Sulis Consultants
CE Marking and Product Approvals

RF Test Report:

Zinwave ORU

FCC part 24 cellular

FCC ID: UPO302-1107

SC_TR_174_C

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1 Revision History

Revision	Originator	Date	Comment	Signature
A	C Blackham Director, Sulis Consultants Ltd	08 Dec 2015	Customer release	
B	C Blackham Director, Sulis Consultants Ltd	09 Jan 2016	1st issue	
C	C Blackham Director, Sulis Consultants Ltd	05 Feb 2016	Minor updates	

2 Purpose

This document details the Zinwave Optical Remote Unit, ORU, model number 302-1107**,** whilst operating in the 1930-1995 MHz cellular band.

3 Reference Documents

[1]	47CFR2	Title 47 Code of Federal Regulations Part 2: frequency allocations and radio treaty matters; general rules and regulations
[2]	47 CFR24	Title 47 Code of Federal Regulations Part 24: Common Carrier Services
[3]	TIA-603-D	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards
[4]	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
[5]	TIA-603-D	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards
[6]	KDB971168 DO1 v02r02	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement guidance for certification of licensed digital transmitters.

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 between 13th October and 6th January 2016 at Zinwave's offices in Harston.

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

Procedure:

- Set the system to maximum gain using the network management software
- Connect the signal generator to the RF service module of the Primary Hub
- Raise the signal level until the maximum output power is reached
- Perform the required test.

Test modulations:

- The system supports operation with a number of narrowband and wideband services, testing was performed with MSK and AWGN signal as per KDB 935210 D05.

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	050750002039
Optical module		OM 3/6	050750002010

Table 2: Support Equipment

5.3 Equipment arrangement

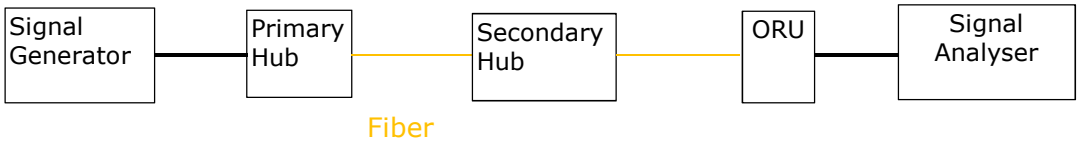


Figure 1: Test configuration – single channel

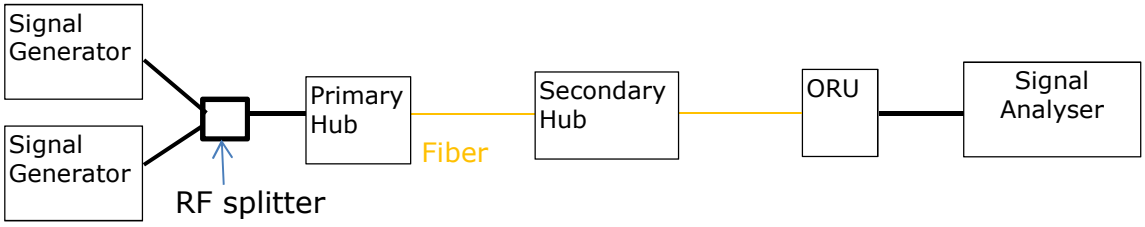


Figure 2: Test configuration – dual channel

Notes – additional connections not shown:

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

5.4 Permitted Antennas

The system is designed for operation with antennas having a maximum gain of 8.0 dBi or 5.85 dBd.

6 Summary of Tests performed

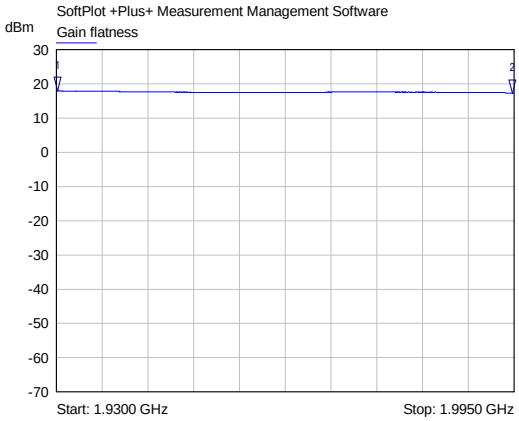
Test	47 CFR Part	FCC limit	Section	Result
Determination of f_0	KDB 935210 D05 Section 3.3	None	7	N/A
Transmit Power	24.232(a)	1640	8	Pass
Occupied Bandwidth	24.238 KDB 935210 D05 Section 3.4	None	9	Pass
Conducted Spurious Emissions	24.238	-13dBm / MHz[1]	10	Pass

Table 3: Summary of tests performed

[1] Except for emissions the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

7 Determination of f_0

As per kDB 935210 D05 section 3.3, but measurement was performed over the service band frequency range only.



Mkr	Trace	X-Axis	Value	Notes
1	Gain flatness	1.9302 GHz	17.99 dBm	Max gain
2	Gain flatness	1.9947 GHz	17.25 dBm	

1930 – 1995 MHz

Figure 3: Determination of f_0 for 1930 – 1995 MHz band

8 Transmit Power

8.1 Test method

The equipment was configured as per figure 1 and the measurements were made in accordance with KDB 971168 D01 using an RMS detector and the Peak to Average ratio was measured using the CCDF function of the analyser.

The signal generator was set to provide -5dBm to the input of the hub and the frequency set to an appropriate channel to include f_0 as determined in section 7.

