

## TEST REPORT

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**EUT DESCRIPTION** Transceiver for Automotive CAN BUS Wireless link

**EUT TRADEMARK** C.O.B.O. S.p.A. - Divisione 3B6

**EUT MODEL** WiCAN2400

**REFERENCE STANDARDS :** FCC part 15.249

**TEST REPORT NUMBER** FCC.TX.09.0068-1

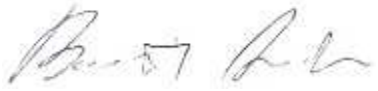
**TEST REPORT ISSUE DATE** 21/07/2009


**TESTING LABORATORY** Prima Ricerca & Sviluppo S.r.l.  
Via Campagna, 92 -22020 Faloppio (Co) –Italy

**TESTING LOCATION** As Above

**DATE OF TEST SAMPLE RECEIPT** 27/10/2008

**DATE OF TEST** 21/01/2009

**TESTED BY** Andrea Bortolotti 

**APPROVED BY** Massimo Maltempì 

*The test results reported in this test report shall refer only to the sample actually tested and shall not refer or be deemed to refer to bulk from which such a sample may be said to have been obtained.  
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## 1. TECHNICAL INFORMATION OF EQUIPMENT UNDER TEST (EUT)

### 1.1 Identification

**Brand name:** C.O.B.O. S.p.A. - Divisione 3B6  
**Manufacturer:** C.O.B.O. S.p.A. - Divisione 3B6  
**Equipment :** Transceiver for Automotive CAN BUS Wireless link  
**Serial number :** Not present  
**FCC ID :** WXN WiCAN2400  
**Country of manufacturer:** ITALY

### 1.2 Technical data

**FCC class:** 47 CFR FCC Part 15 Subpart C § 15.249  
**Product type:** WLAN  
**Radio type:** Intentional transceiver  
**Power type :** Battery  
**Frequency range :** 2400 – 2483.5 MHz  
**Channel number :** 10  
**Carrier frequency:**  
Channel No.1: 2433 MHz                      Channel No.6: 2443 MHz  
Channel No.2: 2435 MHz                      Channel No.7: 2445 MHz  
Channel No.3: 2437 MHz                      Channel No.8: 2447 MHz  
Channel No.4: 2539 MHz                      Channel No.9: 2449 MHz  
Channel No.5: 2441 MHz                      Channel No.10: 2451 MHz

**Field Antenna :** Antenna Type: wire

### 1.3 General Technical data

<b>3B6</b> <sup>®</sup>	<b>QUALITY SYSTEM PROJECT SPECIFICATION</b>		Document: SP WiCAN2400 Radio - UK
	Date : 24/10/2008	Page: 1 / 3	Project Code: WICAN2400

**Application Description**

WiCAN2400 is a transceiver module that permits to link 2 different CAN BUS nets with a wireless CAN link at 2.4GHz.

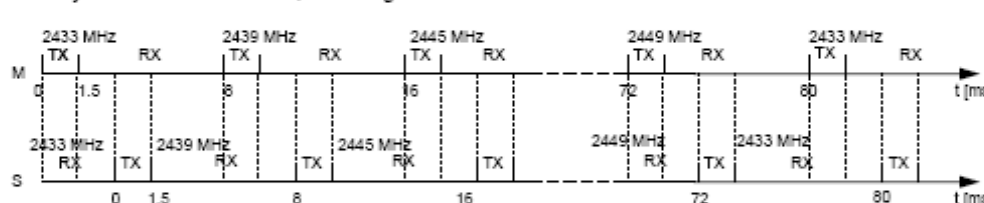
**WiCAN2400 Radio Description**

One module acts like a Master, sending every 8ms a synch packet that contains also data (it takes about 1.5 ms to send it) and then going in RX to listen for a response. The other is a Slave, that stays in RX listening for a Master synch and answer back with a packet with its data (1.5 ms to send it).  
Every 8ms the starting carrier frequency 2433 MHz is changed, according to a sequence of hops shown in this table (in MHz):

Hop0	Hop1	Hop2	Hop3	Hop4	Hop5	Hop6	Hop7	Hop8	Hop9
2433	2439	2445	2451	2435	2441	2447	2437	2443	2449

This hops sequence is restarted every times right after the last hop at 2449 MHz.

The transmission is done in (Shaped) MSK (also known as differential offset QPSK) modulation at the nominal power of 1 dBm, with 250 kbps data rate.  
Every packets are 25 bytes long and they are made of 4 bytes Preamble, 2 bytes Sync word, 17 bytes Payload and 2 bytes CRC. To summarize, the timings of the communication is shown below:



**Radio Packet**

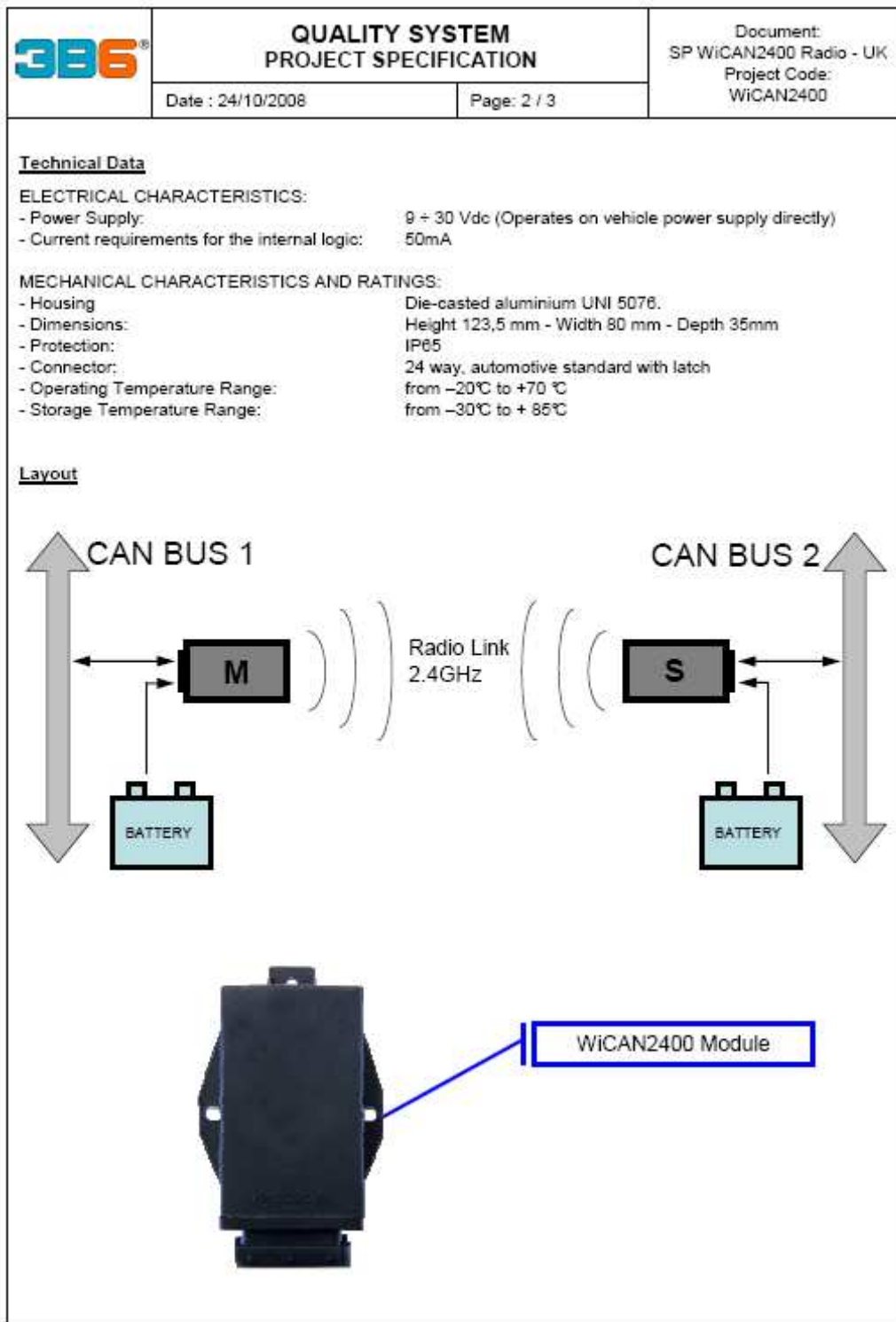
4 bytes	2 bytes	17 bytes	2 bytes
Preamble	Sync word	Payload	CRC


