9.3 Emissions in restricted frequency bands and in unrestricted frequency bands

Tested by .....:	G. Gandini	
Test date .....:	07.11.2023	
Test location (stand) .....:	Semi-anechoic chamber (CMC A070)	
Reference standards.....:	FCC Rules and Regulation; Titles 47 Part. 15.209 ANSI C63.10 cl. 6.3, 6.4, 6.5 and 6.6	
Test set-up description.....:	☒	Table top equipment set-up (80 cm above the reference ground plane)
	☐	Floor standing equipment set-up (insulating material up to 12 mm thick)
	☐	False floor installation equipment set-up (insulating material up to 34 cm above the reference ground plane)
Supplementary test set-up description.....:	--	
Test method applied .....:	OATS or SAC with measurement distance [m]: 10 m for frequencies below 1 GHz 3 m for frequencies above 1 GHz	
Supplementary information.....:	--	

Acceptance limits

Acceptance limits for emissions in restricted frequency bands (f < 1000 MHz)		
Frequency range (MHz)	*Test distance (m)*	*Limits [dB(µV/m)]*
0,009 to 0,490	300	20log(2400/F(kHz))
0,490 to 1,705	30	20log(24000/F(kHz))
1,705 to 30	30	20log(30)
30 to 88	3	20log(100)**
88 to 216	3	20log(150)**
216 to 960	3	20log(200)**
Above 960	3	20log(500)

**: except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54 – 72 MHz, 76 – 88 MHz, 174 – 216 MHz or 470 – 806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.
Perimeter protection systems may operate in the 54 – 72 MHz and 76 – 88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.
Remarks: the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9 – 90 kHz and 110 – 490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector. The results have been extrapolated to the specified distance using an extrapolation factor

Acceptance limits for emissions in restricted frequency bands (f ≥ 1000 MHz)			
Frequency (MHz)	*Test distance (m)*	*AV limits [dB(µV/m)]*	*Peak limits [dB(µV/m)]*
> 1000	3	54	74

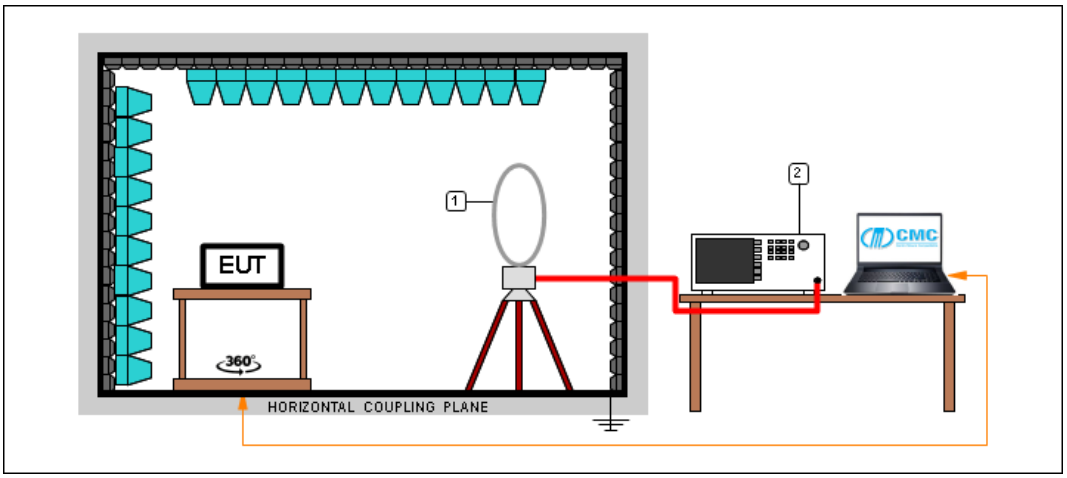
The restricted frequency bands are listed in the following table

MHz	*MHz*	*MHz*	*GHz*
0,090 – 0,110	16,42 – 16,423	399,9 – 410	4,5 – 5,15
0,495 – 0,505	16,69475 – 16,69525	608 – 614	5,35 – 5,46
2,1735 – 2,1905	16,80425 – 16,80475	960 – 1240	7,25 – 7,75
4,125 – 4,128	25,5 – 25,67	1300 – 1427	8,025 – 8,5
4,17725 – 4,17775	37,5 – 38,25	1435 – 1626,5	9,0 – 9,2
4,20725 – 4,20775	73 – 74,6	1645,5 – 1646,5	9,3 – 9,5
6,215 – 6,218	74,8 – 75,2	1660 – 1710	10,6 – 12,7
6,26775 – 6,26825	108 – 121,94	1718,8 – 1722,2	13,25 – 13,4
6,31175 – 6,31225	123 – 138	2200 – 2300	14,47 – 14,5
8,291 – 8,294	149,9 – 150,05	2310 – 2390	15,35 – 16,2
8,362 – 8,366	156,52475 – 156,52525	2483,5 – 2500	17,7 – 21,4
8,37625 – 8,38675	156,7 – 156,9	2690 – 2900	22,01 – 23,12
8,41425 – 8,41475	162,0125 – 167,17	3260 – 3267	23,6 – 24,0
12,29 – 12,293	167,72 – 173,2	3332 – 3339	31,2 – 31,8
12,51975 – 12,52025	240 – 285	3345,8 – 3358	36,43 – 36,5
12,57675 – 12,57725	322 – 335,4	3600 – 4400	Above 38,6
13,36 – 13,41			

Acceptance limits for emissions in non-restricted frequency bands
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

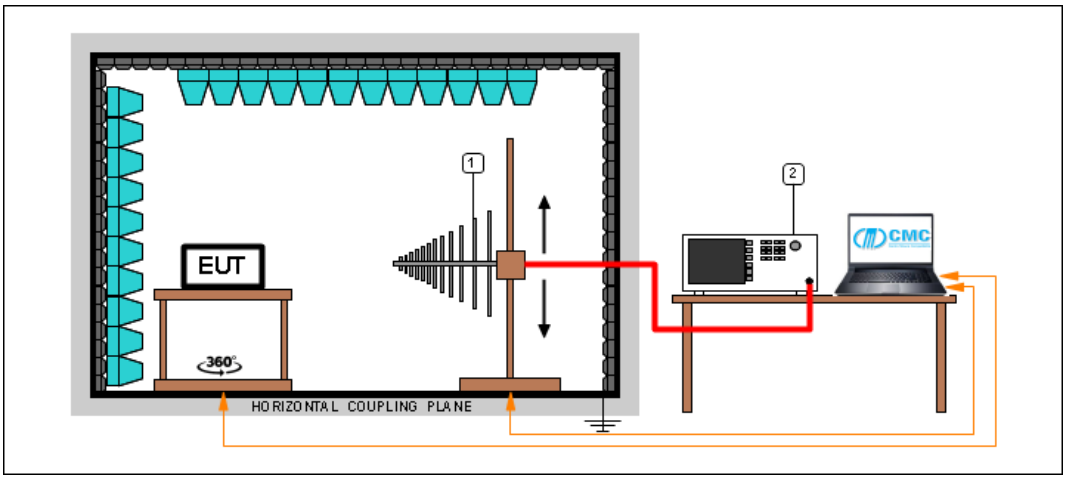
Test setup

Frequency ≤ 30 MHz



Test setup PE004_01							
Nr.	*Id. Number*	*Manufacturer*	*Model*	*Serial number*	*Description*	*Last calibration date*	*Calibration expiration*
2	CMC S353	Rohde & Schwarz	ESW26	101492	Emi Test Receiver	December 2022	December 2023
1	CMC S127	Schaffner	HLA6120	1191	Loop Antenna 9kHz - 30MHz	May 2023	May 2024

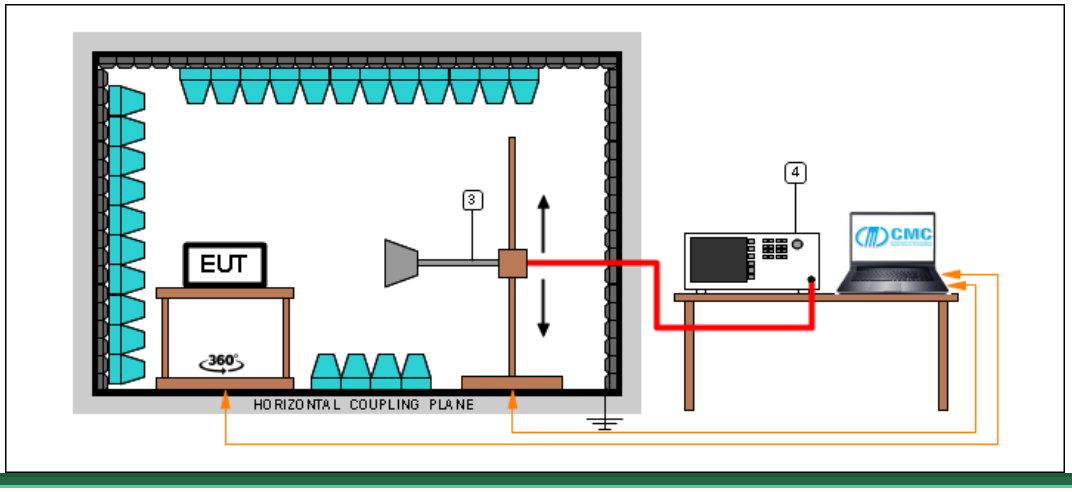
Frequency ≤ 1 GHz



Test setup PE004_02							
Nr.	*Id. Number*	*Manufacturer*	*Model*	*Serial number*	*Description*	*Last calibration date*	*Calibration expiration*
2	CMC S353	Rohde & Schwarz	ESW26	101492	Emi Test Receiver	December 2022	December 2023
1	CMC S271	Schwarzbeck	BBA 9106 + VHBB 9124	831	Broadband Antenna	August 2022	August 2025

Test setup PE004_03							
Nr.	*Id. Number*	*Manufacturer*	*Model*	*Serial number*	*Description*	*Last calibration date*	*Calibration expiration*
2	CMC S353	Rohde & Schwarz	ESW26	101492	Emi Test Receiver	December 2022	December 2023
1	CMC S287	Schwarzbeck	VUSLP 9111B	9111B-203	Broadband Antenna	August 2022	August 2025

Frequency > 1 GHz



Test setup PE004_04							
Nr.	*Id. Number*	*Manufacturer*	*Model*	*Serial number*	*Description*	*Last calibration date*	*Calibration expiration*
4	CMC S353	Rohde & Schwarz	ESW26	101492	Emi Test Receiver	December 2022	December 2023
3	CMC S108	Emco	3115	9811-5622	Waveguide antenna	August 2022	August 2025

Test setup PE004_05							
Nr.	*Id. Number*	*Manufacturer*	*Model*	*Serial number*	*Description*	*Last calibration date*	*Calibration expiration*
4	CMC S353	Rohde & Schwarz	ESW26	101492	Emi Test Receiver	December 2022	December 2023
3	CMC S290	Schwarzbeck	BBHA 9170	733	Horn Antenna	October 2021	October 2026

Result – EUT on expansion board of a receiver unit

Transmission channel (MHz)	*Polarization*	*Frequency Range (MHz)*	*Graphs*	*Result*
Worst case	H	30 – 300	G23154850	P
Worst case	V	30 – 300	G23154851	P
921,425	V	300 – 1000	G23154852	P
921,425	H	300 – 1000	G23154853	P
927,875	H	300 – 1000	G23154854	P
927,875	V	300 – 1000	G23154855	P
915,075	V	300 – 1000	G23154856	P
915,075	H	300 – 1000	G23154857	P
915,075	H	1000 – 10000	G23154858	P
915,075	V	1000 – 10000	G23154859	P
921,425	V	1000 – 10000	G23154860	P
921,425	H	1000 – 10000	G23154861	P
927,875	H	1000 – 10000	G23154862	P
927,875	V	1000 – 10000	G23154863	P
Worst case	Loop	0,009 – 30	G23154864	P

