

# EMC Technologies (NZ) Ltd

Test Report No 100526.1

Report date: 10 June 2010

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## **TEST REPORT**

### **CAS / CAM Global RF Collision Avoidance System Transmitter**

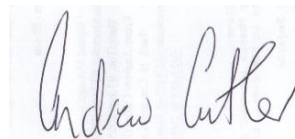
*tested for compliance with the*

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

**Part 90 –Private Land Mobile Services**

*for*

**Advanced Mining Technologies PTY Ltd**



Test Report issued by:

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**Andrew Cutler - General Manager**



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

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## 1. CLIENT INFORMATION

**Company Name** Advanced Mining Technologies PTY Ltd  
**Address** PO Box 5107  
Chittaway Bay  
**State** New South Wales 2261  
**Country** Australia  
**Contact** Mr Dmitri Fechine

## 2. DESCRIPTION OF TEST SAMPLE

**Brand Name** CAS / CAM  
**Model Number** Global RF  
**Product** Collision Avoidance System Transmitter  
**Manufacturer** AMT PTY Ltd  
**Designed in** Australia  
**Manufactured in** Australia  
**FCC ID** YIY-AMTCASG1

The system was powered at 13.8 Vdc using an external lead acid battery.

Section 90.217 of the FCC rules has been applied to this transmitter as the power output does not exceed 120 mW.

Two versions of this transmitter were tested with identical transmitter results obtained.

The versions of the transmitter tested were identified as follows:

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- AMT CAS Heavy Vehicle System that consisted of the following
  - 6 x PROD0118 Colour Camera Units
  - PROD0119 Colour LCD Display
  - PROD0161 CAS Expansion Unit
  - PROD0169 Heavy Vehicle Rear RF Unit. Serial no# 1694 1002 0171
- AMT CAS Light Vehicle System that consisted of the following
  - PROD0711 Light Vehicle Dash Alarm
  - PROD0295 Light Vehicle RF Unit. Serial no# 2963 0904 0185

The transmitter module in each of this RF units is identical with the main difference between the samples being the type and number of ports provided with the device.

The RF module in the system is operated using a whip antenna with a 5 dBi gain.

Testing was therefore carried out with a dummy load for the spurious emission case radiation tests and with the antenna connected to confirm the radiated power from the system.

This report can also be applied to the following devices which are identical to the units tested except for variations in the dip switch settings that result in different unit ID numbers being transmitted and as a result different part numbers.

Mainstream units:

PROD0239 CAS Heavy Vehicle FRONT RF UNIT

PROD0307 CAS Heavy Vehicle RIGHT RF UNIT

PROD0308 CAS Heavy Vehicle LEFT RF UNIT

Special cases:

PROD0193 (CAS CALIBRATION UNIT))

PROD0580 (CAS LVV RF UNIT)

PROD0595 (CAS TEST STATION RF UNIT)

PROD0596 (STATIONARY OBJECT RF UNIT)

PROD0598 (MOBILE PLANT & EQUIPMENT RF UNIT)

PROD0650 (CAS BATTERY LV RF UNIT)

PROD0655 (CAS HV RF INTERLOCK UNIT)

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## 3. COMPLIANCE STATEMENT & TEST RESULTS

The CAS / CAM Global RF Collision Avoidance System **complies with** 47 CFR Part 90, section 90.217.

Testing was carried out in accordance with the test methods defined in 47 CFR Part 2 and 90.

Listed below are the relevant Part 2 test methods and the Part 90 limits.

| <b><u>CLAUSE</u></b> | <b><u>TEST PERFORMED</u></b>            | <b><u>RESULT</u></b> |
|----------------------|---|----------------------|
| 2.1041               | Measurement procedures                  | Noted                |
| 2.1046               | RF power output                         | Complies             |
| 2.1049               | Occupied bandwidth                      | Complies             |
| 2.1051               | Spurious emissions at antenna terminals | Complies             |
| 2.1053               | Field strength of spurious radiation    | Complies             |
| 2.1055               | Frequency stability                     | Complies             |
| 2.1057               | Frequency spectrum to be investigated   | Noted                |
| 90.217               | Exemption from technical standards      | Complies             |

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## 4. TEST SAMPLE DESCRIPTION

The sample tested has the following specifications:

### **Rated Transmitter Output Power**

Maximum output power: 20 mW (+13.0 dBm)

Minimum output power: 0.01 mW(-10.0 dBm)

### **Test Frequencies**

428.0000 MHz, 452.1250 MHz, 452.7000 MHz

### **Transmitter operating range**

421 MHz to 454 MHz

### **FCC Bands**

421 MHz to 512 MHz

### **Modes of operation**

Raised cosine 2 FSK modulation (RC2FSK) with a 1 kHz frequency deviation.  
Data rate is stated to be 7.2 kbaud and the RC alpha is 0.5.

### **Emission designator**

F2D

### **Power Supply**

External DC voltage supply. Typically 13.8 Vdc

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## 5. TEST CONDITIONS

### Standard Temperature and Humidity

Temperature Range: 15°C - 30°C

Humidity Range: 40% - 75%

### 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: 11.7 Vdc

Low Voltage: 15.9 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 test sample was selected by the client.**

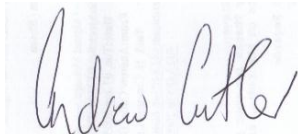
**The report relates only to the sample tested.**

**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.

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

### Introduction

This transmitter has been tested in accordance with the requirements of 47 CFR Section 90.217 – Exemption from technical standards.

- are exempt from the technical requirements set out in this subpart but must instead comply with the following.

In order for this section to apply the following needs to be demonstrated:

- The frequency of operation could be used at stations licensed below 800 MHz on any frequency listed in Subpart B and C of 47 CFR Part 90.

This transmitter can operate in the FCC band 421 – 521 MHz over the range of 421 – 454 MHz.

For testing purposes it has been configured to operate on 428.000 MHz and 452.700 MHz.

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## RF Conducted Power Output

Section 90.217 specifies that the output power of the transmitter shall not exceed 120 mW (20.8 dBm).

The manufacturer states that the transmitter can be operated over the range of -10 dBm (0.01 mW) to +13 dBm (20.0 mW) with a whip antenna with a gain of 5 dBi.

20 mW setting (+13 dBm)

| Frequency (MHz) | Voltage (Vdc) | Rated (dBm) | Measured (dBm) |
|-----------------|---------------|-------------|----------------|
| 428.000         | 11.7          | 13.0        | 12.1           |
| 428.000         | 13.8          | 13.0        | 12.1           |
| 428.000         | 15.9          | 13.0        | 12.1           |

0.01 mW setting (-10 dBm)

| Frequency (MHz) | Voltage (Vdc) | Rated (dBm) | Measured (dBm) |
|-----------------|---------------|-------------|----------------|
| 428.000         | 11.7          | -10.0       | -10.5          |
| 428.000         | 13.8          | -10.0       | -10.5          |
| 428.000         | 15.9          | -10.0       | -10.5          |

20 mW setting (+13 dBm)

| Frequency (MHz) | Voltage (Vdc) | Rated (dBm) | Measured (dBm) |
|-----------------|---------------|-------------|----------------|
| 452.700         | 11.7          | 13.0        | 12.4           |
| 452.700         | 13.8          | 13.0        | 12.4           |
| 452.700         | 15.9          | 13.0        | 12.4           |

0.01 mW setting (-10 dBm)

| Frequency (MHz) | Voltage (Vdc) | Rated (dBm) | Measured (dBm) |
|-----------------|---------------|-------------|----------------|
| 452.700         | 11.7          | -10.0       | -10.1          |
| 452.700         | 13.8          | -10.0       | -10.1          |
| 452.700         | 15.9          | -10.0       | -10.1          |

Measurements were made to confirm that the radiated power was less than 120 mW (+20.8 dBm) when the whip antenna, which has a gain of 5 dBi, was attached.

Measurements were made at the open area test site over a distance of 3 metres.

