Field Service Spares Replacement Procedure – AZ Motor Kit, XX04, 6003A/6004, 4003A & XX06

Approval:

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Revision History

Rev.	ECO	Description of Change	Date
A	8800	Initial release	08-05-2011
B	9041	Clerical revisions	10-18-2011

Field Service Procedure – Replacement Azimuth Motor Kit, XX04, 6003A/6004, 4003A & XX06

1. Brief Summary:

Troubleshooting document for diagnosing a fault with and replacing the azimuth motor on the XX04, 6003A/6004, 4003A and XX06/R/RZ/RZA series antennas.

2. Checklist:

- Verify Initialization
- Pedestal Error
- Verify Encoder Feedback

3. Theory of Operation:

The azimuth motor is used for azimuth stabilization, satellite targeting and signal tracking decisions requiring drive in azimuth. During stabilization, the azimuth motor drives only in response to motion of the stabilized mass of the antenna in 3-dimensional free space (as sensed by the azimuth rate sensor located inside the level cage). 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.

A high output digital encoder is integrated into the top of the azimuth motor to provide the relative position into the PCUs azimuth control loop. During initialization the relative position will be calibrated when the sensor comes into contact with the home flag or end stop. The PCU receives relative drive commands from changes in heading which are fed into the DAC from the vessels gyro compass.

4. Verify Initialization:

- Power cycle the pedestal
    1. Level cage drives to it's 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 systems drive clockwise until the home flag & sensor make contact
    5. Limited azimuth systems drive clockwise into the azimuth end stop, then back off to 630 degrees of relative

If any of these steps fail, or the DAC reports model "xx03/xx04" the PCUs No parameter needs calibrating & verifying that it saves correctly. A drive issue or pedestal error requires further troubleshooting.

5. Pedestal Error (Error 8):

5.1. Decoding a Pedestal Error.

When the DAC displays a pedestal error enter into the remote command window & input "Soooo" then press enter twice. The error code will now be displayed in the Remote Monitor screen. Decode the 4th 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 & 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 miss-pointed 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 & stability limit errors together).
3. **AZ Reference Error –** An azimuth reference error means the there is a corrupt reading in the relative scale. This could be caused by the encoder failing, a limited azimuth antenna hitting its end stop under normal operation, an unlimited antenna completing a 360 degree rotation without the sensor coming into contact with the home flag, the sensor coming into contact with the home flag too early, or a physical problem such the belt 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 & motor gain parameters (N1 = CL, N2 = EL & N3 = AZ) are correctly configured in the PCU through the Remote Command window of the DAC.
2. Verify the balance of the antenna & 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 & then retest the function of the antenna. If the axis still fails to drive correctly the defective motor may have 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 & verify all the pins are seated correctly, check continuity from pin to pin & 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 & verify that the antenna drives clockwise to its end stop & backs of the 630 degrees if it's limited azimuth. Or if the system is unlimited azimuth verify that the antenna drives clockwise until the sensor comes into contact with the home flag. If not verify if the magnet/sensor is present or attempt to move the sensor closer to the magnet. Failing this it's a sensor/feedback failure.
2. Drive the azimuth axis in 90 degree increments & verify that the antenna points correctly & that the DAC displays the correct relative position. Also verify that there is no physical restriction on the azimuth axis such as the belt slipping on the motor pulley or the pulley slipping on the motor shaft.

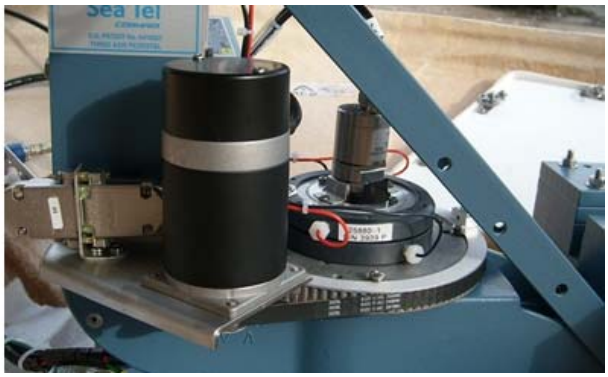
5.5. Test the Motor.

1. Check continuity between ground (the motor connector back shell) & the 3 driver outputs on pins 1, 2 & 3 of the harness.
2. Now check continuity between pins 4, 5, 6, 7 & 8 & the ground (the motor connector back shell).
3. Also check between the individual pins 1, 2 & 3 & the rest of the pins (i.e. test pin 1 to pin 4, 5, 6, 7 & 8 & so on, not between pins 1 & 2, 1 & 3 or 2 & 3).
4. 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 motor driver PCB (inside the PCU) has been damaged & its operation should be verified with a replacement motor. If after replacing the motor the system is still not operational the antennas PCU may be defective & should be replaced.

