

Test Site:  
FCC Test Site No.:  
IC OATS No.:

96997  
IC3475A-1



BUREAU  
VERITAS

## ECL-EMC Test Report No.: 14-203

Equipment under test: **TFAH-ES70/80 852MHz Path**  
FCC ID: **XS5-TFAHES78**

Type of test: **FCC 47 CFR Part 90 Subpart S:2014**  
Private Land Mobile Repeater

Measurement Procedures: 47 CFR Parts 2:2014 (*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*), Part 90:2014 (*Private Land Mobile*), ANSI/TIA-603-C (2004), *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*

Test result: **Passed**

|                   |                        |          |            |
|-------------------|------------------------|----------|------------|
| Date of issue:    | 24.06.15               |          | Signature: |
| Issue-No.:        | 02                     | Author:  |            |
| Date of delivery: | 11.08.14               | Checked: |            |
| Test dates:       | 17.07.14 –<br>20.04.15 |          |            |
| Pages:            | 50                     |          |            |



**Manufacturer:** ANDREW Wireless Systems GmbH  
Industriering 10

D-86675 Buchdorf

Tel.: +49 (0)9099 69 0

Fax: +49 (0)9099 69 140

**Test Location:** Bureau Veritas Consumer Products Services  
Germany GmbH

European Compliance Laboratory (ECL)

Thurn-und-Taxis-Straße 18

D-90411 Nürnberg

Tel.: +49 40 74041 0

Fax: +49 40 74041-2755

**General:**

The purpose of this report is to show compliance to the FCC regulations for licensed devices operating under section 90 of the Code of Federal Regulations title 47.

This report informs about the results of the RF tests, it only refers to the equipment under test. No part of this report may be reproduced in any form, without written permission.



## Table of contents

|         |                                                                 |    |
|---------|-----------------------------------------------------------------|----|
| 1       | TEST RESULTS SUMMARY .....                                      | 6  |
| 2       | EQUIPMENT UNDER TEST (E.U.T.) .....                             | 7  |
| 2.1     | DESCRIPTION .....                                               | 7  |
| 2.1.1   | DOWNLINK .....                                                  | 7  |
| 2.1.2   | UPLINK .....                                                    | 7  |
| 2.1.3   | DESCRIPTION OF EUT .....                                        | 7  |
| 2.1.4   | BLOCK DIAGRAM OF MEASUREMENT REFERENCE POINTS .....             | 8  |
| 2.1.5   | DOWNLINK SYSTEM GAIN AND OUTPUT POWER .....                     | 8  |
| 3       | TEST SITE (ANDREW BUCHDORF) .....                               | 9  |
| 3.1     | TEST ENVIRONMENT .....                                          | 9  |
| 3.2     | TEST EQUIPMENT .....                                            | 9  |
| 3.3     | INPUT AND OUTPUT LOSSES .....                                   | 10 |
| 3.4     | MEASUREMENT UNCERTAINTY .....                                   | 10 |
| 4       | TEST SITE (BUREAU VERITAS CONSUMER PRODUCTS SERVICES) .....     | 10 |
| 5       | RF POWER OUT: §90.635, §2.1046 .....                            | 11 |
| 5.1     | LIMIT .....                                                     | 11 |
| 5.2     | TEST METHOD .....                                               | 12 |
| 5.3     | TEST RESULTS .....                                              | 12 |
| 5.3.1   | DOWNLINK .....                                                  | 13 |
| 5.3.1.1 | Analog .....                                                    | 14 |
| 5.3.1.2 | APCO Phase1 C4FM .....                                          | 14 |
| 5.3.1.3 | APCO Phase2 H-DQPSK .....                                       | 15 |
| 5.3.2   | UPLINK .....                                                    | 15 |
| 5.4     | SUMMARY TEST RESULT .....                                       | 15 |
| 6       | OCCUPIED BANDWIDTH: §90.210, §2.1049 .....                      | 16 |
| 6.1     | LIMIT .....                                                     | 16 |
| 6.2     | TEST METHOD .....                                               | 16 |
| 6.3     | TEST RESULTS .....                                              | 16 |
| 6.3.1   | DOWNLINK .....                                                  | 16 |
| 6.3.1.1 | Analog .....                                                    | 17 |
| 6.3.1.2 | APCO Phase1 C4FM .....                                          | 18 |
| 6.3.1.3 | APCO Phase2 H-DQPSK .....                                       | 19 |
| 6.3.2   | UPLINK .....                                                    | 20 |
| 6.4     | SUMMARY TEST RESULT .....                                       | 20 |
| 7       | SPURIOUS EMISSIONS AT ANTENNA TERMINALS: §90.210, §2.1051 ..... | 21 |
| 7.1     | LIMIT .....                                                     | 21 |
| 7.2     | TEST METHOD .....                                               | 21 |



|         |                                               |    |
|---------|-----------------------------------------------|----|
| 7.3     | TEST RESULTS .....                            | 22 |
| 7.3.1   | DOWNLINK .....                                | 22 |
| 7.3.1.1 | Analog > 1MHz to band edge .....              | 23 |
| 7.3.1.2 | APCO Phase1 C4FM > 1MHz to band edge .....    | 23 |
| 7.3.1.3 | APCO Phase2 H-DQPSK > 1MHz to band edge ..... | 24 |
| 7.3.2   | UPLINK .....                                  | 24 |
| 7.4     | SUMMARY TEST RESULT .....                     | 24 |
| 8       | INTERMODULATION: §90.219 .....                | 25 |
| 8.1     | LIMIT .....                                   | 25 |
| 8.2     | TEST METHOD .....                             | 25 |
| 8.3     | TEST RESULTS .....                            | 26 |
| 8.3.1   | DOWNLINK .....                                | 26 |
| 8.3.1.1 | Analog < 1MHz to band edge .....              | 27 |
| 8.3.1.2 | APCO Phase1 C4FM < 1MHz to band edge .....    | 28 |
| 8.3.1.3 | APCO Phase2 H-DQPSK < 1MHz to band edge ..... | 29 |
| 9       | EMISSION MASK: §90.691, §2.1051 .....         | 30 |
| 9.1     | LIMIT .....                                   | 30 |
| 9.2     | TEST METHOD .....                             | 31 |
| 9.3     | TEST RESULTS .....                            | 31 |
| 9.3.1   | DOWNLINK .....                                | 31 |
| 9.3.1.1 | Analog > 1MHz to band edge .....              | 32 |
| 9.3.1.2 | APCO Phase1 C4FM > 1MHz to band edge .....    | 32 |
| 9.3.1.3 | APCO Phase2 H-DQPSK > 1MHz to band edge ..... | 33 |
| 9.3.1.4 | Analog > 1MHz to band edge .....              | 33 |
| 9.3.1.5 | APCO Phase1 C4FM > 1MHz to band edge .....    | 34 |
| 9.3.1.6 | APCO Phase2 H-DQPSK > 1MHz to band edge ..... | 34 |
| 9.3.2   | UPLINK .....                                  | 35 |
| 9.4     | SUMMARY TEST RESULT .....                     | 35 |
| 10      | OUT OF BAND REJECTION .....                   | 36 |
| 10.1    | LIMIT .....                                   | 36 |
| 10.2    | TEST METHOD .....                             | 36 |
| 10.3    | TEST RESULTS .....                            | 36 |
| 10.3.1  | DOWNLINK .....                                | 37 |
| 10.3.2  | UPLINK .....                                  | 37 |
| 10.4    | SUMMARY TEST RESULT .....                     | 37 |
| 11      | NOISE .....                                   | 38 |
| 11.1    | LIMIT .....                                   | 38 |
| 11.2    | TEST METHOD .....                             | 38 |
| 11.3    | TEST RESULTS .....                            | 39 |
| 11.3.1  | DOWNLINK .....                                | 39 |
| 11.3.2  | UPLINK .....                                  | 39 |
| 11.4    | SUMMARY TEST RESULT .....                     | 40 |



---

|        |                                                                                                  |    |
|--------|--------------------------------------------------------------------------------------------------|----|
| 12     | RADIATED SPURIOUS EMISSIONS AT THE ECL (BUREAU VERITAS): §90.210, §2.1053, RSS-GEN, RSS-131..... | 41 |
| 12.1   | METHOD OF MEASUREMENT.....                                                                       | 44 |
| 12.2   | LIMIT.....                                                                                       | 45 |
| 12.3   | CLIMATIC VALUES IN THE LAB.....                                                                  | 45 |
| 12.4   | TEST RESULTS.....                                                                                | 46 |
| 12.4.1 | 30 MHZ TO 1 GHZ DOWNLINK (BOTTOM – MIDDLE – TOP) SUBPART H.....                                  | 46 |
| 12.4.3 | 30 MHZ TO 1 GHZ DOWNLINK (MIDDLE OF ALL PATHS).....                                              | 47 |
| 12.4.4 | 1 GHZ TO 21 GHZ DOWNLINK (BOTTOM – MIDDLE – TOP) SUBPART H.....                                  | 48 |
| 12.4.6 | 1 GHZ TO 22 GHZ DOWNLINK (MIDDLE OF ALL PATHS).....                                              | 49 |
| 13     | HISTORY.....                                                                                     | 50 |

---



## 1 Test Results Summary

| Name of Test                            | FCC Para. No.            | FCC Method                         | FCC Spec.             | Result   |
|-----------------------------------------|--------------------------|------------------------------------|-----------------------|----------|
| RF Power Output                         | 90.219<br>90.635         | 2.1046                             | 5 Watts ERP           | Complies |
| Occupied Bandwidth                      | 90.210                   | 2.1049                             | Input/Output          | Complies |
| Spurious Emissions at Antenna Terminals | 90.210                   | 2.1051                             | -13dBm                | Complies |
| Intermodulation testing                 | 90.219                   | KDB 935210<br>D02 v02<br>Annex D.3 | -13dBm                | Complies |
| Frequency Stability                     | 90.213                   | 2.1055                             | 1 ppm                 | NA       |
| Out of Band Rejection                   | KDB<br>935210<br>D02 v02 | KDB 935210<br>D02 v02              | KDB 935210<br>D02 v02 | Complies |
| Noise floor                             | KDB<br>935210<br>D02 v02 | KDB 935210<br>D02 v02              | KDB 935210<br>D02 v02 | Complies |
| Radiated Spurious emission              | 90.210                   | 2.1053                             | -13dBm                | Complies |

Frequency stability is given by: The system gets an electrical analog signal from the BSS which is converted into an analog optical signal, transmitted by the optical links and then reconverted in the Remote Unit into an analog electrical signal. During this process happens no frequency change/modification, so input and output have same frequency what can be seen under capture "Occupied Bandwidth".



## 2 Equipment under test (E.U.T.)

### 2.1 Description

|                                   |                                                                                                                                                        |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kind of equipment                 | TFAH-ES70/80                                                                                                                                           |
| Andrew Ident. Number              | Id. No. TFAH-ES70/80                                                                                                                                   |
| Serial no.(SN)                    | 10                                                                                                                                                     |
| Revision                          | 00                                                                                                                                                     |
| Software version and ID           | n. a.                                                                                                                                                  |
| Type of modulation and Designator | F3E (Voice) <input checked="" type="checkbox"/><br>C4FM (D7W) <input checked="" type="checkbox"/><br>H-DQPSK (D1W) <input checked="" type="checkbox"/> |
| Frequency Translation             | F1-F1 <input checked="" type="checkbox"/><br>F1-F2 <input type="checkbox"/><br>N/A <input type="checkbox"/>                                            |
| Band Selection                    | Software <input type="checkbox"/><br>Duplexer <input checked="" type="checkbox"/><br>Full band <input type="checkbox"/>                                |

#### 2.1.1 Downlink

|                                                                   |                        |
|-------------------------------------------------------------------|------------------------|
| Full pass band                                                    | Path 851 MHz – 869 MHz |
| Pass band under test                                              | Path 851 MHz – 862 MHz |
| Max. composite output power based on one carrier per path (rated) | 31 dBm = 1.26 W        |
| Gain*                                                             | 32 dB                  |

\*see 2.1.5

#### 2.1.2 Uplink

|           |       |
|-----------|-------|
| Pass band | n. a. |
| Gain*     | n. a. |

\*see 2.1.5

Note: The EUT does not transmit over the air in the uplink direction.

#### 2.1.3 Description of EUT

TFAH-ES70/80 is a multi-band, multi-operator remote unit configuration used in conjunction with a master unit in the ION optical distribution system. This system transports up to two frequency bands simultaneously (700 MHz and 800MHz), providing a cost-effective solution for distributing capacity from one or more base stations.

This Test Report describes only the approval of the 800 MHz path (851 – 862 MHz)



**2.1.4 Block diagram of measurement reference points**

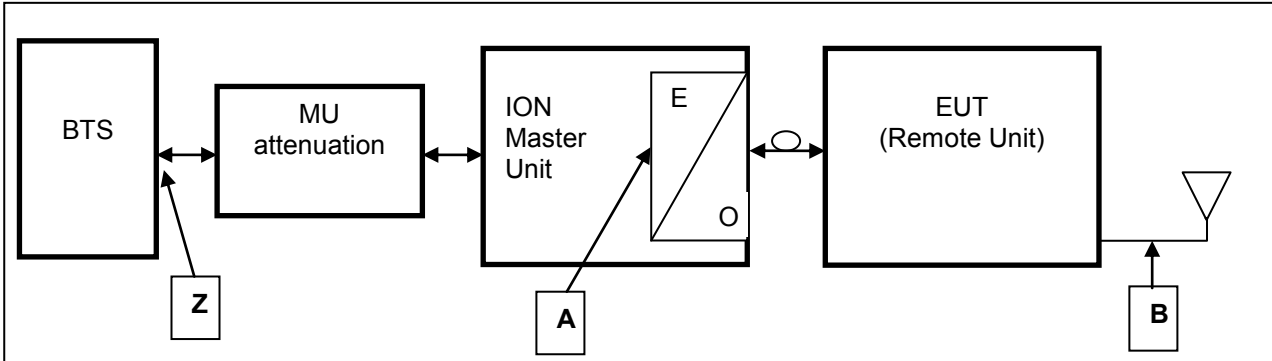


figure 2.1.4-#1 Block diagram of measurement reference points

Remote Unit is the EUT

O/E                      Optical / Electrical converter  
 SRMU                    Sub Rack Master Unit

Reference point A      SRMU              UL output,      DL input  
 Reference point B      Remote Unit      DL output,      UL input  
 Reference point Z      BTS                DL output,      UL input

Downlink:                      Measure from reference point B to A

Since a signal generator does not supply a good output signal with +33 or +43dBm, for the downlink measurement the MU Attenuation is not used. That means for downlink measurements the signal generator is connected to measurement point A at the master optical / electrical converter and the analyzer to the measurement point B at the RU.

