TEST REPORT

Tait T881-35-0500 Base Station

tested for compliance with the

Code of Federal Regulations (CFR) 47

Part 22 – Public Mobile Services

and

Part 90 –Private Land Mobile Services

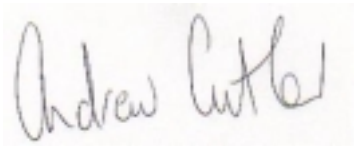
And

Part 101 – Fixed Microwave Services

for

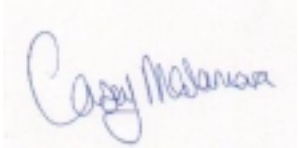
Tait Electronics Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager

Prepared By:



Casey McNamara - Office Administrator

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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	T881-35-0500
Product	Base Station
Manufacturer	Tait Electronics Ltd
Country of Origin	New Zealand
Serial Number	702380
FCC ID	CASTEL0045

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, Part 90 and Part 101.

CLAUSE	TEST PERFORMED	RESULT
2.1041	Measurement procedures	Noted
2.1046	RF power output	Noted
90.205	Power and antenna height limits	Complies
101.113	Transmitter power limitations	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
101.141	Microwave modulation	Not applicable
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
101.109	Bandwidth	Complies
101.111(a)(1)	Emission Limitations	Complies
101.147	Frequency assignments	Noted
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
101.107	Frequency tolerance	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 T881-35-0500 Transmiter Sn# 702380
- 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 (not in use)
- low pass filter input and output ports

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

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

5. TEST SAMPLE DESCRIPTION

The sample tested is a base station transmitter with the following specifications:

Rated Transmitter Output Power

High power: 5 Watts (37.0 dBm)
Low power: 1 Watts (30.0 dBm)

Test frequency

935.1000 MHz

Frequency Range

890.0 – 960.0 MHz

Emission Types and Necessary Bandwidths

Frequency Modulation, analogue speech with narrow band option

11k0F3E: 12.5 kHz channel spacing with 11 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. ATTESTATION

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

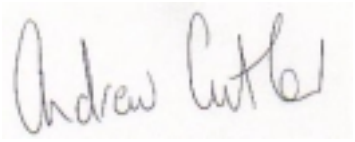
The test sample was selected by the client.

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. Each unit manufactured, imported, or marketed, as defined in the Commission's regulations, will conform to the sample(s) tested with the variations statistical basis. 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

8. 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	5.0	5.01
+25°C	Low	1.0	1.04

Limits:
Part 22 contains no transmitter base power limits.

Part 90 contains no transmitter base power limits.

However section 90.205(j) specifies that LMS systems operating between 902 – 928 MHz pursuant to subpart M are authorised to a maximum of 30 W ERP. In addition LMS systems in the 927.25 – 928 MHz band are authorised to a maximum of 300 W ERP.

Section 90.205(k), which in turn refers to section clause 90.494, allows a power of 1 kW for operations between 929 – 930 MHz.

Part 101 contains no transmitter base power limits.

Section 101.113 defines a number of maximum EiRP power levels that can be used in various bands between 928 and 960 MHz. The band 928 – 929 MHz has the lowest allowable power which is set at +17 dBW (50 W 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 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.

(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 2.5 kHz deviation is 100% for 12.5 kHz channeling.

