EMC Technologies (NZ) Ltd

Test Report No **090629.1**
Report date: 1st July 2009

TEST REPORT

MiMOMax MWL-RADIOUNIT-**D/H B
MiMO Digital Link Transceiver

tested to the

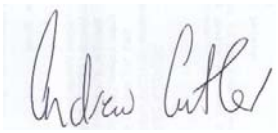
Code of Federal Regulations (CFR) 47

Part 90 –Private Land Mobile Services

Part 15 – Radio Frequency Devices

for

MiMOMax Wireless Ltd



This Test Report is issued with the authority of:

Andrew Cutler - General Manager

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

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1. STATEMENT OF COMPLIANCE

The **MiMOMax MWL-RADIOUNIT-**D/H B MiMO Digital Link Transceiver** complies with the limits defined in 47 CFR Part 90, 47 CFR Part 15 and 47 CFR Part 2 when tested in-accordance with the test methods described in 47 CFR Part 2 and ANSI C63.4, 2003.

2. RESULTS SUMMARY

The results from testing are summarised in the following table:

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) 90.211(a)	Modulation Characteristics Low pass filter response Modulation limiting characteristics Modulation characteristics	Noted Noted Noted Complies
2.1049 2.202 90.207 90.209 90.210	Occupied bandwidth Bandwidths Types of emissions Bandwidth limitations Emission masks	Noted Noted Complies Complies Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Complies
2.1055 90.213	Frequency stability Frequency stability	Noted Complies
90.214	Transient frequency behaviour	Complies
15.109 15.111	Radiated emissions Receiver local oscillator voltage	Complies Complies
1.1310	Radio frequency radiation exposure limits	Complies

3. INTRODUCTION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification.

- The test sample was selected by the client.
- This report relates only to the sample tested.
- This report contains no 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.

4. CLIENT INFORMATION

Company Name	MiMOMax Wireless Ltd
Address	PO Box 1645
City	Christchurch
Country	New Zealand
Contact	Mr Kok Heng Loh

5. DESCRIPTION OF TEST SAMPLE

Brand Name	MiMOMax
Model Number	MWL-RADIOUNIT-**D/H B
Product	MiMO Digital Link Transceiver
Manufacturer	MiMOMax Wireless Ltd
Country of Origin	New Zealand
Serial Number	23000190
FCC ID	XMK-MMXRUDHB002

6. TEST SAMPLE DESCRIPTION

The sample tested is a UHF fixed link digital transceiver using MiMo principles with the following specifications

Rated Transmitter Output Power

2 transmitters each generating 1.0 watts (+30.0 dBm) average or 5 watts (+37 dBm) peak.

Test frequency

Transmit: 463.9875 MHz Receive: 468.9875 MHz

Channel spacing

12.5 and 25 kHz

FCC Band of operation

421.000 – 470.000 MHz

Modulation Types

QPSK, 16QAM, 64QAM, 256QAM

Emission designations

10k0W1W
20k0W1W

Power Supply

Nominally 12.5 Vdc to 24.0 Vdc from an external DC supply.

External Controls

This device has no external controls.

7. TEST CONDITIONS

Standard Temperature and Humidity

Temperature range: +15°C to + 25°C
Relative humidity range: 40% to 70%

Extreme Temperature

High Temperature: +50°C maintained.
Low Temperature: -30° C maintained.

Tests were carried out at these extremes of temperature.

Standard and Extreme Power Supply

This device is powered nominally from 12.5 Vdc to 24.0 Vdc using an external dc power.

Testing at voltage extremes, where required, was therefore carried out at 85% and 115% of the highest nominal operating voltage of 24.0 Vdc which equates to 20.4 Vdc and 27.6 Vdc.

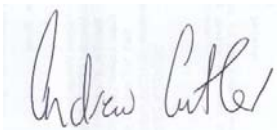
8. COMPLIANCE STATEMENT

The **MiMOMax MWL-RADIOUNIT-**D/H B MiMO Digital Link Transceiver** complies with the Code of Federal Regulations (CFR) 47 Part 90 – Private Land Mobile Services and Part 15 – Radio Frequency Devices.

This equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

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

9. TEST RESULTS

Certification required

Certification of this device is sought for transmissions using 12.5 and 25 kHz channel spacing.

12.5 and 25 kHz channel bandwidth certification is sought for this transmitter under section 90.203(j)(3) as:

- certification has been sought after February 14, 1997 and before January 1, 2011.

- the equipment meets the spectrum efficiency standard of 4800 bits per second per 6.25 kHz of channel bandwidth with a spectral efficency of 12.8 bits / Hz / second enabling a raw data rate of up to 320 kb/s

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 ohm dummy load.

Measurements were carried out when the transmitter was being modulated using an average detector and a peak detector.

Measurements were made with the input voltage set to 24.0 Vdc and when varied +/- 15%.

Channel 1

Frequency (MHz)	Channel Spacing	Voltage (Vdc)	Modulation Type	Peak dBm	Average (dBm)
463.9875	12.5	24.0	QPSK	37.0	30.0
	12.5	24.0	16QAM	37.0	30.0
	12.5	24.0	64QAM	37.0	30.0
	12.5	24.0	256QAM	37.0	30.0
463.9875	25.0	24.0	256QAM	37.0	30.0
	25.0	20.4	256QAM	37.0	30.0
	25.0	27.6	256QAM	37.0	30.0

Channel 2

Frequency (MHz)	Channel Spacing	Voltage (Vdc)	Modulation Type	Peak dBm	Average (dBm)
463.9875	12.5	24.0	QPSK	37.0	30.0
	12.5	24.0	16QAM	37.0	30.0
	12.5	24.0	64QAM	37.0	30.0
	12.5	24.0	256QAM	37.0	30.0
463.9875	25.0	24.0	256QAM	37.0	30.0
	25.0	20.4	256QAM	37.0	30.0
	25.0	27.6	256QAM	37.0	30.0

Limit
The power output is required to be within +/- 1 dB of the rated power output

The rated output is +30 dBm when measured with an average detector

Result: Complies
Measurement Uncertainty: ±0.5 dB

Modulation Characteristics

This transmitter is a MiMO Digital Linking Transceiver that is not capable of producing analogue speech modulations.

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

This measurement could not be carried out as the various digital modulations types are internally generated within the transmitter.

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

This measurement could not be carried out as the various digital modulations types are internally generated within the transmitter.

Emission types:

The following emission types have been declared by the customer as being used:

- W1W

This designator supports the following modulation types

- QPSK
- 16QAM
- 64 QAM
- 256QAM

Bandwidth limitations:

The customer has declared that the authorised bandwidth to be 10.0 kHz for operations in a 12.5 kHz channelling plan and 20 kHz for operations in a 25 kHz channelling plan when using the emission designator W1W.

Using the formulas contained in Part 2.202 and information supplied by the client the necessary bandwidth calculation for data transmission is:

The necessary bandwidth has been calculated in accordance with ITU-R Recommendation SM853-1 where

$B_n = 2 \times R \times K / \log2(S)$

Where R = bit rate:
Where K = is a factor relating to the modulation type and filter roll off:
Where S = modulation order:

For 25 kHz channel operations

256QAM	R = 160 kbps	log2(S) = 8	K = 0.5	$B_n = 2 \times 160 \times 0.5 / 8 =$ 20.0 kHz
64QAM	R = 120 kbps	log2(S) = 6	K = 0.5	$B_n = 2 \times 120 \times 0.5 / 6 =$ 20.0 kHz
16QAM	R = 80 kbps	log2(S) = 4	K = 0.5	$B_n = 2 \times 80 \times 0.5 / 4 =$ 20.0 kHz
QPSK	R = 40 kbps	log2(S) = 2	K = 0.5	$B_n = 2 \times 40 \times 0.5 / 2 =$ 20.0 kHz

For 12.5 kHz channel operations

256QAM	R = 80 kbps	log2(S) = 8	K = 0.5	$B_n = 2 \times 80 \times 0.5 / 8 =$ 10.0 kHz
64QAM	R = 60 kbps	log2(S) = 6	K = 0.5	$B_n = 2 \times 60 \times 0.5 / 6 =$ 10.0 kHz
16QAM	R = 40 kbps	log2(S) = 4	K = 0.5	$B_n = 2 \times 40 \times 0.5 / 4 =$ 10.0 kHz
QPSK	R = 20 kbps	log2(S) = 2	K = 0.5	$B_n = 2 \times 20 \times 0.5 / 2 =$ 10.0 kHz

Measurements have been made to confirm these calculations.

