

**TEST REPORT**
Nr. R20040002**Federal Communication Commission (FCC)**

Report Reference No.	R20040002
Date of issue:	10.06.2020
Total number pages:	105
Applicant's name	MCF88 S.r.l.
Address	Via Roma, 3 – 28060 Sozzago (NO) – Italy
Test specification:	
Standards	FCC Rules & Regulations, Title 47:2019 Part 15 paragraph(s): 203, 209 and 247 Tests details at page 7
Non-standard test method	N/A
Test Report Form No.	15-247_HoppingCMC
Test Report Form(s) Originator ..	CMC Centro Misure Compatibilità S.r.l.
Master TRF	2020-05
General disclaimer:	
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of CMC Centro Misure Compatibilità S.r.l.	
Test item description	Radio module
Trademark	MCF88
Manufacturer	MCF88 S.r.l.
Model / Type reference	iM980A with custom wire antenna
FCC ID	2AWAL409810
Rating(s)	3 Vdc from battery
Report	
Tested by (name + signature)	M. Segalla
Approved by (name + signature)	R. Beghetto



1 Summary

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2 Reference standard	
FCC Rules and Regulation Title 47 part 15:2019	--
3 List of attachments	
Attachment 1: Instruments list, measurement uncertainty, judgement of compliance and quality manual references	
4 Deviation(s) from test specification	
None	
5 Testing location	
CMC Centro Misure Compatibilità S.r.l. Via della Fisica, 20 – 36016 Thiene (VI) – Italy Test site facility's FCC registration number: 182474	

Revision index	Date	Change history
1.0	10.06.2020	--



Testing and sampling:	
Date of receipt of test item.....	11.02.2020
Testing start date	27.04.2020
Testing end date	04.06.2020
Sampling procedure.....	Equipment used for testing was picked up by the manufacturer, at the end of the production process with random criterion. The results relate to the sample as it has been received.
Internal identification.....	Adhesive label with the product number P200211
General remarks:	
This report shall not be reproduced, except in full, without the written approval of CMC. The test results presented in this report relate only to the object tested. “(see appended table)”: refers to a table appended to the report. Throughout this report a comma is used as the decimal separator.	
Possible test case verdicts:	
Test case does not apply to the test object:	N/A (Not Applicable)
Test object does meet the requirement:	P (Pass)
Test object does not meet the requirement:	F (Fail)
Test object does not performed:	N/E (Not Executed)
Definition of symbols used in this test report:	
☒ Indicates that the listed condition, standard or equipment is applicable for this report. ☐ Indicates that the listed condition, standard or equipment is not applicable for this report.	



6 General description of test item(s)

Description	Radio module						
Model Number	iM980A with custom wire antenna						
FCC ID	2AWAL409810						
Serial Number	--						
Brand name	MCF88						
Frequency band	902 – 928 MHz						
Modulation	LoRa 125 kHz LoRa 500 kHz						
Nominal frequencies (LoRa 125 kHz)	F _L : 902,30 MHz	F _M : 908,70 MHz		F _H : 914,90 MHz			
Nominal frequencies (LoRa 500 kHz)	F _L : 903,00 MHz	F _M : 909,40 MHz		F _H : 914,20 MHz			
Rated power supply		Voltage and Frequency	Reference poles				
			N	L1	L2	L3	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 3 V from battery					☐
Test configuration	☒	Table top equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
Type of equipment	☒	Transmitter unit					
	☐	Receiver unit					
Type of station	☐	Fixed station					
	☐	Portable station					
	☒	Mobile station					
Operating modes	No.	Operating mode of test item					
	1	EUT in continuous transmission at maximum power					
Supplemental information to the operating modes	All tests have been performed with radio module installed inside an MCF88 LoRaWAN® wireless actuator model MCF-LW13IO						



6.1 Photos of the test item





7 Verdict summary section

FCC Rules & Regulations, Title 47:2019 Part 15 paragraph(s): 203, 209 and 247			
Clause	Requirement – Test case	Basic standard	Verdict
Part 15.203	Antenna requirements	ANSI C63.10	P
Part 15.209	Radiated emissions and spurious emission	ANSI C63.10	P
Part 15.209 and 15.247	Peak Output Power	ANSI C63.10	P



Normative references	
Reference no.	Description
FCC Rules and Regulation Title 47 part 15:2019	--
KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under section 15.247 of the FCC rules
ANSI C63.4:2014	American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz – 40 GHz
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices



8 Test conditions

8.1 General

Environmental reference conditions.....:	The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment. The climatic conditions during the tests were within the following limits:		
	Temperature	Humidity	Atmospheric pressure
	15 °C – 35 °C	30 % - 60 %	800 hPa – 1060 hPa
	If explicitly required in the basic standard or applied product standard the climatic values are recorded and documented separately in this test report.		
Measurement uncertainties	Attachment 1		



9 Test results

9.1 Antenna requirements

Tested by	M. Segalla	
Test date	05.05.2020	
Reference standards	FCC Rules and Regulation; Titles 47 Part. 15.203 and 15.204	
Test specification	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded	
Antenna type.....	☐	Integral antenna
	☒	External antenna
	☐	Dedicated antenna
Antenna gain.....	0 dBi	
External R.F. power amplifier	Not Present	



9.2 Emissions in restricted frequency bands and in unrestricted frequency bands

Tested by	M. Segalla
Test date	05.05.2020
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	☒ SAC with measurement distance [m]: 10 m at frequencies ≤ 1 GHz 3 m at frequencies > 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(μ V/m)]
0,009 to 0,490	300	48,5 to 13,8
0,490 to 1,705	30	33,8 to 22,9
1,705 to 30	30	29,5
30 to 88	3	40
88 to 216	3	43,5
216 to 960	3	46,0
960 to 1000	3	54

