

8.6 Radiated Emission Measurement 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.205 and 15.209 IC RSS-GEN Issue 4, sections 8.9 and 8.10			
Guide:	ANSI C63.10			
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance d (meters)
	0.009 - 0.490	2400/F(kHz)	67.6 - 20 · log(F(kHz))	300
	0.490 - 1.705	24000/F(kHz)	87.6 - 20 · log(F(kHz))	30
	1.705 - 30.000	30	29.5	30
Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.				
Measurement procedure:	Radiated Emission Measurement 9 kHz to 30 MHz (6.3)			

Comment:	
Date of test:	
Test site:	Open field test site

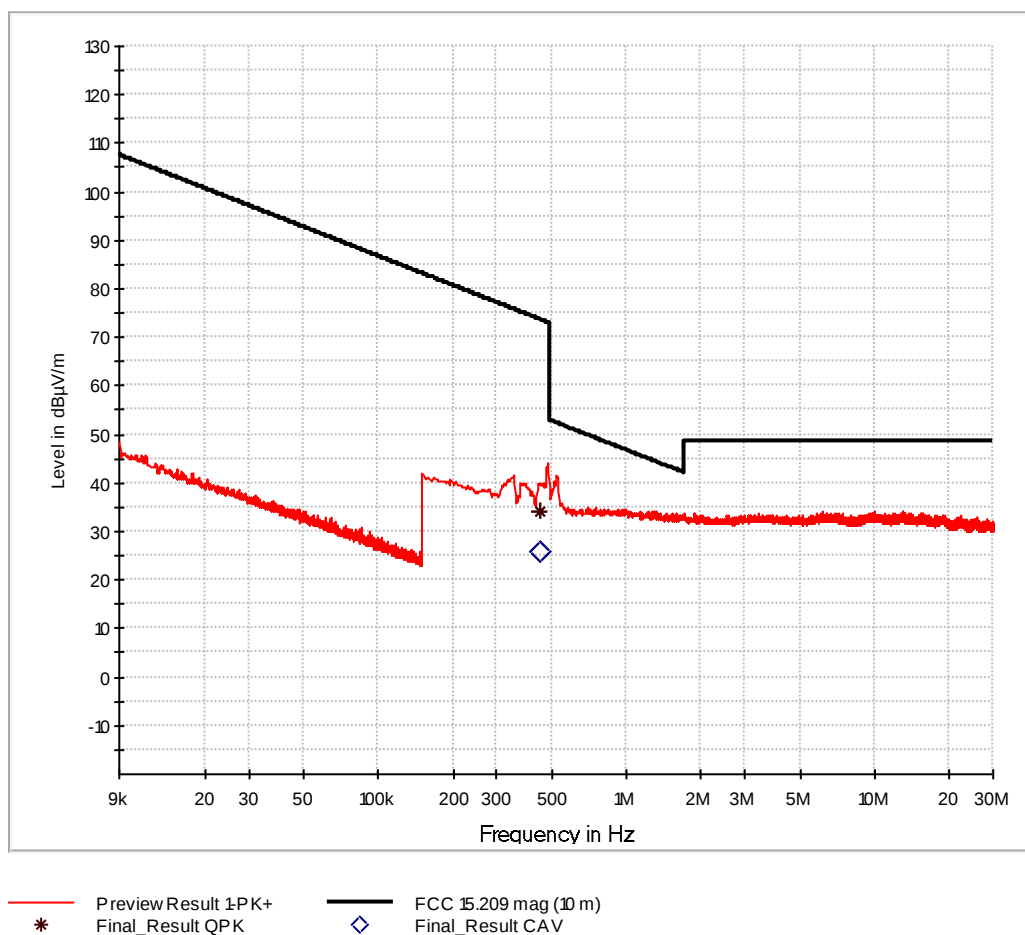
Test Result:	Test passed
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Sample calculation of final values:

$$\begin{aligned} \text{Extrapolation Factor (dB)} &= (\text{Log}(d) - \text{Log}(d_1)) \cdot \text{Extrapolation Factor (dB/decade)} \\ \text{Final Value (dBµV/m)} &= \text{Reading Value } d_1 \text{ (dBµV)} + \text{Correction Factor (dB/m)} \\ &\quad + \text{Extrapolation Factor (dB)} + \text{Pulse Train Correction (dB)} \end{aligned}$$

Note: Extrapolation factor (dB) and final value (dBµV/m) are relating to distance d.

Extrapolation factor: -40 dB/decade										
Frequency (MHz)	Detector	Distance		Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
		d1 (m)	d (m)							
0.44925	Average	10	300	5.8	20.0	-59.1		-33.2	14.6	47.8
0.45150	Average	10	300	5.8	20.0	-59.1		-33.3	14.5	47.8



8.7 Radiated Emission Measurement 30 MHz to 200 GHz

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 4, section 8.9		
Guide:	ANSI C63.10		
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
	30 - 88	100	40.0
	88 - 216	150	43.5
	216 - 960	200	46.0
	Above 960	500	54.0
Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.			
Measurement procedures:	Radiated Emission in Fully or Semi Anechoic Room (6.4) Radiated Emission at Alternative Test Site (6.5)		

Comment:			
Date of test:	2018-03-27 to 2018-04-23		
Test site:	Semi-anechoic room, cabin no. 8		
Test distance:	Frequencies ≤ 8.2 GHz:	3 m	
	Frequencies > 8.2 GHz, ≤ 18 GHz:	1 m	
	Frequencies > 18 GHz, ≤ 60 GHz:	0.5 m	
	Frequencies > 60 GHz, ≤ 90 GHz:	0.25 m	
	Frequencies > 90 GHz:	0.1 m	

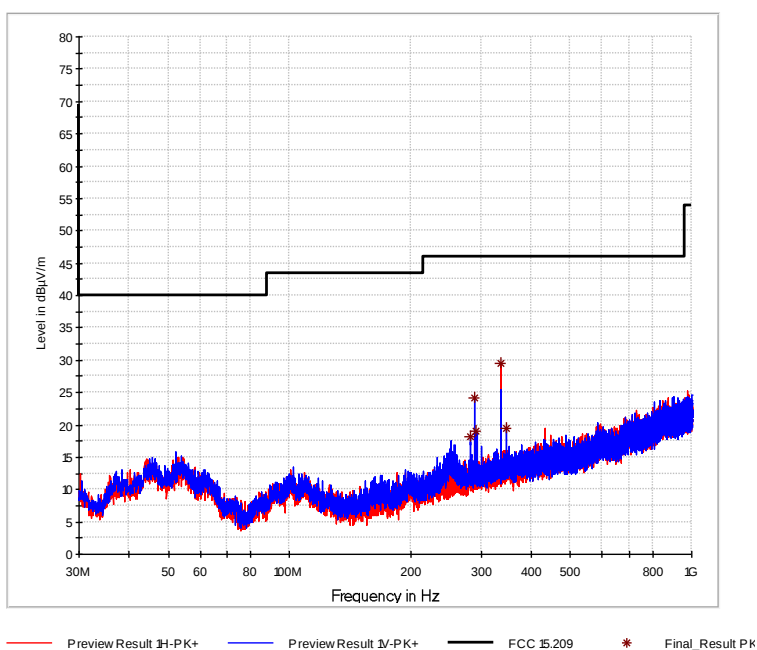
Test Result:	Test passed
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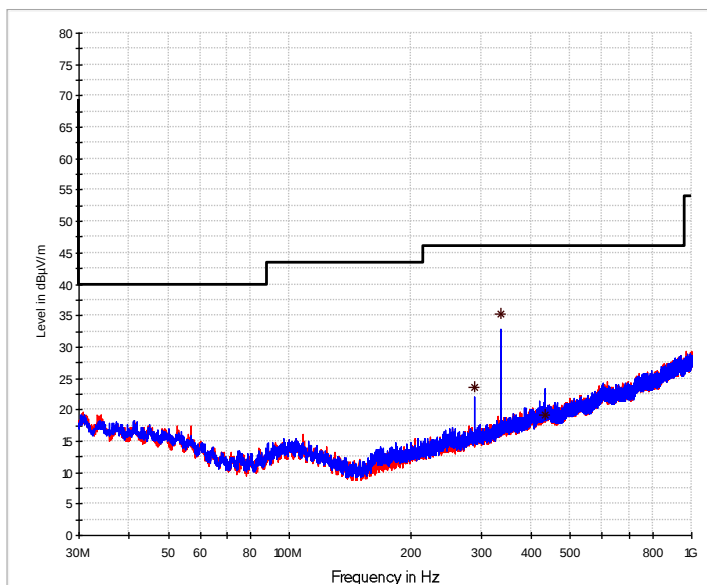
Sample calculation of final values:

$$\text{Final Value (dBµV/m)} = \text{Reading Value (dBµV)} + \text{Correction Factor (dB/m)} + \text{Pulse Train Correction (dB)}$$

