



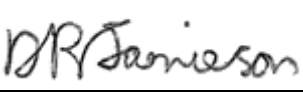
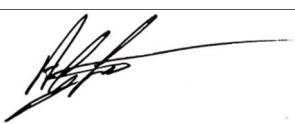
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Test Report for a95, a97, a98, a125, a127 & a128 Marine Multifunction Displays

To 47 CFR Part 15 Subpart C and RSS 210

Model Number	A95, a97, a98, a125, a127 and a128		
Product Description	Marine Multifunction Displays		
Report Number	TP/872/1062		
Report Author David Jamieson EMC Engineer		Date	25 th June 2014
Technical Check Mike Thompson EMC Engineer		Date	30 th June 2014
Approval Andrew Little Compliance Manager		Date	30 th June 2014

Test Date Range	24 th April 2014 – 19 th June 2014
Product Status	PASS

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The test data and results contained within this report relate only to the items tested.

1 47 CFR Part 15 and RSS-210 Test Summary

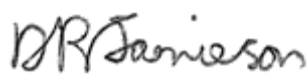
	CFR 47 Part 15	RSS-210	Section	Result
Hopping Sequence	15.247(a)		5.4	Pass
Peak Output Power	15.247(b)	A8.4(2)	5.3	Pass
Carrier Frequency Separation	15.247(a)	A8.1(b)	5.4	Pass
Frequency Band Edges	15.247(d)		5.7	Pass
20dB Bandwidth	15.247(a)(1)	A8.1(a)	5.6	Pass
Radiated Emissions	15.209(a)	RSS-GEN 7.5.2	5.10	Pass
Spurious Emissions	15.247(d)	A8.5	5.11	Pass
Number of Channels	15,247(a)(1)	A8.1(d)	5.4	Pass
Directional antenna with >6dBi	15.247(c)		5.2 Antenna<6dBi	N/A
Dwell Time	15.247(a)	A8.1(d)	5.4	Pass
6dB Bandwidth		A8.2(a)	5.8	Pass
Power Spectral Density		A8.2(b)	5.9	Pass

2 Attestations

This equipment has been tested in accordance with the standards identified in this report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in these reports.

All measuring instruments used to determine the status of the product's compliance to the identified standards are calibrated regularly in accordance with UKAS requirements.

A comprehensive system of traceable calibration in accordance with ISO9001 is maintained.

Name/Position	Signature	Date
David Jamieson EMC Engineer		25 th June 2014

I attest that the necessary measurements were made, under my supervision at:

Raymarine UK Ltd, Marine House, Cartwright Drive, Fareham, PO15 5RJ.



Andy Little
Compliance Manager

Date: 30th June 2014

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3 Test Information

3.1 Test Facilities

Site 1	9m x 6m x 5.5m Semi Anechoic Chamber	FCC ID IC Certification	Reg 371673 Reg 4069B-2
Site 5	2m x 3m x 2.5m Screened Room		

3.2 Overall Test Conditions

Work Area	Relative Humidity (%)	Air Pressure (mbar)	Ambient Temperature (°C)
Site 1-5	62	1005	18.9
Sites 6-10	63	1015	21.1

3.3 Test Methods

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth and WIFI, 2.4GHz ISM band radiators) for the EUT FCC ID Certification and RSS-210 for the Industry Canada certification:

Number	Standard Number	Document Title
1	47 CFR Part 15 (10-01-09 Edition)	Radio Frequency Devices
2	RSS-210 Issue 8 December 2010	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

3.3.1 Deviations from Test Methods

None

4 EUT Information

4.1 Test Rationale

Full compliance

4.2 Description of Equipment under Test (EUT)

Date of Receipt:	24 th April 2014
Client:	Tony Sharp
Brand Name:	Raymarine
Product Range:	a Series
Country of Manufacture:	China
Operational voltage range:	10.8Vdc to 32Vdc

Unit 1

Model Name or Number:	a127
FCC ID	PJ5-WFBT10
IC ID	4069B-WFBT10
Unique Type Identification:	E70236
Serial Number:	0440004
CCT Diagram Number(s) & Issue:	CPU = 1003165-4; Sonar 600W = 1003513-1; Chart Reader = 1003473-1; Keyboard = 1001673-1; GPS = 1003483-3
PCB Assembly Number(s) & Issue:	CPU = 1003166-5; Sonar 600W = 1003514-3; Chart Reader = 1003474-2; Keyboard = 1001674-1; GPS = 1003484-4
Software Version:	Primary: v10.08-00047 Application: v10.24-00575
Modifications to Unit:	None

Unit 2

Model Name or Number:	a127
FCC ID	PJ5-WFBT10
IC ID	4069B-WFBT10
Unique Type Identification:	E70236
Serial Number:	0649904
CCT Diagram Number(s) & Issue:	CPU = 1003165-4; Sonar 600W = 1003513-1; Chart Reader = 1003473-1; Keyboard = 1001673-1; GPS = 1003483-3
PCB Assembly Number(s) & Issue:	CPU = 1003166-5; Sonar 600W = 1003514-3; Chart Reader = 1003474-2; Keyboard = 1001674-1; GPS = 1003484-4
Software Version:	Primary: v10.08-00047 Application: v10.24-00575
Modifications to Unit:	None

4.3 Additional information

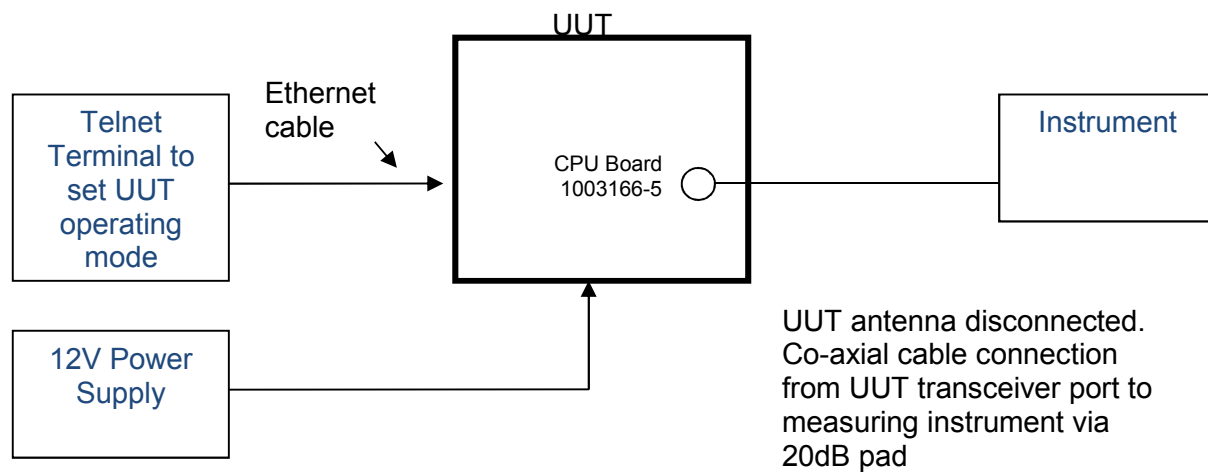
The a95, a97, a98, a125, a127 and a128 all share a common Wi-Fi / Bluetooth module & antenna, therefore conducted RF measurements & radiated emissions above 3GHz were only carried out on the a127.

4.4 Description of Auxiliary Equipment

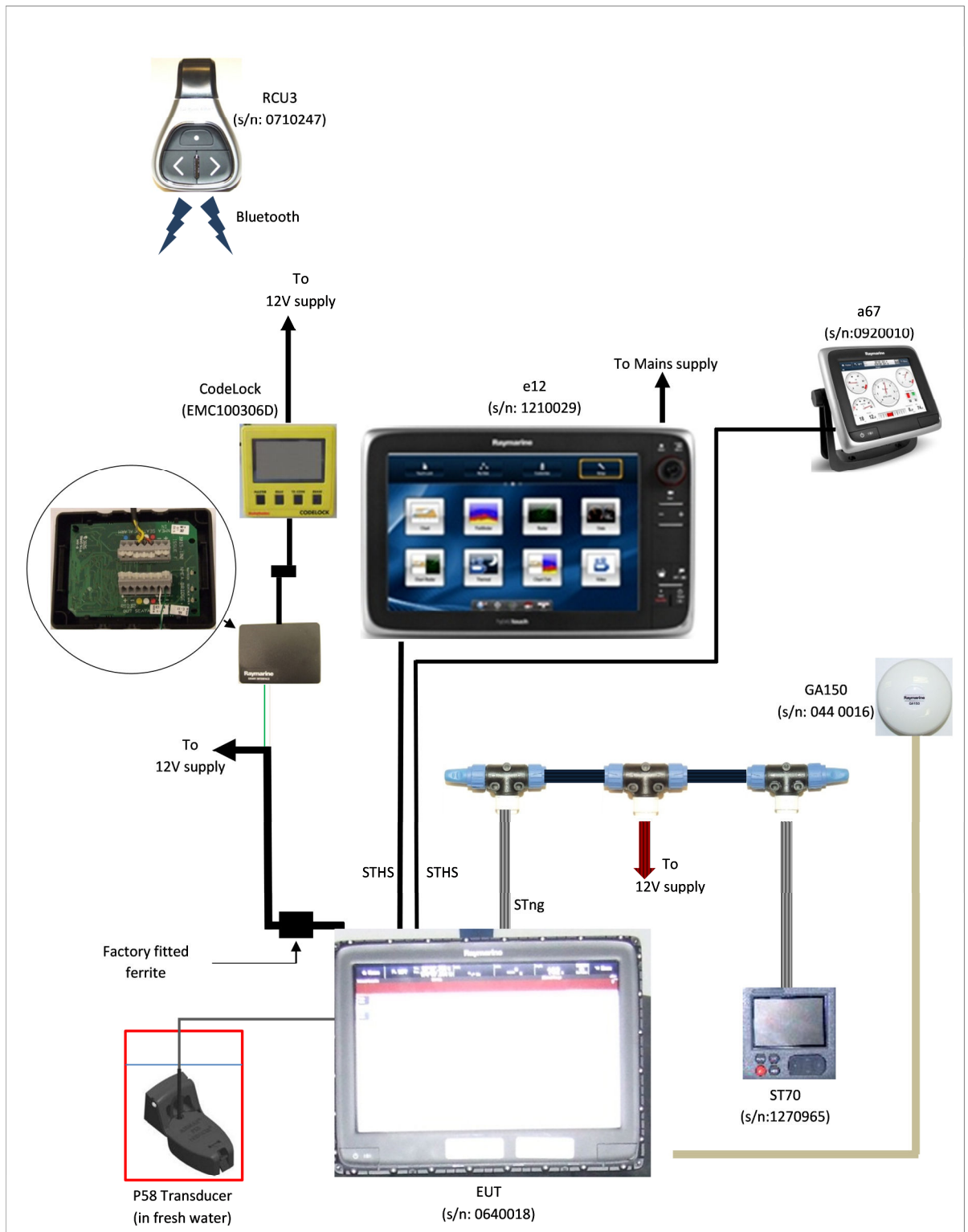
Product Type	Part Number	Serial Number
ST1 Simulator	Codelock	8H20454512
ST1 to NMEA Converter	E85001	EMC111004a
ST70	E22105	1270965
Compaq Laptop	NC6220	RM0048
RCU-3	E62351	0710247
a67 MFD	E70076	0920010
e12 Hybrid Touch	E70024	1210029
GA150	A80288	0440033

4.5 Test Configurations

4.5.1 Maximum Power, EIRP Spectral Density and Frequency Range tests

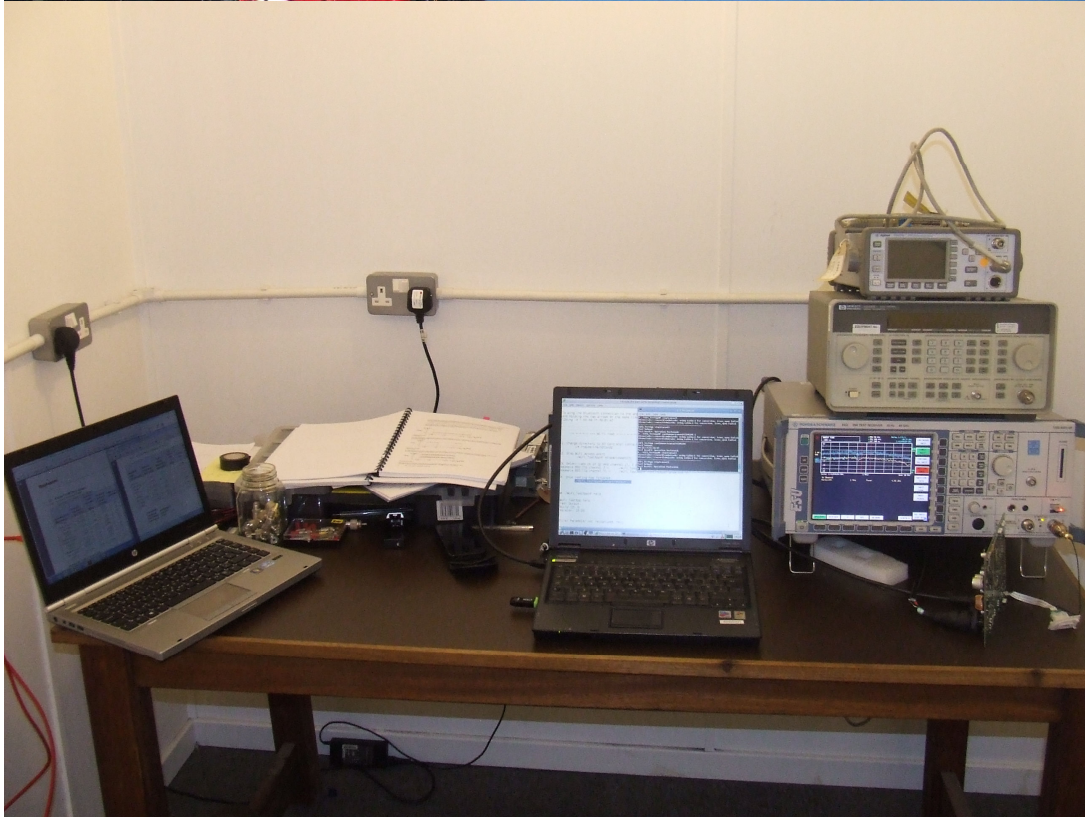
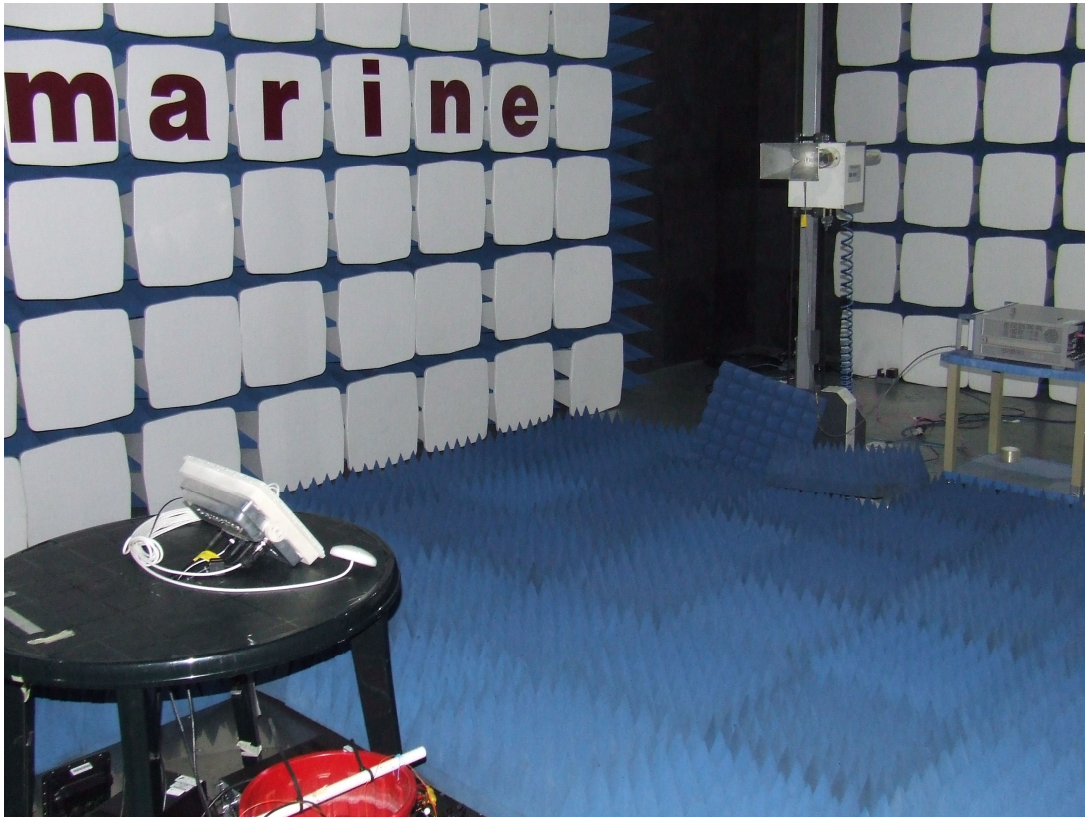


4.5.2 Radiated Emissions Setup



Note: LISN's were not used during this test.

4.5.3 Photos



4.6 Operating Modes

4.6.1 *Peak Output Power and Frequency Range*

The tests performed with the UUT in each of three operating modes:

- Continuously transmitting 802.11b 11Mbps DSSS CCK @ 20dBm nominal
- Continuously transmitting 802.11g 54Mbps OFDM @ 14.5dBm nominal
- Continuously transmitting 1Mbps Bluetooth GFSK, fixed frequency @ 9.5dBm nominal

5 Test Results

5.1 Transmit Duty Cycle, “x”

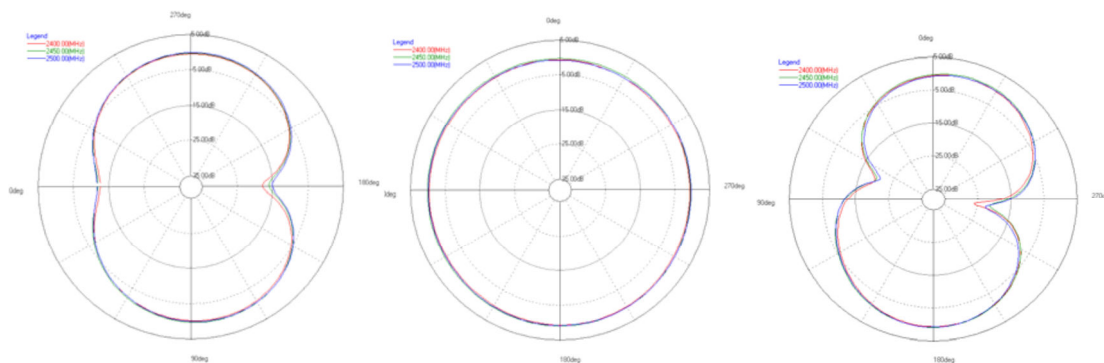
Transmit duty cycle (symbol “x”) is required for the calculations relating average power (measured) to EIRP for Maximum Transmit Power, Maximum EIRP Spectral Density and Frequency Range tests.

UUT Operating Mode	Period (ms)	Transmit On (ms)	Transmit Duty Cycle, x
11Mbps 802.11b DSSS CCK 20dBm nominal	3.0000	1.0000	0.3333
54Mbps 802.11g OFDM 14.5dBm nominal	2.2000	0.2200	0.1000
1Mbps Bluetooth GFSK 9.5dBm nominal	1.0000	1.0000	1.0000

5.2 UUT Antenna Gain, “G”

Antenna gain (symbol “G”) is required for the calculations relating average power (measured) to EIRP for Maximum Transmit Power, Maximum EIRP Spectral Density and Frequency Range tests.

UUT Max Antenna Gain (dBi)
+0.8



5.3 Peak Output Power

Conducted measurements as specified in 15.247(b)(1).

