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Limited RTCM Report On

Emergency Beacon Testing of the
McMurdo Fastfind Plus PLB

Document 75901815 Report 03 Issue 3

December 2007



Product Service

TUV Product Service Ltd, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuvps.co.uk

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REPORT ON

Emergency Beacon Testing of the
McMurdo Fastfind Plus PLB

Document 75901815 Report 03 Issue 3

December 2007

PREPARED FOR

McMurdo
Silver Point
Airport Service Road
Hilsea
Portsmouth
PO3 5PB

PREPARED BY

A handwritten signature in black ink, appearing to read 'N Bennett', written over a horizontal line.

N Bennett
Administrator

APPROVED BY

A handwritten signature in black ink, appearing to read 'M Jenkins', written over a horizontal line.

M Jenkins
Authorised Signatory

DATED

06 December 2007

This report has been up-issued to Issue 3 with new test data for section 2.4 (Operation Life).





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SECTION 1

REPORT SUMMARY

Emergency Beacon Testing of the
McMurdo Fastfind Plus PLB



Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the McMurdo Fastfind Plus PLB to the requirements of RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD).

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	Signature Industries
Model Number(s)	Fastfind Plus PLB
Serial Number(s)	800-00001
Number of Samples Tested	One
Test Specification/Issue/Date	RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD)
Order Number	PC0003097
Date	16 th July 2007
Start of Test	21 st August 2007
Finish of Test	05 th December 2007
Name of Engineer(s)	R Henley M Hardy S Bennett I Tebby R Bennett
Related Document(s)	Cospas-Sarsat T.007 Issue 4 – Rev 1 October 2006



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1.2 APPLICATION FORM

1.2.1 Beacon Manufacturer and Beacon Model

Beacon Manufacturer	Signature Industries
Beacon Model	Fastfind/Fastfind Plus

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 Tmax = +55°C
Operating lifetime	24hrs/48 hours
Battery chemistry	Lithium iron di-sulphide
Battery cell size and number of cells	AA x 7cells
Battery manufacturer	Energizer
Battery pack manufacturer and part number	Manufacturer: All Batteries Part number: 85-722D
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO
Oscillator manufacturer	CMAC
Oscillator part name and number	E4520
Oscillator satisfies long-term frequency stability requirements (Yes or No)	Yes



Characteristic	Specification
Antenna type (Integrated or External)	Integrated
Antenna manufacturer	Doig
Antenna part name and number	85-710B
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	uBlox
- Navigation device model name and part Number	TIM-4P
- GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS
For External Navigation Devices	
- Data protocol for GNSS receiver to beacon interface	
- Physical interface for beacon to navigation device	
- Electrical interface for beacon to navigation device	
- Navigation device model and manufacturer (if beacon designed to use specific devices)	



Characteristic	Specification
Self-Test Mode Characteristics	
- Self-test has separate switch position (Yes or No)	Yes
- Self-test switch automatically returns to normal position when released (Yes or No)	Yes
- Self-test activation can cause an operational mode transmission (Yes or 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
- Results of self-test indicated by (e.g. Pass / Fail Indicator Light, Strobe Light, etc.)	Pass/fail LED
- Self-test can be activated from beacon remote activation points (Yes or 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)	Yes
- Self-test transmits a signal(s) other than at 406 MHz (Yes & details or No)	Yes 121.5MHz
- Self-test can be activated directly at beacon (Yes or No)	Yes
- List of Items checked by self-test	406.037/121.5MHz power, PLL lock, GPS module
- Self-test transmission burst duration (440 or 520 ms)	520 ms
- Self-test format bit ("0" or "1")	1
Beacon includes a homer transmitter (if yes identify frequency of transmission)	121.5MHz
-Homer Transmit Power	20dBm
-Homer Duty Cycle	99.13%
-Duty Cycle of Homer Swept Tone	34%



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Characteristic	Specification
Beacon includes a strobe light (Yes or No)	No
- Strobe light intensity	N/A
- Strobe light flash rate	N/A
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.	No
Beacon includes automatic activation mechanism (Yes or No)	No

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: 20th August 2007

Applicable C/S Standards:

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

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 TUV Document Number 75901815 Report 01.

Signed:

Name:

M Jenkins

Position Held:

Authorised Signatory

Date:

06 December 2007



Product Service

1.2.5 Applicant Details

Company Name	McMurdo		
Address	Silver Point Airport Service Road Hilsea Portsmouth, PO3 5PB		
Category of Applicant	☒ Manufacturer	☐ Importer	
	☐ Distributor	☐ Agent	
Contact Name	Mr Neil Jordan	Telephone	02392623934
Email	neiljordan@mcmurdo.co.uk	Facsimile	02392623997

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	85-800N
- PCB Revision	Issue B
- Battery Model	
Software Version	
Firmware Version	
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: _____

Name: Neil Jordan

Position Held: Senior Electronics Engineer

Date: 20th August 2007



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a McMurdo Fastfind Plus PLB as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.



Equipment Under Test



Product Service

1.4 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.5 MODIFICATION RECORD

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	N/A	N/A
1	Firmware update to correct update interval (prior to C/S testing)	McMurdo	3 rd September 2007
2	Firmware update to correct the Morse P signal	McMurdo	23 rd October 2007
3	Like for like replacement of the following components: RES 8MHz resonator and R55 330R 0603 resistor	McMurdo	25 th October 2007

1.6 ALTERNATIVE TEST SITE

Under our group UKAS Accreditation, TÜV Product Service Ltd conducted the following tests at our Bearley, UK site:

2.12 PEIRP



Product Service

SECTION 2

TEST DETAILS

Emergency Beacon Testing of the
McMurdo Fastfind Plus PLB

**TABLE OF TEST RESULTS**

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min}	T _{amb}	T _{max}	
			(-20°C)	(+23°C)	(+55°C)	
1. INITIAL ALIVENESS TEST (A1.0)				N/R		
Carrier Frequency	406.037±0.001	MHz		N/R		* Range Of Specification updated to reflect current Cospas-Sarsat banding policy
Power Output	35 – 39	dBm		N/R		
2. VIBRATION TEST (A3.0)				N/R		
Exterior Mechanical Inspection	No damage	✓		N/R		
Aliveness Test	Successful self-test	✓		N/R		
Activation	No activation during test	✓		N/R		
3 BUMP TEST (A4.0)				N/R		
Exterior Mechanical Inspection	No damage	✓		N/R		
Aliveness Test	Successful self-test	✓		N/R		
Activation	No activation during test	✓		N/R		
4. SALT FOG TEST (A5.0)				N/R		
Exterior Mechanical Inspection	No damage	✓		N/R		
Aliveness Test	Successful self-test	✓		N/R		
5. DROP TEST (A6.0)						
Exterior Mechanical Inspection	No damage	✓	N/R			
Aliveness Test	Successful self-test	✓	N/R			
Activation	No Activation during test	✓	N/R			



PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min}	T _{amb}	T _{max}	
			(-20°C)	(+23°C)	(+55°C)	
6. LEAKAGE AND IMMERSION TEST (A7.0)				N/R		
Leakage & Immersion				N/R		
- Interior Inspection	No water	✓		N/R		
- Aliveness Test	Successful self-test	✓		N/R		
7. SPURIOUS EMISSIONS TEST (A8.0)						Section 2.2
406 MHz	Figure 2-1	✓	✓	✓	✓	
121.5 MHz	Figure 2-5	✓	✓	✓	✓	
8. COSPAS-SARSAT TYPE APPROVAL (A9.0)	C-S Certificate	✓	✓	✓	✓	Section 2.3



PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min}	T _{amb}	T _{max}	
			(-20°C)	(+23°C)	(+55°C)	
9. OPERATIONAL LIFE TEST (A 10.0)						Section 2.4
Operational Life	Time to first Failure	Hours	88.6665*			See relevant section for details
Frequency						
Nominal Carrier	406.037±0.001*	MHz	Min: 406.036937 Max: 406.036942			* Range Of Specification updated to reflect current Cospas-Sarsat banding policy
Short-term stability	0.002	Parts/million in 100ms	Min: 5.892x10 ⁻¹¹ Max: 1.881x10 ⁻¹⁰			
Medium-term stability						
Mean slope	0.001	Parts/million/min	Min: -4.486x10 ⁻¹¹ Max: 5.11x10 ⁻¹¹			
Residual variation	0.003	Parts/million	Min: 6.539x10 ⁻¹¹ Max: 2.567x10 ⁻¹⁰			
RF output power	35 – 39	dBm	Min: 36.973 Max: 37.019			
Strobe flash rate	20 – 30	/min	N/A			
Auxiliary radio-locating device peak envelope output power	14 – 20	dBm	Min: 19.057 Max: 19.666			



PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min}	T _{amb}	T _{max}	
			(-20°C)	(+24°C)	(+55°C)	
10. SELF-TEST (A 10.2)						Section 2.5
RF pulse duration	0.444 sec or 0.525 sec	✓	✓	✓	✓	
Frame synchronisation pattern	0 1101 0000	✓	✓	✓	✓	
Number of RF bursts	1 – burst	✓	✓	✓	✓	
- Beacon 15 Hex ID	Must be provided by self-test burst	✓	✓	✓	✓	
- 121.5 MHz transmission	1 sec / 3 sweeps	✓	✓	✓	✓	
11. BUOYANCY TEST (Category 1 only) (A11.0)						
Buoyancy	Floats	✓		N/R		
Reserve Buoyancy	>5%	%		N/R		

* The battery discharge was not performed prior to the start of the test. Therefore the calculated discharge time was subtracted from the original time to first failure. This is $95.0065 - 9.34 = 85.6665$ Hours



PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min}	T _{amb}	T _{max}	
			(-20°C)	(+23°C)	(+55°C)	
12. AUXILIARY RADIO-LOCATING DEVICE TRANSMITTER TEST (A12.0)						Section 2.6 Data from page 49
Carrier frequency	121.5 ± 0.006	MHz	121.651477*		121.650354*	* Frequency offset by 0.15MHz to prevent false emergency alert.
Transmission Duty Cycle	Continuous, except for 406 burst	%	98.88		98.92	
Modulation						
Frequency - Range	≥ 700	Hz	1145.87		1147.02	
- Maximum	≥ 300	Hz	337.81		338.87	
- Minimum	≤ 1600	Hz	1483.68		1485.89	
Duty cycle	33 – 55	%	34.76		35.26	
Factor	0.85 – 1.0	✓	0.93		0.92	
Sweep repetition rate	2 – 4	Hz	3.0		3.0	
Sweep Direction	Downwards	✓	✓		✓	
Frequency Coherence		✓	5.448		4.487	
PEIRP (Radiated)	14 – 20	dBm		15.88**		Section 2.12 **Median value
Antenna - Pattern	Omnidirectional	✓		✓		
- Polarization	Vertical	✓		✓		
- VSWR	1.5 : 1	✓		N/A		Antenna is not detachable.

N/R = Not Required.



Product Service

2.1 MORSE 'P' IMPLEMENTATION

2.1.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Paragraph 3

2.1.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.1.3 Date of Test and Modification State

