

13. RADIATED EMISSION LIMIT

Standard: FCC PART 15 : 2013

Section: 15.109

Instrumentation test list:

| CATEGORY | BRAND | TYPE | N° EMITECH |
|---------------------|-----------------------|-----------------------------|------------|
| Antenna | Schwarzbeck | VHA 9103 | 0317 |
| Antenna | Schwarzbeck | UHALP 9108 | 3106 |
| Antenna | Emco | 3115 | 3374 |
| Antenna mast | Maturo | AM 4.0-O | 7625 |
| Cable | Câbles & Connectiques | N-13m | 2452 |
| Cable | - | N-2m | 2805 |
| Cable | Câbles & Connectiques | N-SMA | 2864 |
| Cable | Micro-Coax | N-13m | 8063 |
| Cable | C&C | N-15m | 10229 |
| Filter | Trilithic | 6HC1300-2.5-KK | 1097 |
| Filter | Trilithic | 5EHLX500-3-KK | 1529 |
| Filter | Micro-tronics | HPM 14758 | 4691 |
| Open area test site | Emitech | Aunainville | 0187 |
| Preamplifier | Mini-Circuits | ZFL-1000LN | 0048 |
| Preamplifier | MITEQ | AFS42-00102650-42-10P-42 | 3229 |
| Spectrum analyzer | Rohde & Schwarz | FSP40 (V 4.00SP1-V3.0-10-2) | 5175 |
| Turntable | Maturo | MCU | 7626 |

Equipment under test arrangement:

The system is tested in an open area test site (OATS).

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

Frequency range: from 30 MHz to harmonic 5 (highest frequency used = 5805 MHz).

Bandwidth: 120 kHz (F < 1 GHz)
1 MHz (F > 1 GHz)

Detection mode: Quasi-peak (F < 1 GHz)
Average (F > 1 GHz)

Distance of antenna: 3 meters.

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal, only the highest level is recorded.

Operating mode during the test:

The E.U.T. is blocked in continuous transmission mode.

Results:

No frequencies are observed between 30 MHz to 25 GHz for both polarizations.

Test conclusion: Standard respected

14. DYNAMIC FREQUENCY SELECTION

Standard: FCC PART 15 : 2013

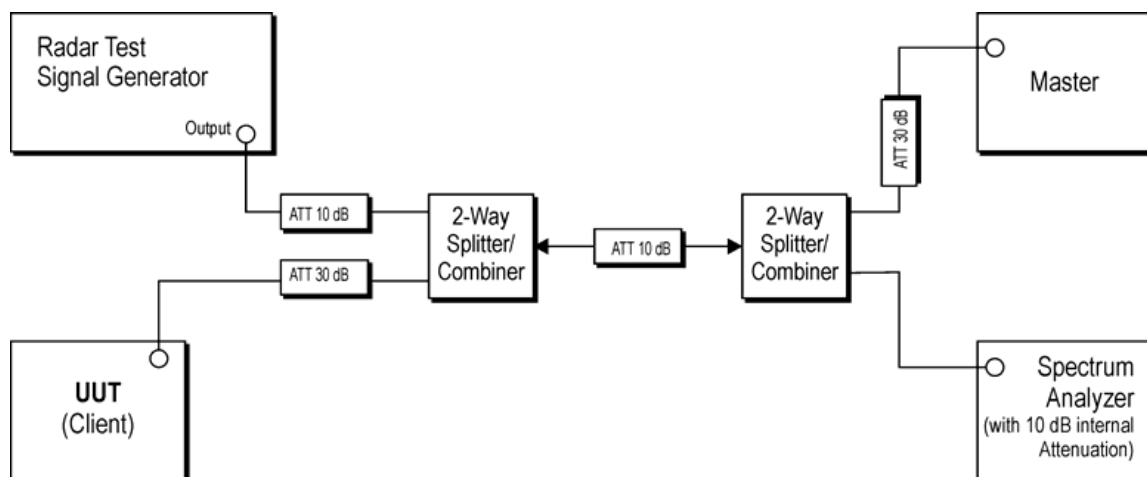
Section: 15.407 (h) (2)

Test equipment used:

| CATEGORY | BRAND | TYPE | N° EMITECH |
|-------------|-----------------|----------|------------|
| Receiver | Rohde & Schwarz | FSU8 | 9129 |
| Synthesizer | Rohde & Schwarz | SMBV10QA | 10351 |

Measured conditions:

The test is carried out in conducted mode and signal test radar type 1 of table 5 is generated.
The tests are carried out with a modulation type OFDM = 54 Mbps bandwidth 20 MHz (Mode a)



Signal generator = SMBV 100A R&S
Spectrum analyzer = SFU 8 R&S
Master = Access point "SagemCom"
Software used is "The DFS analysis tool" of R&S.