5.3.1 Normal Test Conditions; 22°C, 12.0V

Operating Mode (Modulation)	Channel \ Frequency (No. \ MHz)	Power Measured A (dBm)	Tx Duty Cycle x	Peak Power (mW)	Limit max. (mW)	Pass/Fail
11Mbps 802.11b DSSS 20dBm nominal	1 \ 2412	11.25	0.3333	40.01	125	Pass
	7 \ 2442	11.36	0.3333	41.03	125	Pass
	13 \ 2472	11.77	0.3333	45.09	125	Pass
54Mbps 802.11g OFDM 14.5dBm nominal	1 \ 2412	0.01	0.1000	10.02	125	Pass
	7 \ 2442	0.22	0.1000	10.52	125	Pass
	13 \ 2472	0.59	0.1000	11.46	125	Pass
1Mbps Bluetooth GFSK 9.5dBm nominal	1 \ 2402	7.33	1.0000	5.41	125	Pass
	48 \ 2480	6.73	1.0000	4.71	125	Pass
	79 \ 2479	7.1	1.0000	5.13	125	Pass

5.4 Frequency Hopping Requirements

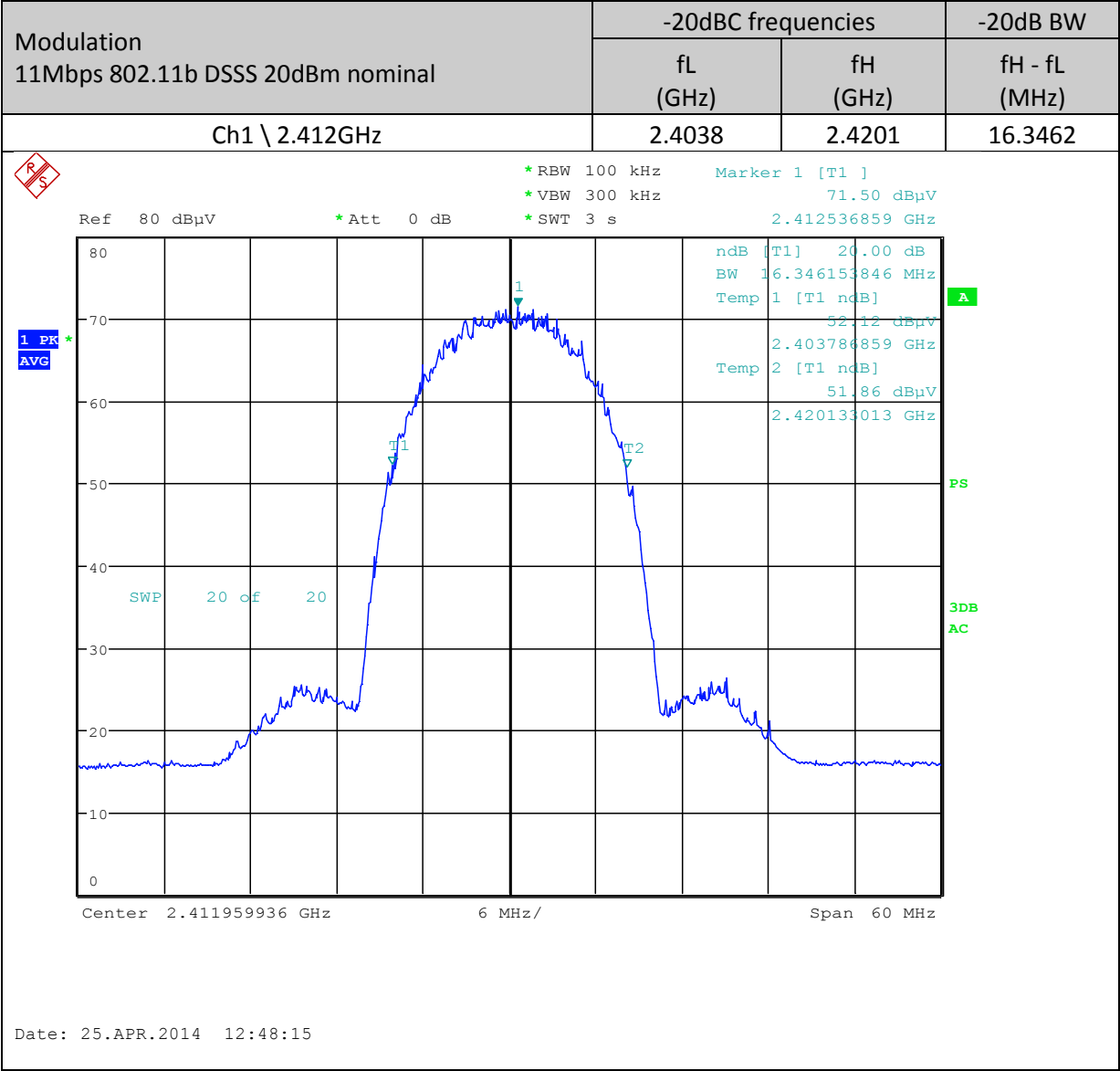
UUT frequency hopping characteristics are as defined by the Bluetooth system specification

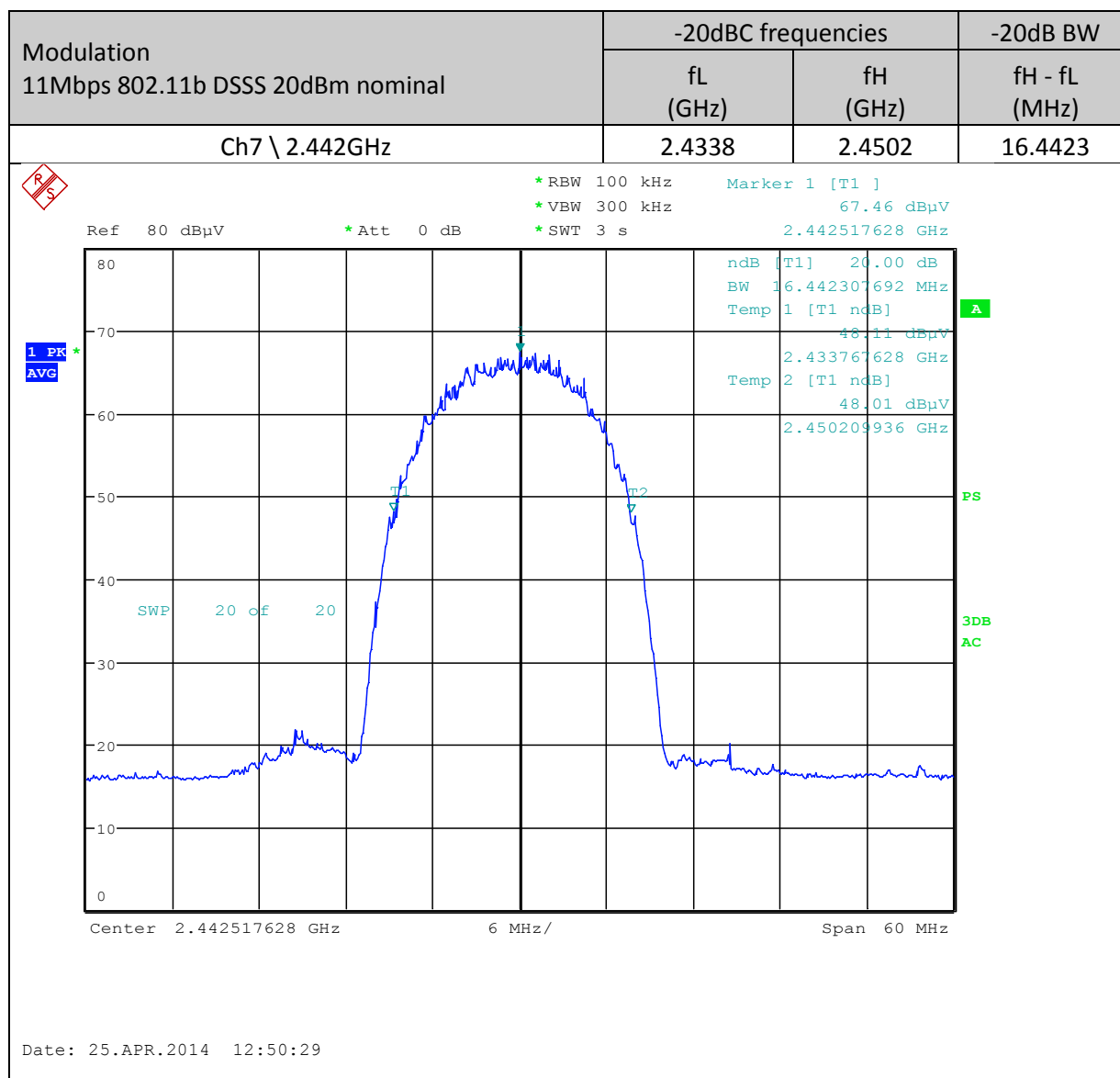
47 CFR 15.247(a)		Bluetooth	Pass / Fail
Technical Specification	Limit		
Dwell Time 15.247(a)	0.4s	0.38s Based on 79 Channels	Pass
Channel Separation 15.247(a)	Channels non-overlapping, 1MHz separation measured at 20dB below peak power	Complies with this requirement	Pass
Hopping Sequence 15.247(a)	Non-adaptive hopping uses 15 channels min.	79	Pass
	Adaptive hopping uses 90% min. of 2.4000 to 2.4835 band	N/A	
	Adaptive hopping uses 20 channels min.	N/A	
	Each channel occupied at least once during period $T = 4 \times \text{dwell time} \times \text{no. of channels}$	The Bluetooth channel hopping sequence is designed to visit each 1 MHz channel spacing frequency regularly and with roughly equal probability	

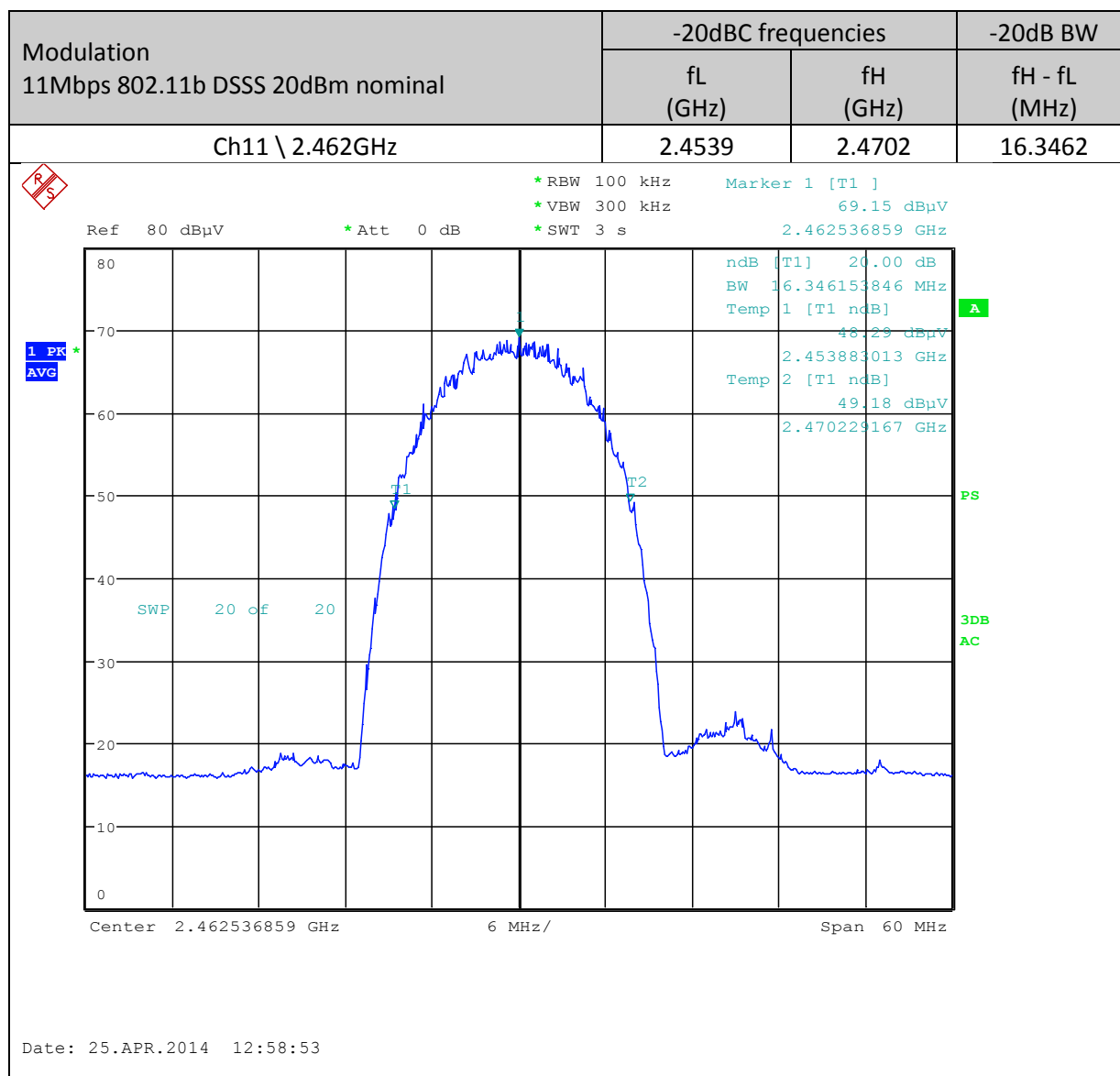
5.5 Medium Access Protocol

		UUT
Technical Specification	Requirement	
Medium Access Protocol	A medium access protocol shall be implemented by the equipment	The UUT implements medium access protocols defined by Bluetooth and IEEE 802.11 b/g specifications