Remarks: EUT was tested in 3 orthogonal planes, graphs are related to the highest detected levels.
Measurements at frequencies lower than 30 MHz have been performed with an EUT – antenna distance of 10 m. Measured values have been corrected with conversion factor 40log(test distance/10) based on the measuring distance provided by the standard.
Measurements at frequencies higher than 30 MHz and lower than 1000 MHz have been performed with an EUT – antenna distance of 10 m. Measured values have been corrected with conversion factor 20log(test distance/10) based on the measuring distance provided by the standard.
Peaks above the limits are caused by the nominal transmitting frequencies

Graphs Legend
PK: Peak; QP [1s] (quasi-peak at 1 second) values are marked with a +
AV: Average; AV [1s] (average at 1 second) values are marked with a X

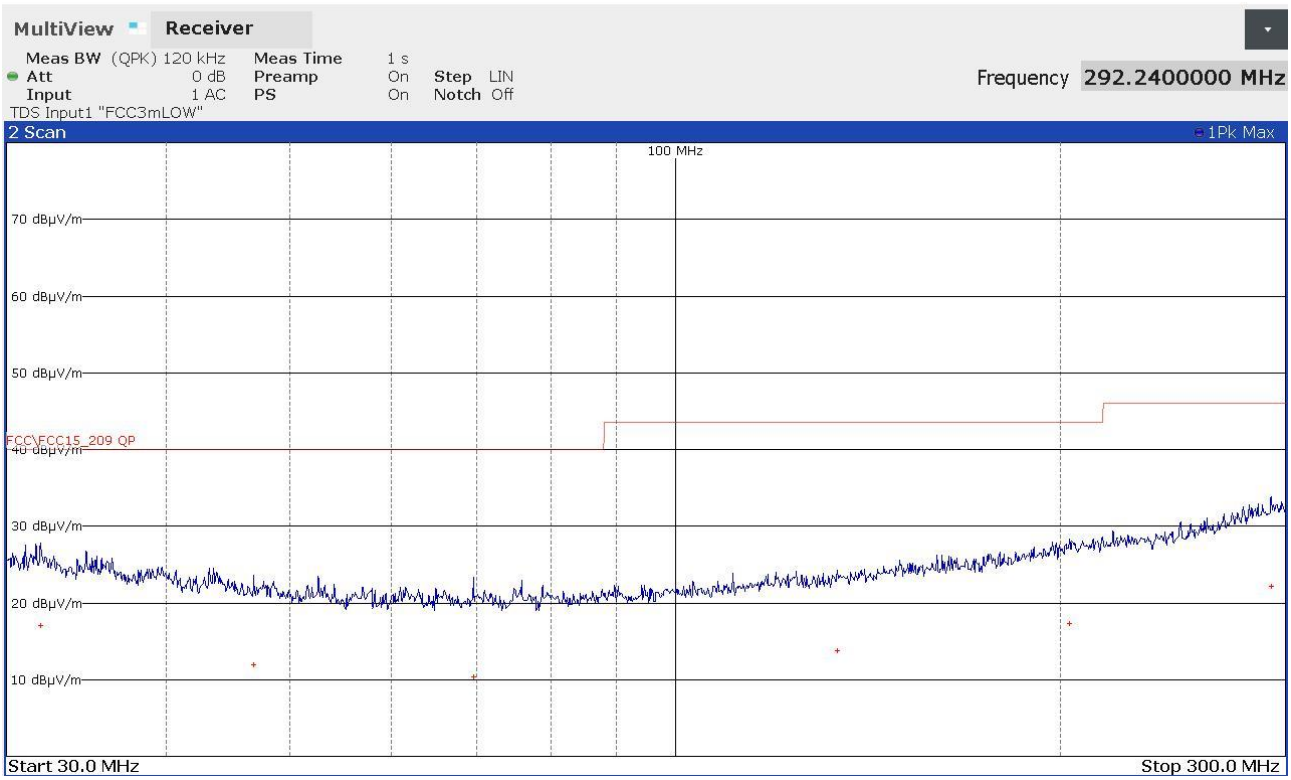
Result – EUT on expansion board of a transmitter unit

Transmission channel (MHz)	*Polarization*	*Frequency Range (MHz)*	*Graphs*	*Result*
Worst case	V	30 – 300	G23154870	P
Worst case	H	30 – 300	G23154871	P
915,075	H	300 – 1000	G23154872	P
915,075	V	300 – 1000	G23154873	P
921,425	V	300 – 1000	G23154874	P
921,425	H	300 – 1000	G23154875	P
927,875	H	300 – 1000	G23154876	P
927,875	V	300 – 1000	G23154877	P
Worst case	Loop	0,009 – 30	G23154878	P
927,875	V	1000 – 10000	G23154879	P
927,875	H	1000 – 10000	G23154880	P
921,425	H	1000 – 10000	G23154881	P
921,425	V	1000 – 10000	G23154882	P
915,075	V	1000 – 10000	G23154883	P
915,075	H	1000 – 10000	G23154884	P

Remarks: EUT was tested in 3 orthogonal planes, graphs are related to the highest detected levels.
Measurements at frequencies lower than 30 MHz have been performed with an EUT – antenna distance of 10 m. Measured values have been corrected with conversion factor 40log(test distance/10) based on the measuring distance provided by the standard.
Measurements at frequencies higher than 30 MHz and lower than 1000 MHz have been performed with an EUT – antenna distance of 10 m. Measured values have been corrected with conversion factor 20log(test distance/10) based on the measuring distance provided by the standard.
Peaks above the limits are caused by the nominal transmitting frequencies

Graphs

Gandini 23154850



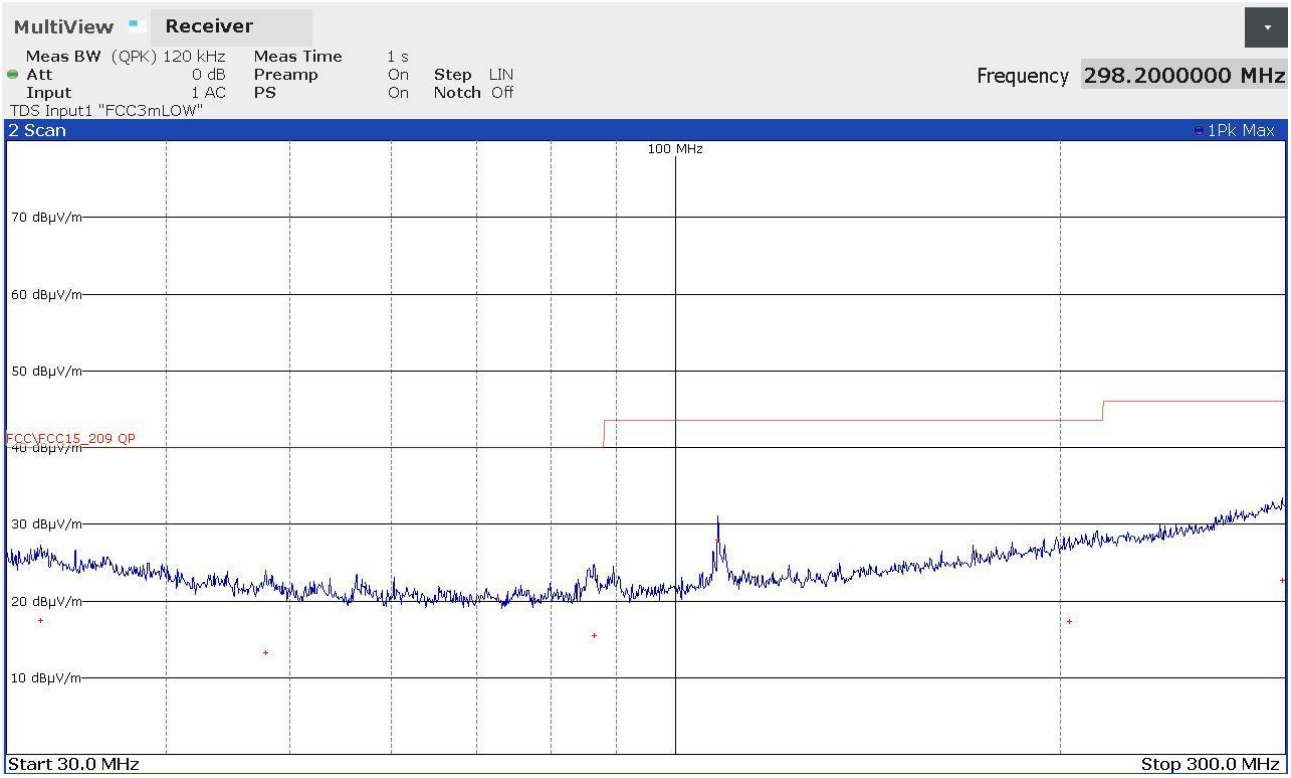
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
31880000	+17,06	-22,94
46800000	+11,87	-28,13
69560000	+10,39	-29,61
133840000	+13,77	-29,75
203400000	+17,26	-26,26
292240000	+22,17	-23,85

23154850_2

Gandini 23154851



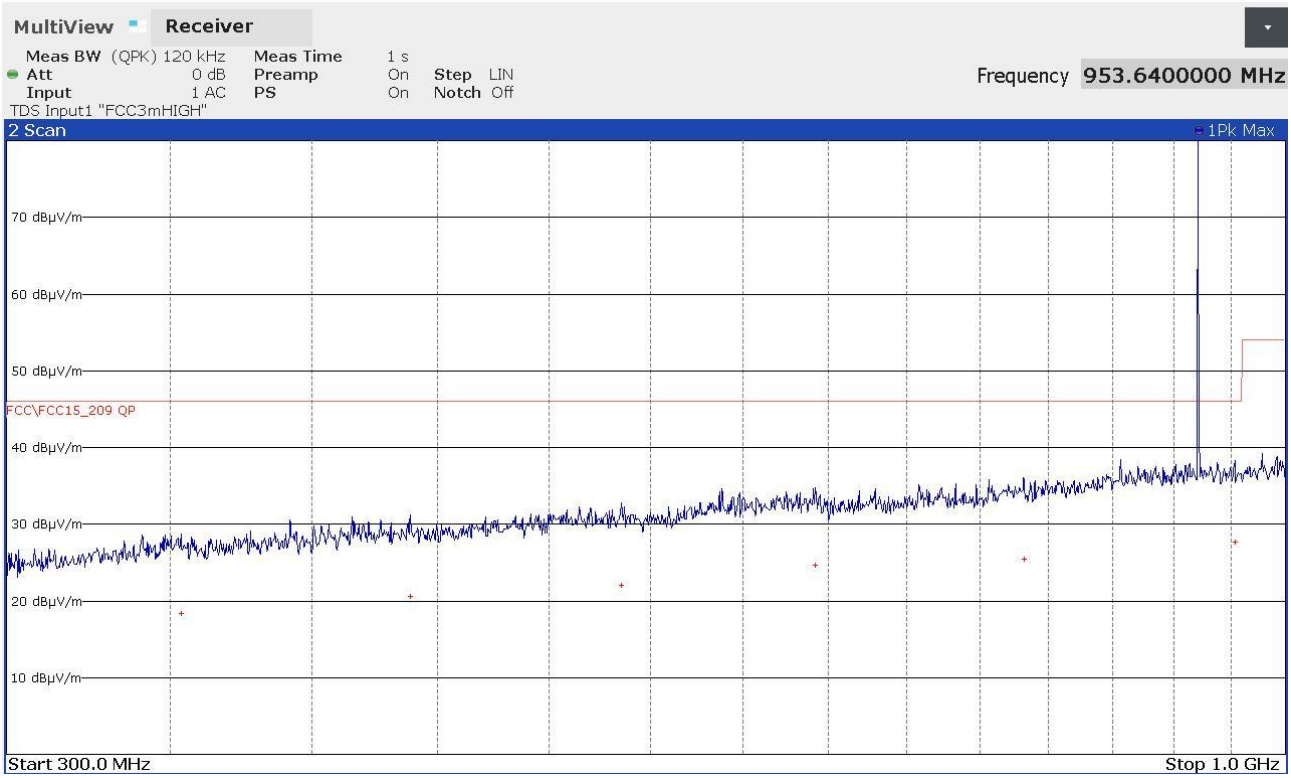
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
31920000	+17,41	-22,59
47840000	+13,31	-26,69
86360000	+15,49	-24,51
108000000	+27,97	-15,55
203280000	+17,36	-26,16
298200000	+22,73	-23,29

