



F2 Labs
16740 Peters Road
Middlefield, Ohio 44062
United States of America
www.f2labs.com

CERTIFICATION TEST REPORT

Manufacturer: Transducers Direct, LLC
12115 Ellington Court
Cincinnati, Ohio 45249 USA

Applicant: Same as Above

Product Name: TDWLB Series Wireless Bluetooth Pressure Transducer, Ver.2

Product Description: Bluetooth Enabled Wireless Pressure Transducer Version 2

Model: TDWLBG2

Part Number: TDWLB0100031*

**Denotes actual part number tested as representative of product family identified in Section 13.0 of this Test Report.*

FCC ID: 2ACGE-TDWLBG2

Testing Commenced: Nov. 7, 2016

Testing Ended: Nov. 9, 2016

Summary of Test Results: **In Compliance**

The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Standards:

- **FCC Part 15 Subpart C, Section 15.247**
- **FCC Part 15.31(e)**
- **ANSI C63.10:2013**



Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

Evaluation Conducted by:

Joe Knepper, EMC Proj. Eng.

Report Reviewed by:

Ken Littell, Director of EMC & Wireless Operations

F2 Labs
26501 Ridge Road
Damascus, MD 20872
Ph 301.253.4500
Fax 301.253.5179

F2 Labs
16740 Peters Road
Middlefield, OH 44062
Ph 440.632.5541
Fax 440.632.5542

This test report may be reproduced in full; partial reproduction only may be made with the written consent of F2 Labs. The results in this report apply only to the equipment tested.



TABLE OF CONTENTS

Section	Title	Page
1	ADMINISTRATIVE INFORMATION	4
2	SUMMARY OF TEST RESULTS/MODIFICATIONS	5
3	TABLE OF MEASURED RESULTS	6
4	ENGINEERING STATEMENT	7
5	EUT INFORMATION AND DATA	8
6	LIST OF MEASUREMENT INSTRUMENTATION	9
7	FCC Part 15.247(a)(2) – OCCUPIED BANDWIDTH	10
8	FCC Part 15.247(b)(3) – CONDUCTED OUTPUT POWER	14
9	FCC Part 15.247(d) – CONDUCTED SPURIOUS EMISSIONS	18
10	FCC Part 15.247(d) – RADIATED SPURIOUS EMISSIONS	43
11	FCC Part 15.247(e) – PEAK POWER SPECTRAL DENSITY (PSD)	48
12	PHOTOS/EXHIBITS	52
13	PRODUCT FAMILY IDENTIFICATION	53



1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

1.2 Measurement Procedure:

All measurements were performed according to the 2013 version of ANSI C63.10 and recommended FCC procedure of measurement of DTS operating under Section 15.247 and in KDB558074. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data, and are expressed with a 95% confidence factor. Note: Only measurements listed below which relate to tests included in this Test Report are applicable to it.

Measurement Range	Expanded Uncertainty	Combined Uncertainty
Radiated Emissions <1 GHz @ 3m	$\pm 5.07\text{dB}$	± 2.54
Radiated Emissions <1 GHz @10m	$\pm 5.09\text{dB}$	± 2.55
Radiated Emissions 1 GHz to 2.7 GHz	$\pm 3.62\text{dB}$	± 1.81
Radiated Emissions 2.7 GHz to 18 GHz	$\pm 3.10\text{dB}$	± 1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	$\pm 2.76\text{dB}$	± 1.38

This Uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

1.4 Document History

Document Number	Description	Issue Date	Approved By
F2LQ8686B-01E	First Issue	Dec. 2, 2016	K. Littell

**2 SUMMARY OF TEST RESULTS**

Test Name	Standard(s)	Results
-6dB Occupied Bandwidth	CFR 47 Part 15.247(a)(2) / KDB558074	Complies
Conducted Output Power	CFR 47 Part 15.247(b)(3) / KDB558074	Complies
Voltage Variations	CFR 47 Part 15.31(e)	Not Applicable
Conducted Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.207 / KDB558074	Complies
Radiated Spurious Emission with 2.1dBi Integral Antenna	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Peak Power Spectral Density	CFR 47 Part 15.247(e) / KDB558074	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	Not Applicable

Note: Product was operated using new batteries.
Requirements of 15.31(e) were met by using new batteries.

Modifications Made to the Equipment
None

**3 TABLE OF MEASURED RESULTS**

Test	Low Channel 2.402 GHz	Mid Channel 2.440 GHz	High Channel 2.48 GHz
Conducted Output Power	3.78mW (5.78dBm)	2.58mW (4.13dBm)	1.71mW (2.33dBm)
Conducted Output Power Limit	1 Watt, (30dBm)	1 Watt, (30dBm)	1 Watt, (30dBm)
E.I.R.P. with 2.1dBi Integral antenna	6.137mW (7.88dBm)	4.198mW (6.23dBm)	2.77mW (4.43dBm)
E.I.R.P. Limit	4 Watts, (36.02dBm)	4 Watts, (36.02dBm)	4 Watts, (36.02dBm)
Peak Power Spectral Density	-3.49dBm	-5.12dBm	-7.15dBm
Peak Power Spectral Density Limit	8 dBm	8 dBm	8 dBm
-6dB Occupied Bandwidth	0.7067 MHz	0.7115 MHz	0.7259 MHz
-6dB Occupied Bandwidth Limit	≥ 500KHz	≥ 500KHz	≥ 500KHz



4 ENGINEERING STATEMENT

This report has been prepared on behalf of Transducers Direct, LLC to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.247 of the FCC Rules using ANSI C63.10:2013 and KDB558074 standards. The test results found in this test report relate only to the items tested.



5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: TDWLB Series Wireless Bluetooth Pressure Transducer, Ver.2

Model: TDWLBG2

Part No.: TDWLB0100031*

Serial No.: None Specified

FCC ID: 2ACGE-TDWLBG2

**Denotes actual part number tested as representative of product family identified in Section 13.0 of this Test Report.*

5.2 Trade Name:

Transducers Direct, LLC

5.3 Power Supply:

Battery-operated

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

2.1dBi Integral Antenna

5.7 Accessories:

N/A

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

The EUT was configured to permit frequency changes from low-mid-upper transmission channel using digital modulation (required for digital transmission systems). For RF antenna conducted tests, the EUT was equipped with an SMA connector for connection to the measuring equipment. For radiated emissions tests, in a semi-anechoic chamber, the EUT was equipped with integral/internal chip antenna. The highest emissions were recorded in the data tables.

**6 LIST OF MEASUREMENT INSTRUMENTATION**

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166-E	AlbatrossProjects	B83117-DF435-T261	US140023	May 12, 2017
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Nov. 25, 2016
Horn Antenna	CL098	Emco	3115	9809-5580	Dec. 10, 2016
Horn Antenna	CL114	A.H. Systems, Inc.	SAS-572	237	Oct. 16, 2017
Pre-Amplifier	CL153	Keysight Tech.	83006A	MY39500791	June 6, 2017
Pre-Amplifier	CL189	Com-Power	PAM-840A	461303	June 18, 2017
Amplifier w/Monopole & 18" Loop	CL163	A.H. Systems, Inc.	EHA-52B	100	May 5, 2017
Software:	Tile Version 1.0		Software Verified: Nov. 7, 2016		
Software:	EMC 32, Version 5.20.2		Software Verified: Nov. 7, 2016		
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Apr. 1, 2017



7 FCC PART 15.247(a)(2) – OCCUPIED BANDWIDTH

7.1 Requirements:

The 6dB bandwidth shall be greater than 500 kHz.

