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ViaSat

Model 3862
Autotrack Digital Controller

Operation and Maintenance Manual

Manual Part No. 1000569
January 2003

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Table of Contents

Table of Contents iii
List of Figures viii
List of Tables ix
Safety Summary x

General Information 1-1
1.1 Introduction 1-1
1.2 Contents of this Manual 1-1
1.3 Use of this Manual 1-1
1.4 Format of this Manual 1-2
1.5 Change Recommendations 1-2
1.6 Description 1-2
1.6.1 Major Components 1-3
1.6.2 Functional Configurations 1-3
1.6.3 Physical Configurations 1-4
1.7 Specifications 1-6
1.8 Glossary of Symbols and Abbreviations 1-7
Installation 2-1
2.1 Introduction 2-1
2.2 Unpacking and Inspection 2-1
2.2.1 Damage or Loss During Shipment 2-1
2.3 Equipment Return 2-1
2.4 Installation Procedure 2-2
2.4.1 General 2-2
2.4.2 Chassis Slide Mounting 2-2
2.4.3 Cable Connectors 2-3
2.4.4 Host Computer Interfaces 2-16
2.4.4.1 Serial Communications 2-16

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2.4.4.2 IEEE-488 Communications 2-16
2.4.5 Time-stamped Position and Autotrack Status Message 2-18
2.4.6 GPS Time-code Interface 2-20
2.4.7 Power Input 2-20
2.5 Initial Checkout 2-20
2.5.1 Initial Turn-on and Checkout 2-21
2.5.2 Axis Position Offsets 2-24
Operation 3-1
3.1 Introduction 3-1
3.2 Modes of Operation 3-1
3.2.1 Local Pedestal Control 3-1
3.2.2 Remote Control 3-2
3.2.3 Front-panel Control 3-2
3.3 Front-panel controls and indicators 3-2
3.3.1 Liquid Crystal Display Indicators 3-4
3.3.2 Data Entry 3-5
3.3.3 Softkeys 3-6
3.3.4 Top Level Softkey Menu 3-6
3.3.5 Front-panel Operating Procedures 3-6
3.3.6 Power Up And Down 3-6
3.3.7 Emergency Shutdown 3-8
3.3.8 Standby Mode 3-8
3.3.9 Position Mode 3-8
3.3.10 Rate Mode 3-9
3.3.11 Track Mode 3-9
3.3.12 Menus 3-9
3.3.13 Softkey Axis Assignment 3-9
3.3.14 Secondary Modes 3-10
3.3.14.1 Standby Mode 3-10
3.3.14.2 Scan Mode 3-11
3.3.14.3 Slave Mode 3-11
3.3.14.4 Stow Mode 3-11

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3.3.15 Setup Menus 3-12
3.3.15.1 Servo Parameters 3-12
3.3.15.1.1 Digital Filter Selection 3-12
3.3.15.1.2 Torque Bias Parameters 3-14
3.3.15.1.3 Test Port Signal Selection 3-14
3.3.15.1.4 Step Response Test 3-15
3.3.15.2 Scan Parameters 3-16
3.3.15.2.1 Sector Scan 3-17
3.3.15.2.2 Step Scan 3-17
3.3.15.2.3 Spiral Scan 3-18
3.3.15.3 Position Parameters 3-18
3.3.15.4 Limit Parameters 3-19
3.3.16 Control Menus 3-20
3.3.16.1 Local/remote Control 3-21
3.3.16.2 Autotrack Mode 3-22
3.3.16.3 Steptrack Mode 3-24
3.3.16.4 AGC Channel Input 3-25
3.3.16.5 Digital Controller Setup Configuration Store/recall 3-26
3.3.16.6 Feed Scan Selection 3-28
3.3.16.7 Time And Date Set 3-29
3.3.16.8 Status And Command Lines 3-29
3.4 Remote operation 3-30

Principles of Operation 4-1

4.1 Introduction 4-1
4.2 Functional description 4-1
4.2.1 Servo Assembly 4-7
4.2.2 Synchro/resolver Assembly 4-8
4.2.3 Operator/remote Interface Assembly 4-10
4.2.4 Autotrack Assembly (Optional) 4-11
4.2.5 Resolver Reference Oscillator Assembly 4-12
4.2.6 Synchro Reference 4-13
4.2.7 Analog Rate Loop Assembly (Optional) 4-13

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4.2.7.1 Loop Compensation....4-13
4.2.7.2 Differential Tach/torque Bias (dual Drive System) 4-13
4.2.8 Motherboard 4-14
4.2.9 Front Panel 4-14
4.2.10 Front-panel Board Assembly....4-15
Maintenance 5-1
5.1 Introduction 5-1
5.2 Preventive Maintenance....5-1
5.2.1 Visual Inspection....5-1
5.2.2 Cleaning....5-2
5.3 Test Equipment....5-2
5.4 Troubleshooting 5-2
5.5 Alignment....5-6
5.6 Repair....5-6
5.6.1 Prerequisites To Removal And Installation....5-7
5.6.2 Internal Component Access....5-7
5.6.3 Servo, Synchro/resolver, ORI, Or Autotrack Board Removal....5-7
5.6.4 Servo, Synchro/resolver, ORI, Or Autotrack Board Installation 5-8
5.6.5 Resolver Reference Board Removal....5-8
5.6.6 Resolver Reference Board Installation 5-9
5.6.7 Power Supply Removal....5-10
5.6.8 Power Supply Installation....5-10
5.6.9 Power Inverter Removal 5-10
5.6.10 Power Inverter Installation 5-11
5.6.11 Optical Encoder Removal 5-11
5.6.12 Optical Encoder Installation 5-12
5.6.13 Fan Assembly Removal....5-13
5.6.14 Fan Assembly Installation....5-13
Parts List 6-1
6.1 Introduction 6-1
6.2 Parts List and Assembly Drawings 6-1
6.2.1 Explanation of Title Block on Parts Listing 6-1

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6.2.2 Explanation of Parts Lists Column Headings 6-1
6.3 Ordering Parts 6-2
Drawings 7-1
7.1 Introduction 7-1
7.2 Drawing Index 7-1

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LIST OF FIGURES

Figure 1.1. 3860 Digital Controller 1-2
Figure 1.2. 3860 Digital Controller Functional Configurations 1-5
Figure 2.1. Typical Slide Mounting 2-2
Figure 2.2. Typical Rear-panel Connector Interface 2-6
Figure 3.1. 3860 Digital Controller Front Panel 3-3
Figure 3.2. LCD Controls And Indicators 3-5
Figure 3.3. Top Level Softkey Menu 3-7
Figure 3.4. Softkey Axis Assignment 3-9
Figure 3.5. Secondary Modes 3-10
Figure 3.6. Servo Parameters 3-13
Figure 3.7. Scan Parameters 3-16
Figure 3.8. Position Parameters 3-19
Figure 3.9. Limit Parameters 3-20
Figure 3.10. Control Menus 3-21
Figure 3.11. Local/remote Control Selection 3-22
Figure 3.12. Autotrack Mode Parameters 3-23
Figure 3.13. Steptrack Mode Parameters 3-24
Figure 3.14. AGC Channel Input Parameters 3-25
Figure 3.15. Digital Controller Setup Configuration Store/recall 3-27
Figure 3.16. Feed Scanner Control 3-28
Figure 3.17. Time And Date Set 3-29
Figure 4.1. 3860 Digital Controller Block Diagram, Single-chassis Configuration 4-3
Figure 4.2. 3860 Digital Controller Block Diagram, Two-chassis Configuration 4-5
Figure 4.3. Servo Assembly Block Diagram 4-7

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Figure 4.4. Synchro/resolver Assembly Block Diagram 4-9

Figure 4.5. Operator/remote Interface Assembly Block Diagram 4-10

Figure 4.6. Autotrack Assembly Block Diagram 4-12

LIST OF TABLES

Table 1-1. Series 13000 Pedestal Technical Specifications 1-4

Table 1-2. Environmental Specifications 1-5

Table 4-1. Position Data Package Electrical Interface 4-4

Table 4-2. Gearmotor Electrical Interface 4-6

Table 5-1. Tools and Test Equipment 5-1

Table 5-2. Periodic Maintenance Chart 5-2

Table 5-3. Routine Inspection 5-2

Table 5-4. Consumable Materials List 5-6

Table 5-5. Troubleshooting Chart 5-7

Table 5-6. Finish Repair Consumable Materials 5-9

Table 7.1. Drawing Index 7-1

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SAFETY SUMMARY

These are general safety precautions that are not related to any specific procedure. These are recommended precautions that personnel must understand and apply.

WARNING

Use care when using metal tools that circuits are not shorted. Some circuits have high current capacity which, when shorted, will flash and may cause burns and/or eye injury.

Remove all jewelry and exposed objects from body and clothing before performing maintenance, adjustments, and/or troubleshooting. Before working inside equipment, remove all power, unless power is required to be on to perform procedures. Do NOT replace parts or modules with power ON.

Servicing this equipment requires working with the equipment while AC power is applied. Extreme caution must be exercised during these procedures.

RESUSCITATION

Personnel working with or near hazardous chemicals or voltages should be familiar with modern methods of resuscitation.

USE SAFETY-APPROVED EQUIPMENT

When cleaners are being applied, approved explosion-proof lights, blowers, and other equipment shall be used. Ensure that firefighting equipment is readily available and in working order. Keep cleaners in special polyethylene bottles or in safety cans and in minimum quantities. Discard soiled cloths into safety cans.

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Chapter 1

General Information

1.1 Introduction

This manual provides general operation and maintenance instructions for the Series 3860 Digital Controller. This manual includes optional equipment and features that may not be present in all configurations.

1.2 Contents of this Manual

This manual consists of the following chapters:

Chapter 1	General Information
Chapter 2	Installation
Chapter 3	Operation
Chapter 4	Principles of Operation
Chapter 5	Maintenance
Chapter 6	Parts List
Chapter 7	Drawings

1.3 Use of this Manual

This manual is divided into chapters, each with a specific purpose. The Table of Contents lists all chapters and paragraphs with their titles and page numbers. Illustrations, tables, and diagrams are provided to support the text. Lists of illustrations and tables indicate their numbers, titles, and page numbers. Abbreviations, phrases, and words appear in the text exactly as they appear on the equipment.

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1.4 Format of this Manual

Paragraph headings of this manual are formatted to indicate subordination of subject matter as follows:

1.1 Primary Heading

1.1.1 First Subordinate

1.1.1.1 Second Subordinate

1.1.1.1.1 Third Subordinate

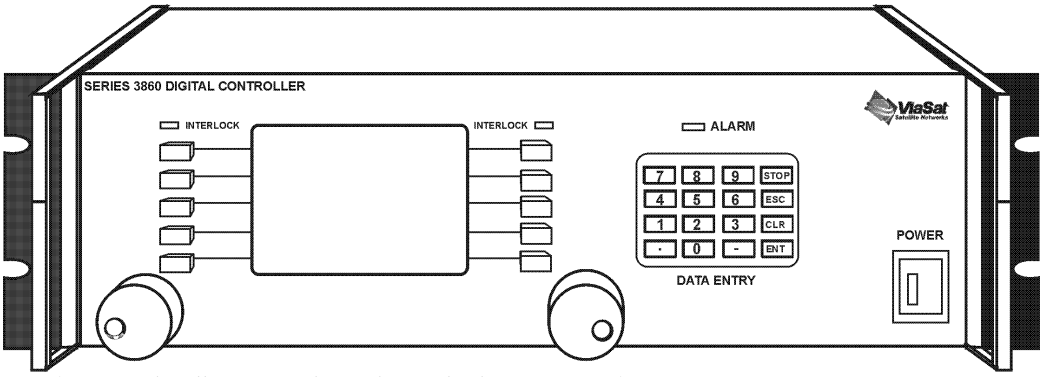
1.1.1.1.1.1 Fourth Subordinate

1.5 Change Recommendations

Submit recommendations concerning changes to ViaSat.

1.6 Description

The Series 3860 of Digital Controllers (Figure 1.1) provide antenna pedestal or positioner control in tracking, communications, and microwave instrumentation applications. These controllers implement full digital servo loop control and compensation in several control modes suitable for use with two-axis pedestals and may be adapted for use with positioners having up to eight axes. The controllers are available in a variety of physical and functional configurations to provide maximum flexibility for any given application.



(NOTE: This illustration shows the single-chassis version.)

Figure 1.1. 3860 Digital Controller

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1.6.1 Major Components

The Digital Controller is made up of several components combined in modular fashion to provide the desired functions and physical configuration. Each block or module performs a unique function. For applications not requiring a particular function, the assembly or module providing that function may be excluded from the controller. The following are the principal components of the Digital Controller (see Chapter 4 for detailed descriptions of each):

- Servo Assembly
- Synchro/Resolver Assembly
- Operator/Remote Interface Assembly
- Autotrack Assembly (Optional)
- Resolver Reference Assembly
- Analog Servo Rate Loop Assembly (Optional)
- Front Panel Assembly
- Motherboard Assembly
- DC Power Supply

1.6.2 Functional Configurations

The Model 3861 Manual Controller provides basic operator control of the pedestal. This controller is equipped with a Servo Assembly and a Synchro/Resolver Assembly and includes the enclosures and/or interfaces appropriate to the physical configuration selected. The Model 3861 operates using an indoor control panel or an external computer and remote interface.

The Model 3862 Autotrack Controller includes the Autotrack Assembly which allows operation with automated tracking systems. The automated tracking (Autotrack) function requires input of both a signal strength and a tracking video signal from the receiver. The Autotrack function can be used with a wide variety of feeds and is compatible with ViaSat Satellite Networks ESCAN and MONOSCAN tracking feeds and the associated digital demodulation techniques.

The Model 3863 Steptrack Controller is equipped with steptrack capability which allows operation with step tracking subsystems. The steptrack function is contained within the Operator/Remote Interface Assembly or within a computer subsystem equipped with the PC Interface Module. The steptrack function requires an automatic gain control (AGC) signal from a receiver and may be used with a wide variety of feeds.

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1.6.3 Physical Configurations

The unit may be provided with all components housed in either one or two rack-mounted chassises as shown in Figure 1.2.

A single-chassis configuration is used in most systems. Using the single-chassis requires that all electrical control cables extend from the pedestal into the control room and be connected directly to the 3860.

Two-chassis configurations are used in large pedestal systems where it is possible to mount a rack-mounted chassis within the base extension. The two-chassis configuration greatly reduces the length and number of electrical control cables from the pedestal into the control room by placing the functional modules that interface to the pedestal within the pedestal equipment. The second chassis provides the operator controls and indicators. The two chassises are functionally connected by a full-duplex fiber optic link.

The operator interface components include the keypad, display screen, position knobs, and power switch on the front panel. The unit chassis is 5.25 inches high and can be mounted in a standard, 19-inch-wide equipment rack. All of the Series 3860 Digital Controller's printed wiring boards provide direct cabling access through integral connector plates on the unit's rear panel. A fan in the rear panel provides cooling for the enclosure.

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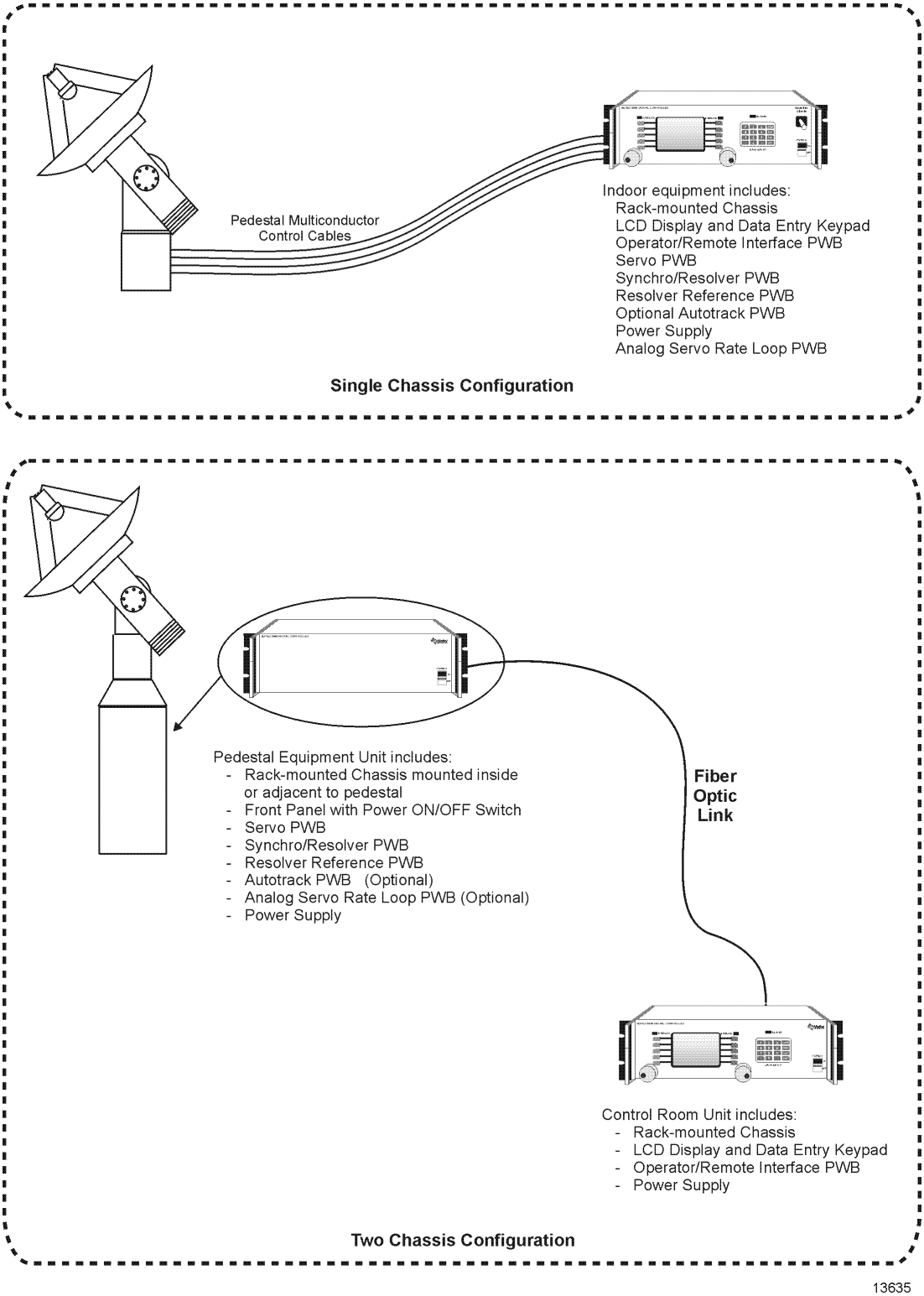


Figure 1.2. 3860 Digital Controller Functional Configurations

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1.7 Specifications

Equipment characteristics and specifications are provided in Tables 1.1 and 1.2.

Table 1.1. Physical and Electrical Specifications

Characteristic	Specification
Dimensions	
Height	5.25 in. (133.35 mm)
Depth	18.00 in. (457.20 mm)
Width	19.00 in. (482.60 mm)
Weight	20 lb nominal
Input Power Requirements	
Voltage	110V ac at 150W or 220V ac at 150W
Frequency	47 to 440 Hz
Host Communication Interface	Serial Link
Selectable Media	RS-422, RS-232, or IEEE-488
Communication Rate	9600 Baud
Controls and Indicators	
Display	High contrast LCD display
Mode Selection	Menu-driven function keys plus full numeric keypad
Axis Position Controls	Analog position knobs and joystick for 2 axes
Status Displays	Up to 32 optically isolated and 32 TTL lines to report various system functions
Servo Functions	Digital servo compensation with four user-selectable servo loop bandwidths. Typically two axes can be configured to control up to eight pedestal or positioner axes
Pedestal Control Modes	Standby, Rate (Slew), Position, Autotrack, Slave, Remote and Scan
Pedestal Position Feedback	Six independent synchro/resolver to digital converters channels

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Table 1.2. Environmental Specifications	
Characteristic	Specification
Ambient Temperatures	
Operation	-0°C to +40°C (+32°F to +104°F)
Storage	-20°C to +60°C (-4°F to +140°F)
Relative Humidity	0% to 95%, without condensation
Altitude	
Operation	10,000 feet
Storage	50,000 feet
Cooling	Fan cooling
Shock and Vibration	Normal benchtop handling and commercial shipping

1.8 Glossary of Symbols and Abbreviations

The following list defines symbols and abbreviations used in this manual.

Symbol or Abbreviation	Definition
ABS	automatic beam switching
ac	alternating current
ACQTIM	acquire time
A/D	analog-to-digital
ADC	analog-to-digital converter
AGC	automatic gain control
AMPL	amplitude
AUTOTRK	autotrack
AUTODV	auto diversity
AZ	azimuth
BIT	built-in test
BKMODE	backup mode
C	celsius
CHANN	channel
CMD, CMND	command

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Symbol or Abbreviation	Definition
COMPSN	compensation
CONFIG	configuration
DAC	digital-to-analog converter
dc	direct current
DISABL	disable
EL	elevation
F	fahrenheit
FDSCAN	feed scan
FNTPNL	front panel
Hz	hertz
I/O	input/output
kHz	kilohertz
LCD	liquid crystal display
LCL	local
LED	light-emitting diode
LCLRMT	local/remote
LNCHAC	launch angle
LOWTRK	low track
mA	milliampere
mm	millimeter
MAXANG	maximum angle
MINANG	minimum angle
MLTPTH	multipath
NS PWR	noise source power
NVRAM	nonvolatile RAM
ORI	operator remote interface
PC	personal computer
PED	pedestal
PID	proportional/integral/derivative
POS, POSN	position
POSERR	position error
POSMEM	position memory
POSNFL, PFLT	position filter

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Symbol or Abbreviation	Definition
POSTIM	position time
PSTART	position start
PWB	printed wiring board
PWR	power
RAM	random-access memory
RATEFL, RFLT	rate filter
RCALL	recall
RCVR	receiver
RF	radio frequency
ROM	read-only memory
RTEMEM	rate memory
RTETIM	rate time
RUNSTP	run step response
SECT	sector
STAT	status
STPRSP	step response
STEPTR	step track
STPSZE	step size
TESTPT	test point
THRHLD	threshold
TIM DUR	time duration
TQBIAS, TQB	torque bias
TRAVL	travel
TTL	transistor-transistor logic
V	volts
W	watts

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Chapter 2

Installation

2.1 Introduction

This chapter provides instructions and guidelines for installing the Series 3860 Digital Controller and for reshipment and storage as required.

2.2 Unpacking and Inspection

While unpacking, carefully compare bill of lading with equipment received. Inspect for transit damage. If equipment is missing, carefully check and sift through packing material to confirm. If errors are confirmed, notify ViaSat and carrier as soon as possible.

2.2.1 Damage or Loss During Shipment

When equipment is damaged or lost in transit, the delivering transportation company is required by law to make notation of damage or loss on the freight bill. The carrier, not the shipper, should be charged with all damage or loss. If damage or loss during shipping occurs, contact the carrier of the equipment. Save the shipping carton. The carrier's inspector must examine the carton and complete an inspection report.

2.3 Equipment Return

ViaSat makes every reasonable effort to ensure that all items arrive safely and in working order. When equipment is received, which is not in working order, return the equipment to the factory for repair or replacement. Return the equipment according to the following procedure. This procedure will apply whenever equipment is returned for warranty or other services.

a) Notify ViaSat of the problem and request a Return Material Authorization (RMA) number and shipping instructions. For a current list of telephone and email contact information refer to Contact Information section of the ViaSat internet site (http://www.viasat.com).

b) Tag or identify defective equipment and note defect and circumstances, if any. If known, reference sales order, purchase order, and date equipment was received.

c) Reship equipment in original shipping container or use a strong shipping container to protect equipment during shipment.

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d) Package equipment using shock-absorbing material around all sides of equipment.

e) Seal container securely and mark outside of container FRAGILE.

2.4 Installation Procedure

2.4.1 General

The 3860 Digital Controller indoor configuration is shipped fully assembled and is designed to be installed in a standard 19-inch panel width equipment rack. The unit should be mounted on chassis slides or angle chassis supports. The controller is cooled by forced air flowing through one side and the rear panel of the unit. The mounting location should be selected to avoid blocking the side panel's air flow or access to the rear-panel cable connections. The unit should not be installed adjacent to other high-heat-producing units.

2.4.2 Chassis Slide Mounting

Two captive nuts (6-32) are provided on each chassis side panel for attachment of chassis slides. The nut pattern matches standard chassis slides. A typical example of slide mounting is shown in Figure 2.1.

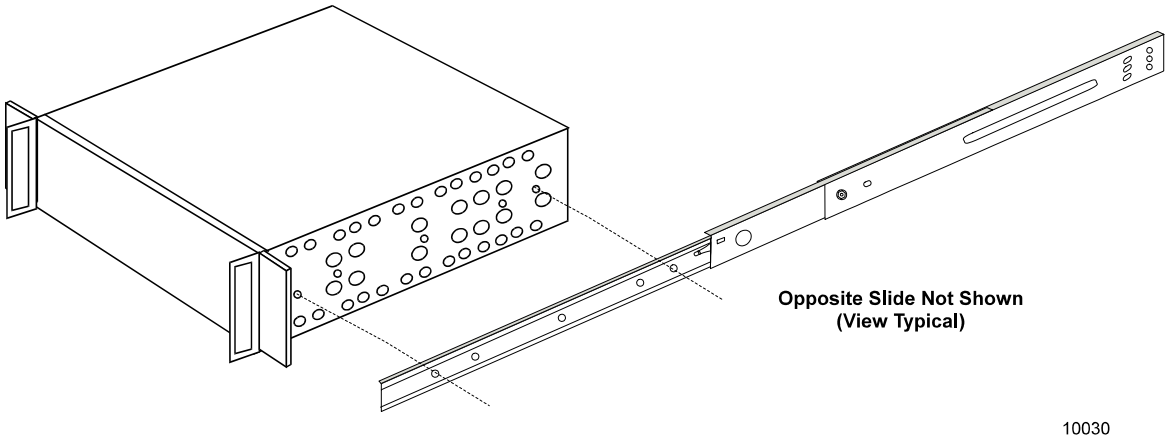


Figure 2.1. Typical Slide Mounting

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2.4.3 Cable Connectors

External cables connect directly to each component assembly on the digital controller's rear panel. Each connector is identified by a reference designation permanently marked on the rear panel (see Figure 2.2). A list of rear-panel connectors with functional descriptions is provided in Table 2.1. Tables 2.2 through 2.22 provide pinout information for each connector excluding the fiber-optic connectors. For units purchased as part of an integrated system, refer to the appropriate system cabling diagram for cable connections.

CAUTION

Avoid shorting signal lines together or to chassis when attaching cables. Equipment damage can result from failure to observe this precaution.

Table 2.1. 3860 Digital Controller Rear-panel Connectors

Function	Reference Designation	Connector Type	Interface Description
Servo Assembly			
Analog I/O	J101	DB25 Male	This connector provides tachometer signal input and command voltage to power amplifiers. Refer to Table 2.2 for pin assignments.
Digital I/O	J102	DB62 Female	This connector provides contact closure input and relay driver output. Refer to Table 2.3 for pin assignments.
Serial Link 1	J103	DB9 Male	This connector is the main command/status link to the operator/remote interface board. Refer to Table 2.4 for pin assignments.
Serial Link 2	J104	DB9 Male	This connector is the RS-422/RS-232 auxiliary/local control data link. Refer to Table 2.5 for pin assignments. Refer to paragraph 2.4.6 for a description of the GPS Time-code interface.
Fiber-optic Receiver	J105	ST	This type ST connector is a fiber-optic command link.
Fiber-optic Transmitter	J106	ST	This type ST connector is a fiber-optic status reporting link.
Synchro/Resolver Assembly			
Synchro/Resolver Interface	J201	DB37 Female	This connector provides interface to resolvers or synchros for axis position feedback or slave input. Refer to Table 2.6 for pin assignments.

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Table 2.1. 3860 Digital Controller Rear-panel Connectors

Function	Reference Designation	Connector Type	Interface Description
Digital I/O	J202	DB44 Female	This connector provides contact closure sensing inputs and relay driver outputs. Refer to Table 2.7 for pin assignments.
Auxiliary TTL I/O	J203	DB44 Female	This connector is a configurable 32-bit TTL level I/O. Refer to Table 2.8 for pin assignments.
Operator/Remote Interface Assembly			
IEEE-488 Remote Interface	J301	IEEE-488 Female	This rear-panel connector provides a parallel data interface conforming to IEEE-488-1978. Refer to Table 2.9 for pin assignments.
External Joystick	J302	DB9 Male	This connector provides connection to the table top joystick used for az/el rate control. Refer to Table 2.10 for pin assignments.
Analog Signals	J303	DB9 Male	This connector provides for AGC input for steptrack operation. Refer to Table 2.11 for pin assignments.
Serial Port 1	J304	DB9 Male	This connector is the main command/status link to the servo board. Refer to Table 2.12 for pin assignments. Refer to paragraph 2.4.5 for a description of the ouput data.
Serial Port 2	J305	DB9 Male	This connector is the link to the system computer. Refer to Table 2.13 for pin assignments.
Fiber-optic Serial Receiver	J306	BNC	This BNC connector is a fiber-optic status reporting link.
Fiber-optic Serial Transmitter	J307	BNC	This BNC connector is a fiber-optic command link.
Autotrack Assembly (Optional)			
Receiver 1 and 2 Video and AGC	J401	DB9 Male	This connector is the receiver interface containing signal strength and tracking video. Refer to Table 2.14 for pin assignments.
Receiver 3 and 4 Video and AGC	J402	DB9 Male	This connector is the receiver interface containing signal strength and tracking video. Refer to Table 2.15 for pin assignments.
Receiver 5 and 6 Video and AGC	J403	DB9 Male	This connector is the receiver interface containing signal strength and tracking video. Refer to Table 2.16 for pin assignments.
Channel 7 AGC	J404	ST	This type ST connector provides AGC input.
Channel 7 Video	J405	ST	This type ST connector provides tracking video input.

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Table 2.1. 3860 Digital Controller Rear-panel Connectors			
Function	Reference Designation	Connector Type	Interface Description
Feed Scanner Interface	J406	DB9 Male	This connector provides feed scan driver output. Refer to Table 2.17 for pin assignments.
Serial Link 1	J407	DB9 Male	This connector is the command/status link to the servo board. Refer to table 2.18 for pin assignments.
Analog Rate Loop Assembly (Optional)			
Analog I/O	J501	DB25 Female	This connector provides input rate command from the position loop. Refer to Table 2.19 for pin assignments.
Analog I/O	J502	DB25 Male	This connector provides tachometer signal input and command to power amplifiers. Refer to Table 2.20 for pin assignments.
Analog I/O	J503	DB25 Female	This connector provides major test points. Refer to Table 2.21 for pin assignments.

