



ELECTROMAGNETIC COMPATIBILITY
ELECTRICAL SAFETY
LASER SPECTROSCOPY
ENVIRONMENTAL PHYSICS

G.S.D. S.r.l.
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Certificate N. 39 00 1850509

G.S.D. Srl PISA - Italy	Test Report n. FCC-16810	Rev. 02
Manufacturer	CAEN RFID s.r.l.	
Address	Via Vetraia, 11 55049 Viareggio (LU) Italy	
Test Family Name	R1620U	
Testing Laboratory Name	G.S.D. S.r.l.	
Address	Via Marmiceto, 8 56121 Ospedaletto Pisa (PI) Italy	
Tel/Fax	+39 050 984254 / +39 050 984262	
P.IVA/VAT	01343950505	
http – e-mail	www.gsd.it - info@gsd.it	
FCC Listed. Registration Number: 424037.		
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G.S.D. s.r.l. Via Marmiceto, 8 56121 OSPEDALETTO - PISA Tel. 050.984254 - Fax 050.984262 P. IVA 01343950505 SENIOR EMC TEST MANAGER Dr. Gian Luca Genovesi QUALITY MANAGER Dr. David Pelliccia 		

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Report Revision History

Revision details

Date	Page No.(s)	Details
2017 January 18	57	Rev. 00 First issue
2017 January 19	57	Rev. 01 Second Issue: Change 15B in 15C Modified Tables pages 26/33
2017 January 24	58	Rev. 02 Third Issue: Radiated Emissions: Change 15A in 15C

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1. MANUFACTURER AND EUT IDENTIFICATION¹	
Manufacturer	CAEN RFID s.r.l..
Address	Via Vetraia, 11 55049 Viareggio (LU) Italy
Test Family Name	R1620U
Date of reception	2016 March 04
Sampling	Laboratory sample for certification
Test Item Description	RFID Device
Nominal Input Voltage	5 Vdc
FCC ID	UVECAENRFID024

¹A detailed documentation is preserved in the internal fascicle.

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*Fig. 1.1
Equipment Photo*

2. REFERENCE STANDARDS

Tests and measurements are performed accordingly to the reference standards given in the table below:

<i>TEST</i>	<i>STANDARD</i>
Emissions: Conducted and Radiated – Section 15.207 and 15.209	FCC Rules and Regulations, Title 47 Part 15 – Sub part C ANSI C63.4 2014 – American National Standard for Methods of Measuring of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz – 40 GHz ANSI C63.10 2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Operation within the band 902-928 MHz: Alternative Test Procedures 15.247 (b) and (c), and (a) Bandwidth and average time of occupancy, Band Edge 15.247 (d)	FCC Rules and Regulations, Title 47 Part 15 – Sub part C DA 00-705 (30 March 2000) – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems ANSI C63.4 2014 – American National Standard for Methods of Measuring of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz – 40 GHz ANSI C63.10 2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Antenna Requirement: §15.203	FCC Rules and Regulations, Title 47 Part 15 – Sub part C

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3. RESULT, CONDITION, MEASUREMENT UNCERTAINTYSummary of Test Results

<i>TEST</i>	<i>RESULT</i>
Emissions: conducted Section 15.207	Pass
Emissions: radiated Section 15.209	Pass
Bandwidth and Average Time of Occupancy Section 15.247 (a)	Pass
Operation within the band 902-928 MHz: Section 15.247 (b) and (c)	Pass
Band Edge Section 15.247 (d)	Pass

Measurement uncertainty

<i>TEST</i>	<i>EXPANDED UNCERTAINTY</i>
Conducted Emission – 50Ω/50μH (150 kHz - 30 MHz)	± 3.5 dB
Radiated Emission – (Semianechoic Room) (30 MHz - 18 GHz)	± 4.7 dB

Climatic Conditions

<i>PARAMETER</i>	<i>VALUE</i>
Temperature	(293 ± 3) K
Relative humidity	(50 ± 5) %

Extensions

The results refer only to the sampled EUT and under the specified conditions.

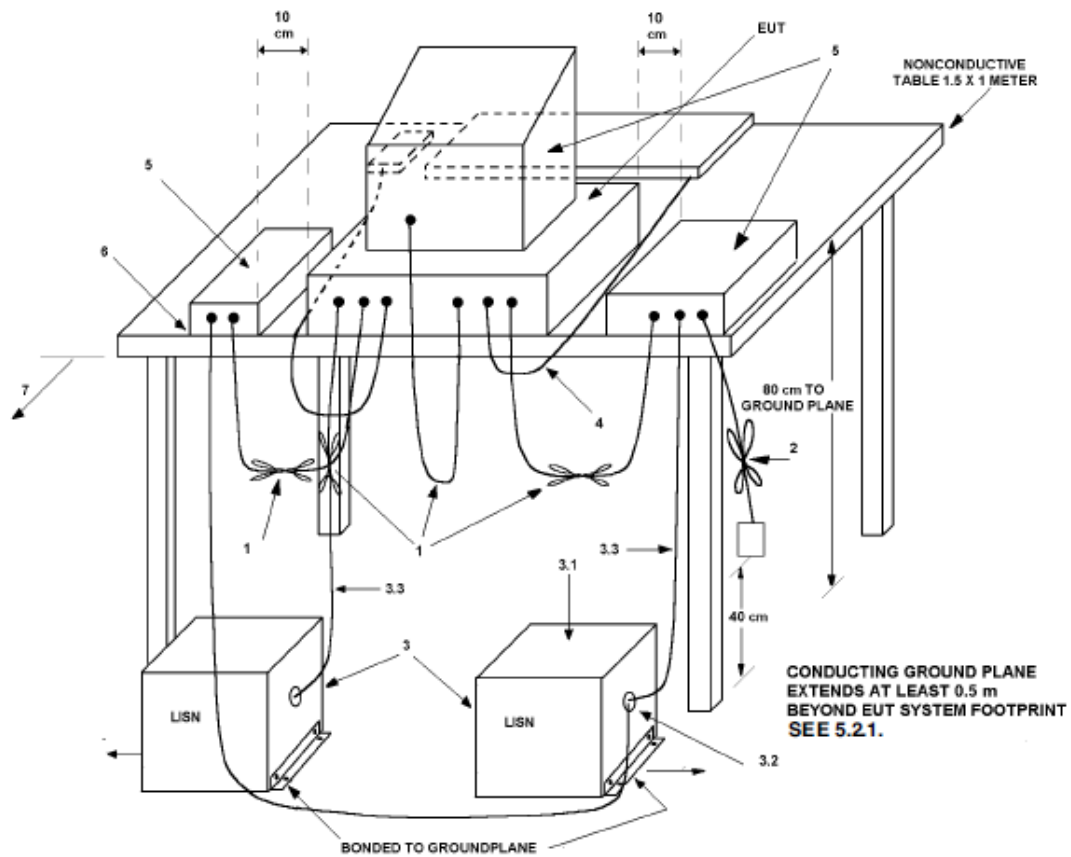
Modulations:

Type 1: (DSB ASK FM0 TX10 RX40)

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Conducted and Radiated EUT Test Set-up example (ANSI C63.10 2013)

4. RADIATED EMISSIONS

In the following table you can find the limits established by the reference standard:

FREQUENCY RANGE (MHz)	<i>Field Strength</i> <i>QUASI-PEAK LIMITS</i> [dB (μV/m)]
0.009 – 0.490	48.15 – 13.8 @ 300m
0.490 – 1.705	33.8 – 23 @ 30m
1.705 – 30	29.5 @ 30m
30 – 88	40
88 – 216	43.5
216 – 960	46
Above 960	54

Test Equipment

EQUIPMENT	MANUFACTURER	MODEL	CAL. DUE
MXE EMI Receiver	Agilent/Keysight	N9038A	01/2017
Anechoic Chamber	Comtest	CSA01	01/2017
Bilog Antenna	Schaffner	CBL6112B	01/2017
Horn Antenna	EMCO	3115	01/2017
Horn Antenna	Alpha Industries	61932500	01/2017
Controller	Deisel	HD100	01/2017
Turn Table	Deisel	MA240	01/2017
LISN	GSD	NTW06	01/2017

Test procedure: RE22R02**Notes**

Azimuth position EUT-Antenna corresponding to 0° identifies the rotating table orientation (TT) in which the instrument to be tested shows the front part turned towards the antenna. Positive grades individuate clockwise rotations of TT when this one is observed from the top. For negative degrees, TT rotation is counter-clockwise.

Antenna height respect to the mass plane is conventionally individuated with: MA=XXX where XXX indicates the height (always positive and greater than 100) expressed in cm.

Antenna horizontal polarisation is indicated by POL=H.

Antenna vertical polarisation is indicated by POL=V.

EUT was tested in the three orthogonal planes.

Note:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated

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measurement.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

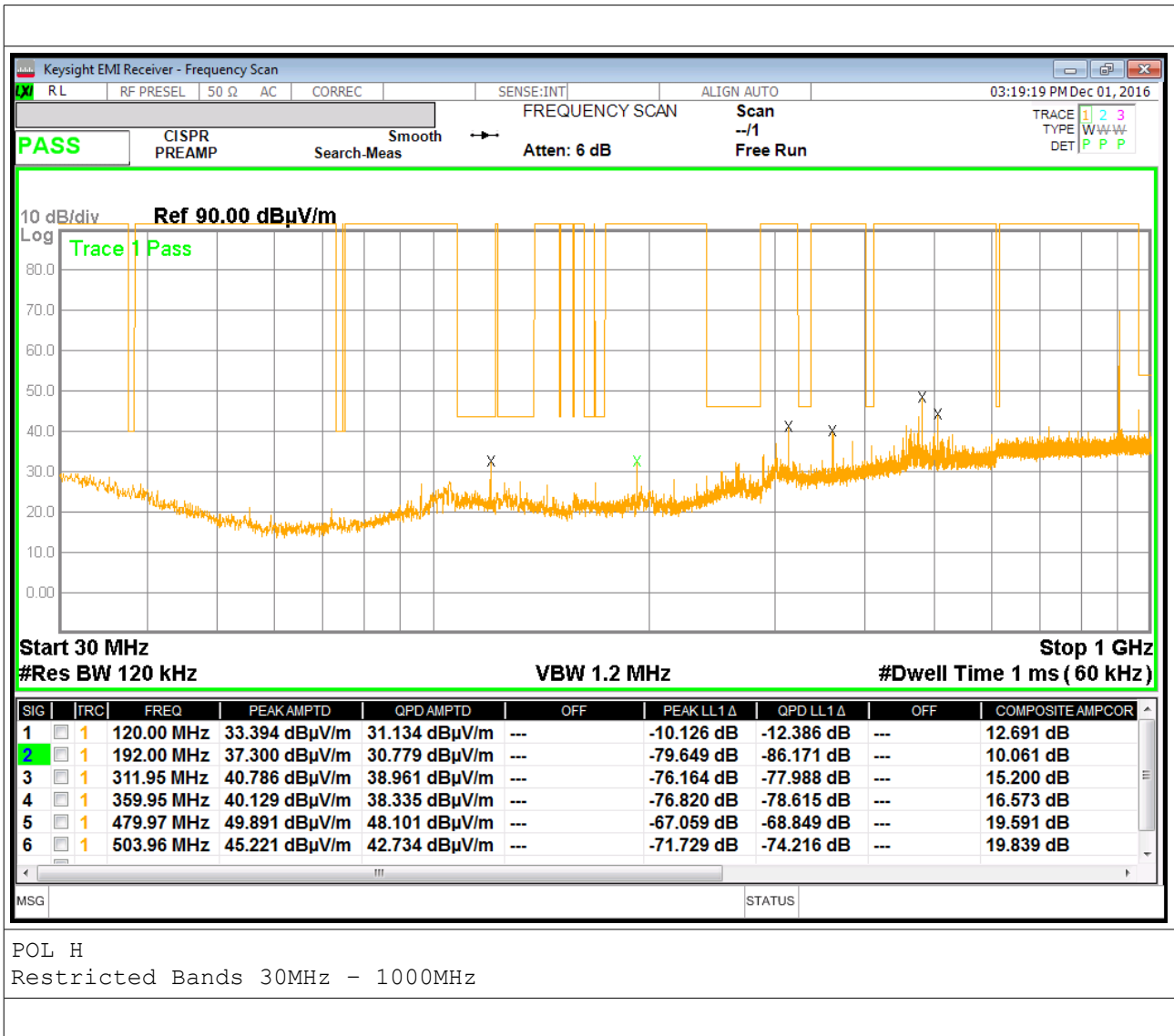
Results and conclusions

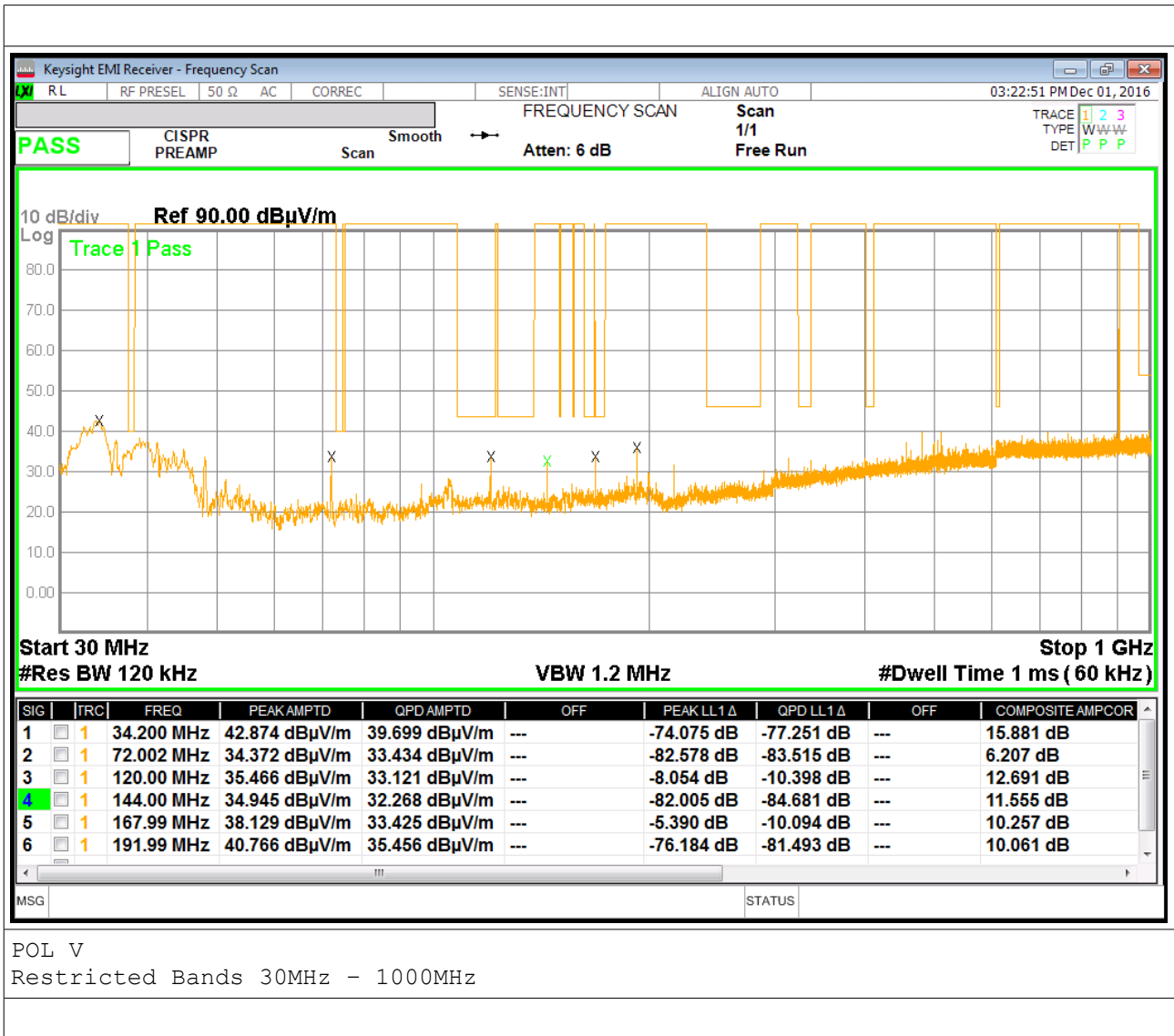
In all the operative conditions, equipment complied with the standard limits. Graphics in following figures show the most significant registrations of the performed measurements.