**Receiver Classification**

Class 3, according to ETSI 300440 - 1.

Rev.	Changes Description	Page

Compiled By: Valerio Cappelli      Reviewed By:



		<b>QUALITY SYSTEM PROJECT SPECIFICATION</b>		Document: SP WiCAN2400 Radio - UK Project Code: WiCAN2400	
Date : 24/10/2008		Page: 3 / 3			
<b><u>RF Transceiver Characteristics</u></b>					
The RF front-end of WiCAN2400 is a Chipcon product from Texas Instruments, the CC2500. The configuration of the transceiver is "cabled" in the initialization procedure code of WiCAN firmware and it is written once in the registers of the CC2500 at the power up of the module.					
<b>Value</b>	<b>CC2500 Register</b>				
0x09	FSCTRL1	Frequency synthesizer control.			
0x00	FSCTRL0	Frequency synthesizer control.			
0x5D	FREQ2	Frequency control word, high byte.			
0x93	FREQ1	Frequency control word, middle byte.			
0xB1	FREQ0	Frequency control word, low byte.			
0x2D	MDMCFG4	Modem configuration.			
0x3B	MDMCFG3	Modem configuration.			
0x73	MDMCFG2	Modem configuration.			
0x22	MDMCFG1	Modem configuration.			
0xF8	MDMCFG0	Modem configuration.			
0xB6	FREND1	Front end RX configuration.			
0x10	FREND0	Front end RX configuration.			
0x35	MCSM1	Main Radio Control State Machine configuration.			
0x18	MCSM0	Main Radio Control State Machine configuration.			
0x1D	FOCCFG	Frequency Offset Compensation Configuration.			
0x1C	BSCFG	Bit synchronization Configuration.			
0xC7	AGCCTRL2	AGC control.			
0x00	AGCCTRL1	AGC control.			
0xB2	AGCCTRL0	AGC control.			
0xEA	FSCAL3	Frequency synthesizer calibration.			
0x0A	FSCAL2	Frequency synthesizer calibration.			
0x00	FSCAL1	Frequency synthesizer calibration.			
0x11	FSCAL0	Frequency synthesizer calibration.			
0x59	FSTEST	Frequency synthesizer calibration.			
0x38	TEST2	Various test settings.			
0x31	TEST1	Various test settings.			
0x0B	TEST0	Various test settings.			
0x2F	IOCFG2	GDO2 output pin configuration.			
0x01	IOCFG1	GDO1 output pin configuration.			
0x06	IOCFG0D	GDO0 output pin configuration.			
0x0C	PKTCTRL1	Packet automation control			
0x05	PKTCTRL0	Packet automation control.			
0x00	ADDR	Device address.			
0x10	PKTLEN	Packet length.			
0xFF	PATABLE				
RX filter bandwidth = 541.7 kHz Data rate = 250 kbps Modulation = MSK CRC operation = CRC calculation in tx and check in rx		Start RF Frequency = 2433 MHz Channel spacing = 200 kHz Sync mode = 30/32 sync word bits detected Preamble count = 4 bytes			

## 1.4 Transceiver data



**CC2500**

### **CC2500** Low-Cost Low-Power 2.4 GHz RF Transceiver

#### Applications

- 2400-2483.5 MHz ISM/SRD band systems
- Consumer electronics
- Wireless game controllers
- Wireless audio
- Wireless keyboard and mouse
- RF enabled remote controls

#### Product Description

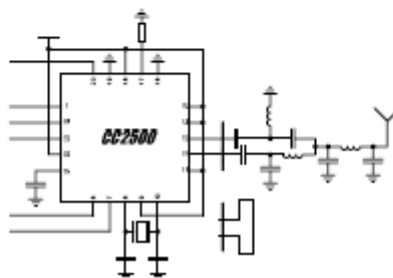
The **CC2500** is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band.

The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 kBaud.

**CC2500** provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio.

The main operating parameters and the 64-byte transmit/receive FIFOs of **CC2500** can be

controlled via an SPI interface. In a typical system, the **CC2500** will be used together with a microcontroller and a few additional passive components.



### 1.5 **Modifications incorporated in E.U.T.**

The following items are the modifications introduced in the equipment under test :

- None

### 1.6 **Ports identification**

This section contains descriptions of all signal ports and AC/DC power input/output ports, the length and the type of the cable provided by manufacturer needed for the tests.

Moreover it is specified if the ports are ever or optionally connected.

Port		Description	Connection
1	Enclosure	Plastic case	By screws and by pressure
2	AC power input/output ports	-----	-----
3	DC power input/output ports	- Power Supply: 9 ÷ 30 Vdc (Operates on vehicle power supply directly)	Cable
4	Signals / control lines	- 4 On/Off Input (High-side) - 4 On/Off Output (High-side, current 0.5A, short circuit current 4A, 1A total max. current) short circuit protected - 2 Analog Input 0 ÷ 30 V, 10 bit resolution - Double safety relay with feedback for check	Cable
5	Telecommunication ports	-----	-----

*Note: During the tests all cables must be what provided the manufacturer or the same that used in the real employment of the EUT.*

### 1.7 **Auxiliary equipment**

- none



## 2. TEST CONDITIONS

### 2.1 *Operating test modes and test conditions*

The equipment has been tested according to the operative conditions described in the user/installation manual provided by the manufacturer and by following reference standards :

Reference Standard:

- 47 CFR FCC Part 15 Subpart C § 15.249(a) sub-clauses (c) , (d), (e)

In the following table there are the operating conditions adopted during tests identified by an indicator (#..) at which has been referred the item “Operating condition of the equipment under test” of all technical sheets of the tests (see Section 4)

<i>Operating condition</i>	<i>Description</i>
#1	<i>TX in Operating Mode</i>

### 2.2 *Test overview*

The appliance is classified as “*Intentional radiator*” in conformity to FCC Part 15 Subpart C § 15.249.

