



Product Service

**Choose certainty.
Add value.**

Report On

Emergency Beacons Testing of the
ACR Electronics, Inc.
SOS-300
In accordance with RTCM 11010.2

Document 75934560 Report 01 Issue 1

July 2017



Product Service

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuv-sud.co.uk

REPORT ON

Emergency Beacons Testing of the
ACR Electronics, Inc.
SOS-300

Document 75934560 Report 01 Issue 1

July 2017

PREPARED FOR

ACR Electronics, Inc.
5757 Ravenswood Road
Fort Lauderdale
FL 33312
USA

PREPARED BY

Robert Hampton
Test Engineer

APPROVED BY

Gareth Stephens
Authorised Signatory

Nic Forsyth
Authorised Signatory

Andy Lawson
Authorised Signatory

DATED

20 July 2017

21 July 2017

20 July 2017



Product Service

CONTENTS

Section		Page No
1	REPORT SUMMARY	3
1.1	Introduction	4
1.2	Brief Summary of Results	5
1.3	Application Form	7
1.4	Product Information	14
1.5	Deviations from the Standard	17
1.6	Waiver Requests	17
1.7	Modifications	17
1.8	Report Modification Record	17
2	TEST DETAILS	18
2.1	Initial Aliveness Test (Pre-conditioning)	19
2.2	Dry Heat	24
2.3	Damp Heat	37
2.4	Low Temperature	42
2.5	Vibration	55
2.6	Bump Test	64
2.7	Drop Test	76
2.8	Thermal Shock Test	80
2.9	Altitude Test	85
2.10	Immersion Test	88
2.11	Spurious Emissions	92
2.12	Operational Life and Self-test	103
2.13	(Limited) Cospas-Sarsat Type Approval Test Procedure	109
2.14	Solar Radiation	110
2.15	Oil Resistance	111
2.16	Corrosion	113
2.17	Compass Safe Distance	117
2.18	Miscellaneous Tests	119
2.19	Annex G Internal Navigation Device Test (Land and Maritime scenarios)	145
3	TEST EQUIPMENT	153
3.1	Test Equipment	154
4	PHOTOGRAPHS	164
4.1	Photographs of Equipment Under Test (EUT)	165
5	ACCREDITATION, DISCLAIMERS AND COPYRIGHT	167
5.1	Accreditation, Disclaimers and Copyright	168
ANNEX A	Limited C/S Testing (Summary of Results)	A.2
ANNEX B	Manufacturer Supplied Information	B.2



Product Service

SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
ACR Electronics, Inc.
SOS-300



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, Inc. SOS-300 to the requirements of RTCM 11010.2.

Objective	To perform Emergency Beacon Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	ACR Electronics, Inc.
Model Number(s)	SOS-300
Serial Number, Brief Description and TUV Reference in Brackets	#1763, Black, 50 Ω output (75934030-TSR0002) #1876, ACRtreuse, 50 Ω output (75934030-TSR0003) #1761, ACRtreuse, fully packaged (75934030-TSR0005) #1765, Black, fully packaged (75934030-TSR0008) Not serialised, IMEI: 300434060816170, ACRtreuse (75934030-TSR0046) Not serialised, IMEI: 300434060627250, Black (75934030-TSR0047) Not serialised, IMEI: 300434060810280, Black (75934030-TSR0048)
Number of Samples Tested	Seven
Test Specification/Issue/Date	RTCM Standard 11010.2 Including Amendments 1 through 5 (2016)
Date of Receipt of Test Samples	15 March 2016
Related Documents	IEC 60945:2002, incorporating corrigendum April 2008 Cospas-Sarsat T.001 Issue 4, December 2016 Cospas-Sarsat T.007 Issue 4 Rev. 11, December 2016 Cospas-Sarsat T.008 Issue 2 Rev. 1, December 2016
Order Number	36443-00
Date	31 October 2016
Start of Test	06 April 2016
Finish of Test	17 July 2017
Name of Engineer(s)	R Hampton A Guy C Hedley F Van Niekerk K Bryant C Bowles M Mawby S Jones



Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with RTCM 11010.2 is shown below.

Section	RTCM 11010.2 Clause	Test Description	Result	Comments
Configuration: SOS-300 (Conducted): Test samples: TSR0002, 0003				
Compulsory Sequence Of Tests (As per A.2)				
2.1	A.1.13	Initial Aliveness Test	Satisfactory	-
2.2	A.3	Dry Heat	Satisfactory	-
2.3	A.4	Damp Heat	Satisfactory	-
2.4	A.5	Low Temperature	Satisfactory	-
Configuration: SOS-300 (Radiated) Test samples: TSR0046, 0047				
Compulsory Sequence Of Tests (As per A.2)				
2.1	A.1.13	Initial Aliveness Test	Satisfactory	-
2.2	A.3	Dry Heat	Satisfactory	-
2.3	A.4	Damp Heat	Satisfactory	-
2.4	A.5	Low Temperature	Satisfactory	-
2.5	A.6	Vibration	Satisfactory	-
2.6	A.7	Bump	Satisfactory	-
2.7	A.9	Drop on Hard Surface	Satisfactory	-
2.8	A.10	Thermal Shock	Satisfactory	-
2.9	A.20.8	Altitude Test	Satisfactory	-
2.10	A.11	Immersion	Satisfactory	-
2.11	A.12	Spurious Emissions	Pass	-
2.12	A.13	Operational Lifetime	Pass	-
2.13	A.14	(Limited) Cospas Sarsat Type Approval	Pass	See Annex A



Product Service

Section	RTCM 11010.2	Test Description	Result	Comments
Configuration: SOS-300 (Radiated) Test samples: TSR0005, 0008, 0046, 0047, 0048				
Other Tests (Non Compulsory Sequence of Tests)				
-	A.15	Buoyancy	Not applicable: EUT does not float.	
-	A.16	Auxiliary Radio-Locating Device Transmitter Tests	No 121.5 MHz homing transmitter: see waiver request.	
2.14	A.17	Solar Radiation	Refer to TÜV SÜD PSB Pte. Ltd. Test Report: 7191160592-CHM17-CCK	
2.15	A.18	Oil Resistance	Satisfactory	-
2.16	A.8	Corrosion	Satisfactory	-
2.17	A.19	Compass Safe Distance	-	See section 2.17
2.18	A.20	Miscellaneous Test	See Section 2.18 for non-compliances	
2.19	Annex G	Internal Navigation Device (Land and Maritime Scenarios)	Pass	-



Product Service

1.3 APPLICATION FORM

G.1 INFORMATION PROVIDED BY THE BEACON MANUFACTURER

Beacon Manufacturer and Beacon Model

Beacon Manufacturer	ACR Electronics, Inc.
Beacon Model Name	SOS-300
Additional Beacon Model Names	SARLink SOS-300

Beacon Type and Operational Configurations

Beacon Type	Beacon used while:	Tick where appropriate
EPIRB Float Free	Floating in water or on deck or in a safety raft	
EPIRB Non-Float Free (automatic and manual activation)	Floating in water or on deck or in a safety raft	
EPIRB Non-Float Free (manual activation only)	Floating in water or on deck or in a safety raft	
EPIRB Float Free with VDR	Floating in water or on deck or in a safety raft	
PLB	On ground and above ground	X
	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)		



Product Service

Beacon Characteristics

Characteristic	Specification
Operating frequency	406.040 MHz
Operating temperature range	T _{min} = -20 C T _{max} = +55 C
Temperature, at which minimum duration of continuous operation is expected	-20 C
Operating lifetime	24 hours
Beacon power supply type (internal non-rechargeable, internal re-chargeable, external, combined, other)	Internal
External power supply parameters (AC/DC and nominal voltage)	N/A
Is external power supply needed to energise the beacon or its ancillary devices in any of operational modes (N/A or Yes or No)	No
Battery cell chemistry	LiMnO ₂
Battery cell model name, cell size, number of cells in a battery pack, and details of the battery pack electrical configuration	CR-123A, 2/3A, 3 cells
Battery cell manufacturer	Panasonic
Battery pack manufacturer and part number	ACR P/N A3-06-2770
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	.25 years
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	7 years
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO
Oscillator manufacturer	RAKON, Made in New Zealand
Oscillator model name/ part number	ACR P/N A1-11-0940 RAKON P/N E5344LF
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 part number	Antenna Assy, A3-06-2911-1
Antenna cable assembly min/max RF- losses at 406 MHz, if applicable	N/A
Navigation device type (Internal, External or None)	Internal
Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime	



Product Service

Characteristic	Specification
resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	Yes
Features in beacon that ensure 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
Encoded position update capability (Yes, No, N/A) and	Yes
Encoded position update interval value (range)	20 min to 4 hours
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	U-BLOX
– Navigation device model name and part Number	ACR P/N A1-11-1037 (U-BLOX P/N MAX-7Q-0)
– Internal navigation device antenna type(integrated, internal, external, passive/active) , manufacturer and model	ACR P/N A3-06-2917 (JIAXING GLEAD ELECT. CO. P/N DAM1575J2NO_ST03_P120mm)
– GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS
For External Navigation Devices	N/A
– Data protocol for GNSS receiver to beacon interface	
– Physical interface for beacon to navigation device	
– Electrical interface for beacon to navigation device	
– Part number of the external navigation interface device (if applicable)	
– Navigation device model and manufacturer (if beacon designed to use specific devices)	



Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-test Mode
- Activated by a separate switch/ separate switch position (Yes or No)	Yes	N/A
- Self-test/GNSS self-test mode switch automatically returns to normal position when released (Yes or No)	Yes	N/A
- Self-test/ GNSS self-test activation can cause an operational mode transmission (Yes or No)	No	N/A
- Results in transmission of a single self-test burst only, regardless of how long the self-test activation mechanism is applied (Yes or No)	Yes	N/A
- Results of self-test/ GNSS self-test are indicated by (provide details, e.g. Pass/ Fail indicator light, strobe light, etc.)	LED	N/A
- The content of the encoded position data fields of the self-test message has default values	Yes	N/A
- Performs an internal check and indicates that RF-power is being emitted at 406 MHz and 121.5 MHz, if beacon includes a 121.5 Hz homer (Yes or No)	Yes	N/A
- Self-test results in transmission of a signal other than at 406 MHz (Yes & details or No)	NO	N/A
- Self-test can be activated directly at beacon (Yes or No)	Yes	N/A
- List of Items checked by self-test	Battery, 406 PWR, Lock detect, Non-Volatile Memory	N/A
- Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)	440 ms	N/A
- Self-test message length format flag in bit 25, ("0" or "1")	1	N/A
- Maximum duration of a self-test mode, sec	10 s	N/A
- Maximum recommended number of self-tests during battery pack replacement period	60	N/A
- Distinct indication of self-test start (Yes or No)	Yes	N/A
- Indication of self-test results(Yes or No)	Yes	N/A
- Distinct indication of insufficient battery capacity (Yes or No)	Yes	N/A
- Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)	Yes	N/A
- Maximum number of GNSS Self Tests (beacons with internal navigation devices only)	N/A	N/A



Product Service

Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-test Mode
– GNSS Self-test results in transmission of a single burst, irrespective of the test result (Yes or No)	N/A	N/A
– Maximum number of self-tests during battery pack replacement period	N/A	N/A
– Self-test/ GNSS self-test can be activated from beacon remote activation points (Yes & details or No)	N/A	N/A
– List all methods of Self-test mode and GNSS Self-test modes activation. Provide details on a separate sheet to describe	Details on separate sheet	N/A
Message Coding Protocols:	(x) Tick the boxes below against the intended protocol options	
User Protocol (tick where appropriate)	☐ Maritime with MMSI	
	☐ Maritime with Radio Call Sign	
	☐ EPIRB Float Free with Serial Number	
	☐ EPIRB Non Float Free with Serial Number	
	☐ Radio Call Sign	
	☐ Aviation	
	☐ ELT with Serial Number	
	☐ ELT with Aircraft Operator and Serial Number	
	☐ ELT with Aircraft 24-bit Address	
	☐ PLB with Serial Number	
	☐ National (Short Message Format)	
	☐ National (Long Message Format)	
Standard Location Protocol (tick where appropriate)	☒ EPIRB with MMSI	
	☒ EPIRB with Serial Number	
	☒ ELT with 24-bit Address	
	☒ ELT with Aircraft Operator Designator	
	☒ ELT with Serial Number	
	☒ PLB with Serial Number	
National Location Protocol (tick where appropriate)	☒ National Location: EPIRB	
	☒ National Location: ELT	
	☒ National Location: PLB	



Product Service

RLS Location Protocol (tick where appropriate) ¹	EPIRB
	ELT
	PLB
User Location Protocol (tick where appropriate)	X Maritime with MMSI
	X Maritime with Radio Call Sign
	EPIRB Float Free with Serial Number
	X EPIRB Non Float Free with Serial Number
	X Radio Call Sign
	X Aviation
	X ELT with Serial Number
	X ELT with Aircraft Operator and Serial Number
	X ELT with Aircraft 24-bit Address
	X PLB with Serial Number
Beacon includes a homer transmitter(s) (Yes or No)	NO
- homer transmitter(s) frequency	N/A
- homer transmitter(s) power	N/A
- homer transmitter(s) duty cycle	N/A %
- duty cycle of homer swept tone	N/A %
Beacon includes a high intensity flashing light (e.g. Strobe)	NO
- light intensity	N/A cd
- flash rate	N/A flashes per 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.	Iridium portion of the beacon
Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism	No
Beacon includes features and functions not listed above, related or non-related to 406 MHz (Yes or No) List features and use a separate sheet if insufficient space	Yes



Product Service

Beacon model hardware part number (P/N) and version	ACR Treuse color: A3-06-2918-1, Rev F Black color: A3-06-2918-2, Rev F
Beacon model software/firmware P/N, version, date of issue/releases	K3-01-0110, Rev C (Ver 2.6), Release 02/10/2016
Beacon model printed circuit board P/N and version	A3-07-0434 Rev D
Known non-compliances with C/S T,001 requirements(Yes or No) If Yes, provide details (or use a separate sheet if insufficient space)	No
Beacon Manufacturer Point of Contact (POC) for this Type Approval application:	Name and Job Title: Mr. Dan Stankovic, Director of Certification and Test Phone: 954-981-3333 X 2175 E-mail: dan.stankovic@acrartex.com

Dated:..02/19/2016.....

Signed:.....

Mr. Dan Stankovic, Director of Certification and Test

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics, Inc. SOS-300 as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.



Equipment Under Test

1.4.2 Physical Test Configuration

The Equipment Under Test (EUT) was operated using its own power sources (internal batteries).

Two samples were modified so that the antenna port could be connected to the test system (50 Ω) using a coaxial cable. These EUT were not water tight like the proposed production units. These EUT, (termed “conducted”) were used for all tests except those involving drops, exposure to water etc.

Two samples were “fully packaged” samples, similar to the proposed production units equipped with their proper antennas and of standard watertightness. These EUT, (termed “radiated”) were used for all tests but due to the lack of RF connection, they were not used for any Performance Check or Test involving detailed RF measurements.



Product Service

1.4.3 Performance Check and Performance Test

The following definitions of Performance Check and Performance Test were used where required by the test clauses and test standard:

RTCM 11010.2 Clause A.1.11, Performance Check – Main Extract

Activate EUT (mode not specified) and measure:

- 406 MHz transmitted frequency (single burst)
- 406 MHz digital message
- Presence of Auxiliary Radio-Locating Device transmission

RTCM 11010.2 Clause A.1.12, Performance Test – Main Extract

Measure the following 406 MHz parameters as per C/S T.007 Annex A:

- Transmitter power output
- Digital message
- Digital message generator (Bit Rate and Stability only)
- Modulation
- Transmitted frequency
- Spurious output

Note that, where required for the purposes of performing Performance Checks and Performance Tests, the EUT was removed from the applied environmental conditions to ambient conditions. When this was necessary, the EUT was wrapped in a thermally-insulating container and the duration at ambient was kept to less than 10 min



Product Service

1.4.4 Modes of Operation

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

Off/Standby Mode

- 406 MHz functions off (if on, press and hold “SOS” button for 3 to 4 s)
- Iridium functions off (if on, press and hold “SOS” button for 3 to 4 s)

Self-test

- Iridium powered on (press and hold Power/Back button for 2 to 3 s)
- 406 MHz Self-test (press and hold “406 ✓” button for ~1 s)
- List of items checked as per Application Form

GNSS Self-test

- Not used

Operating

- Nominal:
 - o Press and hold “SOS” button for 1 to 2 s
 - o Both Primary (406) and Secondary/Rechargeable (Iridium) batteries holding sufficient charge for operation
 - o 406 functions on
 - o Iridium functions on
- EUT worst-case (lifetime test):
 - o Iridium functions off, battery fully discharged (GNSS therefore powered by 406 battery)
 - o 406 functions on (press and hold “SOS” button for 1 to 2 s)
 - o GNSS signals not applied (maximising search time)



1.5 DEVIATIONS FROM THE STANDARD

Sequence of Tests

The compulsory sequence of tests was, where possible, carried out on both the conducted and radiated samples, however, for tests requiring physical impact and / or exposure to water the EUT was not considered suitable due to the modification to provide an output at 50 Ω .

Altitude Test

The EUT was not coded to test user protocol, this was considered unnecessary due to the EUT not activating throughout the test. The EUT was programmed in accordance with Clause A.1.7; *"using a test protocol of appropriate type and format"*.

Cospas-Sarsat Type-Approval Test Procedure

Limited COSPAS SARSAT testing occurred during the compulsory sequence of tests. This was agreed with the Notified Body to allow the COSPAS SARSAT type approval to take place in parallel. Limited testing was carried out in-sequence so that continuing compliance could be demonstrated.

1.6 WAIVER REQUESTS

An FCC Waiver Docket was provided with respect to the EUT and the Manufacturer advises the following:

... the conditions of the Waiver for the device are such that the EUT can only be sold directly by ACR to government agencies and high-risk entities, and will not be sold to the general public via retail outlets.

The Waiver also states the eligibility is limited to government (Federal, State and local) agencies and high-risk commercial industry (including NGOs) where potential users are certified and trained, and with an organised support activity or call centre to manage and respond to messages. Any offer for sale or lease of the SARLink will state these eligibility limits.

Furthermore, the SARLink will be labelled with a notice that the device does not include a 121.5 MHz homing transmitter and that the SARLink will not be marketed or otherwise offered as a PLB, and will not be sold via retail outlets (see para 9 of Waiver Docket No. 15-85 for which a copy may be found in Annex B).

1.7 MODIFICATIONS

The Manufacturer declared that there were no design changes to the EUT during the test campaign.

1.8 REPORT MODIFICATION RECORD

Issue 1 – First Issue



Product Service

SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
ACR Electronics, Inc.
SOS-300



Product Service

2.1 INITIAL ALIVENESS TEST (PRE-CONDITIONING)

2.1.1 Specification Reference

RTCM 11010.2, Clause A.1.13

2.1.2 Equipment Under Test and Modification State

SOS-300 S/N: #1763 (75934030-TSR0002) – Modification State 0
SOS-300 S/N: #1876 (75934030-TSR0003) – Modification State 0
SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0
SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.1.3 Date of Test

06 July 2016 and 23 April 2017

2.1.4 Test Equipment Used

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

2.1.5 Test Method

The following testing was performed as per C/S T.007 Annex A:

- Transmitter power output
- Digital message
- Digital message generator
- Modulation
- Transmitted frequency

2.1.6 Environmental Conditions

Ambient Temperature 21.8 - 21.8 °C
Relative Humidity 54.4 - 39.7 %

2.1.7 Test Results

Visual Inspection

Prior to the start of all testing, the EUT was visually inspected; no signs of damage were found.

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.0399482	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

Performance Test

Test Parameter	Units	Result (Note 1)	Limit
Transmitter power output			
Power output	dBm	38.13 / 38.11	35 - 39
Power output rise time	ms	0.13 / 0.10	<5
Power output 1 ms before burst	dBm	-35.04 / -39.39	<-10
Digital Message (bit numbers)			
Full Hex (all)	-	FFFE2F8C9EF9C0637 FDFF83D15B683E0F00E	(Note 2)
Bit sync (1-15)	P/F	P	P
Frame sync (16-24)	P/F	P	P
Format flag (25)	(1 bit)	1	(Note 2)
Protocol flag (26)	(1 bit)	0	(Note 2)
Identification / position data (27-85)	P/F	P	P
BCH code (86-106)	P/F	P	P
Emergency code / nation. use /suppl. data (107-112)	(6 bits)	110110	(Note 2)
Additional data /BCH (if applicable) (113-144)	P/F	P	P
Position error (if applicable)	km	N/A (Default encoded)	< 5
Digital Message Generator			
Repetition rate T_R - average	s	50.153	48.5 - 51.5
Repetition rate T_R - min	s	47.784	47.5 - 48.0
Repetition rate T_R - max	s	52.400	52.0 - 52.5
Repetition rate T_R - standard deviation	s	1.25	0.5 - 2.0
Bit rate and stability	bit/s	399.93 / 399.92	396 - 404
Total transmission time - short message	ms	N/T	435.6 - 444.4
Total transmission time - long message	ms	520.13 / 520.08	514.8 - 525.2
Unmodulated carrier	bit/s	160.15 / 160.11	158.4 - 161.6
First burst delay	s	N/T	≥ 47.5
Modulation			
Biphase-L	Y/N	Y	Y
Rise time	μ s	199.4 / 180.3	50 - 250
Fall time	μ s	197.7 / 178.6	50 - 250
Phase deviation: positive	rad	1.1443 / 1.0397	+(1.0 to 1.2)
Phase deviation: negative	rad	-1.1542 / -1.0448	-(1.0 to 1.2)
Symmetry measurement	-	0.0206	≤ 0.05



Product Service

Test Parameter	Units	Result (Note 1)	Limit
Transmitted frequency			
Nominal value	MHz	406.0399482 / 406.0399482	C/S T.001
Short Term Stability	/100 ms	83.377E-12 / 83.377E-12	$\leq 2 \times 10^{-9}$
Medium Term Stability - Slope	/min	70.293E-12 / 70.293E-12	$(-1 \text{ to } +1) \times 10^{-9}$
Medium Term Stability - Residual Frequency Variation	-	34.356E-11 / 34.356E-11	$\leq 3 \times 10^{-9}$

Note 1: Where appropriate, results are displayed as Maximum / Minimum.

Note 2: The Encoded message was checked against the intended encoding and C/S T.007.