A connection between the control PC and the analyzer is carried out by GPIB.

Test operating condition of the equipment:

The equipment under test is associate a master.

Results:

Ambient temperature (°C): 23

Relative humidity (%): 50

Power source (V): 3.6

Tests :

Applicability of DFS requirements prior to use of a channel

| Requirement | DFS operational mode | | |
|---------------------------------|----------------------|-------------------------------|----------------------------|
| | Master | Slave without radar detection | Slave with radar detection |
| Non-Occupancy Period | ✓ | Not required | ✓ |
| DFS Detection Threshold | ✓ | Not required | ✓ |
| Channel Availability Check Time | ✓ | Not required | Not required |
| Uniform Spreading | ✓ | Not required | Not required |
| U-NII Detection Bandwidth | ✓ | Not required | ✓ |

Applicability of DFS requirements during normal operation

| Requirement | DFS operational mode | | |
|-----------------------------------|----------------------|-------------------------------|----------------------------|
| | Master | Slave without radar detection | Slave with radar detection |
| DFS Detection Threshold | ✓ | Not required | ✓ |
| Channel Closing Transmission Time | ✓ | ✓ | ✓ |
| Channel Move Time | ✓ | ✓ | ✓ |
| U-NII Detection Bandwidth | ✓ | Not required | ✓ |

The equipment under test is a slave without radar detection.

Channel move time, Channel closing transmission time, and Non-occupancy period

Test method: FCC 06-96

Parameters of DFS test signal:

| Radar Type | Pulse width (µsec) | PRI (µsec) | Number of Pulses |
|------------|--------------------|------------|------------------|
| 1 | 1 | 1428 | 18 |

Threshold level: The maximum transmit power at 5500 MHz is 14.359 mW → level is -62 dBm.

Channel move time

| | Channel move time | Limit | Curve |
|-------------------------------------|-------------------|-------|-------|
| Channel 100 Frequency : 5500 MHz | 1.13 s | 10 s | 1 |

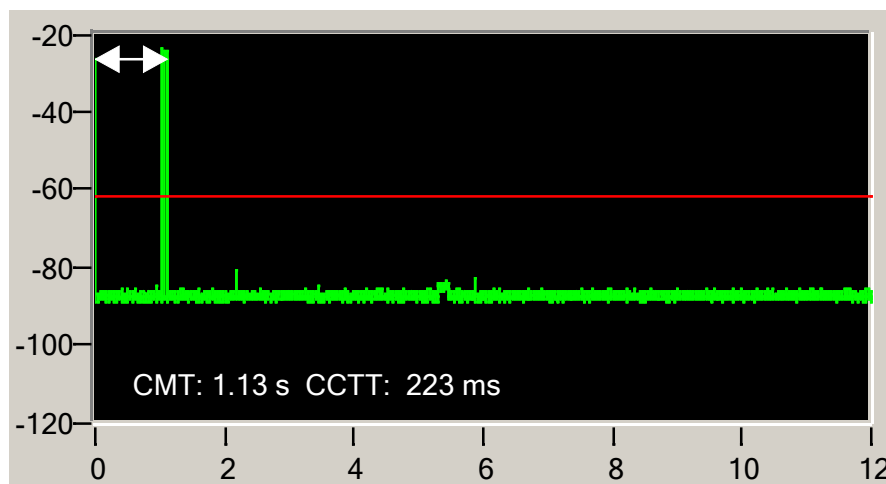
Channel closing transmission time

| | Channel closing transmission time | Limit | Curve |
|-------------------------------------|-----------------------------------|---------|-------|
| Channel 100 Frequency : 5500 MHz | 2.3 ms | < 60 ms | 1 |

