Sulis Consultants
CE Marking and Product Approvals

RF Test Report:

Zinwave ORU

47CFR74

FCC ID: UPO302-1107

SC_TR_180_C

Sulis Consultants Limited
Mead House, Longwater Road, Eversley, Hampshire, RG27 0NW, UK
Registered in England & Wales, number 05466247
http://www.sulisconsultants.com

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1 Revision History

Revision	Originator	Date	Comment	Signature
A	C Blackham Director, Sulis Consultants Ltd	10 Jan 2015	1st release	
B	C Blackham Director, Sulis Consultants Ltd	28 Jan 2015	Additional clarification	
C	C Blackham Director, Sulis Consultants Ltd	07 Feb 2016	Typos corrected	

2 Purpose

This document details the testing performed on Zinwave Optical Remote Unit, ORU, model number 302-1107 against requirements of FCC 47CFR90.

3 Reference Documents

[1]	47 CFR90	Title 47 Code of Federal Regulations Part 90: Private Land Mobile Radio Services
[2]	TIA-603-D	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards
[3]	KDB 935210 D05 V01	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement guidance for Industrial and Non-consumer signal booster, repeater and amplifier devices
[4]	KDB971168 DO1 v02r02	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement guidance for certification of licensed digital transmitters.
[5]	RSS-139 Issue 3	Industry Canada Spectrum Management and Telecommunications Radio Standards Specification Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz
[6]	RSS-Gen Issue 4 (November 13, 2014)	Industry Canada Spectrum Management and Telecommunications Radio Standards Specification General Requirements for Compliance of Radio Apparatus

4 Test Information

4.1 Client and manufacturer

Zinwave Ltd

Harston Mill

Harston

Cambridge

CB22 7GG

UK

4.2 Test Locations

Testing was performed by Charlie Blackham of Sulis Consultants Ltd on 5th January 2016 at Zinwave's offices detailed in section 4.1

4.3 Test sample

The results herein only refer to sample detailed in section 5

5 Test Configuration

5.1 Test sample and Operating mode

The equipment under test (EUT) was:

Manufacturer	Name	Model Number	Serial Number
Zinwave	ORU	302-1107	310400000022

Table 1: Equipment under test

Modifications during test: None

5.2 Support equipment

The following equipment shall be used, configured as shown in Figure 1:

Name	Part Number	Label	Serial Number
Zinwave UNIhub (Primary Hub)			
Chassis		302-1001	00-17-68-00-09-B7
RF Service module		SM 1/6	030370002050
Optical module		OM 1/6	050750002036
Zinwave UNIhub (Secondary Hub)			
Chassis		302-1001	00-17-68-00-09-67
Input Optical module		OM 5/6	50750002039
Optical module		OM 3/6	50750002010

