EMC Technologies (NZ) Ltd
47 MacKelvie Street, Grey Lynn
Auckland 1021
New Zealand
Phone 09 360 0862
Fax 09 360 0861
E-Mail Address: aucklab@emctec.co.nz
Web Site: www.emctech.co.nz

TEST REPORT

Salcom 12-62-0150
(148-174 MHz)
VHF POCSAG Paging Transmitter

tested to the specification

EN 300 224 V2.1.1, 2017-06

Land Mobile Service:
Radio Equipment for use in a Paging Service
Operating within the frequency range 25 MHz-470 MHz;
Harmonized Standard covering the essential requirements
of article 3.2 of Directive 2014/53/EU

for

Sea Air and Land Communications (SALCOM) Ltd

IANZ ACCREDITED LABORATORY

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

This Test Report is issued with the authority of:

Andrew Cutler- General Manager

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1. STATEMENT OF COMPLIANCE

The **Salcom 12-62-0150 VHF POCSAG Paging Transmitter** complies with the EN 300-224 V2.1.1, 2017-06.

2. RESULTS SUMMARY

The results of testing that was carried out between July and October 2017 are summarised below.

Clause	Result
Clause 7: Transmitter	Applicable.
Clause 7.1: Frequency error	Complies.
Clause 7.2.2: Carrier power (conducted)	Complies.
Clause 7.2.3: Effective Radiated Power	Not Applicable.
Clause 7.3: Adjacent channel power	Complies.
Clause 7.4: Frequency deviation.	Not applicable. Device is not modulated by analogue speech.
Clause 7.5: Spurious emissions (conducted)	Complies.
Clause 7.5: Spurious emissions (radiated)	Complies.
Clause 7.6: Transmitter transient behaviour.	Complies.
Clause 8: Receiver spurious emissions	Not applicable.

3. INTRODUCTION

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

The test sample was selected by the client.

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.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

4. CLIENT INFORMATION

Company Name	Salcom Technologies Ltd
Address	10 Vanadium place Addington Christchurch 8024
Country	New Zealand
Contact	Mr John Croft

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Salcom
Model Number	12-62-0150
Product	VHF (148-174 MHz) POCSAG Transmitter
Manufacturer	Sea Air Land Communications Ltd
Manufactured in	New Zealand
Serial Number	1231

Rated Transmitter Output Power

VHF: Power = 5.0 Watts.

Test Frequencies

Testing was carried out on the following frequencies: 148 MHz, 160 MHz, 164 MHz and 174 MHz.

Channel spacing

12.0, 25.0 kHz

Bands of operation

148-174 MHz

Paging Protocols Supported

POCSAG 512 and 1200 baud rate

External Connector

The radio has a permanent external 50 ohm connector.

External Controls

This device has no external controls.

6. TEST CONDITIONS

The following test conditions have been applied

Standard Temperature and Humidity

Temperature: +15 °C to + 30 °C maintained.
Relative Humidity: 20 % to 75 % observed.

Standard Test Power Source

The equipment is powered using an external DC supply.

Test Voltage

Nominal Voltage: 12.0 Vdc
Standard Test Voltage: 13.8 Vdc

Low Voltage: 10.8 Vdc

High Voltage: 15.2 Vdc

Extreme Temperature

High Temperature: + 55 °C maintained.
Low Temperature: - 20 °C maintained.
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7. TEST RESULTS

Frequency Error

Testing was carried out using external software control with a modulated carrier being transmitted.

The frequency error has been determined using the space / mark method described in the clause 7.1.2 of standard.

Nominal Frequency: 148.000 MHz

	Frequency Error (Hz)		
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	+140	+390	+250
+20	+580	+565	+590
-20	+115	+505	+450

Nominal Frequency: 160.000 MHz

	Frequency Error (Hz)		
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	-375	+205	+230
+20	+55	+170	+170
-20	+109	+165	+180

Limit:

Paging base stations operating in the 137-300 MHz paging bands using 12.5 kHz spacing shall have a maximum frequency error no greater than +/- 1000 Hz and 25.0 kHz spacing shall have a maximum frequency error no greater than +/- 2000 Hz.

Result: Complies.
Measurement Uncertainty: ± 50 Hz

Frequency Error

Testing was carried out using external software control with a modulated carrier being transmitted.

The frequency error has been determined using the space / mark method described in the clause 7.1.2 of standard.