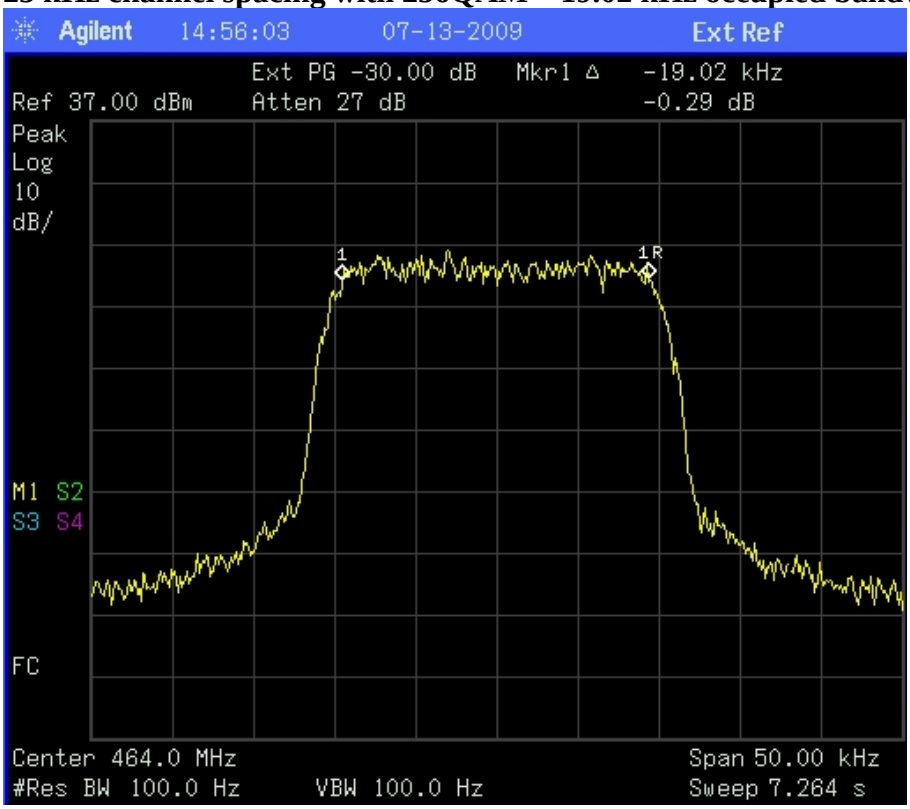
Initially power measurements are made using a resolution bandwidth of 120 kHz using a peak detector which is used as a reference level on the spectrum analyser.

The resolution bandwidth is then changed to 100 Hz and the reference level minus 26 dB (99%) absolute bandwidth points determined

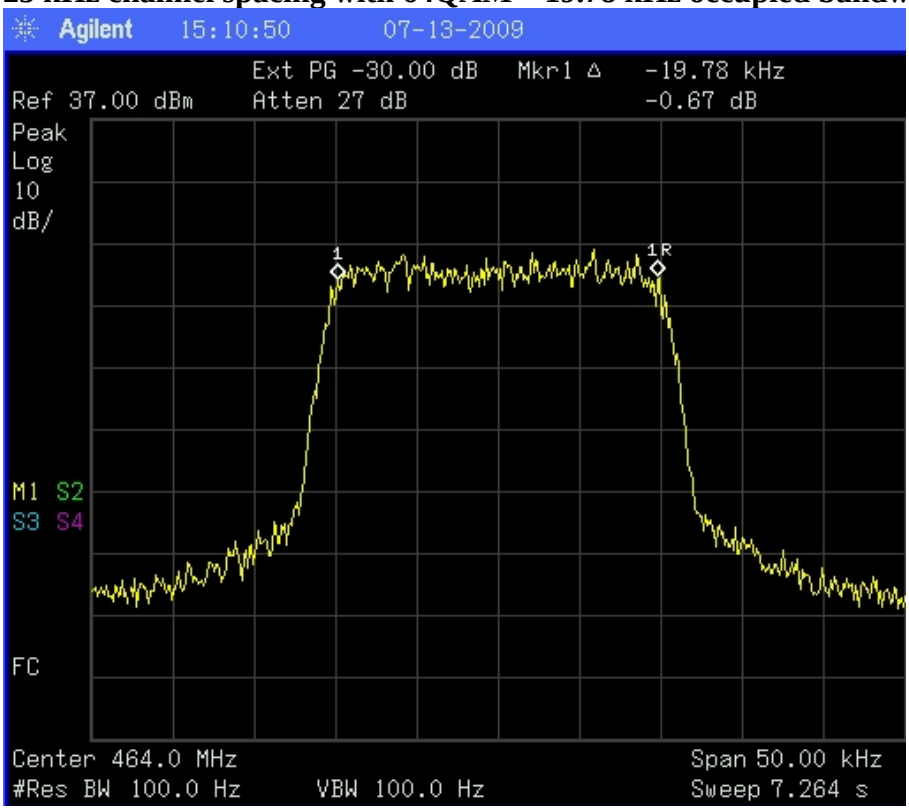
Modulation Type	Measured (kHz)	Measured (kHz)
Calculated	10.00	20.00
QPSK	9.91	19.67
16QAM	9.83	19.67
64QAM	9.91	19.78
256QAM	9.96	19.02

Result: Complies

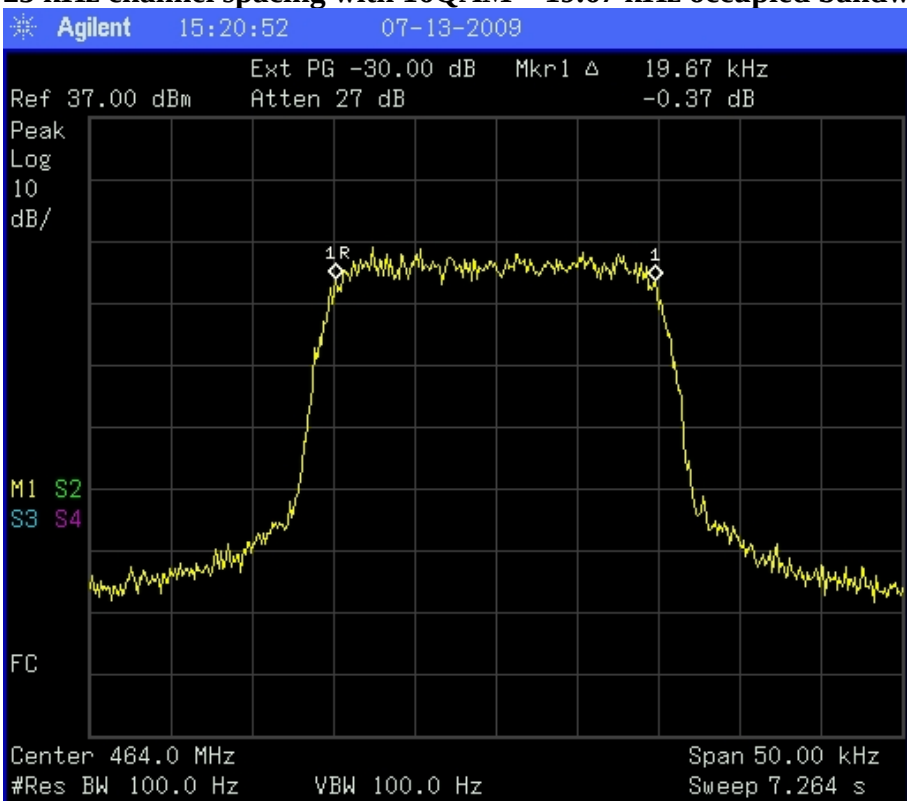
25 kHz channel spacing with 256QAM – 19.02 kHz occupied bandwidth



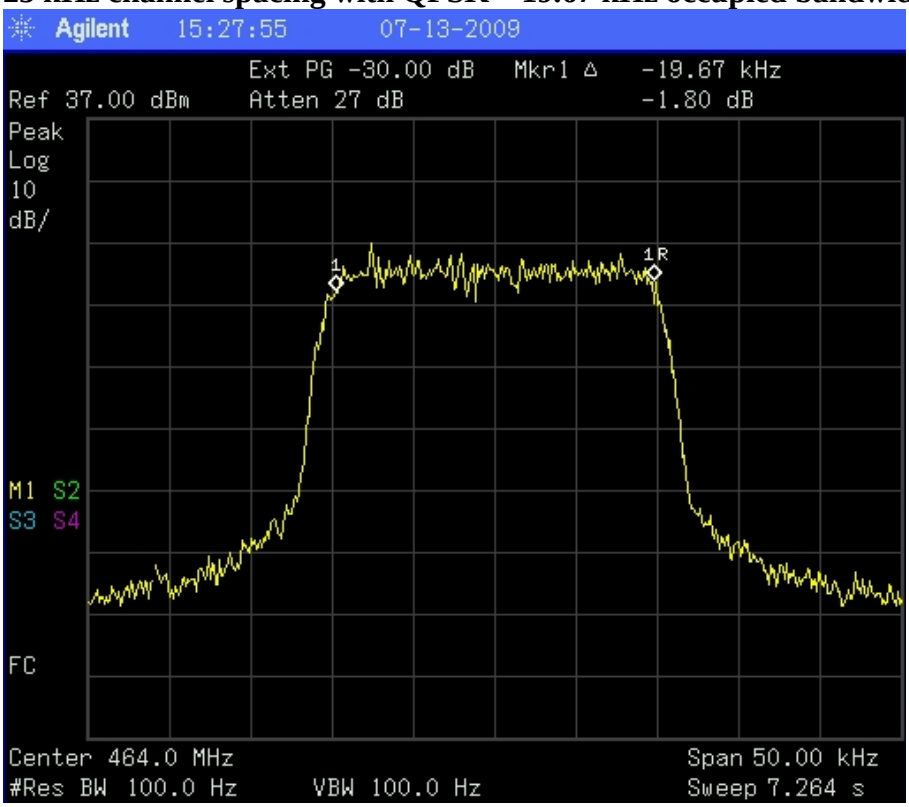
25 kHz channel spacing with 64QAM – 19.78 kHz occupied bandwidth



