

RF Test Report:

Airspan AirSynergy 3650-3700 MHz

FCC ID:O2J-3675AS

SC_TR_91_B

Prepared for:
Airspan Communications Ltd
Capital Point,
33 Bath Road
Slough,
Berkshire
SL1 3UF

Contents

| | | |
|------|---|----|
| 1 | Revision History | 4 |
| 2 | Purpose..... | 4 |
| 3 | Reference Documents | 4 |
| 4 | Test Information | 5 |
| 4.1 | Client..... | 5 |
| 4.2 | Test personnel | 5 |
| 4.3 | Test sample..... | 5 |
| 5 | Product Description..... | 5 |
| 6 | Test Configuration | 6 |
| 6.1 | Test sample and Operating mode | 6 |
| 6.2 | Support equipment..... | 6 |
| 6.3 | Test equipment..... | 7 |
| 6.4 | Equipment set-up..... | 8 |
| 7 | Summary of Tests performed | 9 |
| 8 | Transmit Power 47CFR90.1321 | 10 |
| 8.1 | Requirement and test method | 10 |
| 8.2 | Test results | 11 |
| 9 | Spectral Power Density | 12 |
| 9.1 | Requirement and test method | 12 |
| 9.2 | Test results | 12 |
| 10 | Occupied Bandwidth | 13 |
| 11 | Conducted Emissions Mask (CEM)..... | 14 |
| 11.1 | Requirement and test method | 14 |
| 11.2 | Results | 14 |
| 12 | Conducted Spurious Emissions inc. Band Edge | 17 |
| 12.1 | Requirement and test method | 17 |
| 12.2 | Results for 5 MHz channels..... | 18 |
| 12.3 | Results for 10 MHz channels | 20 |
| 13 | Radiated Spurious Emissions..... | 22 |
| 13.1 | Requirement and test method | 22 |
| 13.2 | Results | 22 |

Tables

| | |
|---|----|
| Table 1: Equipment under test | 6 |
| Table 2: Support Equipment | 6 |
| Table 3: Test Equipment..... | 7 |
| Table 4: Summary of tests performed | 9 |
| Table 5: Transmit power | 11 |
| Table 6: Transmit power spectral density | 12 |
| Table 7: Occupied Bandwidth test results | 13 |
| Table 8: Conducted Emissions masks results..... | 14 |
| Table 9: Conducted spurious emissions, 5 MHz channel, RF-3 | 18 |
| Table 10: Conducted spurious emissions, 10 MHz channel, RF-3..... | 20 |
| Table 11: Radiated Spurious Emissions | 22 |

Figures

| | |
|---|----|
| Figure 1: Airsynergy configuration for test..... | 8 |
| Figure 2: Transmit Power plots..... | 11 |
| Figure 3: Transmit Power plots..... | 12 |
| Figure 4: Occupied Bandwidth plots | 13 |
| Figure 5: 5 MHz channel Spectrum mask plots | 15 |
| Figure 6: 10 MHz channel Spectrum mask plots | 16 |
| Figure 7: Conducted Spurious Emissions plots, 5 MHz channels..... | 19 |
| Figure 8: Conducted Spurious Emissions plots, 10 MHz channels | 21 |
| Figure 9: RSE pre-scans, 5 MHz channel..... | 23 |
| Figure 10: RSE Plots – band edge, 5 and 10 MHz channels | 24 |

1 Revision History

| Revision | Originator | Date | Comment |
|----------|------------|--------------|---|
| A | C Blackham | 31 July 2013 | 1 st release with antenna port tests |
| B | C Blackham | 15 Aug 2013 | Completed report |

2 Purpose

This document details the Airspan AirSynergy base station, model number SYN-XX-00-0A36-000, designed for operation in the 3650-3700 MHz band.

3 Reference Documents

| | | |
|---------|---|---|
| [Ref 1] | 47CFR2 | Title 47 Code of Federal Regulations Part 2: frequency allocations and radio treaty matters; general rules and regulations |
| [Ref 2] | 47 CRF90 | Title 47 Code of Federal Regulations Part 90: Private land mobile radio services |
| [Ref 3] | TIA-603-C | Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards |
| [Ref 4] | KDB 662911 D01 v01r02 | Federal Communications Commission Office of Engineering and Technology Laboratory Division; Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc) |
| [Ref 5] | 965270 D01 Pwr Meas Part 90 Z-Equipment v01 | |

4 Test Information

4.1 Client

Airspan Communications Ltd
Capital Point,
33 Bath Road
Slough,
SL1 3UF
UK

4.2 Test personnel

Conducted Emissions (sections 8 to 12)

Testing was performed by Charlie Blackham of Sulis Consultants Ltd at Airspan Communications offices on 30th July and 14th August 2013 and at Hursley EMC on 9th August 2013.

Radiated Spurious Emissions (section 13)

Testing was performed by Rob St John James at Hursley EMC services Ltd, FCC Registered, UK designation number: UK0006 on 9th August 2013.

4.3 Test sample

The results herein only refer to sample detailed in section 6

5 Product Description

The Airsynergy unit supports operation with 5 and 10 MHz bandwidths, comprising 1024 subcarriers. Each of these subcarriers can be modulated in a number of modes:

- BPSK $\frac{1}{2}$
- QPSK $\frac{1}{2}$ and $\frac{3}{4}$
- 16 QAM $\frac{1}{2}$ and $\frac{3}{4}$
- 64 QAM $\frac{1}{2}$ and $\frac{3}{4}$
- 256 QAM $\frac{5}{6}$

Based on pre-testing, the following modulation schemes will be used during testing:

- 256 QAM $\frac{5}{6}$

The unit is fitted with two RF transceiver RF ports, RF-1 and RF-3. These support MIMO operation and are connected to a variety of external cross-polarised sectored antennas with following gains:

- 5 MHz channels used with antennas of up to 6.5 dBi gain
- 10 MHz channels used with antennas of up to 9.5 dBi gain

Transmit power setting for test were:

- 26.0 dBm (per port) for 5 MHz channels
- 26.5 dBm (per port) for 10 MHz channels

6 Test Configuration

6.1 Test sample and Operating mode

The equipment under test (EUT) was:

| Manufacturer | Name | Model Number | Serial Number |
|---------------------|-------------|---------------------|----------------------|
| Airspan | AirSynergy | SYN-CN-00-0A36-000 | FCC#1 |

Table 1: Equipment under test

6.2 Support equipment

The support equipment was:

| Description | Manufacturer | Name | Serial Number |
|--------------------|---------------------|--------------------------|----------------------|
| Laptop | Dell | Latitude | AIRN005837 |
| Mains – 48 V PSU | Powerbox | PBUS-LUV-54V/100W-SN-QNA | P1131CV022587 |

