# TEST REPORT

Secondo i seguenti Standard / *According to following Standards*

| | |
|---|---|
| **Test Methods** | ANSI/TIA-603-D (2010) |
| **Test specification** | FCC CFR Title 47 Chapter 1 - Part 2: 2016 (Subpart J)<br>FCC CFR Title 47 Chapter 1 - Part 87: 2016 (Subpart D)<br><br>Test plan: / |

| | |
|---|---|
| Modulation Characteristics, FCC Part 2 Section 2.1047;<br>FCC Part 87 Section 87.141 | **Misurato/Measured** |
| RF Power Output, FCC Part 2 Section 2.1046;<br>FCC Part 87 Section 87.131 | **Misurato/Measured** |
| Frequency Stability, FCC Part 2 Section 2.1055;<br>FCC Part 87 Section 87.133 | **Conforme/*Compliant*** |
| Occupied Bandwidth, FCC Part 2 Section 2.1049;<br>FCC Part 87 Section 87.135 | **Misurato/Measured** |
| Spurious Emissions at Antenna Terminals, FCC Part 2 Section 2.1051;<br>FCC Part 87 Section 87.139 | **Conforme/*Compliant*** |
| Field Strength of Spurious Radiation, FCC Part 2 Section 2.1053;<br>FCC Part 87 Section 87.139 | **Conforme/*Compliant*** |

| | |
|---|---|
| **Richiedente / *Applicant's name*** ....: | Leonardo S.p.a. |
| Indirizzo / *Address* .....: | Piazza Montegrappa, 4 – 00195 – Roma – Italy |
| **Produttore / *Manufacturer*** .....: | Leonardo S.p.a. |
| Indirizzo / *Address* .....: | Piazza Montegrappa, 4 – 00195 – Roma – Italy |
| **Dispositivo sottoposto ai test/ *Device Under Test*** .....: | TRA-100B Mode S Transponder, model TAC-6003/03.05<br>FCC ID 2AKB2TRA100B |
| **Data di emissione/ *Date of issue*** | 18th November 2016 |
| **Validità / *Validity*** | Vedi sezione 1.1 / *See section 1.1* |
| **Test report redatto da/ *Author of Test report* .....** | Loris Fruch |
| **Tecnico/i di prova *Engineer/s*** ..... | Loris Fruch |
| **Approvato da (+ firma) *Approved by (+ signature)*.....** | Silvano Chialina<br>Responsabile del laboratorio/<br>*Head of the Laboratory* |
| **Laboratorio / *Testing Laboratory*** ..: | EmilabSrl |
| Indirizzo / *Address* .....: | Via F.lli Solari 5/A – 33020 Amaro (UD) - Italy |

Firmato digitalmente da
**SILVANO CHIALINA**
O = non presente
C = IT
.....

# Index

# 1. Informazioni Generali / *General Information*

## 1.0 Laboratorio / Testing Laboratory

| **Luogo di Prova e partecipanti/ *Testing location and participants:*** | |
|---|---|
| **Testing Laboratory**: | |
| Testing location/ address ..... : | EmilabSrl<br>Via F.lli Solari 5/A – 33020 Amaro (UD) – Italy<br>Tel +39 0433 468625<br>Fax +39 0433 494739<br>Email: info@emilab.it |
| Partecipanti / *Participants*: | Loris Fruch |

## 1.1 Campionamento e Documentazione / *Sampling and Documentation*

I campioni sono stati consegnati dal Cliente. I risultati dei test contenuti in questo documento si riferiscono esclusivamente al modello e numero di serie provato. E' responsabilità del costruttore assicurare che la produzione dei modelli in serie rispetti i requisiti del presente documento. Questo documento non può essere riprodotto in parte senza il consenso scritto del responsabile del laboratorio EMILAB.

EMILAB non si assume nessuna responsabilità per danni derivanti da interpretazioni che esulano dal contesto e dall'applicazione del presente documento.

*The samples was delivered by customer. The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report. This report shall not be reproduced, except in full, without the written approval of the Issuing testing Emilab laboratory.*

*EMILAB takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.*

## 1.2 Specifiche del test / *Test specifications*

| **Test performed according to:** | |
|---|---|
| Test plan | / |
| Test specification | FCC CFR Title 47 Chapter 1 - Part 2: 2016 (Subpart J)<br>Code of Federal Regulations – Telecommunications Federal Communications Commission Frequency Allocations and Radio Treaty Matters; General Rules and Regulations Equipment Authorization. Procedures Revised as of November 1, 2016;<br><br>FCC CFR Title 47 Chapter 1 - Part 87: 2016 (Subpart D)<br>Code of Federal Regulations – Telecommunications Federal Communications Commission Aviation Services Technical Requirements.<br>Revised as of November 1, 2016<br>FCC CFR Title 47 Chapter 1 - Part 87: Not Accreditated by ACCREDIA |
| Test Method/Basic Standard | ANSI/TIA-603-D (2010) Land Mobile FM or PM Communications Equipment Measurement and Performance Standards. |

## 1.3 Svolgimento dei test e condizioni generali / *Test scheduling and general condition*

| | |
|---|---|
| **Svolgimento dei test/ *Scheduling*** ..... : | |
| Data ricezione EUT | |
| *Date of receipt of EUT* ..... : | 07/11/2016 |
| Data esecuzione test | |
| *Date (s) of performance of tests* ..... : | 08/11/2016 – 16/11/2016 |
| **Condizioni ambientali / *Environment Conditions*** | Se non diversamente specificato / *If not otherwise specified:*<br>Temperature: 18-28°C<br>Humidity: 20-90%<br>Pressure: 87-108.56 kPa |
| **Intervallo delle tarature/ *Calibration Interval*** | Minimum 1 year |

## 1.4 Espressione dei risultati finali / *Test case of final verdicts*

| | |
|---|---|
| **I GIUDIZI NON SONO SOGGETTI AD ACCREDITAMENTO** | |
| **/*VERDICTS ARE NOT SUBJECT TO ACCREDITATION*** | |
| - test case does not apply to the test object.. : | N/A |
| - test object does meet the requirement..... : | Compliant or PASS |
| - test object does not meet the requirement.. : | Not Compliant or FAIL |

## 1.5 Incertezza / *Uncertainty*

L'incertezza estesa riportata è espressa come l'incertezza tipo moltiplicata per il fattore di copertura k = 2, che per una distribuzione normale corrisponde ad una probabilità di copertura di circa il 95 %.

*The reported expanded uncertainty of measurements is stated as the standard uncertainty of measurement, multiplied by the coverage factor k=2, which for a normal distribution corresponding to a coverage probability of approximately 95%.*

## 1.6 Termini, Definizioni e Acronimi/ *Terms, definitions and abbreviations*

| | |
|---|---|
| AC | Alternating Current |
| ACK | Acknowledgement |
| AFH | Adaptive Frequency Hopping |
| AM | Amplitude modulation |
| AVE det | Average Detector |
| BIT | Burst Interval Time |
| CAC | Channel Availability Check |
| BW | BandWidth |
| CCA | Clear Channel Assessment |
| CW | Continuous Wave |
| DAA | Detect And Avoid |
| DC | Duty Cycle DFS |
| DFS | Dynamic Frequency Selection |
| DSSS | Direct Sequence Spread Spectrum |
| DUT | Device Under Test |
| EIRP | equivalent isotropically radiated power |
| EMC | Electro Magnetic Compatibility |
| EUT | Equipment Under test |
| FAR | Fully Anechoic Room |
| FM | Frequncy Modulation |
| FHSS | Frequency Hopping Spread Spectrum |
| HT20 High | Throughput in a 20 MHz channel |
| HT40 High | Throughput in a 40 MHz channel |
| LBT | Listen Before Talk |
| LPDA | Logarithmic Periodic Dipole Antenna |
| MCS | Modulation Coding Scheme |
| MIMO | Multiple Input, Multiple Output |
| MU | Medium Utilisation |
| MS/s | Mega-Samples per second |
| NACK | Not Acknowledged |
| OATS | Open Air Test Site |
| OFDM | Orthogonal Frequency Division Multiplexing |
| OM | Operating Modes |
| OOB | Out Of Band |
| PK det | Peak Detector |
| PM | pulse modulation |
| Ppm | parts per million |
| PPS | Pulses Per Second |
| PRF | Pulse Repetition Frequency |
| RBW | Resolution BandWidth |
| RE | Radiated Emission |
| RMS | Root Mean Square |
| RF | Radio Frequency |
| Rx | Receiver |
| SAC | Semi Anechoic Chamber |
| TL | Threshold Level |
| TPC | Transmit Power Control |
| Tx | Transmitter |
| VBW | Video BandWidth |
| VSWR | voltage standing wave ratio |

## 2.0 Apparecchiatura sottoposta a test/ *Device Under Test*

| | |
|---|---|
| **Descrizione/ *Description* ..... :** | TRA-100B Mode S Transponder |
| Marchio commerciale / *Trade Mark*..... : |  |
| Produttore / *Manufacturer* ..... : | Leonardo S.p.a. |
| Modello / *Model/Type reference*..... : | TAC-6003/03 Rev. 05 |
| Voltage/Current ..... : | 115V |
| Frequency ..... : | 380-400Hz |
| Power ..... : | <60W |
| Numero EUT / *EUT Number* ..... : | 16LA00343/01 |
| Serial Number ..... : | S16419478 |
| FCC ID..... : | 2AKB2TRA100B |
| Numero di campioni testati / *Number of samples tested* ..... : | 1 |
| Hardware stage/level ..... : | 05 |
| Software stage/level..... : | TBR-6001/01.08 (revisione 08) |
| Firmware stage/level ..... : | TIS-5432/03.06 (revisione 06) |
| Modification stage ..... : | / |
| Operating Mode..... : | Mode 1 (120 Mode S Long)<br>Mode 2 (1200 ATCRBS)<br>Mode 3 (1200 ATCRBS + 120 Mode S Long) |
| Wiring harness ..... : | 2mt power supply cable, 8mt Control cable, 2mt TOP and BOTTOM antenna cables.<br>For “Field Strength of Spurious Radiation” test all the cables were 8mt long. |
| Monitoring..... : | / |

Info:

The EUT is an Aircraft station transmitter.

**Product family description:**

The TRA-100B Transponder family is composed by the following equipment:
1. TRA-100B for Airbus platforms with code: TAC-6001/03.05
2. TRA-100B for Boeing platforms with code: TAC-6003/03.05
3. TRA-100B for EASA/FAA platforms with code: TAC-6004/03.05

**Tested model**: the device selected for the tests as representative of the above described family is the model TAC-6003/03 Rev. 05.

**Justification**: As stated in the Qualification Strategy document 6AA-FI100190 REV 03: 10/2016, the three P/Ns relevant the TRA-100B family share the same OSW TBR-6001/01 and the same HW/FW TAD-6001/03. The difference is related to the way in which the same SW is executed on the same HW: in fact at production time the setting of a specific register of the equipment dedicated PROM within DPIO HWCI is performed with the specific platform configuration parameter (HW P/N) related to each platform thus justifying the three different P/Ns associated to each of them. Some different functionalities are activated by the unique OSW CSCI that is triggered by the mentioned platform configuration code. In detail, during the equipment startup the platform configuration code is recovered from the specified PROM and stored into a dedicated FPGA register and then it is read by OSW CSCI and stored into a specific volatile memory register. At any time a platform dependent function is to be executed, the OSW CSCI checks the value of such a stored configuration code and then the required function is accordingly executed.

Specifically the main OSW CSCI functionalities differences are:
1. Boeing configuration uses ARINC labels 360 for flight ID, while Airbus one uses ARINC labels from 233 to 237
2. the Maintenance bus is used by Airbus configuration both in Normal and in Interactive Mode, while it is used only in Normal Mode by Boeing one
3. ARINC labels used for different ARINC ports can differ from a configuration to another one.

Complete and detailed information are recorded into Equipment Specification document (Ref. D6).
Basing on what detailed above, the three equipment configurations are therefore composed by the same OSW TBR-6001/01, the same HW/FW TAD-6001/03 and differs for identification labels (same material and dimensions, different text content).

EUT Hardware features
These information are confidentially and were provided to the FCC.

Auxiliary equipment for tests supplied by the applicant:
- Control PC with ARING 429 PCB board model ALTADATA
- IFF-45TS IFF test bench

Test software installed on Control PC:
- Altaview Bus Analyser version 2.6.3.0;
- IFF-45TS Remote Control for Mode S, version 2.31 beta

## 3.0 Modulation Characteristics - Condizioni di prova / *Test Conditions*

| | | |
|---|---|---|
| Technician / Tecnico: Loris Fruch | | |
| Table No. | TEST: Modulation Characteristics, FCC Part 2 Section 2.1047 | \ |
| Method | / | \ |
| Parameters required prior to the test | Laboratory Ambient Temperature | 18 to 28 °C |
| | Relative Humidity | 20 to 90 % |
| Parameters recorded during the test | Laboratory Ambient Temperature | 21 °C |
| | Relative Humidity | 58 % |

Supplementary information:

- Conducted Test, executed on video detector taken at “PROG OUT1” output of the IFF45TS connected to the Oscilloscope;
- EUT powered at 115Vac 400Hz;
- Test executed with the following EUT Operating Mode (see par. 2.0):
  - Mode 1 (120 Mode S Long)
  - Mode 2 (1200 ATCRBS)

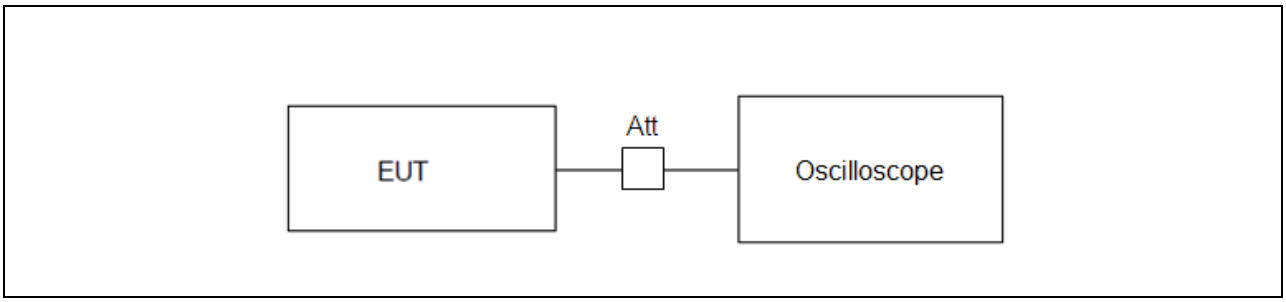
## 3.1 Apparecchiature utilizzate / *Test Equipment Used* – Modulation Characteristics

| ***Apparecchiature usate/Equipment Used*** | ***Modello/Model*** | ***Costruttore/ Manufacturer*** | ***Numero di serie/ Serial Number*** | **Data calibrazione / *Calibration date*** | **Intervallo / *Interval*** |
|---|---|---|---|---|---|
| Oscilloscope | DSO9254A | Agilent | MY52090217 | 12/2015 | 1 year |
| RF Cable | R284C0351050 | Radiall | EL086215 | 10/2016 | 1 year |
| RF Cable TOP | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| RF Cable BOTTOM | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| 2dB Attenuator | PE7085-2 | Pasternack | EL091816 | 10/2016 | 1 year |
| 6dB Attenuator | PE7021-6 | Pasternack | EL017308 | 06/2016 | 1 year |
| 6dB Attenuator | 75-A-MFN-06 | BIRD | 9825 | 02/2016 | 1 year |
| 30dB Attenuator | SBW-N30W5 | Spin | EL041210 | 06/2016 | 1 year |
| AC Power Supply | KBT-100-C-109-451 | BEHLMAN | 5896 | 12/2015 | 1 year |

### 3.1.1 Apparecchiature ausiliarie / *AuxiliaryEquipment*

| **Apparecchiature usate / *Used Equipment*** | **Modello / *Model*** | **Costruttore /*Manufacturer*** | **Numero di serie / *Serial Number*** |
|---|---|---|---|
| PCB board (installed on PC) | ARING 429 | Altadata | / |
| Test bench | IFF-45TS IFF | Aeroflex Wichita INC. | 1000000001 |

## 3.2 Fotografie del setup / *Photo of the test setup* – Modulation Characteristics




## 3.3 Requisiti / *Requirements* - Modulation Characteristics

FCC Section 2.1047 (d) states: “A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.”

FCC Section 2.1049 goes on to describe conditions of this test for various widely used modulation formats. The relevant section to the EUT in question is paragraph 2.1049(d), which states: “Transmitters designed for other types of modulation — when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.”

**That description extracted from the EUT Component Maintenance Manual (CMM) Issue No. 02 of 2016/08 par. 4 follows**.

**TRA-100B Mode S Transponder – Modes Operation**

The basic XPDR System consists of a transponder, a control unit, two antennas, and installation hardware. Communications for the control of the remote transponder are by one-way ARINC 429 bus.

If the transponder is part of a TCAS installation, two-way communications by ARINC 429 data bus are also utilized between the transponder and the TCAS. The transponder will perform normal Air Traffic Control (ATC) functions whether it is or is not part of the TCAS system; however the TCAS system cannot function without the transponder. Antenna diversity operation of the transponder is a requirement for TCAS installations.

The transponder is capable of accepting altitude (air data) information from a variety of optional sources. These include the ARINC 575 and ARINC 706 Air Data Computers. Furthermore, selection between a primary and secondary input for each of these sources is provided.

An input and output ARINC 429 Maintenance Interface is provided that conforms to ARINC 604 and OEM specific requirements.

The transponder may also receive ARINC 429 data from a variety of equipment (i.e. Inertial Reference System (IRS)/Flight Management System (FMS), Data Concentrator, Flight Management Computer (FMC)/Global Navigation Satellite System (GNSS), FMC Gen, Flight Control Computer (FCC)/Maintenance Computer Program (MCP), Control Head, and Air Data System (ADS)).

This data will be utilized to populate:

- Flight Identification required for Elementary Surveillance
- Downlink Aircraft Parameters required for Enhanced Surveillance
- ADS-B Extended Squitters.

The XPDR performs its intended function and not create a hazard to users of the National Airspace System (NAS).

The Transponder TRA-100B is a avionics equipment capable to provide the Mode S Transponder function required by Technical Standard Order (ETSO-C112d/TSO-C112e).
It also provides Extended Squitter ADS-B Out function required by ETSO-C166b/TSO-C166b.
The TRA-100B is designed to be a Level 2 transponder.

For Level 1 includes the following capabilities:

- Mode A identity and Mode C pressure-altitude reporting,
- Air Traffic Control Radar Beacon System (ATCRBS)/Mode-S and Mode S all-call transactions,
- Addressed surveillance altitude and identity transaction,
- Lockout protocols,
- Basic data protocols except data link capability reporting, and
- Air-to-air service and squitter transactions.

For Level 2 includes the following capabilities:

- Bi-directional air-to-air information exchange
- Ground-to-air data uplink, Comm-A
- Air-to-ground data downlink, Comm-B
- Multisite message protocol
- Data link capability reporting
- Aircraft identification reporting
- Traffic Alert and Collision Avoidance System (TCAS)/Airborne Collision Avoidance System (ACAS) crosslink capability

Furthermore the TRA-100B contains the following optional additional features (associated ID code for transponder marking):

- TCAS Compatibility (a)
- Antenna Diversity (d)
- Extended Squitter (e)
- Enhanced Surveillance (including Elementary Surveillance) (n)
- Surveillance Identifier Code (s)

Among the above characteristics, the Transponder TRA-100B:

- exceeds the minimum output power level of 125 watts required by Class 1 equipment as defined in RTCA/DO-181E. Therefore, the XPDR transponder marking for TSO-C112e is Level 2adens, Class 1.

- exceeds the minimum output power level of 125 watts required by Class A1 transmit only equipment as defined in RTCA/DO-260B. Therefore, the XPDR transponder marking for TSO-C166b is Class A1 transmit only.

**ATCRBS System Operation**

The ATCRBS system can be defined as “a secondary surveillance radar system developed for use within the air traffic control system for more precise position reporting of planes. It is used in conjunction with the primary radar, which is used to determine the presence of planes in the airspace. ATCRBS supplements this positional information with positive identification and altitude information allowing controllers to track each plane more precisely and efficiently .”1

In this scenario the ATC ground based interrogator transmits an interrogation by means of sequence of pulses at a frequency of 1030 MHz and call all transponders for a response on the mode being used to reply. The received replies will be displayed on the ATC radar screen.

Analog to the ground based interrogator, an airborne TCAS device may transmits interrogation for airborne traffic. TCAS can detects direction and altitude of an aircraft equipped with a transponder.

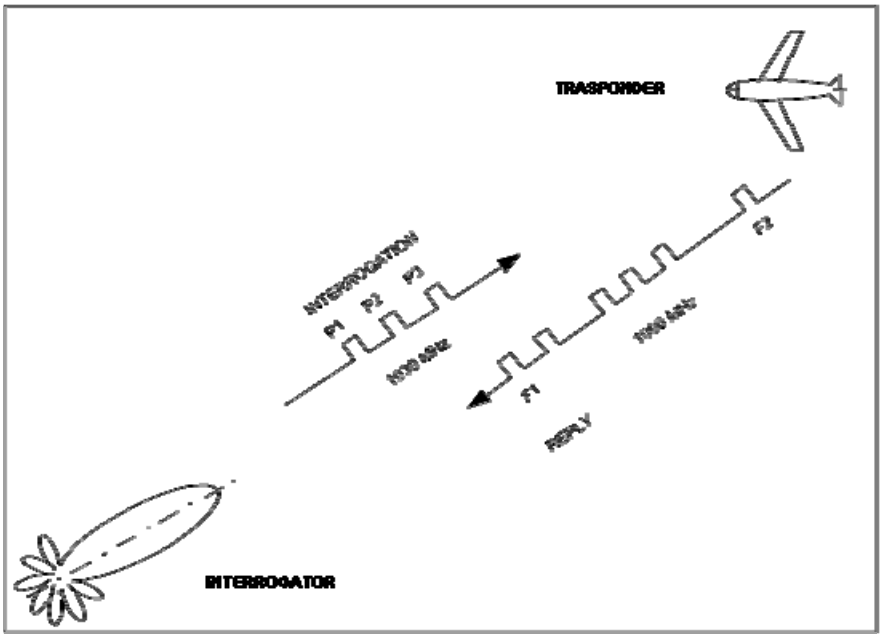



**Figure 0-1 – ATCRBS System**

**ATCRBS Transmission Overview**

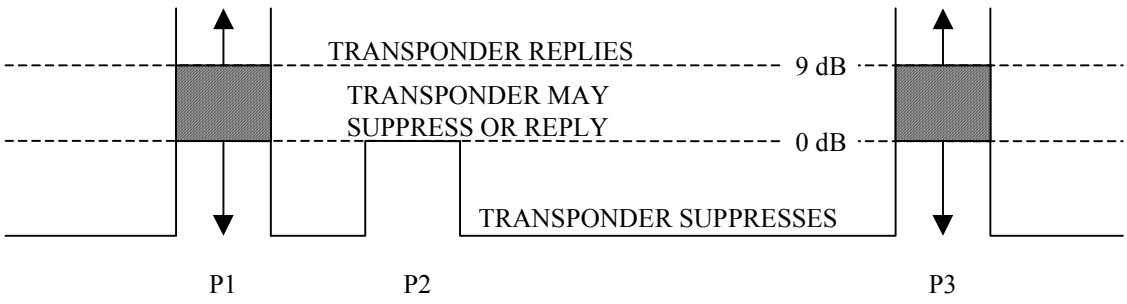
The Air Traffic Control Radar Beacon System (ATCRBS) interrogates aircraft with either Mode A or Mode C. The Mode A interrogation requests the aircraft identification code. The Mode C interrogation requests the aircraft altitude. Any aircraft in the beam of the radar replies.

In order to prevent an undesired reply from an aircraft which are not in the main beam the Side Lobe Suppression (SLS) technique is used.

Looking at the radius antenna diagram, leaking signals (called side lobes), can be identified as interrogation by aircrafts which are not the desired targets.

The interrogation represented in Figure 0-2 would has multiplies replies from Target 1, 2 and 3.

The interrogation represented in Figure 0-3 will receive a reply from Target 1 according to the following diagram:




SLS can also be used to avoid the reflection effects.

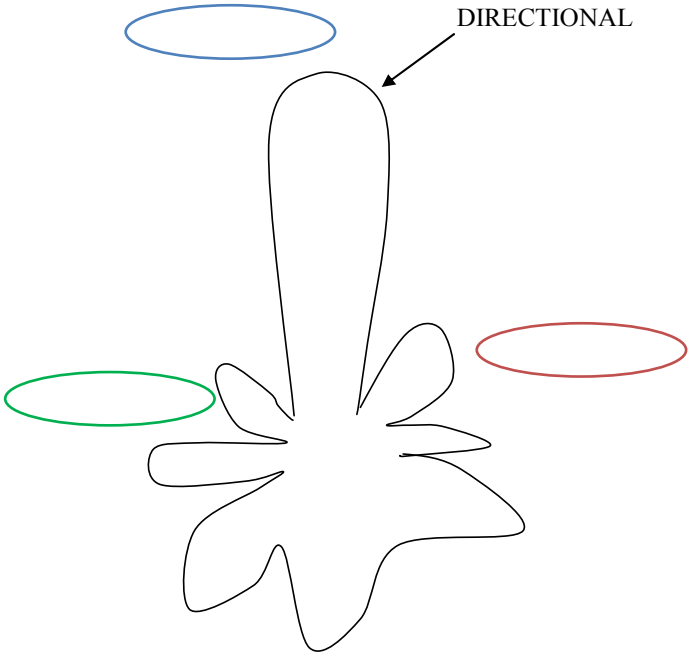



**Figure 0-2 – ATCRBS Interrogation without Side Lobe Suppression (SLS)**

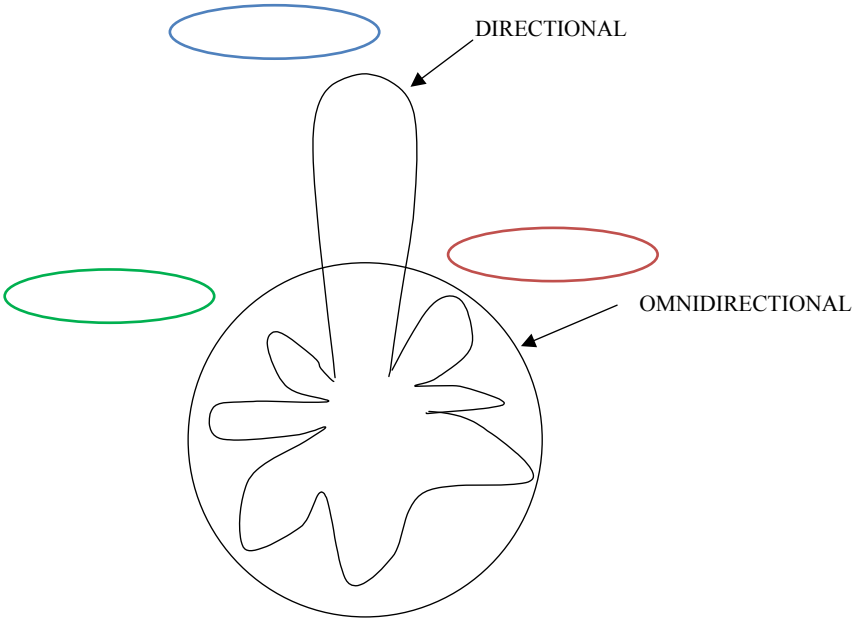



**Figure 0-3 – ATCRBS Interrogation with Side Lobe Suppression**

**OVERVIEW OF MODE S**

Mode Select (Mode S) is a combined secondary surveillance radar beacon system with ground-air-ground and air-air data link capability.

It includes a 24-bit aircraft technical address which provides more than 16 million unique addresses, allowing the interrogator to select then interrogate a specific aircraft of interest.

Each discrete interrogation contains the unique address of the aircraft for which it is intended and elicits a response dependent upon the level of capability of the corresponding transponder.

Civil aircraft have a permanently assigned technical address.

Implementation of a Mode S interrogation capability improve the existing systems in the following ways:

- Aircraft state (heading, speed, etc.) and aircraft intent information is available via Mode S selective interrogations.
- Adaptive re-interrogation will significantly improve the probability of detecting an aircraft that is in a marginal signal condition.
- The Mode S signal structure will provide improved error detection and correction.
- More than sixteen million transponder addresses will allow unique identification of all aircraft.
- Refined range and position accuracy is made possible via Mode S GPS squitter and/or Mode S datalink.

**Signal Characteristics**

Mode S is fully backwards compatible with the existing Air Traffic Control Radar Beacon System (ATCRBS).
Mode S transponders respond to Mode S interrogations.
Mode S interrogators can interrogate ATCRBS or Mode S transponders.
Both systems use the same interrogation and reply frequencies (1030 MHz and 1090 MHz, respectively).

Mode S-only interrogations use binary differential phase shift keying modulation (DPSK) at 4 MB/sec and Mode S replies have binary pulse position modulation (PPM) at 1 MB/sec.

The Mode S coding structure provides enhanced error detection and correction (less than 1 undetected error in 108 messages). Mode S is not secure or jam-resistant and is not intended to replace the encrypted military Mode 4.

