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Test report

231990-1TRFWL

Date of issue: May 29, 2013

Applicant:

Codan Limited

Product:

HF Radio System

Model:

2210

FCC ID:

DYY2210

IC Registration number:

1029A-1

Specifications:

- FCC 47 CFR Part 90

  Private Land Mobile Radio Services

- RSS-125, Issue 2

  Land Mobile and Fixed Radio Transmitters and Receivers, 1.705 to 50.0 MHz, Primarily Amplitude Modulated

Test location

Nemko Canada Inc.
303 River Road
Ottawa, ON, K1V 1H2
Canada
Test site FCC ID: 176392 and IC ID: 2040A-4 (3 m semi anechoic chamber)

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Tested by Kevin Rose, Wireless/EMC Specialist

Reviewed by 

Andrey Adelberg, Senior Wireless/EMC Specialist

May 29, 2013

Date

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

Codan Limited
81 Graves Street
Newton, South Australia
Australia

1.2 Manufacturer

Codan Limited
81 Graves Street
Newton, South Australia
Australia

1.3 Test specifications

Standard	Description
FCC 47 CFR Part 2 Subpart J	Equipment Authorization Procedures
FCC 47 CFR Part 90	Private Land Mobile Radio Services
RSS-125, Issue 2	Land Mobile and Fixed Radio Transmitters and Receivers, 1.705 to 50.0 MHz, Primarily Amplitude Modulated

1.4 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.

1.5 Exclusions

None

1.6 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 90, test results

Clause	Test Method	Test description	Verdict
90.205	2.1046	Output power	Pass
90.207		Type of emissions	Pass
90.209	2.1049	Occupied bandwidth	Pass
90.210	2.1051	Spurious Emissions at the antenna terminal	Pass
90.210	2.1053	Field strength of spurious radiation	Pass
90.213	2.1055	Frequency stability	Pass
90.214	2.1055	Transient Behavior	Not applicable
90.219	2.1055	Use of signal boosters	Not applicable
2.1047	2.1047	Modulation Characteristics	Pass

Notes: Not Applicable the EUT doesn't transmit in the band that requires Transient Behavior and is not used for boosting signals

2.2 IC RSS-125, Issue 2, test results

Part	Test description	Verdict
4.6.1 RSS -GEN	Occupied bandwidth	Pass
7.0	Frequency Stability	Pass
8.0	Receiver Spurious Emissions	Not applicable
6.2	Output Power	Pass
6.3	Unwanted Emissions	Pass

Notes: According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 has been revised.

2.2.3 Receivers Excluded from Industry Canada Requirements

Only radiocommunication receivers operating in stand-alone mode within the band 30–960 MHz and scanner receivers are subject to Industry Canada requirements, as described above. All other receivers are excluded from any Industry Canada certification, testing, labelling and reporting requirements.

The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 26, 2013
Nemko sample ID number	2

3.2 EUT information

Product name	Codan Limited Type 2210 HF Transceiver
Model	2210
Serial number	CA40634B0040

3.3 Technical information

Operating band	Below 25 MHz and 25–50 MHz
Operating frequency	1.71–27.6 MHz
Modulation type	Upper Single Sideband Suppressed Carrier, Upper Single Sideband Full Carrier, Morse Code, AFSK
Rated Power:	125 W PEP
Power requirements	13.8 V_{DC}

3.4 Product description and theory of operation

The Codan Limited Type 2210 HF Transceiver is a Single Side Band (SSB) transceiver that can be installed in a vehicle, or used as a base station. The system is comprised of a 2220 Handset and the 2210 RF Unit. The handset is a hand-held device with a microphone, Push-To-Talk (PTT) button, display and keypad.

The Codan 2210 HF radio is a push-to-talk radio (PTT button, display and keypad on the 2220 handset) with a 50 Ω connector, no integral or detachable antenna.

3.5 EUT exercise details

The Codan Limited Type 2210 HF Transceiver was programmed with low, mid, and high test software.

3.6 EUT setup diagram

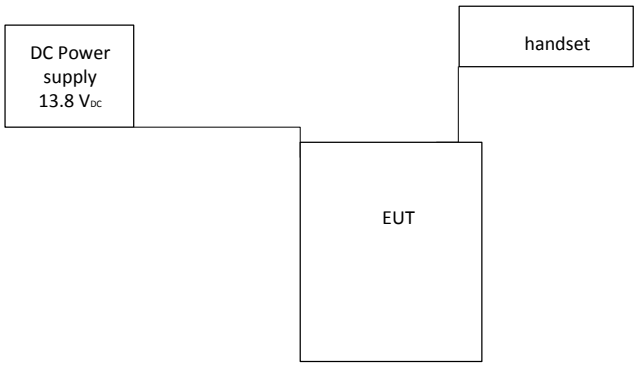

Diagram 3.6-1: Setup diagram

3.7 Support equipment

Description	Brand name	Model/Part number	Serial number	Rev.
Handset	Codan	2220	Ca40597B0040	-
Power supply	Codan	TS3020-H	16104 H	04A

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

None

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: 86–106 kPa

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

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/14
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	May 08/13
Bilog antenna	Sunol	JB3	FA002108	1 year	Feb. 21/14
50 Ω coax cable	Huber + Suhner	NONE	FA002392	1 year	June. 27/13
50 Ω coax cable	Huber + Suhner	NONE	FA002074	1 year	Aug. 23/13
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	June 14/13
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR

Note: NCR - no calibration required

Section 8 Testing data

8.1 RF Power Output

8.1.1 Definitions and limits

FCC:
Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized for new stations authorized after August 16, 1995 is as follows in FCC Part 90.205(a) through (r).
IC
Minimum Standard: The manufacturer's rated peak envelope output power must not be higher than the measured P_{pk}.

8.1.2 Test summary

Test date	April 12, 2013	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1002 mbar	**Relative humidity**	35 %

8.1.3 Observations/special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, and attenuators) for determination of compliance.