8.2 Test results

Mode	Frequency (MHz)	TX power (dBm)	TX power ERP (dBm)	TX power ERP (W)	Limit ERP (W)	Result
Narrowband	1930.2	17.99	25.99	0.40	1640.0	Pass
Wideband	1932.5	18.35	26.35	0.43	1640.0	Pass

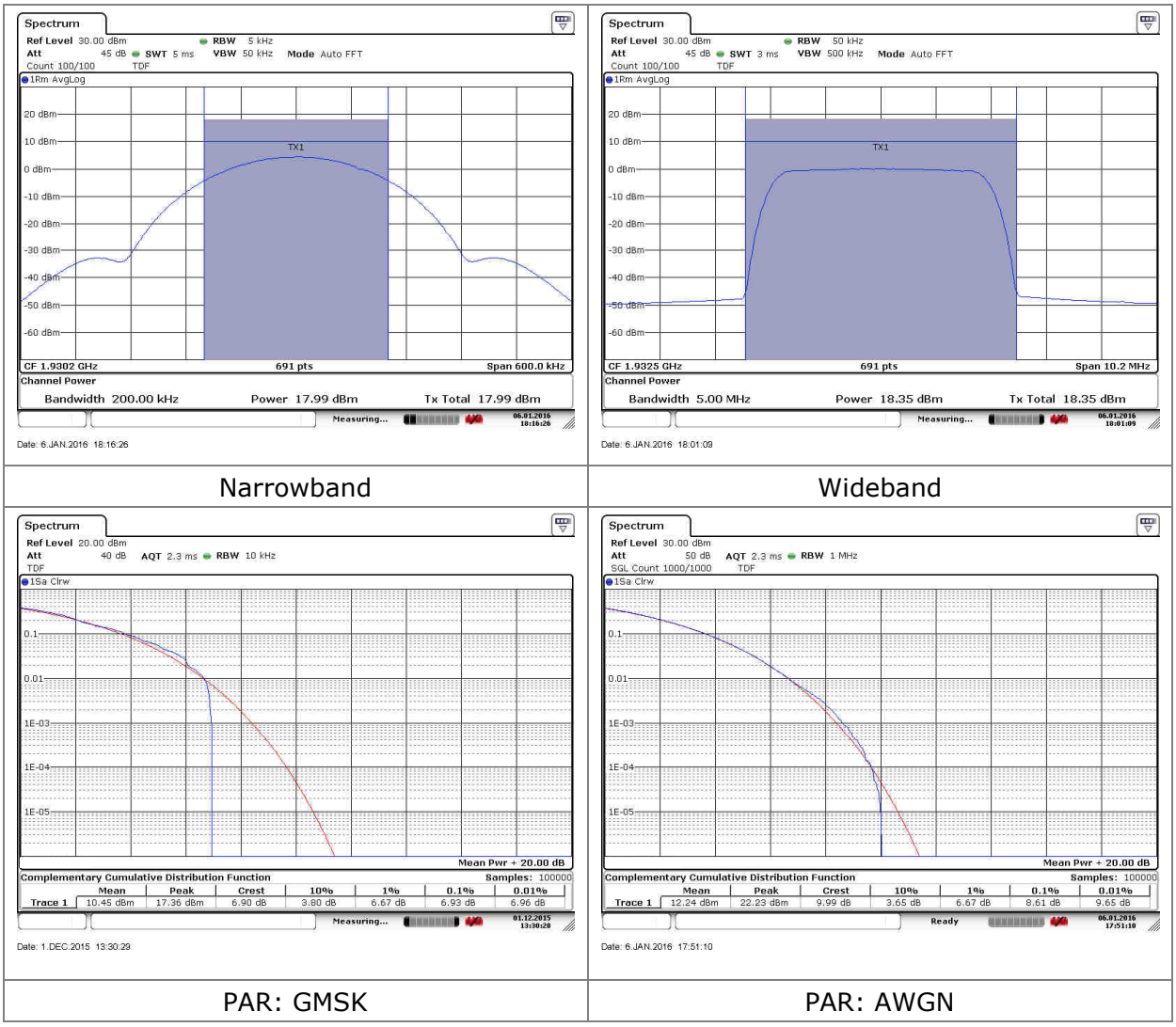


Figure 4: Transit power and Peak to Average (PAR) plots

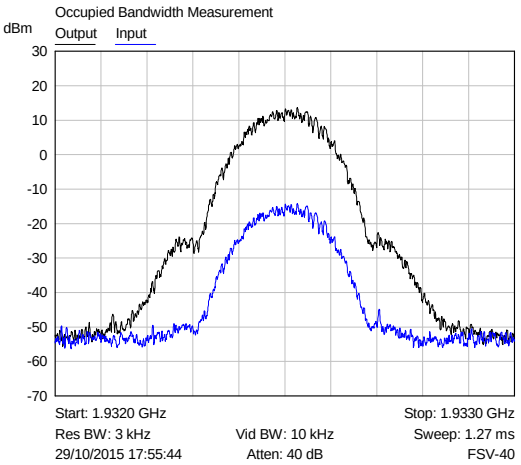
9 Occupied Bandwidth: Input vs output signal

9.1 Test method

KDB 935210 D05 section 3.4

The occupied bandwidths of the input and output signal were measured using the in-built 99% Occupied Bandwidth function of the FSV40.

