

Test Report

Product	Electronic Control Unit for vehicle Integration		
Name and address of the applicant	CPAC Systems AB Bergskroken 3 431 37 Mölndal, Sweden		
Name and address of the manufacturer	CPAC Systems AB Bergskroken 3 431 37 Mölndal, Sweden		
Model	SID 2.0		
Rating	24V _{DC}		
Trademark	CPAC Systems AB		
Additional information	WiFi, BT Classic, BLE, GSM, WCDMA, LTE		
Tested according to	Parts of FCC Part 15 Parts of FCC Parts 22 / 24 / 27 / 90 Parts of Canada RSS-247, Issue 2 Parts of Canada RSS-130 / RSS-132 / RSS-133 / RSS-139 / RSS-199		
Order number	PRJ0024292		
Tested in period	2023-03-01 to 2023-03-13		
Issue date	2023-06-28		
Name and address of the testing laboratory	 Nemko Scandinavia AS Instituttveien 6 2007 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO0470 ISED No: 2040D-1   NORWEGIAN ACCREDITATION TEST 033 An accredited technical test executed under the Norwegian accreditation scheme		
 Prepared by [Frode Sveinsen]  Approved by [G.Suhanthakumar]			
This report was originally distributed electronically with digital signatures. For more information, please contact Nemko Scandinavia AS.			

Revision history

Revision	Date	Comment	Sign
A	2023-06-28	First edition	FS

GENERAL REMARKS

This report applies only to the sample(s) tested. It is the manufacturer's responsibility to ensure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is solely responsible for any modifications to the product that could result in non-compliance with the relevant regulations.

This report shall not be reproduced except in full without the written approval of Nemko.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Group accepts no responsibility for damage suffered by any third party because of decisions made or actions based on this report.

Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither are opinions expressed regarding model variants covered by the testing of this report.

CALIBRATION

All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Between calibrations all test set-ups are controlled and verified on a regular basis by periodic checks to ensure, with 95% confidence, that the instruments remain within the calibrated levels.

MEASUREMENT UNCERTAINTY

Measurement uncertainties are calculated or considered for all instruments and instrument set-ups used during these tests. Uncertainty figures are found in a separate clause in this report.

CONTENTS

1	INFORMATION	4
1.1	Test Item	4
1.2	Normal test conditions	4
1.3	Test Engineer	4
1.4	Radio Modules	5
1.5	EUT Operating Modes	5
1.6	Mobile Frequency Bands and Standards	5
1.7	Comments	5
2	TEST REPORT SUMMARY	6
2.1	General	6
2.2	Test Summary	6
3	TEST RESULTS	7
3.1	Radiated Emissions, Interoperability	7
4	Measurement Uncertainty	32
5	LIST OF TEST EQUIPMENT	33
6	BLOCK DIAGRAM	34
6.1	Test Site Radiated Emission	34

1 INFORMATION

1.1 Test Item

Name	CPAC Systems AB
Model/version	SID 2.0
FCC ID	AHV-SID2
ISED ID	10111-SID2
Serial number	HYD-3891
Hardware identity and/or version	P-01
Software identity and/or version	Hydra_BTSW_1.0
Supported Radio Technologies	Bluetooth Classic Bluetooth Low energy WiFi 2.4 GHz / 5 GHz GSM 850 / 1900 (GPRS and Edge) WCDMA 850 / 1900 / 2100 LTE (FDD/TDD)
Antenna Connector	Fakra
Antenna Type	Antenna element LTE1: Rx/Tx Antenna element LTE2: Rx Only Antenna element WiFi/BT: Rx/Tx 2.4GHz WiFi/BT/BLE Antenna element WiFi: Rx/TX 2.4GHz WiFi Antenna element GNSS: Rx Only GNSS/GPS
Antenna Diversity Supported	Yes, but only for RX on LTE
Smart Antenna System	No
Power Source	External DC Supply (12-48V _{DC})

Description of Test Item

The EUT is a telematics unit with radio modules for BT/BLE/WiFi and Mobile (GSM/WCDMA/LTE). The mobile module is a certified radio module. The EUT also contains GPS and FM receiver.

This test report only covers only interoperability tests for simultaneous operation of the two radio modules.

1.2 Antenna Types

Name	P/N	Function	Number of inputs	Description
2J 2x 4G/3G/2G MIMO, +2x 2.4/5.0 GHz MIMO and GNSS	2J #2J4A50PCFa	2.4GHz Wifi+BT	2	COMBI ANT
		2G+3G+4G	2	
TE ANTENNA BASE FULL FEAT	Volvo #23311779	2.4GHz Wifi+BT	1	WHIP ANT
		2G+3G+4G	1	
TE ANTENNA INTERIOR WLAN	Volvo #23311706	2.4GHz Wifi+BT	1	PATCH ANT

1.3 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	24 V DC

The values are the limit registered during the test period.

The EUT was powered from a regulated power supply during all tests.

1.4 Test Engineer

Frode Sveinsen

1.5 Radio Modules

Data for radio modules				
Manufacturer	Model No	Identification	Original Test Report	RF Technology
ALPS	Alpine UGCZ1	N/A - Not certified	N/A	BT Classic
				BT Low Energy
				WiFi 5.0
Quectel	EG25-G	FCC ID: XMR201903EG25G IC: 10224A-201903EG25G P/N: EG25GGB-256-SGNS		GSM / WCDMA / LTE Cat 4

1.6 EUT Operating Modes

All tests were performed with GSM/WCDMA/LTE and WiFi programmed from an external computer.

Power values for these technologies are noted in the individual test reports.

The mobile signal was adjusted to the maximum output power supported for each technology.

1.7 Mobile Frequency Bands and Standards

Band	FCC	ISED Canada	Uplink Freq	Downlink Freq	Supported Technology	Common Name
B02	Part 24E	RSS-133 Issue 6 A1	1850-1910 MHz	1930-1990 MHz	GSM, WCDMA, LTE	1900 PCS
B04	Part 27C	RSS-139 Issue 3	1710-1755 MHz	2110-2155 MHz	WCDMA, LTE	AWS-1
B05	Part 22H	RSS-132 Issue 3	824-849 MHz	869-894 MHz	GSM, WCDMA, LTE	850
B07	Part 27C	RSS-199 Issue 3	2500-2570 MHz	2620-2690 MHz	LTE	2600
B12	Part 27C	RSS-130 Issue 2	699-716 MHz	729-746 MHz	LTE	700a
B13	Part 27C	RSS-130 Issue 2	777-787 MHz	746-756 MHz	LTE	700c
B25	Part 24E	RSS-133 Issue 6 A1	1850-1915 MHz	1930-1995 MHz	LTE	1900+
B26	Part 90S Part 22H	RSS-119 Issue 12 RSS-132 Issue 3	814-824 MHz 824-849 MHz	859-869 MHz 869-894 MHz	LTE	850+
B38	Part 27C	RSS-199 Issue 3	2570-2620 (TDD)		LTE	TD 2600
B41	Part 27C	RSS-199 Issue 3	2496-2690 (TDD)		LTE	TD 2600+

1.8 Comments

The Quectel cellular mobile is already certified, this report is only to check for interoperability when used together with the ALPS BT/BLE/WiFi chip, and with the described antennas.

All results are tested to limits for FCC 15.209 since these are the strictest limits.

2 TEST REPORT SUMMARY

2.1 General

Tests were performed in accordance with ANSI C63.4-2014, ANSI C63.10-2013 and ANSI C63.26-2015.

Radiated tests were performed in a semi-anechoic chamber at measuring distance 3m.

A description of the test facility is on file with the FCC and ISSED.

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2, RSS-GEN Issue 5 reference	ANSI C63.10-2013 Reference	Result
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6, 6.10 11.12, 11.13 (DTS)	Complies

3 TEST RESULTS

3.1 Radiated Emissions, Interoperability

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Detector: Peak Detector for Pre-scan (Measurements with Quasi-Peak Detector below 1 GHz)

Measuring distance: 3m (1 – 18 GHz)

A 2.4 GHz Band Reject Filter was used for measurements from 1 GHz to 18 GHz

The limit for Part 15.209 was used for all tests since this is the strictest limit.

The limit for licensed bands are -13 dBm average, which is equivalent to 82 dBµV/m @3m.

Antenna factor, PreAmp Gain and Cable Loss are included in spectrum analyzer "Transducer factor".

Results are shown below. No other emissions related to intermodulation were detected.

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
	All Limits below 1GHz are with Quasi Peak Detector	
30 – 88 MHz	100 µV/m	40.0 dBµV/m
88 – 216 MHz	150 µV/m	43.5 dBµV/m
216 – 960 MHz	200 µV/m	46.0 dBµV/m
960 – 1000 MHz	500 µV/m	54.0 dBµV/m
	Average Detector	Peak Detector
1 – 26 GHz	54.0 dBµV/m	74.0 dBµV/m

Combi Antenna

Band 02 + WiFi						
WiFi ch09/10/11 + GSM1900 ch512						
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m) QP	Limit (dBµV/m) QP	Margin (dB) QP
608	11g	2447	1850.2	26.4	46	19.6
608	11g	2452	1850.2	45.0	46	1.0
608	11g	2457	1850.2	45.5	46	0.5
608	11g	2462	1850.2	45.0	46	1.0
608	11n	2447	1850.2	28.6	46	17.4
608	11n	2452	1850.2	44.7	46	1.3
608	11n	2457	1850.2	45.4	46	0.6
608	11n	2462	1850.2	44.4	46	1.6

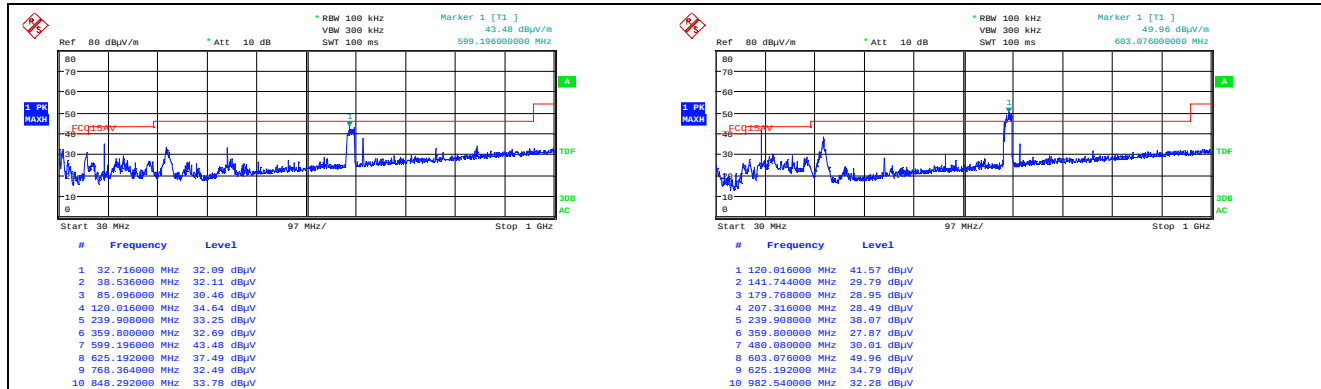
Band 02 + WiFi									
WiFi ch06 + GSM1900 ch725									
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
				Peak	Average	Peak	Average	Peak	Average
1349	11b	2437	1892.8	59.3	53.9	74	54	14.7	0.1
1349	11g	2437	1892.8	57.1	49.9	74	54	16.9	4.1
1349	11n	2437	1892.8	56.5	50.0	74	54	17.5	4.0

Band 04 + WiFi								
WiFi ch06 + WCDMA ch1450								
Measured Frequency (MHz)	Carrier Freq WiFi (MHz)	Carrier Freq WCDMA (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
			Peak	Average	Peak	Average	Peak	Average
Any	2437	1740	< 50	< 44	74	54	> 24	> 10

