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Report On

Emergency Beacons Testing of the
ACR Electronics PLB-375
In accordance with RTCM Standard 11010.2

Document 75911196 Report 06 Issue 1

July 2011



Product Service

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REPORT ON

Emergency Beacons Testing of the
ACR Electronics
PLB-375

Document 75911196 Report 06 Issue 1

July 2011

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DATED

14 July 2011

14 July 2011

14 July 2011





Product Service

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SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
ACR Electronics
PLB-375



Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics PLB-375 to the requirements of RTCM Standard 11010.2 2008

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
Model Number(s)	PLB-375
Serial Number(s)	Unit #25 (TUV Ref:TSR0004) Unit #14 (TUV Ref:TSR0003) Unit #7 (TUV Ref:TSR0036)
Number of Samples Tested	3
Test Specification/Issue/Date	RTCM Standard 11010.2: 2008
Incoming Release Date	Application Form 10 June 2011
Date of Receipt of Test Samples	20 December 2010
Order Number Date	13360-00 10 April 2010
Start of Test	15 March 2011
Finish of Test	4 July 2011
Name of Engineer(s)	M P Hardy M Russell S Mooney C Bowles N Williams



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1.2 APPLICATION FORM

1.2.1 Beacon Manufacturer and Beacon Model

Beacon Manufacturer	ACR Electronics, Inc.
Beacon Model	PLB-375
Other Model Names	ResQLink

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 frequency	406.037 MHz
Operating temperature range	Tmin = -20 °C Tmax = +55 °C
Operating lifetime	24 hours
Battery chemistry	LiMnO2
Battery cell model name, size and number of cells	CR123A, 2/3A, 3 Cells
Battery cell manufacturer	Panasonic
Battery pack manufacturer and part number	ACR, A3-06-2703
Battery pack replacement period	5 years



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Characteristic	Specification
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO
Oscillator manufacturer	Rakon
Oscillator part name and number	A1-11-0687-2 (E4672)
Oscillator satisfies long-term frequency stability requirements (Yes or No)	Yes
Antenna type: Integral or Other (e.g. External, Detachable – specify type)	Integral
Antenna manufacturer	ACR Electronics, Inc.
Antenna part name and number	A3-06-2701
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	GlobalTop Tech Inc.
- Navigation device model name and part Number	A1-11-0877
- GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS
For External Navigation Devices	
- Data protocol for GNSS receiver to beacon interface	N/A
- Physical interface for beacon to navigation device	N/A
- Electrical interface for beacon to navigation device	N/A
- Part number of the external navigation interface device (if applicable)	N/A
- Navigation device model and manufacturer (if beacon designed to use specific devices)	N/A



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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.)	LED	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)	Yes, 121.5 MHz	No
- Self-test can be activated directly at beacon (Yes or No)	Yes	Yes
- List of Items checked by self-test	Battery, 406 Pwr, Lock Det, Non-Volatile Memory	Battery, 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	1
- Maximum duration of Self Test / GNSS Self-test	10 seconds	125 seconds
- Maximum number of GNSS Self Tests (beacons with internal navigation devices only)	N/A	12
- Self-test results in transmission of a single burst, irrespective of the test result (Yes or No)	N/A	Yes
- Maximum number of self-tests during battery pack replacement period	60	N/A



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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
National Location Protocol (tick where appropriate)	☒ PLB with Serial Number
	☐ National Location: EPIRB
	☐ National Location: ELT
User Location Protocol (tick where appropriate)	☒ National Location: PLB
	☐ 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	



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Characteristic	Specification
Beacon includes a homer transmitter (if yes identify frequency of transmission)	121.5 MHz
-Homer Transmit Power	18 dBm
-Homer Duty Cycle	97 %
-Duty Cycle of Homer Swept Tone	33.3 %
Beacon includes a strobe light (Yes or No)	Yes
- Strobe light intensity	N/A
- Strobe light flash rate	20/minute
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, remote control, external audio and light indicators, external activation device). List details on a separate sheet if insufficient space to describe.	N/A
Beacon includes automatic activation mechanism (Yes or No) 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) List features and use a separate sheet if insufficient space	No



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1.2.4 Information Provided by the Cospas-Sarsat Accepted Test Facility

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

Date of Submission for Testing: December 2010

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001	3	11	Oct-10
C/S T.007	4	5	Oct-10

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:

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

Name:

M J Hardy

Position Held:

Authorised Signatory

Date:

14 July 2011



Product Service

1.2.5 Applicant Details

Company Name	ACR Electronics, Inc.		
Address	5757 Ravenswood Road Fort Lauderdale, FL 33312		
Category of Applicant	☒ Manufacturer	☐ Importer	
	☐ Distributor	☐ Agent	
Contact Name	Bryan French	Telephone	954-862-2135
Email	bryan.french@cobham.com	Facsimile	

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	T3b
- PCB Revision	T3a
- Battery Model	A3-06-2703
Software Version	N/A
Firmware Version	T3d
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: Signature held on file.

Name: Thomas Pack

Position Held: Director - New Product Development

Date: June 10, 2011

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a ACR Electronics PLB-375 as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.



Equipment Under Test

1.3.2 Physical Test Configuration

The Equipment Under Test (EUT) was operated using its own power source (internal battery). Two EUT's were configured so that the antenna port was connected to the 50 Ω test system using a coaxial cable. One EUT, #14 (TUV Ref:TSR0003) was used for tests where the specification required a Functional Check and a Functional Test. The second EUT, #7 (TUV Ref:TSR0036) was used for 121 Transmitter Characteristics.

The third EUT, #25 (TUV Ref: TSR0004) was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used for all tests required within the specification but was only subjected to a Functional Check, where required. 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.

Note: Both the conducted and radiated test samples were subjected to the relevant tests in parallel.



Product Service

1.3.3 Modes of Operation

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

Standby Mode:

- No apparent activity

Self-test:

- List of items checked as per Application Form

(Long/GPS Self-test):

- List of items checked as per Application Form

Operating:

- 121 Homing Transmitter
- GPS Receiver active
- 406 Transmitter active



Product Service

1.4 DEVIATIONS

During the drop test a deviation was made to the height of the drop test to enable the requirements of ETSI EN 302 152-1 to be met at the same time. This was more stringent than the conditions of RTCM 11010.2. Further details can be found in section 2.8.

A deviation from the standard was made during the thermal shock test: the deviation was a change in temperature to enable the requirements of ETSI EN 302 152-1 to be met at the same time. This was more stringent than the conditions of RTCM 11010.2. Further details can be found in section 2.9.

1.5 WAIVER REQUESTS

Waiver requests have been provided for Corrosion (A.8), Solar Radiation (A.17) and Oil Resistance (A.18). See Annex B: Customer Supplied Information.



Product Service

1.6 MODIFICATIONS

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: Unit #14			
0	As supplied by manufacturer.	N/A	N/A
2	Firmware upgrade to Rev. T3d to correct frame sync for GNSS Self Test.	M P Hardy	03 March 2011
3	-	-	-
4	Hardware Mod to eliminate 406 non transmitting error.	C Hoffman	11 March 2011
5	n/a to this sample.	-	18 May 2011
6	Mod to repair battery regulator problem (larger capacitors). Unwanted emissions occurred on 406 txr during RTCM Op Life.	Manufacturer	18 May 2011
Serial Number: Unit #25			
0	As supplied by manufacturer.	N/A	N/A
1	-	-	-
2	Firmware upgrade to Rev. T3d to correct frame sync for GNSS Self Test.	M P Hardy	03 March 2011
3	-	-	-
4	Hardware Mod to eliminate 406 non transmitting error.	C Hoffman	11 March 2011
Serial Number: Unit SN#7			
0	As supplied by manufacturer.	N/A	N/A
1	-	-	-
2	-	-	-
3	-	-	-
4	-	-	-
5	Mod to alter 121 power level (off ground plane failure).	Manufacturer	06 May 2011

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

1.7 REPORT MODIFICATION RECORD

Issue 1 – First Issue



Product Service

SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
ACR Electronics
PLB-375



Product Service

TEST RESULTS TABLE

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
1. PRE-CONDITIONING PERFORMANCE CHECK (A.1.13)						
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 4						Result: Pass
Visual Inspection	No Damage	P/F		P		
Carrier Frequency	406.025 MHz ± 0.002 MHz or Other ± 0.001 MHz	MHz		406.0376		
Digital Message	15 Hex / 30 Hex Correct	P/F		P		
121 MHz Homer						
Note Wherever a Performance Check is called for in these Test Results Tables it also includes a Visual Inspection of the PLB.	Functional	P/F		P		
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
Visual Inspection	No Damage	P/F		P		
Carrier Frequency	406.025 MHz ± 0.002 MHz or Other ± 0.001 MHz	MHz		406.0377		
Digital Message	15 Hex / 30 Hex Correct	P/F		P		
121 MHz Homer						
Note Wherever a Performance Check is called for in these Test Results Tables it also includes a Visual Inspection of the PLB.	Functional	P/F		P		



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
2. DRY HEAT TEST (A.3)						
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 4						Result: Pass
Post-Storage Performance Check	Pass/Fail	P/F			P	
Post-Functional Performance Test	Pass/Fail	P/F			P	
406 Output Power	35 – 39dBm	dBm			36.22	
406 Output Power Rise Time	<5mS	P/F			P	
Digital Message	Correct	P/F			P	
Bit Rate and Stability	400bps ± 1%	Bps			400.226	
406 Modulation	Phase Deviation ± 1.1 Rad ± 0.1 Rad	Rad			1.1178	
					-1.093	
406 Frequency	406.025 ± 0.002 or Other ± 0.001	MHz			406.0369756	
406 Spurious Output	Within Emission Mask	P/F			P	
Post-Functional Performance Check	Pass/Fail	P/F	P			



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
Post-Storage Performance Check	Pass/Fail	P/F			P	
Post-Functional Performance Test	Pass/Fail	P/F			N/A	
406 Output Power	35 – 39dBm	dBm			N/A	
406 Output Power Rise Time	<5mS	P/F			N/A	
Digital Message	Correct	P/F			N/A	
Bit Rate and Stability	400bps ± 1%	Bps			N/A	
406 Modulation	Phase Deviation ± 1.1 Rad ± 0.1 Rad	Rad			N/A	
406 Frequency	406.025 ± 0.002 or Other ± 0.001	MHz			N/A	
406 Spurious Output	Within Emission Mask	P/F			N/A	
Post-Functional Performance Check	Pass/Fail	P/F			P	
3. DAMP HEAT TEST (A.4)						
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 4						Result: Pass
Performance Check	Pass/Fail	P/F			P	
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
Performance Check	Pass/Fail	P/F			P	



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
4. LOW TEMPERATURE TEST(A.5)						
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 4						Result: Pass
Post-Storage Performance Check	Pass/Fail	P/F	P			
Post-Functional Performance Test	Pass/Fail	P/F	P			
406 Output Power	35 – 39dBm	dBm	36.56			
406 Output Power Rise Time	<5mS	P/F	P			
Digital Message	Correct	P/F	P			
Bit Rate and Stability	400bps ± 1%	Bps	400.231			
406 Modulation	Phase Deviation ± 1.1 Rad ± 0.1 Rad	Rad	1.0946 -1.1034			
406 Frequency	406.025 ± 0.002 or Other ± 0.001	MHz	406.0370039			
406 Spurious Output	Within Emission Mask	P/F	P			
Post-Functional Performance Check	Pass/Fail	P/F	P			



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
Post-Storage Performance Check	Pass/Fail	P/F	P			
Post-Functional Performance Test	Pass/Fail	P/F	N/A			
406 Output Power	35 – 39dBm	dBm	N/A			
406 Output Power Rise Time	<5mS	P/F	N/A			
Digital Message	Correct	P/F	N/A			
Bit Rate and Stability	400bps ± 1%	Bps	N/A			
406 Modulation	Phase Deviation ± 1.1 Rad ± 0.1 Rad	Rad	N/A			
406 Frequency	406.025 ± 0.002 or Other ± 0.001	MHz	N/A			
406 Spurious Output	Within Emission Mask	P/F	N/A			
Post-Functional Performance Check	Pass/Fail	P/F	P			
5. VIBRATION TEST (A.6)						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
During Test no Activation	No activation during test	P/F		P		
Performance Check	Pass/Fail	P/F		P		
6 BUMP TEST (A.7)						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
During Test, No Activation	No activation during test	P/F		P		
Performance Check	Pass/Fail	P/F		P		



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
8. DROP TEST (A.9)						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
During Test, no Activation	No activation during test	P/F	P			
Performance Check	Pass/Fail	P/F	P			
9. THERMAL SHOCK (A.10)						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
After test examine for signs of water ingress	No evidence of water ingress	P/F	P			
Performance Check	Pass/Fail	P/F	P			
10. IMMERSION TEST (A.11)						
Portable Equipment Temporary Immersion						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
After test examine for signs of water ingress	No evidence of water ingress	P/F		P		No battery compartment is available
Performance Check	Pass/Fail	P/F		P		
11. SPURIOUS EMISSIONS TEST (A.12)						
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 4						Result: Pass
Close in emissions	Comply with Figures 2 and 6	P/F	P	P	P	
Aeronautical, Maritime and Satellite Band Emissions	No signal to exceed 25µW in stated bands	P/F		P		



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PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
12. OPERATIONAL LIFE AND SELF TESTS (A.13)						
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						Result: Pass
Operational Life	24 Hours min	P/F	P			Where two or more results are displayed the upper is the minimum value across 24 hours, the lower is the maximum.
Pre-test battery discharge duration (operating)	-	hours	7.61			
Time to First Failure	-	hours	30.54			
Performance Test carried out every 6 hours	Confirm	Y/N	Y			
406 Output Power	35 – 39dBm	dBm	35.953 36.894			
406 Output Power Rise Time	<5mS	P/F	P			
Digital Message	Correct	P/F	P			
Bit Rate and Stability	400bps ± 1%	Bps	400.0			
			400.2			
406 Modulation	Phase Deviation ± 1.1 Rad ± 0.1 Rad	Rad	1.07			
			1.10			
			-1.09			
			-1.12			
406 Frequency	406.025 ± 0.002 or Other ± 0.001	MHz	406.0370178			
406 Spurious Output	Within Emission Mask	P/F	P			
121 Peak Envelope Output Power	Pass/Fail	P/F	P			



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PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
12. OPERATIONAL LIFE AND SELF TESTS (A.13.2)						
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						Result: Pass
Self-test						
RF Pulse Duration	≤ 0.444 sec or ≤ 0.525 sec	mSec	439.308	439.772	439.615	
Frame synchronization pattern	0 1101 0000	P/F	P	P	P	
Number of RF bursts	1-burst	P/F	P	P	P	
Beacon 15 Hex ID	Must be provided	P/F	P	P	P	
121.5 MHz transmission	≤ 1 sec / 3 sweeps	P/F	P	P	P	
13. Cospas-Sarsat TYPE APPROVAL TESTS (A.14)						
See Main Report Section (2.14)						Result: Pass
Cospas-Sarsat Type Approval Tests	/Certificate	Y/N	N			C/S testing to T.007 was carried out prior to the RTCM test campaign. See section 13 for further details.
14. BUOYANCY TEST (Category 1 PLBs only) (A.15)						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
A.15.1 Buoyancy	Floats	P/F		P		
A15.2 Floating Upright (PLBs designed to work floating in water only)	Self rights <2s	P/F		N/A		



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
15. 121.5 MHz AUXILLY RADIO-LOCATING DEVICE TRANSMITTER TEST (A.16)						
PLB-375 S/N: Unit #7 (TUV Ref TSR0036) Mod State: 5						Result: Pass
Carrier Frequency	121.5 ± 0.006075	MHz	121.498317308		121.499794872	
Transmitter Duty Cycle	Continuous interrupted for up to a maximum of 2 seconds encompassing the 406 MHz burst and plus the additional time required for the Morse “P” transmission.	P/F	P		P	
Modulation						
Frequency	≥ 700 Hz within 300 – 1600Hz	Hz	1033.0		1032.34	
Duty Cycle	33 – 55	%	35.68		35.42	
Factor	0.85 – 1.0		0.90		0.92	
Sweep Repetition Rate	2 – 4	Hz	2.526		2.526	
Frequency Coherence	Pass/Fail	P/F	P		P	
Morse Letter P						
Dot Length	115 ms ± 5%	ms	115.3		114.70	
Dash Length	345 ms ± 5%	ms	344.4	343.45		
Gap	115 ms ± 5%	ms	114.0	116.05		
Mod Frequency	1000 Hz ± 50Hz	Hz	1007.6		1000.0	
PEIRP (Radiated)	Median 14 – 20 dBm (25 – 100 mW)	dBm		17.81		
Max PEIRP	Value	dBm		17.90		
Min PEIRP	Value	dBm		17.80		
Ratio Max – Min	< 4:1 (<6dBm)	dB		0.10:1		
Off Ground Plane PEIRP	≥ 2 mW	mW		2.05		



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
18. COMPASS SAFE DISTANCE TEST (A.19)						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
Standard Compass Safe Distance	Mark Distance on PLB and/or in User Manual	m		0.300		
Emergency Compass Safe Distance	Mark Distance on PLB and/or in User Manual	m		0.200		



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
19. MISCELLANEOUS TESTS (A.20)						
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						Result: Pass
A.20.1 Controls and Indicators						Note: For Section 19 of this table “Y” denotes that the particular parameter or feature was inspected and observations reported at the main section or that Information supplied by the customer is supplied at Annex A. No final decision or comment is made upon compliance.
PLB complies with 4.4.1	Inspection	Y/N		-		
Two independent step activations	Inspection	Y/N		Y		
Visual or Audible indication of activation	Inspection	Y/N		Y		
A.20.2 Self-Test and GNSS Self Test Function						
Self Test automatically resets	Inspection	Y/N		Y		
Self Test has indication of activation	Inspection	Y/N		Y		
Manufacturers declaration complies with 4.4.2 a), b) and c)	Inspection	Y/N		Y*		
GNSS Self Test (if applicable)						
Distinct Means of Operation	Inspection	Y/N		Y		
Prevents Inadvertent Operation	Inspection	Y/N		Y		
Distinct Pass/Fail Indicators	Inspection	Y/N		Y		
Manufacturers declaration complies with 4.4.2 d), e) and f)	Inspection	Y/N		Y*		
A.20.3 Battery						*See Annex B: Customer Supplied Information
Labelling complies with 4.5.2.1	Inspection	Y/N		Y		
Manufacturer has provided evidence that Battery and Cells are either exempt from or meet UN Dangerous Goods regulations	Inspection	Y/N		Y*		
A.20.4 General Construction						
PLB complies with 4.5	Inspection	Y/N		Y		
A.20.5 Exterior Finish						
PLB complies with 4.5.1	Inspection	Y/N		Y		



Product Service

PARAMETER TO BE MEASURED	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			(-20°C)	(+21°C)	(+55°C)	
19. MISCELLANEOUS TESTS (A.20)						
A.20.6 Labelling						*See Annex B: Customer Supplied Information
Labelling complies with 4.5.2.2 to 4.5.2.2.4	Inspection	P/F		Y*		
Labelling tested for Abrasion Resistance	Inspect manufacturers report	P/F		Y*		
Instructions and Pictograms tested for Comprehension	Inspect manufacturers report	P/F		Y*		
A.20.7 Documentation						
Manual complies with 4.5.3	Inspection	P/F		Y		
Packaging complies with 4.5.4	Inspection	P/F		Not inspected		

N/T NOT TESTED



Product Service

2.1 GENERAL TEST CONDITIONS

2.1.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.1.2 Date of Test

1 July 2011 & 4 July 2011

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 Environmental Conditions

Ambient Temperature 22.3 - 24.1°C

Relative Humidity 37.9 - 45.3%

2.1.5 Test Results

Cospas-Sarsat Type Approval

The Cospas-Sarsat Type Approval process was completed as per the Cospas-Sarsat documents C/S T.001 and C/S T.007 as amended.

Cospas-Sarsat Document Versions Applied:

- Cospas-Sarsat T.001 Issue 3 Revision 11 October 2010
- Cospas-Sarsat T.007 Issue 4 Revision 5 October 2010

Cospas-Sarsat Type Approval Certificate(s): See C/S TAC-219.

Power Supply

Power during performance tests was supplied by batteries forming part of the Equipment Under Test.

The other requirements of the Power Supply clause (A.1.2) were observed throughout the test programme.

Warm-up Period

The maximum warm-up period allowed during testing was 15 minutes.



Product Service

2.2 PRE-CONDITIONING PERFORMANCE CHECK

2.2.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003) - Modification State 4

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.2.2 Date of Test

15 March 2011 & 16 March 2011

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 Environmental Conditions

Ambient Temperature 21.0 - 23.0°C

Relative Humidity 32.0 - 38.0%

2.2.5 Test Results

Visual Inspection

Prior to the start of the testing schedule the EUT was visually inspected. No signs of damage were found.

Performance Check

A Performance Check was conducted to ensure that the EUT was functional before all upcoming tests.

Summary of Performance Check Results

S/N: Unit #14 (TUV Ref TSR0003)

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C97F9C0637FDFFF11B237
Normal Mode:	
Normal Message	FF FE2F8C97F9C0637FDFFF11B23783E0F66C
406 MHz Frequency	406.0376
121 MHz Presence	P



Product Service

Summary of Performance Check Results

S/N: Unit #25 (TUV Ref TSR0004)

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0377
121 MHz Presence	P



Product Service

2.3 DRY HEAT TESTS

2.3.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003) - Modification State 4

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.3.2 Date of Test

15, 16 March 2011 & 17 March 2011

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 Environmental Conditions

Ambient Temperature 22.0 - 24.8°C

Relative Humidity 39.0 - 53.0%

2.3.5 Test Method

Storage Test

The EUT was placed in a climatic chamber with the temperature set to 70°C. After 15 hours, the temperature was reduced to 22°C for 2 hours. The EUT was subjected to a performance check during the last 30 mins.

Functional Test

The EUT was placed in a climatic chamber with the temperature set to 55°C. After 14 hours, the EUT was subjected to a performance check and performance test.