6. Verify Encoder Feedback:

During initialization the sensor & home flag will come into contact (typically when the antenna is facing the bow of the ship) at which point the relative position will be calibrated. Changes in relative should be equal to the amount of drive from the pedestal. Drive the azimuth axis of the antenna in 90 degree increments & verify that the pedestal & relative position on the DAC move the correct amount.

XX06 Home Flag (magnet) & Hall Effect Sensor



XX06 Azimuth Motor Assembly

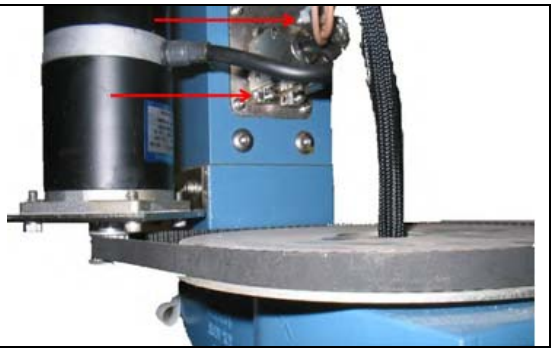
7. Replacing the Azimuth Motor:

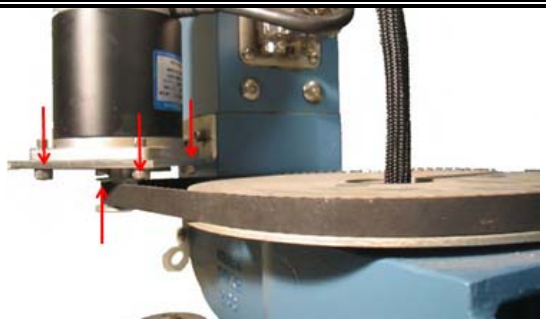
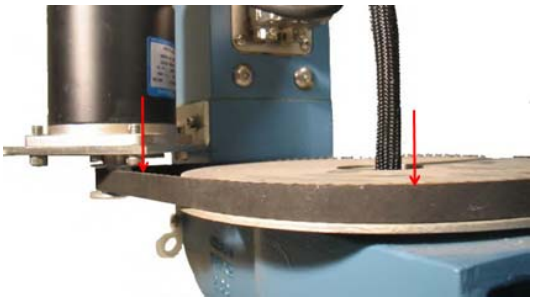
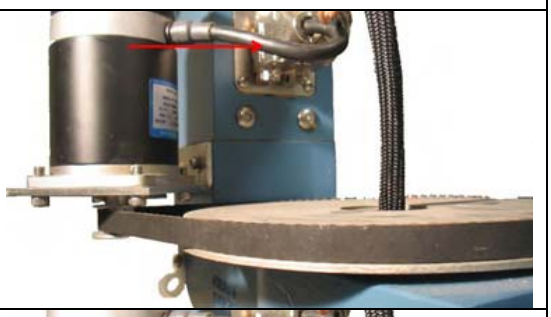
7.1. Tools.

- Snips/Cutters
- 2mm Flat Blade (Terminal) Screwdriver
- 9/64" Allen Wrench/Key
- 1/16" Allen Wrench/Key
- Loctite 222, 242 & 638

7.2. Procedure.

Procedure for replacing the azimuth motor, Sea Tel kit part number: 124112-3 (motor part number: 121951).

***CAUTION:** Power down the pedestal before following this procedure. 1. Using snips, cut the tie wrap holding the AZ motor harness and pedestal interface harness together. 2. Now using a 2mm flat blade screwdriver, loosen the two retaining screws on AZ motor harness and remove the connector from the AZ post connection panel.	

3. Using a 9/64" Allen wrench, remove the four Allen head screws (bottom side of motor bracket) securing AZ motor and remove Motor Assembly. Save the hardware for future use. 4. Apply Loctite 638 to the shaft of the replacement motor and fit the pulley in the same position as the one on the defective motor. Fit the set screws into the pulley with Loctite 222 using a 1/16" Allen wrench. ***Note:** For further information refer to the Loctite Procedure 121730 provided with this kit.	
5. Insert the replacement motor assembly into mounting bracket with the cable harness pointing towards the AZ sprocket. 6. Place the AZ belt around the main sprocket and motor pulley and tension the belt by pulling the motor to the bracket using Loctite 242. 7. Increase the belt tension until the belt can only be easily twisted just ¼ turn with your fingers.	
8. Re-connect the AZ motor harness to the AZ post connector panel and secure the two harness retaining screws.	
9. Rotate the Antenna (by hand) from CCW stop to CW stop for limited azimuth systems or 700 degrees for unlimited systems while observing the belt. Check to see the belt does not rub against motor mounting hardware and that the belt remains level with pulleys. ***Note:** Failure of this step normally indicates improper sprocket placement on the Azimuth Motor shaft.