Band 05 + WiFi								
WiFi ch03/06 + GSM850 ch237								
Measured Frequency (MHz)	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
			Peak	Average	Peak	Average	Peak	Average
Any	2437	846	< 50	< 44	74	54	> 24	> 10

Band 07 + WiFi									
WiFi ch06 + LTE 2600 ch21350									
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq LTE (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
				Peak	Average	Peak	Average	Peak	Average
2312	11g	2437	2560	66.3	53.6	74	54	7.7	0.4
2312	11n	2437	2560	67.7	53.3	74	54	6.3	0.7

Band 02: GSM1900 (Combi Antenna)

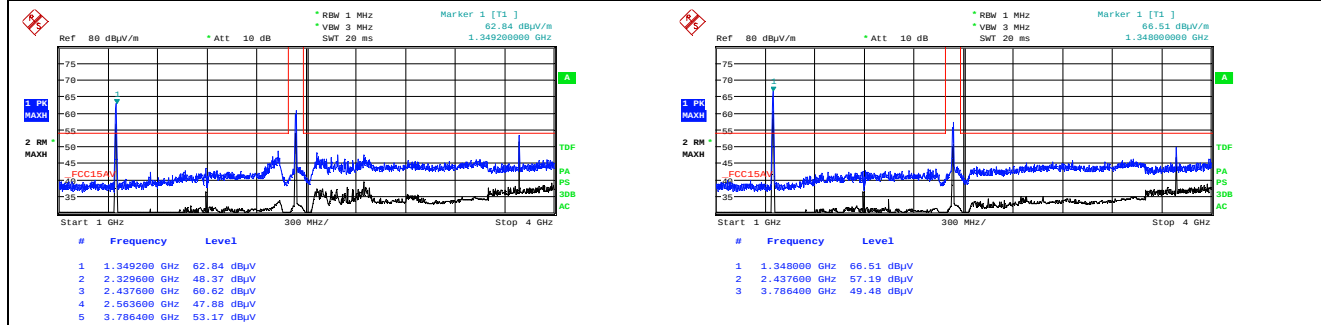


Date: 13.MAR.2023 16:43:13

Date: 13.MAR.2023 16:45:11

30-1000MHz, WiFi ch09 11g 6M + GSM1900 ch512 VP, PL13