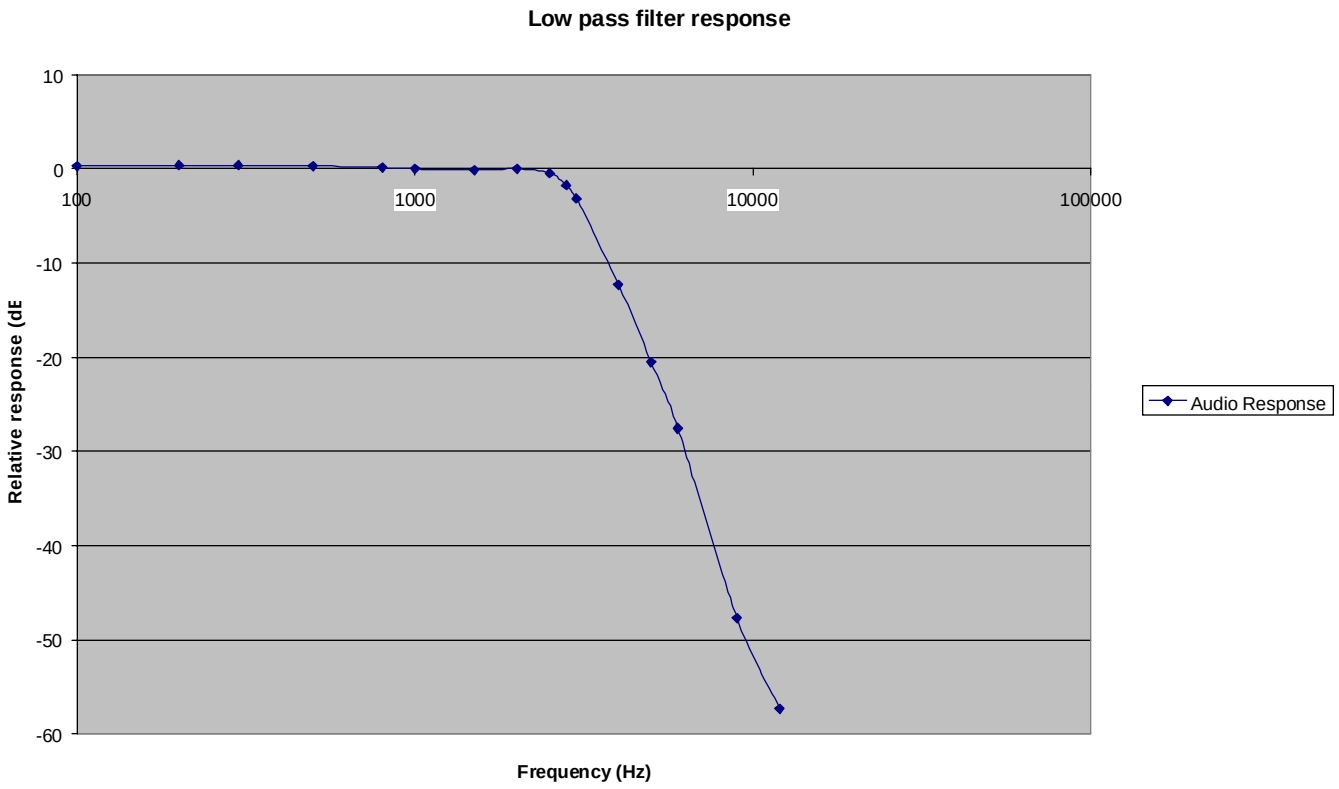
Limit
Part 22 provides no limits for these measurements.

