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Test report

273734-1TRFWL

Date of issue: February 25, 2015

Applicant:

Nautel Limited

Product:

Vector-LP

Model:

VR125

Model Variants:

VR125S, VR125D

FCC ID:

B3WVECTOR125

Specifications:

FCC 47 CFR Part 87

Aviation Services

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC test site registration number: 176392, IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Date	February 25, 2015
Signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant/Manufacturer

Company name	Nautel Maine Inc.
Address	201 Target Industrial Circle
City	Bangor
Province/State	ME
Postal/Zip code	04401
Country	USA

1.2 Test specifications

FCC 47 CFR Part 87	Aviation Services

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.4 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 87 test results

Part	Test description	Verdict
§87.131	Power and emissions	Pass
§87.133	Frequency stability	Pass
§87.135	Bandwidth of emission	Pass
§87.139(a)	Emission limitations	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 14, 2014
Nemko sample ID number	1

3.2 EUT information

Product name	Vector LP
Model	VR125
Serial number	B723

3.3 Technical information

Operating band	190–285 kHz; 325–435 kHz; 510–525 kHz; and 525–535 kHz.
Operating frequency	190–285 kHz; 325–435 kHz; 510–525 kHz; and 525–535 kHz.
Modulation type	NON & A2A
Occupied bandwidth (99 %)	2.35 kHz
Power requirements	Vector LP can use either 90 –270 V_{AC}, 24$V_{DC,}$ or 48V_{DC}
Emission designator	2K04A2A
Antenna information	The EUT uses a unique antenna coupling via ATU (antenna tuning unit).

3.4 Product description and theory of operation

The Vector-LP radio beacon transmitter Automatically transmits specific beacon identification signals at preselected repetition rates. Special codes may also be transmitted when commanded from an external source. Provision is made for local or remote operation of the transmitter as well as antenna fine-tuning through controls on the transmitter's front panel. Emission is continuous carrier (NON), beacon keyed identification tone (A2A) and beacon

3.5 EUT exercise details

The Vector LP was set for 190, 308, and 535 kHz for each of the tests.

3.6 EUT setup diagram

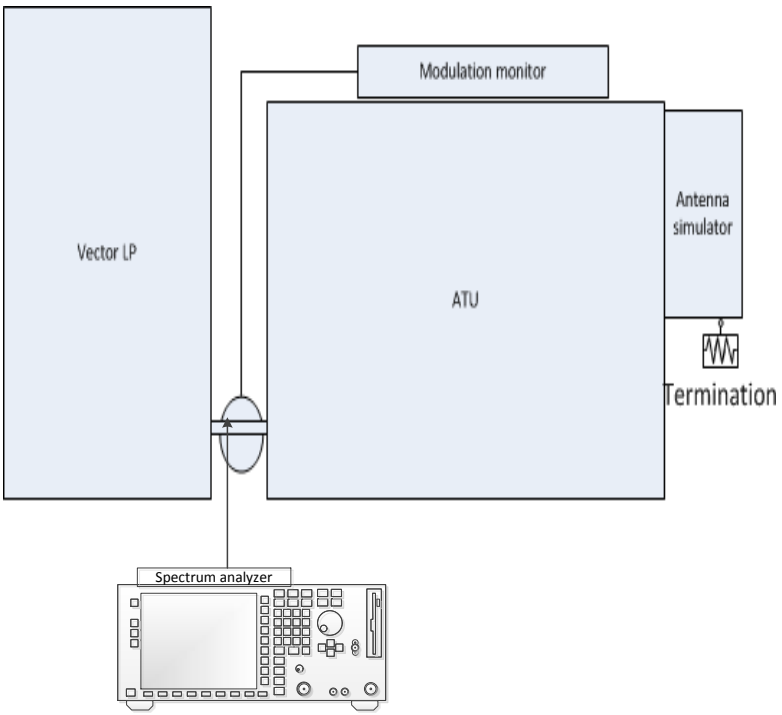


Figure 3.6-1: *Setup diagram*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
ATU (antenna tuning unit)	Nautel	NAT41B	B374
Modulation Monitoring	The wizard	AMMA-2	510687
Antenna simulator	Nautel	-	-

