

# EMC Technologies (NZ) Ltd

Test Report No **41124.1**  
Report date: 25<sup>th</sup> November 2004

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## **TEST REPORT**

### **SIMOCO SRM9000 AC VHF Mobile Transceiver**

*tested to the*

#### **Code of Federal Regulations (CFR) 47**

#### **Part 15 – Radio Frequency Devices**

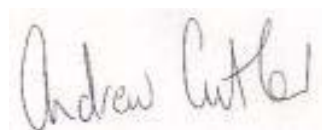
#### **Part 22 – Public Mobile Services**

#### **Part 90 –Private Land Mobile Services**

*for*

### **TMC Radio Pty Ltd**

This Test Report is issued with the authority of:



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**Andrew Cutler - General Manager**



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#### **EMC Technologies (NZ) Ltd**

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# EMC Technologies (NZ) Ltd

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## 1. CLIENT INFORMATION

|                     |                                      |
|---------------------|--------------------------------------|
| <b>Company Name</b> | TMC Radio Pty Ltd                    |
| <b>Address</b>      | 1270 Ferntree Gully Road<br>Scoresby |
| <b>City</b>         | Melbourne                            |
| <b>Country</b>      | Australia                            |
| <b>Contact</b>      | Mr Robert Stowell                    |

## 2. DESCRIPTION OF TEST SAMPLE

|                        |                        |
|------------------------|------------------------|
| <b>Brand Name</b>      | SIMOCO                 |
| <b>Model Number</b>    | SRM9000 AC             |
| <b>Product</b>         | VHF Mobile Transceiver |
| <b>Manufacturer</b>    | TMC Radio Pty Ltd      |
| <b>Designed in</b>     | Australia              |
| <b>Manufactured in</b> | Taiwan                 |
| <b>Serial Number</b>   | 5MACX0447004C          |
| <b>FCC ID</b>          | STZSRM9000AC           |

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## 3. COMPLIANCE STATEMENT AND RESULT SUMMARY

The **SIMOCO SRM9000 AC VHF Mobile Transceiver** complies with the limits defined in 47CFR 15, 47CFR22, 47 CFR Part 90 and 47 CFR Part 2 when tested in accordance with the test methods described in 47 CFR Part 2.

| <u>CLAUSE</u> | <u>TEST PERFORMED</u>                     | <u>RESULT</u> |
|---------------|-------------------------------------------|---------------|
| 2.1041        | Measurement procedures                    | Noted         |
| 90.203        | Certification required                    | Complies      |
| 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         |
| 90.214        | Transient frequency behaviour             | Complies      |
| 15.109        | Radiated emission limits                  | Complies      |
| 15.111        | Antenna conducted power measurement       | Complies      |
| 1.1310        | Radio frequency radiation exposure limits | Complies      |

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## 4. TEST SAMPLE DESCRIPTION

The sample tested has the following specifications:

### Rated Transmitter Output Power

25.0 Watts (44.0 dBm)

### Transmitter frequency range

150 – 174 MHz

### Test frequencies

| Chl | Frequency<br>MHz | Power<br>Watts | Spacing<br>kHz |
|-----|------------------|----------------|----------------|
| 1   | 150.0750         | 25.0           | 12.5           |
| 2   | 162.0750         | 25.0           | 12.5           |
| 3   | 173.9750         | 25.0           | 12.5           |
| 4   | 150.0750         | 25.0           | 25.0           |
| 5   | 162.0750         | 25.0           | 25.0           |
| 6   | 173.9750         | 25.0           | 25.0           |

### Emission Designators / Modes of operation

11k0F3E – Analogue speech

11k0F1D – 1200 baud FFSK

8k10F1E – C4FM digital speech

16k0F3E – Analogue speech

16k0F1D – 1200 baud FFSK

### Power Supply

External DC voltage supply. Typically 13.8 Vdc

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## 5. TEST CONDITIONS

### Standard Temperature and Humidity

Temperature: +25°C ± 4° maintained.

Relative Humidity: 60% ± 10% observed.

### Standard Test Power Source

Standard Test Voltage: 13.8 Vdc.

### Extreme Temperature

High Temperature: + 50°C maintained.

Low Temperature: - 30 °C maintained.

### Extreme Test Voltages

High Voltage: 15.9 Vdc

Low Voltage: 11.7 Vdc

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## 6. ATTESTATION

The **SIMOCO SRM9000 AC VHF Mobile Transceiver** complies with the Code of Federal Regulations (CFR) 47 Part 90 –Private Land Mobile Services , Part 22 – Public Land Mobile Services, Part 15 – Radio Frequency Devices.

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. TEST RESULTS

### Certification required

25 kHz channel bandwidth certification is sought for this transmitter under section 90.203(j)(2)(ii) as:

- certification has been sought after Feb 14<sup>th</sup>, 1997 and before January 1<sup>st</sup>, 2005
- the equipment has multi-bandwidth modes
- the equipment can operate with on 25 kHz and 12.5 kHz channels

**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  $\Omega$  dummy load. Measurements were carried out when the transmitter was not being modulated. Measurements were made with the input voltage set to 13.8 Vdc and when varied +/- 15%. Testing was carried out at maximum power output.

| <u>RF power output</u><br>(dBm) |                |       |          |
|---------------------------------|----------------|-------|----------|
| Frequency                       | Supply voltage | Rated | Measured |
| 150.0750                        | 13.8           | 44.0  | 43.9     |
| 162.0750                        | 13.8           | 44.0  | 43.8     |
| 173.9750                        | 13.8           | 44.0  | 43.7     |

| <u>RF power output</u><br>(dBm) |                |       |          |
|---------------------------------|----------------|-------|----------|
| Frequency                       | Supply voltage | Rated | Measured |
| 162.0750                        | 11.7           | 44.0  | 43.8     |
| 162.0750                        | 13.8           | 44.0  | 43.8     |
| 162.0750                        | 15.9           | 44.0  | 44.0     |

Limits:

Part 90 does not specify the transmitter output power for this band.

Part 22 does not specify the transmitter output power.

**Result:** Complies.

**Measurement Uncertainty:**  $\pm 0.5$  dB

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## Modulation Characteristics

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

### **Analogue Speech**

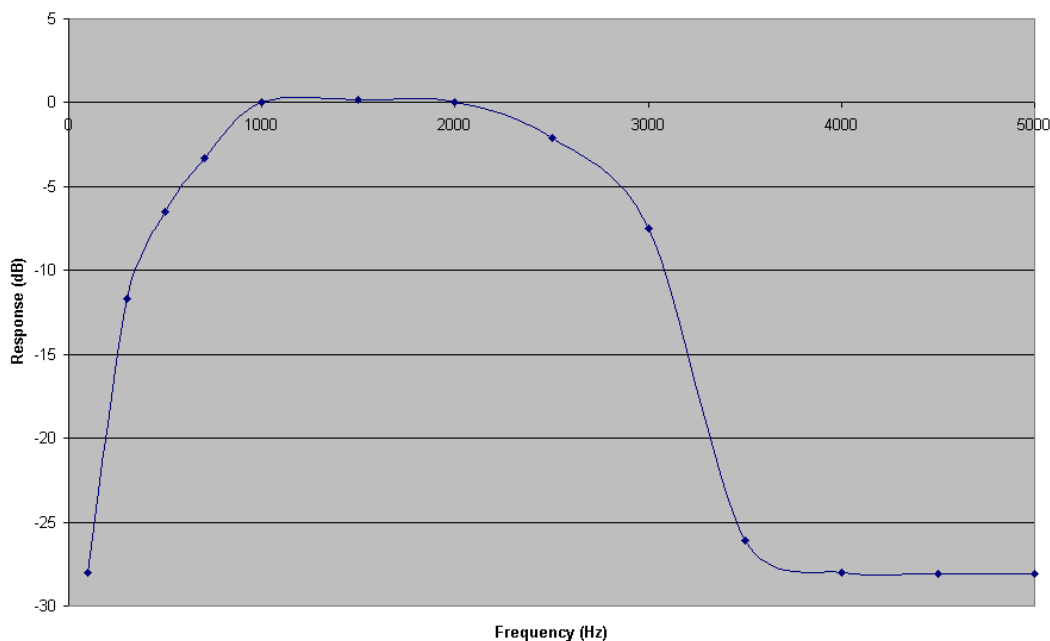
- (a) Frequency response of the audio frequency low pass filter between 100 Hz and 15 kHz.

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.

Low pass filter response - 12.5 kHz transmitter.



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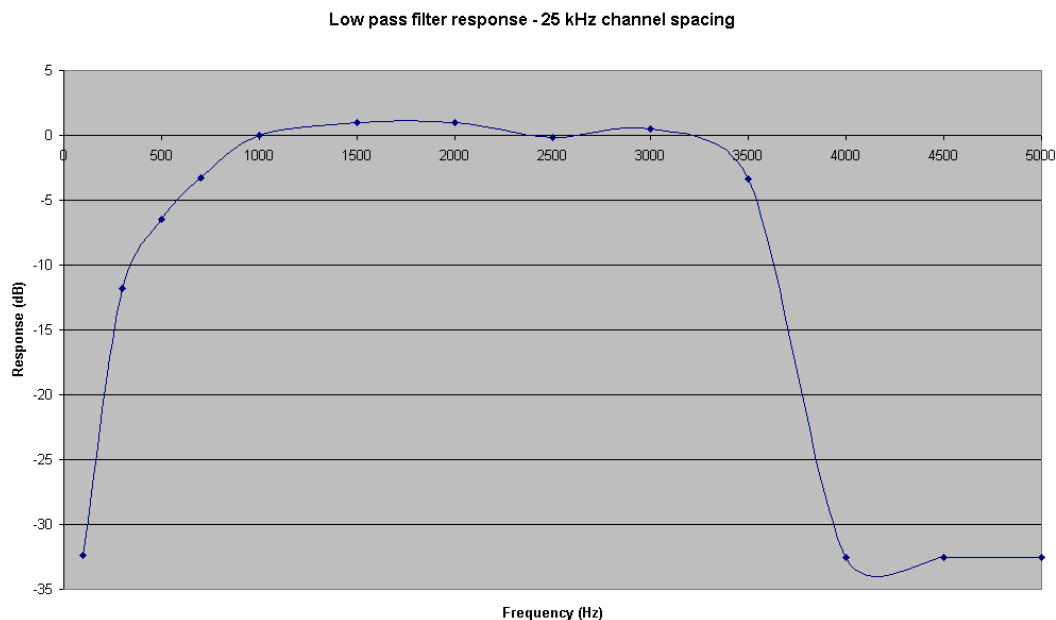
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(b) A family of curves showing the percentage of modulation versus the modulation input voltage.

