EMC Technologies (NZ) Ltd

Test Report No **00729.1**
Report date: 1 August 2000

TEST REPORT

Tait T827-16-0500 Exciter and the Tait T828-10-0500 Power Amplifier

tested for compliance with the

Code of Federal Regulations (CFR) 47

Part 22 – Public Mobile Services

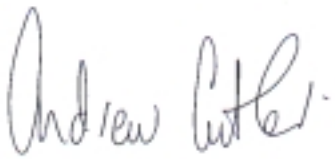
and

Part 90 –Private Land Mobile Services

for

Tait Electronics Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager

Prepared By:

Casey McNamara - Office Administrator

EMC Technologies (NZ) Ltd
STREET ADDRESS - 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand
POSTAL ADDRESS - PO Box 68 307, Newton, Auckland, New Zealand
Telephone: +64 9 360 0862 Fax: +64 9 360 0861
E-mail: aucklab@ihug.co.nz
Web Site: www.emctech.com.au

Table of Contents

EMC Technologies (NZ) Ltd
STREET ADDRESS - 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand
POSTAL ADDRESS - PO Box 68 307, Newton, Auckland, New Zealand
Telephone: +64 9 360 0862 Fax: +64 9 360 0861
E-mail: aucklab@ihug.co.nz
Web Site: www.emctech.com.au

1. CLIENT INFORMATION

Company Name	Tait Electronics Ltd
Address	558 Wairakei Road Burnside
City	Christchurch
Country	New Zealand
Contact	Linda Grose

2. DESCRIPTION OF TEST SAMPLE

Brand Name	Tait	
Model Number	T827-16-0500	T828-10-0500
Product	Exciter	Power Amplifier
Manufacturer	Tait Electronics Ltd	
Country of Origin	New Zealand	
Serial Number	244670	698746
FCC ID	CASTEL0042	

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 22 and Part 90.

CLAUSE	TEST PERFORMED	RESULT
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(a)	Low pass filter response	Complies
2.1047(b)	Modulation limiting characteristics	Complies
90.211(a)	Modulation characteristics	Complies
2.1049	Occupied bandwidth	Noted
2.202	Bandwidths	Noted
22.357	Emission types	Complies
22.359(a)	Emission masks	Complies
90.207	Types of emissions	Complies
90.209	Bandwidth limitations	Complies
90.210	Emission masks	Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Complies
2.1055	Frequency stability	Noted
22.355	Frequency tolerance	Complies
90.213	Frequency stability	Complies
2.1057	Frequency spectrum to be investigated	Noted

4. ARTICLES SUBMITTED

1 x Tait T800-22-0000 base station rack, Sn# 238873 which contained the following items:

- Tait T828-10-0500 Power Amplifier, Sn# 698746
- Tait T827-16-0500 Exciter, Sn# 244670
- Tait T808-10-0000 115 Vac power supply, Sn# 984653
- Tait T800-50-0000 Personality PCB

The base station rack had external controls to allow the following test functions:

- push to talk switch
- high and low power output switch
- narrow and wide band channel selector
- low pass filter input and output ports

1 x Tuning and Adjustment Manual
This manual includes the following items:

- general information
- exciter and power amplifier specifications
- circuit operation
- tuning and adjustment information
- PCB information
- part lists
- schematic diagrams of the exciter and power amplifier

5. TEST SAMPLE DESCRIPTION

The sample tested is a base station transmitter which comprised of a power supply, exciter and a power amplifier with the following specifications:

Rated Transmitter Output Power

High power: 50 Watts (47.0 dBm)
Low power: 10 Watts (40.0 dBm)

Test frequency

76.9000 MHz

Frequency Range

66.0 – 88.0 MHz

Emission Types and Necessary Bandwidths

Frequency Modulation, analogue speech with wide and narrowband options

11k0F3E: 12.5 kHz channel spacing with 11 kHz necessary bandwidth

16k0F3E: 15.0 kHz channel spacing with 16 kHz necessary bandwidth

Power Supply

115 Vac to the Tait T808-10-0000 power supply.

The Tait T808-10-0000 power supply has an output voltage of 13.8 Vdc.