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+13.0 dBm power output setting

| Frequency (MHz) | Level (dBuV/m) | Level (dBm) | Limit (dBm) | Antenna    | Margin (dB) |
|-----------------|----------------|-------------|-------------|------------|-------------|
| 428.0000        | 112.6          | 17.4        | 20.8        | Vertical   | 3.4         |
| 428.0000        | 102.4          | 7.2         | 20.8        | Horizontal | 13.6        |
|                 |                |             |             |            |             |
| 452.7000        | 111.4          | 16.2        | 20.8        | Vertical   | 4.6         |
| 452.7000        | 101.1          | 5.9         | 20.8        | Horizontal | 14.9        |

-10.0 dBm power output setting

| Frequency (MHz) | Level (dBuV/m) | Level (dBm) | Limit (dBm) | Antenna    | Margin (dB) |
|-----------------|----------------|-------------|-------------|------------|-------------|
| 428.0000        | 91.6           | -3.6        | 20.8        | Vertical   | 24.4        |
| 428.0000        | 81.1           | -14.1       | 20.8        | Horizontal | 34.9        |
|                 |                |             |             |            |             |
| 452.7000        | 90.0           | -5.2        | 20.8        | Vertical   | 26.0        |
| 452.7000        | 77.3           | -17.9       | 20.8        | Horizontal | 38.7        |

Testing was carried out using a spectrum analyser operating in peak hold mode using a resolution bandwidth of 1 MHz.

The spectrum analyser was connected directly to the output of the transmitter with a correction factor being applied to the observed levels to allow for the loss in the coax cable.

The transmitter was operated continuously with modulation applied.

## Limits:

The output power shall be within +/- 1 dB of the manufacturers rated power.

In accordance with Section 90.217 the output power cannot exceed 120 mW (+20.8 dBm).

**Result:** Complies

**Measurement Uncertainty:** ±0.5 dB

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## Occupied bandwidth

This transmitter transmits data using F2D.

The occupied bandwidth has been measured and compared against the occupied bandwidth declared by the client.

Measurements have been made using a spectrum analyser operating in peak hold mode.

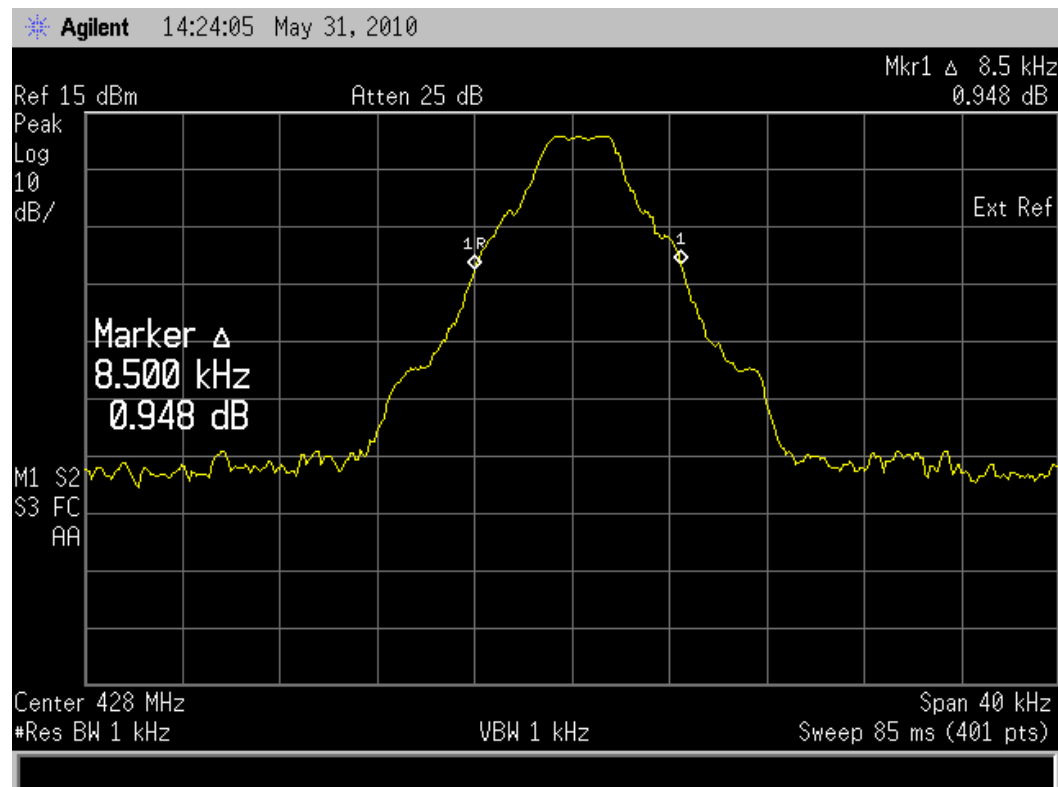
Initially power measurements are made using a resolution bandwidth of 120 kHz.

This level is used as a reference level on the spectrum analyser.

The resolution bandwidth is then changed to 1 kHz and the reference level minus 23 dB (99%) absolute bandwidth points determined.

It was found that the power level at 120 kHz and at 1 kHz were the same hence 1 kHz has been used.

| Emission | Channel Spacing | Measured  | Designation |
|----------|-----------------|-----------|-------------|
| F2D      | 12.5 kHz        | 8.500 kHz | 8k50F2D     |



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## Transmitter spurious emissions at the antenna terminals

The spectrum analyser bandwidth was set to 100 kHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz.

### Frequency: 428.000 MHz

| Spurious emission<br>(MHz) | +13 dBm levels<br>(dBm) | -10 dBm levels<br>(dBm) |
|----------------------------|-------------------------|-------------------------|
| 856.000                    | -52.1                   | -63.5                   |
| 1284.000                   | -43.3                   | -59.9                   |
| 1712.000                   | -54.0                   | -69.4                   |
| 2140.000                   | -46.0                   | -62.3                   |
| 2568.000                   | -57.5                   | -74.9                   |
| 3000.000                   | -57.2                   | -75.0                   |
| 3424.000                   | -58.3                   | -78.3                   |
| 3852.000                   | -54.0                   | -84.0                   |
| 4280.000                   | -65.4                   | -78.0                   |

### Frequency: 452.700 MHz

| Spurious emission<br>(MHz) | +13 dBm levels<br>(dBm) | -10 dBm levels<br>(dBm) |
|----------------------------|-------------------------|-------------------------|
| 905.4000                   | -44.5                   | -68.7                   |
| 1358.1000                  | -43.1                   | -61.4                   |
| 1810.7750                  | -54.9                   | -75.7                   |
| 2263.5000                  | -46.2                   | -63.3                   |
| 2716.2250                  | -59.6                   | -74.7                   |
| 3168.9000                  | -56.2                   | -74.1                   |
| 3621.6000                  | -69.2                   | -80.8                   |
| 4074.3000                  | -56.8                   | -74.8                   |
| 4527.0000                  | -66.4                   | -80.9                   |

Spectrum plots have been provided at the carrier frequencies of 428.000 MHz, 452.100 MHz and 452.7000 MHz.

As the device operates with 12.5 kHz channel spacings a displacement frequency of 25 kHz has been applied.

A resolution bandwidth of 300 Hz has been applied a limit of -30 dBc has been utilised.

