

**NJIT 2.1m ANTENNA**

**MAINTENANCE AND REPAIR MANUAL**

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Serial Number: 001

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## Revision table

<u>Revision</u>	<u>Date</u>	<u>Description of Changes</u>
B	15/10/2013	Updated to reflect current design, added troubleshooting information

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## Introduction

This manual covers the maintenance of the antenna system, control cabinet and related components. Maintenance and repairs should only be performed by qualified technicians familiar with the system and components. Adjustment of drive parameters and setup can cause unwanted sudden movement of the antenna. This manual provides an overview of basic maintenance tasks. For more detailed information, refer to the appropriate Control Techniques documentation.

## Safety Information

### 1.2 Electrical safety - general warning

The voltages used in the drive can cause severe electrical shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to the drive. Specific warnings are given at the relevant places in this User Guide.

### 1.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, the drive may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury. Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and this User Guide carefully.

The STOP and SECURE DISABLE functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

**With the sole exception of the SECURE DISABLE function, none of the drive functions must be used to ensure safety of personnel, i.e. they must not be used for safety-related functions.**

Careful consideration must be given to the functions of the drive which might result in a hazard, either through their intended behaviour or through incorrect operation due to a fault. In any application where a malfunction of the drive or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking. The SECURE DISABLE function has been approved<sup>1</sup> as meeting the requirements of EN954-1 category 3 for the prevention of unexpected starting of the drive. It may be used in a safety-related application. **The system designer is responsible for ensuring that the complete system is**

**safe and designed correctly according to the relevant safety standards.**

### 1.4 Environmental limits

Instructions in this User Guide regarding transport, storage, installation and use of the drive must be complied with, including the specified environmental limits. Drives must not be subjected to excessive physical force.

### 1.5 Compliance with regulations

The installer is responsible for complying with all relevant regulations, such as national wiring regulations, accident prevention regulations and electromagnetic compatibility (EMC) regulations. Particular attention must be given to the cross-sectional areas of conductors, the selection of fuses or other protection, and protective earth (ground) connections. This User Guide contains instruction for achieving compliance with specific EMC standards.

Within the European Union, all machinery in which this product is used must comply with the following directives:

98/37/EC: Safety of machinery.

89/336/EEC: Electromagnetic Compatibility.

### 1.6 Motor

Ensure the motor is installed in accordance with the manufacturer's recommendations. Ensure the motor shaft is not exposed. Standard squirrel cage induction motors are designed for single speed operation. If it is intended to use the capability of the drive to run a motor at speeds above its designed maximum, it is strongly recommended that the manufacturer is consulted first.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective. The motor should be fitted with a protection thermistor. If necessary, an electric forced vent fan should be used. The values of the motor parameters set in the drive affect the protection of the motor. The default values in the drive should not be relied upon. It is essential that the correct value is entered in parameter **0.46** motor rated current. This affects the thermal protection of the motor.

### 1.7 Adjusting parameters

Some parameters have a profound effect on the operation of the drive. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering.

## **System Overview**

### **Axis Encoders**

The elevation and azimuth axes are each fitted with Heidenhain ECN 225 absolute angle encoders. These absolute encoders have an accuracy of 10 arc seconds and provide 25 bit communications resolution using the EnDat2.2 version 02 serial data interface.

The encoders interface with the drives using SM-Universal Encoder Plus modules.

### **Motors**

Elevation and azimuth use the same type of brushless servo motor, 3000RPM, 1.3A stall current, part number 075E2A301VASAA075110 from Emerson Control Techniques. The motors are fitted with holding brakes which are released by applying 24VDC to their actuator coils. Also fitted to the motor shafts are optical SinCos encoders which provide feedback to the speed control loop. The motor shaft encoders provide commutation signals to the drives. Note that the commutation signals are passed through line drivers within the Controller in order to make them compatible with the inputs of the Emerson CT drives.

### **Elevation Jack**

The elevation jack is an in-line roller screw jack with 24" stroke, 0.2" lead, IM30-2402-NF-G05-EM3-P5 from Exlar. It incorporates an anti-backlash mechanism to reduce pointing errors. The motor interfaces with an additional 5:1 planetary gearbox attached to the jack.

### **Azimuth Gearhead**

A 160:1 zero-backlash planetary gearhead, part number CSG-32-160-2UH from Harmonic Drive is used between the azimuth motor and slew ring pinion.

### **Azimuth Limit Switches**

There are two Honeywell NC type limit switches mounted inside the pedestal. One switch provides clockwise limit and the other counter-clockwise limit. They are accessible by removing the pedestal access plate. When operating in Normal Mode, it should never be possible to trip these switches. If a limit switch does occur, it should be thoroughly investigated.

### **Azimuth Sector Switches**

There are two Honeywell NC type limit switches mounted inside the pedestal. One switch disables the clockwise limit allowing the antenna to pass through it to the counter-clockwise limit. The other disables the counter-clockwise limit allowing the antenna to pass through it to the clockwise limit. They are accessible by removing the pedestal access plate.

## **Elevation Limit Switches**

There are two Honeywell NC type limit switches mounted inside the turning head. One switch provides low elevation limit and the other high elevation limit. They are accessible by removing the turning head cover plate. When operating in Normal Mode, it should never be possible to trip these switches. If a limit switch does occur, it should be thoroughly investigated.

## **Controller Cabinet**

The Controller Cabinet is a motion controller for accurate positioning and tracking. It is a fully sealed and weatherized cabinet, complete with installed rain canopy. Control and signal cables are routed to the cabinet using sealed, durable outdoor cable conduit. An Emergency Stop button is equipped on the exterior of the door for quick access.

More details are included in the electrical schematic drawings provided with the system.

## **24VDC Supply**

The controller cabinet contains a 10A, 24VDC power supply to power the drives and other components without the need to the 3-phase contactor to the drives to be closed. This allows for processor and logic functions to operate, without the risk of the motors turning or the antenna moving.

## **Hygrostat**

The controller cabinet contains a hygrostat and heater to keep the humidity level within an acceptable operating level. The 24VDC supply is disabled if the humidity rises above the specified level, 90%. The heater will then activate in order to reduce the level below this limit.

## **Hand Controller**

The hand controller is a remote control box for the system. It can be used to slew the antenna in azimuth as well as lift or lower the elevation angle, both at two different speeds. Indicator LEDs show when a soft limit and a hard limit are tripped. It is also equipped with an Emergency Stop button.

NOTE: When the hand controller is not connected, the supplied dummy jumper connector must be connected in its place to properly close the emergency stop circuit.



# **InterTronic Antennas**

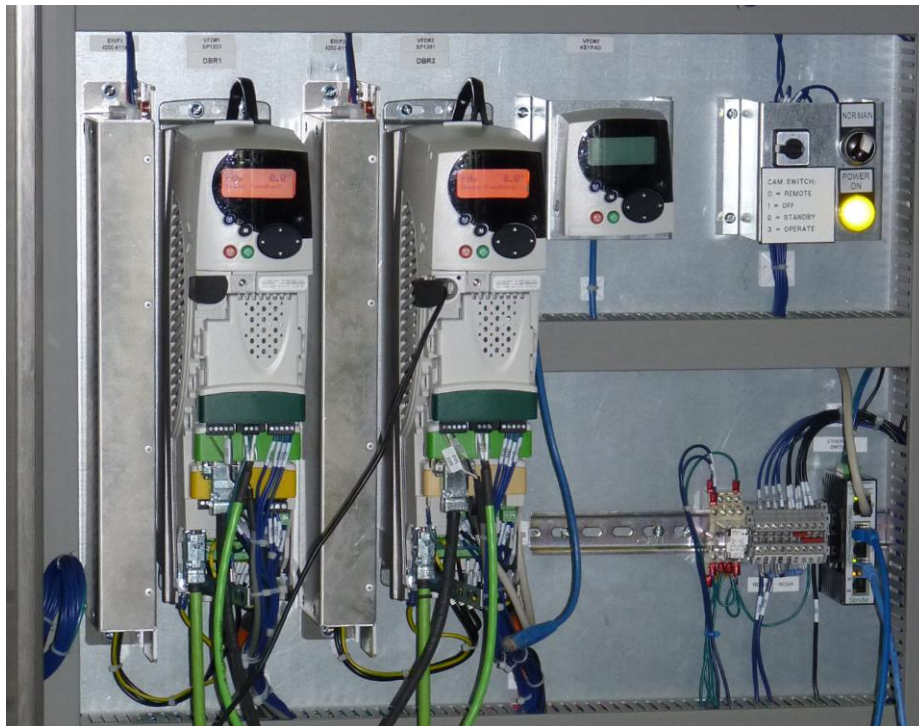
## **Drives**

Each axis motor is controlled by its own drive. They are SP1201 drives from Emerson Control Techniques and interface directly with the motors and encoders used. They operate on 200-240VAC 3-phase or single-phase with a max output of 5.2A.

Each inverter drive contains three expansion slots for various solutions modules. In this application, each drive contains an SM-Applications Plus module (Dark Green) containing the code specific to each drive. They also each contain an SM-Universal Encoder module (Light Green) to interface with the high resolution axis optical encoders. The azimuth drive contains an SM-Ethernet module (Beige) to allow remote communication to the controller. The elevation drive contains an SM-IO Plus module (Yellow) for additional digital I/O connections. Note that the modules and their locations are NOT interchangeable as the drives have been setup with a specific configuration.

The drives are connected together through the SM-Applications Plus modules. They communicate via an internal CNet network, each addressed with a different Node number (Azimuth = 2, Elevation = 1).

The SM-Applications Plus modules also share certain parameters back and forth using a cyclic link feature, allowing parameters from one module to be transferred to another.





## Navigating Drive Menus with the Keypad

Safety Information	Product Information	Mechanical Installation	Electrical Installation	<b>Getting Started</b>	Basic Parameters	Running the motor	Optimisation	Smartcard operation	Onboard PLC	Advanced Parameters	Technical Data	Diagnostics	UL Listing Information
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## 5 Getting Started

This chapter introduces the user interfaces, menu structure and security level of the drive.

### 5.1 Understanding the display

There are two keypads available for the Unidrive SP. The SM-Keypad has an LED display and the SM-Keypad Plus has an LCD display. Both keypads can be fitted to the drive but the SM-Keypad Plus can also be remotely mounted on an enclosure door.

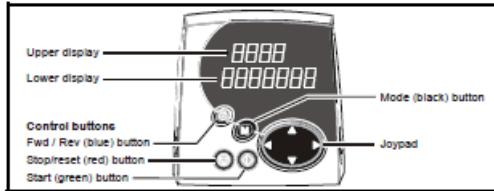
#### 5.1.1 SM-Keypad (LED)

The display consists of two horizontal rows of 7 segment LED displays.

The upper display shows the drive status or the current menu and parameter number being viewed.

The lower display shows the parameter value or the specific trip type.

Figure 5-1 SM-Keypad



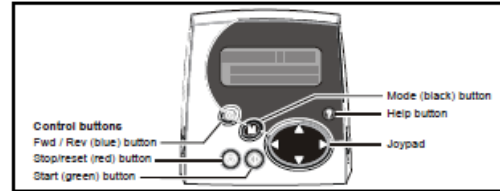
#### 5.1.2 SM-Keypad Plus (LCD)

The display consists of three lines of text.

The top line shows the drive status or the current menu and parameter number being viewed on the left, and the parameter value or the specific trip type on the right.

The lower two lines show the parameter name or the help text.

Figure 5-2 SM-Keypad Plus



**NOTE** The red stop button is also used to reset the drive.

Both the SM-Keypad and the SM-Keypad Plus can indicate when a SMARTCARD access is taking place or when the second motor map is active (menu 21). These are indicated on the displays as follows.

	SM-Keypad	SM-Keypad Plus
SMARTCARD access taking place	The decimal point after the fourth digit in the upper display will flash.	The symbol 'CC' will appear in the lower left hand corner of the display
Second motor map active	The decimal point after the third digit in the upper display will flash.	The symbol 'Mot2' will appear in the lower left hand corner of the display

### 5.2 Keypad operation

#### 5.2.1 Control buttons

The keypad consists of:

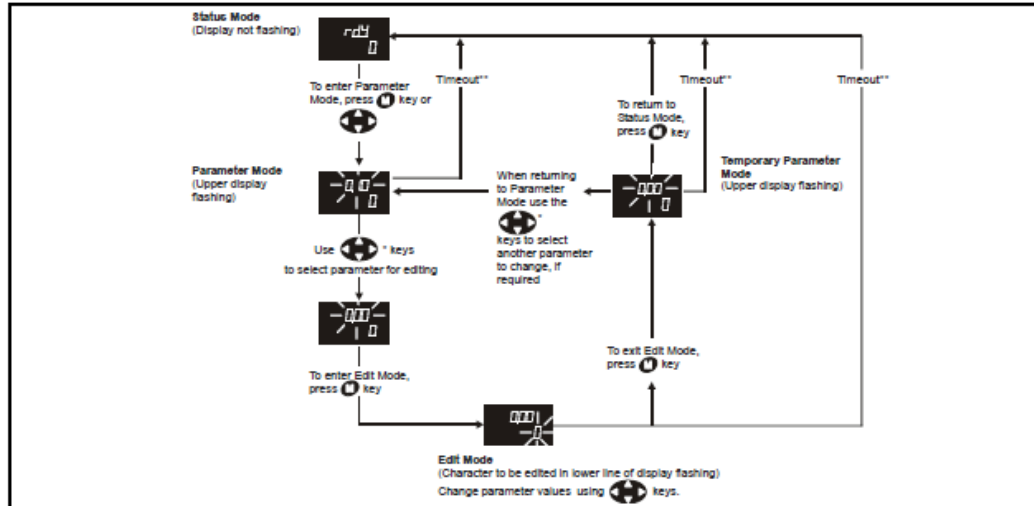
1. Joypad - used to navigate the parameter structure and change parameter values.
2. Mode button - used to change between the display modes – parameter view, parameter edit, status.
3. Three control buttons - used to control the drive if keypad mode is selected.
4. Help button (SM-Keypad Plus only) - displays text briefly describing the selected parameter.