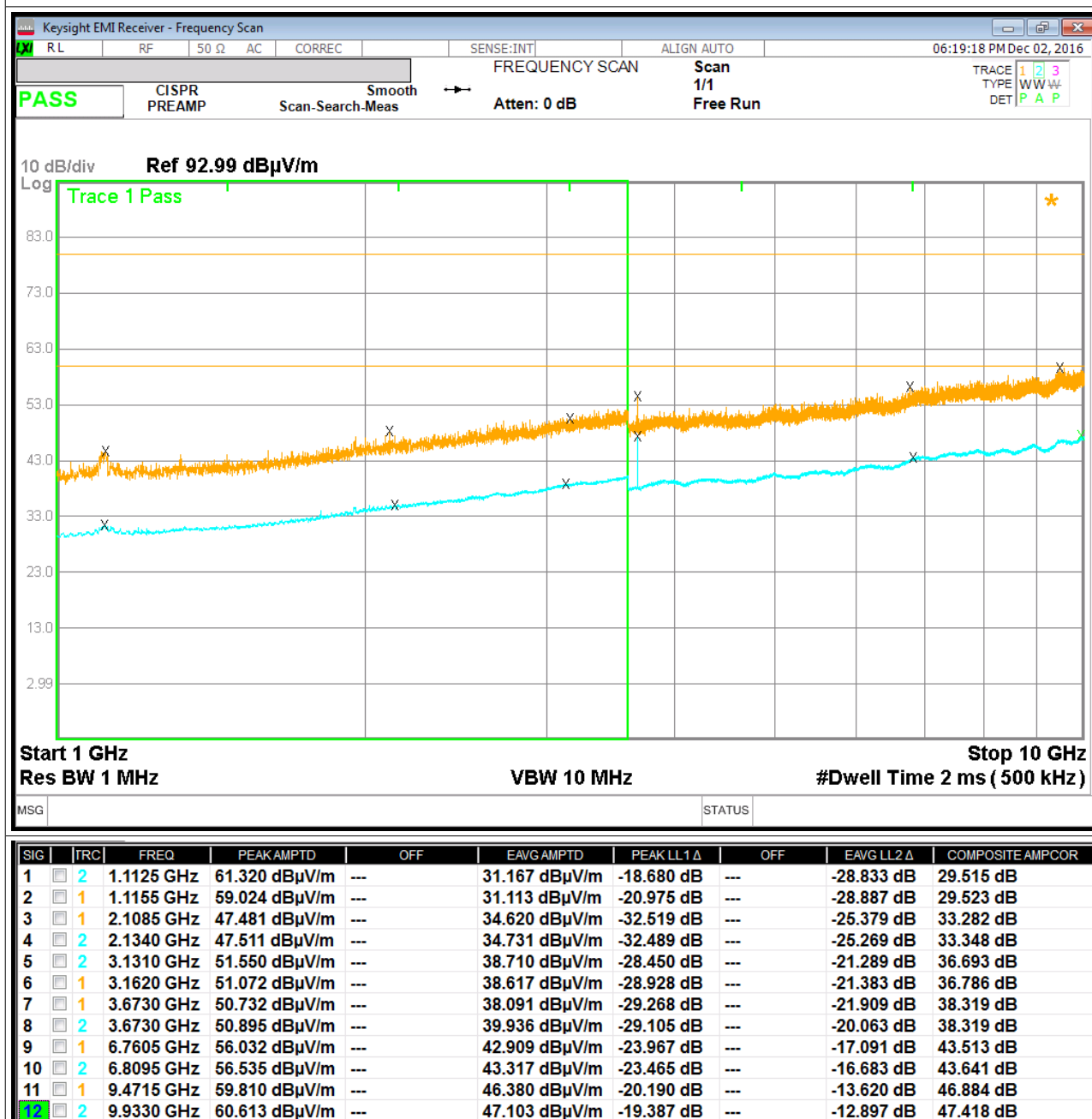
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POL V

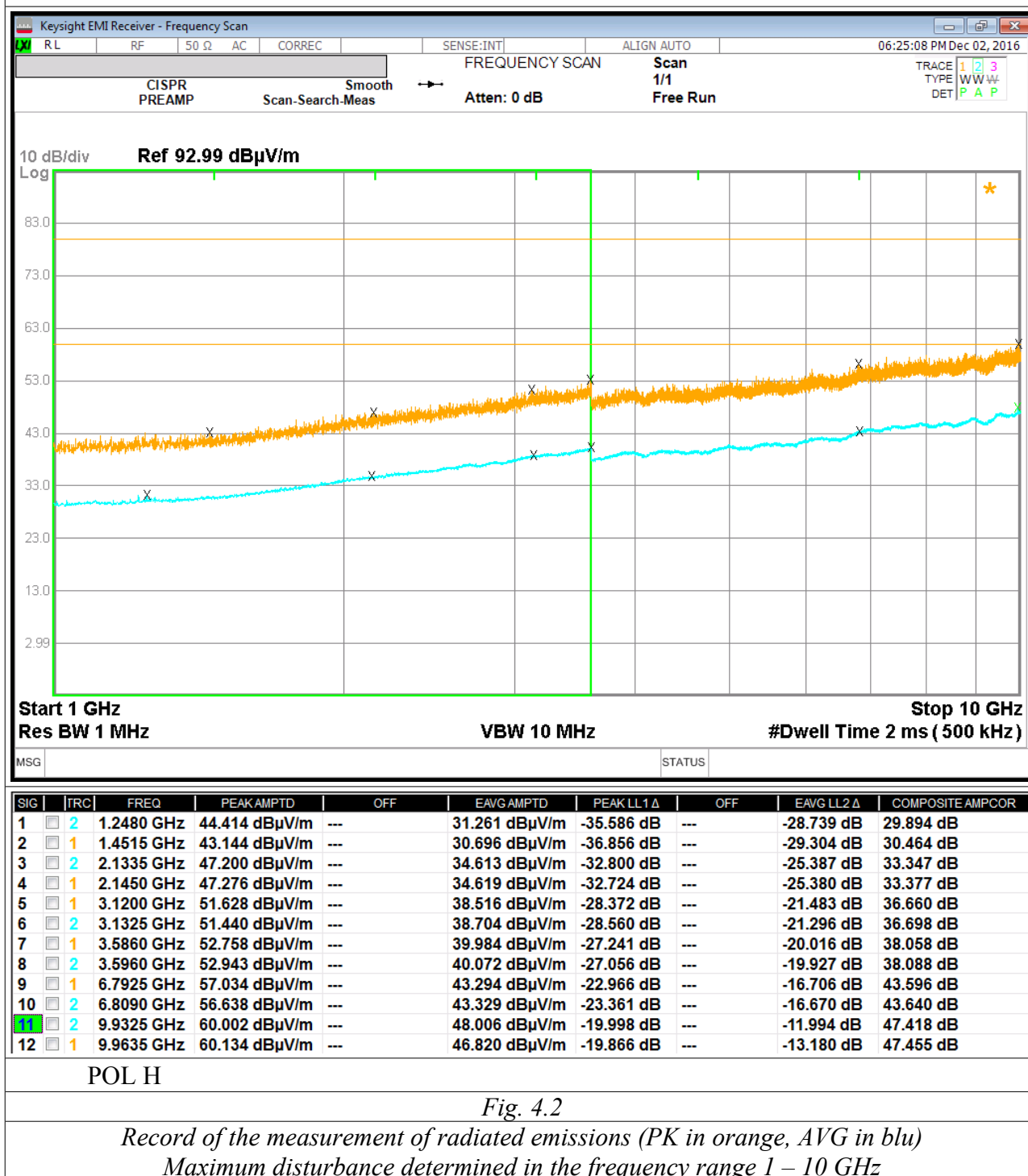
Fig. 4.1

Record of the measurement of radiated emissions (PK in orange, AVG in blu)
Maximum disturbance determined in the frequency range 1 – 10 GHz

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Job Number FCC-16810
 Test Name Radiated Emissions - FCC 15C
 EUT Name CAEN RFID s.r.l. - R1620U

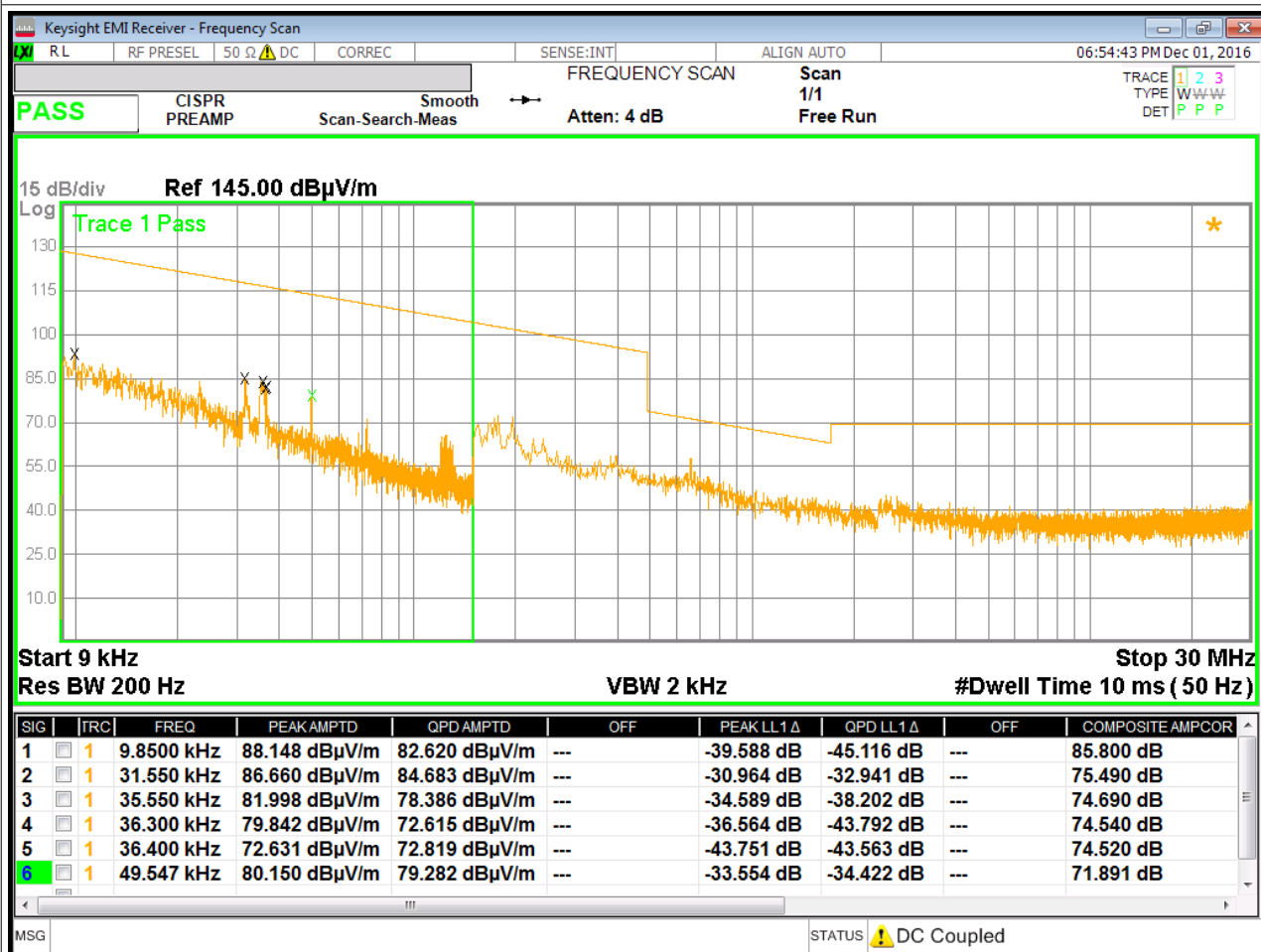


Fig. 4.3

Maximum disturbance determined in the frequency range 150 kHz – 30 MHz.
 Loop Antenna Parallel Polarization

Job Number FCC-16810
Test Name Radiated Emissions - FCC 15C
EUT Name CAEN RFID s.r.l. - R1620U

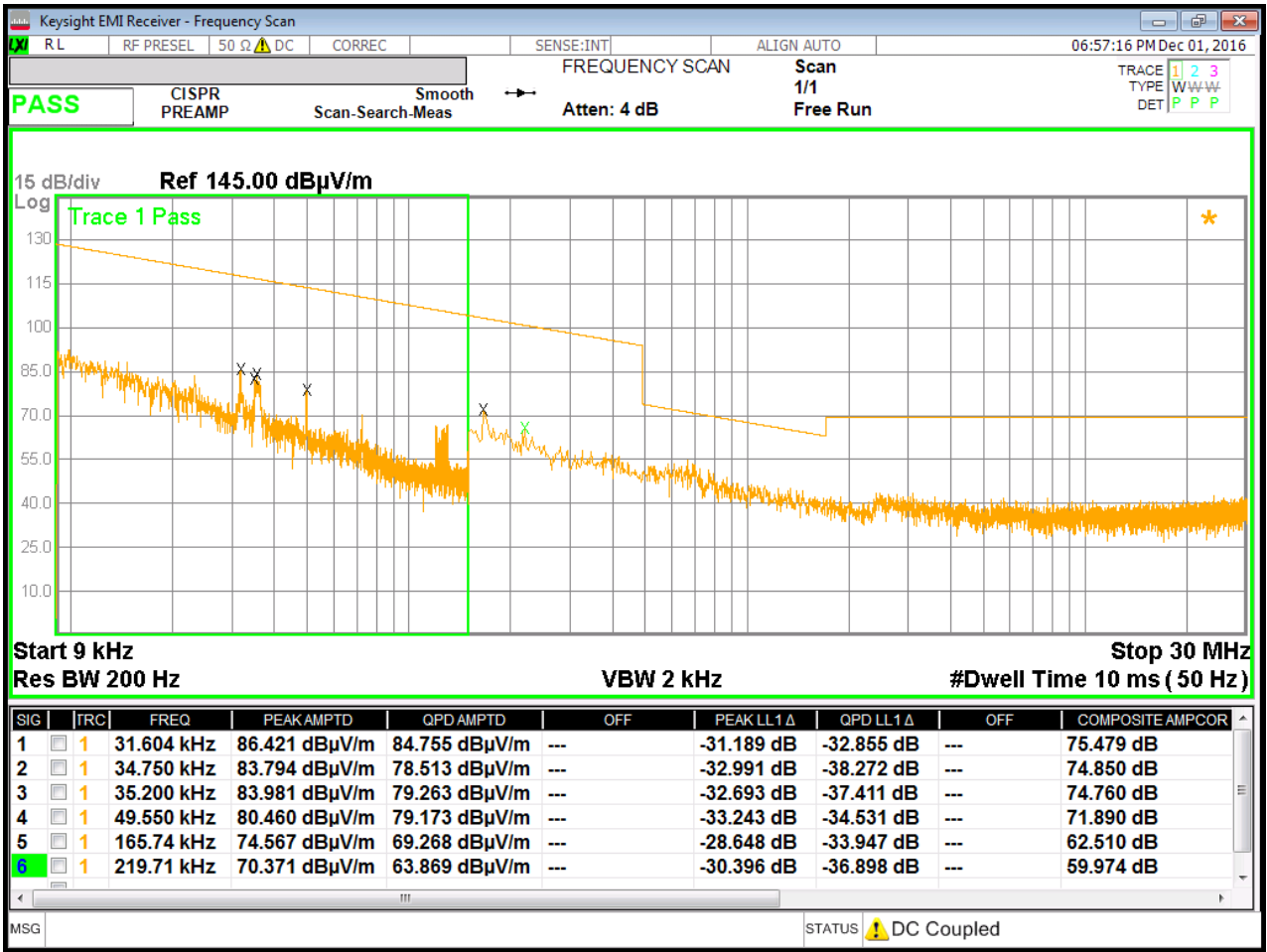


Fig. 4.4

Maximum disturbance determined in the frequency range 150 kHz – 30 MHz.
Loop Antenna Orthogonal Polarization

5. POWER LINES CONDUCTED EMISSIONS

Equipment shall meet the limits below when using a CISPR16 quasi-peak and average detector receivers.

FCC 15.207

FREQUENCY RANGE (MHz)	QUASI-PEAK LIMIT [dB (μV)]	AVERAGE LIMIT [dB (μV)]
0.15 – 0.50	66 – 56 ^(*)	56 – 46 ^(*)
0.50 – 5	56	46
5 – 30	60	50

^(*) Limit decreasing linearly with logarithm of frequency

Test Equipment

EQUIPMENT	MANUFACTURER	MODEL	CAL. DUE
MXE EMI Receiver	Agilent/Keysight	N9038A	01/2017
Screened Room	GSD	CSC01	01/2017
LISN	GSD	GSDA01	01/2017
LISN	COMTEST	---	01/2017

Test procedure: CE22R01

The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a spectrum analyzer by a transient limiter. The conducted emissions from 150 kHz to 30 MHz were monitored and compared to the specification limits

Test method

Test method was in accordance with the reference standard.

EUT modes of operations were tested in order to achieve the maximum level of emission.

Results

Equipment complied with the test specification limits.

Graphics in following figures show some registrations of the frequency spectrum of the conducted emissions.

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Job Number FCC-16810
 Test Name Power Line Conducted Emissions
 FCC 15.207
 EUT Name CAEN RFID s.r.l. - R1620U

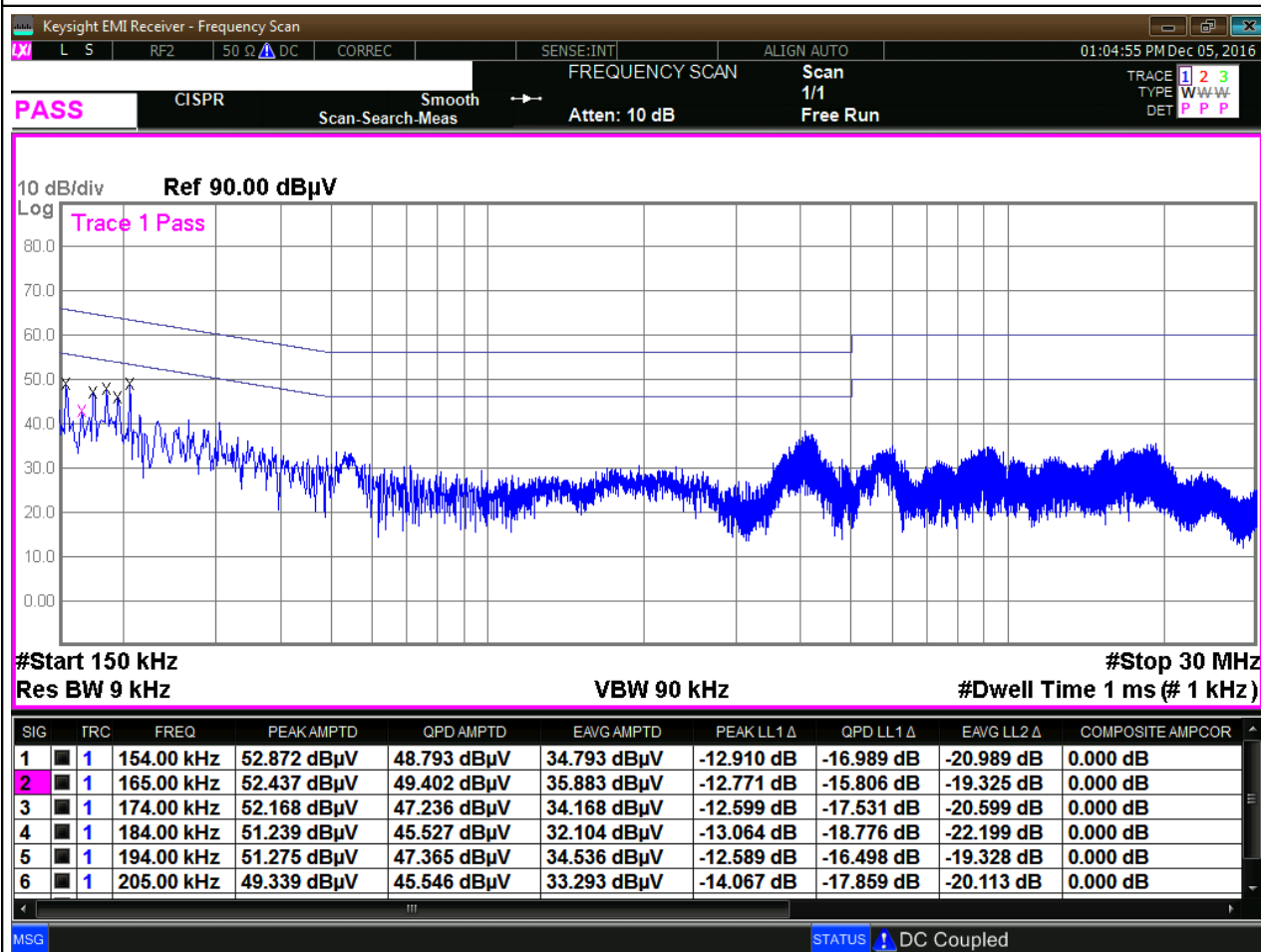


Fig. 5.1

Line 1 of Auxiliary Apparatus

EUT mode: Transmitting

Auxiliary apparatus: Laptop whit power supply linked

B Band (0.15 – 30 MHz)

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Job Number FCC-16810
 Test Name Power line Conducted Emissions
 FCC 15.207
 EUT Name CAEN RFID s.r.l. - R1620U