HP

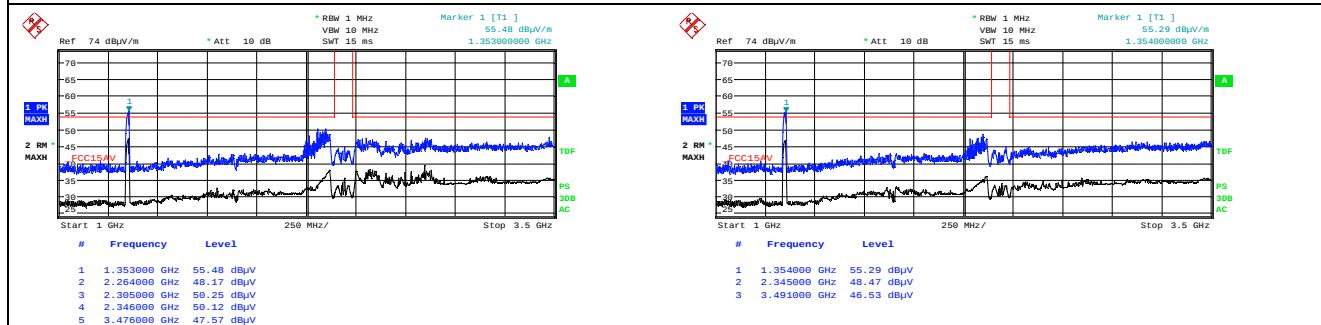


Date: 1.MAR.2023 10:27:40

Date: 1.MAR.2023 10:29:37

1000-4000MHz, WiFi ch06 11b 11M + GSM1900 ch725 VP

HP

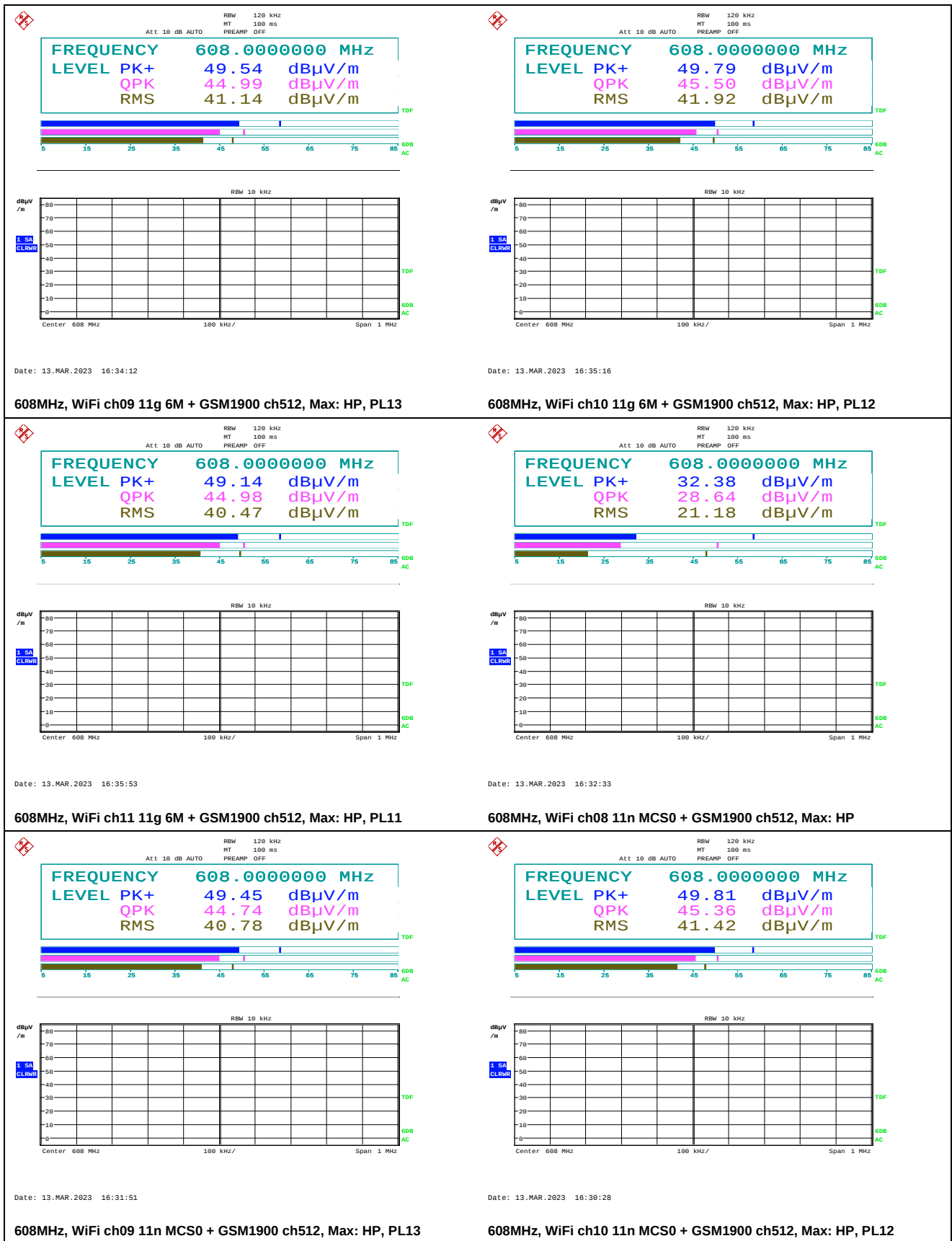


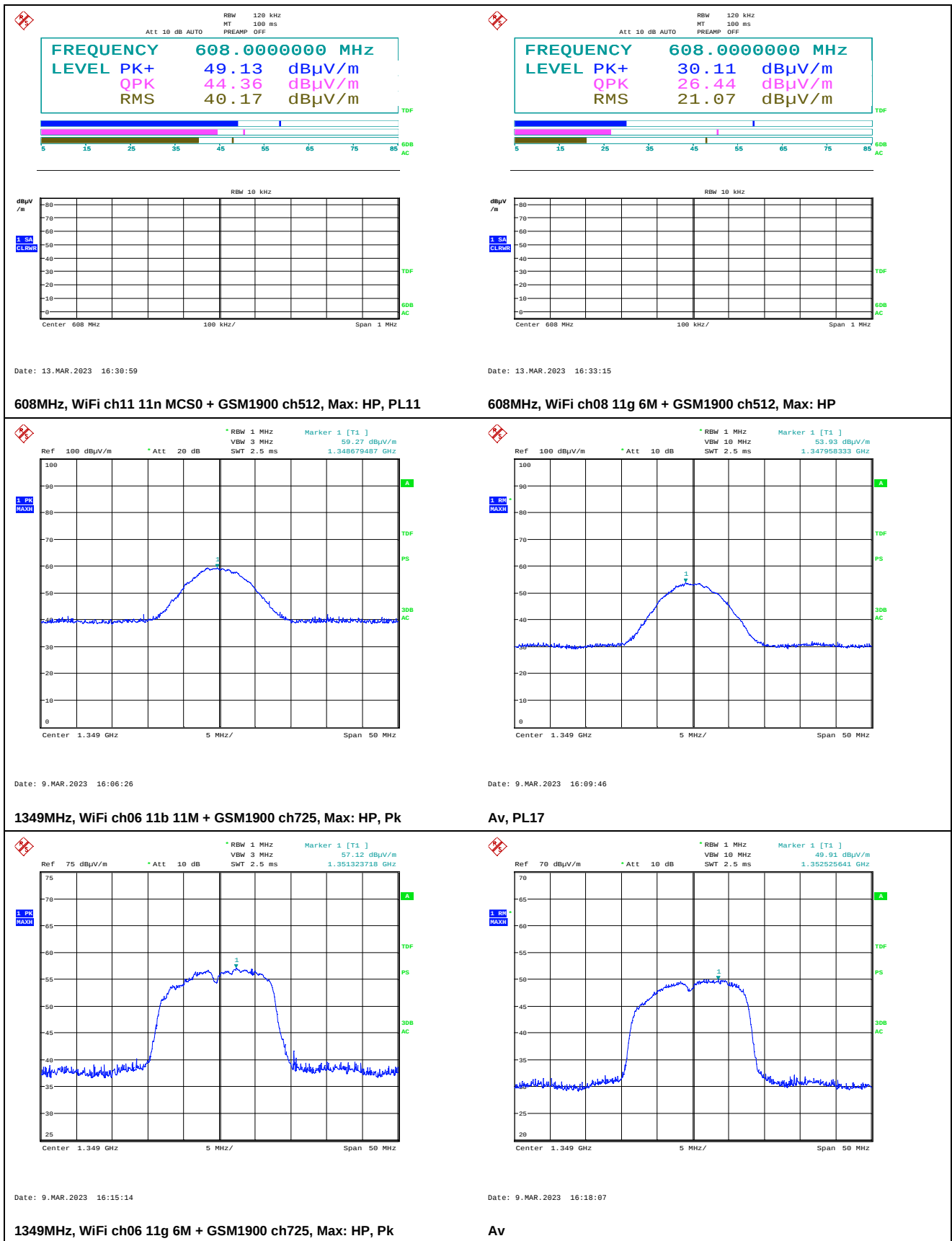
Date: 9.MAR.2023 16:31:05

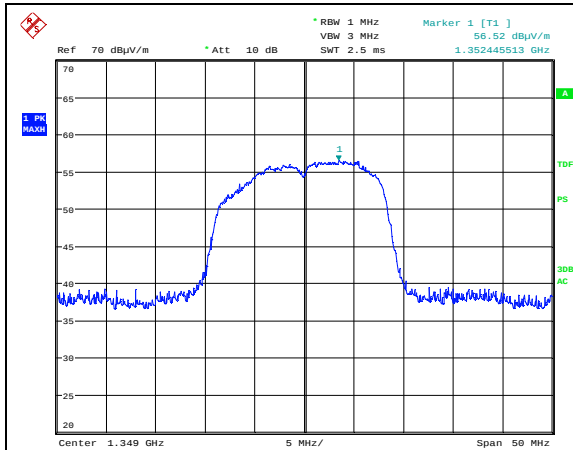
Date: 9.MAR.2023 16:33:03

1000-4000MHz, WiFi ch06 11n MCS0 + GSM1900 ch725 VP

HP

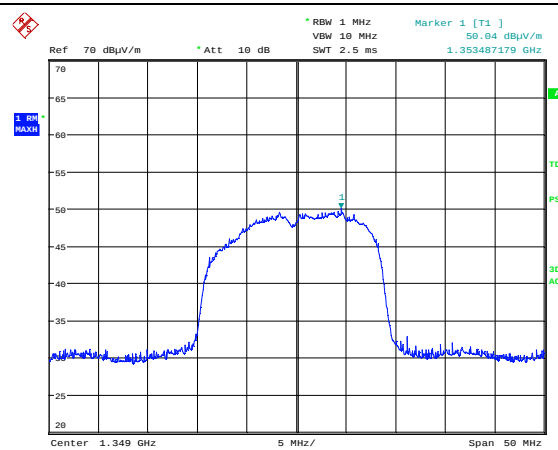






Date: 9.MAR.2023 16:22:58

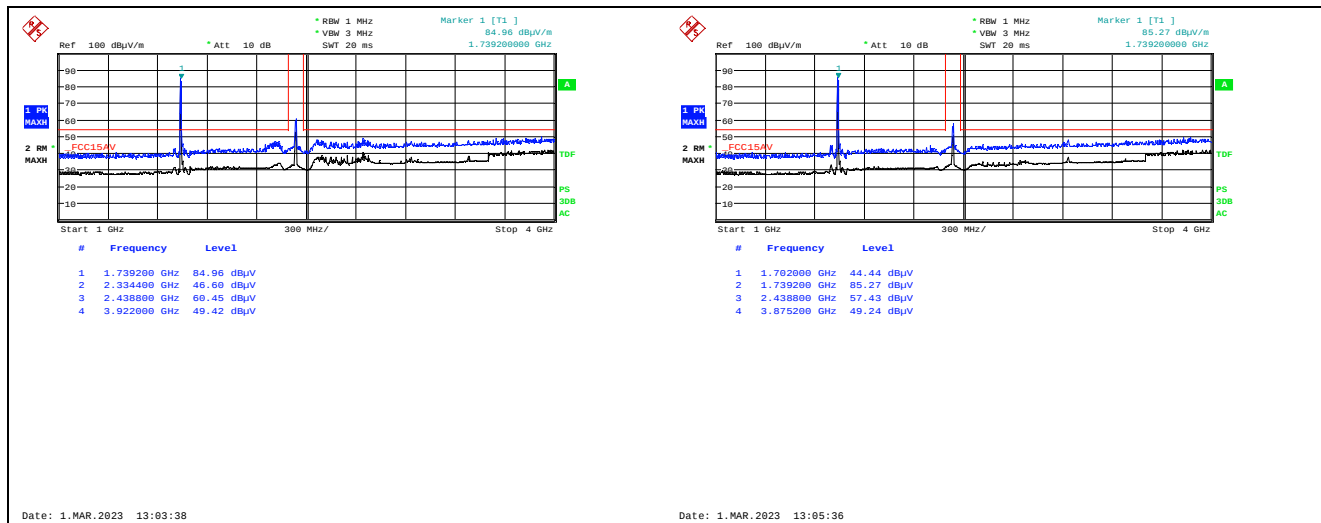
1349MHz, WiFi ch06 11n MCS0 + GSM1900 ch725, Max: HP, Pk



Date: 9.MAR.2023 16:26:01

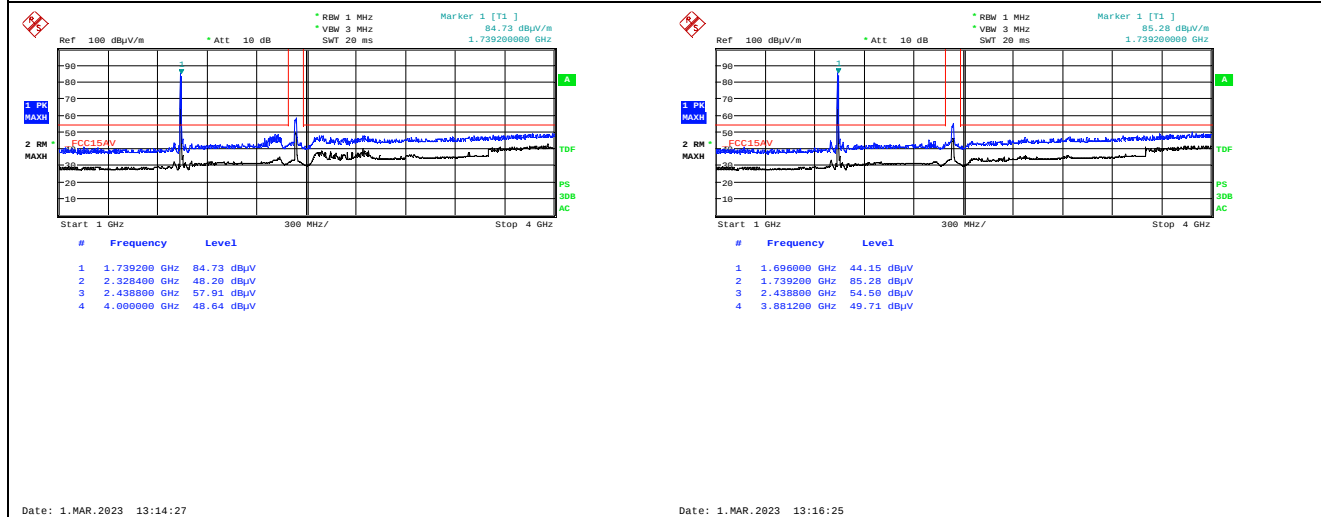
Av

Band 04: WCDMA 1700 (Combi Antenna)