The Help button toggles between other display modes and parameter help mode. The up and down functions on the joypad scroll the help text to allow the whole string to be viewed. The right and left functions on the joypad have no function when help text is being viewed.

The display examples in this section show the SM-Keypad 7 segment LED display. The examples are the same for the SM-Keypad Plus except that the information displayed on the lower row on the SM-Keypad is displayed on the right hand side of the top row on the SM-Keypad Plus.

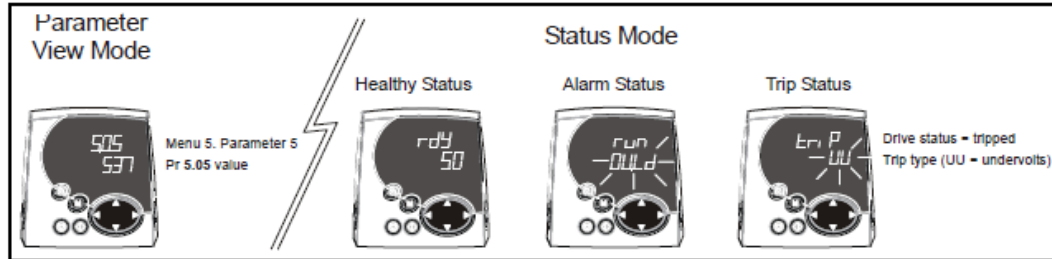
Safety Information	Product Information	Mechanical Installation	Electrical Installation	<b>Getting Started</b>	Basic Parameters	Running the motor	Optimisation	Smartcard operation	Onboard PLC	Advanced Parameters	Technical Data	Diagnostics	UL Listing Information
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Figure 5-3 Display modes



\* can only be used to move between menus if L2 access has been enabled (Pr 0.49). Refer to section 5.9 on page 106.  
 \*\*Timeout defined by Pr 11.41 (default value = 240s).

Figure 5-4 Mode examples



**WARNING**  
 Do not change parameter values without careful consideration; incorrect values may cause damage or a safety hazard.

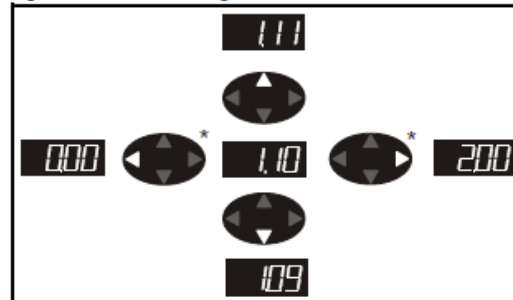
**NOTE**  
 When changing the values of parameters, make a note of the new values in case they need to be entered again.

**NOTE**  
 For new parameter-values to apply after the AC supply to the drive is interrupted, new values must be saved. Refer to section 5.7 Saving parameters on page 106.

### 5.3 Menu structure

The drive parameter structure consists of menus and parameters. The drive initially powers up so that only menu 0 can be viewed. The up and down arrow buttons are used to navigate between parameters and once level 2 access (L2) has been enabled (see Pr 0.49) the left and right buttons are used to navigate between menus. For further information, refer to section 5.9 Parameter access level and security on page 106.

Figure 5-5 Parameter navigation



\* can only be used to move between menus if L2 access has been enabled (Pr 0.49). Refer to section 5.9 Parameter access level and security on page 106.

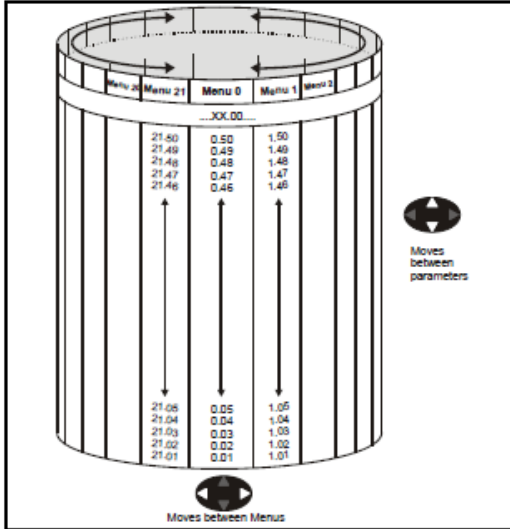
The menus and parameters roll over in both directions.

i.e. if the last parameter is displayed, a further press will cause the display to rollover and show the first parameter.

When changing between menus the drive remembers which parameter was last viewed in a particular menu and thus displays that parameter.

Safety Information	Product Information	Mechanical Installation	Electrical Installation	Getting Started	Basic Parameters	Running the motor	Optimisation	Smartcard operation	Onboard PLC	Advanced Parameters	Technical Data	Diagnostics	UL Listing Information
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Figure 5-6 Menu structure

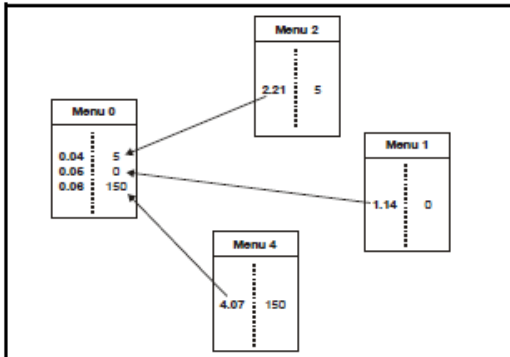


## 5.4 Menu 0

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive. Appropriate parameters are cloned from the advanced menus into menu 0 and thus exist in both locations.

For further information, refer to Chapter 6 Basic parameters (Menu 0) on page 109.

Figure 5-7 Menu 0 Cloning



## 5.5 Advanced menus

The advanced menu consist of groups or parameters appropriate to a specific function or feature of the drive. Menus 0 to 22 can be viewed on both keypads. Menus 40 and 41 are specific to the SM-Keypad Plus (LCD). Menus 70 to 91 can be viewed with an SM-Keypad Plus (LCD) only when an SM-Applications is fitted.

Menu	Description	LED	LCD
0	Commonly used basic set up parameters for quick / easy programming	✓	✓
1	Frequency / speed reference	✓	✓
2	Ramps	✓	✓
3	Slave frequency, speed feedback and speed control	✓	✓
4	Torque and current control	✓	✓
5	Motor control	✓	✓
6	Sequencer and clock	✓	✓
7	Analogue I/O	✓	✓
8	Digital I/O	✓	✓
9	Programmable logic, motorised pot and binary sum	✓	✓
10	Status and trips	✓	✓
11	General drive set-up	✓	✓
12	Threshold detectors and variable selectors	✓	✓
13	Position control	✓	✓
14	User PID controller	✓	✓
15, 16, 17	Solutions Module set-up	✓	✓
18	Application menu 1	✓	✓
19	Application menu 2	✓	✓
20	Application menu 3	✓	✓
21	Second motor parameters	✓	✓
22	Additional Menu 0 set-up	✓	✓
40	Keypad configuration menu	X	✓
41	User filter menu	X	✓
70	PLC registers	X	✓
71	PLC registers	X	✓
72	PLC registers	X	✓
73	PLC registers	X	✓
74	PLC registers	X	✓
75	PLC registers	X	✓
85	Timer function parameters	X	✓
86	Digital I/O parameters	X	✓
88	Status parameters	X	✓
90	General parameters	X	✓
91	Fast access parameters	X	✓

## Modifying and Saving Drive Parameters

To modify a drive parameter:

- Use the keypad to navigate to the desired menu and parameter
- Press the black Mode button to enter the parameter edit mode



- The parameter value will flash
- Use the keypad to modify the parameter to the desired value
- Press the black Mode button again to return to parameter view mode

Once parameters have been changed, the change will not be saved automatically. A save function must be carried out. In order to perform a parameter save:

- Use the keypad to navigate to parameter #0.00
- Press the black Mode button to enter the parameter edit mode
- Modify parameter #0.00 to 1001
- Press the black Mode button again to return to parameter view mode
- Press the red Reset button



- CC will appear on the left of the screen, indicating a parameter save is taking place
- Once parameter #0.00 has returned to 0, the parameter save is complete

## **Regular Maintenance – To be Performed Every 6 Months**

### **Conduit and Wiring Visual Inspection**

- Inspect all cable conduits for cracking, perforation or chafing. Inspect cable conduit end fittings to insure they are tightly connected.
- Inspect all wiring for cracking, perforation or chafing. Make sure cables are not under excessive strain and appropriate strain relief is provided.
- Inspect all motor and encoder wiring connectors. Make sure they are properly secured to their mating connectors.

### **General Visual Inspection**

Inspect all components for physical damage or corrosion due to environmental factors. Insure that any scratches or chips in the paint are touched up to prevent corrosion.

### **Reflector Drainage**

Verify there is no water accumulation in reflector dish and that the drainage pipe is clear of obstructions. The drain pipe should be placed as to funnel rain outside of the pedestal footprint.

### **Soft Limit Test**

- Turn REMOTE/OFF/STANDBY/OPERATE switch to OFF position
- Power down the control system
- Plug in the Hand Controller
- Power up the control system in NORMAL mode
- Turn REMOTE/OFF/STANDBY/OPERATE switch to STANDBY and then to OPERATE
- Using the Hand Controller, move the reflector through its entire range of motion, both in azimuth and elevation. Verify that the control software stops the reflector before tripping the limit switches. The LEDs should flash to indicate a soft limit has been reached.
- Unplug Hand Controller and plug in jumper connector
- Turn REMOTE/OFF/STANDBY/OPERATE switch to OFF position
- Power down the control system
- Unplug Hand Controller and plug in jumper connector.
- Turn REMOTE/OFF/STANDBY/OPERATE switch back to REMOTE

### **Limit Switch Test**

- Turn REMOTE/OFF/STANDBY/OPERATE switch to OFF position
- Power down the control system
- Plug in the Hand Controller
- Power up the control system in MAINTENANCE mode

- Turn REMOTE/OFF/STANDBY/OPERATE switch to STANDBY and then to OPERATE
- Using the Hand Controller, move the reflector through its entire range of motion, both in azimuth and elevation. Verify that the antenna stops when it has tripped a limit switch. It should then only be possible to move away from the limit until the limit switch is released.
- Turn REMOTE/OFF/STANDBY/OPERATE switch to OFF position
- Power down the control system
- Unplug Hand Controller and plug in jumper connector.
- Power up the control system in NORMAL mode
- Turn REMOTE/OFF/STANDBY/OPERATE switch back to REMOTE

## **Emergency Stop Test**

- Turn REMOTE/OFF/STANDBY/OPERATE switch to OFF position
- Power down the control system
- Plug in the Hand Controller
- With the control system in NORMAL mode, turn switch to STANDBY
- Press the emergency stop button on the door of the control cabinet
- Verify that both drives display ETrip (External Trip)
- Release the emergency stop button by turning clockwise
- Press the red reset button on both drives
- Press the emergency button on the Hand Controller
- Verify that both drives display ETrip (External Trip)
- Release the emergency stop button by turning clockwise
- Press the red reset button on both drives
- Turn REMOTE/OFF/STANDBY/OPERATE switch to OFF position
- Power down the control system
- Unplug Hand Controller and plug in jumper connector.
- Power up the control system in NORMAL mode
- Turn REMOTE/OFF/STANDBY/OPERATE switch back to REMOTE

## Slew Ring Bearing Greasing

Remove upper pedestal access plate



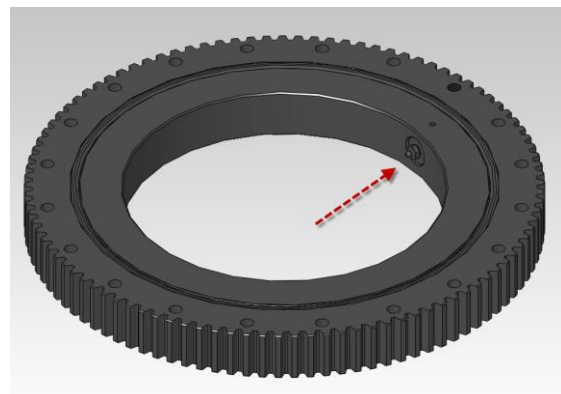
Using a grease gun attached to the grease nipple on the inner ring of the slew ring, insert new grease while rotating the reflector across its entire azimuth range. Take care not to trip the limit switches with the grease gun hose. **IMPORTANT:** It is crucial to rotate the reflector while inserting new grease to insure even distribution around the inner bearings. Failure to do so will reduce the lifespan of the bearing.

**\*\* USE LITHIUM BASED MINERAL OIL GREASE \*\***

Wipe off any excess grease that has been pushed out of the bearing seals.

Reinstall the upper pedestal access plate

Remove protective ring access plate.







Wipe off old grease from pinion gear.