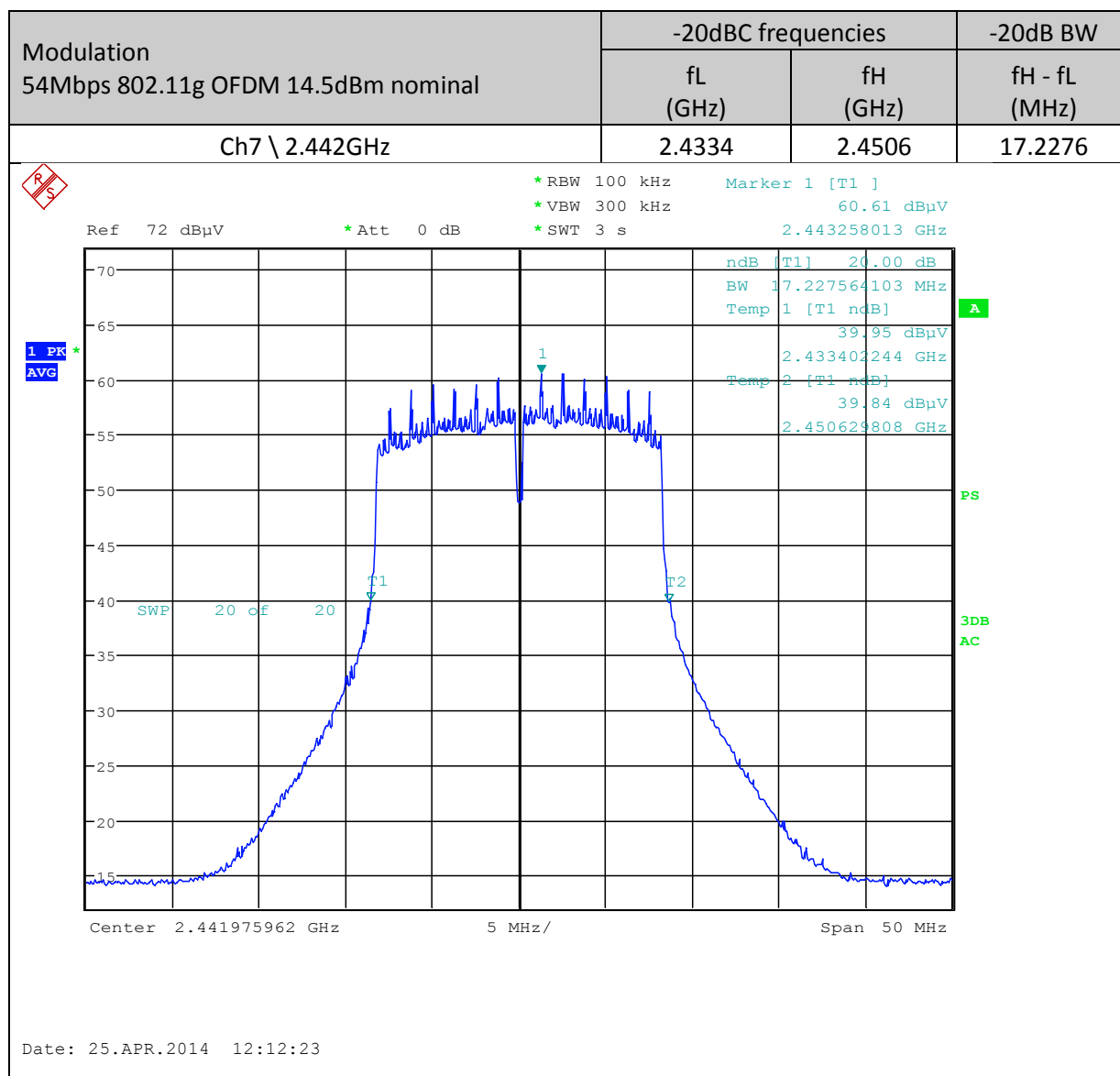
5.6 20dB Channel Bandwidth



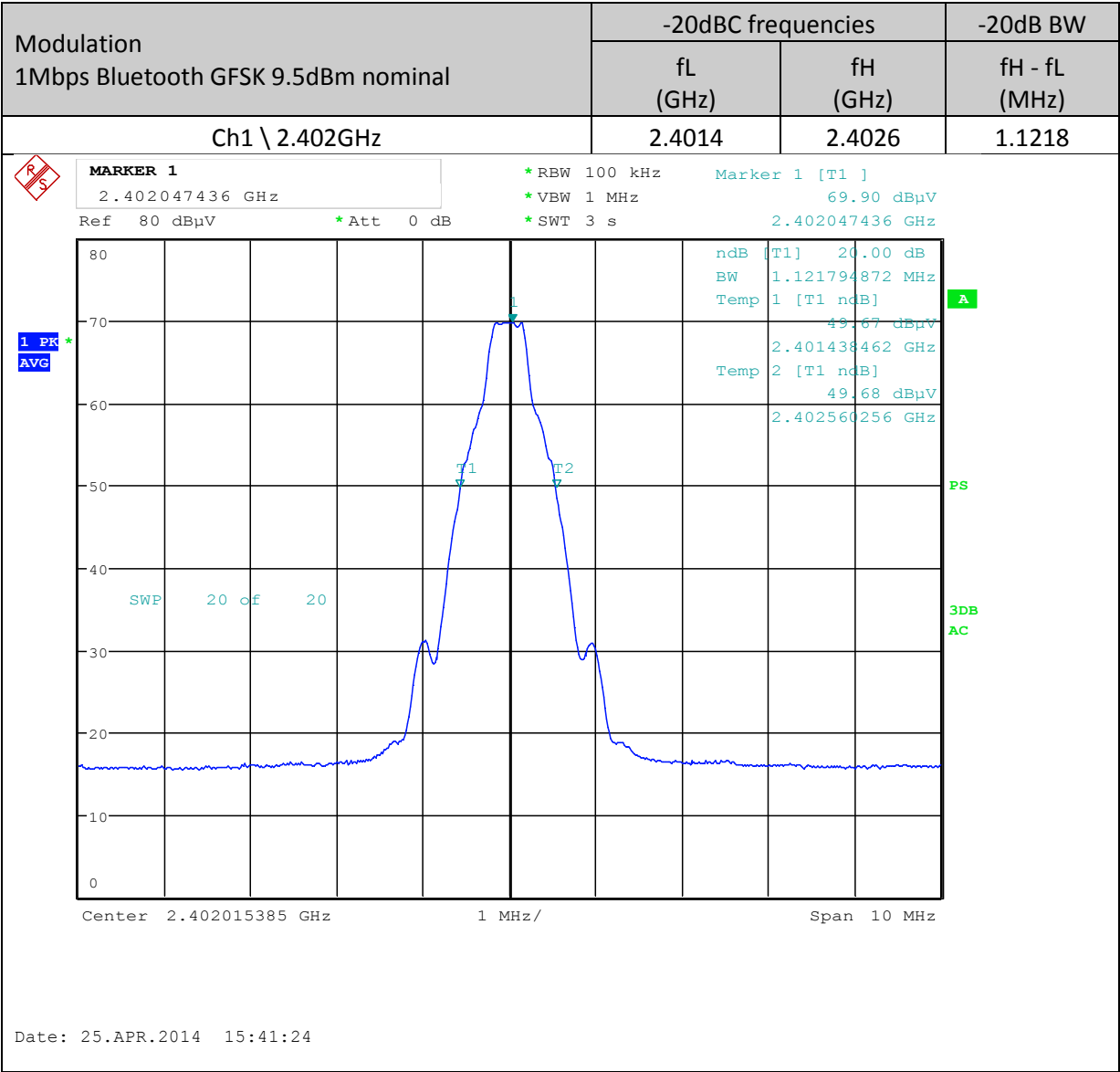


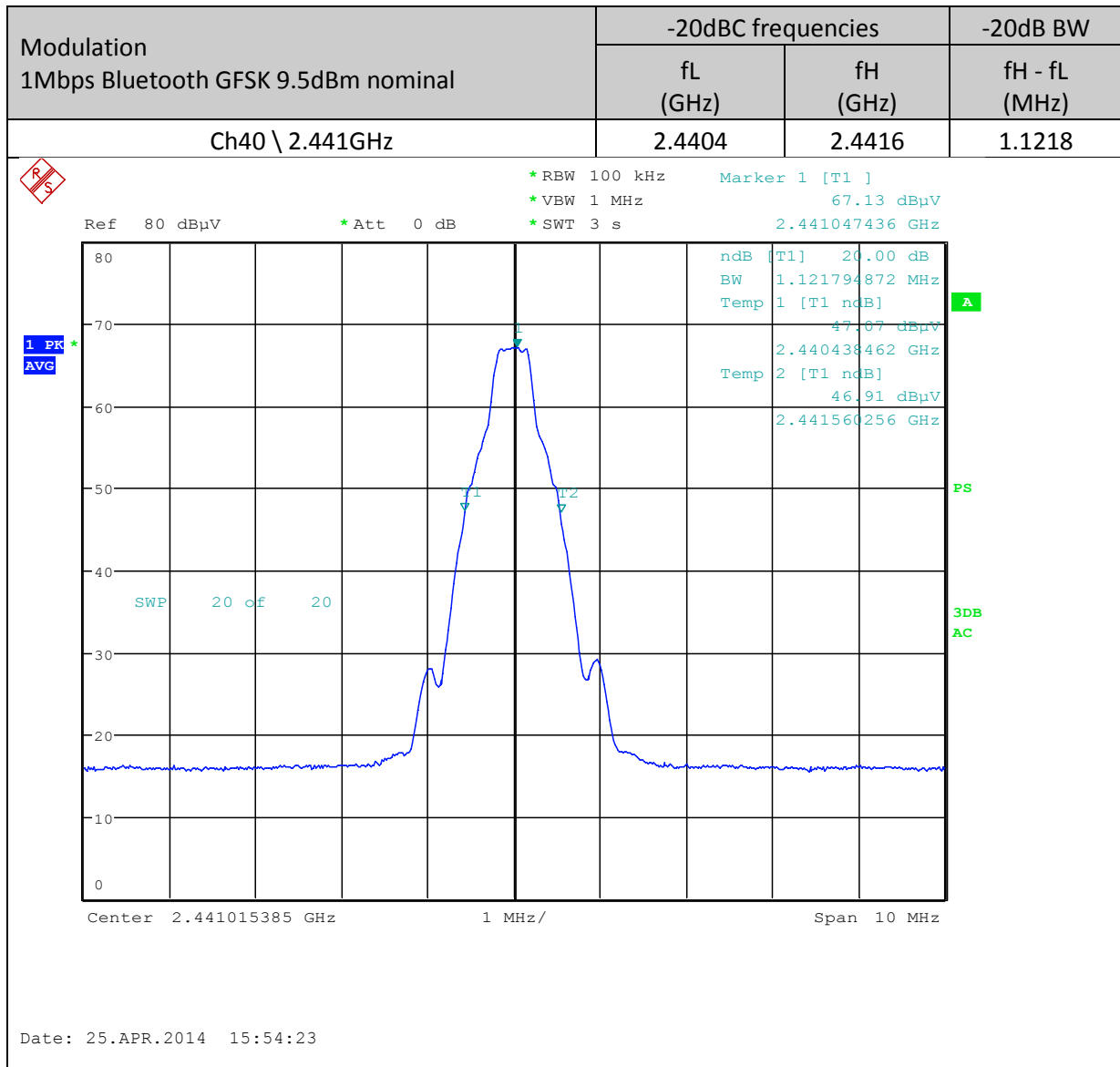


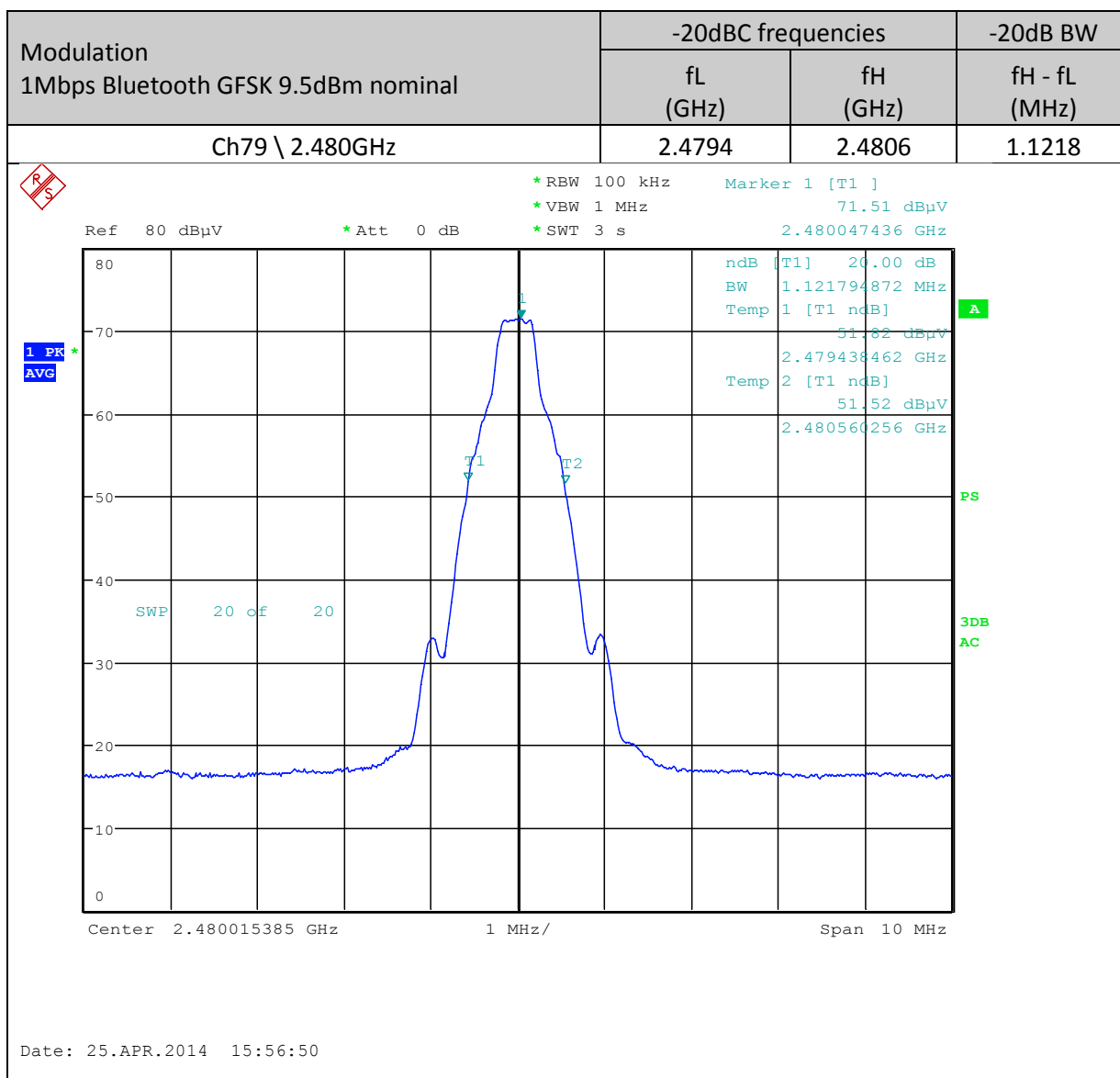
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Issue: 23 Sep 2010







5.7 Frequency Band Edges

Modulation	-20dBC frequency	
	fLow (GHz)	fHigh (GHz)
11Mbps 802.11b DSSS 20dBm nominal		
Lower Band Edge Ch1 \ 2.412GHz	2.40345	
Upper Band Edge Ch11 \ 2.462GHz		2.47065
54Mbps 802.11g OFDM 14.5dBm nominal		
Lower Band Edge Ch1 \ 2.412GHz	2.40295	
Upper Band Edge Ch11 \ 2.462GHz		2.47108
1Mbps Bluetooth GFSK 9.5dBm nominal		
Lower Band Edge Ch1 \ 2.402GHz	2.40133	
Upper Band Edge Ch79 \ 2.480GHz		2.48063

5.8 6dB Channel Bandwidth (RSS-210)

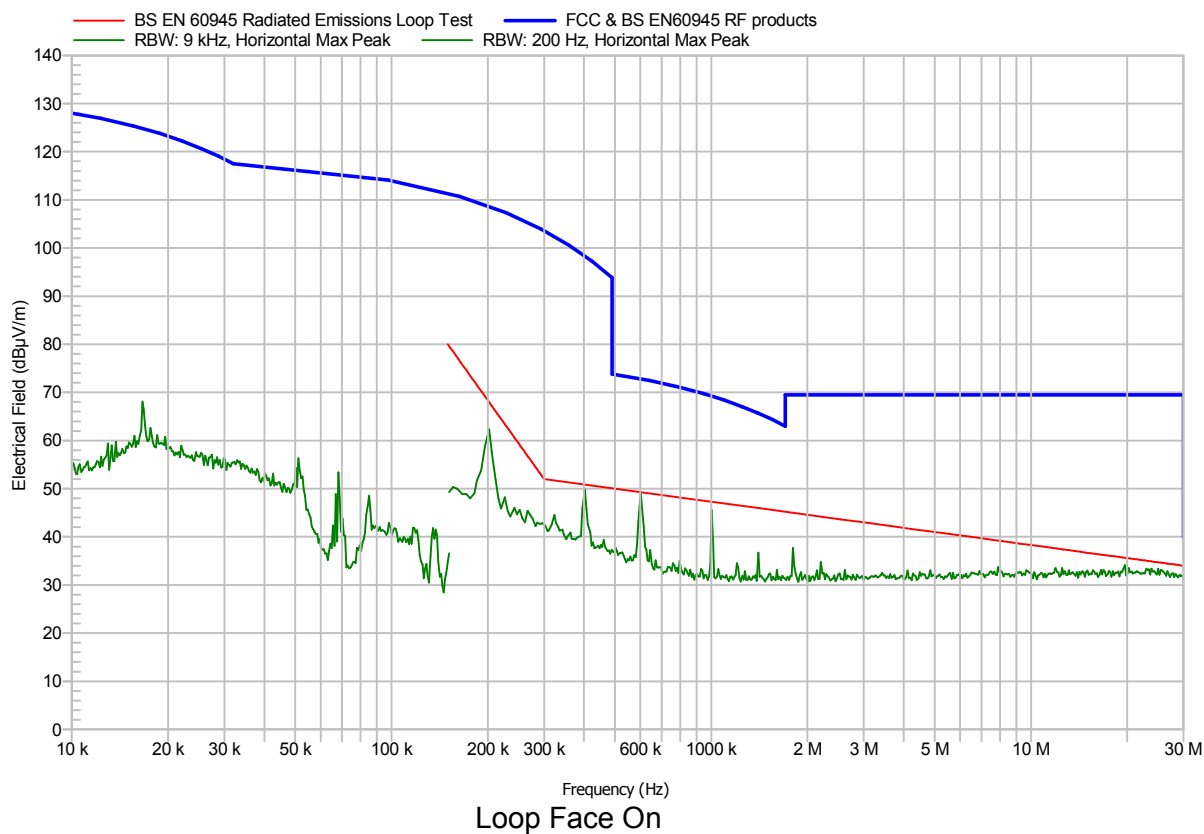
Modulation	-6dB BW (MHz)	Limit	Result
11Mbps 802.11b DSSS 20dBm nominal		>500kHz	
Ch1	9.808		Pass
Ch7	9.904		Pass
Ch11	9.038		Pass
54Mbps 802.11g OFDM 14.5dBm nominal			
Ch1	4.968		Pass
Ch7	6.490		Pass
Ch13	5.609		Pass

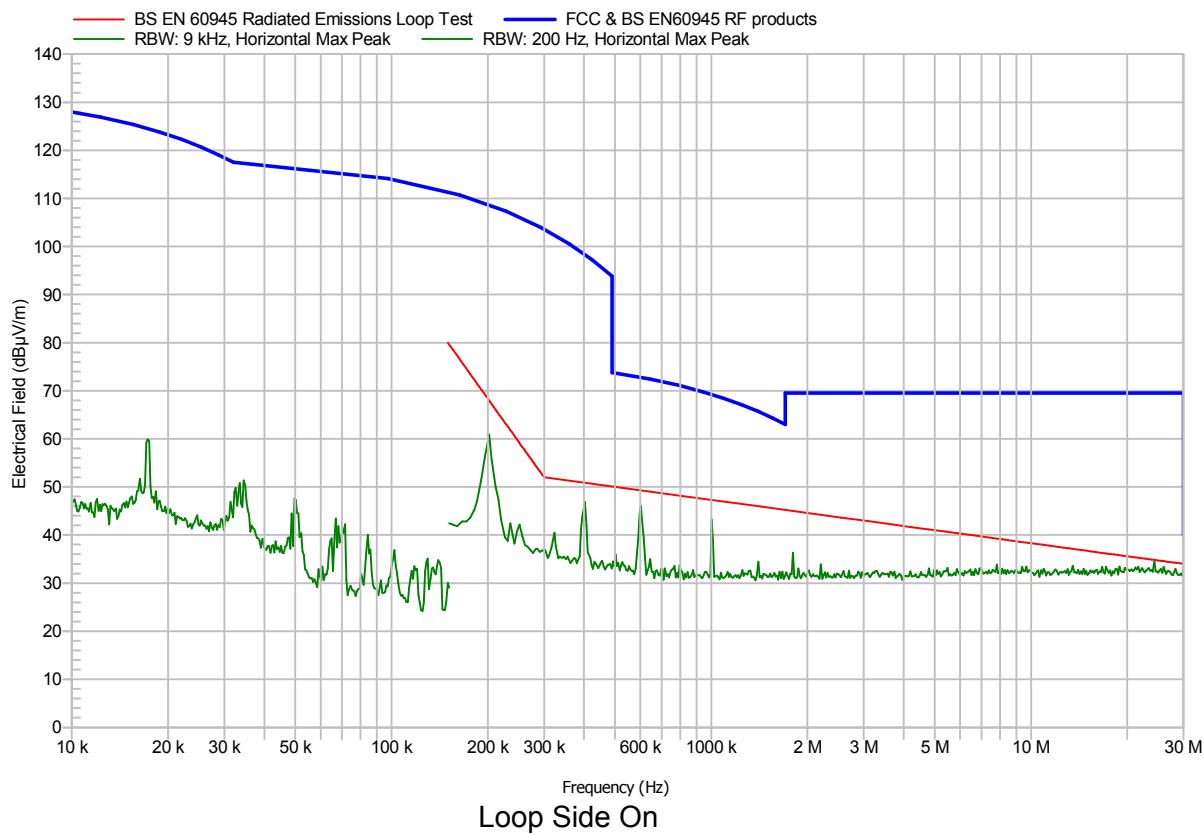
5.9 Power Spectral Density (RSS-210)

Modulation	PSD (dBm/3kHz)	Limit	Result
11Mbps 802.11b DSSS 20dBm nominal		<8dBm	
Ch1	-9.21		Pass
Ch7	-9.41		Pass
Ch11	-8.74		Pass
54Mbps 802.11g OFDM 14.5dBm nominal			
Ch1	-15.1		Pass
Ch7	-15.48		Pass
Ch11	-14.96		Pass

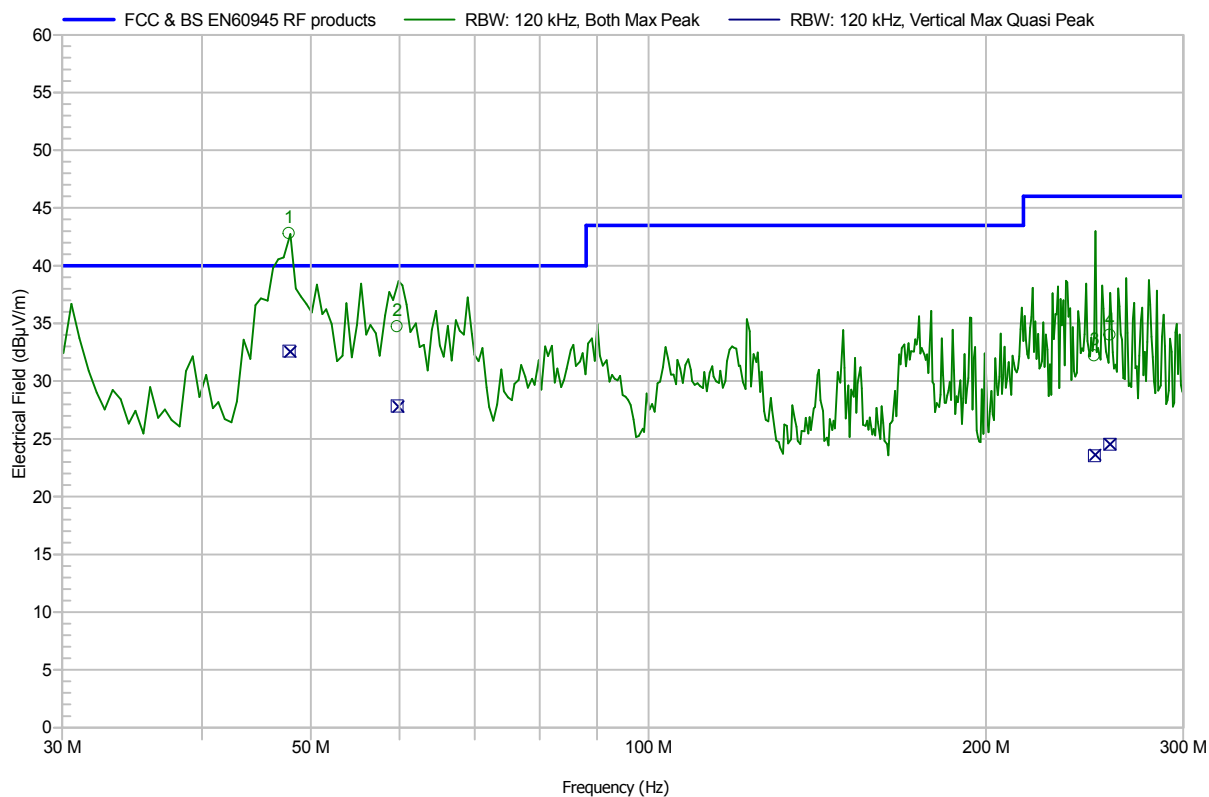
5.10 Transmitter Spurious Emissions

5.10.1 Radiated Emissions a127 9kHz-30MHz



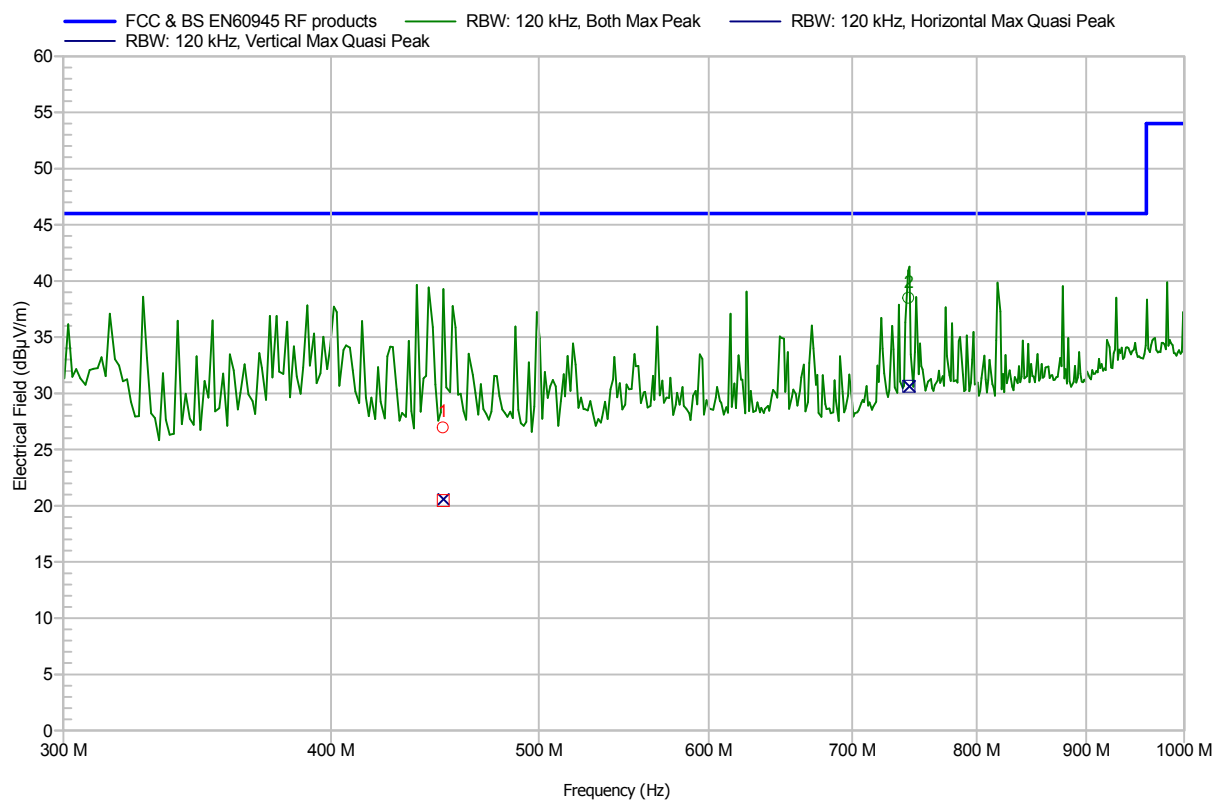


5.10.2 Radiated Emissions a127 30MHz – 300MHz

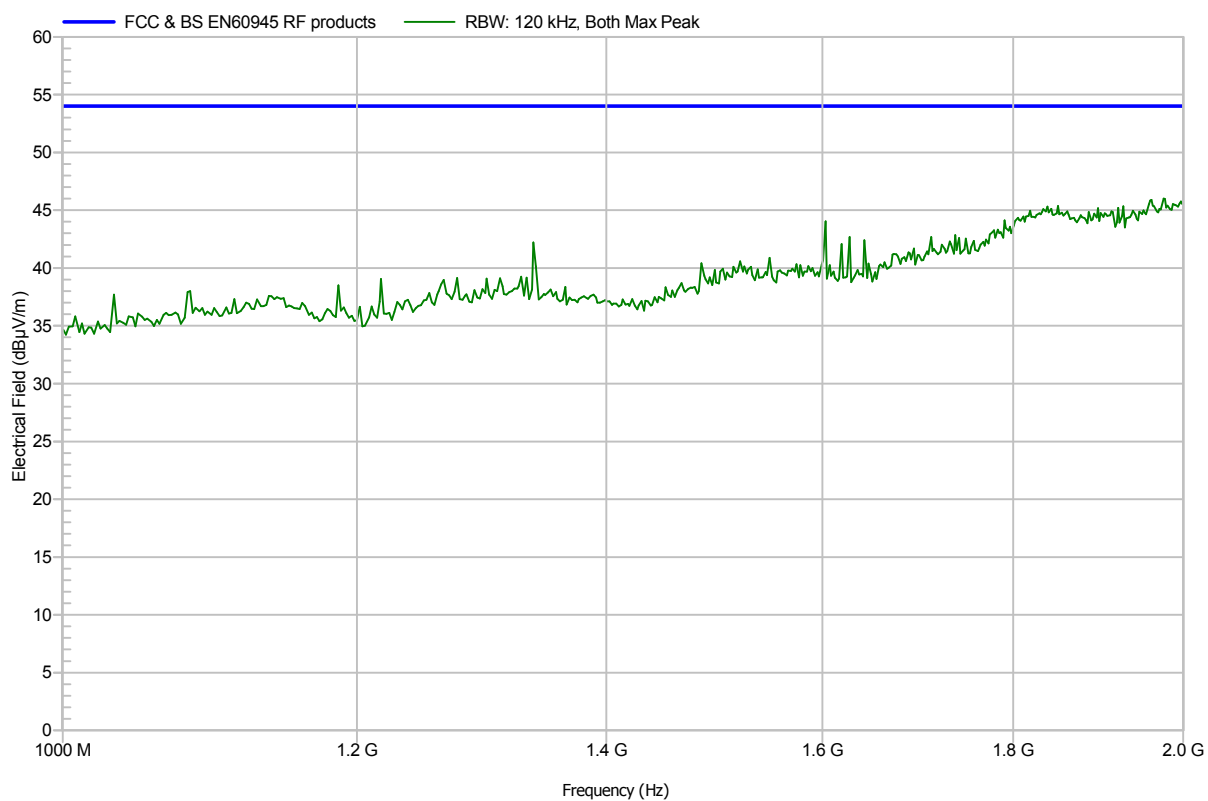


Nr	Frequency	Peak	Quasi-Peak	QP Limit	Status	Angle	Height	Polarization
1	47.82 MHz	42.79 dBμV/m	32.6 dBμV/m	40 dBμV/m	Pass	270 Degree	1.5 m	Vertical
2	59.7 MHz	34.73 dBμV/m	27.85 dBμV/m	40 dBμV/m	Pass	77 Degree	1.5 m	Vertical
3	249.78 MHz	32.22 dBμV/m	23.55 dBμV/m	46 dBμV/m	Pass	192 Degree	1.5 m	Vertical
4	257.88 MHz	34 dBμV/m	24.54 dBμV/m	46 dBμV/m	Pass	77 Degree	1.5 m	Vertical