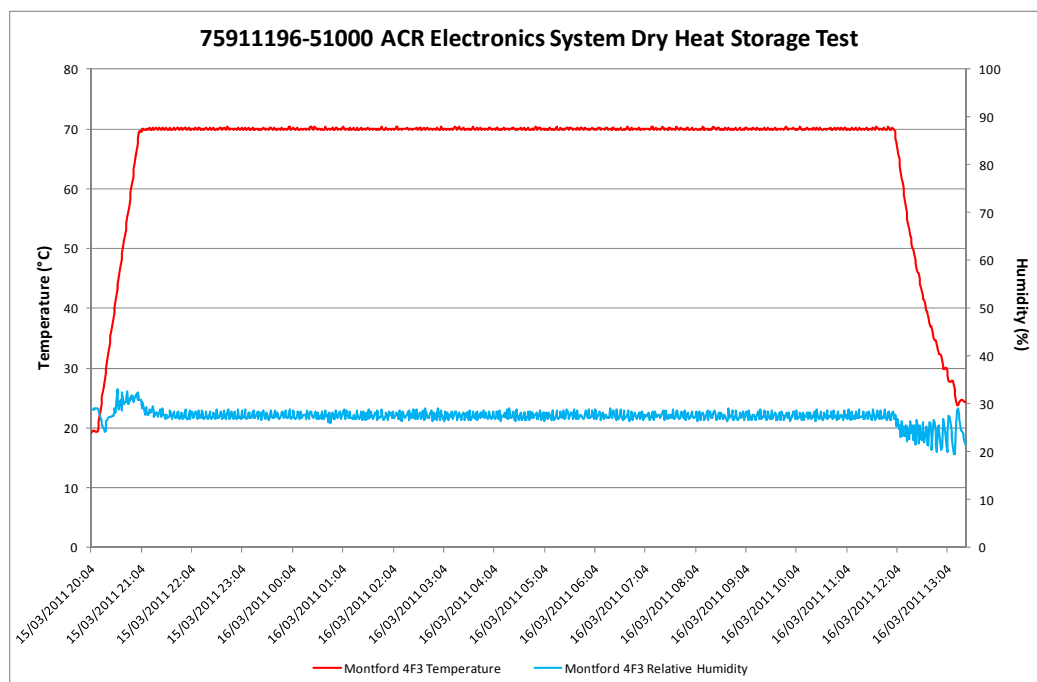


Product Service

2.3.6 Test Results

Storage Test

Temperature Plot



S/N: Unit #14 (TUV Ref TSR0003)

Post-Storage Period Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFED08C97F9C0637FDFFF11B237
Normal Mode:	
Normal Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C
406 MHz Frequency	406.0376
121 MHz Presence	P

S/N: Unit #25 (TUV Ref TSR0004)

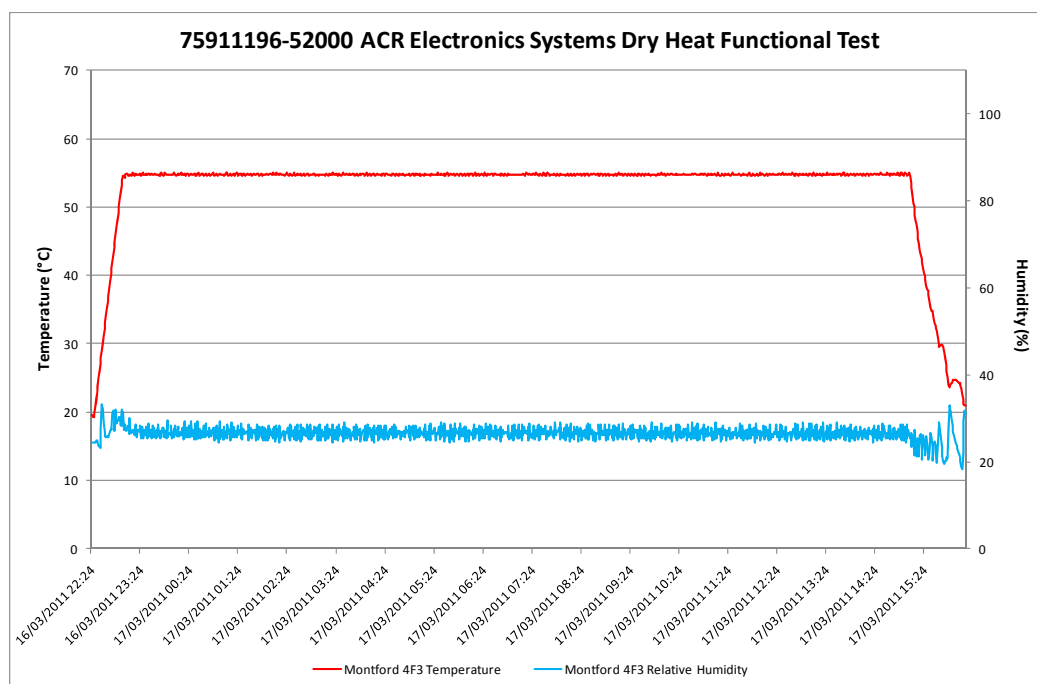
Parameter	Result
Self-test Mode:	
Self-test Message	FFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0377
121 MHz Presence	P



Product Service

Functional Test

Temperature Plot



During Functional Period Performance Test

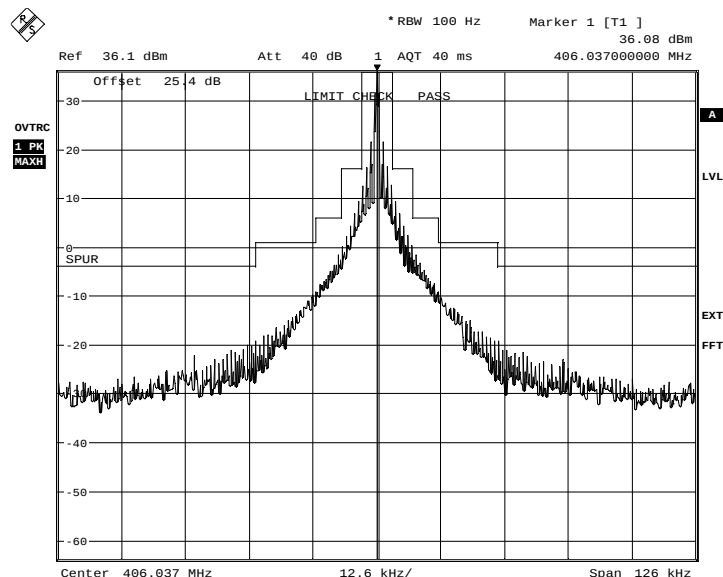
S/N: Unit #14 (TUV Ref TSR0003)

Parameter	Result
Output Power	36.22
Digital Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C
Bit Rate: Average (bps)	400.226
Modulation: Rise Time (uS)	157.3
Modulation: Fall Time (uS)	159.6
Positive Deviation (rad)	1.1178
Negative Deviation (rad)	-1.093
Nominal Frequency (MHz)	406.0369756
Short-term Stability (/100ms)	1.575×10^{-10}
Medium-term Stability – Slope (/minute)	-9.345×10^{-11}
Medium-term Stability – Residual	3.810×10^{-10}
Spurious Emissions	(see Plot)



Product Service

Spurious Emissions during Functional Period



Date: 17.MAR.2011 15:07:37

Post-Functional Period Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FF FE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0372
121 MHz Presence	P

S/N: Unit #25 (TUV Ref TSR0004)

Post-Functional Period Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C97F9C0637FDFFF11B237
Normal Mode:	
Normal Message	FF FE2F8C97F9C0637FDFFF11B23783E0F66C
406 MHz Frequency	406.0372
121 MHz Presence	P



Product Service

2.4 DAMP HEAT TEST

2.4.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003) - Modification State 4

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.4.2 Date of Test

23 March 2011 & 24 March 2011

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 Environmental Conditions

Ambient Temperature 23.1 - 40.0°C

Relative Humidity 41.9 - 95.0%

2.4.5 Test Method

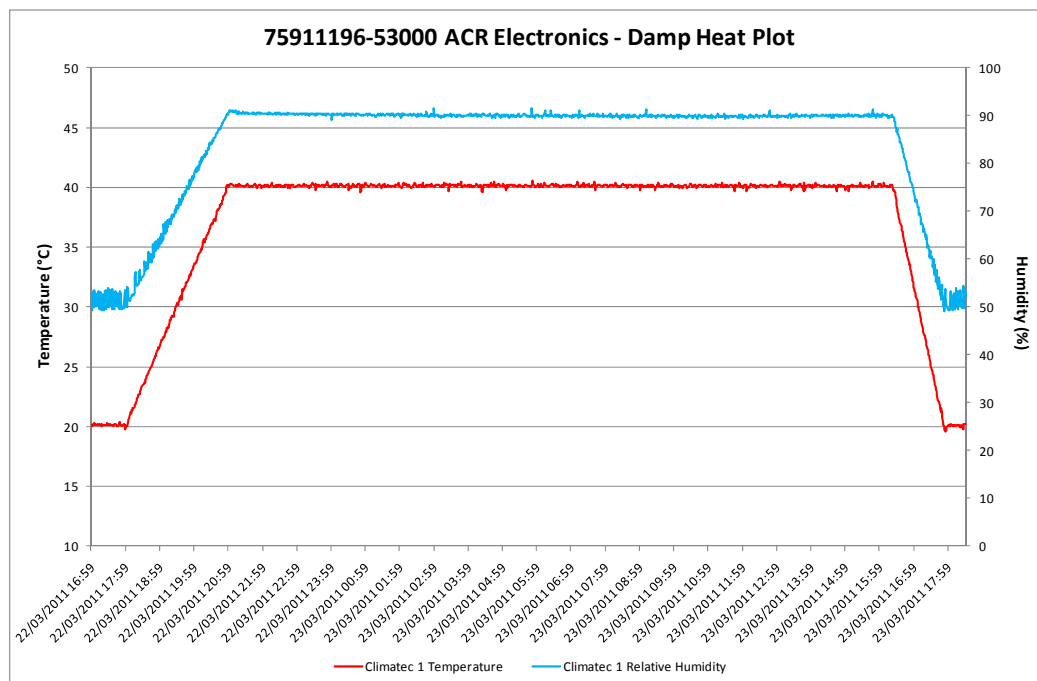
The EUT was placed in a climatic chamber with the temperature increased to 40°C and the relative humidity increased to 95%. After 14 hours, the EUT was activated for at least 2 hours and during this period was subjected to a performance check.



Product Service

2.4.6 Test Results

Temperature Plot



Summary of Performance Check Results

S/N: Unit #14 (TUV Ref TSR0003)

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C97F9C0637FDFFF11B237
Normal Mode:	
Normal Message	FF FE2F8C97F9C0637FDFFF11B23783E0F66C
406 MHz Frequency	406.0372
121 MHz Presence	P

S/N: Unit #25 (TUV Ref TSR0004)

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FF FE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0372
121 MHz Presence	P



Product Service

2.5 LOW TEMPERATURE TESTS

2.5.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003) - Modification State 4

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.5.2 Date of Test

24 March 2011 & 25 March 2011

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 Environmental Conditions

Ambient Temperature 22.8 - 24.3°C

Relative Humidity 38.2 - 43.4%

2.5.5 Test Method

Storage Test

The EUT was placed in a climatic chamber with the temperature reduced to -30°C. After 14 hours, the temperature was increased to ambient and was subjected to a performance check.

Functional Test

The EUT was placed in a climatic chamber with the temperature reduced to -20°C. After 15.5 hours, the EUT was activated for at least 2 hours and during this period was subjected to a performance check and performance test.

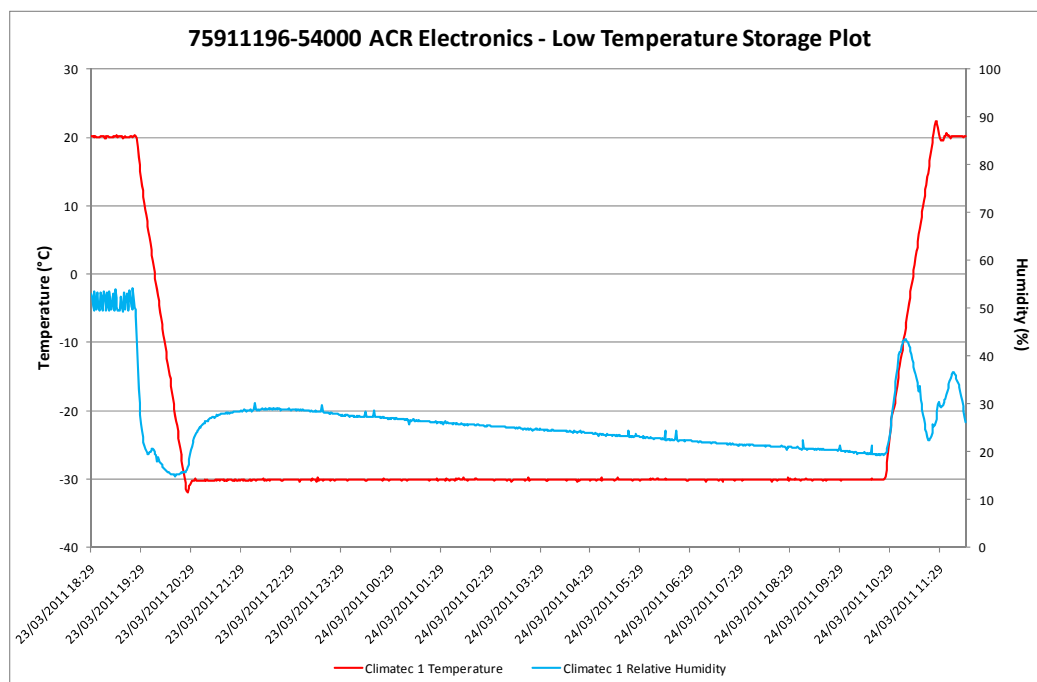


Product Service

2.5.6 Test Results

Storage Test

Temperature Plot



Summary of Performance Check Results

S/N: Unit #14 (TUV Ref TSR0003)

Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFED08C97F9C0637FDFFF11B237
Normal Mode:	
Normal Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C
406 MHz Frequency	406.037017
121 MHz Presence	P



Product Service

S/N: Unit #25 (TUV Ref TSR0004)

Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FF FE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.037055
121 MHz Presence	P

Functional Test

S/N: Unit #14 (TUV Ref TSR0003)

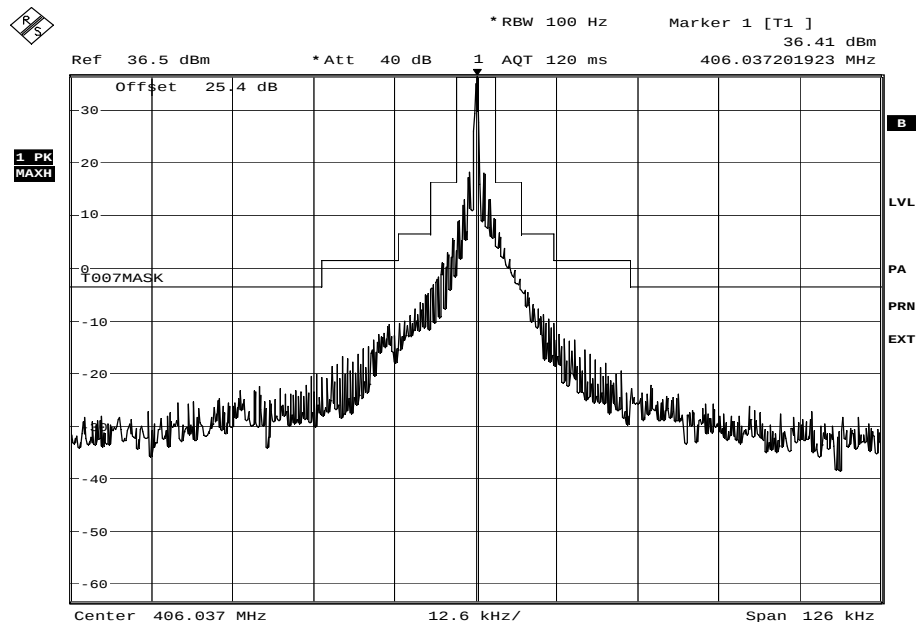
Performance Test

Parameter	Result
Output Power	36.56
Digital Message	FF FE2F8C97F9C0637FDFFF11B23783E0F66C
Bit Rate: Average (bps)	400.231
Modulation: Rise Time (uS)	172.3
Modulation: Fall Time (uS)	168.7
Positive Deviation (rad)	1.0946
Negative Deviation (rad)	-1.1034
Nominal Frequency (MHz)	406.0370039
Short-term Stability (/100ms)	2.101×10^{-10}
Medium-term Stability – Slope (/minute)	2.276×10^{-11}
Medium-term Stability – Residual Frequency Stability (no units)	1.034×10^{-9}
Spurious Emissions	(see Plot)



Product Service

Spurious Emissions



Date: 25.MAR.2011 12:41:57

Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C97F9C0637FDFFF11B237
Normal Mode:	
Normal Message	FF FE2F8C97F9C0637FDFFF11B23783E0F66C
406 MHz Frequency	406.037004
121 MHz Presence	P

S/N: Unit #25 (TUV Ref TSR0004)

Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FF FE2F8C9EF9C0637FDFF83D15B783E0F66
406 MHz Frequency	406.037062
121 MHz Presence	P



Product Service

2.6 VIBRATION TESTS

2.6.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.6.2 Date of Test

31 March 2011 & 4 April 2011

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 Environmental Conditions

Ambient Temperature 23.0 - 24.3°C

Relative Humidity 35.2 - 45.0%

2.6.5 Test Method

The EUT was fixed to the vibration table and was subject to the following vibration profiles:

Resonance Sweep

- 5 Hz and up to 13.2 Hz with an excursion of ± 1 mm (7 m/s² maximum acceleration at 13.2 Hz);
- above 13.2 Hz and up to 100 Hz with a constant maximum acceleration of 7 m/s².

One sweep was performed at a rate of 0.5 octaves / minute.

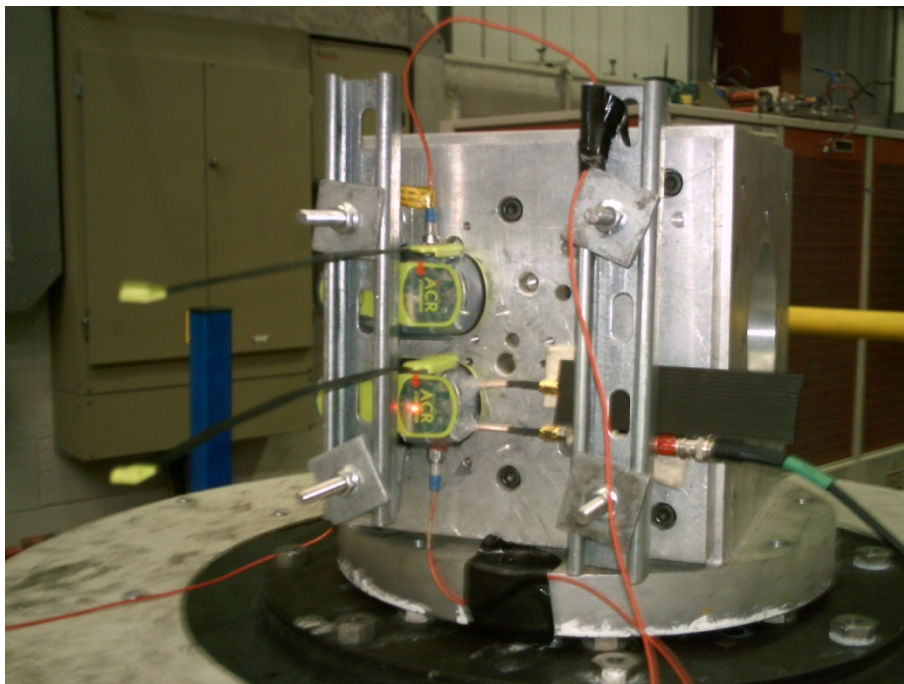
No resonances were found therefore the unit was subjected to a 2 hour endurance run at 30 Hz in each axis as required by the relevant standard.

2.6.6 Test Results

S/N: Unit #25 (TUV Ref TSR0004)

Summary of Performance Check Results

Example Setup Photo (side to side axis)





Product Service

Stage/Parameter	Results
Vertical Axis	
Resonance Search	None Found
Endurance Run	30Hz for 2hours
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0377
121 MHz Presence	P
Lateral Axis	
Resonance Search	None Found
Endurance Run	30Hz for 2hours
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0377
121 MHz Presence	P
Longitudinal Axis	
Resonance Search	None Found
Endurance Run	30Hz for 2hours
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0377
121 MHz Presence	P

Mechanical Inspection

Post test no signs of mechanical degradation were witnessed.

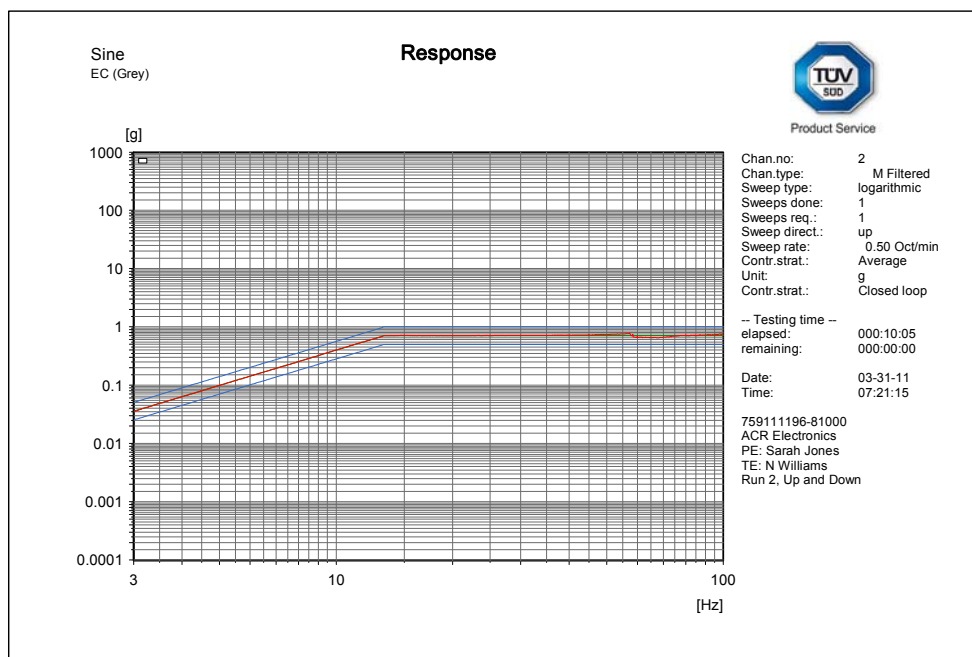
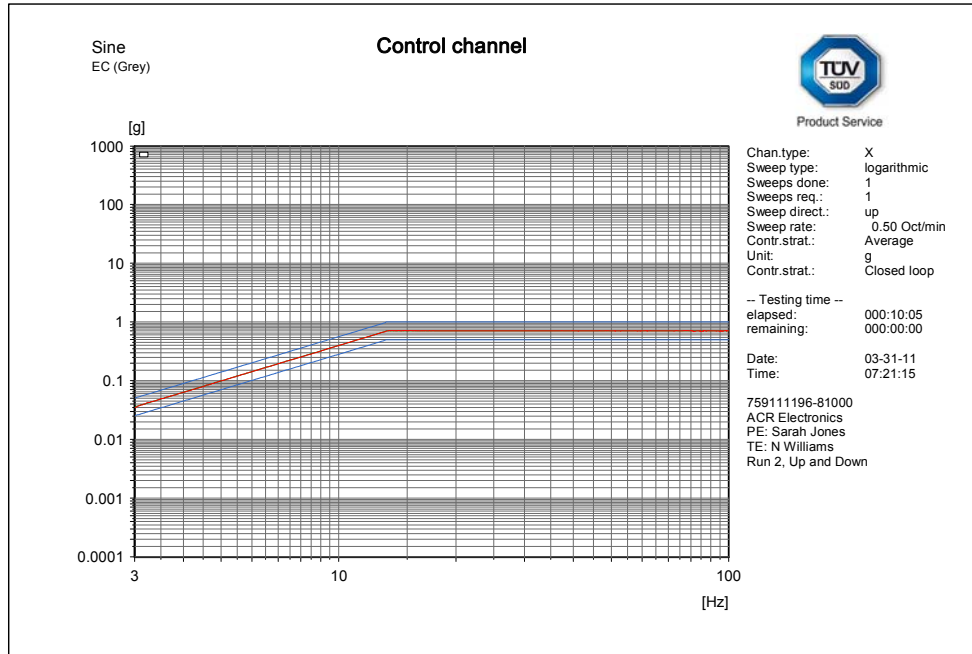
Activation Monitoring

During the test the EUT was monitored for signs of activation, none were found.



