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# Report On

Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-350B (GPS Enabled)

Document 75905359 Report 01 Issue 3 June 2009

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**REPORT ON**

Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-350B (GPS Enabled)

Document 75905359 Report 01 Issue 3

June 2009

**PREPARED FOR**

ACR Electronics, Inc.
5757 Ravenswood Road
Fort Lauderdale
USA

**PREPARED BY**

**R Hampton**
Test Engineer

**APPROVED BY**

**M Jenkins**
Authorised Signatory

**DATED**

09 June 2009

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**SECTION 1**

**REPORT SUMMARY**

Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-350B (GPS Enabled)

## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics, Inc. PLB-350B (GPS Enabled) to the requirements of T.007 Issue 4 – Rev 2 November 2007.

| | | |
|---|---|---|
| Objective | To perform Emergency Beacon Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out. | |
| Manufacturer | ACR Electronics, Inc. | |
| Model Number(s) | PLB-350B (GPS Enabled) | |
| TUV Reference Number(s), Model(s) and Serial Number(s) | 75905359_007 | PLB-350B Floatation, S/N: #22 |
| | 75905359_010 | PLB-350B Slim, S/N: #14 |
| | 75905359_015 | PLB-350B Slim (50Ω), S/N: #2 |
| | 75905359_016 | PLB-350B Slim, S/N: #5 |
| | 75905359_017 | PLB-350B Slim (50Ω), S/N: #3 |
| Number of Samples Tested | Five | |
| Test Specification/Issue/Date | Cospas-Sarsat T.007 Issue 4 – Rev 2 November 2007 | |
| Incoming Release<br>Date | Application Form<br>16 January 2009 | |
| Date of Receipt of Test Samples | 23 January 2009 | |
| Order Number<br>Date | 95233_001<br>10 January 2009 | |
| Start of Test | 29 January 2009 | |
| Finish of Test | 04 June 2009 | |
| Name of Engineer(s) | R Henley<br>R Hampton<br>M Hardy | |

## 1.2 APPLICATION FORM

### 1.2.1 Beacon Manufacturer and Beacon Model

| | |
|---|---|
| **Beacon Manufacturer** | ACR Electronics, Inc |
| **Beacon Model** | PLB-350B (GPS-Enabled) |
| **Other Model Names** | PLB-350B Slim, PLB-350B Float |

### 1.2.2 Beacon Type and Operational Configurations

| **Beacon Type** | **Beacon used while:** | **Tick where appropriate** |
|---|---|---|
| **EPIRB** | Floating in water or on deck or in a safety raft | ☐ |
| **PLB** | On ground and above ground | ☒ |
| | On ground and above ground and floating in water | ☐ |
| **ELT Survival** | On ground and above ground | ☐ |
| | On ground and above ground and floating in water | ☐ |
| **ELT Auto Fixed** | Fixed ELT with aircraft external antenna | ☐ |
| **ELT Auto Portable** | In aircraft with an external antenna | ☐ |
| | On ground, above ground, or in a safety raft with an integrated antenna | ☐ |
| **ELT Auto Deployable** | Deployable ELT with attached antenna | ☐ |
| **Other (specify)** | | ☐ |

### 1.2.3 Beacon Characteristics

| **Characteristic** | **Specification** |
|---|---|
| Operating temperature range | Tmin = -20°C<br>Tmax = +55°C |
| Operating lifetime | 24 hours |
| Battery chemistry | LiMnO2 |
| Battery cell size and number of cells | 2/3A size, 2 connected-in-series Packs (2 series cells per pack) |
| Battery cell manufacturer | Sanyo, CR123A |
| Battery pack manufacturer and part number | ACR, A3-06-2613 |
| Oscillator type (e.g. OCXO, MCXO, TCXO) | TCXO |
| Oscillator manufacturer | Rakon/C-MAC |
| Oscillator part name and number | A1-11-0687-2 (E4672) |
| Oscillator satisfies long-term frequency stability requirements (Yes or No) | Yes |

| Characteristic | Specification |
|---|---|
| Antenna type: Integral or Other (e.g. External, Detachable – specify type) | Integrated |
| Antenna manufacturer | ACR Electronics, Inc. |
| Antenna part name and number | A3-06-2493 |
| Navigation device type (Internal, External or None) | Internal |
| Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A) | Yes |
| Features in beacon that ensures erroneous position data is not encoded into the beacon message (Yes, No or N/A) | Yes |
| Navigation device capable of supporting global coverage (Yes, No or N/A) | Yes |
| For Internal Navigation Devices | |
| - Geodetic reference system (WGS 84 or GTRF) | WGS 84 |
| - GNSS receiver cold start forced at every beacon activation (Yes or No) | Yes |
| - Navigation device manufacturer | Wonde Proud |
| - Navigation device model name and part Number | A1-11-0688-1 |
| - GNSS system supported (e.g. GPS, GLONASS, Galileo) | GPS |
| For External Navigation Devices | |
| - Data protocol for GNSS receiver to beacon interface | na |
| - Physical interface for beacon to navigation device | na |
| - Electrical interface for beacon to navigation device | na |
| - Navigation device model and manufacturer (if beacon designed to use specific devices) | na |

| Characteristic | Specification | |
|---|---|---|
| Self-Test Mode Characteristics | Self-Test Mode | Optional GNSS Self-Test Mode |
| - Self-test has separate switch position (Yes or No) | Yes | Yes |
| - Self-test switch automatically returns to normal position when released (Yes or No) | Yes | Yes |
| - Self-test activation can cause an operational mode transmission (Yes or No) | No | No |
| - Self-test causes a single beacon self-test message burst only regardless of how long the self-test activation mechanism applied (Yes or No) | Yes | Yes |
| - Results of self-test indicated by (e.g. Pass / Fail Indicator Light, Strobe Light, etc.) | 4 beeps/LED | Beeps/LED |
| - Self-test can be activated from beacon remote activation points (Yes or No) | No | No |
| - Self-test performs an internal check and indicates that RF power emitted at 406 MHz and 121.5 MHz if beacon includes a 121.5 MHz homer (Yes or No) | No | No |
| - Self-test transmits a signal(s) other than at 406 MHz (Yes & details or No) | no | no |
| - Self-test can be activated directly at beacon (Yes or No) | Yes | Yes |
| - List of Items checked by self-test | Battery,406PWR,Lock Det | GPS ACQ, 406 burst |
| - Self-test transmission burst duration (440 or 520 ms) | 440 ms | 520 ms |
| - Self-test format bit (“0” or “1”) | 1 | |
| - Maximum duration of GNSS Self Test | N/A | 121 seconds |
| - Maximum number of GNSS Self Tests (beacons with internal navigation devices only) | N/A | 12 |
| Beacon includes a homer transmitter (if yes identify frequency of transmission) | 121.5MHz | |
| -Homer Transmit Power | 17dBm | |
| -Homer Duty Cycle | 98% | |
| -Duty Cycle of Homer Swept Tone | 37.5% | |

| Characteristic | Specification |
|---|---|
| Beacon includes a strobe light (Yes or No) | Yes |
| - Strobe light intensity | N/A |
| - Strobe light flash rate | 21/minutes |
| Beacon transmission repetition period satisfies C/S T.001 requirement that two beacon's repetition periods are not synchronised closer than a few seconds over 5 minute period, and the time intervals between transmissions are randomly distributed on the interval 47.5 to 52.5 seconds (Yes or No) | Yes |
| Other ancillary devices (e.g. voice transceiver). List details on a separate sheet if insufficient space to describe. | na |
| Beacon includes automatic activation mechanism (Yes or No)<br>Specify type of automatic beacon activation mechanism | No |
| Beacon includes software or hardware features and functions not listed above and non-related to 406 MHz (Yes or No)<br><br>List features and use a separate sheet if insufficient space | No |

| Characteristic | Specification | |
|---|---|---|
| **Message Coding Protocols:** | (x) Tick the boxes below against the intended protocol options | |
| User Protocol (tick where appropriate) | ☐ | Maritime with MMSI |
| | ☐ | Maritime with Radio Call Sign |
| | ☐ | EPIRB Float Free with Serial Number |
| | ☐ | EPIRB Non Float Free with Serial Number |
| | ☐ | Radio Call Sign |
| | ☐ | Aviation |
| | ☐ | ELT with Serial Number |
| | ☐ | ELT with Aircraft Operator and Serial Number |
| | ☐ | ELT with Aircraft 24-bit Address |
| | ☐ | PLB with Serial Number |
| | ☐ | National (Short Message Format) |
| | ☐ | National (Long Message Format) |
| Standard Location Protocol (tick where appropriate) | ☒ | EPIRB with MMSI |
| | ☒ | EPIRB with Serial Number |
| | ☒ | ELT with 24-bit Address |
| | ☒ | ELT with Aircraft Operator Designator |
| | ☒ | ELT with Serial Number |
| | ☒ | PLB with Serial Number |
| National Location Protocol (tick where appropriate) | ☒ | National Location: EPIRB |
| | ☒ | National Location: ELT |
| | ☒ | National Location: PLB |
| User Location Protocol (tick where appropriate) | ☐ | Maritime with MMSI |
| | ☐ | Maritime with Radio Call Sign |
| | ☐ | EPIRB Float Free with Serial Number |
| | ☐ | EPIRB Non Float Free with Serial Number |
| | ☐ | Radio Call Sign |
| | ☐ | Aviation |
| | ☐ | ELT with Serial Number |
| | ☐ | ELT with Aircraft Operator and Serial Number |
| | ☐ | ELT with Aircraft 24-bit Address |
| | ☐ | PLB with Serial Number |

### 1.2.4 Information Provided by the Cospas-Sarsat Accepted Test Facility

Name and Location of Beacon Test Facility: TUV Product Service Ltd, United Kingdom

Date of Submission for Testing: 23 January 2009

**Applicable C/S Standards:**

| Document | Issue | Revision | Date |
|---|---|---|---|
| C/S T.001 | 3 | 7 | Nov-05 |
| C/S T.007 | 4 | 1 | Oct-06 |
| C/S T.007 | 4 | 2 | Nov-07 |

I hereby confirm that the 406 MHz beacon described above has been successfully tested in accordance with the Cospas-Sarsat Type Approval Standard (C/S T.007) and complies with the Specification for Cospas-Sarsat 406 MHz Distress Beacons (C/S T.001) as demonstrated in the attached report.

Signed: 

Name: M Jenkins

Position Held: Authorised Signatory

Date: 09 June 2009

### 1.2.5 Applicant Details

| | | | |
|---|---|---|---|
| Company Name | ACR Electronics, Inc. | | |
| Address | 5757 Ravenswood Road<br>Fort Lauderdale, Florida 33312-6645<br>USA | | |
| Category of Applicant | ☒ Manufacturer | ☐ Importer | |
| | ☐ Distributor | ☐ Agent | |
| Contact Name | Chung Tong | Telephone | 954-981-3333, ext.2186 |
| Email | ctong@acrelectronics.com | Facsimile | 954-983-5087 |

### 1.2.6 Manufacturer Details

| | | | |
|---|---|---|---|
| Company Name | Same as above | | |
| Address | | | |
| Contact Name | | Telephone | |
| Email | | Facsimile | |

### 1.2.7 Declaration of Build Status

| | |
|---|---|
| Hardware Version | |
| - PCB Revision | Rev.A (same as T2) |
| - Battery Model | A3-06-2613 |
| Software Version | N/A |
| Firmware Version | Rev.A (same as T2) |
| Other (Specify) | |

### 1.2.8 Applicant's Declaration

I hereby declare that I am entitled to sign on the behalf of the applicant and that the information supplied is correct and complete

Signed: Chung Tong

Name: Chung Tong

Position Held: Principal electrical Engineer

Date: 06/02/2009

## 1.3 PRODUCT INFORMATION

### 1.3.1 Technical Description

The Equipment Under Test (EUT) was a ACR Electronics PLB-350B (GPS Enabled) as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.


Equipment Under Test (75905359_016)

### 1.3.2 Physical Test Configuration

The Equipment Under Test (EUT) was operated using its own power source (internal battery).

Two "50Ω" EUT Samples were configured for direct connection to the 50Ω test system using a coaxial cable (samples 75905359_015 & 75905359_017). These samples were used for all tests except Antenna Characteristics, Satellite Qualitative and Position Accuracy Time and Position Accuracy.

The two other EUT samples were fully packaged beacons, similar to the proposed production beacons equipped with their proper antennas. These EUT samples were used to perform Antenna Characteristics, Satellite Qualitative and Position Acquisition Time and Position Accuracy. The test configuration for these tests is a function of the beacon type and the operational environments supported by the beacon, as declared by the manufacturer.

### 1.3.3 Modes of Operation

Modes of operation of the EUT during testing were as follows:

Standby Mode:

- No apparent EUT activity
- No ancillary devices were declared

Self-test:

- “TEST” button depressed until green LED light indicated Self-test operation
- List of features tested as per Application Form

GNSS Self-test:

- “TEST” button depressed for >5 seconds until green LED light indicated GNSS Self-test operation
- List of features tested as per Application Form

Operating:

- Antenna Raised and Power Button depressed
- 121 MHz homer active and offset to 121.65 MHz
- 243 MHz homer not declared
- Physical configuration as above
- GPS Enabled with no position input unless otherwise stated

## 1.4 MODIFICATIONS

No modifications were made to the test sample during testing.

## 1.5 REPORT MODIFICATION RECORD

Issue 1 – First Issue
Issue 2 – Cospas-Sarsat Worksheet 1: Actions include (but are not limited to):

- New Application Forms (Separated Float and Slim variants)
- Amended Battery Discharge Calculations and corresponding reduction to Operating Lifetime at Minimum Temperature results
- Additional photographs included
- Additional Navigation Testing on “Float” Variant sample
- Numerous omissions and typographical errors corrected

Issue 3 - Cospas-Sarsat Worksheet 1:

- Corrected Sample tested on Page 17 GNSS Self Test.

**SECTION 2**

**TEST DETAILS**

Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-350B (GPS Enabled)

## TEST RESULTS TABLE

| Parameter | | Limits | Units | Test Results | | | Comments |
|---|---|---|---|---|---|---|---|
| | | | | Tmin | Tamb | Tmax | |
| | | | | (-20°C) | (22°C) | (+55°C) | |
| 1. Power Output | | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Transmitter power output | | 35 - 39 | dBm | 37.81 | 37.46 | 37.13 | |
| Power output rise time | | < 5 | ms | 0.012 | 0.012 | 0.012 | |
| Power output 1ms before burst | | < -10 | dBm | -38.04 | -38.49 | -38.60 | |
| 2. Digital Message Coding | | Bit Numbers | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Bit Sync | 1 - 15 | 15 bits “1” | P / F | P | P | P | Decoded Message: Page 21 |
| Frame sync | 16 - 24 | “000101111” | P / F | P | P | P | |
| Format flag | 25 | 1 bit | bit value | 1 | 1 | 1 | |
| Protocol flag | 26 | 1 bit | bit value | 0 | 0 | 0 | |
| Identification / position data | 27 - 85 | 59 bits | P / F | P | P | P | |
| BCH code | 86 -106 | 21 bits | P / F | P | P | P | |
| Emerg. Code/nat. use/supplem. Data | 107 - 112 | 6 bits | bit value | 110111 | 110111 | 110111 | |
| Additional data / BCH (if applicable) | 112 - 144 | 32 bits | P / F | P | P | P | |
| Position Error (if applicable) | | < 5 | km | N/A | N/A | N/A | |
| 3. Digital Message Generator | | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Repetition rate, $T_R$: | | | | | | | |
| Average $T_R$ | | 48.5 ≤ $T_{Ravg}$ ≤ 51.5 | seconds | 50.063 | 50.221 | 50.024 | |
| Minimum $T_R$ | | 47.5 ≤ $T_{Rmin}$ ≤ 48.0 | seconds | 47.812 | 47.703 | 47.844 | |
| Maximum $T_R$ | | 52.0 ≤ $T_{Rmax}$ ≤ 52.5 | seconds | 52.328 | 52.031 | 52.297 | |
| Standard deviation | | 0.5 - 2.0 | seconds | 1.290 | 1.417 | 1.227 | |
| Bit rate | | | | | | | |
| Minimum fb | | ≥ 396 | bits/sec | 399.98 | 400.002 | 399.994 | |
| Maximum fb | | ≤ 404 | bits/sec | 400.074 | 400.023 | 400.018 | |
| Total transmission time | | | | | | | |
| Short message | | 435.6 - 444.4 | ms | N/A | N/A | N/A | |
| Long message | | 514.8 - 525.2 | ms | 520.444 | 520.449 | 520.445 | |
| Unmodulated carrier | | | | | | | |
| Minimum T1 | | ≥ 158.4 | ms | 160.522 | 160.542 | 160.540 | |
| Maximum T1 | | ≤ 161.6 | ms | 160.603 | 160.556 | 160.558 | |
| First burst delay | | ≥ 47.5 | seconds | 100 | 100 | 100 | |

| Parameter | Limits | Units | Test Results | | | Comments |
|---|---|---|---|---|---|---|
| | | | $T_{min}$ (-20°C) | $T_{amb}$ (20°C) | $T_{max}$ (+55°C) | |
| 4. Modulation | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Biphase-L | P / F | P / F | P | P | P | |
| Rise time | 50 - 250 | µs | 174.30 | 176.30 | 168.30 | |
| Fall time | 50 - 250 | µs | 175.70 | 174.70 | 170.70 | |
| Phase deviation: positive | +(1.0 to 1.2) | radians | 1.112 | 1.111 | 1.119 | |
| Phase deviation: negative | -(1.0 to 1.2) | radians | -1.098 | -1.104 | -1.101 | |
| Symmetry measurement | ≤ 0.05 | | 0.0155 | 0.0167 | 0.0163 | |
| 5. 406 MHz Transmitted Frequency | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Nominal Value | C/S T.001 | MHz | 406.0366648 | 406.0366362 | 406.0366332 | |
| Short-term stability | ≤ $2x10^{-9}$ | /100ms | 2.607E-10 | 1.193E-10 | 1.397E-10 | |
| Medium-term stability – Slope | (-1 to +1)$x10^{-9}$ | /minutes | -8.24E-11 | 2.32E-11 | 5.715E-11 | |
| Medium-term stability – Residual frequency variation | ≤ $3x10^{-9}$ | | 3.015E-10 | 1.277E-10 | 2.116E-10 | |
| 6. Spurious Emissions into 50ohms | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| In band (406.0 – 406.1 MHz) | C/S T.001 mask | P / F | P | P | P | Spectrum plots: Page 24 |
| 7. 406 MHz VSWR Check | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Nominal transmitted frequency | C/S T.001 | MHz | 406.0366647 | 406.0366379 | 406.0366331 | |
| Modulation | | | | | | |
| Rise time | 50-250 | µs | 170.30 | 176.40 | 170.30 | |
| Fall time | 50-250 | µs | 178.70 | 175.60 | 174.70 | |
| Phase deviation: positive | + (1.0 to 1.2) | radians | 1.131 | 1.118 | 1.105 | |
| Phase deviation: negative | - (1.0 to 1.2) | radians | -1.081 | -1.098 | -1.116 | |
| Symmetry measurement | ≤ 0.05 | | 0.0182 | 0.0167 | 0.0155 | |
| Digital Message | correct | P / F | P | P | P | Decoded Message: Page 25 |

| Parameter | Limits | Units | Test Results | | | Comments |
|---|---|---|---|---|---|---|
| | | | $T_{min}$ (-20°C) | $T_{amb}$ (22°C) | $T_{max}$ (+55°C) | |
| 8. Self-test Mode | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Frame sync | 011010000 | P / F | P | P | P | Decoded Message: Page 26 |
| Format flag | 1 / 0 | bit value | 1 | 1 | 1 | |
| Single radiated burst | ≤440 / 520 (±1%) | ms | 440.4386 | 440.4559 | 440.4665 | |
| Default position data (if applicable) | correct | P / F | N/A | N/A | N/A | |
| Description | provided | Y / N | | Y | | Applicant's data: See Application Form, Section 1.2 |
| Design data on protection against repetitive self-test mode transmissions | provided | Y / N | | Y | | Applicant's data: See Annex A |
| Single burst verification | one burst | P / F | P | P | P | |
| Provides for 15 Hex ID | correct | P / F | P | P | P | |
| 121.5 MHz RF power (if applicable) | self-test checks that RF power emitted | Y / N | | Y | | |
| 406 MHz power | self-test checks that RF power emitted | Y / N | | Y | | Applicant's data: See Application Form, Section 1.2 |
| 8 (b). GNSS Self-Test Mode (if applicable) | | | | | | Test Sample: 75905359_17 Mod State: 0 **Result: Pass** |
| Frame sync | 011010000 | P / F | P | P | P | Detailed test results: Page 27 |
| Format flag | 1 / 0 | bit value | 1 | 1 | 1 | |
| Single radiated burst | ≤ 520 (+1%) | ms | 519.5 | 521.0 | 519.5 | |
| Position data (if applicable) | (see comment) | M | 50.1 | 148.0 | 50.1 | Must be within 500m (or 5.25km for User Location Protocol) of the actual position |
| Design data showing how GNSS Self-Test is limited in number of transmissions and duration | provided | Y / N | | Y | | Applicant's data: See Annex A |
| Single burst verification | one burst | P / F | P | P | P | |
| 121.5 MHz RF power (if applicable) | checks that RF power is emitted | Y / N | | Y | | Applicant's data: See Application Form, Section 1.2 |
| 406 MHz power | GNSS self-test checks that RF power is emitted | Y / N | | Y | | Applicant's data: See Application Form, Section 1.2 |
| Maximum duration of GNSS Self-Test | ≤120 | secs | 118.64 | 118.67 | 118.50 | |
| Actual duration of Self-Test with encoded location | < maximum duration | secs | 30.41 | 52.83 | 52.02 | |
| Maximum number of GNSS Self-Tests (only beacons with internal navigation devices) | ≤12 | | | 12 | | |

| Parameter | Limits | Units | Test Results | | Comments |
|---|---|---|---|---|---|
| 9. Thermal Shock | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Soak Temperature | 30°C difference | °C | +20.5 | | |
| Measurement Temperature | | °C | +50.5 | | Test Data: Page 31 |
| Transmitted Frequency | | | Min | Max | |
| Nominal value | C/S T.001 | MHz | 406.036625 | 406.036630 | |
| Short-term stability | ≤ $2x10^{-9}$ | /100ms | $7.19x10^{-11}$ | $1.373x10^{-10}$ | |
| Medium-term stability – Slope | (-2 to +2)$x10^{-9}$ | /min | $-1.092x10^{-12}$ | $2.754x10^{-10}$ | |
| Medium-term stability – Residual frequency variation | ≤ $3x10^{-9}$ | | $9.531x10^{-11}$ | $3.637x10^{-10}$ | |
| Transmitter power output | 35 - 39 | dBm | 37.521 | 37.556 | |
| Digital message | correct | P/F | P | | Decoded Message: Page 34 |
| 10 Operating Lifetime at Minimum Temperature | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Pre-test battery discharge duration (operating) | | hours | 4.92 | | Test Data: Page 35 |
| Operational Lifetime Duration | >24 | hours | 32.74 Hours at Tmin = -20 °C | | The Pre-test battery discharge was performed for 4.29 hours prior to the start of the Operating Lifetime at Minimum Temperature. Hence 0.63 hours is deducted to give the Effective Operating Lifetime Duration. |
| Effective Operational Lifetime Duration | >24 | hours | 32.11 Hours at Tmin = -20 °C | | |
| Transmitted Frequency | | | Min | Max | |
| Nominal value | C/S T.001 | MHz | 406.036660 | 406.036664 | Maximum and minimum values are taken up to 24 hours. The first failure was a measurement of Output Power. |
| Short-term stability | ≤ $2x10^{-9}$ | /100ms | $6.467x10^{-11}$ | $2.502x10^{-10}$ | |
| Medium-term stability – Slope | (-1 to +1)$x10^{-9}$ | /min | $-8.612x10^{-11}$ | $1.625x10^{-10}$ | |
| Medium-term stability – Residual frequency variation | ≤ $3x10^{-9}$ | | $5.789x10^{-11}$ | $6.464x10^{-10}$ | |
| Transmitter power output | 35 - 39 | dBm | 36.935 | 38.003 | |
| Digital message | correct | P/F | P | | Decoded Message: Page 38 |

