TEST REPORT

Total Radiated Power (TRP) Test

Measured in Antenna Full-anechoic Room (A-FAR)

Report Reference No. ..... :	EMC-22-FAR-6027-010V2
Date of issue:..... :	28 March 2023
Total number pages: ..... :	17
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Copy to (externally) ..... :	

General disclaimer:

The test results presented in this report only relate to the object tested.

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Testing location:

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Testing location/ address ..... :	Signify Netherlands B.V., EMC & wireless connectivity lab High Tech Campus 26, 5656 AE Eindhoven, The Netherlands
Date of receipt of test item ..... :	28-Jun-2022
Date(s) of performance of tests... :	30-Jun-2022

General remarks:

A cross ☒ in a rectangular shape means that this option is applied.

Table of Contents:

Description of DUT

Model / Type reference ..... :	SNS212 Esr4 module for verification of the total radiated power and total isotropic sensitivity in Zigbee channels 11, 18 and 25. Also pre-compliance conducted spurious emissions in Zigbee channel 18.
Supplementary information ..... :	---

Summary of test configuration

Test configuration

Testing is performed in a fully-anechoic (antenna) room. TRP is calculated based on 3D radiation pattern measurement on a grid with 15° increments in both azimuth and elevation angles. Measured EIRP data are processed towards TRP in line with the procedure outlines in [1].

DUT specific configurations

Test distance.....:	☐	3 m
	☒	4.56 m
	☐	Other:
Supplementary information.....:	The test distance should be larger than 2.5×maximum luminaire dimension as described.	
Transmitted power .....:	+4 dBm	
Communication type .....:	☐	GPRS 2G
	☐	Other:
Communication channels .....:	☒	Zigbee Channels 11, 18, 25 (2.405, 2.44, 2.475 GHz)
	☐	Wi-Fi
	☐	Other:
Operating modes .....:	No.	Operating mode of test item
	1	SNS212 Esr4: TRP measurements with module in constant transmit, carrier only mode at fixed power level of +4 dBm in Zigbee channel 11. The bare sensor was measured without any luminaire.
	2	SNS212 Esr4: Spot TIS measurement in Zigbee channel 11. The bare sensor was measured without any luminaire.
	3	SNS212 Esr4: TRP measurement with module in constant transmit, carrier only mode at fixed power level of +4 dBm in Zigbee channel 18. The bare sensor was measured without any luminaire.
	4	SNS212 Esr4: Spot TIS measurement in Zigbee channel 18. The bare sensor was measured without any luminaire.
	5	SNS212 Esr4: TRP measurement with module in constant transmit, carrier only mode at fixed power level of +4 dBm in Zigbee channel 25. The bare sensor was measured without any luminaire.
	6	SNS212 Esr4: Spot TIS measurement in Zigbee channel 25. The bare sensor was measured without any luminaire.