**2.1.5 Downlink System Gain and Output Power**

| System optimized for BTS power | MU Attenuation (manual leveling) | Maximum rated input power at the MU OTRX | RU Gain | Maximum rated output power at RU Antenna port |
|--------------------------------|----------------------------------|------------------------------------------|---------|-----------------------------------------------|
| Z                              |                                  | A                                        | A to B  | B                                             |
| +33 dBm                        | 34 dB                            | -1 dBm                                   | +32 dB  | +31.0 dBm @ 1 carrier                         |
| <b>System Gain Z to B</b>      | <b>-2 dB</b>                     |                                          |         |                                               |
| +43 dBm                        | 44 dB                            | -1 dBm                                   | +32 dB  | +31.0 dBm @ 1 carrier                         |
| <b>System Gain Z to B</b>      | <b>-12 dB</b>                    |                                          |         |                                               |

table 2.1.5-#1 Equipment under test (E.U.T.) Description Downlink System Gain and Output Power





### 3 Test site (Andrew Buchdorf)

#### 3.1 Test environment

All tests were performed under the following environmental conditions:

| Condition           | Minimum value         | Maximum value |
|---------------------|-----------------------|---------------|
| Barometric pressure | 86 kPa                | 106 kPa       |
| Temperature         | 15°C                  | 30°C          |
| Relative Humidity   | 20 %                  | 75 %          |
| Power supply range  | ±5% of rated voltages |               |
| Test Voltage        | 230V AC 50Hz          |               |

#### 3.2 Test equipment

| ANDREW<br>Inv. No. | Test equipment    | Type          | Manufacturer | Serial No. | Calibration |
|--------------------|-------------------|---------------|--------------|------------|-------------|
| 9102               | Network Analyzer  | ZVB14         | R&S          | 100118     | 08/15       |
| 9054               | Spectrum Analyzer | FSV13         | R&S          | 100859     | 12/15       |
| 9233               | Signal Generator  | SMBV100A      | R&S          | 257777     | 06/15       |
| 8849               | Signal Generator  | SMU200A       | R&S          | 101732     | 04/16       |
| 8671               | Power Meter       | E4418B        | Agilent      | GB39513094 | 06/15       |
| 8672               | Power Sensor      | E9300H        | Agilent      | US41090179 | 06/15       |
| 7306               | Circulator        | C25E-1FFF     | AEROTEK      | 12580      | CIU         |
| 7307               | Circulator        | C25E-1FFF     | AEROTEK      | 12581      | CIU         |
| 7408               | RF-Cable          | 2,0m; N-N     | Andrew       | ---        | CIU         |
| 7409               | RF-Cable          | 2,0m; N-N     | Andrew       | ---        | CIU         |
| 7410               | RF-Cable          | 1,0m; N-N     | Andrew       | ---        | CIU         |
| 7411               | RF-Cable          | 2,0m; N-N     | Andrew       | ---        | CIU         |
| 7373               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7374               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7437               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7438               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7439               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7443               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7444               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7445               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7446               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7447               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7448               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7449               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7450               | RF-Cable          | Multiflex141  | Andrew       | ---        | CIU         |
| 7440               | RF-Cable          | RG-223 0.8m   | Andrew       | ---        | CIU         |
| 7441               | RF-Cable          | RG-223 0.8m   | Andrew       | ---        | CIU         |
| 7453               | RF-Cable          | RG223 2m SMA. | Andrew       | ---        | CIU         |
| 7454               | RF-Cable          | RG223 2m SMA. | Andrew       | ---        | CIU         |
| 7455               | RF-Cable          | RG223 2m SMA. | Andrew       | ---        | CIU         |
| 7144               | Attenuator        | 2N-20dB       | Inmet 64671  | ---        | CIU         |
| 7341               | Power Attenuator  | 768-20        | Narda        | ---        | CIU         |
| 7368               | Matrix            |               | COMMSCOPE    | ---        | weekly      |

CIU = Calibrate in use



### 3.3 Input and output losses

All recorded power levels should be referenced to the input and output connectors of the repeater, unless explicitly stated otherwise.

The test equipment used in this test has to be calibrated, so that the functionality is also checked. All cables, attenuators, splitter, isolator, circulator and combiner etc. must be measured before testing and used for compensation during testing.

### 3.4 Measurement uncertainty

The extended measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor  $k=2$ . The true value is located in the corresponding interval with a probability of 95 %.

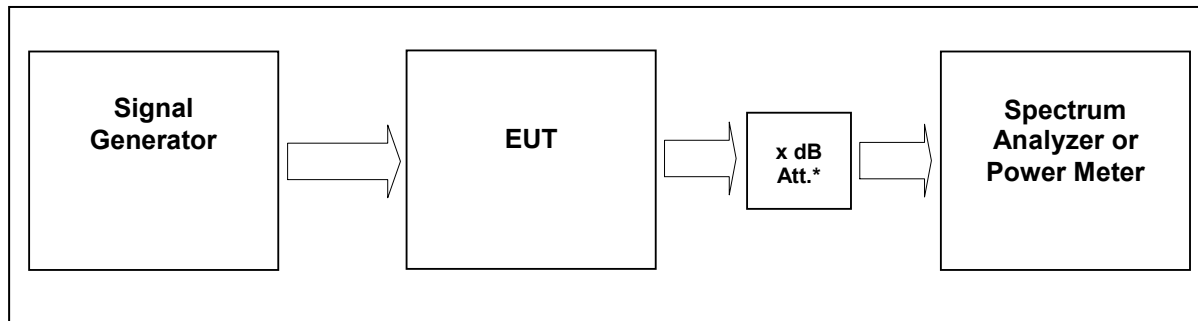
## 4 Test site (Bureau Veritas Consumer Products Services)

FCC Test site: 96997  
IC OATS: IC3475A-1

See relevant dates under section 10 of this test report.



## 5 RF Power Out: §90.635, §2.1046



External Attenuator DL      x dB = 20 dB  
 figure 5-#1 Test setup: RF Power Out: §90.635, §2.1046

|                         |                                                            |
|-------------------------|------------------------------------------------------------|
| Measurement uncertainty | ± 0,38 dB                                                  |
| Test equipment used     | 9054, 9233, 7444; 7306; 7144; 7454; 7453; 7341; 7449; 7368 |

### 5.1 Limit

Minimum standard:

90.219(d) Deployment rules. Deployment of signal boosters must be carried out in accordance with the rules in this paragraph.

(3) Signal boosters must be deployed such that the radiated power of the each retransmitted channel, on the forward link and on the reverse link, does not exceed 5 Watts effective radiated power (ERP).

(e) Device Specifications. In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

§90.541 Transmitting power limits.

The transmitting power of base, mobile, portable and control stations operating in the 769-775 MHz and 799-805 MHz frequency bands must not exceed the maximum limits in this section, and must also comply with any applicable effective radiated power limits in §90.545.

(a) The transmitting power of base transmitters must not exceed the limits given in paragraphs (a), (b) and (c) of §90.635.

§ 90.635 Limitations on power and antenna height.

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.



## 5.2 Test method

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations

## 5.3 Test Results

Detector RMS.

Test signal Analog:

FM signal with 3.0 kHz deviation and 2.5 kHz rate and sine waveform.

Test signal APCO Phase1 C4FM:

Modulation 4FSK, with 1.8 kHz deviation and 4.8 ksym/s symbol rate

Test signal APCO Phase2 H-DQPSK:

Modulation pi/4-DQPSK, 6 ksym/s symbol rate

According to ANSI C63.4 section 13.1 Table 5 for operating frequencies more than 10MHz: The test shall be performed at Bottom, Middle and Top frequencies.



**5.3.1 Downlink**

| Modulation                                      | Measured at |           | RBW<br>VBW<br>Span         | RF Power [dBm] | RF Power [W] | Plot -     |
|-------------------------------------------------|-------------|-----------|----------------------------|----------------|--------------|------------|
| Analog                                          | Middle      | 856.5 MHz | 100kHz<br>300kHz<br>1,5MHz | 31.0           | 1.26         | 5.3.1.1 #1 |
| APCO Phase1 C4FM                                | Middle      | 856.5 MHz | 100kHz<br>300kHz<br>1,5MHz | 31.0           | 1.26         | 5.3.1.2 #1 |
| APCO Phase2 H-DQPSK                             | Middle      | 856.5 MHz | 100kHz<br>300kHz<br>1,5MHz | 31.0           | 1.26         | 5.3.1.3 #1 |
| Maximum output power = 31.0 dBm = 1.26 W        |             |           |                            |                |              |            |
| Limit Maximum output power = 37 dBm = 5 W (erp) |             |           |                            |                |              |            |

table 5.3.1-#1 RF Power Out: §90.635, §2.1046 Test Results Downlink

The max RF Power out is 31 dBm, so the maximum antenna gain (x) can be calculated as follow:

**Limit = 5 W (erp) = 37 dBm**

$$37 \text{ dBm} > 31 \text{ dBm} + x \quad \text{----->} \quad x = 37 \text{ dBm} - 31 \text{ dBm} = \underline{6 \text{ dBd}}$$

$$x \text{ dBi} = 6 \text{ dBd} + 2.15 = \underline{8.15 \text{ dBi}}$$

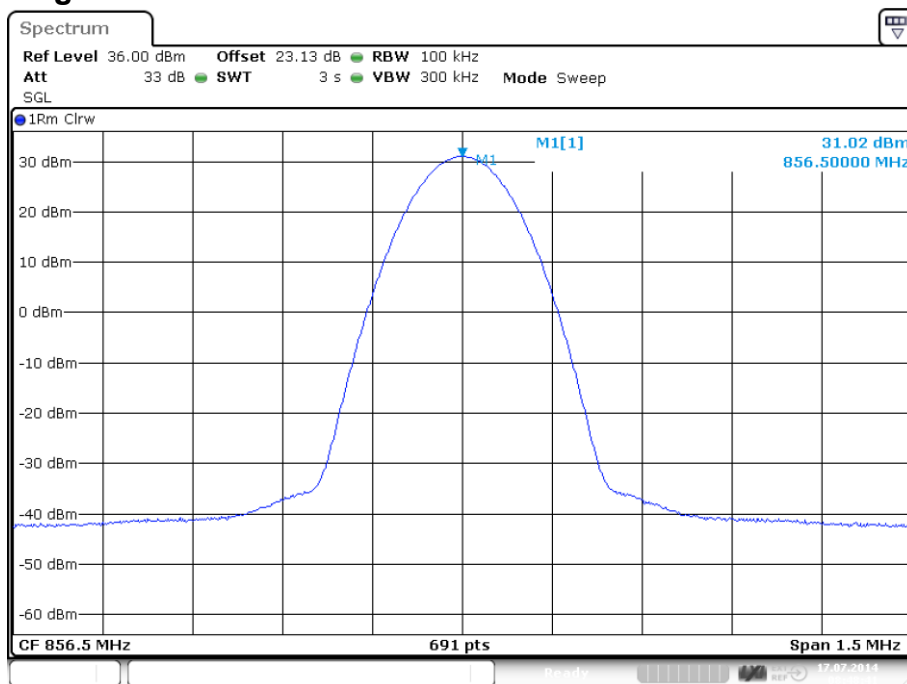
=> The antenna that will use for the complete system have to have a gain lower than 8.15 dBi, relative to a dipol.

| Modulation          | Pin / dBm (Ref. point A) |
|---------------------|--------------------------|
| Analog              | -0.7                     |
| APCO Phase1 C4FM    | -0.3                     |
| APCO Phase2 H-DQPSK | -0.7                     |

table 5.3.1-#2 RF Power Out: §90.635, §2.1046 Test Results; Downlink; Input power



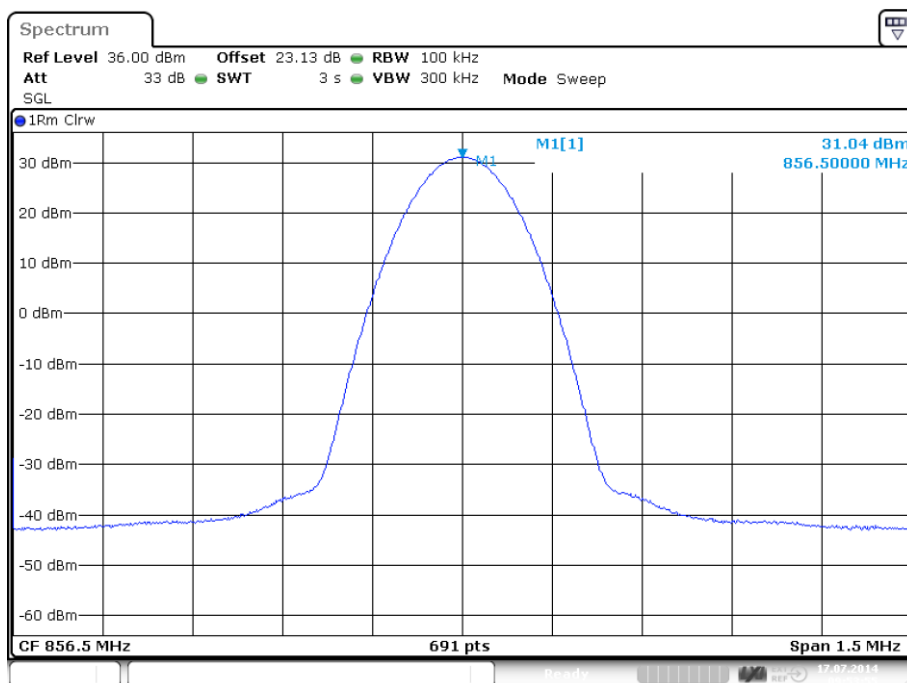
### 5.3.1.1 Analog



Date: 17.JUL.2014 08:48:42

plot 5.3.1.1-#1 RF Power Out: §90.635, §2.1046; Test Results; Downlink; Analog

### 5.3.1.2 APCO Phase1 C4FM



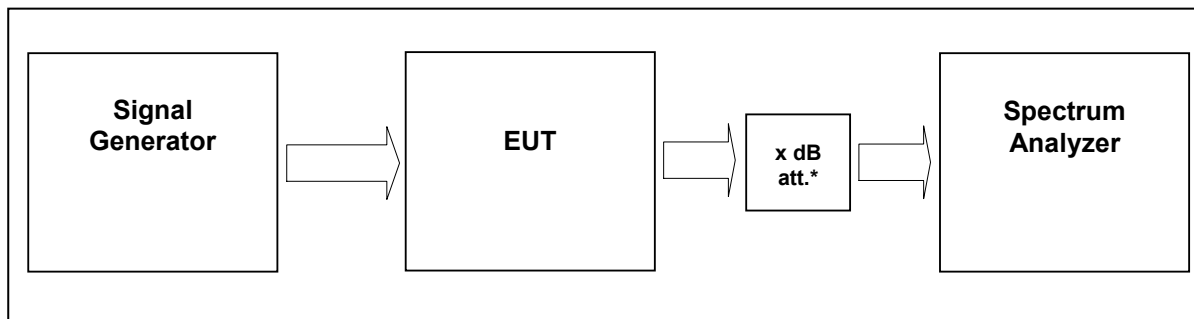
Date: 17.JUL.2014 09:53:56

plot 5.3.1.2-#1 RF Power Out: §90.635, §2.1046; Test Results; Downlink; APCO Phase1 C4FM





## 6 Occupied Bandwidth: §90.210, §2.1049



External Attenuator DL      x dB = 20 dB  
figure 6-#1 Test setup: Occupied Bandwidth: §90.210, §2.1049

|                         |                                                            |
|-------------------------|------------------------------------------------------------|
| Measurement uncertainty | ± 0,38 dB                                                  |
| Test equipment used     | 9054, 9233, 7444; 7306; 7144; 7454; 7453; 7341; 7449; 7368 |

### 6.1 Limit

The spectral shape of the output should look similar to input for all modulations.