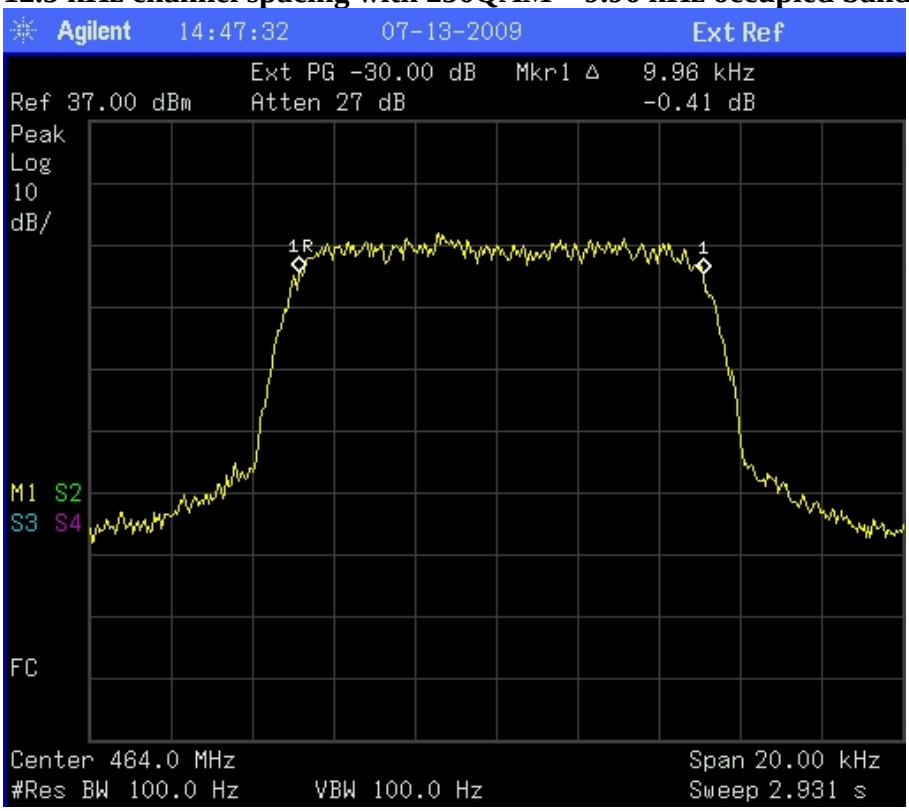
25 kHz channel spacing with 16QAM – 19.67 kHz occupied bandwidth



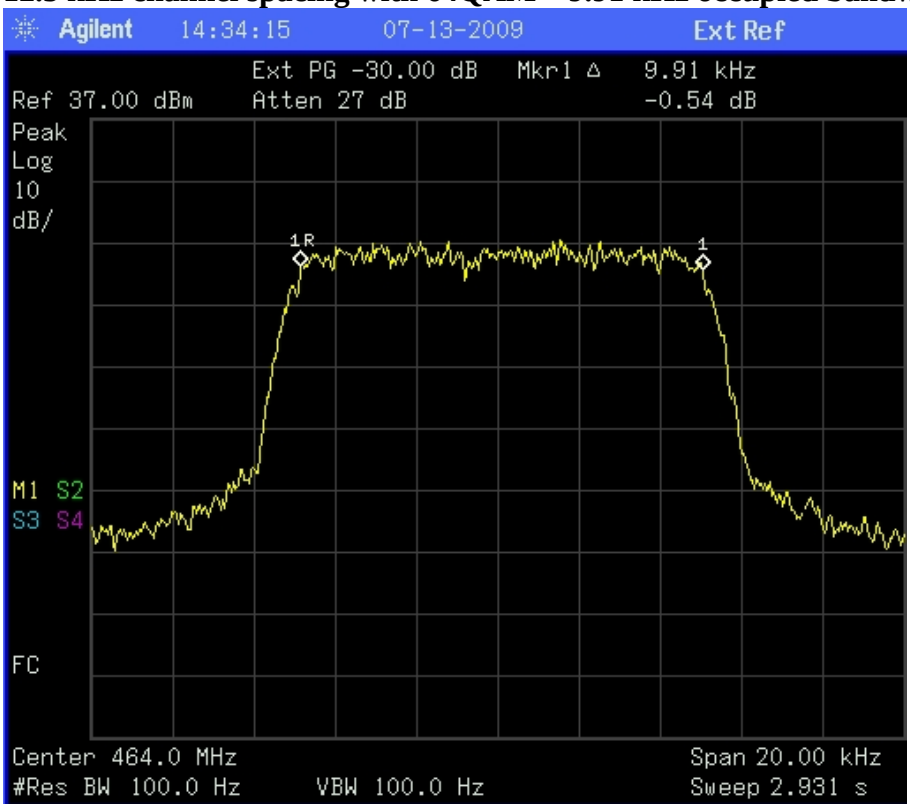
25 kHz channel spacing with QPSK – 19.67 kHz occupied bandwidth



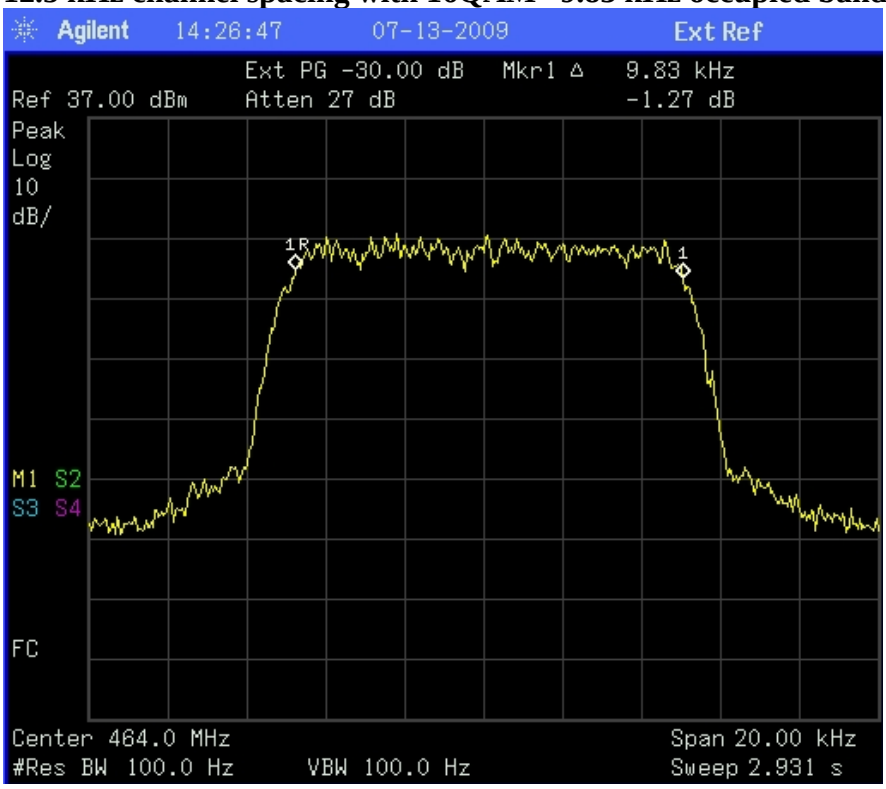
12.5 kHz channel spacing with 256QAM – 9.96 kHz occupied bandwidth



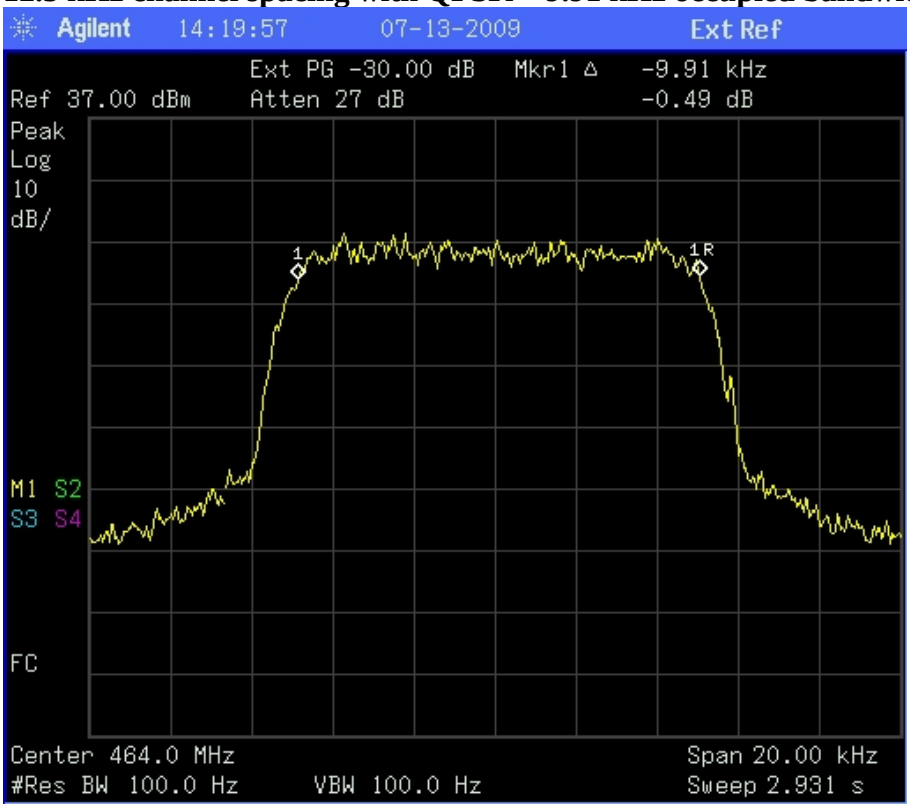
12.5 kHz channel spacing with 64QAM – 9.91 kHz occupied bandwidth



12.5 kHz channel spacing with 16QAM –9.83 kHz occupied bandwidth



12.5 kHz channel spacing with QPSK – 9.91 kHz occupied bandwidth



Spectrum masks

The spectrum masks are defined in:

Section 90.210(C) – Mask C and Section 90.210(d) – Mask D have been applied as this transmitter can operate in the band 421 to 512 MHz using authorised bandwidths of 10 kHz and 20 kHz as per Section 90.209(b)(5).