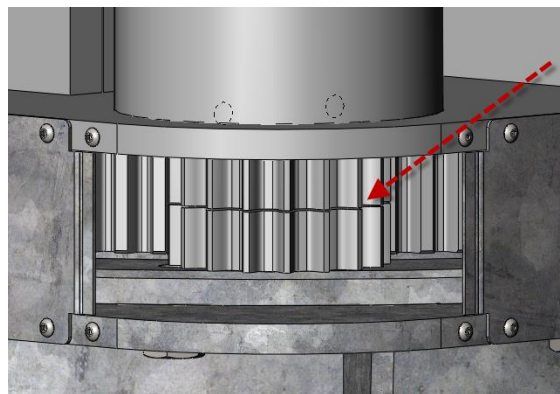
Apply fresh coat of grease around entire pinion. Rotate the reflector as necessary.

**\*\* USE OPEN GEAR EXTREME PRESSURE AND  
TEMPERATURE GREASE \*\***

Rotate reflector across its entire azimuth range so that new grease is spread across the external teeth of the slew ring.

Re-apply another coat of grease to the pinion

Reinstall the protective ring access plate

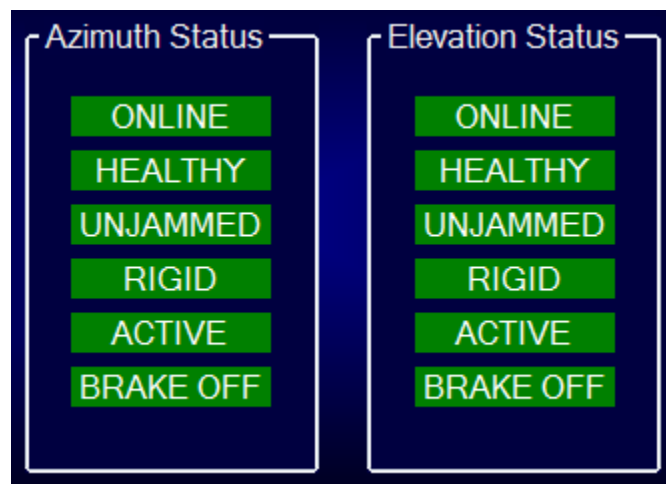




## **Troubleshooting**

Any unexpected system behaviour or error must be investigated. There are various ways of finding useful clues and diagnosing any issues. CTScope is also a powerful tool used to trend and trace various drive parameters. It can be very helpful in tracking down any potential issues. The first step is to look at the diagnostics page in the ACI for any trip codes or error statuses. These parameters can also be seen directly on the drives themselves.

The status page in the ACI displays six status boxes for each drive. All six boxes need to be green for motion to be achieved.



The Online/Offline status indicates if the drive is detected on the network.

The Healthy/Tripped status indicates if the drive is tripped. This includes the Under Voltage trip that occurs when the 3-phase contactor is open.

The Unjammed/Jammed status indicates if the drive has exceeded the rated current of the motor. This would indicate if the axis is jammed and cannot physically move.

The Rigid/Runaway status indicates if there is an excessive difference between the motor RPM and the axis RPM, taking into account the gear ratio. This would indicate that the motor has somehow become uncoupled from the axis encoder either via gearbox failure, or slippage between the motor and gearbox or the axis encoder and axial shaft.

The Active/Inactive status indicates that the drive inverter is active and is able to power the motors.

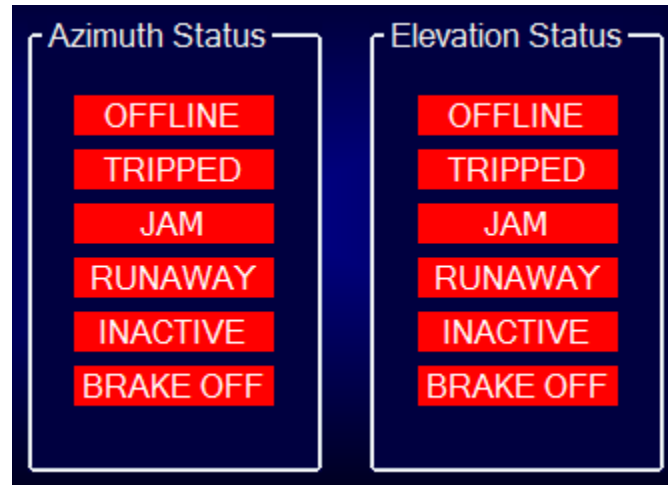
The Brake OFF/Brake ON status indicates the state of the motor brake.

Any current drive trip will be displayed on the drive keypad. Refer to the appropriate Control Techniques documentation for information on specific trips. Some of the most common drive trips are detailed in the Antenna Controller Software Manual.

Here is a list of the most useful parameters to aid with troubleshooting

<b><i>Parameter</i></b>	<b><i>Description</i></b>
#3.02	Motor RPM
#3.29	Motor encoder coarse position
#3.30	Motor encoder fine position
#4.02	Active current
#10.20-#10.22	Last three drive trips
#10.17	Current overload alarm
#10.18	Over-temperature alarm
#10.01	Drive healthy bit
#10.02	Inverter active bit
#10.03	At zero speed bit
#10.04	At or below minimum speed bit
#10.05	Below set speed bit
#10.06	At speed bit
#10.07	Above set speed bit
#10.08	Load reached bit
#10.09	Drive output is at current limit bit
#10.10	Regenerating bit
#10.11	Braking IGBT active bit
#10.12	Braking resistor alarm bit
#10.13	Direction commanded bit
#10.14	Direction running bit
#10.15	Mains loss alarm bit
#15.03	SM-Applications Plus program status
#15.36	SM-Applications Plus CTNet status
#15.48	SM-Applications Plus DPL code line in error
#15.50	SM-Applications Plus error code
#16.50	SM-Universal Encoder Plus error code
#17.06	SM-Ethernet network status
#17.49	SM-Ethernet SNTP warning
#17.50	SM-Ethernet or SM-I/O Plus error code
#88.02	DPL code task in error

## List of Possible Status Faults



- OFFLINE:** SM-Applications Plus module not properly seated in drive, failure of 24VDC supply or supply wiring to drive, faulty wiring between nodes, CTNet setup parameters have been changed
- TRIPPED:** 3-phase power contactor to drive is open resulting in an Under Voltage UU trip, drive is tripped by an E-Stop button resulting in an External Et Trip
- JAM:** Motor is trying to drive against brake (i.e. brake has not released), antenna is physically prevented from moving, high winds causing excessive current draw from the drive
- RUNAWAY:** Encoder has become loose on encoder shaft, motor connection to jack has become loose, gearbox failure
- INACTIVE:** Drive inverter is not active, 3-phase wiring to drive faulty, blown fuse
- BRAKE OFF:** Motor brake is applied, faulty motor wiring, 24VDC supply failure, blown brake fuse

## **Error Codes and Descriptions**

Below is a list of error codes, the drive parameters they are stored in and a brief description of the error. This list is intended to aid in basic trouble shooting and to indicate which parameters to look at to diagnose any errors. Detailed troubleshooting is available in the Control Techniques documentation provided with the system.

**Disclaimer: Only the most common error codes are described below. Please refer to Control Techniques documentation for appropriate Drive/Solutions Module for detailed error description and suggested resolution.**

## **Drive Error Codes and Status Words**

Last, Before Last and Before Before last drive trip stored in parameters **#10.20-#10.22** on each drive.

- 185 = SmartCard Fail
- 189 = Encoder Overload
- 9 = Internal Overload
- 200,205,210 = Hardware Fault
- 203,208,213 = Module Removed
- 190 = Motor Encoder Wire Break
- 192 = Motor Encoder Comms Failure
- 195 = Motor Encoder Initialisation Failed
- 7 = Motor Overspeed
- 9 = 24V Power Supply Overload
- 6 = External Trip (E-Stop)
- 1 = Under Voltage (Main Contactor Open)

The current overload alarm is stored in parameter **#10.17** on each drive

- 1 = Current Overload
- 0 = Normal

The over-temperature alarm is stored in parameter **#10.18** on each drive

- 1 = Over-temperature Alarm
- 0 = Normal

The status word is stored in parameter **#10.40** on each drive. It is decomposed to give parameters **#10.01** (bit 0) to **#10.15** (bit 14)

- #10.01: 1 = Drive Healthy, 0 = Tripped
- #10.02: 1 = Inverter Active, 0 = Not Active
- #10.03: 1 = At Zero Speed, 0 = Not At Zero Speed
- #10.04: 1 = Running at or below min speed, 0 = Not Running at or below min speed
- #10.05: 1 = Below Set Speed
- #10.06: 1 = At Speed
- #10.07: 1 = Above Set Speed
- #10.08: 1 = Load Reached

- #10.09: 1 = Drive Output is at Current Limit
- #10.10: 1 = Regenerating
- #10.11: 1 = Braking IGBT Active
- #10.12: 1 = Braking Resistor Alarm
- #10.13: 1 = Direction Commanded Negative, 0 = Direction Commanded Positive
- #10.14: 1 = Direction Running Negative, 0 = Direction Running Positive
- #10.15: 1 = Mains Loss

## *SM-Applications Plus Module Error Codes*

Applications Module Error code is stored in parameter **#15.50** on each drive.

- 39 = User program stack overflow
- 40 = Unknown error - please contact supplier
- 41 = Parameter does not exist. User has attempted to read or write a non-existent parameter in the module program.
- 42 = Attempt to write to a read-only parameter.
- 43 = Attempt to read from a write-only parameter.
- 44 = Parameter value out of range. (User has written an illegal value to a parameter within a DPL program.) If parameter #MM.17=0 the value written will be automatically limited and no error will occur.
- 45 = Invalid synchronisation modes
- 48 = RS485 not in user mode. Occurs if user attempts to use a user-mode RS485 DPL command but the RS485 port is not in a user-mode.
- 49 = Invalid RS485 configuration. For example, invalid mode
- 50 = Maths error - divide by zero or overflow.
- 51 = Array index out of range. E.g. arr%[20] where arr% has only been dimensioned to 19 elements.
- 52 = Control word user trip. Instigated by setting the trip bit in the control word #90.11
- 53 = DPL program incompatible with target. For example, downloading a program compiled for UD70.
- 54 = DPL task overrun. This occurs if the DPL code within a real-time task (e.g. POS0) cannot be completed in time. Use parameter #88.02 to identify the task in which this error occurred. Check that the task scheduling rate is correct and that there are no loops in the task. This can also occur as a result of external influences such as a large burst of data coming in over CTNet. This problem may be overcome by changing the CTNet priority so that it is lower than the POS tasks. This, however, may cause the CTNet task to be starved. Refer to parameter *Pr 81.44* on page 40 for further information.
- 55 = Invalid encoder configuration. Only applies to system file

V01.02.01 or earlier.

- 56 = Invalid timer unit configuration
- 57 = Function block does not exist.
- 58 = Flash PLC Storage corrupt. Occurs at startup and will mean that the PLC register set (P/Q/T/U) and menu 20 will not have been restored. If this problem persists it may indicate a hardware failure so contact your supplier.
- 59 = Drive rejected application module as Sync master
- 60 = CTNet hardware failure. Please contact your supplier
- 61 = CTNet invalid configuration. Check all configuration parameters.
- 62 = CTNet invalid baud-rate. Check #MM.24 and network connections.
- 63 = CTNet invalid node ID. Check #MM.23.
- 64 = Digital Output overload. Both digital outputs will be taken inactive when this occurs and will remain inactive until the error condition is cleared. The trip threshold is 20mA.
- 65 = Invalid function block parameter(s). You have called a FB within a DPL program but one or more of the inputs are invalid.
- 66 = User heap too large. The program has been compiled for a target that has more RAM than this one has. Occurs at startup.
- 67 = RAM file does not exist or a non-RAM file id has been specified.
- 68 = The RAM file specified is not associated to an array.
- 69 = Failed to update drive parameter database cache in Flash memory. 70 User program downloaded while drive enabled. Will occur if #MM.37 = 1 and a program is downloaded.
- 71 = Failed to change drive mode
- 72 = Invalid CTNet buffer operation.
- 73 = Fast parameter initialisation failure
- 74 = Over-temperature
- 75 = Hardware unavailable. The user program attempted to access unavailable hardware. e.g. if access is made to digital I/O, RS485 port or CTNet on SM-Applications Lite module.
- 76 = Module type cannot be resolved. Module is not Recognised.
- 77 = Inter-Option module comms error with module in slot 1.
- 78 = Inter-Option module comms error with module in slot 2.
- 79 = Inter-Option module comms error with module in slot 3.
- 80 = Inter-Option module comms error with module unknown slot.
- 81 = Slot selected as the reference or feedback does not

contain a position option module OR Attempt to change the Reference source or the Feedback source in more than one task. APC internal error. See Pr 81.38. This may be caused by one of the following:

- CAM table too small
- A change of too many CAM segments has occurred at the CAM table input
- CAM is selected but size is zero
- CAM absolute mode selected and Reset Index or  
Reset Position in segment is out of range

82 = Communications to drive faulty.