6. Test Conditions

Standard Temperature and Humidity

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

Standard Test Power Source

The base station rack was supplied with a 13.8 Vdc power supply which was supplied with 115 Vac.

Standard Test Voltage: 115.0 Vac.

Extreme Temperature

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

Tests carried out in 10° intervals over this range

Extreme Test Voltages

High Voltage: 132.3 Vac
Low Voltage: 97.7 Vac

7. TRANSMITTER TEST RESULTS

RF power ouput

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 not being modulated.

Measurements were made with the input voltage set to 115 Vac.

RF power output (Watts)			
Temp.	**Level**	**Rated**	**Measured**
+25°C	High	50.0	47.6
+25°C	Low	10.0	10.7

Limits:
Part 22 contains no transmitter base power limits. The only powers specified are effective radiated powers. For example clause 22.593 provides for an effective radiated power of 150 watts for fixed stations operating between 72 –76 MHz for point to point operation.

Clause 90.205(c) of Part 90 specifies that maximum effective radiated power for fixed transmitters operating between 72 – 76 MHz is 300 watts eirp.

Result: Complies

Measurement Uncertainty: *±0.5 dB*

Modulation Characteristics

The following graphs are attached:

(a) Frequency response of the audio frequency low pass filter between 100 Hz and 12 kHz.

This measurement was carried out using an audio signal generator and a 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 varried 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 being recorded.

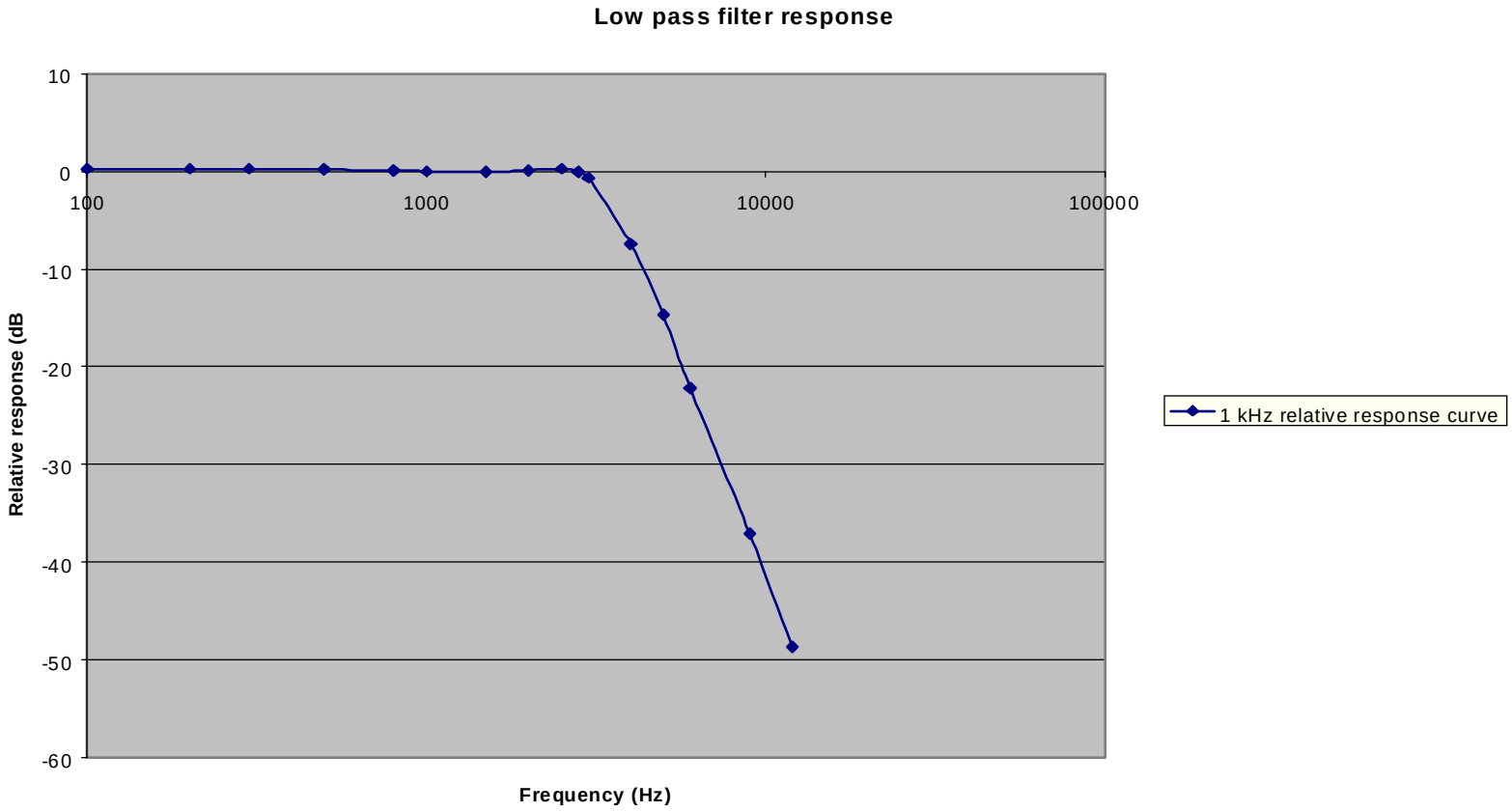
This deviation was then converted to a modulation percentage where 5 kHz deviation is 100% for 25 kHz channelling and 2.5 kHz deviation is 100% for 12.5 kHz channelling.