23154851_2

Gandini 23154852



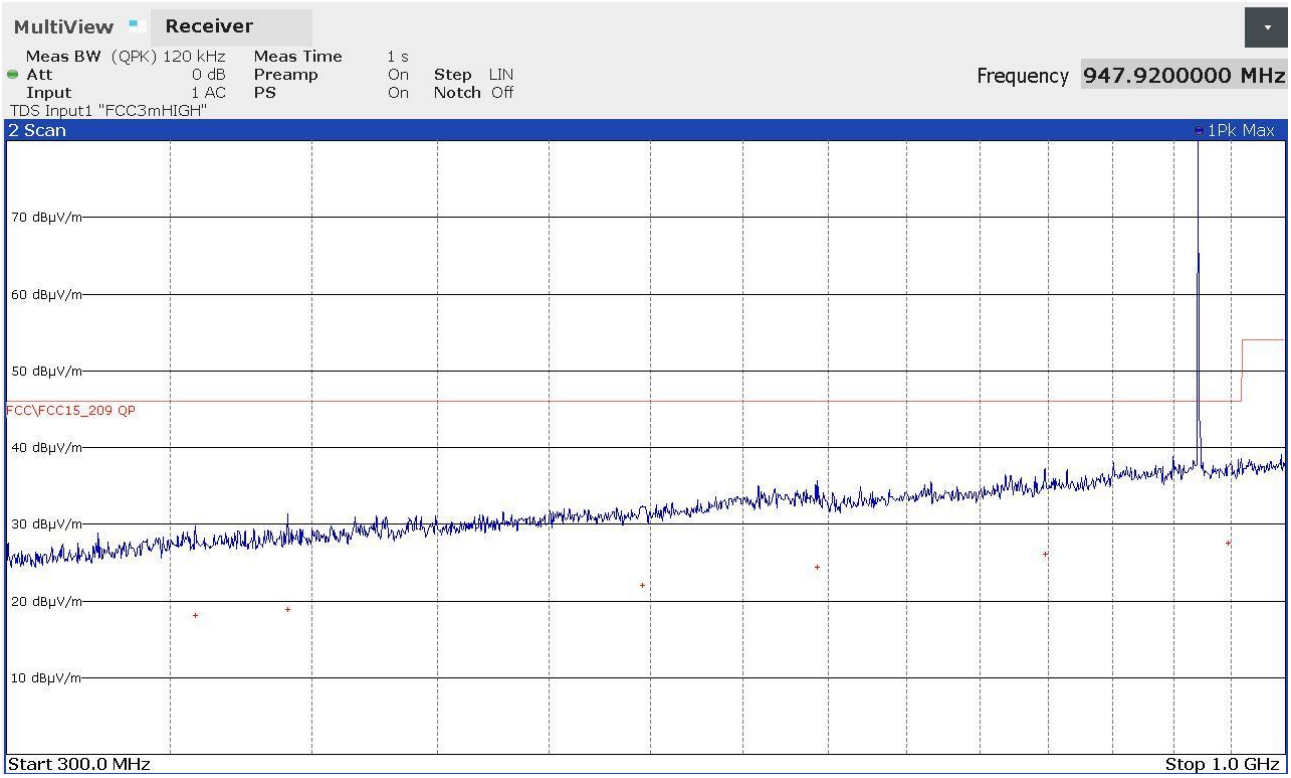
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
353680000	+18,36	-27,66
438640000	+20,63	-25,39
535240000	+22,09	-23,93
642280000	+24,60	-21,42
781640000	+25,47	-20,55
953640000	+27,71	-18,31

23154852_2

Gandini 23154853



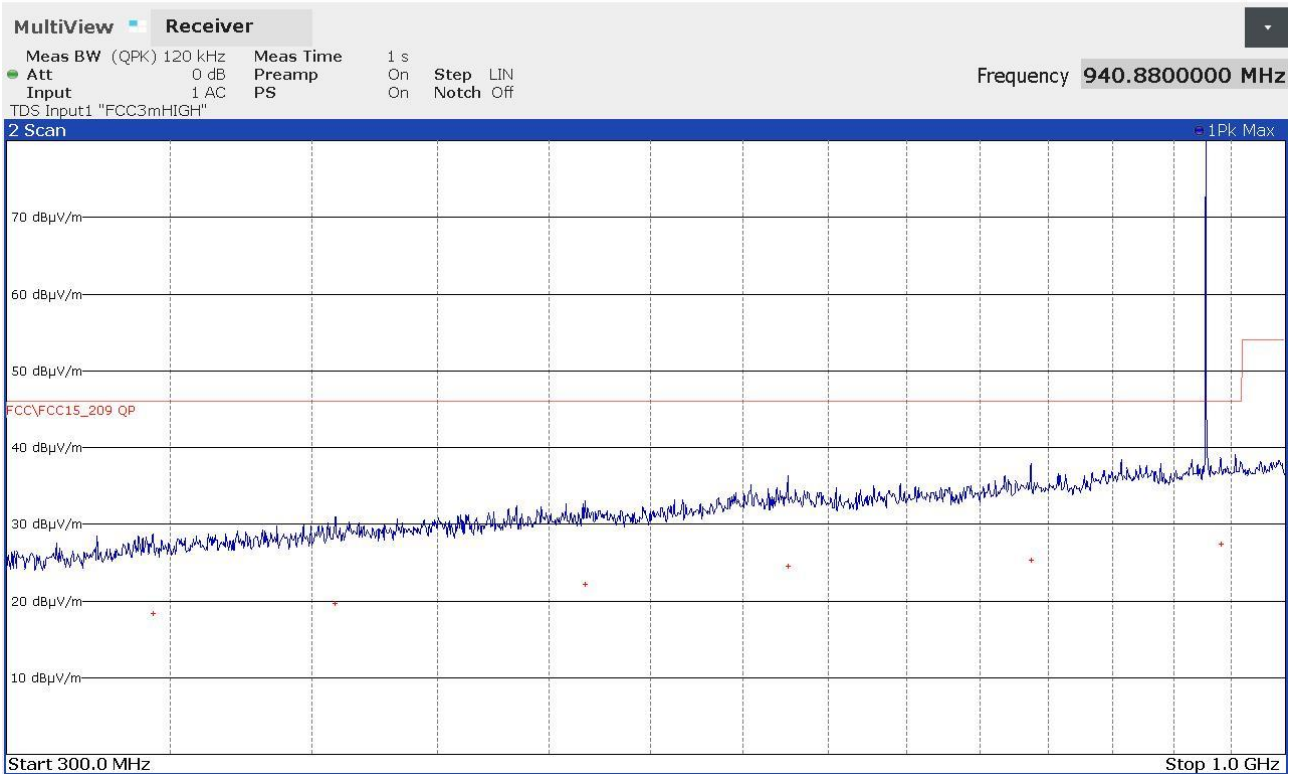
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
358280000	+18,14	-27,88
391040000	+18,92	-27,10
545680000	+22,09	-23,93
643600000	+24,39	-21,63
797320000	+26,07	-19,95
947920000	+27,54	-18,48

23154853_2

Gandini 23154854



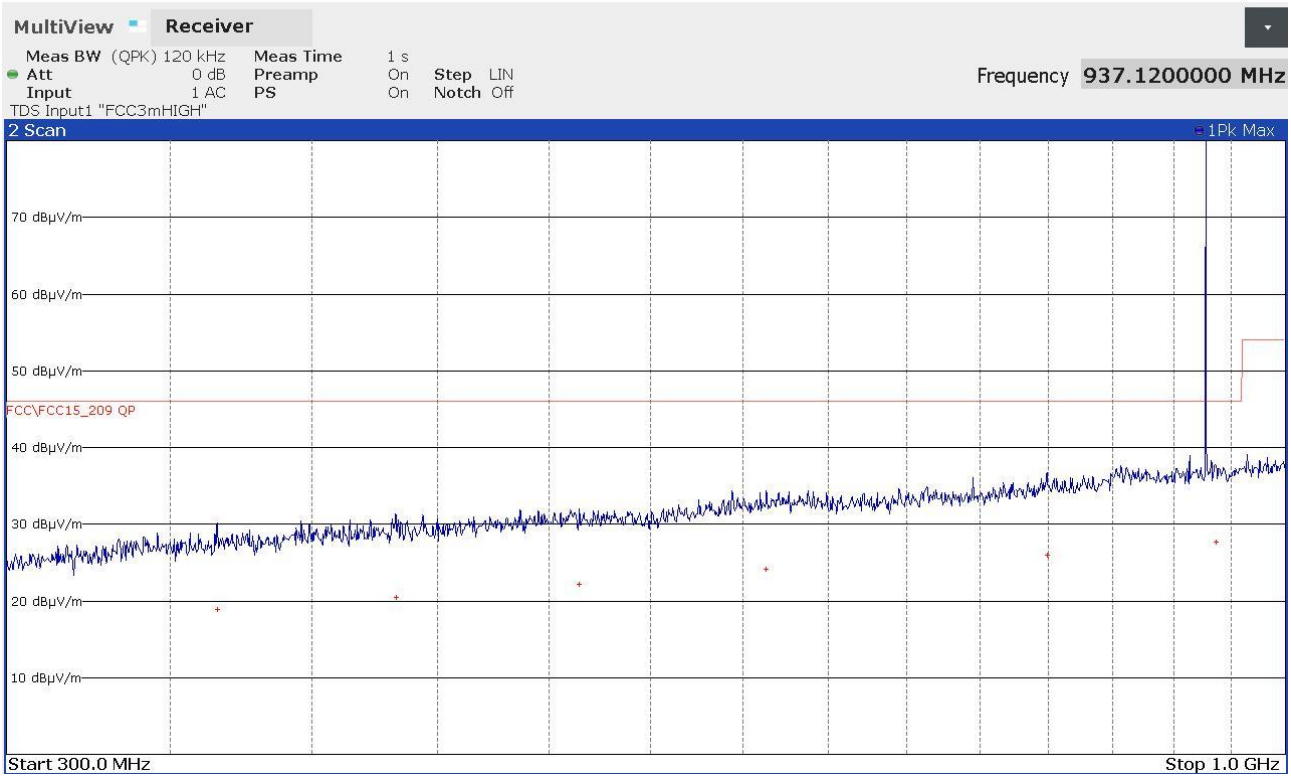
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
344280000	+18,37	-27,65
408920000	+19,71	-26,31
517280000	+22,11	-23,91
626200000	+24,49	-21,53
786880000	+25,29	-20,73
940880000	+27,44	-18,58

