REP019503

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	**2023-11-21**
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 **An accredited technical test executed under the Norwegian accreditation scheme** NORWEGIAN ACCREDITATION TEST 033

Prepared by [Frode Sveinsen] | Approved by [Jan G Eriksen]

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Template version: C

Revision history

Revision	Date	Comment	Sign
A	2023-11-21	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.

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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.

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1 INFORMATION

1.1 Test Item

Name	**CPAC Systems AB**
Model/version	**SID 2.0**
FCC ID	**AHV-SID2B**
ISED ID	**10111A-SID2B**
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 for simultaneous operation of the two radio modules.

Model Overview						
Model Name	**U-NII**	**Marine**	**LTE**	**FCC ID**	**IC ID**	**Description**
SID 2.0	☐	☐	☒	AHV-SID2	10111A-SID2	Model without 5GHz WiFi
SID 2.0	☒	☐	☒	AHV-SID2B	10111A-SID2B	Model with 5GHz WiFi
SID 2.0M	☒	☒	☐	AHV-SID2M	10111A-SID2M	Marine Model without LTE
SID 2.0MLTE	☒	☒	☒	AHV-SID2MLTE	10111A-SID2MLTE	Marine Model with LTE

All models are electrically identical, except SID 2.0M does not have the LTE module installed.

1.2 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.

1.3 Antenna Types

Name	P/N	Function	Number of inputs	Description
2J 2× 4G/3G/2G MIMO, +2× 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

1.4 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 ISED.

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

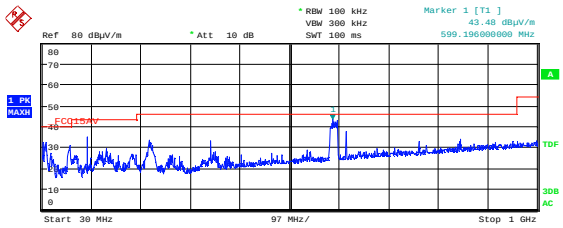
Band 02 + WiFi WiFi ch06 + GSM1900 ch725									
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
				Peak	Average	Peak	Average	Peak	Average
1349	11b	2437	1892.8	59.3	53.9	74	54	14.7	0.1
1349	11g	2437	1892.8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

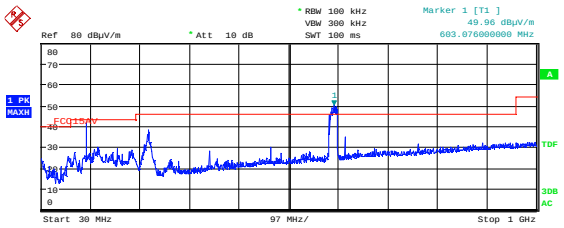
Band 02: GSM1900 (Combi Antenna)



#	Frequency	Level
1	32.716000 MHz	32.09 dBµV
2	38.536000 MHz	32.11 dBµV
3	85.096000 MHz	30.46 dBµV
4	120.016000 MHz	34.64 dBµV
5	239.908000 MHz	33.25 dBµV
6	359.800000 MHz	32.69 dBµV
7	599.196000 MHz	43.48 dBµV
8	625.192000 MHz	37.49 dBµV
9	768.364000 MHz	32.49 dBµV
10	848.292000 MHz	33.78 dBµV

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

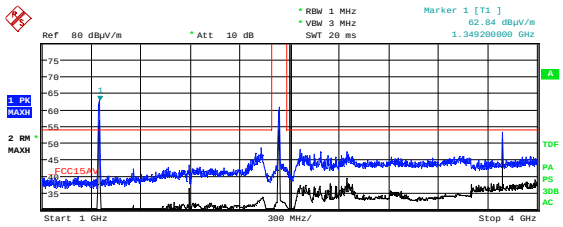
30-1000MHz, WiFi ch09 11g 6M + GSM1900 ch512 VP, PL13



#	Frequency	Level
1	120.016000 MHz	41.57 dBµV
2	141.744000 MHz	29.79 dBµV
3	179.768000 MHz	28.95 dBµV
4	207.316000 MHz	28.49 dBµV
5	239.908000 MHz	38.07 dBµV
6	359.800000 MHz	27.87 dBµV
7	480.080000 MHz	30.01 dBµV
8	603.076000 MHz	49.96 dBµV
9	625.192000 MHz	34.79 dBµV
10	982.540000 MHz	32.28 dBµV

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

HP



#	Frequency	Level
1	1.349200 GHz	62.84 dBµV
2	2.329600 GHz	48.37 dBµV
3	2.437600 GHz	60.62 dBµV
4	2.563600 GHz	47.88 dBµV
5	3.786400 GHz	53.17 dBµV

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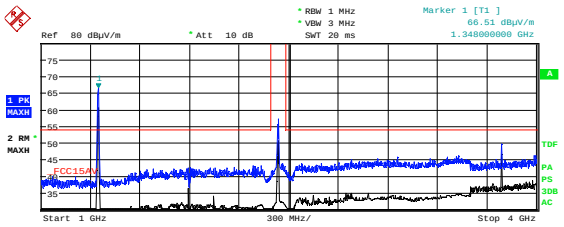
1000-4000MHz, WiFi ch06 11b 11M + GSM1900 ch725 VP



#	Frequency	Level
1	1.348000 GHz	66.51 dBµV
2	2.437600 GHz	57.19 dBµV
3	3.786400 GHz	49.48 dBµV

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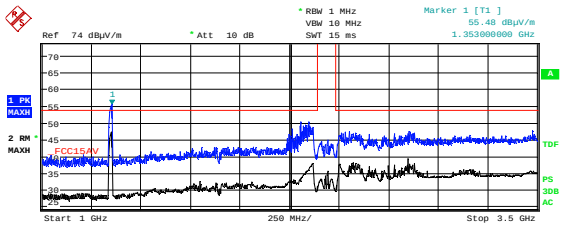
HP



#	Frequency	Level
1	1.353000 GHz	55.48 dBµV
2	2.264000 GHz	48.17 dBµV
3	2.305000 GHz	50.25 dBµV
4	2.346000 GHz	50.12 dBµV
5	3.476000 GHz	47.57 dBµV

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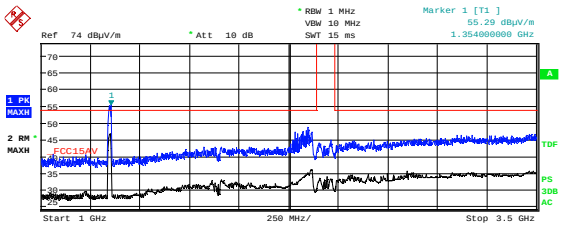
1000-4000MHz, WiFi ch06 11n MCS0 + GSM1900 ch725 VP



#	Frequency	Level
1	1.354000 GHz	55.29 dBµV
2	2.345000 GHz	48.47 dBµV
3	3.491000 GHz	46.53 dBµV

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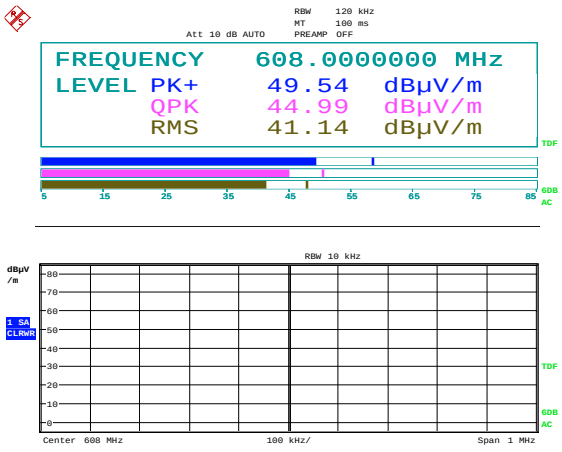
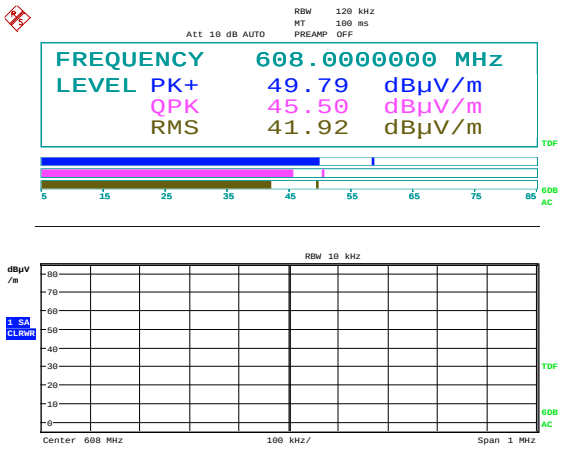
HP



608MHz, WiFi ch09 11g 6M + GSM1900 ch512, Max: HP, PL13



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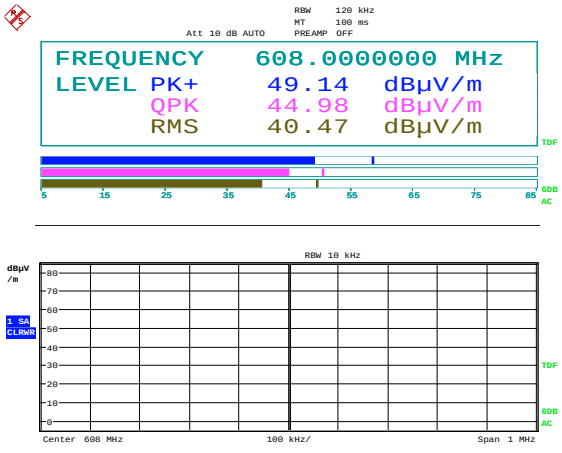

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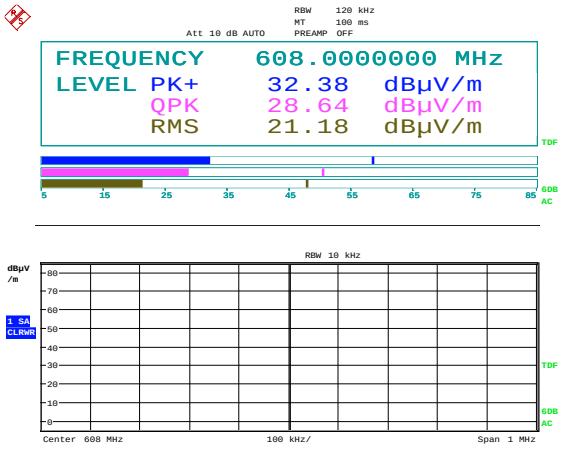

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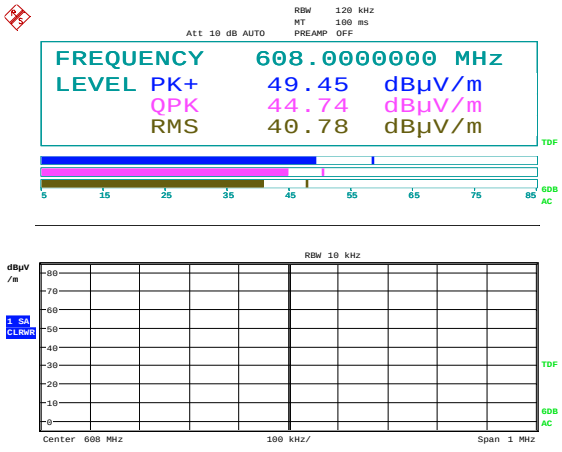

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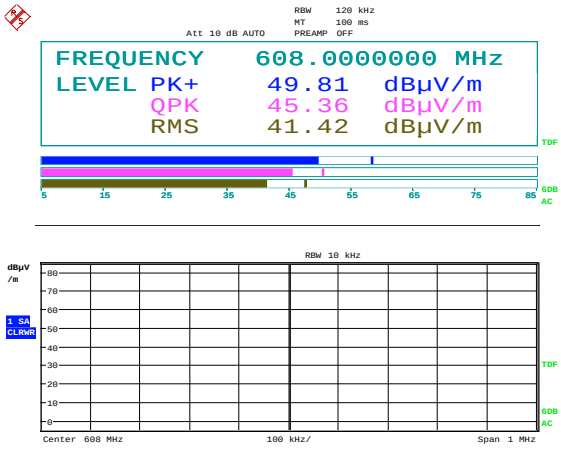