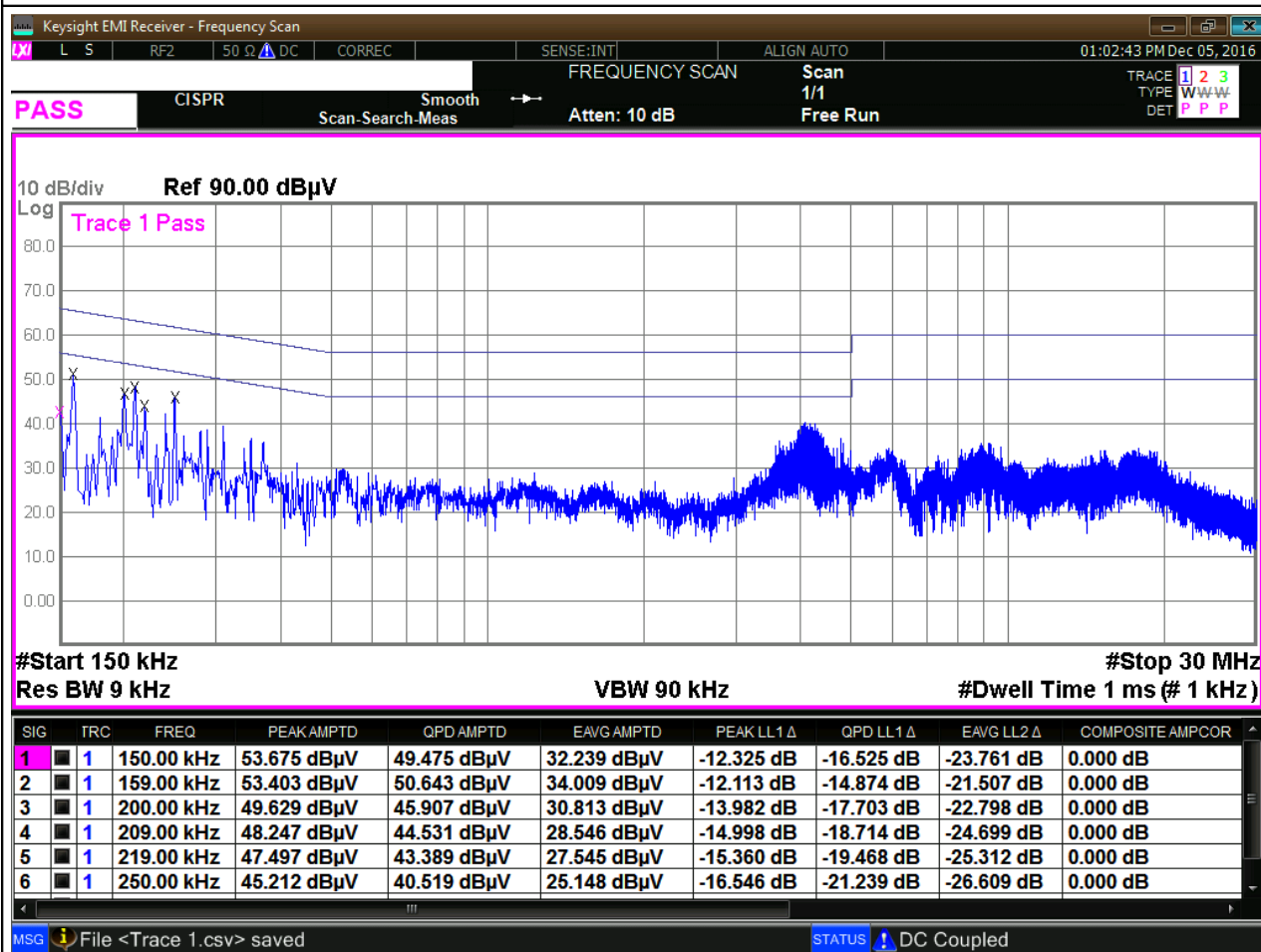


Fig. 5.2

Line 2 of Auxiliary Apparatus

EUT mode: Transmitting

Auxiliary apparatus: Laptop whit power supply linked

B Band (0.15 – 30 MHz)

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6. OPERATION WITHIN THE BAND 902 - 928 MHz

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

6.1. NUMBER OF HOPPING CHANNEL

For frequency hopping systems operating in the 902 – 928 MHz band:

- if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies;
- if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Measurement

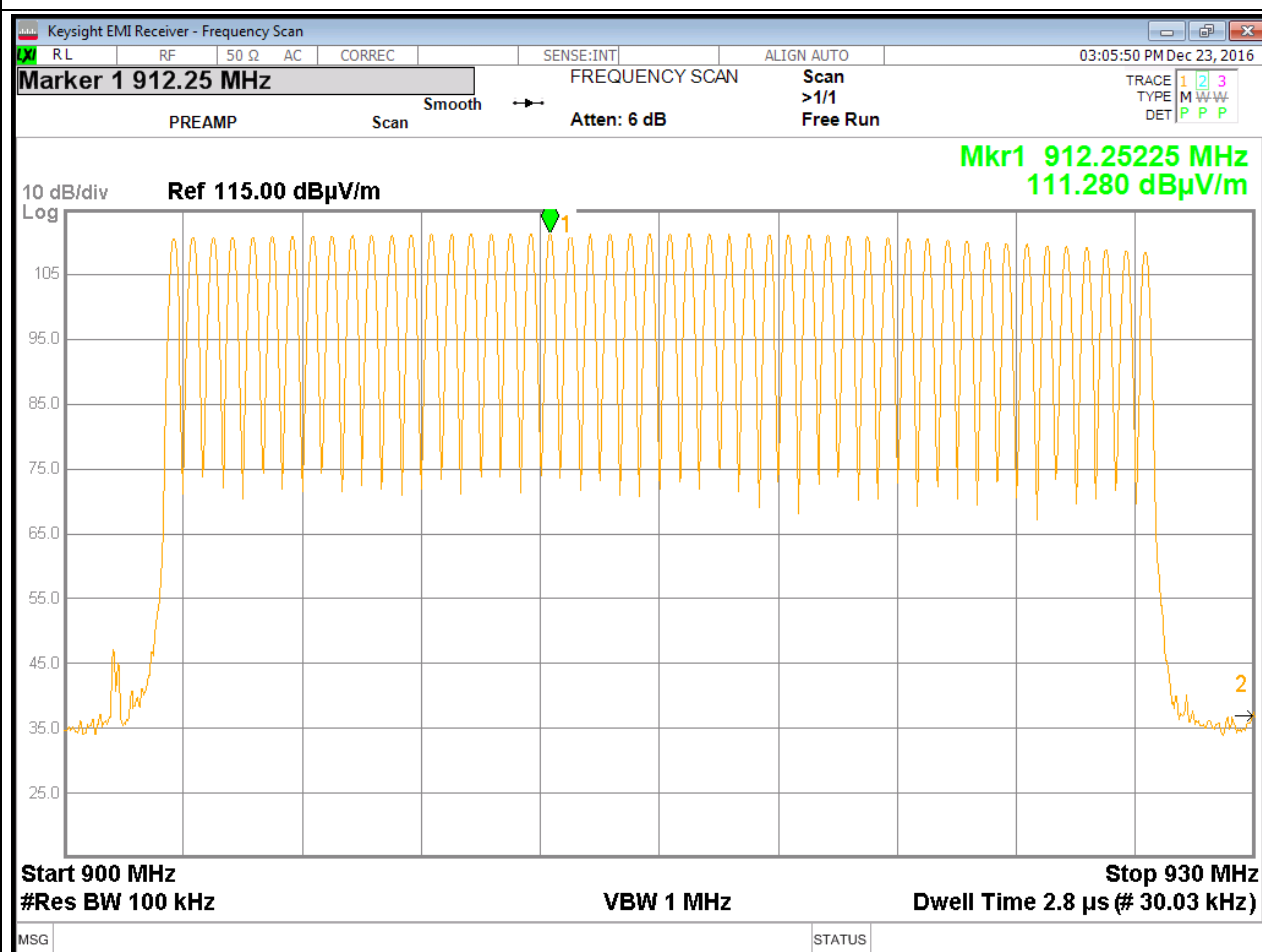
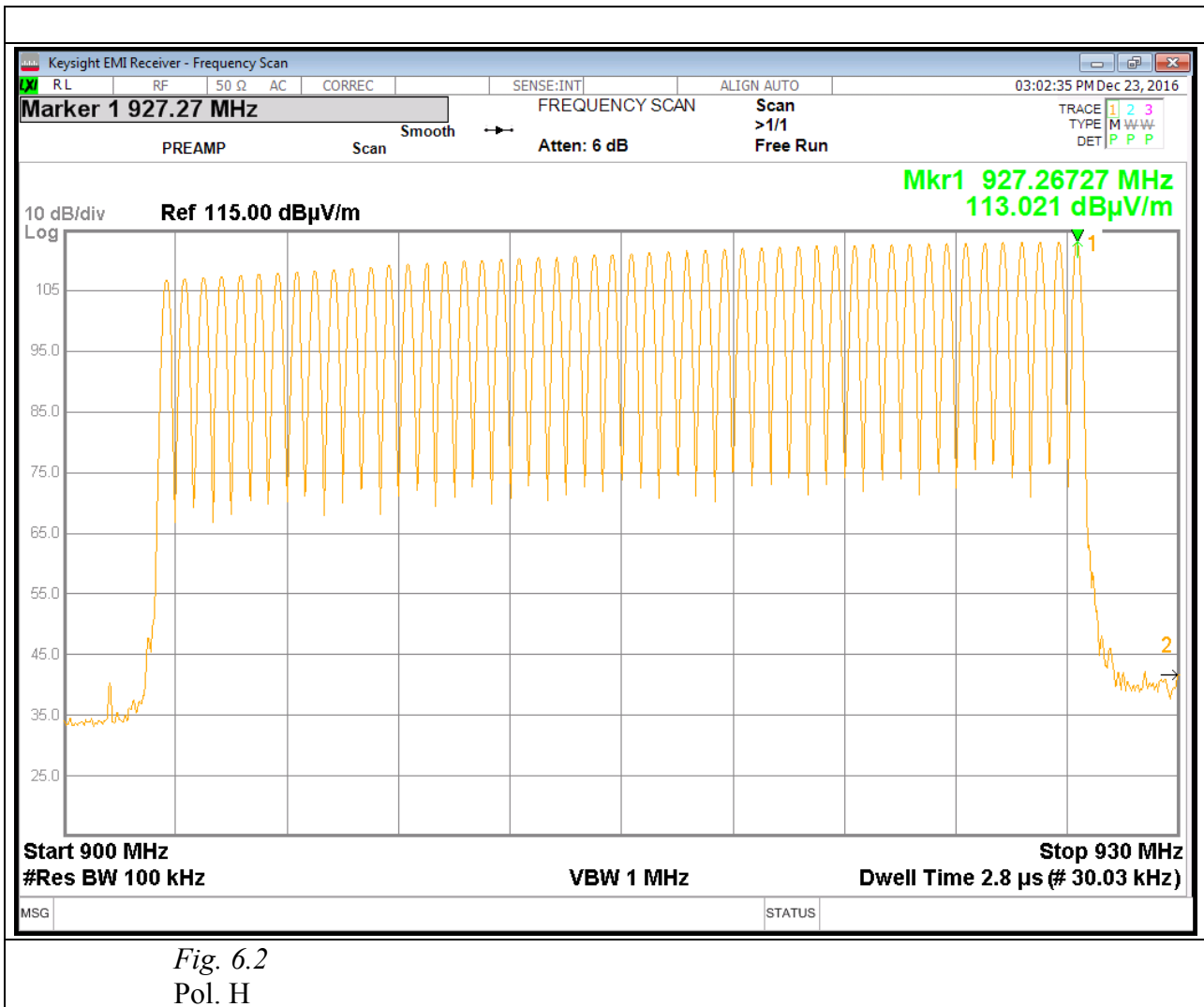


Fig. 6.1
Pol. V



6.2. CARRIER FREQUENCY SEPARATION

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Measurement

The following figures show the acquired graphics.