Measurements were made between 100 Hz to 4 kHz where channel spacings of 12.5 and 25 kHz are utilised.

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 channels and 2.5 kHz deviation is 100% for 12.5 kHz channels.

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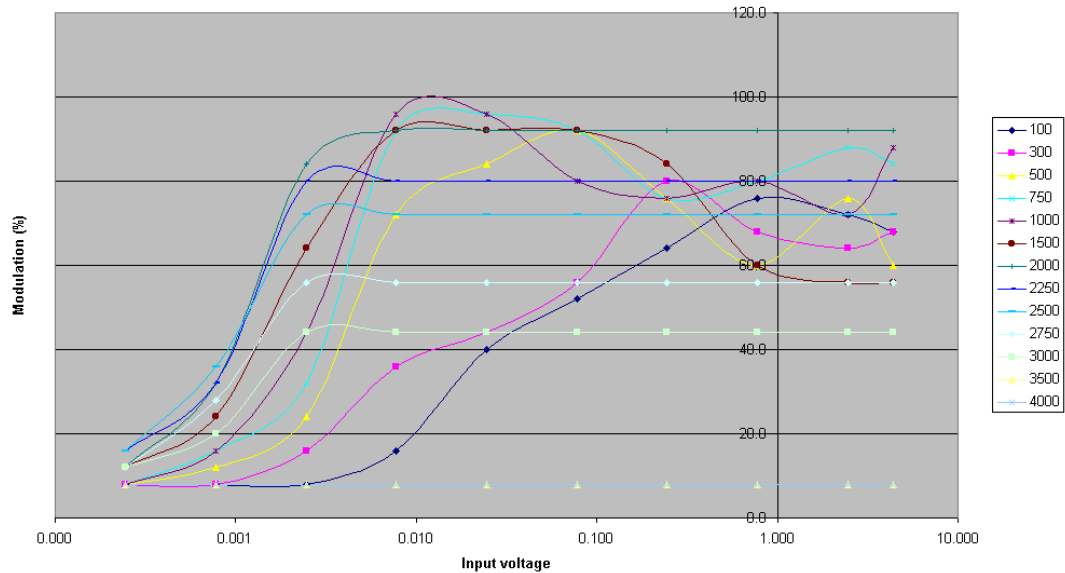
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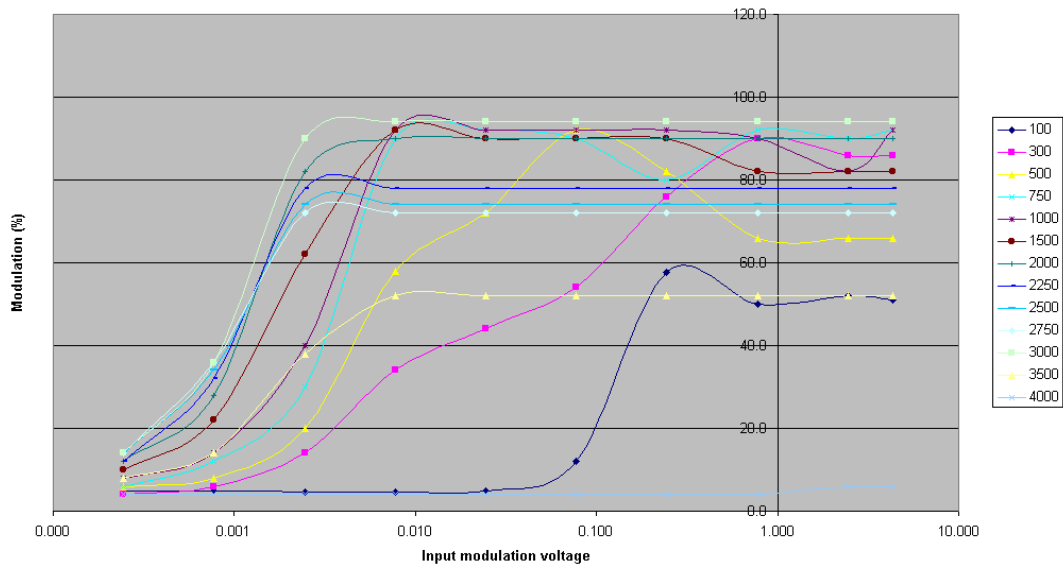
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Modulation limiting - 12.5 kHz transmitter



Modulation Limiting Characteristics - 25 kHz transmitter



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

Digital modulation as detailed below is also used with this transmitter.

The types of modulation used are:

C4FM digital modulation is used for digital telephony (F1E).

1200 baud FFSK data is used for data transmissions (F1D).

*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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## **Part 90.207 – Emission types:**

The following emission types are used:

- F3E: Frequency modulation with analogue speech.
- F1E: Digital telephony using C4FM.
- F1D: Data transmission using 1200 baud FFSK data.

## **Part 90.209 – Bandwidth limitations:**

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

Using the formulas contained in Part 2.202 the necessary bandwidth calculation for the 25 kHz channel step emission is:

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

Where D = maximum deviation: 5.0 kHz

Where M = maximum modulation frequency: 3 kHz

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

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

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

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

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

Part 22.359(a) – Analog modulation. No authorised bandwidth is defined.

The necessary bandwidth is 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 or 5.0 kHz

Where M = maximum modulation frequency: 3 kHz

$$B_n = \underline{11.0 \text{ kHz or } 16 \text{ kHz}}$$

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

Part 22 emission mask measurements have been carried out using necessary bandwidths of 11.25 kHz and 16 kHz respectively.

This transmitter can also transmit digital telephony and data using F1E and F1D.

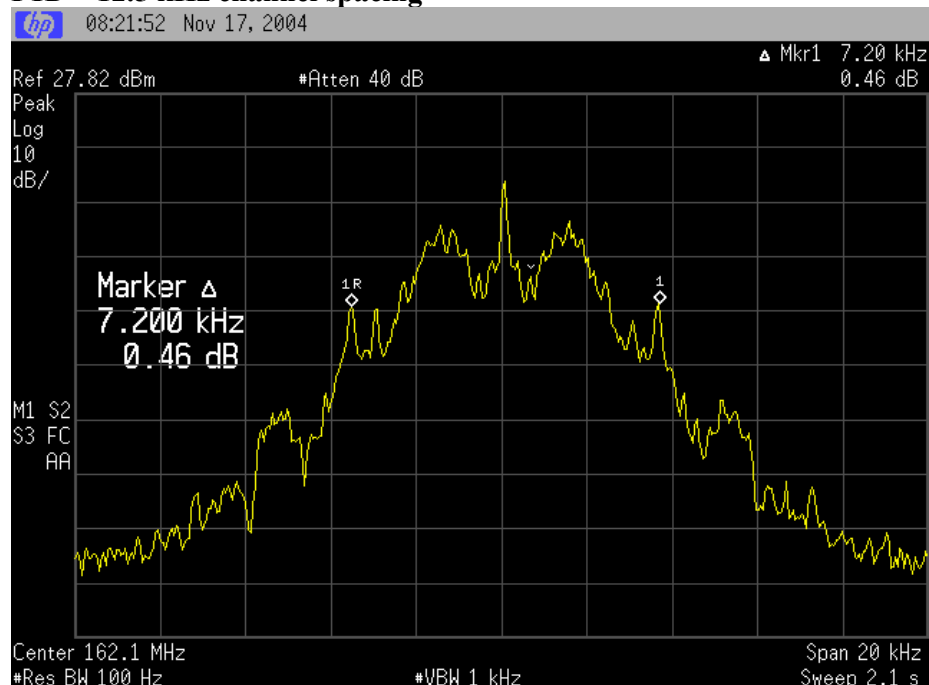
Using the tables in Part 2.202 – Bandwidth a bandwidth for the F1D and F1E emissions could not be determined easily.

Measurements of the authorised / occupied bandwidth at the 99% power level have been carried out.

