

Radio Test Report

According to

FCC part 15.207,

RSS-247, RSS-Gen

DUT Name: PAN9019A
Model No. : ENWF9511C1KF
Customer: Panasonic Industrial Devices Europe GmbH
Address: Zeppelinstr. 19, 21337 Lüneburg, Germany
Summary IN COMPLIANCE
Date of Reception: 27.11.2023
Date(s) of Test(s): 08.02.2024 – 28.02.2024

Tested by Test Engineer



Pekka Pulkkinen

Approved by Technical Manager



Jukka Rauma

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Document Version History	Date of issue	Comments	Approved by
v0.1	1.3.2024	Initial version	
v1.0	5.4.2024	Approved version	Jukka Rauma

1. General Information

Test Engineer(s): Pekka Pulkkinen

Location:

Test Firm Name	Eurofins Electric & Electronics Finland Oy (EEEF)
Test Site	Yrttipellontie, Peltola
Address of Test Site	Yrttipellontie 6, 90230 Oulu, Finland
FCC Designation number	FI0008
FCC site registration number	771880
ISED number	29576
CAB Identifier	T290

Customer: Panasonic Industrial Devices Europe GmbH
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Climate Conditions: Temperature: 15 - 35 °C
Air pressure: 860 - 1060 hPa
Humidity: 30-60 rH%
These limits were not exceeded during testing.

2. Test Samples

General description:

The PAN9019 and PAN9019A are 2.4 GHz and 5 GHz ISM band Wi-Fi, Bluetooth, and 802.15.41 radio modules, which allow easy integration of Wi-Fi, Bluetooth, and 802.15.41 based technologies into various electronic devices.

Test sample:

Sample number	Serial number	Manufacturer	DUT Type	Model	HW version	SW version
3938ER005	00000295	Panasonic	Wireless module + GW.51.5153	ENWF9511C1KF	03	01

Auxiliary equipment:

Sample number	Serial number	Manufacturer	DUT Type	Model	Description
3938ER006	na	Taoglas	Antenna	GW.51.5153	With 3938ER005
3938ER005	#6	Embedded Artists	Host Board	EAK00393	MX8M Mini Developer's Kit V3
3938ER001	#5	Embedded Artists	Host Board	EAK00393	MX8M Mini Developer's Kit V3
3938ER007	na	Phihong Technology Co. Ltd.	Switching Power Supply	PSAA30R-120	
3938ER008	na	Phihong Technology Co. Ltd.	Switching Power Supply	PSAA30R-120	

Description	Information	
Additional model	ENWF9501C1KF, ENWF9511CMKF, ENWF9501CMKF, ENWF9511AMKF, ENWF9501AMKF	
Brand Names(s)	PAN9019, PAN9019A-M2E-EVD, PAN9019-M2E-EVD, PAN9019A-M2E-C-EVD, PAN9019-M2E-C-EVD	
PMN	PAN9019A	
HVIN	ENWF9511C1KF	
FVIN	n/a	
HMN	n/a	
FCC ID	T7V9019	
IC ID	216Q-9019	
Equipment type	Radio module	
Radio type	Transceiver	
- operating frequency range:	2400.0 MHz – 2483.5 MHz, 5150 – 5850 MHz	
- Nominal Channel Bandwidth:	2 /20 / 40 / 80 MHz	
Radio technology / type of equipment	Bluetooth 5.4 / WLAN b/g/b/a/ac/ax	
Modulation:	GFSK, BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM	
Number of antennas	1	
Bluetooth Specification	LE 1Mbps PHY	Yes
	LE 2Mbps PHY	Yes
	LE Coced PHY S=2 (500 kbit)	Yes
	LE Coced PHY S=8 (125 kbit)	Yes
	Stable Modulation Index - Transmitter	No
	Stable Modulation Index - Reer	No
Antenna 1	Type	2.4/5.0/6.0 GHz WIFI 6E / WIFI 7 ISM Flexible ultra-thin PCB Adhesive Antenna
	Model	2JF1002P
	Manufacturer	2J Antennas
	Gain	2.4GHz ISM band 4.2 U-NII-1 = 6.6 dBi U-NII-2A = 7.3 dBi U-NII-2C = 8.0 dBi U-NII-3 = 6.6 dBi
Antenna 2	Type	Terminal Mount Dipole Antenna
	Model	GW.51.5153
	Manufacturer	Taoglas
	Gain	2.4GHz ISM band 5.2 U-NII-1 = 3.9 dBi U-NII-2A = 4.5 dBi U-NII-2C = 5.5 dBi

		U-NII-3 = 3.8 dBi
Antenna 3	Type	TDK RF Ceramic Chip Antenna
	Model	ANT162442DT-2001A2
	Manufacturer	TDK
	Gain	2.4GHz ISM band 2.1 dBi U-NII-1 = 1.0 dBi U-NII-2A = 1.1 dBi U-NII-2C = 1.5 dBi U-NII-3 = 2.1 dBi
Supply voltage	1.8/3.3VDC	
Type of Power source	Host board / AC/DC adapter	
Operating Temperature	TNom = 25°C TMin = -40°C TMax = 85°C	
Manufacturer	Panasonic Industrial Devices Europe GmbH Zeppelinstr. 19, 21337 Lüneburg, Germany	

3. Configuration and Operation Modes

Test modes / description
Continuous modulated carrier at 2442 MHz, power level setting 8 dBm, Bluetooth LE 2M PHY
U-NII-2C WLAN 802.11ac, MCS 0, 20MHz, channel 64
WLAN 802.11g, 6 Mbps, channel 6

Test/configuration software

Manufacturer	Name	Version
Panasonic Industry	Web server application	

4. Test equipment

New ID	Manufacturer	Equipment type	Description	Serial	Calibration information	Next calibration
G4C265	Rohde & Schwarz	ESW26	EMI test receiver	101324	29.6.2023	29.6.2024
G4C273	Frankonia	ALX-4000E	Broadband Antenna, 25MHz-4GHz with 6dB (50-A-MFN-06) att.	00816+1531	22.1.2024	22.1.2027
G4C503	Rohde & Schwarz	ESIB26	EMI Test Receiver 20Hz...26.5GHz	100263	7.11.2023	7.11.2025
G4C515	Rohde & Schwarz	ENV216	Two-line V-Network LISN	101472	15.5.2023	15.5.2024
G4C576	Rohde & Schwarz	HF907	Double-Ridged Waveguide Horn Antenna 800MHz-18GHz	100163	9.8.2022	9.8.2025

Test software

Description	Manufacturer	Name	Version
EMC Software	Rohde & Schwarz	EMC32	10.60.20
RF Software	Rohde & Schwarz	WMS32	11.60.00

5. Uncertainties

Description	Expanded Uncertainty (k=2)
RF Output Power	0,99
Peak Power	0,80
Power Spectral Density	0,99
Accumulated Transmit Time	0,01%
Minimum Frequency Occupation Time	0,01%
Hopping Frequency Separation	0,60%
Occupied Channel Bandwidth	2,08 %
Out-of-band emissions	0,89
Transmitter unwanted emissions in the spurious domain	1,76
AC conducted emission	2,24
Radiated emission ≤ 1 GHz	4,62
Radiated emission > 1 GHz	5,72

6. Sample emission level calculation

The following is a description of term and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBuV.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strength to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. RF path losses, including RF cables and preamplifiers, have been included with the A.F to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dBuV)} + \text{A.F. (dB/m)} = \text{Net field strength (dBuV/m)}$$

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBuV/m). The FCC limits are given in units of uV/m. The following formula is used to convert the units of uV/m to dbuV/m:

$$\text{Limit (dBuV/m)} = 20 * \log(\text{uV/m})$$

Margin :

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading + AF	= Net Reading :	Net reading – FCC limit	= Margin
+ 21.5 dBuV + 26 dB/m	= 47.5 dBuV/m :	47.5 dBuV/m – 57.0 dBuV/m	= -9.5 dB

