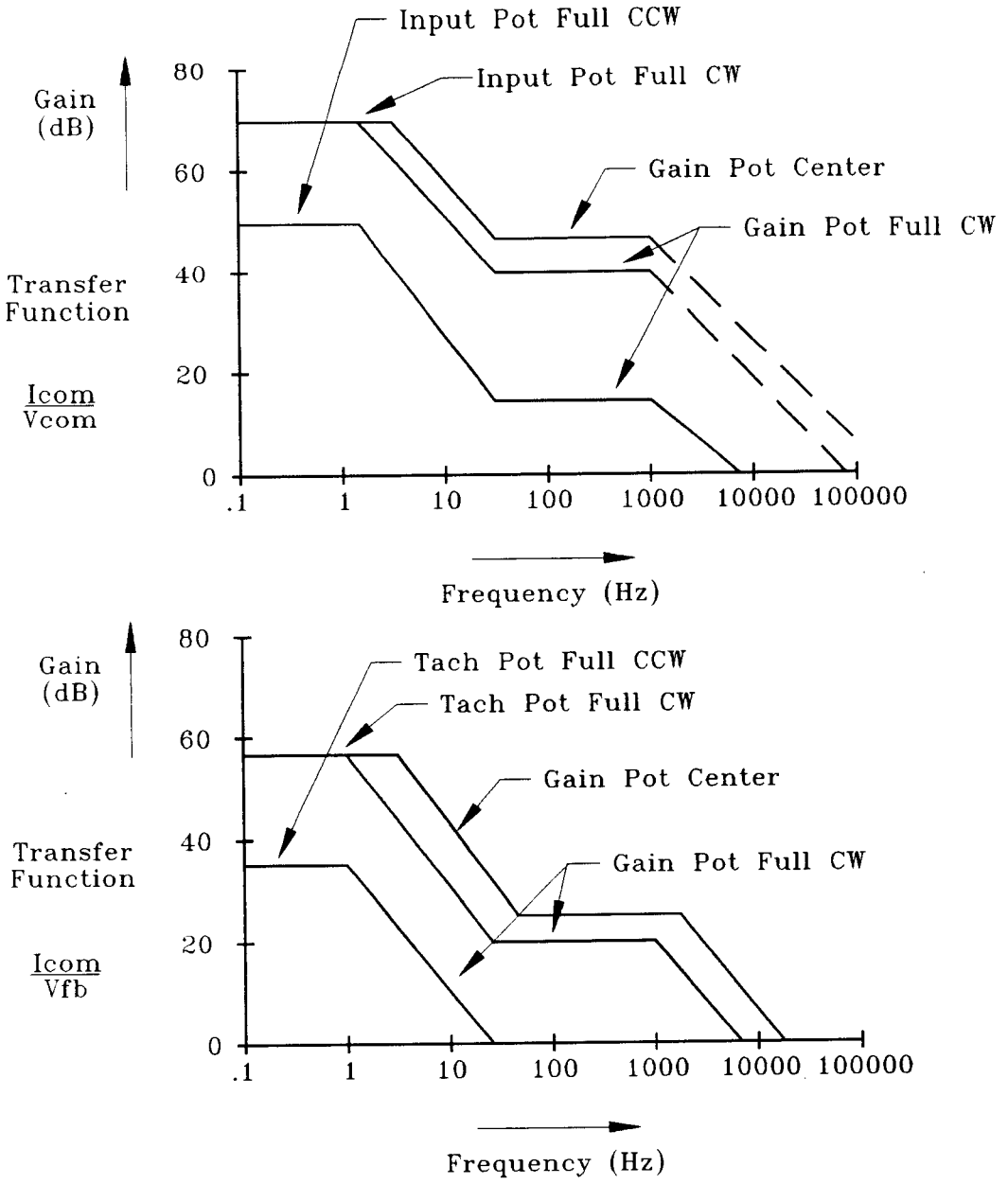
SECTION 2-10 WIRING DS8020 INTO A SYSTEM

A typical user interconnect wiring diagram for two DS8020s operating from a common DC bus and ±12 VDC control supply is shown in Figure 2-8.

Exercise caution when wiring the DS8020 servo amplifiers to the DC bus and control power supplies.

Most important of the wiring considerations is the length of the interconnect wiring between the DC bus power supply and connector J1, pins 28 and 32 of the DS8020. This interconnect wiring **must never exceed** 18 inches (0.45 meter) between these two points (see Figure 2-8). Also, the interconnect wiring between the DC bus and pins 28 and 32 **must be twisted tightly together** and be of no less than #14 AWG gauge ($21x10^{-3}$ CM^2).

CAUTION: FAILURE TO OBSERVE THE CONSIDERATIONS LISTED ABOVE MAY RESULT IN PERMANENT DAMAGE TO THE POWER STAGE OF THE DS8020



NOTE: TRANSFER FUNCTIONS SHOWN ABOVE ARE WITH RESPECT TO VALUES OF RCN4 SHOWN IN FIGURE 2-4.

