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TEST REPORT

Simoco SDP660 UW UHF Portable Transceiver

tested to the

Code of Federal Regulations (CFR) 47

Part 90 –Private Land Mobile Services

for

Simoco Australasia Pty Ltd



All tests reported
herein have been
performed in accordance
with the laboratory's
scope of accreditation

This Test Report is issued with the authority of:

A handwritten signature in black ink, appearing to read "Andrew Cutler".

Andrew Cutler- General Manager

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1. COMPLIANCE STATEMENT

The **Simoco SDP660 UW UHF Portable Transceiver** complies with the limits defined in 47 CFR Part 90 and 47 CFR Part 2 when tested in-accordance with the test methods described in 47 CFR Part 2 and ANSI/ TIA-603-C.

2. RESULT SUMMARY

The results of testing, carried out between 21st and 30th April 2015, are summarised below.

Clause	Description	Result
90.203	Certification required	Noted
2.1046 90.205	RF power output Power and antenna height limits	Noted Complies
2.1047 2.1047(a) 2.1047(b)	Modulation Characteristics Low pass filter response Modulation limiting characteristics	Noted Noted Noted
2.1049 2.202	Occupied bandwidth Bandwidths	Noted Noted
90.207 90.209 90.210	Types of emissions Bandwidth limitations Emission masks	Complies Complies Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Complies
2.1055	Frequency stability	Noted
90.213	Frequency stability	Complies
90.214	Transient frequency behaviour	Complies
1.1310	Radio frequency exposure limits	Not applicable. SAR testing carried out separately.

3. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

This report does not contain corrections or erasures.

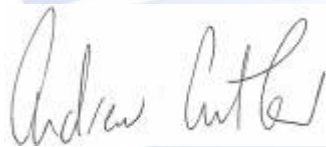
Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

4. CLIENT INFORMATION

Company Name	Simoco Australasia Pty Ltd
Address	1270 Ferntree Gully Road Scoresby
State	Victoria, 3179
Country	Australia
Contact	Mr Robert Stowell

5. TEST SAMPLE DESCRIPTION

Brand Name	Simoco
Model Number	SDP660 UW
Product	UHF Portable Transceiver
Manufacturer	Simoco
Manufactured in	Taiwan
Designed in	Australia
Serial Number	36NUW15140134
FCC ID	STZSDP600UW

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The sample tested has the following specifications:

Rated Transmitter Output Power

5.0 Watts (37.0 dBm)

Transmitter FCC Frequency Bands

Part 90: 421 - 512 MHz

Test frequencies

Frequency (MHz)	Power (Watts)	Spacing (kHz)
440.175	5.0	12.5
476.175	5.0	12.5
511.975	5.0	12.5

Emission Designators / Modes of operation

11k2F3E – Analogue speech

7k60FXE – DMR 4FSK 9600 bps TDMA digital speech and data

7k60FXD – DMR 4FSK 9600 bps TDMA digital data

Power Supply

DC voltage supply typically 7.4 Vdc

Standard Temperature and Humidity

Temperature: +15°C to + 30°C maintained.

Relative Humidity: 20% to 75% observed.

Standard Test Power Source

Standard Test Voltage: 7.4 Vdc

Extreme Temperature

High Temperature: + 50°C maintained.

Low Temperature: - 30 °C maintained.

Extreme Test Voltages

Low Voltage: 6.3 Vdc

This portable radio is powered by at a Lithium Ion battery pack which never exceeds 7.4 Vdc when it is re-charged.

Therefore testing was not carried out at 115% as this voltage will never be present.

Testing was carried out at 85% and 100% as indicated above.

6. TEST RESULTS

Certification required

Certification of this device is sought for digital and analogue speech transmissions in accordance with section 90.203(j)(4)(ii) and 90.203(j)(5)

- certification has been sought after January 1, 2015.
- the equipment operates under FCC Part 90
- the equipment is designed to operate in various FCC Part 90 bands between 421 - 512 MHz
- the equipment can operate in single bandwidth mode using analogue or digital modulation
- the equipment can operate in multi-bandwidth mode using analogue and digital modulation
- the equipment meets the spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth by using two voice channels per 12.5 kHz bandwidth.
- the equipment can operate with a data rate greater than 4.8 kbps per 6.25 kHz of channel bandwidth

The equipment operates using two-slot TDMA technology utilising 4FSK digital modulation operating at 9600 bps on 12.5 kHz channel spacing with a time slot durations of 30 ms.

Result: Complies.

RF power output

Measurements were carried out at the RF output terminals of the transmitter using a 30 dB power attenuator and a 50 Ω dummy load.

Measurements were carried out when the transmitter was modulated using analogue and digital and speech modulation and with an unmodulated carrier.

The highest levels observed were those with an unmodulated carrier which is recorded below.

Testing was carried out at maximum power output.

Frequency (MHz)	Voltage (Vdc)	Rated (dBm)	Measured (dBm)
440.175	7.4	37.0	37.1
476.175	7.4	37.0	36.9
476.175	6.8	37.0	36.7
511.975	7.4	37.0	36.9

Limits:

Part 90 does not specify the transmitter output power.

Result: Complies.

Measurement Uncertainty: ± 0.5 dB

Modulation Characteristics

This transmitter is capable of producing analogue speech and digital speech modulations.

Frequency response of the audio frequency low pass filter between 100 Hz and 15 kHz.

This measurement was carried out using an audio signal generator and an audio modulation analyser.

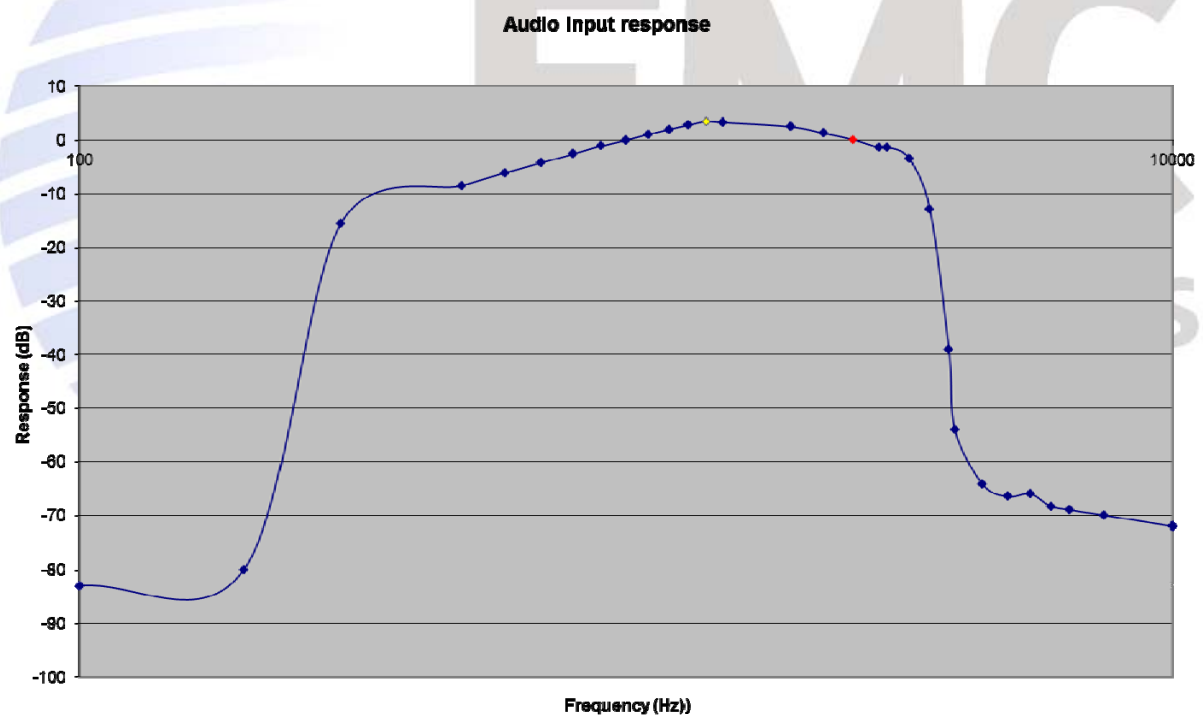
At 1 kHz an audio signal was applied which was used as a 0 dB response reference.