### 3. REFERENCE STANDARD FOR PERFORMED TESTS

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in ANSI C63.4-2003 and 47 CFR FCC Part 15 Subpart C.

## 4. SUMMARY OF TEST RESULTS

### 4.1 Emission tests

Port		Phenomena	Basic standard	Operating condition <sup>1</sup>	Result
1	Enclosure	Radiated emission	FCC Part 15 § 15 249 (a)	#1	Within the limit
2	AC mains Input ports	RF Disturbance voltage: • continuous	FCC Part 15 § 15 207	Powered by internal battery supply	

## 5. TEST RESULTS

RADIATED EMISSION 9 KhZ $\pm 10^{\text{th}}$ Harmonic .....	13
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**TEST  
1**

**RADIATED EMISSION 9 KHZ  $\pm 10^{\text{TH}}$  HARMONIC**

**REFERENCE  
DOCUMENT**

FCC 47CFR Part 15

- **TEST LOCATION:** Semi-anechoic chamber
- **TEST EQUIPMENT USED FOR TEST:** EMI receiver Rohde & Schwarz Mod. ESU 40  
Chase Antenna Mod. CBL 6111 A  
Bilog Antenna Mod. HL025
- **TESTED PORT:** Enclosure
- **EMISSION LIMITS:** Acc. to Section 15.209 of reference document
- **UNCERTAINTY OF MEASURE:** Combined uncertainty =  $\pm 1.75$  dB  
Total uncertainty = (k=2)  $\pm 3.5$  dB

TEST CONDITIONS:	MEASURED
Ambient temperature : 15 - 35 °C	23,5 $\pm$ 3 °C
Ambient humidity : 25 - 75 %rH	39 $\pm$ 5 %rH
Pressure : 85 - 106 kPa (860 mbar - 1060 mbar)	950 $\pm$ 50 mbar

**OPERATING CONDITION (Rif. Section. 2) : #1**

**RESULT: WITHIN THE LIMIT**

<b>CH1</b>	<b>2433MHz</b>
<b>CH5</b>	<b>2441MHz</b>
<b>CH10</b>	<b>2451MHz</b>

## EMI Auto Test Template: Electric Field Strength FCC

Hardware Setup: Electric Field Strength FCC  
 Measurement Type: Open-Area-Test-Site  
 Frequency Range: 30 MHz - 18 GHz  
 Graphics Level Range: 0 dBµV/m - 80 dBµV/m

Data Reduction:  
 Limit Line #1: FCC 15\_249 Peak  
 Limit Line #2: FCC 15\_249 AV  
 Peak Search: 6 dB  
 Maximum Results: 4  
 Subrange Maxima: 0  
 Maxima per Subrange: 1  
 Acceptance Offset: -10 dB  
 Maximum Number of Results: 4

<b>Subrange</b>	<b>Detectors</b>	<b>IF Bandwidth</b>	<b>Meas. Time</b>	<b>Receiver</b>
30 MHz - 1 GHz	MaxPeak; Average	120 kHz	1 s	Receiver
1 GHz - 2.8 GHz	MaxPeak; Average	1 MHz	0.1 s	Receiver
2.8 GHz - 18 GHz	MaxPeak; Average	1 MHz	0.1 s	Receiver

### Graphics Legend:

30MHz/18GHz	Max Peak detector measurement
30MHz/18GHz	Average detector measurement
18GHz/25GHz	Max Peak detector measurement
18GHz/25GHz	Average detector measurement

