Field Service Replacement Procedure – ICU Assembly Kit, 4012

Approval:

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Revision History

Rev.	ECO	Description of Change	Date
A	9487	Initial release	03-23-2012

1. Brief Summary:

Troubleshooting document for diagnosing a fault with and replacing the ICU assembly on the 4012 antenna.

2. Checklist:

- Verify Initialization
- ICU Status LED
- Pedestal Error
- Verify Stabilization/Sensor Feedback
- Communications (EoC)
- Pol Drive

3. Theory of Operation:

The 4012 Integrated Control Unit (ICU) assembly contains a main PCB, motion platform PCB and two 24VDC power supplies, one to power the pedestal and one for the BUC.

The motion platform PCB houses 5 sensors for stabilization of the antenna. 3 rate sensors, one for each axis, for short term stabilization reference and 2 solid state MEM sensors for horizon and gravity reference and long term stabilization feedback. The antennas level position if defined during the initialization process when the elevation and cross level axis's aligning themselves, then under dynamic conditions forces will be exerted on the system, offsetting the rate sensor(s) from their axis causing the voltage to deviate from their nominal (2.5VDC). In turn the main ICU PCB will calculate the amount of force exerted on the system based on the amount of voltage change over time and send the command to the Motor Driver Enclosure (MDE) to drive the relevant motor an equal and opposite amount of motion to maintain the stabilization of the axis pedestal.

Once the profile setting of the ICU has been calibrated the gains for each of the motors and the dishscan pattern have been configured for the size of the antenna from now on the ICU will act on target, tracking and drive commands issues from the MXP as well as calculating the forces exerted on the system based on feedback from the sensors on the motion platform PCB.

The ICU PCB now features an integrated tuning receiver and coax switch to feed the IF frequencies from both the X-pol and Co-Pol LNBs directly into the ICU assembly offering a shorter distance and improving RF performance over previous designs. Based on signal level inputs from the four quadrants of the systems dishscan pattern the ICU will issue drive commands to the MDE based on the direction of the highest signal level to optimize the receive signal of the antenna.

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 ICU's horizon reference
    3. Cross level axis drives to level based on the ICU's horizon reference
    4. Unlimited azimuth axis will drive clockwise until the home flag and sensor make contact

If any of these steps fail verify that the 4012's Profile 1 setting is configured correctly and saves to the ICU. A drive issue, pedestal error or error LED will require further troubleshooting.

5. ICU Status LED Diagnostics

A status LED is installed on the ICU main PCB and can be viewed from the underside of the ICU assembly. The different colors statuses indicate:

Solid Green	ICU status is good.
Solid Red	ICU fault detection. Operational software will never leave the status LED solid RED. Reprogram the ICU software. Replace the ICU main PCB.
Solid Orange	Software update to the ICU main PCB is in process.
Blinking Orange	Software update to the motor driver enclosure (through the ICU) is in process.
Blinking Red	Communication error with the motor driver enclosure. Check the MDE status LEDs. If MDE is good, check to assure that the harness connections are seated properly. Check harness connections (pin-pin, wire-wire and wire-ground) for good continuity. Replace the ICU main PCB. Replace the MDE.

6. Pedestal Error (Error 8):

6.1. Decoding a Pedestal Error.

For the 4012 antenna if the red error LED is illuminated on the MXP enter into the "system" screen and select the error icon to view the displayed error(s).

6.2. Error Types.

The 3 types of pedestal error are.....

1. **Servo Limit (CL, LV and AZ**) **–** A servo limit error means the ICU main PCB is issuing the command to the motor driver enclosure 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 mispointed from its desired position by more than half a degree. When a stability limit error is flagged on a VSAT antenna the MXP 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 Limit and Stability Limit.

1. Reinitialize the pedestal; does it drive correctly or at all? If none of the axis drive verify the No or Profile setting is configured correctly for your model of antenna.
2. Verify the balance of the antenna and check for physical restrictions on the pedestal – If the axis isn't correctly balanced the ICU 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 you find the motor is defective replace it and then test the function of the motor driver enclosure. If the axis still fails to drive correctly the motor may have damaged it. Replace the motor driver.

6.4. 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 correct then there is a sensor/feedback failure.
2. Drive the azimuth axis in 90 degree increments and verify that the antenna points correctly and that the MXP displays the correct relative position. Also verify that there is no physical restriction on the azimuth axis such as the chain slipping on the motor pulley or the pulley slipping on the motor shaft.