Program Status of software loaded into Application Module is stored in parameter **#15.03**

0 = None (no program is loaded)

1 = Stop (program has been stopped)

2 = Run (program is running)

3 = Trip (program has tripped and is no longer running)

The line number in the DPL code where the error occurred is stored in parameter **#15.48**

The intra-module communications protocol CTNet status is stored in parameter **#15.36**

>0 = Healthy

0 = No Network

-1 = Recon

-2 = Initialisation Error

-3 = MyRecon

The software task where an error occurred is stored in parameter **#88.02**

50 = System

1 = Initial

2 = Background

3 = Clock

4 = Error

5 = Pos0

6 = Pos1

7 = Event

8 = Event1

9 = Event2

10 = Event3

11 = APC

## ***SM-Universal Encoder Plus Module***

The axis encoder module error code is stored in parameter **#16.50** on both drives

1= Power Supply Short Circuit

2 = Wire Break

4 = Comms Failure

6 = Power Supply Failure

7 = Initialisation Failed

12 = Auto-Configuration Failed

74 = Module Overheated

## ***SM-Ethernet Module***

The Ethernet module error code is stored in parameter **#17.50** on the Azimuth Drive

- 74= Overheated,
- 75= Not Responding
- 76 = Timeout,
- 80-83 = Inter-option communication failure.

The SNTP connection warning code is stored in parameter **#17.49** on the Azimuth Drive

- 3 = SNTP Delay
- 0 = None

The network status is stored in parameter **#17.06**

- >0 = Network Healthy,
- 0 = Link Established
- 1 = Initialisation Complete
- 95 = Initialisation Failed

## ***SM-I/O Plus Module***

The I/O module error code is stored in parameter **#17.50** on the Elevation Drive

- 0 = No errors
- 1 = Digital output short circuit
- 74 = Module over-temperature



## **Component Replacement**

### **Drive Module Replacement**

**Wait at least two minutes after the controller has been powered down before removing any modules.**

#### **SM-I/O Plus and SM-Universal Encoder Plus**

The SM-I/O Plus module (Yellow) located on the Elevation Drive, as well as the SM-Universal Encoder Plus modules (Light Green) located in both drives can be replaced without any special procedure.

#### **SM-Ethernet**

To replace the SM-Ethernet module (Beige) located in the Azimuth Drive, the SNTP time server source must be setup.

- Once the new module is connected to the drive, power the cabinet up, but leave the REMOTE/OFF/STANDBY/OPERATE switch in the OFF position.
- Navigate to parameter #17.10 on the azimuth drive and input the desired IP address for the cabinet in parameters #17.10 through #17.13, the subnet mask in parameters #17.14 through #17.17 and the default gateway address in parameters #17.18 through #17.21
- Save the IP change by entering 1001 into menu #0.00 and press the red reset button
- Change parameter #17.32 to ON to perform a re-initialize of the Ethernet module
- Connect to the controller with a web browser by typing the IP into the address bar
- Login using the username and password. Initially these are set to root/intertronic
- Navigate to Protocols -> Scheduled Events -> Modify Configuration
- Enter the IP address of the SNTP time source, check Source Enabled and set the type to SNTP Request with a 1 Minute update warning delay. Set the request interval to 30 seconds and select No Timezone Set and deselect Automatic DST. Click Apply.
- Under Event, click New
- Create an Event called "Write Time". Set the Time of First Event to 000 ms. Leave the other boxes empty. Set the Event Action to Write Time and choose Seconds since 1970. Enter #70.51 into the Base Parameter. Set the Recurrence Rule to 1 Second. Click Apply.
- Under Event, click New
- Create an Event called "Clock Set". Set the Time of First Event to 100 ms. Leave the other boxes empty. Set the Event Action to Trigger event Task and select Slot 1. Set the Recurrence Rule to 1 Second. Click Apply.

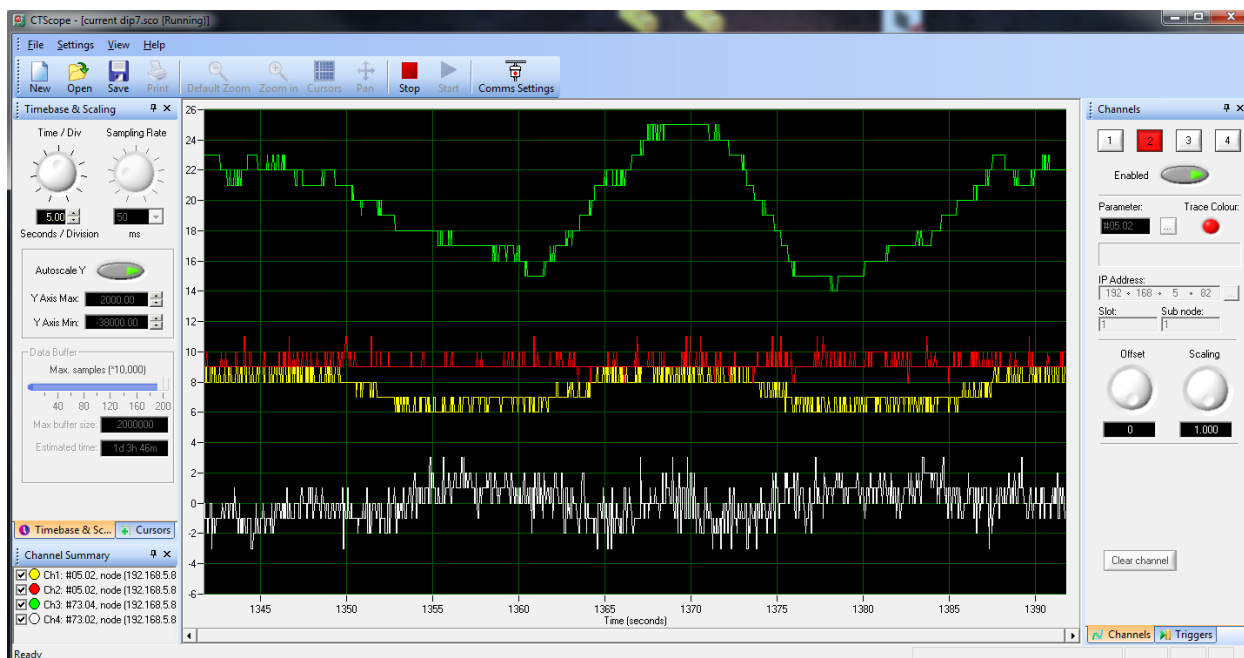
## SM-Applications Plus

The SM-Applications Plus modules (Dark Green) are not interchangeable as they contain specific software for each drive. If a module fails a new one can easily be fitted, but the software must be uploaded into the new module. Wait at least two minutes after the controller has been powered down before removing the modules. In order to upload the module software, the supplied WinFlash program is used.

**CTScope must be installed in order for WinFlash to function correctly as it installs and runs the CT Comms Server process required to communicate with the controller.**

## Installing CTScope

CTScope is a Microsoft Windows PC Tool designed to trend and trace the values of parameters on Control Techniques drives and option modules. CTScope provides a single oscilloscope display on which a number of channels can be displayed. A feature set (and look and feel) similar to that of a hardware oscilloscope is provided. It is an essential tool for monitoring the performance of the system, and diagnosing any potential issues.



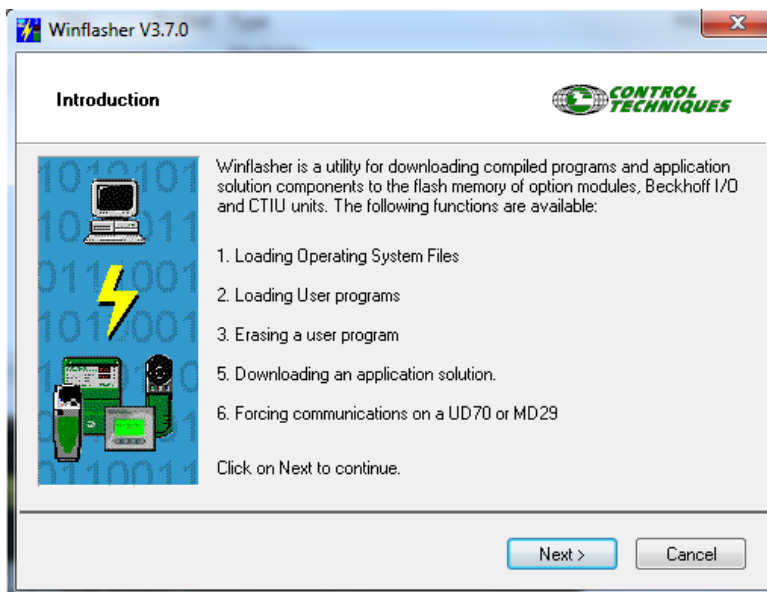
To install, simply unzip CTScope V01.01.04.zip and run CTScope V01\_01\_04.exe. Follow the instructions to complete installation.

Full operating instructions are provided in the CTScope help files.

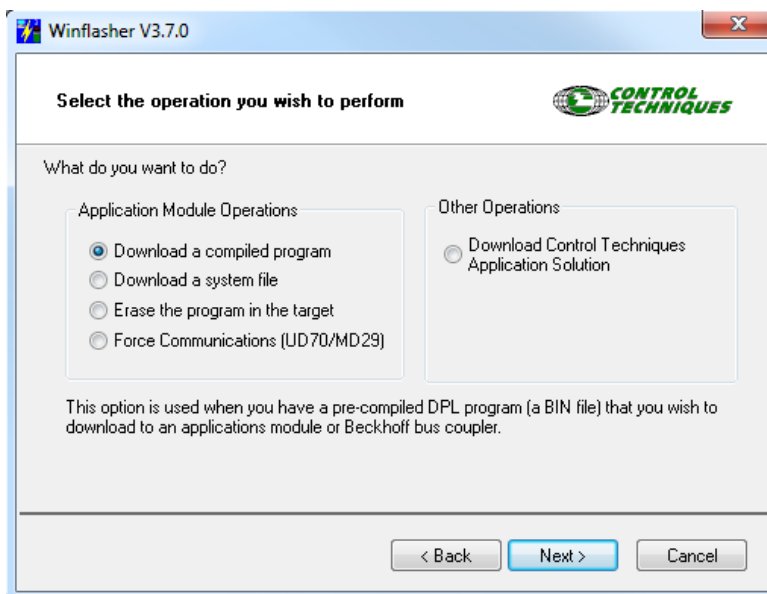
## Installing WinFlash

WinFlash is a utility for downloading compiled programs and application solution components to the flash memory of the option modules. To upload new code into the modules, the drives must be powered up, with the REMOTE/OFF/STANDBY/OPERATE switch in the Standby position.

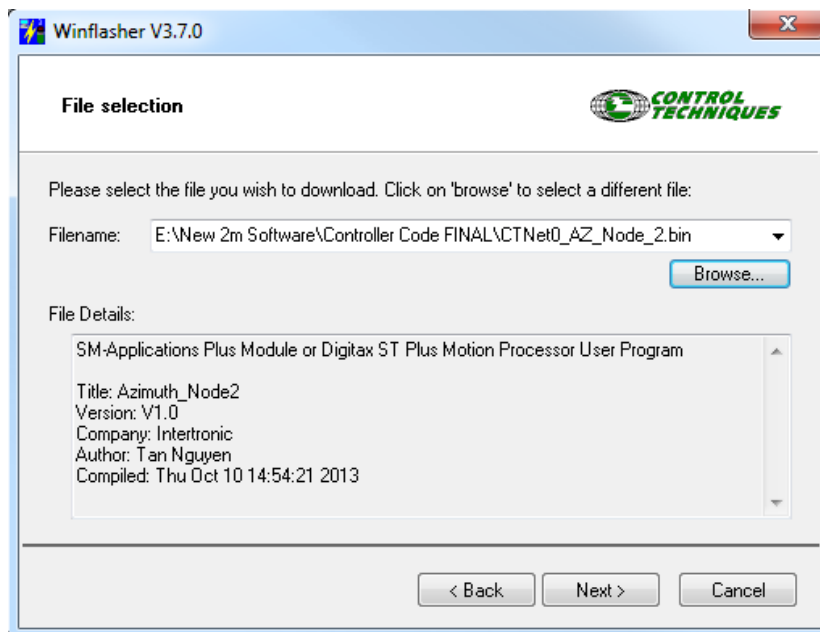
To run, simply unzip Winflash370.zip and run winflash.exe.