### Acronymus:

CSA                      Semi-anechoic chamber



**PRIMA**

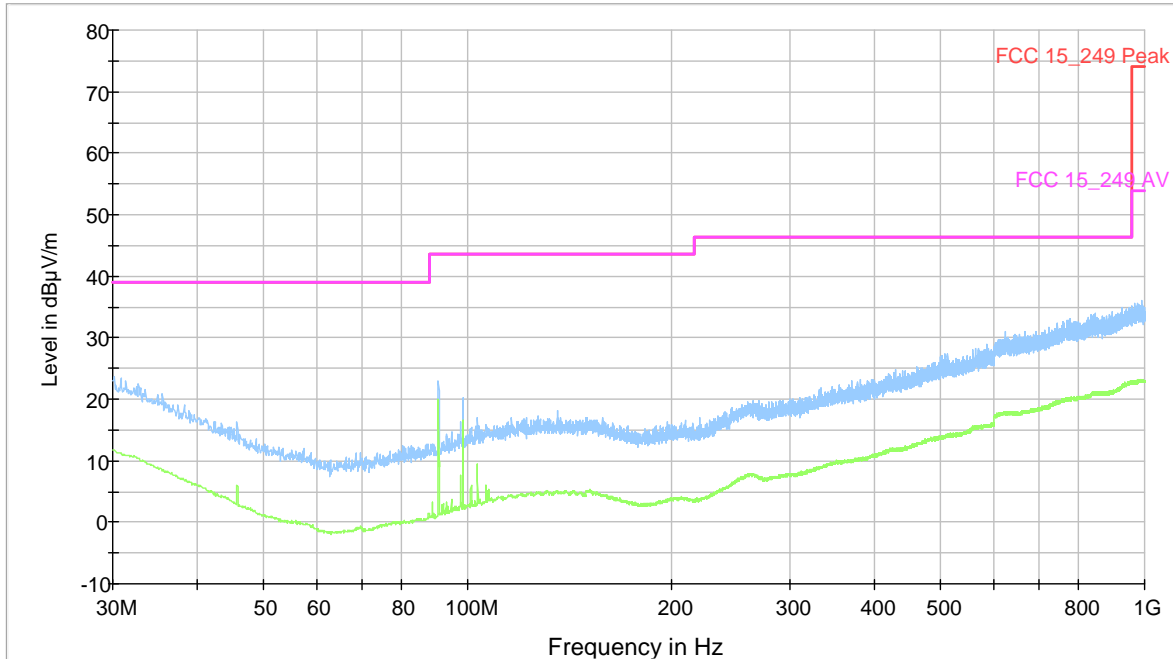
RICERCA & SVILUPPO

CH1: 30-1000MHz

VERTICAL

FCC.TX.  
09.0068-1

Electric Field Strength FCC



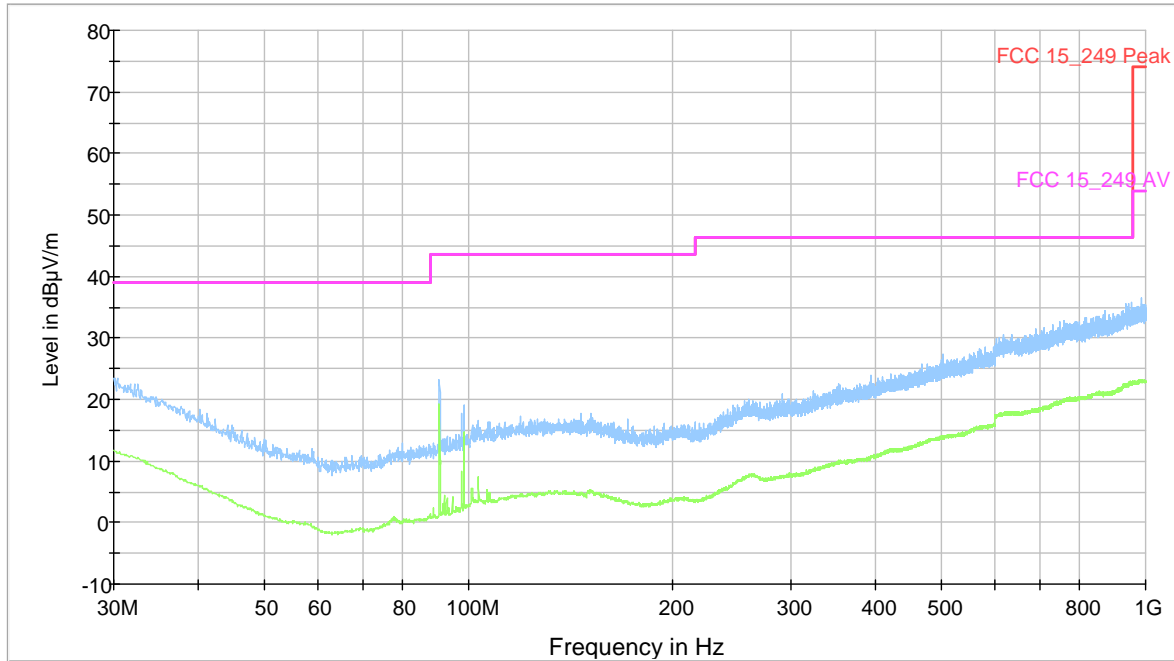
— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**No disturbance above CSA noise level**



**Horizontal**

Electric Field Strength FCC



— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**No disturbance above CSA noise level**