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 ($f \geq 1000$ MHz)			
Frequency (MHz)	Test distance (m)	AV limits [dB(μ V/m)]	Peak limits [dB(μ V/m)]
> 1000	3	54	74



The restricted frequency bands are listed in the following table

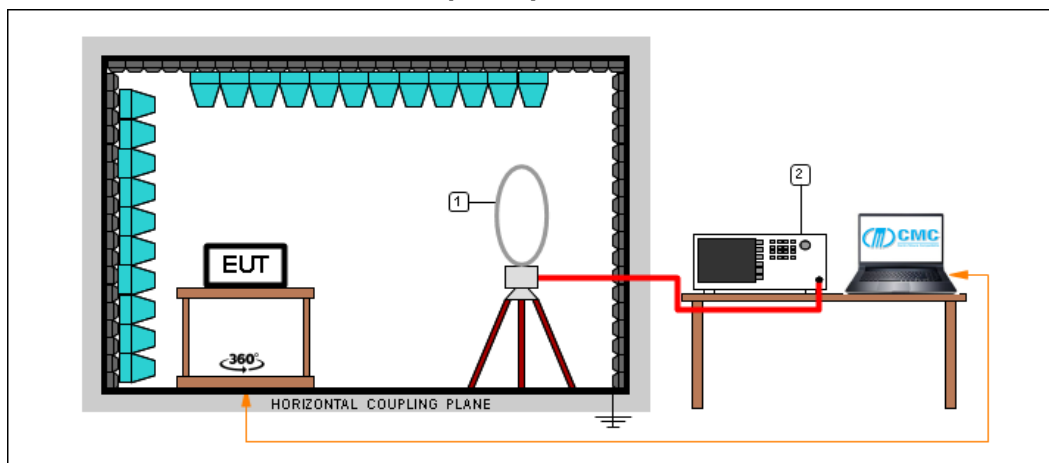
MHz	MHz	MHz	GHz
0,090 – 0,110	16,42 – 16,423	399,9 – 410	4,5 – 5,15
0,495 – 0,505	16,69475 – 16,69525	608 – 614	5,35 – 5,46
2,1735 – 2,1905	16,80425 – 16,80475	960 – 1240	7,25 – 7,75
4,125 – 4,128	25,5 – 25,67	1300 – 1427	8,025 – 8,5
4,17725 – 4,17775	37,5 – 38,25	1435 – 1626,5	9,0 – 9,2
4,20725 – 4,20775	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

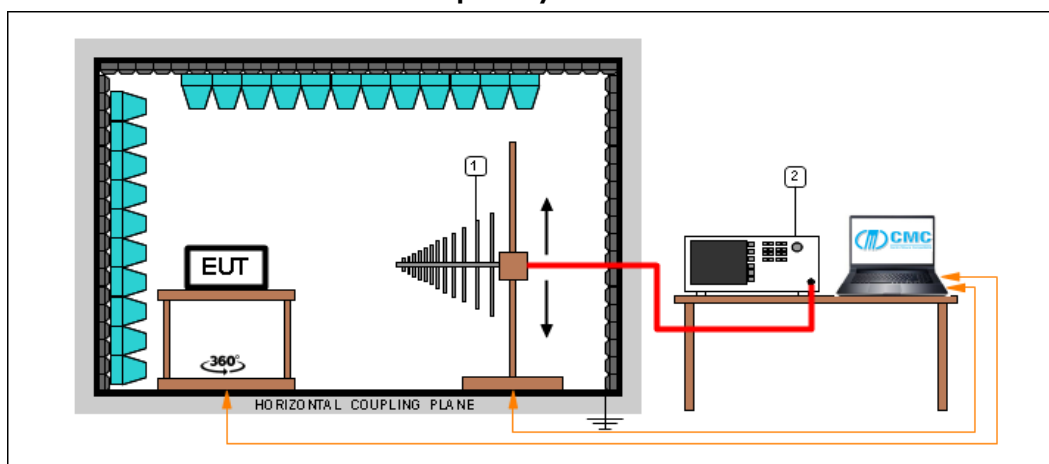
Frequency ≤ 30 MHz



Test setup PE004_01

Nr.	Id. Number	Manufacturer	Model	Description
2	CMC S164	Rohde & Schwarz	ESU26	Receiver 20 Hz - 26.5 GHz
1	CMC S127	Schaffner	HLA6120	Loop Antenna 9kHz - 30MHz

Frequency ≤ 1 GHz



Test setup PE004_02

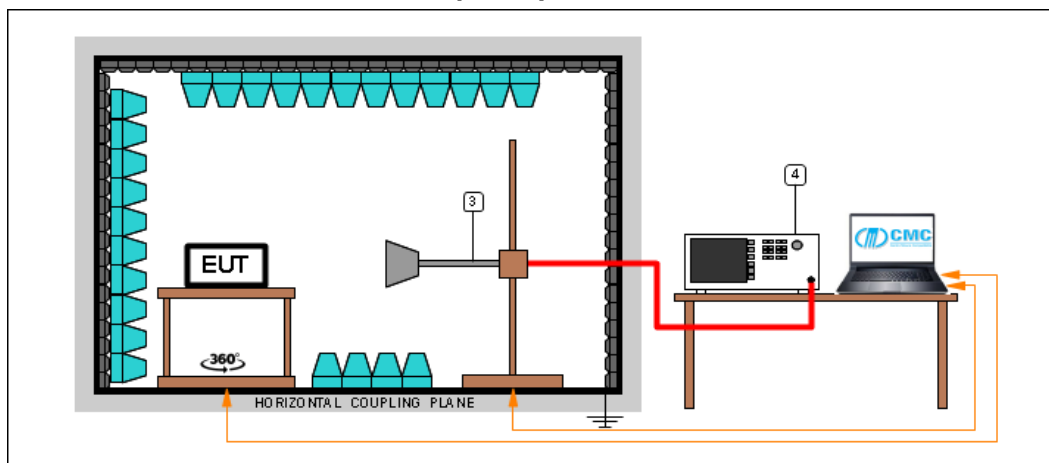
Nr.	Id. Number	Manufacturer	Model	Description
2	CMC S164	Rohde & Schwarz	ESU26	Receiver 20 Hz - 26.5 GHz
1	CMC S271	Schwarzbeck	BBA 9106 + VHBB 9124	Broadband Antenna