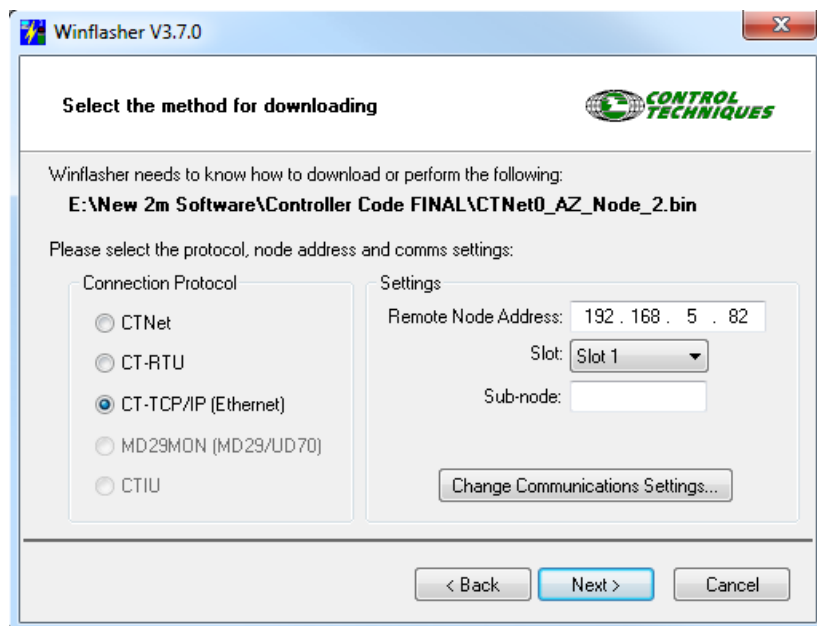
Click Next



Select "Download a compiled program" and click Next



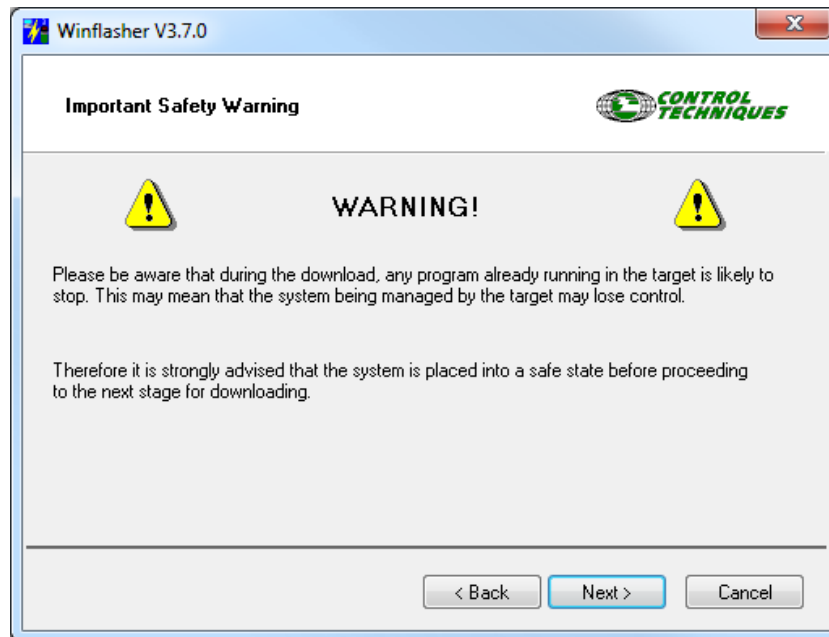
Click Browse and navigate to the folder where the .bin files are stored. Select the appropriate file depending which drive is to be updated. Click Next.



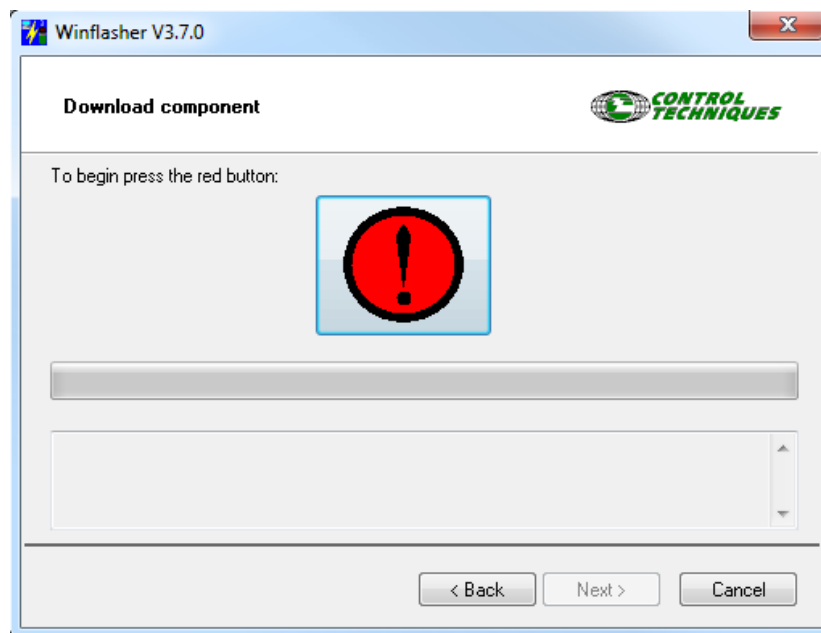
Select CT-TCP/IP(Ethernet), enter the IP address of the controller and select Slot 1 from the dropdown list.

If updating the Azimuth Drive (Node 2), leave the Sub-node box empty.  
If updating the Elevation Drive (Node 1), enter 1 in the Sub-node box.

Click Next



Click Next



Click the Red Button to start the upload. A progress bar will appear and the module will be updated.

## **Motor and Encoder Replacement**

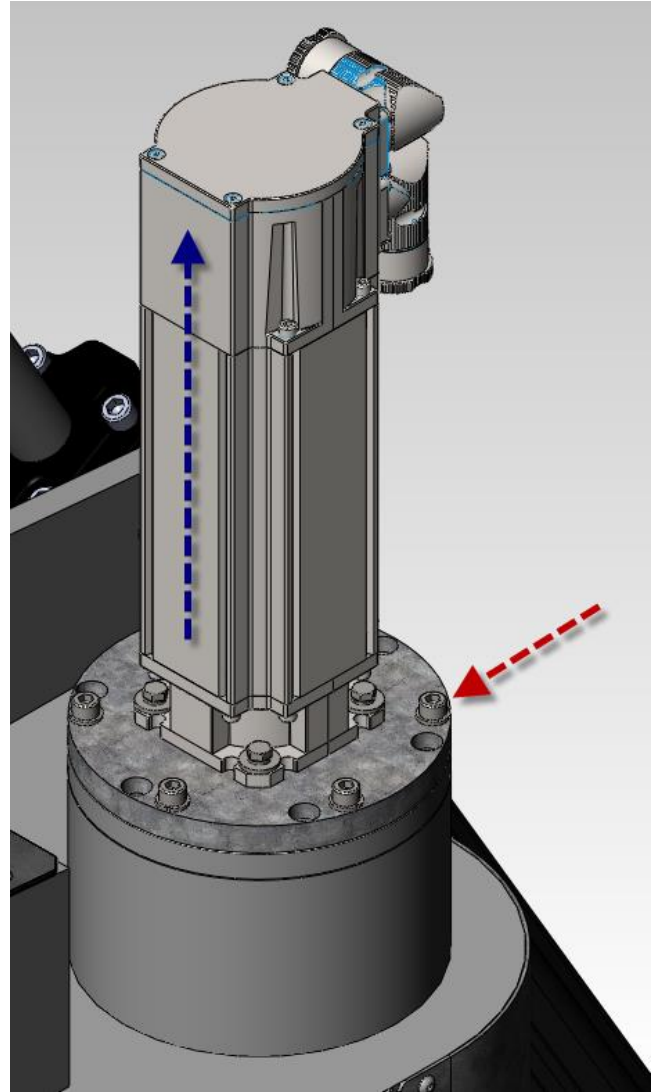
### **Motor Auto-Tune Procedure**

If a motor is being replaced, the new motor must be auto-tuned in order to properly set various drive parameters. This must be done BEFORE connecting the motor to any load or gearbox.

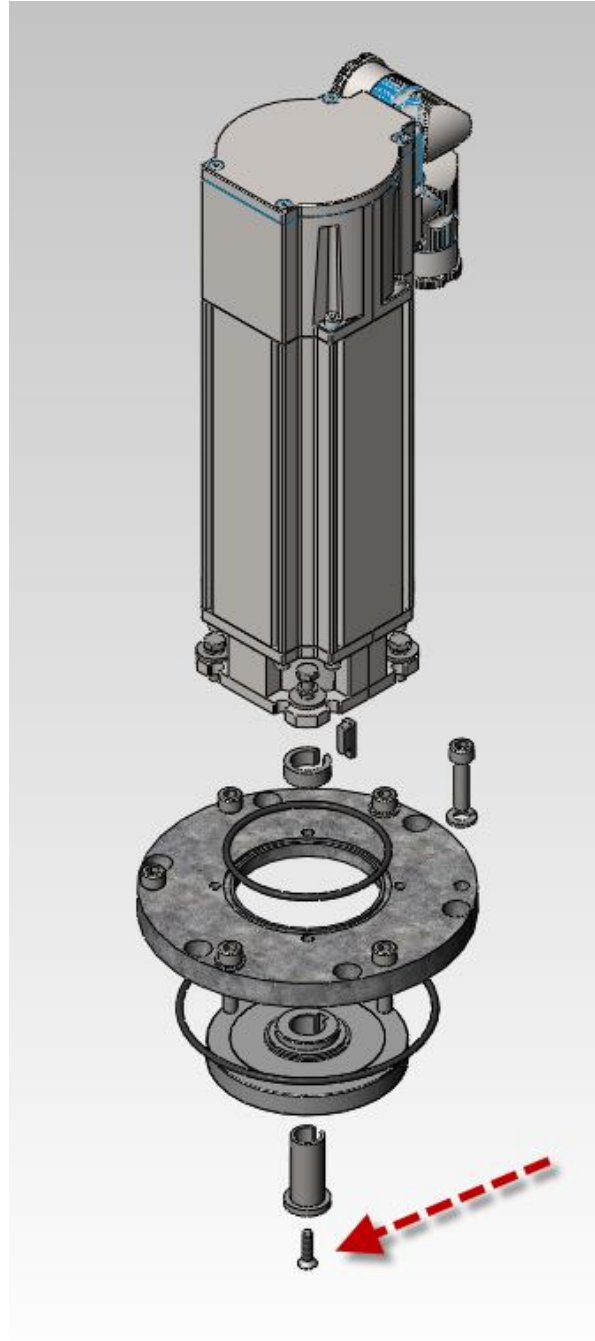
- Power down the controller
- Connect motor power and signal cables
- Power up the controller in Maintenance Mode
- Switch to Standby and then to Operate
- Change parameter #5.12 to 2
- Press and hold the UP button on the hand controller if replacing the elevation motor, or the LEFT button if replacing the azimuth motor. This will produce the RUN signal necessary to start the auto-tune process.
- The motor will spin during the process. The drive will indicate Auto-Tune in Progress
- After about 20 seconds parameter #5.12 will return to 0
- Release the hand controller button
- Save the drive parameters by entering 1001 into menu #0.00
- The motor can now be attached to the gearbox and re-assembled to the antenna.

## Azimuth Motor

- Turn switch to OFF position
- Power down the control system
- Unplug the motor cables
- Remove the 6 exposed screws holding the motor mounting plate onto the head of the pedestal.
- Remove the motor, mount plate and harmonic drive wave generator by lifting vertically. CAUTION: Do not tilt the motor assembly before the wave generator has cleared the harmonic drive.
- Cover the harmonic drive gearhead to insure no debris is allowed to contact the grease packing.

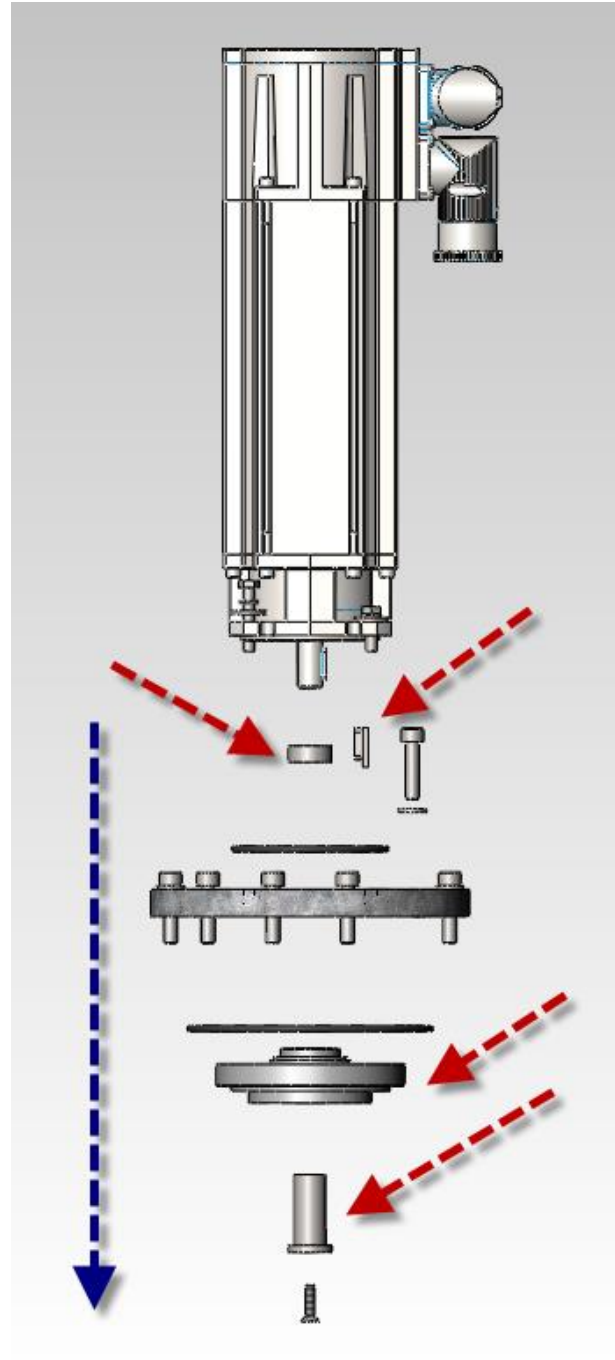


- Remove screw from end of motor shaft. (Screw will have threadlocker on threads and will be difficult to remove)

