

## **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<br>Director,<br>Sulis Consultants Ltd | 08 Dec<br>2015 | Customer<br>release   |  |
| B        | C Blackham<br>Director,<br>Sulis Consultants Ltd | 09 Jan<br>2016 | 1 <sup>st</sup> issue |                                                                                     |
| C        | C Blackham<br>Director,<br>Sulis Consultants Ltd | 05 Feb<br>2016 | Minor<br>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 13<sup>th</sup> October and 6<sup>th</sup> 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     |
|---------------------------------------|-------------|----------|-------------------|
| <b>Zinwave UNIhub (Primary Hub)</b>   |             |          |                   |
| Chassis                               |             | 302-1001 | 00-17-68-00-09-B7 |
| RF Service module                     |             | SM 1/6   | 030370002050      |
| Optical module                        |             | OM 1/6   | 050750002036      |
| <b>Zinwave UNIhub (Secondary Hub)</b> |             |          |                   |
| 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

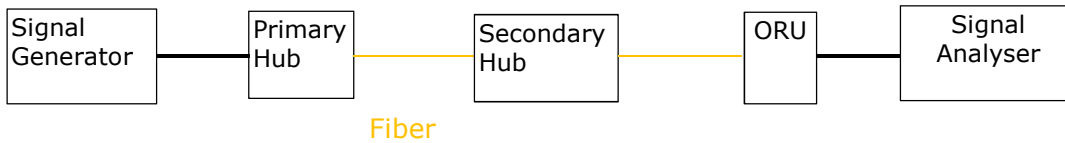


Figure 1: Test configuration – single channel

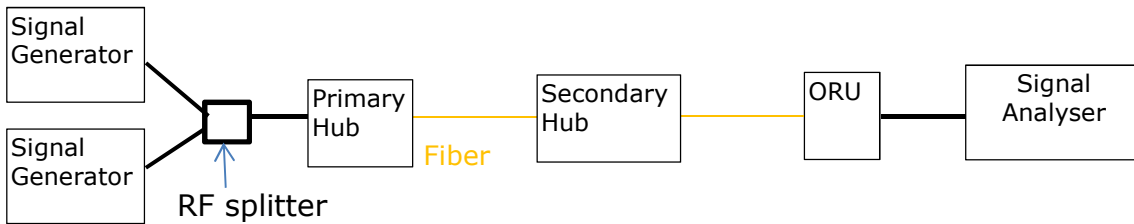


Figure 2: Test configuration – dual channel

Notes – additional connections not shown:

1. IQ output from Signal Generator #1 connected 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

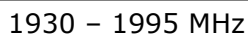
| Test                         | 47 CFR Part                             | FCC limit                 | Section | Result |
|------------------------------|-----------------------------------------|---------------------------|---------|--------|
| Determination of $f_0$       | KDB 935210 D05<br>Section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

**Table 3: Summary of tests performed**

---

<sup>1</sup> 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.