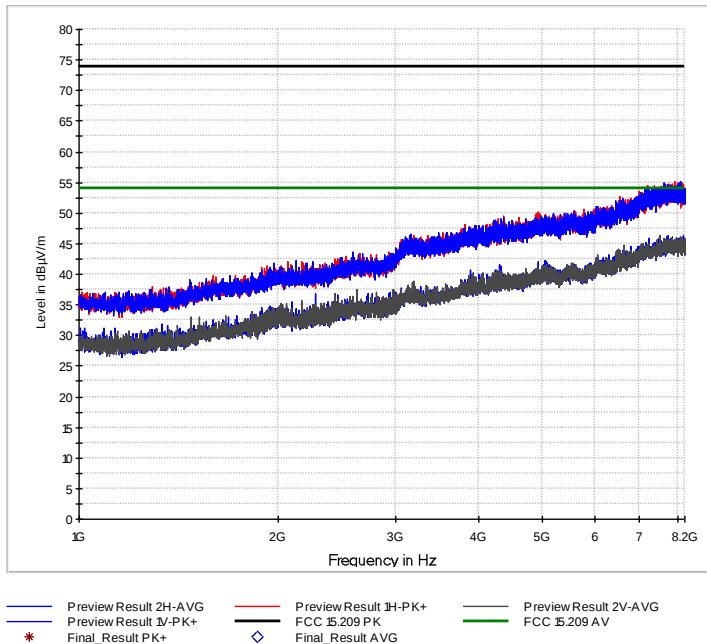
Plots for EUT No. 1

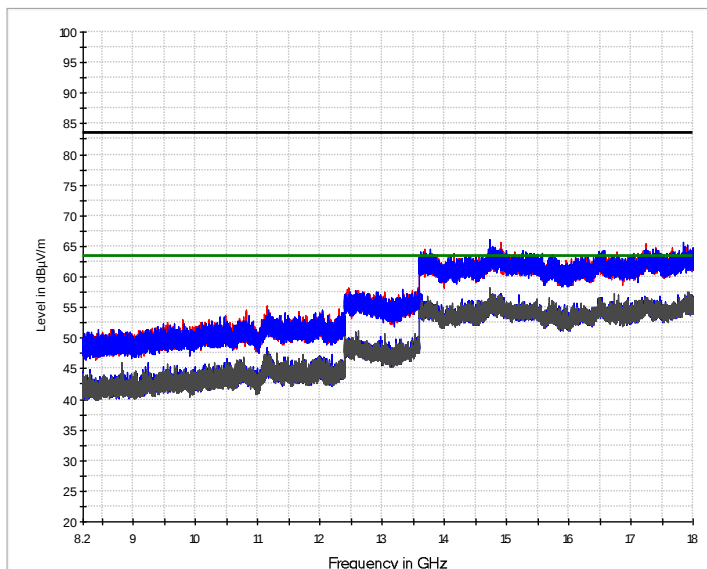
Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBμV)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dBμV/m)	Limit (dBμV/m)	Margin (dB)
282.720	vertical	Peak	1.4	16.7		18.1	46.0	27.9
288.000	vertical	Quasi-Peak	8.5	15.1		23.6	46.0	22.4
288.030	vertical	Peak	7.4	16.8		24.2	46.0	21.8
292.035	vertical	Peak	2.2	16.9		19.1	46.0	26.9
336.000	vertical	Quasi-Peak	18.9	16.4		35.3	46.0	10.7
336.045	horizontal	Peak	11.8	17.7		29.5	46.0	16.5
345.090	vertical	Peak	1.6	17.9		19.5	46.0	26.5
432.025	vertical	Quasi-Peak	-0.1	19.3		19.3	46.0	26.8



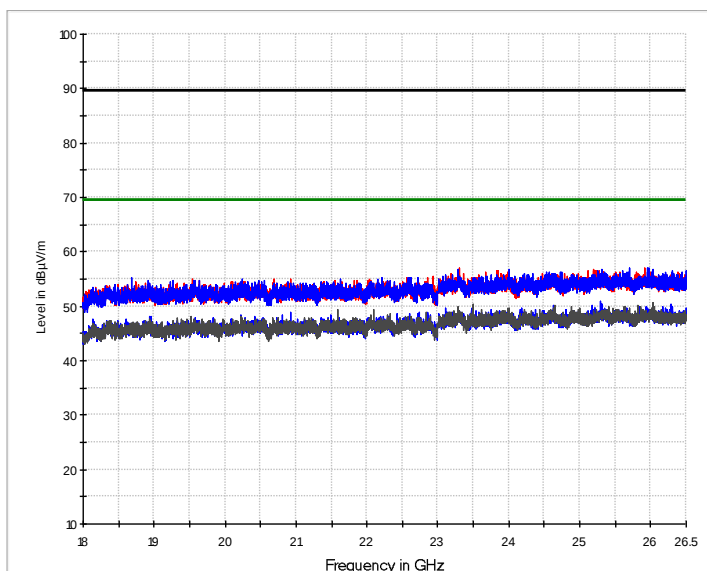


Final test

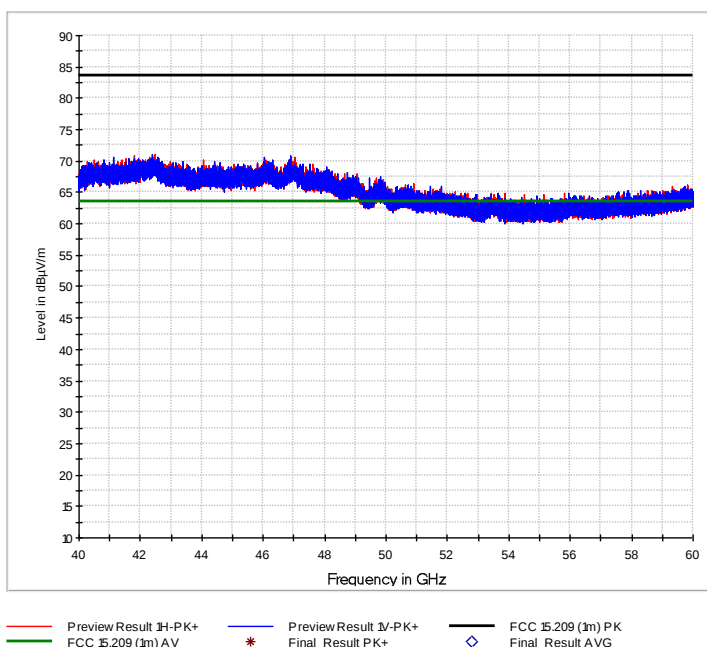
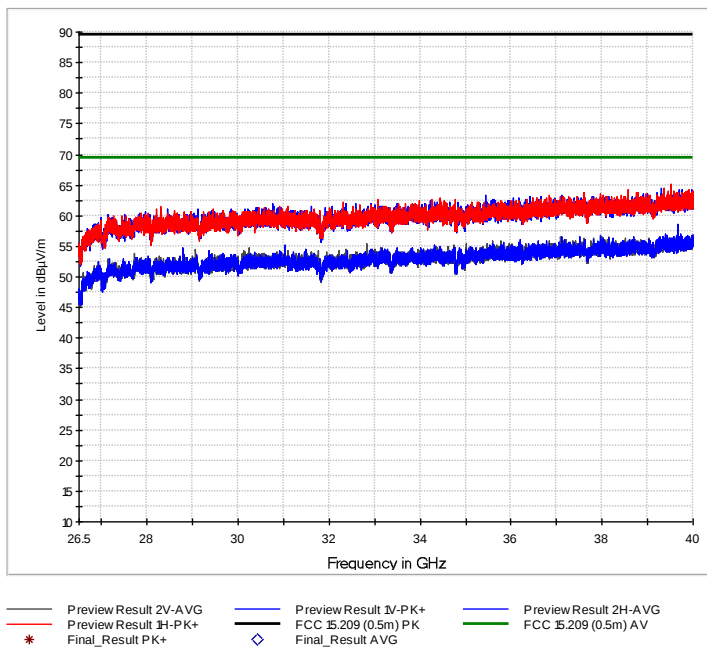


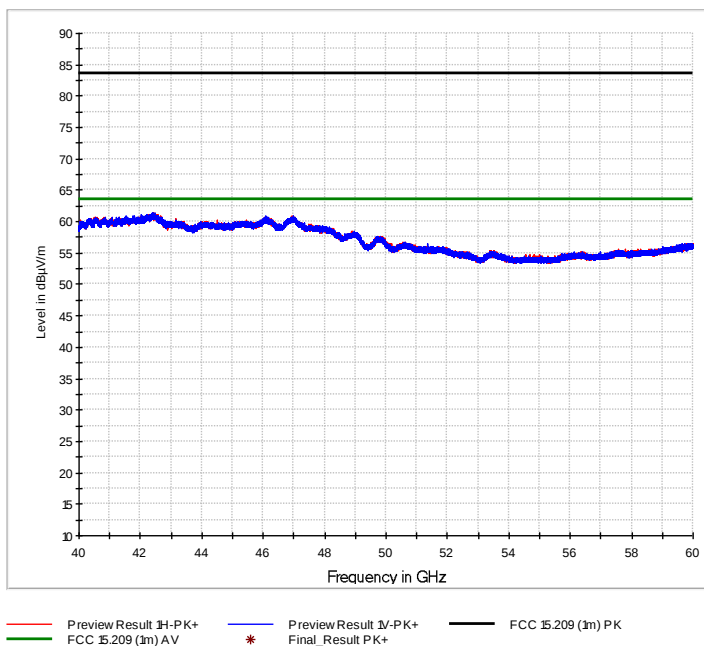


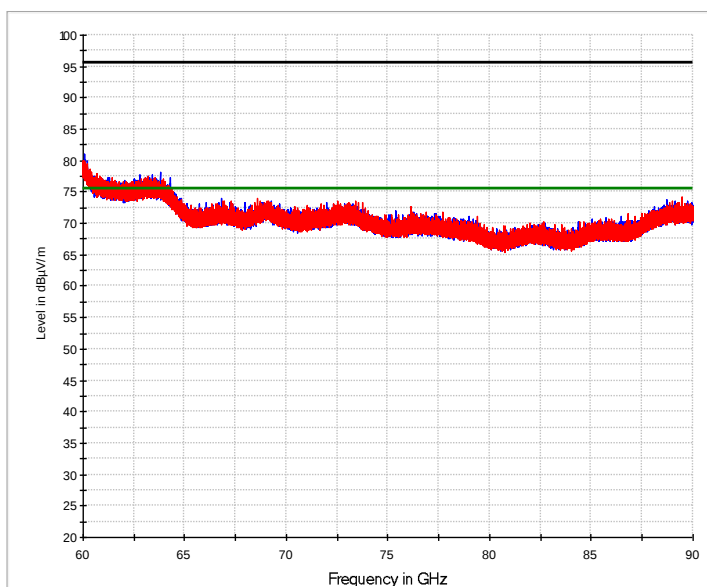
Preview Result 2H-AVG
 Preview Result 1V-PK+
 Preview Result 2V-AVG
 FCC 5.209 (3m) PK
 FCC 5.209 (3m) AV
 Final Result PK+
 Final Result AVG



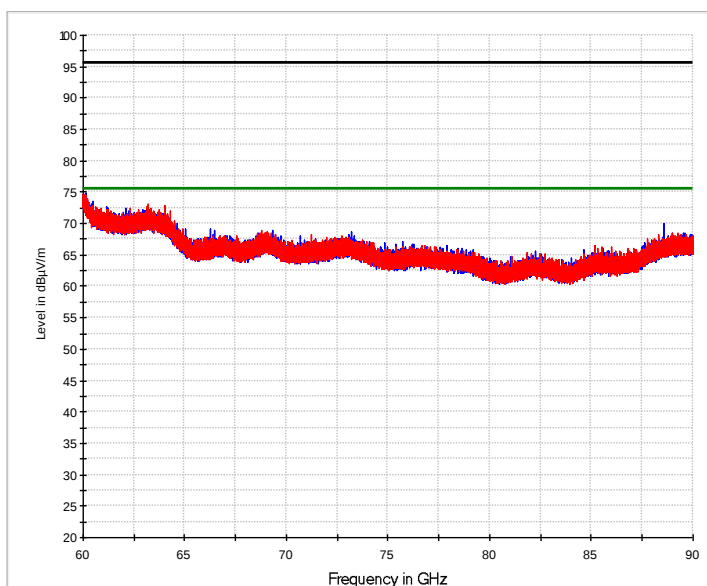
Preview Result 2H-AVG
 Preview Result 1V-PK+
 Preview Result 2V-AVG
 FCC 5.209 (0.5m) PK
 FCC 5.209 (0.5m) AV
 Final Result PK+
 Final Result AVG