Product Service

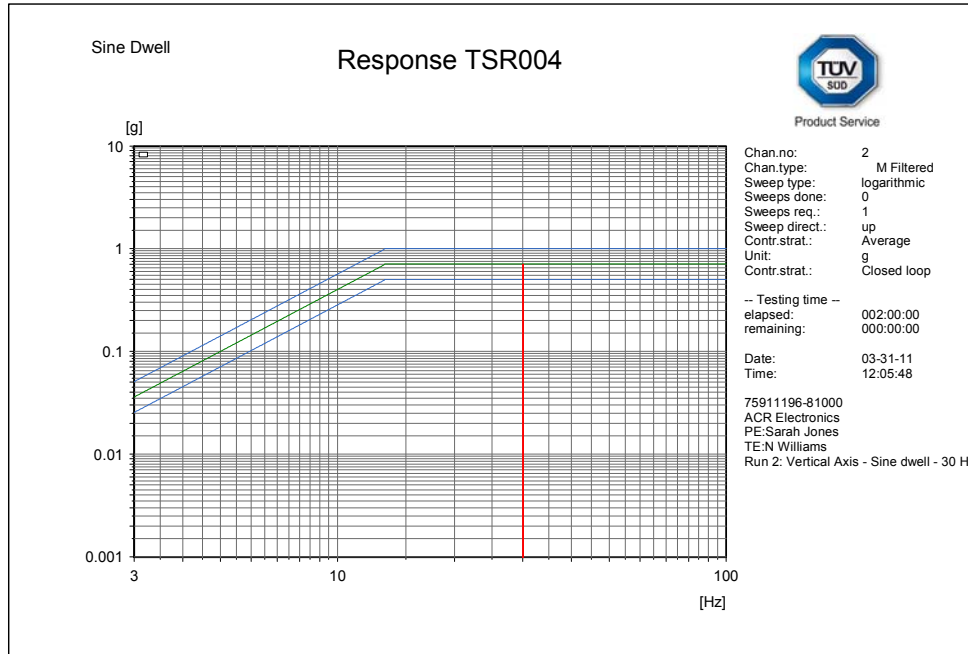
Vertical Axis





Product Service

Vertical Axis - Endurance

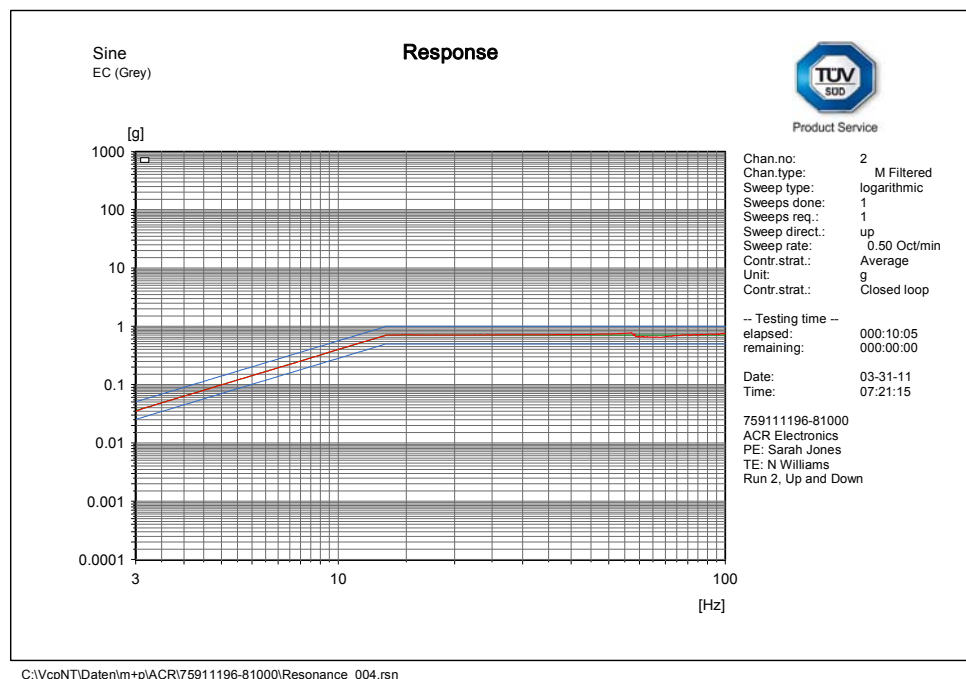
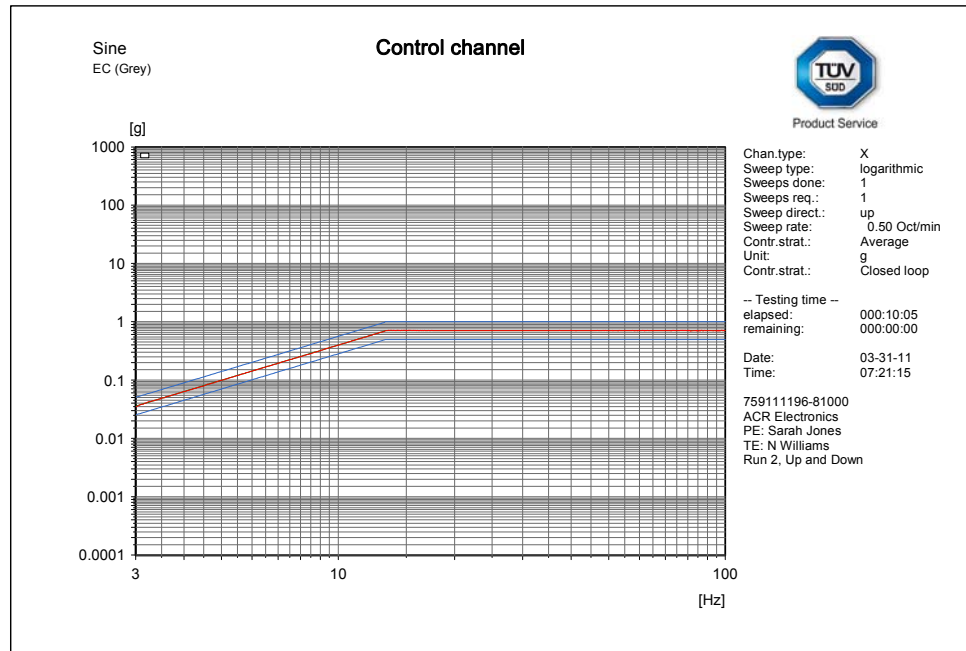


C:\VcpNT\Datos\m+p\ACR\75911196-81000\sine dwell-30 Hz. 003.rsd



Product Service

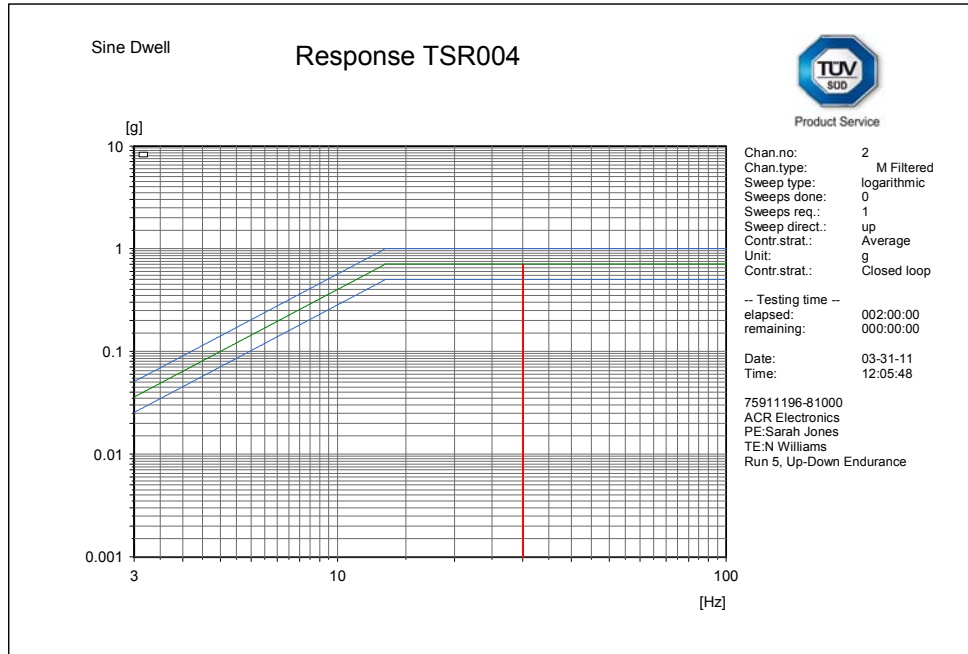
Lateral Axis





Product Service

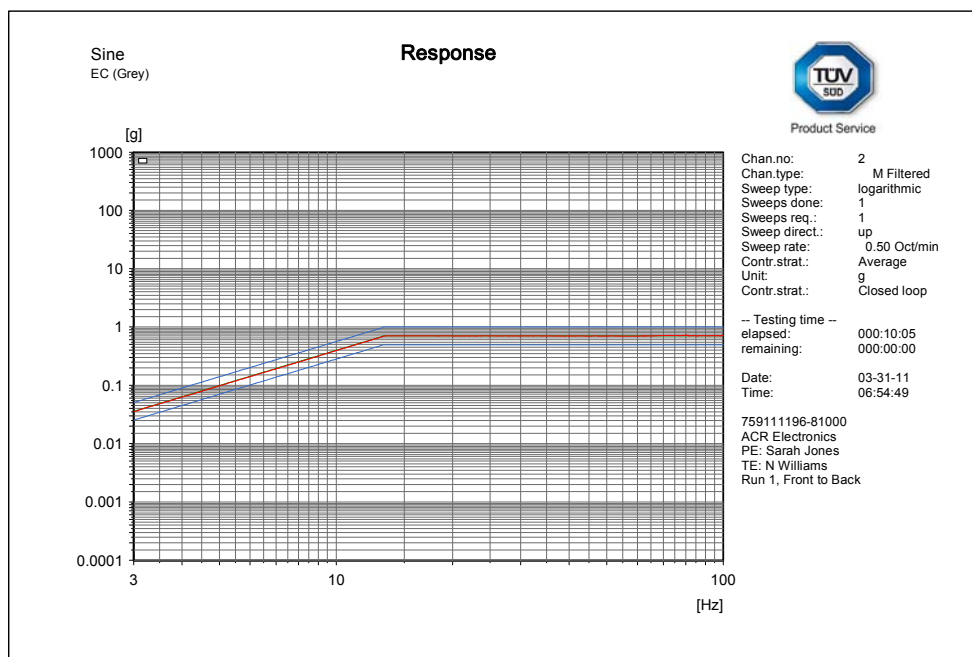
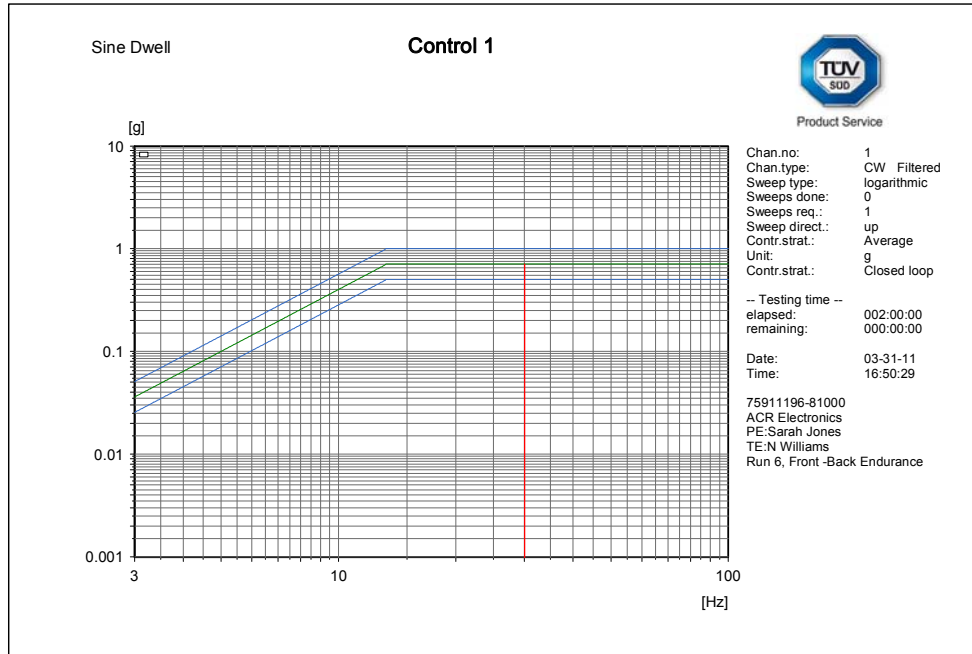
Lateral Axis – Endurance





Product Service

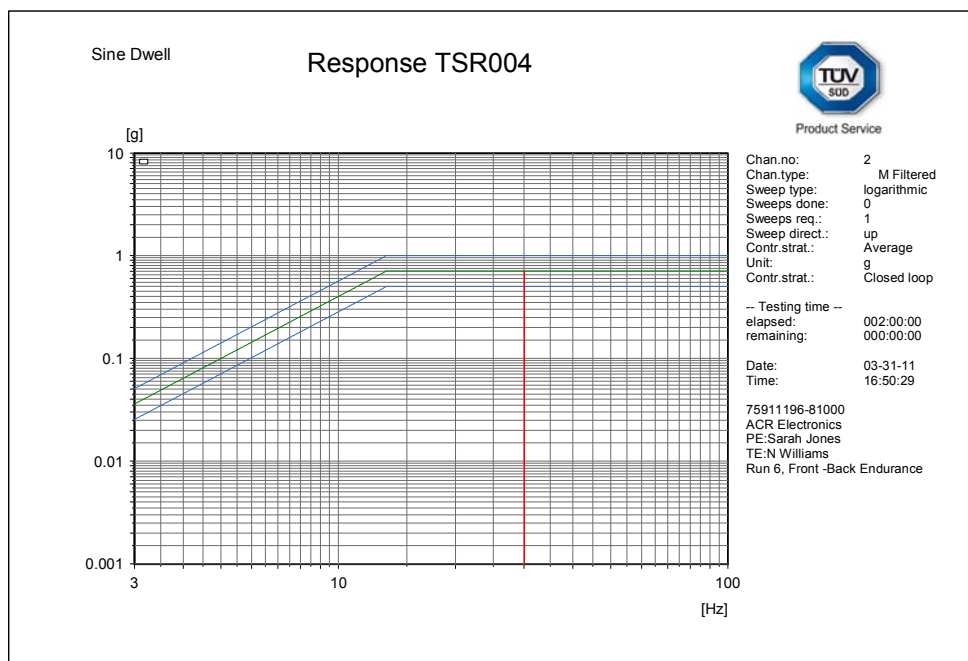
Longitudinal Axis





Product Service

Longitudinal Axis – Endurance





Product Service

2.7 BUMP TEST

2.7.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.7.2 Date of Test

1 April 2011

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 Environmental Conditions

Ambient Temperature 24.0°C

Relative Humidity 41.0%

2.7.5 Test Method

The PLB was subjected to the bump test according to the following profile:

Peak acceleration: 98 m/s² +/-10%

Pulse duration: 16 ms +/-10 %

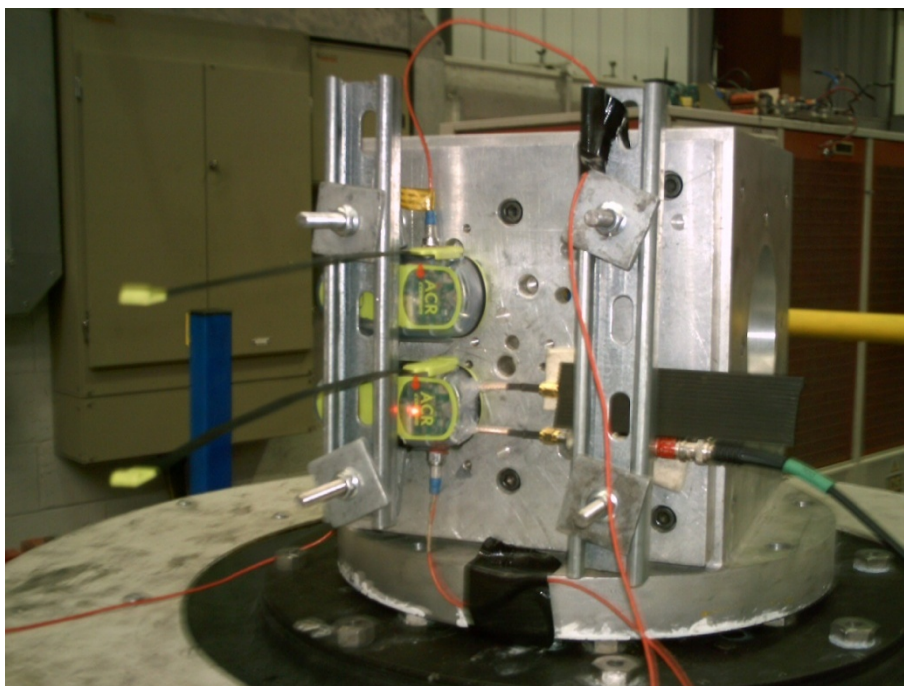
Wave shape: Half-cycle sinewave

Number of bumps: 4000

The test was carried out three times once with the PLB in each of the three axes.

2.7.6 Test Results

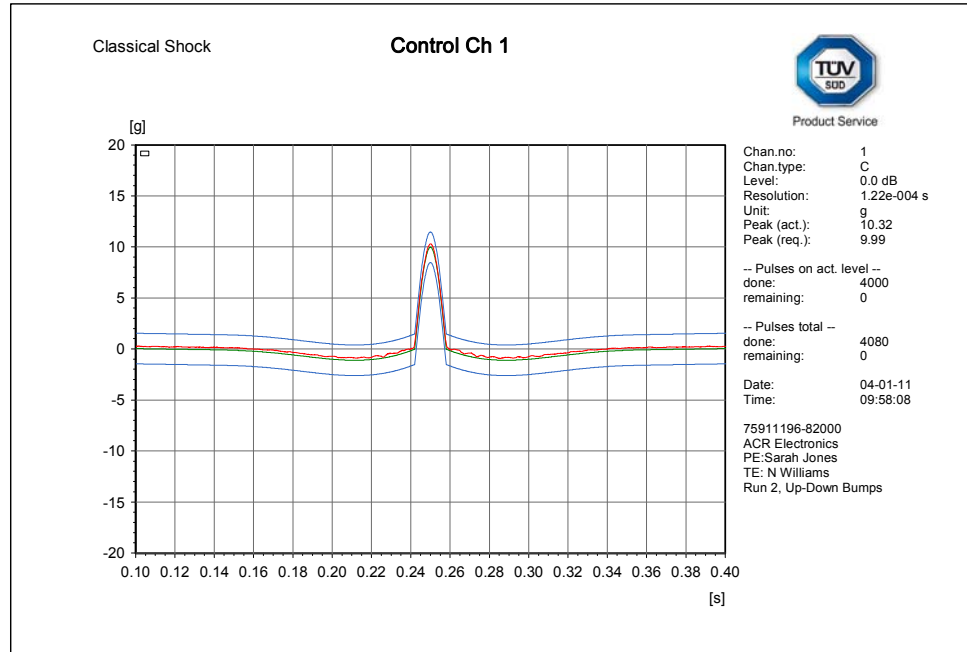
Example Setup Photo (side to side axis)



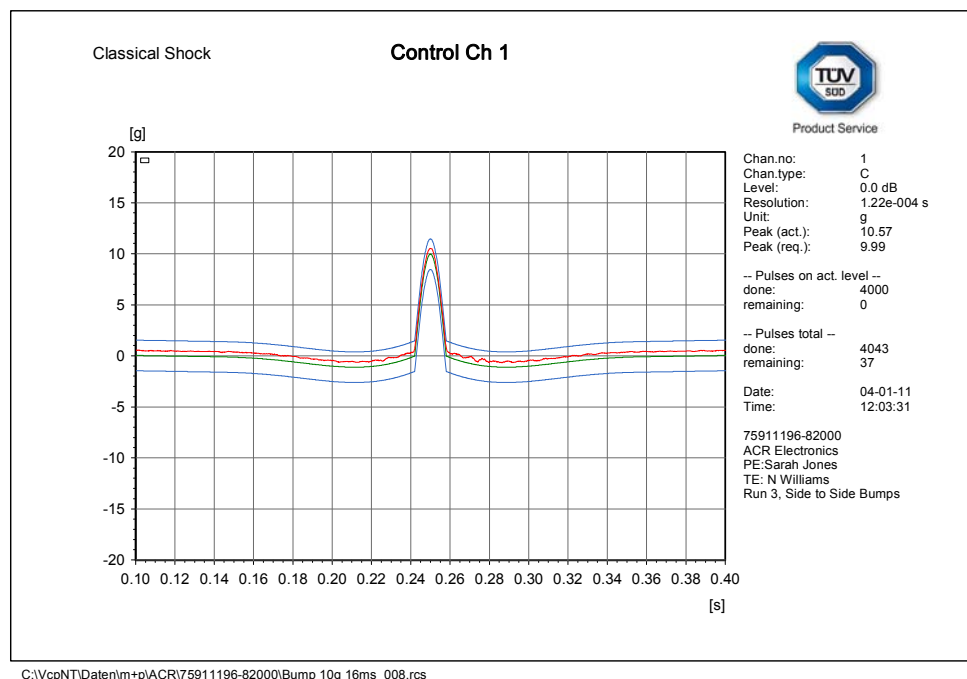


Product Service

Vertical Axis, 4000 Bumps



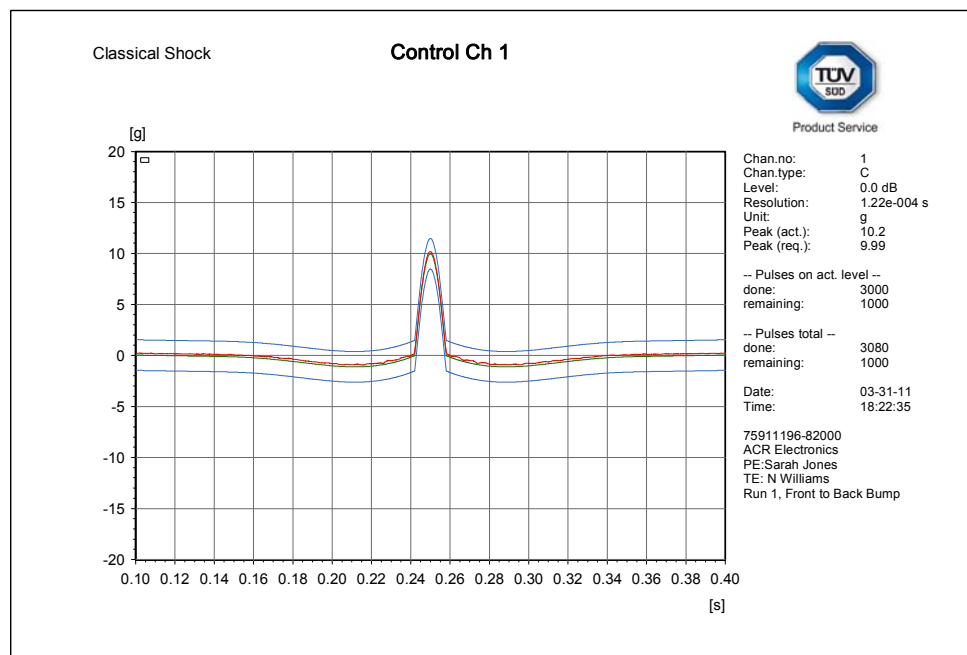
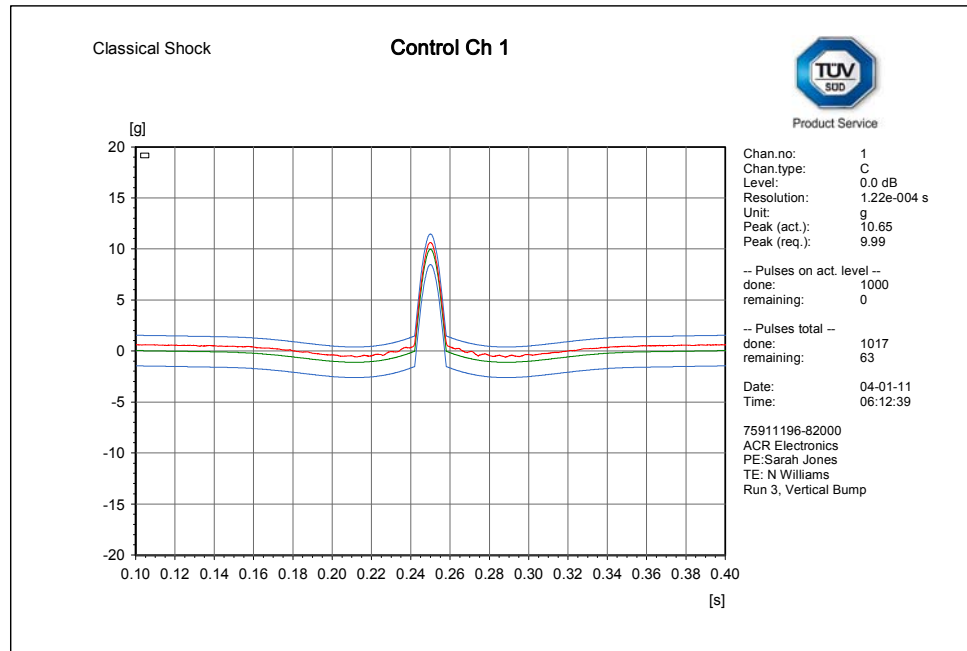
Horizontal Axis, 4000 Bumps





Product Service

Lateral Axis, 4000 Bumps



Post Test Inspection

No signs of mechanical degradation were observed.