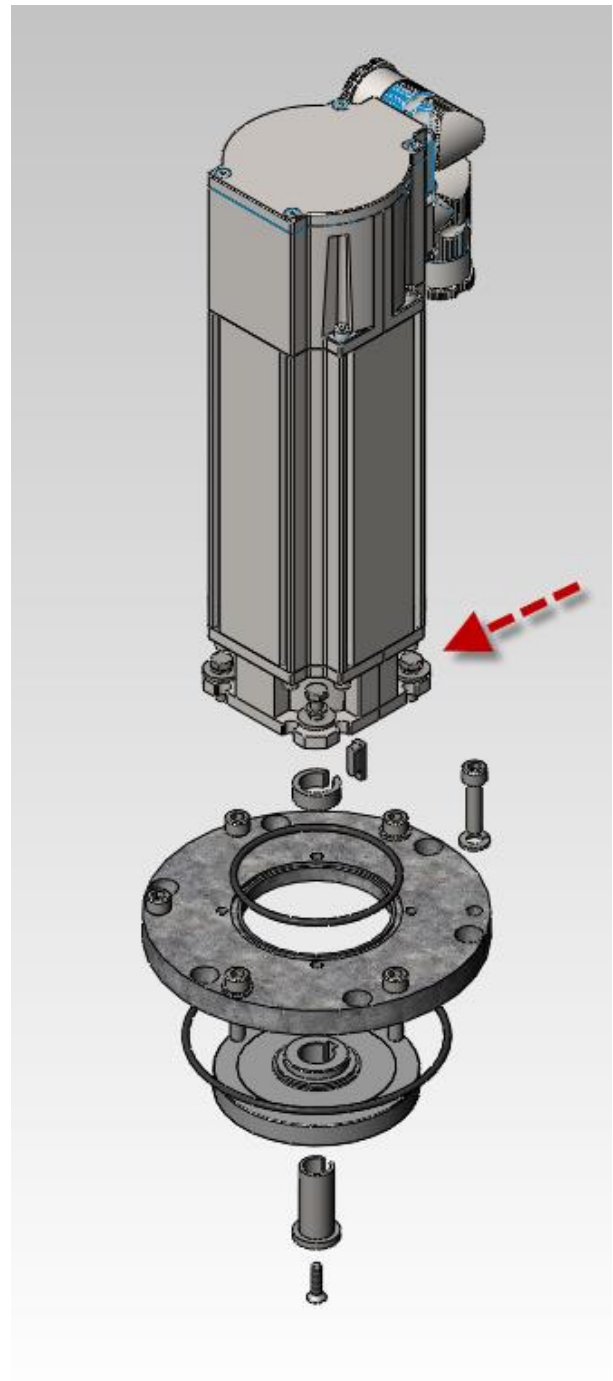




- Slide harmonic drive wave generator, shaft adaptor, spacer and key off of the motor shaft. CAUTION: Take care not to damage the mating surfaces of these parts.



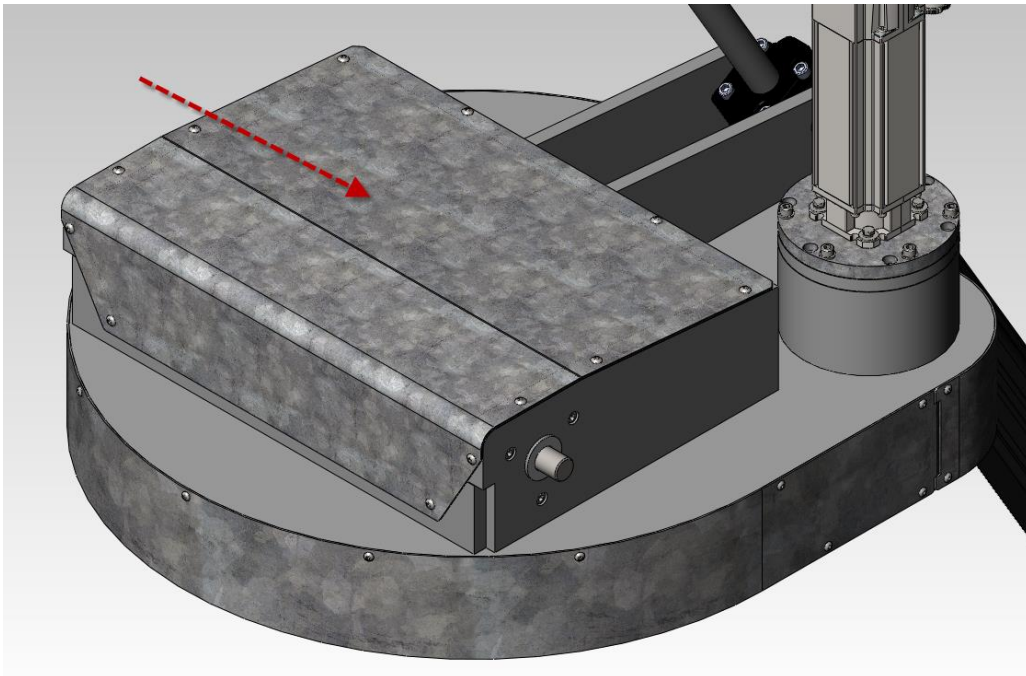
- Remove the 4 screws holding the motor to the mounting plate and remove the motor
- Assembly is the reverse of disassembly
- Replace O-Rings and apply new medium strength threadlocker to motor shaft screw
- If a new motor is to be used, the motor auto-tune procedure **MUST** be performed before connecting it to the gearbox



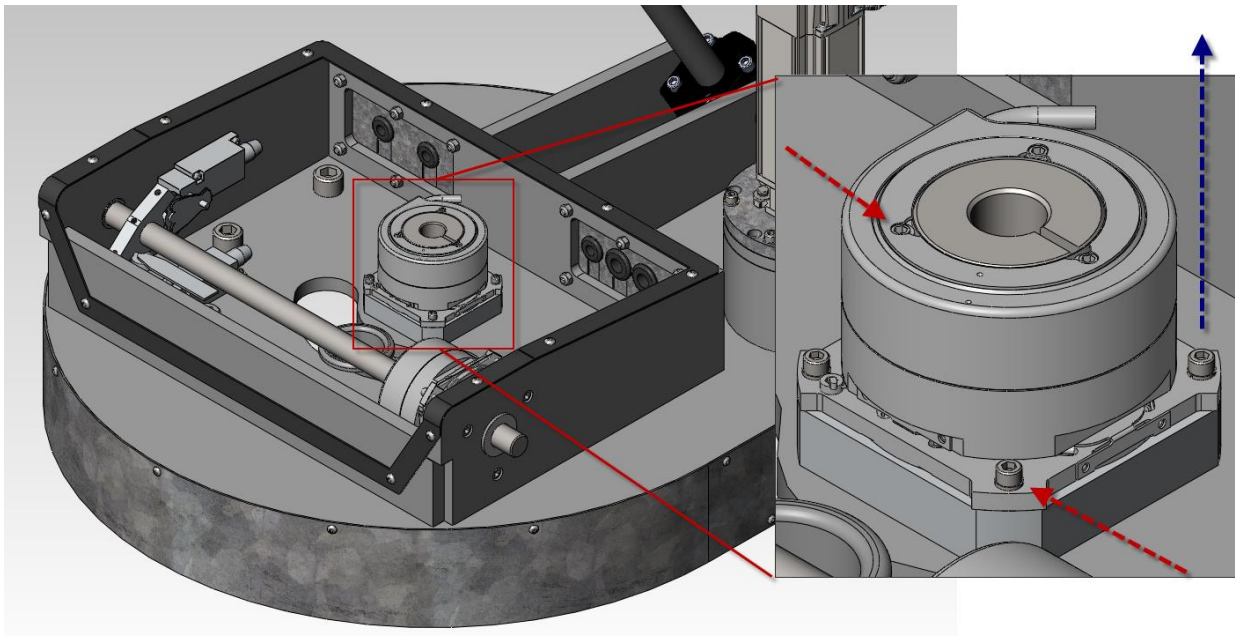
## Azimuth Encoder

**\*\*WARNING\*\*** Removing or replacing the encoders will result in loss of calibration for pointing and tracking functions. This should only be done once all other avenues have been explored. Once replaced, the antenna commissioning procedure must be completed again.

- If possible, note the angle reading of the encoder from the control software
- Turn the REMOTE/OFF/STANDBY/OPERATE switch to OFF
- Power down the control system
- Remove the upper pedestal access plate
- Locate the wiring connector for the encoder and unplug the two halves



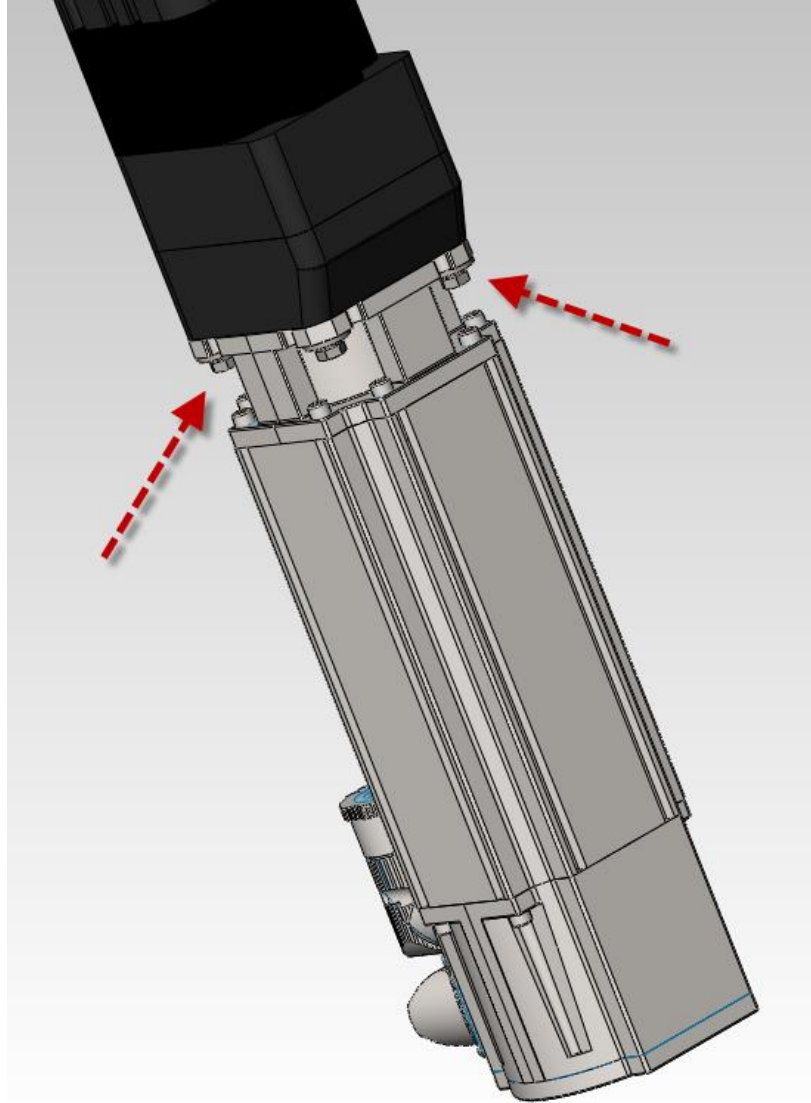
- Loosen the 3 clamp screws on the encoder. Note the relative position of the small dimple on the encoder. This can be used to roughly re-position the new encoder.
- Remove the 4 screws holding the encoder to the base and slide encoder upwards off the center shaft



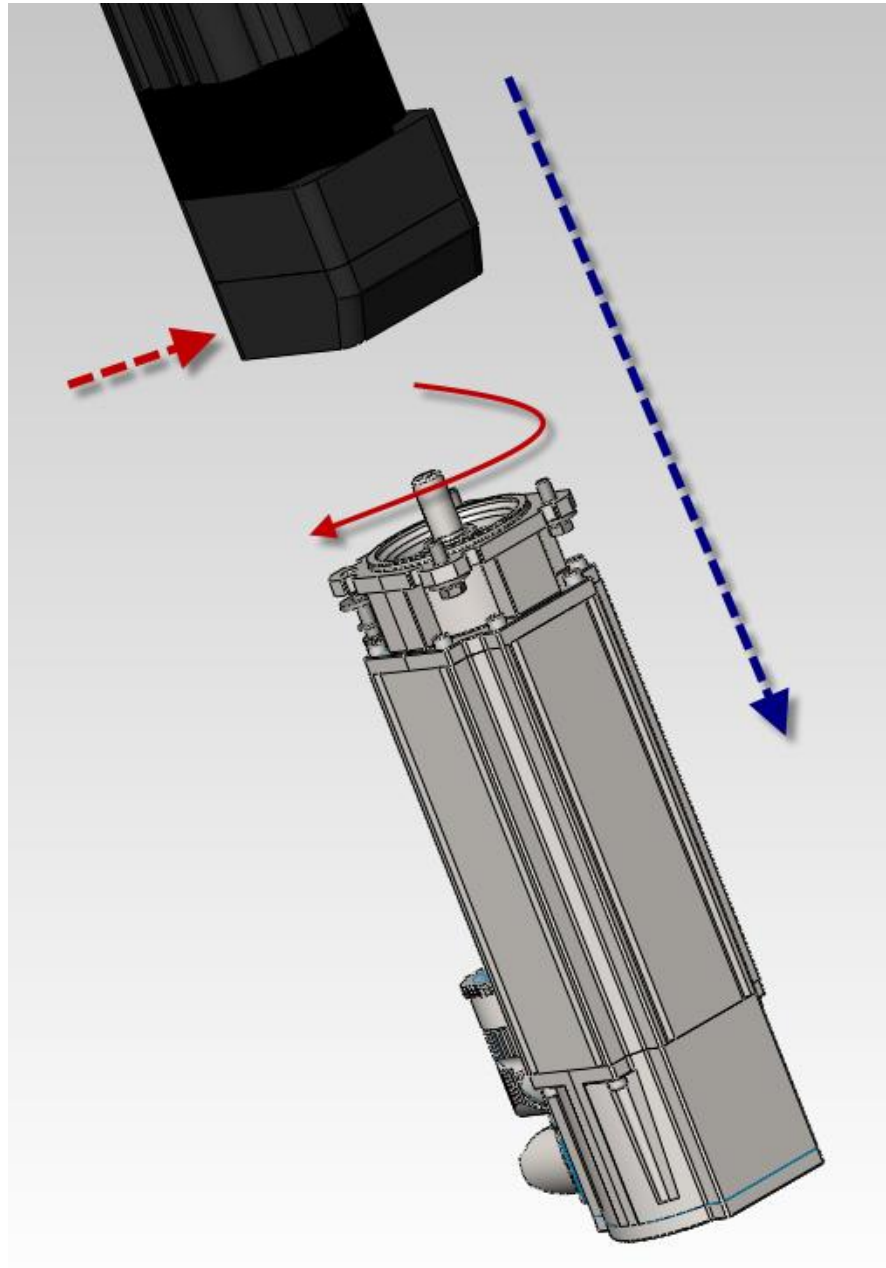
- Carefully feed the unplugged connector through the sliding cable guide and out
- Assembly is the reverse of disassembly. Make sure to re-attach the new encoder cable to the wiring bundle and include in cable wrapping
- Power up control system
- Before tightening the 3 clamp screws, mechanically adjust encoder to get as close to original reading as possible using the ACI readout. Use the encoder fixed offset parameter #20.21 for fine adjustment to bring the encoder readout back to the initial value.