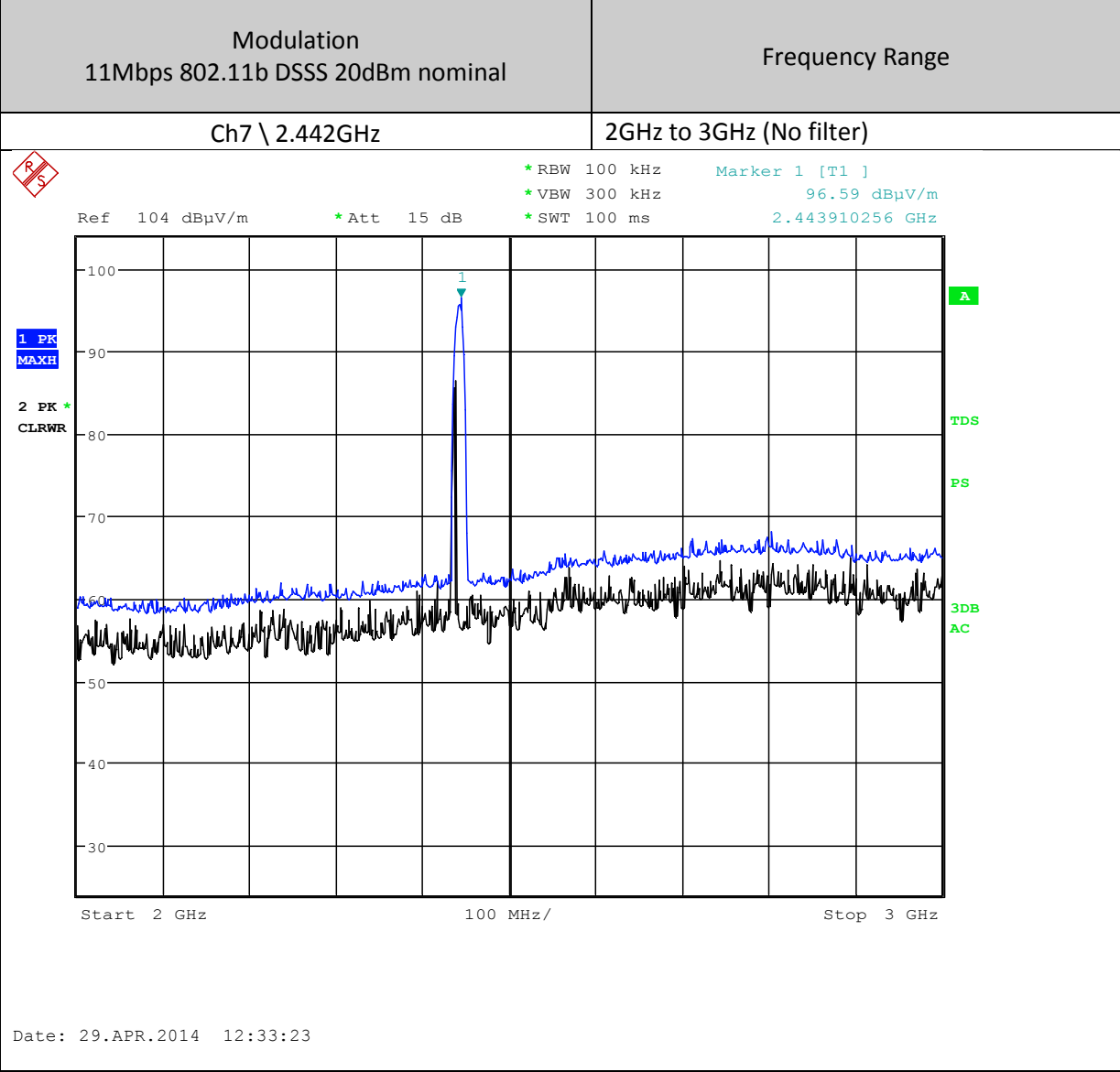
5.10.3 Radiated Emissions a127 300MHz-1GHz



5.10.4 Radiated Emissions a127 1GHz-2GHz



5.10.5 Radiated Emissions a127 2GHz-3GHz (No filter)



Modulation
11Mbps 802.11b DSSS 20dBm nominal

Frequency Range
2GHz to 3GHz (With 2.4GHz blocking filter)