Figure 2-5: Transfer Function of Pre-Amplifer Circuit

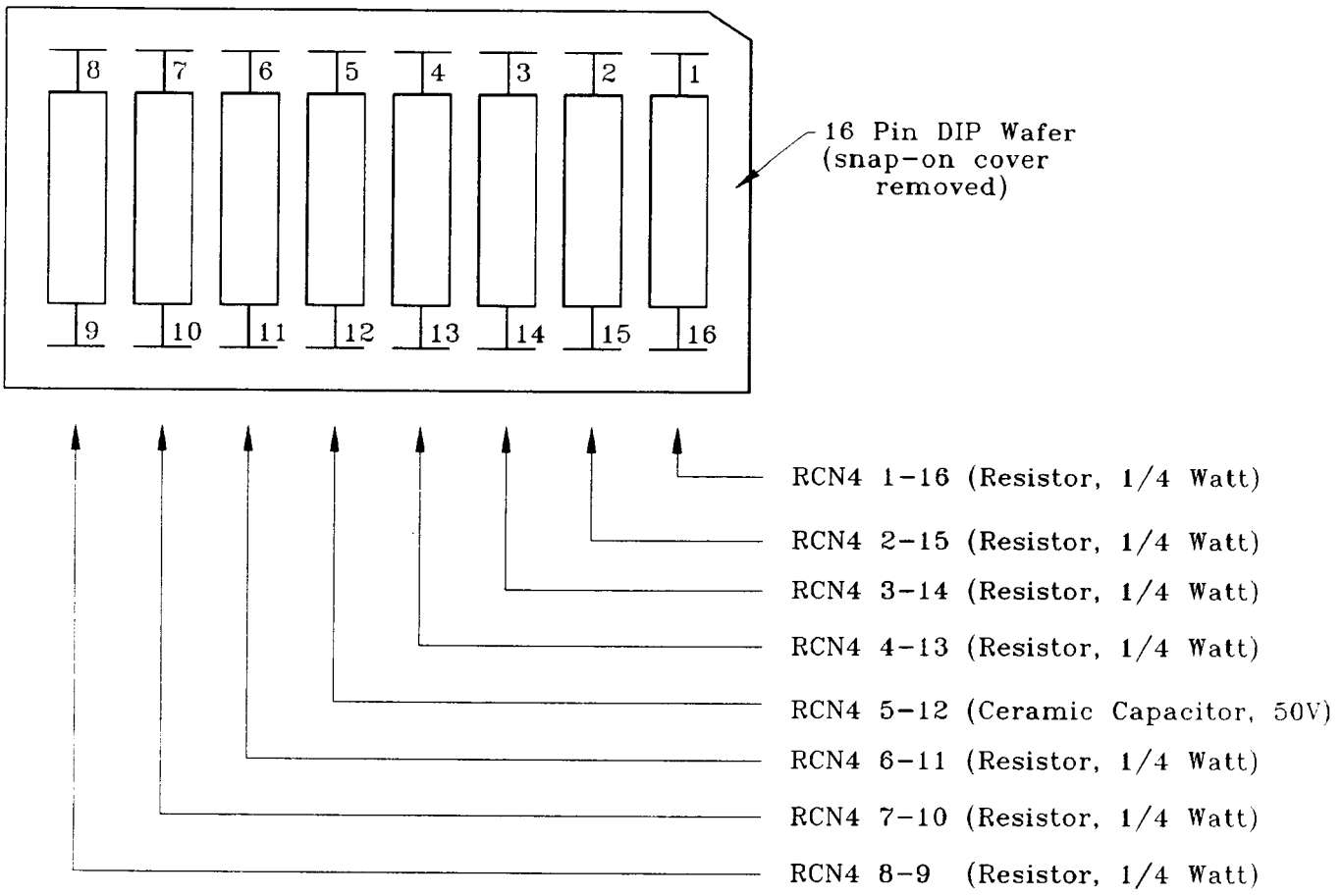


Figure 2-6: Outline of Personality Module RCN4

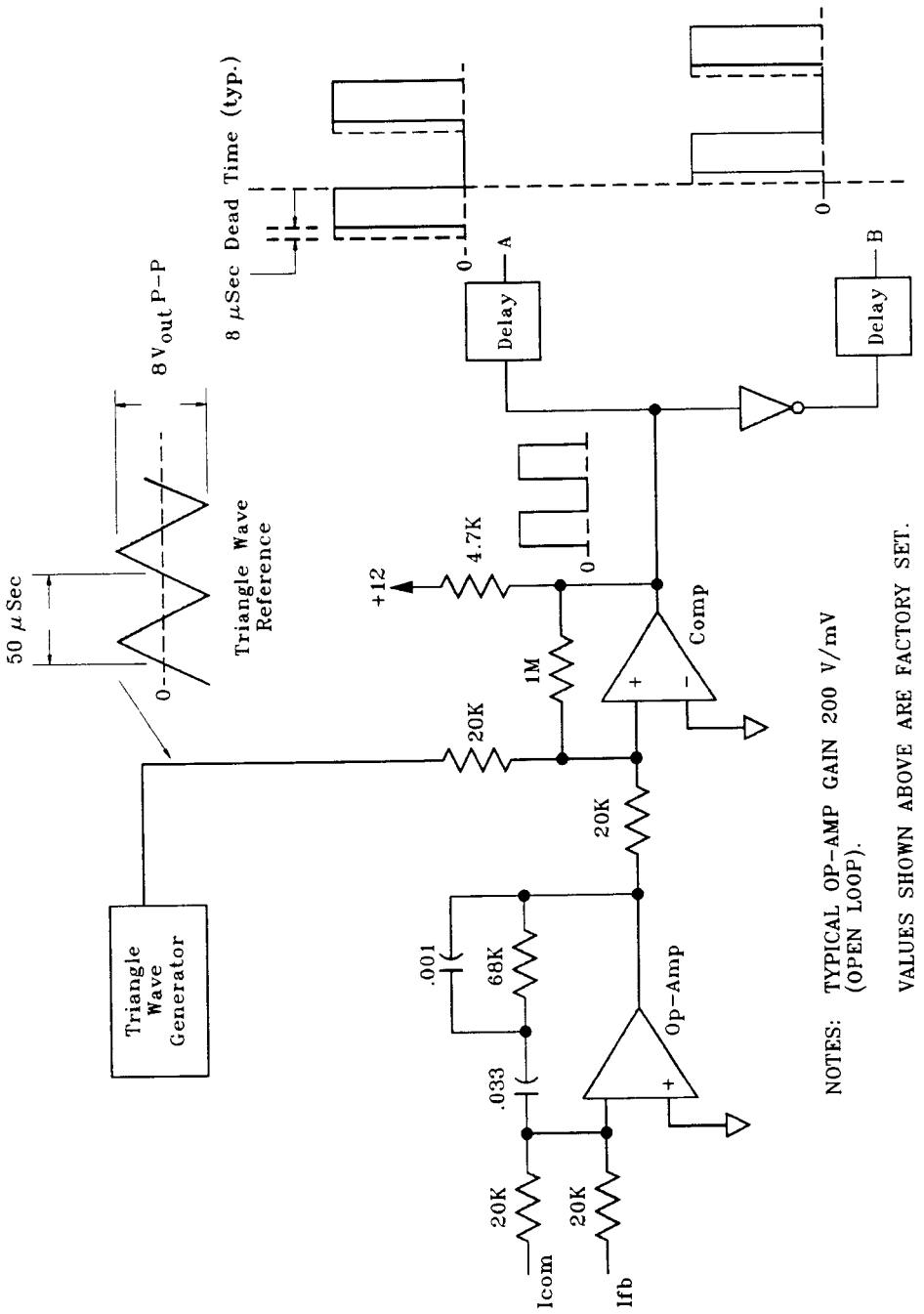


Figure 2-7: Detailed Electrical Diagram of DS8020 Post-Amplifier Circuit

The DC bus filter capacitor (labeled "C" in Figure 2-8) must be no smaller than 3000 μF for each DS8020 connected to the bus, and must be of computer grade electrolytic type. Each of the DC bus interconnect twisted wire pair that connects to pins 28 and 32 of J1 on each DS8020 amplifier, should be run *separately* to the DC bus filter capacitor(s). This wiring technique eliminates potential control signal "cross talk" between two or more DS8020 wired to the same DC bus power supply.

Connect the "signal common" (pin 4 and/or 24 of J1) of each DS8020 to the " + B RETURN" point of the DC bus as shown in Figure 2-8. Connect earth ground to the " + B RETURN" point as shown.

The potential between the signal common (pin 24 of J1) and + B RETURN (pin 32 of J1) must never exceed ±4 volts as specified in Table 2-1. A 100 ohm impedance separates these two points. This impedance is used to minimize "ground loop" effects on the control stage of the DS8020 amplifier. For best results, these points should always be tied together and referenced to earth ground at + B Return terminal (see Figure 2-8).

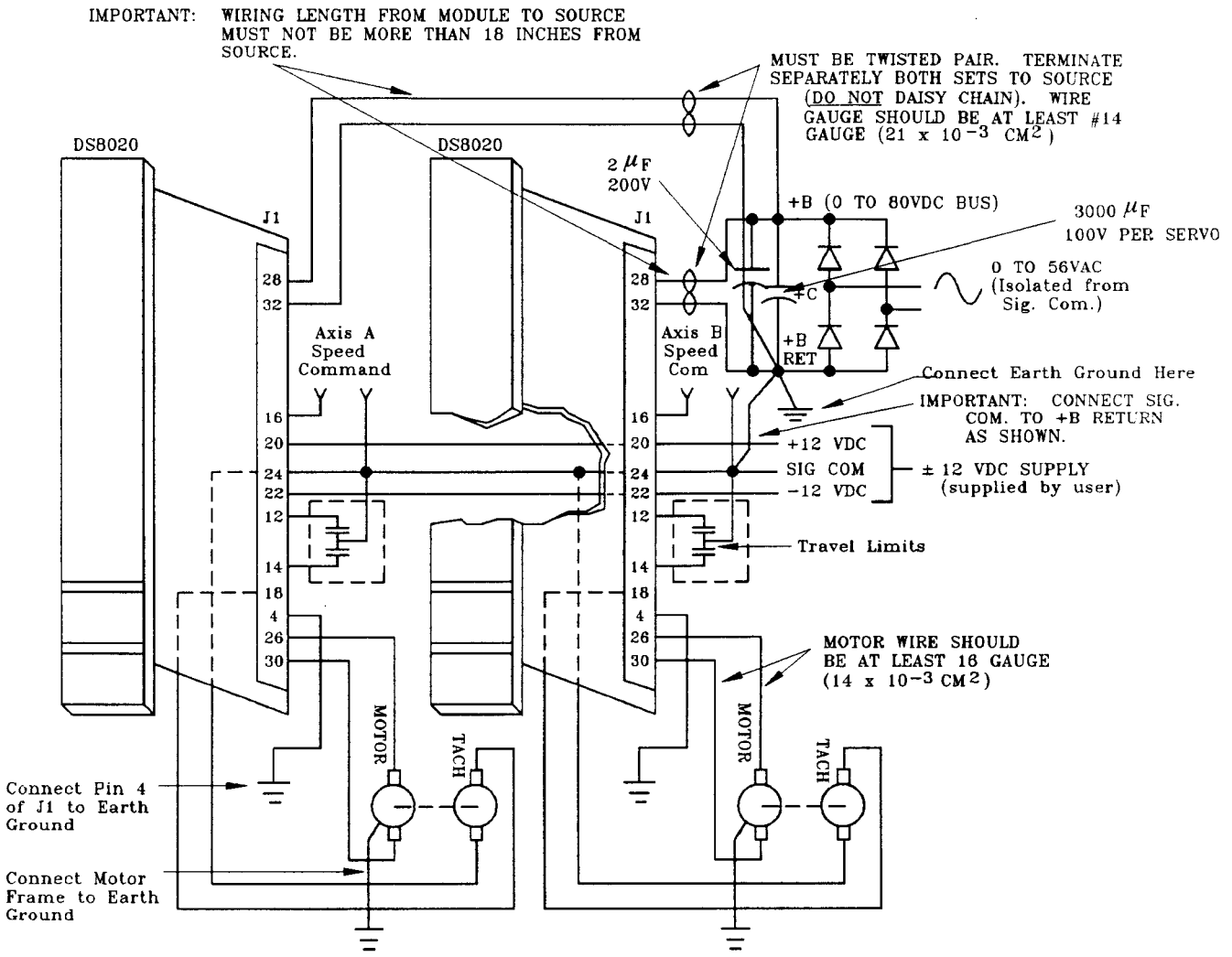


Figure 2-8: Wiring Diagram for One or More DS8020 Servo Modules When Not Used with the Optional DSHR or DSFR Mounting Racks

SECTION 2-11 TROUBLESHOOTING THE DS8020

A troubleshooting guide for the DS8020 Servo Amplifier module is provided in Table 2-2.

A. DS8020 SPARE PARTS

A list of recommended spare parts for the DS8020 Servo Amplifier module is shown in shown in Table 2-3.

Table 2-1, *Electrical Specifications*, is listed on this and the following pages.

ELECTRICAL SPECIFICATIONS

POWER SPECIFICATIONS	VALUE	PIN	FIGURE	COMMENT
Peak output current				
(amps) maximum	20	J1-26, 30	2-3, 2-8	2 seconds max, 10% duty cycle
Continuous output current				
Amps (with fan)	10	J1-26, 30	2-3, 2-8	5 amps and above require external fan flow at 20 CFM min.
Amps (without fan)	5			
DC bus input voltage				
VDC max (regen)	100			100 VDC max intermittently for regeneration margin. 7VDC min. for MOSFET conduction margin
VDC max (operating)	80	J1-28, 32	2-3, 2-8	
VDC min (for conduction)	7			

Table 2-1: Electrical Specifcations

Output Power				
Watts (peak)	1460	J1-26, 30	2-3, 2-8	Measured data
Watts (continuous) (with fan)	765			using TV1.5 transformer to supply DC bus filter capacitors of 15,000 μF
Load inductance				
mH (min)	2	J1-26, 30	2-3, 2-8	This value must be sustained at 20 amps DC

ENVIRONMENTAL SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Operating temperature				
°C (max)	50	---	2-1	Ambient temperature of the servo module heatsink, not the enclosure
°C (min)	0			
Storage temperature				
°C (max)	+85	---	2-1	Shelf storage only, not stand-by use
°C (min)	-30			
Humidity (%)	10 to 90	---	2-1	Non-condensing

PRE-AMPLIFIER SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Input signal offset null adjustment				
mV (nominal)	±15	J1-16	2-3, 2-4	This adjustment is made through the "balance" pot. Value specified is with respect to input or tach connection.
Output drift				
μV/C (nominal)	10	---	2-3, 2-4	Value specified is with respect to pre-amplifer output signal Icom

Table 2-1: Continued

Bandwidth				
Hz (nominal)	100	---	2-3, 2-4	Value specified is with respect to pre-amplifier output signal Icom and is dependent on values selected for RCN4
Current limit adjustment range (Icom)				
Volts (max)	0 to ±6.6	---	2-3, 2-4	This adjustment is made through "current limit" pot. Signal ratio is 3 amp/volt
Voltage gain (open loop)				
dB (nominal)	100	---	2-3, 2-4	Value specified dependent on value selected for RCN4

POST-AMPLIFIER SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Current feedback (Ifb)				
Volts (max)	6.6	---	2-3, 2-7	Signal ratio is 3 amp/volt
Bandwidth				
Hz (nominal)	1000	---	2-3, 2-7	Value specified with motor load inductance of 2mH
Switching deadtime				
μSec (max)	8	---	2-3, 2-7	±10% variation
Switching frequency				
kHz (nominal)	20	J1-26, 30	2-3, 2-7	± 5% variation

POWER STAGE SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Short circuit trip				
Amps (min)	25	J1-26, 30	2-3, 2-8	Requires power-down reset. Maximum may be as high as 35 amps

Table 2-1: Continued

Typical input/output impedance Ohms (max)	.3	J1-26, 28, 30, 32	2-3, 2-8	From bus connection (28 or 32) to motor connection (26 or 30)
DC bus high voltage trip Volts, DC (min)	105	J1-28, 32	2-3, 2-8	Requires power-down reset
Typical switching efficiency % (min)	93	---	2-3, 2-8	Efficiency based on switching and resistance losses