The frequency of the input signal was then varied and the output response noted.

This measurement was carried out from 100 Hz to 5000 Hz as required by Part 2 with further measurements carried out in order to show the full range of this filter.

The peak deviation response was found to be at 1400 Hz.

The -3dB roll off from peak deviation occurs at 2600 Hz, and is denoted as a red data series point on the following graph.

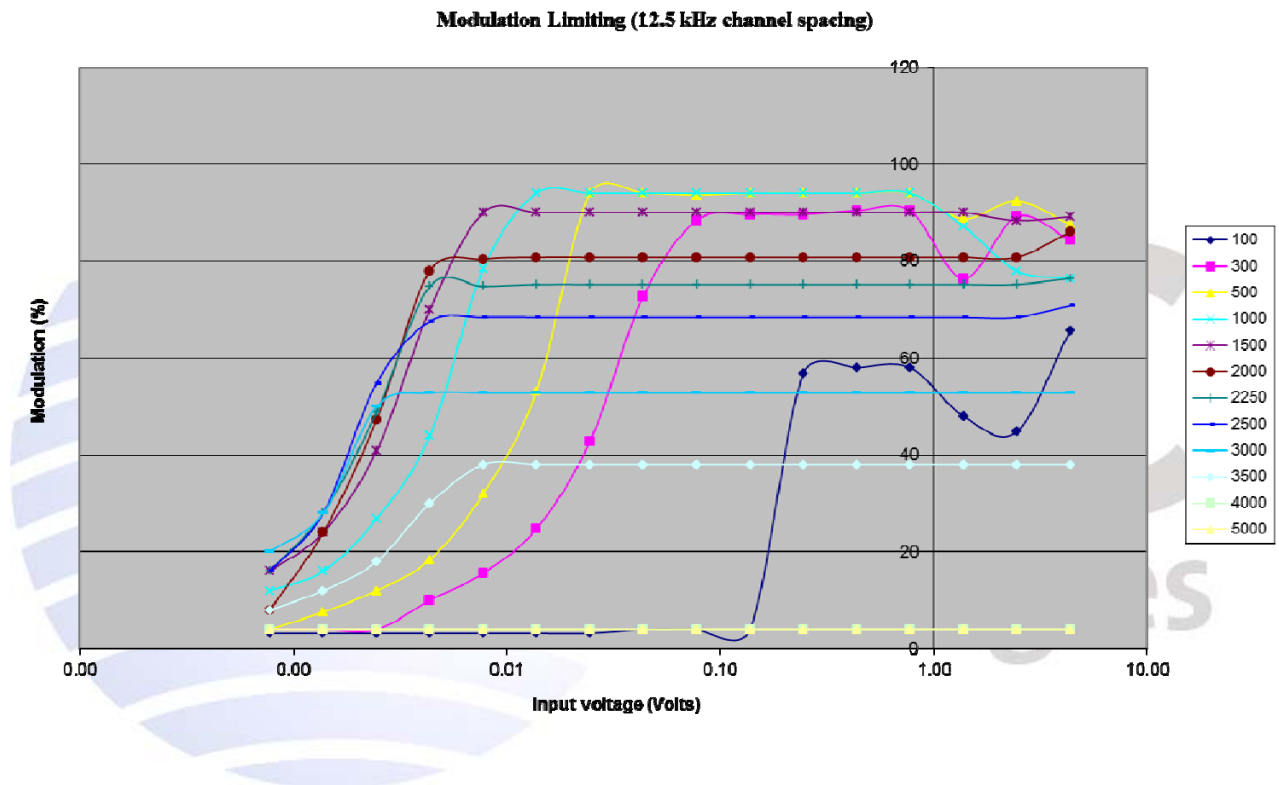


- (a) A family of curves showing the percentage of modulation versus the modulation input voltage.

Measurements were made between 100 Hz to 5 kHz.

At each frequency the input voltage was slowly increased with the resulting frequency deviation of the transmitter being recorded.

This deviation was then converted to a modulation percentage where 2.5 kHz deviation is 100% for 12.5 kHz channels.



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

The following other modulation types are used with this transmitter.

- 4FSK 9600 bps TDMA digital speech and data.

Result: Complies.

Measurement Uncertainty: $\pm 1\%$.

Part 90.209 – Bandwidth limitations:

The authorised bandwidth is taken to be the necessary bandwidth.

Using the formulas contained in Part 2.202 the necessary bandwidth calculation for the 12.5 kHz channel step emission is:

$$B_n = 2 \times D + 2 \times M$$

Where D = maximum deviation: 2.5 kHz

Where M = maximum modulation frequency: 3 kHz

$$B_n = \underline{11 \text{ kHz}}$$

Measurements show the following

$$B_n = 2 \times 2350 \text{ Hz} + 2 \times 2600 \text{ Hz}$$

$$B_n = \underline{9.9 \text{ kHz}}$$

This is confirmed in the emission designation 11k2F3E

For Digital Modulation 4FSK an emission designator of 7k60FXE has been declared by the client.

Measurements have also been made to verify this declared bandwidth.

The occupied bandwidth has been measured and compared against the occupied bandwidth declared by the client.