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.0399460	406.040 $\pm$ 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Test Parameter	Units	Result (Note 1)	Limit
Transmitter power output			
Power output	dBm	38.31 / 38.30	35 - 39
Power output rise time	ms	0.12 / 0.09	<5
Power output 1 ms before burst	dBm	-34.47 / -38.40	<-10
Digital Message (bit numbers)			
Full Hex (all)	-	FFFE2F8C9F70465FC 0FF01F754769F3C0672	(Note 2)
Bit sync (1-15)	P/F	P	P
Frame sync (16-24)	P/F	P	P
Format flag (25)	(1 bit)	1	(Note 2)
Protocol flag (26)	(1 bit)	0	(Note 2)
Identification / position data (27-85)	P/F	P	P
BCH code (86-106)	P/F	P	P
Emergency code / nation. use /suppl. data (107-112)	(6 bits)	110110	(Note 2)
Additional data /BCH (if applicable) (113-144)	P/F	P	P
Position error (if applicable)	km	N/A (Default encoded)	< 5



Product Service

Test Parameter	Units	Result (Note 1)	Limit
Digital Message Generator			
Repetition rate T_R - average	s	50.465	48.5 - 51.5
Repetition rate T_R - min	s	47.940	47.5 - 48.0
Repetition rate T_R - max	s	52.136	52.0 - 52.5
Repetition rate T_R - standard deviation	s	1.32	0.5 - 2.0
Bit rate and stability	bit/s	399.93 / 399.92	396 - 404
Total transmission time - short message	ms	N/T	435.6 - 444.4
Total transmission time - long message	ms	520.13 / 520.09	514.8 - 525.2
Unmodulated carrier	bit/s	160.16 / 160.12	158.4 - 161.6
First burst delay	s	N/T	≥ 47.5
Modulation			
Biphase-L	Y/N	Y	Y
Rise time	μ s	212.3 / 190.3	50 - 250
Fall time	μ s	208.7 / 187.7	50 - 250
Phase deviation: positive	rad	1.1460 / 1.0362	+(1.0 to 1.2)
Phase deviation: negative	rad	-1.1489 / -1.0438	-(1.0 to 1.2)
Symmetry measurement	-	0.0205	≤ 0.05
Transmitted frequency			
Nominal value	MHz	406.0399460 / 406.0399460	C/S T.001
Short Term Stability	/100 ms	75.424E-12 / 75.424E-12	$\leq 2 \times 10^{-9}$
Medium Term Stability - Slope	/min	15.608E-11 / 15.608E-11	$(-1 \text{ to } +1) \times 10^{-9}$
Medium Term Stability - Residual Frequency Variation	-	38.259E-11 / 38.259E-11	$\leq 3 \times 10^{-9}$

Note 1: Where appropriate, results are displayed as Maximum / Minimum.

Note 2: The Encoded message was checked against the intended encoding and C/S T.007.

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.041	406.040 $\pm$ 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Not tested (no 50 Ω output)



Product Service

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.041	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Not tested (no 50 Ω output)



Product Service

2.2 DRY HEAT

2.2.1 Specification Reference

RTCM 11010.2, Clause A.3

2.2.2 Equipment Under Test and Modification State

SOS-300 S/N: #1763 (75934030-TSR0002) – Modification State 0
SOS-300 S/N: #1876 (75934030-TSR0003) – Modification State 0
SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0
SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.2.1 Date of Test

06-07 July 2016, 13-14 July 2016, 24-25 April 2017 and 27-28 April 2017

2.2.2 Test Equipment Used

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

2.2.3 Environmental Conditions

	06-07/07/16	13-14/07/16	24-25/04/17	27-28/04/17
Ambient Temperature (°C)	21.6 - 25.6	20.3 - 25.2	21.4 - 25.2	17.9 - 21.4
Relative Humidity (%)	33.2 - 43.7	33.7 - 50.3	25.9 - 31.7	19.5 - 29.5

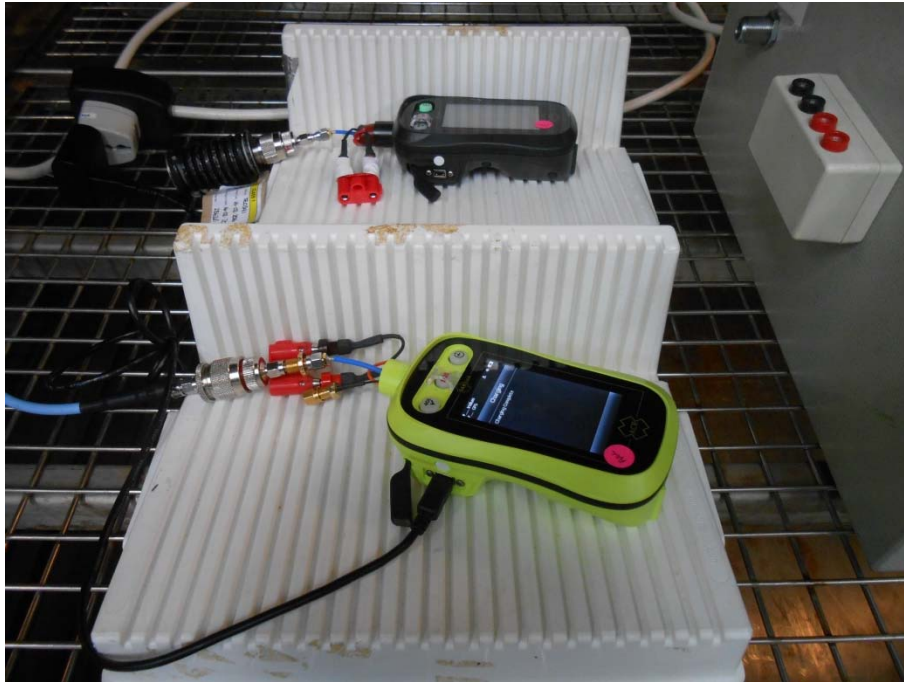
2.2.4 Test Setup



Storage Test Setup (Conducted Samples)



Storage Test Setup (Radiated Samples)



Functional Test Setup (Conducted Samples)



Functional Test Setup (Radiated Samples)

2.2.5 Test Method

Storage Test

The EUT's were placed in a climatic chamber where the temperature was increased from laboratory ambient temperature to +70 °C. After 10 h to 16 h, the temperature was returned to ambient conditions. The EUT was subjected to a performance check at the end of the test.

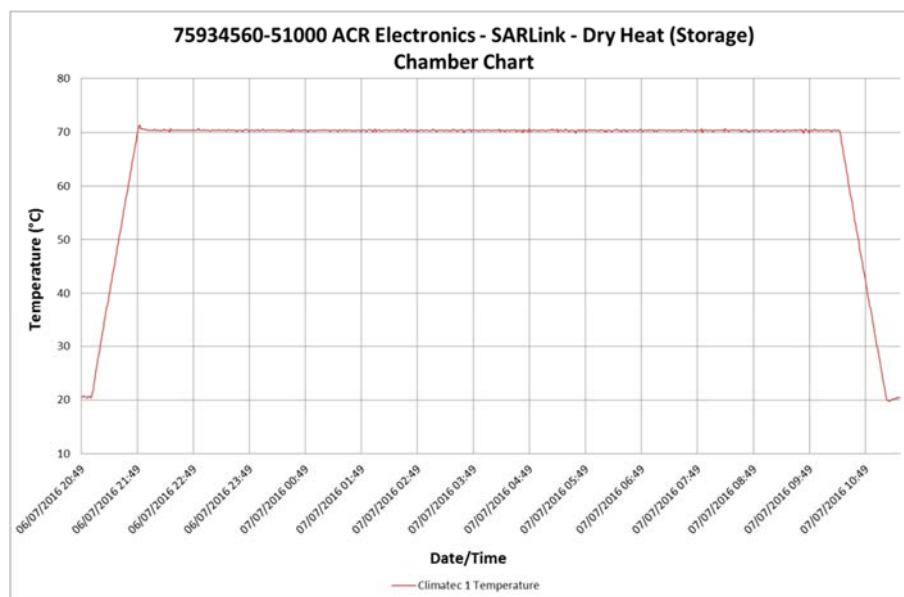
Functional Test

The EUT was switched on, and placed in a climatic chamber where the temperature was increased from ambient temperature to +55 °C. The conditions remained for a period of 10 h to 16 h. Towards the end of this period, the EUT was subjected to a performance check and performance test. At the end of the test, the temperature was returned to laboratory ambient conditions.

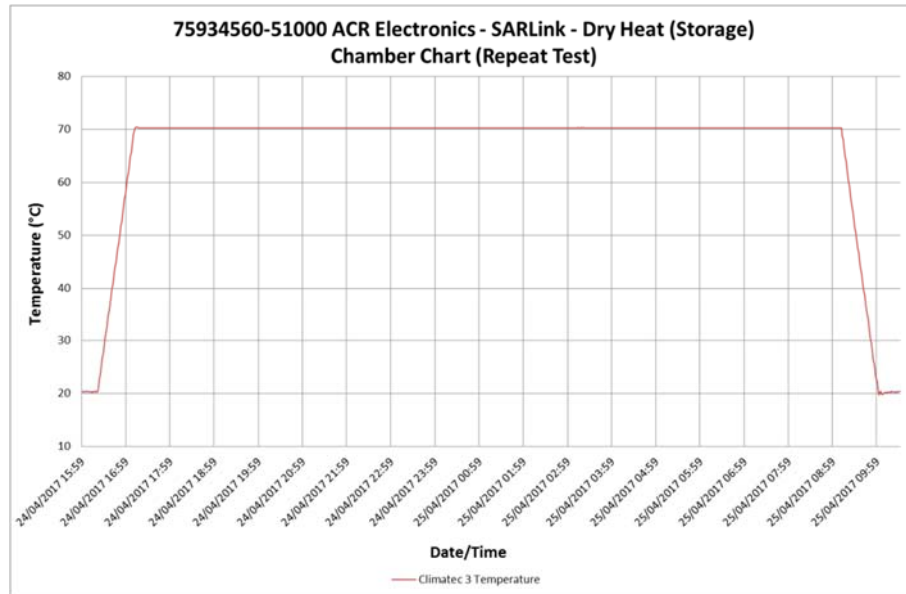
At the conclusion of all testing, a Performance Check was carried out.

2.2.6 Test Results

Storage Test



Temperature Plot (Conducted Samples)



Temperature Plot (Radiated Samples)

Post-test Performance Checks

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039994	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039990	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040036	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

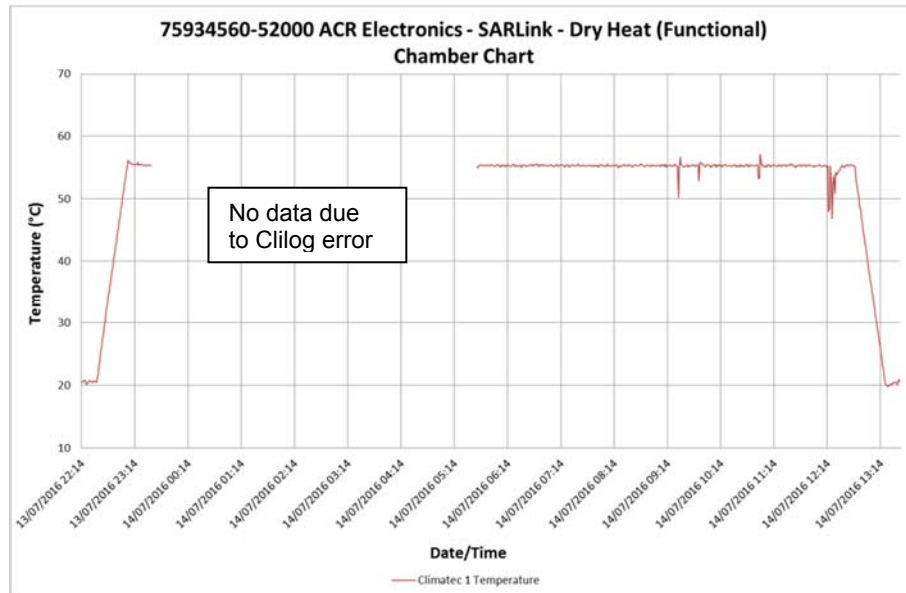
SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

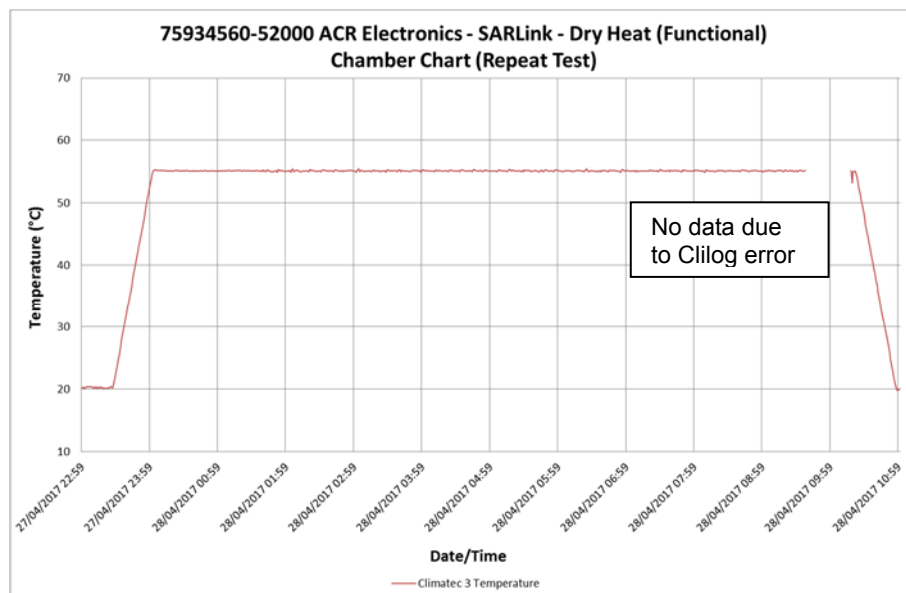
Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040041	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Functional Test

Temperature Plot



Temperature Plot (Conducted Samples)



Temperature Plot (Radiated Samples)



Product Service

Soak Period Performance Check and Performance Test

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039969	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Test Parameter	Units	Result (Note 1)	Limit
Transmitter power output			
Power output	dBm	37.13 / 37.07	35 - 39
Power output rise time	ms	0.12 / 0.08	<5
Power output 1 ms before burst	dBm	-33.78 / -37.89	<-10
Digital Message (bit numbers)			
Full Hex (all)	-	FFFE2F8C9EF9C0637 FDFF83D15B683E0F00E	(Note 2)
Bit sync (1-15)	P/F	P	P
Frame sync (16-24)	P/F	P	P
Format flag (25)	(1 bit)	1	(Note 2)
Protocol flag (26)	(1 bit)	0	(Note 2)
Identification / position data (27-85)	P/F	P	P
BCH code (86-106)	P/F	P	P
Emergency code / nation. use /suppl. data (107-112)	(6 bits)	110110	(Note 2)
Additional data /BCH (if applicable) (113-144)	P/F	P	P
Position error (if applicable)	km	N/A (Default encoded)	< 5
Digital Message Generator			
Bit rate and stability	bit/s	399.93 / 399.91	396 - 404
Modulation			
Biphase-L	Y/N	Y	Y
Rise time	µs	189.3 / 171.3	50 - 250
Fall time	µs	186.7 / 169.7	50 - 250
Phase deviation: positive	rad	1.1503 / 1.0341	+(1.0 to 1.2)
Phase deviation: negative	rad	-1.1521 / -1.0333	-(1.0 to 1.2)
Symmetry measurement	-	0.0210	≤ 0.05

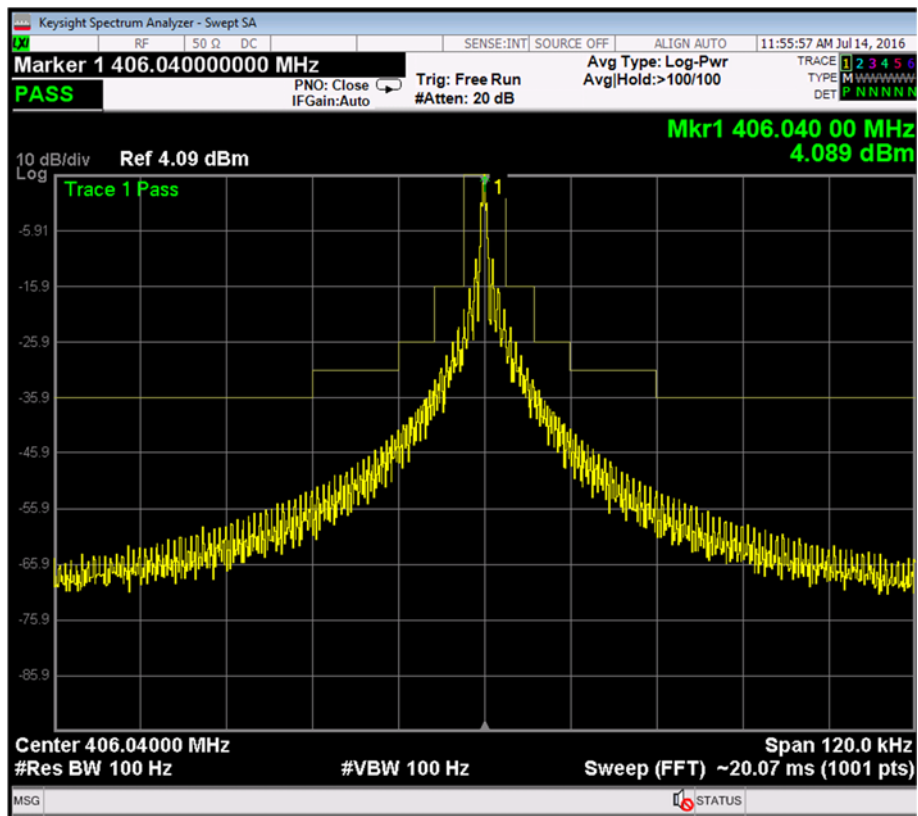


Product Service

Test Parameter	Units	Result (Note 1)	Limit
Transmitted frequency			
Nominal value	MHz	406.0399689 / 406.0399689	C/S T.001
Short Term Stability	/100 ms	83.400E-12 / 83.182E-12	$\leq 2 \times 10^{-9}$
Medium Term Stability - Slope	/min	56.040E-12 / 41.840E-12	$(-1 \text{ to } +1) \times 10^{-9}$
Medium Term Stability - Residual Frequency Variation	-	23.993E-11 / 23.208E-11	$\leq 3 \times 10^{-9}$
Spurious Output			
Meets C/S T.001 mask	Y / N	Y	Y

Note 1: Where appropriate, results are displayed as Maximum / Minimum.

Note 2: The Encoded message was checked against the intended encoding and C/S T.007.



Spurious Output



Product Service

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039941	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Test Parameter	Units	Result (Note 1)	Limit
Transmitter power output			
Power output	dBm	37.27 / 37.25	35 - 39
Power output rise time	ms	0.11 / 0.08	<5
Power output 1 ms before burst	dBm	-33.11 / -37.40	<-10
Digital Message (bit numbers)			
Full Hex (all)	-	FFFE2F8C9F70465FC 0FF01F754769F3C0672	(Note 2)
Bit sync (1-15)	P/F	P	P
Frame sync (16-24)	P/F	P	P
Format flag (25)	(1 bit)	1	(Note 2)
Protocol flag (26)	(1 bit)	0	(Note 2)
Identification / position data (27-85)	P/F	P	P
BCH code (86-106)	P/F	P	P
Emergency code / nation. use /suppl. data (107-112)	(6 bits)	110110	(Note 2)
Additional data /BCH (if applicable) (113-144)	P/F	P	P
Position error (if applicable)	km	N/A (Default encoded)	< 5
Digital Message Generator			
Bit rate and stability	bit/s	399.94 / 399.92	396 - 404
Modulation			
Biphase-L	Y/N	Y	Y
Rise time	µs	196.3 / 179.3	50 - 250
Fall time	µs	195.6 / 178.6	50 - 250
Phase deviation: positive	rad	1.1355 / 1.0317	+(1.0 to 1.2)
Phase deviation: negative	rad	-1.1509 / -1.0474	-(1.0 to 1.2)
Symmetry measurement	-	0.0202	≤ 0.05

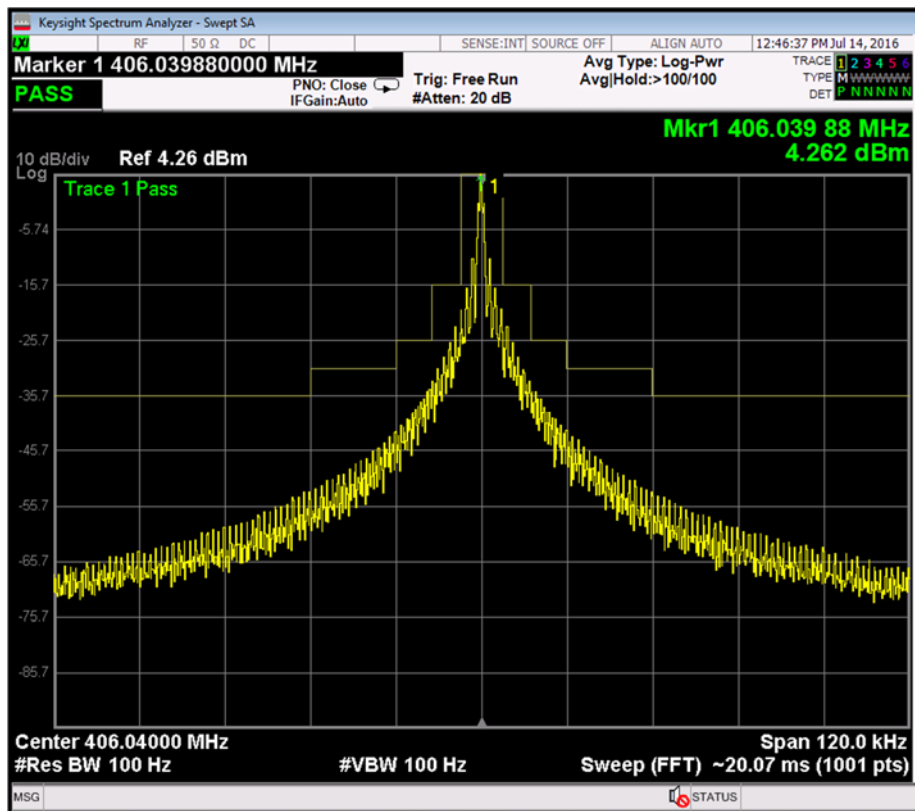


Product Service

Test Parameter	Units	Result (Note 1)	Limit
Transmitted frequency			
Nominal value	MHz	406.0399414 / 406.0399414	C/S T.001
Short Term Stability	/100 ms	97.818E-12 / 85.221E-12	$\leq 2 \times 10^{-9}$
Medium Term Stability - Slope	/min	-50.921E-12 / -71.309E-12	$(-1 \text{ to } +1) \times 10^{-9}$
Medium Term Stability - Residual Frequency Variation	-	72.062E-11 / 68.471E-11	$\leq 3 \times 10^{-9}$
Spurious Output			
Meets C/S T.001 mask	Y / N	Y	Y

Note 1: Where appropriate, results are displayed as Maximum / Minimum.