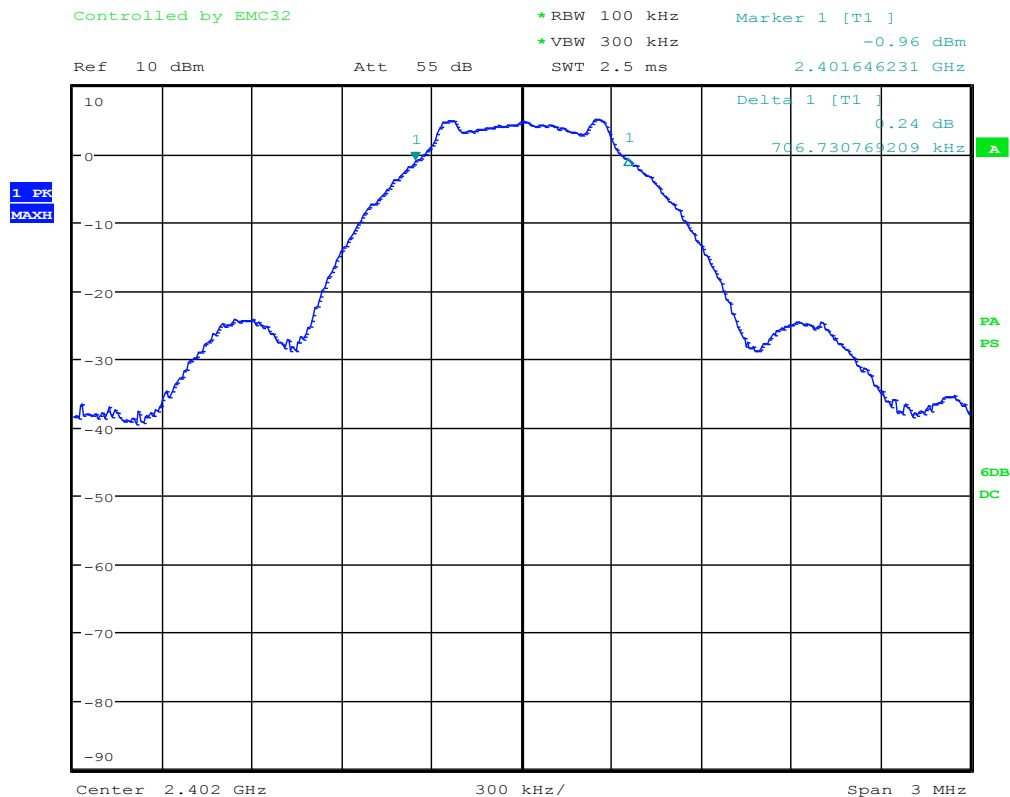
Bandwidth measurements were made at the low (2.402 GHz), mid (2.440 GHz) and upper (2.480 GHz) frequencies. The bandwidth was measured using the analyzer's marker function.



7.2 Occupied Bandwidth Test Data

Test Date:	Nov. 8, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(a)(2); KDB558074	Air Temperature:	20.6°C
		Relative Humidity:	47%

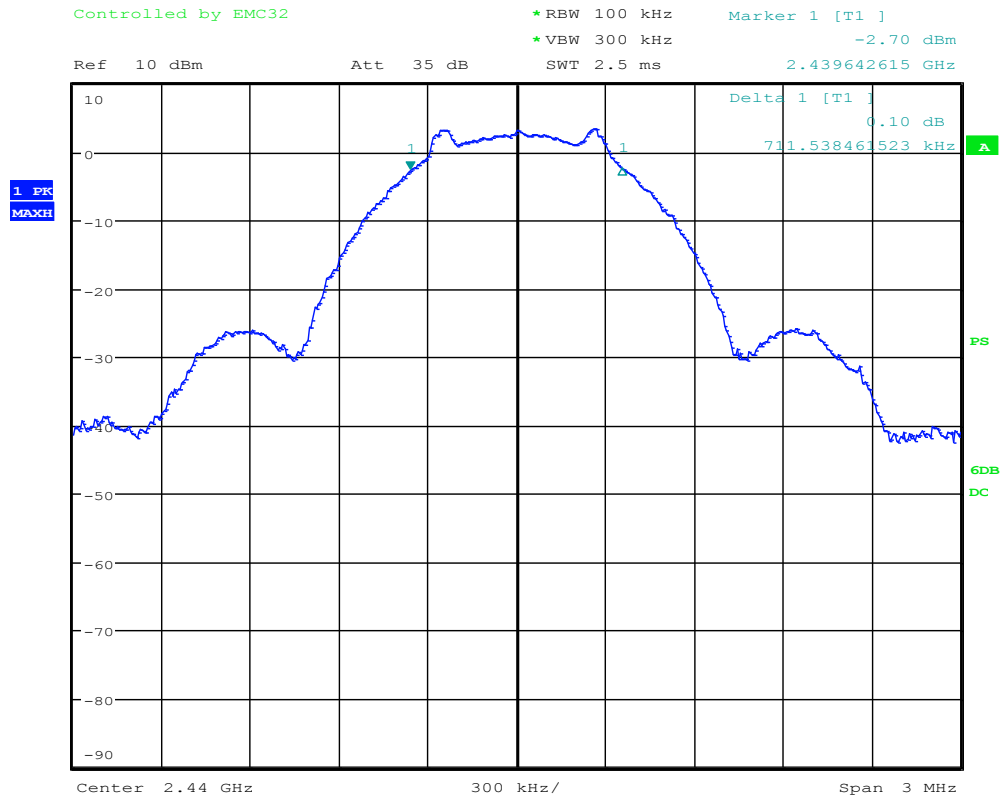
Low Channel



Date: 8.NOV.2016 12:52:02



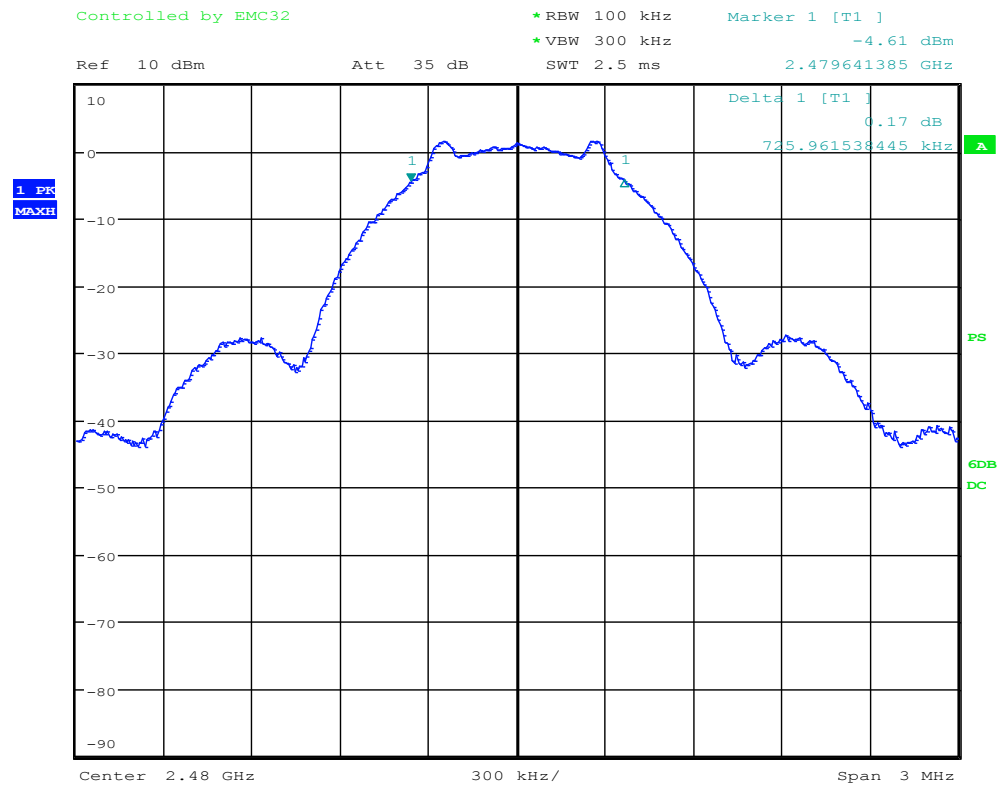
Mid Channel



Date: 8.NOV.2016 13:05:07



High Channel



Date: 8.NOV.2016 13:23:05



8 FCC PART 15.247(b)(3) – CONDUCTED OUTPUT POWER

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the receiver. The peak power output was measured.