Limit
Part 22 provides no limits for these measurements.

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

Result: Complies

Measurement Uncertainty: *±1%.*



EMC Technologies (NZ) Ltd

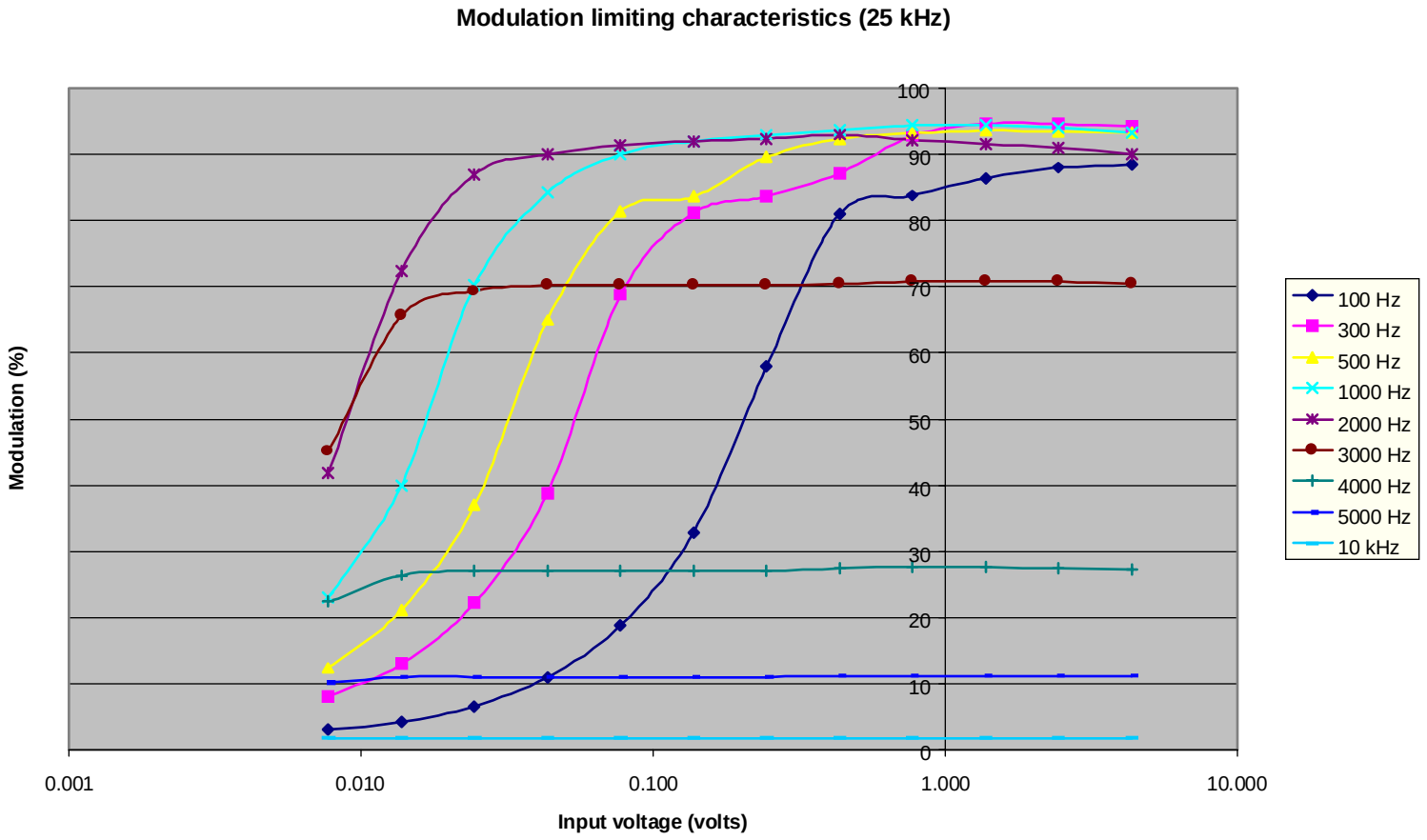
STREET ADDRESS - 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand

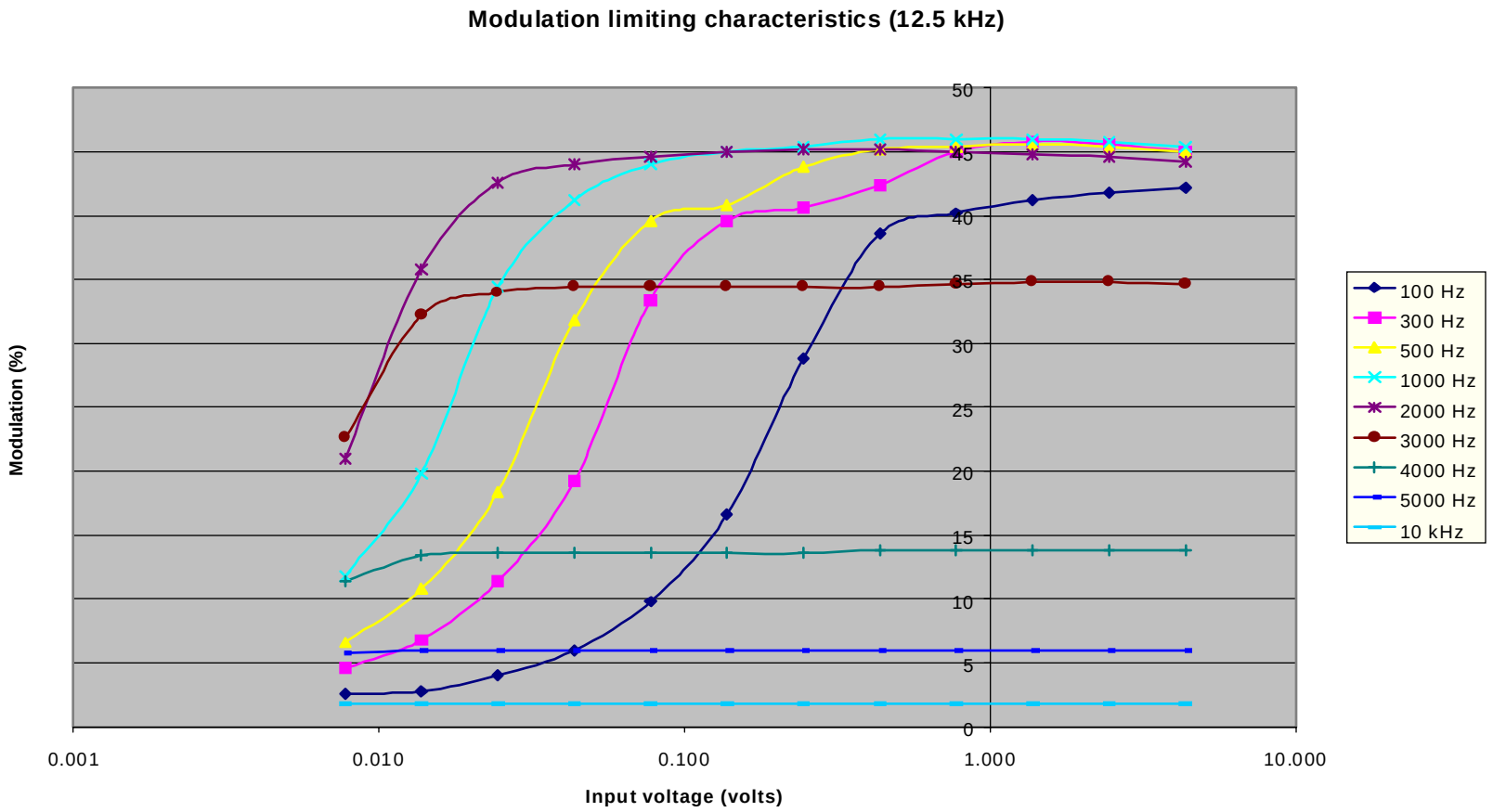
POSTAL ADDRESS - PO Box 68 307, Newton, Auckland, New Zealand