Table 2: Support Equipment

6.3 Test equipment

| Description | Manufacturer | Name | Serial Number | Calibration certificate |
|------------------|--------------------|-------------|---------------|--|
| Receiver | R&S | FSQ 26 | 200108 | R&S Ref:95436 27 Jun 2013 |
| Signal Generator | R&S | SMB100A03 | 175535 | R&S 20-400919 16 Dec 2012 |
| Attenuator | Inmet | 18N10W-10dB | N/A | Calibrated in-situ and loaded as Transducer Factor |
| RF cable | Rhophase Microwave | - | B2288 | |
| Sig Gen | HP | 8341B | - | HEMC ID#195 ¹ |
| Pre-amp | HP | 8449B | - | HEMC ID#070 ¹ |
| Pre-amp | HP | 8447D | - | HEMC ID#050 ¹ |
| Receiver | R&S | ESCI7 | - | HEMC ID#347 ¹ |
| Spec An | HP | 8593EM | - | HEMC ID#033 ¹ |
| Receiver | R&S | ESIB40 | - | HEMC ID#021 ¹ |
| TX antenna | Schwarzbeck | BBHA 9120 | - | HEMC ID#466 ¹ |
| cable | - | - | - | HEMC ID#434 ¹ |

Table 3: Test Equipment

¹ Equipment serial number and calibration data is held by Hursley EMC Services Ltd under their UKAS accreditation, schedule no. 1871.

6.4 Equipment set-up

Equipment was configured as per figure 1:

- A "putty" sessions running on the laptop allows the Airsynergy unit to be controlled and set to required frequency, bandwidth, modulation and power.
- The insertion loss of the Attenuator and Co-ax cable were measured using a Signal Generator and the FSQ and their combined path-loss was programmed into the FSQ as a Transducer Factor.

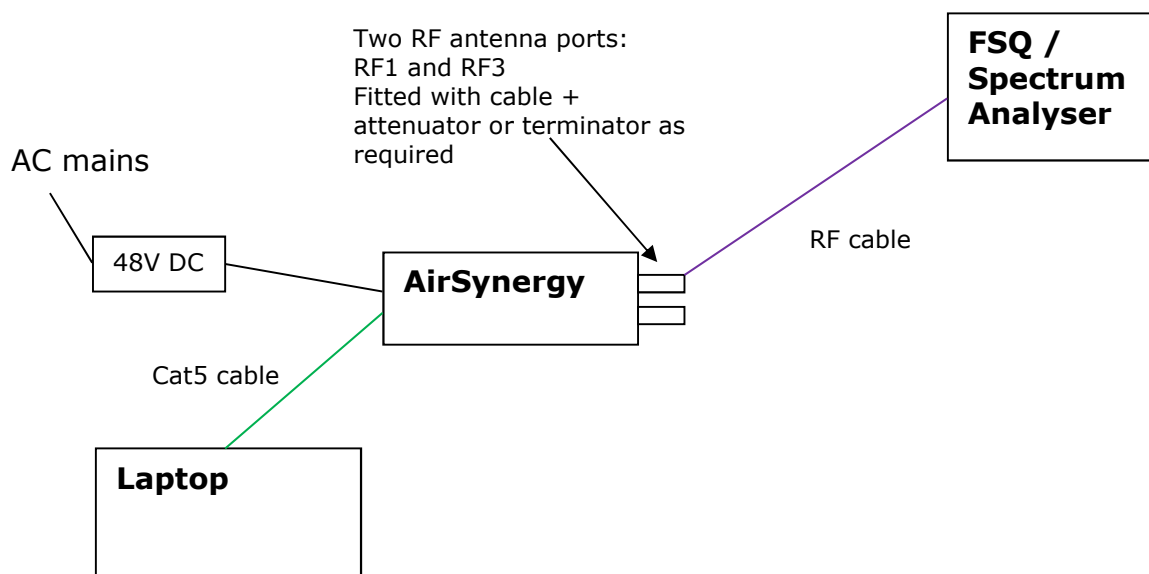


Figure 1: Airsynergy configuration for test

7 Summary of Tests performed

| Test | 47 CFR Part | Limit | Result | Section |
|--|---------------------|--------------|---------------|----------------|
| Transmit Power | 90.1321(a) / 2.1046 | 5W 10W | Pass | 8 |
| Spectral Power Density | 90.1321(a) / 2.1046 | 1W / MHz | Pass | 9 |
| Occupied Bandwidth | 90.209 / 2.1049 | None | Pass | 10 |
| Conducted Emissions masks | 90.201(n) / 2.1051 | Mask B | Pass | 11 |
| Conducted Spurious Emissions (out of band) | 90.1323 / 2.1051 | -13 dBm | Pass | 12 |
| Radiated Spurious Emissions | 90.1323 / 2.1053 | -13 dBm | Pass | 13 |

Table 4: Summary of tests performed

8 Transmit Power 47CFR90.1321

8.1 Requirement and test method

90.1321 Power and antenna limits.

- a) Base and fixed stations are limited to 25 watts/25 MHz equivalent isotropically radiated power (EIRP). In any event, the peak EIRP power density shall not exceed 1 Watt in any one-megahertz slice of spectrum.

The equipment was configured as per figure 1 and the measurements were made in accordance with KDB 965270 v01

The total power was summed in accordance with KDB662911D01 and the result compared against the limit.

8.2 Test results

| Channel Bandwidth | Port | TX power (dBm) | Summed TX power (dBm) | TX power EIRP (dBm) | TX power EIRP (W) | Limit EIRP (W) | Result |
|-------------------|------|----------------|-----------------------|---------------------|-------------------|----------------|--------|
| 5 | RF3 | 25.91 | 28.77 | 35.27 | 3.37 | 5.0 | Pass |
| | RF1 | 25.61 | | | | | |
| 10 | RF3 | 26.83 | 29.45 | 38.95 | 7.86 | 10.0 | Pass |
| | RF1 | 26.02 | | | | | |