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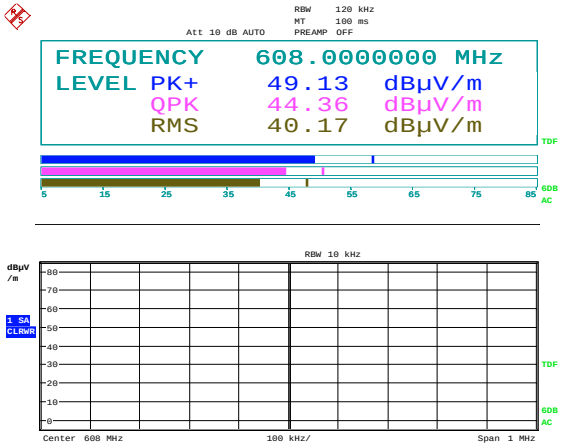

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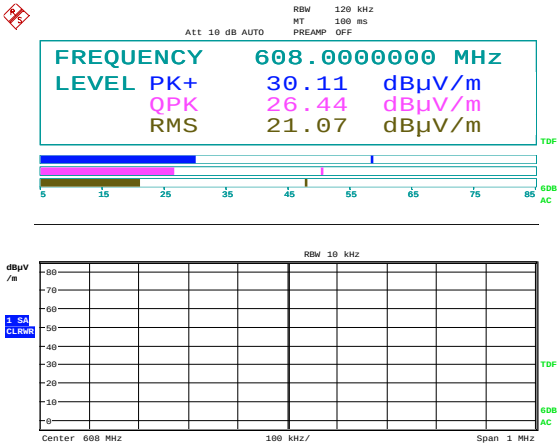
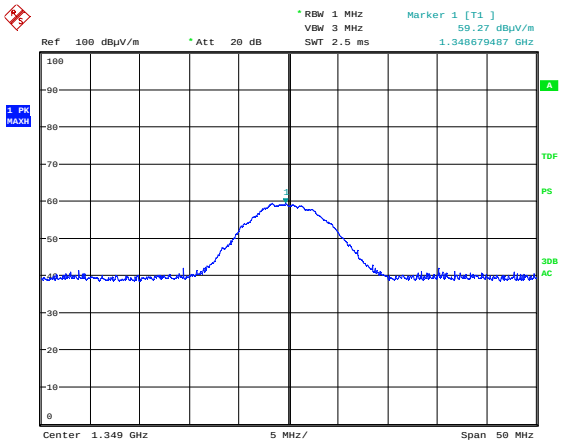
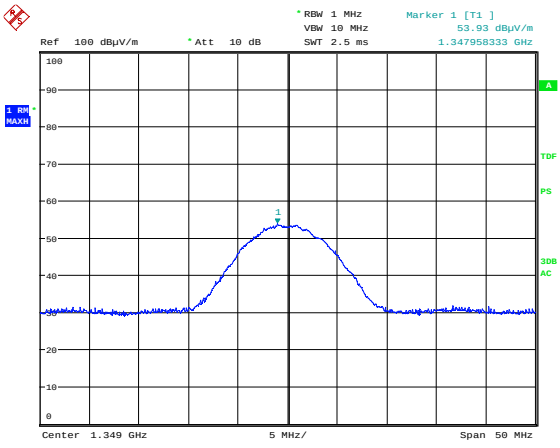


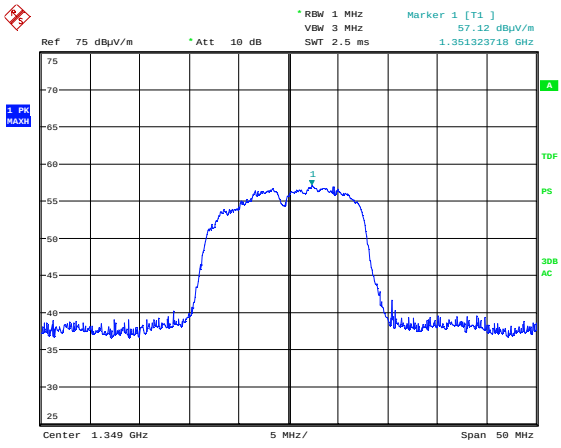
608MHz, WiFi ch08 11g 6M + GSM1900 ch512, Max: HP



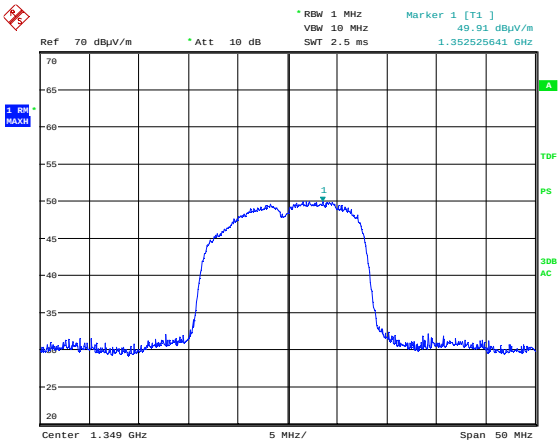
1349MHz, WiFi ch06 11b 11M + GSM1900 ch725, Max: HP, Pk



Av, PL17



1349MHz, WiFi ch06 11g 6M + GSM1900 ch725, Max: HP, Pk



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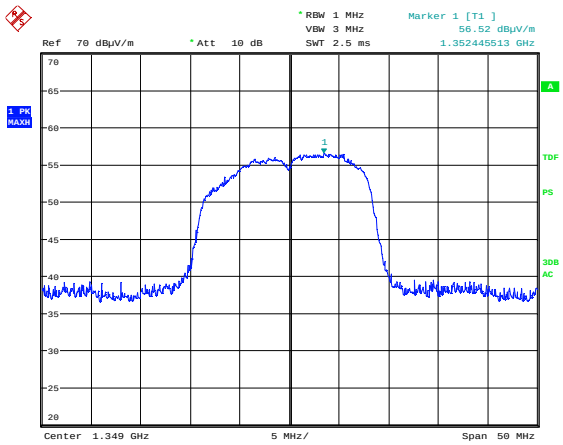

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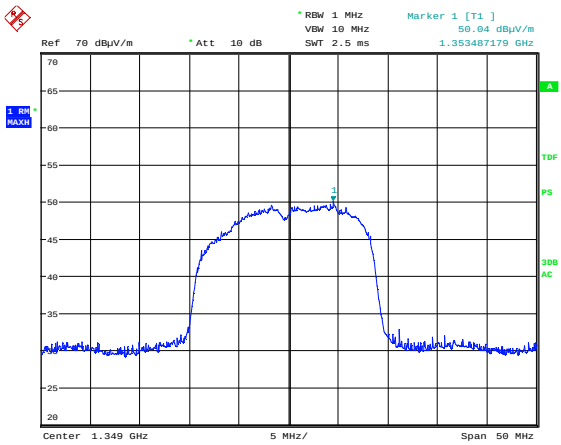
1349MHz, WiFi ch06 11n MCS0 + GSM1900 ch725, Max: HP, Pk



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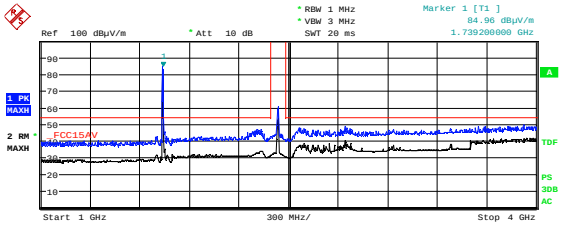
Av

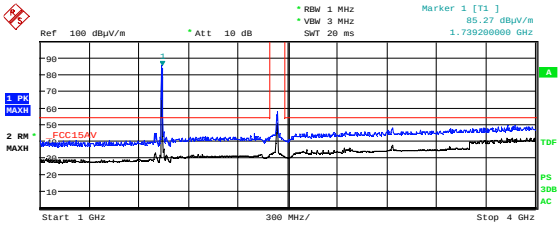
Band 04: WCDMA 1700 (Combi Antenna)



#	Frequency	Level
1	1.739200 GHz	84.96 dBµV
2	2.334400 GHz	46.60 dBµV
3	2.438800 GHz	60.45 dBµV
4	3.922000 GHz	49.42 dBµV

Date: 1.MAR.2023 13:03:38

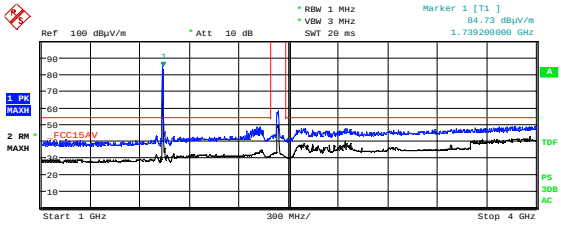
1000-4000MHz, WiFi ch06 11b 11M + WCDMA ch1450 VP



#	Frequency	Level
1	1.702000 GHz	44.44 dBµV
2	1.739200 GHz	85.27 dBµV
3	2.438800 GHz	57.43 dBµV
4	3.875200 GHz	49.24 dBµV

Date: 1.MAR.2023 13:05:36

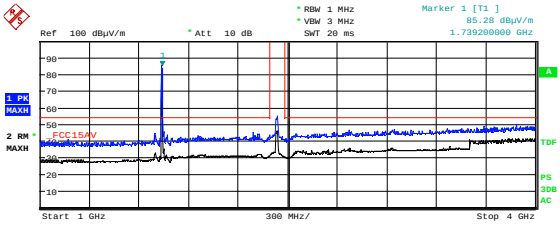
HP



#	Frequency	Level
1	1.739200 GHz	84.73 dBµV
2	2.328400 GHz	48.20 dBµV
3	2.438800 GHz	57.91 dBµV
4	4.000000 GHz	48.64 dBµV

Date: 1.MAR.2023 13:14:27

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

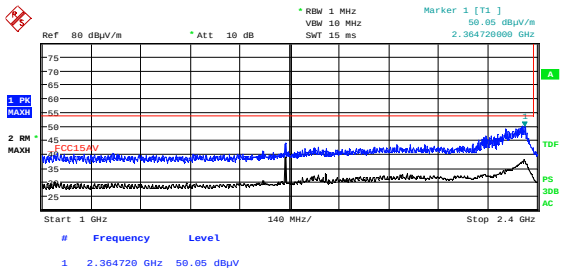


#	Frequency	Level
1	1.696000 GHz	44.15 dBµV
2	1.739200 GHz	85.28 dBµV
3	2.438800 GHz	54.50 dBµV
4	3.881200 GHz	49.71 dBµV

Date: 1.MAR.2023 13:16:25

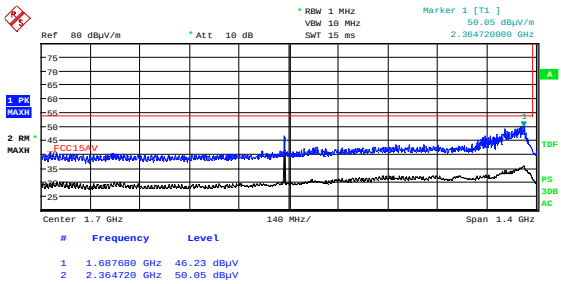
HP

Band 05: GSM850 (Combi Antenna)



