

18 March 2002

EMC Technologies (NZ) Ltd

Test Report No 20308 FCC

Report date: 18 March 2002

TEST REPORT

Eclipse 50 Series Base Station Transceiver

Tested for compliance with the

Code of Federal Regulations (CFR) 47

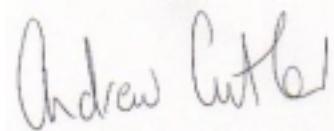
Part 90 – Private Land Mobile Services

Part 15 – Radio Frequency Devices

For

RF Technology Pty Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager

Prepared By:



Karen Miller - Office Administrator



EMC Technologies (NZ) Ltd

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1. CLIENT INFORMATION

Company Name RF Technology Pty Ltd

Address Unit 10, 8 Leighton Place
Hornsby

State NSW 2007

Country Australia

Contact Mr Ron Tilley

2. DESCRIPTION OF TEST SAMPLE

Brand Name Eclipse

Model 50 Series

Product Base Station Transceiver

Serial number 00101

FCC ID KRE50A

The base station rack is made up of the following modules:

Model, Product PA50A Power Amplifier (25 – 32 MHz).

Model, Product PA50B Power Amplifier (30 – 40 MHz).

Model, Product PA50C Power Amplifier (38 – 50 MHz).

Model, Product R50 Receiver.

Model, Product T50 Transmitter / Exciter.

Manufacturer RF Technology Pty Ltd.

Country of Origin Australia.

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3. SUMMARY OF TEST RESULTS

Testing was carried out in accordance with the test methods defined in 47 CFR Part 2. Listed below are the relevant Part 2 test methods and the limits defined in Part 90 and Part 15.

<u>CLAUSE</u>	<u>TEST PERFORMED</u>	<u>RESULT</u>
2.1041	Measurement procedures	Noted
2.1046	RF power output	Noted
90.205	Power and antenna height limits	Complies
2.1047	Modulation Characteristics	
2.1047(d)	Other types of equipment	Complies
90.211(a)	Modulation characteristics	Complies
2.1049	Occupied bandwidth	Noted
90.207	Types of emissions	Complies
90.209	Bandwidth limitations	Complies
90.210	Emission masks	Complies
2.1051	Spurious emissions at the transmitter antenna terminals	Complies
2.1053	Field strength of transmitter spurious radiation	Complies
15.109	Receiver radiated emissions	Complies
15.111	Antenna power conduction limits for receivers	Complies
2.1055	Frequency stability	Noted
90.213	Frequency stability	Complies
90.214	Transient frequency behavior	Not applicable
2.1057	Frequency spectrum to be investigated	Noted
15.33	Frequency range of unintentional radiators	Noted

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4. TEST SAMPLE DESCRIPTION

The sample tested is a VHF base station which consisted of separate receiver, exciter and three power amplifier modules which were all contained in a common 19" rack.

Rated Transmitter Output Power

100 Watts (50 dBm)

Test frequencies

PA50A	28.5000 MHz
PA50B	35.0000 MHz
PA50C	44.0000 MHz

Band of operation

PA50A	25.0 – 32.0 MHz
PA50B	30.0 – 40.0 MHz
PA50C	38.0 – 50.0 MHz

FCC Band of operation

25.0 – 50.0 MHz

Emission Types and Necessary Bandwidths

16k0F3E

Authorised bandwidth

20.0 kHz

Channel spacing

20.0 kHz

CTCSS frequency

107.2 Hz

Power Supply

External DC power supply (eg lead acid battery).

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5. TEST CONDITIONS

Standard Temperature and Humidity

Temperature: +25°C ± 4° maintained.
Relative Humidity: 60% ± 10% observed.

Extreme Temperature

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

Tests carried out in 10° intervals over this range.

Standard Test Voltage

Standard Voltage: 28.0 Vdc

Extreme Test Voltages

High Voltage: 32.2 Vdc
Low Voltage: 23.8 Vdc

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6. 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.

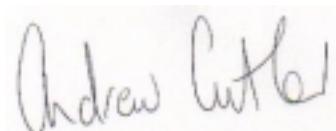
The report relates only to the sample tested.

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. 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

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7. TRANSMITTER TEST RESULTS

RF power output

Measurements were carried out at the RF output terminals of the transmitter using a 30 dB power attenuator and a spectrum analyser using a resolution bandwidth wider than the occupied bandwidth of the transmitter operating in peak hold.

A resolution bandwidth of 30 kHz has been used.

Measurements made with and without CTCSS applied with an input voltage of 28.0 Vdc.

RF power output (dBm)			
Frequency	CTCSS	Rated	Measured
28.500	-	50.0	50.0
28.500	107.2	50.0	50.0
35.000	-	50.0	50.3
35.000	107.2	50.0	50.3
44.000	-	50.0	50.3
44.000	107.2	50.0	50.3

Limits:

Part 90 contains no transmitter base power limits.

Section 90.205(d) defines that maximum allowable station ERP which is dependent upon the station's antenna HAAT and required service area.

Result: Complies

Measurement Uncertainty: ± 0.5 dB

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Modulation Characteristics

The following graphs are attached:

(a) 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, which were connected to the output of the power amplifier.