Receiver/spectrum analyzer settings 100 kHz RBW and 300 kHz VBW

8.1.4 Test data

Table 8.1-1: Output power limits

Frequency, MHz	Modulation type	Maximum PEP, dBm	Maximum PEP, W	Maximum PEP Rated, W
1.71	J3E	51.36	136.7	125
14.4	J3E	51.69	145.5	125
27.6	J3E	51.41	138.4	125
1.71	H3E	51.84	152.7	125
14.4	H3E	51.68	147.2	125
27.6	H3E	51.46	139.9	125

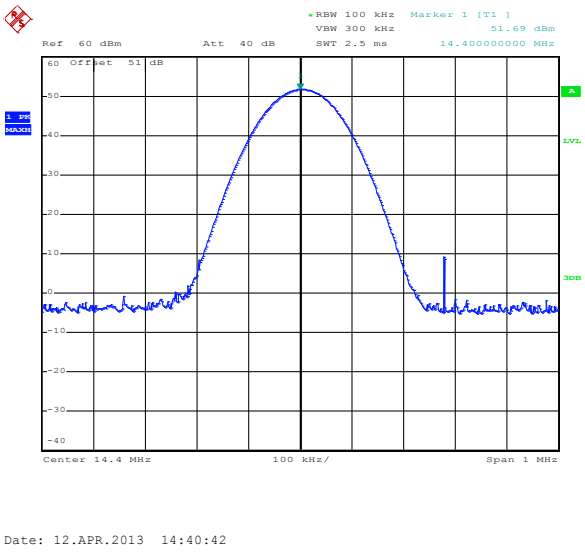

Figure 8.1-1: Example of the peak output power

8.2 Modulation Characteristics

8.2.1 Definitions and limits

FCC Clause 2.1047
(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

(c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of § 2.1049 for the occupied bandwidth tests.

(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

8.2.2 Test summary

Test date	March 26, 2013	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1001 mbar	**Relative humidity**	33 %

8.2.3 Observations/special notes and procedures

None

8.2.1 Test data

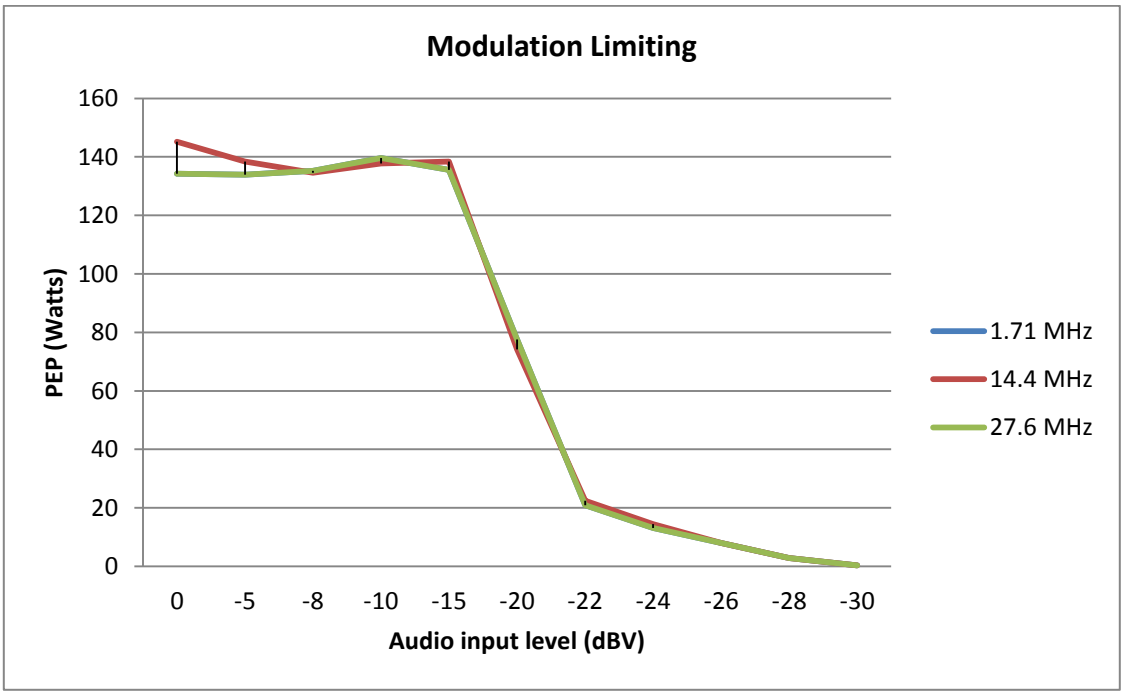

Figure 8.2-1: Filter frequency response

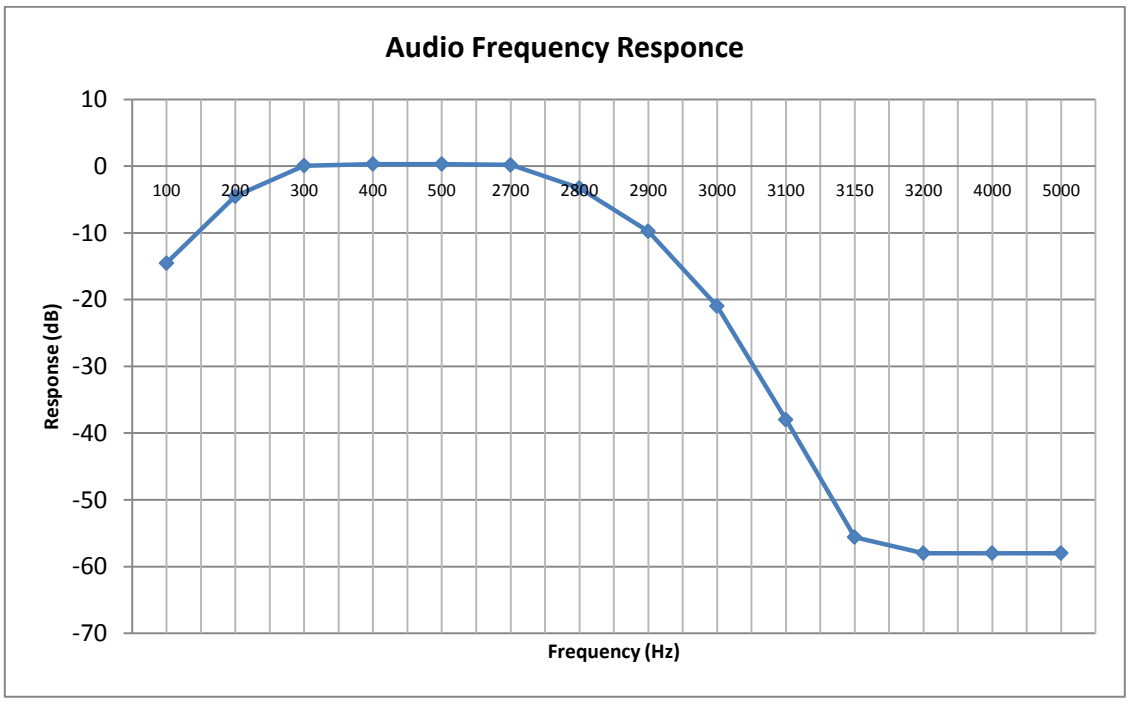

Figure 8.2-2: Filter frequency response

8.3 Emission Mask and Occupied Bandwidth

8.3.1 Definitions and limits

90.210 Emission masks.

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Table 8.3-1: Emissions mask specifications

Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
Below 25	A or B	A or C
25–50	B	C

§ 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(a) Radiotelegraph transmitters for manual operation when keyed at 16 dots per second.