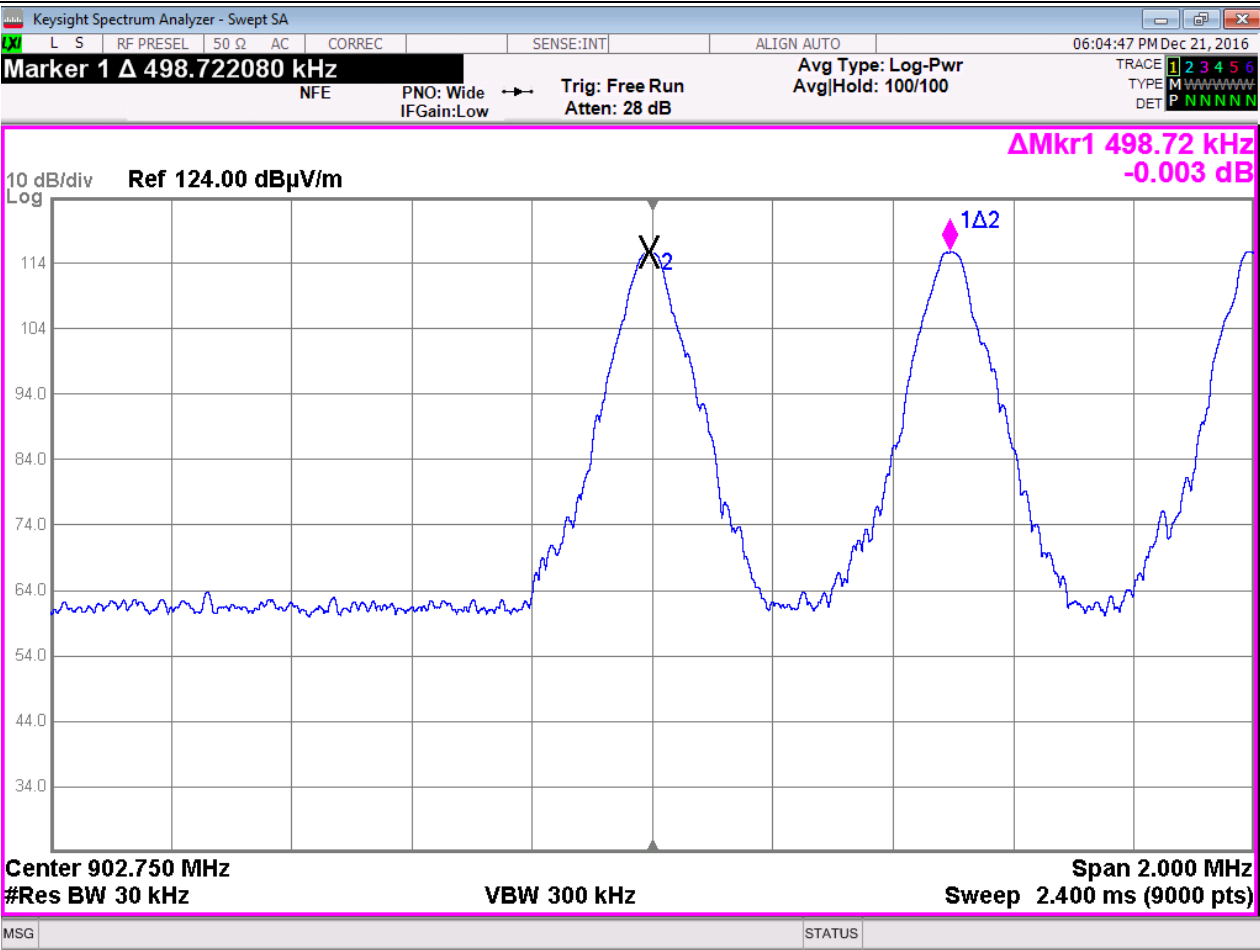
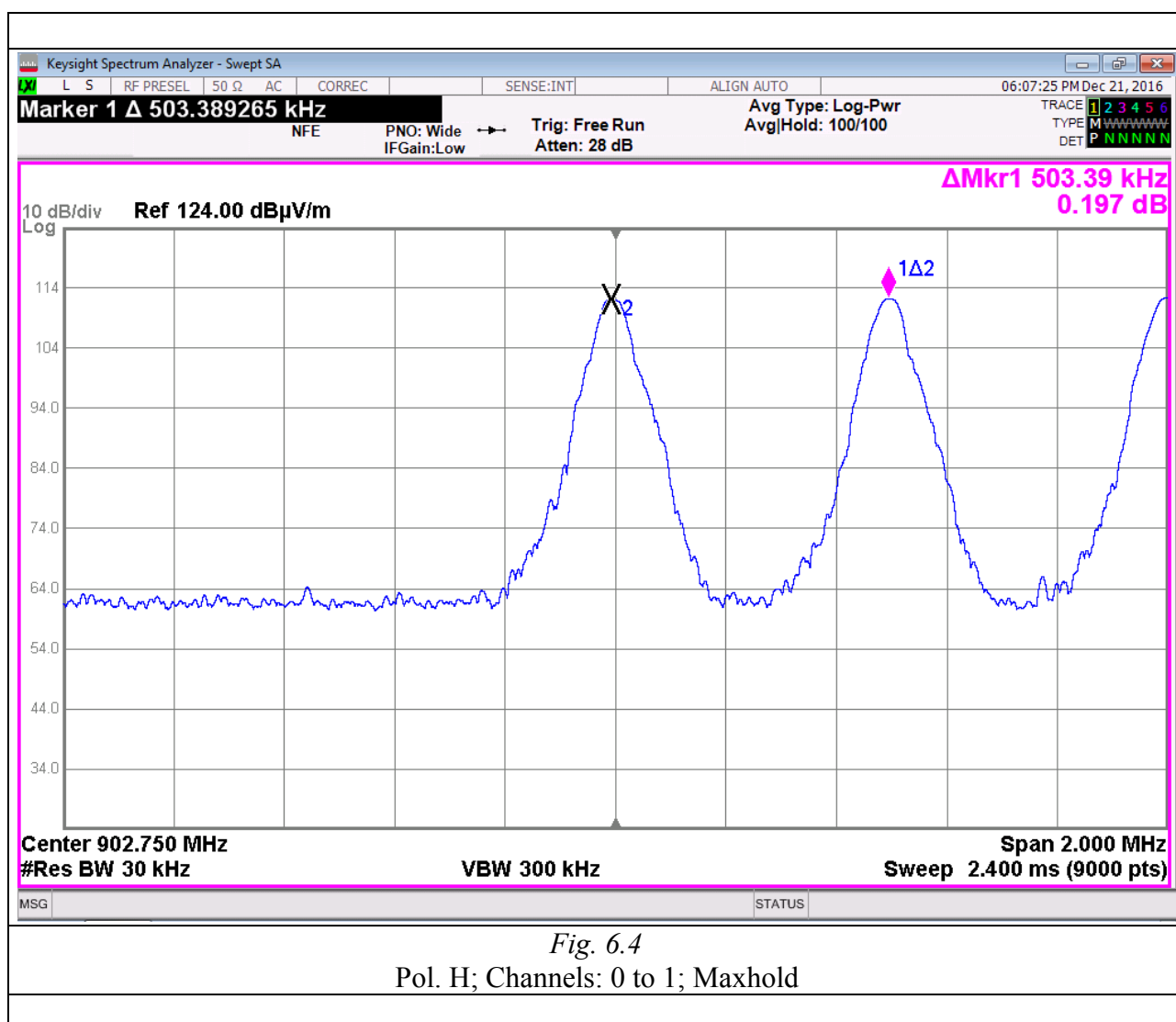
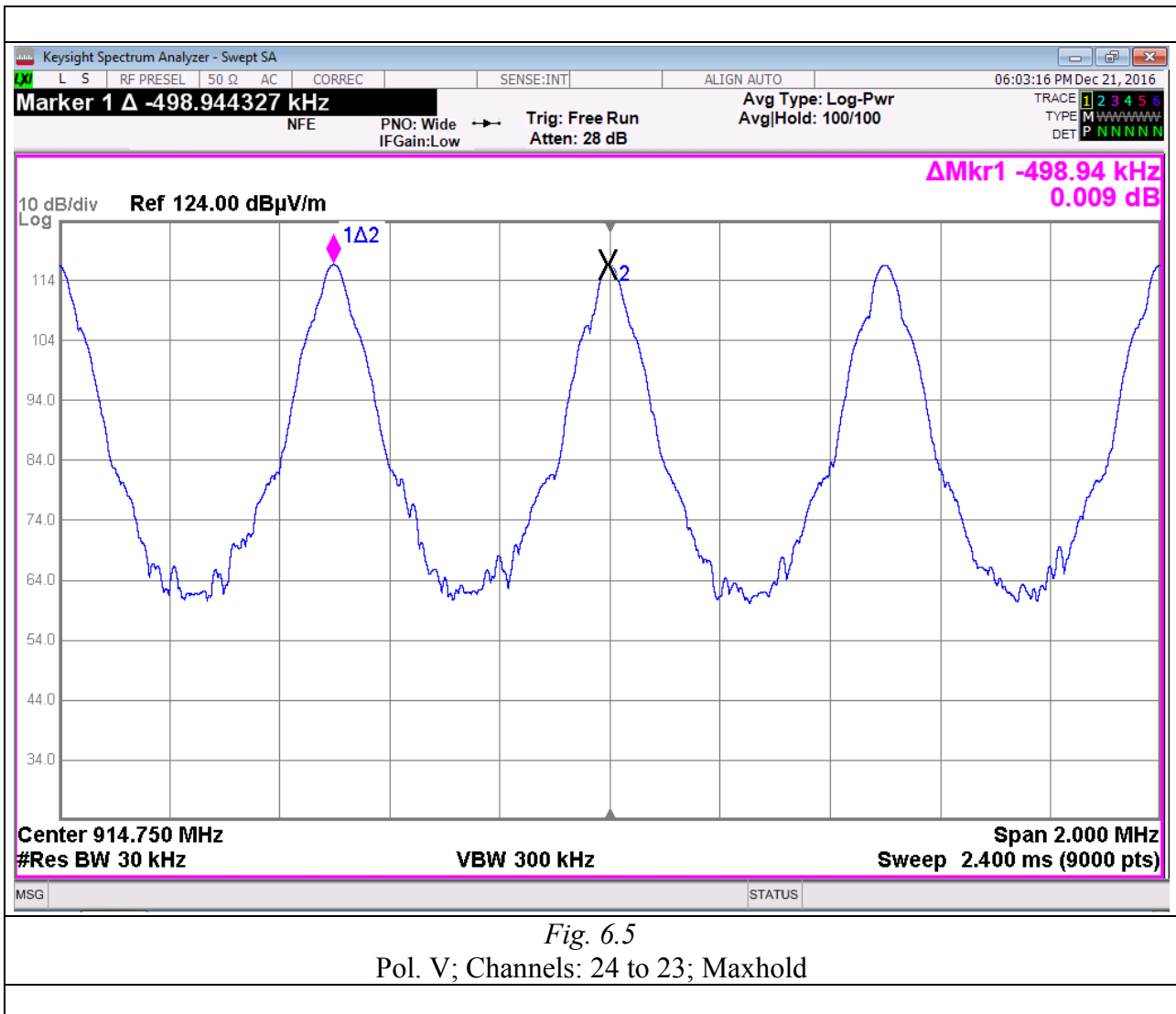
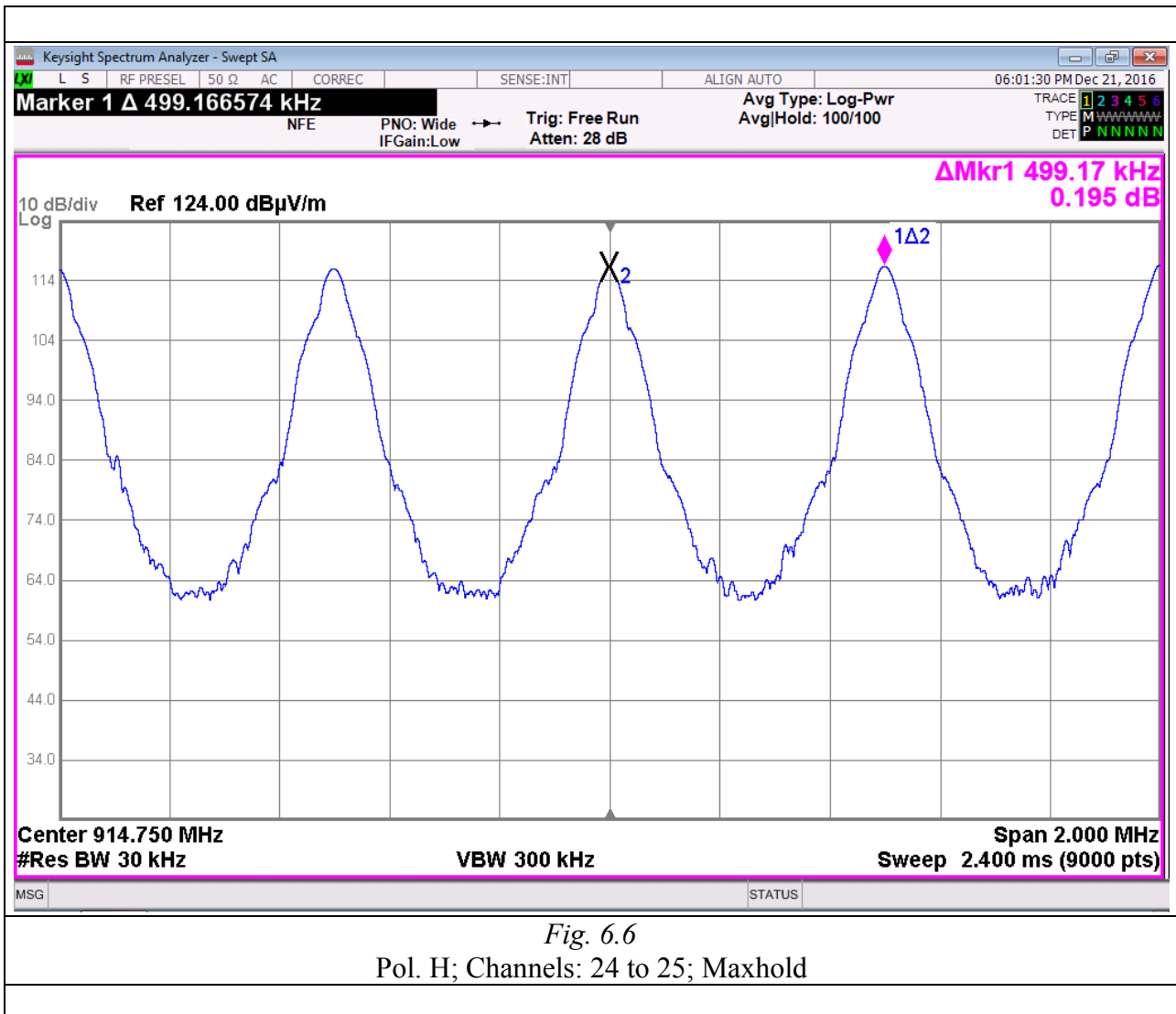


Fig. 6.3
Pol. V; Channels: 0 to 1; Maxhold



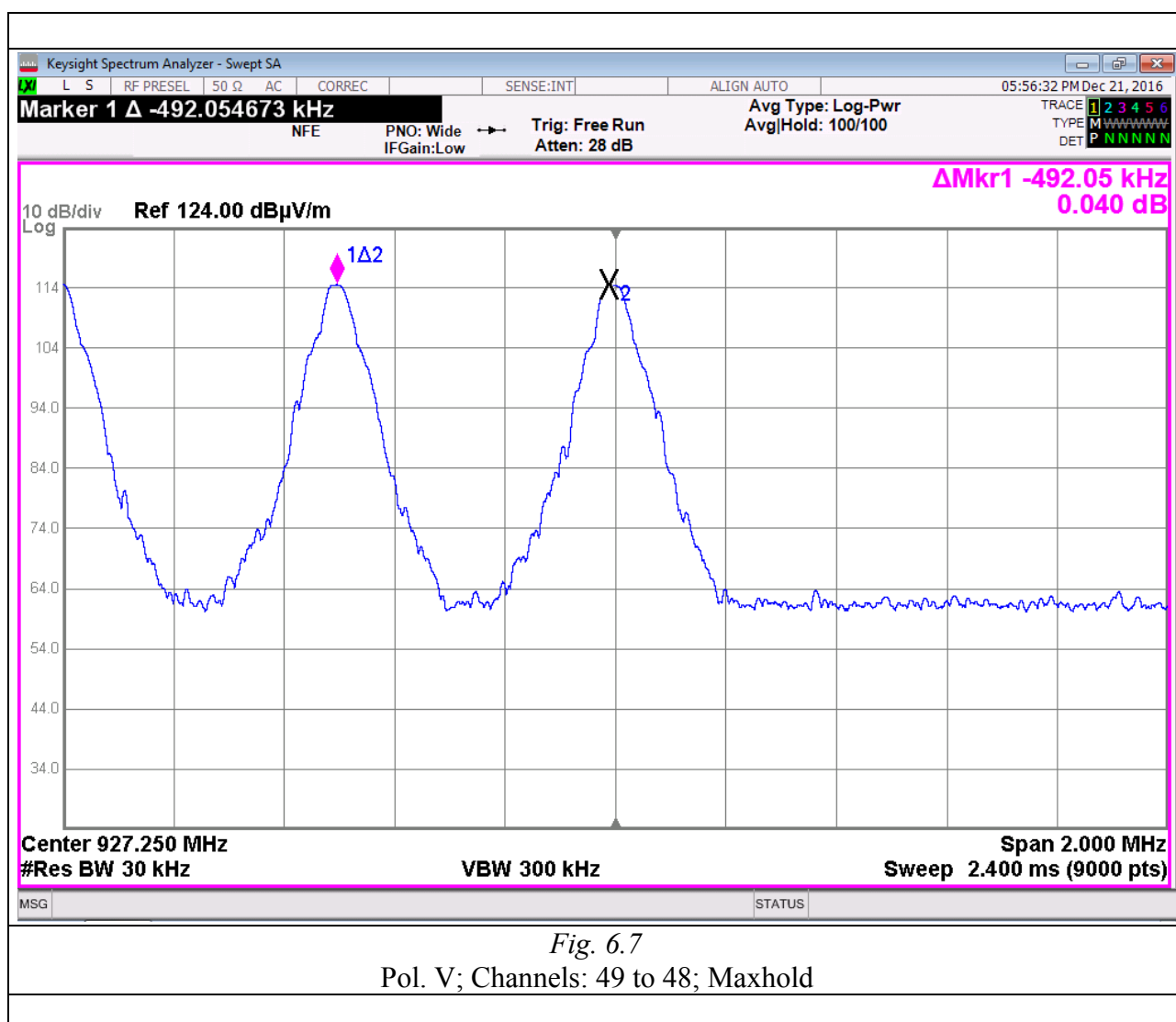




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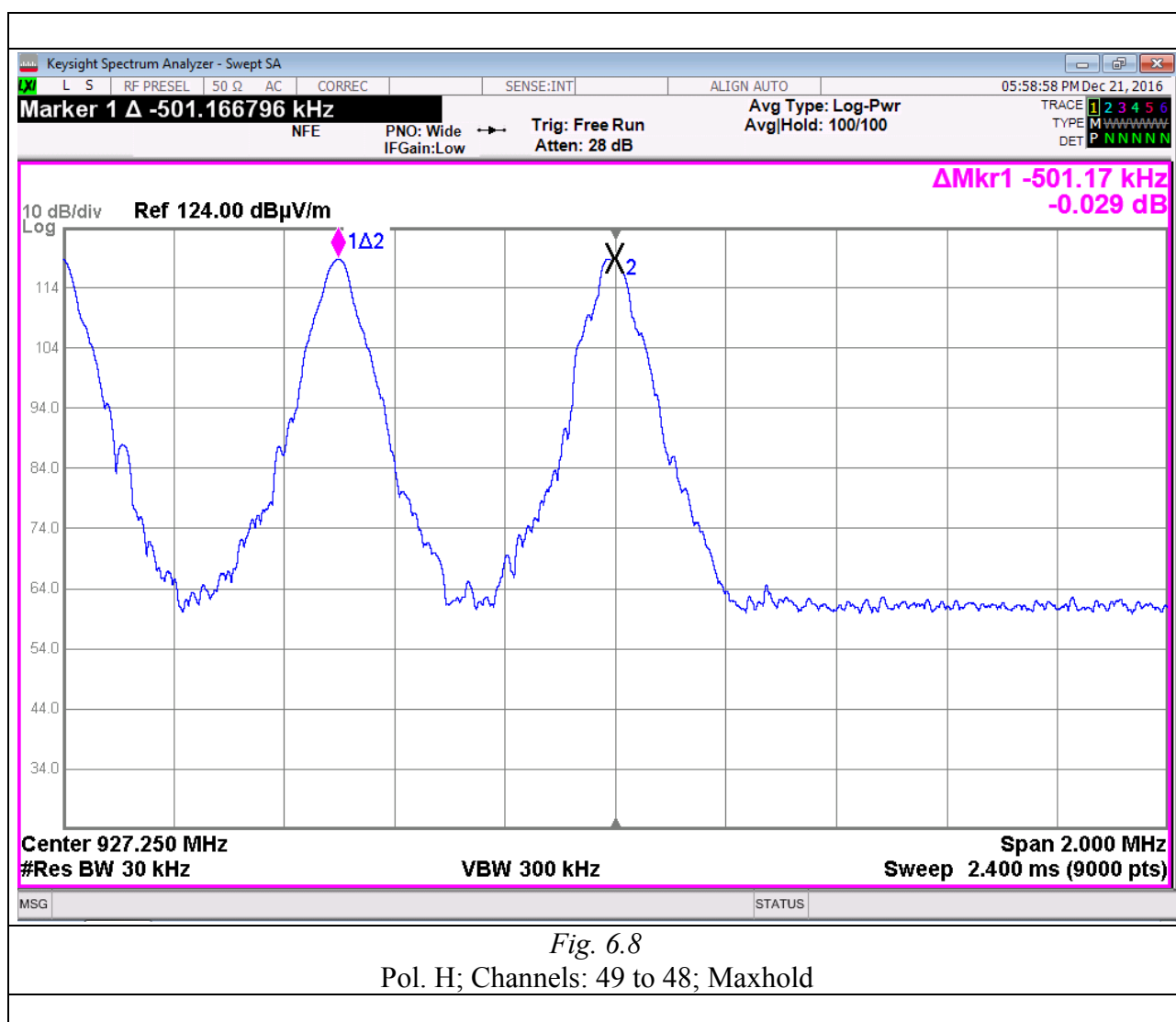
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6.3. <i>TIME OF OCCUPANCY</i>					
<u>Measurements</u>					
Channel	Dwell Time (ms)	Nr. of Transmission for channel (average)	Time of Occupancy (ms)	Limit (msec)	Result
0	28.99	6 (in 20 s)	174.9 (in 20 s)	400	Pass
24	28.98	6 (in 20 s)	173.9 (in 20 s)	400	Pass
49	28.99	6 (in 20 s)	174.9 (in 20 s)	400	Pass
The following figures show the acquired graphics.					

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Time of transmission

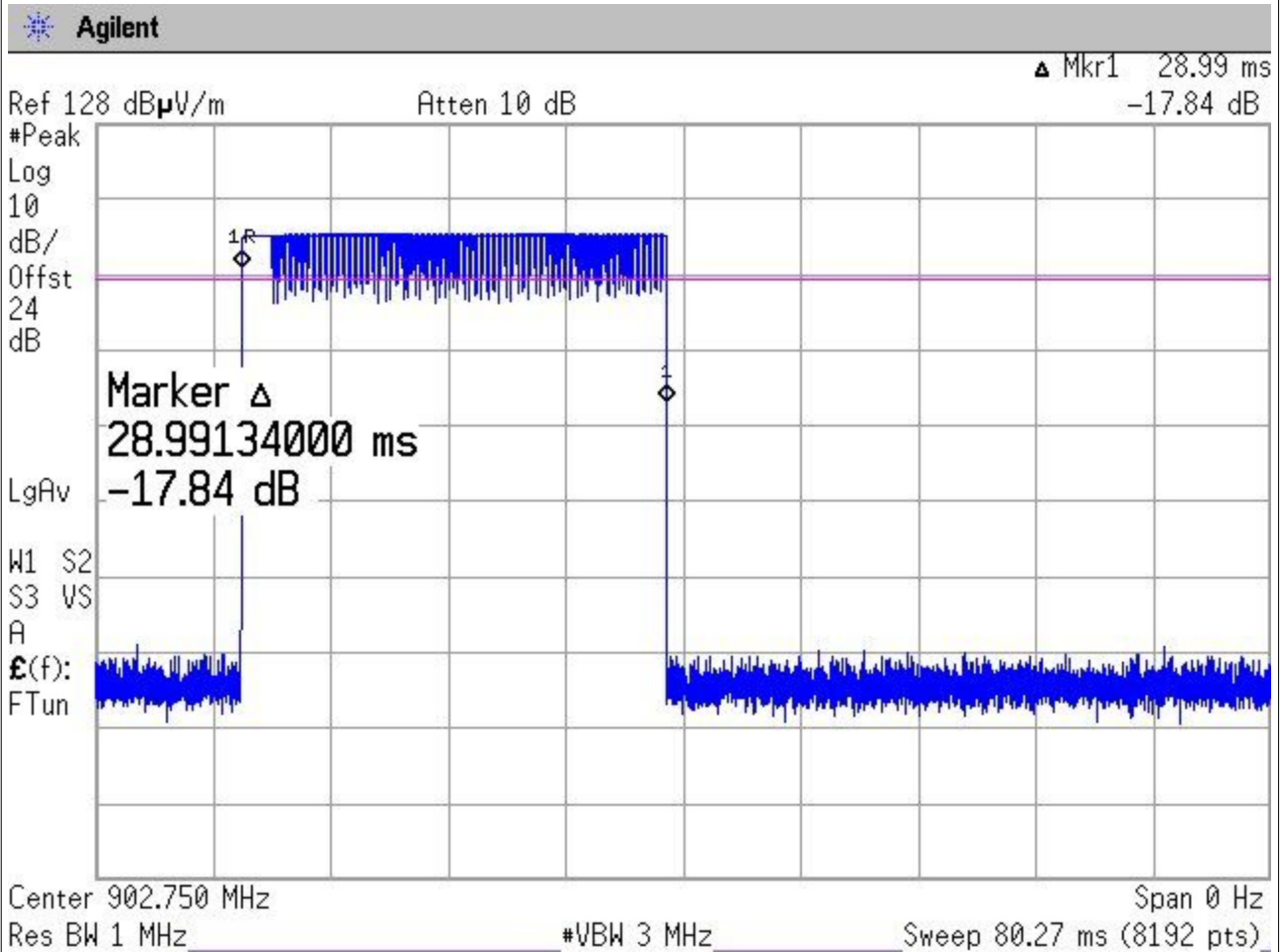


Fig. 6.9
Channel: 0 (Maxhold)