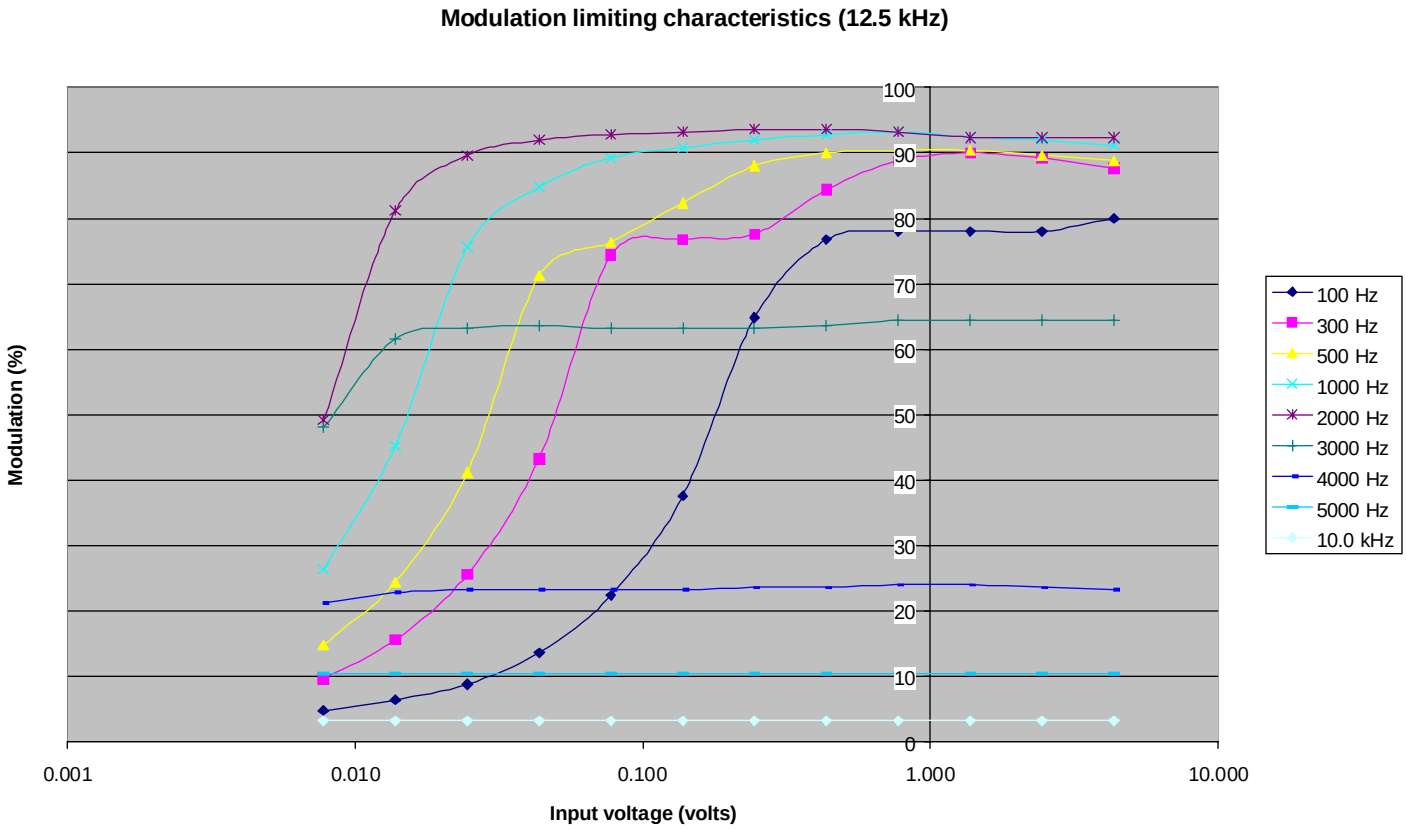
Part 90.211 – Modulation requirements states the transmitter must meet the emission requirements of 90.210. Refer to the Occupied Bandwidth measurements in this report.

Part 101 provides no limits for these measurements. Section 101.141 – Microwave modulation only refers to services operating on frequencies higher than 960 MHz.

Result: Complies

Measurement Uncertainty: ±1%.





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 (2.5 kHz deviation) at the frequency of maximum response. The frequency of maximum frequency response was found to be at 2000 Hz.

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

The spectrum mask is defined in:
Section 22.359(a) – Analog modulation
Section 90.210(b) – Mask B has been applied as the transmitter can operate in the band 929 - 930 MHz and it can operate above 940 MHz.
Section 101.111(a)(1) – Transmissions other than those using digital modulation techniques.

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
Where M = maximum modulation frequency: 3 kHz
$B_n =$ 11 kHz

This is confirmed in the emission designation, 11k0F3E as declared by the client.

Section 90.209(b)(5) defines the authorised bandwidth as 13.6 kHz where 12.5 kHz channeling is used in the bands 896 – 901 / 935 – 940 MHz.

For all other bands the authorised bandwidth is taken to be the necessary bandwidth, 11 kHz, as calculated above.

Section 101.109 states that a 12.5 kHz authorised bandwidth can be used in the bands 932 – 932.5 MHz and 941 – 941.5 MHz. Bandwidths greater than 12.5 kHz can also be used in the bands 928 – 929 MHz, 932.5 – 935 MHz, 941.5 – 944 MHz and 952 – 960 MHz. In addition Section 101.109 states that the maximum bandwidth authorised for each particular frequency in these bands is defined in Section 101.147. 12.5 kHz authorised bandwidth frequencies are defined in Tables 1, 3, 5 and 7.

Therefore emission mask testing has been carried out with a worst case bandwidth of 11 kHz which relates to the necessary bandwidth.

In doing so this transmitter will meet the following requirements:
- Part 22 where the authorised bandwidth = necessary bandwidth = 11 kHz.
- Part 90 where 13.6 kHz authorised bandwidths apply.
- Part 101 where 12.5 kHz authorised bandwidths apply.

