EMC Technologies (NZ) Ltd
PO Box 68-307
Newton, Auckland
Phone 09 360 0862
Fax 09 360 0861
E-Mail Address: aucklab@ihug.co.nz
Web Site: www.emctech.com.au

TEST REPORT

SIMOCO SDM600 AC
VHF Mobile Transceiver

tested to the

Code of Federal Regulations (CFR) 47

Part 90 –Private Land Mobile Services

for

ComGroup Australia Pty Ltd

This Test Report is issued with the authority of:

Andrew Cutler - General Manager

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

Table of Contents

1. COMPLIANCE STATEMENT

The **Simoco SDM600 AC VHF Mobile Transceiver** complies with the limits defined in 47 CFR Part 90 and 47 CFR Part 2 when tested in-accordance with the test methods described in 47 CFR Part 2.

2. RESULT SUMMARY

The results of testing, carried out in February and March, 2012, are summarised below.

Clause	Description	Result
90.203	Certification required	Noted
2.1046 90.205	RF power output Power and antenna height limits	Noted Complies
2.1047 2.1047(a) 2.1047(b) 90.211(a)	Modulation Characteristics Low pass filter response Modulation limiting characteristics Modulation characteristics	Noted Noted Noted Complies
2.1049 2.202 90.207 90.209 90.210	Occupied bandwidth Bandwidths Types of emissions Bandwidth limitations Emission masks	Noted Noted Complies Complies Complies Complies Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Complies
2.1055 90.213	Frequency stability Frequency stability	Noted Complies
90.214	Transient frequency behaviour	Complies
1.1310	Radio frequency exposure limits	Complies

3. INTRODUCTION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification.

The client selected the test sample.

This report relates only to the sample tested.

This report contains no 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.

4. CLIENT INFORMATION

Company Name	ComGroup Australia Pty Ltd
Address	1270 Ferntree Gully Road Scoresby
State	Victoria, 3179
Country	Australia
Contact	Mr Robert Stowell

5. TEST SAMPLE DESCRIPTION

Brand Name	Simoco
Model Number	SDM600 AC
Product	VHF mobile radio
Manufacturer	Simoco
Manufactured in	Taiwan
Designed in	Australia
Serial Number	360AC12010001
FCC ID	STZSDM600AC

The test sample has sockets for a transmit antenna and an accessory (Handset (PTT TX & RX Audio)) interface.

The sample tested has the following specifications:

Rated Transmitter Output Power

25.0 Watts (44.0 dBm)

Transmitter FCC frequency range

Part 90: 150- 174 MHz

Test frequencies

Chl	Frequency MHz	Power Watts	Spacing kHz
1	150.075	25.0	12.5
2	162.075	25.0	12.5
3	173.975	25.0	12.5

Emission Designators / Modes of operation

11k2F3E – Analogue speech
7k60FXE – DMR 4FSK 9600 bps TDMA digital speech and data
7k60FXD – DMR 4FSK 9600 bps TDMA digital data

Power Supply

Lead acid rechargeable battery DC voltage supply typically 13.8 Vdc

Standard Temperature and Humidity

Temperature: +15°C to + 30° maintained.
Relative Humidity: 20% to 75% 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: 15.6 Vdc
Low Voltage: 10.8 Vdc

6. ATTESTATION

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

The client selected the test sample.

The report relates only to the sample tested.

This report does not contain corrections or erasures.

This report replaces report number 120205.4 in order to remove all reference to FCC part 15 and FCC part 22 for certification purposes.

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

7. TEST RESULTS

Certification required

Certification of this device is sought for transmissions using 12.5 kHz channel spacing.

12.5 kHz channel bandwidth certification is sought for this transmitter under section 90.203(j)(4) and (5) as:

- certification has been sought after January 1, 2011.

- the equipment meets the spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth

- the equipment can operate with a data rate greater than 4.8 kbps per 6.25 kHz of channel bandwidth

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 Ω dummy load.

Measurements were carried out when the transmitter was not being modulated.

Testing was carried out at maximum power output.

Frequency (MHz)	Voltage (Vdc)	Rated (dBm)	Measured (dBm)
150.075	13.8	44.0	43.4
162.075	13.8	44.0	43.4
173.975	13.8	44.0	43.4

Frequency (MHz)	Voltage (Vdc)	Rated (dBm)	Measured (dBm)
162.075	10.8 Vdc	44.0	43.1
162.075	15.6 Vdc	44.0	43.6

Limits:
Clause 90.205(h) of Part 90 specifies that in the band 150 – 174 MHz the maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and the required service area.

Result: Complies
Measurement Uncertainty: ±0.5 dB

Modulation Characteristics

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

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.

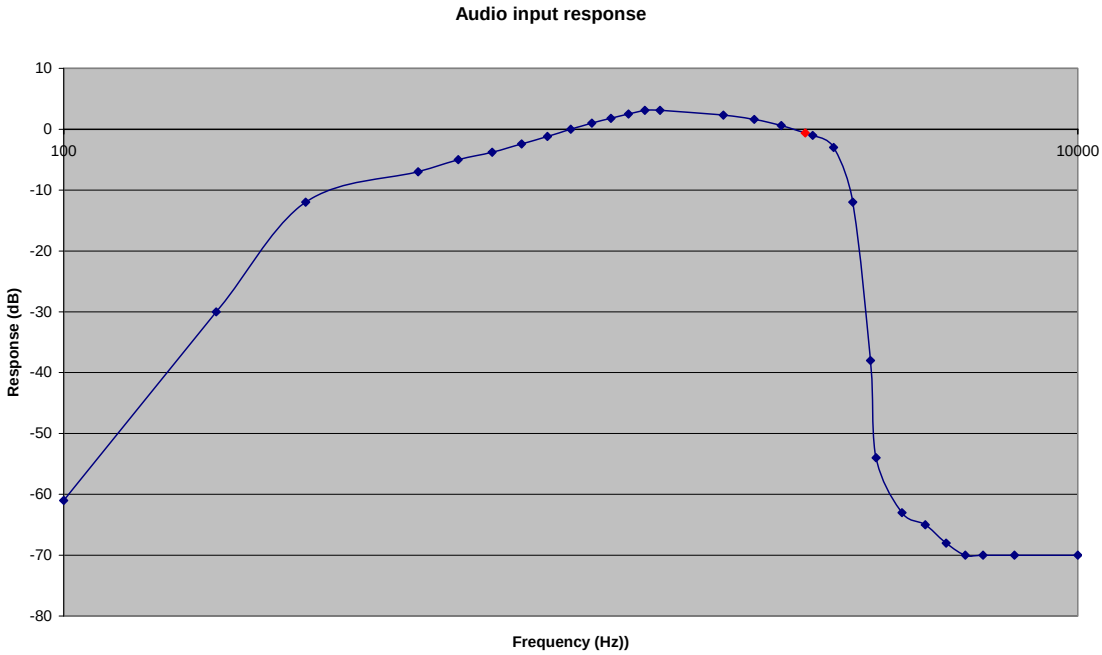
At 1 kHz an audio signal was applied which was used as a 0 dB response reference.

