

LBT PROJECT 2x8.4m TELESCOPE

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LBT PROJECT 2 X 8.4m OPTICAL TELESCOPE

Instrument Rotator and Cable Chain Drive Power Module Description and Operations Manual

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Approved		

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1. Revision History

Issue	Date	Changes	Responsible
a	9-March-07	First draft	Mike Gusick

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3. About this document

This document will describe the function and operation of the rotator drive module electrical system.

3.1. Reference Documents

[RD1] CAN670s007a – Instrument Rotator and Cable Chain Detailed Design Description

[RD2] CAN675s001a – General Purpose SERDES Communications Protocol Standard

[RD3] CAN675s002a – General Purpose SERDES Communications PC Board Description and Operations Manual

[RD4] CAN675s004a – Instrument Rotator and Cable Chain Interface Module Description and Operations Manual

[RD5] CAN675r002a.PDF - Instrument Rotator and Cable Chain Relay Logic Board Schematics and Board Design

3.2. Abbreviations

MCR Master Control Relay

MCS Mount Control System

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4. Introduction

The purpose of rotator drive power modules is to provide a mechanical enclosure, electrical drive interface and low-level relay logic interlocks for the instrument rotator and cable chain drive systems. See [RD1] for a detailed overview of the instrument rotator and cable chain system.

4.1. Rotator Drive Module Hardware

Each rotator drive power module contains the required electrical power equipment to drive a single rotator axis that consists of two rotator drive motors, one cable chain drive motor and associated support and safety devices. The rotator drive modules are 5U rack mountable enclosures that are housed in the telescope's elevation axis upper right tree house.

Each power module houses three synchronous AC motor drives, drive output reactors, input three phase power contactors and breaker, three phase power monitoring unit, an external regenerative resistor, low level relay logic interlock board, front panel operating controls, status indicators and electrical interface connectors to field devices and the rotator interface module. Internal fans provide forced air ventilation for components in the module.

Figure 1 is a conceptual rendering of the inside layout of a 5U rack mount rotator power module. Two such power modules are required to drive two rotator axes (1 rotator pair).