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



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

## 8 Transmit Power

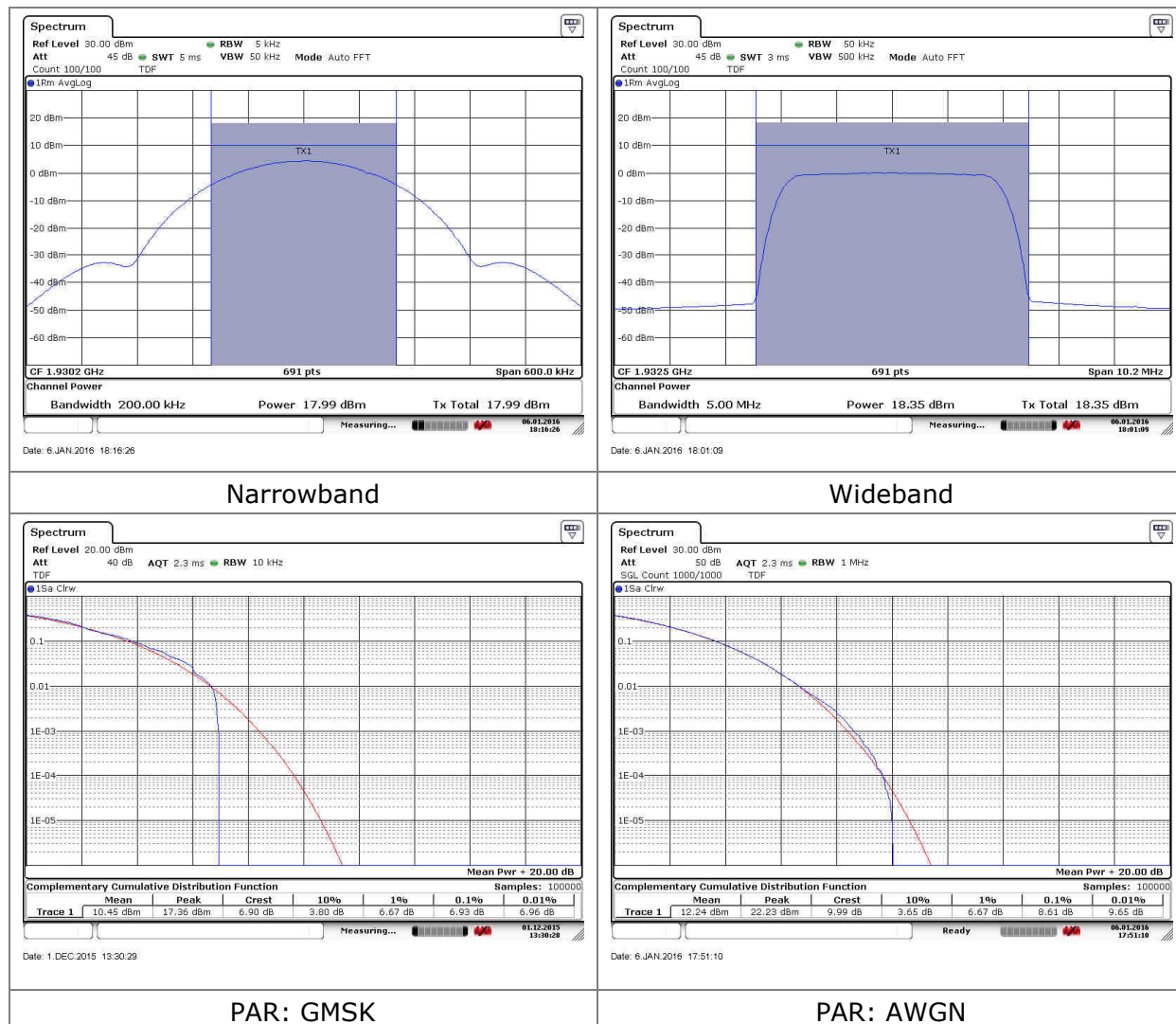