Table 2: Support Equipment

5.3 Equipment arrangement

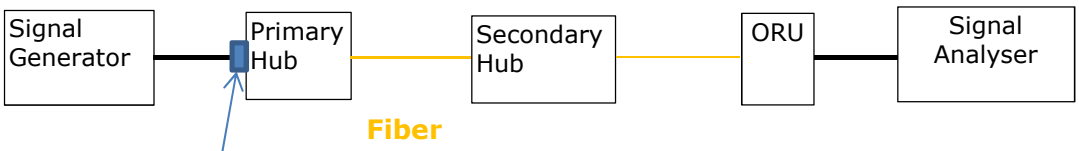


Figure 1: Test configuration – single channel

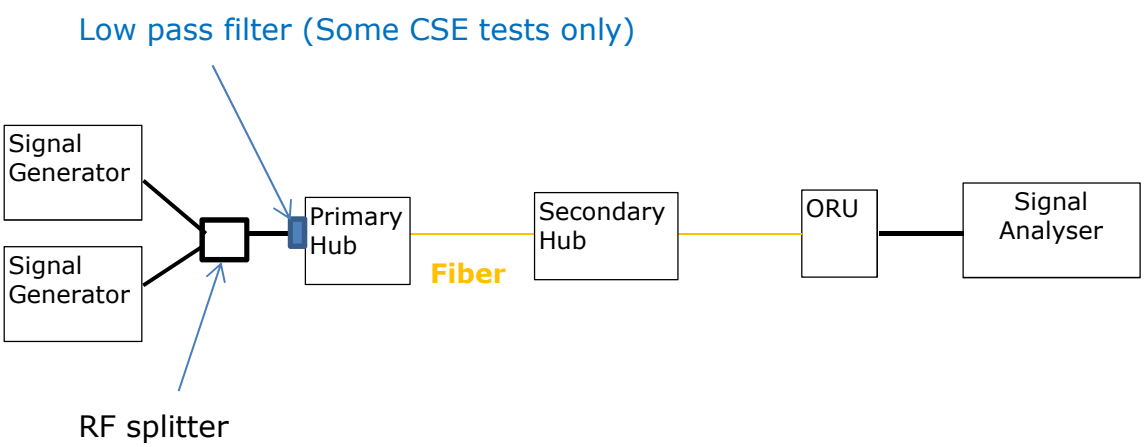


Figure 2: Test configuration – dual channel

Notes – additional connections not shown:

1. For dual channel measurements, IQ output from Signal Generator #1 connected to IQ input of signal generator #2
2. 10 MHz Ref Clock output of FSV Signal Analyser connected to Ref Clock inputs of the two signal generators

5.4 Supported Services

Frequency Band (MHz)	Service	Modulation	Channel Bandwidth	Emission designator
470 - 608	P25	C4FM (QPSK)	12.5kHz	11K2G1E
614 – 698	P25	C4FM (QPSK)	12.5kHz	11K2G1E

6 Summary of Tests performed

This report contains results for the following tests:

Test	47 CFR Part	Section	Result
Passband gain and Determination of f_0	N/A	7	N/A
Transmit Power	74.861(e)(1)(ii)	8	Pass
Occupied Bandwidth	74.861(e)(5)	9	Pass
Conducted Spurious Emissions	74.861(e)(6)	10	Pass

