

**Field Service Spares Replacement Procedure – EL, CL & AZ Motor Kit,  
XX97, XX97A & XX00**

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Revision History

Rev.	ECO	Description of Change	Date
X1	8878	Initial release	08-18-2011
A	9059	Clerical revisions	10-30-2011

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# ***Field Service Procedure - EL, CL & AZ Motor Kit, XX97, XX97A & XX00***

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## **1. Brief Summary:**

Troubleshooting document for diagnosing a fault with and replacing the elevation, cross level and azimuth motor on the XX97, XX97A and XX00 series antennas.

## **2. Checklist:**

- Verify Initialization
- Check Motor Drive
- Pedestal Error

## **3. Theory of Operation:**

The elevation, cross level and azimuth motors are used for stabilization. During stabilization the motors drive in response to motion of the stabilized mass of the antenna in 3-dimensional free space (as sensed by the rate and tilt sensors, which are both located inside the level cage). Elevation and azimuth targeting and signal tracking decisions also require motor drive, the PCU receives azimuth drive commands and ships heading input from the DAC.

The BLDC motor does not have brushes, therefore, it must be commutated by a servo amp/motor controller. Hall sensors in the motor provide feedback to the controller so it can commutate and control the torque output of the motor. When no drive is applied to the motor it offers very little rotational friction, allowing inertia to provide 98 percent of stabilization.

## **4. Verify Initialization:**

- Power cycle the pedestal
  1. Level cage drives to its end stop, then backs off exactly 45 degrees
  2. Elevation axis drives to 45 degrees based on the level cages horizon reference
  3. Cross level axis drives to level based on the level cages horizon reference
  4. Unlimited azimuth axis drives clockwise until the home flag and sensor make contact

If any of these steps fail, or the DAC reports model "xx97", the PCUs No parameter needs calibrating and verifying that it saves correctly. A drive issue, pedestal error or error LED requires further troubleshooting.

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## 5. Pedestal Error (Error 8):

### 5.1. Decoding a Pedestal Error.

When the DAC displays a pedestal error enter into the remote command window and input "Soooo" then press enter twice. The error code will now be displayed in the Remote Monitor screen. Decode the 4<sup>th</sup> character of the error code from the below table...

@	None	K	Ref + LV + CL	V	Stab Limit + AZ + LV
A	CL	L	Ref + AZ	W	Stab Limit + AZ + LV + CL
B	LV	M	Ref + AZ + CL	X	Stab Limit + Ref
C	CL + LV	N	Ref + AZ + LV	Y	Stab Limit + Ref + CL
D	AZ	O	Ref + AZ + LV + CL	Z	Stab Limit + Ref + LV
E	AZ + CL	P	Stab Limit	[	Stab Limit + Ref + LV + CL
F	AZ + LV	Q	Stab Limit + CL	\	Stab Limit + Ref + AZ
G	AZ + LV + CL	R	Stab Limit + LV	]	Stab Limit + Ref + AZ + CL
H	Ref	S	Stab Limit + CL + LV	^	Stab Limit + Ref + AZ + LV
I	Ref + CL	T	Stab Limit + AZ	_	Stab Limit + Ref + AZ + LV + CL
J	Ref + LV	U	Stab Limit + AZ + CL		

### 5.2. Error Types.

The 3 types of pedestal error are.....

1. **Servo Limit (CL, LV and AZ)** – A servo limit error means the PCU motherboard is issuing the command to the motor driver PCB/servo amp to drive the relevant axis harder than it should under normal operation (the servo limit has been reached). This could be whilst the antenna is trying to maintain its pointing angle, or whilst the antenna is driving the axis to a target position.
2. **Stability Limit** – A stability limit error means the antenna has mispointed from its desired target position by more than half a degree. When a stability limit error is flagged on a VSAT antenna the DAC will send the TX Mute command to inhibit the transmit function of the satellite modem (It's common to see the servo limit and stability limit errors together).
3. **AZ Reference Error** – An azimuth reference error means there is a corrupt reading in the antennas relative scale. This could be caused by the system completing a 360 degree rotation without the switch coming into contact with the home flag, the switch coming into contact with the home flag too early, or a physical problem such as the chain slipping on the motor pulley or the pulley slipping on the motor shaft.

### **5.3. Troubleshooting Pedestal Errors – Servo Limit and Stability Limit.**

1. Reinitialize the pedestal; does it drive correctly or at all. If none of the axis drive verify the No and motor gain parameters (N<sub>1</sub> = CL, N<sub>2</sub> = EL and N<sub>3</sub> = AZ) are correctly configured in the PCU through the Remote Command window of the DAC.
2. Verify the balance of the antenna and check for physical restrictions on the pedestal. If the axis isn't correctly balanced the PCU will be outputting additional drive commands to maintain the antennas level position.
3. If the motor isn't driving correctly or no motor drive is present, test the motor for faults using the below procedure, if the motor is defective replace it and then retest the function of the antenna. If the axis still fails to drive correctly the defective motor has damaged the motor driver PCB. Replace the PCU assembly.
4. Another potential problem could be a damaged or intermittent harness connection. Remove the harness back shells and verify all the pins are seated correctly, check continuity from pin to pin and also across the pins to verify there is no short in the connections.