Product Service

EUT Response

The EUT did not activate during the test.

Summary of Performance Check Results

S/N: Unit #25 (TUV Ref TSR0004)

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FF FE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0377
121 MHz Presence	P



Product Service

2.8 DROP TEST

2.8.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.8.2 Date of Test

1 April 2011

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 Environmental Conditions

Ambient Temperature 24.0°C

Relative Humidity 41.0%

2.8.5 Test Method

The test procedure below was followed to satisfy the requirements of ETSI EN 302 152 and is considered as an over test to the requirements of RTCM 11010.2

The EUT was placed in chamber and preconditioned at a temperature of -30°C for at least 2.5 hours. The drop test was completed within 5 minutes of removing the EUT from the preconditioning chamber.

The EUT was dropped 6 times, one on each face, from a height of 1220 mm onto the test surface (solid piece of hardwood).

2.8.6 Test Results

S/N: Unit #25 (TUV Ref TSR0004)

Setup Photo



Test Observations

The EUT was monitored and did not activate automatically during the test. The EUT was subjected to a visual inspection post-test and no signs of external damage were observed.

Summary of Performance Check Results

Parameter	Result
Self-test Mode:	
Self-test Message	FF FED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FF FE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0375
121 MHz Presence	P



Product Service

2.9 THERMAL SHOCK

2.9.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.9.2 Date of Test

4 April 2011 & 6 April 2011

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 Environmental Conditions

Ambient Temperature 24.3 - 24.4°C

Relative Humidity 33.7 - 42.1%

2.9.5 Test Method

The EUT was placed in the pre-conditioning climatic chamber at a temperature of 70°C for 1 hour.

The EUT was then immersed in a water vessel (preconditioned for approximately 1 hours) at 20°C*, at a level of 100mm below the surface of the water (measured to the highest point of the EUT).

The EUT was subjected to 48 hours of immersion.

* This temperature is a deviation from the standard to cover the requirements of ETSI EN 302 152-1 V1.1.1: 2003, and is regarded to be a more stringent test.

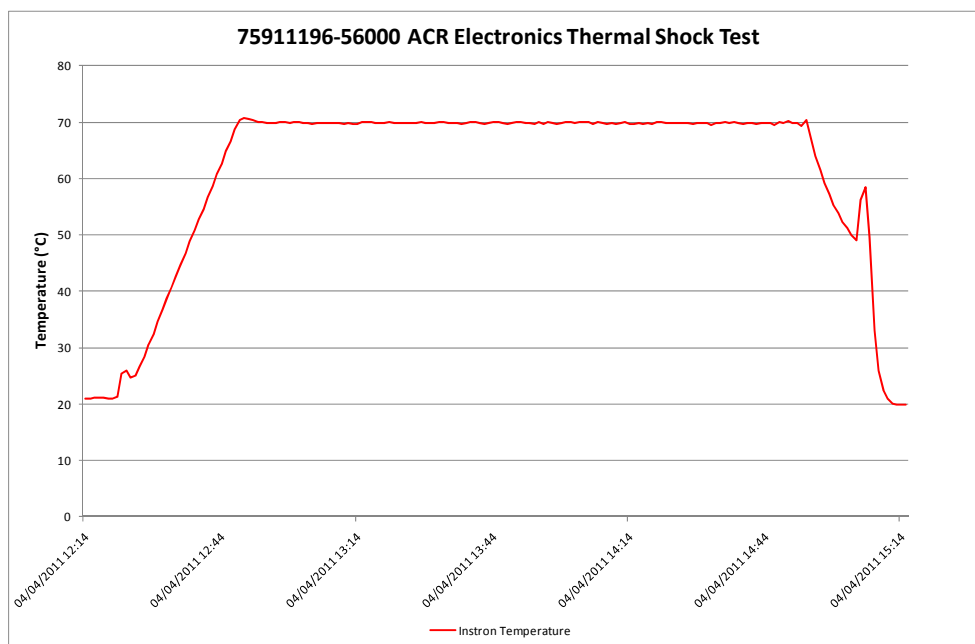


Product Service

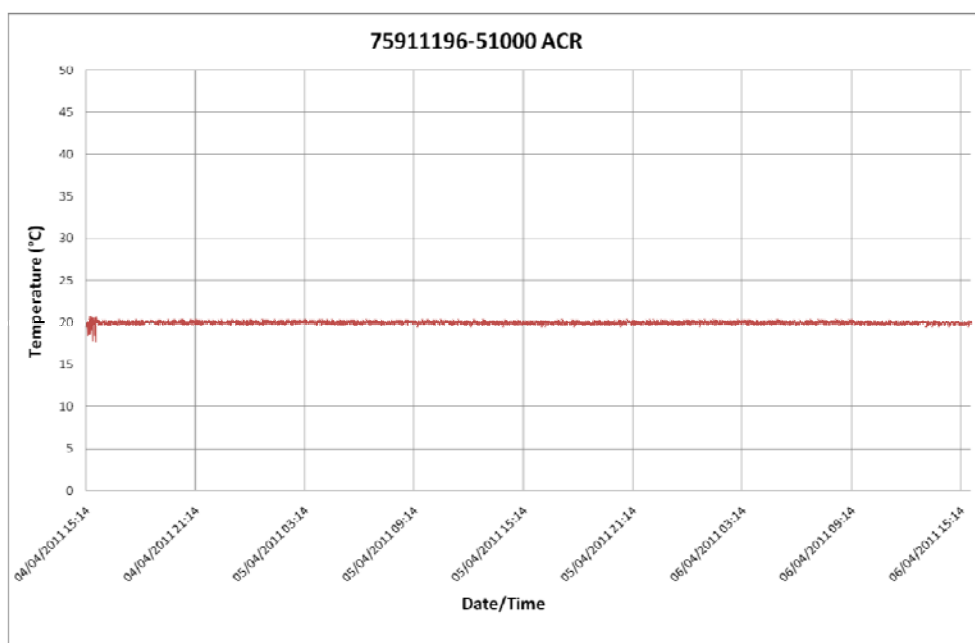
2.9.6 Test Results

S/N: Unit #14 (TUV Ref TSR0003)

Preconditioning Temperature Plot



Water Temperature Plot





Product Service

Setup Photo



Summary of Performance Check Results

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.037022
121 MHz Presence	P



Product Service

2.10 IMMERSION TEST

2.10.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.10.2 Date of Test

8 April 2011

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 Environmental Conditions

Ambient Temperature 20.5°C

Relative Humidity 40.0%

2.10.5 Test Method

Temporary Immersion

The EUT was completely submerged in a vessel of water and then positioned in an overpressure chamber and a gauge corresponding to 10 m was applied for a period of 1 hour(s).

The EUT was weighed before and after the test to indicate if any ingress occurred.



Product Service

2.10.6 Test Results

S/N: Unit #25 (TUV Ref TSR0004)

Setup Photo



Weight Before (Kg)	0.142
Weight After (Kg)	0.142

The weight after the test was the same as before the test, indicating no measurable ingress occurred.

Inspection

On completion of the test the EUT case was dismantled and inspected internally. No sign of water ingress was found.

Summary of Performance Check Results

Parameter	Result
Self-test Mode:	
Self-test Message	FFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.037028
121 MHz Presence	P



Product Service

2.11 SPURIOUS EMISSIONS TEST

2.11.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003)- Modification State 4

2.11.2 Date of Test

12 April 2011 & 13 April 2011

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 Environmental Conditions

Ambient Temperature 22.5 - 23.2°C

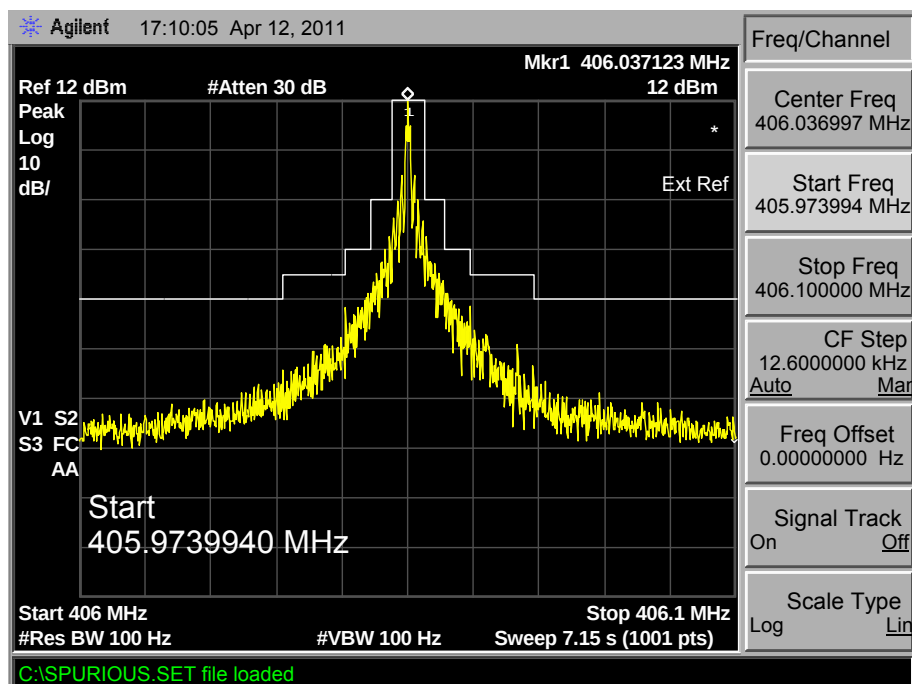
Relative Humidity 29.1 - 30.3%

2.11.5 Test Results

S/N: Unit #14 (TUV Ref TSR0003)

Close In Emissions

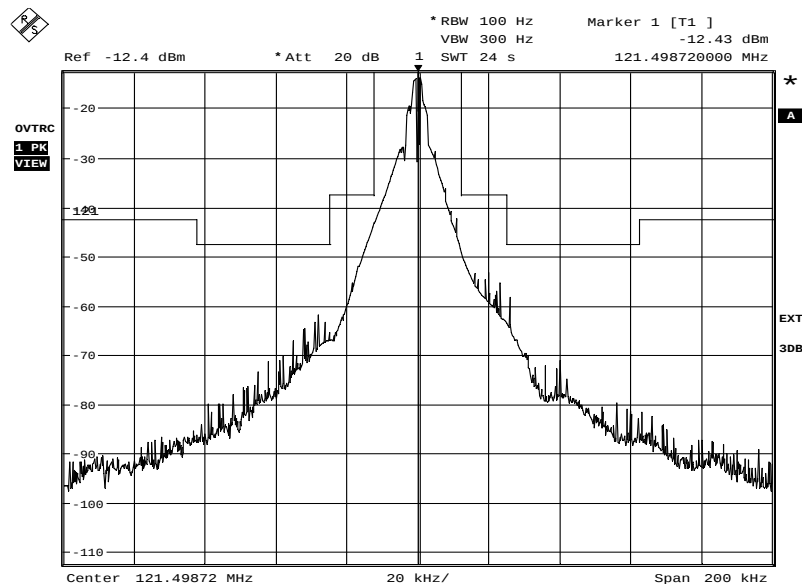
406 MHz Combined Plot Over Ambient Temperature, +55°C and -20°C



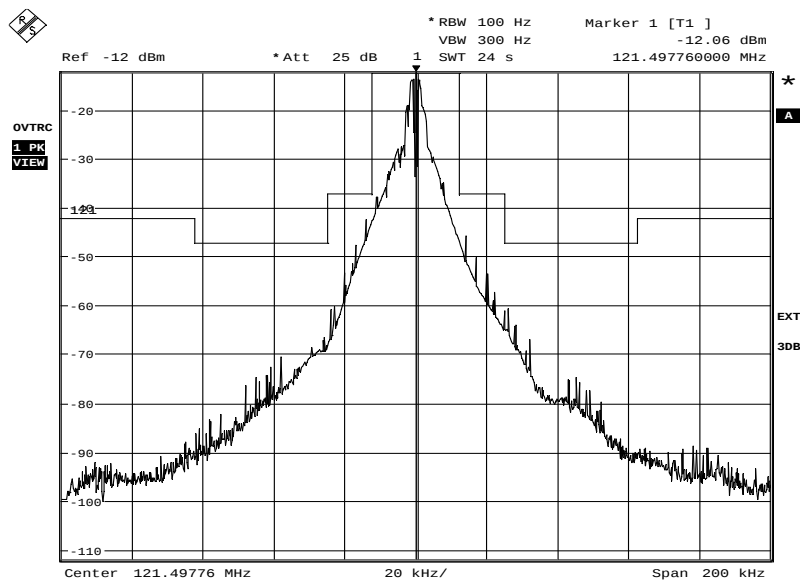


Product Service

121 MHz Plot at Ambient Temperature



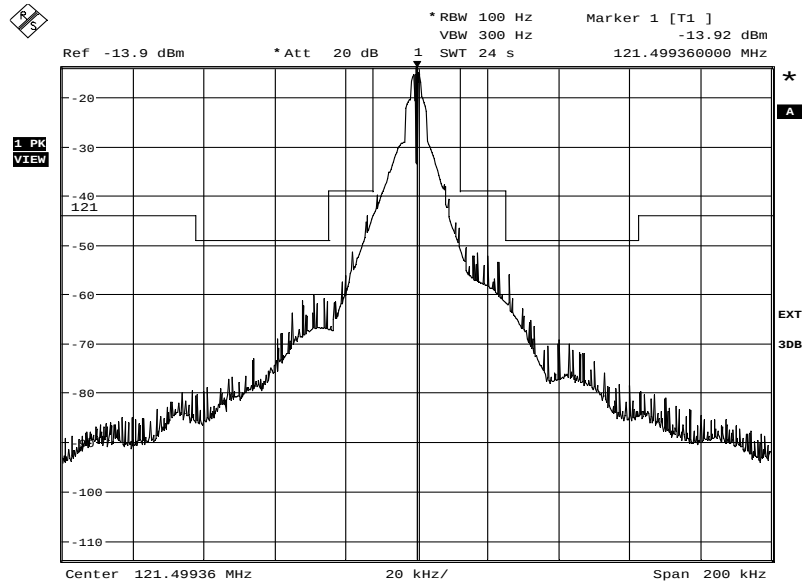
121 MHz Plot at Maximum Temperature (+55°C)





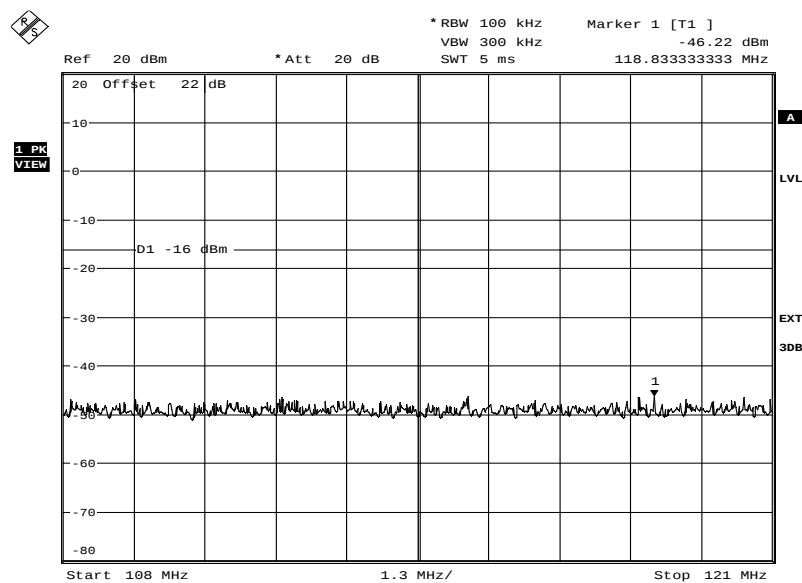
Product Service

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



Out of Band

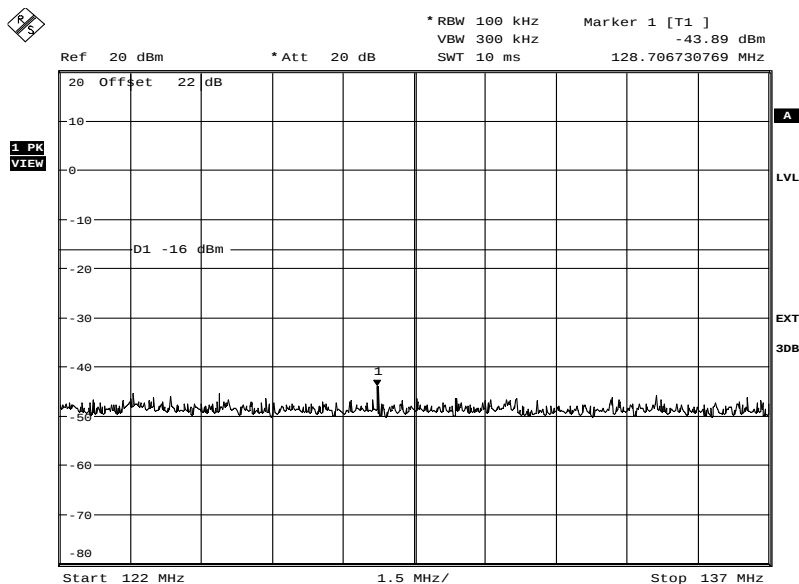
108 MHz to 121 MHz



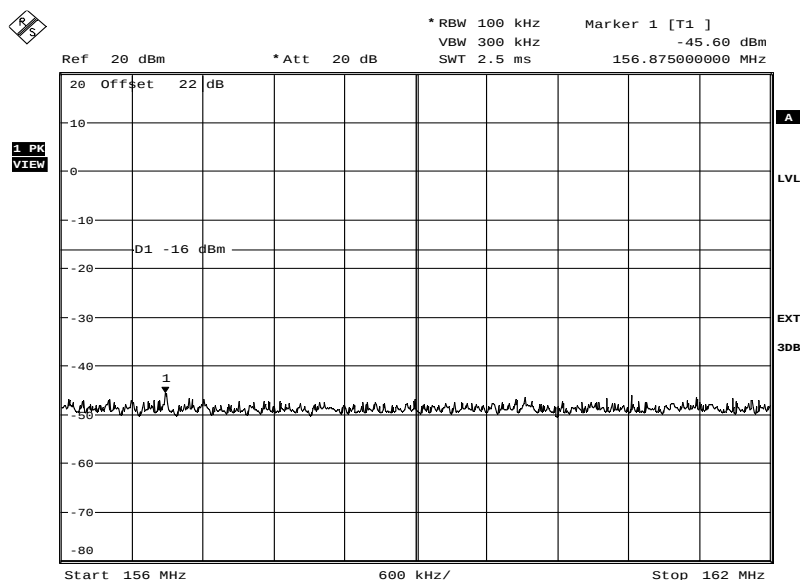


Product Service

122 MHz to 137 MHz



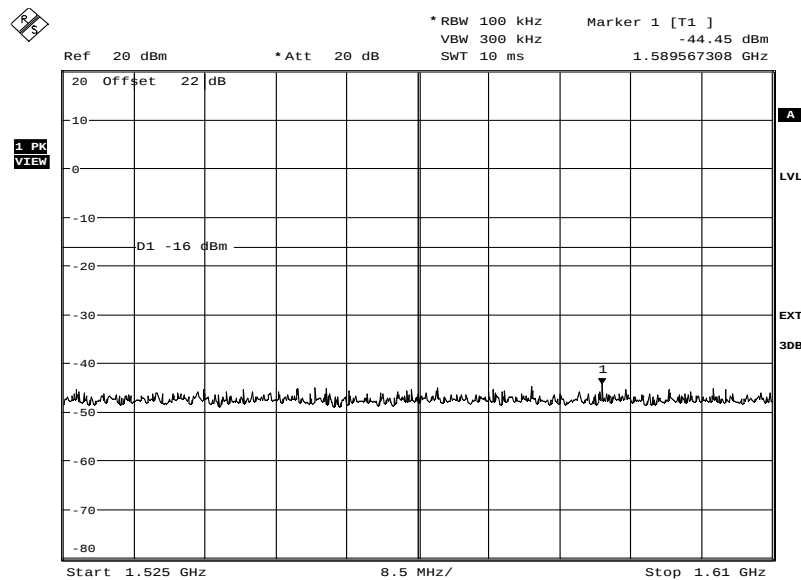
156 MHz to 162 MHz





Product Service

1525 MHz to 1610 MHz



Note: Limit of 25 μ W (-16.0 dBm) is displayed on the result plots.