Telephone: +64 9 360 0862 Fax: +64 9 360 0861

E-mail: aucklab@ihug.co.nz

Web Site: www.emctech.com.au





EMC Technologies (NZ) Ltd

STREET ADDRESS - 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand

POSTAL ADDRESS - PO Box 68 307, Newton, Auckland, New Zealand

Telephone: +64 9 360 0862 Fax: +64 9 360 0861

E-mail: aucklab@ihug.co.nz

Web Site: www.emctech.com.au

Occupied Bandwidth

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 (1.25 and 2.5 kHz deviation respectively) at the frequency of maximum response. This was found to be at 300 Hz for both 12.5 and 25 kHz channel spacings.

Before occupied bandwidth measurements were made, the 0 dB reference point of the spectrum mask was determined by operating the transmitter with no modulation.

Spectrum masks as defined in:
Part 22.359(a) – Analog modulation
Part 90.210(b) – Mask B has been applied.

Two plots are attached as follows:
Plot 1: 2500 Hz modulation. 25 kHz spacing
Plot 2: 2500 Hz modulation. 12.5 kHz spacing

Part 22 has no authorised bandwidth's defined.

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

Using the formulas contained in Part 2.202:
$B_n = 2 \times D + 2 \times M$
Where D = maximum deviation: 2.5 kHz and 5.0 kHz
Where M = maximum modulation frequency: 3 kHz
$B_n =$ 11 kHz and 16 kHz respectively.

This is confirmed in the emission designations, 16k0F3E and 11k0F3E as declared by the client.

The following clauses are also covered by these tests:

Part 22.357 - Emission types:
The transmitter uses analogue speech which complies with the appropriate emission mask.