8.1 Requirements:

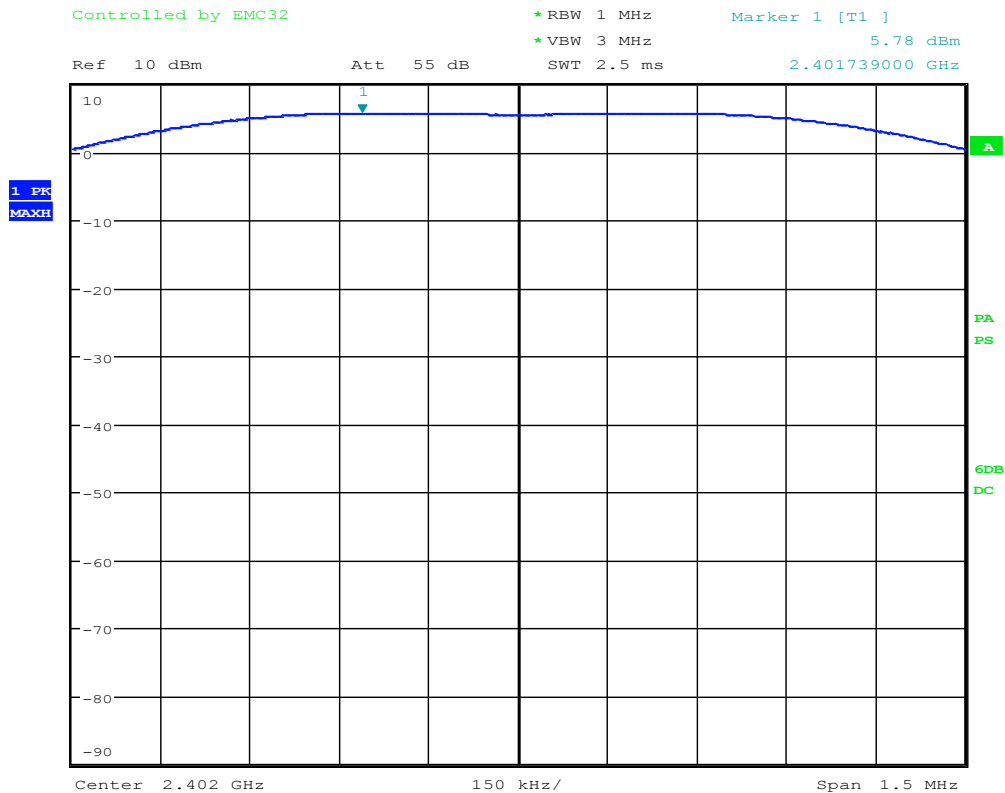
The peak power output shall be 1 watt (30 dBm) or less when using an antenna with a gain of less than 6dBi. For antennas having a gain of more than 6dBi, the limit is reduced by 1dB for every dB the antenna gain is over 6dBi.



8.2 Conducted Output Power Test Data

Test Date:	Nov. 8, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(b)(3); KDB558074	Air Temperature:	20.6°C
		Relative Humidity:	47%