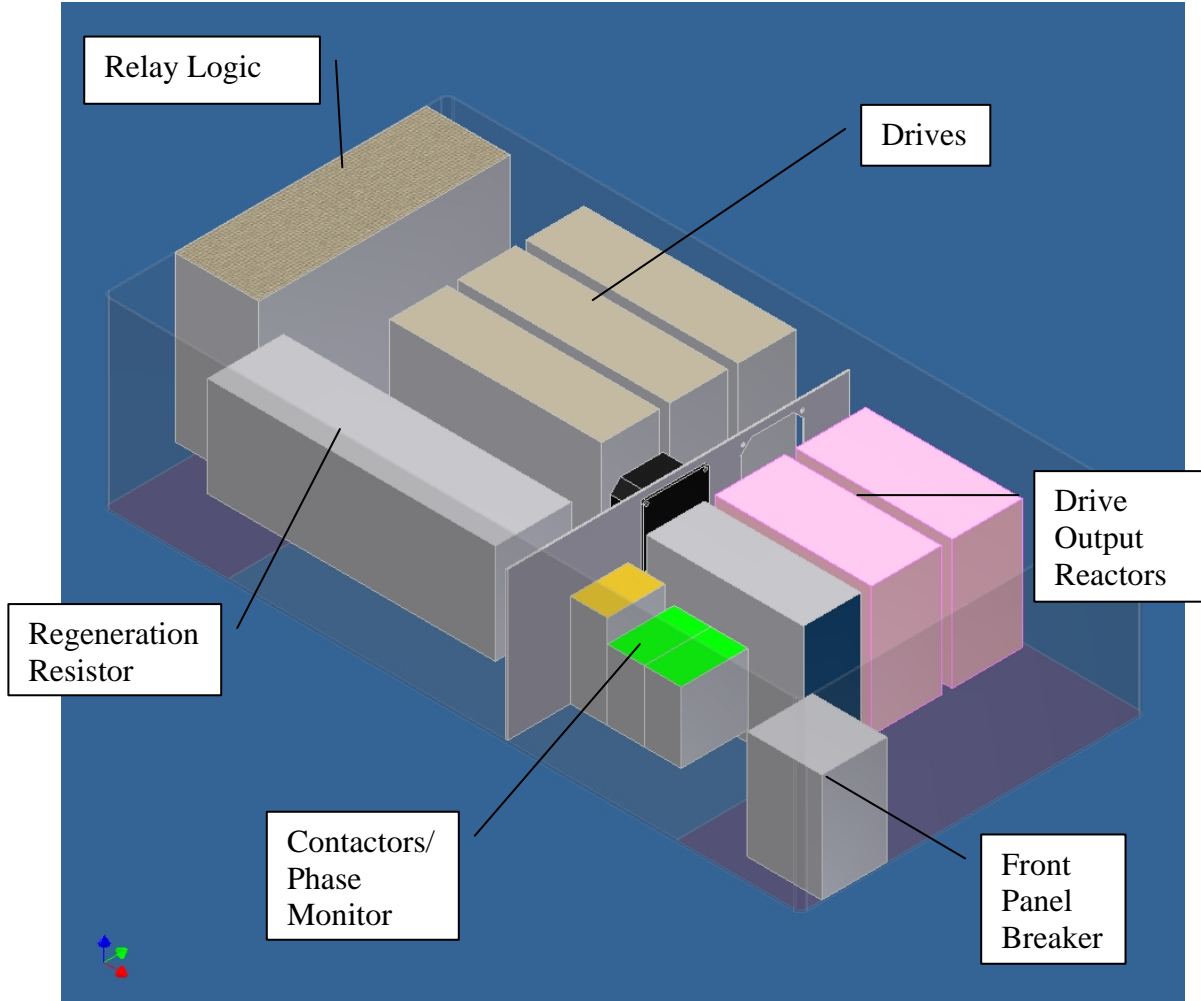


Figure 1

4.2. Rotator Drive Module Operation

The drive power module contains three Kollmorgen ServoStar 300 series digital servo drives/amplifiers. The rotator is driven by a pair of ServoStar 310 drives that are operated in torque mode and controlled by a position/velocity loop run remotely by the Mount Control System (MCS) via a high speed fiber serial link [RD2][RD3]. The cable chain is driven by a ServoStar 306 drive and is also operated in torque mode and controlled by a position/velocity loop run remotely by the Mount Control System (MCS). The cable

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chain position relative to the rotator is determined using a relative position sensor connected between the rotator and cable chain.

The rotator and cable chain drives receive analog torque commands from the rotator interface module [RD4] and provide drive status information back to the rotator interface module via a Controller Area Network (CAN) connection running the CANopen protocol. The CAN network cable is daisy chained from the first to the last drive in the drive power module. The last drive connection in the daisy chained CAN cable is terminated with a 120 ohm resistor. The rotator interface module is connected to the rotator control system that is housed in the auxiliary control room via a high speed fiber serial link.

The rotator drive power module supplies breaker protected three phase 208VAC and fused +24VDC power to the drives and provides electrical connections to the rotator and cable chain motors and associated field controls, sensors and limit switches. The module also contains a low level hardware relay logic board that provides emergency stop, lock out and interlocks for safe operation of the rotator and cable chain. Remote lockout switches for each rotator axis may be daisy chained and located any where on the elevation axis. A remote lockout rear panel connector is provided to allow remote lockout stations. All digital inputs/outputs are optically coupled in the ServoStar drives.

All rotator drive power modules are interchangeable at the hardware level so any module may be used with any rotator. Therefore, it is only necessary to determine that a power module is non-functional and the complete unit can be swapped out in the field and later troubleshot and repaired on the bench. **Note: The center bent rotators may not be compatible with the current design due to other requirements for these rotators.**

5. Module/Component Specifications

Drive Power Module AC Power Input - 208VAC 3Phase, internal 10A breaker
 Drive Power Module DC Power Input - +24VDC UPS ~5A (actual amps TBD)
 ServoStar S310 Servo Drives 208VAC 3 Phase Input Power – 4 kVA
 ServoStar S310 Servo Drives Rated Output Current– 10Arms
 ServoStar S310 Servo Drives DC Input Power - 24VDC 1A, no fan/brake
 ServoStar S306 Servo Drives 208VAC 3 Phase Input Power – 2kVA
 ServoStar S306 Servo Drives Rated Output Current– 6Arms
 ServoStar S306 Servo Drives Input DC Power - 24VDC 1A, no fan/brake
 ServoStar altitude derating – 1000 to 2500 meters - 1.5%/100 meters
 Operating Temperature – 0C to +30C

6. Front Panel

The proposed panel layout is shown in figure 2. Each ServoStar drive may be individually configured through the appropriate RS-232 serial connection on the front panel. The front panel also provides status information regarding drive power, pending interlocks, emergency limits, emergency stop system, a lock out switch for the associated rotator, main and emergency bypass and master control relay (MCR) reset inputs to allow recovery from an emergency stop/limit condition.

