Field Service Spares Replacement Procedure – EL & CL Motor Kit, XX09

Approval:

Approving Authority	Signature	Date
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Revision History

Rev.	ECO	Description of Change	Date
A	8800	Initial release	08-12-2011
B	9041	Clerical revisions	10-19-2011

1. Brief Summary:

Troubleshooting document for diagnosing a fault with and replacing the elevation and cross level motor on the MK1 and MK2 XX09 antennas.

2. Checklist:

- Verify Initialization
- Verify MDE LED Status (MK2 Only)
- Pedestal Error

3. Theory of Operation:

The elevation and cross level motors are used for antenna positioning and stabilization. During stabilization the motors drive in response to motion of the mass of the antenna in 3-dimensional free space (as sensed by the rate and MEM sensors, which are both located on the motion platform PCB inside the PCU). Elevation targeting and signal tracking decisions also require drive in elevation. An integrated brake mechanism in the elevation and cross level motors is used to restrict the axis from moving when AC power is lost to the pedestal.

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.

4. Verify Initialization:

- Power cycle the pedestal
    1. 24VDC is supplied to the motors brakes to release them, then 12VDC holds them open
    2. Elevation axis drives to 45 degrees based on the motion platform PCBs horizon reference
    3. Cross level axis drives to level based on the motion platform PCBs horizon reference
    4. Unlimited azimuth axis drives clockwise until the home flag and sensor make contact

***Note:** If the PCU software 2.01a or higher the EL & 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 correctly setting. Verify that it saves correctly. A drive issue, pedestal error or error LED requires further troubleshooting.

5. MDE Status LED Diagnostics:

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

Green	Motor is good.
Solid Red	Motor or harness short circuit (winding-winding, winding-ground, or winding to 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.

5.1. 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 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^{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 + LV	**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 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 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 chain slipping on the motor pulley or the pulley slipping on the motor shaft.

6.3. Troubleshooting Pedestal Errors – Servo and Stability Limit.

1. Reinitialize the pedestal; does it drive correctly or at all? If none of the axes drive verify the No and motor gain parameters (N1 = CL, N2 = EL and 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 procedure below. If the motor is defective replace it.
4. Excessive current draw from a defective motor could potentially damage the PCUs motherboard PCB. If normal operation doesn't return after replacing the motor and then the motor driver enclosure the PCU motherboard should be the next component to be replaced.
5. Verify if the brakes have released properly. If the movement of the axis is restricted, measure the output to the motor to verify if the 12V is present across pins 14 & 15 of the D-sub connector. If so, the brake hasn't released and the motor is defective. If the 12V isn't present, troubleshoot the harness / motor driver enclosure.
6. 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.

6.4. Troubleshooting Pedestal Errors – Azimuth Reference Error.

1. Reinitialize the system & verify that the antenna drives until the sensor comes into contact with the home flag. If not verify if the home flag/sensor is, 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.

6.5. 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 one 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 (which would be highlighted by the diagnostic LEDs on the MDE). The antennas operation should be verified with a replacement motor. If normal operation doesn't return the MDE/PCU will require further troubleshooting.

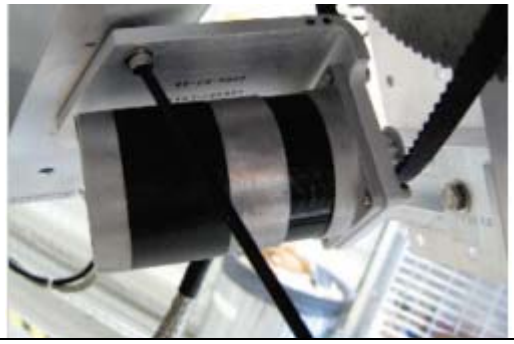
7. Replacing the Elevation Motor:

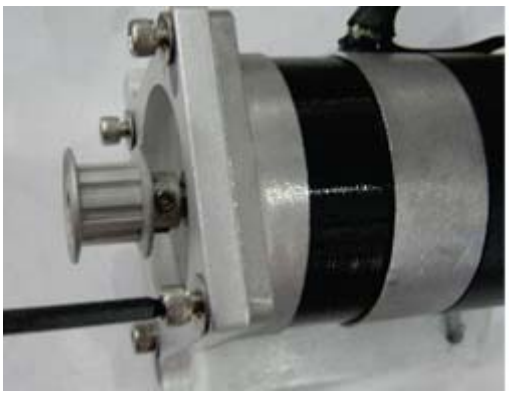
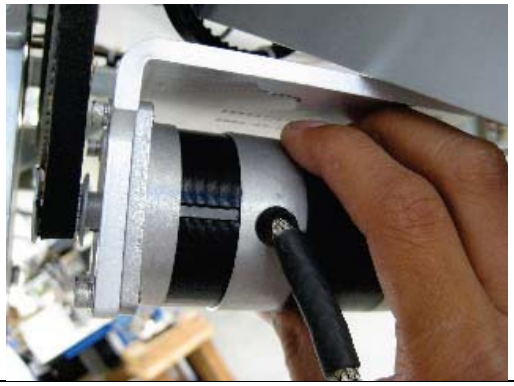
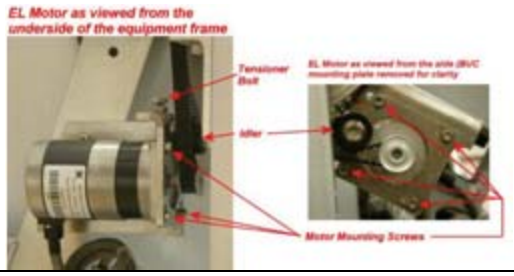
7.1. Tools.