Nominal Frequency: 164.000 MHz

Frequency Error (Hz)			
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	-305	-200	-200
+20	+770	+555	+600
-20	+218	+855	+800

Nominal Frequency: 174.000 MHz

Frequency Error (Hz)			
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	-300	-255	-260
+20	+665	+350	+350
-20	+650	+800	+800

Limit:

Paging base stations operating in the 137-300 MHz paging bands using 12.5 kHz spacing shall have a maximum frequency error no greater than +/- 1000 Hz and 25.0 kHz spacing shall have a maximum frequency error no greater than +/- 2000 Hz.

Result: Complies.
Measurement Uncertainty: ± 50 Hz

Carrier Power (Conducted)

Rated transmitter output power: 5.0 W (37.0 dBm)

Nominal Frequency: 148.000 MHz

Carrier Power (dBm)			
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	37.0	38.1	38.2
+20	37.5	38.4	38.4
-20	37.6	38.1	38.3

Nominal Frequency: 160.000 MHz

Carrier Power (dBm)			
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	36.6	37.3	37.5
+20	36.6	37.1	37.2
-20	36.7	37.0	37.3

Limit:

Base transmitters: the rated carrier output power shall be less than or equal to 5 W (37 dBm)

Under normal test conditions, the measured carrier output shall be within +/- 1.5 dB of the rated carrier output power. Under extreme test conditions the measured carrier output shall be within +2.0 and -3.0 dB of the rated carrier output power.

Result: Complies
Measurement Uncertainty: ± 0.5 dB

Carrier Power (Conducted)

Rated transmitter output power: 5.0 W (37.0 dBm)

Nominal Frequency: 164.000 MHz

Carrier Power (dBm)			
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	36.6	38.0	38.2
+20	36.7	37.9	38.0
-20	36.9	37.9	38.0

Nominal Frequency: 174.000 MHz

Carrier Power (dBm)			
Temp (°C)	**Vdc Low**	**Vdc Nominal**	**Vdc High**
+55	36.5	37.4	37.5
+20	36.6	37.2	37.4
-20	36.8	37.3	37.4

Limit:

Base transmitters: the rated carrier output power shall be less than or equal to 5 W (37 dBm)

Under normal test conditions, the measured carrier output shall be within +/- 1.5 dB of the rated carrier output power. Under extreme test conditions the measured carrier output shall be within +2.0 and -3.0 dB of the rated carrier output power.

Result: Complies
Measurement Uncertainty: ± 0.5 dB

Adjacent Channel Power

Adjacent channel power was carried under ambient temperature and voltage conditions as the frequency error tests were carried out in extreme conditions.

Nominal Frequency: 148.000 MHz
Measured Power: 38.4 dBm

Channel Spacing: 25 kHz

Modulation: POCSAG 512 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-81.6	-78.3
dBm	-43.2	-39.9

Modulation: POCSAG 1200 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-81.8	-80.9
dBm	-43.4	-42.5

Channel Spacing: 12.5 kHz

Modulation: POCSAG 512 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-69.7	-67.1
dBm	-31.3	-28.7

Modulation: POCSAG 1200 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-68.3	-68.1
dBm	-29.9	-29.7

Limit:

The adjacent channel power shall be at least -70 dBc for 25 kHz channelling without the need to be below 0.2 µW (-37.0 dBm).

The adjacent channel power shall be at least -60 dBc for 12.5 kHz channelling without the need to be below 0.2 µW (-37.0 dBm).

Result: Complies
Measurement Uncertainty: ±0.5dB

Adjacent Channel Power

Adjacent channel power was carried out at 160.0 MHz under ambient temperature and voltage conditions as the frequency error tests were carried out in extreme conditions.

Nominal Frequency: 160.000 MHz
Measured Power: 37.1 dBm

Channel Spacing: 25 kHz

Modulation: POCSAG 512 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-81.3	-80.5
dBm	-44.2	-43.4

Modulation: POCSAG 1200 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-75.9	-77.3
dBm	-38.8	-40.2

Channel Spacing: 12.5 kHz

Modulation: POCSAG 512 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-72.3	-70.9
dBm	-35.2	-33.8

Modulation: POCSAG 1200 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-70.4	-69.3
dBm	-33.3	-32.2

Limit:

The adjacent channel power shall be at least -70 dBc for 25 kHz channelling without the need to be below 0.2 µW (-37.0 dBm).

The adjacent channel power shall be at least -60 dBc for 12.5 kHz channelling without the need to be below 0.2 µW (-37.0 dBm).

Result: Complies
Measurement Uncertainty: ±0.5dB

Adjacent Channel Power

Adjacent channel power was carried under ambient temperature and voltage conditions as the frequency error tests were carried out in extreme conditions.