| Parameter | Limits | Units | Test Results | | | | Comments |
|---|---|---|---|---|---|---|---|
| 11. Temperature Gradient (5°C/hr) | | | | | | | Test Sample: 75905359_15 Mod State: 0 **Result: Pass** |
| Transmitted Frequency | | | Min | | Max | | Test Data: Page 46 |
| Nominal value | C/S T.007 | MHz | 406.0366190 | | 406.0366660 | | |
| Short-term stability | ≤ $2x10^{-9}$ | /100ms | $6.009x10^{-11}$ | | $3.081x10^{-10}$ | | |
| Medium-term stability – Slope[1] | (-1 to +1)$x10^{-9}$ | /min | $-3.264x10^{-10}$ | | $2.982x10^{-10}$ | | Limits between points B to C+15 minutes and D to E+15 minutes as per C/S T.007 are (-2 to +2)$x10^{-9}$ |
| Medium-term stability – Residual frequency variation | ≤ $3x10^{-9}$ | | $5.329x10^{-11}$ | | $1.524x10^{-9}$ | | |
| Transmitter power output | 35 – 39 | dBm | 37.170 | | 37.882 | | |
| Digital message | correct | P/F | P | | | | Decoded Message: Page 49 |
| 12. Oscillator Aging | | | | | | | |
| Data | provided | Y / N | Y | | | | Applicant's data: See Annex A |
| 13. Protection Against Continuous Transmission | | | | | | | |
| Description | provided | Y / N | Y | | | | Applicant's data: See Annex A |
| 14. Satellite Qualitative Tests | | | | | | | Test Sample: 75905359_07 Mod State: 0 Result: Pass<br>Test Sample: 75905359_16 Mod State: 0 Result: Pass |
| Test Configuration | As per C/S T.007 | | Configuration 7 | | Configuration 8 | | |
| | | | 007 | 016 | 007 | 016 | |
| 15 Hex ID Decoded by LUT | correct | P / F | P | P | P | P | Test Data: Page 50 |
| Doppler Location results with error ≤5km | ≥80 | % | 100 | 100 | 100 | 100 | |
| 15. Antenna Characteristics | | | | | | | Test Sample: 75905359_07 Mod State: 0 Result: Pass<br>Test Sample: 75905359_16 Mod State: 0 Result: Pass |
| Test Configuration | C/S T.007 | Figure | B.2 | | B.5 | | |
| | | | 007 | 016 | 007 | 016 | |
| Polarisation | linear or RHCP | | Linear | | | | Test Data: Page 54 |
| VSWR | ≤1.5 | | N/A | | | | Detachable Antennas Only |
| $EIRP_{LOSS}$ | | dB | 0.52 | 0.52 | 0.52 | 0.52 | |
| $EIRP_{maxEOL}$ | ≤43 | dBm | 42.9 | 43.3 * | 40.4 | 41.5 | * MU Pass |
| $EIRP_{minEOL}$ | ≥32 | dBm | 31.9 * | 32.0 | 33.1 | 33.2 | * MU Pass |
| Azimuth gain variation at 40° elevation angle | ≤3 | dB | 0.98 | 1.14 | N/A | N/A | |

| Parameter | Limits | Units | Test Results | | | Comments |
|---|---|---|---|---|---|---|
| 16. Beacon Coding Software | | | | | | |
| Sample message for each coding option of the applicable coding types | correct | P / F | P | | | Applicant's data: See Annex A |
| Sample self-test message for each coding option of the applicable coding types | correct | P / F | P | | | |
| 17. Navigation System | | | | | | Test Samples: **Result: Pass**<br>Standard (50Ω) 75905359_015 Mod State: 0<br>Standard 75905359_016 Mod State: 0<br>National (50Ω) 75905359_017 Mod State: 0<br>National 75905359_010 Mod State: 0<br>Standard (Float) 75905359_007 Mod State: 0 |
| Location protocol | C/S T.001 | | National | Standard | User | |
| Position data default values | correct | P / F | P | P | N/A | Test Data: Page 58 |
| Position acquisition time (Slim Variant) | <10/1 | min | 1.68 | 1.68 | N/A | Test samples 75905359_016 and 75905359_010 were used for Position Acquisition Time And Position Accuracy (Float Variant).<br>Test sample 75905359_007 was used for Position Acquisition Time And Position Accuracy (Float Variant). |
| Position accuracy (Slim Variant) | C/S T.001 | P / F | P | P | N/A | |
| Position acquisition time (Float Variant) | <10/1 | min | N/T | 1.68 | N/A | |
| Position accuracy (Float Variant) | C/S T.001 | P / F | N/T | P | N/A | |
| Encoded position data update interval | >20 | min | 22.5 | 22.5 | N/A | |
| Position clearance after deactivation | cleared | P / F | P | P | N/A | |
| Position data input update interval (as applicable) | 20/1 | Min | N/A | N/A | N/A | |
| Position data encoding | correct | P / F | P | P | N/A | |
| Retained last valid position after navigation input lost | 240(±5) | min | 240 | 240 | N/A | |
| Default position data transmitted after 240(±5) minutes without valid position data | cleared | P / F | P | P | P | |
| Information on protection against beacon degradation due to navigation device, interface or signal failure or malfunction | provided | Y / N | | | | Applicant's data: See Annex A |

## 2.1 DIGITAL MESSAGE

### 2.1.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015

### 2.1.2 Date of Test and Modification State

29 January, 02 February and 03 February 2009 - Modification State 0

### 2.1.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.1.4 Test Results

Ambient Temperature

```
 Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF              2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFE2F96EE2F80017FDFF8EA71B783E0F66C

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1111 0000 0111 1100 0001 1110 1100 1101 100
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                               1
Protocol Flag      26            0 Location NEW                               0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                  1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                   110
Fixed Bit         110             1                                           1
Encode Pos Device 111             1 Internal                                  1
121.5 Homing      112             1 YES                                       1
Position Change   113-132         DEFAULT              1000 0011 1110 0000 1111
Resultant Position              --> Not Defined
BCH Encoded       133-144         Errors=0                        0110 0110 1100
BCH Generated     133-144                                         0110 0110 1100
```

Minimum Temperature

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF             2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFE2F96EE2F80017FDFF8EA71B783E0F66C

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1111 0000 0111 1100 0001 1110 1100 1101 100
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                               1
Protocol Flag      26            0 Location NEW                               0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                  1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                   110
Fixed Bit         110            1                                            1
Encode Pos Device 111            1 Internal                                   1
121.5 Homing      112            1 YES                                        1
Position Change   113-132          DEFAULT              1000 0011 1110 0000 1111
Resultant Position              --> Not Defined
BCH Encoded       133-144          Errors=0                        0110 0110 1100
BCH Generated     133-144                                          0110 0110 1100
```

Maximum Temperature

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF              2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFE2F96EE2F80017FDFF8EA71B783E0F66C

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1111 0000 0111 1100 0001 1110 1100 1101 100
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                              1
Protocol Flag      26            0 Location NEW                              0
MID                27- 36      366 USA                             0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                  110
Fixed Bit         110              1                                         1
Encode Pos Device 111              1 Internal                                1
121.5 Homing      112              1 YES                                     1
Position Change   113-132          DEFAULT              1000 0011 1110 0000 1111
Resultant Position               --> Not Defined
BCH Encoded       133-144          Errors=0                       0110 0110 1100
BCH Generated     133-144                                         0110 0110 1100
```

## 2.2 SPURIOUS EMISSIONS

### 2.2.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015

### 2.2.2 Date of Test and Modification State

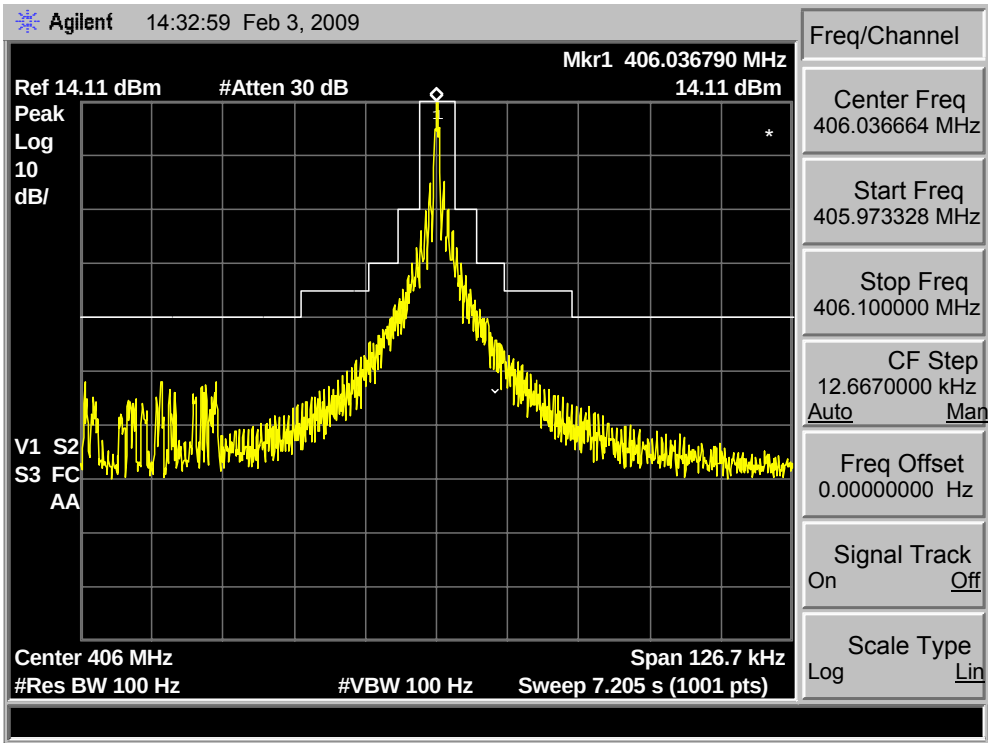
02 and 03 February 2009 - Modification State 0

### 2.2.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.2.4 Test Results

Combined Temperature (Ambient, +55°C, -20°C)



## 2.3 406 MHz VSWR CHECK – DECODED MESSAGE

### 2.3.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015

### 2.3.2 Date of Test and Modification State

29 January, 02 February and 03 February 2009 - Modification State 0

### 2.3.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.3.4 Test Results

Digital Message

**Please note: The digital message for VSWR was identical for all 3 test temperatures.**

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF             2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFE2F96EE2F80017FDFF8EA71B783E0F66C

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1111 0000 0111 1100 0001 1110 1100 1101 100
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                               1
Protocol Flag      26            0 Location NEW                               0
MID                27- 36      366 USA                                0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                   1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                   110
Fixed Bit         110             1                                           1
Encode Pos Device 111             1 Internal                                  1
121.5 Homing      112             1 YES                                       1
Position Change   113-132         DEFAULT              1000 0011 1110 0000 1111
Resultant Position              --> Not Defined
BCH Encoded       133-144         Errors=0                        0110 0110 1100
BCH Generated     133-144                                         0110 0110 1100
```

## 2.4 SELF-TEST MODE – DECODED MESSAGE

### 2.4.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015

### 2.4.2 Date of Test and Modification State

29 January, 02 February and 03 February 2009 - Modification State 0

### 2.4.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.4.4 Test Results

Digital Message

Note: The digital message for Self-test was identical for all three test temperatures.

```
Beacon Id Format......... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF             2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFED096EE2F80017FDFF8EA71B700000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1110 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message: bcn entered Short Non-Spec    1
Protocol Flag      26            0 Location NEW                                0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                 1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Fixed Bits        107-109                                                   110
Fixed Bit         110             1                                           1
Encode Pos Device 111             1 Internal                                  1
121.5 Homing      112             1 YES                                       1
Resultant Position               --> Not Defined
```

## 2.5 GNSS SELF-TEST MODE

### 2.5.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_017

### 2.5.2 Date of Test and Modification State

07 to 08 April 2009 - Modification State 0

### 2.5.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.5.4 Test Results

Digital Message (Ambient)

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDE000119AE039              2DDE00013F81FE0 Default_Id
 30 Hex (Bits 25-144) = 96EF00008CD701CC95F23790040CA6

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1110 0000 0000 0000 0001 0001 1001 1010 1110 0000 0011 1001
   1001 0010 1011 1110 0100 0110 1111 0010 0000 0000 1000 0001 1001 0100 110
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                              1
Protocol Flag      26            0 Location NEW                              0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       15 Test (National)                       1111
Serial Number      41- 58        2                          0000 0000 0000 0000 10
Medium Position    59- 85          Data Present
Latitude Flag      59            0 North:                                    0
Latitude Degrees   60- 66       51  51 deg                           0110 011
Lat. Minutes /2    67- 71       11  22 min                             0101 1
Longitude Flag     72            1 West:                                     1
Long. Degrees      73- 80        1   1 deg                          0000 0001
Long. Minutes /2   81- 85       25  50 min                             1100 1
BCH Encoded        86-106          Errors=0           1001 0010 1011 1110 0100 0
BCH Generated      86-106                             1001 0010 1011 1110 0100 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                  110
More Data Flag    110            1 Position Data in bits 113-132             1
Encode Pos Device 111            1 Internal                                  1
121.5 Homing      112            1 YES                                       1
Position Change   113-126          Data Present
Lat. Change Sign  113            1 Plus:                                     1
Lat. Chg. Minutes 114-115        0  0 min                                   00
Lat. Chg. Secs /4 116-119        8 32 sec                                1000
Long Change Sign  120            0 Minus:                                    0
Long Chg. Minutes 121-122        0  0 min                                   00
Long Chg. Secs /4 123-126        1  4 sec                                 0001
Resultant Position             -->  51.37556 LAT,   -1.83222 LONG
                   51 deg 22 min 32 sec N,    1 deg 49 min 56 sec W
National Use      127-132        0 Default                           0000 00
BCH Encoded       133-144          Errors=0                    1100 1010 0110
BCH Generated     133-144                                      1100 1010 0110
```

Digital Message (+55°C and -20°C)

Note: The digital message for GNSS Self-test was identical at the two extreme temperatures.

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDE000119AE039              2DDE00013F81FE0 Default_Id
 30 Hex (Bits 25-144) = 96EF00008CD701CC95F2379208025B

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1110 0000 0000 0000 0001 0001 1001 1010 1110 0000 0011 1001
   1001 0010 1011 1110 0100 0110 1111 0010 0100 0001 0000 0000 0100 1011 011
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                                1
Protocol Flag      26            0 Location NEW                                0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       15 Test (National)                        1111
Serial Number      41- 58        2                          0000 0000 0000 0000 10
Medium Position    59- 85          Data Present
Latitude Flag      59            0 North:                                      0
Latitude Degrees   60- 66       51  51 deg                               0110 011
Lat. Minutes /2    67- 71       11  22 min                                 0101 1
Longitude Flag     72            1 West:                                       1
Long. Degrees      73- 80        1   1 deg                               0000 0001
Long. Minutes /2   81- 85       25  50 min                                 1100 1
BCH Encoded        86-106          Errors=0           1001 0010 1011 1110 0100 0
BCH Generated      86-106                             1001 0010 1011 1110 0100 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                   110
More Data Flag    110            1 Position Data in bits 113-132              1
Encode Pos Device 111            1 Internal                                   1
121.5 Homing      112            1 YES                                        1
Position Change   113-126          Data Present
Lat. Change Sign  113            1 Plus:                                      1
Lat. Chg. Minutes 114-115        0  0 min                                    00
Lat. Chg. Secs /4 116-119        9 36 sec                                  1001
Long Change Sign  120            0 Minus:                                     0
Long Chg. Minutes 121-122        0  0 min                                    00
Long Chg. Secs /4 123-126        2  8 sec                                  0010
Resultant Position              -->  51.37667 LAT,   -1.83111 LONG
                   51 deg 22 min 36 sec N,    1 deg 49 min 52 sec W
National Use      127-132        0 Default                                0000 00
BCH Encoded       133-144          Errors=0                       0010 0101 1011
BCH Generated     133-144                                         0010 0101 1011
```

Position Error (Ambient)

| Position | Latitude | Longitude |
|---|---|---|
| Input ① | N 51° 22' 35" | W 001° 49' 50" |
| Output (as decoded message above) | N 51° 22' 32" | W 001° 49' 56" |
| Error | 148.0 m | |

Positional accuracy was estimated using the Haversine Formula, Earth's radius taken as 6367km.

① Input from GPS simulator.

Position Error (+55°C and -20°C)

| Position | Latitude | Longitude |
|---|---|---|
| Input ① | N 51° 22' 35" | W 001° 49' 50" |
| Output (as decoded message above) | N 51° 22' 36" | W 001° 49' 52" |
| Error | 50.1 m | |

Positional accuracy was estimated using the Haversine Formula, Earth's radius taken as 6367km.

① Input from GPS simulator.

Actual GNSS Self-test Duration

During the capture of the Digital Messages, above, a stopwatch was used to record the following times.

| Parameter | Result | | |
|---|---|---|---|
| | Low (-20°C) | Ambient | High (+55°C) |
| Time from button press to GNSS Self-test mode activation | 5.87 s | 5.91 s | 5.82 s |
| Time from GNSS Self-test mode activation to Indication of success and Burst transmission | 36.28 s | 58.74 | 57.84 s |
| Difference, i.e. Actual GNSS Self-test duration | 30.41 s | 52.83 s | 52.02 s |

Note: Input from GPS simulator as per Digital Message and Position Error, above.

Maximum GNSS Self-test Duration

The EUT was placed in the GNSS Self-test mode and a stopwatch was used to record the following times:

| Parameter | Result | | |
|---|---|---|---|
| | Low (-20°C) | Ambient | High (+55°C) |
| Time from button press to GNSS Self-test mode activation | 5.78 | 5.81 s | 5.81 s |
| Time from GNSS Self-test mode activation to Indication of failure | 124.42 | 124.48 s | 124.31 |
| Difference, i.e. Maximum GNSS Self-test duration | 118.64 s | 118.67 s | 118.50 s |

Note: No navigation Data input was provided for this test.

Maximum Number of GNSS Self-tests

GNSS Self-tests were conducted repeatedly until the EUT indicated that no more were possible. The maximum number of GNSS Self-tests allowed by the EUT was 12.

## 2.6 THERMAL SHOCK

### 2.6.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015

### 2.6.2 Date of Test and Modification State

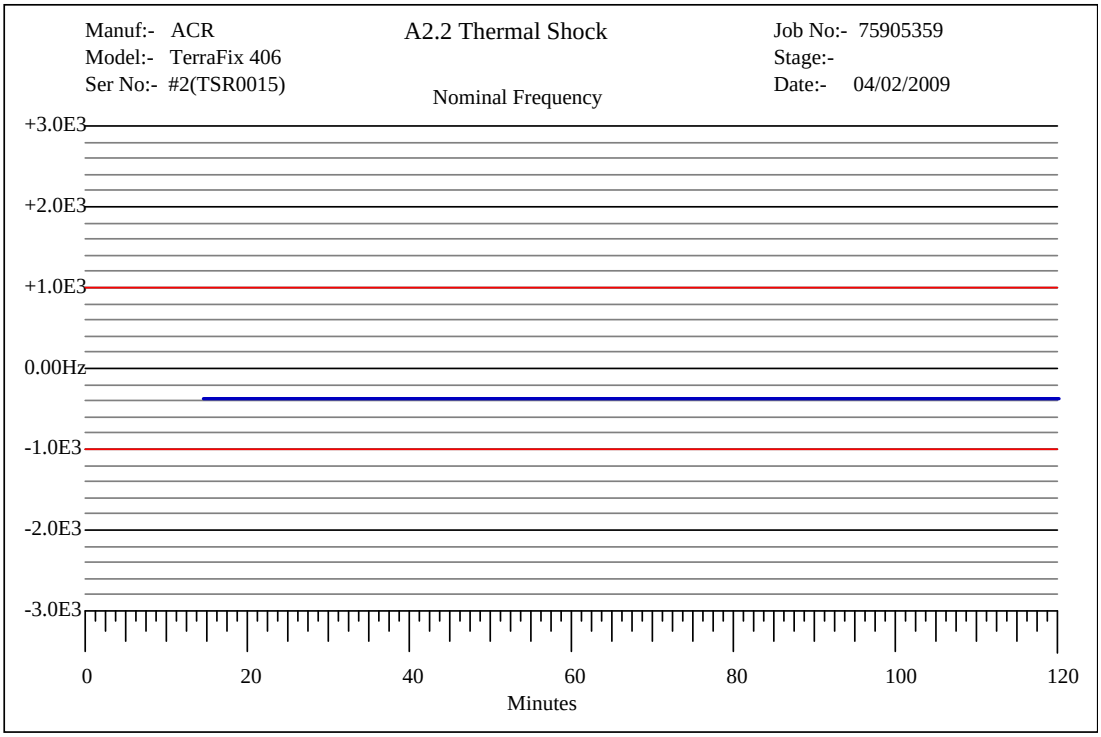
04 February 2009 - Modification State 0

### 2.6.3 Test Equipment Used

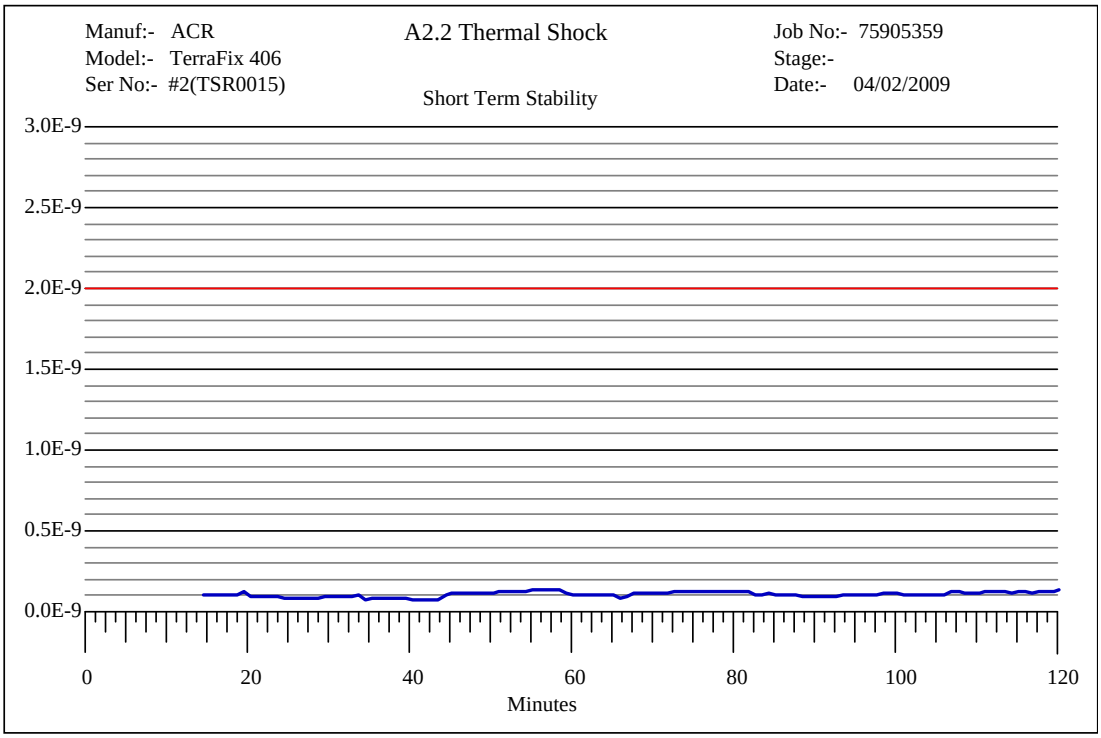
The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.6.4 Test Results

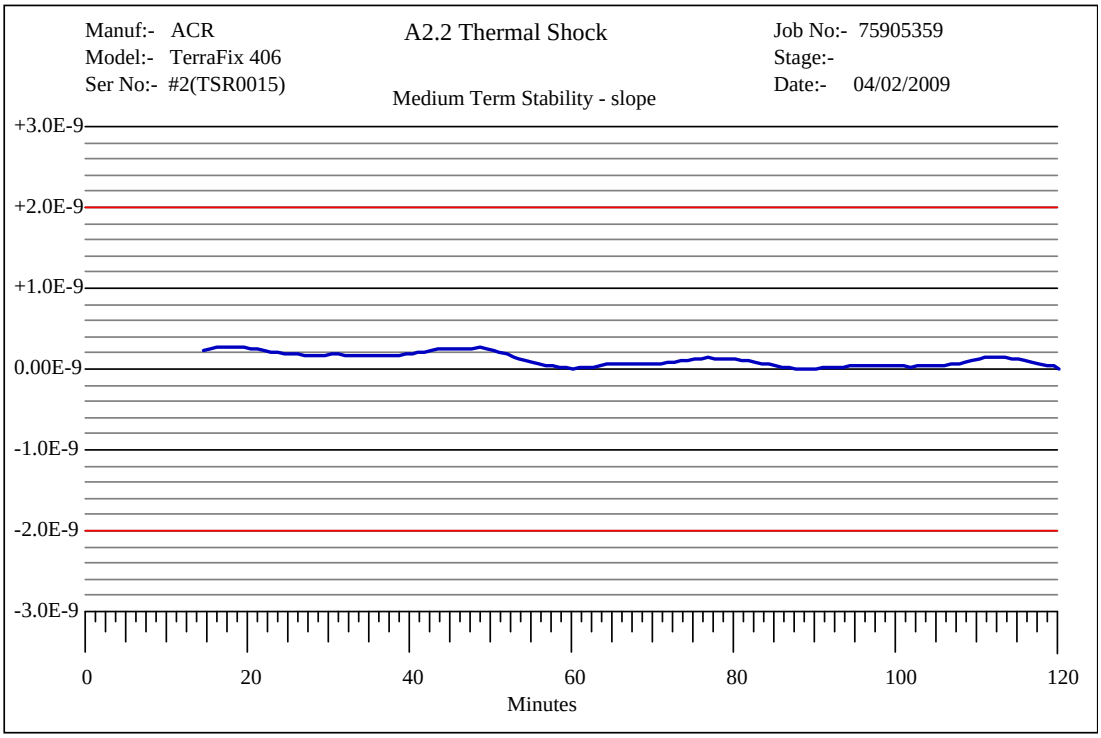
Nominal Frequency



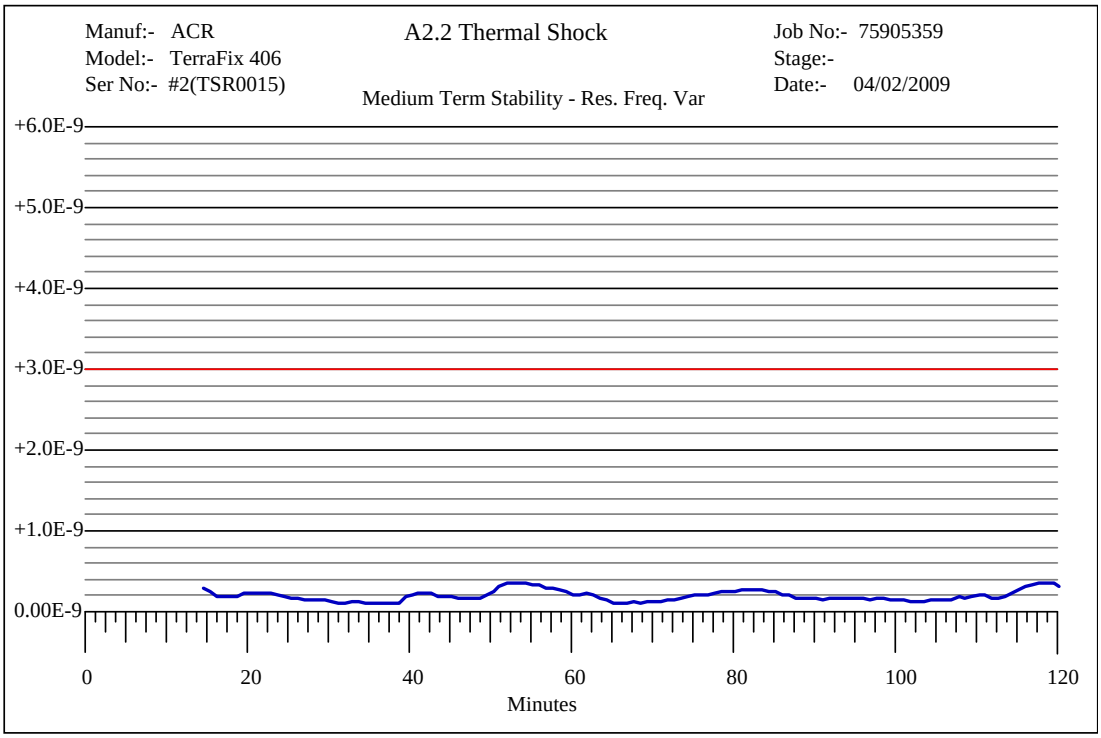
## Short Term Stability



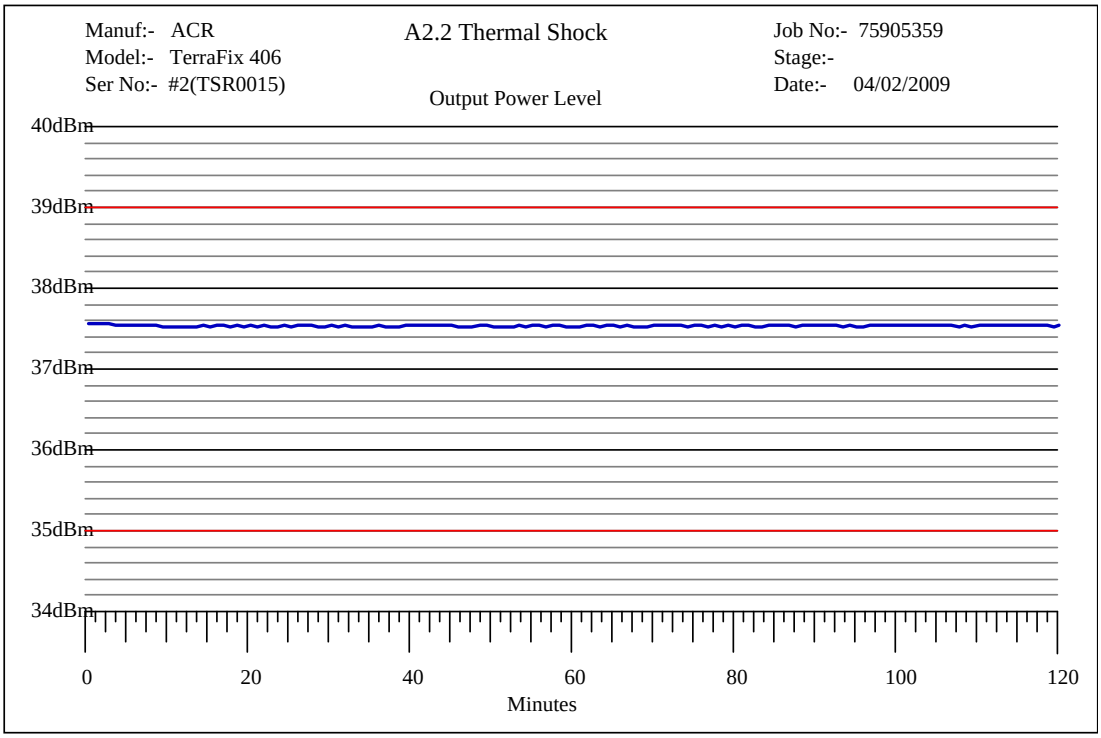

## Medium Term Stability, Mean Slope



## Medium Term Stability, Residual Frequency Variation




## Output Power



Digital Message

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF             2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFE2F96EE2F80017FDFF8EA71B783E0F66C

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1111 0000 0111 1100 0001 1110 1100 1101 100
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                               1
Protocol Flag      26            0 Location NEW                               0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                  1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                   110
Fixed Bit         110            1                                            1
Encode Pos Device 111            1 Internal                                   1
121.5 Homing      112            1 YES                                        1
Position Change   113-132          DEFAULT              1000 0011 1110 0000 1111
Resultant Position              --> Not Defined
BCH Encoded       133-144          Errors=0                        0110 0110 1100
BCH Generated     133-144                                          0110 0110 1100
```