The following clauses are also covered by these tests:

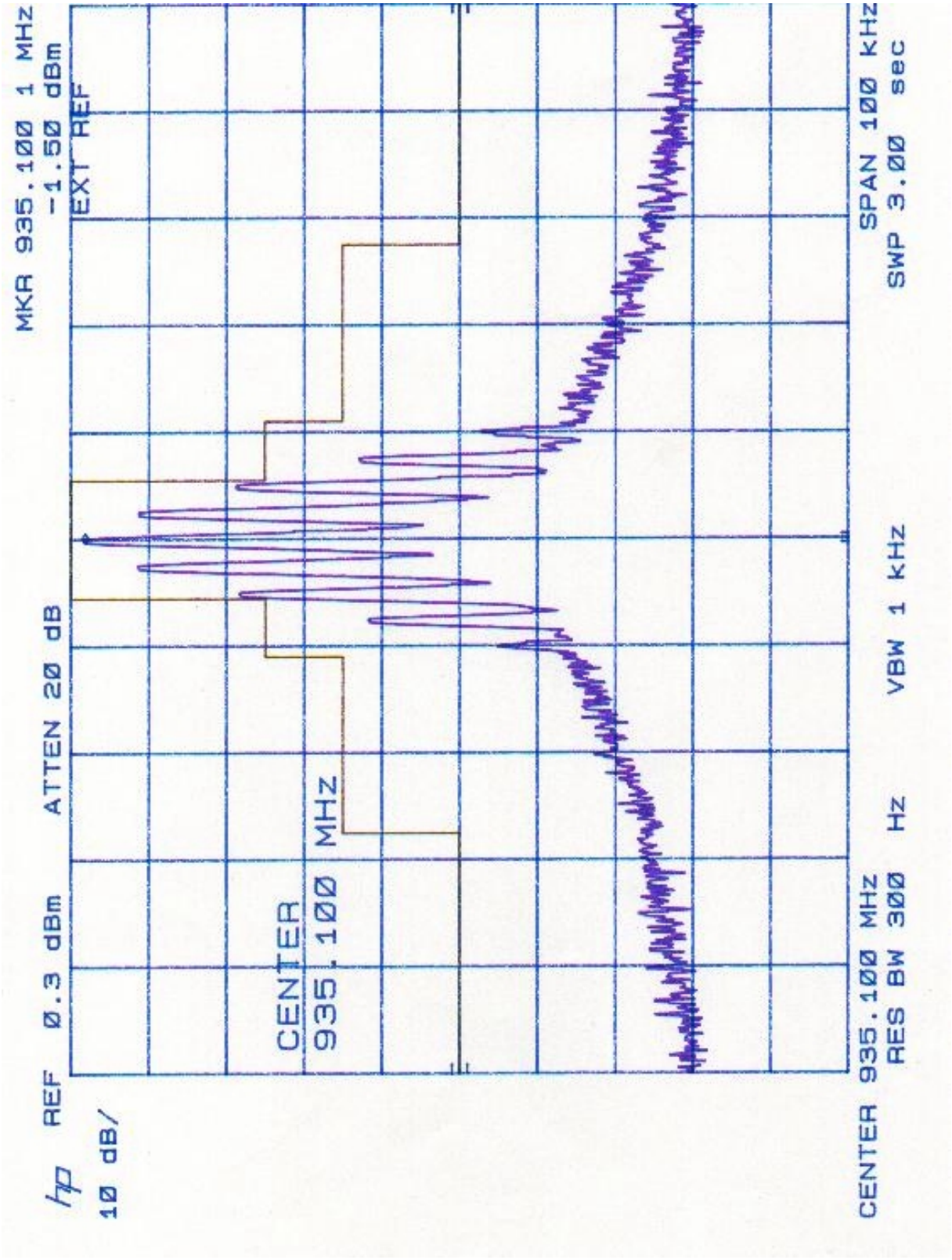
Part 22.357 - Emission types:
The transmitter uses analogue speech which complies with the appropriate emission mask.