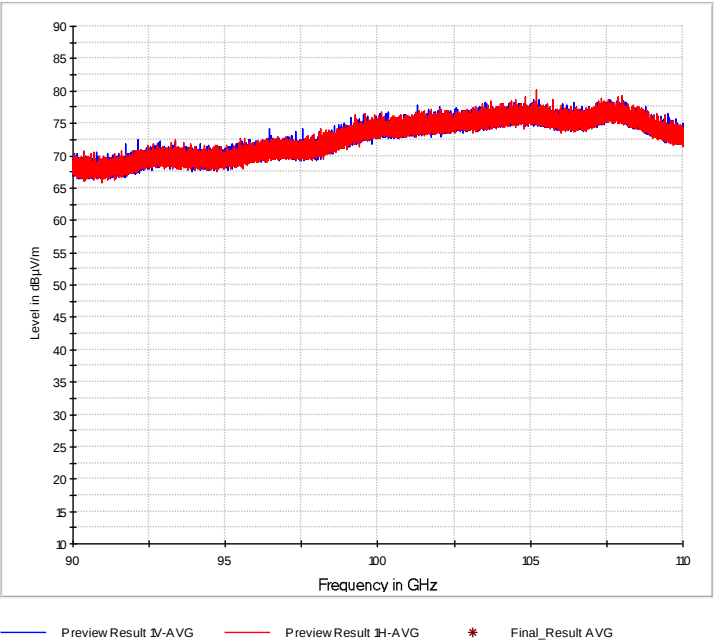
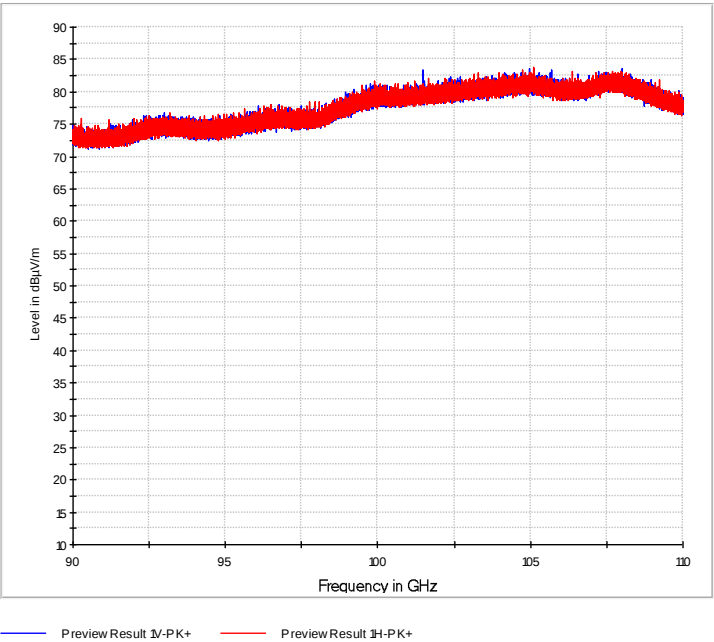


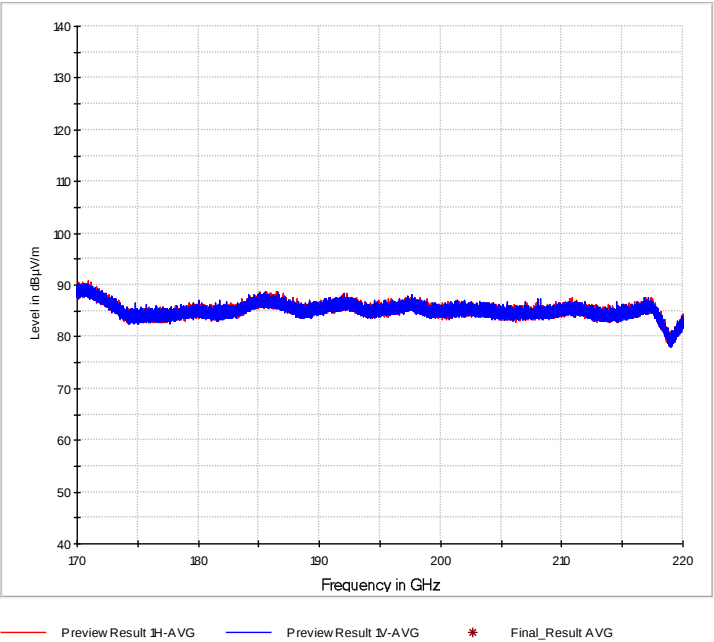
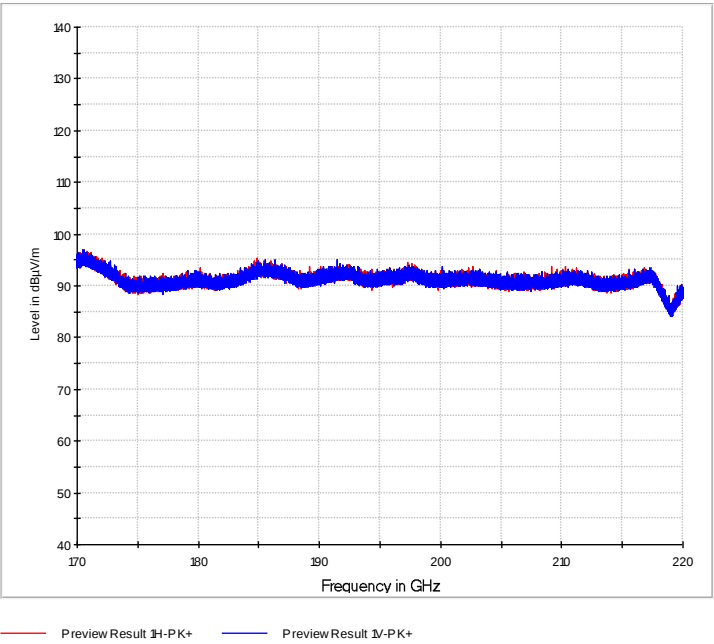


— Preview Result 1I-PK+ — Preview Result 1H-PK+
— FCC 5.209 (0.25m) PK — FCC 5.209 (0.25m) AV



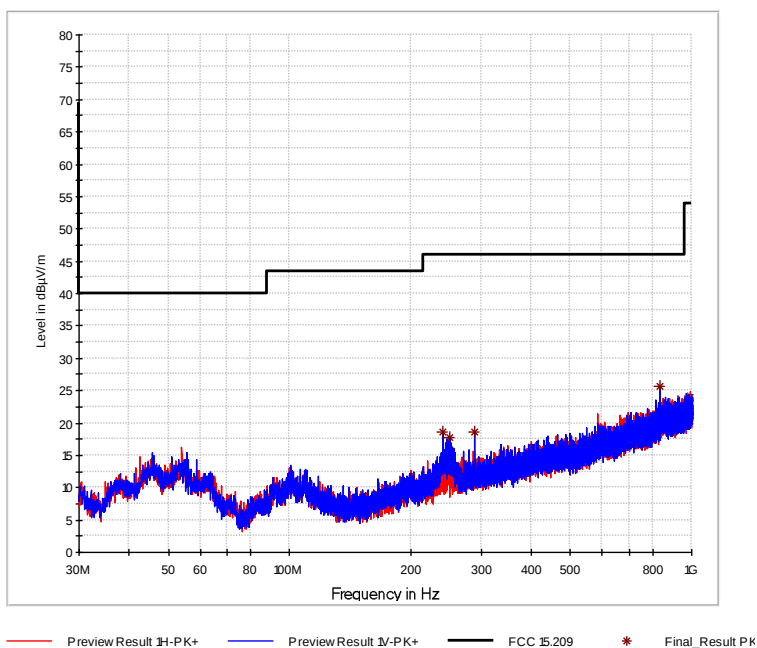
— Preview Result 1I-AVG — Preview Result 1H-AVG
— FCC 5.209 (0.25m) PK — FCC 5.209 (0.25m) AV

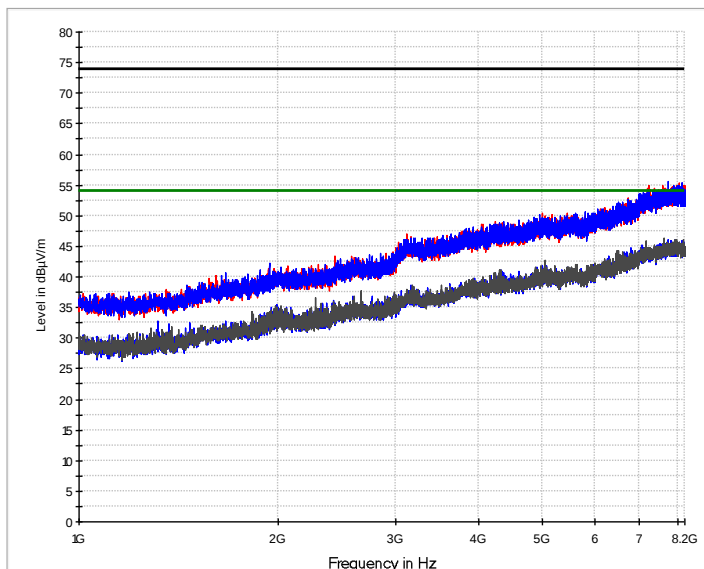




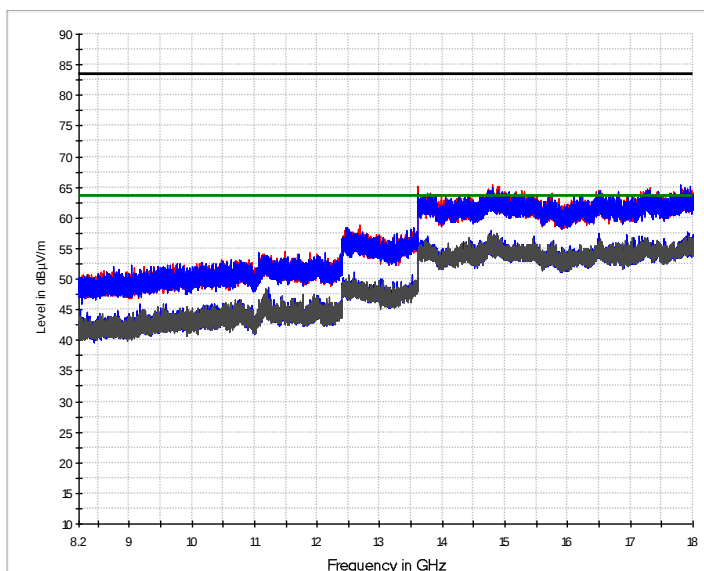
Plots for EUT No. 2

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBμV)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dBμV/m)	Limit (dBμV/m)	Margin (dB)
240.015	vertical	Quasi-Peak	3.0	15.7		18.7	46.0	27.3
250.140	vertical	Quasi-Peak	2.0	15.8		17.8	46.0	28.2
287.985	vertical	Quasi-Peak	1.8	16.8		18.6	46.0	27.4
288.000	vertical	Quasi-Peak	8.5	15.1		23.6	46.0	22.4
336.000	vertical	Quasi-Peak	18.9	16.4		35.3	46.0	10.7
432.025	vertical	Quasi-Peak	-0.1	19.3		19.3	46.0	26.8
832.563	vertical	Quasi-Peak	1.0	24.8		25.8	46.0	20.2