Nr. of Transmission for channel

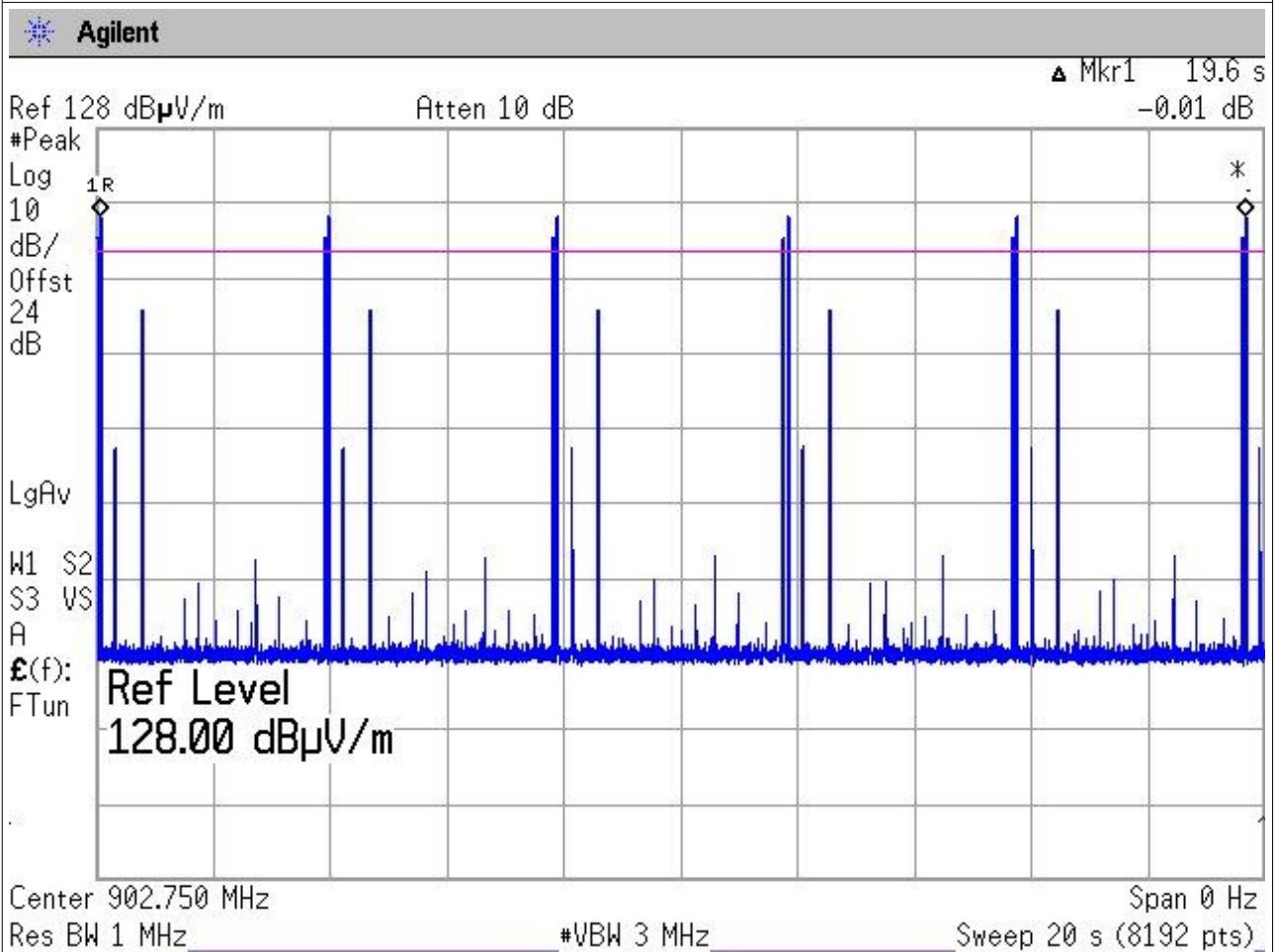
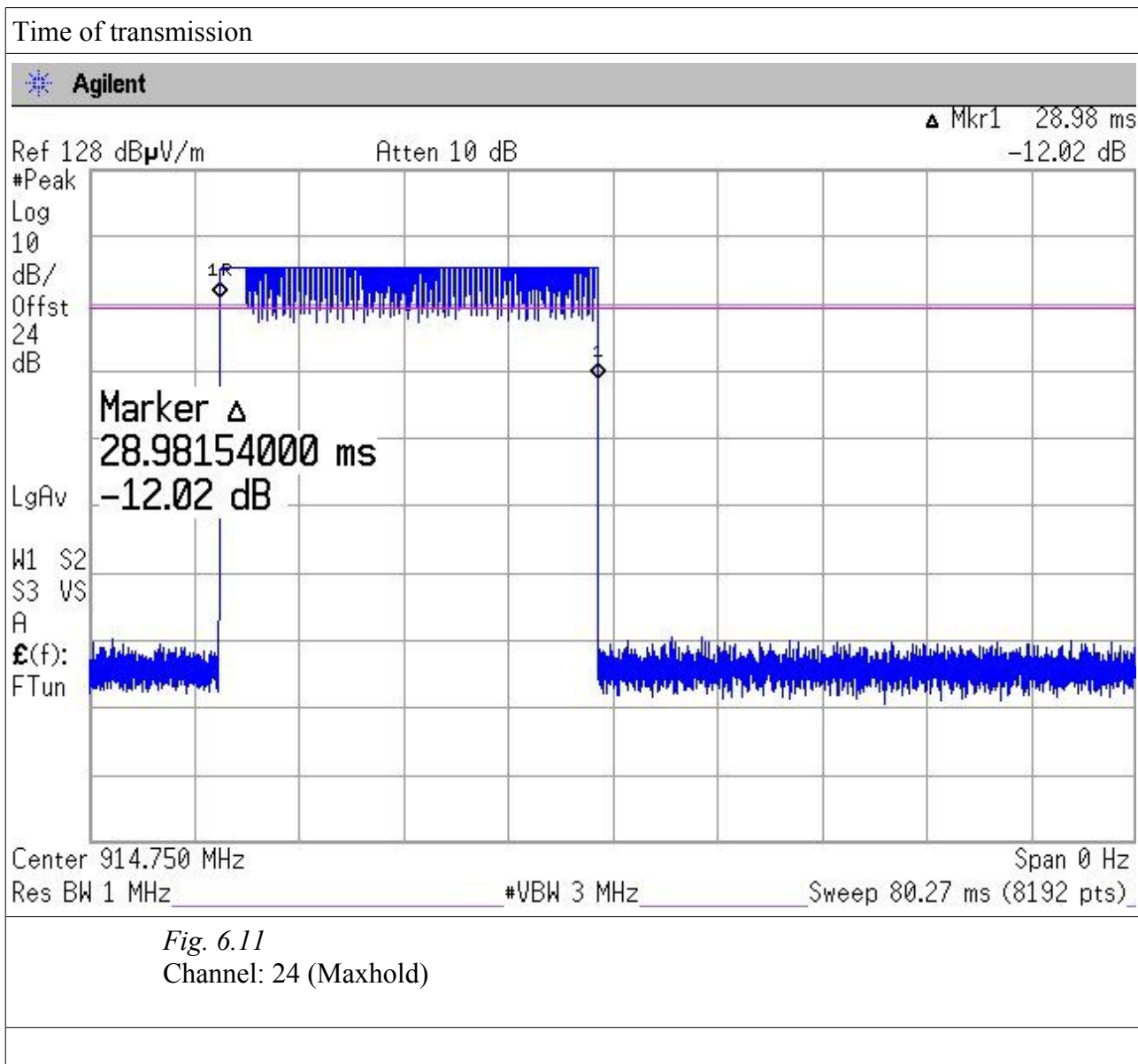


Fig. 6.10
Channel: 0



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Nr. of Transmission for channel

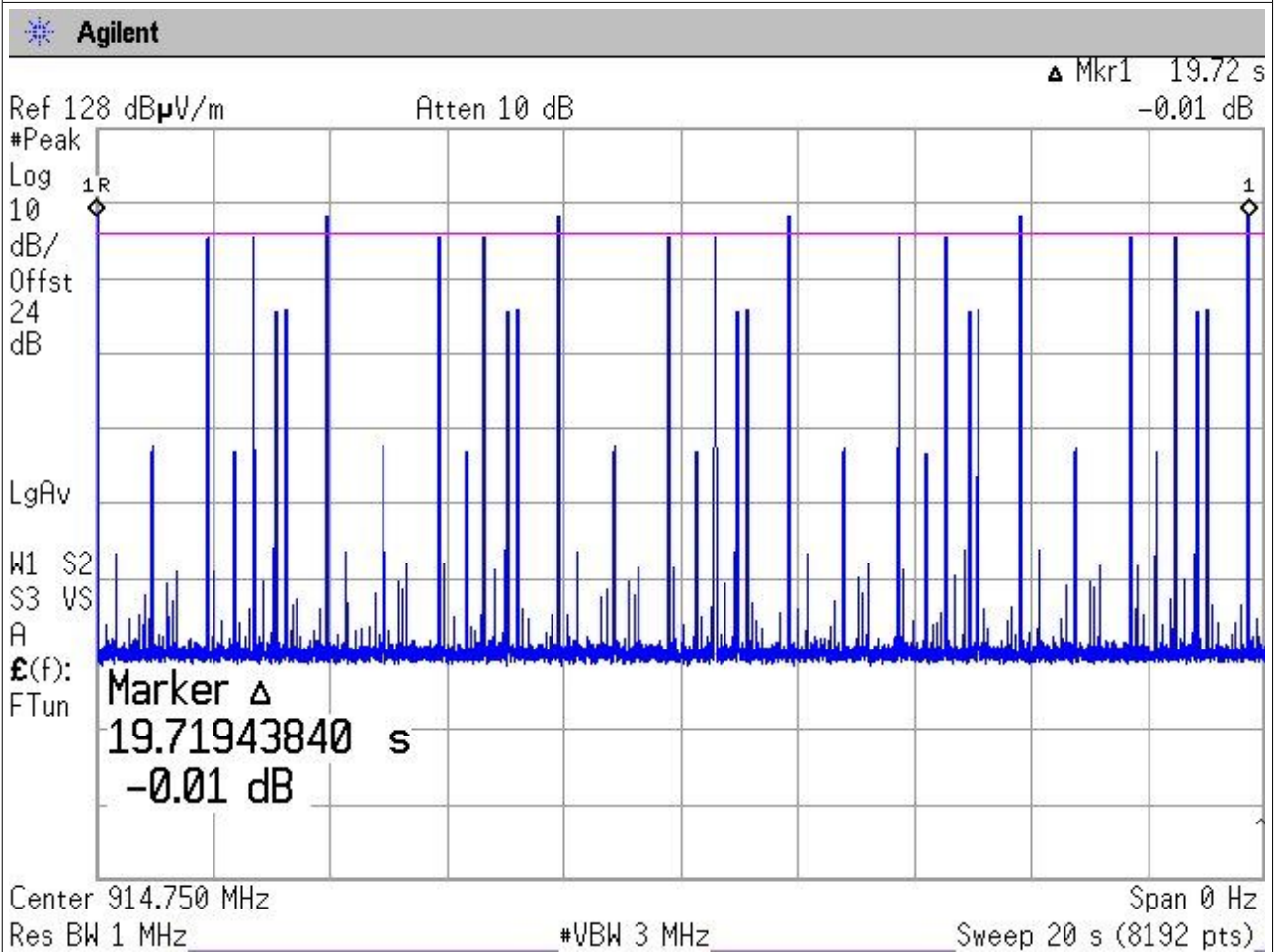
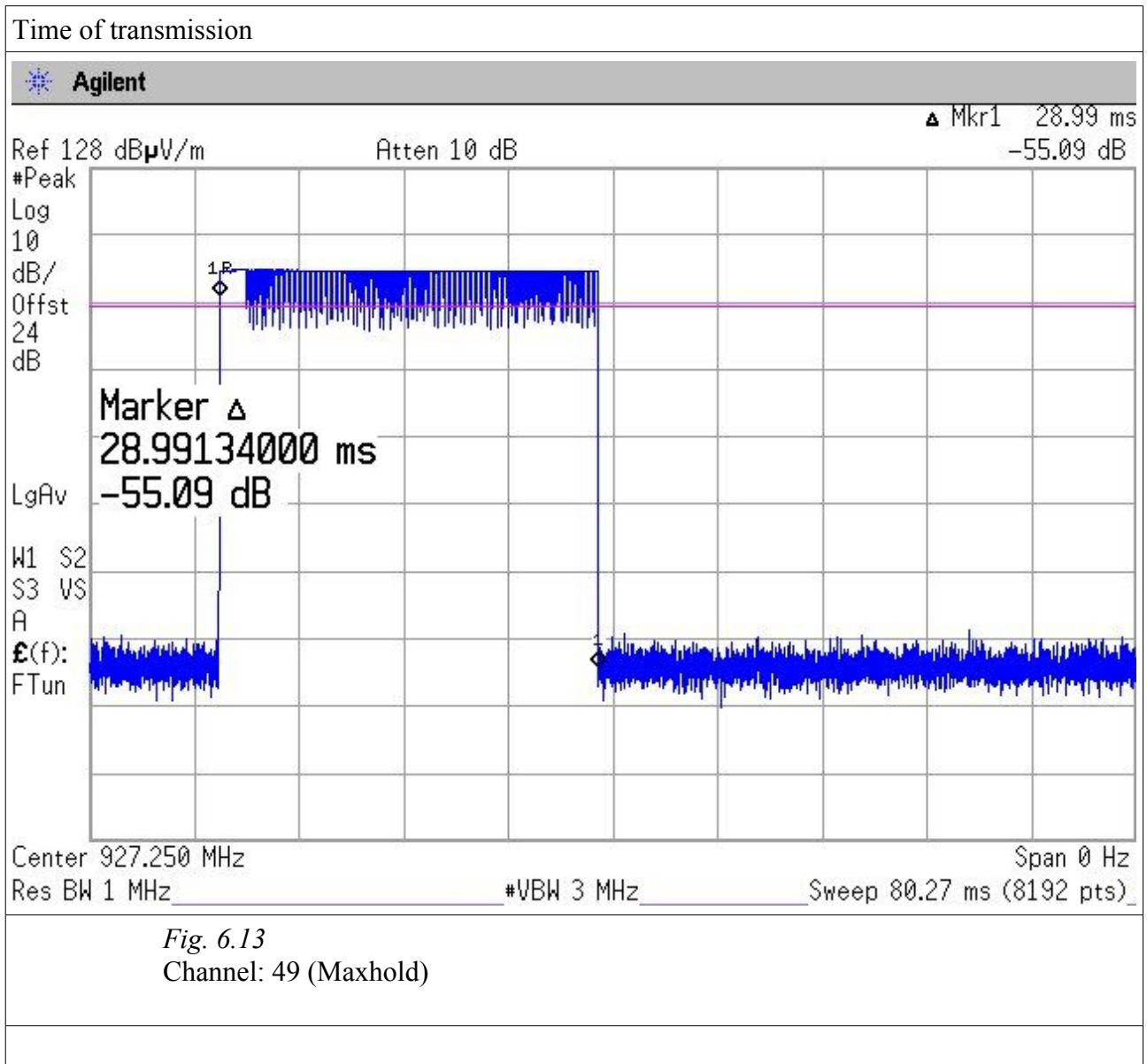


Fig. 6.12
Channel: 24



Nr. of Transmission for channel

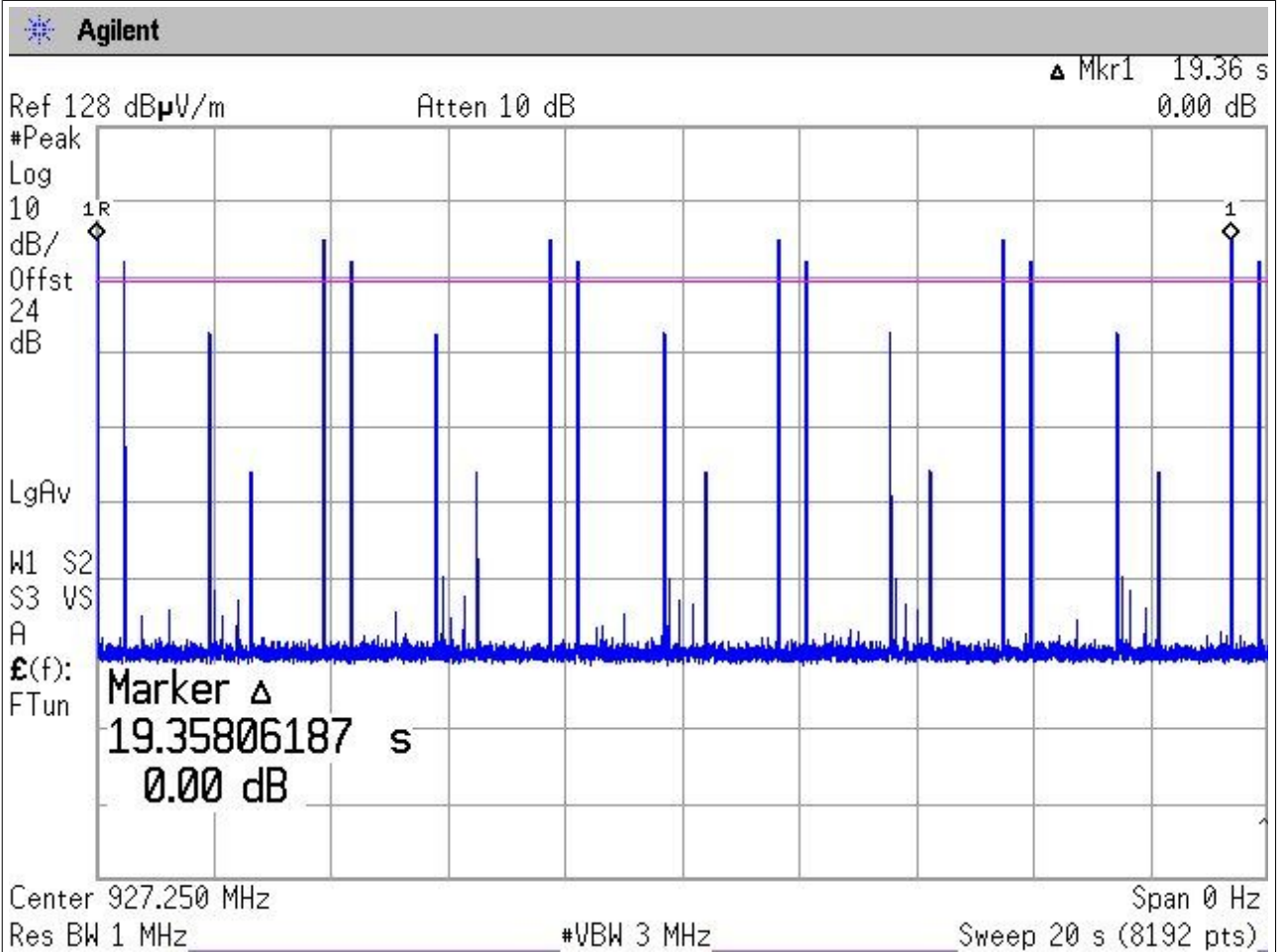


Fig. 6.14
Channel: 49

6.4. 20 dB BANDWIDTH				
<u>Measurements</u>				
<i>Modulation: Pol. V</i>				
Channel	Frequency [MHz]	Bandwidth [kHz]	Limit [kHz]	Result
0	902.74702	85.7	500	Pass
24	914.74728	85.8	500	Pass
49	927.24692	86.7	500	Pass
<i>Modulation: Pol H</i>				
Channel	Frequency [MHz]	Bandwidth [kHz]	Limit [kHz]	Result
0	902.74755	85.7	500	Pass
24	914.74755	85.8	500	Pass
49	927.24768	86.5	500	Pass
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Ch 0: Bandwidth