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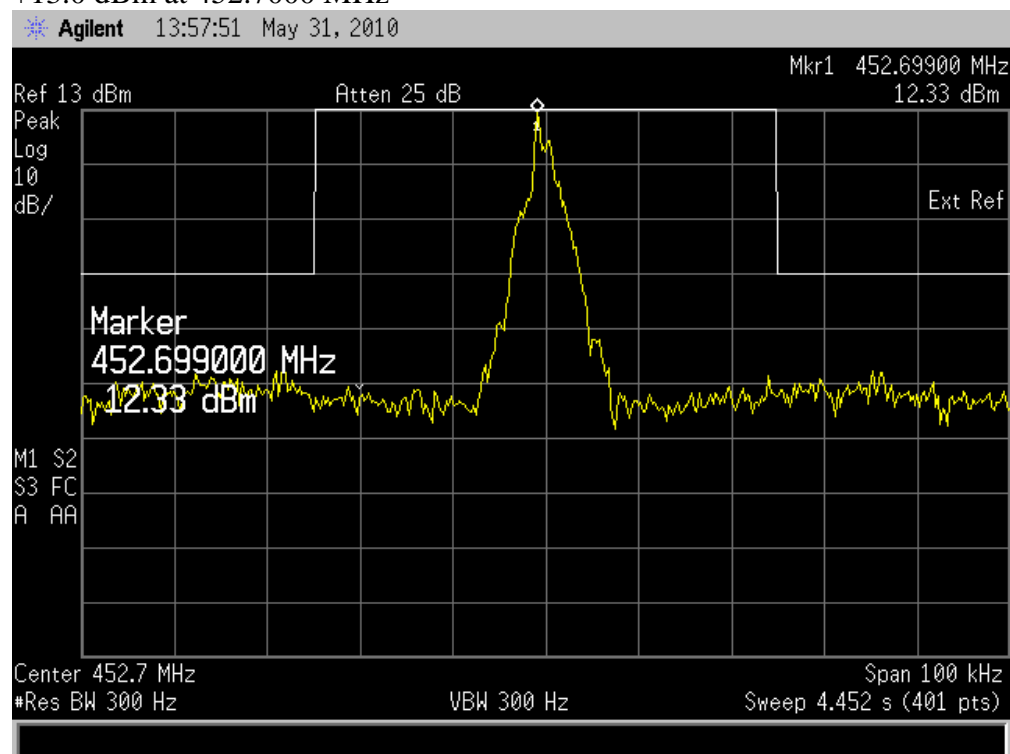
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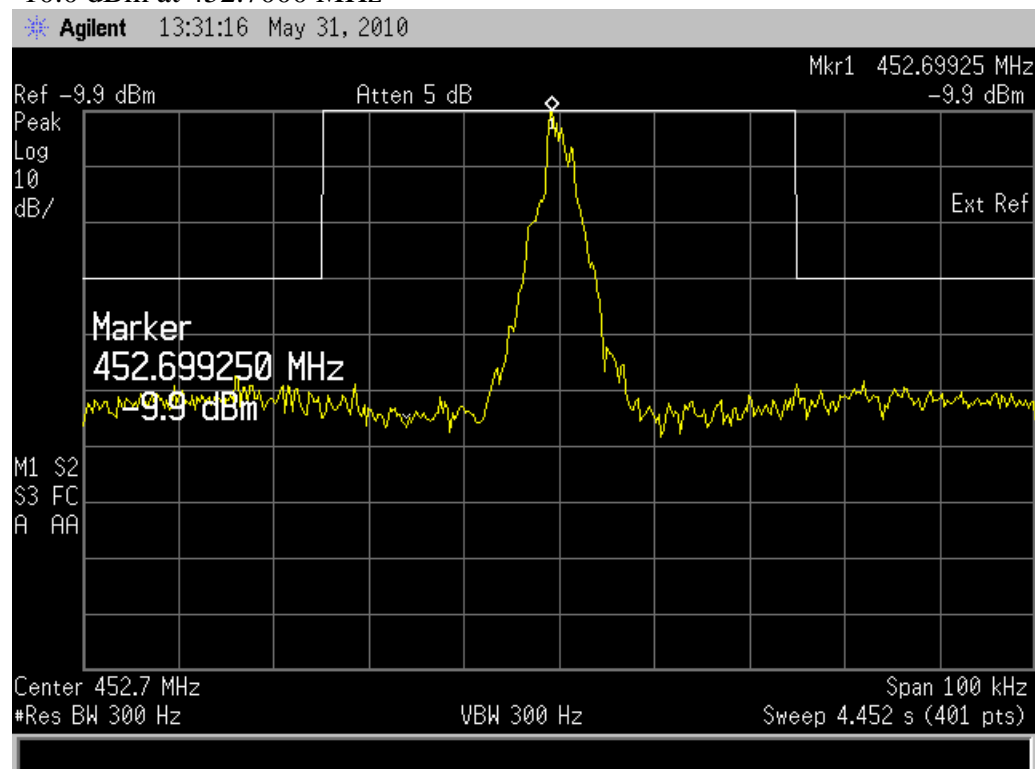
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+13.0 dBm at 452.7000 MHz



-10.0 dBm at 452.7000 MHz



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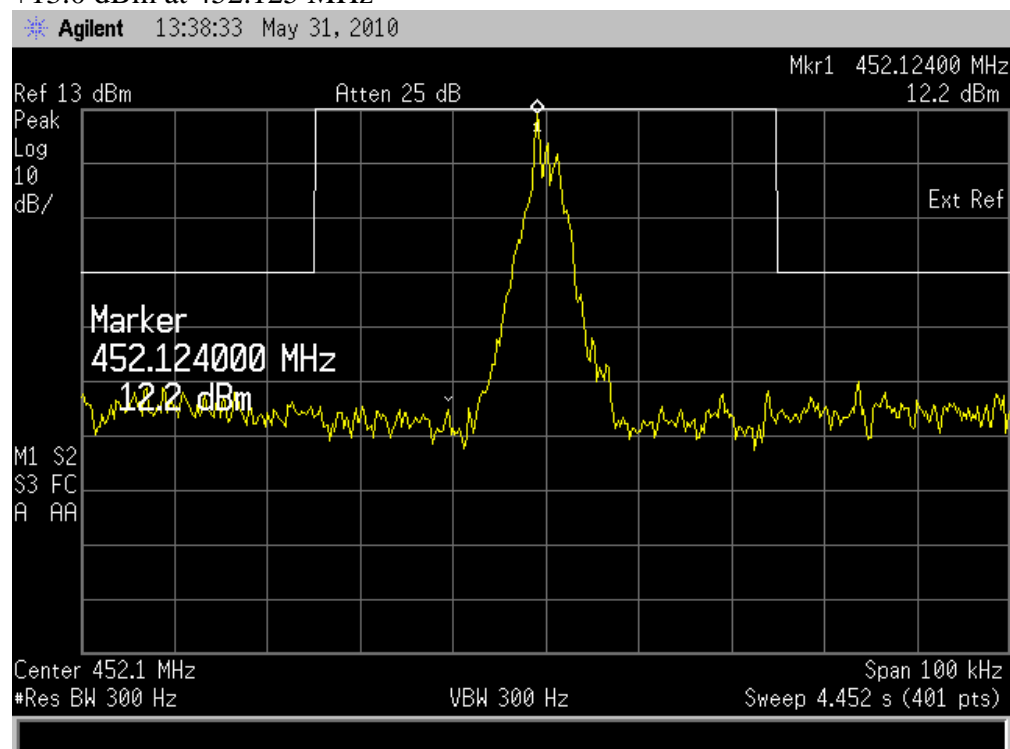
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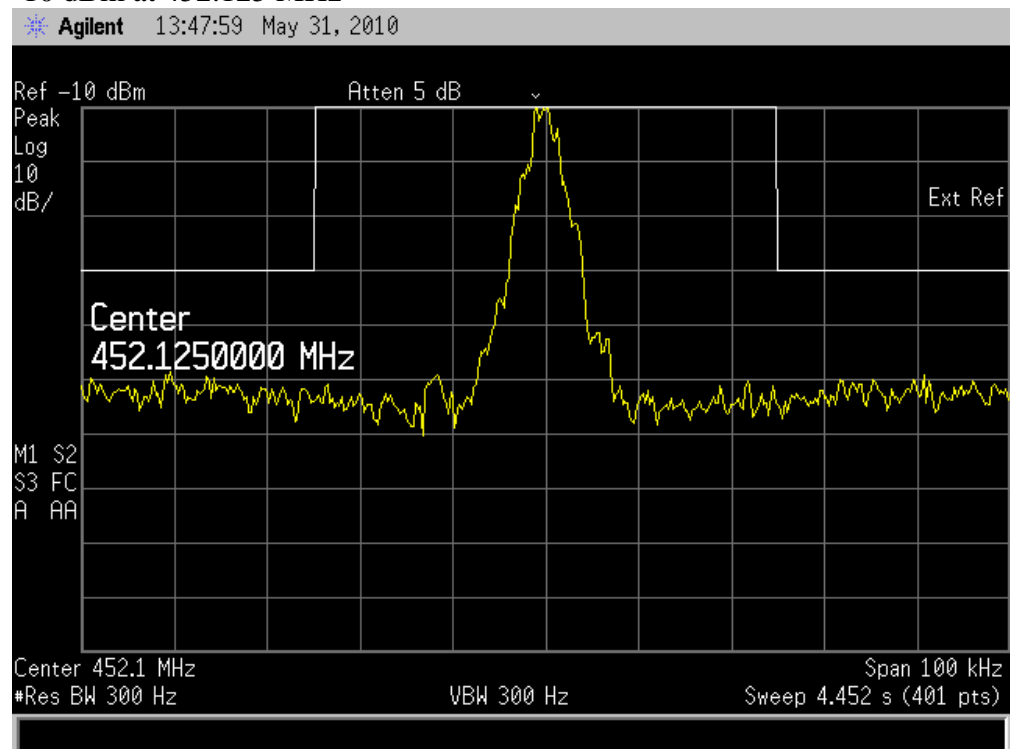
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+13.0 dBm at 452.125 MHz