Table 3: Summary of tests performed

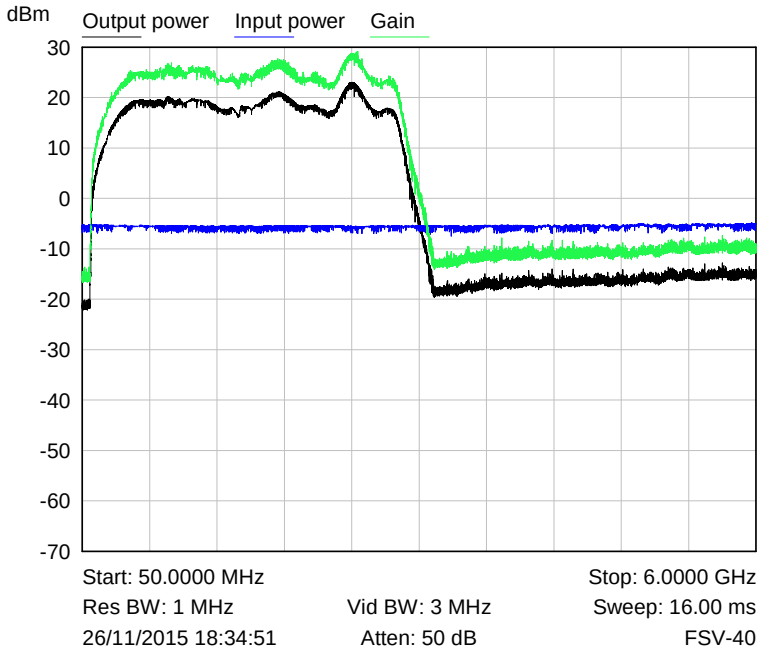
7 Pass band gain

7.1 Gain across whole band

7.1.1 Test method – whole band of operation

1. Connect a signal generator to the input of the Spectrum Analyser.
2. Configure a swept CW signal with the following parameters:
   a. Frequency range = ± 250 % of the passband from the centre of the passband.
   b. Set power so that the received level to be -5dB.
   c. Dwell time = 50 ms
   d. Number of points = SPAN/(RBW/2).
3. Set the span of the spectrum analyser to the same as the frequency range of the signal generator.
4. Set the detector to Peak Max-Hold and wait for the spectrum analyser's spectral display to fill.
5. Record trace.
6. Connect Signal Generator to RF service module or Primary Hub
7. Connect a spectrum analyser to the output of the EUT using appropriate attenuation.
8. Set the detector to Peak Max-Hold and wait for the spectrum analyser's spectral display to fill.
9. Record trace.
10. Calculate and report Gain, which is difference between input and output signal.

7.1.2 Measurement result



7.2 Gain across individual service bands

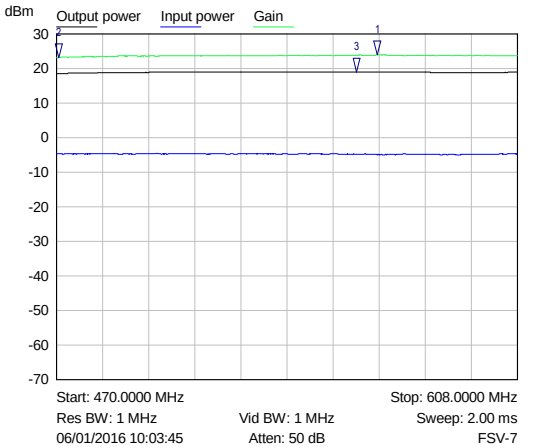
7.2.1 Test method – service band

Test method is similar to 8.1.1 except that the frequency range is limited to the lower and upper band edges of the relevant service band.

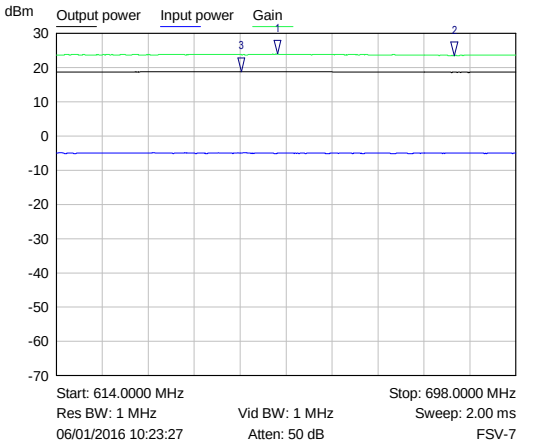
All measurements performed with Signal Generator set to -5dBm. Exact power fed into Hub shown on plot as "input power" and resultant output shown as "output power". Gain calculated as "output power – input power" (as input power is –ve)

Freq range (MHz)	Maximum gain (MHz)	Frequency f_0
470 – 608	23.97	566 MHz
614 - 698	23.92	654 MHz

Table 4: gain variance within service bands



Mkr	Trace	X-Axis	Value	Notes
1	Gain	566.1441 MHz	23.97 dBm	Maximum gain
2	Gain	470.6907 MHz	23.17 dBm	Minimum gain
3	Output power	559.7898 MHz	19.07 dBm	Max output power



Mkr	Trace	X-Axis	Value	Notes
1	Gain	654.4444 MHz	23.92 dBm	Maximum gain
2	Gain	686.7327 MHz	23.54 dBm	Minimum gain
3	Output power	647.8018 MHz	18.84 dBm	Max output power

470 – 608 MHz	614 - 698 MHz

Figure 3: gain variance within service bands

8 Transmit Power

The Maximum transmit power is determined from the maximum output power determined using a CW signal in section 7

Freq range (MHz)	Maximum conducted transmit power (dBm)	Maximum permitted
470 – 608	19.07	250 mW / 24.0 dBm
614 - 698	18.84	250 mW / 24.0 dBm