(b) Other keyed transmitters—when keyed at the maximum machine speed.

(c) Radiotelephone transmitters equipped with a device to limit modulation or peak envelope power shall be modulated as follows. For single sideband and independent sideband transmitters, the input level of the modulating signal shall be 10 dB greater than that necessary to produce rated peak envelope power.

(1) Other than single sideband or independent sideband transmitters—when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

(2) Single sideband transmitters in A3A or A3J emission modes—when modulated by two tones at frequencies of 400 Hz and 1800 Hz (for 3.0 kHz authorized bandwidth), or 500 Hz and 2100 Hz (for 3.5 kHz authorized bandwidth), or 500 Hz and 2400 Hz (for 4.0 kHz authorized bandwidth), applied simultaneously. The input levels of the tones shall be so adjusted that the two principal frequency components of the radio frequency signal produced are equal in magnitude.

(3) Single sideband transmitters in the A3H emission mode—when modulated by one tone at a frequency of 1500 Hz (for 3.0 kHz authorized bandwidth), or 1700 Hz (for 3.5 kHz authorized bandwidth), or 1900 Hz (for 4.0 kHz authorized bandwidth), the level of which is adjusted to produce a radio frequency signal component equal in magnitude to the magnitude of the carrier in this mode.

(4) As an alternative to paragraphs (c) (2) and (3) of this section, other tones besides those specified may be used as modulating frequencies, upon a sufficient showing of need. However, any tones so chosen must not be harmonically related, the third and fifth order intermodulation products which occur must fall within the −25 dB step of the emission bandwidth limitation curve, the seventh and ninth order products must fall within the −35 dB step of the referenced curve and the eleventh and all higher order products must fall beyond the −35 dB step of the referenced curve.

(5) Independent sideband transmitters having two channels—when modulated by 1700 Hz tones applied simultaneously to both channels. The input levels of the tones shall be so adjusted that the two principal frequency components of the radio frequency signal produced are equal in magnitude.

(d) Radiotelephone transmitters without a device to limit modulation or peak envelope power shall be modulated as follows. For single sideband and independent sideband transmitters, the input level of the modulating signal should be that necessary to produce rated peak envelope power.

8.3.1 Definitions and limits, continued

(1) Other than single sideband or independent sideband transmitters—when modulated by a 2500 Hz tone of sufficient level to produce at least 85 percent modulation. If 85 percent modulation is unattainable, the highest percentage modulation shall be used.

(2) Single sideband transmitters in A3A or A3J emission modes—when modulated by two tones at frequencies of 400 Hz and 1800 Hz (for 3.0 kHz authorized bandwidth), or 500 Hz and 2100 Hz (for 3.5 kHz authorized bandwidth), or 500 Hz and 2400 Hz (for 4.0 kHz authorized bandwidth), applied simultaneously. The input levels of the tones shall be so adjusted that the two principal frequency components of the radio frequency signal produced are equal in magnitude.

(3) Single sideband transmitters in the A3H emission mode—when modulated by one tone at a frequency of 1500 Hz (for 3.0 kHz authorized bandwidth), or 1700 Hz (for 3.5 kHz authorized bandwidth), or 1900 Hz (for 4.0 kHz authorized bandwidth), the level of which is adjusted to produce a radio frequency signal component equal in magnitude to the magnitude of the carrier in this mode.

(4) As an alternative to paragraphs (d) (2) and (3) of this section, other tones besides those specified may be used as modulating frequencies, upon a sufficient showing of need. However any tones so chosen must not be harmonically related, the third and fifth order intermodulation products which occur must fall within the −25 dB step of the emission bandwidth limitation curve, the seventh and ninth order products must fall within the −35 dB step of the referenced curve and the eleventh and all higher order products must fall beyond the −35 dB step of the referenced curve.

(5) Independent sideband transmitters having two channels—when modulated by 1700 Hz tones applied simultaneously to both channels. The input levels of the tones shall be so adjusted that the two principal frequency components of the radio frequency signal produced are equal in magnitude.

Clause 6.3 **Unwanted Emissions:** The unwanted emissions comprise of out-of band emissions in the vicinity of the passband, spurious emissions and harmonics.

6.3.1 Unwanted Emissions of J3E, R3E and H3E

Adjust the transmitter to the manufacturer's rated output power before performing the other test below.

Connect the equipment as in 6.2.1 (Peak Envelope Power Test) for J3E and R3E emission categories, and as in 6.2.2 for the H3E category.

Adjust the levels of audio tone generators ($V_{t1} = V_{t2}$) to a level 10 dB higher than that is necessary to produce rated P_{pk}.

Minimum Standard: The power of unwanted emissions shall be attenuated below the transmitter peak envelope power in accordance with the following schedule:

i. on any frequency removed from the assigned frequency by more than 50% (i.e.: outside the band f_c - 0.1 kHz to f_c + 2.9 kHz*) and up to and including 150% of the authorized bandwidth: at least 25 dB, measured with a resolution bandwidth of 300 Hz. (* **Note:** the spectrum analyzer centre frequency corresponds to f_c - 0.25 kHz and f_c + 3.05 kHz at the edges of the band).
ii. on any frequency removed from the assigned frequency by more than 150% and up to and including 250% of the authorized bandwidth: at least 35 dB, measured with a resolution bandwidth of 300 Hz.
iii. in any 30 kHz band removed from the assigned frequency by more than 250% of the authorized bandwidth: at least 43 + 10*log(P_{pk}) or 70 dB. The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency) or 100 kHz below its lowest assignable frequency, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated or used without exceeding 23 GHz.

Note: The assigned frequency = f_c + 1.4 kHz

6.3.2 Unwanted Emissions of A3E

Adjust the equipment to the manufacturer's rated output power before performing the test below.

Connect the equipment as in 6.2.3 (Mean Output Power Test).

Adjust the level of the audio tone generator until the two RF sideband powers are each 12 dB below the carrier level, i.e. the modulation index is 50%.

Increase the voltage of the audio tone generator by 16 dB.