Table 5: Transmit power

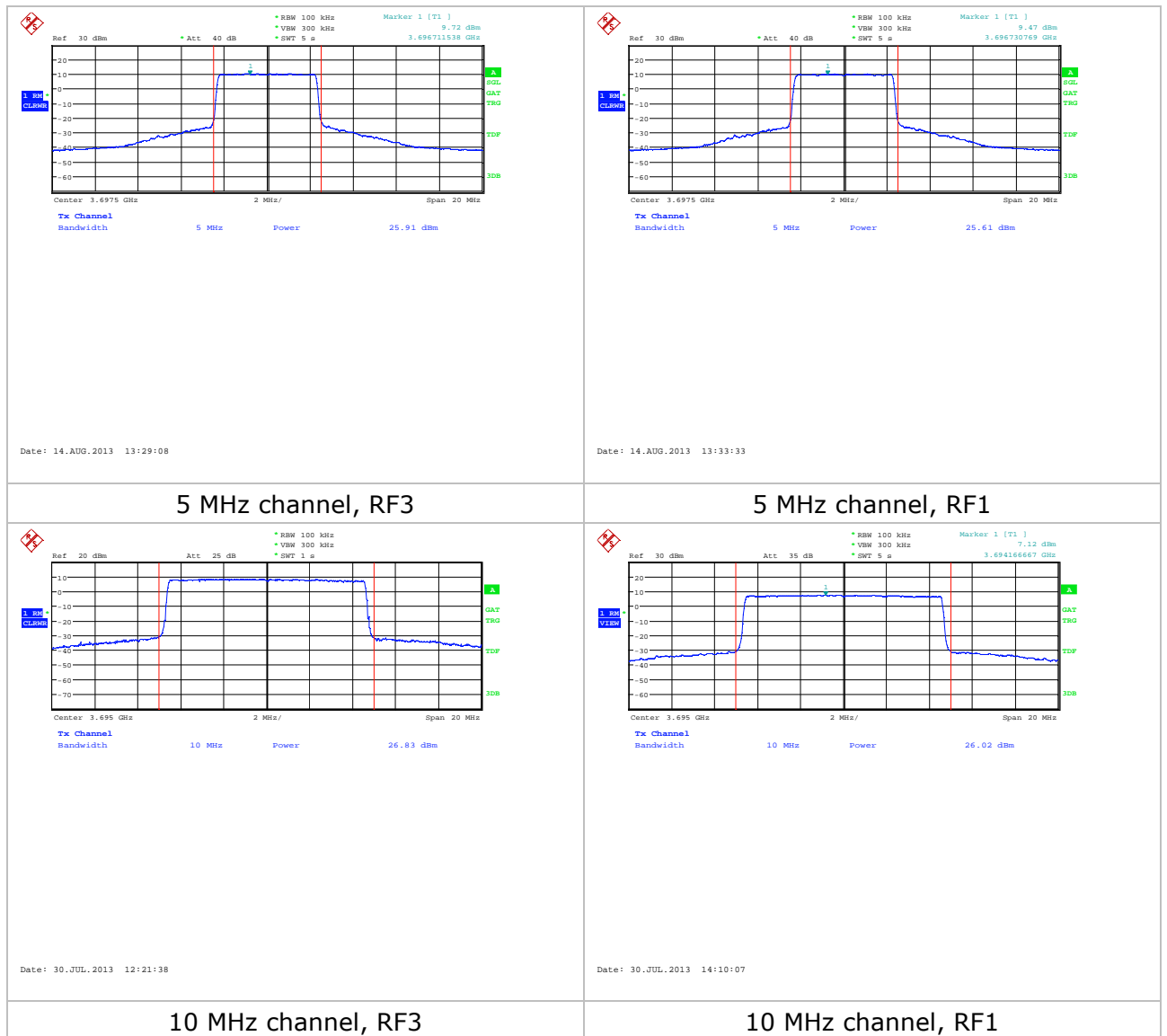


Figure 2: Transmit Power plots

9 Spectral Power Density

9.1 Requirement and test method

As per section 8.1

9.2 Test results

| Channel Bandwidth | Port | TX power (dBm) | Summed TX power (dBm) | TX power EIRP (dBm) | TX power EIRP (W) | Limit EIRP (W) | Result |
|-------------------|------|----------------|-----------------------|---------------------|-------------------|----------------|--------|
| 5 | RF3 | 20.07 | 22.91 | 29.41 | 0.87 | 1.0 | Pass |
| | RF1 | 19.72 | | | | | |
| 10 | RF3 | 17.38 | 20.33 | 29.83 | 0.96 | 1.0 | Pass |
| | RF1 | 17.26 | | | | | |

Table 6: Transmit power spectral density

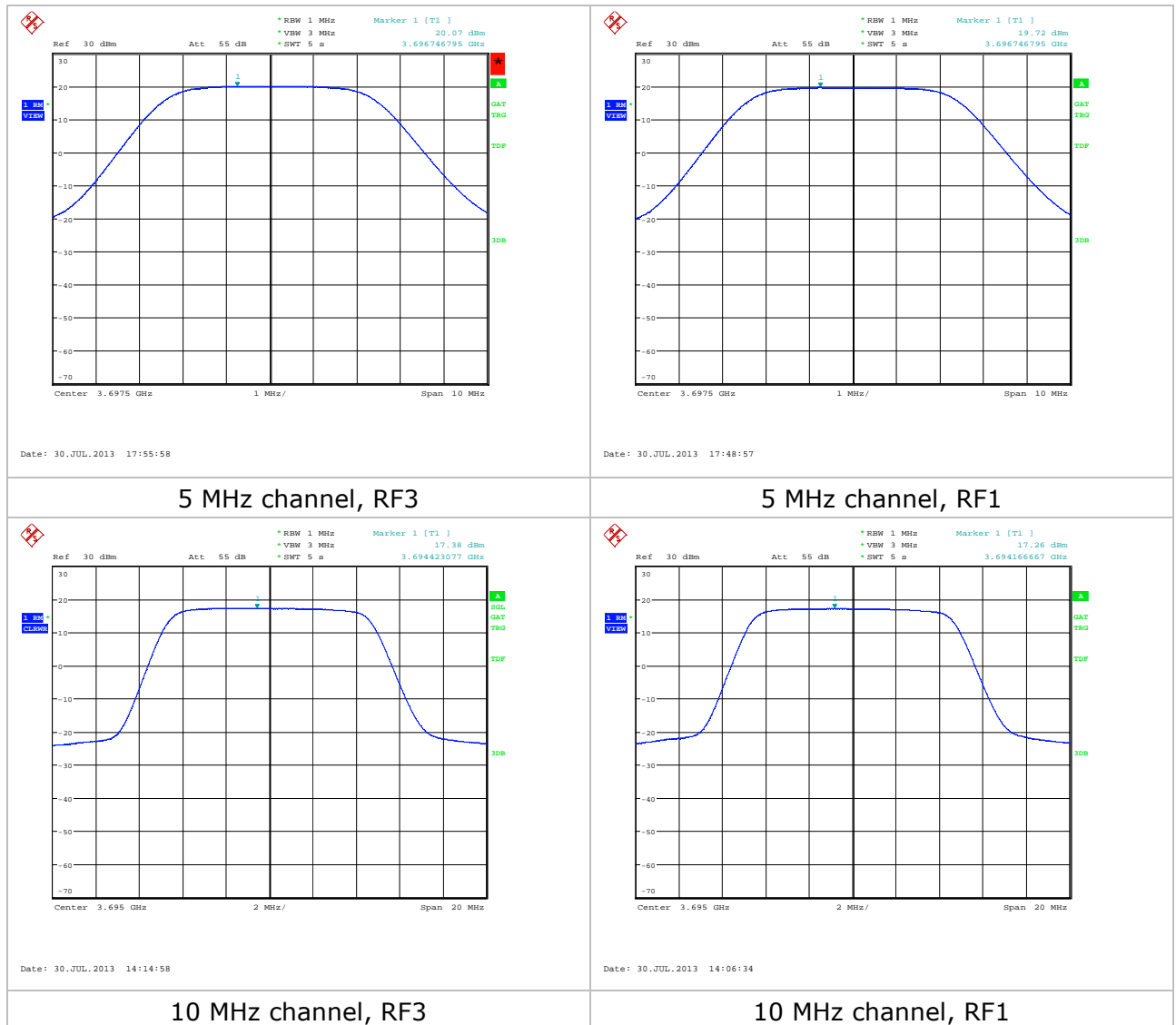


Figure 3: Transmit Power plots

10 Occupied Bandwidth

The occupied bandwidth was measured using the inbuilt function on the FSQ set to measure the 99.5% (-26 dB) emission bandwidth. Measurement was made using RMS detector and gated measurement. There is no pass/fail criterion so measurement results are reported without reference to a limit.