Three phase power to the module is controlled by a front panel breaker. After three phase power is turned on it is necessary to reset the three phase power either remotely or locally before the rotator and cable chain drives can be powered or enabled. There are three events that can unlatch the MCR and therefore disabled the drives: 1) E-Stop, 2) rotator/cable chain relative or absolute emergency limit tripped, 3) Local or remote lockout key switch. If the three phase power monitor detects a fault it will unlatch a latching relay and disable the rotator drives and set the rotator brake. The power monitor latching relay may be reset remotely through software and is also reset locally whenever the MCR reset switch is depressed.

Indicators on the front panel provide status information for drive power, drive enable signals, emergency limits, E-Stop and lock out. Should an emergency limit be reached, bypass switches are provided to allow the rotator to be driven out of the emergency limit.

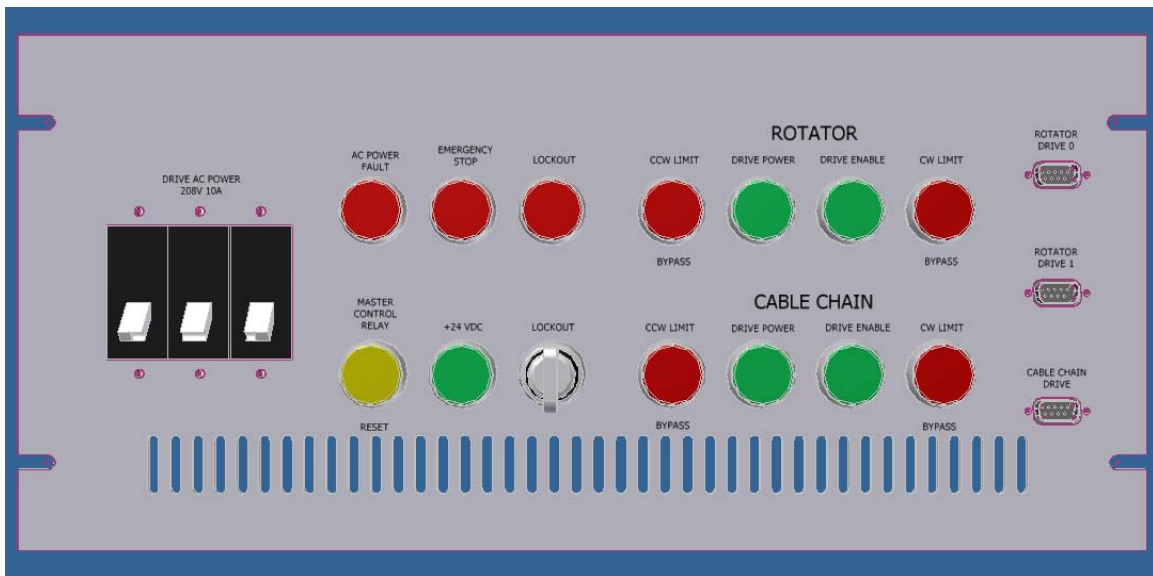


Figure 2

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7. Relay Logic Board

The drive power module also includes a custom relay logic PC board [RD5]. The proposed relay logic board is shown in Figure 3. The relay logic board provides low level relay logic hardware to perform the following:

- 1) Disables all drives and sets rotator brake in the event of an E-Stop, emergency limit reached, rotator locked out by key switch. Drives can not be AC powered, enabled, or rotator brake released when these conditions exist. +24VDC power is still supplied to drive. The pending fault must be removed and the MCR locally reset for operation to continue.
- 2) Disables all drives and sets rotator brake when the three phase power monitor detects a power fault condition. Drives can not be AC powered, enabled, or rotator brake released while this conditions exist. +24VDC power is still supplied to drive. The pending power fault must be removed and the power monitor latch locally or remotely reset for operation to continue.
- 3) Provides a discrete signal that can be remotely controlled through software to reset a fault condition on all drives.
- 4) Ensures drives are in an acceptable state before being powered, enabled or rotator brake is released. +24VDC must be supplied to drives and the drive indicates no faults present before the drive may be AC powered. The drive must be AC and 24VDC powered and indicate no faults before being enabled. The drive must be powered and enabled with no faults before the rotator brake may be released.