Nominal Frequency: 164.000 MHz
Measured Power: 37.9 dBm

Channel Spacing: 25 kHz

Modulation: POCSAG 512 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-76.4	-75.6
dBm	-38.5	-37.7

Modulation: POCSAG 1200 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-80.8	-80.5
dBm	-42.9	-42.6

Channel Spacing: 12.5 kHz

Modulation: POCSAG 512 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-74.1	-73.9
dBm	-36.2	-36.0

Modulation: POCSAG 1200 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-72.8	-71.2
dBm	-34.9	-33.3

Limit:

The adjacent channel power shall be at least -70 dBc for 25 kHz channelling without the need to be below 0.2 µW (-37.0 dBm).

The adjacent channel power shall be at least -60 dBc for 12.5 kHz channelling without the need to be below 0.2 µW (-37.0 dBm).

Result: Complies
Measurement Uncertainty: ±0.5dB

Adjacent Channel Power

Adjacent channel power was carried under ambient temperature and voltage conditions as the frequency error tests were carried out in extreme conditions.

Nominal Frequency: 174.000 MHz
Measured Power: 37.2 dBm

Channel Spacing: 25 kHz

Modulation: POCSAG 512 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-76.6	-75.1
dBm	-39.4	-37.9

Modulation: POCSAG 1200 baud

	+ 25.0 kHz	- 25.0 kHz
dBc	-75.8	-75.4
dBm	-38.6	-38.3

Channel Spacing: 12.5 kHz

Modulation: POCSAG 512 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-69.9	-67.9
dBm	-32.7	-30.7

Modulation: POCSAG 1200 baud

	+ 12.5 kHz	- 12.5 kHz
dBc	-69.4	-68.6
dBm	-32.2	-31.4

Limit:

The adjacent channel power shall be at least -70 dBc for 25 kHz channelling without the need to be below 0.2 μW (-37.0 dBm).

The adjacent channel power shall be at least -60 dBc for 12.5 kHz channelling without the need to be below 0.2 μW (-37.0 dBm).

Result: Complies
Measurement Uncertainty: ±0.5dB

Transmitter Spurious Emissions:

Transmitter spurious emission measurements were made at the antenna terminal while the device was transmitting continuously at a rated power of +37 dBm.

The device was transmitting its factory default modulated signal.

Nominal Frequency: 148.000 MHz

Frequency (MHz)	Emission Level (dBm)	Temp (°C)
296.0	-43.0	+20
444.0	-52.7	+20
296.0	-42.3	+55
444.0	-51.2	+55
296.0	-41.3	-20
444.0	-51.5	-20

Nominal Frequency: 160.000 MHz

Frequency (MHz)	Emission Level (dBm)	Temp (°C)
320.0	-52.0	+20
480.0	-59.3	+20
320.0	-53.0	+55
480.0	-60.1	+55
320.0	-54.0	-20
480.0	-62.1	-20

No other emissions observed when the transmitter was transmitting.

Limits

Frequency Range	9 kHz – 1.0 GHz	1.0 GHz-4.0 GHz
Tx operating	0.25 µW (-36 dBm)	1 µW (-30 dBm)
Tx in stand by	2 nW (-57 dBm)	20 nW (-47 dBm)

Result: Complies.
Measurement Uncertainty: ± 4.1 dB

Transmitter Spurious Emissions:

Transmitter spurious emission measurements were made at the antenna terminal while the device was transmitting continuously at a rated power of +37 dBm.

The device was transmitting its factory default modulated signal.

Nominal Frequency: 164.000 MHz

Frequency (MHz)	Emission Level (dBm)	Temp (°C)
328.0	<-50.0	+20
492.0	<-50.0	+20
328.0	<-50.0	+55
492.0	<-50.0	+55
328.0	<-50.0	-20
492.0	<-50.0	-20

Nominal Frequency: 174.000 MHz

Frequency (MHz)	Emission Level (dBm)	Temp (°C)
348.0	<-50.0	+20
522.0	<-50.0	+20
348.0	<-50.0	+55
522.0	<-50.0	+55
348.0	<-50.0	-20
522.0	<-50.0	-20

No other emissions observed when the transmitter was transmitting.