Note 2: The Encoded message was checked against the intended encoding and C/S T.007.



Spurious Output



Product Service

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040038	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Not tested - Radiated configuration prohibits meaningful results.

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040049	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Not tested - Radiated configuration prohibits meaningful results.



Product Service

Post-test Performance Checks

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039992	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039986	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039925	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040018	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

2.3 DAMP HEAT

2.3.1 Specification Reference

RTCM 11010.2, Clause A.4

2.3.2 Equipment Under Test and Modification State

SOS-300 S/N: #1763 (75934030-TSR0002) – Modification State 0
 SOS-300 S/N: #1876 (75934030-TSR0003) – Modification State 0
 SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0
 SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.3.3 Date of Test

14-15 July 2016 and 02-03 May 2017

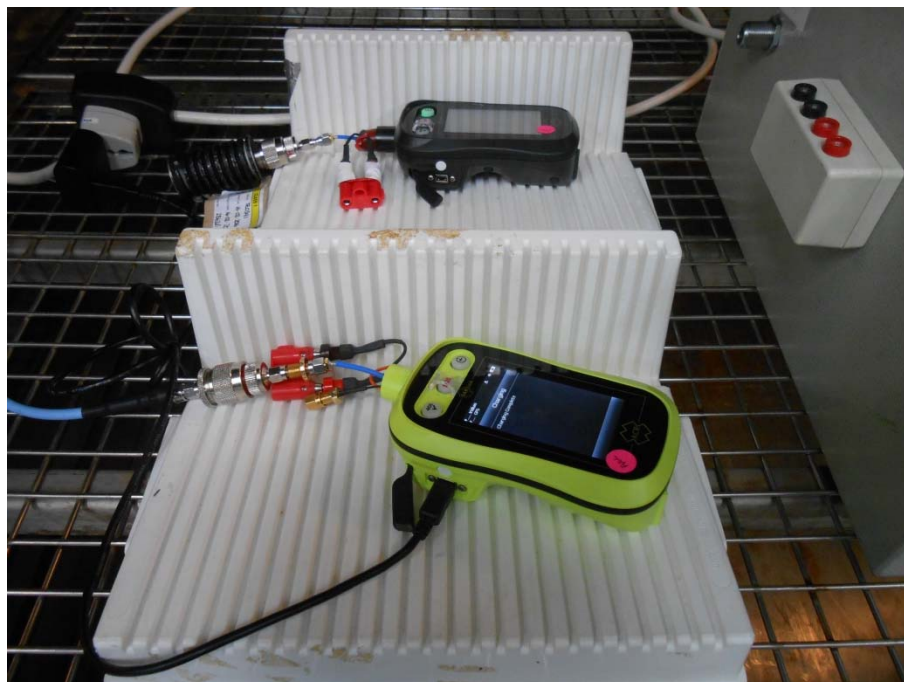
2.3.4 Test Equipment Used

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

2.3.5 Environmental Conditions

	14-15/07/16	02-03/05/17
Ambient Temperature (°C)	17.6 - 23.2	15.1 - 24.2
Relative Humidity (%)	48.1 - 59.6	27.6 - 50.5

2.3.6 Test Setup



Test Setup (Conducted Samples)

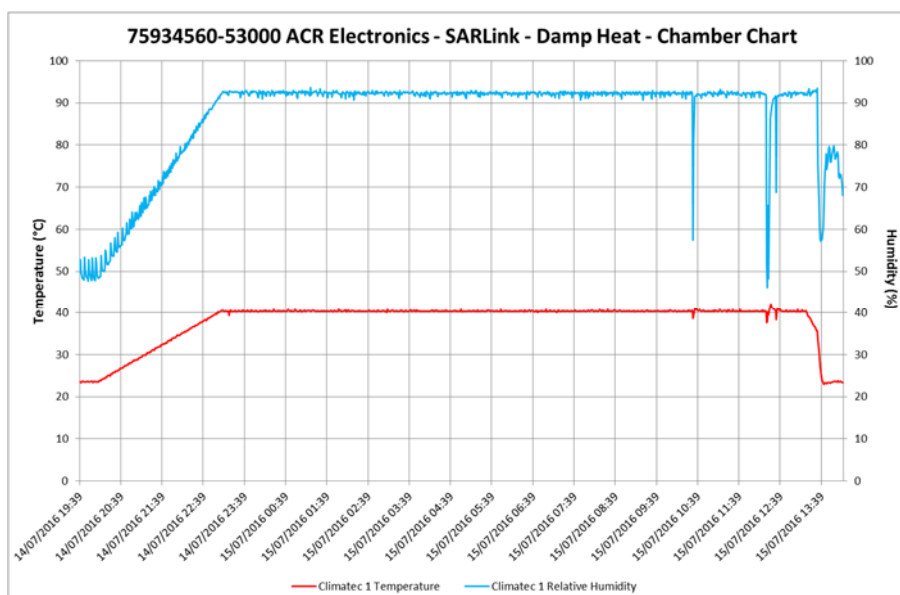


Test Setup (Radiated Samples)

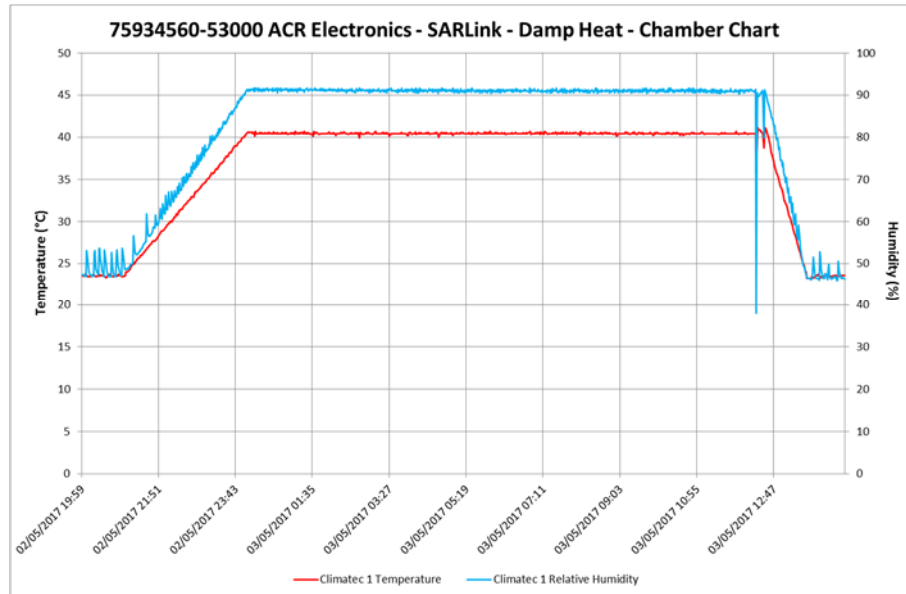
2.3.7 Test Method

The EUT was placed in a climatic chamber with the temperature increased to 40 °C and the relative humidity increased to 93 %. After 10 h to 16 h, the EUT was activated for at least 2 h, during this period was subjected to a performance check.

2.3.8 Test Results



Temperature and Humidity Plot (Conducted Samples)



Temperature and Humidity Plot (Radiated Samples)



Product Service

Soak Period Performance Check and Performance Test

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039966	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039929	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039941	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040015	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

Post-test Performance Checks

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039972	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039967	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040019	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040029	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

2.4 LOW TEMPERATURE

2.4.1 Specification Reference

RTCM 11010.2, Clause A.5

2.4.2 Equipment Under Test and Modification State

SOS-300 S/N: #1763 (75934030-TSR0002) – Modification State 0
SOS-300 S/N: #1876 (75934030-TSR0003) – Modification State 0
SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0
SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.4.3 Date of Test

15-17 July 2016, 18-19 July 2016, 03-04 May 2017 and 04-05 April 2017

2.4.4 Test Equipment Used

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

2.4.5 Environmental Conditions

	15-17/07/16	18-19/07/16	03-04/05/17	04-05/05/17
Ambient Temperature (°C)	20.8 - 25.9	21.2 - 29.3	18.6 - 24.2	18.6 - 24.4
Relative Humidity (%)	52.5 - 61.3	44.4 - 65.0	31.7 - 45.2	31.5 - 45.2

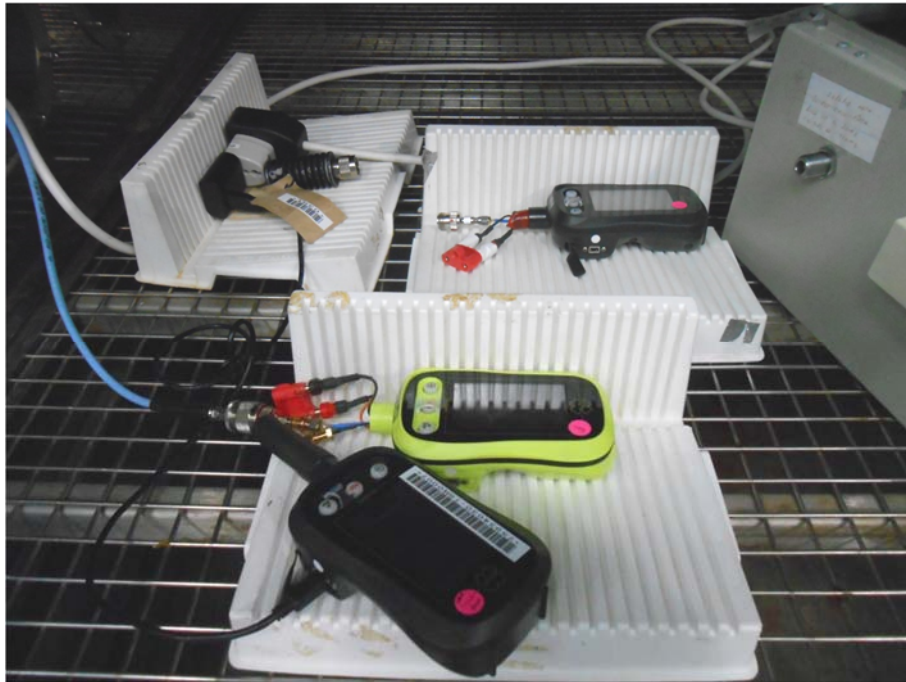
2.4.6 Test Setup



Storage Test Setup (Conducted Samples)



Storage Test Setup (Radiated Samples)



Functional Test Setup (Conducted Samples)



Functional Test Setup (Radiated Samples)

2.4.7 Test Method

Storage Test

The EUT's were placed in a climatic chamber where the temperature was decreased from laboratory ambient temperature to -30 °C. After 10 h to 16 h, the temperature was returned to ambient conditions. The EUT was subjected to a performance check at the end of the test.

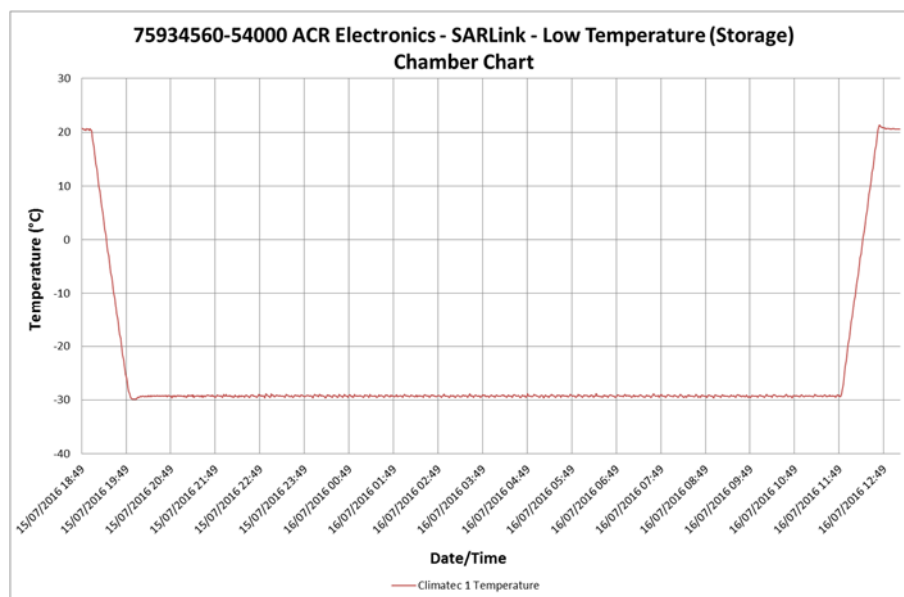
Functional Test

The EUT was placed in a climatic chamber where the temperature was decreased from ambient temperature to -20 °C. The conditions remained for a period of 10 h to 16 h. At the end of this period, the EUT was switched on and kept operational for at least 2 h. The EUT was subjected to a performance check and performance test during this period. At the end of the test, the temperature was returned to laboratory ambient conditions.

At the conclusion of all testing, a Performance Check was carried out.

2.4.8 Test Results

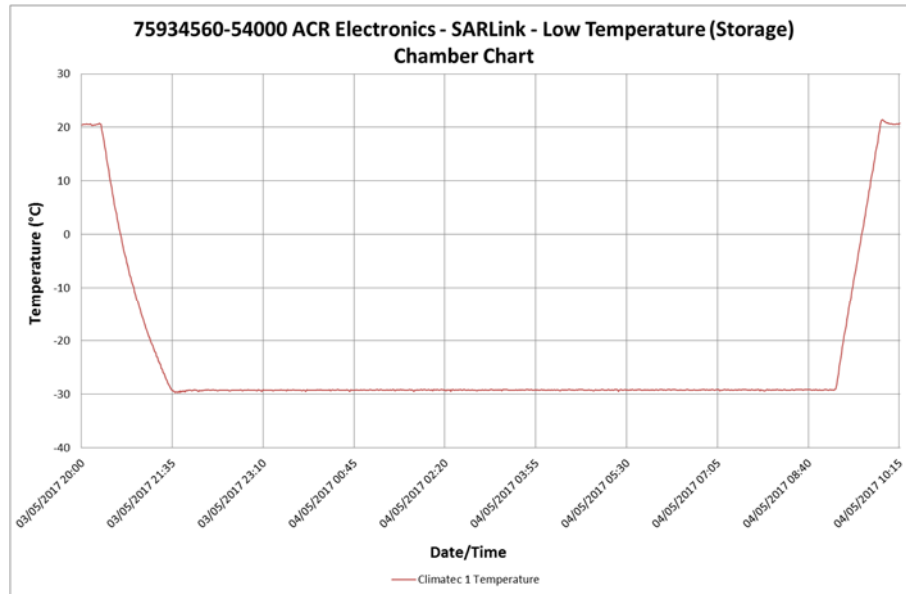
Storage Test



Temperature Plot (Conducted Samples)



Product Service



Temperature Plot (Radiated Samples)

Post-test Performance Checks

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039974	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039961	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040025	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

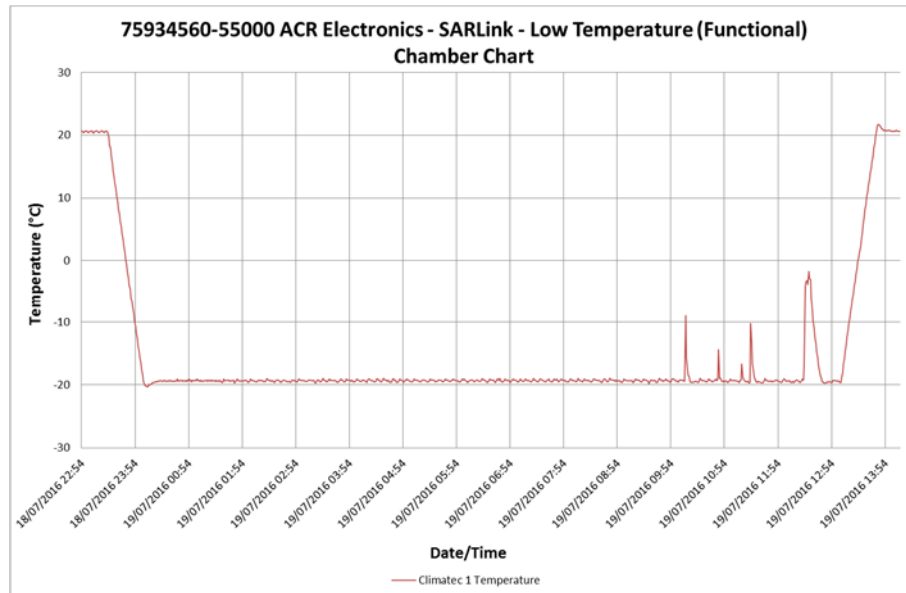
SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

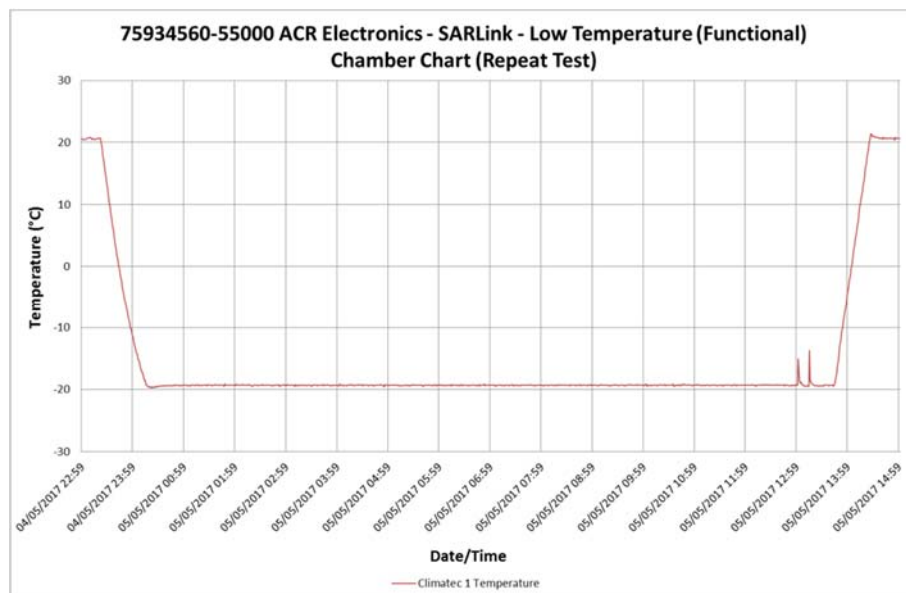
Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040030	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Functional Test

Temperature Plot



Temperature Plot (Conducted Samples)



Temperature Plot (Radiated Samples)



Product Service

Soak Period Performance Check and Performance Test

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039976	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Test Parameter	Units	Result (Note 1)	Limit
Transmitter power output			
Power output	dBm	36.94 / 36.79	35 - 39
Power output rise time	ms	0.19 / 0.14	<5
Power output 1 ms before burst	dBm	-33.37 / -38.22	<-10
Digital Message (bit numbers)			
Full Hex (all)	-	FFFE2F8C9EF9C0633 2E02BC44E369C80429F	(Note 2)
Bit sync (1-15)	P/F	P	P
Frame sync (16-24)	P/F	P	P
Format flag (25)	(1 bit)	1	(Note 2)
Protocol flag (26)	(1 bit)	0	(Note 2)
Identification / position data (27-85)	P/F	P	P
BCH code (86-106)	P/F	P	P
Emergency code / nation. use /suppl. data (107-112)	(6 bits)	110110	(Note 2)
Additional data /BCH (if applicable) (113-144)	P/F	P	P
Position error (if applicable)	km	0.04	< 5
Digital Message Generator			
Bit rate and stability	bit/s	399.94 / 399.92	396 - 404
Modulation			
Biphase-L	Y/N	Y	Y
Rise time	µs	202.4 / 179.3	50 - 250
Fall time	µs	203.7 / 174.7	50 - 250
Phase deviation: positive	rad	1.1710 / 1.0168	+(1.0 to 1.2)
Phase deviation: negative	rad	-1.1721 / -1.0242	-(1.0 to 1.2)
Symmetry measurement	-	0.0214	≤ 0.05

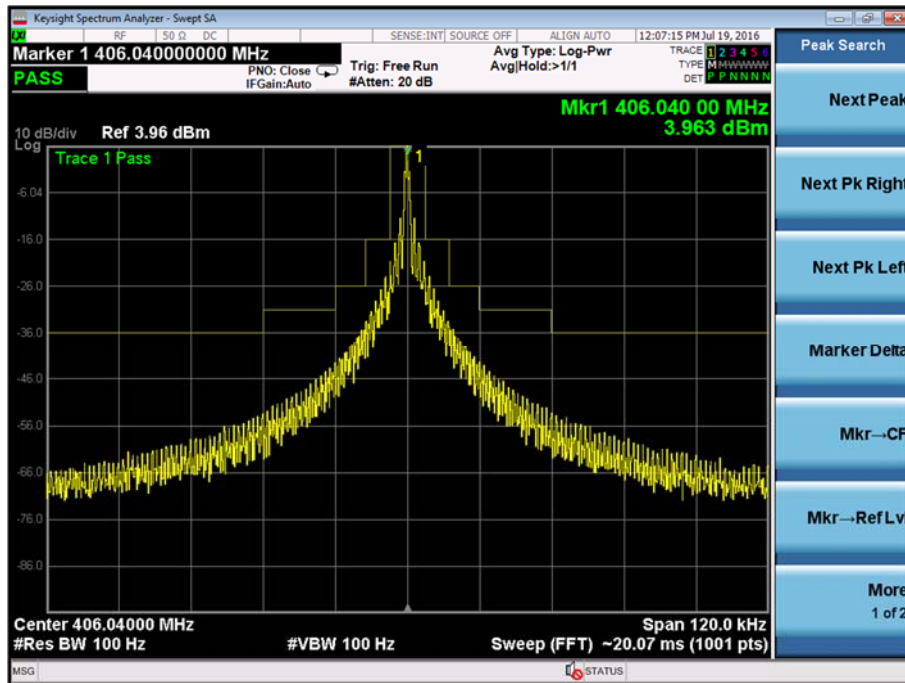


Product Service

Test Parameter	Units	Result (Note 1)	Limit
Transmitted frequency			
Nominal value	MHz	406.0399697 / 406.0399697	C/S T.001
Short Term Stability	/100 ms	13.079E-11 / 13.079E-11	$\leq 2 \times 10^{-9}$
Medium Term Stability - Slope	/min	-67.636E-13 / -67.636E-13	$(-1 \text{ to } +1) \times 10^{-9}$
Medium Term Stability - Residual Frequency Variation	-	70.981E-11 / 70.981E-11	$\leq 3 \times 10^{-9}$
Spurious Output			
Meets C/S T.001 mask	Y / N	Y	Y

Note 1: Where appropriate, results are displayed as Maximum / Minimum.