-10 dBm at 452.125 MHz



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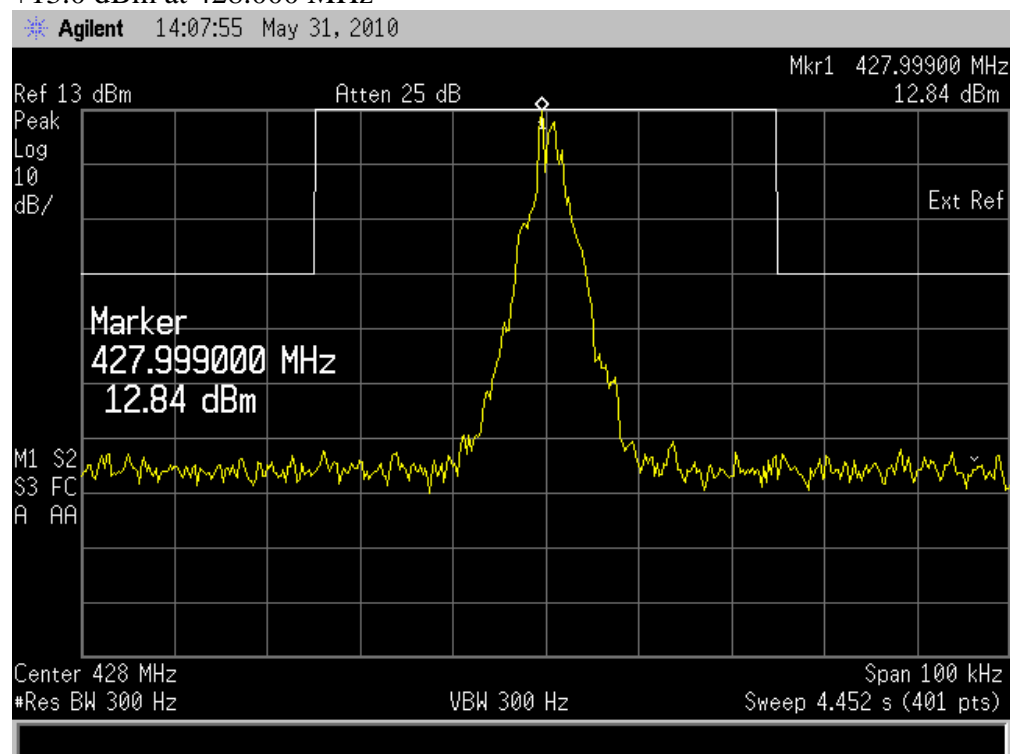
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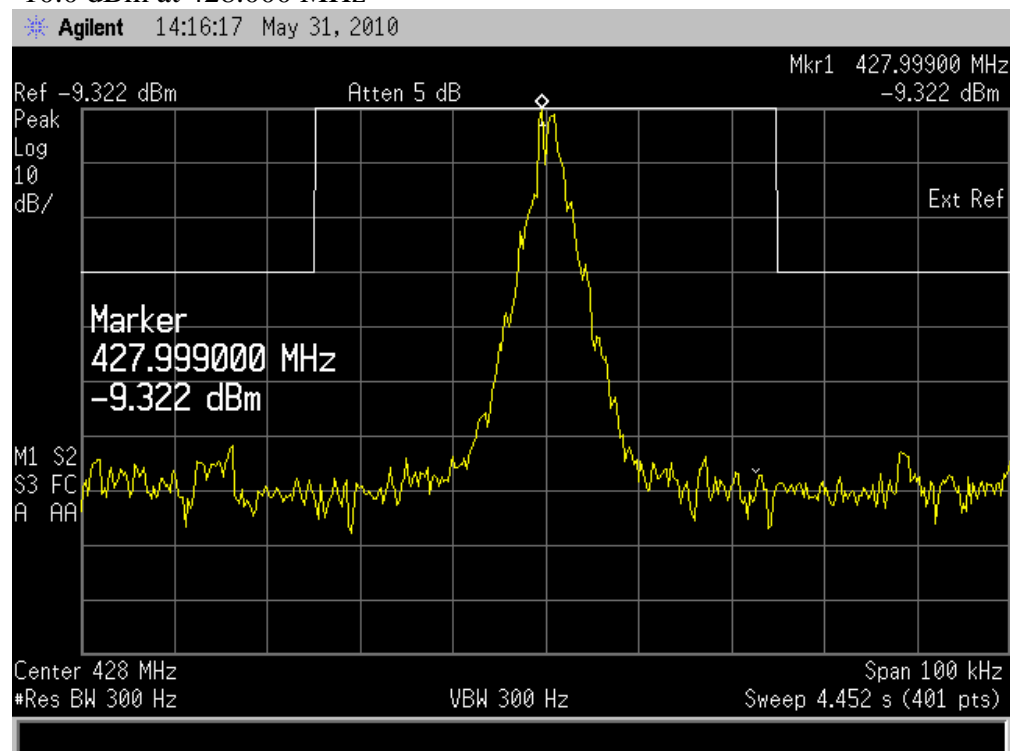
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+13.0 dBm at 428.000 MHz



-10.0 dBm at 428.000 MHz



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## Limit:

90.217 (a) states that for equipment designed to operate with a 12.5 kHz channel bandwidth, any emission appearing on a frequency more than 25 kHz from the assigned frequency, shall be attenuated by at least 30 dB below the unmodulated carrier.

A transmitter output power of +13.0 dBm gives a limit of -17.0 dBm and a transmitter output power of -10.0 dBm gives a limit of -40.0 dBm

**Result:** Complies

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

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## Field strength of the transmitter spurious emissions

Frequency: 428.000 MHz at +13.0 dBm

| Frequency (MHz) | Level (dBuV/m) | Power (dBm) | Limit (dBm) | Polarity   | Margin (dB) |
|-----------------|----------------|-------------|-------------|------------|-------------|
| 856.0000        | 30.6           | -64.6       | -17.0       | Vertical   | 47.6        |
| 856.0000        | 29.2           | -66.0       | -17.0       | Horizontal | 49.0        |
| 1284.0000       | 52.7           | -42.5       | -17.0       | Vertical   | 25.5        |
| 1284.0000       | 54.5           | -40.7       | -17.0       | Horizontal | 23.7        |
| 1712.0000       | 33.9           | -61.3       | -17.0       | Vertical   | 44.3        |
| 1712.0000       | 31.6           | -63.6       | -17.0       | Horizontal | 46.6        |
| 2140.0000       | 37.4           | -57.8       | -17.0       | Vertical   | 40.8        |
| 2140.0000       | 36.9           | -58.3       | -17.0       | Horizontal | 41.3        |
| 2568.0000       | -              | -           | -17.0       | Vertical   | -           |
| 2568.0000       | -              | -           | -17.0       | Horizontal | -           |
| 2996.0000       | -              | -           | -17.0       | Vertical   | -           |
| 2996.0000       | -              | -           | -17.0       | Horizontal | -           |
| 3424.0000       | -              | -           | -17.0       | Vertical   | -           |
| 3424.0000       | -              | -           | -17.0       | Horizontal | -           |
| 3852.0000       | -              | -           | -17.0       | Vertical   | -           |
| 3852.0000       | -              | -           | -17.0       | Horizontal | -           |
| 4280.0000       | -              | -           | -17.0       | Vertical   | -           |
| 4280.0000       | -              | -           | -17.0       | Horizontal | -           |