| Channel Bandwidth | TX Freq (MHz) | Port | Occupied Bandwidth (MHz) |
|-------------------|---------------|------|--------------------------|
| 5 | 3697.5 | RF3 | 4.615 |
| | | RF1 | 4.615 |
| 10 | 3695.0 | RF3 | 9.199 |
| | | RF1 | 9.199 |

Table 7: Occupied Bandwidth test results

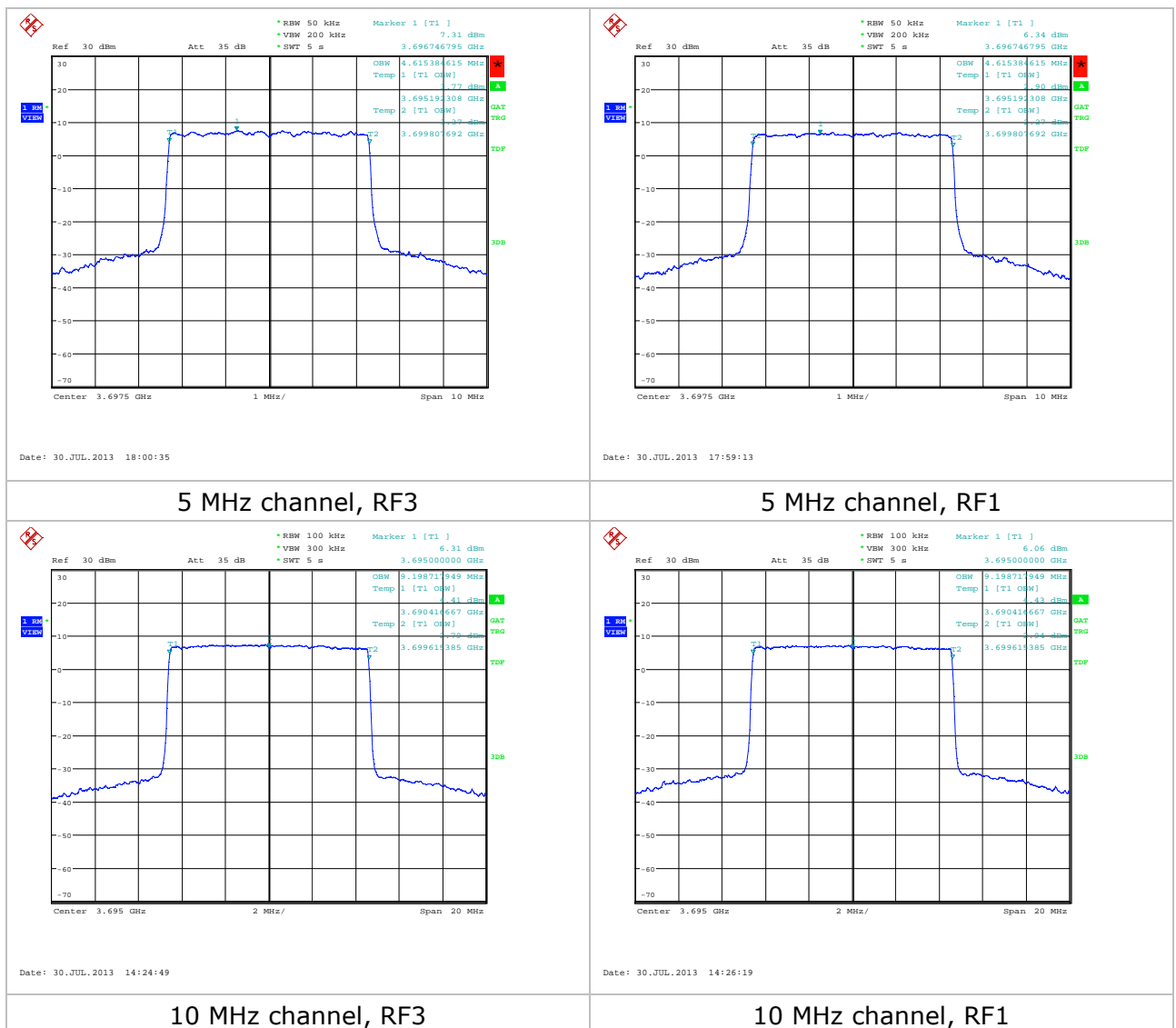


Figure 4: Occupied Bandwidth plots

11 Conducted Emissions Mask (CEM)

11.1 Requirement and test method

90.210 Emission masks.

- b) *Emission Mask B.* For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
- 1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
 - 2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
 - 3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

Method:

- Compliance with mask is determined using Spectrum Analyser in-built limit-check function.
- The channel power was measured using a resolution bandwidth equal to channel bandwidth
- Maximum level was determined using Peak Search
- Mask placed on this point by changing transducer factor
- RBW reduced to 1 MHz and emissions compared to mask
- Emissions exceeded mask near edges so RBW was reduced to 100 kHz and mask lowered by 10dB to compensate for reduced measurement bandwidth.

11.2 Results

| Channel Bandwidth | TX Freq (MHz) | Port | Plot | Result |
|-------------------|---------------|------|-------------------|--------|
| 5 | 3697.5 | RF3 | 5M RF3 100kHz BW | Pass |
| | | RF1 | 5M RF1 100kHz BW | Pass |
| 10 | 3695.0 | RF3 | 10M RF3 100kHz BW | Pass |
| | | RF1 | 10M RF1 100kHz BW | Pass |