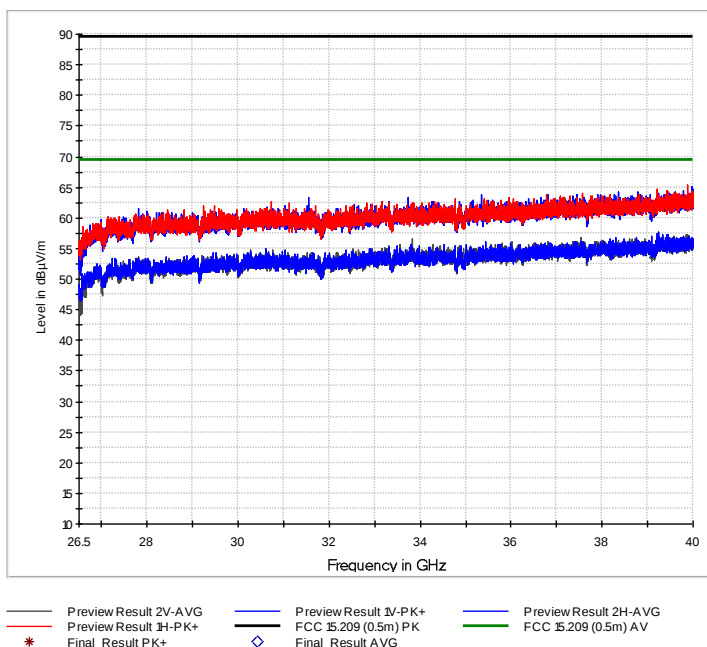
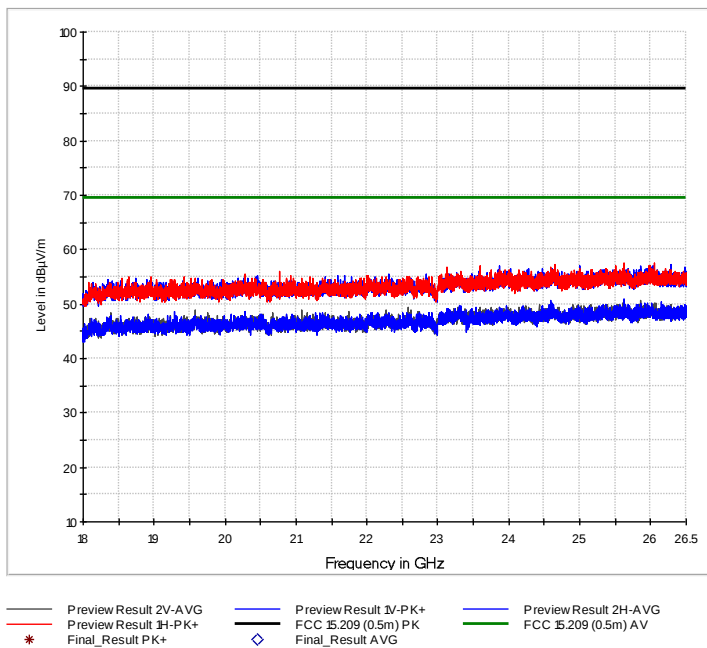


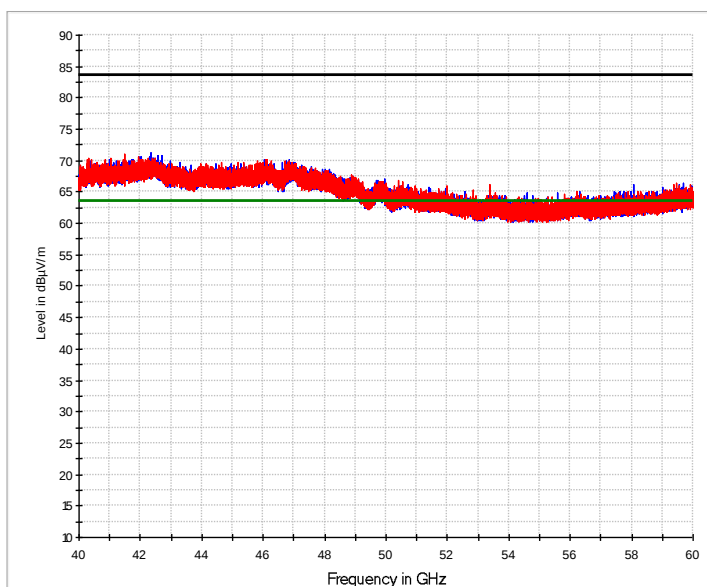


Preview Result 2H-AVG
 Preview Result 1V-PK+
 Final_Result PK+
 Preview Result 1H-PK+
 FCC 5.209 PK
 Final_Result AVG
 Preview Result 2V-AVG
 FCC 5.209 AV

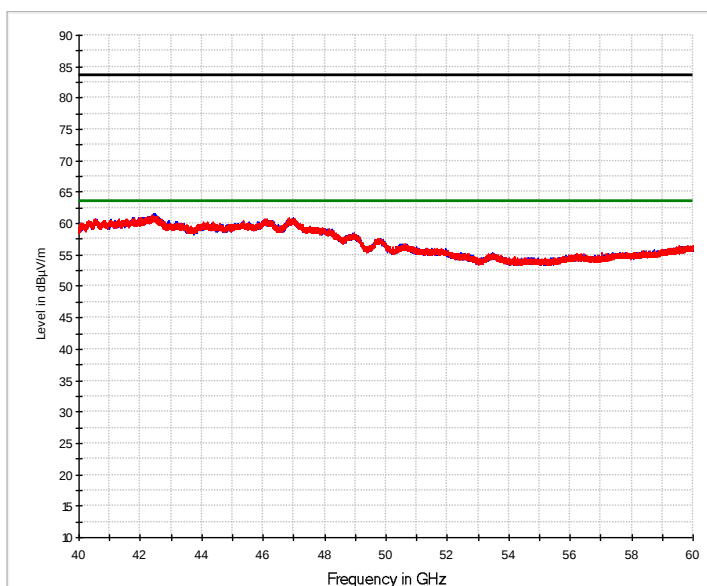


Preview Result 2H-AVG
 Preview Result 1V-PK+
 Final_Result PK+
 Preview Result 1H-PK+
 FCC 5.209 (1m) PK
 Final_Result AVG
 Preview Result 2V-AVG
 FCC 5.209 (1m) AV

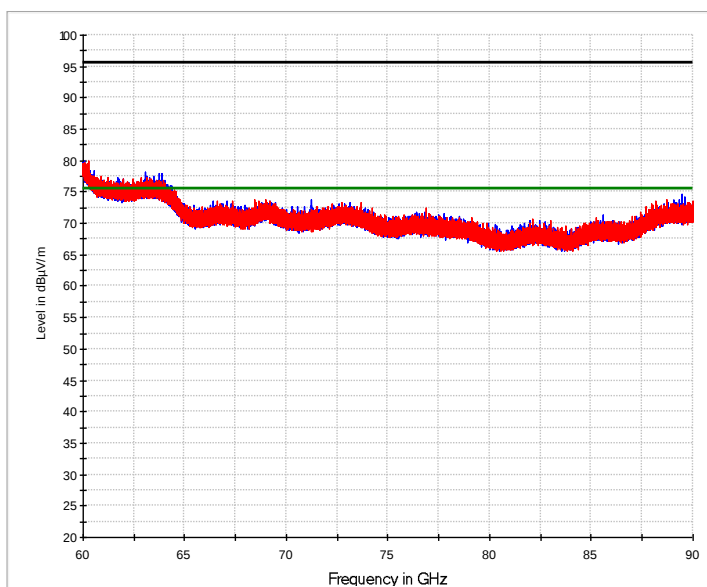




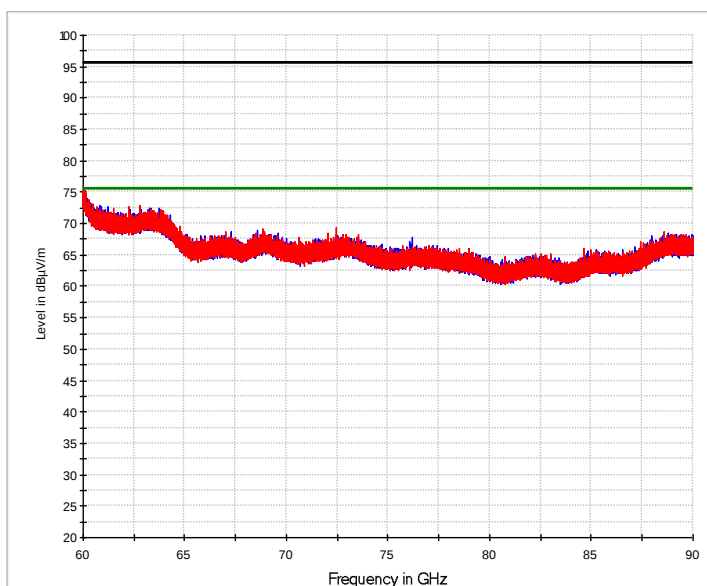
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— FCC 5.209 (3m) AV * Final Result PK+ ◇ Final Result AVG