Mode S has two basic message lengths: 56 bits and 112 bits.
The 56 bit surveillance formats include a 32 bit command field and a 24 bit address field.
The 112 bits communication formats include a 32 bit command field, a 56 bit data field and a 24 bit address field.
The 112 bit extended length message formats include an 8 bit command field, an 80 bit data field and a 24 bit address field.

**Interrogation Process**

Fully operational Mode S interrogators or clusters of interrogators are allocated on interrogator identification (II) code which, in conjunction with the unique aircraft technical address, enables linking between the interrogator and the aircraft of interest.

All-call interrogations are sent to all aircraft in a region to obtain the corresponding 24-bit technical addresses. These addresses are maintained in an internal database and, once the address is obtained, the all-call acquisition doesn't need to be repeated for that aircraft.

Upon receiving the technical address, the interrogator sends a lockout message to inhibit the corresponding transponder form replying to further Mode S all-call interrogations from any sensor with that interrogator identification code. Lockout is refreshed each antenna scan as part of the normal surveillance protocol and time-out occurs in 18 seconds if no further lockout commands are received. The interrogator also has the provision (lockout override") to command a transponder to respond regardless of the lockout status effect.

Once it has the unique transponder address, the interrogator can selectively interrogate to obtain altitude and Mode 3/A codes for Mode S to Mark XII correlation or other useful information.

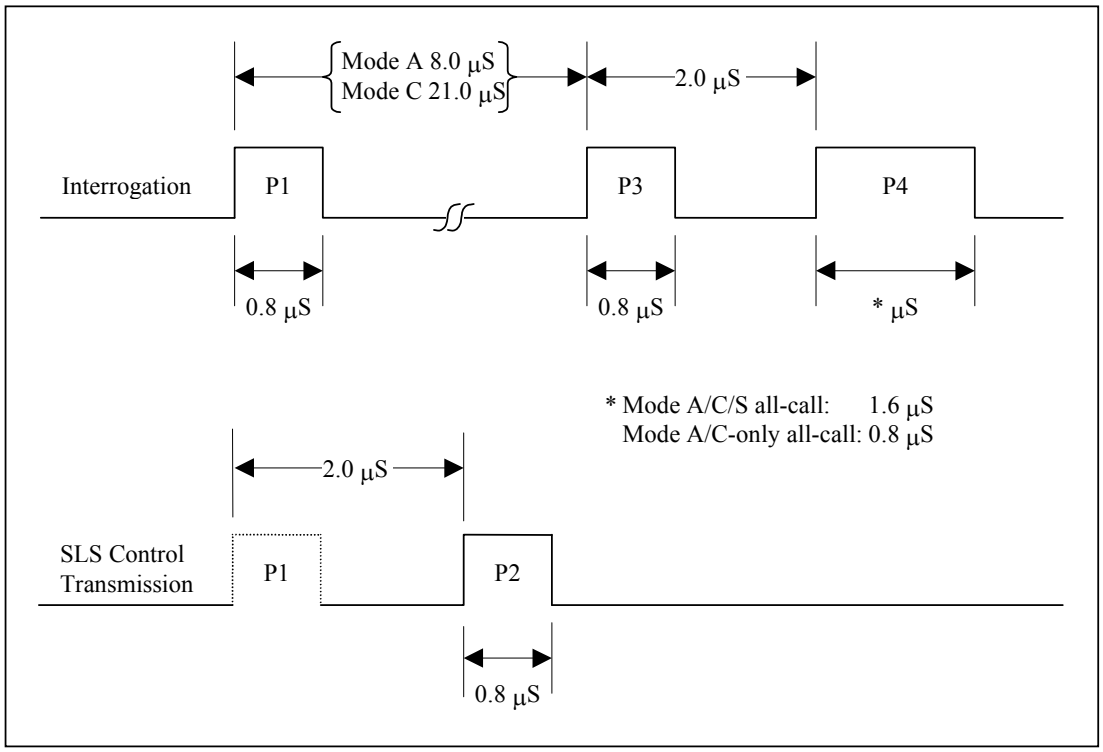



Figure 0-4 – Intermode (Mode A/C and S) Interrogation **Pulse Sequence**

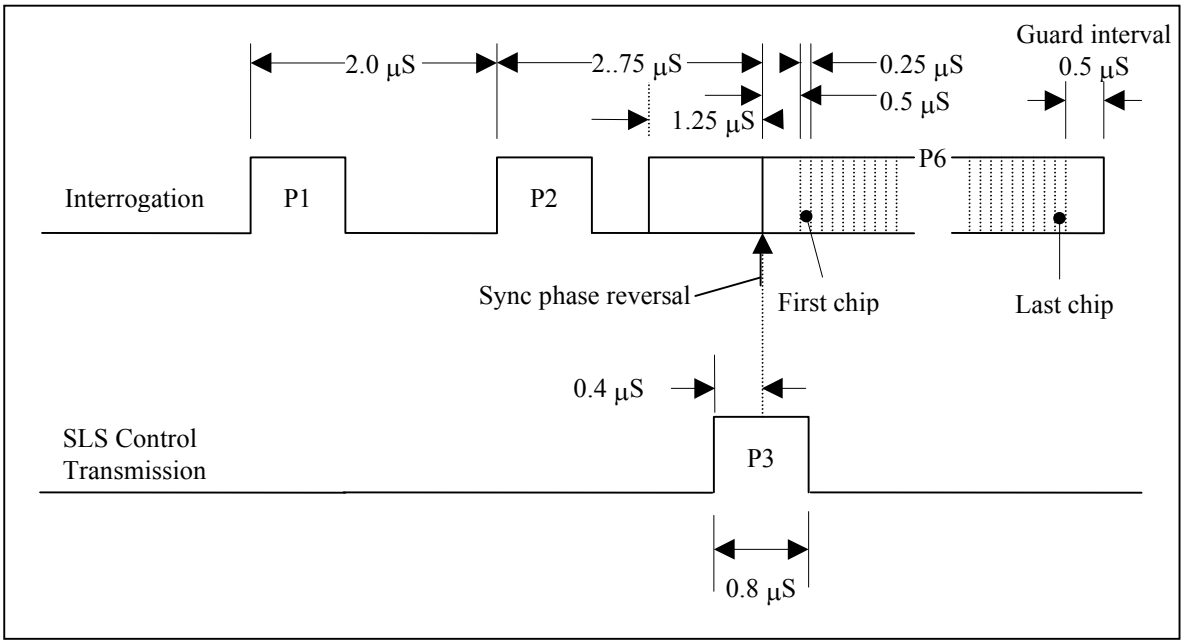



**Figure 0-5 – Mode S Interrogation Pulse Sequence**

The mode S reply consist of a long train of 0.5 µs and 1.0 µs pulses lasting for up to 130 µs. It is possible that such a train of pulses would give rise to multiple SSR bracket detections which could overload the plot extractor and effect its proper operation. It is advisable

FCC Test Firm Registration #: 643914

that an SSR plot extractor design should anticipate the introduction of Mode S and include circuitry to provide protection against Mode S replies.
In order to detect a Mode S reply it is only necessary to detect the four Mode S preamble pulses. These pulses are detected as follows:

- a second pulse leading edge occurs 7-9 clock periods after detection of the first pulse leading edge;
- a third pulse leading edge occurs 28-30 clock periods after detection of the first pulse leading edge;
- a fourth pulse leading edge occurs 36-38 clock periods after detection of the first pulse leading edge.

The detection of a Mode S preamble should suppress bracket detection for a period of 120 μs (994 clock periods). After preamble detection the train of pulse leading edges should be monitored for a gap of at least 22 clock periods. Such a gap would exceed that which is possible in a Mode S reply and would indicate that the preamble had been spurious, possibly owing to chance overlapping fruit replies. If a gap of that size is detected, the bracket detection suppression should be released so that SSR reply processing can resume.

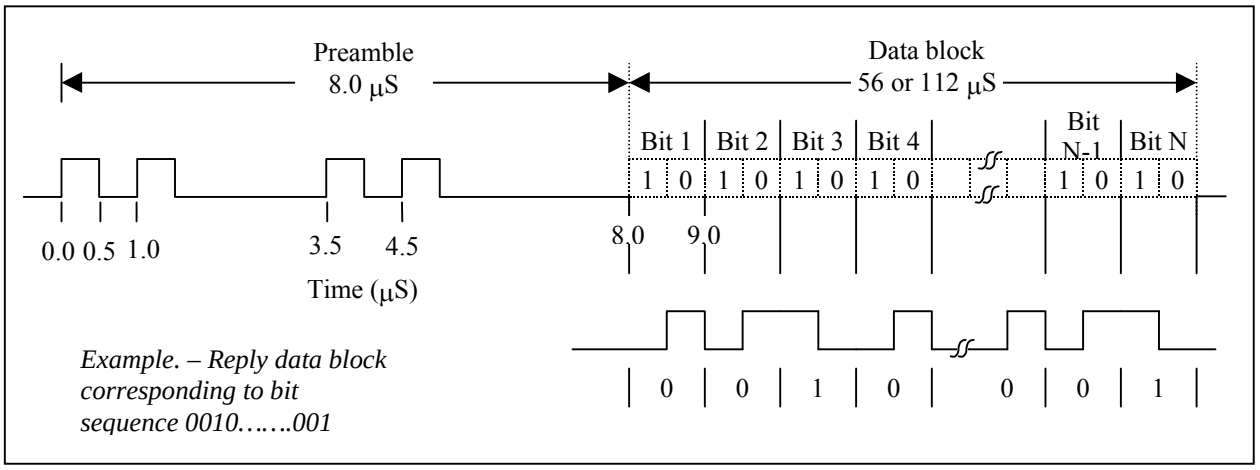
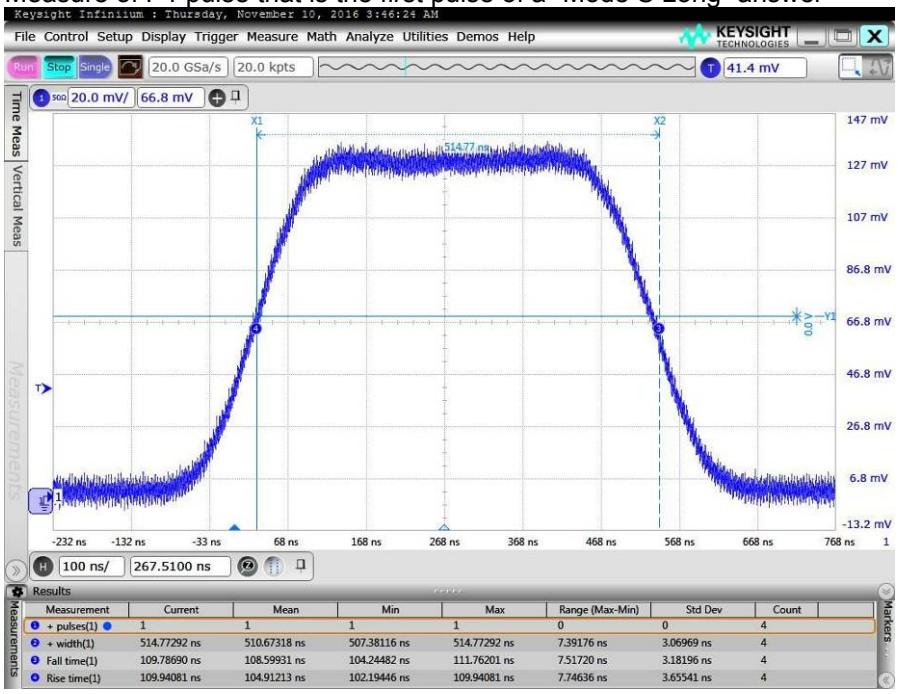



**Figure 0-6 – Mode S Reply**

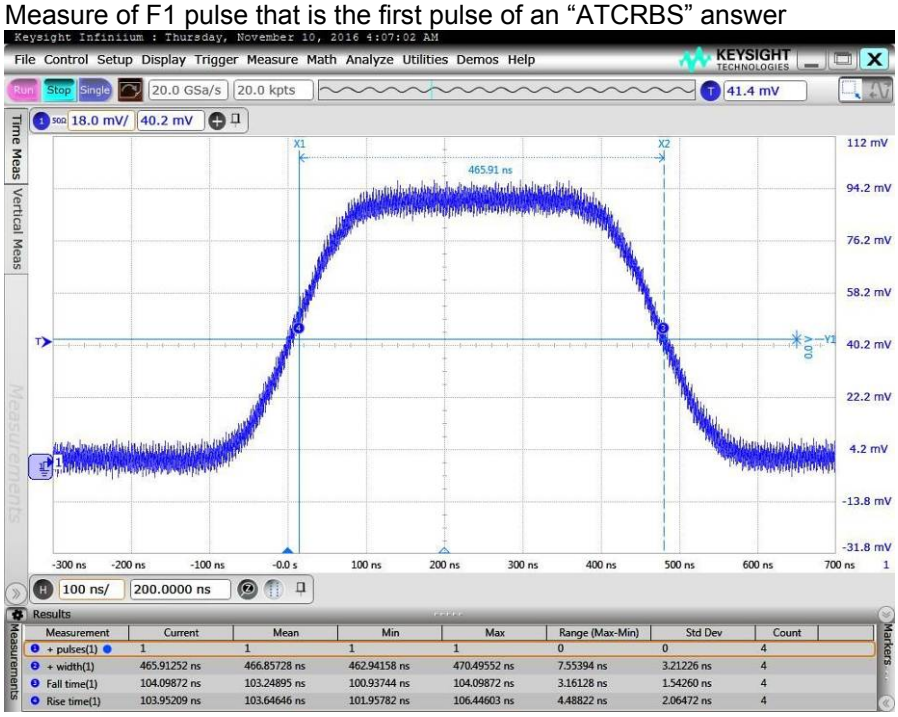
## 3.4 Misure / Measures - Modulation Characteristics

These measures were performed on the Top Antenna Output, the measures performed on the Bottom Antenna Output are similar to these.

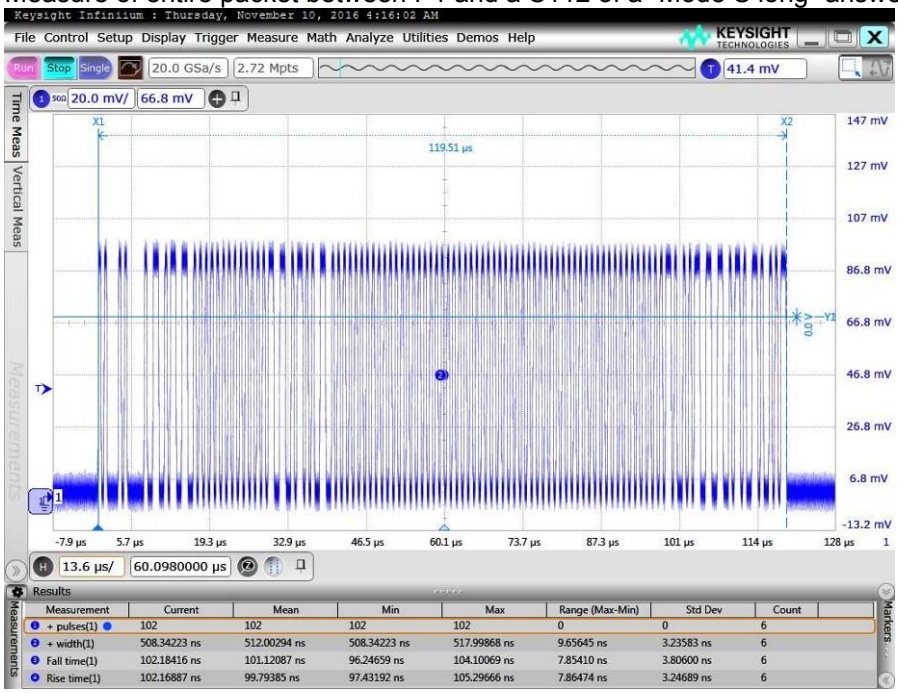
Measure of P1 pulse that is the first pulse of a “Mode S Long” answer



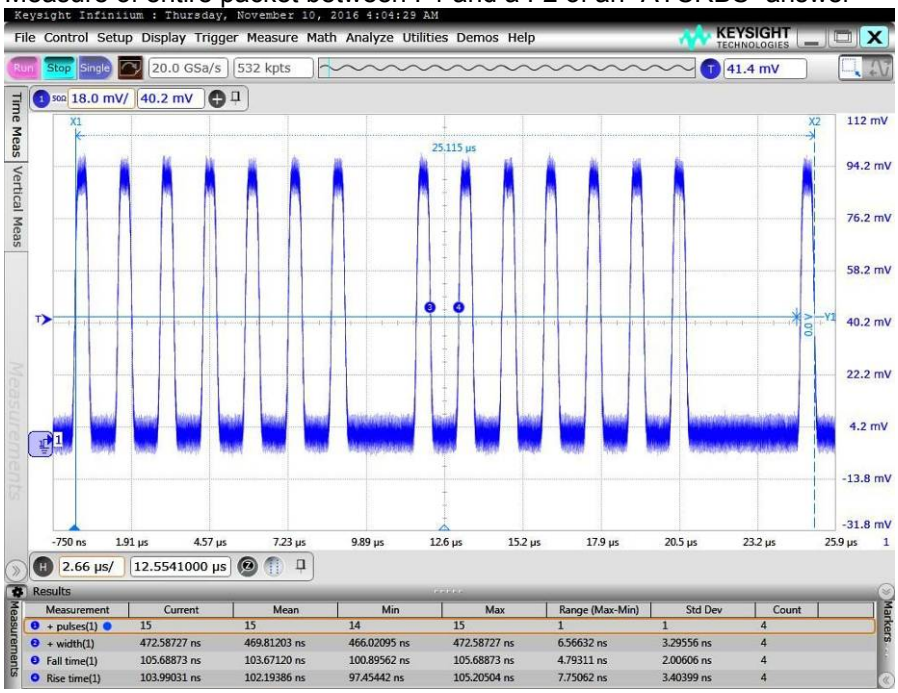

Measure of F1 pulse that is the first pulse of an “ATCRBS” answer



Measure of entire packet between P1 and a S112 of a “Mode S long” answer




Measure of entire packet between F1 and a F2 of an “ATCRBS” answer



## 4.0 RF Power Output - Condizioni di prova / *Test Conditions*

| | | |
|---|---|---|
| Technician / Tecnico: Loris Fruch | | |
| Table No. | RF Power Output, FCC Part 2 Section 2.1046;<br>FCC Part 87 Section 87.131 | \ |
| Method | / | \ |

| | | |
|---|---|---|
| Parameters required prior to the test | Laboratory Ambient Temperature | 18 to 28 °C |
| | Relative Humidity | 20 to 90% |
| Parameters recorded during the test | Laboratory Ambient Temperature | 21 °C |
| | Relative Humidity | 60 % |

Supplementary information:

- Conducted Test, executed at antenna output (50ohm, ARINC600) TOP and BOTTOM connected to the Spectrum Analyser through an attenuator (43 dB);
- EUT powered at 115Vac 400Hz;
- Tuned frequency: 1090MHz;
- Test executed with the following EUT Operating Mode (see par. 2.0):
  - Mode 1 (120 Mode S Long)
  - Mode 2 (1200 ATCRBS)
  - Mode 3 (1200 ATCRBS + 120 Mode S Long)
- Spectrum analyser settings setup:
  - Detector: Peak
  - RBW: 1MHz and VBW=3MHz for measures with EUT in operating mode 3
  - RBW: 3MHz and VBW=3MHz for measures with EUT in operating mode 1 and 2
  - Instrument mode: Channel Power

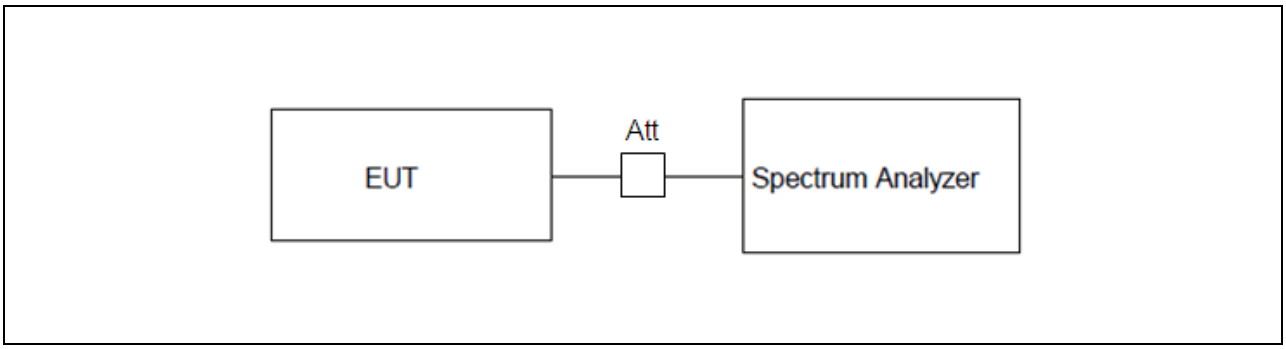
## 4.1 Apparecchiature utilizzate / *Test Equipment Used* – RF Power Output

| ***Apparecchiature usate/Equipment Used*** | ***Modello/Model*** | ***Costruttore/ Manufacturer*** | ***Numero di serie/ Serial Number*** | **Data calibrazione / *Calibration date*** | **Intervallo / *Interval*** |
|---|---|---|---|---|---|
| EMI Receiver MXE | N9038A | Agilent Technologies | MY51210230 | 06/2016 | 1 year |
| RF Cable | R284C0351050 | Radiall | EL086215 | 10/2016 | 1 year |
| RF Cable TOP | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| RF Cable BOTTOM | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| 2dB Attenuator | PE7085-2 | Pasternack | EL091816 | 10/2016 | 1 year |
| 6dB Attenuator | PE7021-6 | Pasternack | EL017308 | 06/2016 | 1 year |
| 6dB Attenuator | 75-A-MFN-06 | BIRD | 9825 | 02/2016 | 1 year |
| 30dB Attenuator | SBW-N30W5 | Spin | EL041210 | 06/2016 | 1 year |
| AC Power Supply | KBT-100-C-109-451 | BEHLMAN | 5896 | 12/2015 | 1 year |

### 4.1.1 Apparecchiature ausiliarie / *Auxiliary Equipment*

| Apparecchiature usate / *Used Equipment* | Modello / *Model* | Costruttore /*Manufacturer* | Numero di serie / *Serial Number* |
|---|---|---|---|
| PCB board (installed on PC) | ARING 429 | Altadata | / |
| Test bench | IFF-45TS IFF | Aeroflex Wichita INC. | 1000000001 |

## 4.2 Schema del setup / T*est setup diagram* – RF Power Output




## 4.3 Requisiti / *Requirements* - RF Power Output

FCC Section 2.1046 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”.

FCC Section 87.131, Note 7 “Frequency, emission, and maximum power will be determined by appropriate standards during the certification process”.

## 4.4 Misure / *Measurements* - RF Power Output

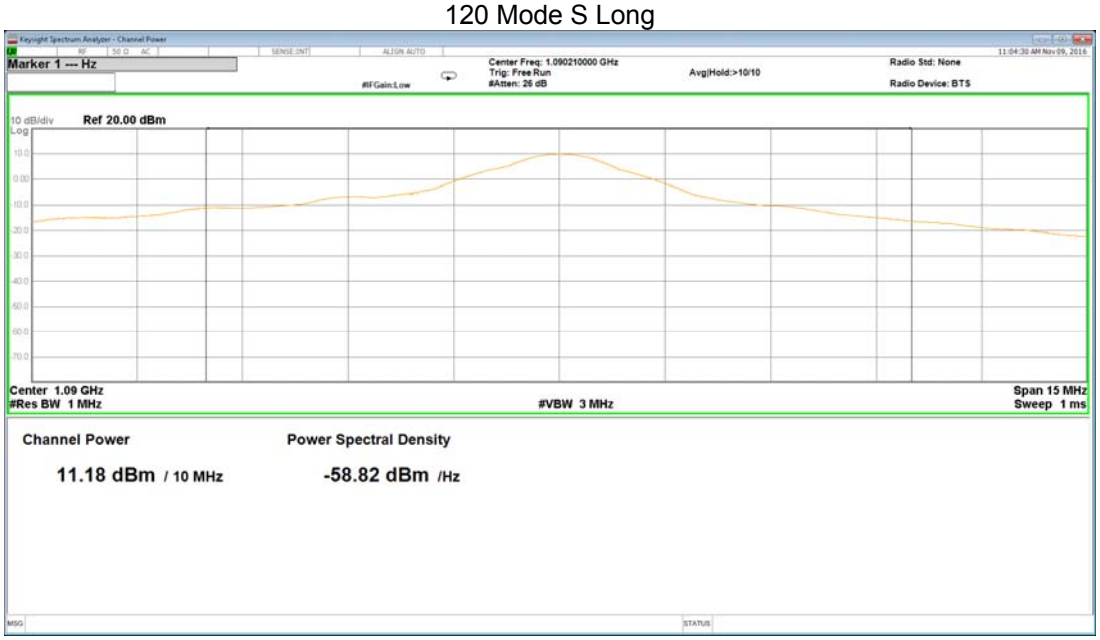
The measured transmitter power output for each of the operating conditions is contained below:

| Antenna Out | Test Mode | Frequency (MHz) | Channel Power (dBm) | Insertion Loss Attenuators (dBm) | Insertion Loss Cable TOP/BOT (dBm) | Insertion Loss Cable EL086215 (dBm) | Calculated Peak RF Output Power (dBm) | Calculated Peak RF Output Power (W) |
|---|---|---|---|---|---|---|---|---|
| TOP | 120 Mode S Long | 1090 | 11,2 | 44,3 | 1,1 | 0,5 | 57,1 | 510.5 |
| TOP | 1200 ATCRBS | 1090 | 9,1 | 44,3 | 1,1 | 0,5 | 55,0 | 319.2 |
| TOP | 1200 ATCRBS + 120 Mode S Long | 1090 | 11,1 | 44,3 | 1,1 | 0,5 | 57,0 | 500.0 |
| BOTTOM | 120 Mode S Long | 1090 | 11,1 | 44,3 | 1,1 | 0,5 | 57,0 | 502.3 |
| BOTTOM | 1200 ATCRBS | 1090 | 9,1 | 44,3 | 1,1 | 0,5 | 55,0 | 316.2 |
| BOTTOM | 1200 ATCRBS + 120 Mode S Long | 1090 | 11,1 | 44,3 | 1,1 | 0,5 | 57,0 | 500.0 |

### 4.3.1 Grafici / G*raphical representation of data* – RF Power Output

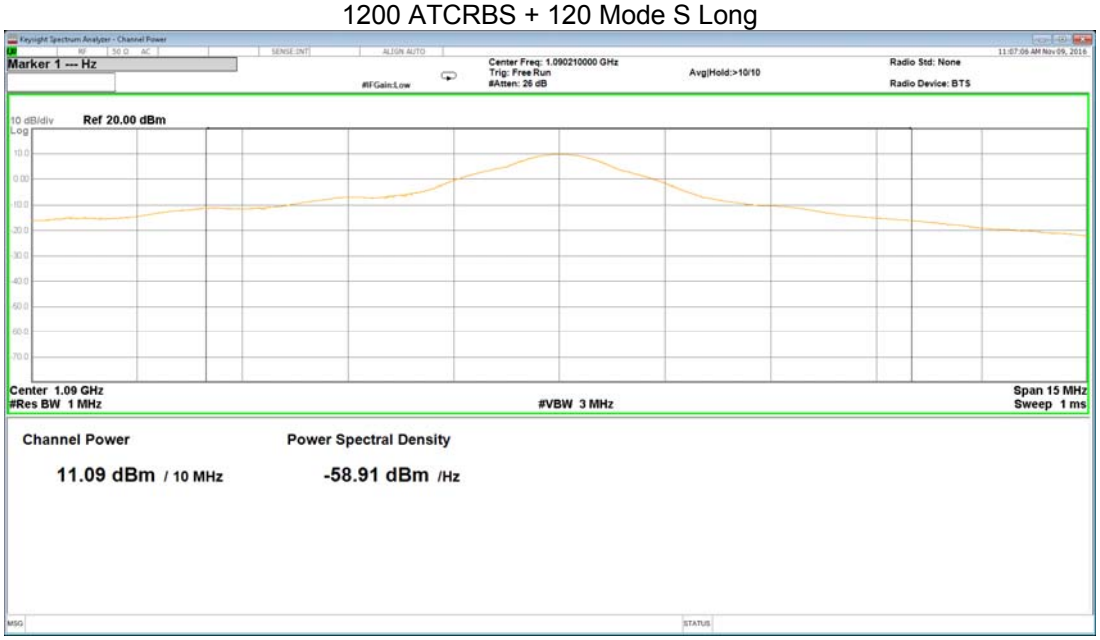
Antenna Output: TOP

120 Mode S Long



1200 ATCRBS

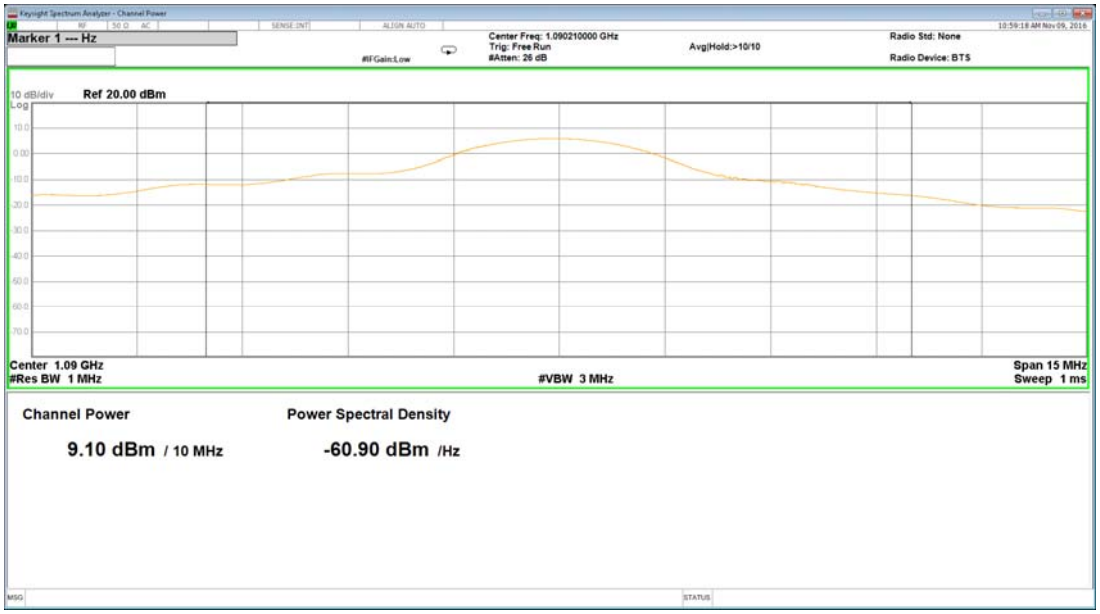

1200 ATCRBS + 120 Mode S Long



Antenna Output: BOTTOM

120 Mode S Long


1200 ATCRBS



1200 ATCRBS + 120 Mode S Long

## 5.0 Frequency Stability - Condizioni di prova / *Test Conditions*

| | | |
|---|---|---|
| Technician / Tecnico: Loris Fruch | | |
| Table No. | TEST: Frequency Stability, FCC Part 2 Section 2.1055;<br>FCC Part 87 Section 87.133 | \ |
| Method | / | \ |

| | | |
|---|---|---|
| Parameters required prior to the test | Laboratory Ambient Temperature | 18 to 28 °C |
| | Relative Humidity | 20 to 90 % |
| Parameters recorded during the test | Laboratory Ambient Temperature | 23 °C |
| | Relative Humidity | 52 - 54 % |