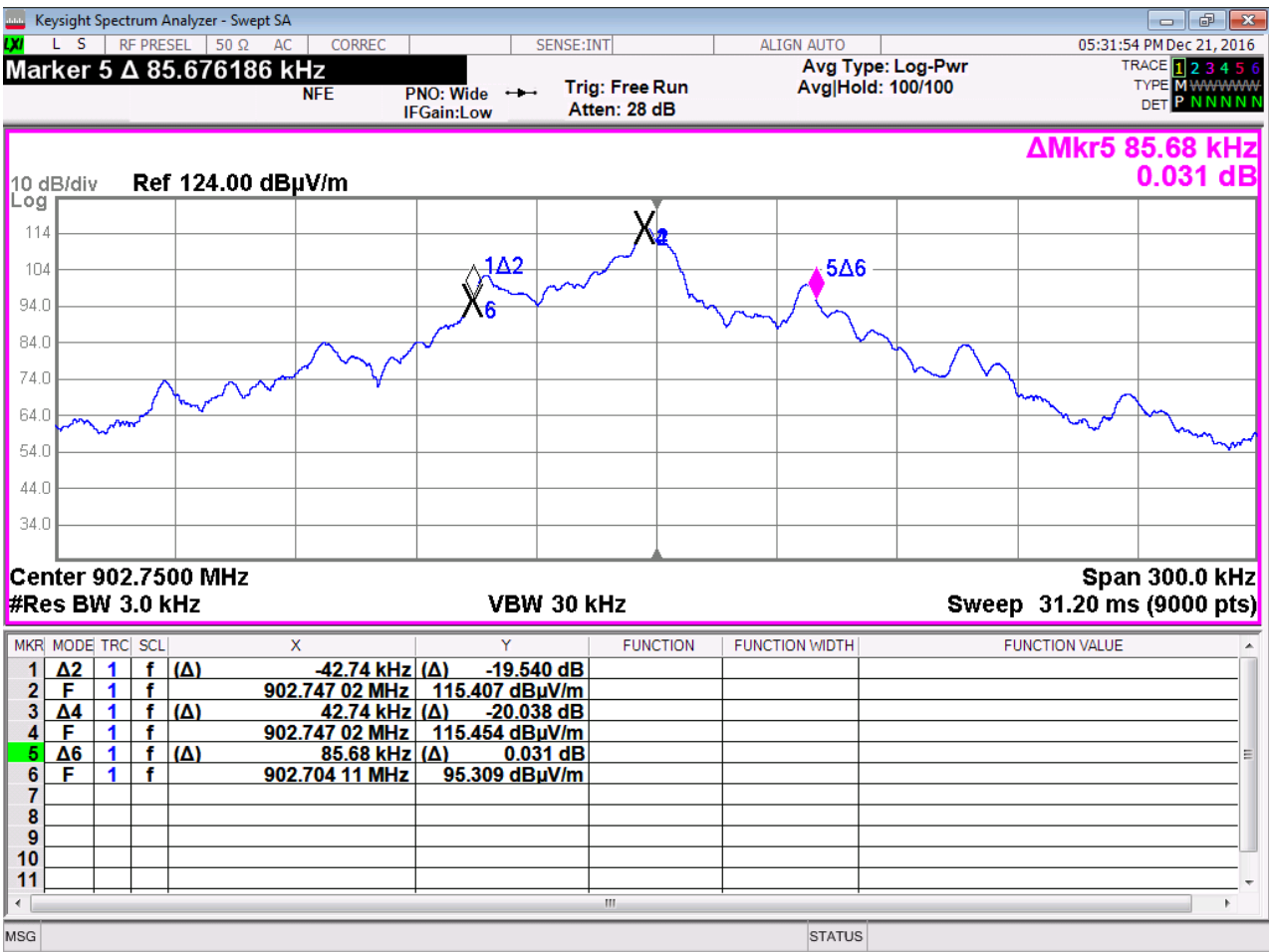


Fig. 6.15
Pol. V

Ch 0: Bandwidth

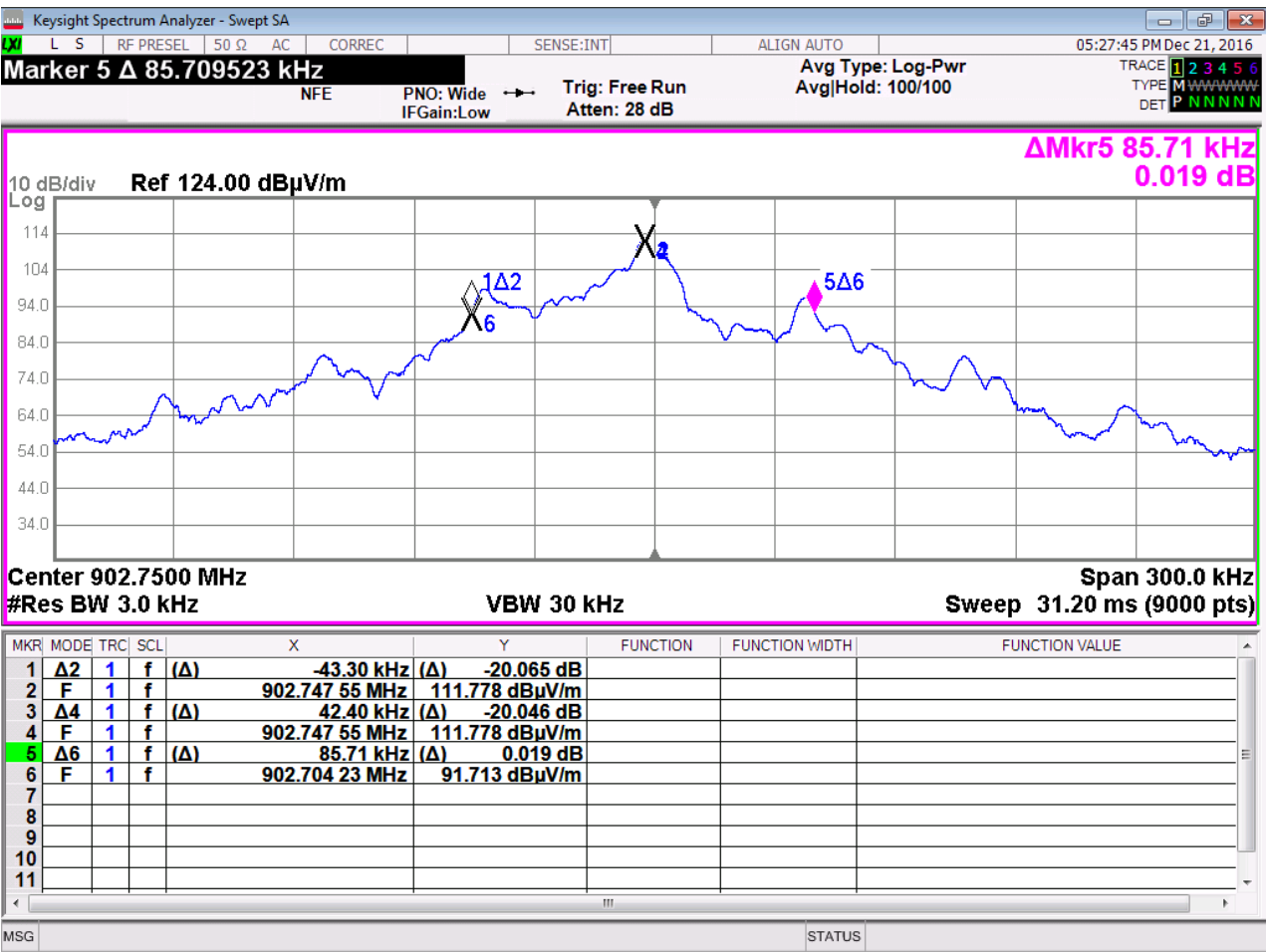


Fig. 6.16
Pol. H

Ch 24: Bandwidth

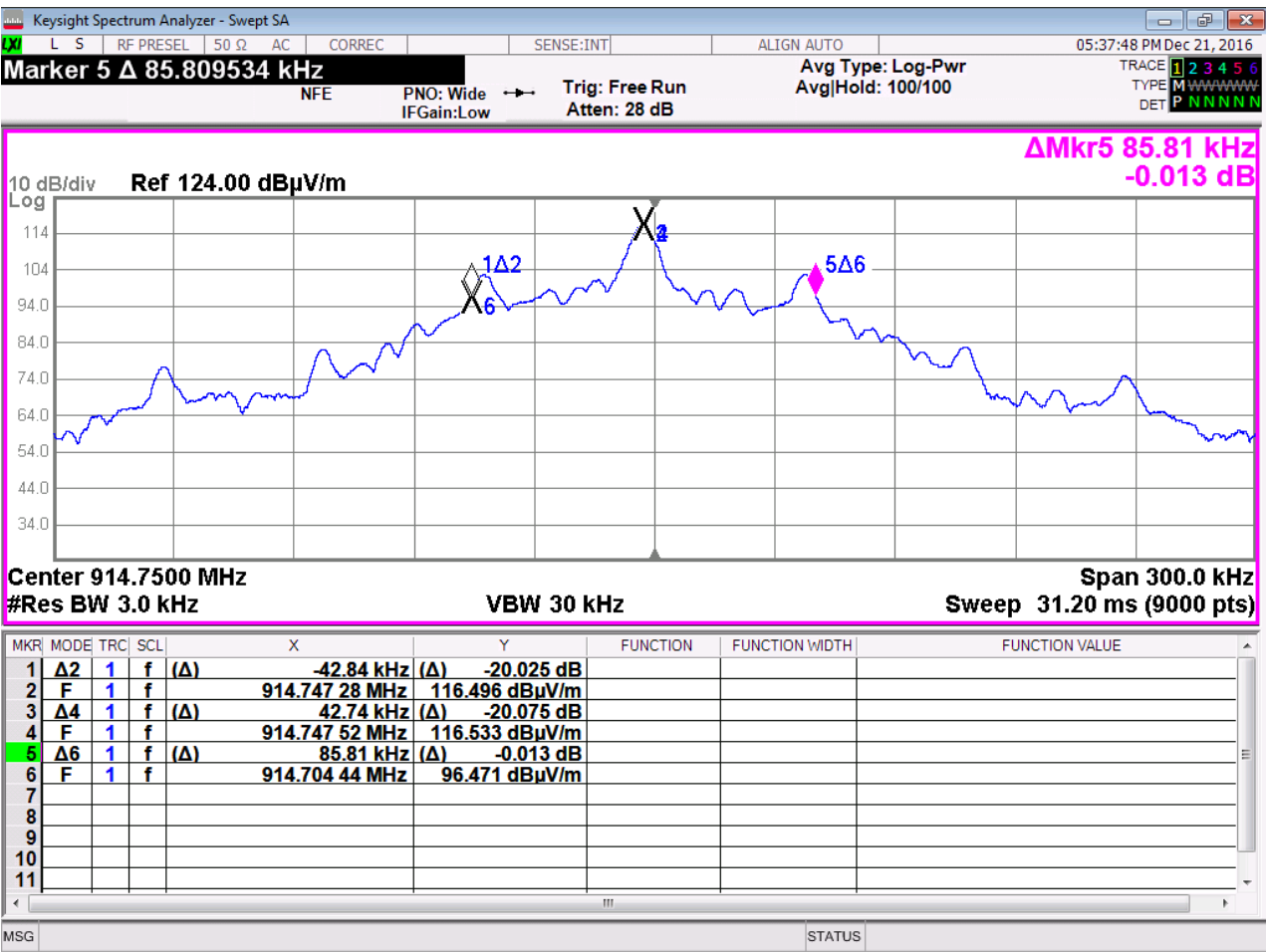


Fig. 6.17
Pol. V

Ch 24: Bandwidth

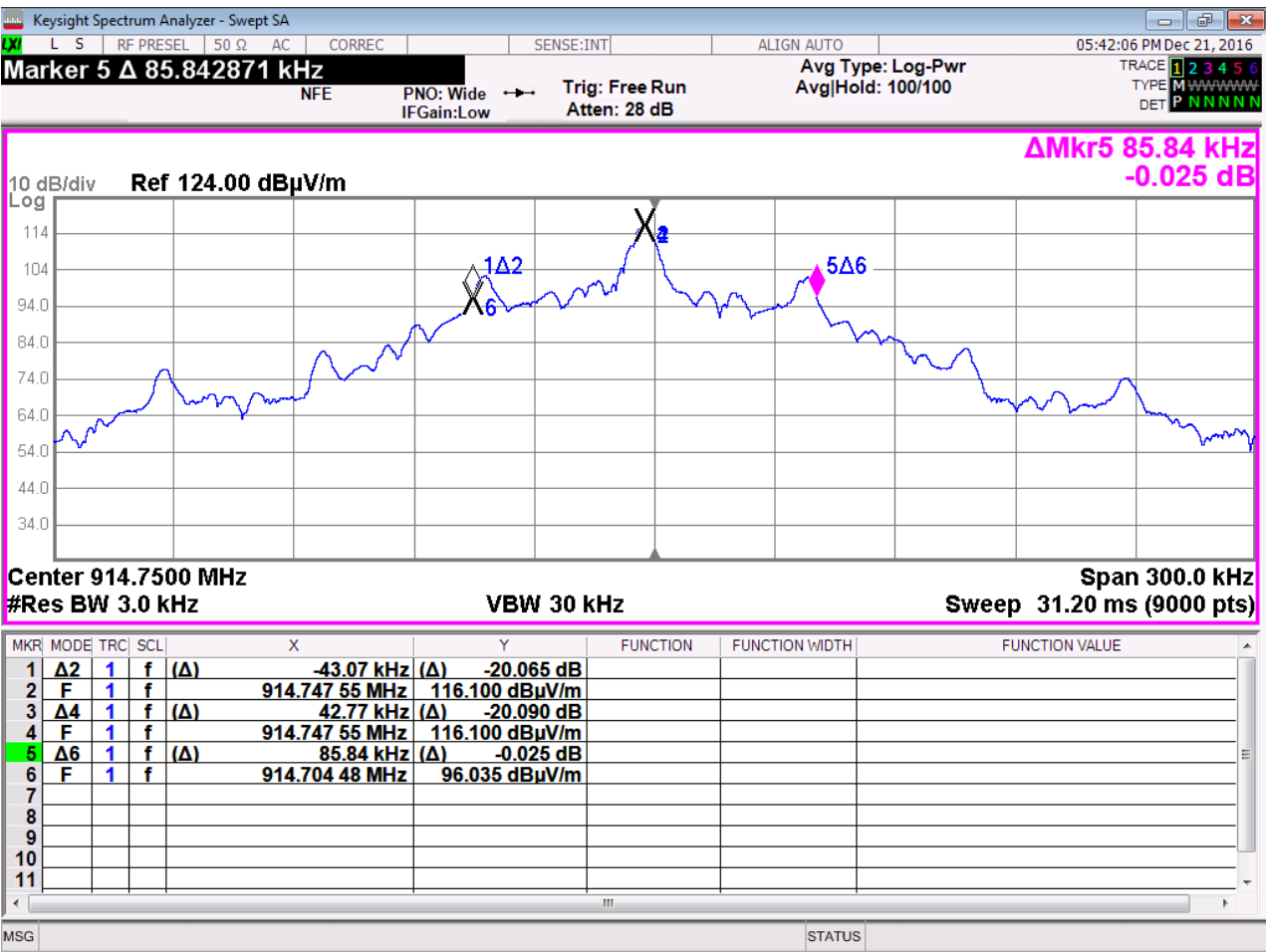


Fig. 6.18
Pol. H

Ch 49: Bandwidth

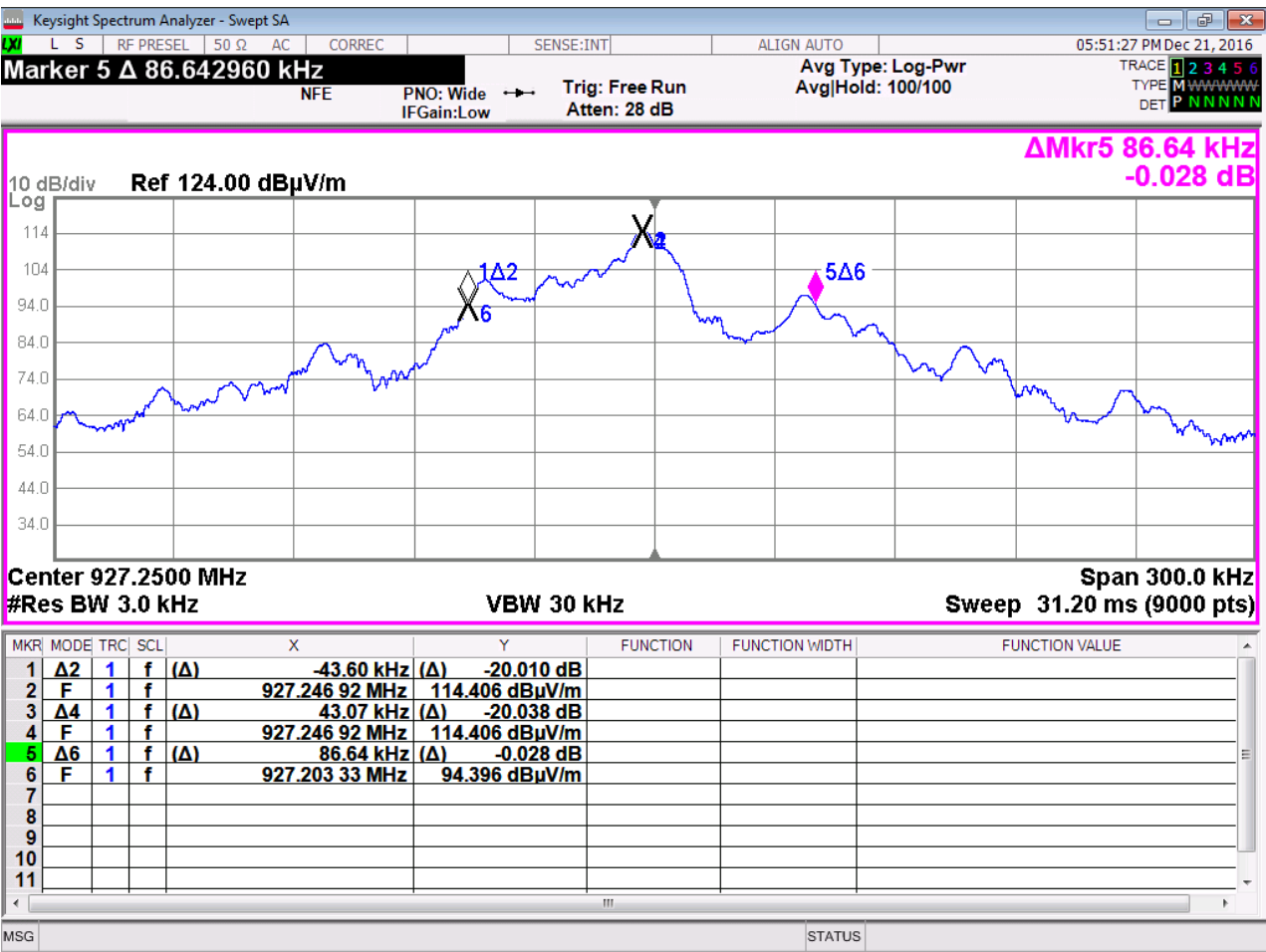


Fig. 6.19
Pol. V

Ch 49: Bandwidth

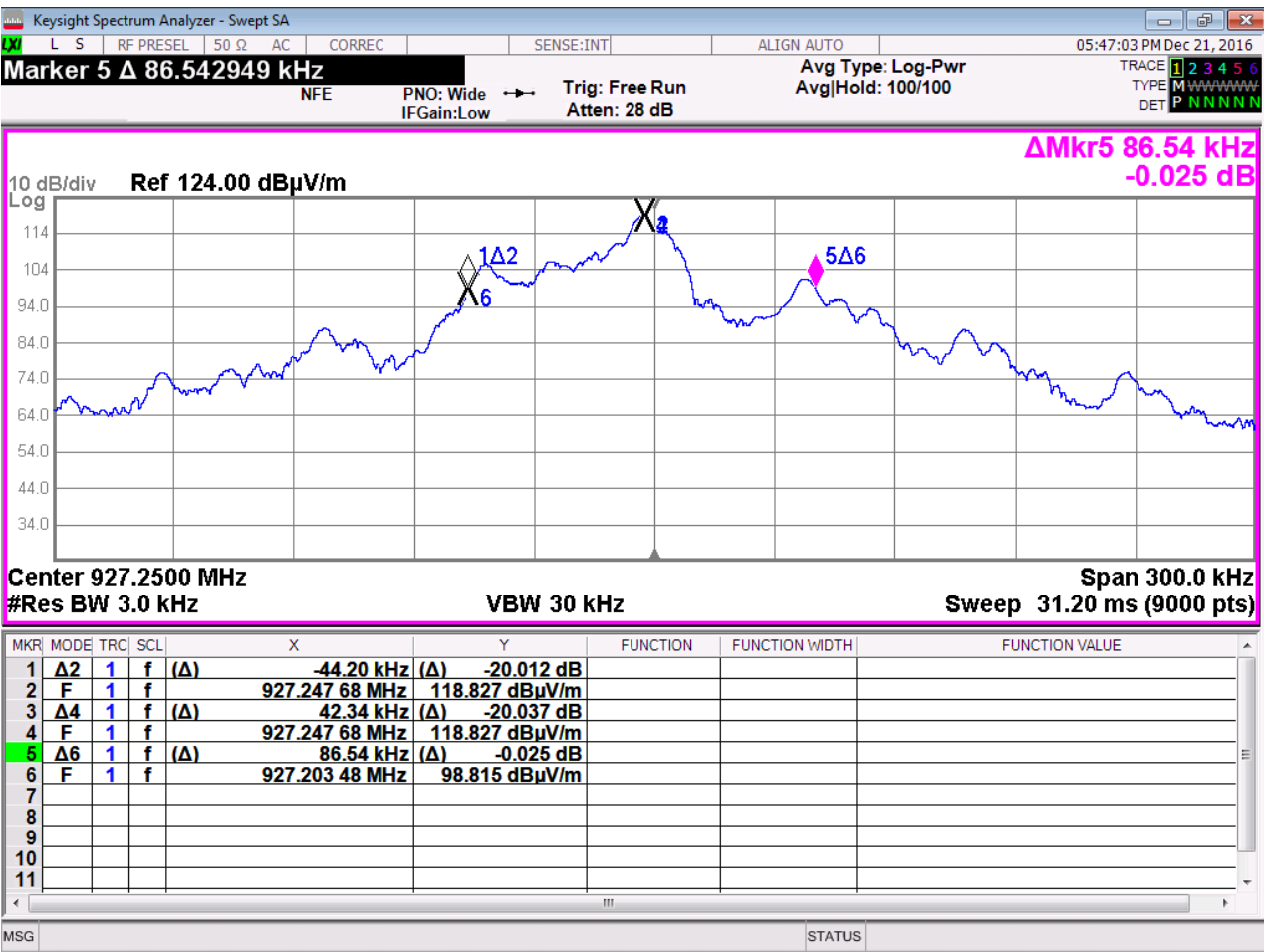


Fig. 6.20
Pol. H

6.5. *PEAK OUTPUT POWER*

Equipment shall meet the limits below.

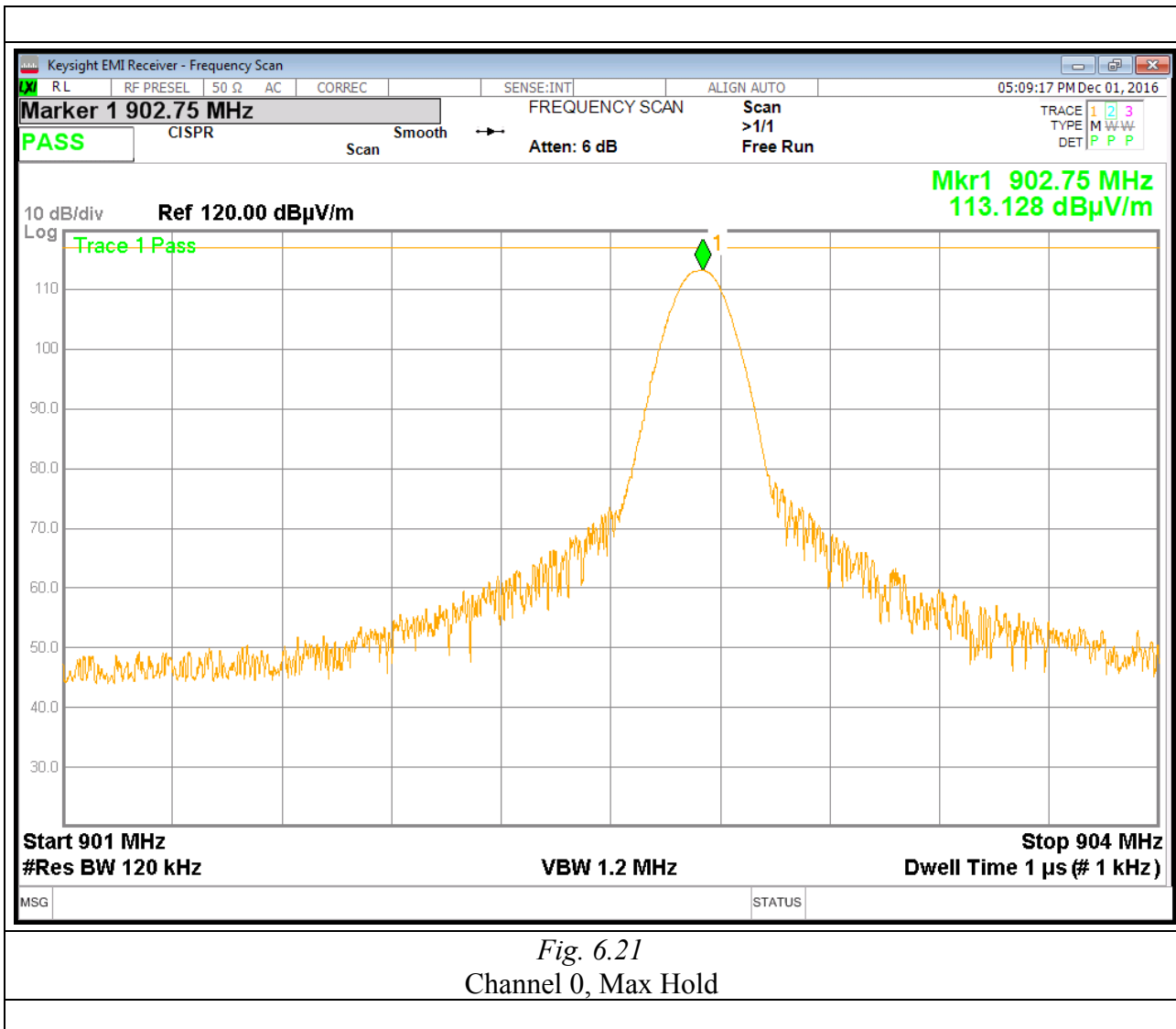
<i>FREQUENCY RANGE</i> [MHz]	<i>NR OF CHANNEL</i> [#]	<i>RF POWER OUTPUT LIMIT</i> [dBm]