24th October 2007 - Modification State 2

2.1.4 Test Equipment Used

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



Product Service

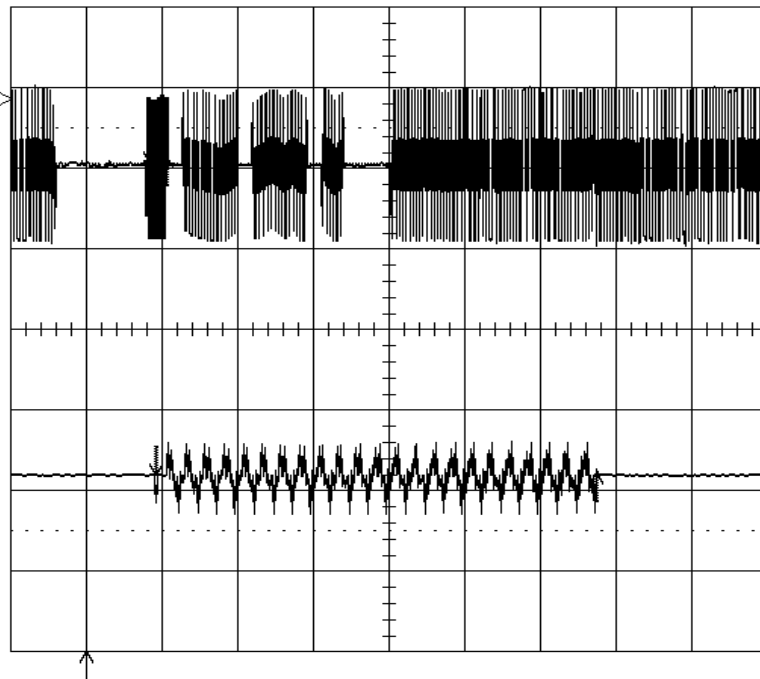
2.1.5 Test Results

Dot Period

24-Oct-07
9:04:46

1
.5 s
-0.9 V
3.0 V

A: 1
20 ms
-0.9 V
3.0 V



MEASURE

OFF **Cursors**
Parameters

mode
Time
Amplitude

type
Relative
Absolute

show
Diff - Ref
Diff & Ref

Reference
cursor
Track **OFF** On

Difference
cursor

.5 s

1 .5 V DC $\times 100$

Δt 116.6 ms $\frac{1}{\Delta t}$ 8.576 Hz

5 kS/s

2 1 V DC $\times 100$



1 DC 39 V

□ STOPPED



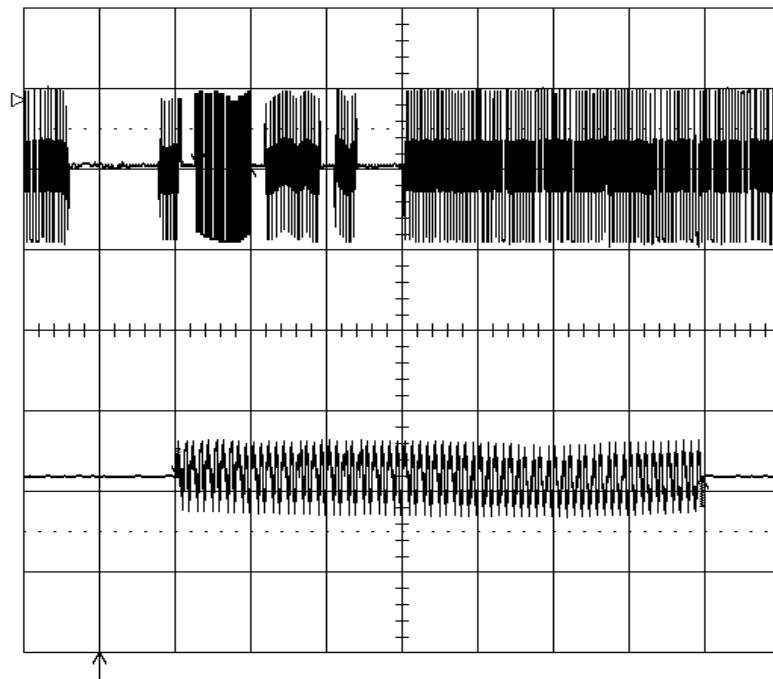
Product Service

Dash period

24-Oct-07
9:24:21

1
.5 s
-1.3 V
-1.7 V

A: 1
50 ms
-1.3 V
-1.7 V



MEASURE

OFF **Cursors**
Parameters

mode
Time
Amplitude

type
Relative
Absolute

show
Diff - Ref
Diff & Ref

Reference
cursor
Track **OFF** On

Difference
cursor

.5 s

1 .5 V DC ∞

Δt 346.75 ms $\frac{1}{\Delta t}$ 2.8839 Hz

5 kS/s

2 1 V DC ∞



1 DC 39 V

□ STOPPED



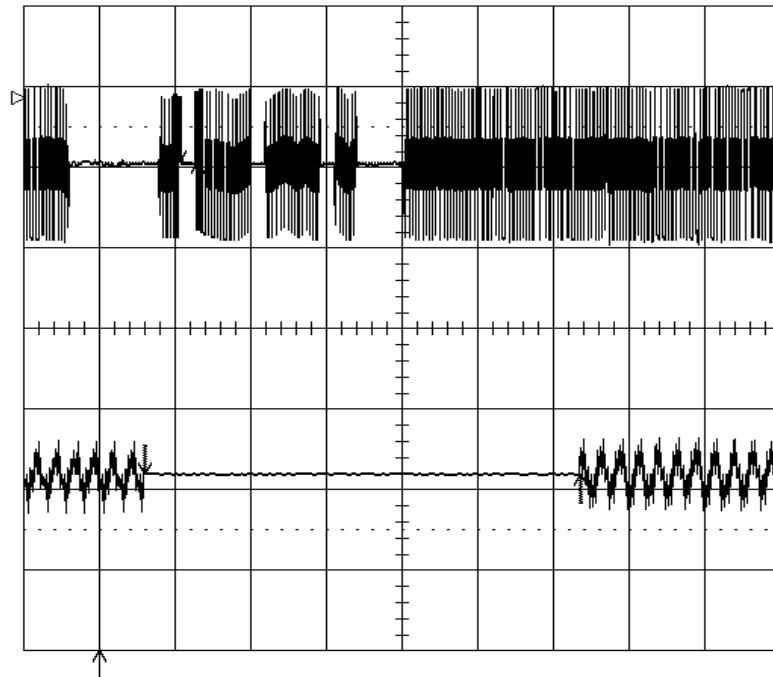
Product Service

Space Period

24-Oct-07
9:22:46

1
.5 s
-0.9 V
-0.9 V

2
20 ms
-0.9 V
-0.9 V



MEASURE

OFF **Cursors**
Parameters

mode
Time
Amplitude

type
Relative
Absolute

show
Diff - Ref
Diff & Ref

Reference
cursor
Track **OFF** On

Difference
cursor

.5 s

1 .5 V DC ∞

Δt

115.3 ms

$\frac{1}{\Delta t}$

8.673 Hz

5 kS/s

2 1 V DC ∞



1 DC 39 V

□ STOPPED



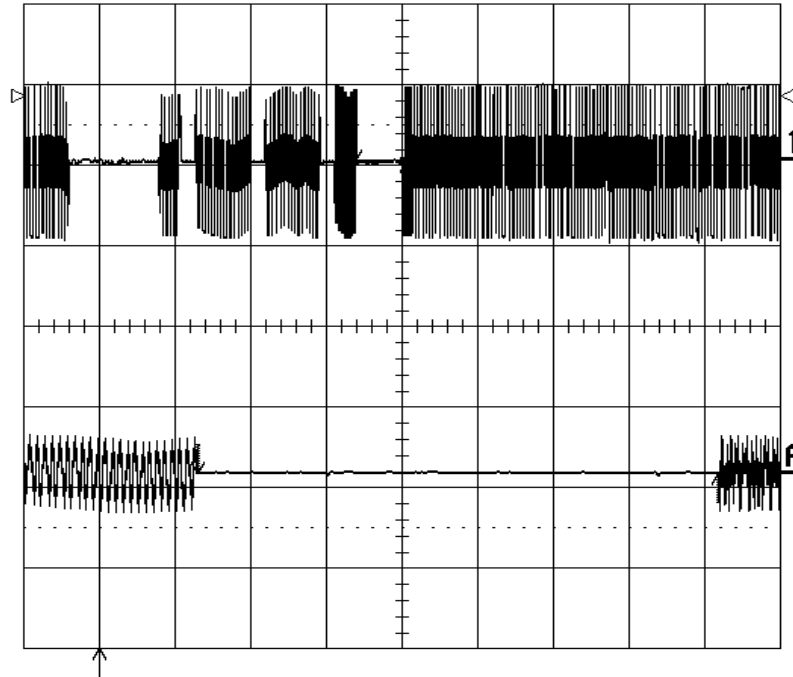
Product Service

Final Space Period

24-Oct-07
9:25:44

1
.5 s
-1.7 V
-1.7 V

1
50 ms
-1.7 V
-1.7 V



MEASURE

OFF **Cursors**
Parameters

mode
Time
Amplitude

type
Relative
Absolute

show
Diff - Ref
Diff & Ref

Reference
cursor
Track **OFF** On

Difference
cursor

.5 s

1 .5 V DC ∞

Δt 344.00 ms $\frac{1}{\Delta t}$ 2.9070 Hz

5 kS/s

2 1 V DC ∞



1 DC 39 V

□ STOPPED



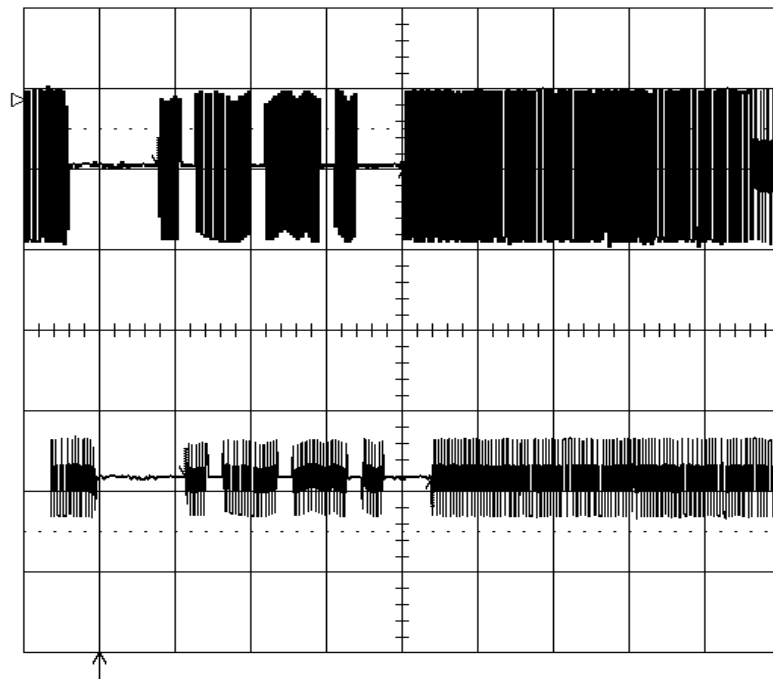
Product Service

Total Letter Length

24-Oct-07
9:27:11

1
.5 s
-2.4 V
-2.4 V

A: 1
.5 s
-2.4 V
-2.4 V



MEASURE

OFF **Cursors**
Parameters

mode
Time
Amplitude

type
Relative
Absolute

show
Diff - Ref
Diff & Ref

Reference
cursor
Track **OFF** On

Difference
cursor