Ch1 \ 2.412GHz

Ref 72 dBμV/m * Att 0 dB

* RBW 100 kHz * VBW 300 kHz * SWT 100 ms

Marker 1 [T1] 34.59 dBμV/m 2.415705128 GHz

1 PK MAXH

2 PK * CLRWR

A

TDS

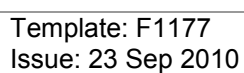
LNA

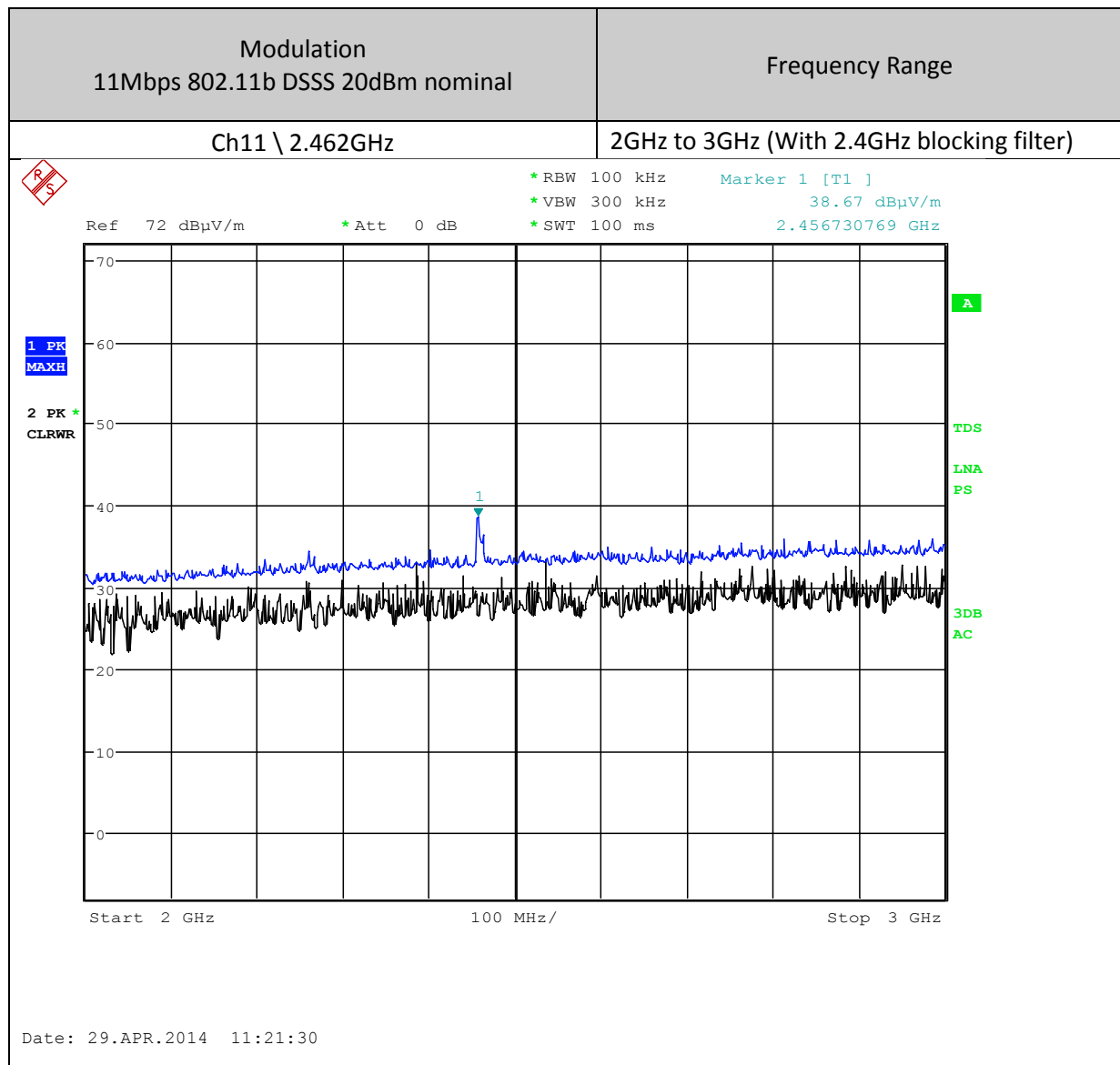
PS

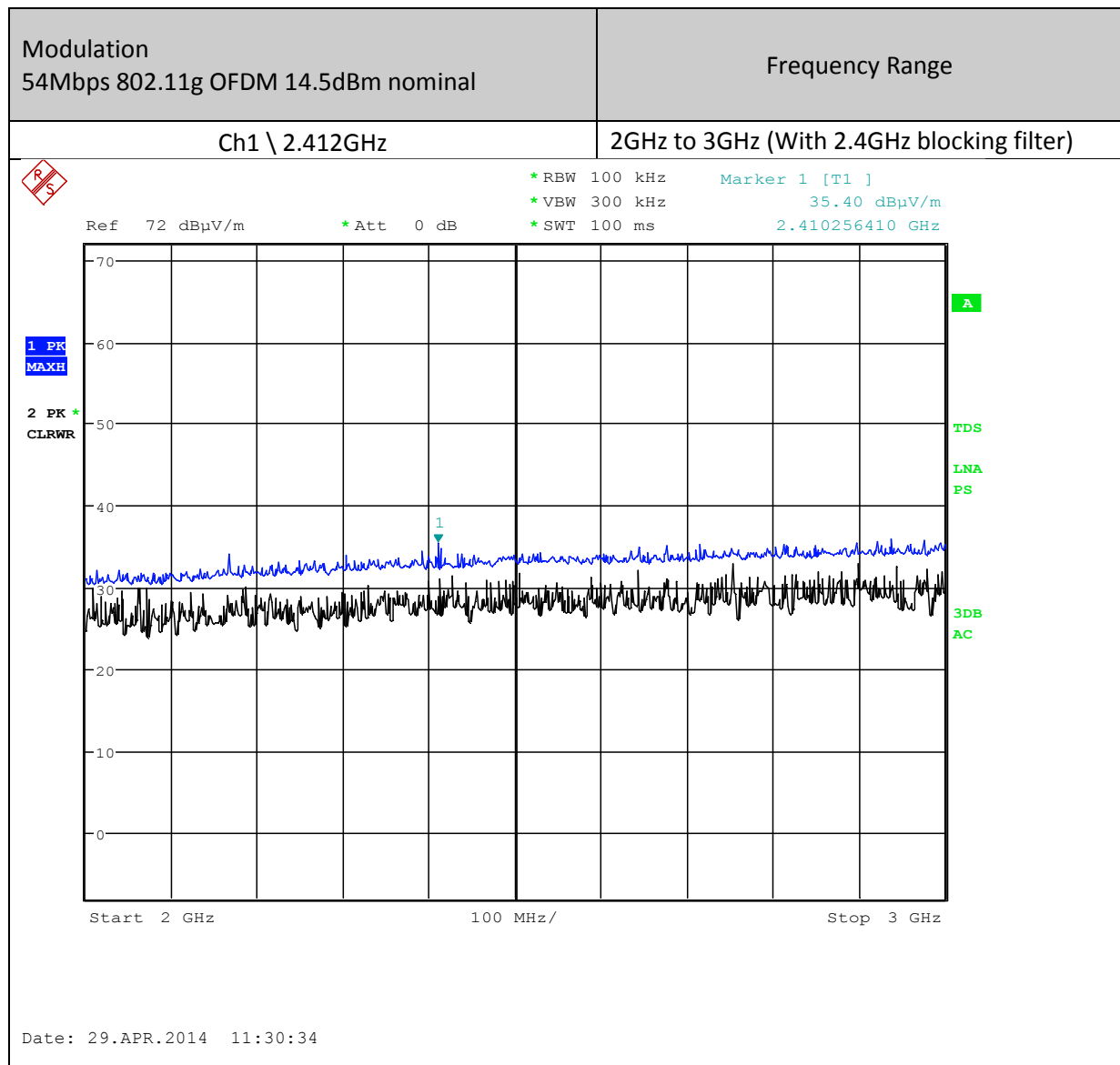
3DB

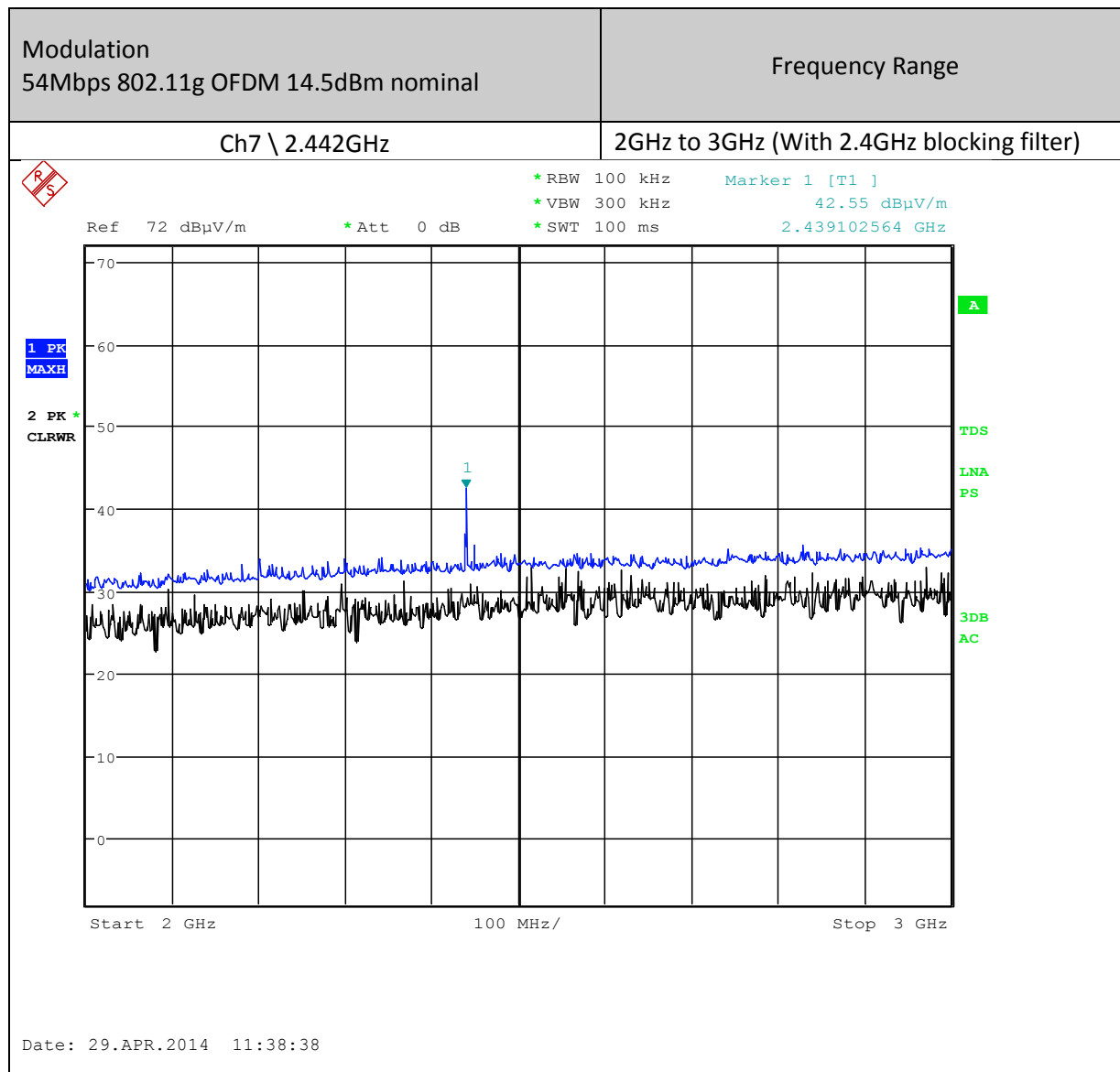
AC

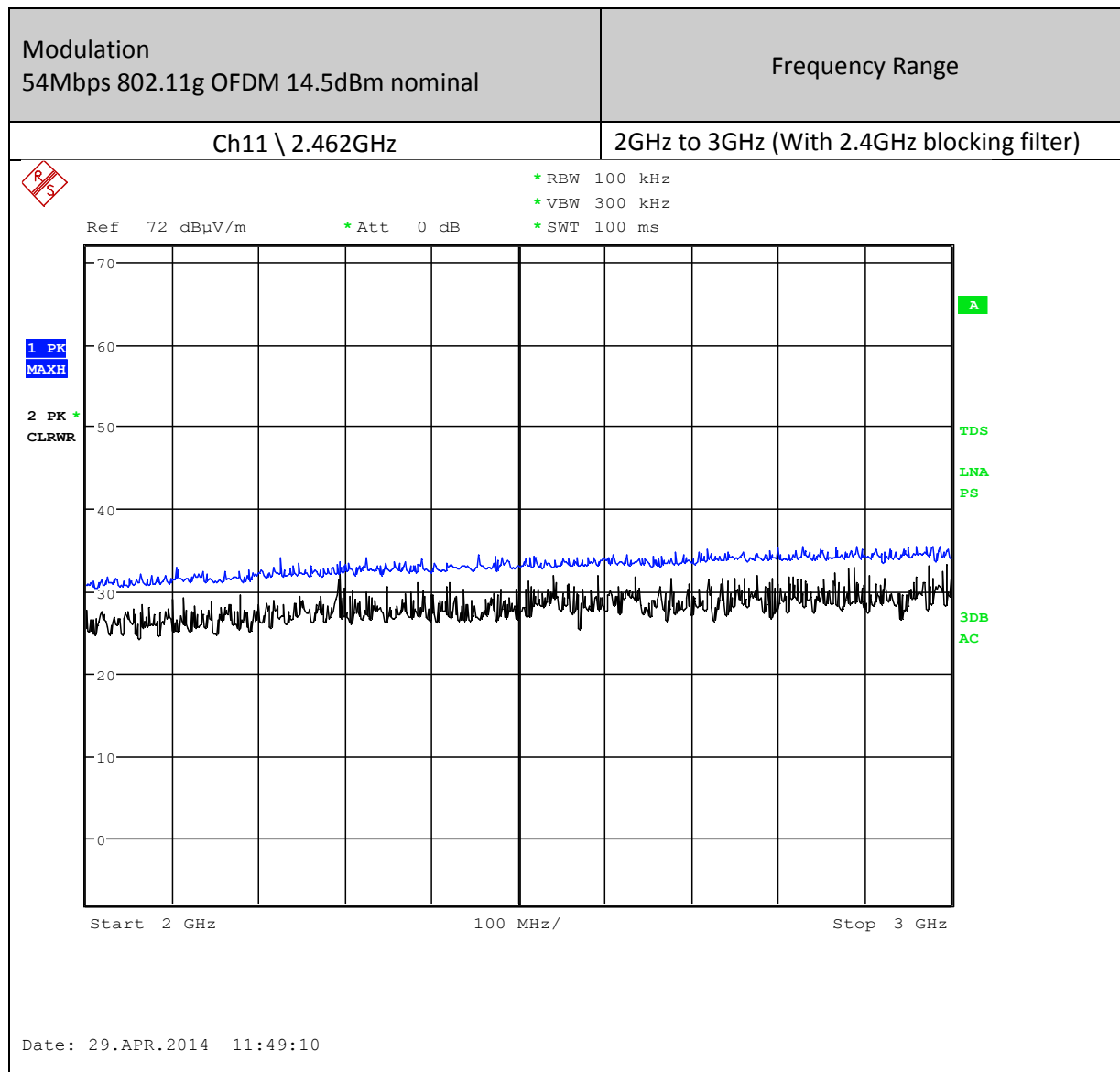
Start 2 GHz 100 MHz/ Stop 3 GHz