1000-4000MHz, WiFi ch06 11b 11M + WCDMA ch1450 VP

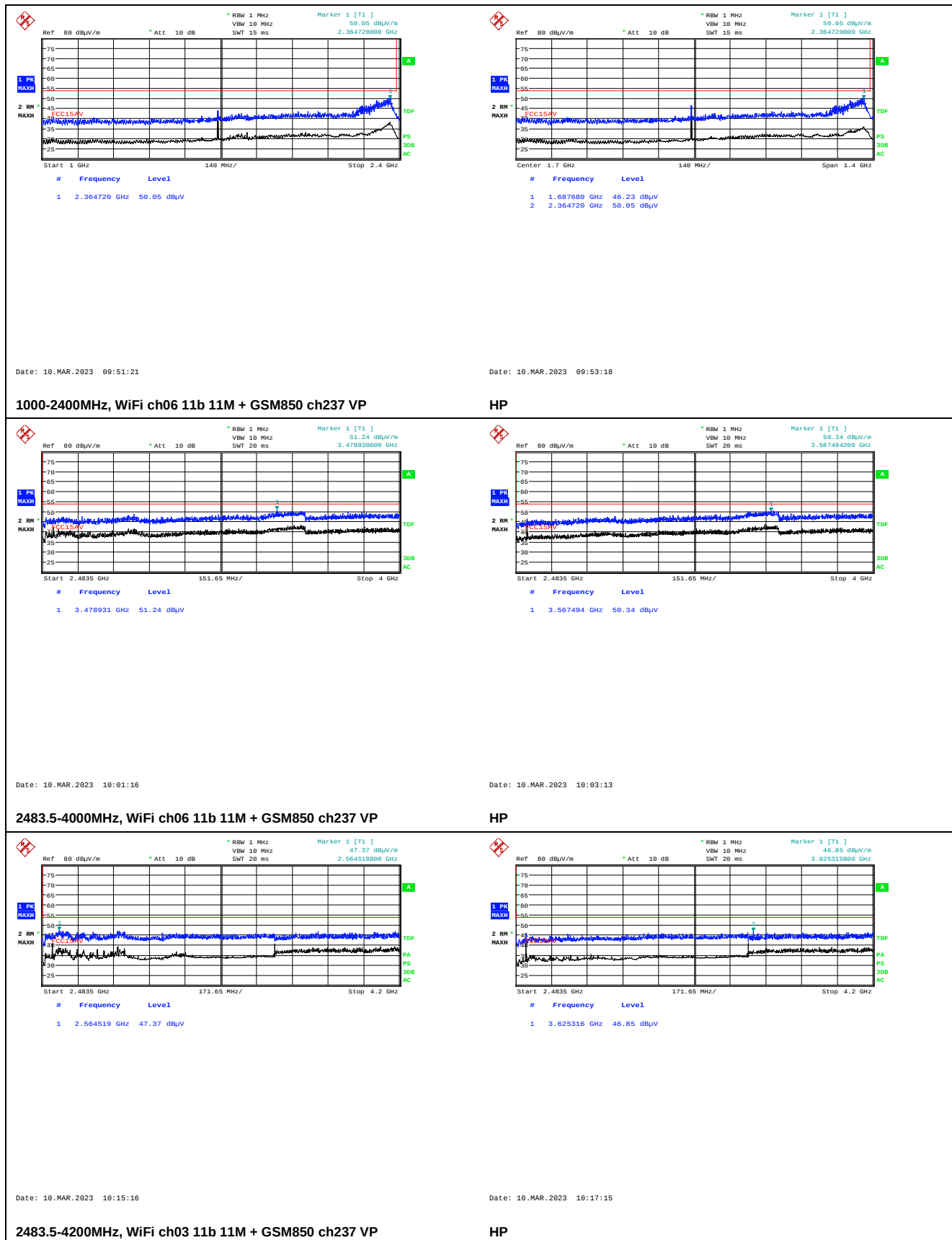
HP



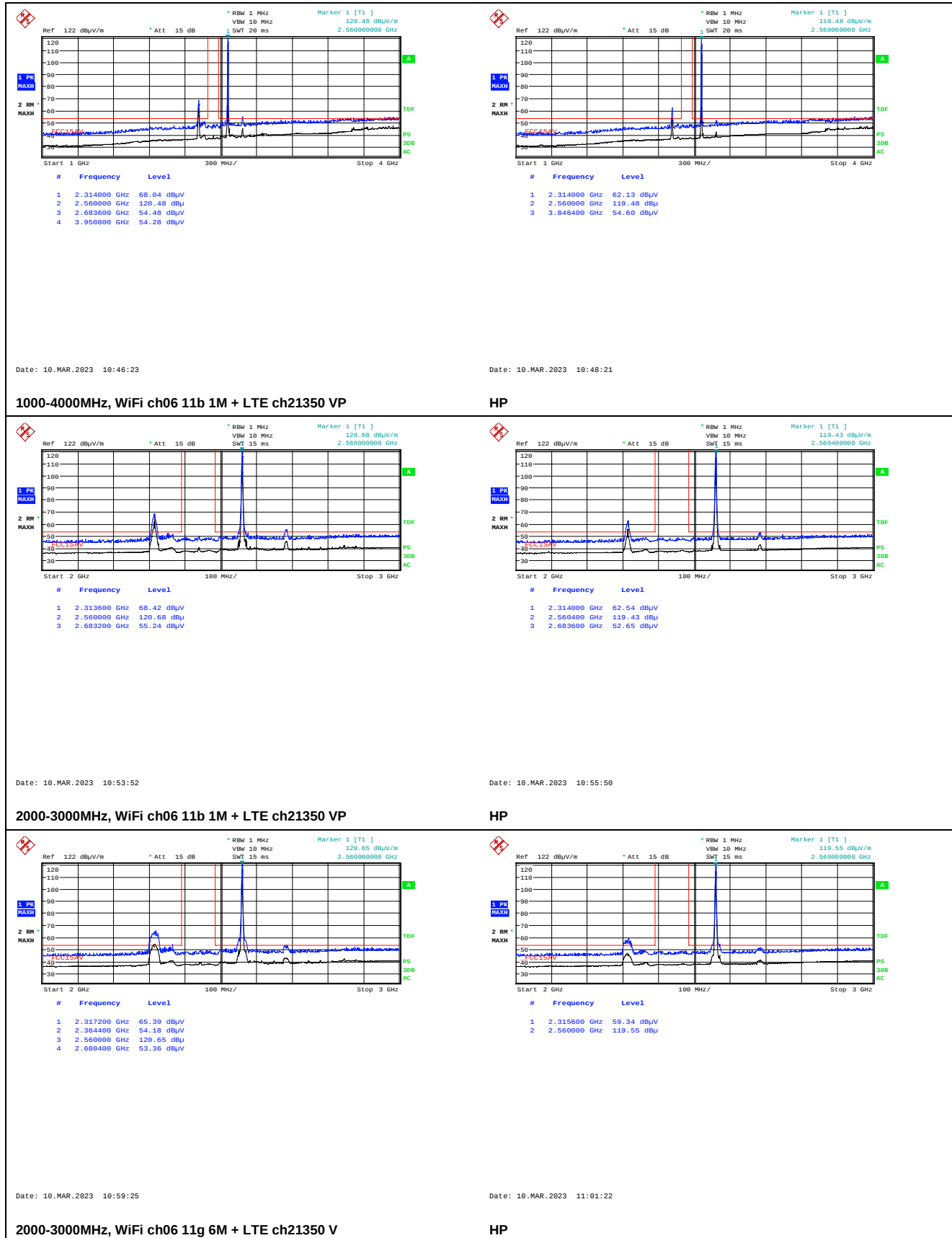
1000-4000MHz, WiFi ch06 11g 6M + WCDMA ch1450 VP

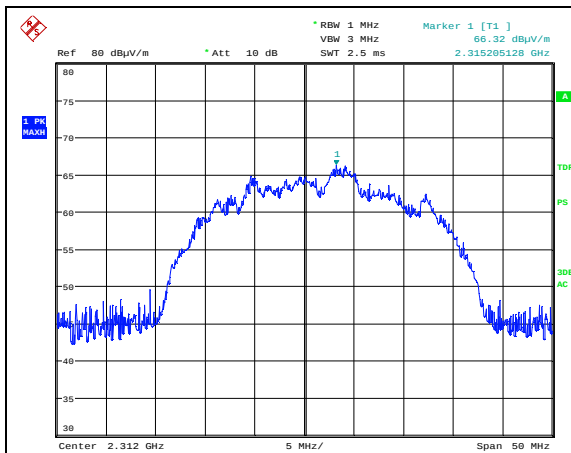
HP

Band 05: GSM850 (Combi Antenna)



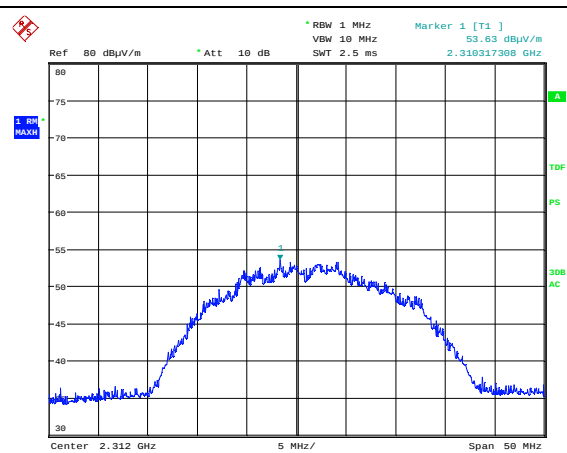
Band 07: LTE 2600 (Combi Antenna)





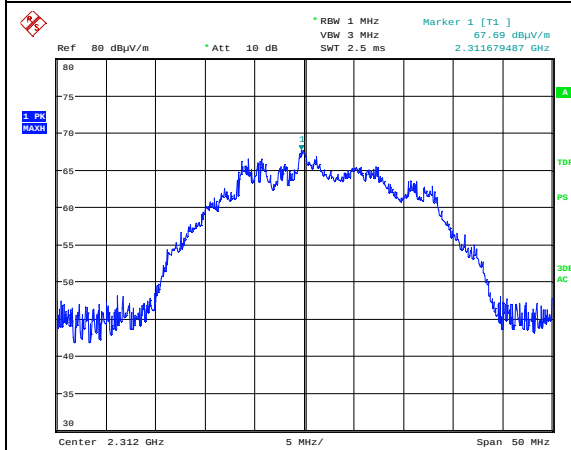
Date: 10.MAR.2023 12:25:36

2312MHz, WiFi ch06 11g 6M + LTE ch21350 VP, Max: VP, Pk



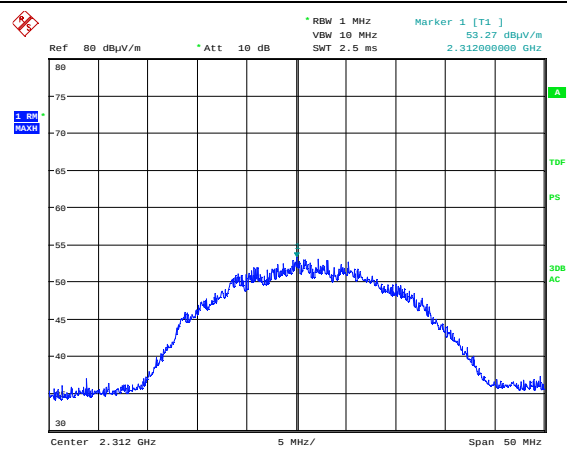
Date: 10.MAR.2023 12:30:33

Av



Date: 10.MAR.2023 12:50:44

2312MHz, WiFi ch06 11n MCS0 + LTE ch21350 VP, Max: VP, Pk



Date: 10.MAR.2023 12:46:59

Av

Whip + Patch Antenna (Ant0=Whip Ant., Ant1=Patch Ant.)

Band 02 + WiFi						
WiFi ch09/10/11 + GSM1900 ch512						
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m) QP	Limit (dBµV/m) QP	Margin (dB) QP
608	11b	2452	1850.2	39.4	46	6.6
608	11b	2457	1850.2	45.4	46	0.6
608	11b	2462	1850.2	44.9	46	1.1
608	11g	2452	1850.2	45.2	46	0.8
608	11g	2457	1850.2	45.4	46	0.6
608	11g	2462	1850.2	41.5	46	4.5
608	11n	2457	1850.2	45.7	46	0.3
611.8	11n	2462	1850.2	44.7	46	1.3

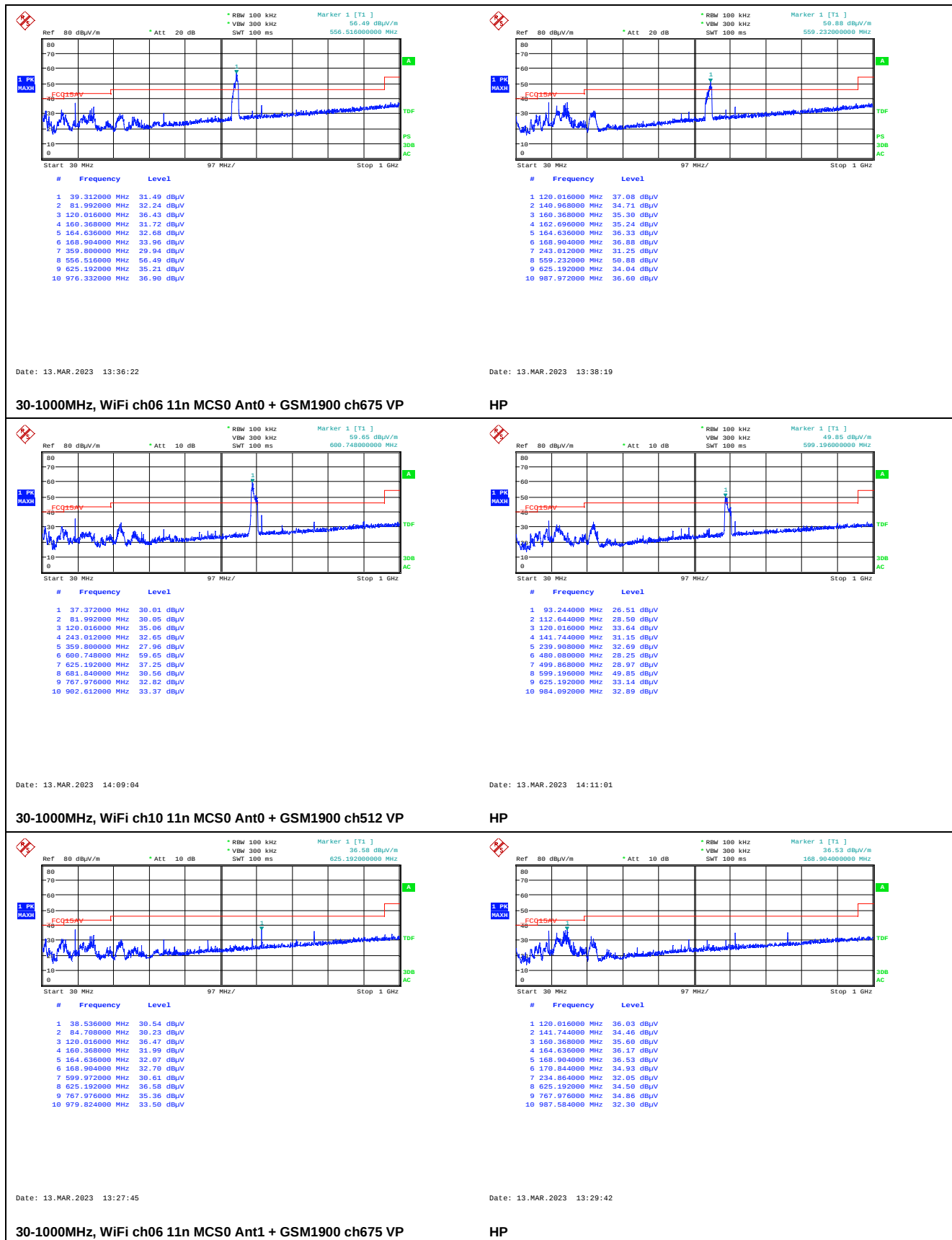
Band 02 + WiFi									
WiFi ch06 + GSM1900 ch725									
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
				Peak	Average	Peak	Average	Peak	Average
1349	11b	2437	1892.8	57.0	53.5	74	54	17.0	0.5
1349	11g	2437	1892.8	55.2	49.6	74	54	18.8	4.4

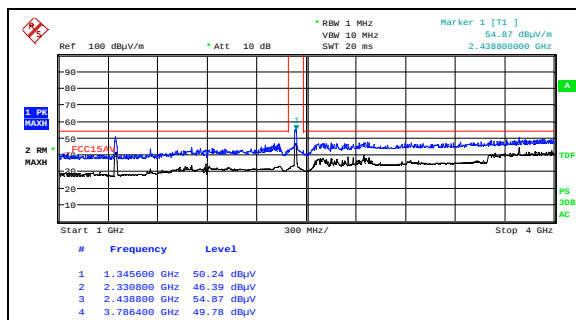
Band 04 + WiFi								
WiFi ch06 + WCDMA ch1350/1450								
Measured Frequency (MHz)	Carrier Freq WiFi (MHz)	Carrier Freq WCDMA (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
			Peak	Average	Peak	Average	Peak	Average
Any	2437	1720/1740	< 50	< 44	74	54	> 24	> 10