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.

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

These measurements were carried out with modulating frequencies from 100 Hz to 10 kHz.

At each frequency the input voltage was slowly increased with the resulting frequency deviation of the transmitter, as measured at the output of the power amplifier, being recorded.

Measurements were made over the range -32 to +12 dBm which is the manufacturers stated 600 line input sensitivity range on the flat (no pre-emphasis) and the pre-emphasis line input.

This deviation was then converted to a modulation percentage where 5 kHz deviation is 100%.

Limit

Part 90.211 – Modulation requirements states the transmitter must meet the emission requirements of 90.210. Refer to the Occupied Bandwidth measurements in this report.

Result: Complies

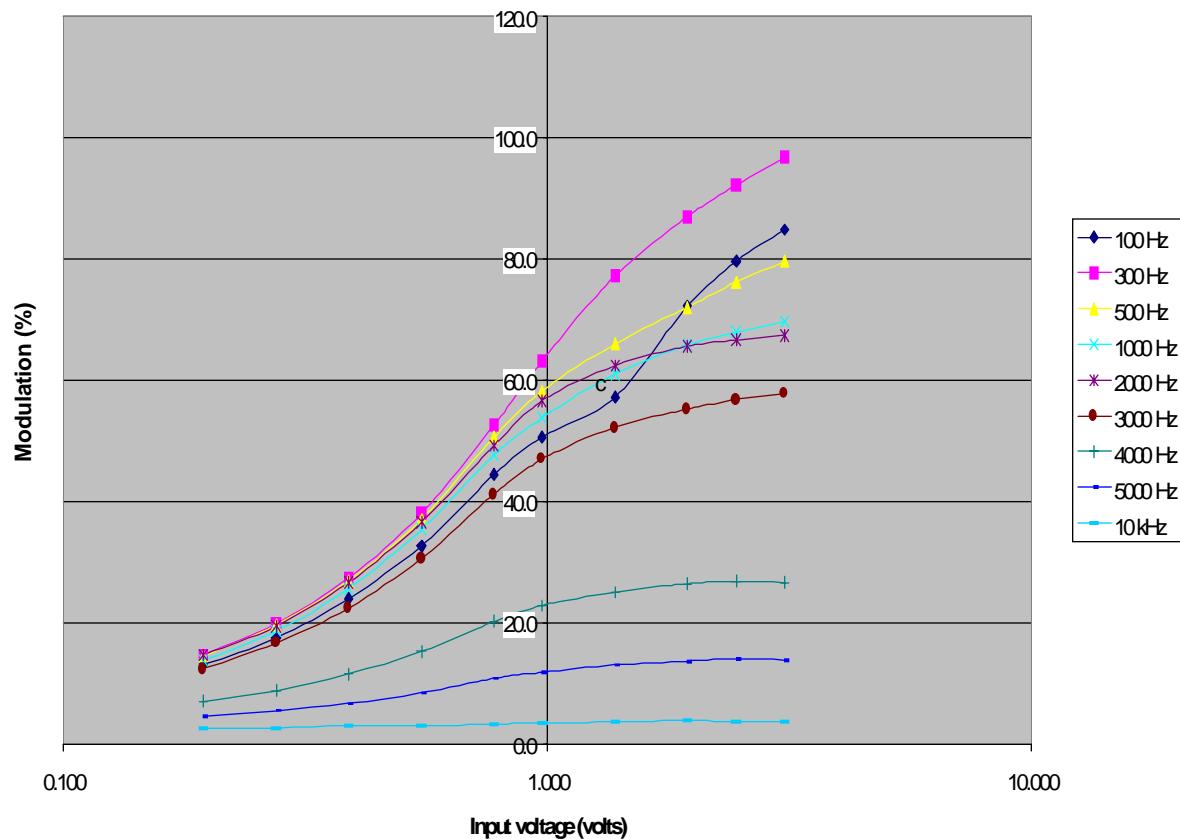
Measurement Uncertainty: $\pm 1\%$.

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Modulation limiting characteristics - Flat response input