23154854_2

Gandini 23154855



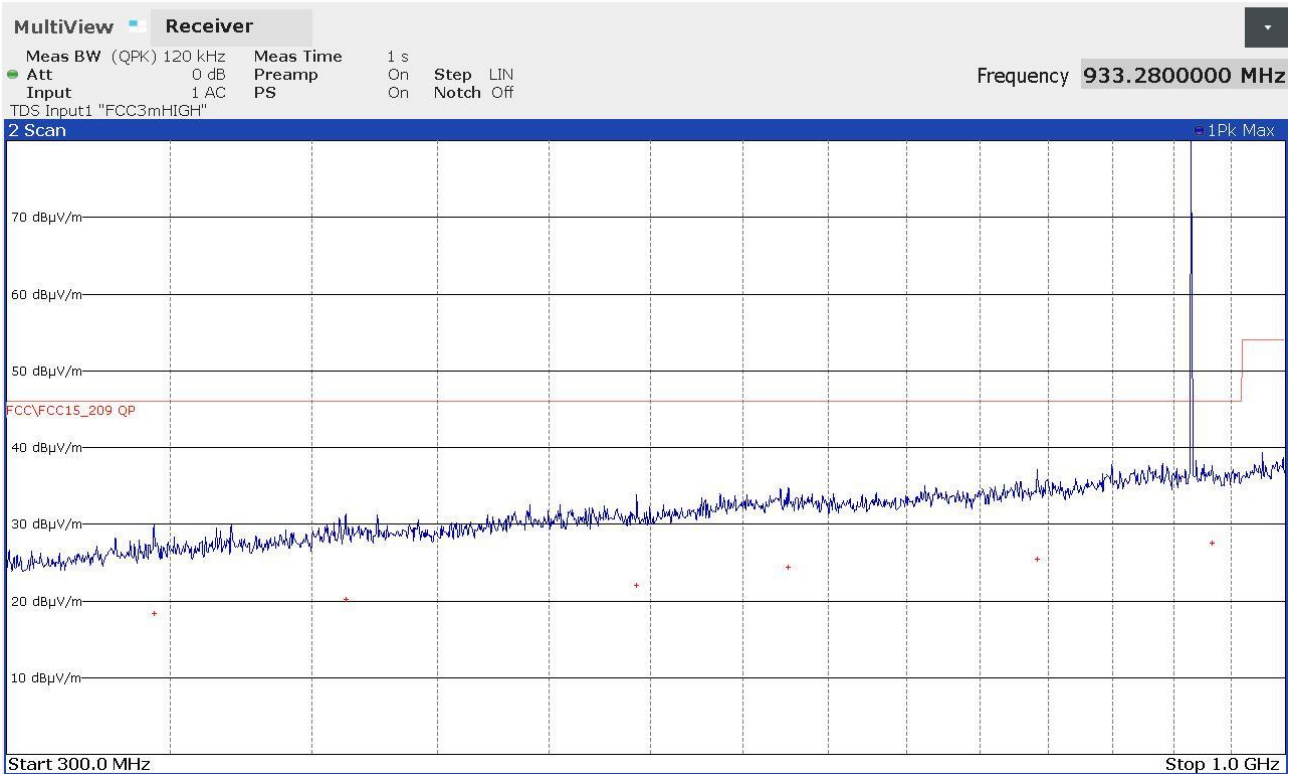
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
365760000	+18,90	-27,12
432800000	+20,52	-25,50
514400000	+22,17	-23,85
613480000	+24,08	-21,94
798880000	+25,93	-20,09
937120000	+27,64	-18,38

23154855_2

Gandini 23154856



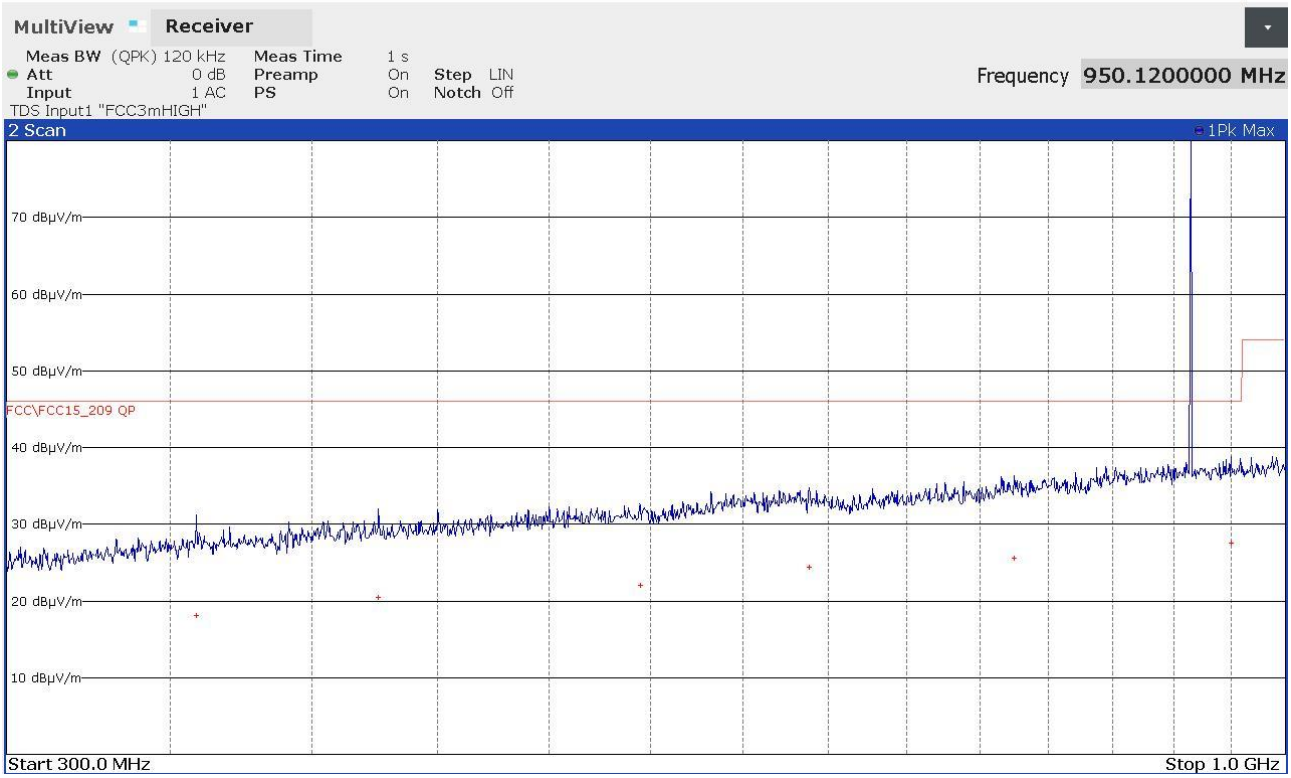
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
344640000	+18,36	-27,66
412840000	+20,22	-25,80
542840000	+22,06	-23,96
626440000	+24,42	-21,60
791800000	+25,46	-20,56
933280000	+27,57	-18,45

23154856_2

Gandini 23154857



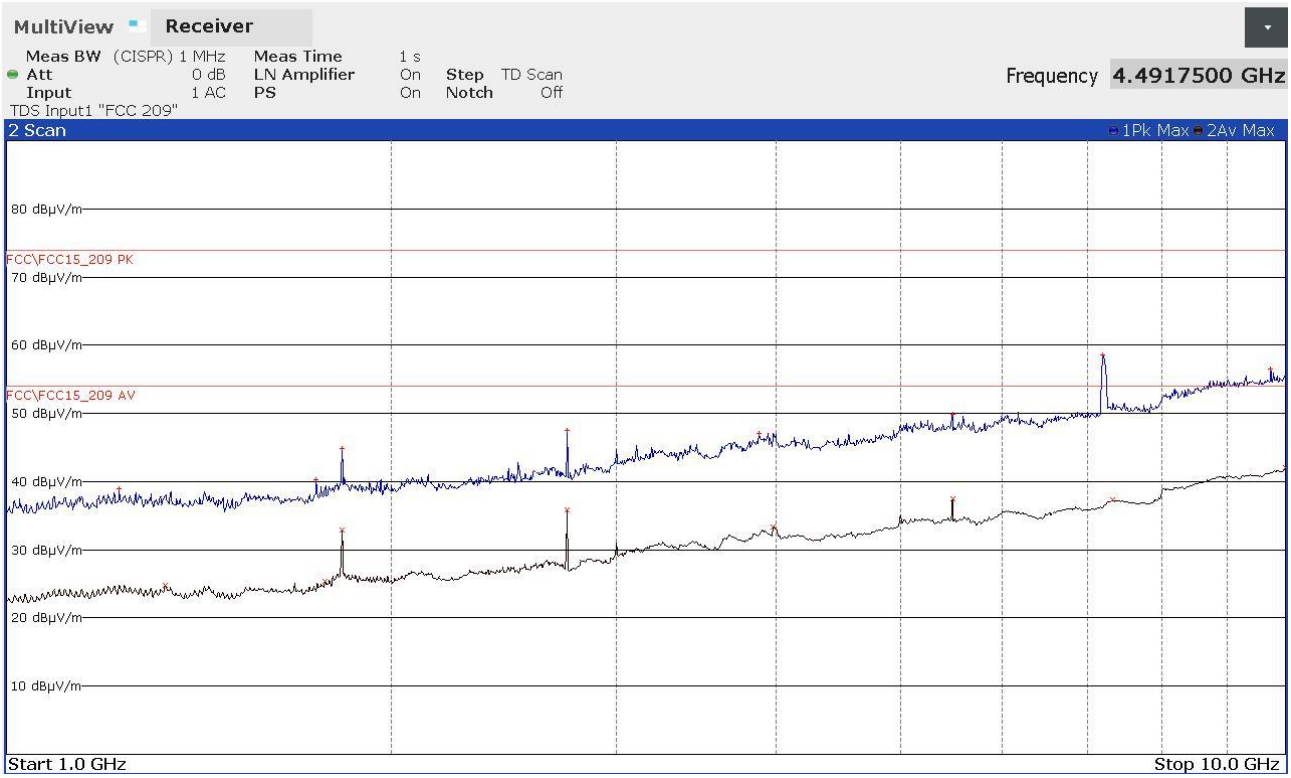
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
358800000	+18,10	-27,92
425600000	+20,45	-25,57
544640000	+21,99	-24,03
638520000	+24,41	-21,61
774760000	+25,54	-20,48
950120000	+27,55	-18,47

23154857_2

Gandini 23154858



FINAL RESULT TABLE

MAX PEAK

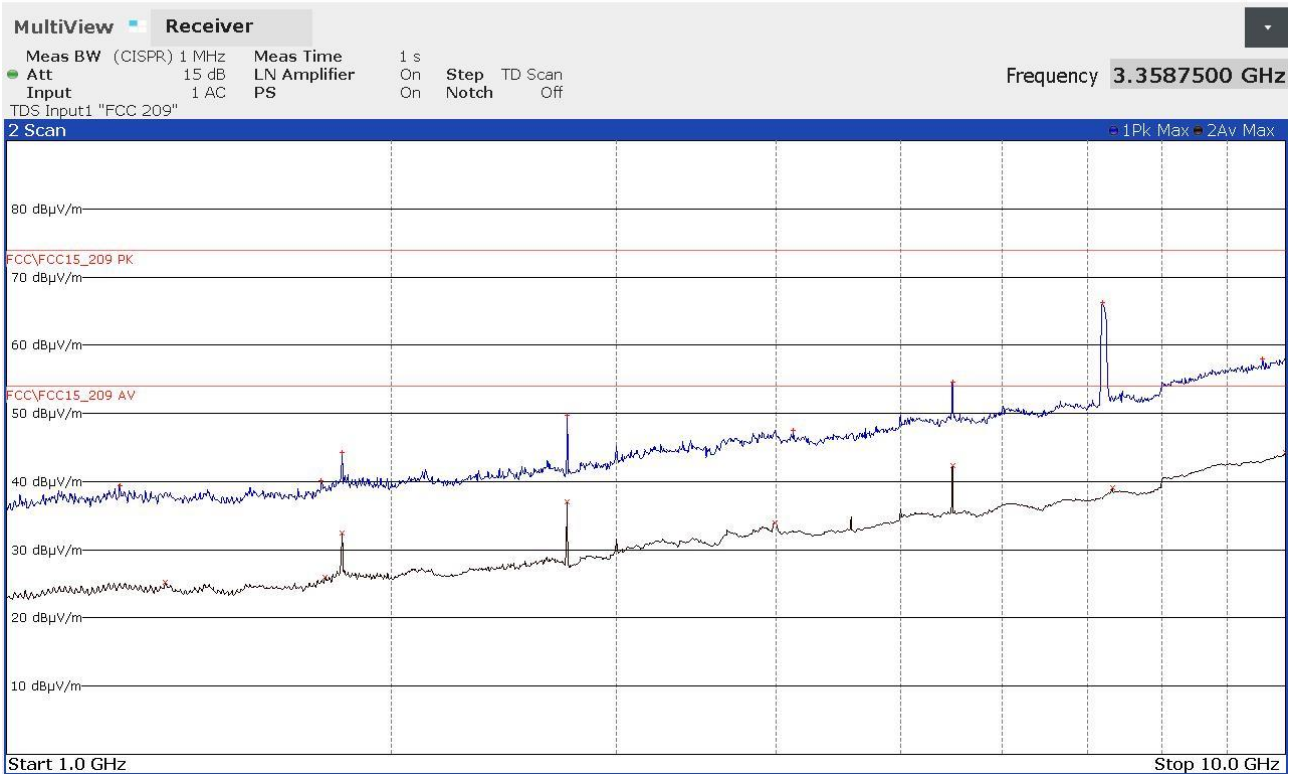
Freq Hz	Lev dBuV/m	Margin dB
1224250000	+38,88	-35,10
1746000000	+40,26	-33,72
1830000000	+44,83	-29,15
2745250000	+47,50	-26,48
3873250000	+47,09	-26,89
5490500000	+49,83	-24,15
7198000000	+58,56	-15,42
9738000000	+56,55	-17,43