### 6.2 Test method

Para. No.2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

### 6.3 Test results

#### 6.3.1 Downlink

Detector peak

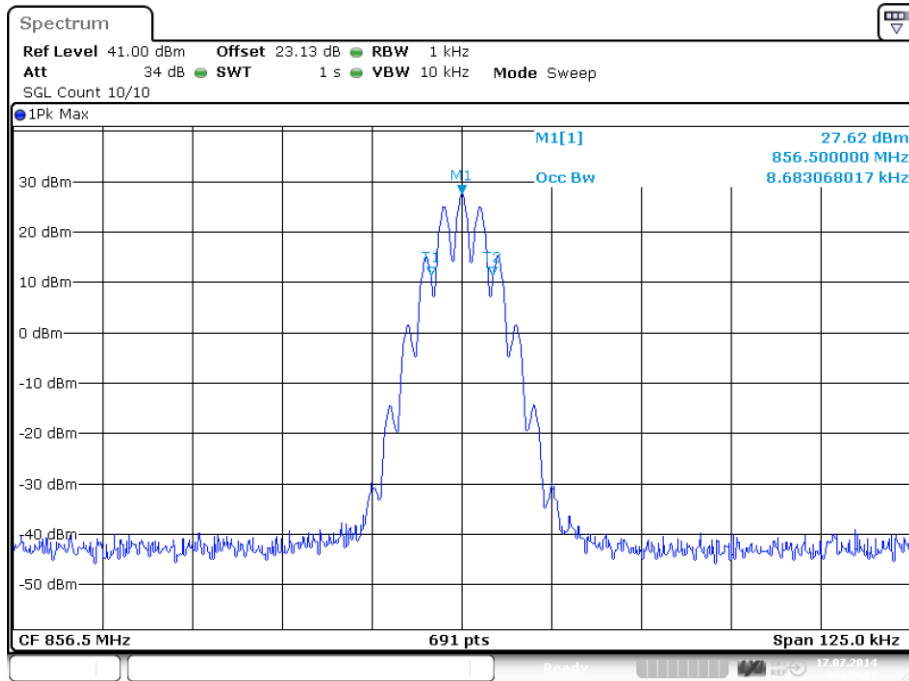
| Modulation              | Measured at |           | Channel bandwidth | RBW<br>VBW<br>Span         | Occupied Bandwidth | Plot #            |
|-------------------------|-------------|-----------|-------------------|----------------------------|--------------------|-------------------|
| Analog                  | Middle      | 856.5 MHz | 12.5 kHz          | 1 kHz<br>10 kHz<br>125 kHz | 8.68 kHz           | 6.3.1.1<br>#1, #2 |
| APCO Phase1<br>C4FM     | Middle      | 856.5 MHz | 12.5 kHz          | 1 kHz<br>10 kHz<br>125 kHz | 6.51 kHz           | 6.3.1.2<br>#1, #2 |
| APCO Phase2 H-<br>DQPSK | Middle      | 856.5 MHz | 12.5 kHz          | 1 kHz<br>10 kHz<br>125 kHz | 7.96 kHz           | 6.3.1.3<br>#1, #2 |

table 6.3-#1 Occupied Bandwidth: §90.210, §2.1049 Test results



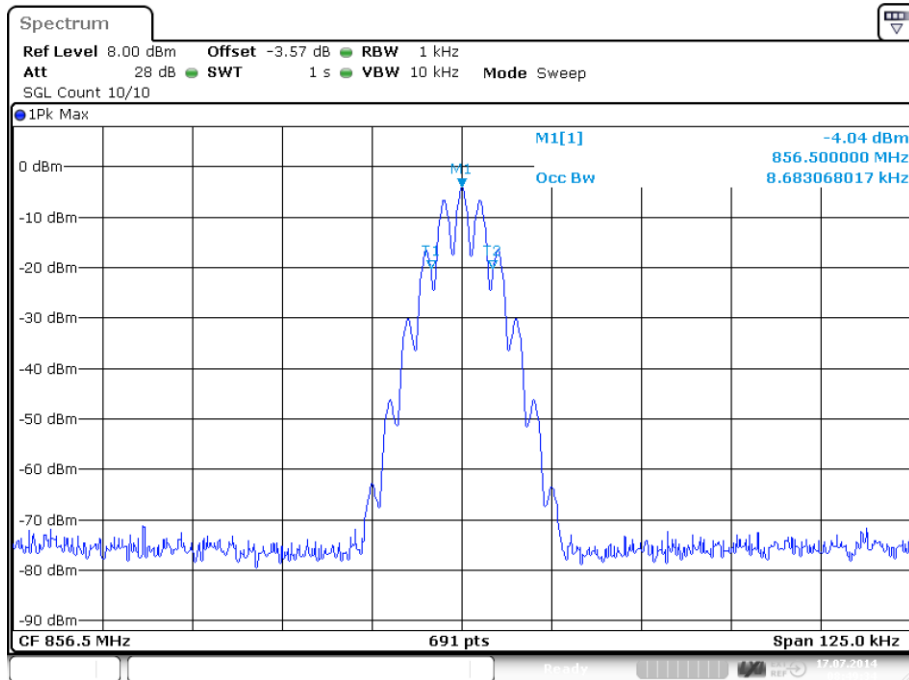


**6.3.1.1 Analog**



Date: 17.JUL.2014 08:49:21

plot 6.3.1.1-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Analog Output

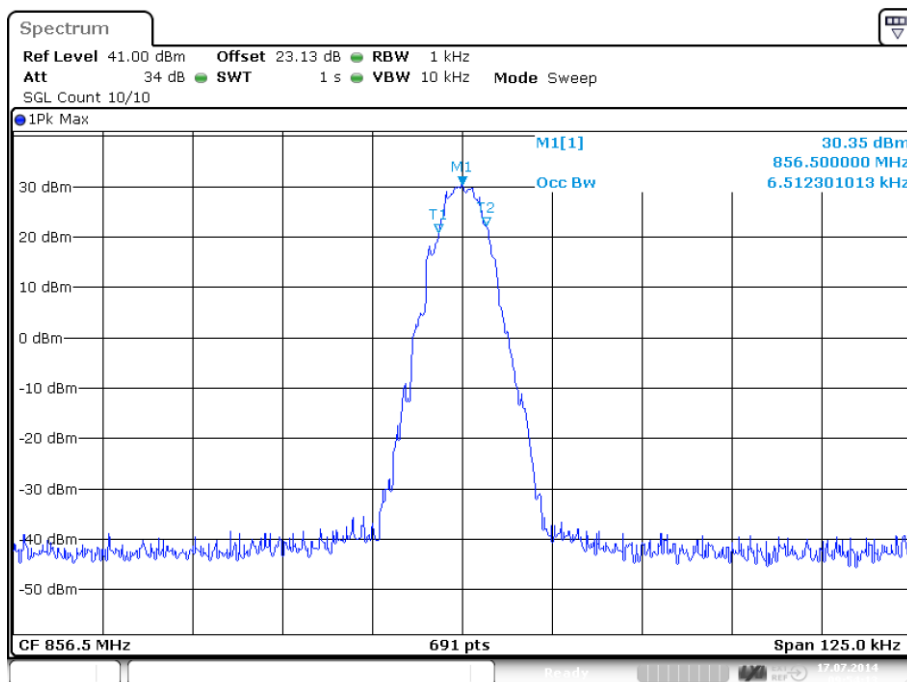


Date: 17.JUL.2014 08:49:35

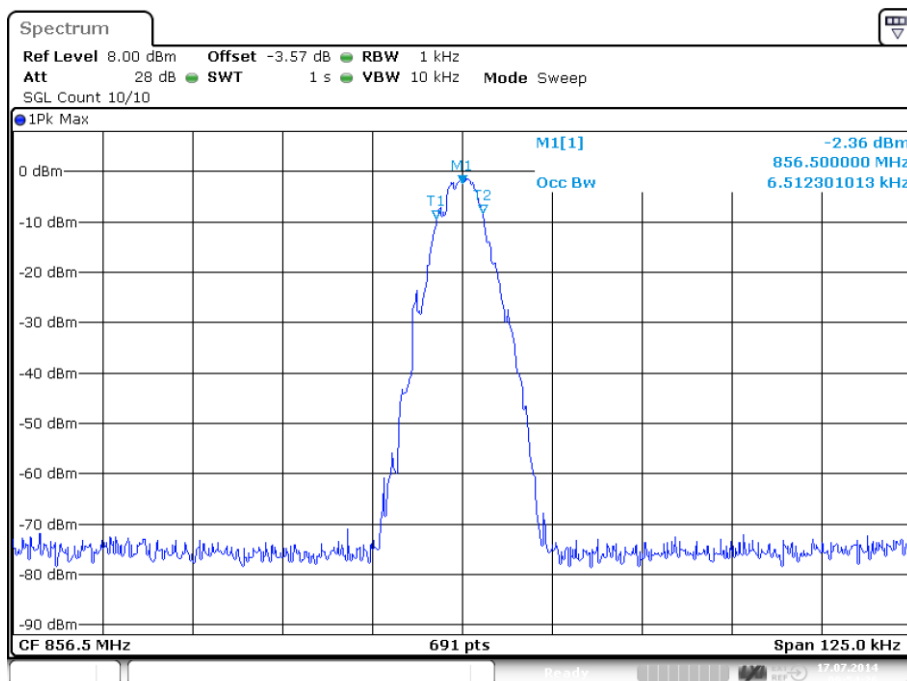
plot 6.3.1.1-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Analog Input



### 6.3.1.2 APCO Phase1 C4FM



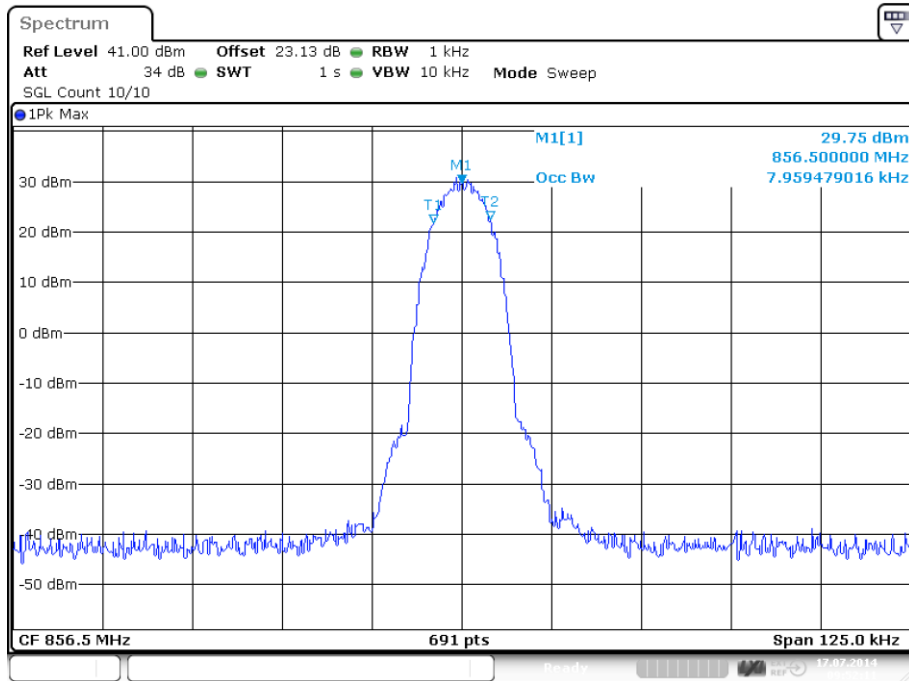
plot 6.3.1.2-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; APCO Phase1 C4FM Output



plot 6.3.1.2-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; APCO Phase1 C4FM Input

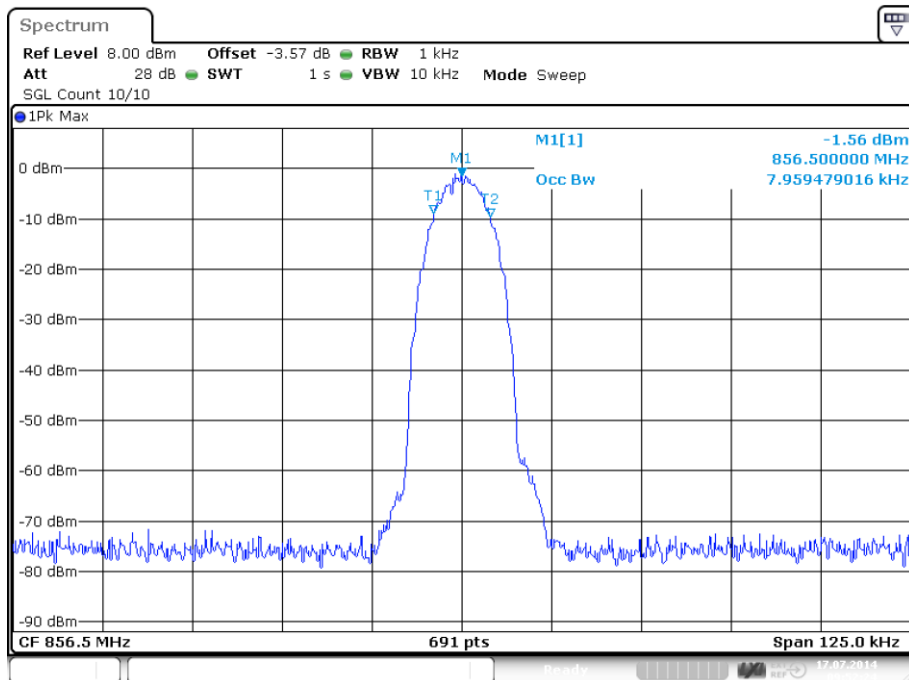


### 6.3.1.3 APCO Phase2 H-DQPSK



Date: 17.JUL.2014 09:52:11

plot 6.3.1.3-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; APCO Phase2 H-DQPSK Output



Date: 17.JUL.2014 09:52:25

plot 6.3.1.3-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; APCO Phase2 H-DQPSK Input



### 6.3.2 Uplink

n.a.

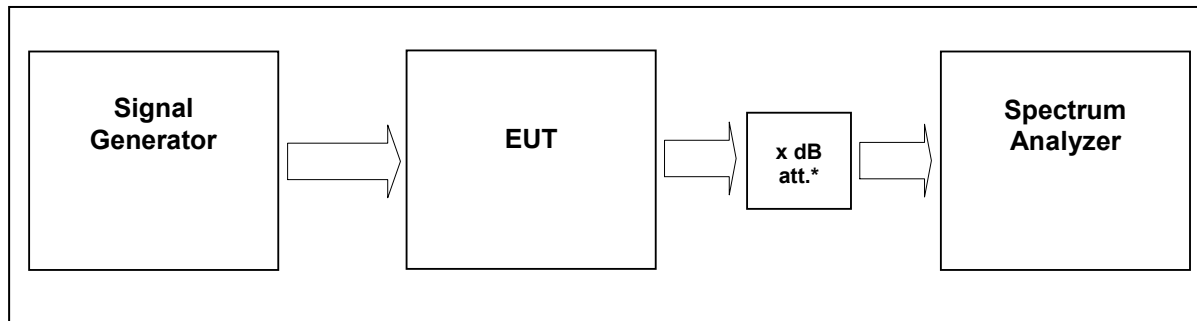
Note: The EUT does not transmit over the air in the uplink direction.