902 – 928	50	30.0 (1 W)
902 – 928	< 50	24.0 (0.25 W)

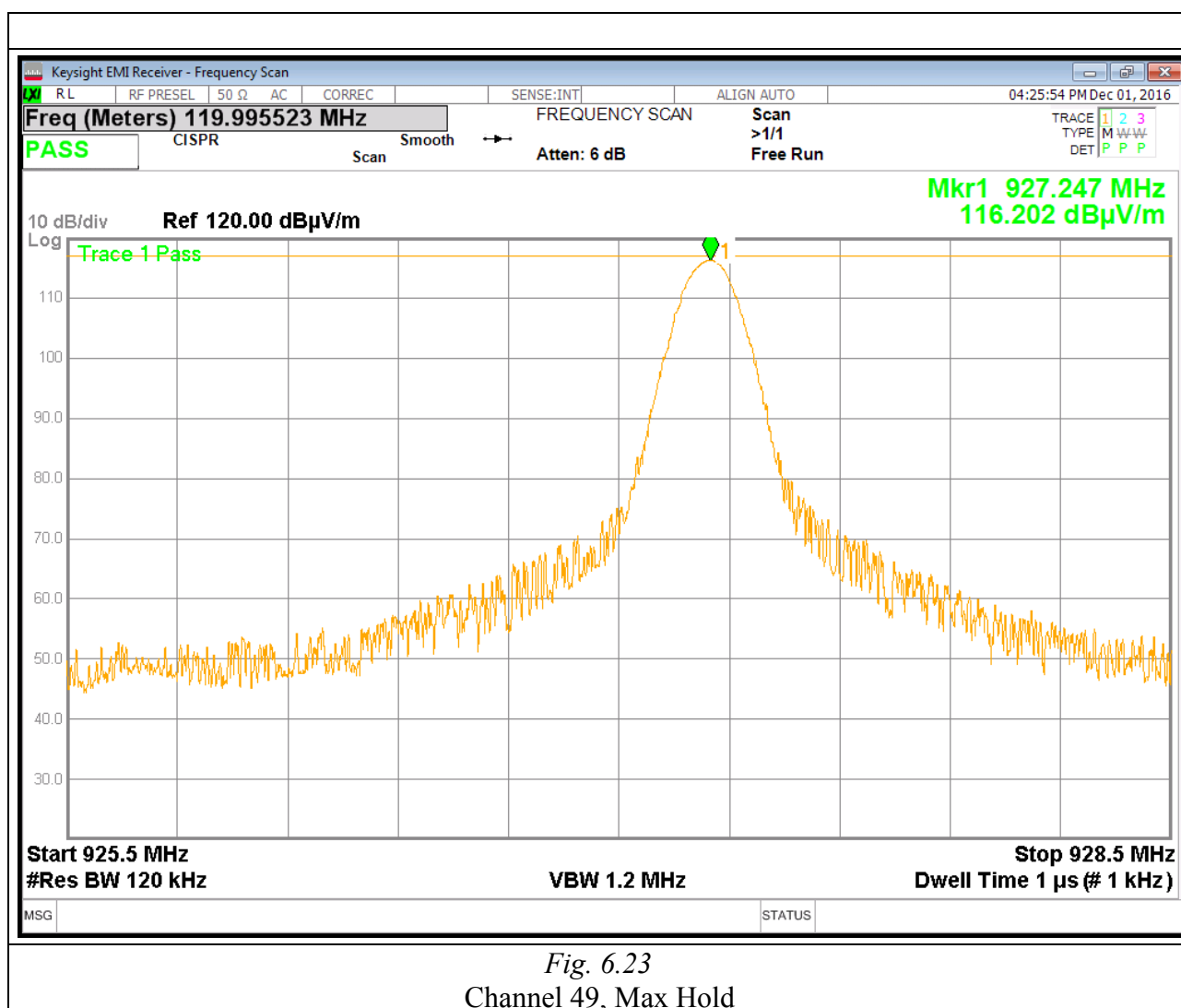
Measurement

The measured values are:

<i>CHANNEL</i>	Field @ 3m	Output Power	
	(dBμV/m)	(mW)	(dBm)
0	113.13	37.6	15.75
24	115.39	63.3	18.01
49	116.20	76.3	18.82

The following figures show the acquired graphics.





6.6. *BAND EDGE*

Emissions must be within the band 902-928 MHz.

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

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Measurements

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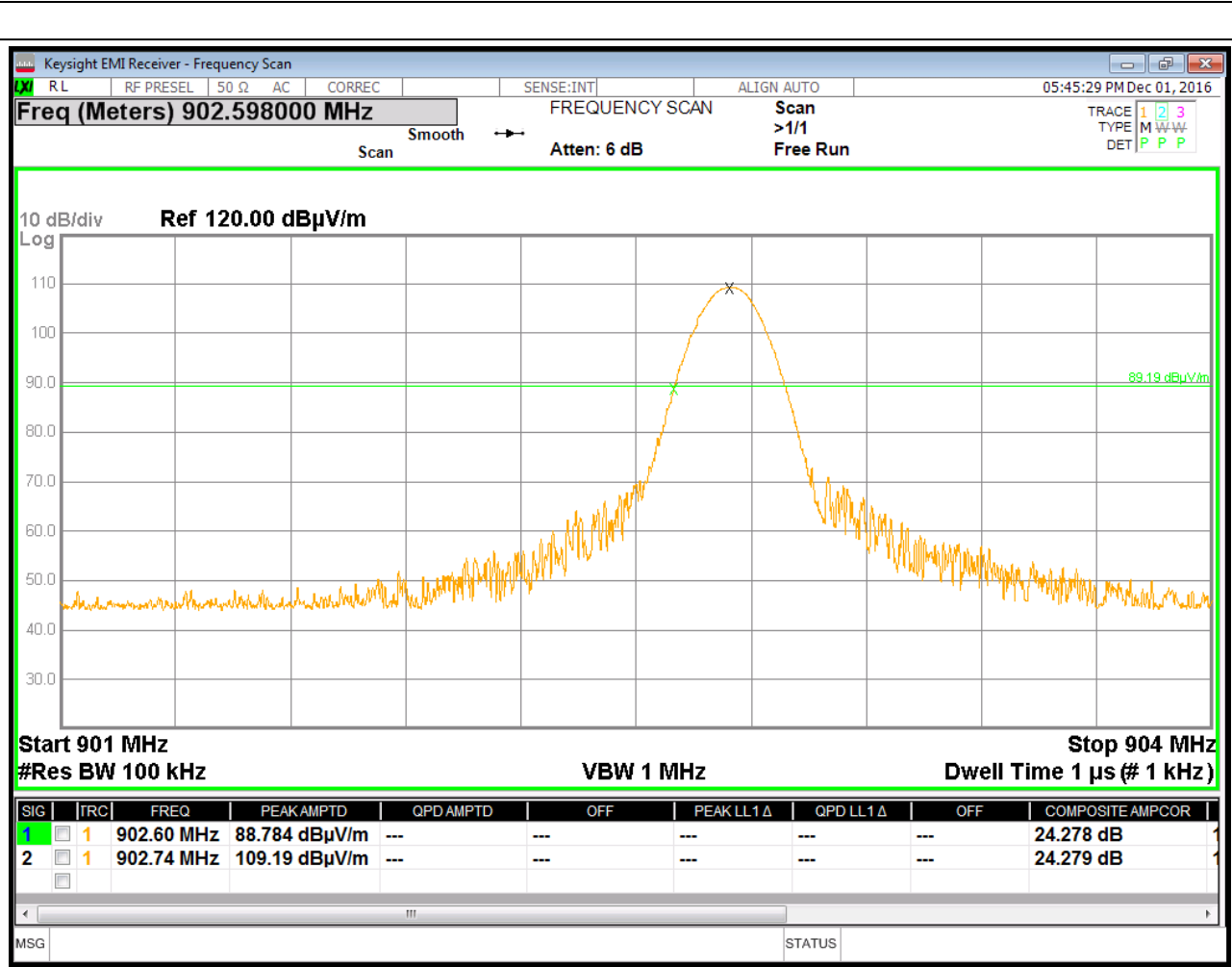


Fig. 6.24
Pol. V
Channel "0" (Ch Low)