Product Service

2.12 OPERATIONAL LIFE TEST

2.12.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003) - Modification State 6

2.12.2 Date of Test

14 April 2011, & 26, 27 & 28 May 2011

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 Environmental Conditions

Ambient Temperature 21.9 - 22.9°C

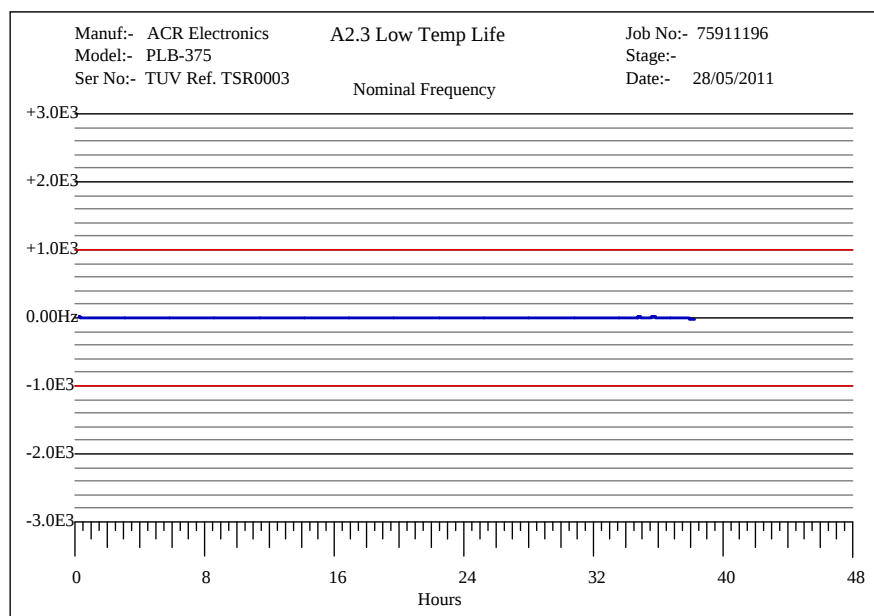
Relative Humidity 34.0 - 39.6%

2.12.5 Test Results

S/N: Unit #14 (TUV Ref TSR0003)

Test Method Used: 1

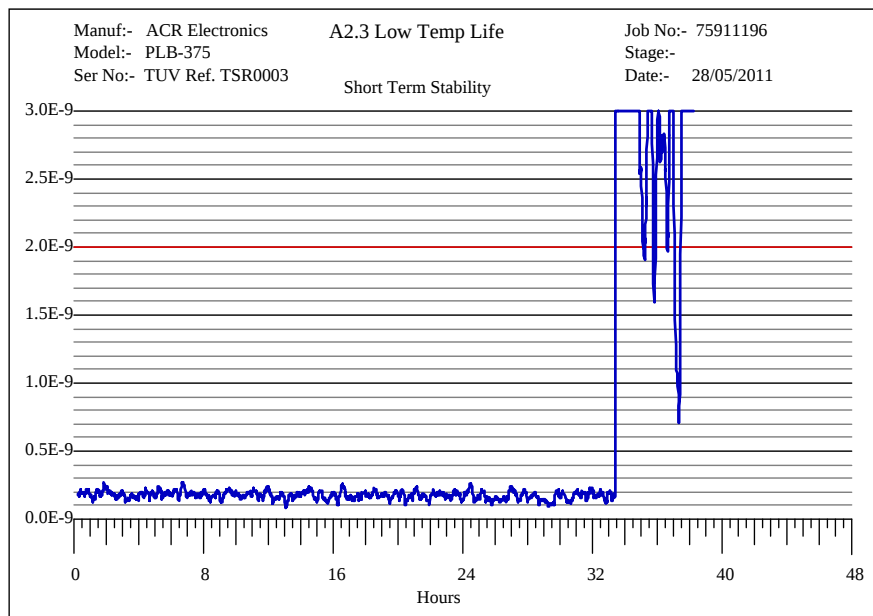
Nominal Frequency



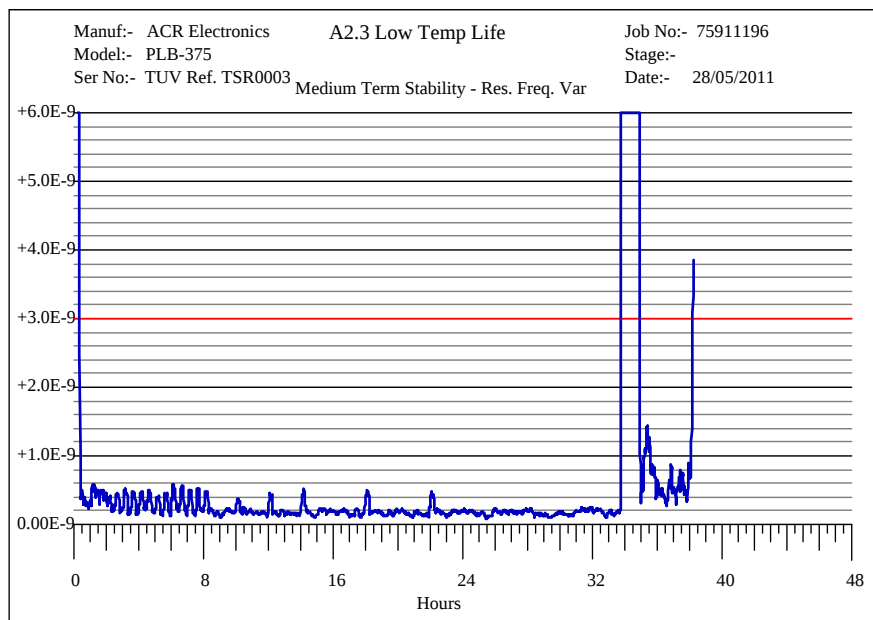


Product Service

Short Term Stability



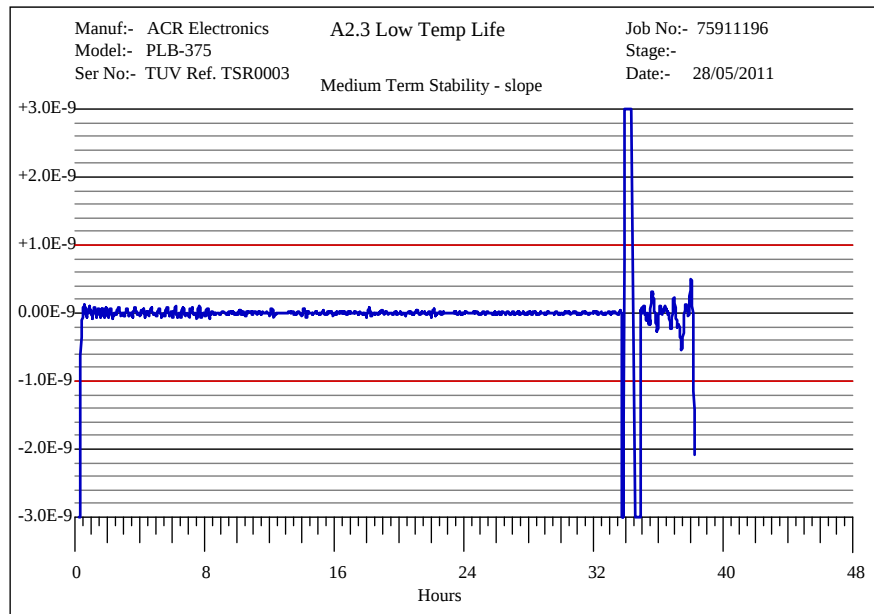
Medium Term Stability, Mean Slope



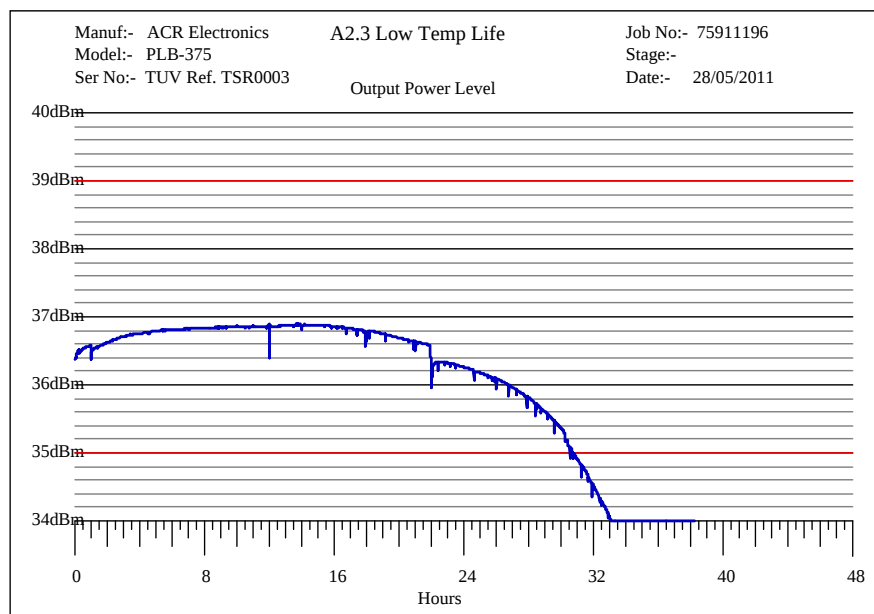


Product Service

Medium Term Stability, Residual Frequency Variation



Output Power





Product Service

Digital Message

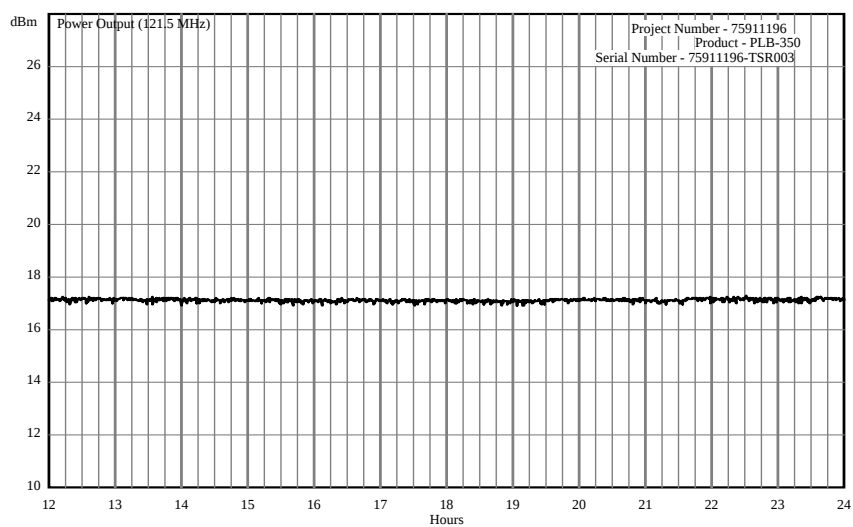
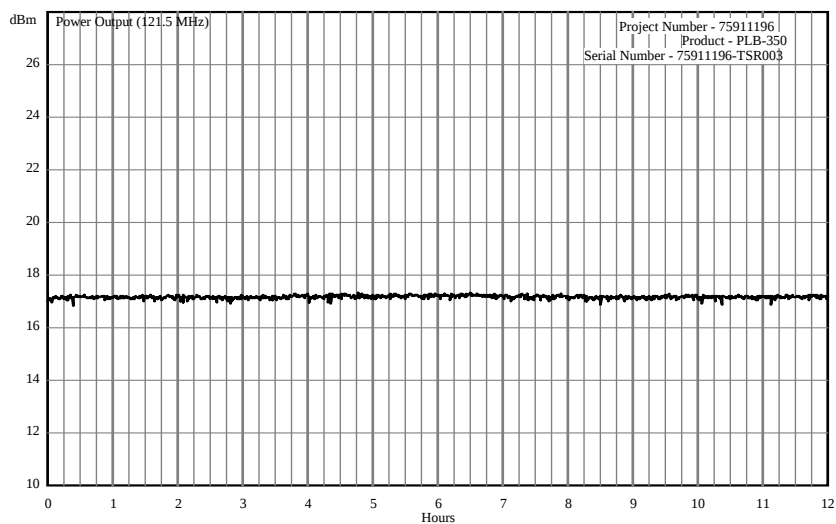
=====															
Beacon Id Format..... 30 Hex Id, Long Message, Bits 25-144															
15 Hex (Bits 26- 85) = 192FF380C6FFBFF 192FF380C6FFBFF Default_Id															
30 Hex (Bits 25-144) = 8C97F9C0637FDFFF11B23783E0F66C															
	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82
1	0001	1001	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

121 MHz Peak Envelope Power Results

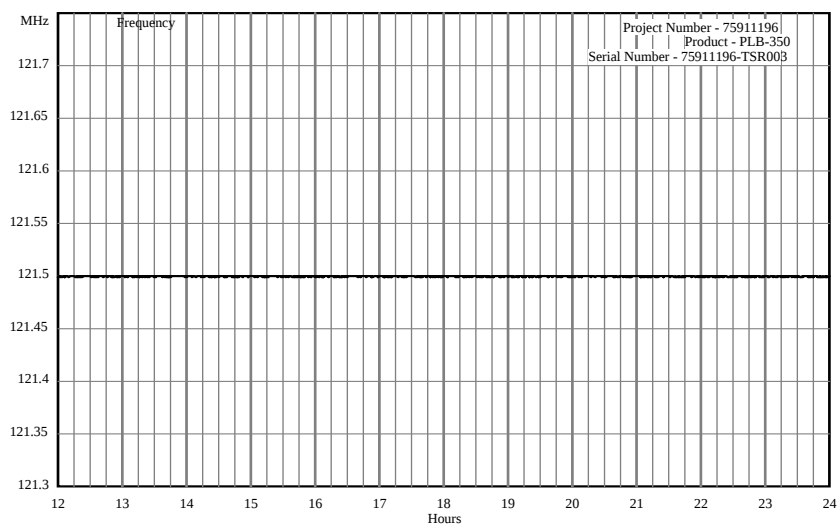
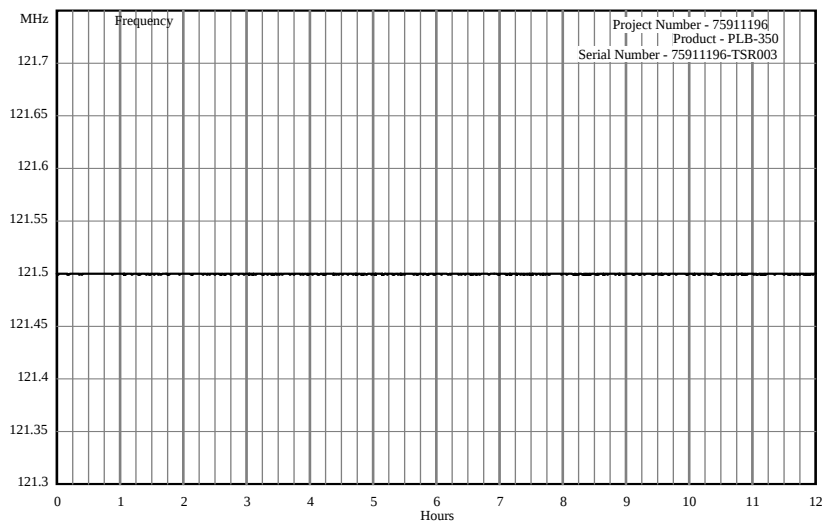
Output Power (to 24 hours)





Product Service

Output Frequency (to 24 hours)





Product Service

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	: 15 minutes	(899928 ms)
Self-test Current	: 8.96 seconds	(8960 ms)
GPS ST Current	: 129 seconds	(129200 ms)
Operating Current	: 9.94 minutes	(596480 ms)

Assumptions / Supplied Data

Battery Replacement Interval	: 12 years	
Battery Capacity	: 1.55 Ah	
Battery Self Drain	: 1.00 % per year	
Self-test Interval	: 12 tests per year	
GPS Self-test Interval	: 1 tests per year	(12 in total over 12 years)

Test Results

Mode Current	= Accumulated Charge / Time	
Standby Current	= $294429.19 \text{ pC} / 899928 \text{ ms}$	= 0.33 nA
Self-test Current	= $775074.4 \text{ uC} / 8960 \text{ ms}$	= 86.50 mA
GPS ST Current	= $4739646 \text{ uC} / 129200 \text{ ms}$	= 36.68 mA
Operating Current	= $17482149 \text{ uC} / 596480 \text{ ms}$	= 29.31 mA

Battery Preconditioning / Discharge Time Calculations

$$\begin{aligned} \text{Battery Self Drain} &= \text{Capacity} - [(100\% - \text{Self Drain/Year}\%)^{\text{Replacement Interval}} \times \text{Capacity}] \\ &= 1.6 - ((1 - 0.0100)^{\#} \times 1.55) = 0.1761 \text{ Ah} \end{aligned}$$

$$\begin{aligned} \text{Standby Drain} &= \text{Hours per year} \times \text{Battery Replacement Interval} \times \text{Standby Current} \\ &= 365 \times 24 \times \# \times 0.33 \times 10^{-9} = 0.0000 \text{ Ah} \end{aligned}$$

$$\text{Worst Case} = 1 \times 0.0000 \text{ Ah} = 0.0000 \text{ Ah}$$

$$\begin{aligned} \text{Self-test Drain} &= \text{Self-tests per battery} \times \text{Self-test Current} \times \text{Self-test duration} \\ &= 12 \times \# \times 86.50 \times 10^{-3} \times (8.96 / 3600) = 0.0310 \text{ Ah} \end{aligned}$$

$$\text{Worst Case} = 1 \times 0.0310 \text{ Ah} = 0.0310 \text{ Ah}$$

$$\begin{aligned} \text{GPS ST Drain} &= \text{Self-tests per battery} \times \text{Self-test Current} \times \text{Self-test duration} \\ &= 1 \times 1 \times 36.68 \times 10^{-3} \times (129 / 60) = 0.0158 \text{ Ah} \end{aligned}$$

$$\text{Worst Case} = 1 \times 0.0158 \text{ Ah} = 0.0158 \text{ Ah}$$

$$\begin{aligned} \text{Total Drain} &= \text{Self Drain} + \text{Standby Drain} + \text{Self-test Drain} + \text{GPS ST Drain} \\ &= 0.1761 + 0.0000 + 0.0310 + 0.0158 \text{ Ah} = 0.2229 \text{ Ah} \end{aligned}$$

$$\begin{aligned} \text{Battery Preconditioning / Discharge Time} &= \text{Worst Case drain} / \text{Operational Current} \\ &= 0.2229 / (29.31 \times 10^{-3}) \\ &= \underline{7.61 \text{ hours}} \end{aligned}$$



Product Service

2.13 SELF-TEST

2.13.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003) - Modification State 6

2.13.2 Date of Test

30 June 2011

2.13.3 Test Equipment Used

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

2.13.4 Environmental Conditions

Ambient Temperature 21.1 - 22.1°C

Relative Humidity 38.7 - 44.2%

2.13.5 Test Results

S/N: Unit #14 (TUV Ref TSR0003)

The EUT was fitted with a separate switch to activate the Self Test function.

Summary of Self-test Results

Parameter	Limit/Units	Test Results		
		(-20°C)	(20°C)	(+55°C)
Self-test Indication	P/F	P	P	P
Pulse duration	≤ 444 mS	439.308	439.772	439.615
Frame sync pattern	011010000	P	P	P
Single Burst Verification	P/F	P	P	P
15 Hex ID	P/F	P	P	P
Self-test 121 MHz transmission	< 1 second or 3 sweeps	P	P	P

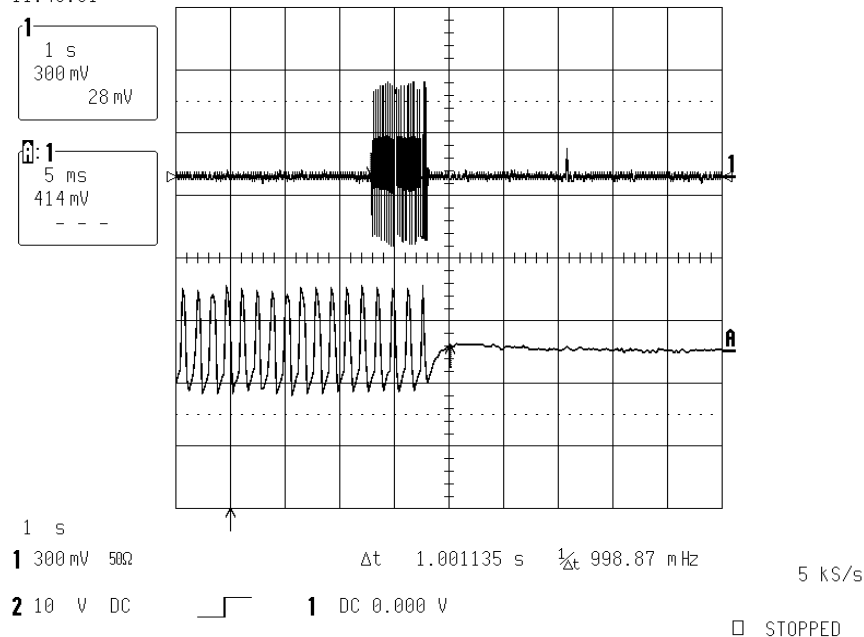


Product Service

Ambient

121 Signal Duration

30-Jun-11
11:45:01



Digital Message

=====

Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
15 Hex (Bits 26- 85) = 192FF380C6FFBFF 192FF380C6FFBFF Default_Id
30 Hex (Bits 25-144) = 8C97F9C0637FDFFF11B23700000000

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	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	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
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	

121 Signal Duration

☐ STOPPED

=====

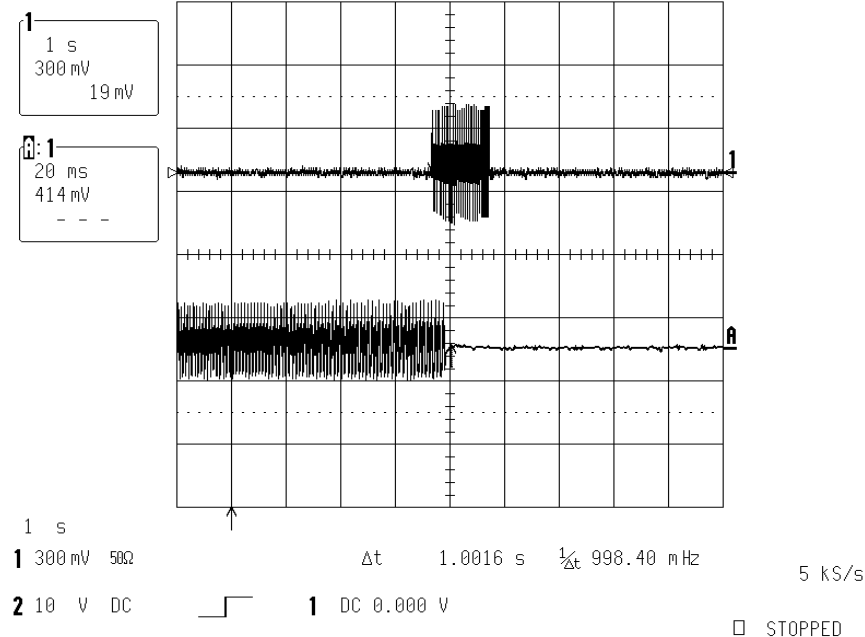


Product Service

Minimum Temperature

121 Signal Duration

30-Jun-11
14:36:34



Digital Message

```
=====
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
15 Hex (Bits 26- 85) = 192FF380C6FFBFF 192FF380C6FFBFF Default_Id
30 Hex (Bits 25-144) = 8C97F9C0637FDFFF11B23700000000

 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 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    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
Fixed Bits      107-109
Fixed Bit       110       1 1
Encode Pos Device 111     1 Internal 1
121.5 Homing    112     1 YES 1
Resultant Position --> Not Defined

=====
```



Product Service

2.14 COSPAS-SARSAT TYPE APPROVAL TEST PROCEDURE

2.14.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #14 (TUV Ref TSR0003)- Modification State 6

PLB-375 S/N: Unit #25 (TUV Ref TSR0004)- Modification State 4

2.14.2 Date of Test

30 June 2011

2.14.3 Test Equipment Used

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

2.14.4 Environmental Conditions

Ambient Temperature 21.8°C

Relative Humidity 37.8%

2.14.5 Test Results

Full Cospas-Sarsat testing was carried out prior to the RTCM 11010.2 sequence of test as requested by ACR Electronics. A limited number of Cospas-Sarsat tests were repeated in order to demonstrate continuing compliance. The summary of results of the limited test campaign which was carried out as required by the sequence of tests (A.2) can be found in annex A.