9.2 Test results



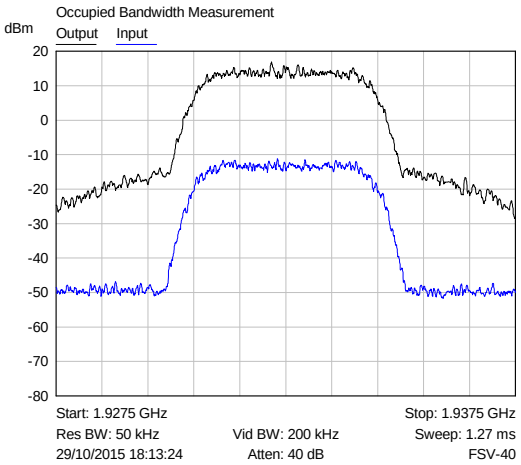
Output

Measurement Parameter	Value
Occupied Power Bandwidth	246.0000 kHz

Input

Measurement Parameter	Value
Occupied Power Bandwidth	256.5000 kHz

200k GMSK



Output

Measurement Parameter	Value
Occupied Power Bandwidth	4.1400 MHz

Input

Measurement Parameter	Value
Occupied Power Bandwidth	4.1050 MHz

4M2 AWGN

Figure 5: input vs output plots

10 Conducted Spurious Emissions inc. Band Edge

10.1 Requirement and test method

27.53(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

(3) Measurement procedure.

(i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(ii) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

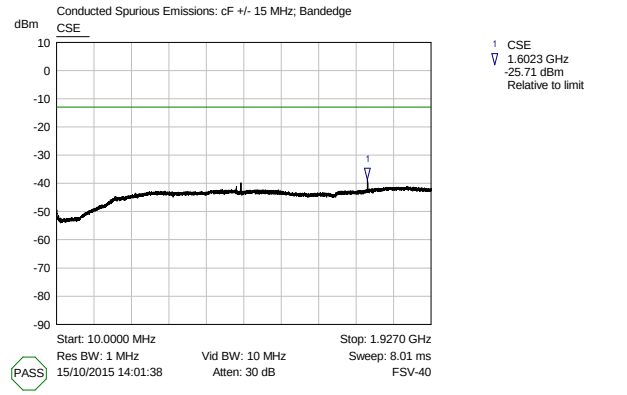
(iii) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

The licensed band of operation was considered to be a single 5 MHz channel for the 5 MHz operation.

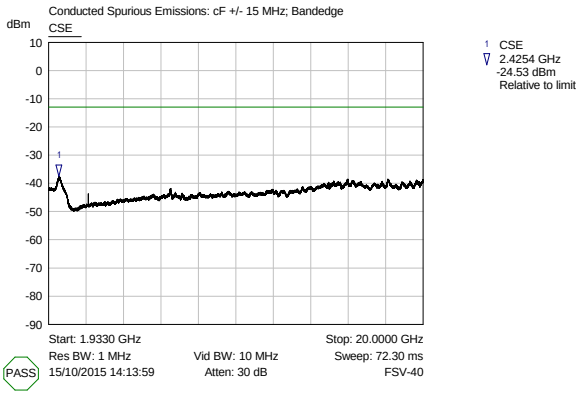
Emissions exceeded the limit close to the fundamental transmission frequency and these were investigated using RMS detector and adjacent channel power measurement capability of the spectrum analyser as shown on plots Screen 11.