	7	Conducted spurious emissions on modified SNS212 Esr4 module in Zigbee channel 18.
Supplementary information.....:		

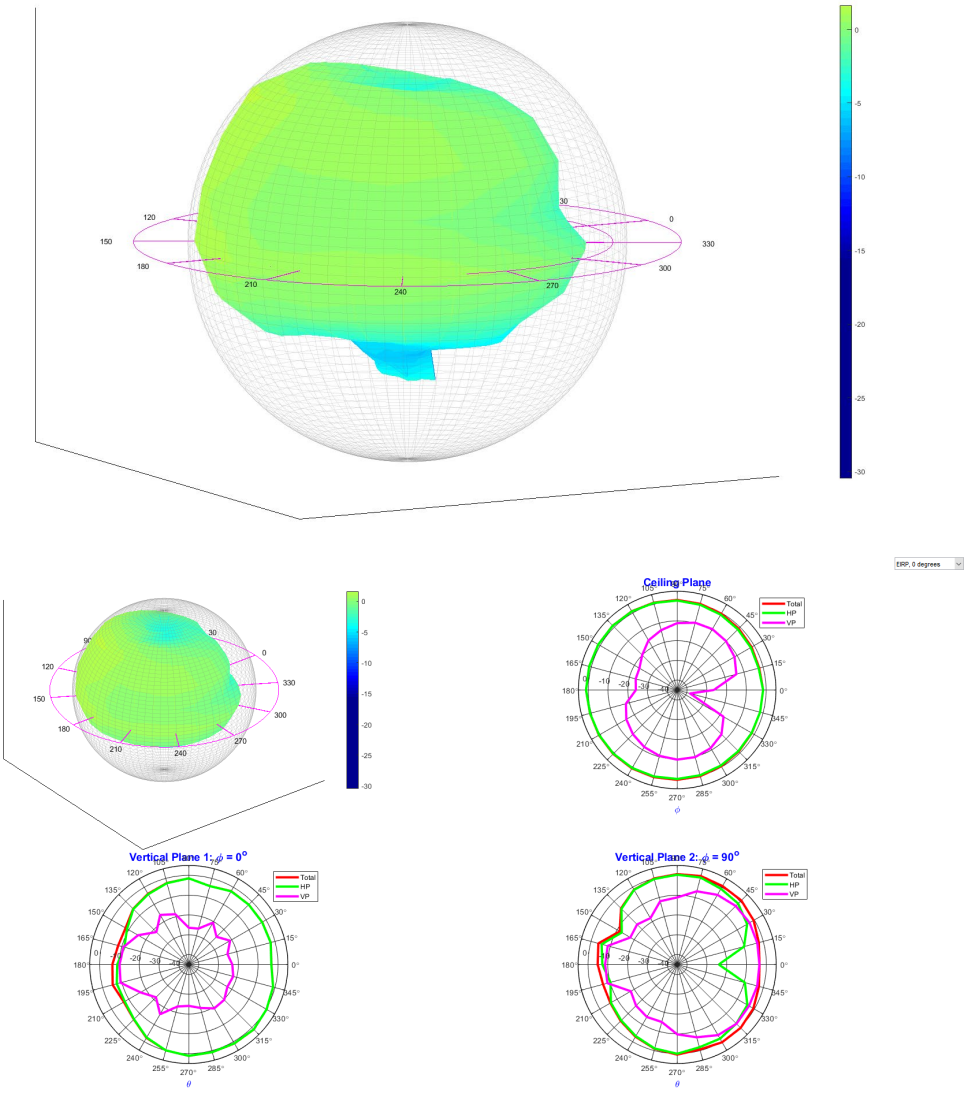
Results

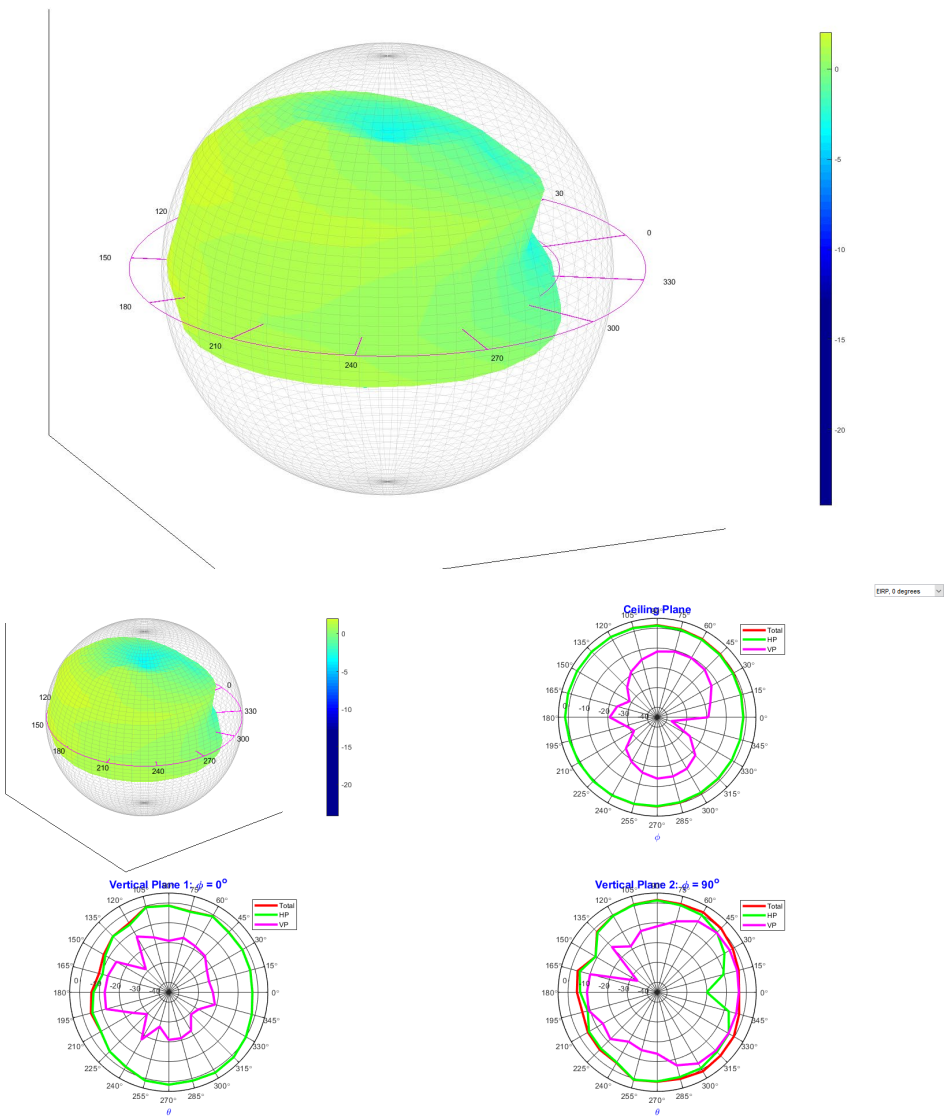
TRP & TIS from A-FAR measurement system

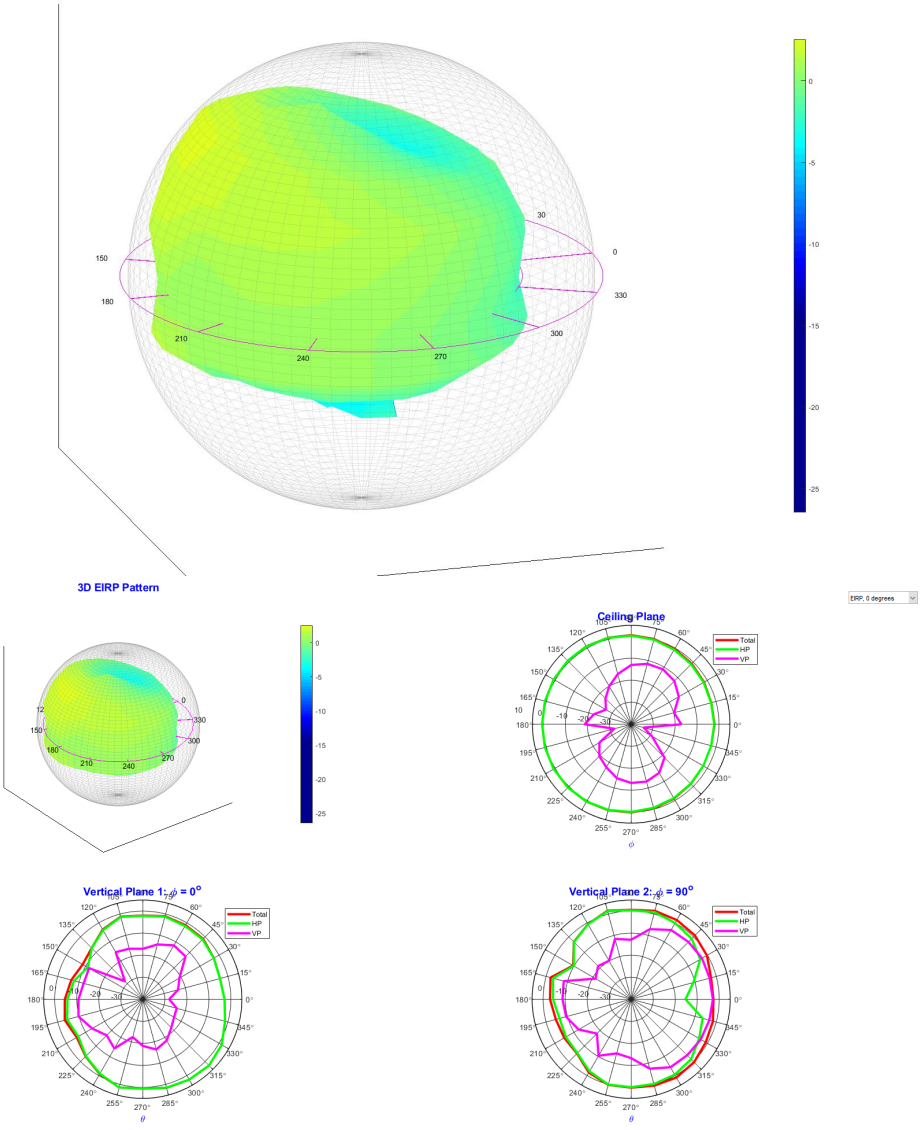
Measurement # / Configuration	Channel	Frequency (MHz)	TRP/TIS (dBm)	$EIRP_{max}$ (dBm)	Realized Gain (dBi)
1 SNS212 TRP	11	2405	-1.1	1.6	-2.4
2 SNS212 TIS	11	2405	-108.1		
3 SNS212 TRP	18	2440	-0.6	2.0	-2.0
4 SNS212 TIS	18	2440	-105.6		
5 SNS212 TRP	25	2475	-0.5 dBm	2.5	-1.5
6 SNS212 TIS	25	2475	-103.2 dBm		
7 SNS212 Fundamental and Spurious Emissions	18	2440	2.44 GHz 4.88 GHz 7.32 GHz 7.76 GHz 12.20 GHz 14.64 GHz	+5.33 dBm -60.60 dBm -57.35 dBm -78.79 dBm -79.67 dBm -87.59 dBm	