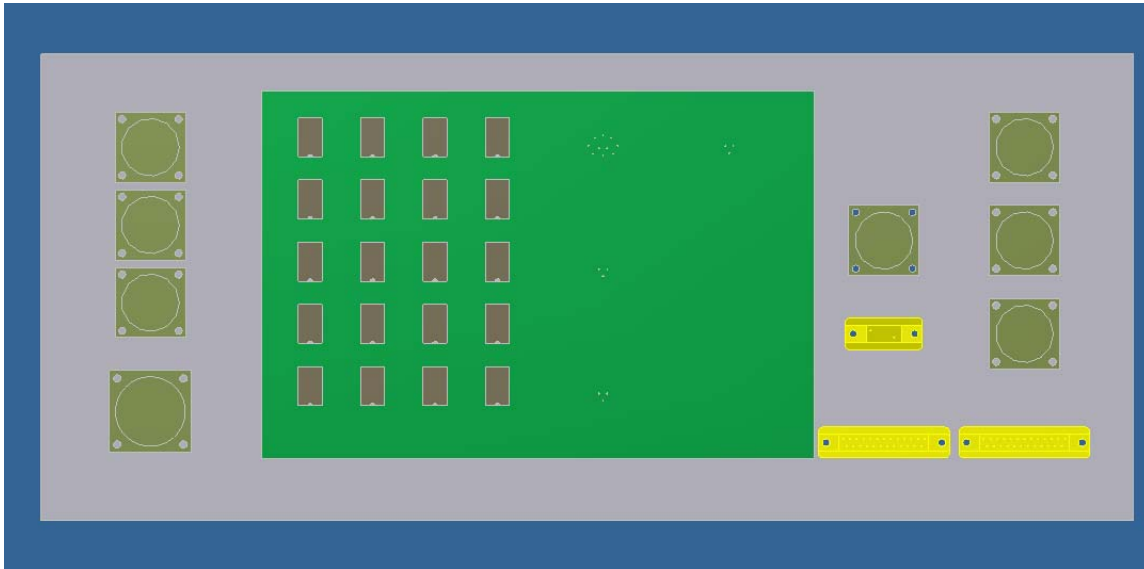


Figure 3

8. Rear Panel

The rear panel provides connectors for the electrical interfaces to the interface module, power supplies and field devices. The proposed rear panel layout is shown in figure 4.