10.2 Band edge results

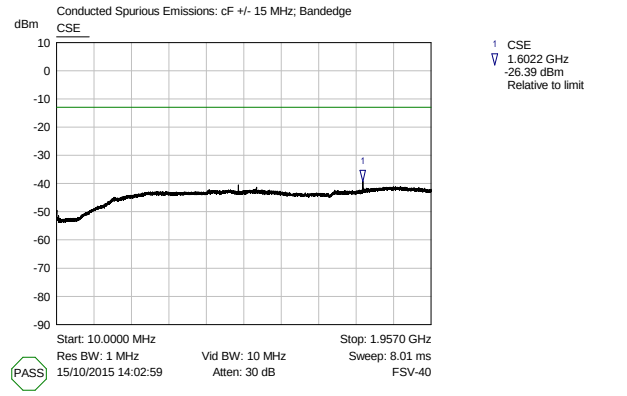
10.2.1 Narrowband single frequency



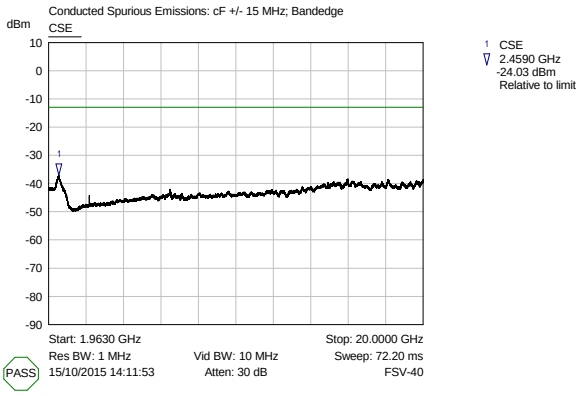
1930.2 below band edge



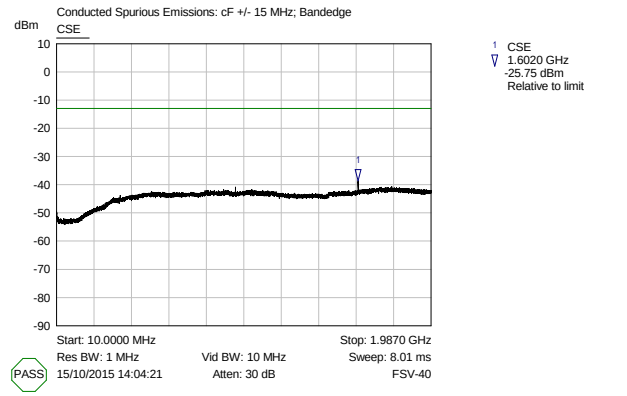
1930.2 above band edge



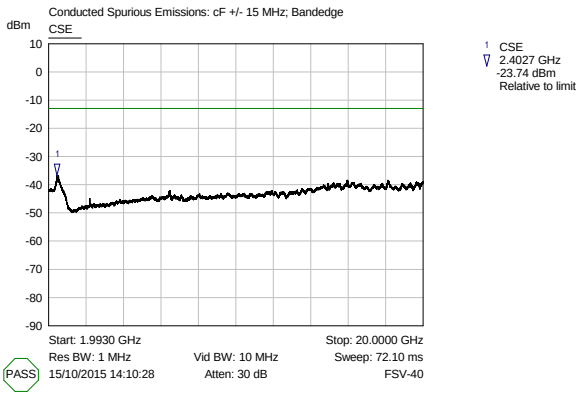
1960.0



1960.0

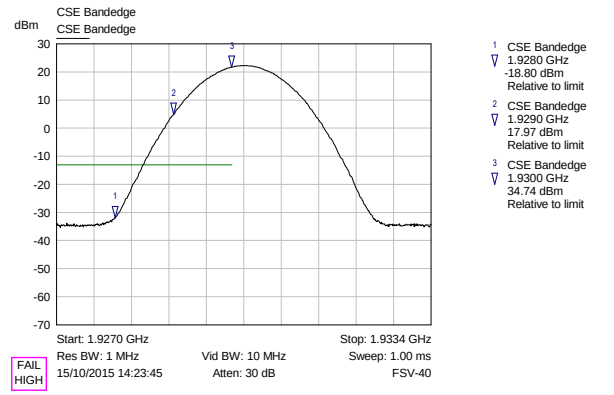


1989.8 below band edge



1989.8 above band edge

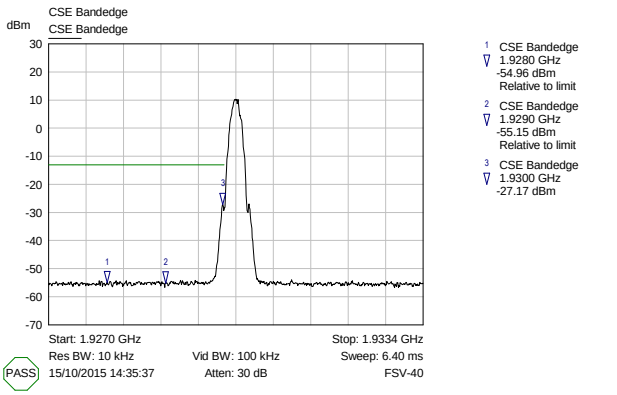
Figure 6: Narrow band CSE except band edge



CSE Bandedge

Measurement Parameter	Value
Channel bandwidth	1.00 MHz
Channel spacing	1.70 MHz
On- channel power	21.12 dBm
Adjacent channel power (channel -1)	-25.03 dB
Adjacent channel power (channel +1)	-24.72 dB

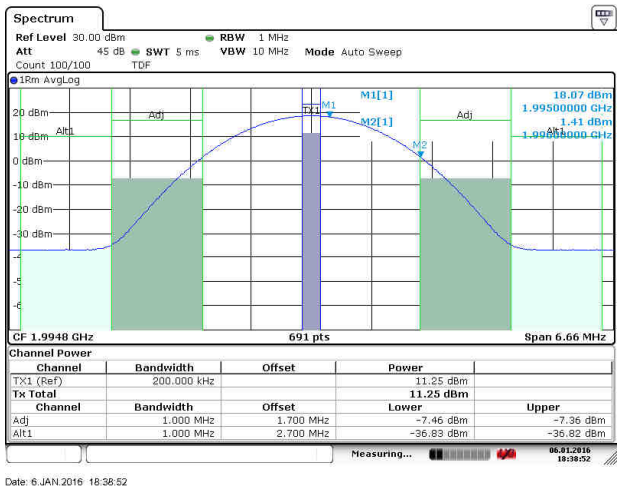
1930.2



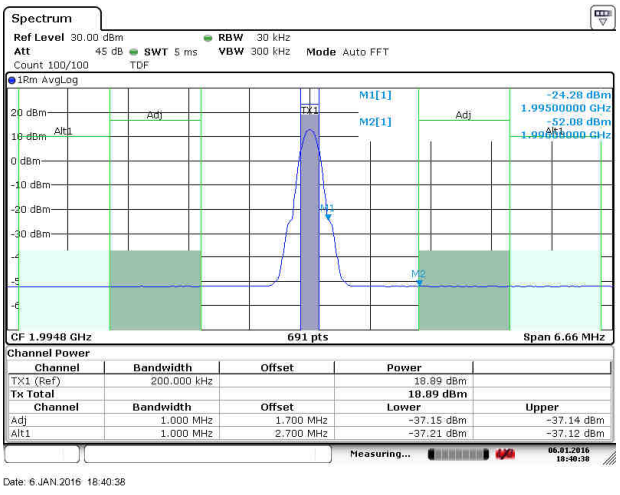
CSE Bandedge

Measurement Parameter	Value
Channel bandwidth	1.00 MHz
Channel spacing	1.70 MHz
On- channel power	20.74 dBm
Adjacent channel power (channel -1)	-56.18 dB
Adjacent channel power (channel +1)	-56.60 dB

