Procedure, Field Replacement, Level Cage, Base Exit

Approval:

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Revision History

Rev.	ECO	Description of Change	Date
A	8791	Initial release	08-05-2011
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1. Brief Summary:

Troubleshooting document for diagnosing a fault with and replacing the level cage assembly.

2. Checklist:

- Verify Remote Tilt
- Verify Initialization
- Verify Sensor Outputs using DacRemP
- Azimuth and Relative Targeting
- Drift and Sensor Monitoring

3. Theory of Operation:

The level cage contains 4 sensors. These are a fluid filled tilt sensor which is used as the systems horizon reference (level position) and long term stabilization reference, and 3 solid state rate sensors, one for each axis which acts as the antennas short term stabilization reference. A faulty sensor inside the level cage will cause the antenna to lose stability and mispoint from the satellite under dynamic conditions although the system may appear to be operational in the port when there is no motion to counteract. This document will run through testing the sensors inside the level cage, replacing the level cage assembly and calibrating the systems remote tilt setting.

4. Verify Remote Tilt:

If the pedestal is having stability problems firstly check the remote tilt setting by looking at the level bubble on top of the level cage (note: older systems didn't have a bubble installed on top of the level cage). If the bubble isn't as close to central as possible the remote tilt setting isn't correctly calibrated, meaning the rate sensors won't be correctly aligned with their axis. This will cause the rate sensors to output incorrect feedback into the PCUs control loop, potentially causing a stabilization issue. Calibrate the remote tilt setting as per the instructions at the end of this document and continue to test the level cage using the follow procedures.

5. Verify Initialization:

- Power cycle the pedestal
    1. Brakes release (if applicable)
    2. Level cage drives to its end stop, then backs off exactly 45 degrees
    3. Elevation axis drives to 45 degrees based on the level cages horizon reference
    4. Cross level axis drives to level based on the level cages horizon reference
    5. Unlimited azimuth systems drive clockwise until the home flag and sensor make contact
    6. Limited azimuth systems drive clockwise into the azimuth end stop, then back off to 630 degrees of relative

If any of these steps fail, or the ACU reports model "xx03/xx04", the antennas No parameter needs calibrating and verified it saves correctly. A drive issue or pedestal error requires further troubleshooting.

6. 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 tilt sensor. Alternatively observe the pedestal. Normal trace is +/- 4 divisions from red line.

2. Verify Cross Level response:

   Push the cross level beam down to the left (CCW) and hold it in position. Verify that the CL 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. Now push the cross level beam down to the right and hold it in position. Verify that the CL 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.

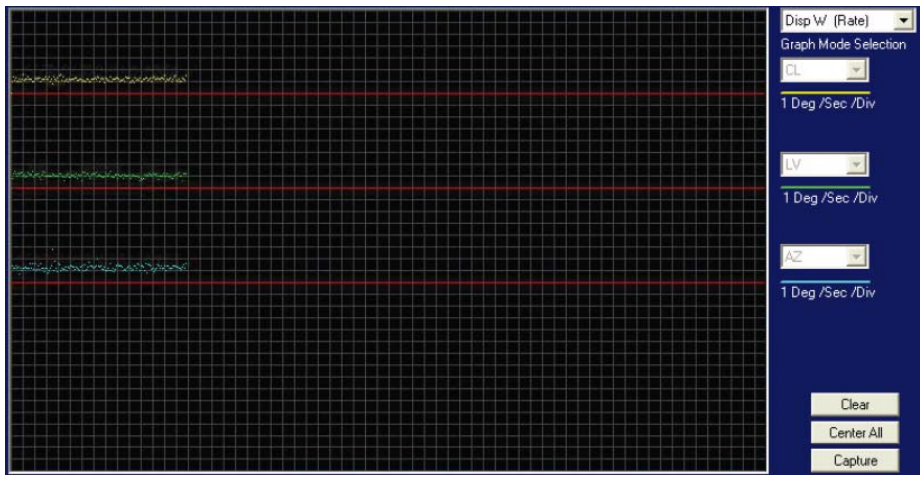
3. Verify Level (Elevation) response:

   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 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.

7. 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.



8. 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 driving 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 AZ 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.

9. 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 CL and EL axis have the tilt sensor as their long term reference (although should the rate sensors drift be large enough to overpower the tilt sensor you would see the system driving into one of the CL or EL 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.

10. 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 in the level cage. The next step will be to replace the level cage 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 bad connection on the reference harness between the level cage and PCU corrupting the feedback, or possibly the PCU itself not calculating the feedback correctly. However as the level cage is the most likely component to be causing this issue replacing it is the first step in the troubleshooting procedure.

Once the problem has been rectified its good practice to refit the original level cage and see if the fault returns. It's possible that there was corrosion on the pins of the reference harness and by connecting the replacement level cage the pins have been cleaned, allowing good metal to metal contact and giving the impression that replacing the level cage rectified the fault (cleaning the pins on the PCU end of the reference harness is also advisable).

11. 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 (servo amp) for the relevant axis. A defective level cage won't flag an error 8 as the PCU doesn't know if the feedback from the level cage is corrupt which is why the antenna will mispoint if the level cage is defective.

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.

12. 2406 Level Cage Configuration:

To use the level cage (part number: 122937-1) on the 2406 pedestal, it will need to be converted into a 122937-2. This is done simply by re configuring the end stops on the back of the level cage assembly as per the below image. The standard 122937-1 level cages has the end stops on the left-hand side, these will need to be moved to the right-hand side to use the level cages on the 2406 pedestal.

122937-1 122937-2

13. XX06 Level Cage Install:

Note: How the nylock nut is installed, tensioning the centre collar of the bearing, preventing the level cage from moving from side to side on the spindle, not over tightened so it can move smoothly.