Note 2: The Encoded message was checked against the intended encoding and C/S T.007.



Spurious Output

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039999	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

Performance Test

Test Parameter	Units	Result (Note 1)	Limit
Transmitter power output			
Power output	dBm	37.79 / 37.62	35 - 39
Power output rise time	ms	0.17 / 0.15	<5
Power output 1 ms before burst	dBm	-33.34 / -38.39	<-10
Digital Message (bit numbers)			
Full Hex (all)	-	FFFE2F8C9F70465FC 0FF01F754769F3C0672	(Note 2)
Bit sync (1-15)	P/F	P	P
Frame sync (16-24)	P/F	P	P
Format flag (25)	(1 bit)	1	(Note 2)
Protocol flag (26)	(1 bit)	0	(Note 2)
Identification / position data (27-85)	P/F	P	P
BCH code (86-106)	P/F	P	P
Emergency code / nation. use /suppl. data (107-112)	(6 bits)	110110	(Note 2)
Additional data /BCH (if applicable) (113-144)	P/F	P	P
Position error (if applicable)	km	N/A (Default encoded)	< 5
Digital Message Generator			
Bit rate and stability	bit/s	399.94 / 399.92	396 - 404
Modulation			
Biphase-L	Y/N	Y	Y
Rise time	µs	225.4 / 185.4	50 - 250
Fall time	µs	212.6 / 183.7	50 - 250
Phase deviation: positive	rad	1.1662 / 1.0118	+(1.0 to 1.2)
Phase deviation: negative	rad	-1.1706 / -1.0130	-(1.0 to 1.2)
Symmetry measurement	-	0.0230	≤ 0.05

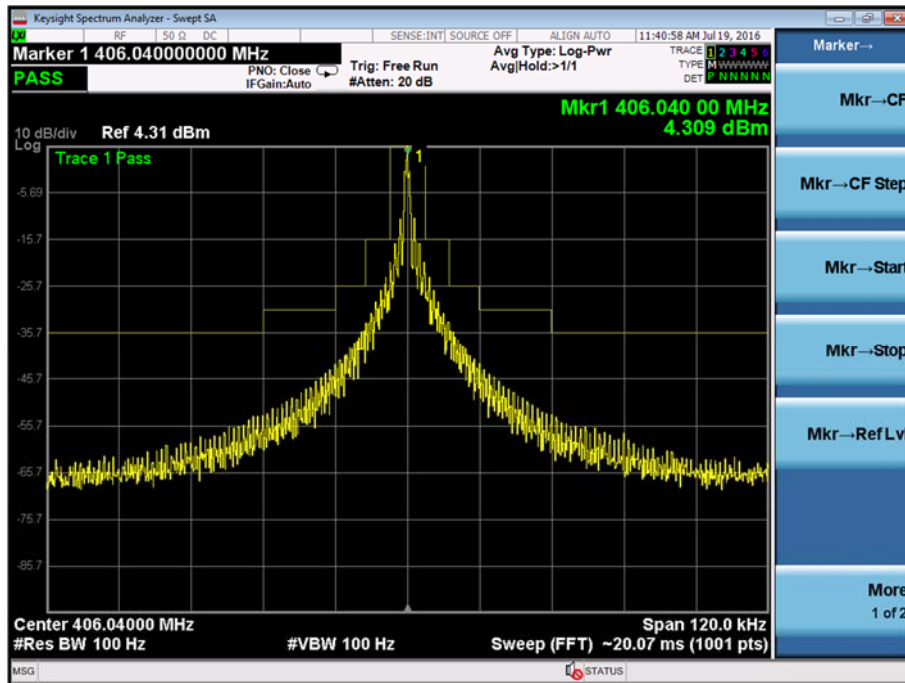


Product Service

Test Parameter	Units	Result (Note 1)	Limit
Transmitted frequency			
Nominal value	MHz	406.0399884 / 406.0399884	C/S T.001
Short Term Stability	/100 ms	89.800E-12 / 89.800E-12	$\leq 2 \times 10^{-9}$
Medium Term Stability - Slope	/min	40.879E-12 / 40.879E-12	$(-1 \text{ to } +1) \times 10^{-9}$
Medium Term Stability - Residual Frequency Variation	-	12.185E-10 / 12.185E-10	$\leq 3 \times 10^{-9}$
Spurious Output			
Meets C/S T.001 mask	Y / N	Y	Y

Note 1: Where appropriate, results are displayed as Maximum / Minimum.

Note 2: The Encoded message was checked against the intended encoding and C/S T.007.



Spurious Output



Product Service

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039896	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Not tested - Radiated configuration prohibits meaningful results.

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040051	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Performance Test

Not tested - Radiated configuration prohibits meaningful results.



Product Service

Post-test Performance Checks

SOS-300 S/N: #1763 (75934030-TSR0002)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039963	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 S/N: #1876 (75934030-TSR0003)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039969	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040038	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040043	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

2.5 VIBRATION

2.5.1 Specification Reference

RTCM 11010.2, Clause A.6

2.5.2 Equipment Under Test and Modification State

SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0

SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.5.3 Date of Test

12 and 15 May 2017

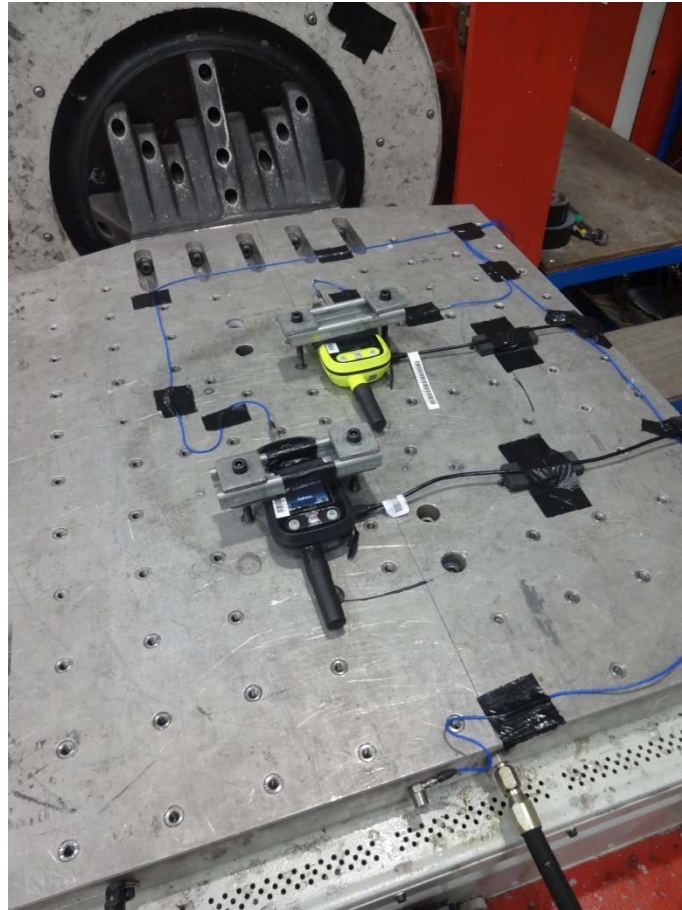
2.5.4 Test Equipment Used

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

2.5.5 Environmental Conditions

	12 May 17	15 May 17
Ambient Temperature (°C)	21.5 - 24.1	19.7 - 22.8
Relative Humidity (%)	52.5 - 61.3	49.1 - 57.9

2.5.6 Test Setup



Test Setup

2.5.7 Test Method

The EUT's were 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.

Where a resonant frequency was found the EUT was subjected to an endurance run of 2 h at that frequency. If no frequency was found the EUT endurance run was carried out at 30 Hz. At the end of the test, the EUT was subjected to a Performance Check.

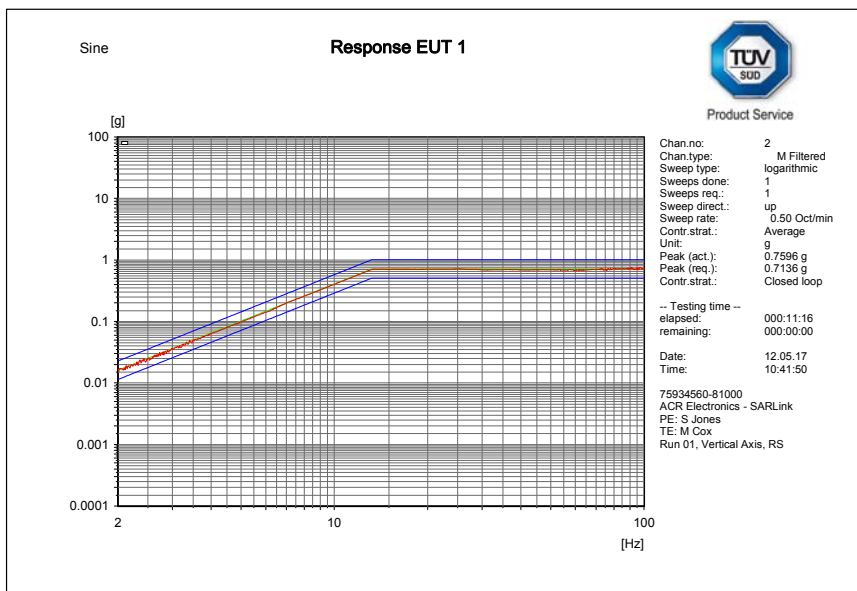


Product Service

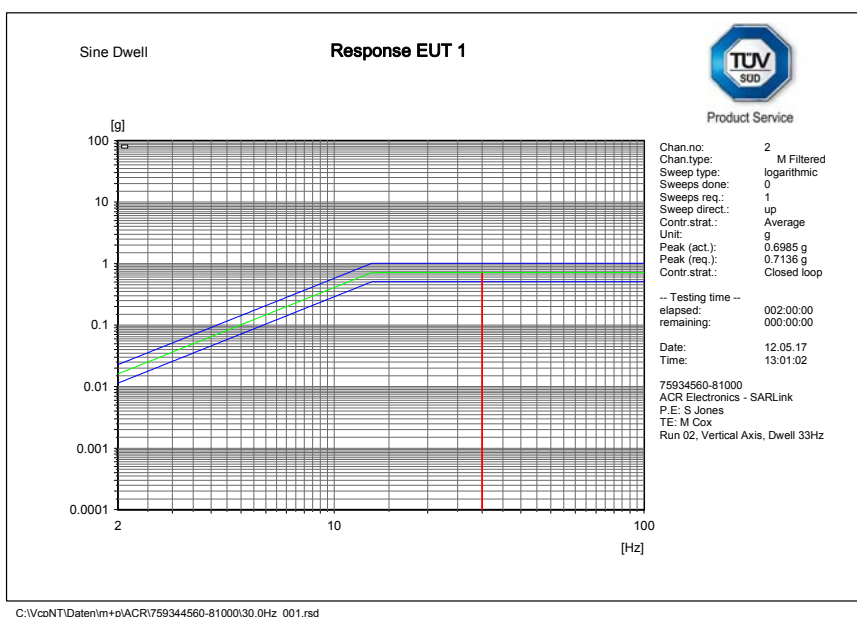
2.5.8 Test Results

Vibration Plots

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)



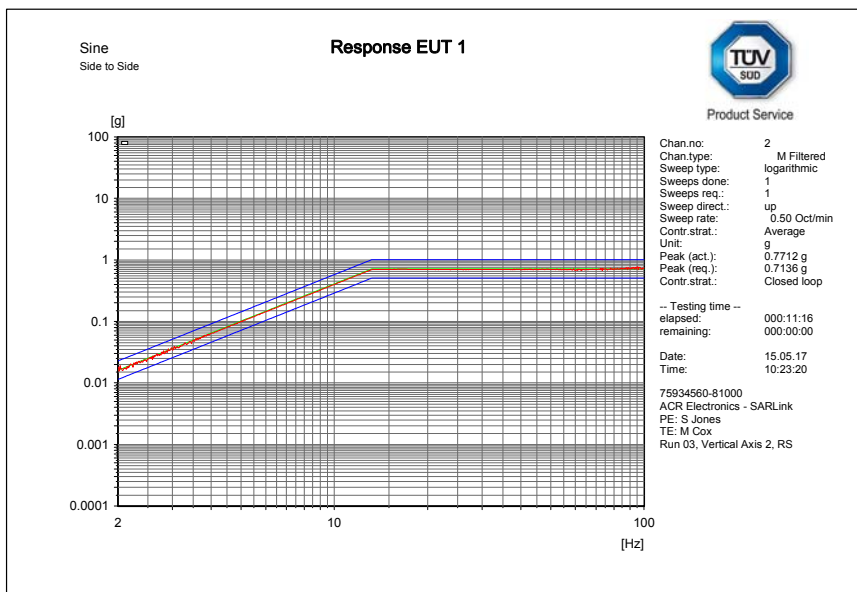
Front and Back - Resonance Search



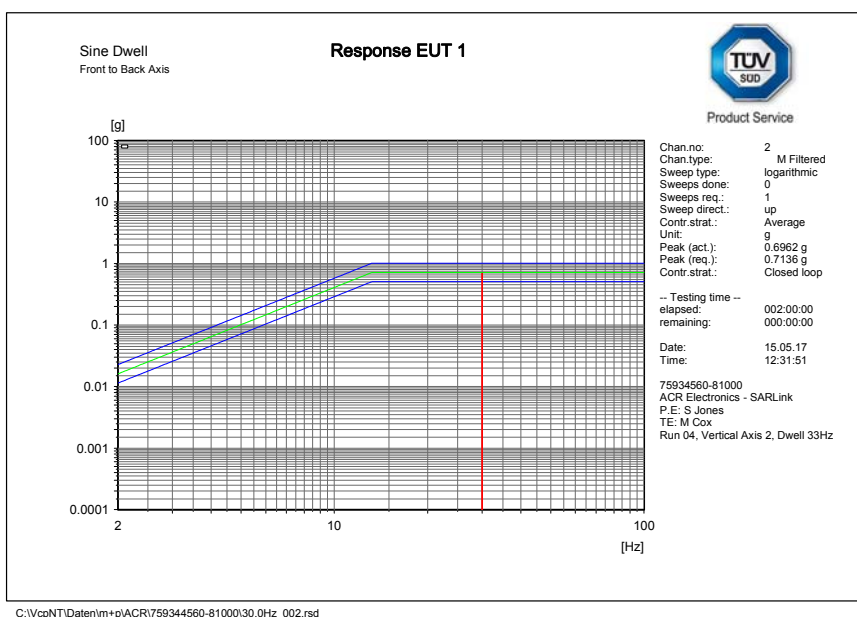
Front and Back - Endurance Run



Product Service



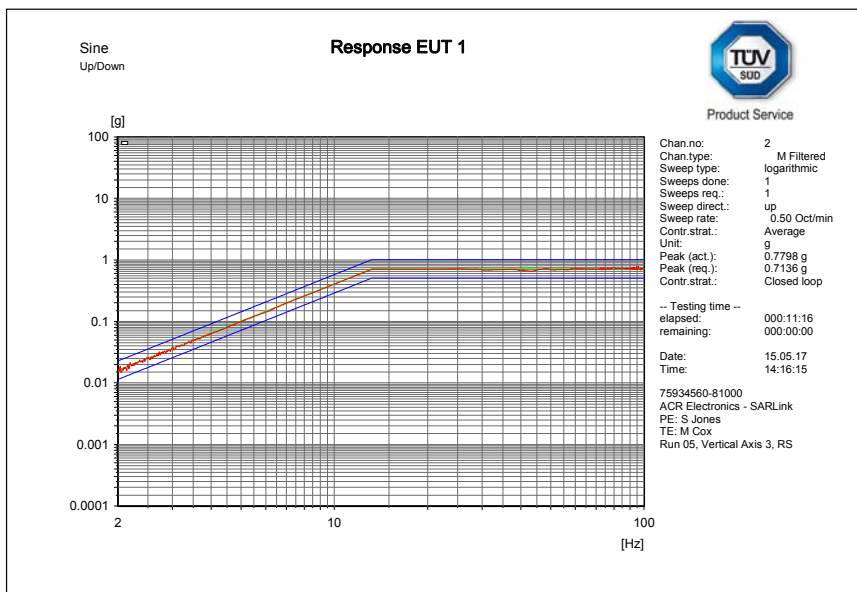
Side to Side - Resonance Search



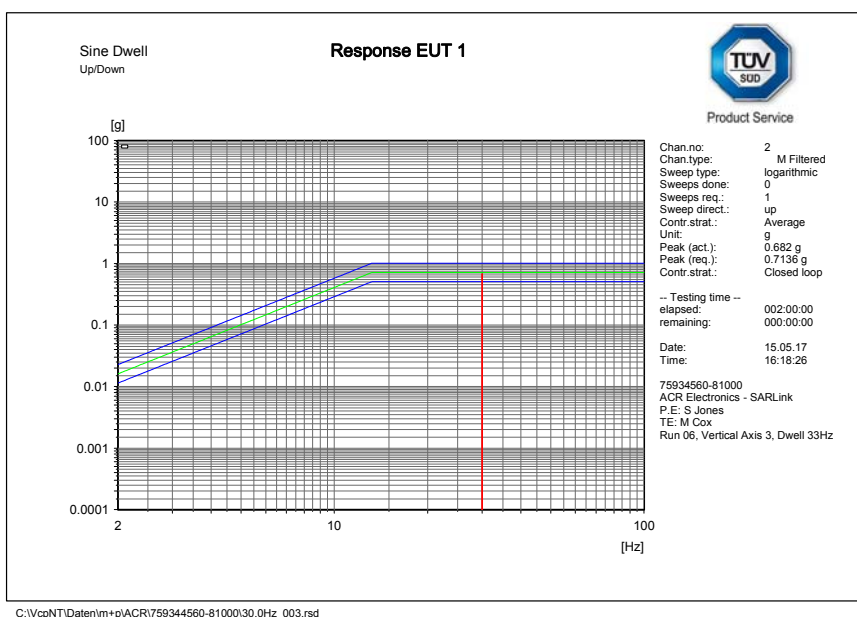
Side to Side - Endurance Run



Product Service



Up and Down - Resonance Search

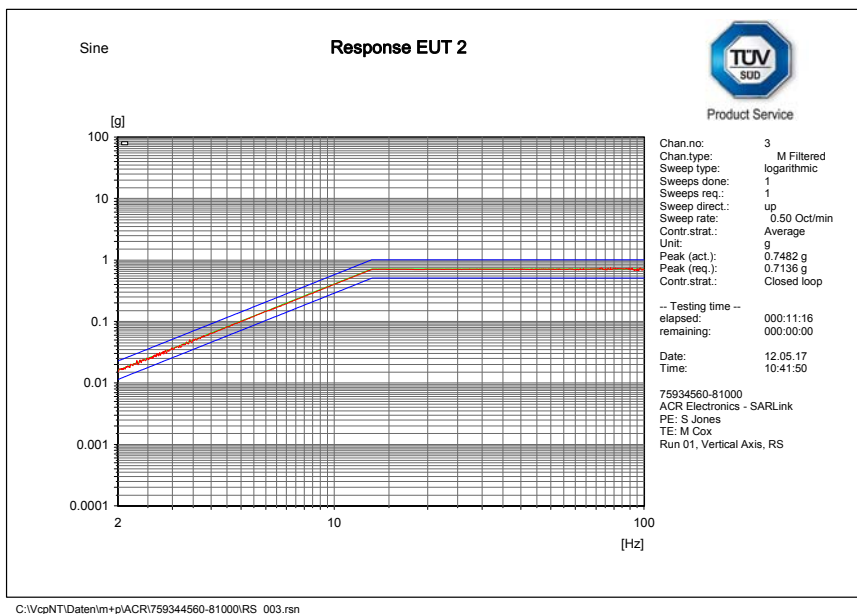


Up and Down - Endurance Run

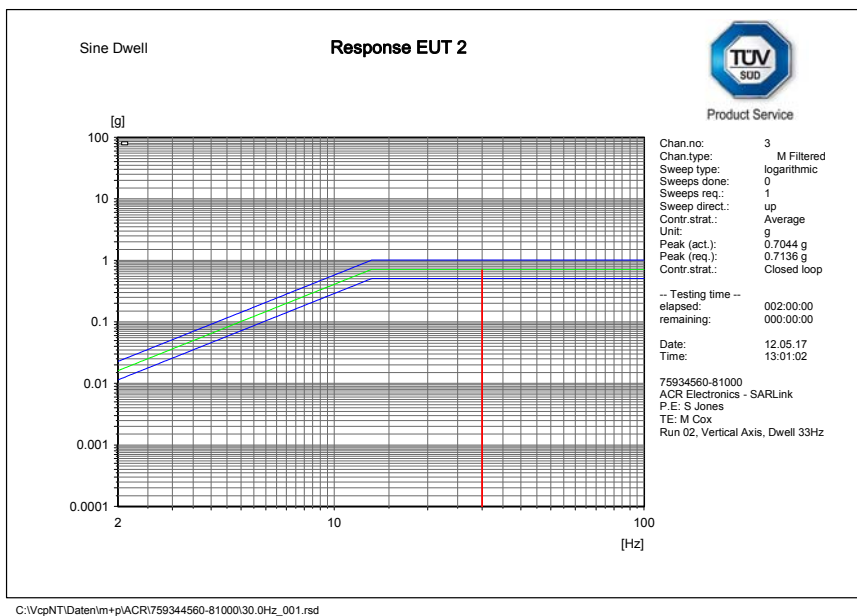


Product Service

SOS-300 IMEI: 300434060627250 (75934030-TSR0047)