Table 5: Maximum transmit power within service bands

9 Occupied Bandwidth

9.1 Test method

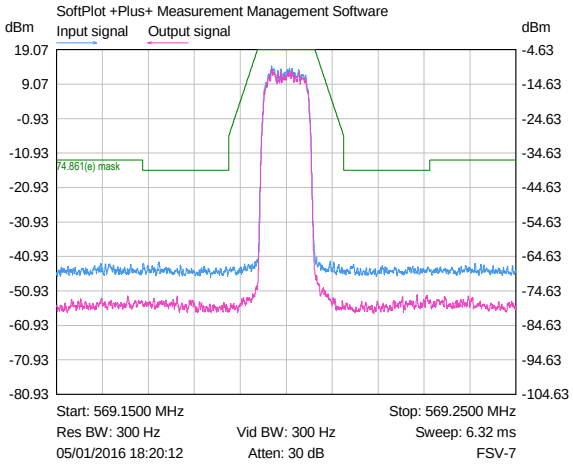
For a single channel amplifier, the 99% emission bandwidth shall be measured under the conditions described in section 4.3.2 and the spectrum analyser plots submitted in the test report.

Set the resolution bandwidth of the spectrum analyser from 1% to 3% of the 99% emission bandwidth and set the video bandwidth to 3 times the resolution bandwidth. Record both the amplifier input and set the video bandwidth to 3 times the resolution bandwidth. Record both the amplifier input and output signals.

The plot was also compared against the mask in 74.861(e)

9.2 Test results

Measurement was made at f_0 for each band

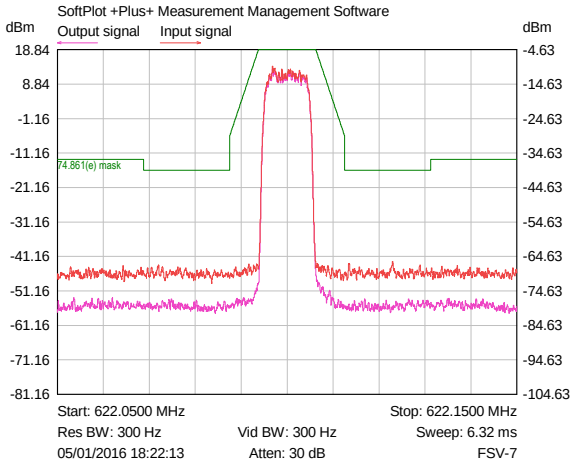
<table>
<tr>
<td> 

Input signal

Measurement Parameter	Value
Occupied Power Bandwidth	9.74 kHz

Output signal

Measurement Parameter	Value
Occupied Power Bandwidth	9.74 kHz

</td>
<td> 

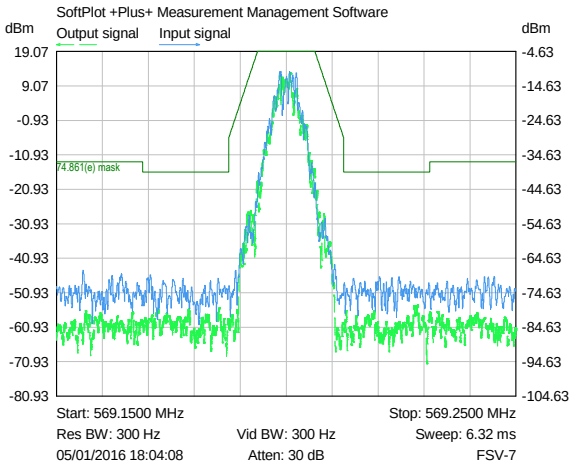
Input signal

Measurement Parameter	Value
Occupied Power Bandwidth	9.73 kHz

Output signal

Measurement Parameter	Value
Occupied Power Bandwidth	9.74 kHz

</td>
</tr>
<tr>
<td>470 – 608 MHz band, QPSK</td>
<td>614 - 698 MHz band, QPSK</td>
</tr>
</table>