Minimum Standard: The power of emissions shall be attenuated below the transmitter mean power (P_{mean}) in accordance with the following schedule:

i. on any frequency removed from the carrier frequency by more than 50% and up to and including 150% of the authorized bandwidth: at least 25 dB, measured with a resolution bandwidth of 300 Hz;
ii. on any frequency removed from the carrier frequency by more than 150% and up to and including 250% of the authorized bandwidth: at least 35 dB, measured with a resolution bandwidth of 300 Hz;
iii. in any 30 kHz band removed from the carrier frequency by more than 250% of the authorized bandwidth: at least 43 +10*log(P_{mean}) or 70 dB. The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency) or 100 kHz below its lowest assignable frequency, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated or used without exceeding 23 GHz.

Note: The assigned frequency = f_c

8.3.2 Test summary

Test date	April 10, 2013	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1003 mbar	**Relative humidity**	37 %

8.3.3 Observations/special notes and procedures

Emission Mask A. For transmitters utilizing J3E emission, the carrier must be at least 40 dB below the peak envelope power and the power of emissions must be reduced below the output power (P in watts) of the transmitter as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 150 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 150 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log P dB.

8.3.4 Test data

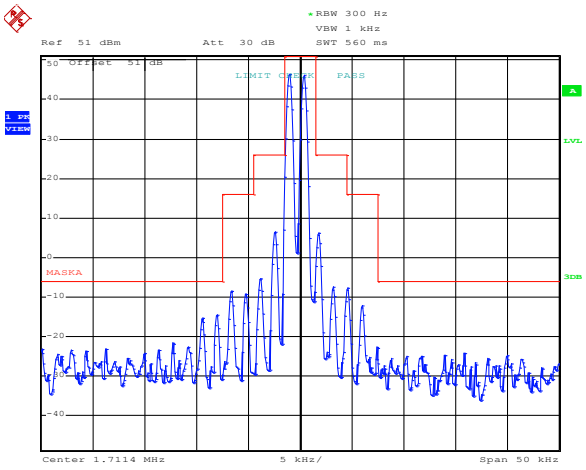

Figure 8.3-1: Mask A for J3E, Low channel

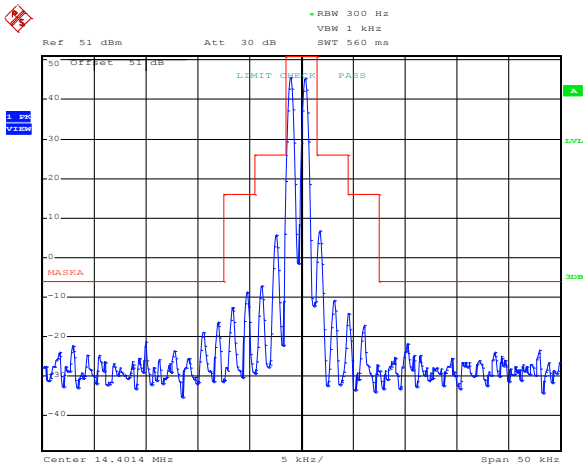

Figure 8.3-2: Mask A for J3E, Mid channel

8.3.4 Test data, continued

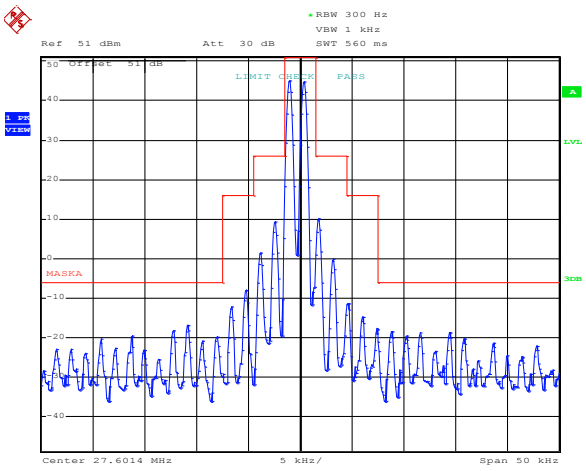

Figure 8.3-3: Mask A for J3E, High channel

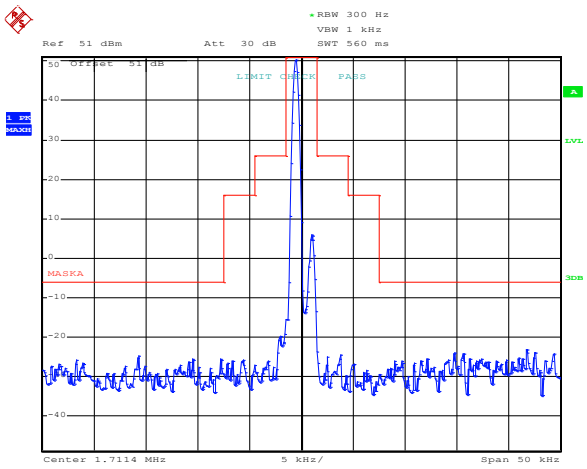

Figure 8.3-4: Mask A for J2B, Low channel

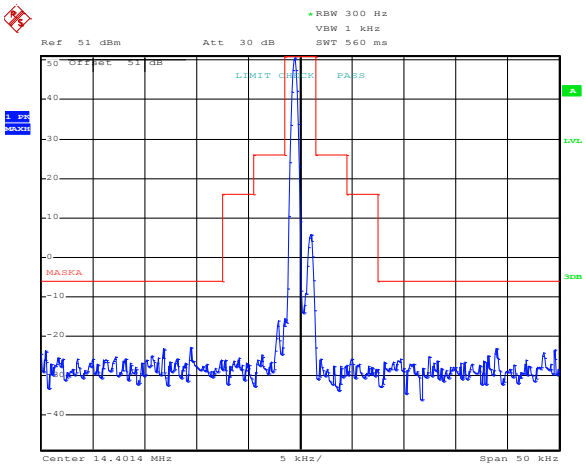

Figure 8.3-5: Mask A for J2B, Mid channel

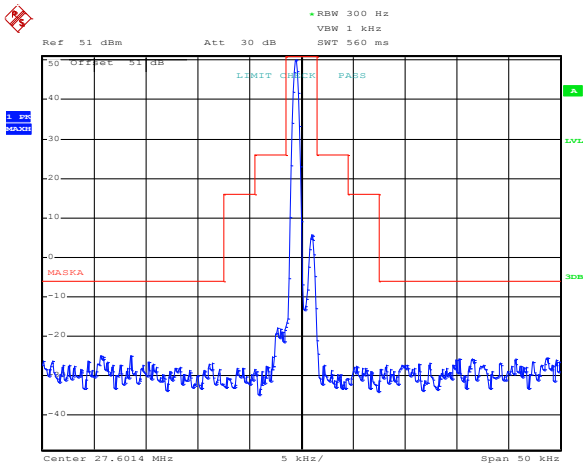

Figure 8.3-6: Mask A for J2B, High channel

8.3.4 Test data, continued

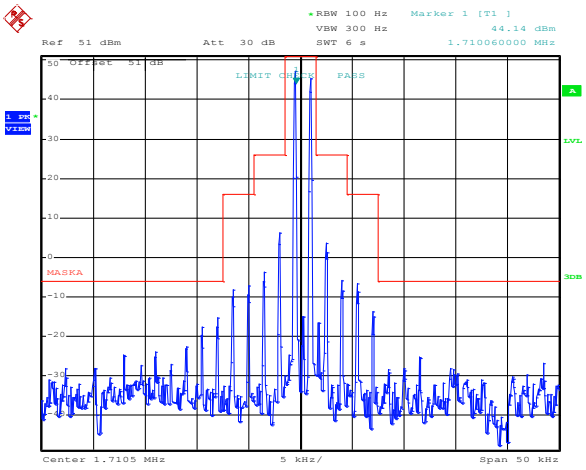

Figure 8.3-7: Mask A for H3E, Low channel

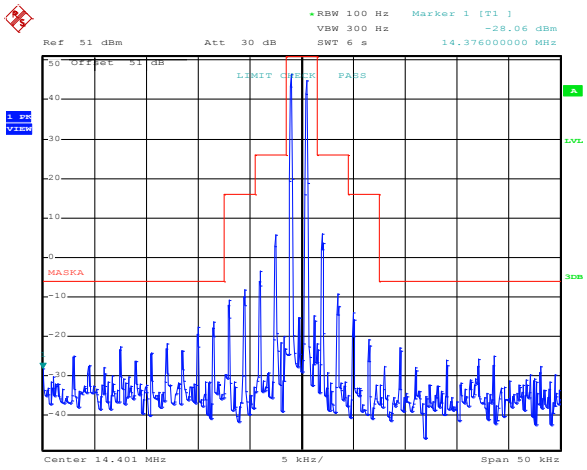

Figure 8.3-8: Mask A for H3E, Mid channel

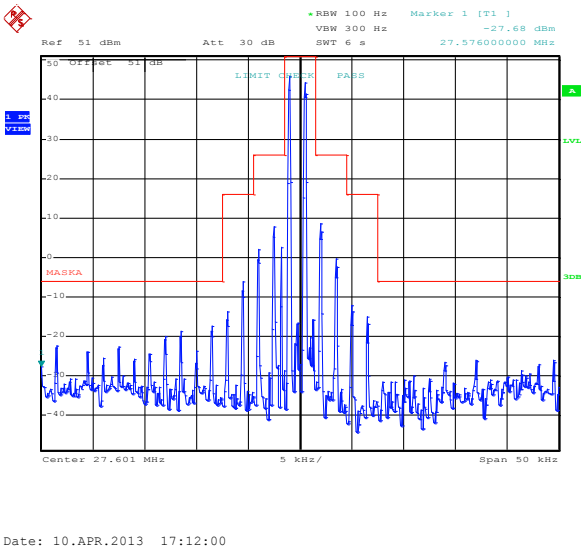

Figure 8.3-9: Mask A for H3E, High channel

8.3.4 Test data Continued

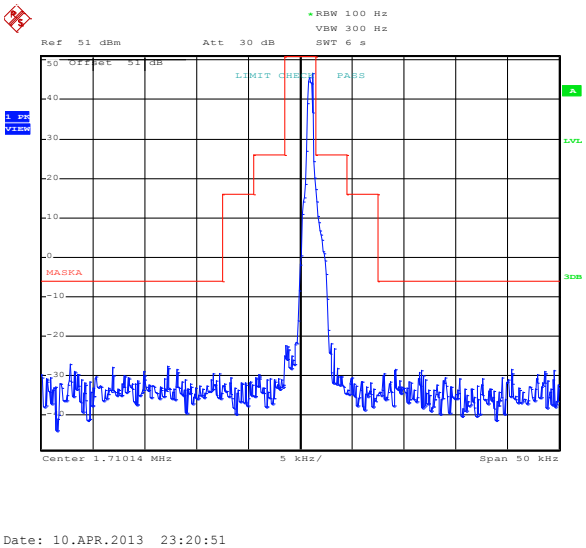

Figure 8.3-10: Mask A for ASFK, Low channel

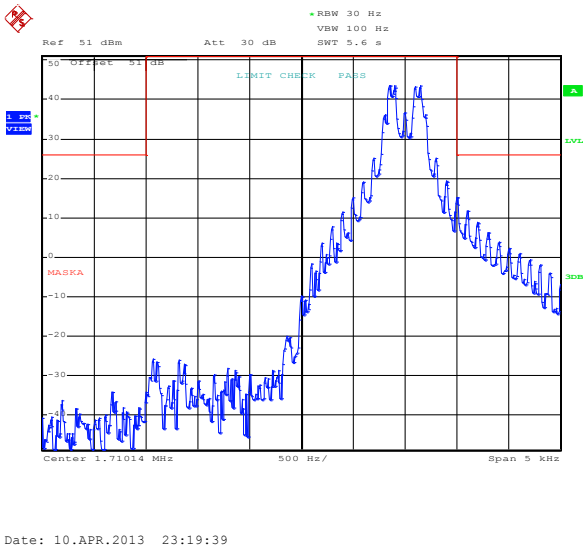

Figure 8.3-11: Mask A for ASFK, Low channel zoom

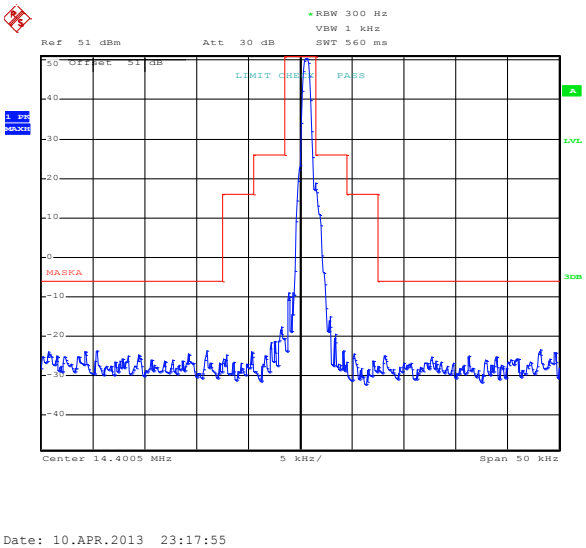

Figure 8.3-12: Mask A for ASFK, mid channel

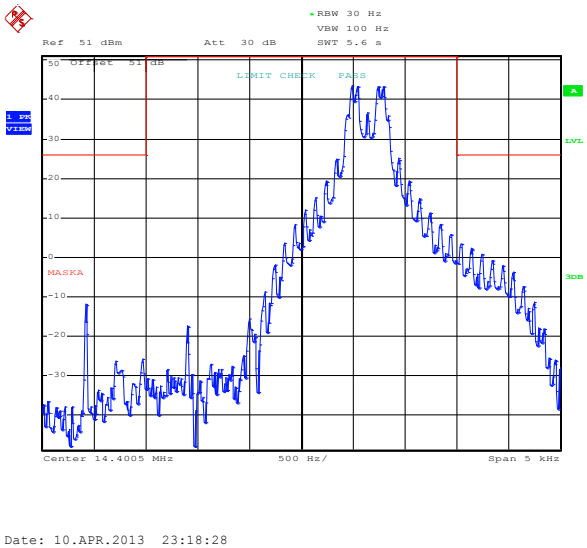

Figure 8.3-13: Mask A for ASFK, mid channel zoom

8.3.4 Test data Continued

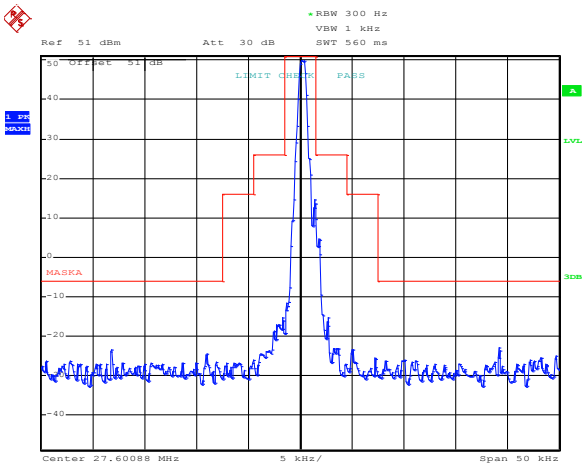

Figure 8.3-14: Mask A for ASFK, high channel

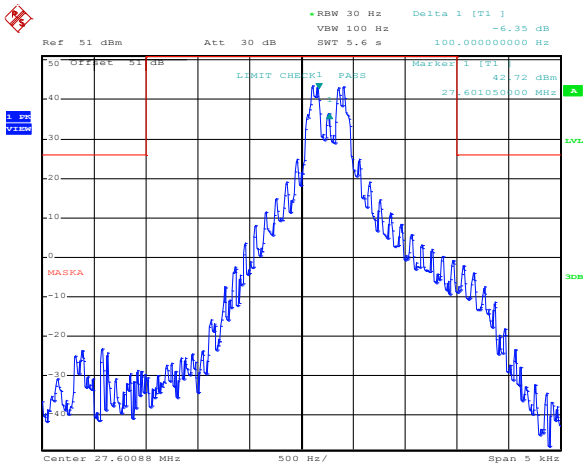

Figure 8.3-15: Mask A for ASFK, high channel zoom