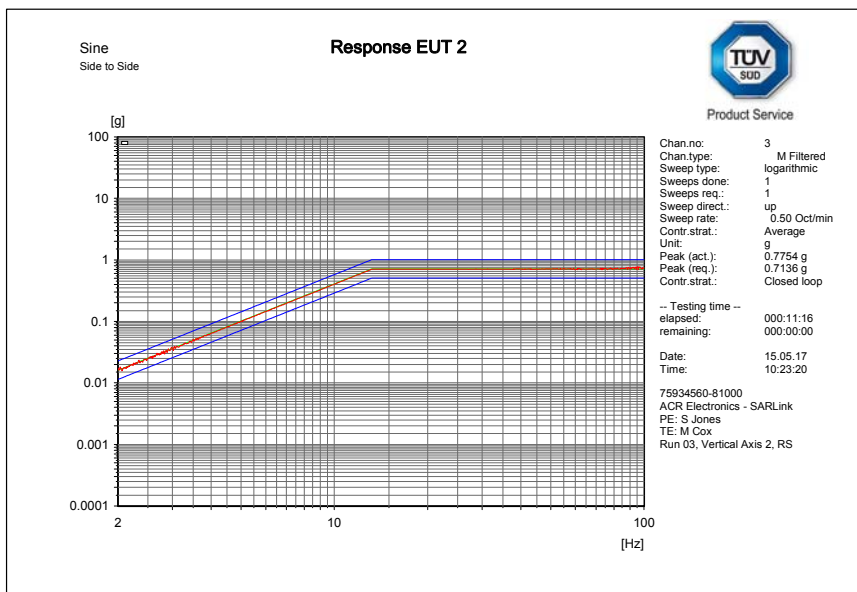
Front and Back - Resonance Search



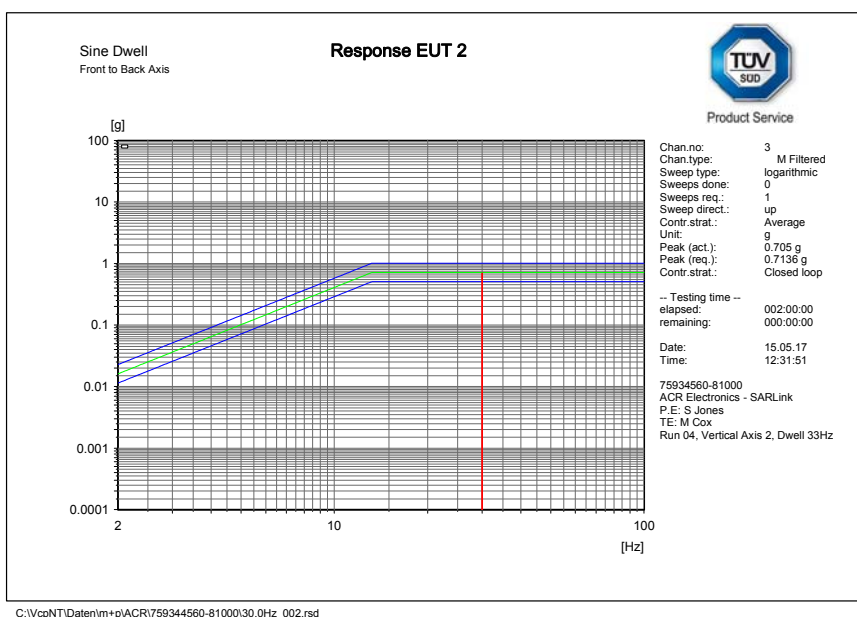
Front and Back - Endurance Run



Product Service



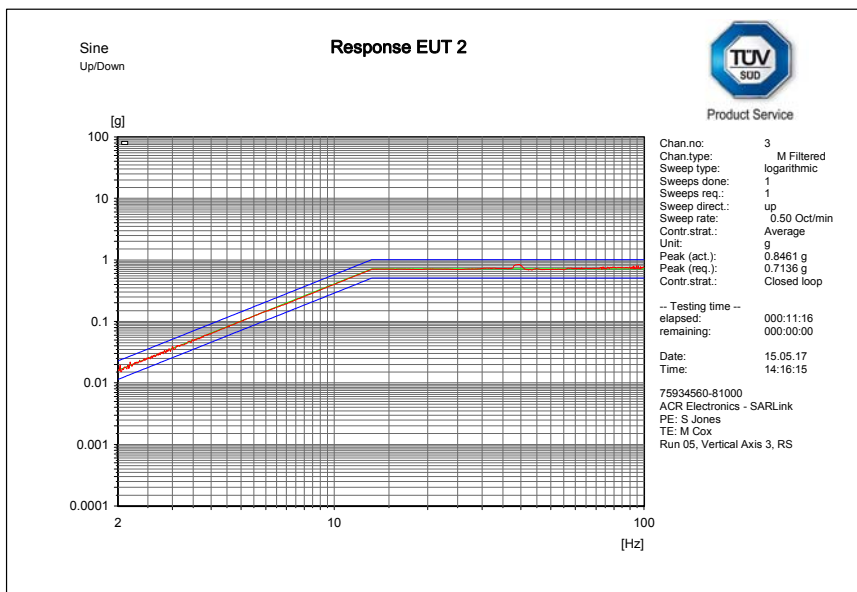
Side to Side - Resonance Search



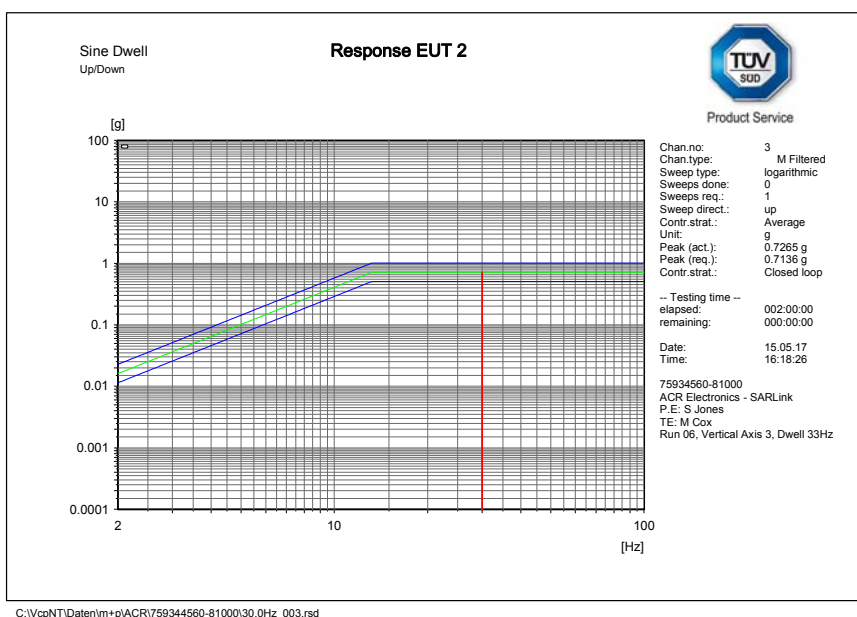
Side to Side - Endurance Run



Product Service



Up and Down - Resonance Search



Up and Down - Endurance Run



Product Service

Post-test Performance Checks

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040033	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040044	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Activation Check

The EUT was monitored throughout the test, no activation was observed.

2.6 BUMP TEST

2.6.1 Specification Reference

RTCM 11010.2, Clause A.7

2.6.2 Equipment Under Test and Modification State

SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0

SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.6.3 Date of Test

24 and 25 May 2017

2.6.4 Test Equipment Used

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

2.6.5 Environmental Conditions

Ambient Temperature (°C) 21.0 - 26.6

Relative Humidity (%) 40.5 - 53.0

2.6.6 Test Setup



Test Setup



Product Service

2.6.7 Test Method

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

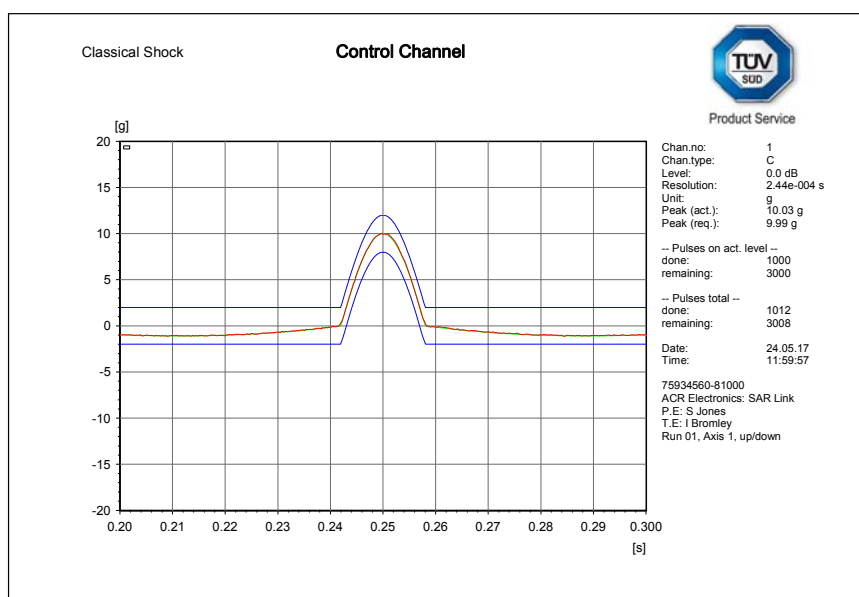
Peak acceleration: 98 m/s² +/-10 %
Pulse duration: 16 ms +/-10 %
Wave shape: Half-cycle sine wave
Test Axes: Three orthogonal axes
Number of bumps: 4000 per axis (2000 positive, 2000 negative)

2.6.8 Test Results

Bump Plots

Control Channel (Input)

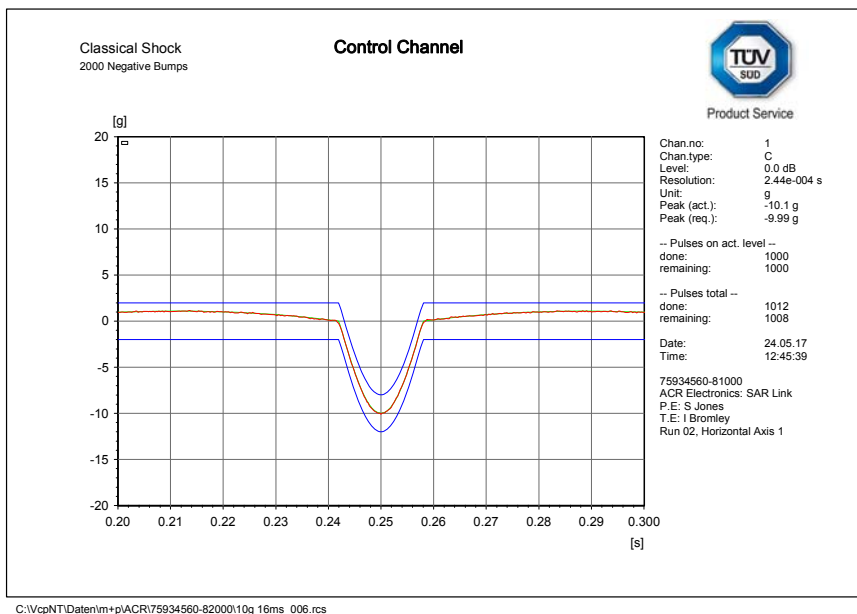
The test was performed simultaneously on both test samples; hence, the input was the same for both samples. Individual EUT responses can be found below.



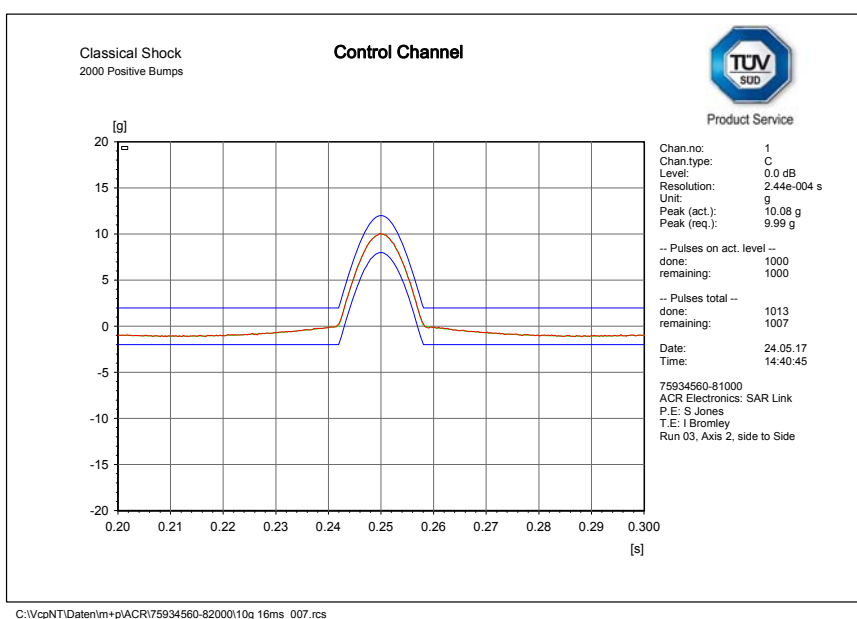
Up and Down - 2000 Positive Bumps



Product Service



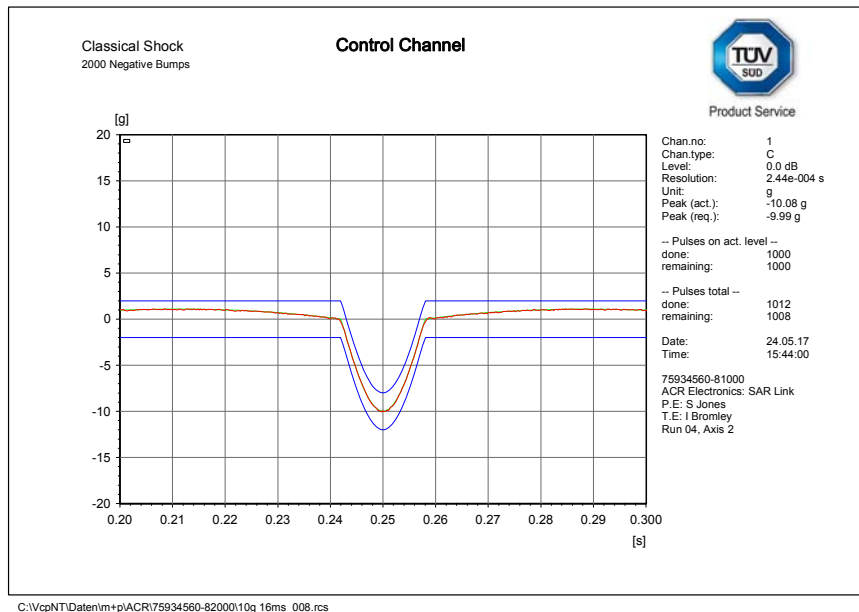
Up and Down - 2000 Negative Bumps



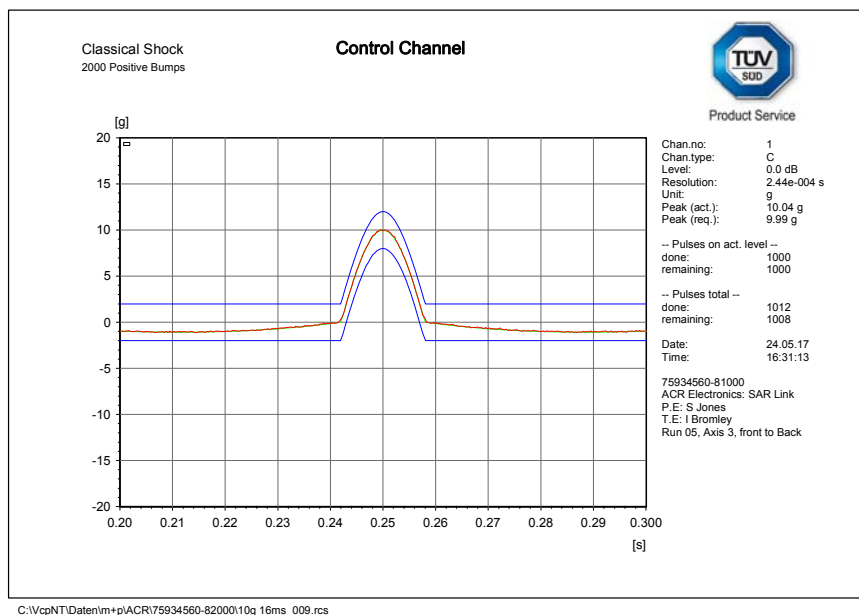
Side to Side - 2000 Positive Bumps



Product Service



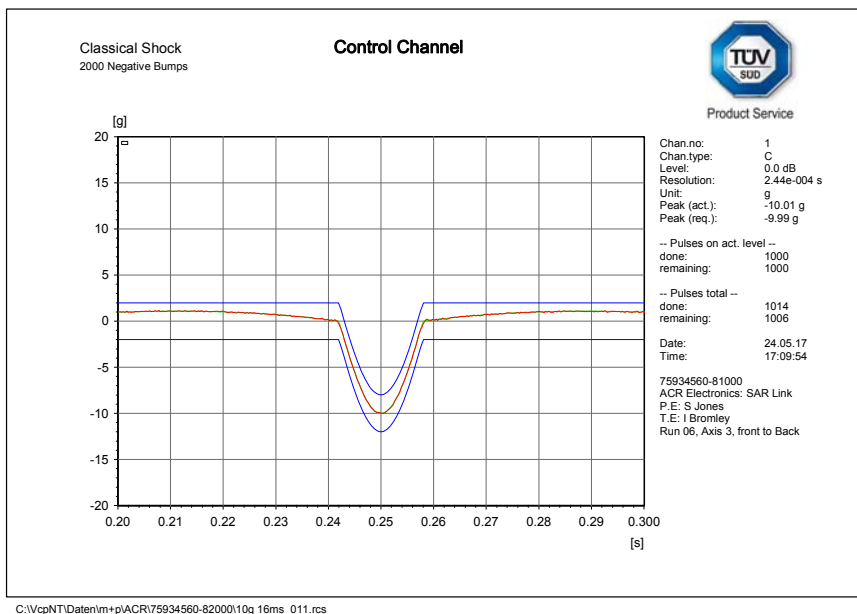
Side to Side - 2000 Negative Bumps



Front and Back - 2000 Positive Bumps

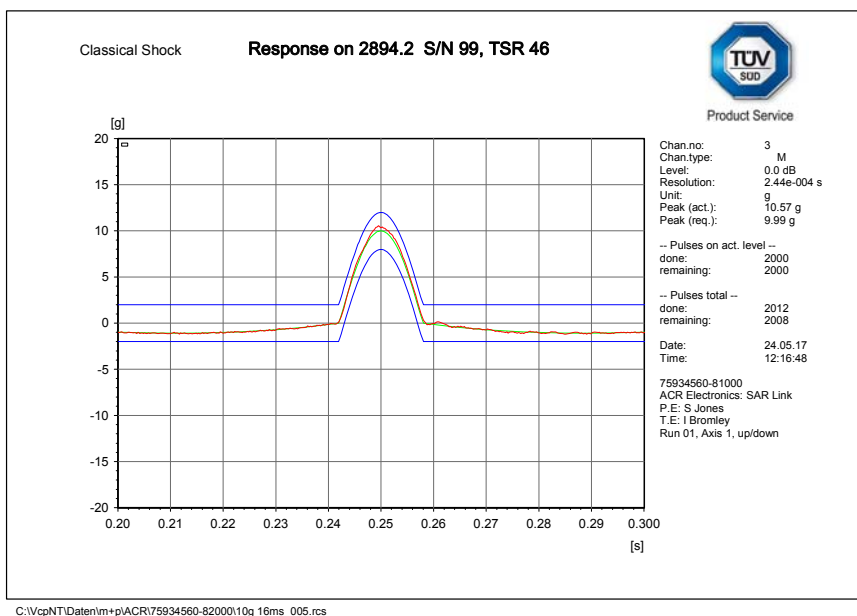


Product Service



Front and Back - 2000 Negative Bumps

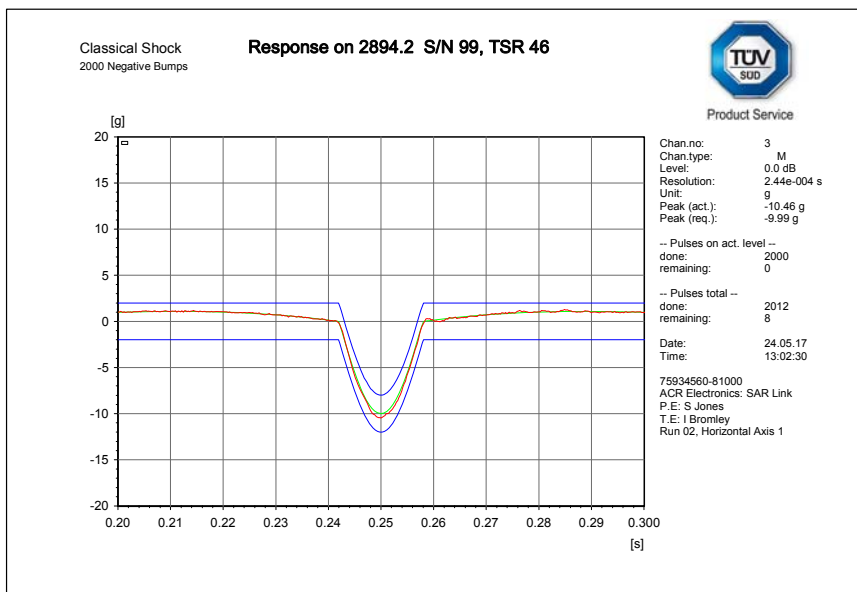
SOS-300 IMEI: 300434060816170 (75934030-TSR0046)