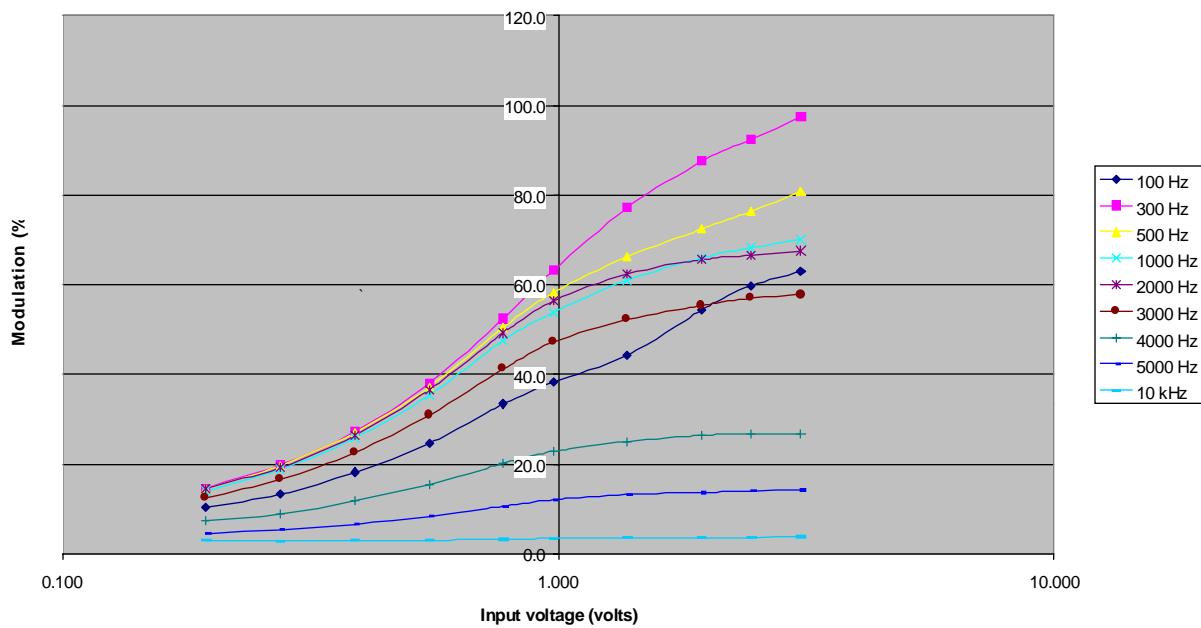


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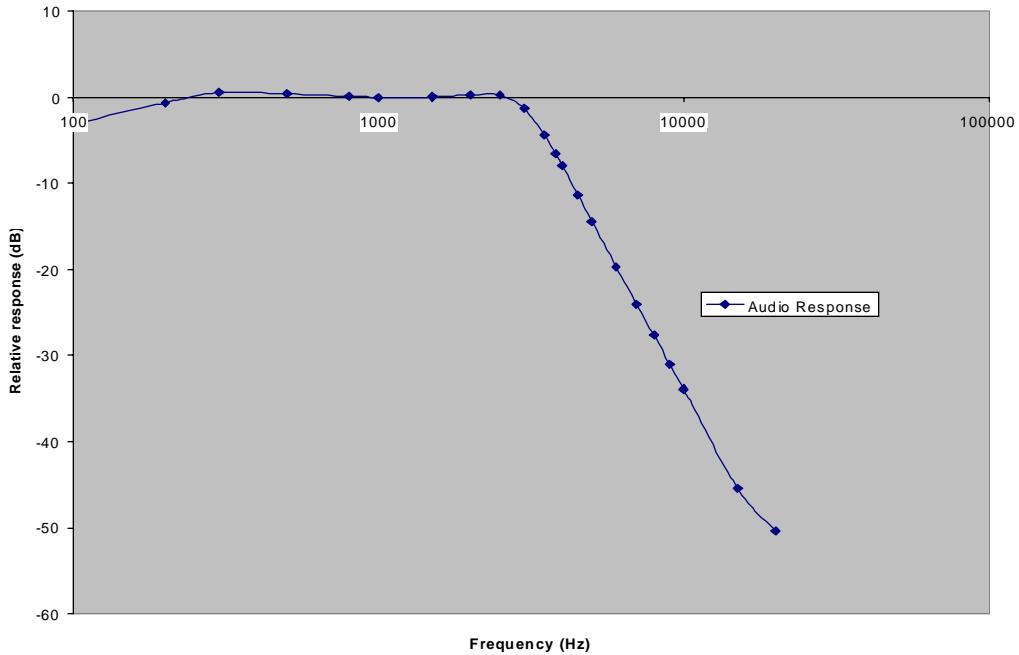
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Modulation limiting characteristics - Pre-emphasis input