Realized Gain = maximum total EIRP – input power (+4 dBm)

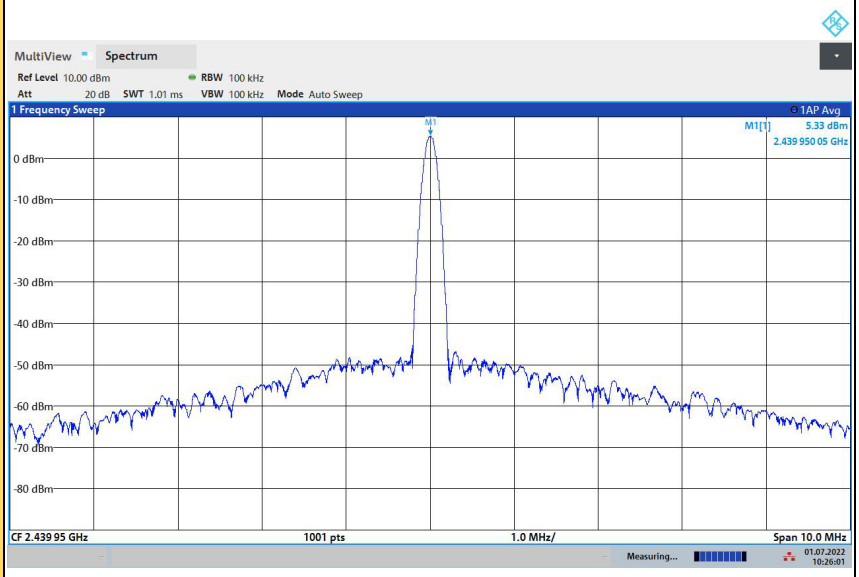
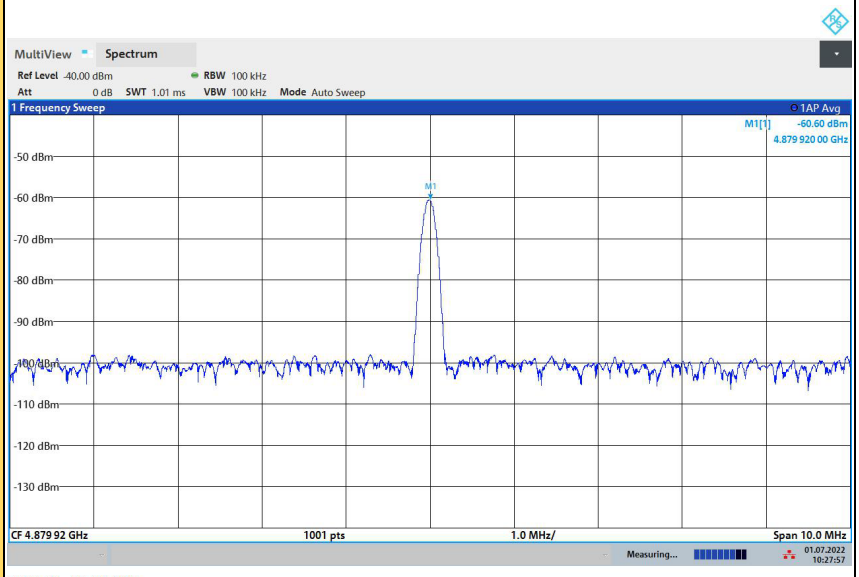
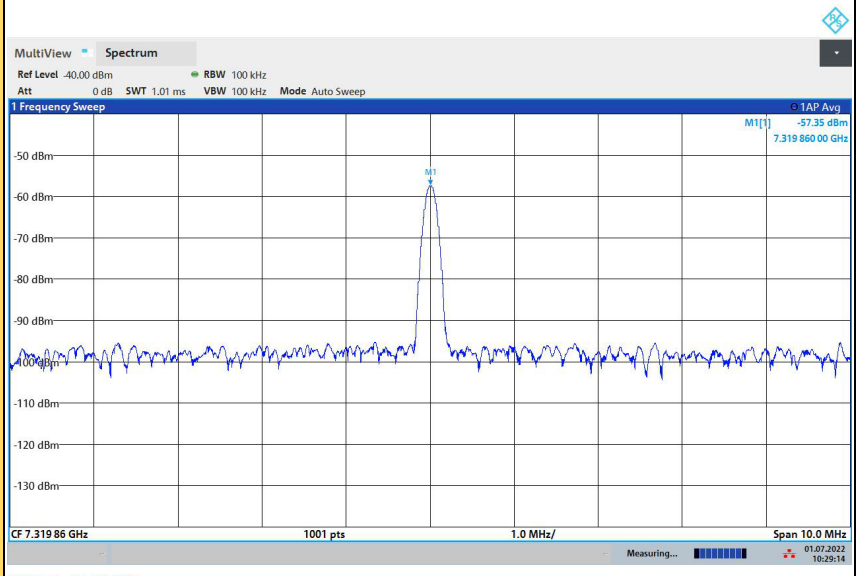
Antenna pattern results