Supplementary information:

- Test executed at antenna output (50ohm, ARINC600) TOP and BOTTOM connected to the Spectrum Analyser through an attenuator (43 dB);
- Test executed with the following EUT Operating Mode (see par. 2.0):
  - Mode 3 (1200 ATCRBS + 120 Mode S Long)
- The measures were performed with the EUT powered at 100%, 85% and 115% of 115Vac nominal power supply voltage, for each test voltage the frequency was set at 380Hz and 420Hz (minimum and maximum frequency range);
- The EUT was placed in a temperature chamber with all other equipment outside at room ambient. The test unit was operated at the minimum, nominal and maximum applied AC voltages and relative frequencyes. Sufficient time was allowed to stabilize the unit after the chamber reached the desidered temperature (1hour). Data was taken in 10 degree steps from -30°C to +50°C;
- Short-term transient effects were verified by the Oscilloscope and the Spectrum Analiser as described at par. 5.4;
- Spectrum analyser settings setup:
  - Detector: Peak
  - RBW: 1KHz, VBW=1kHz, SPAN: 100KHz
  - Reference Level: -5 dBm, Display Mode: 10 dB/div
  - Input Attenuation: 20 dB

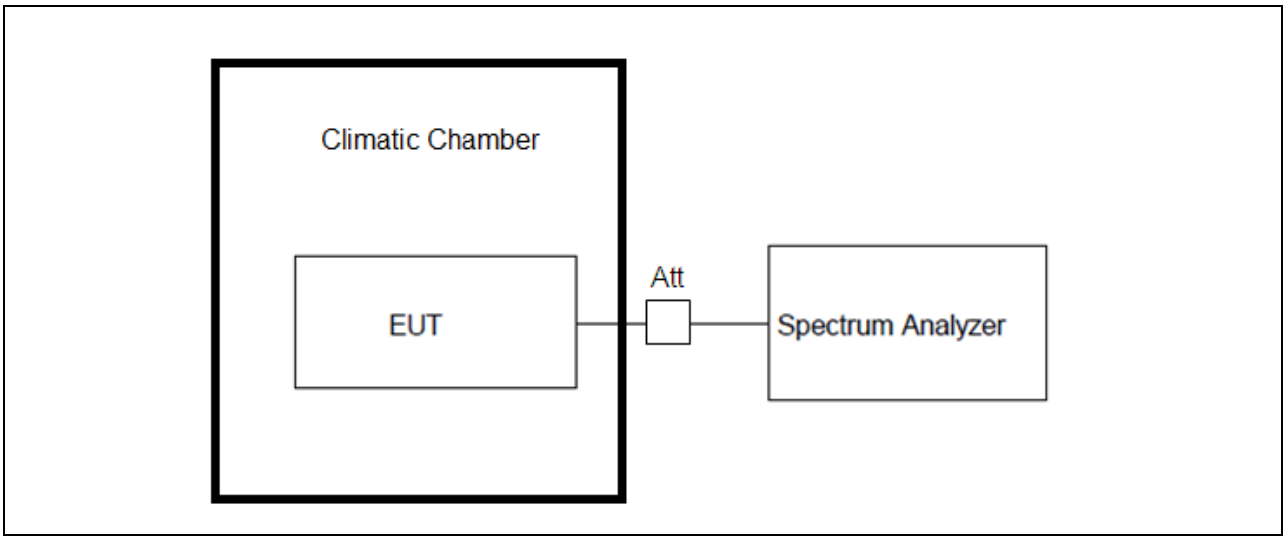
## 5.1 Apparecchiature utilizzate / *Test Equipment Used* – Frequency Stability

| ***Apparecchiature usate/Equipment Used*** | ***Modello/Model*** | ***Costruttore/ Manufacturer*** | ***Numero di serie/ Serial Number*** | **Data calibrazione / *Calibration date*** | **Intervallo / *Interval*** |
|---|---|---|---|---|---|
| EMI Receiver MXE | N9038A | Agilent | MY51210230 | 06/2016 | 1 year |
| Oscilloscope | DSO9254A | Agilent | MY52090217 | 12/2015 | 1 year |
| RF Cable | R284C0351050 | Radiall | EL086215 | 10/2016 | 1 year |
| RF Cable TOP | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| RF Cable BOTTOM | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| 2dB Attenuator | PE7085-2 | Pasternack | EL091816 | 10/2016 | 1 year |
| 6dB Attenuator | PE7021-6 | Pasternack | EL017308 | 06/2016 | 1 year |
| 6dB Attenuator | 75-A-MFN-06 | BIRD | 9825 | 02/2016 | 1 year |
| 30dB Attenuator | SBW-N30W5 | Spin | EL041210 | 06/2016 | 1 year |
| Data Logger USB TC | OM-EL-USB-TC-LCD | Omega Engineering | 10033112 | 06/2016 | 1 year |
| Fast Cycling temperature Chamber | D-E702-800 | Haida International Equipment Co., LTD | 151200301 | 06/2016 | 1 year |
| AC Power Supply | KBT-100-C-109-451 | BEHLMAN | 5896 | 12/2015 | 1 year |

### 5.1.1 Apparecchiature ausiliarie / *Auxiliary Equipment*

| Apparecchiature usate / *Used Equipment* | Modello / *Model* | Costruttore /*Manufacturer* | Numero di serie / *Serial Number* |
|---|---|---|---|
| PCB board (installed on PC) | ARING 429 | Altadata | / |
| Test bench | IFF-45TS IFF | Aeroflex Wichita INC. | 1000000001 |

## 5.2 Schema del setup / T*est setup diagram* – Frequency Stability




## 5.3 Requisiti / *Requirements* - Frequency Stability

FCC Section 2.1055
(a) (1) The frequency shall be measured with variation of ambient temperature from -30° to +50° centigrade for equipment licensed for use aboard aircraft in the Aviation Services under 47CFR2.1055.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) Not applicable; the reference source is not an ovenized oscillator.

(d) (1) (3) The frequency stability shall be measured with variation of primary supply voltage from 85 to 115 percent of the nominal value. The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Definition from 47CFR2.1 *Frequency Tolerance.* The maximum permissible departure by the center frequency of the frequency band occupied by an emission from the assigned frequency or, by the characteristic frequency of an emission from the reference frequency.

CFR47 87.133 (d) requirements
The EUT i can be defined as “a secondary surveillance radar system developed for use within the air traffic control system for more precise position reporting of planes” (see pag. 11 of this test report).For radar transmitters, except non-pulse signal radio altimeters, the frequency at which maximum emission occurs

must be within the authorized frequency band and must not be closer than 1.5/T MHz to the upper and lower limits of the authorized bandwidth, where T is the pulse duration in microseconds.
For pulse width T equal to 0.5 microseconds this equation produces 3 MHz restriction from the OBW edge. Testing of 99% Occupied Band Width (OBW) demonstrated a minimum of11 MHz. Therefore stability requirement would be OBW-(2*3*$10^6$)=5MHz. This would require stability of something less than 5 MHz. The EUT demonstrated less than 1 MHz requirement (well within the DO 181D standard).

The FAA requirements for frequency stability is ±1000 PPM.

## 5.4 Risultati / *Results* - Frequency Stability

The measured frequencies are inside the limits than the result of the test is: **PASS.** See the details in the charts/tables of the following paragraphs (see the worst case in bold text).

Short-term transient measurement: through the oscilloscope was measured the signal in the base band and through the spectrum analyser was verified that the FM residual components.
The frequency band measured through the spectrum analyser at -6dB from the peak carrier is about 10KHz (see par. 5.4.1.1 Figure 3 ), so we can say that the FM residual components do not are greater than 10KHz.

### 5.4.1 Tabelle e grafici dei risultati / *Tables and graphical representation of data* – Frequency Stability

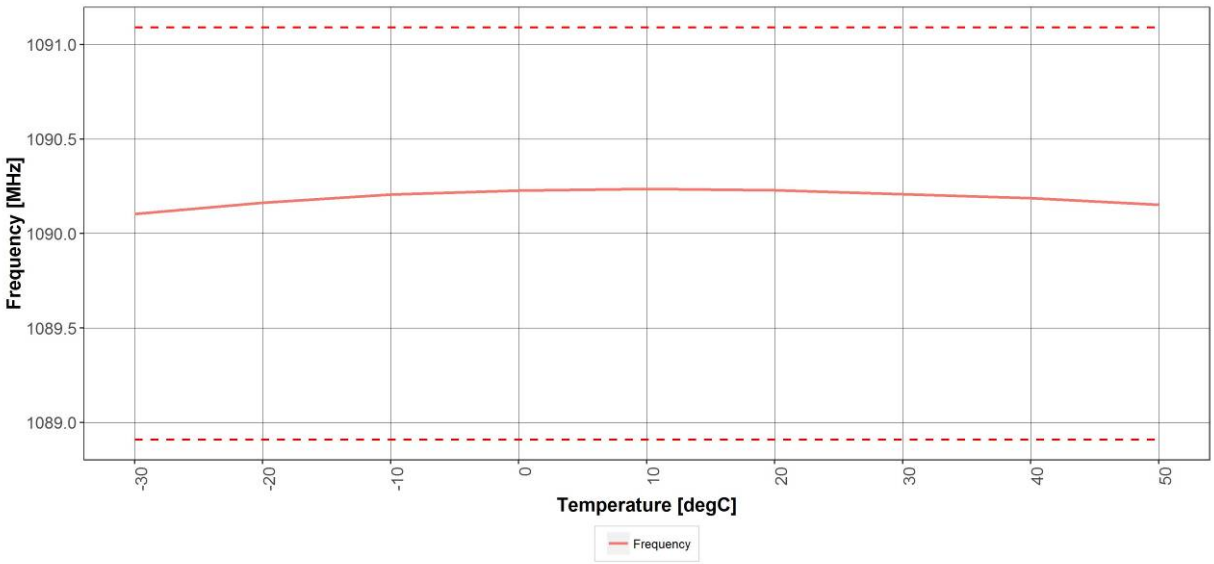
Measure on TOP Antenna Cable
Carrier frequency: 1090MHz

| | AC Supply 97.75V | | AC Supply 115V | | AC Supply 132.25V | |
|---|---|---|---|---|---|---|
| | 380Hz | 420Hz | 380Hz | 420Hz | 380Hz | 420Hz |
| Temperature (°C) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) |
| -30 | 1090,113 | 1090,115 | 1090,109 | 1090,104 | 1090,118 | 1090,117 |
| -20 | 1090,155 | 1090,163 | 1090,165 | 1090,163 | 1090,167 | 1090,167 |
| -10 | 1090,207 | 1090,207 | 1090,207 | 1090,207 | 1090,206 | 1090,206 |
| 0 | 1090,227 | 1090,227 | 1090,227 | 1090,227 | 1090,227 | 1090,227 |
| 10 | 1090,236 | 1090,236 | 1090,236 | 1090,236 | 1090,236 | 1090,236 |
| 20 | 1090,229 | 1090,229 | 1090,229 | 1090,229 | 1090,229 | 1090,229 |
| 30 | 1090,208 | 1090,208 | 1090,208 | 1090,208 | 1090,209 | 1090,208 |
| 40 | 1090,187 | 1090,186 | 1090,187 | 1090,187 | 1090,187 | 1090,187 |
| 50 | 1090,151 | 1090,151 | 1090,151 | 1090,152 | 1090,153 | 1090,153 |

Measure on BOTTOM Antenna Cable
Carrier frequency: 1090MHz

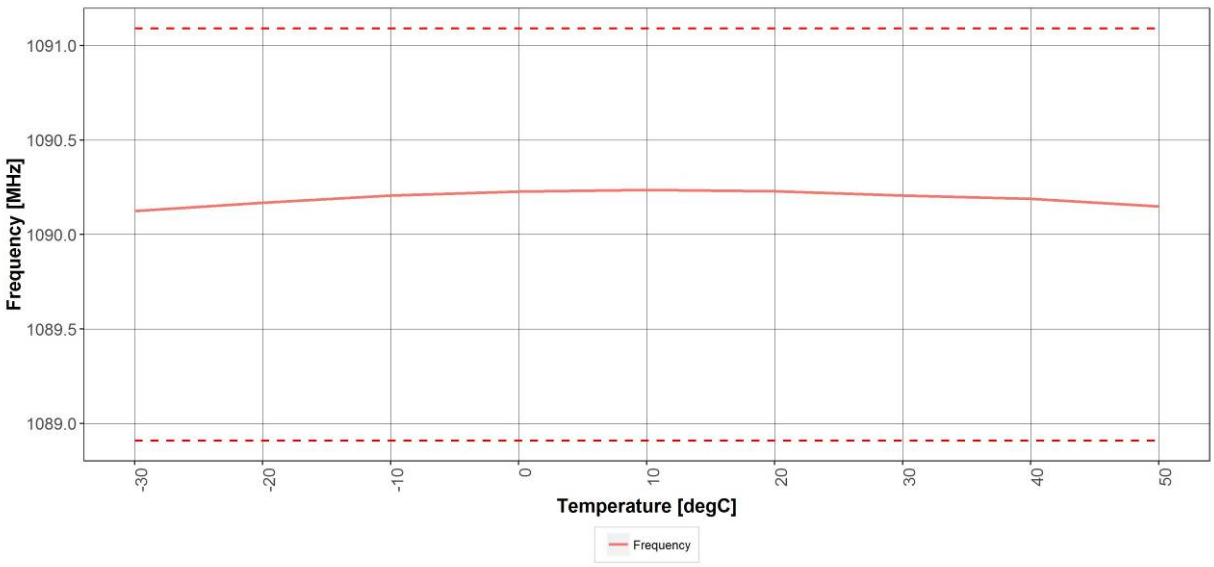
| | AC Supply 97.75V | | AC Supply 115V | | AC Supply 132.25V | |
|---|---|---|---|---|---|---|
| | 380Hz | 420Hz | 380Hz | 420Hz | 380Hz | 420Hz |
| Temperature (°C) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) | Frequency (MHz) |
| -30 | 1090,125 | 1090,125 | 1090,123 | 1090,124 | 1090,122 | 1090,121 |
| -20 | 1090,169 | 1090,168 | 1090,168 | 1090,169 | 1090,167 | 1090,165 |
| -10 | 1090,207 | 1090,207 | 1090,207 | 1090,207 | 1090,207 | 1090,207 |
| 0 | 1090,227 | 1090,227 | 1090,227 | 1090,227 | 1090,227 | 1090,227 |
| 10 | 1090,235 | 1090,236 | 1090,236 | 1090,236 | 1090,236 | 1090,236 |
| 20 | 1090,230 | 1090,229 | 1090,230 | 1090,229 | 1090,230 | 1090,230 |
| 30 | 1090,207 | 1090,207 | 1090,207 | 1090,207 | 1090,207 | 1090,207 |
| 40 | 1090,189 | 1090,189 | 1090,189 | 1090,189 | 1090,191 | 1090,190 |
| 50 | 1090,149 | 1090,149 | 1090,149 | 1090,149 | 1090,149 | 1090,149 |

Top Antenna-AC Supply 115V, 420Hz




*Result: PASS*

Bottom Antenna-AC Supply 115V, 420Hz




*Result: PASS*

### 5.4.1.1 Short-term transient measurement performed on TOP Antenna Output

At the Key-ON the EUT do not transmits, transmission start about after 2sec.

Note: the measures performed on BOTTOM antenna are similar to this, and no differences were detected respect the measures performed at -30 °C and the measures performed at + 50 °C.

Signal in the base band measured through the Oscilloscope

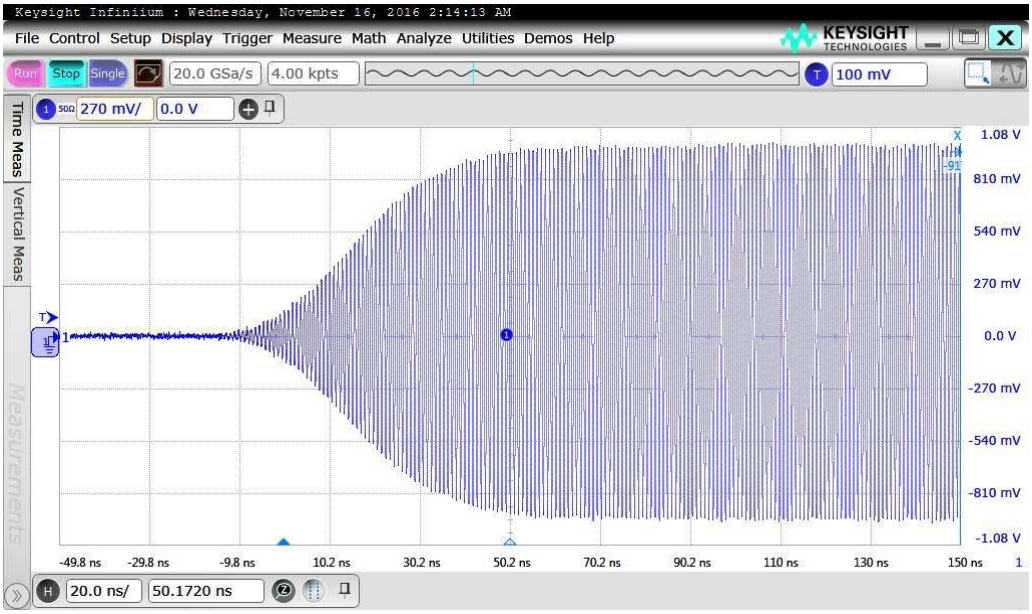



Figure 1

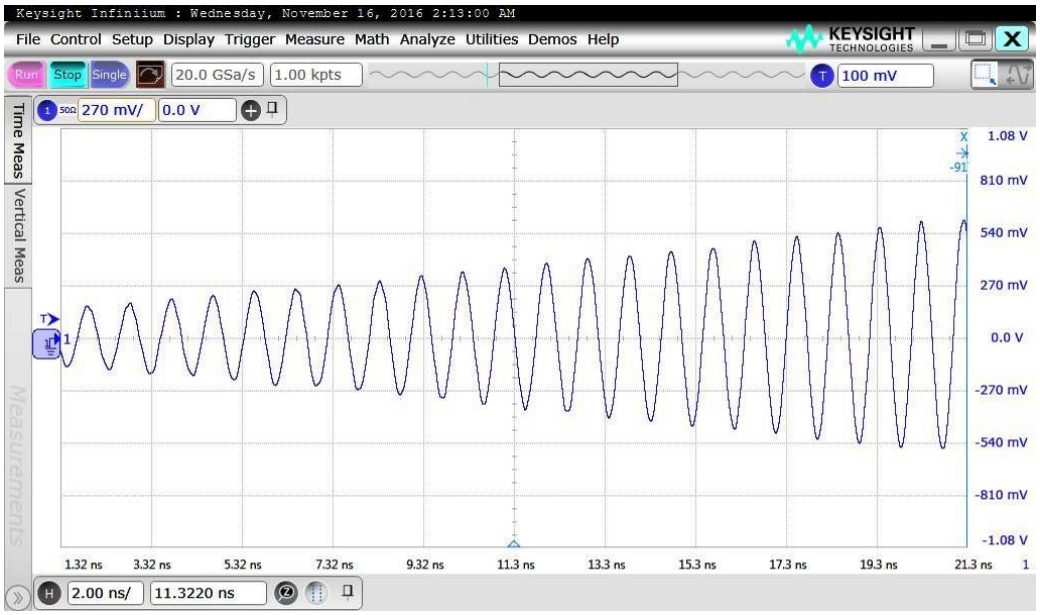



Figure 2

Check of FM residual components through the Spectrum Analyser

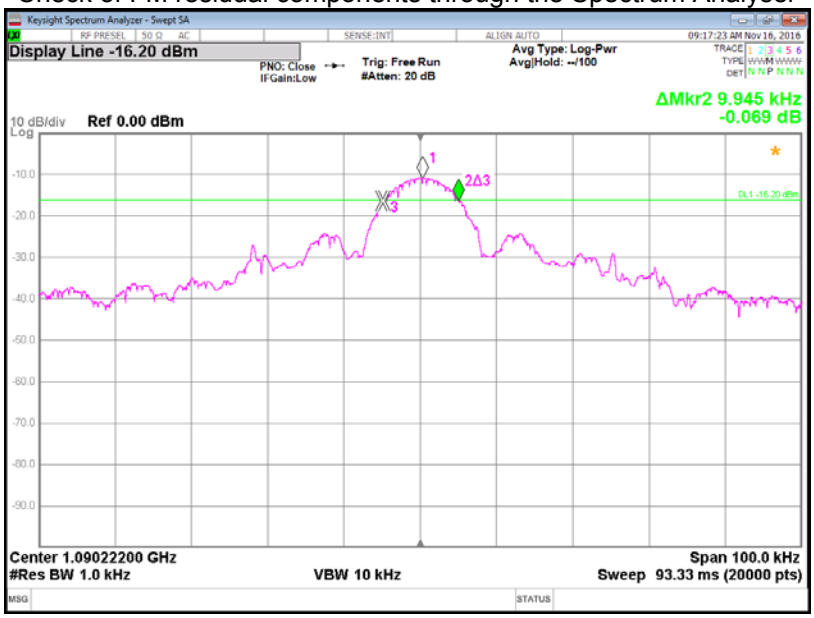



Figure 3

## 6.0 Occupied Bandwidth - Condizioni di prova / *Test Conditions*

| | | |
|---|---|---|
| Technician / Tecnico: Loris Fruch | | |
| Table No. | TEST: Occupied Bandwidth, FCC Part 2 Section 2.1049;<br>FCC Part 87 Section 87.135 | \ |
| Method | / | \ |

| | | |
|---|---|---|
| Parameters required prior to the test | Laboratory Ambient Temperature | 18 to 28 °C |
| | Relative Humidity | 20 to 90 % |
| Parameters recorded during the test | Laboratory Ambient Temperature | 21 °C |
| | Relative Humidity | 60 % |

Supplementary information:

- Conducted Test, executed at antenna output (50ohm, ARINC600) TOP and BOTTOM connected to the Spectrum Analyser through an attenuator (43 dB);
- EUT powered at 115Vac 400Hz;
- Tuned frequency: 1090MHz;
- Test executed with the following EUT Operating Mode (see par. 2.0):
  - Mode 1 (120 Mode S Long)
  - Mode 2 (1200 ATCRBS)
  - Mode 3 (1200 ATCRBS + 120 Mode S Long)
- Spectrum analyser settings setup:
  - 99% automatic bandwidth measurement
  - Detector: Peak,
  - Trace: max hold (sweep until a solid representation of the transmitted signal is present)
  - RBW: 100 kHz
  - SPAN: 20 MHz
  - Reference Level: 20 dBm
  - Display Mode: 10 dB/div
  - Input Attenuation: 20 dB

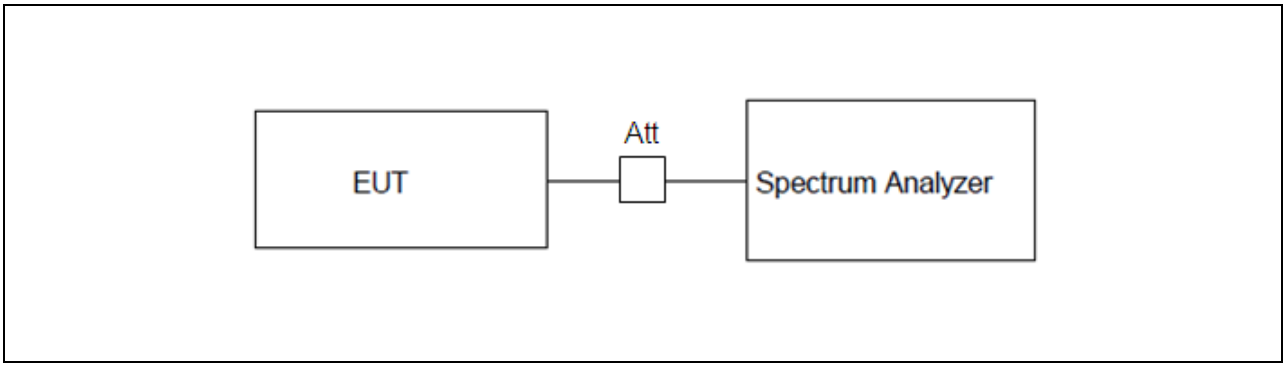
## 6.1 Apparecchiature utilizzate / *Test Equipment Used* – Occupied Bandwidth

| ***Apparecchiature usate/Equipment Used*** | ***Modello/Model*** | ***Costruttore/ Manufacturer*** | ***Numero di serie/ Serial Number*** | **Data calibrazione / *Calibration date*** | **Intervallo / *Interval*** |
|---|---|---|---|---|---|
| EMI Receiver MXE | N9038A | Agilent Technologies | MY51210230 | 06/2016 | 1 year |
| RF Cable | R284C0351050 | Radiall | EL086215 | 10/2016 | 1 year |
| RF Cable TOP | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| RF Cable BOTTOM | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| 2dB Attenuator | PE7085-2 | Pasternack | EL091816 | 10/2016 | 1 year |
| 6dB Attenuator | PE7021-6 | Pasternack | EL017308 | 06/2016 | 1 year |
| 6dB Attenuator | 75-A-MFN-06 | BIRD | 9825 | 02/2016 | 1 year |
| 30dB Attenuator | SBW-N30W5 | Spin | EL041210 | 06/2016 | 1 year |
| AC Power Supply | KBT-100-C-109-451 | BEHLMAN | 5896 | 12/2015 | 1 year |

### 6.1.1 Apparecchiature ausiliarie / *Auxiliary Equipment*

| Apparecchiature usate / *Used Equipment* | Modello / *Model* | Costruttore /*Manufacturer* | Numero di serie / *Serial Number* |
|---|---|---|---|
| PCB board (installed on PC) | ARING 429 | Altadata | / |
| Test bench | IFF-45TS IFF | Aeroflex Wichita INC. | 1000000001 |

## 6.2 Schema del setup / T*est setup diagram* – Occupied Bandwidth




## 6.3 Requisiti / *Requirements* - Occupied Bandwidth

FCC Section 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.”

FCC Section 2.1049 (h) “Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user”.

FCC Section 87.135
(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.
(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.
(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Section 87.137 Authorized Bandwidth for Emission Type M1D.