**PRIMA**

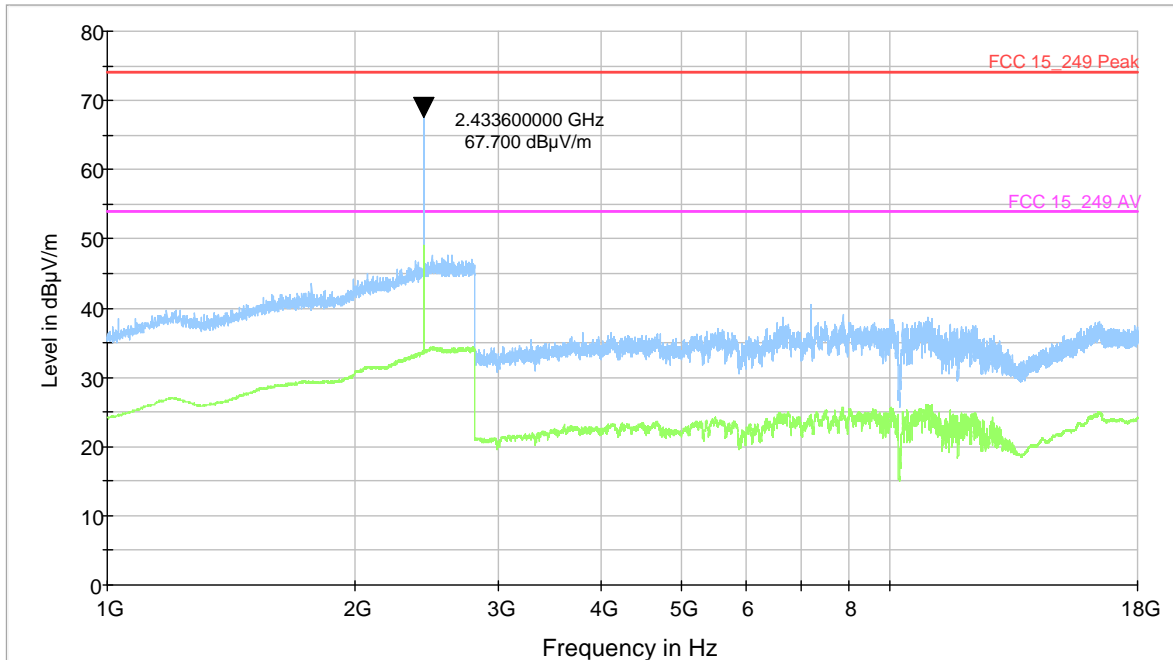
RICERCA & SVILUPPO

CH1: 1-18GHz

Vertical

FCC.TX.  
09.0068-1

Electric Field Strength FCC

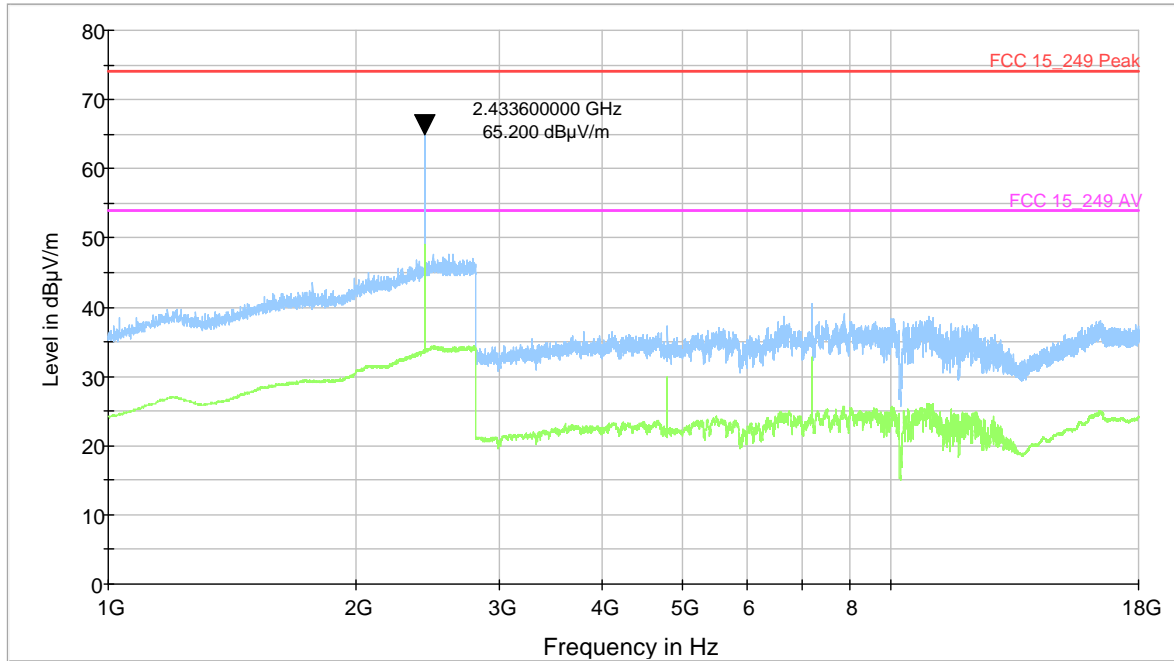


— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2



Horizontal

Electric Field Strength FCC

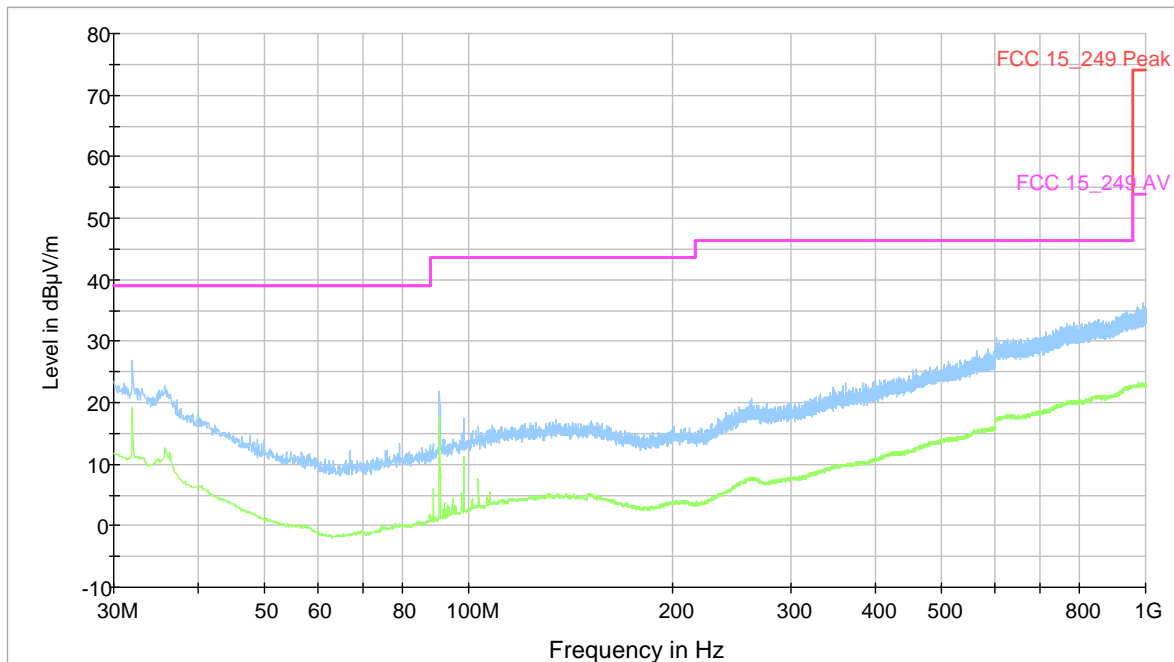


— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

CH5: 30-1000 MHz

Vertical

Electric Field Strength FCC



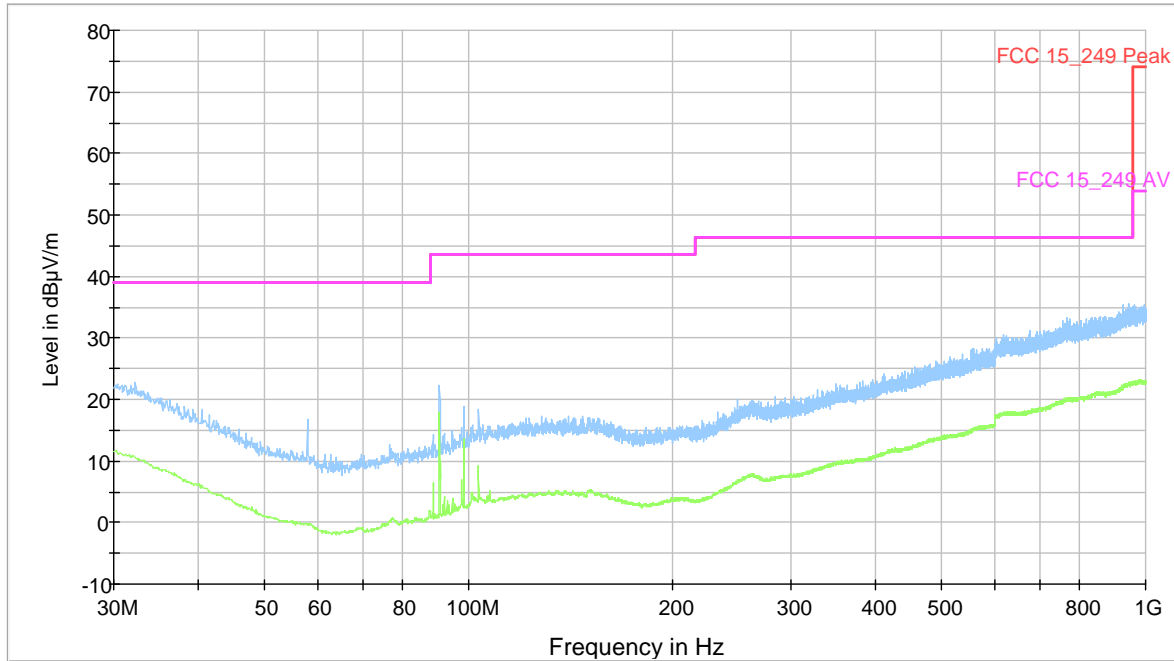
— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**No disturbance above CSA noise level**



**Horizontal**

Electric Field Strength FCC



— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**No disturbance above CSA noise level**