EUT tested in accordance with Cospas-Sarsat T.001 Issue 3 Revision 11 October 2010 and Cospas-Sarsat T.007 Issue 4 Revision 5 October 2010 and results of the full test campaign were submitted to Cospas-Sarsat Secretariat for approval.

Cospas-Sarsat Type Approval Certificate: See C/S TAC-219.

This is intended to show compliance with the above Specification References.



Product Service

2.15 BUOYANCY TEST

2.15.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

Note: for this test the EUT was fitted with a customer-supplied "floatation pouch".

2.15.2 Date of Test

30 June 2011

2.15.3 Test Equipment Used

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

2.15.4 Environmental Conditions

Ambient Temperature 21.6°C

Relative Humidity 38.2%

2.15.5 Test Results

S/N: Unit #25 (TUV Ref TSR0004)

The buoyancy was calculated by dividing the volume of the unit above the waterline by the total volume of the EUT.

EUT volume above waterline = 0.0042 m³

EUT volume (total) = 0.0232 m³

Buoyancy = $\frac{0.0042}{0.0232}$

Buoyancy = 0.181 = 18.10%



Product Service

2.16 121.5 MHZ AUXILLARY RADIO-LOCATING DEVICE TRANSMITTER TEST

2.16.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit SN#7 - Modification State 5

2.16.2 Date of Test

24 May 2011, 16 June 2011, 17 June 2011, 27 June 2011 & 28 June 2011

2.16.3 Test Equipment Used

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

2.16.4 Environmental Conditions

Ambient Temperature 19.1 - 22.6°C

Relative Humidity 40.5 - 52.8%

2.16.5 Test Results

S/N: Unit #7 (TUV Ref TSR0036)

Carrier Frequency

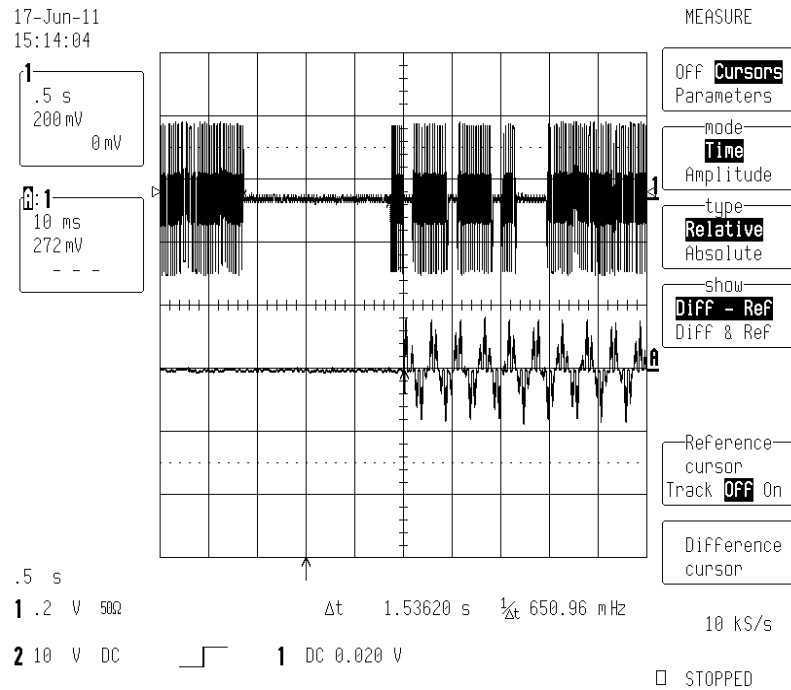
Parameter	Limit	Units	Test Results		
			T _{min} (-20°C)	T _{amb}	T _{max} (+55°C)
Carrier Frequency	121.5 ± 0.006	MHz	121.499794872	n/a	121.498317308

Transmitter Duty Cycle

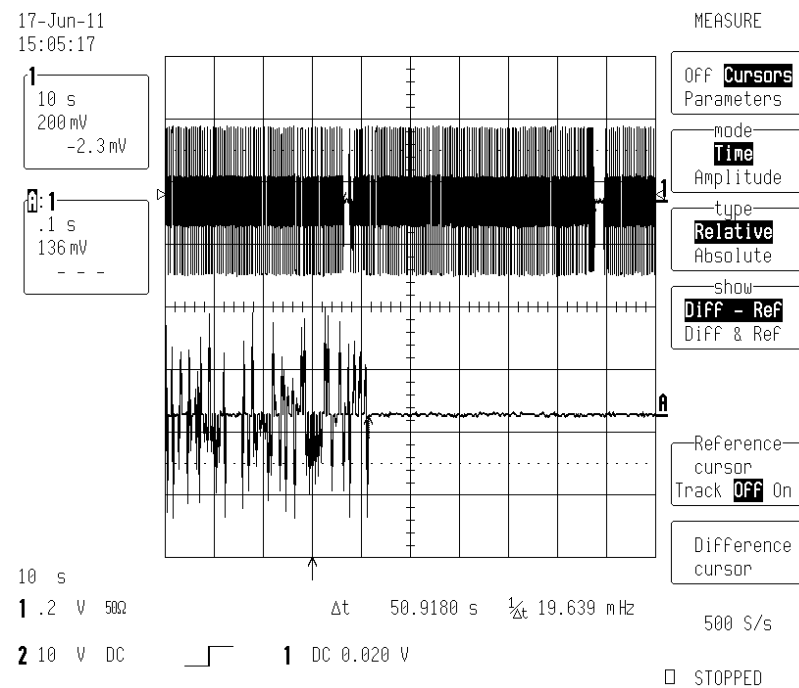
Note: Transmitter Duty Cycle = $\frac{\text{interval} - \text{duration}}{\text{interval}}$

Parameter	Units	Test Results		
		T _{min} (-20°C)	T _{amb} *	T _{max} (+55°C)
121.5 MHz transmission interruption interval	seconds	50.918	n/a	51.998
121.5 MHz transmission interruption duration	seconds	1.5362	n/a	1.5301
Transmitter Duty Cycle	P/F	P	n/a	P

Plot showing 121.5MHz interruption duration (Minimum Temperature)



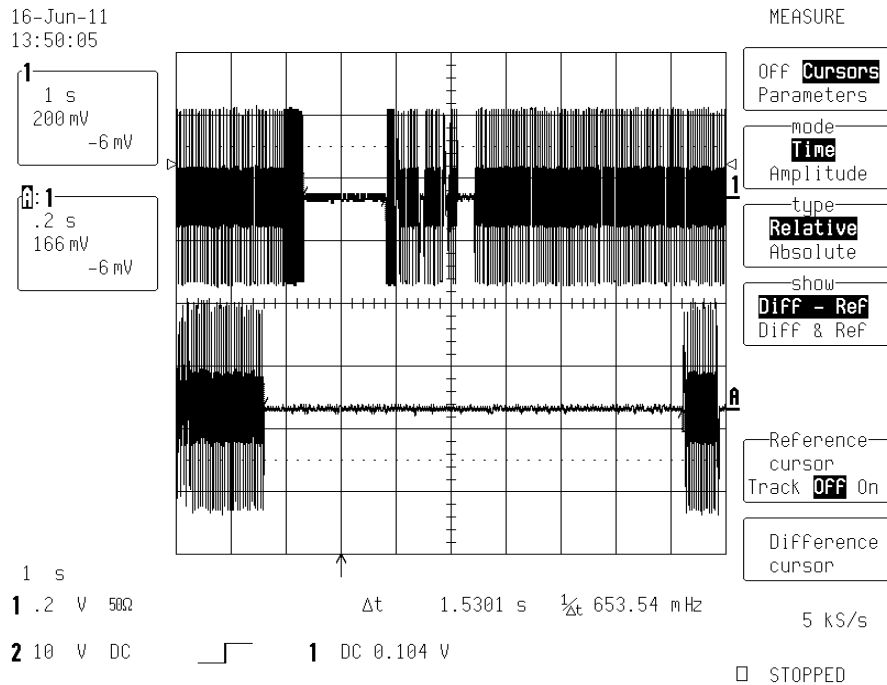
Plot showing 121.5MHz interruption interval (Minimum Temperature)



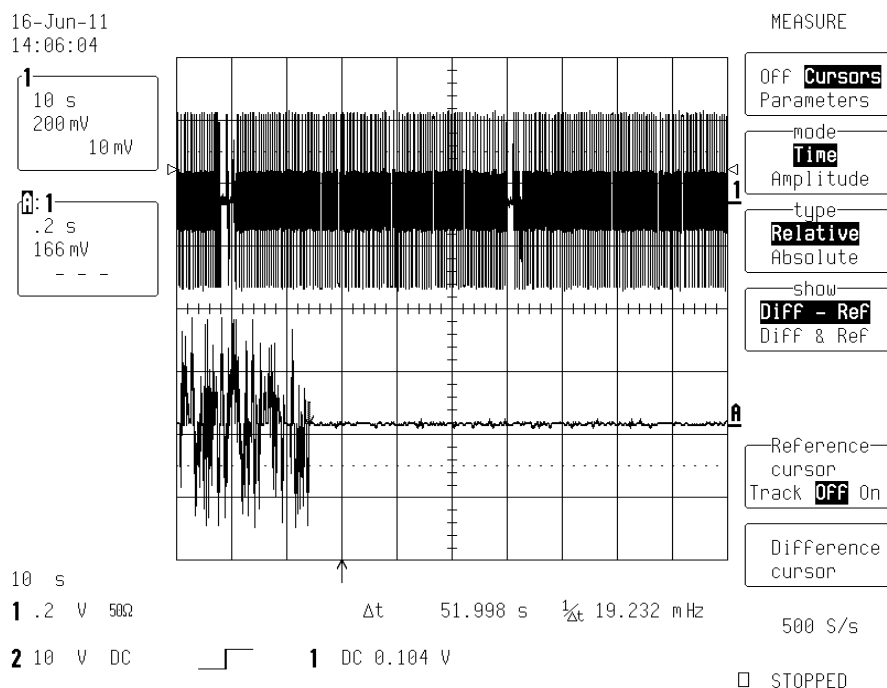


Product Service

Plot showing 121.5MHz interruption duration (Maximum Temperature)



Plot showing 121.5MHz interruption interval (Maximum Temperature)





Product Service

Modulation Frequency and Sweep Repetition Rate/Modulation Duty Cycle

Parameter	Units	Test Results		
		T _{min} (-20°C)	T _{amb}	T _{max} (+55°C)
Frequency Range	Hz	1032.34	n/a	1033.0
Minimum Frequency	Hz	544.96	n/a	542.0
Maximum Frequency	Hz	1577.3	n/a	1575.0
Modulation Duty Cycle	%	35.42	n/a	35.68
Sweep repetition rate	sweeps per second	2.526	n/a	2.526

Modulation Factor

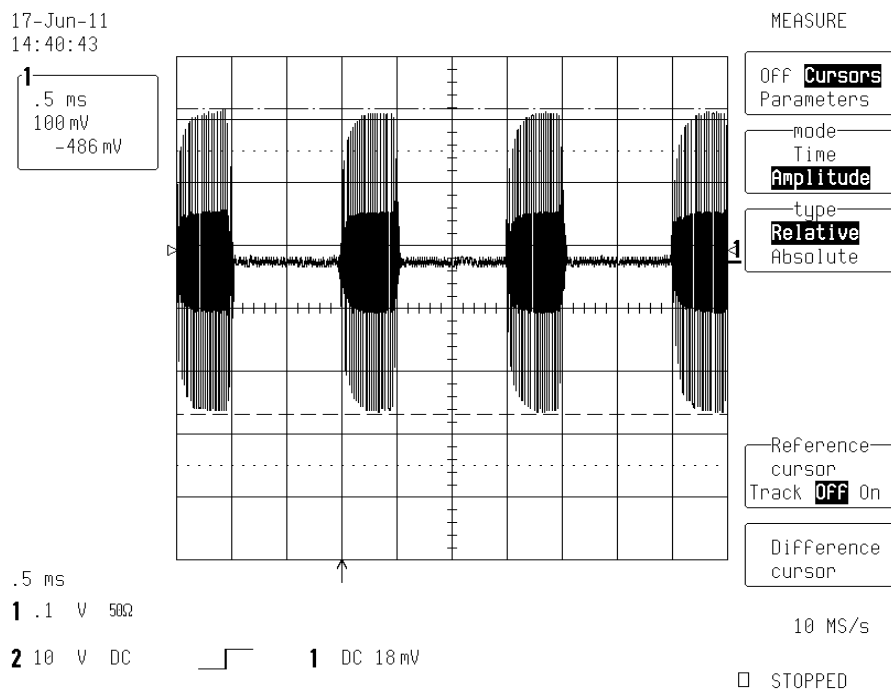
Note: Modulation Factor = (A - B) / (A + B)

Parameter	Units	Test Results		
		T _{min} (-20°C)	T _{amb}	T _{max} (+55°C)
A	mV	486	n/a	561
B	mV	25	n/a	23
Modulation Factor	(no units)	0.902	n/a	0.921

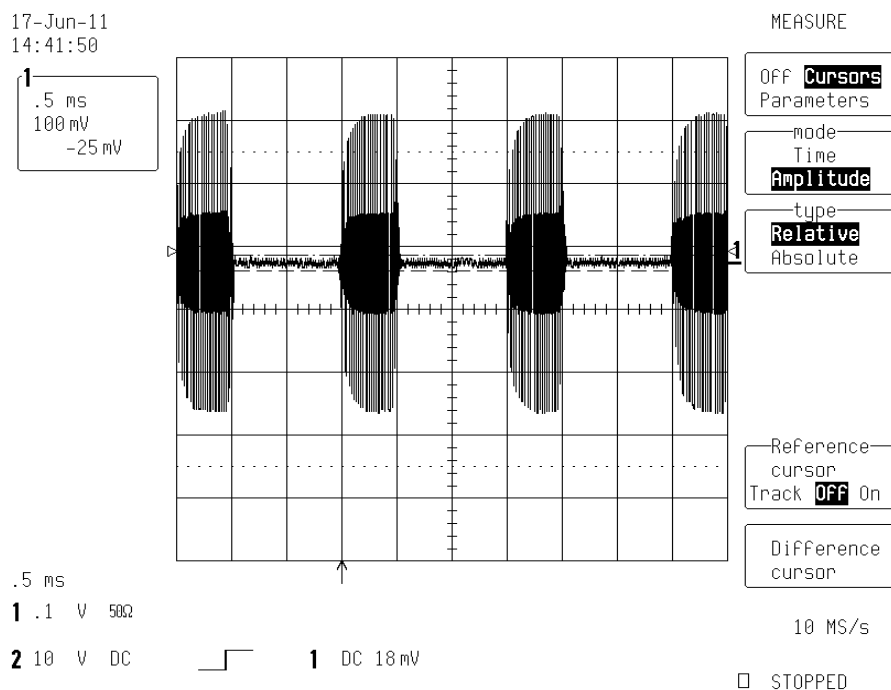


Product Service

Plot showing "A" at Minimum Temperature



Plot Showing "B" at Minimum Temperature



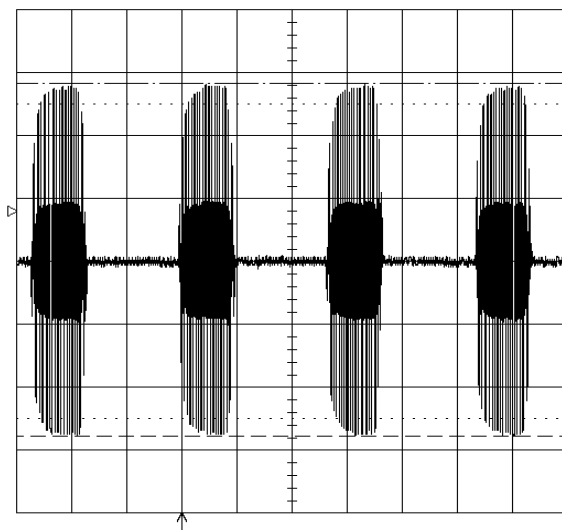


Product Service

Plot showing "A" Maximum Temperature

16-Jun-11
16:32:22

1
.5 ms
100 mV
-561 mV



.5 ms

1 .1 V 50Ω

2 10 V DC



1 DC 80 mV

MEASURE

OFF Cursors
Parameters

mode
Time
Amplitude

type
Relative
Absolute

Reference
cursor
Track OFF On

Difference
cursor

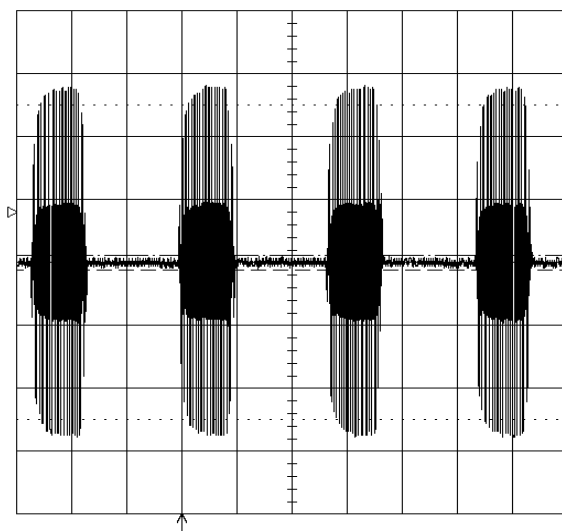
10 MS/s

□ STOPPED

Plot Showing "B" Maximum Temperature

16-Jun-11
16:33:19

1
.5 ms
100 mV
-23 mV



.5 ms

1 .1 V 50Ω

2 10 V DC



1 DC 80 mV

MEASURE

OFF Cursors
Parameters

mode
Time
Amplitude

type
Relative
Absolute

Reference
cursor
Track OFF On

Difference
cursor

10 MS/s

□ STOPPED



Product Service

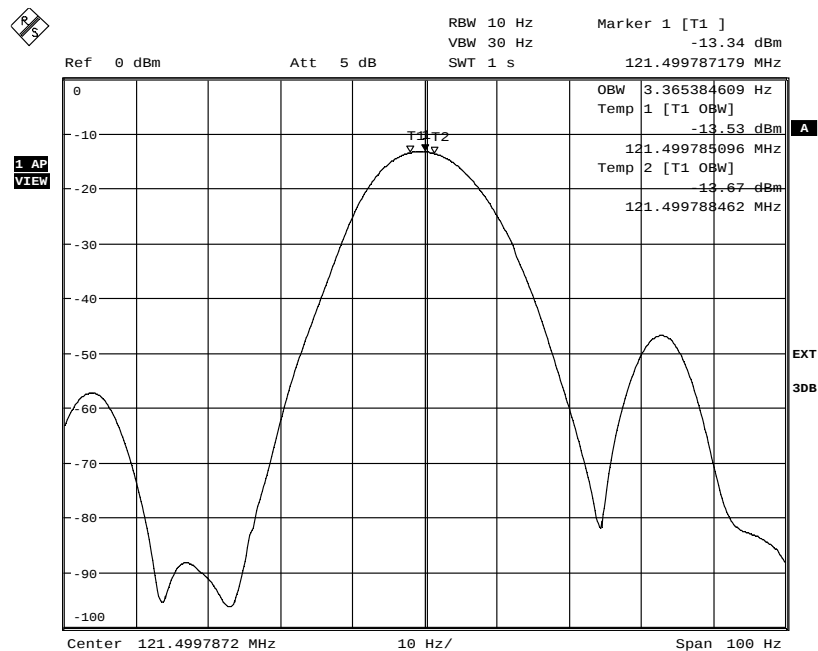
Frequency Coherence

Parameter	Units	Test Results		
		T _{min} (-20°C)	T _{amb}	T _{max} (+55°C)
Frequency Coherence:				
Occupied Bandwidth	P/F	P	n/a	P
Frequency Shift	P/F	P	n/a	P

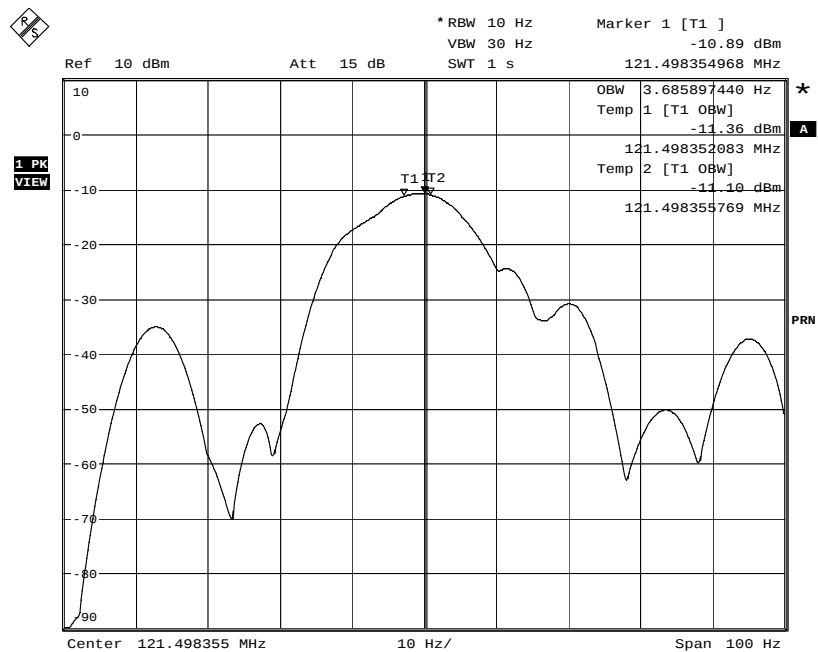


Product Service

Occupied Bandwidth Plot for Minimum Temperature



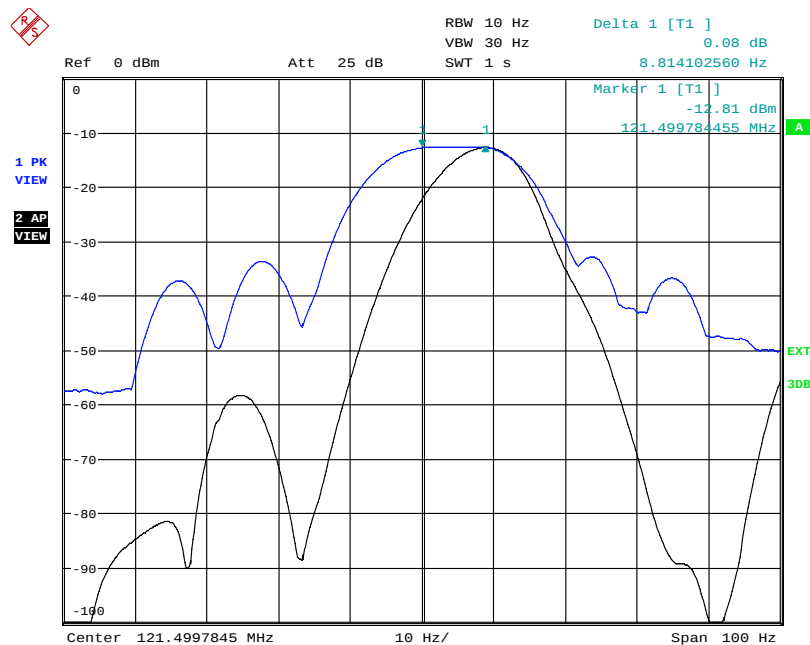
Occupied Bandwidth Plot for Maximum Temperature



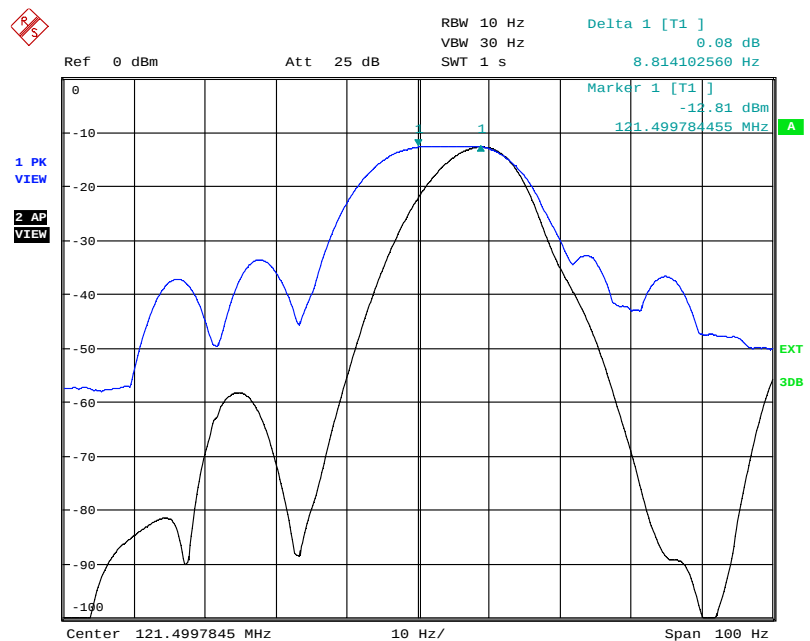


Product Service

Frequency Shift Plot for Minimum Temperature



Frequency Shift Plot for Minimum Temperature



Note: Trace A shown on the Frequency Shift Plots was set to Maximum Hold retaining the worst case frequency drift for the duration of the measurement.