Low pass filter response - Flat response input



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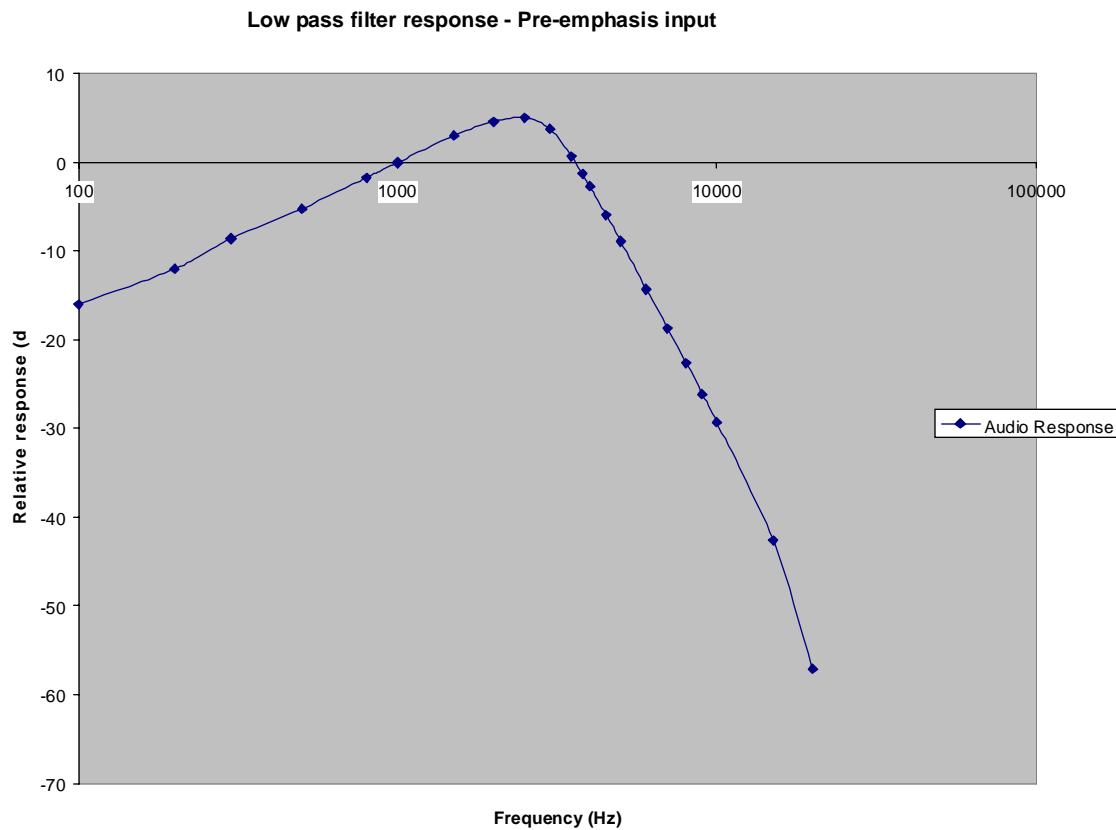
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Occupied Bandwidth

The spectrum mask is defined in:

Section 90.210(b) – Mask B has been applied as the transmitter can operate in the band 25 - 50 MHz.

Section 90.209(b)(5) defines the authorised bandwidth as 20 kHz where 20 kHz channeling is used in the band 25 – 50 MHz.

The reference level for all emission mask measurements has been determined using a resolution bandwidth of 30 kHz when the transmitter is not being modulated.

Measurements were carried out with a 2500 Hz modulating frequency applied at a level 16 dB higher than the level required to achieve 50% modulation (2.5 kHz deviation) at the frequency of maximum response. The frequency of maximum response was found to be at 2500 Hz.

The following clauses are also covered by these tests:

Part 90.207 – Emission types:

Emission type F3E is used by this transmitter.

Part 90.209 – Bandwidth limitations:

The necessary authorised bandwidth is taken to be the necessary bandwidth.

Using the formulas contained in Part 2.202:

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

Where D = maximum deviation: 5.0 kHz

Where M = maximum modulation frequency: 3 kHz

$$B_n = 16 \text{ kHz}$$

This is confirmed in the emission designation, 16k0F3E as declared by the client.

Two plots have been provided for each power amplifier.

One plot is with CTCSS applied and the other is when CTCSS has not been applied.