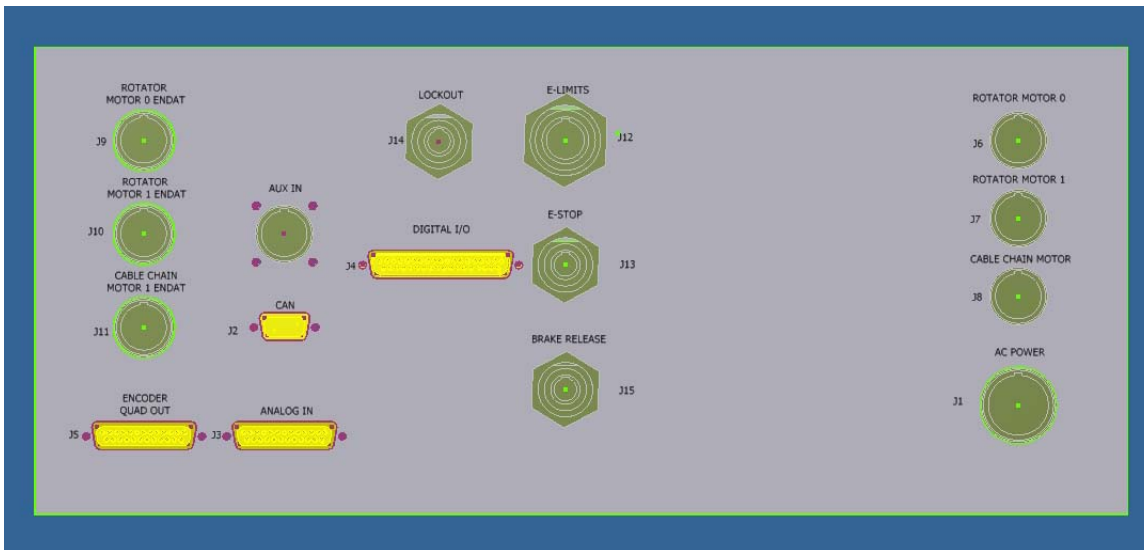


Figure 4

Rear panel connectors:

J1 – Three Phase 208V Power Input (to power mains) [MIL 16-8]

Pin Number	Pin Name	Description
A	L1	208VAC Phase
B	L2	208VAC AC Phase
C	L3	208VAC AC Phase
D	Neutral	208VAC AC Neutral
E	PE	Protective Earth
F	NC	No Connect
G	NC	No Connect
H	NC	No Connect

J2 – CAN [DB9]

Pin Number	Pin Name	Description
1	CANH	CAN Differential +
2	CANL	CAN Differential -
3	AGND	Analog Gnd
4	NC	No Connect
5	NC	No Connect
6	NC	No Connect
7	NC	No Connect
8	NC	No Connect
9	NC	No Connect

J3 –Analog Input (from rotator interface module) [DB25]

Shield not connected at drive end

Pin Number	Pin Name	Description
1	ROTDR0AN1+	Rotator Drive 0 Differential IN1+
2	ROTDR0AN1-	Rotator Drive 0 Differential IN1 -
3	ROTAGND0	Rotator Drive 0 Analog Gnd
4	ROT01SHLD	Rotator Drive 0 Pair 1 Shield
5	ROTDR0AN2+	Rotator Drive 0 Differential IN2+
6	ROTDR0AN2-	Rotator Drive 0 Differential IN2 -
7	ROT02SHLD	Rotator Drive 0 Pair 2 Shield
8	ROTDR1AN1+	Rotator Drive 1 Differential IN1+
9	ROTDR1AN1-	Rotator Drive 1 Differential IN1 -
10	ROTAGND1	Rotator Drive 1 Analog Gnd
11	ROT11SHLD	Rotator Drive 1 Pair 1 Shield
12	ROTDR1AN2+	Rotator Drive 1 Differential IN2+
13	ROTDR1AN2-	Rotator Drive 1 Differential IN2 -

14	ROT12SHLD	Rotator Drive 1 Pair 2 Shield
15	CCDRAN1+	Chain Drive Differential IN1+
16	CCDRAN1-	Chain Drive Differential IN1 -
17	CCAGND2	Chain Drive Analog Gnd
18	CABLE1SHLD	Chain Drive Pair 1 Shield
19	CCDRAN2+	Chain Drive Differential IN2+
20	CCDRAN2-	Chain Drive Differential IN2 -
21	CABLE2SHLD	Chain Drive Pair 2 Shield
22	NC	No Connect
23	NC	No Connect
24	NC	No Connect
25	NC	No Connect

J4 – Digital Input/Output and DC power input (to rotator interface module) [DB37]

Pin Number	Pin Name	Description
1	REL_CCW_NO_EMERG	OUT - Relative CCW E-limit
2	REL_CW_NO_EMERG	OUT - Relative CW E-limit
3	ABS_CCW_NO_EMERG	OUT - Absolute CCW E-limit
4	ABS_CW_NO_EMERG	OUT - Absolute CW E-limit
5	MCR_MON	OUT - MCR monitor
6	ESTOP_MON	OUT - E-Stop monitor
7	LOCK_MON	OUT - Lock out switch monitor
8	FAN_OK	OUT - Fan OK
9	3PHASE_OK	OUT - 3 Phase power OK
10	ROT_DR_ON	OUT - Rotator drives ON
11	CABLE_DR_ON	OUT - Cable drive ON
12	ROT_DR_OK	OUT - Rotator drives OK
13	CABLE_DR_OK	OUT - Cable drive OK
14	ROT_BRKS_REL	OUT - Rotator brakes released
15	REL_BRAKE	IN - Release Rotator Brakes
16	RESET_DR_FAULT	IN - Reset all 3 drive faults
17	ROT_PWR	IN - Power Rotator Drives
18	CABLE_PWR	IN - Power Cable Drive
19	ROT_ENABLE	IN - Enable Rotator Drives
20	CABLE_ENABLE	IN - Enable Cable Drive
21	3PHASE_RESET	IN - 3 Phase Power Reset
22	DCOM	Digital common
23	DCOM	Digital common
24	DCOM	Digital common
25	DCOM	Digital common