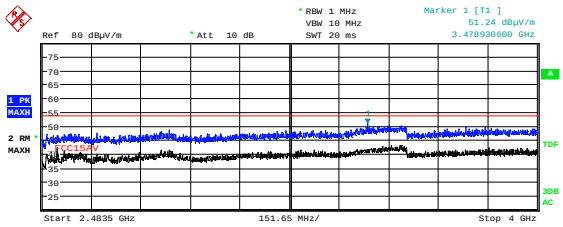
Date: 10.MAR.2023 09:51:21

1000-2400MHz, WiFi ch06 11b 11M + GSM850 ch237 VP



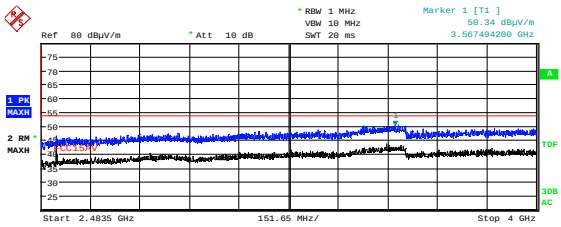
Date: 10.MAR.2023 09:53:18

HP



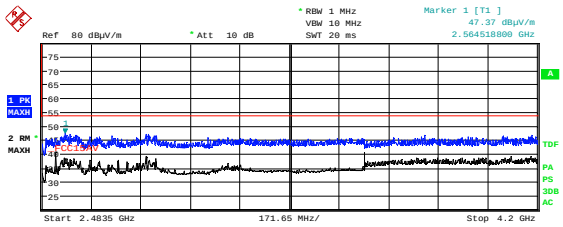
Date: 10.MAR.2023 10:01:16

2483.5-4000MHz, WiFi ch06 11b 11M + GSM850 ch237 VP



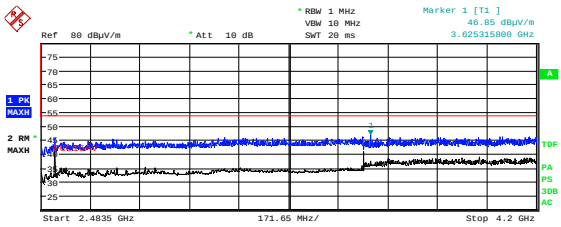
Date: 10.MAR.2023 10:03:13

HP



Date: 10.MAR.2023 10:15:16

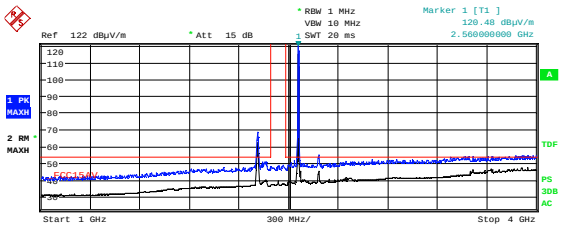
2483.5-4200MHz, WiFi ch03 11b 11M + GSM850 ch237 VP



Date: 10.MAR.2023 10:17:15

HP

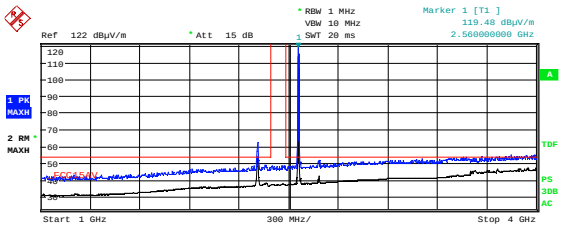
Band 07: LTE 2600 (Combi Antenna)



#	Frequency	Level
1	2.314000 GHz	68.04 dBµV
2	2.560000 GHz	120.48 dBµ
3	2.683600 GHz	54.48 dBµV
4	3.950800 GHz	54.28 dBµV

Date: 10.MAR.2023 10:46:23

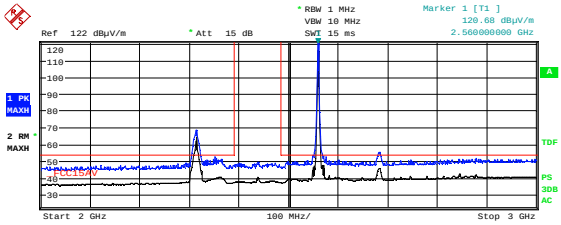
1000-4000MHz, WiFi ch06 11b 1M + LTE ch21350 VP



#	Frequency	Level
1	2.314000 GHz	62.13 dBµV
2	2.560000 GHz	119.48 dBµ
3	3.846400 GHz	54.60 dBµV

Date: 10.MAR.2023 10:48:21

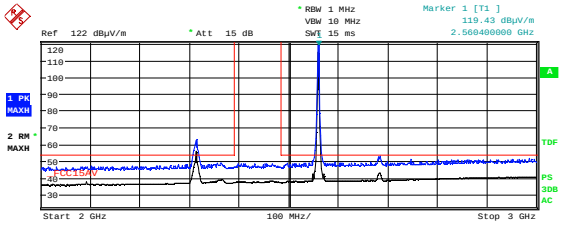
HP



#	Frequency	Level
1	2.313600 GHz	68.42 dBµV
2	2.560000 GHz	120.68 dBµ
3	2.683200 GHz	55.24 dBµV

Date: 10.MAR.2023 10:53:52

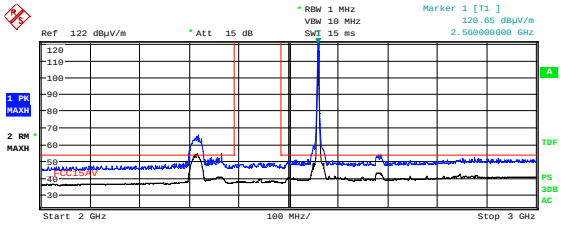
2000-3000MHz, WiFi ch06 11b 1M + LTE ch21350 VP



#	Frequency	Level
1	2.314000 GHz	62.54 dBµV
2	2.560400 GHz	119.43 dBµ
3	2.683600 GHz	52.65 dBµV

Date: 10.MAR.2023 10:55:50

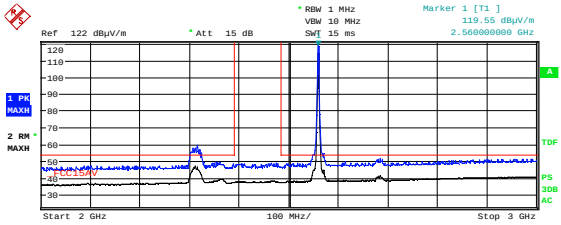
HP



#	Frequency	Level
1	2.317200 GHz	65.39 dBµV
2	2.364400 GHz	54.18 dBµV
3	2.560000 GHz	120.65 dBµ
4	2.680400 GHz	53.36 dBµV

Date: 10.MAR.2023 10:59:25

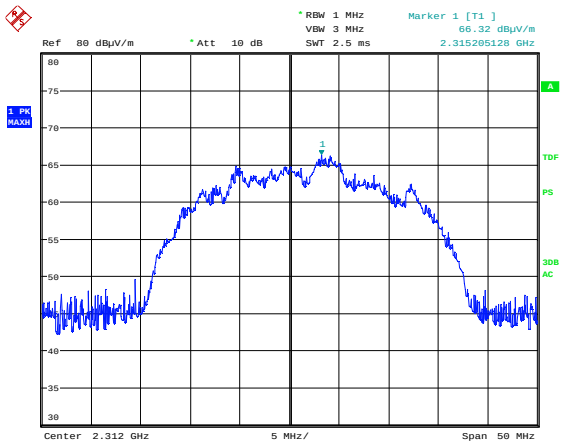
2000-3000MHz, WiFi ch06 11g 6M + LTE ch21350 V



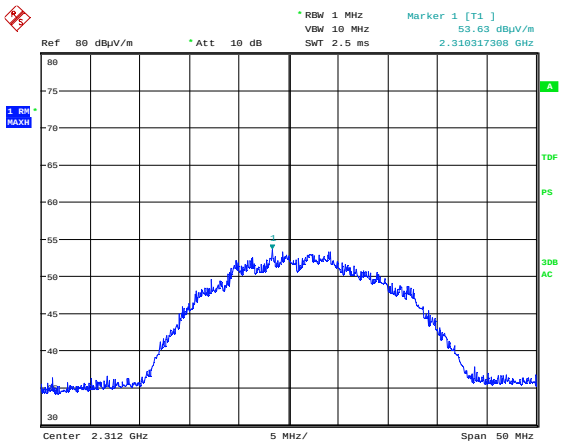
#	Frequency	Level
1	2.315600 GHz	59.34 dBµV
2	2.560000 GHz	119.55 dBµ

Date: 10.MAR.2023 11:01:22

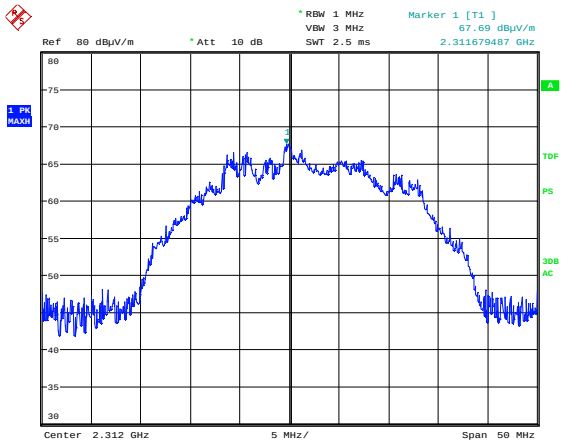
HP



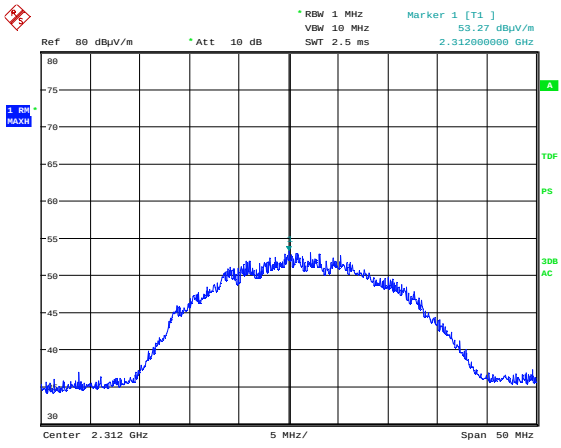
2312MHz, WiFi ch06 11g 6M + LTE ch21350 VP, Max: VP, Pk



Av



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



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

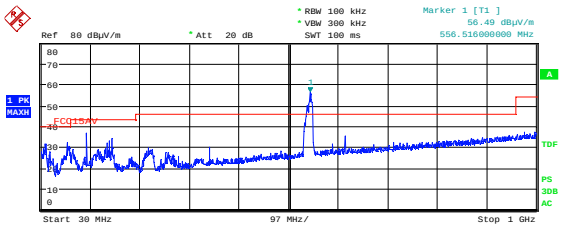
Band 02 + WiFi WiFi ch06 + GSM1900 ch725									
Measured Frequency (MHz)	WiFi Modulation	Carrier Freq WiFi (MHz)	Carrier Freq GSM (MHz)	Measured Emissions (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
				Peak	Average	Peak	Average	Peak	Average
1349	11b	2437	1892.8	57.0	53.5	74	54	17.0	0.5
1349	11g	2437	1892.8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

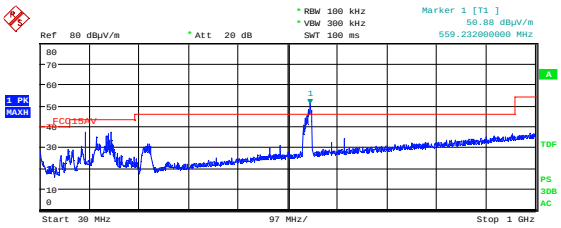
Band 02: GSM 1900 (Whip + Patch Antenna)



#	Frequency	Level
1	39.312000 MHz	31.49 dBµV
2	81.992000 MHz	32.24 dBµV
3	120.016000 MHz	36.43 dBµV
4	160.368000 MHz	31.72 dBµV
5	164.636000 MHz	32.68 dBµV
6	168.904000 MHz	33.96 dBµV
7	359.800000 MHz	29.94 dBµV
8	556.516000 MHz	56.49 dBµV
9	625.192000 MHz	35.21 dBµV
10	976.332000 MHz	36.90 dBµV

Date: 13.MAR.2023 13:36:22

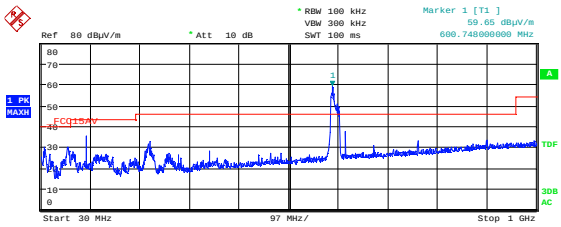
30-1000MHz, WiFi ch06 11n MCS0 Ant0 + GSM1900 ch675 VP