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

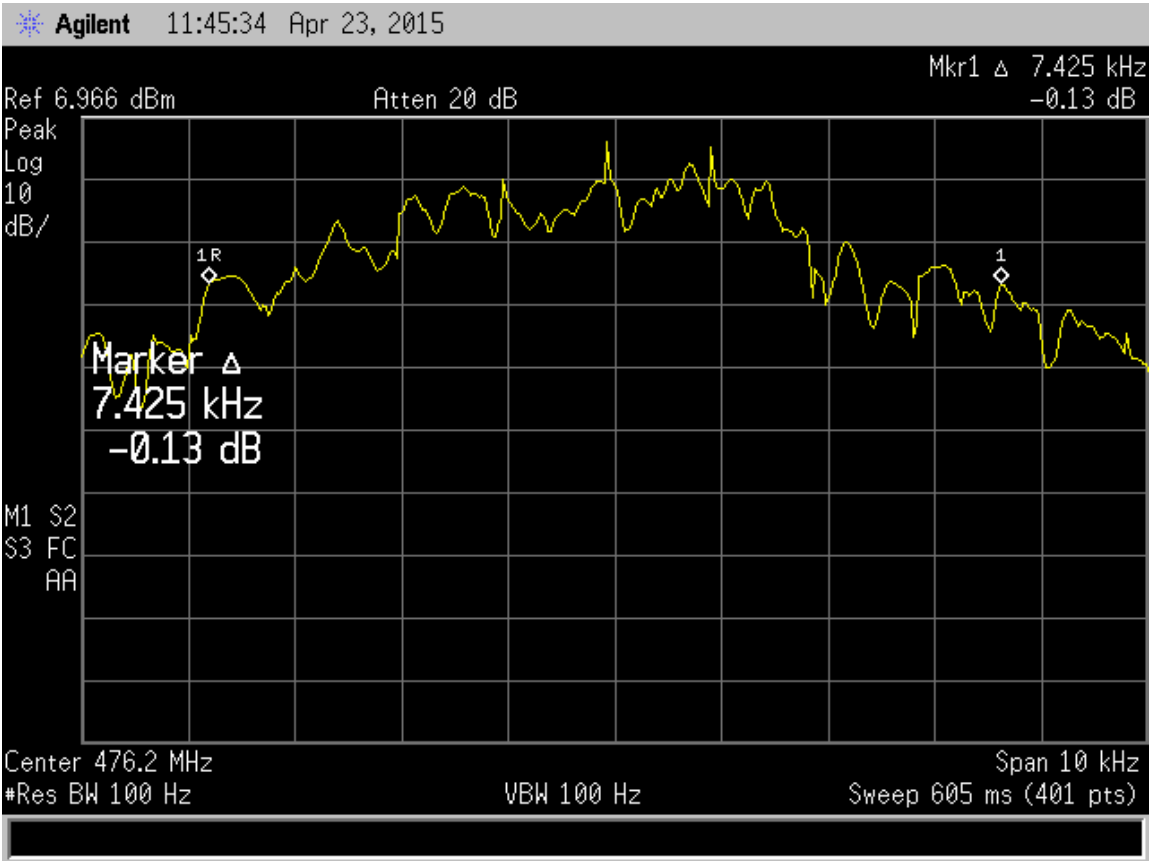
Initially power measurements are made using a resolution bandwidth of 120 kHz.

This level is used as a reference level on the spectrum analyser.

The resolution bandwidth is then changed to 100 Hz and the reference level minus 23 dB (99%) absolute bandwidth points determined

Result: Complies.

Emission	Channel	Measured	Designated
FXE / FXD	12.5 kHz	7.425 kHz	7.600 kHz



Spectrum Masks

The spectrum masks are defined in:

Section 90.210(d) – Mask D has been applied as the transmitter can operate in the band 421 - 512 MHz using an authorised bandwidth of 12.5 kHz as per Section 90.209(b)(5).

The reference level for the following emission mask measurements has been determined using a resolution bandwidth of 120 kHz with the transmitter modulated.

All measurements have been made with a 30 dB attenuator is placed between the transmitter and the spectrum analyser.

The reference level on all of the plots below will therefore be +30 dB higher than indicated.

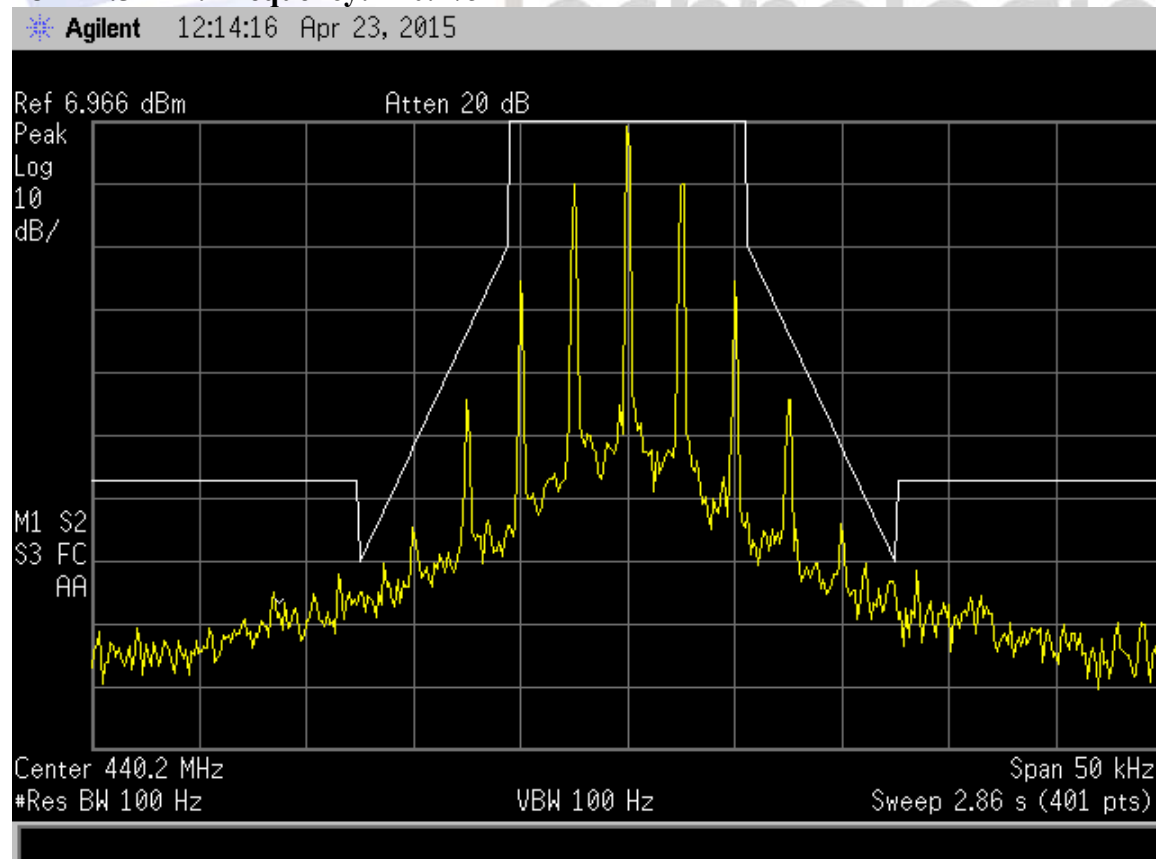
Measurements were made in peak hold with the transmitter operating on 476.175 MHz.