This was carried out at the –23 dB points with the spectrum analyser in peak hold mode.

| Emission | Channel  | Measured  | Designation |
|----------|----------|-----------|-------------|
| F1D      | 12.5 kHz | 7.20 kHz  | 11k0F1D     |
| F1E      | 12.5 kHz | 8.10 kHz  | 8k10F1E     |
| F1D      | 25.0 kHz | 10.95 kHz | 16k0F1D     |

## F1D – 12.5 kHz channel spacing



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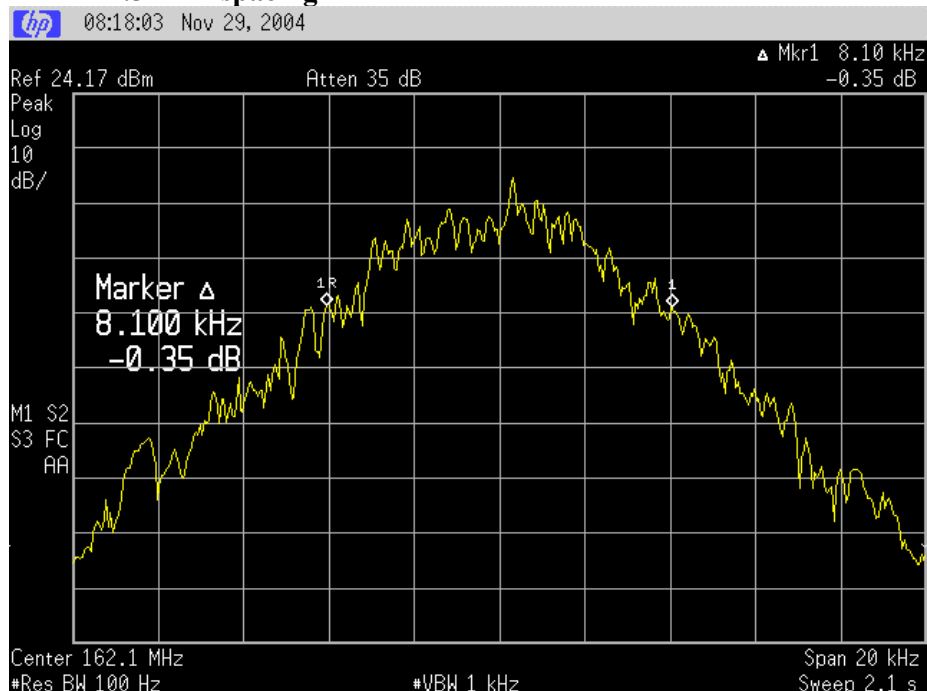
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## F1E – 12.5 KHz spacing



## F1D – 25.0 kHz channel spacing



**Result: Complies**

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## **Occupied Bandwidth**

The spectrum masks are defined in:

Section 90.210(d) – Masks B and D have been applied as the transmitter can operate in the band 421 – 512 MHz using an authorised bandwidth of 20.0 kHz and 11.25 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 30 kHz with the transmitter not being modulated.

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

Measurements were made in peak hold with the transmitter operating on 162.0750 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 F1E and F1D modes the transmitter was modulated uses modulation sources internal to the transmitter as supplied by the client.

Section 22.359(a) has been applied when analogue speech is utilised. The authorised bandwidth is taken as the necessary bandwidth which has been determined by calculation.

The 12.5 kHz transmitter has an authorised bandwidth (necessary bandwidth calculated) of 11 kHz applied and the 25 kHz transmitter has an authorised bandwidth of 16 kHz applied

Section 22.359(b)(1) has been applied to when F1D and F1E are utilised. Authorised bandwidths of 7.2, 8.1 and 11 kHz (based upon the measured occupied bandwidths) have been applied.

**Result:** Complies

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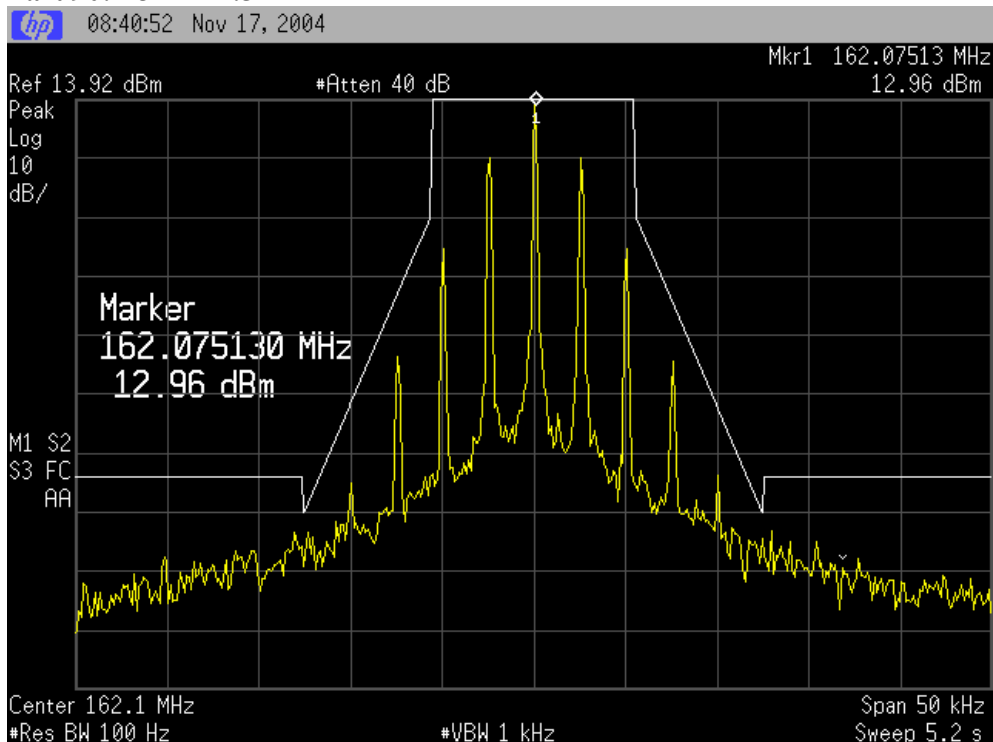
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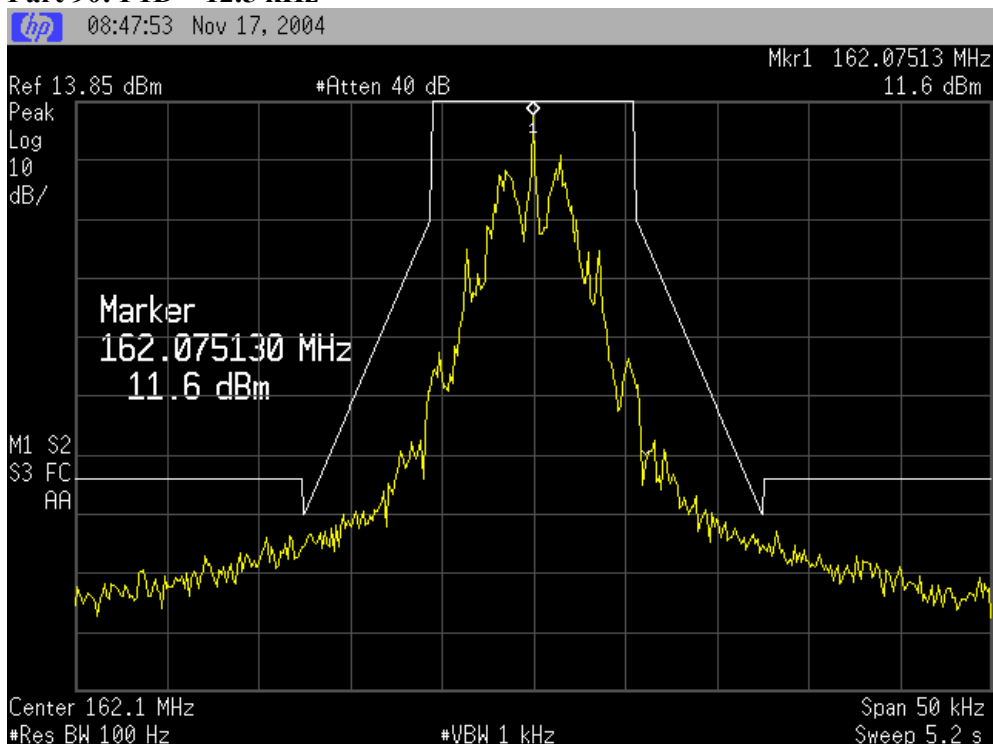
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## Part 90: F3E – 12.5 kHz



## Part 90: F1D – 12.5 kHz



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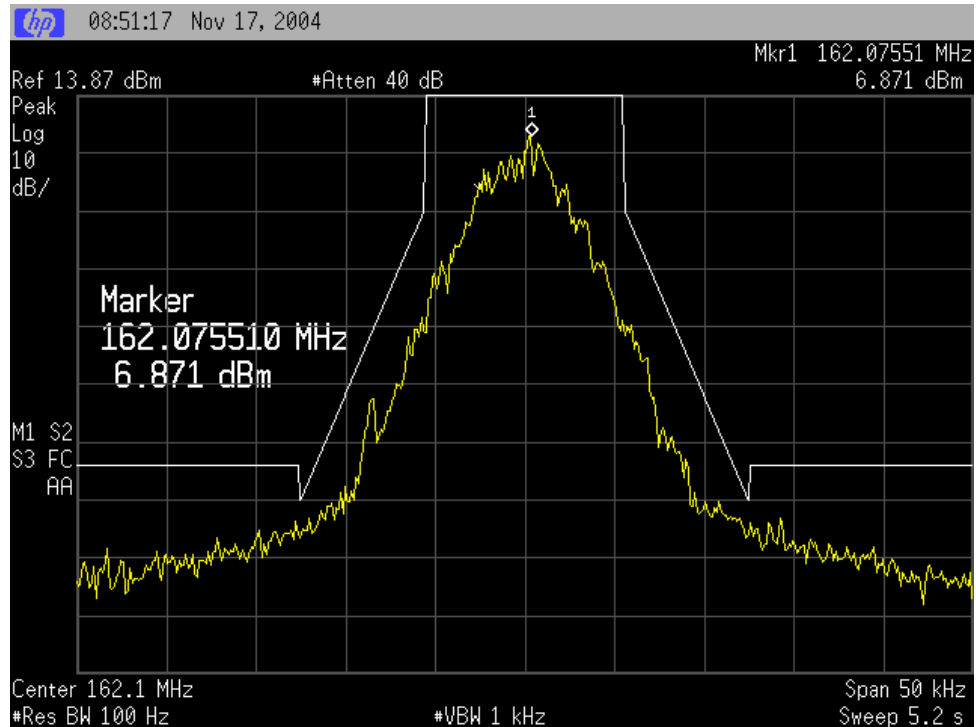
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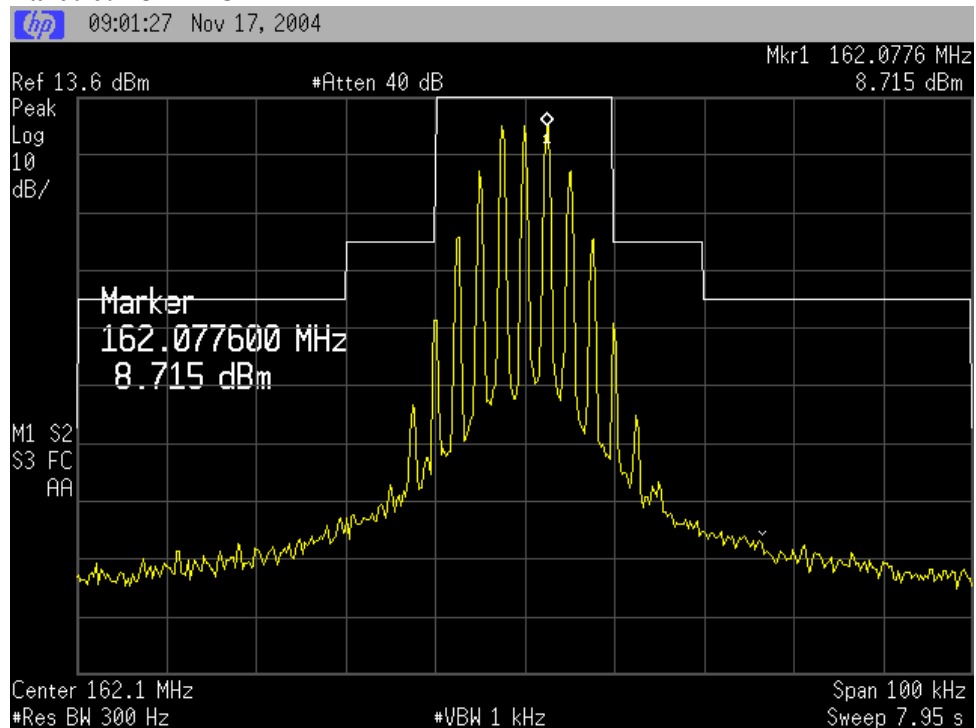
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## Part 90: F1E – 12.5 kHz