Table 2.2. Pin Functions for J101, Analog I/O			
Pin	Function	Pin	Function
1	GND	14	DAC6
2	AZZ TACH LO	15	DAC5
3	AGND	16	DAC4
4	AGND	17	DAC3
5	+ 15 V	18	DAC2
6	Not Connected	19	DAC1
7	- 15 V	20	AMP_OUT (Test Point)
8	ADC10	21	MUX_OUT (Test Point)
9	ADC9	22	ADC4
10	ADC8	23	ADC3
11	ADC7	24	ADC2
12	ADC6	25	ADC1
13	ADC5		

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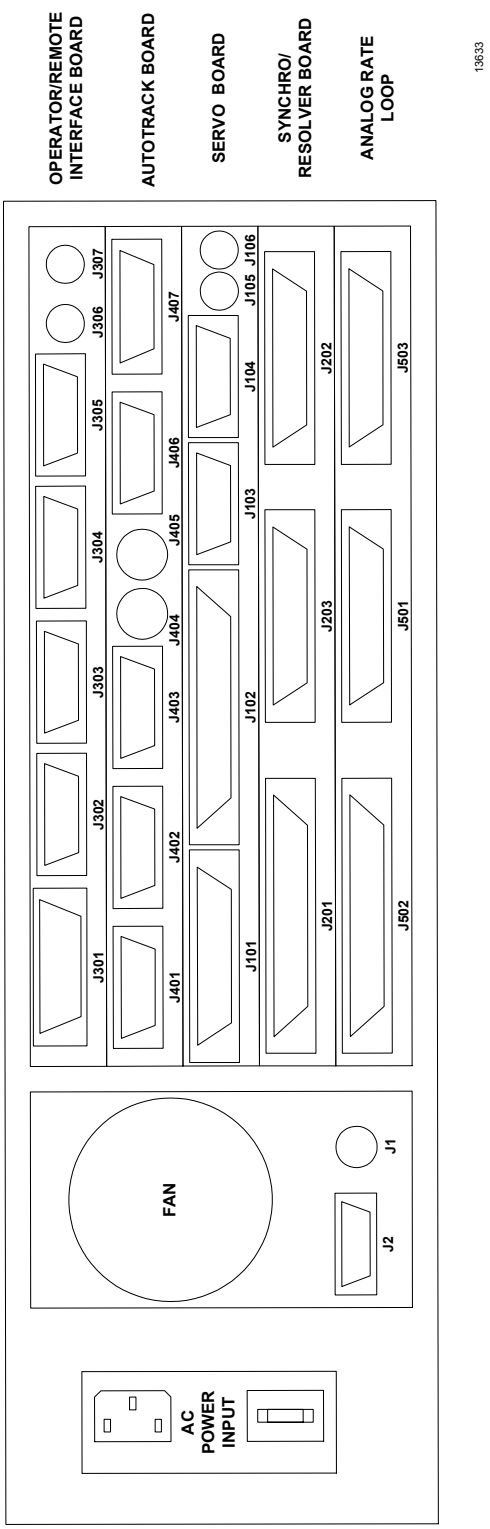


Figure 2.2. Typical Rear-panel Connector Interface

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Table 2.3. Pin Functions for J102, Digital I/O

Pin	Function	Pin	Function
1	Pull-Up For CNTRL Output Lines	32	Not Connected
2	GND	33	Not Connected
3	GND	34	Not Connected
4	GND	35	Not Connected
5	GND	36	Not Connected
6	GND	37	Not Connected
7	External Pull-Up	38	Not Connected
8	Not Connected	39	Cmnd01
9	STAT16	40	Cmnd02
10	STAT15	41	Cmnd03
11	STAT14	42	Cmnd04
12	STAT13	43	Cmnd05
13	STAT12	44	Cmnd06
14	STAT11	45	Cmnd07
15	STAT10	46	Cmnd08
16	STAT09	47	Not Connected
17	STAT08	48	Not Connected
18	STAT07	49	Not Connected
19	STAT06	50	Not Connected
20	STAT05	51	Not Connected
21	STAT04	52	Not Connected
22	STAT03	53	Not Connected
23	STAT02	54	Not Connected
24	STAT01	55	Not Connected
25	Not Connected	56	Not Connected
26	Not Connected	57	Not Connected
27	Not Connected	58	Input Pull-Up For Stat09 - Stat16 Lines
28	Not Connected	59	Not Connected
29	Not Connected	60	Input Pull-Up For Stat08 - Stat01 Lines
30	Not Connected	61	Not Connected

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Table 2.3. Pin Functions for J102, Digital I/O

Pin	Function	Pin	Function
31	Not Connected	62	Not Connected

Table 2.4. Pin Functions for J103, Serial Link 1

Pin	Function	Pin	Function
1	GND	6	+RX1 RS-422
2	TX1 RS-232	7	Not Connected
3	–TX1 RS-422	8	RX1 RS-232
4	–RX1 RS-422	9	+TX1 RS-422
5	GND		

Table 2.5. Pin Functions for J104, Serial Link 2

Pin	Function	Pin	Function
1	CTS2 RS-232	6	+RX2 RS-422
2	TX2 RS-232	7	Not Connected
3	–TX1 RS-422	8	RX2 RS-232
4	–RX1 RS-422	9	+TX2 RS-422
5	GND		

Table 2.6. Pin Functions for J201, Synchro/Resolver Interface

Pin	Function	Pin	Function
1	Resolver Reference –	20	Resolver Reference +
2	Not Connected	21	S64 (Channel 6 Lead S4)
3	S63 (Channel 6 Lead S3)	22	S62 (Channel 6 Lead S2)
4	S61 (Channel 6 Lead S1)	23	Not Connected
5	S54 (Channel 5 Lead S4)	24	S53 (Channel 5 Lead S3)

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Table 2.6. Pin Functions for J201, Synchro/Resolver Interface

Pin	Function	Pin	Function
6	S52 (Channel 5 Lead S2)	25	S51 (Channel 5 Lead S1)
7	Not Connected	26	S44 (Channel 4 Lead S4)
8	S43 (Channel 4 Lead S3)	27	S42 (Channel 4 Lead S2)
9	S41 (Channel 4 Lead S1)	28	Not Connected
10	S34 (Channel 3 Lead S4)	29	S33 (Channel 3 Lead S3)
11	S32 (Channel 3 Lead S2)	30	S31 (Channel 3 Lead S1)
12	Not Connected	31	S24 (Channel 2 Lead S4)
13	S23 (Channel 2 Lead S3)	32	S22 (Channel 2 Lead S2)
14	S21 (Channel 2 Lead S1)	33	Not Connected
15	S14 (Channel 1 Lead S4)	34	S13 (Channel 1 Lead S3)
16	S12 (Channel 1 Lead S2)	35	S11 (Channel 1 Lead S1)
17	Not Connected	36	Not Connected
18	Not Connected	37	Synchro Reference
19	Synchro Reference +		

Standard Channel Designations:
Channel 1 — Azimuth Coarse
Channel 2 — Azimuth Fine
Channel 3 — Elevation Coarse
Channel 4 — Elevation Fine
Channel 5 — Azimuth Slave
Channel 6 — Elevation Slave

Table 2.7. Pin Functions for J202, Digital I/O

Pin	Function	Pin	Function
1	STAT21	23	STAT31
2	STAT17	24	CMND17
3	CMND10	25	CMND19
4	CMND12	26	CMND21
5	CMND14	27	CMND23
6	CMND16	28	STAT25
7	STAT30	29	STAT27

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Table 2.7. Pin Functions for J202, Digital I/O

Pin	Function	Pin	Function
8	STAT32	30	Selected pull-up for outputs 9–16
9	CMND18	31	External pull-up for status lines 1–8
10	CMND20	32	STAT24
11	CMND22	33	STAT22
12	CMND24	34	STAT20
13	STAT26	35	STAT18
14	STAT28	36	Not Connected
15	External output pull-up for status lines 9–16	37	GND
16	STAT23	38	GND
17	STAT19	39	GND
18	CMND09	40	External input pull-up for status lines 9–16
19	CMND11	41	Not Connected
20	CMND13	42	Not Connected
21	CMND15	43	External pull-up for outputs 1–8
22	STAT29	44	Selected pull-up for outputs 1–8

Table 2.8. Pin Functions for J203, Auxiliary TTL I/O

Pin	Function	Pin	Function
1	I/O line 30	23	I/O line 11
2	I/O line 23	24	I/O line 13
3	I/O line 21	25	I/O line 15
4	I/O line 19	26	I/O line 6
5	I/O line 17	27	I/O line 4
6	I/O line 8	28	I/O line 2
7	I/O line 10	29	I/O line 0
8	I/O line 12	30	Not connected
9	I/O line 14	31	I/O line 28
10	I/O line 7	32	I/O line 27

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Table 2.8. Pin Functions for J203, Auxiliary TTL I/O

Pin	Function	Pin	Function
11	I/O line 5	33	I/O line 26
12	I/O line 3	34	I/O line 25
13	I/O line 1	35	I/O line 24
14	Not Connected	36	GND
15	Not Connected	37	Not Connected
16	I/O line 29	38	Not Connected
17	I/O line 31	39	Not Connected
18	I/O line 22	40	Not Connected
19	I/O line 20	41	Data strobe 1
20	I/O line 18	42	BA Clock 1
21	I/O line 16	43	BA Clock 2
22	I/O line 9	44	Data Strobe 2

Table 2.9. Pin Functions for J301, IEEE-488 Bus Signal Assignments

Pin	Function	Pin	Signal Name
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	REN
6	DAV	18	GND
7	NRFD	19	GND
8	NDAC	20	GND
9	IFC	21	GND
10	SRQ	22	GND
11	ATN	23	GND
12	GND	24	GND

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Table 2.10. Pin Functions for J302, External Joystick

Pin	Function	Pin	Function
1	+ 15 V	6	Pull-up 10 k to + 15 V
2	Channel 6 of AD Converter	7	Fire Button
3	Channel 7 of AD Converter	8	Channel 11 of AD converter pulled down to – 15 V through 60 k
4	KY2	9	Channel 10 of AD converter pulled down to – 15 V through 60 k
5	– 15 V		

Table 2.11. Pin Functions for J303, Analog Signals

Pin	Function	Pin	Function
1	GND	6	Channel 5 of AD Converter (not buffered)
2	GND	7	Channel 4 of AD Converter (not buffered)
3	Not Connected	8	Channel 3 of AD Converter (input buffered)
4	Channel 2 of AD Converter (input buffered)	9	Channel 1 of AD Converter (input buffered)
5	Channel 0 of AD Converter (input buffered)		

Table 2.12. Pin Functions for J304, Serial Port 1

Pin	Ground Function	Pin	Function
1	GND	6	+ RX1 RS-422
2	TX1 RS-232	7	Not Connected
3	– TX1RS-422	8	RX1 RS-232
4	– RX1 RS-422	9	+ TX1 RS-422
5	GND		

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Table 2.13. Pin Functions for J305, Serial Port 2			
Pin	Function	Pin	Function
1	CTS2 RS-232	6	+ RX2 RS-422
2	TX2 RS-232	7	RTS2 RS-232
3	– TX2 RS-422	8	RX2 RS-232
4	– RX2 RS-422	9	+ TX2 RS-422
5	GND		

Table 2.14. Pin Functions for J401, Receiver 1 and 2 Video and AGC			
Pin	Function	Pin	Function
1	Analog GND	6	Channel 2 AGC
2	Channel 1 AGC	7	Channel 2 AGC Return
3	Channel 1 AGC Return	8	Channel 2 Video Return
4	Channel 1 Video Return	9	Channel 2 Video
5	Channel 1 Video		

Table 2.15. Pin Functions for J402, Receiver 3 and 4 Video and AGC			
Pin	Function	Pin	Function
1	Analog GND	6	Channel 4 AGC
2	Channel 3 AGC	7	Channel 4 AGC Return
3	Channel 3 AGC Return	8	Channel 4 Video Return
4	Channel 3 Video Return	9	Channel 4 Video
5	Channel 3 Video		

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Table 2.16. Pin Functions for J403, Receiver 5 and 6 Video and AGC

Pin	Function	Pin	Function
1	Analog GND	6	Channel 6 AGC
2	Channel 5 AGC	7	Channel 6 AGC Return
3	Channel 5 AGC Return	8	Channel 6 Video Return
4	Channel 5 Video Return	9	Channel 6 Video
5	Channel 5 Video		

Table 2.17. Pin Functions for J406, feed Scanner Interface

Pin	Function	Pin	Function
1	GND	6	Not Connected
2		7	Not Connected
3		8	Not Connected
4		9	Not Connected
5			

Table 2.18. Pin Functions for J407, Serial Link 1

Pin	Function	Pin	Function
1	GND	6	+ RX1 RS-422
2	TX1 RS-232	7	Not Connected
3	– TX1 RS-422	8	RX1 RS-232
4	– RX1 RS-422	9	+ TX1 RS-422
5	GND		

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Table 2.19. Pin Functions for J501

Pin	Function	Pin	Function
1	GND	14	DAC6 (Position Error)
2	Not Connected	15	DAC5
3	AGND	16	DAC4
4	AGND	17	DAC3 (AZ Rate Input)
5	+15 Vdc	18	DAC2
6	Not Connected	19	DAC1 (EL Rate Input)
7	-15 Vdc	20	AMP_OUT (Test Point)
8	ADC10 (Position Test Input)	21	MUX_OUT (Test Point)
9	ADC9	22	ADC4
10	ADC8	23	ADC3
11	ADC7	24	ADC2
12	ADC6	25	ADC1
13	ADC5		

Table 2.20. Pin Functions for J502

Pin	Function	Pin	Function
1	GND	14	Position Error
2	AGND	15	DAC5
3	AGND	16	DAC4 (1)
4	AGND	17	AZ DC Error Output (1)
5	+15 Vdc	18	DAC2 (1)
6	AGND	19	EL DC Error Output 1
7	-15 Vdc	20	EL Tach 2-
8	ADC10 (Position Test Input)	21	AZ Tach 2-
9	ADC9	22	EL Tach 2+
10	ADC8	23	AZ Tach 2+
11	ADC7	24	EL Tach 1+
12	EL Tach 1 - or ADC6 (1)	25	AZ Tach 1+
13	AZ Tach 1 - or ADC5 (1)		

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Table 2.21. Pin Functions for J503

Pin	Function	Pin	Function
1	EL Diff Tach Gain	14	Position Error Output
2	AZ Diff Tach Gain	15	Not Connected
3	Analog RTN	16	AZ DC Error Output 1
4	EL DC Rate Error	17	AZ DC Error Output 2
5	+15 Vdc	18	AZ ACU Rate Input
6	AZ DC Rate Error	19	EL ACU Rate Input
7	-15 Vdc	20	EL DC Error Output 1
8	Position Test Input	21	EL DC Error Output 2
9	AZ Rate Test Input	22	AZ Tach 1
10	EL Rate Test Input	23	AZ Tach 2
11	Motor 2 Single Test	24	EL Tach 1
12	Bias Control	25	EL Tach 2
13	Not Connected		

2.4.4 Host Computer Interfaces

Communications with a remote, or host, computer are possible using one of four industry-standard forms supported by the Operator Remote Interface PWB. Serial communications are available via RS-232-C, RS-422 and fiber-optic links; parallel communication is available via IEEE-488 interface.

2.4.4.1 Serial Communications

The 3860 Digital Controller provides a serial communications channel on the Operator Remote Interface (ORI) which is used to interface to a host computer. This channel is connected simultaneously to three sets of serial interface circuits for RS-232-C, RS-422 and fiber-optic interfaces. Any one of these three may be connected provided the remaining two are not connected. RS-232-C and RS-422 communication rates are fixed at 9600 baud. The fiber-optic link operates at a fixed rate of 1×10^5 baud.

2.4.4.2 IEEE-488 Communications

The 3860 Digital Controller uses jumpers on the Operator Remote Interface PWB to set the GPIB address. The factory default address is set as device 3. If the digital controller communicates with a host computer via IEEE-488, the

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GPIB primary address may need to be set. Table 2.22 lists the jumper configurations for each valid address.

Table 2.22. IEEE-488 Primary Device Addresses

Address	J14 Pins 1 to 16 Bit Weight =16	J14 Pins 2 to 15 Bit Weight =8	J14 Pins 3 to 14 Bit Weight =4	J14 Pins 4 to 13 Bit Weight =2	J14 Pins 5 to 12 Bit Weight =1
0	On	On	On	On	On
1	On	On	On	On	Off
2	On	On	On	Off	On
3	On	On	On	Off	Off
4	On	On	Off	On	On
5	On	On	Off	On	Off
6	On	On	Off	Off	On
7	On	On	Off	Off	Off
8	On	Off	On	On	On
9	On	Off	On	On	Off
10	On	Off	On	Off	On
11	On	Off	On	Off	Off
12	On	Off	Off	On	On
13	On	Off	Off	On	Off
14	On	Off	Off	Off	On
15	On	Off	Off	Off	Off
16	Off	On	On	On	On
17	Off	On	On	On	Off
18	Off	On	On	Off	On
19	Off	On	On	Off	Off
20	Off	On	Off	On	On
21	Off	On	Off	On	Off
22	Off	On	Off	Off	On
23	Off	On	Off	Off	Off
24	Off	Off	On	On	On
25	Off	Off	On	On	Off
26	Off	Off	On	Off	On

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Table 2.22. IEEE-488 Primary Device Addresses

Address	J14 Pins 1 to 16 Bit Weight =16	J14 Pins 2 to 15 Bit Weight =8	J14 Pins 3 to 14 Bit Weight =4	J14 Pins 4 to 13 Bit Weight =2	J14 Pins 5 to 12 Bit Weight =1
27	Off	Off	On	Off	Off
28	Off	Off	Off	On	On
29	Off	Off	Off	On	Off
30	Off	Off	Off	Off	On
31	Off	Off	Off	Off	Off

2.4.5 Time-stamped Position and Autotrack Status Message

A time-stamped serial data output is provided by the 3860 on connector J304. Signals may be found on the following pins: Pin 2 – Output Data, Pins 1,5 – Signal Return.

The output signal conforms to RS-232 data format. The following characteristics apply:

- Baud rate 9600
- Parity None
- Data bits 8
- Stop bits 1
- No flow control

The output data message is sent at a 10-hertz rate. The following is the format for the time stamped data:

dddhhmmssttt,angle1,angle2,autotrackData<cr><lf>

where:

ddd is the day number,

hh is hour,

mm is minute,

ss is second,

ttt is milliseconds,

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angle 1 is 000.000 to 359.999 Azimuth angle,

angle 2 is 000.000 to 090.000 Elevation angle,

autotrackData is a number between 00-13 representing autotrack status,

<cr><lf> is a carriage return, line feed sequence

All data is in ASCII and fixed length by use of leading zeros. The message length is thus 31 characters (not counting the carriage return, line feed). This time and angle format is easily viewable and verifiable without requiring conversions.

The autotrack status value is constructed as a 4-bit value with bit b0 being the least significant bit and b3 the most significant. Interpretation of the bits is as follows:

b0 = Ka-band Feed Select Left or Right; 0 for Left, 1 for Right

b2,b1 = Autotrack Channel Select; 00 for Ka band, 01 for S-Left, 10 for

S-Right, 11 is never used

b3 = Autotracking Above Threshold; 1 = Autotrack, 0 = Program Track

For example, any even number is Ka-band Left, any odd number is Ka-band

Right, any number 8 and above is Autotracking, 7 and below is Program Track.

Here are some further examples:

04 = Program Track, S-Band Right Channel Selected, Ka Band Left Feed

Selected

08 = Autotrack, Ka Band Channel Selected, Ka Band Left Feed Selected

12 = Autotrack, S-Band Right Channel Selected, Ka Band Left Feed Selected

13 = Autotrack, S-Band Right Channel Selected, Ka Band Right Feed Selected

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2.4.6 GPS Time-code Interface

A serial interface from the 3860 to a Datum 9390-6000 ExacTime GPS Time Code and Frequency Generator is provided on connector J104. This interface is used by the 3860 to read the current time and synchronize its internal timebase to the Datum. Signals may be found on the following pins:

Pin 2 – Transmit Data from the 3860

Pin 8 – Receive Data

Pin 5 – Signal Return

This interface conforms to RS-232 data format. The following characteristics apply:

Baud rate	9600
Parity	None
Data bits	8
Stop bits	1
No flow control	

2.4.7 Power Input



WARNING

For all installations, the power line neutral must be common to the neutral supplied to the pedestal power input. Severe electrical shock or equipment damage may result from failure to observe this warning.

A 7.5-foot, 3-wire power cord is supplied with each unit. The input power connector is located at the rear of the unit. The input power requirements are listed in Table 1.1.

2.5 Initial Checkout

Before applying power to the system, read the operation instructions provided with all other equipment used with the system and become familiar with the operating controls and indicators. A list of these related publications is given in Chapter 1 of the system manual.

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No adjustments are required before initial turn-on.

2.5.1 Initial Turn-on and Checkout

Perform the following procedures to verify that the digital controller is in proper working order.

a) Apply power to control console.

b) Set POWER switch on the Series 3860 Digital Controller front or rear panel to ON. The internal microprocessor initiates all front-panel functions and selects STANDBY mode.

c) Verify that power indicator is lit and that BIT diagnostics register no faults. Initial display should appear as follows:

```
RUNNING SELF TEST
MEMORY CHECK:    OK
SERVO BOARD 8:     PRESENT
AUTOTRACK BD1:   PRESENT
SERVO BOARD 9:     NOT PRESENT
AUTOTRACK BD2:   NOT PRESENT
STEPTRACK MODULE INSTALLED
```

RUNNING SELF TEST — will always appear.

MEMORY CHECK: — should indicate OK.

SERVO BOARD 8: PRESENT — should indicate PRESENT; will indicate NOT PRESENT if communication failure occurs or board is not installed. (The servo board's bus address is 8; if a second servo board is installed, its bus address is 9.)

AUTOTRACK BD1: PRESENT — should indicate PRESENT if configured for autotrack; will indicate NOT PRESENT if communication failure occurs or board is not installed.

SERVO BOARD 9: PRESENT — will indicate PRESENT if second servo board is installed; will indicate NOT PRESENT if board is installed and

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communication failure occurs or board is not installed.

AUTOTRACK BD2: PRESENT — will indicate PRESENT if second servo board is installed; will indicate NOT PRESENT if board is installed and communication failure occurs or board is not installed.

STEPTRACK MODULE INSTALLED — will appear on display if steptrack module is installed.

a) Verify that "PWR" is displayed indicating that the pedestal is energized. Use softkeys to apply pedestal power, as required.



WARNING

Ensure that all personnel are clear of the pedestal equipment. Failure to observe this warning may result in serious injury or death.

NOTE

For versions without joystick, delete steps b) through I) and l) through m).

NOTE

To stop pedestal movement in the event of a malfunction or emergency, press the STOP button on the keypad. Pressing the STOP button places all axes in Standby mode.

b) Press RATE softkey on azimuth side of display.

c) Verify that "RATE" is displayed.

d) Enter 2.0 and press the ENT key on the numeric keypad.

e) Verify that displayed azimuth position increases. If displayed position angle changes erratically or not at all, stop antenna by releasing joystick. Refer to system documentation for troubleshooting procedures.

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f) If operation appears to be smooth, deflect stick to the right until "+LIMIT" appears on the display and ALARM indicator is lit. At this point, antenna has reached its primary azimuth limit and cannot be operated further in the same direction.

g) Reverse antenna direction by entering -2.0 and pressing the ENT key on the numeric keypad .

h) Verify that displayed azimuth position decreases. If rough operation is observed on position display, stop antenna by pressing the STOP key on the numeric keypad. Refer to system documentation for troubleshooting procedures.

i) If operation appears to be smooth, allow the pedestal to continue until "–LIMIT" is displayed and ALARM indicator is lit. At this point, the antenna has reached its primary azimuth axis limit and cannot be operated further in the same direction.

j) Press azimuth axis STANDBY softkey.

k) Verify that "STANDBY" is displayed for azimuth axis.

l) Press the RATE softkey on elevation side of display.

m) Verify that "RATE" is displayed.

n) Verify smooth elevation operation of antenna from limit to limit as in the preceding steps for azimuth operation. If operation is nominal, press elevation axis STANDBY softkey.

o) Verify that "STANDBY" is displayed for elevation axis.

p) Press azimuth axis POSN softkey.

q) Verify that "POSITION" is displayed indicating that pedestal is in Position Mode.

r) Operate azimuth position knob and observe that antenna follows position commands as displayed. Command antenna from limit to limit in azimuth.

s) Repeat steps r., s., and t. for elevation axis and command antenna from limit to limit.

t) Return system to Standby mode by pressing STOP key on numeric keypad.

u) Verify that "STANDBY" is displayed for azimuth and elevation axes.

If an external single-speed resolver or synchro position command is available, the system can be checked out in the Slave mode of operation. To

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check out Slave mode, press the MENUS, MODE, and SLAVE softkeys for each axis and observe movement of the antenna as the slave source is operated. Pedestal and antenna pointing will not match the true position commanded by the slave source until the position readouts are aligned to north. Refer to the following paragraph for information concerning alignment to north.

2.5.2 Axis Position Offsets

After the system is installed and functionally operational, it is usually necessary to adjust the position displays to an accurate reference (setting azimuth relative to true north, for example). In order to calibrate the position display it is necessary to have an RF boresight with a known azimuth angle relative to the pedestal.

The softkeys and the numeric keypad can be used to offset the resolver (or synchro) position feedback to the desired reference. Position information from each axis can be adjusted up to 359.999 degrees as follows:

a) Place system in Standby mode for both axes.

b) Press MENUS, SETUP, POSN, OFFSET softkeys for the desired axis.

c) Enter 0.00 offset using numeric keypad and press ENTER.

d) Point antenna (or desired axis) to the reference position. Point as accuracy as possible to ensure best results.

e) Examine position readout and calculate difference as reference angle minus readout. If difference is positive, use difference as the offset to be entered in step h). If difference is negative, add 360 degrees to the difference to determine offset.

f) Place system in Standby mode for both axes.

g) Press MENUS, SETUP, POSN, OFFSET softkeys for the desired axis.

h) Enter calculated offset using numeric keypad and press ENTER.

i) Position axis to reference and verify that the correct readouts are displayed.

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Chapter 3

Operation

3.1 Introduction

This chapter contains operation instructions for the Series 3860 Digital Controller. These instructions describe:

- Align position readouts to true north (or other appropriate reference).
- Determine that target signal specifications powering on the controller and choosing operational parameters. Prior to operation, such as frequency and polarization, are known and within the operating range of the system.

3.2 Modes of Operation

The 3860 Digital Controller has three operational modes:

- LOCAL — controller accepts commands from a computer located at the pedestal.
- REMOTE — controller accepts commands from an external host computer.
- FRONT PANEL — controller accepts commands from the optional front-panel controls.

3.2.1 Local Pedestal Control

Local pedestal control may be purchased as an accessory item and is not described in full detail by this manual.

In the local pedestal operating mode, a portable computer is connected to the local control connector at the pedestal. Local control software running on the computer provides most of the functions of the digital controller's front panel. While in local mode, the digital controller's front-panel controls are not active, but the front-panel display is updated. The front panel displays "LCL" when in local mode. Note that connecting or disconnecting the local mode cable places all axes in Standby mode.

Enter local mode by selecting from softkey menus and connecting the local control cable. When operating in local mode, commands from the front panel or another control computer are ignored.

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3.2.2 Remote Control

The digital controller can be controlled by an external computer over a serial (RS-232 or RS-422) or parallel (IEEE-488) interface. Refer to Appendix A for remote control commands.

Begin remote control by selecting the remote control mode from the front panel (indoor unit). The operator can also end remote control. The remote computer cannot initiate or terminate remote mode. The remote computer can receive status information at any time, but cannot change pedestal status unless remote mode is active. Remote mode has the lowest priority of the three modes of operation.

3.2.3 Front-panel Control

In this mode, the digital controller is operated with optional front-panel controls and indicators. Commands or a remote computer are ignored in this operating mode. If a local computer is connected, front-panel commands are ignored. Front-panel operation has a higher priority than a remote computer, but a lower priority than a local computer.

3.3 Front-panel controls and indicators

Figure 3.1 illustrates the front panel. Controls and indicators are divided into eight functional groups:

- Liquid Crystal Display - The LCD displays information such as labels for the multi-function softkeys, axis position and commanded angles, and axis operational modes.

- Multifunction Softkeys - These ten keys (five on each side of the LCD) are assigned functions through software control, allowing many choices from only ten keys.

- Interlock Indicators - These LEDs indicate an axis interlock is engaged. These safety interlocks prevent operation of drive motors when a manual hand drive is engaged, brakes are manually released, or the pedestal DISABLE switch is not in the RUN position. The LED over the left row of softkeys is assigned to the same axis as the left softkeys, and the right LED is assigned to the same axis as the right softkeys.

- Position Handwheels - These handwheels can enter an axis position angle command when in Position mode. Turning the wheels left or right decreases or increases the angle. The commanded angle is shown on the LCD, and changes as the handwheel is turned. The left handwheel is assigned to the same axis as the left softkeys, and the right handwheel is assigned to the same axis as the right softkeys.

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- Alarm LED - This LED lights when there is an alarm condition. Items monitored for alarm status will vary from system to system. Refer to system documentation to determine items monitored for alarm status.

- Data Entry Keypad - These keys allow general-purpose data input.

Figure 3.1 illustrates the front panel and Table 3.1 describes front-panel controls and indicators.

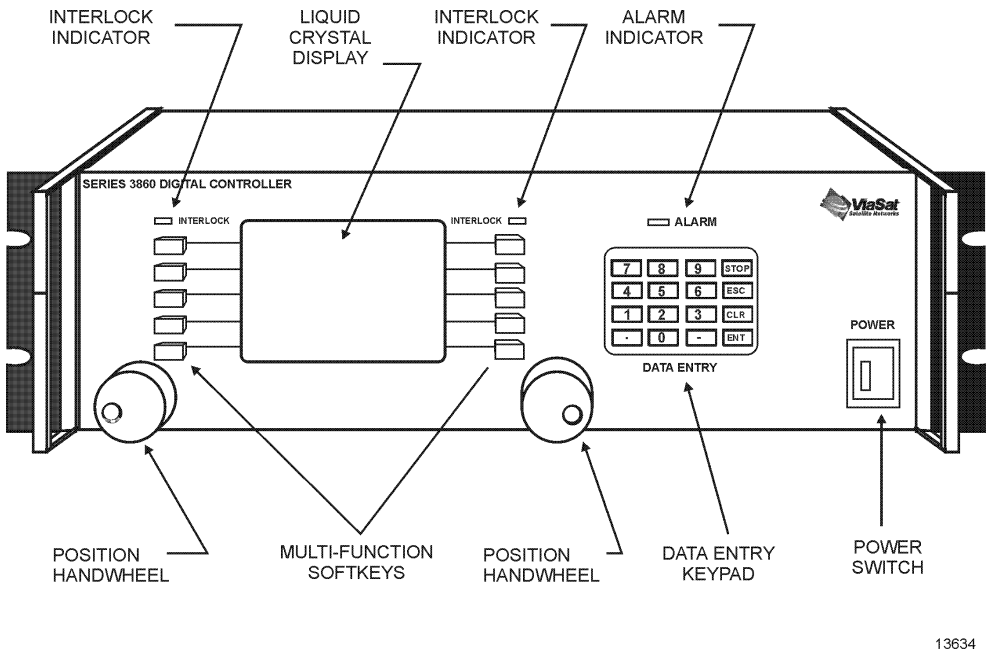


Figure 3.1. 3860 Digital Controller Front Panel

Table 3.1. Front-panel Controls and Indicators

Switch		Description
POWER		Power on/off switch for the Series 3860 Digital Controller (may be on rear panel in some versions).
Key(s)	Mode	Description
STOP		Places pedestal in STANDBY mode.
ESC		Steps backward through previously selected menus one step at a time. Also will terminate data entry with no change.
CLR		Clears last entry prior to entering confirmation.
ENT		Enters displayed data.
0,1,2,3,4,5,6,7,8,9,-,.		Adds character to display.
Softkeys		Executes action or selects new menu.

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Table 3.1. Front-panel Controls and Indicators

Switch		Description
Indicator	Mode	Description
POWER		Lights when 3860 power is on.
ALARM		Lights during an alarm condition.
INTERLOCK		Lights when an interlock is engaged.
LCD Display		Displays softkey labels, status indicators, pedestal angles, etc. Refer to paragraph 3.3.1.
Control	Mode	Description
Handwheels	Position	Position control of the pedestal.

3.3.1 Liquid Crystal Display Indicators

The liquid crystal display (LCD) displays most of the digital controller's controls and indicators. The ten keys (five on either side) of the LCD are referred to as softkeys, because their function changes according to software control. The current function of the key is displayed beside it on the LCD. Figure 3.2 illustrates and describes the LCD's controls and indicators.

NOTE

LCD indicators are displayed in reverse video (light text on dark background) when the item is active. For example, when POSITION is in normal video and AUTOTRACK is in reverse video under the axis angle displays, the system is autotracking a target with the Position Mode selected as backup.

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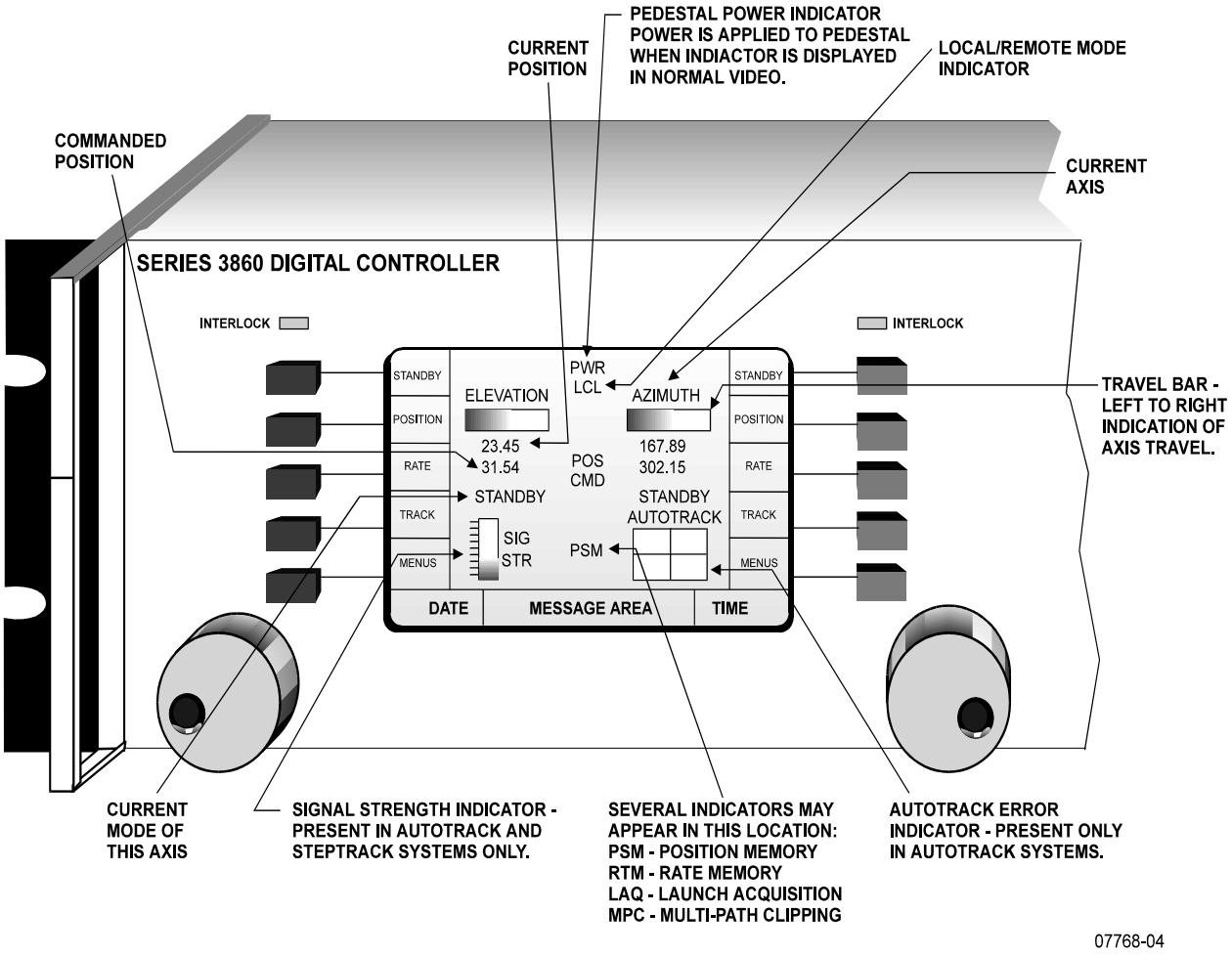


Figure 3.2. LCD Controls And Indicators

3.3.2 Data Entry

Pressing some softkeys (such as POSN or RATE) results in a request for data entry. This request is displayed at the lower, center area of the LCD. To enter data, press the appropriate keys on the numeric keypad, and then press ENT to enter the value. To correct data before entering, press CLR to clear and key in new data. Pressing ESC before pressing ENT exits the data entry request without entering the keyed digits.