7. Test conditions

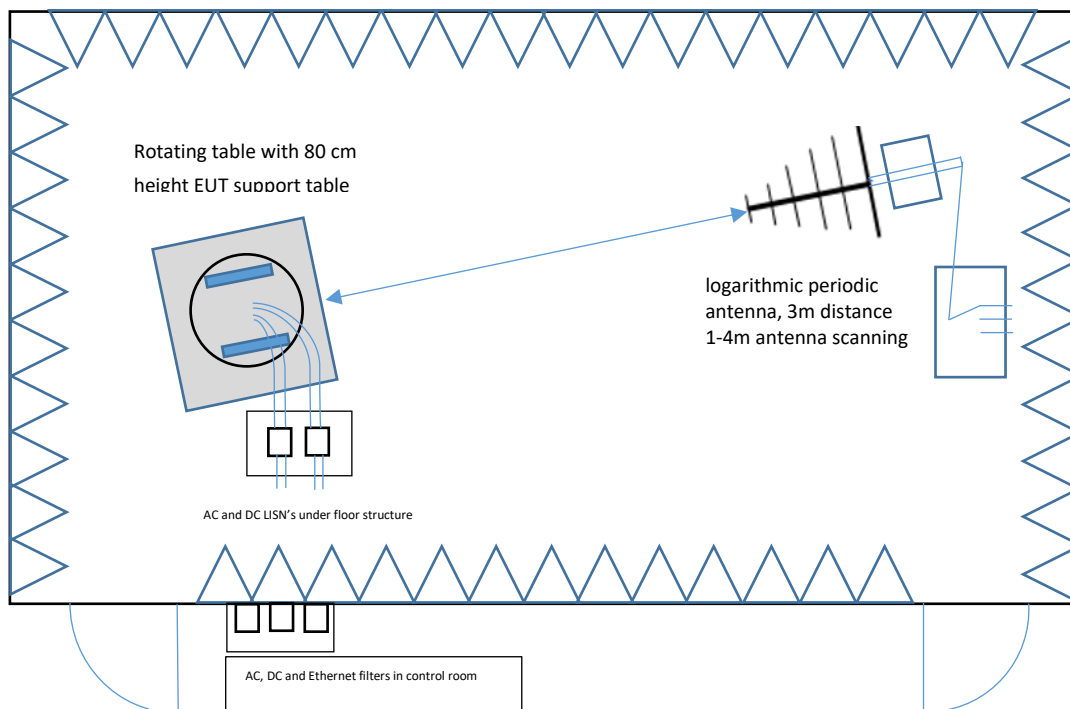
All radiated tests were performed in a semi-anechoic chamber, where the measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz, 1 GHz-18 GHz Double-ridged horn antenna and 18 GHz-40 GHz horn antenna) is located at a distance of 3 m.

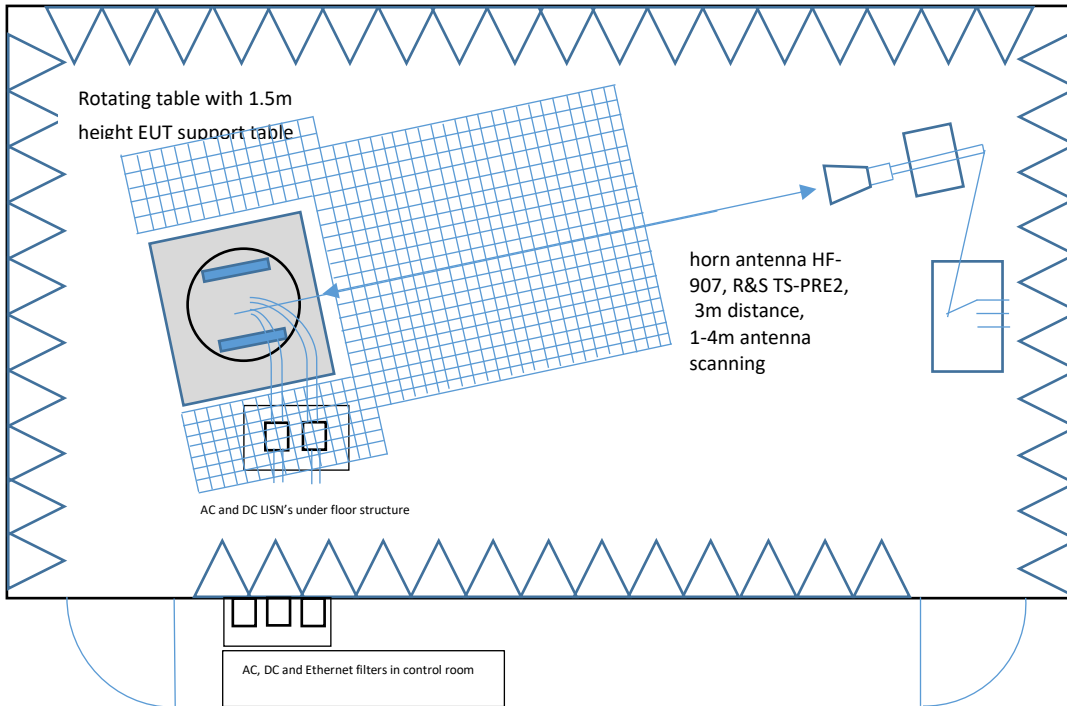
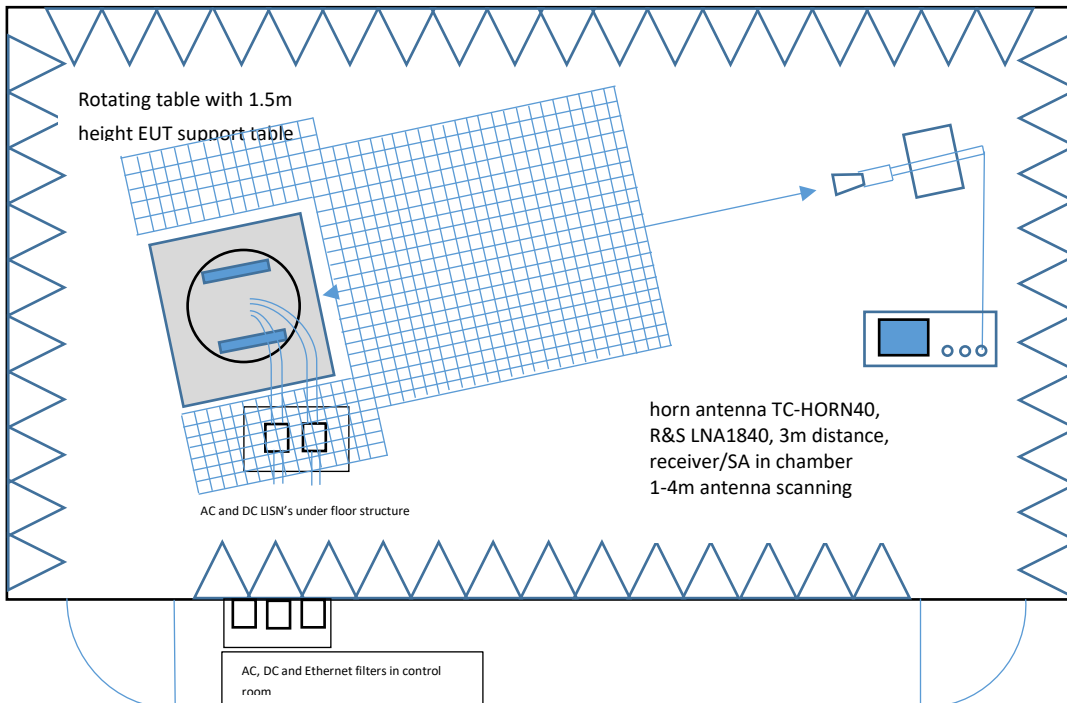
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (all antennas) was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