Test setup PE004_03

Nr.	Id. Number	Manufacturer	Model	Description
2	CMC S164	Rohde & Schwarz	ESU26	Receiver 20 Hz - 26.5 GHz
1	CMC S287	Schwarzbeck	VUSLP 9111B	Broadband Antenna



Frequency > 1 GHz



Test setup PE004_04

Nr.	Id. Number	Manufacturer	Model	Description
4	CMC S164	Rohde & Schwarz	ESU26	Receiver 20 Hz - 26.5 GHz
3	CMC S108	Emco	3115	Waveguide antenna



Result – LoRa 125 kHz modulation

Polarization	Frequency Range (MHz)	Graphs	Remarks	Result
H	300 – 1000	G200400A02	Lowest channel	P
V	300 – 1000	G200400A03	Lowest channel	P
H	300 – 1000	G200400A05	Medium channel	P
V	300 – 1000	G200400A06	Medium channel	P
H	300 – 1000	G200400A08	Highest channel	P
V	300 – 1000	G200400A09	Highest channel	P
V	30 – 300	G200400A10	Highest channel	P
H	30 – 300	G200400A11	Highest channel	P
H	30 – 300	G200400A12	Medium channel	P
V	30 – 300	G200400A13	Medium channel	P
V	30 – 300	G200400A14	Lowest channel	P
H	30 – 300	G200400A15	Lowest channel	P
V	1000 – 10000	G200400A16	Highest channel	P
H	1000 – 10000	G200400A17	Highest channel	P
H	1000 – 10000	G200400A18	Medium channel	P
V	1000 – 10000	G200400A19	Medium channel	P
V	1000 – 10000	G200400A20	Lowest channel	P
H	1000 – 10000	G200400A21	Lowest channel	P
Loop	0,009 – 30	G200400A22	Worst case	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 $40\log(\text{test distance}/10)$ 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 $20\log(\text{test distance}/10)$ 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 – LoRa 500 kHz modulation

Polarization	Frequency Range (MHz)	Graphs	Remarks	Result
H	30 – 300	G200400A50	Lowest channel	P
V	30 – 300	G200400A51	Lowest channel	P
V	30 – 300	G200400A52	Medium channel	P
H	30 – 300	G200400A53	Medium channel	P
H	30 – 300	G200400A54	Highest channel	P
V	30 – 300	G200400A55	Highest channel	P
H	300 – 1000	G200400A57	Lowest channel	P
V	300 – 1000	G200400A58	Lowest channel	P
H	300 – 1000	G200400A60	Medium channel	P
V	300 – 1000	G200400A61	Medium channel	P
H	300 – 1000	G200400A63	Highest channel	P
V	300 – 1000	G200400A64	Highest channel	P
H	1000 – 10000	G200400A65	Highest channel	P
V	1000 – 10000	G200400A66	Highest channel	P
V	1000 – 10000	G200400A67	Medium channel	P
H	1000 – 10000	G200400A68	Medium channel	P
H	1000 – 10000	G200400A69	Lowest channel	P
V	1000 – 10000	G200400A70	Lowest channel	P
Loop	0,009 – 30	G200400A71	Worst case	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 $40\log(\text{test distance}/10)$ 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 $20\log(\text{test distance}/10)$ based on the measuring distance provided by the standard.