### **5.4. Troubleshooting Pedestal Errors – Azimuth Reference Error.**

1. Reinitialize the system and verify the switch comes into contact with the home flag as the system drives in azimuth. If not verify if the switch is present.
2. Drive the azimuth axis in 90 degree increments and verify that the antenna points correctly and that the DAC displays the correct relative position. Also verify that there is no physical restriction on the azimuth axis such as the chain slipping on the motor pulley, or the pulley slipping on the motor shaft

### **5.5. Test the Motor.**

1. Check continuity between ground (the motor connector back shell) and the 3 driver outputs on pins 1, 2 and 3 of the harness.
2. Now check continuity between pins 4, 5, 6, 7 and 8 and the ground (the motor connector back shell).
3. Also check between the individual pins 1, 2 and 3 and the rest of the pins (i.e. test pin 1 to pin 4, 5, 6, 7 and 8 and so on, not between pins 1 and 2, 1 and 3 or 2 and 3).

If there is any continuity measured on the steps mentioned above, the motor is defective. If the motor has drawn excessive current then there is a possibility the servo amplifier has been damaged and its operation should be verified with a replacement motor. If after replacing the motor the system is still not operational it's possible the antennas servo amplifier may be defective and will need to be replaced.

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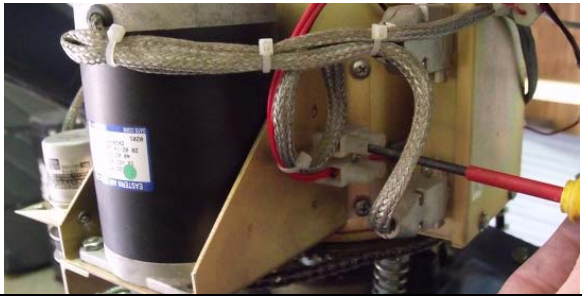


### **6. Replacing the Azimuth Motor:**

#### **6.1. Tools.**




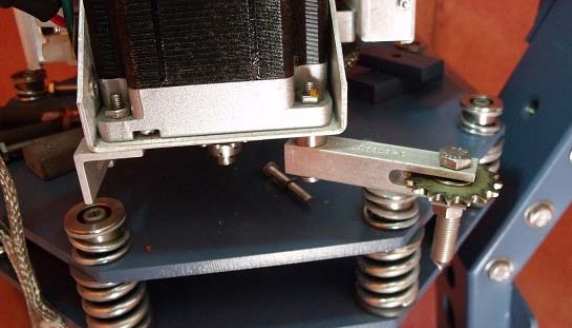
- 2mm Flat Blade (Terminal) Screwdriver
- Snips/Cutters
- #2 Phillips Screwdriver
- #1 Phillips Screwdriver
- 3/8" Wrench
- Loctite 242 and 638
- Cable Ties/Tie wraps

#### **6.2. Procedure.**





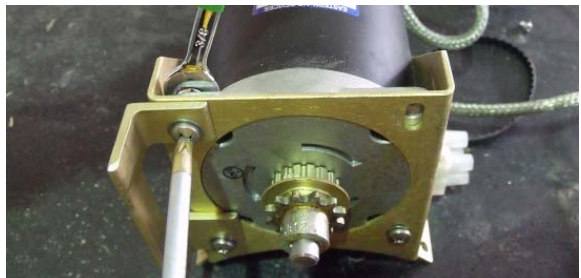
Procedure for replacing the azimuth motor on the XX97, XX97A and XX00 series pedestals, Sea Tel kit part number: 134933 (motor part number: 116047-1).

<p><b>*CAUTION:</b> Power down the pedestal before following this procedure.</p> <p>1. Using a 2mm flat blade screwdriver remove the AC cables from the termination block.</p>	
<p>2. Cut the cable ties securing the azimuth motor harness using a pair of snips.</p>	
<p>3. Disconnect the azimuth motor D-sub connector from the servo amplifier using a 2mm screwdriver.</p>	




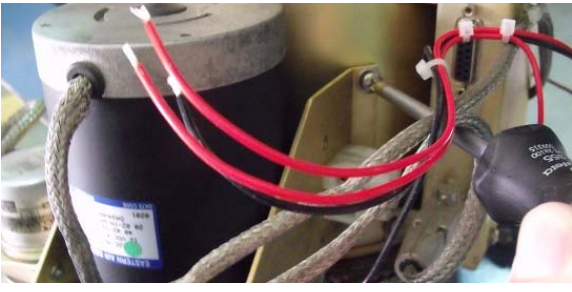

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<p>4. Remove the screw securing the encoder harness to the servo amplifier using a #1 Phillips screwdriver.</p>	
<p>5. Remove the encoder D-sub connector from the home switch assembly using a 2mm flat blade screwdriver.</p>	
<p>6. Disconnect the spring from the azimuth chain tensioner using a 2mm flat blade screw driver to unhook it from the bracket.</p>	
<p>7. Disengage the tensioning pulley from the azimuth drive chain.</p>	