## 6.4 Misure / Measures - Occupied Bandwidth

| Cable Antenna Top | | |
|---|---|---|
| **Mode of Operation** | **99% Power Occupied Bandwidth (MHz)** | **Reference Figure** |
| Mode 1 (120 Mode S Long) | 11.22 | Figure 1 |
| Mode 2 (1200 ATCRBS) | 12.10 | Figure 2 |
| Mode 3 (1200 ATCRBS + 120 Mode S Long) | 11.32 | Figure 3 |

| Cable Antenna Bottom | | |
|---|---|---|
| **Mode of Operation** | **99% Power Occupied Bandwidth (MHz)** | **Reference Figure** |
| Mode 1 (120 Mode S Long) | 11.00 | Figure 4 |
| Mode 2 (1200 ATCRBS) | 11.08 | Figure 5 |
| Mode 3 (1200 ATCRBS + 120 Mode S Long) | 11.34 | Figure 6 |

### 6.4.1 Grafici / *Graphical representation data* – Occupied Bandwidth


Figure 1


Figure 2


Figure 3


Figure 4


Figure 5


Sweep Time 5.33 ms
Center Freq: 1.090210000 GHz
Trig: Free Run
#Atten: 20 dB
Avg|Hold:>10/10
Radio Std: None
Radio Device: BTS
Mkr1 433.96056 MHz
--- dBm
10 dB/div
Log
Ref 20.00 dBm
Center 1.09 GHz
#Res BW 100 kHz
#VBW 100 kHz
Span 20 MHz
#Sweep 5.333 ms
Occupied Bandwidth
11.337 MHz
Total Power 10.6 dBm
Transmit Freq Error -1.3310 MHz
% of OBW Power 99.00 %
x dB Bandwidth 2.070 MHz
x dB -6.00 dB

Figure 6

## 7.0 Spurious Emissions at Antenna Terminals - Condizioni di prova / *Test Conditions*

| | | |
|---|---|---|
| Technician / Tecnico: Loris Fruch | | |
| Table No. | TEST: Spurious Emissions at Antenna Terminals, FCC Part 2 Section 2.1051; FCC Part 87 Section 87.139 | \ |
| Method | / | \ |

| | | |
|---|---|---|
| Parameters required prior to the test | Laboratory Ambient Temperature | 18 to 28 °C |
| | Relative Humidity | 20 to 90 % |
| Parameters recorded during the test | Laboratory Ambient Temperature | 20 - 21 °C |
| | Relative Humidity | 58 - 60 % |

Supplementary information:

- Conducted Test, executed at antenna output (50ohm, ARINC600) TOP and BOTTOM connected to the Spectrum Analyser:
  - through an attenuator (43 dB) for measures from 9KHz to 1168MHz;
  - through a DC Coupler loaded with 50ohm high power termination for measures from 1168MHz to 11GHz;
- EUT powered at 115Vac 400Hz;
- Tuned frequency: 1090MHz;
- Test executed with the following EUT Operating Mode (see par. 2.0):
  - Mode 3 (1200 ATCRBS + 120 Mode S Long)
- Frequency range of the measurements: 9KHz to 11GHz.
- Spectrum analyser settings setup:
  - Detector = Peak from 9KHz to 1012MHz and from 1168MHz to 11GHz
    Average from 1012MHz to 1168MHz
  - Trace = max hold (over last 20 sweeps),
  - RBW, VBW and sweep time:

| Start Freq | Stop Freq | Res BW |
|---|---|---|
| 9 kHz | 0.15 MHz | 200 Hz |
| 0.15 MHz | 30 MHz | 9 kHz |
| 30 MHz | 11 GHz | 120 kHz |

## 7.1 Apparecchiature utilizzate / *Test Equipment Used* – Spurious Emissions at Antenna Terminals

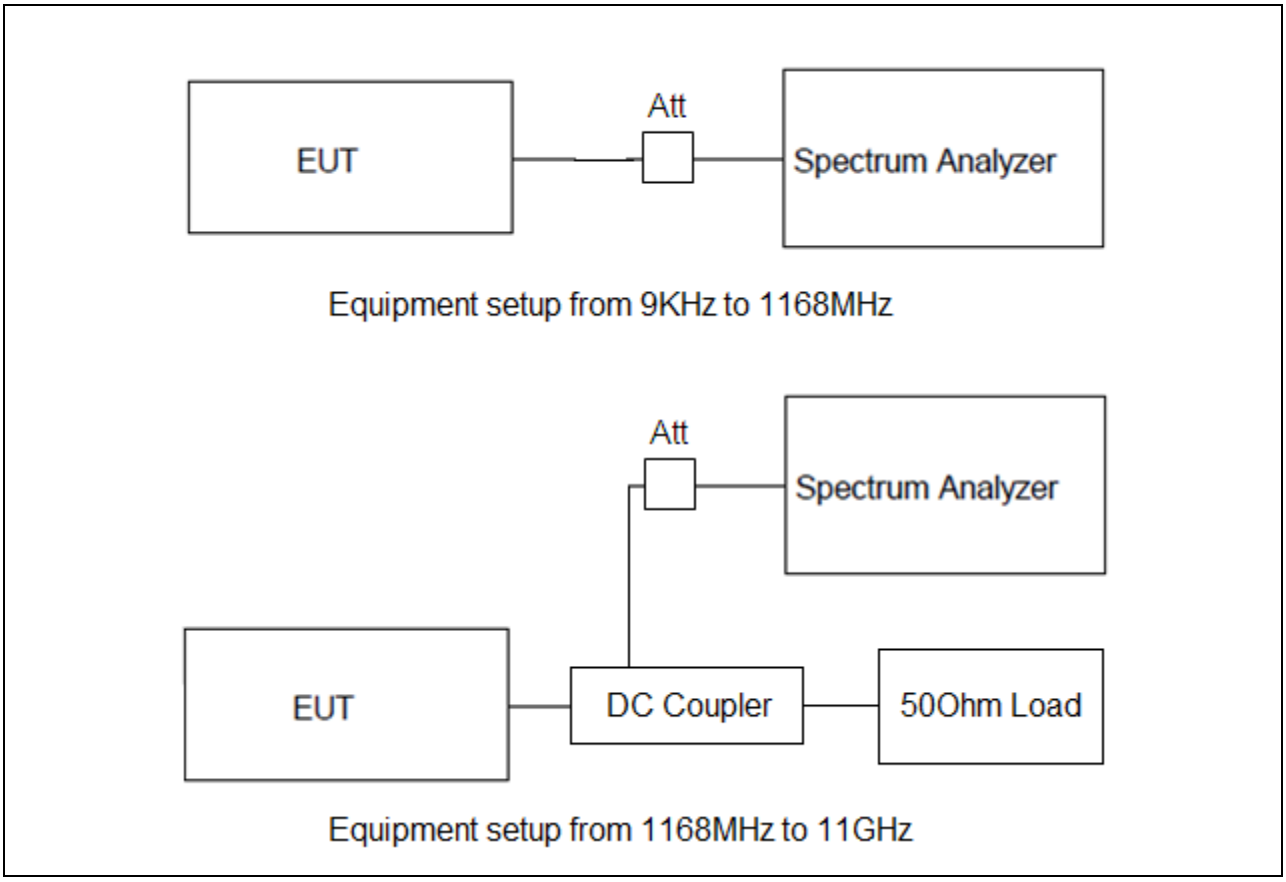
| *Apparecchiature usate/Equipment Used* | *Modello/Model* | *Costruttore/ Manufacturer* | *Numero di serie/ Serial Number* | Data calibrazione / *Calibration date* | Intervallo / *Interval* |
|---|---|---|---|---|---|
| EMI Receiver MXE | N9038A | Agilent Technologies | MY51210230 | 06/2016 | 1 year |
| RF Cable | R284C0351050 | Radiall | EL086215 | 10/2016 | 1 year |
| RF Cable TOP | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| RF Cable BOTTOM | TAN-5386/01 | Selex ES | / | 10/2016 | 1 year |
| 2dB Attenuator | PE7085-2 | Pasternack | EL091816 | 10/2016 | 1 year |
| 6dB Attenuator | PE7021-6 | Pasternack | EL017308 | 06/2016 | 1 year |
| 6dB Attenuator | 75-A-MFN-06 | BIRD | 9825 | 02/2016 | 1 year |

| | | | | | |
|---|---|---|---|---|---|
| 30dB Attenuator | SBW-N30W5 | Spin | EL041210 | 06/2016 | 1 year |
| DC Coupler | PE2236-35 | Pasternack | EL017408 | 02/2016 | 1 year |
| 10dB Attenuator | SA4014 | CPE Italia Spa | 03VCV-5093 | 09/2016 | 1 year |
| 10dB Attenuator | R411810121 | Radiall | EL021709 | 07/2016 | 1 year |
| Load 50Ohm | PE6039 | Pasternack | EL034809 | 08/2016 | 1 year |
| AC Power Supply | KBT-100-C-109-451 | BEHLMAN | 5896 | 12/2015 | 1 year |

### 7.1.1 Apparecchiature ausiliarie / *Auxiliary Equipment*

| **Apparecchiature usate / *Used Equipment*** | **Modello / *Model*** | **Costruttore /*Manufacturer*** | **Numero di serie / *Serial Number*** |
|---|---|---|---|
| PCB board (installed on PC) | ARING 429 | Altadata | / |
| Test bench | IFF-45TS IFF | Aeroflex Wichita INC. | 1000000001 |

## 7.2 Schema del setup / T*est setup diagram* – Spurious Emissions at Antenna Terminals



## 7.3 Requisiti / *Requirements* - Spurious Emissions at Antenna Terminals

The EUT is an Aircraft station transmitter.

FCC Section 2.1051 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.

The referenced section in 2.1049 is (i) Transmitters designed for other types of modulation—when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

FCC Section 87.139 (a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

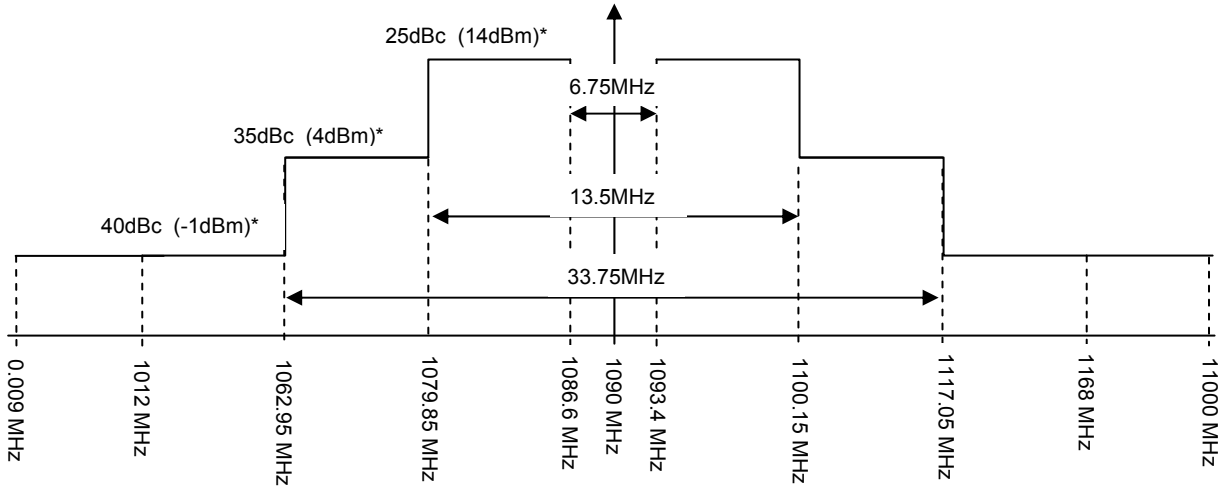
(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB;

Therefore the limit is the following:

Carrier frequency = 1090MHz
Authorized bandwidth = 13.5MHz
50% of Authorized bandwidth = 6.75MHz
100% of Authorized bandwidth = 13.5MHz
250% of Authorized bandwidth = 33.75MHz




(*) the amplitude was calculated respect 57dBm (RF Output Power measured at par. 4.4)

## 7.4 Risultati / *Results* - Spurious Emissions at Antenna Terminals

The amplitude of spurious emissions is lower to the limit, thus the result of the test is: **PASS**. See the details in the charts of the following paragraphs.

The worst case emissions are:

Antenna Output: TOP

| Frequency (MHz) | Average Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 1093,700 | -2,3 | 14,0 | -16,3 | Pass |

Antenna Output: BOTTOM

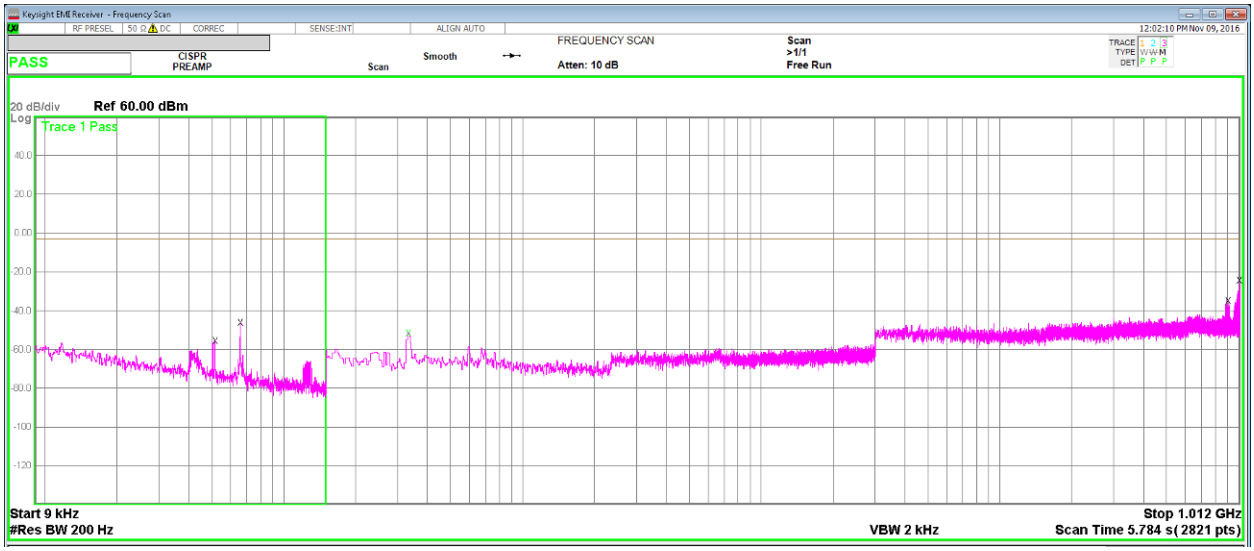
| Frequency (MHz) | Average Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 1085,400 | -2,3 | 14,0 | -16,3 | Pass |

Note: this is a measurement into a broadband 50 ohm system, and does not include any frequency-dependent attenuation due to possible antenna mismatch.

### 7.3.1 Grafici dei risultati / *Graphical representation data* – Conducted Spurious Emissions

Antenna Output: TOP

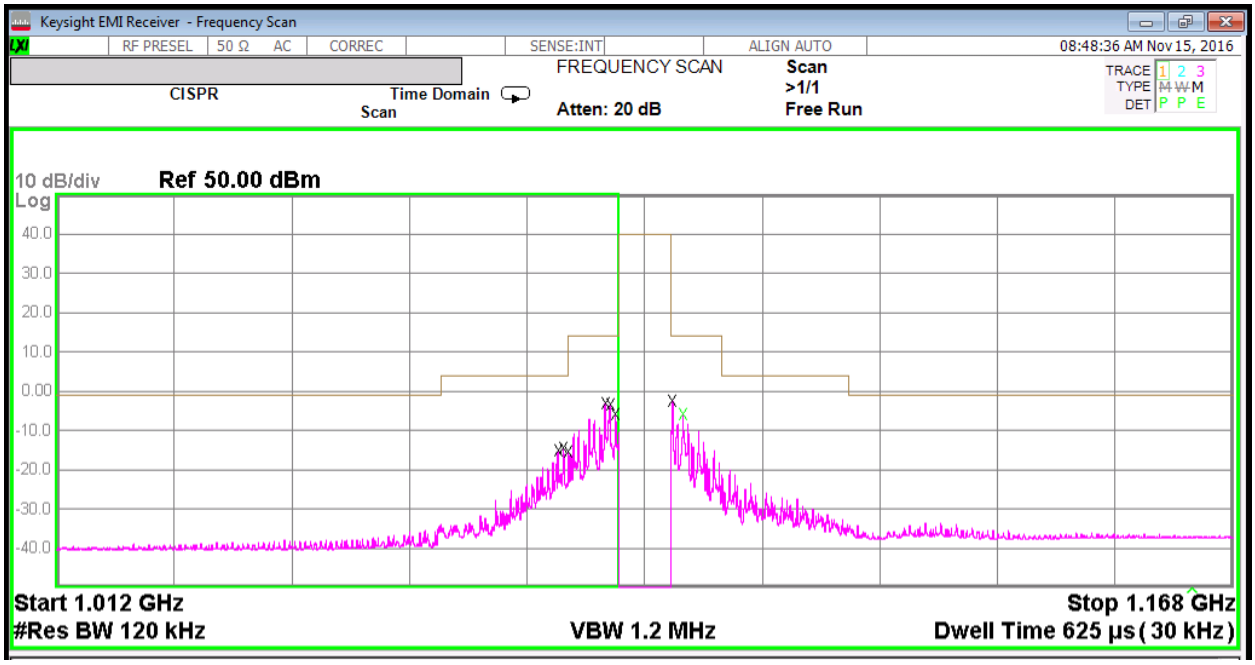
Measure from 9KHz to 1012MHz




Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 0,051 | -55,5 | -1,0 | -54,5 | Pass |
| 0,066 | -45,8 | -1,0 | -44,8 | Pass |
| 0,332 | -51,2 | -1,0 | -50,2 | Pass |
| 0,901 | -34,9 | -1,0 | -33,9 | Pass |
| 1006,200 | -24,3 | -1,0 | -23,3 | Pass |

Measure from 1012MHz to 1168MHz

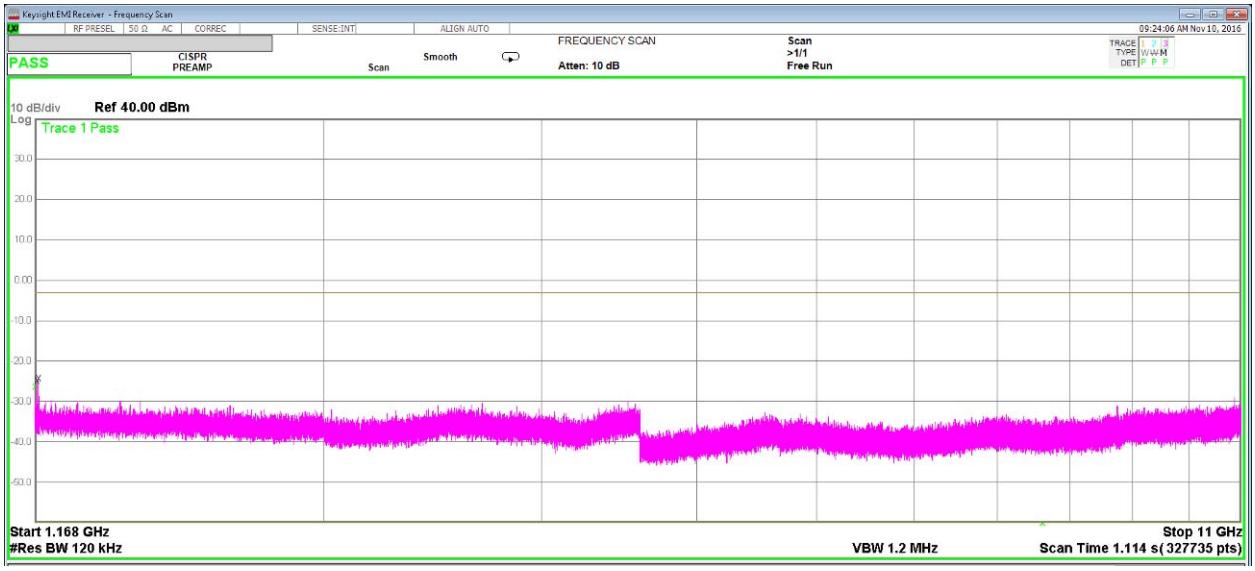



Signal list

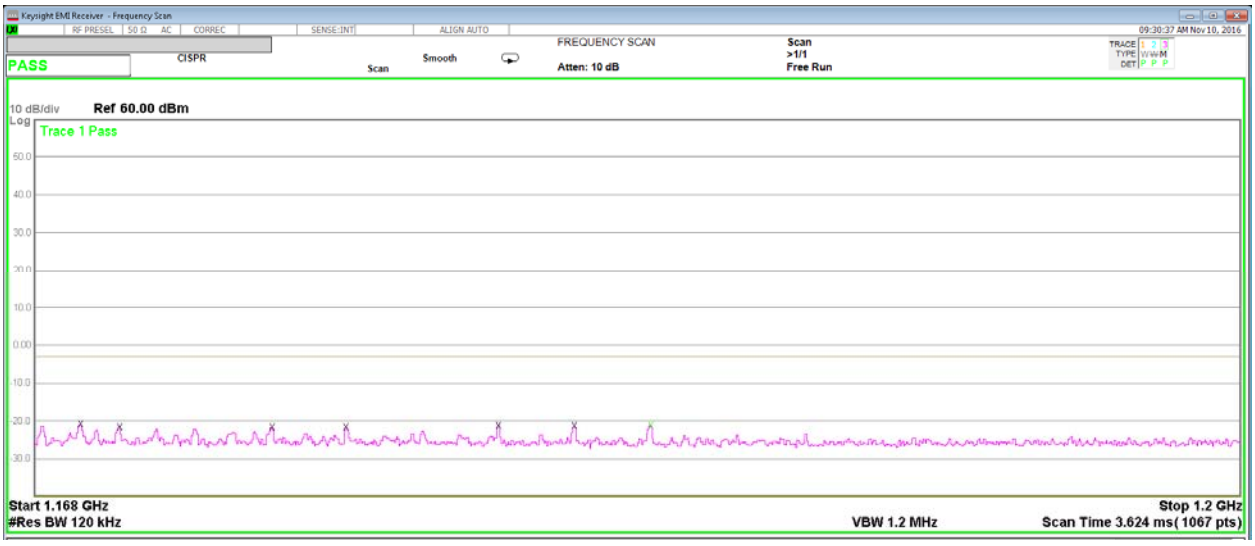
| Frequency (MHz) | Average Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 1078,500 | -15,0 | 4,0 | -19,0 | Pass |
| 1079,200 | -14,4 | 4,0 | -18,4 | Pass |
| 1079,900 | -15,4 | 14,0 | -29,4 | Pass |
| 1084,700 | -3,1 | 14,0 | -17,1 | Pass |
| 1085,400 | -3,4 | 14,0 | -17,4 | Pass |
| 1086,100 | -6,0 | 14,0 | -20,0 | Pass |
| 1093,700 | -2,3 | 14,0 | -16,3 | Pass |
| 1095,100 | -5,9 | 14,0 | -19,9 | Pass |

FCC Test Firm Registration #: 643914

Measure from 1168MHz to 11000MHz




Detail from 1168MHz to 1200MHz




Signal list

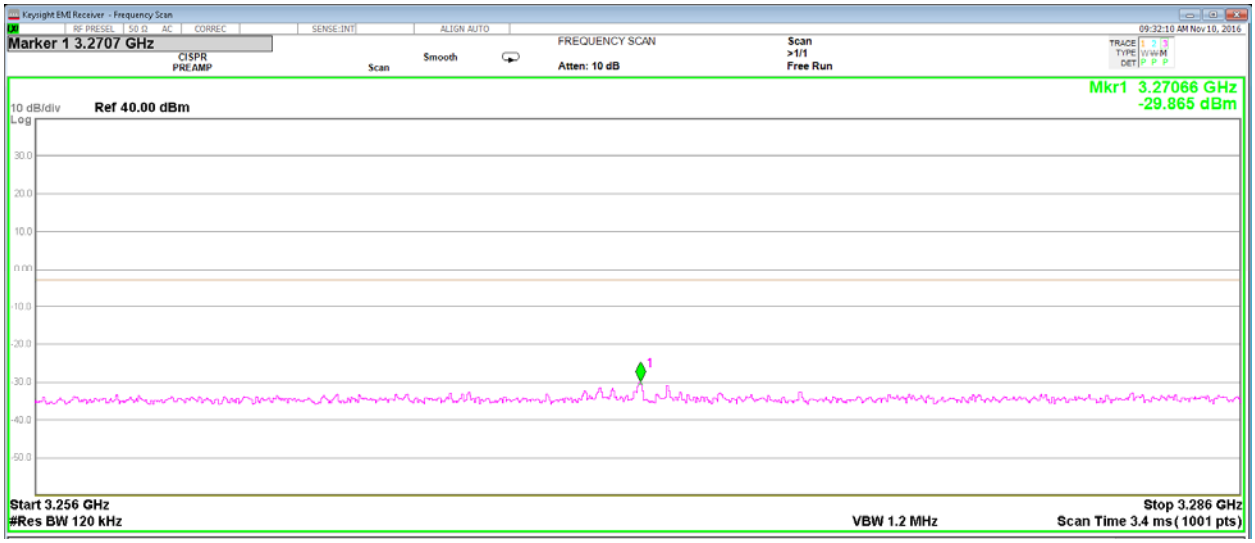
| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 1169,200 | -20,9 | -1,0 | -19,9 | Pass |
| 1170,300 | -21,5 | -1,0 | -20,5 | Pass |
| 1174,200 | -21,6 | -1,0 | -20,6 | Pass |
| 1176,200 | -21,6 | -1,0 | -20,6 | Pass |
| 1180,200 | -21,1 | -1,0 | -20,1 | Pass |
| 1182,200 | -21,3 | -1,0 | -20,3 | Pass |
| 1184,200 | -21,1 | -1,0 | -20,1 | Pass |

Measure on first harmonic


Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 2180,400 | -34,8 | -1,0 | -33,8 | Pass |

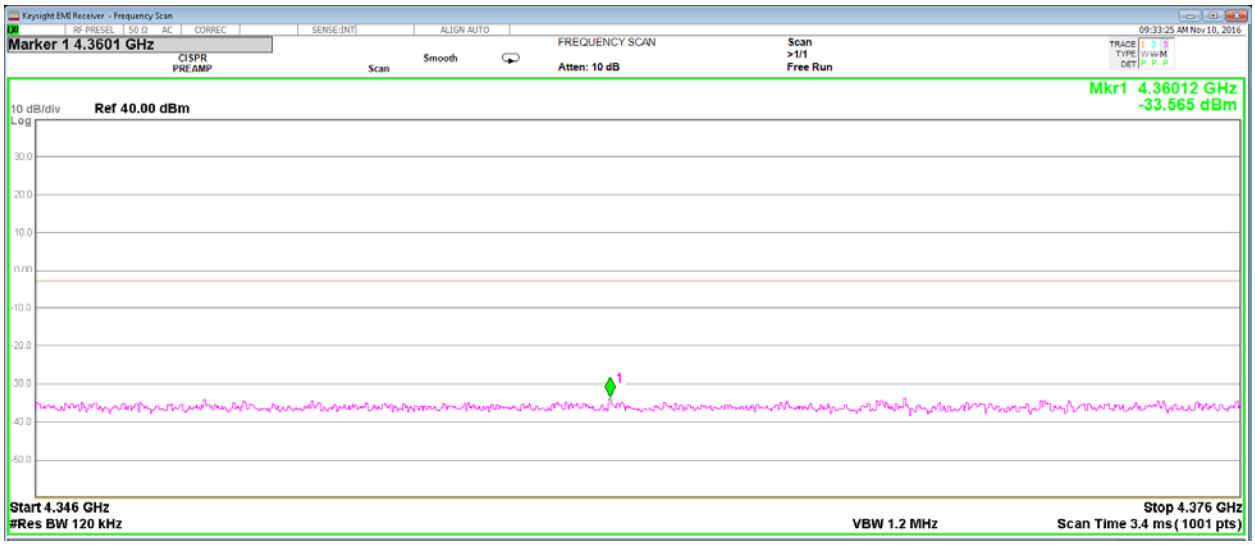
Measure on second harmonic




Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 3270,700 | -29,9 | -1,0 | -28,9 | Pass |

Measure on third harmonic

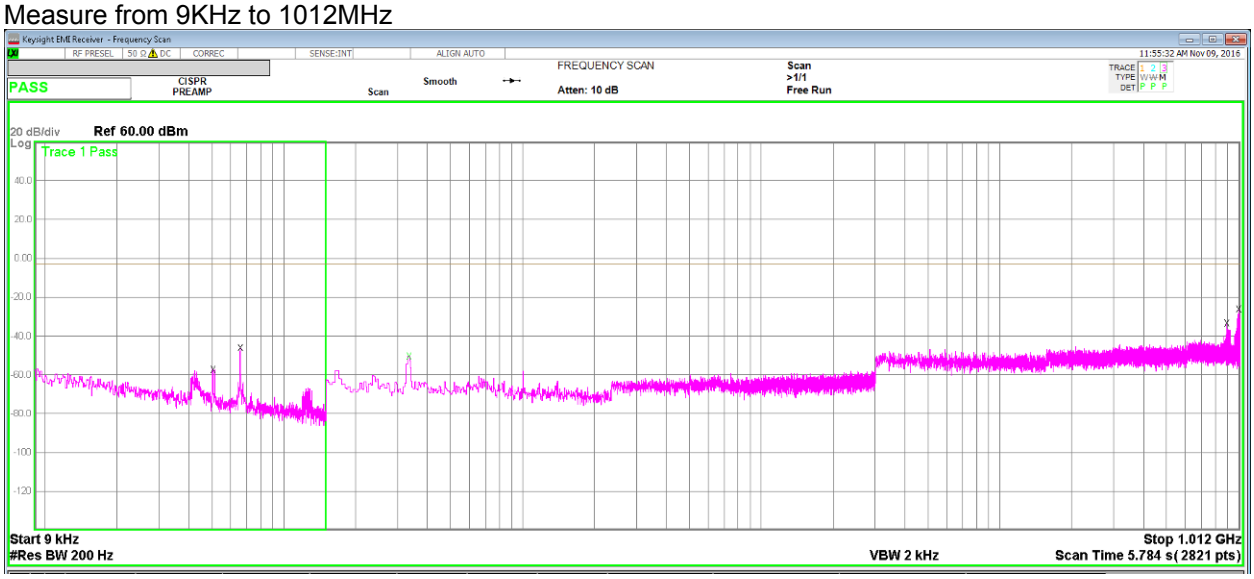



Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 4360,100 | -33,6 | -1,0 | -32,6 | Pass |