Limits

Frequency Range	9 kHz – 1.0 GHz	1.0 GHz-4.0 GHz
Tx operating	0.25 µW (-36 dBm)	1 µW (-30 dBm)
Tx in stand by	2 nW (-57 dBm)	20 nW (-47 dBm)

Result: Complies.
Measurement Uncertainty: ± 4.1 dB

Transmitter Radiated Spurious Emissions:

Radiated emissions testing was carried out over the frequency range of 25 to 4000 MHz at the laboratory's open area test site - located at 670 Kawakawa-Orere Road, RD5, Papakura, New Zealand.

Before testing was carried out, a receiver Self Test and Internal Calibration was undertaken along with a check of all connecting cables and programmed antenna factors.

The device was placed on the test tabletop, which was a total of 1.5 m above the test site ground plane.

Measurements of the radiated field were made with the antenna located at a 3 metre horizontal distance from the boundary of the devices under test.

Testing is carried out by scanning between 30 and 4000 MHz monitoring for emissions.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height with an automated antenna tower.

The emission is measured in both vertical and horizontal antenna polarisations using a Quasi Peak detector with a bandwidth of 120 kHz.

During the test, a number of ambient emissions are identified (list of which can be provided upon request).

The emission level is determined in field strength by taking the following into consideration:
Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB/m) + Coax Loss (dB)

Test set up

The device was powered at 13.8 Vdc.

Output of the transmitter was terminated onto a dummy load.

Limits

Frequency Range	25 MHz – 1 GHz	1 GHz – 4 GHz
Tx operating	0.25 µW (-36 dBm)	1 µW (-30 dBm)
Tx in standby	2 nW (-57 dBm)	20 nW (-47 dBm)

Frequency: 160.000 MHz

Transmitter Harmonics

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
320.0000	52.0	-45.4	-36.0	Vertical	9.4	Pass
	50.7	-46.7	-36.0	Horizontal	10.7	Pass
480.0000	47.0	-50.4	-36.0	Vertical	14.4	Pass
	51.8	-45.6	-36.0	Horizontal	9.6	Pass
640.0000	47.5	-49.9	-36.0	Vertical	13.9	Pass
	46.3	-51.1	-36.0	Horizontal	15.1	Pass
800.0000	33.9	-63.5	-36.0	Vertical	27.5	Pass
	38.6	-58.8	-36.0	Horizontal	22.8	Pass
960.0000	47.0	-50.4	-36.0	Vertical	14.4	Pass
	48.0	-49.4	-36.0	Horizontal	13.4	Pass
1120.0000	-	-	-30.0	Vertical	-	Pass
	-	-	-30.0	Horizontal	-	Pass
1280.0000	-	-	-30.0	Vertical	-	Pass
	-	-	-30.0	Horizontal	-	Pass
1440.0000	-	-	-30.0	Vertical	-	Pass
	-	-	-30.0	Horizontal	-	Pass
1600.0000	-	-	-30.0	Vertical	-	Pass
	-	-	-30.0	Horizontal	-	Pass
1760.0000	-	-	-30.0	Vertical	-	Pass
	-	-	-30.0	Horizontal	-	Pass
1920.0000	-	-	-30.0	Vertical	-	Pass
	-	-	-30.0	Horizontal	-	Pass

Other emissions observed when the transmitter was transmitting

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
83.984	23.4	-74.0	-36.0	Vertical	38.0	Pass
445.361	48.5	-48.9	-36.0	Vertical	12.9	Pass

Standby Emissions

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
30.900	19.5	-77.9	-57.0	Vertical	20.9	Pass

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (25 – 4000 MHz) ± 4.1 dB

Transmitter Transient Performance

Results:

Spacing	Period t_1 (kHz)	Period t_2 (kHz)	Period t_3 (kHz)
25.0 kHz	Less than 6.25	Less than 6.25	Less than 6.25
12.5 kHz	Less than 3.125	Less than 3.125	Less than 3.125

Limits:

Time Interval	Period	12.5 kHz Deviation (kHz)	25 kHz Deviation (kHz)
t_1	10 ms	± 12.5	± 25.0
t_2	25 ms	± 6.25	± 12.5
t_3	10 ms	± 12.5	± 25.0

The frequency difference from the nominal frequency of the transmitter shall not exceed the following values of channel separation for the transient period duration described above and below:

(a) One channel separation during the period t_1 and t_3.
(b) Half channel separation during the period t_2.

The frequency difference after the end of t_2 and before the start of t_3, shall be within the limit of frequency error (see Clause 3.2.1).

In the case of hand portable stations with a transmitter output power of less than 5 W, the frequency deviation during t_1 and t_3 may be greater than one channel. The corresponding plot of frequency versus time during t_1 and t_3 shall be recorded in the test report.