NOTE

When a request for data entry is displayed ("ENTER ANGLE:" for example), all mode control operations are disabled until data is entered or the ESC key is pressed.

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3.3.3 Softkeys

The softkeys are divided into two groups of five. Each group corresponds to one pedestal or positioner axis. Pressing any key will display that function's subordinate menu softkeys, if any, with the same group. This allows each key to perform many functions. The two groups of soft keys are independent. For example, the left group can be assigned to an azimuth axis in Standby mode while the right group is assigned to an elevation axis in another mode. Each axis is controlled independently.

The current function of each softkey is displayed beside it on the LCD. If a key has no label displayed, it has no function at that menu level. Selected softkey functions are highlighted with reversed background and text.

3.3.4 Top Level Softkey Menu

When the digital controller is powered up, the LCD displays the top level softkey menu as shown in Figure 3.3. This menu contains the most used, or primary, axis modes: Standby, Position, Rate and Track. It also includes the MENUS softkey, which gives access to the lower level menus.

The menus are related in a hierarchical order. Pressing a key displays the next lower menu level or a request for data entry. Pressing the ESC key on the numeric keypad displays the next higher menu level. If "RETURN" is displayed beside a softkey, pressing that key redisplays the top level menu for that axis.

3.3.5 Front-panel Operating Procedures

The 3860 Digital Controller is a versatile unit. Many operational scenarios are possible, precluding a fixed set of procedures. Determine mission requirements and refer to the general procedures in this chapter. These procedures give information on applying and removing power, emergency shutdown, entering the different operating modes for each axis, selecting operating parameters, and entering data.

3.3.6 Power Up And Down

Refer to the initial turn-on and checkout procedure in paragraph 2.5. There are no initial switch or control settings. To apply power to the digital controller, press the power switch on the rear panel. The power indicator will light. After a few seconds of self-test, the LCD displays the initial control screen, and all axes are placed in Standby mode. Ensure that the interlock and alarm indicators are off, and that there are no error messages displayed.

To power down the controller, press the power switch again.

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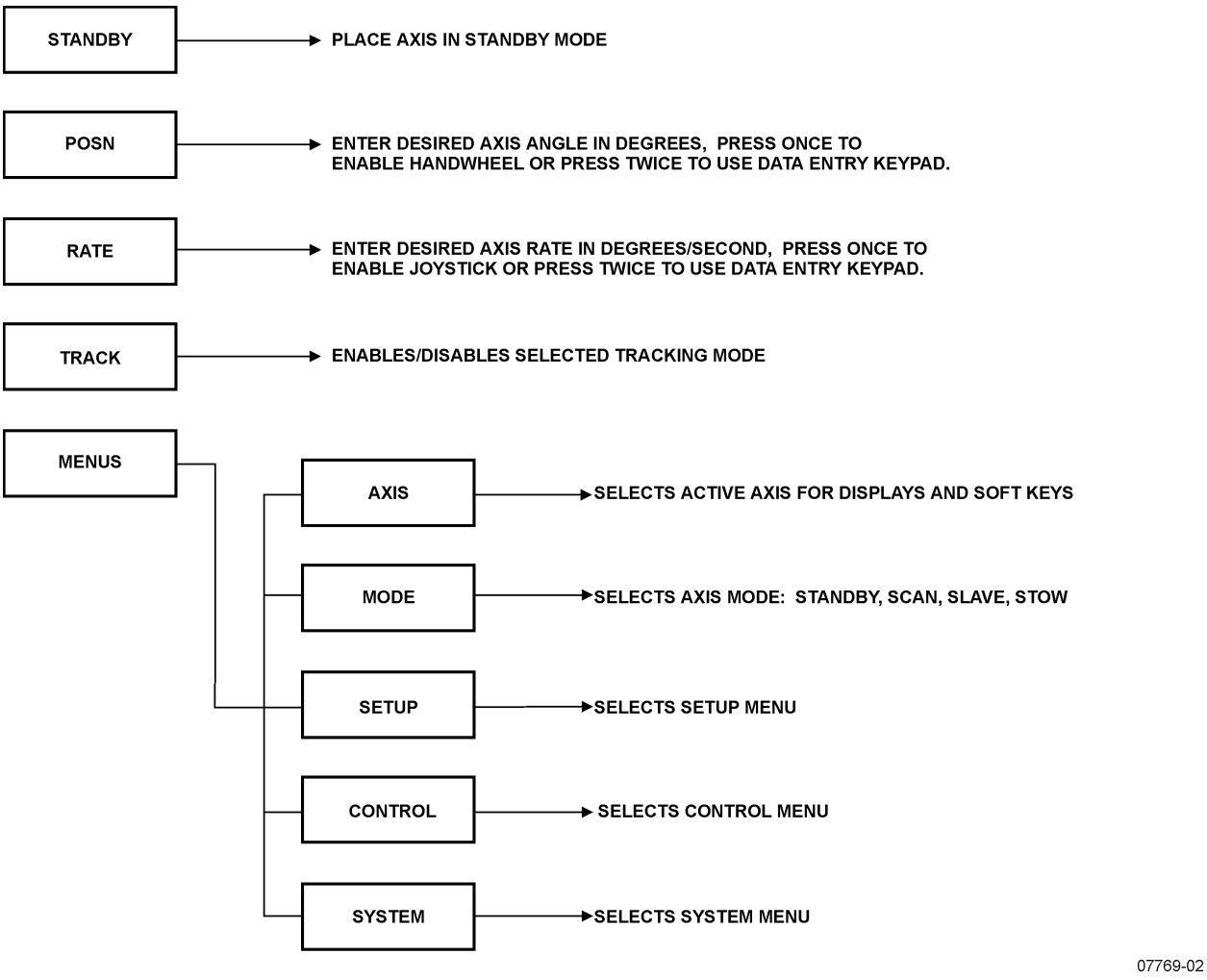


Figure 3.3. Top Level Softkey Menu

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3.3.7 Emergency Shutdown

To immediately stop all pedestal axes, press the STOP key on the numeric keypad on the digital controller front panel. This action places all axes in Standby mode and stops axis motion but does not remove power from the digital controller or the pedestal. To remove power from the digital controller, press the power switch in the lower right of the front panel.



WARNING

- The STOP key does not function if communications link between ORI and Servo boards fails.

Switching off power to the indoor unit in an indoor/outdoor configuration will not remove power from the pedestal.

Under either of these conditions, the unit will automatically revert to Standby mode for all axes and switch off pedestal power in approximately 10 seconds.

3.3.8 Standby Mode

Refer to Figure 3.3. To enter Standby mode, press the STANDBY softkey on the top level menu. Only the axis corresponding to the softkey pressed enters Standby mode. The other axes' modes remain unchanged. In Standby, power is applied to the axis, but the drive motor is disabled and the brakes are set. Standby is the default mode at power up.

In an emergency situation, pressing the STOP key on the numeric keypad places all axes in Standby mode.

3.3.9 Position Mode

Refer to Figure 3.3. To enter Position mode, press the POSN softkey on the top level menu. Only the axis corresponding to the softkey pressed enters Position mode. The other axes' modes remain unchanged. In Position mode, key in the desired position angle on the numeric keypad and press ENT, or use the position knob. Press the softkey once to use the position knob and a second time to enter a value. Turning the knob counterclockwise decreases the angle and turning it clockwise increases the angle. Refer to paragraph 3.3.15.3 and Figure 3.8 for information on Position mode parameters.

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3.3.10 Rate Mode

Refer to Figure 3.3. To enter Rate mode, press the RATE softkey on the top level menu. Pressing RATE once activates the joystick; pressing RATE again allows entering a value from the keypad. Only the axis whose softkey is pressed enters Rate mode; the other axes can be in other modes. Press the RATE softkey twice and enter the desired rate in degrees per second on the numeric keypad and press ENT. Rate commands can also be entered with the joystick. Press the RATE softkey once and then press and hold the button on the end of the joystick and move the stick to enter a command.

3.3.11 Track Mode

Refer to Figure 3.3. To enable or disable tracking, press the TRACK softkey on the top level menu. If autotracking is available, track is enabled for the axis whose softkey is pressed; the other axes can be in other modes. If the controller is configured for step tracking, both axes will enter Steptrack mode.

3.3.12 Menus

Refer to Figure 3.3. To access the lower level menus for an axis, press the MENUS softkey on its respective top level menu. The subordinate level menu is displayed.

3.3.13 Softkey Axis Assignment

Each of the two groups of softkeys can be assigned to only one axis at a time. The softkey axis assignment must be changed to access the third axis. Figure 3.4 shows the softkey menu choices that assign a group of softkeys to another axis.

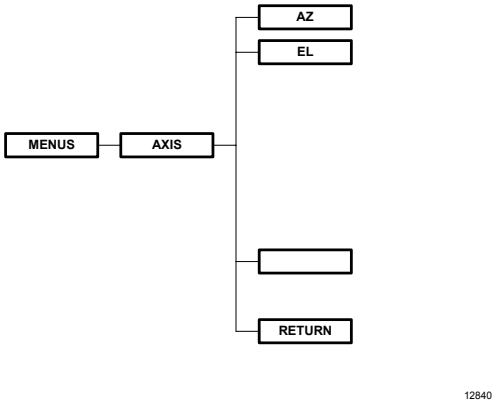


Figure 3.4. Softkey Axis Assignment

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a) With top level menu displayed, press MENUS from the softkey group to reassign.

b) Press AXIS. The three axis choices are displayed.

c) Press softkey for desired axis, AZ or EL, or press RETURN to return to top level menu.

d) Selected axis is assigned to softkey group.

3.3.14 Secondary Modes

Refer to Figure 3.5. Secondary axis modes include Scan, Rate and Stow. Standby mode is duplicated on this menu for safety and convenience. These modes appear at this menu level because they are used less frequently than the primary modes.

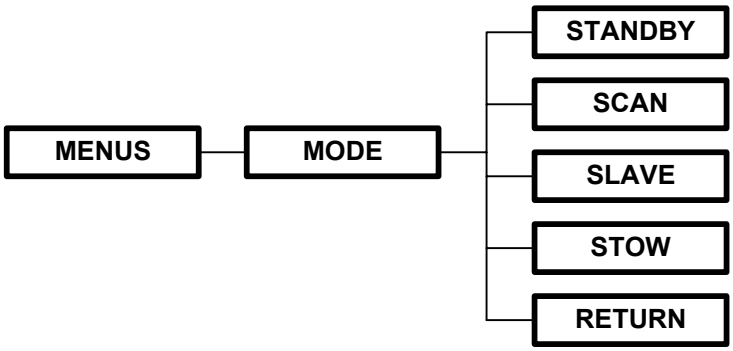


Figure 3.5. Secondary Modes

a) To access secondary modes, first press MENUS from the top level menu.

b) Press MODE. The secondary modes menu is displayed.

c) Refer to paragraphs 3.3.14.1 through 3.3.14.4 for a description of the secondary modes.

3.3.14.1 Standby Mode

Refer to Figure 3.5. This mode is duplicated in the top level and secondary level mode menus. To enter Standby mode, press the STANDBY softkey. In Standby, power is applied to the axis, but the drive motor is disabled and the brakes are set.

In an emergency situation, pressing the STOP key on the numeric keypad places all axes in Standby mode.

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3.3.14.2 Scan Mode

Refer to Figure 3.5. Use this mode to support signal acquisition. Scan mode causes the axis to scan at a constant amplitude around the commanded axis position. In Autotrack systems, scanning terminates when the target is acquired. If the target is lost, scanning may be resumed depending on the backup mode selected. Scan can be selected along with another (backup) mode. Refer to paragraph 3.3.15.2 and Figure 3.7 for information on scan parameters.

a) With top level menu displayed, press MENUS softkey for the desired axis.

b) Press MODE. Secondary modes menu is displayed.

c) Press SCAN. Scan mode is activated.

3.3.14.3 Slave Mode

Refer to Figure 3.5. Use this mode to slave an axis to an external single-speed resolver or synchro position command.

a) With top level menu displayed, press MENUS.

b) Press MODE. Secondary mode menu is displayed.

c) Press SLAVE. Slave mode is activated.

3.3.14.4 Stow Mode

Refer to Figure 3.5. Entering Stow mode commands the axis to a preset position. Stow position is normally 90 degrees for the elevation axis and 0 degrees for the azimuth axis.

a) With top-level menu displayed, press MENUS softkey for the desired axis.

b) Press MODE. Secondary modes menu is displayed.

c) Press STOW. Stow mode is activated and the axis moves to its preset stow position.

NOTE

In systems with elevation remote stow pins, selecting Stow mode will only drive the elevation axis to the stow position. This mode does not control the remote stow pins.

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3.3.15 Setup Menus

The setup menus allow entry of parameters for servo operation, Scan mode, Position mode, and axis travel limits. Selections in each setup menu affect only the axis which is currently assigned to the group of softkeys being used.

3.3.15.1 Servo Parameters

Refer to Figure 3.6. Servo parameters available from this menu include a selection of digital filters for position and rate, torque bias, test signal selection, and step response test.

3.3.15.1.1 Digital Filter Selection



CAUTION

Servo compensation is performed by firmware in the 3860 Digital Controller. Compensation values for each position and/or rate filter are preset by the factory.

Select only filters that are preset by the factory. Selecting non-preset filters may result in unpredictable system performance.

a) With top-level menu displayed, press MENUS softkey for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SERVO. Servo menu is displayed.

d) Press COMPSN. Compensation menu is displayed.

e) Press either position softkey, POSNFL, or rate softkey, RATEFL. The filter selection menu is displayed.

f) Press softkey for desired filter.

g) Press RETURN to display the top level menu.

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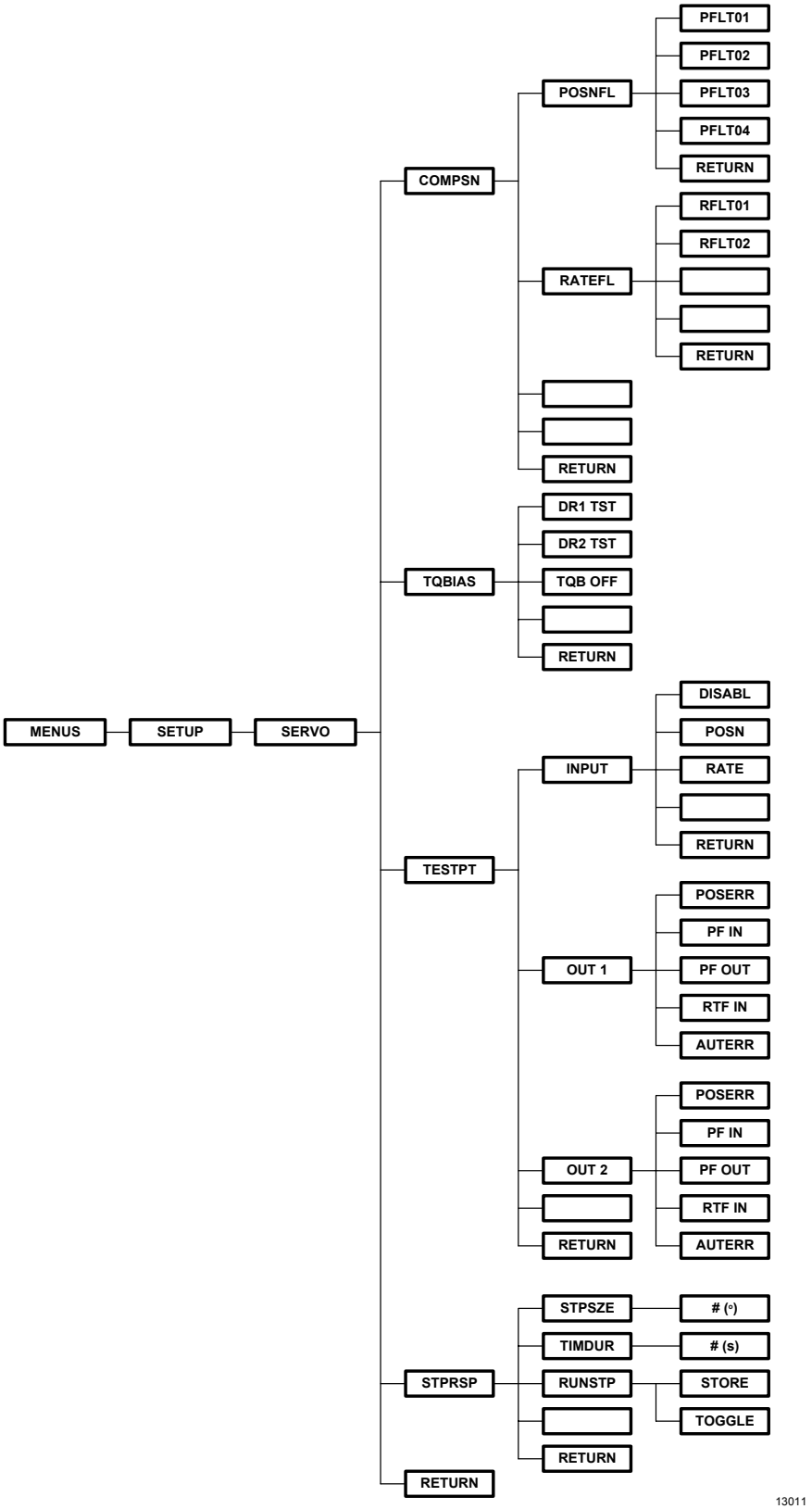


Figure 3.6. Servo Parameters

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3.3.15.1.2 Torque Bias Parameters



CAUTION

Torque bias parameters are set by the factory. Do not change unless absolutely necessary. Improperly set torque bias will result in severely degraded servo performance.

The digital controller provides programmable control of torque bias operation of dual drive pedestals. Torque bias values are set at the front panel, as described here, or from a remote computer.

These softkeys set up axis servo parameters for torque bias.

a) With top level menu displayed, press MENUS softkey for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SERVO. Servo menu is displayed.

d) Press TQBIAS. Torque bias menu is displayed.

e) Press TQBON to enable torque bias function or TQBOFF to disable the function and set torque bias level to zero.

f) If the function is enabled, press BIAS and enter desired value of torque bias in volts.

3.3.15.1.3 Test Port Signal Selection

These softkeys select the signal routed into and out of the digital controller's test port. Refer to Figure 3.6. An input is a test input pin where a function generator can be connected. These softkeys then select where the test signal is injected into the servo loop. Output refers to a separate test output pin from a digital-to-analog converter. An oscilloscope or other instrument can be connected to this point.

a) With top level menu displayed, press MENUS softkey for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SERVO. Servo menu is displayed.

d) Press TESTPT. Test port menu is displayed.

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To specify signal routed to test port, press INPUT. Input menu is displayed. Input choices are: DISABL (disable the test input port), POSN (route the test signal to the position loop) and RATE (route test signal to the rate loop).

To specify output of test port, press OUT1 or OUT2 from the test port menu. Output menu is displayed. Output choices are: POSERR (position error signal), PF IN (signal into position compensation filter), PF OUT (output from position compensation filter), RTF IN (signal to rate compensation filter), and AUTERR (autotrack processing output signal). POSERR and AUTERR will be the same signal when the axis is in Autotrack Mode.

3.3.15.1.4 Step Response Test

These softkeys perform a step response test on the selected axis.

a) With top level menu displayed, press MENUS softkey for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SERVO. Servo menu is displayed.

d) Press STPRSP. Step response menu is displayed.

e) Press STPSZE. Enter step size in degrees.

f) Press TIMDUR. Enter length of time in seconds (1 to 10) to record step response after initial step is applied.

g) Press RUNSTP to begin step response test. All axes are placed in Standby mode, and the step response test is performed on the selected axis. The LCD displays the test results.

h) To save step response data and analysis results, press STORE. Store overwrites any previously saved test results.

i) To switch display between current test results and previously stored test results, press TOGGLE.

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3.3.15.2 Scan Parameters

Refer to Figure 3.7. These softkeys set up parameters for scan operation.

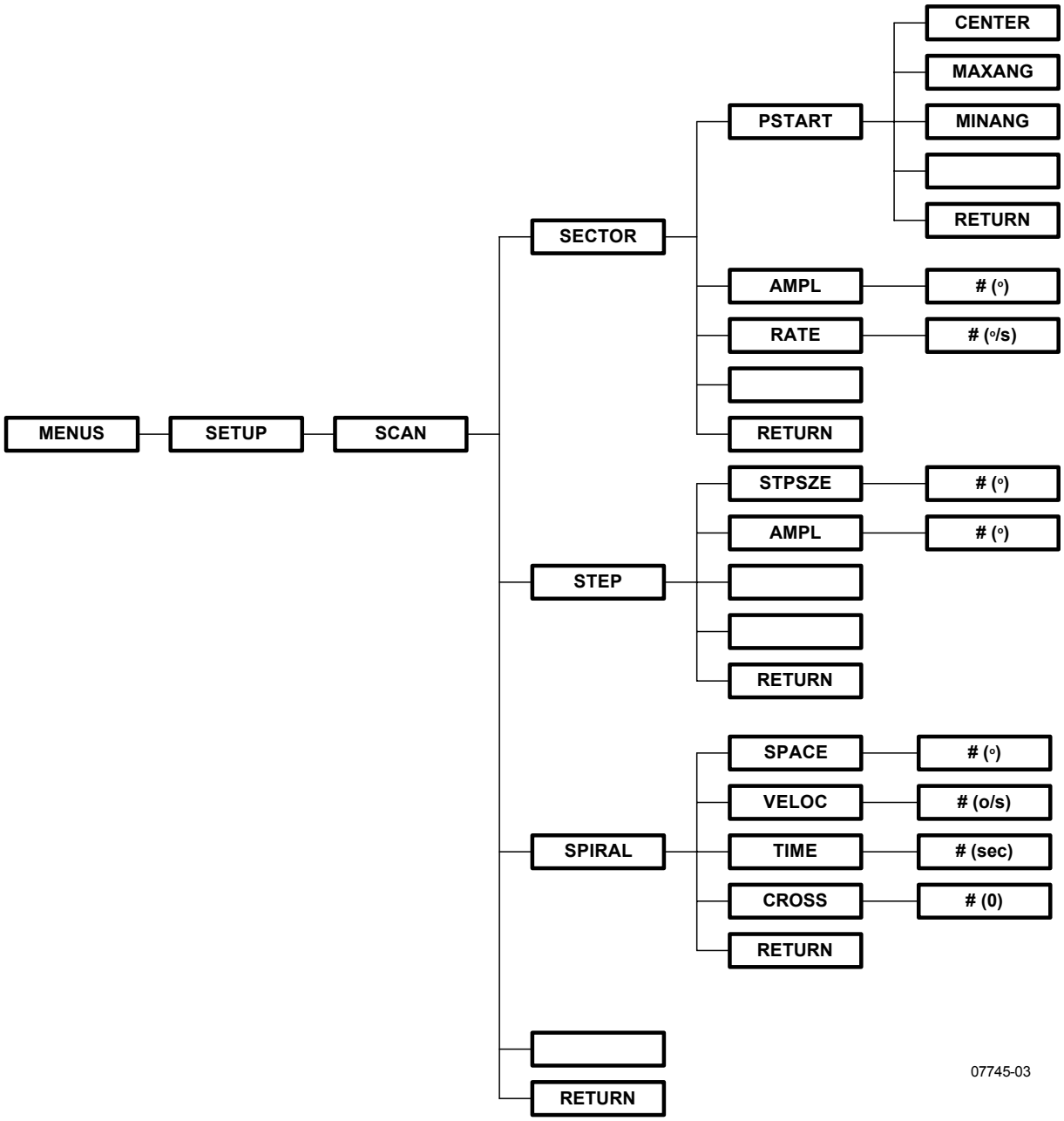


Figure 3.7. Scan Parameters

a) With top level menu displayed, press MENUS for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SCAN. Scan menu is displayed.

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d) Press SECTOR, STEP or SPIRAL. Parameter menu is displayed for the selected type of scan. The following paragraphs describe each scan type and define the parameters associated with that scan type.

3.3.15.2.1 Sector Scan

Sector scan will move the antenna back and forth through a sector. Parameters may be entered via soft key menus or remotely through the computer interface.

a) With top level menu displayed, press MENUS for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SCAN. Scan menu is displayed.

d) Press SECTOR.

e) Press PSTART to set start position for the scan. Position choices are CENTER (current position command), MAXANG (current position plus scan amplitude) and MINANG (current position minus scan amplitude).

f) Press ESC on numeric keypad to return to sector menu.

g) Press AMPL and enter scan amplitude in degrees.

h) Press RATE and enter scan rate in degrees per second.

i) Press ESC on numeric keypad to return to scan menu.

3.3.15.2.2 Step Scan

Step scan moves the antenna in increments defined by step size and amplitude. Parameters may be entered via soft key menus or remotely through the computer interface.

a) With top level menu displayed, press MENUS for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SCAN. Scan menu is displayed.

d) Press STEP.

e) Press STPSZE to set step size in degrees.

f) Press AMPL to set the scan amplitude in degrees (centered about start position) of the range of the steps. This value must be greater than step size or no step will occur.

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3.3.15.2.3 Spiral Scan

In a spiral scan, an Archimedean spiral or linear spiral is traced by the axes. In these scans, it is the angular spacing between intersections along a ray from the center of the spiral that is constant. This scan always begins at the center of the spiral (current position), and continues until the selected amplitude is obtained. Both axes will then immediately move back to the center position and repeat the scan until it is disabled or autotracking mode is entered.

a) With top level menu displayed, press MENUS for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press SCAN. Scan menu is displayed.

d) Press SPIRAL.

e) Press VELOC to enter the Tangential rate of antenna beam travel during scan movement. Enter a value between 0.01°/s to 5.625°/s.

f) Press TIME to enter the duration of scan; after this period, the axes travel back to the center and repeat scan. Enter a value of 0 to 60 seconds.

g) Press CROSS to enter the Crossover Elevation If the pedestal elevation is above this value, the time duration is doubled for the scan. This creates a larger scan to cover the increased velocity of the spacecraft relative to the antenna.. Enter a value of 0.01° to +1.406°

h) Press SPACE to enter the Spacial angle between adjacent scans. Enter a value of 0° to +90°.

3.3.15.3 Position Parameters

Refer to Figure 3.8. These softkeys select axis position display and control parameters.

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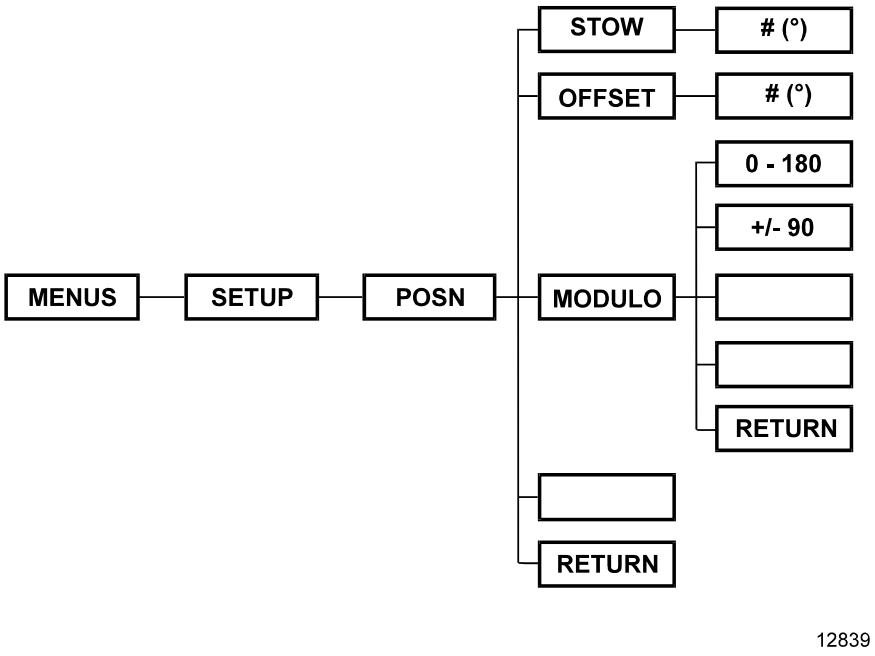


Figure 3.8. Position Parameters

a) With top level menu displayed, press MENUS for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press POSN. Position menu is displayed.

d) Press STOW. Enter axis stow position in degrees.

e) Press OFFSET. Enter axis position offset in degrees.

f) Press MODULO. Choose 0-180 or ±90. These choices are mutually exclusive. The 0-180 choice sets the display to show position angles from 0 to 1799.999 degrees centered at 90 degrees. The ±90 choice sets the display to show position angles from 0 to 89.999 degrees and -89.999 degrees centered at 0.

3.3.15.4 Limit Parameters

The digital controller provides programmable scaling of the front-panel axis travel bars and a means to set a rate limit on position command values. Scaling and limiting values are set from the front panel or from a remote computer.

NOTE

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The rate limit does not affect the slew rate capability but does limit the effective rate generated by changing position commands received by the servo from the front panel or a remote computer. Setting the rate limit arbitrarily small will prevent the system from following rapidly changing target positions.

Refer to Figure 3.9. These softkeys select axis limit parameters for travel and rate.

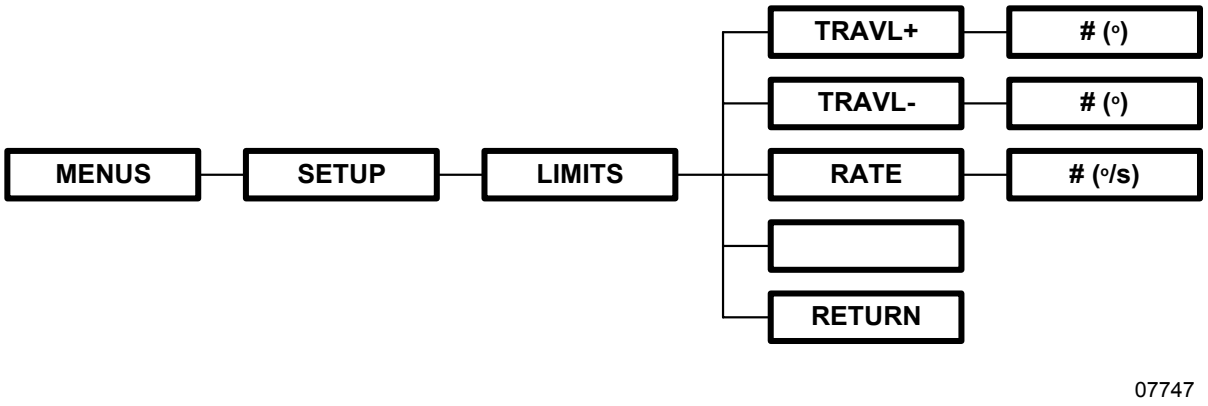


Figure 3.9. Limit Parameters

a) With top level menu displayed, press MENUS for the desired axis.

b) Press SETUP. Setup menu is displayed.

c) Press LIMITS. Limits menu is displayed.

d) Press TRAVL+. Enter travel limit in degrees. This value should be less than the mechanical switch limit value.

e) Press TRAVL-. Enter travel limit in degrees. This value should be less than the mechanical switch limit value.

f) Press RATE. Enter maximum slew rate in degrees per second.

3.3.16 Control Menus

Refer to Figure 3.10. Selections in the control menu affect global settings of the controller and are independent of which side of the display is used to set them and independent of the active axis for that side of the display.

The control softkeys allow the operator to set parameters for:

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- selecting local or remote operation
- Autotrack mode
- Steptrack mode
- AGC channel input
- storing and recalling digital controller setup parameters
- entering current date and time
- selecting and controlling feed scanner drive

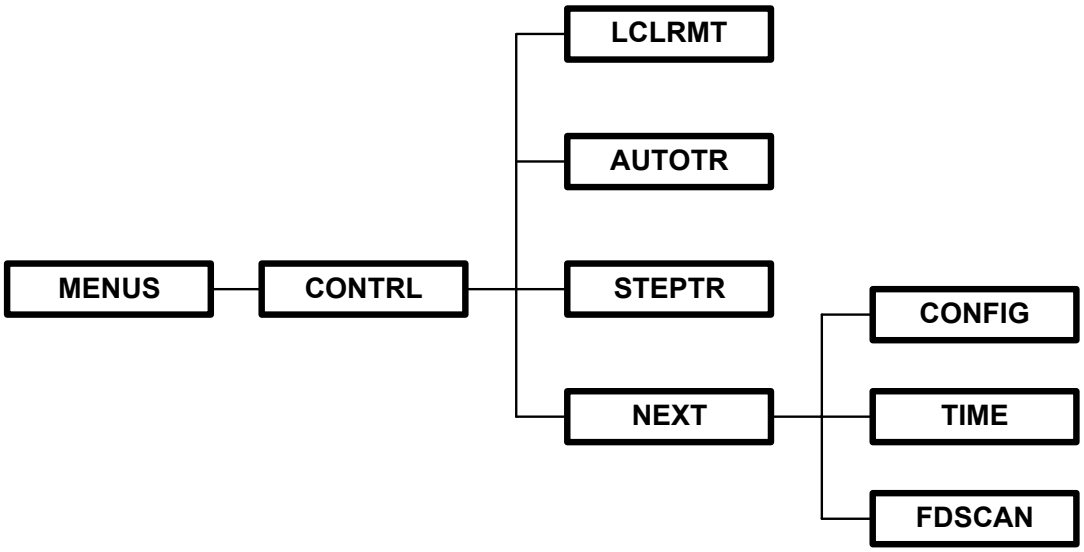


Figure 3.10. Control Menus

3.3.16.1 Local/remote Control

Refer to Figure 3.11. These softkeys allow choosing local or remote control for the digital controller.