1930.2 band edge narrow RBW



1994.8



1994.8 band edge narrow RBW

Figure 7: Narrowband CSE band edge

10.2.2 Wideband single frequency

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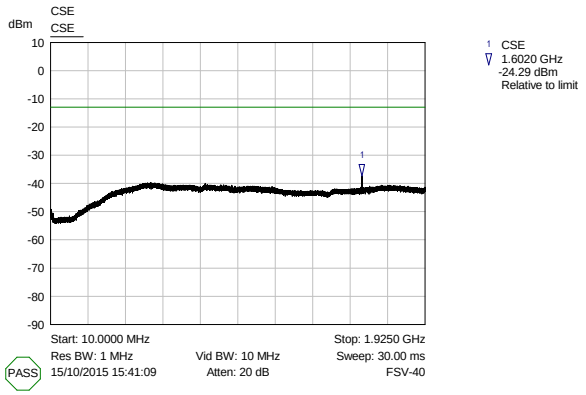
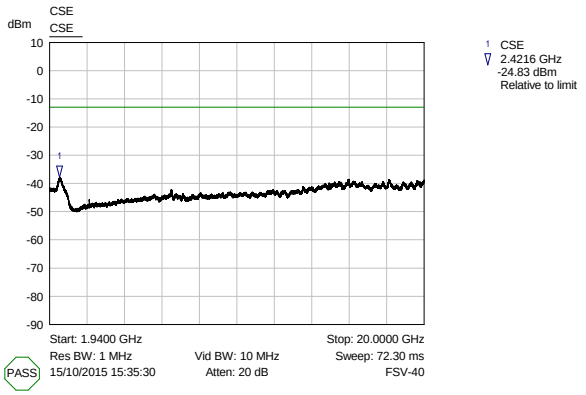
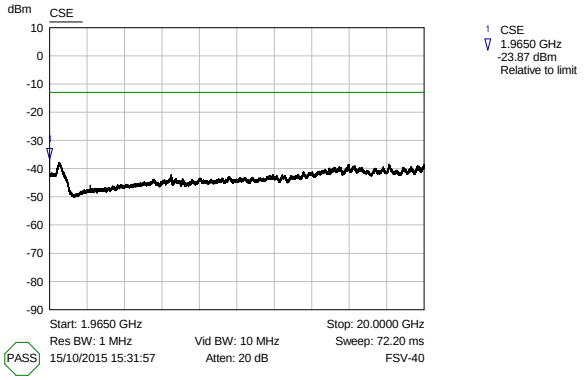
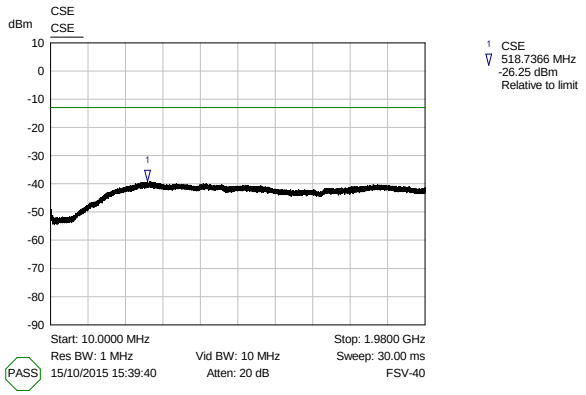
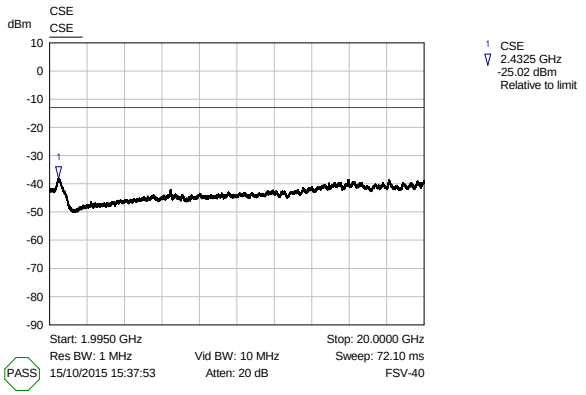
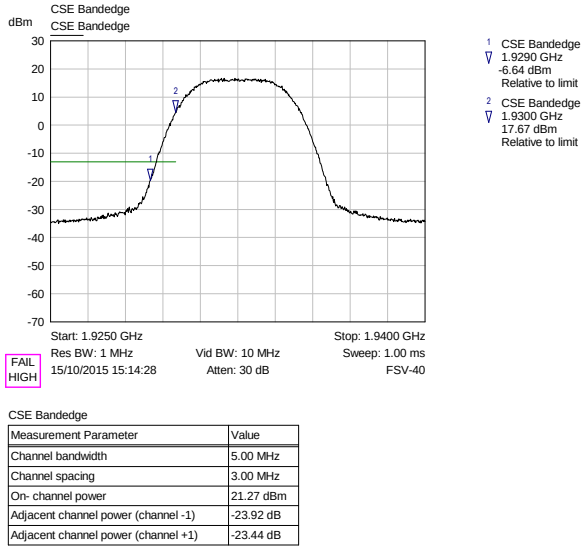
<tr><td> 
</td><td> 
</td></tr>
<tr><td>1932.5 below band edge</td><td>1932.5 above band edge</td></tr>
<tr><td>Plot not recorded
No emission within 25dB of limit</td><td> 
</td></tr>
<tr><td>1960.0 below band edge</td><td>1960.0 above band edge</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>1987.5 below band edge</td><td>1987.5 above band edge</td></tr>
</table>