.5 s

1 .5 V DC ∞

Δt 1.6325 s $\frac{1}{\Delta t}$ 612.56 mHz

5 kS/s

2 1 V DC ∞



1 DC 39 V

□ STOPPED



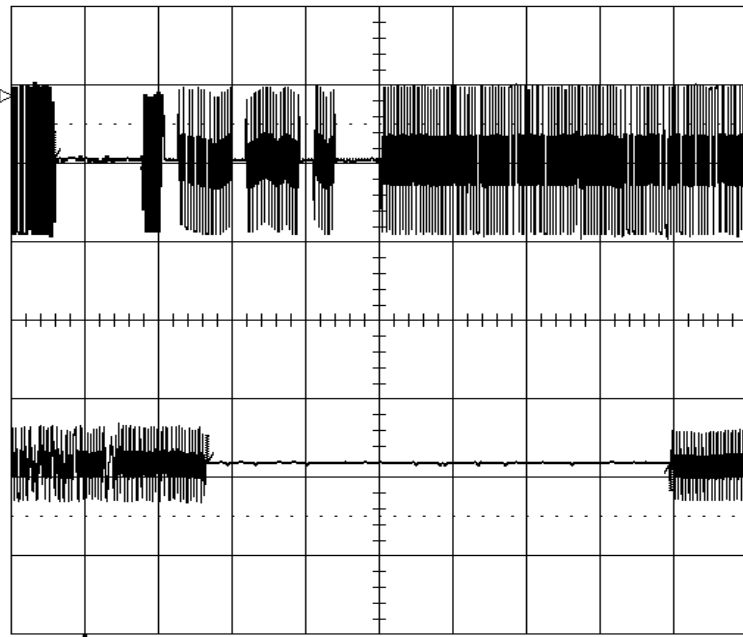
Product Service

Interruption period during 406MHz transmission

24-Oct-07
9:02:43

1
.5 s
-1.3 V
-0.9 V

A: 1
.1 s
-1.3 V
-0.9 V



MEASURE

OFF **Cursors**
Parameters

mode
Time
Amplitude

type
Relative
Absolute

show
Diff - Ref
Diff & Ref

Reference
cursor
Track **OFF** On

Difference
cursor

.5 s

1 .5 V DC $\times_{100}$

Δt

629.5 ms

$\frac{1}{\Delta t}$ 1.5886 Hz

5 kS/s

2 1 V DC $\times_{100}$



1 DC 39 V

☐ STOPPED

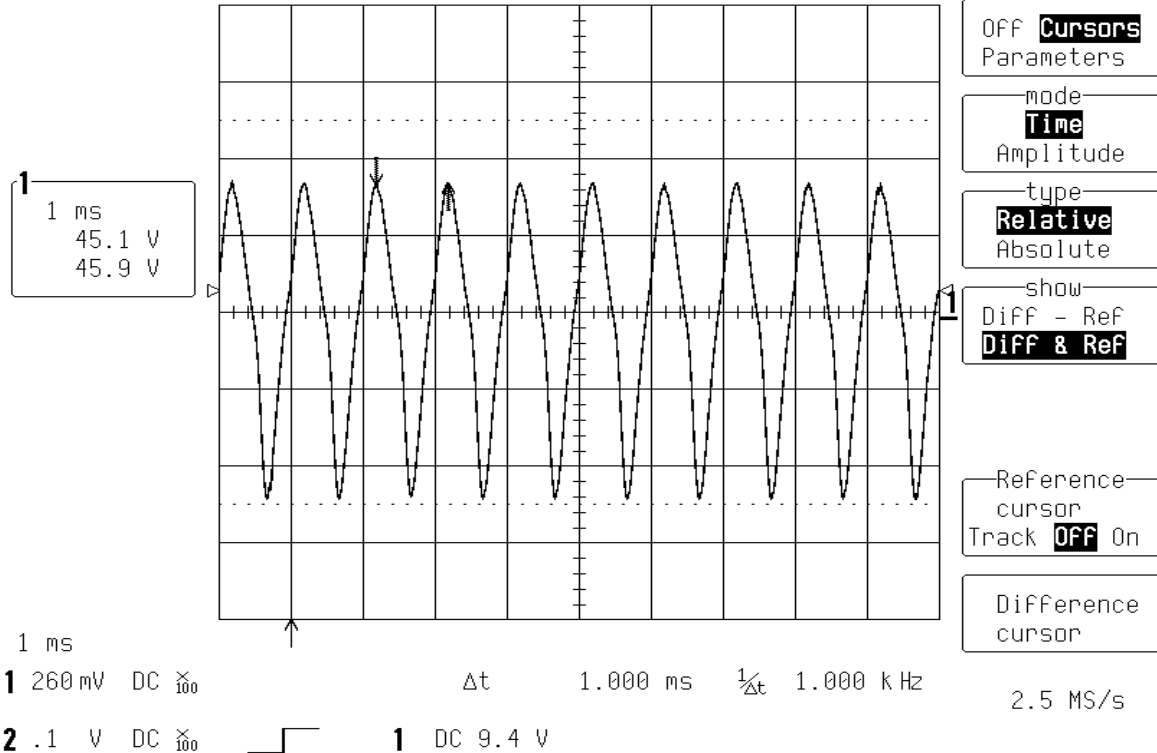


Product Service

Modulation frequency during dot and dash intervals

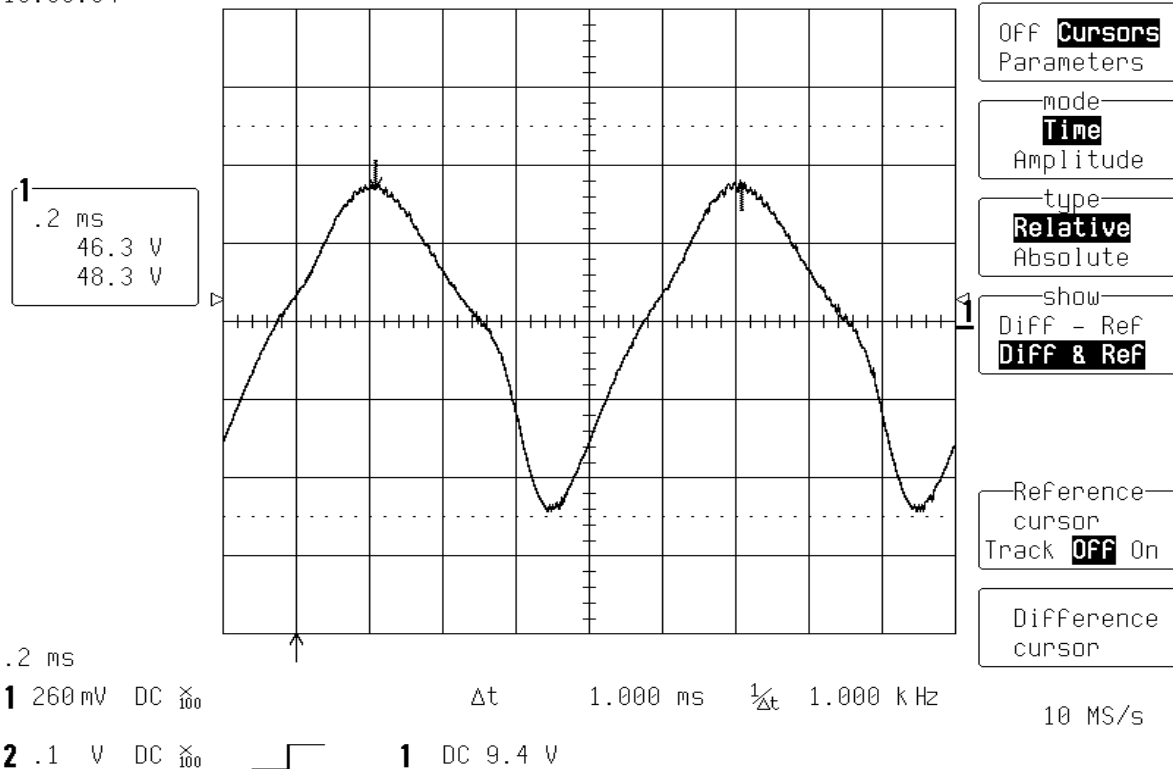
24-Oct-07

13:56:49



24-Oct-07

13:58:54





Morse 'P' Summary

PARAMETER	RESULT	LIMIT
Dot Period (1 unit)	116.6 ms	109.25 – 120.75 ms
Dash Period (3 units)	346.75 ms	327.75 – 362.25 ms
Space Period (1 unit)	115.3 ms	109.25 – 120.75 ms
Final Space Period (3 units)	344.0 ms	327.75 – 362.25 ms
Total Letter Length (14 units)	1632.5 ms	1529.5 – 1690.5 ms
Interruption period during 406 MHz transmission	629.5 ms	≤ 2 seconds
Modulation Depth during dot and dash intervals	96.96 %	≥ 85 %
Modulation frequency during dot and dash intervals	1000 Hz	1000 Hz ± 50 Hz
The repetition period varies between 47.5 seconds and 52.5 seconds	√	50 s ± 2.5 s



Product Service

2.2 SPURIOUS EMISSIONS TEST

2.2.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.8.0

2.2.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.2.3 Date of Test and Modification State

22nd August 2007, - Modification State 0
26th and 29th October 2007 - Modification State 3

2.2.4 Test Equipment Used

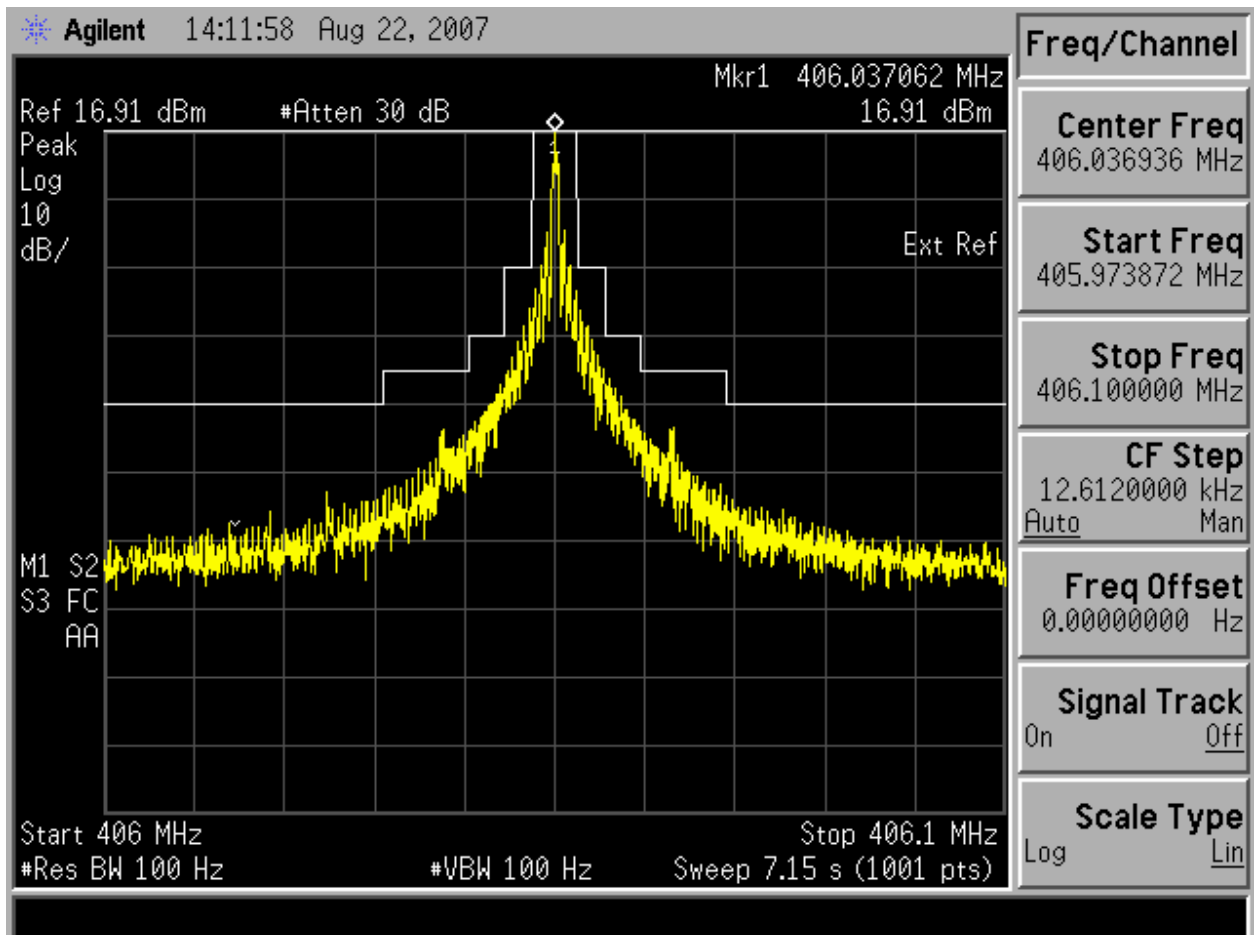
The major items of test equipment used for the above tests are identified in Section 3.1.



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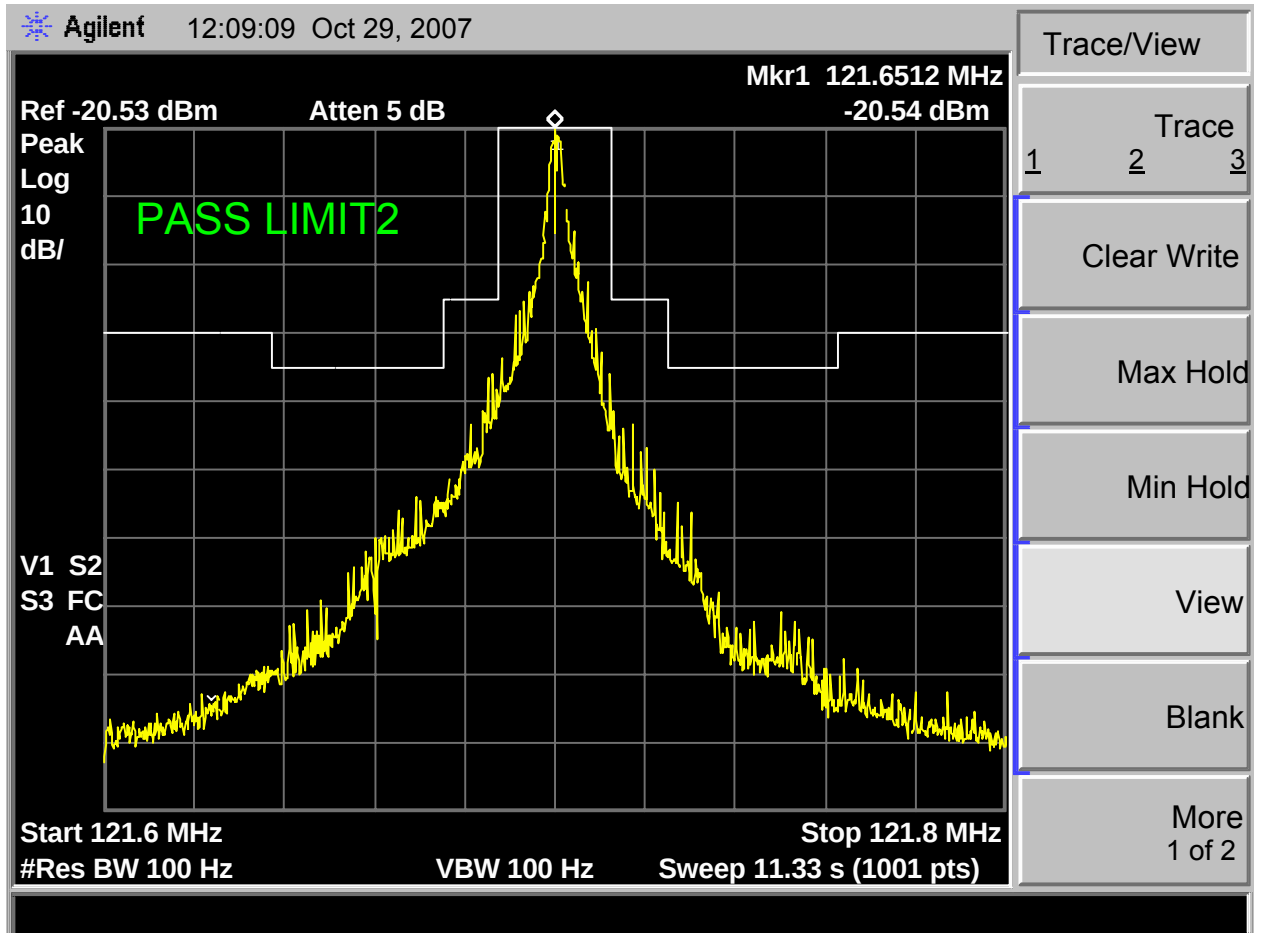
2.2.5 Test Results

Combined Plot at Ambient, Maximum and Minimum Temperatures (406MHz)





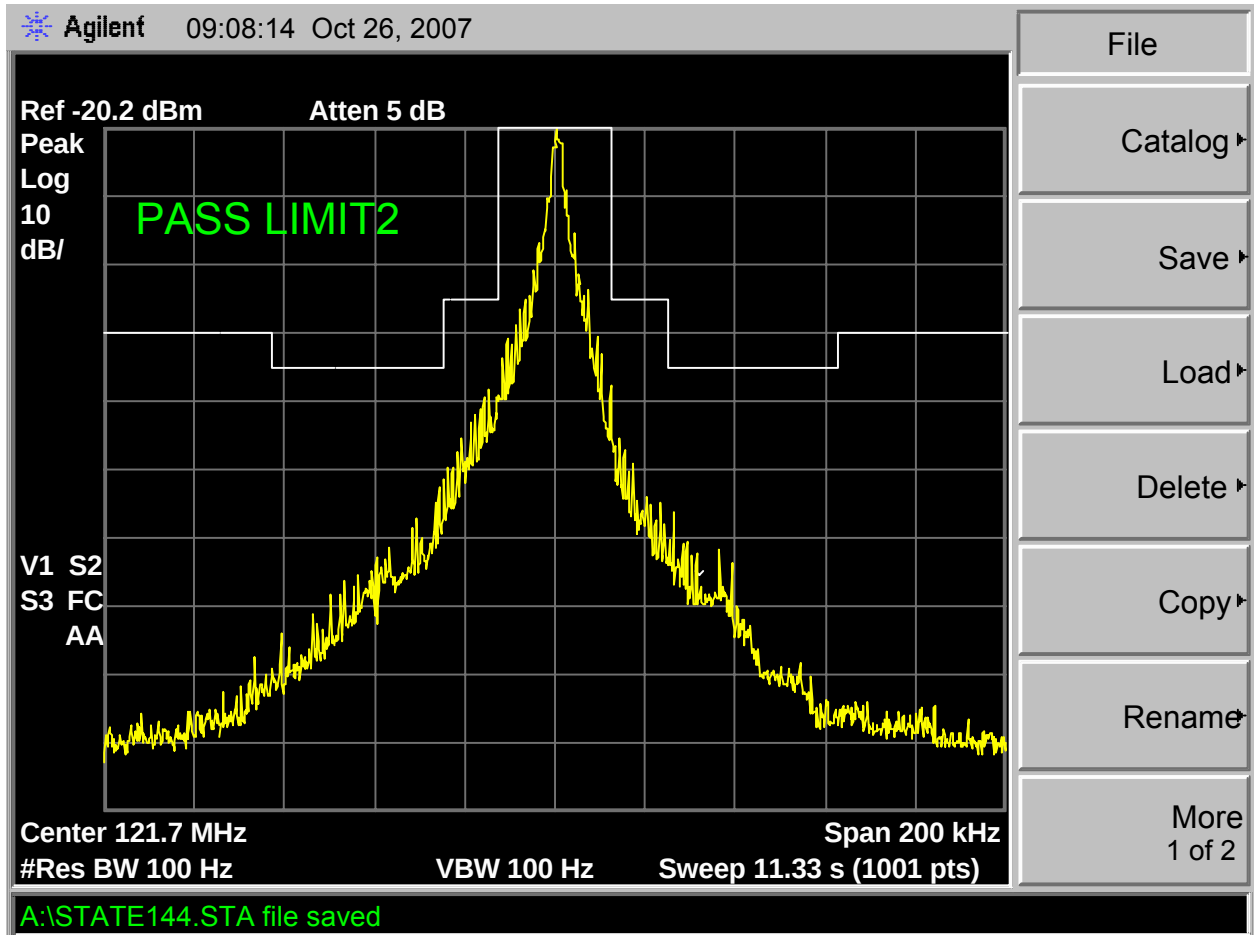
Product Service

Plot at Ambient Temperature (121.5MHz)