## Part 90: F3E – 25 kHz



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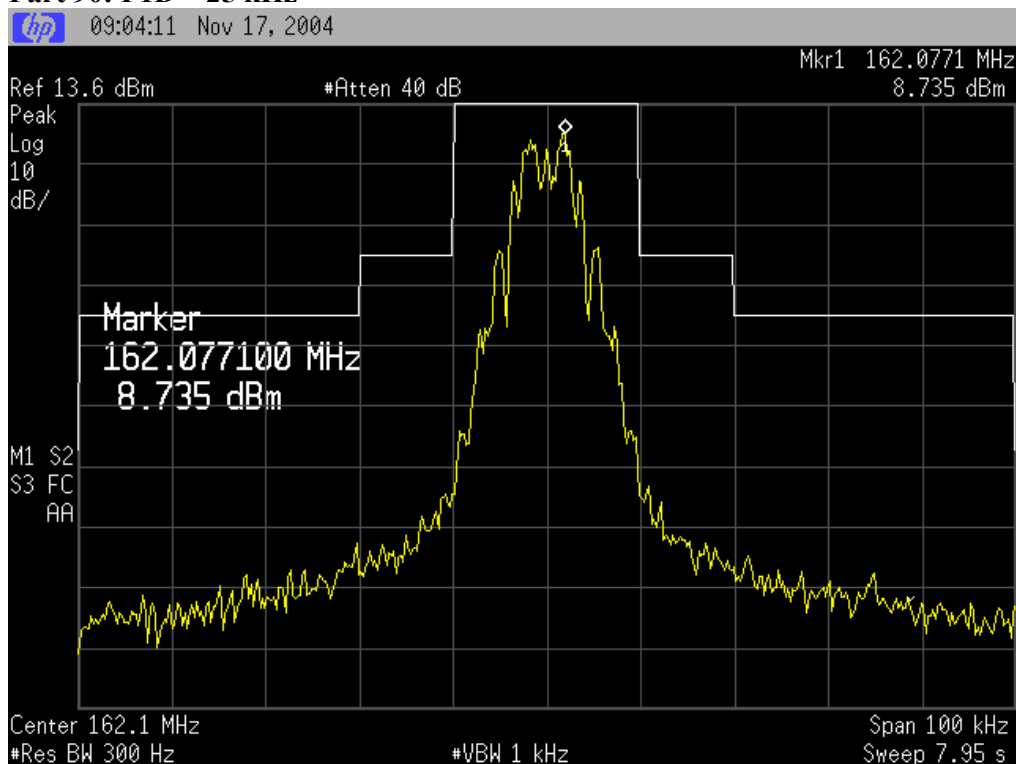
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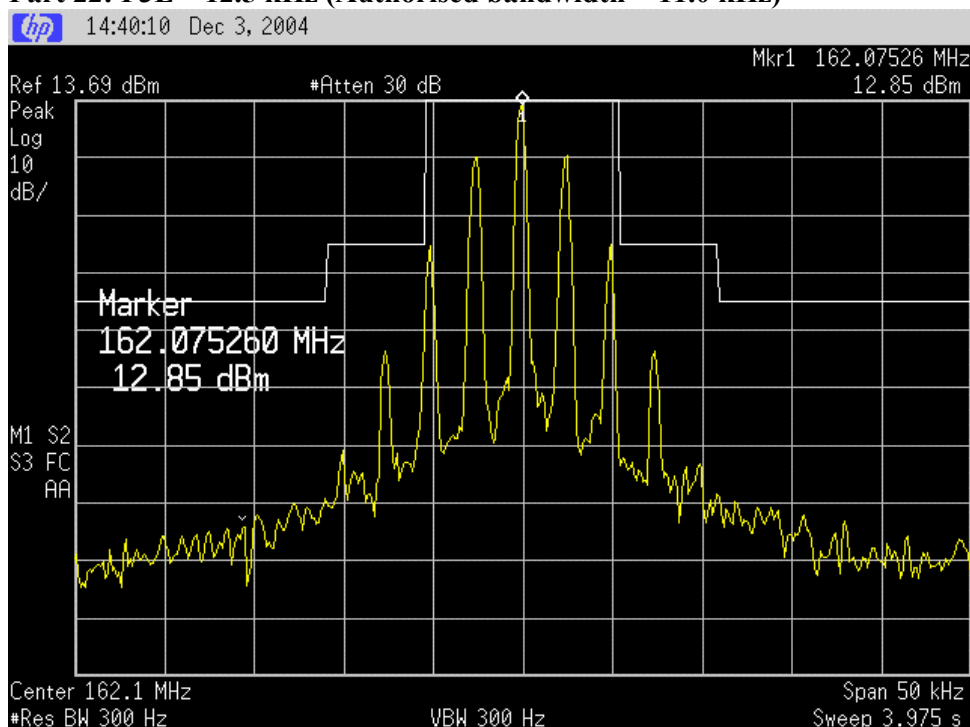
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## Part 90: F1D – 25 kHz



## Part 22: F3E – 12.5 kHz (Authorised bandwidth = 11.0 kHz)



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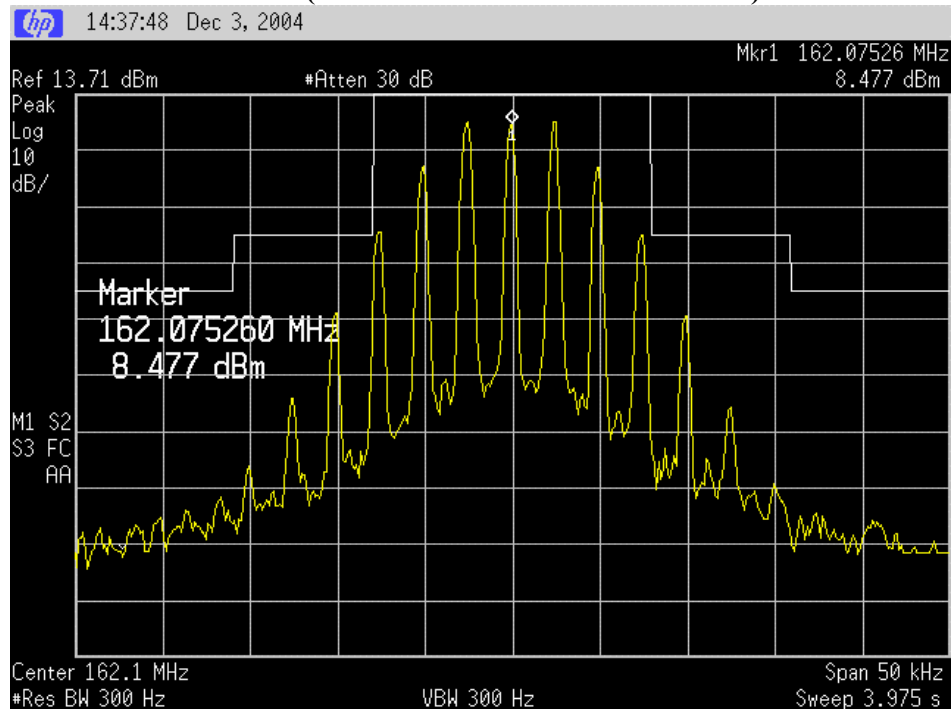
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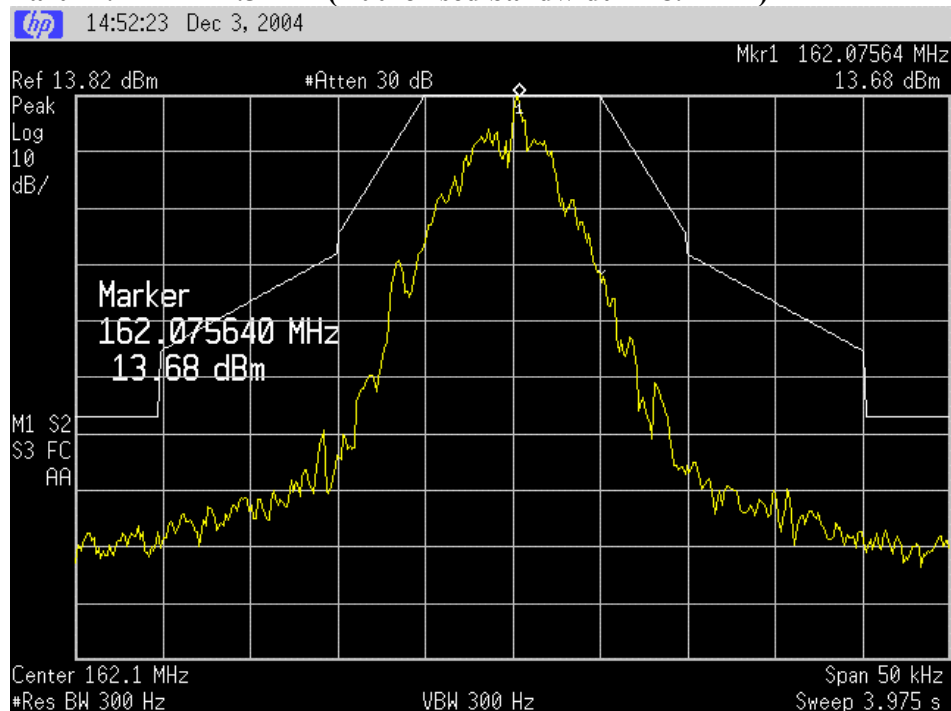
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## Part 22: F3E – 25 kHz (Authorised bandwidth = 16.0 kHz)