### 6.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 17.07.2014                          |



## 7 Spurious Emissions at Antenna Terminals: §90.210, §2.1051



External Attenuator DL                      x dB = 20 dB

figure 7-#1 Test setup: Spurious Emissions at Antenna Terminals: §90.210, §2.1051

|                         |                                                                                 |                                                     |
|-------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------|
| Measurement uncertainty | ± 0,54 dB<br>± 1,2 dB<br>± 1,5 dB                                               | 9 kHz to 3 GHz<br>3 GHz to 7 GHz<br>7 GHz to 26 GHz |
| Test equipment used     | 9054, 9233, 8849; 7444; 7443; 7306; 7307;<br>7144; 7454; 7453; 7341; 7449; 7368 |                                                     |

### 7.1 Limit

Minimum standard: §90.210, Table “Application Emission Mask”

| Frequency Band (MHz)         | Mask for equipment with Audio Low pass filter | Mask for Equipment without audio low pass filter |
|------------------------------|-----------------------------------------------|--------------------------------------------------|
| 806–809/851–854              | B                                             | H                                                |
| 809–824/854–869 <sup>3</sup> | B                                             | G                                                |

<sup>3</sup> Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.

| MASK        | Spurious Limit |
|-------------|----------------|
| A,B,C,G,H,I | -13dBm         |

### 7.2 Test method

Para. No 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

[39 FR 5919, Feb. 15, 1974. Redesignated and amended at 63 FR 36599, July 7, 1998]



### 7.3 Test results

#### 7.3.1 Downlink

>1MHz from Band Edge

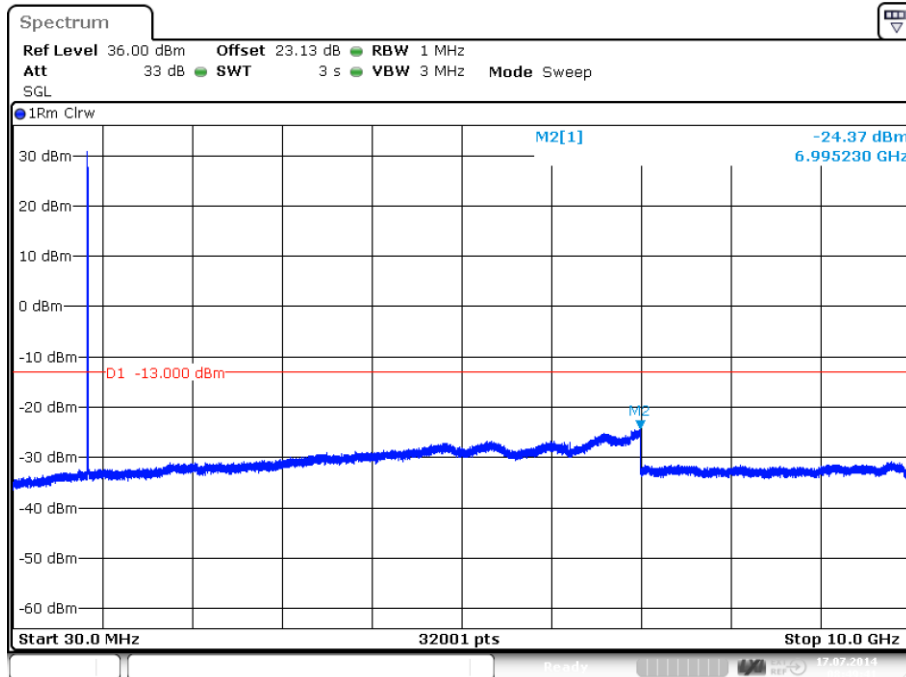
Detector: RMS

| Modulation                 | Carrier   | RBW<br>VBW<br>Span            | Max. level<br>(dBm) | Plot          |
|----------------------------|-----------|-------------------------------|---------------------|---------------|
| Analog                     | 865.5 MHz | 1MHz<br>3MHz<br>30MHz – 10GHz | -24.3               | 7.3.1.1<br>#1 |
| APCO<br>Phase1 C4FM        | 865.5 MHz | 1MHz<br>3MHz<br>30MHz – 10GHz | -24.6               | 7.3.1.2<br>#1 |
| APCO<br>Phase2 H-<br>DQPSK | 865.5 MHz | 1MHz<br>3MHz<br>30MHz – 10GHz | -24.3               | 7.3.1.3<br>#1 |
|                            |           |                               |                     |               |

table 7.3-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051 Test results >1MHz from Band Edge

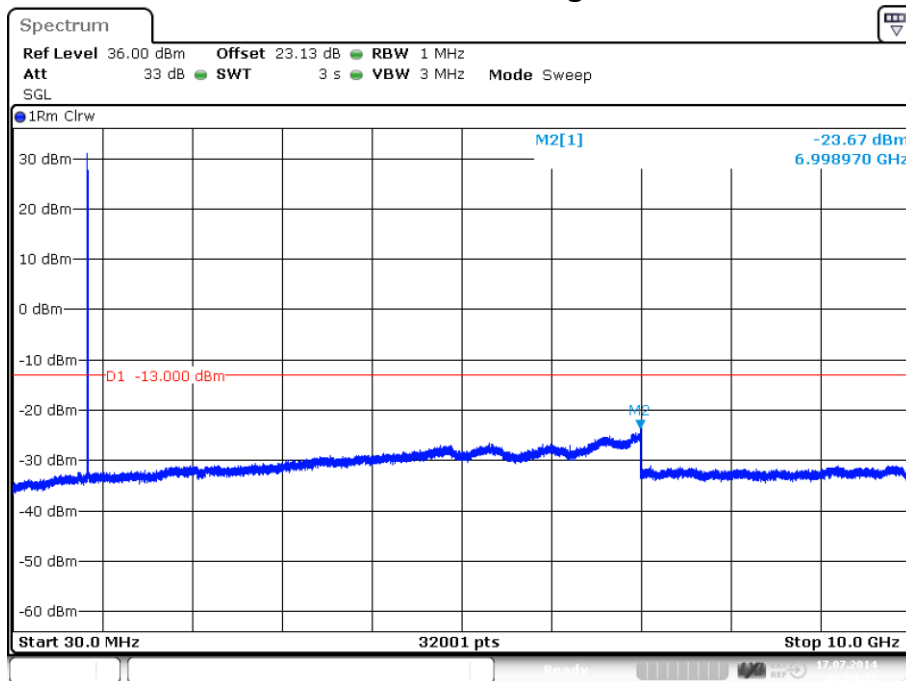


### 7.3.1.1 Analog > 1MHz to band edge



plot 7.3.1.1-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Analog > 1MHz to band edge

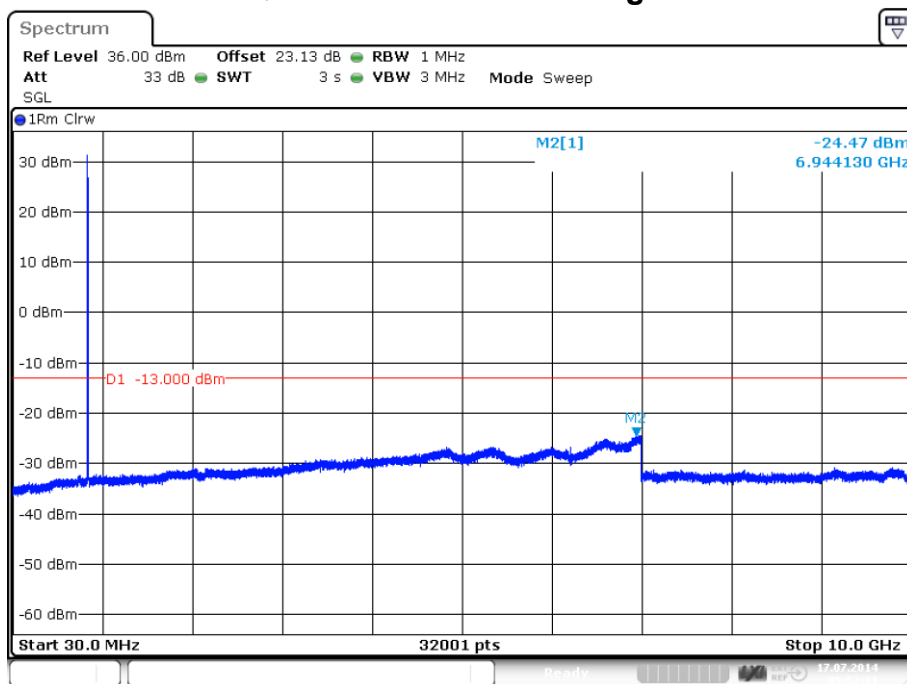
### 7.3.1.2 APCO Phase1 C4FM > 1MHz to band edge



plot 7.3.1.2-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; APCO Phase1 C4FM > 1MHz to band edge



### 7.3.1.3 APCO Phase2 H-DQPSK > 1MHz to band edge



Date: 17.JUL.2014 09:52:31

plot 7.3.1.3-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; APCO Phase2 H-DQPSK > 1MHz to band edge

### 7.3.2 Uplink

n.a.

Note: The EUT does not transmit over the air in the uplink direction.

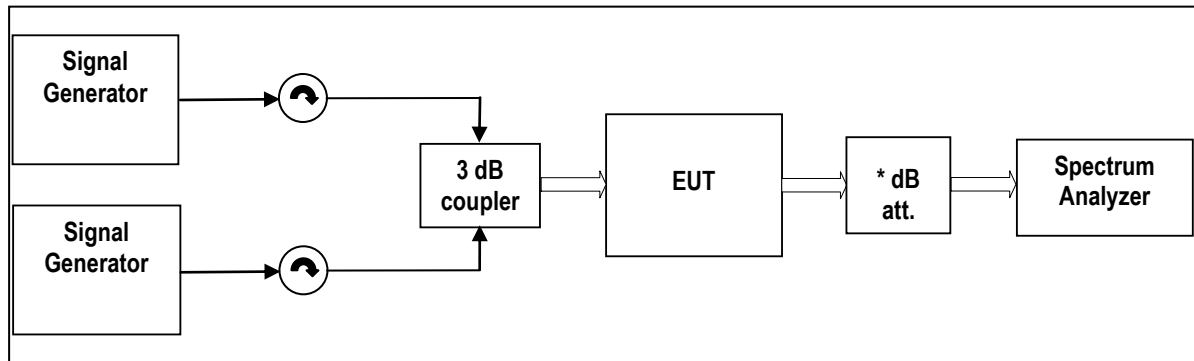
### 7.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 17.07.2014                          |





## 8 Intermodulation: §90.219



External Attenuator DL x dB = 20 dB  
figure 8-#1 Test setup: Intermodulation: §90.219

|                         |                                                                                 |                                                     |
|-------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------|
| Measurement uncertainty | ± 0,54 dB<br>± 1,2 dB<br>± 1,5 dB                                               | 9 kHz to 3 GHz<br>3 GHz to 7 GHz<br>7 GHz to 26 GHz |
| Test equipment used     | 9054, 9233, 8849; 7444; 7443; 7306; 7307;<br>7144; 7454; 7453; 7341; 7449; 7368 |                                                     |

### 8.1 Limit

Minimum standard: §90.210, Table “Application Emission Mask”

| Frequency Band (MHz)         | Mask for equipment with Audio Low pass filter | Mask for Equipment without audio low pass filter |
|------------------------------|-----------------------------------------------|--------------------------------------------------|
| 806–809/851–854              | B                                             | H                                                |
| 809–824/854–869 <sup>3</sup> | B                                             | G                                                |

<sup>3</sup> Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.

| MASK        | Spurious Limit |
|-------------|----------------|
| A,B,C,G,H,I | -13dBm         |

### 8.2 Test method

Para. No 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

[39 FR 5919, Feb. 15, 1974. Redesignated and amended at 63 FR 36599, July 7, 1998]



### 8.3 Test results

#### 8.3.1 Downlink

<1MHz from Band Edge

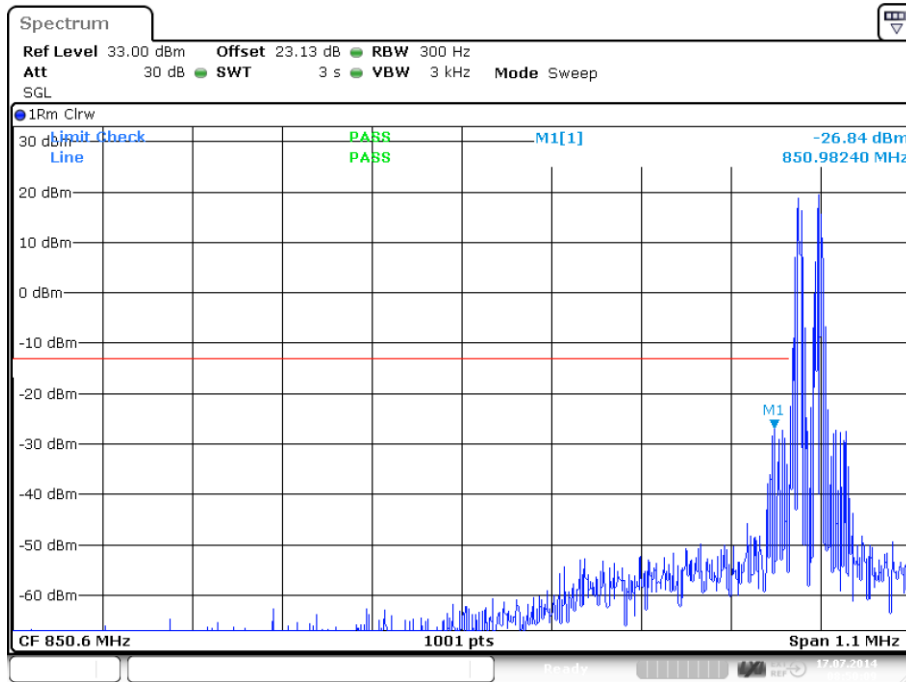
Detector: RMS

| Modulation             | Measured at Band Edge    | Carriers                                                     | RBW<br>VBW<br>Span<br>Sweep points         | Max. level (dBm) | Plot                |
|------------------------|--------------------------|--------------------------------------------------------------|--------------------------------------------|------------------|---------------------|
| Analog                 | Lower Edge<br>Upper Edge | 851.0125 MHz<br>851.0375 MHz<br>868.9625 MHz<br>868.9875 MHz | 300 Hz<br>3 kHz<br>1.1 MHz<br>10001 points | -28.9            | 8.3.1.1<br>#1<br>#2 |
| APCO Phase1<br>C4FM    | Lower Edge<br>Upper Edge | 851.0125 MHz<br>851.0375 MHz<br>868.9625 MHz<br>868.9875 MHz | 300 Hz<br>3 kHz<br>1.1 MHz<br>10001 points | -31.7            | 8.3.1.2<br>#1<br>#2 |
| APCO Phase2<br>H-DQPSK | Lower Edge<br>Upper Edge | 851.0125 MHz<br>851.0375 MHz<br>868.9625 MHz<br>868.9875 MHz | 300 Hz<br>3 kHz<br>1.1 MHz<br>10001 points | -28.4            | 8.3.1.3<br>#1<br>#2 |
|                        |                          |                                                              |                                            |                  |                     |

table 8.3-#1 Intermodulation: §90.219 Test results <1MHz from Band Edge

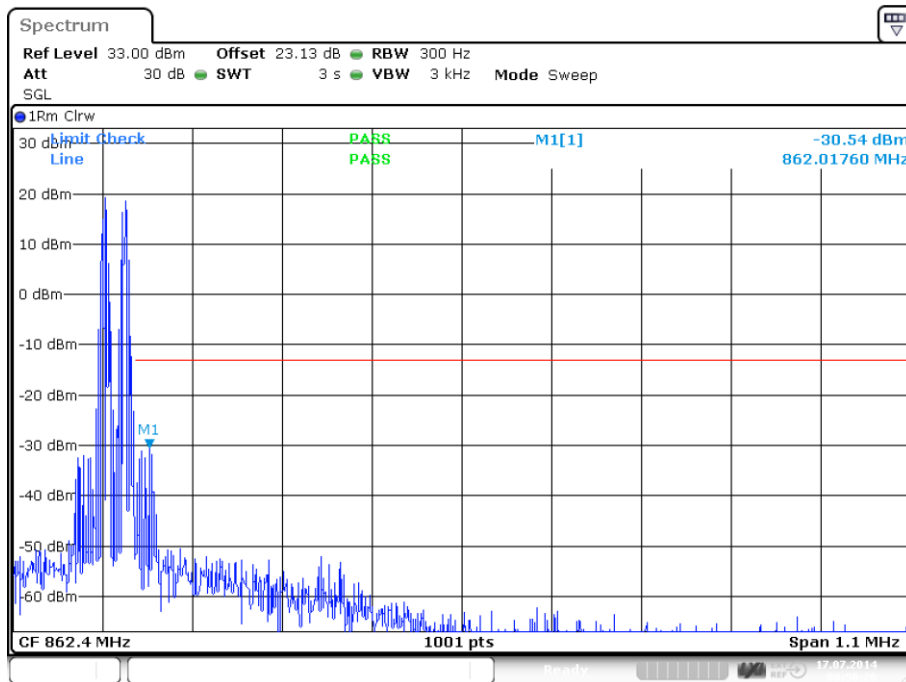


### 8.3.1.1 Analog < 1MHz to band edge



Date: 17.JUL.2014 08:50:09

plot 8.3.1.1-#1 Intermodulation: §90.219; Test results; Downlink; Analog < 1MHz to band edge; Lower Band Edge