### 8.1 Test method

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**

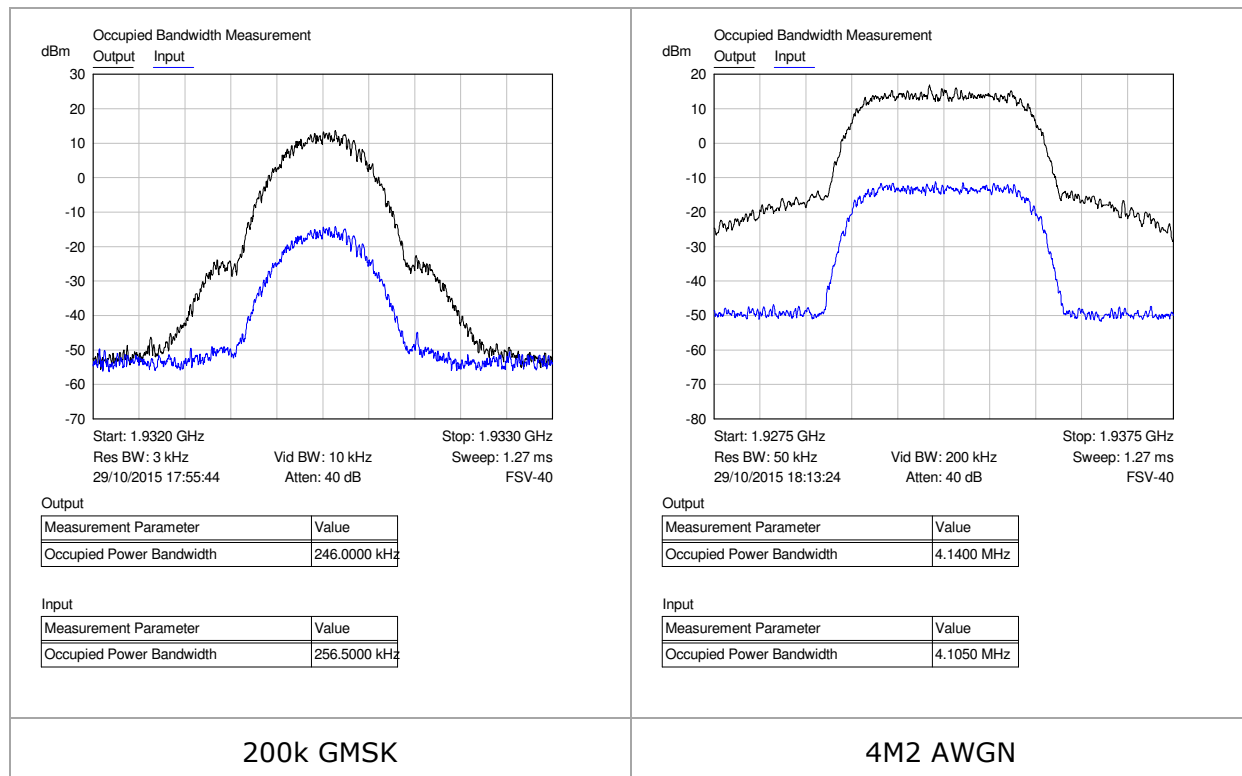
## 9 Occupied Bandwidth: Input vs output signal