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.

The peak deviation response was found to be at 1500 Hz.

The -3dB roll off from peak deviation occurs at 2900 Hz, and is denoted as a red data series point on the following graph.

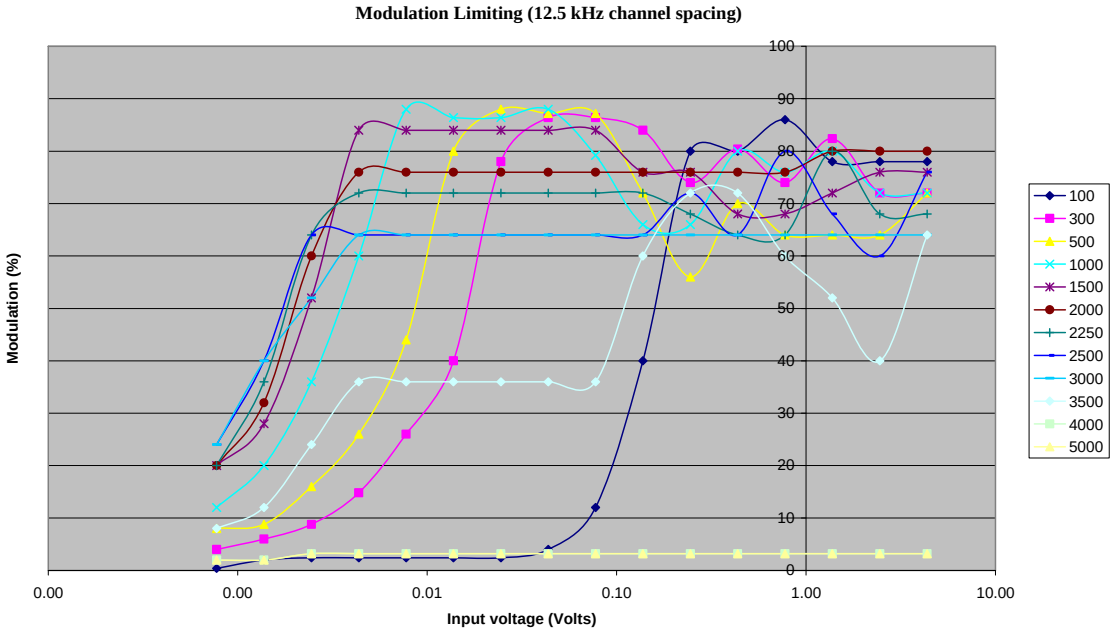


(a) A family of curves showing the percentage of modulation versus the modulation input voltage.

Measurements were made between 100 Hz to 5 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 channels.



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

The following other modulation types are used with this transmitter.

- 4FSK digital modulation is used for data and speech telephony.

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: ±1%.

Part 90.207 – Emission types:

The following emission types are used:

- F3E: Frequency modulation with analogue speech.
- FXE: DMR 4FSK 9600 bps TDMA digital speech and data.
- FXD: DMR 4FSK 9600 bps TDMA digital data

Part 90.209 – Bandwidth limitations:

The authorised bandwidth is taken to be the necessary bandwidth.

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
$B_n = 11$ kHz

Measurements show the following
$B_n = 2 \times 2250$ Hz $+ 2 \times 2900$ Hz
$B_n = 10.3$ kHz

This is confirmed in the emission designation 11k2F3E

For Digital Modulation 4FSK an emission designator of 7k60FXE has been declared by the client.

Measurements have also been made to verify this declared bandwidth.