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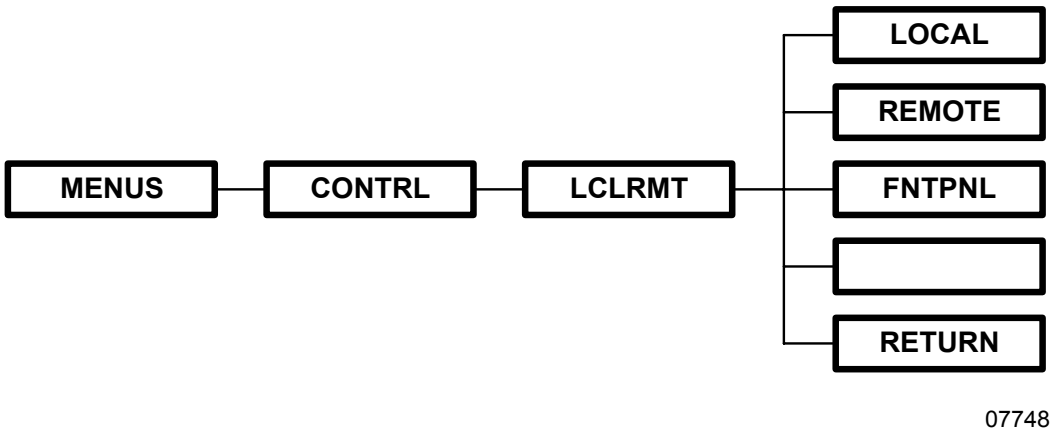


Figure 3.11. Local/remote Control Selection

a) With top level menu displayed, press MENUS.

b) Press CONTRL. Control menu is displayed.

c) Press LCLRMT. Local/remote control menu is displayed.

d) Observe LOCAL softkey. If it is highlighted, controller is in Local control mode. Local mode is entered and exited at the local control unit at the pedestal. Front-panel controls have no effect on local control.

e) Press REMOTE to transfer control to a remote computer. This key must be selected before remote control is possible. The controller cannot be placed in or removed from local or front-panel control by a remote computer. Note that the remote computer can read status from the digital controller even when Remote mode is not active.

f) Press FNTPNL to control the digital controller from its front panel.

3.3.16.2 Autotrack Mode

The Autotrack mode is available in Model 3862 Digital Controllers only. Refer to Figure 3.12. These softkeys allow entering Autotrack mode parameters. In Autotrack mode, position error commands are generated by the autotrack PWB from the tracking video.

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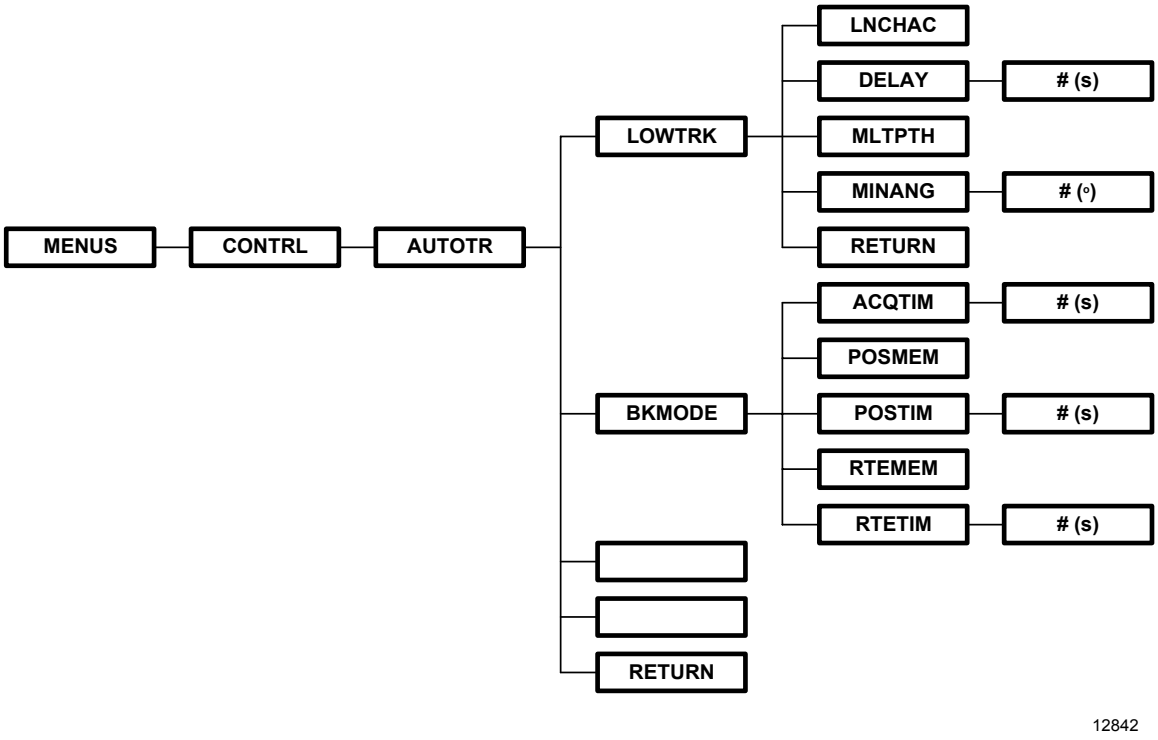


Figure 3.12. Autotrack Mode Parameters

a) With top level menu displayed, press MENUS desired axis.

b) Press CONTRL. Control menu is displayed.

c) Press AUTOTR. Autotrack menu is displayed.

d) Press LOWTRK to select setup parameters for low-angle target tracking during autotrack operation. LOWTRK menu is displayed.

1. Press LNCHAC to select or deselect Launch Acquisition mode during tracking. LNCHAC prevents axis from tracking in a negative direction for time period preset for delay.

2. Press DELAY. Enter time in seconds during which Launch Acquisition mode is active after tracking starts.

3. Press MLTPTH to select or deselect Multipath mode during Autotrack. MLTPTH prevents axis from tracking below the preset minimum angle.

4. Press MINANG. Enter in degrees the minimum angle below which digital controller will not command pedestal after tracking begins.

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e) Press BKMODE to setup backup mode parameters for autotrack operation. BKMODE menu is displayed.

1) Press ACQTIM. Enter time in seconds after target acquisition required to establish accurate tracking rates. If selected, Position Memory will be the Backup mode for loss of target during this time period. After this time, Rate Memory serves as the Backup mode if previously selected.

2) Press POSMEM. This key selects or deselects Position Memory as Backup mode for Autotrack operation. If target is lost, axis is positioned at the last location where signal strength exceeded minimum acquisition level.

3) Press POSTIM. Enter time in seconds after loss of target that the Position mode will operate. After this time, the axis returns to the mode that was active before autotrack acquisition occurred.

4) Press RTEMEM. This key selects or deselects Rate Memory as Backup mode for Autotrack operation. If target is lost after ACQTIM, axis motion continues at the average rate of the last two seconds of tracking.

5) Press RTETIM. Enter time in seconds after loss of target that the Rate mode will operate. After this length of time, axis returns to the mode that was active before target acquisition.

3.3.16.3 Steptrack Mode

Refer to Figure 3.13. These softkey provides access to Steptrack mode parameters. In Steptrack mode, target tracking is maintained by repeated peaking of the AGC signal using steptrack techniques.

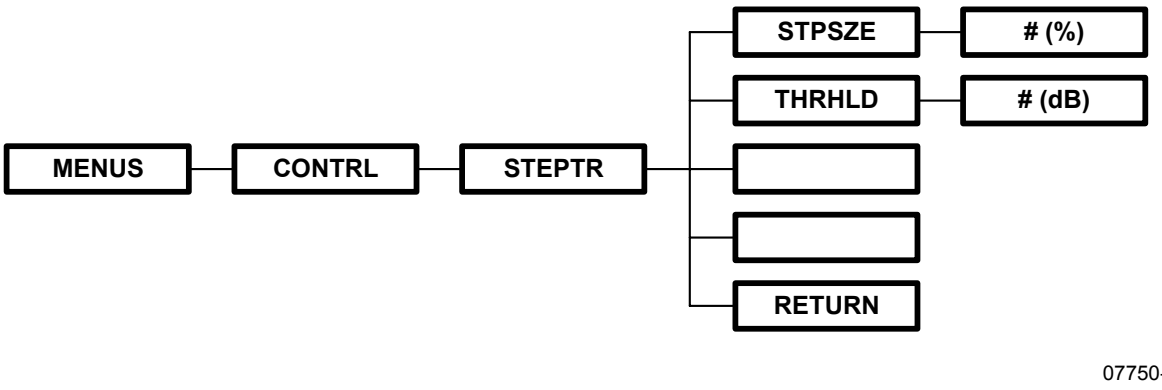


Figure 3.13. Steptrack Mode Parameters

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a) With top level menu displayed, press MENUS for desired axis.

b) Press CONTRL. Control menu is displayed.

c) Press STEPTR. Steptrack menu is displayed.

d) Press STPSZE. Enter in degrees the position change for this axis during Steptrack signal optimization.

e) Press THRHLD. Enter in dB the threshold signal level to engage Steptrack mode.

3.3.16.4 AGC Channel Input

Refer to Figure 3.14. These softkeys select the input channel for signal strength and tracking video.

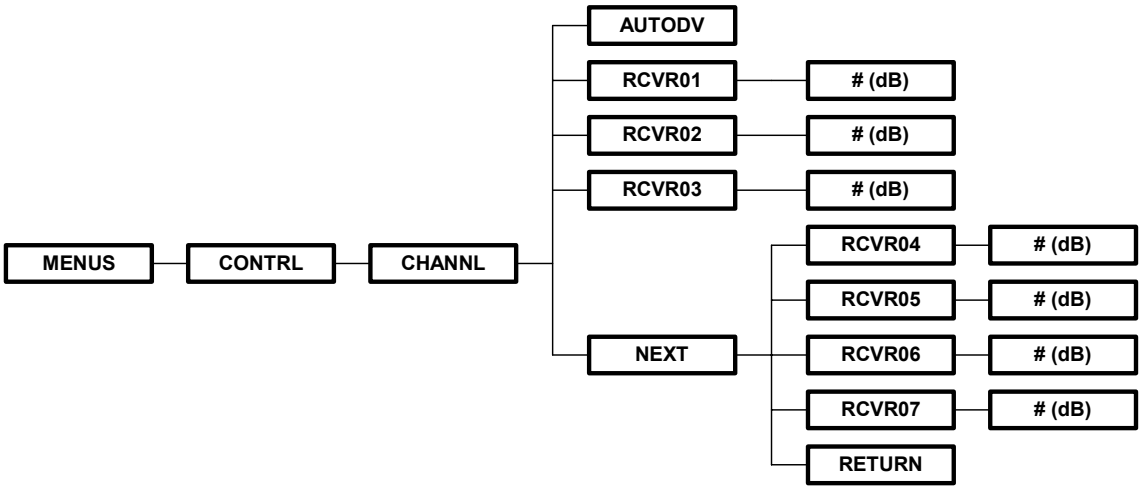


Figure 3.14. AGC Channel Input Parameters

a) With top level menu displayed, press MENUS for the desired axis.

b) Press CONTRL. Control menu is displayed.

c) Press CHANNL. Channel selection menu is displayed.

d) Press AUTODV. This key selects or deselects autodiversity between receivers. It allows automatic receiver selection (RCVR01 through RCVR07) based on highest signal strength.

e) Press WIDE to select the wideband receiver for input. Enter in dB the signal strength sufficient to enable tracking.

f) Press NARROW to select the narrowband receiver for input. Enter in dB the signal strength sufficient to enable tracking.

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g) Press RCVR03 to select receiver3 for input. Enter in dB the signal strength sufficient to enable tracking.

h) Press NEXT to display softkeys for receivers 4 through 6.

i) Press RCVR04 to select receiver 4 for input. Enter in dB the signal strength sufficient to enable tracking.

j) Press RCVR05 to select receiver 5 for input. Enter in dB the signal strength sufficient to enable tracking.

k) Press RCVR06 to select receiver 6 for input. Enter in dB the signal strength sufficient to enable tracking.

l) Press RCVR07 to select receiver 7 for input. Enter in dB the signal strength sufficient to enable tracking.

3.3.16.5 Digital Controller Setup Configuration Store/recall

Refer to Figure 3.15. These softkeys store and recall digital controller configurations. The stored parameters are listed below.

1. Setup parameters
   - Scan amplitude
   - Scan rate
   - Scan mode
   - Filter selection
   - Secondary mode selection
   - Rate limit
   - Torque bias amount and status
2. Control parameters
   - Scan code generator mode (fixed, swept, etc.)
   - Fixed scan code generator frequency
   - Autotrack acquisition threshold for all seven channels (if installed)
   - Autotrack receiver channel selection (if installed)
   - Steptrack stepsize (if installed)
   - Steptrack beamwidth (if installed)

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- Autotrack valid acquire time (if installed)
- Autotrack rate memory time (if installed)
- Autotrack position memory time (if installed)
- Autotrack launch acquisition time (if installed)
- Autotrack low track angle minimum (if installed)

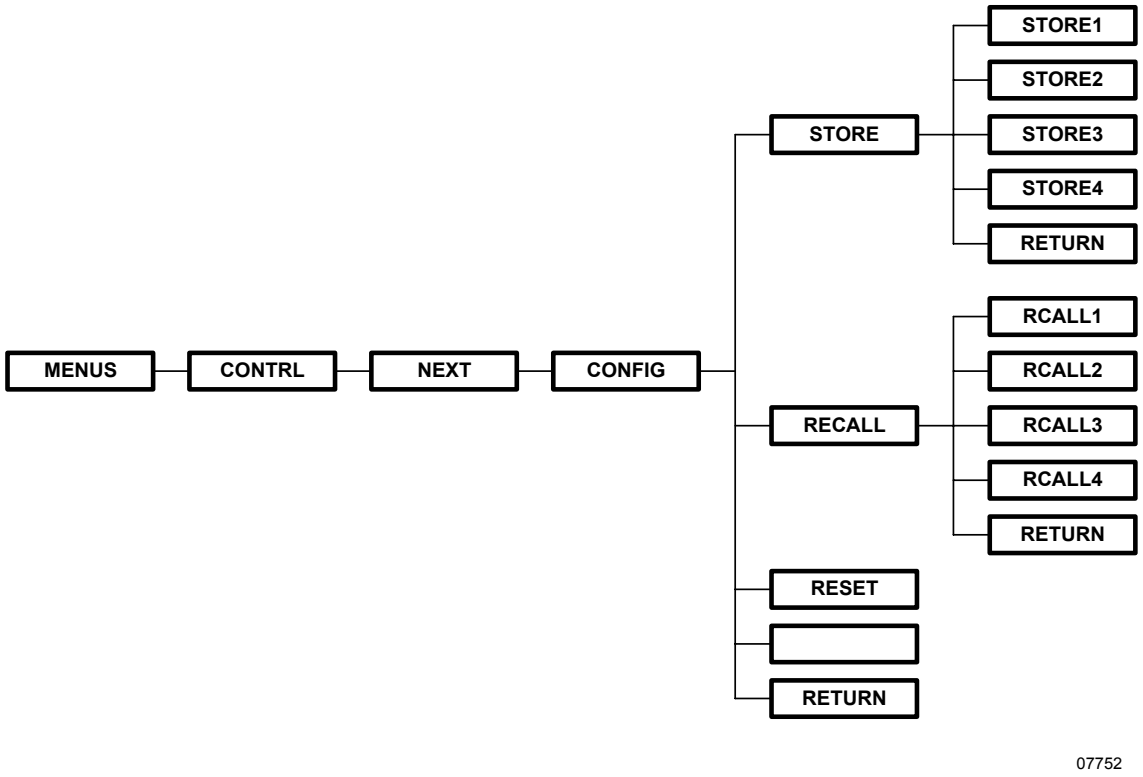


Figure 3.15. Digital Controller Setup Configuration Store/recall

a) With top level menu displayed, press MENUS for the desired axis.

b) Press CONTRL. Control menu is displayed.

c) Press NEXT. Next selection menu is displayed.

d) Press CONFIG. Setup configuration menu is displayed.

e) Press STORE. Store menu is displayed. Press STORE1 through STORE4 to assign current configuration as number 1 through number 4.

f) Press RECALL. Recall menu is displayed. Press RCALL1 through RCALL4 to recall the desired configuration.

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g) Press RESET to reset the digital controller to preset factory values, if desired.

3.3.16.6 Feed Scan Selection

Refer to Figure 3.16. These softkeys select the feed scan drive type and control the drive.

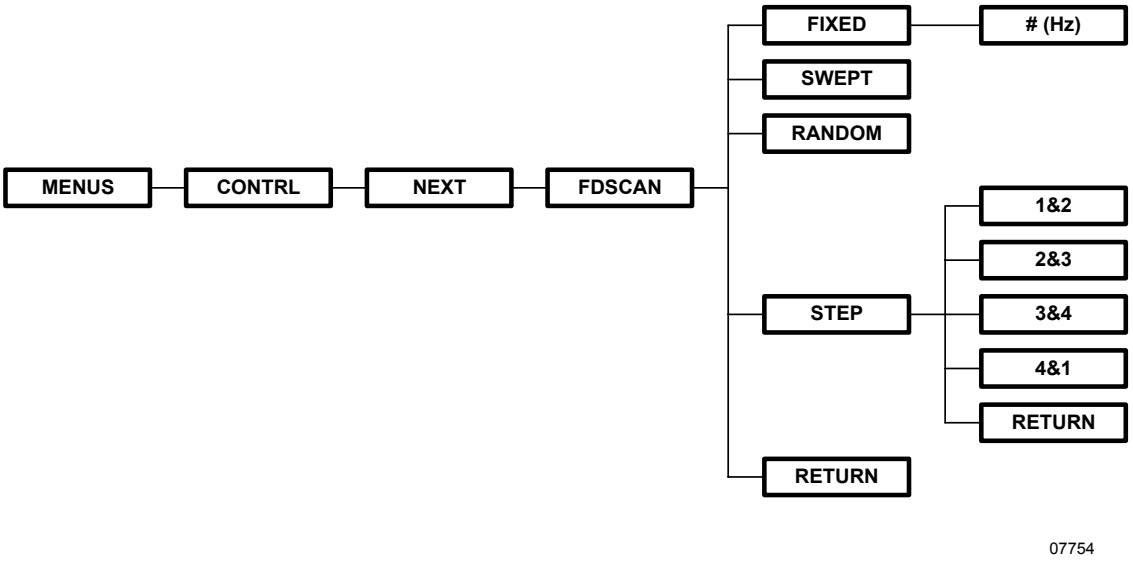


Figure 3.16. Feed Scanner Control

a) With top level menu displayed, press MENUS.

b) Press CONTRL. Control menu is displayed.

c) Press NEXT. Next selection menu is displayed.

d) Press FDSCAN. Feed scanner control menu is displayed.

e) To select a fixed value for feed driver frequency, press FIXED. Key in fixed value in Hertz and press ENT.

f) To sweep feed driver frequency between preset, nonadjustable limits, press SWEPT.

g) To change feed driver frequency in a pseudorandom manner between preset, nonadjustable limits, press RANDOM.

h) To set feed scanner to a particular scan position, press STEP. Press FIXED, SWEPT or RANDOM to resume scanning.

1. Press 1&2 to select feed elements 1 and 2. The resulting signal is the sum of the signals from feed elements 1 and 2.

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2. Press 2&3 to select feed elements 2 and 3. The resulting signal is the sum of the signals from feed elements 2 and 3.

3. Press 3&4 to select feed elements 3 and 4. The resulting signal is the sum of the signals from feed elements 3 and 4.

4. Press 4&1 to select feed elements 4 and 1. The resulting signal is the sum of the signals from feed elements 4 and 1.

3.3.16.7 Time And Date Set

Refer to Figure 3.17. These softkeys set the time and date for the controller's internal clock.

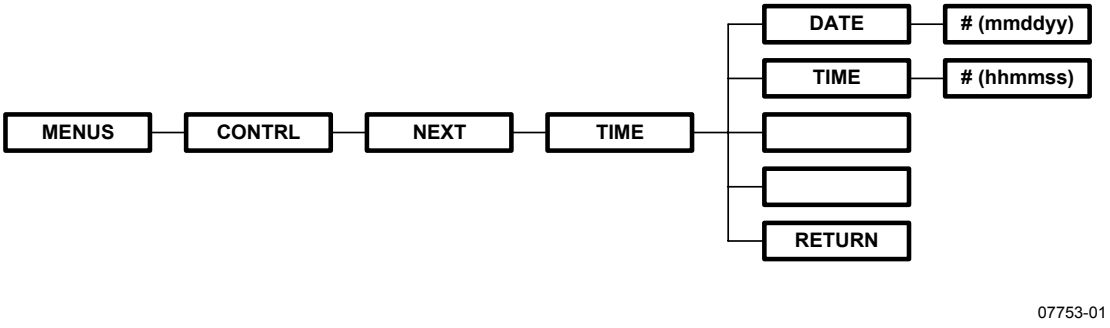


Figure 3.17. Time And Date Set

a) With top level menu displayed, press MENUS.

b) Press CONTRL. Control menu is displayed.

c) Press NEXT. Next selection menu is displayed.

d) Press TIME. Time setup menu is displayed.

e) Press DATE to enter date. Enter day, month and year in MMDDYY format. Press ENT to accept the entered value.

f) Press TIME to enter time. Enter time in HHMMSS format. Note that digital controller uses a 24-hour clock, from 00:00:00 to 23:59:59. Press ENT to accept entered value.

3.3.16.8 Status And Command Lines

Refer to Appendix B for descriptions of status and command lines. These softkeys select status and command lines for monitoring and controlling system equipment. STAT menus indicate remote status of switch closures and cannot be changed from the front panel. STAT lines are closed when the menu item is displayed in normal video (light background with dark characters). CMND menus provide actuation of Darlington drivers to control

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remote switch closures. CMND lines are closed when the menu item is shown in reverse video (a dark background with light characters).

a) With top level menu displayed, press MENUS.

b) Press CONTRL. Control menu is displayed.

c) Press SYSTEM. Status and command menu is displayed.

d) Press STAT 1, STAT 2, CMND 1 or CMND 2, as desired.

e) Refer to Appendix B for detailed information on status and command softkey selections. Make selections as desired.

3.4 Remote operation

During remote operation, commands are entered from a remote computer (referred to as the host) and are sent to the digital controller over a serial (RS-232 or RS-422) or parallel (IEEE-488) interface. Refer to paragraph 3.3.16.1 for the procedure to enter remote operation mode.

Refer to Appendix A for detailed information on remote interface commands.

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Chapter 4

Principles of Operation

4.1 Introduction

This chapter provides functional descriptions and block diagrams of the major components of the Series 3860 Digital Controller.

4.2 Functional description

The Series 3860 Digital Controller consists of four major functional modules: Servo Printed Wiring Board Assembly, Synchro/Resolver Printed Wiring Board Assembly, Operator/Remote Interface Printed Wiring Board Assembly, and an Autotrack Printed Wiring Board Assembly.

Support units consist of a resolver reference oscillator printed wiring board assembly, dc power supply, front-panel assembly, backplane (motherboard), indoor enclosure, and an outdoor enclosure.

The Servo Board is a microprocessor-controlled assembly that interfaces with the Synchro/Resolver Board through a 16-bit parallel bus. The servo board contains analog-to-digital converters (ADCs) to measure tachometer feedback, digital-to-analog converters (DACs) to generate drive commands, opto-coupled digital inputs to monitor pedestal status, and Darlington drivers to control relays and other switching devices.

The Synchro/Resolver Board contains the pedestal position measurement circuits and auxiliary digital I/O circuits identical to those on the servo board. The servo board and the synchro/resolver board are connected through the backplane. The servo board is equipped with the digital controller firmware and, along with the synchro/resolver board, contains the functionality required to interface the pedestal.

The Operator/Remote Interface (ORI) Board is a microprocessor-controlled assembly which interfaces the servo board through a fast serial link. The ORI contains drivers for the front panel, IEEE-488 interface, and external link interface. This module also contains the user interface and provides remote control capabilities to the digital controller. All functions available through the front-panel are also available over the remote serial link or the IEEE-488 link.

The Autotrack Board is a microprocessor-controlled assembly, interfacing the servo board through a fast serial link. The board has feed control drivers and receives automatic gain control (AGC) and tracking video signals from the

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tracking receiver. The autotrack board provides the scan-controlled switching of the feed elements and derives tracking error from the demodulation of the tracking video signal.

Figures 4.1 and 4.2 provide block diagrams of the Series 3860 Digital Controller. Figure 4.1 illustrates the single-chassis configuration, figure 4.2 illustrates the two-chassis configuration. Both configurations use the same functional modules in different physical arrangement to implement the control system.

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Figure 4.1. 3860 Digital Controller Block Diagram, Single-chassis Configuration

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Figure 4.2. 3860 Digital Controller Block Diagram, Two-chassis Configuration

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4.2.1 Servo Assembly

The Servo Assembly (Figure 4.3) is equipped with a Motorola 68302 microprocessor and serves as the main pedestal control interface. This assembly provides digital position and rate loop closure as well as torque bias control. In the Autotrack mode, the Servo Assembly reads tracking errors from the Autotrack board and uses these errors to close the servo loops. This assembly also provides control signals to the pedestal or positioner (other than the interface to the synchros/resolvers) such as limits, interlocks, power amplifier control, brake control, and others.

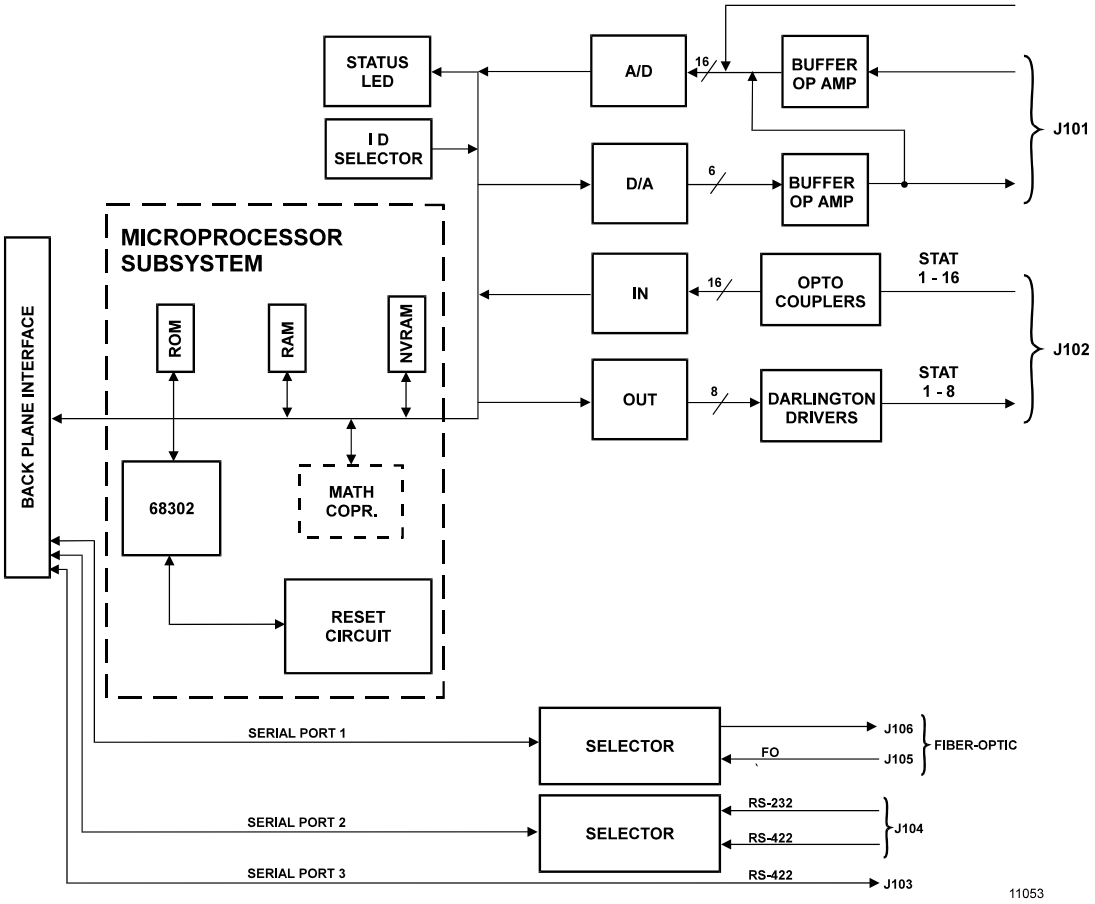


Figure 4.3. Servo Assembly Block Diagram

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The Servo Assembly contains the microprocessor, up to 512 kbytes ROM, 64 kbytes RAM, and 64 kbytes NVRAM. A Motorola MC68881 mathematical coprocessor may be installed as an option on the Servo Assembly board to process mathematical algorithms.

This assembly has 16 low-voltage, contact-closure-sensing lines. The inputs are opto-coupled and have internal pull-ups. The pull-up voltage can be +5V, +15V, or an external voltage source. The inputs can sense contact closure and the presence of voltage up to the pull-up voltage value on the input pin.

The Servo Assembly is equipped with eight open collector Darlington drivers. The drive voltage for relays may be delivered from outside the controller in the range of 5 to 50V dc. The driver can sink up to 500 mA per pin. The controller may optionally be configured to source 5- or 15-volt relay drive voltage with 250 mA of total current capability.

The assembly has 16 analog input channels. Each channel is served by a 12-bit, analog-to-digital converter for data acquisition. Two of the analog input channels (four in torque bias systems) are dedicated for tachometer data acquisition. The input stage of the analog-to-digital converter is configured to accept tachometer signals in the ±10V dc range.

The Servo Assembly has three 12-bit digital-to-analog converters which allow up to 6 channels of analog output (two channels per converter). The analog outputs are dedicated to generate dc command signals over a range of ±10V to the power amplifiers.

The assembly is equipped with three fast serial ports for communication. Media is selectable: fiber optics, twisted pair with multidrop capabilities (RS-422/485), or RS-232. Baud rate of the serial links is user selectable and can be set to 1200, 2400, 4800, 9600, 19200, 38400, or in the 100 kbaud range.

The Servo Assembly's firmware provides the board with built-in testing. Startup self-test functions include RAM write/read test, NVRAM checksum, and DAC/ADC loopback test.

4.2.2 Synchro/resolver Assembly

The Synchro/Resolver Assembly (Figure 4.4) translates the position feedback signals from the pedestal, in synchro or resolver format, to a digital word which can be utilized by the Servo Assembly's microprocessor. The Synchro/Resolver Assembly is connected through a parallel bus to the Servo Assembly to provide rapid update of pedestal position. The assembly has six synchro/resolver conversion channels which are configurable as synchro or resolver with selectable configuration. The position feedback component can be a single-speed or a dual-speed synchro or resolver package. In the case of a dual-speed arrangement, the position data from the two units is combined into a single position value by the firmware. The status of tracking synchro/resolver to digital converters is monitored and read by the Servo Assembly in its BIT functions.

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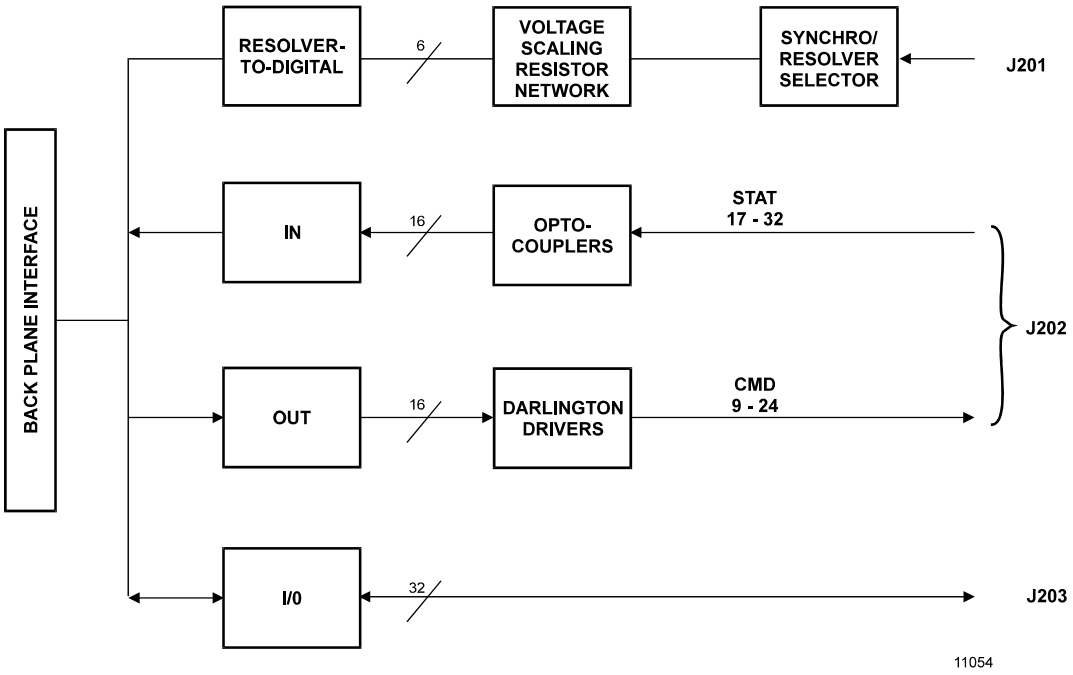


Figure 4.4. Synchro/resolver Assembly Block Diagram

The assembly has 16 low-voltage contact closure sensing lines. The input voltage sources are opto-coupled and have internal pull-ups. The pull-up voltage can be +5V, +15V, or external. The inputs can sense contact closure and the presence of voltage up to the pull-up voltage value on the input pin.