## Elevation Motor

- Turn switch to OFF position
- Power down control system
- Unplug motor cables
- Support motor and remove 4 attachment screws



- Rotate motor so that set screw is visible through access hole in gearhead attached to end of jack. Loosen the clamp screw and slide motor out.
- Assembly is the opposite of disassembly. Orient motor connectors downwards.
- If a new motor is to be used, the motor auto-tune procedure **MUST** be performed before connecting it to the gearbox



## Elevation Encoder

**\*\*WARNING\*\*** Removing or replacing the encoders will result in loss of calibration for pointing and tracking functions. This should only be done once all other avenues have been explored. Once replaced, the antenna commissioning procedure must be completed again.

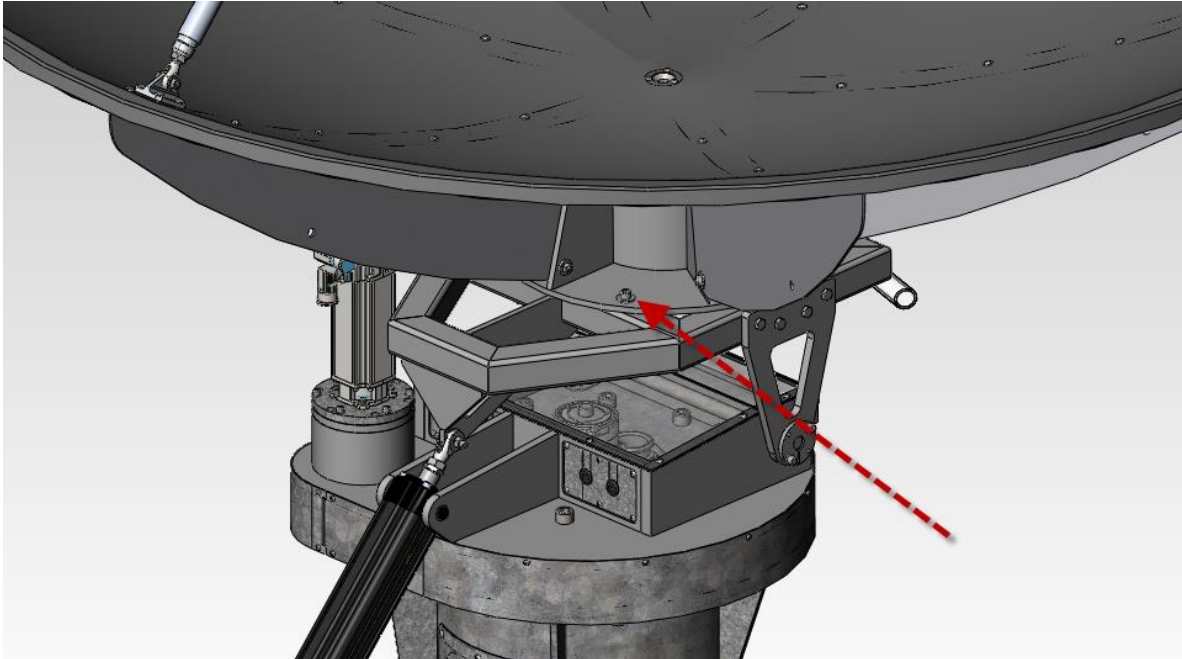
In order to remove elevation axis encoder, the reflector dish must be removed, as well as the supporting frame.

- Disconnect any wires running from feed to the antenna head.
- Move reflector 88 degrees elevation.





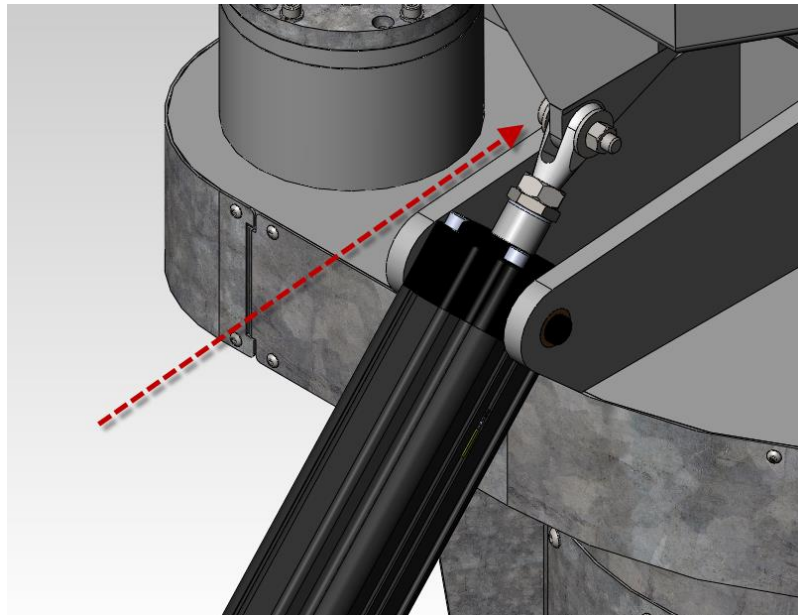
- Turn switch to OFF position and power down the system
- While holding the reflector, remove 6 bolts holding reflector hub to supporting frame



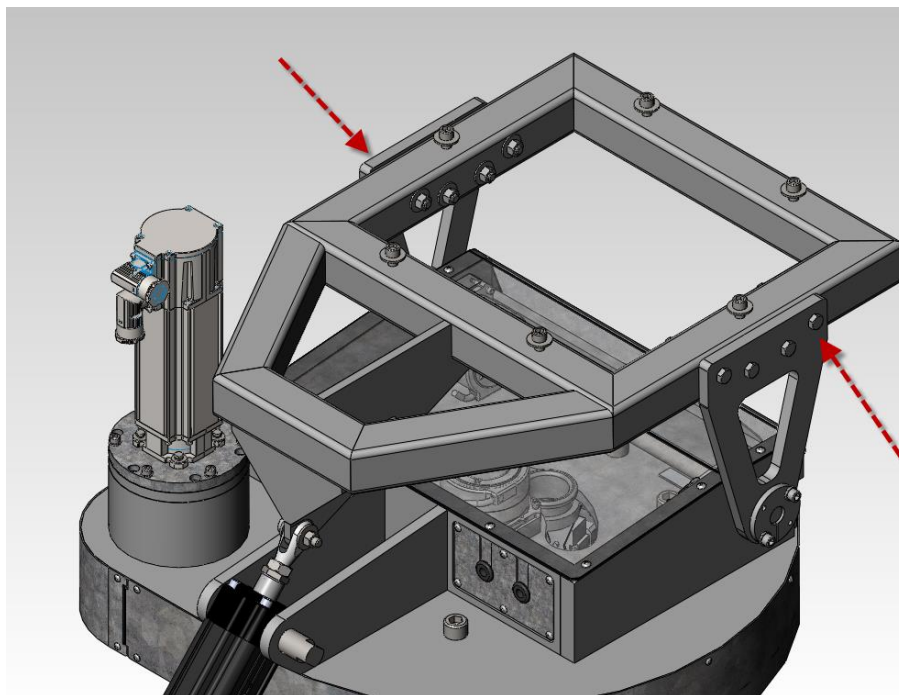
- Remove reflector and rest it on hub mounting service while removed from the pedestal.  
CAUTION: Only handle reflector assembly from the ribs. NEVER handle reflector from the edges or apply pressure to the parabolic surface.



- Remove shoulder bolt from jack clevis. CAUTION: Supporting frame will now be free to rotate.



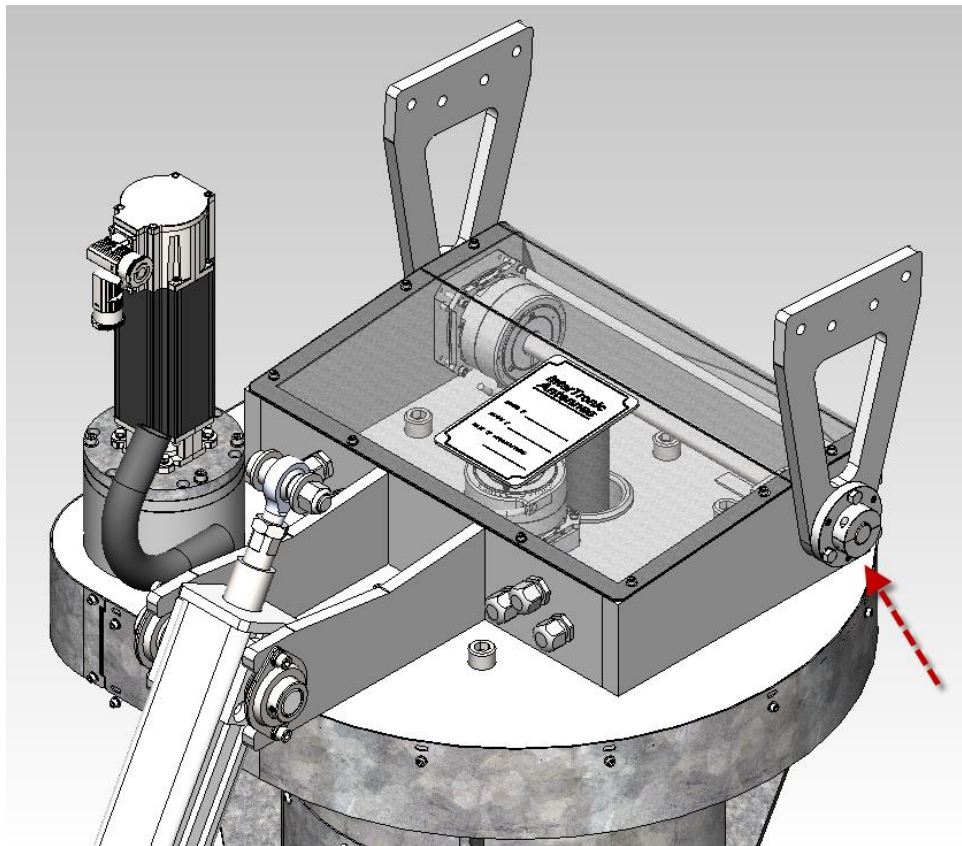
- Remove row of 4 screws attaching arm onto frame on both sides while supporting frame.