## 2.7 OPERATING LIFETIME AT MINIMUM TEMPERATURE

### 2.7.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015

### 2.7.2 Date of Test and Modification State

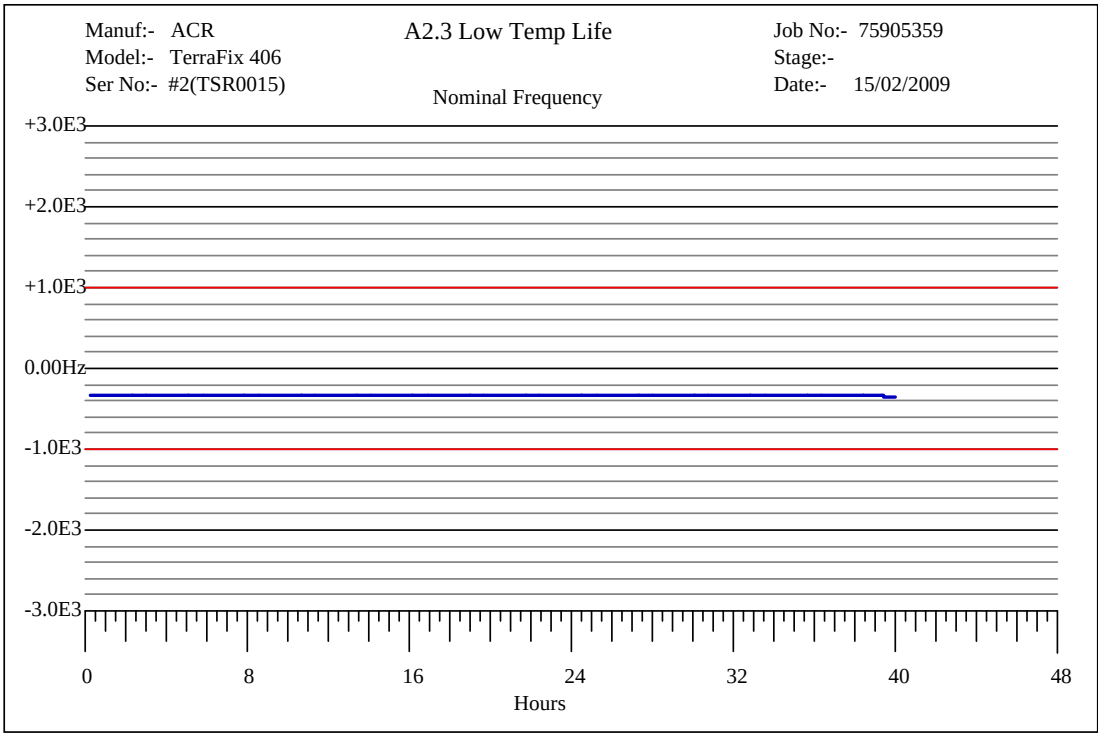
13 February 2009 - Modification State 0

### 2.7.3 Test Equipment Used

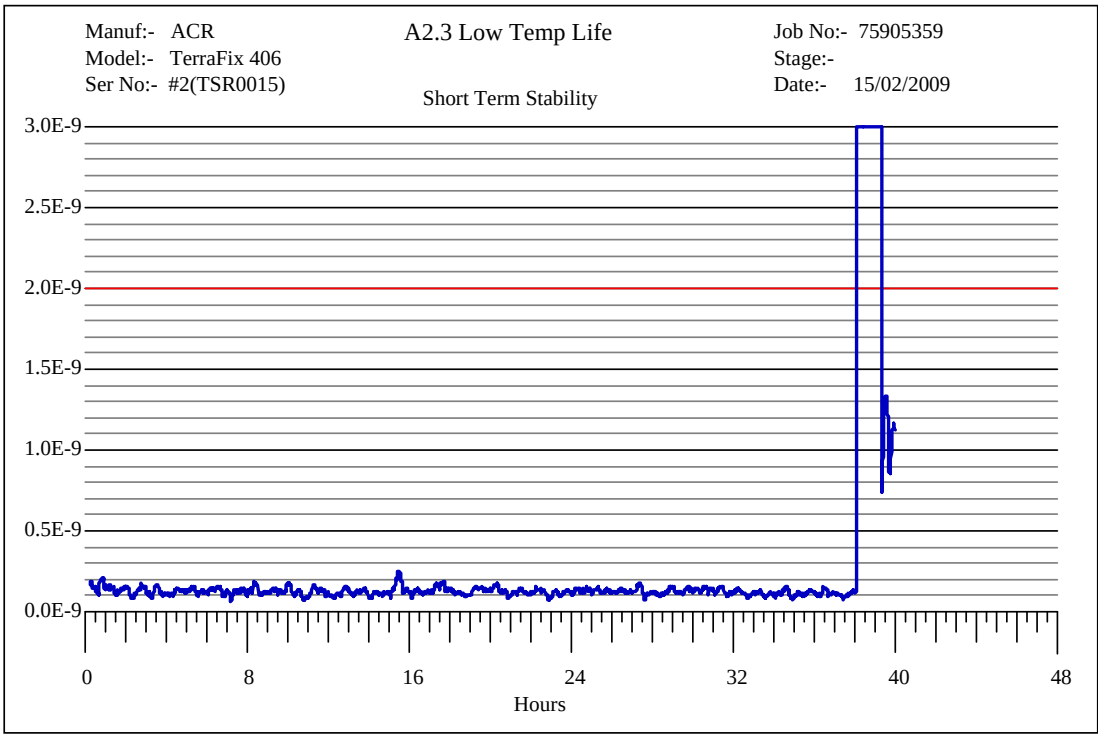
The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.7.4 Test Results

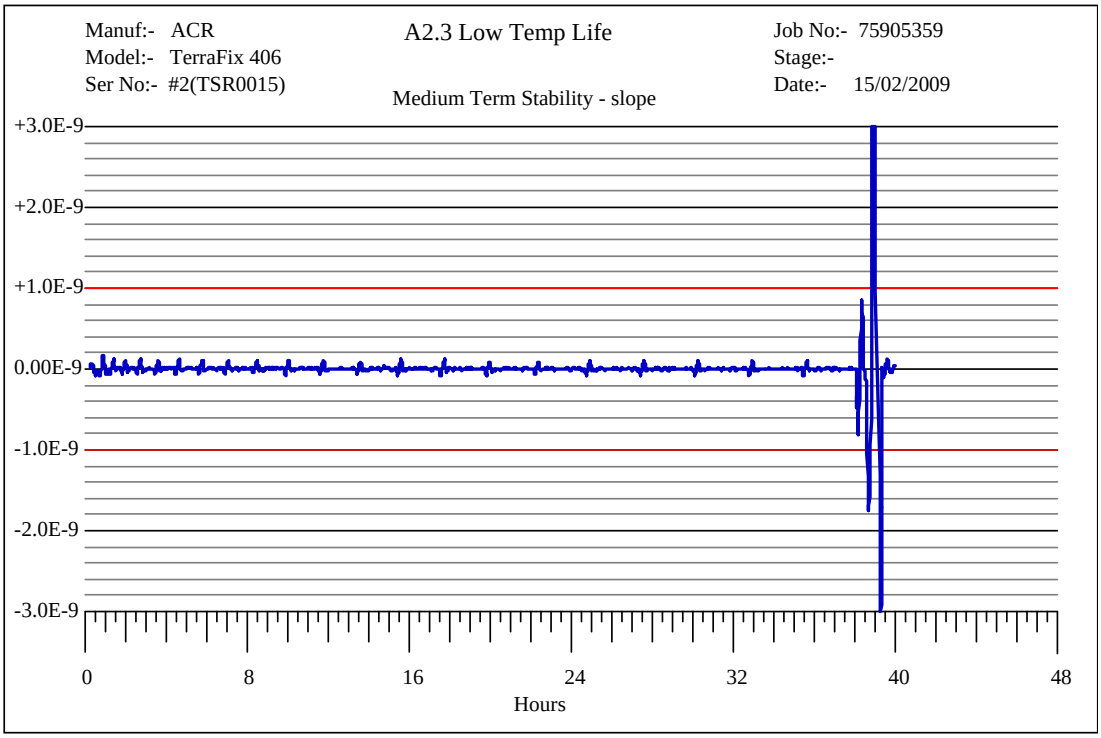
Nominal Frequency



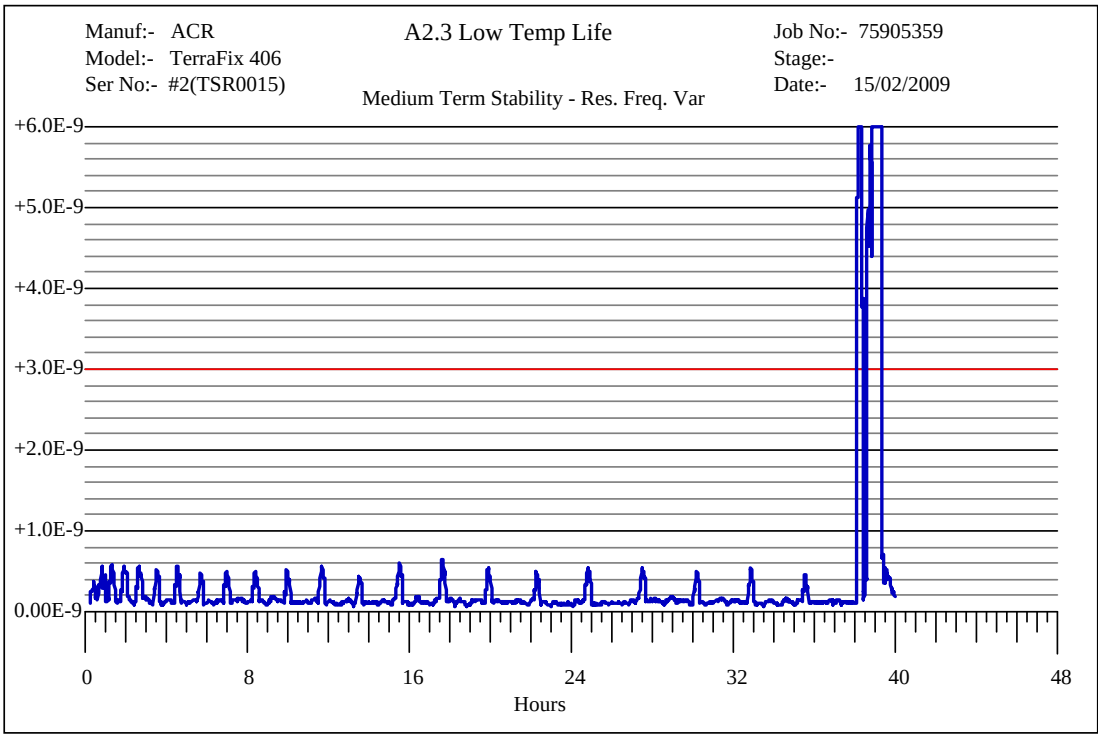
Short Term Stability



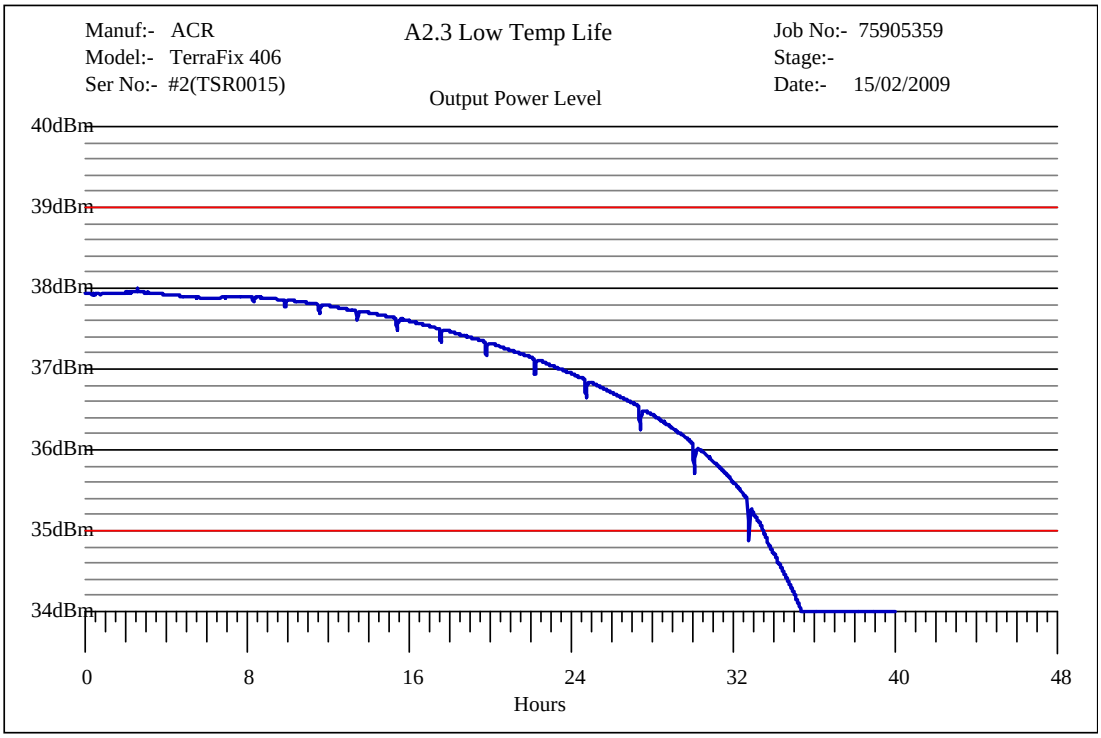

Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation




Output Power



Digital Message

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF             2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFE2F96EE2F80017FDFF8EA71B783E0F66C