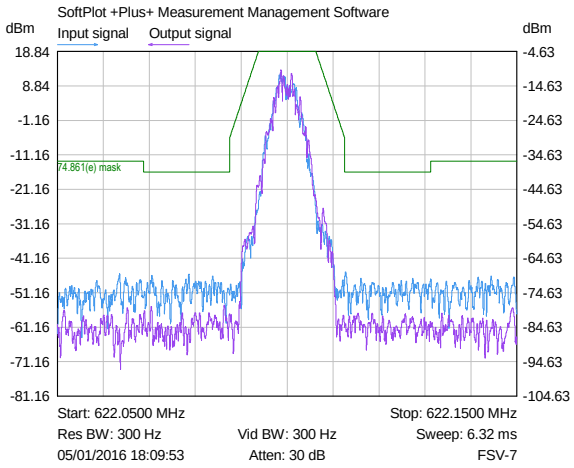
Input signal

Measurement Parameter	Value
Occupied Power Bandwidth	8.68 kHz

Output signal

Measurement Parameter	Value
Occupied Power Bandwidth	8.72 kHz

470 – 608 MHz band, C4FM



Input signal

Measurement Parameter	Value
Occupied Power Bandwidth	8.48 kHz

Output signal

Measurement Parameter	Value
Occupied Power Bandwidth	8.73 kHz

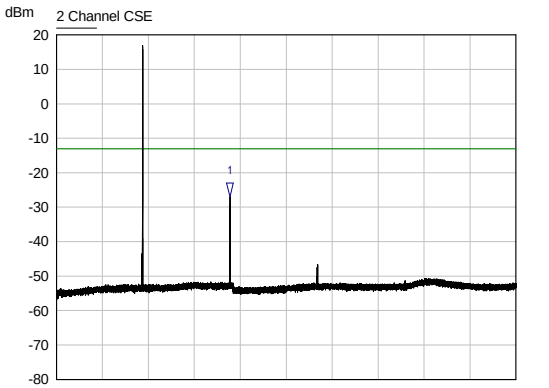
614 - 698 MHz band, C4FM

10 Spurious Emissions

10.1 Dual channel

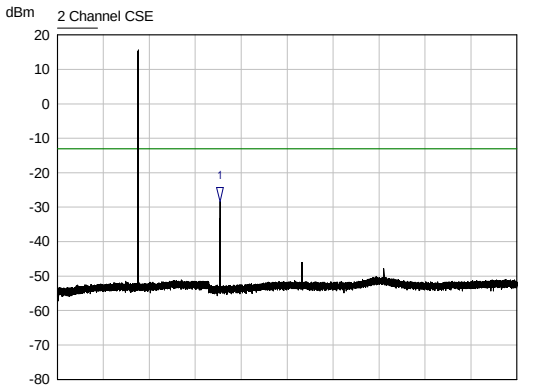
Measurement performed using RMS detector and sweep averaging method as for Transmit Power.

CW signal



Mkr	Trace	X-Axis	Value	Notes
1	2 Channel CSE	1.1380 GHz	-14.07 dBm	Relative to limit

470 – 608 MHz band



Mkr	Trace	X-Axis	Value	Notes
1	2 Channel CSE	1.2440 GHz	-15.31 dBm	Relative to limit

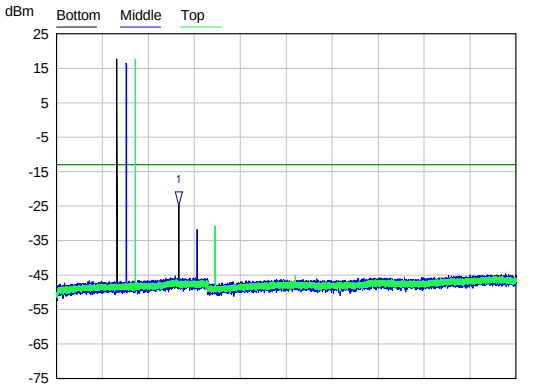
614 - 698 MHz band

10.2 Single channel

The level of Harmonic emissions from transmit frequencies at bottom, middle and top channels for each band were investigated.