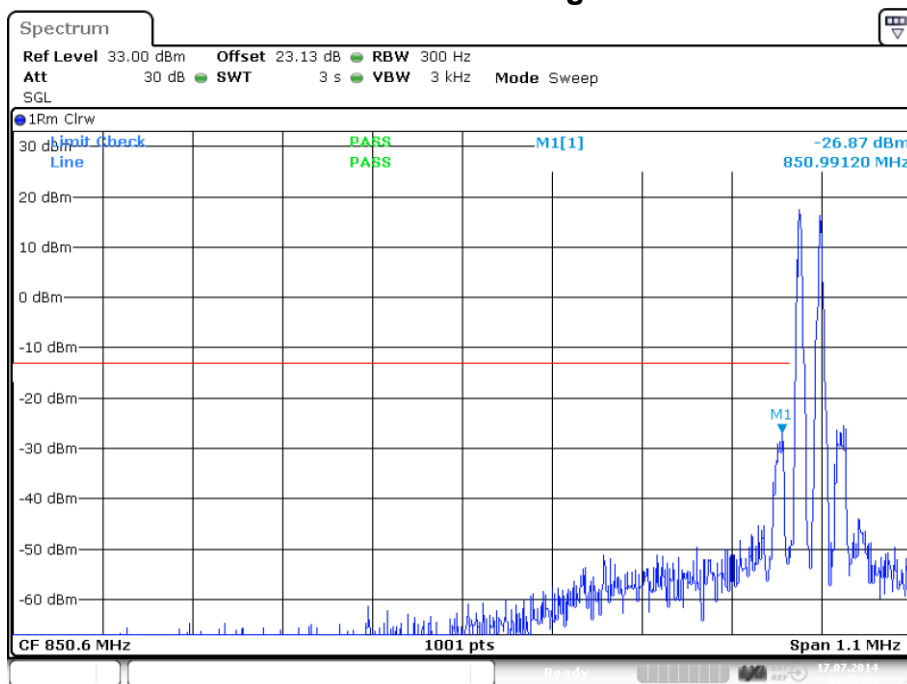


Date: 17.JUL.2014 08:50:27

plot 8.3.1.1-#2 Intermodulation: §90.219; Test results; Downlink; Analog < 1MHz to band edge; Upper Band Edge

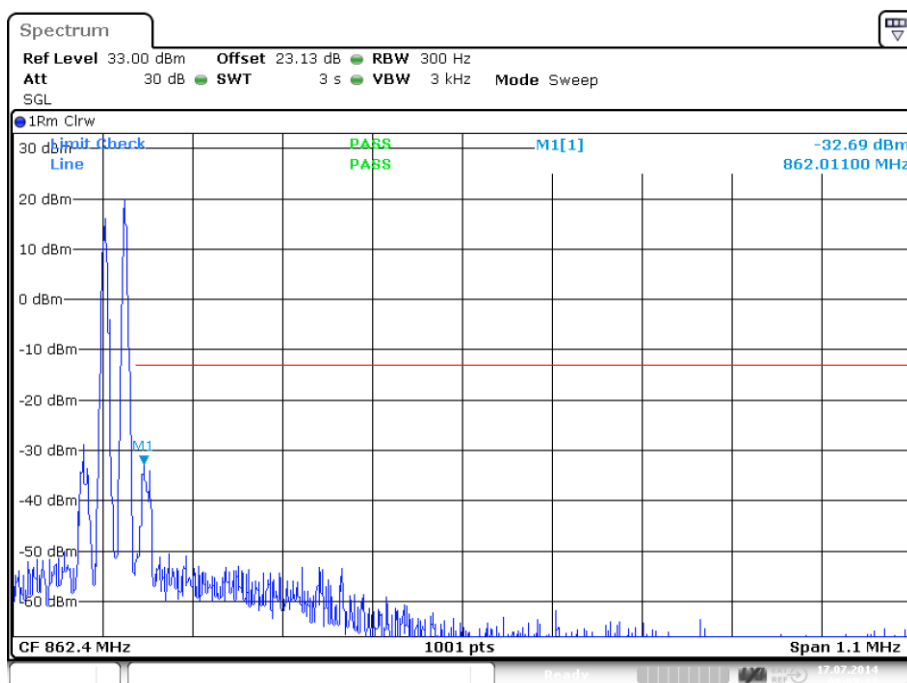


### 8.3.1.2 APCO Phase1 C4FM < 1MHz to band edge



Date: 17.JUL.2014 09:55:02

plot 8.3.1.2-#1 Intermodulation: §90.219; Test results; Downlink; APCO Phase1 C4FM < 1MHz to band edge; Lower Band Edge

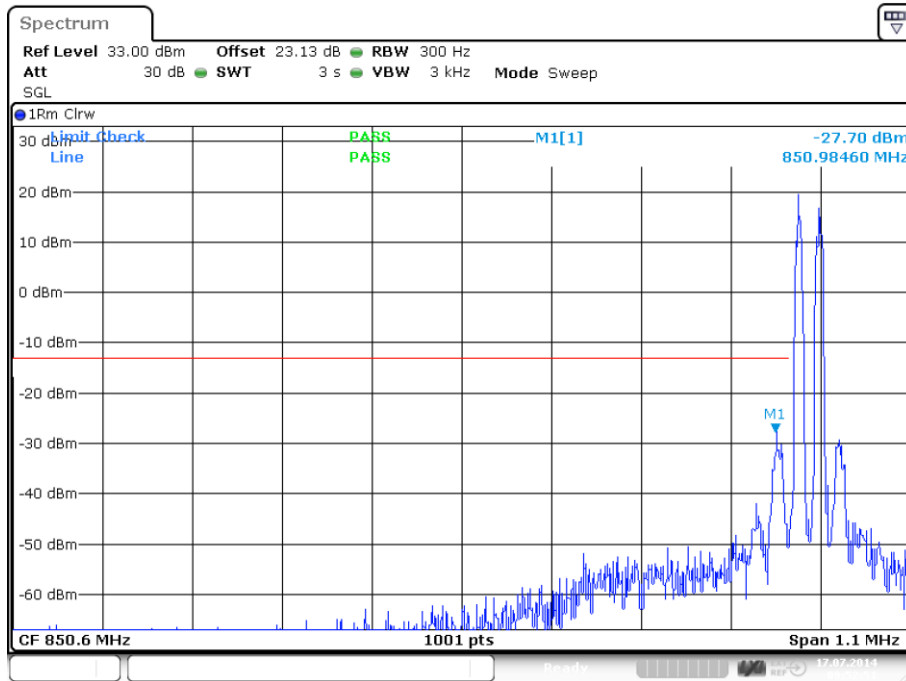


Date: 17.JUL.2014 09:55:37

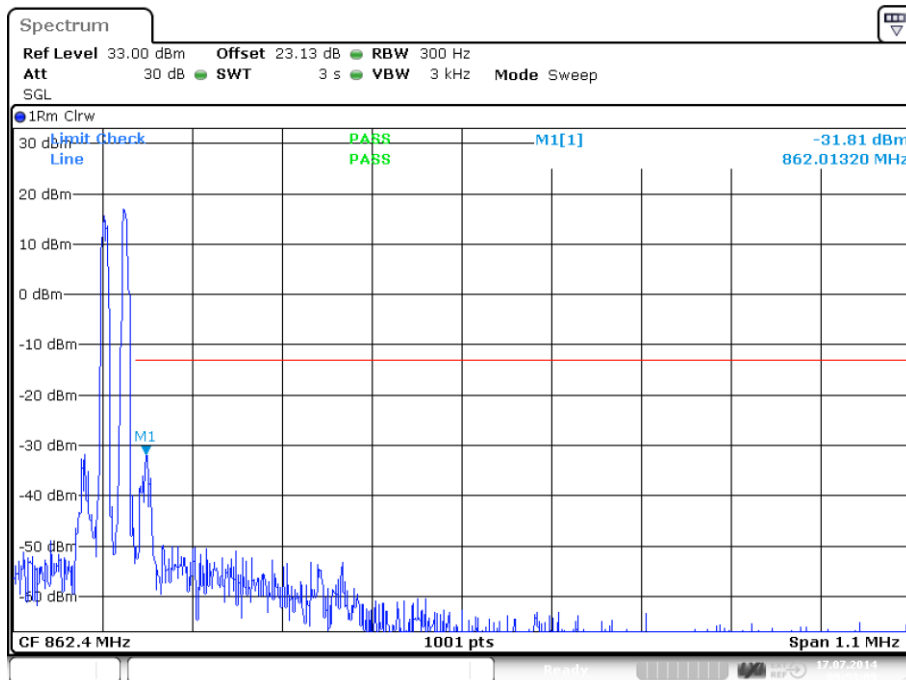
plot 8.3.1.2-#2 Intermodulation: §90.219; Test results; Downlink; APCO Phase1 C4FM < 1MHz to band edge; Upper Band Edge



### 8.3.1.3 APCO Phase2 H-DQPSK < 1MHz to band edge



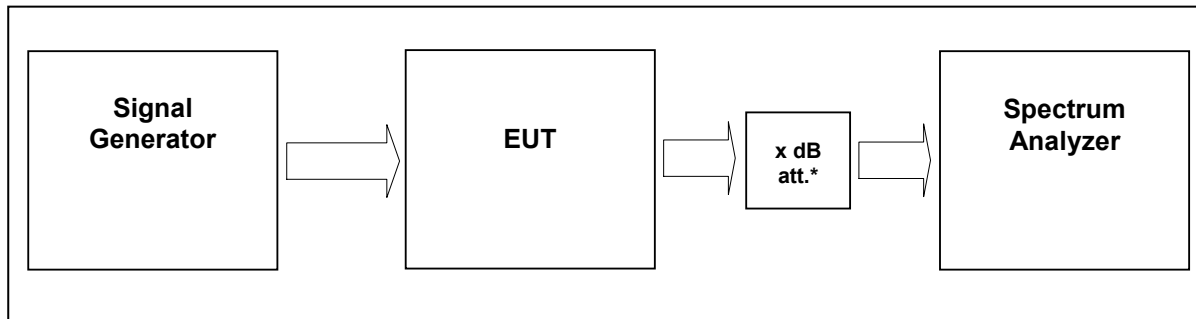
plot 8.3.1.3-#1 Intermodulation: §90.219; Test results; Downlink; APCO Phase2 H-DQPSK < 1MHz to band edge; Lower Band Edge



plot 8.3.1.3-#2 Intermodulation: §90.219; Test results; Downlink; APCO Phase2 H-DQPSK < 1MHz to band edge; Upper Band Edge



## 9 Emission Mask: §90.691, §2.1051



External Attenuator DL      x dB = 20 dB  
figure 9-#1 Test setup: Emission Mask: §90.691, §2.1051

|                         |                                                                                 |                                                     |
|-------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------|
| Measurement uncertainty | ± 0,54 dB<br>± 1,2 dB<br>± 1,5 dB                                               | 9 kHz to 3 GHz<br>3 GHz to 7 GHz<br>7 GHz to 26 GHz |
| Test equipment used     | 9054, 9233, 8849; 7444; 7443; 7306; 7307;<br>7144; 7454; 7453; 7341; 7449; 7368 |                                                     |

### 9.1 Limit

#### Applicable Emission Masks

| Frequency band (MHz)           | Mask for equipment with audio low pass filter | Mask for equipment without audio low pass filter |
|--------------------------------|-----------------------------------------------|--------------------------------------------------|
| 806-809/851-854                | B                                             | H                                                |
| 809-824/854-869 <sup>3 5</sup> | B                                             | G                                                |



## 9.2 Test method

Para. No 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

[39 FR 5919, Feb. 15, 1974. Redesignated and amended at 63 FR 36599, July 7, 1998]

## 9.3 Test results

### 9.3.1 Downlink

#### >1MHz from Band Edge

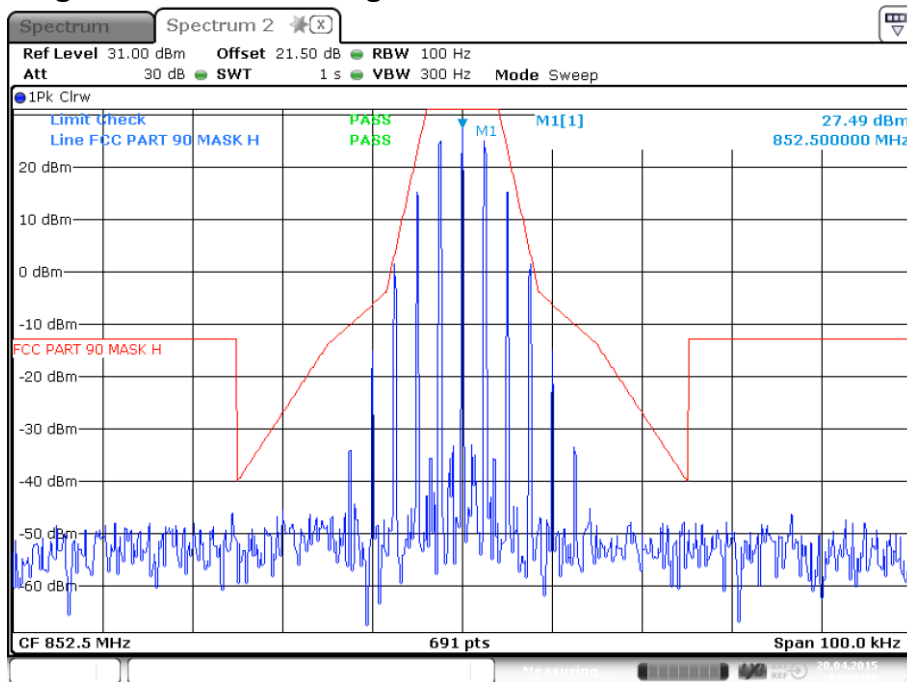
Detector: RMS

| Modulation                 | Carrier   | RBW<br>VBW<br>Span       | pass / fail | Plot          |
|----------------------------|-----------|--------------------------|-------------|---------------|
| Analog                     | 852.5 MHz | 100Hz<br>300Hz<br>100kHz | pass        | 9.3.1.1<br>#1 |
| APCO<br>Phase1 C4FM        | 852.5 MHz | 100Hz<br>300Hz<br>100kHz | pass        | 9.3.1.2<br>#1 |
| APCO<br>Phase2 H-<br>DQPSK | 852.5 MHz | 100Hz<br>300Hz<br>100kHz | pass        | 9.3.1.3<br>#1 |
| Analog                     | 858 MHz   | 100Hz<br>300Hz<br>100kHz | pass        | 9.3.1.4<br>#1 |
| APCO<br>Phase1 C4FM        | 858 MHz   | 100Hz<br>300Hz<br>100kHz | pass        | 9.3.1.5<br>#1 |
| APCO<br>Phase2 H-<br>DQPSK | 858 MHz   | 100Hz<br>300Hz<br>100kHz | pass        | 9.3.1.6<br>#1 |
|                            |           |                          |             |               |

table 9.3-#1 Emission Mask: §90.691, §2.1051 Test results <1MHz from Band Edge



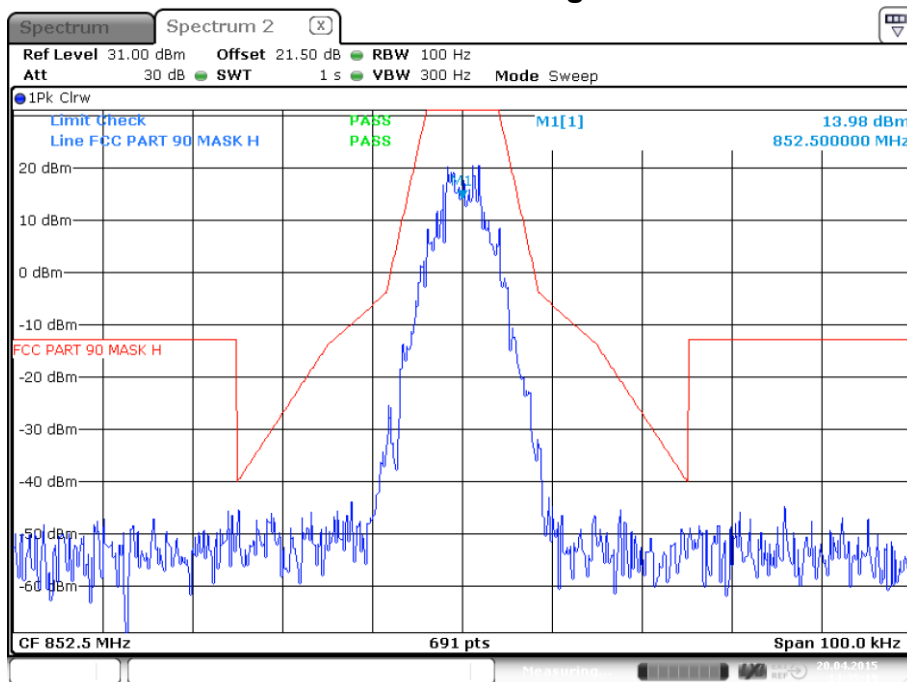
### 9.3.1.1 Analog > 1MHz to band edge



Date: 20.APR.2015 14:31:30

plot 9.3.1.1-#1 Emission Mask: §90.691, §2.1051; Test results; Downlink; Analog > 1MHz to band edge