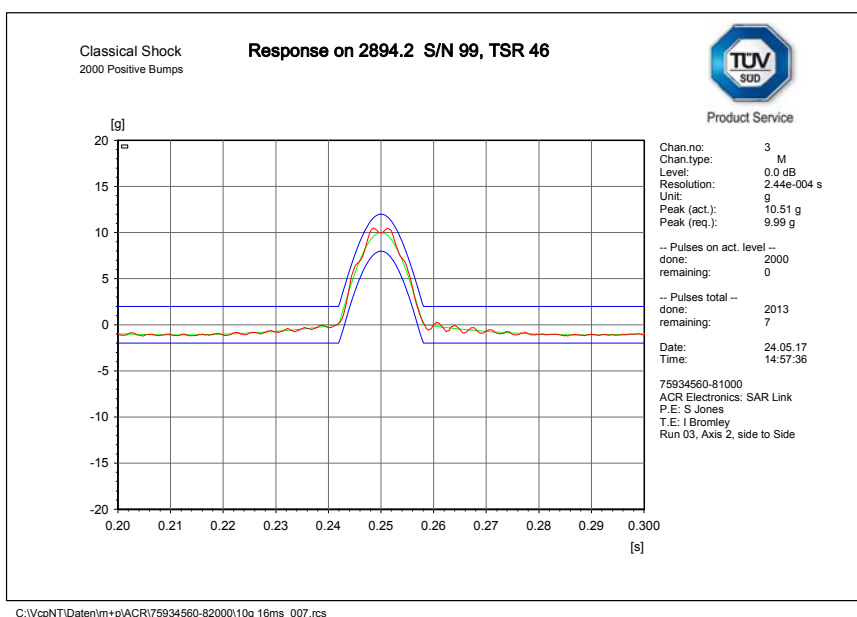
Up and Down - 2000 Positive Bumps



Product Service



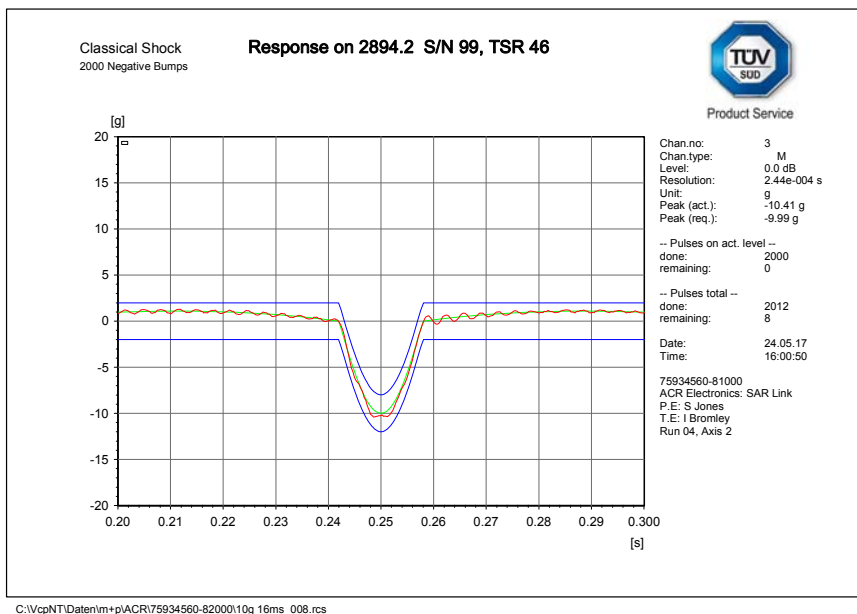
Up and Down - 2000 Negative Bumps



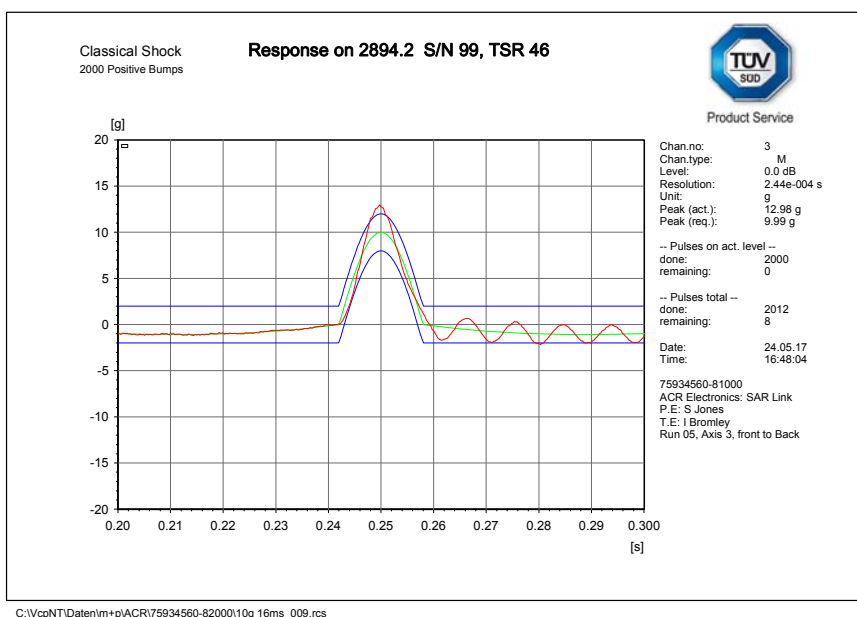
Side to Side - 2000 Positive Bumps



Product Service



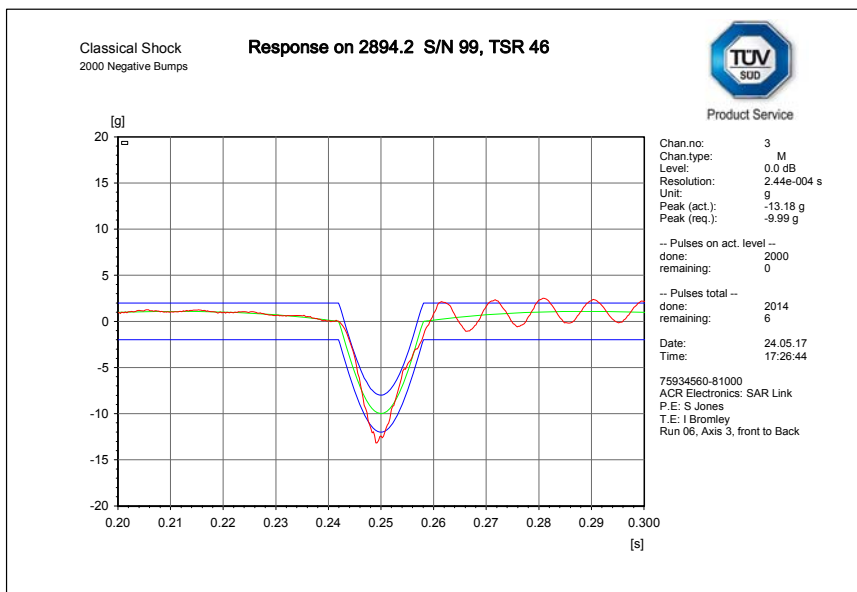
Side to Side - 2000 Negative Bumps



Front and Back - 2000 Positive Bumps



Product Service

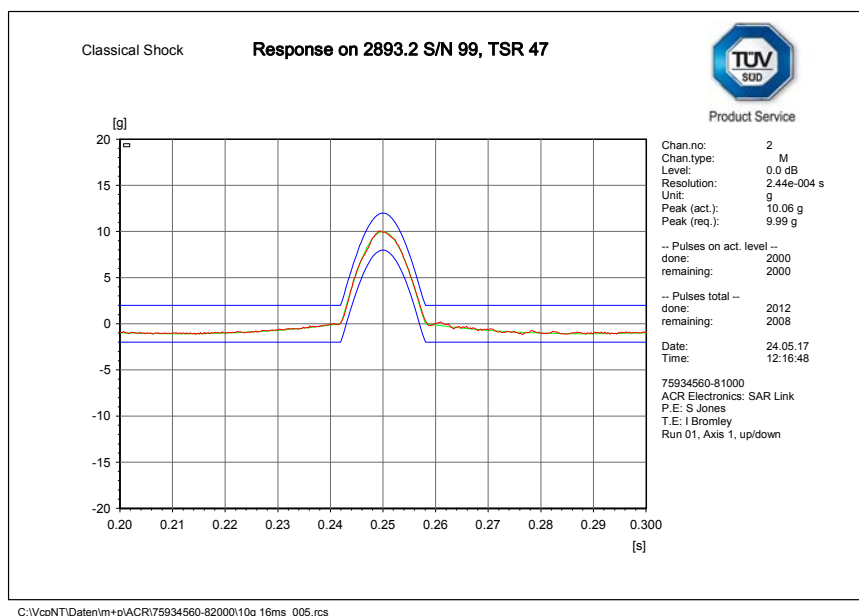


Front and Back - 2000 Negative Bumps

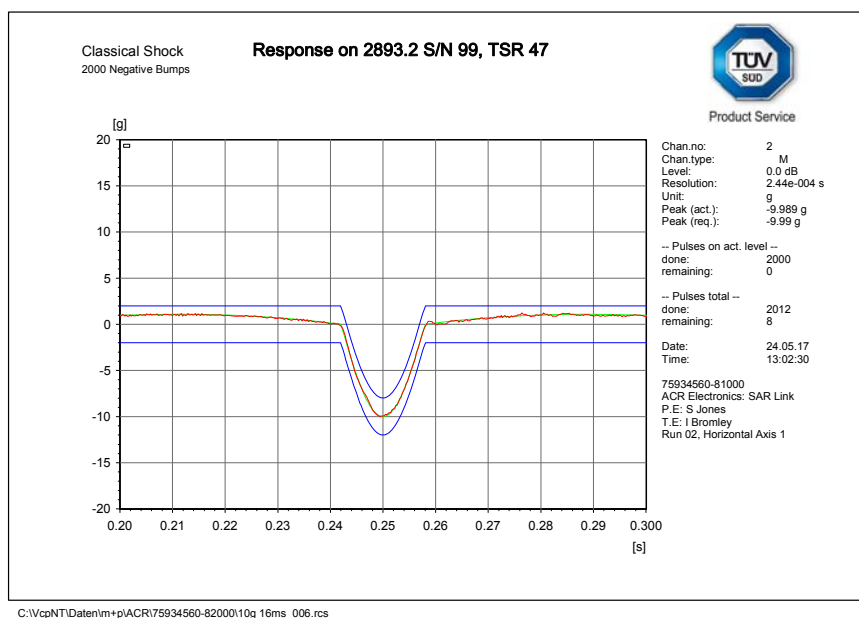


Product Service

SOS-300 IMEI: 300434060627250 (75934030-TSR0047)



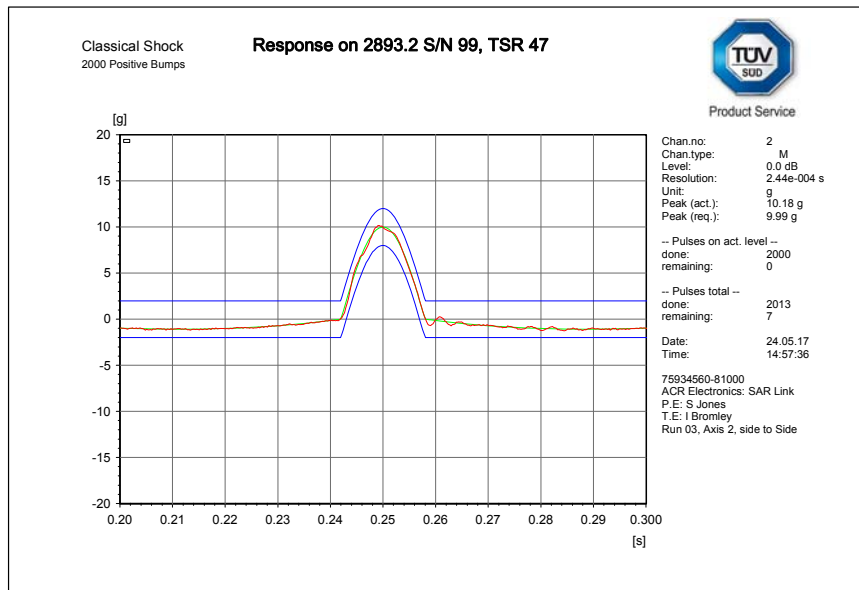
Up and Down - 2000 Positive Bumps



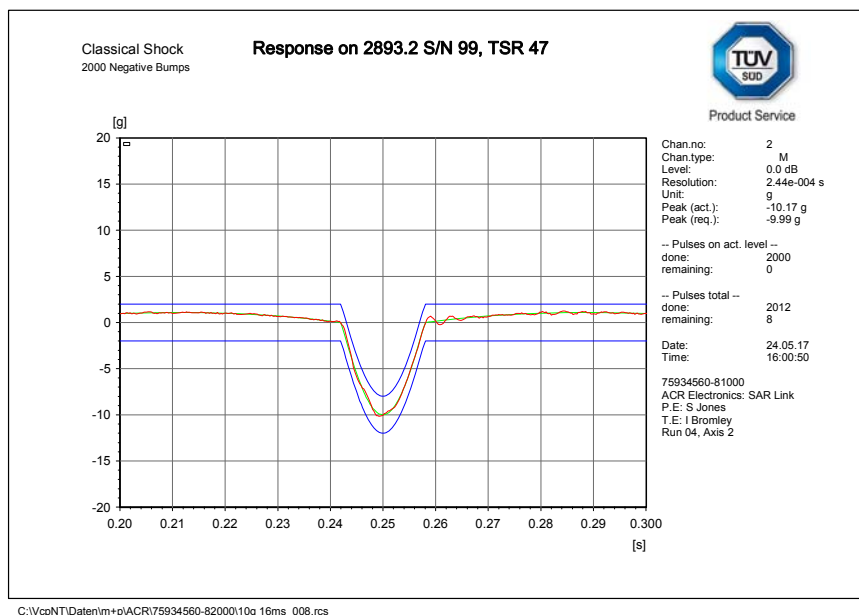
Up and Down - 2000 Negative Bumps



Product Service



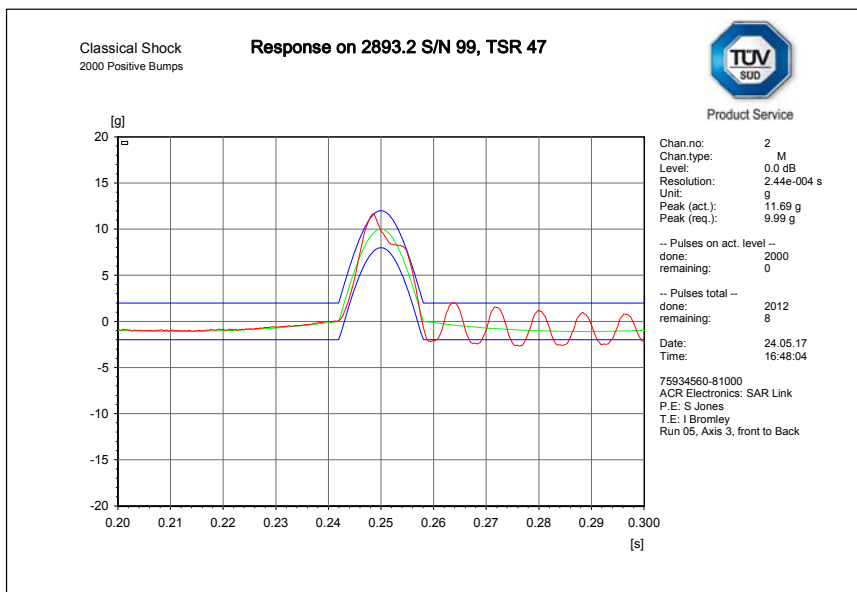
Side to Side - 2000 Positive Bumps



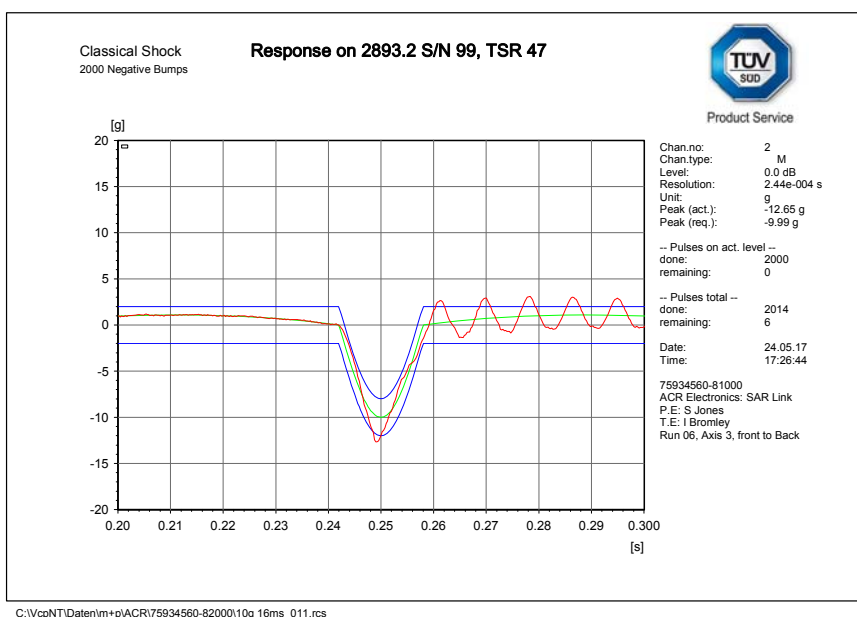
Side to Side - 2000 Negative Bumps



Product Service



Front and Back - 2000 Positive Bumps



Front and Back - 2000 Negative Bumps



Product Service

Visual Inspection

Following the test, the EUT was visually inspected. No signs of mechanical degradation were observed.

Post-test Performance Checks

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040031	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040041	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Activation Check

The EUT was monitored throughout the test, no activation was observed.

2.7 DROP TEST

2.7.1 Specification Reference

RTCM 11010.2, Clause A.9

2.7.2 Equipment Under Test and Modification State

SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0

SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.7.3 Date of Test

25 and 26 May 2017

2.7.4 Test Equipment Used

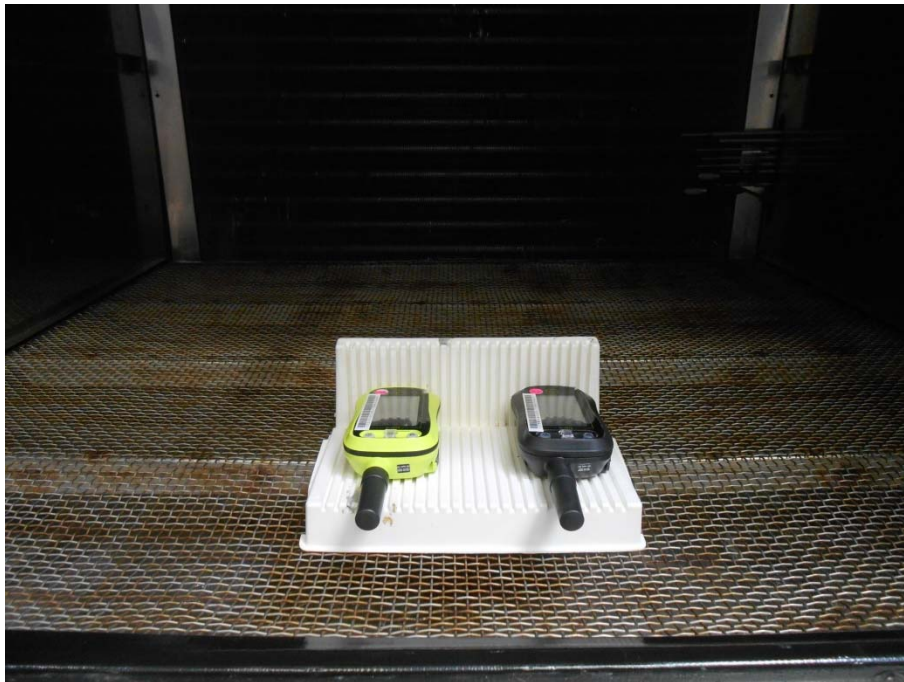
The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Environmental Conditions

Ambient Temperature (°C) 22.0 - 26.6

Relative Humidity (%) 34.7 - 47.6

2.7.6 Test Setup



Pre-conditioning Test Setup



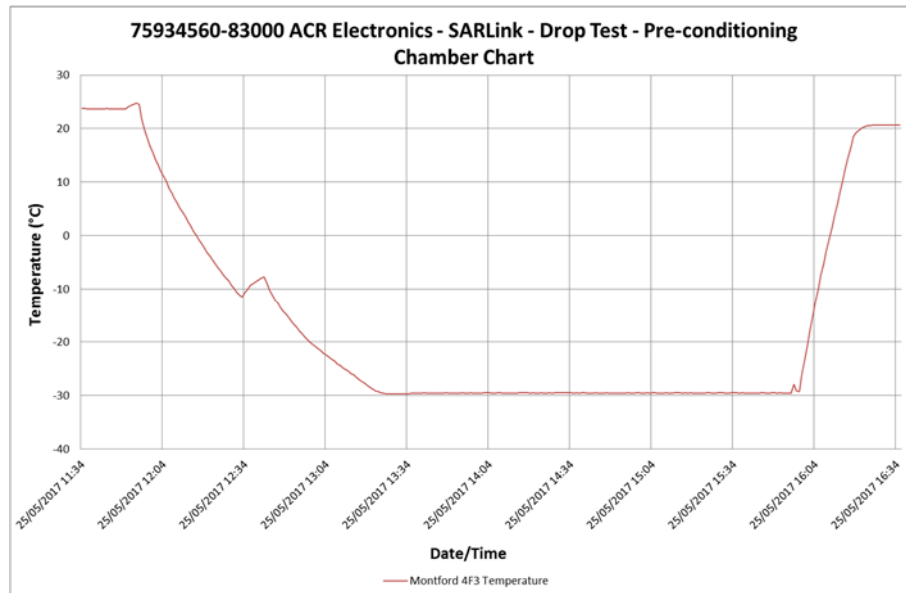
Drop Test Setup

2.7.7 Test Method

The EUT was soaked at -30°C for 4 hours 25 mins and was then dropped 6 times, once on each face, from a height of $1000\text{ mm} \pm 10\text{ mm}$ onto the test surface (solid piece of hardwood).

2.7.8 Test Results

Pre-conditioning



Temperature Plot

Activation Check

The EUT was monitored throughout the test, no activation was observed.

Visual Inspection

Following the test, the EUT was visually inspected. No signs of mechanical degradation were observed.

Post-test Performance Checks

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	*	406.040 ± 0.001
Digital message correctness	Y/N	*	Y

* Due to the EUT 406 MHz battery losing charge, it was not possible to obtain valid data from the EUT, the Iridium (rechargeable) side did, however, power up and report a Self-test failure based on inadequate voltage during the 406 MHz burst. Replacing the battery was postponed until after the Immersion Test due to a history of ingress issues on previous



Product Service

attempts at the test campaign. Validation that the 406 MHz circuitry was fully functional apart from the low battery can be found in Section 2.10. Further validation of the design can be found by looking at the Performance Check results for the black-coloured sample (SOS-300 IMEI: 300434060816170 (75934030-TSR0047)) below; the manufacturer stated that other than the colour of the plastic, the design was identical.