#	Frequency	Level
1	120.016000 MHz	37.08 dBµV
2	140.968000 MHz	34.71 dBµV
3	160.368000 MHz	35.30 dBµV
4	162.696000 MHz	35.24 dBµV
5	164.636000 MHz	36.33 dBµV
6	168.904000 MHz	36.88 dBµV
7	243.012000 MHz	31.25 dBµV
8	559.232000 MHz	50.88 dBµV
9	625.192000 MHz	34.04 dBµV
10	987.972000 MHz	36.60 dBµV

Date: 13.MAR.2023 13:38:19

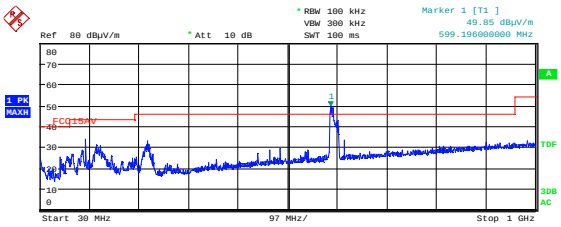
HP



#	Frequency	Level
1	37.372000 MHz	30.01 dBµV
2	81.992000 MHz	30.05 dBµV
3	120.016000 MHz	35.06 dBµV
4	243.012000 MHz	32.65 dBµV
5	359.800000 MHz	27.96 dBµV
6	600.748000 MHz	59.65 dBµV
7	625.192000 MHz	37.25 dBµV
8	681.840000 MHz	30.56 dBµV
9	767.976000 MHz	32.82 dBµV
10	902.612000 MHz	33.37 dBµV

Date: 13.MAR.2023 14:09:04

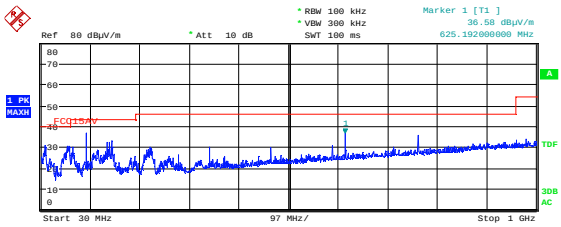
30-1000MHz, WiFi ch10 11n MCS0 Ant0 + GSM1900 ch512 VP



#	Frequency	Level
1	93.244000 MHz	26.51 dBµV
2	112.644000 MHz	28.50 dBµV
3	120.016000 MHz	33.64 dBµV
4	141.744000 MHz	31.15 dBµV
5	239.908000 MHz	32.69 dBµV
6	480.080000 MHz	28.25 dBµV
7	499.868000 MHz	28.97 dBµV
8	599.196000 MHz	49.85 dBµV
9	625.192000 MHz	33.14 dBµV
10	984.092000 MHz	32.89 dBµV

Date: 13.MAR.2023 14:11:01

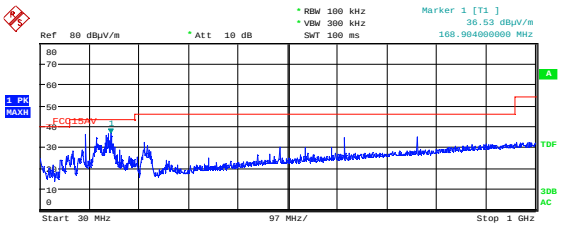
HP



#	Frequency	Level
1	38.536000 MHz	30.54 dBµV
2	84.708000 MHz	30.23 dBµV
3	120.016000 MHz	36.47 dBµV
4	160.368000 MHz	31.99 dBµV
5	164.636000 MHz	32.07 dBµV
6	168.904000 MHz	32.70 dBµV
7	599.972000 MHz	30.61 dBµV
8	625.192000 MHz	36.58 dBµV
9	767.976000 MHz	35.36 dBµV
10	979.824000 MHz	33.50 dBµV

Date: 13.MAR.2023 13:27:45

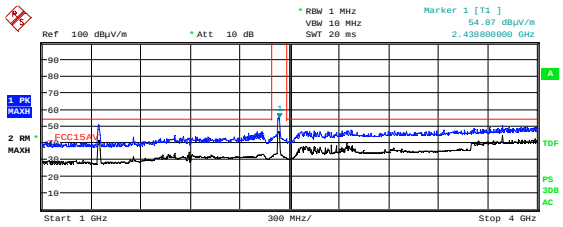
30-1000MHz, WiFi ch06 11n MCS0 Ant1 + GSM1900 ch675 VP



#	Frequency	Level
1	120.016000 MHz	36.03 dBµV
2	141.744000 MHz	34.46 dBµV
3	160.368000 MHz	35.60 dBµV
4	164.636000 MHz	36.17 dBµV
5	168.904000 MHz	36.53 dBµV
6	170.844000 MHz	34.93 dBµV
7	234.864000 MHz	32.05 dBµV
8	625.192000 MHz	34.50 dBµV
9	767.976000 MHz	34.86 dBµV
10	987.584000 MHz	32.30 dBµV

Date: 13.MAR.2023 13:29:42

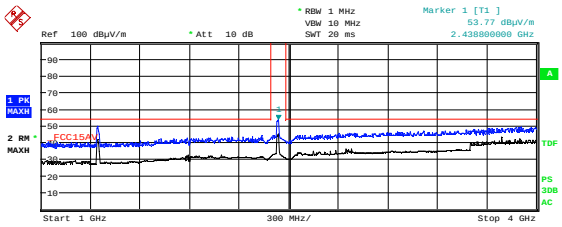
HP



#	Frequency	Level
1	1.345600 GHz	50.24 dBµV
2	2.330800 GHz	46.39 dBµV
3	2.438800 GHz	54.87 dBµV
4	3.786400 GHz	49.78 dBµV

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

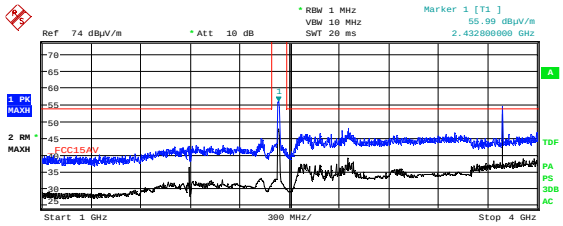
1000-4000MHz, WiFi ch06 11g 6M Ant0 + GSM1900 ch725 VP



#	Frequency	Level
1	1.342000 GHz	49.45 dBµV
2	2.438800 GHz	53.77 dBµV
3	3.908800 GHz	49.03 dBµV

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

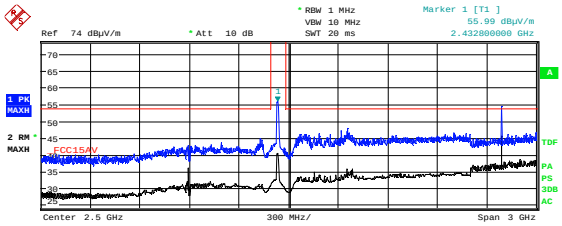
HP



#	Frequency	Level
1	2.432800 GHz	55.99 dBµV
2	2.857600 GHz	47.91 dBµV
3	3.786400 GHz	54.31 dBµV

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

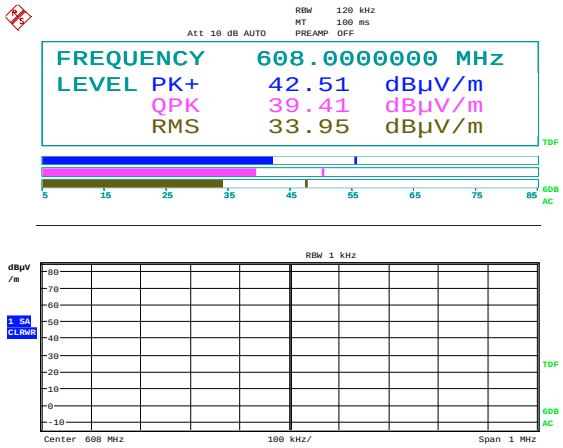
1000-4000MHz, WiFi ch06 11g 6M Ant1 + GSM1900 ch725 VP



#	Frequency	Level
1	2.432800 GHz	55.99 dBµV
2	3.786400 GHz	54.31 dBµV

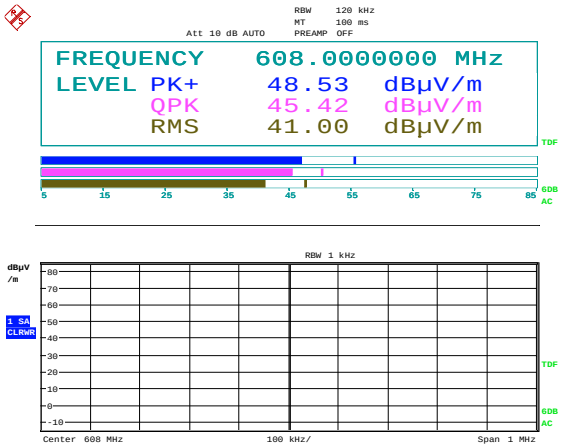
Date: 9.MAR.2023 09:40:47

HP



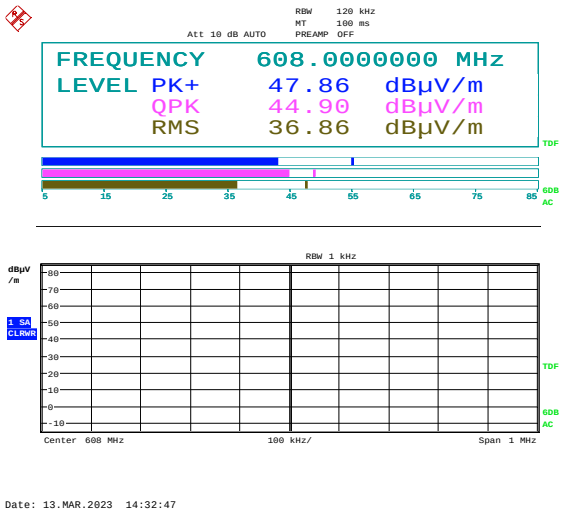
Date: 13.MAR.2023 14:34:53

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

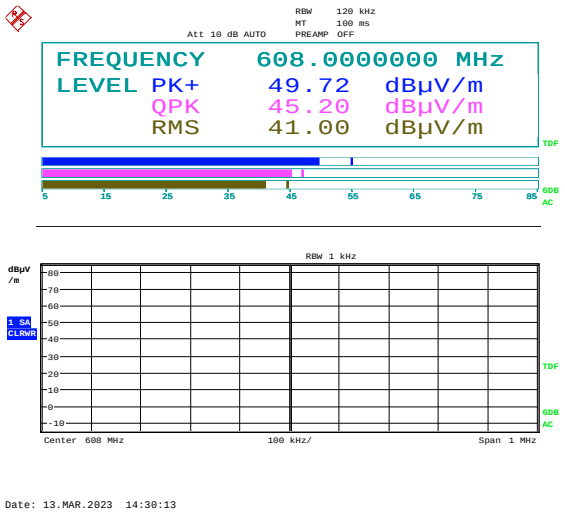


Date: 13.MAR.2023 14:34:23

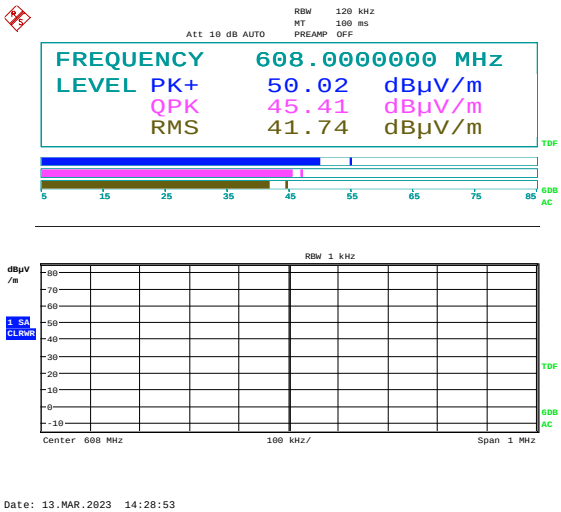
608MHz, WiFi ch10 11b 11M + GSM1900 ch512, (Max: HP) PL13