Antenna Output: BOTTOM

Measure from 9KHz to 1012MHz

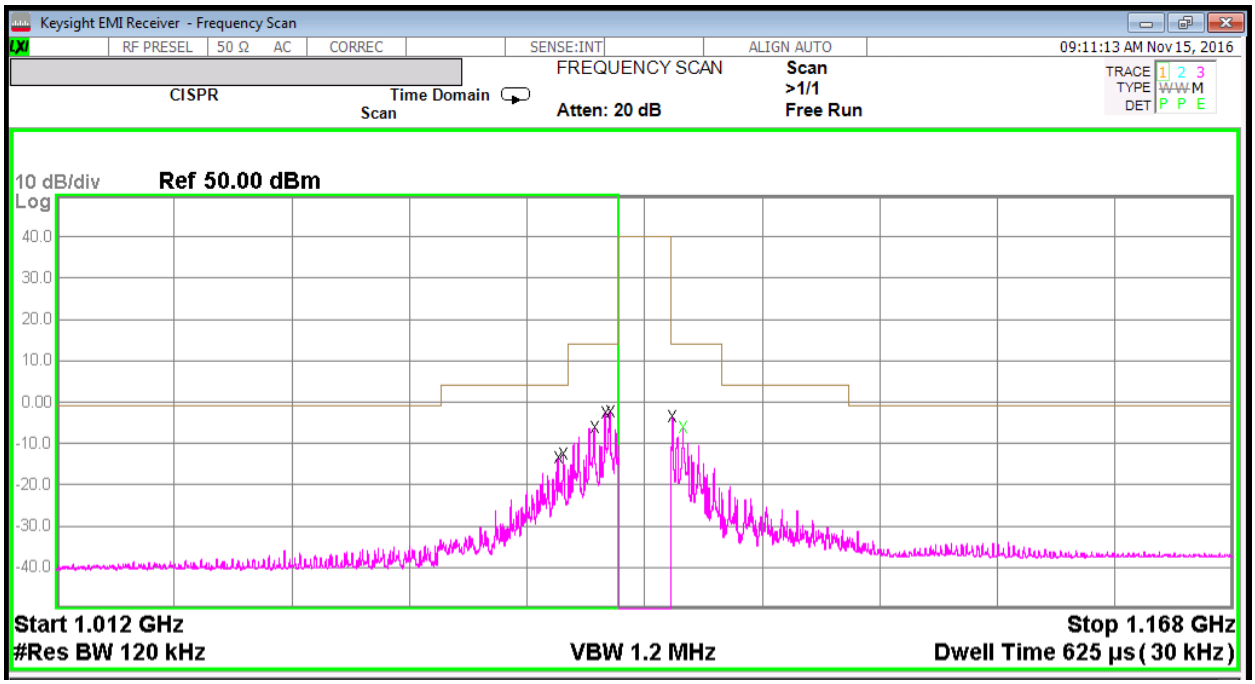



Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 0,050 | -57,2 | -1,0 | -56,2 | Pass |
| 0,065 | -46,1 | -1,0 | -45,1 | Pass |
| 0,335 | -50,4 | -1,0 | -49,4 | Pass |
| 0,892 | -33,3 | -1,0 | -32,3 | Pass |
| 0,996 | -26,0 | -1,0 | -25,0 | Pass |

FCC Test Firm Registration #: 643914

Measure from 1012MHz to 1168MHz

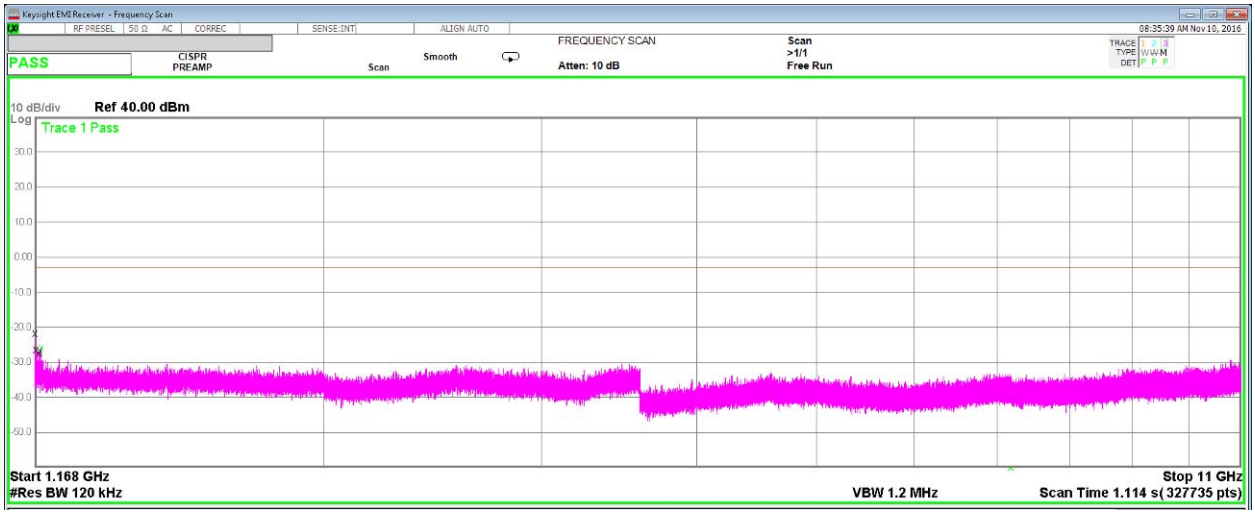



Signal list

| Frequency (MHz) | Average Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 1078,500 | -13,4 | 4,0 | -17,4 | Pass |
| 1079,200 | -12,4 | 4,0 | -16,4 | Pass |
| 1083,300 | -6,0 | 14,0 | -20,0 | Pass |
| 1084,700 | -2,6 | 14,0 | -16,6 | Pass |
| 1085,400 | -2,3 | 14,0 | -16,3 | Pass |
| 1093,700 | -3,2 | 14,0 | -17,2 | Pass |
| 1095,100 | -6,0 | 14,0 | -20,0 | Pass |

FCC Test Firm Registration #: 643914

Measure from 1168MHz to 11000MHz

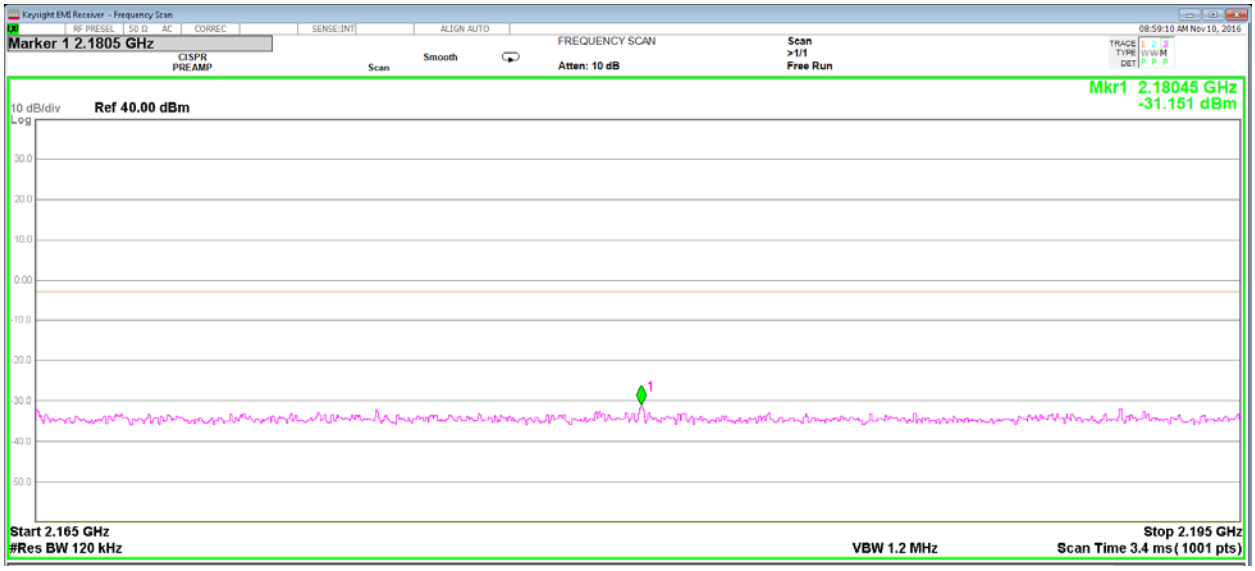



Detail from 1168MHz to 1200MHz


Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 1168,200 | -21,4 | -1,0 | -20,4 | Pass |
| 1169,200 | -22,0 | -1,0 | -21,0 | Pass |
| 1170,200 | -22,0 | -1,0 | -21,0 | Pass |
| 1171,200 | -22,6 | -1,0 | -21,6 | Pass |
| 1172,200 | -21,9 | -1,0 | -20,9 | Pass |
| 1173,200 | -23,7 | -1,0 | -22,7 | Pass |
| 1174,200 | -22,9 | -1,0 | -21,9 | Pass |
| 1176,200 | -22,6 | -1,0 | -21,6 | Pass |
| 1178,200 | -22,8 | -1,0 | -21,8 | Pass |
| 1180,200 | -22,9 | -1,0 | -21,9 | Pass |
| 1182,200 | -23,2 | -1,0 | -22,2 | Pass |
| 1184,200 | -22,3 | -1,0 | -22,3 | Pass |

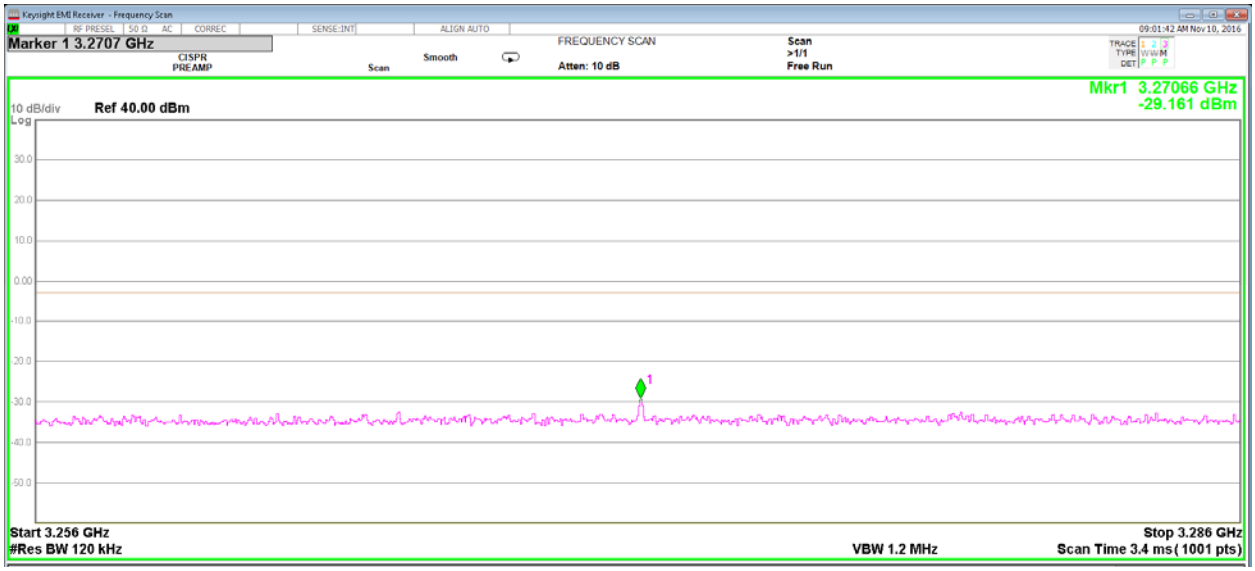
Measure on first harmonic




Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 2180,500 | -31,2 | -1,0 | -30,2 | Pass |

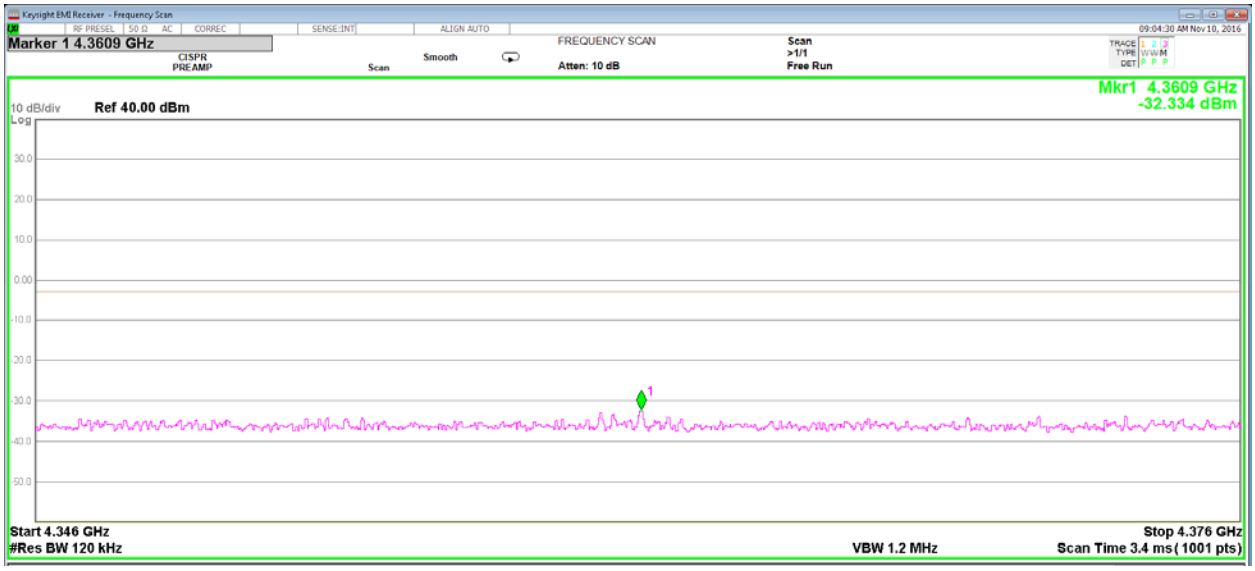
Measure on second harmonic




Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 3270,700 | -29,2 | -1,0 | -28,2 | Pass |

Measure on third harmonic




Signal list

| Frequency (MHz) | Peak Measure (dBm) | Limit (dBm) | Difference from limit (dB) | Result (Pass/Fail) |
|---|---|---|---|---|
| 4360,900 | -32,3 | -1,0 | -31,3 | Pass |

## 8.0 Field Strength of Spurious Radiation – Condizioni di prova / *Test Conditions*

| | | | |
|---|---|---|---|
| Technician / Tecnico: Loris Fruch | | | |
| Table No. | TEST: Field Strength of Spurious Radiation, FCC Part 2 Section 2.1053; FCC Part 87 Section 87.139 | | \ |
| Method | ANSI/TIA-603-D (2010), Par. 2.2 | | \ |
| Parameters required prior to the test | | Laboratory Ambient Temperature | 18 to 28 °C |
| | | Relative Humidity | 20 to 90 % |
| Parameters recorded during the test | | Laboratory Ambient Temperature | 20-21 °C |
| | | Relative Humidity | 51-56 % |

Supplementary information:

- Frequency range of the measurements: 9KHz to 11GHz;
- Test site: SAC for measures from 30MHz to 1GHz and FAR (Semi-anechoic chamber with additional absorbers on the floor) for measures from 9KHz to 30MHz and from 1GHz to 11GHz;
- EUT powered at 115Vac 400Hz;
- Test executed with the following EUT Operating Mode (see par. 2.0): Mode 3 (1200 ATCRBS + 120 Mode S Long)
- Measures were performed first with the EUT that transmits on TOP antenna output terminated on 50Ω load and then with the EUT that transmits on BOTTOM antenna output terminated on 50Ω load;
- The EUT was placed on turn-platform on a dielectric support of 0.8m height (above the ground plane) for measures up to 1GHz and on a dielectric support of 1.5m height for measures from 1GHz to 11GHz;
- The EUT was placed 3m apart from the receiving antenna;
- The receiving antenna was positioned in horizontal and vertical polarization;
- Exploratory measures were performed manually, manipulating the harness and rotating the EUT from 0° to 360° degrees and moving the antenna height from 1m to 4m to determine the position of possible maximum emission level.
- Pre-scan measures were performed with the EUT at 0° and 180° (worst positions detected) and changing the antenna height from 1m to 4m by means of an automatic procedure computer assisted, to find the highest emission. For measures from 1GHz to 11GHz the antenna aim the EUT;
- Pre-scan measurements were performed with the detector set to PEAK within a IF bandwidth of 200Hz from 9KHz to 150KHz, of 9KHz from 150KHz to 30MHz, of 120KHz from 30MHz to 1GHz and of 1000KHz from 1GHz to 11GHz; The detected spurious emissions were re-measured with the Average detector;
- The final measures of each detected spurious components (see par. 8.4), were performed using the substitution method specified by ANSI/TIA-603-D (2010) par. 2.2, as follows:
  1) The EUT was removed from the Semi-anechoic chamber and was substituted with the substitution antenna;
  2) The substitution antenna was connected to the output of the signal generator by a RF cable;
  3) On the signal generator the frequency was set as the frequency of the spurious to measure and the power was increased until, on the EMI Receiver was measured the amplitude level (average detector) detected during the pre-scan;
  4) At this point, the power at the substitution antenna input was measured by connecting the RF cable coming from the signal generator to the EMI Receiver set as power meter;
  5) The EIRP level of the spurious is given by the power at the substitution antenna input adding the substitution antenna gain;
  6) The procedure was repeated for each spurious that shall be measured;
- Rx measuring Antennas: Loop antenna from 9KHz to 30MHz, Bilog antenna from 30MHz to 1GHz and Horn antenna from 1GHz to 11GHz;

## 8.1 Apparecchiature utilizzate / *Test Equipment Used* – Field Strength of Spurious Radiation

| ***Apparecchiature usate/Equipment Used*** | ***Modello/Model*** | ***Costruttore/ Manufacturer*** | ***Numero di serie/ Serial Number*** | **Data calibrazione / *Calibration date*** | **Intervallo / *Interval*** |
|---|---|---|---|---|---|
| EMI Receiver MXE | N9038A | Agilent Technologies | MY51210230 | 06/2016 | 1 year |
| Loop Antenna | 6502 | ETS-Lindgren | 164807 | 06/2016 | 1 year |
| Bilog Antenna | Bilog CBL6111C | Chase | 2415 | 10/2015<br>09/2016 (verification) | 1 year |
| Horn Antenna Double-Ridged Waveguides | 3117 | ETS-Lindgren | 00201258 | 08/2015<br>08/2016 (verification) | 1 year |
| Pre-Amplifier | JS32-00104000-58-5P-R | Narda -Miteq | 2008138 | 11/2016 | 1 year |
| Pre-Amplifier | HP8447F, OPT H64 | Hewlett/Packard | 3113A07568 | 04/2016 | 1 year |
| Substitution Antenna ≥30MHz and ≤1GHz | SBA 9114 | Schwarzbeck | UBAA 9114-250 | 12/2015 | 1 year |
| Substitution Antenna >1GHz | VT10180DRHA10NK | Vector Telecom Pty Ltd | 1407630100 01 | 05/2014<br>05/2016 (verification) | 1 year |
| RF Cable for substitution method | 41.275.000-L04 | CPE Italia Spa | F4539 | 02/2016 | 1 year |
| Signal Generator | 83752A | Hewlett Packard | 3447A00549 | 09/2016 | 1 year |
| RF Cable | S5LL-900 | Spin electronics | 02-053-12 | 03/2016 | 1 year |
| RF Cable | SLULL18-NMNM-4.00M | Timesmicrowave | 07035-002-001 | 07/2016 | 1 year |
| RF Cable | 41.275.000-L03 | CPE Italia Spa | F4538 | 02/2016 | 1 year |
| RF Cable | SKBL-2M-LOW | Minicircuits | 1101189 | 09/2016 | 1 year |
| Multi-Device Controller | 2090 | ETS-Lindgren | 81311 | - | - |
| Antenna Mast | 2175 | ETS-Lindgren | 136028 | - | - |
| Accessory for azimuth antenna control | - | Emilab | EL088916 | - | - |
| SAC3 – DC Filter | N6006 | ETS-Lindgren | 202031 | - | - |
| Semi-Anechoic Chamber | - | ETS-Lindgren | 5207 | - | - |
| AC Power Supply | KBT-100-C-109-451 | BEHLMAN | 5896 | 12/2015 | 1 year |

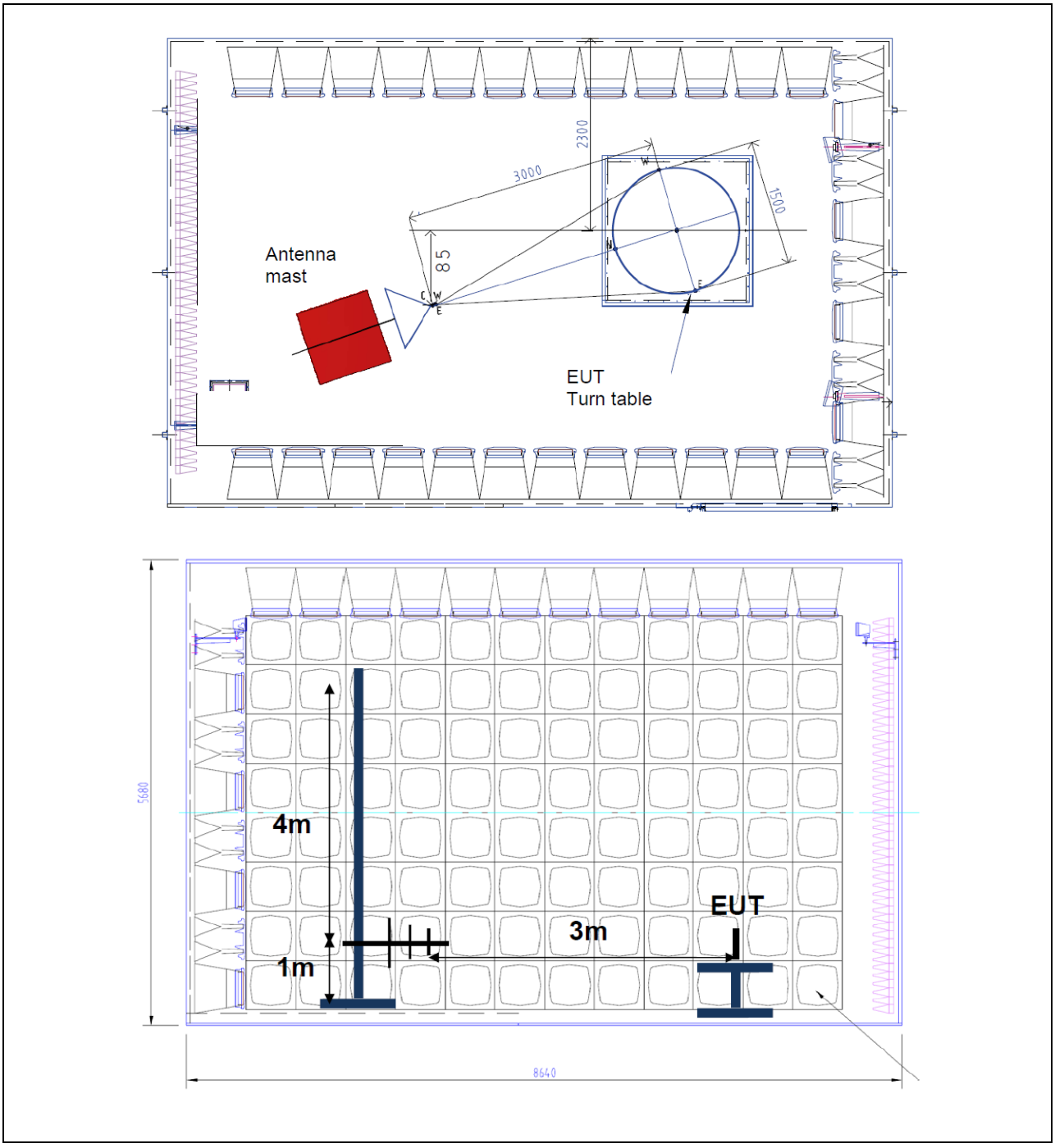
| ***Software*** | ***Revisione/Revision*** | ***Costruttore/Manufacturer*** | **Intervallo Verifica/*Verification Interval*** |
|---|---|---|---|
| Integral EMI/EMC measurement software | RadiMation Version 2016.1.3 | DARE Instruments | 1 year |

### 8.1.1 Apparecchiature ausiliarie / *Auxiliary Equipment*

| **Apparecchiature usate / *Used Equipment*** | **Modello / *Model*** | **Costruttore /*Manufacturer*** | **Numero di serie / *Serial Number*** |
|---|---|---|---|
| PCB board (installed on PC) | ARING 429 | Altadata | / |
| Test bench | IFF-45TS IFF | Aeroflex Wichita INC. | 1000000001 |

FCC Test Firm Registration #: 643914

## 8.2 Schema del setup / *Test setup diagram* – Field Strength of Spurious Radiation



## 8.3 Requisiti / *Requirements* - Field Strength of Spurious Radiation

FCC Section 2.1053

(a) “Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. …Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas”.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(2) All equipment operating on frequencies higher than 25 MHz.

FCC Section 87.139

(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB;

## 8.4 Risultati / *Results* - Field Strength of Spurious Radiation

The result of the test is: **PASS**. See the details in the charts/tables of the following paragraphs.
In the following two tables, are collected the maximum EIRP power of each spurious detected.

Limit: the EUT carrier peak power is 500W, the duty cycle is 1.6% than the carrier mean power is 500 x 0.016 = 8W equal to 39dBm, at this value is added the dipole antenna gain of 1.64dBm than the carrier mean power is 40.64dBm.
The limit is -40dB respect to the carrier mean power: 40.6 – 40 = **0.6dBm**

| Antenna TOP to 50Ω load | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Spurious Frequency [MHz]** | **Antenna Polarization** | **Power at substitution antenna input [dBm]** | **Substitution antenna Gain [dBi]** | **EIRP Power (dBm)** | **Limit [dBm]** | **Difference from limit [dB]** | **Result** |
| 48,00 | Horizontal | -42,2 | -24,7 | -66,9 | 0,6 | 67,5 | Pass |
| 336,00 | Vertical | -46,3 | 1,5 | -44,8 | 0,6 | 45,4 | Pass |
| 2180,00 | Vertical | -56,2 | 9,1 | -47,1 | 0,6 | 47,7 | Pass |
| 5451,00 | Horizontal | -72,9 | 10,3 | -62,6 | 0,6 | 63,2 | Pass |
| 6541,00 | Horizontal | -73,1 | 11,6 | -61,5 | 0,6 | 62,1 | Pass |
| 3271,00 | Horizontal | -67,4 | 9,2 | -58,2 | 0,6 | 58,8 | Pass |
| 4361,00 | Vertical | -73,8 | 10,4 | -63,4 | 0,6 | 64,0 | Pass |

| Antenna BOTTOM to 50Ω load | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Spurious Frequency [MHz]** | **Antenna Polarization** | **Power at substitution antenna input [dBm]** | **Substitution antenna Gain [dBi]** | **EIRP Power (dBm)** | **Limit [dBm]** | **Difference from limit [dB]** | **Result** |
| 48,00 | Vertical | -39,7 | -24,7 | -64,4 | 0,6 | 65,0 | Pass |
| 336,00 | Vertical | -51,6 | 1,5 | -50,1 | 0,6 | 50,7 | Pass |
| 2180,00 | Horizontal | -56,5 | 9,1 | -47,4 | 0,6 | 48,0 | Pass |
| 5451,00 | Vertical | -72,1 | 10,3 | -61,8 | 0,6 | 62,4 | Pass |
| 6541,00 | Horizontal | -74,4 | 11,6 | -62,8 | 0,6 | 63,4 | Pass |
| 3271,00 | Vertical | -67,1 | 9,2 | -57,9 | 0,6 | 58,5 | Pass |
| 4361,00 | Vertical | -73,7 | 10,4 | -63,3 | 0,6 | 63,9 | Pass |

Note: below 30MHz only noise floor was measured (no spurious emissions were detected).

