Field Service Spares Replacement Procedure – Motion Platform PCB Kit, USAT

Approval:

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Revision History

Rev.	ECO	Description of Change	Date
A	9145	Initial release	03-09-2012

1. Brief Summary:

Troubleshooting document for diagnosing a fault with and replacing the motion platform PCB on the USAT series antennas.

2. Checklist:

- Verify Initialization
- Verify Sensor Output
- Drift

3. Theory of Operation:

The motion platform PCB houses 3 sensors the elevation rate sensor, azimuth rate sensor and elevation MEM sensor. The elevation MEM sensor is used as the elevation axis's horizon reference and is used as the reference for the elevation rate sensor. The MEM sensor also outputs the look angle of the axis as an absolute value (like an encoder) meaning the elevation position displayed on the DAC is an absolute value.

As forces are exerted on the system under dynamic conditions the elevation rate sensor will detect motion, as it's offset from its nominal position the voltage output from the elevation rate sensor will increment/decrement depending on the direction of motion which in turn will be fed into the PCU. This will measure the voltage change over time to calculate the amount of motion and in turn will then issue drive to the elevation motor to drive it an equal amount in the opposite direction in turn maintaining the stabilization of the axis and the elevation look angle.

The azimuth rate sensor is used throughout the elevation range and is cross-coupled with feedback from the other rate sensors to provide the PCU with the correct amount of force being exerted on the system and therefore how much azimuth motor drive is required. While on satellite, tracking information is used as the reference for the azimuth rate sensor. Under normal operation the ships heading, relative heading, and input from sensors are combined to provide a reference for the azimuth rate sensor.

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. Verify Stabilization:

The purpose of this procedure is to physically move the systems axis under static conditions, introducing error into the PCU's control loop and then verify the system is able to return to its level position (stabilize itself) efficiently. These tests can be performed by monitoring the sensor outputs on DacRemP or also by physically moving the antenna and observing how it responds.

1. Turn tracking off and Open the DISP_V screen of DacRemP, it will now plot the level position of the MEM sensors or alternatively observe the pedestal. Normal trace is +/- 4 divisions from red line.

2. Verify Level (Elevation) response:

   Push the Reflector up in Elevation (CCW) and hold it in position. Verify that the LV trace on DacRemP moves down an equal amount to the movement exerted on the axis. Release the Axis and verify the DacRemP trace returns (or the systems axis returns) back to its original position instantly, without deviating or taking time to settle. Push the Reflector down in Elevation (CW) and hold it in position. Verify that the LV trace on DacRemP moves up an equal amount to the movement exerted on the axis. Release the Axis and verify the DacRemP trace returns (or the systems axis returns) back to its original position instantly, without deviating or taking time to settle.

If using DacRemP the elevation trace should look similar to this image, note how after each movement the system returns to its level position efficiently without taking time to settle. Should the system take time to settle, or not stabilize to the original position (not necessarily on the red line) then this is an indication that the antenna isn't maintaining its horizon reference correctly and further troubleshooting will need to be undertaken.

6. Rate Sensor Monitoring:

Rate sensor outputs can also be monitored using the DISP_W screen of DacRemP to verify any deviations under static conditions. The traces should remain consistent, any drifting or spikes are an indication the sensors voltage output is changing and the sensor is defective (provided no forces are being exerted on the system). Normal trace is +/- 1 division from red line.

7. Azimuth Targeting:

Should the antenna have issues targeting, such as not accurately finding the satellite or repeatedly finding the satellite in different azimuth positions, then it's important to ascertain if the system is mispointing in azimuth or relative. Relative feedback from the AZ encoder can be verified by initializing the system, verifying it calibrates itself correctly and then drives the pedestal clockwise in 90 degree increments over a 360 degree rotation, noting that the system points correctly (bow, starboard, aft, port, bow and starboard) and that no azimuth reference error is flagged by the PCU. A mechanical problem such as the belt skipping on the sprocket, or another physical restriction, could also cause this kind of error. Skewing the antenna in azimuth by holding the right or left arrow key to drive the antenna slowly may also present an issue.