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1111 0000 0111 1100 0001 1110 1100 1101 100
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                               1
Protocol Flag      26            0 Location NEW                               0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                  1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                   110
Fixed Bit         110            1                                            1
Encode Pos Device 111            1 Internal                                   1
121.5 Homing      112            1 YES                                        1
Position Change   113-132          DEFAULT              1000 0011 1110 0000 1111
Resultant Position              --> Not Defined
BCH Encoded       133-144          Errors=0                        0110 0110 1100
BCH Generated     133-144                                          0110 0110 1100
```

Product Service

## Battery Current Measurement Results

### Battery Discharge Current

The discharge current for the batteries was measured for each of the following beacon states.

Beacon in the Off or Standby State, "Standby Current"
Beacon performing a Self-test, "Self-test Current"
Beacon activated and transmitting, "Operating Current"

The individual tests were conducted for the following durations:

| | | | |
|---|---|---|---|
| Standby Current | : | 30 minutes | (1799920 ms) |
| Self-test Current | : | 4.88 seconds | (4880 ms) |
| GPS Test Current | : | 128 seconds | (128000 ms) |
| GPS Burst Current | : | 74.16 seconds | (74160 ms) |
| Operating Current | : | 22.51 minutes | (1350560 ms) |

### Assumptions / Supplied Data

| | |
|---|---|
| Battery Replacement Interval | : 5.75 years |
| Battery Capacity | : 1.4 Ah |
| Battery Self Drain | : 1.00 % per year |
| Self-test Interval | : 12 tests per year |
| GPS Tests | : 2.4 tests per year |

### Test Results

| Mode Current | = | Accumulated Charge | / | Time | | |
|---|---|---|---|---|---|---|
| Standby Current | = | 50656.47 pC | / | 1799920 ms | = | 0.03 nA |
| Self-test Current | = | 575703 uC | / | 4880 ms | = | 117.97 mA |
| GPS Test Current | = | 2678847.2 uC | / | 128000 ms | = | 20.93 mA |
| GPS Burst Current | = | 2323980 uC | / | 74160 ms | = | 31.34 mA |
| Operating Current | = | 35243603.05 uC | / | 1350560 ms | = | 26.10 mA |

Product Service

Battery Preconditioning / Discharge Time Calculations

Battery Self Drain = Capacity - [(100% - Self Drain/Year%)$^{\text{Replacement Interval}}$ x Capacity]
= 1.4- ((1- 0.0100)$^{6}$ x 1.4 ) = 0.0786 Ah