**PRIMA**

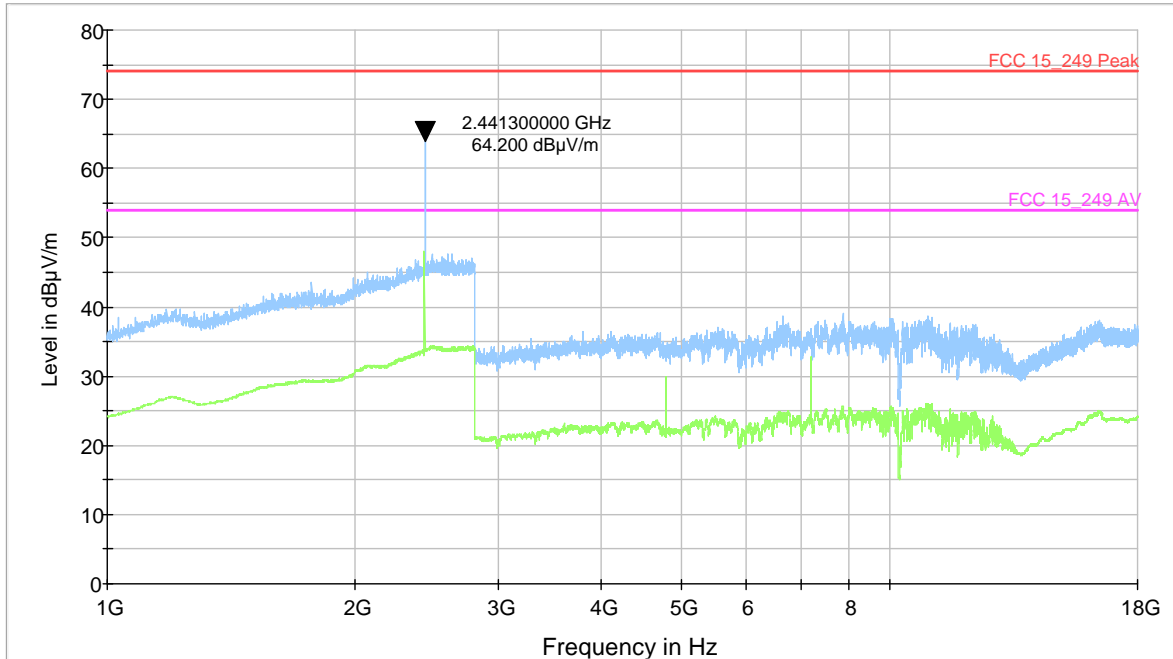
RICERCA & SVILUPPO

FCC.TX.  
09.0068-1

CH5: 1-18GHz

Vertical

Electric Field Strength FCC

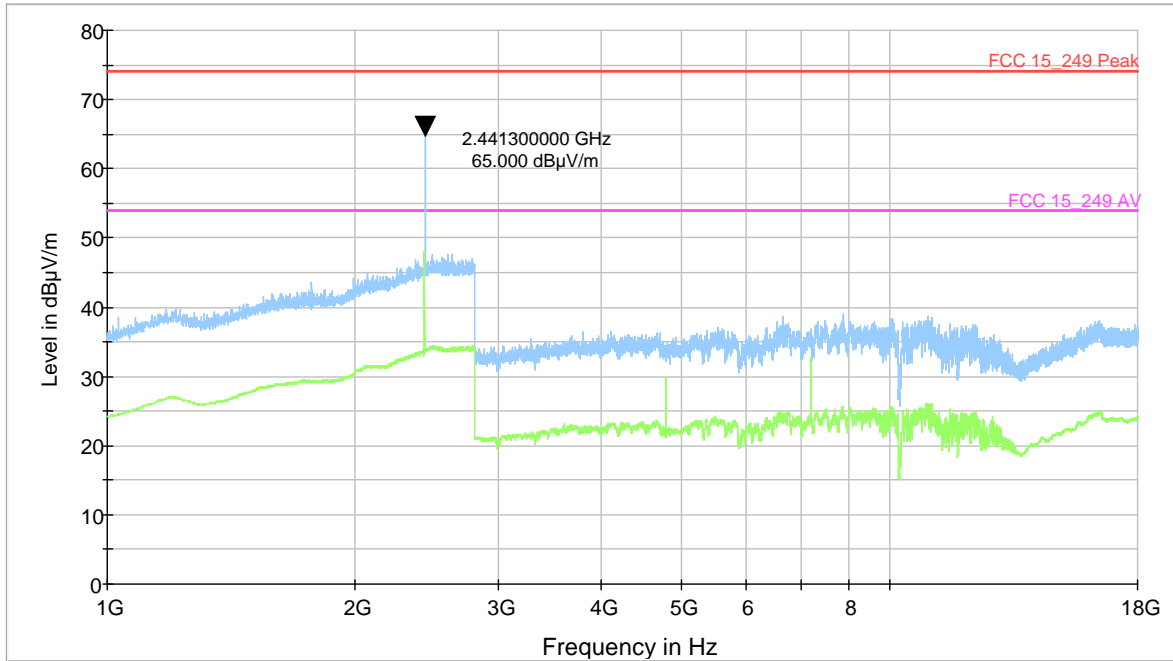


— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2



Horizontal

Electric Field Strength FCC

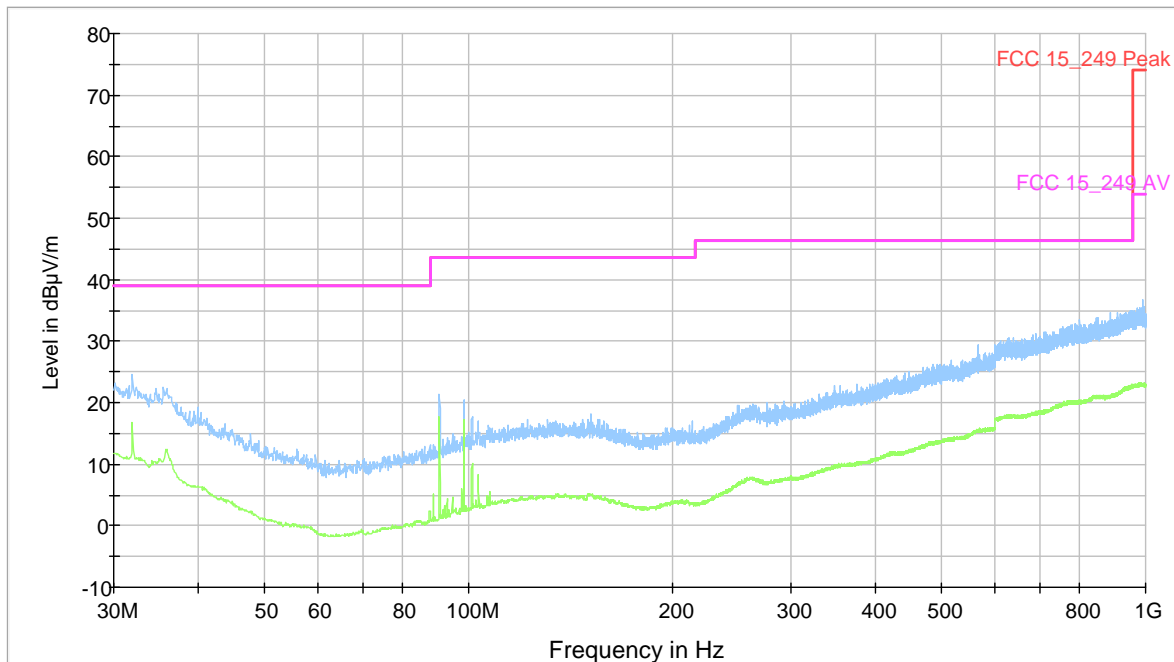


— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**CH10: 30-1000MHz**

**Vertical**

Electric Field Strength FCC

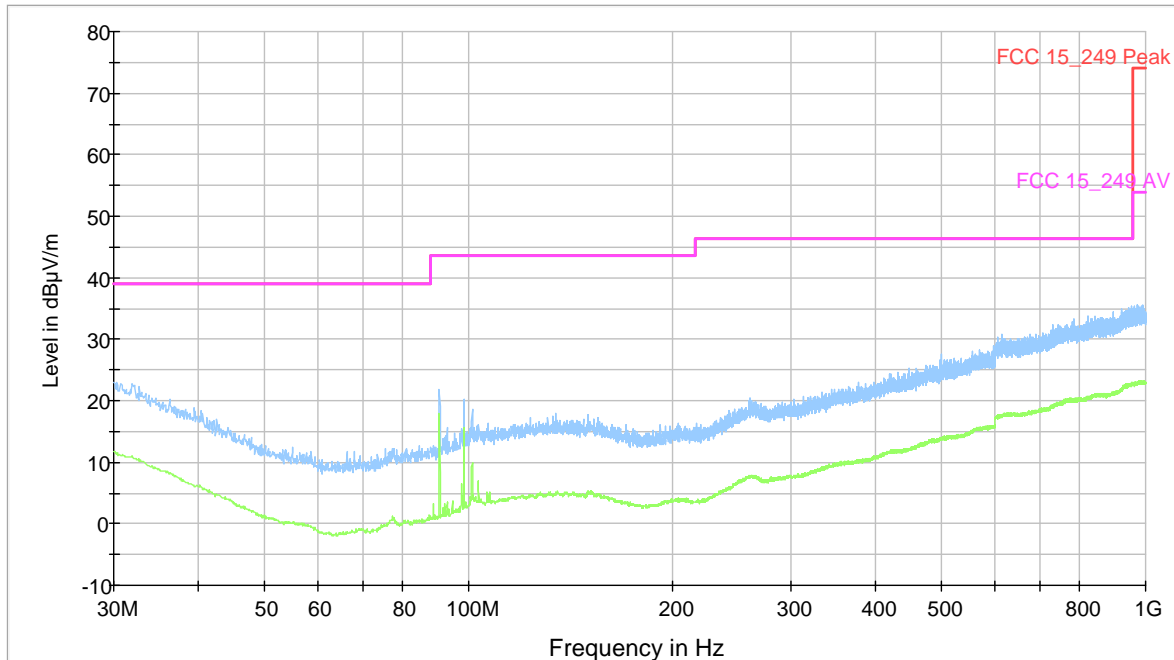


— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**No disturbance above CSA noise level**