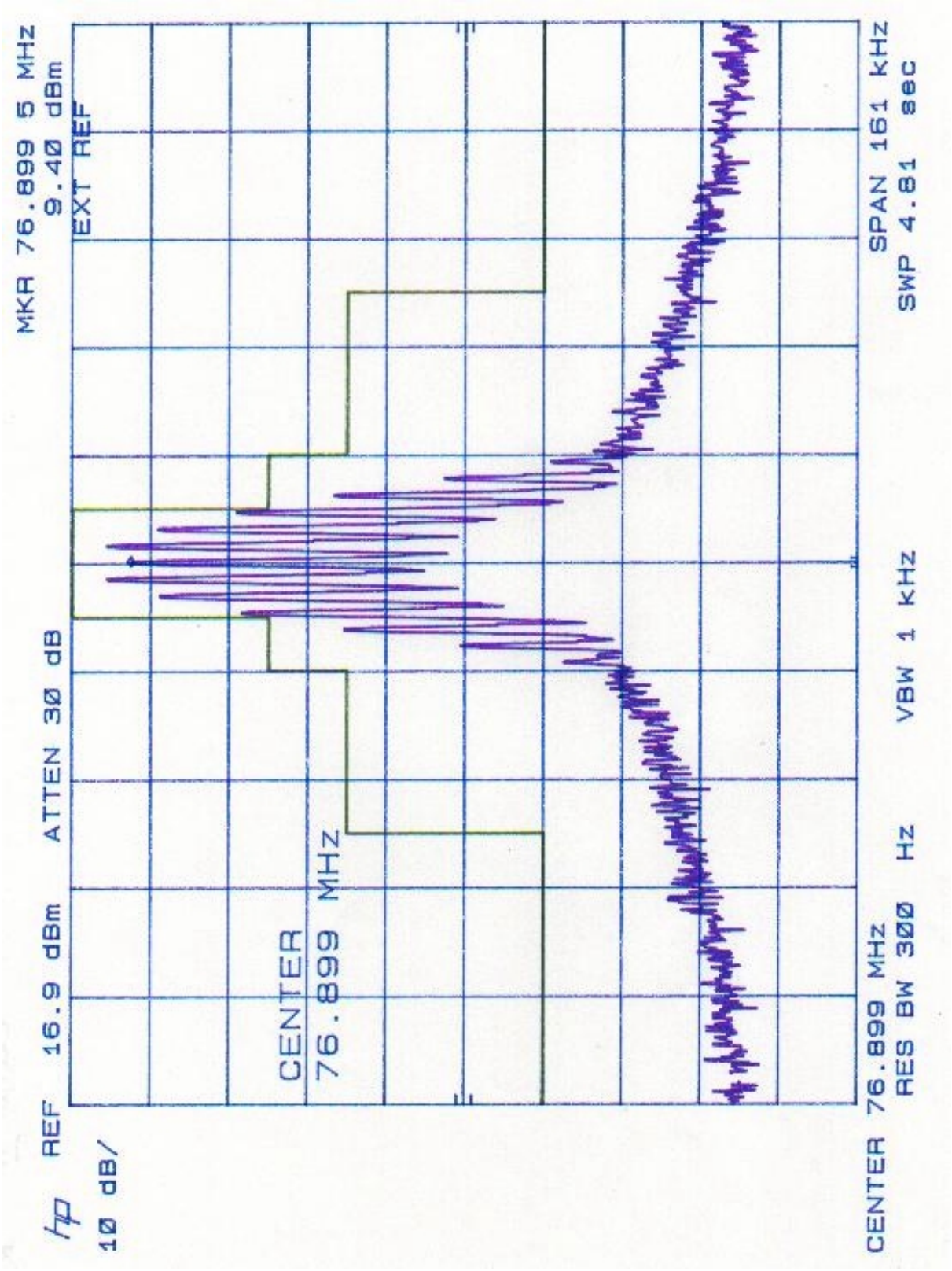
Part 90.207 – Emission types:
F3E is used by this 76.9 MHz transmitter.