### 9.3.1.2 APCO Phase1 C4FM > 1MHz to band edge



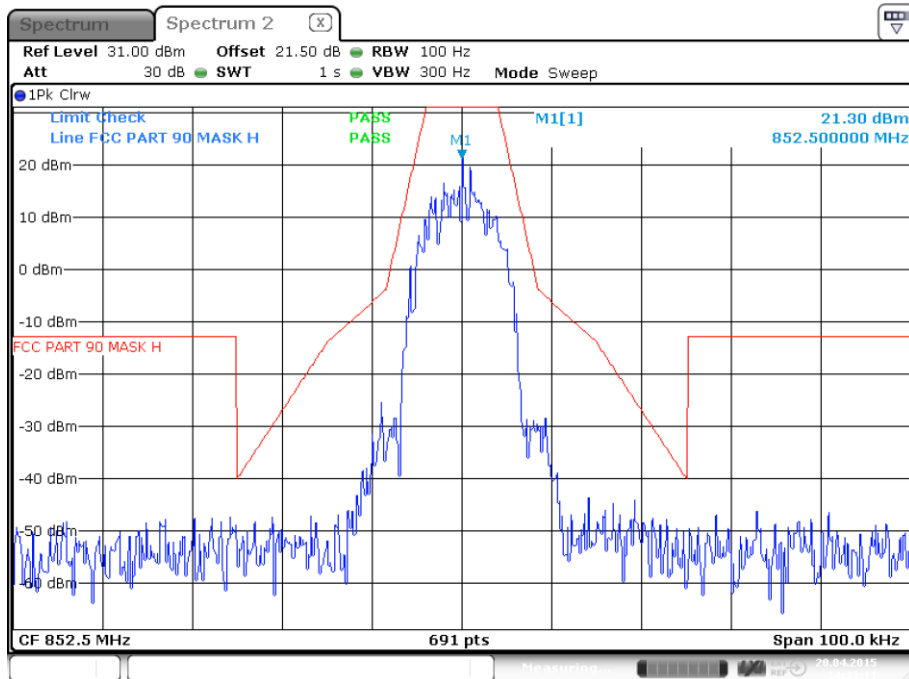
Date: 20.APR.2015 14:35:19

plot 9.3.1.2-#1 Emission Mask: §90.691, §2.1051; Test results; Downlink; APCO Phase1 C4FM > 1MHz to band edge



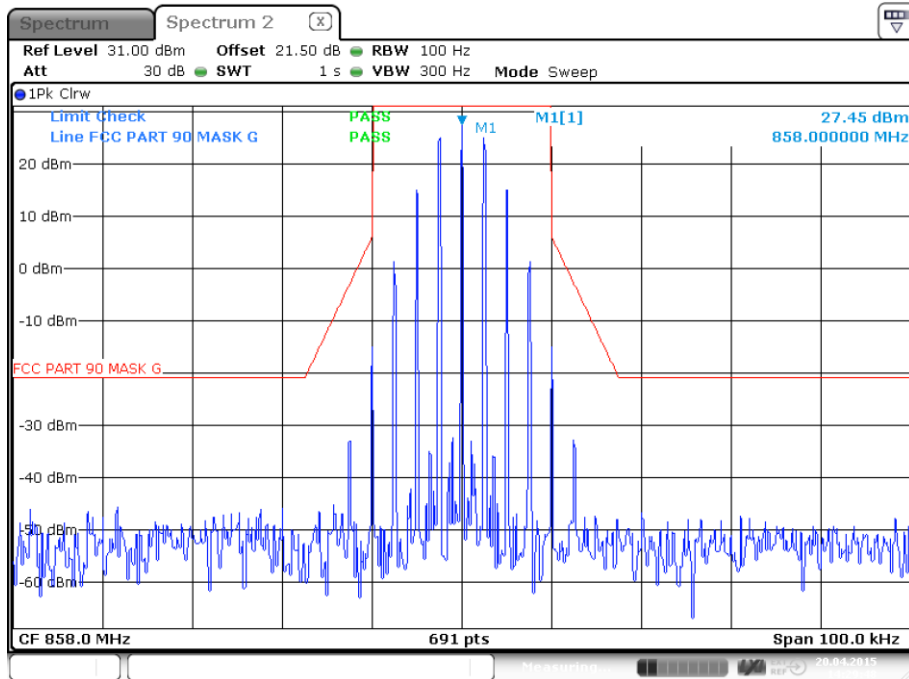


9.3.1.3 APCO Phase2 H-DQPSK > 1MHz to band edge



plot 9.3.1.3-#1 Emission Mask: §90.691, §2.1051; Test results; Downlink; APCO Phase2 H-DQPSK > 1MHz to band edge

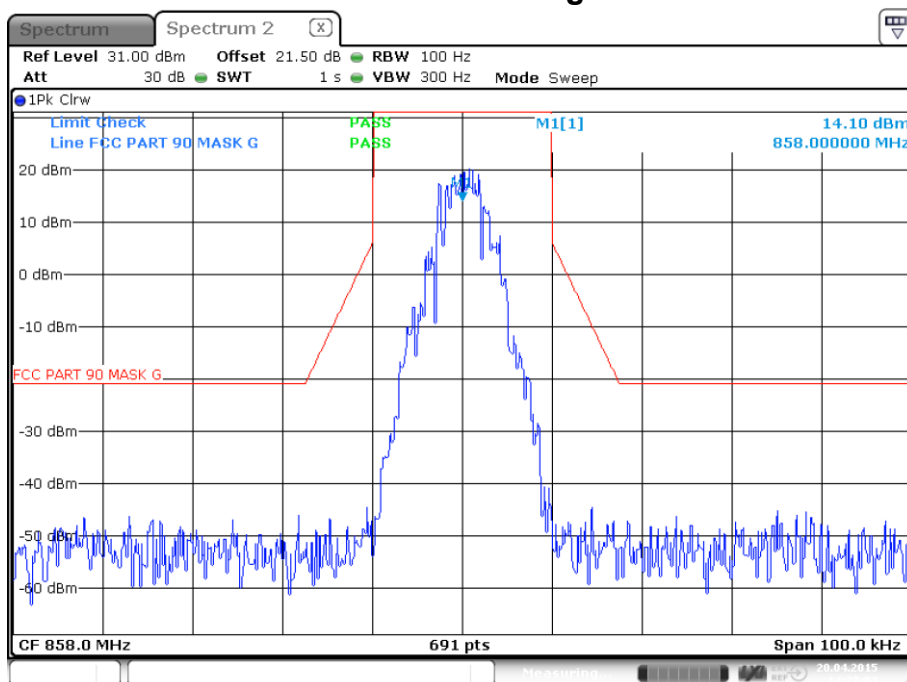
9.3.1.4 Analog > 1MHz to band edge



plot 9.3.1.4-#1 Emission Mask: §90.691, §2.1051; Test results; Downlink; Analog > 1MHz to band edge



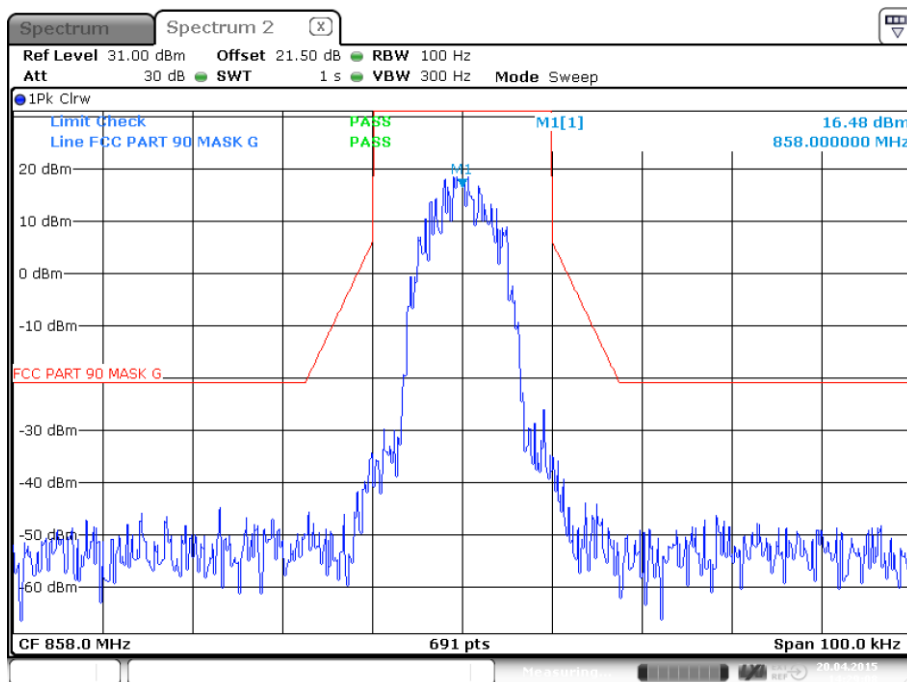
### 9.3.1.5 APCO Phase1 C4FM > 1MHz to band edge



Date: 20.APR.2015 14:28:03

plot 9.3.1.5-#1 Emission Mask: §90.691, §2.1051; Test results; Downlink; APCO Phase1 C4FM > 1MHz to band edge

### 9.3.1.6 APCO Phase2 H-DQPSK > 1MHz to band edge



Date: 20.APR.2015 14:29:07

plot 9.3.1.6-#1 Emission Mask: §90.691, §2.1051; Test results; Downlink; APCO Phase2 H-DQPSK > 1MHz to band edge



### 9.3.2 Uplink

n.a.

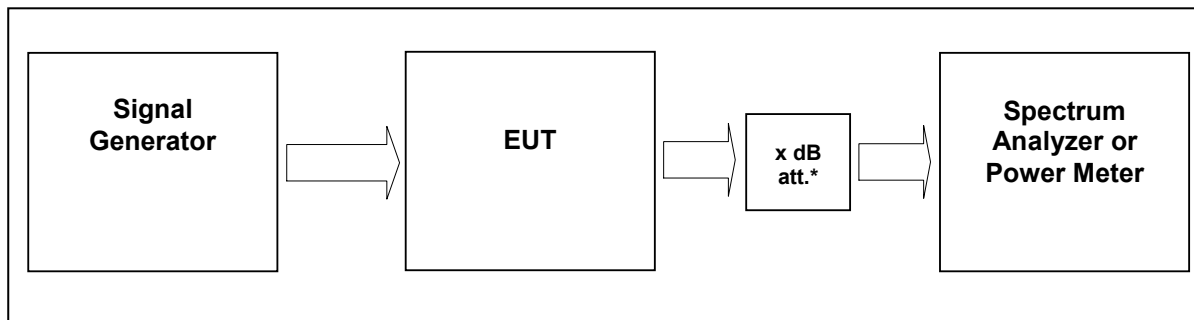
Note: The EUT does not transmit over the air in the uplink direction.

### 9.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 20.04.2015                          |



## 10 Out of Band Rejection



External Attenuator DL      x dB = 20 dB  
figure 10-#1 Test setup: Out of Band Rejection

|                         |                                                         |
|-------------------------|---------------------------------------------------------|
| Measurement uncertainty | ± 0,38 dB                                               |
| Test equipment used     | 9054, 9233, 7444; 7306; 7144; 7454; 7453;<br>7341; 7449 |

### 10.1 Limit

KDB 935210 D02 v02

Clause: D.3 POLICIES AND PROCEDURES;

Subclause:

(I) Out of Band Rejection – Test for rejection of out of band signals. Filter frequency response plots are acceptable.

### 10.2 Test method

KDB 935210 D02 v02

Clause: D.3 POLICIES AND PROCEDURES;

Subclause:

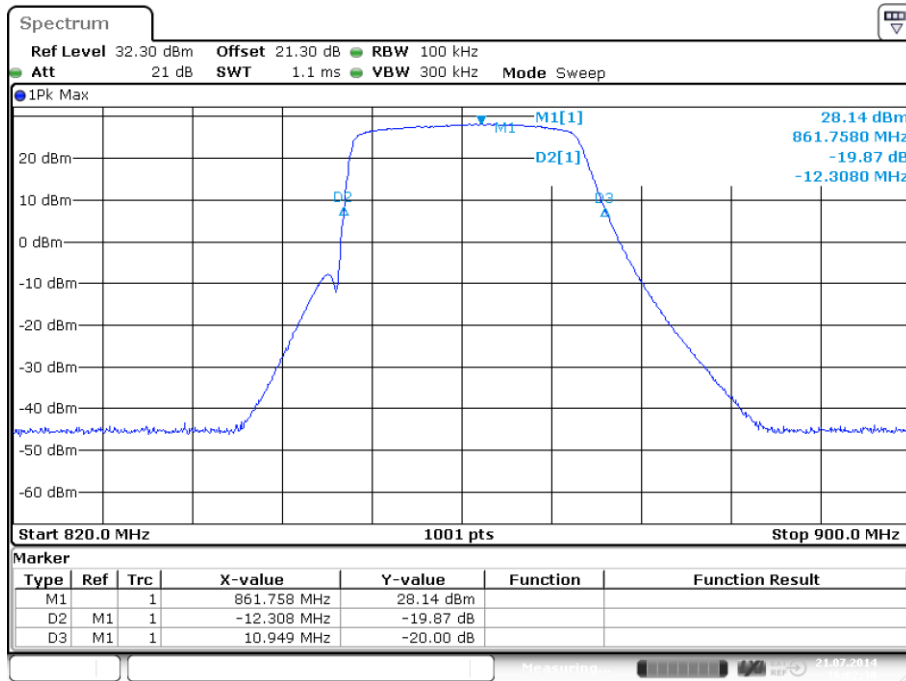
(I) Out of Band Rejection – Test for rejection of out of band signals. Filter frequency response plots are acceptable.

### 10.3 Test results

Detector Peak max hold



### 10.3.1 Downlink



Date: 21.JUL.2014 16:02:30

plot 10.3.1-#1 Out of Band Rejection; Test results; Downlink;

### 10.3.2 Uplink

n.a.

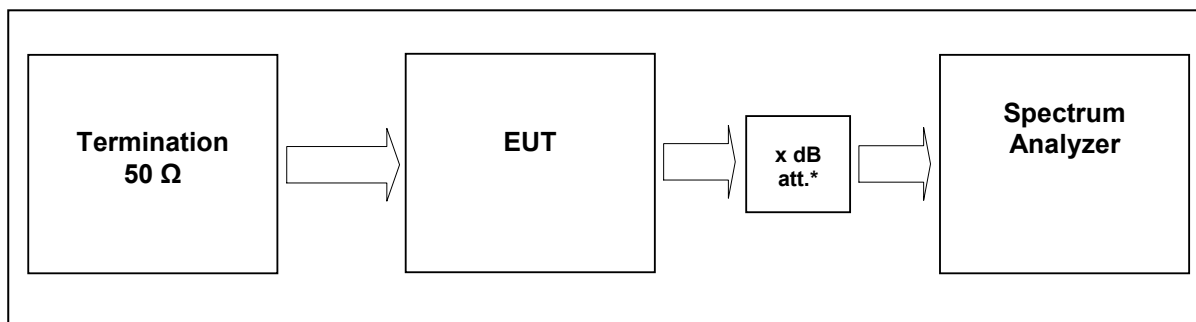
Note: The EUT does not transmit over the air in the uplink direction.

### 10.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 21.07.2014                          |



## 11 Noise



External Attenuator DL      x dB = 20 dB  
figure 11-#1 Test setup: Noise

|                         |                               |
|-------------------------|-------------------------------|
| Measurement uncertainty | ± 0,38 dB                     |
| Test equipment used     | 9054, 7144; 7454; 7453; 7449; |

### 11.1 Limit

§90.219 (d) (6) (ii) In general, the ERP of noise within the passband should not exceed -43 dBm in 10 kHz measurement bandwidth.