CONTROL IMPEDANCE SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Input command connection Volts (max) Kohms (impedance)	±20 6	J1-16	2-3, 2-4	This connection is for the speed (current command) input control to the servo module.
Tach feedback connection Volts (max) Kohms (impedance)	±40 6	J1-18	2-3, 2-4	This connection is for velocity feedback to the servo module.
$\overline{\text{Shutdown}}$ connection Volts (max)	-5 to +20 10	J1-6	2-3, 2-4	This input provides shutdown to the power stage of the servo module. Pulling this input to signal common inhibits switching at the power stage.
$\overline{\text{I limit}}$ + Connection VDC Kohms (impedance)	0 to 5	J1-12	2-3, 2-4	This input provides directional current limit to the servo module (via limit

Table 2-1: Continued

Heatsink ground	---	J1-4	2-3, 2-4	Earth grounding point for heatsink

DS8020 TROUBLESHOOTING GUIDE (Table 2-2)

CONDITION	POSSIBLE CAUSE	REFERENCES
Active LED is deenergized, even with ±12 VDC applied to pins 20 and 22 of J1.	• Shutdown input (pin 6, J1) is pulled low.	• See Figure 2-3 (see also Table 2-1, Control Interface Specifications)
	• High DC bus voltage (pins 28, 32 of J1)	• See Figure 2-3, 2-8
	• ±12 VDC input (pin 20, J1) is below +11 VDC	• See Figure 2-3, 2-8 (see also Table 2-1 for Control Interface Specifications.)
	• Short circuit exists at motor connections (pin 26, 30 of J1)	• See Figure 2-3, 2-8 (**NOTE**: Power-down Reset is required for all conditions above.)
Active LED is energized, but no torque is present at motor shaft.	• Motor load fuse F1 is open.	• See Figure 2-2, 2-3
	• I limit + (pin 12, J1) and/or I limit - (pin 14, J1) contact closed to signal common.	• See Figure 2-3, 2-8 (see also Table 2-1, Control Interface Specifications).
	• No DC bus voltage on +B, +B Return (pins 28, 32 of J1)	• See Figure 2-3, 2-8
	• Current limit pot turned full CW.	• See Figure 2-2, 2-3, 2-4
Motor accelerated to full speed when ±12 VDC power and DC bus power is applied.	• Tach feedback wires reversed (pin 18, 24 of J1)	• See Figure 2-3, 2-8 (see also Table 2-1, Control Interface Specifications).

Table 2-2: DS8020 Troubleshooting Guide

	• Personality module removed	• See Figure 2-2, 2-4
Motor has high pitch (oscillation) sound when ±12 VDC and DC bus power is applied	• Tach and/or gain pot turned too high	• See Figure 2-4
Motor gets execessively hot when running at minimum load condition (reference current monitor, pin 8 of J1)	• Ripple current (peak to peak) in excess of 20% of continuous return of motor, due to too high pre-amplifier gains. • Ripple current (peak to peak) in excess of 20% of continous rating of motor, due to too low motor inductance.	• See Figure 2-4

DS8020 REPLACEMENT PARTS (Table 2-3)

ITEM	AEROTECH PART NUMBER	COMMENT
DS8020 servo amplifier module	• EFA454	----
Motor load fuse, F1	----	• Use any "slow-blow" fuse (no greater than 10 amps, with no less than a 125 VAC rating). Fuse size: 3AG
Personality module	• EIK135 and EIK162	• Used for pre-selection of gain parameters for other motor combinations.
Quick-connect mating connector for connector J1	• ECK381	

Table 2-3: DS8020 Replacement Parts

		• Mating connector for "discrete" back plane termination.
Solder-type mating connector for connector J1	• ECK352	• Mating connector for printed circuit "motherboard" termination.

Table 2-3: Continued

CHAPTER 3: DSFR AND DSHR MOUNTING RACKS

Two types of mounting racks for the DS8020 Servo Amplifier module may be supplied as an option. Figures 3-1 and 3-2 contain photographs of these racks.

SECTION 3-1 THREE-AXIS MOUNTING RACK (DSHR)

The three-axis mounting rack (DSHR) shown in Figure 3-1 contains all necessary functions for interfacing up to three DS8020 Servo Modules with three DC motors. The only additional item necessary is a transformer for generating power for the internal DC bus power supply.

A 1.5 KVA transformer is usually all that is necessary for driving up to three DS8020 amplifiers in a typical servo application.

The control voltages (±12 VDC supply) are derived internally from an external 115/230 VAC, 50 to 400Hz power source.

SECTION 3-2 SHUNT REGULATOR OPTION

An optional DC bus shunt regulator circuit (integral to the mounting rack) may be supplied to clamp an elevated DC bus voltage caused by excess motor power regeneration during deceleration.

SECTION 3-3 CONTROL & POWER TO MOUNTING RACKS

Control and power connections to the mounting rack are accessed via an extension board at the rear of the mounting rack. The mounting rack base height is 3U, in accordance with international DIN standards. The control and power extension board is less than 1U in additional height.

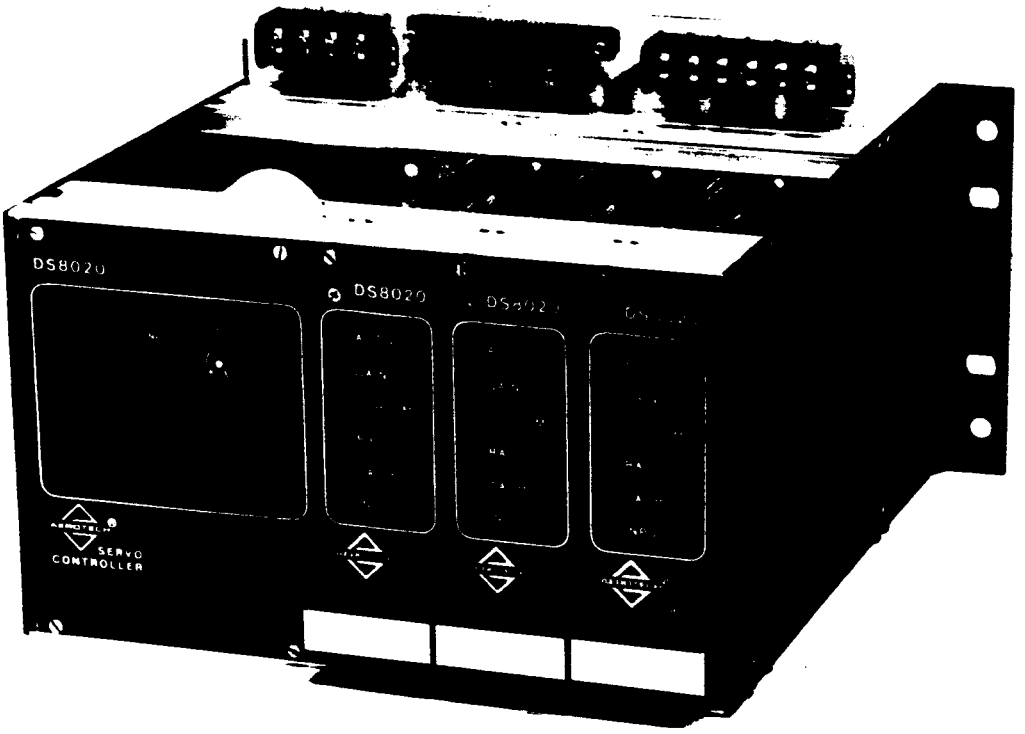


Figure 3-1: Photograph of Three-Axis Mounting Rack (DSHR)

SECTION 3-4 SIX AXIS MOUNTING RACK (DSFR)

The six-axis mounting rack (DSFR) is shown in Figure 3-2. This rack consists of two three-axis racks joined together.

Thus, for purposes of simplification, this Chapter provides only those specifications that are pertinent to the three-axis rack. Specifications for the six-axis rack are provided only for those specific items that differ from the three-axis version.

SECTION 3-5 MOUNTING SPECIFICATIONS (DSHR/DSFR)

Mounting specifications for the DSHR and DSFR mounting racks are shown in Figure 3-3.

Refer to additional dimensions for fans shown in Figure 3-4, if optional fan cooling is required. (P/N BA1 for DSHR and P/N BA2 for DSFR.) Fans are required for the DS8020 Servo Amplifiers when continuous current greater than 5 amps is required.

WARNING: Adequate ventilation space must be provided above and below the mounting rack for adequate convection cooling of the DS8020 amplifiers. This requirement is applicable to units with or without optional fan cooling. (See Figure 3-4 for minimum air flow space.)

A side view of the DSFR and DSHR mounting racks is shown in Figure 3-5. The sides of both mounting racks can be reversed in the field by removing the eight screws as shown. This feature allows for field selectable panel mounting or rack mounting. The DSFR (six-axis) mounting rack is the standard 19" width allowing it to be panel mounted or rack mounted.