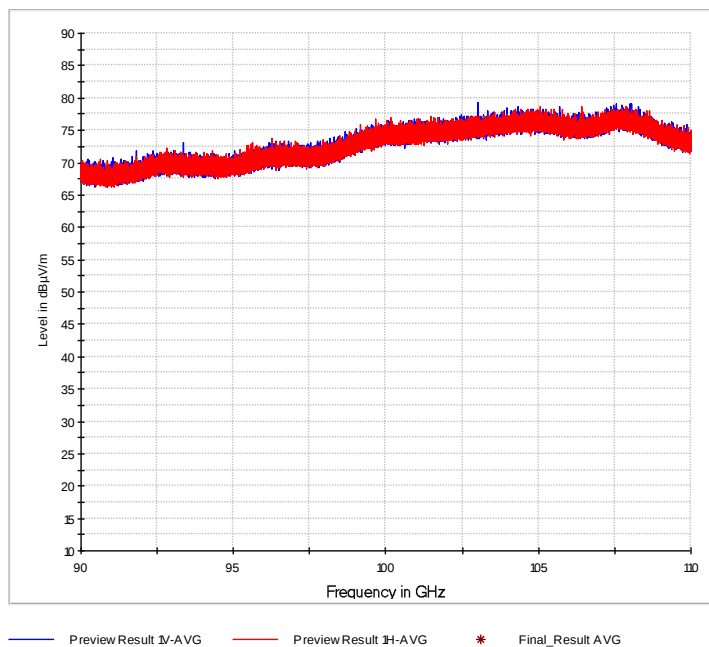
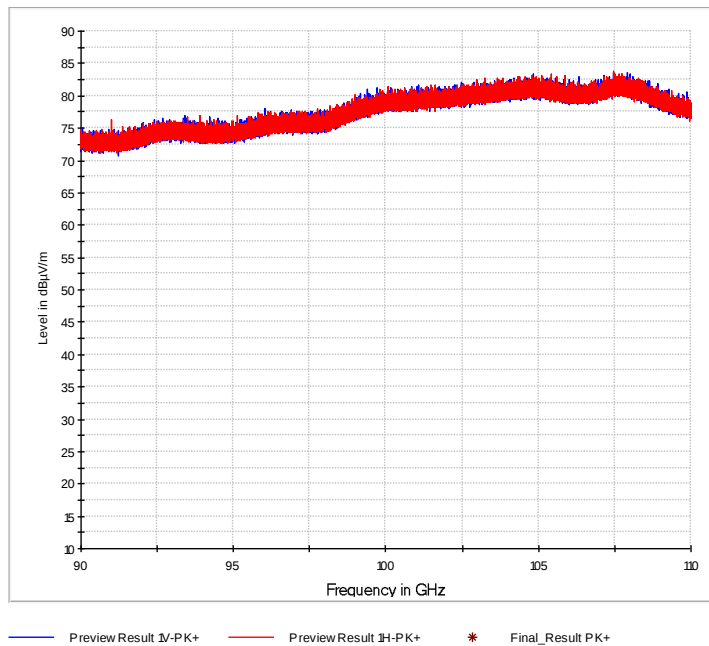
— Preview Result 1V-PK+ — Preview Result 1H-PK+
— FCC 5.209 (3m) PK — FCC 5.209 (3m) AV

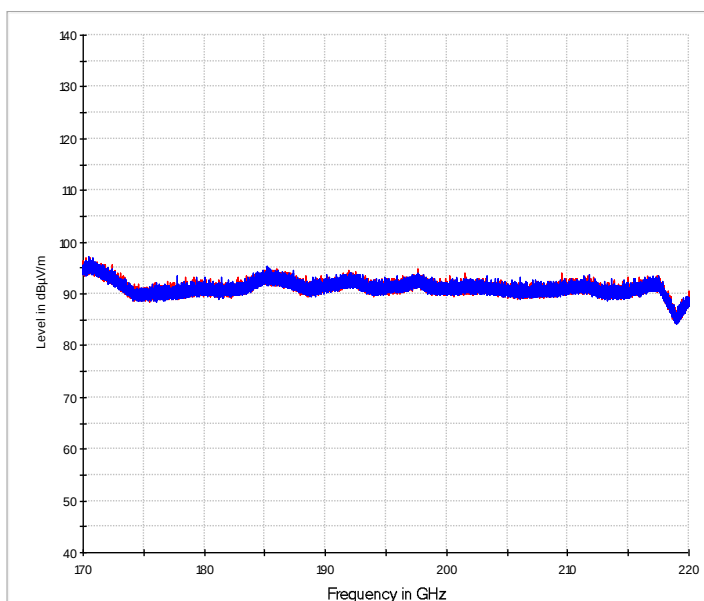


— Preview Result 1I-PK+ — Preview Result 1I-PK+
 — FCC 5.209 (0.25m) PK — FCC 5.209 (0.25m) AV

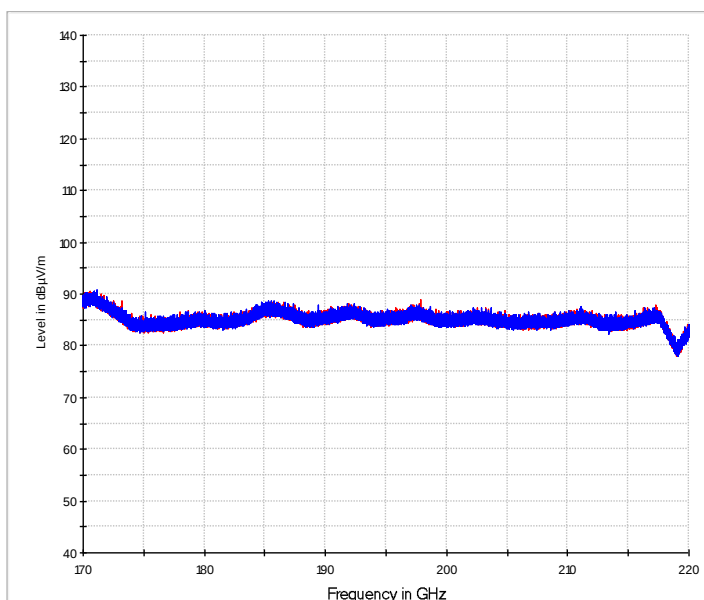


— Preview Result 1I-AVG — Preview Result 1I-AVG
 — FCC 5.209 (0.25m) PK — FCC 5.209 (0.25m) AV





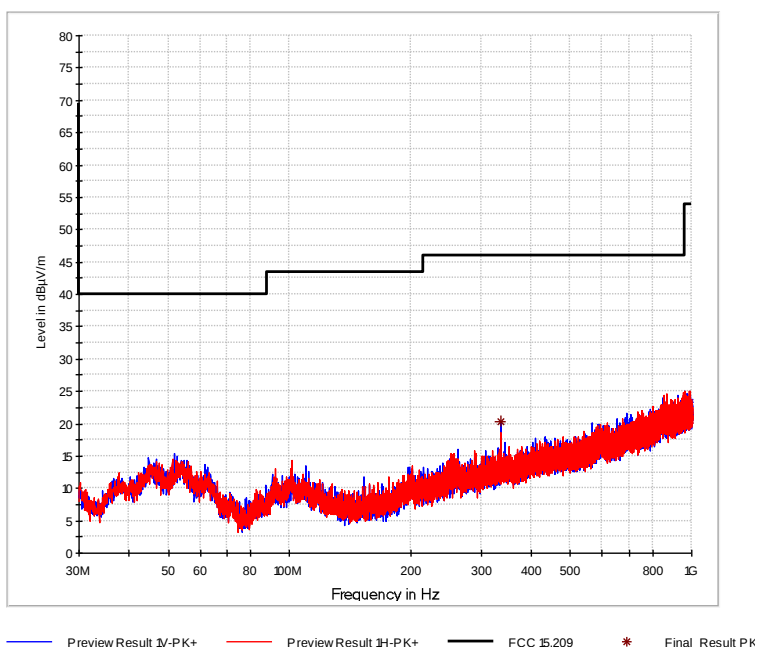
— Preview Result IH-PK+ — Preview Result IV-PK+ * Final_Result PK+

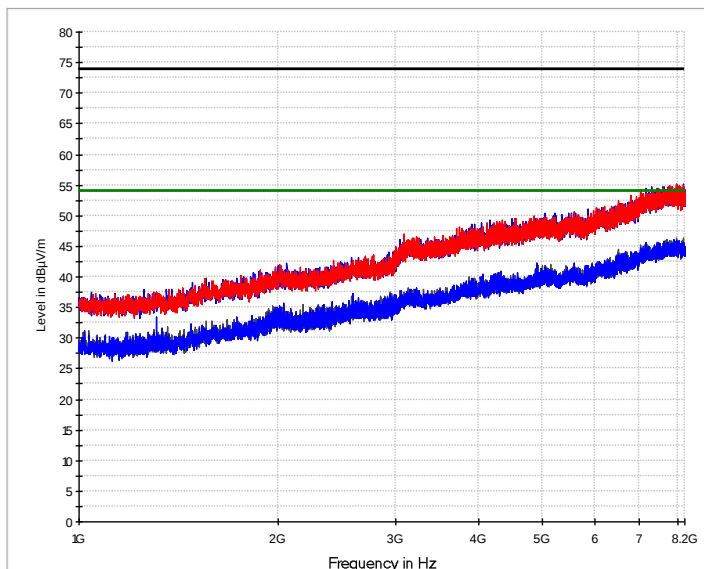


— Preview Result IH-AVG — Preview Result IV-AVG

Plots for EUT No. 3

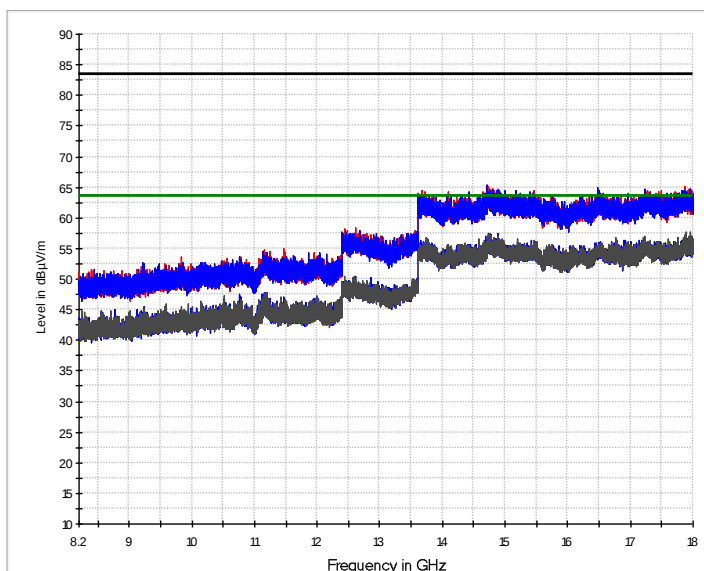
Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBμV)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dBμV/m)	Limit (dBμV/m)	Margin (dB)
288.000	vertical	Quasi-Peak	8.5	15.1		23.6	46.0	22.4
336.000	vertical	Quasi-Peak	18.9	16.4		35.3	46.0	10.7
336.045	vertical	Peak	2.6	17.7		20.3	46.0	25.8
432.025	vertical	Quasi-Peak	-0.1	19.3		19.3	46.0	26.8