Band 05 + WiFi								
WiFi ch03/06 + GSM850 ch237								
Measured Frequency (MHz)	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
			Peak	Average	Peak	Average	Peak	Average
Any	2437	846	< 50	< 44	74	54	> 24	> 10

Band 07 + WiFi									
WiFi ch06 + LTE 2600 ch21350									
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq LTE (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
				Peak	Average	Peak	Average	Peak	Average
2315	11b	2437	2560	71.0	52.9	74	54	3.0	1.1
2315	11g	2437	2560	67.9	51.4	74	54	6.1	2.6
2315	11n	2437	2560	69.2	50.4	74	54	4.8	3.6
2315	11n MIMO	2437	2560	70.9	52.1	74	54	3.1	1.9

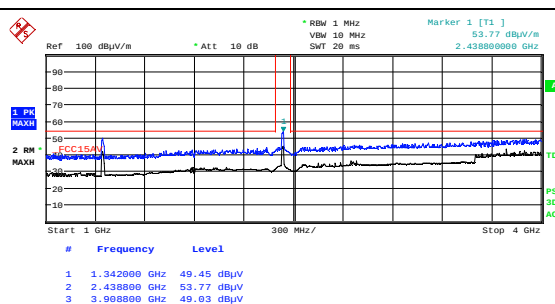
Band 02: GSM 1900 (Whip + Patch Antenna)





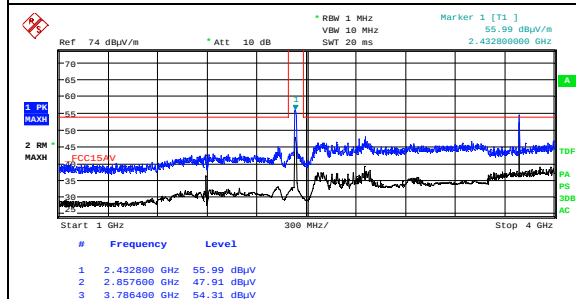
Date: 1.MAR.2023 14:54:26

1000-4000MHz, WiFi ch06 11g 6M Ant0 + GSM1900 ch725 VP



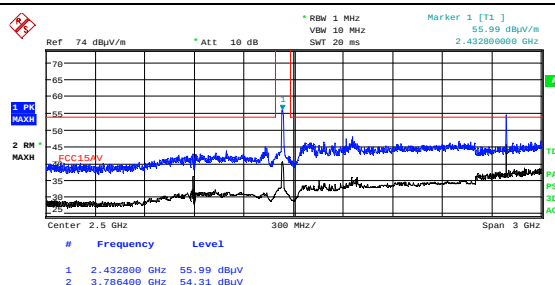
Date: 1.MAR.2023 14:56:24

HP



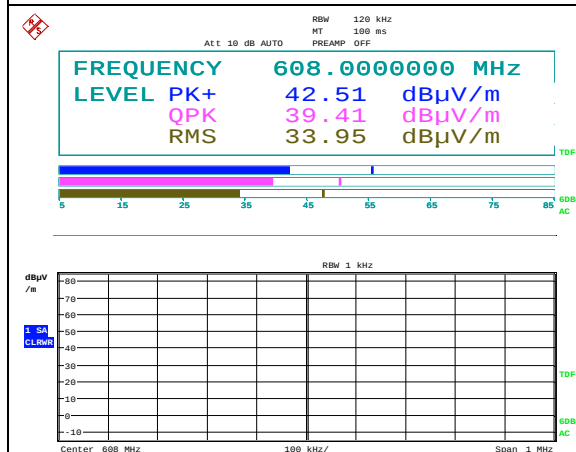
Date: 9.MAR.2023 09:38:49

1000-4000MHz, WiFi ch06 11g 6M Ant1 + GSM1900 ch725 VP



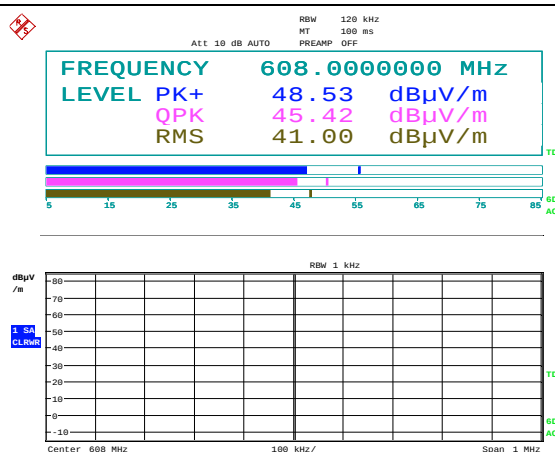
Date: 9.MAR.2023 09:40:47

HP



Date: 13.MAR.2023 14:34:53

608MHz, WiFi ch09 11b 11M + GSM1900 ch512, (Max: HP) PL18



Date: 13.MAR.2023 14:34:23

608MHz, WiFi ch10 11b 11M + GSM1900 ch512, (Max: HP) PL13



608MHz, WiFi ch11 11b 11M + GSM1900 ch512, (Max: HP) PL12



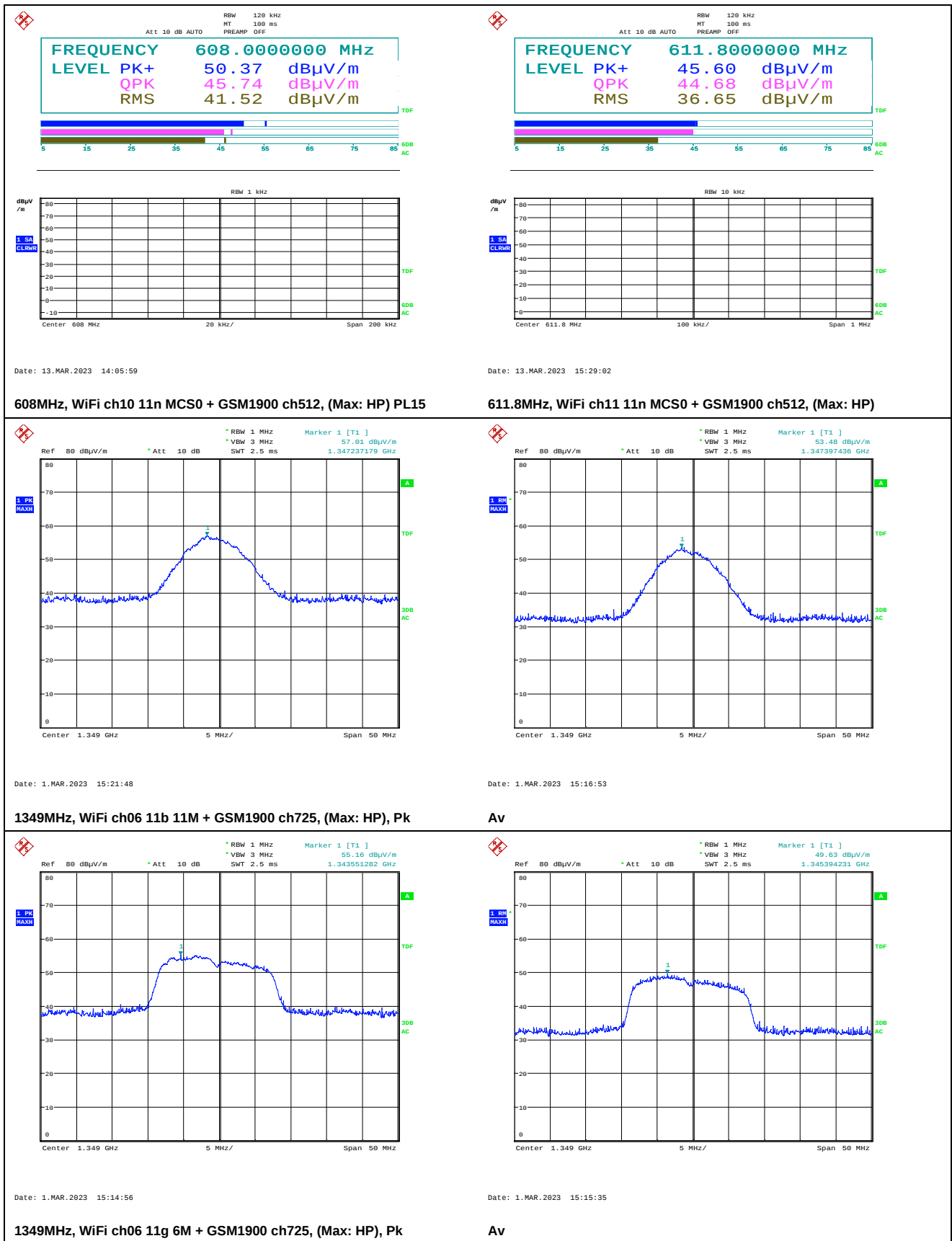
608MHz, WiFi ch09 11g 6M + GSM1900 ch512, (Max: HP) PL16



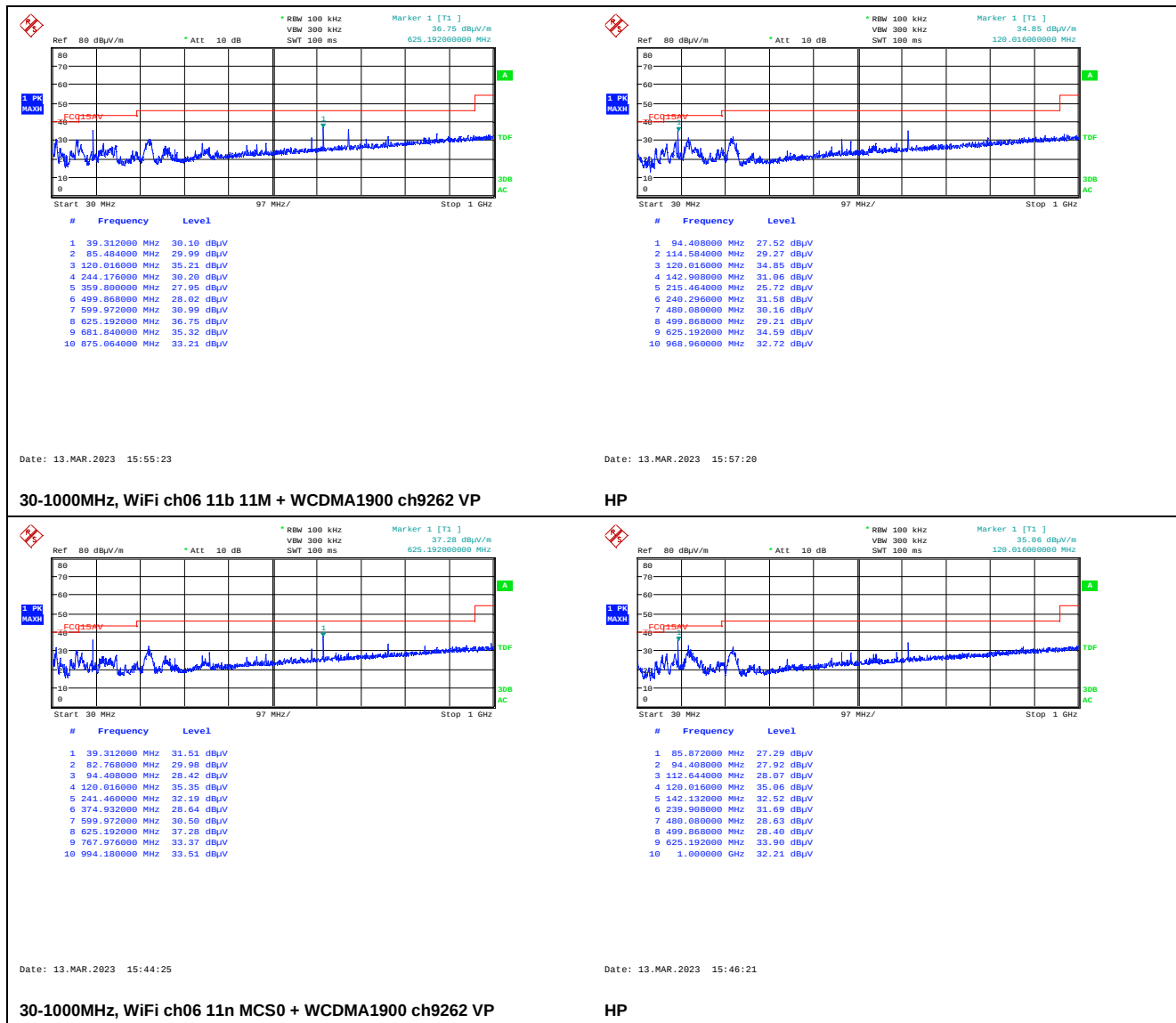
608MHz, WiFi ch10 11g 6M + GSM1900 ch512, (Max: HP) PL15