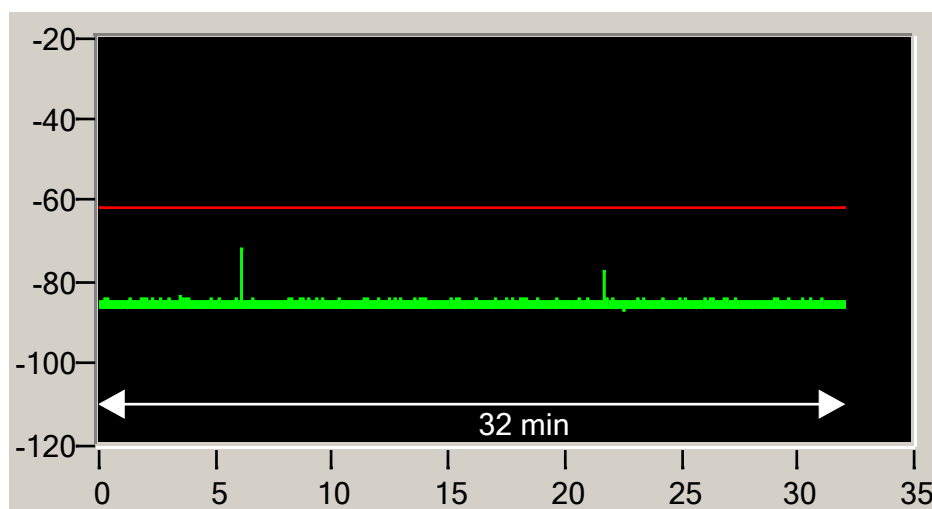
Non-occupancy period

| | Non-occupancy period | Limit | Curve |
|-------------------------------------|------------------------------|---------|-------|
| Channel 100 Frequency : 5500 MHz | > 30 mn Nothing to report | > 30 mn | 2 |

Curve 1:



Curve 2:



« □□□ End of report, 4 annexes to be forwarded □□□ »

ANNEX 1

Antenna factors, insertion losses and amplifier values

BILL OF MATERIAL

The test antenna used for the radiated emission between 9 kHz and 30 MHz is the active loop antenna n°9579. Antenna factors are given in table 1.

The test antenna used for the radiated emission between 30 MHz and 200 MHz is the biconical antenna n°317. Antenna factors are given in table 2.

The test antenna used for the radiated emission between 200 MHz and 1 GHz is the log-periodic antenna n°3106. Antenna factors are given in table 3.

The measuring receiver n°1216 used in the frequency range 30 MHz to 1 GHz has an integrated preamplifier.

The spectrum analyzer n°5175 is used in the frequency range 1 GHz to 25 GHz.

The test cable used between 9 kHz and 30 MHz to connect the antennas to the receiver for measurements at a distance of 30 meters has losses given in table 4.

The test cable used between 30 MHz and 1 GHz to connect the antennas to the receiver for measurements at a distance of 3 meters has losses given in table 5.

The test antenna used for the radiated emission between 1 GHz and 18 GHz is the horn antenna n°3374. Factors are given in table 6.

The test antenna used for the radiated emission between 18 GHz and 25 GHz is the horn antenna n°1045. Factors are given in table 7.

The amplifier n°3229 used to connect the spectrum analyzer to the test cable has gain values given in the table 8.

The test cable used between 1 GHz and 26 GHz to connect the horn antenna to the amplifier for measurements at a distance of 3 meters has losses given in table 9.

| Frequency (MHz) | Antenna factor (dB/m) | Frequency (MHz) | Antenna factor (dB/m) |
|-----------------|-----------------------|-----------------|-----------------------|
| 0.009 | - 21.8 | 0.8 | - 35.2 |
| 0.01 | - 22.7 | 1 | - 35.2 |
| 0.015 | - 25.7 | 1.5 | - 35.3 |
| 0.02 | - 28.4 | 2 | - 35.4 |
| 0.03 | - 31.2 | 3 | - 35.4 |
| 0.05 | - 33.6 | 5 | - 35.4 |
| 0.08 | - 34.7 | 8 | - 35.4 |
| 0.1 | - 35.0 | 10 | - 35.4 |
| 0.15 | - 35.4 | 15 | - 35.4 |
| 0.2 | - 35.5 | 20 | - 35.7 |
| 0.3 | - 35.5 | 25 | - 36.1 |
| 0.5 | - 35.4 | 30 | - 36.9 |