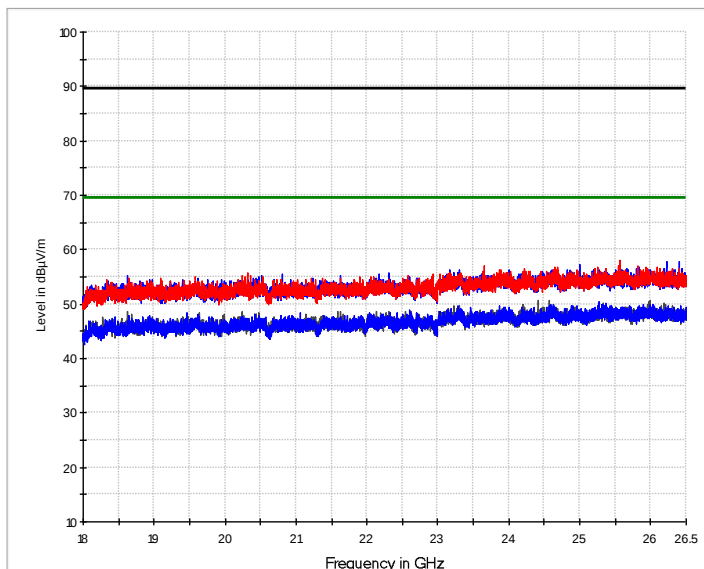
— Preview Result 2V-AVG
 — Preview Result 1H-PK+
 * Final_Result PK+

— Preview Result 1V-PK+
 — Preview Result 2H-AVG
 — FCC 5.209 PK
 — FCC 5.209 AV
 ◇ Final_Result AVG

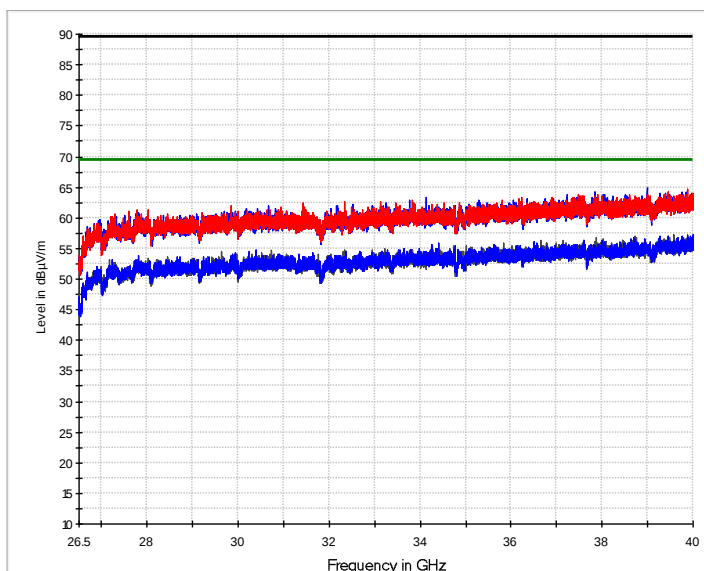


— Preview Result 2H-AVG
 — Preview Result 1H-PK+
 * Final_Result PK+

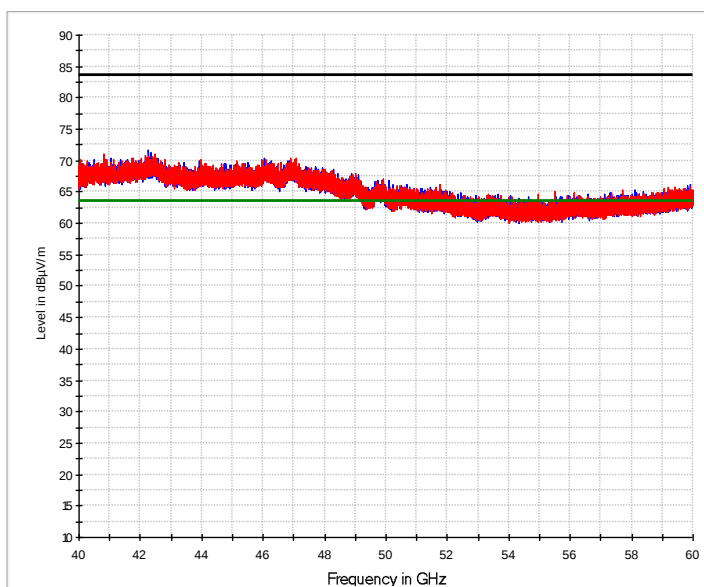
— Preview Result 1H-PK+
 — Preview Result 2V-AVG
 — FCC 5.209 (1m) PK
 — FCC 5.209 (1m) AV
 ◇ Final_Result AVG



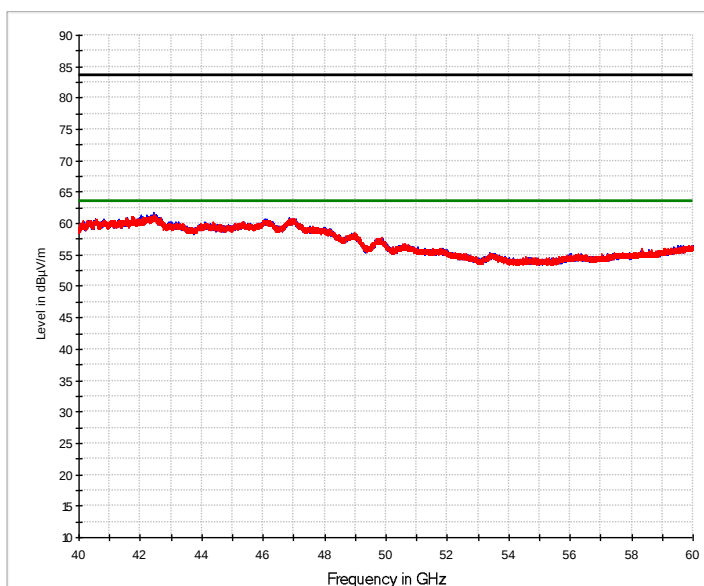
— Preview Result 2V-AVG
 — Preview Result 3H-PK+
 * Final_Result PK+
 — Preview Result 1V-PK+
 — FCC 5.209 (0.5m) PK
 ◇ Final_Result AVG
 — Preview Result 2H-AVG
 — FCC 5.209 (0.5m) AV



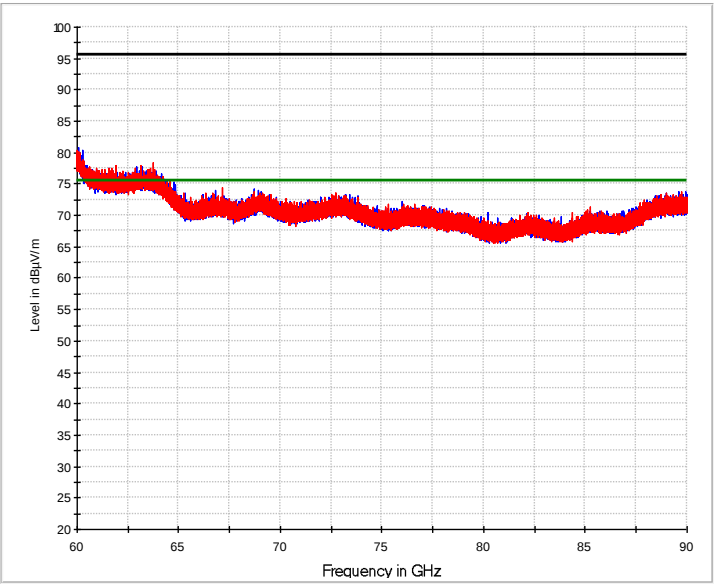
— Preview Result 2V-AVG
 — Preview Result 3H-PK+
 * Final_Result PK+
 — Preview Result 1V-PK+
 — FCC 5.209 (0.5m) PK
 ◇ Final_Result AVG
 — Preview Result 2H-AVG
 — FCC 5.209 (0.5m) AV



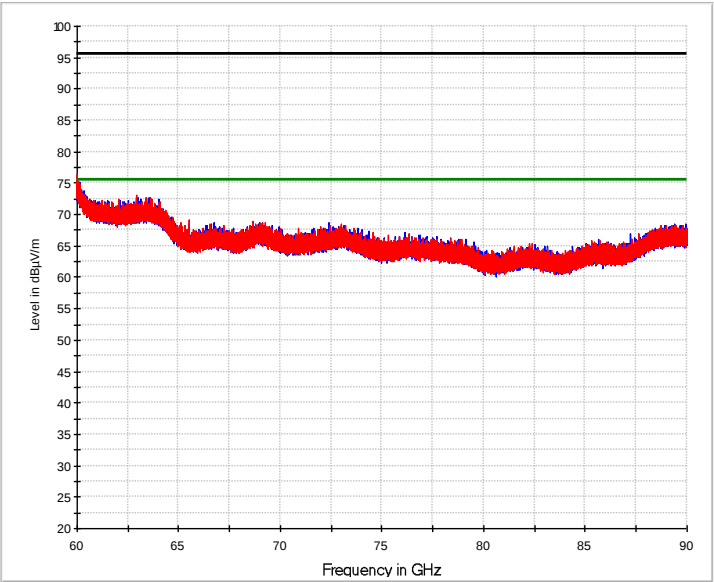
— Preview Result 1I-PK+ — Preview Result 1I-PK+ — FCC 5.209 (3m) PK
— FCC 5.209 (3m) AV * Final_Result PK+ ◇ Final_Result AVG