Frequency: 428.000 MHz at -10.0 dBm

| Frequency (MHz) | Level (dBuV/m) | Power (dBm) | Limit (dBm) | Polarity   | Margin (dB) |
|-----------------|----------------|-------------|-------------|------------|-------------|
| 856.0000        | 21.2           | -74.0       | -40.0       | Vertical   | 34.0        |
| 856.0000        | 20.8           | -74.4       | -40.0       | Horizontal | 34.4        |
| 1284.0000       | 33.8           | -61.4       | -40.0       | Vertical   | 21.4        |
| 1284.0000       | 32.5           | -62.7       | -40.0       | Horizontal | 22.7        |
| 1712.0000       | 29.6           | -65.6       | -40.0       | Vertical   | 25.6        |
| 1712.0000       | 28.7           | -66.5       | -40.0       | Horizontal | 26.5        |
| 2140.0000       | 35.9           | -59.3       | -40.0       | Vertical   | 19.3        |
| 2140.0000       | 38.1           | -57.1       | -40.0       | Horizontal | 17.1        |
| 2568.0000       | -              | -           | -40.0       | Vertical   | -           |
| 2568.0000       | -              | -           | -40.0       | Horizontal | -           |
| 2996.0000       | -              | -           | -40.0       | Vertical   | -           |
| 2996.0000       | -              | -           | -40.0       | Horizontal | -           |
| 3424.0000       | -              | -           | -40.0       | Vertical   | -           |
| 3424.0000       | -              | -           | -40.0       | Horizontal | -           |
| 3852.0000       | -              | -           | -40.0       | Vertical   | -           |
| 3852.0000       | -              | -           | -40.0       | Horizontal | -           |
| 4280.0000       | -              | -           | -40.0       | Vertical   | -           |
| 4280.0000       | -              | -           | -40.0       | Horizontal | -           |

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**Frequency:** 452.7000 MHz at +13.0 dBm

| Frequency (MHz) | Level (dBuV/m) | Power (dBm) | Limit (dBm) | Polarity   | Margin (dB) |
|-----------------|----------------|-------------|-------------|------------|-------------|
| 905.4000        | 33.1           | -62.1       | -17.0       | Vertical   | 45.1        |
| 905.4000        | 30.3           | -64.9       | -17.0       | Horizontal | 47.9        |
| 1358.1000       | 54.8           | -40.4       | -17.0       | Vertical   | 23.4        |
| 1358.1000       | 54.5           | -40.7       | -17.0       | Horizontal | 23.7        |
| 1810.8000       | 36.5           | -58.7       | -17.0       | Vertical   | 41.7        |
| 1810.8000       | 40.8           | -54.4       | -17.0       | Horizontal | 37.4        |
| 2263.5000       | 39.6           | -55.6       | -17.0       | Vertical   | 38.6        |
| 2263.5000       | 39.5           | -55.7       | -17.0       | Horizontal | 38.7        |
| 2716.2000       | 38.5           | -56.7       | -17.0       | Vertical   | 39.7        |
| 2716.2000       | 39.9           | -55.3       | -17.0       | Horizontal | 38.3        |
| 3168.9000       | -              | -           | -17.0       | Vertical   | -           |
| 3168.9000       | -              | -           | -17.0       | Horizontal | -           |
| 3621.6000       | -              | -           | -17.0       | Vertical   | -           |
| 3621.6000       | -              | -           | -17.0       | Horizontal | -           |
| 4074.3000       | -              | -           | -17.0       | Vertical   | -           |
| 4074.3000       | -              | -           | -17.0       | Horizontal | -           |
| 4527.0000       | -              | -           | -17.0       | Vertical   | -           |
| 4527.0000       | -              | -           | -17.0       | Horizontal | -           |

**Frequency:** 452.7000 MHz at -10.0 dBm

| Frequency (MHz) | Level (dBuV/m) | Power (dBm) | Limit (dBm) | Polarity   | Margin (dB) |
|-----------------|----------------|-------------|-------------|------------|-------------|
| 905.4000        | 24.7           | -70.5       | -40.0       | Vertical   | 30.5        |
| 905.4000        | 25.4           | -69.8       | -40.0       | Horizontal | 29.8        |
| 1358.1000       | 33.6           | -61.6       | -40.0       | Vertical   | 21.6        |
| 1358.1000       | 33.4           | -61.8       | -40.0       | Horizontal | 21.8        |
| 1810.8000       | 31.9           | -63.3       | -40.0       | Vertical   | 23.3        |
| 1810.8000       | 31.5           | -63.7       | -40.0       | Horizontal | 23.7        |
| 2263.5000       | 39.3           | -55.9       | -40.0       | Vertical   | 15.9        |
| 2263.5000       | 39.2           | -56.0       | -40.0       | Horizontal | 16.0        |
| 2716.2000       | 39.3           | -55.9       | -40.0       | Vertical   | 15.9        |
| 2716.2000       | 38.5           | -56.7       | -40.0       | Horizontal | 16.7        |
| 3168.9000       | -              | -           | -40.0       | Vertical   | -           |
| 3168.9000       | -              | -           | -40.0       | Horizontal | -           |
| 3621.6000       | -              | -           | -40.0       | Vertical   | -           |
| 3621.6000       | -              | -           | -40.0       | Horizontal | -           |
| 4074.3000       | -              | -           | -40.0       | Vertical   | -           |
| 4074.3000       | -              | -           | -40.0       | Horizontal | -           |
| 4527.0000       | -              | -           | -40.0       | Vertical   | -           |
| 4527.0000       | -              | -           | -40.0       | Horizontal | -           |

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Other radiated emissions observed.

| Frequency<br>(MHz) | Level<br>(dBuV/m) | Power<br>(dBm) | Limit<br>(dBm) | Polarity   | Margin<br>(dB) |
|--------------------|-------------------|----------------|----------------|------------|----------------|
| 54.035             | 34.5              | -60.7          | -40.0          | Vertical   | 20.7           |
| 54.035             | 28.1              | -67.1          | -40.0          | Horizontal | 27.1           |
| 60.000             | 26.7              | -68.5          | -40.0          | Vertical   | 28.5           |
| 141.150            | 25.0              | -70.2          | -40.0          | Horizontal | 30.2           |
| 567.352            | 32.5              | -62.7          | -40.0          | Horizontal | 22.7           |
| 567.352            | 34.3              | -60.9          | -40.0          | Horizontal | 20.9           |
| 621.388            | 42.1              | -53.1          | -40.0          | Vertical   | 13.1           |
| 621.388            | 32.8              | -62.4          | -40.0          | Horizontal | 22.4           |
| 675.422            | 38.1              | -57.1          | -40.0          | Vertical   | 17.1           |
| 675.422            | 31.9              | -63.3          | -40.0          | Horizontal | 23.3           |
| 729.453            | 33.4              | -61.8          | -40.0          | Vertical   | 21.8           |
| 783.489            | 34.7              | -60.5          | -40.0          | Vertical   | 20.5           |
| 837.525            | 36.3              | -58.9          | -40.0          | Vertical   | 18.9           |
| 891.554            | 36.9              | -58.3          | -40.0          | Vertical   | 18.3           |
| 891.554            | 32.7              | -62.5          | -40.0          | Horizontal | 22.5           |
| 945.590            | 36.7              | -58.5          | -40.0          | Vertical   | 18.5           |
| 945.590            | 38.3              | -56.9          | -40.0          | Horizontal | 16.9           |
| 999.626            | 40.1              | -55.1          | -40.0          | Horizontal | 15.1           |

The level of these emissions was the same regardless of whether the transmitter was operating at +13 dBm or -10 dBm.