Standby Drain = Hours per year x Battery Replacement Interval x Standby Current
= 365 x 24 x 6 x 0.03 x $10^{-9}$ = 0.0000 Ah (0.0012 mAh too small
Worst Case = 1.65 x 0.0000 Ah = 0.0000 Ah to be relevant)

Self-test Drain = Self-tests per battery x Self-test Current x Self-test duration (in hours)
= 12 x 6 x 117.97 x $10^{-3}$ x (4.88 / 3600) = 0.0110 Ah
Worst Case = 1.65 x 0.0110 Ah = 0.0182 Ah

GPS Test Drain = Self-tests per beacon x Self-test Current x Self-test duration (in hours)
= 2.4 x 6 x 20.93 x $10^{-3}$ x (128 / 3600) = 0.0103 Ah
Worst Case = 1.65 x 0.0103 Ah = 0.0169 Ah

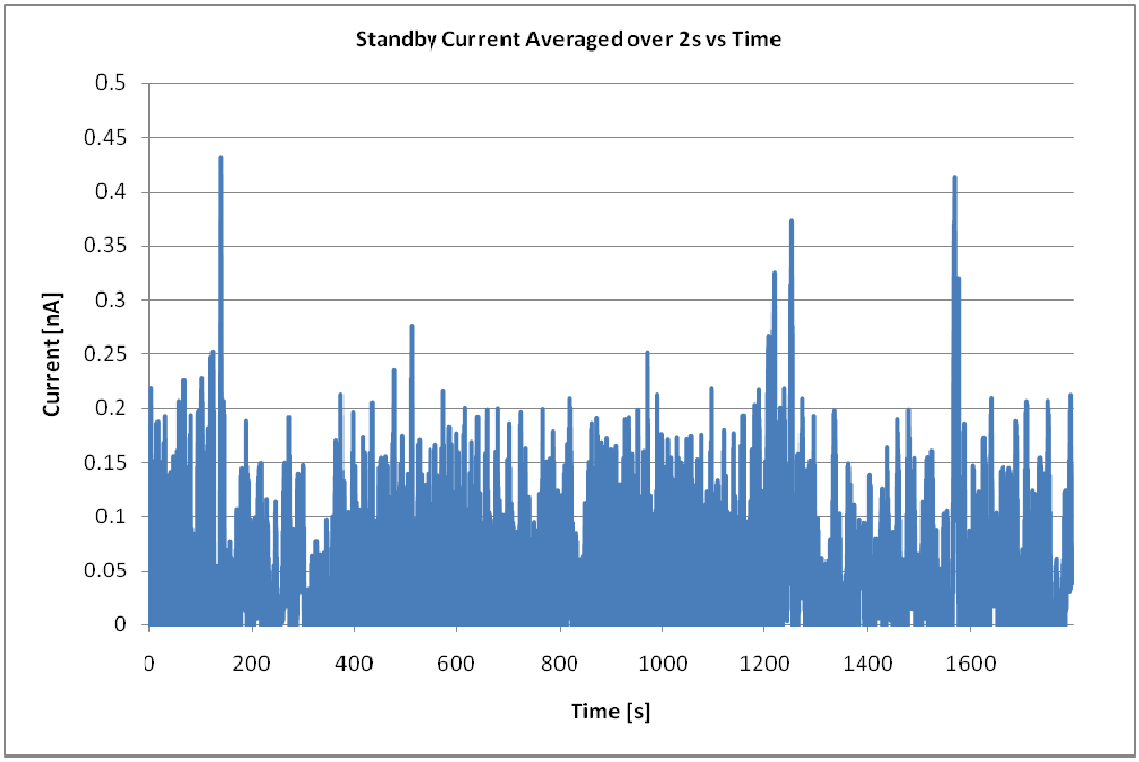
GPS Burst Drain = GPS-tests per beacon x GPS Burst Current x GPS Burst duration (in hours)
= 2.4 x 6 x 31.34 x $10^{-3}$ x (74.2 / 3600) = 0.0089 Ah
Worst Case = 1.65 x 0.0089 Ah = 0.0147 Ah

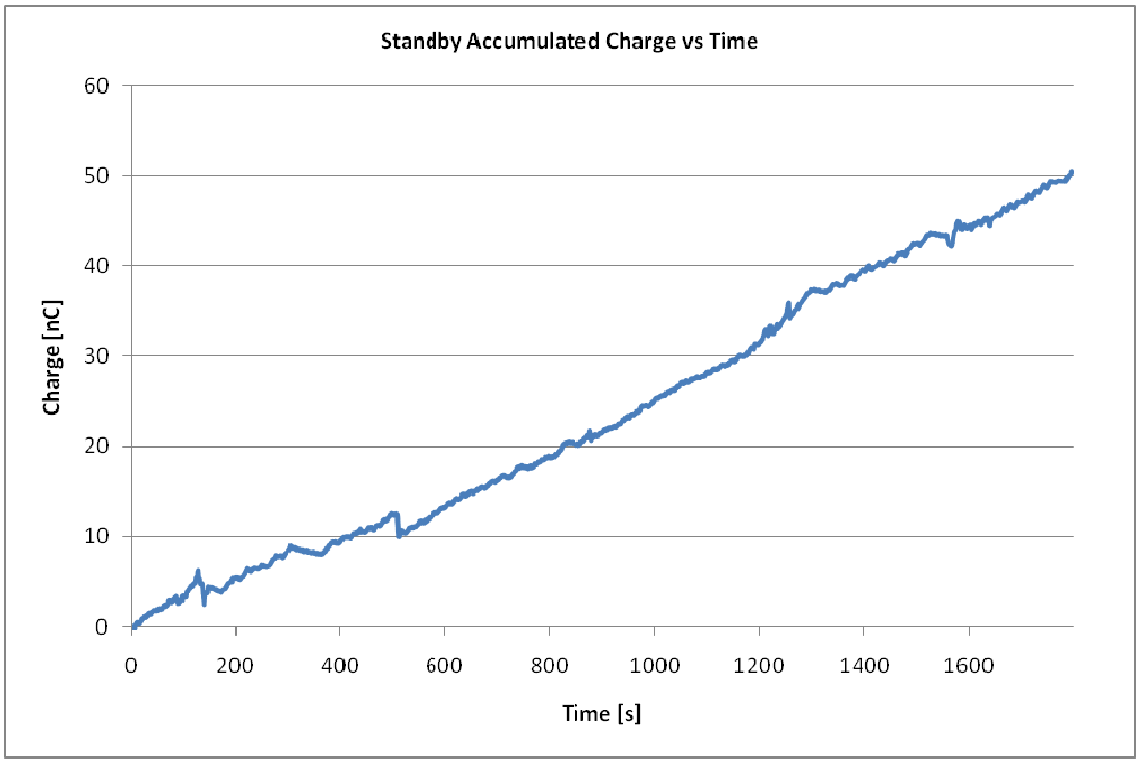
Total Drain = Self Drain + Standby Drain (Worst Case) + Self-test Drain (Worst Case)
= 0.0786 + 0.0000 + 0.0182 + 0.0169 + 0.0147 = 0.1285 Ah

Battery Preconditioning / Discharge Time = Worst Case drain / Operational Current
= 0.1285 / ( 26.10 x $10^{-3}$)
= 4.92 hours

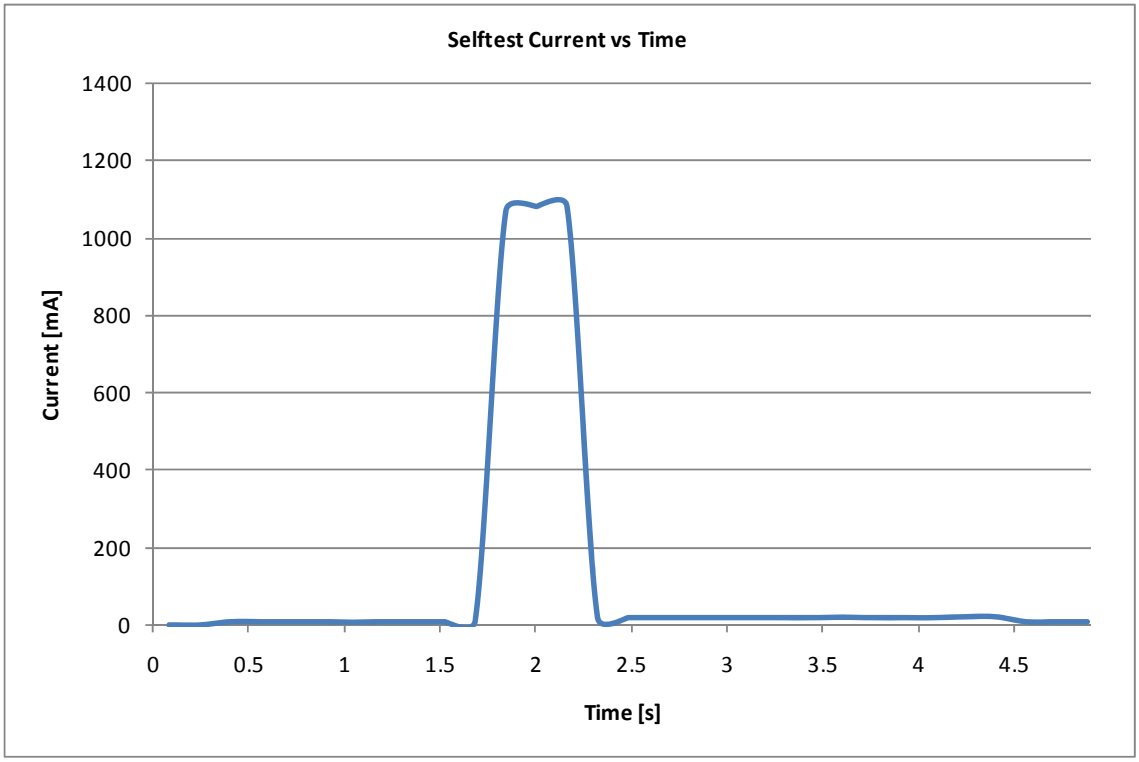
4.92 hours = 4 hours 55 minutes, a fresh battery was discharged by operating the beacon in the same configuration as the Operating Current was measured above for 4.29 hours; hence 0.63 hours must be deducted from the final Operating Lifetime Duration to provide an 'Effective Operating Lifetime Duration'. This can be found in the Test Results Table.

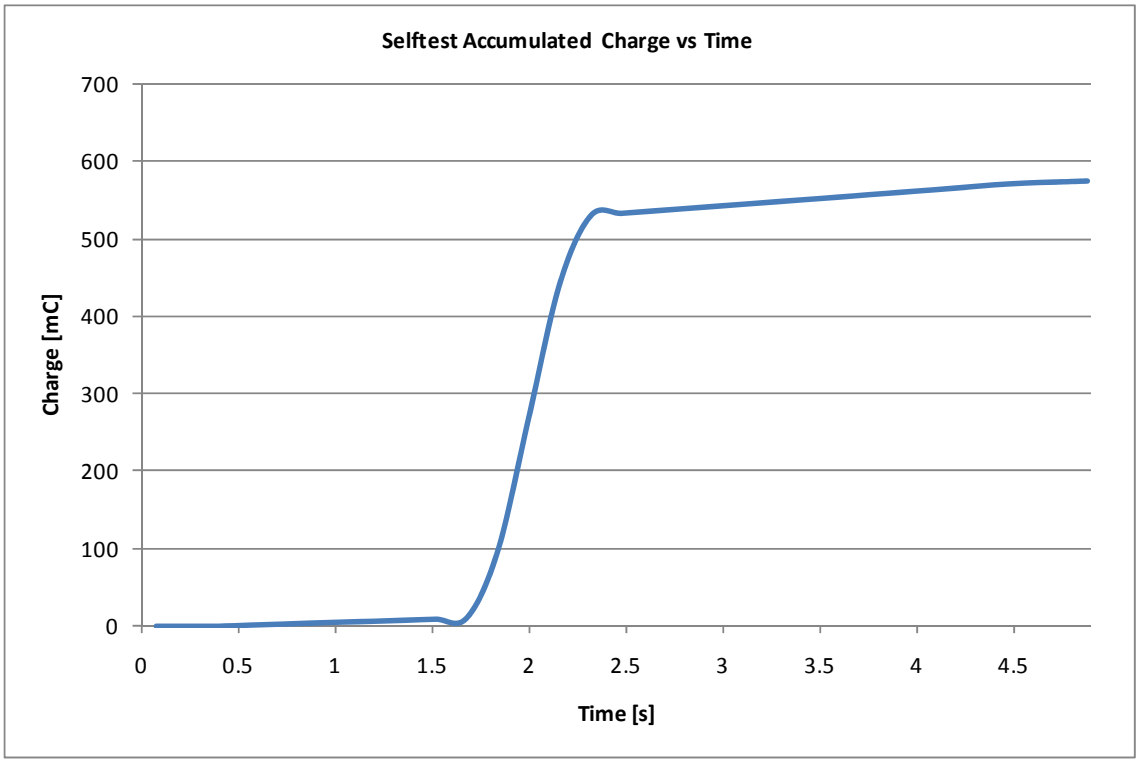
Standby Mode Plots



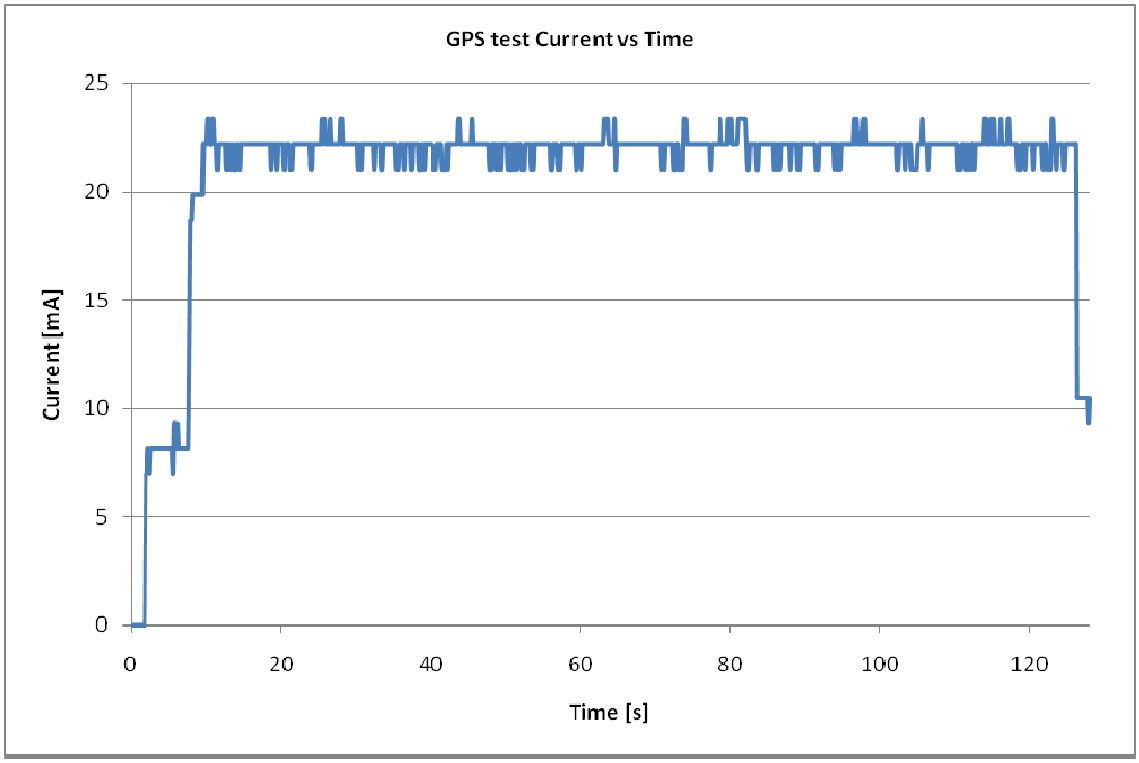



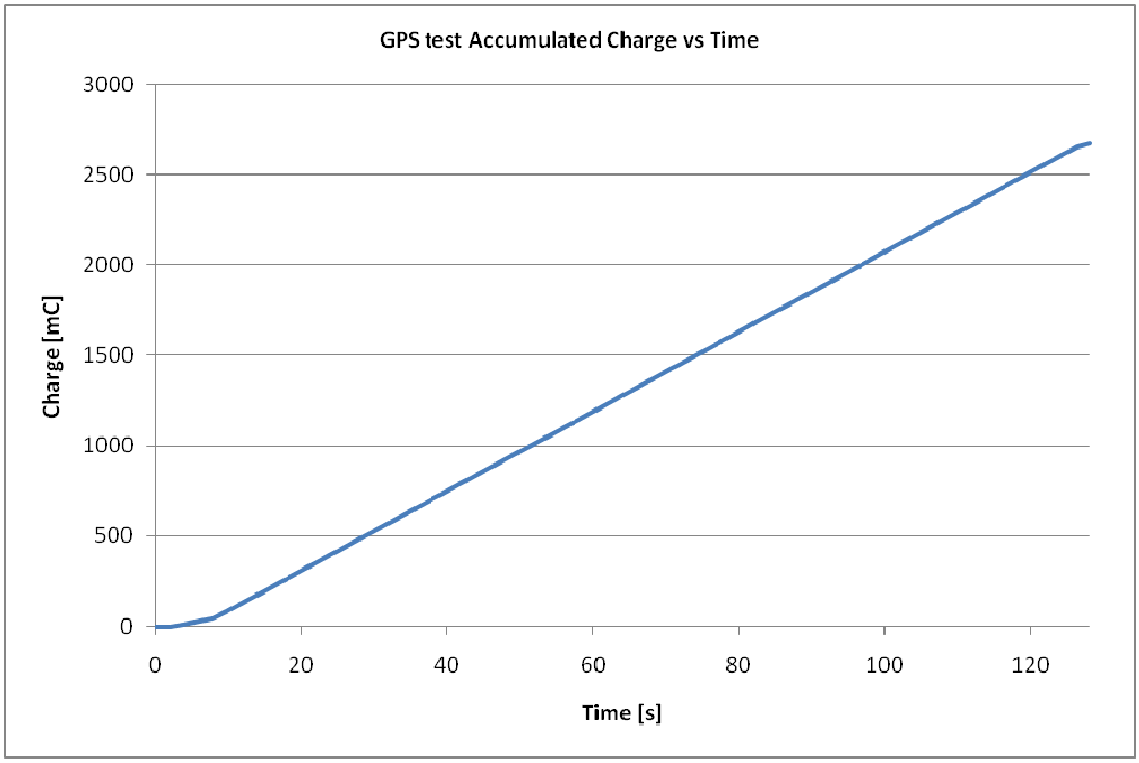
Self-test Plots



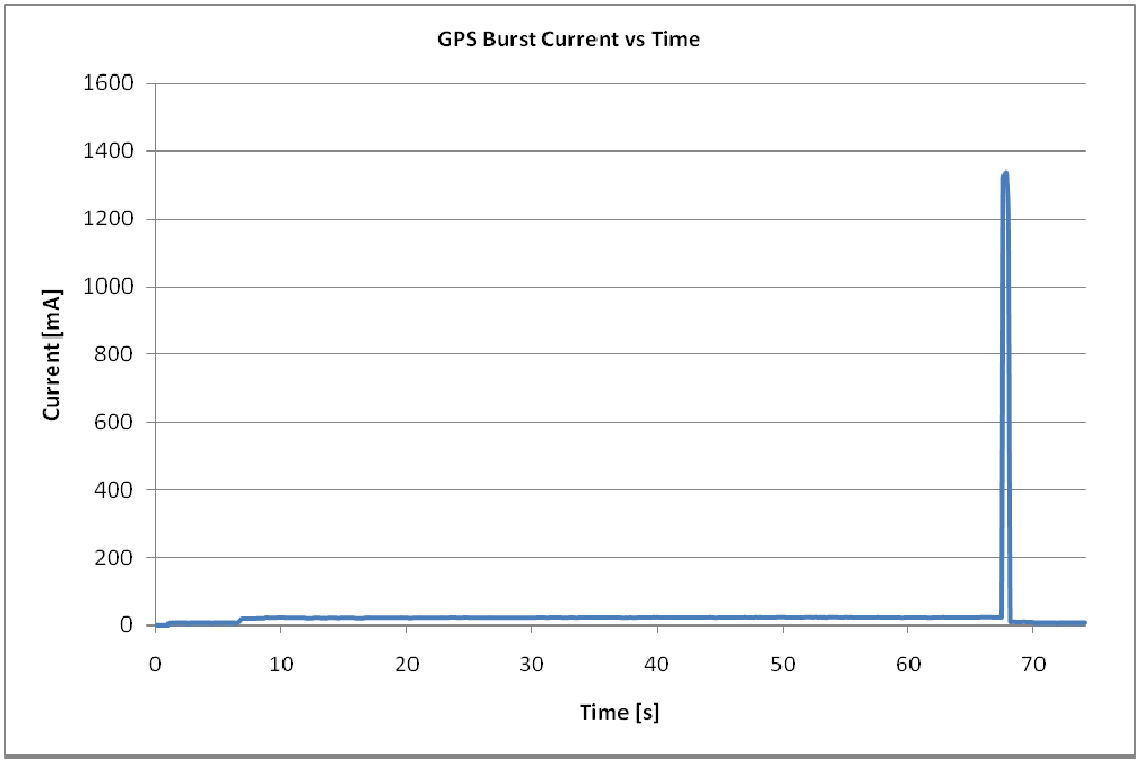



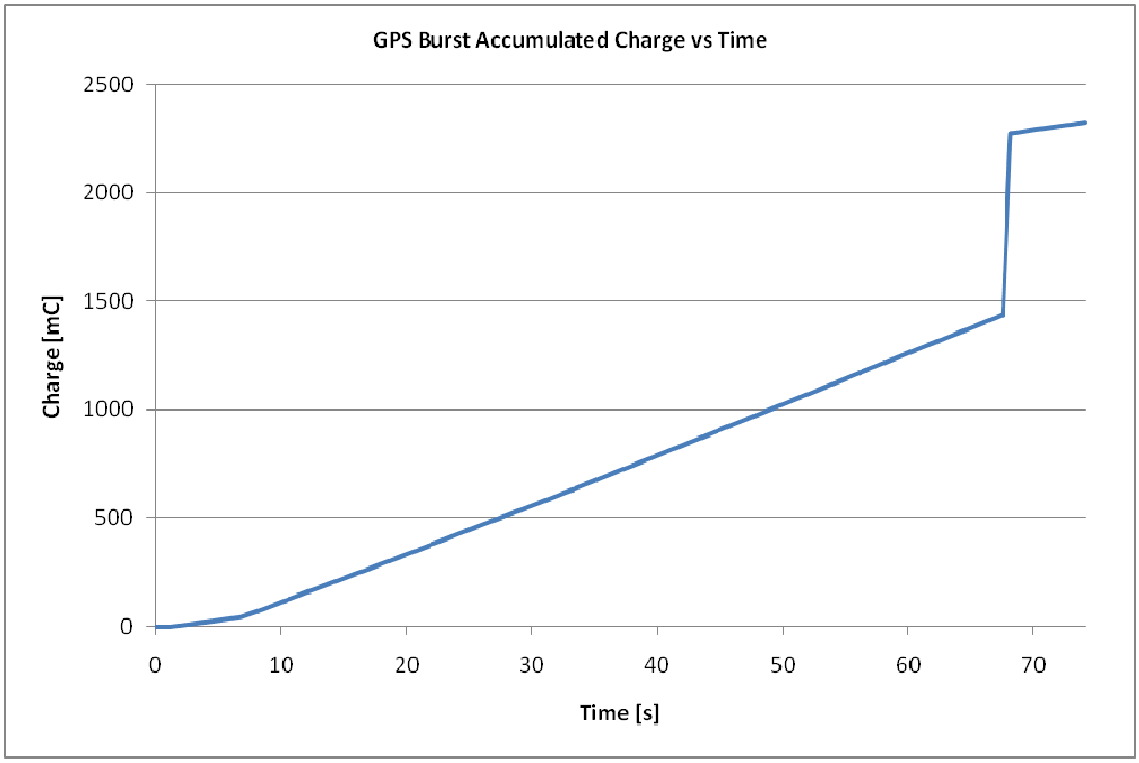
GPS Test Mode Plots



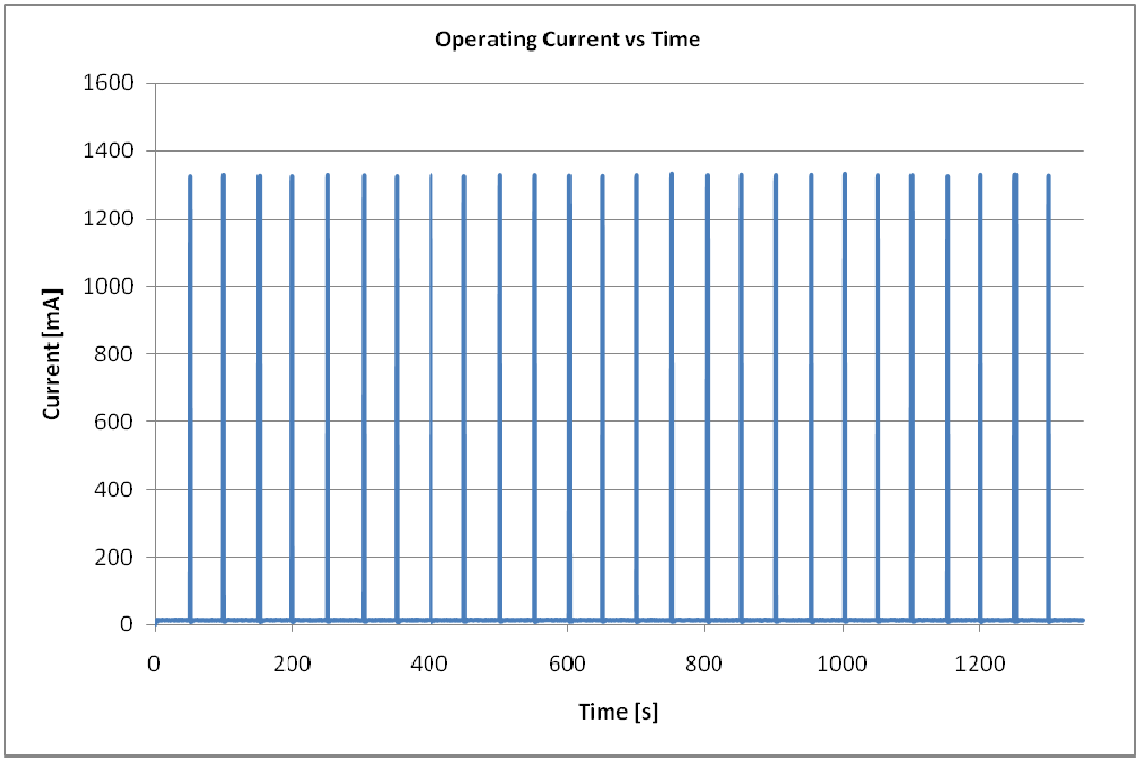



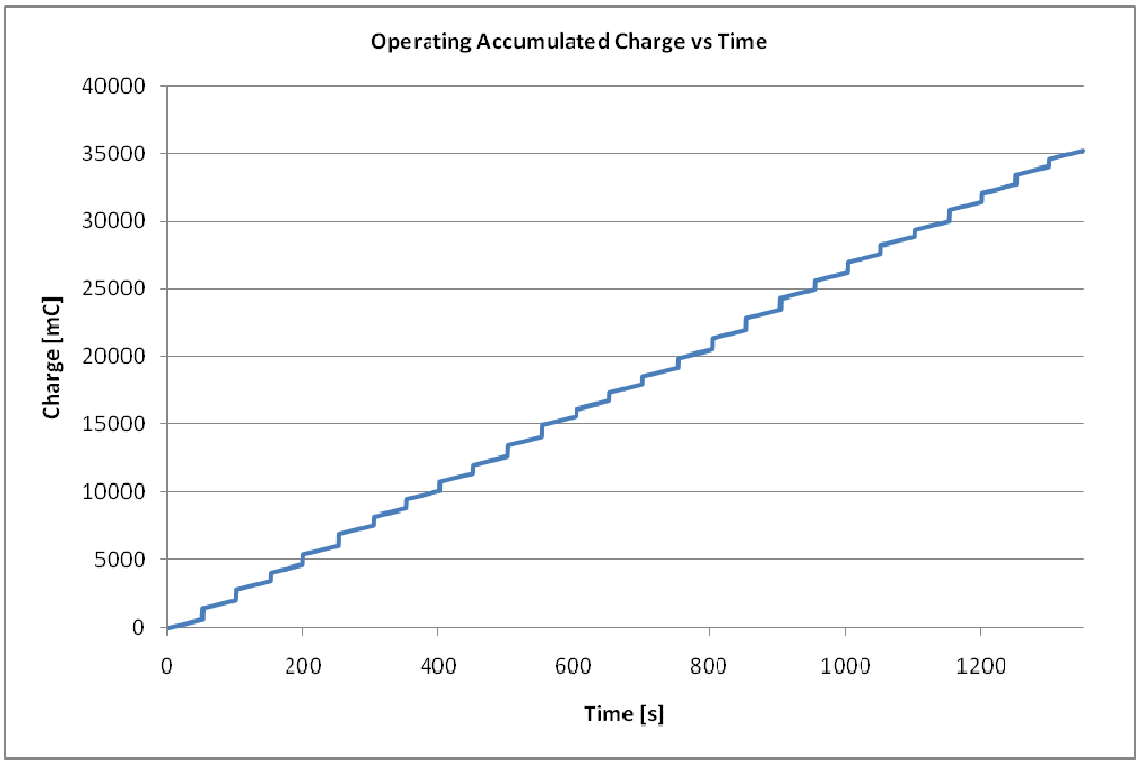
GPS Burst Mode Plots



Operating Mode Plots



## 2.8 FREQUENCY STABILITY WITH TEMPERATURE GRADIENT

### 2.8.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015

### 2.8.2 Date of Test and Modification State

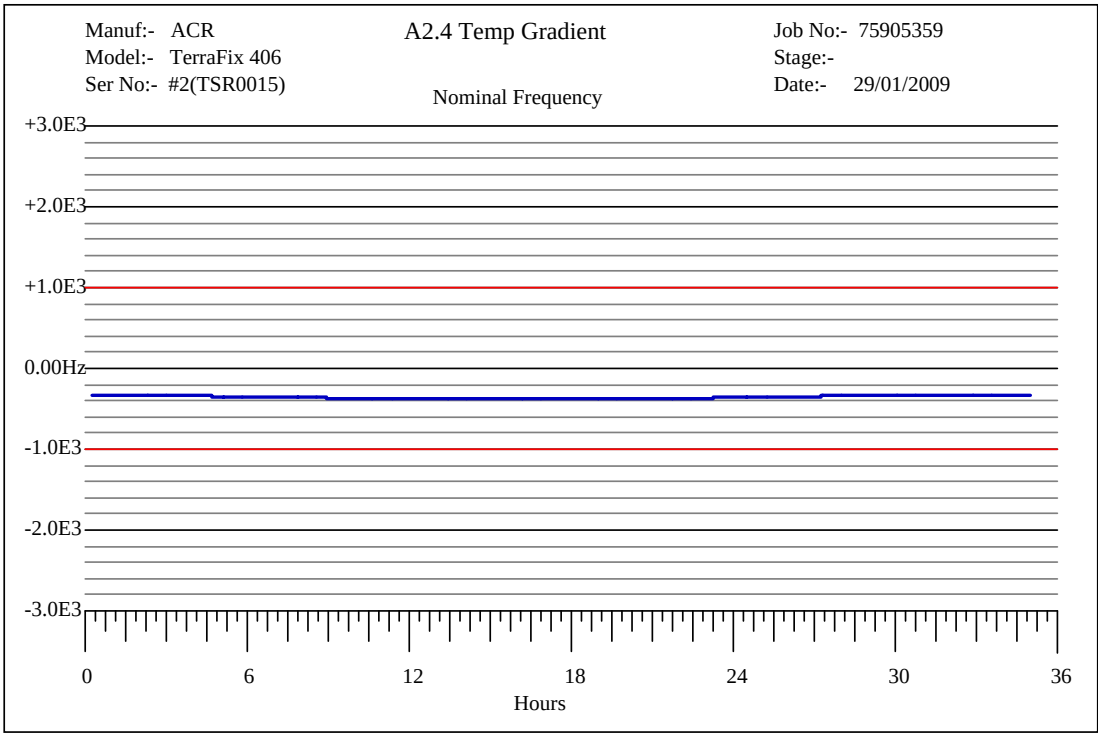
27 to 29 January 2009 - Modification State 0

### 2.8.3 Test Equipment Used

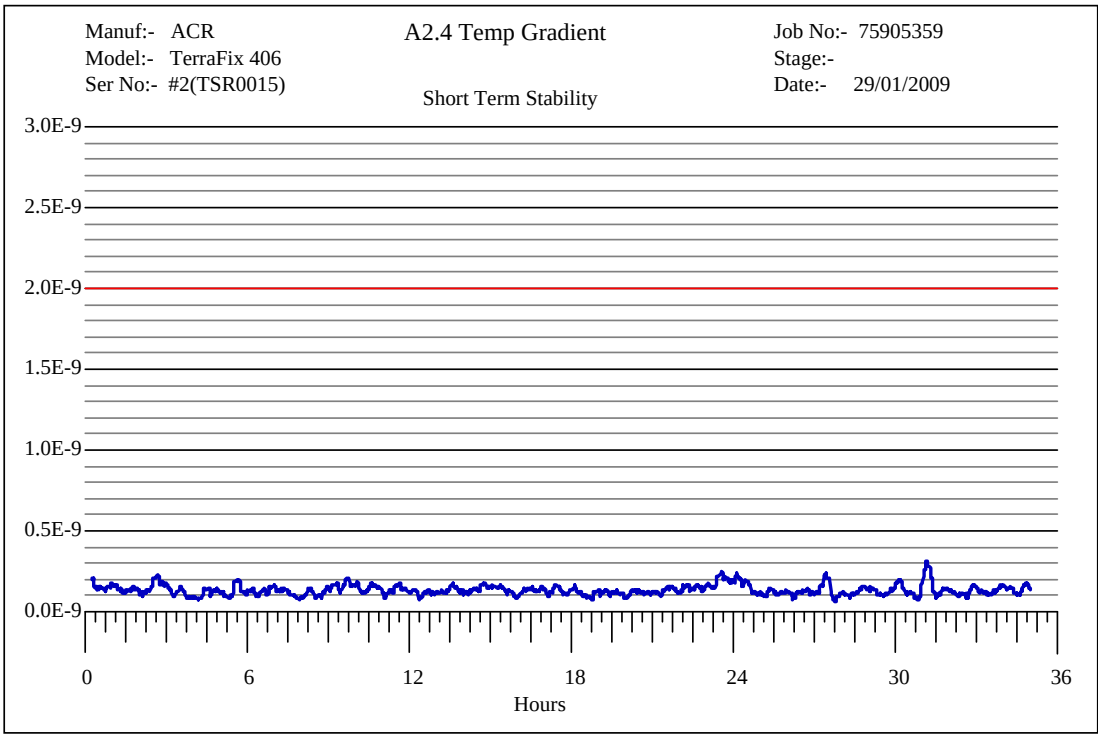
The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.8.4 Test Results

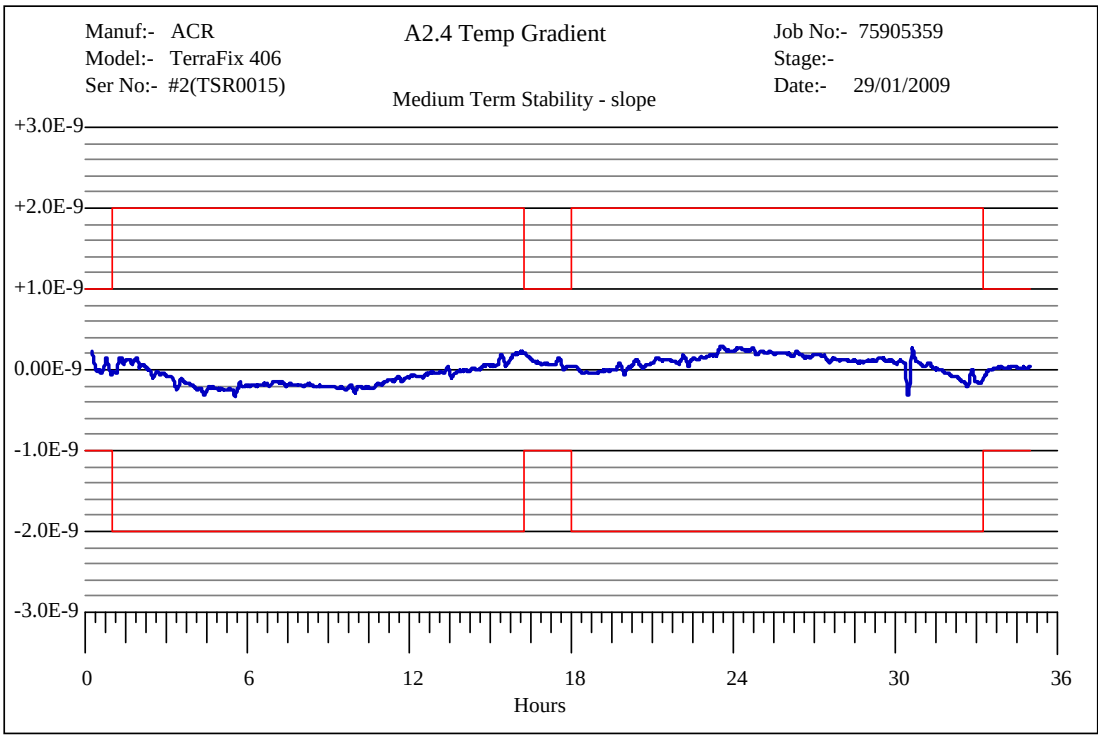
Nominal Frequency



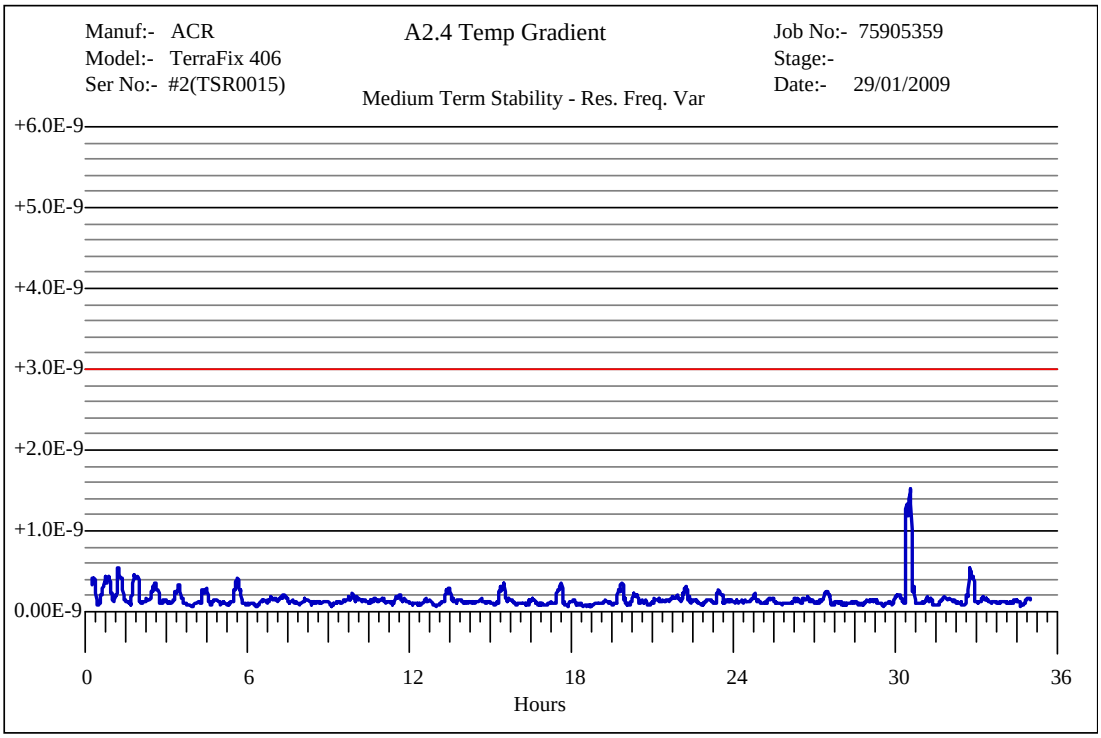
Short Term Stability



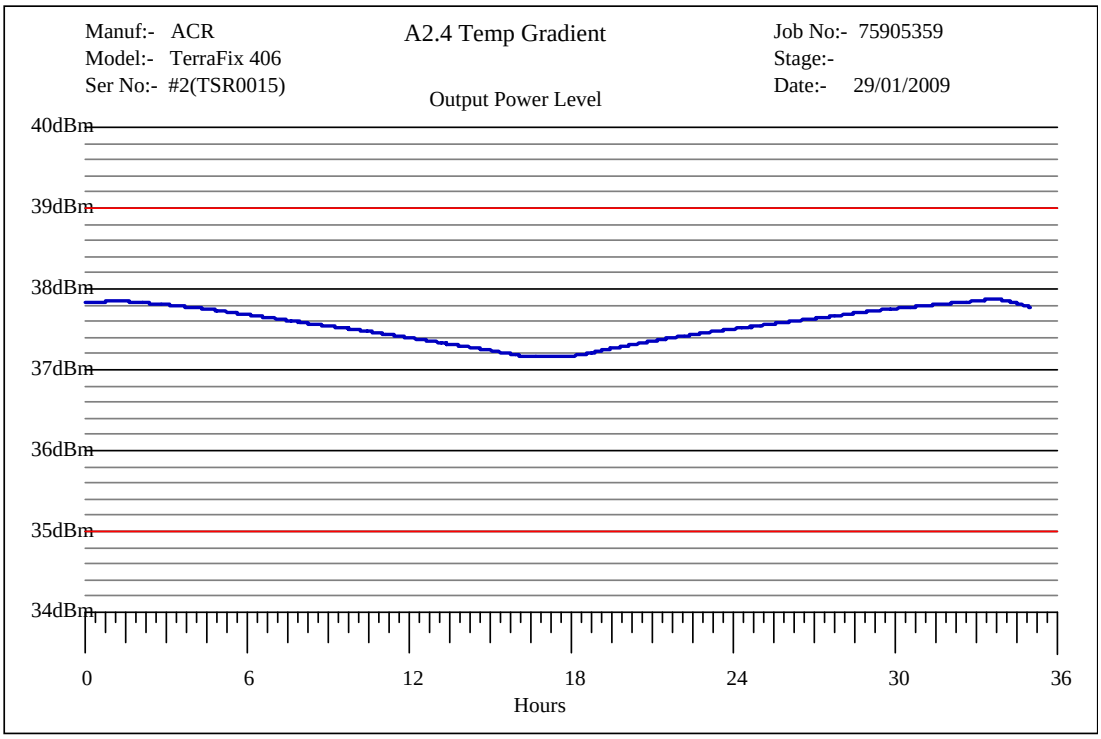

Medium Term Stability, Mean Slope



## Medium Term Stability, Residual Frequency Variation




## Output Power



Digital Message