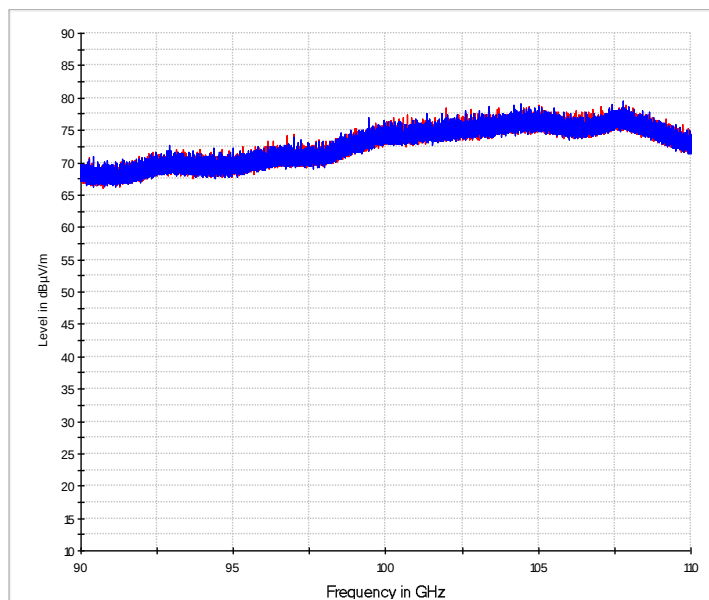
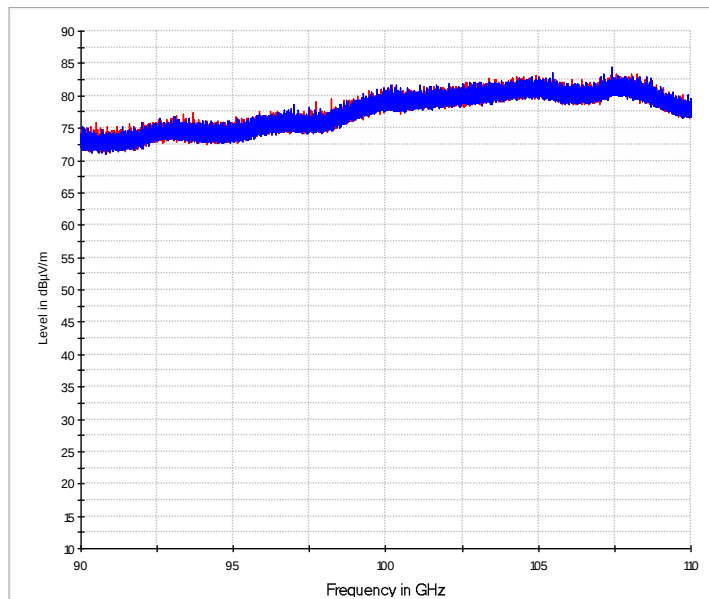
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— FCC 5.209 (3m) AV — FCC 5.209 (3m) AV

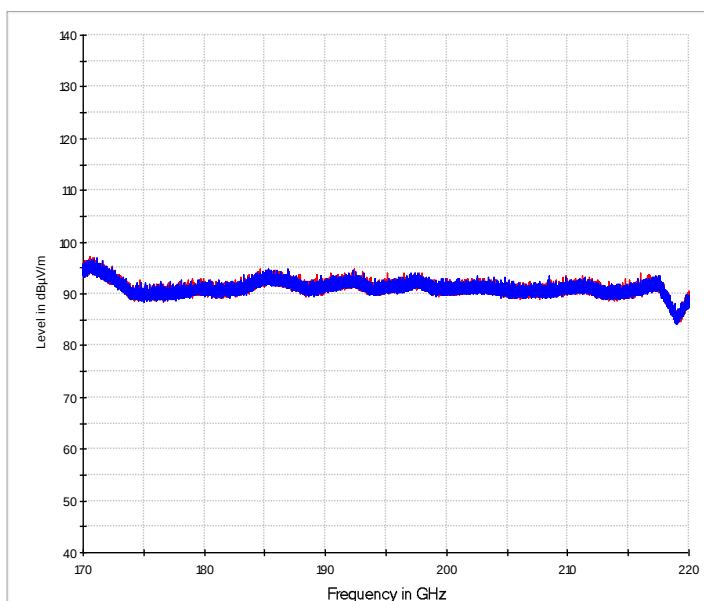


Preview Result 1I-PK+ Preview Result 1H-PK+
FCC 5.209 (0.25m) PK FCC 5.209 (0.25m) AV

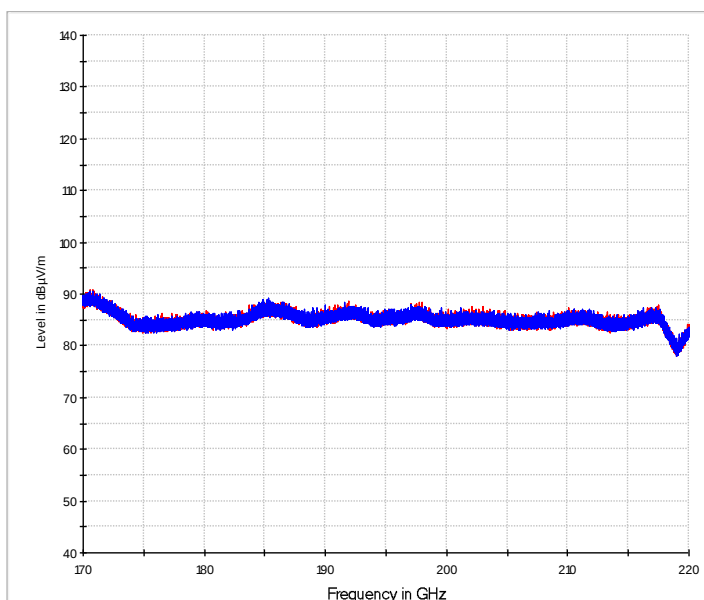


Preview Result 1I-AVG Preview Result 1H-AVG FCC 5.209 (0.25m) PK
FCC 5.209 (0.25m) AV * Final_Result AVG





— Preview Result IH-PK+ — Preview Result IV-PK+ * Final_Result PK+



— Preview Result IH-AVG — Preview Result IV-AVG

8.8 RF Exposure Requirement

Rules and specifications:	CFR 47 Part 1, section 1.1307(b)(1)				
Guide:	OET Bulletin 65, Edition 97-01				
Limits	Limits for general population / uncontrolled exposure:				
	<i>Frequency Range (MHz)</i>	<i>Electric Field Strength (V/m)</i>	<i>Magnetic Field Strength (A/m)</i>	<i>Power Density (mW/cm²)</i>	<i>Averaging Time (min)</i>
	0.3 – 1.34	614	1.63	100 *	30
	1.34 – 30	824/f	2.19 / f	180 / f *	30
	30 – 300	27.5	0.073	0.2	30
	300 – 1500	---	---	f / 1500	30
	1500 - 100000	---	---	1.0	30
	f = Frequency in MHz				
	* Plane wave equivalent power density				

<i>EUT No.</i>	<i>Variant</i>	<i>Antenna</i>	<i>EIRP_{RMS} (dBm)</i>	<i>EIRP_{RMS} (μW)</i>
1	FMR60L	Drip-off PTFE 2"	-21.9	6.5
2	FMR62L	Integrated PEEK 1.5"	-20.5	8.9
3	FMR67L	Flush mouth 3"	-15.1	30.9

Prediction: ⁶	$S = PG / (4 \pi R^2)$
Where:	S: Power density P: Power input into antenna G: Power gain of the antenna relative to an isotropic radiator R: Distance to the center of radiation of the antenna
Maximum output power:	P = 30.9 μW
Antenna gain:	G: Not applicable
Prediction distance	R = 5 mm
Power density at 20 cm:	S = 0.0001 mW/cm ²
Limit	S _{lim} = 1.0 mW/cm ²

Test Result:	Test passed
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⁶ MPE Prediction of MPE according to equation from page 19 of OET Bulletin 65, Ed. 97-01

8.9 Exposure of Humans to RF Fields

Rules and specifications:	IC RSS-Gen Issue 4, section 3.2
Guide:	IC RSS-102 Issue 5, section 2.5

Exposure of Humans to RF Fields	Applicable	Declared by applicant	Measured	Exemption																				
The antenna is																								
☐ detachable																								
The conducted output power (CP in watts) is measured at the antenna connector: $CP = \dots\dots\dots \text{ W}$ The effective isotropic radiated power (EIRP in watts) is calculated using ☐ the numerical antenna gain: $G = \dots\dots\dots$ $EIRP = G \cdot CP \Rightarrow EIRP = \dots\dots\dots \text{ W}$ ☐ the field strength⁷ in V/m: $FS = \dots\dots\dots \text{ V/m}$ $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = \dots\dots\dots \text{ W}$ with: Distance between the antennas in m: $D = \dots\dots\dots \text{ m}$			☐																					
☒ not detachable																								
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by⁷: <table border="1"> <thead> <tr> <th>EUT No.</th> <th>Variant</th> <th>Antenna</th> <th>$EIRP_{RMS}$ (dBm)</th> <th>$EIRP_{RMS}$ (μW)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>FMR60</td> <td>Drip-off PTFE 2"</td> <td>-21.9</td> <td>6.5</td> </tr> <tr> <td>2</td> <td>FMR62</td> <td>Integrated PEEK 1.5"</td> <td>-20.5</td> <td>8.9</td> </tr> <tr> <td>3</td> <td>FMR67</td> <td>Flush mouthn 3"</td> <td>-15.1</td> <td>30.9</td> </tr> </tbody> </table>	EUT No.	Variant	Antenna	$EIRP_{RMS}$ (dBm)	$EIRP_{RMS}$ (μW)	1	FMR60	Drip-off PTFE 2"	-21.9	6.5	2	FMR62	Integrated PEEK 1.5"	-20.5	8.9	3	FMR67	Flush mouthn 3"	-15.1	30.9			☒	
EUT No.	Variant	Antenna	$EIRP_{RMS}$ (dBm)	$EIRP_{RMS}$ (μW)																				
1	FMR60	Drip-off PTFE 2"	-21.9	6.5																				
2	FMR62	Integrated PEEK 1.5"	-20.5	8.9																				
3	FMR67	Flush mouthn 3"	-15.1	30.9																				
Selection of output power																								
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.): $TP = 30.9 \text{ μW}$																								

⁷ The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses. If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is				
☒ less than or equal to 20 cm		☒		
☐ greater than 20 cm				
Transmitting device is				
☐ in the vicinity of the human head		☐		
☐ body-worn				

SAR evaluation

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in the table.