Therefore the -40.0 dBm lower limit has been applied as the transmitter is operating continuously.

When operating in transmit mode no significant emissions were detected between the harmonic emissions.

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.

The transmitter was tested while transmitting continuously into an attached 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.

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

The level recorded is the signal generator output level in dBm less any gains / losses due to the coax cable and the dipole antenna.

**Limit:**

90.217 (a) states that for equipment designed to operate with a 12.5 kHz channel bandwidth, any emission appearing on a frequency more than 25 kHz from the assigned frequency, shall be attenuated by at least 30 dB below the unmodulated carrier.

A transmitter output power of +13.0 dBm gives a limit of -17.0 dBm and a transmitter output power of -10.0 dBm gives a limit of -40.0 dBm

The spectrum was investigated up to the 10<sup>th</sup> harmonic of the transmitter.

**Result:** Complies

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

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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).

| Frequency Error (Hz) – 452.700 MHz |          |          |          |
|------------------------------------|----------|----------|----------|
| Temp.                              | 11.7 Vdc | 13.8 Vdc | 15.9 Vdc |
| +50°C                              | -88.0    | -88.0    | -88.0    |
| +40°C                              | -188.0   | -188.0   | -188.0   |
| +30°C                              | -163.0   | -163.0   | -163.0   |
| +20°C                              | -190.0   | -188.0   | -190.0   |
| +10°C                              | -230.0   | -230.0   | -230.0   |
| 0°C                                | -230.0   | -230.0   | -230.0   |
| -10°C                              | +10.0    | +10.0    | +10.0    |
| -20°C                              | +30.0    | +30.0    | +30.0    |
| -30°C                              | +100.0   | +100.0   | +100.0   |

| Frequency Error (Hz) – 428.000 MHz |          |          |          |
|------------------------------------|----------|----------|----------|
| Temp.                              | 11.7 Vdc | 13.8 Vdc | 15.9 Vdc |
| +50°C                              | -50.0    | -50.0    | -50.0    |
| +40°C                              | -180     | -180     | -180     |
| +30°C                              | -261     | -261     | -261     |
| +20°C                              | -321     | -321     | -321     |
| +10°C                              | -180.0   | -180.0   | -180.0   |
| 0°C                                | -190.0   | -190.0   | -190.0   |
| -10°C                              | +10.0    | +10.0    | +10.0    |
| -20°C                              | +50.0    | +50.0    | +50.0    |
| -30°C                              | +90.0    | +90.0    | +90.0    |

### Limit:

In the absence of a specified limit the stability for mobile stations less than 2 watts operating in a 12.5 kHz band plan as per Part 90.213 has been applied where the frequency stability between 421 – 512 MHz is 2.5 ppm.

Testing was carried out on 428.000 MHz.  $2.5 \text{ ppm} = 2.5 \times 428 \text{ MHz} = 1070 \text{ Hz}$  (worst case).

**Result:** Complies

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

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## 8. TEST EQUIPMENT USED

| Instrument        | Manufacturer    | Model      | Serial No  | Asset Ref | Cal Due       |
|-------------------|-----------------|------------|------------|-----------|---------------|
| Aerial Controller | EMCO            | 1090       | 9112-1062  | RFS 3710  | Not applic    |
| Aerial Mast       | EMCO            | 1070-1     | 9203-1661  | RFS 3708  | Not applic    |
| Turntable         | EMCO            | 1080-1-2.1 | 9109-1578  | RFS 3709  | Not applic    |
| Receiver          | R & S           | ESHS 10    | 828404/005 | 3728      | 21 Aug 2010   |
| Mains Network     | R & S           | ESH2-Z5    | 881362/032 | 3628      | 21 Aug 2010   |
| Receiver          | R & S           | ESCS 30    | 847124/020 | E1595     | 21 Feb 2011   |
| Receiver          | R & S           | ESIB 40    | 100171     | R-27-1    | 21 Aug 2010   |
| Spectrum Analyser | Hewlett Packard | E7405A     | US39150142 | 3771      | 20 April 2011 |
| Microwave Preamp  | Hewlett Packard | 8349B      | 2644A01659 | -         | 20 April 2011 |
| VHF Balun         | Schwarzbeck     | VHA 9103   | -          | RFS 3603  | 7 Feb 2011    |
| Biconical Antenna | Schwarzbeck     | BBA 9106   | -          | RFS 3612  | 7 Feb 2011    |
| Log Periodic      | Schwarzbeck     | VUSLP 9111 | 9111-228   | 3785      | 7 Feb 2011    |
| Horn Antenna      | Electrometrics  | RGA-60     | 6234       | E1492     | 10 May 2011   |

## 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 up dated on January, 2010.

Testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/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 NZS/ISO/IEC 17025.



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## 10. PHOTOGRAPH(S)

External views of items tested



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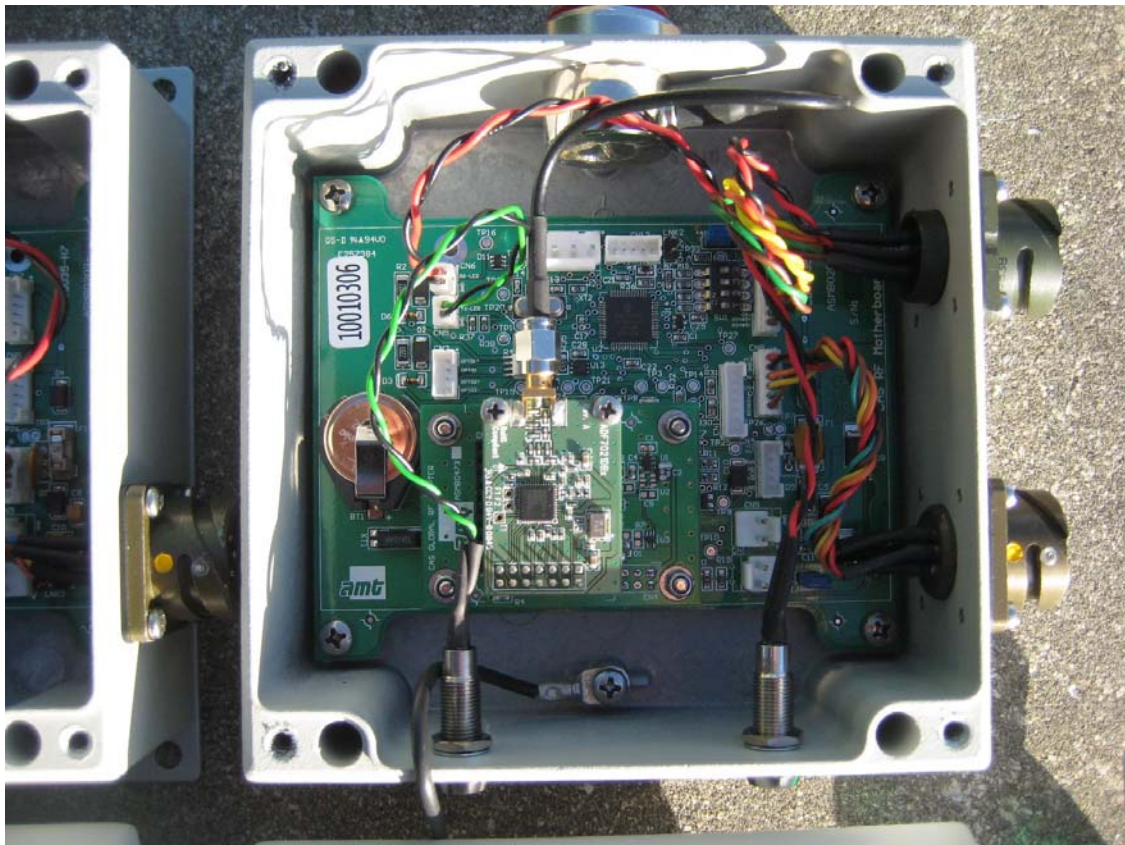
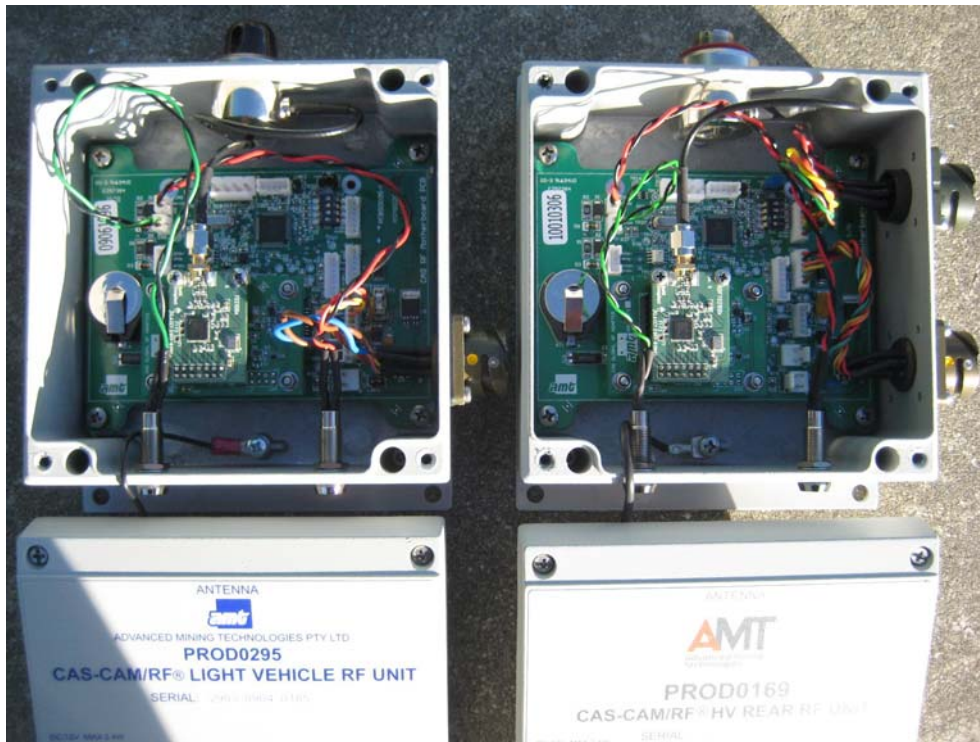