7. Test The Motor:

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

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

Also check between the individual pins 1, 2, 3 and the rest of the pins (i.e. test pin 1 to pin 4, 5, 6, 7, 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 (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/ICU will require further troubleshooting.

8. Verify Stabilization:

The purpose of this procedure is to physically move the systems axis under static conditions, introducing error into the ICU's control loop, and then verify the system is able to return to its level position (stabilize itself). These tests can be performed by monitoring the sensor outputs using DacRemP or the 4012 graphs screen and by physically moving the antenna and observing how it responds.

1. Turn tracking off and open the DISP_V screen of DacRemP or access the graphs screen of the 4012 GUI. The software will now plot the level position of the LV and CL MEM sensors. Observe for any abnormalities.
2. Verify Cross Level response:

   Standing behind the system, push the cross level beam down to the left and hold it in position. Verify that the CL trace moves down an equal amount to the movement exerted on the axis. Release the axis and verify that the trace and system axis both return back to their original positions instantly, without deviating or taking time to settle. Now push the cross level beam down to the right and hold it in position. Verify that the CL trace moves up an equal amount to the movement exerted on the axis. Release the axis and verify the trace and system axis both return back to their original positions instantly, without deviating or taking time to settle.
3. Verify Level (Elevation) response:

   Push the reflector up in elevation and hold it in position. Verify that the LV trace moves down an equal amount to the movement exerted on the axis. Release the axis and verify the trace and system axis both return back to their original positions instantly, without deviating or taking time to settle. Push the reflector down in elevation and hold it in position. Verify that the LV trace moves up an equal amount to the movement exerted on the axis. Release the axis and verify the trace and system axis both return back to their original positions instantly, without deviating or taking time to settle.
4. In the trace should look similar to the below 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.

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9. Rate Sensor Monitoring:

Rate sensor outputs can also be monitored using the DISP_W screen of DacRemP or from the graphs screen of the 4012 GUI 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).

10. Azimuth Targeting:

Should the antenna have issues targeting in azimuth, such as not accurately finding the satellite or repeatedly finding the satellite in different azimuth positions, then it's important to diagnose if the system is mispointing in azimuth or relative. Relative feedback from the azimuth encoder can be verified by initializing the system, verifying it calibrates itself correctly, and then driving the pedestal clockwise in 90 degree increments over a 360 degree rotation. Note that the system points correctly relative to the vessel and that no azimuth reference error is flagged by the ICU. A mechanical problem such as the belt slipping on the sprocket could also cause this kind of error.

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.

11. Drift:

If a rate sensor is "drifting" its nominal voltage output has changed from the correct 2.5VDC. This will cause error in the axis control loop and cause the antenna to move. It is more common to see this drift in the azimuth axis as the cross level and elevation axis both have a long term reference, provided by the tilt sensor. However, should the rate sensors drift be large enough, it can over-compensate the tilt sensor and the system will drive into one of the cross level or elevation end stops.

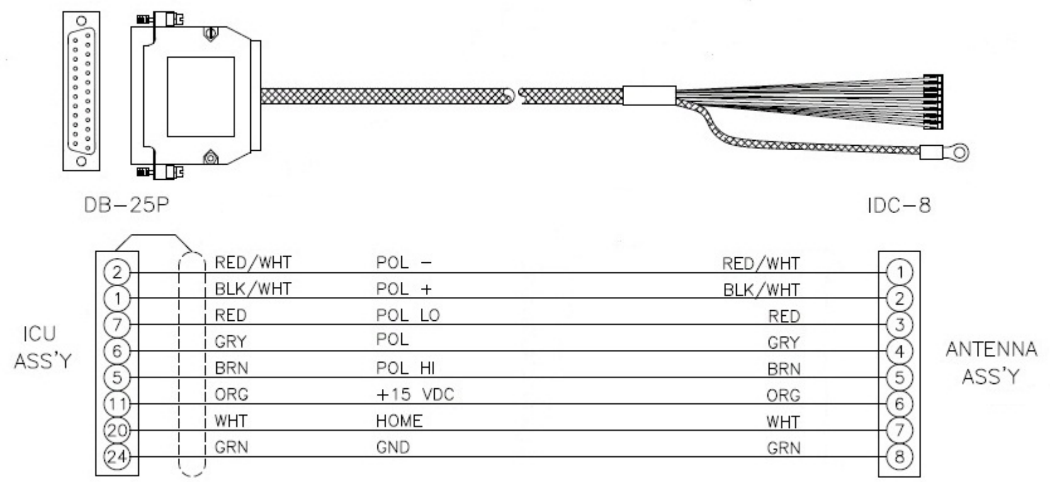
To verify if the system is drifting in azimuth, turn tracking off and monitor the relative position. Under static conditions, when the vessels heading is unchanged, the relative count should remain stationary. If the relative value begins to change from its current position, the azimuth rate sensor is drifting, introducing error into the axis control loop.