TABLE 1 : ACTIVE LOOP ANTENNA

| Frequency (MHz) | Antenna factor (dB/m) | Frequency (MHz) | Antenna factor (dB/m) |
|-----------------|-----------------------|-----------------|-----------------------|
| 30 | 18.9 | 90 | 8.5 |
| 35 | 17.1 | 100 | 10.1 |
| 40 | 15.1 | 120 | 13.0 |
| 45 | 13.3 | 140 | 14.5 |
| 50 | 11.5 | 160 | 15.5 |
| 60 | 8.0 | 180 | 15.7 |
| 70 | 6.4 | 200 | 16.1 |
| 80 | 6.9 | - | - |

TABLE 2 : BICONICAL ANTENNA

| Frequency (MHz) | Antenna factor (dB/m) | Frequency (MHz) | Antenna factor (dB/m) |
|-----------------|-----------------------|-----------------|-----------------------|
| 200 | 24.0 | 700 | 20.6 |
| 300 | 14.5 | 800 | 21.1 |
| 400 | 16.8 | 900 | 22.2 |
| 500 | 17.9 | 1000 | 23.2 |
| 600 | 19.5 | - | - |

TABLE 3 : LOG-PERIODIC ANTENNA

| Frequency (MHz) | Loss (dB) | Frequency (MHz) | Loss (dB) |
|-----------------|-----------|-----------------|-----------|
| 0.009 | 0.0 | 6.000 | 0.5 |
| 0.020 | 0.0 | 7.000 | 0.5 |
| 0.050 | 0.0 | 8.000 | 0.5 |
| 0.100 | 0.0 | 9.000 | 0.6 |
| 0.500 | 0.1 | 10.00 | 0.6 |
| 1.000 | 0.2 | 15.00 | 0.7 |
| 2.000 | 0.2 | 20.00 | 0.8 |
| 3.000 | 0.3 | 25.00 | 1.0 |
| 4.000 | 0.4 | 30.00 | 1.1 |
| 5.000 | 0.4 | - | - |

TABLE 4 : TEST CABLE FOR 30M MEASUREMENT INTO 9 kHz AND 30 MHz

| Frequency (MHz) | Loss (dB) | Frequency (MHz) | Loss (dB) |
|-----------------|-----------|-----------------|-----------|
| 30 | 0.7 | 250 | 1.8 |
| 40 | 0.7 | 300 | 2.1 |
| 50 | 0.9 | 400 | 2.3 |
| 60 | 0.9 | 500 | 2.5 |
| 70 | 0.9 | 600 | 3.0 |
| 80 | 0.9 | 700 | 3.4 |
| 90 | 1.1 | 800 | 3.6 |
| 100 | 1.1 | 900 | 3.9 |
| 150 | 1.4 | 1000 | 4.1 |
| 200 | 1.6 | - | - |

TABLE 5 : TEST CABLE FOR 3M MEASUREMENT INTO 30 MHz AND 1 GHz

| Frequency (GHz) | Antenna factor (dB/m) | Frequency (GHz) | Antenna factor (dB/m) |
|-----------------|-----------------------|-----------------|-----------------------|
| 1.0 | 23.7 | 10.0 | 37.6 |
| 1.5 | 24.6 | 10.5 | 37.8 |
| 2.0 | 27.5 | 11.0 | 38.1 |
| 2.5 | 28.8 | 11.5 | 38.3 |
| 3.0 | 29.8 | 12.0 | 38.8 |
| 3.5 | 31.2 | 12.5 | 38.8 |
| 4.0 | 32.5 | 13.0 | 39.4 |
| 4.5 | 32.5 | 13.5 | 40.0 |
| 5.0 | 33.5 | 14.0 | 40.1 |
| 5.5 | 34.1 | 14.5 | 40.6 |
| 6.0 | 34.1 | 15.0 | 40.6 |
| 6.5 | 34.4 | 15.5 | 39.7 |
| 7.0 | 35.4 | 16.0 | 39.3 |
| 7.5 | 36.6 | 16.5 | 39.9 |
| 8.0 | 36.6 | 17.0 | 41.4 |
| 8.5 | 37.0 | 17.5 | 45.1 |
| 9.0 | 37.1 | 18.0 | 46.3 |
| 9.5 | 37.2 | | |