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## Internal views



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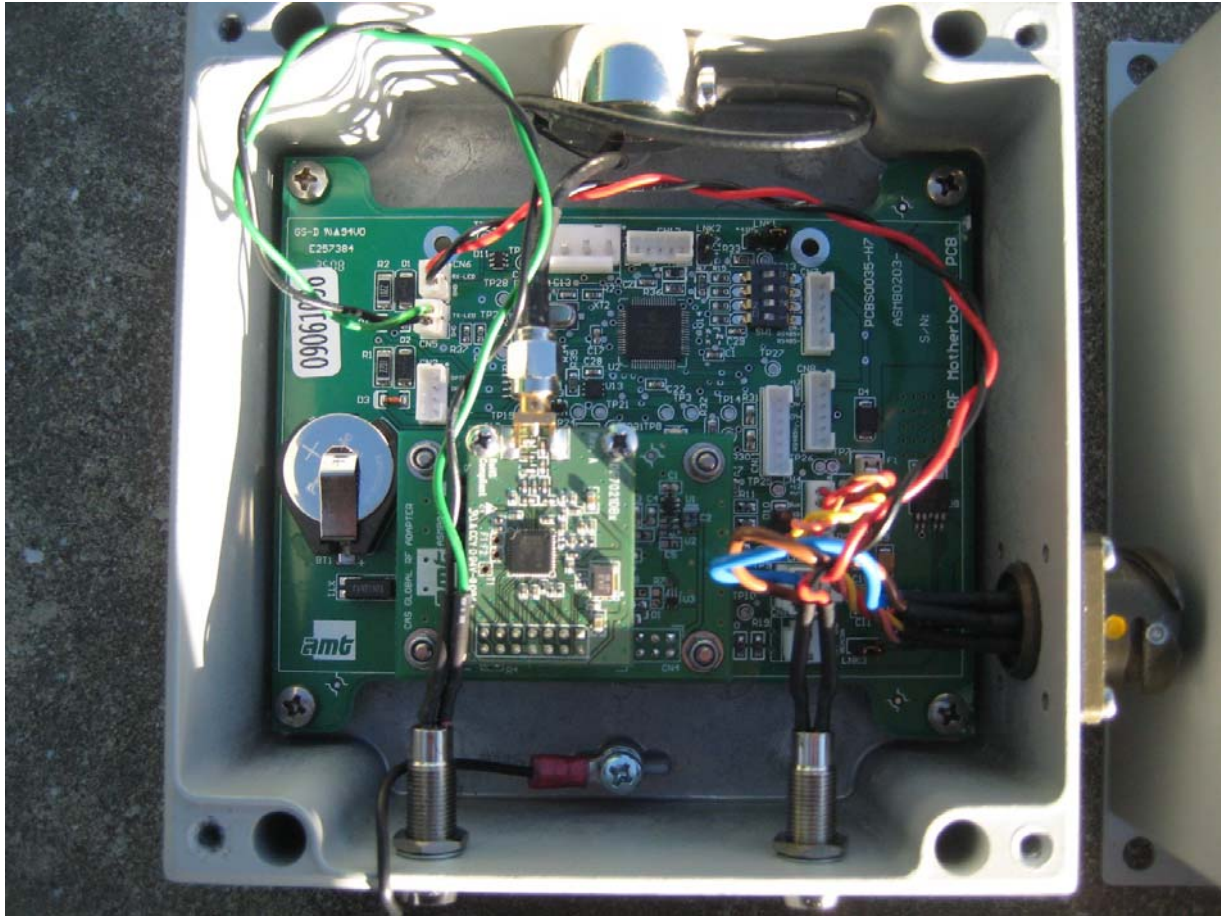
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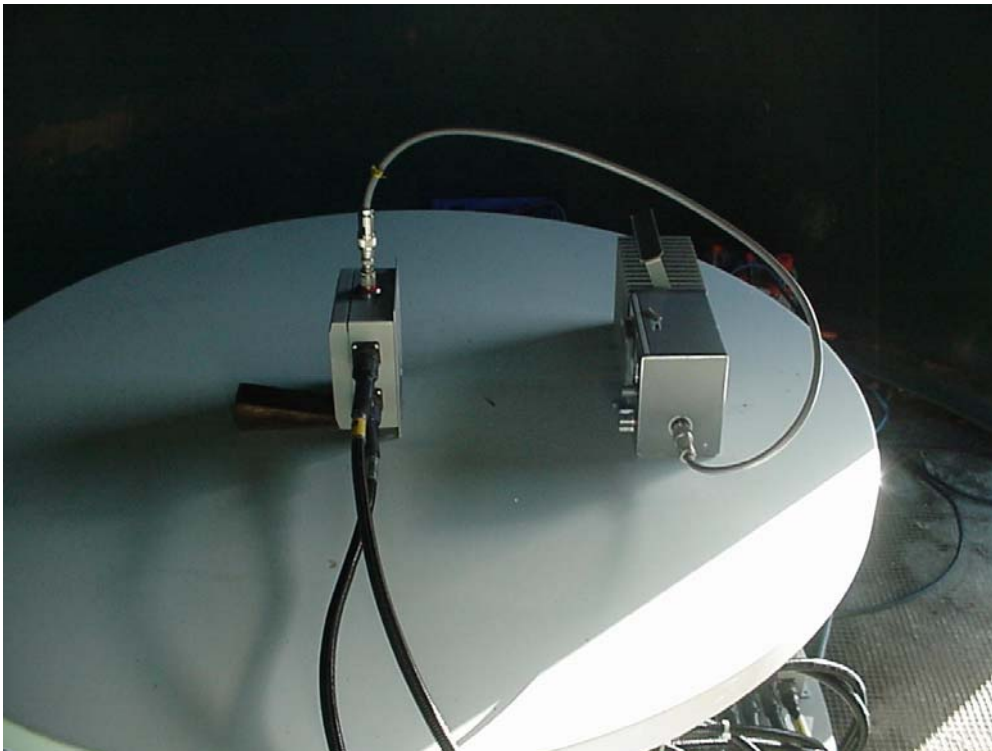
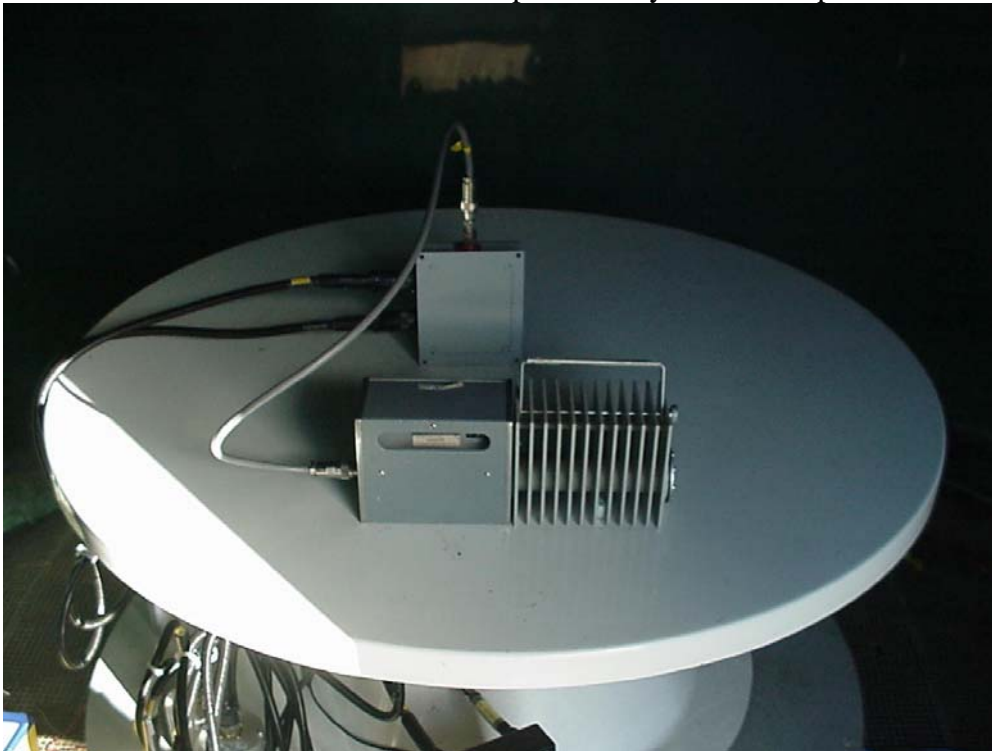
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Radiated emissions test set up – Dummy load on output