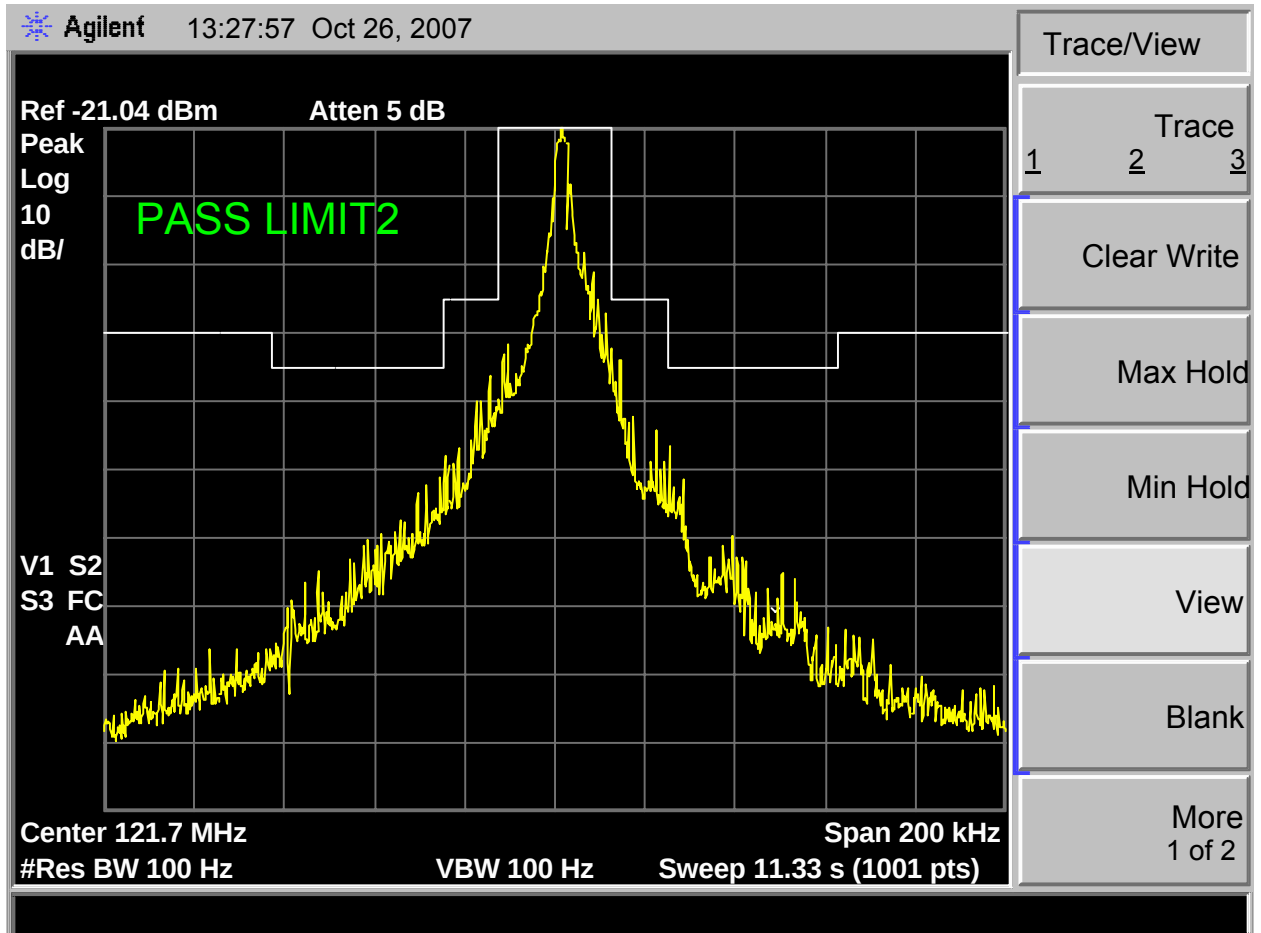
Product Service

Plot at Maximum Temperature +55°C (121.5MHz)





Product Service

Plot at Minimum Temperature -20°C (121.5MHz)



Product Service

2.3 COSPAS-SARSAT TYPE APPROVAL

2.3.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.9.0

2.3.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.3.3 Date of Test and Modification State

21st August 2007 to 15th October 2007 - Modification State 1

2.3.4 Test Equipment Used

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

2.3.5 Test Results

Refer to Cospas-Sarsat Test Report / Certificate – TUV Report 75901815 Report 01.



Product Service

2.4 OPERATION LIFE

2.4.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.10.0

2.4.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.4.3 Date of Test and Modification State

30th November to 5th December 2007 - Modification State 3

2.4.4 Test Equipment Used

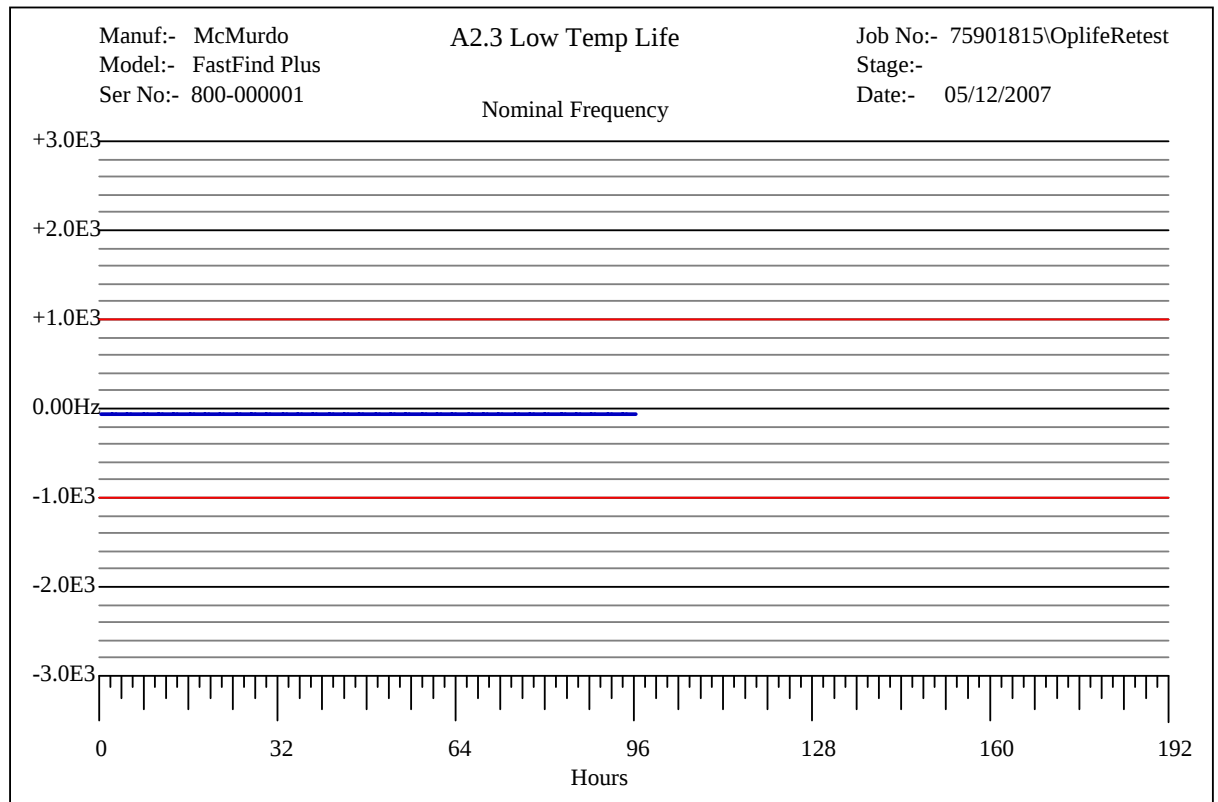
The major items of test equipment used for the above tests are identified in Section 3.1.



Product Service

2.4.5 Test Results

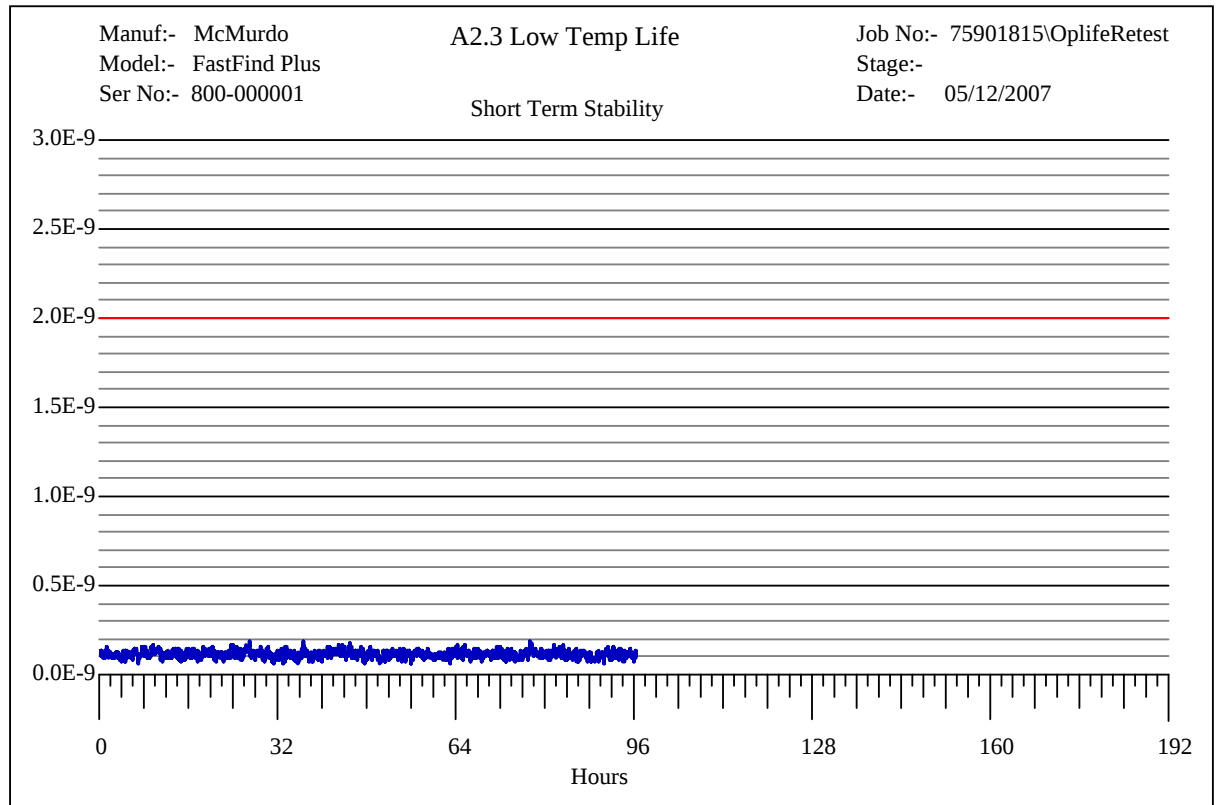
Minimum Temperature – Nominal Frequency





Product Service

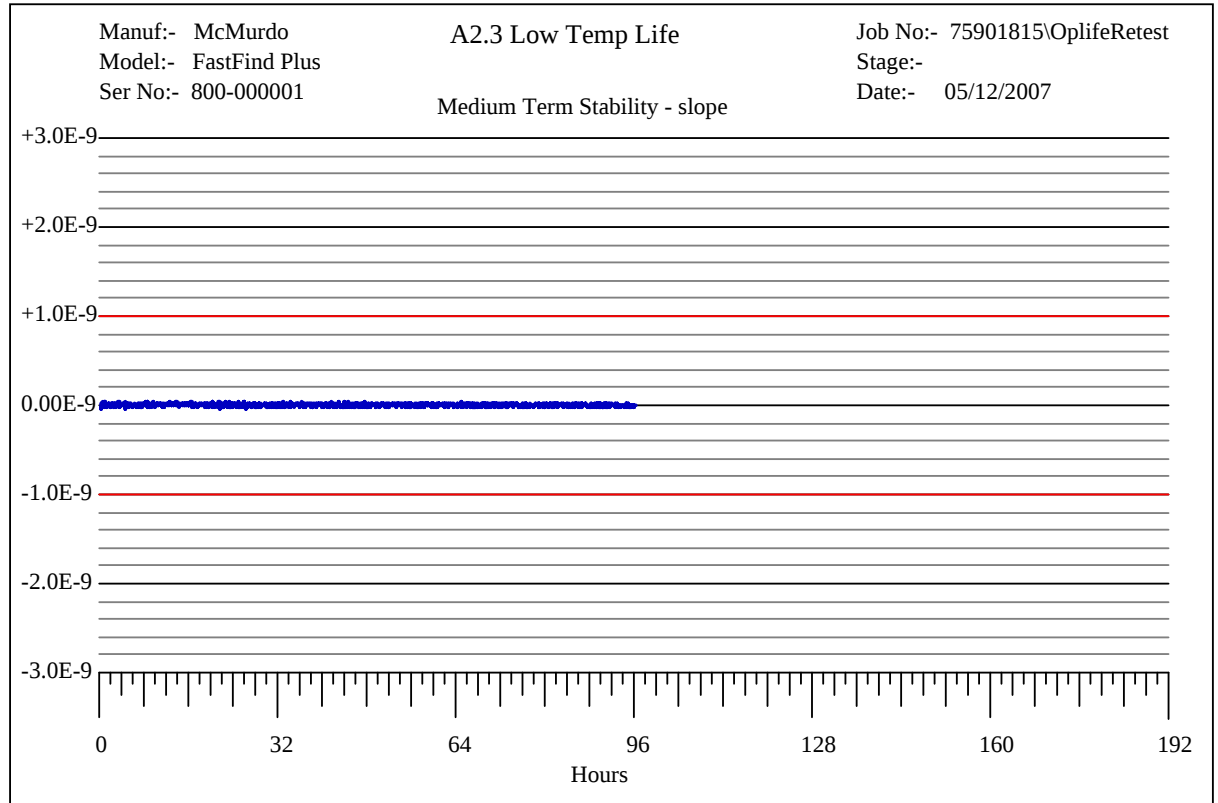
Minimum Temperature – Short Term Stability