When operating in F3E mode a 2500 Hz tone, which was found to be the frequency of maximum response, that was applied at a level 16 dB higher than that required to achieve 50% modulation.

For the FXE / FXD mode the transmitter was modulated using the modulation source internal to the transmitter which operates at a fixed data rate of 9600 bps.

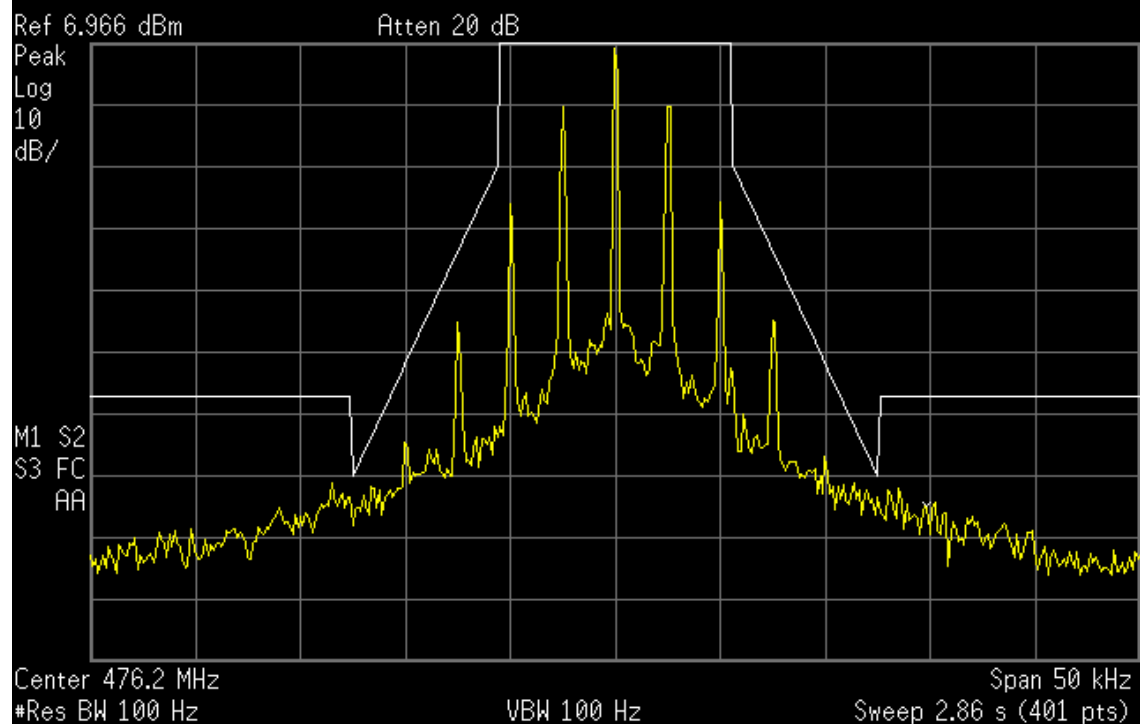
Result: Complies.