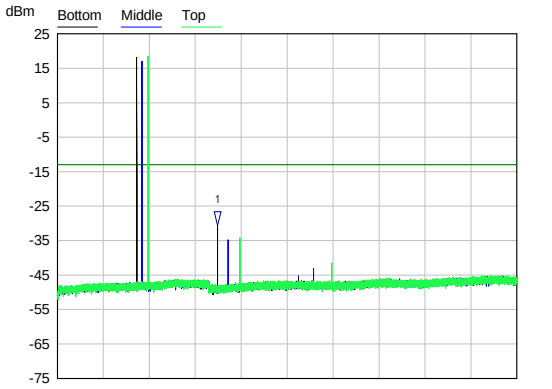
The table accompanying each plot shows the level of worst case harmonic for each mode.

Measurement performed using RMS detector and sweep averaging method as for Transmit Power.



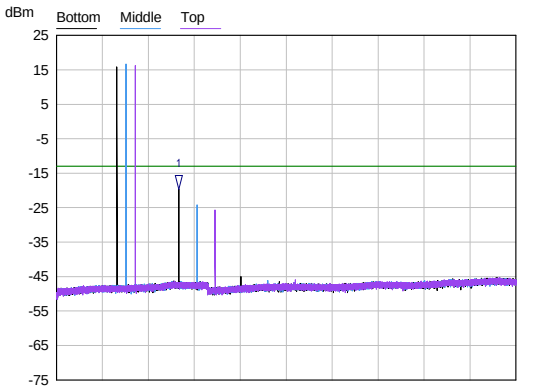
Mkr	Trace	X-Axis	Value	Notes
1	Bottom	940.0050 MHz	-11.80 dBm	Relative to limit

470 – 608 MHz band, QPSK



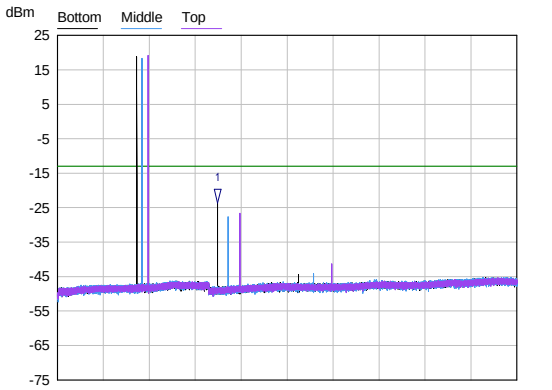
Mkr	Trace	X-Axis	Value	Notes
1	Bottom	1.2280 GHz	-17.71 dBm	Relative to limit

614 - 698 MHz band, QPSK



Mkr	Trace	X-Axis	Value	Notes
1	Bottom	940.0050 MHz	-6.66 dBm	Relative to limit

470 – 608 MHz band, C4FM



Mkr	Trace	X-Axis	Value	Notes
1	Bottom	1.2280 GHz	-10.61 dBm	Relative to limit

614 - 698 MHz band, C4FM

11 Test equipment

Description	Manufacturer	Model	Serial Number	Calibration
Signal Analyser	Rohde & Schwarz	FSV 7	Zinwave asset 000073	R&S 20-516458 Due 14 Nov 16
Signal Generator	Hewlett Packard	ESG-D3000A	US37231547	Cert: Testwall 73435 Due: 18 Sept 16
Cable	Utiflex	BUA01G	FA210A0009M30309	ABEX UK. Ref: green bua01g Due 08 Oct 17
Signal Generator	Rohde & Schwarz	SMJ100A	100156	Verified as part of system test
Signal Generator	Rohde & Schwarz	SM300	100320	
Attenuator	Mini-circuits	VAT 10	3 0433	
Cable (input)	Mini-circuits	CBL-1M-SMNM+	120274	
Cable (input)	Mini-circuits	CBL-1M-SMNM+	120295	
2-way splitter (input)	Mini-circuits	ZN2PD2-63-S+	UU21401232	
Low pass filter DC-600 MHz	Mini-circuits	SLP-600+	R8636400710	
Low pass filter DC-1000 MHz	Mini-circuits	15542	UU14401231	

Table 6: Test Equipment

Measurement uncertainty for test equipment

Analyser ±0.5 dB