Table 8: Conducted Emissions masks results

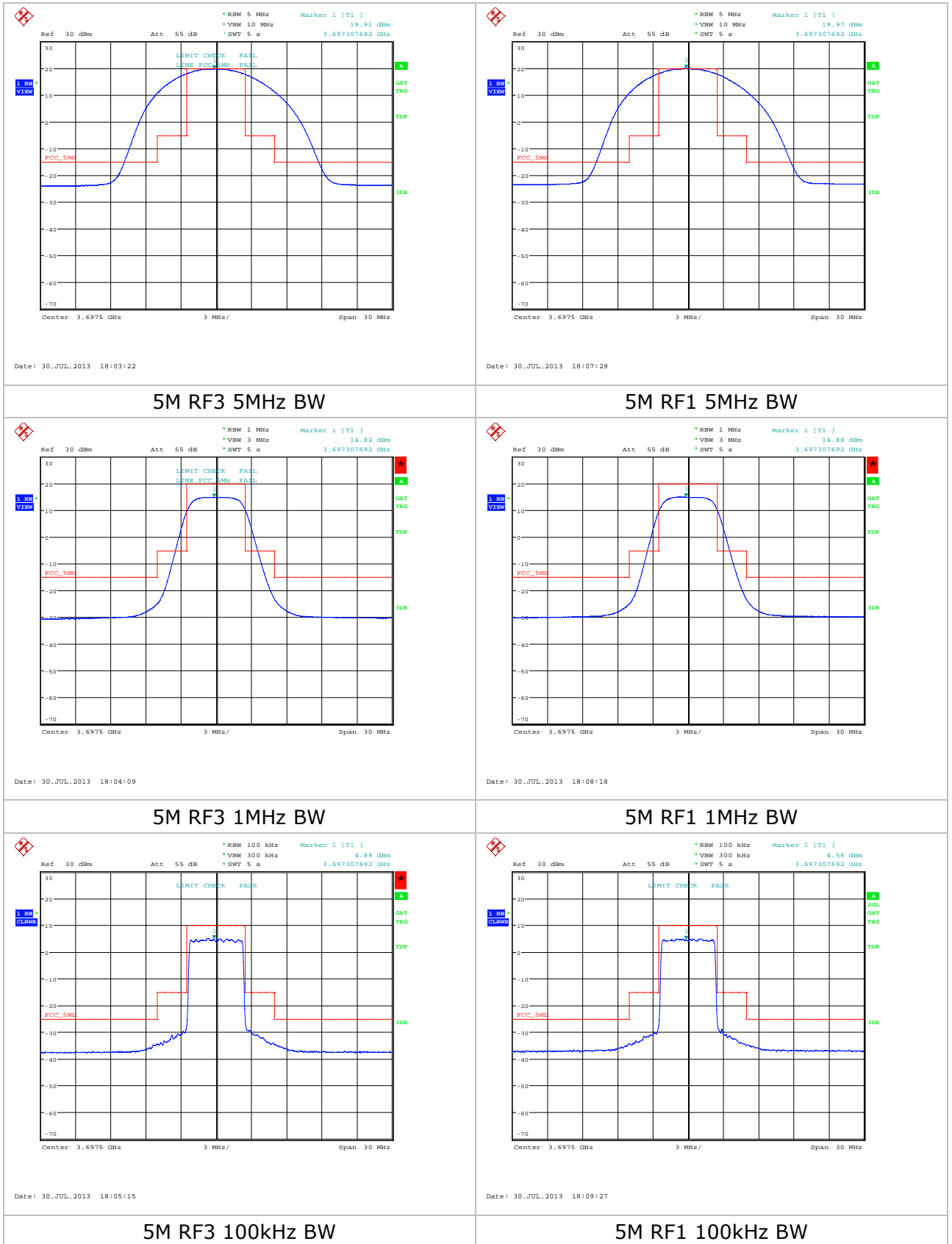


Figure 5: 5 MHz channel Spectrum mask plots

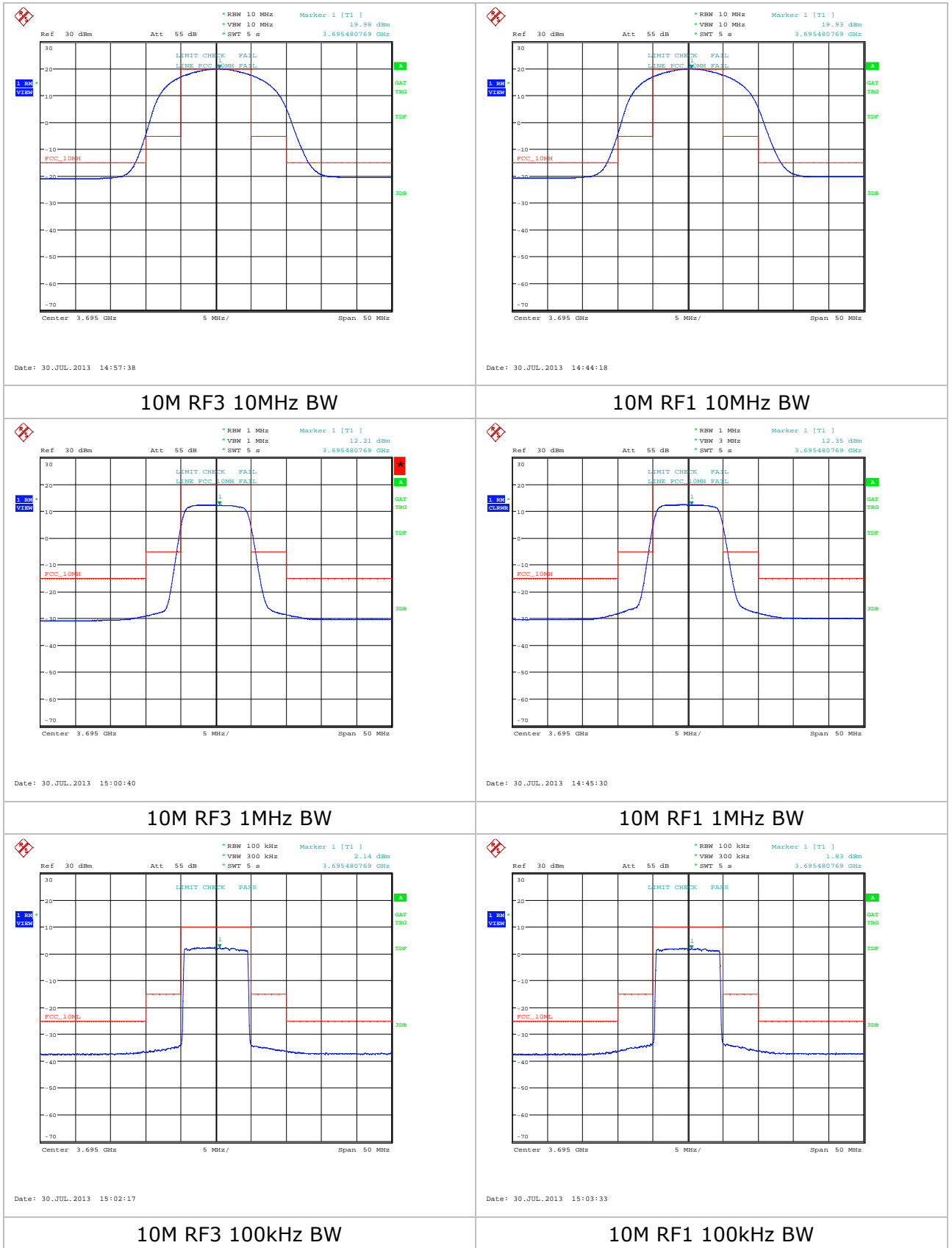


Figure 6: 10 MHz channel Spectrum mask plots

12 Conducted Spurious Emissions inc. Band Edge

12.1 Requirement and test method

§ 90.1323 Emission limits.