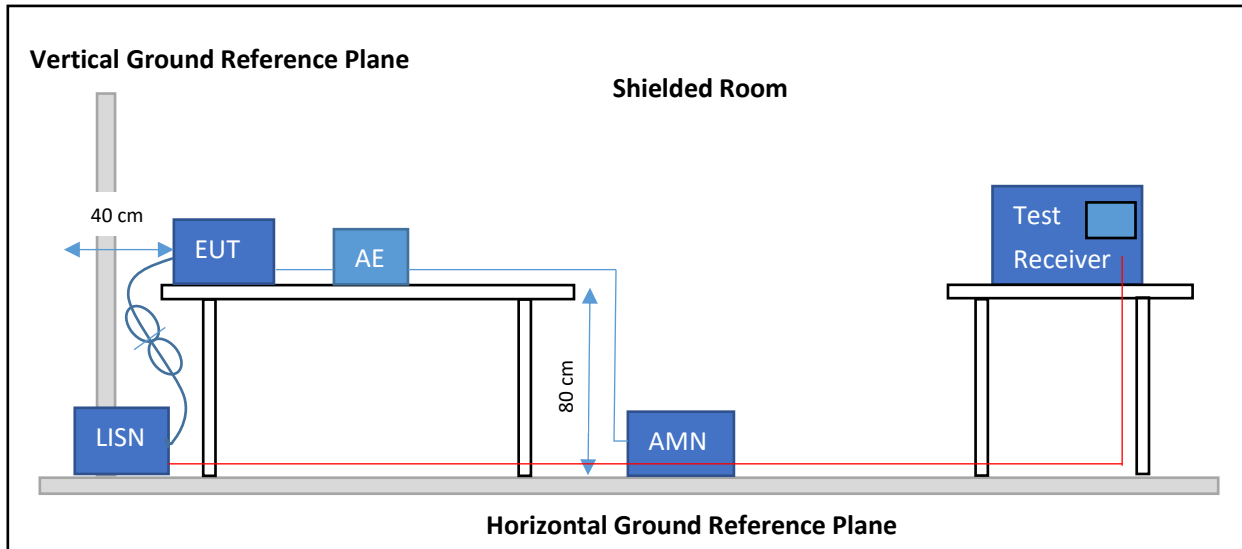
A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

Radiated measurements setup from 30 MHz to 1 GHz:

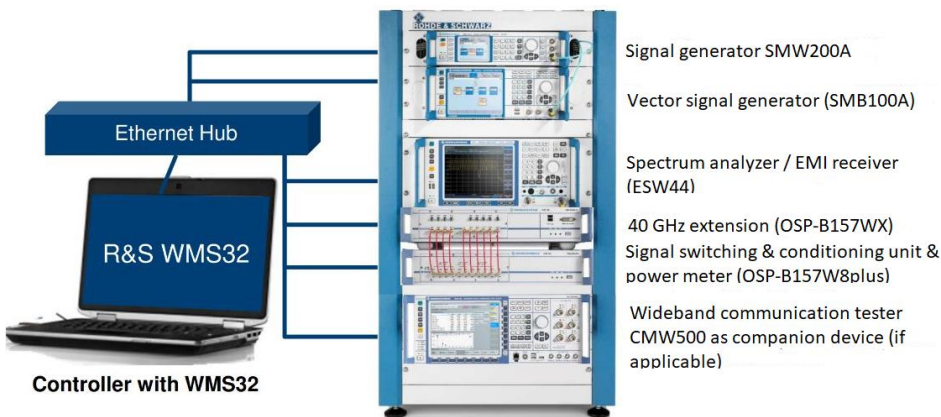


Radiated measurements setup from 1 GHz to 18 GHz:Radiated measurements setup from 18 GHz to 26 / 40 GHz:

Conducted emission setup



Conducted RF measurement system:



8. Summary

FCC/ISED Requirement (15.247 / RSS-247)		Reference method	Result	Remark
AC power line conducted emissions	FCC § 15.207 / RSS-247, Issue 3 (section 3.1)	ANSI C63.10-2013	PASS	
Possible test case verdicts: PASS = Tested device meets the requirements FAIL = Tested device does not meet the requirements N/A = Test requirement not applicable for tested device N/T = Test requirement applicable for tested device, but not tested				

9. AC power line conducted emissions

Reference: FCC §15.207, ISED RSS-247, Issue 3 (section 3.1)

Test method: ANSI C63.10-2013 (6.2)

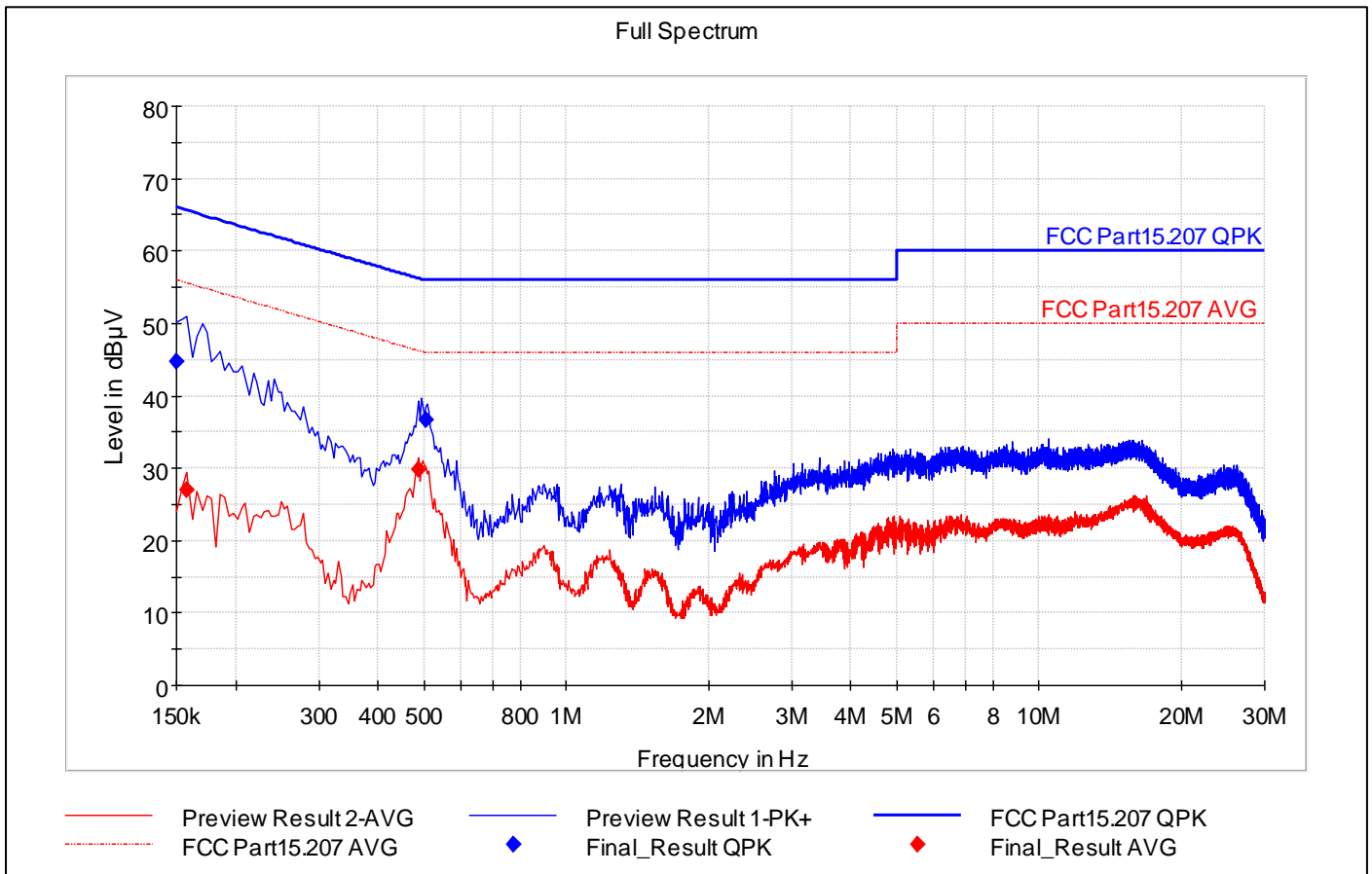
Limits		
Frequency (MHz)	Quasi-Peak (dBuV)	Average (dBuV)
0.15 – 0.5	66 -56*	56 – 46*
0.5 – 5	56	46
5 - 30	60	50
*Limit decreases linearly with the logarithm of the frequency		

Operation mode(s)	Configuration	Test Verdict
Bluetooth LE TX, 2 Mbps	Mid channel 2442 MHz	PASS
WLAN 802.11ac, MCS 0, 20MHz	Channel 64, 5310 MHz	PASS
WLAN 802.11g, 6Mbps, 20MHz	Channel 6, 2437 MHz	PASS