Product Service

Morse Letter P

Parameter	Limit /Units	Test Results		
		T _{min} (-20°C) *	T _{amb}	T _{max} (+55°C)
Dot 1 Length *	115 ± 5% ms	114.70	n/a	115.3
Gap 1 Length *	115 ± 5% ms	116.05	n/a	114.0
Dash 1 Length *	345 ± 5% ms	343.45	n/a	344.4
Gap 2 Length	115 ± 5% ms	116.30	n/a	116.1
Dash 2 Length	345 ± 5% ms	343.65	n/a	343.5
Gap 3 Length	115 ± 5% ms	116.20	n/a	116.3
Dot 2 Length	115 ± 5% ms	113.40	n/a	113.5
Modulation Frequency	1000 Hz ± 50 Hz	1000.0	n/a	1007.6

Peak Equivalent Isotropic Radiated Power

The results (from the vertically polarised dipole) were converted to PEIRP (mW) in the following tables:

EIRP (mW)	0	30	60	90	120	150	180	210	240	270	300	330
5	61.79	60.39	60.67	60.39	60.39	60.39	61.79	60.39	60.39	60.39	60.39	61.79
10	55.65	54.39	54.39	54.39	54.39	55.65	54.39	55.65	53.15	54.39	54.39	56.95
15	50.89	50.89	49.73	49.73	48.60	48.60	49.73	49.73	48.60	49.73	48.60	50.89
20	41.18	42.14	43.12	41.18	42.14	44.12	43.12	42.14	44.12	43.12	43.12	42.14

The median of the twelve values was 60.39 mW, or 17.81 dBm.

Of the 11 highest values, the max was 61.79 mW and the minimum was 60.38 mW, the ratio between these is 1.023:1 to 1 (0.10 dB)

Off Ground Plane Radiated Power Test

EIRP (mW)	0	90	180	270
5	2.19	2.40	2.09	2.05
10	1.50	1.46	1.50	1.64
15	1.11	1.11	1.11	1.22
20	0.73	0.82	0.86	0.75

The minimum of the four values was 2.05 mW, or -32.7 dBm.



Product Service

2.17 COMPASS SAFE DISTANCE TEST

2.17.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.17.2 Date of Test

20 April 2011

2.17.3 Test Equipment Used

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

2.17.4 Environmental Conditions

Ambient Temperature 23.9°C

Relative Humidity 29.2%

2.17.5 Test Results

S/N: Unit #25 (TUV Ref TSR0004)

Horizontal maximum flux density, Magnetic North (H)	H=	20.15
Standard compass deviation limit (degrees)	5.4/H	0.3
Emergency compass deviation limit (degrees)	18/H	0.9

EUT Operating Mode

Orientation of the EUT	Un-powered State		Normalised		Powered Up	
	Distance From Compass (cm) at 0.3° deflection	Distance From Compass (cm) at 0.9° deflection	Distance From Compass (cm) at 0.3° deflection	Distance From Compass (cm) at 0.9° deflection	Distance From Compass (cm) at 0.3° deflection	Distance From Compass (cm) at 0.9° deflection
Front	26 to tip of antenna	17 to tip of antenna	27 to tip of antenna	17 to tip of antenna	28 to tip of antenna	17 to tip of antenna
Top	26	16.5 0.5° deflection	26	16.5 0.5° deflection	26	16.5 0.5° deflection
Left Hand Side	25	16.5 0.5° deflection	25	16.5 0.5° deflection	25	16.5 0.5° deflection
Right Hand Side	16.5 0.2° deflection	16.5 0.2° deflection	16.5 0.2° deflection	16.5 0.2° deflection	16.5 0.0° deflection	16.5 0.0° deflection
Underside	16.5	16.5 0.3° deflection	16.5	16.5 0.3° deflection	16.5	16.5 0.3° deflection
Rear	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection



Product Service

EUT Standby Mode

Orientation of the EUT	Un-powered State		Normalised		Powered Up	
	Distance From Compass (cm) at 0.3° deflection	Distance From Compass (cm) at 0.9° deflection	Distance From Compass (cm) at 0.3° deflection	Distance From Compass (cm) at 0.9° deflection	Distance From Compass (cm) at 0.3° deflection	Distance From Compass (cm) at 0.9° deflection
Front	26 to tip of antenna	17 to tip of antenna	27 to tip of antenna	17 to tip of antenna	28 to tip of antenna	17 to tip of antenna
Top	26	16.5 0.5° deflection	26	16.5 0.5° deflection	26	16.5 0.5° deflection
Left Hand Side	25	16.5 0.5° deflection	25	16.5 0.5° deflection	25	16.5 0.5° deflection
Right Hand Side	16.5 0.2° deflection	16.5 0.2° deflection	16.5 0.2° deflection	16.5 0.2° deflection	16.5 0.0° deflection	16.5 0.0° deflection
Underside	16.5	16.5 0.3° deflection	16.5	16.5 0.3° deflection	16.5	16.5 0.3° deflection
Rear	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection	16.5 0.1° deflection

Standard Compass safe distance	300mm
Emergency Compass safe distance	200mm



Product Service

2.18 MISCELLANEOUS TESTS

2.18.1 Equipment Under Test and Modification State

PLB-375 S/N: Unit #25 (TUV Ref TSR0004) - Modification State 4

2.18.2 Date of Test

4 July 2011

2.18.3 Test Equipment Used

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

2.18.4 Environmental Conditions

Ambient Temperature 22.0 - 22.1°C

Relative Humidity 33.9 - 35.0%

2.18.5 Test Results

S/N: Unit #25 (TUV Ref TSR0004)

Controls and Indicators

The following requirements met the standard:

- All controls are clearly and durably marked
- All controls are designed to prevent accidental activation and require at least two separate actions to activate the EUT
- Activation of the EUT shall not require the use of two hands
- There should be a clear indication once the EUT has been activated
- Controls should be few in number and simple to activate. All controls should be designed so that they can be activated by personnel wearing gloves or mittens. (Confirmed by Manufacturer).
- As a minimum, the EUT should have integral manual controls to operate the device in the following modes:

OFF – EUT deactivated

ON – EUT activated

TEST – See below



Product Service

Self-test Function – Manufacturer data provided in Annex B.

Manufacturer's declaration verifies that the Self Test function tests the following items:

- Battery
- 121 and 406 RF output ports
- Phase Locked Loop (PLL) of the 406 output (if used)
- A separate switch is present for the test function

GNSS Self-test Function

- The GNSS self test mode is activated by a distinctly different operation from the normal self test mode
- Activation results in a single burst
- Limited number of GNSS self test bursts (declared by the manufacturer)
- Distinct indication of either success or failure of GNSS burst
- Indication of when the maximum number of GNSS Self Tests has been reached
- Limited time duration of each GNSS burst (declared by the manufacturer)

Battery

The manufacturer is to provide information with regard to the battery construction and safety.

General Construction

A Sharp Edge Tester, consisting of a 'repeatable-force arm' and a padded 'finger' covered with tape, was run along the following edges:

- Antenna
- Antenna plastic swivel arm
- Antenna retaining fixture

Upon inspection of the tape covering the 'finger' no cuts were found.



Product Service

Exterior Finish

The EUT case is predominantly a high visible yellow colour.

Labelling (Resistance)

For Sunlight, Seawater and Oil resistance see Customer Supplied Statement on Materials at Annex B.

Labelling abrasion resistance information can be found at Annex B.

Labelling (Legibility)

For legibility test results the customer intends to waive the tests based on historical usage of symbols and instructions without issue. See Annex B for Waiver Request

Labelling (Instructions and Information)

Customer Supplied Information at Annex B details the EUT labelling scheme.

Labelling (Comprehensibility)

For legibility test results the customer intends to waive the tests based on historical usage of symbols and instructions without issue. See Annex B.



Product Service

SECTION 3

TEST EQUIPMENT USED



Product Service

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 2.2 Beacons – Pre Conditioning Performance Check					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	02-Jun-2011
Section 2.3 Climatic - High Temperature					
Power Meter	Hewlett Packard	436A	47	12	09-Jul-2011
Climatic Chamber	Montford	4F3	2126	12	01-Jun-2011
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Time Interval Analyser	Yokogawa	TA720	181	12	01-Mar-2012
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	21-Feb-2012
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	17-Jun-2011
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	12-Nov-2011
Beacon RF Unit	TUV	N/A	3066	-	TU
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	23-Jun-2011
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	10-Jun-2011
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	10-Jun-2011
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	10-Jun-2011
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	13-Aug-2011
ScopeCorder	Yokogawa	DL750 701210	3254	12	08-Nov-2011
Power Sensor	Agilent	8482A	3290	12	08-Dec-2011
Cable (1m, N type)	Rhophase	NPS-1601-1000-NPS	3350	12	20-Apr-2011
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	20-Apr-2011
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	20-Apr-2011
Cable (3m, N-type)	Rhophase	NPS-1601-3000-NPS	3361	12	20-Apr-2011
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3410	12	13-Aug-2011
Rubidium Frequency Standard	Symmetrcom	8040C	3490	12	08-Mar-2012
Section 2.4 Climatic – Humidity					
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	12-Nov-2011
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	10-Jun-2011
Climatic Chamber	Montford	4F3	2126	12	01-Jun-2011
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	20-Apr-2011
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	20-Apr-2011
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3410	12	13-Aug-2011
Rubidium Frequency Standard	Symmetrcom	8040C	3490	12	08-Mar-2012



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.5 Climatic - Low Temperature					
Power Meter	Hewlett Packard	436A	47	12	09-Jul-2011
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Climatic Chamber	Montford	4F3	2126	12	01-Jun-2011
Time Interval Analyser	Yokogawa	TA720	181	12	01-Mar-2012
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	21-Feb-2012
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	12-Nov-2011
Beacon RF Unit	TUV	N/A	3066	-	TU
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	23-Jun-2011
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	10-Jun-2011
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	10-Jun-2011
ScopeCorder	Yokogawa	DL750 701210	3254	12	08-Nov-2011
Power Sensor	Agilent	8482A	3290	12	08-Dec-2011
Cable (1m, N type)	Rhophase	NPS-1601-1000-NPS	3350	12	20-Apr-2011
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	20-Apr-2011
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	20-Apr-2011
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3410	12	13-Aug-2011
Rubidium Frequency Standard	Symmetrcom	8040C	3490	12	08-Mar-2012
Section 2.6 Shock - Half Sine					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Vibration Table	Ling Dynamic Systems	875	3170	6	10-May-2011
Isotron Accelerometer	Endevco	256-10	3380	6	27-Jul-2011
Isotron Accelerometer	Endevco	256-10	3390	6	15-May-2011
Vibration Controller (8 Ch)	Muller & Partner	VibPilot 8	3777	12	4-Apr-2011
Isotron Accelerometer	Endevco	256-10	3788	6	21-Jul-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Section 2.7 Vibration - Bump					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Vibration Table	Ling Dynamic Systems	875	3170	6	10-May-2011
Isotron Accelerometer	Endevco	256-10	3390	6	15-May-2011
Vibration Controller (8 Ch)	Muller & Partner	VibPilot 8	3777	12	4-Apr-2011
Isotron Accelerometer	Endevco	256-10	3788	6	21-Jul-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Section 2.8 ENV - Drop					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Hardwood Block	Unknown	ELM	2650	-	TU
Tape Measure	Stanley	Fatmax 5 m	3712	-	TU
Climatic Chamber	Instron	906	2128	12	25-Nov-2011
Timer	Radio Spares	427-590	3282	-	TU
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.9 Climatic - Thermal Shock					
Climatic Chamber	Instron	906	2128	12	25-Nov-2011
Climatic Chamber	Montford	4F3	2126	12	01-Jun-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Section 2.10 Climatic – Immersion					
Over Pressure (T)	ASL (TUV)	0 TO 15 PSI	2125	-	TU
Digital Pressure Indicator	Druck	DPI 700	2351	12	23-Sep-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Section 2.3 and 2.11 Beacons - Spurious Emissions					
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	15-Jan-2012
Hygrometer	Rotronic	I-1000	3068	12	10-Jul-2011
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	10-Jun-2011
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3162	12	23-Jun-2011
Bandpass filter	Trilithic	5BE406/35-1-AA	3206	12	12-Aug-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Cable (1m, N type)	Rhophase	NPS-1601-1000-NPS	3350	12	20-Apr-2011
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	20-Apr-2011
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	23-Feb-2012
Section 2.11 Beacons - 121 Spurious Emissions					
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Hygrometer	Rotronic	I-1000	3068	12	10-Jul-2011
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	20-Apr-2011
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3410	12	13-Aug-2011
Accelerometer	Endevco	256-10	3470	6	15-May-2011
Charge Amplifier	Endevco	133	3480	12	6-Jul-2011
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	23-Feb-2012



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.12 Beacons - Operating Lifetime					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	47	12	9-Jul-2011
Power Meter	Hewlett Packard	436A	83	12	17-Aug-2011
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	15-Jan-2012
Signal Generator	Hewlett Packard	8644A	199	12	12-Aug-2011
Attenuator 10dB/10W	Trilithic	HFP-50N	454	12	21-Jul-2011
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	23-Jun-2011
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	23-Jun-2011
Attenuator: 6dB/10W	Trilithic	HFP-50N	476	12	21-Jul-2011
Attenuator: 10dB/20W	Narda	766-10	480	12	21-Jul-2011
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	21-Feb-2012
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	17-Jun-2011
Digital Temperature Indicator	Fluke	51	2267	12	30-Jun-2011
Distress Beacon RF Unit	TUV	-	2445	-	TU
Stop Clock	R.S Components	RS328 061	2674	-	TU
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	12-Nov-2011
Beacon RF Unit	TUV	N/A	3066	-	TU
Hygrometer	Rotronic	I-1000	3068	12	10-Jul-2011
Termination (50ohm, 1W)	Suhner		3080	12	7-Mar-2012
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	23-Jun-2011
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	10-Jun-2011
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	10-Jun-2011
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3162	12	23-Jun-2011
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	10-Jun-2011
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	13-Aug-2011
Bandpass filter	Trilithic	5BE406/35-1-AA	3206	12	12-Aug-2011
Bandpass Filter	Trilithic	5BE406/35-1-AA	3207	12	13-Aug-2011
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	8-Nov-2011
ScopeCorder	Yokogawa	DL750 701210	3254	12	8-Nov-2011
Beacon Tester	WS Technologies	BT100S	3263	-	TU
8 Channel Datalogger + Terminal Board	Pico Technology Ltd	ADC-16	3287	12	17-Dec-2011
Power Sensor	Agilent	8482A	3289	12	8-Dec-2011
Power Sensor	Agilent	8482A	3290	12	8-Dec-2011
Resistor (Nominal 0.25ohm)	TUV	2x RS Components 188-071 R5/100W Resistors	3343	12	21-Oct-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Cable (1m, N type)	Rhophase	NPS-1601-1000-NPS	3350	12	19-Apr-2012
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	19-Apr-2012
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	19-Apr-2012
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	19-Apr-2012
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	19-Apr-2012
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3355	12	20-Apr-2012
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	12	20-Apr-2012
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3357	12	20-Apr-2011
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	12	20-Apr-2012



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.12 Beacons - Operating Lifetime					
Cable (3m, N-type)	Rhophase	NPS-1601-3000-NPS	3361	12	20-Apr-2012
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3410	12	13-Aug-2011
Rubidium Frequency Standard	Symmetrcom	8040C	3490	12	8-Mar-2012
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	23-Feb-2012
Combiner/Splitter	Weinschel	1506A	3878	12	22-Feb-2012
Section 2.13 Beacons - Self Test					
Power Meter	Hewlett Packard	436A	47	12	9-Jul-2011
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	15-Jan-2012
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	8-Nov-2011
Signal Generator	Hewlett Packard	8644A	199	12	12-Aug-2011
Distress Beacon RF Unit	TUV	-	2445	-	TU
Hygrometer	Rotronic	I-1000	3068	12	10-Jul-2011
Termination (50ohm, 6W)	Micronde	R404613	3074	12	17-Mar-2012
Termination (50ohm, 1W)	Suhner		3080	12	7-Mar-2012
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	23-Jun-2012
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	10-Jun-2012
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	13-Aug-2011
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	8-Nov-2011
Power Sensor	Agilent	8482A	3289	12	8-Dec-2011
Power Sensor	Agilent	8482A	3290	12	8-Dec-2011
Cable (1m, N type)	Rhophase	NPS-1601-1000-NPS	3350	12	19-Apr-2012
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	12	20-Apr-2012
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3357	12	20-Apr-2012
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	12	20-Apr-2012
Cable (3m, N-type)	Rhophase	NPS-1601-3000-NPS	3361	12	20-Apr-2012
Section 2.14 (Annex A) Beacons - Constant Temperature Tests					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	83	12	17-Aug-2011
Load (50ohm/30W)	Weinschel	50T-054	285	12	6-Sep-2011
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	21-Feb-2012
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	13-Oct-2011
Beacon RF Unit	TUV	N/A	3066	-	TU
Termination (50ohm, 15W)	Diamond Antenna	DL-30N	3098	12	7-Mar-2012
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	10-Jun-2012
Bandpass filter	Trilithic	5BE406/35-1-AA	3206	12	12-Aug-2011
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	8-Nov-2011
ScopeCorder	Yokogawa	DL750 701210	3254	12	8-Nov-2011
Power Sensor	Agilent	8482A	3289	12	8-Dec-2011
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	6-Jun-2012
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	19-Apr-2012
Cable (3m, N-type)	Rhophase	NPS-1601-3000-NPS	3361	12	20-Apr-2012
Rubidium Frequency Standard	Symmetrcom	8040C	3490	12	8-Mar-2012



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.15 Climatic - Buoyancy					
Balance	Geniweigher	GM-11K	2334	12	14-Mar-2012
Section 2.16 Beacons - 121 Modulation Characteristics					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
1GHz Digital Oscilloscope	Lecroy	9370M	612	12	19-Oct-2011
Hygrometer	Rotronic	I-1000	3068	12	10-Jul-2011
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	23-Jun-2012
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	6-Jun-2012
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	19-Apr-2012
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	12	20-Apr-2012
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3410	12	13-Aug-2011
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	8-Mar-2012
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	23-Feb-2012
Section 2.17 EMC – Compass Safe Distance					
Sussex Helmholtz Coil	Various	88771	327	-	TU
Power Supply Unit	Hewlett Packard	6253A	614	-	TU
Magnetometer	Bartington	MAG01	671	36	3-Sep-2011
Hygrometer	Rotronic	A1	2760	12	10-Jul-2011
Compass Verification Unit	TUV	CVU	3579	-	TU
Handheld Digital Multimeter	Agilent	U1241A	3625	12	14-Sep-2011
Marine Binacle Compass with Repeater Display	Cassens & Plath	Compass: Type 11	3834	-	TU

TU – Traceability Unscheduled

OP MON – Output Monitored with Calibrated Equipment



Product Service

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)



Front View



Rear View



Antenna Extended



Modified 50Ω Conducted Sample



Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

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
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Product Service

ANNEX A

LIMITED C/S TESTING (SUMMARY OF RESULTS)



Product Service

TEST RESULTS TABLE

TEST RESULTS TABLE						
Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
1. Power Output						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Transmitter power output	35 - 39	dBm	36.29	36.30	36.04	
Power output rise time	< 5	ms	0.328	0.348	0.308	
Power output 1ms before burst	< -10	dBm	-26.82	-26.17	-26.3	
2. Digital Message Coding						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Bit Sync	1 - 15	15 bits "1"	P / F	P	P	Decoded Message: See 75911196 Report 05
Frame sync	16 - 24	"000101111"	P / F	P	P	
Format flag	25	1 bit	bit value	1	1	
Protocol flag	26	1 bit	bit value	0	0	
Identification / position data	27 - 85	59 bits	P / F	P	P	
BCH code	86 -106	21 bits	P / F	P	P	
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	bit value	110111	110111	
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	P	P	
Position Error (if applicable)	< 5	km	n/a	n/a	n/a	



Product Service

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
3. Digital Message Generator						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Repetition rate, T _R :						
Average T _R	48.5 ≤ T _{Ravg} ≤ 51.5	seconds	49.786	50.168	49.899	
Minimum T _R	47.5 ≤ T _{Rmin} ≤ 48.0	seconds	47.593	47.625	47.578	
Maximum T _R	52.0 ≤ T _{Rmax} ≤ 52.5	seconds	52.328	52.328	52.344	
Standard deviation	0.5 - 2.0	seconds	1.526	1.555	1.566	
Bit rate						
Minimum fb	≥ 396	bits/sec	400.194	400.192	400.197	
Maximum fb	≤ 404	bits/sec	400.247	400.239	400.261	
Total transmission time						
Short message	435.6 - 444.4	ms	n/a	n/a	n/a	
Long message	514.8 - 525.2	ms	519.453	519.460	519.500	
Unmodulated carrier						
Minimum T1	≥ 158.4	ms	159.681	159.675	159.717	
Maximum T1	≤ 161.6	ms	159.725	159.713	159.755	
First burst delay	≥ 47.5	seconds	140	140	140	
4. Modulation						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Biphase-L	P / F	P / F	P	P	P	
Rise time	50 - 250	µs	170.3	160.3	151.3	
Fall time	50 - 250	µs	170.7	160.7	156.7	
Phase deviation: positive	+(1.0 to 1.2)	radians	1.1227	1.104	1.1141	
Phase deviation: negative	-(1.0 to 1.2)	radians	-1.0742	-1.1007	-1.0955	
Symmetry measurement	≤ 0.05		0.0151	0.014	0.0143	