Low Channel



Date: 8.NOV.2016 12:56:25

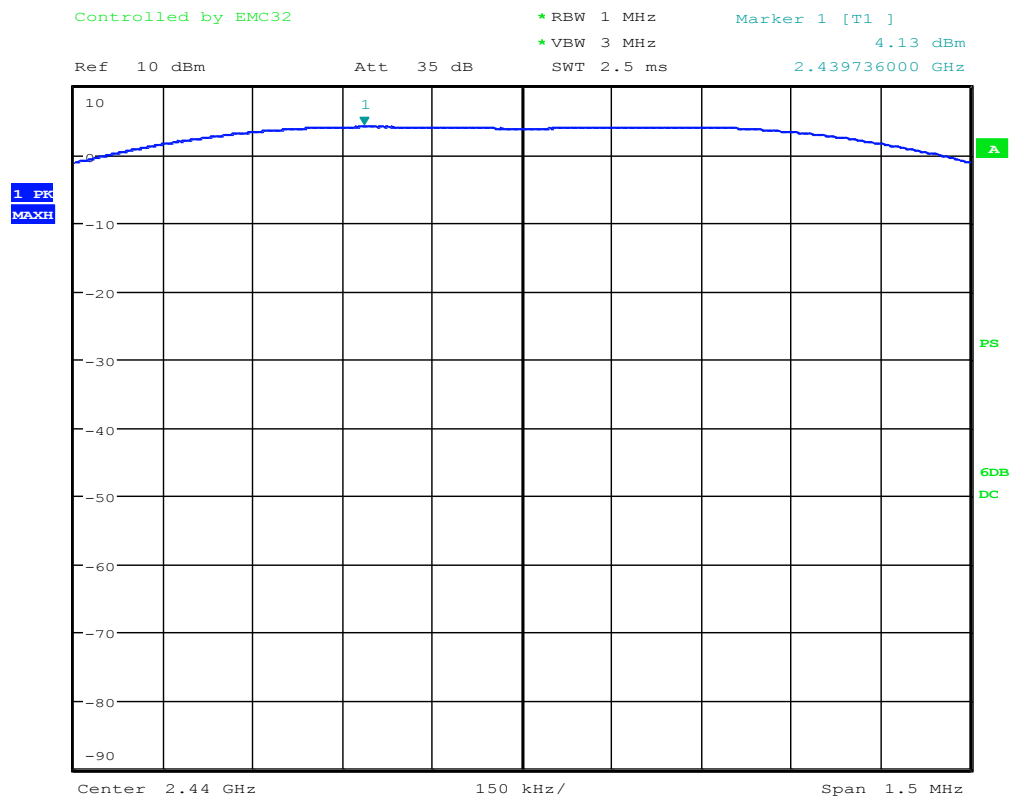


Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

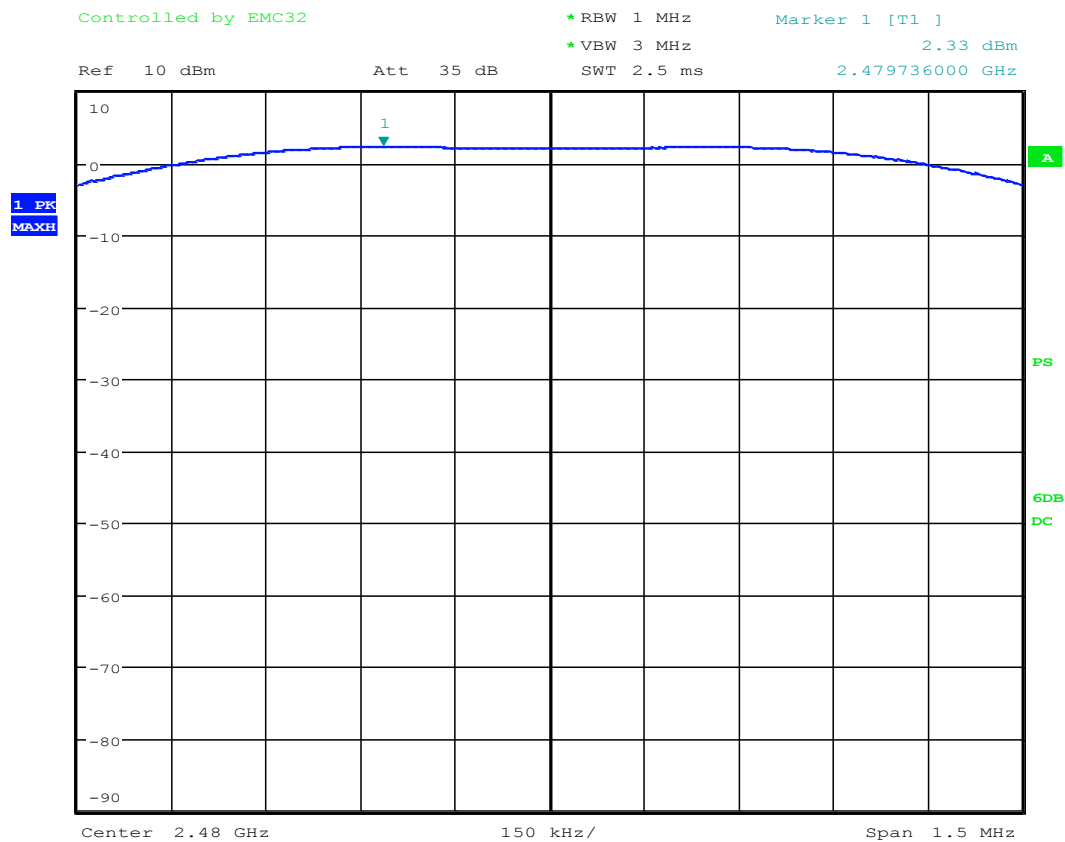
Mid Channel



Date: 8.NOV.2016 13:16:35



High Channel



Date: 8.NOV.2016 13:25:08



9 FCC Part 15.247(d) – CONDUCTED SPURIOUS EMISSIONS

The following tests were performed to demonstrate compliance.

RF Antenna Conducted Test

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the spectrum analyzer.

9.1 Requirements:

All Spurious Emissions must be at least 20dB down from the highest emission level measured within the authorized band up through the tenth harmonic.

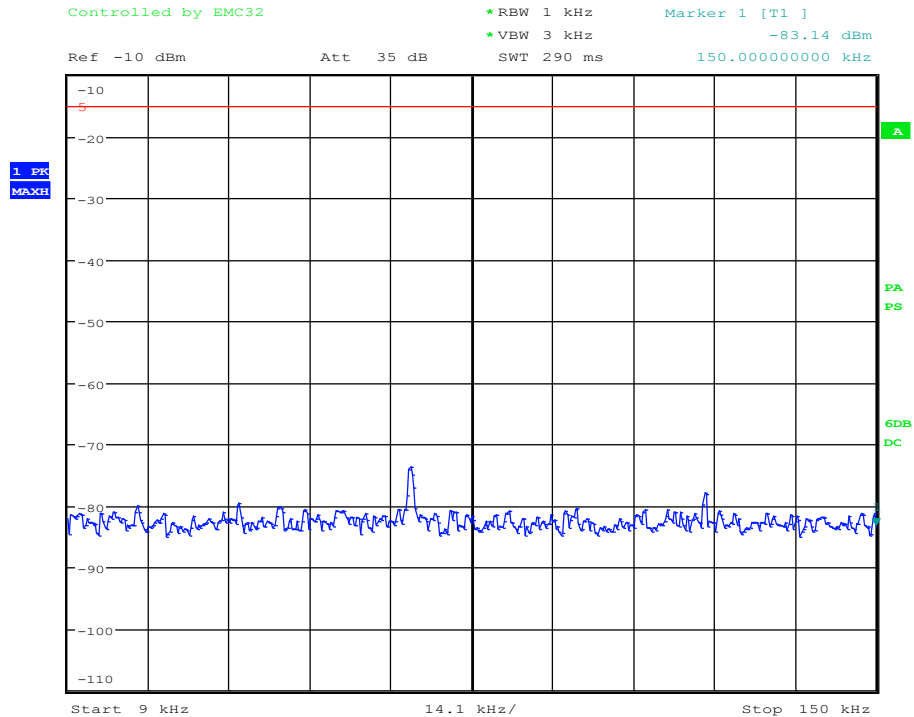
Spurious emissions measurements were made at the low, mid, and upper channels with the appropriate spectrum analyzer impulse bandwidth. Additionally, 20dB down points were measured for the low and high channels to verify band edge compliance.



9.2 Conducted Spurious Emissions Test Data

Test Date:	Nov. 8, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(d) / Part 15.207 KDB558074	Air Temperature:	20.7°C
		Relative Humidity:	47%