26	DCOM	Digital common
27	+24VDC In	DC Power In
28	+24VDC In	DC Power In
29	+24VDC In	DC Power In
30	+24VDC In	DC Power In
31	+24VDC In	DC Power In
32	D0DIN2	Drive 0 Digital IN2
33	D0DOUT2	Drive 0 Digital OUT2
34	D1DIN2	Drive 1 Digital IN2
35	D1DOUT2	Drive 1 Digital OUT2
36	CABLEDIN2	Cable Drive Digital IN2
37	CABLEDOUT2	Cable Drive Digital OUT2

J5– Encoder Quadrature Output (to interface module) [DB25]

Pin Number	Pin Name	Description
1	ROTDR0_A+	Rotator Drive 0 Quad A+ Output
2	ROTDR0_A-	Rotator Drive 0 Quad A- Output
3	ROTDR0_B+	Rotator Drive 0 Quad B+ Output
4	ROTDR0_B-	Rotator Drive 0 Quad B- Output
5	ROTDR1_A+	Rotator Drive 1 Quad A+ Output
6	ROTDR1_A-	Rotator Drive 1 Quad A- Output
7	ROTDR1_B+	Rotator Drive 1 Quad B+ Output
8	ROTDR1_B-	Rotator Drive 1 Quad B- Output
9	CCDR_A+	Chain Drive Quad A+ Output
10	CCDR_A-	Chain Drive Quad A- Output
11	CCDR_B+	Chain Drive Quad B+ Output
12	CCDR_B-	Chain Drive Quad B- Output
13	X0+	Spare RS-422 Output
14	X0-	Spare RS-422 Output
15	X1+	Spare RS-422 Output
16	X1-	Spare RS-422 Output
17	X2+	Spare RS-422 Output
18	X2-	Spare RS-422 Output
19	X3+	Spare RS-422 Output
20	X3-	Spare RS-422 Output
21	ROT0AGND	Rotator 0 Analog Gnd
22	ROT1AGND	Rotator 1 Analog Gnd
23	CABLEAGND	Cable Analog Gnd
24	AGND	Spare Analog Gnd
25	AGND	Spare Analog Gnd

J6 – Rotator Motor 0 [MIL 14-5]

Pin Number	Pin Name	Description
1	U1	Motor Phase Winding
2	V1	Motor Phase Winding
3	W1	Motor Phase Winding
4	PE	Protective Earth
5	NC	No Connect

J7 – Rotator Motor 1 [MIL 14-5]

Pin Number	Pin Name	Description
1	U1	Motor Phase Winding
2	V1	Motor Phase Winding
3	W1	Motor Phase Winding
4	PE	Protective Earth
5	NC	No Connect

J8 – Cable Chain Motor [MIL 14-5]

Pin Number	Pin Name	Description
1	U1	Motor Phase Winding
2	V1	Motor Phase Winding
3	W1	Motor Phase Winding
4	PE	Protective Earth
5	NC	No Connect

J9 – Rotator Motor 0 ENDAT encoder [MIL 14-18]

Pin Number	Pin Name	Description
1	Clock/	Differential clock -
2	Thermal2	Thermal Contact 2
3	Data/	Differential Data -
4	+5 Sense	5VDC sense
5	A+	Differential A+
6	Gnd Sense	Ground sense
7	B+	Differential B+
8	Clock	Differential clock+
9	Thermal1	Thermal Contact 1
10	Data	Differential Data+
11	+5V	+5VDC Power
12	A-	Differential A-
13	5VGND	5V Ground
14	B-	Differential B-
15	NC	No Connect

16	NC	No Connect
17	NC	No Connect
18	NC	No Connect

J10 – Rotator Motor 1 ENDAT encoder [MIL 14-18]