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040055	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

2.8 THERMAL SHOCK TEST

2.8.1 Specification Reference

RTCM 11010.2, Clause A.10

2.8.2 Equipment Under Test and Modification State

SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0

SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.8.3 Date of Test

27 to 29 May 2017

2.8.4 Test Equipment Used

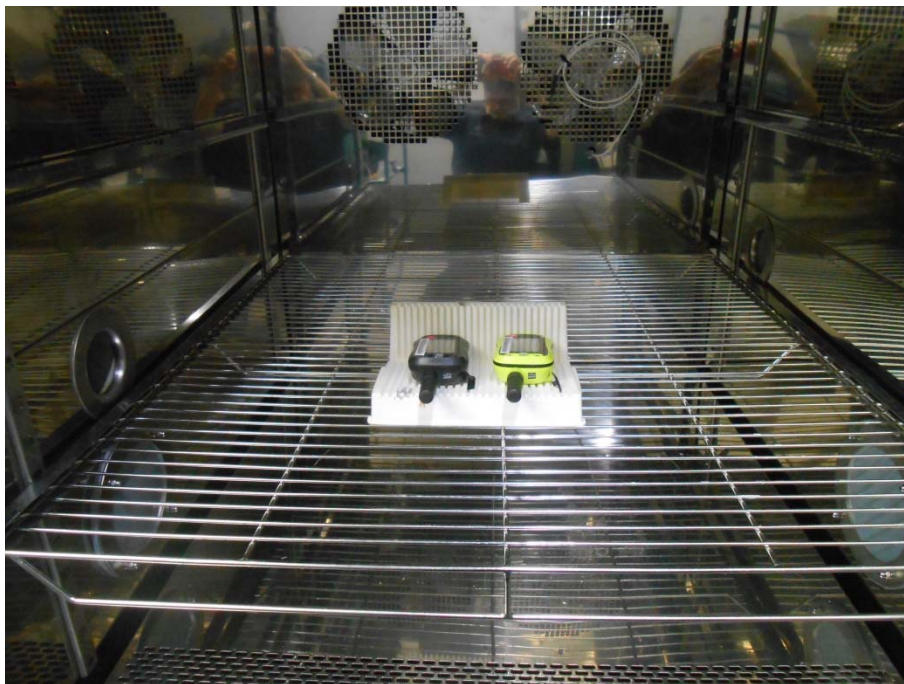
The major items of test equipment used for the above tests are identified in Section 3.1.

2.8.5 Environmental Conditions

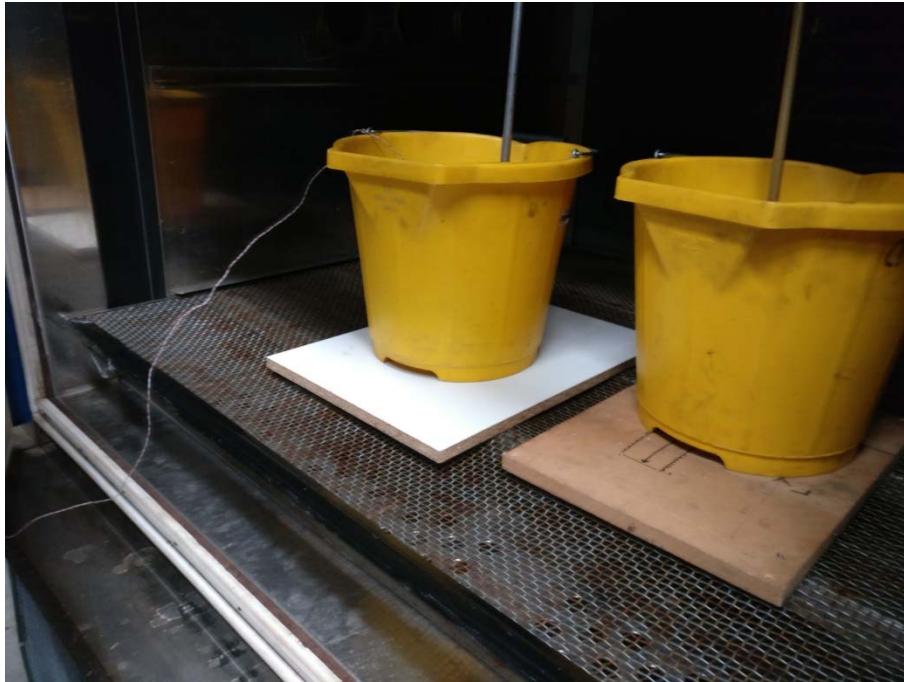
Ambient Temperature (°C) 20.0 - 23.0

Relative Humidity (%) 48.4 - 64.5

2.8.6 Test Setup



Pre-conditioning Test Setup



Test Setup

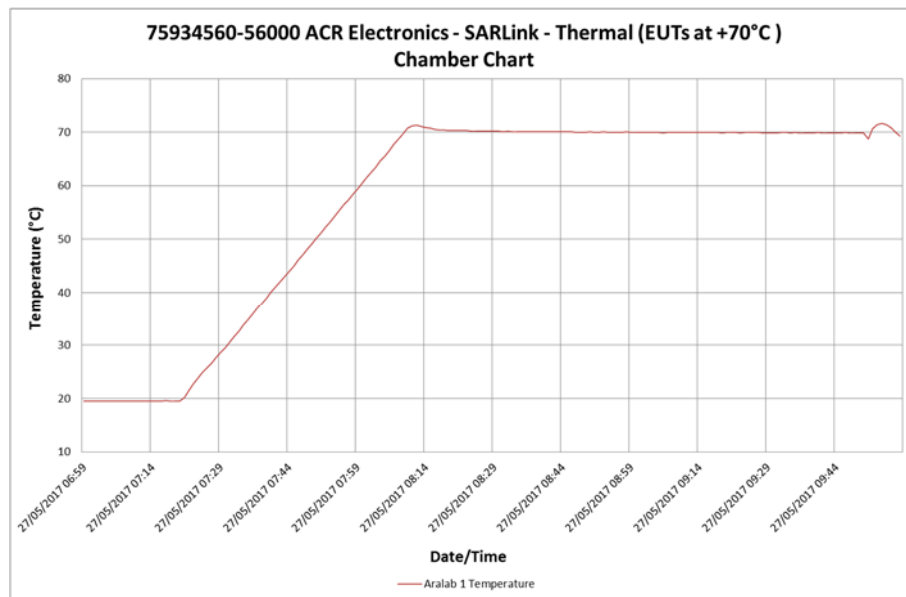
2.8.7 Test Method

The EUT was soaked for at least 1 h at +70 °C then totally immersed in fresh water at a temperature of +25 °C to a depth of 100 mm $\pm$ 5 mm measured from the highest point of the EUT to the surface of the water, for a period of 48 h.

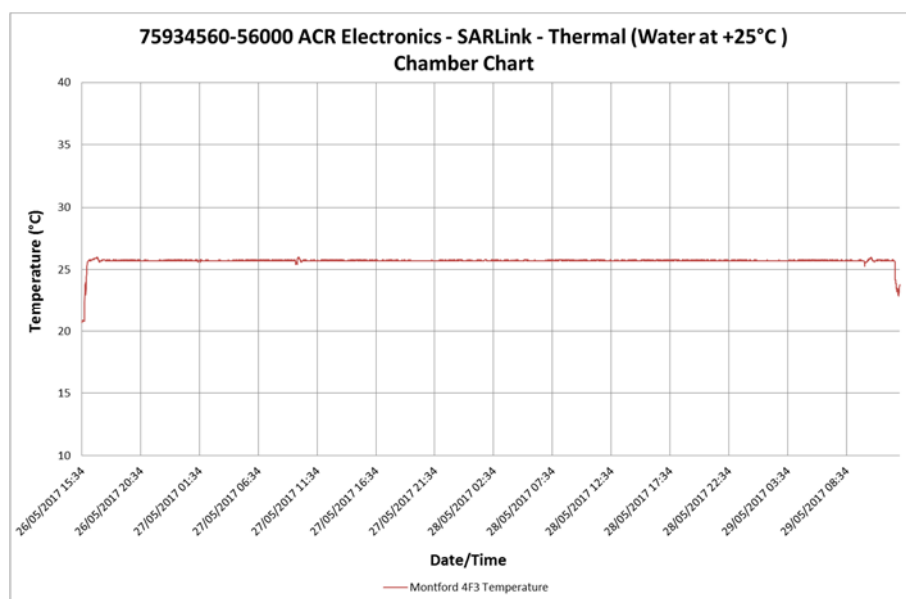
After the test, the EUT was subjected to a Performance Check.

The EUT was externally inspected for signs of ingress. Subject to a satisfactory Performance Check, the opening of the EUT to check for ingress was postponed until the completion of all water ingress tests.

2.8.8 Test Results



Pre-conditioning Temperature Plot



Test Temperature Plot

Visual Inspection

Following the test, the EUT was visually inspected (externally). No signs of water ingress were observed.



Product Service

Mass Inspection

Before the test, test EUT was weighed (dry) to determine its mass. After the test, the EUT was weighed again (dried but possibly still retaining some water) to determine whether there was any mass gain due to water ingress.

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Mass before: 352.6 g
Mass after: 354.9 g
Difference: +2.3 g

The additional mass was attributed to the small amount of water retained in seals and recesses and not to the ingress of water into the EUT.

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Mass before: 352.1 g
Mass after: 352.0 g
Difference: -0.1 g

The difference was considered negligible.

Post-test Performance Checks

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	*	406.040 ± 0.001
Digital message correctness	Y/N	*	Y

* Due to the EUT 406 MHz battery losing charge, it was not possible to obtain valid data from the EUT, the Iridium (rechargeable) side did, however, power up and report a Self-test failure based on inadequate voltage during the 406 MHz burst. Replacing the battery was postponed until after the Immersion Test due to a history of ingress issues on previous attempts at the test campaign. Validation that the 406 MHz circuitry was fully functional apart from the low battery can be found in Section 2.10. Further validation of the design can be found by looking at the Performance Check results for the black-coloured sample (SOS-300 IMEI: 300434060816170 (75934030-TSR0047)) below; the manufacturer stated that other than the colour of the plastic, the design was identical.



Product Service

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.0401	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

2.9 ALTITUDE TEST

2.9.1 Specification Reference

RTCM 11010.2, Clause A.20.8

2.9.2 Equipment Under Test and Modification State

SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0

SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.9.3 Date of Test

01 June 2017

2.9.4 Test Equipment Used

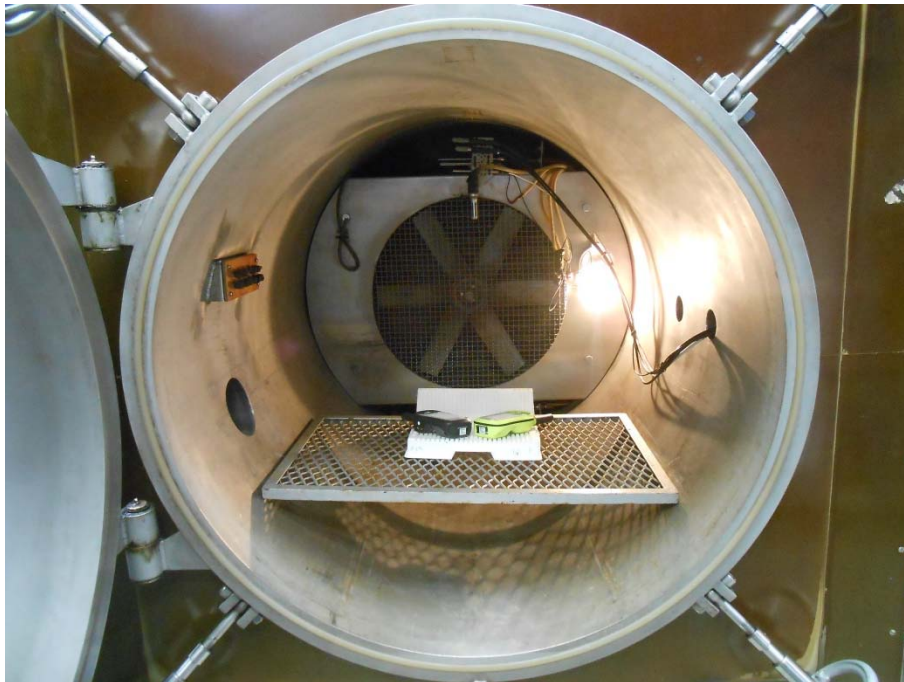
The major items of test equipment used for the above tests are identified in Section 3.1.

2.9.5 Environmental Conditions

Ambient Temperature (°C) 24.4 - 26.4

Relative Humidity (%) 45.9 - 64.5

2.9.6 Test Setup



Test Setup

2.9.7 Test Method

Clause A.20.8 Main Extract

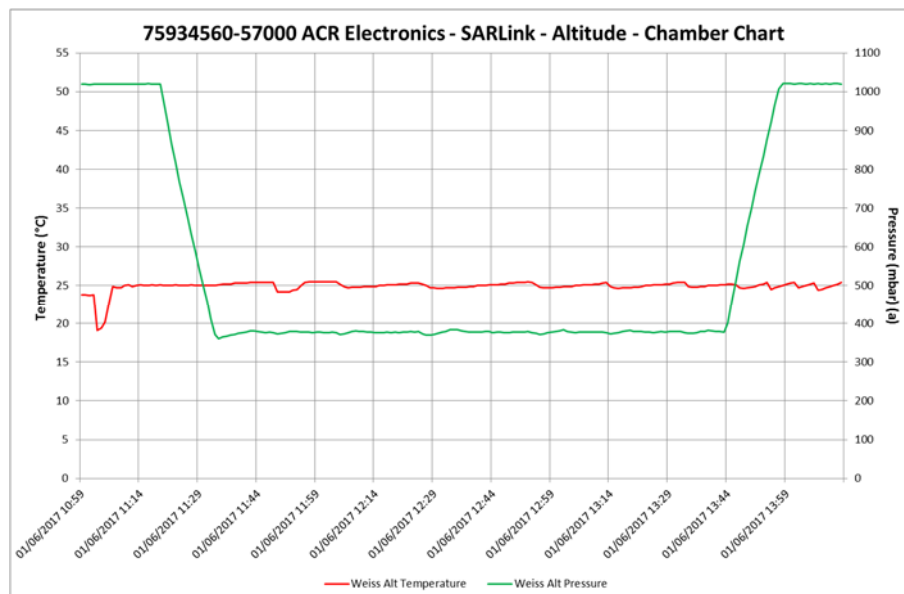
- EUT coded using test user protocol
- Activation switch OFF
- Place EUT in test chamber at normal test conditions
- Reduce chamber pressure to equivalent of 25,000 feet (7,620 m), $\pm 5\%$
 - o Rate of pressure change ≤ 1.5 in-Hg/min (5 kPa/min)
- Maintain pressure for ≥ 2 h
- Increase pressure in the test chamber to ambient
 - o Rate of pressure change as above
- Ensure EUT does not activate during the test
- Perform self-test, verify pass result

2.9.8 Test Results

The test method was carried out satisfactorily, with the following deviation from the standard.

Deviation from the Standard

The EUT was not coded to test user protocol, this was considered unnecessary due to the EUT not activating throughout the test. The EUT was programmed in accordance with Clause A.1.7; *"using a test protocol of appropriate type and format"*.



Pressure and Temperature Plot



Product Service

Post-test Performance Checks

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	*	406.040 ± 0.001
Digital message correctness	Y/N	*	Y

* Due to the EUT 406 MHz battery losing charge, it was not possible to obtain valid data from the EUT, the Iridium (rechargeable) side did, however, power up and report a Self-test failure based on inadequate voltage during the 406 MHz burst. Replacing the battery was postponed until after the Immersion Test due to a history of ingress issues on previous attempts at the test campaign. Validation that the 406 MHz circuitry was fully functional apart from the low battery can be found in Section 2.10. Further validation of the design can be found by looking at the Performance Check results for the black-coloured sample (SOS-300 IMEI: 300434060816170 (75934030-TSR0047)) below; the manufacturer stated that other than the colour of the plastic, the design was identical.

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039993	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y

Activation Check

The EUT was monitored throughout the test, no activation was observed.

2.10 IMMERSION TEST

2.10.1 Specification Reference

RTCM 11010.2, Clause A.11

2.10.2 Equipment Under Test and Modification State

SOS-300 IMEI: 300434060816170 (75934030-TSR0046) – Modification State 0

SOS-300 IMEI: 300434060627250 (75934030-TSR0047) – Modification State 0

2.10.3 Date of Test

02 and 03 June 2017

2.10.4 Test Equipment Used

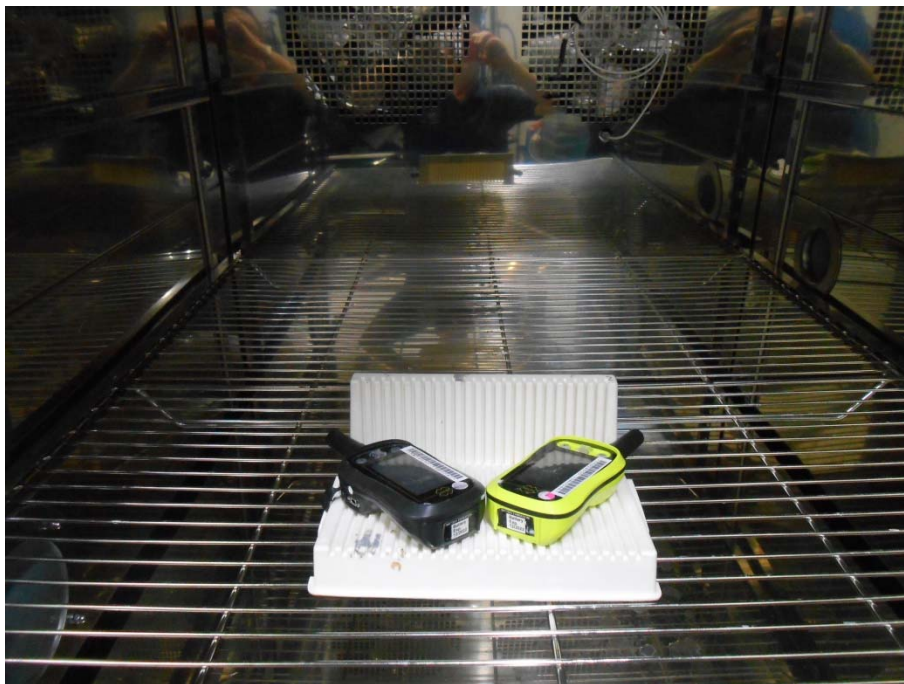
The major items of test equipment used for the above tests are identified in Section 3.1.

2.10.5 Environmental Conditions

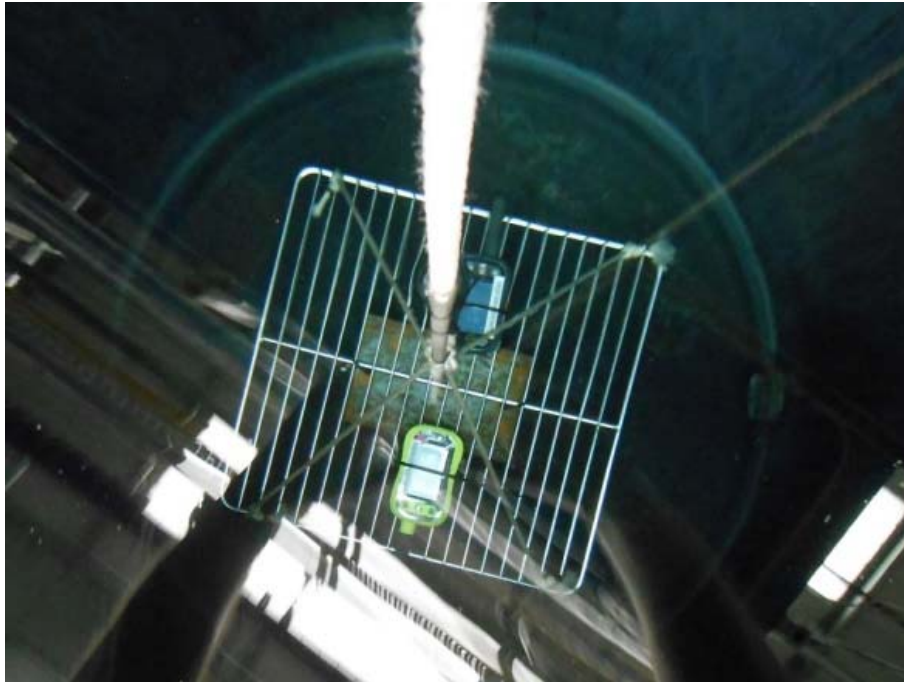
Ambient Temperature (°C) 22.2 - 25.6

Relative Humidity (%) 45.4 - 56.4

2.10.6 Test Setup



Pre-conditioning Test Setup



Test Setup

2.10.7 Test Method

- Immerse the EUT in water and satisfy the following conditions:
 - o Highest point of EUT 1 m below surface of water
 - o Duration 1 h
 - o Water temperature to EUT temperature difference ≤ 5 K
- After the test
 - o Performance check
 - o Examine the EUT for damage
 - o Examine the EUT (externally and internally) for unwanted ingress of water
 - o Reseal EUT as per manufacturer's instructions

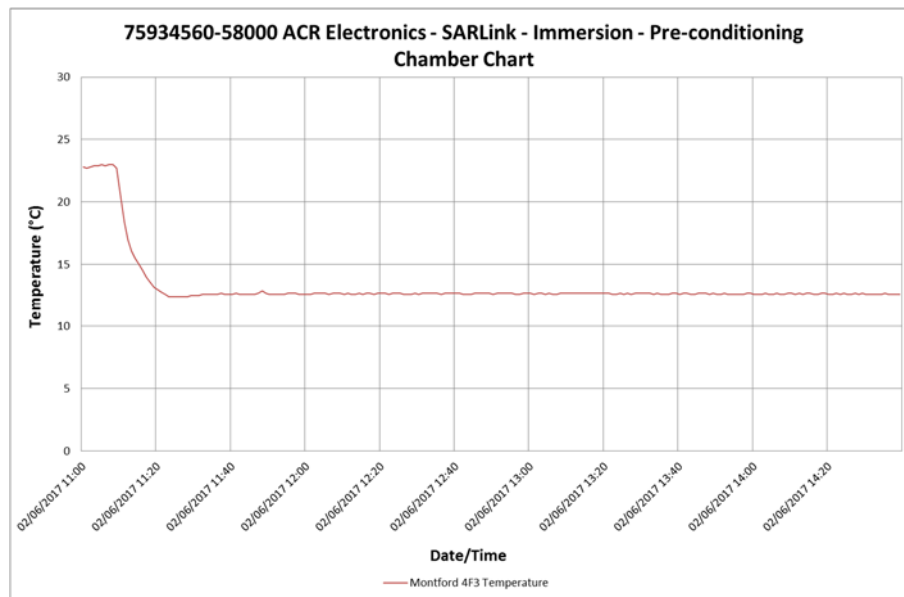
2.10.8 Test Results

The test method was completed satisfactorily.