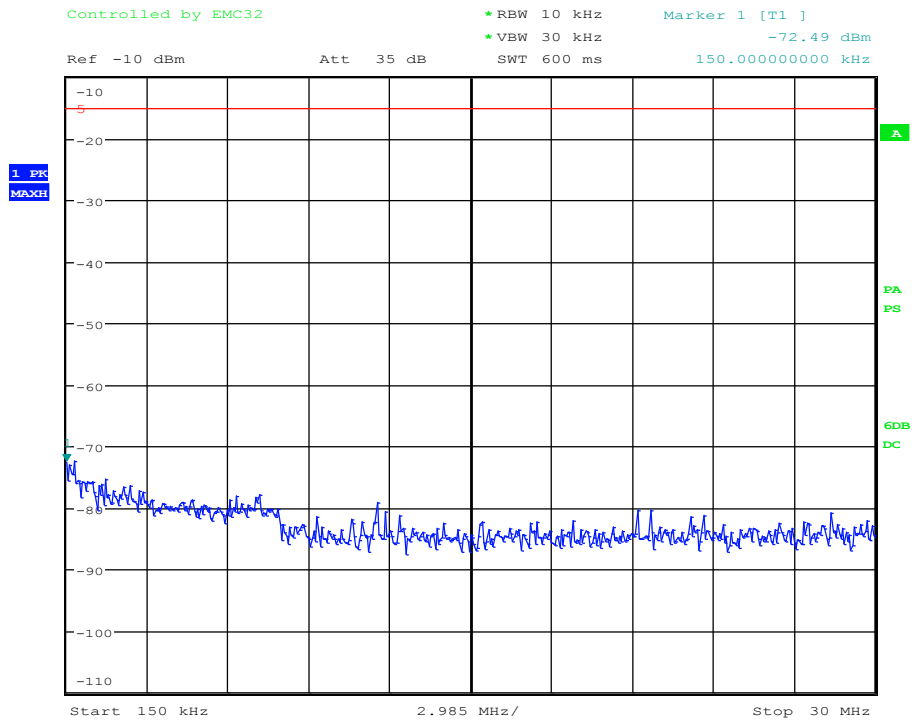
Low Channel



Date: 8.NOV.2016 13:00:45

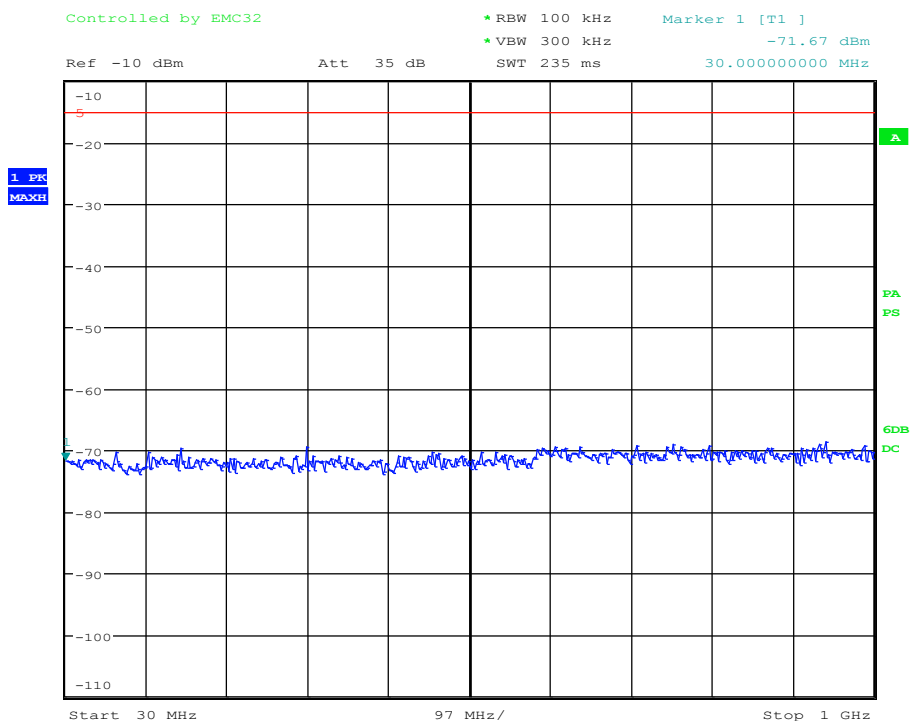


Low Channel, cont'd



Date: 8.NOV.2016 13:01:02

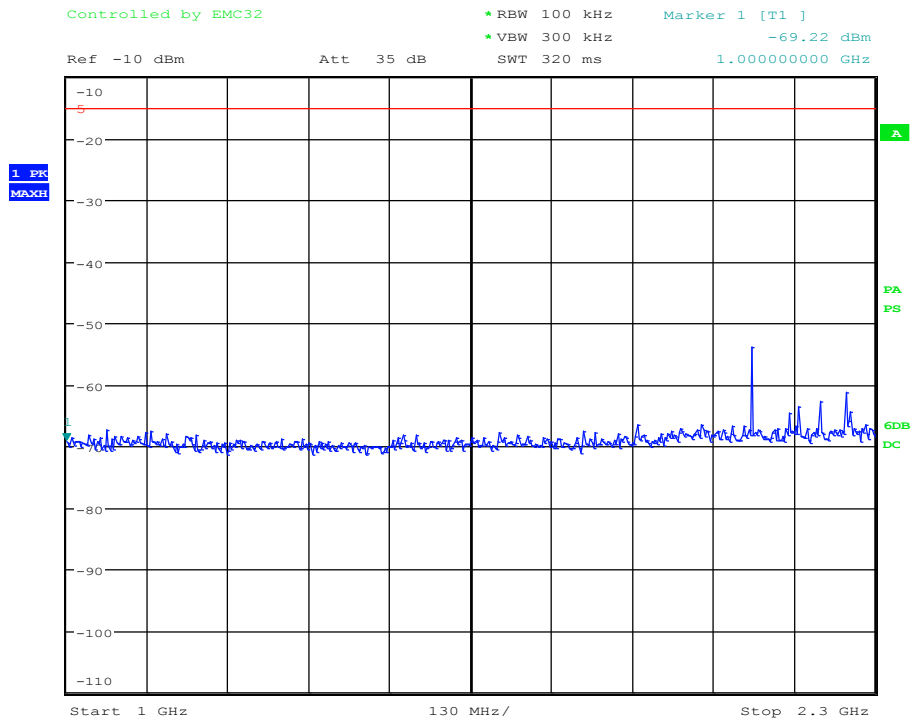
Low Channel, cont'd



Date: 8.NOV.2016 13:01:16



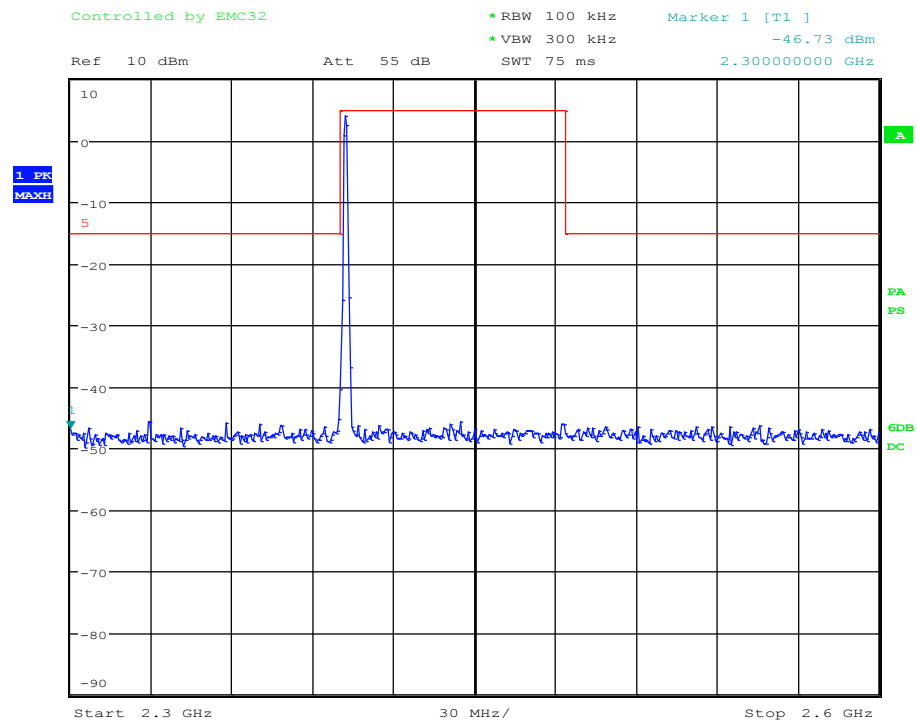
Low Channel, cont'd



Date: 8.NOV.2016 13:01:29



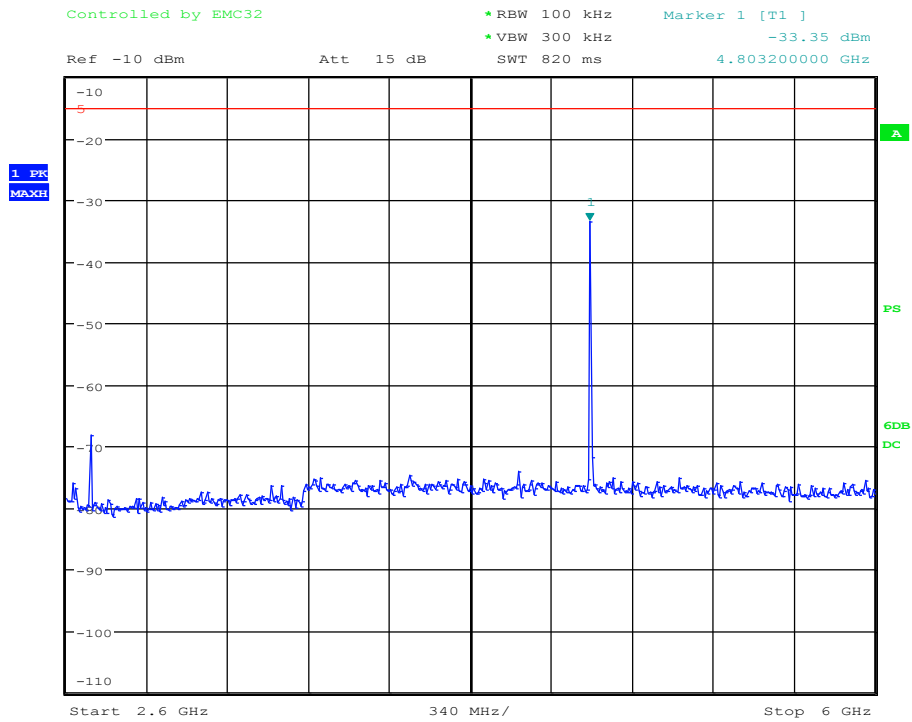