Product Service

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
5. 406 MHz Transmitted Frequency						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Nominal Value	C/S T.001	MHz	406.037000 9	406.0369973	406.036967 3	
Short-term stability	≤ 2x10 ⁻⁹	/100ms	1.477x10 ⁻¹⁰	2.134x10 ⁻¹⁰	1.481x10 ⁻¹⁰	
Medium-term stability – Slope	(-1 to +1)x10 ⁻⁹	/minutes	7.226x10 ⁻¹¹	7.294x10 ⁻¹¹	-1.428x10 ⁻¹¹	
Medium-term stability – Residual frequency variation	≤ 3x10 ⁻⁹		4.687x10 ⁻¹⁰	6.971x10 ⁻¹⁰	4.145x10 ⁻¹⁰	
6. Spurious Emissions into 50ohms						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 4						
In band (406.0 – 406.1 MHz)	C/S T.001 mask	P / F	P			See 75911196 Report 05
7. 406 MHz VSWR Check						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Nominal transmitted frequency	C/S T.001	MHz	406.037001 3	406.0369969	406.036967 5	
Modulation rise time	50-250	µs	177.3	161.3	152.3	
Modulation fall time	50-250	µs	170.7	158.7	155.7	
Modulation phase deviation: positive	+ (1.0 to 1.2)	radians	1.1192	1.1093	1.104	
Modulation phase deviation: negative	- (1.0 to 1.2)	radians	-1.0922	-1.1047	-1.1071	
Modulation symmetry measurement	≤ 0.05		0.015	0.015	0.013	
Digital Message	correct	P / F	P	P	P	See 75911196 Report 05



Product Service

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8(a). Self-test Mode						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Frame sync	011010000	P / F	P	P	P	See 75911196 Report 05
Format flag	1 / 0	bit value	1	1	1	
Single radiated burst	≤440 / 520 (±1%)	ms	439.3088	439.773	439.6156	
Default position data (if applicable)	correct	P / F	P	P	P	See 75911196 Report 05
Description	provided	Y / N	Y			
Design data on protection against repetitive self-test mode transmissions	provided	Y / N	Y			
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)	verify that RF power emitted	P / F	P	P	P	
406 MHz power	verify that RF power emitted	P / F	P	P	P	



Product Service

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8 (b). GNSS Self-Test Mode (if applicable)						Result: Pass
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6						
Frame sync	011010000	bit value ms	n/a	P	n/a	See 75911196 Report 05
Format flag	1 / 0		n/a	1	n/a	
Single radiated burst	≤ 520 (+1%) must be within 500m (or 5.25km for User Location Protocol) of the actual position		n/a	519.736	n/a	
Position data (if applicable)		P / F	n/a	P	n/a	See 75911196 Report 05
Design data showing how GNSS Self-test is limited in number of transmissions and duration	provided	Y / N	Y			
Single burst verification	one burst	P / F	n/a	P	n/a	
121.5 MHz RF power (if applicable)	GNSS self-test checks that RF power is emitted	Y / N	N			
406 MHz power	GNSS self-test checks that RF power is emitted	Y / N	Y			
Maximum duration of GNSS Self-test	125	s	n/a	125	n/a	See 75911196 Report 05
Actual duration of Self-test with encoded location	Less than maximum duration	s	n/a	43	n/a	
Maximum number of GNSS Self-tests (only beacons with internal navigation devices)	12	Number	n/a	12	n/a	See 75911196 Report 05



Product Service

Parameters to be Measured	Range of Specification	Units	Test Results		Comments		
9. Thermal Shock					Result: Pass		
PLB-375 S/N: Unit #14 (TUV Ref TSR0003) Mod State: 6							
Soak Temperature	30°C difference	°C	20.0		See 75911196 Report 05		
Measurement Temperature		°C	-10.0				
Transmitted Frequency	C/S T.001	MHz	Min	Max			
Nominal value			406.0370105	406.0370108			
Short-term stability		/100ms	1.207×10^{-10}	2.606×10^{-10}			
Medium-term stability – Slope		/min	-1.066×10^{-10}	9.539×10^{-11}			
Medium-term stability – Residual frequency variation	$\leq 3 \times 10^{-9}$		1.535×10^{-10}	5.496×10^{-10}	See 75911196 Report 05		
Transmitter power output	35 - 39	dBm	36.386	36.747			
Digital message	correct	P/F	P				
14. Satellite Qualitative Tests					Result: Pass		
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4							
Test Configuration	As per C/S T.007	P / F	Configuration				See 75911196 Report 05
15 Hex ID Decoded by LUT	correct		5	6	7	8	
Doppler Location results with error ≤5km	≥80	%	-	-	-	P	
			-	-	-	95.0	



Product Service

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
17. Navigation System						Result: Pass
PLB-375 S/N: Unit #25 (TUV Ref TSR0004) Mod State: 4						
Location protocol	C/S T.001		National	Standard	User	See 75911196 Report 05
Position data default values	correct	P / F	n/a	n/a	n/a	
Configuration 5						
Position accuracy - A.3.8.2.1	C/S T.001	m	-	-	-	
Position Acquisition Time - A.3.8.2.1	<10/1	min	-	-	-	
Position accuracy - A.3.8.2.2	C/S T.001	m	-	-	-	
Position Acquisition Time - A.3.8.2.2	<10/1	min	-	-	-	
Configuration 6						
Position accuracy - A.3.8.2.1			-	-	-	
Position Acquisition Time - A.3.8.2.1			-	-	-	
Position accuracy - A.3.8.2.2			-	-	-	
Position Acquisition Time - A.3.8.2.2			-	-	-	
Configuration 7						
Position accuracy - A.3.8.2.1			n/a	55.6	n/a	
Position Acquisition Time - A.3.8.2.1			n/a	100s	n/a	
Position accuracy - A.3.8.2.2			n/a	49.2	n/a	
Position Acquisition Time - A.3.8.2.2			n/a	100s	n/a	
Configuration 8						
Position accuracy - A.3.8.2.1			n/a	68.8	n/a	
Position Acquisition Time - A.3.8.2.1			n/a	100s	n/a	
Position accuracy - A.3.8.2.2			n/a	49.8	n/a	
Position Acquisition Time - A.3.8.2.2			n/a	100s	n/a	
Encoded position data update interval	>20	min	n/a	n/a	n/a	
Position clearance after deactivation	cleared	P / F	n/a	n/a	n/a	
Position data input update interval (as applicable)	20/1	Min	n/a	n/a	n/a	



Product Service

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
Position data encoding	correct	P / F	n/a	n/a	n/a	See 75911196 Report 05
Retained last valid position after navigation input lost	240(±5)	min	n/a	n/a	n/a	
Default position data transmitted after 240(±5) minutes without valid position data	cleared	P / F	n/a	n/a	n/a	
Information on protection against beacon degradation due to navigation device, interface or signal failure or malfunction	provided	Y / N	Y			



Product Service

ANNEX B

CUSTOMER SUPPLIED INFORMATION



Product Service

LITHIUM BATTERY

CR123A

SPECIFICATION

Approved by: Scotty Scott Date: October 15, 2009

Prepared by: David McCain Date: October 15, 2009

**Panasonic Energy Corporation of America
Lithium Battery Division**



Product Service

1. Designation	: CR123A
2. Nominal Voltage	: 3 V
3. Nominal Capacity	: 1550 mAh
Load	: 100 Ω at 20 °C
Cut Off V	: 2.0 V
4. Max. Continuous Discharge Current	: 1000 mA at 20 °C
5. Construction	
5.1 Appearance, Dimensions	: There shall be no noticeable deformation. The dimensions shall be according to the attached drawings.
5.2 Weight	: Approx. 17 g
6. Performance	
6.1 Open Circuit Voltage	: Min. 3 V
6.2 Duration 1. (at 21 $\pm$ 2°C)	
6.2.1 Pulse Discharge Conditions	: Average 2000 cycles
Pulse Current	: 900 mA
One Cycle	: 3 seconds on, 27 seconds off
Cut Off V.	: 1.55 V
6.3 Duration 2. (at - 21 $\pm$ 2°C)	
6.3.1 Pulse Discharge Conditions	: Average 1100 cycles
Pulse Current	: 900 mA
One Cycle	: 3 seconds on, 27 seconds off
Cut Off V.	: 1.55 V
6.4 Impedance	: Between 0.1 and 1.0 Ω
6.5 Vibration Resistance	: Deterioration of performance shall not occur.
6.6 Temperature Range	: Discharge -20 to 60 °C Storage -20 to 45 °C Note: Contact Panasonic in case of continuous usage in temperatures over 60°C.



Product Service

6.7 High Temperature Storage : The battery shall not show leakage or salting which harms performance (as described in 7.3 viii)).

6.8 Recommended Storage Conditions : Temperature: 5° C to 35° C
Humidity: Less than 70% RH

7. Test Conditions, Measuring Instruments and Measuring Methods

7.1 Test Conditions : If not otherwise specified,
Temperature ; $25 \pm 5^{\circ}\text{C}$
Humidity ; $65 \pm 10\% \text{ RH}$

7.2 Measuring Instruments

- i) Volt Meter : Input impedance ; $\geq 10\text{M}\Omega$
- ii) Battery Impedance Meter : Accuracy ; $\leq 0.5\%$
: Sine wave AC method (1 kHz, 0.1mA)
(National Digital milliohm Meter [VP-2811A])
- iii) Caliper : Accuracy ; $\leq 1\%$ by JIS
- iv) Balance : Sensitivity ; $\leq 100 \text{ mg}$

7.3 Measuring Method

- i) Outer Dimensions : This shall be measured with the caliper described in Item 7.2 iii)).
- ii) Weight : This shall be measured with the balance described in Item 7.2 iv)).
- iii) Appearance : Deformation or tarnish shall be visually checked.
- iv) Open Circuit Voltage : This shall be measured with the volt meter described in Item 7.2 i)).
- v) Operating Time (Duration) : Operating time shall be measured with cycles until terminal voltage reaches the specified cut -off voltage.
- vi) Battery Impedance : This shall be measured by the meter described in Item 7.2 ii)).
- vii) Vibration Test : This test shall be carried out by the following condition according to the UN Manual of Test and Criteria, Part III, sub-section 38.3.4.3,
Amplitude: 0.8mm
Frequency: 7 Hz $\leftrightarrow$ 200 Hz
Directions: X, Y, Z
Duration: 15 minutes, 12 times (each direction)



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- viii) High Temperature Storage : The battery shall be stored at 60°C for 28 days. After storage, the battery shall be kept in a dry place at 25±5°C for 4 hours, then leakage and appearance shall be checked by the naked eye.

8. Indication

- 8.1 Below items are indicated on the battery or its package.
(Design of indication can be changed without notice.)

Model code	CR123A
Nominal voltage	3V
Manufacture or its brand	Panasonic
Production	U.S.A.

- 8.2 Date Code System: MM-YYYY expiration date

Example:

01-2019

01= January (month of manufacture)

2019 = 2009 (year of manufacture) + 10 years

Final method to be determined pending customer requirement.

- 8.3 UL Standard

This battery is certified by Underwriters Laboratories under UL 1642, Lithium Batteries. The UL file number is MH12210.

- 8.4 Production Site

Panasonic Energy Corporation of America - Lithium Battery Division
One Panasonic Drive, Columbus, GA 31907, U.S.A.

9. Operations and Modification of This Specification

Modification must be carried out under mutual agreement. Any accidents caused by non-described items in this specification must be discussed and solved mutually.

10. Important Notes (Warranty)

1) The batteries are warranted to conform to the description contained in this specification for a period of twelve [12] months from the ex-factory date and any claim by you (customer) must be made within such period.

During that warranty period, if the batteries are proved to become defective; non-defective and conforming batteries will be supplied in due course at sole expense of Panasonic Energy Corporation of America – Lithium Battery Division upon Panasonic Energy Corporation of America – Lithium Battery Division's own determination that this is apparently caused by negligence of Panasonic Energy Corporation of America – Lithium Battery Division.

Any further claims based on the delivery of defective batteries shall be excluded. Such exclusion shall not affect the liability of Panasonic Energy Corporation of America – Lithium Battery Division based



Product Service

on product liability for grossly negligent or intentional behavior of Panasonic Energy Corporation of America – Lithium Battery Division.

2) Confirmation of the matching and reliability of batteries into your actual sets or units is your own responsibility.

3) Panasonic Energy Corporation of America – Lithium Battery Division shall not warrant or be responsible in any case where your failure to carry out proper handling, operating, installation, testing, service and checkout of the batteries and / or to follow the instructions, cautions, warnings, notes provided in these specifications, or other Panasonic Energy Corporation of America – Lithium Battery Division reasonable instructions or advice.

4) You will be responsible for any tabbing and lead wire (with connector) application.

11. Others

- 1) The CR123A was developed for camera use. It is recommended that the batteries should be replaced within two years if it is used for an application, other than camera use.
- 2) This product specification will be validated assuming that it is accepted when it is not returned within six months from the date of issue.
- 3) The weight of lithium metal content in this battery is within the limits of Special Provisions 188 and A45 as established in ICAO, IMO, and DOT transportation regulations. This battery has passed the T-Test requirements of the UN Transport of Dangerous Goods – Manual of Test and Criteria.
- 4) This battery does not contain any toxic materials, such as mercury, cadmium or lead.

12. Precautions for use

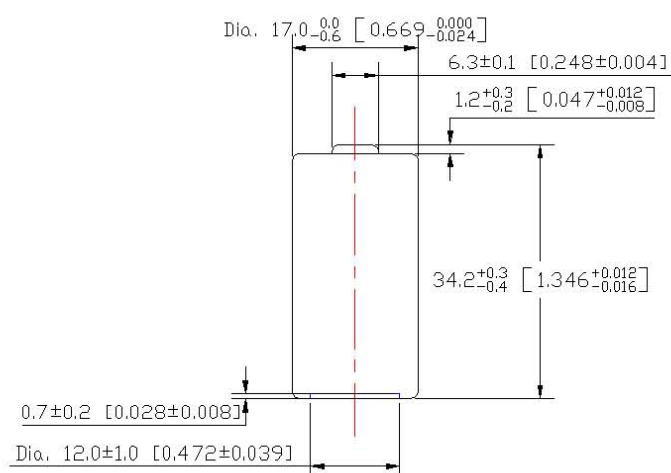
- 1) The battery shall not be stored at temperatures in excess of 45°C. Storage at less than 35° C is recommended. Storage at less than –20°C can deform the plastic parts and may cause leakage. To prevent self-discharge caused by corrosion or decrease of insulation; humidity during storage shall be less than 70%RH.
- 2) The battery has an explosion resistant construction. But the following cautions should be taken, because combustible materials such as lithium metal and organic electrolyte are contained in the battery.
 - Do not use except in applicable model or equipment.
 - Do not connect more than two cells in series.
 - Do not mix new (fresh) and old (end of life) batteries.
 - Do not force-discharge
 - Do not mix different types (chemistries) of batteries.
 - Do not short circuit.
 - Do not dispose in fire.
 - Do not charge.
 - Do not disassemble.
 - Do not heat up more than 100°C.
 - Do not solder directly onto batteries.
 - Do not soak in water.
 - Do not deform.
 - Do not inadequately modify and remodel for installation.
 - Insert the batteries in correct polarity position.
 - Keep in original packaging until ready to use.



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- 3) Keep away from heat source or flame.
- 4) The battery shall not be washed by ultrasonic wave washer.
- 5) Keep away from children and infants to prevent the possibility of swallowing by mistake.

CR123A Product Drawing



Voltage : 3V
Terminals : Flat Contacts
Jacket : Resin Label

Remarks

- * The heights of overlapped portion is not specified
- * PTC device is installed inside

unit : mm (inch)

Scale : none

Product Type : Lithium Battery

Approved by: Scotty Scott Date: October 15, 2009

Prepared by : David McCain Date: October 15, 2009

Panasonic Energy Corporation of America – Lithium Battery Division



Product Service

ACR PLB-375:
Verification of Compliance to Section 4.4.2 of
RTCM 11010.2 (PLB Standard)

This document provides evidence that ACR Electronics has verified that the PLB-375 complies with Section 4.4.2 a), b), c), d), e) and f) of the RTCM Standard 11010.2 for 406 MHz Satellite Personal Locator Beacons (PLBs) dated July 10, 2008.

In particular, the following items have been verified at the minimum, ambient, and maximum operating temperatures on production units awaiting final approval for shipment.

4.4.2 a) The PLB battery experiences full-load current drain during the Self-test:

The current was measured during the self-test and compared to the current during a live transmission; the currents were found to be identical.

4.4.2 b) Each self-test pass/fail indicator correctly identifies a fail condition when a failure in the monitored function has been induced:

Each Self-Test failure condition was tested to ensure that a failure in that test would produce a Self-Test fail indication: a red LED flashed at the end of the test. The tests are briefly summarized below:

1. 406 MHz RF power – Tested by placing a wrong component in the circuit thus inducing a power mismatch in the 406 RF circuit and by disconnecting the 406 RF power input into the micro.
2. 121.5 MHz RF Power - Tested by running the test with the wrong load on the antenna and by disconnecting the 121.5 RF A to D input into the micro.
3. PLL Lock Detect – Tested by disconnecting a component in the PLL lock detect circuit so the signal oscillated and never locked.
4. Non-Volatile Memory (NVM) – Tested by writing the wrong checksum for the 406 message data into NVM.
5. GPS Module – Tested by both disconnecting the GPS module without any NMEA message injected on the GPS data line into the micro and disconnecting the GPS module and injecting the wrong NMEA message header into the micro's GPS data line.

4.4.2 c) Any transmission in either self-test mode is limited to one burst:

Self-test or GNSS Self-Test runs only once and transmits only one 406 message. This was confirmed by running each test and picking up the Self-Test 406 transmission with the FPR-300 data logger and confirming that only one 406 transmission was detected; the unit power was also monitored and the unit turned off as expected after both Self-Tests.



4.4.2 d) If a GNSS Self-Test mode is provided it shall be tested to verify that under worst case conditions (no GNSS reception or input) it is limited in duration (all location protocol beacons) and number (beacons with internal navigation devices only):

For worst case condition test no GPS signal was provided and the GNSS Self-Test was limited to 2 minutes. To confirm this the time from the start of the test until the GPS ON line from the micro went low (GPS turned off) was measured as was the time to end-of-test, the GNSS Self-Test 406 transmission and the unit power were also monitored; the GPS ON line went low after 2 minutes plus the approximately 5 seconds it takes to evoke the GNSS Self-Test; the 406 transmission occurred thereafter and was picked up by the FPR-300, it had default position data and no further 406 transmissions occurred; the red LED then flashed for 3 seconds followed by the strobe LED; the unit then turned off as expected in approximately 2 minutes 8 ½ seconds.

The number of GNSS Self-Tests is limited to 12 self-tests. This was tested by first running the GNSS Self-Test 12 times, confirming that the self-test ran to completion, a 406 burst was received by the FPR-300 data logger each time, and the red or green LED and strobe LED flashed at the end of the test; on the next, thirteenth, and subsequent attempts instead of the 3 green LED flashes indicating the start of the GNSS Self-Test there were 3 red LED flashes and the unit turned off; no 406 transmissions were received by the FPR-300 data logger and no end-of-test LED flashes occurred.

4.4.2 e) If a GNSS Self-Test mode is provided, it shall be verified that inadvertent activation of this mode is precluded:

The GNSS Self-Test is initiated by pressing the Self-Test button for at least 5 seconds; this precludes inadvertent activation; pressing the Self-Test button for at least ½ second and less than 5 seconds activates the regular Self-Test; continuing to press the Self-Test button for longer than 5 seconds, even past the end of the GNSS Self-Test has no additional effect, the GNSS Self-Test runs only once and then the unit turns off. All conditions were checked.

4.4.2 f) If a GNSS Self-Test mode is provided, it shall be tested to ensure the correct operation of the GNSS Self-Test pass/fail indicator(s):

As stated in d) above, if no valid fix is obtained the GNSS self-test fails, the red LED flashes at the end of test and the 406 message contains default position data; to test the pass condition a GPS signal was provided and the green LED flashed at the end of the test indicating a pass condition; the 406 message picked up using the FPR-300 data logger contained valid position data.



Product Service

COBHAM

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July 11, 2011

Subject: PLB-375 Material Waiver and Disclosure Information, including Waiver Statement for Label Legibility and Label Comprehensibility Tests

To Whom It May Concern:

Please be advised that the labeling on the exterior of the PLB-375 has been tested for abrasion resistance, per RTCM 11010.2 (A.20.6), by ACR Electronics Inc. and found successful. The same pad print process has been widely used on numerous ACR products for many years, including the previously approved PLB-350A/B and PLB-300 beacons, and found no degradation.

ACR Electronics, Inc. hereby declares that the labeling on the PLB-375 product fully complies with the requirements of RTCM 11010.2, section A.20.6.

As stipulated in the referenced standards, where a manufacturer can produce evidence that the components, materials and finishes employed in the equipment would satisfy the following tests then the tests shall be waived:

- Corrosion (Salt Mist) IEC 60945 (8.12) & ETSI 302-152-1 (6.5) & RTCM 11010.2 (A.8)
- Solar Radiation IEC 60945 (8.10) & RTCM 11010.2 (A.17)
- Oil Resistance IEC 60945 (8.11) & RTCM 11010.2 (A.18)

In this instance ACR Electronics, Inc. claim, for one or more of the reasons listed below that these criteria are met for the PLB-375 and therefore make application that the tests be waived.

1. The materials have a proven history of service in a marine environment, either from use in ACR Electronics, Inc.'s existing approved marine equipment range, or by implication from a long established history of exposure without effect (e.g. stainless steel).
2. The material manufacturer has conducted equivalent testing and has declared the product as being immune to these effects in the relevant data sheet.
3. ACR Electronics, Inc. in-house testing has proven the materials to be immune to the cause of degradation (e.g. oil resistance).

ACR Electronics, Inc. hereby declares that the materials used in the construction of the PLB-375 as here-in listed are not affected by the degrading agents listed above.

ACR Electronics, Inc. doing business as Cobham Beacon Solutions

www.acrelectronics.com
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The following is a list of components and materials used in the PLB-375 that are in direct contact with the marine environment:

Back Case	EXL-1330
Front Case	EXL-1434T
Front Case Overmould	GLS Versollan RU2205-1
Sealing Gasket	Silicone
Antenna Sealing O-ring	EPDM 540
Antenna Moulding	Polypropylene with UV inhibitor
Antenna Bushing	316 grade Stainless Steel
Antenna Blade	301 grade Stainless Steel
Screw, 4-40, Self-sealing	18-8 grade Stainless Steel
Washer, Antenna Detent	Spring Tempered Steel, Electro-Polished

Signed on behalf of ACR Electronics, Inc.

Thomas J. Pack
Director, New Product Development