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TEST REPORT

Salcom 12-90 UHF Transceiver

tested to the

Code of Federal Regulations (CFR) 47

Part 90 –Private Land Mobile Services

&

Part 15 – Radio Frequency Devices

for

Sea Air and Land Communications 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

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1. COMPLIANCE STATEMENT

The **Salcom 12-90 UHF Transceiver & Store and Forward Repeater** complies with 47 CFR Part 90, section 90.217 and 47 CFR Part 15 section 15.111 when testing was carried out in accordance with the test methods defined in 47 CFR Part 2 and ANSI C63.4, 2002.

2. RESULT SUMMARY

The results of testing, carried out in 3rd – 7th September 2012, are summarised below.

Part 90 results

Clause	Description	Result
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	Spectrum to be investigated	Noted
90.217	Exemption from technical standards	Complies
1.1310	Radio frequency exposure limits	Complies

Part 15 results provided for information purposes only

Clause	Description	Result
15.109	Receiver radiated emissions	Complies
15.111	Antenna power conduction limits for receivers	Complies

3. CLIENT INFORMATION

Company Name	Sea Air and Land Communications Ltd
Address	10 Magdala Place, Middleton 8024
City	Christchurch
Country	New Zealand
Contact	Mr Shannon Reardon

4. TEST SAMPLE DESCRIPTION

Brand Name	Salcom
Model Number	12-90
Product	UHF Transceiver
Manufacturer	Sea Air and Land Communications Ltd
Country of Origin	New Zealand
Serial Number	00142
FCC ID	O871290

The sample tested is a UHF Transceiver that can also operate as a Store and Forward Repeater in areas of low signal where message are forwarded on by the device to pocket pagers.

The sample tested has the following specifications:

Rated Transmitter Output Power

+18.0 dBm

Transmitter frequency range

Part 90: 440 – 479 MHz

Receiver frequency range

Part 15: 300 – 479 MHz

Test frequencies

Transmit Mode: 459.000 MHz

Receive Mode: 300.050, 459.000, 470.000 MHz

Emission Designators / Modes of operation

9k50F1DBN

Power Supply

10-17 Vdc voltage supply, typically 12.0 Vdc

Standard Temperature and Humidity

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

Standard Test Power Source

Standard Test Voltage: 12.0 Vdc

5. 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 12812.1a with the internal photos of the device having been removed.

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

6. TEST RESULTS

Certification required

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

Such transmitters 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 operates between 440 – 479 MHz in a single mode sending data with a power level that is less than 500 mW.

The client has declared that the device has been designed to use 12.5 kHz channels with an occupied bandwidth of 8 kHz using data rates of 512 and 1200 bps.

Therefore the spectrum efficiency requirements of 90.203(j)(3) will not apply (pre transition date Jan 1, 2013).

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)	Measured (dBm)	Rated (dBm)
459.000	12.0	17.7	18.0

Limits:

Clause 2.1046 (c) of Part 2 specifies, pursuant to (a) and (b) that no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth of emission limitations.