Peaks above the limits are caused by the nominal transmitting frequencies

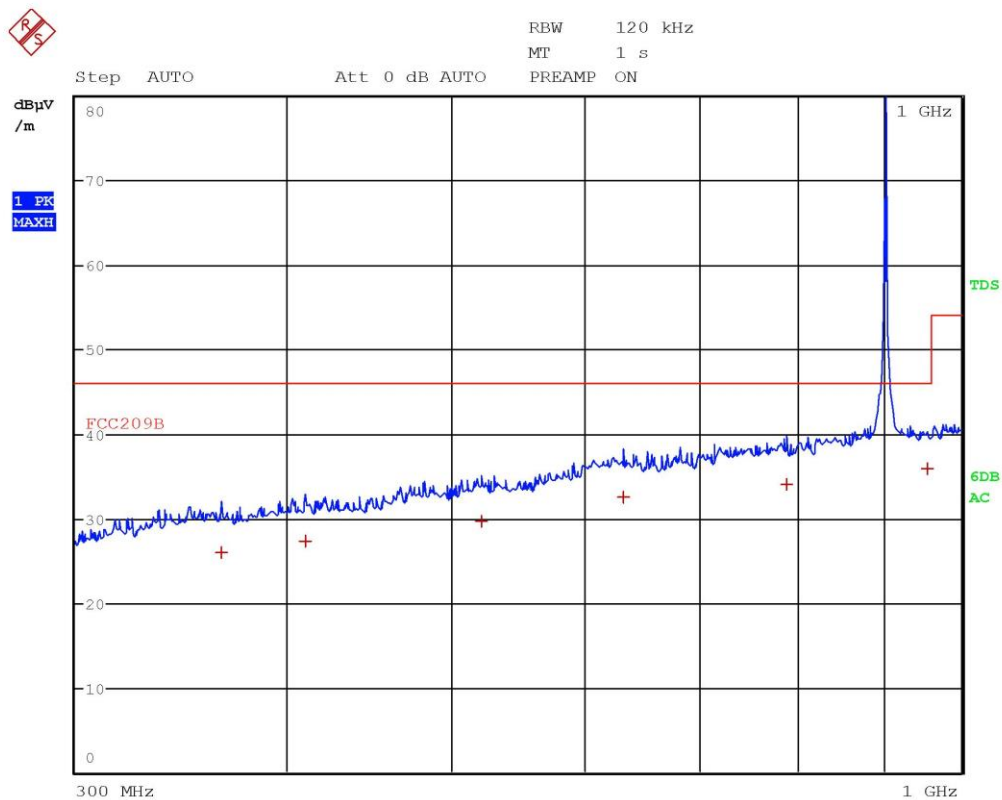
Graphs Legend

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



Graphs

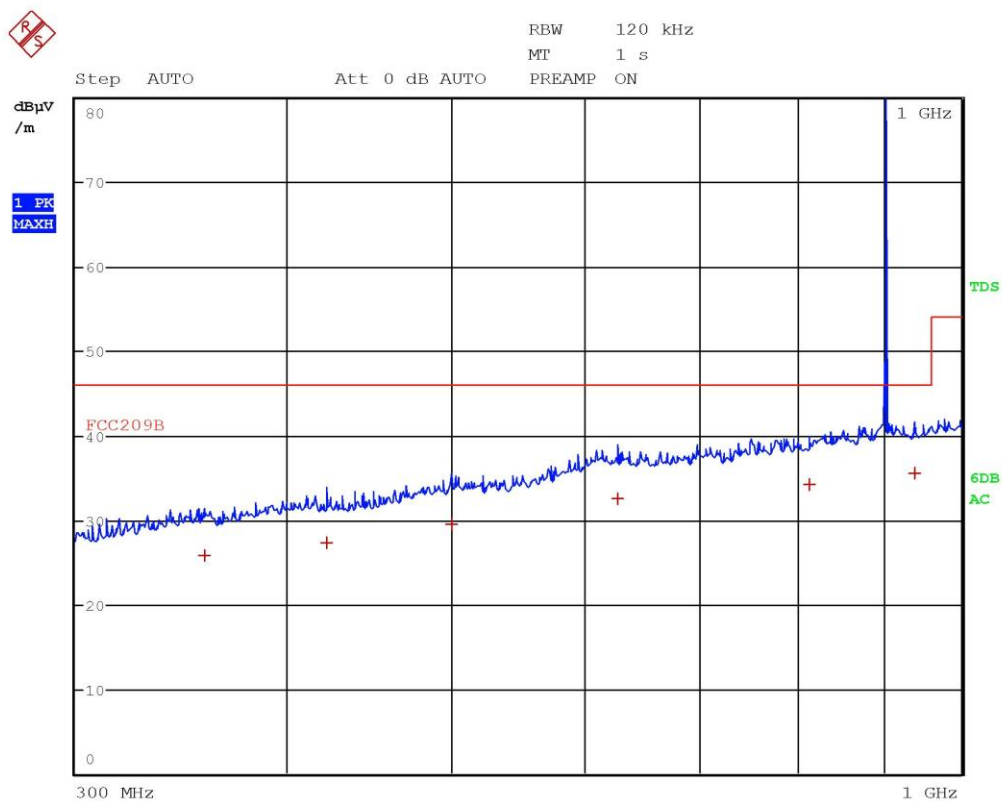


Segalla 200400A02



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	366.08 MHz	25.94	-20.08
1 Quasi Peak	409.84 MHz	27.28	-18.74
1 Quasi Peak	521.36 MHz	29.66	-16.36
1 Quasi Peak	631.96 MHz	32.46	-13.55
1 Quasi Peak	789 MHz	34.04	-11.97
1 Quasi Peak	953.88 MHz	35.82	-10.19