### 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



**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  $43 + 10 \log_{10}(P)$  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

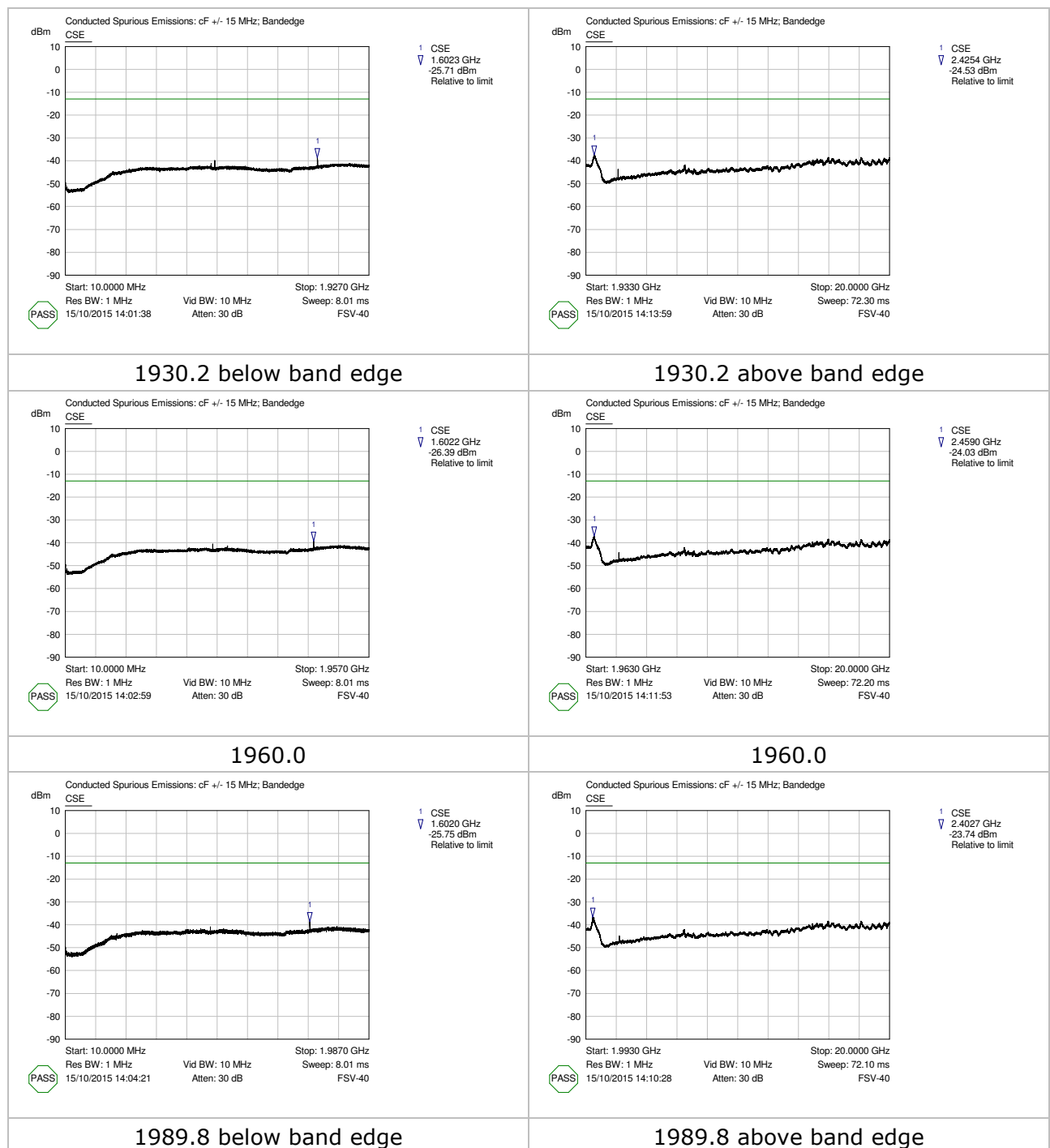


Figure 6: Narrow band CSE except band edge

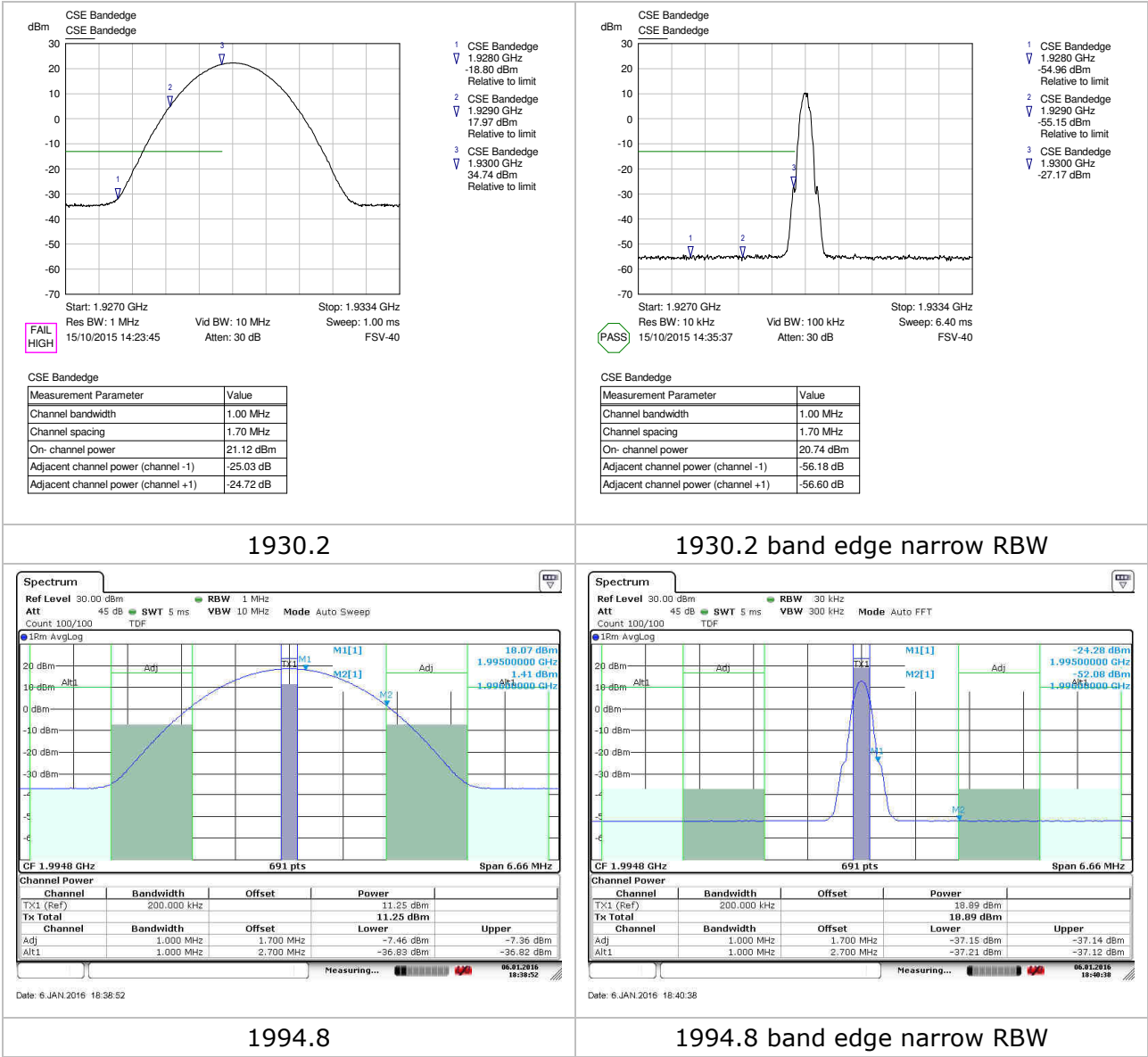
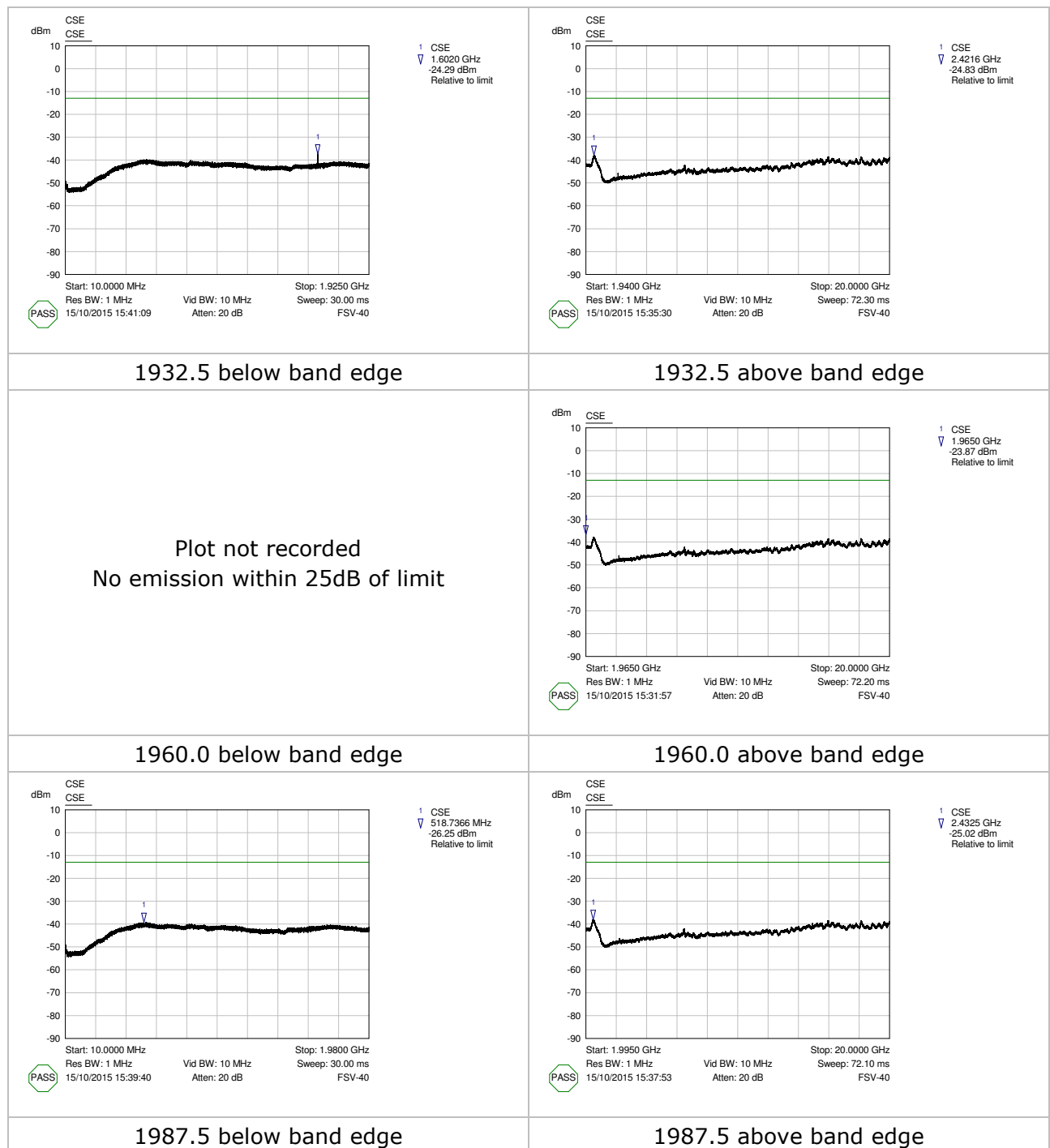