Low Channel, cont'd



Date: 8.NOV.2016 13:01:45

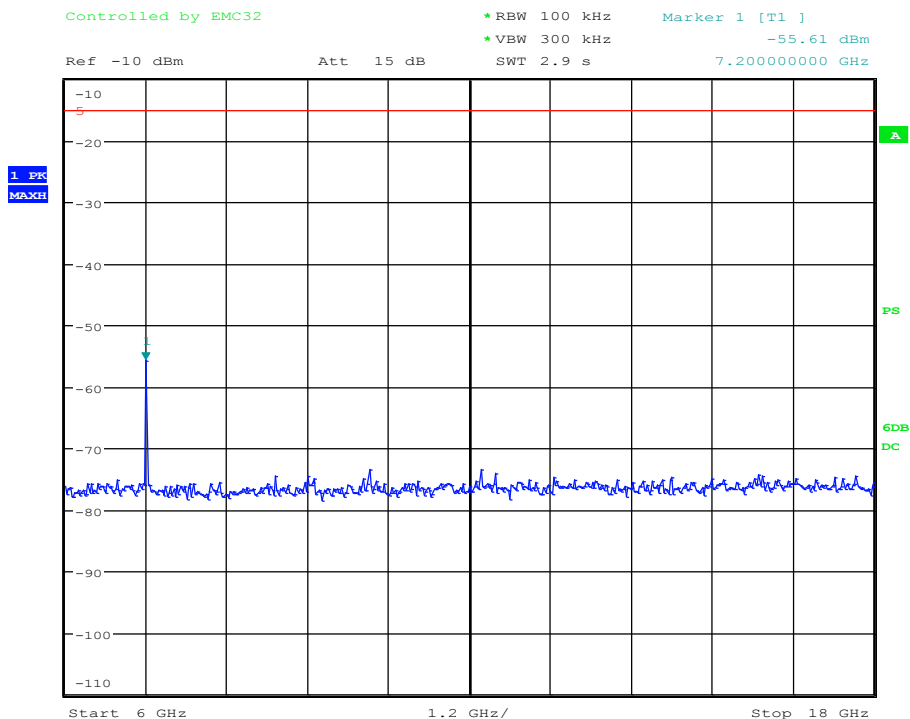


Low Channel, cont'd



Date: 8.NOV.2016 13:02:10

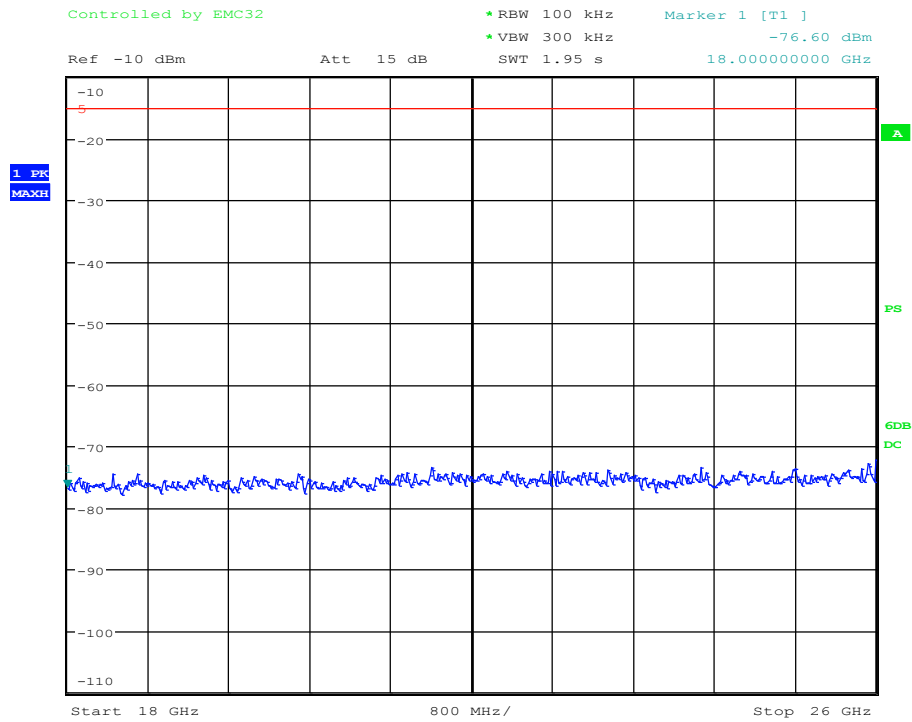
Low Channel, cont'd



Date: 8.NOV.2016 13:02:28



Low Channel, cont'd



Date: 8.NOV.2016 13:02:42

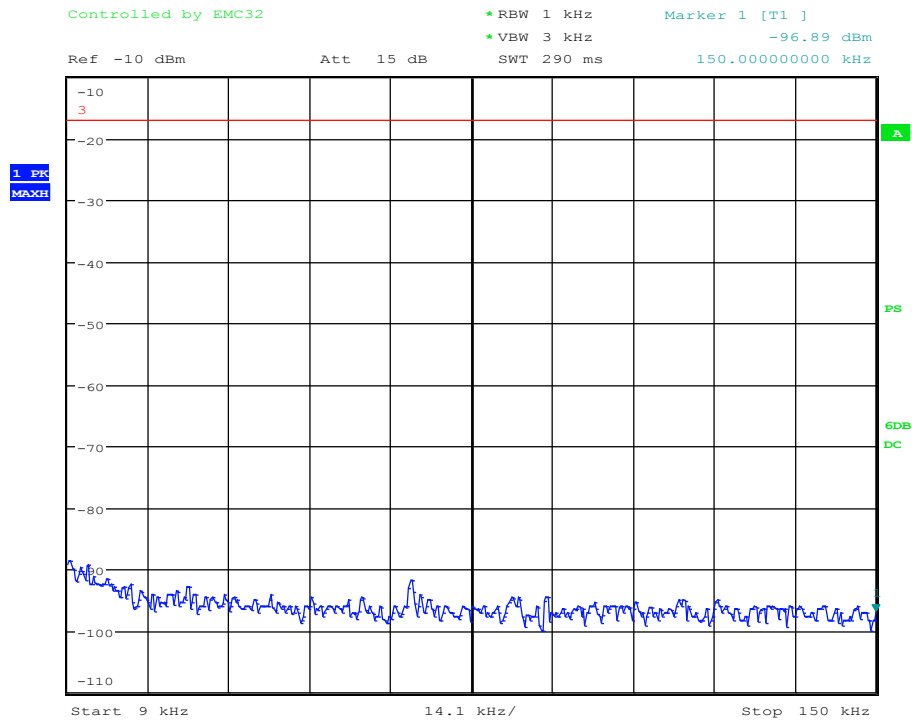


Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

