Field Service Spares Replacement Procedure – EL Motor Kit, USAT

Approval:

Approving Authority	Signature	Date
Doc Control:	Ron Chaffee / Signature on file.	3-26-12
Assistant Service Manager, Global	John VanderJagt / Signature on file.	3-27-12
Author:	Stuart Broadfield / Signature on file.	03.23.12

Revision History

Rev.	ECO	Description of Change	Date
A	9117	Initial release	11-15-2011

1. Brief Summary:

Troubleshooting document for diagnosing a fault with and replacing the elevation motor on the USAT series antennas.

2. Checklist:

- Verify Initialization
- Check Motor Drive
- Pedestal Error

3. Theory of Operation:

The elevation motor is used for stabilization. During stabilization the motor will drive in response to motion of the stabilized mass of the antenna in 3-dimensional free space (as sensed by the rate and MEM sensors. Elevation targeting and signal tracking decisions also require drive in elevation).

The BLDC elevation 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.

4. Verify Initialization:

- Power cycle the pedestal:
    1. The elevation axis activates, the antenna reflector is driven down to the lower elevation stop.
    2. The azimuth axis activates, the USAT 24 antenna is driven clockwise to its upper physical stop then azimuth is driven counter-clockwise to a relative position of 630°. The USAT 30 antenna is driven counter-clockwise to its lower physical stop then azimuth is driven clockwise to a relative position of 180°.
    3. The polarity axis activates, the polarity assembly is driven to center of range (at which point the LNB will be horizontal).
    4. The antenna is then driven to a 45° elevation pointing angle.

If any of these steps fail, or the DAC reports model "USATxx", the PCUs No parameter needs calibrating. Verify that it saves correctly. A drive issue, pedestal error or error LED 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 and 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 while the antenna is trying to maintain its pointing angle, or while 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 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 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 as the belt slipping on the motor pulley.

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 (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 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 may have damaged the motor driver PCB. If so, replace the PCU assembly.

5.4. Troubleshooting Pedestal Errors – Azimuth Reference Error.

1. Reinitialize the system and verify that the USAT 24 antenna drives clockwise to its end stop or the USAT 30 drives counter clockwise to its end stop.
2. Drive the azimuth axis in 90 degree increments and verify that the antenna points correctly as well as 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.

6. Test The Motor:

Check continuity between ground (the motor connector back shell) and the 3 driver outputs on pins 1, 2 & 3 of the harness.

Now check continuity between pins 4, 5, 6, 7 and 8 and the ground (the motor connector back shell).

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 motor driver PCB (inside the PCU) 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 PCU maybe defective and should be replaced.

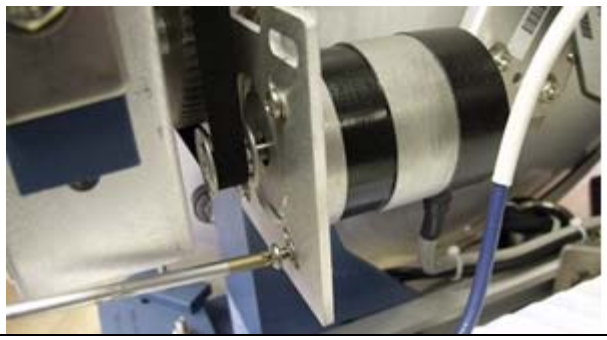
7. Replacing the Elevation Motor:

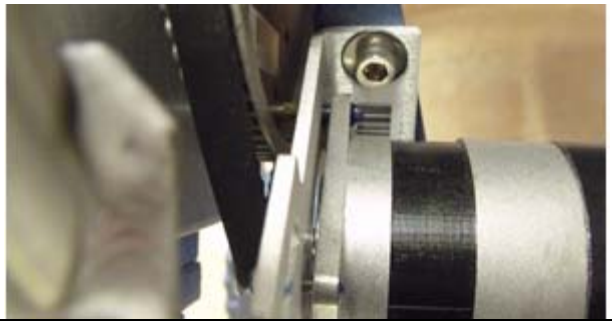
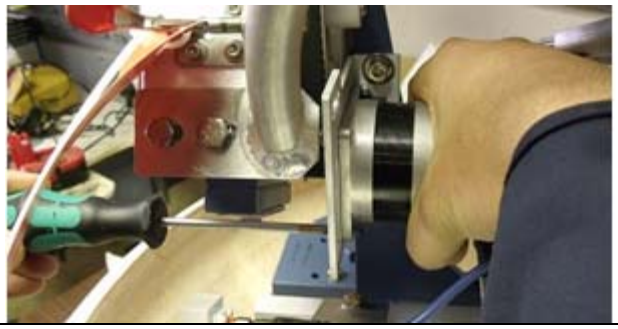
7.1. Tools.

- 2mm Flat Blade (Terminal) Screwdriver
- Snips/Cutters
- #1 Phillips Screwdriver
- 1/16" Allen Wrench/Key
- Cable Ties/Tie Wraps
- Loctite 222, 242 and 638

7.2. Procedure.

Procedure for replacing the elevation motor, Sea Tel kit part number: 130775 (motor part number: 128209-2).

***Caution:** Power down the pedestal before following this procedure. 1. Using a 2mm flat blade screwdriver disconnect the elevation motors D-sub connector from the PCU.	
2. Cut the cable ties securing the elevation motor harness using a pair of cutters.	
3. Using a #1 Phillips screwdriver remove the 3 visible screws securing the elevation motor to its bracket. Save the hardware for future use. ***Note:** Rotate the elevation axis to its upper end stop to allow access to the screws.	

4. Remove the 4th screw by aligning the holes in the EL pan and elevation pulley to allow access to the screw head, undo using a #1 Phillips screwdriver and remove the motor. ***Note:** Once removed the 4th screw will rest on the inside of the elevation pulley.	
5. 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.	
6. Apply Loctite 242 to the hardware removed in step 3 and install the replacement motor assembly, with the cable pointing downwards. For the 4th screw apply the Loctite to the thread of the motor. Do not fully tighten the screws at this time.	
7. Using your hand apply pressure to the motor to tension the elevation belt and tighten two of the retaining screws.	

8. Verify the tension of the belt by pressing on it at the central position between the motor pulley and the main drive sprocket. There should be a little give, but the belt should be tight enough that the axis will drive correctly, without skipping on the teeth of the pulley. If the belt is to tight/loose repeat the previous step until the belt tension is correct and tighten all four of the screws.	
9. Install the elevation motors D-sub connector to the PCU using a 2mm flat blade screwdriver.	
10. Secure the elevation motor harness using cable ties.