Figure 7: Narrowband CSE band edge

## 10.2.2 Wideband single frequency



**Figure 8: Narrow band CSE except band edge**

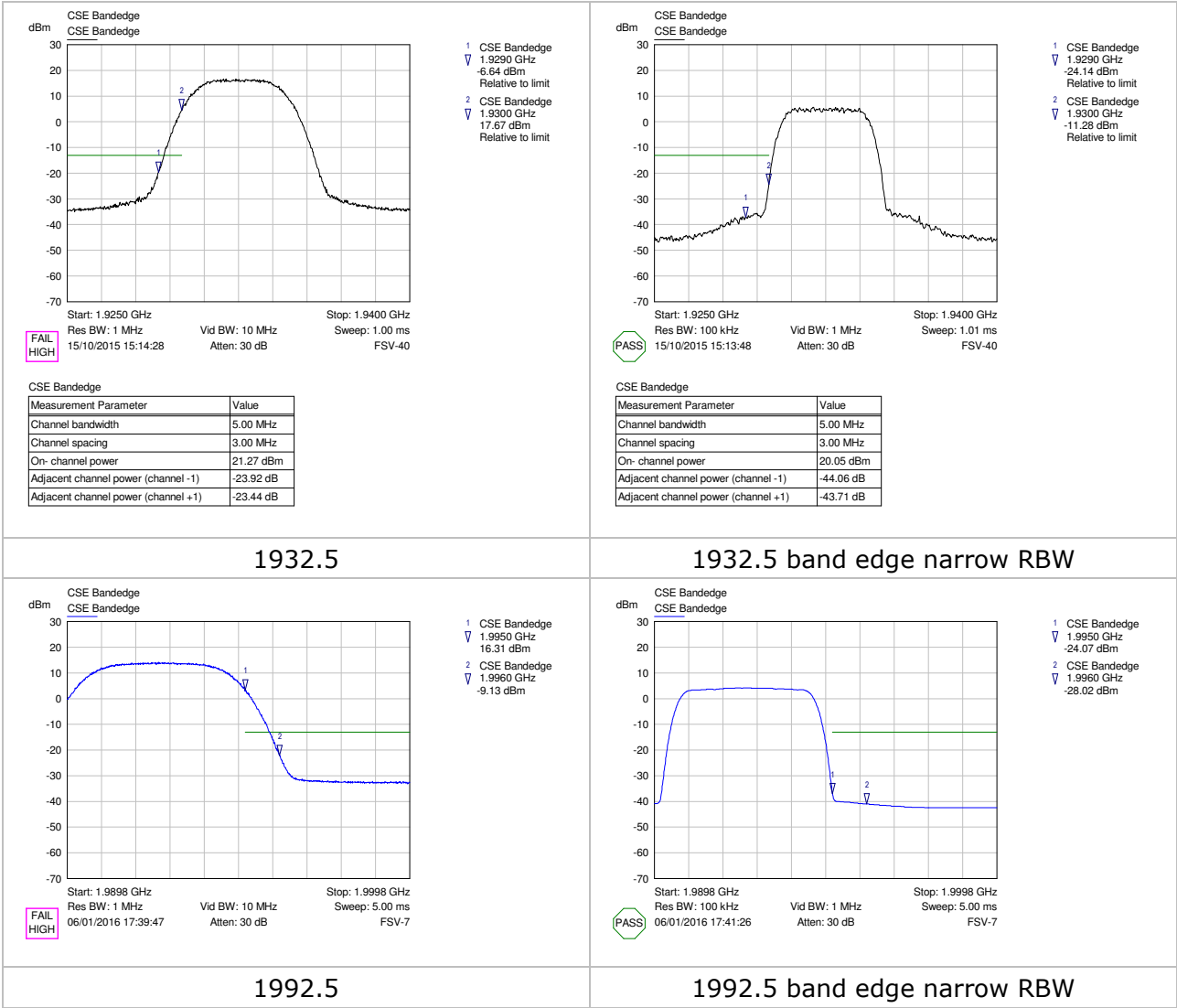
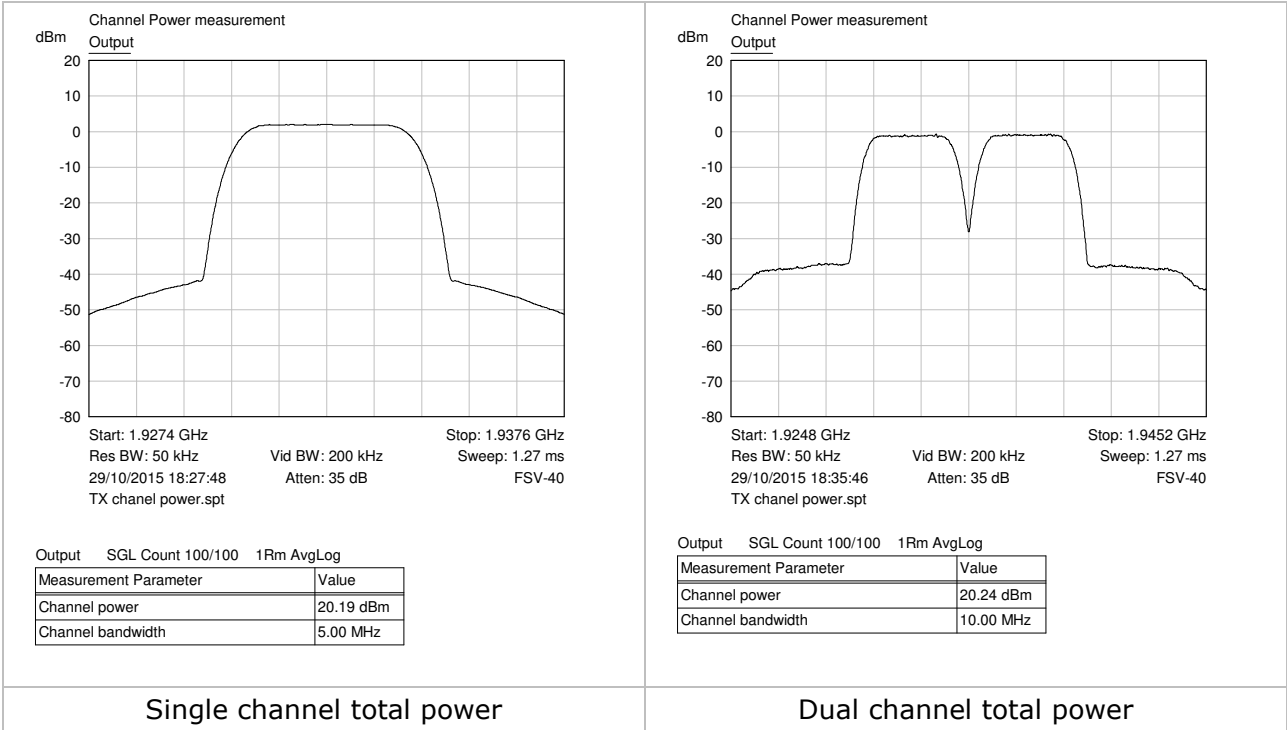