(a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

The licensed band of operation was considered to be a single 5 MHz channel for 5 MHz operation and a single 10 MHz channel for 10 MHz operation.

Initial scan was performed on top channel using peak detector and max-hold on port RF-3 which had the highest transmit power density.

Emissions exceeded the limit close to the fundamental transmission frequency and these were investigated using RMS detector, gated measurement and channel power measurement capability of the spectrum analyser as shown on plots 5M_CSE3-2 thru -4 and 10M_CSE3-2 thru -4.

Determination of total spurious emission was done by adding $10 \log (2)$, or 3dB to the emission level measured on port RF-3 and this was compared with limit of -13dBm.

12.2 Results for 5 MHz channels

| Frequency Range | Maximum emission (Measured) | Maximum emission (calculated) | Limit (dBm) | Result | Plot |
|-----------------|-----------------------------|-------------------------------|-------------|--------|--|
| 3600-3710 | -18.82 | -15.82 | -13.0 | Pass | 5M_CSE3-1 5M_CSE3-2 5M_CSE3-3 5M_CSE3-4 |
| 3710-5000 | -26.53 | -23.53 | -13.0 | Pass | 5M_CSE4 |

Table 9: Conducted spurious emissions, 5 MHz channel, RF-3

All other measurements were at least 20 dB below the specification limit or below the measurement system noise floor.

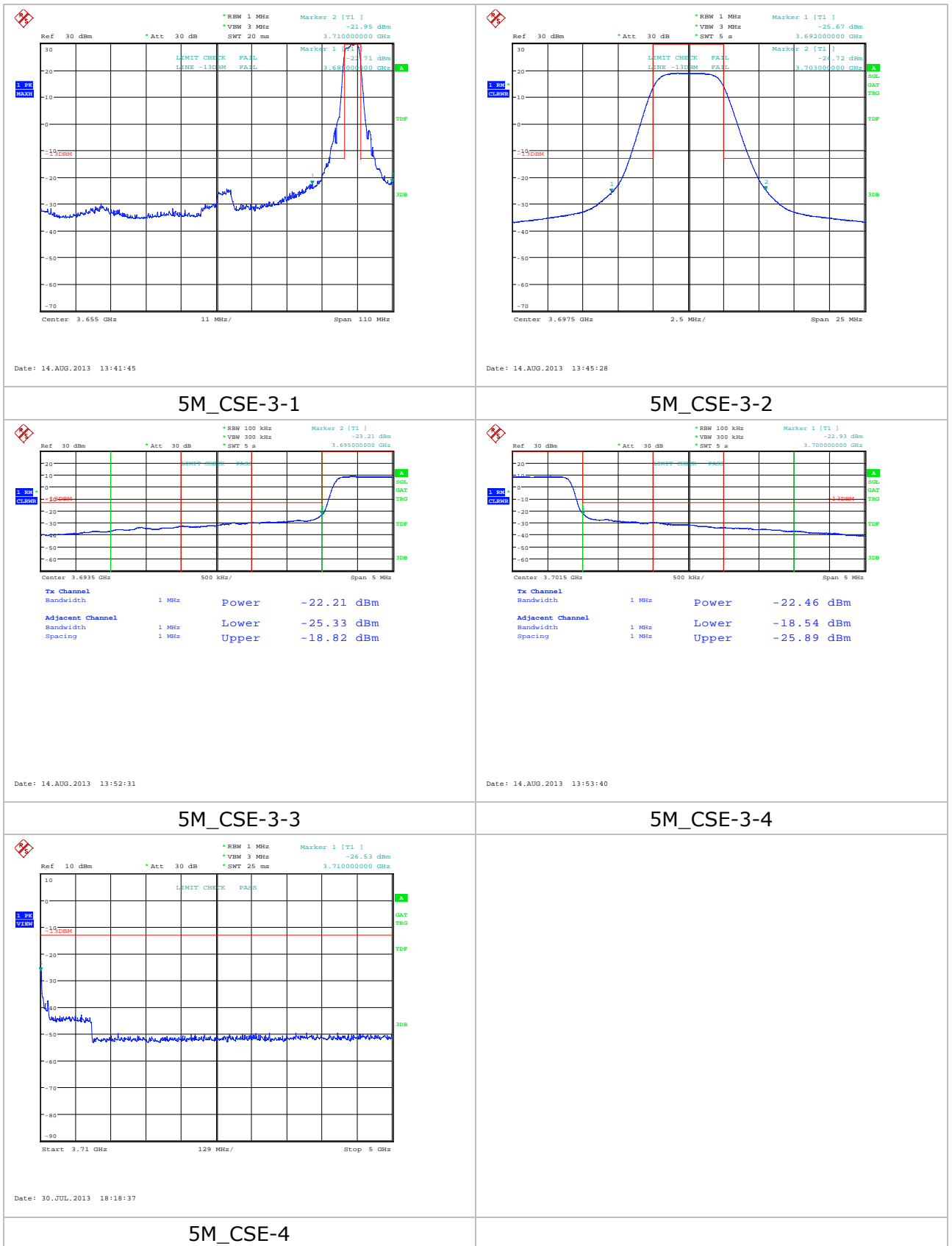


Figure 7: Conducted Spurious Emissions plots, 5 MHz channels

12.3 Results for 10 MHz channels

| Frequency Range | Maximum emission (Measured) | Maximum emission (calculated) | Limit (dBm) | Result | Plot (Figure 6 unless stated) |
|-----------------|-----------------------------|-------------------------------|-------------|--------|--|
| 3600-3720 | -22.12 | -19.12 | -13.0 | Pass | 10M_CSE3-1 10M_CSE3-2 10M_CSE3-3 10M_CSE3-4 |
| 3720-5000 | -32.88 | -29.88 | -13.0 | Pass | 10M_CSE4 |

Table 10: Conducted spurious emissions, 10 MHz channel, RF-3

All other measurements were at least 20 dB below the specification limit or below the measurement system noise floor.