Product Service

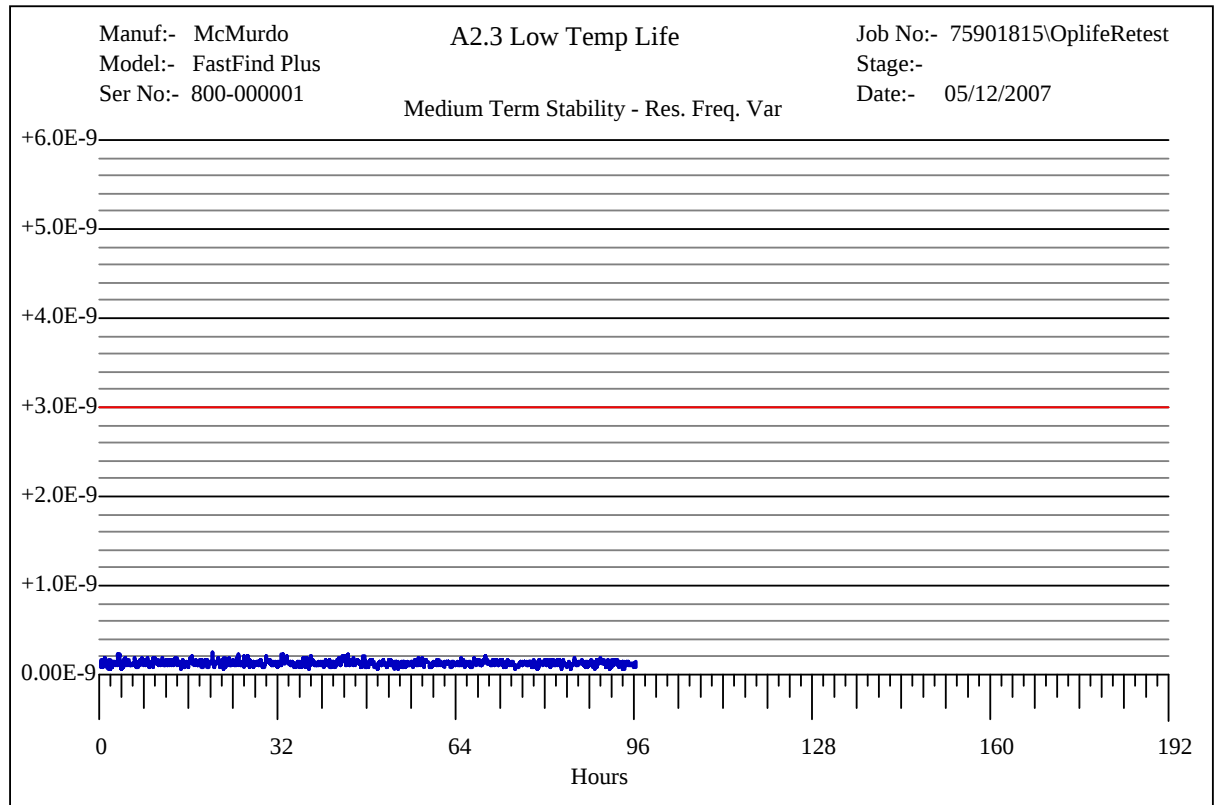
Minimum Temperature – Medium Term Stability, Mean Slope





Product Service

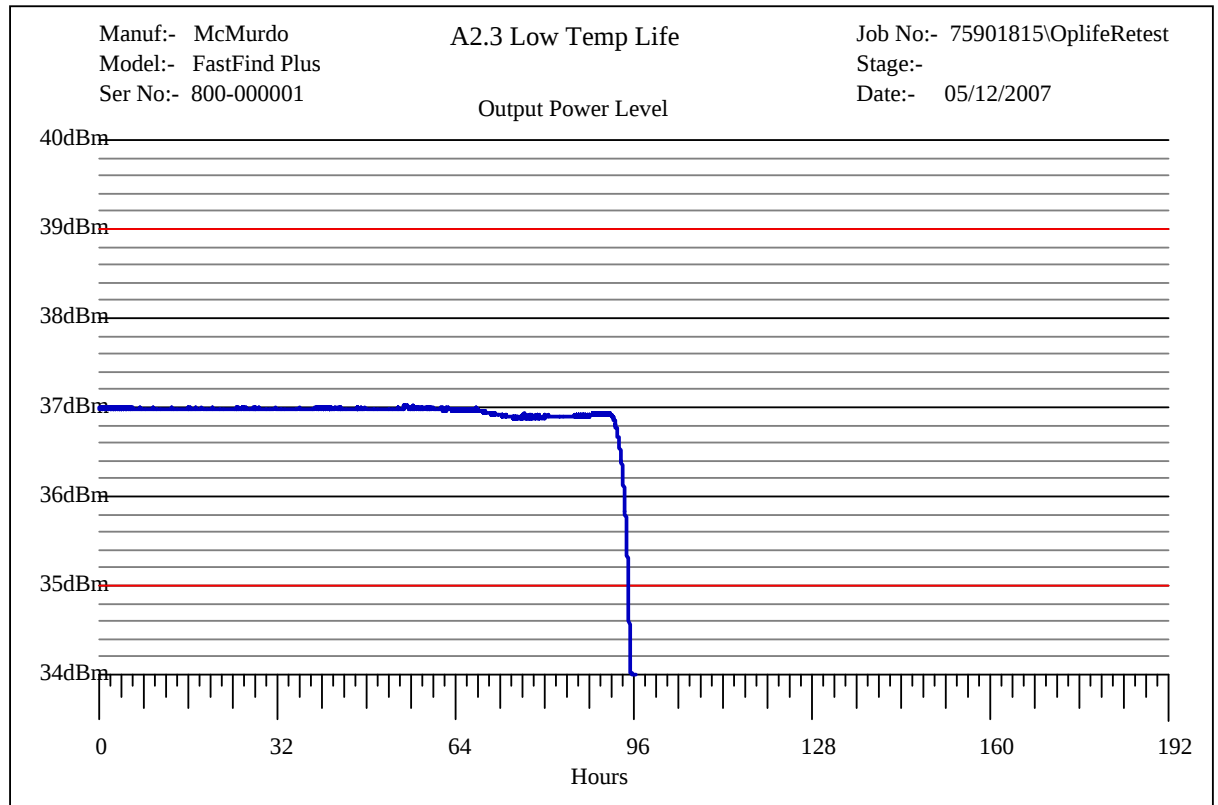
Minimum Temperature – Medium Term Stability, Residual Frequency Variation





Product Service

Minimum Temperature – Output Power





Battery Current and 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	: 28.5 minutes	(1711440 ms)
Self-test Current	: 8.88 seconds	(8880 ms)
Operating Current	: 30 minutes	(1799920 ms)

Assumptions / Supplied Data

Useful Battery Life	: 12 years
Battery Capacity	: 3.3 Ah
Battery Self Drain	: 1.00 % per year
Self-test Interval	: 12 tests per year

Test Results

Mode Current	= Accumulated Charge / Time
Standby Current	= 129350090.8 pC / 1711440 ms = 75.58 nA
Self-test Current	= 915176.8 uC / 8880 ms = 103.06 mA
Operating Current	= 80804696.02 uC / 1799920 ms = 44.89 mA

Battery Preconditioning / Discharge Time Calculations

$$\begin{aligned} \text{Battery Self Drain} &= \text{Capacity} - [(100\% - \text{Self Drain/Year}\%)^{\text{Useful Battery Life}} \times \text{Capacity}] \\ &= 3.3 - ((1 - 0.0100)^{12} \times 3.3) = 0.3749 \text{ Ah} \end{aligned}$$

$$\begin{aligned} \text{Standby Drain} &= \text{Hours per year} \times \text{Battery Replacement Interval} \times \text{Standby Current} \\ &= 365 \times 24 \times 12 \times 75.58 \times 10^{-9} = 0.0079 \text{ Ah} \end{aligned}$$

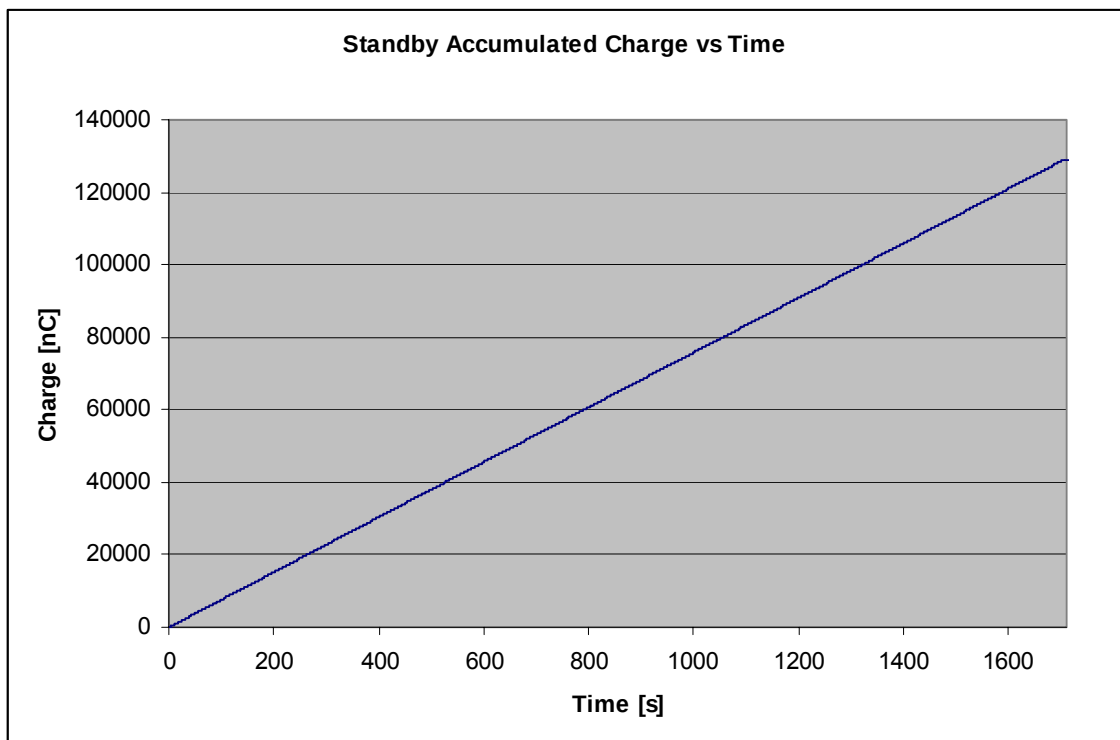
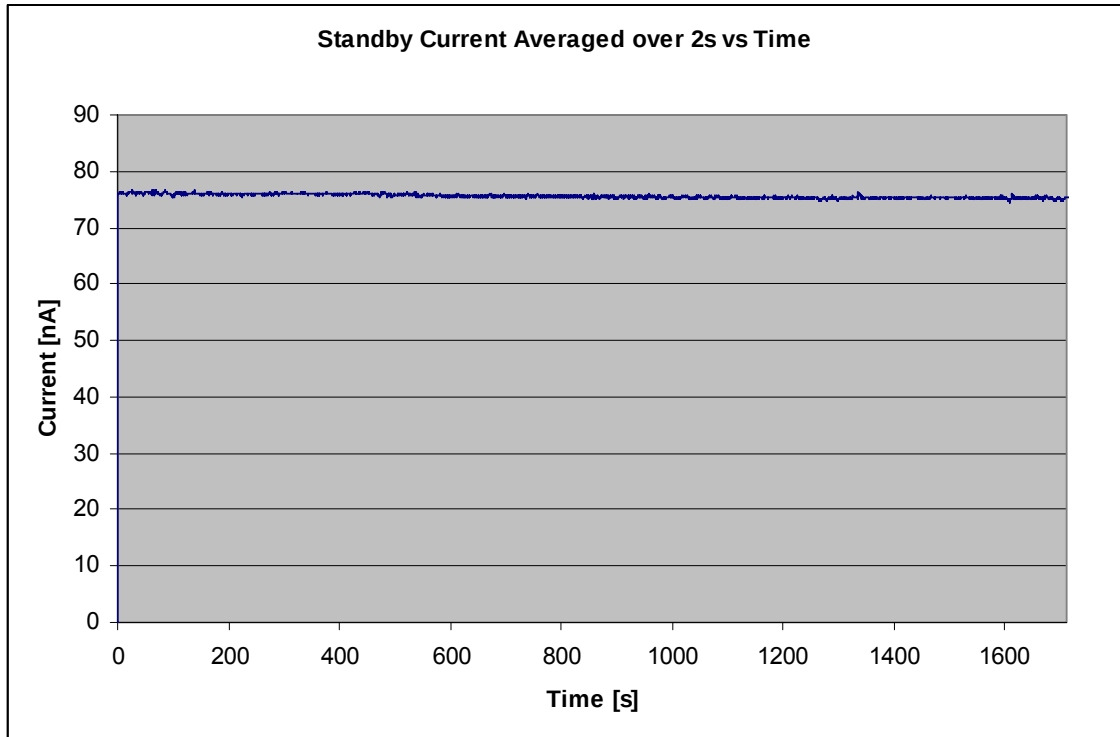
$$\begin{aligned} \text{Self-test Drain} &= \text{Self-tests per battery} \times \text{Self-test Current} \times \text{Self-test duration (in hours)} \\ &= 12 \times 12 \times 103.06 \times 10^{-3} \times (8.88 / 3600) = 0.0366 \text{ Ah} \end{aligned}$$