Power shall not exceed 120 mW or 20.8 dBm

Result: Complies
Measurement Uncertainty: ±0.5 dB

Occupied bandwidth

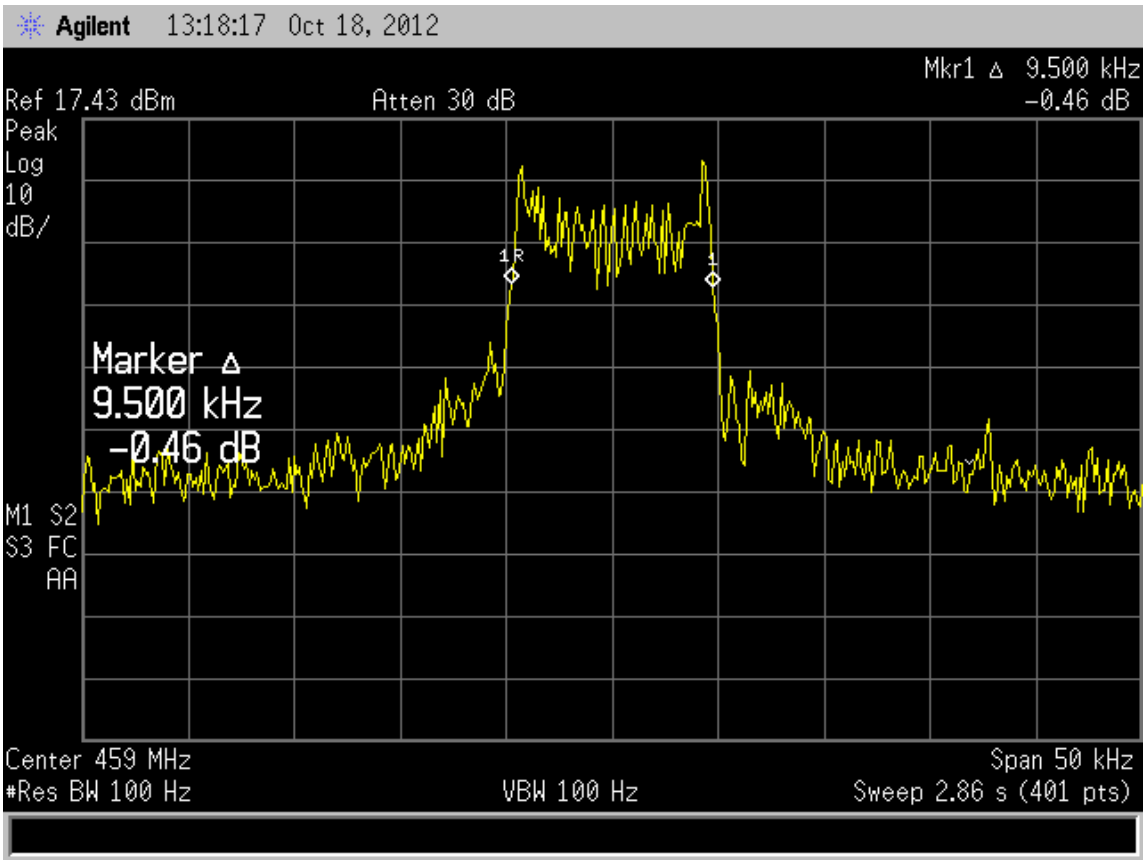
Measurements have been made to verify the occupied bandwidth.

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



When operating in a band plan with 12.5 kHz channelling an occupied bandwidth of 9.5 kHz will comply with the authorised bandwidth requirement of 11.25 kHz.

Result: Complies

Transmitter spurious emissions at the antenna terminals

Frequency: 459.000 MHz

Spurious emission (MHz)	Emission level (dBm)	Limit (dBm)
918.000	-45.3	-12.3
1377.000	-51.8	-12.3
1836.000	-85.0	-12.3
2295.000	-81.4	-12.3
2754.000	-73.0	-12.3
3213.000	<-90.0	-12.3
3672.000	-60.5	-12.3
4131.000	-79.0	-12.3
4590.000	-44.3	-12.3

Limit:

When operating on 459.000 MHz the highest power level determined was +17.7 dBm.

A limit of -30 dBc has been applied

Therefore a limit of -12.3 dBm has been applied

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.

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

Result: Complies
Measurement Uncertainty: ± 3.3 dB

Receiver spurious emissions at antenna terminals

Frequency: 305.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
304.188	-94.0	-57.0
608.375	-92.7	-57.0
912.563	-97.0	-57.0
1216.750	-78.0	-57.0

Frequency: 459.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
458.1875	-89.3	-57.0
916.3750	-81.0	-57.0
1374.5625	-82.7	-57.0
1832.7500	-90.4	-57.0

Frequency: 470.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
469.1875	-86.9	-57.0
938.3750	-80.5	-57.0
1407.5625	-83.7	-57.0
1876.7500	-92.0	-57.0

No other emissions up to the 10th harmonic observed.

The receiver has an intermediate frequency of 812.5 kHz

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).

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 10th harmonic if the transmitter operates below 10 GHz.

No measurements were made above the 10th harmonic.