# **InterTronic Antennas**

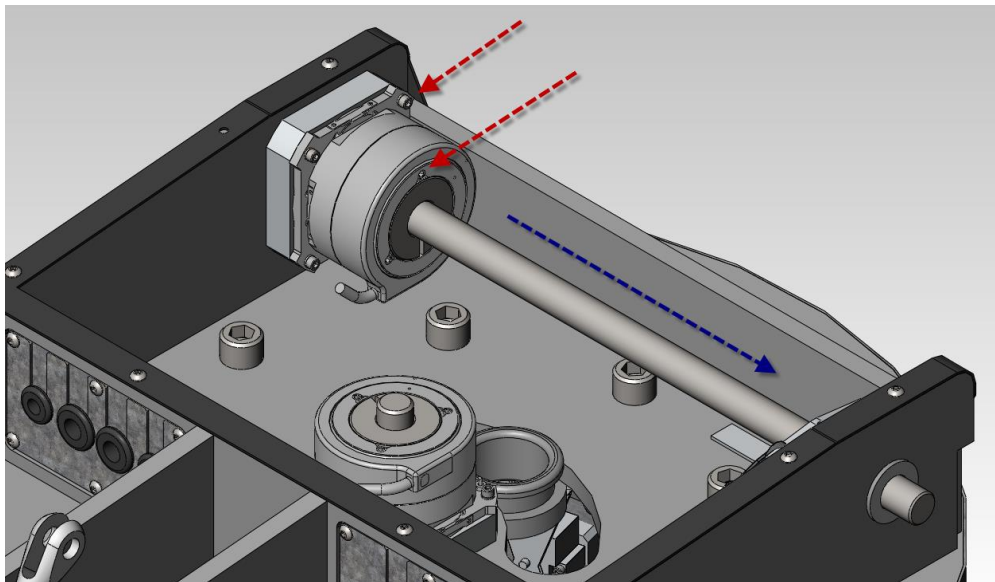
- 42 -

- Remove frame
- Loosen clamp screw from shaft collar
- Remove 3 screws holding bushing. Repeat on opposite side

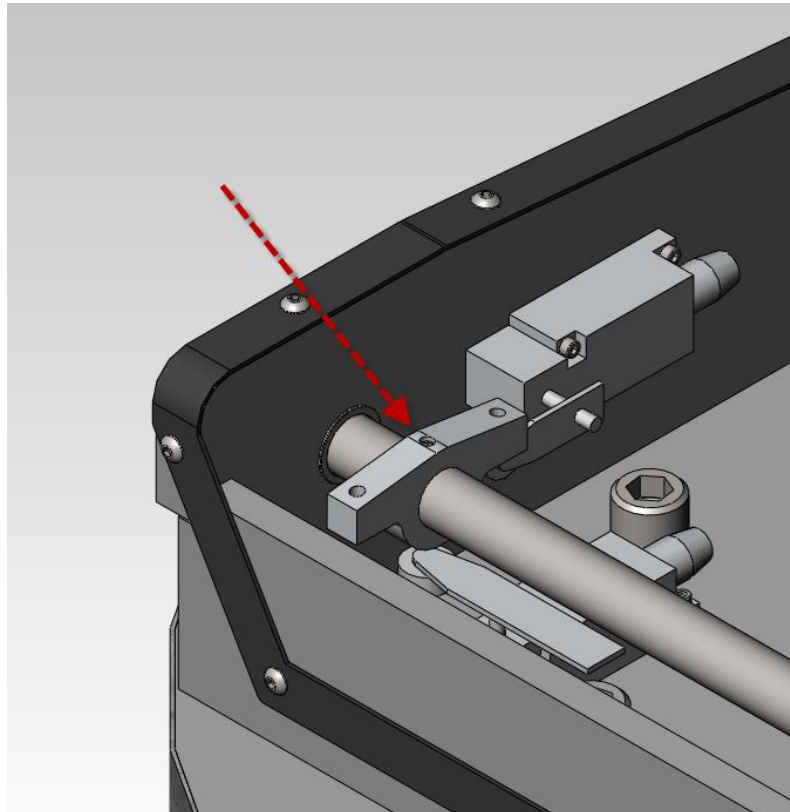


- Repeat on opposite side.
- Remove shaft collars and support arms

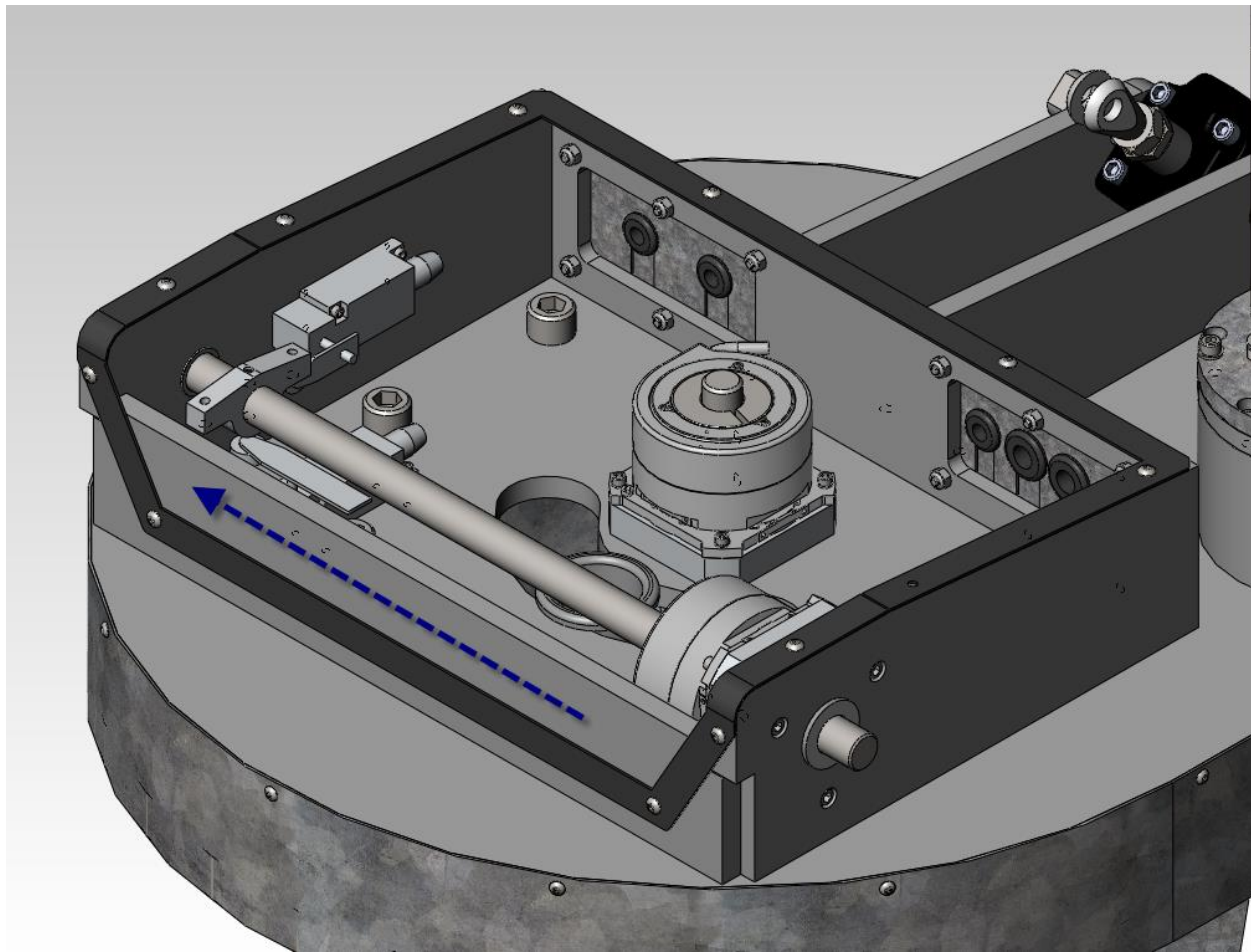
- Remove upper access cover plate
- Locate the wiring connector for the encoder and unplug the two halves
- Loosen the 3 clamps screws on the encoder. Note the relative position of the small dimple on the encoder. This can be used to roughly re-position the new encoder.
- Remove the 4 screws holding the encoder to the base and slide encoder off the mounting block.



- Loosen set screws holding limit switch trip block onto shaft. There are two screws on opposite sides of the block. (Setscrews will have threadlocker on threads and will be difficult to loosen)

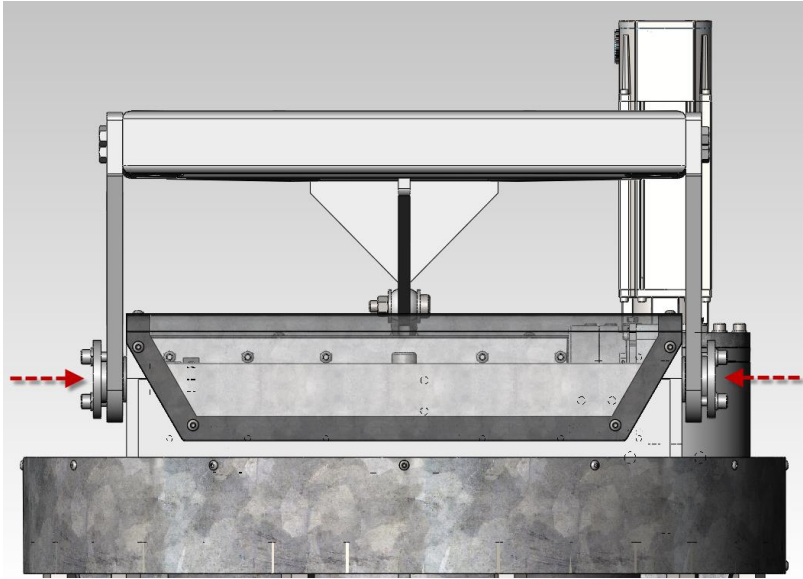


- Firmly grasp the elevation shaft and slide out one side enough to free the encoder. CAUTION: Do NOT impact the shaft with a hammer or other object. Doing so may damage the elevation bearings.



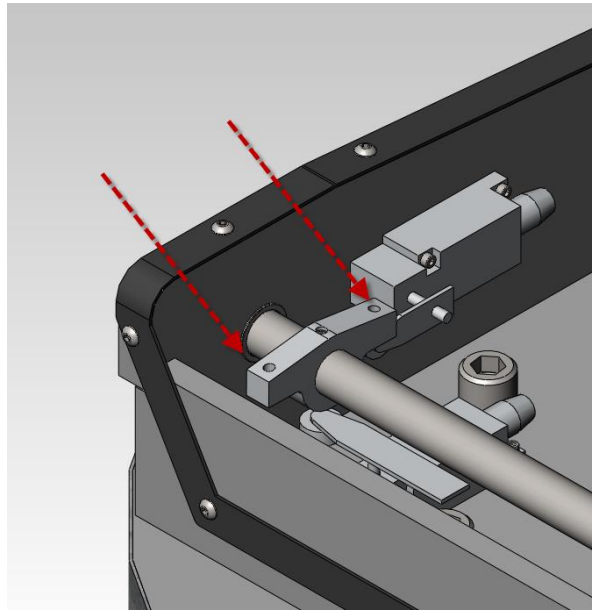
- Carefully feed the unplugged connector through the sliding cable guide and out
- Installation is the reverse of disassembly. Make sure to re-attach the new encoder cable to the wiring bundle and include in cable wrapping Reapply new medium strength threadlocker where required.

- Before tightening shaft collars, make sure there is no axial play between the hub support frame and the turning head.



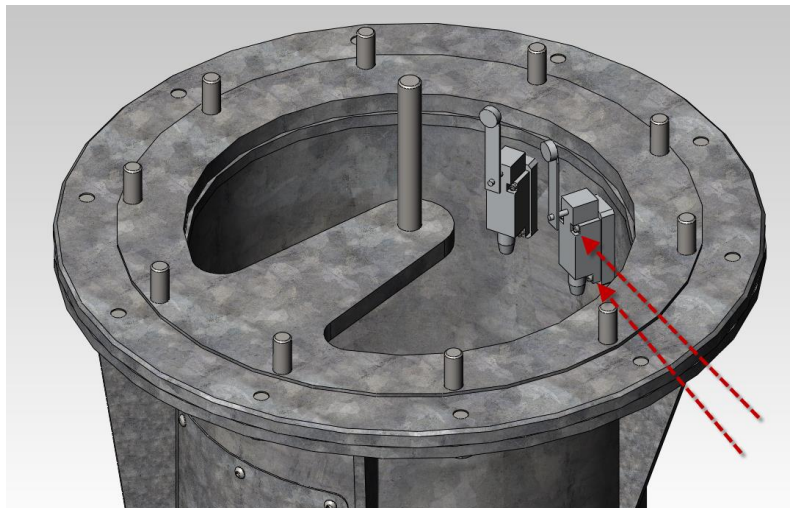
- Power up control system
- Before tightening the 3 clamp screws, mechanically adjust encoder to get as close to original reading as possible. Use the encoder fixed offset parameter #20.21 for fine adjustment to bring the encoder readout back to the initial value.
- Verify that elevation limit switches still trip outside of the soft limits but before the mechanical limit of the elevation jack. Adjust fine tune set screws as necessary.



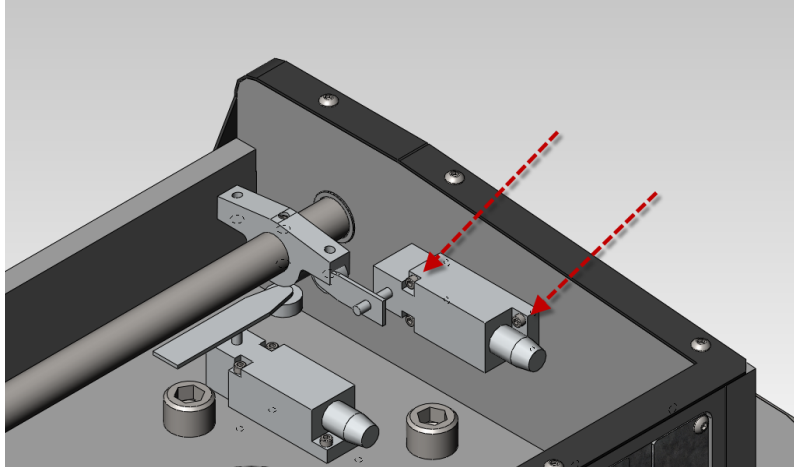


## **Limit Switch Replacement**

- Remove upper pedestal access cover
- Turn switch to OFF position and power down system
- Remove 4x mounting screws



- Remove turning head cover plate



- Remove cover plate from switch and unscrew terminals. Feed wires through cable gland.
- Installation is the reverse of disassembly. Adjust new limit switch so lever is at the same length, angle and orientation as switch being replaced. Power up system and verify correct functioning of new limit switch. It may be necessary to adjust the limit switches so the hard limit is outside of the soft limit.