AVERAGE

Freq Hz	Lev dBuV/m	Margin dB
1331000000	+24,81	-29,17
1775000000	+25,41	-28,57
1830250000	+32,89	-21,09
2745250000	+35,79	-18,19
3976750000	+33,34	-20,64
5490500000	+37,44	-16,54
7320500000	+37,40	-16,58
10000000000	+42,11	-11,87

23154858_2

Gandini 23154859



FINAL RESULT TABLE

MAX PEAK

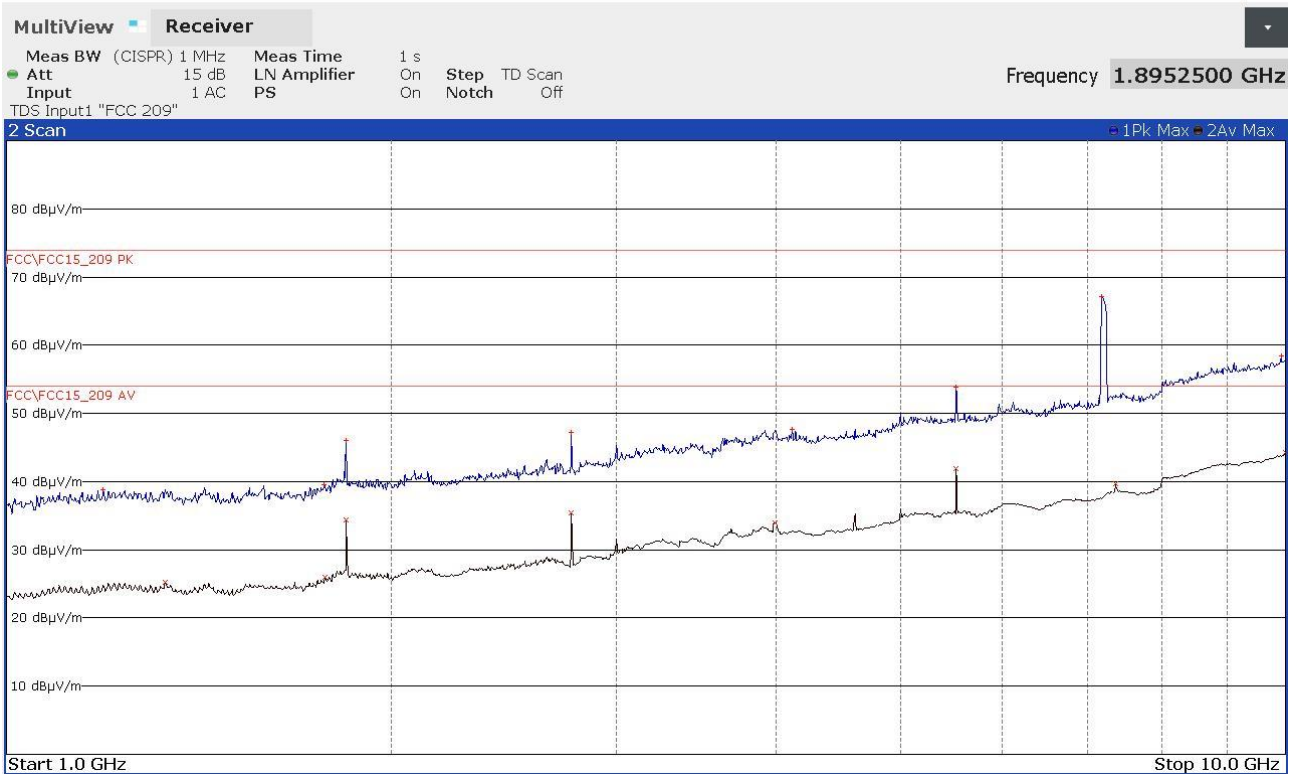
Freq Hz	Lev dBuV/m	Margin dB
1226000000	+39,39	-34,59
1762500000	+40,10	-33,88
1830250000	+44,32	-29,66
2745250000	+49,72	-24,26
4123000000	+47,54	-26,44
5490500000	+54,62	-19,36
7197500000	+66,24	-7,74
9598250000	+57,96	-16,02

AVERAGE

Freq Hz	Lev dBuV/m	Margin dB
1331250000	+25,16	-28,82
1775000000	+25,96	-28,02
1830250000	+32,47	-21,51
2745250000	+37,06	-16,92
3989500000	+33,99	-19,99
5490500000	+42,36	-11,62
7320500000	+39,14	-14,84
10000000000	+44,27	-9,71

23154859_2

Gandini 23154860



FINAL RESULT TABLE

MAX PEAK

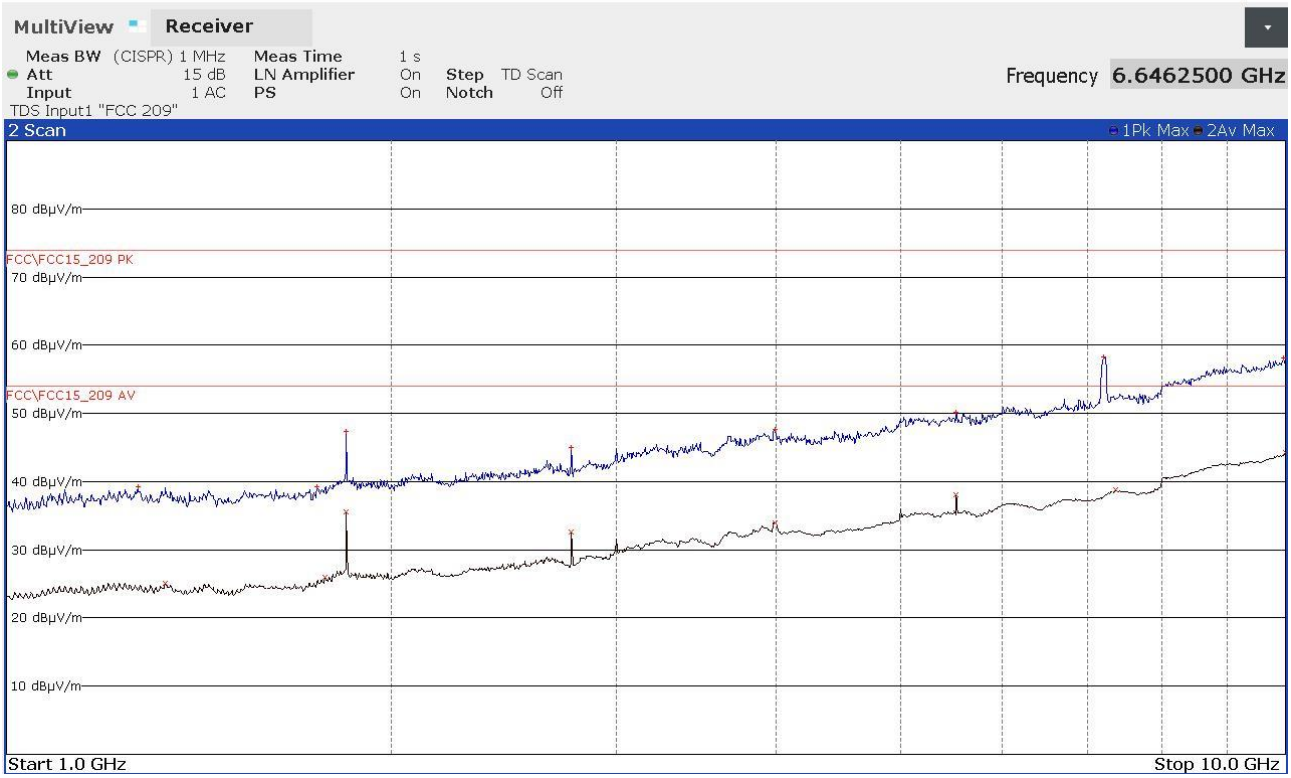
Freq Hz	Lev dBuV/m	Margin dB
1190000000	+38,78	-35,20
1772000000	+39,55	-34,43
1842750000	+46,06	-27,92
2764250000	+47,26	-26,72
4115750000	+47,59	-26,39
5528500000	+53,91	-20,07
7181000000	+67,17	-6,81
9927750000	+58,37	-15,61

AVERAGE

Freq Hz	Lev dBuV/m	Margin dB
1331000000	+25,17	-28,81
1774750000	+25,97	-28,01
1842750000	+34,31	-19,67
2764250000	+35,44	-18,54
3989500000	+33,99	-19,99
5528500000	+41,88	-12,10
7371500000	+39,73	-14,25
10000000000	+44,31	-9,67