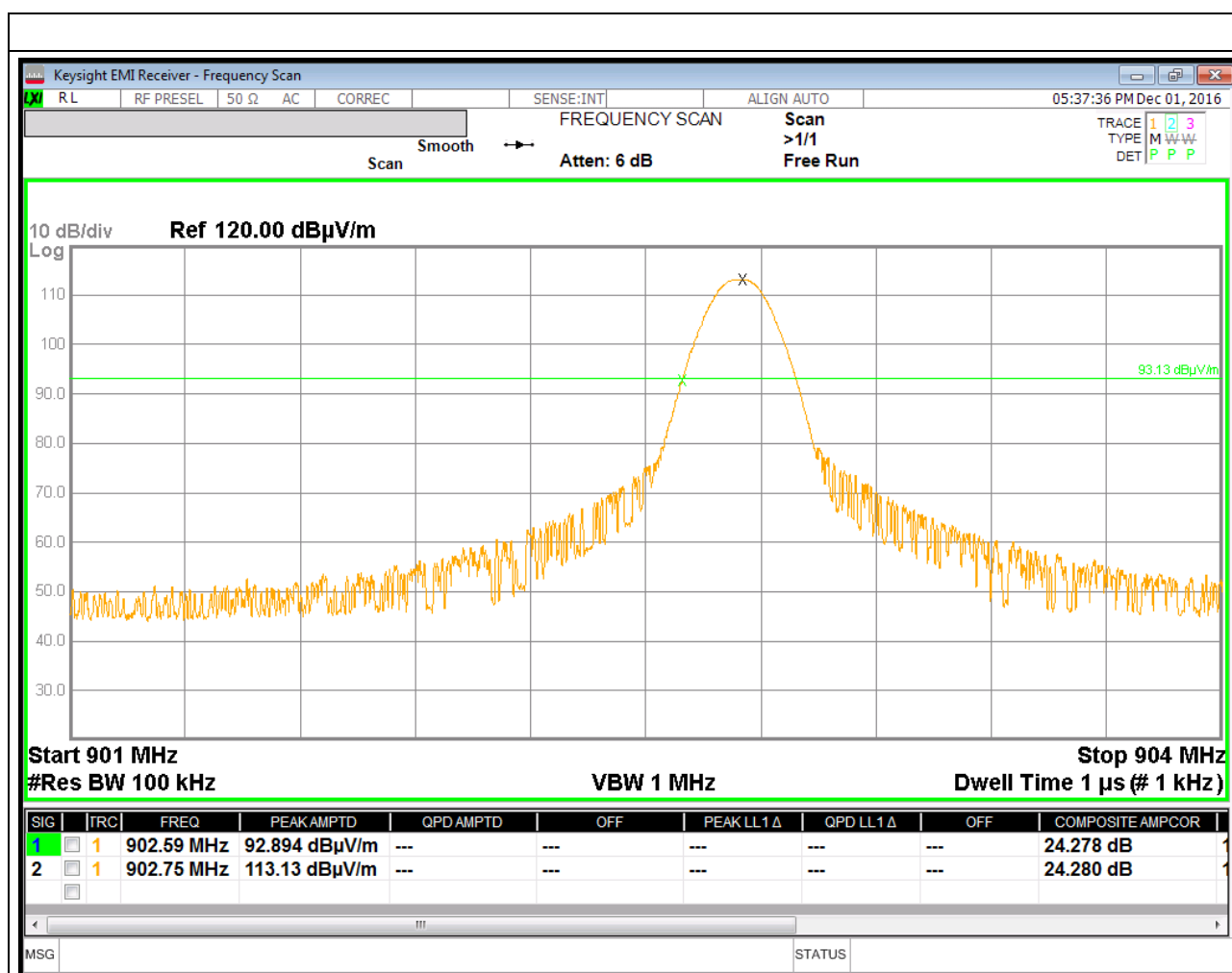


Fig. 6.25
Pol. H
Channel "0" (Ch Low)

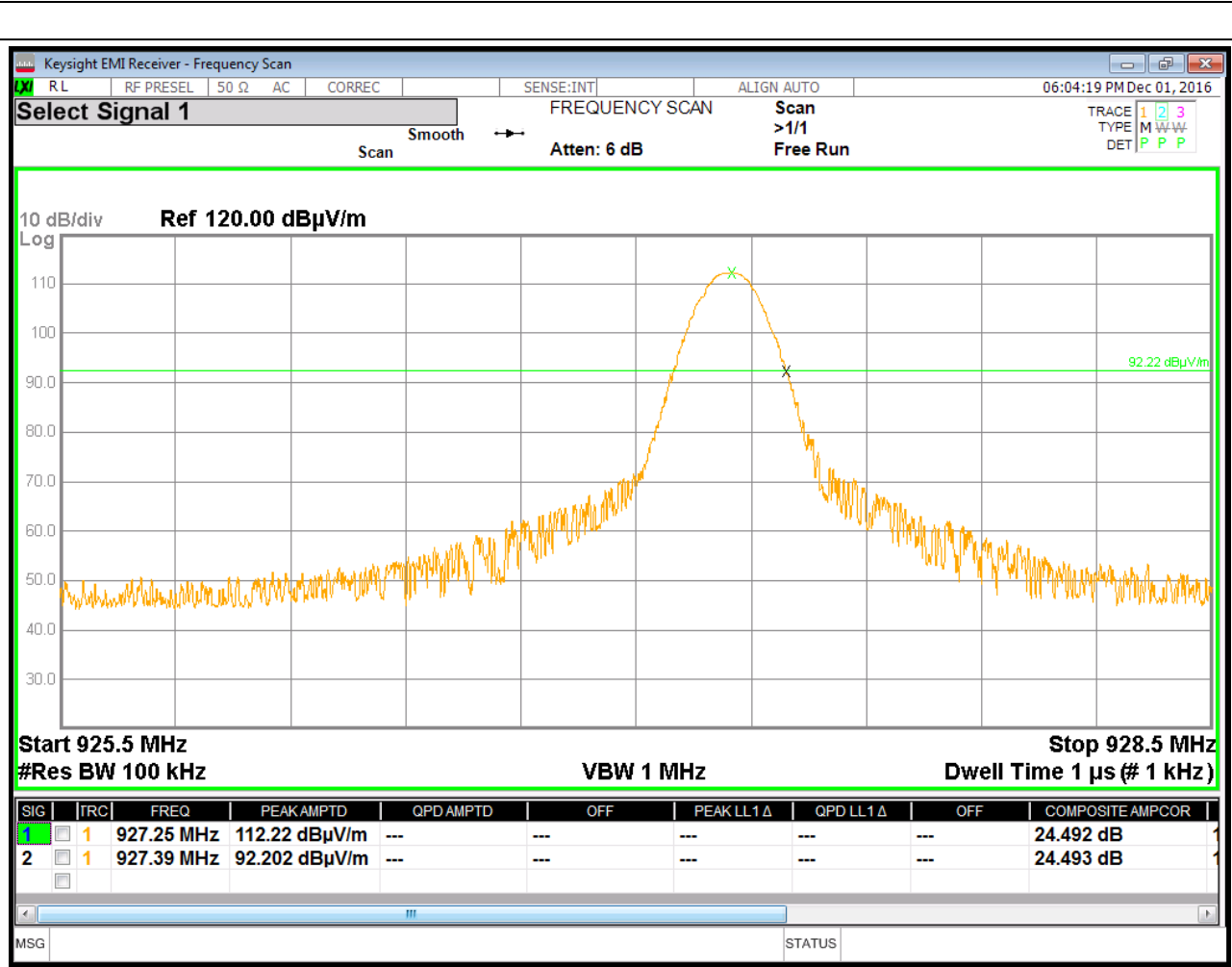


Fig. 6.26
Pol. V
Channel "49" (Ch High)

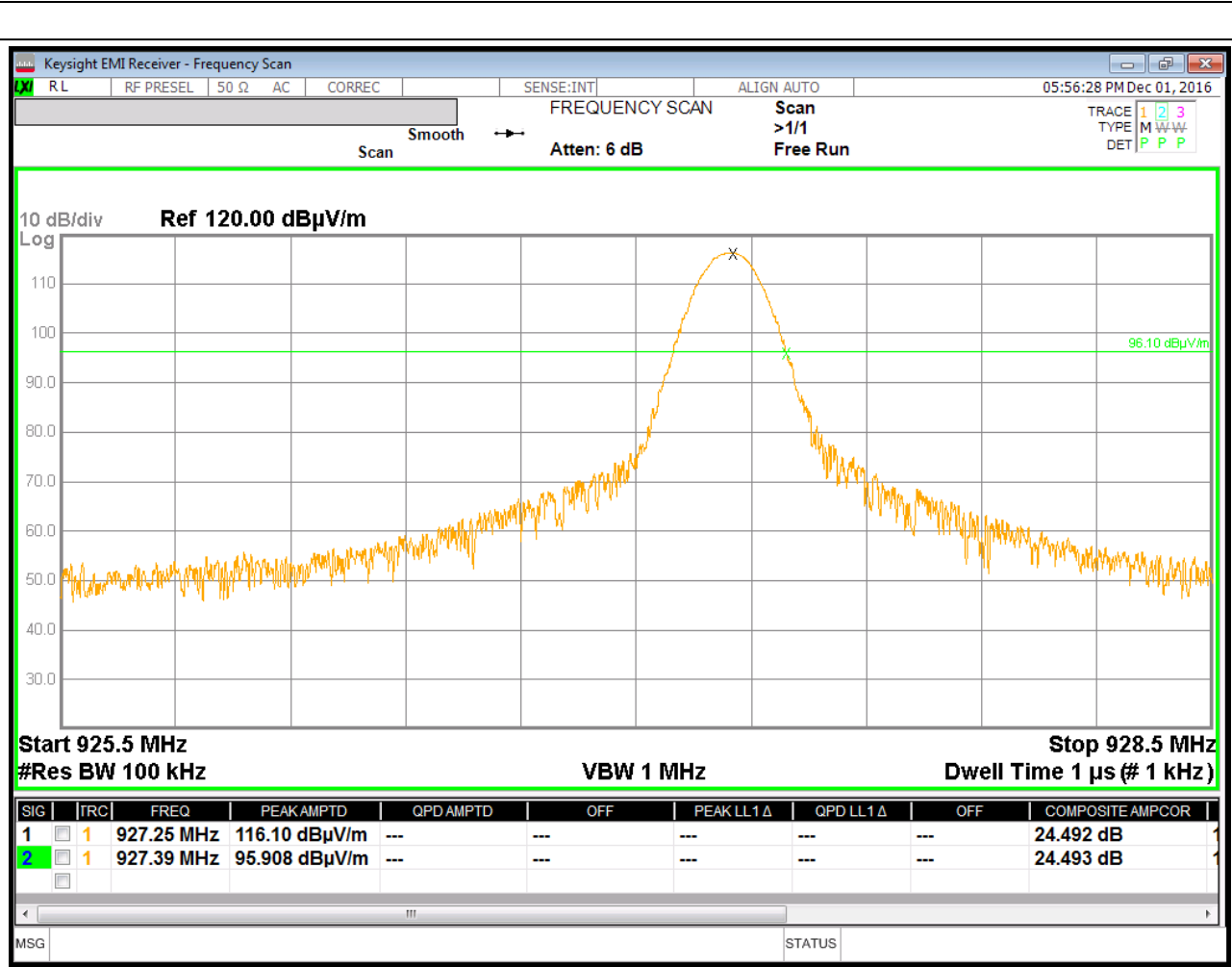


Fig. 6.27
Pol. V
Channel "49" (Ch High)

<u>Test Equipment</u>			
EQUIPMENT	MANUFACTURER	MODEL	CAL. DUE
MXE EMI Receiver	Agilent/Keysight	N9038A	01/2017
EMI Receiver	Agilent	E4440	01/2017
Anechoic Chamber	Comtest	CSA01	01/2017
Bilog Antenna	Schaffner	CBL6112B	01/2017
Horn Antenna	EMCO	3115	01/2017
Controller	Deisel	HD100	01/2017
Turn Table	Deisel	MA240	01/2017
Attenuator	Narda	768-10	01/2017
<u>Test procedure:</u> CT15C01			

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6.7. SPURIOUS RADIATED EMISSIONS

Nr Harmonics	AV Level (dBµV/m)						AV Limits (dBµV/m)	Remark
	Ch 0		Ch 24		Ch 49			
	F (MHz)	(dBµV/m)	F (MHz)	(dBµV/m)	F (MHz)	(dBµV/m)		
2	1805.50	44.3	1829.50	36.7	1854.50	40.6	54.0	
3	2708.25	--	2744.25	--	2781.75	--	54.0	
4	3611.00	30.0	3659.00	30.5	3709.00	--	54.0	
5	4513.75	--	4573.75	--	4636.25	30.0	54.0	
6	5416.50	32.7	5488.50	--	5563.50	--	54.0	
7		--		--		--	54.0	
8		--		--		--	54.0	
9		--		--		--	54.0	
10		--		--		--	54.0	

Note: Levels below 20 dB of limits are indicated with (--).

Nr Harmonics	Peak Level (dBµV/m)						AV Limits (dBµV/m)	Remark
	Ch 0		Ch 24		Ch 49			
	F (MHz)	(dBµV/m)	F (MHz)	(dBµV/m)	F (MHz)	(dBµV/m)		
2	1805.50	--	1829.50	--	1854.50	--	74.0	
3	2708.25	--	2744.25	--	2781.75	--	74.0	
4	3611.00	--	3659.00	--	3709.00	--	74.0	
5	4513.75	--	4573.75	--	4636.25	--	74.0	
6	5416.50	--	5488.50	--	5563.50	--	74.0	
7		--		--		--	74.0	
8		--		--		--	74.0	
9		--		--		--	74.0	
10		--		--		--	74.0	

Note: Levels below 20 dB of limits are indicated with (--).

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<u>Test Equipment</u>			
EQUIPMENT	MANUFACTURER	MODEL	CAL. DUE
EMI Receiver	Agilent	E4440	01/2017
MXE EMI Receiver	Agilent/Keysight	N9038A	01/2017
Anechoic Chamber	Comtest	CSA01	01/2017
Bilog Antenna	Schaffner	CBL6112B	01/2017
Horn Antenna	EMCO	3115	01/2017
Controller	Deisel	HD100	01/2017
Turn Table	Deisel	MA240	01/2017
LISN	GSD	NTW06	01/2017
<u>Test procedure:</u> CT15R01			

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7. PHOTO

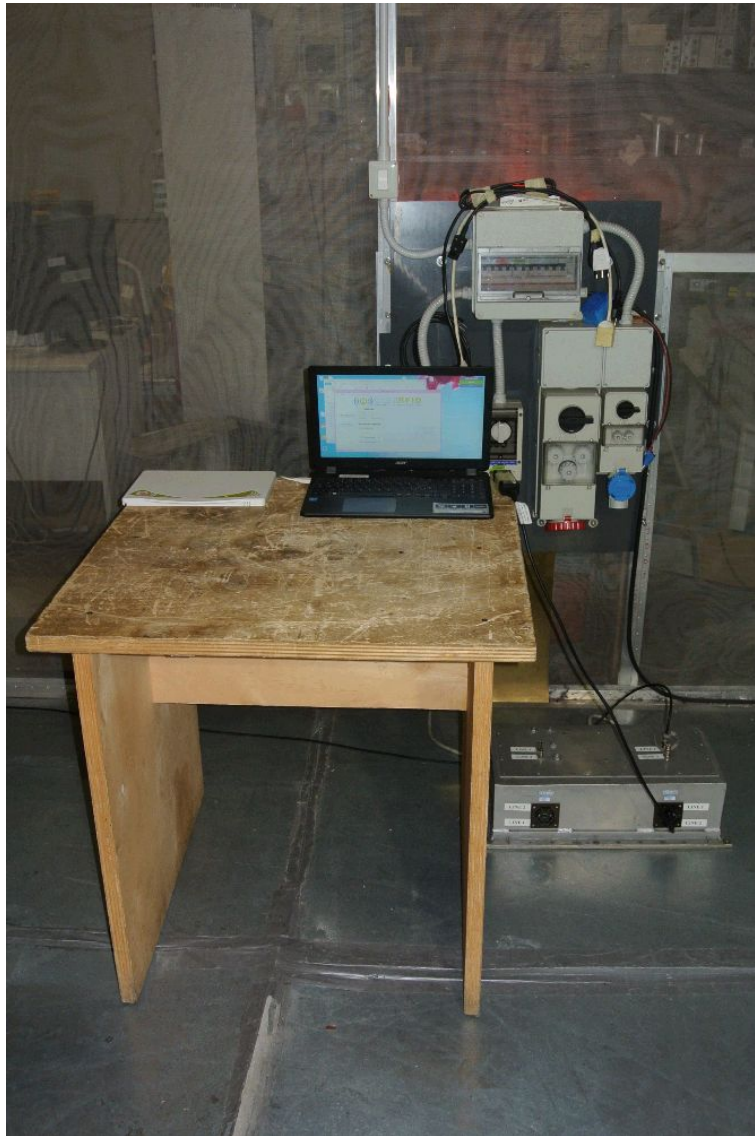


Fig. 7.1
Conducted Emissions Test Set-up



Fig. 7.2

*FCC part 15C Radiated Emissions Test Set-up
Range: 30 – 1000 MHz*



Fig. 7.3

*FCC part 15C Radiated Emissions Test Set-up
Range: 30 – 1000 MHz*



Fig. 7.4

*FCC part 15C Radiated Emissions Test Set-up
Range: 1 – 10 GHz*

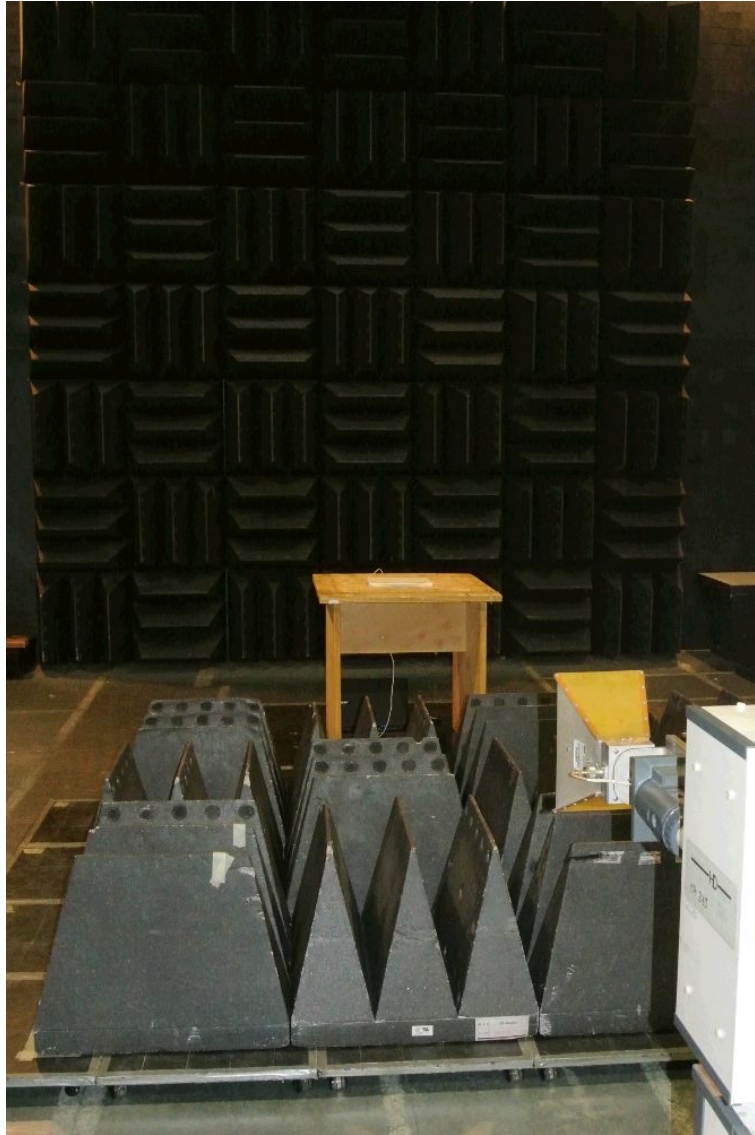


Fig. 7.5

*FCC part 15C Radiated Emissions Test Set-up
Range: 1 – 10 GHz*



Fig. 7.6

*FCC part 15C Radiated Emissions Test Set-up
Range: 9 kHz – 30 MHz*