For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in the table, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

Frequency (MHz)	Exemption limits (mW) ⁸ at separation distance of									
	≤5 mm	10 mm	15 mm	20 mm	25 mm	30 mm	35 mm	40 mm	45 mm	≥50 mm
≤300 ⁹	71	101	132	162	193	223	254	284	315	345
450	52	70	88	106	123	141	159	177	195	213
835	17	30	42	55	67	80	92	105	117	130
1900	7	10	18	34	60	99	153	225	316	431
2450	4	7	15	30	52	83	123	173	235	309
3500	2	6	16	32	55	86	124	170	225	290
5800	1	6	15	27	41	56	71	85	97	106

Carrier frequency: f = **75 GHz – 85 GHz**

Distance: d = **5 mm**

Transmitter output power: TP = **0.0309 mW**

Limit: TP_{limit} = **1 mW**

☐ SAR evaluation is documented in test report no.

⁸ The exemption limit in the table are based on measurements and simulations on half-wave dipole antennas at separation distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.

⁹ Transmitters operating between 3 kHz and 10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in IC RSS-102, issue 5, section 4.

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
RF exposure evaluation				
RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows: ☐ below 20 MHz¹⁰ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance). ☐ between 3 kHz and 10 MHz exposure limits apply as following: ☐ In a uncontrolled environment the basic restriction for the instantaneous internal electric field strength is equal to or less than $2.7 \cdot 10^{-4} f \text{ V/m}_{\text{rms}}$ at any part of the body where f is in Hz. The instantaneous RF field strength is equal or less than 83 V/m_{rms} and equal or less than 90 A/m_{rms}. ☐ In a controlled environment the basic restriction for the instantaneous internal electric field strength is equal to or less than $1.35 \cdot 10^{-4} f \text{ V/m}_{\text{rms}}$ at any part of the body where f is in Hz. The instantaneous RF field strength is equal or less than 170 V/m_{rms} and equal or less than 180 A/m_{rms}. ☐ at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4,49/f^{0.5} \text{ W}$ (adjusted for tune-up tolerance, where f is in MHz). ☐ at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance). ☐ at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \cdot 10^{-2} f^{0.6834} \text{ W}$ (adjusted for tune-up tolerance), where f is in MHz. ☐ at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance). In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.				
Carrier frequency: f = Transmitter output power: TP = Limit: TP_{limit} =				☐
☐ RF exposure evaluation is documented in test report no.				

Test Result:

Test passed

¹⁰ Transmitters operating between 3 kHz and 10 MHz, meeting the exemption from routine RF Exposure evaluation, shall demonstrate compliance to the instantaneous limits in IC RSS-102, issue 5, section 4.

9 Referenced Regulations

All tests were performed with reference to the following regulations and standards:

☒	CFR 47 Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)	October 1, 2017
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2017
☐	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	June 13, 2014 (published on June 20, 2014)
☒	ANSI C63.10	American national Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	June 27, 2013 (published on September 13, 2013)
☒	RSS-Gen	Radio Standards Specification RSS-Gen Issue 4 containing General Requirements for Compliance of Radio Apparatus, published by Industry Canada	November 2014
☒	RSS-210	Radio Standards Specification RSS-210 Issue 9 for Licence-Exempt Radio Apparatus: Category I Equipment, published by Industry Canada	August 2016
☐	RSS-310	Radio Standards Specification RSS-310 Issue 3 for Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category II Equipment, published by Industry Canada	December 2010
☒	RSS-102	Radio Standards Specification RSS-102 Issue 5: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada	March 2015
☐	ICES-003	Interference-Causing Equipment Standard ICES-003 Issue 6: Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement, published by Industry Canada	January 2016
☒	CISPR 22	Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, "Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement"	1997
☐	CAN/CSA CISPR 22-10	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement (Adopted IEC CISPR 22:2008, sixth edition, 2008-09)	2010



TRC-43

Designation of Emissions, Class of Station and Nature of Service, published by Industry Canada

November 2012

10 Test Equipment List with Calibration Data

Type	Inv.-No.	Type Designation	Serial Number	Manufacturer	Calibration Organization	Last Calibration	Next Calibration
EMI test receiver	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	12-2017	12-2018
EMI test receiver	28268	ESW26	101315	Rohde & Schwarz	Rohde & Schwarz	06-2017	06-2018
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	08-2017	08-2018
Spectrum analyser	2364	FSV40	101448	Rohde & Schwarz	Rohde & Schwarz	01-2018	01-2019
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	10-2016	10-2019
Double ridged horn antenna	2073	HF907	100154	Rohde & Schwarz	Rohde & Schwarz	06-2017	06-2019
Horn antenna	1014	3160-07	9112-1008	EMCO Elektronik	See note 3		
Horn antenna	1015	3160-08	9112-1002	EMCO Elektronik	See note 3		
Horn antenna	1265	3160-09	9403-1025 (931941-010)	EMCO Elektronik	See note 3		
Horn antenna	1575	3160-10	399185	EMCO Elektronik	See note 3		
Horn antenna	2086	24240-20	157845	Flann	See note 3		
Horn antenna	27898	25240-20	249763	Flann	See note 3		
Horn antenna	27899	27240-20	244048	Flann	See note 3		
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	07-2016	07-2018
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	07-2016	07-2019
Waveguide mixer	25849	FS-Z60	100177	Rohde & Schwarz	Rohde & Schwarz	04-2017	04-2020
Waveguide mixer	25850	FS-Z90	101610	Rohde & Schwarz	Rohde & Schwarz	12-2016	12-2019
Waveguide mixer	25851	FS-Z110	101464	Rohde & Schwarz	Rohde & Schwarz	11-2016	11-2019
Waveguide mixer	22553	FS-Z170	100953	Rohde & Schwarz	Rohde & Schwarz	08-2016	08-2019
Waveguide mixer	25854	FS-Z220	100965	Rohde & Schwarz	Rohde & Schwarz	03-2018	03-2021

Note 1: No calibration required.

Note 2: Not calibrated separately but with the whole test system when recording calibration data.

Note 3: No calibration required. Devices are checked before use.



Note 4: No calibration required. Devices are checked by calibrated equipment during test.

11 Measurement Uncertainty

Radio Testing			
Test	k_p	Expanded Uncertainty	Note
Occupied Bandwidth	2.0	$\pm 1.14 \%$	2
RF-Frequency error	1.96	$\pm 1 \cdot 10^{-7}$	7
RF-Power, conducted carrier	2	$\pm 0.079 \text{ dB}$	2
RF-Power uncertainty for given BER	1.96	$+0.94 \text{ dB}$ $/ -1.05$	7
RF power, conducted, spurious emissions	1.96	$+1.4 \text{ dB}$ $/ -1.6 \text{ dB}$	7
RF power, radiated			
25 MHz – 4 GHz	1.96	$+3.6 \text{ dB} / -5.2 \text{ dB}$	8
1 GHz – 18 GHz	1.96	$+3.8 \text{ dB} / -5.6 \text{ dB}$	8
18 GHz – 26.5 GHz	1.96	$+3.4 \text{ dB} / -4.5 \text{ dB}$	8
40 GHz – 170 GHz	1.96	$+4.2 \text{ dB} / -7.1 \text{ dB}$	8
Spectral Power Density, conducted	2.0	$\pm 0.53 \text{ dB}$	2
Maximum frequency deviation			
300 Hz – 6 kHz	2	$\pm 2.89 \%$	2
6 kHz – 25 kHz	2	$\pm 0.2 \text{ dB}$	2
Maximum frequency deviation for FM	2	$\pm 2.89 \%$	2
Adjacent channel power 25 MHz – 1 GHz	2	$\pm 2.31 \%$	2
Temperature	2	$\pm 0.39 \text{ K}$	4
(Relative) Humidity	2	$\pm 2.28 \%$	2
DC- and low frequency AC voltage			
DC voltage	2	$\pm 0.01 \%$	2
AC voltage up to 1 kHz	2	$\pm 1.2 \%$	2
Time	2	$\pm 0.6 \%$	2

Radio Interference Emission Testing			
Test	k_p	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50 Ω /50 μ H AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50 Ω /50 μ H AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50 Ω /5 μ H AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50 Ω /50 μ H AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50 Ω /50 μ H AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1

Radio Interference Emission Testing (continued)			
Test	k_p	Expanded Uncertainty	Note
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1
Harmonic Current Emissions			4
Voltage Changes, Voltage Fluctuations and Flicker			4

Immunity Testing			
Test	k_p	Expanded Uncertainty	Note
Electrostatic Discharges			4
Radiated RF-Field			
Pre-calibrated field level	2	+32.2 / -24.3 %	5
Dynamic feedback field level	2.05	+21.2 / -17.5 %	3
Electrical Fast Transients (EFT) / Bursts			4
Surges			4
Conducted Disturbances, induced by RF-Fields			
via CDN	2	+15.1 / -13.1 %	6
via EM clamp	2	+42.6 / -29.9 %	6
via current clamp	2	+43.9 / -30.5 %	6
Power Frequency Magnetic Field	2	+20.7 / -17.1 %	2
Pulse Magnetic Field			4
Voltage Dips, Short Interruptions and Voltage Variations			4
Oscillatory Waves			4
Conducted Low Frequency Disturbances			
Voltage setting	2	± 0.9 %	2
Frequency setting	2	± 0.1 %	2
Electrical Transient Transmission in Road Vehicles			4

Note 1:

The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of $k_p = 2$, providing a level of confidence of $p = 95.45\%$

Note 2:

The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of $k_p = 2$, providing a level of confidence of $p = 95.45\%$

Note 3:

The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of $k_p = 2.05$, providing a level of confidence of $p = 95.45\%$

Note 4:

It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95% confidence.

Note 5:

The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of $k_p = 2$, providing a level of confidence of $p = 95.45\%$

Note 6:

The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of $k_p = 2$, providing a level of confidence of $p = 95.45\%$

Note 7:

The expanded uncertainty reported according to ETSI TR 100 028 V1.4.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of $k_p = 1.96$, providing a level of confidence of $p = 95.45\%$

Note 8:

The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of $k_p = 1.96$, providing a level of confidence of $p = 95.45\%$

12 Revision History

Revision History			
<i>Edition</i>	<i>Date</i>	<i>Issued by</i>	<i>Modifications</i>
1	2018-05-29	M. Steindl	First Edition
2	2018-07-09	M. Steindl	Updated type-designations. Altered RF-Exposure evaluation to 5 mm