- 2mm Flat Blade (Terminal) Screwdriver
- 5/32" Allen Wrench/Key
- 5/64" Allen Wrench/Key
- 1/16" Allen Wrench/Key
- Loctite 222, 242, 638

7.2. Procedure.

Procedure for replacing the XX09 elevation motor, Sea Tel kit part number: 134930 (motor part number: 125644-1.

***CAUTION:** Power down the pedestal before following this procedure. 1. Using a small flat blade screwdriver remove the EL motor cable from the elevation motor interface harness that routes to the MDE.	
2. Using a 5/32" Allen wrench remove the screws that secure the bracket to the elevation beam. Retain the hardware for future use.	

3. Using a 9/64" Allen wrench, remove the 4 screws that secure the motor to the bracket. 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. 5. Install the replacement motor into the bracket by loosely re-installing the 4 motor mounting screws. **6. MK2 belt tension** – loosen the tensioning bolt locking nut and loosen/unthread tensioning bolt.	
7. Apply Loctite 242 to the two bracket mounting screws. 8. Loosely install one of the bracket mounting screws and the slide belt onto motor pulley.	
9. Align the bracket to beam and install the second bracket mounting screw and tighten both screws. **MK1 motor tension** (no idler or tensioning screw). Tension the belt by pulling down on the motor along the slots in the bracket and tighten all 4 motor mounting screws. 10. Check belt tension by twisting the belt with your fore finger and thumb. 11. Increase the belt tension until the belt can only be easily twisted just ¼ turn with your fingers.	
MK2 motor tension (idler and tensioning screw). 12. Tighten the tensioning bolt and check the belt tension by twisting the belt with your fore finger and thumb. 13. Increase the belt tension until the belt can only be easily twisted just ¼ turn with your fingers & tighten the locking nut on the tensioning bolt.	
14. One at a time, apply Loctite 242 to the 4 motor mounting screws and tighten each to secure the motor. 15. Using a small flat blade screwdriver install the EL motor cable.	

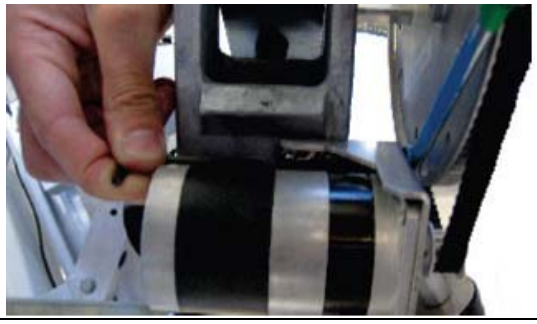
8. Replacing the Cross Level Motor:

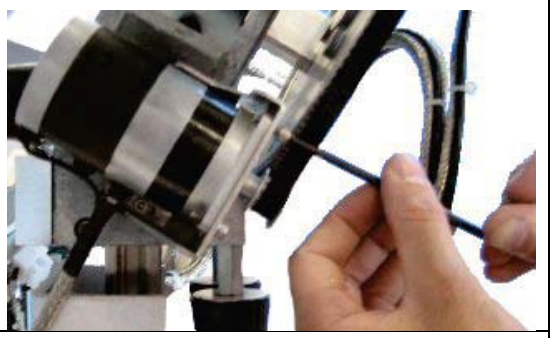
8.1. Tools.

- 2mm Flat Blade (Terminal) Screwdriver
- 5/32" Allen Wrench/Key
- 5/16" Wrench/Spanner
- 1/16 Allen Wrench/Key
- Loctite 222, 242 & 638

8.2. Procedure.

Procedure for replacing the XX09 cross level motor, Sea Tel kit part number: 134930 (motor part number: 125644-1).

***CAUTION:** Power down the pedestal before following this procedure. 1. Using a small flat blade screwdriver loosen the hardware that secures the CL motor harness to the MDE and disconnect the D-sub connector.	
2. Using a 5/32" Allen wrench remove 3 of the four screws that secure the CL motor to its bracket.	
3. Using a 5/32" Allen wrench and a 5/16" wrench remove the final screw that secures the CL motor to its bracket. 4. Remove the CL motor and place it out of the away.	

5. 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 and tighten with a 1/16" Allen wrench. 6. Install the replacement motor into the bracket by loosely re-installing the 4 motor mounting screws. **MK2 motor tension** – loosen the tensioning bolt locking nut and loosen/unthread tensioning bolt.	
MK1 motor tension (no idler or tensioning screw). 7. Using a long screwdriver or similar as a pry-bar (between the motor body and mounting bracket lip). Apply downward pressure to apply belt tension and tighten all 4 motor mounting screws. 8. Check belt tension by twisting the belt with your fore finger and thumb. 10. Increase the belt tension until the belt can only be easily twisted just ¼ turn with your fingers.	
11. Connect and secure the CL motor harness to the MDE.