Pre-conditioning

The EUT was pre-conditioned for at least 2 h before the test to the temperature of the immersion tank ± 5 K, equivalent to ± 5 °C

Water temperature: 14.8 °C



Pre-conditioning Temperature Plot

Visual Inspection

Following the test, the EUT was visually inspected (externally and internally). No damage was found and no signs of water ingress were observed.

Post-test Performance Checks

SOS-300 IMEI: 300434060816170 (75934030-TSR0046)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.040049	406.040 $\pm$ 0.001
Digital message correctness	Y/N	Y	Y

* The primary (non-rechargeable) battery (for the 406 MHz circuitry) was replaced following the internal inspection; this successful Performance Check is intended to validate the previously unsuccessful Performance Checks that resulted from the low battery.



Product Service

SOS-300 IMEI: 300434060816170 (75934030-TSR0047)

Performance Check

Test Parameter	Units	Result	Limit
Transmitted frequency (single burst)	MHz	406.039990	406.040 ± 0.001
Digital message correctness	Y/N	Y	Y



Product Service

2.11 SPURIOUS EMISSIONS

2.11.1 Specification Reference

RTCM 11010.2, Clause A.12

2.11.2 Equipment Under Test and Modification State

SOS-300 S/N: #1763 (75934030-TSR0002) – Modification State 0

SOS-300 S/N: #1876 (75934030-TSR0003) – Modification State 0

2.11.3 Date of Test

23, 24 & 26 September 2016

2.11.4 Test Equipment Used

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

2.11.5 Environmental Conditions

Ambient Temperature (°C) 20.8 - 22.2

Relative Humidity (%) 23.1 - 52.2

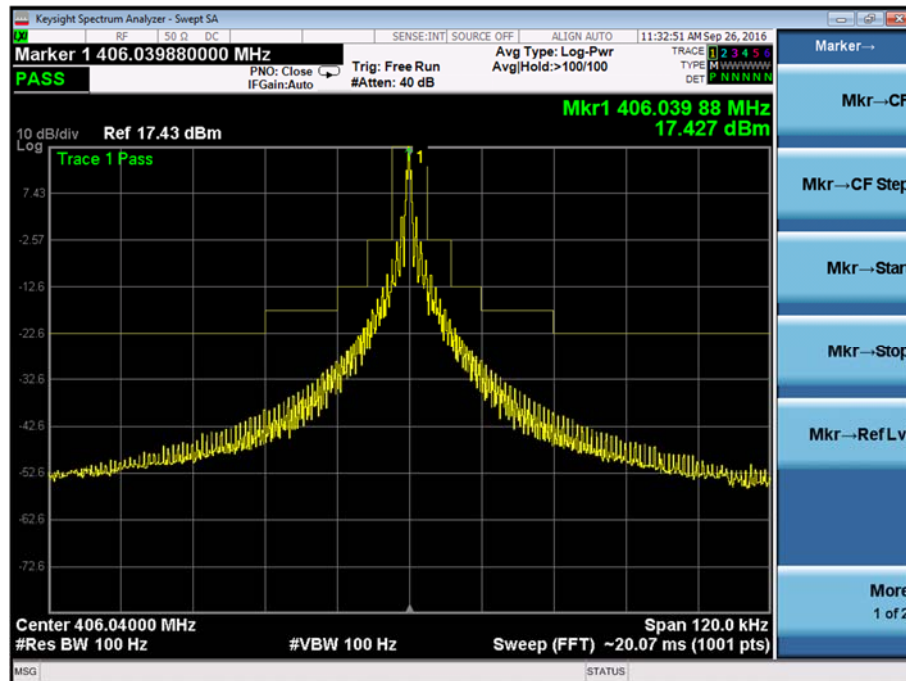


Product Service

2.11.6 Test Method

Close in Emissions

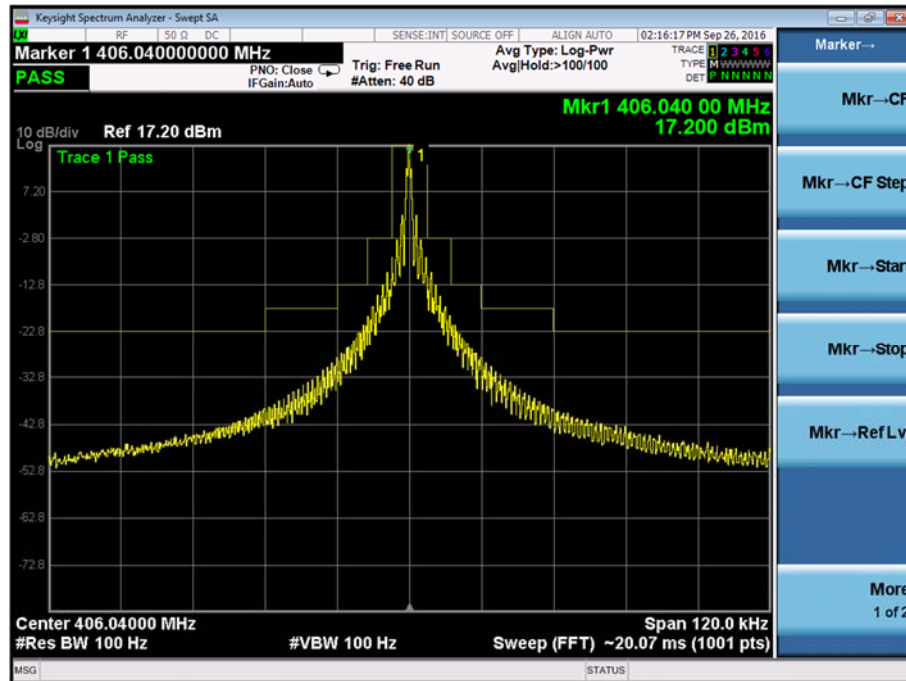
SOS-300 S/N: #1763 (75934030-TSR0002)



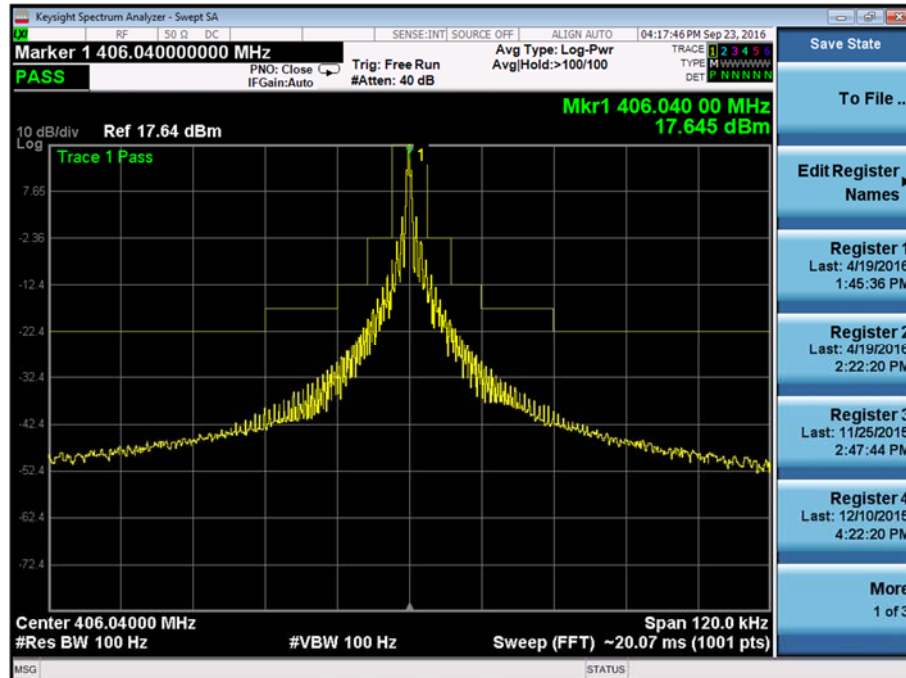
Ambient Temperature



Product Service



High Temperature (+55 °C)

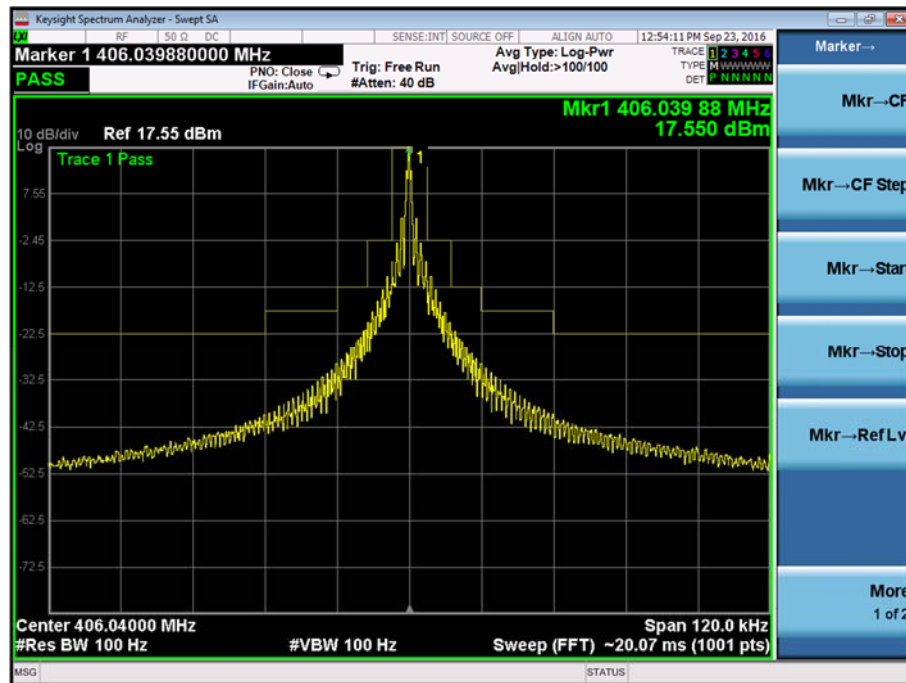


Low Temperature (-20 °C)

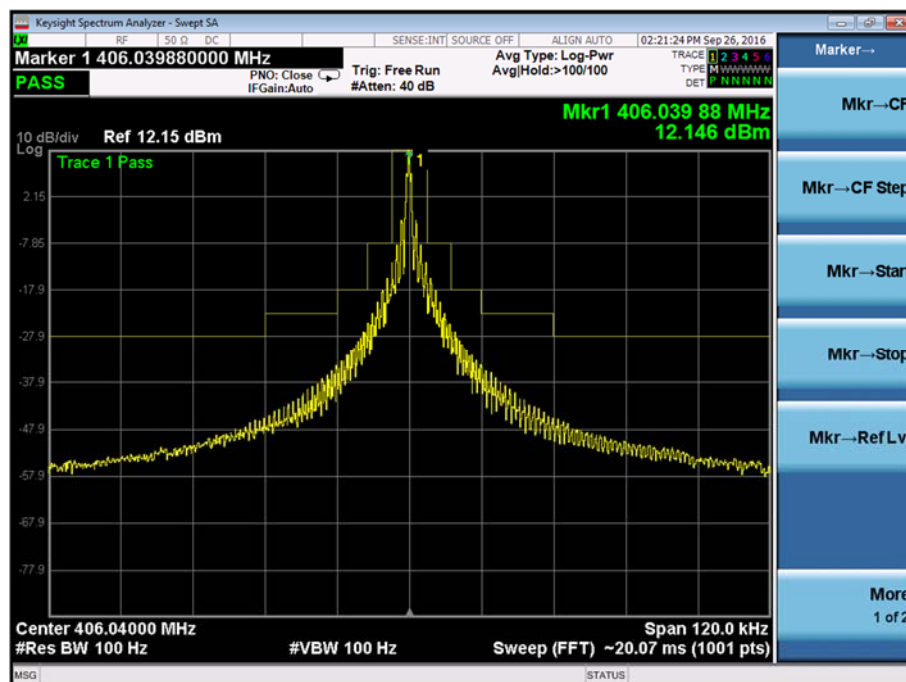


Product Service

SOS-300 S/N: #1876 (75934030-TSR0003)



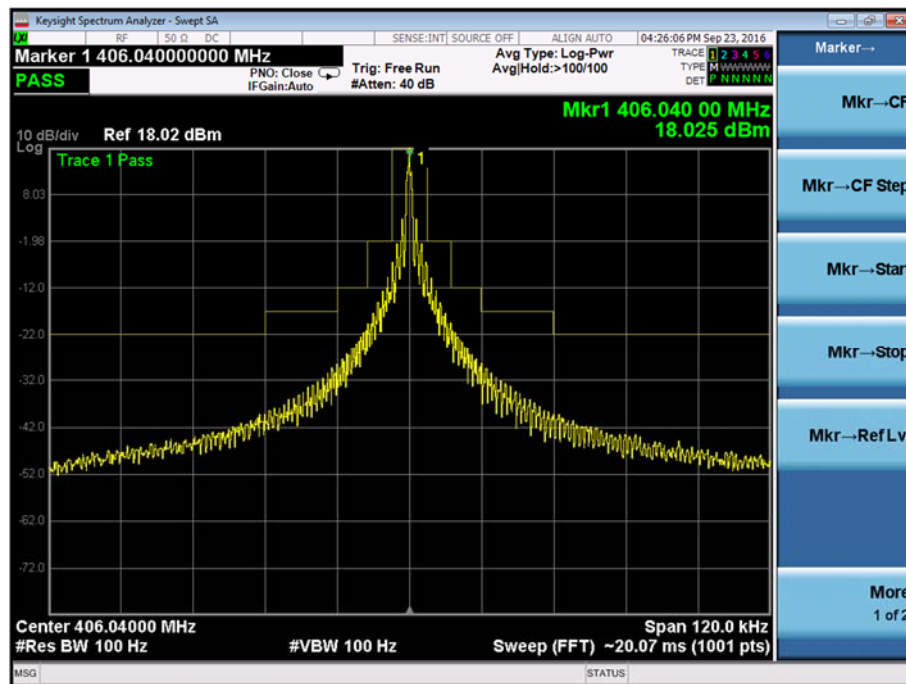
Ambient Temperature



High Temperature (+55 °C)



Product Service



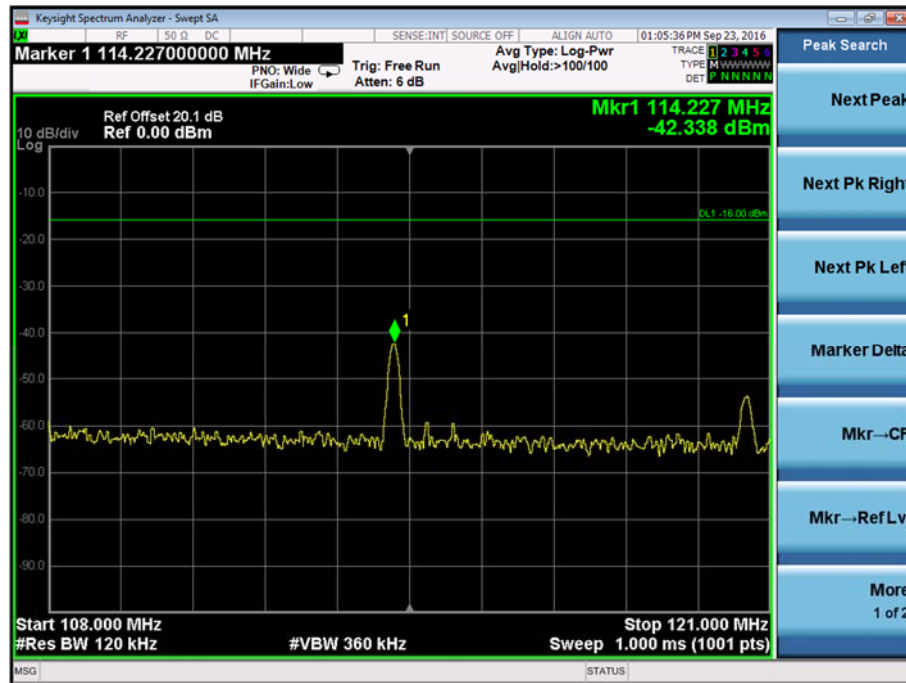
Low Temperature (-20 °C)



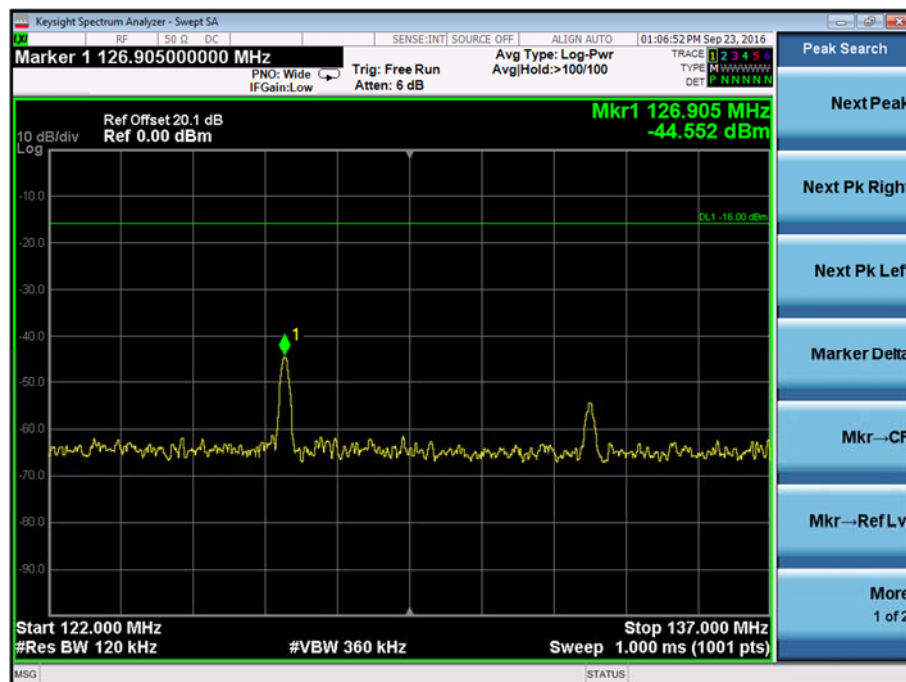
Product Service

Aeronautical, Maritime and Satellite Band Emissions

SOS-300 S/N: #1763 (75934030-TSR0002)



108 MHz to 121 MHz

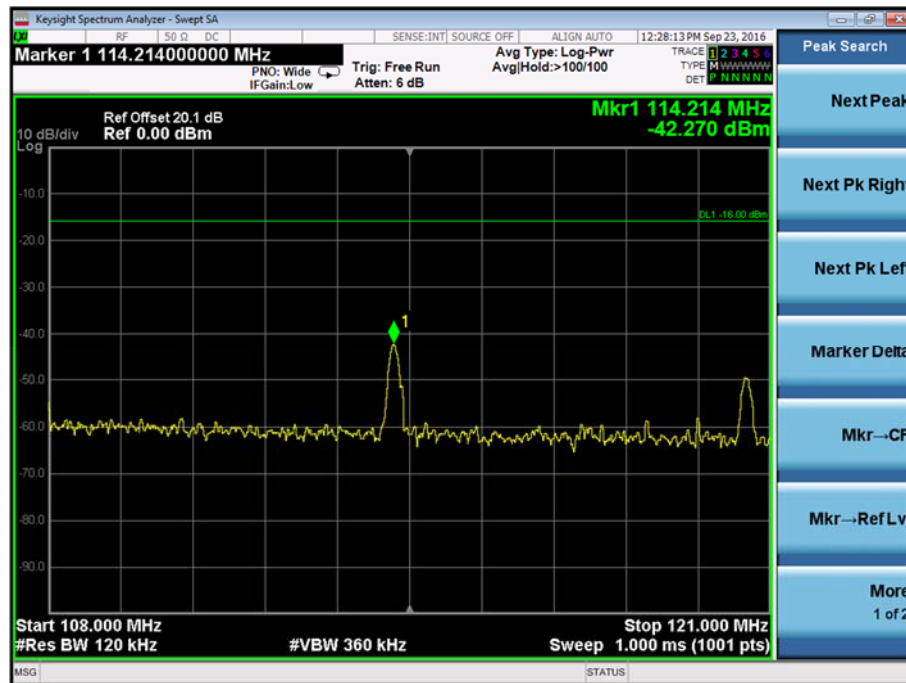


122 MHz to 137 MHz

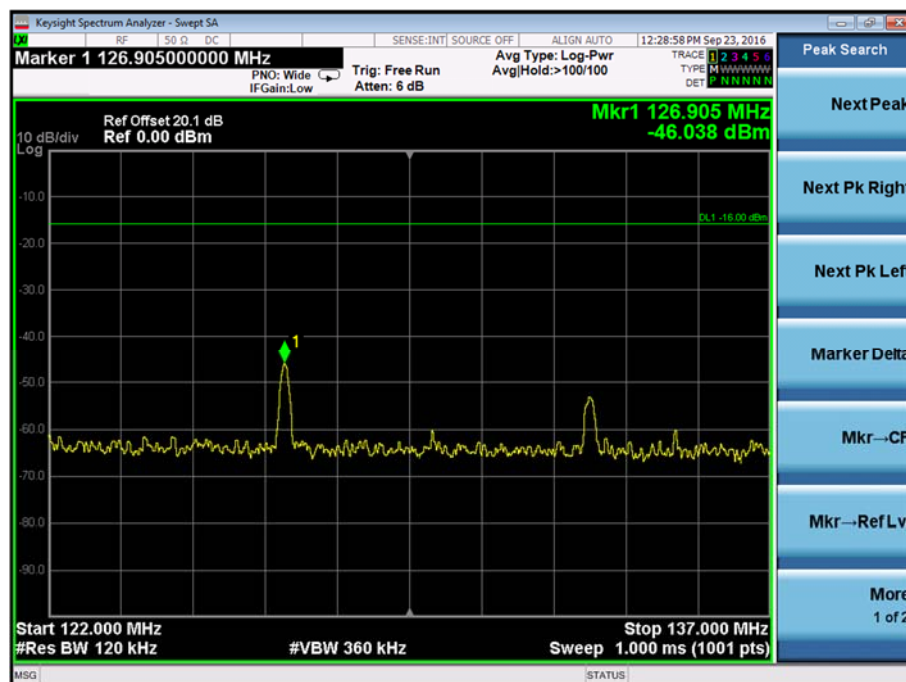


Product Service

SOS-300 S/N: #1876 (75934030-TSR0003) [406 MHz Port]



108 MHz to 121 MHz



122 MHz to 137 MHz