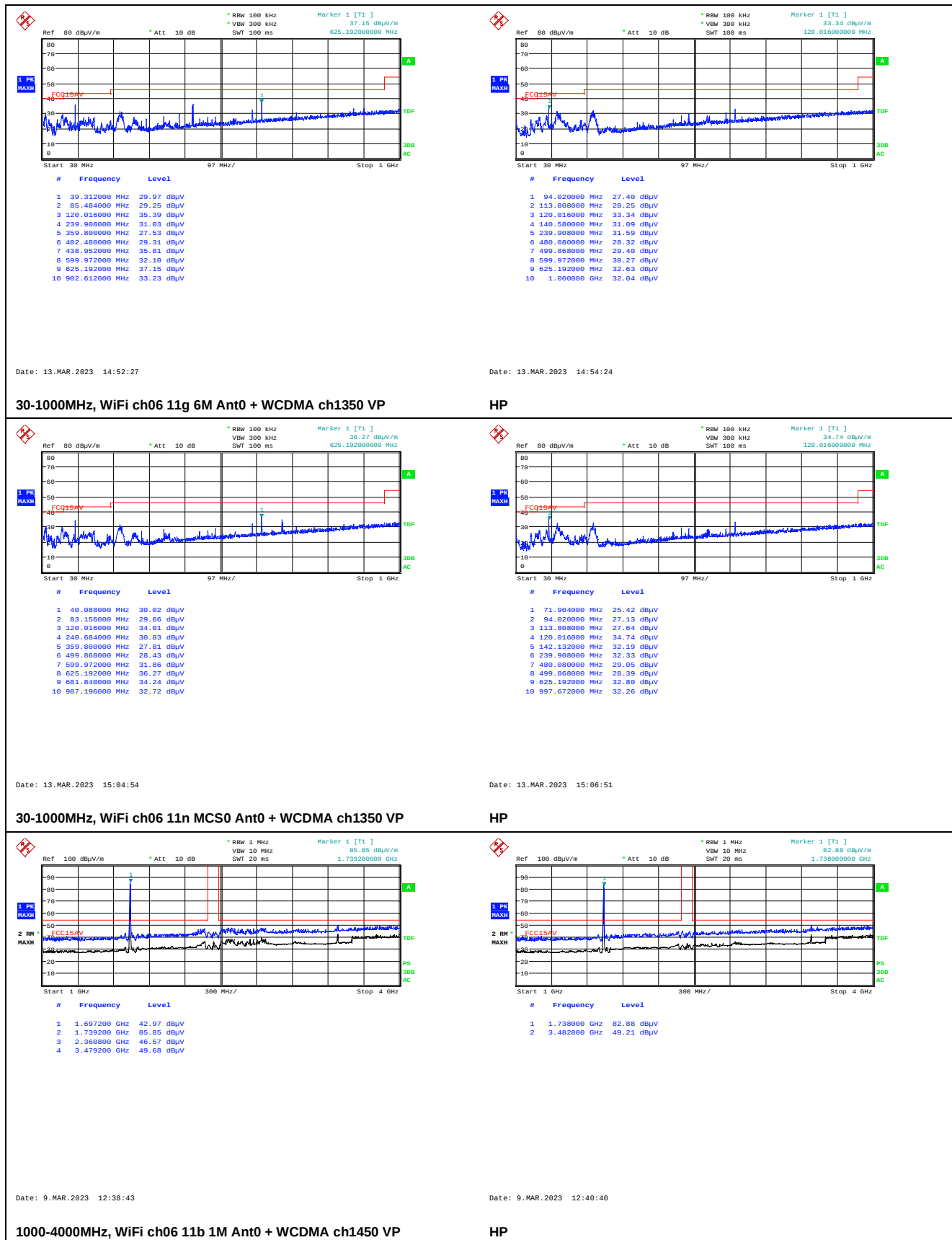
608MHz, WiFi ch11 11g 6M + GSM1900 ch512, (Max: HP) PL11



Band 02: WCDMA 1900 (Whip + Patch Antenna)

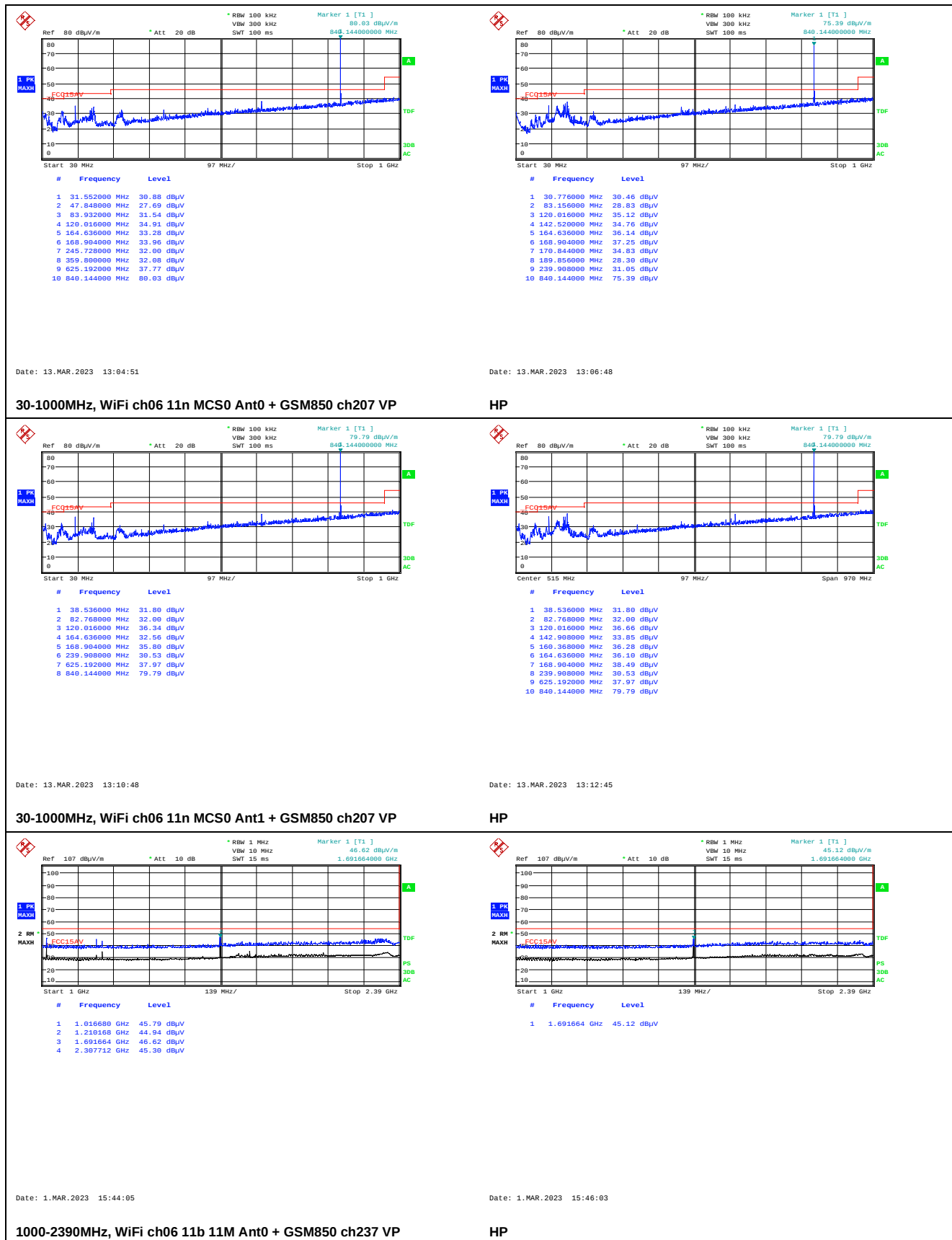


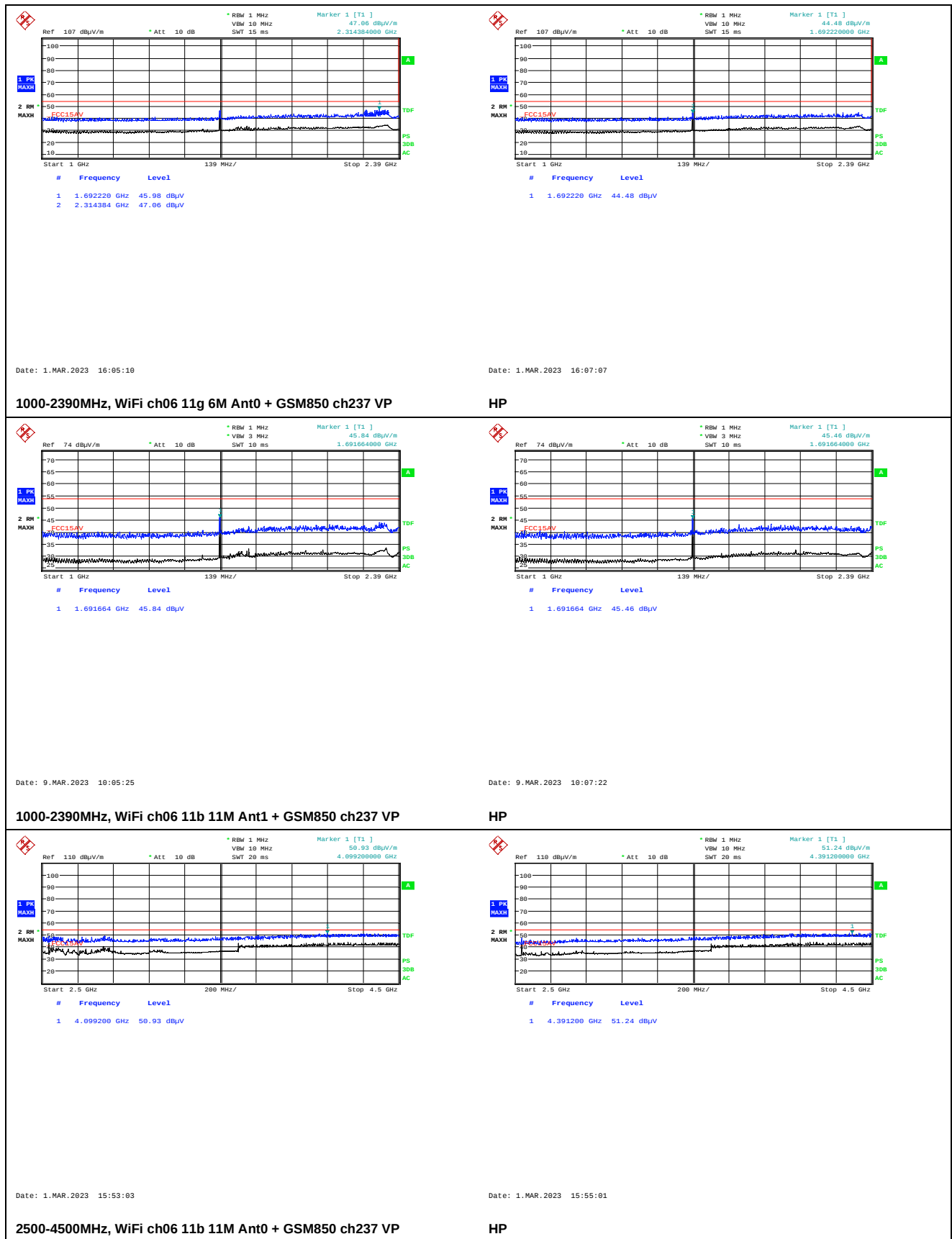
Band 04: WCDMA 1700 (Whip + Patch Antenna)