If the system keeps finding the satellite at different azimuth positions but at the same relative, then the encoder is functioning correctly and the azimuth rate sensor is calculating the movement incorrectly causing the antenna to mispoint.

8. Drift:

Another failure which can occur is if a rate sensor starts drifting. This means the sensors voltage output deviates from what the PCU is expecting (2.5VDC), which introduces error into the control loop. It's more common to see this in the azimuth axis as the elevation axis has a MEM sensor as its long term reference (although should the rate sensors drift be large enough to overpower the MEM sensor you would see the system driving into one of the elevation end stops).

To verify if the system is drifting in azimuth turn off tracking and monitor the relative position, under static conditions (i.e. when the vessels heading isn't changing), it should remain still. If the relative value begins to increase/decrease from its nominal position then the azimuth rate sensor is drifting, feeding error into the PCU's control loop which is causing the PCU to believe the vessels heading is changing and in turn driving the relative in the opposite direction to compensate.

9. Diagnostics:

Any incorrect readings from the above tests would relate to an error in the antennas control loop causing the system to not stabilize correctly. The most likely cause of this is a defective sensor on the motion platform PCB. The next step will be to replace the motion platform PCB and repeat the test which the antenna failed to verify if the system is now functioning correctly.

Should the problem persist other possibilities are a defective sensor on the PCU PCB, a bad connection on the reference harness between the motion platform PCB and PCU corrupting the feedback, or possibly the PCU itself not calculating the feedback correctly. However as the motion platform PCB is the most likely component to be causing this issue replacing it is the first step in the troubleshooting procedure.

10. Further Information:

Should the system fail to target the correct elevation (physically pointing at a different position to the reading on the DAC) or have issues driving past a certain elevation position then the most likely cause is a defective level cage motor.

If the system is displaying a pedestal error (error 8) then there is a drive issue with the antenna and attention will need to be paid to the motor and motor driver (inside the PCU) for the relevant axis.

Another potential issue which could cause the antenna to lose the satellite is if the vessels gyro compass is drifting, accumulating error which is then fed into the control loop. This can be verified by running a DacRemP log file at sea to monitor the pedestals readings when the AGC drops, or by putting the system into satellite reference mode to bypass the gyro from the azimuth control loop.

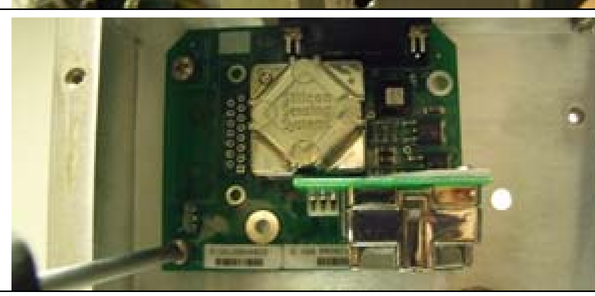
11. Replacing the Motion Platform PCB:

11.1. Tools.

- 2mm Flat Blade (Terminal) Screwdriver
- 3/16" Wrench/Spanner
- #1 Phillips Screwdriver
- Loctite 242

11.2. Procedure.

Procedure for replacing the motion platform PCB, Sea Tel kit part number: 135920 (motion platform PCB part number: 128088).

***Caution:** Power down the pedestal before following this procedure. 1. Disconnect the motion platform PCB D-Sub connector from the elevation pan.	
2. Remove the standoffs from the elevation pan using a 3/16" wrench.	
3. Remove the 6 screws securing the elevation pan cover to the using a #1 Phillips screwdriver. Save the hardware for future use.	
4. Remove the 3 screws securing the defective motion platform PCB to the elevation pan using a #1 Phillips screwdriver. Remove the defective motion platform PCB, save the hardware for future use.	

5. Apply Loctite 242 to the hardware removed in the previous step and install the replacement motion platform PCB.	
6. Install the standoffs to the elevation pan using a 3/16" wrench.	
7. Apply Loctite 242 to the 6 screws removed in step 3 and reinstall the elevation pan cover.	
8. Connect the motion platform PCB D-sub connector to the elevation pan using a 2mm flat blade screwdriver.