23154860_2

Gandini 23154861



FINAL RESULT TABLE

MAX PEAK

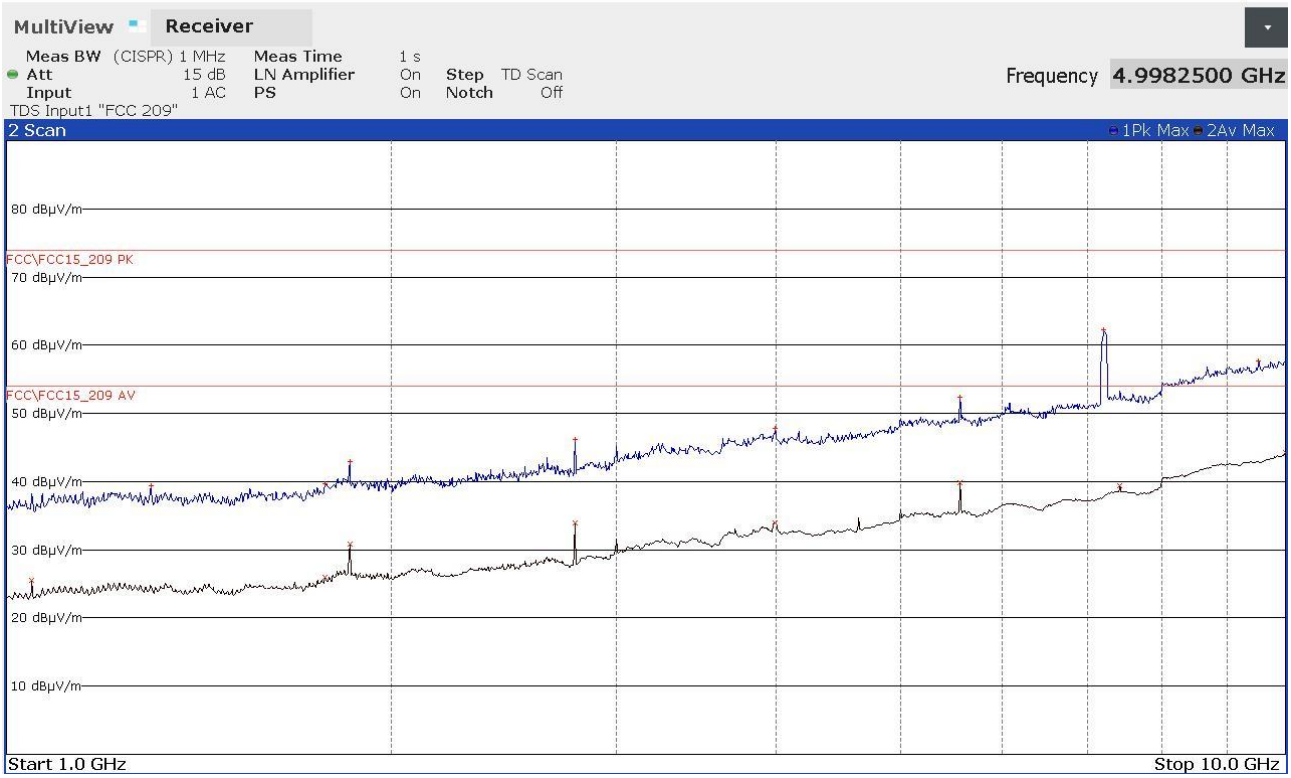
Freq Hz	Lev dBuV/m	Margin dB
1267750000	+39,25	-34,73
1748750000	+39,28	-34,70
1842750000	+47,32	-26,66
2764250000	+44,99	-28,99
3987000000	+47,71	-26,27
5528500000	+50,23	-23,75
7212000000	+58,31	-15,67
9967250000	+58,07	-15,91

AVERAGE

Freq Hz	Lev dBuV/m	Margin dB
1331250000	+25,15	-28,83
1774750000	+25,96	-28,02
1842750000	+35,59	-18,39
2764250000	+32,59	-21,39
3990000000	+33,99	-19,99
5528500000	+38,09	-15,89
7371500000	+38,80	-15,18
10000000000	+44,28	-9,70

23154861_2

Gandini 23154862



FINAL RESULT TABLE

MAX PEAK

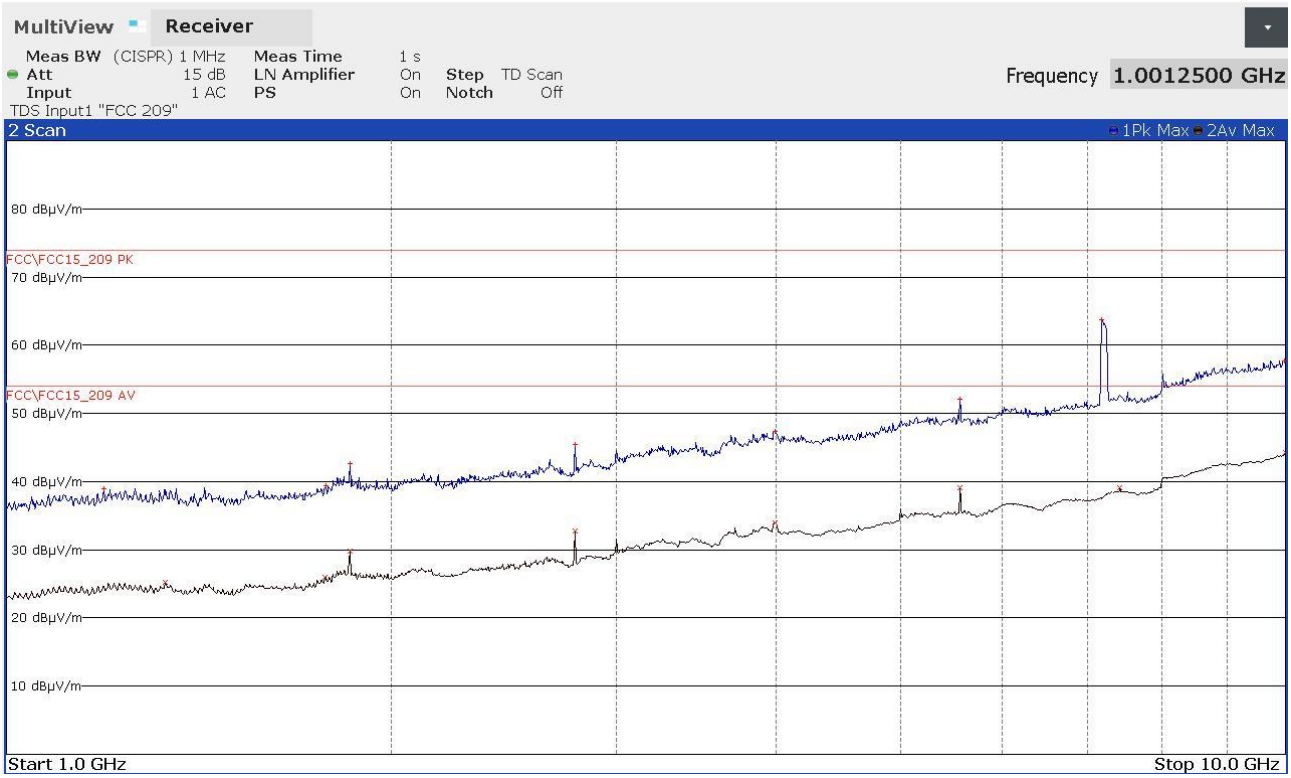
Freq Hz	Lev dBuV/m	Margin dB
1296750000	+39,34	-34,64
1775500000	+39,63	-34,35
1855750000	+42,95	-31,03
2783750000	+46,23	-27,75
3991750000	+47,87	-26,11
5567500000	+52,35	-21,63
7211250000	+62,26	-11,72
9530500000	+57,73	-16,25

AVERAGE

Freq Hz	Lev dBuV/m	Margin dB
1046750000	+25,48	-28,50
1774500000	+25,95	-28,03
1855750000	+30,85	-23,13
2783500000	+33,89	-20,09
3989750000	+33,99	-19,99
5567250000	+39,87	-14,11
7423000000	+39,46	-14,52
10000000000	+44,30	-9,68

23154862_2

Gandini 23154863



FINAL RESULT TABLE

MAX PEAK

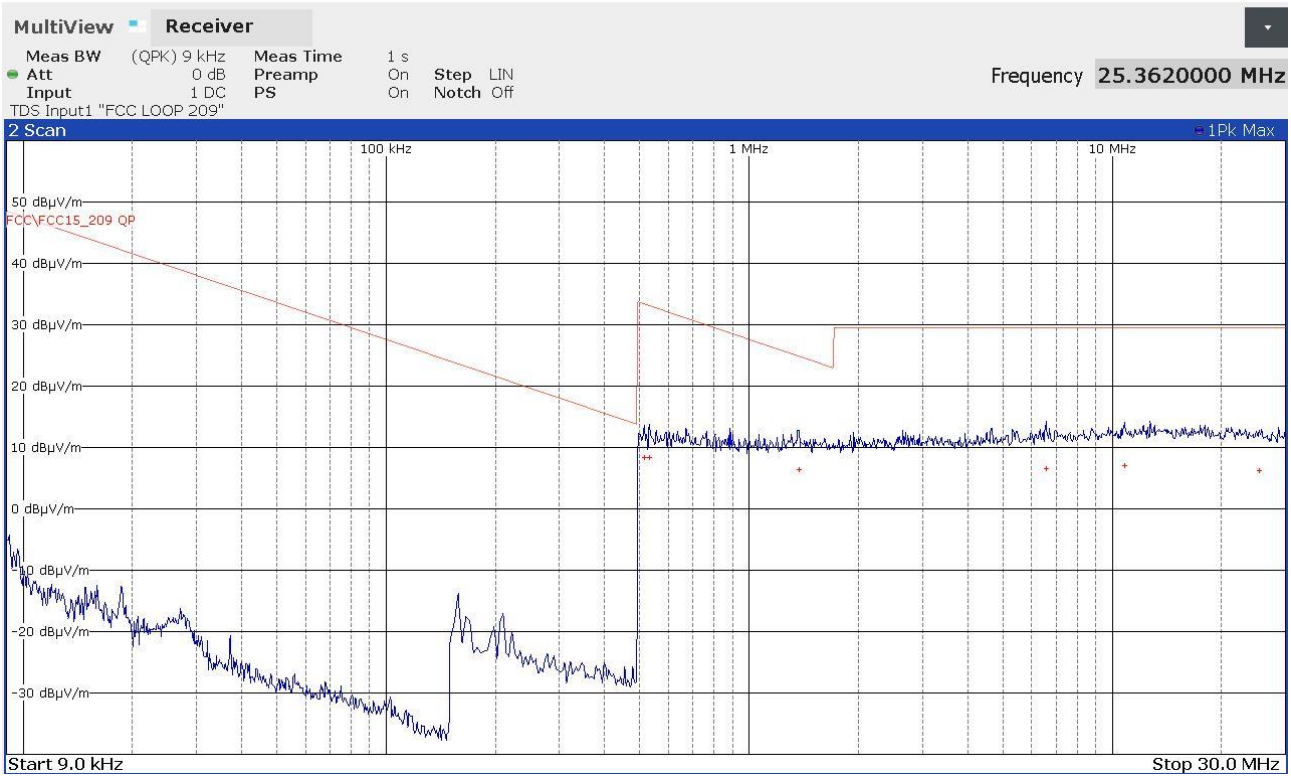
Freq Hz	Lev dBuV/m	Margin dB
1191750000	+39,01	-34,97
1777500000	+39,37	-34,61
1855750000	+42,70	-31,28
2783750000	+45,47	-28,51
3989750000	+47,38	-26,60
5567250000	+52,10	-21,88
7181750000	+63,80	-10,18
9979750000	+57,74	-16,24

AVERAGE

Freq Hz	Lev dBuV/m	Margin dB
1331000000	+25,16	-28,82
1774500000	+25,95	-28,03
1855750000	+29,77	-24,21
2783500000	+32,76	-21,22
3990000000	+33,99	-19,99
5567250000	+39,05	-14,93
7423000000	+39,16	-14,82
10000000000	+44,31	-9,67