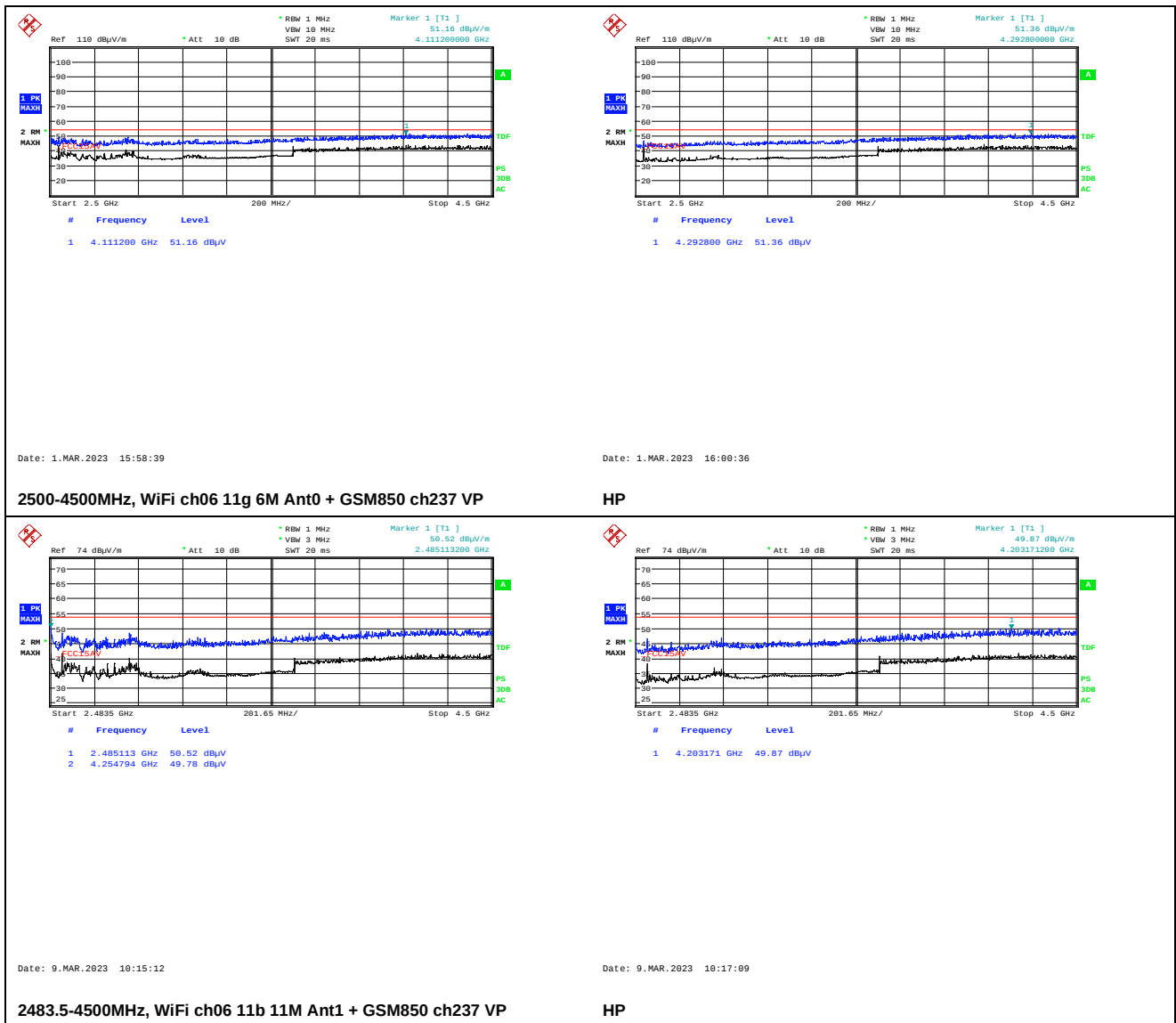




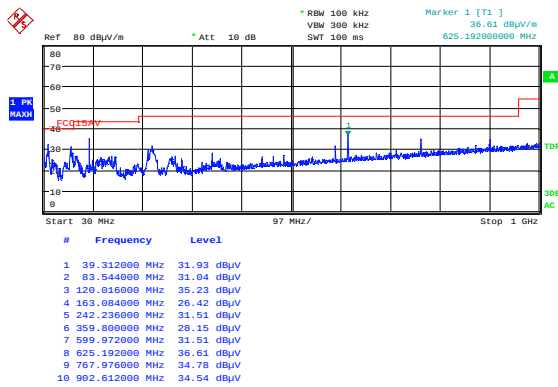
Band 05: GSM 850 (Whip + Patch Antenna)



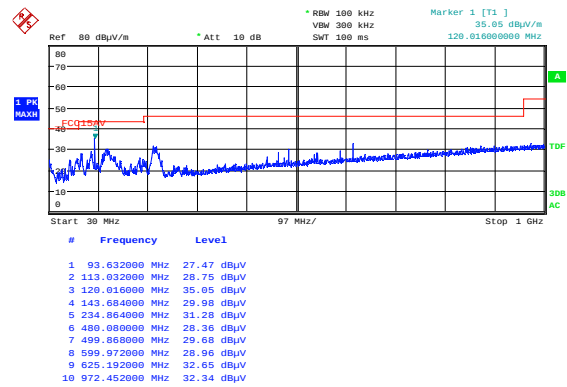




Band 07: LTE 2600 (Whip + Patch Antenna)



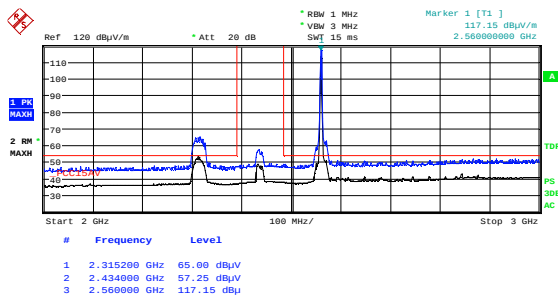
Date: 13.MAR.2023 15:15:09



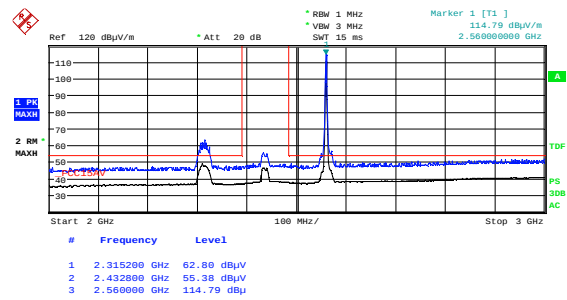
Date: 13.MAR.2023 15:17:05

30-1000MHz, WiFi ch06 11n MCS0 + LTE ch21350 VP

HP



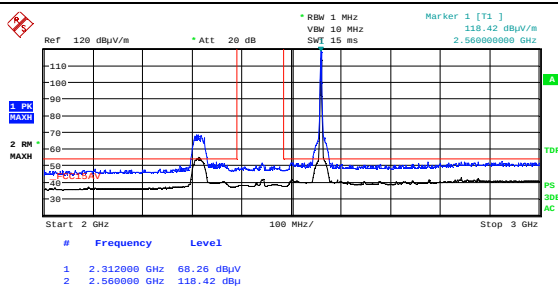
Date: 1.MAR.2023 16:31:55



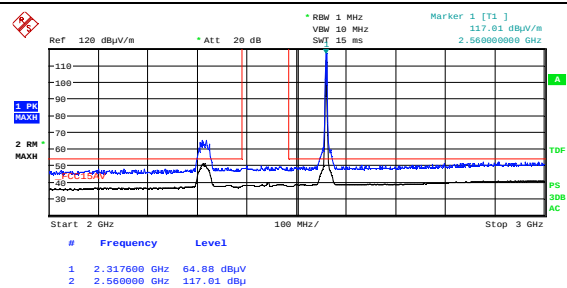
Date: 1.MAR.2023 16:33:53

2000-3000MHz, WiFi ch06 11g 6M + LTE ch21350 VP

HP



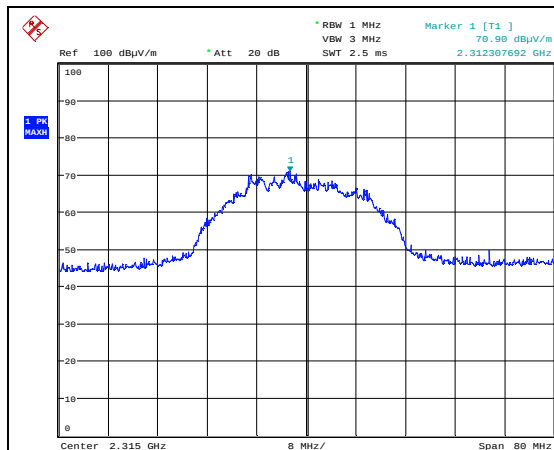
Date: 9.MAR.2023 10:44:01



Date: 9.MAR.2023 10:45:59

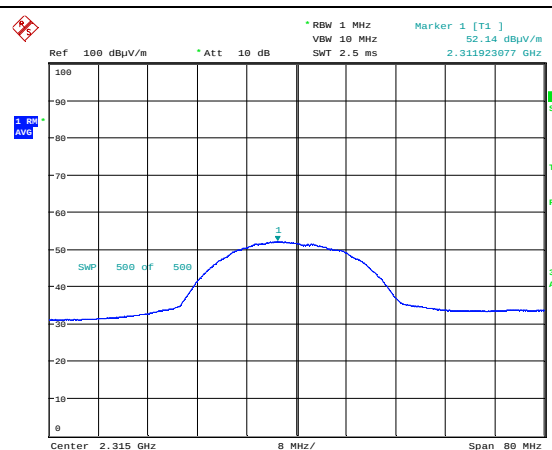
2000-3000MHz, WiFi ch06 11n MCS0 MIMO + LTE ch21350VP