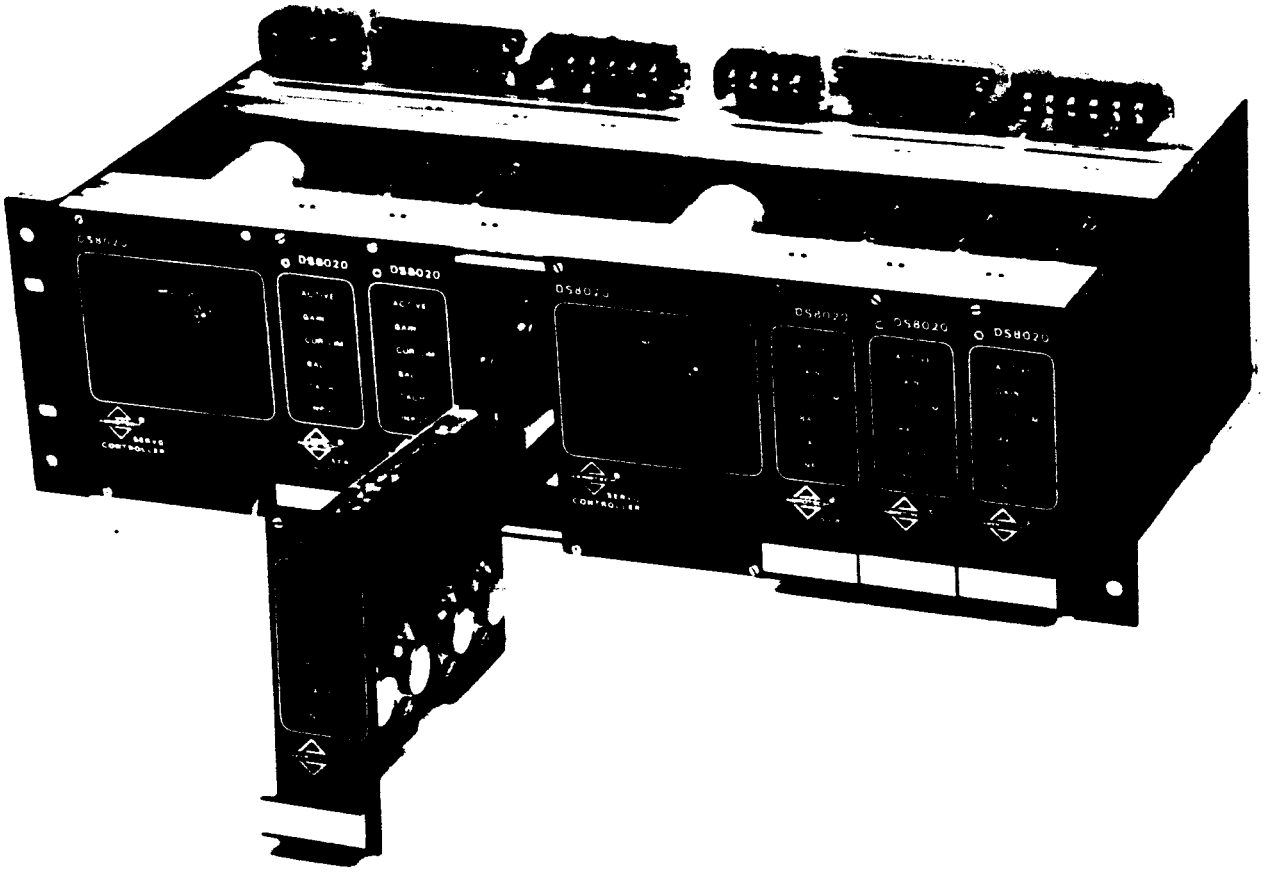
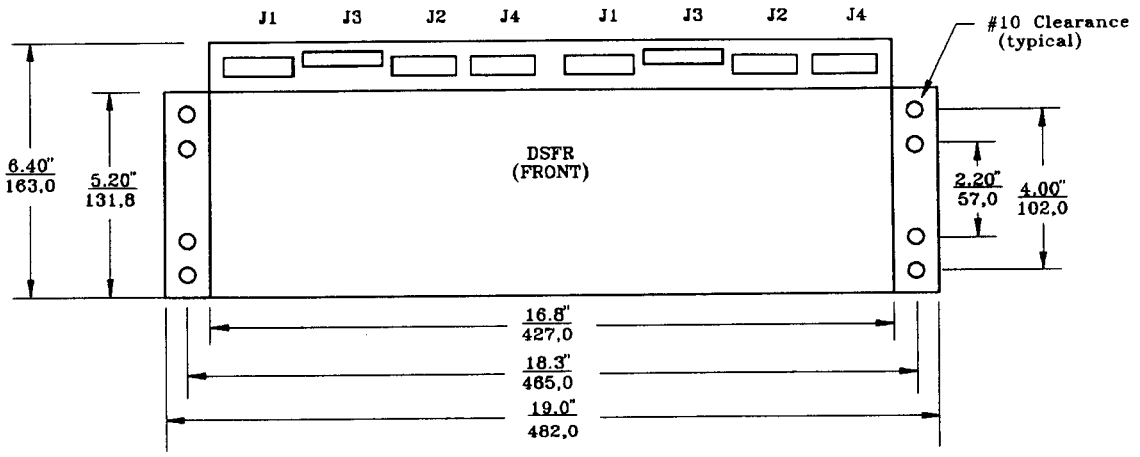
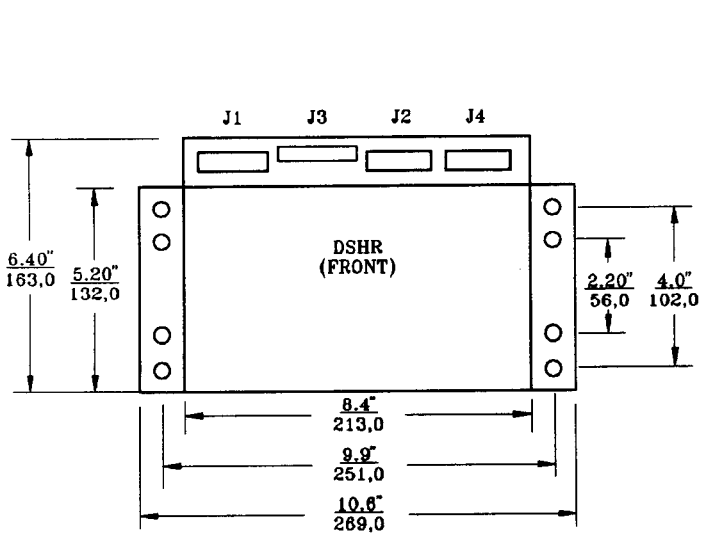


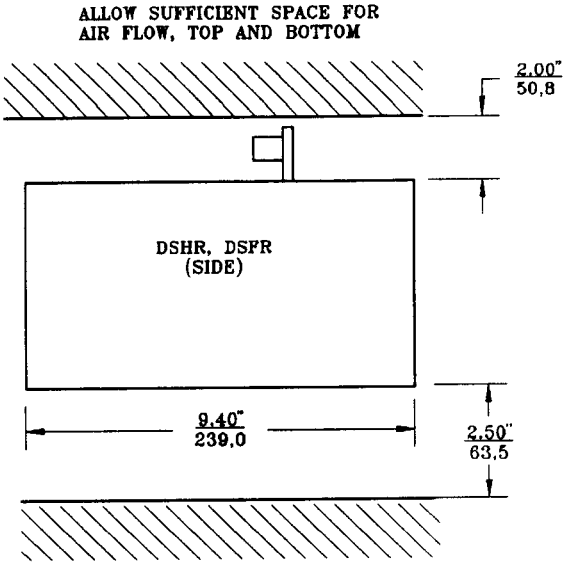
Figure 3-2: Photograph of Six-Axis Mounting Rack (DSFR)



FRONT VIEW OF 6-AXIS MOUNTING RACK (DSFR)

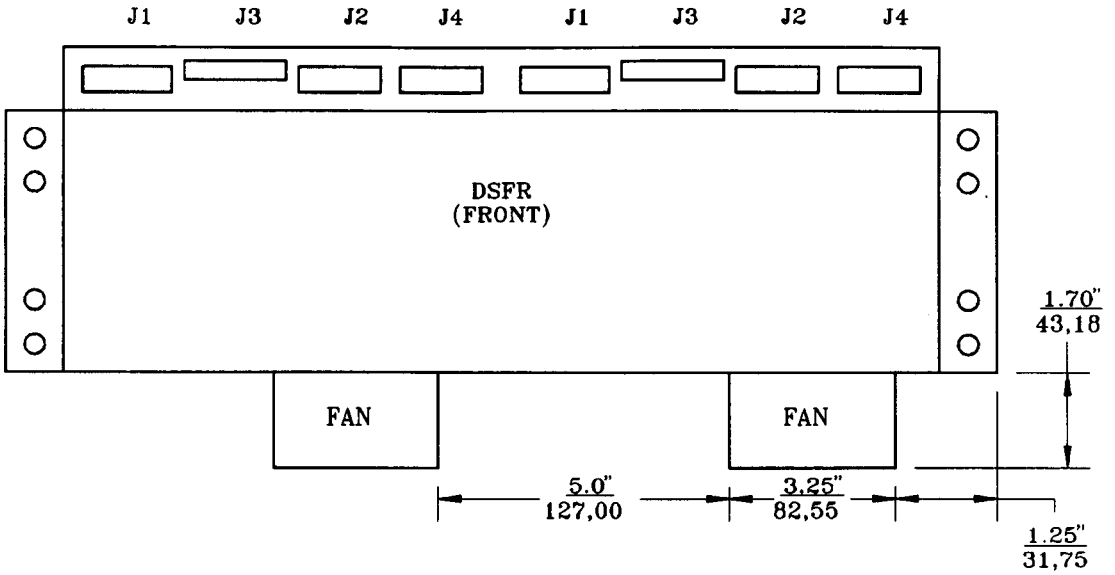


FRONT VIEW OF 3 AXIS
MOUNTING RACK (DSHR)

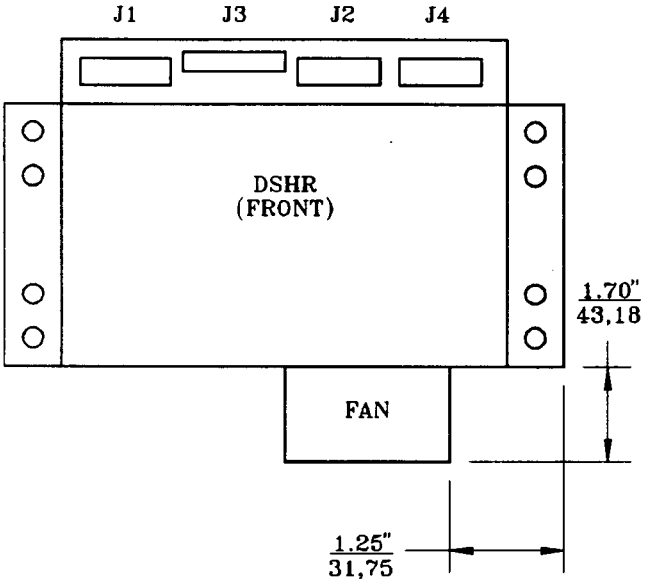


SIDE VIEW OF BOTH 3 AND 6 AXIS
MOUNTING RACKS (DSHR, DSFR)

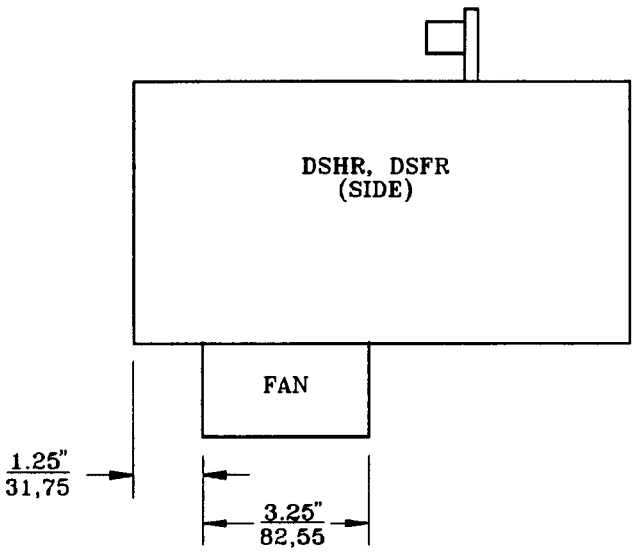
Figure 3-3: DSHR and DSFR Mounting Dimensions



FRONT VIEW OF 6-AXIS MOUNTING RACK (DSFR)



FRONT VIEW OF 3 AXIS
MOUNTING RACK (DSHR)



SIDE VIEW OF BOTH 3 AND 6 AXIS
MOUNTING RACKS (DSHR, DSFR)

Figure 3-4: DSHR and DSFR Fan Option Dimensions

SECTION 3-6 ELECTRICAL SPECIFICATIONS-DSFR/DSHR

Electrical specifications for the DSFR and DSHR mounting racks are listed in Table 3-1. Each specification listed in Table 3-1 contains reference information regarding input/output connector pin numbers, and additional Figure numbers contained in this Chapter. Comments are also included for each specification.