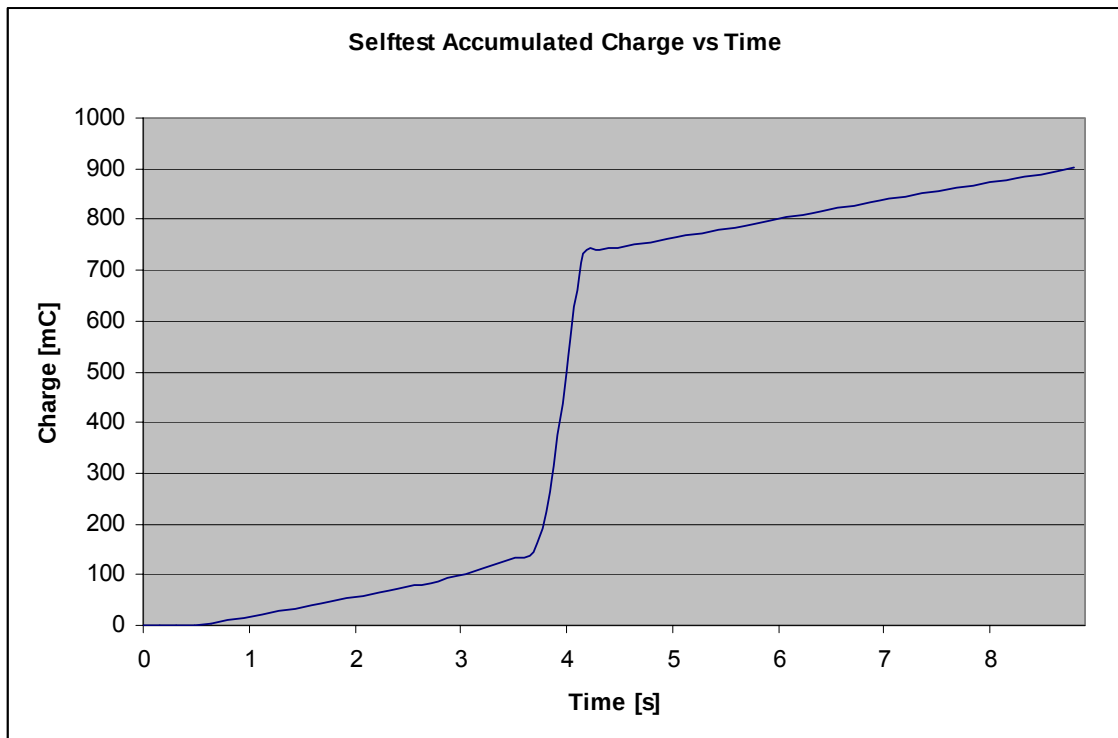
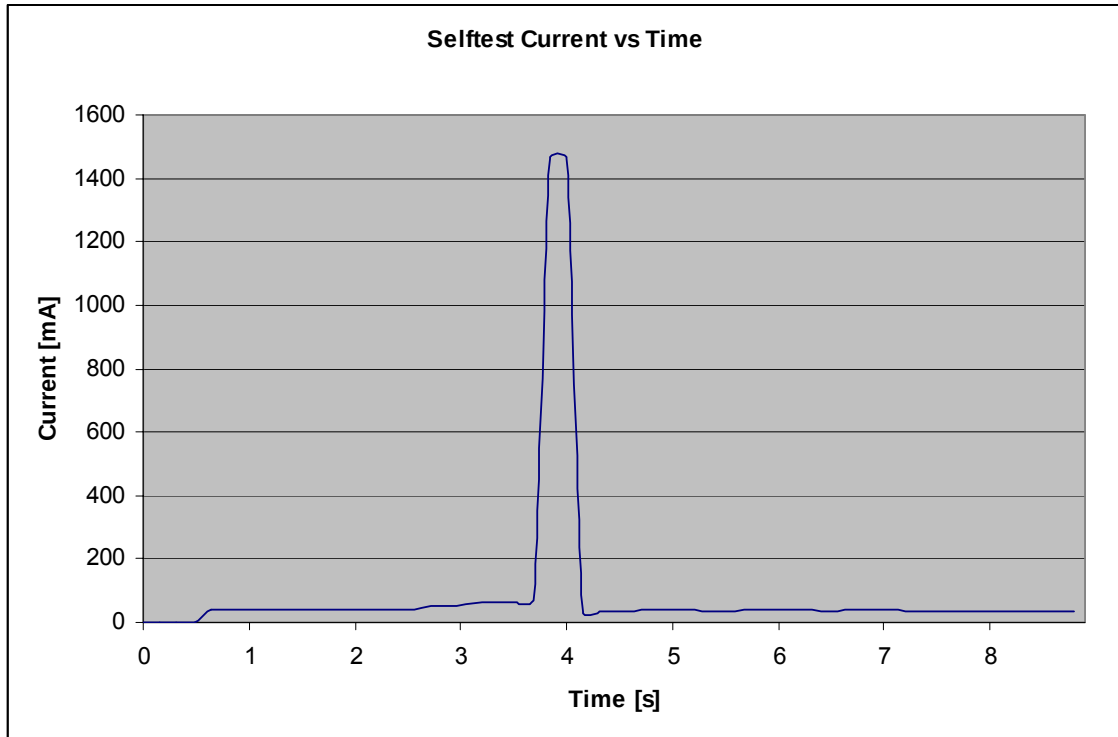
$$\begin{aligned} \text{Total Drain} &= \text{Self Drain} + \text{Standby Drain} + \text{Self-test Drain} \\ &= 0.3749 + 0.0079 + 0.0366 = 0.4195 \text{ Ah} \end{aligned}$$

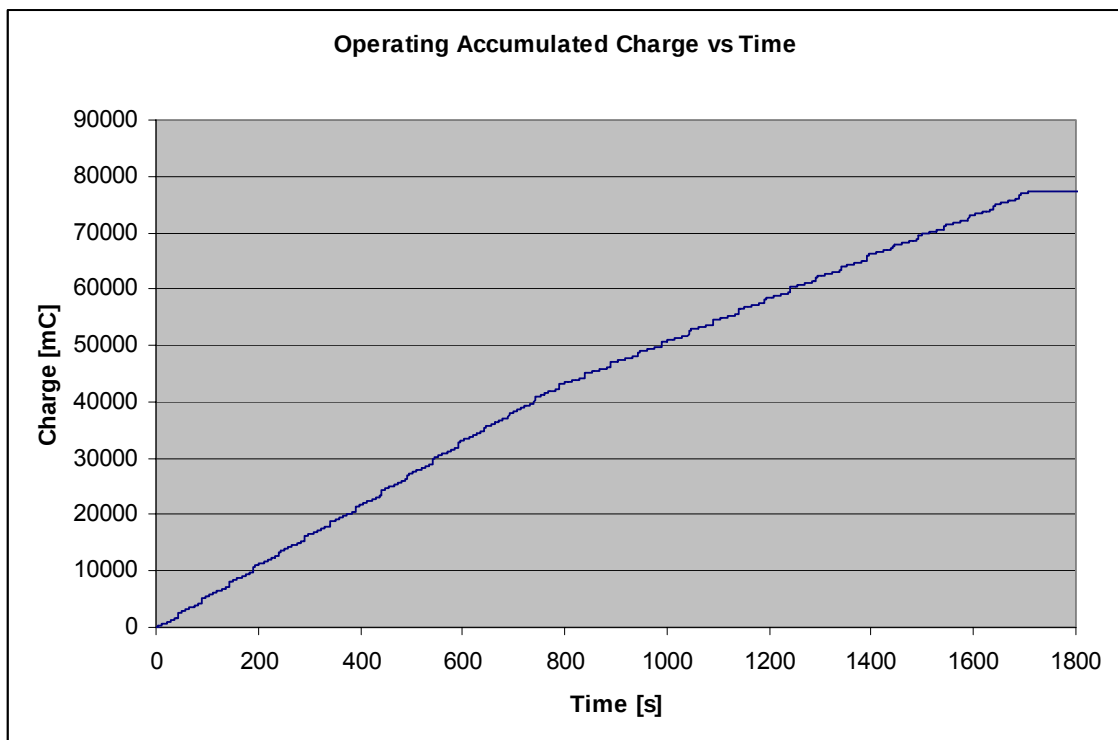
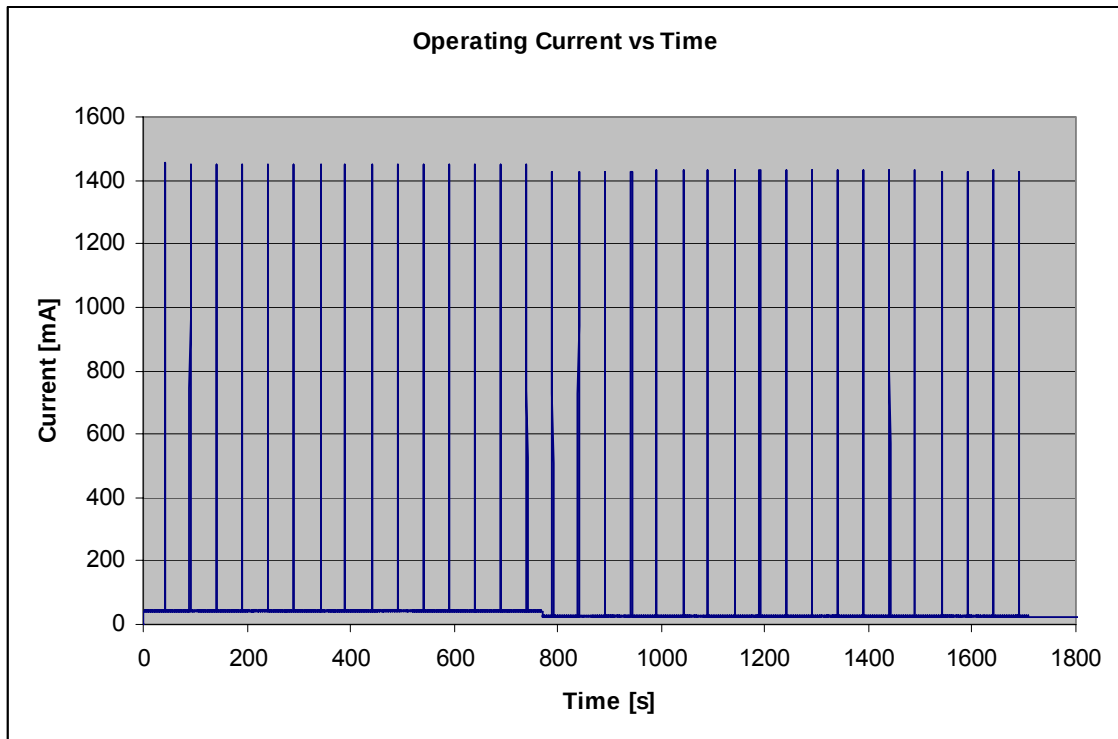
$$\begin{aligned} \text{Battery Preconditioning / Discharge Time} &= \text{Worst Case drain / Operational Current} \\ &= 0.4195 / (44.89 \times 10^{-3}) \\ &= \underline{9.34 \text{ hours}} \end{aligned}$$



Battery Current and Measurement Results – Standby Mode



Battery Current and Measurement Results – Self-Test Mode

Battery Current and Measurement Results – Operational Mode

Note: Internal navigation circuitry was denied GPS signals and hence the power draw indicates a search mode up to approximately 800 seconds, thereafter it apparently enters a sleep mode. This was confirmed verbally by the client.



Product Service

2.5 SELF TEST

2.5.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.10.2

2.5.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.5.3 Date of Test and Modification State

21st August 2007 - Modification State 0
26th October 2007 - Modification State 3

2.5.4 Test Equipment Used

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



2.5.5 Test Results

Digital Message at Ambient Temperature

Full message: FFFED08C97F9C0637FDFFF11B23783E0F66C

Bit/Frame Sync Portion: FFFED0

Bit/Frame Sync Required: FFFED0

Message decode:

Beacon Id Format..... 30 Hex Id, Long Message, Bits 25-144

15 Hex (Bits 26- 85) = 192FF380C6FFBFF 192FF380C6FFBFF Default_Id

36 Hex (Bits 25-144) = 8C97F9C0637FDFFF11B23783E0F66C

26	30	34	38	42	46	50	54	58	62	66	70	74	78	82
1	0001	1001	0010	1111	1111	0011	1000	0000	1100	0110	1111	1111	1011	1111
	1110	0010	0011	0110	0100	0110	1111	0000	0111	1100	0001	1110	1100	1101
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	201 ALBANIA	0011 0010 01
Protocol Code	37- 40	7 PLB - Serial (Standard)	0111
CSTA Number	41- 50	999	1111 1001 11
Serial Number	51- 64	99	0000 0001 1000 11
Coarse Position	65- 85	DEFAULT	0111 1111 1101 1111 1111 1
BCH Encoded	86-106	Errors=0	1110 0010 0011 0110 0100 0
BCH Generated	86-106		1110 0010 0011 0110 0100 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

Digital Message at -20°C

Full message: FFFED08C97F9C0637FDFFF11B23783E0F66C

Bit/Frame Sync Portion: FFFED0

Bit/Frame Sync Required: FFFED0

Message decode:

Beacon Id Format..... 30 Hex Id, Long Message, Bits 25-144

15 Hex (Bits 26- 85) = 192FF380C6FFBFF 192FF380C6FFBFF Default_Id

36 Hex (Bits 25-144) = 8C97F9C0637FDFFF11B23783E0F66C

26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	
1	0001	1001	0010	1111	1111	0011	1000	0000	1100	0110	1111	1111	1011	1111	1111
	1110	0010	0011	0110	0100	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	201 ALBANIA	0011 0010 01
Protocol Code	37- 40	7 PLB - Serial (Standard)	0111
CSTA Number	41- 50	999	1111 1001 11
Serial Number	51- 64	99	0000 0001 1000 11
Coarse Position	65- 85	DEFAULT	0111 1111 1101 1111 1111 1
BCH Encoded	86-106	Errors=0	1110 0010 0011 0110 0100 0
BCH Generated	86-106		1110 0010 0011 0110 0100 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

Digital Message at +55°C

Full message: FFFED08C97F9C0637FDFFF11B23783E0F66C

Bit/Frame Sync Portion: FFFED0

Bit/Frame Sync Required: FFFED0

Message decode:

Beacon Id Format..... 30 Hex Id, Long Message, Bits 25-144

15 Hex (Bits 26- 85) = 192FF380C6FFBFF 192FF380C6FFBFF Default_Id

36 Hex (Bits 25-144) = 8C97F9C0637FDFFF11B23783E0F66C

26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	
1	0001	1001	0010	1111	1111	0011	1000	0000	1100	0110	1111	1111	1011	1111	1111
	1110	0010	0011	0110	0100	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	201 ALBANIA	0011 0010 01
Protocol Code	37- 40	7 PLB - Serial (Standard)	0111
CSTA Number	41- 50	999	1111 1001 11
Serial Number	51- 64	99	0000 0001 1000 11
Coarse Position	65- 85	DEFAULT	0111 1111 1101 1111 1111 1
BCH Encoded	86-106	Errors=0	1110 0010 0011 0110 0100 0
BCH Generated	86-106		1110 0010 0011 0110 0100 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

2.6 AUXILIARY RADIO LOCATING DEVICE TRANSMITTER TEST (CARRIER FREQUENCY)

2.6.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.12.1

2.6.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.6.3 Date of Test and Modification State

23rd and 24th August 2007 - Modification State 0

2.6.4 Test Equipment Used

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

2.6.5 Test Results

Test Conditions	Frequency Error (Hz)		
		121.500 MHz*	
T _{min} (-20°C)		121.651	
T _{max} (55°C)		121.650	
Maximum freq. Error (ppm)		8.22	
Measurement uncertainty (Hz)	± 46 Hz		
Limit	121.500 MHz ± 50ppm		

*The homing device operating frequency was offset to 121.650MHz in order to prevent false emergency alert.