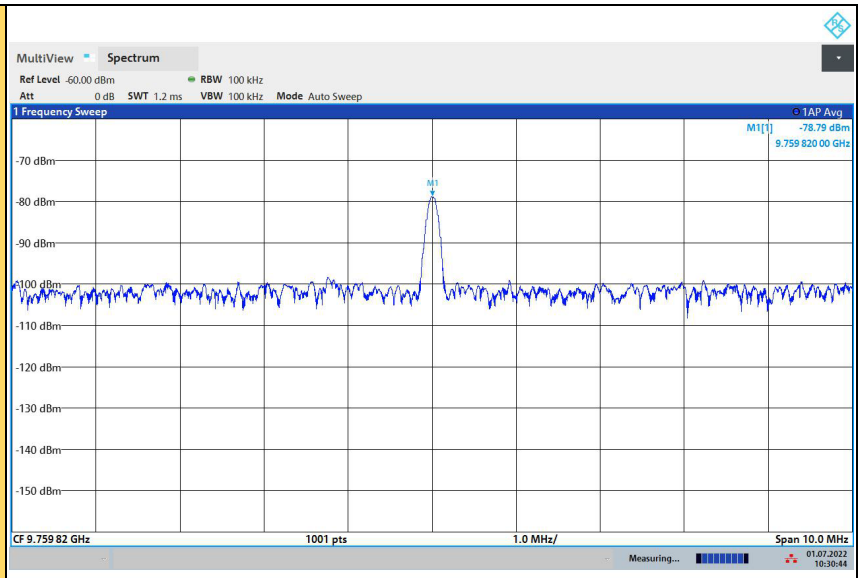
EIRP Measurement 1:	SNS212 EIRP
Channel 11, P_{TX} = +4 dBm	

EIRP Measurement 3:	SNS212 EIRP
Channel 18, P_{TX} = +4 dBm	

EIRP Measurement 5:	SNS212 EIRP
Channel 25, P_{TX} = +4 dBm	

Spurious emissions results

Emissions Measurement 7:	SNS212 Fundamental and Spurious
Channel 25, P_{TX} = +4 dBm	  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Spectrum
Ref Level -60.00 dBm
RBW 100 kHz
Att 0 dB SWT 1.2 ms VBW 100 kHz Mode Auto Sweep
1 Frequency Sweep
1AP Avg
M1[1] -78.79 dBm
9.759 820 00 GHz
-70 dBm
-80 dBm
-90 dBm
-100 dBm
-110 dBm
-120 dBm
-130 dBm
-140 dBm
-150 dBm
CF 9.759 82 GHz
1001 pts
1.0 MHz/
Span 10.0 MHz
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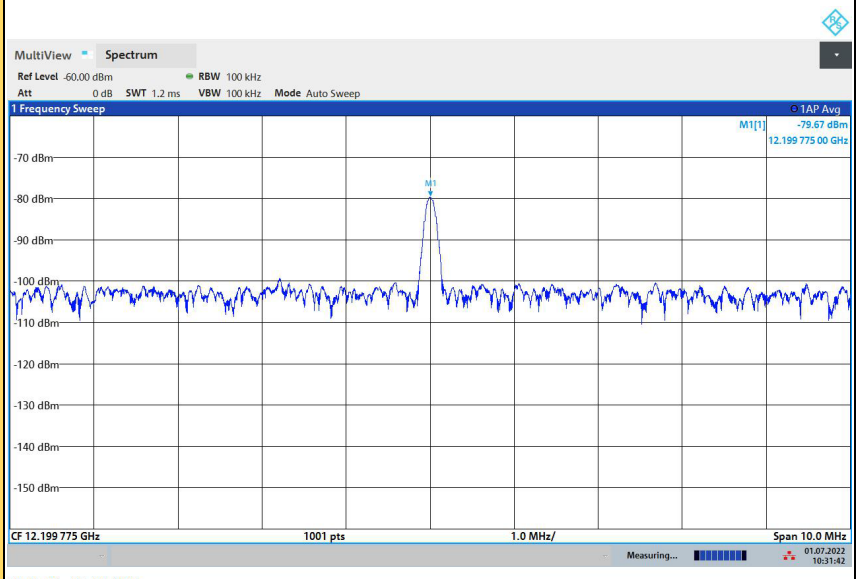
10:30:44
10:30:45 01.07.2022


MultiView
Spectrum
Ref Level -60.00 dBm
RBW 100 kHz
Att 0 dB SWT 1.2 ms VBW 100 kHz Mode Auto Sweep
1 Frequency Sweep
1AP Avg
M1[1] -79.67 dBm
12.199 775 00 GHz
-70 dBm
-80 dBm
-90 dBm
-100 dBm
-110 dBm
-120 dBm
-130 dBm
-140 dBm
-150 dBm
CF 12.199 775 GHz
1001 pts
1.0 MHz/
Span 10.0 MHz
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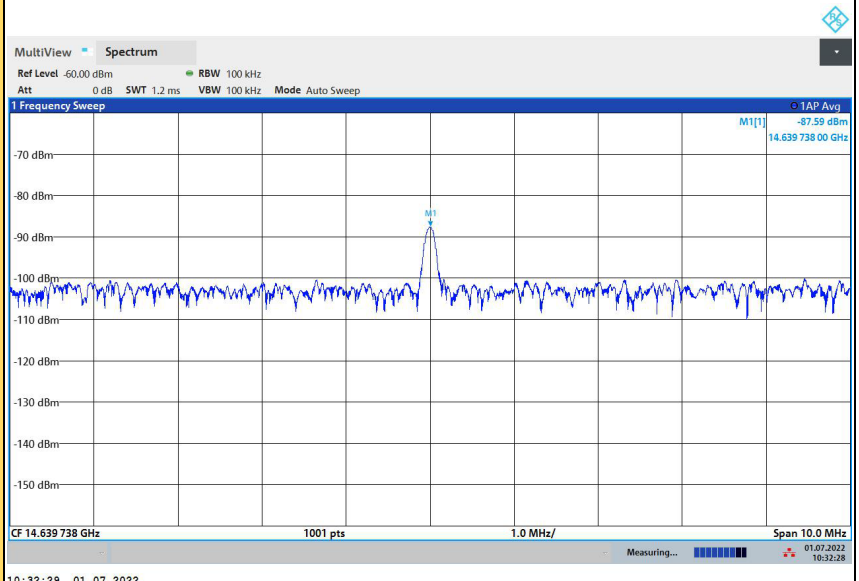
10:31:42 01.07.2022