## Part 22: F1E – 12.5 kHz (Authorised bandwidth = 8.1 kHz)



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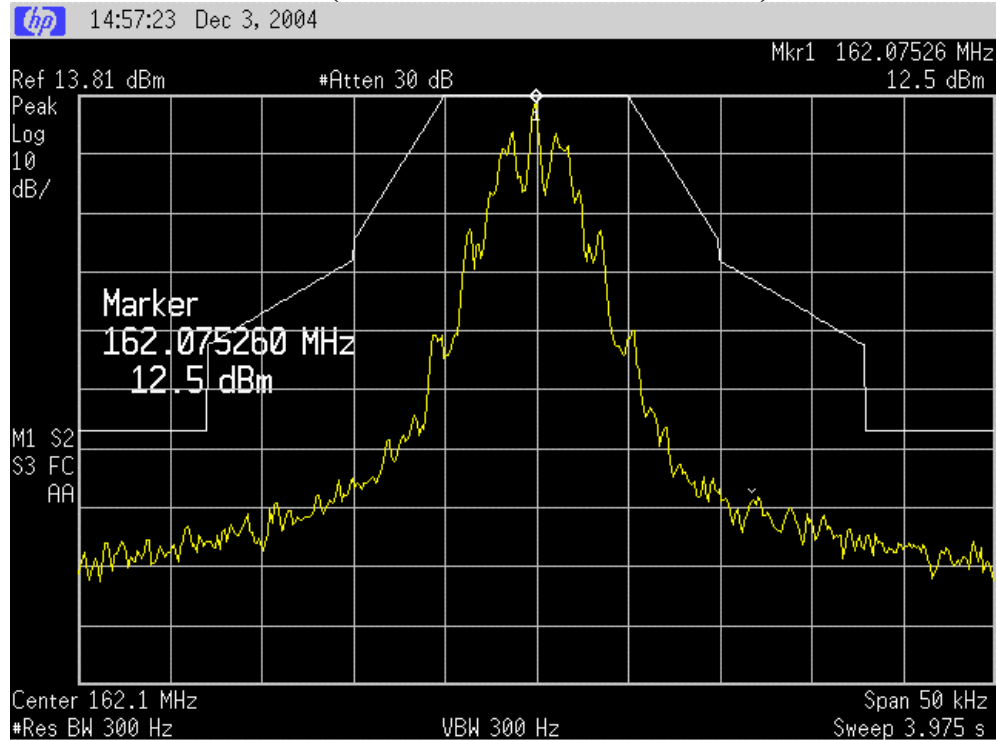
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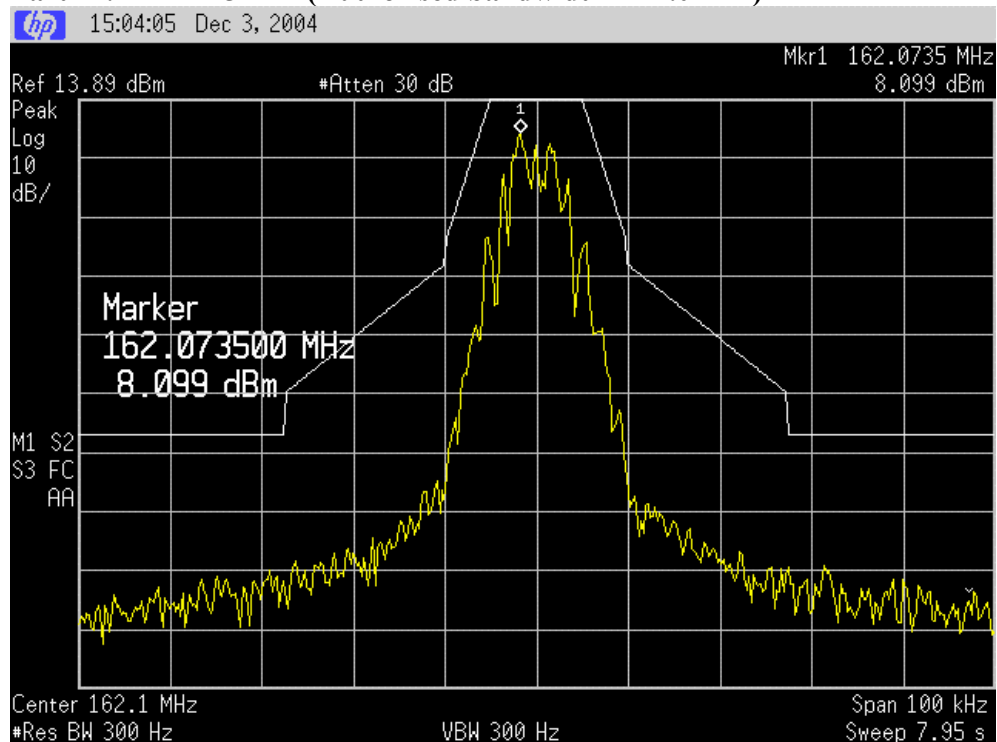
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## Part 22: F1D – 12.5 kHz (Authorised bandwidth = 7.2 kHz)



## Part 22: F1D – 25 kHz (Authorised bandwidth = 11.0 kHz)



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## Transmitter spurious emissions at the antenna terminals

Frequency: 162.0750 MHz

| Measured Spurious Emission |                         |                |
|----------------------------|-------------------------|----------------|
| Spurious emission<br>(MHz) | Emission level<br>(dBm) | Limit<br>(dBm) |
| 324.1500                   | -37.0                   | -20.0          |
| 486.2250                   | -46.3                   | -20.0          |
| 648.3000                   | -53.9                   | -20.0          |
| 810.3750                   | Less than -55.0         | -20.0          |
| 972.4500                   | Less than -55.0         | -20.0          |
| 1134.5250                  | Less than -55.0         | -20.0          |
| 1296.6000                  | Less than -55.0         | -20.0          |
| 1458.6750                  | Less than -55.0         | -20.0          |
| 1620.7500                  | Less than -55.0         | -20.0          |
| 151.3750                   | -42.0                   | -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.

The spurious emission limit defined by Mask D has been applied as this transmitter can operate using channel spacings 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 10<sup>th</sup> harmonic if the transmitter operates below 10 GHz.

A rated power of 25.0 watts gives a limit of -20 dBm.

Emissions less than -40 dBm have been reported for completeness.

No measurements were made above the 10<sup>th</sup> harmonic.

**Result:** Complies

***Measurement Uncertainty:***  $\pm 3.3$  dB

---

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# EMC Technologies (NZ) Ltd

Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

---

## Receiver Spurious emissions at antenna terminals

Receive frequency: 162.0750 MHz

Intermediate frequency: 45.000 MHz

| Measured Spurious Emission |                         |                |
|----------------------------|-------------------------|----------------|
| Spurious emission<br>(MHz) | Emission level<br>(dBm) | Limit<br>(dBm) |
| 207.0750                   | -115.0                  | -57.0          |
|                            |                         |                |

All other emissions observed less than -110.0 dBm.