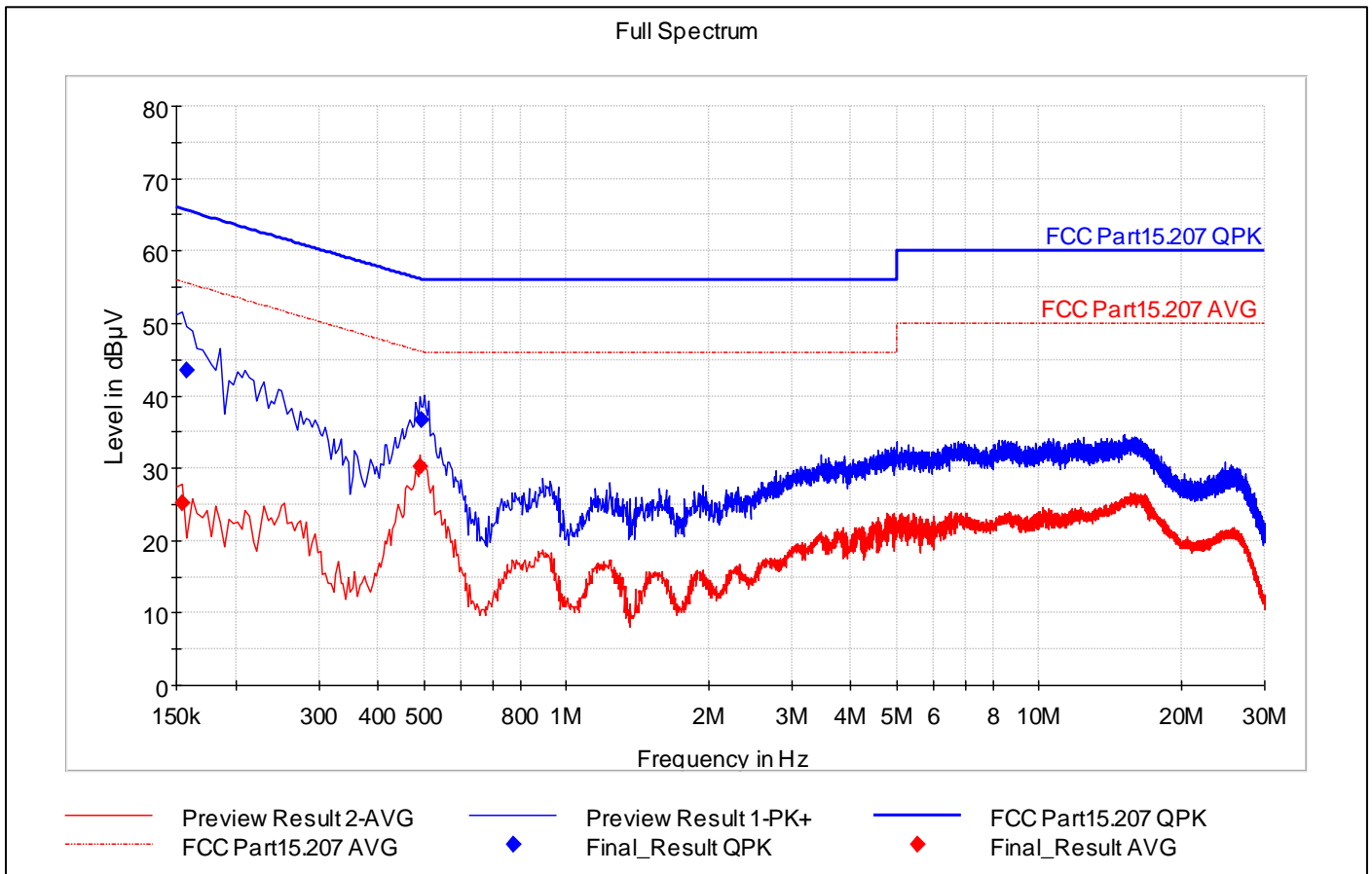
Test data Bluetooth LE, 2442 MHz

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas, Time (ms)	Bandwidth (kHz)	Line	Filter	Corr, (dB)	Comment
0,15	44,83	---	66,00	21,17	15000	9,00	L1	ON	9,50	PASS
0,158	---	27,01	55,57	28,56	15000	9,00	L1	ON	9,50	PASS
0,486	---	29,89	46,24	16,35	15000	9,00	L1	ON	9,60	PASS
0,506	36,59	---	56,00	19,41	15000	9,00	L1	ON	9,60	PASS
0,154	---	25,27	55,78	30,51	15000	9,00	N	ON	9,50	PASS
0,158	43,62	---	65,57	21,95	15000	9,00	N	ON	9,50	PASS
0,49	---	30,13	46,17	16,04	15000	9,00	N	ON	9,60	PASS
0,494	36,75	---	56,10	19,36	15000	9,00	N	ON	9,60	PASS

Conducted emission graph L1 line, Bluetooth LE:



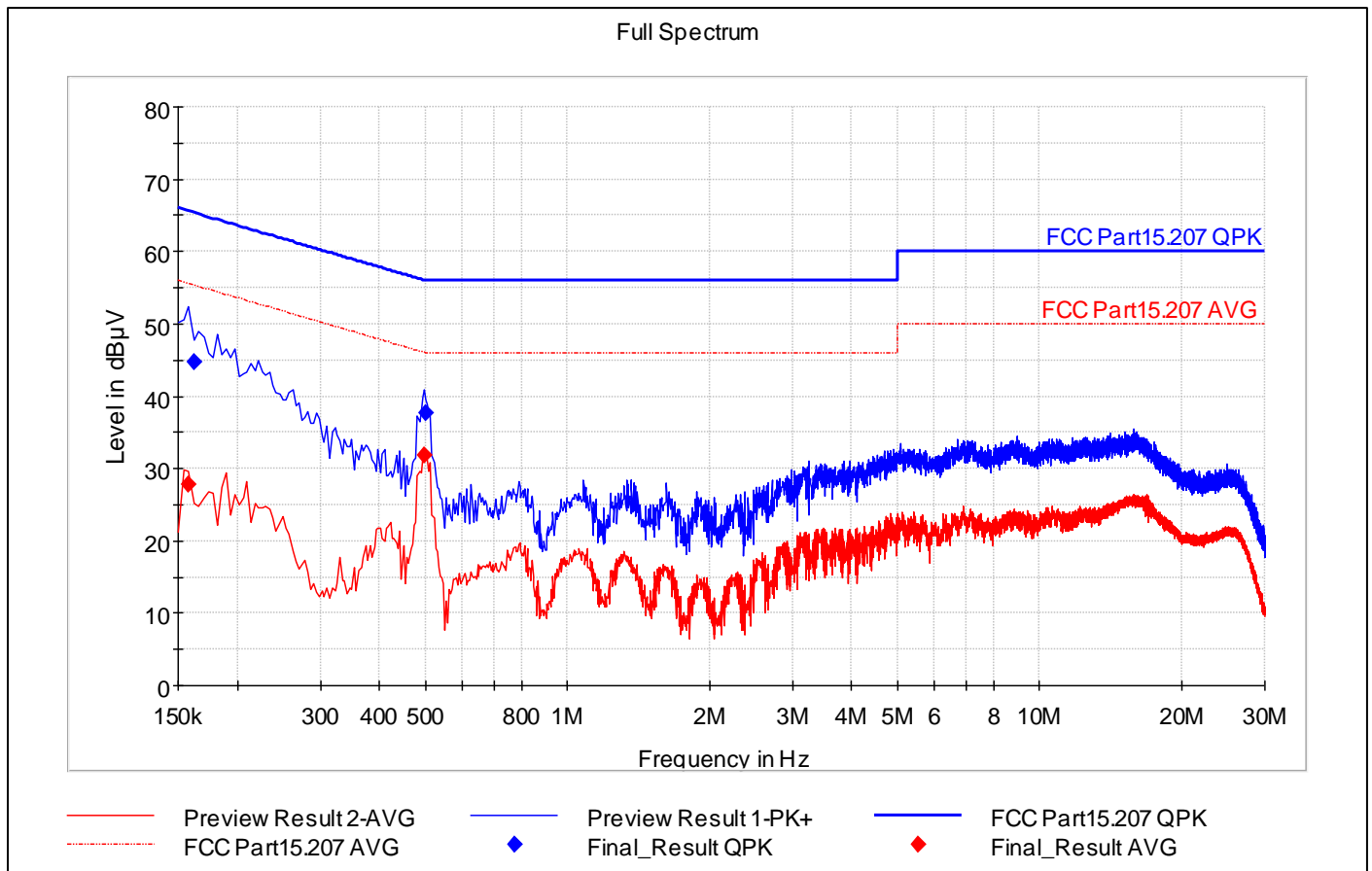
Conducted emission graph Neutral line, Bluetooth LE:



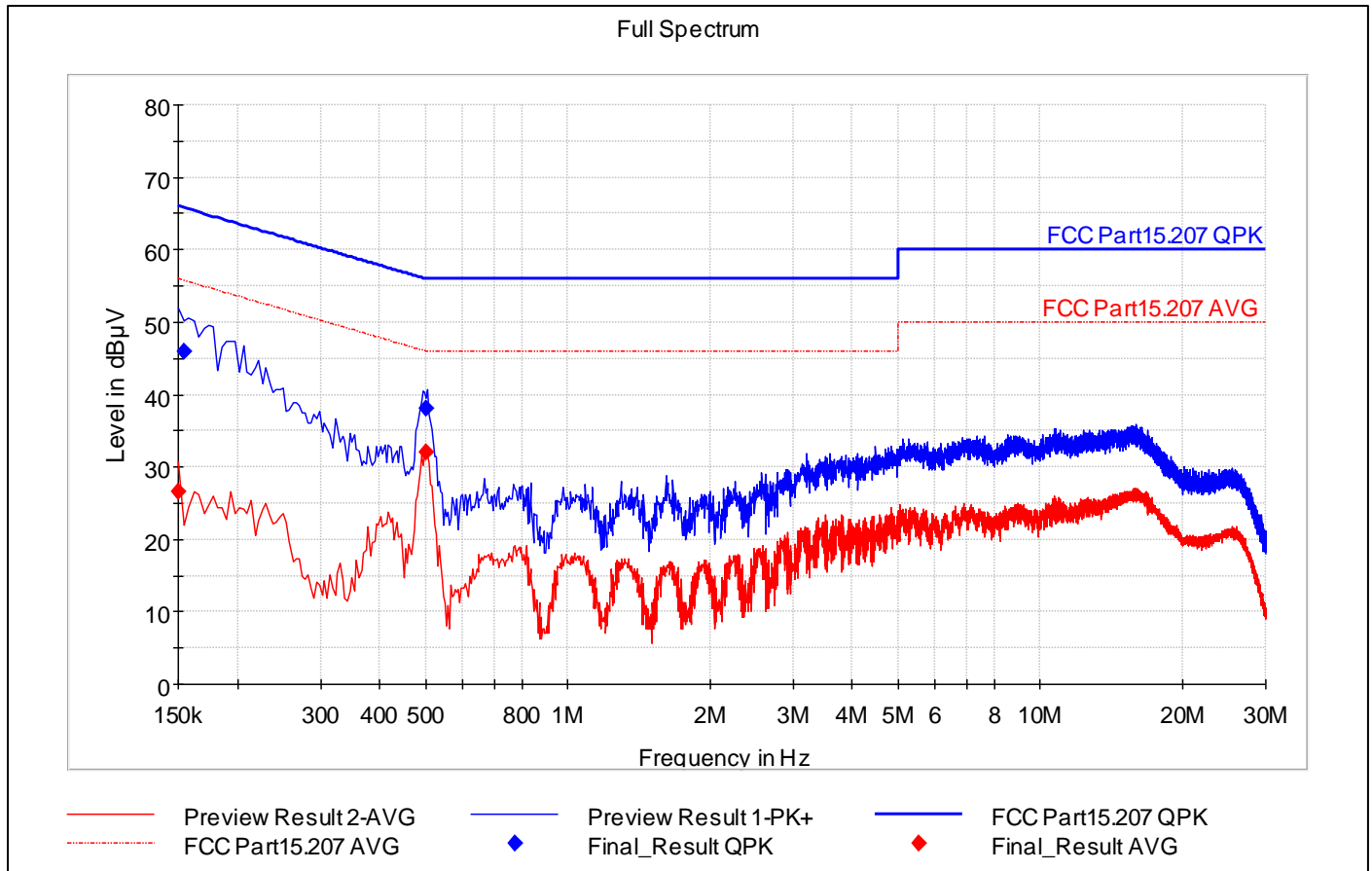
Test data WLAN 802.11ac MCS 0

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas, Time (ms)	Bandwidth (kHz)	Line	Filter	Corr, (dB)	Comment
0.158000	---	27,89	55,57	27,68	15000.0	9,00	L1	ON	9,50	PASS
0.162000	44,66	---	65,36	20,70	15000.0	9,00	L1	ON	9,50	PASS
0.498000	---	31,86	46,03	14,17	15000.0	9,00	L1	ON	9,60	PASS
0.502000	37,74	---	56,00	18,26	15000.0	9,00	L1	ON	9,60	PASS
0.150000	---	26,56	56,00	29,44	15000.0	9,00	N	ON	9,50	PASS
0.154000	45,85	---	65,78	19,93	15000.0	9,00	N	ON	9,50	PASS
0.502000	---	32,09	46,00	13,91	15000.0	9,00	N	ON	9,60	PASS
0.502000	38,14	---	56,00	17,86	15000.0	9,00	N	ON	9,60	PASS

Conducted emission graph L1 line 802.11ac:



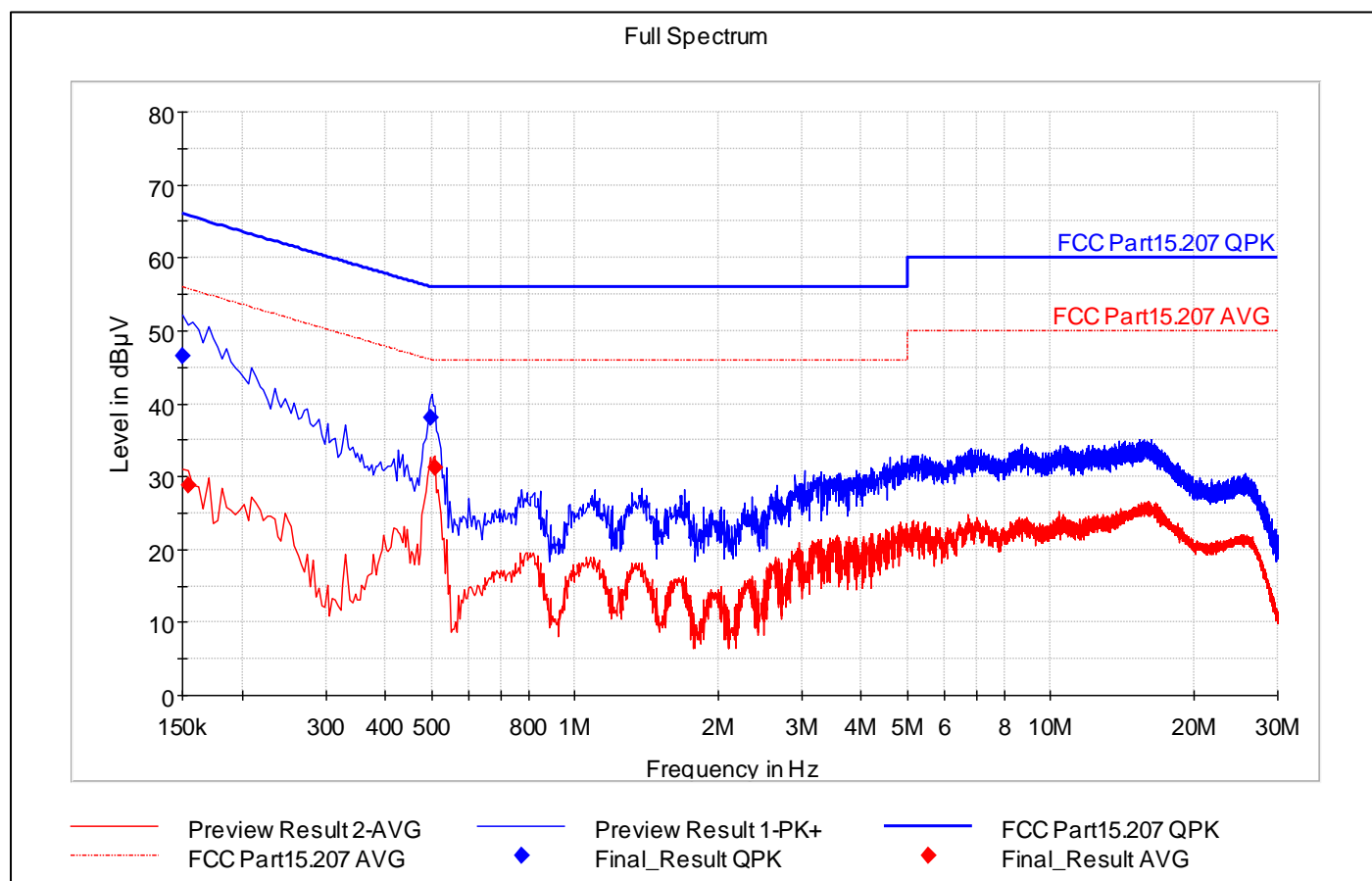
Conducted emission graph N line 802.11ac:



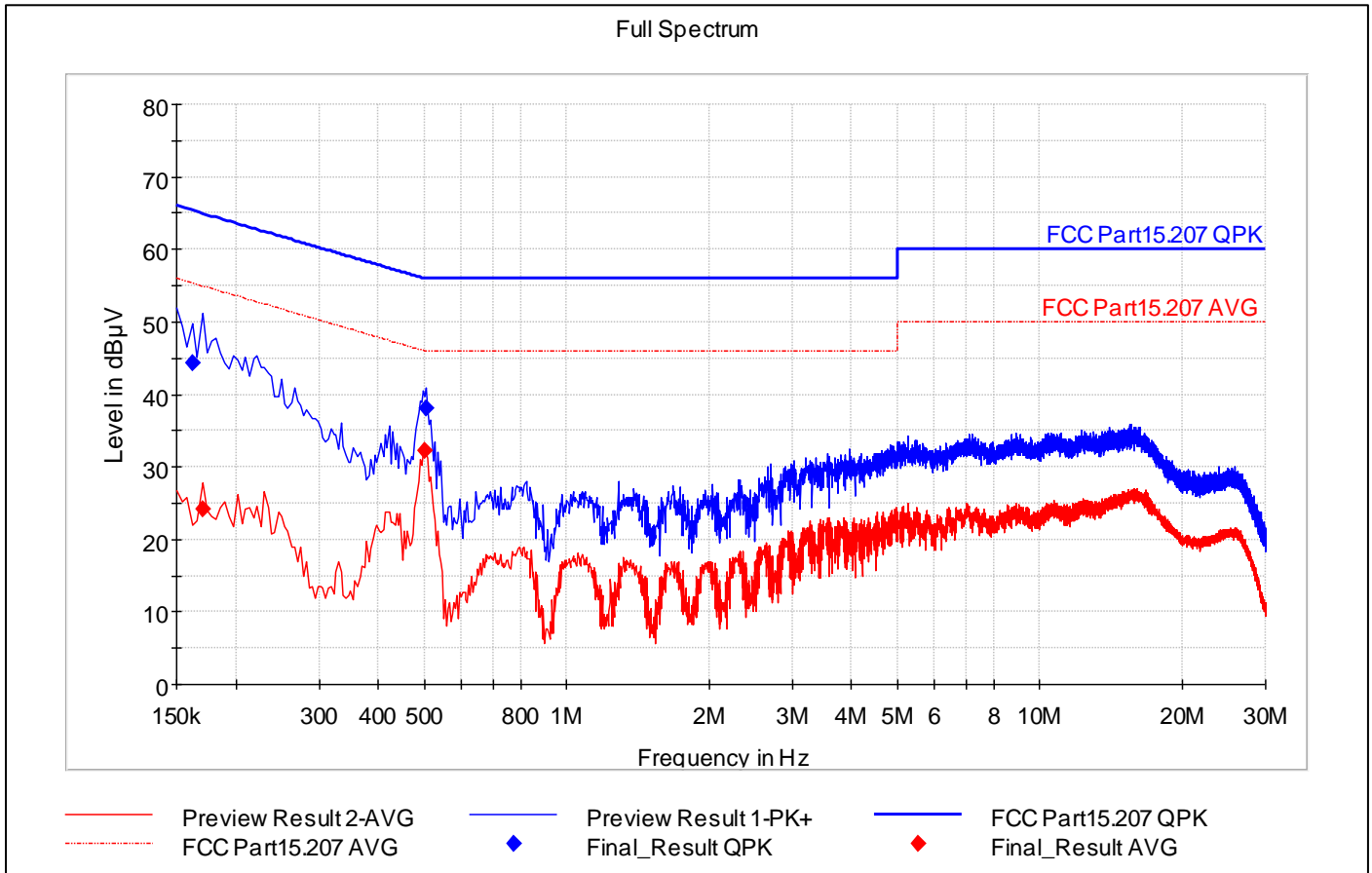
Test data WLAN 802.11g 6 Mbps

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas, Time (ms)	Bandwidth (kHz)	Line	Filter	Corr, (dB)	Comment
0.150000	46,54	---	66,00	19,46	15000.0	9,00	L1	ON	9,50	PASS
0.154000	---	28,89	55,78	26,89	15000.0	9,00	L1	ON	9,50	PASS
0.498000	38,07	---	56,03	17,96	15000.0	9,00	L1	ON	9,60	PASS
0.510000	---	31,22	46,00	14,78	15000.0	9,00	L1	ON	9,60	PASS
0.162000	44,33	---	65,36	21,03	15000.0	9,00	N	ON	9,50	PASS
0.170000	---	24,23	54,96	30,73	15000.0	9,00	N	ON	9,50	PASS
0.502000	---	32,28	46,00	13,72	15000.0	9,00	N	ON	9,60	PASS
0.506000	38,06	---	56,00	17,94	15000.0	9,00	N	ON	9,60	PASS

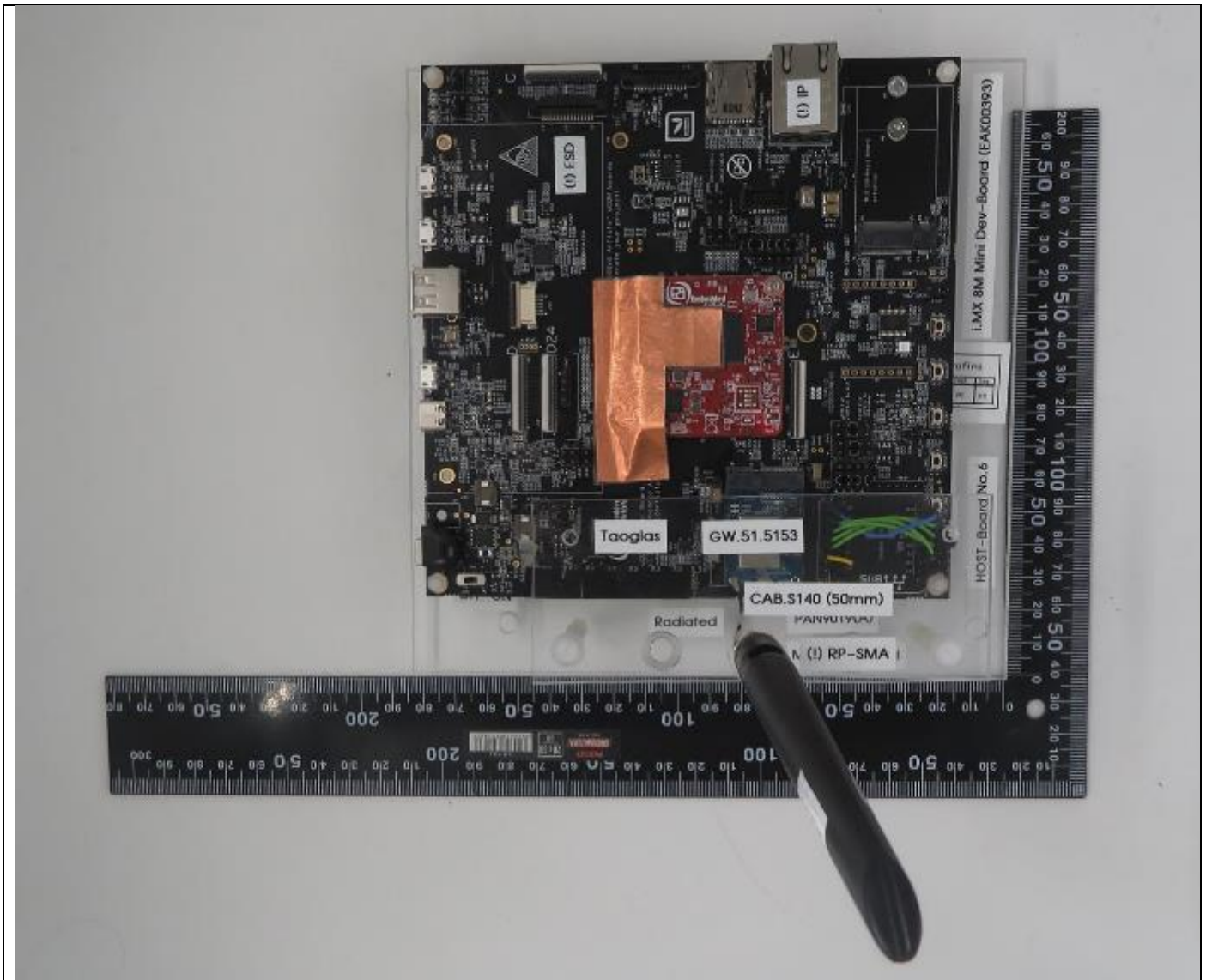
Conducted emission graph L1 line 802.11g:



Conducted emission graph N line 802.11:



10. Photographs – Equipment External

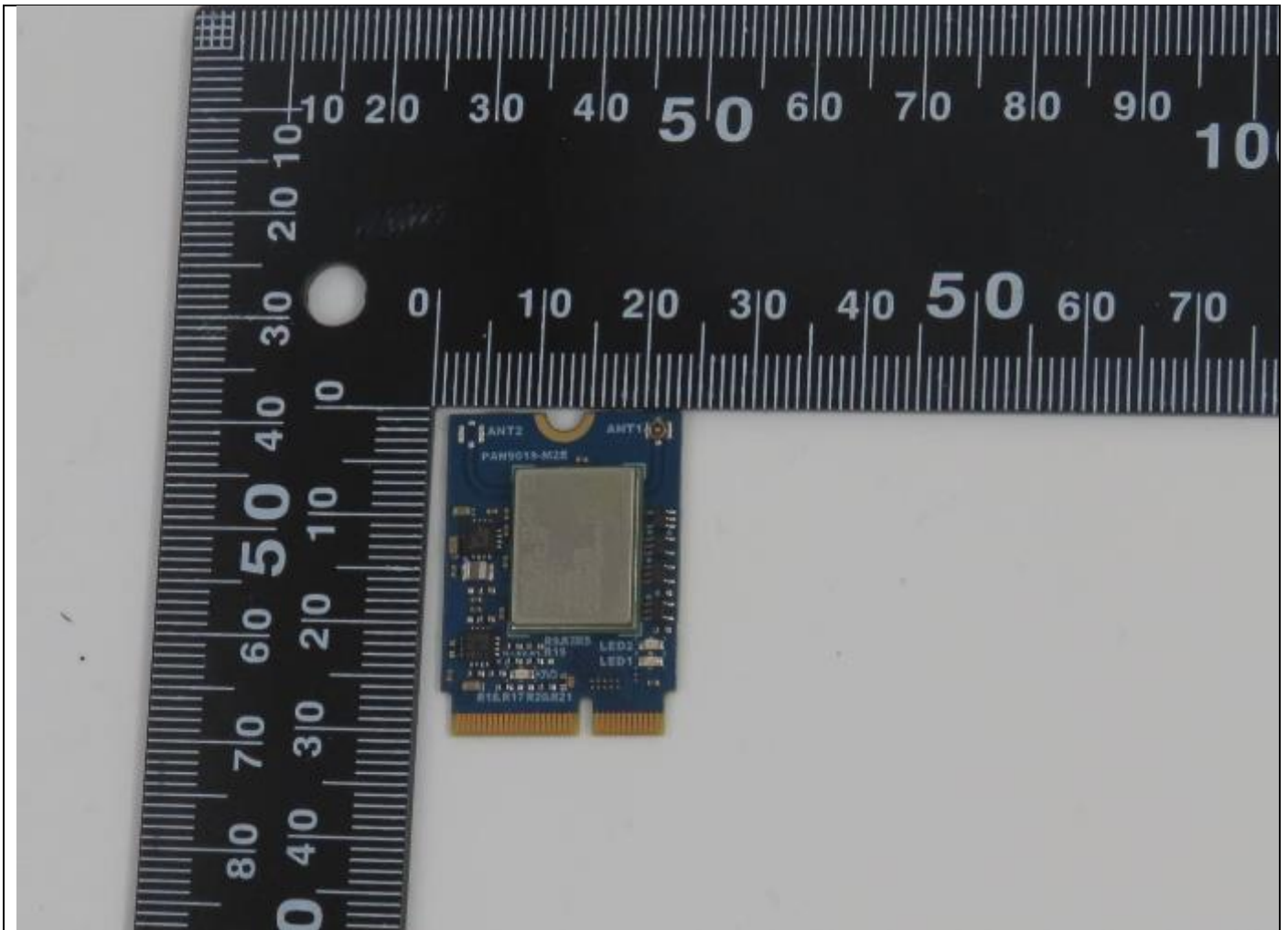


Picture 1, Host board with EUT Top view

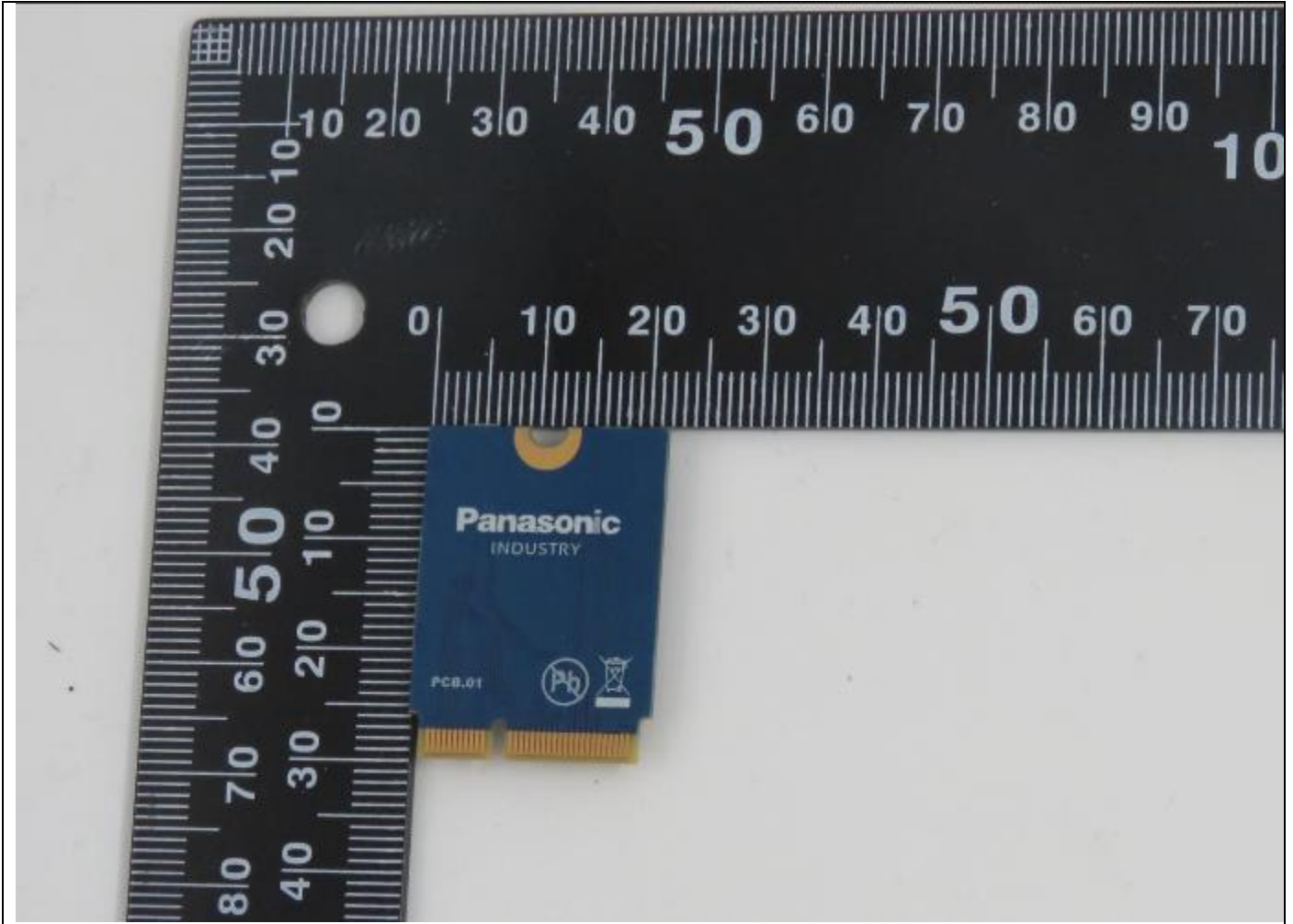


Picture 2, EUT with auxiliary equipment

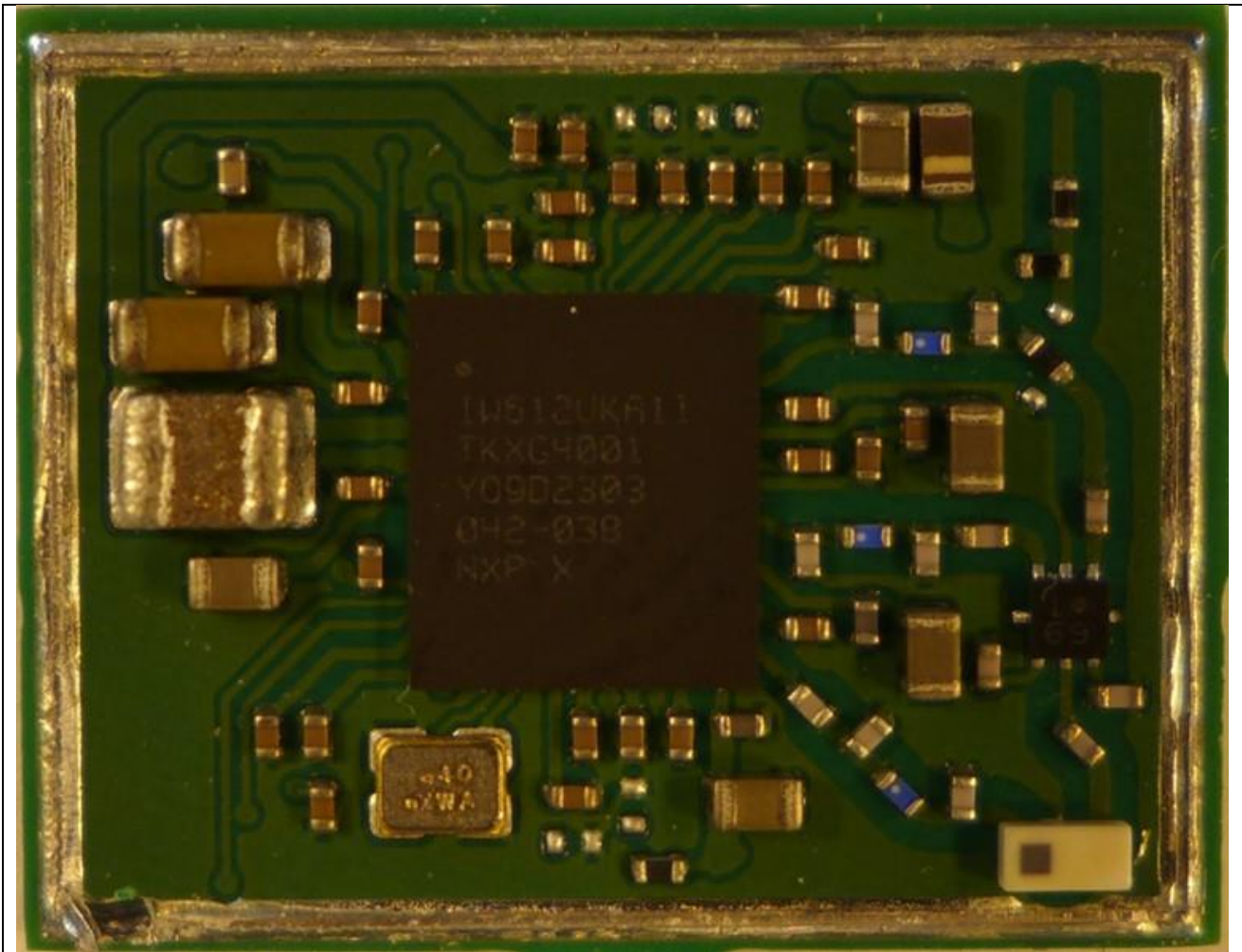