The Synchro/Resolver Assembly is equipped with 16 open collector Darlington drivers. The drive voltage for relays may be delivered from outside the controller in the range of 5 to 50V dc. The driver can sink up to 500 mA per pin. The controller can optionally be configured to source 5 or 15-volt relay drive voltage with 250 mA of total current capability.

The assembly has a 32 transistor-to-transistor logic (TTL) line auxiliary parallel digital I/O port. The port can be configured as input or output in sections of 16 bits. The strobe lines (BAclocks) for input direction are provided on the connector to enhance usability of the port.

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4.2.3 Operator/remote Interface Assembly

The Operator/Remote Interface (ORI) Assembly (Figure 4.5) is equipped with a Motorola 68302 microprocessor and provides all functions necessary to allow an operator to interface with the 3860 Digital Controller. This interface is accomplished through the front-panel controls. The Operator/Remote Interface Assembly has an internal processor to communicate with the controller, display status and position data on the front-panel display, and accept user commands from the front-panel controls. The assembly also has a serial interface to remote control computers in RS-422, RS-232, or IEEE-488 format. The assembly provides the digital conversion of the AGC from the receiver for steptrack applications. The Operator/Remote Interface Assembly is not required in the outdoor configuration where no indoor unit, and therefore no front panel, is provided. In that instance, the PC Interface Module is required for user interface and steptrack capabilities.

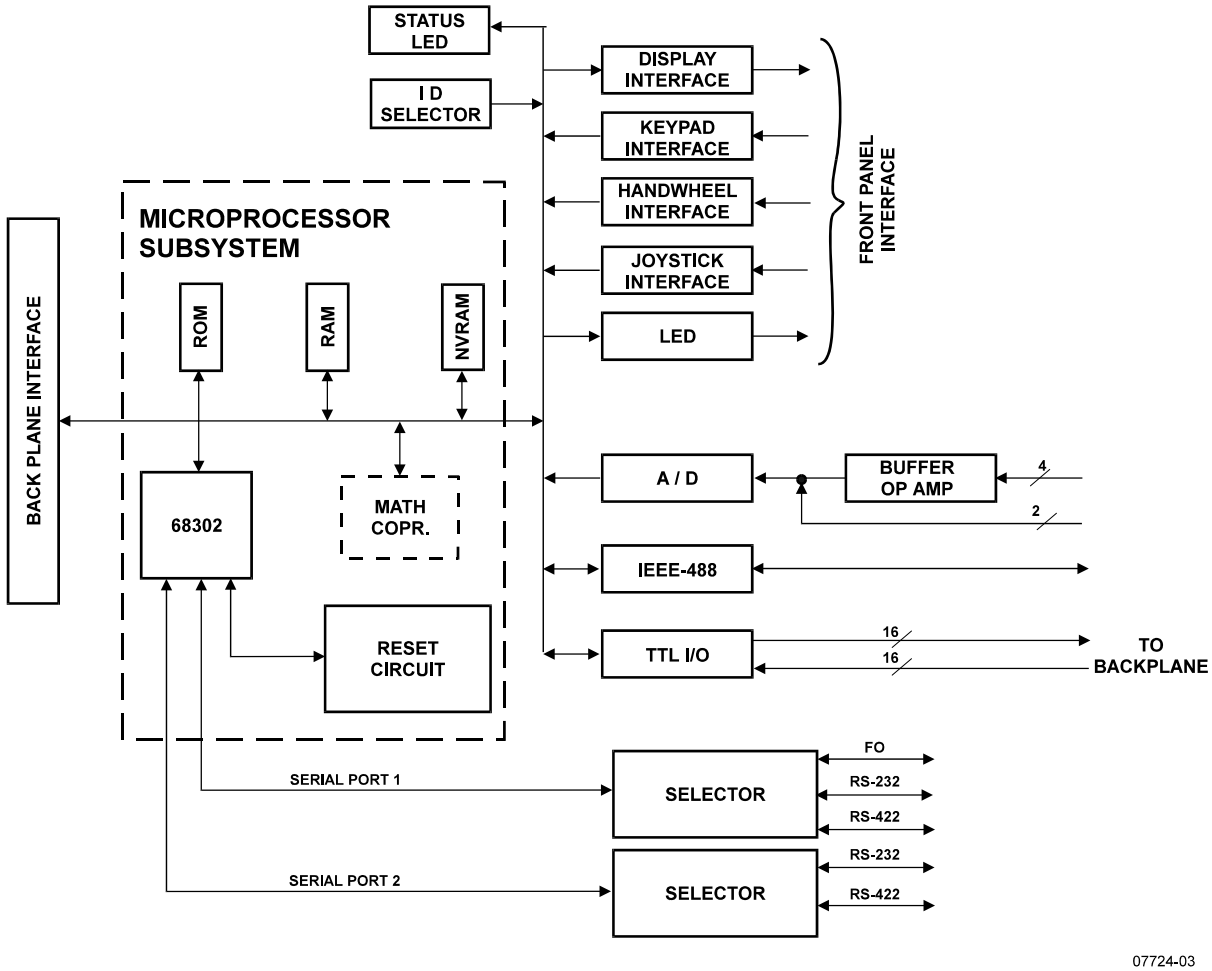


Figure 4.5. Operator/remote Interface Assembly Block Diagram

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The Operator/Remote Interface Assembly contains the microprocessor, up to 512 kbytes ROM, 64 kbytes RAM, and 64 kbytes NVRAM. A Motorola MC68881 mathematical coprocessor is optionally installed on the ORI board to process mathematical algorithms.

The assembly has 16 analog input channels. Each channel is served by a 12-bit analog-to-digital converter for data acquisition. The input stage of the analog-to-digital converter is configured to accept signals in the ±10V dc range.

The assembly has 16 TTL auxiliary inputs and 16 TTL outputs.

The assembly is equipped with three fast serial links for communication. Serial link one is dedicated to communication with the servo board; link two is dedicated to communication with the system controller. Media is selectable: fiber optics, twisted pair with multidrop capabilities (RS-422/485), RS-232, or IEEE-488. Host interface is 9600 baud: ORI to servo board is 100 kbaud.

The assembly's firmware provides the board with built-in testing. Startup self-test functions include RAM write/read test, NVRAM checksum, and DAC/ADC loopback test.

4.2.4 Autotrack Assembly (Optional)

The Autotrack Assembly option (Figure 4.6) is used in tracking applications to allow the system to follow a moving target based on error information derived from a tracking feed. The Autotrack Assembly is equipped with a Motorola 68302 microprocessor and provides scanning signals to the tracking feed for modulation of difference signal information (tracking video) onto the data signal. The assembly also demodulates the tracking video from the tracking receiver to generate axis position errors for use in positioning the pedestal and antenna. The demodulated errors from the Autotrack Assembly are sent to the servo board, via the backplane serial interface, every 20 milliseconds. The assembly has the capability of receiving inputs from up to seven receivers simultaneously.

The Autotrack Assembly contains the microprocessor, up to 512 kbytes ROM, 64 kbytes RAM, and 64 kbytes NVRAM.

The assembly has 16 analog input channels. Each channel is served by a 12-bit analog-to-digital converter for data acquisition. The input stage of the analog-to-digital converter is configured to accept signals in the ±10 V dc range.

The Autotrack Assembly has feed and scanner control with TTL differential drivers which are compatible with ViaSat Satellite Networks ESCAN and MONOSCAN tracking feeds.

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The assembly is equipped with a fast serial link for communication with the servo board. Serial port media is selectable: twisted pair with multidrop capabilities (RS-422/485) or RS-232. Baud rate of the serial link is fixed at 100 kbaud.

The assembly's firmware provides the board with built-in testing. Startup self-test functions include RAM write/read test, NVRAM checksum, and ADC loopback test

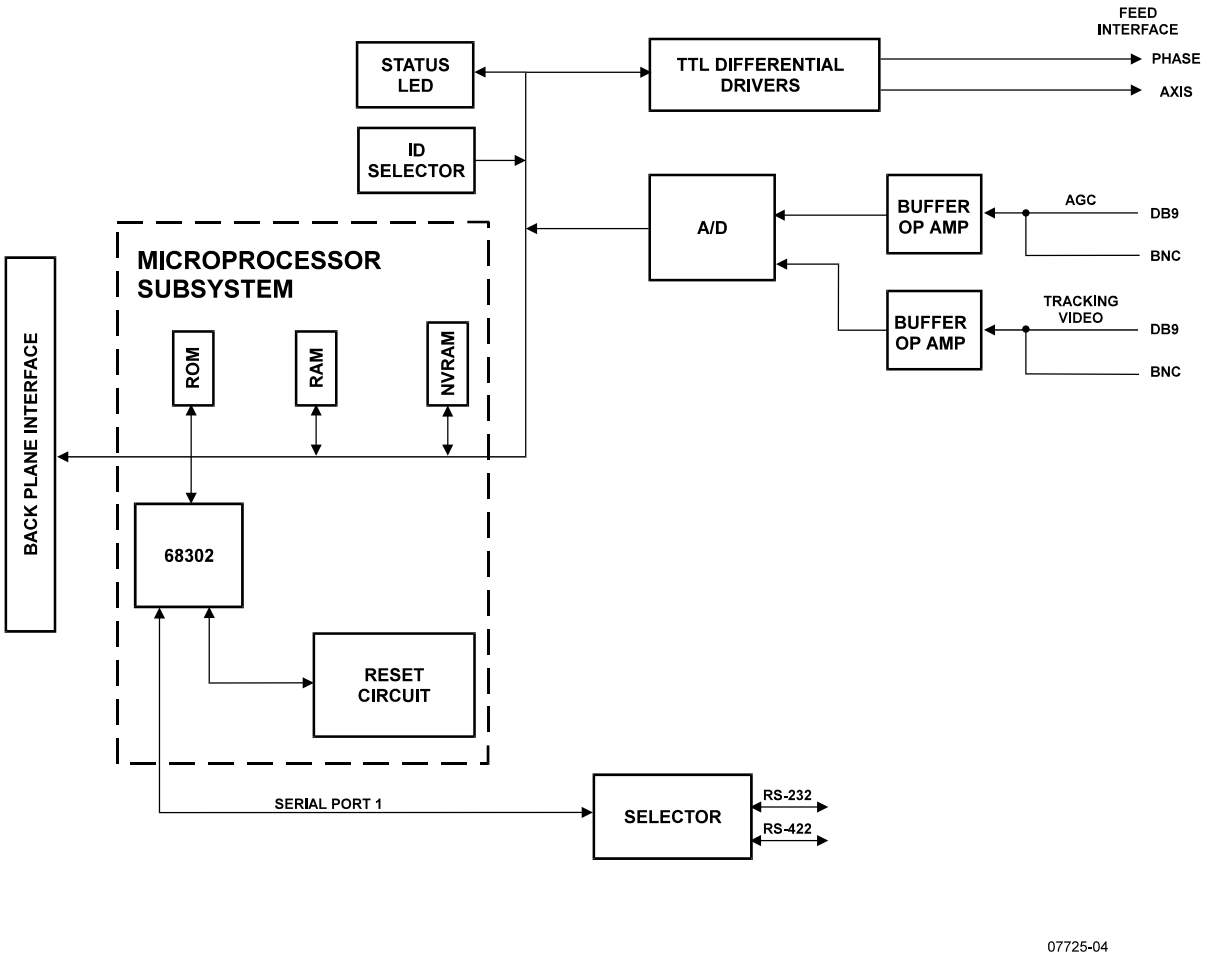


Figure 4.6. Autotrack Assembly Block Diagram

4.2.5 Resolver Reference Oscillator Assembly

The ac reference signal for the resolver(s) is generated in the controller by means of a 1 kHz or 2 kHz reference signal generator which is powered by an internal dc power supply. This reference signal is distributed to the resolvers in the pedestal and to the Synchro/Resolver Assembly to facilitate data conversion.

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4.2.6 Synchro Reference

The ac reference signal for the synchro(s) is generated in the 3860 by tapping off the switched ac input power. This reference signal is distributed to the synchros in the pedestal and to the Synchro/Resolver Assembly to facilitate data conversion.

4.2.7 Analog Rate Loop Assembly (Optional)

The 3860 ACU Analog Rate Loop Assembly operation is considered on two circuit levels in this section: the Loop Compensation circuit and the Differential Tach/Torque Bias circuit.

4.2.7.1 Loop Compensation

The Loop Compensation circuit receives analog input commands from the ACU Servo Assembly and tach feedback signals from the pedestal through differential amplifiers. The signals are compared resulting in a dc Rate Error signal. This signal is then compensated to generate an error signal proportional to the difference in command and tachometer voltage. This error signal is used as input command to the servo amplifier. In the case of dual drive axis, the error signal for each drive is combined with the differential tach loop signal and torque bias voltage to produce the dc input command used by each servo amplifier to drive its respective motor.

4.2.7.2 Differential Tach/torque Bias (dual Drive System)

A tachometer is rigidly attached to the shaft of each motor. Each tachometer produces a voltage proportional to the instantaneous velocity of the shaft. These voltages are amplified to generate synchronizing signals. One of the tachometer signals is applied directly to one amplifier, The second tachometer signal is inverted by a second amplifier being applied to a summing amplifier. Thus, the output of the summing amplifier is proportional to the difference been the two tachometer signals. If the two tachometers are rotating at the same speed, the two signals are equal and the output of the summing amplifier is zero. Under this condition, the synchronizing signals are also zero. If for any reason the tachometers are instantaneously rotating at different speeds, the output of the summing amplifier will not be zero since it is proportional to the difference between the two tachometer voltages. The output of the summing amplifier is coupled to the respective DC error signal. The phasing of these signals is such that the motor producing the higher velocity is driven toward a lower velocity, and the motor producing the lower velocity is driver toward a higher velocity. A balance adjustment is provided to compensate for the difference in tachometer voltage gradients. A gain adjustment is provided to adjust the gain of the synchronizing loop.

Bias voltages from potentiometers provide means for introducing a bias torque in the pedestal dual drive train to minimize backlash.

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4.2.8 Motherboard

The Motherboard provides the interface between the other component boards. The motherboard provides the communications and power buses for the component boards and connection to the front-panel assembly.

On one side, the motherboard has five card slots. All five card slots are connected by a serial bus. The following list defines the communication and power lines to each slot.

- Servo Board – address, data, and control buses, serial bus, power
- Synchro/Resolver Board – address, data, and control buses to servo board, power
- ORI Board – address, data, and control buses, serial bus, power
- Autotrack Board – serial bus, power
- Not Used

The five slots are divided into two sections of three and two slots each connected by the parallel bus. This division allows two servo boards to operate in one digital controller.

On the other side of the motherboard are connectors for power, external resolver reference, display power, ribbon cable connection to the front panel, and a spare I/O connection.

4.2.9 Front Panel

The front-panel controls provide the functions necessary to allow an operator to interface with the 3860 Digital Controller. The front panel contains a general-purpose keypad for input of data and control over axis/mode-independent functions. Also, a set of push buttons are used as softkeys for menu selection using the graphics display for actuation of various system functions. Two front-panel handwheels are used as position input devices. The joystick can be used for manual rate control of the pedestal. Indications of power on, travel limit/interlock condition, and alarm are provided by LEDs on the front panel.

4.2.10 Front-panel Board Assembly

The Front-panel Board Assembly is the interface between the front-panel components and the Operator/Remote Interface Assembly. The front-panel board contains no active components.

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Chapter 5

Maintenance

5.1 Introduction

This chapter describes maintenance of the Series 3860 Digital Controller. Procedures are included for preventive maintenance and for troubleshooting.

5.2 Preventive Maintenance

5.2.1 Visual Inspection

Periodically inspect the controller as follows:

WARNING

High voltages are used in the operation of this equipment. Always remove power before opening the unit or replacing the fuse. Failure to observe this warning may result in serious injury or death.

a) Pull unit out of equipment rack on chassis slides.

b) Remove cover from unit.

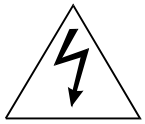
c) Inspect all wiring and cabling for damage or loose connections.

d) Check all components for evidence of overheating, breakage, vibration damage, corrosion, or loose or corroded connections. Any damage found during inspection should be corrected immediately.

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5.2.2 Cleaning

Clean the digital controller as follows:



WARNING

- Remove ac power from unit before cleaning. Failure to observe this warning may result in physical injury or death.
- Wear eye protective glasses or goggles before cleaning unit with compressed air. Failure to observe this warning may result in physical injury or blindness.

a) Use a vacuum cleaner with a soft bristle brush attachment. Remove foreign matter from the chassis and the front panel.

b) Remove dust from internal recesses and printed-wiring boards with a hand-controlled dry air jet, not more than 15 psi.

5.3 Test Equipment

The test equipment recommended for digital controller maintenance is listed in Table 5.1. Instruments other than those listed may be used if their performance equals or exceeds that of the recommended instruments.

Table 5.1. Test Equipment

Description	Manufacturer	Model No.
Digital Multimeter	HP	HP E2378A
Clamp-on Current Probe for Multimeter	HP	HP 34302A
Oscilloscope - General Purpose, 4 Channel, Storage, 150 MHz Bandwidth	HP	HP 54602A
Counter	HP	5381

5.4 Troubleshooting

These procedures aid in troubleshooting equipment faults. The minimal number of active components in the digital controller signal paths provide a highly reliable design. Periodic preventive maintenance reduces the possibility of failure. If, however, the digital controller should fail, follow these general procedures.

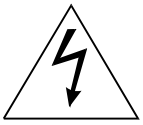
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The following checkout procedure checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first steps assure proper connection, operation, and calibration. If these checks do not locate the trouble, the remaining steps help to locate any defective circuits or components. When a faulty component is located, it should be replaced.

a) Check all control settings. Incorrect control settings may falsely indicate trouble. Refer to Chapter 3 for the correct function or operation of any control.

b) Visually check the unit. Indications such as broken wires, damaged circuit boards, damaged components, etc can quickly identify many problems.

c) Check associated equipment before proceeding with troubleshooting. Verify that associated equipment is operating correctly, signals are properly routed, and interconnecting cables are not defective.



WARNING

Always remove power before opening the unit or replacing the fuse. Failure to observe this warning may result in serious injury or death.

d) Check ac power source. If fuse must be replaced, remove power cord, slide open fuse cap, and replace fuse with the same type. After replacing fuse cap, replace power cord. Turn power ON.

e) When isolating a fault, remember the following troubleshooting tips:

1) When the operator remote interface (ORI) PWB is running properly, the row of LEDs (D10 - D12) will flash at about 2 Hertz. If the unit is powered on and the LEDs are not flashing, the ORI board is in need of replacement.

2) Eight LEDs (CR5 - CR12) on the servo board indicate various internal functions:

(a) CR10 and CR12 indicate proper operation of the servo firmware by running as a 2-bit counter.

(b) CR5 and CR7 indicate serial interface activity with the ORI PWB. CR5 is toggled on every received command from the ORI. CR7 is toggled after the reply to the ORI is sent.

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(c) CR6 and CR9 indicate serial interface activity with an Autotrack PWB (if one is present in the unit). CR9 is toggled on every transmission to the Autotrack PWB, CR6 is toggled when a reply is received. Thus, if the unit does not contain an Autotrack PWB, only CR9 will flash, indicating repeated attempts to send data with no reply.

(d) CR8 lights to indicate that a maintenance computer has been connected to the servo PWB for local control operation.

f) Refer to Table 5.2 to help isolate the fault to a particular module. Often the controller can be quickly repaired by replacing a module. Refer to the schematic diagrams in Chapter 7 as necessary.

g) After replacing the faulty module, retest the controller.

Table 5.2. Troubleshooting

Symptom	Things to Check
Nothing happens when power switch turned ON	Verify power supply voltages and check fuses.
Front-panel screen has rolling horizontal lines	Verify ORI PWB is running by checking LEDs on the PWB. If LEDs are not flashing, replace board. If LEDs are functioning, check cable and connections between 3860 backplane and front-panel PWB. Replace front-panel PWB.
Display is dark; difficult to read	Verify that back light wires from front panel PWB are connected to the high voltage driver board mounted to the back of the front-panel PWB. Replace defective high voltage driver PWB.
Message at bottom of screen reads "Trnsmt Error: Serial Prt 1"	This message indicates a break in the communications channel between the ORI PWB and the servo PWB in the 3860. Check the connection between these PWBs first. Depending on the system configuration, this may be a serial cable link, a pair of fiber- optic cables, or traces on the indoor unit backplane. Also, ensure that both selected axes are axes that exist in the system. For example, axes A-D are assigned to the first servo PWB. Axes E-H are assigned to a second servo PWB. In systems with only one servo PWB, if one of axes E-H is selected, a transmit error is generated. Verify servo board is running by checking LEDs CR10 and CR12 on the board. If LEDs are not flashing, replace board. The host computer may have made an attempt to send or receive data to or from a nonexistent axis. Check the latest communications packet from the host. If this was the cause of the message, the error message may be cleared by pressing the ESC key on the front panel.

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Table 5.2. Troubleshooting

Symptom	Things to Check
Cannot change axis modes	System is in Local mode of operation; check the front-panel display for "LCL" indication.
Angle display readouts always read "000.000"	Check the resolver/synchro cable connected to the resolver/digital board. Repair or replace resolver/digital board. Repair or replace resolver reference board if present. (Not needed for synchro systems.)
Axis does not move when in position or rate modes and command does not equal current position	Check the brake release switch for that axis. When the switch is ON, the power amplifier enable signal is disabled by the controller. Check all pedestal or positioner components including power amplifiers, motors, brakes, range cables, etc. Repair or replace servo board.
Axis does not follow commands or oscillates when commanded to a new position	Check with ViaSat Satellite Networks for possible compensation parameter changes. Ensure test input on softkey menu is disabled.
Cannot communicate with the ORI using the host RS-232 interface	Check all cables between the host and the ORI. Ensure internal jumpers are set correctly. Repair or replace ORI board.
Cannot communicate with the ORI using the host IEEE-488 interface	Check all cables between the host and the ORI. Ensure internal jumpers are set correctly. Replace ORI board.
Message at bottom of screen reads "Error has occurred: xxxx", where xxxx is a 4-character hex value	Report error to ViaSat Satellite Networks.
Travel bars on front-panel display do not work	Check the position limit parameters; MENUS/SETUP/LIMITS/TRAVL(+ or -).
Axis operates properly in Position mode but does not move or moves slowly in Rate mode	Check the rate limit parameter (MENUS/SETUP/LIMITES/RATE). Check connections to the front-panel joystick. Replace the front-panel joystick.
Unit reports that Autotrack board is not present in an Autotrack system, there is no signal strength or error indication on the front panel, or the system performs properly in all modes except Autotrack mode.	Replace Autotrack board.

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Table 5.2. Troubleshooting

Symptom	Things to Check
When in Position mode, turning the front-panel knob does not change the CMD angle.	Check front-panel handwheel cable connection. Replace the front-panel handwheel.
System will not track a Wideband signal.	1. Manually point the antenna at the boresight. Perform a wideband loop back test. If test fails, perform a narrowband loop back test. If narrowband test passes, the wideband tracking channel is suspect. 2. Connect a spectrum analyzer to the output of the IF Distribution Unit wideband tracking channel. Perform a wideband loop back test. The analyzer should see a 375 MHz signal at >-50 dB. If it does, the wideband tracking channel is OK up to the output of the IF Distribution Unit. 3. If signal is not present, move the spectrum analyzer up to the output of each device in the chain. Look for 375 MHz at the output. If signal appears, the previous device checked was defective. 4. If signal was present at the output of the IF Distribution Unit, remove the controller top cover as described in paragraph 5.6.2. Verify 924-9 AM Demod operation as described in paragraph 5.5. If test fails, replace the AM Demod.

5.5 Alignment

All internal alignment adjustments for 3860 Digital Controller have been made at the factory. No routine adjustment or alignment of internal controls is recommended.

5.6 Repair

Repair of the the 3860 Digital Controller consists of replacing defective modules or printed wiring board assemblies identified during the performance of troubleshooting procedures in Table 5.2. The following paragraphs contain the procedures for removing and replacing field-replaceable components.

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5.6.1 Prerequisites To Removal And Installation



CAUTION

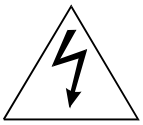
Failure to remove power from the digital controller prior to replacing components may result in equipment damage.

a) Set front-panel POWER switch OFF.

b) Disconnect power cable from rear-panel connector.

5.6.2 Internal Component Access

Perform the following procedures to gain access to the interior of the digital controller for assembly replacement. Refer to the engineering drawings in Chapter 7 for component locations.



WARNING

High voltages are used in the operation of this equipment. Prior to working on the equipment ensure that all electrical power is off. Failure to observe this warning may result in serious injury or death.

a) Disconnect power as described in paragraph 5.6.1.

b) If digital controller is mounted in equipment rack, perform the following:

1. Remove four screws securing digital controller to equipment rack.
2. Pull digital controller handles until mounting slides are fully extended and mechanical stops are reached.

c) Remove three screws securing cover to chassis.

d) Slide cover towards rear of unit until it clears mounting slots.

5.6.3 Servo, Synchro/resolver, ORI, Or Autotrack Board Removal



CAUTION

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Failure to remove power from the digital controller prior to replacing components could result in equipment damage.

NOTE

It is not necessary to remove the chassis cover to remove the printed wiring boards.

a) Identify board by connector number on rear panel.

b) Disconnect connectors from rear panel of board to be replaced.

c) Loosen two captive screws securing board to card cage.

d) Carefully pull board by extractor handles to remove board from card cage guide rails.

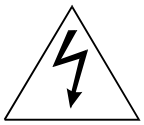
5.6.4 Servo, Synchro/resolver, ORI, Or Autotrack Board Installation

a) Note proper location of each board in the card cage. Holding board by extractor handles, insert board into slots in the card cage guide rails. Carefully push the extractor handles until board connector is seated in backplane connector.

b) Tighten two captive screws to secure board to card cage.

c) Attach appropriate connectors to rear panel of board.

5.6.5 Resolver Reference Board Removal



WARNING

High voltages are used in the operation of this equipment. Prior to working on the equipment ensure that all electrical power is off. Failure to observe this warning may result in serious injury or death.

a) Remove cover from chassis (refer to paragraph 5.6.2).

b) Remove wire harness connectors (qty 2) from board edge connectors.

c) From underneath chassis, remove four screws and lockwashers securing board to bottom panel.

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5.6.6 Resolver Reference Board Installation

a) Position board heatsink over four mounting holes on chassis bottom panel.

b) From underneath chassis, attach board to panel with four screws and lockwashers.

c) Reconnect wire harness connectors (qty 2) to board edge connectors.

d) Replace cover on chassis and secure with three screws.

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5.6.7 Power Supply Removal



WARNING

High voltages are used in the operation of this equipment. Prior to working on the equipment ensure that all electrical power is off. Failure to observe this warning may result in serious injury or death to personnel.

a) Remove cover from chassis (refer to paragraph 5.6.2).

b) Remove wire harness connectors from power supply connectors.

c) From underneath chassis, remove four screws and lockwashers securing power supply to bottom panel.

d) Remove four screws, spacers, lockwashers and nuts securing power supply cover to power supply. Retain cover for replacement.

5.6.8 Power Supply Installation

a) Position power supply cover on power supply and attach with four screws, spacers, lockwashers, and nuts.

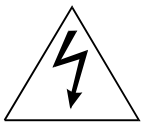
b) Position power supply over four mounting holes on chassis bottom panel.

c) From underneath chassis, attach power supply to bottom panel with four screws and lockwashers.

d) Attach wire harness connectors to power supply connectors.

e) Replace cover on chassis and secure with three screws.

5.6.9 Power Inverter Removal



WARNING

High voltages are used in the operation of this equipment. Prior to working on the equipment ensure that all electrical power is off. Failure to observe this warning may result in serious injury or death to personnel.

a) Remove cover from chassis (refer to paragraph 5.6.2).

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b) Remove two screws and lockwashers securing inverter cover to spacers. Retain cover for replacement.

c) Disconnect front-panel wire harness connector from inverter connector.

d) Carefully pull inverter away from front-panel board until inverter connector disengages socket J6 on front-panel board.

5.6.10 Power Inverter Installation

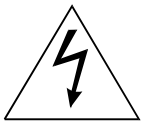
a) Carefully position power inverter on front-panel board so that inverter connector seats in front-panel board socket J6.

b) Connect front-panel wire harness connector to inverter connector.

c) Secure cover to spacers with two screws and lockwashers.

d) Replace cover on chassis and secure with three screws.

5.6.11 Optical Encoder Removal



WARNING

High voltages are used in the operation of this equipment. Prior to working on the equipment ensure that all electrical power is off. Failure to observe this warning may result in serious injury or death to personnel.

NOTE

This removal procedure requires a support surface to be placed in front of the digital controller chassis.

a) Remove cover from chassis (refer to paragraph 5.6.2).

b) Remove set screw securing encoder knob to shaft. Retain knob and set screw for replacement.

c) Remove nut and lockwasher from encoder shaft.

d) Remove two screws and upper chassis bezel from chassis.

e) Carefully lift front-panel assembly up and away from controller chassis and place face down on support surface.

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f) Remove applicable encoder connector from front-panel board connector J2 or J3.

g) Remove six screws, lockwashers, and spacers securing front-panel board to front panel.

h) Remove board from front-panel and place on support surface. Do not place tension on wire harnesses or ribbon cable connected to front-panel board.

i) Remove optical encoder from rear of front panel.

5.6.12 Optical Encoder Installation

a) Remove nut and lockwasher supplied with encoder from encoder shaft.

b) Center encoder shaft in hole in front panel and secure to front panel with nut and lockwasher.

c) Position front-panel board on front panel and attach with six screws, lockwashers, and spacers.

d) Connect encoder connector to applicable front-panel board connector J2 or J3.

e) Carefully lift front-panel assembly and position on chassis.

f) Secure upper chassis bezel to chassis with two screws.

g) Position encoder knob on shaft and secure with set screw.

h) Replace cover on chassis and secure with three screws.

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5.6.13 Fan Assembly Removal



WARNING

High voltages are used in the operation of this equipment. Prior to working on the equipment ensure that all electrical power is off. Failure to observe this warning may result in serious injury or death to personnel.

NOTE

This removal procedure will require a support surface to be placed in front of the digital controller chassis.

a) Remove cover from chassis (refer to paragraph 5.6.2).

b) Refer to drawing 578460 (Indoor Enclosure Assembly) and drawing 528771 (Fan Assembly) for removal and installation procedures.

c) Disconnect fan assembly power cable.

d) Remove four screws, four nuts and eight washers that secure the fan assembly to the enclosure rear panel.

e) Remove fan assembly.

5.6.14 Fan Assembly Installation

a) Install fan assembly into the enclosure rear panel. Align the mounting holes.

b) Install four screws, four nuts, and eight washers to secure the fan assembly to the enclosure rear panel.

c) Connect fan assembly power cable.

d) Replace cover on chassis and secure with three screws.

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Chapter 6

Parts List

6.1 Introduction

This chapter provides parts lists which support the assembly drawings located in Chapter 7 of this manual.

6.2 Parts List and Assembly Drawings

The parts lists in this chapter describe the parts referenced or illustrated by the assembly drawings. Use the information to identify and requisition parts, and as an aid in disassembly/assembly procedures. Parts lists in this chapter are arranged in numerical order by assembly number. When a drawing has a parts list on the drawing, the parts list may not be repeated in this chapter.

6.2.1 Explanation of Title Block on Parts Listing

Each parts list starts at the top of the page with a title block. The title block contains the assembly number, assembly title and the revision level of the assembly at the time this manual was published. Whenever a parts list is longer than one page the title block is repeated on the following page(s) until the list is complete.

6.2.2 Explanation of Parts Lists Column Headings

The parts list is separated into main groups or assemblies and keyed to associated assembly drawing(s) by item or find number and/or reference designation.

Level Multiple level bills of material include parts from subassemblies. Level 1 indicates the parts structured to the part number while level 2 and below indicate parts from subordinate assemblies.

Ref This column contains the component Reference Designation used to identify the component on assembly drawings or as marked on the chassis or printed wiring boards.

Qty This column contains the number of units of this part in the group or assembly.

UOM This column indicates the Unit Of Measure of the line item.

Item This column contains the ViaSat part number.

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Revision This column indicates the revision level if the line item.

Description This column contains a brief description of the part.

6.3 Ordering Parts

When ordering parts from ViaSat, always include the ViaSat part number, the part description, the unit name and unit serial number.