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

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

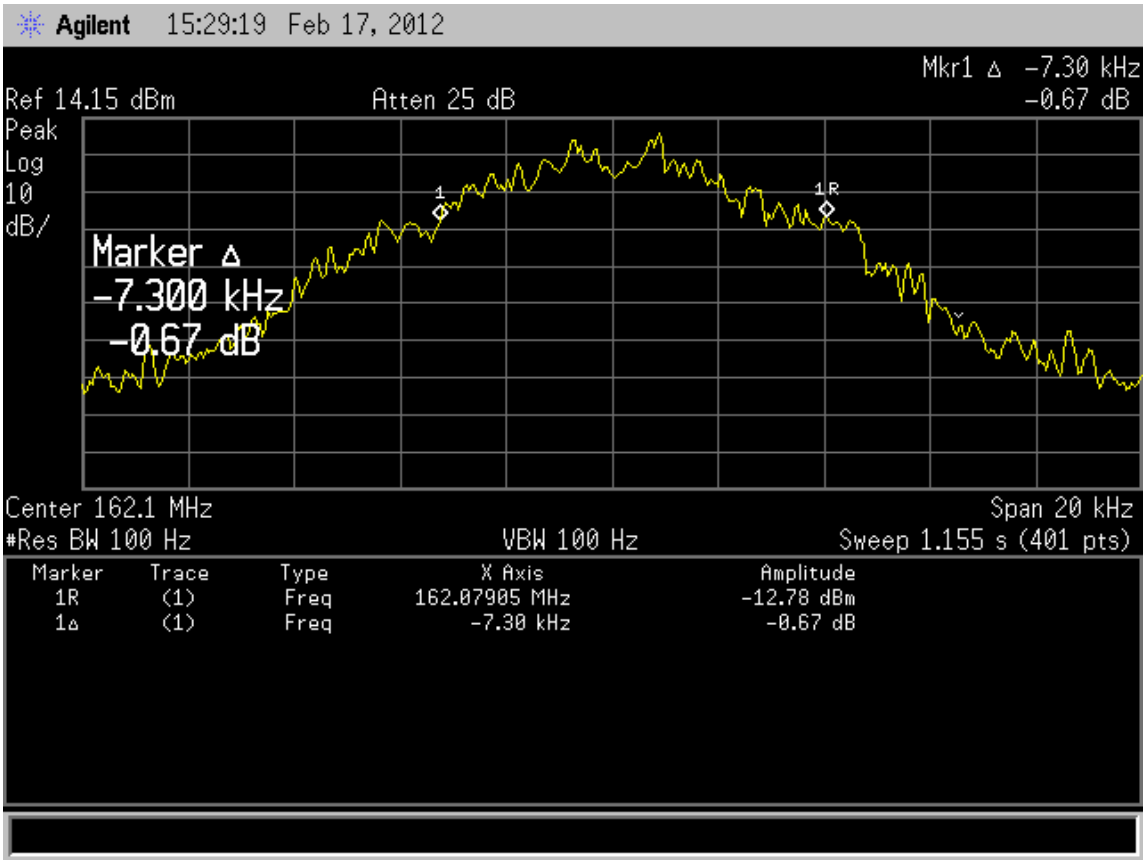
Initially power measurements are made using a resolution bandwidth of 120 kHz.

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

The resolution bandwidth is then changed to 100 Hz and the reference level minus 23 dB (99%) absolute bandwidth points determined

FXE / FXD – 12.5 kHz spacing

Emission	Channel	Measured	Designated
FXE / FXD	12.5 kHz	7.3 kHz	7.6 kHz



Result: Complies

Spectrum Masks

The spectrum masks are defined in:

Section 90.210(d) – Mask D has been applied as the transmitter can operate in the band 150-174 MHz using an authorised bandwidth of 12.5 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 120 kHz with the transmitter modulated.

All measurements have been made with a -30 dB correction factor as a 30dB attenuator is placed between the transmitter and the spectrum analyser.

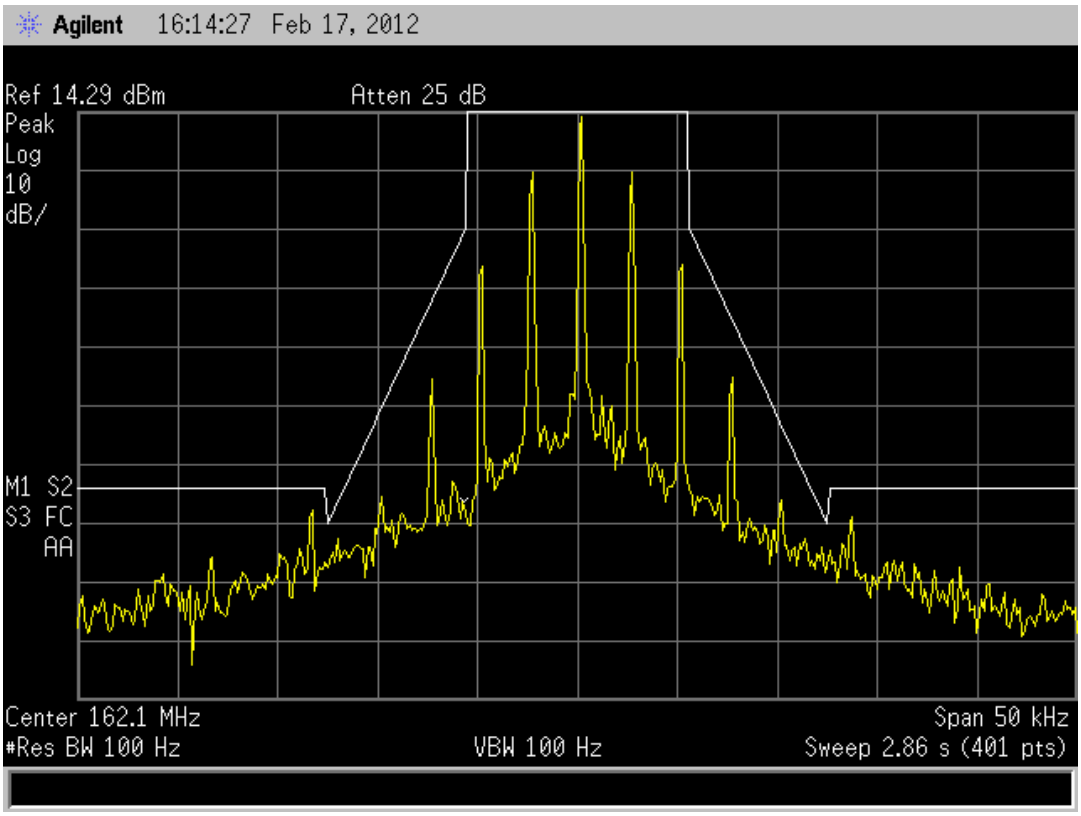
Measurements were made in peak hold with the transmitter operating on 162.075 MHz.

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.