An outline of the DSHR (three-axis) mounting rack is shown in Figure 3-6. This outline provides reference information for user terminated input and output control and power wiring.

A rear view of the DSHR rack is shown in Figure 3-7. This outline shows the location of the shunt regulator fuse (for Shunt Regulator option).

SECTION 3-7 FUNCTIONAL DIAGRAM-DSHR/DSFR

A functional diagram of the DSHR mounting rack is shown in Figure 3-8. Locations of input and output connectors J1 through J4 are shown in Figure 3-6.

Pertinent information concerning the locations of key items shown in the function diagram (Figure 3-8) are shown in Figure 3-9.

DANGER: HIGH VOLTAGE EXISTS ON THE REAR OF THE DS SERIES MOTHER BOARD.

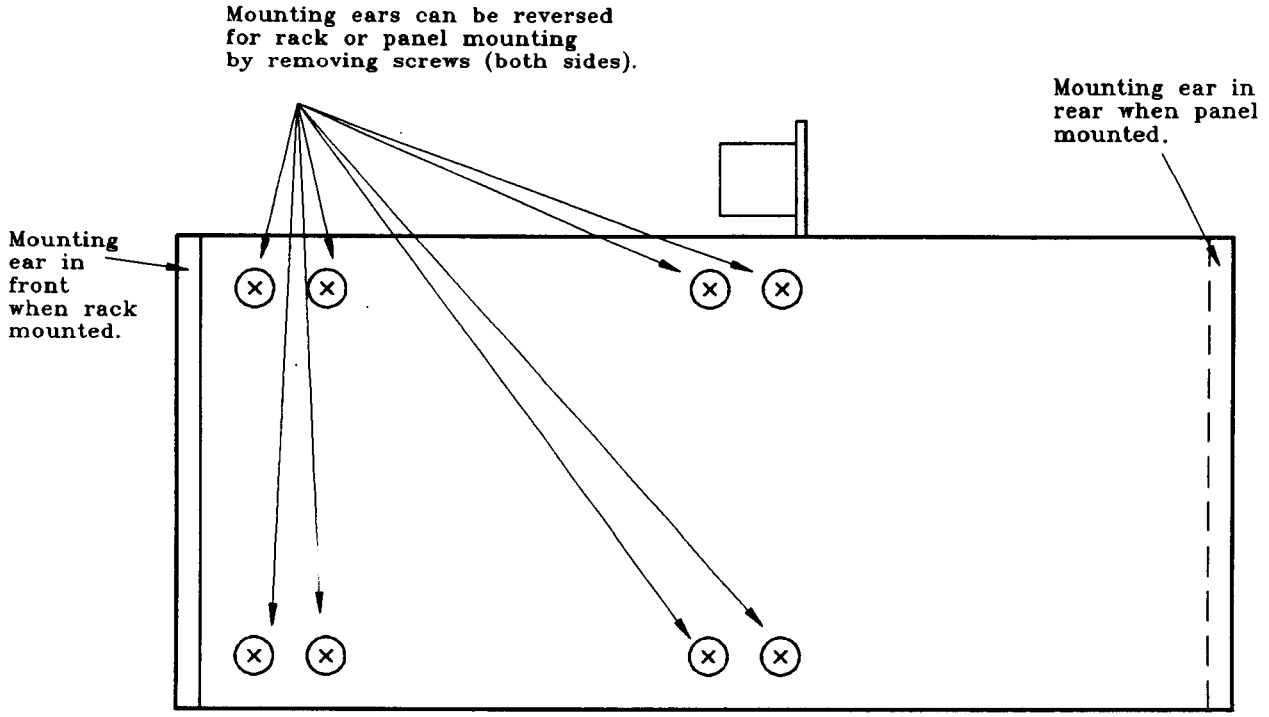


Figure 3-5: Side View of DSFR or DSHR Mounting Rack

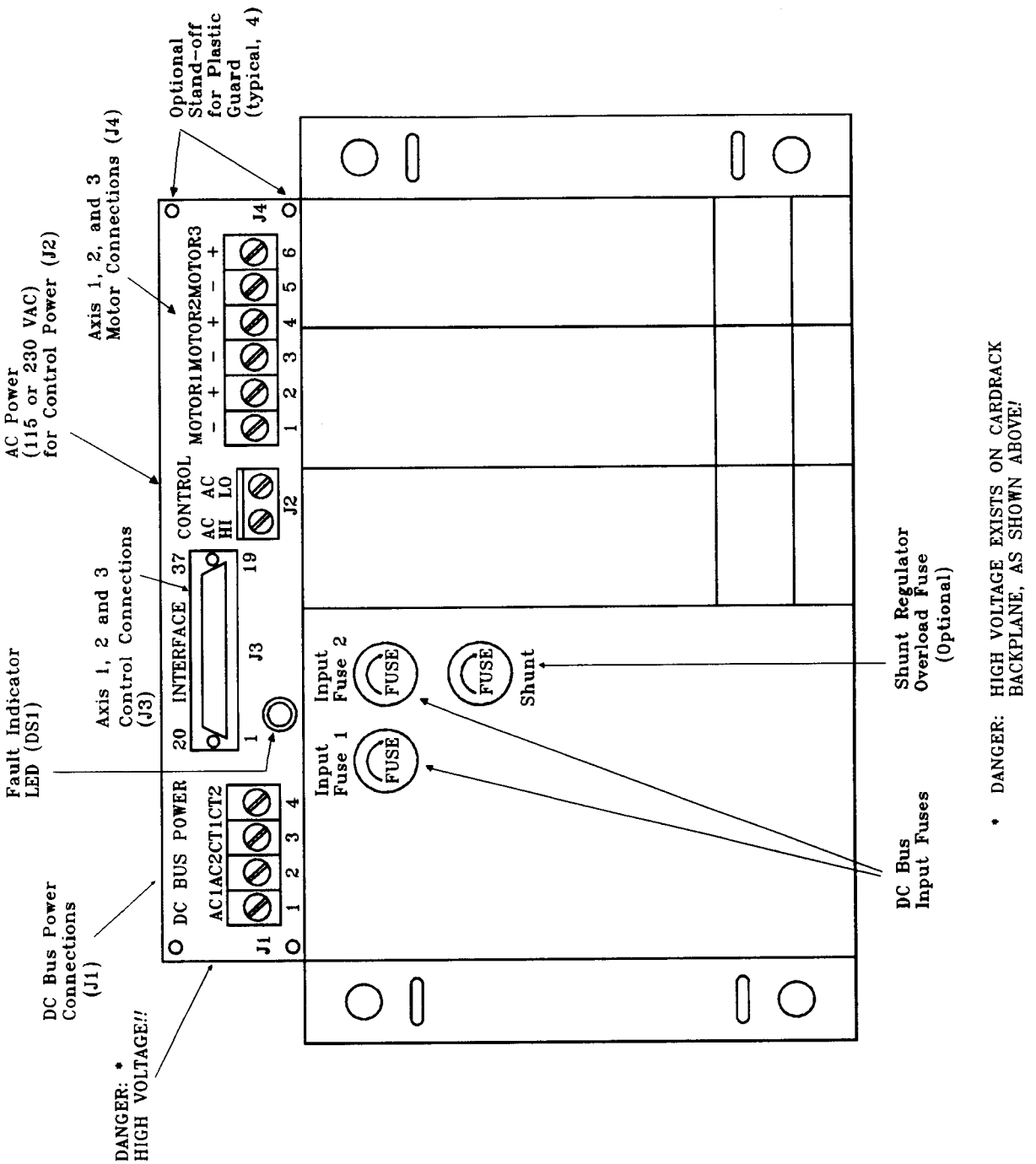


Figure 3-6: Front View of DSHR (1/2 DSFR) (showing Locations of Input and Output Control and Power Connections)