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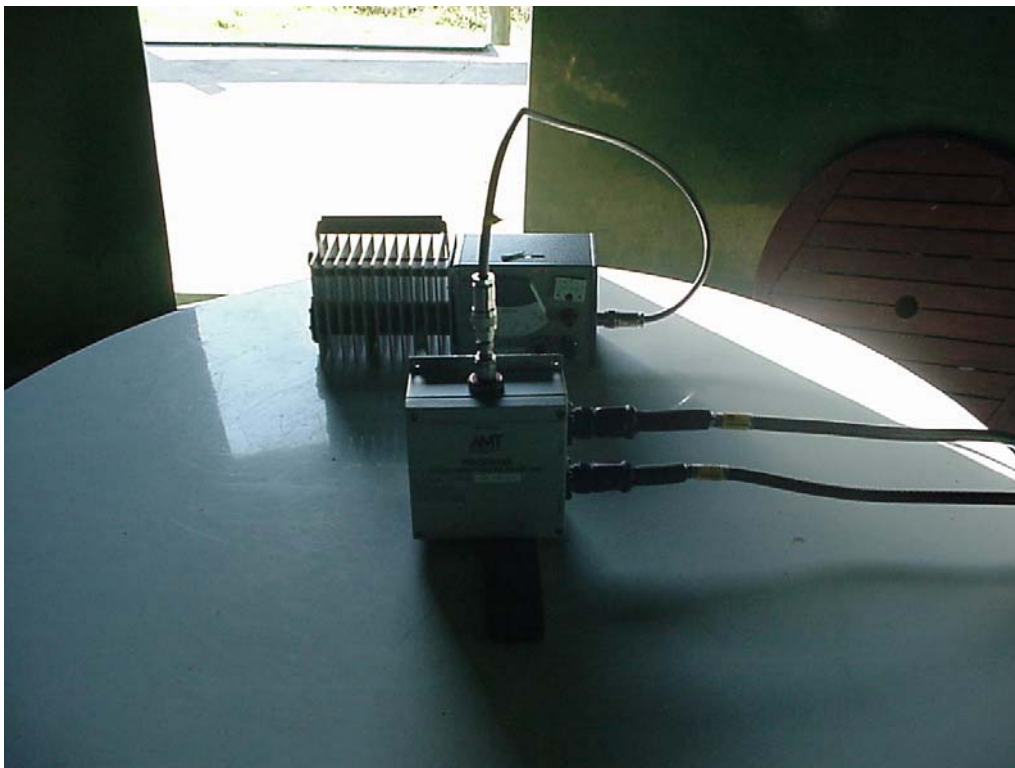
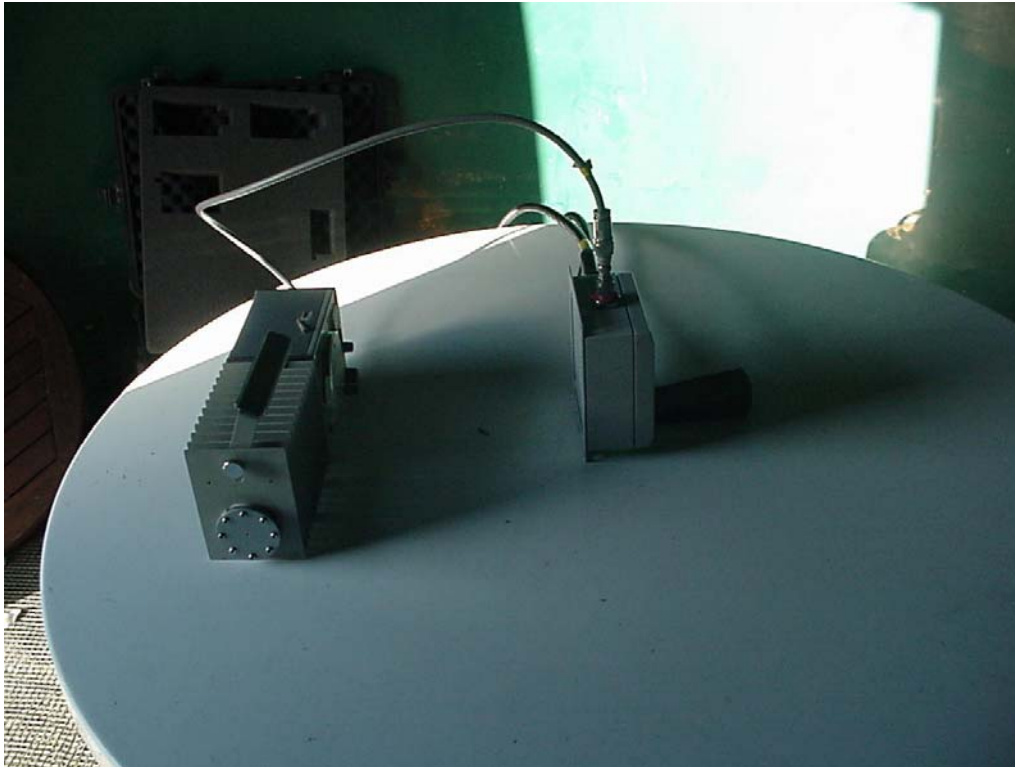
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Radiated emissions test set up – Whip antenna on output



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