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

12.5 kHz transmitter turn on (160.000 MHz)

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

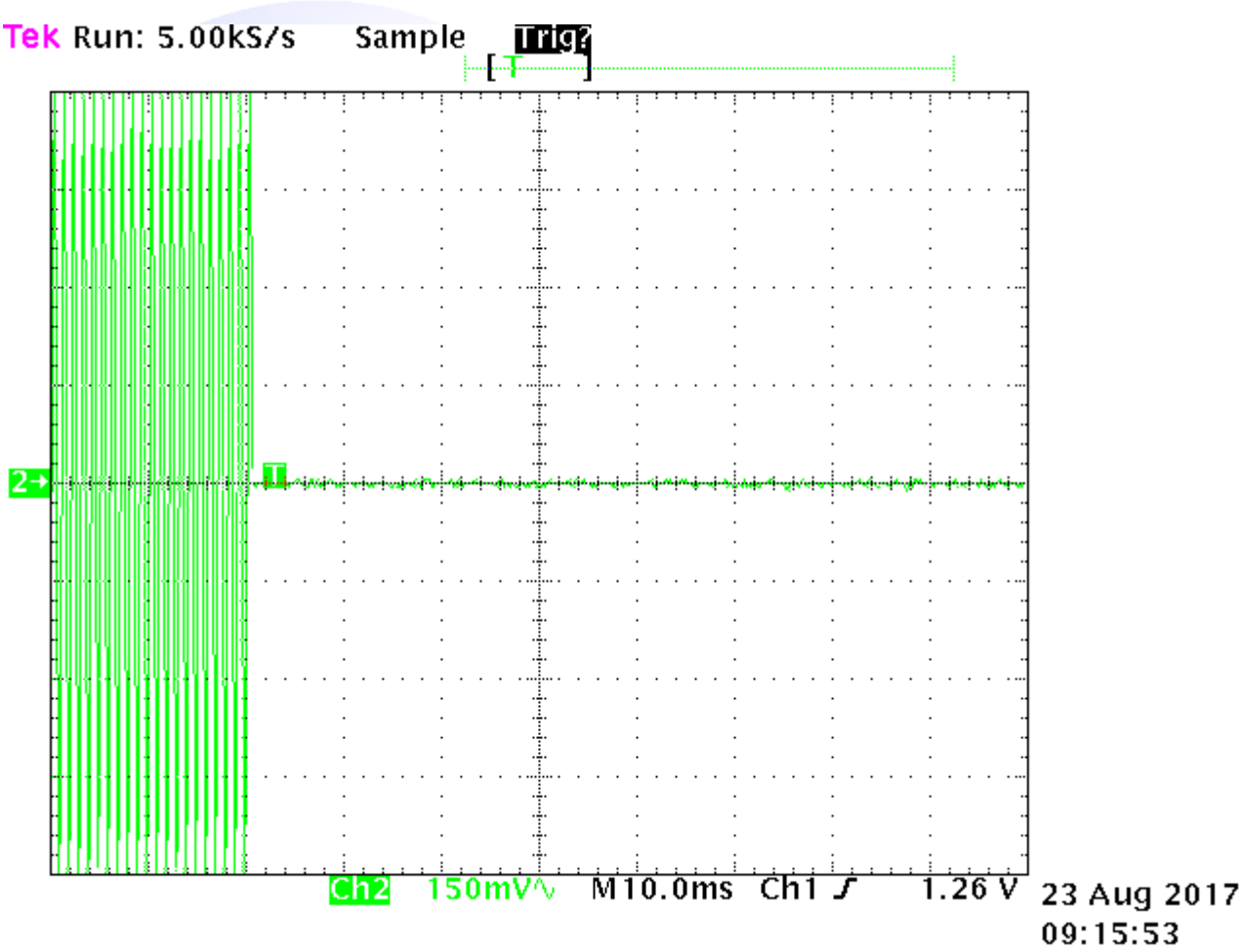
Green trace has been maximised to give full screen indication of +/- 12.5 kHz.
Therefore each Y axis division = 3.125 kHz per division.
The X axis has been set to a sweep rate of 10 ms/division.

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

*t*on occurs at 20 ms.

*t*1 occurs between 2.0 and 3.0 divisions from the left hand edge.
t2 occurs between 3.0 and 5.5 divisions from the left hand edge.

No transient response can be observed during t1 and t2.