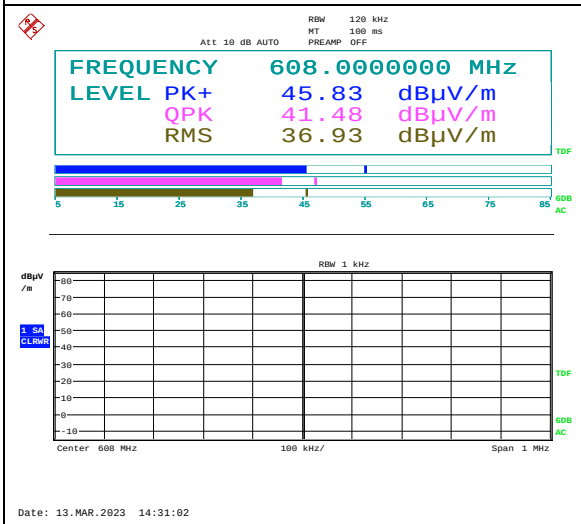
608MHz, WiFi ch11 11b 11M + GSM1900 ch512, (Max: HP) PL12



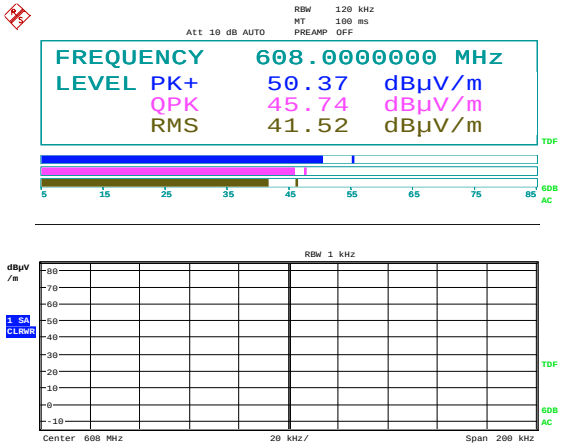
608MHz, WiFi ch09 11g 6M + GSM1900 ch512, (Max: HP) PL16



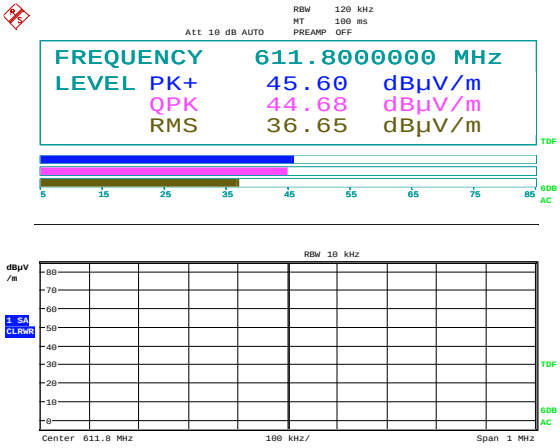
608MHz, WiFi ch10 11g 6M + GSM1900 ch512, (Max: HP) PL15



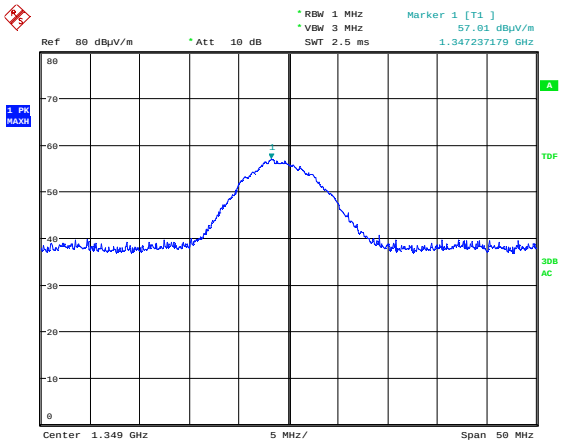
608MHz, WiFi ch11 11g 6M + GSM1900 ch512, (Max: HP) PL11



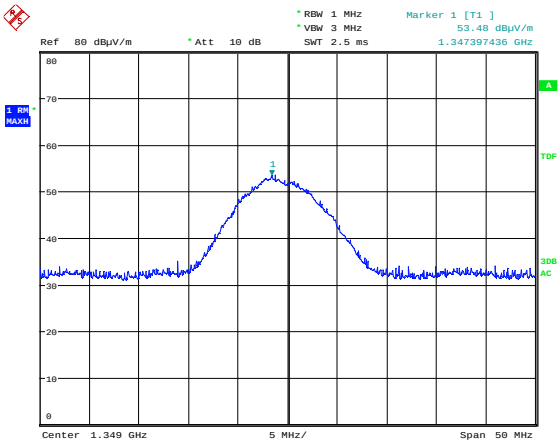
608MHz, WiFi ch10 11n MCS0 + GSM1900 ch512, (Max: HP) PL15



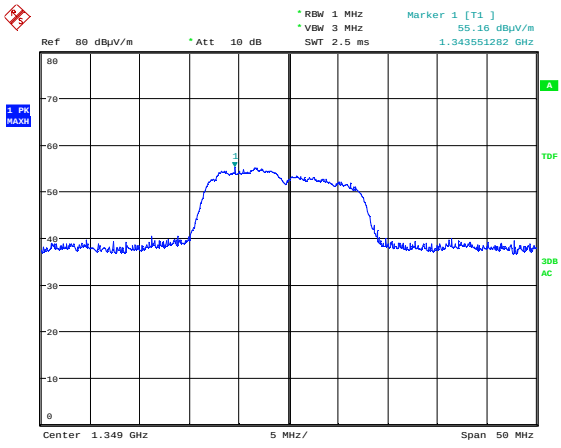
611.8MHz, WiFi ch11 11n MCS0 + GSM1900 ch512, (Max: HP)



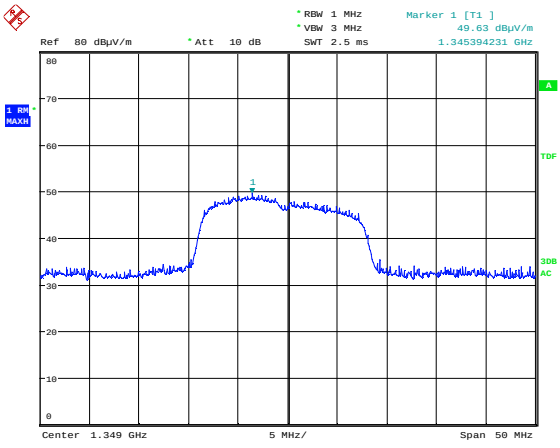
1349MHz, WiFi ch06 11b 11M + GSM1900 ch725, (Max: HP), Pk



Av

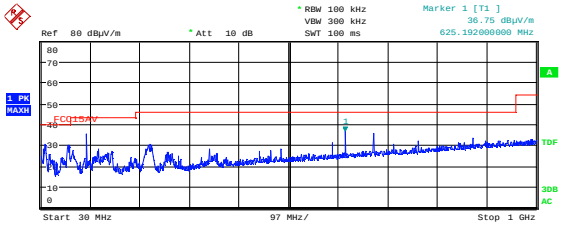


1349MHz, WiFi ch06 11g 6M + GSM1900 ch725, (Max: HP), Pk



Av

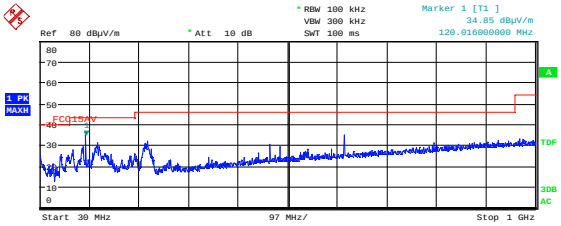
Band 02: WCDMA 1900 (Whip + Patch Antenna)



#	Frequency	Level
1	39.312000 MHz	30.10 dBµV
2	85.484000 MHz	29.99 dBµV
3	120.016000 MHz	35.21 dBµV
4	244.176000 MHz	30.20 dBµV
5	359.800000 MHz	27.95 dBµV
6	499.868000 MHz	28.02 dBµV
7	599.972000 MHz	30.99 dBµV
8	625.192000 MHz	36.75 dBµV
9	681.840000 MHz	35.32 dBµV
10	875.064000 MHz	33.21 dBµV

Date: 13.MAR.2023 15:55:23

30-1000MHz, WiFi ch06 11b 11M + WCDMA1900 ch9262 VP



#	Frequency	Level
1	94.408000 MHz	27.52 dBµV
2	114.584000 MHz	29.27 dBµV
3	120.016000 MHz	34.85 dBµV
4	142.908000 MHz	31.06 dBµV
5	215.464000 MHz	25.72 dBµV
6	240.296000 MHz	31.58 dBµV
7	480.080000 MHz	30.16 dBµV
8	499.868000 MHz	29.21 dBµV
9	625.192000 MHz	34.59 dBµV
10	968.960000 MHz	32.72 dBµV

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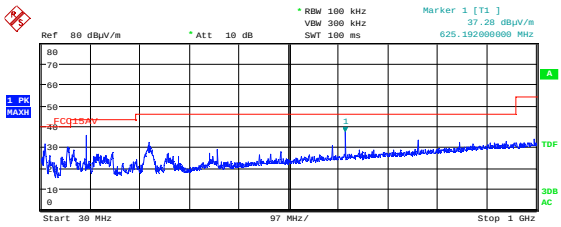
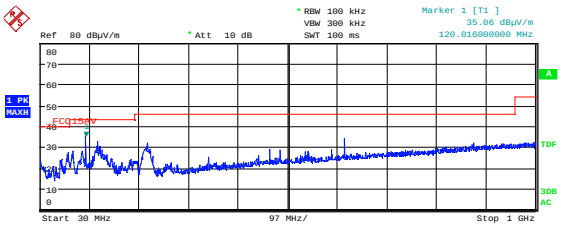
HP



#	Frequency	Level
1	39.312000 MHz	31.51 dBµV
2	82.768000 MHz	29.98 dBµV
3	94.408000 MHz	28.42 dBµV
4	120.016000 MHz	35.35 dBµV
5	241.460000 MHz	32.19 dBµV
6	374.932000 MHz	28.64 dBµV
7	599.972000 MHz	30.50 dBµV
8	625.192000 MHz	37.28 dBµV
9	767.976000 MHz	33.37 dBµV
10	994.180000 MHz	33.51 dBµV

Date: 13.MAR.2023 15:44:25

30-1000MHz, WiFi ch06 11n MCS0 + WCDMA1900 ch9262 VP

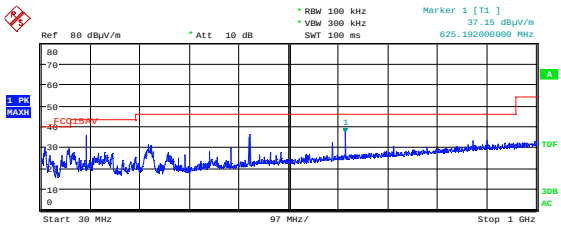


#	Frequency	Level
1	85.872000 MHz	27.29 dBµV
2	94.408000 MHz	27.92 dBµV
3	112.644000 MHz	28.07 dBµV
4	120.016000 MHz	35.06 dBµV
5	142.132000 MHz	32.52 dBµV
6	239.908000 MHz	31.69 dBµV
7	480.080000 MHz	28.63 dBµV
8	499.868000 MHz	28.40 dBµV
9	625.192000 MHz	33.90 dBµV
10	1.000000 GHz	32.21 dBµV

Date: 13.MAR.2023 15:46:21

HP

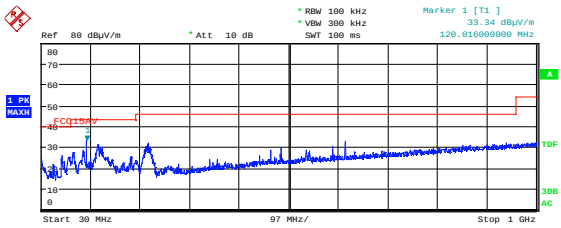
Band 04: WCDMA 1700 (Whip + Patch Antenna)