Segalla 200400A02

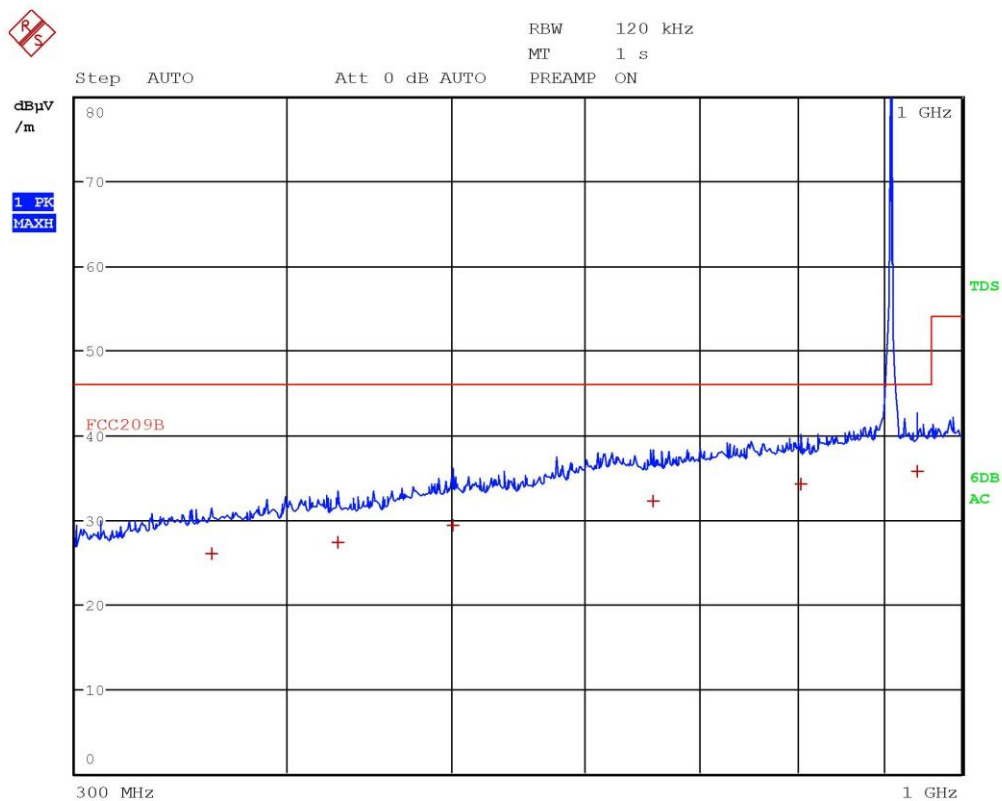


Segalla 200400A03



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	357.84 MHz	25.80	-20.21
1 Quasi Peak	422.4 MHz	27.35	-18.66
1 Quasi Peak	500.32 MHz	29.42	-16.59
1 Quasi Peak	626.64 MHz	32.50	-13.51
1 Quasi Peak	812.88 MHz	34.18	-11.83
1 Quasi Peak	937.92 MHz	35.62	-10.39

Segalla 200400A03

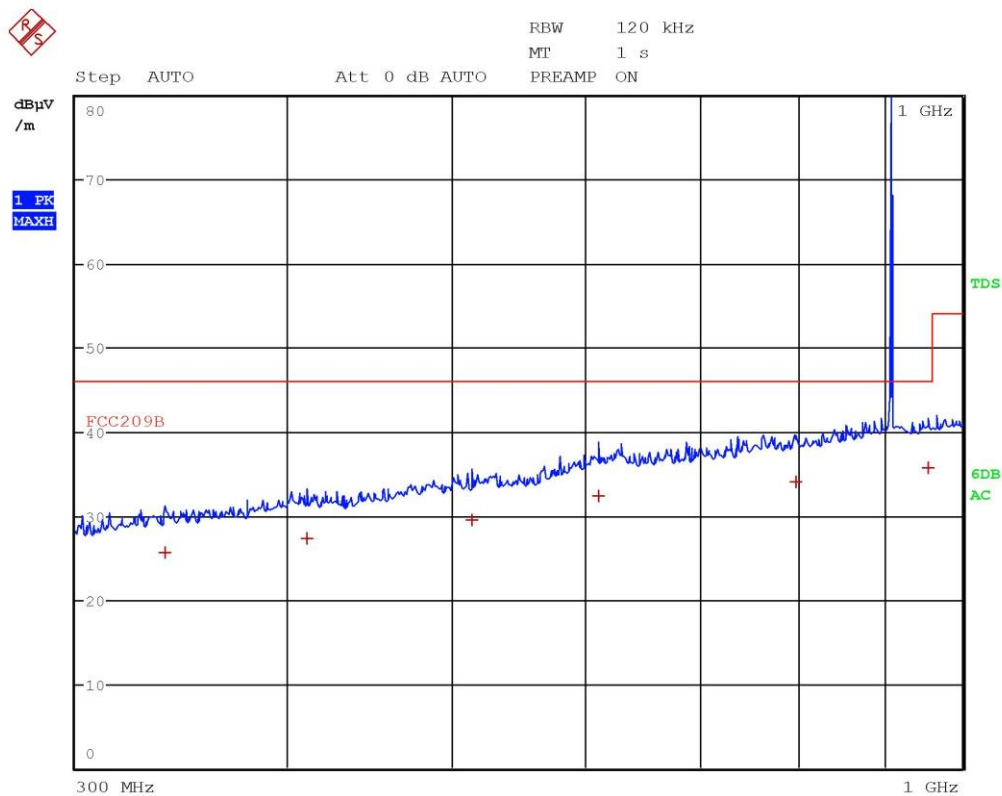


Segalla 200400A05



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	361.32 MHz	25.90	-20.11
1 Quasi Peak	428.4 MHz	27.26	-18.76
1 Quasi Peak	501.6 MHz	29.39	-16.62
1 Quasi Peak	658 MHz	32.18	-13.83
1 Quasi Peak	804.68 MHz	34.23	-11.78
1 Quasi Peak	941.28 MHz	35.78	-10.23