**Horizontal**

Electric Field Strength FCC



— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**No disturbance above CSA noise level**





**PRIMA**

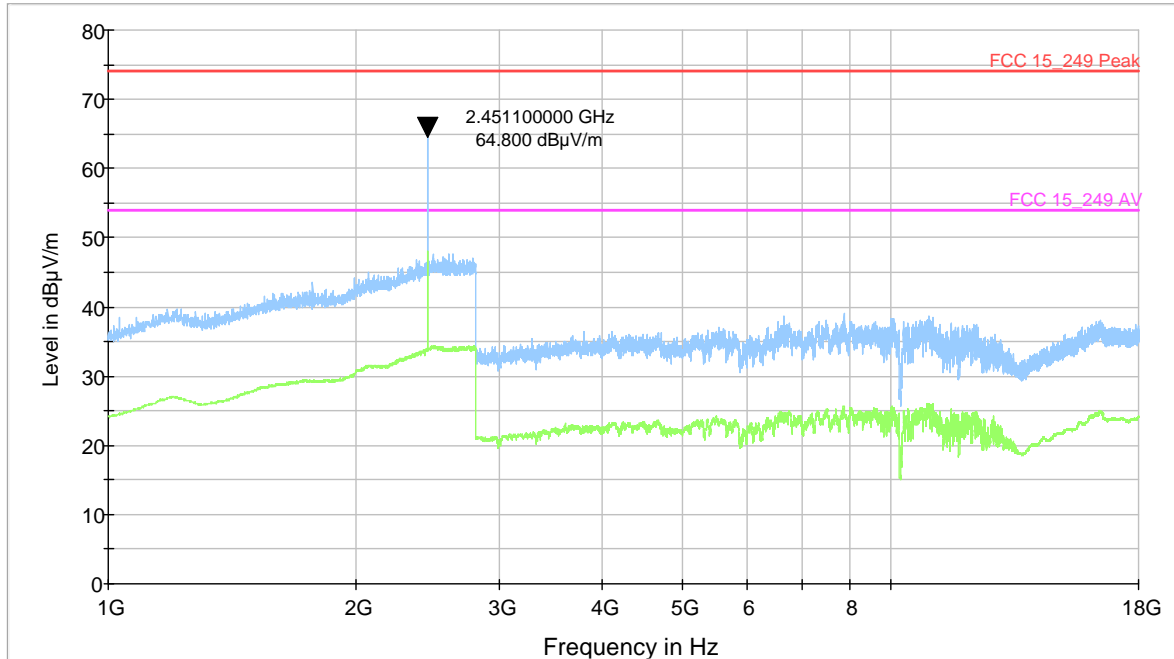
RICERCA & SVILUPPO

FCC.TX.  
09.0068-1

CH10:1-18GHz

Vertical

Electric Field Strength FCC

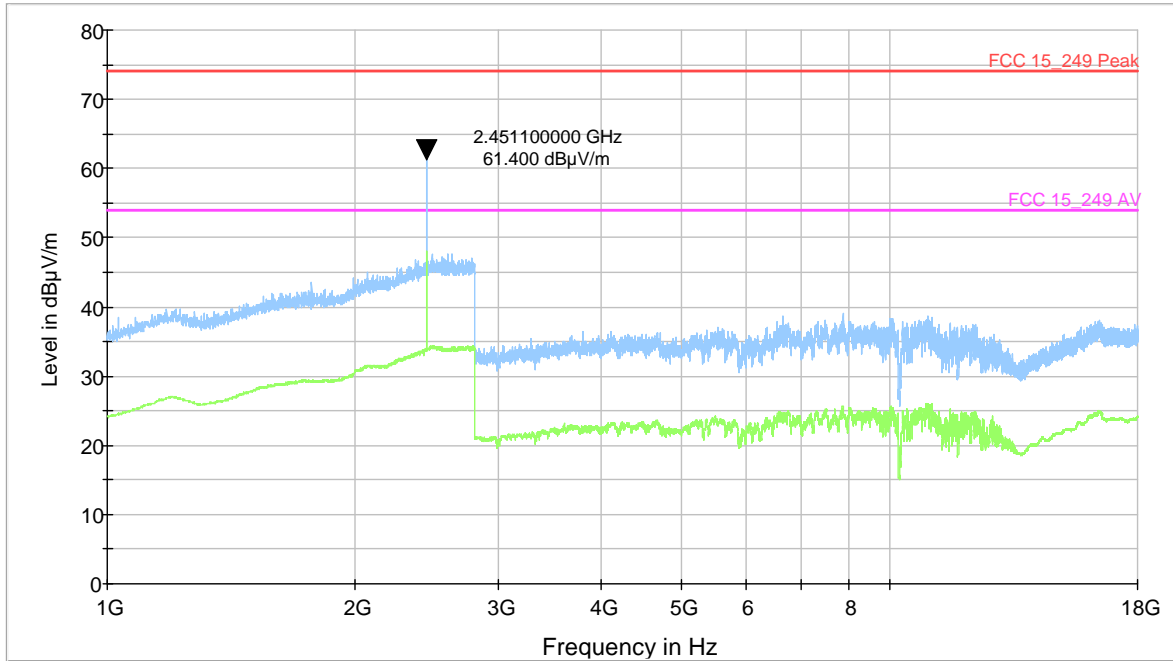


— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2



Horizontal

Electric Field Strength FCC



— FCC 15\_249 Peak.LimitLine — FCC 15\_249 AV.LimitLine — Preview Result 1 — Preview Result 2