F3E 12.5 kHz. Frequency: 440.175 MHz



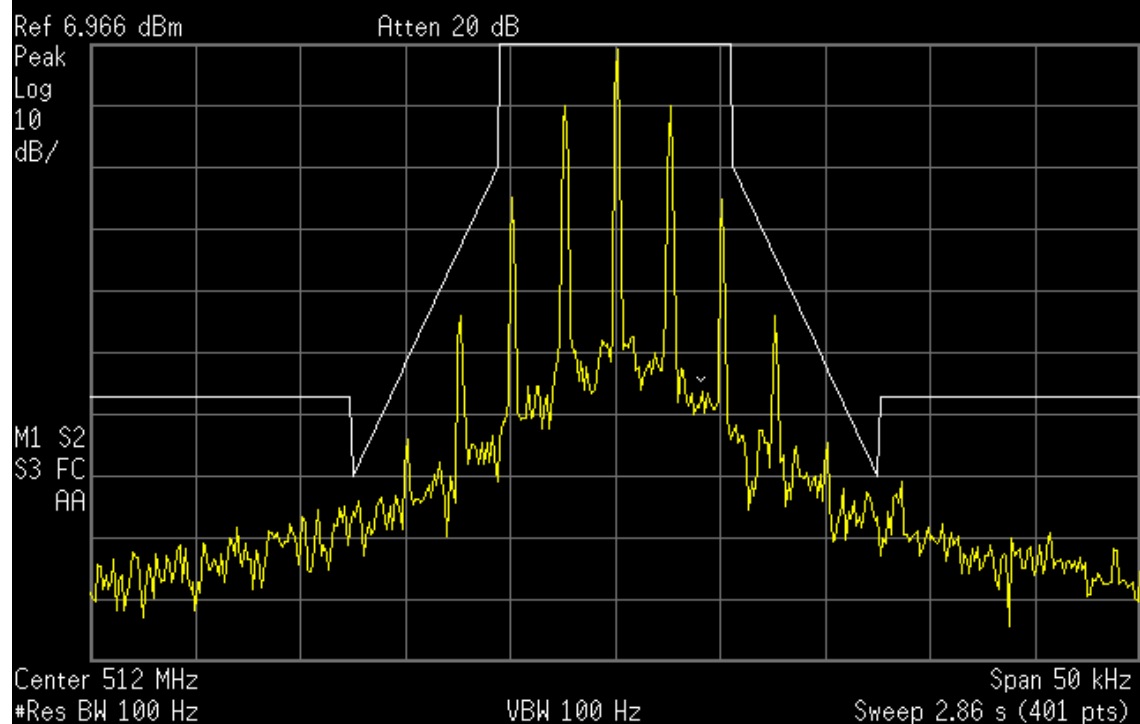
Frequency: 476.175 MHz

Agilent 11:58:19 Apr 23, 2015



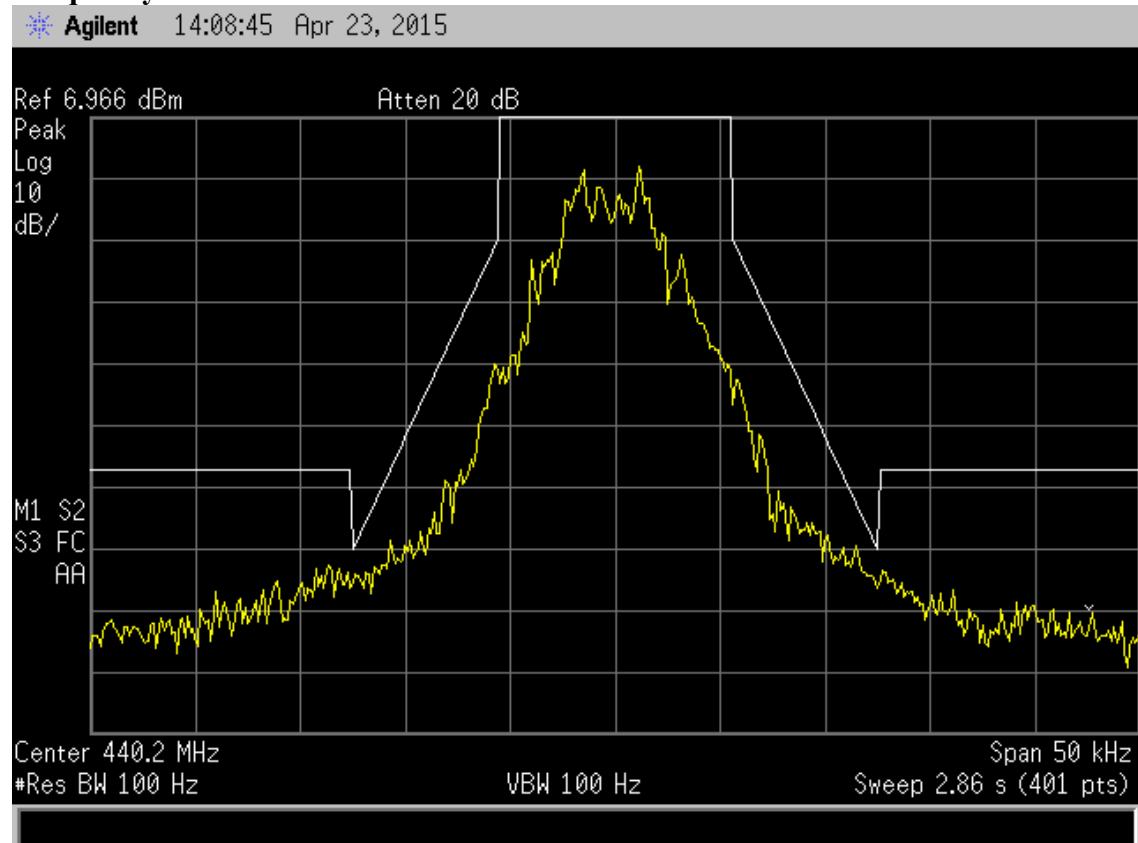
Frequency: 511.975 MHz

Agilent 14:00:04 Apr 23, 2015

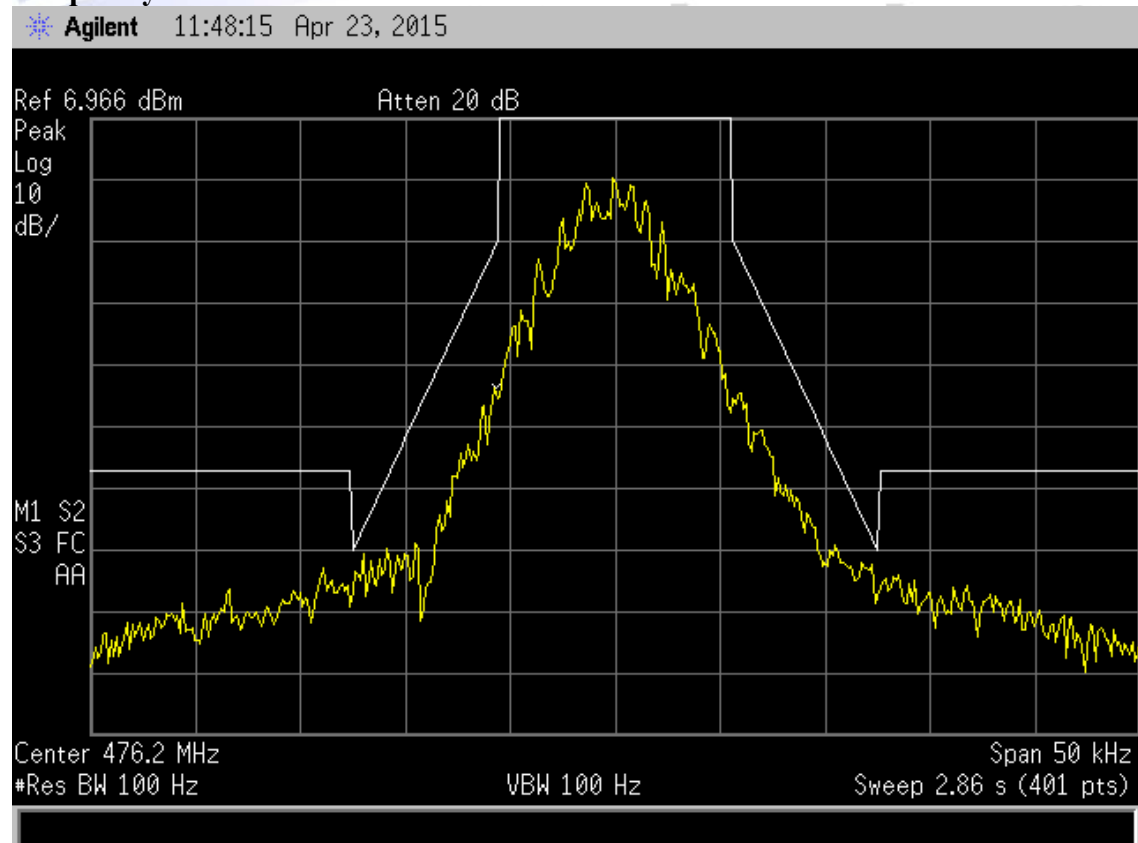


FXE / FXD 12.5 kHz at 9600 bps

Frequency: 440.175 MHz

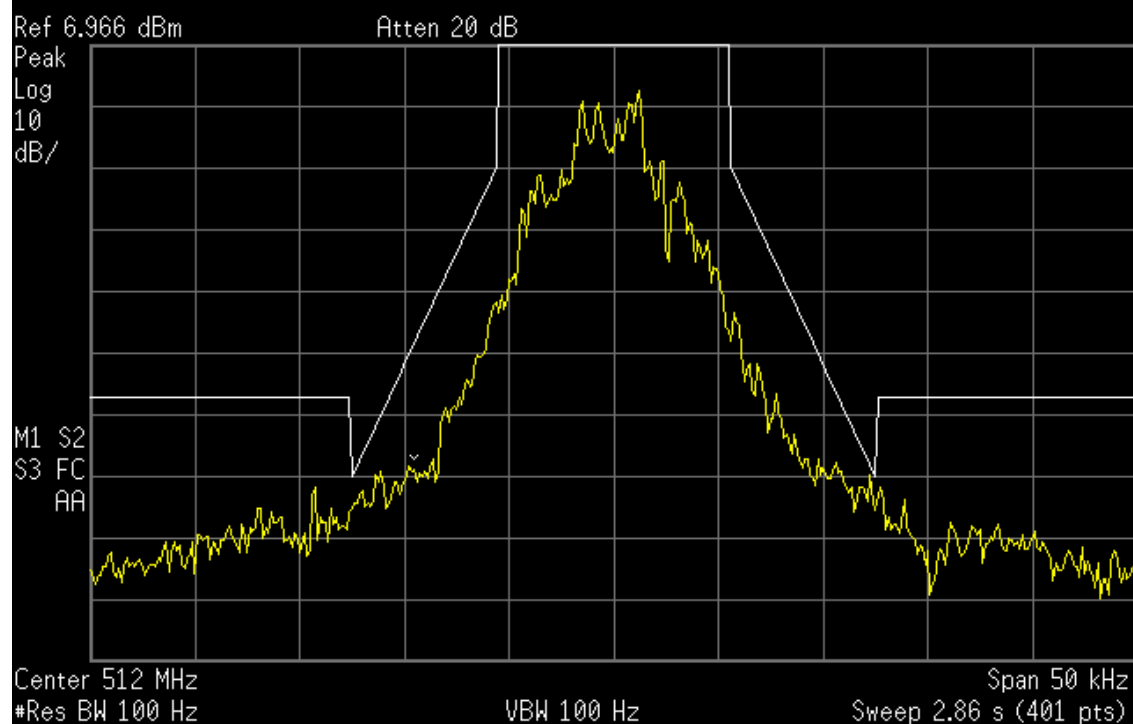


Frequency: 476.175 MHz



Frequency: 511.975 MHz

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Transmitter spurious emissions at the antenna terminals

Frequency: 476.175 MHz

Spurious emission (MHz)	Emission level (dBm)	Limit (dBm)
952.350	-39.0	-20.0
1428.525	<-65.0	-20.0
1904.700	<-65.0	-20.0
2380.875	<-65.0	-20.0
2857.050	<-65.0	-20.0
3333.225	<-65.0	-20.0
3809.400	<-65.0	-20.0
4285.575	<-65.0	-20.0
4761.750	<-65.0	-20.0

Measurements were carried out when the transmitter modulated using analogue and digital and speech modulation and with an unmodulated carrier.

The highest levels observed were those with an unmodulated carrier which is recorded below.

No other emissions were observed

Limit:

Part 90.210(d) Mask D, (3) on any frequency removed from the centre of the authorised bandwidth by a displacement frequency of more than 12.5 kHz shall be attenuated by at least $50 + 10 \log (P)$ or 70 dB whichever is the lesser attenuation.

The spurious emission limit defined by Mask D has been applied as this transmitter can operate using channel spacing of 12.5 kHz.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified.

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

A rated power of 5.0 watts gives a limit of -20.0 dBm.

No measurements were made above the 10th harmonic.

Result: Complies.

Measurement Uncertainty: ± 3.3 dB

Field strength of the transmitter spurious emissions

Frequency: 440.175 MHz

Frequency (MHz)	Level (dBμV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
880.350	42.6	-54.8	-20.0	Vertical	34.8	Pass
	40.9	-56.5	-20.0	Horizontal	36.5	Pass
1320.525	48.0	-49.4	-20.0	Vertical	29.4	Pass
	49.4	-48.0	-20.0	Horizontal	28.0	Pass
1760.700	52.1	-45.3	-20.0	Vertical	25.3	Pass
	52.5	-44.9	-20.0	Horizontal	24.9	Pass
2200.875	54.0	-43.4	-20.0	Vertical	23.4	Pass
	55.0	-42.4	-20.0	Horizontal	22.4	Pass