#	Frequency	Level
1	39.312000 MHz	29.97 dBµV
2	85.484000 MHz	29.25 dBµV
3	120.016000 MHz	35.39 dBµV
4	239.908000 MHz	31.03 dBµV
5	359.800000 MHz	27.53 dBµV
6	402.480000 MHz	29.31 dBµV
7	438.952000 MHz	35.81 dBµV
8	599.972000 MHz	32.10 dBµV
9	625.192000 MHz	37.15 dBµV
10	902.612000 MHz	33.23 dBµV

Date: 13.MAR.2023 14:52:27

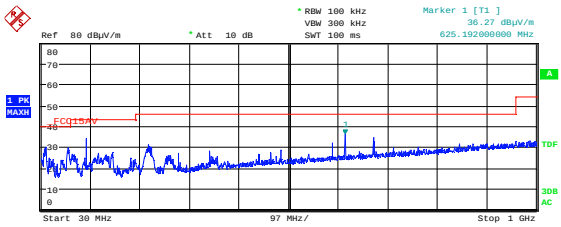
30-1000MHz, WiFi ch06 11g 6M Ant0 + WCDMA ch1350 VP



#	Frequency	Level
1	94.020000 MHz	27.40 dBµV
2	113.808000 MHz	28.25 dBµV
3	120.016000 MHz	33.34 dBµV
4	140.580000 MHz	31.09 dBµV
5	239.908000 MHz	31.59 dBµV
6	480.080000 MHz	28.32 dBµV
7	499.868000 MHz	29.40 dBµV
8	599.972000 MHz	30.27 dBµV
9	625.192000 MHz	32.63 dBµV
10	1.000000 GHz	32.04 dBµV

Date: 13.MAR.2023 14:54:24

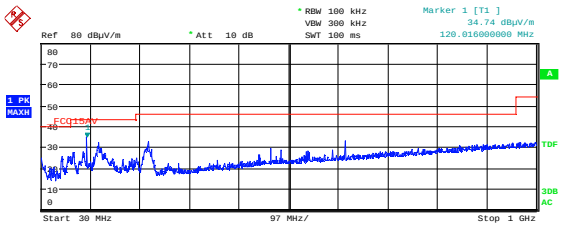
HP



#	Frequency	Level
1	40.088000 MHz	30.02 dBµV
2	83.156000 MHz	29.66 dBµV
3	120.016000 MHz	34.01 dBµV
4	240.684000 MHz	30.83 dBµV
5	359.800000 MHz	27.81 dBµV
6	499.868000 MHz	28.43 dBµV
7	599.972000 MHz	31.86 dBµV
8	625.192000 MHz	36.27 dBµV
9	681.840000 MHz	34.24 dBµV
10	987.196000 MHz	32.72 dBµV

Date: 13.MAR.2023 15:04:54

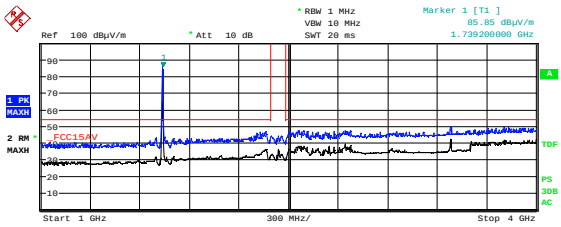
30-1000MHz, WiFi ch06 11n MCS0 Ant0 + WCDMA ch1350 VP



#	Frequency	Level
1	71.904000 MHz	25.42 dBµV
2	94.020000 MHz	27.13 dBµV
3	113.808000 MHz	27.64 dBµV
4	120.016000 MHz	34.74 dBµV
5	142.132000 MHz	32.19 dBµV
6	239.908000 MHz	32.33 dBµV
7	480.080000 MHz	29.05 dBµV
8	499.868000 MHz	28.39 dBµV
9	625.192000 MHz	32.80 dBµV
10	997.672000 MHz	32.26 dBµV

Date: 13.MAR.2023 15:06:51

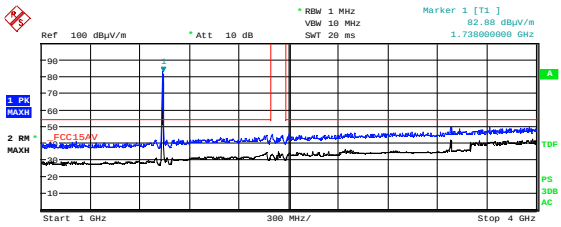
HP



#	Frequency	Level
1	1.697200 GHz	42.97 dBµV
2	1.739200 GHz	85.85 dBµV
3	2.360800 GHz	46.57 dBµV
4	3.479200 GHz	49.68 dBµV

Date: 9.MAR.2023 12:38:43

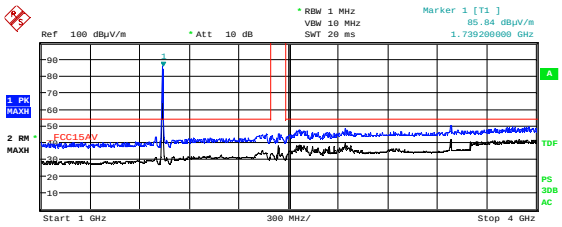
1000-4000MHz, WiFi ch06 11b 1M Ant0 + WCDMA ch1450 VP



#	Frequency	Level
1	1.738000 GHz	82.88 dBµV
2	3.482800 GHz	49.21 dBµV

Date: 9.MAR.2023 12:40:40

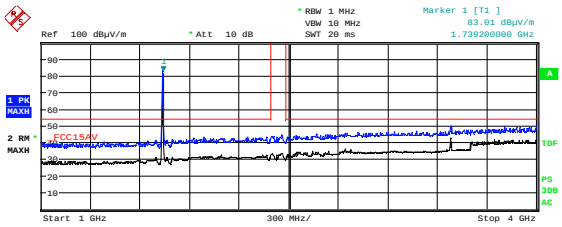
HP



#	Frequency	Level
1	1.696000 GHz	43.10 dBµV
2	1.739200 GHz	85.84 dBµV
3	3.482800 GHz	49.92 dBµV

Date: 9.MAR.2023 12:44:23

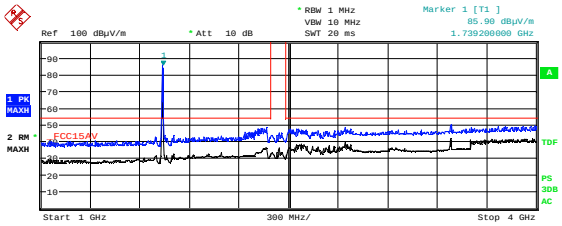
1000-4000MHz, WiFi ch06 11b 1M Ant1 + WCDMA ch1450 VP



#	Frequency	Level
1	1.739200 GHz	83.01 dBµV
2	3.482800 GHz	49.72 dBµV

Date: 9.MAR.2023 12:46:20

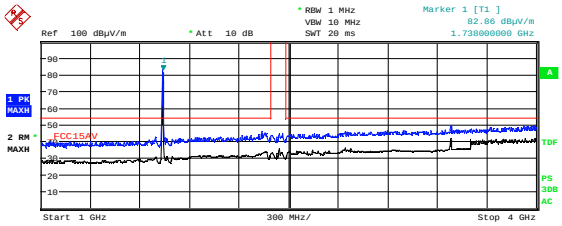
HP



#	Frequency	Level
1	1.739200 GHz	85.90 dBµV
2	2.364400 GHz	48.13 dBµV
3	3.482800 GHz	49.84 dBµV

Date: 9.MAR.2023 12:31:35

1000-4000MHz, WiFi ch06 11g 6M Ant0 + WCDMA ch1450 VP

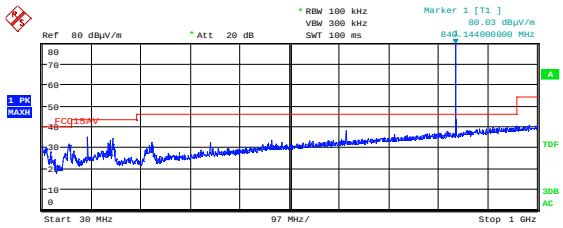


#	Frequency	Level
1	1.738000 GHz	82.86 dBµV
2	2.338000 GHz	45.90 dBµV
3	3.482800 GHz	49.17 dBµV

Date: 9.MAR.2023 12:33:32

HP

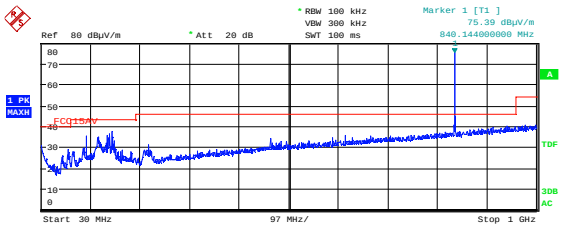
Band 05: GSM 850 (Whip + Patch Antenna)



#	Frequency	Level
1	31.552000 MHz	30.88 dBµV
2	47.848000 MHz	27.69 dBµV
3	83.932000 MHz	31.54 dBµV
4	120.016000 MHz	34.91 dBµV
5	164.636000 MHz	33.28 dBµV
6	168.904000 MHz	33.96 dBµV
7	245.728000 MHz	32.00 dBµV
8	359.800000 MHz	32.08 dBµV
9	625.192000 MHz	37.77 dBµV
10	840.144000 MHz	80.03 dBµV

Date: 13.MAR.2023 13:04:51

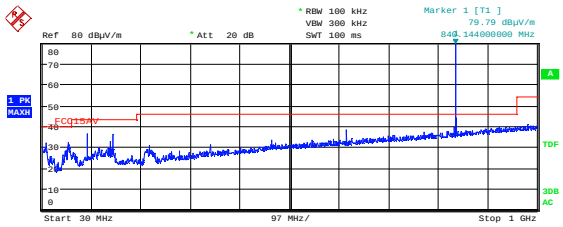
30-1000MHz, WiFi ch06 11n MCS0 Ant0 + GSM850 ch207 VP



#	Frequency	Level
1	30.776000 MHz	30.46 dBµV
2	83.156000 MHz	28.83 dBµV
3	120.016000 MHz	35.12 dBµV
4	142.520000 MHz	34.76 dBµV
5	164.636000 MHz	36.14 dBµV
6	168.904000 MHz	37.25 dBµV
7	170.844000 MHz	34.83 dBµV
8	189.856000 MHz	28.30 dBµV
9	239.908000 MHz	31.05 dBµV
10	840.144000 MHz	75.39 dBµV

Date: 13.MAR.2023 13:06:48

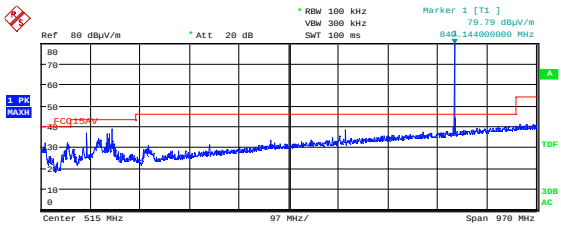
HP



#	Frequency	Level
1	38.536000 MHz	31.80 dBµV
2	82.768000 MHz	32.00 dBµV
3	120.016000 MHz	36.34 dBµV
4	164.636000 MHz	32.56 dBµV
5	168.904000 MHz	35.80 dBµV
6	239.908000 MHz	30.53 dBµV
7	625.192000 MHz	37.97 dBµV
8	840.144000 MHz	79.79 dBµV

Date: 13.MAR.2023 13:10:48

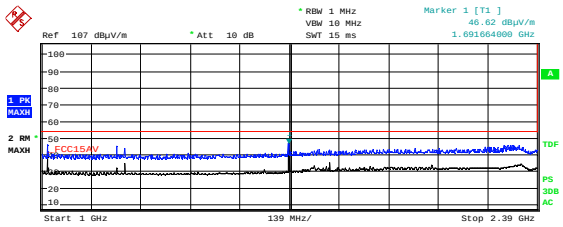
30-1000MHz, WiFi ch06 11n MCS0 Ant1 + GSM850 ch207 VP