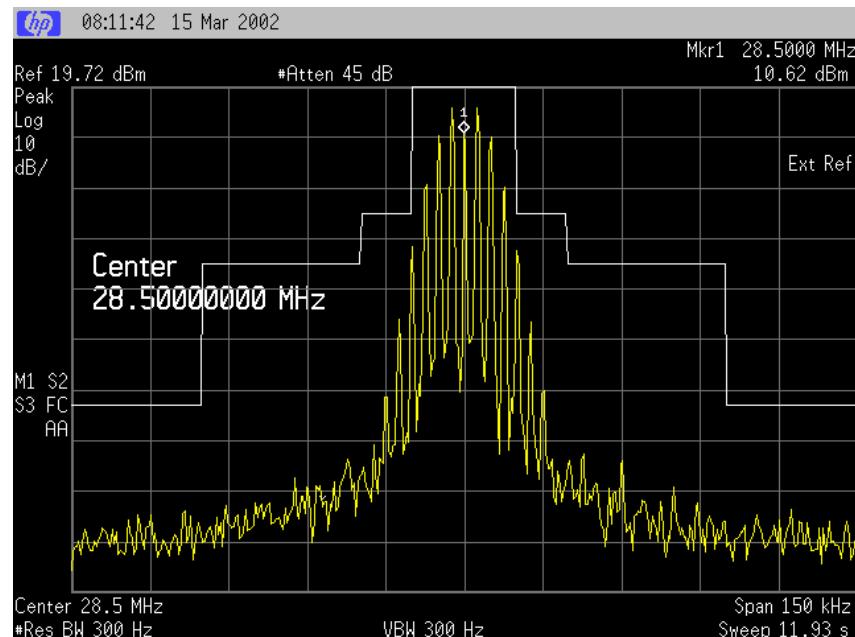
Result: Complies

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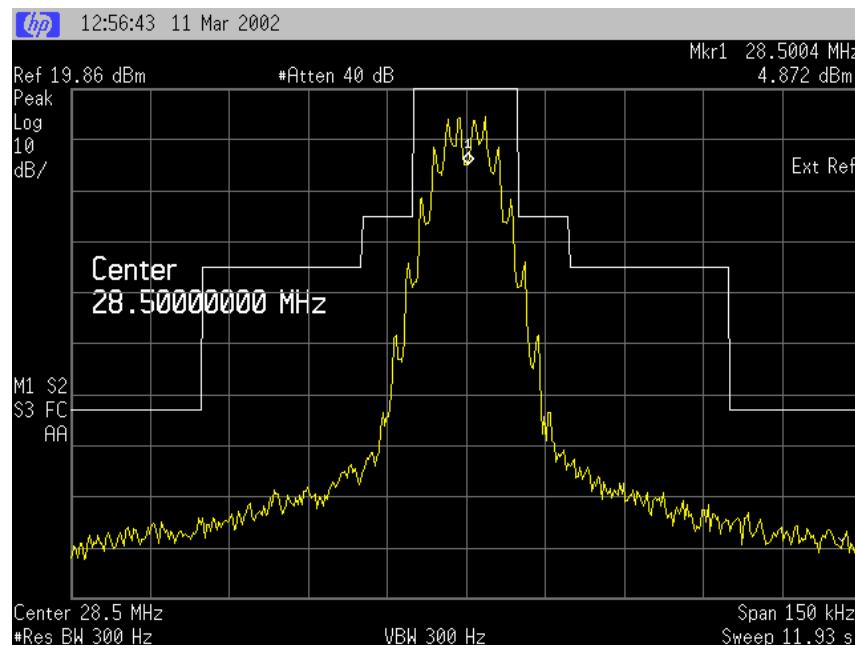
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28.5000 without CTCSS



28.500 MHz with CTCSS

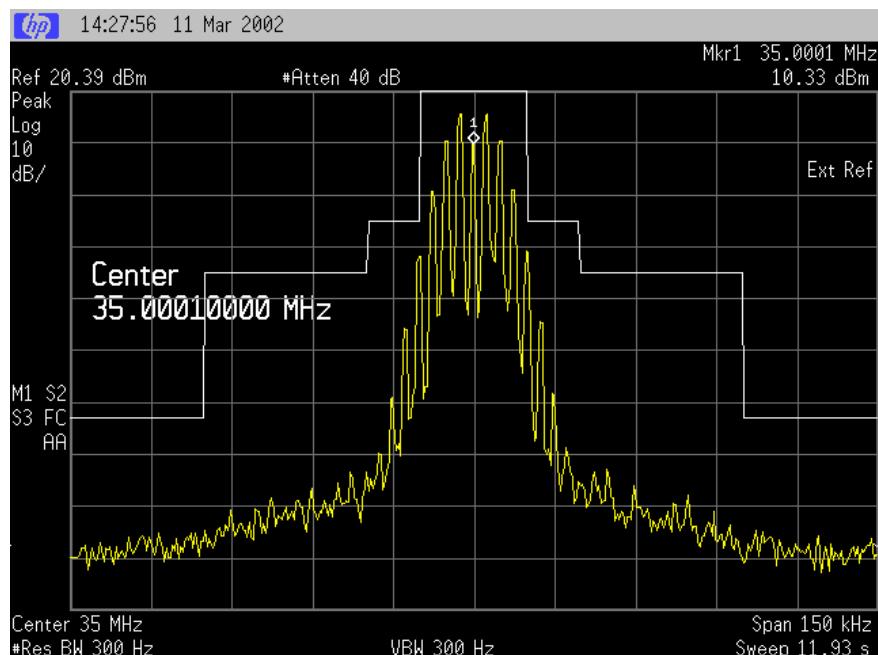


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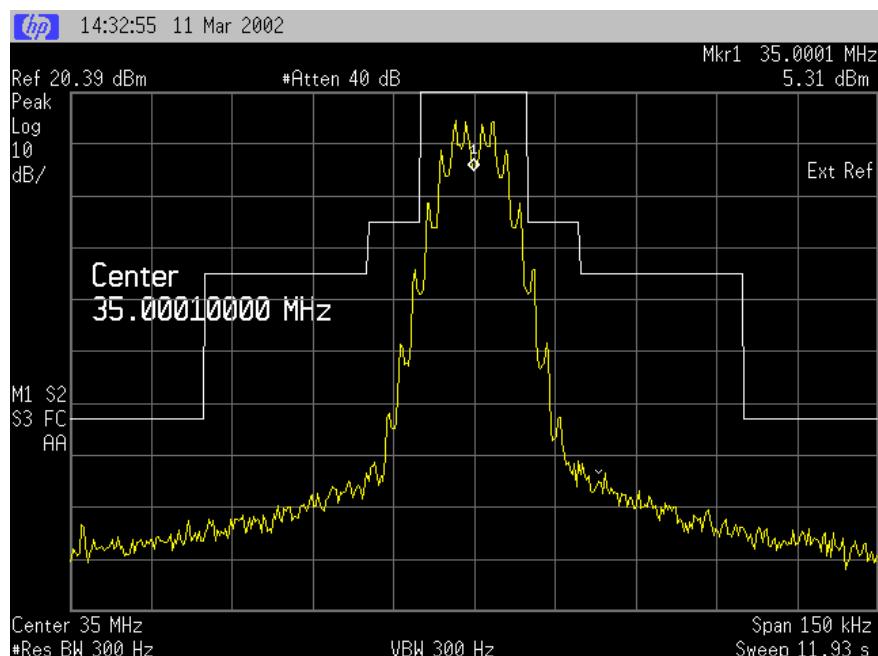
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35.000 MHz without CTCSS