6.4 Parts List Index

Part Number	Description	Page
1004886	ANTENNA CONTROL UNIT, AUTOTRACK (P/L ONLY)	6-3
720142-001	CHASSIS ASSY 3860 ANTENNA CONTRL UNIT PL	6-4

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Item: 1004886 ANTENNA CONTROL UNIT, AUTOTRACK (P/L ONLYRevision: 002

Level	Ref	Qty	UOM	Item	Rev	Description
1		1	EAC	720176	B	3860 ANTENNA CONTROL UNIT (SEE DASH#)
1		1	EAC	720202	A	ACU PRODUCTION TEST PROCEDURE (PLACEHOLD
1		1	EAC	720201	0	ANTENNA CONTROL UNIT CONFIGURATION LIST
1		1	EAC	720206	0	ANTENNA CONTROL UNIT FAMILY TR
1		1	EAC	720545	A	DEMOD KIT INSTALLATION INSTRUCTIONS
1	001	1	EAC	720142-001	C	CHASSIS ASSY 3860 ANTENNA CONT UNIT PL
1	026	1	EAC	532148	C	LABEL- ASSY/SERIAL NUMBER
1	078	7	EAC	529974	00	CAP STATIC & CONDUCTIVE PROT D 9 MALE
1	079	1	EAC	529977	00	CAP STATIC & CONDUCTIVE PROTECTION DB-25
1	081	2	EAC	535591	00	CAP CAPLUG SLEEVE CAP-3/8 DIA BLK PLASTI
1	082	1	EAC	536056	00	CAP STATIC CONDUCTIVE PROTECTI GPIB FE
1	085	0	EAC	720199	0	LABEL- UL LISTED, TBD (PLACEHOLDER)
1	086	1	EAC	536198	00	LABEL 1.875 X .25 WHT UL/CSA
1	087	0	EAC	720200	0	ACU FIRMWARE LABEL (PLACEHOLDE
1	099	1	EAC	532061	C	ACCESSORY KIT ACU
1	A001	1	EAC	720375-001	D	ASSY, PWB, ESD- ORI (P/L ONLY)
1	A002	1	EAC	720377-001	E	ASSY, PWB, ESD- AUTOTRACK (P/L ONLY)
1	A003	1	EAC	720380-001	E	ASSY, PWB, ESD- SERVO (P/L ONL
1	A004	1	EAC	720382-001	B	PWB ASSY, ESD- SYNCHRO/RESOLVE (P/L)
1	A005	1	EAC	1004878	001	ALTERED ITEM ASSEMBLY, ANALOG RATE LOOP PWB
1	A012	0	EAC	720385-001	A	WB AM DEMOD KIT 375 MHZ (P/L ONLY)

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Item: 720142-001 CHASSIS ASSY 3860 ANTENNA CONTRL UNIT PL Revision: C

Level	Ref	Qty	UOM	Item	Rev	Description
1		1	EAC	720371	A	ACU INTERCONNECT DIAGRAM
1		1	EAC	720142	B	CHASSIS ASSY 3860 ACU (SEE DAS #)
1		1	EAC	720209	A	ACU CHASSIS FAMILY TREE
1	001	1	EAC	221154	0	COVER 17 IN CASE
1	002	2	EAC	525249	C	COVER SIDE VENTILATED -5.25 CHASSIS
1	003	2	EAC	308629	B	BRACKET,CORNER IF PROCESSOR
1	004	2	EAC	312104	B	BRACKET,CORNER REAR 5 1/4 PANE
1	005	2	EAC	89699	96	BRACKET, RACK MOUNTING
1	006	1	EAC	578497	A	PANEL BOTTOM ANTENNA CONTROL UNIT
1	008	1	EAC	578498	B	PANEL REAR ACU
1	009	1	EAC	525248	A	COVER SIDE - 5.25 CHASSIS
1	010	2	EAC	220573	B	BEZEL,17 IN. WIDE CHASSIS
1	011	1	EAC	318101	0	CUSHION, FRT PNL MTG 16" MDL 1885
1	013	2	EAC	495096	A	COVER CAGE ASSY
1	018	1	EAC	255140	97	SCREEN FILTER
1	020	2	EAC	487113	B	SIDE FRAME,MODIFICATION
1	021	4	EAC	158086	D	FILLER,HANDLE MODEL 4647
1	023	1	EAC	530564	B	BRACKET POWER SUPPLY ACU
1	024	1	EAC	530570	B	BRACKET REF OSCILLATOR
1	027	1	EAC	535616	00	LABEL HIGH VOLTAGE INTL VINYL 1.5 X 1.5"
1	028	0	EAC	532146	B	LABEL FUSE/INPUT POWER
1	029	2	EAC	535615	00	LABEL PROTECTIVE EARTH GND INT POLYESTR
1	030	1	EAC	535617	00	LABEL CAUTION INTL SYM VINYL 1 X 1.5"
1	039	#	EAC	72358	96	SCREW 6-32 X 3/8 F HD,82 DEG,S
1	040	#	EAC	72358	96	SCREW 6-32 X 3/8 F HD,82 DEG,S
1	042	4	EAC	72329	96	SCREW 4-40 X 7/16 PAN HD,SST
1	044	4	EAC	72367	96	SCREW 6-32 X 1/2 PAN HD,SST
1	046	7	EAC	72865	96	SPACER NO.6 ID 7/32 OD 1/4 L PLT BRS
1	047	6	EAC	174554	A	WASHER NO. 4 LOCK, SPLIT, SST
1	048	9	EAC	73268	96	WASHER NO. 6 LOCK, SPLIT, ZINC PLT STL
1	049	7	EAC	71498	96	NUT 6-32 UNC-2B,SM PATT 1/4 HEX,SST
1	050	12	EAC	72363	96	SCREW 6-32 X 3/8 PAN HD,SST
1	051	8	EAC	76208	0	SCREW 6-32 X 7/16 PAN HD,SST
1	052	#	EAC	73270	96	WASHER-NO. 6- .156 .312 .035 AUS SST

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Item: 720142-001 CHASSIS ASSY 3860 ANTENNA CONTRL UNIT PL Revision: C

Level	Ref	Qty	UOM	Item	Rev	Description
1	053	5	EAC	71503	96	NUT 10-32 UNF-2B,PLAIN-HEX,SST
1	054	4	EAC	71494	96	NUT 4-40 UNC-2B,PLAIN-HEX,SST
1	055	15	EAC	75943	97	WASHER NO. 10 LOCK,INT TOOTH CAD PLATE
1	056	1	EAC	72382	96	SCREW 6-32 X 1.0 PAN HD,SST
1	060	4	EAC	75803	0	SCREW 10-32 X 3/8 F HD,82 DEG SST
1	065	6	EAC	72381	A	SCREW 6-32 X 7/8 PAN HD,SST
1	066	#	EAC	73270	96	WASHER-NO. 6- .156 .312 .035 AUS SST
1	067	3	EAC	72319	A	SCREW 4-40 X 5/16 PAN HD,SST
1	068	8	EAC	72401	0	SCREW 8-32 X 1/2 PAN HD,SST
1	069	8	EAC	73272	96	WASHER-NO. 8- .188 .375 .049 AUS SST
1	070	8	EAC	174556	96	WASHER NO. 8 LOCK, SPLIT, SST
1	075	4	EAC	529814	00	CABLE MOUNT FLT CBL ADHESIVE BACK GRAY P
1	076	10	EAC	87296	A	MOUNT,CABLE TIE,.75 SQ,4 WAY,ADHESIVE BACKED,WHT
1	077	10	EAC	449726	00	CABLE TIE 3.9 X .1 INCH LOCKIN UL94V-0
1	083	.1	LFT	77938	96	TUBING HEAT SHRINK .375ID SHRINKS TO.187
1	086	1	EAC	536198	00	LABEL 1.875 X .25 WHT UL/CSA
1	088	1	EAC	719230	0	LABEL EQUIPOTENTIALITY IEC 417 5021-A
1	A006	1	EAC	532082-001	C	ASSY,PWB,ESD- RESOLVER REF OSC (P/L ONLY
1	A007	1	EAC	530575-001	B	PWB ASSY, ESD MOTHERBOARD 3860 (P/L ONLY
1	A008	1	EAC	499217	00	ENCLOSURE CARD CAGE 5X EUROCAR "A" HORI
1	A010	1	EAC	493720	D	FAN ASSY W/PANEL AND FINGER GUARD
1	A011	1	EAC	720373	A	FRONT PANEL ASSEMBLY 3860 ACU
1	F001	2	EAC	535387	00	FUSE 5A 250V 5 X 20MM FAST CLE APPRVD
1	PS001	1	EAC	497305	00	PWR SUPPLY 15V,5V,24V,+OR - 15VDC OUT 85
1	W001	1	EAC	720372	A	HARNESS ASSEMBLY POWER INDOOR ENCLOSURE
1	W002	1	EAC	720082	A	POWER HARNESS ASSY LOW VOLT W/ DEMOD
1	W003	1	EAC	532088	B	CABLE ASSY 3860 RESOLVER REF
1	W004	1	EAC	495485	C	CABLE ASSEMBLY FRONT PANEL

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Item: 720142-001 CHASSIS ASSY 3860 ANTENNA CONTRL UNIT PL Revision: C

Level	Ref	Qty	UOM	Item	Rev	Description
						RIBBON

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Chapter 7

Drawings

7.1 Introduction

This chapter provides assembly drawings and schematic diagrams. Drawings are presented in hierarchical order with the highest order drawings shown first.

7.2 Drawing Index

A drawing index is provided in Table 7.1. The drawing number, revision, drawing title and page location of each drawing is included in the table. A dash in the revision column indicates the original release of the drawing.

Table 7.1. Drawing Index

Drawing	Rev.	Title	Page
720176	A	Antenna Control Unit Assembly	7-3
720371	A	ACU Interconnect Diagram	7-7

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Blank

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APPLICATION		
QTY REQD	NEXT ASSY	USED ON

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE PER ECN SN61228		

NOTES:

1. UNIT SHALL BE TESTED IAW ANTENNA CONTROL UNIT PRODUCTION TEST PROCEDURE, S-A SPECIFICATION 720202.

2. SEE DESCRIPTION AND DASH NUMBER FOR CORRECT DASH NUMBER CONFIGURATION.

3. ADD THE FOLLOWING TO ITEM 26 TO COMPLETE THE LABEL:
   - IN THE DESCRIPTION BLOCK, INSERT "ANTENNA CONTROL UNIT"
   - IN THE PART NUMBER BLOCK, INSERT "720176-XXX" WHERE "XXX" IS THE APPLICABLE DASH NUMBER.
   - IN THE SERIAL NUMBER BLOCK, INSERT THE APPROPRIATE SERIAL NUMBER.

4. INSTALL CONDUCTIVE CONNECTOR COVERS IAW TABLE BELOW:

ITEM	P/N	CONNECTOR
78	529973	A1 J302 - J304 A2 J402, J403, J407 A3 J103
79	529977	A4 J203
81	535591	A2 J404, J405
82	536056	A1 J301

5. CONFIGURATION LIST IS GIVEN IN 720201.

6. MARK LATEST BOM REV LEVEL IN .125 MIN HIGH CHARACTERS WITH PERMANENT INK STAMP OR LABEL USING ITEM 86 OR EQUIVALENT.

7. MARK THE LATEST FIRMWARE REVISIONS TO COMPLETE ITEM 87 LABEL REFER TO 720201 FOR LATEST REVISIONS. PLACE LABEL APPROXIMATELY WHERE SHOWN SO THAT TEXT IS LEGIBLE FROM THE BACK OF THE UNIT.

8. SEE INSTALLATION INSTRUCTIONS 720545.

SEE SEPARATE PARTS LIST

ITEM OR FIND NO.	QTY REQD	S - A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	CAGE CODE

PARTS LIST

A	A	A	A	REV
4	3	2	1	SHEET

REV STATUS OF SHEETS

CAD GENERATED ORIGINAL

INTERPRET PER ANSI Y14.5

ALL DIMENSIONS IN INCHES
UNLESS OTHERWISE SPECIFIED
TOLERANCES
3 PLACE DECIMAL ± .005
2 PLACE DECIMAL ± .02
1 PLACE DECIMAL ± .1
FRACTION ± ANGLES ± 0.5°

MAX SURFACE ROUGHNESS 125 ALL MACHINE SURFACES EXCEPT AS NOTED
BREAK SHARP EDGES AND CORNERS .010 MAX

FINISH NONE

CONTRACT NO.

DWN	WINKLER	5-18-99
ENGR	Wm. J Minschwaner	5-26-99
CHK		
PROD		
APVD		
APVD		

ViaSat
4311 Communications Dr.
Norcross, GA 30093

ANTENNA CONTROL UNIT ASSEMBLY

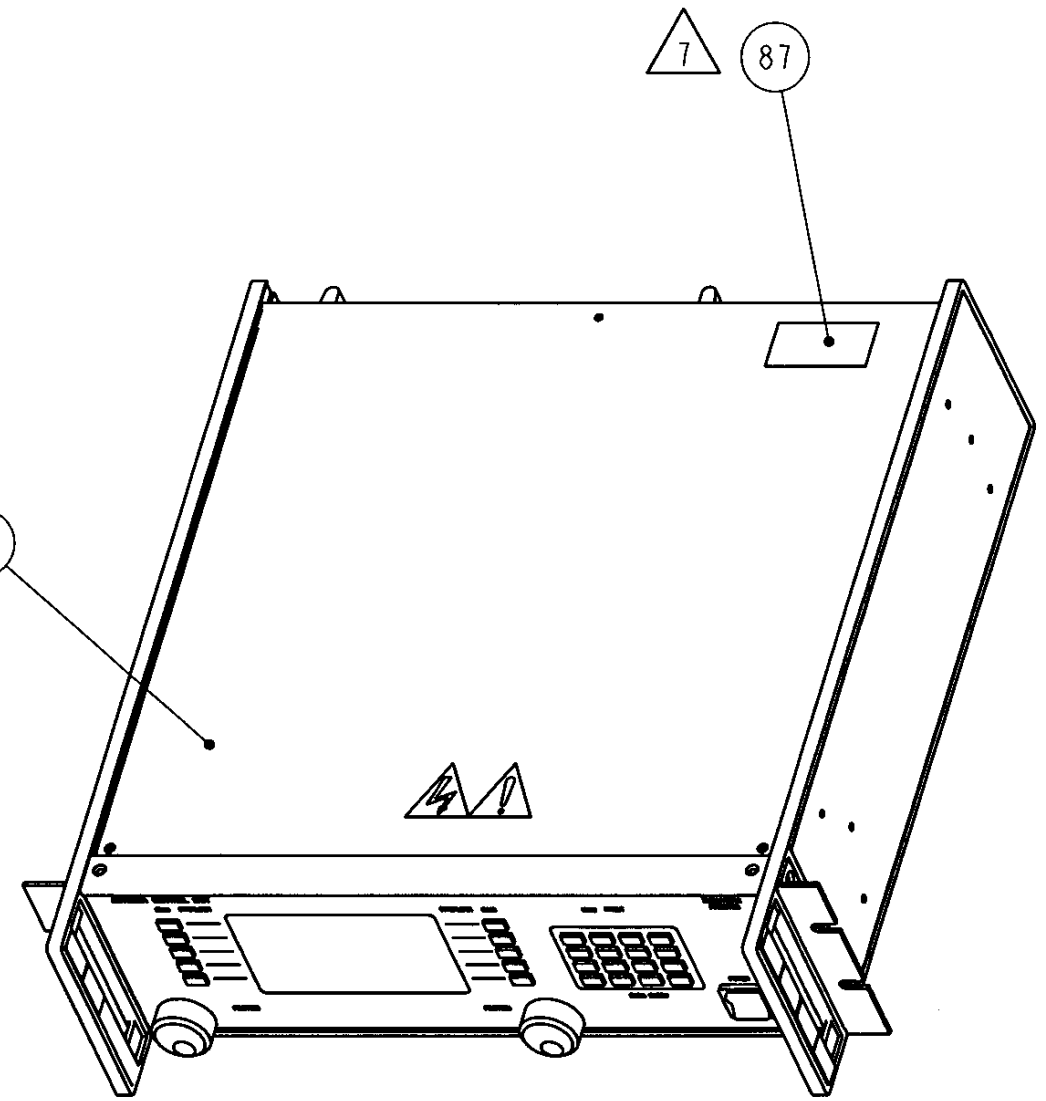
SIZE	CAGE CODE	DWG NO.	REV
B		720176 △2	A
SCALE NONE	WT 1b	SHEET 1 OF 4	

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DWG. NO.	720176	SH 2	REV A

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	SEE SHEET ONE		



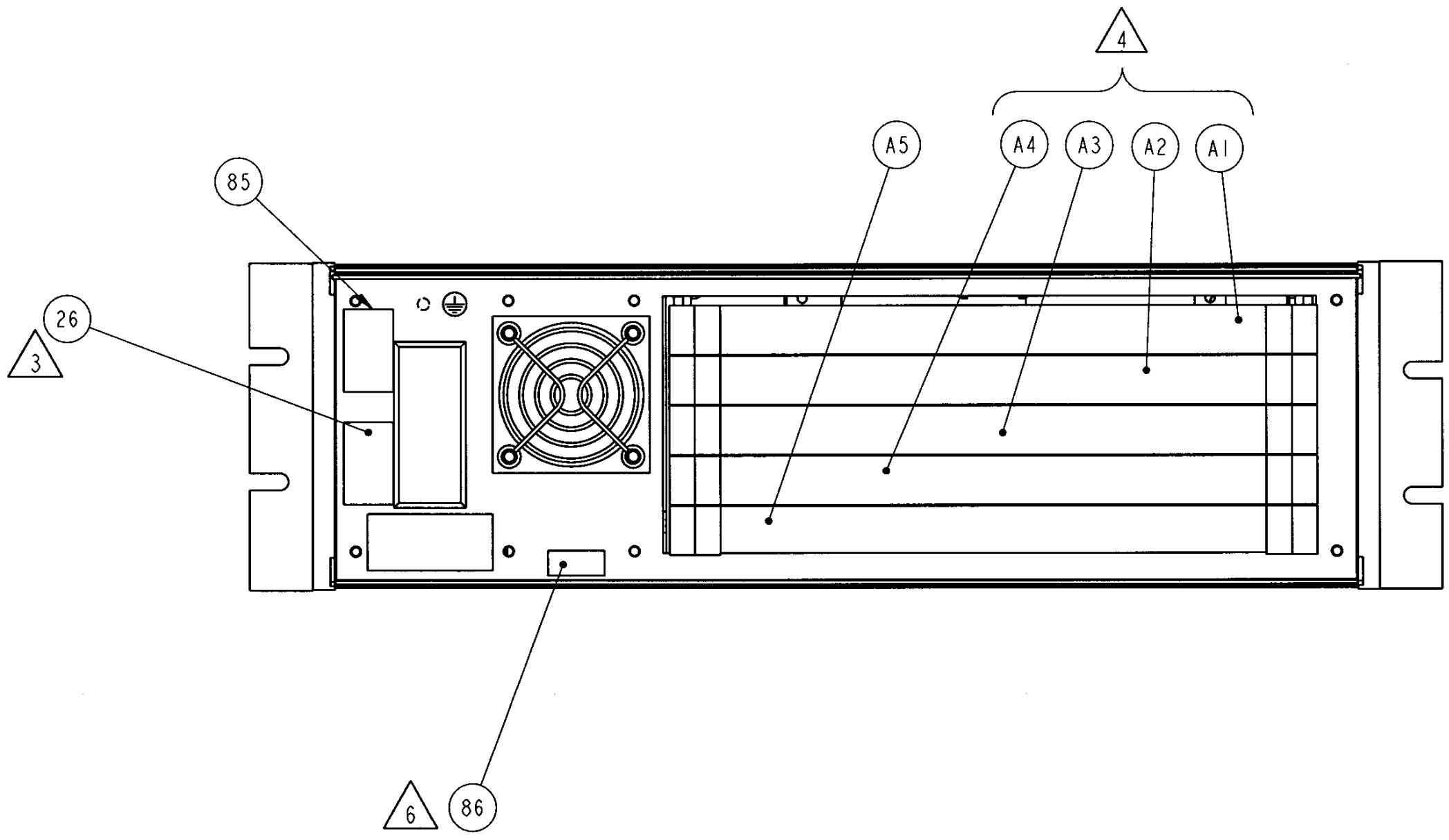
ViaSat	4311 Communications Dr. Norcross, GA 30093			
SIZE B	CAGE CODE	DWG NO. 720176		REV A
SCALE 1.000	CAD GENERATED ORIGINAL	SHEET 2 OF 4		

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DWG. NO.	720176	SH 3	REV A

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	SEE SHEET ONE		



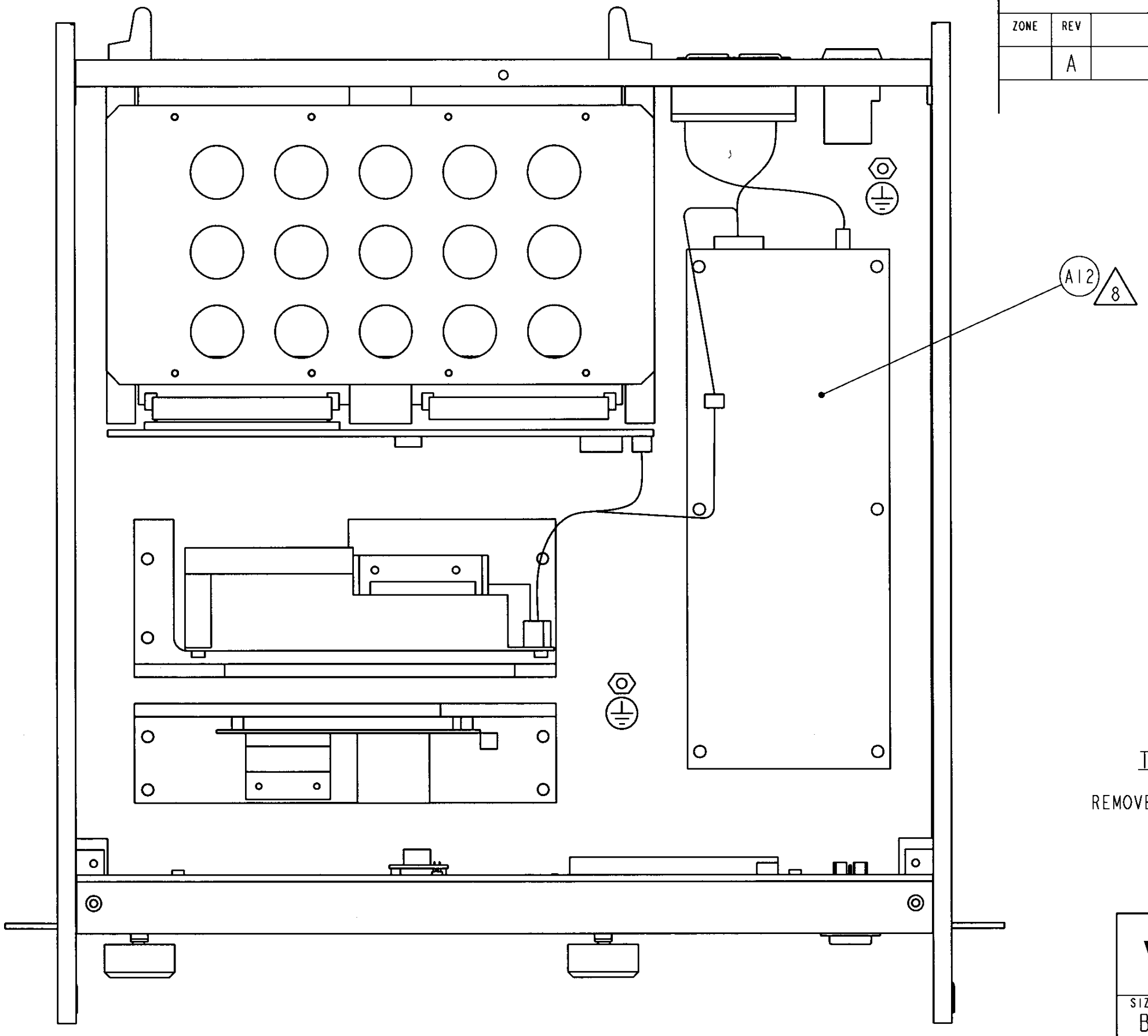
ViaSat	4311 Communications Dr. Norcross, GA 30093			
SIZE B	CAGE CODE	DWG NO. 720176		REV A
SCALE 0.500	CAD GENERATED ORIGINAL	SHEET 3 OF 4		

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DWG. NO.	720176	SH 4	REV A

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	SEE SHEET ONE		



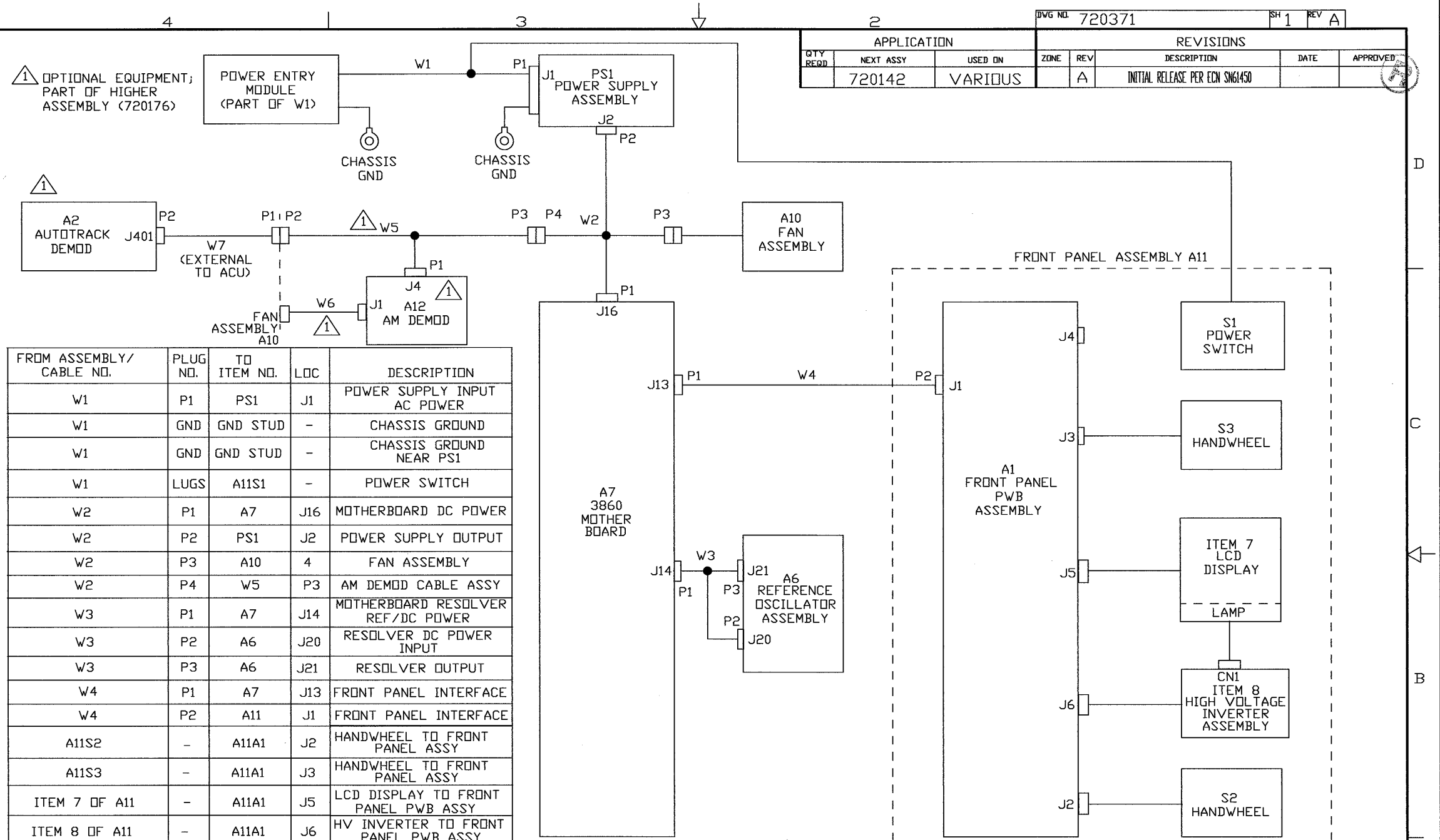
TOP VIEW
COVER
REMOVED FOR CLARITY

ViaSat	4311 Communications Dr. Norcross, GA 30093			
SIZE B	CAGE CODE	DWG NO. 720176		REV A
SCALE 0.500	CAD GENERATED ORIGINAL	SHEET 4 OF 4		

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DWG NO. 720371 | SH 1 | REV A

APPLICATION			REVISIONS				
QTY REQD	NEXT ASSY	USED ON	ZONE	REV	DESCRIPTION	DATE	APPROVED
	720142	VARIOUS		A	INITIAL RELEASE PER ECN SN61450		



FROM ASSEMBLY/ CABLE NO.	PLUG NO.	TO ITEM NO.	LOC	DESCRIPTION
W1	P1	PS1	J1	POWER SUPPLY INPUT AC POWER
W1	GND	GND STUD	-	CHASSIS GROUND
W1	GND	GND STUD	-	CHASSIS GROUND NEAR PS1
W1	LUGS	A11S1	-	POWER SWITCH
W2	P1	A7	J16	MOTHERBOARD DC POWER
W2	P2	PS1	J2	POWER SUPPLY OUTPUT
W2	P3	A10	4	FAN ASSEMBLY
W2	P4	W5	P3	AM DEMOD CABLE ASSY
W3	P1	A7	J14	MOTHERBOARD RESOLVER REF/DC POWER
W3	P2	A6	J20	RESOLVER DC POWER INPUT
W3	P3	A6	J21	RESOLVER OUTPUT
W4	P1	A7	J13	FRONT PANEL INTERFACE
W4	P2	A11	J1	FRONT PANEL INTERFACE
A11S2	-	A11A1	J2	HANDWHEEL TO FRONT PANEL ASSY
A11S3	-	A11A1	J3	HANDWHEEL TO FRONT PANEL ASSY
ITEM 7 OF A11	-	A11A1	J5	LCD DISPLAY TO FRONT PANEL PWB ASSY
ITEM 8 OF A11	-	A11A1	J6	HV INVERTER TO FRONT PANEL PWB ASSY
ITEM 7 OF A11	-	ITEM 8 OF A11	CN1	LCD LAMP TO INVERTER
W5	P3	W2	P4	DC POWER HARNESS
W5	P1	A12	J4	AM DEMOD POWER/DATA
W5	P2	A10	-	CUT-OUT ON FAN ASSY
W6	-	A12	J1	AM DEMOD SIGNAL INPUT
W6	-	A10	-	CUT-OUT ON FAN ASSY
W7	P1	A10	W5P2	AM DEMOD DATA OUTPUT
W7	P2	A1	J401	AUTOTRACK DEMOD INPUT

CAD GENERATED ORIGINAL

ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED
TOLERANCES
3 PLACE DECIMAL ± .005
2 PLACE DECIMAL ± .02
1 PLACE DECIMAL ± .1
FRACTION ± ANGLES ± 0.5°
MAX SURFACE ROUGHNESS 125
ALL MACHINE SURFACES EXCEPT AS NOTED
BREAK SHARP EDGES AND CORNERS .010 MAX
FINISH NONE

CONTRACT NO.

DWN	J. WINKLER	5/21/99
ENGR	Wm. J. Winchester	5-26-99
CHK		
PROD		
APVD		
APVD		

ViaSat 4311 Communications Drive Norcross GA 30093

ACU INTERCONNECT DIAGRAM

SIZE	CAGE CODE	DWG. NO.	REV
C	1Q601	720371	A

SCALE NONE | WT | SHEET 1 OF

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Appendix A
REMOTE INTERFACE COMMANDS

A.1 INTRODUCTION

This appendix describes using the remote interface to control and monitor digital controller operation. There are three remote interfaces available: RS-232, RS-422, and IEEE-488. All of the interfaces use the same communications protocol as described in this appendix.

All communications proceed using the "send and wait" protocol method; that is, a command is sent to the ACU via the chosen interface, and the sending device must wait until a response has been received before issuing another command. The ACU will only respond to commands received, it does not spontaneously issue any messages. Response time to messages varies with the message type; however, response times will generally be much less than 100 milliseconds.

All interface transactions employ the ASCII character set. Nonprinting ASCII characters are referred to in the text by enclosing the ASCII name for the character in angle brackets (see the table below).

The following conventions are used in this description:

- [ ] (square brackets) enclose items that are optional.
- ... (ellipsis) indicate that the preceding item may be repeated zero or more times.
- <cr> indicates the carriage return character (0D hex).
- <lf> indicates the line feed character (0A hex).
- <ack> indicates acknowledge character (06 hex).
- <nak> indicates the not-acknowledge character (15 hex).

Upper-case letters in the command format indicate required characters; lower-case indicate variable input strings.

Each message to the ACU starts with the '@' character. The next character is the PWB ID. All commands to the Servo PWB begin with @8. All commands to the operator remote interface (ORI) PWB begin with @0. Each message is terminated with the <cr><lf> characters.

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Each message contains a 1- to 3-letter mnemonic which indicates the purpose of the message. Most of the messages also require a 'W' (to write data) or an 'R' (to read data). Data may be read at any time by the host, but the ACU must be in the REMOTE mode of operation before any writes to the servo board are allowed. Writes to the ORI may be made at any time.

Following the 'W' or 'R' are various fields which are shown in the individual paragraphs. Write commands require data fields, whose formats vary according to the message. One or more data fields may be written, using commas as the field separator. Commas with no data fields preceding them may be used to skip fields. For example, 'W,,0002' will store data in the third element of whatever data set is being written without modifying the first two elements.

When optional multiple data fields are specified in the command, writing more than one data field will result in data being written to the next logical element. For example, commands writing data to axis-dependent fields (POS, CMD, etc.) will write the optional data to the next sequential axis: @8MOD W3,1 will write a 3 to axis A and a 1 to axis B. Read commands may optionally include a character indicating the number of data items to be read. However, the number of data items to be read plus the optional element pointer of the command must not exceed the total number of elements in the set; for example, @8MOD B R3 is acceptable, since the element pointer is set to axis B and 3 elements are requested (B, C, and D).