```
Beacon Id Format......... 30 Hex Id, Long Message, Bits 25-144
 15 Hex (Bits 26- 85) = 2DDC5F0002FFBFF             2DDC5F0002FFBFF Default_Id
 36 Hex (Bits 25-144) = FFFE2F96EE2F80017FDFF8EA71B783E0F66C

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 1 0010 1101 1101 1100 0101 1111 0000 0000 0000 0010 1111 1111 1011 1111 1111
   0001 1101 0100 1110 0011 0110 1111 0000 0111 1100 0001 1110 1100 1101 100
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            1 Long Message                               1
Protocol Flag      26            0 Location NEW                               0
MID                27- 36      366 USA                              0101 1011 10
Protocol Code      37- 40       14 Test Serial (Standard)                  1110
Spare              41- 64                          0010 1111 1000 0000 0000 0001
Coarse Position    65- 85          DEFAULT            0111 1111 1101 1111 1111 1
BCH Encoded        86-106          Errors=0           0001 1101 0100 1110 0011 0
BCH Generated      86-106                             0001 1101 0100 1110 0011 0
Long Message      107-144          Data Present
Fixed Bits        107-109                                                   110
Fixed Bit         110            1                                            1
Encode Pos Device 111            1 Internal                                   1
121.5 Homing      112            1 YES                                        1
Position Change   113-132          DEFAULT              1000 0011 1110 0000 1111
Resultant Position              --> Not Defined
BCH Encoded       133-144          Errors=0                        0110 0110 1100
BCH Generated     133-144                                          0110 0110 1100
```

## 2.9 SATELLITE QUALITATIVE TESTS

### 2.9.1 Equipment Under Test

Runs 1 & 3 PLB-350 B, TUV Reference 75905359_007
Runs 2 & 4 PLB-350 B, TUV Reference 75905359_016

### 2.9.2 Date of Test and Modification State

| | |
|---|---|
| Run 1 – 25 and 26 February 2009 | 16:58 to 08:26 - Modification State 0 |
| Run 2 – 26 and 27 February 2009 | 17:27 to 08:27 - Modification State 0 |
| Run 3 – 04 to 05 March 2009 | 16:50 to 10:00 - Modification State 0 |
| Run 4 – 30 to 31 March 2009 | 10:20 to 09:20 - Modification State 0 |

### 2.9.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.9.4 Test Results

Run 1, Configuration 7, Sample: Serial Number: #22 (TUV_007)

Beacon 15 Hex ID: 2DDC5 F000A FFBFF
Actual location of the test beacon: Latitude: 052° 14.447'N
Longitude: 001° 43.970'W

Beacon test configuration: C/S T.007 Configuration 7

| Satellite ID | Satellite Pass Number | 15 Hex ID Provided by LUT | Doppler Latitude | Doppler Longitude | Mean Rx Power (dBm) | TCA | CTA (deg) | Location Error (kM) |
|---|---|---|---|---|---|---|---|---|
| S11 | 12226 | 2DDC5 F000A FFBFF | 52.23194 | -1.72168 | -132.44 | 08:16:22 | -19.405 | 1.242 |
| S7 | 56099 | 2DDC5 F000A FFBFF | 52.24252 | -1.72424 | -131.91 | 07:51:13 | 17.445 | 0.616 |
| S8 | 43464 | 2DDC5 F000A FFBFF | 52.24132 | -1.72206 | -124.90 | 07:38:26 | 10.694 | 0.735 |
| S7 | 56098 | 2DDC5 F000A FFBFF | 52.24157 | -1.72566 | -126.11 | 06:12:23 | 4.405 | 0.496 |
| S7 | 56097 | 2DDC5 F000A FFBFF | 52.23955 | -1.72216 | -127.19 | 04:32:12 | -10.681 | 0.739 |
| S8 | 43463 | 2DDC5 F000A FFBFF | 52.23947 | -1.72081 | -126.45 | 05:58:06 | -3.709 | 0.831 |
| S10 | 19429 | 2DDC5 F000A FFBFF | 52.24216 | -1.72564 | -131.03 | 04:26:40 | 15.449 | 0.513 |
| S8 | 43462 | 2DDC5 F000A FFBFF | 52.23566 | -1.72230 | -131.93 | 04:16:18 | -19.277 | 0.915 |
| S10 | 19428 | 2DDC5 F000A FFBFF | 52.23885 | -1.71741 | -124.61 | 02:46:44 | 1.883 | 1.071 |
| S10 | 19427 | 2DDC5 F000A FFBFF | 52.23667 | -1.72317 | -129.03 | 01:05:23 | -13.504 | 0.801 |
| S9 | 34691 | 2DDC5 F000A FFBFF | 52.24590 | -1.72026 | -127.61 | 22:14:08 | -11.580 | 1.027 |
| S11 | 12220 | 2DDC5 F000A FFBFF | 52.24611 | -1.71697 | -123.92 | 21:46:31 | -8.112 | 1.231 |
| S9 | 34690 | 2DDC5 F000A FFBFF | 52.24972 | -1.72433 | -124.97 | 20:33:48 | 3.586 | 1.149 |
| S11 | 12219 | 2DDC5 F000A FFBFF | 52.24650 | -1.73130 | -122.35 | 20:06:21 | 6.787 | 0.644 |
| S11 | 12218 | 2DDC5 F000A FFBFF | 52.24401 | -1.73361 | -128.95 | 18:27:32 | 19.284 | 0.362 |
| S8 | 43456 | 2DDC5 F000A FFBFF | 52.24291 | -1.71652 | -122.25 | 17:42:21 | -8.373 | 1.135 |
| S9 | 34689 | 2DDC5 F000A FFBFF | 52.25034 | -1.75285 | -130.73 | 18:54:50 | 16.827 | 1.727 |
| S7 | 56091 | 2DDC5 F000A FFBFF | 52.24115 | -1.71855 | -129.98 | 18:03:40 | -16.870 | 0.973 |

$$\text{Ratio of successful solutions} = \frac{\text{number of Doppler solution within 5km with } 1° < \text{CTA} < 21°}{\text{number of satellite passes over test duration with } 1° < \text{CTA} < 21°}$$

$$= \frac{18}{18} = 100.0\%$$

Run 2, Configuration 7, Sample: Serial Number: #5 (TUV_016)

Beacon 15 Hex ID: 2DDC5 F0006 FFBFF
Actual location of the test beacon: Latitude: 052° 14.447'N
Longitude: 001° 43.970'W

Beacon test configuration: C/S T.007 Configuration 7

| Satellite ID | Satellite Pass Number | 15 Hex ID Provided by LUT | Doppler Latitude | Doppler Longitude | Mean Rx Power (dBm) | TCA | CTA (deg) | Location Error (kM) |
|---|---|---|---|---|---|---|---|---|
| S9 | 34705 | 2DDC5 F0006 FFBFF | 52.24460 | -1.71679 | -121.62 | 21:50:41 | -7.991 | 1.171 |
| S11 | 12235 | 2DDC5 F0006 FFBFF | 52.24142 | -1.72538 | -131.77 | 23:07:01 | -20.406 | 0.512 |
| S11 | 12234 | 2DDC5 F0006 FFBFF | 52.24403 | -1.71810 | -122.54 | 21:25:40 | -4.924 | 1.065 |
| S9 | 34704 | 2DDC5 F0006 FFBFF | 52.24710 | -1.72976 | -125.05 | 20:10:41 | 6.894 | 0.732 |
| S11 | 12233 | 2DDC5 F0006 FFBFF | 52.24612 | -1.72953 | -123.71 | 19:45:47 | 9.632 | 0.634 |
| S8 | 43470 | 2DDC5 F0006 FFBFF | 52.24488 | -1.71736 | -122.63 | 17:30:28 | -6.530 | 1.147 |
| S9 | 34703 | 2DDC5 F0006 FFBFF | 52.23552 | -1.68713 | -129.96 | 18:32:01 | 19.392 | 3.165 |
| S7 | 56105 | 2DDC5 F0006 FFBFF | 52.24548 | -1.72042 | -126.93 | 17:39:25 | -13.161 | 0.993 |
| S9 | 34711 | 2DDC5 F0006 FFBFF | 52.20040 | -1.70423 | -133.07 | 08:19:21 | -19.377 | 4.892 |
| S7 | 56113 | 2DDC5 F0006 FFBFF | 52.24147 | -1.72207 | -128.55 | 07:27:41 | 14.617 | 0.736 |
| S7 | 56111 | 2DDC5 F0006 FFBFF | 52.24080 | -1.72009 | -123.47 | 04:08:00 | -14.392 | 0.867 |
| S10 | 19443 | 2DDC5 F0006 FFBFF | 52.23950 | -1.72243 | -127.21 | 04:16:18 | 14.173 | 0.722 |
| S10 | 19441 | 2DDC5 F0006 FFBFF | 52.23760 | -1.72351 | -131.06 | 00:54:42 | -15.146 | 0.726 |

$$\text{Ratio of successful solutions} = \frac{\text{number of Doppler solution within 5km with } 1° < \text{CTA} < 21°}{\text{number of satellite passes over test duration with } 1° < \text{CTA} < 21°}$$

$$= \frac{13}{13} = 100.0\%$$

Run 3 Configuration 8, Sample: Serial Number: #22 (TUV_007)

Beacon 15 Hex ID: 2DDC5 F000A FFBFF
Actual location of the test beacon: Latitude: 052° 14.447'N
Longitude: 001° 43.970'W

| Satellite ID | Satellite Pass Number | 15 Hex ID Provided by LUT | Doppler Latitude | Doppler Longitude | Mean Rx Power (dBm) | TCA | CTA (deg) | Location Error (kM) |
|---|---|---|---|---|---|---|---|---|
| S9 | 34791 | 2DDC5 F000A FFBFF | 52.24257 | -1.71841 | -127.68 | 22:51:59 | -17.451 | 1.001 |
| S11 | 12320 | 2DDC5 F000A FFBFF | 52.24033 | -1.71650 | -123.92 | 22:42:23 | -16.681 | 1.113 |
| S11 | 12319 | 2DDC5 F000A FFBFF | 52.24424 | -1.72416 | -118.16 | 21:01:25 | -1.251 | 0.704 |
| S9 | 34790 | 2DDC5 F000A FFBFF | 52.24462 | -1.71962 | -123.73 | 21:11:06 | -2.025 | 0.995 |
| S9 | 34789 | 2DDC5 F000A FFBFF | 52.24369 | -1.72873 | -123.55 | 19:31:37 | 12.161 | 0.427 |
| S11 | 12318 | 2DDC5 F000A FFBFF | 52.24608 | -1.72700 | -120.41 | 19:21:52 | 12.802 | 0.710 |
| S8 | 43555 | 2DDC5 F000A FFBFF | 52.24832 | -1.71918 | -125.05 | 18:00:32 | -10.999 | 1.251 |
| S7 | 56190 | 2DDC5 F000A FFBFF | 52.24519 | -1.72319 | -123.48 | 16:55:25 | -6.438 | 0.819 |
| S10 | 19527 | 2DDC5 F000A FFBFF | 52.24127 | -1.72308 | -124.71 | 03:13:42 | 5.757 | 0.666 |
| S10 | 19526 | 2DDC5 F000A FFBFF | 52.23920 | -1.72359 | -126.59 | 01:32:44 | -9.323 | 0.653 |

$$\text{Ratio of successful solutions} = \frac{\text{number of Doppler solution within 5km with } 1° < \text{CTA} < 21°}{\text{number of satellite passes over test duration with } 1° < \text{CTA} < 21°}$$

$$= \frac{10}{10} = 100.0\%$$

Test 4, Configuration 8, Sample: Serial Number: #5 (TUV_016)

Beacon 15 Hex ID: 2DDC5 F0006 FFBFF
Actual location of the test beacon: Latitude: 050° 49.091'N
Longitude: 001° 11.870'W

| Satellite ID | Satellite Pass Number | 15 Hex ID Provided by LUT | Doppler Latitude | Doppler Longitude | Mean Rx Power (dBm) | TCA | CTA (deg) | Location Error (kM) |
|---|---|---|---|---|---|---|---|---|
| S9 | 35161 | 2DDC5 F0006 FFBFF | 50.82116 | -1.19497 | -124.05 | 22:47:16 | -17.557 | 0.387 |
| S11 | 12689 | 2DDC5 F0006 FFBFF | 50.82341 | -1.19213 | -118.36 | 22:03:25 | -11.022 | 0.705 |
| S9 | 35160 | 2DDC5 F0006 FFBFF | 50.82411 | -1.19059 | -119.44 | 21:06:26 | -1.653 | 0.832 |
| S11 | 12688 | 2DDC5 F0006 FFBFF | 50.82617 | -1.20158 | -117.72 | 20:23:01 | 4.587 | 0.926 |
| S11 | 12687 | 2DDC5 F0006 FFBFF | 50.81520 | -1.22732 | -120.02 | 18:44:02 | 18.143 | 2.097 |
| S9 | 35159 | 2DDC5 F0006 FFBFF | 50.82607 | -1.20338 | -122.15 | 19:27:01 | 12.977 | 0.959 |
| S7 | 56561 | 2DDC5 F0006 FFBFF | 50.82099 | -1.19237 | -124.79 | 18:13:24 | -19.086 | 0.494 |
| S8 | 43922 | 2DDC5 F0006 FFBFF | 50.82421 | -1.18931 | -120.58 | 17:54:59 | -9.799 | 0.898 |
| S7 | 56560 | 2DDC5 F0006 FFBFF | 50.82523 | -1.18592 | -118.77 | 16:32:28 | -3.163 | 1.146 |
| S8 | 43921 | 2DDC5 F0006 FFBFF | 50.82686 | -1.20481 | -120.16 | 16:14:08 | 5.759 | 1.081 |
| S7 | 56559 | 2DDC5 F0006 FFBFF | 50.82674 | -1.20495 | -121.18 | 14:52:59 | 11.651 | 1.074 |
| S8 | 43920 | 2DDC5 F0006 FFBFF | 50.82423 | -1.21084 | -124.73 | 14:34:42 | 18.996 | 1.134 |
| S10 | 19886 | 2DDC5 F0006 FFBFF | 50.82240 | -1.18883 | -120.41 | 13:44:27 | -6.595 | 0.787 |
| S11 | 12683 | 2DDC5 F0006 FFBFF | 50.82008 | -1.20009 | -118.06 | 12:15:03 | 16.474 | 0.264 |
| S11 | 12682 | 2DDC5 F0006 FFBFF | 50.81639 | -1.19117 | -109.45 | 10:35:52 | 2.547 | 0.508 |
| S10 | 19885 | 2DDC5 F0006 FFBFF | 50.82436 | -1.20240 | -120.96 | 12:03:46 | 8.703 | 0.758 |
| S9 | 35154 | 2DDC5 F0006 FFBFF | 50.81518 | -1.18994 | -121.50 | 11:20:08 | 9.022 | 0.647 |
| S9 | 35153 | 2DDC5 F0006 FFBFF | 50.81544 | -1.19808 | -120.54 | 09:40:20 | -6.160 | 0.305 |
| S7 | 56569 | 2DDC5 F0006 FFBFF | 50.81995 | -1.19699 | -125.20 | 08:01:14 | 19.925 | 0.205 |
| S8 | 43930 | 2DDC5 F0006 FFBFF | 50.82036 | -1.19163 | -120.93 | 07:51:33 | 12.789 | 0.498 |
| S7 | 56568 | 2DDC5 F0006 FFBFF | 50.81948 | -1.18973 | -120.20 | 06:22:40 | 6.883 | 0.587 |
| S8 | 43929 | 2DDC5 F0006 FFBFF | 50.81737 | -1.21955 | -120.19 | 06:11:25 | -1.864 | 1.527 |
| S7 | 56567 | 2DDC5 F0006 FFBFF | 50.81969 | -1.19580 | -119.80 | 04:42:42 | -8.503 | 0.220 |
| S8 | 43928 | 2DDC5 F0006 FFBFF | 50.81505 | -1.20314 | -125.41 | 04:29:49 | -17.871 | 0.510 |
| S10 | 19894 | 2DDC5 F0006 FFBFF | 50.81906 | -1.19403 | -120.80 | 03:42:10 | 10.595 | 0.284 |
| S10 | 19893 | 2DDC5 F0006 FFBFF | 50.81638 | -1.18864 | -119.58 | 02:01:41 | -4.448 | 0.676 |
| S10 | 19892 | 2DDC5 F0006 FFBFF | 50.83161 | -1.21606 | -125.35 | 00:19:41 | -20.553 | 1.966 |

$$\text{Ratio of successful solutions} = \frac{\text{number of Doppler solution within 5km with } 1° < \text{CTA} < 21°}{\text{number of satellite passes over test duration with } 1° < \text{CTA} < 21°}$$

$$= \frac{27}{27} = 100.0\%$$

## 2.10 ANTENNA CHARACTERISTICS

### 2.10.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_007
PLB-350 B, TUV Reference 75905359_016

### 2.10.2 Date of Test and Modification State

21 February 2009 (Configuration B2) - Modification State 0
24 February 2009 (Configuration B5) - Modification State 0

### 2.10.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.10.4 Test Results

Antenna Model A3-06-2493 Serial Number: #22, (TUV_007), Configuration: C/S T.007 Figure B.5

| | Elevation Angle (degrees) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | | 30 | | 40 | | 50 | |
| Azimuth Angle (degrees) | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi |
| 0 | 39.7 | 2.23 | 40.3 | 2.87 | 38.5 | 1.09 | 35.6 | -1.86 | 33.7 | -3.81 |
| 90 | 39.8 | 2.29 | 40.4 | 2.92 | 38.7 | 1.28 | 36.3 | -1.13 | 35.3 | -2.20 |
| 180 | 40.0 | 2.58 | 40.9 | 3.48 | 39.5 | 2.08 | 37.1 | -0.32 | 36.1 | -1.35 |
| 270 | 40.0 | 2.57 | 40.9 | 3.39 | 39.2 | 1.72 | 36.4 | -1.10 | 34.1 | -3.38 |

$EIRP_{LOSS}$ = $Pt_{amb}$ - $Pt_{EOL}$ = (37.46 – 36.94) = 0.52dB

$EIRP_{maxEOL}$ = MAX [$EIRP_{max}$, ($EIRP_{max}$ - $EIRP_{LOSS}$)] = MAX (40.9, 40.4) = 40.4dBm

$EIRP_{minEOL}$ = MIN [$EIRP_{min}$, ($EIRP_{min}$ - $EIRP_{LOSS}$)] = MIN (33.7, 33.1) = 33.1dBm

$Pt_{amb}$ is the power at ambient from the summary table
$Pt_{EOL}$ is the power at the end of Operating Life at Minimum Temperature
$EIRP_{max}$ is the maximum EIRP from the antenna characteristics spreadsheet
$EIRP_{min}$ is the minimum EIRP from the antenna characteristics spreadsheet

Antenna Model A3-06-2493 Serial Number: #5, (TUV_016), Configuration: C/S T.007 Figure B.5

| | Elevation Angle (degrees) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | | 30 | | 40 | | 50 | |
| Azimuth Angle (degrees) | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi |
| 0 | 40.6 | 3.10 | 40.9 | 3.47 | 39.1 | 1.61 | 35.9 | -1.51 | 33.7 | -3.76 |
| 90 | 40.5 | 3.03 | 40.9 | 3.48 | 39.1 | 1.67 | 35.7 | -1.78 | 34.3 | -3.15 |
| 180 | 40.9 | 3.46 | 41.5 | 4.06 | 39.8 | 2.37 | 36.6 | -0.85 | 35.7 | -1.71 |
| 270 | 40.9 | 3.40 | 41.4 | 3.94 | 39.8 | 2.30 | 36.7 | -0.73 | 34.6 | -2.83 |

$EIRP_{LOSS}$ = $Pt_{amb}$ - $Pt_{EOL}$ = (37.46 – 36.94) = 0.52dB

$EIRP_{maxEOL}$ = MAX [$EIRP_{max}$, ($EIRP_{max}$ - $EIRP_{LOSS}$)] = MAX (41.5, 41.0) = 41.5dBm

$EIRP_{minEOL}$ = MIN [$EIRP_{min}$, ($EIRP_{min}$ - $EIRP_{LOSS}$)] = MIN (33.7, 33.2) = 33.2dBm

$Pt_{amb}$ is the power at ambient from the summary table
$Pt_{EOL}$ is the power at the end of Operating Life at Minimum Temperature
$EIRP_{max}$ is the maximum EIRP from the antenna characteristics spreadsheet
$EIRP_{min}$ is the minimum EIRP from the antenna characteristics spreadsheet

Antenna Model A3-06-2493 Serial Number: #22, (TUV_007), Configuration: C/S T.007 Figure B.2

| | Elevation Angle (degrees) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | | 30 | | 40 | | 50 | |
| Azimuth Angle (degrees) | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi |
| 0 | 39.7 | 2.28 | 42.2 | 4.76 | 42.9 | 5.40 | 36.8 | -0.68 | 32.7 | -4.79 |
| 30 | 39.7 | 2.29 | 42.1 | 4.67 | 42.7 | 5.20 | 36.9 | -0.51 | 32.7 | -4.75 |
| 60 | 39.5 | 2.07 | 41.8 | 4.36 | 42.6 | 5.10 | 37.3 | -0.15 | 33.1 | -4.39 |
| 90 | 39.6 | 2.17 | 41.8 | 4.37 | 42.6 | 5.12 | 37.6 | 0.14 | 32.8 | -4.66 |
| 120 | 39.6 | 2.18 | 41.9 | 4.47 | 42.4 | 4.92 | 37.4 | -0.07 | 32.8 | -4.67 |
| 150 | 39.4 | 1.89 | 42.0 | 4.58 | 42.6 | 5.14 | 37.6 | 0.14 | 32.4 | -5.05 |
| 180 | 39.2 | 1.78 | 41.8 | 4.39 | 42.6 | 5.13 | 37.3 | -0.15 | ~~32.1~~ | -5.41 |
| 210 | 39.6 | 2.16 | 41.9 | 4.48 | 42.6 | 5.12 | 37.2 | -0.26 | ~~31.3~~ | -6.15 |
| 240 | 39.9 | 2.47 | 41.9 | 4.49 | 42.5 | 5.01 | 37.3 | -0.20 | ~~30.8~~ | -6.67 |
| 270 | 40.1 | 2.66 | 41.8 | 4.37 | 42.5 | 5.00 | 36.9 | -0.57 | ~~30.8~~ | -6.64 |
| 300 | 39.9 | 2.47 | 41.9 | 4.48 | 42.8 | 5.31 | 36.6 | -0.84 | ~~30.8~~ | -6.64 |
| 330 | 39.9 | 2.39 | 41.8 | 4.37 | 42.7 | 5.21 | 36.7 | -0.79 | ~~32.2~~ | -5.28 |
| Gain Variation | 0.88 | | 0.40 | | 0.48 | | 0.98 | | 2.28 | |

| | Elevation Angle (degrees) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | | 30 | | 40 | | 50 | |
| Azimuth Angle (degrees) | Vv | Vh | Vv | Vh | Vv | Vh | Vv | Vh | Vv | Vh |
| 0 | 111.60 | 90.50 | 113.70 | 86.50 | 113.60 | 92.80 | 106.40 | 89.70 | 100.50 | 89.90 |
| 30 | 111.60 | 91.80 | 113.60 | 89.10 | 113.40 | 93.20 | 106.60 | 88.00 | 100.90 | 67.20 |
| 60 | 111.40 | 88.90 | 113.30 | 85.30 | 113.30 | 93.10 | 107.00 | 85.10 | 101.10 | 86.90 |
| 90 | 111.50 | 89.70 | 113.30 | 90.30 | 113.30 | 94.80 | 107.30 | 83.30 | 100.90 | 83.90 |
| 120 | 111.50 | 90.30 | 113.40 | 88.50 | 113.10 | 94.40 | 107.10 | 68.90 | 100.80 | 87.10 |
| 150 | 111.20 | 91.50 | 113.50 | 91.50 | 113.30 | 95.90 | 107.30 | 80.80 | 100.30 | 88.90 |
| 180 | 111.10 | 90.80 | 113.30 | 92.60 | 113.30 | 95.20 | 107.00 | 85.20 | 99.80 | 90.10 |
| 210 | 111.50 | 87.70 | 113.40 | 91.30 | 113.30 | 94.50 | 106.90 | 81.70 | 98.90 | 90.60 |
| 240 | 111.80 | 89.80 | 113.40 | 92.30 | 113.20 | 94.00 | 106.80 | 93.00 | 98.60 | 88.20 |
| 270 | 112.00 | 88.00 | 113.30 | 88.50 | 113.20 | 93.20 | 106.60 | 71.20 | 98.20 | 91.30 |
| 300 | 111.80 | 89.80 | 113.40 | 90.80 | 113.50 | 94.20 | 106.30 | 85.10 | 98.40 | 90.20 |
| 330 | 111.70 | 92.40 | 113.30 | 90.30 | 113.40 | 94.10 | 106.30 | 89.20 | 99.80 | 91.30 |
| Min (Vv-Vhh) | 19.30 | | 20.70 | | 17.40 | | 13.80 | | 6.90 | |

$EIRP_{LOSS}$ = $Pt_{amb}$ - $Pt_{EOL}$ = (37.5 – 36.94) = 0.52dB

$EIRP_{maxEOL}$ = MAX [$EIRP_{max}$, ($EIRP_{max}$ - $EIRP_{LOSS}$)] = MAX (42.9, 42.3) = 42.9dBm

$EIRP_{minEOL}$ = MIN [$EIRP_{min}$, ($EIRP_{min}$ - $EIRP_{LOSS}$)] = MIN (32.4, 31.9) = 31.9dBm

$Pt_{amb}$ is the power at ambient from the summary table
$Pt_{EOL}$ is the power at the end of Operating Life at Minimum Temperature
$EIRP_{max}$ is the maximum EIRP from the antenna characteristics spreadsheet
$EIRP_{min}$ is the minimum EIRP from the antenna characteristics spreadsheet

Antenna Model A3-06-2493 Serial Number: #5, (TUV_016), Configuration: C/S T.007 Figure B.2

| | Elevation Angle (degrees) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | | 30 | | 40 | | 50 | |
| Azimuth Angle (degrees) | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi | EIRP dBm | Ant dBi |
| 0 | 39.9 | 2.46 | 42.4 | 4.96 | ~~43.4~~ | 5.90 | 36.8 | -0.61 | 33.7 | -3.72 |
| 30 | 39.8 | 2.37 | 42.5 | 5.07 | 43.3 | 5.80 | 37.1 | -0.33 | 33.9 | -3.59 |
| 60 | 39.7 | 2.26 | 42.3 | 4.86 | 43.2 | 5.70 | 37.6 | 0.14 | 33.7 | -3.78 |
| 90 | 39.8 | 2.36 | 42.3 | 4.87 | 43.2 | 5.72 | 37.9 | 0.45 | 33.3 | -4.12 |
| 120 | 39.8 | 2.37 | 42.3 | 4.86 | 43.1 | 5.62 | 37.8 | 0.33 | 33.5 | -3.94 |
| 150 | 39.6 | 2.18 | 42.4 | 4.97 | ~~43.3~~ | 5.84 | 37.9 | 0.44 | 33.3 | -4.19 |
| 180 | 39.4 | 1.97 | 42.2 | 4.78 | ~~43.3~~ | 5.83 | 37.7 | 0.23 | 33.0 | -4.45 |
| 210 | 39.8 | 2.36 | 42.4 | 4.97 | 43.2 | 5.72 | 37.6 | 0.13 | 32.7 | -4.75 |
| 240 | 40.1 | 2.67 | 42.3 | 4.87 | 43.2 | 5.73 | 37.4 | -0.05 | ~~32.2~~ | -5.22 |
| 270 | 40.3 | 2.86 | 42.1 | 4.66 | 43.1 | 5.61 | 37.0 | -0.46 | 32.5 | -4.94 |
| 300 | 40.1 | 2.66 | 42.2 | 4.77 | ~~43.4~~ | 5.92 | 36.9 | -0.52 | ~~32.4~~ | -5.10 |
| 330 | 40.0 | 2.58 | 42.2 | 4.77 | 43.3 | 5.81 | 36.8 | -0.69 | 33.5 | -3.93 |
| Gain Variation | 0.88 | | 0.41 | | 0.31 | | 1.14 | | 1.63 | |

| | Elevation Angle (degrees) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | | 30 | | 40 | | 50 | |
| Azimuth Angle (degrees) | Vv | Vh | Vv | Vh | Vv | Vh | Vv | Vh | Vv | Vh |
| 0 | 111.80 | 87.80 | 113.90 | 86.40 | 114.10 | 93.50 | 106.50 | 88.00 | 101.60 | 90.60 |
| 30 | 111.70 | 89.20 | 114.00 | 89.00 | 114.00 | 93.70 | 106.80 | 86.50 | 101.90 | 87.70 |
| 60 | 111.60 | 85.90 | 113.80 | 85.90 | 113.90 | 93.50 | 107.30 | 83.20 | 101.70 | 87.60 |
| 90 | 111.70 | 87.30 | 113.80 | 90.60 | 113.90 | 95.40 | 107.60 | 84.60 | 101.40 | 86.30 |
| 120 | 111.70 | 88.60 | 113.80 | 88.10 | 113.80 | 95.10 | 107.50 | 77.80 | 101.50 | 88.50 |
| 150 | 111.50 | 90.70 | 113.90 | 90.30 | 114.00 | 96.40 | 107.60 | 81.80 | 101.20 | 89.10 |
| 180 | 111.30 | 89.80 | 113.70 | 91.20 | 114.00 | 96.00 | 107.40 | 80.40 | 100.90 | 89.40 |
| 210 | 111.70 | 86.20 | 113.90 | 89.30 | 113.90 | 95.40 | 107.30 | 73.80 | 100.50 | 90.30 |
| 240 | 112.00 | 89.40 | 113.80 | 90.60 | 113.90 | 95.80 | 107.10 | 85.30 | 100.20 | 87.60 |
| 270 | 112.20 | 87.40 | 113.60 | 86.20 | 113.80 | 94.20 | 106.70 | 81.80 | 100.20 | 91.20 |
| 300 | 112.00 | 88.40 | 113.70 | 89.70 | 114.10 | 95.30 | 106.60 | 87.40 | 100.10 | 90.50 |
| 330 | 111.90 | 91.10 | 113.70 | 89.70 | 114.00 | 94.80 | 106.40 | 89.30 | 101.30 | 91.40 |
| Min (Vv-Vhh | 20.80 | | 22.50 | | 17.60 | | 17.10 | | 9.00 | |

$EIRP_{LOSS}$ = $Pt_{amb}$ - $Pt_{EOL}$ = (37.5 – 36.94) = 0.52dB

$EIRP_{maxEOL}$ = MAX [$EIRP_{max}$, ($EIRP_{max}$ - $EIRP_{LOSS}$)] = MAX (43.3, 42.8) = 43.3dBm

$EIRP_{minEOL}$ = MIN [$EIRP_{min}$, ($EIRP_{min}$ - $EIRP_{LOSS}$)] = MIN (32.5, 32.0) = 32.0dBm