MultiView
Spectrum
Ref Level -60.00 dBm
RBW 100 kHz
Att 0 dB SWT 1.2 ms VBW 100 kHz Mode Auto Sweep
1 Frequency Sweep
1AP Avg
M1[1] -87.59 dBm
14.639 738 00 GHz
-70 dBm
-80 dBm
-90 dBm
-100 dBm
-110 dBm
-120 dBm
-130 dBm
-140 dBm
-150 dBm
CF 14.639 738 GHz
1001 pts
1.0 MHz/
Span 10.0 MHz
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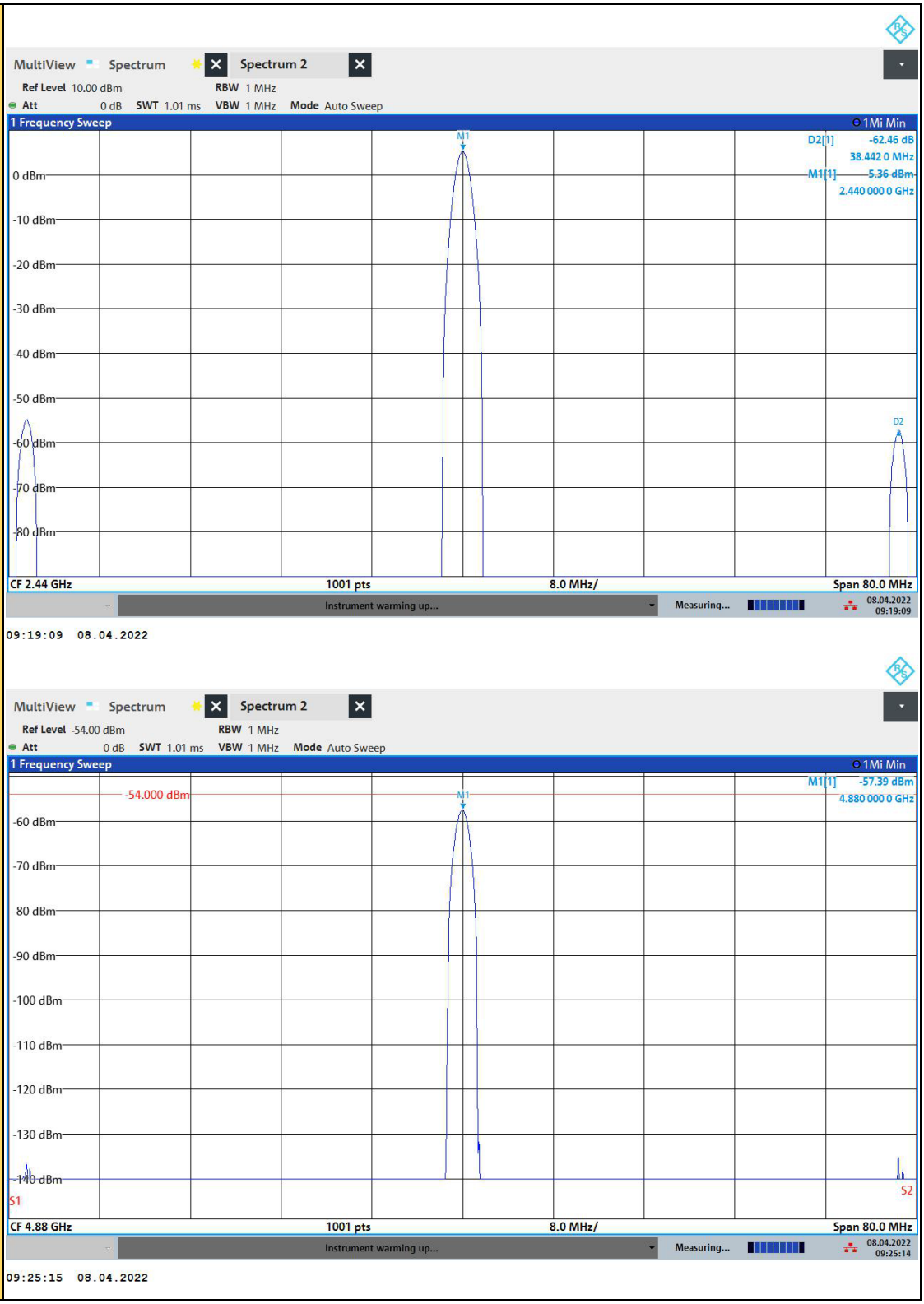
10:32:28
10:32:29 01.07.2022

Channel 18	

MultiView
Spectrum
Spectrum 2
Ref Level 10.00 dBm
RBW 1 MHz
Att 0 dB
SWT 1.01 ms
VBW 1 MHz
Mode Auto Sweep
1 Frequency Sweep
1Mi Min
D2[1] -62.46 dB
38.442 0 MHz
M1[1] -5.36 dBm
2.440 000 0 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D2
CF 2.44 GHz
1001 pts
8.0 MHz/
Span 80.0 MHz
Instrument warming up...
Measuring...
08.04.2022
09:19:09
09:19:09 08.04.2022
MultiView
Spectrum
Spectrum 2
Ref Level -54.00 dBm
RBW 1 MHz
Att 0 dB
SWT 1.01 ms
VBW 1 MHz
Mode Auto Sweep
1 Frequency Sweep
1Mi Min
M1[1] -57.39 dBm
4.880 000 0 GHz
-54.000 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
-100 dBm
-110 dBm
-120 dBm
-130 dBm
-140 dBm
M1
S1
S2
CF 4.88 GHz
1001 pts
8.0 MHz/
Span 80.0 MHz
Instrument warming up...
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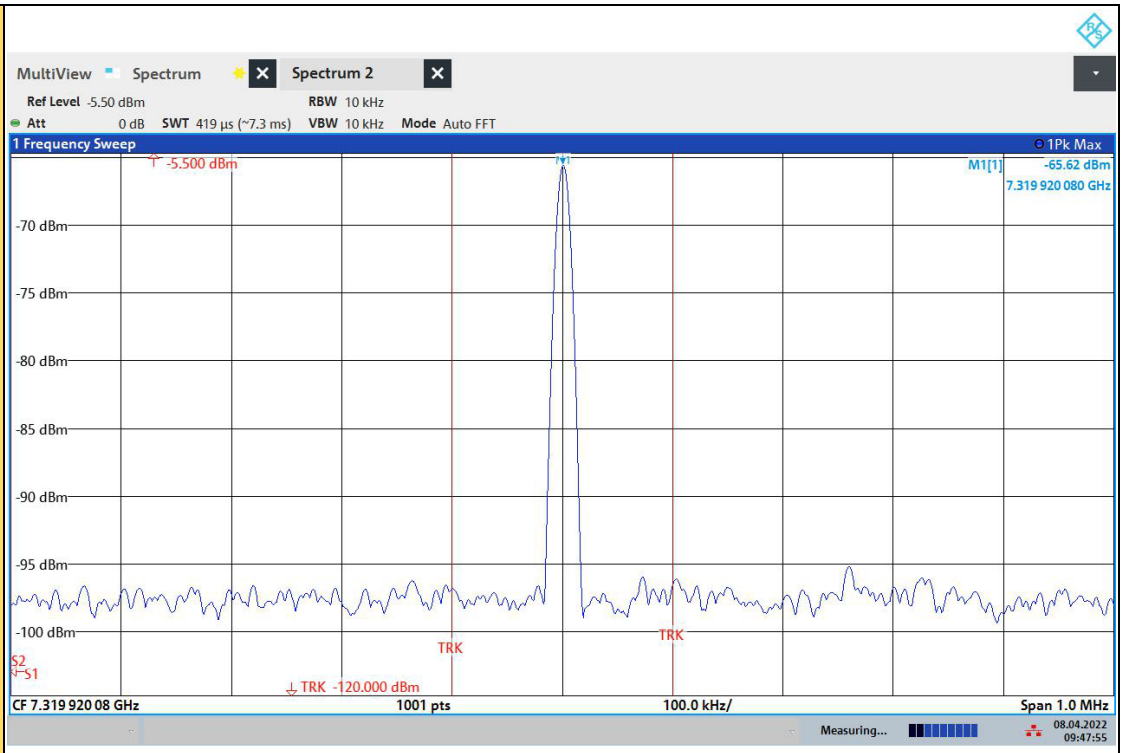
09:25:14
09:25:15 08.04.2022