This transmitter does not contain a low pass audio filter as it is a digital link transmitter.

The reference level for the following emission mask measurements has been determined using a resolution bandwidth of 120 kHz using either a peak or an average detector with the transmitter modulated.

In peak this gave a reference level of +37 dBm and in average this gave a reference level of +30 dBm.

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

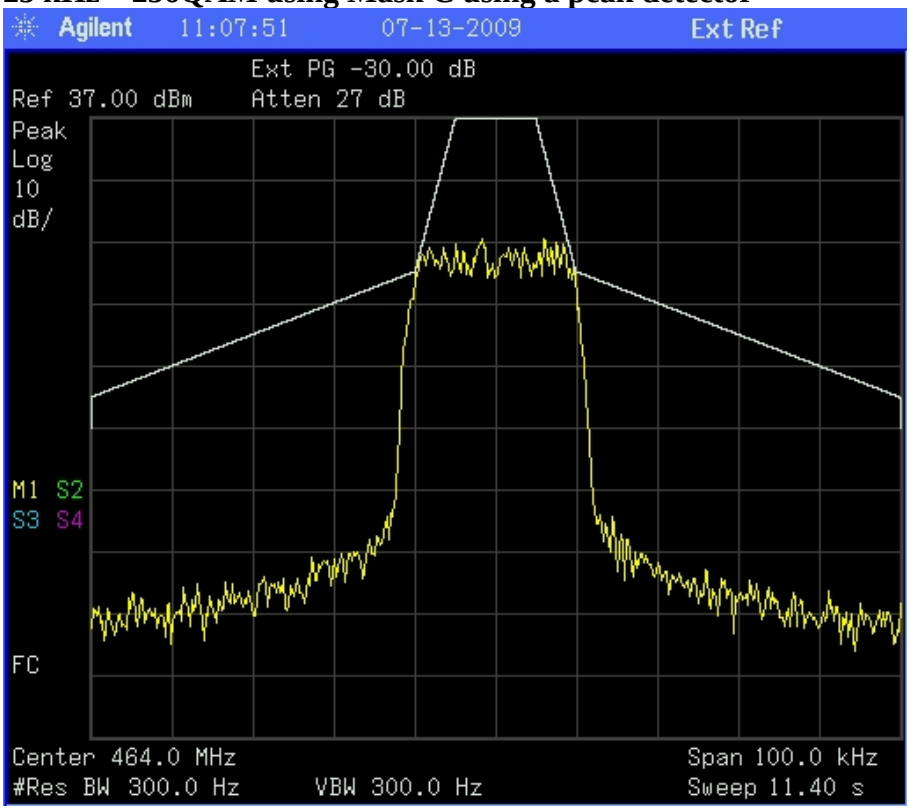
The mask C measurements were made in peak hold

The mask D measurements were made using an average

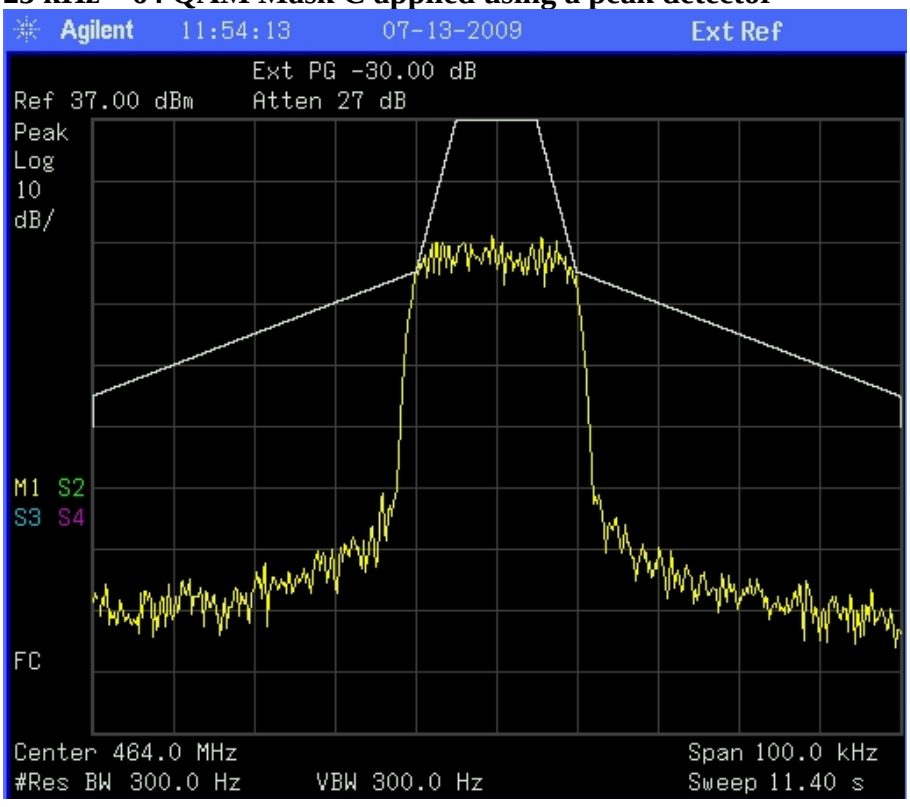
The transmitter was transmitting on the assigned frequency of 463.9875 MHz with the modulation for this test being supplied internally by the transmitter

Result: Complies.

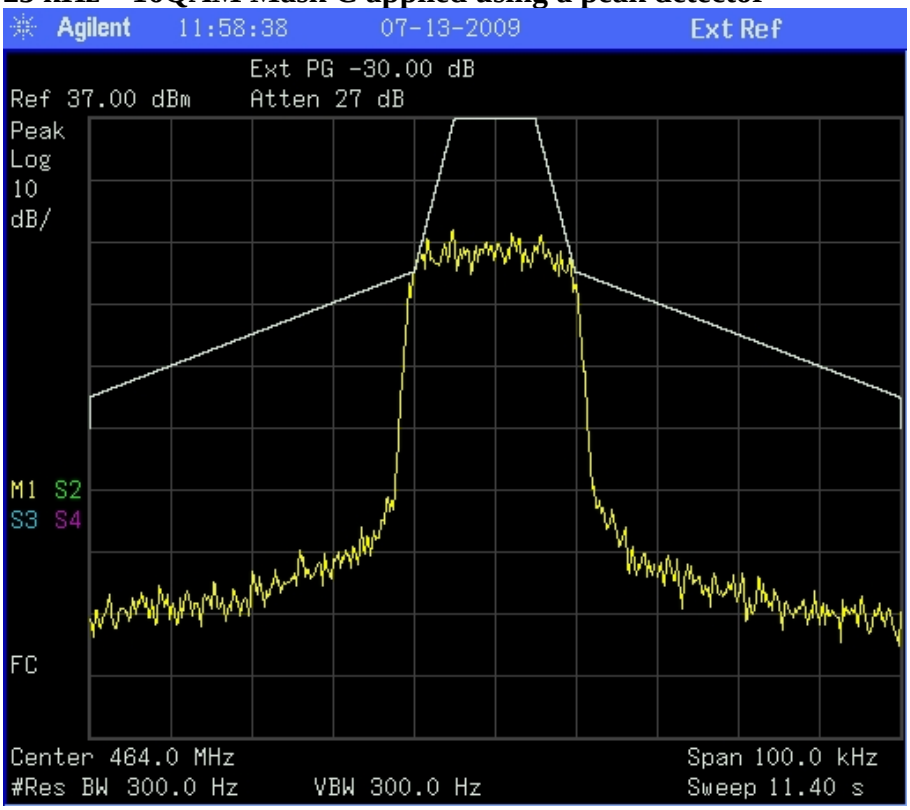
25 kHz – 256QAM using Mask C using a peak detector