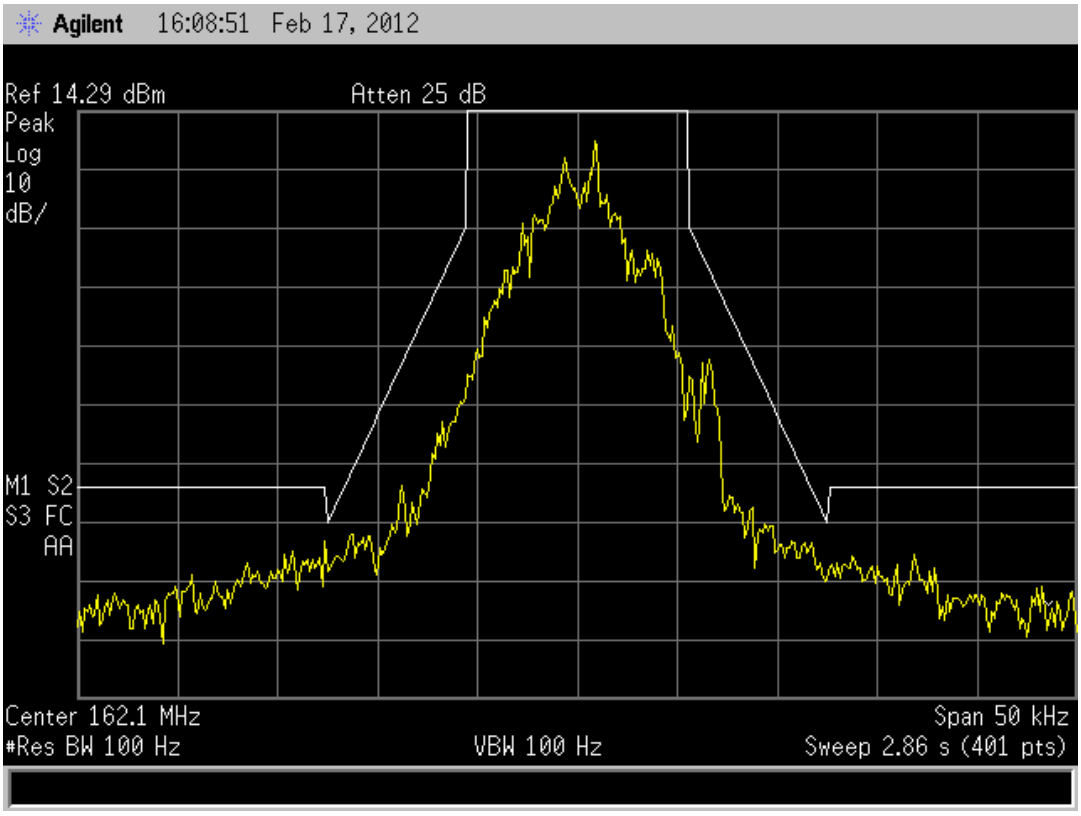
For the FXE / FXD mode the transmitter was modulated using the modulation sources internal to the transmitter as supplied by the client.

Result: Complies

F3E 12.5 kHz



FXE / FXD 12.5 kHz



Transmitter spurious emissions at the antenna terminals

Frequency: 162.075 MHz

Spurious emission (MHz)	Emission level (dBm)	Limit (dBm)
324.150	-53.4	-20.0
486.225	-57.9	-20.0
648.300	<-60.0	-20.0
810.375	<-60.0	-20.0
972.450	<-60.0	-20.0
1134.525	<-60.0	-20.0
1296.600	<-60.0	-20.0
1458.675	<-60.0	-20.0
1620.750	<-60.0	-20.0

No other emissions were observed

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^{th} harmonic if the transmitter operates below 10 GHz.

A rated power of 25.0 watts gives a limit of –20.0 dBm.

Some emissions less that –40 dBm have been reported for completeness.

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

Result: Complies
Measurement Uncertainty: ±3.3 dB

Field strength of the transmitter spurious emissions

Frequency: 150.075 MHz

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)
300.1500	28.0	-69.4	-20.0	Vertical	49.4
300.1500	36.3	-61.1	-20.0	Horizontal	41.1
450.2250	26.0	-71.4	-20.0	Vertical	51.4
450.2250	28.0	-69.4	-20.0	Horizontal	49.4
600.3000	43.0	-54.4	-20.0	Vertical	34.4
600.3000	38.0	-59.4	-20.0	Horizontal	39.4
750.3750	35.0	-62.4	-20.0	Vertical	42.4
750.3750	33.0	-64.4	-20.0	Horizontal	44.4
900.4500	27.6	-69.8	-20.0	Vertical	49.8
900.4500	28.5	-68.9	-20.0	Horizontal	48.9
1050.525	34.5	-62.9	-20.0	Vertical	42.9
1050.525	39.5	-57.9	-20.0	Horizontal	37.9
1200.600	35.5	-61.9	-20.0	Vertical	41.9
1200.600	41.1	-56.3	-20.0	Horizontal	36.3
1350.675	32.0	-65.4	-20.0	Vertical	45.4
1350.675	35.0	-62.4	-20.0	Horizontal	42.4
1500.750	34.5	-62.9	-20.0	Vertical	42.9
1500.750	34.0	-63.4	-20.0	Horizontal	43.4

Frequency: 162.075 MHz

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)
324.1500	33.2	-64.2	-20.0	Vertical	44.2
324.1500	43.0	-54.4	-20.0	Horizontal	34.4
486.2250	26.0	-71.4	-20.0	Vertical	51.4
486.2250	27.0	-70.4	-20.0	Horizontal	50.4
648.3000	28.0	-69.4	-20.0	Vertical	49.4
648.3000	30.0	-67.4	-20.0	Horizontal	47.4
810.3750	27.1	-70.3	-20.0	Vertical	50.3
810.3750	28.0	-69.4	-20.0	Horizontal	49.4
972.4500	34.5	-62.9	-20.0	Vertical	42.9
972.4500	40.1	-57.3	-20.0	Horizontal	37.3
1134.525	31.0	-66.4	-20.0	Vertical	46.4
1134.525	33.8	-63.6	-20.0	Horizontal	43.6
1296.600	34.0	-63.4	-20.0	Vertical	43.4
1296.600	33.5	-63.9	-20.0	Horizontal	43.9
1458.675	32.0	-65.4	-20.0	Vertical	45.4
1458.675	32.0	-65.4	-20.0	Horizontal	45.4
1620.750	36.0	-61.4	-20.0	Vertical	41.4
1620.750	33.0	-64.4	-20.0	Horizontal	44.4