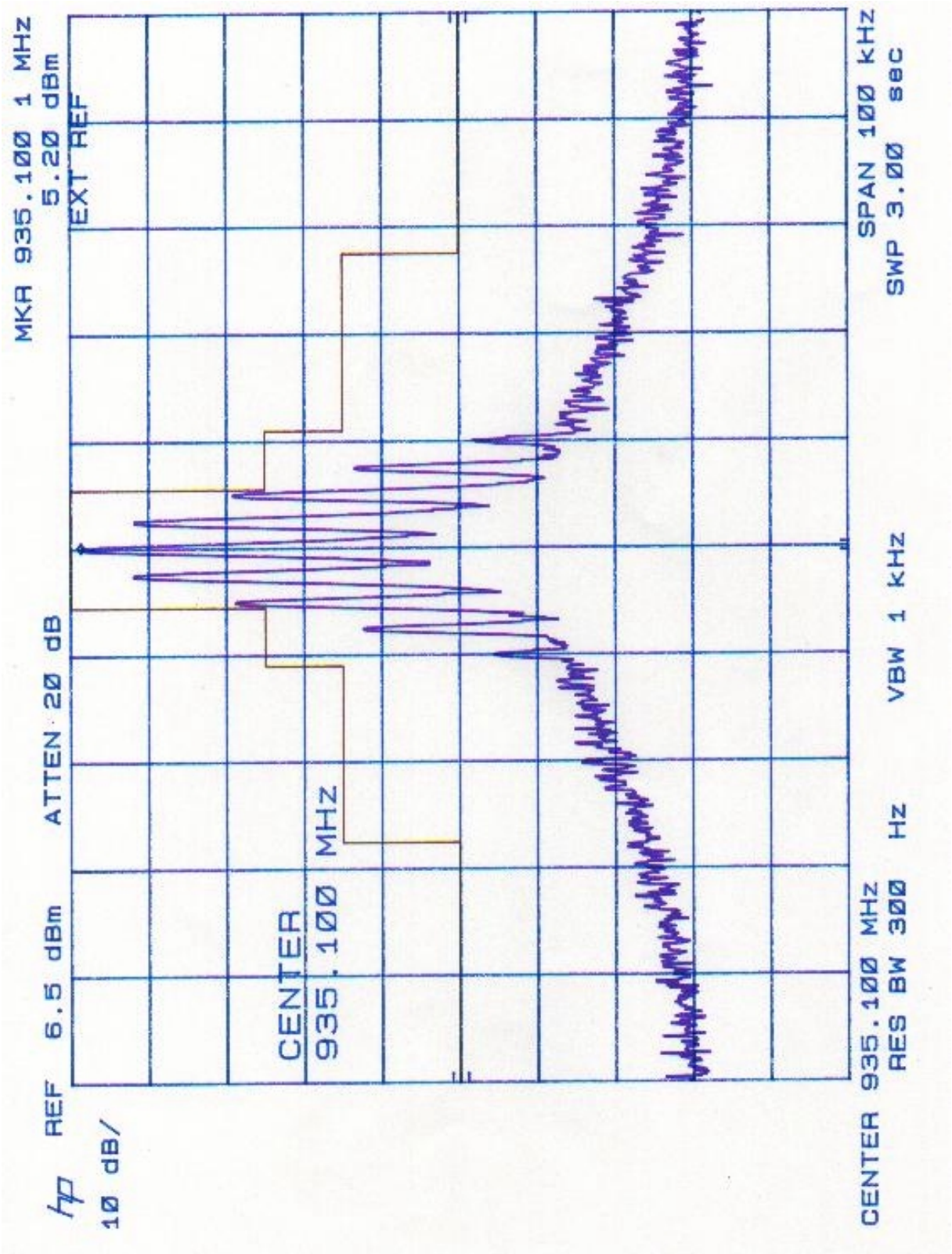
Part 90.207 – Emission types:
Emission type F3E is used by this transmitter.

Part 90.209 – Bandwidth limitations:
Bandwidth has been calculated using the formula contained in Part 2.202 as described for the Part 22 requirements above.

Two plots have been provided. One plot is for high power operation and the other plot is for low power operation.