Product Service

2.7 AUXILIARY RADIO LOCATING DEVICE TRANSMITTER TEST (TRANSMITTER DUTY CYCLE)

2.7.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.12.2.1

2.7.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.7.3 Date of Test and Modification State

23rd and 24th August 2007 - Modification State 0

2.7.4 Test Equipment Used

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

2.7.5 Test Results

Test Conditions	Transmitter Duty Cycle %		
		121.500 MHz	
T _{min} (-20°C)		98.88	
T _{max} (55°C)		98.92	
Measurement uncertainty (Hz)	± 5 %		

Does the carrier transmit continuously except for a period of up to 2 seconds during the 406MHz transmission?

Yes [☒] No [☐]



2.8 AUXILIARY RADIO LOCATING DEVICE TRANSMITTER TEST (MODULATION FREQUENCY AND SWEEP RATE)

2.8.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.12.2.2

2.8.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.8.3 Date of Test and Modification State

23rd and 24th August 2007 - Modification State 0

2.8.4 Test Equipment Used

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

2.8.5 Test Results

Test Conditions	Modulation Parameters	
T _{min} (-20°C)	Sweep Direction	Downwards
	Minimum Audio Frequency	337.81Hz
	Maximum Audio Frequency	1483.68Hz
	Audio Frequency Range	1145.87Hz
	Sweep Repetition Rate	3Hz
T _{max} (+55°C)	Sweep Direction	Downwards
	Minimum Audio Frequency	338.87Hz
	Maximum Audio Frequency	1485.89Hz
	Audio Frequency Range	1147.02Hz
	Sweep Repetition Rate	3Hz
Measurement uncertainty	Minimum Audio Frequency	± 22.4 Hz
	Maximum Audio Frequency	± 121.56 Hz
	Audio Frequency Range	± 123.6 Hz
	Sweep Repetition Rate	± 5 %

LIMITS

Minimum Audio Frequency	≥ 300 Hz
Maximum Audio Frequency	≤ 1600 Hz
Audio Frequency Range	≥ 700 Hz
Sweep Repetition Rate	2 to 4 Hz



Product Service

2.9 AUXILIARY RADIO LOCATING DEVICE TRANSMITTER TEST (MODULATION DUTY CYCLE)

2.9.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.12.2.3

2.9.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.9.3 Date of Test and Modification State

23rd and 24th August 2007 - Modification State 0

2.9.4 Test Equipment Used

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

2.9.5 Test Results

Parameter	RESULT (%)	
	121.500 MHz	
	-20°C	+55°C
Modulation Duty Cycle	34.76	35.26
Measurement Uncertainty	± 5 %	
Limit (%)	33 to 55	



Product Service

2.10 AUXILIARY RADIO LOCATING DEVICE TRANSMITTER TEST (MODULATION FACTOR)**2.10.1 Specification Reference**

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.12.2.4

2.10.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.10.3 Date of Test and Modification State23rd and 24th August 2007 - Modification State 0**2.10.4 Test Equipment Used**

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

2.10.5 Test Results

Parameter	RESULT (%)	
	121.500 MHz	
	-20°C	+55°C
Modulation Factor	0.93	0.92
Measurement Uncertainty	± 5 %	
Limit (%)	0.85 to 1.0	



Product Service

2.11 AUXILIARY RADIO LOCATING DEVICE TRANSMITTER TEST (FREQUENCY COHERENCE)**2.11.1 Specification Reference**

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.12.2.5

2.11.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.11.3 Date of Test and Modification State

23rd and 24th August 2007 - Modification State 0

2.11.4 Test Equipment Used

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

2.11.5 Test Results

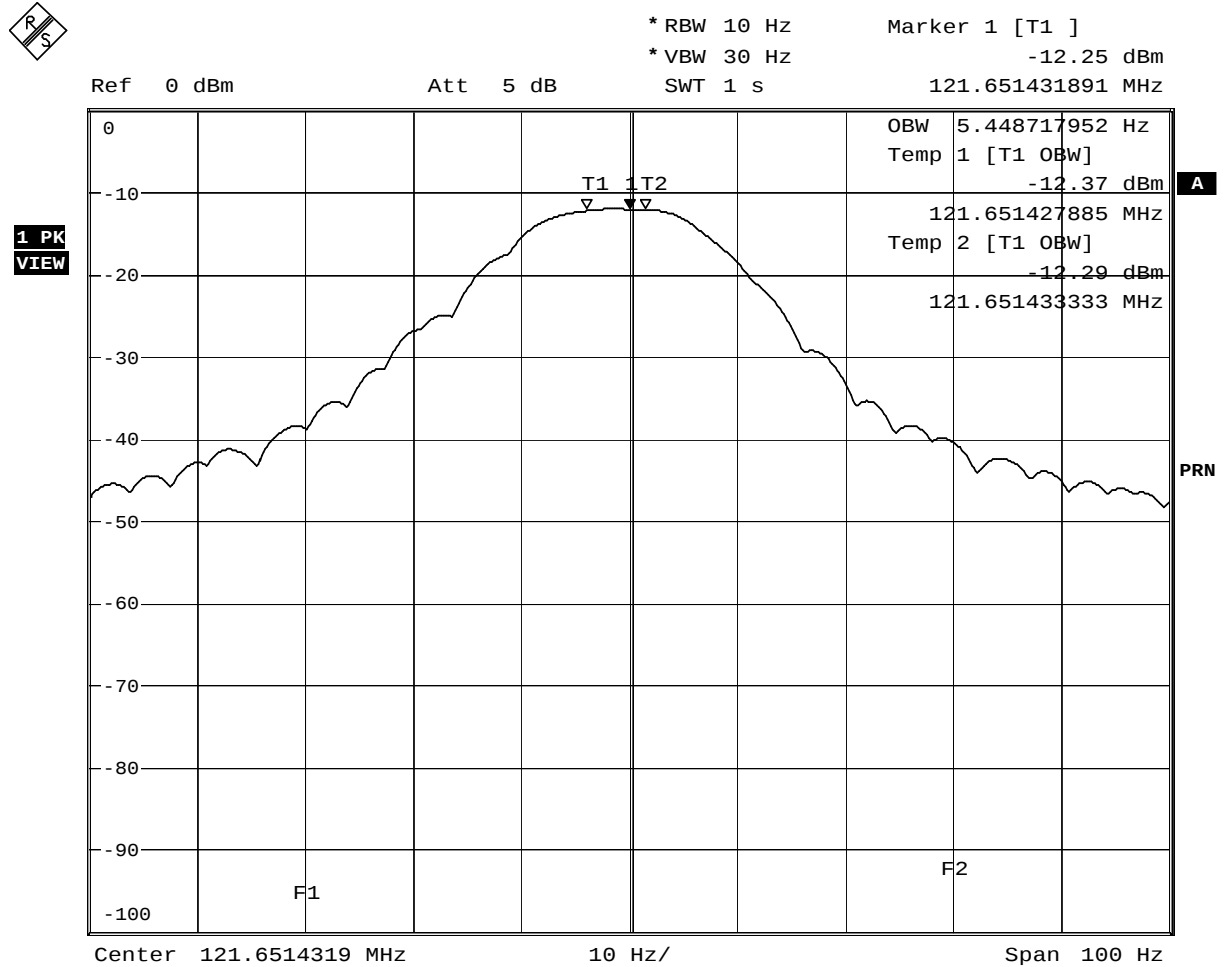
The following plots are a measurement showing 30% of the total power emitted during a transmission cycle.

Frequency Lines (F1 & F2) are at $\pm 30\text{Hz}$ to the centre frequency (carrier)