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

Model variants: VR125S & VR125D

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 18/15
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Power source	California Instruments	3001i	FA001021	1 year	June 27/15
Power source	California Instruments	5001ix	FA001238	1 year	Sept. 18/15
Active loop antenna (0.01–30 MHz)	EMCO	6502	FA001686	1 year	Sept. 17/15
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Mar. 12/15
50 Ω coax cable	C.C.A.	None	FA002555	1 year	June 23/15
50 Ω coax cable	Huber + Suhner	None	FA002074	1 year	June 23/15
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Dec. 23/14
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Mar. 20/15
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	July 08/15
Wide band current transformer	Pearson electronics	411	FA001853	1 year	Mar. 07/15
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
Multimeter	Fluke	16	FA001831	1 year	Feb. 04/15

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 87.131 Power and emissions

8.1.1 Definitions and limits

Class of station	Frequency band/frequency	Authorized emission(s)9	Maximum power1
(Radionavigation)	Various[7]	Various[7]	Various.[7]

[7]Frequency, emission, and maximum power will be determined by appropriate standards during the certification process.
[9]Excludes automatic link establishment.

8.1.2 Test summary

Test date	November 18, 2014	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	32 %

8.1.3 Observations, settings and special notes

Power measurements were made using a 50 dB decoupled RF signal. Using CW

Test receiver settings:

Detector mode	Peak
Resolution bandwidth	>OBW
Video bandwidth	>RBW
Trace mode	Max Hold
Measurement time	Auto

8.1.4 Test data

Table 8.1-1: *Conducted Power results*

Frequency, kHz	High power output , dBm	High power output , Watts	Low power output , dBm	Low power output , Watts
190	51.36	136.77	42.00	15.85
308	51.44	139.31	41.33	13.58
535	51.38	137.40	41.30	13.49

8.2 FCC 87.139(a) Emission limitations

8.2.1 Definitions and limits

The mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:
(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

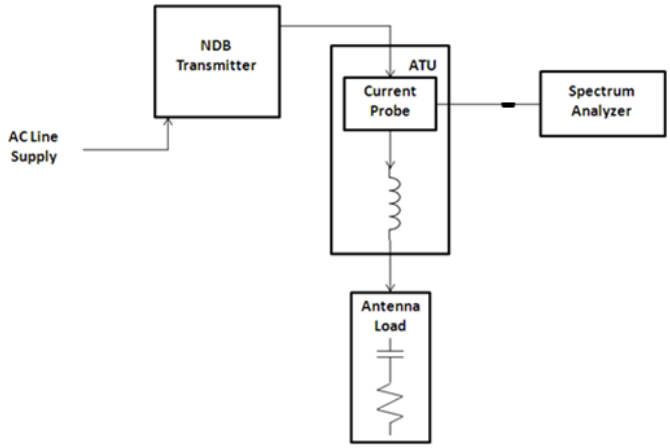
(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 $\log_{10}$ pY dB.

8.2.2 Test summary

Test date	November 18, 2014	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	32 %

8.2.3 Observations, settings and special notes

The spectrum was scanned from 9 kHz to the 10th harmonic
The radiated measurements were performed at the distance of 3 m.
Radiated Emission limit of 82.23 dBµV/m was calculated from −13 dBm +95.23 dB
A current probe was used on the output of the ATU, before the input of the antenna. The ATU is tuned for each frequency to maximize performance.
Rated power level 125 W = 50.9 dBm (Modulated tone was used of power measurement)
63.9 dBc was calculated to be the equivalent to −13 dBm
= (50.9 dBm – (−13.0 dBm)) = 63.9 dBc delta



Detector mode	Peak
Resolution bandwidth	100 Hz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.2.4 Test data