$Pt_{amb}$ is the power at ambient from the summary table
$Pt_{EOL}$ is the power at the end of Operating Life at Minimum Temperature
$EIRP_{max}$ is the maximum EIRP from the antenna characteristics spreadsheet
$EIRP_{min}$ is the minimum EIRP from the antenna characteristics spreadsheet

## 2.11 NAVIGATION SYSTEM – STANDARD LOCATION PROTOCOL

### 2.11.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_015 (All testing except where stated)
PLB-350 B, TUV Reference 75905359_016
PLB-350 B, TUV Reference 75905359_007

### 2.11.2 Date of Test and Modification State

19 February & 04 June 2009 - Modification State 0

### 2.11.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.11.4 Test Results

Position Data Default Values

The beacon was activated without receiving GPS signals/without providing data and operated for 30 minutes. Message content was checked for all bursts during this period.

| 30 Hex Message | Message Count |
|---|---|
| FFFE2F96EE2F80017FDFF8EA71B783E0F66C | 35 |

Position Acquisition Time and Position Accuracy (Slim Variant TUV Reference 75905359_016)

A3.8.2.1: Location 50° 52.163'N, 1° 14.607'W ①
A3.8.2.2 : Location 51° 22.417'N, 1° 50.067'W ②

| Operation Configuration | C/S T.007 Section A3.8.2.1 | | C/S T.007 Section A3.8.2.2 | |
|---|---|---|---|---|
| | Time to Acquire Position (sec) | Location Error in metres | Time to Acquire Position (sec) | Location Error in metres |
| Beacon on ground plane | 100 | 68.8 | 100 | 31.5 |
| Beacon above ground plane | 100 | 68.8 | 100 | 31.5 |

Positional accuracy was estimated using the Haversine Formula, Earth's radius taken as 6367km.

① GPS Site Survey – Live Location
② Input from GPS simulator.

Position Acquisition Time and Position Accuracy (Float Variant TUV Reference 75905359_007)

A3.8.2.1: Location 50° 52.135'N, 1° 14.694'W ①
A3.8.2.2 : Location 51° 22.583'N, 1° 49.833'W ②

| Operation Configuration | C/S T.007 Section A3.8.2.1 | | C/S T.007 Section A3.8.2.2 | |
|---|---|---|---|---|
| | Time to Acquire Position (sec) | Location Error in metres | Time to Acquire Position (sec) | Location Error in metres |
| Beacon on ground plane | 101 | 40.1 | 101 | 50.1 |
| Beacon above ground plane | 101 | 40.1 | 101 | 50.1 |

Positional accuracy was estimated using the Haversine Formula, Earth's radius taken as 6367km.

① GPS Site Survey – Live Location
② Input from GPS simulator.

Encoded Position Data Update Interval

| Location: N 21° 4.600' W 6° 3.400' ② | | |
|---|---|---|
| Time from activation to 1st message | 100s | |
| First Message Acquired at | 4:00:51 | FFFE2F96EE2F80011520C64274B792636F3C |
| Data Acquired at | 4:00:51 | FFFE2F96EE2F80011520C64274B792636F3C |
| Location: N 50° 48.683' W 1° 37.417' ② | | |
| First Message Acquired at | 4:03:21 | FFFE2F96EE2F80011520C64274B792636F3C |
| Data Updated at | 4:23:23 | FFFE2F96EE2F800132E031C9A3778EA76951 |
| Data Update Interval | 22min 32s | |

Position Clearance After Deactivation

Following the Encoded Position Data Update Interval test, the beacon was deactivated and reactivated without providing navigation data.

| Deactivated at | 4:25:10 | |
|---|---|---|
| Time from re-activation to 1st message | 100s | |
| Default data present | 4:27:00 | FFFE2F96EE2F80017FDFF8EA71B783E0F66C |

② Input from GPS simulator.

Last Valid Position

| Location: N 50° 48.683' W 1° 37.417' ② | | |
|---|---|---|
| Time from activation to 1st message | 100s | |
| First Message Acquired at | 11:21:14 | FFFE2F96EE2F800132E031C9A3778EA76951 |
| Data Acquired at | 11:21:14 | FFFE2F96EE2F800132E031C9A3778EA76951 |
| GPS Signal Navigation Data Removed | 11:22:04 | |
| Last Message with Positional Data | 3:21:01 | FFFE2F96EE2F800132E031C9A3778EA76951 |
| First Message with Default Data | 3:21:49 | FFFE2F96EE2F80017FDFF8EA71B783E0F66C |
| Last Valid Position Held | 240min | |

② Input from GPS simulator.

Coarse Position and Delta Offset

| Script Reference (See table D.3 of C/S T.007 – Issue 4 November 2005) | Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal) | Confirmation that BCH Correct (✓) |
|---|---|---|
| 1 | Bits 65-85 = FFBFF<br>Bits 113-132 = 83E0F | ✓ |
| 2 | Bits 65-85 = 2404<br>Bits 113-132 = 8E227<br>Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 45 | ✓ |
| 3 | Bits 65-85 = 2404<br>Bits 113-132 = F8227 | ✓ |
| 4 | Bits 65-85 = 3404<br>Bits 113-132 = 88227 | ✓ |
| 5 | Bits 65-85 = 3404<br>Bits 113-132 = 74627 | ✓ |
| 6 | Bits 65-85 = 2404<br>Bits 113-132 = 8227 | ✓ |
| 7 | Bits 65-85 = 2404<br>Bits 113-132 = 83D7 | ✓ |
| 8 | Bits 65-85 = 2406<br>Bits 113-132 = 8227 | ✓ |
| 9 | Bits 65-85 = 2406<br>Bits 113-132 = 81B8 | ✓ |
| 10 | Bits 65-85 = 2402<br>Bits 113-132 = 8206 | ✓ |

Test Scripts from GPS simulator.

## 2.12 NAVIGATION SYSTEM – NATIONAL LOCATION PROTOCOL

### 2.12.1 Equipment Under Test

PLB-350 B, TUV Reference 75905359_017 (All testing except where stated)
PLB-350 B, TUV Reference 75905359_010

### 2.12.2 Date of Test and Modification State

19, 20 February and 17 March 2009 - Modification State 0

### 2.12.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.12.4 Test Results

Position Data Default Values

The beacon was activated without receiving GPS signals/without providing data and operated for 30 minutes. Message content was checked for all bursts during this period.

| 30 Hex Message | Message Count |
|---|---|
| FFFE2F96EF00009FC0FF00320C379F3C0010 | 35 |

Position Acquisition Time and Position Accuracy (TUV Reference 75905359_010)

A3.8.2.1: Location 50° 52.163'N, 1° 14.607'W ①
A3.8.2.2 : Location 51° 22.417'N, 1° 50.067'W ②

| Operation Configuration | C/S T.007 Section A3.8.2.1 | | C/S T.007 Section A3.8.2.2 | |
|---|---|---|---|---|
| | Time to Acquire Position (sec) | Location Error in metres | Time to Acquire Position (sec) | Location Error in metres |
| Beacon on ground plane | 100 | 68.8 | 100 | 31.5 |
| Beacon above ground plane | 100 | 55.6 | 100 | 31.5 |

Positional accuracy was estimated using the Haversine Formula, Earth's radius taken as 6367km.

① GPS Site Survey – Live Location
② Input from GPS simulator.

Encoded Position Data Update Interval

| | | |
|---|---|---|
| Location: N 50° 48.683' W 1° 37.417' ② | | |
| Time from activation to 1st message | 100s | |
| First Message Acquired at | 10:12:56 | FFFE2F96EF00008CB1019950ADF794240FCD |
| Data Acquired at | 10:12:56 | FFFE2F96EF00008CB1019950ADF794240FCD |
| Location: N 21° 4.600' W 6° 3.400' ② | | |
| First Message Acquired at | 10:14:35 | FFFE2F96EF00008CB1019950ADF794240FCD |
| Data Updated at | 10:35:27 | FFFE2F96EF000085450615DCDA77922408CC |
| Data Update Interval | 22min 31s | |

Position Clearance After Deactivation

Following the Encoded Position Data Update Interval test, the beacon was deactivated and reactivated without providing navigation data.

| | | |
|---|---|---|
| Deactivated at | 10:36:00 | |
| Time from re-activation to 1st message | 100s | |
| Default data present | 12:20:12 | FFFE2F96EF00009FC0FF00320C379F3C0010 |

②Input from GPS simulator.

Last Valid Position

| Location: N 50° 48.683' W 1° 37.417' ② | | |
|---|---|---|
| Time from activation to 1st message | 100s | |
| First Message Acquired at | 11:39:19 | FFFE2F96EF00008CB1019950ADF794240FCD |
| Data Acquired at | 11:39:19 | FFFE2F96EF00008CB1019950ADF794240FCD |
| GPS Signal Navigation Data Removed | 11:39:45 | |
| Last Message with Positional Data | 15:39:06 | FFFE2F96EF00008CB1019950ADF794240FCD |
| First Message with Default Data | 15:39:56 | FFFE2F96EF00009FC0FF00320C379F3C0010 |
| Last Valid Position Held | 240min | |

②Input from GPS simulator.

Coarse Position and Delta Offset

| Script Reference (See table D.3 of C/S T.007 – Issue 4 November 2005) | Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal) | Confirmation that BCH Correct (✓) |
|---|---|---|
| 1 | Bits 59-85 = 3F81FE0<br>Bits 113-126 = 27CF | ✓ |
| 2 | Bits 59-85 = A8A0C2<br>Bits 113-126 = 2489<br>Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 49s | ✓ |
| 3 | Bits 59-85 = A8A0C2<br>Bits 113-126 = 3F09 | ✓ |
| 4 | Bits 59-85 = D8A0C2<br>Bits 113-126 = 2189 | ✓ |
| 5 | Bits 59-85 = D8A0C2<br>Bits 113-126 = B09 | ✓ |
| 6 | Bits 59-85 = C8B67D<br>Bits 113-126 = 749 | ✓ |
| 7 | Bits 59-85 = C8B67D<br>Bits 113-126 = 77E | ✓ |
| 8 | Bits 59-85 = C8967C<br>Bits 113-126 = 702 | ✓ |
| 9 | Bits 59-85 = C8967C<br>Bits 113-126 = 77E | ✓ |
| 10 | Bits 59-85 = C8B67D<br>Bits 113-126 = 749 | ✓ |

Test Scripts from GPS simulator.

**SECTION 3**

**TEST EQUIPMENT USED**

## 3.1 TEST EQUIPMENT

List of absolute measuring and other principal items of test equipment.

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| **Section 2.10 Beacons - Antenna Characteristics** | | | | | |
| Antenna, (Tuned Dipole Set) | Roberts Antenna | A-100 | 569 | - | TU |
| Spectrum Analyser | Hewlett Packard | 8568B | 571 | 12 | 11-Feb-2010 |
| Test Receiver | Rohde & Schwarz | ESVP | 1669 | 12 | 7-Nov-2009 |
| Antenna Mast | EMCO | 1050 | 1707 | - | TU |
| Turntable Controller | Various | RH253 | 1708 | - | TU |
| Spectrum Analyser | Rohde & Schwarz | EZM | 1823 | - | TU |
| Open Area Site 2 | TUV | OATS2 | 1850 | 36 | 11-Sep-2011 |
| Floppy Disc Station | Rohde & Schwarz | LAS-Z11 | 1854 | - | TU |
| Turntable Interface | Various | RH-253.6 | 1855 | - | TU |
| Antenna Tower 6M | EMCO | 1050 | 1859 | - | TU |
| Roberts Antenna 406MHz | Compliance Design | - | 1861 | 24 | 7-Sep-2009 |
| Antenna (Bilog, 20MHz-2GHz) | York Electronics | CBL6111B | 1868 | 24 | 20-Aug-2010 |
| Signal Generator, 9kHz to 6GHz | Rohde & Schwarz | SMB 100A | 3501 | 12 | 19-May-2009 |
| **10 in Test Results Table Beacons - Battery Current Measurements** | | | | | |
| Load (50ohm) | Diamond | DL-30N | 392 | 12 | 1-Sep-2009 |
| Hygrometer | Rotronic | I-1000 | 3068 | 12 | 26-Jun-2009 |
| 8 Channel Datalogger + Terminal Board | Pico Technology Ltd | ADC-16 | 3287 | 12 | 17-Dec-2009 |
| Resistor (Nominal 0.25ohm) | TUV | 2x RS Components 188-071 R5/100W Resistors | 3343 | - | TU |
| **Section 2.1, 2.2, 2.3, 2.4 plus 2, 3, 6, 8 in Test Results Table Beacons - Constant Temperature Tests** | | | | | |
| Climatic Chamber | Heraeus Votsch | VMT 04/30 | 40 | - | O/P Mon |
| Power Meter | Hewlett Packard | 436A | 83 | 12 | 13-Aug-2009 |
| Climatic Chamber | Heraeus Votsch | VM 04/100 | 85 | - | O/P Mon |
| Rubidium Frequency Standard | Quartzlock | A10-B | 92 | 12 | 12-Jan-2010 |
| Signal Generator | Hewlett Packard | 8644A | 96 | 12 | 17-Apr-2009 |
| Time Interval Analyser | Yokogawa | TA720 | 181 | 12 | 27-Feb-2009 |
| High Resolution Oscilloscope | Gould | 840 | 182 | 12 | 6-Mar-2009 |
| Load (50ohm, 15W) | Diamond Antenna | DL-30N | 337 | 12 | 1-Sep-2009 |
| Load (50ohm) | Diamond | DL-30N | 392 | 12 | 1-Sep-2009 |
| Attenuator 10dB 25W | Weinschel | 46-10-43 | 400 | 12 | 6-May-2009 |
| Attenuator 10dB/10W) | Trilithic | HFP-50N | 454 | 12 | 22-Jul-2009 |
| Signal Generator (100kHz to 2.6GHz) | Hewlett Packard | 8663A | 1063 | 12 | 13-Feb-2009 |
| Distress Beacon RF Unit | TUV | - | 2445 | - | TU |
| Beacon RF Unit | TUV | N/A | 3066 | - | TU |
| Hygrometer | Rotronic | I-1000 | 3068 | 12 | 26-Jun-2009 |
| Termination (50ohm, 2W) | Omni-Spectra | 3001-6100 | 3081 | 12 | 15-Mar-2009 |
| Termination (50ohm, 15W) | Diamond Antenna | DL-30N | 3097 | 12 | 15-Mar-2009 |

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| **Section 2.1, 2.2, 2.3, 2.4 plus 2, 3, 6, 8 in Test Results Table Beacons - Constant Temperature Tests** | | | | | |
| Termination (50ohm, 15W) | Diamond Antenna | DL-30N | 3098 | 12 | 15-Mar-2009 |
| Attenuator (20dB, 10W) | Aeroflex / Weinschel | 23-20-34 | 3159 | 12 | 2-Jun-2009 |
| Attenuator (3dB, 20W) | Aeroflex / Weinschel | 23-3-34 | 3161 | 12 | 2-Jun-2009 |
| Attenuator (3dB, 20W) | Aeroflex / Weinschel | 23-3-34 | 3163 | 12 | 2-Jun-2009 |
| Thermocouple Thermometer | Fluke | 51 | 3172 | 12 | 3-Jul-2009 |
| Thermocouple Thermometer | Fluke | 51 | 3173 | 12 | 3-Jul-2009 |
| Bandpass filter | Trilithic | 5BE406/35-1-AA | 3206 | 12 | 1-Aug-2009 |
| Bandpass Filter | Trilithic | 5BE406/35-1-AA | 3207 | 12 | 1-Aug-2009 |
| Time Interval Analyser | Yokogawa | TA720 704510 | 3253 | 12 | 4-Nov-2009 |
| ScopeCorder | Yokogawa | DL750 701210 | 3254 | 12 | 5-Nov-2009 |
| Short Circuit | TUV | Short Cicuit | 3272 | - | TU |
| Power Sensor | Agilent | 8482A | 3289 | 12 | 1-Dec-2009 |
| Cable (1m, N Type) | Rhophase | NPS-1601-1000-NPS | 3352 | 12 | 22-Apr-2009 |
| Cable (1m, N Type) | Rhophase | NPS-1601-1000-NPS | 3354 | 12 | 22-Apr-2009 |
| Cable (2m, N Type) | Rhophase | NPS-1601-2000-NPS | 3356 | 12 | 22-Apr-2009 |
| Cable (2m, N Type) | Rhophase | NPS-1601-2000-NPS | 3358 | 12 | 22-Apr-2009 |
| Cable (2m, N Type) | Rhophase | NPS-1601-2000-NPS | 3359 | 12 | 22-Apr-2009 |
| Cable (3m, N-type) | Rhophase | NPS-1601-3000-NPS | 3361 | 12 | 22-Apr-2009 |
| Rubidium Frequency Standard | Symmetricom | 8040C | 3490 | 12 | 21-Feb-2009 |
| **Section 2.7 Beacons - Operating Lifetime** | | | | | |
| Power Meter | Hewlett Packard | 436A | 47 | 12 | 8-Jul-2009 |
| Power Meter | Hewlett Packard | 436A | 83 | 12 | 13-Aug-2009 |
| Climatic Chamber | Heraeus Votsch | VM 04/100 | 85 | - | O/P Mon |
| Beacon Tester | WS Technologies | BT 100S | 87 | - | TU |
| Rubidium Frequency Standard | Quartzlock | A10-B | 92 | 12 | 12-Jan-2010 |
| Signal Generator | Hewlett Packard | 8644A | 96 | 12 | 17-Apr-2009 |
| Spectrum Analyser | Hewlett Packard | E4407B | 1154 | 12 | 9-Jun-2009 |
| Beacon RF Unit | TUV | N/A | 3066 | - | TU |
| Hygrometer | Rotronic | I-1000 | 3068 | 12 | 26-Jun-2009 |
| Attenuator (20dB, 10W) | Aeroflex / Weinschel | 23-20-34 | 3159 | 12 | 2-Jun-2009 |
| Attenuator (20dB, 10W) | Aeroflex / Weinschel | 23-20-34 | 3160 | 12 | 2-Jun-2009 |
| Attenuator (3dB, 20W) | Aeroflex / Weinschel | 23-3-34 | 3163 | 12 | 2-Jun-2009 |
| Thermocouple Thermometer | Fluke | 51 | 3173 | 12 | 3-Jul-2009 |
| Bandpass Filter | Trilithic | 5BE406/35-1-AA | 3207 | 12 | 1-Aug-2009 |

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| **Section 2.7 Beacons - Operating Lifetime** | | | | | |
| Time Interval Analyser | Yokogawa | TA720 704510 | 3253 | 12 | 4-Nov-2009 |
| ScopeCorder | Yokogawa | DL750 701210 | 3254 | 12 | 5-Nov-2009 |
| Power Sensor | Agilent | 8482A | 3289 | 12 | 1-Dec-2009 |
| Power Sensor | Agilent | 8482A | 3290 | 12 | 1-Dec-2009 |
| ESA-E Series Spectrum Analyser | Agilent | E4402B | 3348 | 12 | 21-Apr-2009 |
| Cable (1m, N Type) | Rhophase | NPS-1601-1000-NPS | 3353 | 12 | 22-Apr-2009 |
| Cable (1m, N Type) | Rhophase | NPS-1601-1000-NPS | 3354 | 12 | 22-Apr-2009 |
| Cable (2m, N Type) | Rhophase | NPS-1601-2000-NPS | 3357 | 12 | 22-Apr-2009 |
| Cable (2m, N Type) | Rhophase | NPS-1601-2000-NPS | 3359 | 12 | 22-Apr-2009 |
| Bandpass Filter | Trilithic | 5BE121.55/35-3-BA | 3410 | 12 | 4-Aug-2009 |
| **Section 2.8 Beacons - Temperature Gradient** | | | | | |
| Power Meter | Hewlett Packard | 436A | 83 | 12 | 13-Aug-2009 |
| Climatic Chamber | Heraeus Votsch | VM 04/100 | 85 | - | O/P Mon |
| Signal Generator | Hewlett Packard | 8644A | 96 | 12 | 17-Apr-2009 |
| Beacon RF Unit | TUV | N/A | 3066 | - | TU |
| Attenuator (20dB, 10W) | Aeroflex / Weinschel | 23-20-34 | 3159 | 12 | 2-Jun-2009 |
| Attenuator (3dB, 20W) | Aeroflex / Weinschel | 23-3-34 | 3163 | 12 | 2-Jun-2009 |
| Thermocouple Thermometer | Fluke | 51 | 3173 | 12 | 3-Jul-2009 |
| Bandpass Filter | Trilithic | 5BE406/35-1-AA | 3207 | 12 | 1-Aug-2009 |
| Time Interval Analyser | Yokogawa | TA720 704510 | 3253 | 12 | 4-Nov-2009 |
| ScopeCorder | Yokogawa | DL750 701210 | 3254 | 12 | 5-Nov-2009 |
| Power Sensor | Agilent | 8482A | 3289 | 12 | 1-Dec-2009 |
| Cable (1m, N Type) | Rhophase | NPS-1601-1000-NPS | 3352 | 12 | 22-Apr-2009 |
| **Section 2.5 Beacons - GNSS Self-test** | | | | | |
| Climatic Chamber | Heraeus Votsch | VMT 04/30 | 40 | - | O/P Mon |
| Beacon Tester | WS Technologies | BT 100S | 87 | - | TU |
| Beacon RF Unit | TUV | N/A | 97 | - | TU |
| 1GHz Digital Oscilloscope | Lecroy | 9370M | 612 | 12 | 30-Sep-2009 |
| Stop Clock | R.S Components | RS328 061 | 2674 | - | TU |
| GPS/SBAS Simulator | Spirent | STR4500 | 3056 | - | TU |
| Attenuator (20dB, 10W) | Aeroflex / Weinschel | 23-20-34 | 3160 | 12 | 2-Jun-2009 |
| Thermocouple Thermometer | Fluke | 51 | 3172 | 12 | 3-Jul-2009 |
| Cable (1m, N type) | Rhophase | NPS-1601-1000-NPS | 3350 | 12 | 22-Apr-2009 |
| Cable (1m, N Type) | Rhophase | NPS-1601-1000-NPS | 3353 | 12 | 22-Apr-2009 |
| Cable (1m, N Type) | Rhophase | NPS-1601-1000-NPS | 3354 | 12 | 22-Apr-2009 |
| Timer ('Electronic Clock Timer') | R.S Components | 870A | 3558 | - | TU |

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| **Section 2.6 Climatic - Thermal Shock** | | | | | |
| Chamber | Heraeus | HC 4033 | 2174 | 12 | 5-Sep-2009 |
| Balance | Geniweigher | GM-11K | 2334 | 12 | 1-Apr-2009 |
| Climatic Chamber | Climatec | WALK-IN | 2847 | 12 | 2-Apr-2009 |
| 5 metre Tape Measure | Stanley | 33-719 | 3549 | - | TU |
| **Sections 2.11 and 2.12 Beacons - Navigation System** | | | | | |
| Beacon Tester | WS Technologies | BT 100S | 87 | - | TU |
| Stop Clock | R.S Components | RS328 061 | 2674 | - | TU |
| GPS/SBAS Simulator | Spirent | STR4500 | 3056 | - | TU |
| Hygrometer | Rotronic | I-1000 | 3068 | 12 | 26-Jun-2009 |
| Cable (1m, N type) | Rhophase | NPS-1601-1000-NPS | 3350 | 12 | 22-Apr-2009 |
| Copper GRP | TUV | 27cm Diameter | 3538 | - | TU |

TU – Traceability Unscheduled
OP MON – Output Monitored with Calibrated Equipment

## SECTION 4

## PHOTOGRAPHS

## 4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)


75905359_007, PLB-350B Floatation, S/N: #22 Front View


75905359_007, PLB-350B Floatation, S/N: #22 Rear View


75905359_015, PLB-350B Slim (50Ω), S/N: #2 Front View


75905359_015, PLB-350B Slim (50Ω), S/N: #2 Rear View


75905359_016, PLB-350B Slim, S/N: #5 Front View

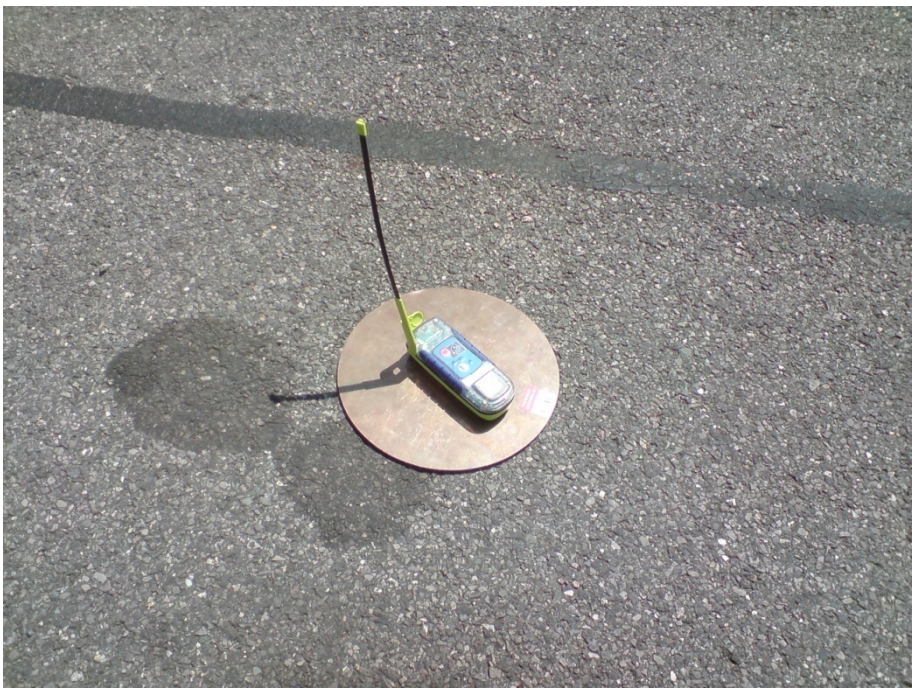

75905359_016, PLB-350B Slim, S/N: #5 Rear View


75905359_017, PLB-350B Slim (50Ω), S/N: #3 Front View


75905359_017, PLB-350B Slim (50Ω), S/N: #3 Rear View

Configuration 3

Configuration 4



Configuration 7

Configuration 8

## SECTION 5

## ACCREDITATION, DISCLAIMERS AND COPYRIGHT

## 5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

# ANNEX A

# CUSTOMER SUPPLIED INFORMATION

01/22/2009

# PROTECTION AGAINST REPETITIVE SELF-TEST MODE TRANSMISSIONS, PLB-350B

The self-test algorithm is in-line code with no loops that execute consecutive instructions implementing self-test with checks interspersed to monitor the switch positions. It is possible to either complete one self-test, one GPS test, enter the ON mode, or turn off. It is not possible to repeat the instructions. The self-test algorithm causes the software to continuously monitor the hardware during self-test. If the switch is left in self-test during and after the GPS test is generated, the stuck mode is entered for a maximum time of 50 seconds. This mode alternately flashes the red LED, the green LED, and sounds the buzzer, then times out after 50 seconds. Nothing else can be generated when in this mode. Therefore, if the switch is left in the self-test position, it is not possible to generate more than one self-test.

03/23/2009

# PLB-350B GNSS Self Test Description

The PLB-350B model which is the GPS-Enabled model, provides the Cospas Sarsat GNSS Self Test feature, and this feature should not be performed more than twelve times during the life of the battery pack. Once this GNSS testing feature reaches 12 times, the feature will be disabled by internal software.

**GNSS Self Test Procedure:**

Press the self-test button for greater than 5 seconds. Observe the beacon for the entire GPS test. A BEEP and green LED will indicate that the GPS has been turned ON. The beacon will BEEP every 3 seconds and the GPS will remain ON until LAT/LON coordinates have been obtained or until 2 minutes have elapsed. If good LAT/LON data has been obtained, a single 406MHz test burst will be sent out with location data and the GPS will be turned OFF and the green LED will light for at least 3 seconds along with a long beep. This LAT/LON data is not saved for use. The green LED indicates that the GPS is functioning properly and that the beacon is in a location or environment where it can receive the necessary signals from GPS satellites. If the GPS does not acquire good Location data, the GPS will turn OFF after 2 minutes, followed with a RED LED light up for 3 seconds along with a long beep, and no 406MHz burst sent out.