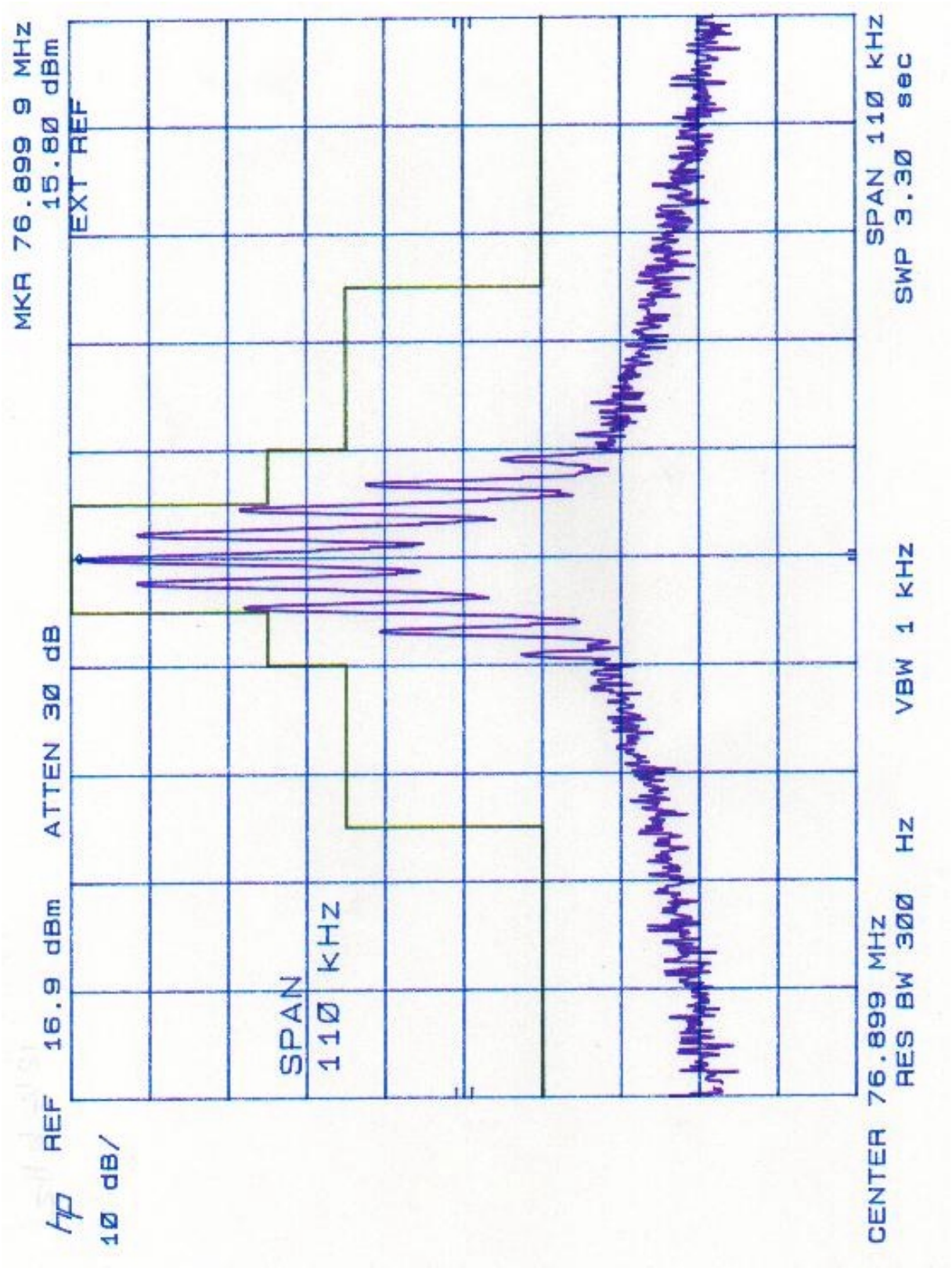
Part 90.209 – Bandwidth limitations:
Bandwidth has been calculated using the formula contained in Part 2.202.

The 20 kHz authorised bandwidth allowed for in the 72 – 76 MHz band has not been utilised as this transmitter does not use 20 kHz channel spacing (25 or 12.5 kHz channelling) and the transmitter can operate between 66 – 72 MHz and 76 – 88 MHz if required.

Result: Complies

EMC Technologies (NZ) Ltd
STREET ADDRESS - 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand
POSTAL ADDRESS - PO Box 68 307, Newton, Auckland, New Zealand
Telephone: +64 9 360 0862 Fax: +64 9 360 0861
E-mail: aucklab@ihug.co.nz
Web Site: www.emctech.com.au





Spurious emissions at antenna terminals

Frequency: 76.9000 MHz

Measured Spurious Emission		
Spurious emission (MHz)	**Emission level – High power (dBm)**	**Emission level – Low power (dBm)**
153.800	- 54.2	- 54.2
230.700	- 52.3	- 67.7
307.600	-	-
384.500	-	-
461.400	-	-
538.300	-	-
615.200	-	-
692.100	-	-
769.000	-	-

Limit

Part 22.359(a) Analogue Modulation, (3) on any frequency removed by more thatn 250% all emissions are to be attenuated by at least 43 + 10 log (P) dB or 80 dB which ever is the lesser attenuation.

Part 90.210(b) Mask B, (3) on any frequency removed by more than 250% all emissions are to 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 10^{th} harmonic if the transmitter operates below 10 GHz.

Rated powers are 50 watts and 10 watts. 43 + 10 log (P) gives 60 dB and 53 dB. This gives a limit of –13 dBm for both 50 watts and 10 watts.

No measurements less that –33 dBm have been reported except those reported.

No measurements were made above the 10^{th} harmonic.