35.000 MHz with CTCSS

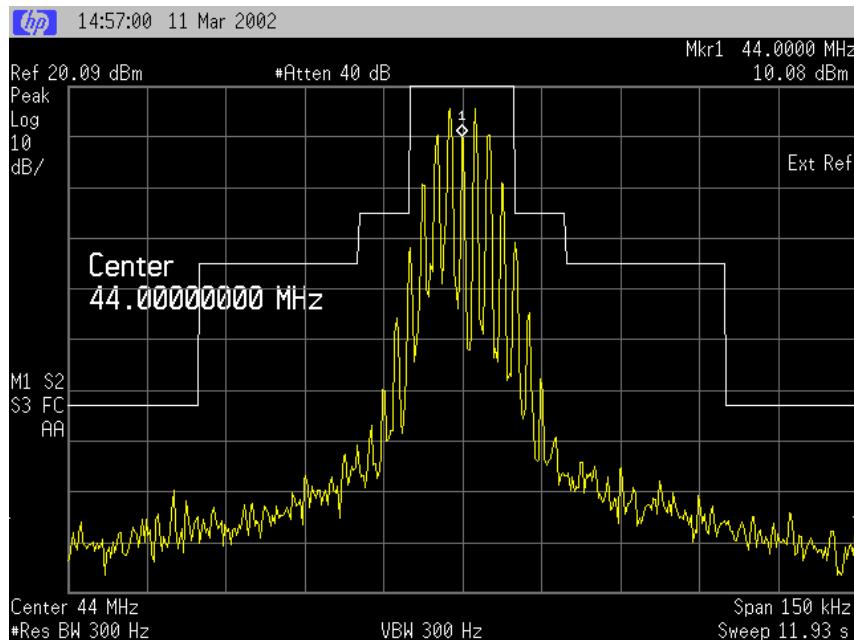


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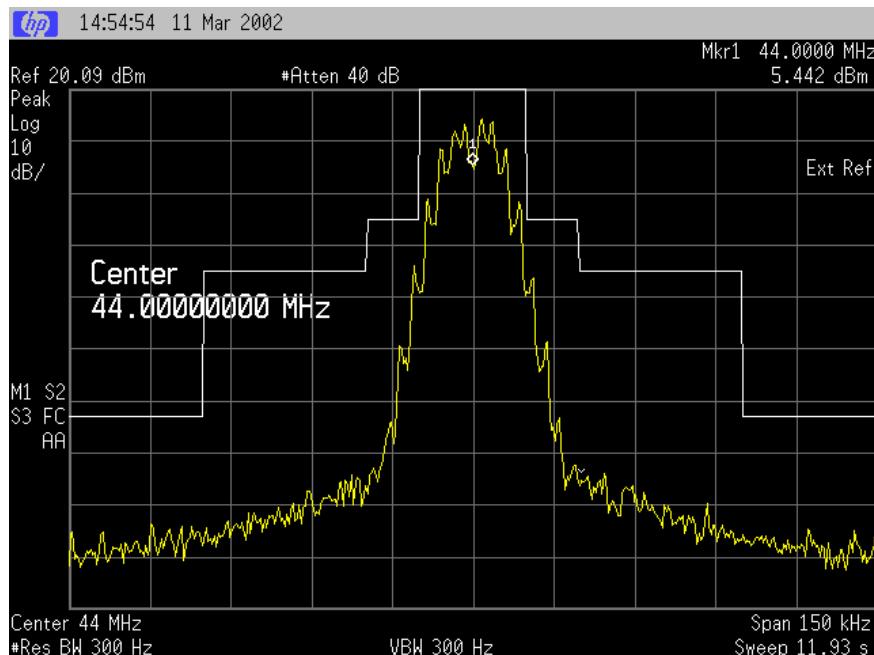
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44.000 MHz without CTCSS



44.000 MHz with CTCSS



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Spurious emissions at the transmitter antenna terminals

Frequency: 28.5000 MHz

Measured Spurious Emission	
Spurious emission (MHz)	Emission level (dBm)
17.800	-34.0
57.000	-25.7
85.500	-33.8
114.000	-52.6
142.500	-44.7
171.000	-53.7
199.500	-52.9
228.000	-
256.500	-
285.000	-

Frequency: 35.0000 MHz

Measured Spurious Emission	
Spurious emission (MHz)	Emission level (dBm)
70.000	-28.5
105.000	-31.3
140.000	-49.1
175.000	-43.1
210.000	-52.0
245.000	-
280.000	-54.0
315.000	-
350.000	-

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Frequency: 44.0000 MHz

Measured Spurious Emission	
Spurious emission (MHz)	Emission level (dBm)
33.300	-33.9
88.000	-24.6
132.000	-32.4
176.000	-50.8
220.000	-43.3
264.000	-51.1
308.000	-51.2
352.000	-54.0
396.000	-57.4
440.000	-58.4

Limit

Part 90.210(b) Mask B, (3) on any frequency removed from the assigned frequency by more than 250% of the authorised bandwidth shall be attenuated by at least $43 + 10 \log(P)$.