The worst case current consumption scenario for the PLB-350B GNSS self test feature is 12 times of 2 minutes and 12 406 MHz bursts.

Product Service

Oscillator Aging (Document 1)

RAKON

## CERTIFICATE OF COMPLIANCE: COSPAS-SARSAT

Rakon UK Limited
Dowsett House
Sadler Road
Lincoln
LN6 3RS
United Kingdom

Tel.: +44-1522-883500

This is to certify that the following crystal oscillator:

| Item | Rakon Part No. | Description |
|---|---|---|
| 1 | E4672LF | TCXO, 12.688656 MHz, Class II, SM 7x5 mm |

is fully compliant with the short-term and medium-term transmitted frequency stability requirements of the Cospas-Sarsat system beacons including the oscillator aging requirements in paragraph A.3.5 Oscillator Aging of document C/S T.007, Issue 4, Revision 3 (dated: October 2008).

The type of compensation used to correct the frequency of the oscillator for temperature changes within the TCXO remains constant with the individual characterization set in non-volatile memory. No adjustment is required, or available , to correct for aging for the life of the device, so this characterization is not perturbed. There is no mechanism to suggest any change or aging affect to the medium or short-term stability exists.

Signature: ..... Date: January 22nd, 2008
(authorized representative of Rakon UK Limited)

Name: ...David R Woodall ..... Telephone: +44 (0)1522 883528

Title: ... Quality Manager - FCP..... e-mail: DavidW@rakon.co.uk

Product Service

Oscillator Aging (Document 2)

Rakon UK Ltd.

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E-mail: DavidW@rakon co uk

## PRODUCT EVALUATION REPORT

REPORT No. : **2006-016C**

Date: 26th November 2007

Product type: Temperature Compensated, Voltage Controlled Crystal Oscillator (TC/VCXO)

Construction: 1) Surface Mount (7 x 5 mm)
2) "Pluto" ASIC

Generic Type: "Cospas Sarsat" Beacon Oscillator

Parts Tested: Batch 1 - p/no. E3357 (12.551630 MHz)
Batch 2 - p/no. E3233 (12.688375 MHz)

Applicable to:

This report is applicable to the following part numbers all of which are identical to the parts tested with respect to materials used, including the same crystal, construction, manufacture and test. And are to the same or a looser internal specification.

12.551630 MHz - E3356 & E3357
12.688281 MHz - E3403
12.688375 MHz - E3233, E3261, E3279, E3328, E3476, E3499, E4150, E4218, E4281, E4472, E4478, E4495
12.688656 MHz - E4520, E4574 & E4672

## Long Term Performance Verification

This document sets out the steps taken by RAKON UK to address the requirements for long term assurance of performance with respect to short and medium term stability. Specifically with respect to the short and medium term stability addressed in the second paragraph of the specification requirement:

**Cospas-Sarsat type approval standard T.007 Issue 4 Nov 2005.**
**Section A.3.5 Oscillator Aging:**

Long-term frequency stability shall be demonstrated by data (e.g. oscillator manufacturer's test data) provided by the beacon manufacturer to the test facility.

For oscillators which require compensation over the operating temperature range, measurement results and a technical analysis shall also be provided to substantiate that short and medium-term stability would remain within specification after five years.

The long-term frequency stability or oscillator aging requirement is industry standard and has established procedures both company specific and as laid out by international standards, for example as referenced in MIL-PRF-55310 section 4.8.35. However the long term verification of the short and in particular the medium term stability requirements has no directly established procedure. The 100ms short term stability is not associated with the temperature compensation part of the oscillator and so should not be degraded by the use of a TCXO as opposed to an OCXO type oscillator. The short term stability also forms part of the medium term stability in respect of the residual error requirements, and so it should only be necessary to study the medium term stability to cover both of these requirements.

For oscillators which include a frequency adjustment or trim component for either initial calibration in the beacon or for correction of aging during lifetime then there is a recognised degradation process called trim effect. This is where the compensation can be degraded when the oscillator is tuned away from its nominal or compensated condition. This effect can be tested for by measurement of the frequency temperature characteristics at the frequency adjustment limits as well as the nominal condition during for example production verification. Whether the oscillator is adjustable or not should be clearly stated in any beacon qualification so this point can be addressed.

This however is not the case for the oscillators addressed in this document as they have no frequency adjustment available after manufacture. As such we have usually stated in respect of the above requirement:

' For RAKON UK TCXO's the type of compensation used to correct the frequency of the oscillator for temperature changes within the TCXO remains constant with the individual characterisation set in non-volatile memory. No adjustment is required, or available, to correct for aging for the life of the device, so this characterisation is not perturbed. There is no known mechanism to suggest any change or ageing effect to the Medium or Short term stability exists.'

The medium term stability requirements for the beacon are difficult to achieve with temperature compensation techniques and were until recently not achievable. Therefore the long term verification of performance to this required level was not specifically available, although no degradation was expected from either extrapolation of less precise data on comparable oscillators or from analysis of any possible aging mechanism.

With aging verification it is standard practice to use data from accelerated aging conditions, ie aging at high temperature. Data taken during this time is then fitted and extrapolated with established procedures, for example as MIL-PRF-55310. Also standard acceleration factors are often applied for example "30 days at 85C is roughly equivalent to 1 year at room". For the medium term stability requirement, no established procedures or acceleration factors exist and continuous or periodic measurement is not possible. Therefore real data over a reasonable period of time with significant numbers of oscillators was studied.

Two studies are presented. One batch of devices were measured before and after a 8 month period (measurements in August 2005 and April 2006) and a second set of devices was measured after a period of approximately 1 year.

Batch 1 results:

The histograms show the results for August 2005 in red and April 2006 in blue

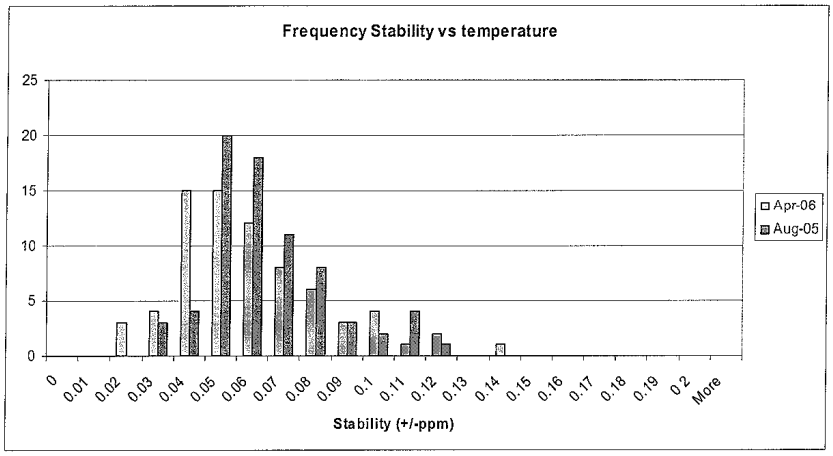



**Figure 1 Frequency Stability vs. Temperature**

The average change for frequency stability vs. temperature over the batch is -0.0007 ppm, effectively zero or a extremely small improvement.

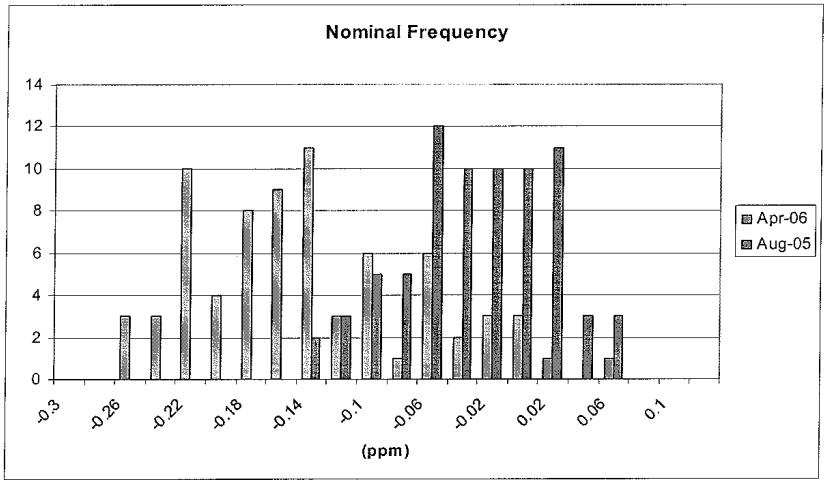



**Figure 2 Nominal frequency**

The average change for nominal frequency over the batch is -0.10 ppm, considerably inside the aging requirements for nominal frequency.

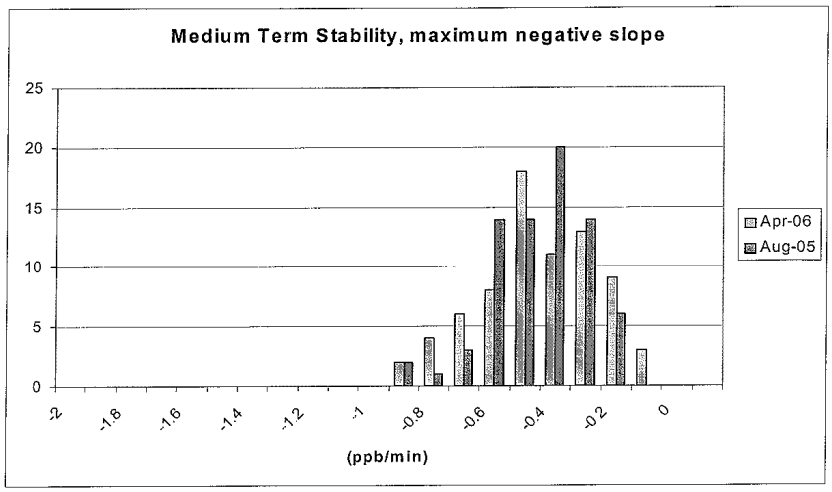



Figure 3 Medium term stability, Slope

The average change over the batch for maximum negative slope for 8 months is +0.004ppb/min and for the maximum positive slope -0.0011ppb/min. This again effectively shows no change or very small improvement within the measurement uncertainties involved.

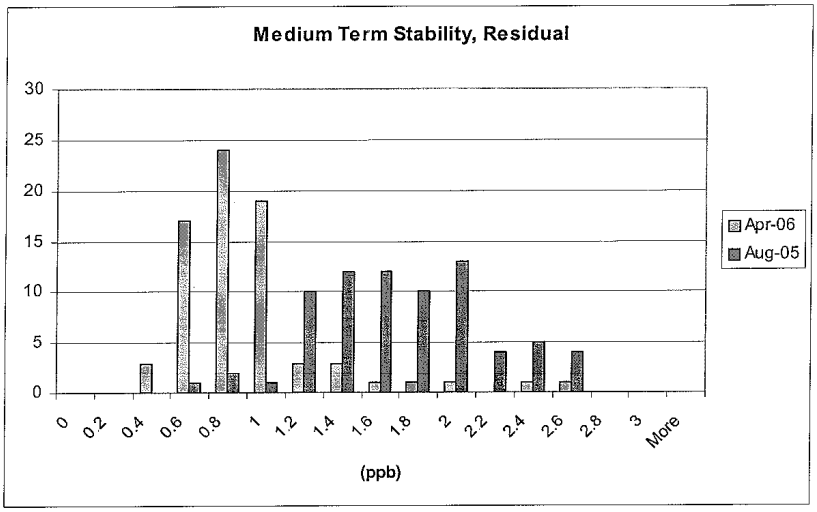
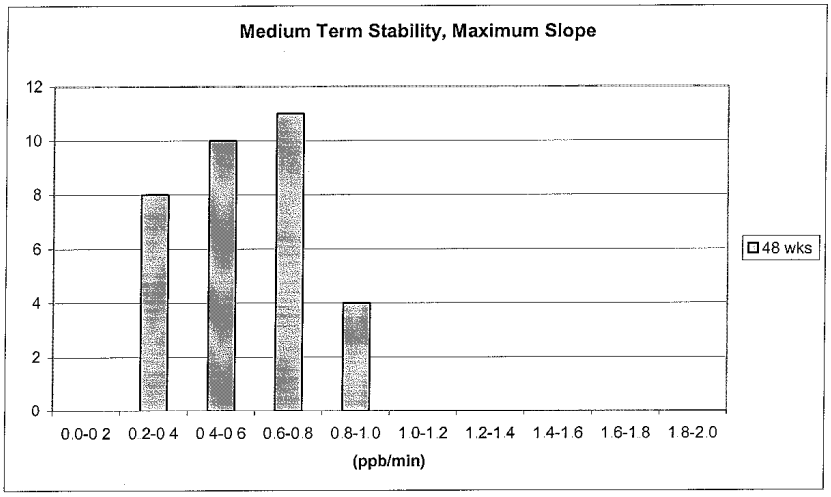


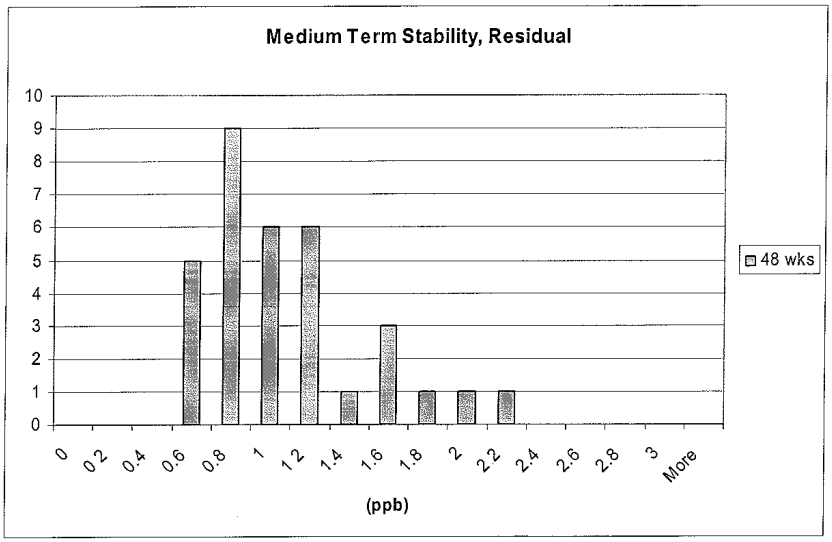

Figure 4 Medium term stability, Residual

The average change over the batch for medium term stability residual error shows an apparent improvement of -0.78 ppb. However this improvement is due in the main part to improvements in the measurement system noise floor and not to any improvement in the oscillator performance over this period.

Batch 2 results:

These devices were re-measured after a period of between 44 and 52 weeks after manufacture and initial testing. Results after an average of 48 wks are shown below.



Product Service

Conclusion:

In conclusion, no noticeable degradation in temperature compensation performance was observed and all devices stayed with specification. Therefore, we conclude the requirement to provide measurement and technical analysis for long-term conformance has been demonstrated for these oscillators.

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16 May 2006

01/22/2009

PROTECTION AGAINST CONTINUOUS TRANSMISSION for PLB-350A and PLB-350B

The protection against continuous transmission of the 406 MHz signal is provided through redundant controlling hardware and software. The 406 MHz RF power module is controlled by a single circuit/switch under microprocessor control. The transmission must cease if the microprocessor control line output is not high, putting out current at 3.3 volts. Therefore, if the microprocessor should fail the transmission must stop. It is fail safe. The entire synthesizer/modulator circuitry is turned on and off for each transmission. Therefore, the transmission can never be continuous.

The microprocessor used in this design has a built in function that periodically resets the microprocessor unless it is cleared during operation. When the microprocessor is reset, the control for the 406 MHz RF power is turned off. This provides protection should the software ever get to an unknown state or stop completely.

Therefore, continuous transmission of the 406 MHz signal cannot occur.

## Table F-D.2 of C/S T.007:
## Examples of Location Protocol Beacon Messages

| Protocol | Operational Message (in hexadecimal including bit and frame synchronisation bits) | | Self-Test Message (in hexadecimal including bit and frame synchronization bits) | GNSS Self Test Message (if applicable, in hexadecimal, including bit and frame synchronization bits) |
|---|---|---|---|---|
| | Location "A" | Location "B" | | Location "A" |
| Standard Location: EPIRB with MMSI | **FFFE2F8C92F423F01A2A0B81CCF78C44DA11** | **FFFE2F8C92F423F019A9FCF3FA3704010735** | **FFFED08C92F423F07FDFFB2BF037** | **FFFED08C92F423F01A2A0B81CCF78C44DA11** |
| Standard Location: EPIRB with Serial Number | **FFFE2F8C96F9C0631A2A0938D3F78C44DA11** | **FFFE2F8C96F9C06319A9FE4AE53704010735** | **FFFED08C96F9C0637FDFF992EF37** | **FFFED08C96F9C0631A2A0938D3F78C44DA11** |
| Standard Location: ELT with 24-bit Address | **FFFE2F8C93AF0F0F1A2A088356B78C44DA11** | **FFFE2F8C93AF0F0F19A9FFF1607704010735** | **FFFED08C93AF0F0F7FDFF8296A77** | **FFFED08C93AF0F0F1A2A088356B78C44DA11** |
| Standard Location: ELT with Serial Number | **FFFE2F8C94F9C0631A2A0D8811378C44DA11** | **FFFE2F8C94F9C06319A9FAFA27F704010735** | **FFFED08C94F9C0637FDFFD222DF7** | **FFFED08C94F9C0631A2A0D8811378C44DA11** |
| Standard Location: ELT with Aircraft Operator Designator | **FFFE2F8C95C631F41A2A09D7D3378C44DA11** | **FFFE2F8C95C631F419A9FEA5E5F704010735** | **FFFED08C95C631F47FDFF97DEFF7** | **FFFED08C95C631F41A2A09D7D3378C44DA11** |
| Standard Location: PLB with Serial Number | **FFFE2F8C97F9C0631A2A0FBB8EF78C44DA11** | **FFFE2F8C97F9C06319A9F8C9B83704010735** | **FFFED08C97F9C0637FDFFF11B237** | **FFFED08C97F9C0631A2A0FBB8EF78C44DA11** |
| National Location: EPIRB | **FFFE2F8C9A0018C685502DEFF9F71D080674** | **FFFE2F8C9A0018C65F4FB35C517721000BDE** | **FFFED08C9A0018DFC0FF02AD4477** | **FFFED08C9A0018C685502DEFF9F71D080674** |
| National Location: ELT | **FFFE2F8C980018C6855 0295F3B371D080674** | **FFFE2F8C980018C65F4FB7EC93B721000BDE** | **FFFED08C980018DFC0FF061D86B7** | **FFFED08C980018C68550295F3B371D080674** |
| National Location: PLB | **FFFE2F8C9B0018C685502B6CA4F71D080674** | **FFFE2F8C9B0018C65F4FB5DF0C7721000BDE** | **FFFED08C9B0018DFC0FF042E1977** | **FFFED08C9B0018C685502B6CA4F71D080674** |
| User-Location2 | **N/A** | **N/A** | | **N/A** |

## 1. PLB-350B Model

The PLB-350B has an internal GPS. Location "A" represents latitude N 26° 3' 4" and Longitude W 80° 10' 8". Location "B" represents latitude N 25° 29' 0"and Longitude W 79° 44' 0".

## 2. Introduction

### 2.1 Purpose

This document contains the printouts of sample messages as generated by the beacon coding software for each coding protocol applicable to beacon model PLB350B to satisfy the technical data requirements as stated in Annex C, Table C.1, and Table F.1, item 16. [C/S T.007 – Issue 4 – November 2005].

Each message includes beacon identification and location data, and each protocol has at least two messages showing locations at least 500 meters apart. [C/S T.007 – Issue 4 – November 2005, Section 4.3, Paragraph A.2.8)].

Sample messages generated by the beacon coding software for each coding option applicable to the beacon models as per Appendix D to Annex F. [C/S T.007 – Issue 4 – November 2005, Section 5, Paragraph b, iv)].

### 2.2 Document Organization and Information

Sections 3, 4, and 5, contain the coding options for Standard Location Protocol, National Location Protocol, and Test Location Protocol, respectively. Under each of these main headings are sections for each coding option. Each of these subsections includes the beacon's 15 Hex ID, what information was encoded for each message and a list of the printouts associated with the coding option for that specific model. Position data for all messages were generated by GPS simulators.

## 3. EPIRB with MMSI Standard Location

### 3.1Hex Messages for PLB350B

**3.1.1 15 Hex ID:** 1925E847E0FFBFF

**3.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: Standard Location - EPIRB (MMSI)
- MID: 999999
- Specific Beacon: 0
- Aux Device: 121.5 MHz homer

### 3.2 Sample Hex Messages

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 0-1 | FFFE2F8C92F423F01A2A0B81CCF78C44DA11 | Operational Message | N 26° 3' 4" | W 80° 10' 8" |
| 0-2 | FFFED08C92F423F07FDFFB2BF037 | Self Test Message | N 26° 3' 4" | W 80° 10' 8" |
| 0-3 | FFFED08C92F423F01A2A0B81CCF78C44DA11 | GNSS Self Test Message | N 26° 3' 4" | W 80° 10' 8" |

## 4. EPIRB with Serial Number Standard Location

### 4.1Hex Messages for PLB350B

**4.1.1 15 Hex ID:** 192DF380C6FFBFF

**4.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: Standard Location - EPIRB (Serial)
- Cospas-Sarsat #: 999
- Serial Number: 99
- Aux Device: 121.5 MHz homer

4.2 Sample Hex Messages

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 1-1 | FFFE2F8C96F9C0631A2A0938D3F78C44DA11 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 1-2 | FFFED08C96F9C0637FDFF992EF37 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 1-3 | FFFED08C96F9C0631A2A0938D3F78C44DA11 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

**5. ELT with 24-bit Address Standard Location**
**5.1Hex Messages for PLB350B**
**5.1.1 15 Hex ID:** 19275E1E1EFFBFF
**5.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: Standard Location - ELT (24-bit Address)
- 24 Bit Aircraft ID (decimal): 11472655
- 24 Bit Aircraft ID (Hex): AF0F0F
- Aux Device: 121.5 MHz homer

**5.2 Sample Hex Messages**

| Msg, | Hex Message, | Comment, | GPS Latitude, | GPS Longitude |
|---|---|---|---|---|
| 2-1, | FFFE2F8C93AF0F0F1A2A088356B78C44DA11 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 2-2, | FFFED08C93AF0F0F7FDFF8296A77 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 2-3, | FFFED08C93AF0F0F1A2A088356B78C44DA11 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

**6. ELT with Serial Number Standard Location**
**6.1Hex Messages for PLB350B**
**6.1.1 15 Hex ID:** 1929F380C6FFBFF
**6.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: Standard Location - ELT (Serial)
- Cospas-Sarsat #: 999
- Serial Number: 99
- Aux Device: 121.5 MHz homer

**6.2 Sample Hex Messages**

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 3-1 | FFFE2F8C94F9C0631A2A0D8811378C44DA11 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 3-2 | FFFED08C94F9C0637FDFFD222DF7 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 3-3 | FFFED08C94F9C0631A2A0D8811378C44DA11 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

**7. ELT with Aircraft Operator Designator**
**7.1Hex Messages for PLB350B**
**7.1.1 15 Hex ID:** 192B8C63E8FFBFF
**7.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: Standard Location - ELT (Aircraft Operator Designator)
- ELT Operator: AAA
- ELT Number: 500
- Aux Device: 121.5 MHz homer

**7.2 Sample Hex Messages**

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 4-1 | FFFE2F8C95C631F41A2A09D7D3378C44DA11 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 4-2 | FFFED08C95C631F47FDFF97DEFF7 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 4-3 | FFFED08C95C631F41A2A09D7D3378C44DA11 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

**8. Standard Location:PLB with Serial Number**
**8.1Hex Messages for PLB350B**
**8.1.1 15 Hex ID:** 192FF380C6FFBFF
**8.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: Standard Location - PLB (Serial)
- Cospas-Sarsat #: 999
- Serial Number: 99
- Aux Device: 121.5 MHz homer

**8.2 Sample Hex Messages**

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 5-1 | FFFE2F8C97F9C0631A2A0FBB8EF78C44DA11 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 5-2 | FFFED08C97F9C0637FDFFF11B237 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 5-3 | FFFED08C97F9C0631A2A0FBB8EF78C44DA11 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

**9.National Location:EPIRB**
**9.1Hex Messages for PLB350B**
**9.1.1 15 Hex ID:** 19340031BF81FE0
**9.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: National Location - EPIRB
- Serial Number: 99
- Aux Loc. Device: 121.5 MHz homer

**9.2 Sample Hex Messages**

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 6-1 | FFFE2F8C9A0018C685502DEFF9F71D080674 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 6-2 | FFFED08C9A0018DFC0FF02AD4477 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 6-3 | FFFED08C9A0018C685502DEFF9F71D080674 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

**10.National Location: ELT**
**10.1Hex Messages for PLB350B**
**10.1.1 15 Hex ID:** 19300031BF81FE0
**10.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: National Location - ELT
- Serial Number: 99
- Aux Loc. Device: 121.5 MHz homer

**10.2 Sample Hex Messages**

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 7-1 | FFFE2F8C980018C68550295F3B371D080674 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 7-2 | FFFED08C980018DFC0FF061D86B7 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 7-3 | FFFED08C980018C68550295F3B371D080674 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

**11. National Location:PLB**
**11.1Hex Messages for PLB350B**
**11.1.1 15 Hex ID:** 19360031BF81FE0
**11.1.2 Encoded Data**

- Protocol: Location Protocol
- Country code: 201
- Type of location protocol: National Location - PLB
- Serial Number: 99

**11.2 Sample Hex Messages**

| Msg | Hex Message | Comment | GPS Latitude | GPS Longitude |
|---|---|---|---|---|
| 8-1 | FFFE2F8C9B0018C685502B6CA4F71D080674 | Operational Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 8-2 | FFFED08C9B0018DFC0FF042E1977 | Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |
| 8-3 | FFFED08C9B0018C685502B6CA4F71D080674 | GNSS Self Test Message | N 26° 3’ 4” | W 80° 10’ 8” |

01/22/2009

## 406 MHZ TRANSMISSIONS ARE NOT DEGRADED BY MALFUNCTIONING GPS OR FAILURE TO ACQUIRE CORRECT DATA

The algorithm that accesses the GPS location information serially inputs the GPS data from the GPS module. The data is interrogated such that the correct header information must be verified. That is, the predetermined header data is verified, the location data is collected, then the GPS Quality Indicator is verified to be GPS SPS Mode, fix valid. If the header and Quality factor are not verified, the location is left as the default location in the message. If the header is recognized and the Quality factor is good, the location received from the GPS module is entered into the message. Therefore, there is no way the 406 MHz transmissions can be degraded by malfunctioning GPS or the failure of the GPS to acquire correct data.