## 8.4.1 Tabelle e grafici dei risultati / Tables and *graphical representation data* – Field Strength of Spurious Radiation

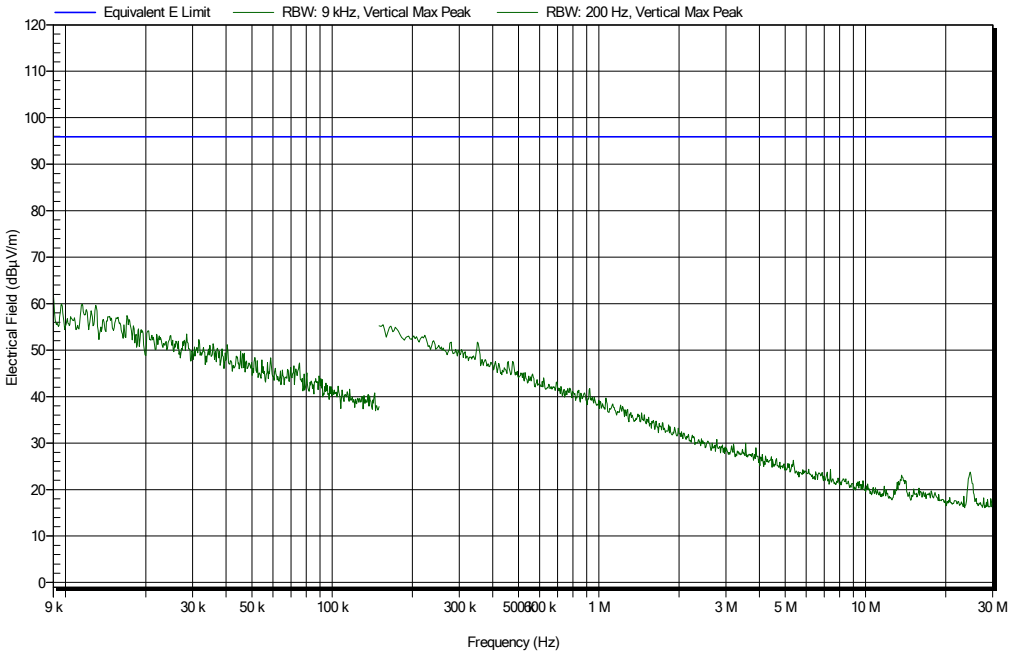
Note: the equivalent "E limit" used during pre-scan phase and represented on the next graphics, was calculated by the next formula:

$$E = \frac{\sqrt{P_t \times 30}}{r}$$

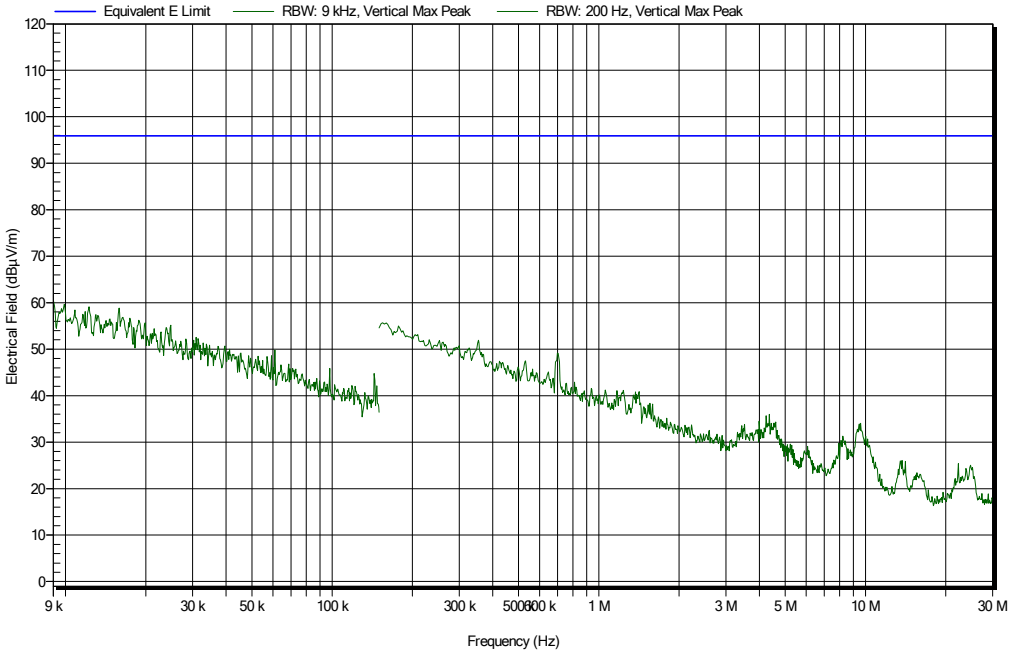
where $P_t$ is the total power radiated from an isotropic radiator and $r$ is the distance from the isotropic radiator.

**Noise Floor Measures from 9KHz to 30MHz**

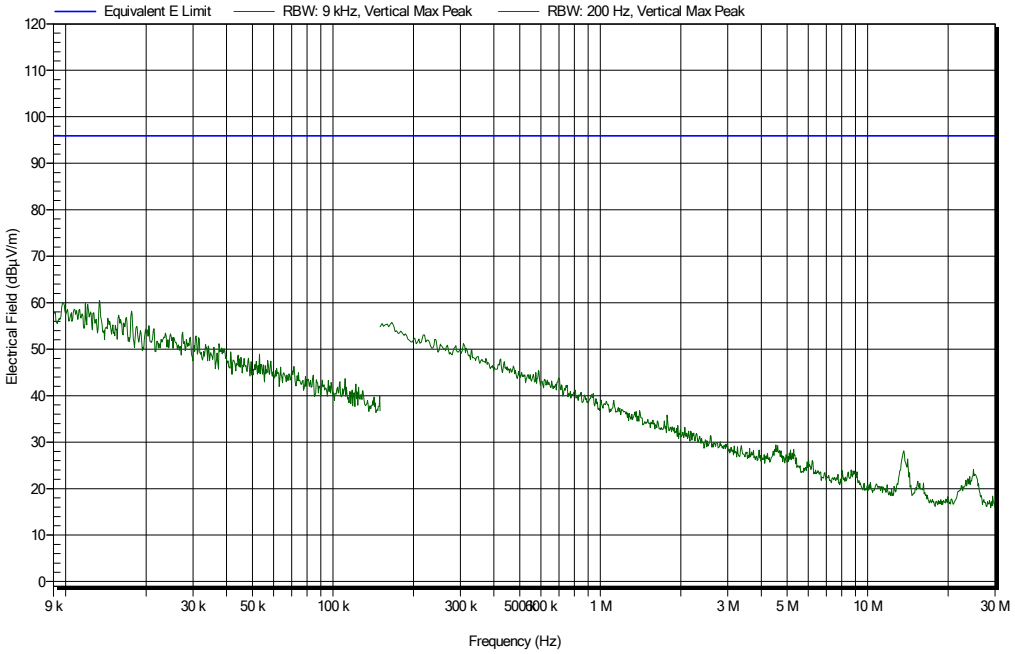
Noise floor measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Vertical polarization, orthogonal respect to the EUT-Antenna axis.



Noise floor measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Vertical polarization, parallel respect to the EUT-Antenna axis.

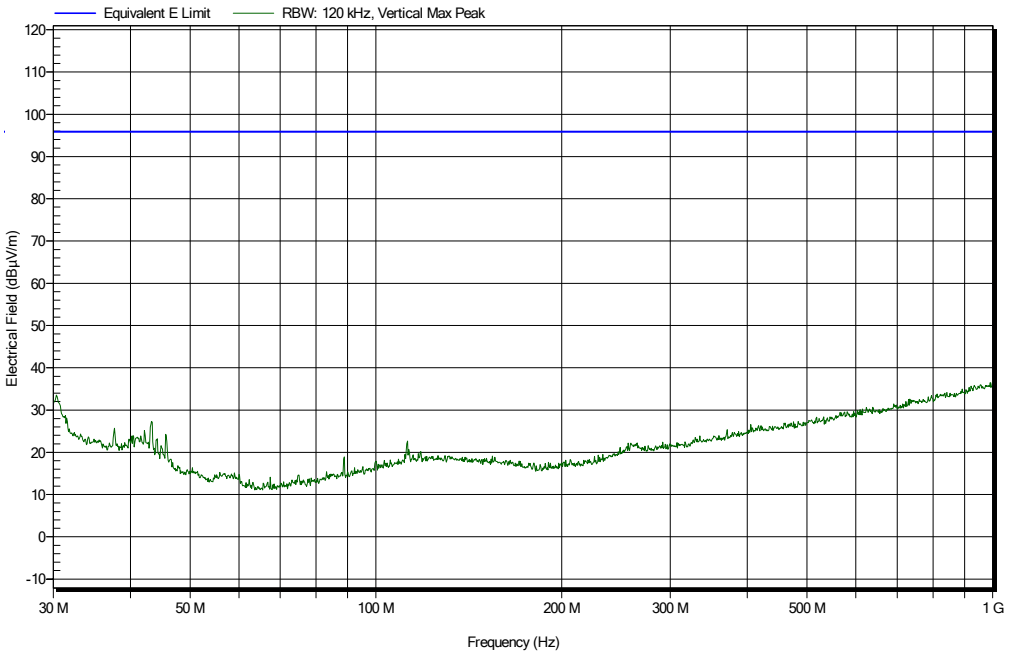


Noise floor measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Horizontal polarization.

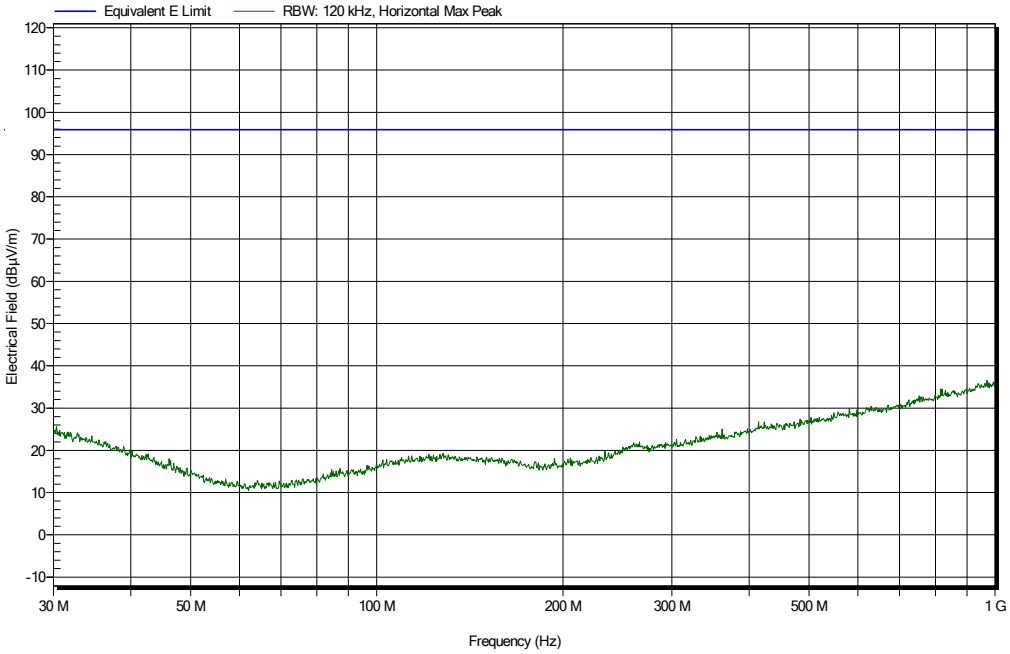


## Noise Floor Measures from 30MHz to 1GHz

Noise floor measured from 30MHz to 1GHz. Peak detector (green trace) with IF=120KHz. Average equivalent E limit (blue line). Vertical polarization.

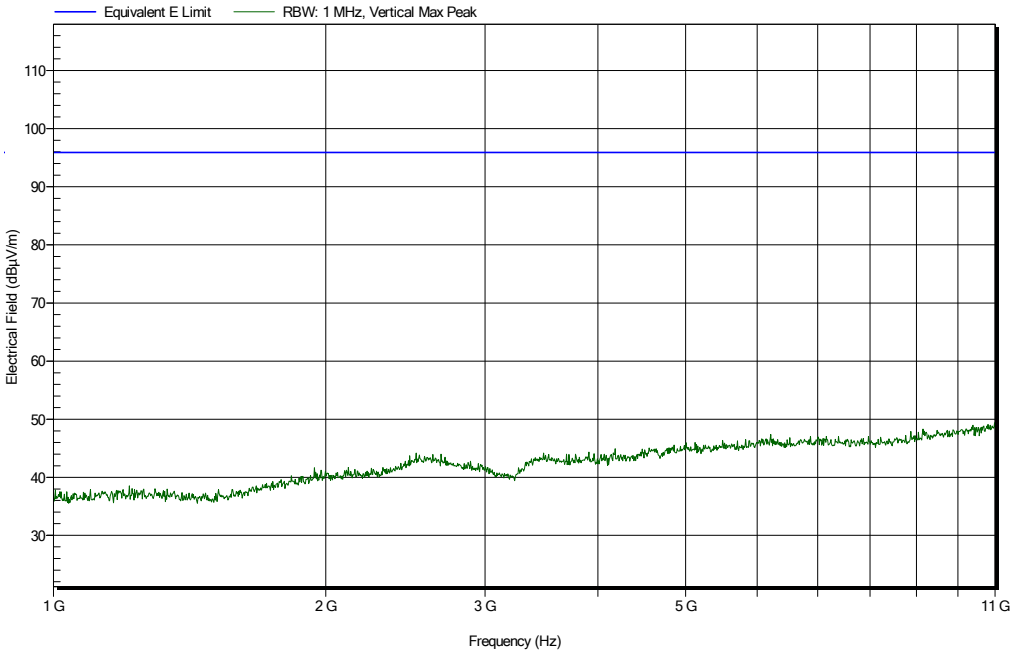



Noise floor measured from 30MHz to 1GHz. Peak detector (green trace) with IF=120KHz. Average equivalent E limit (blue line). Horizontal polarization.

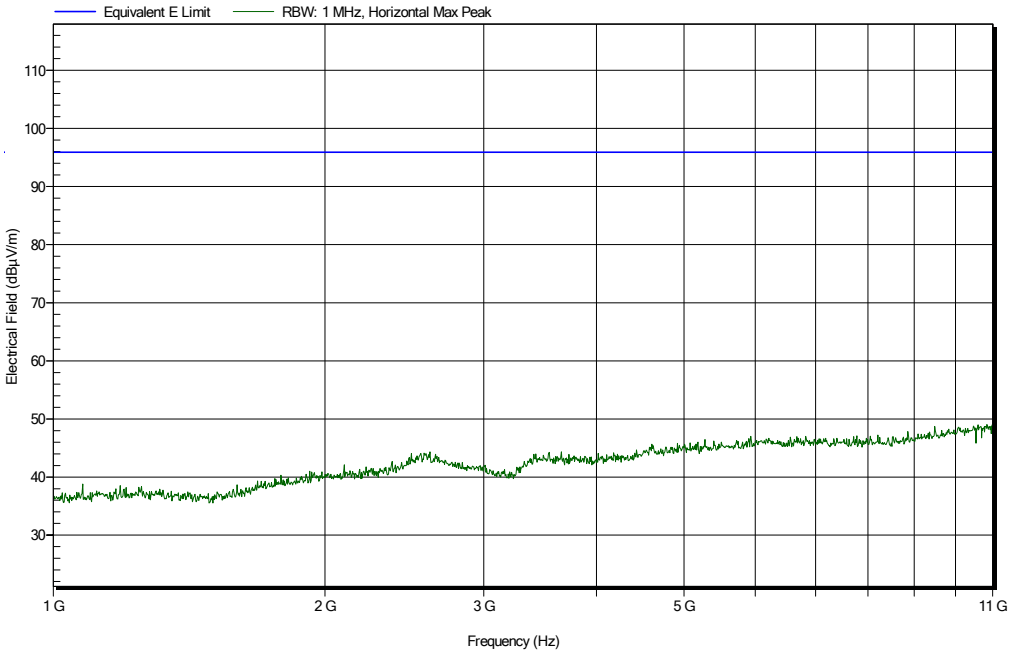


## Noise Floor Measures from 1GHz to 11GHz

Noise floor measured from 1GHz to 11GHz. Peak detector (green trace) with IF=1MHz. Average equivalent E limit (blue line). Vertical polarization.



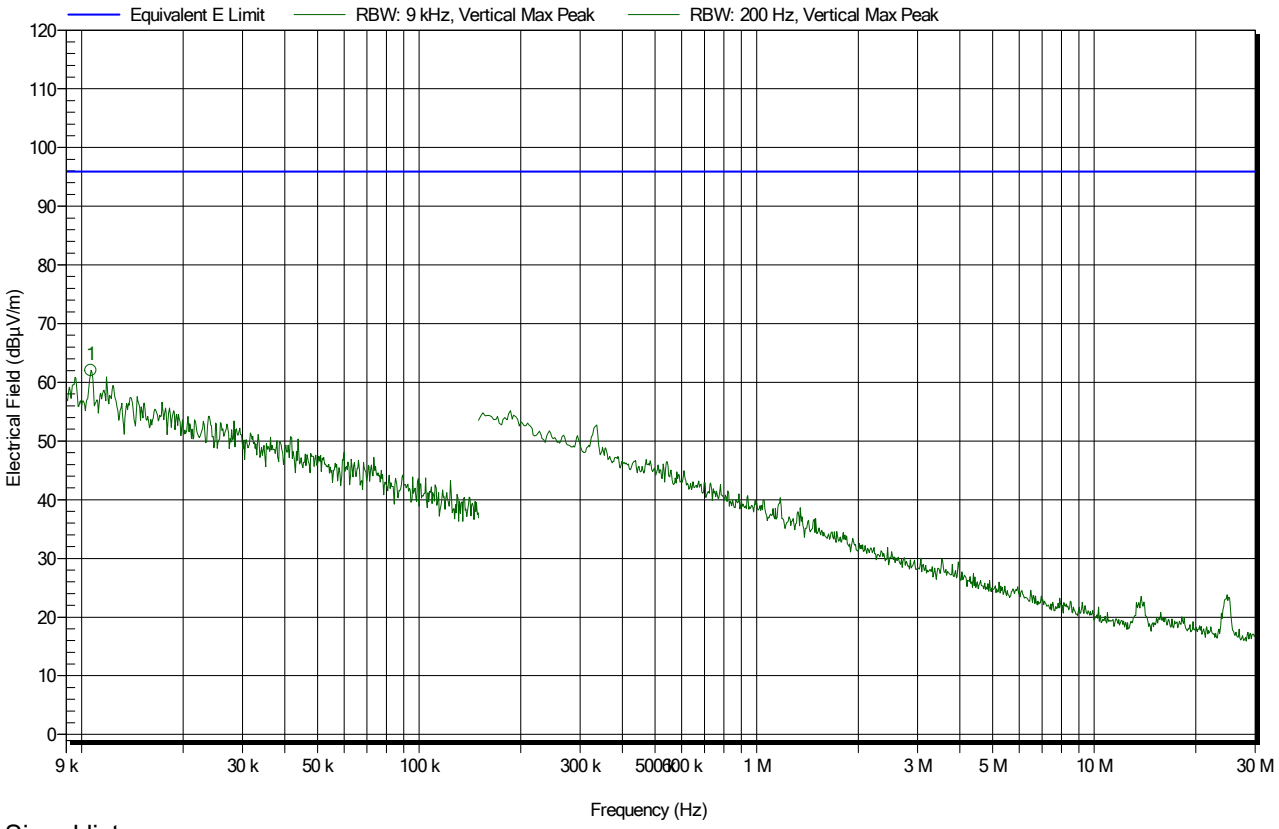

Noise floor measured from 1GHz to 11GHz. Peak detector (green trace) with IF=1MHz. Average equivalent E limit (blue line). Horizontal polarization.



## Cable of antenna TOP connected to 50ohm Load

**Measure on EUT from 9KHz to 30MHz**

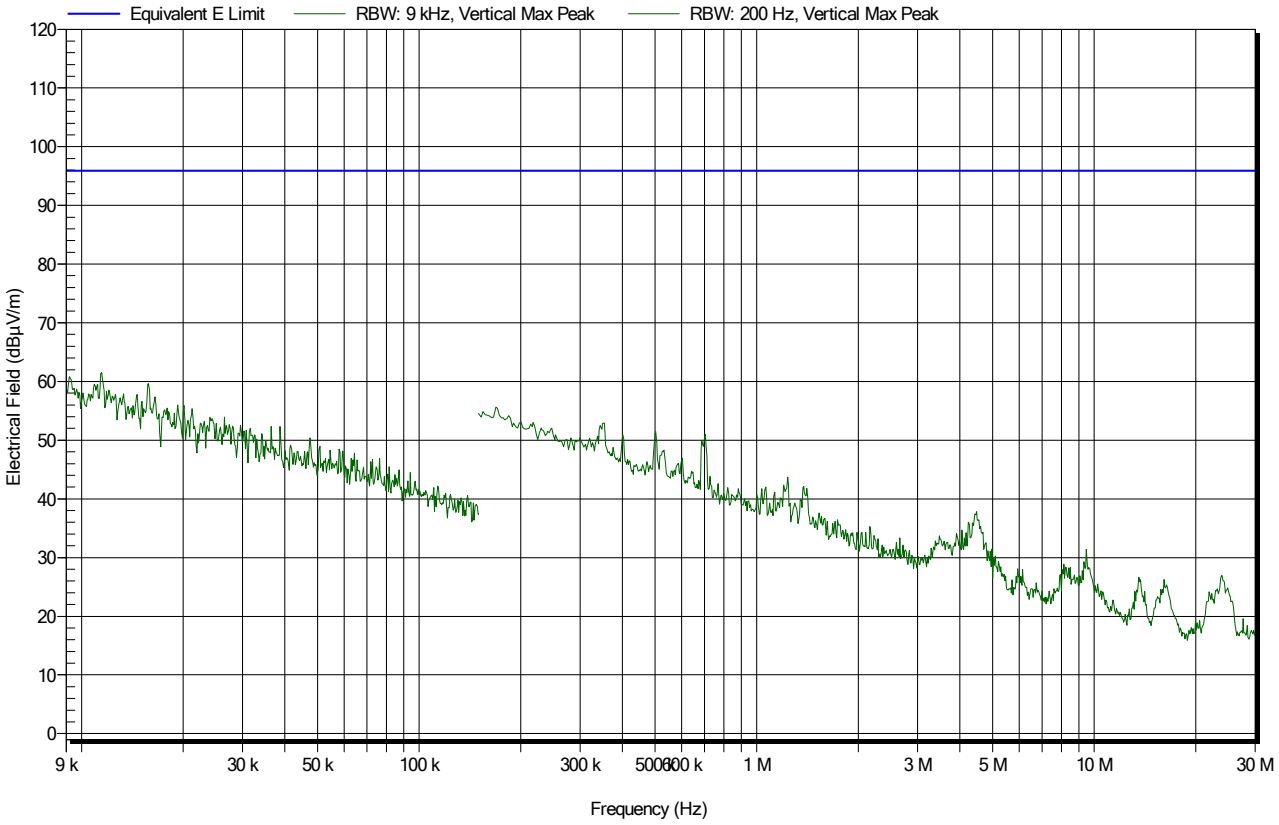
Radiated emissions measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Vertical polarization, orthogonal respect to the EUT-Antenna axis.



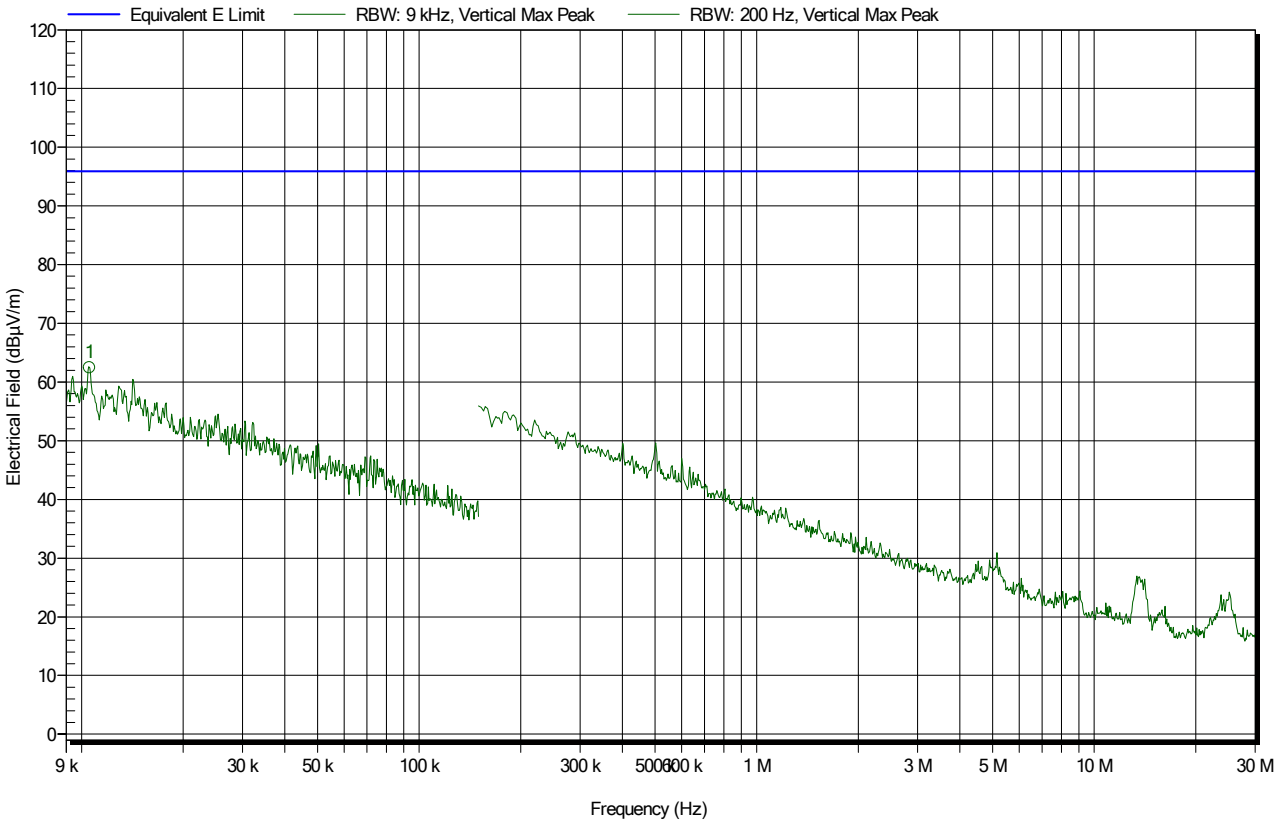

Signal list

| Frequency [KHz] | Peak [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 10,650 | 62,0 | 95,9 | -33,9 | 0 | 1,00 | Pass |

Radiated emissions measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Vertical polarization, parallel respect to the EUT-Antenna axis.



Radiated emissions measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Horizontal polarization.