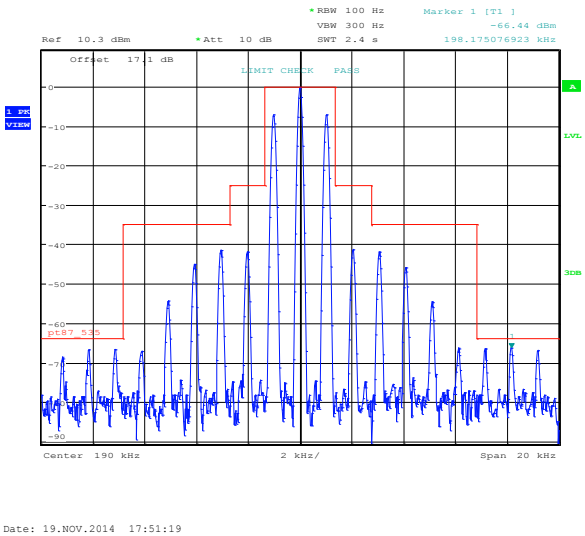


Figure 8.2-1: *Low channel Mask*

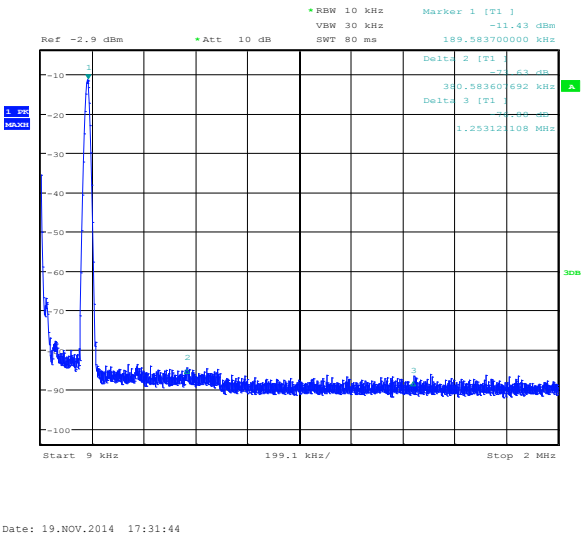


Figure 8.2-2: *Low channel conducted spurious*

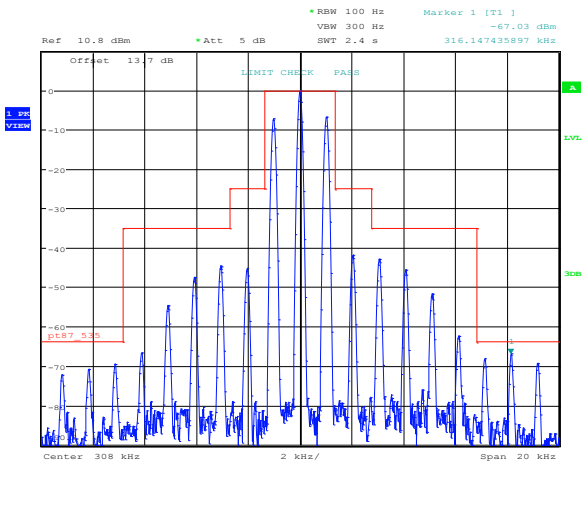


Figure 8.2-3: *Mid channel Mask*

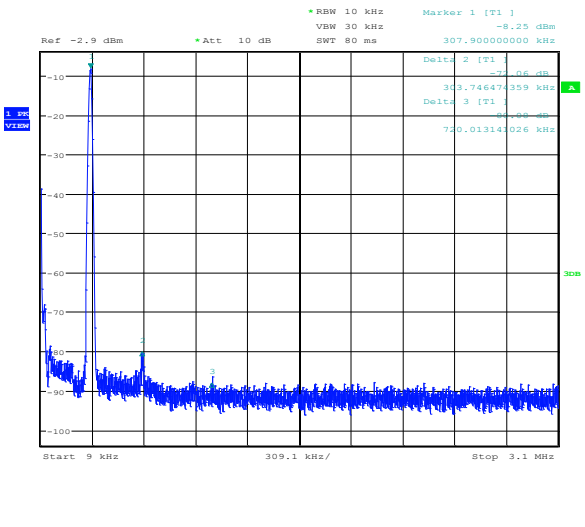


Figure 8.2-4: *Mid channel conducted spurious*

8.2.4 Test data continued

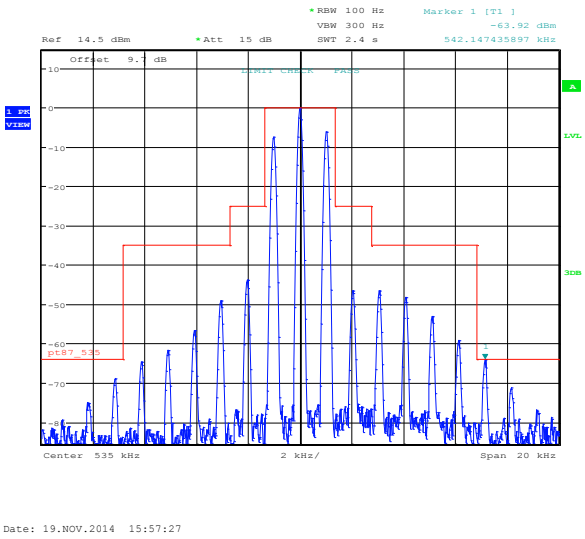


Figure 8.2-5: *High channel Mask*

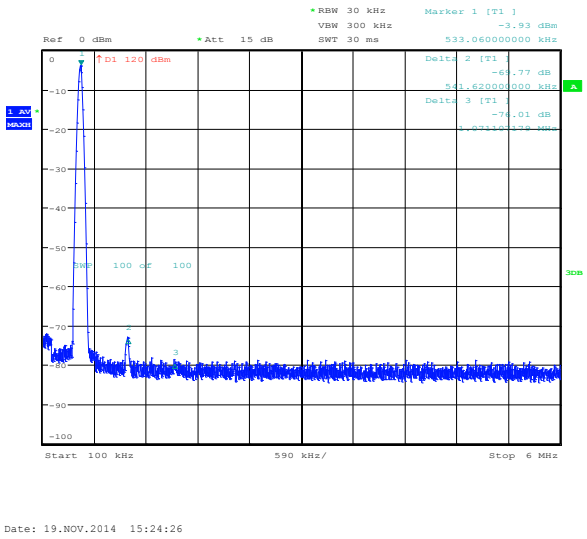


Figure 8.2-6: *High channel conducted spurious*

Table 8.2-1: *Conducted harmonic results*

Frequency, kHz	Harmonic, dBc	Limit, dBc	Margin, dB
190	73.63	63.9	9.73
308	72.06	63.9	8.16
535	69.77	63.9	5.87

8.2.4 Test data continued

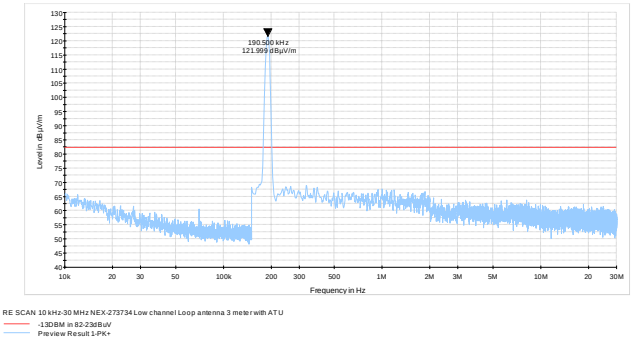