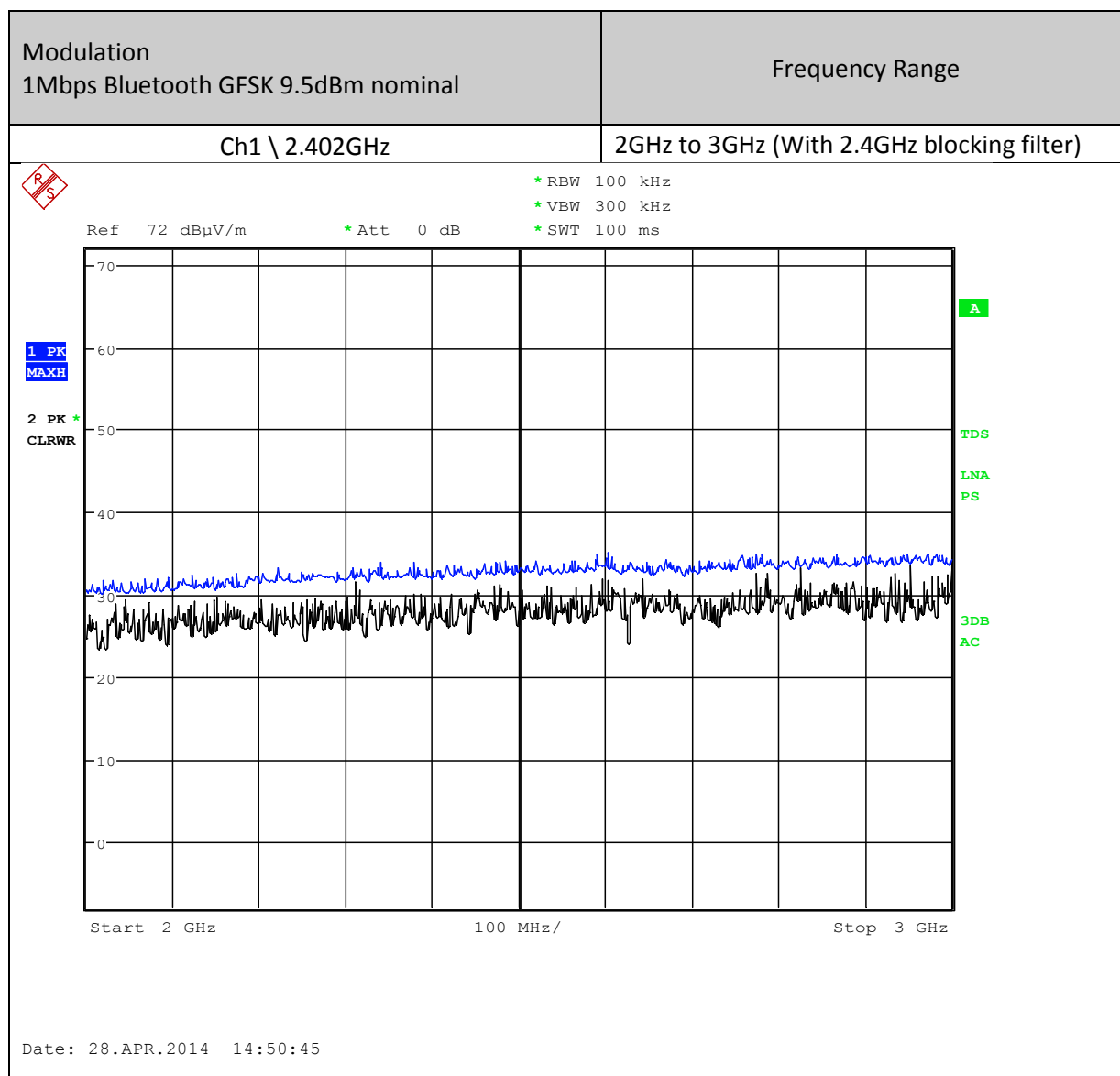


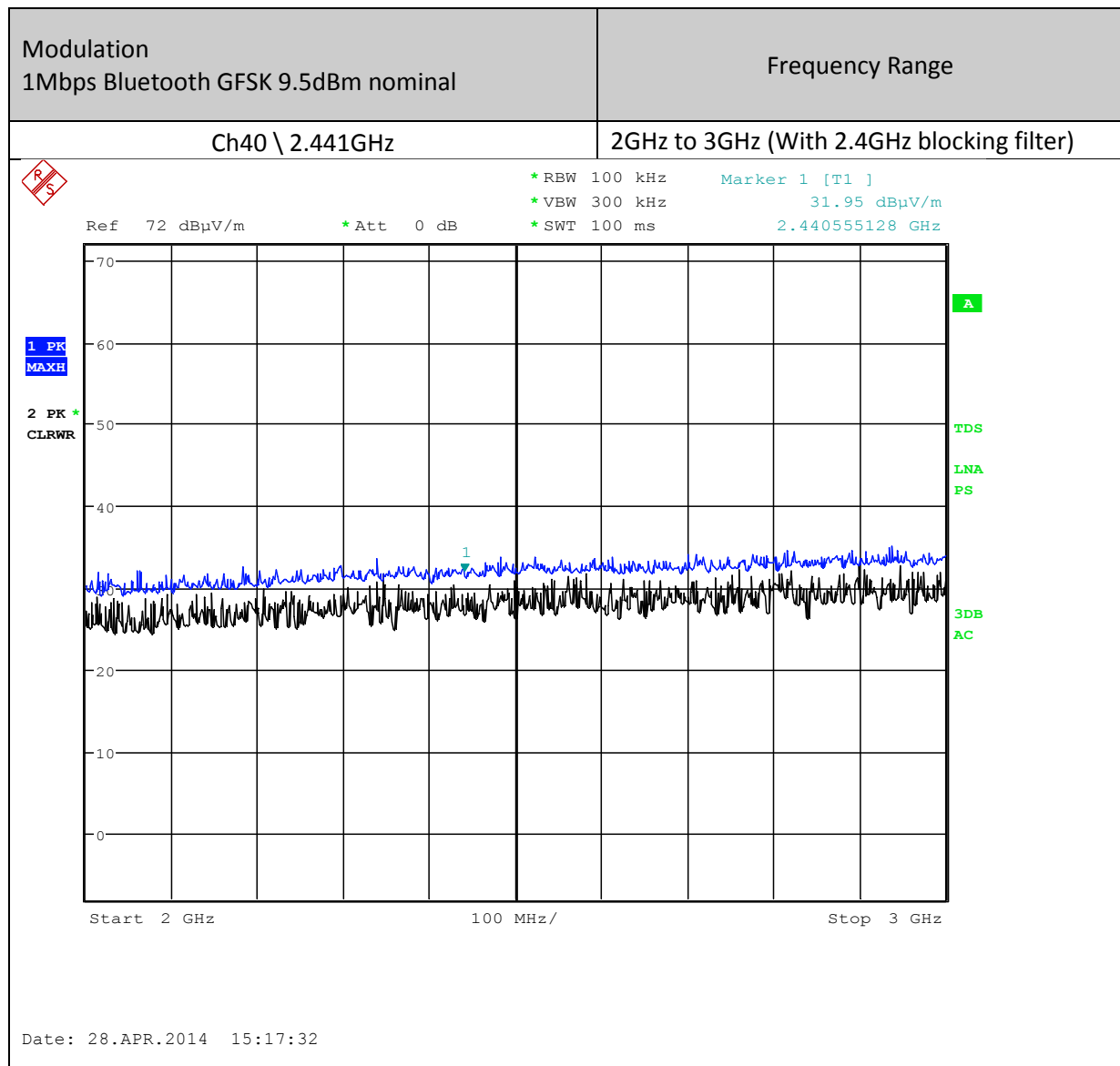


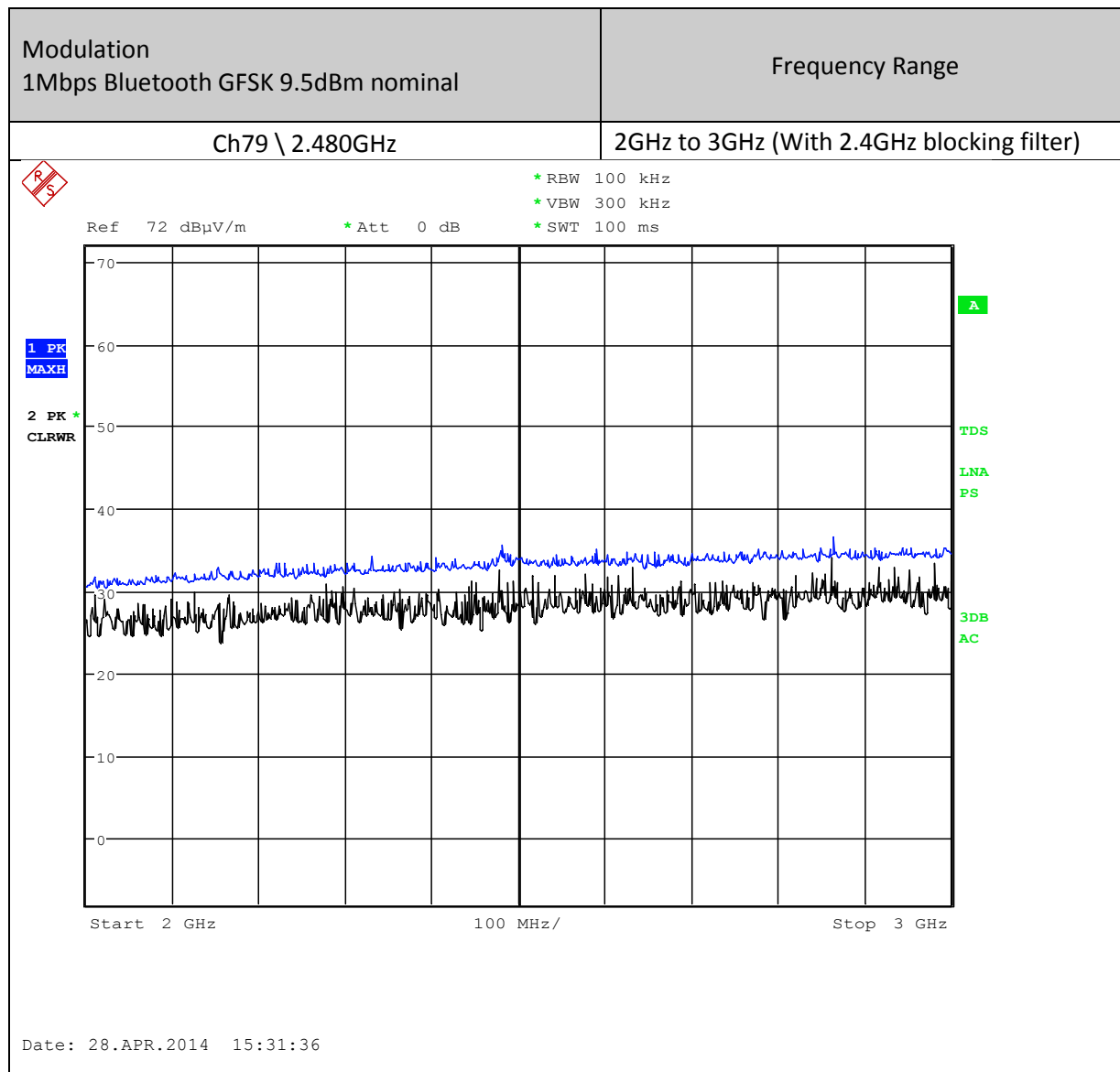




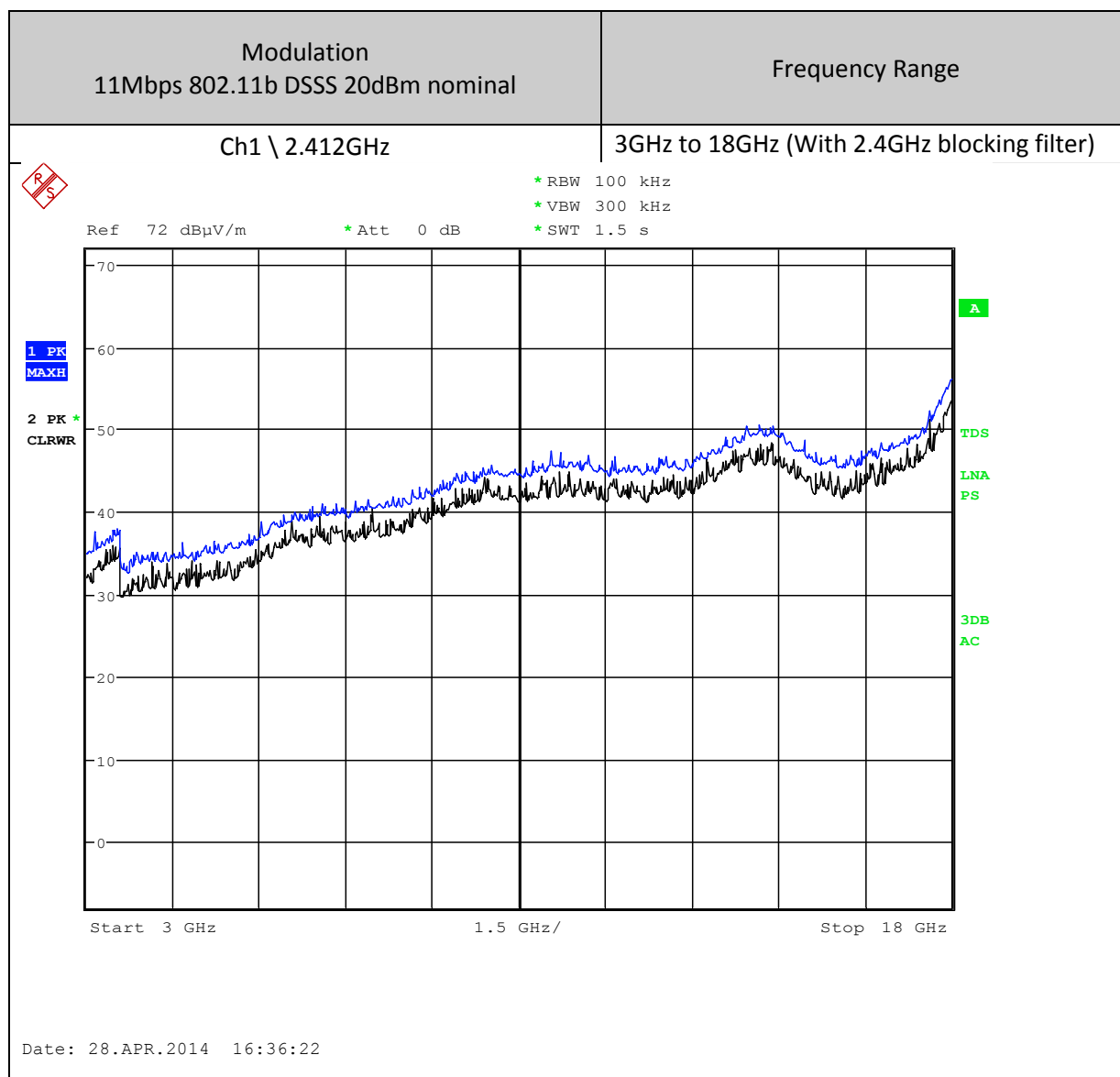


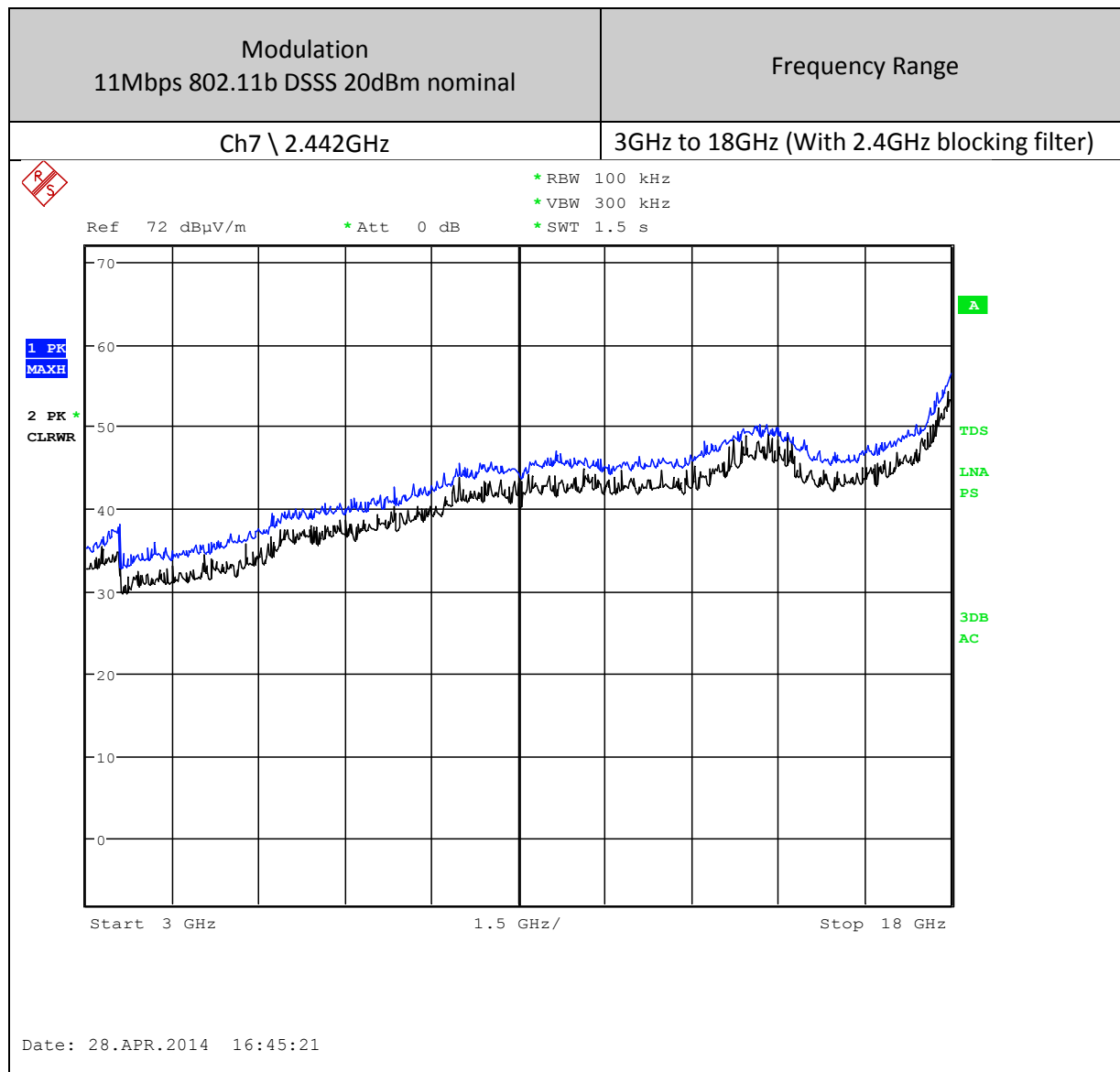


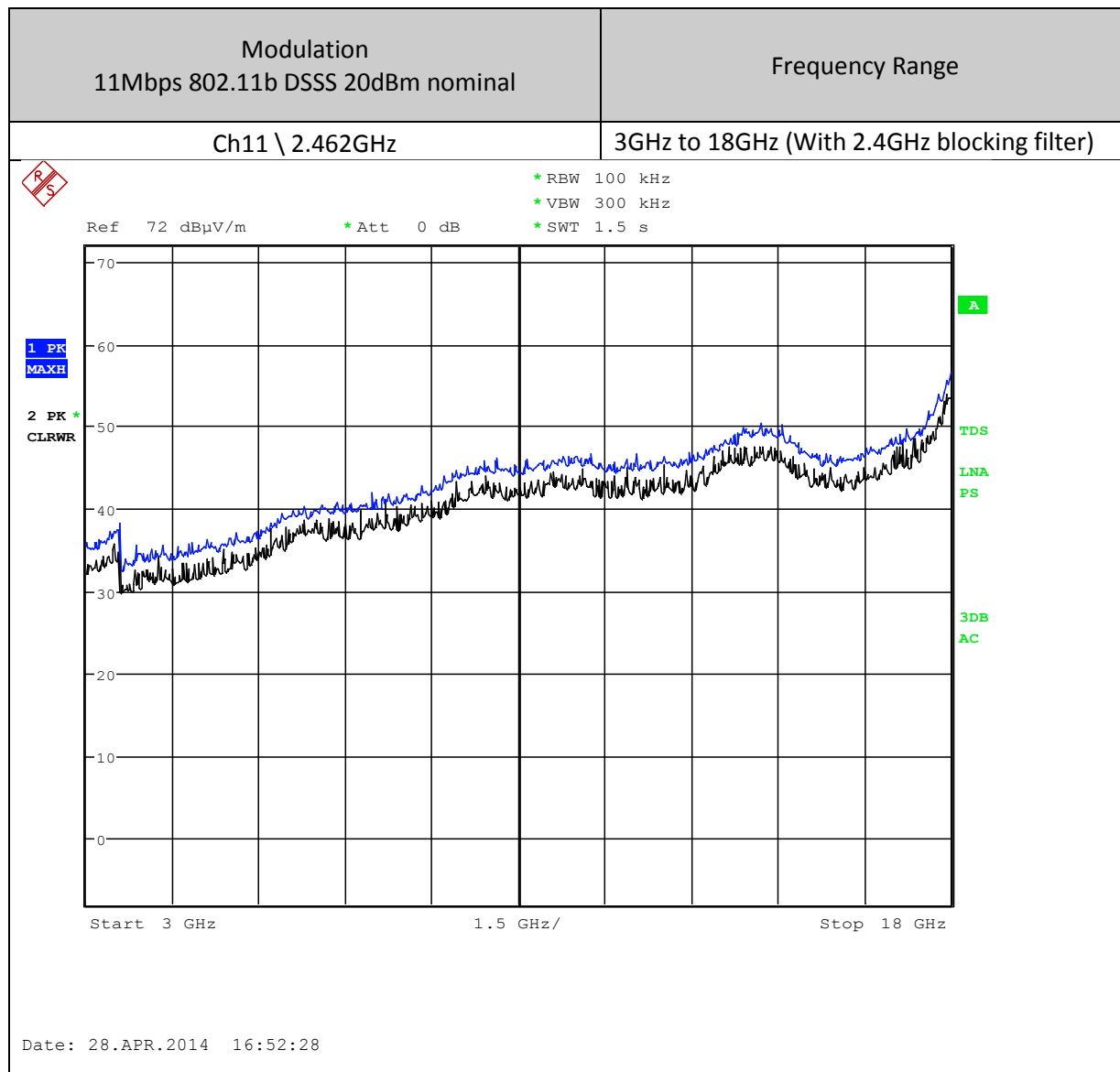


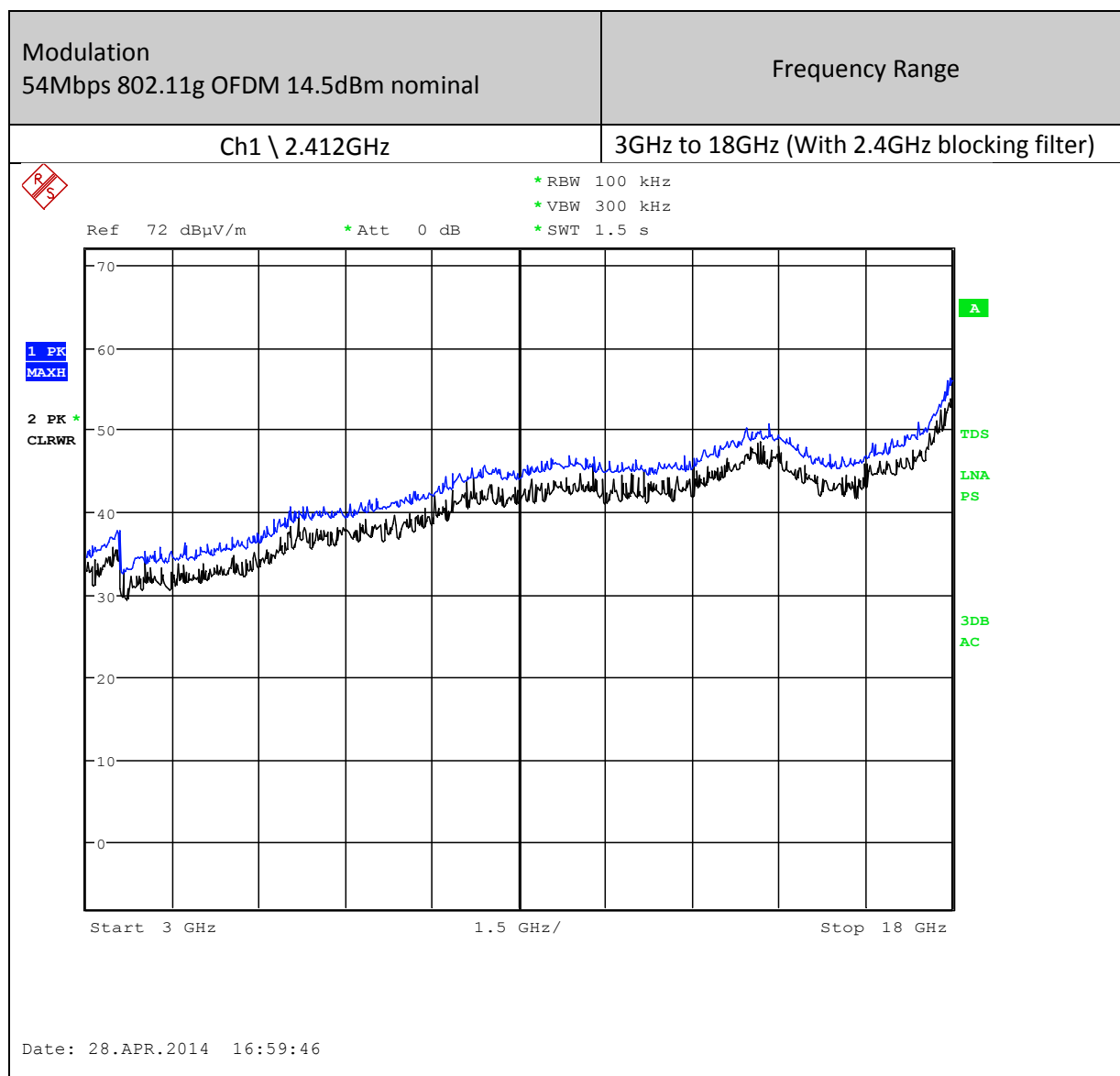


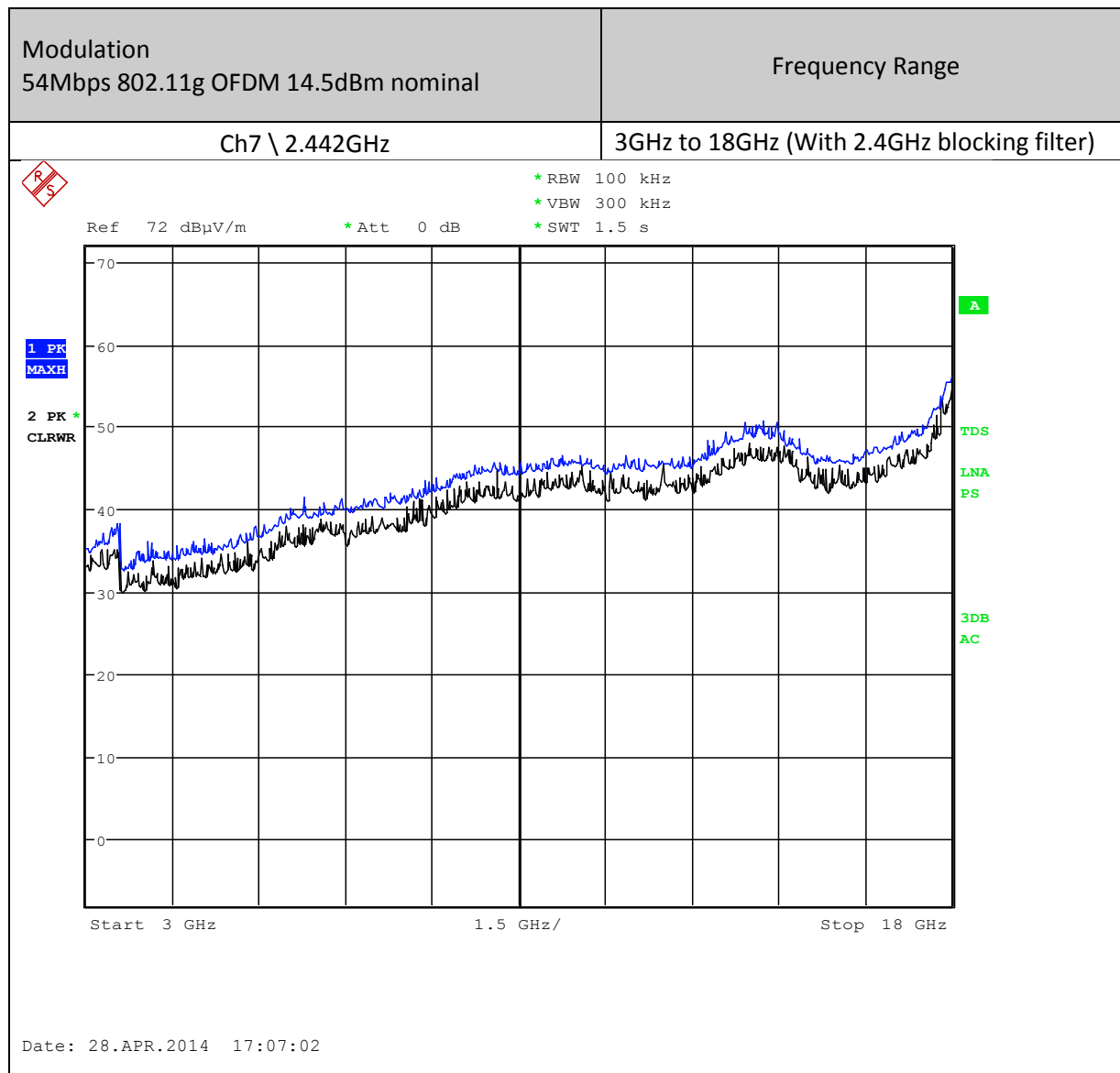
5.10.7 Radiated Emissions 3GHz-18GHz