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<p>8. Using a #2 Phillips screwdriver remove the four screws securing the azimuth motor assembly from the AZ canister.</p>	
<p>9. Disengage the azimuth motor sprocket from the drive chain and remove the motor assembly (chain tensioner not shown).</p>	
<p>10. Loosen the four screws securing the encoder to its bracket.</p>	
<p>11. Using a #1 Phillips screwdriver remove the 3 screws securing the encoder assembly to the azimuth motor assembly.</p> <p>12. Disengage the encoder pulley from the belt and remove the encoder assembly.</p>	
<p>13. Using a 3/8" wrench and #2 Phillips screwdriver remove the hardware securing the motor to the bracket and the chain tensioner assembly (not shown).</p> <p><b>*Note:</b> The orientation of the brackets and the orientation of the motor harness for future reference.</p>	

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<p>14. Install the azimuth pulley to the replacement motor in the same position as on the defective motor. Apply loctite 638 to the dowel pin and insert it through the pulley and motor shaft. Allow 20 minutes for the Loctite to set.</p> <p><b>*Note:</b> For further information refer to the Loctite Procedure 121730 provided with this kit.</p> <p><b>*Note:</b> Two pulleys are provided in the kit, one for the azimuth and another for the Elevation and cross level axis. Verify you have the correct one before installing.</p>	
<p>15. Apply Loctite 242 to the three screws and reinstall the encoder assembly to the azimuth motor bracket.</p>	
<p>16. Apply Loctite 242 to the four screws securing the encoder assembly and install loosely.</p> <p>17. Pull the encoder away from the motor to tension the belt and tighten the four screws. Verify the belt tension and repeat the procedure if necessary.</p>	
<p>18. Slip the azimuth motor sprocket into the drive chain and align the motor assembly.</p> <p>19. Apply Loctite 242 to the four motor screws and install the motor assembly to the azimuth canister.</p> <p>20. Reengage the chain tensioning sprocket to the drive chain and secure the tensioning spring to the bracket (not shown)</p>	
<p>21. Reconnect the AC cables to the termination block.</p>	



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<p>22. Reinstall the encoder harness D-sub connector to the home switch assembly.</p> <p>23. Apply Loctite 242 to the mounting screw and install the P-clip securing the encoder harness to the servo amplifier.</p>	
<p>24. Reconnect the azimuth motor harness D-sub connector to the servo amplifier.</p> <p>25. Secure the excess harness with cable ties.</p>	

### 7. Replacing the Elevation and Cross Level Motors:


#### 7.1. Tools.

- #1 Phillips Screwdriver
- Snips/Cutters
- 2mm Flat Blade (Terminal) Screwdriver
- #2 Phillips Screwdriver
- 3/8" Allen Wrench
- Loctite 242 and 638
- Cable Ties/Tie Wraps






#### 7.2. Procedure.

Procedure for replacing the cross level and elevation motors on the XX97, XX97A and XX00 series pedestals, Sea Tel kit part number: 134933 (motor part number: 116047-1).





**\*Note:** Although this procedure is for replacing the cross level motor the same principal applies to the elevation motor.

<p><b>*CAUTION:</b> Power down the pedestal before following this procedure.</p> <p>1. Using a #1 Phillips screwdriver remove the screw and P-clip securing the harness assemblies to the cross level motor bracket.</p>	
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<p>2. Cut the cable ties securing the cross level motor harness using a pair of snips.</p>	
<p>3. Remove the cross level motor D-sub connector from the servo amplifier.</p>	
<p>4. Using a #2 Phillips screw driver remove the four screws securing the cross level motor assembly to the azimuth canister.</p> <p>5. Slip the cross level motor pulley out of the belt and remove the assembly.</p>	
<p>6. Remove the four screws securing the cross level motor to the bracket using a #2 Phillips screwdriver and a 3/8" Allen wrench.</p>	
<p>7. Install the pulley to the replacement motor in the same position and orientation as the defective one. Apply Loctite 638 to the dowel pin and insert, allow 20 minutes for the Loctite to set.</p> <p><b>*Note:</b> For further information refer to the Loctite Procedure 121730 provided with this kit.</p>	

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<p>8. Install the replacement motor assembly to the bracket with the harness in the correct orientation (as shown on the right).</p>	
<p>9. Reinstall the motor assembly by slotting the pulley into the belt. Apply Loctite 242 to the 4 screws and loosely install them.</p> <p>10. Apply downward pressure on the motor to tension the belt and tighten two of the screws.</p>	
<p>11. Verify the belt tension, the belt should easily rotate, tightening at 90 degrees at the center point between both sprockets. If the belt can easily be rotated part 90 degrees it's too loose, if the belt cannot be rotated to 90 degrees it's too tight. If necessary repeat the above procedure then tighten all four of the retaining screws.</p>	
<p>12. Reconnect the azimuth motor harness D-sub connector to the servo amplifier.</p> <p>13. Secure the excess harnesses using cable ties.</p>	
<p>14. Apply Loctite 242 to the screw and reinstall the P-clip, securing the harnesses to left side of the cross level motor bracket.</p>	