### *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:***  $\pm 3.3$  dB

# EMC Technologies (NZ) Ltd

Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

---

## **Field strength of the transmitter spurious emissions**

**Frequency:** 162.0750 MHz

| <b>Frequency<br/>(MHz)</b> | <b>Level<br/>(dBuV/m)</b> | <b>Power<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Polarity</b> | <b>Margin<br/>(dB)</b> |
|----------------------------|---------------------------|------------------------|------------------------|-----------------|------------------------|
| 324.1500                   | 65.0                      | -32.4                  | -20.0                  | Horizontal      | 12.4                   |
| 324.1500                   | 55.1                      | -42.3                  | -20.0                  | Vertical        | 22.3                   |
| 486.2250                   | 40.8                      | -56.6                  | -20.0                  | Horizontal      | 36.6                   |
| 486.2250                   | 39.3                      | -58.1                  | -20.0                  | Vertical        | 38.1                   |
| 648.3000                   | 35.1                      | -62.3                  | -20.0                  | Horizontal      | 42.3                   |
| 648.3000                   | 30.3                      | -67.1                  | -20.0                  | Vertical        | 47.1                   |
| 810.3750                   | 41.0                      | -56.4                  | -20.0                  | Horizontal      | 36.4                   |
| 810.3750                   | 36.2                      | -61.2                  | -20.0                  | Vertical        | 41.2                   |
| 972.4500                   | 31.0                      | -66.4                  | -20.0                  | Horizontal      | 46.4                   |
| 972.4500                   | 32.2                      | -65.2                  | -20.0                  | Vertical        | 45.2                   |
| 1134.5250                  | 40.1                      | -57.3                  | -20.0                  | Horizontal      | 37.3                   |
| 1134.5250                  | 35.7                      | -61.7                  | -20.0                  | Vertical        | 41.7                   |
| 1296.6000                  | 36.7                      | -60.7                  | -20.0                  | Horizontal      | 40.7                   |
| 1296.6000                  | 39.1                      | -58.3                  | -20.0                  | Vertical        | 38.3                   |
| 1458.6750                  | -                         | -                      | -20.0                  | Horizontal      | -                      |
| 1458.6750                  | -                         | -                      | -20.0                  | Vertical        | -                      |
| 1620.7500                  | -                         | -                      | -20.0                  | Horizontal      | -                      |
| 1620.7500                  | -                         | -                      | -20.0                  | 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 February 17<sup>th</sup>, 2004.

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

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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# EMC Technologies (NZ) Ltd

Test Report No **41124.1**

Report date: 25<sup>th</sup> November 2004

---

*Limit:*

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

The rated power of 25 watts gives a limit of  $-20$  dBm.

No measurements were made above the 10<sup>th</sup> harmonic.

**Result:** Complies

***Measurement Uncertainty:***  $\pm 4.1$  dB

---

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# EMC Technologies (NZ) Ltd

Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

---

## **Field strength of the receiver spurious emissions**

**Frequency:** 162.0750 MHz    **Intermediate frequency:** 45.000 MHz

| Frequency<br>(MHz) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Polarity | Margin<br>(dB) |
|--------------------|-------------------|-------------------|----------|----------------|
| 207.0750           | 18.1              | 43.5              | Vertical | -25.4          |
| 207.0750           | 21.1              | 43.5              | Vertical | -22.4          |

No other emissions detected within 20 dB of the limit.

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 February 17<sup>th</sup>, 2004.

The receiver was tested while receiving continuously while attached to a dummy load.

### *Limit:*

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

**Result:** Complies

---

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## 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.

Measurements were made with the supply varied between 115% and 85% of the nominal supply voltage (13.8 Vdc).

Nominal Frequency: 162.0750 MHz

| Voltage<br>Temp. | Frequency Error (Hz) |          |          |
|------------------|----------------------|----------|----------|
|                  | 11.7 Vdc             | 13.8 Vdc | 15.9 Vdc |
| +50°C            | -10.0                | -11.0    | -10.0    |
| +40°C            | -13.0                | -14.0    | -13.0    |
| +30°C            | -17.0                | -16.0    | -16.0    |
| +20°C            | -16.0                | -15.0    | -15.0    |
| +10°C            | -17.0                | -17.0    | -17.0    |
| 0°C              | +7.0                 | +8.0     | +8.0     |
| -10°C            | +7.0                 | +7.0     | +8.0     |
| -20°C            | +9.0                 | +9.0     | +10.0    |
| -30°C            | +10.0                | +9.0     | +10.0    |

### *Limit:*

Part 22.355 and Part 90.213 state that mobile transmitters operating with a power output greater than 2 watts between 150 – 174 MHz are required to have a frequency tolerance of 5 ppm.

This transmitter operates on 162.0750 MHz. 5 ppm = 5 x 162 = 810 Hz.

**Result:** Complies

***Measurement Uncertainty:*** ±30 Hz

# EMC Technologies (NZ) Ltd

Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

## Transient frequency behaviour

Transient frequency behaviour measurements are applicable to wide band and narrow band transmitters operating in the frequency band 150 – 174 MHz.

Measurements were carried out at 162.0750 MHz 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 162.0750 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.

| Measured Transient Deviation                          |                            |                            |
|-------------------------------------------------------|----------------------------|----------------------------|
| Period t <sub>1</sub> (ms)                            | period t <sub>2</sub> (ms) | period t <sub>3</sub> (ms) |
| 5.0                                                   | 20.0                       | 5.0                        |
| Frequency Difference from the Nominal Frequency (kHz) |                            |                            |
| 12.5 kHz: nil                                         | nil                        | nil                        |
| 25.0 kHz: nil                                         | nil                        | nil                        |

### *Limits:*

| Channel Spacing (kHz) | Transmitter Period t <sub>1</sub> (kHz) | Transmitter Period t <sub>2</sub> (kHz) | Transmitter Period t <sub>3</sub> (kHz) |
|-----------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|
| 12.5                  | ± 12.5                                  | ± 6.25                                  | ± 12.5                                  |
| 25.0                  | ± 25.0                                  | ± 12.5                                  | ± 25.0                                  |

**Result:** Complies

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

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# EMC Technologies (NZ) Ltd

Test Report No **41124.1**

Report date: 25<sup>th</sup> November 2004

---

## 12.5 kHz transmitter turn on

Green Trace = 1 kHz tone with FM deviation of 12.5 kHz and any transient.  
Black trace = transmitter amplitude response (AC coupled) (Information only).

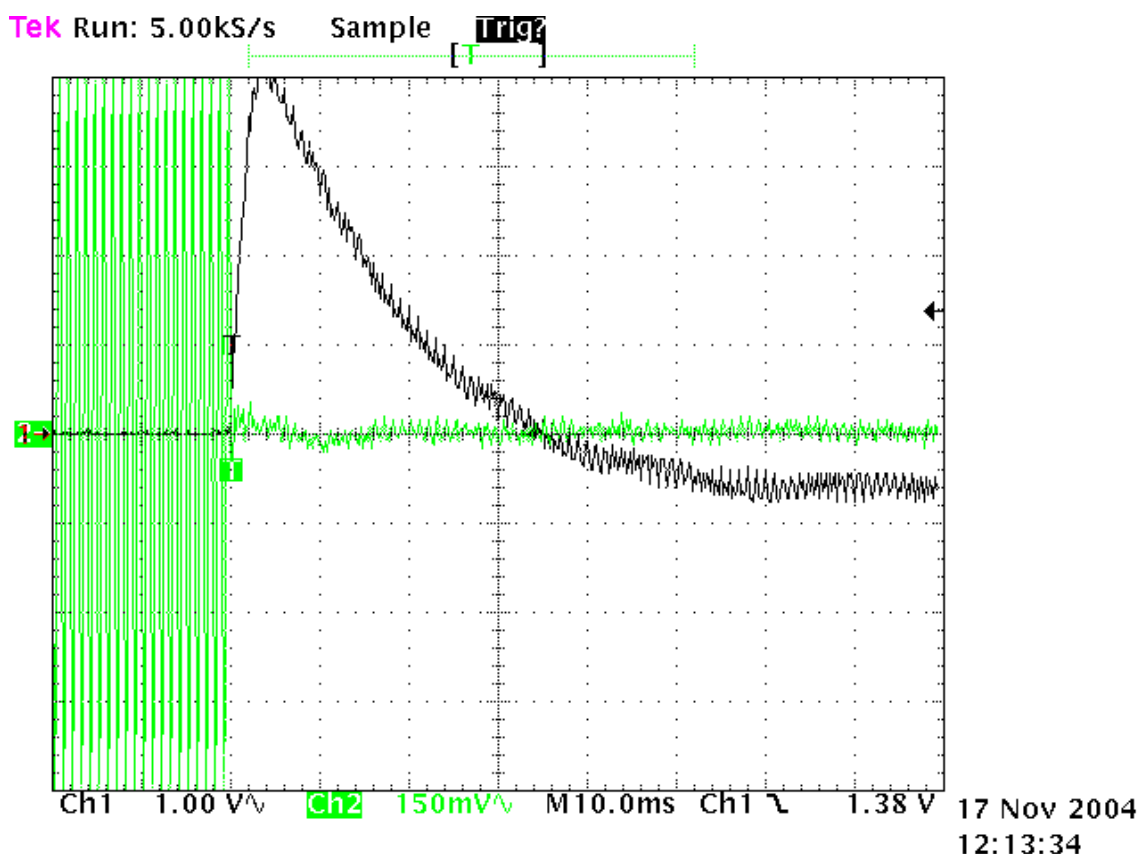
Green trace has been maximised to give full screen indication of a  $\pm 12.5$  kHz.  
Therefore each Y axis division = 3.125 kHz per division.  
The X axis has been set to a sweep rate of 10 mS/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 mS).  
This is position *ton*.

*t1* occurs between 2.0 and 2.5 divisions from the left-hand edge.

*t2* occurs between 2.5 and 4.5 divisions from the left-hand edge.

No transient responses can be observed.



---

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## 12.5 kHz transmitter turn off

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

Black trace = transmitter amplitude response (AC coupled) (Information only).

Green trace has been maximised to give full screen indication of a  $\pm 12.5$  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.