Figure 8.2-7: *Low channel Radiated Spurious*

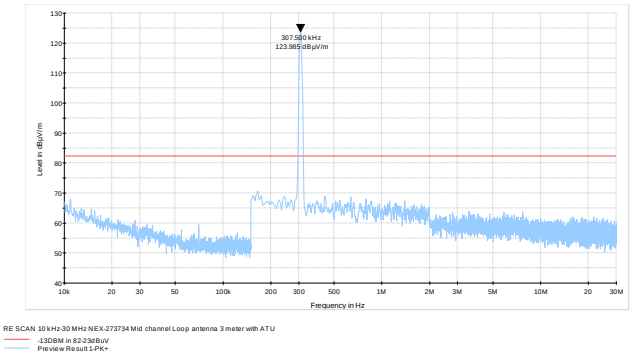


Figure 8.2-8: *Mid channel Radiated Spurious*

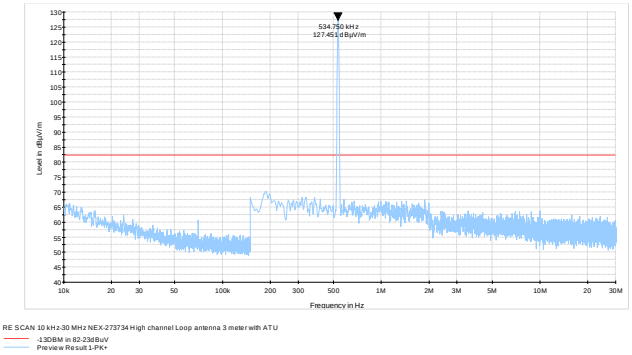


Figure 8.2-9: *High channel Radiated Spurious*

8.3 FCC 87.133 Frequency stability

8.3.1 Definitions and limits

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance[1], ppm	Tolerance[2], ppm
(1) Band-9 to 535 kHz:		
Aeronautical stations	100	100
Aircraft stations	200	100
Survival craft stations on 500 kHz	5,000	20 Hz
Survival craft stations on 500 kHz	100	100

Note:[1] This tolerance is the maximum permitted until January 1, 1990, for transmitters installed before January 2, 1985, and used at the same installation. Tolerance is indicated in parts in 10^6 unless shown as Hertz (Hz).