HP



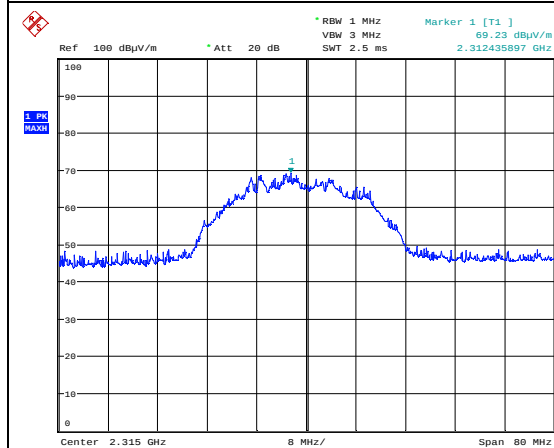
Date: 9.MAR.2023 11:54:32

2315 MHz, WiFi ch06 11n MCS0 MIMO + LTE ch21350, Max: VP, Pk



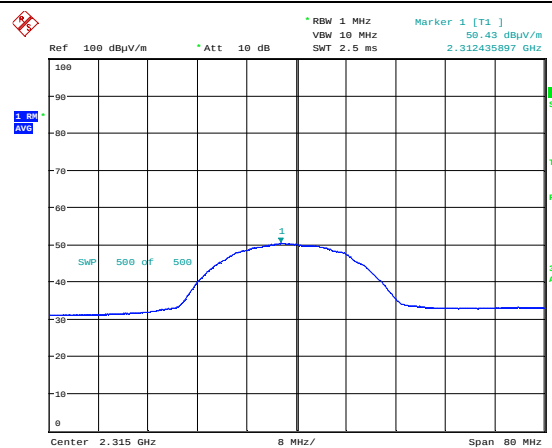
Date: 9.MAR.2023 11:55:21

Av



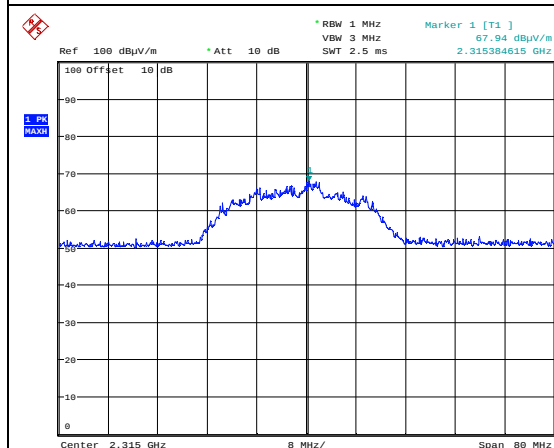
Date: 9.MAR.2023 11:56:52

2315 MHz, WiFi ch06 11n MCS0 SISO + LTE ch21350, Max: VP, Pk



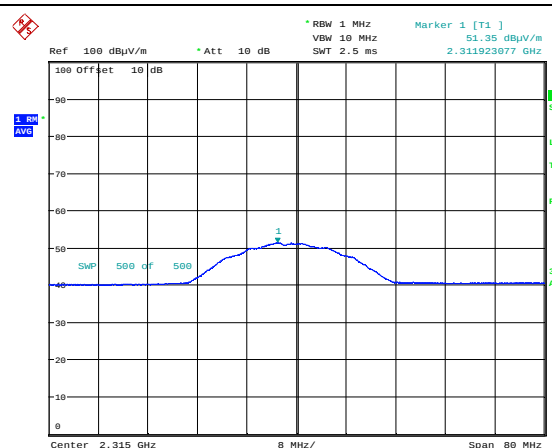
Date: 9.MAR.2023 11:57:43

Av



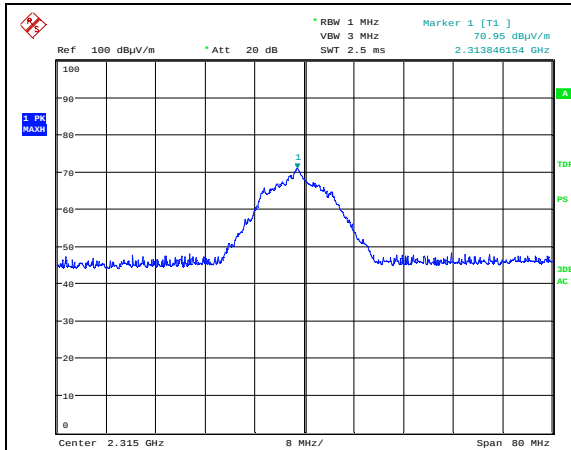
Date: 9.MAR.2023 12:14:27

2315 MHz, WiFi ch06 11g 6M + LTE ch21350, Max: VP, Pk



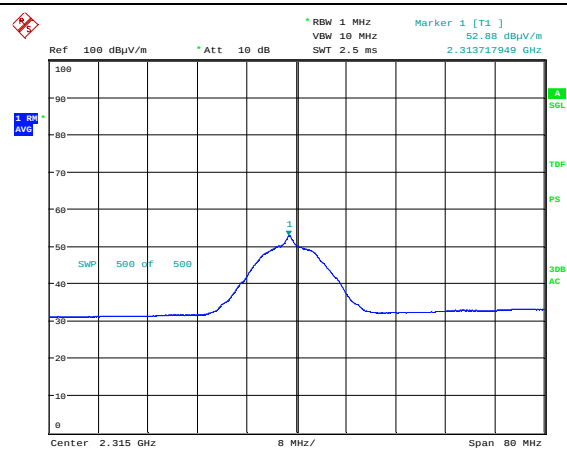
Date: 9.MAR.2023 12:08:16

Av



Date: 9.MAR.2023 11:59:16

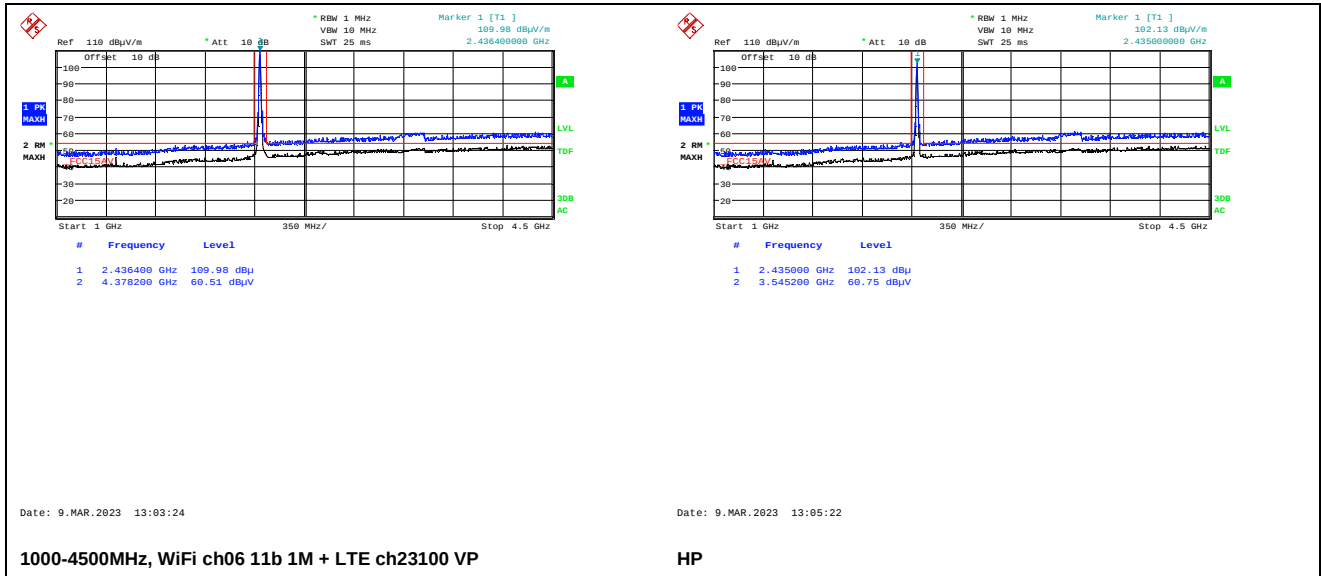
2315 MHz, WiFi ch06 11b 11M + LTE ch21350, Max: VP, Pk



Date: 9.MAR.2023 12:01:02

Av, PL16

Band 12: LTE 700a (Whip + Patch Antenna)



4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2023-01	2024-01
2	6810-17B	Attenuator	Suhner	LR 1669	COU	
3	N0324415	BandStop Filter (2.4GHz)	Microwave Circuits	LR 1760	COU	
4	WLK5-1100-1485-7000-40SS	Low Pass Filter (1GHz)	Wainwright Inst.	LR 1761	COU	
5	310	Preamplifier	Sonoma Inst.	LR 1686	2022-08	2023-08
6	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2022-08	2023-08
7	3115	Horn Antenna	EMCO	LR 1330	N/A	
10	6032A	System Power Supply	Hewlett Packard	LR 1062	COU	
11	Model 87V	Multimeter	Fluke	LR 1600	2022-03	2024-03

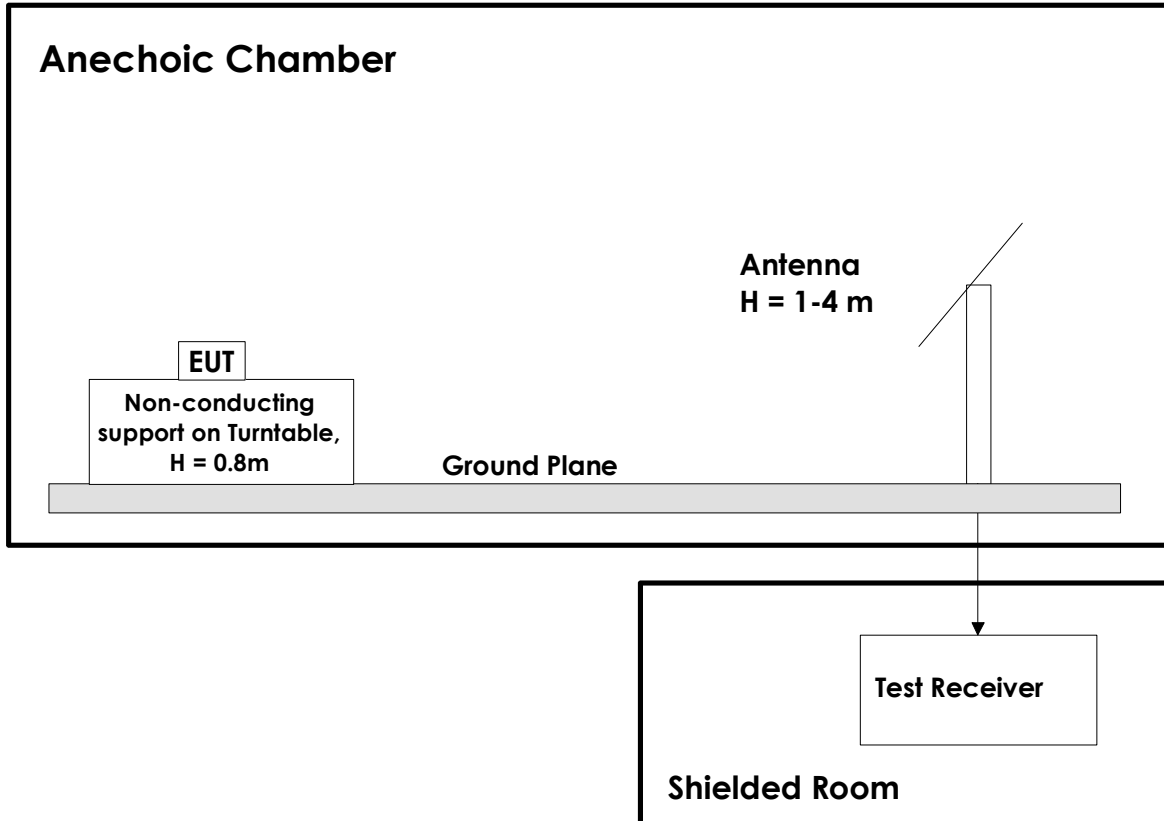
Note: COU – calibrate on use; N/A – Not Applicable

The software listed below has been used for one or more tests.

No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.10	EMC test software
2	Nemko AS	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

6 BLOCK DIAGRAM

6.1 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.