2641.050	58.0	-39.4	-20.0	Vertical	19.4	Pass
	58.0	-39.4	-20.0	Horizontal	19.4	Pass
3081.225	54.8	-42.6	-20.0	Vertical	22.6	Pass
	53.5	-43.9	-20.0	Horizontal	23.9	Pass
3521.400	56.8	-40.6	-20.0	Vertical	20.6	Pass
	56.8	-40.6	-20.0	Horizontal	20.6	Pass
3961.575	58.0	-39.4	-20.0	Vertical	19.4	Pass
	58.0	-39.4	-20.0	Horizontal	19.4	Pass
4401.750	62.0	-35.4	-20.0	Vertical	15.4	Pass
	60.0	-37.4	-20.0	Horizontal	17.4	Pass

Frequency: 476.175 MHz

Frequency (MHz)	Level (dBμV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
952.350	45.5	-51.9	-20.0	Vertical	31.9	Pass
	48.0	-49.4	-20.0	Horizontal	29.4	Pass
1428.525	48.3	-49.1	-20.0	Vertical	29.1	Pass
	48.0	-49.4	-20.0	Horizontal	29.4	Pass
1904.700	53.8	-43.6	-20.0	Vertical	23.6	Pass
	53.7	-43.7	-20.0	Horizontal	23.7	Pass
2380.875	56.8	-40.6	-20.0	Vertical	20.6	Pass
	56.8	-40.6	-20.0	Horizontal	20.6	Pass
2857.0500	54.1	-43.3	-20.0	Vertical	23.3	Pass
	54.1	-43.3	-20.0	Horizontal	23.3	Pass
3333.225	54.3	-43.1	-20.0	Vertical	23.1	Pass
	54.0	-43.4	-20.0	Horizontal	23.4	Pass
3809.400	57.1	-40.3	-20.0	Vertical	20.3	Pass
	57.2	-40.2	-20.0	Horizontal	20.2	Pass
4285.575	58.8	-38.6	-20.0	Vertical	18.6	Pass
	58.7	-38.7	-20.0	Horizontal	18.7	Pass
4761.750	60.5	-36.9	-20.0	Vertical	16.9	Pass
	60.5	-36.9	-20.0	Horizontal	16.9	Pass

Frequency: 511.975 MHz

Frequency (MHz)	Level (dBμV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
1023.950	45.6	-51.8	-20.0	Vertical	31.8	Pass
	47.8	-49.6	-20.0	Horizontal	29.6	Pass
1535.925	49.5	-47.9	-20.0	Vertical	27.9	Pass
	49.1	-48.3	-20.0	Horizontal	28.3	Pass
2047.900	55.0	-42.4	-20.0	Vertical	22.4	Pass
	55.2	-42.2	-20.0	Horizontal	22.2	Pass
2559.875	58.7	-38.7	-20.0	Vertical	18.7	Pass
	58.1	-39.3	-20.0	Horizontal	19.3	Pass
3071.8500	55.0	-42.4	-20.0	Vertical	22.4	Pass
	54.0	-43.4	-20.0	Horizontal	23.4	Pass
3583.825	60.1	-37.3	-20.0	Vertical	17.3	Pass
	57.5	-39.9	-20.0	Horizontal	19.9	Pass
4095.800	58.5	-38.9	-20.0	Vertical	18.9	Pass
	58.5	-38.9	-20.0	Horizontal	18.9	Pass
4607.775	60.1	-37.3	-20.0	Vertical	17.3	Pass
	60.1	-37.3	-20.0	Horizontal	17.3	Pass
5119.750	61.0	-36.4	-20.0	Vertical	16.4	Pass
	61.0	-36.4	-20.0	Horizontal	16.4	Pass

The transmitter was tested while transmitting continuously while attached to a dummy load.