[2]This tolerance is the maximum permitted after January 1, 1985 for new and replacement transmitters and to all transmitters after January 1, 1990. Tolerance is indicated in parts in 106 unless shown as Hertz (Hz).

8.3.2 Test summary

Test date	November 18, 2014	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	32 %

8.3.3 Observations, settings and special notes

26 dBc points including frequency tolerance were assessed to remain within assigned band.
Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	10 Hz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.3.4 Test data

Table 8.3-1: *Frequency stability results high power*

Temperature, C	Voltage, Vac	Frequency, kHz	Deviation, ppm	Limit, ±ppm
50	102.0	190.000000000	0.86	100
50	264.5	190.000000000	0.86	100
40	102.0	190.000000000	0.86	100
40	264.5	190.000000000	0.86	100
30	102.0	190.000000000	0.86	100
30	264.5	190.000000000	0.86	100
20	102.0	190.000162500	0.00	100
20	120.0	190.000162500	0.00	100
20	264.5	190.000162500	0.00	100
10	102.0	190.000162500	0.00	100
10	264.5	190.000162500	0.00	100
0	102.0	190.000168750	-0.03	100
0	264.5	190.000168750	-0.03	100
-10	102.0	190.000331250	-0.89	100
-10	264.5	190.000331250	-0.89	100
-20	102.0	190.000493750	-1.74	100
-20	264.5	190.000493750	-1.74	100
-30	102.0	190.000656250	-2.60	100
-30	264.5	190.000656250	-2.60	100

Deviation = measured nominal temperature and voltage –extreme temperature and voltage/nominal temperature and voltage in MHz=ppm

Table 8.3-2: *Carrier power level stability results high power*

Temperature, C	Voltage, Vac	Power, dBm	Deviation, dB
50	102.0	51.29	-0.03
50	264.5	51.30	-0.04
40	102.0	51.22	0.04
40	264.5	51.22	0.04
30	102.0	51.23	0.03
30	264.5	51.24	0.02
20	102.0	51.25	0.01
20	120.0	51.26	0.00
20	264.5	51.25	0.01
10	102.0	51.26	0.00
10	264.5	51.26	0.00
0	102.0	51.28	-0.02
0	264.5	51.27	-0.01
-10	102.0	51.29	-0.03
-10	264.5	51.29	-0.03
-20	102.0	51.31	-0.05
-20	264.5	51.30	-0.04
-30	102.0	51.32	-0.06
-30	264.5	51.31	-0.05

Power Stability =Power at normal temperature and voltage verses power during extreme conditions.

8.3.4 Test data continued

Table 8.3-3: *Frequency stability results low power*

Temperature, C	Voltage, Vdc	Frequency, kHz	Deviation, ppm	Limit, ±ppm
50	20.4	534.999838150	0.61	100
50	27.6	534.999838150	0.61	100
40	20.4	535.000000000	0.30	100
40	27.6	535.000000000	0.30	100
30	20.4	535.000000000	0.30	100
30	27.6	535.000000000	0.30	100
20	20.4	535.000162175	0.00	100
20	24.0	535.000162175	0.00	100
20	27.6	535.000162175	0.00	100
10	20.4	535.000325000	-0.30	100
10	27.6	535.000325000	-0.30	100
0	20.4	535.000653700	-0.92	100
0	27.6	535.000653700	-0.92	100
-10	20.4	535.000818750	-1.23	100
-10	27.6	535.000818750	-1.23	100
-20	20.4	535.000983213	-1.53	100
-20	27.6	535.000983213	-1.53	100
-30	20.4	535.001306125	-2.14	100
-30	27.6	535.001306125	-2.14	100

Deviation = measured nominal temperature and voltage –extreme temperature and voltage/nominal temperature and voltage in MHz=ppm

Table 8.3-4: *Carrier power level stability results low power*

Temperature, C	Voltage, Vdc	Power, dBm	Deviation, dB
50	20.4	41.03	0.07
50	27.6	41.03	0.07
40	20.4	41.03	0.07
40	27.6	41.03	0.07
30	20.4	41.07	0.03
30	27.6	41.07	0.03
20	20.4	41.10	0.00
20	24.0	41.10	0.00
20	27.6	41.10	0.00
10	20.4	41.12	-0.02
10	27.6	41.12	-0.02
0	20.4	41.16	-0.06
0	27.6	41.16	-0.06
-10	20.4	41.17	-0.07
-10	27.6	41.17	-0.07
-20	20.4	41.18	-0.08
-20	27.6	41.18	-0.08
-30	20.4	41.23	-0.13
-30	27.6	41.23	-0.13

Power Stability =Power at normal temperature and voltage verses power during extreme conditions.