11. Photographs – Equipment Internal



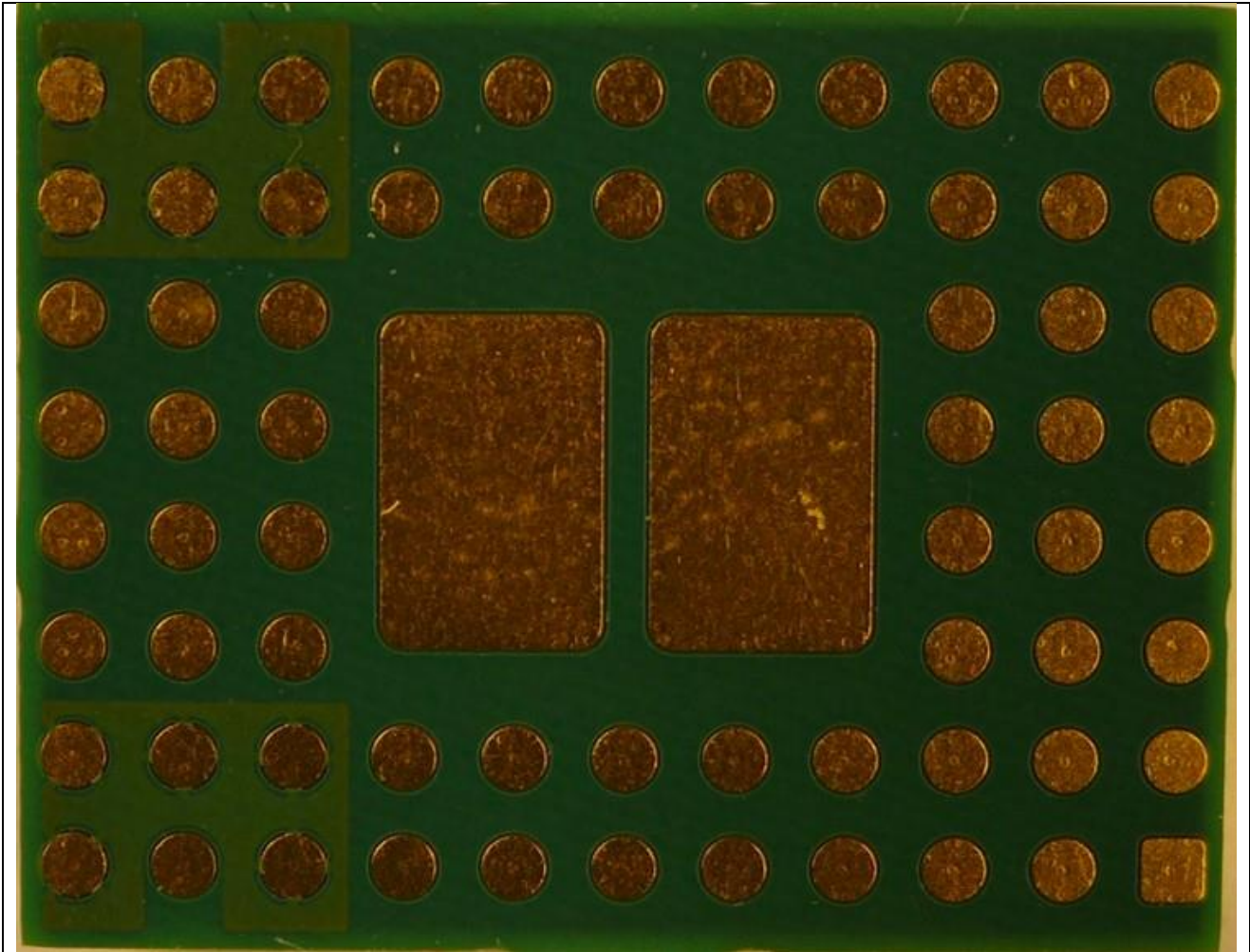
Picture 3, EUT PCB top



Picture 4, EUT PCB bottom



Picture 5, EUT Moduke internal



Picture 6, EUT Module bottom

12. Photographs – Test Setups



Picture 7, AC Power Line Conducted Emissions