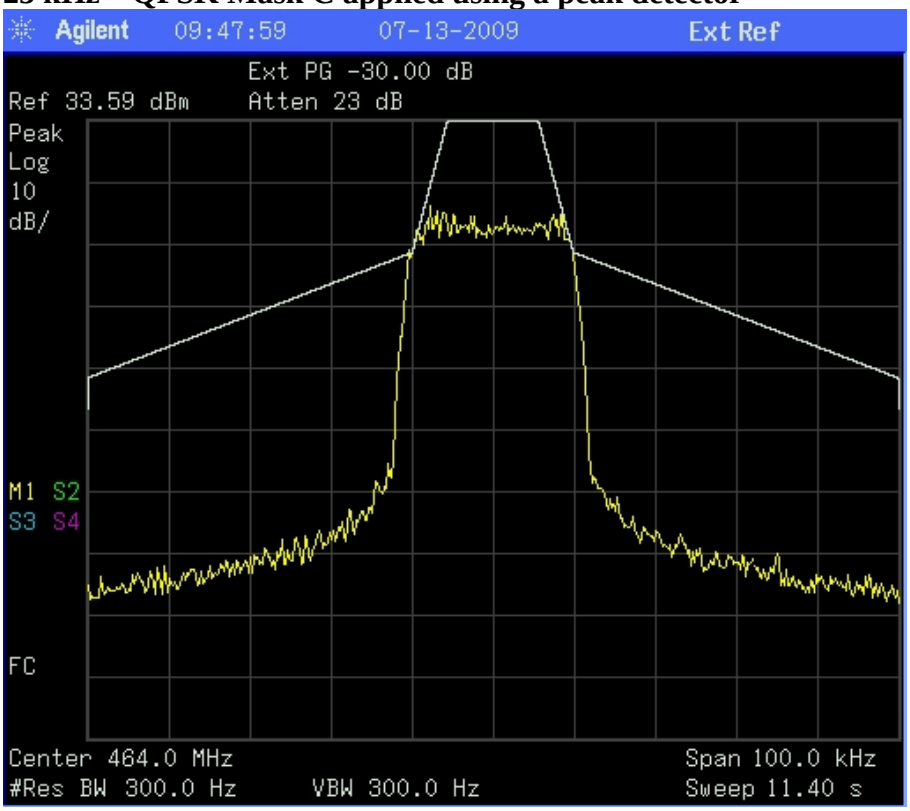
25 kHz – 64 QAM Mask C applied using a peak detector



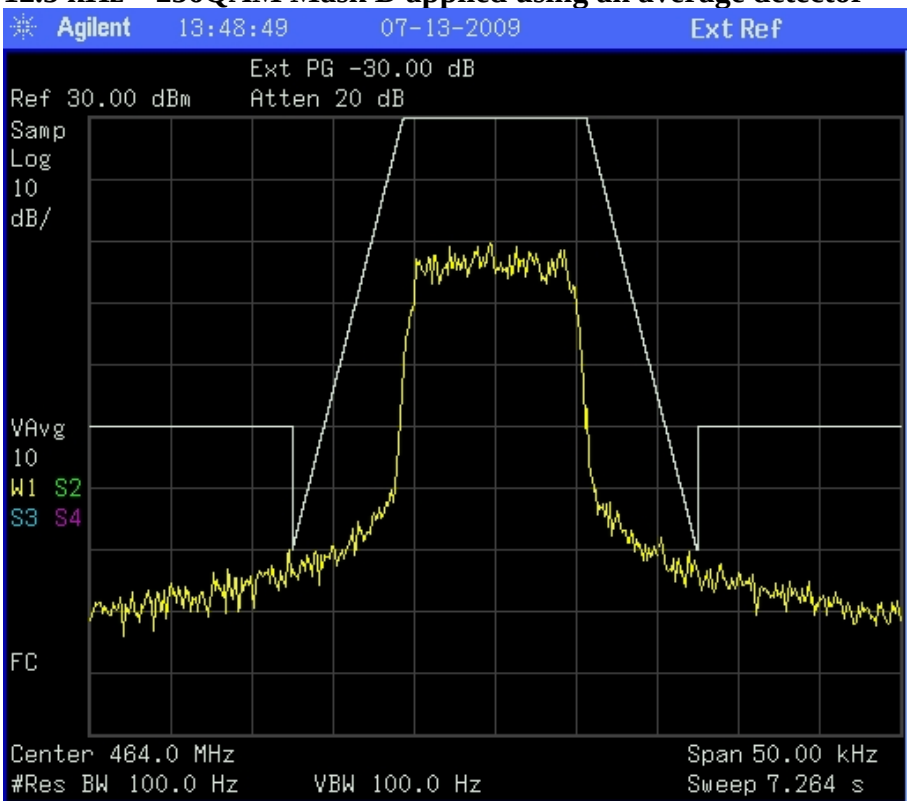
25 kHz – 16QAM Mask C applied using a peak detector



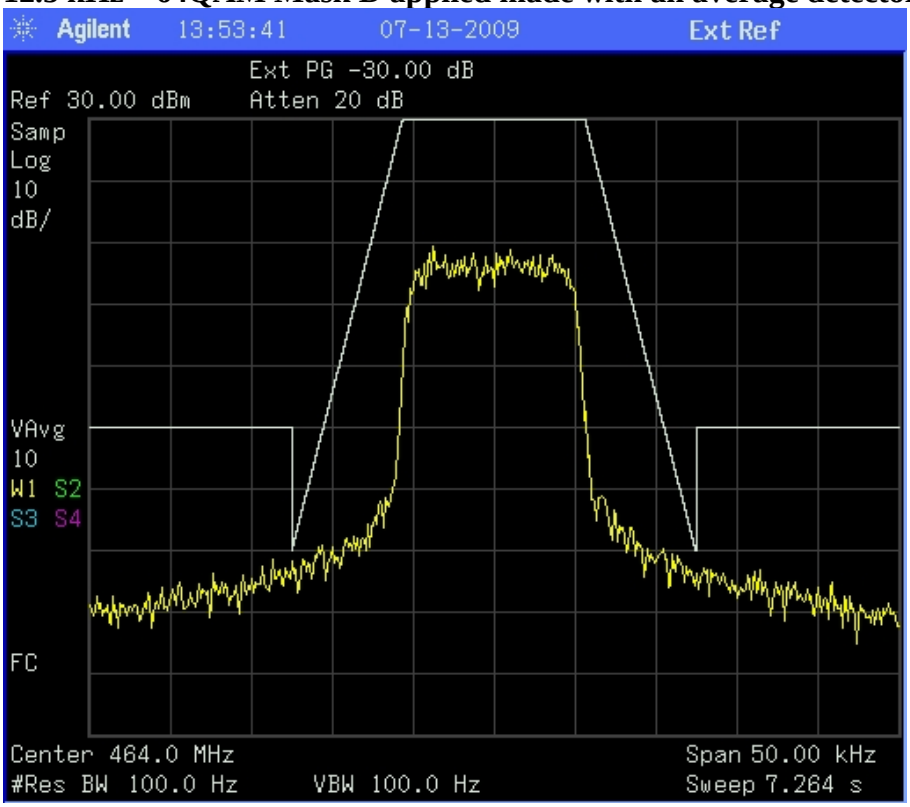
25 kHz – QPSK Mask C applied using a peak detector



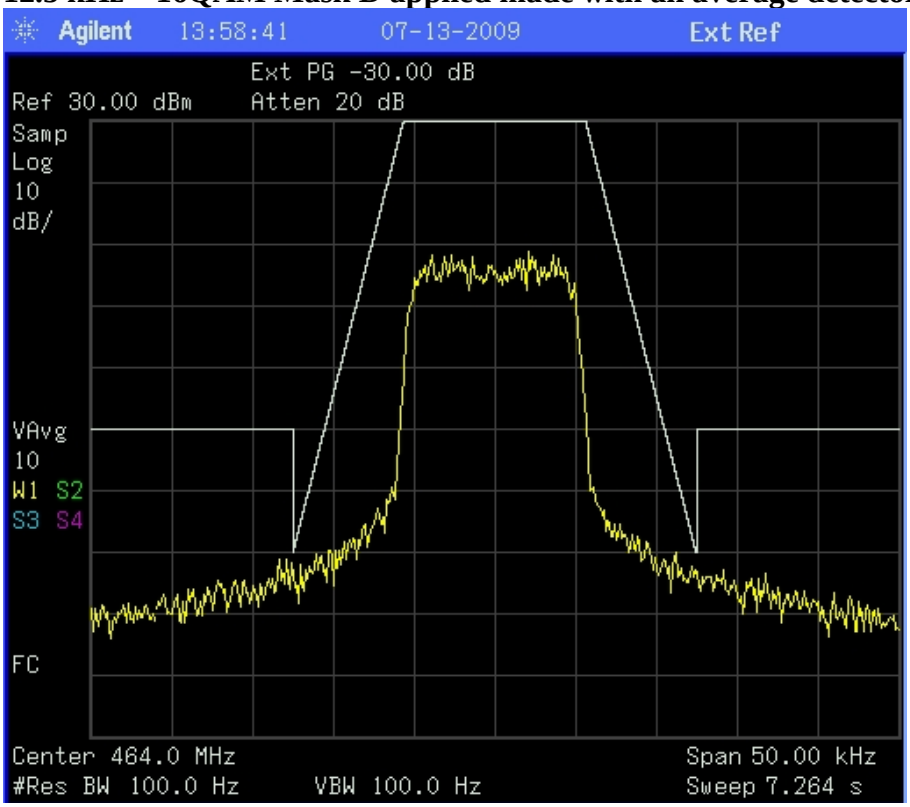
12.5 kHz – 256QAM Mask D applied using an average detector