Segalla 200400A05

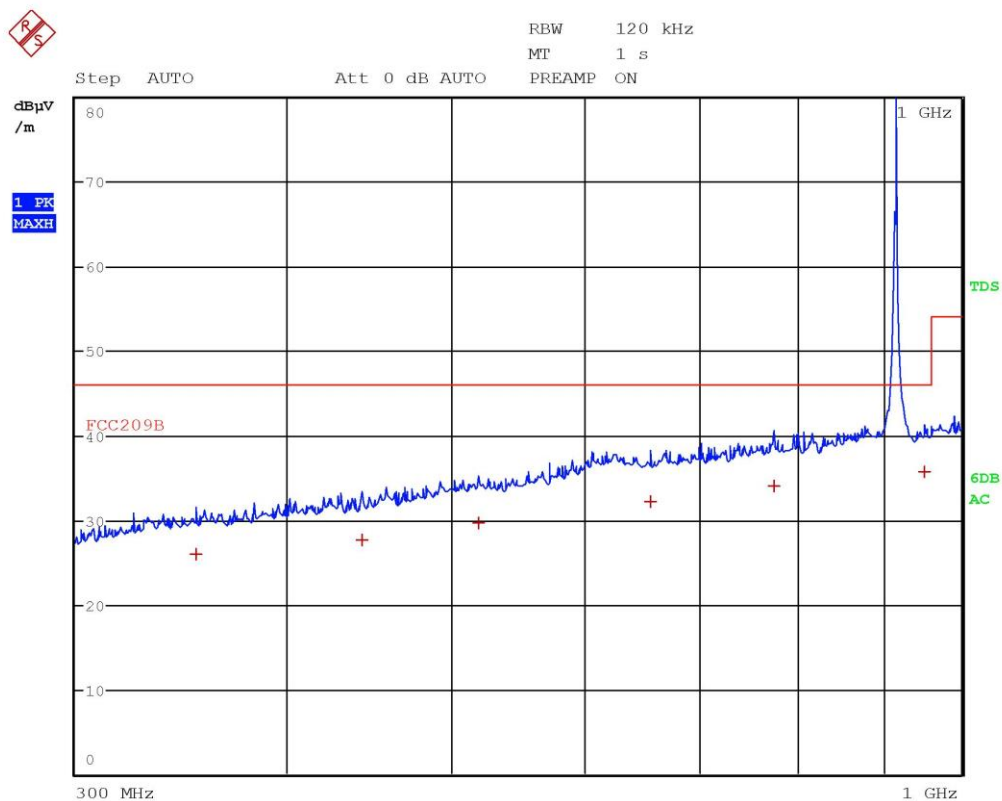


Segalla 200400A06



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	338.96 MHz	25.58	-20.44
1 Quasi Peak	410.84 MHz	27.31	-18.71
1 Quasi Peak	514.24 MHz	29.54	-16.47
1 Quasi Peak	610.6 MHz	32.33	-13.68
1 Quasi Peak	797.8 MHz	34.05	-11.96
1 Quasi Peak	954.52 MHz	35.76	-10.25

Segalla 200400A06

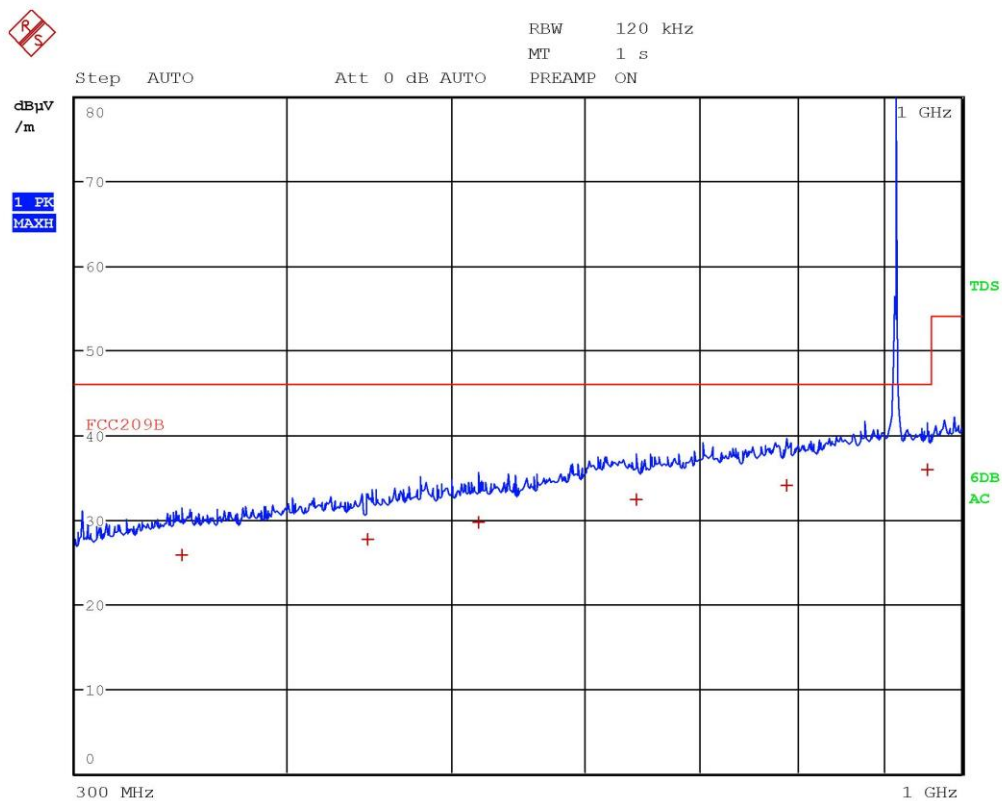


Segalla 200400A08



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	353.32 MHz	25.88	-20.13
1 Quasi Peak	442.56 MHz	27.63	-18.38
1 Quasi Peak	518.4 MHz	29.62	-16.39
1 Quasi Peak	655.92 MHz	32.25	-13.76
1 Quasi Peak	774.8 MHz	34.10	-11.91
1 Quasi Peak	950.44 MHz	35.75	-10.26