Figure 9: Narrowband CSE band edge

10.2.3 Dual Channel band edge - AWGN

Check set-up



Channel Power measurement

Output



Start: 1.9248 GHz

Res BW: 50 kHz

29/10/2015 18:35:46

TX chanel power.spt

Stop: 1.9452 GHz

Sweep: 1.27 ms

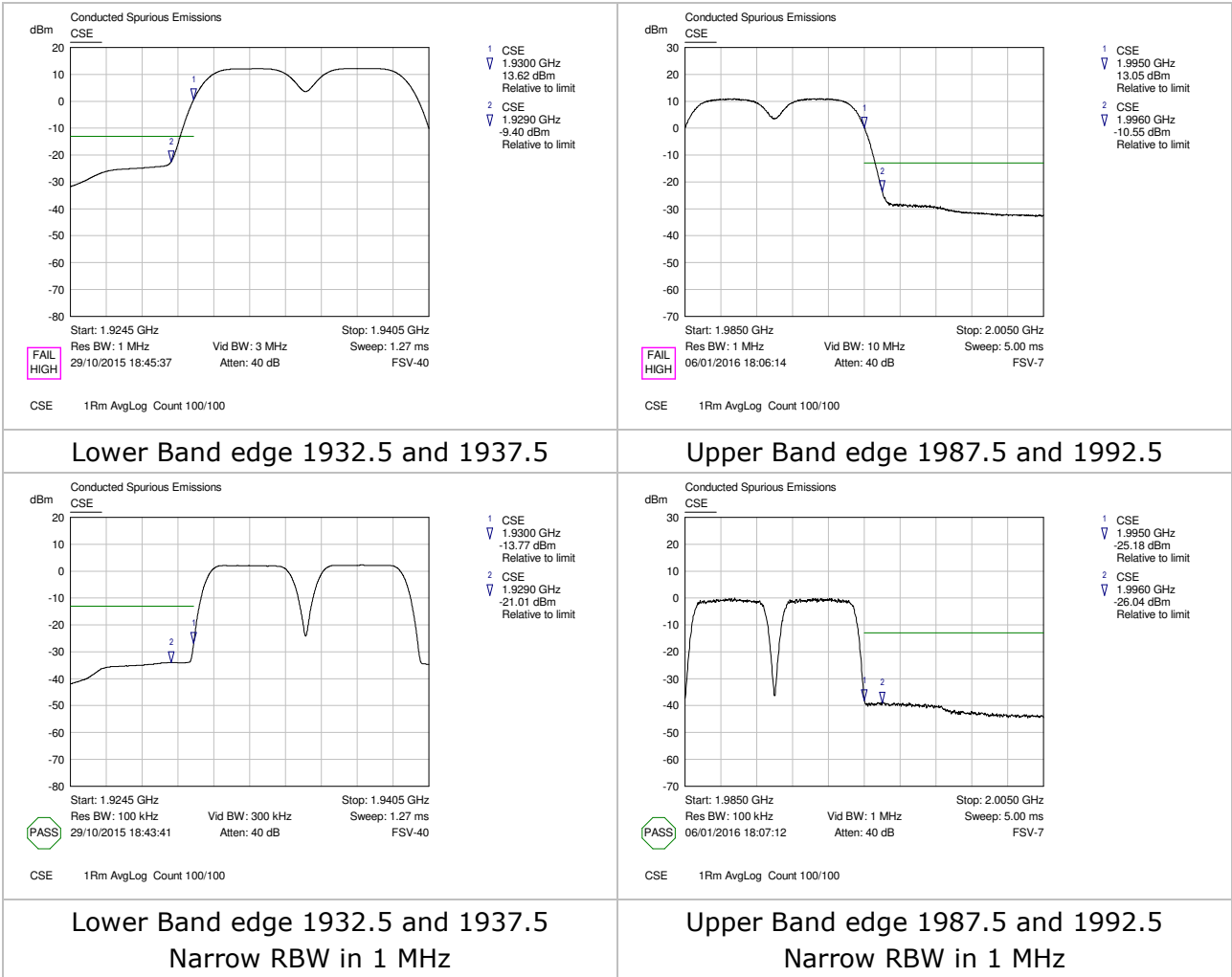
FSV-40

Vid BW: 200 kHz

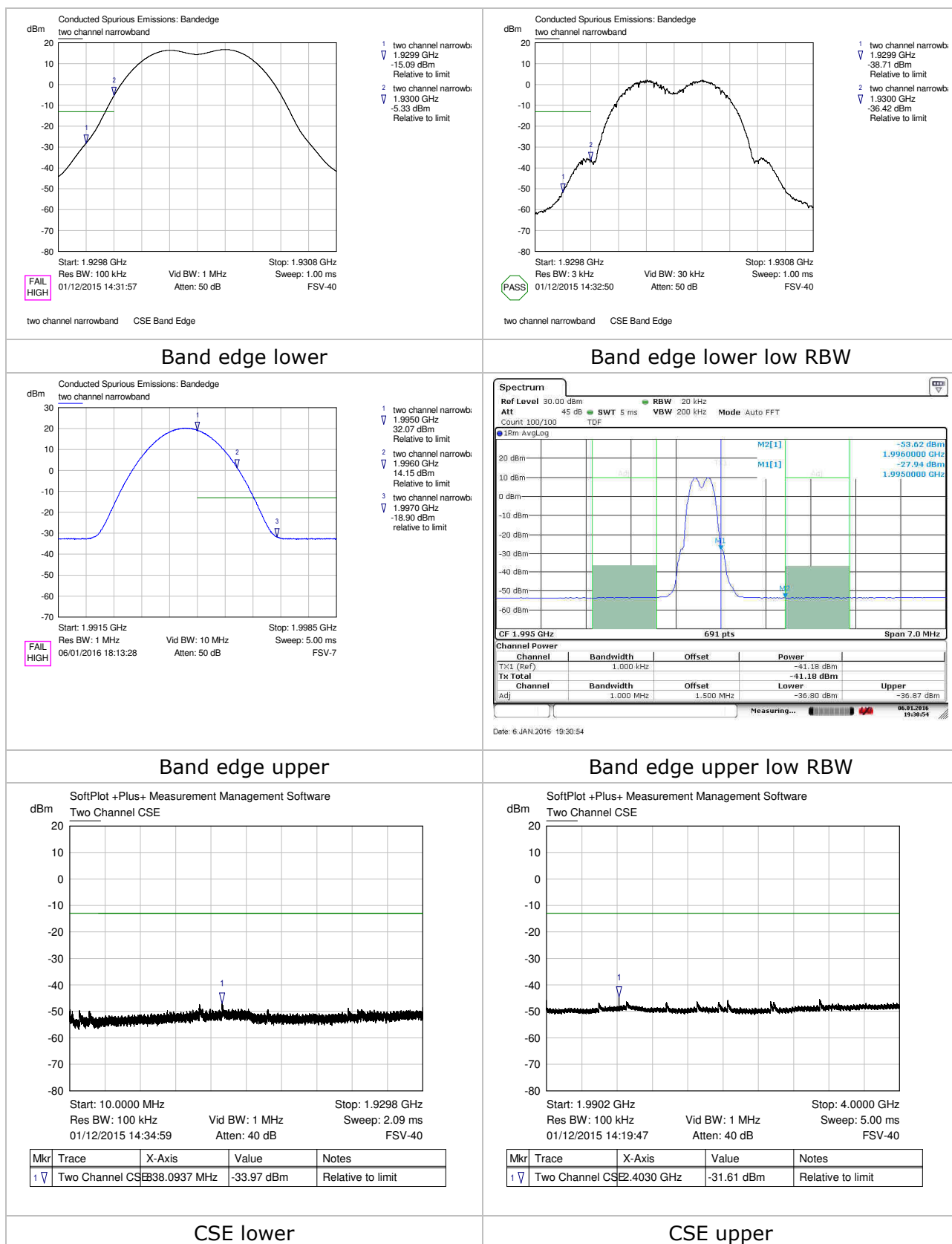
Atten: 35 dB

|                       |                   |            |
|-----------------------|-------------------|------------|
| Output                | SGL Count 100/100 | 1Rm AvgLog |
| Measurement Parameter | Value             |            |
| Channel power         | 20.24 dBm         |            |
| Channel bandwidth     | 10.00 MHz         |            |

Dual channel total power



## 10.2.4 Dual Channel band edge - Narrowband



## 11 Test equipment

| Description            | Manufacturer    | Model        | Serial Number                 | Calibration                                 |
|------------------------|-----------------|--------------|-------------------------------|---------------------------------------------|
| Signal Analyser        | Rohde & Schwarz | FSV 40       | Livingston Hire asset X479651 | Code: 161467<br>Due 19 May 16               |
| Signal Analyser        | Rohde & Schwarz | FSV 7        | Zinwave asset 000073          | R&S 20-516458<br>Due 14 Nov 16              |
| Signal Generator       | Rohde & Schwarz | SMBV100A     | Microlease asset 45440        | Ref: 45440<br>Due 19 Nov 15                 |
| Signal Generator       | Rohde & Schwarz | SMJ100A      | 100156                        | T493937A<br>Due: 24 Dec 16                  |
| Cable                  | Utiflex         | BUA01G       | FA210A0009M30309              | ABEX UK. Ref: green bua01g<br>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  $\pm 0.5$  dB