MultiView
Spectrum
Spectrum 2
Ref Level -5.50 dBm
RBW 10 kHz
Att 0 dB SWT 419 µs (~7.3 ms) VBW 10 kHz Mode Auto FFT
1 Frequency Sweep
1Pk Max
-5.500 dBm
M1[1] -65.62 dBm
7.319 920 080 GHz
-70 dBm
-75 dBm
-80 dBm
-85 dBm
-90 dBm
-95 dBm
-100 dBm
TRK
TRK
S2
S1
TRK -120.000 dBm
CF 7.319 920 08 GHz
1001 pts
100.0 kHz/
Span 1.0 MHz
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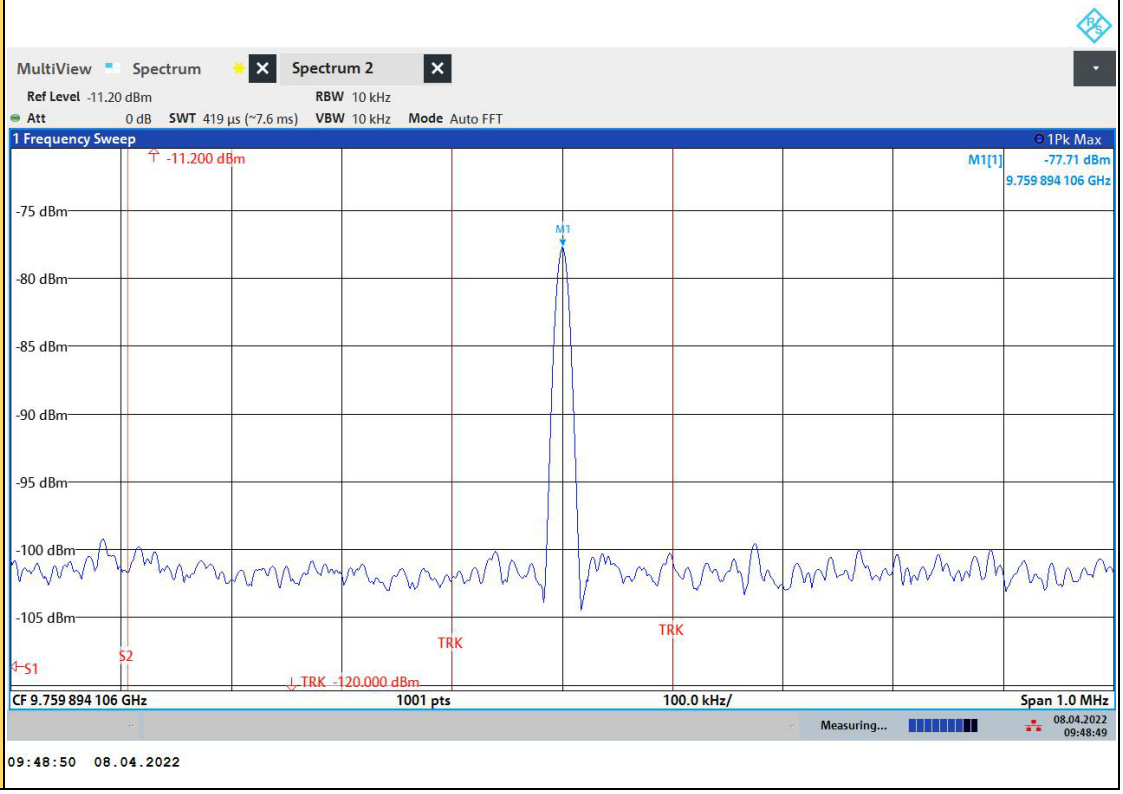
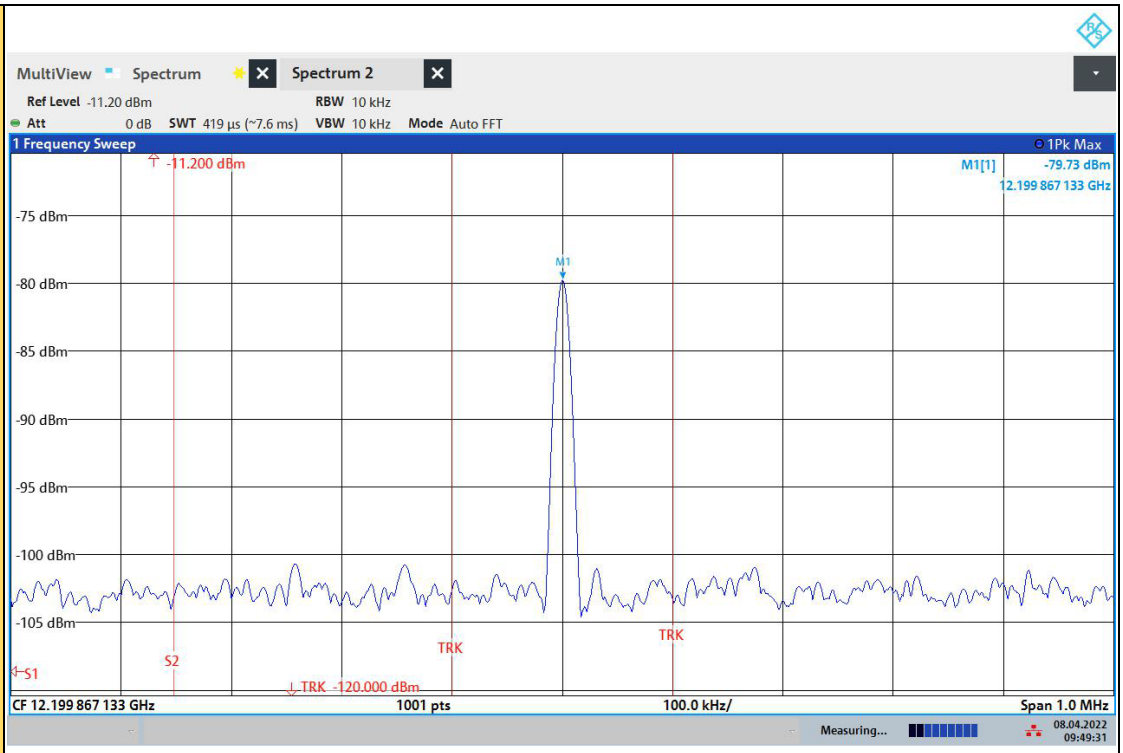
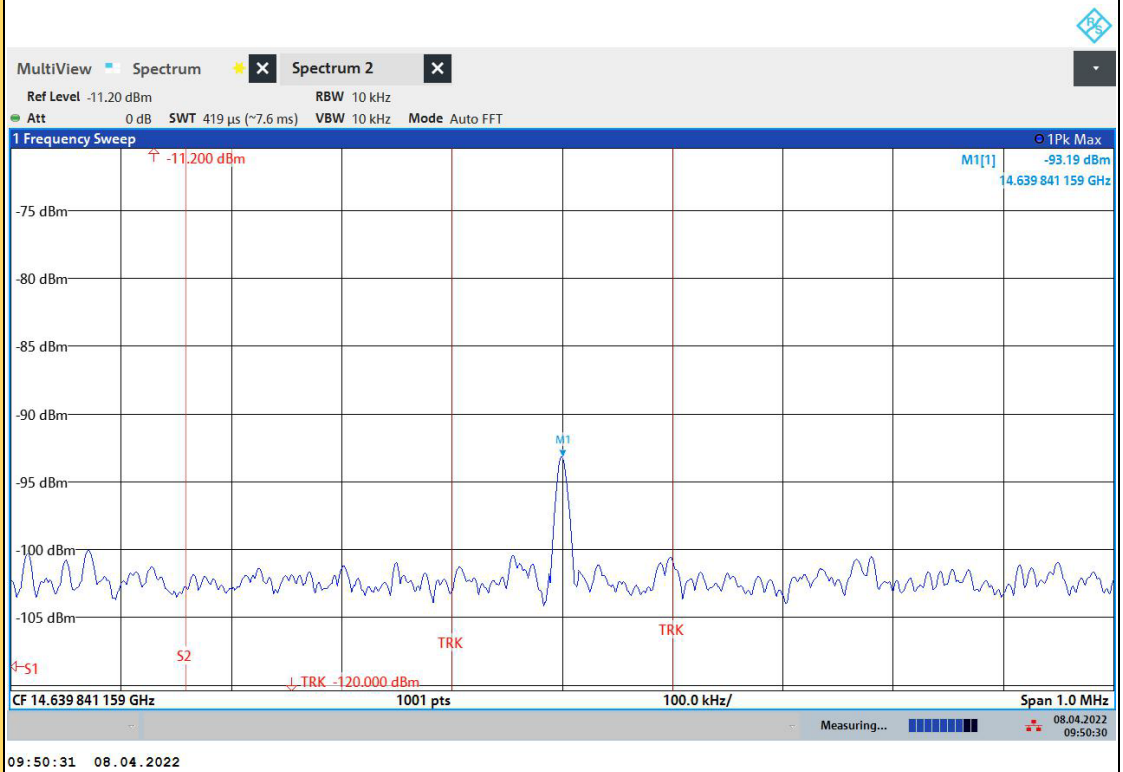
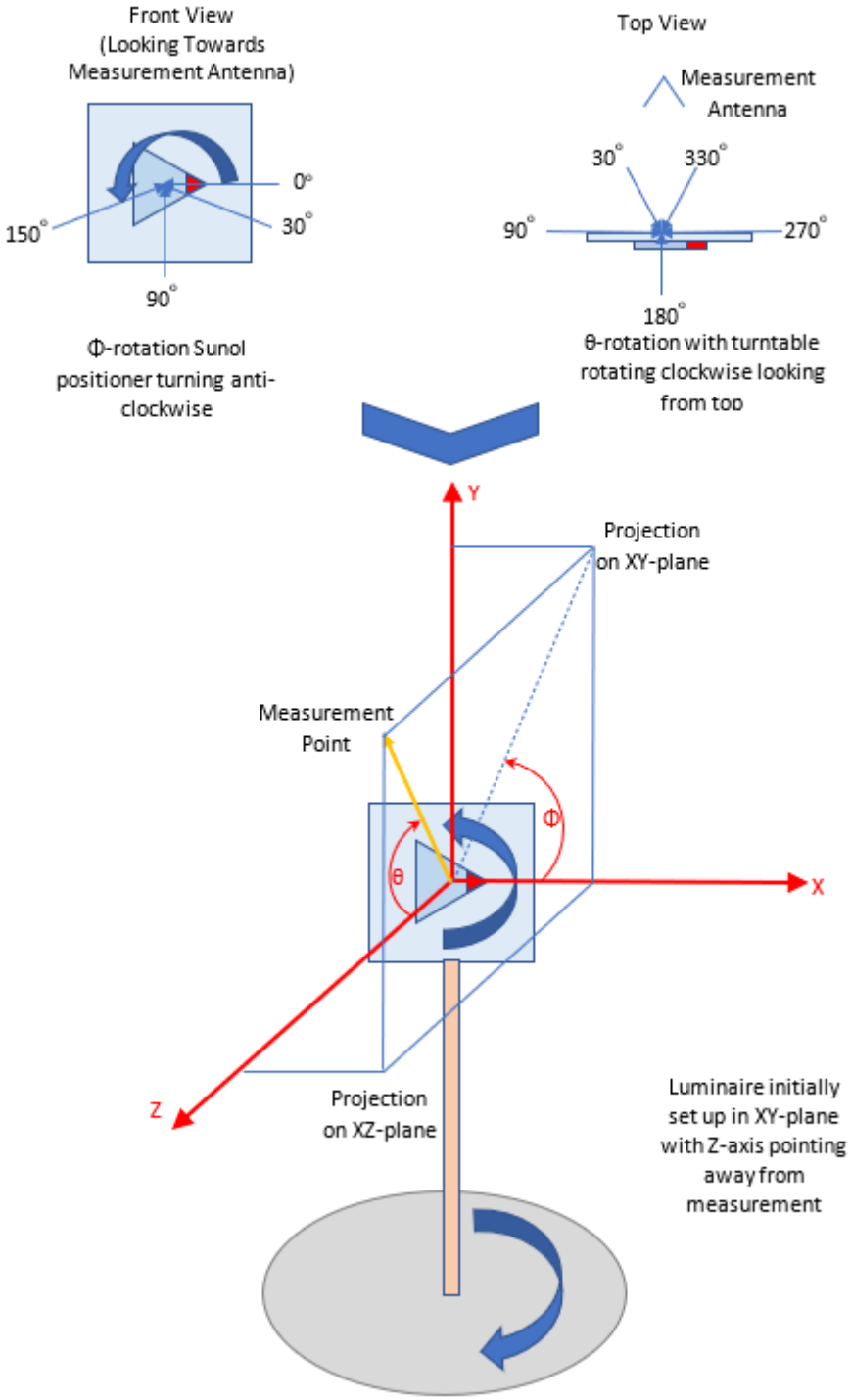
09:47:55
09:47:56 08.04.2022