12.5 kHz transmitter turn off (160.000 MHz)

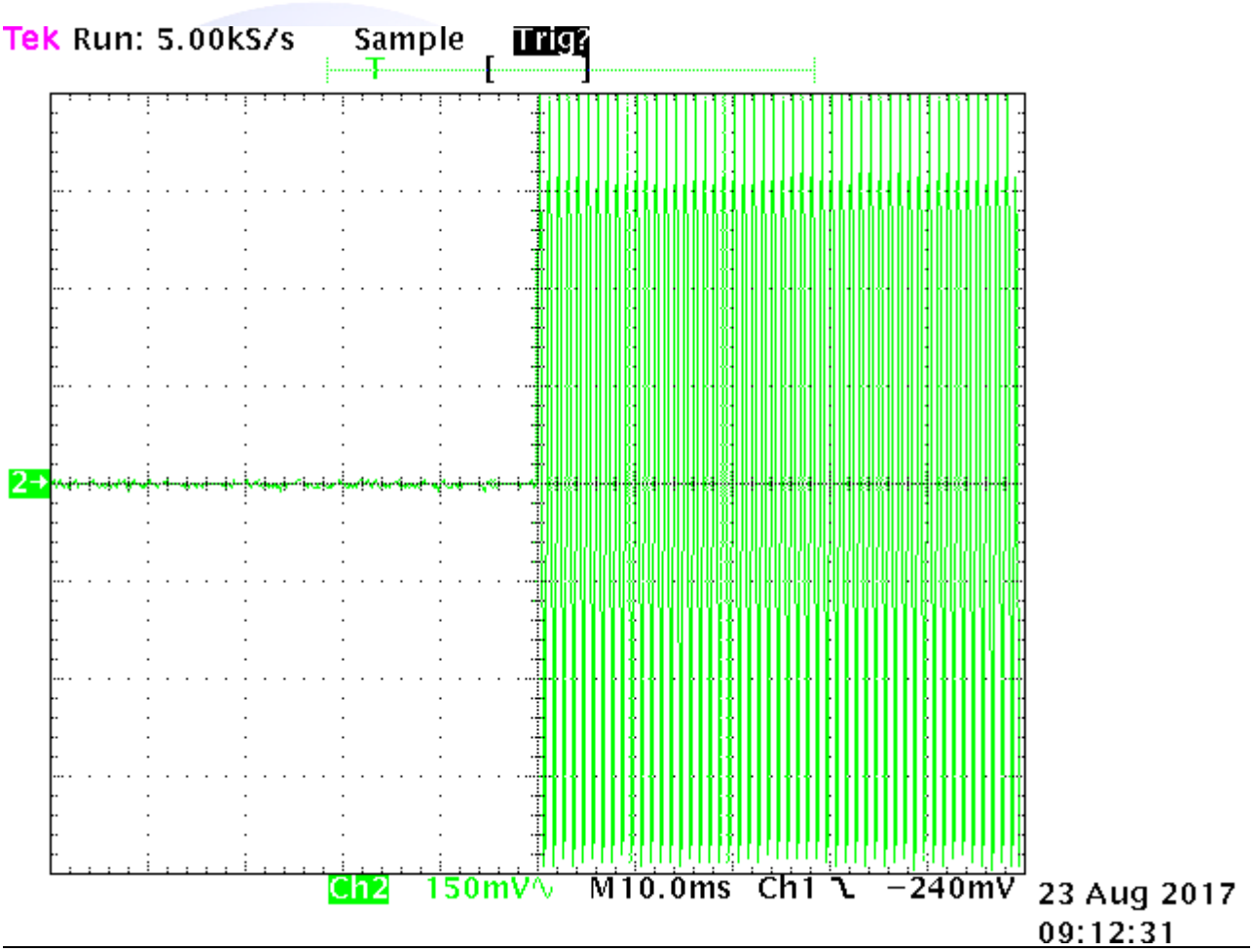
Green Trace = 1 kHz tone with FM deviation of 12.5 kHz.

Green trace has been maximised to give full screen indication of +/- 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 4.0 and 5.0 divisions from the left hand edge.

No transient response can be observed before *t*off.



25.0 kHz Transmitter turn on (160.000 MHz)

Green Trace = 1 kHz tone with FM deviation of 25.0 kHz.