Mid Channel



Date: 8.NOV.2016 13:19:05

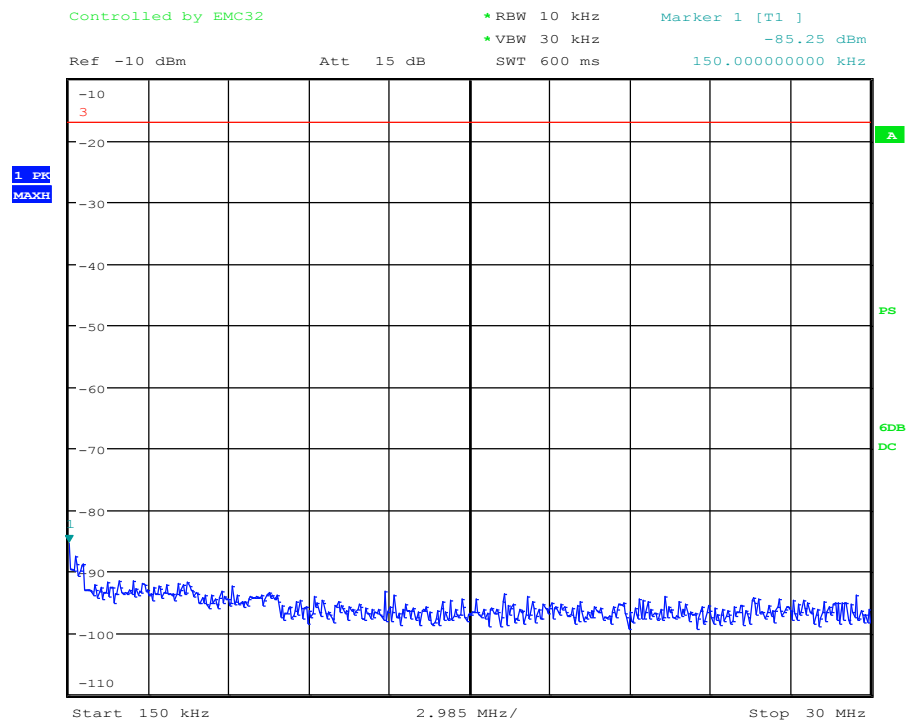


Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

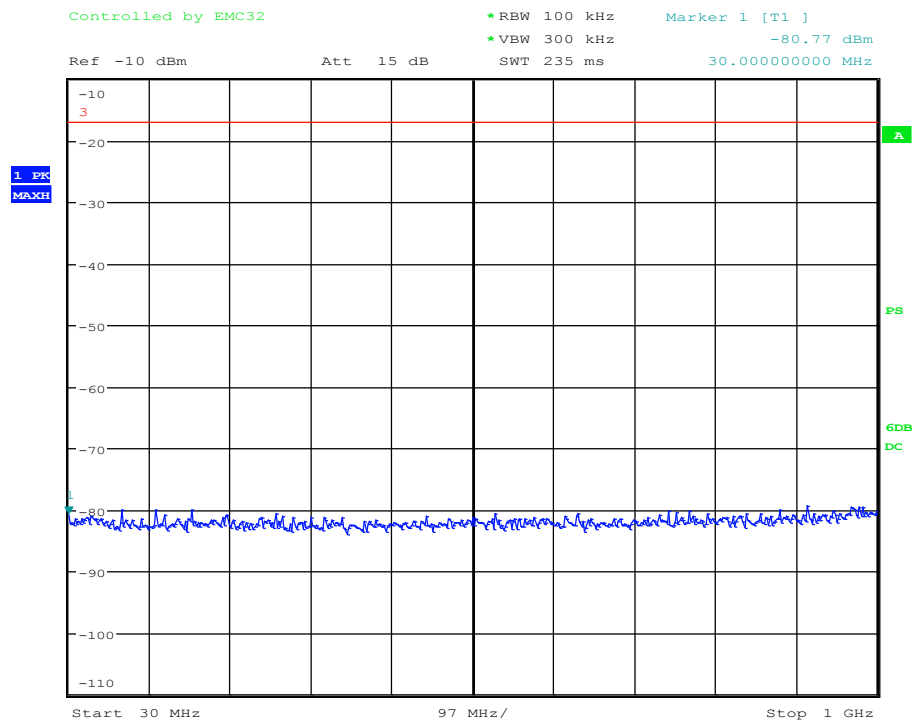
Mid Channel, cont'd



Date: 8.NOV.2016 13:19:29



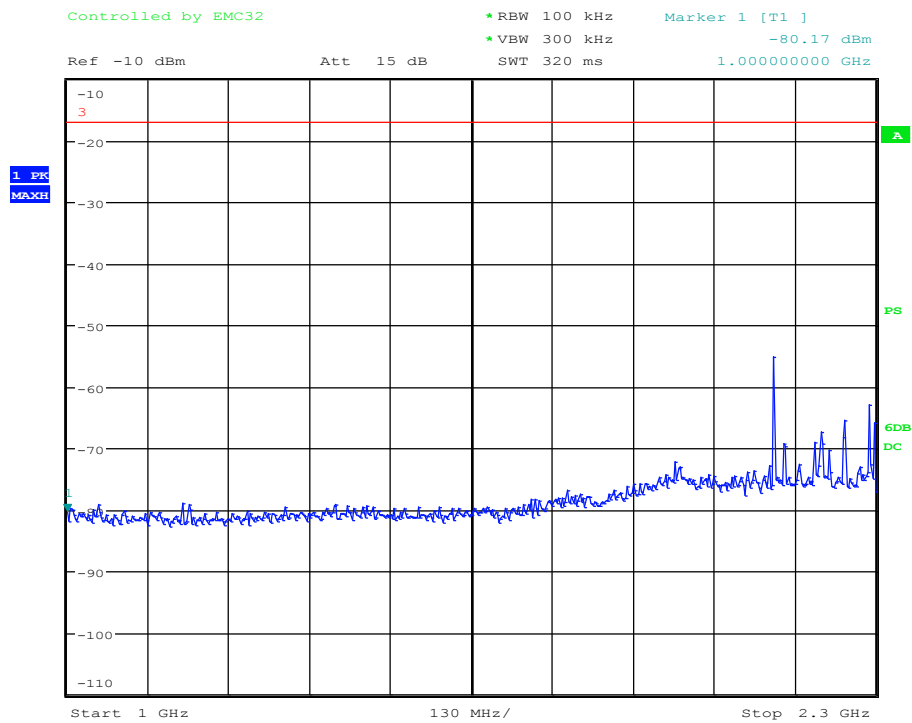
Mid Channel, cont'd



Date: 8.NOV.2016 13:19:47



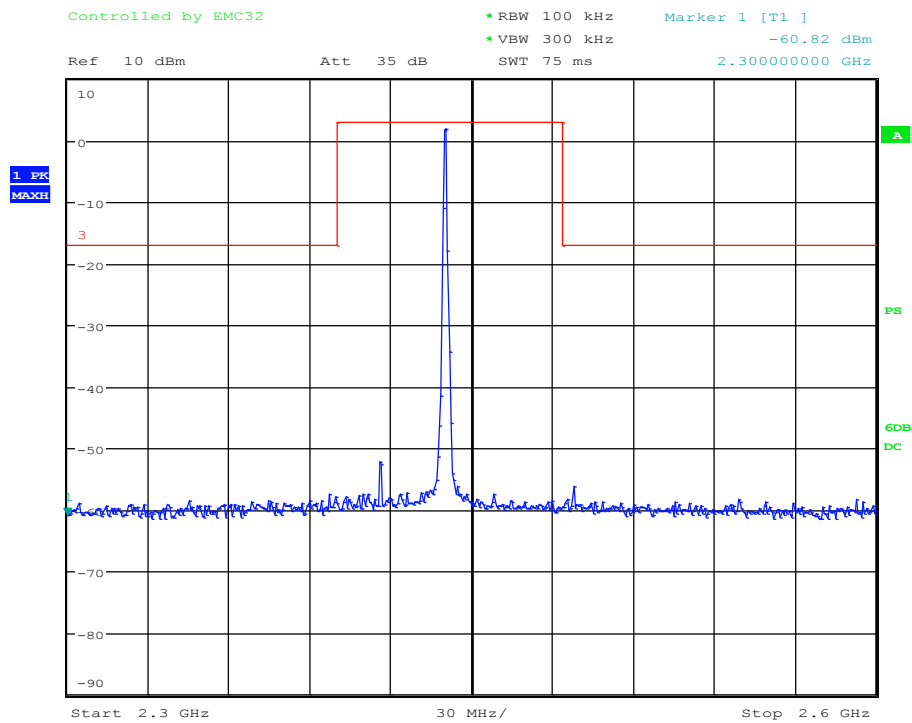