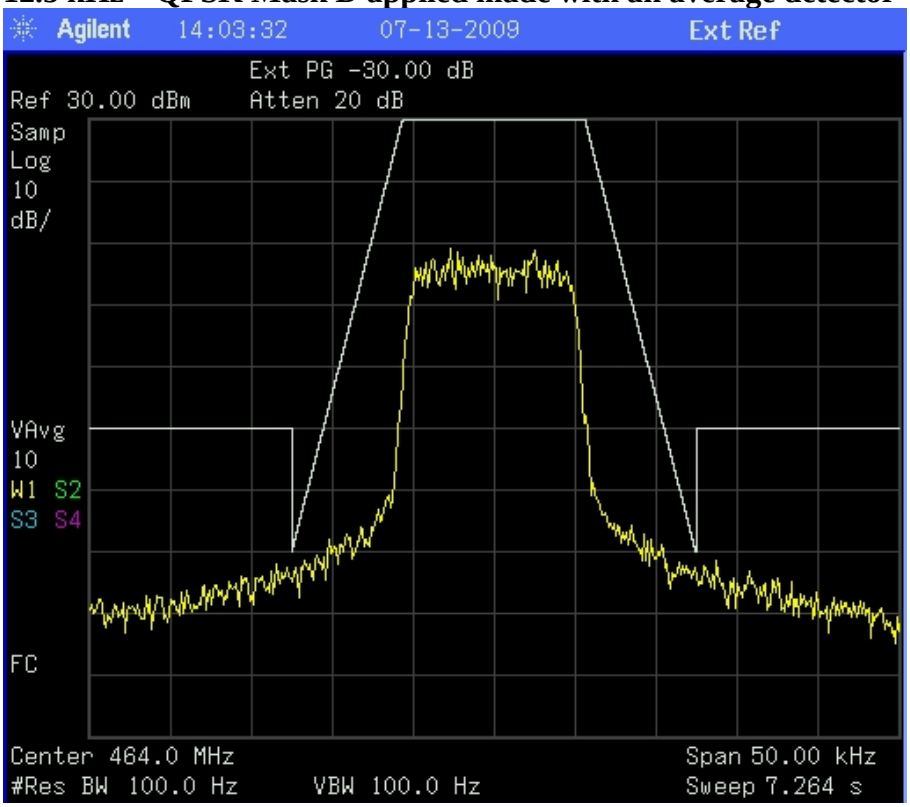
12.5 kHz – 64QAM Mask D applied made with an average detector



12.5 kHz – 16QAM Mask D applied made with an average detector



12.5 kHz – QPSK Mask D applied made with an average detector



Transmitter spurious emissions at the antenna terminals

Frequency: 463.9875 MHz

Harmonics

Spurious emission (MHz)	Tx 1 Level (dBm)	Tx 2 Level (dBm)	Limit (dBm)
927.9750	< -60.0	< -60.0	-20.0
1391.9625	< -60.0	< -60.0	-20.0
1855.9500	< -60.0	< -60.0	-20.0
2319.9375	< -60.0	< -60.0	-20.0
2783.9250	< -60.0	< -60.0	-20.0
3247.9125	< -60.0	< -60.0	-20.0
3711.9000	< -60.0	< -60.0	-20.0
4175.8875	< -60.0	< -60.0	-20.0
4639.8750	< -60.0	< -60.0	-20.0

Other emissions observed

Spurious emission (MHz)	Tx 1 Level (dBm)	Tx 2 Level (dBm)	Limit (dBm)
314.5891	< -60.0	< -60.0	-20.0
405.0000	-51.9	-41.9	-20.0
442.6086	< -60.0	< -60.0	-20.0
456.8478	< -60.0	< -60.0	-20.0
458.6956	< -60.0	< -60.0	-20.0
463.8478	< -60.0	< -60.0	-20.0

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.

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 peak output power of 5 watts gives a limit of –20 dBm.

Result: Complies
Measurement Uncertainty: ±3.3 dB

Field strength of the transmitter spurious emissions

Frequency: 463.9875 MHz

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)
902.500	-	-	-20.0	Vertical	-
902.500	-	-	-20.0	Horizontal	-
1353.500	-	-	-20.0	Vertical	-
1353.500	-	-	-20.0	Horizontal	-
1804.500	-	-	-20.0	Vertical	-
1804.500	-	-	-20.0	Horizontal	-
2255.500	-	-	-20.0	Vertical	-
2255.500	-	-	-20.0	Horizontal	-
2706.500	-	-	-20.0	Vertical	-
2706.500	-	-	-20.0	Horizontal	-
3157.500	-	-	-20.0	Vertical	-
3157.500	-	-	-20.0	Horizontal	-
3608.500	-	-	-20.0	Vertical	-
3608.500	-	-	-20.0	Horizontal	-
4059.500	-	-	-20.0	Vertical	-
4059.500	-	-	-20.0	Horizontal	-
4510.500	-	-	-20.0	Vertical	-
4510.500	-	-	-20.0	Horizontal	-

When operating in transmit mode no significant emissions (emissions exceeding -50 dBm) were detected from the harmonics and between the harmonics.

The transmitters were tested transmitting continuously into dummy loads attached to both transmitters.

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.

Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on January 18th, 2007

Testing was carried out using the substitution method where by the power level of each emission was determined by replacing the transmitter with a dipole antenna that was connected to a signal generator.

The signal generator output level was increased until the same field strength level was observed at each emission frequency.

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 W peak or 1 W average gives a limit of –20 dBm.

No measurements were made above the 10th harmonic.

Result: Complies
Measurement Uncertainty: ±4.1 dB

Receiver spurious emissions at the antenna terminals

Frequency: 468.9875 MHz

Spurious emission (MHz)	Rx 1 Level (dBm)	Rx 2 Level (dBm)	Limit (dBm)
423.9875	-92.1	-91.1	-57.0
847.9750	< -95.0	< -95.0	-57.0
1271.9625	-91.5	-92.5	-57.0
1695.9500	-64.5	-62.7	-57.0
2119.9375	-85.4	< -95.0	-57.0
2543.9250	-84.1	-72.7	-57.0
2967.9125	-92.0	< -95.0	-57.0
3391.9000	< -95.0	< -95.0	-57.0
3815.8875	< -95.0	< -95.0	-57.0
4239.8750	< -95.0	< -95.0	-57.0

The receiver has an intermediate frequency of 45 MHz

Measurements were made when the transmitters were turned off which allowed measurements to be made directly at the antenna terminal for each transceiver.

Limit:
In accordance with CFR 47 Part 15, section 15.111 the power of any emission at the antenna terminal should not exceed 2 nW (–57.0 dBm).

Result: Complies
Measurement Uncertainty: ±3.3 dB

Standby and Receiver radiated spurious emissions

Receiver emissions observed when tuned to: 468.9875 MHz

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Polarity	Margin (dB)
423.9875	-	46.0	Vert / Hort	-
847.9750	-	46.0	Vert / Hort	-
1271.9625	-	54.0	Vert / Hort	-
1695.9500	-	54.0	Vert / Hort	-
2119.9375	-	54.0	Vert / Hort	-
2543.9250	-	54.0	Vert / Hort	-
2967.9125	-	54.0	Vert / Hort	-
3391.9000	-	54.0	Vert / Hort	-
3815.8875	-	54.0	Vert / Hort	-
4239.8750	-	54.0	Vert / Hort	-

No specific receiver emissions were detected from the transceiver when the transmitters were turned off.

Dummy loads were attached to each of transceiver antenna terminals

The receiver has an intermediate frequency of 45 MHz

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

Limit:
The field strength limits as per CFR 47 Part 15, section 15.109 have been applied.

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.

The nominal 24 Vdc supply to the device was varied by +/- 15%.

Nominal Frequency: 463.9875 MHz

Temp.	- 15%	24 Vdc	+ 15%
+50°C	-93.0	-93.0	-93.0
+40°C	-55.0	-55.0	-55.0
+30°C	-113.0	-113.0	-113.0
+20°C	-147.0	-147.0	-147.0
+10°C	-60.0	-60.0	-60.0
0°C	-113.0	-113.0	-113.0
-10°C	-129.0	-129.0	-129.0
-20°C	-181.0	-181.0	-181.0
-30°C	-246.0	-246.0	-246.0

Measurements were made with the modulation turned off.

Variation in the nominal dc supply voltage did not alter the indicated frequency

Limit:
Part 90.213 states that in the 421 – 512 MHz band fixed stations and base stations operating with 12.5 kHz channel spacing must have a frequency stability of 1.5 ppm.

1.5 ppm = 1.5 x 463.9875 MHz = 696 Hz.

Result: Complies
Measurement Uncertainty: ±30 Hz

Transmitter Transient Performance

Transient frequency behaviour measurements are applicable to wide 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 with the modulation turned off.

In summary this method calls for the use of an external signal generator tuned to 463.9875 MHz with a 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.

Results:

Spacing	Period t_1 (kHz)	Period t_2 (kHz)	Period t_3 (kHz)
12.5 kHz	-	-	-
25.0 kHz	-	-	-

Limits:

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

Result: Complies
Measurement Uncertainty: Frequency ±1.6 kHz, Time ±1 ms

12.5 kHz transmitter turn on

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

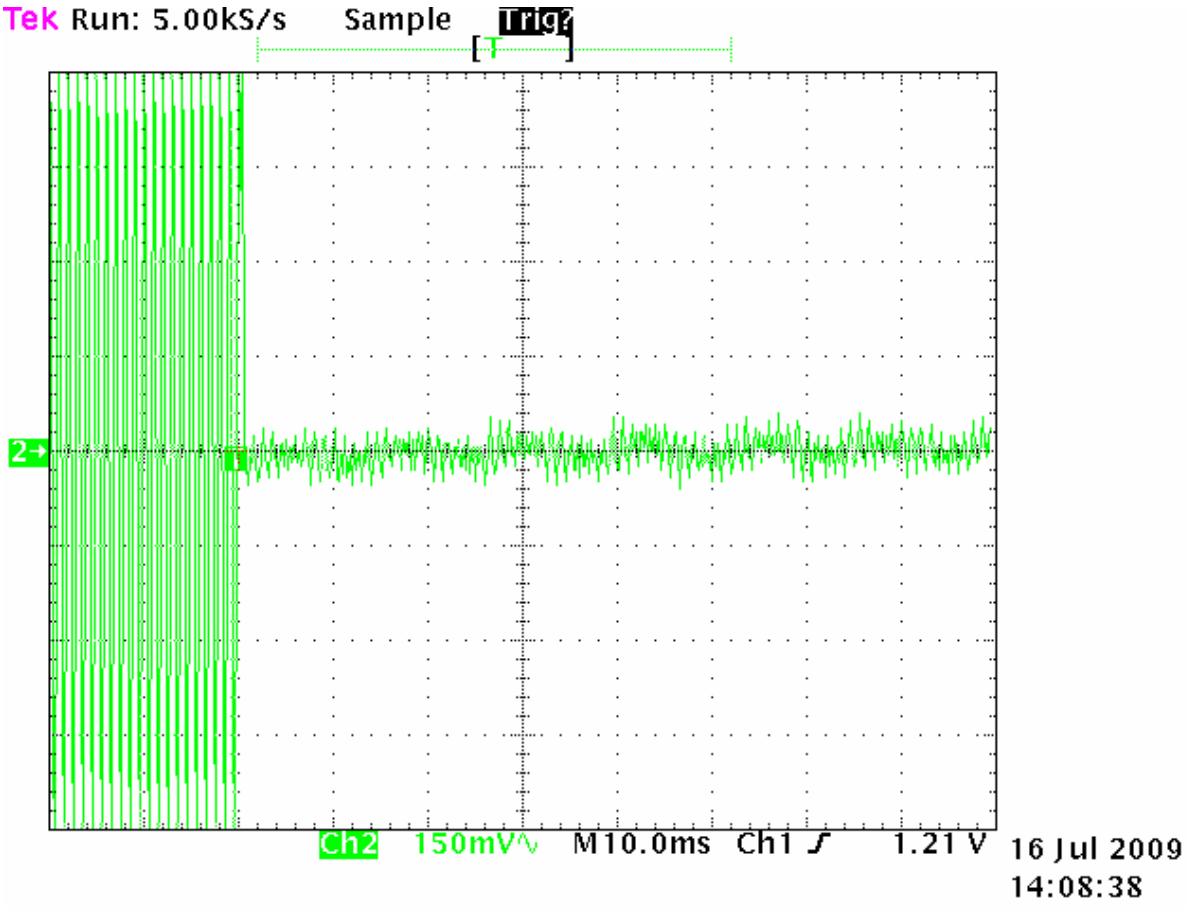
Green trace has been maximised to give full screen indication of +/- 12.5 kHz.
Therefore each Y axis division = 3.125 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 mS).

*t*on occurs at 20 mS.

*t*1 occurs between 2.0 and 3.0 divisions from the left hand edge.
t2 occurs between 3.0 and 5.5 divisions from the left hand edge.

No transient response can be observed during *t*1.



12.5 kHz transmitter turn off

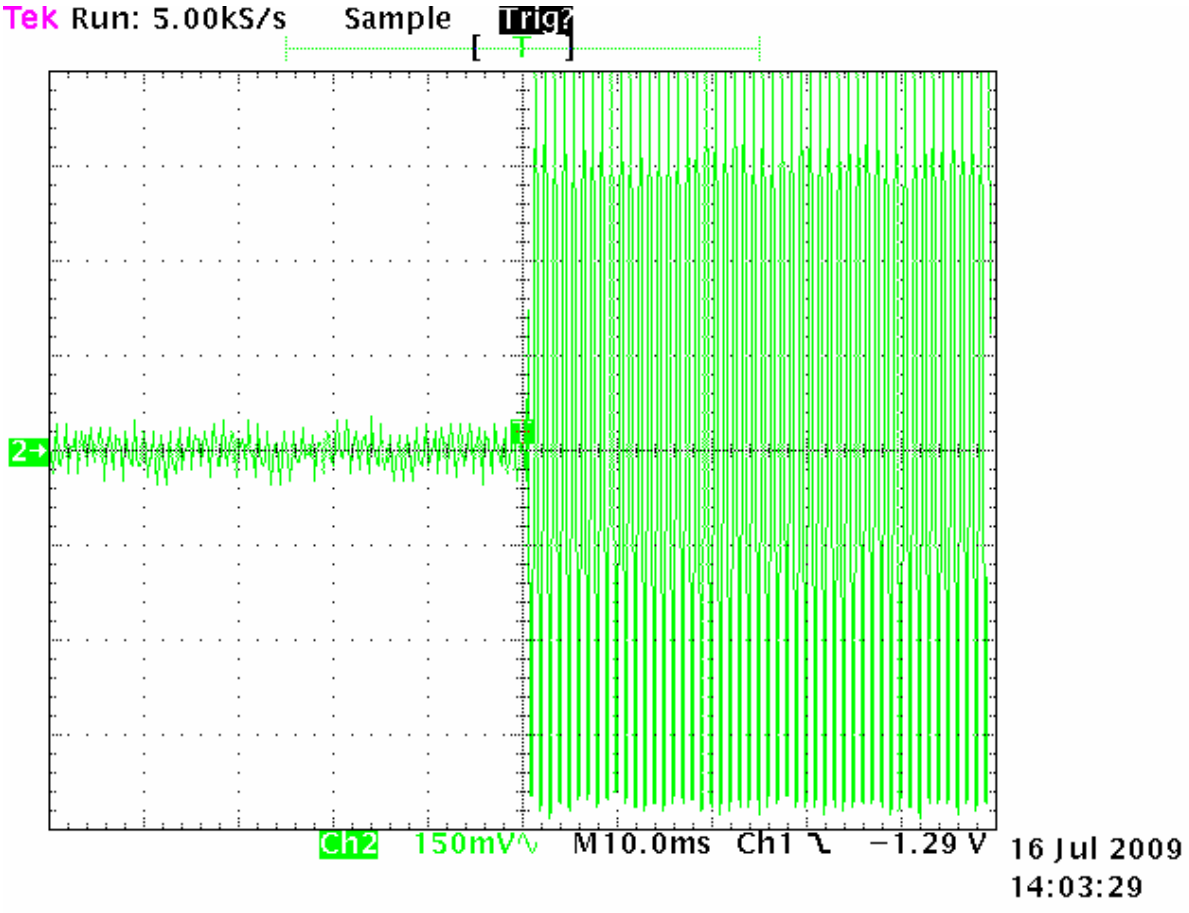
Green Trace = 1 kHz tone with FM deviation of 12.5 kHz.

Green trace has been maximised to give full screen indication of +/- 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 *t*off.

*t*3 occurs between 4.0 and 5.0 divisions from the left hand edge..

No transient responses can be observed during *t3*.



25.0 kHz transmitter turn on

Green Trace = 1 kHz tone with FM deviation of 25.0 kHz.

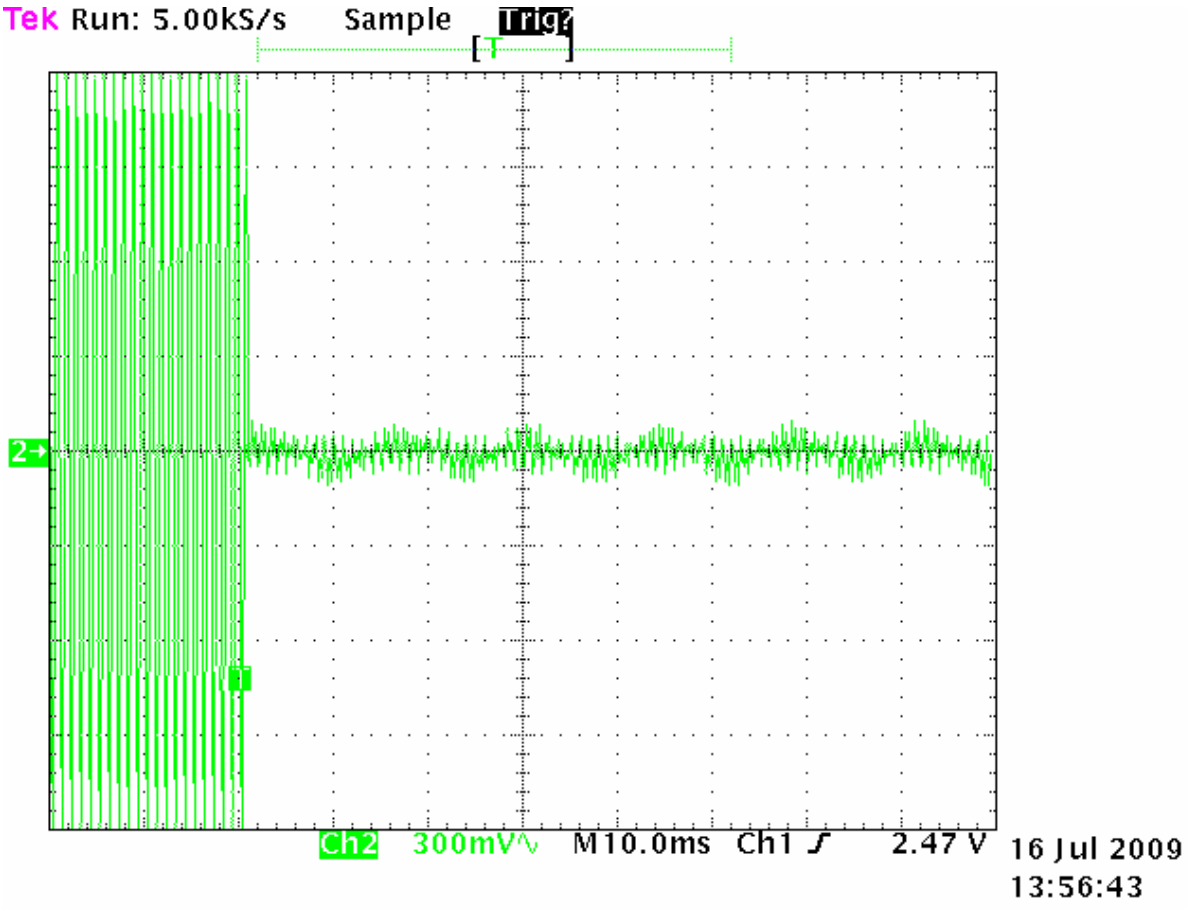
Green trace has been maximised to give full screen indication of +/- 25.0 kHz.
Therefore each Y axis division = 6.25 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 mS).