Frequency: 173.975 MHz

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)
347.9500	25.0	-72.4	-20.0	Vertical	52.4
347.9500	30.1	-67.3	-20.0	Horizontal	47.3
521.9250	24.8	-72.6	-20.0	Vertical	52.6
521.9250	25.0	-72.4	-20.0	Horizontal	52.4
695.9000	33.0	-64.4	-20.0	Vertical	44.4
695.9000	34.0	-63.4	-20.0	Horizontal	43.4
869.8750	35.0	-62.4	-20.0	Vertical	42.4
869.8750	39.0	-58.4	-20.0	Horizontal	38.4
1043.850	35.0	-62.4	-20.0	Vertical	42.4
1043.850	39.0	-58.4	-20.0	Horizontal	38.4
1217.825	32.0	-65.4	-20.0	Vertical	45.4
1217.825	31.5	-65.9	-20.0	Horizontal	45.9
1391.800	34.0	-63.4	-20.0	Vertical	43.4
1391.800	36.0	-61.4	-20.0	Horizontal	41.4
1565.775	32.0	-65.4	-20.0	Vertical	45.4
1565.775	32.0	-65.4	-20.0	Horizontal	45.4
1739.750	37.0	-60.4	-20.0	Vertical	40.4
1739.750	37.0	-60.4	-20.0	Horizontal	40.4

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

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

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 in January 2011

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:

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^{th} harmonic.

Result: Complies
Measurement Uncertainty: ±4.1 dB

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.

Frequency: 162.075 MHz

Temperature	Voltage 10.8 Vdc	Voltage 13.8 Vdc	Voltage 15.6 Vdc
+50°C	-13.0	-13.0	-13.0
+40°C	-16.0	-16.0	-16.0
+30°C	-3.0	-3.0	-3.0
+20°C	-9.0	-9.0	-9.0
+10°C	-17.0	-17.0	-17.0
0°C	+35.0	+35.0	+35.0
-10°C	+42.0	+42.0	+42.0
-20°C	+55.0	+55.0	+55.0
-30°C	+46.0	+46.0	+46.0

Limit:
Part 90.213 states that mobile station transmitters operating between 150 – 174 MHz and 50 – 450 MHz with 12.5 kHz channelling are required to have a frequency tolerance of 5.0 ppm.

This transmitter was tested on 162.075 MHz. 5.0 ppm = 5 x 163.0 = 815 Hz.

Result: Complies
Measurement Uncertainty: ±30 Hz

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 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 transmitter transmit frequency of 162.075 MHz with an 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.

Channel Spacing	Period t_1 (kHz)	Period t_2 (kHz)	Period t_3 (kHz)
12.5 kHz	Nil	Nil	Nil

Limits:

Time Interval	Period	12.5 kHz Deviation (kHz)	25 kHz Deviation (kHz)
t_1	5 ms	± 12.5	± 25.0
t_2	20 ms	± 6.25	± 12.5
t_3	5 ms	± 12.5	± 25.0

Result: Complies
Measurement Uncertainty: Frequency difference ±1.6 kHz, Time period ±1 ms

12.5 kHz transmitter turn on

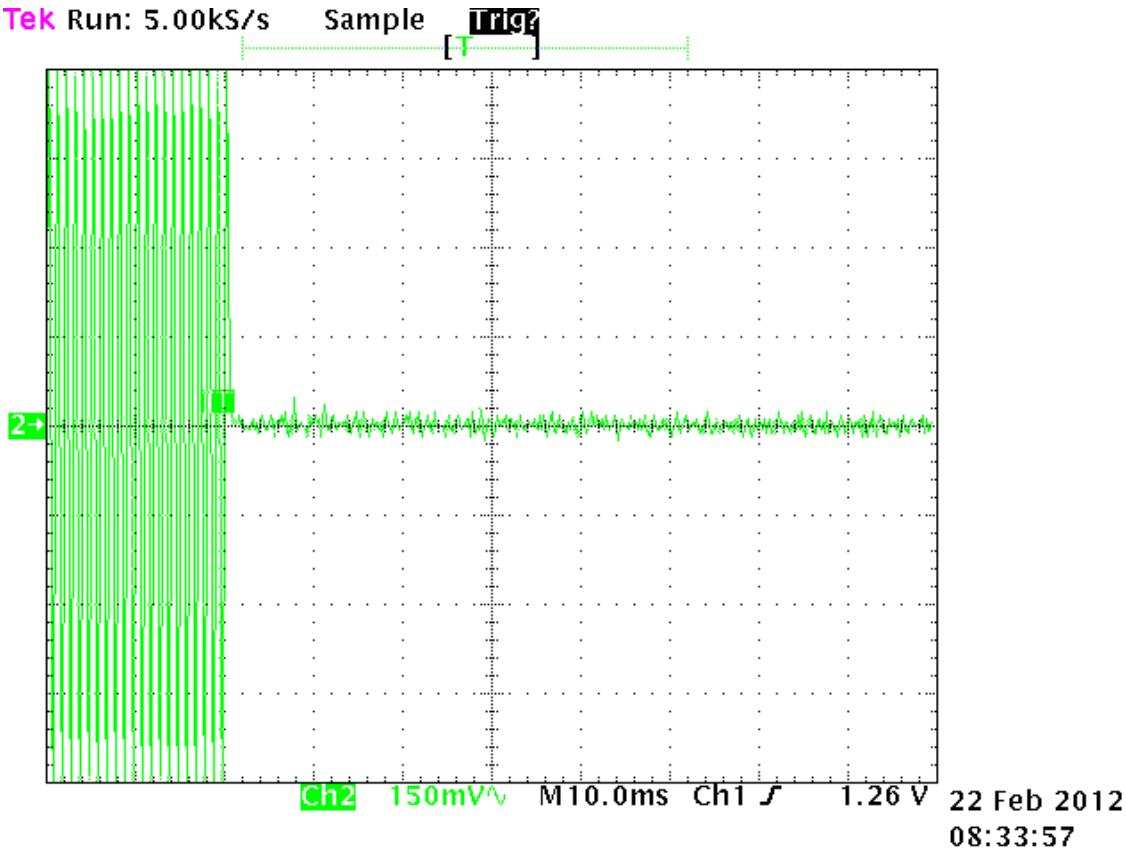
Green Trace = 1 kHz tone with FM deviation of 12.5 kHz and any transient.