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.

Rated power is 100 watts. $43 + 10 \log(P)$ gives a limit of -13.0 dBm.

No measurements less than -33 dBm have been reported except those reported.

No measurements were made above the 10th harmonic.

Result: Complies

Measurement Uncertainty: $\pm 3.3 \text{ dB}$

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Field strength of transmitter spurious emissions at the antenna terminals

Frequency: 28.500 MHz

Transmit frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Margin (dB)	Polarity
57.000	66.3	-28.5	-20.0	-8.5	Vertical
85.500	71.5	-21.8	-20.0	-1.8	Vertical
114.000	53.9	-41.3	-20.0	-21.3	Vertical
142.500	54.8	-40.4	-20.0	-20.4	Vertical
171.000	48.4	-46.8	-20.0	-26.8	Vertical
199.500	50.1	-45.1	-20.0	-25.1	Vertical
228.000	43.1	-52.1	-20.0	-32.1	Vertical
256.600	64.0	-33.1	-20.0	-13.1	Vertical
285.000	58.2	-37.0	-20.0	-17.0	Vertical

Frequency: 35.000 MHz

Transmit frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Margin (dB)	Polarity
70.0	62.2	-29.7	-20.0	-9.7	Vertical
105.0	73.1	-23.5	-20.0	-3.5	Vertical
140.0	62.6	-37.2	-20.0	-17.2	Vertical
175.0	60.4	-34.8	-20.0	-14.8	Horizontal
210.0	54.3	-40.9	-20.0	-20.9	Vertical
245.0	54.7	-40.5	-20.0	-20.5	Vertical
280.0	62.5	-32.7	-20.0	-12.7	Horizontal
315.0	52.6	-42.6	-20.0	-22.6	Horizontal
350.0	58.2	-37.0	-20.0	-17.0	Horizontal

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Frequency: 44.000 MHz

Transmit frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Margin (dB)	Polarity
88.000	71.3	-22.0	-20.0	-2.0	Vertical
132.000	69.6	-30.1	-20.0	-10.1	Vertical
176.000	70.0	-29.6	-20.0	-9.6	Vertical
220.000	67.2	-30.4	-20.0	-10.4	Vertical
264.000	62.1	-33.1	-20.0	-13.1	Vertical
308.000	63.9	-31.3	-20.0	-11.3	Horizontal
352.000	58.6	-36.6	-20.0	-16.6	Vertical
396.000	60.0	-35.2	-20.0	-15.2	Vertical
440.000	66.6	-28.6	-20.0	-8.6	Horizontal

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 March 12th, 2002.

The transmitter was tested while in stand by mode and while transmitting continuously into a dummy load while being powered at 28 Vdc using an external DC power supply.

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.

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Limit

All spurious emissions are to be attenuated by at least $50 + 10 \log (P)$.

The rated power is 100 watts, which gives a limit of -20 dBm.

No measurements were made above the 10th harmonic.

All transmitter harmonic emissions observed have been reported.

All other emissions are more than 20 dB below the specification limit and have not been reported in accordance with Section 2.1057(c).

Result: Complies

Measurement Uncertainty: $\pm 4.1 \text{ dB}$

Field strength of receiver spurious emissions

Tests carried out in accordance with Part 15, Section 15.109.

IF Frequencies: 246.0 MHz, 21.4 MHz, 455 kHz

Receive frequency: 28.500 MHz

Emission frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity
224.600	20.2	46.0	-25.8	Vertical
274.500	23.2	46.0	-22.8	Horizontal

Receive frequency: 35.000 MHz

Emission frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity
281.000	25.2	46.0	-20.8	Horizontal
224.600	20.1	46.0	-25.9	Horizontal

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Receive frequency: 44.000 MHz

Emission frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity
290.000	24.1	46.0	-21.9	Horizontal
224.600	26.4	46.0	-19.6	Vertical

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 March 12th, 2002.

The receiver was operated continuously at each receive frequency with an antenna attached to the receiver antenna terminal.

The receiver antenna was attached using a 10 metre length of coax cable and was positioned to the side of the turntable using horizontal polarisation.

Limit

Part 15 section 15.109(a). The following limits have been applied:

216 – 960 MHz: 200 uV/m = 46.0 dBuV/m

above 960 MHz: 500 uV/m = 54.0 dBuV/m

No measurements were made above the 6th harmonic.

Result: Complies

Measurement Uncertainty: $\pm 4.1 \text{ dB}$

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Antenna power conduction limits for receivers

Tests carried out in accordance with Part 15, Section 15.111.