Responses from the ACU always begin with the '@' character, followed by the PWB ID indicating which board is responding (see the paragraph above). The next character will be an <ack> to indicate a successful message transaction or an <nak> to indicate that there was a problem with the host message. No other information is given with the <nak> to indicate the nature of the problem.

For successful read transactions, the requested data fields follow the <ack> in a format dictated by the message. Data fields are separated by commas, and the last field is always followed by a final comma before the <cr><lf>.

NOTE

In general, all references to axis A apply to the Azimuth axis and all references to axis B apply to the Elevation axis.

A.2 COMMUNICATION WITH A HOST COMPUTER

The host computer communications commands are listed in Table A.1.1. The number preceding the command in the list corresponds with the paragraph number in which a description of the command may be found.

In general, paragraphs A-2.1 through A-2.6 deal with commands for the ORI board exclusively. Commands in paragraphs A-2.7 and A-2.8 may be sent to either the ORI or servo boards. Commands in paragraphs A-2.9 through A-2.46 may be sent to only the servo board. The remainder of the commands are specific to this application.

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Table A.1.1. Remote Interface Messages

Paragraph	Message	Mnemonic
	Setup and Configuration Messages	
A.2.1.1	User Setup Communications	BAU
A.2.1.2	Axis Label Change	LBL
A.2.1.3	Status Softkey Label Change	STA
A.2.1.4	Command Softkey Label Change	CMD
A.2.1.5	Alarm Mask Set	ALM
A.2.1.6	System Setup Word	SYS
A.2.1.7	User Revision Request Response	REV
A.2.1.8	Soft Reset	RES
A.2.1.9	Mutually Exclusive Mask	MUT
A.2.10	Time Entry	TIM
A.2.11	Date Entry	DAT
	Mode Messages	
A.2.2.1	Axis Mode Control	MOD
A.2.2.2	Auxiliary Mode Control	AXM
	Position and Rate Messages	
A.2.3.1	Set Regular Dump Mode	REG
A.2.3.2	Set Raw Angle Dump Mode	RAW
A.2.3.3	Dump Axis Data Command	DMP
A.2.3.4	Position Command	POS
A.2.3.5	Position Feedback 1 Status	PF1
A.2.3.6	Position Feedback 2 Status	PF2
A.2.3.7	Position Feedback #1 Offset	OFF
A.2.3.8	Rate Command	RTE
	Scan Messages	
A.2.4.1	Scan Mode Control	SMD
A.2.4.2	Scan Amplitude (Span) Control	SCN
A.2.4.3	Scan Rate/Step Control	SNR
	Input/Output Port Messages	
A.2.5.1	Digital Output Port Mask On	MON
A.2.5.2	Digital Output Port Mask Off	MOF
A.2.5.3	Digital Output Port Command	DO
A.2.5.4	Digital Input Port Command	DI
A.2.5.5	ADC Port Status	TCH

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Table A.1.1. Remote Interface Messages

Paragraph	Message	Mnemonic
	Servo Loop Messages	
A.2.6.1	Filter Parameters Command	FIL
A.2.6.2	Filter Linear Gain Terms	FLI
A.2.6.3	Filter Integrator Terms	FIN
A.2.6.4	Filter Quadratic Terms	FQU
A.2.6.5	Filter Copy Command	CPY
A.2.6.6	Load Filter Command	LOA
A.2.6.7	Axis Limiting Command	LIM
A.2.6.8	Torque Bias Select	TRQ
A.2.6.9	Torque Bias Amount	BIA
	Autotrack Messages	
A.2.7.1	Scan Code Generator Mode	SM
A.2.7.2	Fixed Scan Code Frequency	SF
A.2.7.3	Preset Acquisition Thresholds	AQ
A.2.7.4	Receiver Channel Selection	CS
A.2.7.5	Autotrack Mode Control	AMD
A.2.7.6	Autotrack Azimuth Offset	AO
A.2.7.7	Autotrack Elevation Offset	EO
A.2.7.8	Autotrack Gain Settings	AGA, AGB, EGA, EGB
A.2.7.9	Autotrack Valid Acquire Time	AQT
A.2.7.10	Autotrack Rate Memory Time	RMT
A.2.7.11	Autotrack Posn Memory Time	PMT
A.2.7.12	Autotrack Launch Acq Time	LAT
A.2.7.13	Autotrack Lowtrack Min Angle	MPC
A.2.7.14	Read Autotrack Errorr and AGC	AER
A.2.8.1	Data Gathering Start	DGS
A.2.8.2	Data Gathering Dump	DGD
A.2.8.3	Step Test Start	STS
A.2.8.4	Step Test Results/Status	STR
A.2.8.5	Step Test Data	STD
A.2.8.6	Test Input Select	TI
A.2.8.7	Test Output Select	TO

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A.2.1 Setup and Configuration Messages

A.2.1.1 User Setup Communications

Command format: @0BAU R<cr> <lf>

or @0BAU Wx<cr> <lf>

Parameters: x: baud rate to be set; format is decimal, such as '9600' for 9600 baud.

Response: @0<ack>x<cr> <lf> for read

or @0<ack><cr> <lf> for write

Example commands: @0BAU R<cr> <lf>

@0BAU W19200<cr><lf>

A.2.1.2 Axis Label Change

Command format: @0LBL [a] R[n]<cr> <lf>

or @0LBL [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected axis (optional); 'A' - 'H'. If no axis specified, 'A' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

x: axis label in ASCII format. Axis labels are nine characters long. Labels are used on the front panel of the ACU as the "title" of an axis when its data set is selected for display. Examples of this would be ELEVATION for axis B and AZIMUTH for axis A. If fewer than nine characters are written, only the first characters of the old label are replaced.

Response: @0<ack>x,[x,]...<cr> <lf> for read

or @0<ack><cr> <lf> for write

Example commands: @0LBL R2<cr><lf> read axis labels A and B

@0LBL C R2<cr><lf> read axis label C and D

@0LBL WAXIS A, AXIS B <cr><lf> update axes labels A thru B

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Example responses: @0<ack>AZIMUTHbb,ELEVATION,<cr><lf>

@0<ack> AXIS Cbbb,AXIS Dbbb,<cr><lf>

@0<ack><cr><lf>

A.2.1.3 Status Softkey Label Change

Command format: @0STA [a] R[n]

or @0STA [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected status line (optional); '1' - '64', decimal format. If no axis specified, '1' is assumed.

n number of status line labels to read. If no number specified, '1' is assumed.

x: status softkey label in ASCII format. Softkey labels are six characters long. These labels are used on the front panel of the ACU when displaying pedestal status. Pressing the menu keys MENUS, SYSTEM, and STATI or STATII displays these keys. If fewer than six characters are written, only the first characters of the old label are replaced.

Response: @0<ack>x,[x,]...<cr> <lf> for read

or @0<ack><cr> <lf> for write

Example commands: @0STA R2<cr><lf> read status labels 1 and 2

@0STA 6 R2<cr><lf> read status labels 6 and 7

@0STA 8 W LIM1A<cr><lf> update label 8

Example responses: @0<ack>PEDPWR,DISABL,<cr><lf>

@0<ack> LIM1Ab ,SECT E,<cr><lf>

@0<ack>PEDPWR,DISABL,STOW A,BRKRLA,<cr><lf>

A.2.1.4 Command Softkey Label Change

Command format: @0CMD [a] R[n]<cr> <lf>

or @0CMD [a] Wx[,x]...<cr> <lf>

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Parameters:
- a: selected command line (optional); '1' - '48', decimal format. If no line specified, '1' is assumed.
- n: number of command line labels to read. If no number specified, '1' is assumed.
- x: command softkey label in ASCII format. Softkey labels are six characters long. These labels are used on the front panel of the ACU when selecting control line outputs. Pressing the menu keys MENUS, SYSTEM, and CMNDI or CMNDII displays these keys. If fewer than six characters are written, only the first characters of the old label are replaced.

Response: @0<ack>x,[x,]...<cr> <lf> for read

or @0<ack><cr> <lf> for write

Example commands:
- @0CMD R2<cr><lf> read command label 1 and 2
- @0CMD 6 R2<cr><lf> read command label 6 and 7
- @0CMD 12 WOPERA1<cr><lf> update label 12

Example responses:
- @0<ack>PEDPWR,CMND02<cr><lf>
- @0<ack>OPERA1,OPERB1<cr><lf>
- @0<ack>PEDPWR,CMND02,CMND03,CMND04<cr><lf>

A.2.1.5 Alarm Mask Set

The alarm command changes the mask used to activate the front-panel alarm LED. Each bit represents a specific status line. The ACU 'ands' the mask with the status bits. If any of the bits are 1, the LED is lighted. Since the convention is used that a 1 represents a fault, this 'and-ing' has the effect of determining if there are any faults.

Command format: @0ALM [a] R<cr> <lf>

or @0ALM [a] Wx,<cr> <lf>

Parameters:
- a: Selected mask. If no number is specified, a '1' is assumed.

  1 = STAT01 to STAT16, Servo Board 1

  2 = STAT17 to STAT32, Synchro/Resolver Board 1

  3 = STAT01 to STAT16, Servo Board 2

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4 = STAT17 to STAT32, Synchro/Resolver Board 2

(see Tables 2.3 and 2.7; Board 2 references are for applications with an additional servo board and synchro/resolver board (non-standard configuration))

x: mask commands in hex format. x is the hexidecimal representation of the 16 bit status mask. The MSB is STAT16 or STAT32, as applicable.

Response: @0<ack>x,<cr><lf> for read

or @0<ack><cr><lf> for write

Example commands: @0ALM 1 W24C2,<cr><lf>

Example responses: @0<ack>

A.2.1.6 System Setup Word

Command format: @0SYS [a] R[n]<cr> <lf>

or @0SYS [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected axis (optional); 'A' - 'H'. If no axis specified, 'A' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

x: system setup word (see below for definition).

Response: @0<ack>x,[x,]...<cr><lf> for read

or @0<ack><cr><lf> for write

Example commands: @0SYS R<cr><lf> read setup word for axis A

@0SYS B WC000<cr><lf> write setup word for axis B

Example responses: @0<ack>6000<cr><lf>

@0<ack><cr><lf>

The system setup word selects pedestal configurations of the pedestal. The system setup word is in a bit field format and is defined as follows:

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Bit Positions	Contents
15	Sector switch
	0 - Sector switch not in use
	1 - Sector switch in use
14	Limit switches
	0 - Limit switches not in use
	1 - Limit switches in use
13	Axis Modulo
	0 - Position Display, 0-360^{O}
	1 - Position Display, ±180^{O}

A.2.1.7 User Revision Request Response

Command format: @0REV<cr> <lf>

or @8REV<cr> <lf>

Parameters: None

Response: Firmware part number and revision level in ASCII

Example responses: @0<ack>495067A<cr><lf>

@8<ack>495068B<cr><lf>

A.2.1.8 Soft Reset

This command causes the ACU to reset the ORI or Servo CCA microprocessors.

Command format: @0RES<cr> <lf> or @8RES<cr><lf>

Parameters: none

Response: @0<ack><cr><lf> or @8<ack><cr><lf>

A.2.1.9 Mutually Exclusive Mask

Command format: @0MUT R[n]<cr><lf>

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or @0MUT Wx[,x]<cr><lf>

Parameters:
- n: number of data values to read. If no number specified, '1' is assumed.
- x: hexadecimal value representing the same 16-bit integer which is used as the digital output port command.

Response: @0<ack>x,[x,]...<cr><lf> for read

or @0<ack><cr><lf> for write

Example commands: @0MUT W6363<cr><lf>

@0MUT W,EEEE<cr><lf>

@0MUT R<cr><lf>

Example responses: @0<ack><cr><lf>

@0<ack>3FC5,<cr><lf>

A.2.1.10 Time Entry

Command format: @0TIM R<cr><lf>

or @0TIM Wxx:yy:zz<cr><lf>

Parameters:
- x: x is the number of hours.
- y: y is the number of minutes.
- z: z is the number of seconds. (Note: only whole number entry of seconds is allowed, but seconds readback is up to a tenth of a second)

Response: @0<ack>xx:yy:zz.z<cr><lf> for read

or @0<ack><cr><lf> for write

Example commands: @0TIM R<cr><lf> read the current setting

@0TIM W07:08:16<cr><lf> set the time to 7:08:16 AM

Example responses: @0<ack>15:24:16.8<cr><lf> current time

@0<ack><cr><lf

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A.2.1.11 Date Entry

Command format: @0DAT R<cr><lf>

or @0DAT Wxx/yy/zz<cr><lf>

Parameters:
- x: x is the month.
- y: y is the year.
- z: z is the day

Response: @0<ack>xx/yy/zz<cr><lf> for read

or @0<ack><cr><lf> for write

Example commands:
- @0DAT R<cr><lf> read the current date
- @0DAT W09/03/95<cr><lf> set the current date

Example responses:
- @0<ack>09/03/95<cr><lf> current date
- @0<ack><cr><lf

A.2.2 Mode Messages

A.2.2.1 Axis Mode Control

Command format: @8M[OD] [a] R[n]<cr> <lf>

or @8M[OD] [a] Wx[,x]...<cr> <lf>

Parameters:
- a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.
- n: number of data values to read. If no number specified, '1' is assumed.
- x: hexadecimal value representing a 16-bit integer which selects the operational mode of the selected axis of the pedestal. The axis mode word is in a bit field format and is defined as follows:

Bit Positions	Contents
00 - 02 (LSB)	Mode select
	0 - Standby mode selected

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1 - Rate mode selected

2 - Synchro slave

3 - Position mode selected

4-7 - Not used

Bit Positions	Contents
03	Type I/II

0 - Use type I filters

1 - Use type II filters

Bit Positions	Contents
04	Scan mode

0 - Disable scan

1 - Enable scan

Bit Positions	Contents
05	Local control status (read only)

0 - Not in local mode

1 - In local mode (maintenance port connected)

Bit Positions	Contents
06	Rate feed forward

0 - Disables rate feed forward

1 - Enables rate feed forward

Bit Positions	Contents
07	Autotrack select

0 - Disable autotrack mode

1 - Enable autotrack mode

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	08	Autotrack status (read only) 0 - Autotrack mode inactive 1 - Autotrack mode active
	09 - 10	Position loop filter select 0 - Select position loop filter 1 1 - Select position loop filter 2 2 - Select position loop filter 3 3 - Select position loop filter 4
	11	Rate loop filter select 0 - Select rate loop filter 1 1 - Select rate loop filter 2
	12 - 15	Not used
Response:	@8<ack>x,[x,]...<cr><lf>	for read
or	@8<ack><cr><lf>	for write
Example commands:	@8MOD R2<cr><lf>	
	@8MOD C R1<cr><lf>	
	@8MOD W0003<cr><lf>	
Example responses:	@8<ack>0001,0002,<cr><lf>	
	@8<ack>000B,<cr><lf>	
	@8<ack><cr><lf>	

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A.2.2.2 Auxiliary Mode Control

Command format: @0AXM R or @0AXM Wx

Parameters: x: auxiliary mode command

Response: Auxiliary modes requested or ack

Example commands: @0AXM R<cr><lf>

@0AXM W0002<cr><lf>

Example responses: @0<ack>0000,<cr><lf>

@0<ack><cr><lf>

The auxiliary mode word selects auxiliary operational modes of the controller. The auxiliary mode word is in a bit field format and is defined as follows:

Bit Positions	Contents
13	Step track enable 0 - Disable Steptrack mode 1 - Enable Steptrack mode

A.2.3 Position and Rate Messages

A.2.3.1 Set Regular Dump Mode

This command sets the response mode of the DMP command (see below). When received, it sets the response to a DMP command to include current axis position and command.

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Command format: @8REG<cr> <lf>

Parameters: None

Response: @8<ack><cr><lf>

A.2.3.2 Set Raw Angle Dump Mode

This command sets the response mode of the DMP command (see below). When received, it sets the response to a DMP command to include the raw synchro or resolver inputs of the selected axis.

Command format: @8RAW<cr> <lf>

Parameters: None

Response: @8<ack><cr><lf>

A.2.3.3 Dump Axis Data Command

The response to this command varies depending on the current response mode and which board is being addressed. The ORI board will always respond in the regular response mode. The servo board may be toggled between the regular and raw response modes by the REG and RAW commands (see above). The servo board always powers up in the regular response mode.

Command format: @0DMP a<cr> <lf>

or @8DMP a<cr> <lf>

Parameters: a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

Response: @0<ack>d1,d2,d3,d4,d5,[d6,][d7,][d8]<cr><lf>

or @8<ack>d1,d2,d3,d4,d5,[d6,][d7,][d8]<cr><lf>

where

d1: axis position feedback 1 (as in PF1 command) in the regular response mode, or the raw course axis synchro/resolver feedback in the raw response mode. Coarse data is typically from a position readout geared 1:1 with the axis. Raw data is also in scaled-binary coded angle format.

d2: axis mode (as in MOD command)

d3: axis position command (as in POS command) in the regular response mode, or the raw fine axis synchro/resolver feedback in the raw response mode. Fine data is from a position readout geared

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N:1 with the axis, where N may vary from system to system. Raw data is also in scaled-binary coded angle format.

d4,d5: digital status inputs (as in DI R2 command)

d6,d7,d8: If an autotrack demod is present, two or three additional values are output. The first is the current autotrack demod status (see below). The second is the currently selected tracking receiver AGC. If the axis pointer is A or B, the third is the autotrack demod error for that axis. No error is output for axis C or D. All values are output as 16-bit hexadecimal values.

Demod status bits are assigned as follows: the most significant 12 bits contain the same information as if an AMD read were done (see paragraph for AMD). The lower 4 bits reports demod status as:

bit 3 = acquisition status (1 = ACQ)

bits 2,1,0 = current receiver channel being used for tracking (1 through 7)

Example commands: @8DMP A<cr><lf>

@0DMP C<cr><lf>

Example responses: @8<ack>1234,0001,1232,00F0,019E<cr><lf>

@0<ack>1234,0001,1232,00F0,019E,000B,025D,0004<cr><lf>

A.2.3.4 Position Command

Command format: @8P[OS] [a] R[n]<cr> <lf>

or @8P[OS] [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

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x: angle commands in scaled-binary coded angle format. See paragraph A.-4 for the format style. These commands are used by the ACU to position the pedestal when in Position mode and Rate mode.

Response: @8<ack>x,[x,]...<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8POS R2<cr><lf> read axes position A and B

@8POS C R2<cr><lf> read axes position C and D

@8POS R4<cr><lf> read axes position A thru D

@8P W0,0,0,0<cr><lf> update axes position A thru D

Example responses: @8<ack>528F,FE02<cr><lf>

@8<ack>31AE,0000<cr><lf>

@8<ack>0000,6872,9087,BCCD<cr><lf>

@8<ack><cr><lf>

A.2.3.5 Position Feedback 1 Status

Command format: @8PF1 [a] R[n]<cr> <lf>

Parameters: a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

Response: @8<ack>x,[x,]...<cr><lf>

where x: position angles in scaled-binary coded angle format. See paragraph A.4 for the format style. Some axes have dual position readout capability. This command reads the position of the primary feedback.

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Example commands: @8PF1 R2<cr><lf> read axes position A and B

@8PF1 C R2<cr><lf> read axes position C and D

@8PF1 R4<cr><lf> read axes position A thru D

Example responses: @8<ack>528F,FE02<cr><lf>

@8<ack>31AE,0000<cr><lf>

@8<ack>0000,6872,9087,BCCD<cr><lf>

A.2.3.6 Position Feedback 2 Status

Command format: @8PF2 [a] R[n]<cr> <lf>

Parameters:
- a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.
- n: number of data values to read. If no number specified, '1' is assumed.

Response: @8<ack>x,[x,]...<cr><lf>

where
- x: position angles in scaled-binary coded angle format. See paragraph A.4 for the format style. Some axes have dual position readout capability. This command reads the position of the secondary feedback.

Example commands: @8PF1 R2<cr><lf> read axes position A and B

@8PF1 C R2<cr><lf> read axes position C and D

@8PF1 R4<cr><lf> read axes position A thru D

Example responses: @8<ack>528F,FE02<cr><lf>

@8<ack>31AE,0000<cr><lf>

@8<ack>0000,6872,9087,BCCD<cr><lf>

A.2.3.7 Position Feedback #1 Offset

Command format: @8OFF [a] R[n]<cr> <lf>

or @8OFF [a] Wx[,x]...<cr> <lf>

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Parameters:
- a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.
- n: number of data values to read. If no number specified, '1' is assumed.
- x: angle offsets in scaled-binary coded angle format. See paragraph A.4 for the format style. This number is added directly to the pedestal angles read from the synchro(resolver)-to-digital converter (A and B axes), and the result becomes the PF1 value.

Response: @8<ack>x,[x,]...<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands:
- @8OFF R2<cr><lf> read position offset A and B
- @8OFF C R2<cr><lf> read position offset C and D
- @8OFF W0002<cr><lf> write position offset A

Example responses:
- @8<ack>528F,FE02,<cr><lf>
- @8<ack>31AE,0000,<cr><lf>
- @8<ack><cr><lf>

A.2.3.8 Rate Control

Command format: @8RTE [a] R[n]<cr> <lf>

or @8RTE [a] Wx[,x]...<cr> <lf>

Parameters:
- a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.
- n: number of data values to read. If no number specified, '1' is assumed.
- x rate commands in scaled-binary coded angle format. See paragraph A.4 for the format style. These commands are used by the ACU to slew the pedestal when in RATE mode.

Response: @8<ack>x,[x,]...<cr><lf> for read

or @8<ack><cr><lf> for write

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Example commands: @8RTE W0100,0845<cr><lf> write rates for axis A and B

@8RTE C W0021,236F<cr><lf> write rates for axis C and D

@8RTE R2<cr><lf> read rates for A and B

Example responses: @8<ack><cr><lf>

@8<ack>FFF4,0200,<cr><lf>

A.2.4 Scan Messages

A.2.4.1 Scan Mode Control

Command format: @8SMD [a] R[n]<cr> <lf>

or @8SMD [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

x: decimal value indicating the desired scan pattern to use when in SCAN mode of operation:

Value	Type of Scan
00	Independent axis scan started at zero
01	Independent axis scan started at +max offset
02	Independent axis scan started at -max offset
03	Raster scan started at zero
04	Raster scan started at +max offset
05	Raster scan started at -max offset

Response: @8<ack>x,[x,]...<cr><lf> for read

or @8<ack><cr><lf> for write

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Example commands: @8SMD W0001,0005,<cr><lf>

@8SMD C W00,02,<cr><lf>

@8SMDR4<cr><lf>

Example responses: @8<ack><cr><lf>

@8<ack>0001,0003,0005,0003,<cr><lf>

A.2.4.2 Scan Amplitude (Span) Control

Command format: @8SCN [a] R[n]<cr> <lf>

or @8SCN [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

x: scan amplitude in scaled-binary coded angle format. See paragraph A.4 for the format style. When the axis is scanning, the actual width of the scan box will be twice the commanded scan amplitude.

Response: @8<ack>x,[x,]...<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8SCN R2<cr><lf> read scan amplitude A and B

@8SCN C R2<cr><lf> read scan amplitude C and D

@8SCN W0400<cr><lf> write scan amplitude A

Example responses: @8<ack>528F,FE02,<cr><lf>

@8<ack>31AE,0000,<cr><lf>

@8<ack><cr><lf>

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A.2.4.3 Scan Rate/Step Control

Command format: @8SNR [a] R[n]<cr> <lf>

or @8SNR [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

x: rate commands in scaled-binary coded angle format. See paragraph A.4 for the format style. When the axis is scanning, this command sets the following:

- For independent axis scan: The angular velocity of the axis.
- For raster scan: The step size for the axis when the other axis reaches its scan amplitude

Response: @8<ack>x,[x,]...<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands:

@8SNR W0100,0845<cr><lf> write scan rates/steps for A and B

@8SNR C W0021,236F<cr><lf> write scan rates/steps for C and D

@8SNR R4<cr><lf> read all four axis scan rates/steps

Example responses:

@8<ack><cr><lf>

@8<ack>0200,FF80,0010,0000,<cr><lf>

A.2.5 Input/Output Port Messages

A.2.5.1 Digital Output Port Mask On

This command allows the host computer to set a mask of bits ON in either digital output port. The bit fields for output are the same as in the DO command. If a bit in the data written is a logical one, then that output will be turned ON. All outputs whose bits are zero are left unchanged. This allows individual outputs to be turned ON without having to keep track of the state of all outputs. The ACU is responsible, however, for turning OFF any outputs which are paired with any selected output in a mutually exclusive sense.

Command format: @8MON Wx[,x]<cr><lf>

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Parameters: x: a 16-bit hex ASCII data field indicating which outputs to turn ON

Response: @8<ack><cr><lf>

Example command: @8MON W,0001<cr><lf> turn on CMND09

A.2.5.2 Digital Output Port Mask Off

This command allows the host computer to set a mask of bits OFF in either digital output port. The bit fields for output are the same as in the DO command. If a bit in the data written is a logical one, then that output will be turned OFF. All outputs whose bits are zero are left unchanged. This allows individual outputs to be turned OFF without having to keep track of the state of all outputs. The ACU is responsible, however, for turning ON any outputs which are paired with any selected output in a mutually exclusive sense.

Command format: @8MOF Wx[,x]<cr><lf>

Parameters: x: a 16-bit hex ASCII data field indicating which outputs to turn ON

Response: @8<ack><cr><lf>

Example command: @8MOF W0000,0010<cr><lf> turn off CMND13

A.2.5.3 Digital Output Port Command

Command format: @8DO R[n]<cr> <lf>

or @8DO Wx[,x]<cr> <lf>

Parameters: n: number of data values to read. If no number specified, '1' is assumed.

x: hexadecimal value representing a 16-bit integer which will be used as the digital output port command. There are two output ports only. See Tables 2.3 and 2.7 for a list of the outputs. The first value read or written corresponds to commands CMND01 through CMND08. The second value read or written corresponds to commands CMND09 (LSB) through CMND24(MSB).

Response: @8<ack>x,[x,]<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8DO W2323<cr><lf>

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@8DO W,EEEE<cr><lf>

@8DO R<cr><lf>

Example responses: @8<ack><cr><lf>

@8<ack>3FC5,<cr><lf>

A.2.5.4 Digital Input Port Command

Command format: @8DI [a] R[n]<cr> <lf>

Parameters:

a: number of digital input port (optional); can be a '1' or a '2'. If not specified, a 1 is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

Response: @8<ack>x,[x,]...<cr><lf>

where

x: hexadecimal value representing a 16-bit integer which indicates the current status of the digital input ports. There are two input ports only. See Tables 2.3 and 2.7 for a list of the inputs. The first value read corresponds to status STAT01 (LSB) through STAT16 (MSB). The second value read corresponds to status STAT17 (LSB) through STAT32(MSB).

Example commands: @8DI R<cr><lf>

@8DI R2<cr><lf>

Example responses: @8<ack>04A0,<cr><lf>

@8<ack>02EF,3CFF,<cr><lf>

A.2.5.5 ADC Port Status

Command format: @8T[CH] [a] R[n]<cr> <lf>

Parameters:

a: selected value (optional); '1' - '16', indicating the channel of the A/D converter whose output is desired to be read. If not specified, '1' is assumed.

n: number of data values to read. If no number specified, '1' is assumed.

Response: @8<ack>x,[x,]...<cr><lf>

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where x: hexadecimal value representing a 16-bit integer. Each integer is the output of a particular A/D converter channel. What each value represents in terms of a system voltage depends on the system cabling. The A/D converter is a 12-bit device; the 12-bits are stored in the lower 12 of the 16-bit value, and the upper 4 bits are sign-extended. The format of the value is 2's complement.

Example commands: @8TCH R2<cr><lf>

@8TCH 2 R<cr><lf>

@8TCH 8 R<cr><lf>

Example responses: @8<ack>F000,3450,<cr><lf>

@8<ack>4308,<cr><lf>

@8<ack>A30B,<cr><lf>

A.2.6 Servo Loop Messages

A.2.6.1 Filter Parameters Command

Command format: @8FIL cd R<cr><lf>

or @8FIL cd Wx,y,z<cr><lf>

Parameters:

c: selected axis; 'A' - 'D'. Must be specified.

d: filter number according to the list in paragraph A.3.

x: filter Smax; this number only applies to position loop filters and is in floating point degrees. Any input signal to the filter (i.e., position error) exceeding this value will cause the filter to automatically switch to Type I operation (if not already in Type I).

y: filter gain; this is the overall filter gain in dB using a floating point format.

z: filter offset; this is the offset applied to the output of the filter in degrees using a floating point format.

Response: @8<ack>x,y,z<cr><lf> for read

@8<ack><cr><lf> for write

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Example commands: @8FIL A1 W10.000,-3.0,0.0<cr><lf>

@8FIL B5 R<cr><lf>

Example responses: @8<ack><cr><lf>

@8<ack>180.000,0.000,0.000,<cr><lf>

A.2.6.2 Filter Linear Gain Terms

Command format: @8FLI cd R<cr> <lf>

or @8FLI cd Wn1[,x1]...n2[,x2]...<cr> <lf>

Parameters:

c: selected axis; 'A' - 'D'. Must be specified.

d: filter number according to the lsit in paragraph A.3.

n1: the number of linear zero terms for the filter

x1: break frequencies for the zero terms; format is in hertz, floating point; the number of entries here is determined by n1 and are only included if n1 > 0.

n2: the number of linear pole terms for the filter

x2: break frequencies for the pole terms; format is in hertz, floating point; the number of entries here is determined by n2 and are only included if n2 > 0.

Response: @8<ack>n1[,x1]...n2[,x2]...<cr><lf> for read

@8<ack><cr><lf> for write

Example commands: @8FLI A1 W2,0.01,0.003,2,1.10,1.40<cr><lf>

@8FLI B5 R<cr><lf>

Example responses: @8<ack><cr><lf>

@8<ack>2,0.01,0.003,2,1.10,1.40,<cr><lf>

A.2.6.3 Filter Integrator Terms

Command format: @8FIN cd R<cr> <lf>

or @8FIN cd Wn1[,x1]...<cr> <lf>

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Parameters:
- c: selected axis; 'A' - 'D'. Must be specified.
- d: filter number according to the list in paragraph A.3.
- n1: the number of integrating terms for the filter
- x1: break frequencies for the terms; format is in hertz, floating point; the number of entries here is determined by n1 and are only included if n1 > 0.

Response:
@8<ack>n1[,x1]...<cr><lf> for read

@8<ack><cr><lf> for write

Example commands:
@8FIN A2 W2,0.01,0.0025<cr><lf>

@8FIN B3 R<cr><lf>

Example responses:
@8<ack><cr><lf>

@8<ack>1,0.01,<cr><lf>

A.2.6.4 Filter Quadratic Terms

Command format:
@8FQU cd R<cr> <lf>

or
@8FQU cd Wn1[,x1,y1]...n2[,x2,y2]...<cr> <lf>

Parameters:
- c: selected axis; 'A' - 'D'. Must be specified.
- d: filter number according to the list in paragraph A.3.
- n1: the number of quadratic zero terms for the filter
- x1: break frequencies for the zero terms; format is in hertz, floating point; the number of entries here is determined by n1 and are only included if n1 > 0.
- y1: natural frequencies for the zero terms; format is in hertz, floating point; the number of entries here is determined by n1 and are only included if n1 > 0.
- n2: the number of quadratic pole terms for the filter
- x2: break frequencies for the pole terms; format is in hertz, floating point; the number of entries here is determined by n2 and are only included if n2 > 0.

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y2: natural frequencies for the pole terms; format is in hertz, floating point; the number of entries here is determined by n1 and are only included if n2 > 0.

Response: @8<ack>n1[,x1,y1]...n2[,x2,y2]...<cr><lf> for read

@8<ack><cr><lf> for write

Example commands: @8FQU A1 W0,1,20,20<cr><lf>

@8FQU B5 R<cr><lf>

Example responses: @8<ack><cr><lf>

@8<ack>1,1.10,1.40,0,<cr><lf>

A.2.6.5 Filter Copy Command

Command format: @8CPY c1d1 c2d2<cr> <lf>

Parameters:

c1: selected axis to copy from; 'A' - 'D'. Must be specified.

d1: filter number according to the list in paragraph A.3.

c2: selected axis to copy to; 'A' - 'D'. Must be specified.

d2: filter number according to the list in paragraph A.3.

Response: @8<ack><cr><lf>

Example command: @8CPY A1 B1<cr><lf>

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A.2.6.6 Load Filter Command

This command must be used after loading the appropriate gains, integrators, linears, etc. for the filter. The actual digital filter will not change until after issuing this command.

Command format: @8LOA cd<cr> <lf>

Parameters:
- c: selected axis; 'A' - 'D'. Must be specified.
- d: filter number according to the list in paragraph A.3.