8.4 Part 87.135 Bandwidth of emission

8.4.1 Definitions and limits

(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.

(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

8.4.2 Test summary

Test date	November 19, 2014	Temperature	21 °C
Test engineer	Kevin Rose	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	26 %

8.4.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of span
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.4.1 Test data

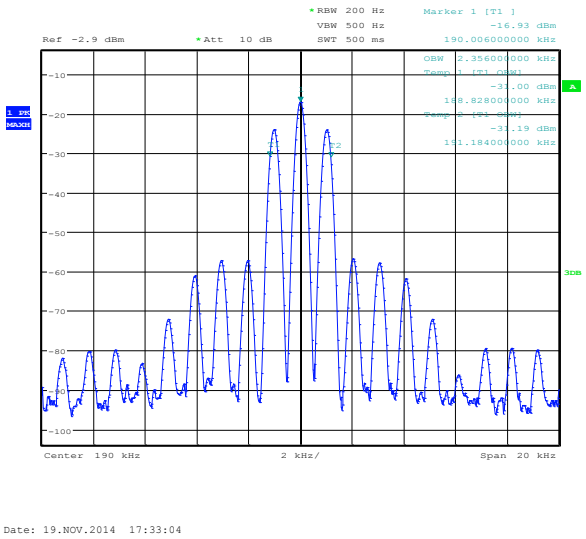


Figure 8.4-1: *Low channel Bandwidth*

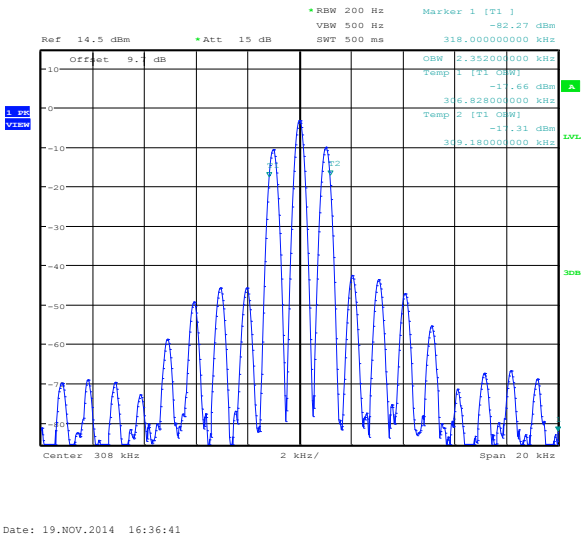


Figure 8.4-2: *Mid channel Bandwidth*

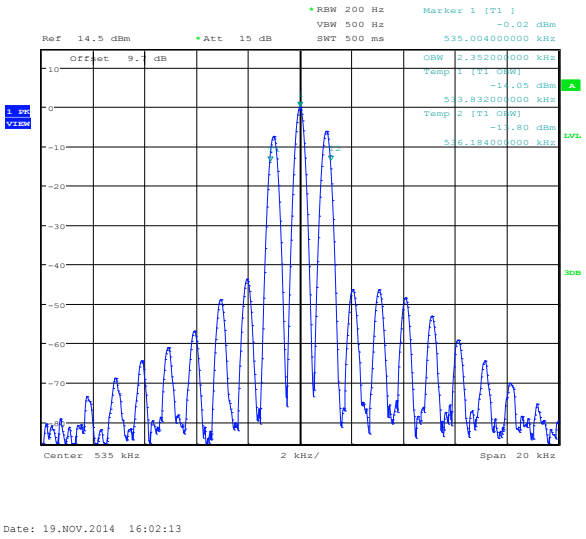


Figure 8.4-3: *High channel Bandwidth*

Table 8.4-1: *Bandwidth of emission results*

Frequency, kHz	Bandwidth , kHz
190	2.356
308	2.352
535	2.352

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up