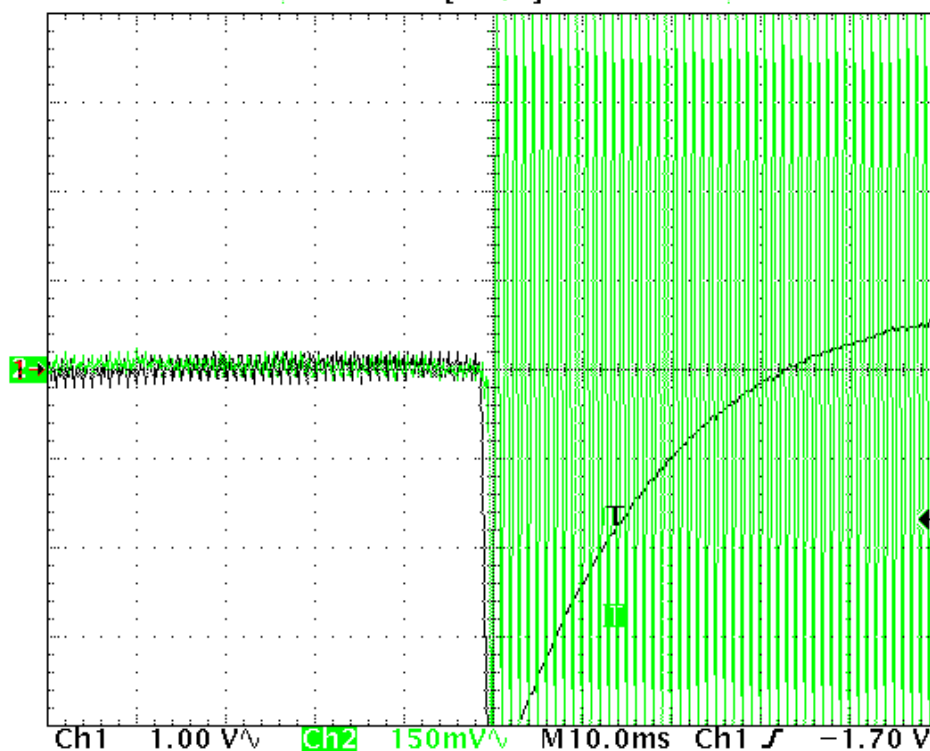
The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 mS).

This is position toff.

$t_3$  occurs between 4.5 and 5.0 divisions from the left hand edge.

No transient responses can be observed before toff.

Tek Run: 5.00kS/s Sample [Trigger]



17 Nov 2004  
12:15:50

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# EMC Technologies (NZ) Ltd

Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

## 25 kHz transmitter turn on

Green Trace = 1 kHz tone with FM deviation of 25 kHz and any transient.

Black trace = transmitter amplitude response (AC coupled) (Information only).

Green trace has been maximised to give full screen indication of a  $\pm 25$  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.

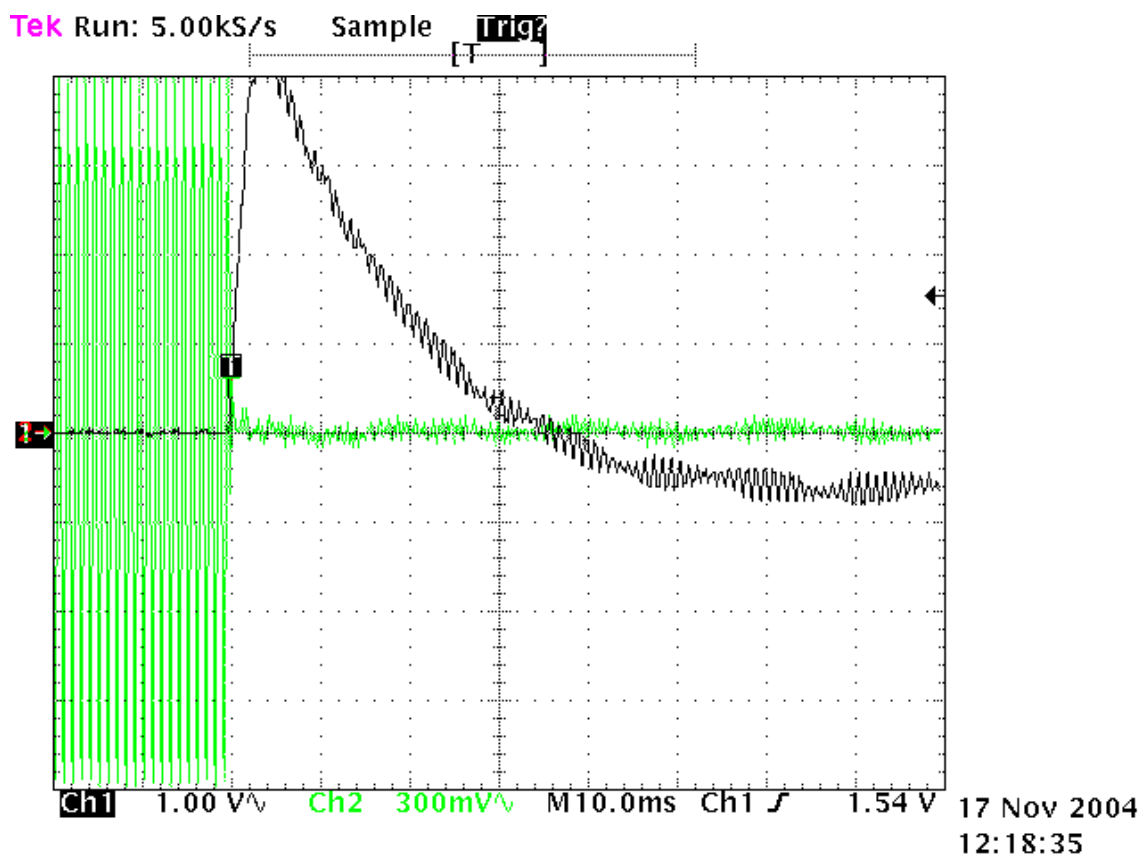
Triggering has been set to occur 2 divisions from the left hand edge (20 mS).

This is position *ton*.

*t1* occurs between 2.0 and 2.5 divisions from the left-hand edge.

*t2* occurs between 2.5 and 4.5 divisions from the left-hand edge.

No transient responses can be observed.



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# EMC Technologies (NZ) Ltd

Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

## 25 kHz transmitter turn off

Green Trace = 1 kHz tone with FM deviation of 25 kHz and transient.

Black trace = transmitter amplitude response (AC coupled) (Information only).

Green trace has been maximised to give full screen indication of a  $\pm 25$  kHz.

Therefore each Y axis division = 6.25 kHz per division.

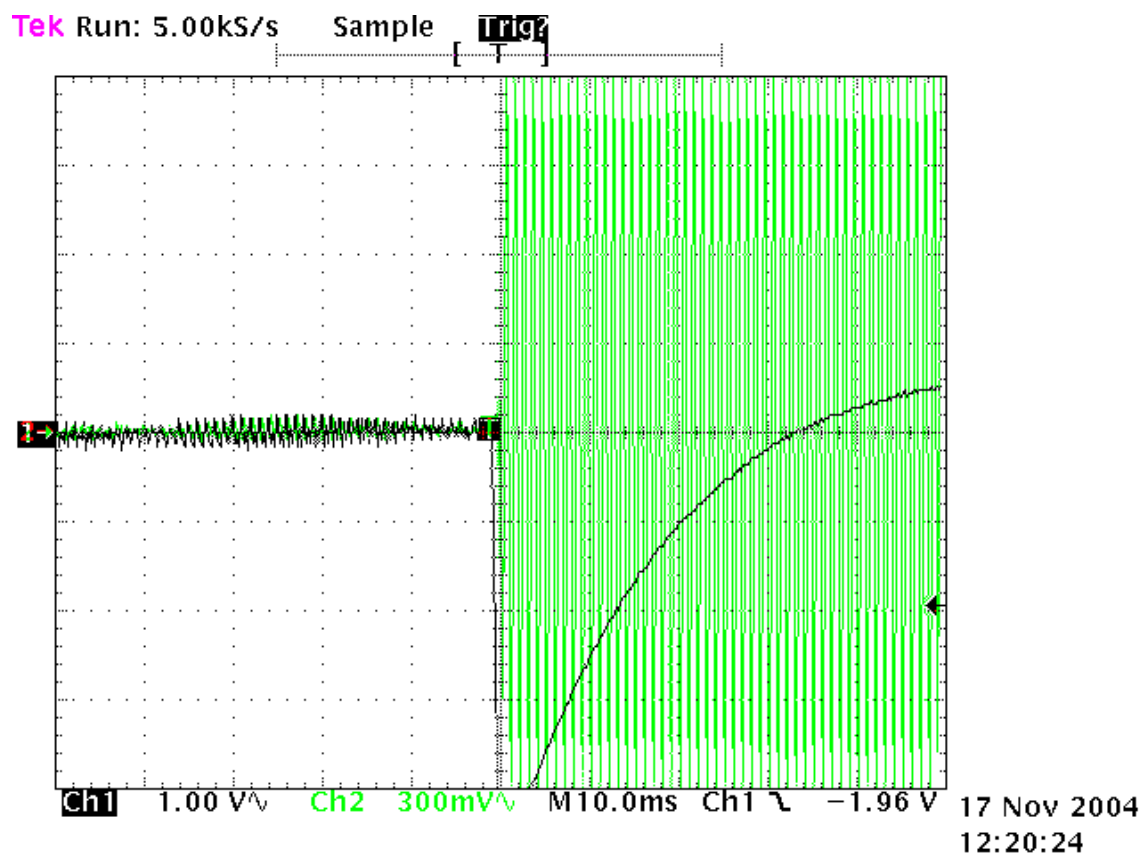
The X axis has been set to a sweep rate of 10 mS/division.

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

This is position toff.

$t_3$  occurs between 4.5 and 5.0 divisions from the left hand edge.

No transient responses can be observed before toff.



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# EMC Technologies (NZ) Ltd

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---

## **Radio Frequency Hazard Information**

As per Section 1.1310 and Section 2.1091 certification of this transmitters is sought using the Controlled / Occupational exposure limits as detailed in OST/OET Bulletin Number 65 as a power of 25 watts is to be used in a mobile environment where the use of the transmitter will be employment related.

In addition calculations have been made using the General Public/Uncontrolled Exposure limits.