If the rate sensors are checked as OK, a ships gyro can induce drift. This will introduce loop error into the ICU control loop and cause the antenna to drift. If it's suspected the heading is causing the antenna to drift the system can be set to satellite reference mode to uncouple the gyro compass from the control loop.

Note: If the ICU and gyro compass are displaying the same heading reading this isn't an indication that the heading value is correct, only that the ICU is reading the information correctly.

12. Verify Pol Drive:

As the pol aux relay is integrated into the ICU main PCB a fault with the pol alignment could potentially be caused by this PCB. If no pol drive is present set the pol setting to manual and apply drive to the feed assembly and measure the voltage to the motor on the IDC connector, 24VDC should be present. If voltage is present but the motor isn't driving the motor is defective and needs replacing. If no voltage is present verify the connections of the reflector harness by measuring pin to pin as per the below diagram.



If the harness connections are good, then the ICU main PCB outputting the voltage to drive the motor and needs replacing.

As long as the pol range is within the pot limits the ICU will issue the 24VDC to drive the pol motor based on the antenna targeting, a change in the vessels GPS position or operator inputs. The ICU main PCB will drive the pol motor, which will rotate the feed assembly until the correct output from the pot has been received. At which point the feed will be in the optimum reception position (providing the system is functioning and calibrated correctly). Therefore there is also the possibility for a pol drive fault to be caused by the ICU main PCB.

13. Communication Diagnostics (EoC):

The MXP and ICU both contain a diagnostic LED to verify the status of the systems communications. One of the EoC (Ethernet over Coax) LEDs will blink to verify the status of the communications between the ADE and BDE. Based on which unit (MXP or ICU) has sent the verification command will depend on which one of the EoC LED's is blinking, if neither of the LEDs are blinking then further diagnostics needs to be undertaken.

14. Replacing the ICU Assembly:

14.1. Tools.

- 5/16" Wrench/Spanner
- 2mm Flat Blade (Terminal) screwdriver
- A pair of 7/16" Wrenches/Spanners, or a 7/16" Wrench and Socket
- Loctite 242

14.2. Procedure.

Procedure for replacing the ICU assembly, Sea Tel kit part number: 136740 (ICU assembly part number: 134735-1).

***Caution:** Power down the pedestal before following this procedure. 1. Disconnect the GPS antennas RJ-45 connector from the ICU.	
2. Disconnect the AC power input socket from the ICU.	
3. Disconnect the RF power connection from the ICU.	

4. Disconnect the 3 SMA cables from the ICU using a 5/16" wrench.	
5. Using a 2mm flat blade screw driver disconnect the D-sub connectors from the ICU.	
6. Using a pair of 7/16" wrenches (or a wrench and socket) undo the 4 sets of hardware securing the ICU to the elevation pan and remove the defective ICU. ***Note:*** Due to weight of the ICU removing it will affect the balance of the pedestal. Support the system in cross level as the ICU is removed.	
7. Install the replacement ICU assembly using the new hardware provided in the kit, apply Loctite 242 to the threads and secure using a pair of 7/16" wrenches or a wrench and socket.	
8. Connect the AC power connector to the ICU.	

9. Connect the RF power connector to the ICU.	
10. Connect the SMA cables to the ICU with the orange X-pol IF cable into the "LNB A" port, the yellow Co-Pol IF cable into the "LNB B" port and the Black RX IF cable into the "RJ" port. As shown in the image on the right.	
11. Connect the D-sub connectors to the ICU using a 2mm flat blade screw driver. 12. Connect the GPS antennas RJ-45 connector.