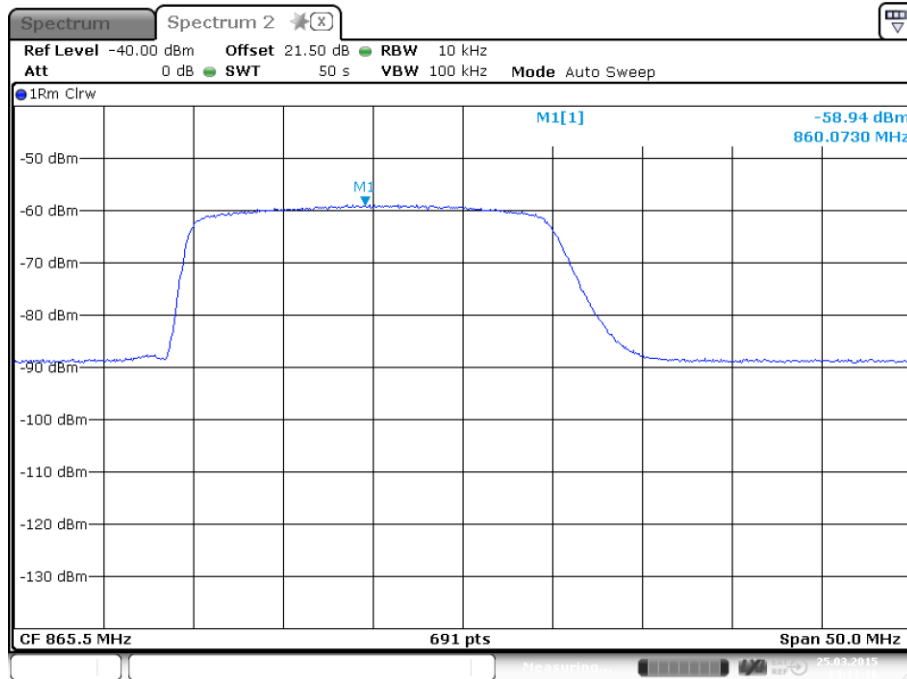
### 11.2 Test method

KDB 935210 D03 v02r01 7.7



### 11.3 Test results

#### 11.3.1 Downlink



Date: 25.MAR.2015 14:11:16

plot 11.3.1-#1 Noise; Test results; Downlink;

#### 11.3.2 Uplink

n.a.

Note: The EUT does not transmit over the air in the uplink direction.



## 11.4 Summary test result

|             |                                     |
|-------------|-------------------------------------|
| Test result | complies, according the plots above |
| Tested by:  | M. Leinfelder                       |
| Date:       | 25.03.2015                          |

### The noise figure limit of 9 dB is passed, because of the following reasons:

- The noise power at the output of a RF 2-port is dependent on noise figure NF and gain G; i.e a high NF does not mean necessarily high noise power at the output;
- FCC limits the noise figure NF of a signal booster to max. 9 dB (also in DL)
- FCC defines: “signal boosters” as all manners of amplifiers, repeaters, boosters, *distributed antenna systems* and in-building radiation that serve to amplify signals between a device and a wireless network “;
- Noise figure NF is a useful and common manner for the characterization of a noisy RF 2-port;
- The DUT (DAS) uses also an optical medium (fiber) for signal transport (i.e. not solely RF lines / waveguides); after the photodiode we clearly have a RF 2-port (output photodiode to output remote unit);  
→ The DUT is **attenuating** till the position right after the photodiode; only from the position right after the photodiode to the output of the remote  
the DUT is **amplifying** (this chain of RF components is the only complete and cohesive chain with predominantly amplifying stages (including the output port) (output port shall be included, since noise power at the output is of interest));  
→ above mentioned FCC definition of signal boosters (“serve to amplify signals”) + definition of “noise figure” for RF 2-ports entail to set the reference planes for determining

NF of the DL at the position right after the photodiode and the output of the remote unit;  
This means that NF of the DUT in DL has to be determined between these two reference planes (NF of the amplification stages between output of the photodiode and output of the remote unit);

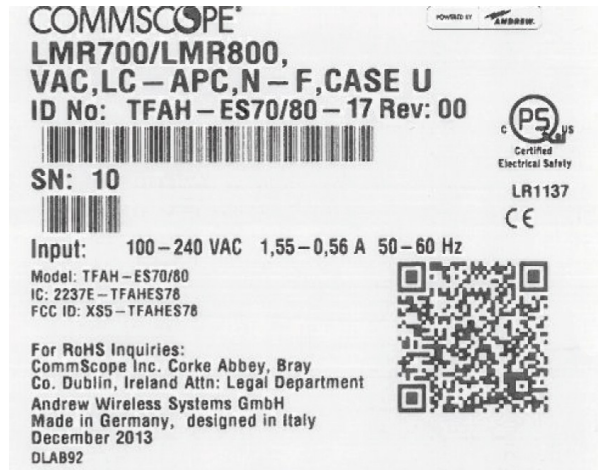
### This noise figure is significantly below 9 dB!

To verify this fact, it would be necessary to carry out a second NF measurement with a reference remote OTRx, containing only the photodiode. Knowing both noise figures (complete DUT + reference remote OTRx), NF of the required amplification stages can be calculated.

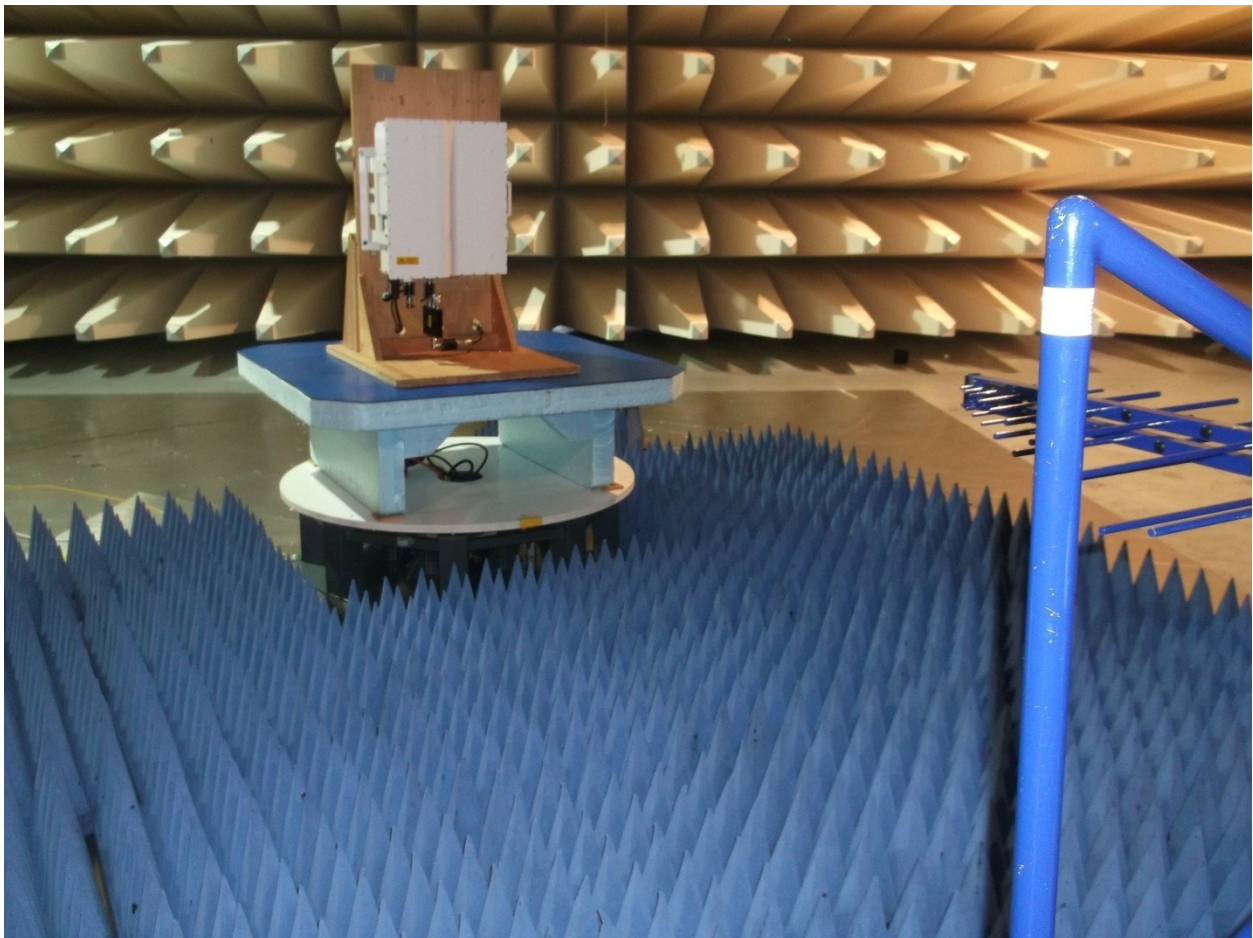
**Another way to get the NF of the required amplification stages, is to accept line up calculation. This should be acceptable, since NF of the amplification stages is significant lower than 9 dB. In addition to that, the output noise level, which is crucial, was measured and is far below the limit.**



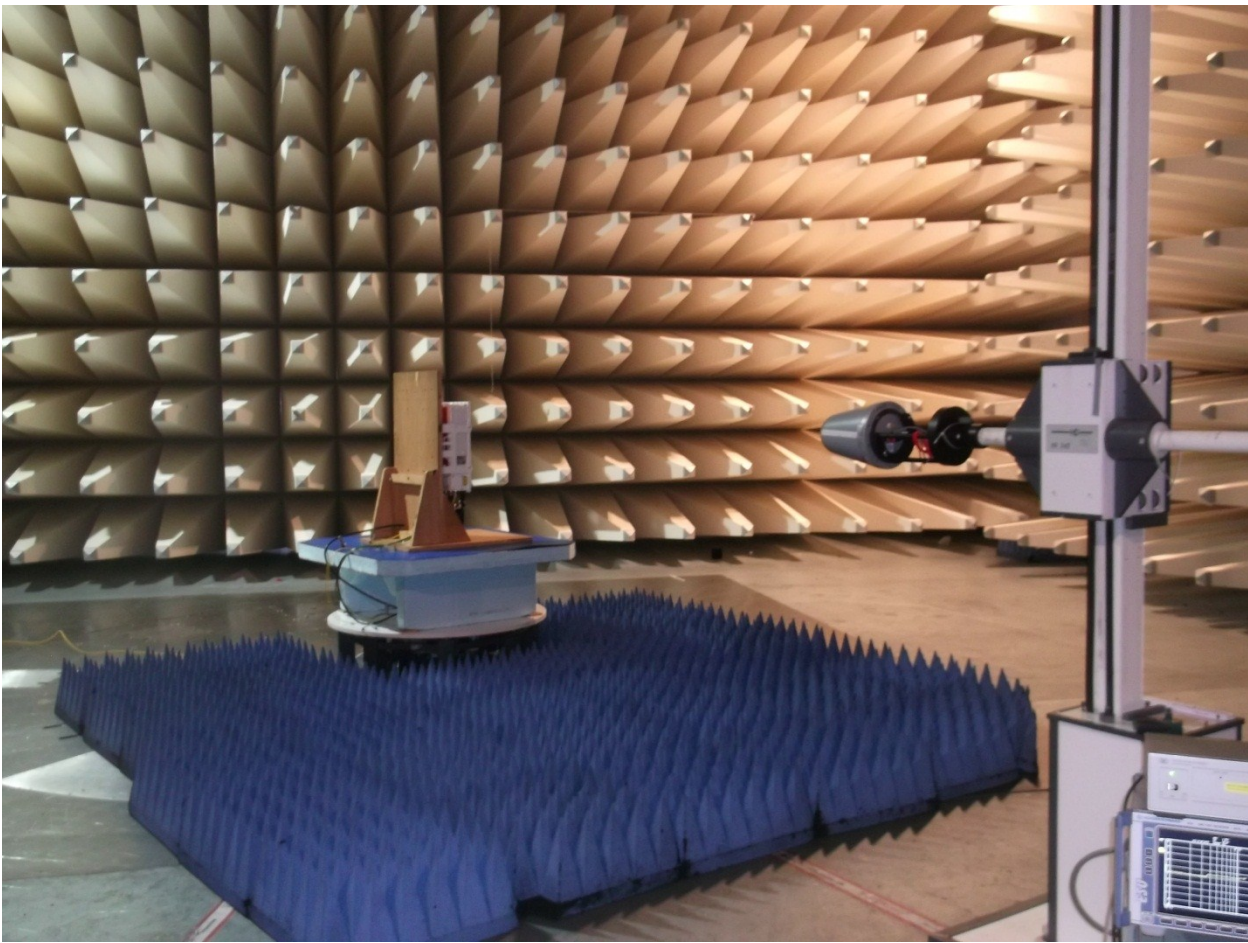
## 12 Radiated Spurious Emissions at the ECL (Bureau Veritas): §90.210, §2.1053, RSS-Gen, RSS-131



picture 10.1: name plate



picture 10.2: Test setup: Field Strength Emission <1 GHz @3m in the SAC



**picture 7.3:** Test setup: Field Strength Emission >1 GHz @3m in the SAC



This clause specifies requirements for the measurement of radiated emission.

| Frequency range | Distance:<br>EUT <-> antenna /<br>location | Limit                  | Test method        |
|-----------------|--------------------------------------------|------------------------|--------------------|
| 30 MHz - 1 GHz  | 3 metres / SAC                             | FCC 47 CFR Part 90.210 | TIA/EIA-603-C:2004 |
| 1 GHz – 21 GHz  | 3 metres / SAC                             |                        |                    |

**Test equipment used:**

| Designation       | Type          | Manufacturer    | Invent.-no. | Cal.-date  | due Cal.-<br>date | used |
|-------------------|---------------|-----------------|-------------|------------|-------------------|------|
| EMI test receiver | ESI40         | Rohde & Schwarz | E1687       | 28.11.2013 | 28.11.2014        | X    |
| Antenna           | CBL 6111      | Chase           | K1026       | 27.06.2014 | 27.06.2015        | X    |
| Pre amplifier     | AM1431        | Miteq           | K1721       | 16.04.2014 | 16.04.2015        | X    |
| Antenna           | HL 025        | R&S             | K1114       | 03.03.2014 | 03.03.2015        | X    |
| Preamplifier      | AFS4-00102000 | Miteq           | K817        | 12.03.2014 | 12.03.2015        | X    |
| RF Cable          | Sucoflex 100  | Suhner          | K1760       | 03.07.2014 | 03.07.2015        | X    |

The REMI version 2.135 has been used for max search.

**Test set-up:**

Test location: SAC  
 Both, the Fully Anechoic Chamber (FAC) and the Semi Anechoic Chamber (SAC) fulfil the requirements of ANSI C63.4 and CISPR 16-1-4 with regards to NSA and SVSWR.

Test Voltage: 115V / 60 Hz  
 Type of EUT: Wall mounted

**Measurement uncertainty:**

|                                                  |                                                                         |
|--------------------------------------------------|-------------------------------------------------------------------------|
| Measurement uncertainty expanded<br>(95% or K=2) | ± 4,7 dB for ANSI C63.4 measurement<br>± 0,5 dB for TIA-603 measurement |
|--------------------------------------------------|-------------------------------------------------------------------------|

## 12.1 Method of Measurement

### Measurement procedure. TIA-603-C

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic dipole (see Figure 7.2).

From KDB (AMPLIFIER, BOOSTER, AND REPEATER REMINDER SHEET):

Radiated spurs (enclosure) – Use of CW signal (low, mid, and high freq.) is acceptable rather than all modulations.