Measurements were carried out when the transmitter modulated using analogue and digital and speech modulation and with an unmodulated carrier.

The highest levels observed were those with an unmodulated carrier which is recorded below.

When operating in transmit mode no significant emissions were detected between the harmonic emissions that were detected.

Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland.

The level recorded is the signal generator output level in dBm less any gains / losses due to the coax cable and the dipole antenna.

Limit:

All spurious emissions are to be attenuated by at least $50 + 10 \log (P)$. The rated power of 5 watts gives a limit of -20 dBm.

No measurements were made above the 10th harmonic.

Result: Complies.

Measurement Uncertainty: ± 4.1 dB

Frequency Stability

Frequency stability measurements were between - 30 °C and + 50°C in 10°C increments.

At each temperature the transmitter was given a period of 30 minutes to stabilise.

The transmitter was then turned on and the frequency error measured after a period of 1 minute.

This portable radio is powered by at a Lithium Ion battery pack which never exceeds 7.4 Vdc when it is re-charged.

Therefore testing was not carried out at 115% as this voltage will never be present.

Testing was also carried out at 85% and 100% as indicated below.

Frequency: 476.175 MHz

Temperature (°C)	Voltage 6.3 Vdc	Voltage 7.4 Vdc
+50	+24.0	+17.0
+40	+55.0	+59.0
+30	+29.0	+67.0
+20	+83.0	+92.0
+10	+26.0	+7.0
0	-18.0	-21.0
-10	-82.0	-87.0
-20	+41.0	+36.0
-30	+32.0	+41.0

A worst case frequency stability of +92.0 Hz or 0.18 ppm was observed.

Limit:

Part 90.213 states that mobile station transmitters operating between 421 – 512 MHz with 12.5 kHz channelling are required to have a frequency tolerance of 2.5 ppm.

Result: Complies.

Measurement Uncertainty: ± 30 Hz

Transient frequency behaviour

Transient frequency behaviour measurements are applicable to wide band and narrow band transmitters operating in the frequency band 421 - 512 MHz.

Measurements were carried out using the method described in TIA-603 and EN 300-086.

In summary this method calls for the use of an external signal generator tuned to transmitter transmit frequency of 476.175 MHz with an output level 0.1 % (-30 dB) of the level from the transmitter with a 1 kHz tone with a frequency deviation of 12.5 kHz being applied to the input of a modulation analyser along with the output from the transmitter.

The modulation analyser produces an amplitude difference signal and a frequency difference signal, which are applied to the input of a storage oscilloscope.

The unmodulated transmitter is then keyed which produces a trigger pulse that is AC coupled to the oscilloscope that produces a display on the screen.

The result of the change in the ratio of power between the test signal from the signal generator and the transmitter output will produce 2 separate sides on the oscilloscope picture. One will show the 1000 Hz test modulation and the other will be the frequency difference of the transmitter versus time.

Channel Spacing (kHz)	Period t_1 (kHz)	Period t_2 (kHz)	Period t_3 (kHz)
12.5	Nil	Nil	Nil

Limits:

Time Interval	Period (mS)	12.5 kHz Deviation (kHz)	25 kHz Deviation (kHz)
t_1	10	± 12.5	± 25.0
t_2	25	± 6.25	± 12.5
t_3	10	± 12.5	± 25.0

Result: Complies.

Measurement Uncertainty: Frequency difference ± 1.6 kHz, Time period ± 1 ms.

12.5 kHz transmitter turn on

Green Trace = 1 kHz tone with FM deviation of 12.5 kHz and any transient.

Green trace has been maximised to give full screen indication of a ± 12.5 kHz.

Therefore each Y axis division = 3.125 kHz per division.

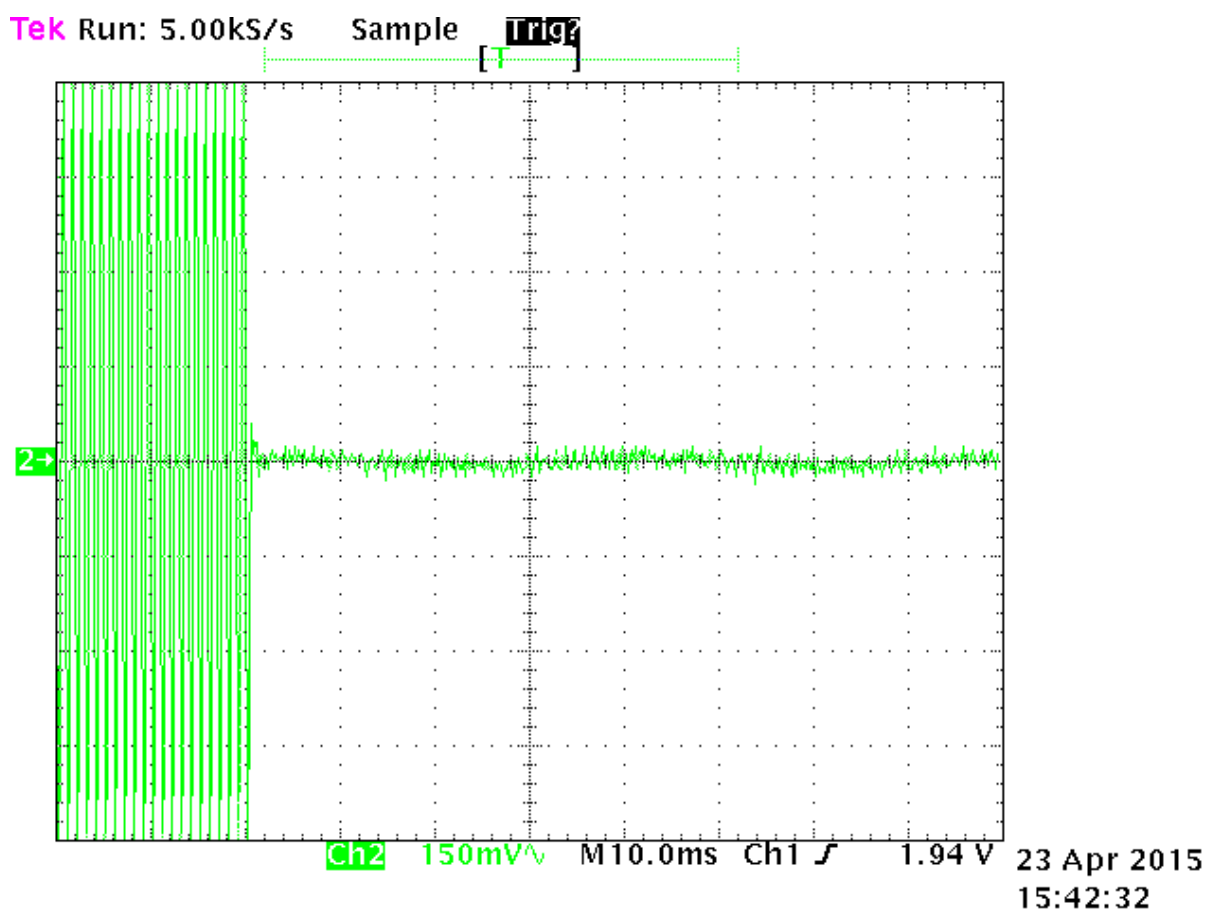
The X axis has been set to a sweep rate of 10 ms/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 ms). This is position t_{on} .

t_1 occurs between 2.0 and 3.0 divisions from the left-hand edge.

t_2 occurs between 3.0 and 5.5 divisions from the left-hand edge.