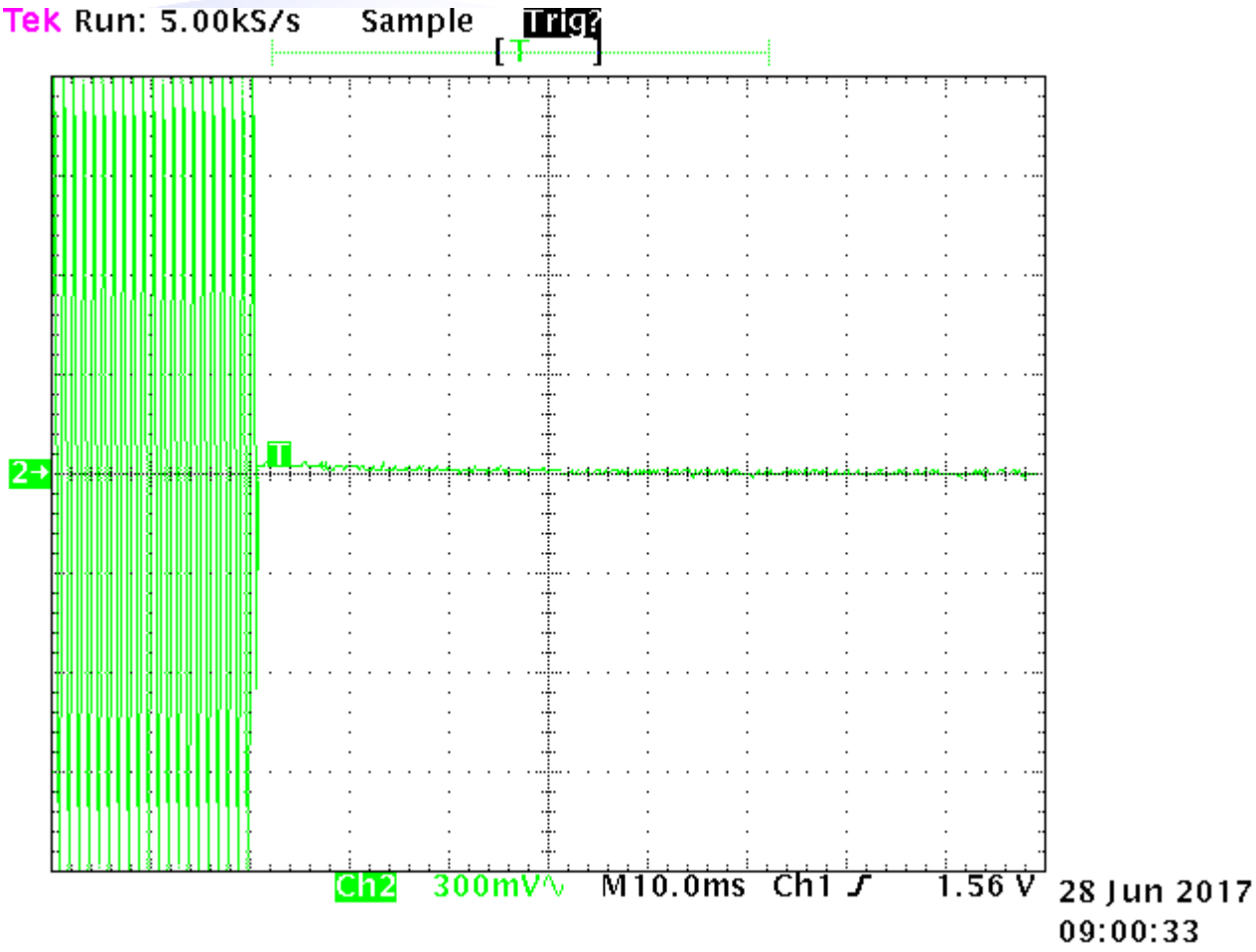
Green trace has been maximised to give full screen indication of +/- 25.0 kHz.
Therefore each Y axis division = 6.25 kHz per division.
The X axis has been set to a sweep rate of 10 ms/division.

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

*t*on occurs at 20 ms

*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 response can be observed during *t*1 and *t*2.



25.0 kHz transmitter turn off (160.000 MHz)