Segalla 200400A08

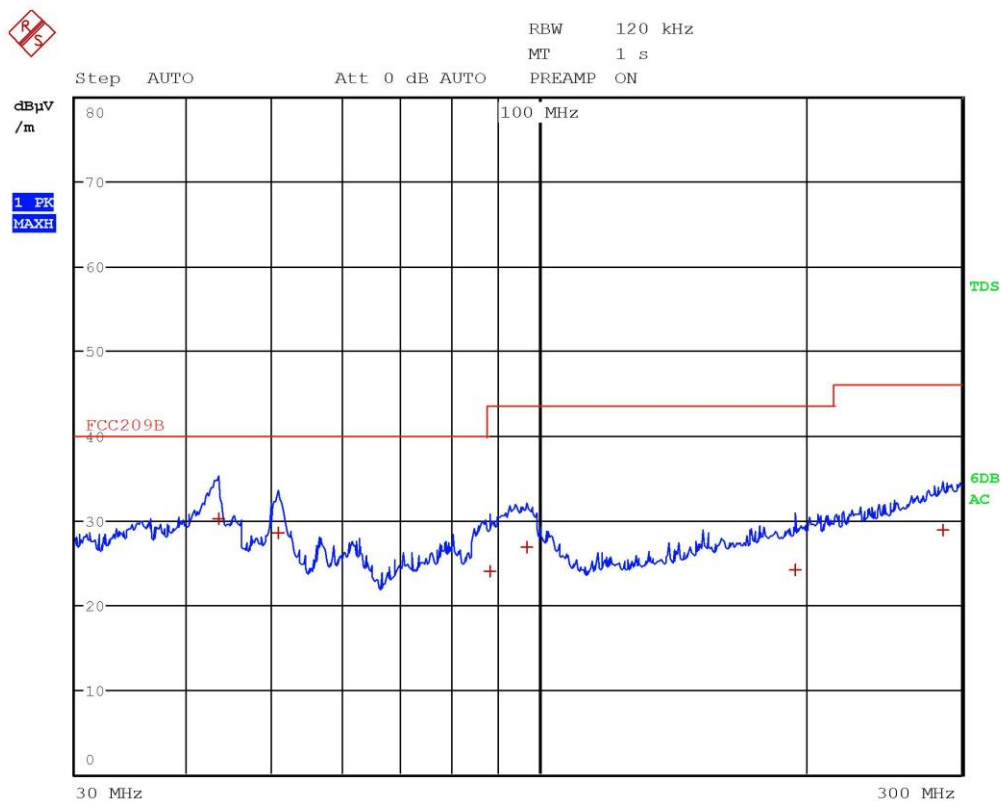


Segalla 200400A09



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	346.48 MHz	25.78	-20.23
1 Quasi Peak	446.56 MHz	27.64	-18.37
1 Quasi Peak	519.24 MHz	29.59	-16.42
1 Quasi Peak	642.6 MHz	32.29	-13.72
1 Quasi Peak	788.4 MHz	34.04	-11.98
1 Quasi Peak	954.84 MHz	35.80	-10.21

Segalla 200400A09

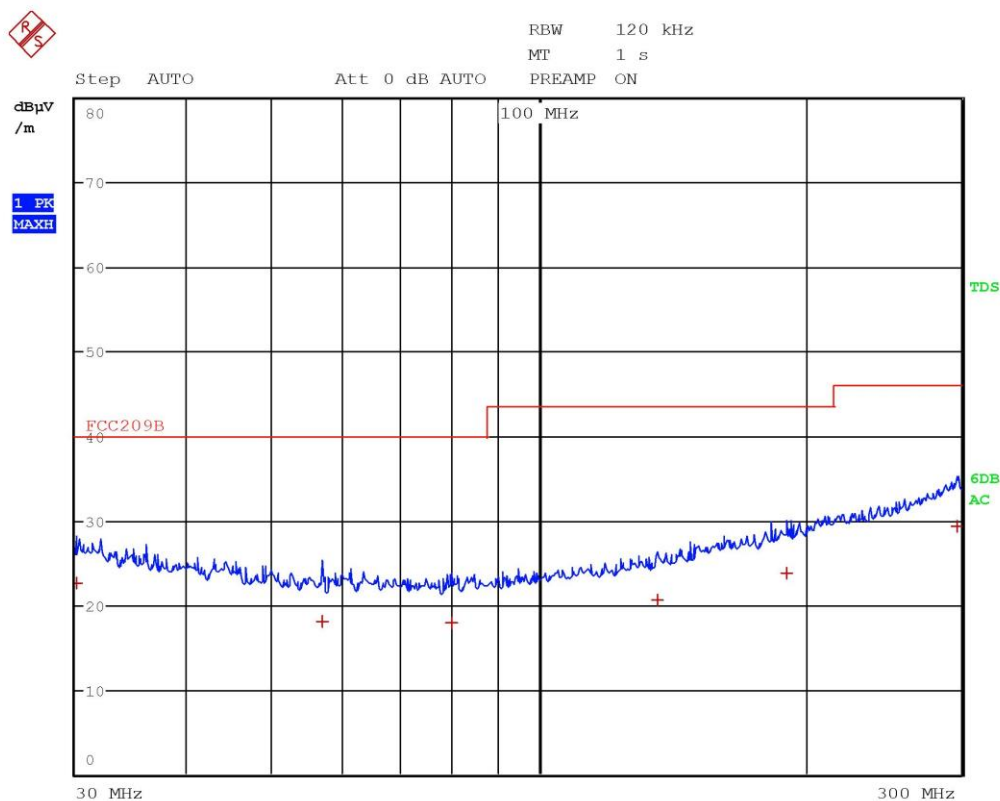


Segalla 200400A10



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	43.48 MHz	30.16	-9.83
1 Quasi Peak	50.88 MHz	28.45	-11.54
1 Quasi Peak	87.92 MHz	23.96	-16.03
1 Quasi Peak	97 MHz	26.77	-16.74
1 Quasi Peak	194.8 MHz	24.11	-19.40
1 Quasi Peak	285.76 MHz	28.85	-17.16