Result: Complies





Spurious emissions at antenna terminals

Frequency: 935.1000 MHz

Measured Spurious Emission		
Spurious emission (MHz)	**Emission level – High power (dBm)**	**Emission level – Low power (dBm)**
924.4	-48.8	-
1870.2	-44.5	-53.0
2805.3	-57.5	-67.0
3740.4	-34.1	-45.4
4675.5	-56.8	-61.6
5610.6	-61.0	-
6545.7	-	-
7480.8	-48.1	-63.4
8415.9	-	-
9351.0	-	-

Limit
Part 22.359(a) Analogue Modulation, (3) on any frequency removed by more than 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 101.111(a)(1)(iii) on any frequency removed by more than 250% all emissions are to be attenuated by at least 43 + 10 log (P) or 80 dB which ever 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 10^{th} harmonic if the transmitter operates below 10 GHz.

Rated powers are 5 watts and 1 watts. 43 + 10 log (P) gives 50 dB and 43 dB. This gives a limit of –13 dBm for both 5 watts and 1 watts.

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

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: 935.1000 MHz

Emission Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Margin (dB)	Polarity
65.00	45.0	-52.4	-13.0	-39.4	Vertical
1870.20	59.7	-37.7	-13.0	-24.7	Vertical
2805.30	50.5	-46.9	-13.0	-33.9	Vertical
3740.40	51.3	-46.1	-13.0	-33.1	Horizontal
4675.50	-	-	-13.0	-	Vert/Hort
5610.60	-	-	-13.0	-	Vert/Hort
6545.70	-	-	-13.0	-	Vert/Hort
7480.80	-	-	-13.0	-	Vert/Hort
8415.90	-	-	-13.0	-	Vert/Hort
9351.00	-	-	-13.0	-	Vert/Hort

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 than 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).

Part 101.111(a)(1)(iii) on any frequency removed by more than 250% all emissions are to be attenuated by at least 43 + 10 log (P) or 80 dB which ever is the lesser attenuation.

Rated power is 5 watts and 1 watt. 43 + 10 log (P) gives 50 dB and 43 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: 935.100 000 MHz

Frequency Error (Hz)			
Voltage Temp.	**97.7 Vac**	**115 Vac**	**132.3 Vac**
+50°C	-25.0	-25.0	-24.0
+40°C	-19.0	-20.0	-19.0
+30°C	-5.0	-5.0	-4.0
+20°C	-16.0	-17.0	-16.0
+10°C	-10.0	-11.0	-10.0
0°C	-59.0	-62.0	-59.0
-10°C	-11.0	-11.0	-11.0
-20°C	-38.0	-40.0	-40.0
-30°C	-220.0	-220.0	-218.0

Limit
Part 22.355 states base transmitters operating between 929 – 960 MHz are required to have frequency tolerance of 1.5 ppm.

Part 90.213 states a number of frequency stability requirements for fixed and base transmitters as detailed below:
- 0.1 ppm if operating between 896 – 901 MHz and 935 – 940 MHz
- 2.5 ppm if operating between 902 – 928 MHz
- 1.5 ppm if operating between 929 – 930 MHz.

As the transmitter can operate between 890 – 960 MHz the worst case stability of 0.1 ppm has been applied.
If the transmitter does not meet this requirement Part 90 operations of this transmitter will be restricted to bands where frequency stability requirements are met.

This transmitter operates on 935.1 MHz. 0.1 ppm = 0.1 x 935.1 = 93.5 Hz.
1.5 ppm = 1.5 x 935.1 = 1402.6 Hz

Part 101.107 defines the frequency tolerance below:

- 0.0005% 929 – 930 MHz
- 0.00015% 932 – 932.5 MHz
- 0.00025% 932.5 – 935 MHz
- 0.00015% 941 – 941.5 MHz
- 0.00025% 941.5 – 944 MHz
- 0.0005% 944 – 1000 MHz

A worst case frequency tolerance of 0.00015 % has been applied.

935.1 MHz x 0.00015% (1.5 ppm) = 1403.4 Hz

Result: Complies when a minimum frequency stability / tolerance limit of 1.5 ppm / 0.00015% is applied.

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
Coax Cable	Sucoflex	104PA	2736/4PA	
Spectrum Analyzer	Hewlett Packard	E7015A	US39150142	RFS 3776
Horn Antenna	Electrometrics	RGA-60	6234	E1494

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.

11. PHOTOGRAPH(S)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T881-35-0500 R
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Tait Electronics Limited
Made in New Zealand