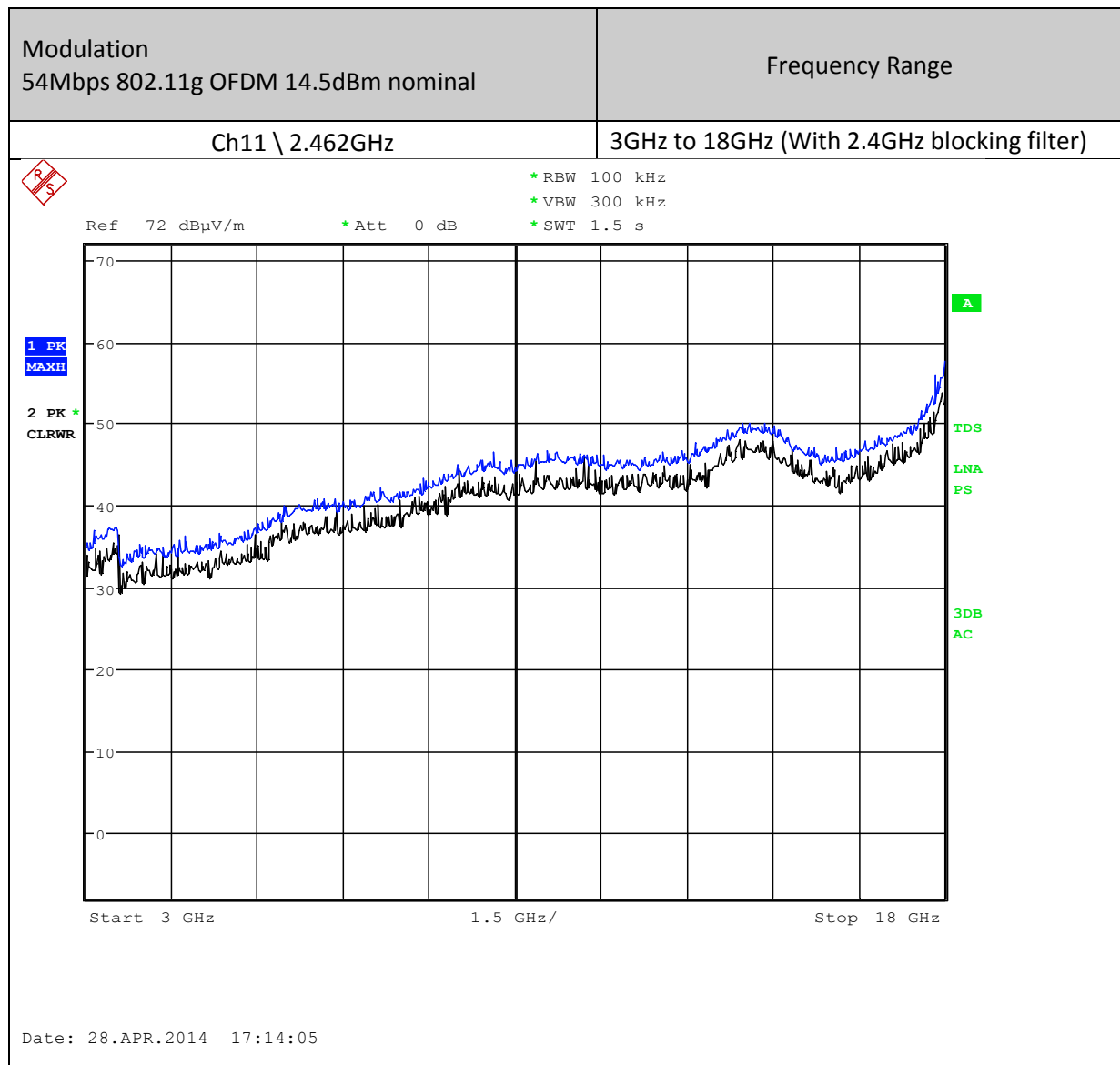


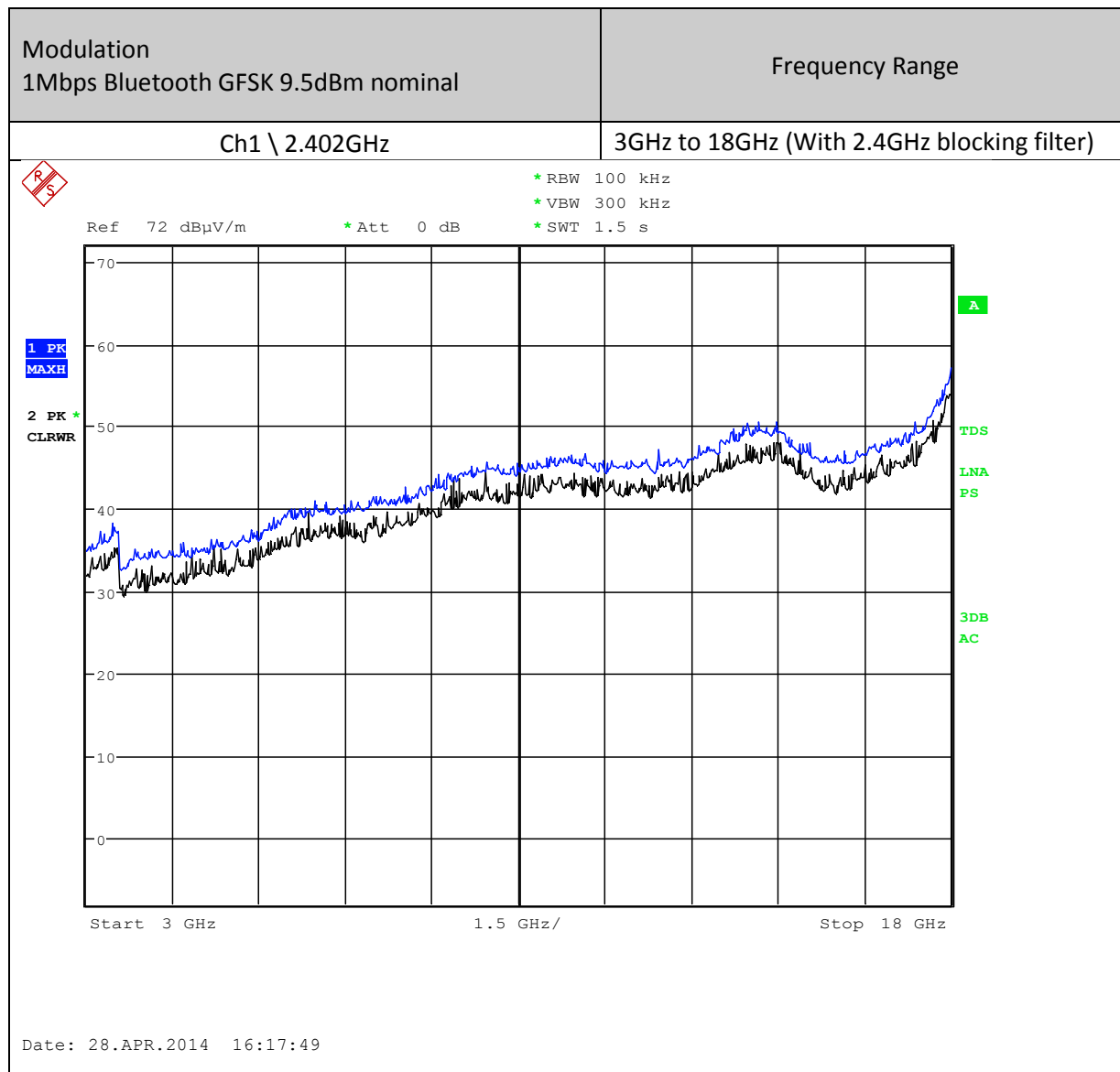


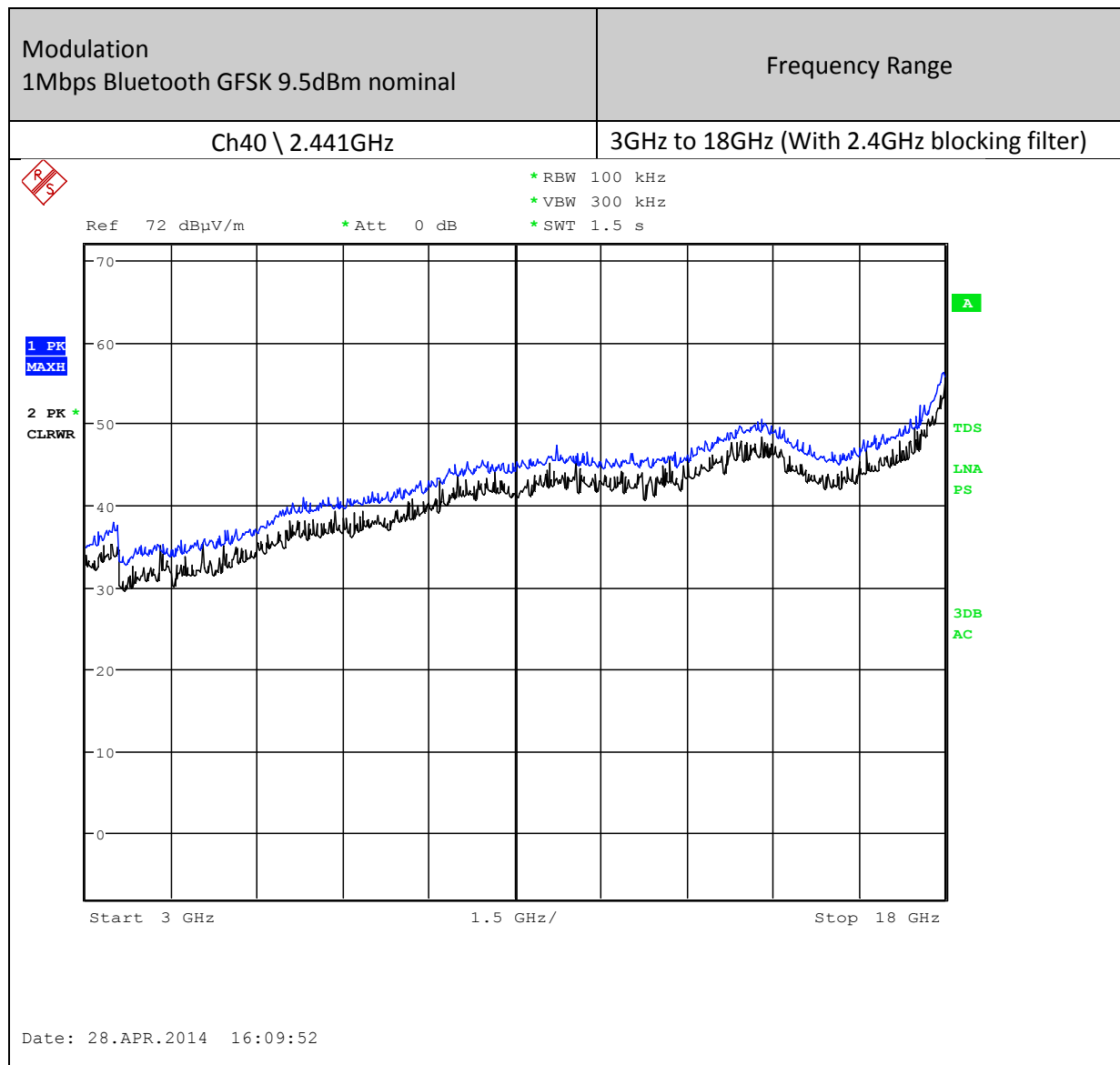


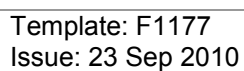




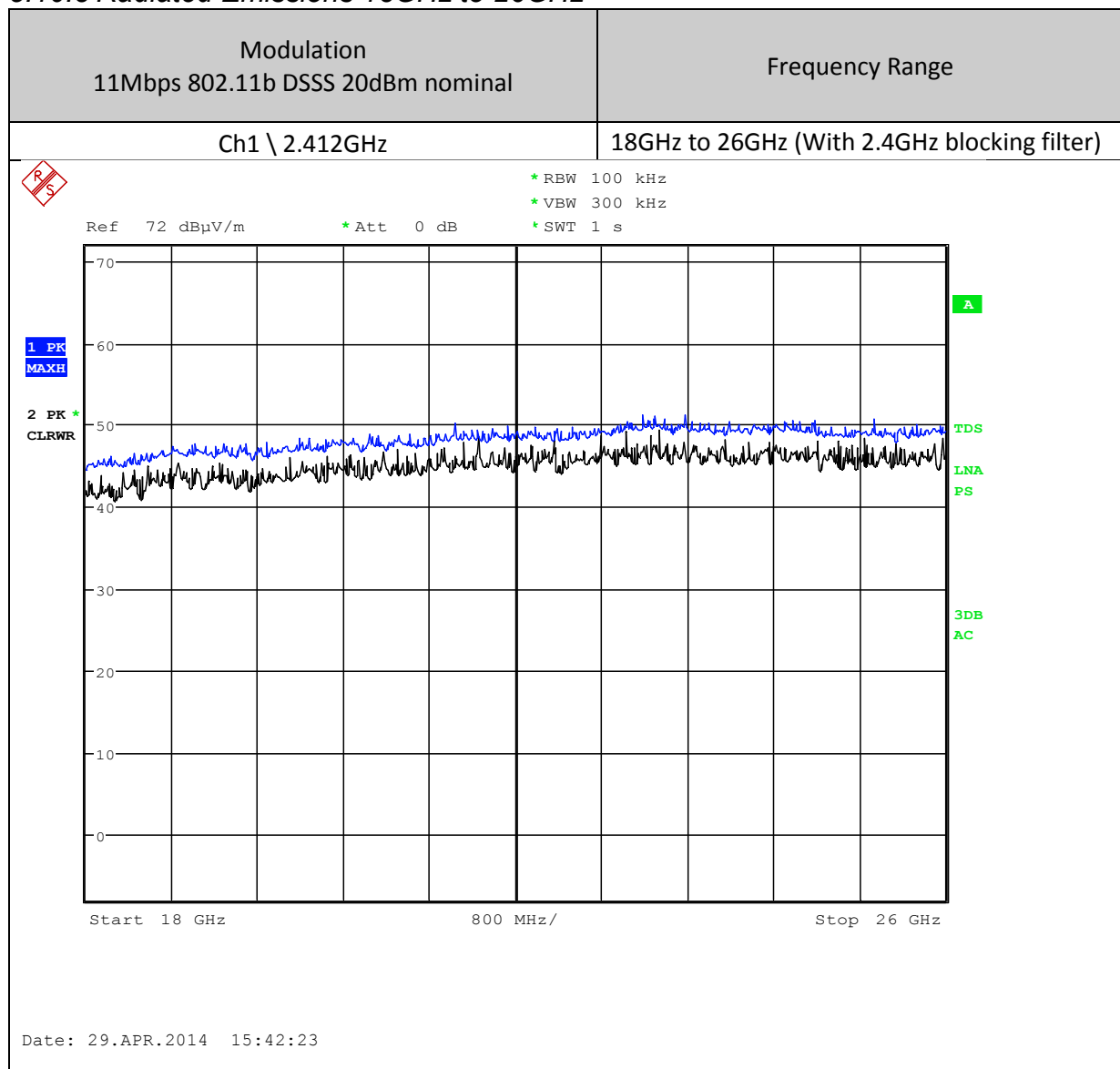


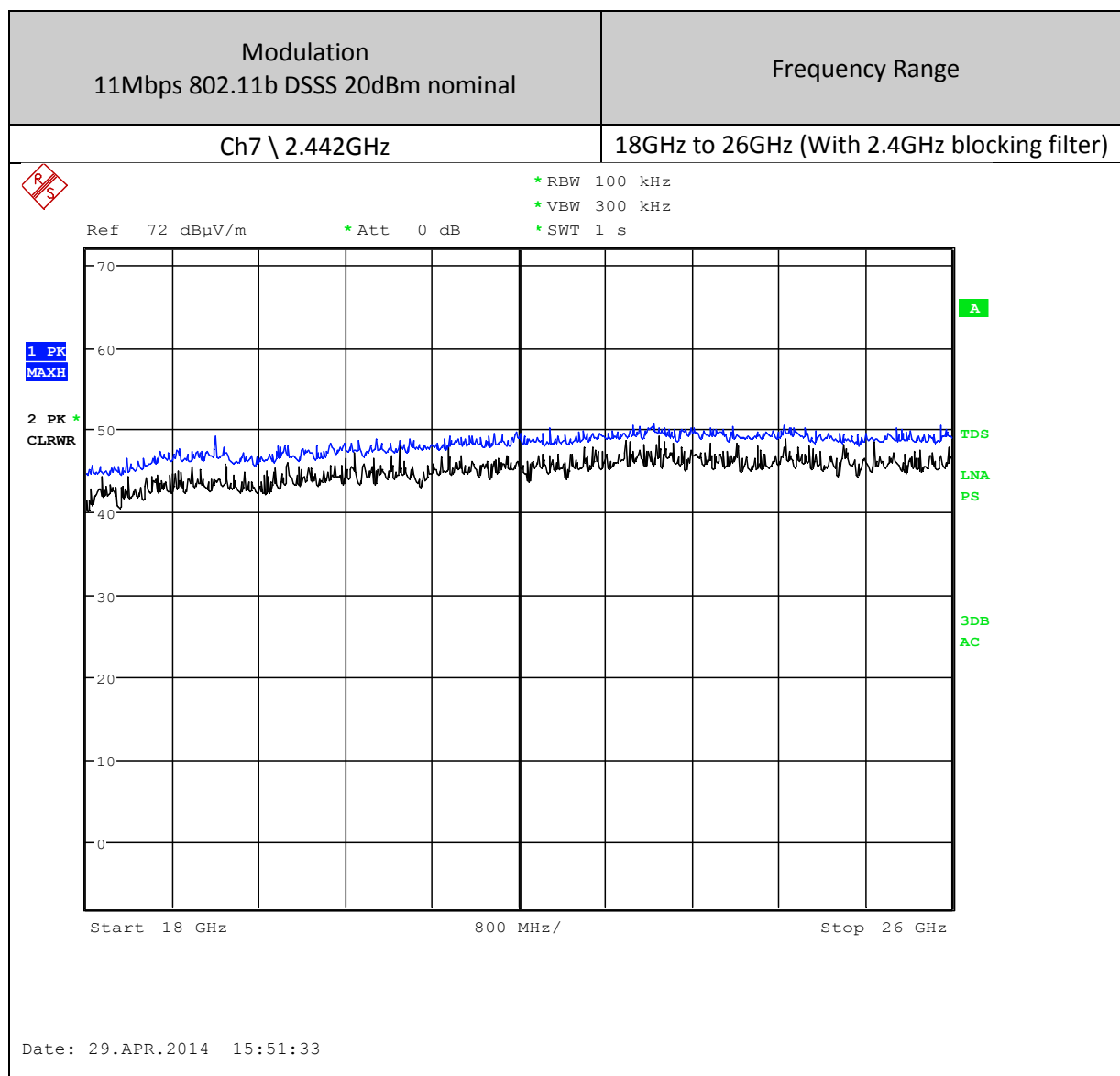


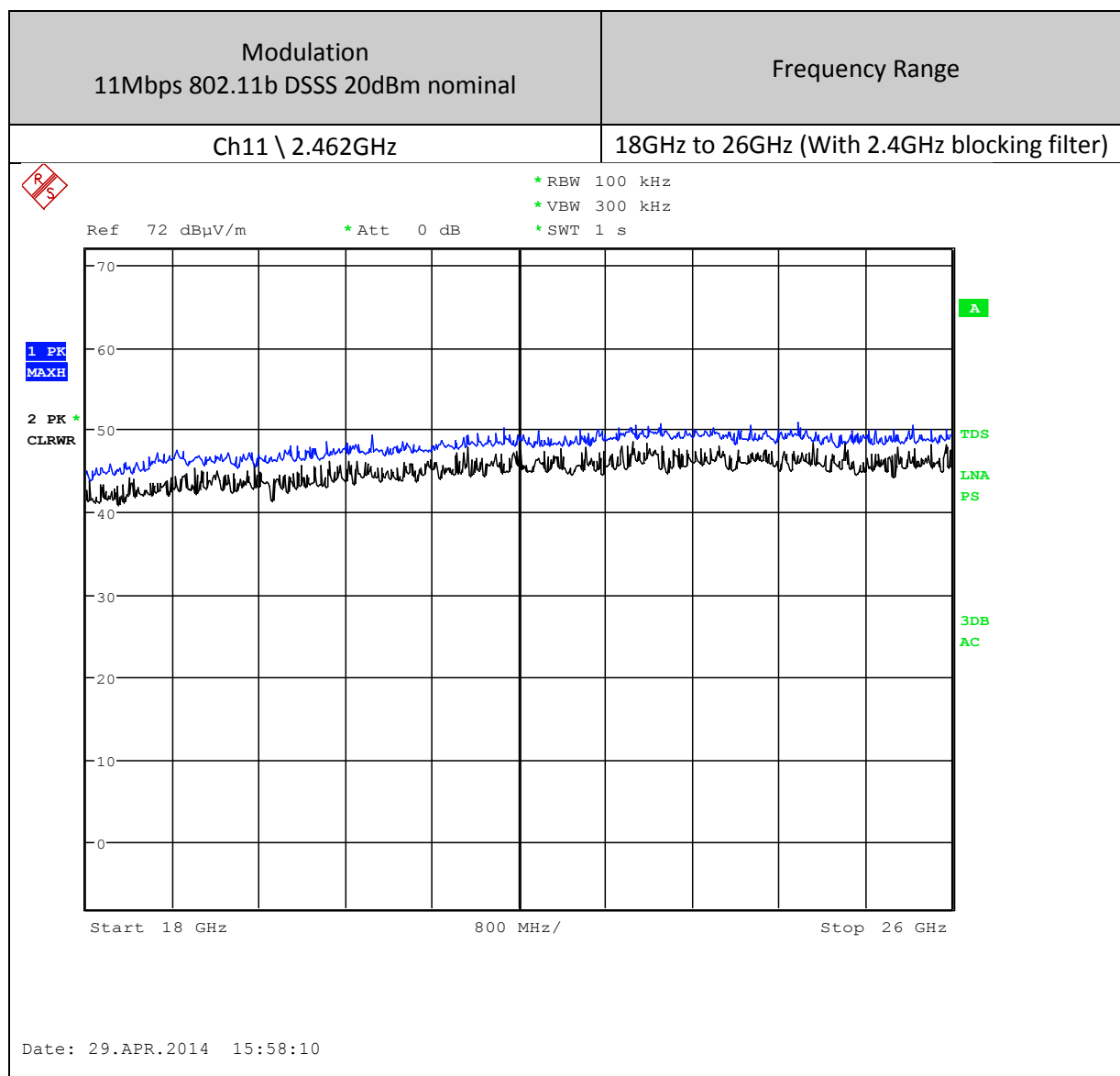


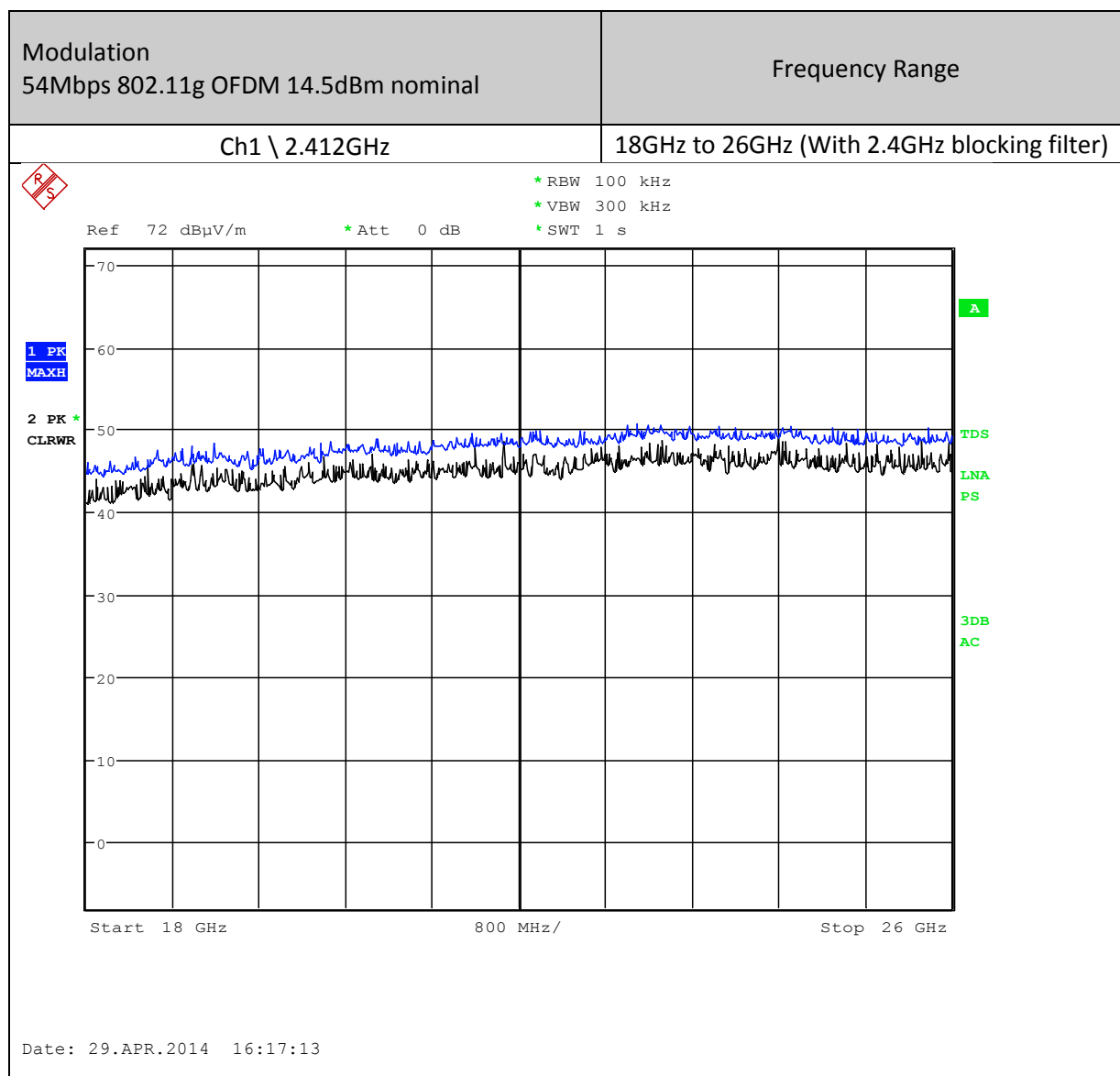


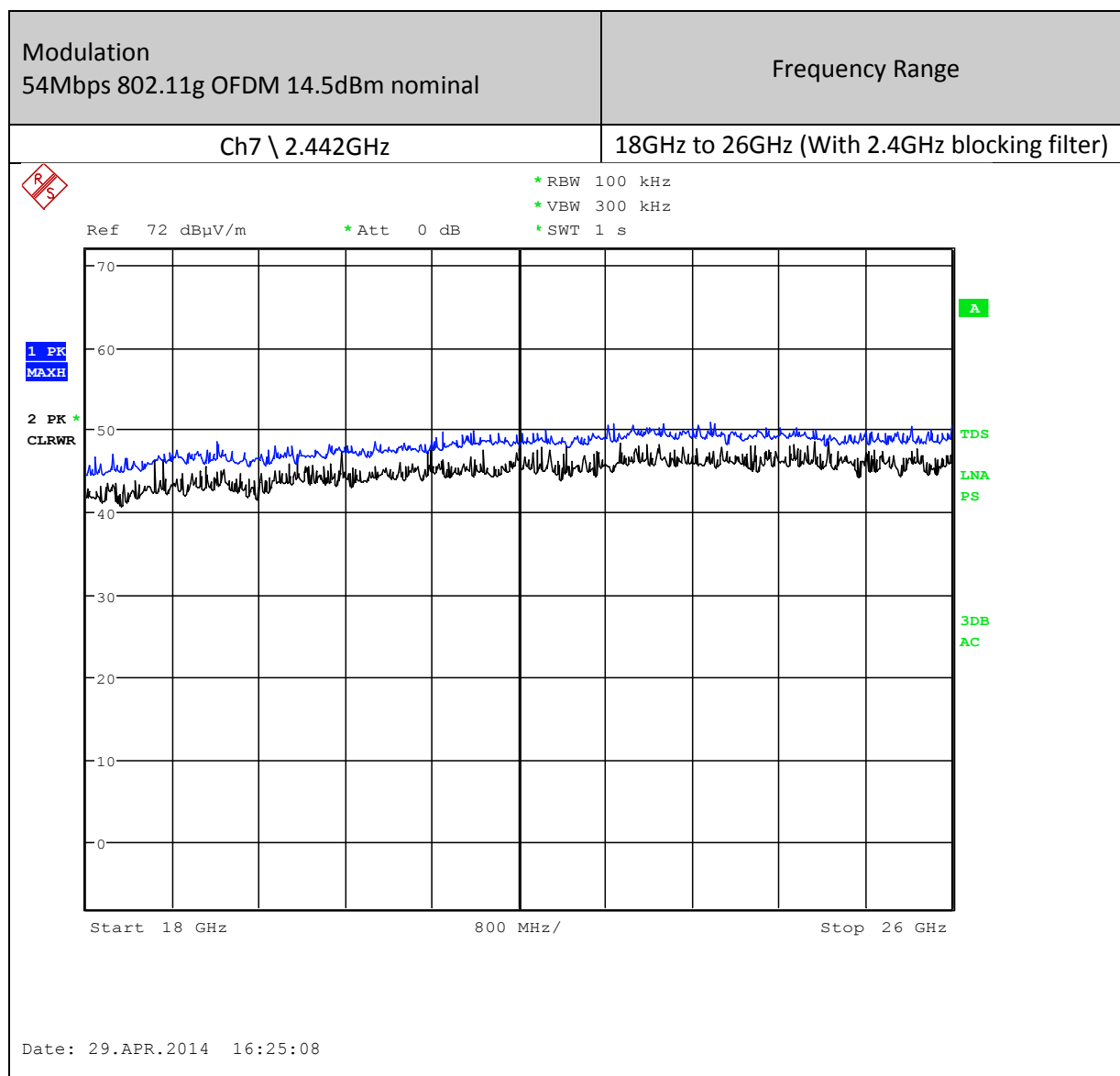
5.10.8 Radiated Emissions 18GHz to 26GHz