23154863_2

Gandini 23154864



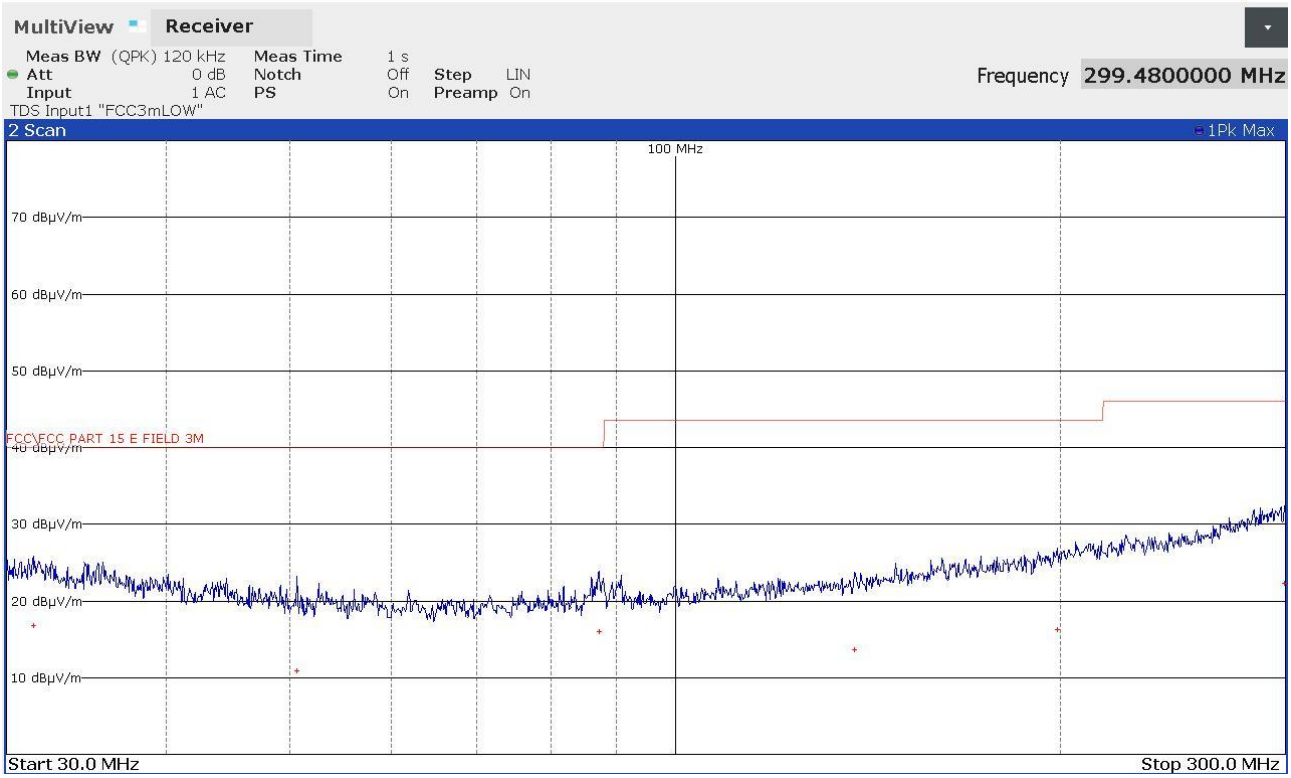
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
514000	+8,41	-24,97
530000	+8,34	-24,78
1374000	+6,40	-18,44
6586000	+6,58	-22,96
10826000	+7,05	-22,49
25362000	+6,30	-23,24

23154864_2

Gandini 23154870



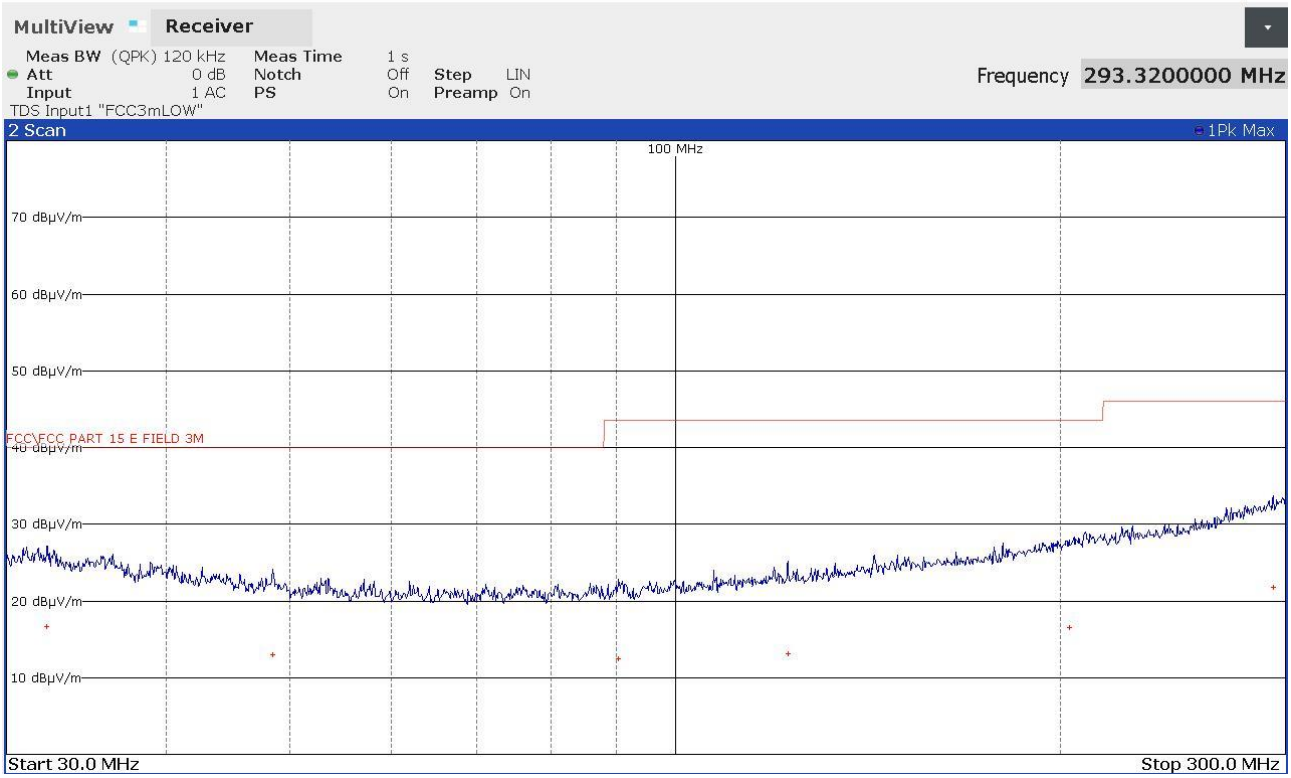
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
31480000	+16,82	-23,18
50600000	+10,88	-29,12
87160000	+15,94	-24,06
138160000	+13,60	-29,90
198960000	+16,23	-27,27
299480000	+22,26	-23,74

23154870_2

Gandini 23154871



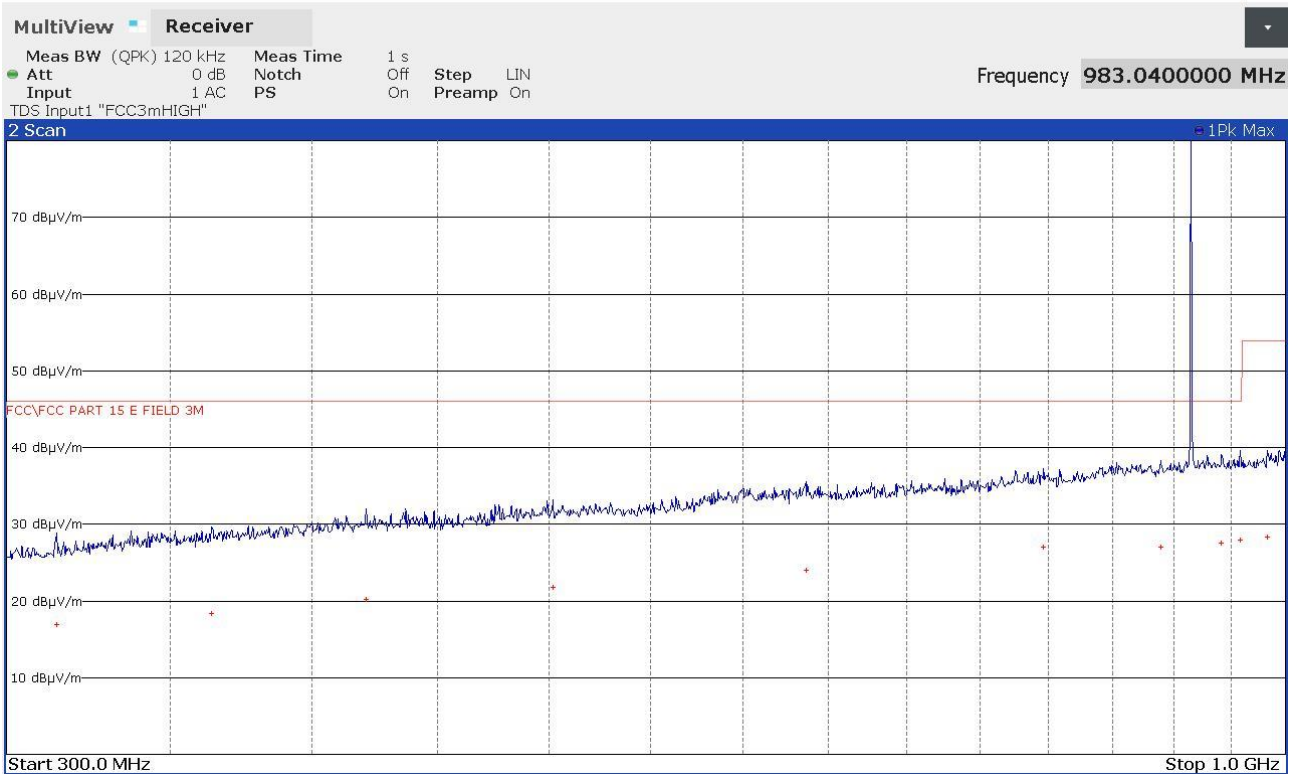
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
32280000	+16,71	-23,29
48440000	+13,03	-26,97
90280000	+12,51	-30,99
122440000	+13,09	-30,41
203240000	+16,57	-26,93
293320000	+21,83	-24,17

23154871_2

Gandini 23154872



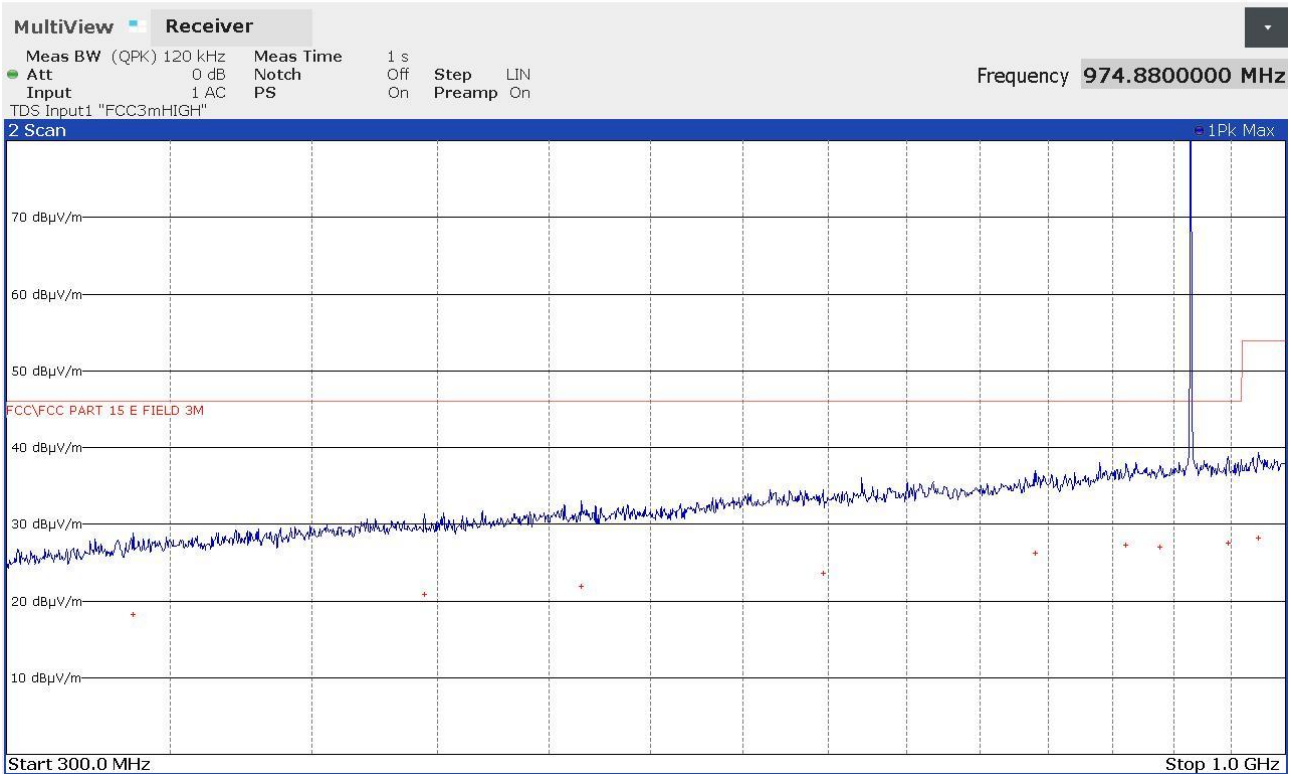
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
314520000	+16,97	-29,03
363880000	+18,42	-27,58
420880000	+20,19	-25,81
501920000	+21,83	-24,17
636720000	+24,04	-21,96
796240000	+27,07	-18,93
889480000	+27,08	-18,92
941640000	+27,56	-18,44
958280000	+27,93	-18,07
983040000	+28,38	-25,52