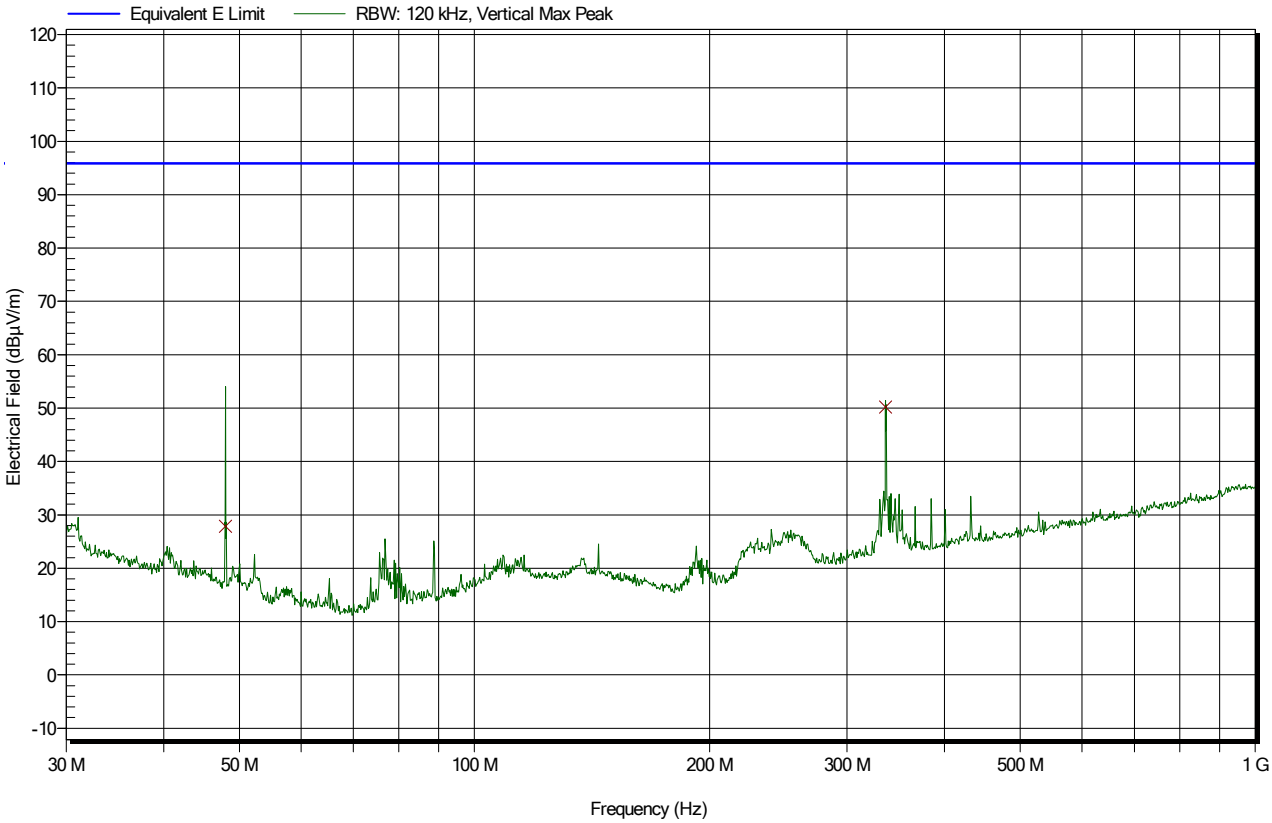



Signal list

| Frequency [KHz] | Peak [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 10,550 | 62,4 | 95,9 | -33,5 | 0 | 1,00 | Pass |

## Measure on EUT from 30MHz to 1GHz

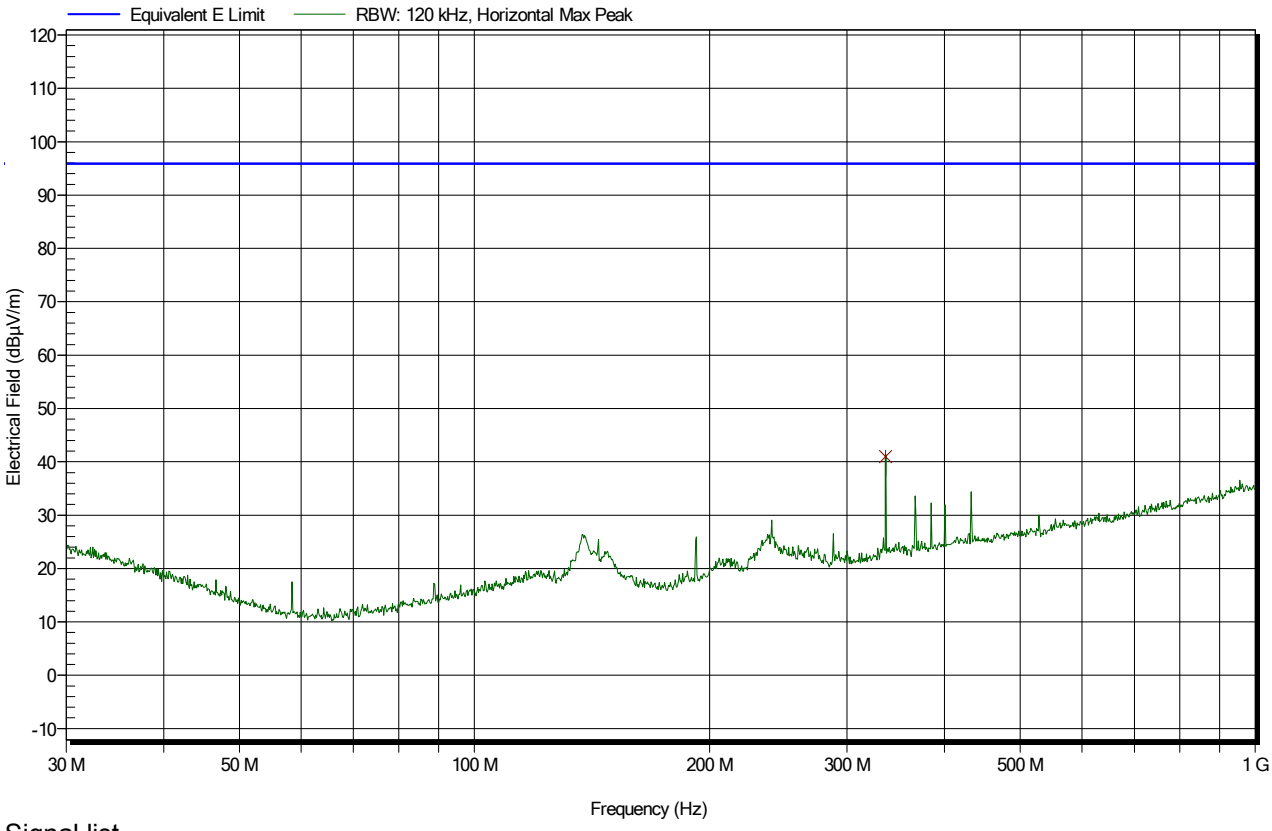
Radiated emissions measured from 30MHz to 1GHz. Peak detector (green trace) with IF=120KHz. Average equivalent E limit (blue line). Vertical polarization.




Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 48,000 | 27,9 | 95,9 | -68,0 | 0 | 1,00 | Pass |
| 336,000 | 50,2 | 95,9 | -45,7 | 0 | 1,00 | Pass |

Radiated emissions measured from 30MHz to 1GHz. Peak detector (green trace) with IF=120KHz. Average equivalent E limit (blue line). Horizontal polarization.



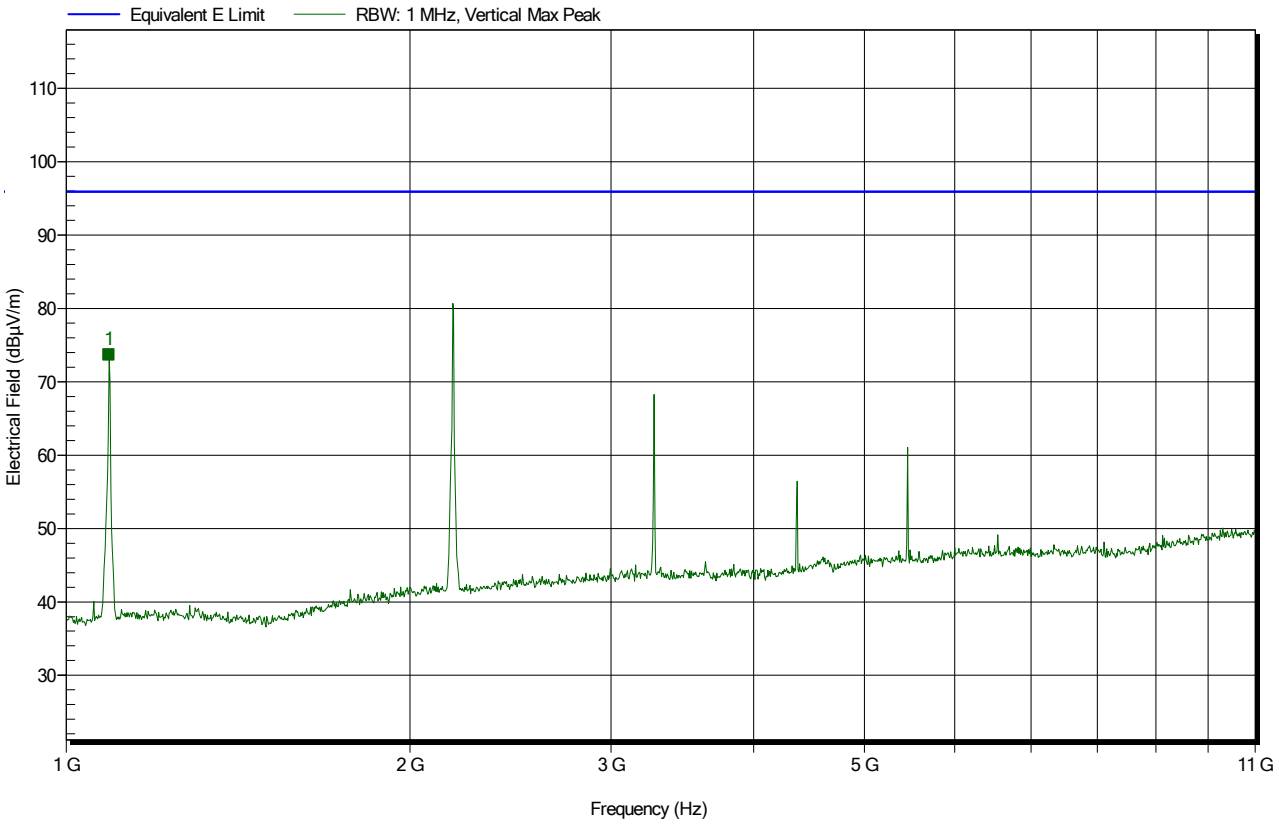

Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 336,000 | 41,0 | 95,9 | -54,9 | 0 | 2,81 | Pass |

## Measure on EUT from 1GHz to 11GHz

Radiated emissions measured from 1GHz to 11GHz. Peak detector (green trace) with IF=1MHz. Average equivalent E limit (blue line). Vertical polarization.

Note: carrier intentional emission at 1090MHz



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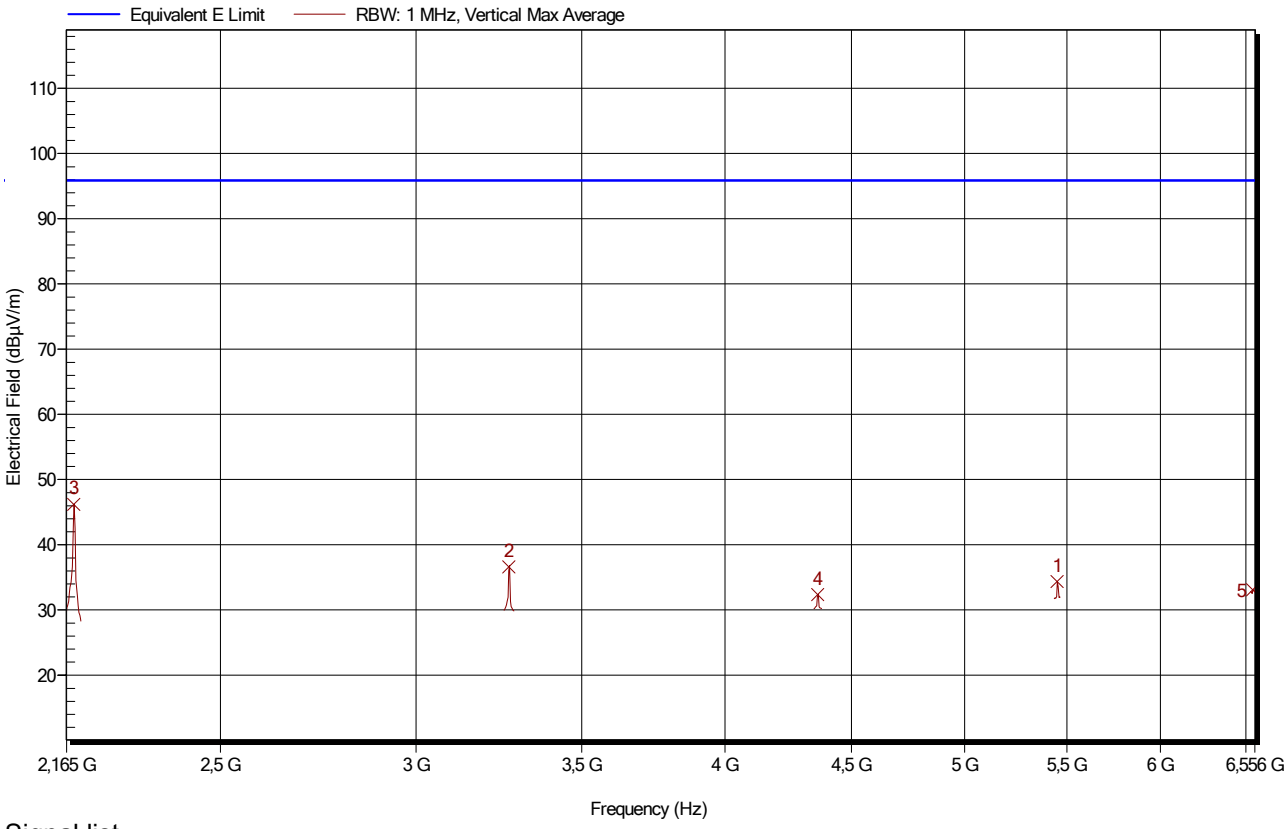
Radiated emissions measured from 2.165GHz to 6.556GHz. Average detector (brown trace) with IF=1MHz. Average equivalent E limit (blue line). Vertical polarization.



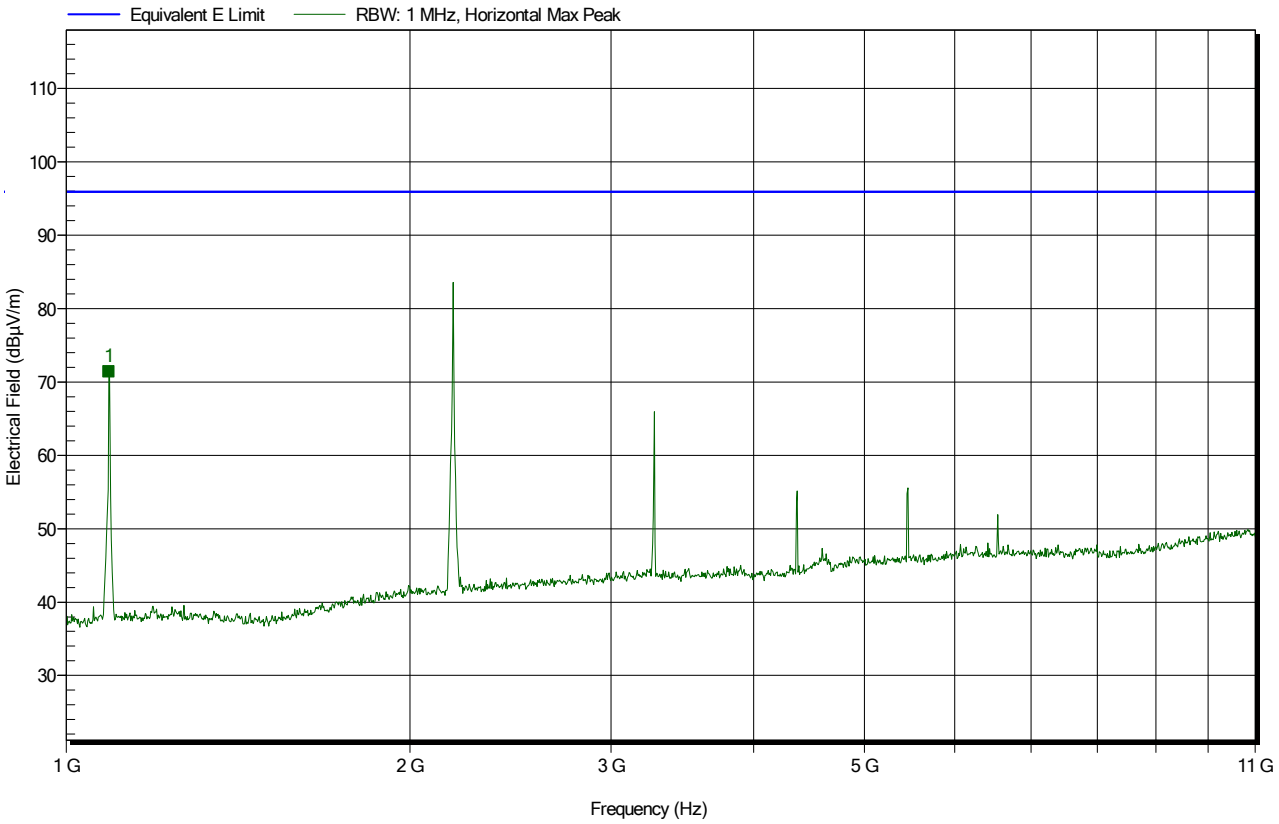

Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 2181,000 | 46,2 | 95,9 | -49,7 | 0 | 3,79 | Pass |
| 3271,000 | 36,6 | 95,9 | -59,3 | 0 | 2,29 | Pass |
| 4361,000 | 32,4 | 95,9 | -63,5 | 0 | 2,29 | Pass |
| 5451,000 | 34,4 | 95,9 | -61,5 | 0 | 1,86 | Pass |
| 6541,000 | 33,1 | 95,9 | -62,8 | 0 | 1,86 | Pass |

FCC Test Firm Registration #: 643914

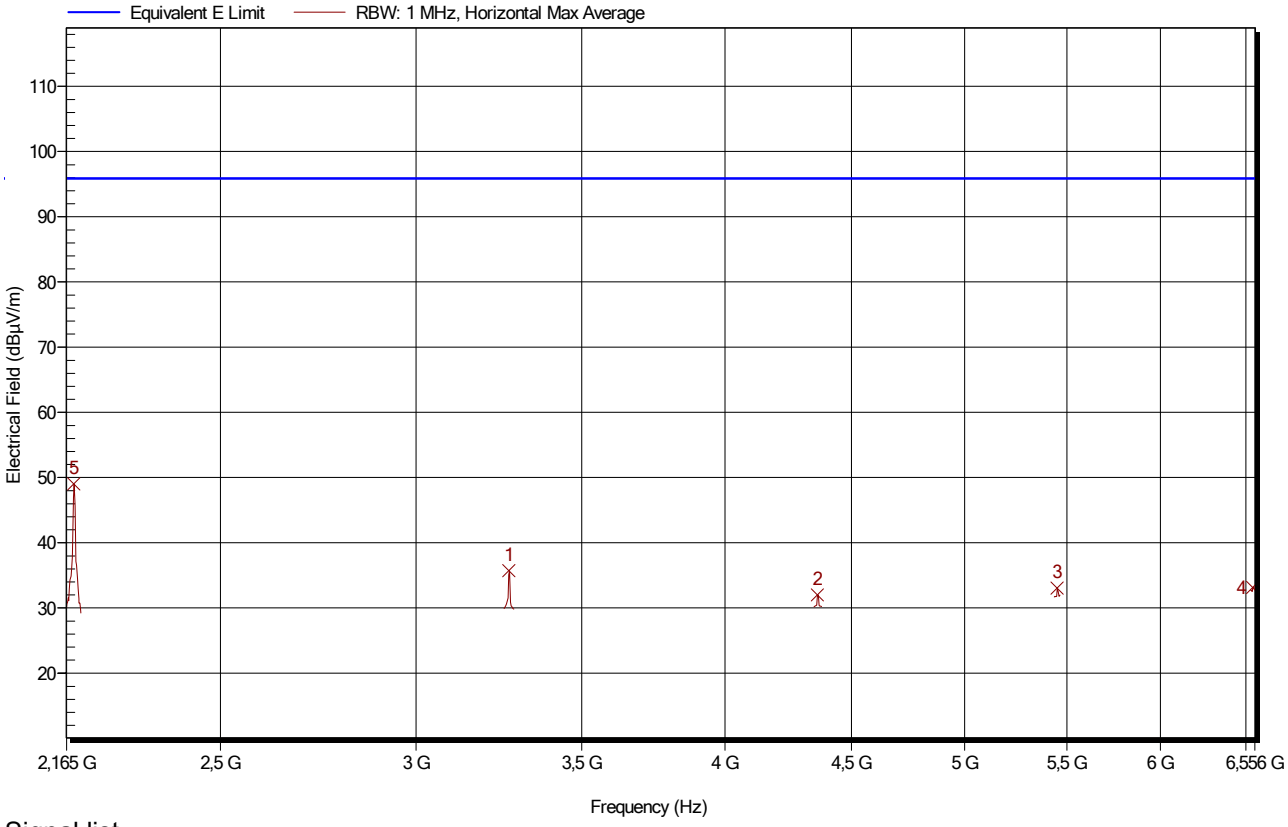
Radiated emissions measured from 1GHz to 11GHz. Peak detector (green trace) with IF=1MHz. Average equivalent E limit (blue line). Horizontal polarization.

Note: carrier intentional emission at 1090MHz



FCC Test Firm Registration #: 643914

Radiated emissions measured from 2.165GHz to 6.556GHz. Average detector (brown trace) with IF=1MHz. Average equivalent E limit (blue line). Horizontal polarization.



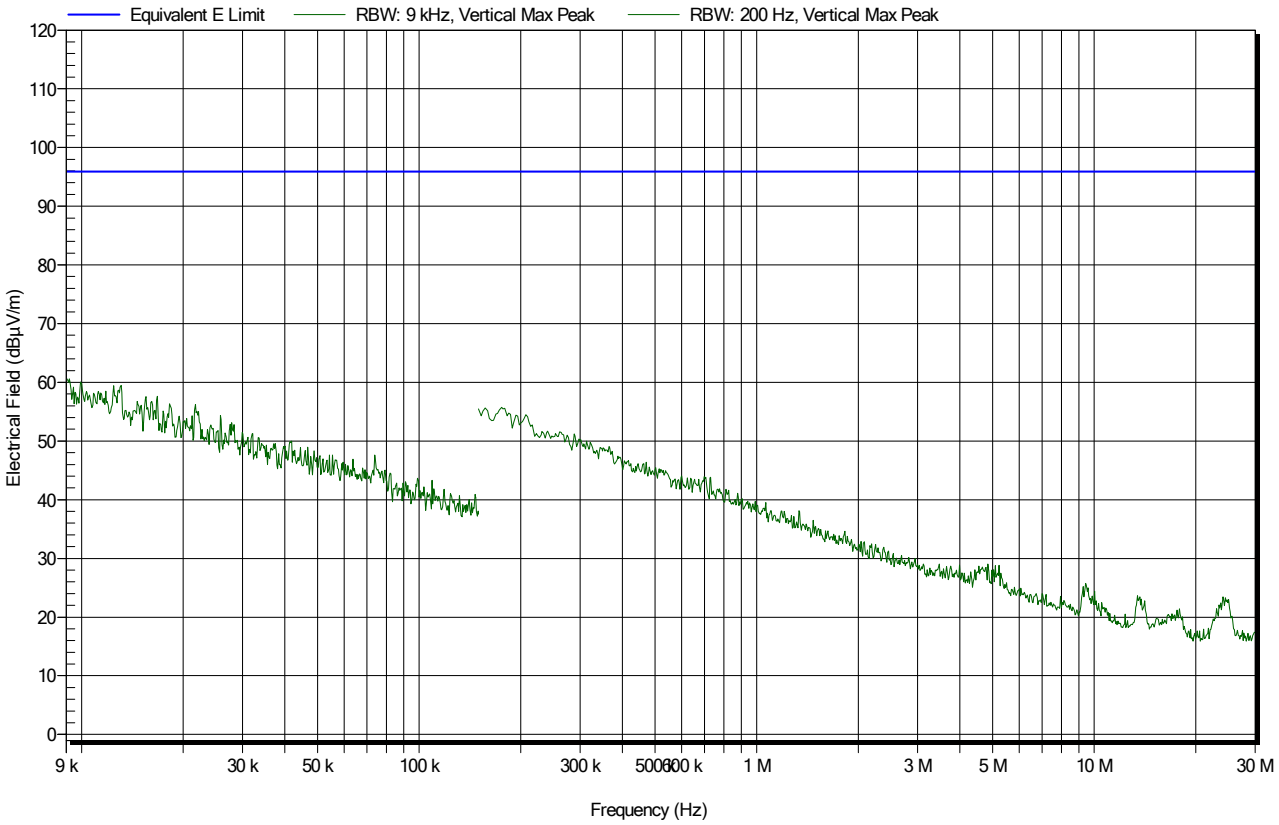

Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 2180,000 | 49,0 | 95,9 | -46,9 | 0 | 3,36 | Pass |
| 3271,000 | 35,7 | 95,9 | -60,2 | 0 | 2,29 | Pass |
| 4360,000 | 32,0 | 95,9 | -63,9 | 0 | 1,86 | Pass |
| 5451,000 | 33,1 | 95,9 | -62,8 | 0 | 1,86 | Pass |
| 6541,000 | 33,2 | 95,9 | -62,7 | 0 | 1,00 | Pass |

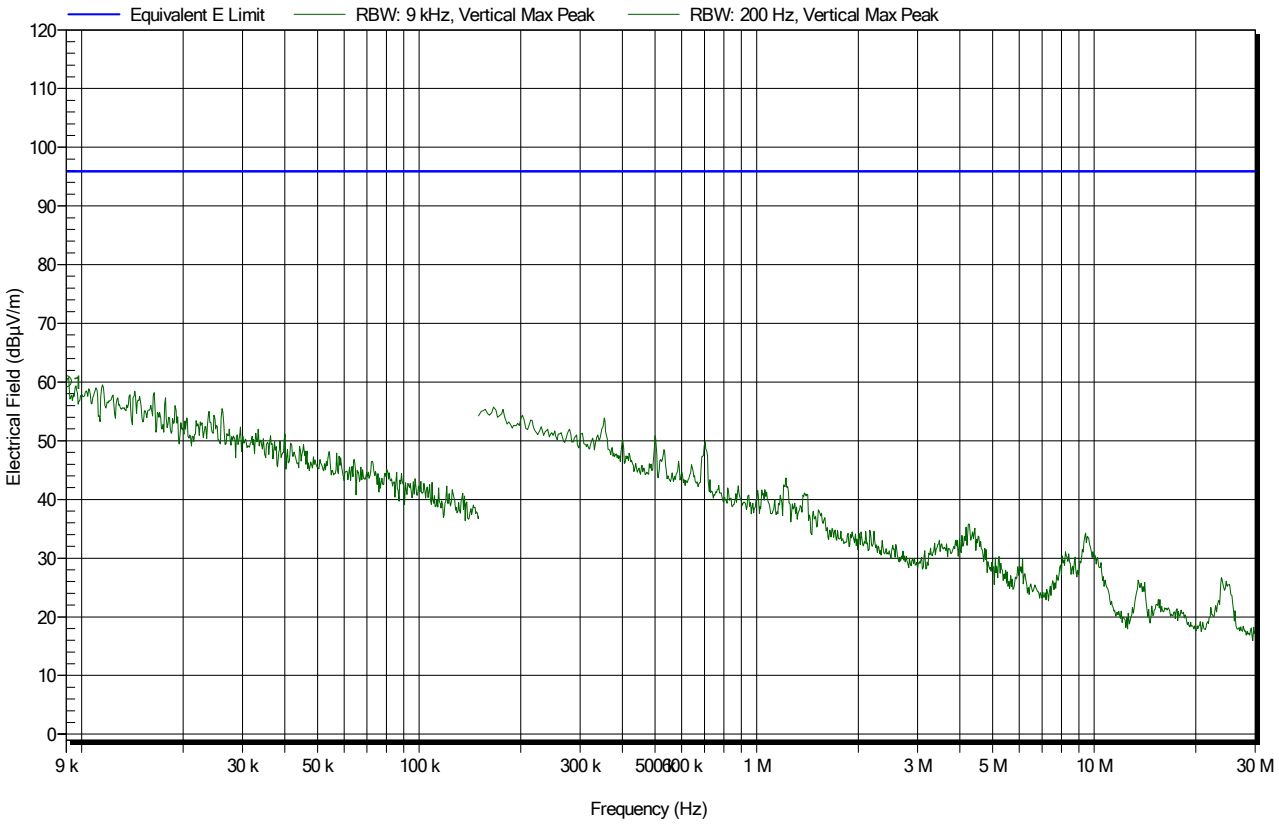
## Cable of antenna BOTTOM connected to 50ohm Load

**Measure on EUT from 9KHz to 30MHz**

Radiated emissions measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Vertical polarization, orthogonal respect to the EUT-Antenna axis.



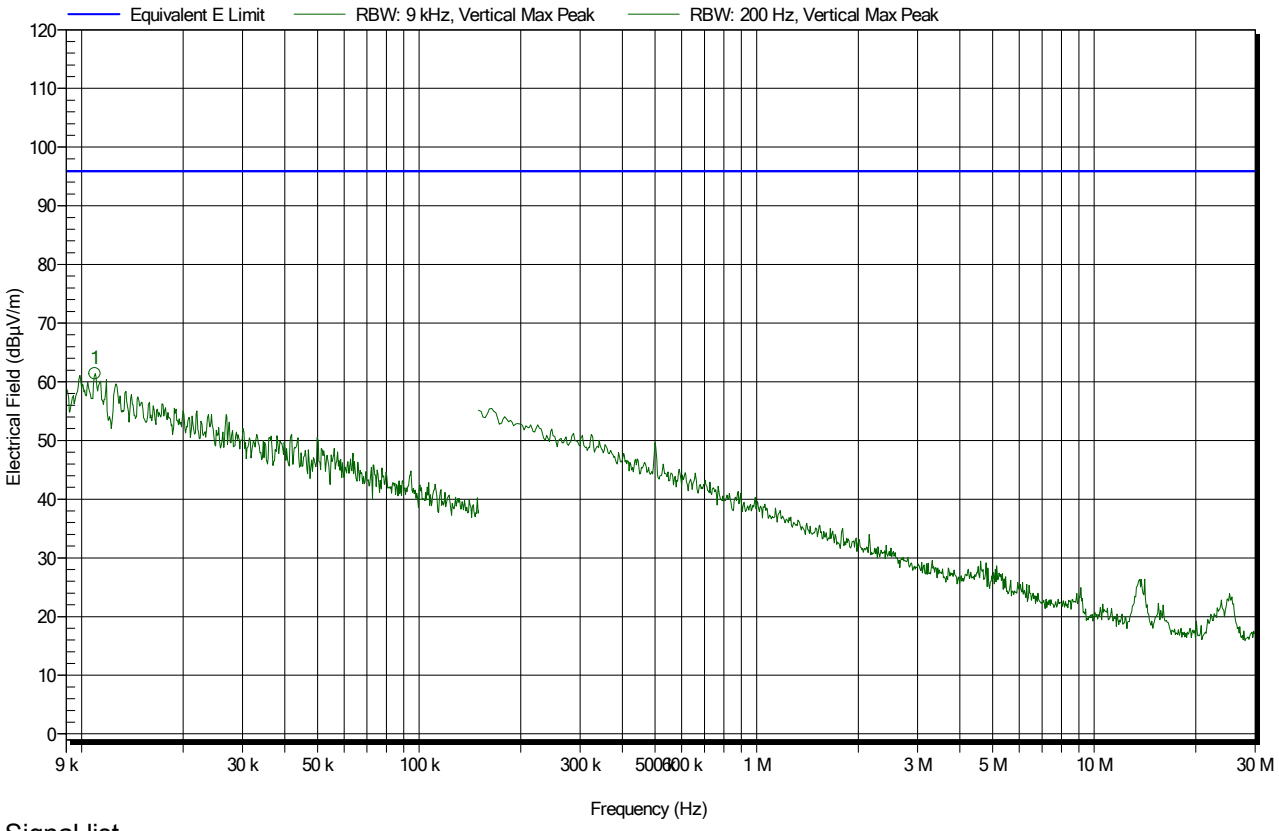
Radiated emissions measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Vertical polarization, parallel respect to the EUT-Antenna axis.