Result: Complies
Measurement Uncertainty: ± 3.3 dB

Field strength of the transmitter spurious emissions

Frequency: 459.000 MHz

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)
918.0000	45.1	-52.3	-12.3	Vertical	22.3
918.0000	48.6	-48.8	-12.3	Horizontal	18.8
1377.0000	53.8	-43.6	-12.3	Vertical	13.6
1377.0000	59.5	-37.9	-12.3	Horizontal	7.9
1836.0000	57.6	-39.8	-12.3	Vertical	9.8
1836.0000	61.0	-36.4	-12.3	Horizontal	6.4
2295.0000	57.2	-40.2	-12.3	Vertical	10.2
2295.0000	55.6	-41.8	-12.3	Horizontal	11.8
2754.0000	58.2	-39.2	-12.3	Vertical	9.2
2754.0000	60.9	-36.5	-12.3	Horizontal	6.5
3213.0000	53.5	-43.9	-12.3	Vertical	13.9
3213.0000	-	-	-12.3	Horizontal	-
3672.0000	58.6	-38.8	-12.3	Vertical	8.8
3672.0000	-	-	-12.3	Horizontal	-
4131.0000	57.1	-40.3	-12.3	Vertical	10.3
4131.0000	-	-	-12.3	Horizontal	-
4590.0000	59.3	-38.1	-12.3	Vertical	8.1
4590.0000	-	-	-12.3	Horizontal	-

Limit:

When operating on 459.000 MHz the highest power level measured at the antenna port was +17.7 dBm.

A limit of -30 dBc has been applied.

Therefore a limit of -12.3 dBm has been applied.

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 10th harmonic if the transmitter operates below 10 GHz.

No measurements were made above the 10th harmonic.

Result: Complies
Measurement Uncertainty: ± 4.1 dB

Field strength of the receiver spurious emissions

Frequency: 459.000 MHz.

The receiver has an intermediate frequency of 812.5 kHz.

Device was tested on an open area test site at a distance of 3 metres.

Below 1000 MHz a quasi peak detector was used with a bandwidth of 120 kHz and 1000 MHz an average detector was used with a bandwidth of 1 MHz.

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

Frequency (MHz)	Level (dBµV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)
458.1875	20.9	-76.5	-57.0	Vertical	19.5
458.1875	19.6	-77.8	-57.0	Vertical	20.8

Limit:

While testing to Part 15 section 15.109 is not specifically required, as the receiver has an antenna port and measurements have been made in accordance with Part 15 section 15.111, it has been carried out on a single representative frequency for completeness.

A limit of -57 dBm (2nW) has been applied.

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.

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.

Measurements were made with the supply varied between nominal voltage of the battery and the stated end point of the nominal supply voltage (12.0 Vdc).

Nominal frequency: 459.000 MHz

Temp. °C	Frequency Error (Hz)
+50°C	-412.0
+40°C	-393.0
+30°C	-263.0
+20°C	-237.0
+10°C	-195.0
0°C	+299.0
-10°C	-333.0
-20°C	-303.0
-30°C	-250.0

Limit:

Specified limit the stability for mobile stations less than 2.5 watts 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 459.000 MHz 2.5 ppm = 2.5 x 459.000 MHz = 1,147.0 Hz.

Result: Complies
Measurement Uncertainty: ± 30 Hz

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 1.53 mW/m^2
(f/300 = 459 MHz/300)

- General Population / Uncontrolled exposure limit will be 0.306 mW/m^2
(f/1500 = 459 MHz/1500)

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)) / d

Controlled	**Uncontrolled**
$E = 1.53\ W/m^2 = E^2/3770$	$E = 0.306\ W/m^2 = E^2/3770$
E= √ 1.53*3770	E= √ 0.306*3770
E = 75.9 V/m	E = 34.0 V/m

The rated maximum transmitter power = 0.063 watts (+18 dBm).

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 100% however in practice the duty cycle would be less.

Controlled	**Uncontrolled**
d = √ (30 * P * G*DC) / E	
d = √ (30 * 0.063 * 1.64 * 1.0) / 75.9	d = √ (30 * 0.063 * 1.64 * 1.0) / 34.0
d = 0.023 metres or 2.3 cm	d = 0.052 metres or 5.2 cm

Result: Complies if a safe distance of a least 20 cm is defined for each environment.

7. 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
Biconical Antenna	Schwarzbeck	BBA 9106	9594	RFS 3680	12/01/15
Log Periodic	Schwarzbeck	VUSLP9111	9111-228	RFS 3785	12/12/15
Horn Antenna	Electro-metrics	RGA 60	-	E1494	04/07/14
Receiver	Rohde & Schwarz	ESIB 40	100171	EMC4003	20/10/13
Power Supply	Hewlett Packard	6032A	2743A-02859	E1069	N/a
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	RFS 3776	14/12/12
Thermal chamber	Contherm	M180F	86025	E1129	01/06/13
Thermometer	DSIR	RT200	035	E1049	01/06/13
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	N/a

8. 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 a number of accreditation bodies in various economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

9. PHOTOGRAPHS

External views

Open Air Test Site Setup