#	Frequency	Level
1	38.536000 MHz	31.80 dBµV
2	82.768000 MHz	32.00 dBµV
3	120.016000 MHz	36.66 dBµV
4	142.908000 MHz	33.85 dBµV
5	160.368000 MHz	36.28 dBµV
6	164.636000 MHz	36.10 dBµV
7	168.904000 MHz	38.49 dBµV
8	239.908000 MHz	30.53 dBµV
9	625.192000 MHz	37.97 dBµV
10	840.144000 MHz	79.79 dBµV

Date: 13.MAR.2023 13:12:45

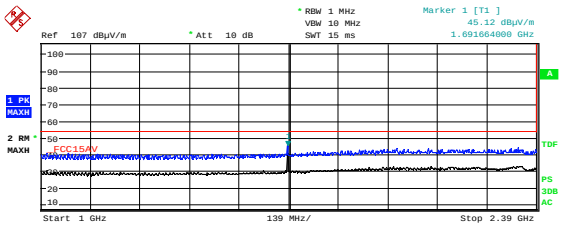
HP



#	Frequency	Level
1	1.016680 GHz	45.79 dBµV
2	1.210168 GHz	44.94 dBµV
3	1.691664 GHz	46.62 dBµV
4	2.307712 GHz	45.30 dBµV

Date: 1.MAR.2023 15:44:05

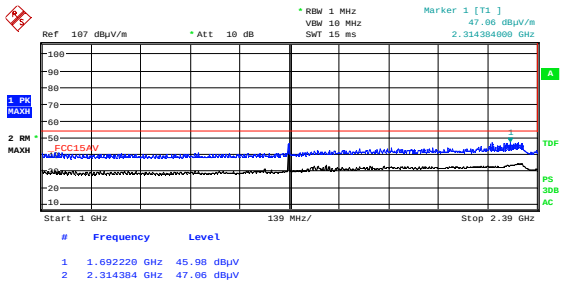
1000-2390MHz, WiFi ch06 11b 11M Ant0 + GSM850 ch237 VP



#	Frequency	Level
1	1.691664 GHz	45.12 dBµV

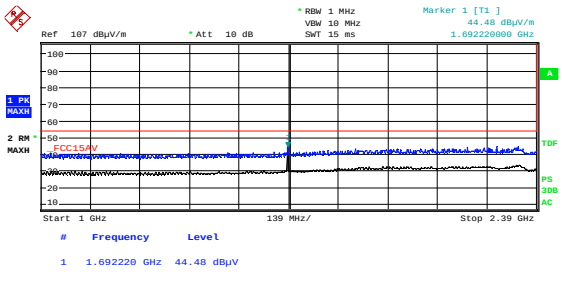
Date: 1.MAR.2023 15:46:03

HP



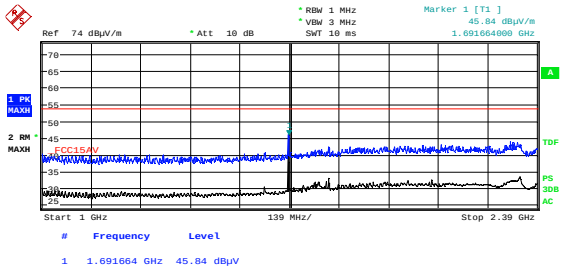
Date: 1.MAR.2023 16:05:10

1000-2390MHz, WiFi ch06 11g 6M Ant0 + GSM850 ch237 VP



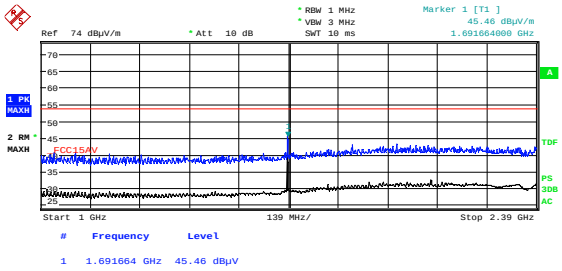
Date: 1.MAR.2023 16:07:07

HP



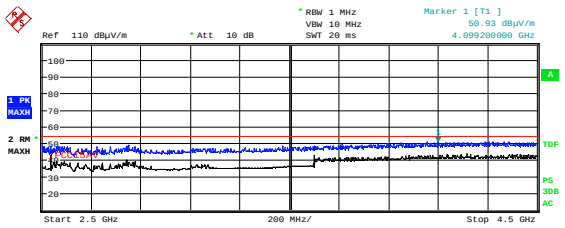
Date: 9.MAR.2023 10:05:25

1000-2390MHz, WiFi ch06 11b 11M Ant1 + GSM850 ch237 VP



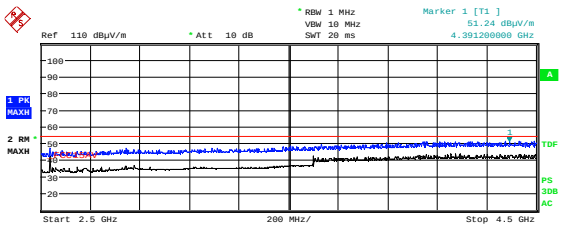
Date: 9.MAR.2023 10:07:22

HP



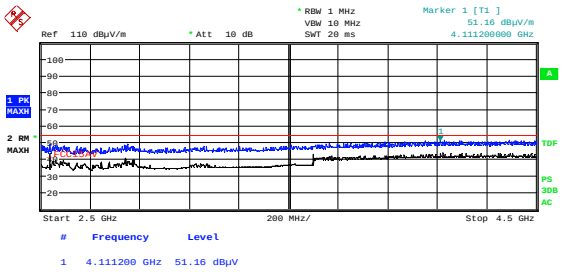
Date: 1.MAR.2023 15:53:03

2500-4500MHz, WiFi ch06 11b 11M Ant0 + GSM850 ch237 VP

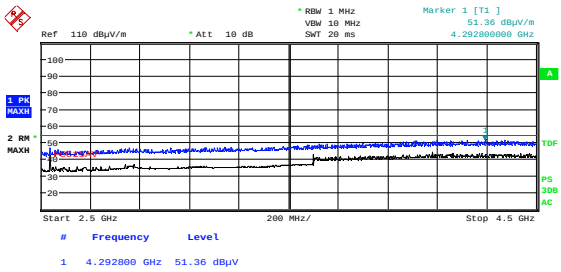


Date: 1.MAR.2023 15:55:01

HP



2500-4500MHz, WiFi ch06 11g 6M Ant0 + GSM850 ch237 VP



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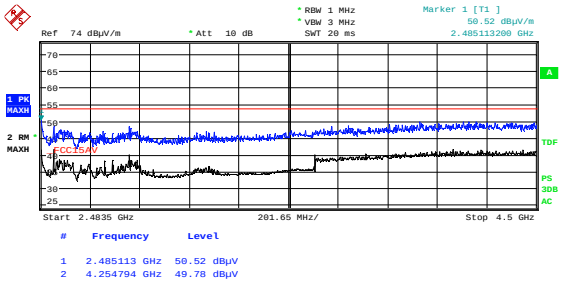
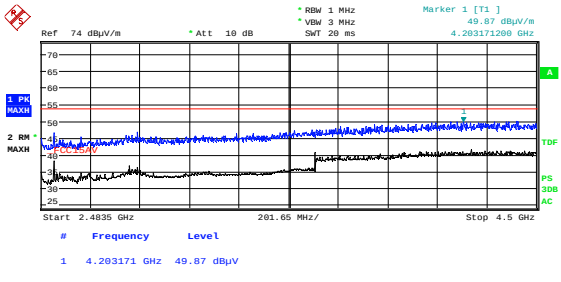
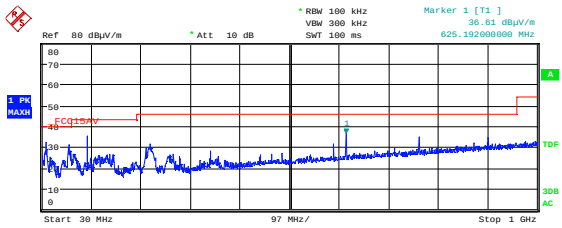


2483.5-4500MHz, WiFi ch06 11b 11M Ant1 + GSM850 ch237 VP



HP

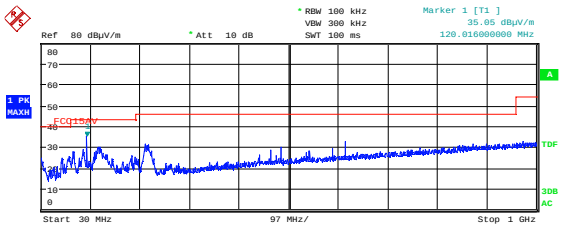
Band 07: LTE 2600 (Whip + Patch Antenna)



#	Frequency	Level
1	39.312000 MHz	31.93 dBµV
2	83.544000 MHz	31.04 dBµV
3	120.016000 MHz	35.23 dBµV
4	163.084000 MHz	26.42 dBµV
5	242.236000 MHz	31.51 dBµV
6	359.800000 MHz	28.15 dBµV
7	599.972000 MHz	31.51 dBµV
8	625.192000 MHz	36.61 dBµV
9	767.976000 MHz	34.78 dBµV
10	902.612000 MHz	34.54 dBµV

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

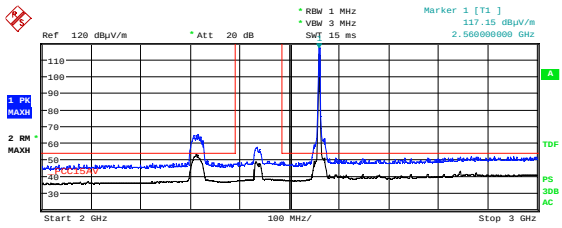
30-1000MHz, WiFi ch06 11n MCS0 + LTE ch21350 VP



#	Frequency	Level
1	93.632000 MHz	27.47 dBµV
2	113.032000 MHz	28.75 dBµV
3	120.016000 MHz	35.05 dBµV
4	143.684000 MHz	29.98 dBµV
5	234.864000 MHz	31.28 dBµV
6	480.080000 MHz	28.36 dBµV
7	499.868000 MHz	29.68 dBµV
8	599.972000 MHz	28.96 dBµV
9	625.192000 MHz	32.65 dBµV
10	972.452000 MHz	32.34 dBµV

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

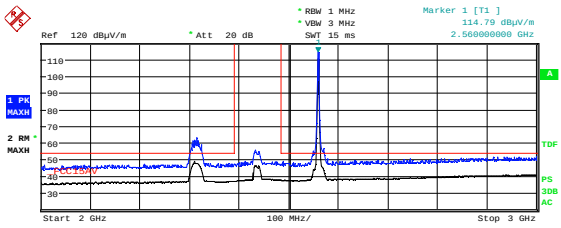
HP



#	Frequency	Level
1	2.315200 GHz	65.00 dBµV
2	2.434000 GHz	57.25 dBµV
3	2.560000 GHz	117.15 dBµ

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

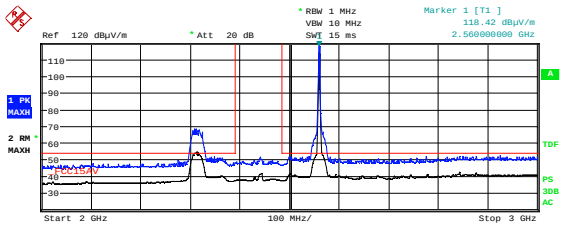
2000-3000MHz, WiFi ch06 11g 6M + LTE ch21350 VP