Signal list

| Frequency [KHz] | Peak [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 9,000 | 60,1 | 95,9 | -35,8 | 0 | 1,00 | Pass |

Radiated emissions measured from 9KHz to 30MHz. Peak detector (green trace) with IF=200Hz from 9KHz to 150KHz and 9KHz from 150KHz to 30MHz. Average equivalent E limit (blue line). Horizontal polarization.

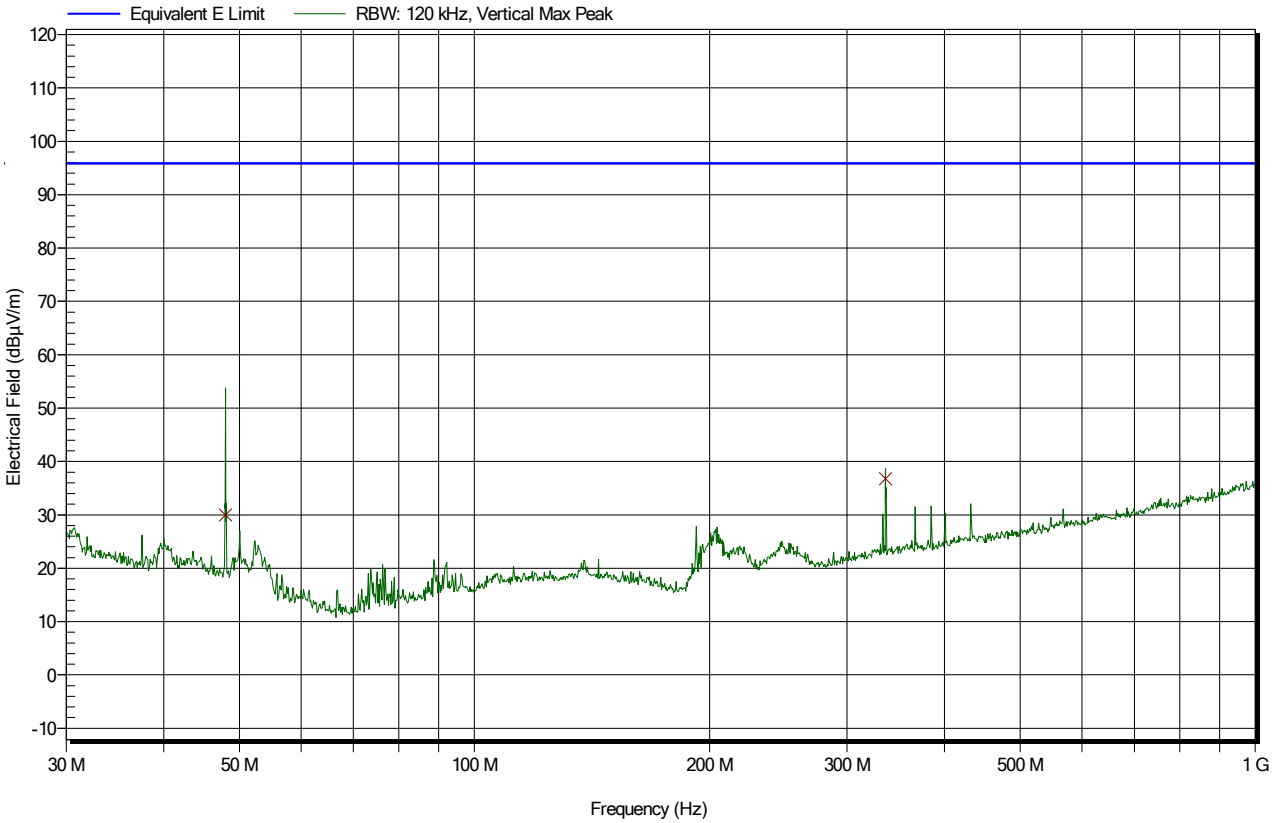



Signal list

| Frequency [KHz] | Peak [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 10,950 | 61,4 | 95,9 | -34,5 | 0 | 1,00 | Pass |

## Measure on EUT from 30MHz to 1GHz

Radiated emissions measured from 30MHz to 1GHz. Peak detector (green trace) with IF=120KHz. Average equivalent E limit (blue line). Vertical polarization.




Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 48,000 | 30,0 | 95,9 | -65,9 | 0 | 1,50 | Pass |
| 336,000 | 36,8 | 95,9 | -59,1 | 0 | 1,00 | Pass |

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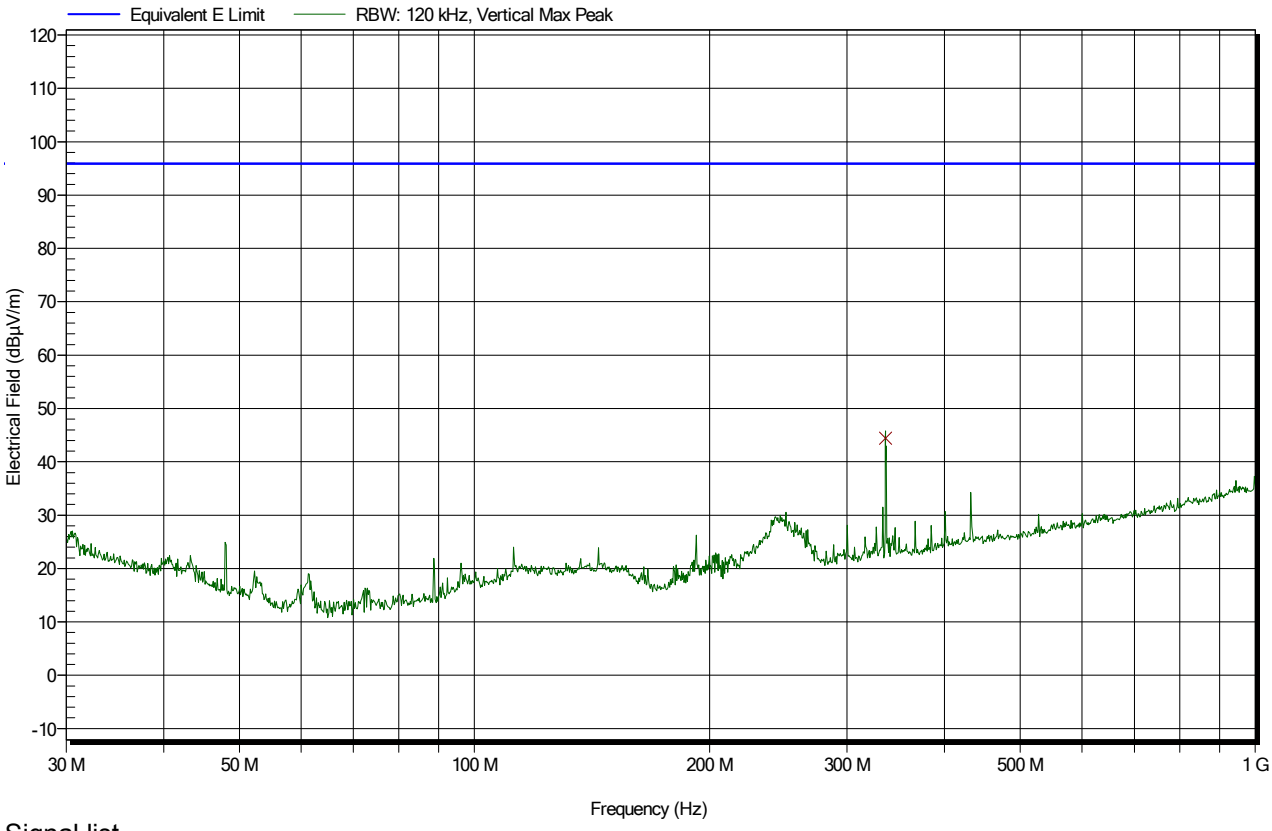
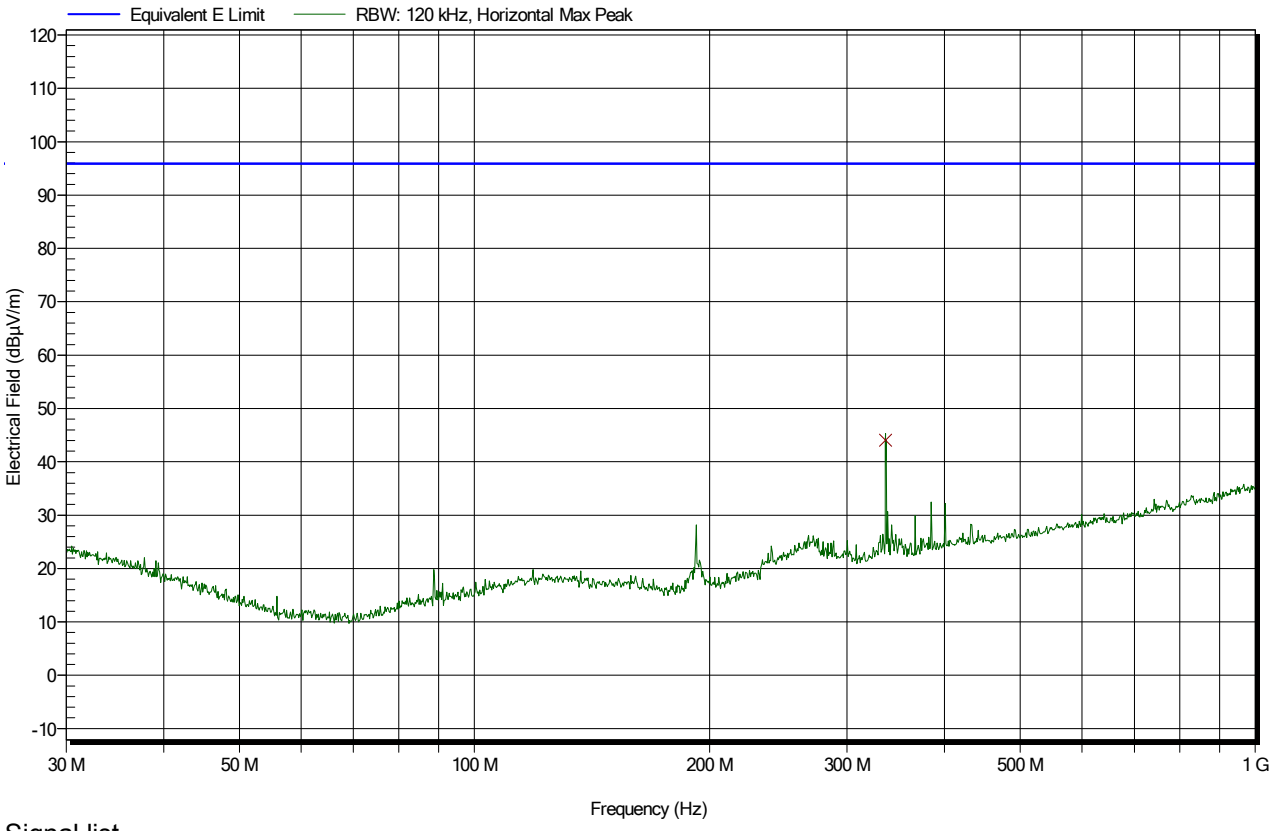
Radiated emissions measured from 30MHz to 1GHz. Peak detector (green trace) with IF=120KHz. Average equivalent E limit (blue line). Vertical polarization.




Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 336,000 | 44,4 | 95,9 | -51,5 | 180 | 1,00 | Pass |

Radiated emissions measured from 30MHz to 1GHz. Peak detector (green trace) with IF=120KHz. Average equivalent E limit (blue line). Horizontal polarization.



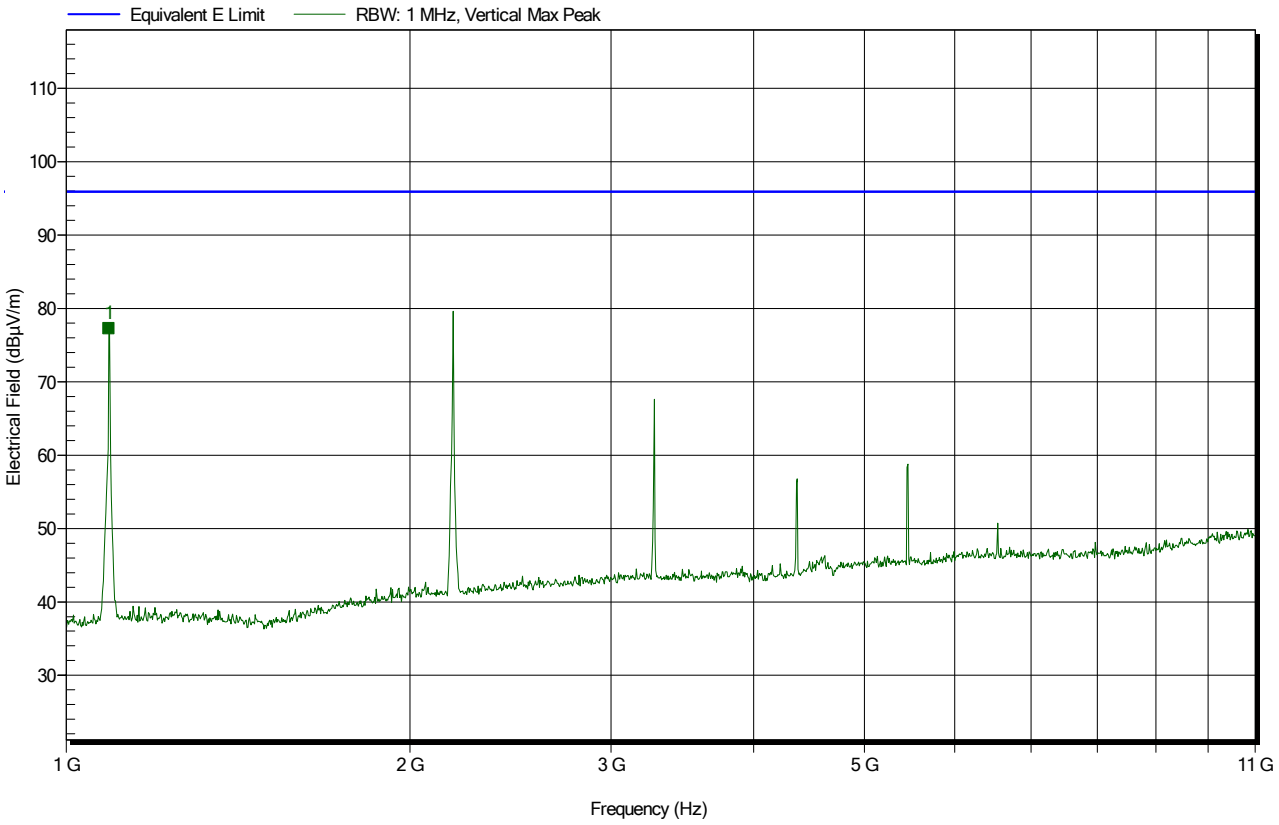

Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 336,000 | 44,1 | 95,9 | -51,8 | 180 | 1,00 | Pass |

## Measure on EUT from 1GHz to 11GHz

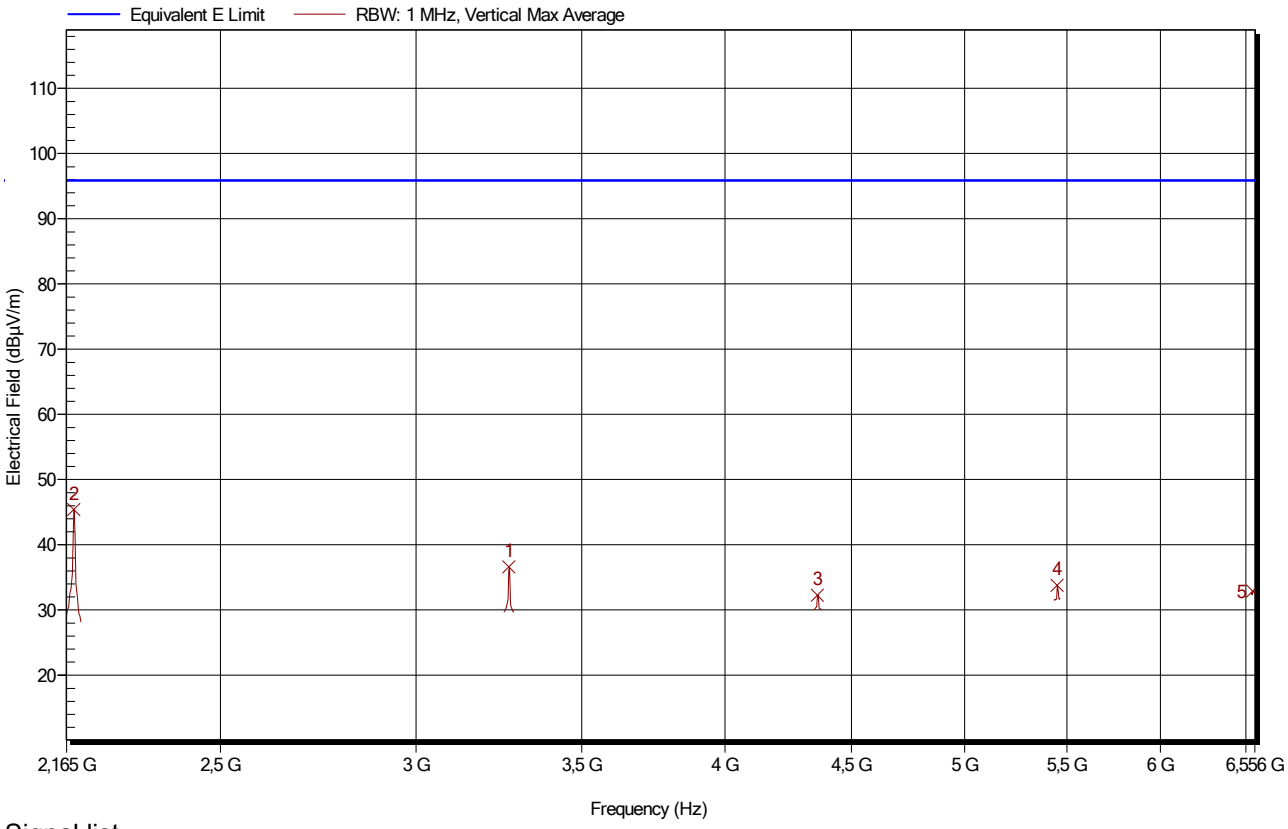
Radiated emissions measured from 1GHz to 11GHz. Peak detector (green trace) with IF=1MHz. Average equivalent E limit (blue line). Vertical polarization.

Note: carrier intentional emission at 1090MHz



FCC Test Firm Registration #: 643914

Radiated emissions measured from 2.165GHz to 6.556GHz. Average detector (brown trace) with IF=1MHz. Average equivalent E limit (blue line). Vertical polarization.

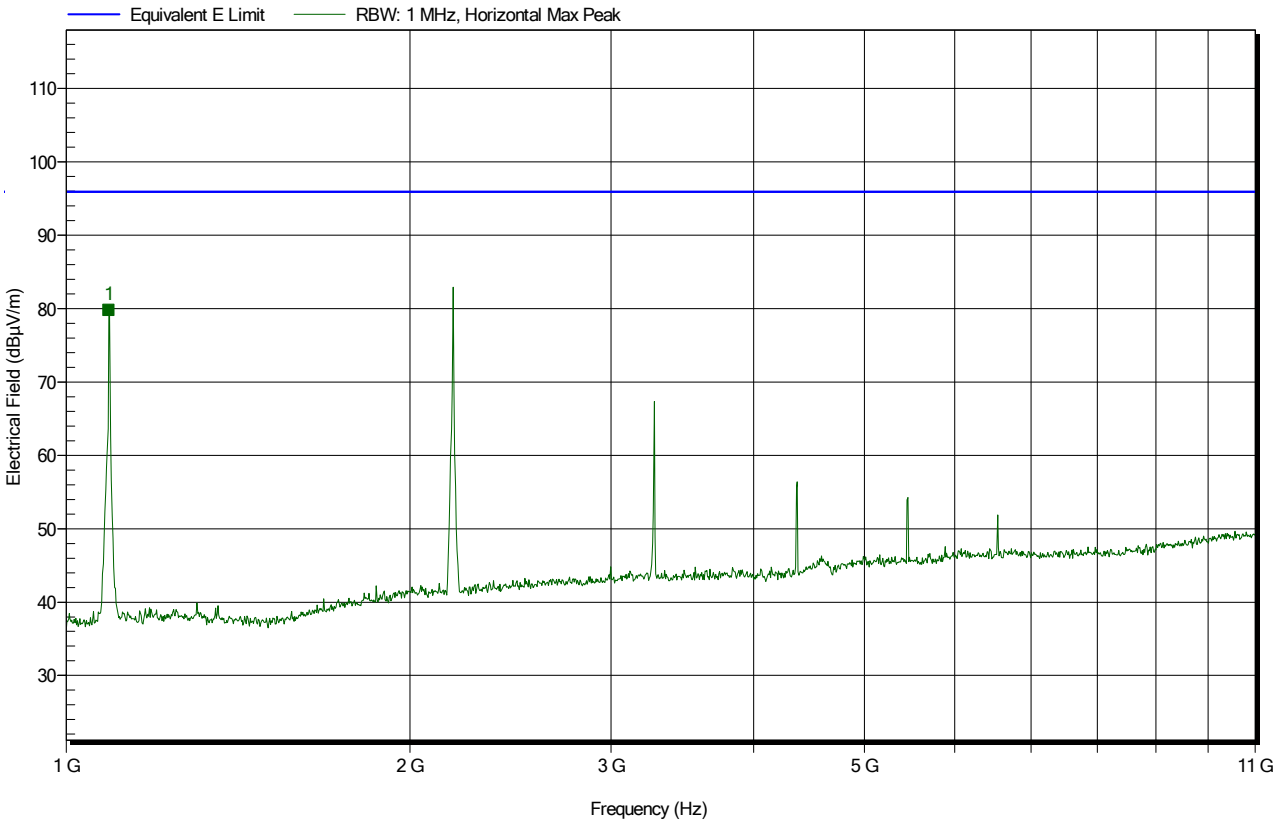



Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 2180,000 | 45,4 | 95,9 | -50,5 | 0 | 2,93 | Pass |
| 3271,000 | 36,6 | 95,9 | -59,3 | 0 | 2,29 | Pass |
| 4360,000 | 32,3 | 95,9 | -63,6 | 0 | 2,29 | Pass |
| 5451,000 | 33,8 | 95,9 | -62,1 | 0 | 1,86 | Pass |
| 6541,000 | 32,9 | 95,9 | -63,0 | 0 | 2,07 | Pass |

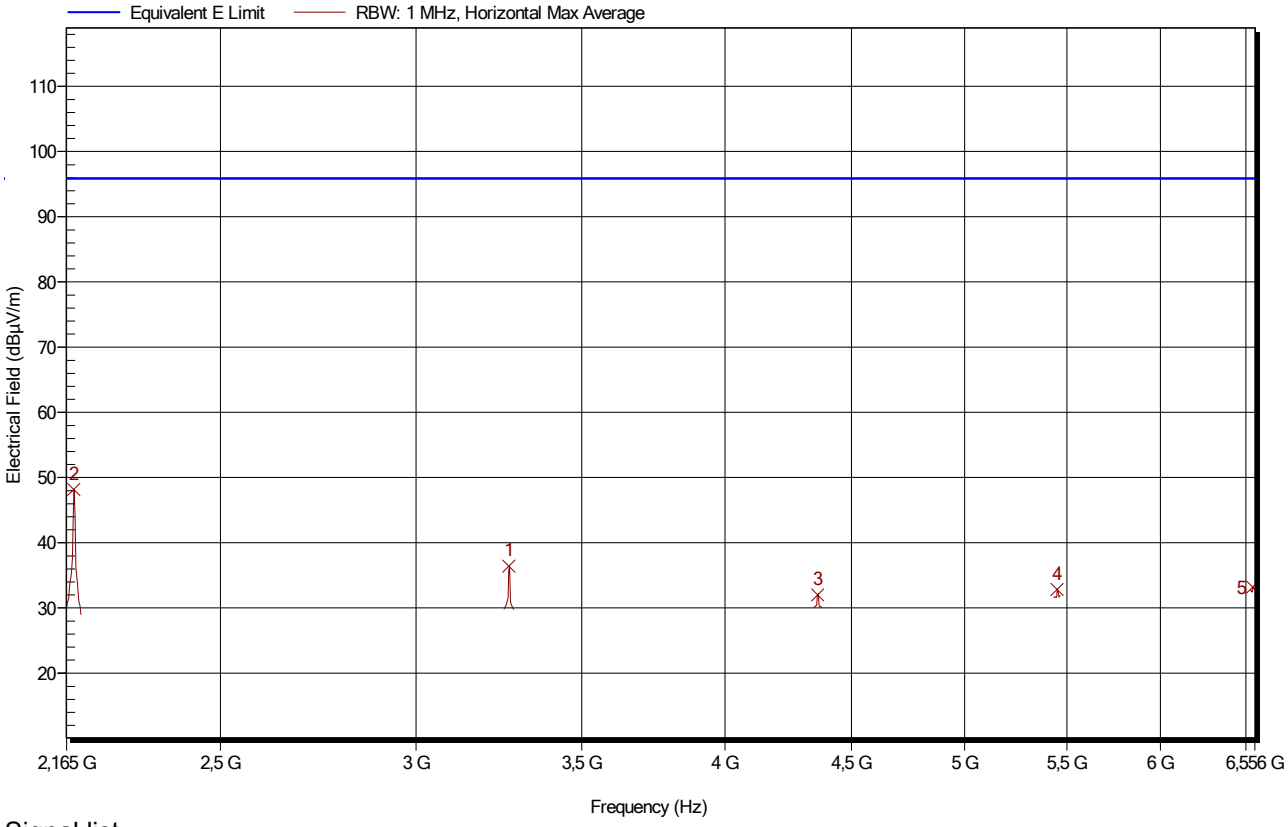
Radiated emissions measured from 1GHz to 11GHz. Peak detector (green trace) with IF=1MHz. Average equivalent E limit (blue line). Horizontal polarization.

Note: carrier intentional emission at 1090MHz



FCC Test Firm Registration #: 643914

Radiated emissions measured from 2.165GHz to 6.556GHz. Average detector (brown trace) with IF=1MHz. Average equivalent E limit (blue line). Horizontal polarization.




Signal list

| Frequency [MHz] | Average [dBµV/m] | Average Limit [dBµV/m] | Difference from Limit [dB] | EUT Angle [°] | Antenna Height [mt] | Result |
|---|---|---|---|---|---|---|
| 2180,000 | 48,2 | 95,9 | -47,7 | 0 | 3,36 | Pass |
| 3271,000 | 36,4 | 95,9 | -59,5 | 0 | 2,07 | Pass |
| 4361,000 | 32,0 | 95,9 | -63,9 | 0 | 2,07 | Pass |
| 5451,000 | 32,9 | 95,9 | -63,0 | 0 | 1,86 | Pass |
| 6541,000 | 33,2 | 95,9 | -62,7 | 0 | 1,64 | Pass |

# Allegato 2 / Annex 2: Incertezza / Uncertainty

## A.2.1 Radiated Emissions: FCC

From 9kHz to 30MHz using Loop antenna
Field intensity : ± 4.2dB

From 30MHz to 1000MHz using Bilog antenna
Field intensity : ± 4.7dB

From 1GHz to 18GHz using Horn antenna
Field intensity : ± 4.9dB

## A.2.2 Radio test

| | |
|---|---|
| Conducted output power | : ± 2.1dB |
| Conducted Bandwidth | : ± 8.1KHz (Span=20M, RBW=100KHz, 10000pti) |
| Conducted spurious emission | : ± 3.7dB |
| RF Frequency | : ± 350Hz |