Field Service Spares Replacement Procedure – Azimuth Motor Kit, 3011

Approval:

Approving Authority	Signature	Date
Doc Control:	Ron Chaffee / Signature on file.	5-22-12
Assistant Service Manager, Global	John VanderJagt / Signature on file.	5-22-12
Author:	Stuart Broadfield / Signature on file.	05-22-12

Revision History

Rev.	ECO	Description of Change	Date
A	9629	Initial release	03-15-2012

1. Brief Summary:

Troubleshooting document for diagnosing a fault with and replacing the azimuth motor on the 3011 antenna.

2. Checklist:

- Verify Initialization
- MDE Status LED
- Pedestal Error
- Verify Encoder Feedback

3. Theory of Operation:

The azimuth motor is used for azimuth stabilization, satellite targeting and signal tracking decisions requiring unlimited 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 on the motion platform PCB inside the in the PCU). The PCU also receives azimuth drive commands from the DAC based on targeting decisions and ships heading inputs from the vessels gyro compass.

The BLDC motor is driven by a servo amp/motor controller, hall sensors in the motor provide feedback to the controller so it can drive 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 digital encoder is integrated into the top of the azimuth motor to provide the relative position information into the PCU's azimuth control loop. During initialization the relative position will be calibrated when the sensor is activated by the home flag. 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. Elevation axis drives to 45 degrees based on the PCU's horizon reference
    2. Cross level axis drives to level, based on the motion platform PCB's horizon reference
    3. Unlimited azimuth axis drives clockwise until the home flag and sensor make contact

***Note:** If the PCU software 2.01a or higher the EL and CL axis will initialize at the same time saving 20 seconds on the initialization process.

If any of these steps fail, or the DAC reports model "xx09", the PCUs No parameter needs calibrating and verifying that it saves correctly. A drive issue or pedestal error requires further troubleshooting.

5. MDE Status LEDs:

5.1. MDE Motor Status LEDs (top 3 are EL, CL and AZ).

Green	Motor is good.
Solid Red	Motor or harness short circuit (winding-winding, winding-ground, or winding-supply). Replace the appropriate motor. If that does not clear the LED status, replace the MDE.
Solid Orange	Hall sensor error (hall sensor or harness wire). Replace the motor. If that does not clear the LED status, replace the MDE.

5.2. MDE Status (4^{th} LED).

Green	Motor Driver is good.
Solid Red	Motor Driver fault detection. Operational software will never leave the status LED solid red. Replace MDE.
Solid Orange	Software update to the MDE in process.
Blinking Red	Communication error with PCU. Check to assure that the harness connections are seated properly. Check harness (pin-pin, wire-wire and wire-ground) for good continuity. Replace MDE. Replace Main PCB.

6. Pedestal Error (Error 8):

6.1. Decoding a Pedestal Error.

When the DAC displays a pedestal error access the remote command window, input "Soooo" and then press enter twice. The error code will now be displayed in the remote monitor screen. Decode the 4^{th} 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 + L	**U**	Stab Limit + AZ + CL		

6.2. 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 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 mis-pointed from its desired 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. If a stability limit error is flagged on a dual TVRO installation the arbitrator will switch to the other pedestal (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 sensor being activated by the home flag, the sensor being activated too early, or a physical problem such as the belt slipping on the motor pulley or the pulley slipping on the motor shaft.

6.1. 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 (N1 = CL, N2 = EL and N3 = AZ) are correctly configured in the PCU.
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 following procedure. If the motor is defective replace it and then test the function of the motor driver. If the axis still fails to drive correctly it's possible the motor driver has failed. Replace the motor driver.

6.2. Troubleshooting Pedestal Errors – Azimuth Reference Error.

1. Reinitialize the system and verify the sensor comes into contact with the home flag as the system drives clockwise in azimuth (the LED will illuminate). If not, verify if the home flag/sensor is present. If this is correct, it's a sensor/feedback failure.
2. Drive the azimuth axis in 90 degree increments to verify that the antenna points correctly and that the DAC displays the correct relative position. Also verify 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.

6.3. 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).
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 enclosure has been damaged and its operation should be verified with a replacement motor. If after replacing the motor the system is still not operational the antennas MDE maybe defective and should be replaced.

7. Verify Encoder Feedback:

During initialization the sensor and home flag will come into contact (typically when the antenna is facing the bow of the vessel) 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 and verify that the pedestal and relative position on the DAC move the correct amount.

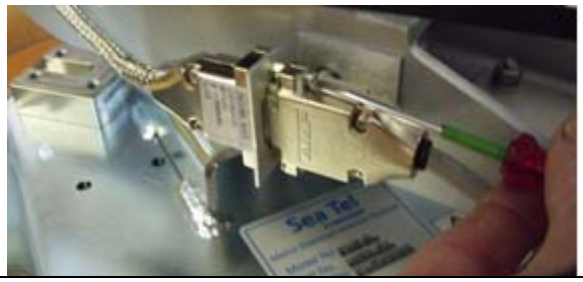
8. Replacing the Azimuth Motor:

8.1. Tools.

- Snips/Cutters
- 2mm Flat Blade (Terminal) Screwdriver
- 3/32" Allen Wrench/Key
- 1/16" Allen Wrench/Key
- Cable Ties/Tie Wraps
- Loctite 242

8.2. Procedure.

Procedure for replacing the azimuth motor, Sea Tel kit part number: 136814 (azimuth motor part number: 128209-2).

***Caution:** Power down the pedestal before following this procedure. 1. Snip the cable tie securing the motor harness to the azimuth post.	
2. Disconnect the azimuth motor D-sub connector from the bracket using a 2mm flat blade screwdriver.	
3. Remove the 4 Allen head bolts securing the azimuth motor bracket using a 3/32" Allen wrench. Save the hardware for future use.	

4. In the same orientation as on the defective motor install the new pulley to the replacement motor, applying Loctite 638 to the shaft. Apply Loctite 222 to the set screw and install it into the pulley, making sure it's aligned with the flat edge of the motor shaft. Tighten the set screw with a 1/16" Allen wrench. ***Note:** For further information refer to the Loctite Procedure 121730 provided with this kit.	
5. Locate the motor pulley into the azimuth belt and secure it to the bracket using the hardware removed in step 3, apply Loctite 242 to the threads. Pressure the motor away from the pedestal to tension the belt and tighten two of the screws.	
6. At the central position of the belt between the motor pulley and main drive sprocket the belt should easily rotate 90 degrees then become stiff. If the belt can be rotated past 90 degrees it's too loose, if it's difficult to rotate it to 90 degrees it's too tight. 7. If the belt is to tight/loose repeat steps 5-6 until the belt tension is correct and tighten all four of the screws.	
8. Connect the motors D-sub connector to the bracket using a 2mm flat blade Allen wrench. 9. Secure the excess motor harness to the azimuth post using a cable tie.