The maximum RFI field strength was determined during the measurement by rotating the turntable ( $\pm 180$  degrees) and varying the height of the receive antenna ( $h = 1 \dots 4$  m) as like defined in ANSI C63.4. A measurement receiver has been used with a RBW 120 kHz up to 1 GHz and 1 MHz above 1 GHz. Steps with during pre measurement was half the RBW.

Both, the Fully Anechoic Chamber (FAC) and the Semi Anechoic Chamber (SAC) fulfil the requirements of ANSI C63.4 and CISPR 16-1-4 with regards to NSA and SVSWR.

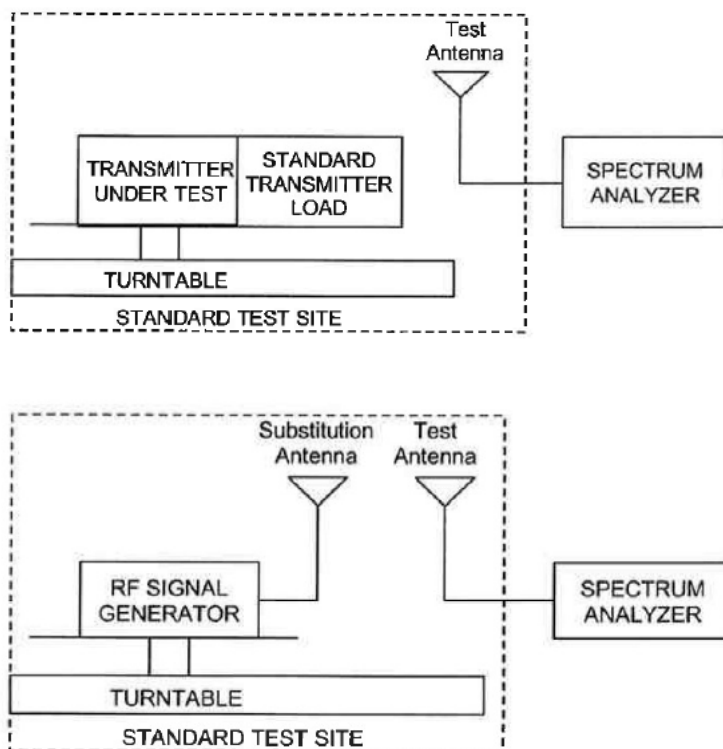


Figure #7.2 Substitution methods TIA/EIA-603-C



## 12.2 Limit

Minimum standard: §90.210, Table “Application Emission Mask”

| Frequency Band (MHz)         | Mask for equipment with Audio Low pass filter | Mask for Equipment without audio low pass filter |
|------------------------------|-----------------------------------------------|--------------------------------------------------|
| 806–809/851–854              | B                                             | H                                                |
| 809–824/854–869 <sup>3</sup> | B                                             | G                                                |

<sup>3</sup> Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.

| MASK        | Spurious Limit |
|-------------|----------------|
| A,B,C,G,H,I | -13dBm         |

## 12.3 Climatic values in the lab

Temperature: 21°  
 Relative Humidity: 47%  
 Air-pressure: 998 hPa

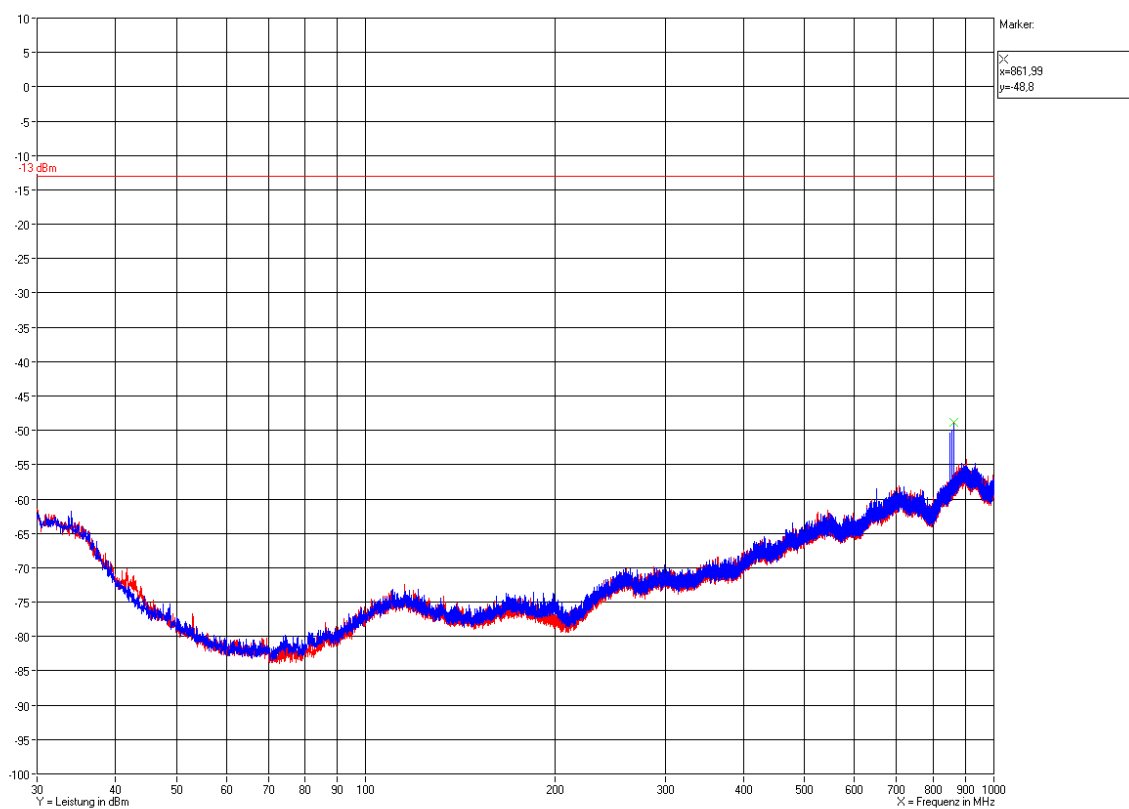


## 12.4 Test results

### 12.4.1 30 MHz to 1 GHz Downlink (Bottom – Middle – Top) Subpart H

Bottom: 851 MHz; Middle: 856.5 MHz; Top: 862 MHz

Vertikal / Horizontal

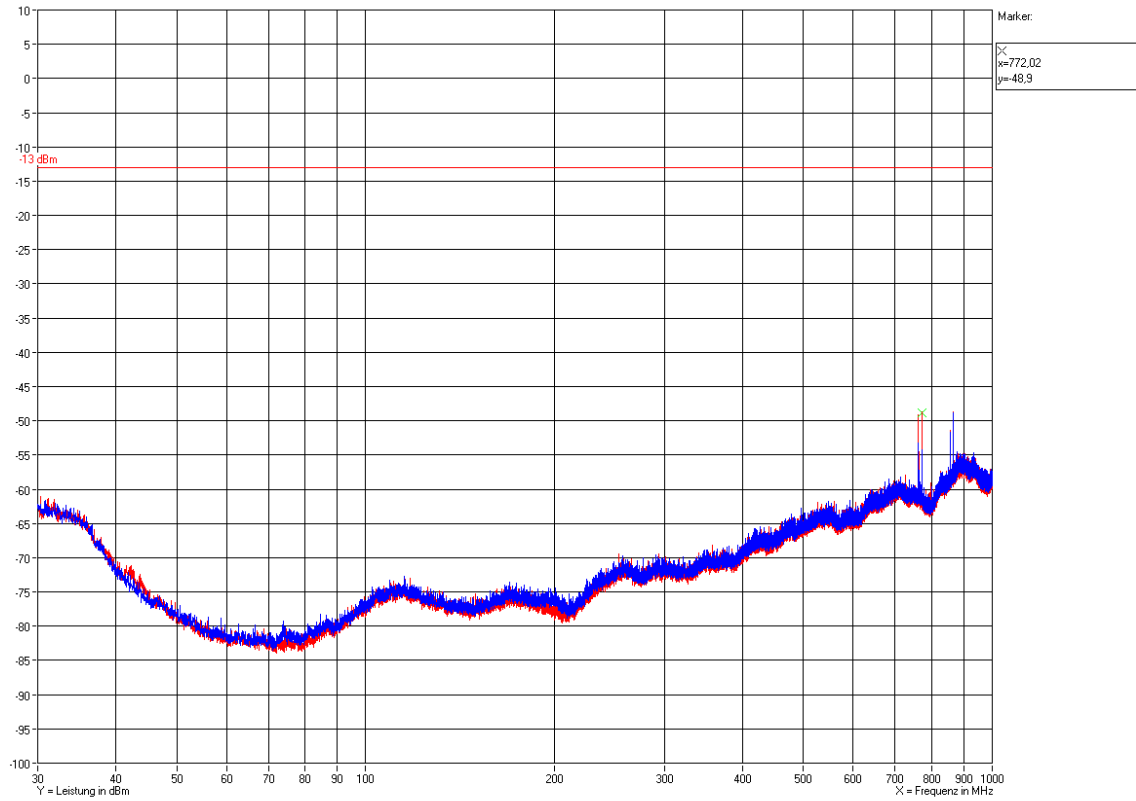




### 12.4.3 30 MHz to 1 GHz Downlink (Middle of all paths)

F1: 763 MHz; F2: 772 MHz; F3: 856.5 MHz; F4: 865.5 MHz

Vertikal / Horizontal

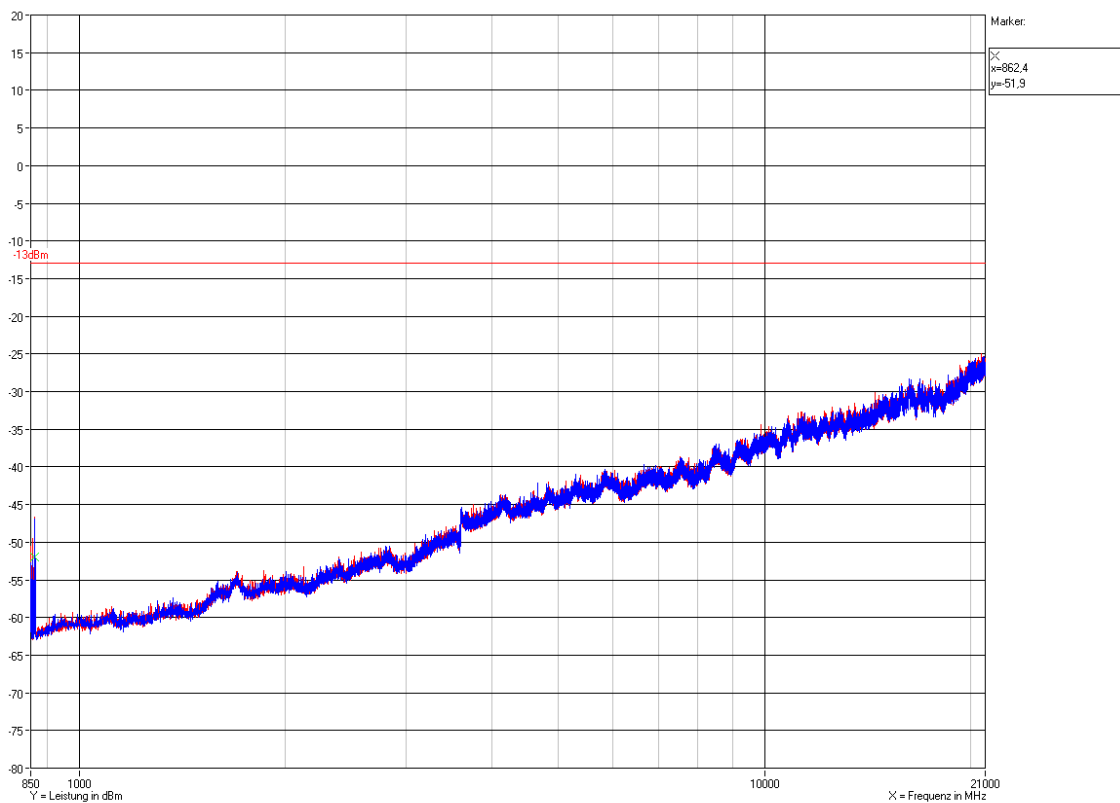




### 12.4.4 1 GHz to 21 GHz Downlink (Bottom – Middle – Top) Subpart H

Bottom: 851 MHz; Middle: 856.5 MHz; Top: 862 MHz

Vertikal / Horizontal



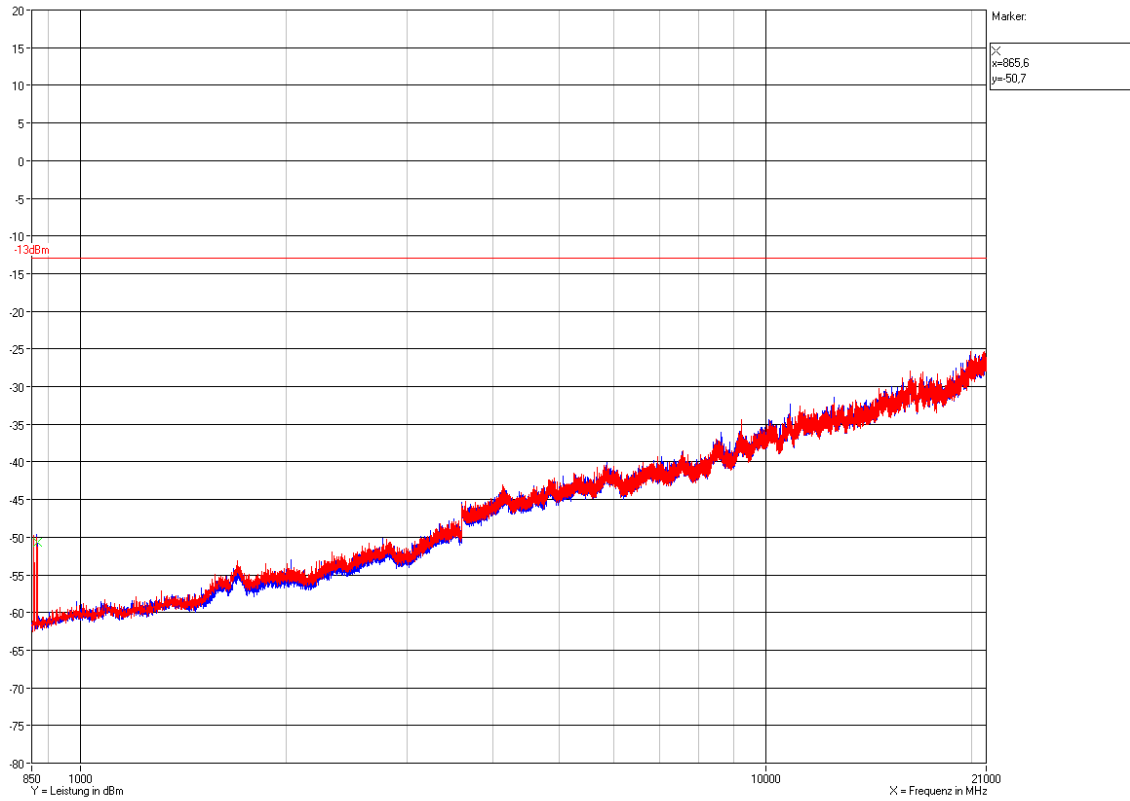




### 12.4.6 1 GHz to 22 GHz Downlink (Middle of all paths)

F1: 763 MHz; F2: 772 MHz; F3: 856.5 MHz; F4: 865.5 MHz

Vertikal / Horizontal



FEK / 12.08.2014

**The radiated spurious emission measurements have been passed!**



### 13 History

| Revision | Modification                                                                                                                                                                                               | Date       | Name     |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| 01.00    | Initial report                                                                                                                                                                                             | 03.11.2014 | Zahlmann |
| 02.00    | Change RF power out limit => change antenna gain<br>Add chapter 8 "intermodulation"<br>Add emission mask at chapter 9<br>Add noise measurement at chapter 11<br>Editorial changes at "Test Result Summary" | 23.04.2015 | Zahlmann |
|          |                                                                                                                                                                                                            |            |          |
|          |                                                                                                                                                                                                            |            |          |

**\*\*\*\*\* End of test report \*\*\*\*\***