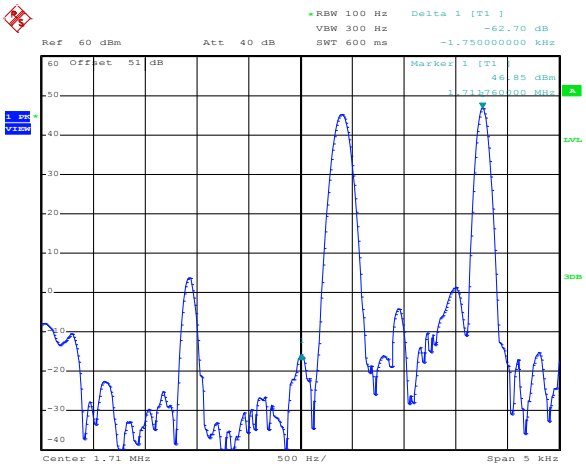

Figure 8.3-16: Low channel carrier suppression

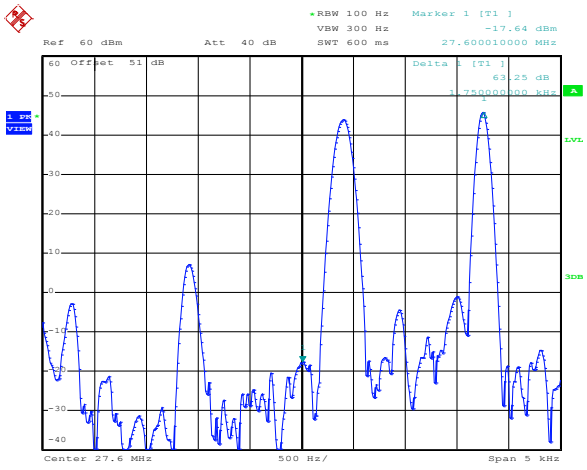

Figure 8.3-17: high channel carrier suppression

8.4 RSS-Gen Clause 4.6.1 Occupied bandwidth

8.4.1 Definitions and limits

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 percent emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

8.4.2 Test summary

Test date	April 12, 2013	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1004 mbar	**Relative humidity**	34 %

8.4.3 Observations/special notes

Measurements were performed with peak detector using RBW = 1–5 % of span. VBW was set wider than RBW.

8.4.1 Test data

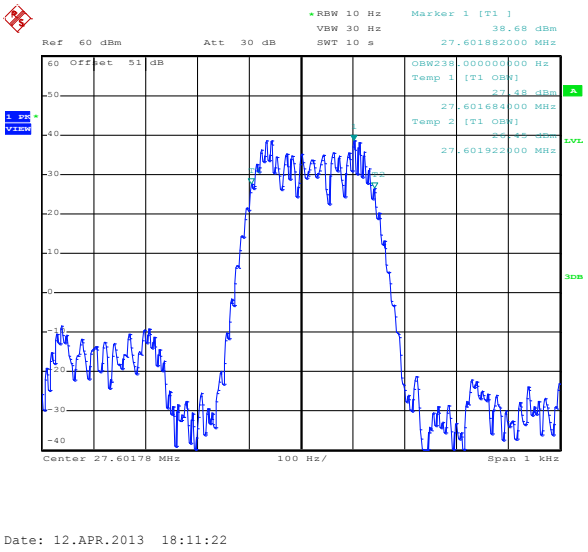

Figure 8.4-1: 99 % bandwidth AFSK Example

Frequency and modulation (MHz)	99 % bandwidth (Hz)
1.71 (AFSK)	238
14.4 (AFSK)	238
27.6 (AFSK)	238

8.5 Spurious Emissions at Antenna Terminals

8.5.1 Definitions and limits

FCC 2.1051 Measurements required: Spurious emissions at antenna terminals.
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.
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in any 30 kHz band removed from the assigned frequency by more than 250% of the authorized bandwidth: at least 43 + 10*log(P_{pk}) or 70 dB. The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency) or 100 kHz below its lowest assignable frequency, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated or used without exceeding 23 GHz.

