WIFI MAXIMUM AVERAGE POWER SPECTRAL DENSITY

FCC Rule Part(s)	Standards Doc(s) for FCC Rule Part(s)	IC Rule Part(s)	Standards Docs for IC Rule Part(s)
CFR47 §15.247 (e)	KDB 558074 §10.3 KDB 558074 §10.5	RSS-247 §5.5	Cannot find reference.

WiFi Power Spectral Density Measurements

Each conducted measurement was taken once with the opposite antenna turned off, and once with the opposite antenna also transmitting simultaneously. The measurements are grouped into one block of all measurements taken with the opposite antenna off, and a second block of all measurements with the opposite antenna transmitting simultaneously with the measured antenna.

The maximum measured WiFi Power Spectral Density for both block s of measurements is **-1.44 dBm**. The mode in which this was measured is: 802.11b Ch 6 Ant 1.

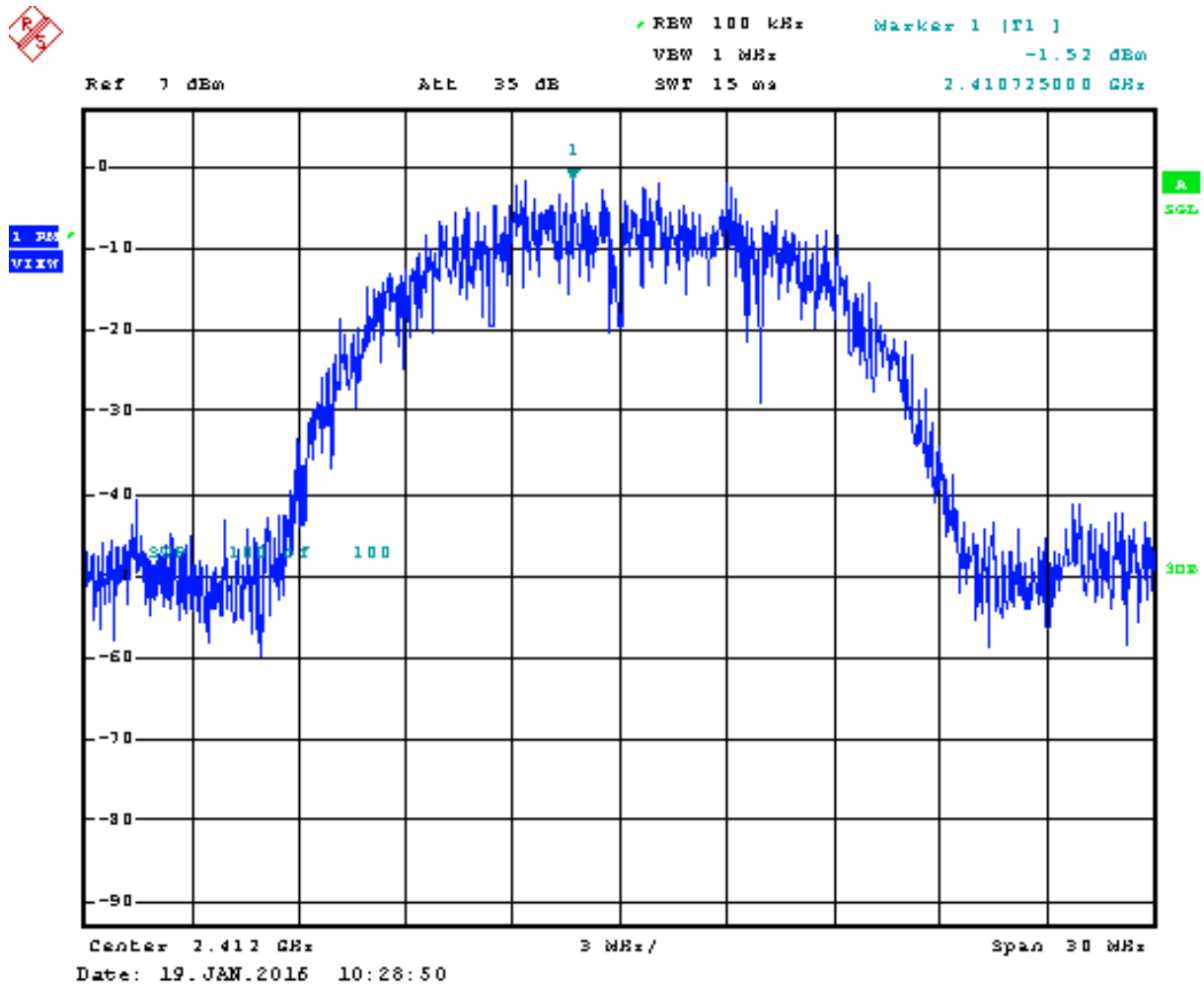
Measurements are shown starting on the next page.

Block 1 – Measurements with Opposite Antenna Off

In Block 1, all measurements are taken for Antenna 1 with Antenna 2 disabled, and vice-versa.

802.11b Operation

802.11b Ch 1 Ant 1:

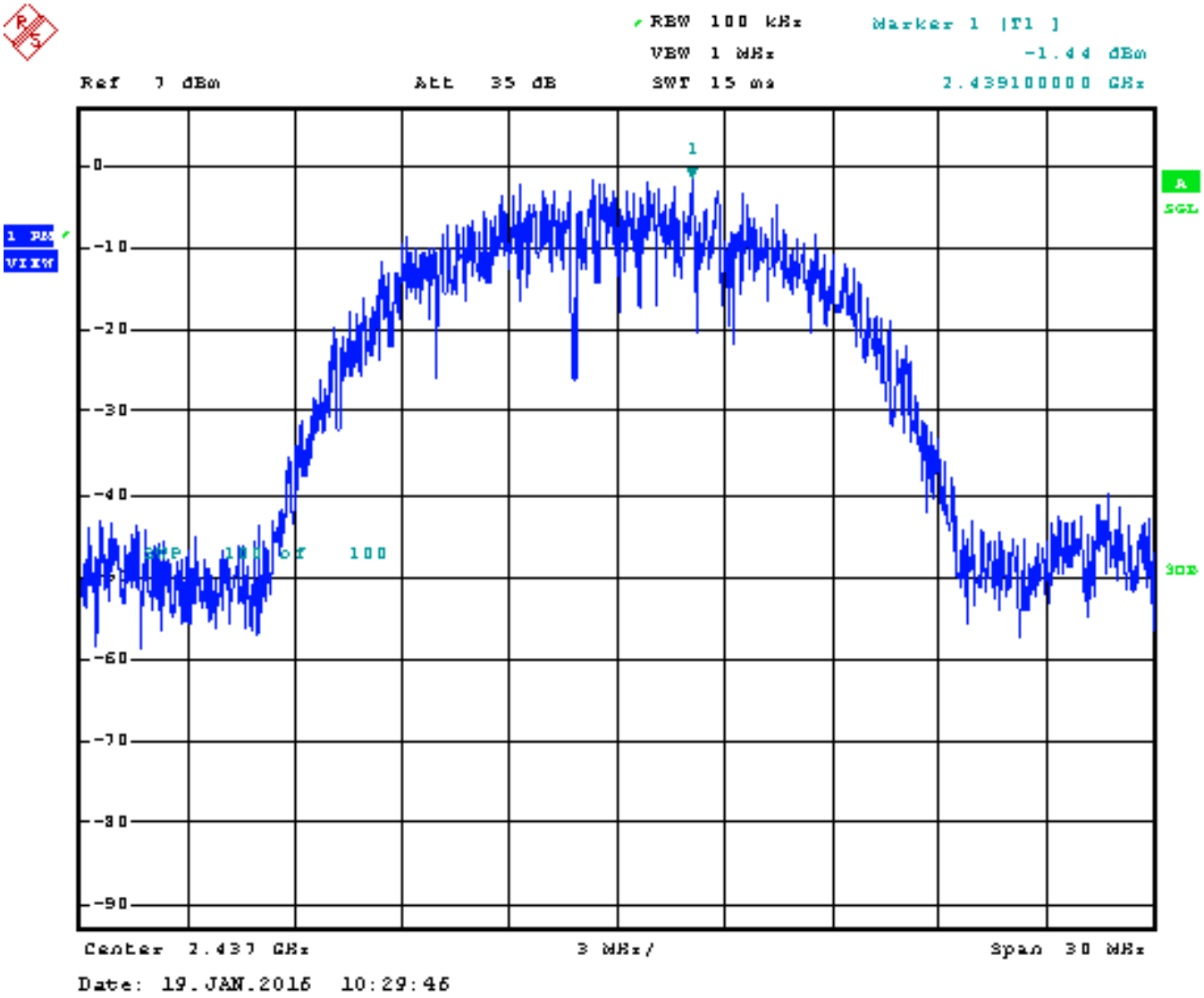


Power: -1.52 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 6 Ant 1:

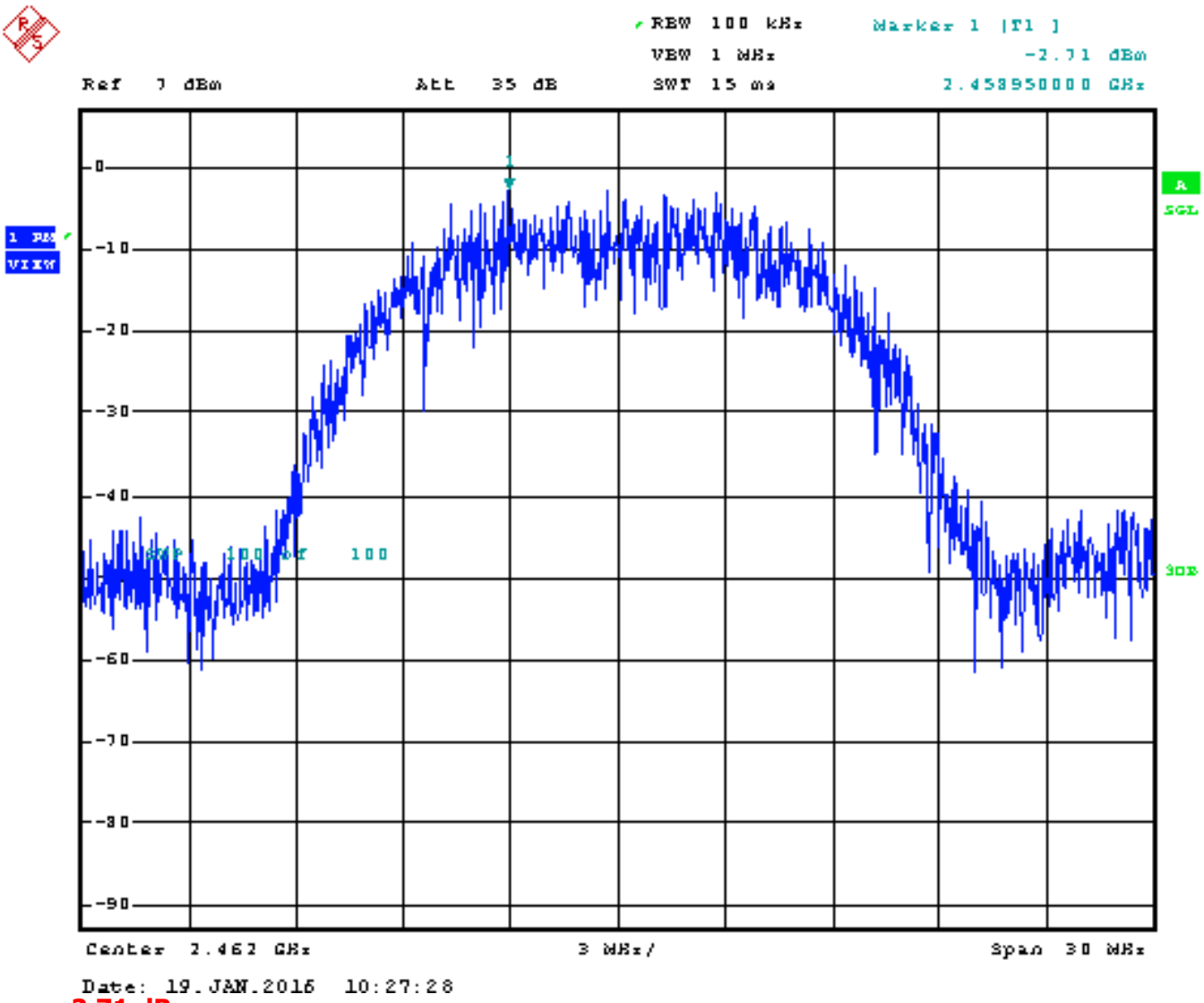


Power: -1.44 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 11 Ant 1:

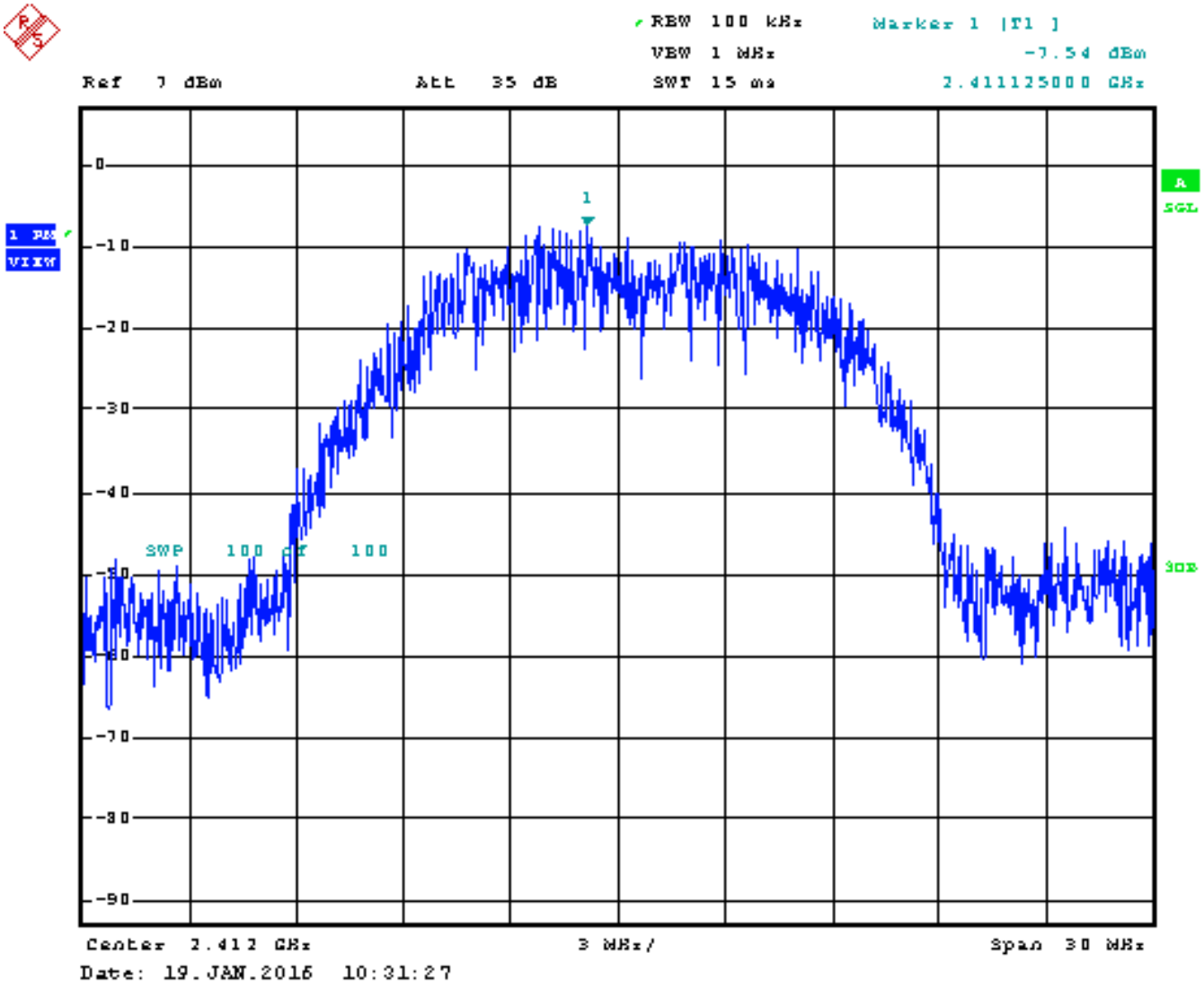


Power: -2.71 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 1 Ant 2:

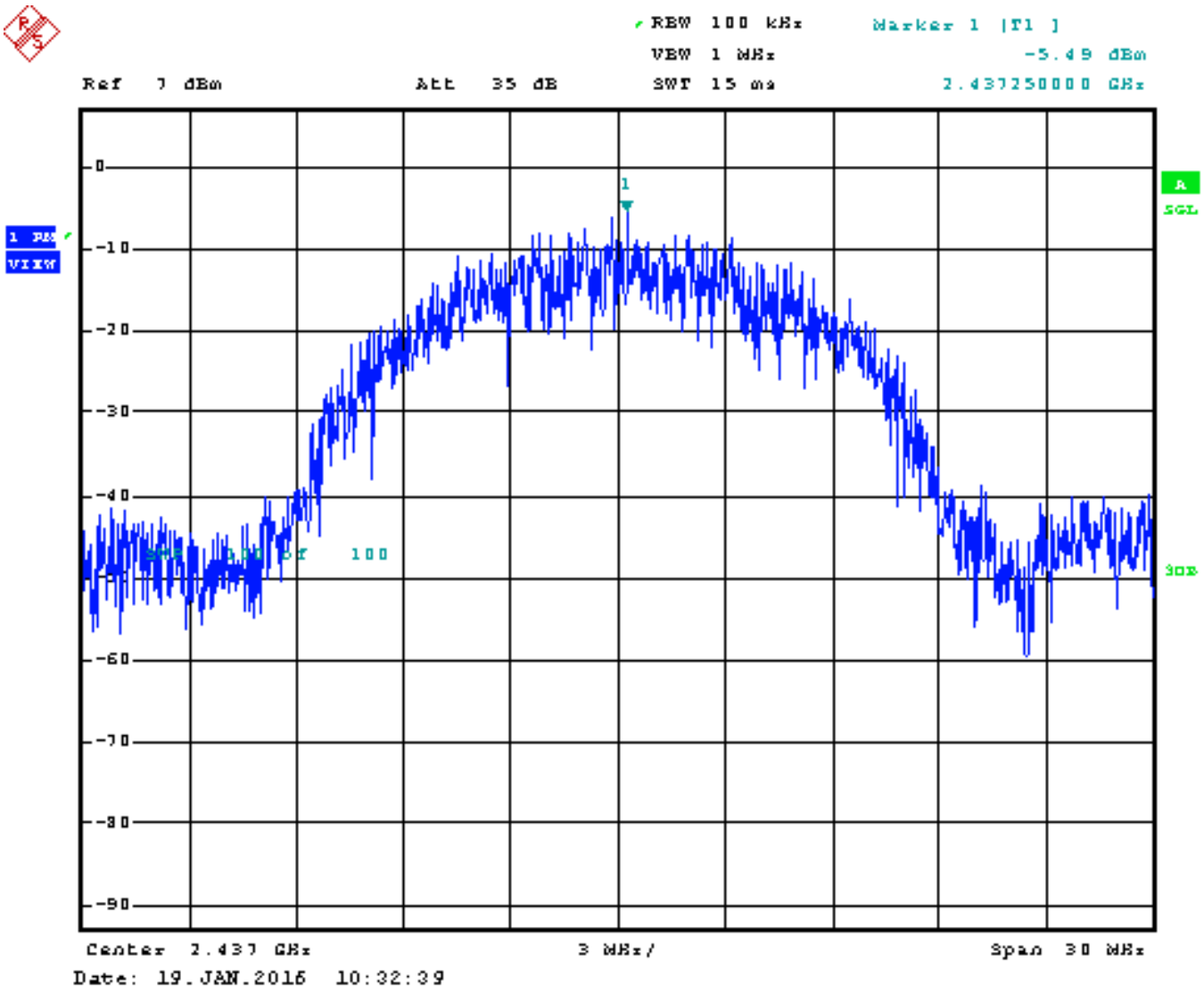


Power: -7.54 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 6 Ant 2:

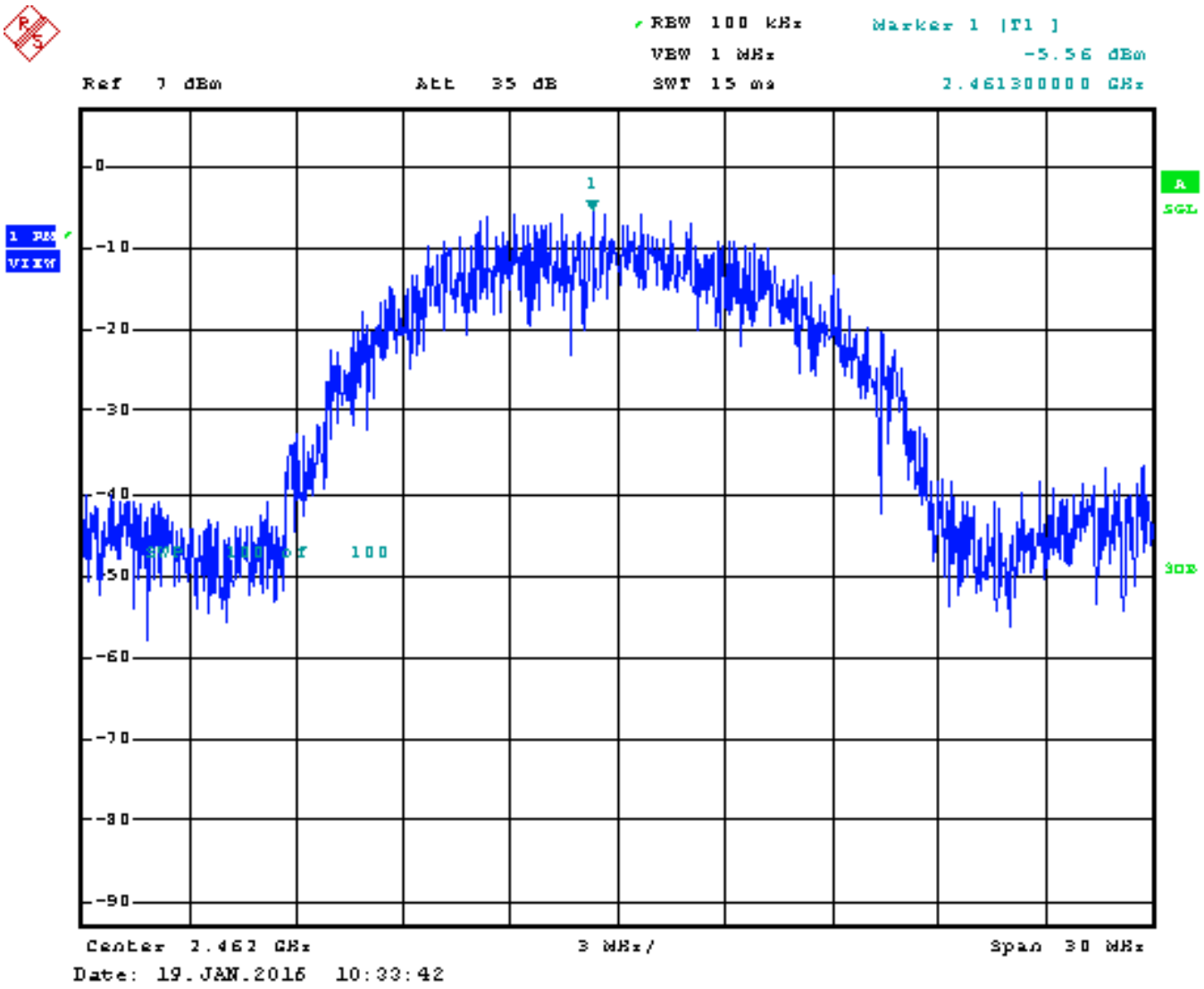


Power: -5.49 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 11 Ant 2:



Power: -5.56 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Operation

For 802.11g operation, the lab report states on page 14, section 7.1 that the WiFi duty cycle for 802.11g is measured to be less than 98%. For the lab report, refer to lab report file "TSSCBASE1 EXHIBIT 5-3C-A FCC AND IC RADIATED EMISSIONS FOR WIFI Part 1 of 2.pdf" and "TSSCBASE1 EXHIBIT 5-3C-A FCC AND IC RADIATED EMISSIONS FOR WIFI Part 2 of 2.pdf". A copy of the duty cycle from this section is pasted below. Therefore KDB 558734, section 10.5 is followed for 802.11g operation. Section 10.5 describes "Method AVGPSD-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction)." This section permits the duty cycle correction factor to be added to the measured average power.

7.1. ON TIME AND DUTY CYCLE

LIMITS

None, for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

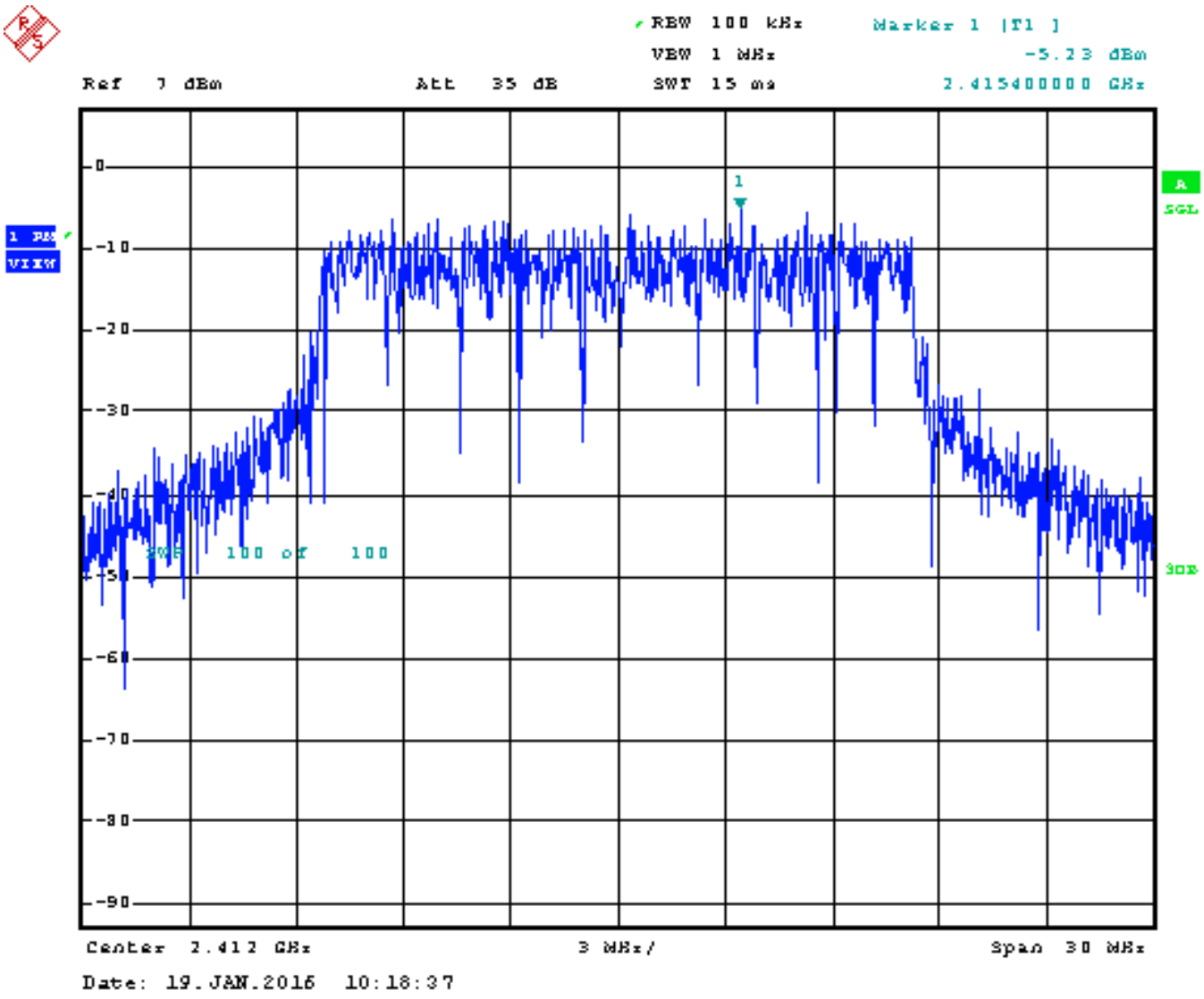
ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
802.11b (ANTENNA 1)	1.889	1.903	0.993	99.26%	0.00	0.010
802.11b (ANTENNA 2)	1.888	1.904	0.992	99.16%	0.00	0.010
802.11g (ANTENNA 1)	0.800	0.821	0.975	97.51%	0.11	1.250
802.11g (ANTENNA 2)	0.800	0.821	0.975	97.54%	0.11	1.249
802.11n HT20 (ANTENNA 1)	2.912	2.933	0.993	99.28%	0.00	0.010
802.11n HT20 (ANTENNA 2)	2.912	2.933	0.993	99.28%	0.00	0.010

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 1 Ant 1:

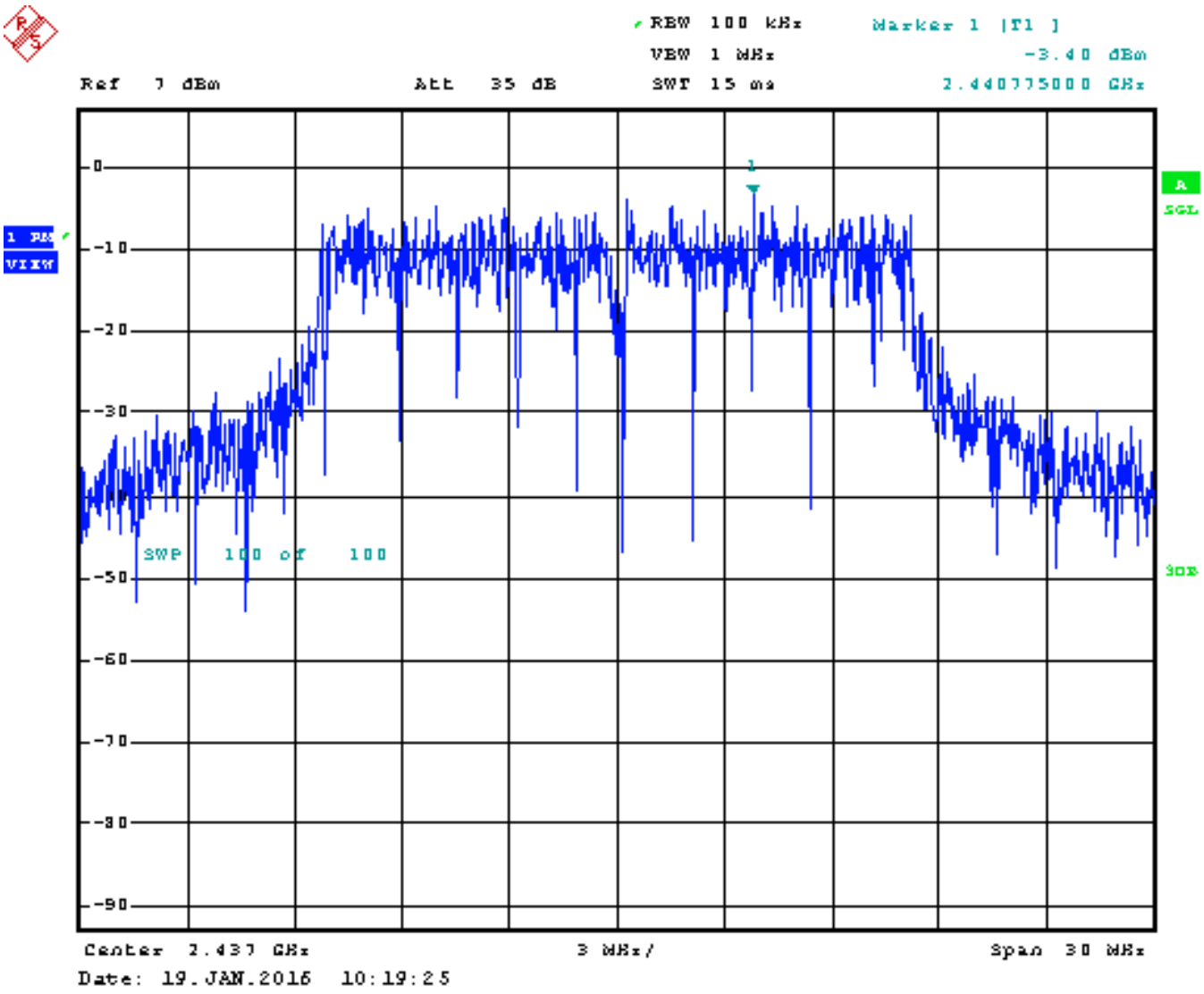


Measured Power: -5.23 dBm
Actual Power: =-5.23 dBm (measured) + 0.11 dBi (duty correction)
=**-5.12 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 6 Ant 1:

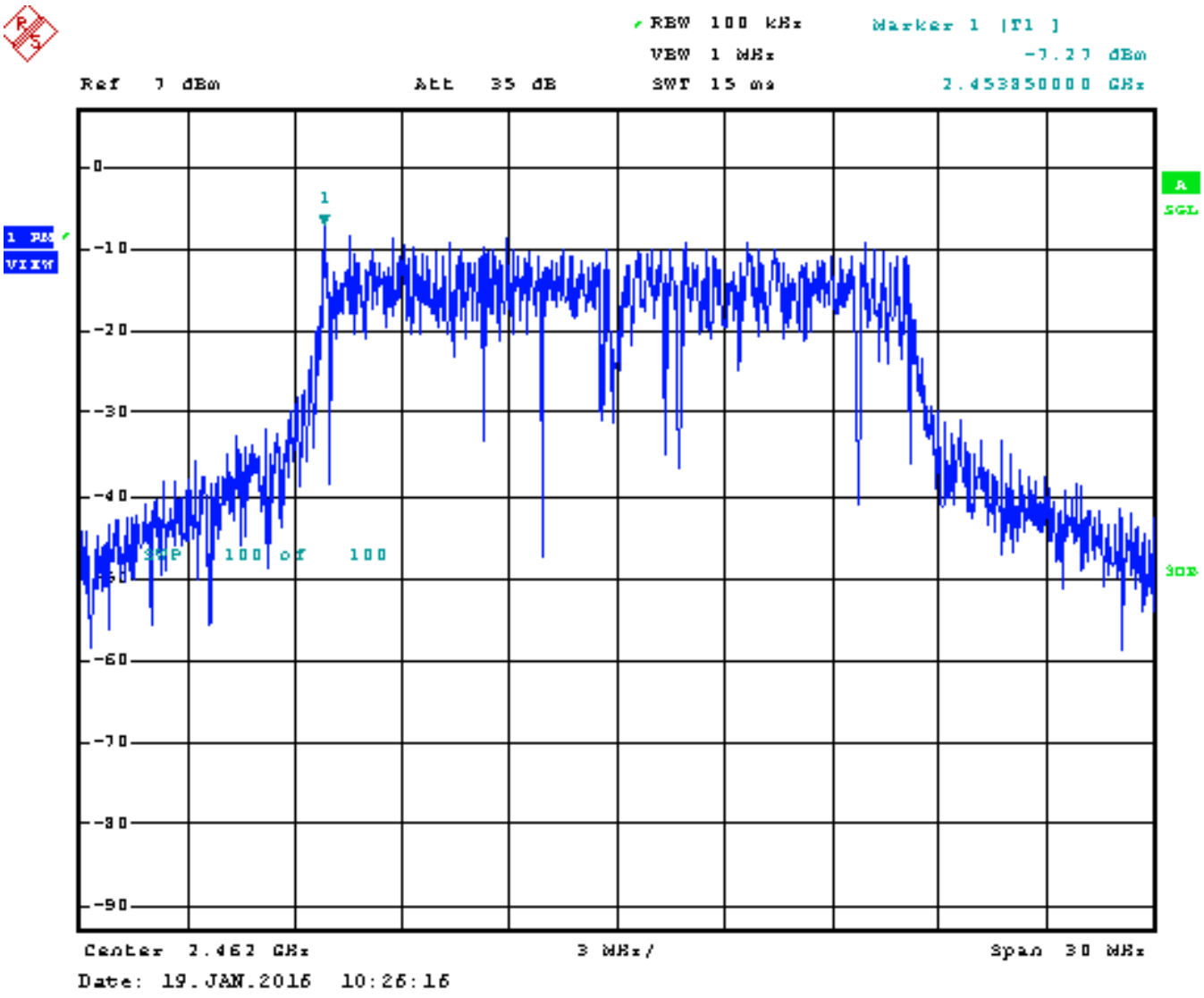


Measured Power: -3.40 dBm
Actual Power: =-3.40 dBm (measured) + 0.11 dBi (duty correction)
=**-3.29 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 11 Ant 1:

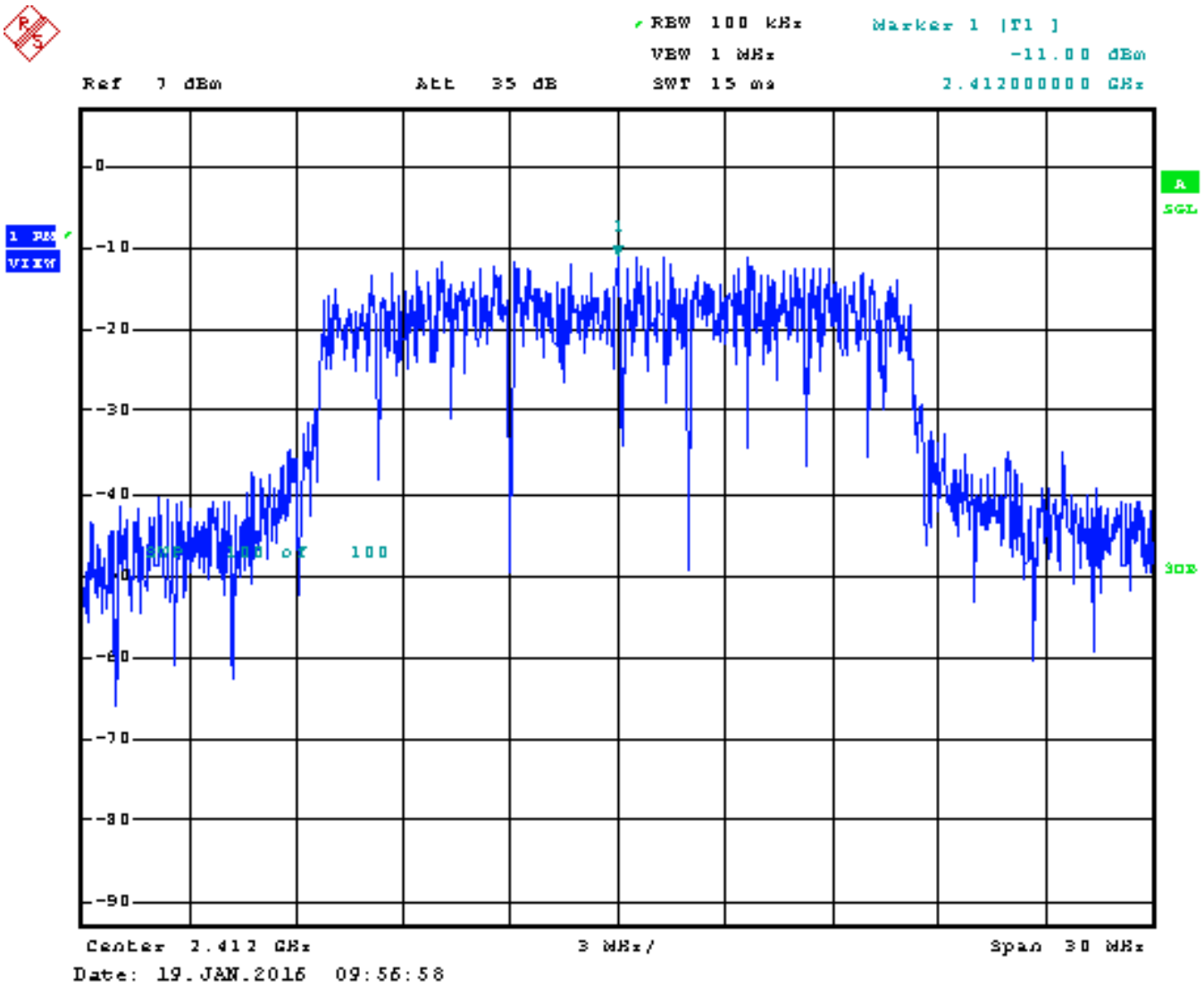


Measured Power: -7.27 dBm
Actual Power: =-7.27 dBm (measured) + 0.11 dBi (duty correction)
=**-7.16 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 1 Ant 2:

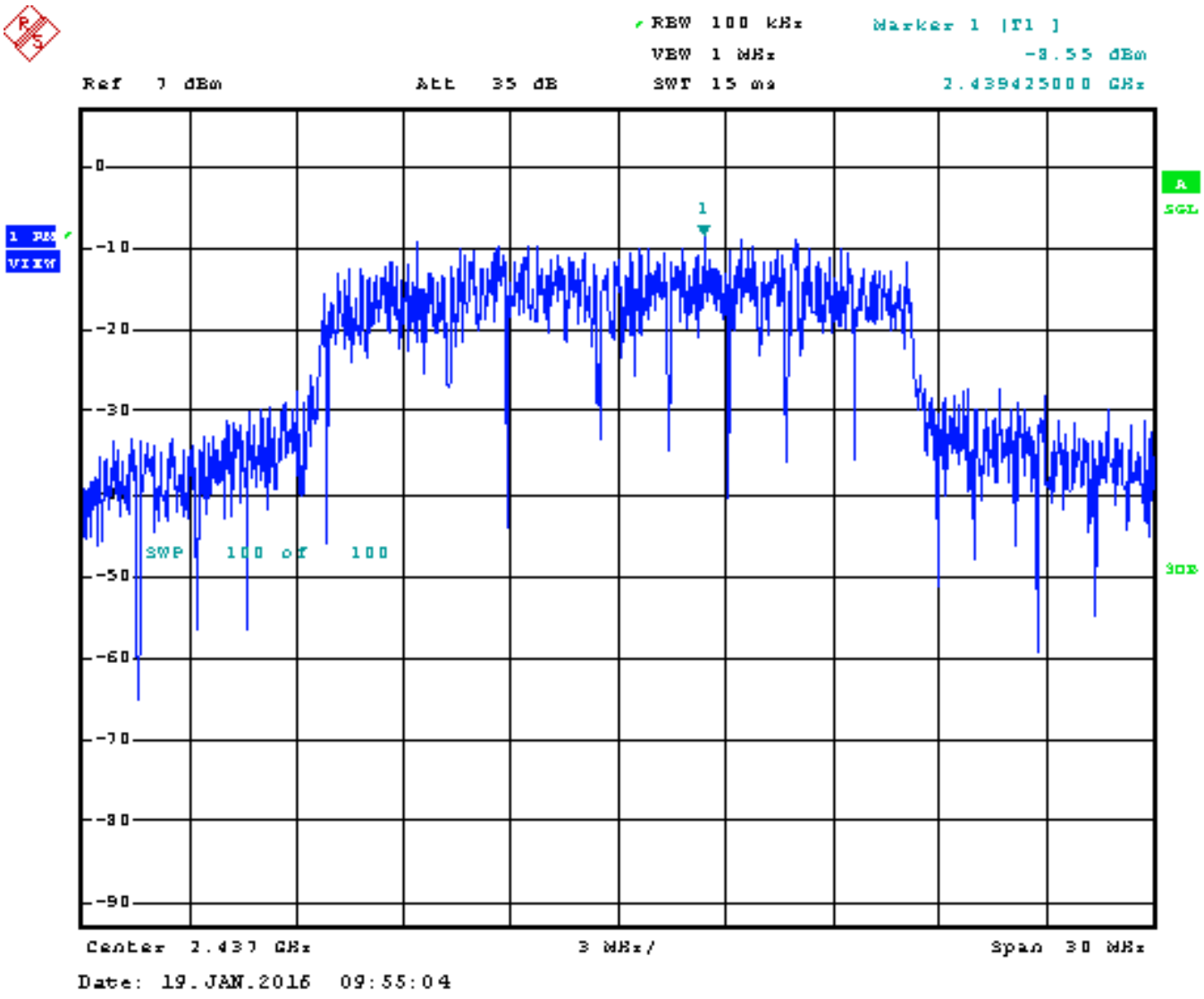


Measured Power: -11.00 dBm
Actual Power: =-11.00 dBm (measured) + 0.11 dBi (duty correction)
=**-10.89 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 6 Ant 2:

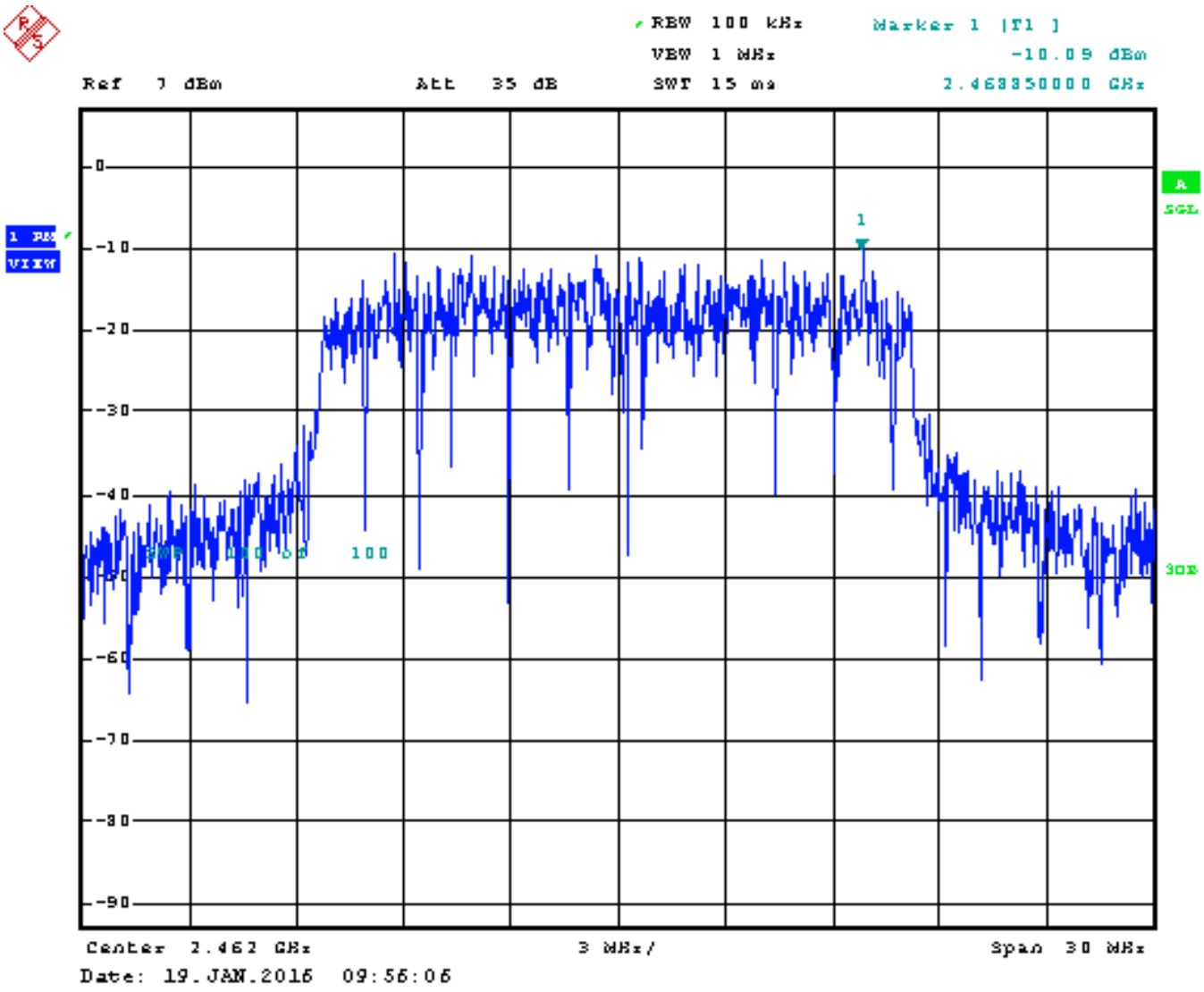


Measured Power: -8.55 dBm
Actual Power: =-8.55 dBm (measured) + 0.11 dBi (duty correction)
=**-8.44 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 11 Ant 2:



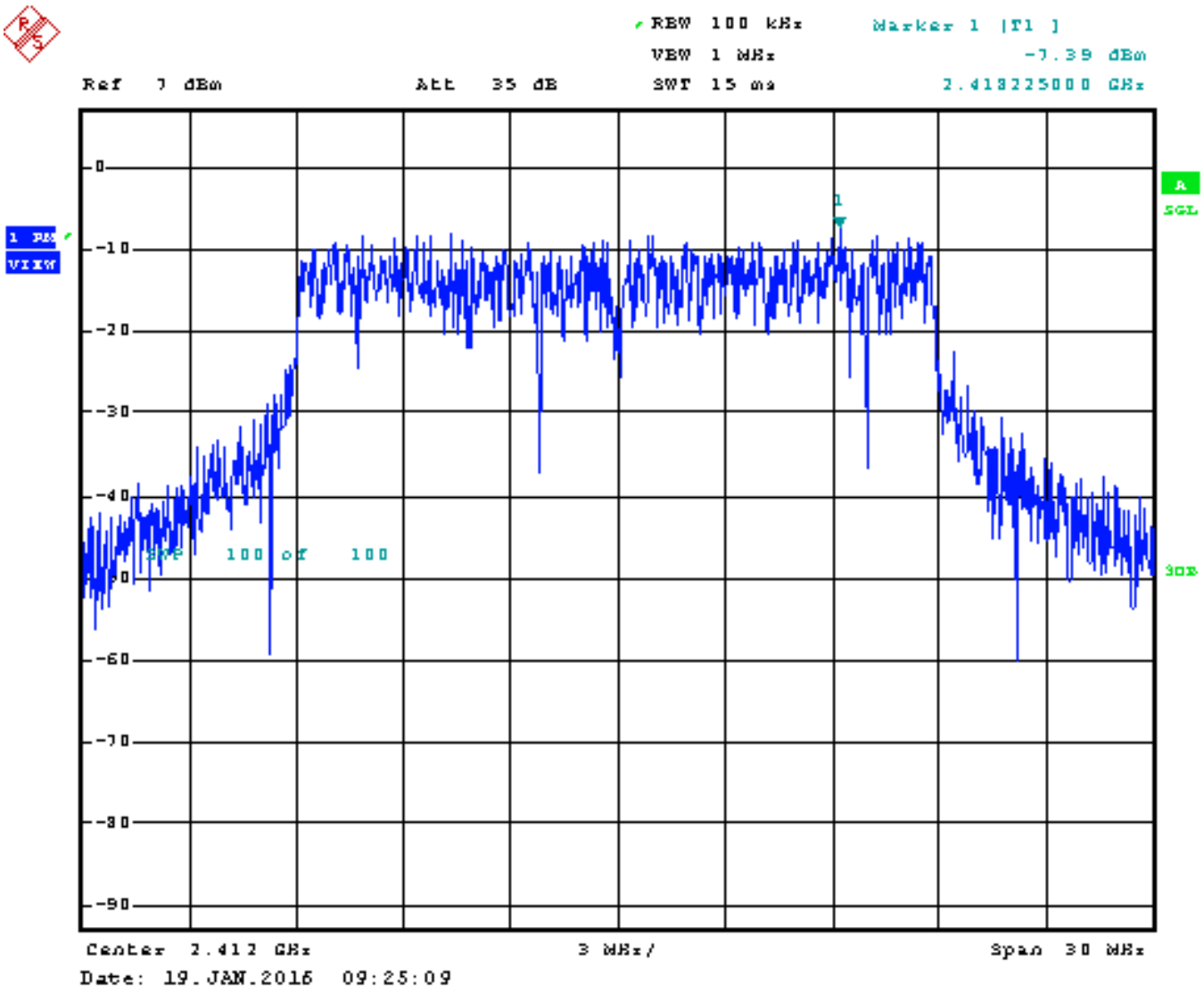
Measured Power: -10.09 dBm
Actual Power: =-10.09 dBm (measured) + 0.11 dBi (duty correction)
=**-9.98 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Measurements:

802.11n Ch 1 Ant 1:

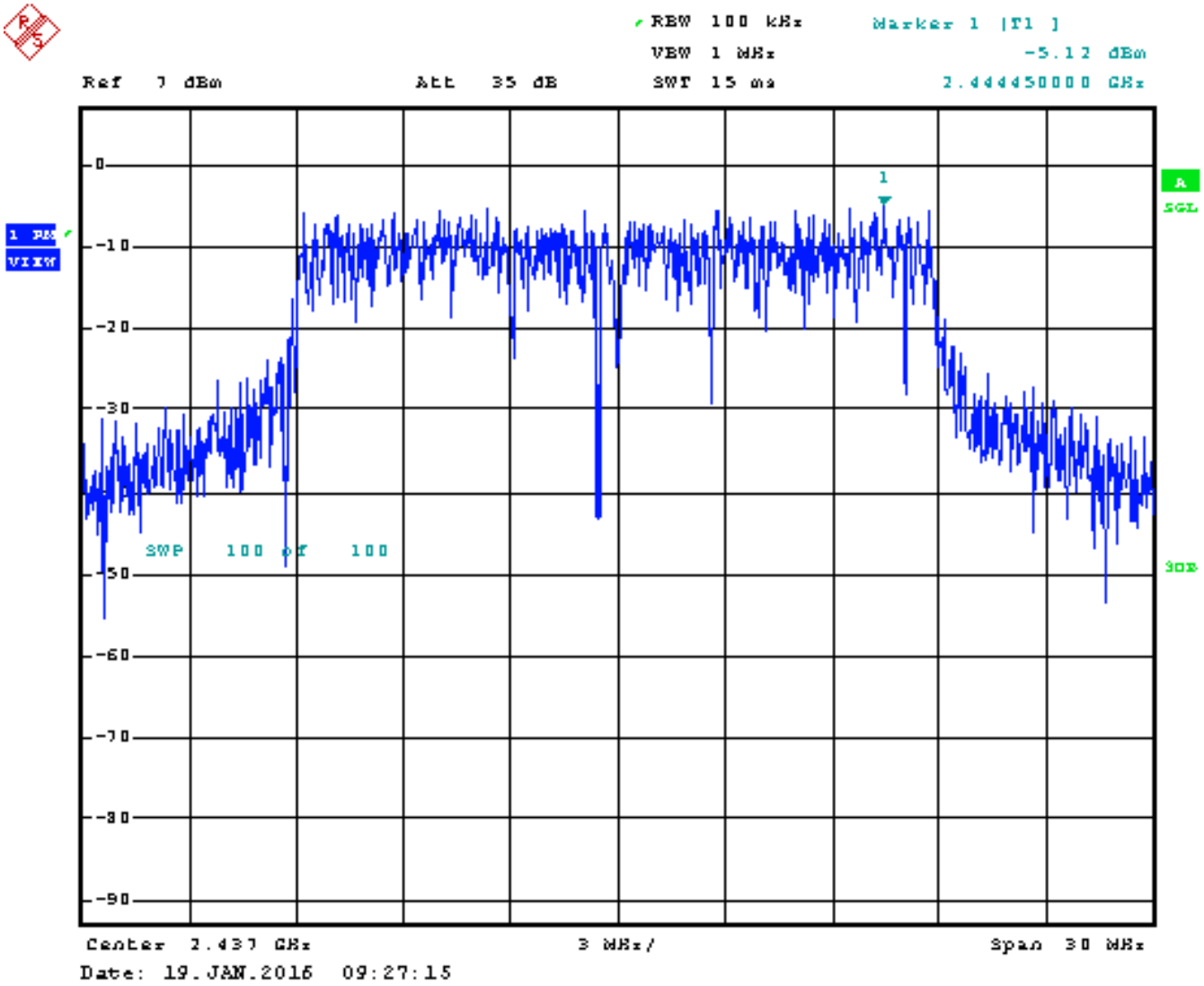


Power: -7.39 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 6 Ant 1:

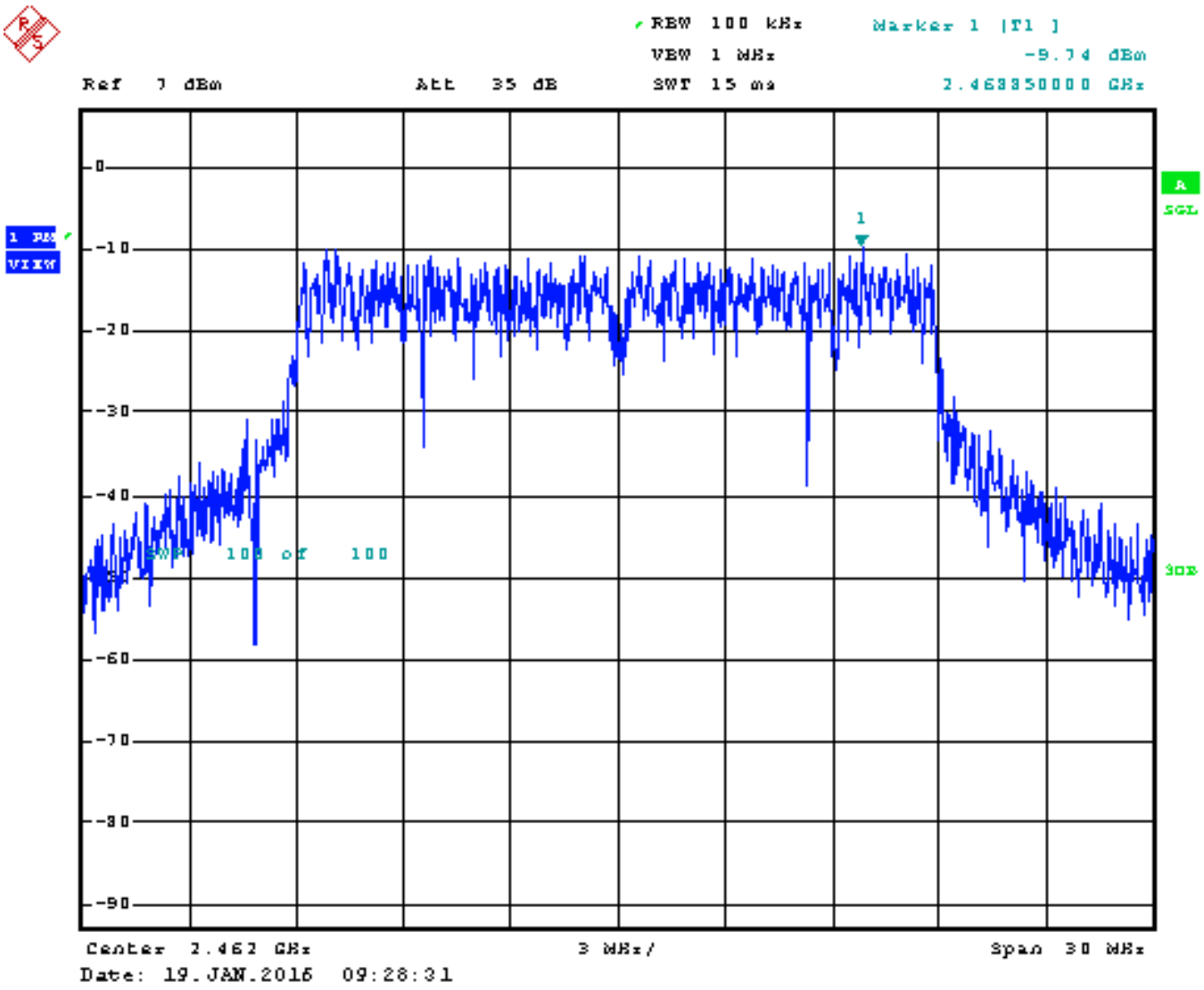


Power: -5.12 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 11 Ant 1:

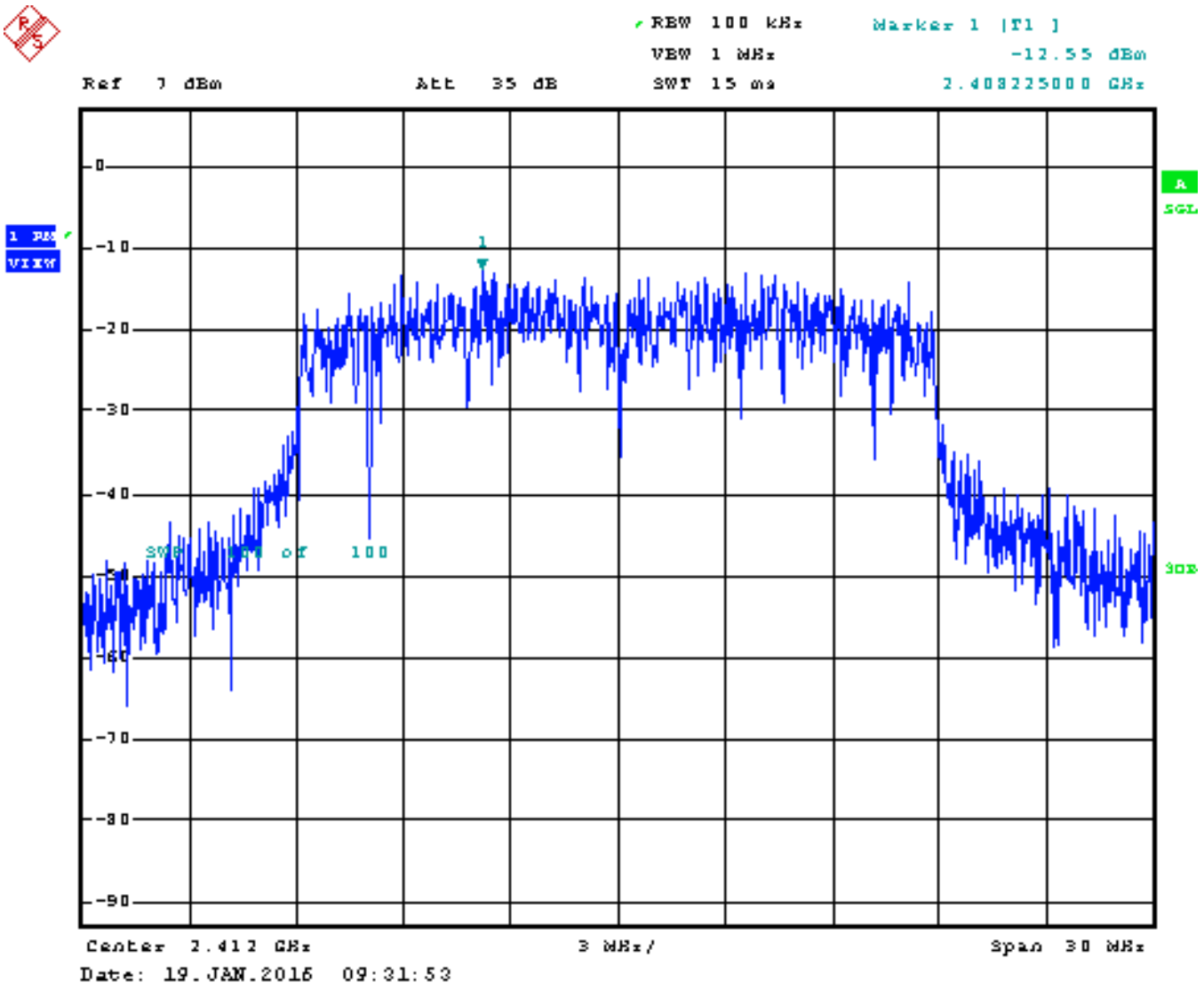


Power: -9.74 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 1 Ant 2:

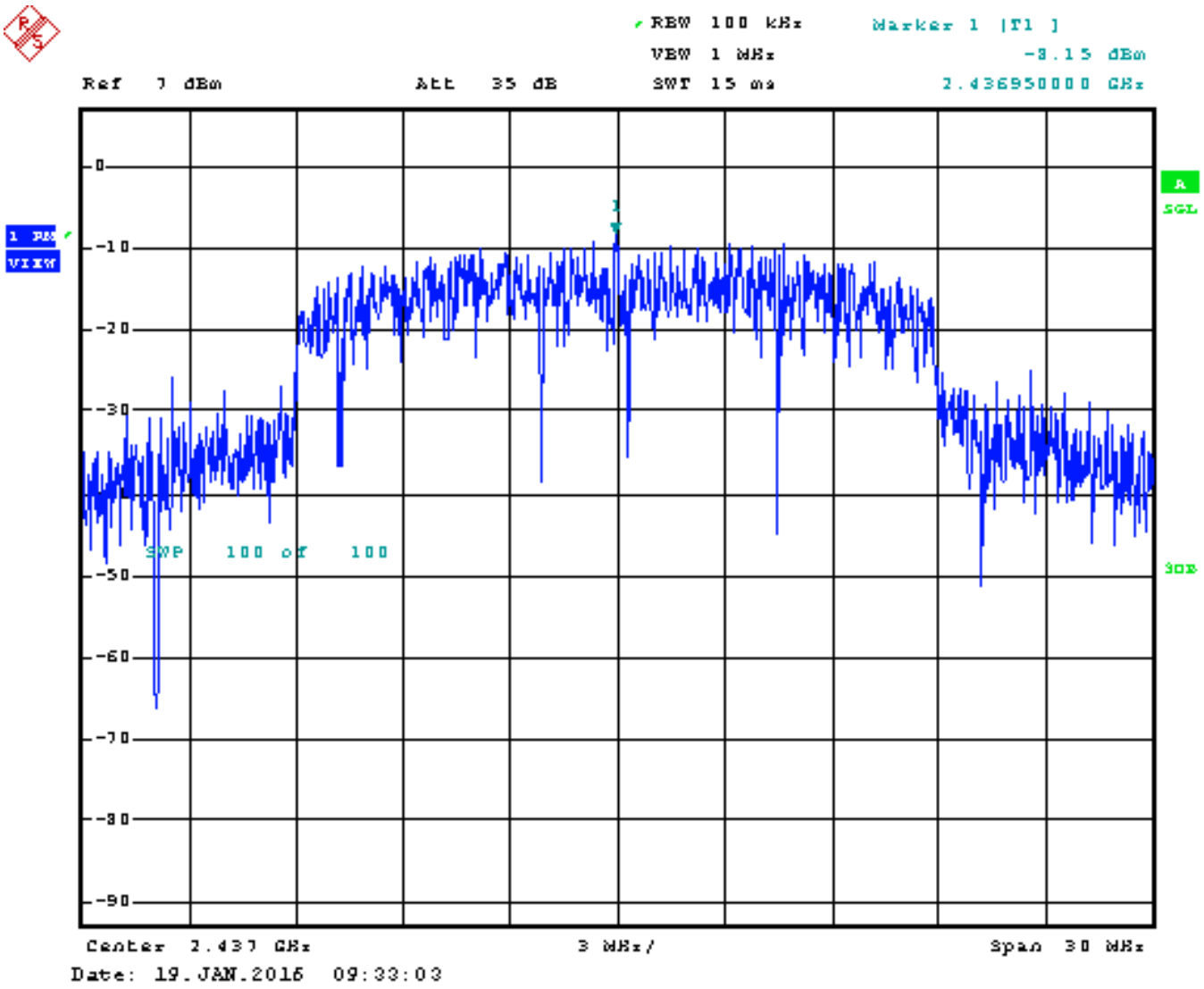


Power: -12.55 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 6 Ant 2:

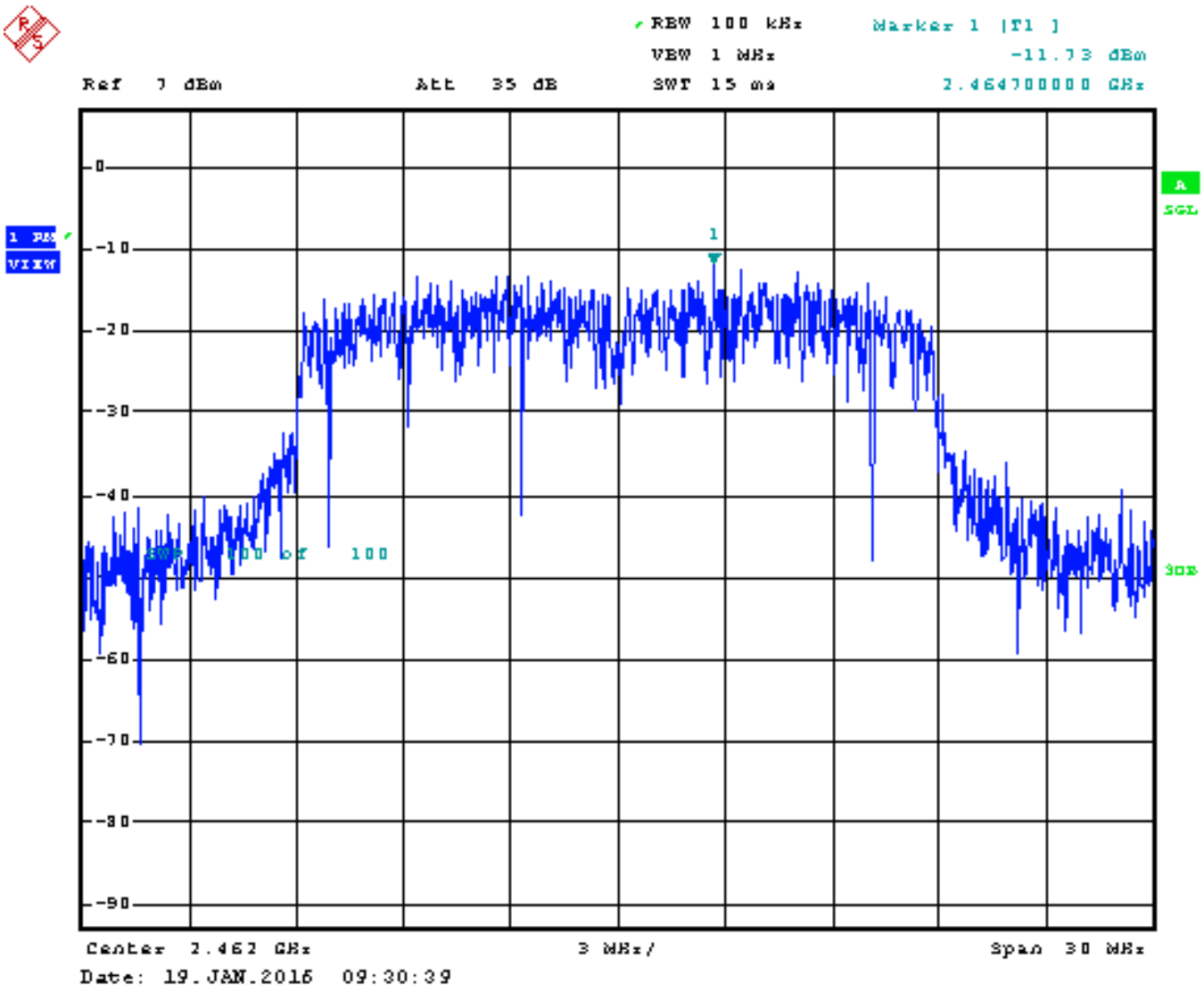


Power: -8.15 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 11 Ant 2:



Power: -11.73 dBm

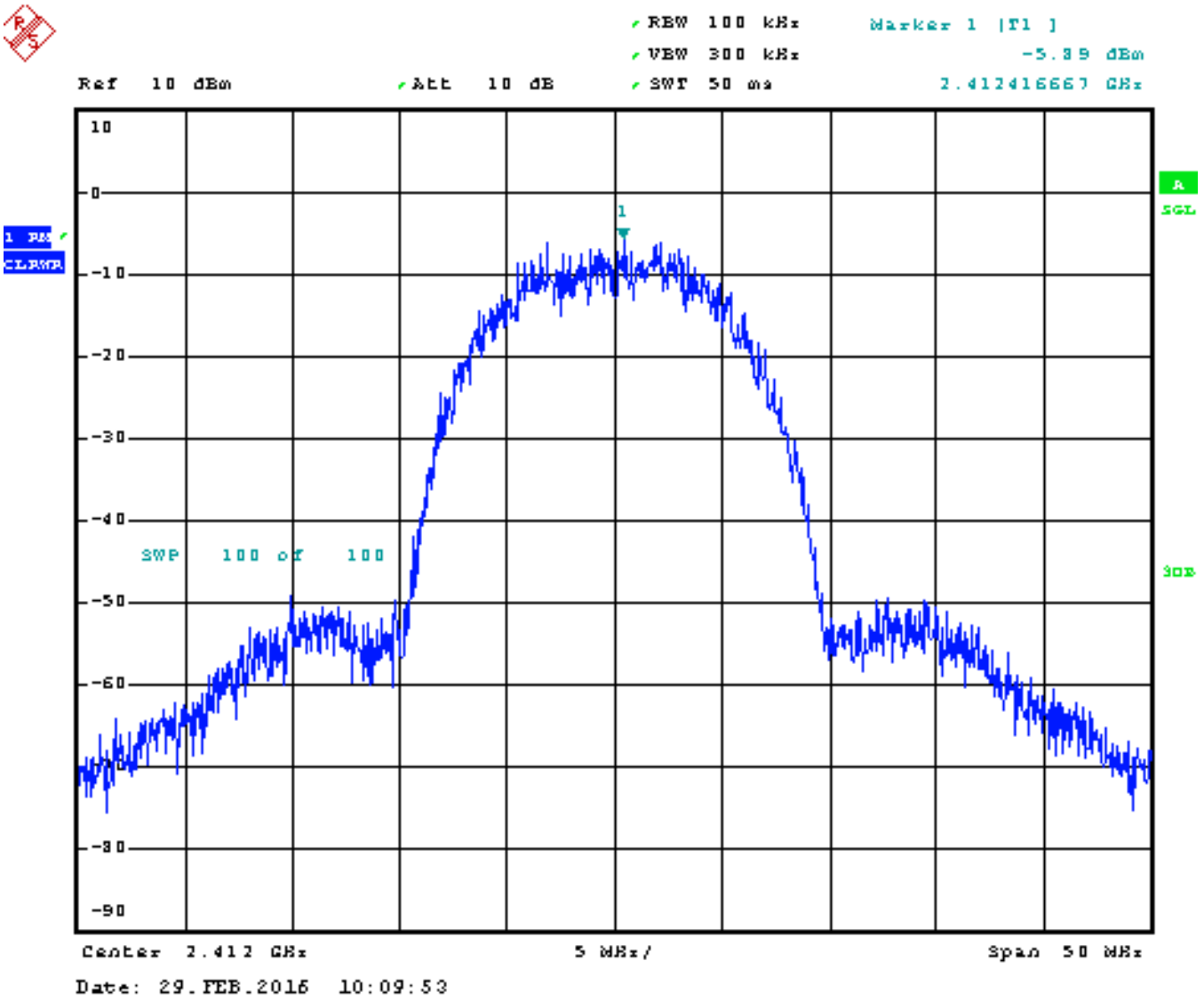
MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

Block 2 – Measurements with Opposite Antenna On

- In Block 2, all measurements for Antenna 1 are taken with Antenna 2 also transmitting, and vice-versa.
- For 802.11g measurements, a duty factor of 0.11 dB is applied per **KDB 558074 §10.5**. More information is given in the '802.11g Operation' section below.

802.11b Operation

802.11b Ch 1 Ant 1:

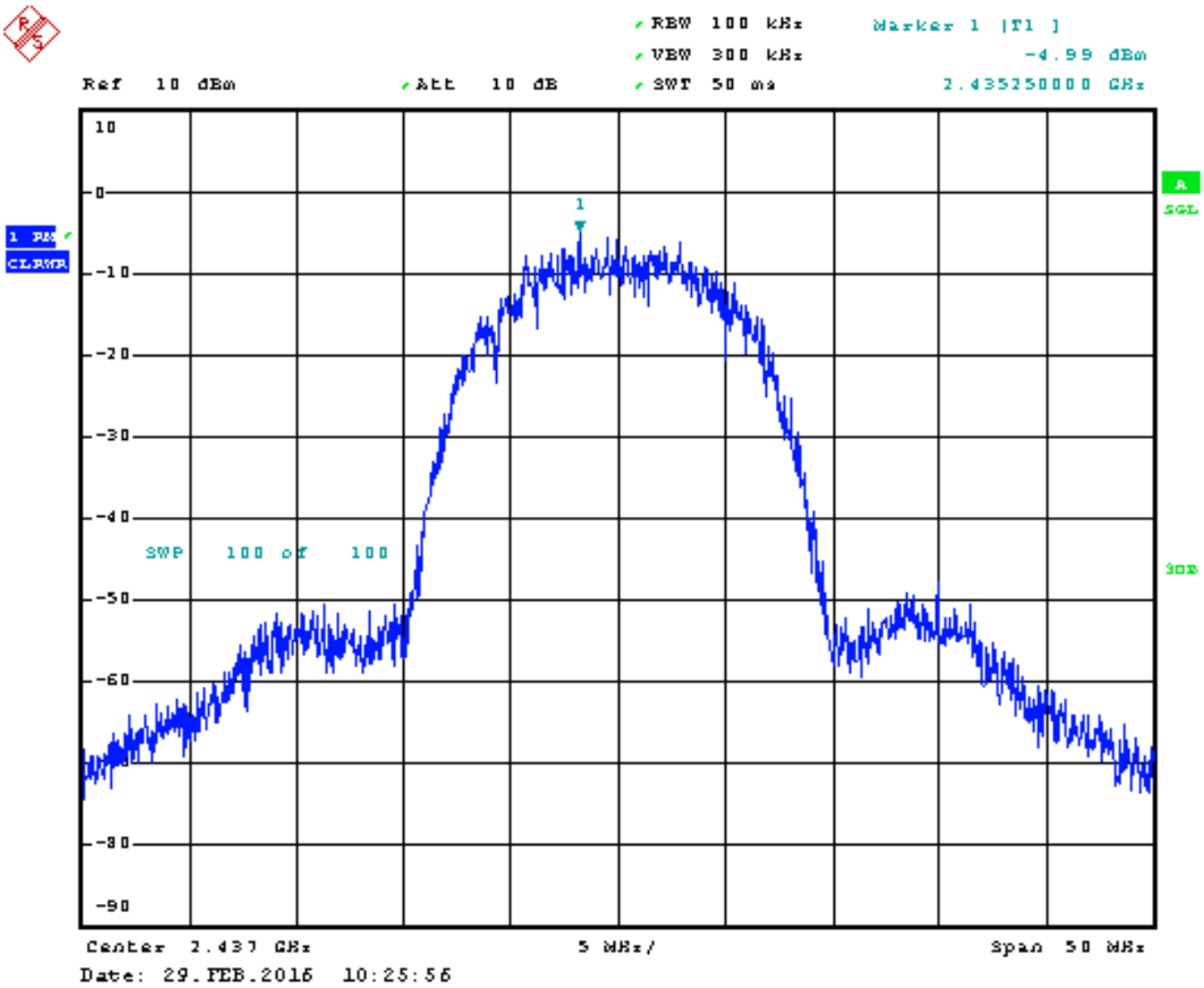


Power: -5.89 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 6 Ant 1:

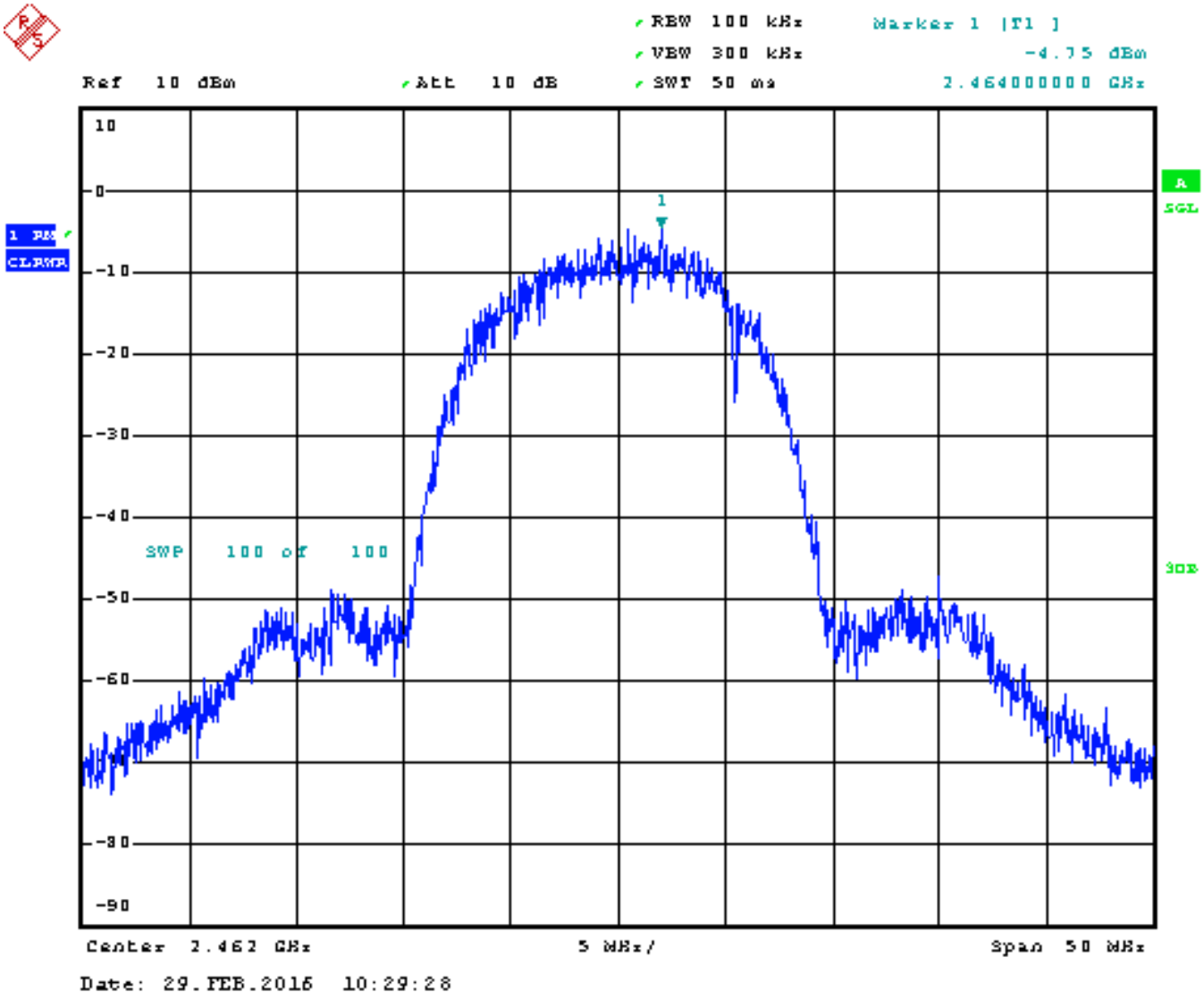


Power: -4.99 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 11 Ant 1:

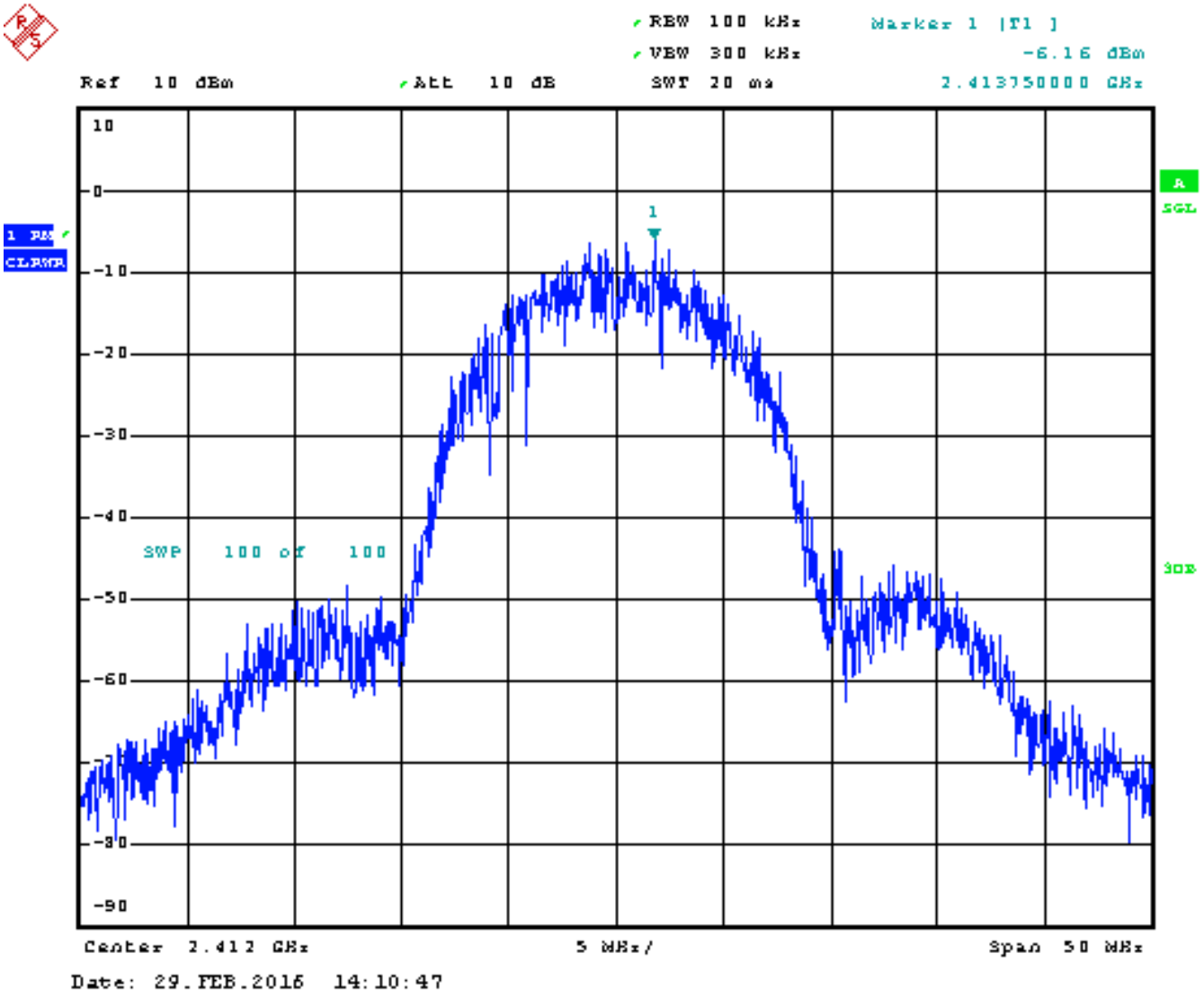


Power: -4.75 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 1 Ant 2:

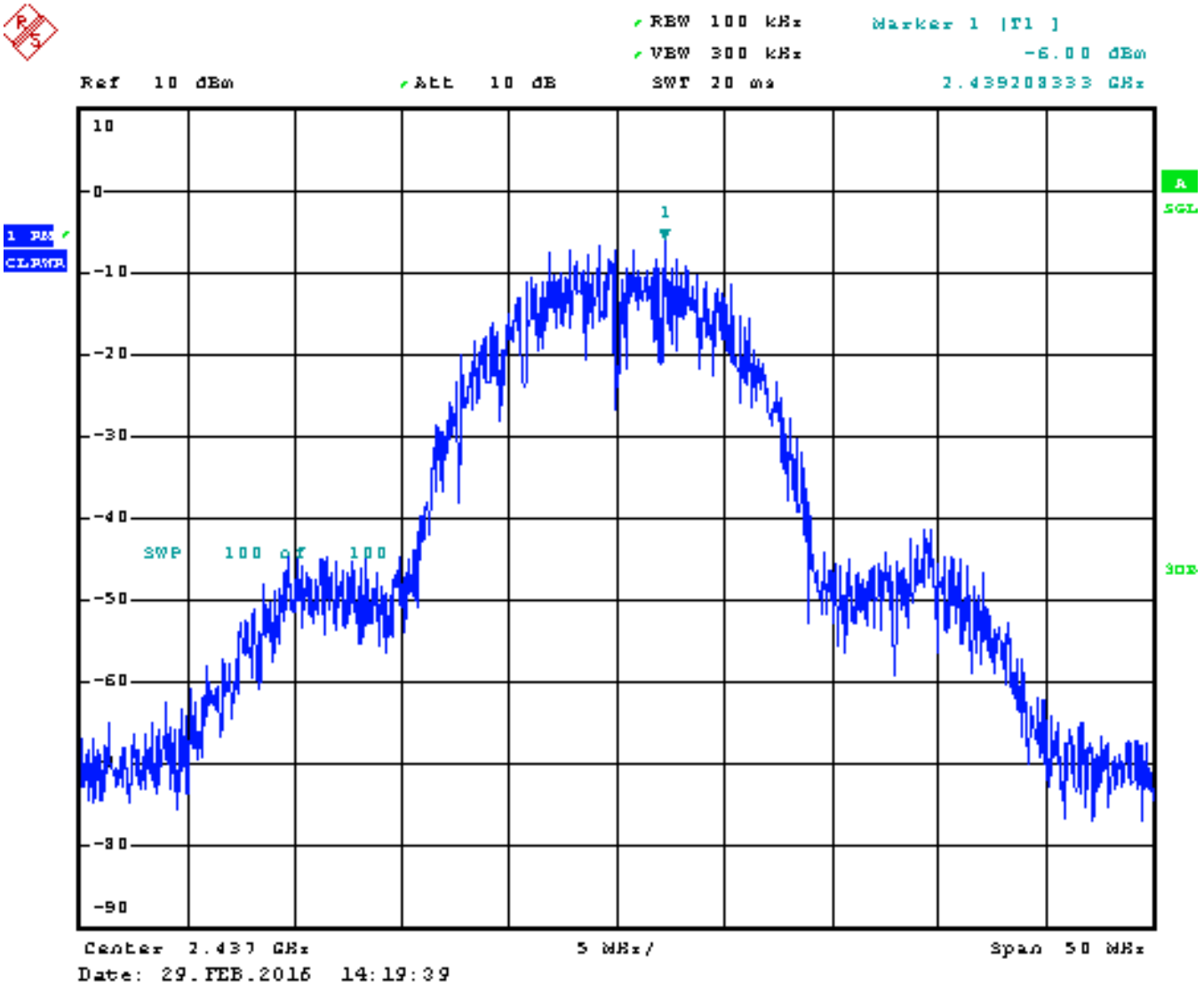


Power: -6.16 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 6 Ant 2:

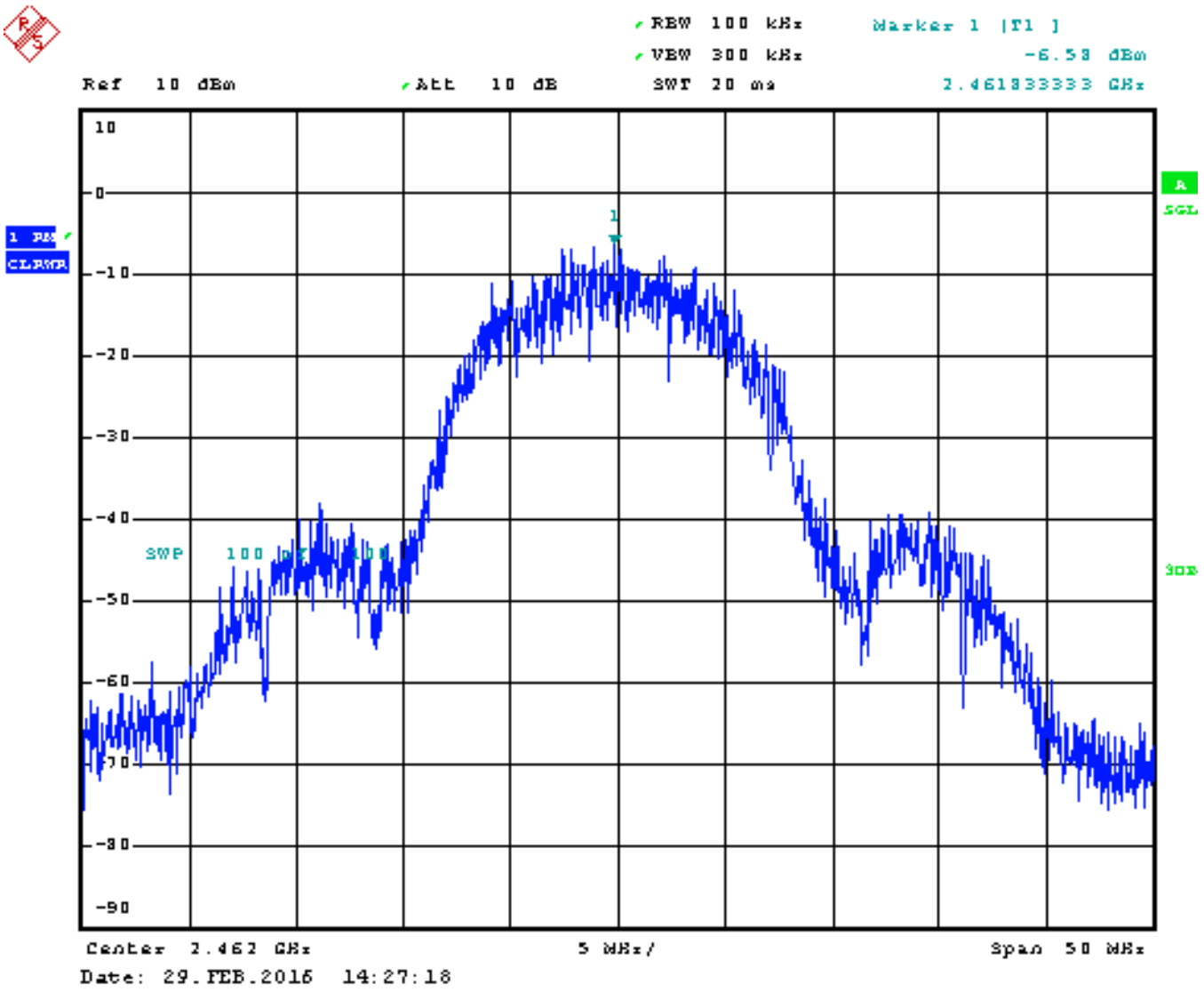


Power: -6.00 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11b Ch 11 Ant 2:



Power: -6.58 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Operation

For 802.11g operation, the lab report states on page 14, section 7.1 that the WiFi duty cycle for 802.11g is measured to be less than 98%. For the lab report, refer to lab report file "TSSCBASE1 EXHIBIT 5-3C-A FCC AND IC RADIATED EMISSIONS FOR WIFI Part 1 of 2.pdf" and "TSSCBASE1 EXHIBIT 5-3C-A FCC AND IC RADIATED EMISSIONS FOR WIFI Part 2 of 2.pdf". A copy of the duty cycle from this section is pasted below. Therefore KDB 558734, section 10.5 is followed for 802.11g operation. Section 10.5 describes "Method AVGPSD-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction)." This section permits the duty cycle correction factor to be added to the measured average power.

7.1. ON TIME AND DUTY CYCLE

LIMITS

None, for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

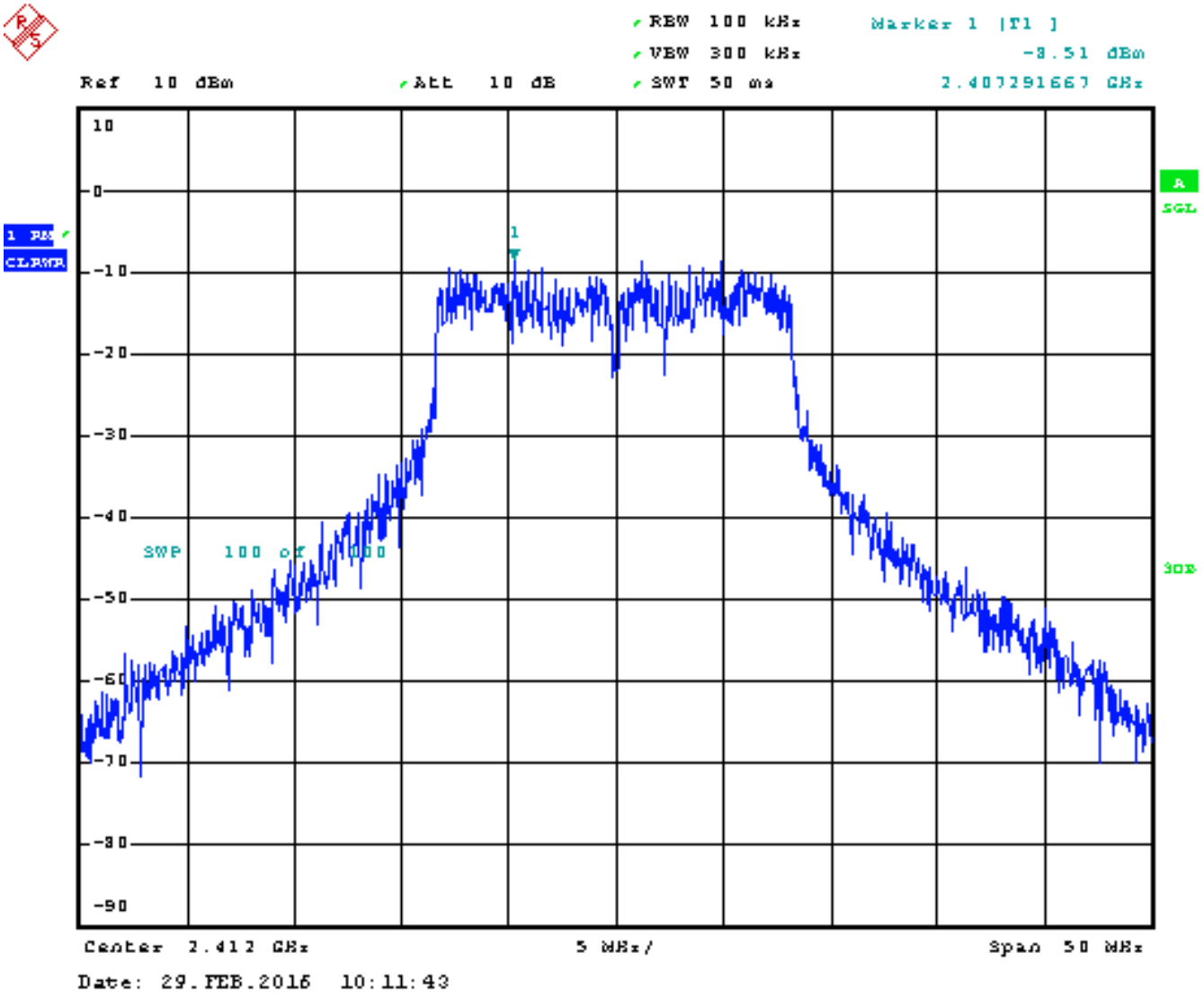
ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
802.11b (ANTENNA 1)	1.889	1.903	0.993	99.26%	0.00	0.010
802.11b (ANTENNA 2)	1.888	1.904	0.992	99.16%	0.00	0.010
802.11g (ANTENNA 1)	0.800	0.821	0.975	97.51%	0.11	1.250
802.11g (ANTENNA 2)	0.800	0.821	0.975	97.54%	0.11	1.249
802.11n HT20 (ANTENNA 1)	2.912	2.933	0.993	99.28%	0.00	0.010
802.11n HT20 (ANTENNA 2)	2.912	2.933	0.993	99.28%	0.00	0.010

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 1 Ant 1:

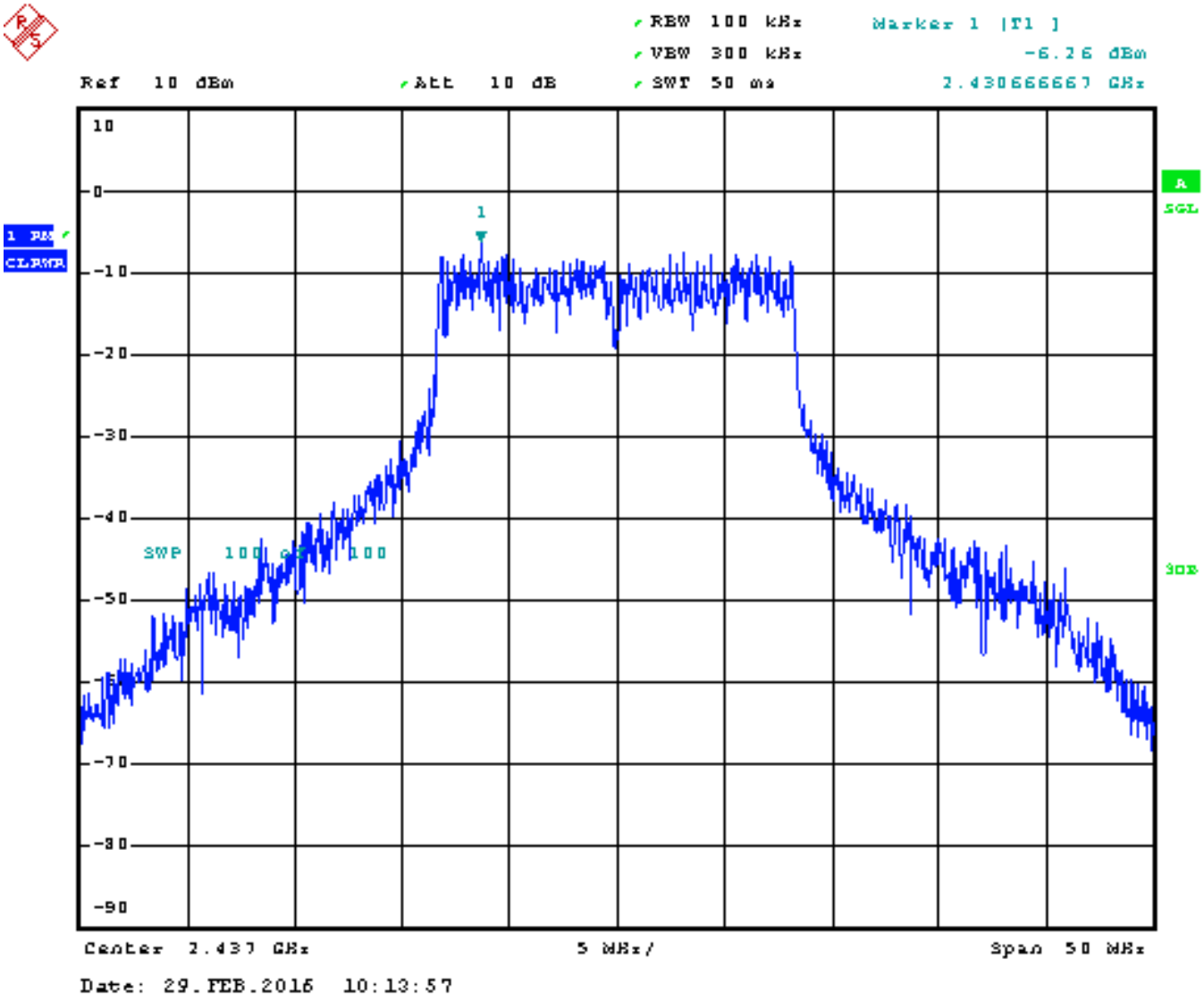


Measured Power: -8.51 dBm
Actual Power: =-8.51 dBm (measured) + 0.11 dBi (duty correction)
=**-8.40 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 6 Ant 1:

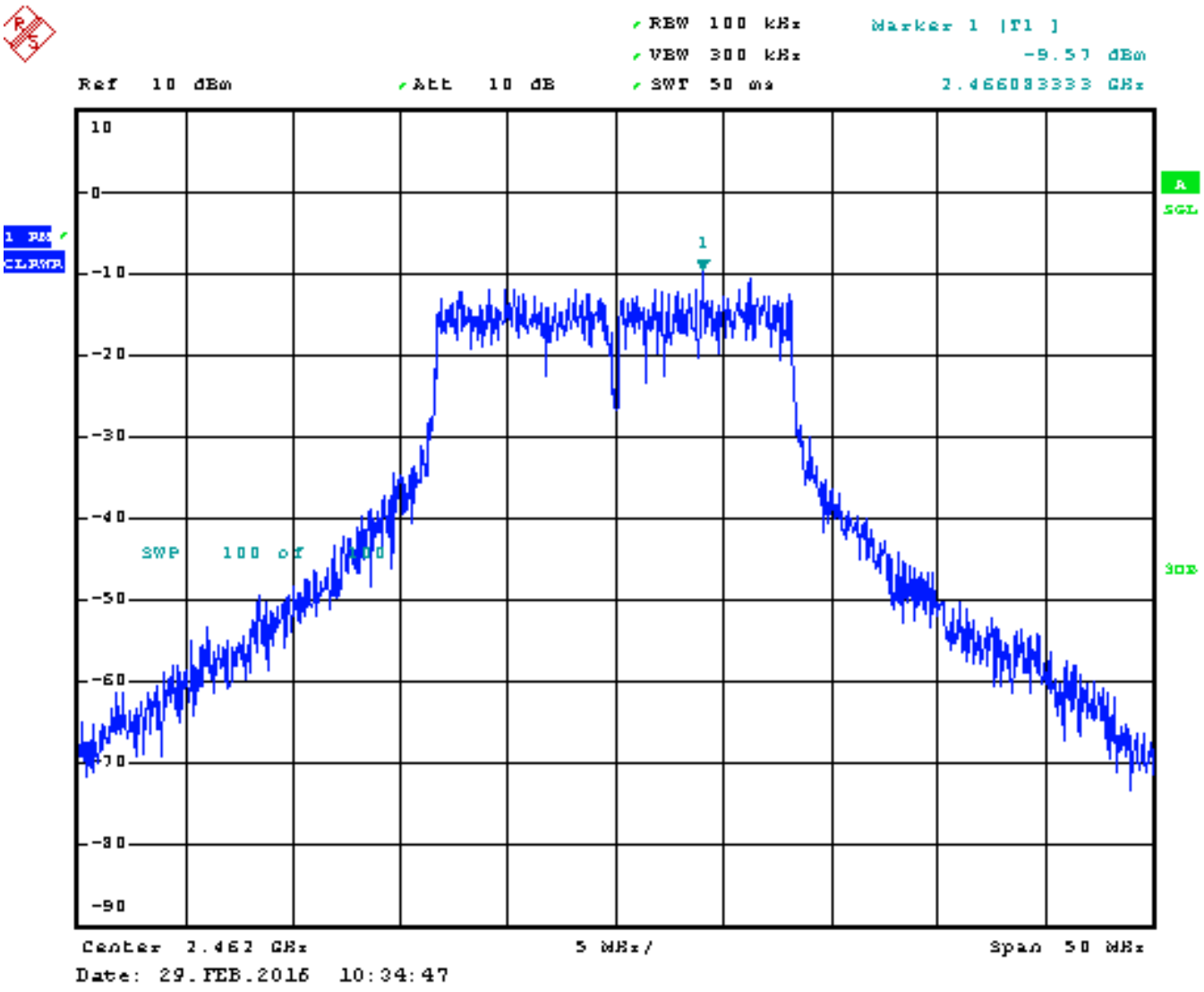


Measured Power: -6.26 dBm
Actual Power: =-6.26 dBm (measured) + 0.11 dBi (duty correction)
=**-6.15 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 11 Ant 1:

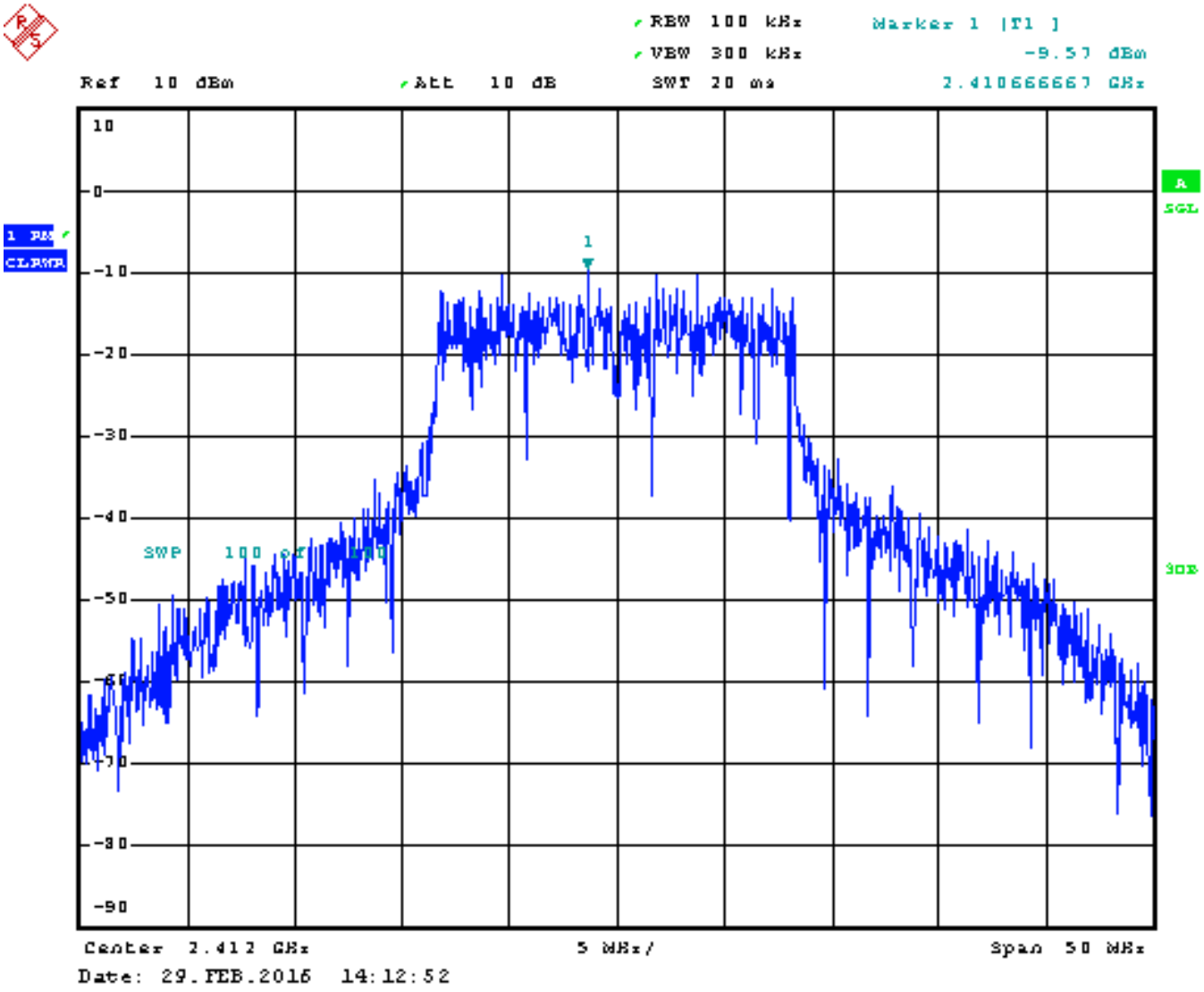


Measured Power: -9.57 dBm
Actual Power: =-9.57 dBm (measured) + 0.11 dBi (duty correction)
=**-9.46 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 1 Ant 2:

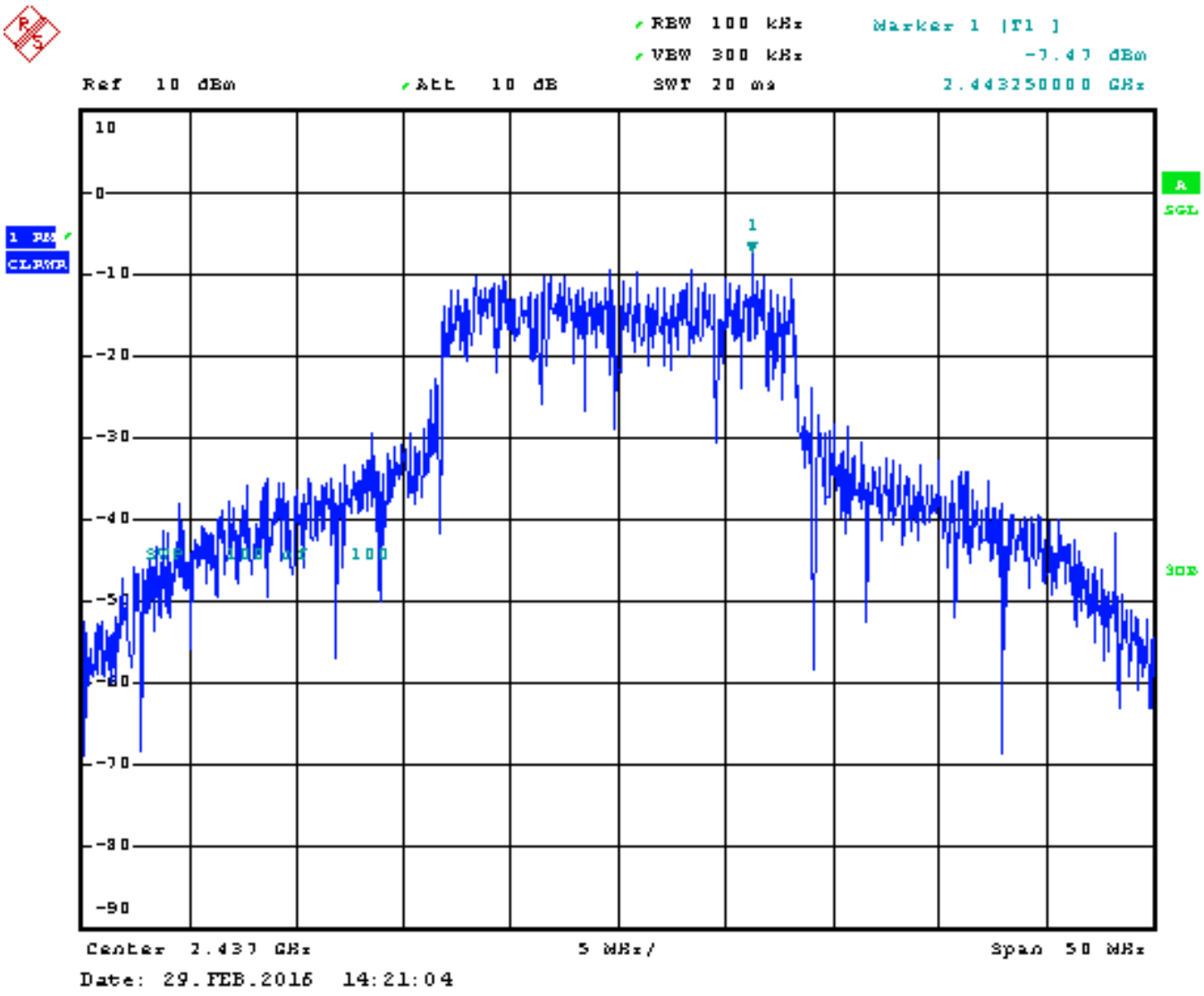


Measured Power: -9.57 dBm
Actual Power: =-9.57 dBm (measured) + 0.11 dBi (duty correction)
=**-9.46 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 6 Ant 2:

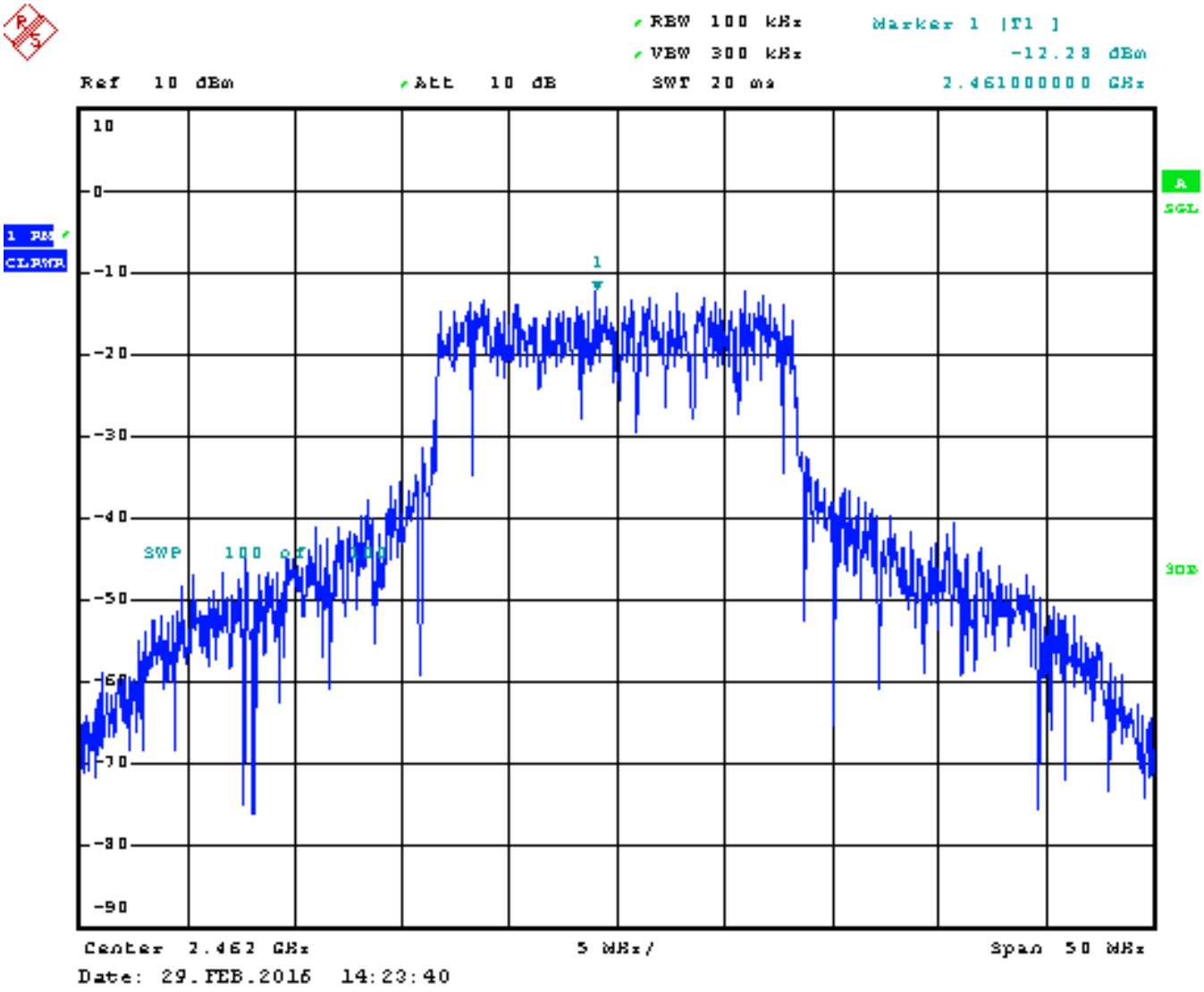


Measured Power: -7.47 dBm
Actual Power: =-7.47 dBm (measured) + 0.11 dBi (duty correction)
=**-7.36 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11g Ch 11 Ant 2:



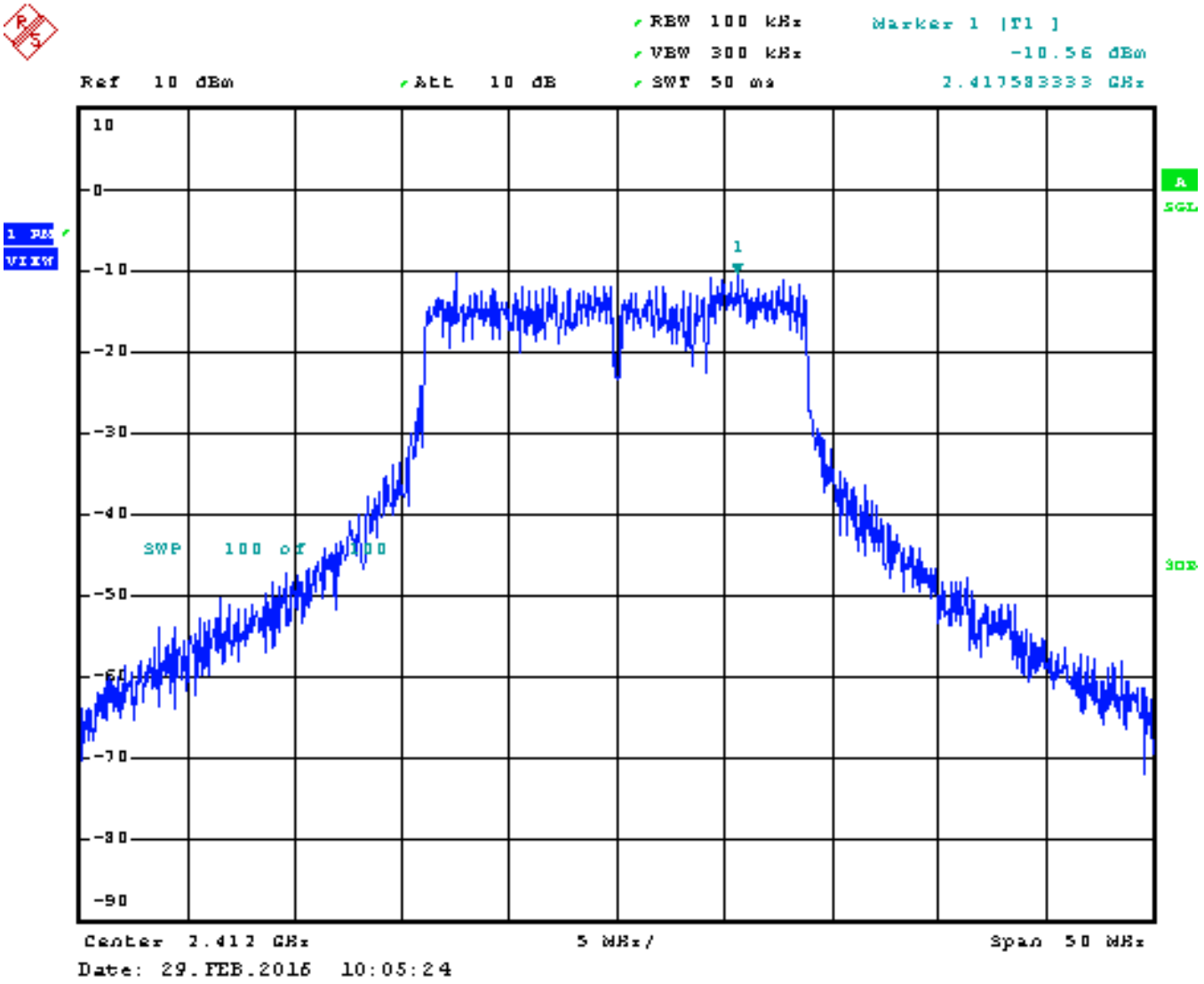
Measured Power: -12.28 dBm
Actual Power: =-12.28 dBm (measured) + 0.11 dBi (duty correction)
=**-12.17 dBm**

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

<u>802.11n Measurements</u>:

802.11n Ch 1 Ant 1:

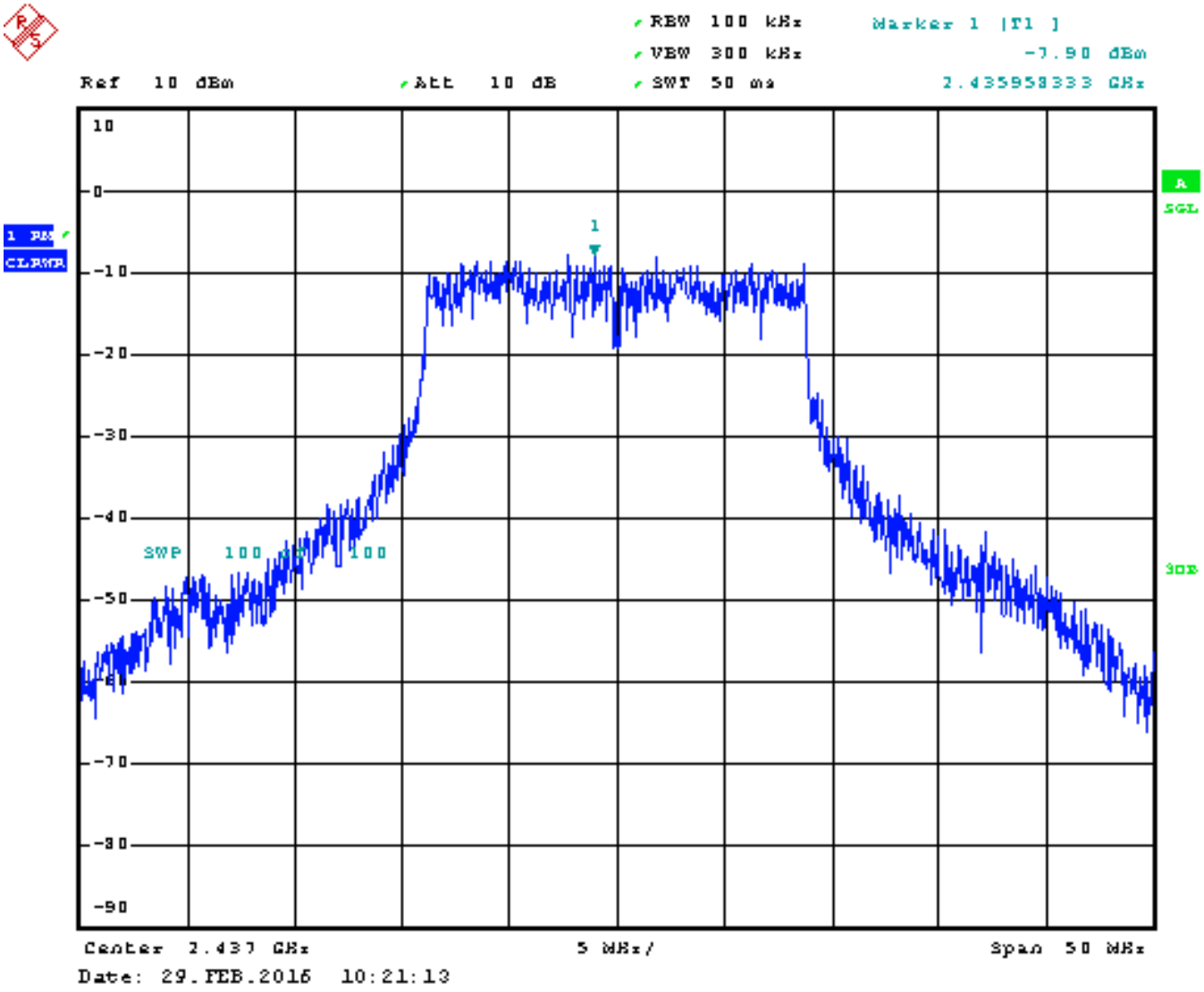


Power: -10.56 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 6 Ant 1:

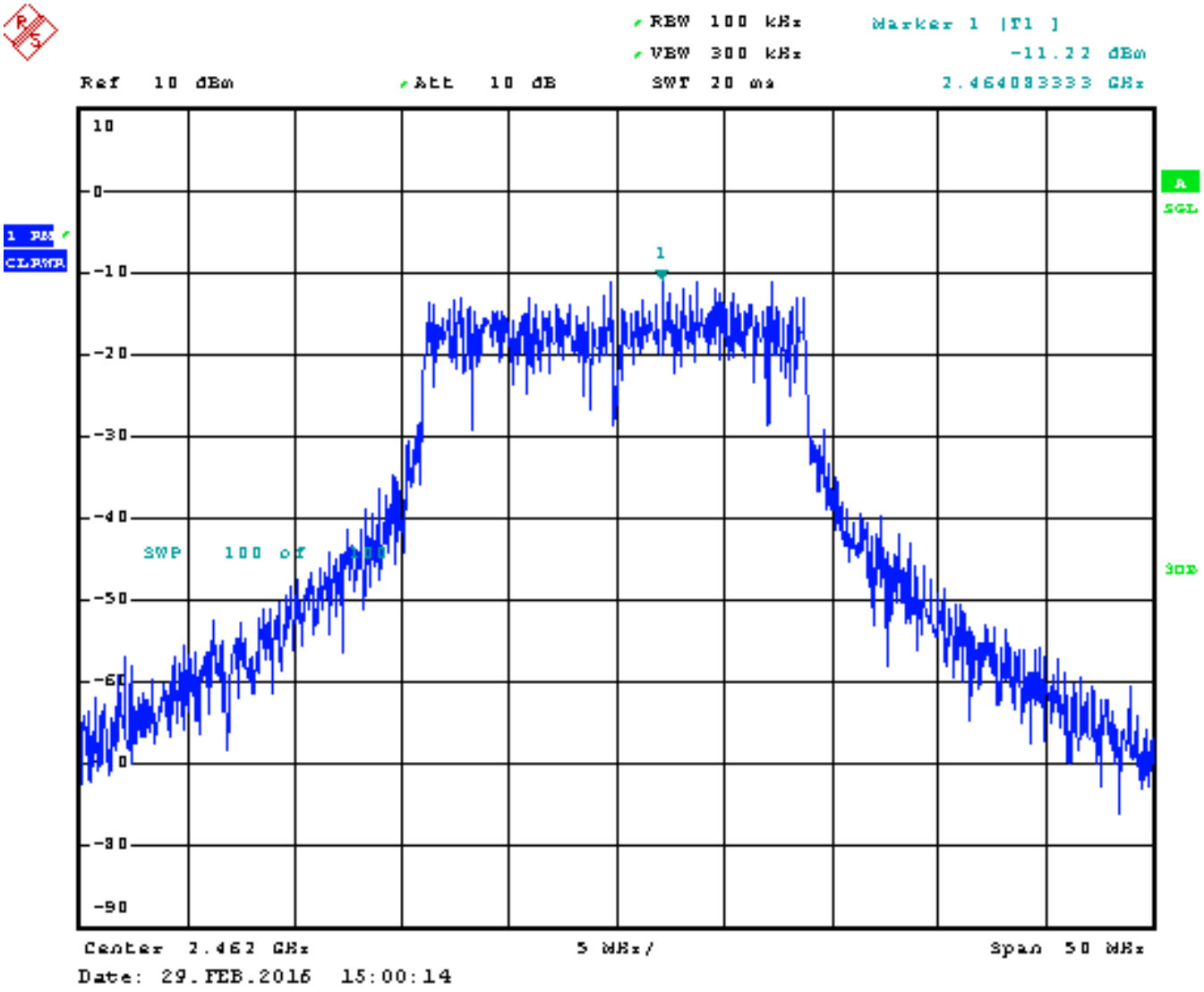


Power: -7.90 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 11 Ant 1:

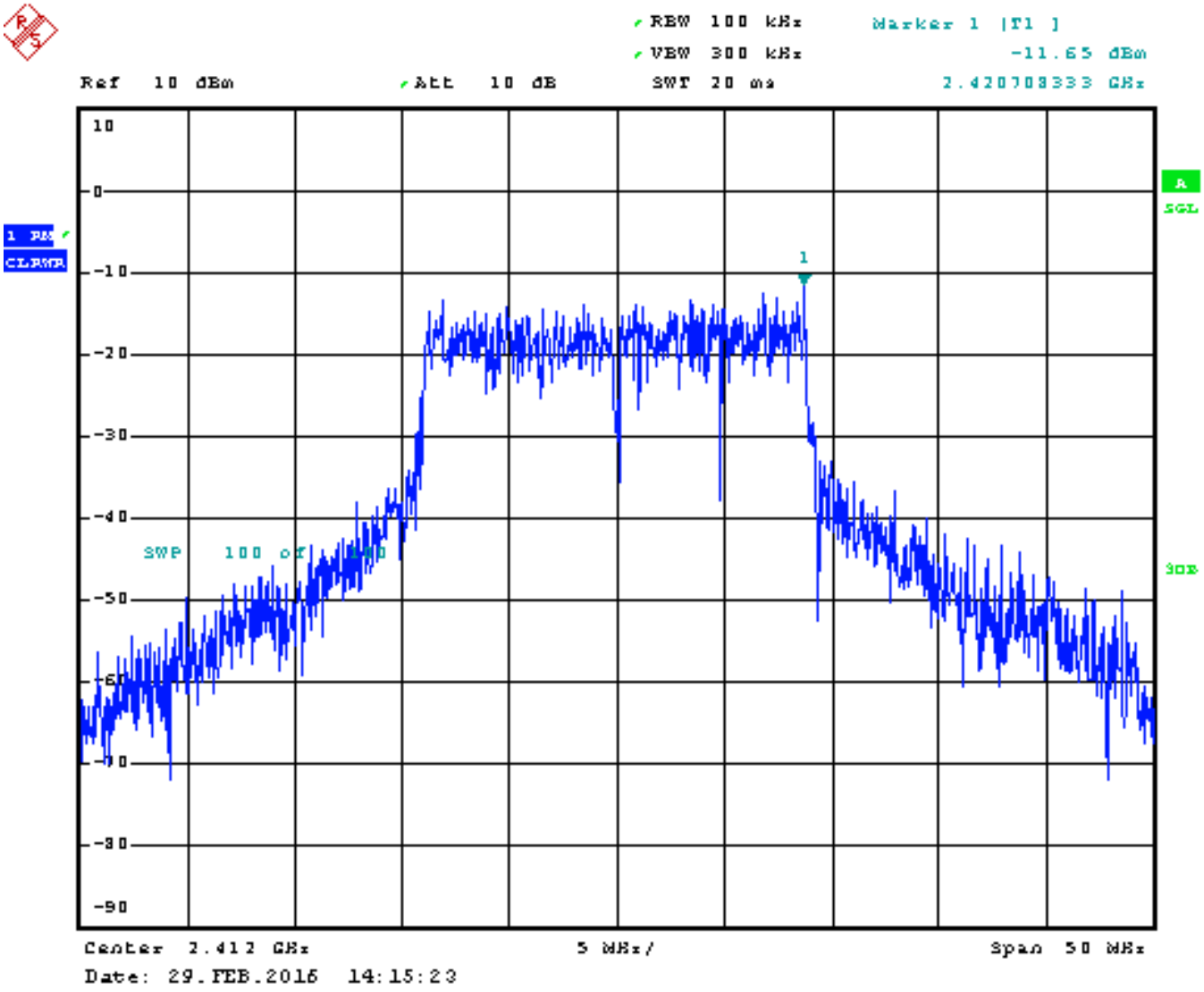


Power: -11.22 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 1 Ant 2:

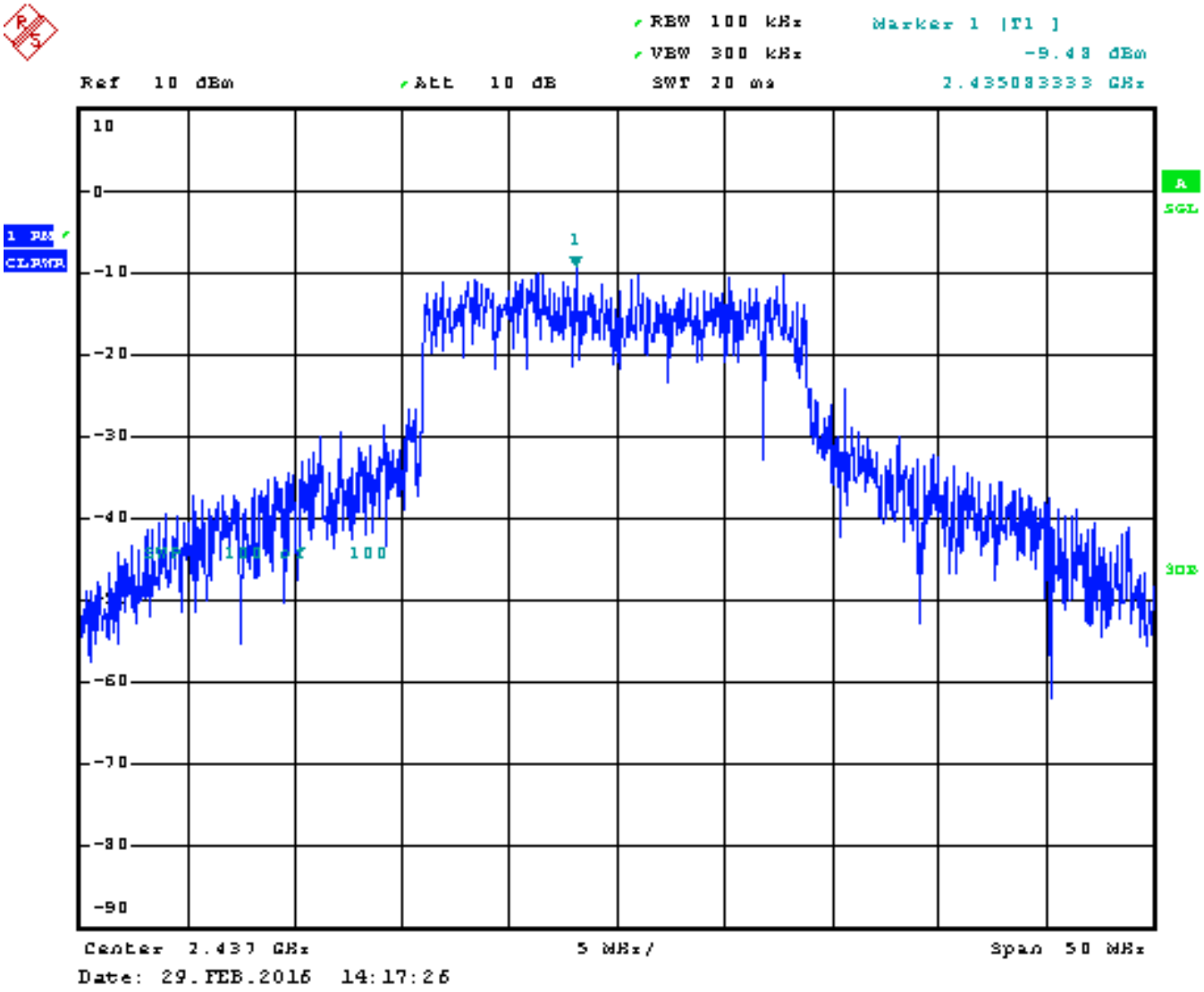


Power: -11.65 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 6 Ant 2:

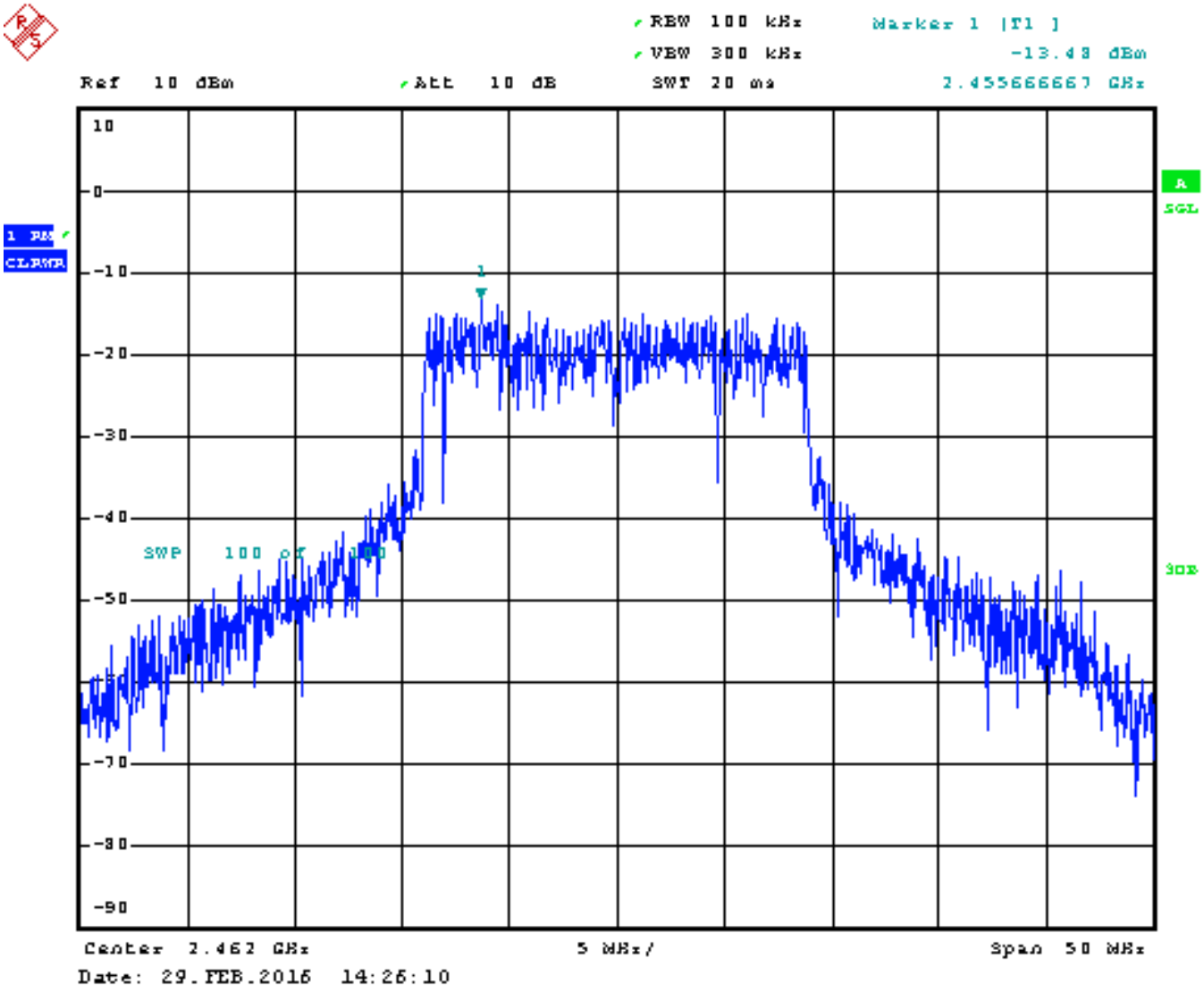


Power: -9.48 dBm

MAXIMUM AVERAGE POWER SPECTRAL DENSITY CONT.

WiFi Power Spectral Density Measurements Cont.

802.11n Ch 11 Ant 2:



Power: -13.48 dBm

Block 2 PSD Summation

Antenna Directional Gain

Summation is done as per KDB662911, section E.(2), method (b). This states:

KDB662911, §E.(2)(b):
Measure and sum spectral maxima across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs. These operations shall be performed separately over frequency spans that have different out-of-band or spurious emission limits,

Summary of Conducted Gains Block1 and Block2 Measurements

- In Block 1, Measured PSD is taken individually for each antenna.
- In block 2, an equivalent total conducted output power for both antennas is calculated by summing their individual PSD outputs as described in the KDB above. The results from Block 1 & Block 2are organized in the table below. The maximum PSD value is highlighted.

	Freq-uency (MHz)	Modu-lation	Ch	Ant	Meas. PSD (dBm)	Combined PSD (Block 2 Only) (dBm)
Block 1	2412	802.11b	1	1	-1.52	-1.52
	2412			2	-7.54	-7.54
	2437		6	1	-1.44	-1.44
	2437			2	-5.49	-5.49
	2467		11	1	-2.71	-2.71
	2467			2	-5.56	-5.56
	2412	802.11g	1	1	-5.12	-5.12
	2412			2	-10.89	-10.89
	2437		6	1	-3.29	-3.29
	2437			2	-8.44	-8.44
	2467		11	1	-7.16	-7.16
	2467			2	-9.98	-9.98
	2412	802.11n	1	1	-7.39	-7.39
	2412			2	-12.55	-12.55
	2437		6	1	-5.12	-5.12
	2437			2	-8.15	-8.15
	2467		11	1	-9.74	-9.74
	2467			2	-11.73	-11.73
Block 2	2412	802.11b	1	1	-5.89	-3.01
	2412			2	-6.16	
	2437		6	1	-4.99	-2.46
	2437			2	-6.00	
	2467		11	1	-4.75	-2.56
	2467			2	-6.58	
	2412	802.11g	1	1	-8.40	-5.89
	2412			2	-9.46	
	2437		6	1	-6.15	-3.70
	2437			2	-7.36	
	2467		11	1	-9.46	-7.60
	2467			2	-12.17	
	2412	802.11n	1	1	-10.56	-8.06
	2412			2	-11.65	
	2437		6	1	-7.90	-5.61
	2437			2	-9.48	
	2467		11	1	-11.22	-9.19
	2467			2	-13.48	

PSD Measurement Summary