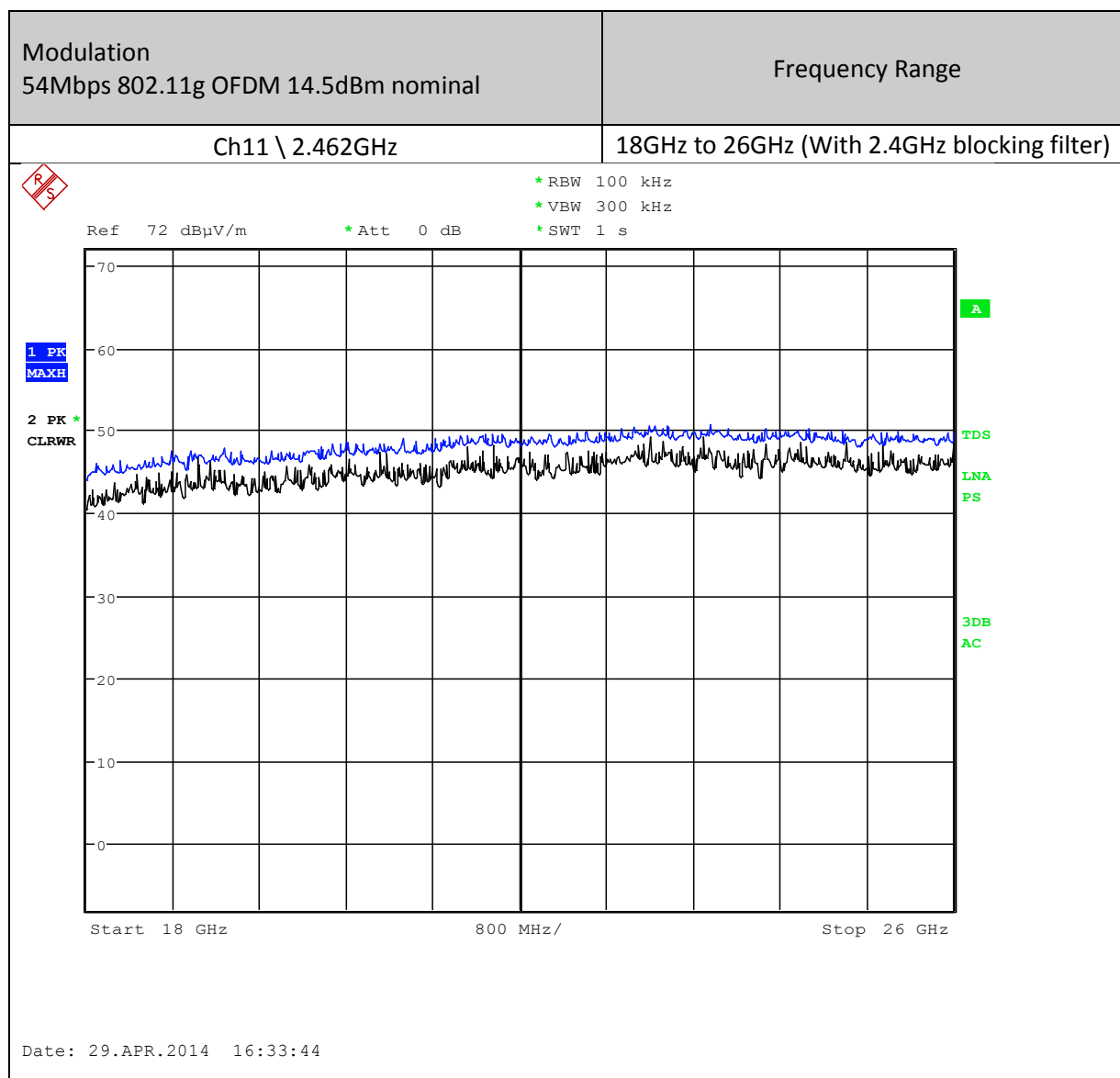


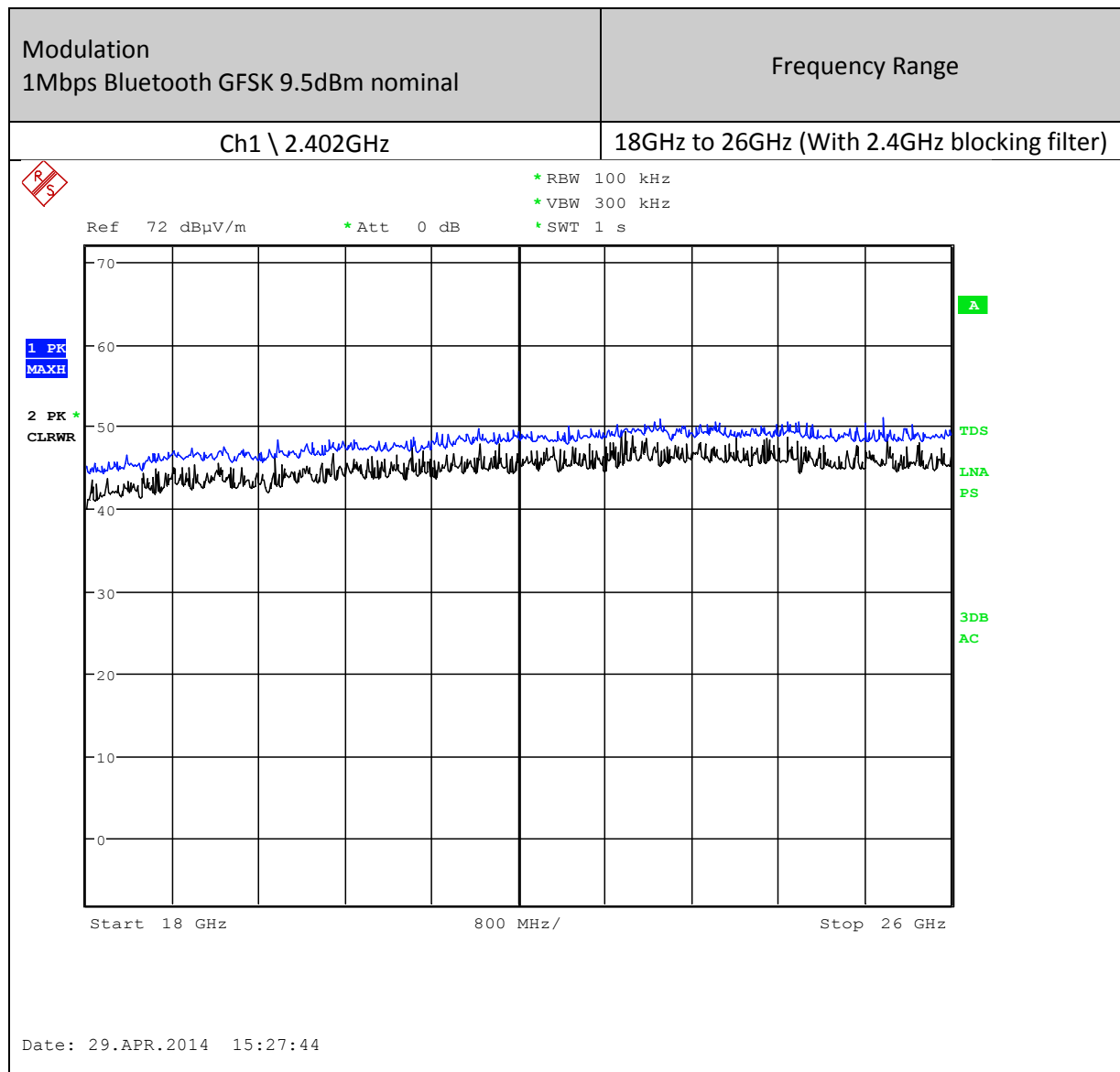


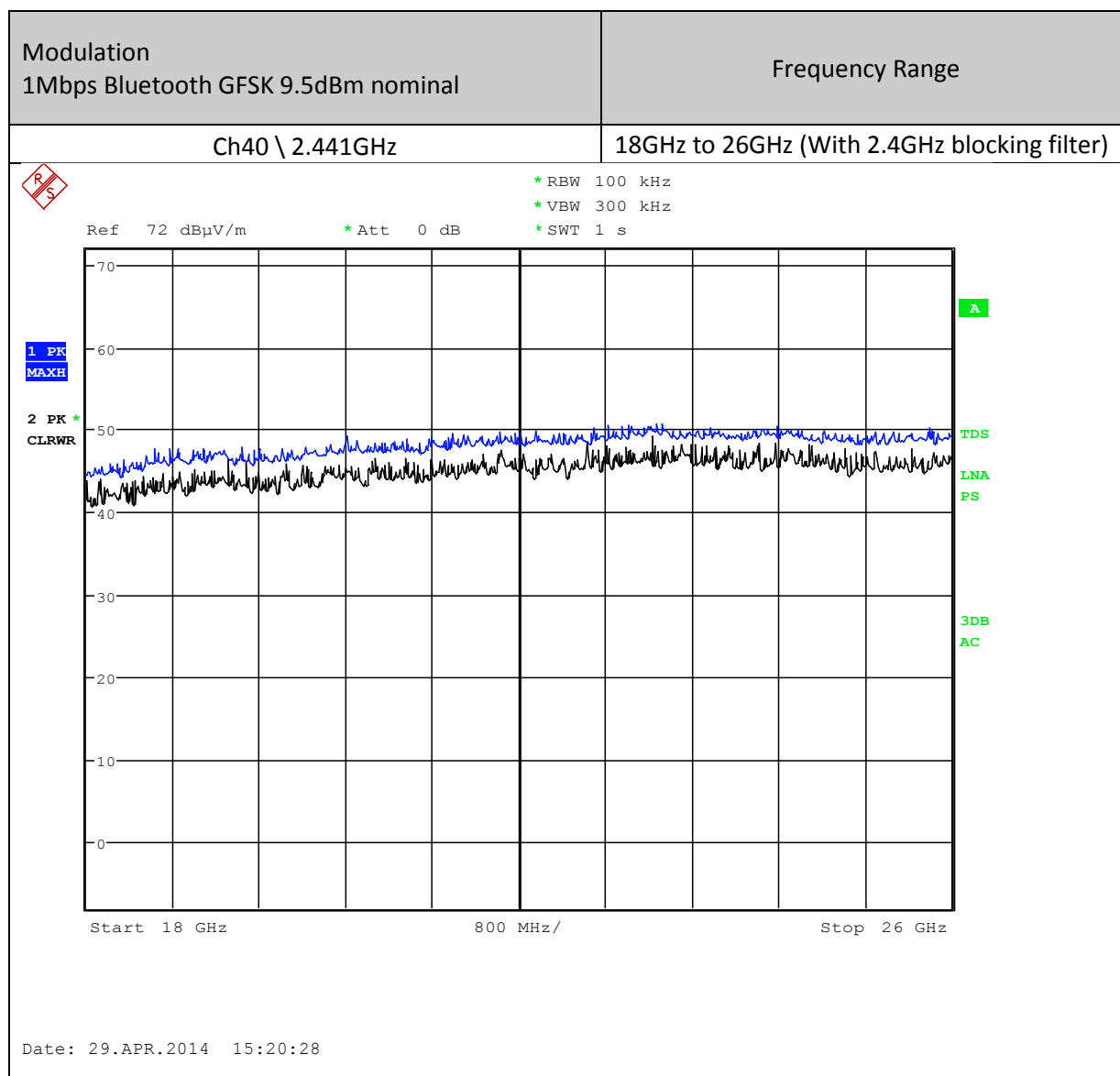


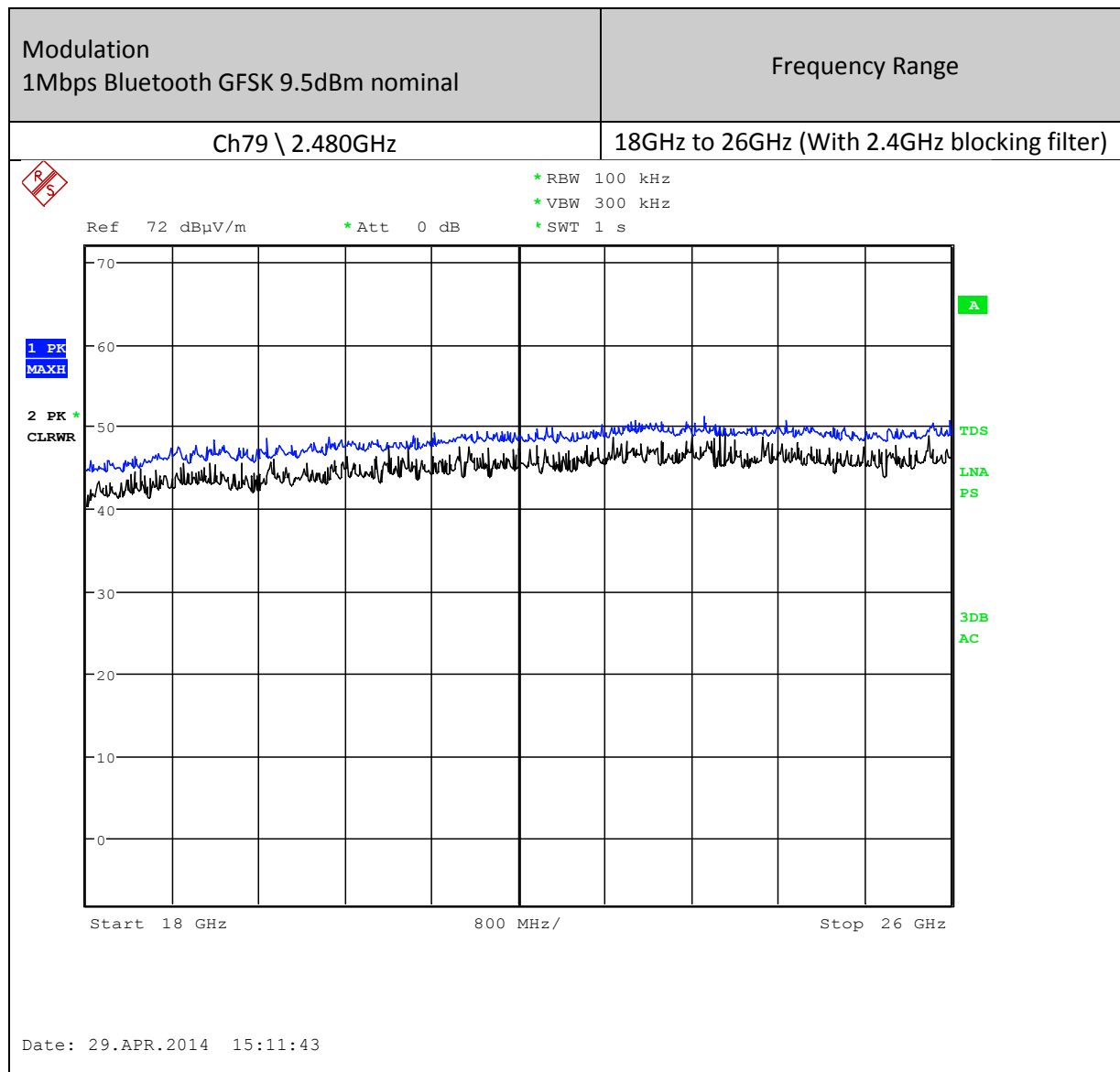




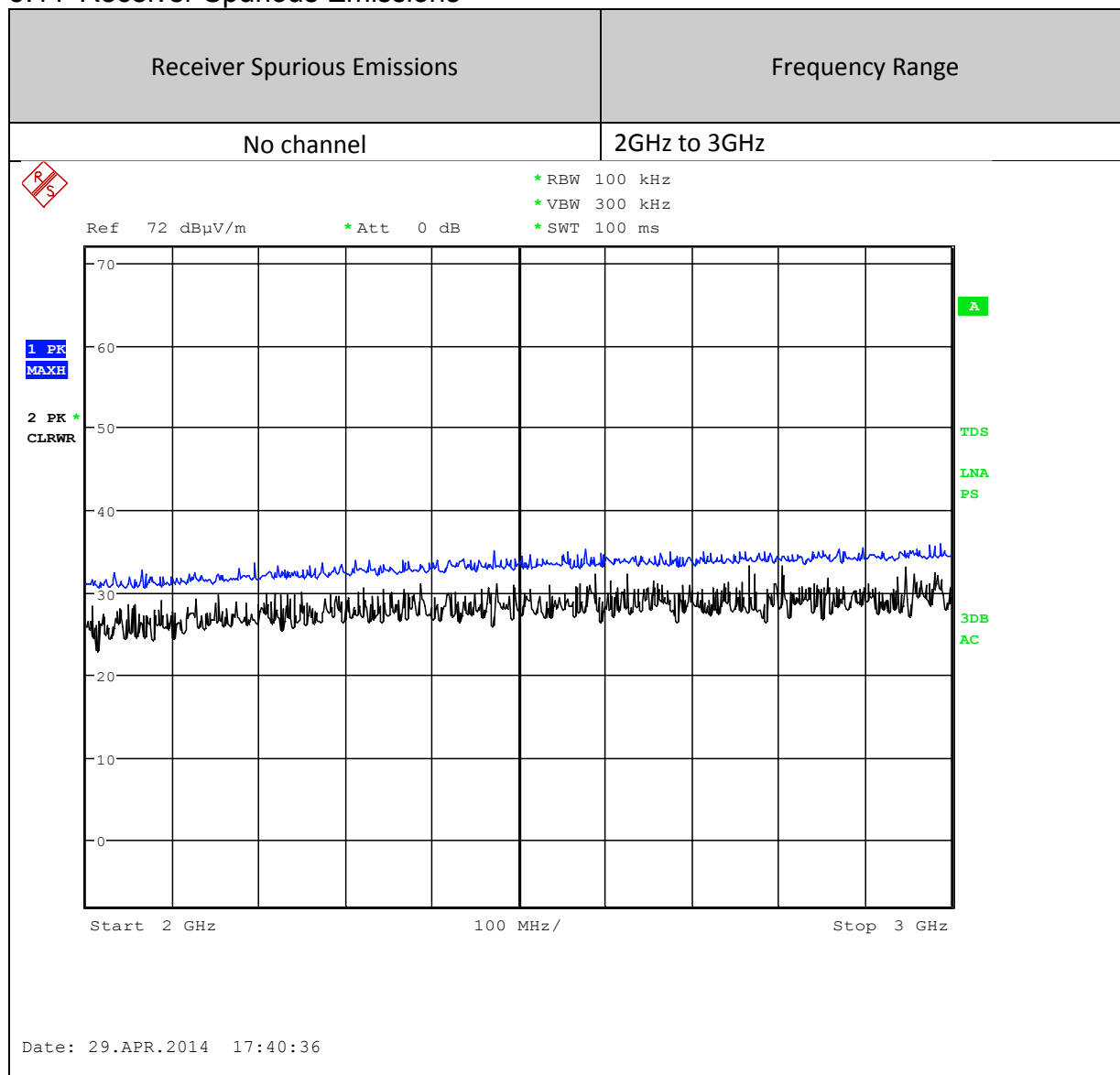


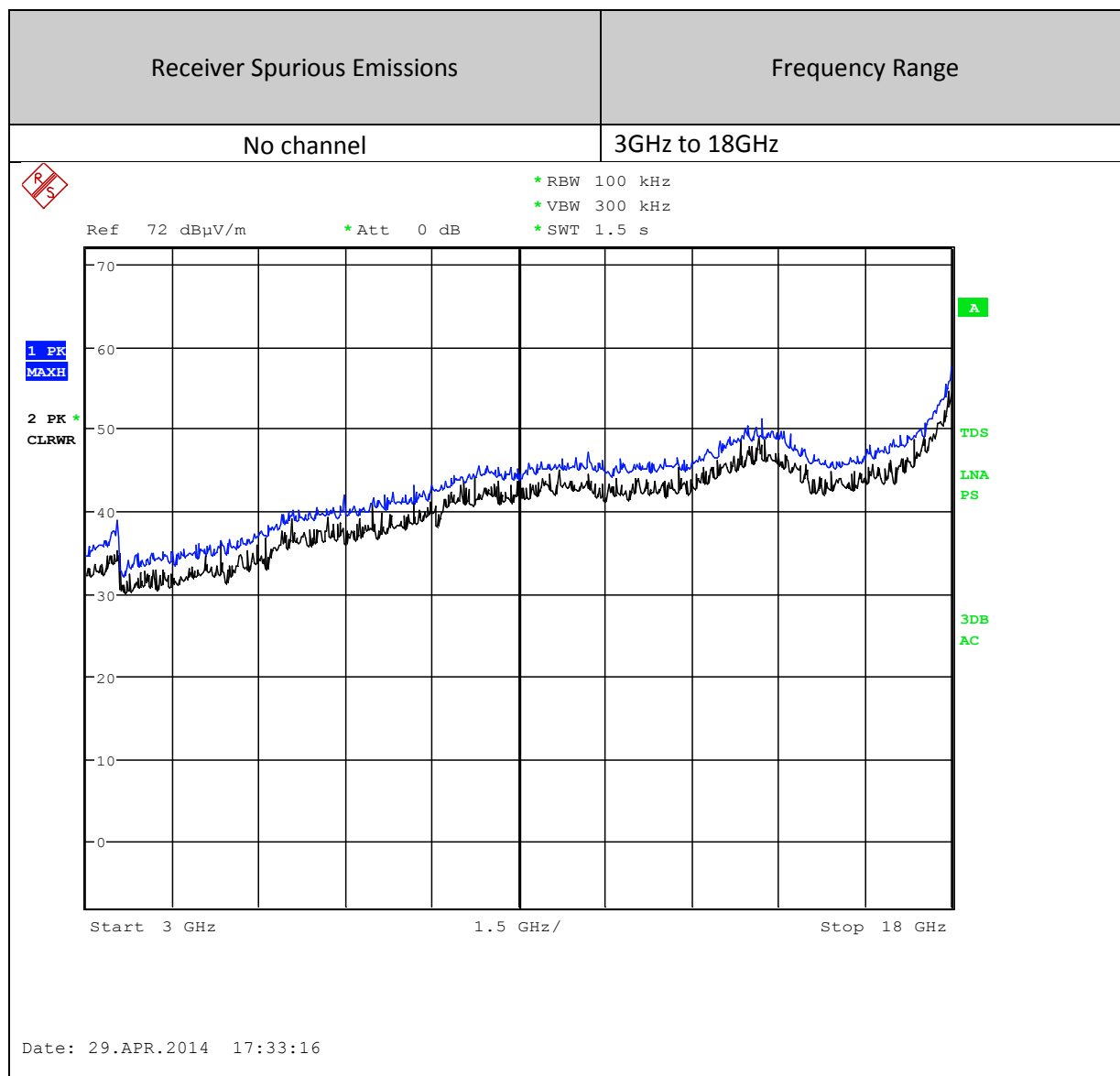


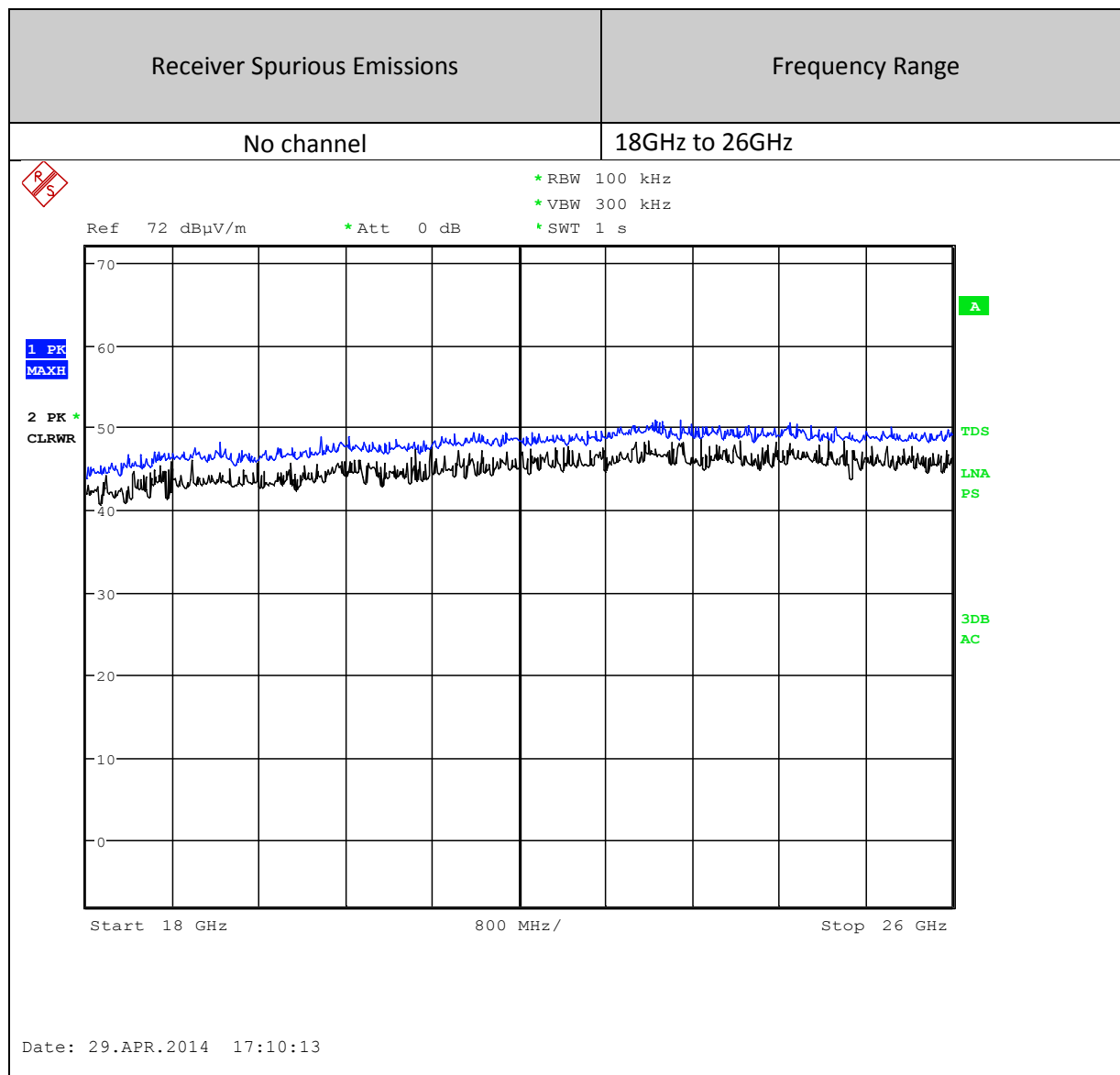




5.11 Receiver Spurious Emissions







6 List of Test Equipment

Test Equipment Type	Manufacturer and Type Number	Serial Number	Cal No.	Cal Due
Digital Multimeter	Fluke 175	97460092	2248	13 th Nov 2014
EMI Receiver 20Hz to 26.5GHz	Rohde & Schwarz ESCI	100416	001692	5 nd Feb 2015
Active Loop Antenna 9kHz - 30MHz	Chase EMC HLA6120	1122	00442	20 th Mar 2016
Loop Antenna PSU/Charger	Chase EMC CBP9721	N/A	02671	N/A
Antenna Horn 1GHz-18GHz	Chase BBHA9120D	9120D-578	01719	22 nd Nov 2015
Antenna Horn 18GHz-26GHz	Credowan 20-R-2843-0007	36755	482	16 th Nov 2014
Antenna 30MHz-2GHz	Chase CBL6141-4038	4038	00448	14 th Aug 2014
Antenna Mast (Site 1)	Inn-co GmbH MM4000	MM4000/056/13750 806/L	02075	N/A
Turntable (Site 1)	Inn-co GmbH DS1200S	DS1200S/175/1375 0806/L	02076	N/A
Mast/Turntable Controller (Site 1)	Inn-co GmbH Co 2000	CO/2000/359/137/5 0806/L	02077	N/A
EMI Receiver 20Hz to 40GHz	Rohde & Schwarz ESU40	100017	01721	7 th Mar 2014
Power Supply Unit	Palstar PS30M	G290775401	2020	N/A

In accordance with UKAS requirements, all measuring equipment is on a calibration cycle.