23154872_2

Gandini 23154873



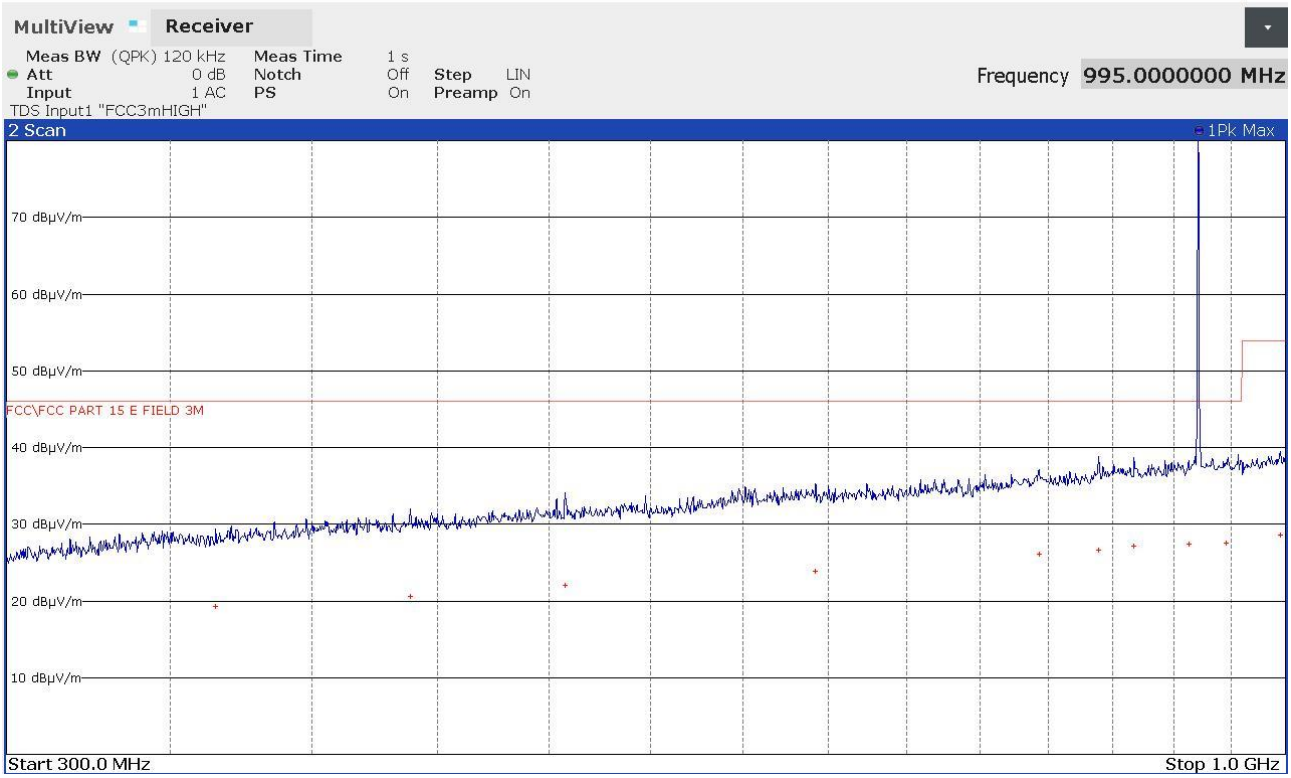
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
338080000	+18,22	-27,78
444640000	+20,90	-25,10
515400000	+21,93	-24,07
647360000	+23,60	-22,40
790360000	+26,21	-19,79
860680000	+27,26	-18,74
888760000	+27,00	-19,00
947360000	+27,50	-18,50
974880000	+28,21	-25,69

23154873_2

Gandini 23154874



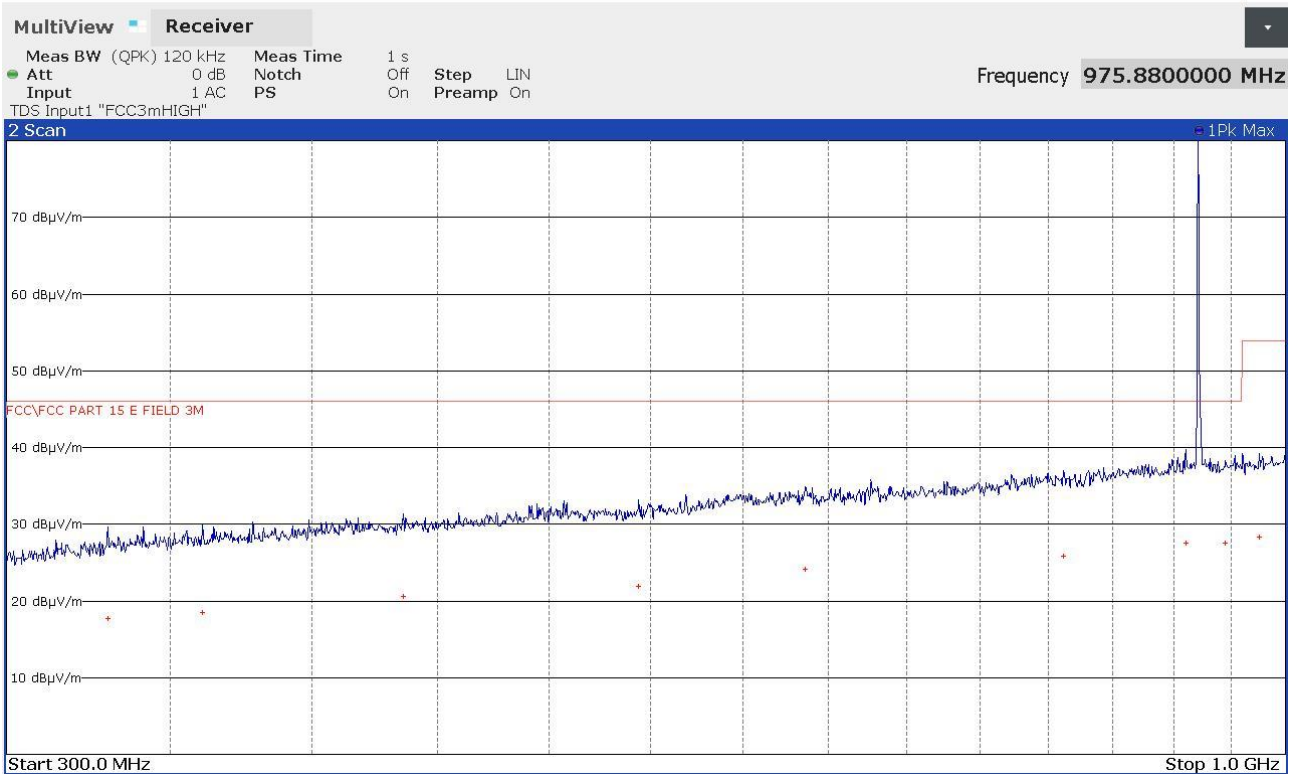
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
365280000	+19,22	-26,78
438840000	+20,64	-25,36
507400000	+21,99	-24,01
642640000	+23,83	-22,17
792840000	+26,13	-19,87
838760000	+26,63	-19,37
867000000	+27,21	-18,79
912920000	+27,41	-18,59
945480000	+27,48	-18,52
995000000	+28,65	-25,25

23154874_2

Gandini 23154875



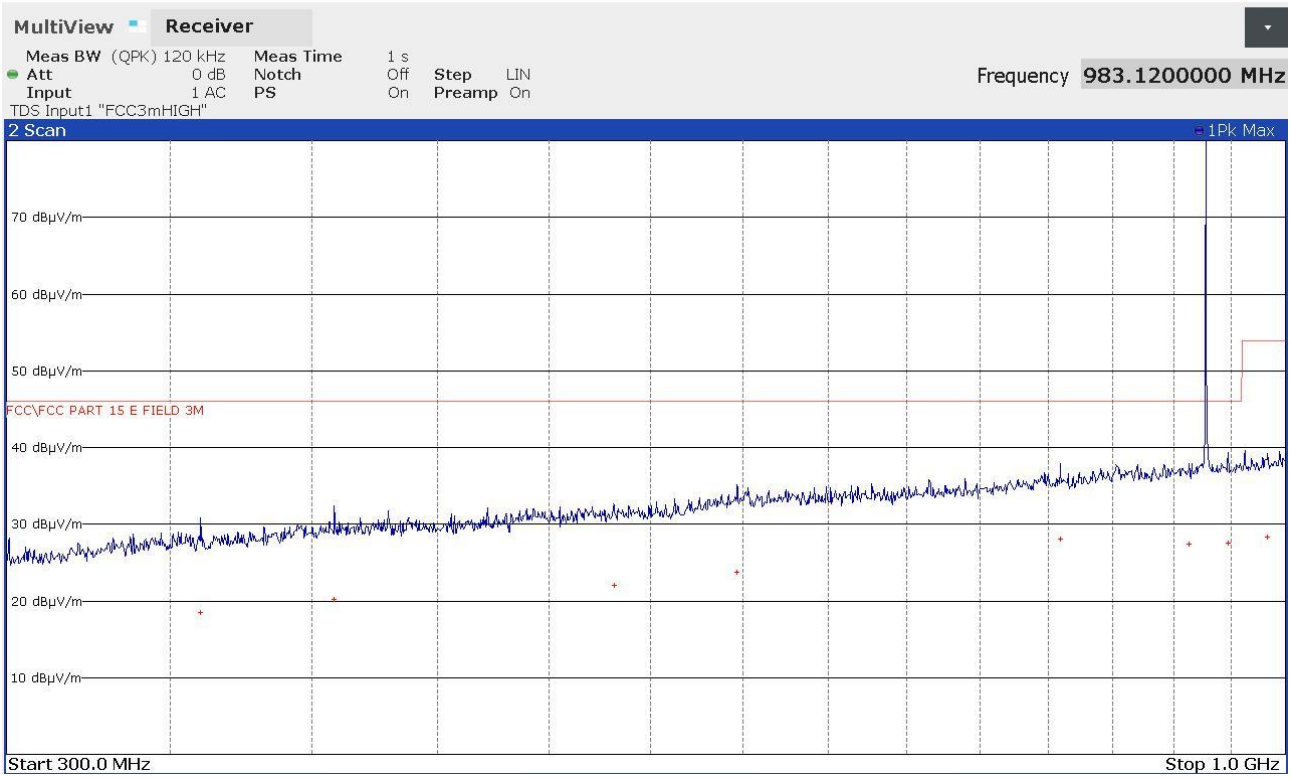
FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
330000000	+17,68	-28,32
360760000	+18,47	-27,53
435920000	+20,65	-25,35
543800000	+21,88	-24,12
636400000	+24,09	-21,91
811600000	+25,78	-20,22
910320000	+27,51	-18,49
945000000	+27,58	-18,42
975880000	+28,28	-25,62

23154875_2

Gandini 23154876



FINAL RESULT TABLE

QUASI PEAK

Freq Hz	Lev dBuV/m	Margin dB
360040000	+18,52	-27,48
408400000	+20,25	-25,75
531440000	+22,04	-23,96
596920000	+23,80	-22,20
809080000	+28,07	-17,93
913280000	+27,40	-18,60
947320000	+27,58	-18,42
983120000	+28,34	-25,56

23154876_2