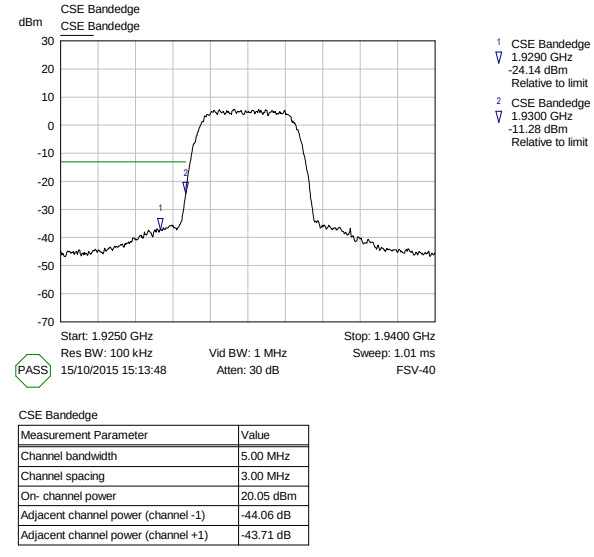
Figure 8: Narrow band CSE except band edge



CSE Bandedge

Measurement Parameter	Value
Channel bandwidth	5.00 MHz
Channel spacing	3.00 MHz
On- channel power	21.27 dBm
Adjacent channel power (channel -1)	-23.92 dB
Adjacent channel power (channel +1)	-23.44 dB

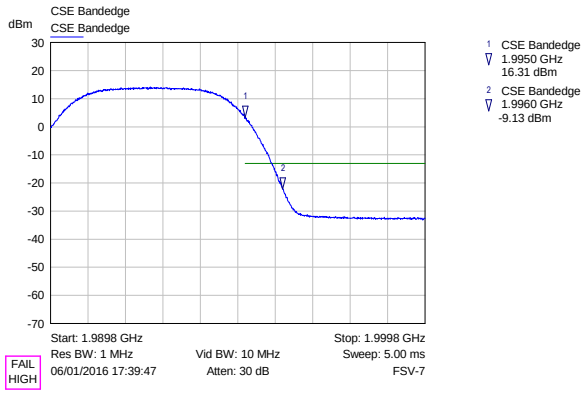
1932.5



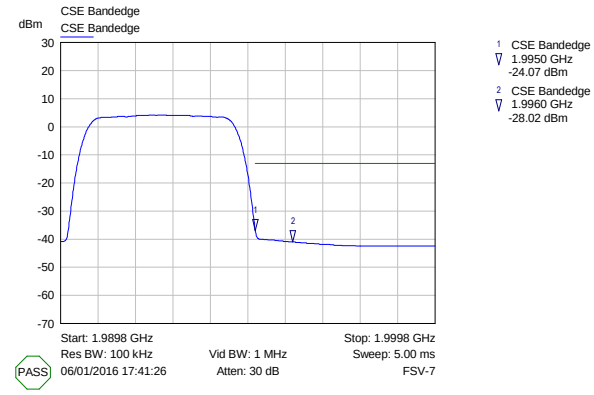
CSE Bandedge

Measurement Parameter	Value
Channel bandwidth	5.00 MHz
Channel spacing	3.00 MHz
On- channel power	20.05 dBm
Adjacent channel power (channel -1)	-44.06 dB
Adjacent channel power (channel +1)	-43.71 dB