No transient can be observed just after t_{on} .



12.5 kHz transmitter turn off

Green Trace = 1 kHz tone with FM deviation of 12.5 kHz and any transient.

Green trace has been maximised to give full screen indication of a ± 12.5 kHz.

Therefore each Y axis division = 3.125 kHz per division.

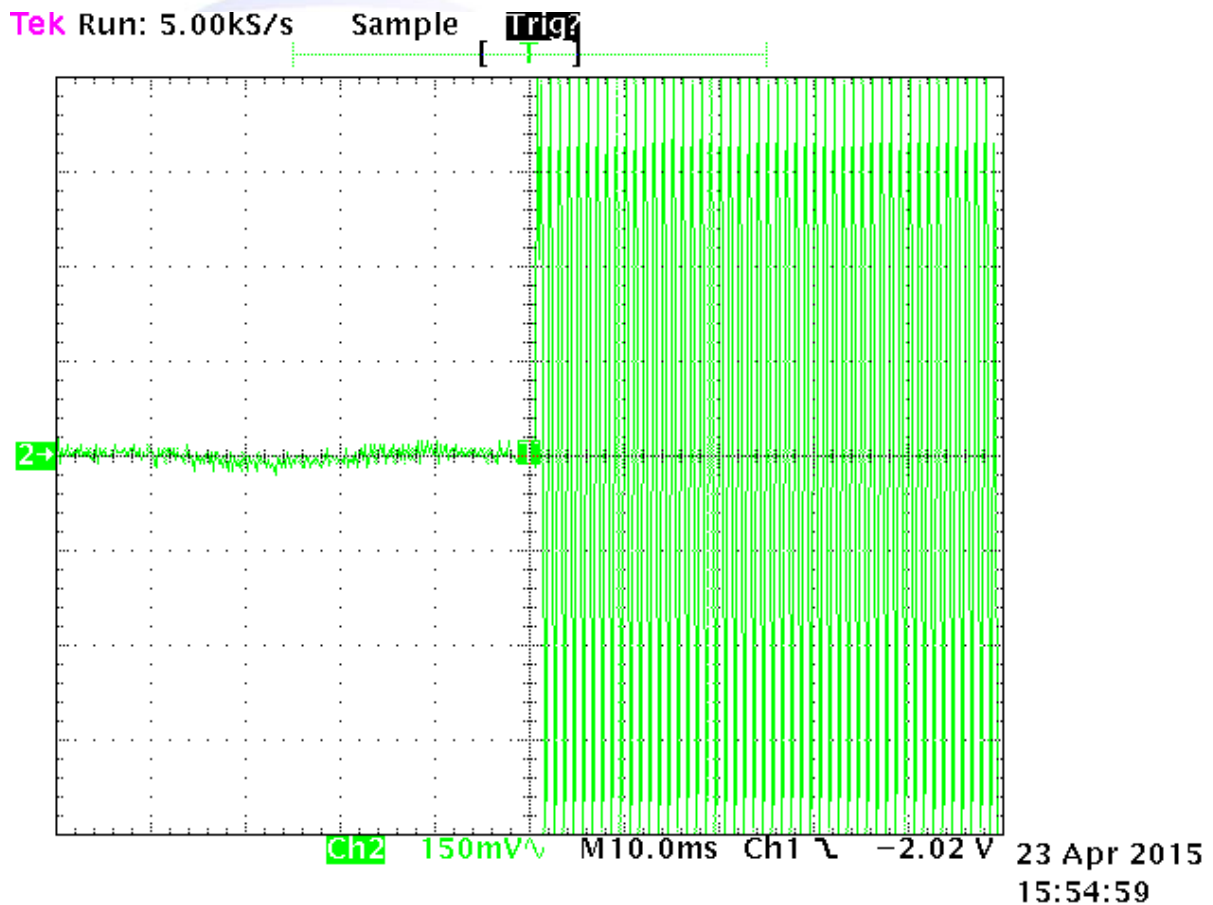
The X axis has been set to a sweep rate of 10 ms/division.

The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 ms).

This is position toff.

t_3 occurs between 4.0 and 5.0 divisions from the left hand edge.

No transient response can be observed just before toff.



7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset	Cal Due	Interval
Aerial Controller	EMCO	1090	9112-1062	3710	N/a	N/a
Aerial Mast	EMCO	1070-1	9203-1661	3708	N/a	N/a
Biconical Antenna	Schwarzbeck	BBA 9106	-	3612	03/02/2018	3 years
Horn Antenna	EMCO	3115	9511-4629	E1526	04/06/2017	3 years
Level generator	Anritsu	MG443B	M61689	E1143	21/05/2016	2 years
Log Periodic Antenna	Schwarzbeck	VUSLP 91111	9111-228	3785	17/12/2017	3 years
Modulation Analyzer	Rohde & Schwarz	FMA	837807/020	E1552	15/06/2015	2 years
Modulation Analyzer	Hewlett Packard	8901B	2608A00782	E1090	15/10/2016	2 years
Oscilloscope	Tektronics	745A	B010643	E1569	15/06/2015	2 years
Power Attenuator	JFW	50FH-030-100	-	-	N/a	N/a
Power Supply	Hewlett Packard	6032A	2743A-02859	E1069	N/a	N/a
Receiver	Rohde & Schwarz	ESIB-40	100171	4003	16/04/2016	1 year
Selective Level Meter	Anritsu	ML422C	M35386	E1140	03/07/2015	2 years
Signal Generator	Rohde & Schwarz	SMHU	838923/028	E1493	22/06/2015	2 years
Spectrum Analyzer	Hewlett Packard	E7405A	US39150142	3776	26/06/2015	1 year
Thermal chamber	Contherm	M180F	86025	E1129	01/06/2015	N/a
Thermometer	DSIR	RT200	035	E1049	01/06/2015	N/a
Turntable	EMCO	1080-1-2.1	9109-1578	3709	N/a	N/a
VHF Balun	Schwarzbeck	VHA9103	-	3603	03/02/2018	3 years

At the time of testing all test equipment was within calibration.

8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies Ltd registration with the Federal Communications Commission as a listed facility, registration number: 90838, which was updated in June 2014.

All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

9. PHOTOGRAPHS

External Photos