Product Service

Plot for 30% of Total Power Minimum Temperature -20°C

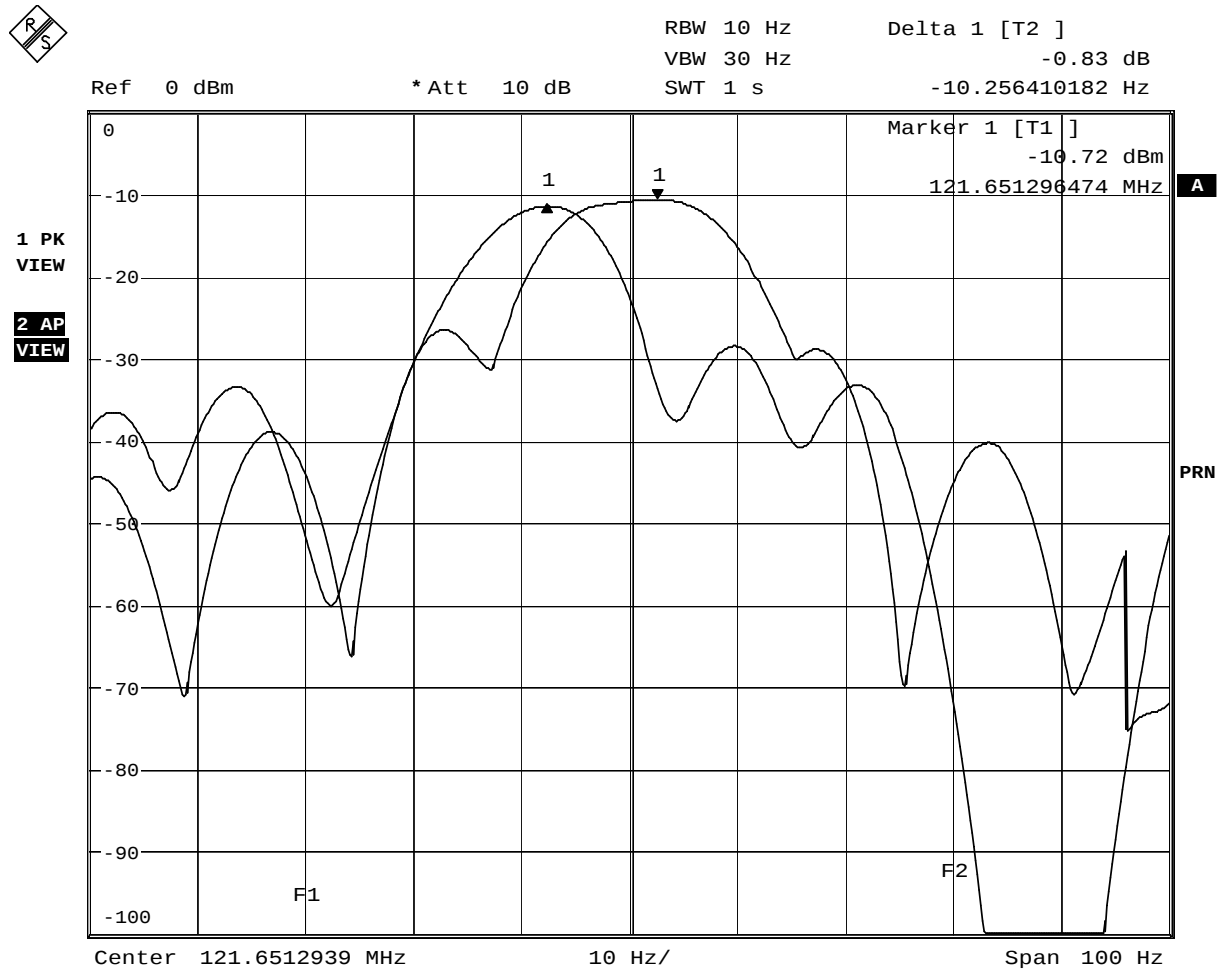


Date: 23.AUG.2007 16:38:45



Product Service

Plot for Frequency Drift Minimum Temperature -20°C



Date: 9.NOV.2007 16:43:59

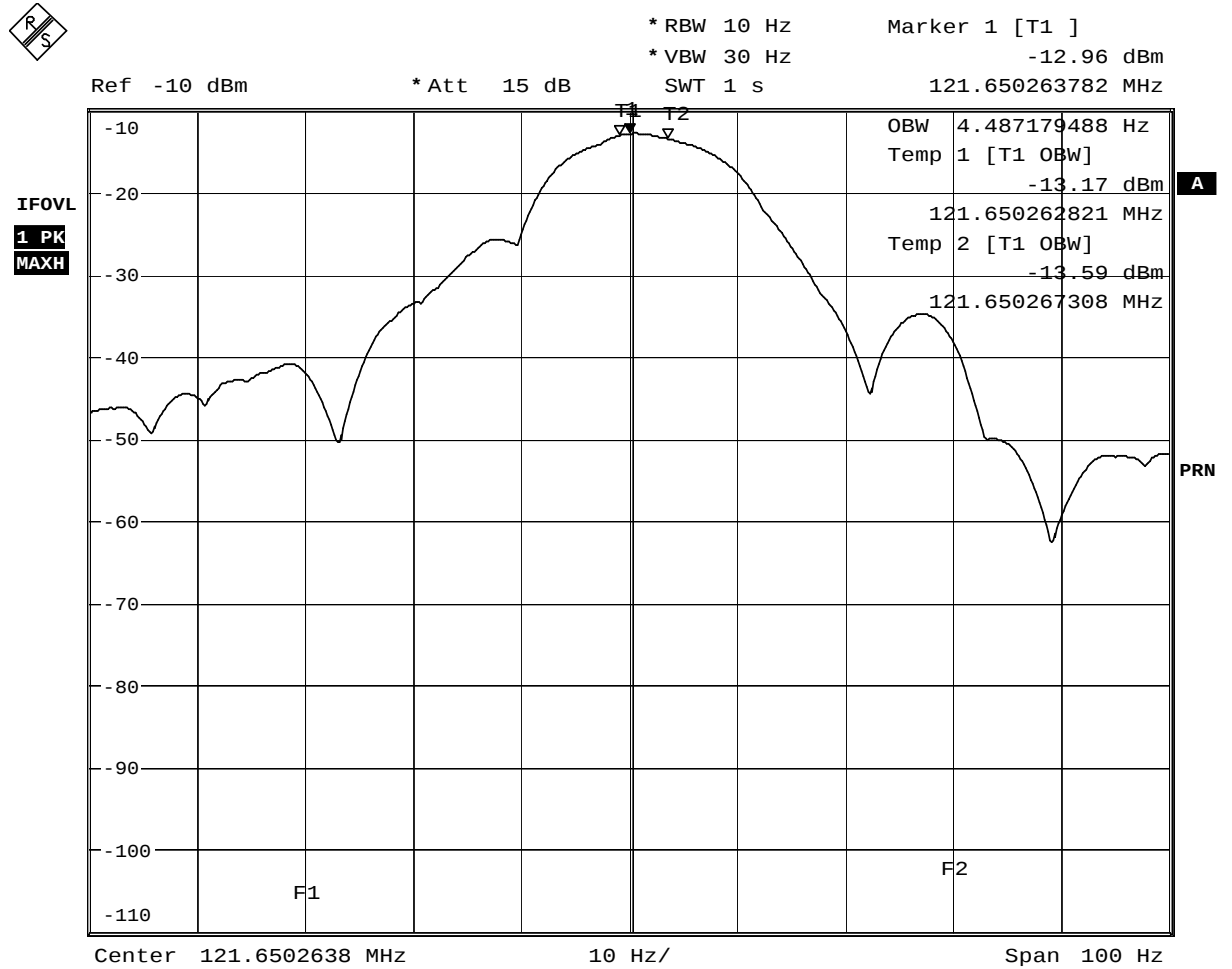
Is the transmission interrupted by the 406MHz burst?	Yes
If yes:- Frequency Shift (Hz)	10.26

Limit	The carrier frequency must not shift by more than ± 30 Hz.
-------	--



Product Service

Plot for 30% Total Power Maximum Temperature +55°C

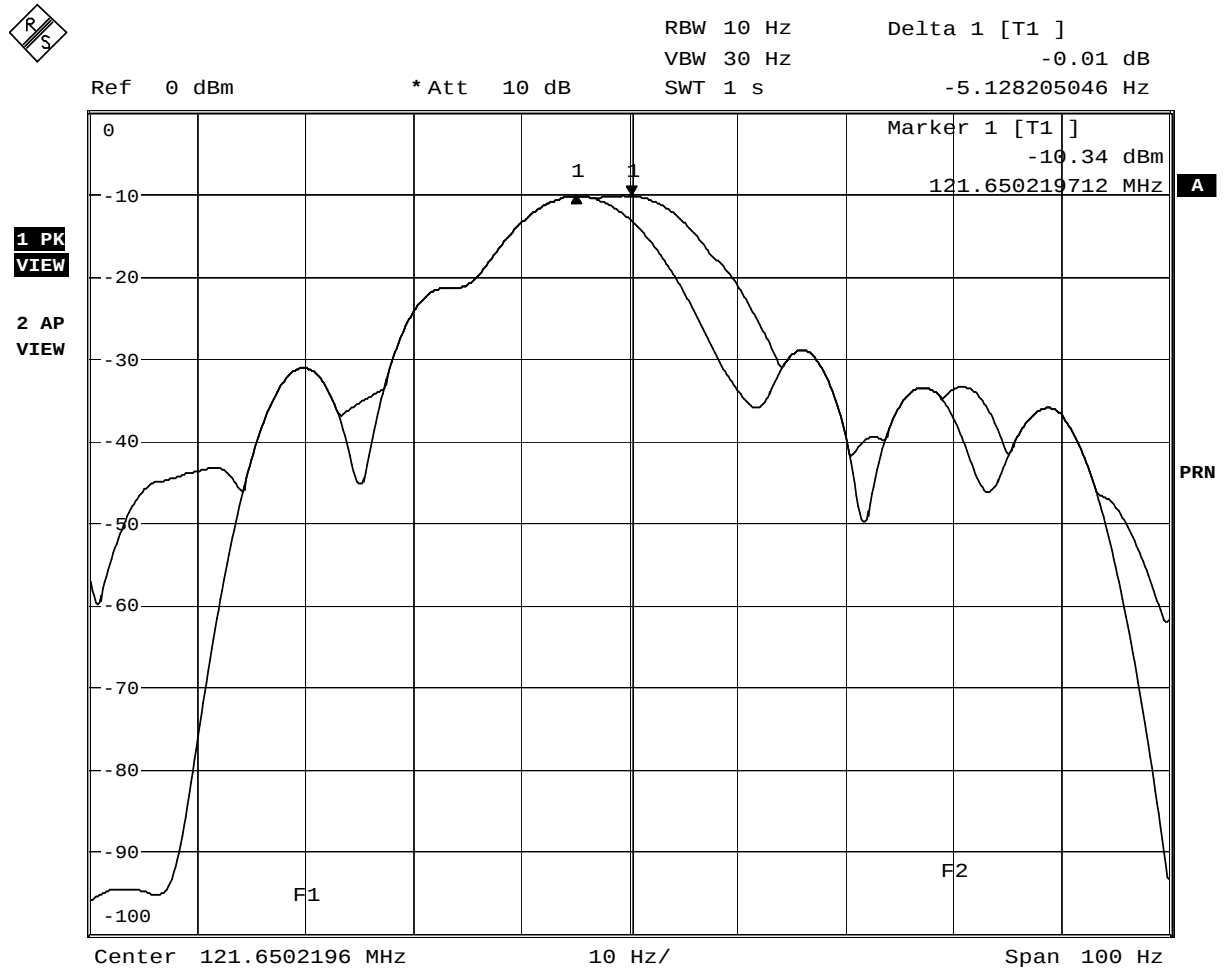


Date: 24.AUG.2007 10:26:26



Product Service

Plot for Frequency Drift Maximum Temperature +55°C



Date: 9.NOV.2007 13:39:20

Is the transmission interrupted by the 406MHz burst?	Yes
If yes:- Frequency Shift (Hz)	5.13
Limit	The carrier frequency must not shift by more than ± 30 Hz.



Product Service

2.12 AUXILIARY RADIO LOCATING DEVICE TRANSMITTER TEST (PEIRP, PEAK EQUIVALENT ISOTROPIC RADIATED POWER)

2.12.1 Specification Reference

RTCM 11010.1 (RTCM Paper 76-2002/SC110-STD) Clause A.12.3

2.12.2 Equipment Under Test

Fastfind Plus PLB, 800-00001

2.12.3 Date of Test and Modification State

5th October 2007 - Modification State 2

2.12.4 Test Equipment Used

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

2.12.5 Test Results

The test was performed with the EUT in the following mode(s): Operating.

Note: The EUT battery used for test had been operational for a duration of ≥ 44 hours.

Measurements were made (in dBm) at an arbitrarily chosen azimuth angle across a range of elevation angles. Upon finding the maximum, the elevation was fixed and 12 measurements made at 30° azimuth increments.

These results (from the vertically polarised dipole) were converted to PEIRP in mW. See the following table.

Elevation (°)	Azimuth (°)											
	0	30	60	90	120	150	180	210	240	270	300	330
5	39.672	39.672	38.769	37.887	38.769	41.542	41.542	38.769	38.769	37.024	37.024	38.769
10	39.671	-	-	-	-	-	-	-	-	-	-	-
15	41.237	-	-	-	-	-	-	-	-	-	-	-
20	42.58	-	-	-	-	-	-	-	-	-	-	-

The median result was calculated to be 38.769 mW, 15.88dBm.

The ratio between the maximum and minimum values was calculated to be 1.15. (showing the antenna to be omnidirectional).



Product Service

SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

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

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.11 - 121 Frequency Coherence				
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	O/P Mon
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	19-Jun-2008
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	24-Jul-2008
Hygrometer	Rotronic	I-1000	3068	25-Apr-2008
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-3-34	3161	30-May-2008
Thermocouple Thermometer	Fluke	51	3172	18-Jun-2008
Power Divider (N) 1W	Weinschel	1506A	3344	10-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	18-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	18-Apr-2008
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3411	28-Jul-2008
Section 2.8, 2.9 & 2.10 - 121 Modulation Characteristics				
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	O/P Mon
Signal Generator	Hewlett Packard	8644A	96	11-Jan-2008
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	19-Jun-2008
Oscilloscope	Lecroy	9310A	840	2-Aug-2008
Filter, Broadband	Texscan	8BC-134-67-3-BB	1241	TU
Beacon RF Unit	TUV	N/A	2445	TU
Beacon RF Unit	TUV	N/A	3066	TU
Hygrometer	Rotronic	I-1000	3068	25-Apr-2008
Termination (50ohm, 6W)	Micronde	R404613	3074	24-Feb-2008
Termination (50ohm, 15W)	Diamond Antenna	DL-30N	3096	16-Mar-2008
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-3-34	3161	30-May-2008
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-3-34	3162	19-Jun-2008



Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.8, 2.9 & 2.10 - 121 Modulation Characteristics				
Thermocouple Thermometer	Fluke	51	3172	18-Jun-2008
Bandpass Filter	Trilithic	5BE406/35-1-AA	3207	Class 1 (Int)
Time Interval Analyser	Yokogawa	TA720 704510	3253	4-Oct-2007
Scope Corder	Yokogawa	DL750 701210	3254	9-Oct-2007
Communications Receiver, AM, FM, & WFM	Unknown	IC-R5	3330	TU
Power Divider (N) 1W	Weinschel	1506A	3344	10-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	18-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	18-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3357	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3359	18-Apr-2008
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3411	28-Jul-2008
Section 2.10 - 121 Modulation Factor				
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	O/P Mon
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	19-Jun-2008
Oscilloscope	Lecroy	9370	2832	21-Sep-2007
Hygrometer	Rotronic	I-1000	3068	25-Apr-2008
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-3-34	3161	30-May-2008
Thermocouple Thermometer	Fluke	51	3172	18-Jun-2008
Power Divider (N) 1W	Weinschel	1506A	3344	10-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	18-Apr-2008
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3411	28-Jul-2008



Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.2 - 121 Spurious Emissions				
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	O/P Mon
Attenuator (10dB)	Weinschel	47-10-34	481	26-Feb-2008
Filter, Broadband	Texscan	8BC-134-67-3-BB	1241	TU
Hygrometer	Rotronic	I-1000	3068	25-Apr-2008
Attenuator (20dB, 75W)	Bird	8308-200	3076	26-Feb-2008
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	16-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3357	18-Apr-2008
Section 2.7 - 121 Transmitter Duty Cycle				
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	O/P Mon
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	19-Jun-2008
Oscilloscope	Lecroy	9370	2832	21-Sep-2007
Hygrometer	Rotronic	I-1000	3068	25-Apr-2008
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-3-34	3161	30-May-2008
Thermocouple Thermometer	Fluke	51	3172	18-Jun-2008
Power Divider (N) 1W	Weinschel	1506A	3344	10-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	18-Apr-2008
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	18-Apr-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	18-Apr-2008
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3411	28-Jul-2008



Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.12 - PEIRP				
Spectrum Analyser	Hewlett Packard	8568B	571	4-Jan-2008
Signal Generator	Rohde & Schwarz	SMS-2/28	1431	2-May-2008
Antenna Mast	EMCO	1050	1707	TU
Turntable Controller	Various	RH253	1708	TU
Open Area Site 2	TUV	OATS2	1850	3-Oct-2008
Turntable Interface	Various	RH-253.6	1855	TBD
Antenna Tower 6M	EMCO	1050	1859	TU
Roberts Antenna 406MHz	Compliance Design	-	1860	29-Jun-2009
Section 2.2 - Spurious Emissions				
Climatic Chamber	Heraeus Votsch	VM 04/100	85	O/P Mon
Attenuator 10dB 25W	Weinschel	46-10-43	400	13-Apr-2008
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	19-Jul-2008
Temperature Chamber	Montford	2F3	467	O/P Mon
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	19-Jun-2008
Attenuator: 10dB/20W	Narda	766-10	480	19-Jul-2008
Spectrum Analyser	Hewlett Packard	E4407B	1154	19-Jul-2008
GPS Frequency Standard	Rapco	GPS-804/3	1312	15-Sep-2007
Rubidium Oscillator	Rapco	GPS-805	1313	15-Sep-2007
Hygrometer	Rotronic	I-1000	2891	6-Jan-2008
Hygrometer	Rotronic	I-1000	3068	25-Apr-2008
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	30-May-2008
Thermocouple Thermometer	Fluke	51	3172	18-Jun-2008
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	18-Apr-2008

TU – Traceability Unscheduled

OP MON – Output Monitored with Calibrated Equipment



Product Service

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)



EUT



EUT – Close up view



Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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