Response: @8<ack><cr><lf>

Example commands: @8LOA A1<cr><lf>

A.2.6.7 Axis Command Limiting

Command format: @8LIM [a] R<cr> <lf>

or @8LIM [a] Wx[,y][,z]<cr> <lf>

Parameters:
- a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.
- x: the limiting value to be used on the output of the servo loop position filter. This is a decimal value in percentage. For example, 50.0 indicates 50 % limiting.
- y: the limiting value to be used on the rate of change of the output of the servo loop position filter. This is a decimal value in percent per second. For example, 50.0 indicates that the output is only allowed to change by 50 percent of full scale in one second. Actually, the change is limited at the loop sample rate to be 0.02 times the limiting value (50 percent would mean a maximum filter output delta of 1 percent of full scale per sample). This limiting is done before the limiting for 'x' above.
- z: the limiting value to be used on pedestal velocity when in the rate mode of operation. This is a decimal value in degrees/second (i.e., 35.0 (d/s))

Response:
- @8<ack>x,y,z<cr><lf> for read
- @8<ack><cr><lf> for write

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Example commands: @8LIM A W99,500,5<cr><lf>

@8LIM R<cr><lf>

Example responses: @8<ack>50,100,10.2<cr><lf>

@8<ack><cr><lf>

A.2.6.8 Torque Bias Select

Command format: @8TRQ [a] R[n]<cr> <lf>

or @8TRQ [a] Wx[,x]...<cr> <lf>

Parameters:

a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

x: torque bias select command; enables and disables the torque bias loop as defined below:

Command	Function
0	Torque bias disabled
1	Torque bias enabled

Response: @8<ack>x,[x,]...<cr><lf> for read

@8<ack><cr><lf> for write

Example commands: @8TRQ W1,0<cr><lf>

@8TRQ B R2<cr><lf>

Example responses: @8<ack><cr><lf>

@8<ack>0000,0000,<cr><lf>

A.2.6.9 Torque Bias Amount

Command format: @8BIA [a] R[n]<cr> <lf>

or @8BIA [a] Wx[,x]...<cr> <lf>

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Parameters: a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.

x: torque bias amount, decimal number (0.0 - 10.0) in volts

Response: @8<ack>x,[x,]...<cr><lf> for read

@8<ack><cr><lf> for write

Example commands: @8BIA A2 W1.5<cr><lf>

@8BIA B1 R<cr><lf>

Example responses: @8<ack><cr><lf>

@8<ack>0000,<cr><lf>

The torque bias amount determines the differential voltage between the two motors. The torque bias amount can range from 0 to 10 Volts.

A.2.7 Autotrack Messages

A.2.7.1 Scan Code Generator Mode

Command format: @8SM R<cr> <lf>

or @8SM Wx<cr> <lf>

Parameters: x: a single digit indicating the desired scan mode:

0 - fixed scan

1 - swept scan

2 - random scan

3 - static: X/Y = 0; phase = 0

4 - static: X/Y = 1; phase = 0

5 - static: X/Y= 0; phase = 1

6 - static: X/Y = 1; phase = 1

Response: @8<ack>x<cr><lf> for read

@8<ack><cr><lf> for write

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Example commands: @8SM R<cr><lf> read scan mode

@8SM W1<cr><lf>

Example responses: @8<ack>0002,<cr><lf>

@8<ack><cr><lf>

A.2.7.2 Fixed Scan Code Frequency

Command format: @8SF R<cr> <lf>

or @8SF Wx<cr> <lf>

Parameters: x: fixed frequency of scan when in fixed mode. Value is in hexadecimal hertz (example: 01F4 is 500 decimal, for 500 hertz).

Response: @8<ack>x<cr><lf> for read

@8<ack><cr><lf> for write

Example commands: @8SF R<cr><lf>

@8SF W01A5<cr><lf> change fixed scan freq to 421 Hz

Example responses: @8<ack>00F0,<cr><lf>

@8<ack><cr><lf>

A.2.7.3 Preset Acquisition Thresholds

Command format: @8AQ [a] R<cr> <lf>

or @8AQ [a] Wx[,x]...<cr> <lf>

Parameters: a: receiver channel number; value may range from '1' to '7' to select receiver 1 to 7 respectively; if no channel specified, '1' is assumed

x: acquisition level to set, value is floating point number between 0.0 and 100.0

Response: @8<ack>x,[x,]...<cr><lf> for read

@8<ack><cr><lf> for write

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Example commands: @8AQ 2 R<cr><lf> read channel 2 threshold

@8AQ 1 W29.1<cr><lf> change channel 1 threshold to 29.1 dB

Example responses: @8<ack>10.0,<cr><lf>

@8<ack><cr><lf>

A.2.7.4 Receiver Channel Selection

Command format: @8CS R<cr> <lf>

or @8CS Wx<cr> <lf>

Parameters: x: a single digit indicating the desired receiver channel:

0 - select auto-diversity

1 - select channel 1

2 - select channel 2

3 - select channel 3

4 - select channel 4

5 - select channel 5

6 - select channel 6

7 - select channel 7

Response: @8<ack>x<cr><lf> for read

@8<ack><cr><lf> for write

Example commands: @8CS R<cr><lf> read channel selection

@8CS W2<cr><lf> change receiver channel to #2

Example responses: @8<ack>0002,<cr><lf>

@8<ack><cr><lf>

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A.2.7.5 Autotrack Mode Control/Status

Command format: @8AMD R<cr> <lf>

or @8AMD Wx<cr> <lf>

Parameters: x: autotrack backup mode command; hexadecimal value representing a 16-bit integer which selects the backup mode(s) for autotrack. The mode word is in a bit field format and is defined as follows:

Bit	Contents
0 - 2	Current receiver channel being used for tracking (1 through 7)
3	Acquisition status (1 = ACQ)
4	Launch Acquisition status (read only) 0 - Launch Acquisition mode inactive 1 - Launch Acquisition mode active
5	Multi-path Clipping status (read only) 0 - Multi-path clipping mode inactive 1 - Multi-path clipping mode active
6	Position Memory status (read only) 0 - Position Memory mode inactive 1 - Position Memory mode active
7	Rate Memory status (read only) 0 - Rate Memory mode inactive 1 - Rate Memory mode active
8	Reserved
9	Demod Gain select 0 = Gain A

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1 = Gain B

10 Reserved

11 N/A

12 Launch Acquisition select

0 - Disable Launch Acquisition mode

1 - Enable Launch Acquisition mode

13 Multi-path Clipping select

0 - Disable Multi-path clipping mode

1 - Enable Multi-path clipping mode

14 Position Memory select

0 - Disable Position Memory mode

1 - Enable Position Memory mode

15 Rate Memory select

0 - Disable Rate Memory mode

1 - Enable Rate Memory mode

Response: @8<ack>x,[x,]...<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8AMD R<cr><lf>

@8AMD W0003<cr><lf>

Example responses: @8<ack>0003,<cr><lf>

@8<ack><cr><lf>

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A.2.7.6 Autotrack Azimuth Offset

Command format: @8AO R<cr> <lf>

or @8AO Wx<cr> <lf>

Parameters: x: autotrack demod azimuth offset; value is hexadecimal, gradient determined by autotrack demod gain setting.

Response: @8<ack>x<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8AO R<cr><lf> read azimuth offset

@8AO W5<cr><lf> write an offset of 5

Example responses: @8<ack>0002,<cr><lf>

@8<ack><cr><lf>

A.2.7.7 Autotrack Elevation Offset

Command format: @8EO R<cr> <lf>

or @8EO Wx<cr> <lf>

Parameters: x: autotrack demod elevation offset; value is hexadecimal, gradient determined by autotrack demod gain setting.

Response: @8<ack>x<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8AO R<cr><lf> read elevation offset

@8AO WFFF5<cr><lf> write an offset of -11

Example responses: @8<ack>FFFB,<cr><lf>

@8<ack><cr><lf>

A.2.7.8 Autotrack Gain Settings

These commands are similar, allowing setting of the autotrack azimuth gain A, autotrack azimuth gain B, autotrack elevation gain A and autotrack elevation gain B. The command format is

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the same for all of these commands. The only difference is which axis gain is being set (azimuth or elevation), and which gain setting (A or B).

Command format: @8xxx [y] R<cr> <lf>

or @8xxx [y] Wz[,z]...<cr> <lf>

Parameters:

x: command type :

AGA: az gain A

AGB: az gain B

EGA: el gain A

EGB: el gain B

y: receiver channel number; value may range from '1' to '7' to select receiver 1 to 7 respectively; if no channel specified, '1' is assumed.

z: gain setting in hex; gain is deterned by the value divided by 256. For example, 0x0100 = gain of 1, 0x0200 = gain of 2, 0x0080 = gain of 0.5, etc.

Response:	@8<ack>z,[z,]...<cr><lf>	for read
or	@8<ack><cr><lf>	for write
Example commands:	@8AGA R<cr><lf>	read azimuth gain for setting A
	@8EGB W0380<cr><lf>	write elevation gain for setting B
Example responses:	@8<ack>0628,<cr><lf>	read gain of 6.16
	@8<ack><cr><lf>	

A.2.7.9 Autotrack Valid Acquire Time

Command format: @8AQT R<cr> <lf>

or @8AQT Wx<cr> <lf>

Parameters:

x: the minimum time required after target acquisition to establish accurate tracking rates of the target in autotrack mode. If track is lost before this time, the backup mode will be Position Memory (if

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selected). If track is lost after this time, the backup mode will be rate Memory (if selected). The value is written or read as an integer value, with the LSB weighted as 0.02 second.

Response:	@8<ack>x<cr><lf>	for read
or	@8<ack><cr><lf>	for write
Example commands:	@8AQT R<cr><lf>	read the current setting
	@8AQT W00FA<cr><lf>	set the acquire time to 5 secs
Example responses:	@8<ack>00C8,<cr><lf>	current time is 4 secs
	@8<ack><cr><lf>	

A.2.7.10 Autotrack Rate Memory Time

Command format: @8RMT R<cr> <lf>

or @8RMT Wx<cr> <lf>

Parameters: x: the length of time after loss of autotrack that the rate backup mode will operate (if selected). After this time, the axis will revert to the mode which was active before autotrack acquisition occurred. The value is written or read as an integer value, with the LSB weighted as 0.02 second.

Response:	@8<ack>x<cr><lf>	for read
or	@8<ack><cr><lf>	for write
Example commands:	@8RMT R<cr><lf>	read the current setting
	@8RMT W02EE<cr><lf>	set the acquire time to 15 secs
Example responses:	@8<ack>03E8,<cr><lf>	current time is 20 secs
	@8<ack><cr><lf>	write successful

A.2.7.11 Autotrack Posn Memory Time

Command format @8PMT R<cr> <lf>

or @8PMT Wx<cr> <lf>

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Parameters: x: the length of time after loss of autotrack that the position backup mode will operate (if selected). After this time, the axis will revert to the mode which was active before autotrack acquisition occurred. The value is written or read as an integer value, with the LSB weighted as 0.02 second.

Response: @8<ack>x<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8PMT R<cr><lf> read the current setting

@8PMT W01F4<cr><lf> set the acquire time to 10 secs

Example responses: @8<ack>0258,<cr><lf> current time is 12 secs

@8<ack><cr><lf>

A.2.7.12 Autotrack Launch Acq Time

Command format: @8LAT R<cr> <lf>

or @8LAT Wx<cr> <lf>

Parameters: x: the length of time launch acquisition will be in effect after the initiation of autotrack. The value is written or read as an integer value, with the LSB weighted as 0.02 second.

Response: @8<ack>x<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8PMT R<cr><lf> read the current setting

@8PMT W01F4<cr><lf> set the acquire time to 10 secs

Example responses: @8<ack>0258,<cr><lf> current time is 12 secs

@8<ack><cr><lf>

A.2.7.13 Autotrack Lowtrack Min Angle

Command format: @8MPC R<cr> <lf>

or @8MPC Wx<cr> <lf>

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Parameters: x: the minimum angle below which the controller will not command the pedestal axis after the initiation of autotracking; the angle is in scaled-binary coded angle format. See paragraph A.4 for the format style.

Response: @8<ack>x<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8MPC R<cr><lf> read the current setting

@8MPC W01F4<cr><lf> set the minimum angle to 2.754 degrees

Example responses: @8<ack>038E,<cr><lf> current ang is 5 degrees

@8<ack><cr><lf>

A.2.7.14 Read Autotrack Error and AGC

Command format: @8AER<cr> <lf>

Parameters: none

Response: @8<ack>x,y,z<cr><lf>

where x: axis A autotrack error voltage

y: axis B autotrack error voltage

z: current tracking receiver AGC (signal strength) value

All values are in 16-bit hexadecimal format; the error values are proportional to the current autotrack errors, but the gradient is variable depending on the gain setting of the autotrack demod. The AGC gradient is set to approximately 0.05 dB per LSB.

Example command: @8AER<cr><lf>

Example response: @8<ack>0020,FFFB,0045,<cr><lf>

A.2.8 Diagnostic and Testing Messages

A.2.8.1 Data Gathering Start

Reception of this command will cause the servo processor to begin storing pedestal angles in memory every servo interrupt (50 Hz). Up to 10 seconds of data may be gathered. Data may be read using the DGD command.

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Command format: @8DGS [a] W[n]<cr> <lf>

Parameters:
- a: selected axis (optional); 'A' - 'D'. If no axis specified, 'A' is assumed.
- n: number of data points to store. "n" is a hexadecimal value between 1 and 500 (10 seconds). If n = 0, this will stop the gathering process.

Response: @8<ack><cr><lf>

Example commands: @8DGS W50<cr><lf> gather 50 angles for axis A

A.2.8.2 Data Gathering Dump

Command format: @8DGD R[n]<cr> <lf>

Parameters:
- n: number of data block to read. If no number specified, '0' is assumed. A block of data is defined as 5 angles. Since up to 500 angles may be stored (see DGS), block numbers may vary from 0 to 99 decimal.

Response: @8<ack>x1,x2,x3,x4,x5<cr><lf>

where x1, x2, x3, x4, and x5 are scaled-binary coded angles. See paragraph A.4 for the format style

Example commands: @8DGD R26<cr><lf> read gathered data block 26

Example responses: @8<ack>FFFB,FFF3,FFE7,FFE1,FFCD,<cr><lf>

A.2.8.3 Step Test Start

Command format: @0STS [a] Wx,y<cr> <lf>

Parameters:
- a: selected axis (optional); 'A' - 'B'. If no axis specified, 'A' is assumed. Axes are always X and Y.
- x: step size in degrees in scaled-binary coded angle format. See paragraph A.4 for the format style.
- y: duration of test; number in decimal from 1 to 10 (seconds). Numbers greater than 10 will be limited to 10.

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Response: @0<ack><cr><lf>

Example command: @0STS A W0393,5<cr><lf>

Example response: @0<ack><cr><lf>

A.2.8.4 Step Test Results/Status

This command reads the calculated step test results from the ACU.

Command format: @0STR<cr> <lf>

Parameters: none

Response: @0<ack>x,y,z<cr><lf>

If the test is still running and results are not yet available the three parameters will all be set to '0.0'. Otherwise, the three parameters are all in floating point format (ex: '35.7') as:

x: overshoot in %

y: rise time in milliseconds

z: settling time in milliseconds

Example command: @0STR<cr><lf>

Example responses: @0<ack>15.428,35.800,210.555,<cr><lf>

@0<ack>0.0,0.0,0.0,<cr><lf>

A.2.8.5 Step Test Data

This command reads the raw step test data from the ACU.

Command format: @0STD a<cr> <lf>

Parameters: a: a decimal value between 0 and 49 which indicates which block of data to read. Each data block consists of 10 pedestal angles in scaled-binary coded angle format. See paragraph A.4 for the format style. Block 0 is the first 10 angles recorded during the test, block 1 is the next 10, etc. Since there are 50 blocks, up to 500 angles may be read using this command.

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Response: @0<ack>x1,x2,x3,x4,x5,x6,x7,x8,x9,x10<cr><lf>

where x1,...,x10 are the scaled-binary coded angles in the block.

Example command: @0STD 5<cr><lf>

Example responses: @0<ack>0111,0115,0118,0120,0127,0130,0138,0140,0147,

014F,<cr><lf>

A.2.8.6 Test Input Select

Command format: @8TI R<cr> <lf>

or @8TI Wx<cr> <lf>

Parameters: x: test input command. The test input command inserts the analog test input signal into the compensation loop as defined below.

Value	Test Signal Injected:
0	Test input disabled
1	Axis A position loop
2	Axis A rate loop
3	Axis B position loop
4	Axis B rate loop

Response: @8<ack>x<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8TI R<cr><lf>

@8TI W2<cr><lf>

Example responses: @8<ack>0002,<cr><lf>

@8<ack><cr><lf>

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A.2.8.7 Test Output Select

Command format: @8TO R<cr> <lf>

or @8TO Wx<cr> <lf>

Parameters: x: test output command. The test output command selects which point of the compensation loop will be output to the test output DAC. The voltage can be measured on the servo board on TP6.

Value	Compensation Point Output
0	Axis A position error
1	Axis A position filter input (includes test input, if present)
2	Axis A position filter output
3	Axis A rate filter input (includes test input, if present)
4	Axis A autotrack error
5	Axis B position error
6	Axis B position filter input (includes test input, if present)
7	Axis B position filter output
8	Axis B rate filter input (includes test input, if present)
9	Axis B autotrack error

Response: @8<ack>x<cr><lf> for read

or @8<ack><cr><lf> for write

Example commands: @8TO R<cr><lf>

@8TO W7<cr><lf>

Example responses: @8<ack>0003,<cr><lf>

@8<ack><cr><lf>

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A.3 FILTER COMMANDS REFERENCE

Filter commands must reference a particular filter. Two characters are used for this; the first specifies the axis (A-D), the second specifies the particular filter. Use this list to determine the filter numbers:

Filter Number	Filter
1	Position error filter #1
2	Position error filter #2
3	Position error filter #3
4	Position error filter #4
5	Velocity error filter #1
6	Velocity error filter #2
7	Position feedback #1 filter
8	Position feedback #2 filter
9	Rate feedback #1 filter
10	Rate feedback #2 filter

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A.4 DATA TRANSFER FORMATS

A.4.1 Position Format

Position values are represented in the Scaled Binary Coded Angle (SBCA) format. The equivalent weight of any bit in degrees is given by the formula:

360 / 2^N, where N = bit number (MSB = bit 1)

This gives the following bit weightings:

MSB: (bit 1) 180 degrees

(bit 2) 90 degrees

(bit 3) 45 degrees

(bit 4) 22.5 degrees

.....

(bit 16) 0.00549 degrees

SBCA values are represented as a 16-bit hexadecimal number. For example:

Hexadecimal Value	Position
8000H	180 deg
1000H	22.5 deg
0001H	0.00549 deg
C000H	-90 (270) deg

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A.4.2 Rate Format

Rate values are represented in 2's complement binary code with a range of ±45 degrees/second. The values are represented as a 16-bit hexadecimal number. For example:

Hexadecimal Value	Rate Commanded
7FFFH	+45 deg/sec
1000H	5.625 deg/sec
0001H	0.00137 deg/sec
0000H	0.0 deg/sec
FFFFH	-0.00137 deg/sec
F000H	-5.625 deg/sec
8000H	-45 deg/sec

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Appendix B

STATUS AND COMMAND LINES DESCRIPTION

B.1 INTRODUCTION

Appendix B describes a typical status and command line configuration for the Series 3860 Digital Controller. Status and command lines are factory configured to meet the requirements of each system.

B.2 STATUS LINES

Status lines monitor system equipment. They indicate the status (open or closed) of switches in the system. A status line is closed when the menu item is displayed in normal video (light background with dark characters). Table B.1 describes the status line configuration. Figure B.1 illustrates the softkey menu structure of the status line configuration. The STAT II branch of the menu would be similar to STAT I.

B.3 COMMAND LINES

Command lines control switch closures. A command line is closed when the menu item is displayed in reverse video (dark background with light characters). Table B.2 describes the command line configuration. Figure B.1 illustrates the softkey menu structure of the command line configuration.

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Table B.1. Status Lines

Mnemonic Label	Softkey Label	Description	Connector Pin
STAT01	PEDPWR	PEDESTAL POWER	J102-24
STAT02	DISABL	DISABLE	J102-23
STAT03	STOWAZ	AZ STOW PIN	J102-22
STAT04	BRKAZ	AZIMUTH BRAKE RELEASE	J102-21
STAT05	+LM1AZ	AZIMUTH + PRIMARY LIMIT	J102-20
STAT06	-LM1AZ	AZIMUTH - PRIMARY LIMIT	J102-19
STAT07	SECTAZ	AZIMUTH SECTOR	J102-18
STAT08	+LM2AZ	ELEVATION + SECONDARY LIMIT	J102-17
STAT09	-LM2AZ	ELEVATION - SECONDARY LIMIT	J102-16
STAT10	STOWEL	ELEVATION STOW PIN	J102-15
STAT11	BRK EL	ELEVATION BRAKE RELEASE	J102-14
STAT12	+LM1EL	ELEVATION + PRIMARY LIMIT	J102-13
STAT13	-LM1EL	ELEVATION - PRIMARY LIMIT	J102-12
STAT14	PS1ALM	POWER SUPPLY 1 ALARM	J102-11
STAT15	PS2ALM	POWER SUPPLY 2 ALARM	J102-10
STAT16			J102-9
STAT17			J202-35
STAT18	NRMAL1	PWM AMP FAULT AZ 1	J202-34
STAT19			J202-33
STAT20			J202-32
STAT21	NRMEL1	PWM AMP FAULT EL 1	J202-2
STAT22			J202-17
STAT23			J202-1
STAT24	NRMLA2	PWM AMP FAULT AZ 2	J202-16
STAT25			J202-28
STAT26			J202-13
STAT27	NRMLE2	PWM AMP FAULT EL 2	J202-29
STAT28			J202-14
STAT29			J202-22
STAT30			J202-7
STAT31			J202-23
STAT32			J202-8

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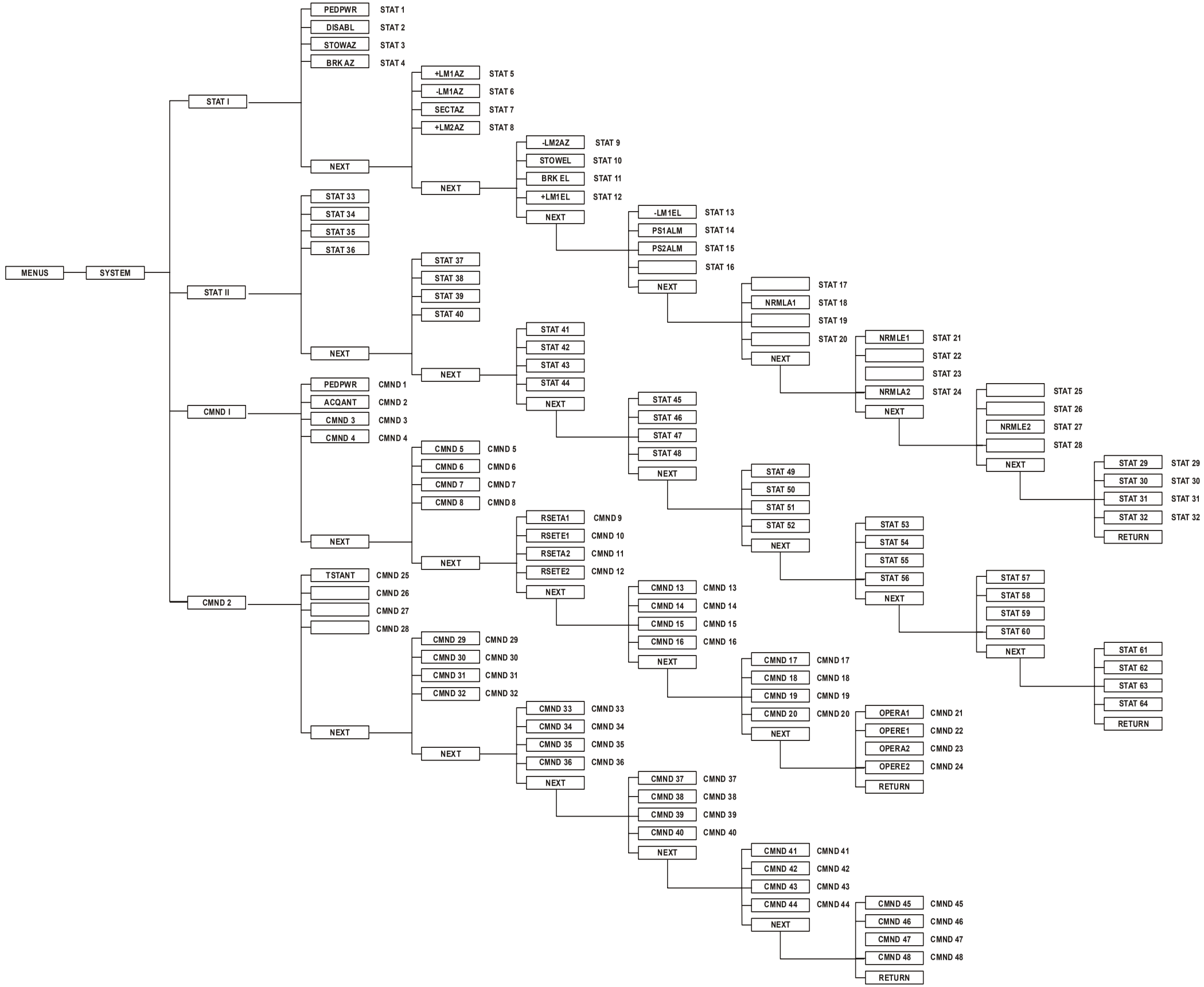
Table B.2. Command Lines

Mnemonic Label	Softkey Label	Description	Connector Pin
CMND01	PEDPWR	PEDESTAL POWER CONTROL	J102-39
CMND02	ACQANT	ACQUISITION ANTENNA SELECT	J102-40
CMND03	CMND03		J102-41
CMND04	CMND04		J102-42
CMND05	CMND05		J102-43
CMND06	CMND06		J102-44
CMND07	CMND07		J102-45
CMND08	CMND08		J102-46
CMND09	RSETA1	RESET SERVO AMP AZIMUTH 1	J202-16
CMND10	RSETE1	RESET SERVO AMP ELEVATION 1	J202-15
CMND11	RSETA2	RESET SERVO AMP AZIMUTH 2	J202-14
CMND12	RSETE2	RESET SERVO AMP ELEVATION 2	J202-13
CMND13	CMND13		J202-12
CMND14	CMND14		J202-11
CMND15	CMND15		J202-10
CMND16	CMND16		J202-9
CMND17	CMND17		J202-35
CMND18	CMND18		J202-34
CMND19	CMND19		J202-33
CMND20	CMND20		J202-32
CMND21	CMND21		J202-2
CMND22	CMND22		J202-17
CMND23	CMND23		J202-1
CMND24	CMND24		J202-16
CMND24	TSTANT	TEST ANTENNA SELECT	J203-1

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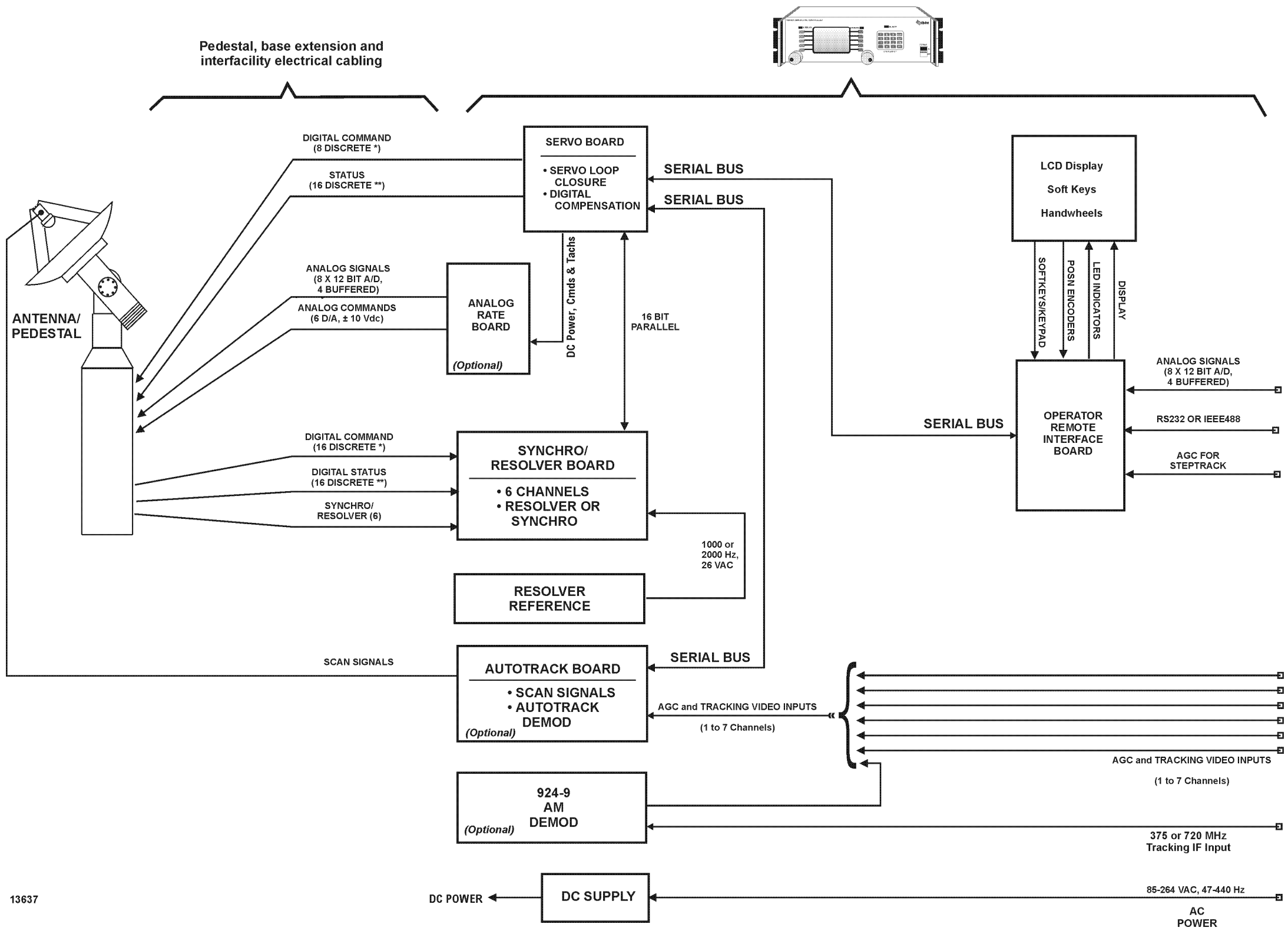


Figure 4.1. 3860 Digital Controller Block Diagram, Single-chassis Configuration

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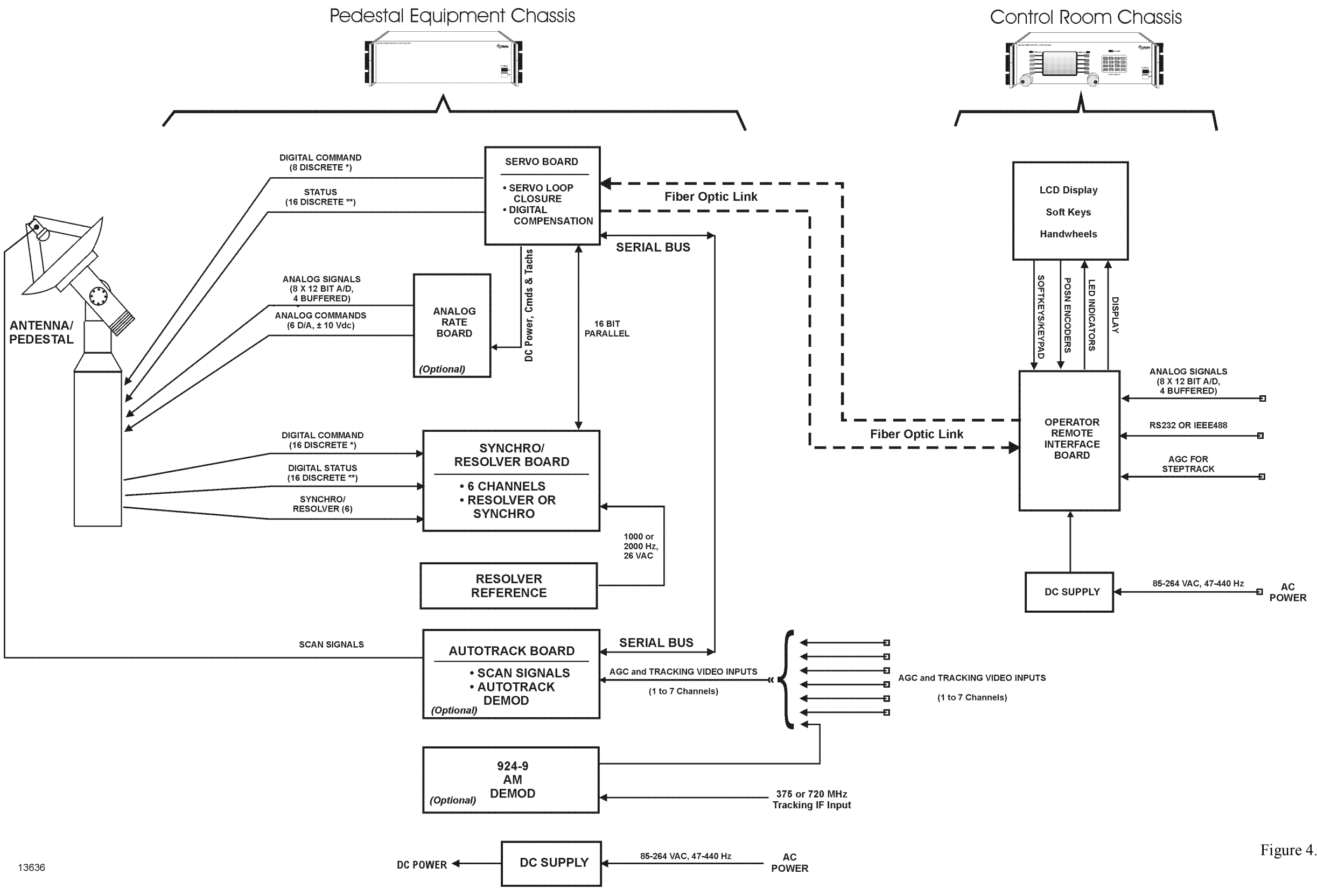


Figure 4.2 3860 Digital Controller Block Diagram, Two-chassis Configuration

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