Green trace has been maximised to give full screen indication of a ±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 *t*on.

*t*1 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 can be observed just after *t*on.



12.5 kHz transmitter turn off

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

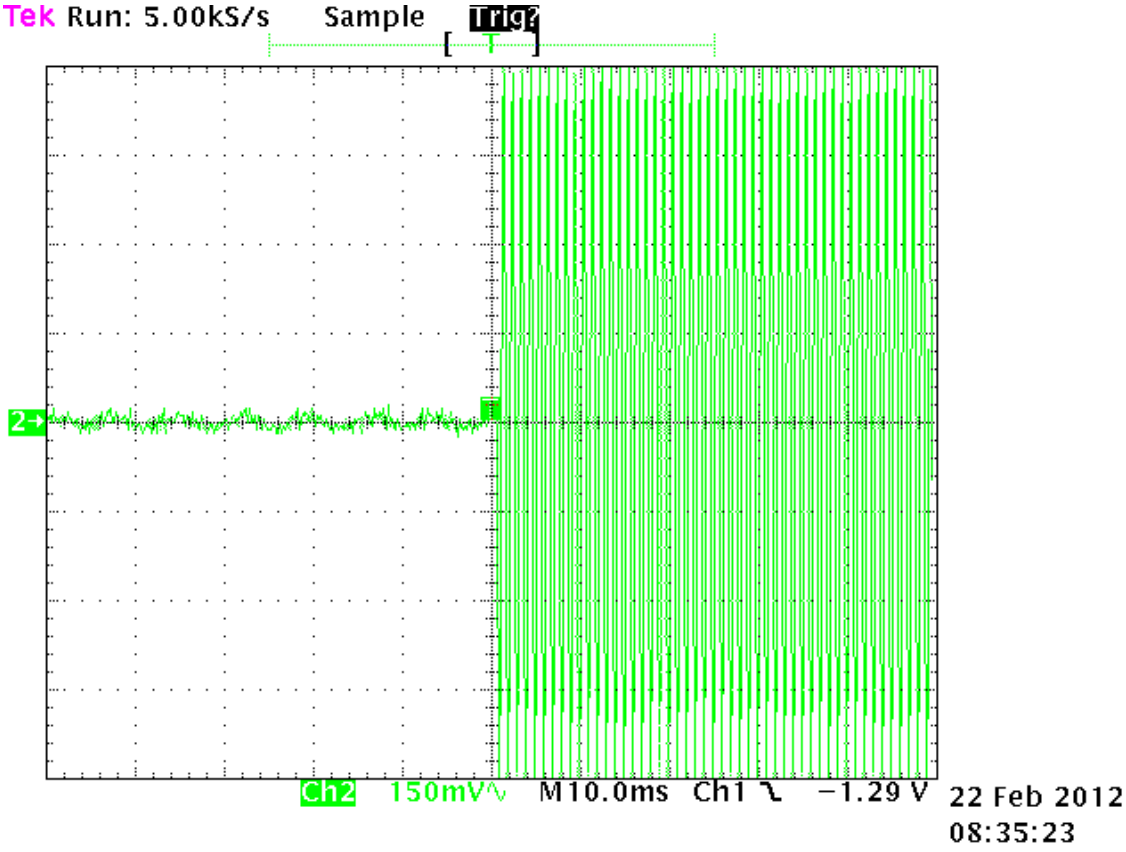
Green trace has been maximised to give full screen indication of a ± 12.5 kHz.
Therefore each Y axis division = 3.125 kHz per division.
The X axis has been set to a sweep rate of 10 ms/division.

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

This is position *t*off.

*t*3 occurs between 4.5 and 5.0 divisions from the left hand edge.

No transient response can be observed just before toff.



Exposure of humans to RF fields

As per Section 1.1310 mobile transmitters are required to be operated in a manner that ensures the public is not exposed to RF energy levels in accordance with OST/OET Bulletin Number 65.

Calculations have been made using the General Public/Uncontrolled Exposure limits.

Minimum safe distances have been calculated below.

Power density, $mW/m^2 = E^2/3770$

- Occupational / Controlled Exposure limit will be 10 mW/m^2 or 60 V/m

- General Population / Uncontrolled exposure limit will be 2 mW/m^2 or 28 V/m

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, V/m = (√ (30 * P * G * DC)) / d

The rated maximum transmitter power = 25 watts.

Transmitter is operated using a quarter wave whip antenna with a gain of 2.14 dBi (1.64).

The client has declared a duty cycle of 50% as the device operates on a push to talk basis

Controlled	**Uncontrolled**
d = √ (30 * P * G*DC) / E	
d = √ (30 * 25 * 1.64 * 0.5) / 60	d = √ (30 * 25 * 1.64 * 0.5) / 28
d = 0.41 metres or 41 cm	d = 0.89 metres or 89 cm

Result: Complies if the safe distances defined for each environment are applied.

8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset	Cal Due
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	N/a
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	N/a
Audio Analyzer	Hewlett Packard	8903A	2216A01713	E1146	29/03/12
Biconical Antenna	Schwarzbeck	BBA 9106	9594	RFS 3680	12/01/15
Frequency Counter	Hewlett Packard	HP 5342A	1916A01713	E1224	17/12/12
Level generator	Anritsu	MG443B	M61689	E1143	10/02/13
Log Periodic	Schwarzbeck	VUSLP9111	9111-228	RFS 3785	12/12/15
Receiver	Rohde & Schwarz	ESCS 30	847124/020	E1595	29/3/12
Modulation Analyzer	Rohde & Schwarz	FMA	837807/020	E1552	07/12/12
Modulation Analyzer	Hewlett Packard	8901B	2608A00782	E1090	29/03/12
Oscilloscope	Tektronics	745A	B010643	E1569	07/12/12
Pre Amplifier	Hewlett Packard	8349B	2644A01659	-	N/a
Power Attenuator	Weinschel	49-20-43	GC104	E1308	N/a
Power Supply	Hewlett Packard	6032A	2743A-02859	E1069	N/a
RF Power Meter	Hewlett Packard	HP 436A	2512A22439	E1198	29/03/12
Selective Level Meter	Anritsu	ML422C	M35386	E1140	21/10/13
Signal Generator	Rohde & Schwarz	SMHU.58	838923/028	E1493	07/12/12
Spectrum Analyzer	Hewlett Packard	E7405A	US39150142	RFS 3776	14/12/12
Thermal chamber	Contherm	M180F	86025	E1129	01/06/12
Thermometer	DSIR	RT200	035	E1049	01/06/12
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	N/a

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 in January 2011.