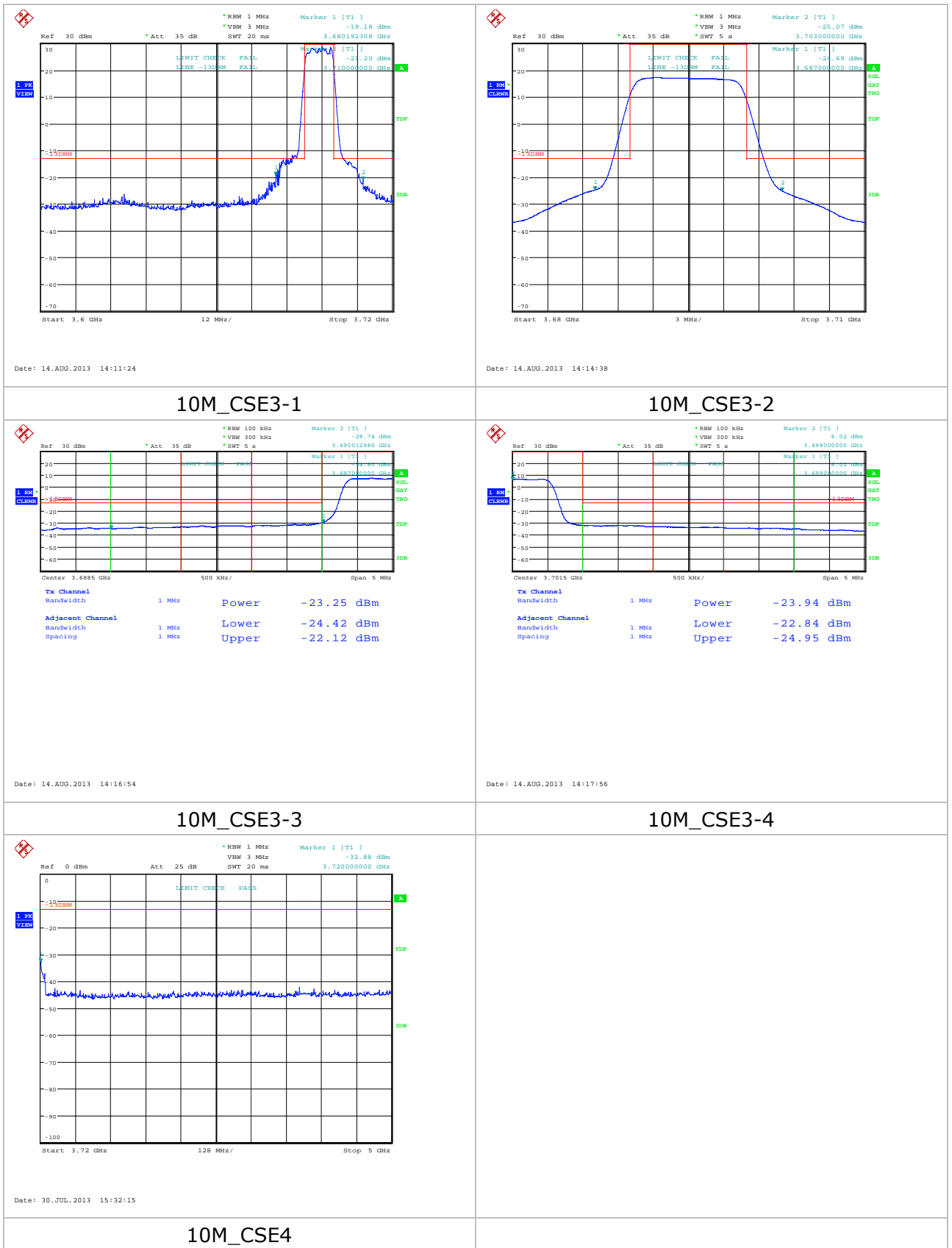


Figure 8: Conducted Spurious Emissions plots, 10 MHz channels

13 Radiated Spurious Emissions

13.1 Requirement and test method

§ 90.1323 Emission limits.

(a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

Attenuation of $43+10\log(P)$ dBm equates to an absolute limit of -13dBm

All measurements were performed at a 3m distance

Pre-scan measurements were performed with a spectrum analyser, using a peak detector with 100 kHz RBW for frequencies below 1 GHz and 1 MHz for frequencies above 1 GHz.

The cabinet radiation was performed while antenna ports were terminated with 50Ω load.

Initial pre-scan measurements were performed with limit determined by

$$E = \text{EIRP} - 20\log D + 104.8$$

Where pre-scans showed emissions within 20dB of the limit, final measurement was made using substitution method.

13.2 Results

Initial pre-scans were performed using peak detector.

For any emissions within 20dB of the limit, a substitution test was performed which was only required for band edge:

| Channel Bandwidth | Frequency (MHz) | Substituted radiated power (dBm) | Limit (dBm) | Result |
|-------------------|-----------------|----------------------------------|-------------|--------|
| 5 MHz | 3695.0 | -23.30 | -13.0 | Pass |
| | 3700.0 | -26.79 | -13.0 | Pass |
| 10 MHz | 3690.0 | -25.67 | -13.0 | Pass |
| | 3700.0 | -26.95 | -13.0 | Pass |

Table 11: Radiated Spurious Emissions

Pre-scan plots for 5 MHz channels are included below in figure 9 for information.