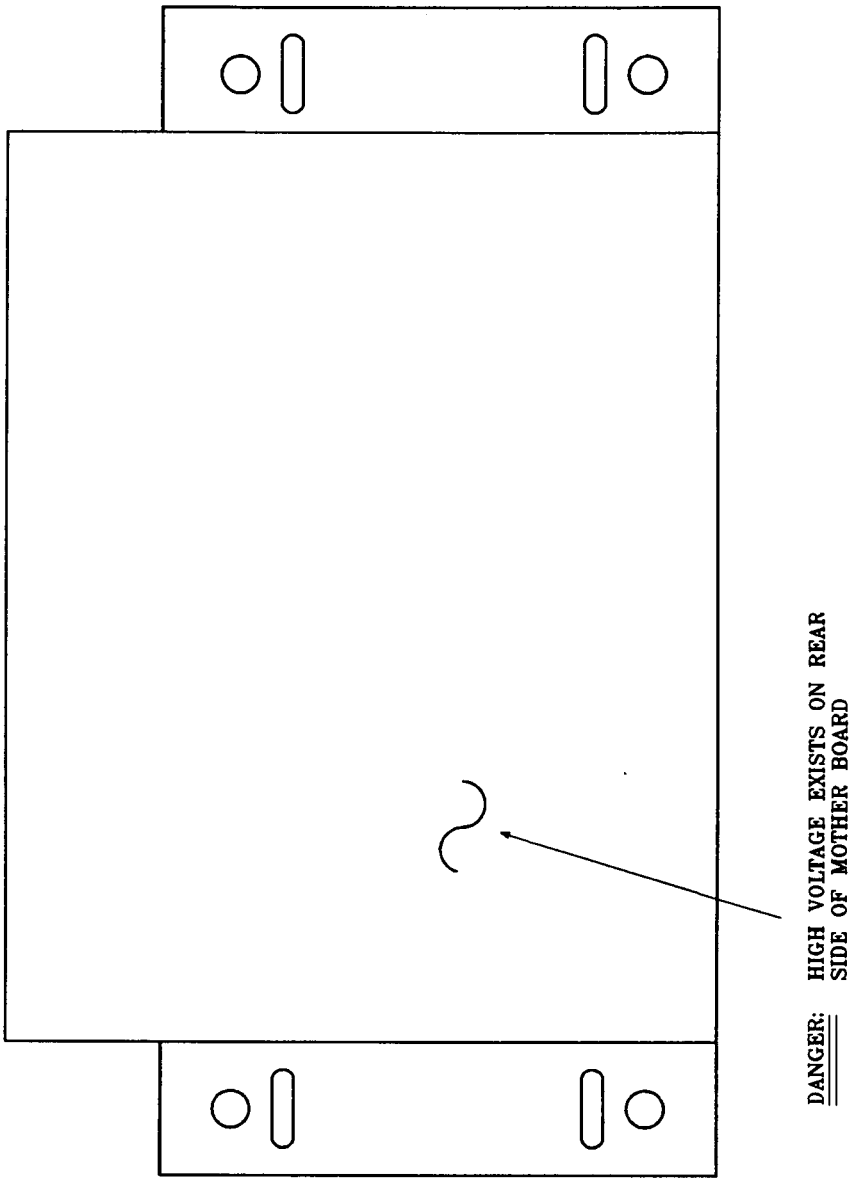


Figure 3-7: Rear View of DSHR (1/2 DSFR) Mounting Rack

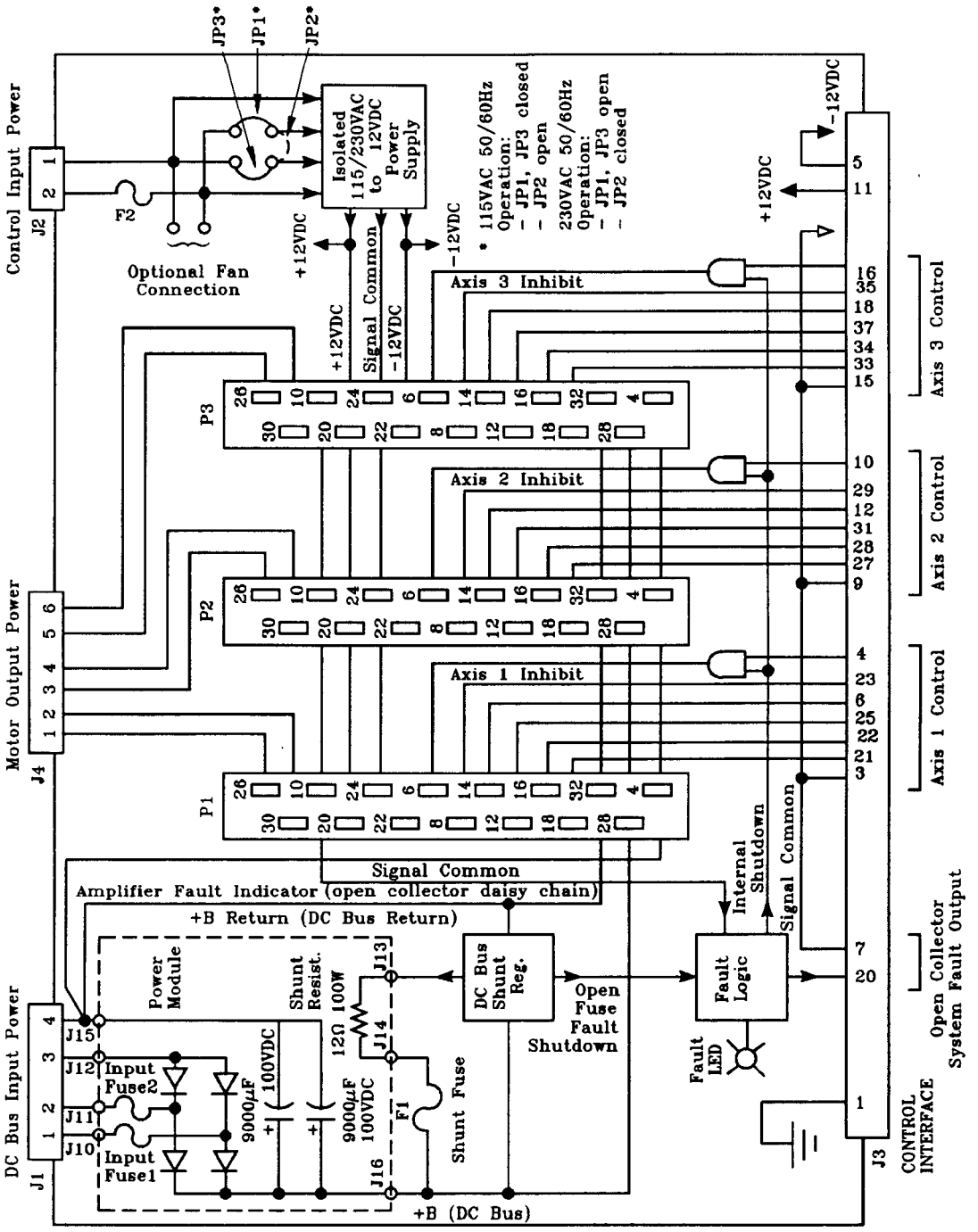
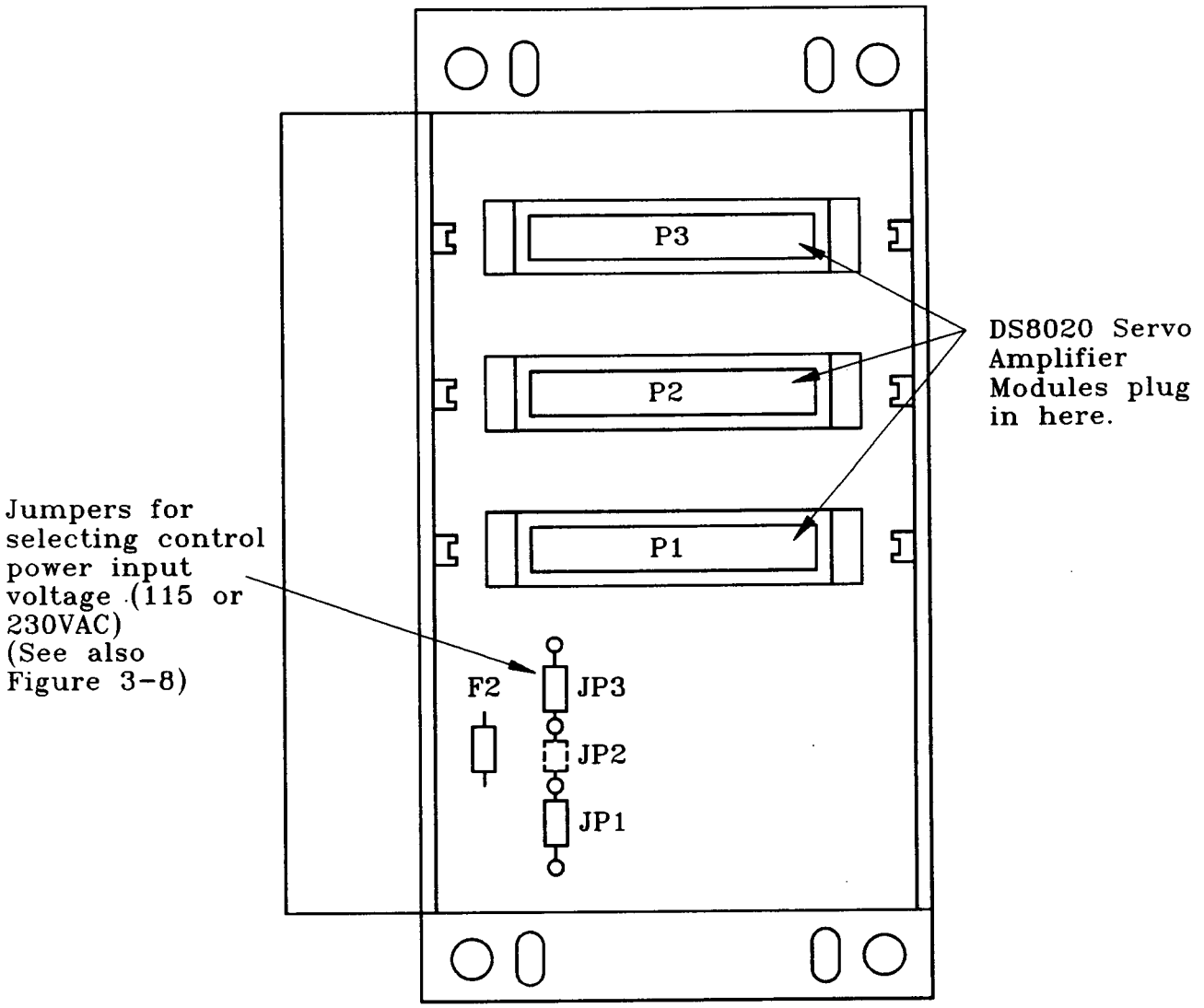


Figure 3-8: Electrical Block Diagram of DSHR (1/2 DSFR) Mounting Rack



e 3-9: Inside View Of DSHR Mounting Rack (DS8020 Servo Amplifier And Power Supply
Jule Removed)

SECTION 3-8 WIRING DSFR/DSHR INTO SYSTEM

An interconnect diagram for input power and output motor wiring is shown in Figure 3-10. The input DC bus power wiring (J1) allows for two configurations, single-phase full wave or single-phase center tap. The internally generated DC bus voltage relationship to input AC voltage can be derived with the following equation (this equation applies to both center tap and non-center tap configurations).

DC BUS (VDC) = INPUT VAC RMS x 1.414

NOTE: Connections J1 pin 4 and J3 pin 7 *must both* be connected to earth ground. (See Figure 3-10.)

An outline and pin-out specification for the control interface connector (J3) is shown in Figure 3-11. Connector J3 accommodates a standard 37 pin "D" type male mate.

SECTION 3-9 THE TV 1.5 DC BUS POWER TRANSFORMER

An outline of the optional TV 1.5 DC bus power supply transformer (P/N EAX141) is shown in Figure 3-12. This transformer is supplied as an option to the DSFR and DSHR mounting racks. The transformer allows the generation of a 40 VDC bus (28 VAC taps), 60 VDC bus (42 VAC taps), and 80 VDC (56 VAC taps).

Figure 3-13 shows the typical DC Bus "droop" characteristics of the TV 1.5 transformer, connected to the DC bus input power connection (J1) of the DSHR rack (see Figure 3-10). DC bus voltage level V_o of Figure 3-13 is in respect to the filter capacitors (9000μf x 2) with given value of output current I_o distributed to the three DS8020 Servo Amplifier modules.

SECTION 3-10 TROUBLESHOOTING THE DSHR & DSFR

A troubleshooting guide for the DSFR and DSHR mounting racks is shown in Table 3-2 (located at the end of this Chapter).

SECTION 3-11 DSHR & DSFR SPARE PARTS

A list of spare parts for the DSFR and DSHR mounting racks is shown in Table 3-3 (located at the end of this Chapter).