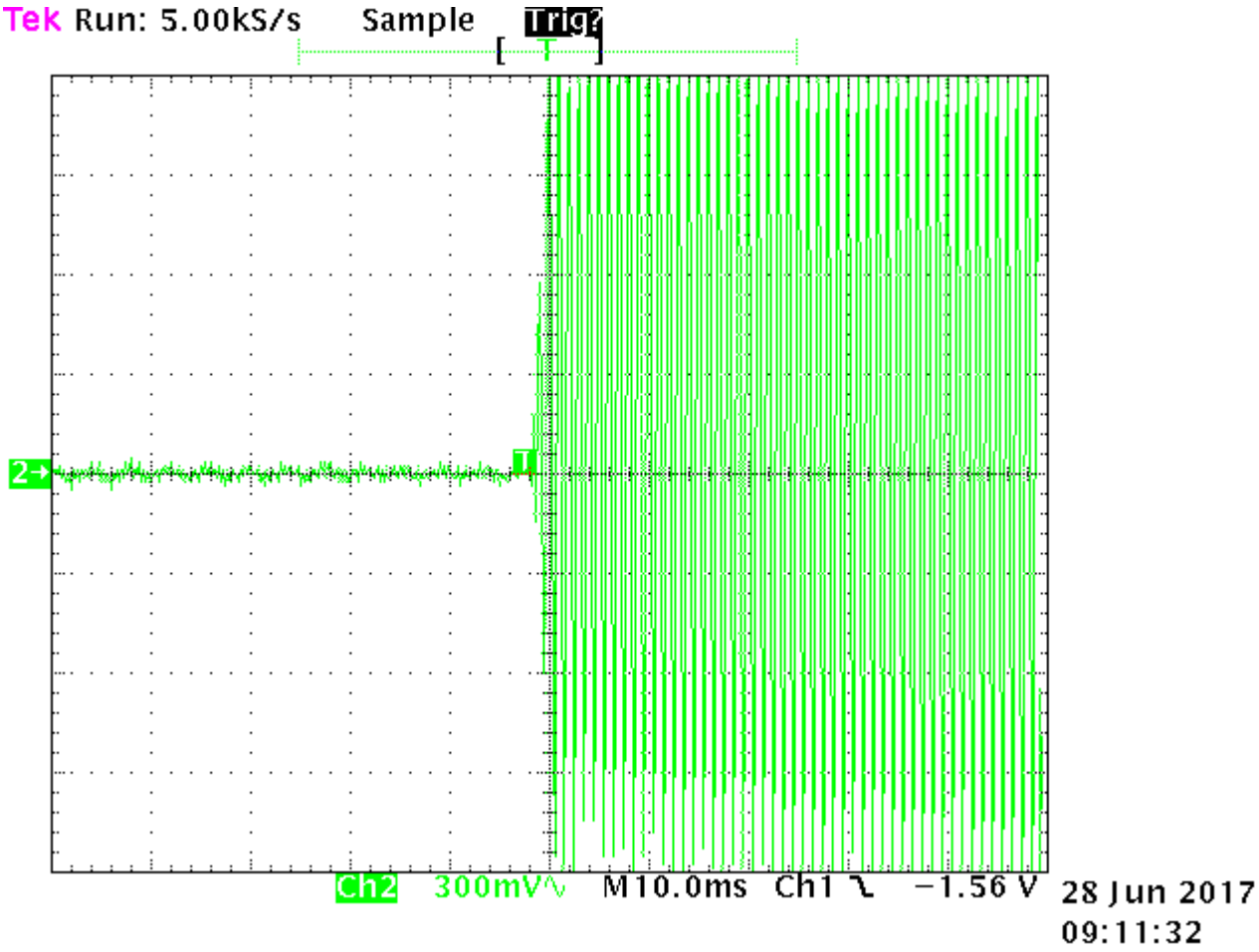
Green Trace = 1 kHz tone with FM deviation of 25.0 kHz.

Green trace has been maximised to give full screen indication of +/- 25.0 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 *t*off.

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

A small transient response can be observed before *t*off.



8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Ref No
Aerial Controller	EMCO	1090	9112-1062	3710
Aerial Mast	EMCO	1070-1	9203-1661	3708
Biconical Antenna	Schwarzbeck	BBA 9106	-	3612
Coax Cable	Sucoflex	104PA	2736/4PA	-
Horn Antenna	EMCO	3115	9511-4629	E1526
Log Periodic Antenna	Schwarzbeck	VUSLP 9111	9111-228	3785
Measurement Receiver	Rohde & Schwarz	ESIB40	100295	E4030
Modulation Analyser	Hewlett Packard	8901B	-	E1090
Power Supply	Hewlett Packard	6032A	-	E1069
Signal Generator	Rohde & Schwarz	SMHU.58	838923/028	E1493
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3716
Thermal Chamber	Contherm	M180F	86025	E1129
Thermometer	DSIR	RT200	035	E1049
Turntable	EMCO	1080-1-2.1	9109-1578	3709

All test equipment was within calibration at the time of testing.

9. ACCREDITATIONS

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

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of 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

Radiated emissions test setup