*t*on occurs at 20 mS.

*t*1 occurs between 2.0 and 3.0 divisions from the left hand edge.
t2 occurs between 3.0 and 5.5 divisions from the left hand edge.

No transient response can be observed during *t*1.



25.0 kHz transmitter turn off

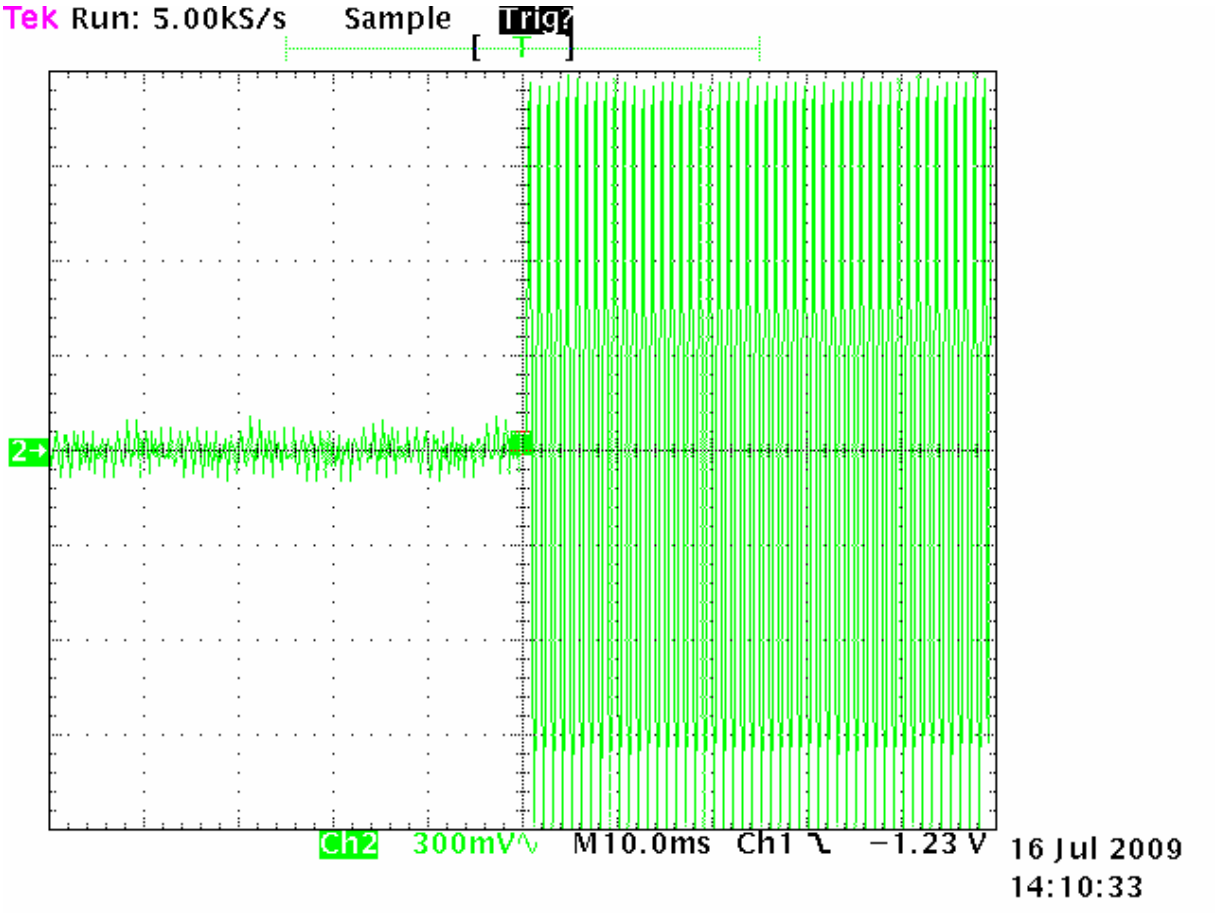
Green Trace = 1 kHz tone with FM deviation of 25.0 kHz.

Green trace has been maximised to give full screen indication of +/- 25.0 kHz.
Therefore each Y axis division = 6.25 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 *t*off.

*t*3 occurs between 4.5 and 5.0 divisions from the left hand edge..

No transient response can be observed before *t*off.



Radio Frequency Hazard Information

As per Section 1.1310 and Section 2.1091 certification of this transmitter is sought using the Controlled / Occupational exposure limits as detailed in OST/OET Bulletin Number 65.

This transmitter is a fixed linked digital transmitter that uses two transmitters that transmit identical modulation with one transmitter transmitting using a horizontally polarised antenna and the other transmitter transmits using a vertically polarised antenna.

The client supplies a choice of two antennas they being a panel antenna and a circular polarised antenna.

Radio Frequency Hazard measurements and calculations were made using the circular polarised antenna as this antenna has the highest gain.

The Radio Frequency Hazard assessment has been carried out using a peak detector as this gave the worst case result.

The transmitters have a peak output power of 5 watts (+37 dBm) per transmitter and the client advises that the circular polarised yagi antenna has a gain of greater than 10 dBi.

This gives a theoretical radiated power that is greater than +47 dBm.

At a distance of 10 metres the EIRP power of the transmitters in both horizontal and vertical polarisations was measured to be +55 dBm or 316 watts

Calculations have also been made using the General Public/Uncontrolled Exposure limits.

Minimum safe distances have been calculated below.

Power density, $mW/cm^2 = E^2/3770$

Occupational / Controlled Exposure limit: 1.55 mW/cm^2 (f/300 = 464 MHz/300)

General Population / Uncontrolled exposure limit: 0.31 mW/cm^2 (f/1500 = 464 MHz/1500)

The minimum distance from the antenna at which the MPE is met is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain, transmitter duty cycle and separation distance in metres:

$E, V/m = (\sqrt{(30 * P * G)}) / d$

Controlled / Occupational	**Uncontrolled / General Public**
$E = 1.55\ mW/cm^2 = E^2/3770$	$E = 0.31\ mW/cm^2 = E^2/3770$
$E = \sqrt{1.55*3770}$	$E = \sqrt{0.31*3770}$
$E = 76.4\ V/m$	$E = 34.2\ V/m$

The maximum radiated transmitter power = 316 watts.

This figure takes into consideration the transmitter output power, antenna gain, coax losses and an assumption that a 100% duty cycle will be in used

Controlled / Occupational	**Uncontrolled / General Public**
$d = \sqrt{(30 * P * G*DC) / E}$	$d = \sqrt{(30 * P * G*DC) / E}$
$d = \sqrt{(30 *316) / 76.4}$	$d = \sqrt{(30 * 316) / 34.2}$
d = 1.27 metres	d = 2.85 metres

Result: Complies if the user is advised of the above safe distances in the appropriate documentation.

10. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset
Aerial Controller	EMCO	1090	9112-1062	RFS 3710
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708
Attenuator 10 dB	Hewlett Packard	HP8491A	24838	E1329
Attenuator 20 dB	Weinschel	49-20-43	GC-104	E1308
Audio Analyzer	Hewlett Packard	8903A	2216A01713	E1146
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612
Frequency Counter	Hewlett Packard	HP 5342A	1916A01713	E1224
Level generator	Anritsu	MG443B	M61689	E1143
Log Periodic	Schwarzbeck	VUSLP9111	9111-228	3785
Receiver	Rohde & Schwarz	ESCS 30	847124/020	E1595
Modulation Analyzer	Rohde & Schwarz	FMA	837807/020	E1552
Modulation Analyzer	Hewlett Packard	8901B	2608A00782	E1090
Oscilloscope	Tektronics	745A	B010643	1569
Power Attenuator	Weinschel	49-20-43	GC104	E1308
Power Supply	Hewlett Packard	6032A	2743A-02859	E1069
RF Power Meter	Hewlett Packard	HP 436A	2512A22439	E1198
Selective Level Meter	Anritsu	ML422C	M35386	E1140
Signal Generator	Rohde & Schwarz	SMHU.58	838923/028	E1493
Spectrum Analyzer	Agilent	N9320A	CN063000567	E4002
Spectrum Analyser	Hewlett Packard	8566B	2140A01303	3771/3772
Thermal chamber	Contherm	M180F	86025	E1129
Thermometer	DSIR	RT200	035	E1049
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709
Horn antenna	Electrometrics	RGA-60	6234	E1494
Pre Amplifier	Hewlett Packard	8349B	2644A01659	-

11. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was last updated on January 18th, 2007.

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

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

12. PHOTOGRAPH (S)

Label

External Views


EMC FCC TEST UNIT
ETH

Radiated emissions test set up