Pin Number	Pin Name	Description
1	Clock/	Differential clock -
2	Thermal2	Thermal Contact 2
3	Data/	Data -
4	+5 Sense	5VDC sense
5	A+	Differential A+
6	Gnd Sense	Ground sense
7	B+	Differential B+
8	Clock	Differential clock+
9	Thermal1	Thermal Contact 1
10	Data	Differential Data+
11	+5V	+5VDC Power
12	A-	Differential A-
13	5VGND	5V Ground
14	B-	Differential B-
15	NC	No Connect
16	NC	No Connect
17	NC	No Connect
18	NC	No Connect

J11 – Cable Chain Motor ENDAT encoder [MIL 14-18]

Pin Number	Pin Name	Description
1	Clock/	Differential clock -
2	Thermal2	Thermal Contact 2
3	Data/	Data -
4	+5 Sense	5VDC sense
5	A+	Differential A+
6	Gnd Sense	Ground sense
7	B+	Differential B+
8	Clock	Differential clock+
9	Thermal1	Thermal contact 1
10	Data	Differential Data+
11	+5V	+5VDC Power
12	A-	Differential A-
13	5VGND	5V Ground
14	B-	Differential B-

15	NC	No Connect
16	NC	No Connect
17	NC	No Connect
18	NC	No Connect

J12– E-Limits [MIL 14-19]

Pin Number	Pin Name	Description
1	REL_CCW_NO_EMERG	Relative CCW E-limit N.O.
2	REL_CCW_NC_EMERG	Relative CCW E-limit N.C.
3	REL_CW_NO_EMERG	Relative CW E-limit N.O.
4	REL_CW_NC_EMERG	Relative CW E-limit N.C.
5	ABS_CCW_NO_EMERG	Absolute CCW E-limit N.O.
6	ABS_CCW_NC_EMERG	Absolute CCW E-limit N.C.
7	ABS_CW_NO_EMERG	Absolute CW E-limit N.O.
8	ABS_CW_NC_EMERG	Absolute CW E-limit N.C.
9	DCOM	Digital Common
10	DCOM	Digital Common
11	+24V	+24VDC
12	+24V	+24VDC
13	NC	No Connect
14	NC	No Connect
15	NC	No Connect
16	NC	No Connect
17	NC	No Connect
18	NC	No Connect
19	NC	No Connect

J13 – E-Stop [MIL 8-98, 3 pin]

Pin Number	Pin Name	Description
1	EStop	+24VDC E-Stop In
2	ECom	E-Stop Common
3	NC	No Connect

J14 – Remote Lockout [MIL 8-3]

Pin Number	Pin Name	Description
1	Lock_A	Remote lock loop signal A
2	Lock_B	Remote lock loop signal B
3	DCOM	Digital Common

J15 – Brake Release [MIL 8-98S, 3 pin]

Pin Number	Pin Name	Description
1	BRK_REL	Rotator Release Brakes Output
2	DCOM	Digital Common
3	NC	No Connect

J16–Auxiliary RS-422 Input [MIL 14-19P]

Pin Number	Pin Name	Description
1	X0+	Spare RS-422 Input
2	X0-	Spare RS-422 Input
3	X1+	Spare RS-422 Input
4	X1-	Spare RS-422 Input
5	X2+	Spare RS-422 Input
6	X2-	Spare RS-422 Input
7	X3+	Spare RS-422 Input
8	X3-	Spare RS-422 Input
9	AGND	Analog GND
10	AGND	Analog GND
11	AGND	Analog GND
12	AGND	Analog GND
13	AGND	Analog GND
14	AGND	Analog GND
15	AGND	Analog GND
16	AGND	Analog GND
17		
18		
19		

9. Bill of Materials

- | | |
|---|---------|
| 1) Kollmorgen S310 Servo Drive | 2 each |
| 2) Kollmorgen S306 Servo Drive | 1 each |
| 3) 3 Phase 208VAC drive output reactors | 3 each |
| 4) 208VAC 3 Phase 10 breaker | 1 each |
| 5) 3 Phase power monitor | 1 each |
| 6) 3 Phase 208VAC contactors | 2 each |
| 7) Momentary switches plus indicator | 13 each |
| 8) Custom relay logic board | 1 each |
| 9) Mil Connectors | 12 each |
| 10) D-type connectors | 7 each |
| 10) Fans | 2 each |
| 11) Regen Resistor | 1 each |

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