Minimum safe distances for each of these situations have been calculated below.

In accordance with Section 1.1310 the following Maximum Permissible Exposure (MPE) power density limits have been applied:

- Occupational / Controlled Exposure of 1.0 mW/cm<sup>2</sup>
- General Population / Uncontrolled exposure of 0.2 mW/cm<sup>2</sup>

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:

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

### **Controlled**

$$E = 1.0 \text{ mW/cm}^2 = E^2/3770$$

$$E = \sqrt{1.0 * 3770}$$

$$E = \underline{61.4 \text{ V/m}}$$

### **Uncontrolled**

$$E = 0.2 \text{ mW/cm}^2 = E^2/3770$$

$$E = \sqrt{0.2 * 3770}$$

$$E = \underline{27.5 \text{ V/m}}$$

The rated maximum transmitter power = 25 watts.

Transmitter operated using a quarter wave whip antenna with a gain of 2.15 dBi (1.64).

The transmitter is a push to talk device that would typically be used with a duty cycle of 50% in a 6 minute period or a 30 minute period.

### **Controlled**

$$d = \sqrt{30 * P * G * DC} / E$$

$$d = \sqrt{30 * 25.0 * 1.64 * 0.5} / 61.4$$

$$d = \underline{0.4038 \text{ metres or } 40 \text{ cm}}$$

### **Uncontrolled**

$$d = \sqrt{30 * 25.0 * 1.64 * 0.5} / 27.5$$

$$d = \underline{0.9018 \text{ metres or } 90 \text{ cm}}$$

**Result:** Complies

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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 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 Antenna  | Schwarzbeck     | UHALP 9107 |             | RFS 3702 |
| Measurement Receiver  | Rohde & Schwarz | ESCS 30    | 839873/1    |          |
| 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    |
| Rubidium Oscillator   | Ball Efratom    | FRS – C    | 4287        | E1053    |
| Selective Level Meter | Anritsu         | ML422C     | M35386      | E1140    |
| Signal Generator      | Rohde & Schwarz | SMHU.58    | 838923/028  | E1493    |
| Spectrum Analyzer     | Hewlett Packard | E7405A     | US39150142  | 3776     |
| Thermal chamber       | Contherm        | M180F      | 86025       | E1129    |
| Thermometer           | DSIR            | RT200      | 035         | E1049    |
| Turntable             | EMCO            | 1080-1-2.1 | 9109-1578   | RFS 3709 |
| Variac                | General Radio   | 1592       | -           | 3690     |

## 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 last updated on February 17<sup>th</sup>, 2004.

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.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with 46 accreditation bodies in 34 economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

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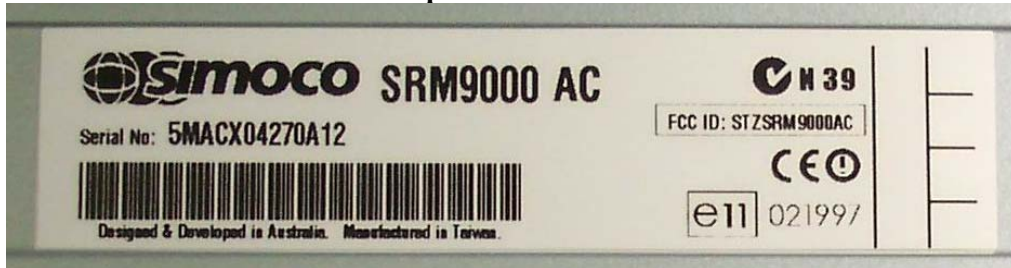
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Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

## 10. PHOTOGRAPHS

Sample Product Label



RF Exposure label location



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Report date: 25<sup>th</sup> November 2004

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**Overall Photo**



**Case Front View**



**Case Rear View**



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**Case Top**



**Case Bottom**



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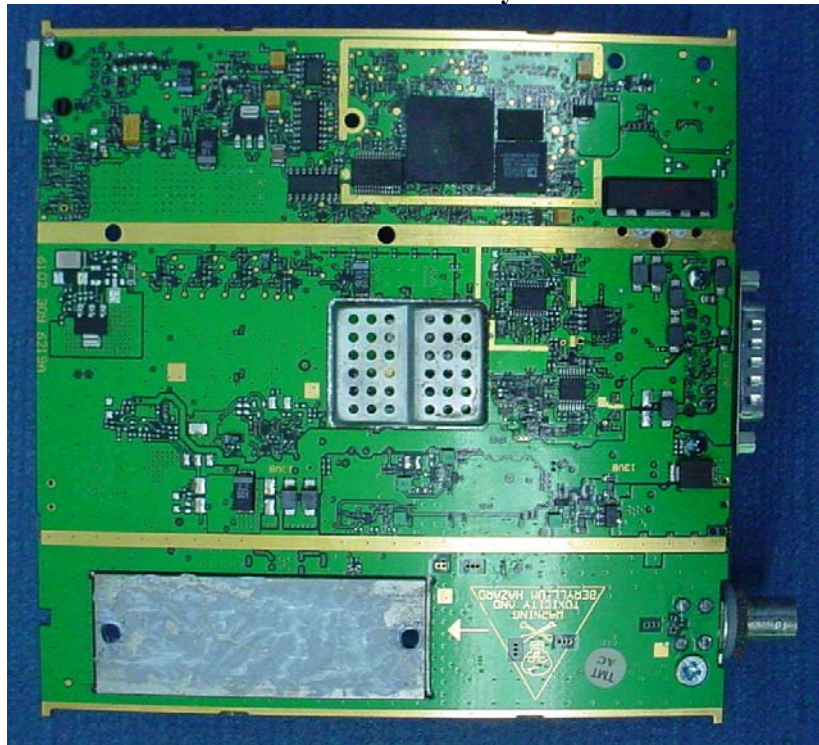
Report date: 25<sup>th</sup> November 2004

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**PCB Top Layer**



**PCB Bottom Layer**



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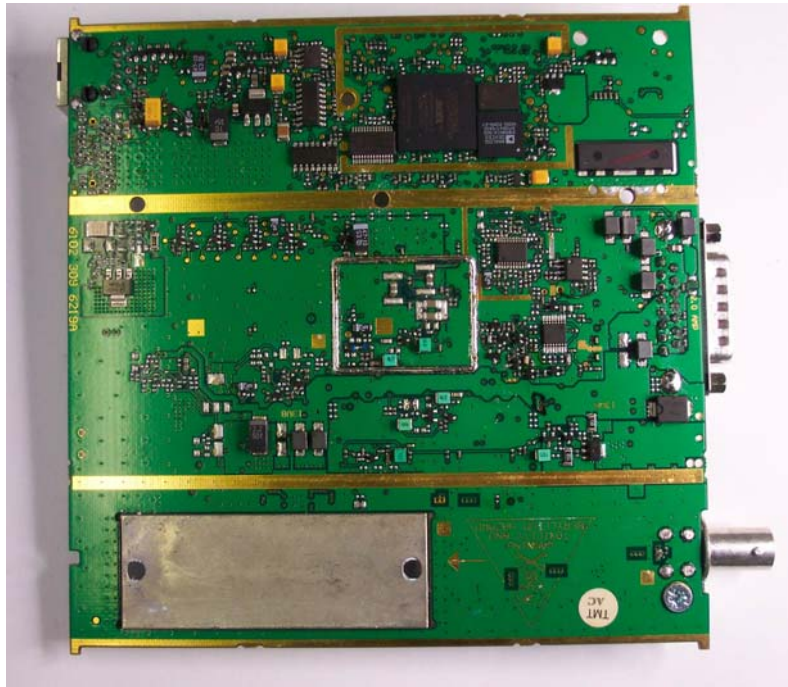
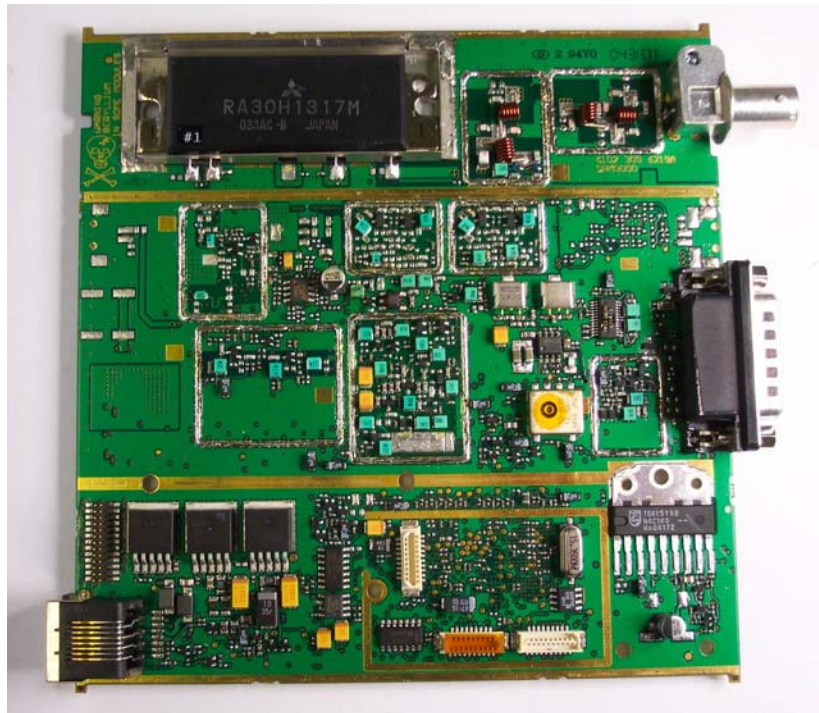
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**Internal photos with the shields removed.**



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**EMC Technologies (NZ) Ltd**

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# EMC Technologies (NZ) Ltd

Test Report No 41124.1

Report date: 25<sup>th</sup> November 2004

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## Radiated emissions test set up



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