TABLE 6 : HORN ANTENNA

| Frequency (GHz) | Antenna factor (dB/m) | Frequency (GHz) | Antenna factor (dB/m) |
|-----------------|-----------------------|-----------------|-----------------------|
| 18.0 | 31.5 | 22.5 | 32.7 |
| 18.5 | 31.8 | 23.0 | 33.2 |
| 19.0 | 31.9 | 23.5 | 33.1 |
| 19.5 | 32.1 | 24.0 | 33.2 |
| 20.0 | 32.2 | 24.5 | 33.3 |
| 20.5 | 32.4 | 25.0 | 33.3 |
| 21.0 | 32.5 | 25.5 | 33.2 |
| 21.5 | 32.4 | 26.0 | 33.1 |
| 22.0 | 32.4 | - | - |

TABLE 7 : HORN ANTENNA

| Frequency (GHz) | Gain value (dB) | Frequency (GHz) | Gain value (dB) |
|-----------------|-----------------|-----------------|-----------------|
| 1.0 | 34.9 | 13.0 | 32.3 |
| 1.5 | 34.8 | 14.0 | 32.1 |
| 2.0 | 35.1 | 15.0 | 33.0 |
| 2.5 | 35.1 | 16.0 | 33.5 |
| 3.0 | 35.3 | 17.0 | 33.5 |
| 4.0 | 35.7 | 18.0 | 33.7 |
| 5.0 | 36.0 | 19.0 | 33.7 |
| 6.0 | 36.2 | 20.0 | 32.5 |
| 7.0 | 35.5 | 21.0 | 33.0 |
| 8.0 | 34.8 | 22.0 | 33.0 |
| 9.0 | 33.2 | 23.0 | 33.0 |
| 9.5 | 31.9 | 24.0 | 34.3 |
| 10.0 | 31.3 | 25.0 | 33.2 |
| 10.5 | 31.1 | 26.0 | 32.0 |
| 11.0 | 30.9 | | |
| 12.0 | 31.9 | | |

TABLE 8 : AMPLIFIER GAIN VALUE

| Frequency (GHz) | Loss (dB) | Frequency (GHz) | Loss (dB) |
|-----------------|-----------|-----------------|-----------|
| 1.0 | 3.4 | 12.0 | 10.9 |
| 1.5 | 4.2 | 13.0 | 11.5 |
| 2.0 | 4.8 | 14.0 | 12.2 |
| 2.5 | 5.3 | 15.0 | 12.4 |
| 3.0 | 6.1 | 16.0 | 12.9 |
| 3.5 | 6.6 | 17.0 | 13.3 |
| 4.5 | 7.5 | 18.0 | 13.6 |
| 5 | 8.2 | 19.0 | 14.3 |
| 6 | 9.1 | 20.0 | 14.7 |
| 8 | 9.9 | 22.0 | 15.6 |
| 10 | 11.6 | 24.0 | 16.6 |
| 11.0 | 10.4 | 26.0 | 17.0 |

TABLE 9: TEST CABLE FOR 3M MEASUREMENT INTO 1 TO 26 GHz

ANNEX 2

External photographs





ANNEX 3

Test setup photographs







ANNEX 4

Calibration dates

| N° EMITECH | LAST CALIBRATION | CALIBRATION DUE DATE |
|------------|------------------|----------------------|
| 1216 | 12/12/2011 | 12/12/2013 |
| 0187 | 15/03/2013 | 15/03/2016 |
| 3106 | 27/04/2012 | 27/04/2014 |
| 2452 | 24/10/2012 | 24/10/2014 |
| 2805 | 01/08/2013 | 01/08/2015 |
| 10229 | 01/03/2012 | 01/03/2014 |
| 3374 | 08/02/2012 | 08/02/2016 |
| 2864 | 14/12/2011 | 14/12/2013 |
| 8063 | 06/08/2012 | 06/08/2014 |
| 1097 | 15/03/2013 | 15/03/2015 |
| 1529 | 15/03/2013 | 15/03/2015 |
| 4691 | 15/03/2013 | 15/03/2015 |
| 5175 | 27/03/2012 | 27/03/2014 |
| 9579 | 22/10/2012 | 22/10/2014 |
| 4359 | 07/03/2012 | 07/03/2014 |
| 0317 | 19/08/2010 | 19/08/2014 |
| 1045 | 13/12/2010 | 13/12/2014 |
| 3229 | 25/10/2012 | 25/12/2013 |
| 8021 | 22/02/2013 | 22/02/2015 |