Result: Complies

Measurement Uncertainty: *±3.3 dB*

Field strenght of spurious emissions at antenna terminals

Frequency: 76.9000 MHz

Transmit frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Margin (dB)	Polarity
52.50	40.5	-56.9	-13.0	-43.9	Vertical
55.00	44.0	-53.4	-13.0	-40.4	Vertical
64.80	45.4	-52.0	-13.0	-39.0	Vertical
153.80	33.2	-64.2	-13.0	-51.2	Vertical
153.80	28.2	-69.2	-13.0	-56.2	Vertical
230.70	43.2	-54.2	-13.0	-41.2	Vertical
230.70	47.7	-49.7	-13.0	-36.7	Vertical
307.60	22.5	-74.9	-13.0	-61.9	Horizontal
307.60	25.1	-72.3	-13.0	-59.3	Vertical
384.50	21.2	-76.2	-13.0	-63.2	Horizontal
461.40	24.5	-72.9	-13.0	-59.9	Horizontal
769.00	29.8	-67.6	-13.0	-54.6	Horizontal
769.00	24.1	-73.3	-13.0	-60.3	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 si located at Dakota Lane, Ardmore Aerodrome, Auckland. Details of this site have been filed with the Commission, Registration Number:90838, which was last updated on February 11, 2000.

The transmitter tested operating on high power with a 50 ohm dummy load attached to the output.

All significant emissions from the base station have been recorded.

Field strength measurements have been carried out and converted to transmitted power measurements using the formula

Field strength (V/m) = $\sqrt{}$ (1.64 x 30 x P) / D

Where:
P is the eirp transmitted power
1.64 is a the gain of a dipole antenna when compared to an isotropic antenna D is
D is the distance in metres. In this case 3 metres

Limit
Part 22.359(a) Analogue Modulation, (3) on any frequency removed by more thatn 250% all emissions are to be attenuated by at least 43 + 10 log (P) dB.

Part 90.210(b) Mask B, (3) on any frequency removed by more than 250% all emissions are to be attenuated by at least 43 + 10 log (P).

Rated power is 50 watts. 43 + 10 log (P) gives 60 dB and 53 dB. This gives a limit of –13 dBm .

No measurements were made above the 10^{th} harmonic.

Result: Complies

Measurement Uncertainty: *±4.1 dB*

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

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

Nominal Frequency: 76.900 000 MHz

Frequency Error (Hz)			
Voltage Temp.	**97.7 Vac**	**115 Vac**	**132.3 Vac**
+50°C	- 0	- 0	- 0
+40°C	-20	-20	-20
+30°C	-30	-30	-30
+20°C	-0	-0	-0
+10°C	-40	-40	-40
0°C	-50	-50	-40
-10°C	-40	-40	-40
-20°C	-30	-30	-30
-30°C	-20	-20	-20

Limit
Part 22.355 states base transmitters operating between 50 – 450 MHz are required to have frequency tolerance of 5.0 ppm.

Part 90.213 states the the minimum stability for fixed and base transmitters operating between 72 – 76 MHz is 5 Parts per million (ppm).

This transmitter operates on 76.9 MHz. 5 ppm = 5 x 76.9 = 384.5 Hz.

Result: Complies

Measurement Uncertainty: ±30 Hz

9 TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset
Attenuator 10 dB	Weinschel	40-10-33	CU 386	E1281
Attenuator 20 dB	Narda	766-20	7807	E1305
Audio Analyzer	Hewlett Packard	HP 8903B		E1046
DC Power Supply	Hewlett Packard	HP6032A		E1069
Frequency Counter	Hewlett Packard	HP 5342A		E1224
Level generator	Anritsu	MG443B	M72691	E1142
Modulation Analyzer	Hewlett Packard	HP 8901B		E1090
Resistance Thermometer Meter	DSIR	RT200	35	E1409
RF Power Meter	Hewlett Packard	HP 436A		E1209
Rubidium Oscillator	Ball Efratom	FRS – C	4287	
Spectrum Analyzer	Hewlett Packard	8566B		3771/3772
Thermal chamber	Contherm	M180F		E1129
Aerial Controller	EMCO	1090	9112-1062	RFS 3710
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708
Biconical Antenna	Schwarzbeck	BBA 9106		RFS 3612
Log Periodic Antenna	Schwarzbeck	UHALP 9107		RFS 3702
Measurement Receiver	Rohde & Schwarz	ESCS 30	839873/1	
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709

10. 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 February 11th, 2000.

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