8.5.2 Test summary

Test date	April 10, 2013	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	21 °C	**Air pressure**	1003 mbar	**Relative humidity**	34 %

8.5.3 Observations/special notes and procedures

All Modulations and frequencies were investigates and the worst case results were presented.

8.5.4 Test data

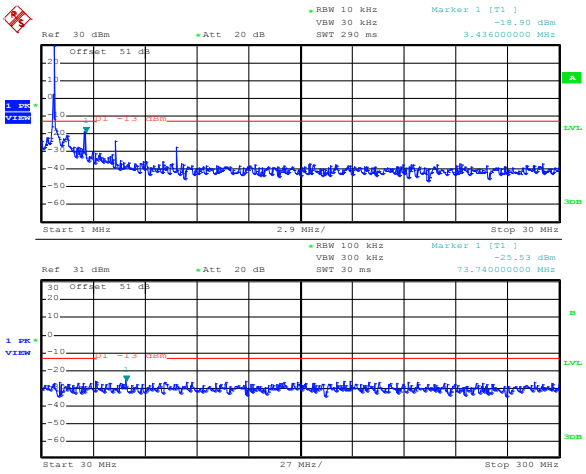

Figure 8.5-1: Antenna Spurious– Low channel

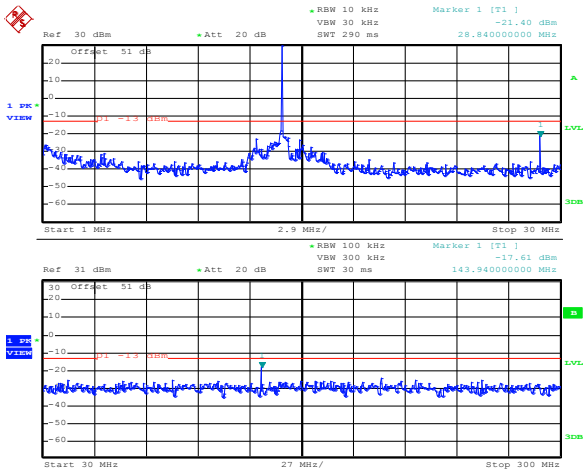

Figure 8.5-2: Antenna Spurious– Mid channel

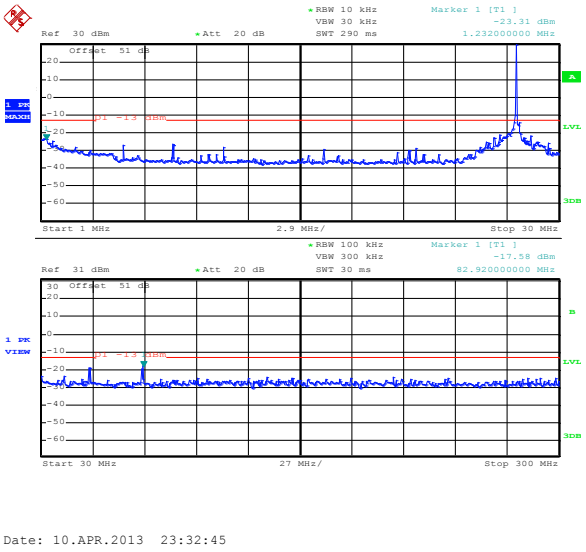

Figure 8.5-3: Antenna Spurious– High channel

8.6 Field strength of spurious radiation

8.6.1 Definitions and limits

FCC:
Measurements required: Field strength of spurious radiation.
(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
(2)All equipment operating on frequencies higher than 25 MHz.
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission.

IC
In any 30 kHz band removed from the assigned frequency by more than 250% of the authorized bandwidth: at least 43 + 10 × log(Ppk) or 70 dB. The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency) or 100 kHz below its lowest assignable frequency, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated or used without exceeding 23 GHz.

8.6.2 Definitions and limits, continued

8.6.3 Test summary

Test date	April 24, 2013	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1001 mbar	**Relative humidity**	35 %

8.6.4 Observations/special notes and procedures

100 kHz RBW and 300 kHz VBW was used during the scan.