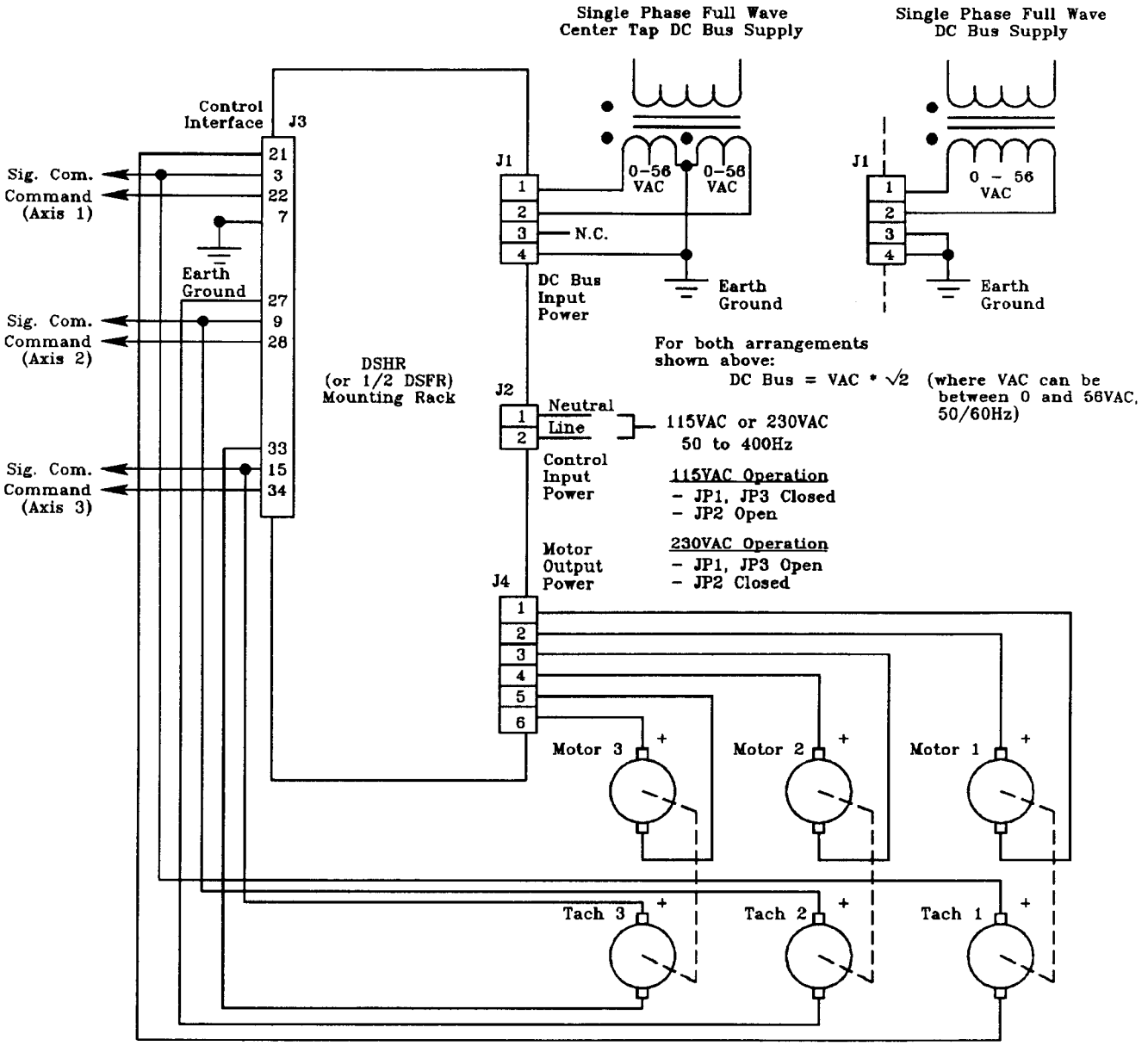


Figure 3-10 Interconnection for DSHR (1/2 DSFR) Mounting Rack

PIN-OUT DEFINITION FOR CONTROL INTERFACE CONNECTOR J3

1 Shield
2 (N.C.)
3 Signal common
4 Motor 1 shutdown
5 -12VDC (for external use)
6 Motor 1 I Limit-
7 Signal common
8 (N.C.)
9 Signal common
10 Motor 2 shutdown
11 + 12VDC (for external use)
12 Motor 2 I Limit-
13 (N.C.)
14 (N.C.)
15 Signal common
16 Motor 3 shutdown
17 (N.C.)
18 Motor 3 I Limit-
19 (N.C.)
20 System fault
21 Motor 1 tach feedback (V_{FB})
22 Motor 1 input command (V_{COM})
23 Motor 1 current monitor (I_{FB})
24 (N.C.)
25 Motor 1 I Limit +
26 (N.C.)
27 Motor 2 tach feedback (V_{FB})
28 Motor 2 input command (V_{COM})
29 Motor 2 current monitor (I_{FB})
30 (N.C.)
31 Motor 2 I Limit +
32 (N.C.)
33 Motor 3 tach feedback (V_{FB})
34 Motor 3 input command (V_{COM})
35 Motor 3 current monitor (I_{FB})
36 (N.C.)
37 Motor 3 I Limit +

OUTLINE OF CONNECTOR J3

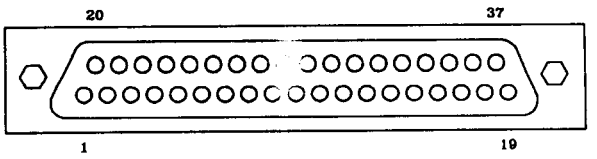


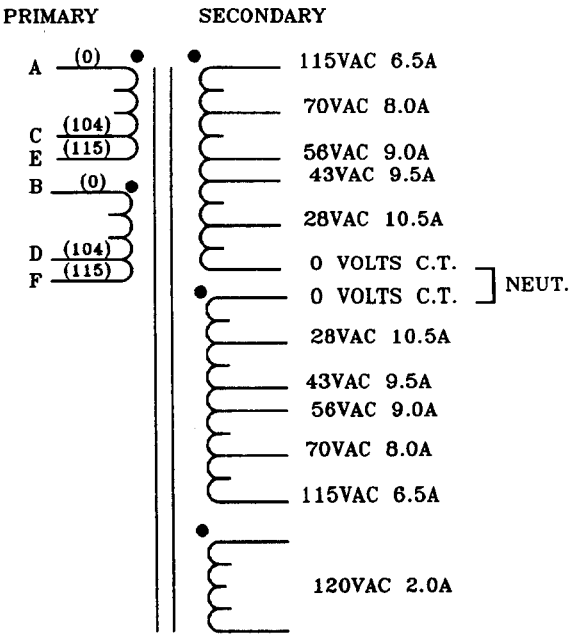
Figure 3-11: Pin Out Definitions for Control Connector J3

ELECTRICAL SPECIFICATIONS

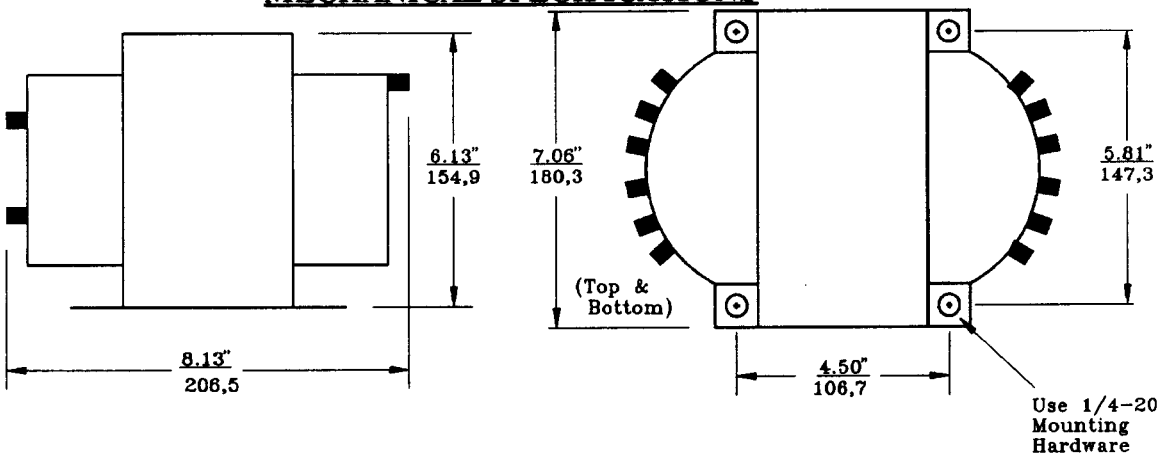
INPUT VOLTAGE	PRIMARY JUMPER	INPUT CONNECTION
104	A–B C–D	A&D
115	A–B E–F	A&F
208	C–B	A&D
230	B–E	A&F

Total KVA Rating – 1.5 KVA
Frequency – 50 or 60 Hz

Maximum Secondary Phase Current Ip – 9 Amps RMS (any tap, per winding set)

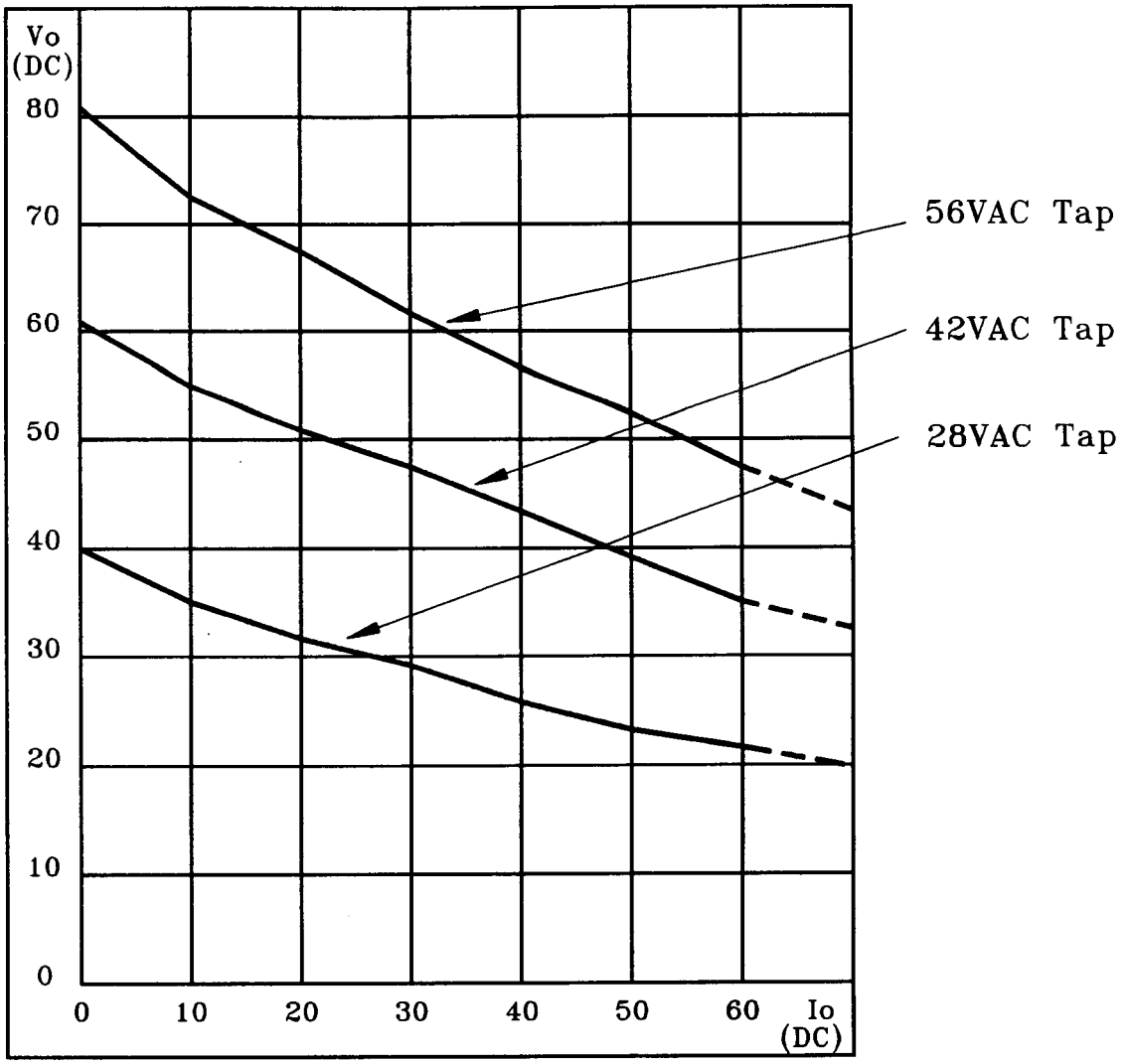


MECHANICAL SPECIFICATIONS



WEIGHT: 28 LBS. (12.73 Kg)