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.

10. PHOTOGRAPHS

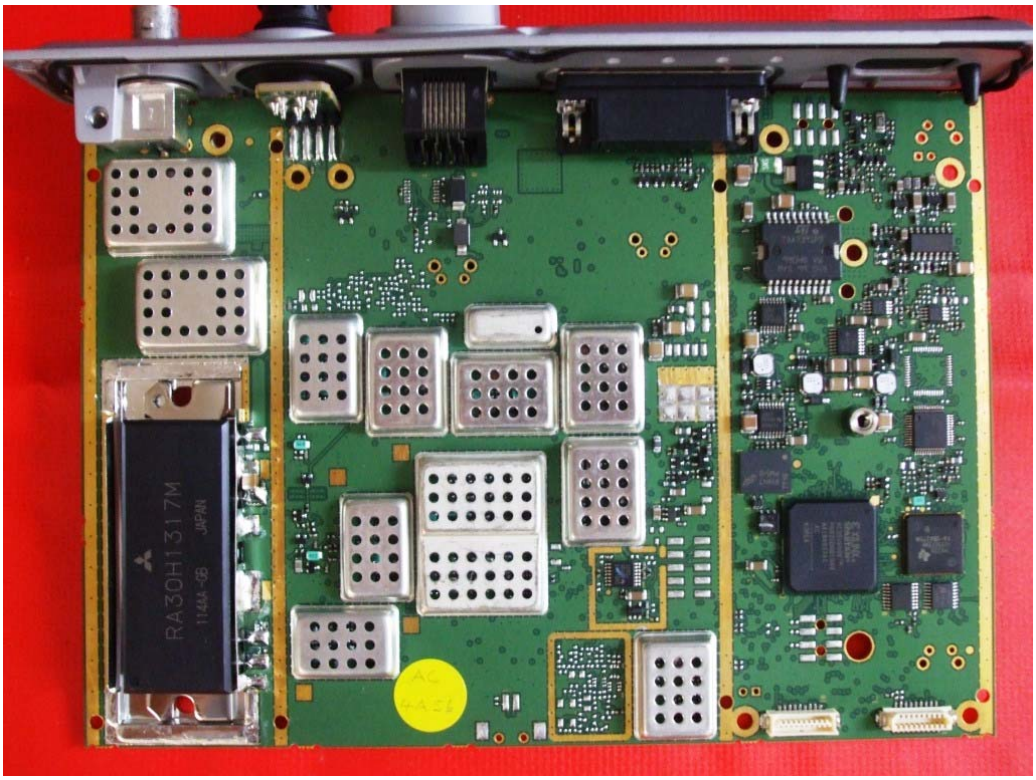
External views –

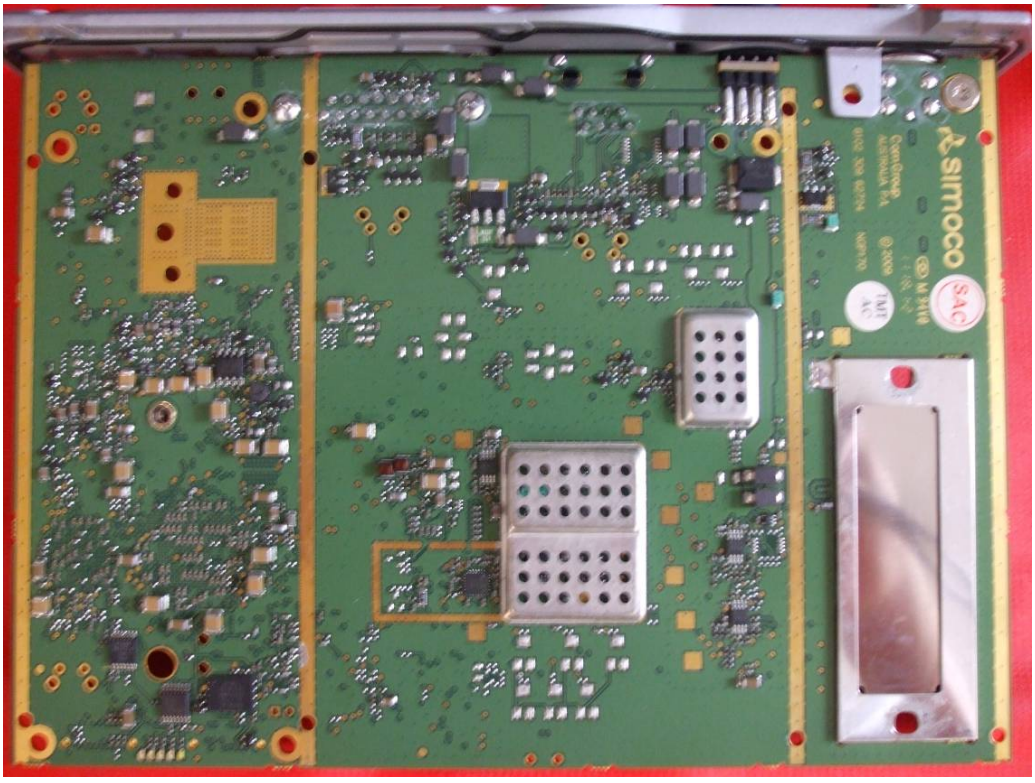