8.6.4 Test data, continued

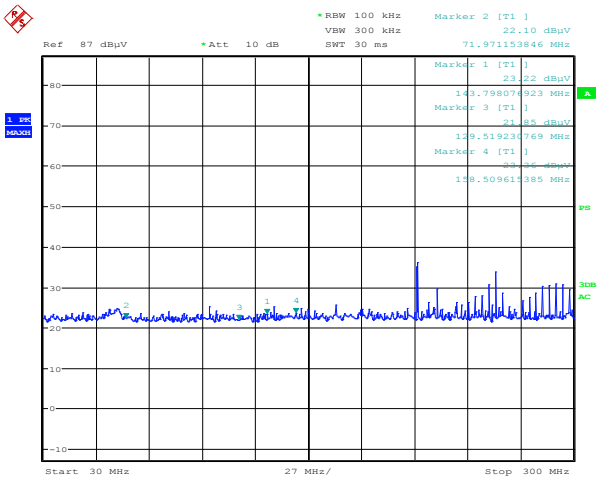

Figure 8.6-1: Radiated spurious emissions on low channel

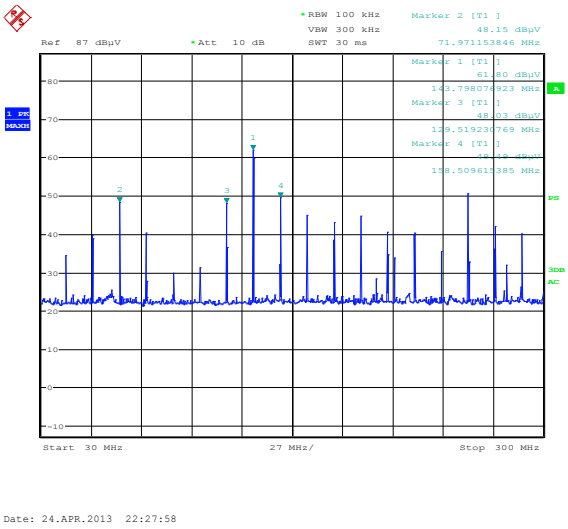

Figure 8.6-2: Radiated spurious emissions on mid channel

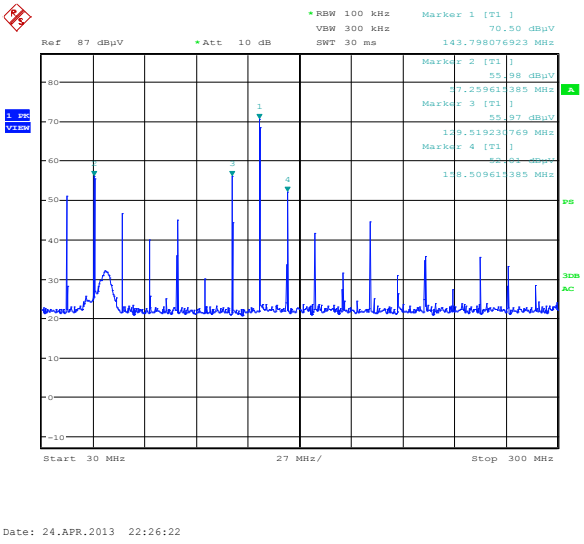

Figure 8.6-3: Radiated spurious emissions on high channel

Table 8.6-1: ERP of spurious emissions

Frequency (MHz)	Received signal (dBµV)	Substitution factor (dB)	ERP (dBm)	ERP limit (dBm)	Margin (dB)
82.78	53.40	-90.41	-37.01	-13.00	24.01
165.86	64.69	-87.42	-22.73	-13.00	9.73
138.17	61.48	-84.29	-22.81	-13.00	9.81
276.20	46.09	-85.31	-39.22	-13.00	26.22
143.80	70.50	-84.37	-13.87	-13.00	0.87
57.25	55.98	-89.69	-33.71	-13.00	20.71
129.50	55.97	-81.14	-25.17	-13.00	12.17
276.20	46.09	-85.31	-39.22	-13.00	26.22

8.7 FCC 90.213 and RSS-125 Clause 7 Transmitter frequency stability

8.7.1 Definitions and limits

FCC:
Unless noted elsewhere, transmitters used in the services governed by this part must have minimum frequency stability as specified in the following table.

IC:
The applicant shall ensure frequency stability by showing that the occupied bandwidth is maintained within the band of operation when tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

Table 8.7-1: Minimum frequency stability limits FCC 90.213

Frequency range, MHz	Mobile station over 2 W, ppm
Below 25	100
25–50	20

Note: For single sideband operations below 25 MHz, the carrier frequency must be maintained within 50 Hz of the authorized carrier frequency.

Table 8.7-2: Minimum frequency stability limits IC

Frequency, MHz	Frequency stability
1.705–4.0 (SSB only)	40 Hz
4.0–29.7 (SSB and DSB)	50 Hz[1] or40 ppm

Note: [1] For transmitters operating in the band 26.175–27.5 MHz with an output power not exceeding 15 W, the permissible stability is ± 40 ppm.

8.7.2 Test summary

Test date	April 10, 2013	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1003 mbar	**Relative humidity**	35 %

8.7.3 Observations/special notes

RSS-Gen was used as test guidance.

8.7.4 Test data

Table 8.7-3: Frequency stability at 1.71 MHz results

Temperature, °C	Voltage	Nominal frequency, MHz	Frequency measured, MHz	Offset, Hz	Limit IC, Hz	Limit FCC, Hz
60	Nominal	1.710000	1.7100004	0.4	40	50
50	Nominal	1.710000	1.7100004	0.4	40	50
40	Nominal	1.710000	1.7100004	0.4	40	50
30	Nominal	1.710000	1.7100004	0.4	40	50
20	Nominal +15 %	1.710000	1.7100000	0	40	50
20	Nominal	1.710000	1.7100000		Reference	
20	Nominal −15 %	1.710000	1.7100000	0	40	50
10	Nominal	1.710000	1.7100000	0	40	50
0	Nominal	1.710000	1.7100000	0	40	50
−10	Nominal	1.710000	1.7100004	0.4	40	50
−20	Nominal	1.710000	1.7100004	0.4	40	50
−30	Nominal	1.710000	1.7100004	0.4	40	50

Table 8.7-4: Frequency stability at 14.4 MHz results

Temperature, °C	Voltage	Nominal frequency, MHz	Frequency measured, MHz	Offset, Hz	Limit IC, Hz	Limit FCC, Hz
60	Nominal	14.400000	14.4000008	0.8	50	50
50	Nominal	14.400000	14.4000020	2.0	50	50
40	Nominal	14.400000	14.4000012	1.2	50	50
30	Nominal	14.400000	14.4000004	0.4	50	50
20	Nominal +15 %	14.400000	14.4000000	0	50	50
20	Nominal	14.400000	14.4000000		Reference	
20	Nominal −15 %	14.400000	14.4000000	0	50	50
10	Nominal	14.400000	14.4000000	0	50	50
0	Nominal	14.400000	14.4000000	0	50	50
−10	Nominal	14.400000	14.4000012	1.2	50	50
−20	Nominal	14.400000	14.4000028	2.8	50	50
−30	Nominal	14.400000	14.4000028	2.8	50	50

Table 8.7-5: Frequency stability at 27.6 MHz results

Temperature, °C	Voltage	Nominal frequency, MHz	Frequency measured, MHz	Offset, Hz	Limit IC, Hz	Limit FCC*, Hz
60	Nominal	27.6000004	27.6000012	1.2	50	566
50	Nominal	27.6000004	27.6000004	0.4	50	566
40	Nominal	27.6000004	27.6000020	2.0	50	566
30	Nominal	27.6000004	27.6000008	0.8	50	566
20	Nominal +15 %	27.6000004	27.6000004	0	50	566
20	Nominal	27.6000004	27.6000004		Reference	
20	Nominal −15 %	27.6000004	27.6000004	0	50	566
10	Nominal	27.6000004	27.6000002	-0.2	50	566
0	Nominal	27.6000004	27.6000003	-0.1	50	566
−10	Nominal	27.6000004	27.6000016	1.6	50	566
−20	Nominal	27.6000004	27.6000056	5.6	50	566
−30	Nominal	27.6000004	27.6000052	5.2	50	566

Note: * - The limit was calculated using 20 ppm of 27.6 MHz

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up