MultiView
Spectrum
Spectrum 2
Ref Level -11.20 dBm
RBW 10 kHz
Att 0 dB SWT 419 µs (~7.6 ms) VBW 10 kHz Mode Auto FFT
1 Frequency Sweep
1Pk Max
-11.200 dBm
M1[1] -77.71 dBm
9.759 894 106 GHz
M1
-75 dBm
-80 dBm
-85 dBm
-90 dBm
-95 dBm
-100 dBm
-105 dBm
TRK
TRK
S2
S1
TRK -120.000 dBm
CF 9.759 894 106 GHz
1001 pts
100.0 kHz/
Span 1.0 MHz
Measuring...
08.04.2022
09:48:49
09:48:50 08.04.2022


MultiView
Spectrum
Spectrum 2
Ref Level -11.20 dBm
RBW 10 kHz
Att 0 dB
SWT 419 µs (~7.6 ms)
VBW 10 kHz
Mode Auto FFT
1 Frequency Sweep
1Pk Max
-11.200 dBm
M1[1]
-79.73 dBm
12.199 867 133 GHz
-75 dBm
-80 dBm
-85 dBm
-90 dBm
-95 dBm
-100 dBm
-105 dBm
M1
TRK
TRK
S2
S1
TRK -120.000 dBm
CF 12.199 867 133 GHz
1001 pts
100.0 kHz/
Span 1.0 MHz
Measuring...
08.04.2022
09:49:31
09:49:31 08.04.2022


MultiView
Spectrum
Spectrum 2
Ref Level -11.20 dBm
RBW 10 kHz
Att 0 dB
SWT 419 µs (~7.6 ms)
VBW 10 kHz
Mode Auto FFT
1 Frequency Sweep
1Pk Max
-11.200 dBm
M1[1]
-93.19 dBm
14.639 841 159 GHz
-75 dBm
-80 dBm
-85 dBm
-90 dBm
-95 dBm
-100 dBm
-105 dBm
M1
TRK
TRK
S2
S1
TRK -120.000 dBm
CF 14.639 841 159 GHz
1001 pts
100.0 kHz/
Span 1.0 MHz
Measuring...
08.04.2022
09:50:30
09:50:31 08.04.2022

Reference System

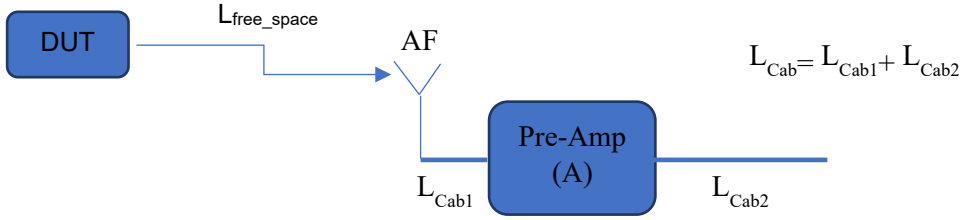


Equipment list

No.	Type	Instrument	Manufacturer	Calibration date
9400-0063	FSP	Spectrum Analyzer	Rohde & Schwarz	No calibration required
9400-3034	LNA-40-00101800-25-10P	Amplifier	Miteq	No calibration required
9400-3031	BBHX 9120E	Horn antenna	Schwarzbeck	No calibration required
6400-3063	FSV3044	Signal & Spectrum Analyzer	Rohde & Schwarz	22 August 2023
9400 0373	RFDS-F/A-100	Anechoic chamber	ETS Lindgren	No calibration required
Test software		Matlab Ver 9.5.0.1586782 (R2018b) Instrument Control Toolbox Ver.3.14 (R2018b)		

Appendix 1: TRP Measurement Procedure

First measure the effective isotropic radiated power (EIRP):



$$EIRP_{dBm} = P_{meas,dBm} + L_{free-space,dB} - G_{dB} - (A_{dB} - L_{Cab,dB})$$

with

- $P_{meas,dBm}$ are the measurement power values.
- G_{dB} is the antenna gain obtained for the appropriate polarization using.
- $A_{dB} - L_{Cab,dB}$ is the fixed loss/gain factor of all cables, preamplifier, and switches connected between the antenna connector and the connector of the spectrum analyser.
- $L_{free-space,dB}$ is the free-space path loss at the measurement distance d_{meas}

$$L_{free-space,dB} = 20 \cdot log10\left(\frac{4\pi d_{meas}}{\lambda}\right)$$

The TRP is then calculated from the EIRP measured for the two polarizations as follows:

References

[1]	Test Plan for Wireless Device Over-the-Air Performance: Method of Measurement for Radiated RF Power and Receiver Performance. Revision 3.3.2, September 2014, http://www.ctia.org/certification.