14. Replacing the Level Cage Assembly:

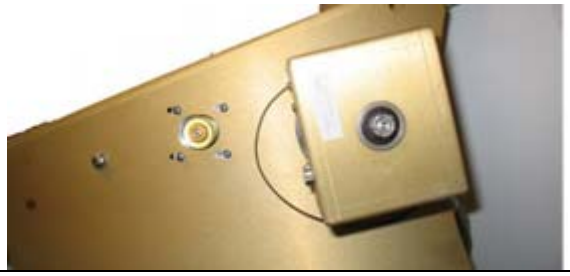
14.1. Tools.

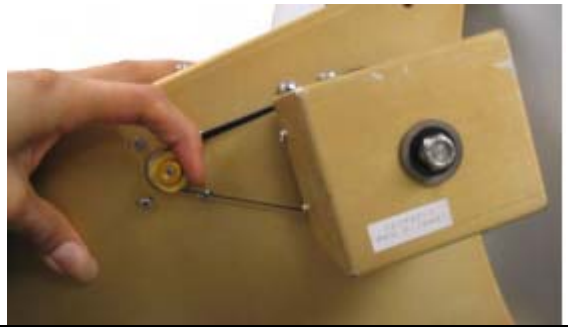
- 2mm Flat Blade (Terminal) Screw Driver
- #1 Phillips Screwdriver
- ½" Wrench/Spanner

14.2. Procedure.

Procedure for replacing the level cage assembly, Sea Tel kit part number: 135343 (level cage assembly part number: 122937-1) and tensioning the level cage belt. The principal is the same for the XX06 level cage, although it's installed in a different orientation (as shown above).

***CAUTION:** Power down the pedestal before following this procedure. 1. Using a 2mm flat blade screwdriver loosen the screws securing the reference harness D-Sub connector to level cage.	

2. Using a #1 Phillips screwdriver, loosen the four screws attaching level cage motor to the EL pan **(do not fully remove)**. 3. Slide the motor towards the reflector and remove the belt from level cage motor sprocket.	
4. Using a ½" socket or wrench remove the Nylock nut securing the level cage to the spindle.	
5. Take care not to remove the level standoff spacer from the spindle.	
6. Install the replacement level cage onto the spindle, slipping the belt over the level cage pulley and making sure its end stops are aligned correctly. Secure it with the 1/2" Nylock nut, tightened so it slightly preloads the bearings. 7. Rotate the level cage by hand and verify it has 90 degrees of motion and that the cage rotates freely without rubbing against the EL pan.	
8. Place the belt on the level cage sprocket and then slip it over the sprocket of the level cage motor.	

9. Tension the belt by sliding the motor assembly by hand away from level cage and tighten <u>one</u> of the four screws.	
10. Increase the belt tension until the belt can only be easily twisted just ¼ turn with your fingers. 11. If the belt tension is too tight/lose adjust until correct and then secure the motor.	
12. Plug the reference harness back into the level cage D-Sub connector and tighten the retaining screws (no need to Loctite as split washers are installed on the harness).	

15. Calibrating the Remote Tilt Setting:

This procedure is required to calibrate the level cage so that all the sensors will be accurately aligned to their axis. The fluid filled tilt sensor provides a two dimensional horizon reference. The system is not able to automatically calculate the exact center value, therefore it is necessary to perform this procedure to manually enter any offset required to make sure the PCU receives a true horizon reference.

1. Turn dishscan off:

   Enter into the Setup Menu by pressing and holding the  arrows together until the EL Trim or Auto Trim parameter is displayed.

   Use the  arrow key to scroll through the menu until the dishscan window is displayed.

   Press the  arrow to activate the window and then press the  arrow, followed by the  button to turn dishscan from on to off.

   ***Note:** When you press the  arrow to turn dishscan off you won't see the display change until you press the  button.

(*Steps 2-7 requires assistance to observe and operate antenna simultaneously*)

2. Enter into the Setup Menu by pressing and holding the  arrows together until the EL Trim or Auto Trim parameter is displayed.

3. Push the  arrow key until the Remote Tilt window is displayed.

4. Push the  arrow key to activate the Remote Tilt setting.

5. Use the arrow keys to position the bubble as close to the center as possible. Each press of an arrow key on the directional pad will move the Remote Tilt ½ a degree. It is advised that you only press the button once and wait for the axis to move before pressing it again.

   When standing behind the antenna looking at the bubble, if the bubble is over to the right, you need to press the  (right) arrow to bring the bubble into the center. If the bubble is down towards you, you need to press the  (down) arrow to bring it towards the center. If the bubble is to the left, you need to press the  (left) arrow and if the bubble is up towards the top, you need press the  (up) arrow to move it towards the center.

When correct the bubble should be as close to the center of the fluid as possible

6. When the bubble is as central as possible press the ENTER button to deactivate the Remote Tilt setting.
7. Turn dishscan on:

   Enter into the Setup Menu by pressing and holding the arrows until either the EL Trim or Auto Trim parameter is displayed.

   Use the arrow key to scroll through the menu until the dishscan window is displayed.

   Press the arrow key to activate the window and then press the arrow key, followed by the ENTER button to turn dishscan from off to on.

   ***Note:** When you press the arrow to turn dishscan on you won't see the display change until you press the ENTER button.

8. Save the Remote Tilt setting in the PCU:

   Press the arrow key until the Remote Parameters window is displayed.

   Press the arrow key to activate the window followed by the ENTER button (you'll see a confirmation on the display saying "Saved").

9. As good practice make a note of your N4 and N5 parameters once you have correctly set the remote tilt. The N4 and N5 parameters are a numeric read of the remote tilt. To do this go to the remote command window and key in N4999 to read the CL setting, followed by N5999 to read the EL setting.