#	Frequency	Level
1	2.315200 GHz	62.80 dBµV
2	2.432800 GHz	55.38 dBµV
3	2.560000 GHz	114.79 dBµ

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

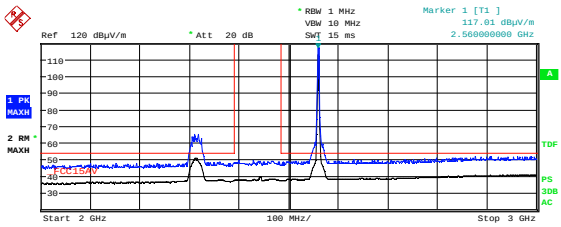
HP



#	Frequency	Level
1	2.312000 GHz	68.26 dBµV
2	2.560000 GHz	118.42 dBµ

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

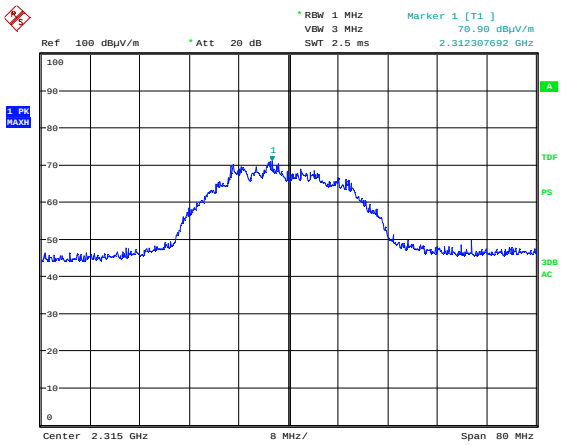
2000-3000MHz, WiFi ch06 11n MCS0 MIMO + LTE ch21350VP

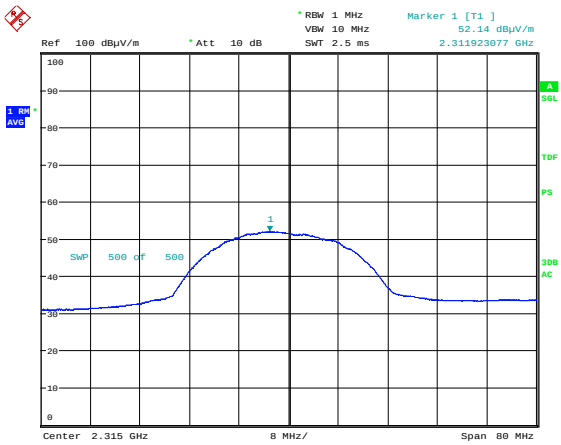


#	Frequency	Level
1	2.317600 GHz	64.88 dBµV
2	2.560000 GHz	117.01 dBµ

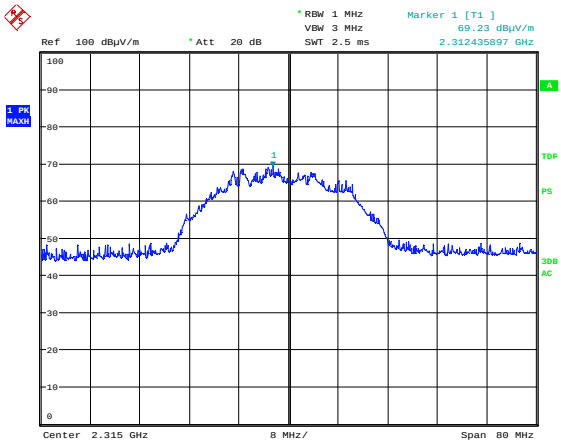
Date: 9.MAR.2023 10:45:59

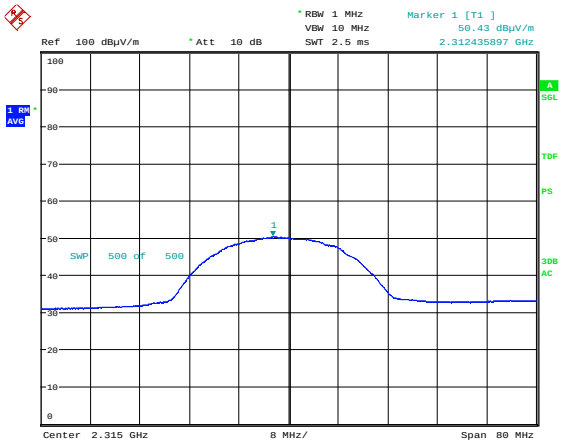
HP



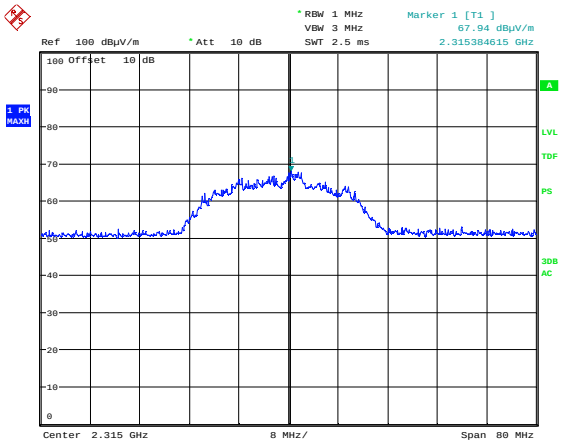


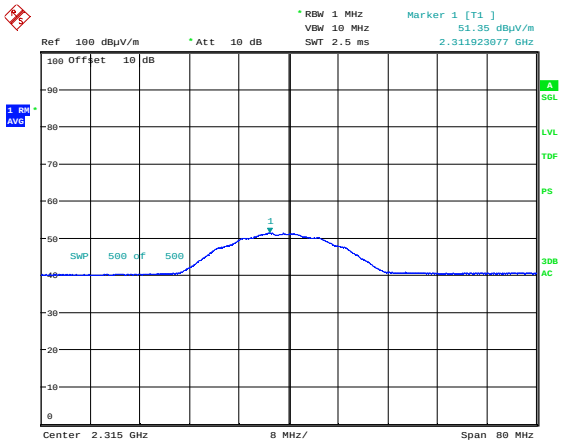
2315 MHz, WiFi ch06 11n MCS0 MIMO + LTE ch21350, Max: VP, Pk **Av**



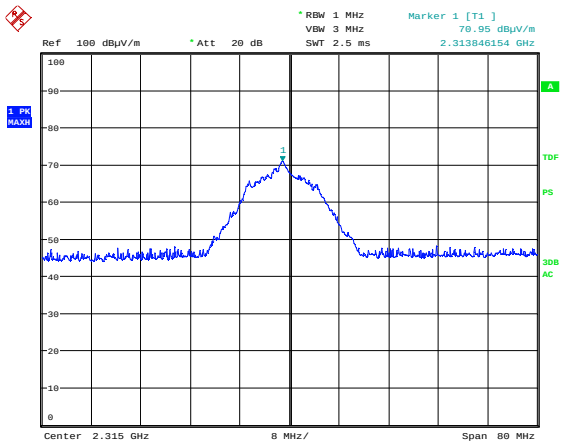


2315 MHz, WiFi ch06 11n MCS0 SISO + LTE ch21350, Max: VP, Pk **Av**



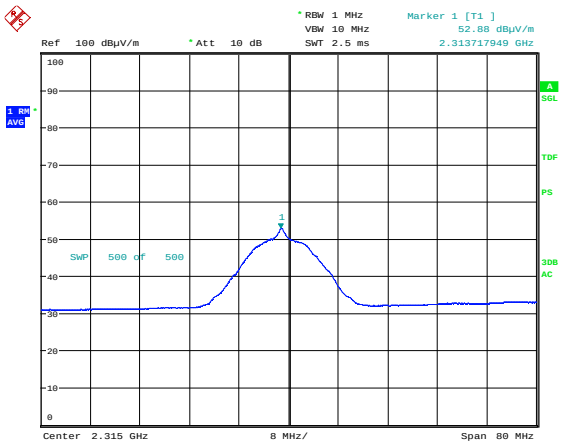


2315 MHz, WiFi ch06 11g 6M + LTE ch21350, Max: VP, Pk **Av**



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

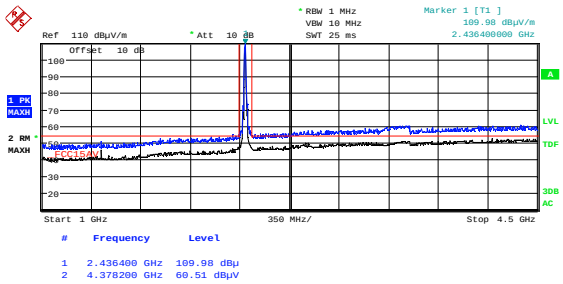
2315 MHz, WiFi ch06 11b 11M + LTE ch21350, Max: VP, Pk



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

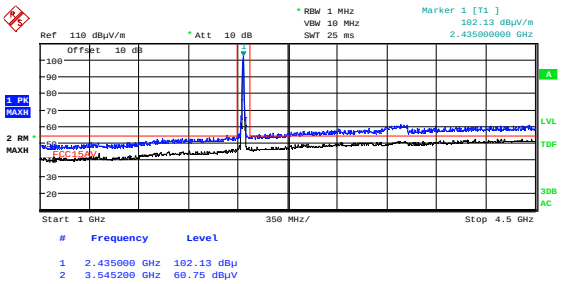
Av, PL16

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



Date: 9.MAR.2023 13:03:24

1000-4500MHz, WiFi ch06 11b 1M + LTE ch23100 VP



Date: 9.MAR.2023 13:05:22

HP

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

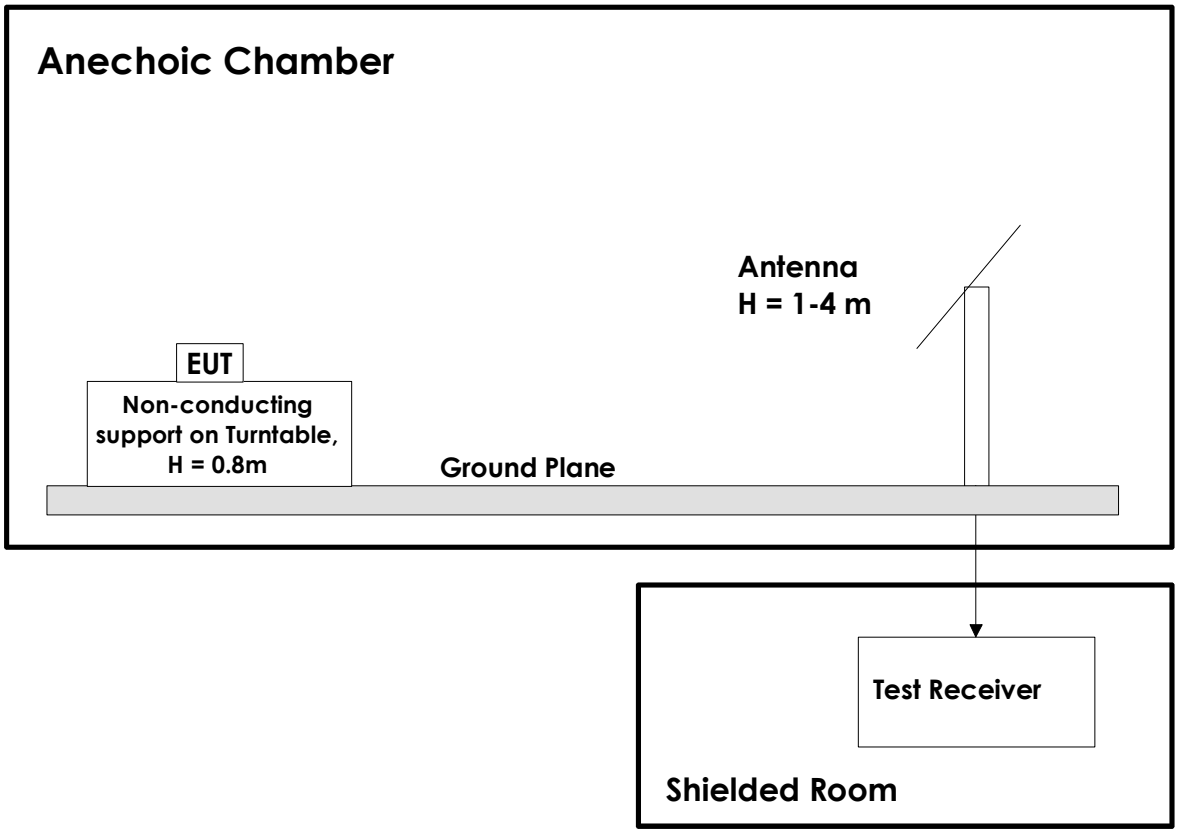
Note: COU – calibrate on use; N/A – Not Applicable

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.