1932.5 band edge narrow RBW



1992.5

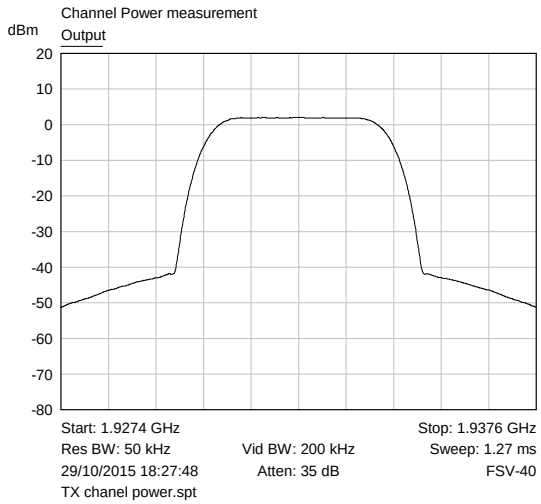


1992.5 band edge narrow RBW

Figure 9: Narrowband CSE band edge

10.2.3 Dual Channel band edge - AWGN

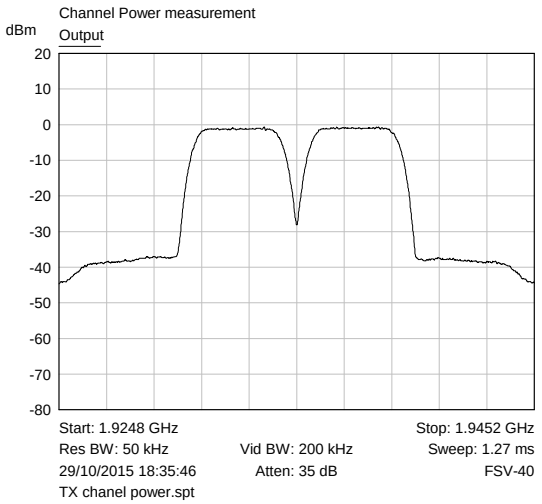
Check set-up



Output SGL Count 100/100 1Rm AvgLog

Measurement Parameter	Value
Channel power	20.19 dBm
Channel bandwidth	5.00 MHz

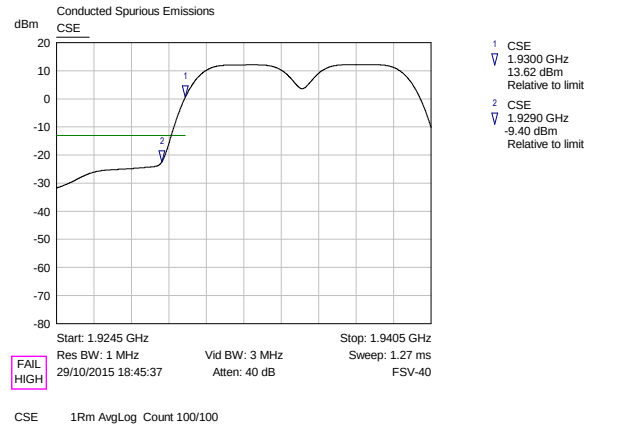
Single channel total power



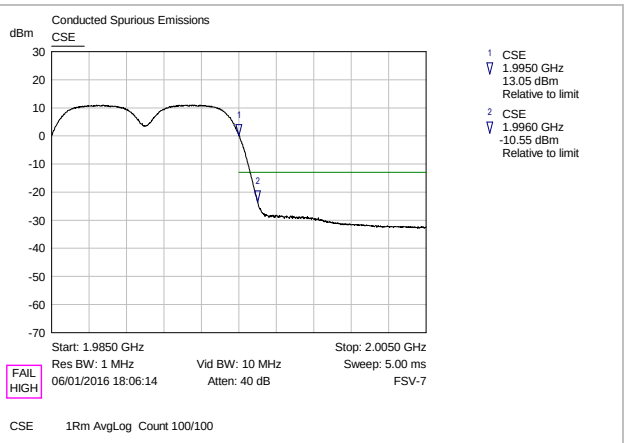
Output SGL Count 100/100 1Rm AvgLog

Measurement Parameter	Value
Channel power	20.24 dBm
Channel bandwidth	10.00 MHz

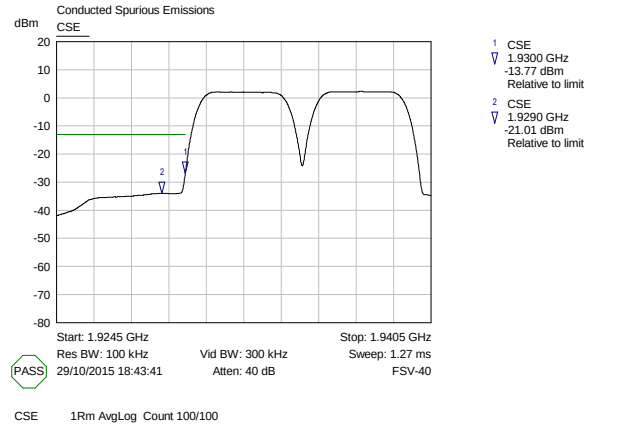
Dual channel total power



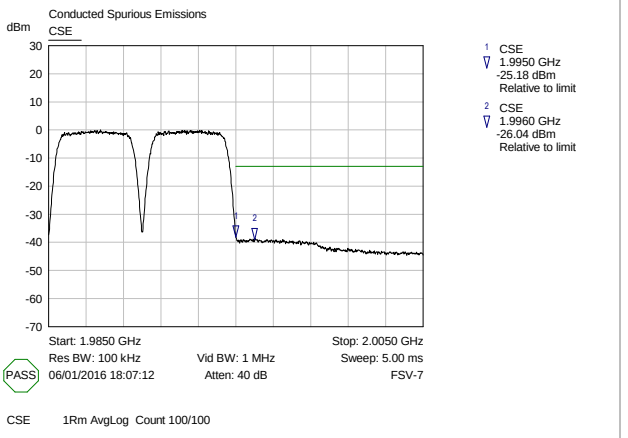
Lower Band edge 1932.5 and 1937.5



Upper Band edge 1987.5 and 1992.5

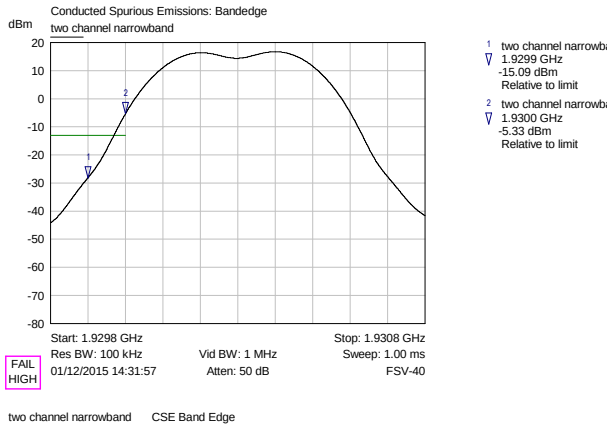


Lower Band edge 1932.5 and 1937.5
Narrow RBW in 1 MHz

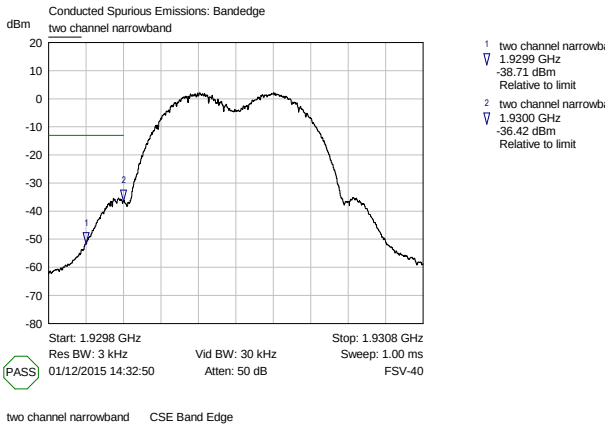


Upper Band edge 1987.5 and 1992.5
Narrow RBW in 1 MHz

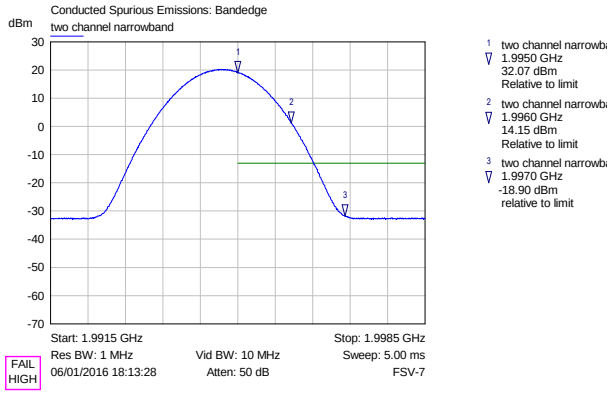
10.2.4 Dual Channel band edge - Narrowband



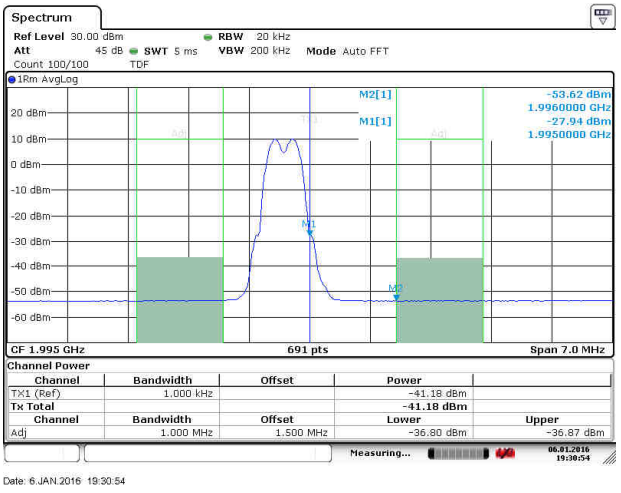