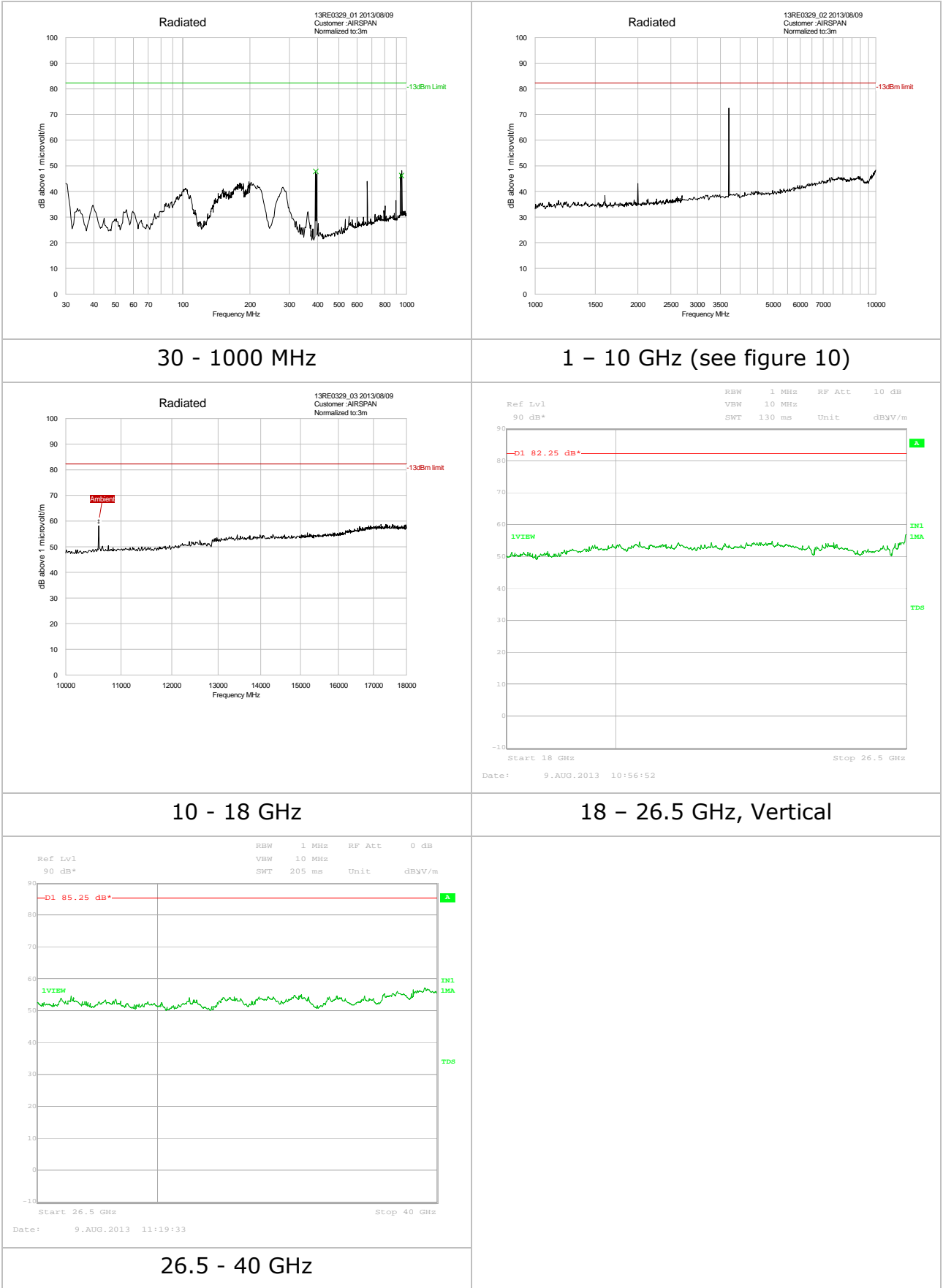
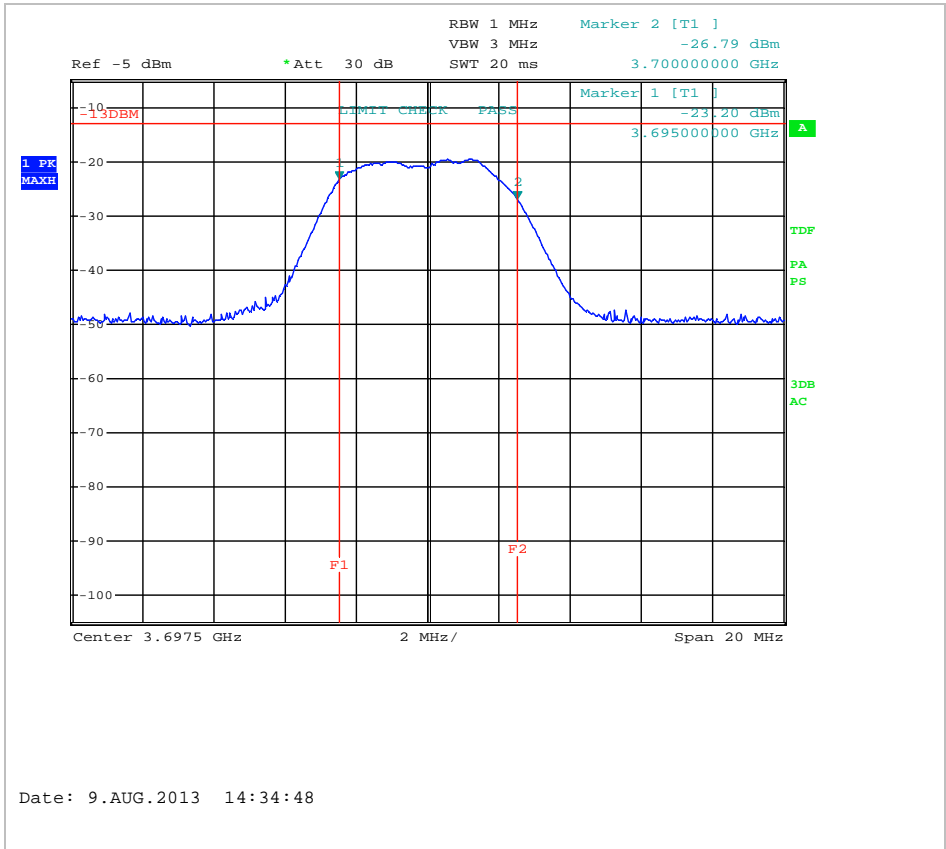
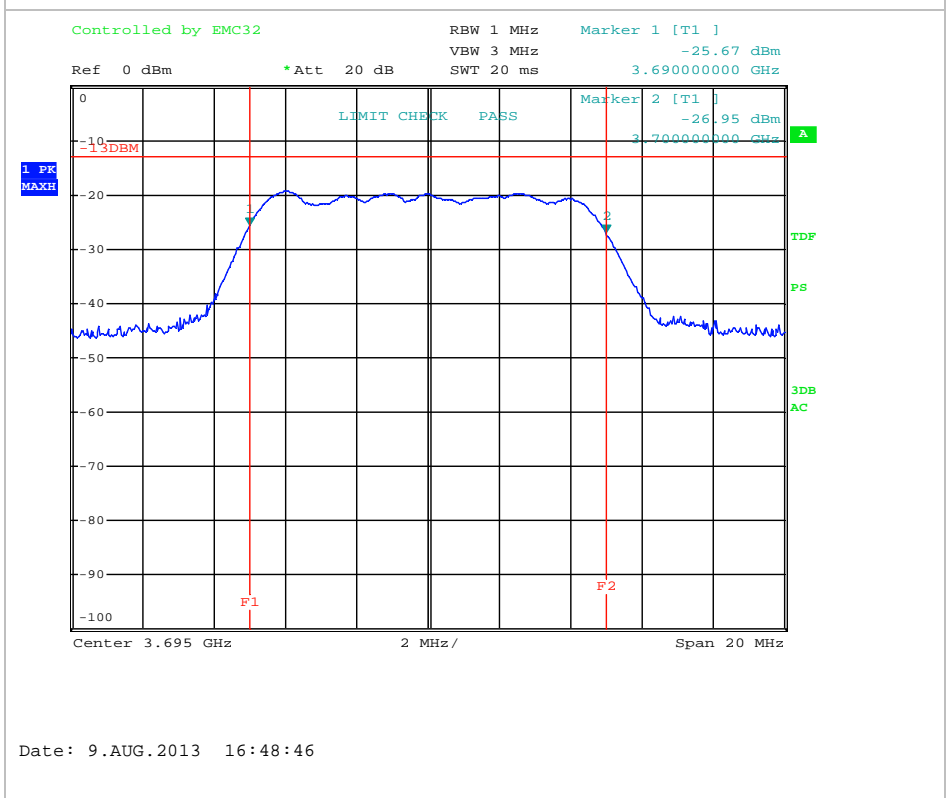


Figure 9: RSE pre-scans, 5 MHz channel



5 MHz channel



10 MHz channel

Figure 10: RSE Plots – band edge, 5 and 10 MHz channels