**SPURIUS EMISSION 18 to 25 GHz**

Channel/ detector	Frequency (MHz)	Meter reading (dB $\mu$ V)	Preamp + Antenna factor (dB)	Cable loss (dB)	Field strength level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
CH1 pk	19468,8	61,4	27,3	1,48	35,58	74	-38,42
CH1 av	19468,8	49,2	27,3	1,48	23,38	54	-30,62
CH5 pk	19530,4	61,3	27,3	1,48	35,48	74	-38,52
CH5 av	19530,4	49,1	27,3	1,48	23,28	54	-30,72
CH10 pk	19608,8	60,4	27,3	1,48	34,58	74	-39,42
CH10 av	19608,8	48,7	27,3	1,48	22,88	54	-31,12
CH1 pk	21902,4	61,2	26,4	1,65	36,45	74	-37,55
CH1 av	21902,4	50,2	26,4	1,65	25,45	54	-28,55
CH5 pk	21971,7	60,7	26,4	1,65	35,95	74	-38,05
CH5 av	21971,7	50,3	26,4	1,65	25,55	54	-28,45
CH10 pk	22059,9	60,2	26,4	1,65	35,45	74	-38,55
CH10 av	22059,9	51,2	26,4	1,65	26,45	54	-27,55
CH1 pk	24336	60,6	25,4	1,81	37,01	74	-36,99
CH1 av	24336	49,6	25,4	1,81	26,01	54	-27,99
CH5 pk	24413	59,9	25,4	1,81	36,31	74	-37,69
CH5 av	24413	48,9	25,4	1,81	25,31	54	-28,69
CH10 pk	24511	61,1	25,4	1,81	37,51	74	-36,49
CH10 av	24511	50,3	25,4	1,81	26,71	54	-27,29

Note: Worst condition

Field strength level = Meter reading – (Preamp + Antenna factor) + cable loss

Cable: Rosemberg UFB142A 0 01000 30 30

Preamp + Antenna: Bonn BLMA 1840-1A

**5.1 Equipment list used for EUT testing**

EQUIPMENT	MANUFACTURER	MODEL	SERIAL N.	CAL. DUE
EMI TEST RECEIVER 20HZ 40GHZ	ROHDE & SCHWARZ	ESU40	100111	JUL 2009
EMI TEST RECEIVER 26GHZ	ROHDE & SCHWARZ	ESMI26	835862/016+838325/007	JUL 2009
ARTIFICIAL MAINS NETWORK	ROHDE & SCHWARZ	ESH 2 - Z5	841887/011	SEPT.2009
ABSORBING CLAMP	ROHDE & SCHWARZ	MDS21	840031/005	JUL.2009
RF SEMI-ANECHOIC CHAMBER (CSSA)	SIEMENS	B83117-D6019-T232	003-005-134/94C	APR.2010
BILOG ANTENNA	CHASE	CBL6111A	1798	JUL.2009
BILOG ANTENNA	CHASE	CBL6111C	2717	JUL.2009
RF SIGNAL GENERATOR 9 KHZ - 6 GHZ	ROHDE & SCHWARZ	SMB100A	100831	JUN 2011
LOG PERIODIC ANTENNA BROAD BAND 1-18 GHZ	ROHDE & SCHWARZ	HL025	350380/007	DEC.2009
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSP40	100038	FEB.2010
PROGRAMMABLE DC POWER SUPPLY	HEWLETT PACKARD	6623A	3448A04501	SEPT.2009
RF PREAMPLIFIER	BONN ELEKTRONIK	BLMA 1840-1A	087084B	AUG 2009
RF PREAMPLIFIER	BONN ELEKTRONIK	BLMA 0118-M	087084A	AUG 2009
RF SIGNAL GENERATOR 40 GHZ	ROHDE & SCHWARZ	SMP 04	825007/005	AUG 2009
DOUBLE RIDGED GUIDE ANTENNA	ELECTRO-METRICS	EM-6961	6278	JUL.2009



**5.2 Photographic documentation**

PHOTO 1 – E.U.T. IDENTIFICATION

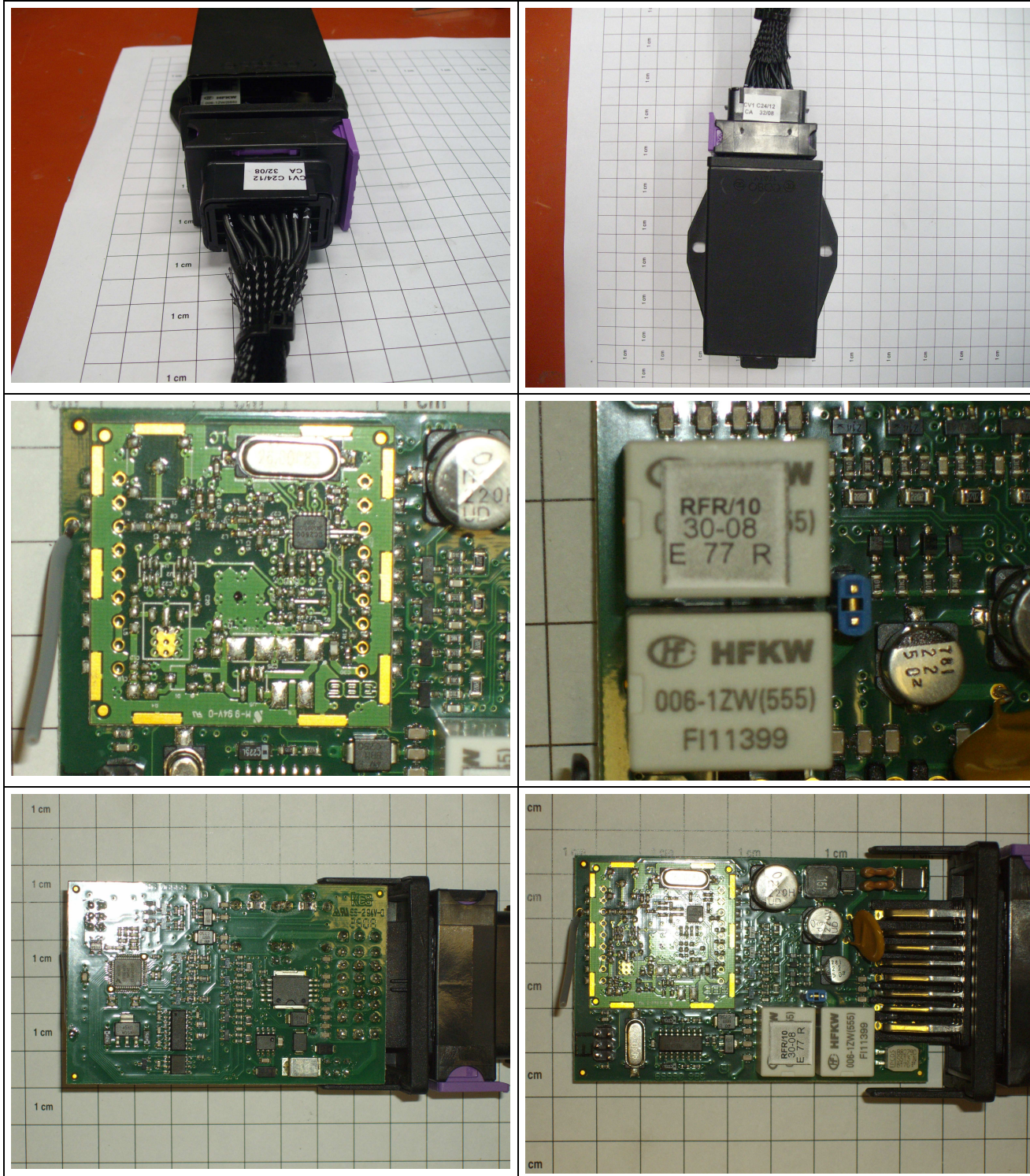




PHOTO 2 – SET-UP FOR EMISSION RADIATED TEST