Segalla 200400A10

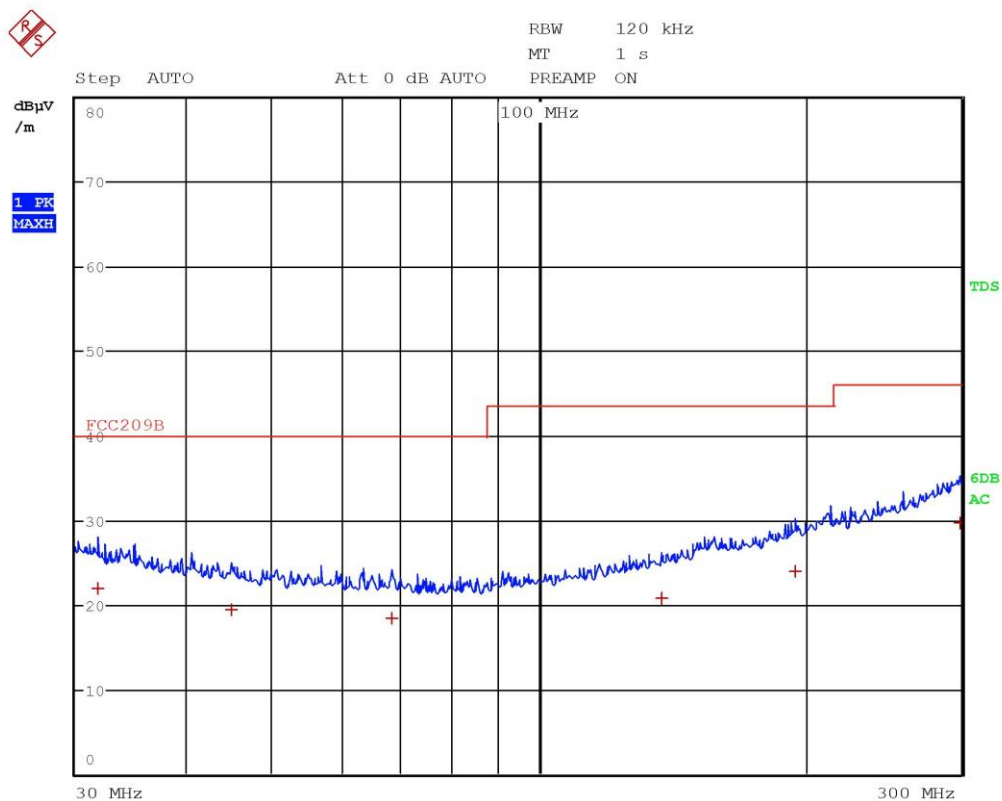


Segalla 200400A11



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	30.08 MHz	22.57	-17.42
1 Quasi Peak	56.92 MHz	18.10	-21.89
1 Quasi Peak	79.64 MHz	17.91	-22.09
1 Quasi Peak	136 MHz	20.65	-22.86
1 Quasi Peak	190.16 MHz	23.77	-19.74
1 Quasi Peak	297 MHz	29.36	-16.65

Segalla 200400A11

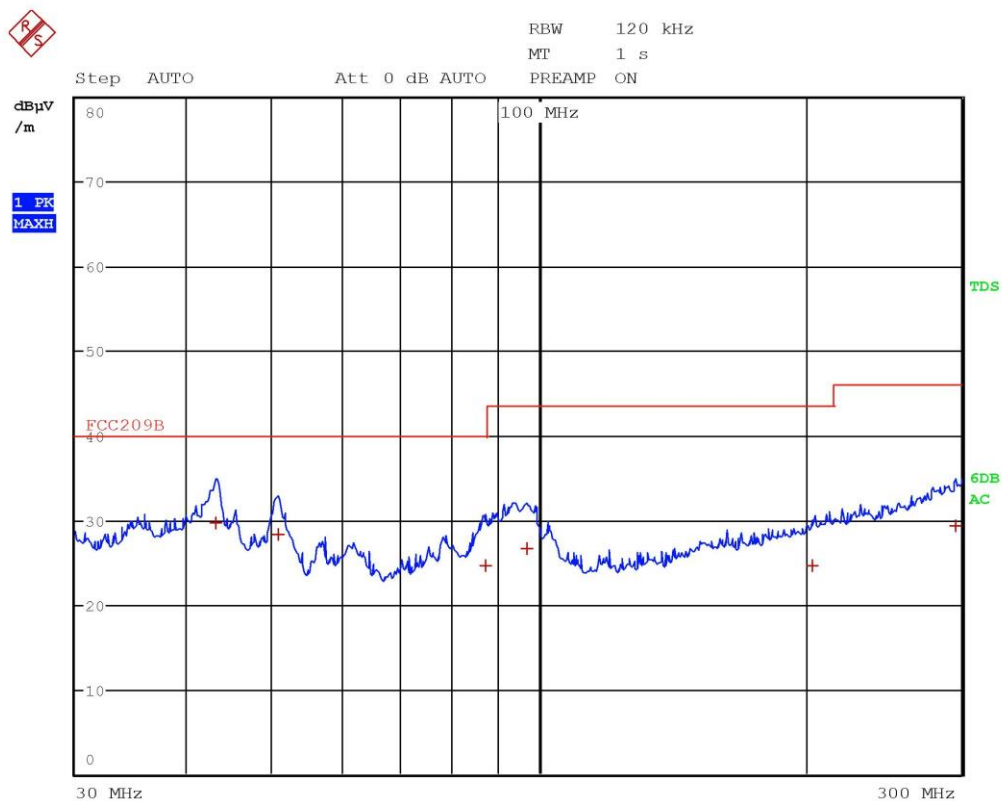


Segalla 200400A12



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC209B		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBμV/m	DELTA LIMIT dB
1 Quasi Peak	31.76 MHz	21.89	-18.10
1 Quasi Peak	45.04 MHz	19.43	-20.56
1 Quasi Peak	68.36 MHz	18.32	-21.67
1 Quasi Peak	137.68 MHz	20.69	-22.82
1 Quasi Peak	194.72 MHz	24.03	-19.48
1 Quasi Peak	299.12 MHz	29.69	-16.32

Segalla 200400A12



Segalla 200400A13