IF Frequencies: 246.0 MHz, 21.4 MHz, 455 kHz

Receive frequency: 28.500 MHz

Measured Spurious Signals		
Spurious signal (MHz)	Level at the receiver input (dBm)	Description
49.910	-80.6	-
274.400	-74.0	Lo1
1123.100	-84.0	5Lo2

Receive frequency: 35.000 MHz

Measured Spurious Signals		
Spurious signal (MHz)	Level at the receiver input (dBm)	Description
56.300	-85.6	-
281.000	-73.6	Lo1
1123.000	-84.2	5Lo2

Receive frequency: 44.000 MHz

Measured Spurious Signals		
Spurious signal (MHz)	Level at the receiver input (dBm)	Description
65.500	-	-
290.070	-73.4	Lo1
1123.290	-83.4	5Lo2

Limit

The spurious emission power should not exceed 2 nW (-57 dBm).

Result: Complies

Measurement Uncertainty: $\pm 3.3 \text{ dB}$

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Frequency Stability

Frequency stability measurements were made over the range - 30 °C to + 50°C in + 10°C increments.

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

Measurements were made with the supply varied between 115% and 85% of the nominal supply voltage (28 Vdc).

Nominal Frequency: 28.5000 MHz

Frequency Error (Hz)			
Voltage Temp.	23.8 Vdc	28.0 Vdc	32.2 Vdc
+50°C	-60.0	-61.0	-63.0
+40°C	-51.0	-53.0	-55.0
+30°C	-27.0	-28.0	-25.0
+20°C	-29.0	-25.0	-25.0
+10°C	+19.0	+14.0	+22.0
0°C	+54.0	+53.0	+49.0
-10°C	+69.0	+72.0	+72.0
-20°C	+64.0	+67.0	+72.0
-30°C	+36.0	+34.0	+33.0

Nominal Frequency: 35.000 MHz

Frequency Error (Hz)			
Voltage Temp.	23.8 Vdc	28.0 Vdc	32.2 Vdc
+50°C	-44.0	-50.0	-55.0
+40°C	-19.0	-20.0	-18.0
+30°C	-23.0	-24.0	-25.0
+20°C	-28.0	-25.0	-29.0
+10°C	+69.0	+79.0	+65.0
0°C	+110.0	+109.0	+110.0
-10°C	+92.0	+88.0	+90.0
-20°C	+12.0	+16.0	+20.0
-30°C	-35.0	-32.0	-27.0

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Nominal Frequency: 44.000 MHz

Voltage Temp.	Frequency Error (Hz)		
	23.8 Vdc	28.0 Vdc	32.2 Vdc
+50°C	-80.0	-81.0	-83.0
+40°C	-38.0	-40.0	-42.0
+30°C	+17.0	+19.0	+20.0
+20°C	-32.0	-32.0	-25.0
+10°C	+24.0	+25.0	+22.0
0°C	+125.0	+133.0	+132.0
-10°C	+141.0	+144.0	+145.0
-20°C	+163.0	+170.0	+165.0
-30°C	-37.0	-36.0	-35.0

Limit

Part 90.213 states a number of frequency stability requirements for fixed and base transmitters operating between 25 – 50 MHz is 20 ppm.

This transmitter operates on 28.5, 35.0 and 44.0 MHz. 20 ppm gives:

$$20 \times 28.5 = 570 \text{ Hz}$$

$$20 \times 35.0 = 700 \text{ Hz}$$

$$20 \times 44.0 = 880 \text{ Hz}$$

Result: Complies.

Measurement Uncertainty: $\pm 30 \text{ Hz}$

Transient frequency behaviour

Not applicable as this transmitter does not operate in the 150 – 174 MHz or the 412 – 512 MHz frequency bands.

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8. 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	Hewlett Packard	HP8491A	24838	E1329
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3698
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612
Frequency Counter	Hewlett Packard	HP 5342A	1916A01835	E1224
Horn Antenna	EMCO	3115	9511-4629	E1526
Level generator	Anritsu	MG443B	M61689	E1143
Log Periodic Antenna	Schwarzbeck	UHALP 9107	-	RFS 3702
Measurement Receiver	Rohde & Schwarz	ESCS 30	847124/020	E1595
Modulation Analyzer	Hewlett Packard	HP 8901B	2608A00782	E1090
Power Attenuator	Wienschel	49-20-43	GC104	E1308
Power Supply	Hewlett Packard	HP6032A	2743A-02859	E1069
Resistance Thermometer Meter	DSIR	RT200	35	E1409
Rubidium Oscillator	Ball Efratom	FRS - C	4287	E1053
Selective Level Meter	Anritsu	ML422C	M35386	E1040
Signal Generator	Rohde & Schwarz	SMHU 58	2642A00853	E1067
Spectrum Analyzer	Hewlett Packard	E7405A	US39150142	3776
Thermal chamber	Contherm	M180F	-	E1129
Turtable	EMCO	1080-1-2.1	9109-1578	RFS 3709
VHF Balun	Schwarzbeck	BBA 9106	-	RFS 3697
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603

9. 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 updated on March 12th, 2002.

The tests were carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to the New Zealand Code of Laboratory Management Practice incorporating ISO Guide 25: 1990 and ISO 9002: 1994.

All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to the New Zealand Code of Laboratory Management Practice incorporating ISO Guide 25: 1990 and ISO 9002: 1994.