Band edge lower



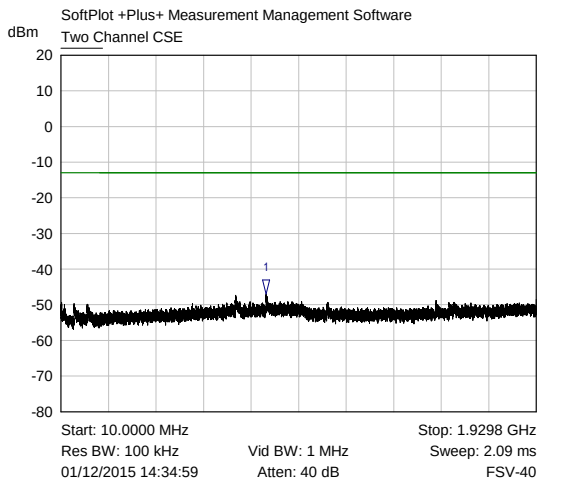
Band edge lower low RBW



Band edge upper

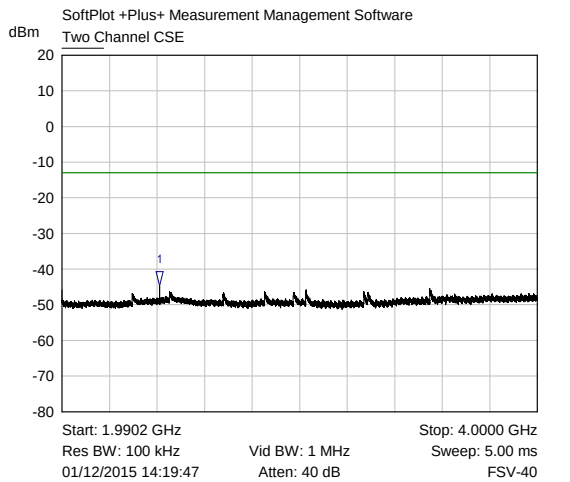


Band edge upper low RBW



Mkr	Trace	X-Axis	Value	Notes
1	Two Channel CSE	38.0937 MHz	-33.97 dBm	Relative to limit

CSE lower



Mkr	Trace	X-Axis	Value	Notes
1	Two Channel CSE	2.4030 GHz	-31.61 dBm	Relative to limit

CSE upper

11 Test equipment

Description	Manufacturer	Model	Serial Number	Calibration
Signal Analyser	Rohde & Schwarz	FSV 40	Livingston Hire asset X479651	Code: 161467 Due 19 May 16
Signal Analyser	Rohde & Schwarz	FSV 7	Zinwave asset 000073	R&S 20-516458 Due 14 Nov 16
Signal Generator	Rohde & Schwarz	SMBV100A	Microlease asset 45440	Ref: 45440 Due 19 Nov 15
Signal Generator	Rohde & Schwarz	SMJ100A	100156	T493937A Due: 24 Dec 16
Cable	Utiflex	BUA01G	FA210A0009M30309	ABEX UK. Ref: green bua01g Due 08 Oct 17
Signal Generator	Agilent	E4437B	US39260377	Verified as part of system test
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	

Table 4: Test Equipment

Measurement uncertainty for test equipment

Analyser ±0.5 dB