Figure 3-12: TV 1.5 Transformer Specifications



NOTE: Curves shown above are for center tap and full wave configurations (see Figure 3-10)

Figure 3-13: Typical DC Bus Voltage Characteristics of TV1.5 & DSHR Mounting Rack

ELECTRICAL SPECIFICATIONS
TABLE 3-1

INPUT/OUTPUT DC BUS POWER SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Peak DC Bus Output Current				
Amps, DC (max)	60	P1,P2, P3-28,32	3-8,3-9	Assume equal distribution of total current over all 3 sets of connections
Continuous DC Bus Output Current				
Amps, DC (max)	20	P1,P2, P3-23,32	3-8,3-9	Maximum current per connection is 10 amps
DC Bus Input Supply Ac Voltage				
VAC (max)	56	J1-1,2,	3-6,3-8,	Maximum is a
VAC (min)	0	3,4	3-10	nominal line value. Maximum allowable "high line" is 10% (i.e., 62 VAC)
DC Bus regeneration limit (without Shunt Regulator Option)	95	----	3-8	Limit for motor regeneration only. This is **not** intended to be a nominal operating level for the DS8020.
DC Bus Shunt Regeneration Set Point (Shunt Regulator Option)				
VDC (max)	95	----	3-8,3-10	

Table 3-1: DSHR and DSFR Mounting Rack Electrical Specifications

CONTROL INPUT POWER SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Control Input Voltage				
115 VAC Operation:				
VAC (max)	130	J2-1,2	3-6,3-8,	240 VAC and 220
VAC (min)	95		3-10	VAC (European
230 VAC Operation:				Service) are
VAC (max)	260	J2-1,2	3-6,3-8,	considered nominal
VAC (min)	190		3-10	values for 230 VAC configuration.
Control Input Voltage Frequency				
Hz (min)	50	J2-1,2	3-6,3-8,	60 Hz is typically
Hz (max)	400		3-10	the standard input frequency for North American Service.
Control Input Voltage Current				
115 VAC Operation:				
mA (max)	70mA	J2-1,2	3-6,3-8, 3-10	Power draw is typically less than 5 Watts.
230 VAC Operation:				
mA (max)	35mA			

MOTOR OUTPUT POWER SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Motor Connection Output Specifications	----	J4-1,2, 3,4,5,6	3-6,3-8, 3-10	See Table 2-1 for DS8020 Servo Module specifications.

Table 3-1: Continued

CONTROL INTERFACE SPECIFICATIONS

	VALUE	PIN	FIGURE	COMMENT
Auxiliary +12,-12VDC Output Connections				
mA (max)	±50	J3-11,5	3-6,3-8, 3-11	This is maximum draw for external use.
Motor Shutdown Connections				
Volts (max)	-5 to +20	J3-4,10, 16	3-6,3-8, 3-11	Connnection is separate for each motor axis.
Kohms (impedance)	10			Pulling this input to signal common inhibits switching of respective Servo Amplifier (DS8020). This input is pulled up internally to +12. High bus voltage (without optional shunt regulator) or open shunt fuse (see Fig. 3-7, with shunt option) also causes shutdown.
System Fault Output Connection				
mA (max)	-50	J3-20,	3-6,3-8	Open collector
VDC (max)	+30	7	3-11	output driver. Drives low if any DS8020 module is current tripped, or if DC bus is too high (loss of shunt regulator).

NOTE: For electrical specifications on all other connections to internal connector J3, see Table 2-1, Control Connection Specifications.

Table3-1: Continued

TROUBLESHOOTING THE DSHR AND DSFR

Table 3-2

CONDITION	POSSIBLE CAUSE	REFERENCE
Active LED(s) on DS8020 servo are de-energized with 115 (230) VAC applied at connector J2.	• Shutdown inputs (pins 4, 10, 16 of J3) are pulled to signal common.	• See Figure 3-8, 3-11 (see also Tables 3-1, Control Interface Specifications).
	• 115 (230) VAC control input power below minimum level.	• See Figure 3-8, 3-10 (see also Table 3-1, Control Interface Specifications).
	• Motor short circuit condition at motor output power connections (pin 1 through 6 on J4).	• See Figure 3-8, 3-10
	• ±12 VDC power supply fuse F2 open	• See Figure 3-8, 3-9, **(NOTE: If fuse is open, do not attempt repair!)**
Active LED(s) on DS8020 servo module(s) are energized, but no torque is present on motor shaft.	• Directional current limit contacts (I limit + and I limit- : pins 6, 12, 18, 25, 31 and 37 of J3) are pulled to signal common.	• See Figure 3-8, 3-11 (see also Table 2-1, Control Interface Specifications).
	• Current limit pots on DS8020 servo module are full CW.	• See Figure 2-2, 2-3.
	• No DC bus input voltage (J1) or input DC bus fuse open.	• See Figure 3-6, 3-8, 3-10.
Motor(s) accelerate to full speed when ±12VDC power (J2) DC bus power (J1) is applied.	• Tach feedback connected (pin 21, 27, 33 of J3) are required with respect to signal common.	• See Figure 3-8, 3-10, 3-11 (see also Table 2-1, Control Interface Specifications).

Table 3-2: DSHR and DSFR Mounting Rack Troubleshooting Guide

DC bus shunt regulator fuse opens periodically (shunt regulator option).	• Excessive motor regeneration (due to deceleration of high inertia load).	• See Figure 3-7, 3-8 (see also Table 3-1, Input/Output DC Bus Power Specifications).
	• DC input power greater than 56 VAC	• See Figure 3-8, 3-10 (see also Table 3-1).
Fault LED is energized.	• Shunt regulator fuse is open (shunt option).	• See Figure 3-7, 3-8.
	• One or more DS8020(s) have short circuit current trip condition at motor output connections (J4).	• See Figure 3-8, 3-10
	• DC bus voltage in excess of 95 VDC (no shunt regulator option).	

Table 3-2: Continued

REPLACEMENT PARTS FOR THE DSHR AND DSFR
Table 3-3

ITEM	AEROTECH PART NUMBER	COMMENT
DSHR three-axis mounting rack	EFA 456	Consult factory for fan option (P/N BA1)
DSFR six-axis mounting rack	EFA 457	Consult factory for fan option (P/N BA2)
Shunt regulator option	----	Consult factory for shunt regulator option
DC bus input 1 and input 2 fuses	----	Use 20 amp "slow-blow" 3AG type fuses
Shunt regulator overload fuse (F1)	----	Use 3 1/2 amp "slow blow" 3AG fuse DO NOT EXCEED 3 1/2 AMP!

Table 3-3: DSFR and DSHR Replacement Parts List

CHAPTER 4: SERVICE AND REPAIR

On-site service should be performed by an experienced Aerotech-trained technician.

WARNING: WHILE UNDER WARRANTY, CUSTOMER REPAIR OF THE EQUIPMENT SHOULD NOT BE ATTEMPTED, TO DO SO MAY VOID THE WARRANTY.

When calling for service, **PLEASE HAVE THE EQUIPMENT SERIAL NUMBER AVAILABLE.**

SECTION 4-1 SHIPMENT

The procedure for shipping equipment back to Aerotech described below, pertains to warranty as well as non-warranty repairs.

1. Before returning any equipment a "*Return Authorization Number*" *must be obtained from Aerotech. (Have the equipment serial number available when calling.)*

2. The equipment being returned must be encased in a proper cushioning material and enclosed in a cardboard box.

Warning: Damage due to improper packaging voids warranty!

Aerotech Service Centers are listed below. For service and information, contact the office servicing your area.

AEROTECH, INC. SERVICE CENTERS

World Headquarters
AEROTECH, INC.
101 Zeta Drive
Pittsburgh, PA 15238

Phone (412) 963-7470
FAX (412) 963-7459
TWX (710) 795-3125

AEROTECH LTD.
3 Jupiter House, Calleva Park
Aldermaston
Berkshire RG7 4QW England
Phone (07356) 77274
TLX 847228
FAX (07356) 5022

AEROTECH GMBH
Neumeyerstrasse 90
8500 Nuernberg 10
West Germany
Phone (0911) 521031
TLX 622474
FAX (0911) 521235

Warranty and Field Service Policy

Aerotech, Inc. warrants its products to be free from defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products which are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability on any claim for loss or damage arising out of the sale, resale or use of any of its products shall in no event exceed the selling price of the unit.

Laser Product Warranty

Aerotech, Inc. warrants its laser products to the original purchaser for a minimum period of one year from date of shipment. This warranty covers defects in workmanship and material and is voided for all laser power supplies, plasma tubes and laser systems subject to electrical or physical abuse, tampering (such as opening the housing or removal of the serial tag) or improper operation as determined by Aerotech. This warranty is also voided for failure to comply with Aerotech's return procedures.

Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within (30) days of shipment of incorrect materials. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. Any returned product(s) must be accompanied by a return authorization number. The return authorization number may be obtained by calling an Aerotech service center. Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than (30) days after the issuance of a return authorization number will be subject to review.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warrantied defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an air freight return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Returned Product Non-Warranty Determination

After Aerotech's examination, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within (30) days of notification will result in the product(s) being returned as is, at the buyer's expense. Repair work is warranted for (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-Site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty- related, then the following policy applies.

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special service rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-Site Non-Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies.

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

AEROTECH, Inc., 101 Zeta Drive, Pittsburgh, Pennsylvania 15238

Phone (412) 963-7470 • TWX 710-795-3125 • FAX (412) 963-7459

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