MAR630CH Controller

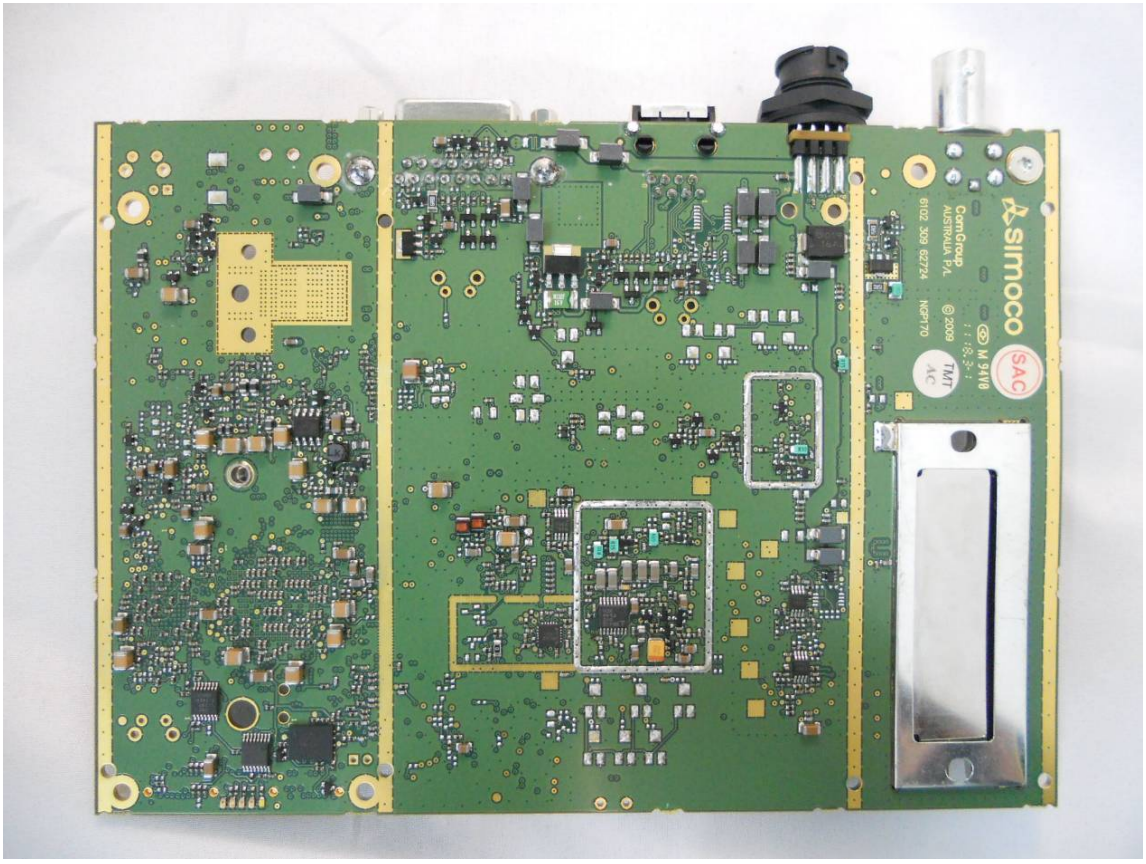
MAR610CM Controller

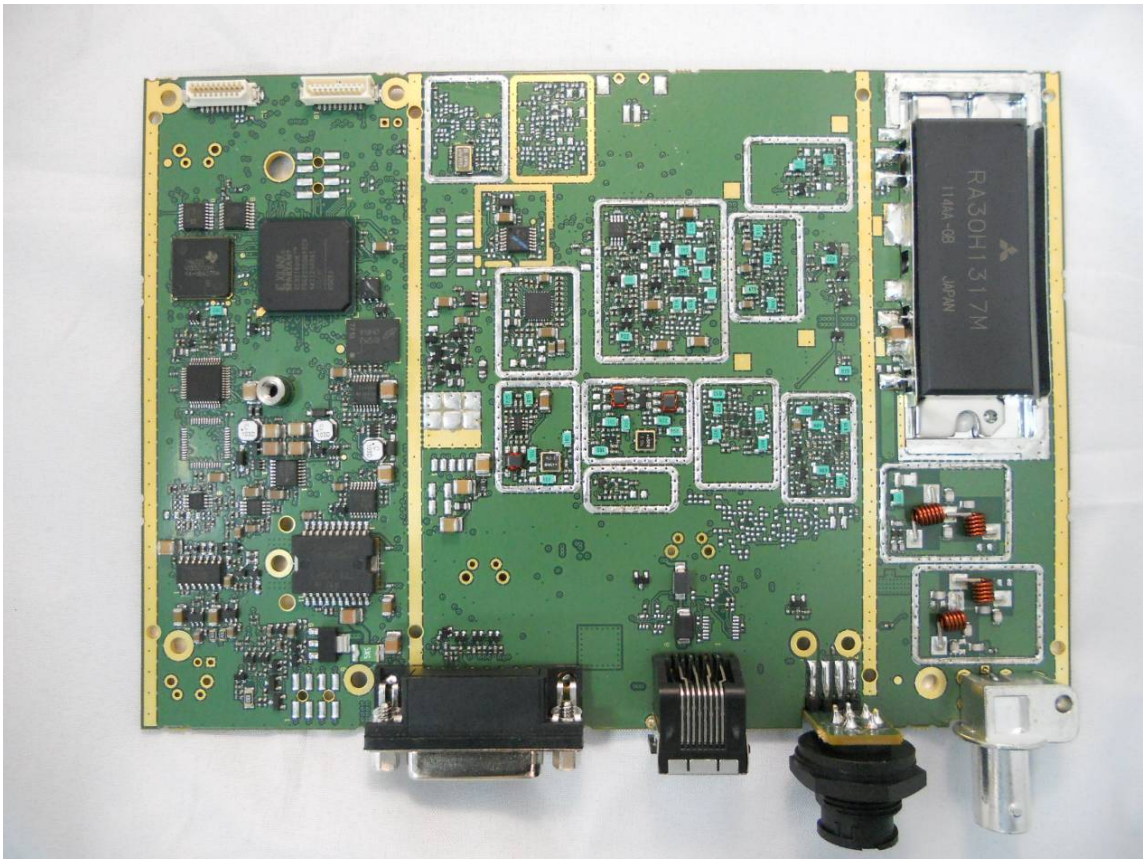
Internal Views

Main PCB









Open Air Test Site Setup