Mid Channel, cont'd



Date: 8.NOV.2016 13:20:08



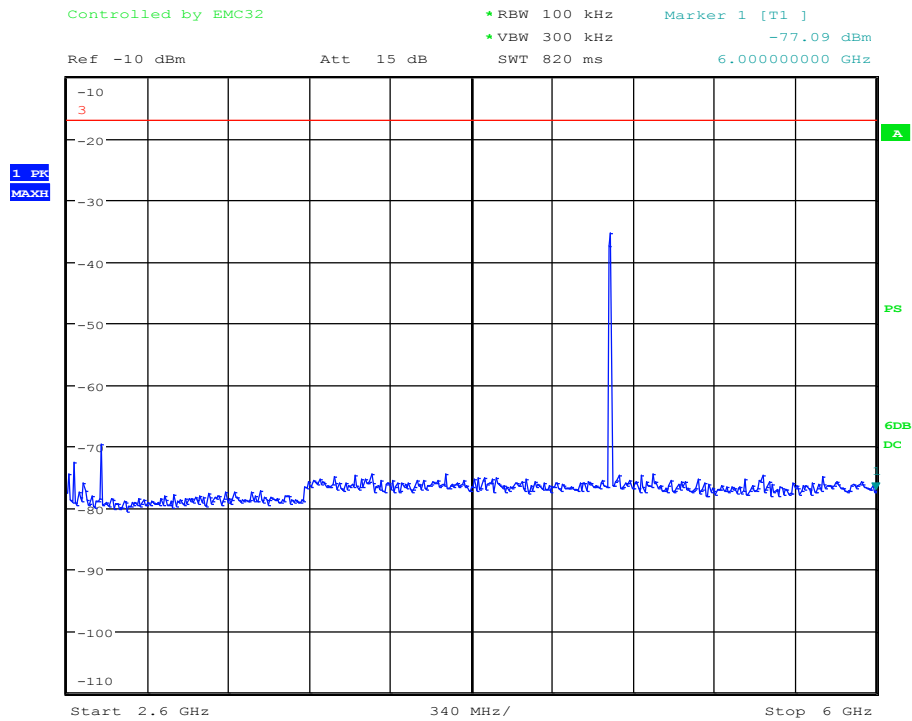
Mid Channel, cont'd



Date: 8.NOV.2016 13:20:26



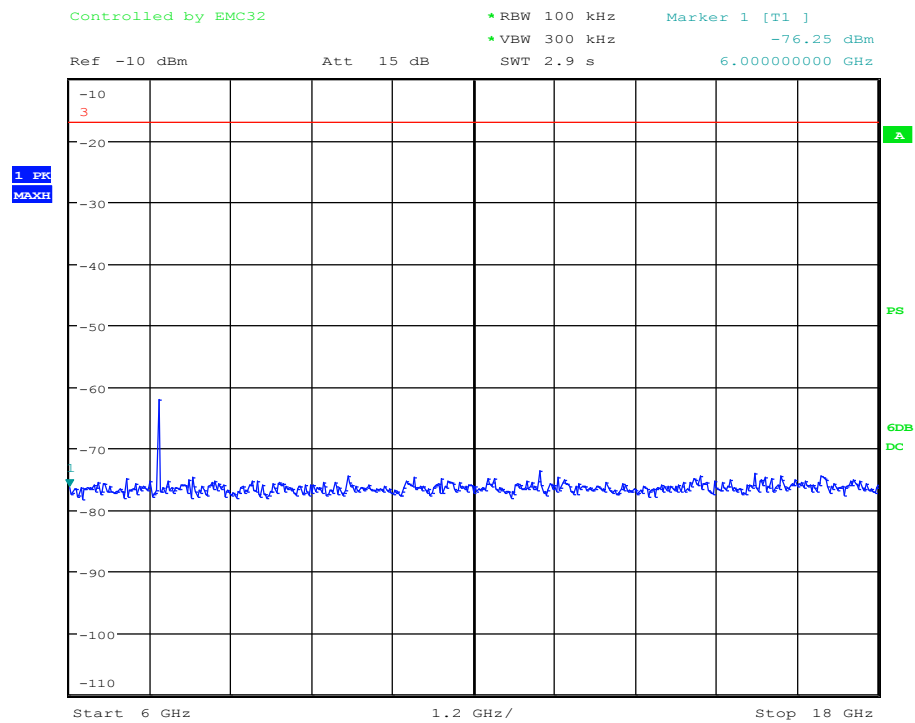
Mid Channel, cont'd



Date: 8.NOV.2016 13:20:53



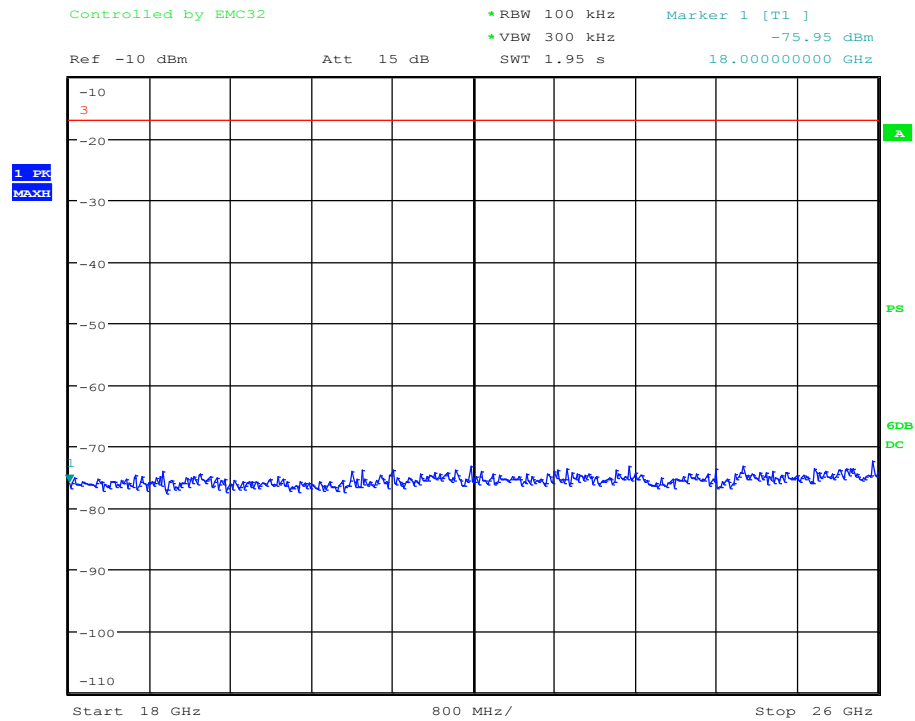
Mid Channel, cont'd



Date: 8.NOV.2016 13:21:08



Mid Channel, cont'd



Date: 8.NOV.2016 13:21:23

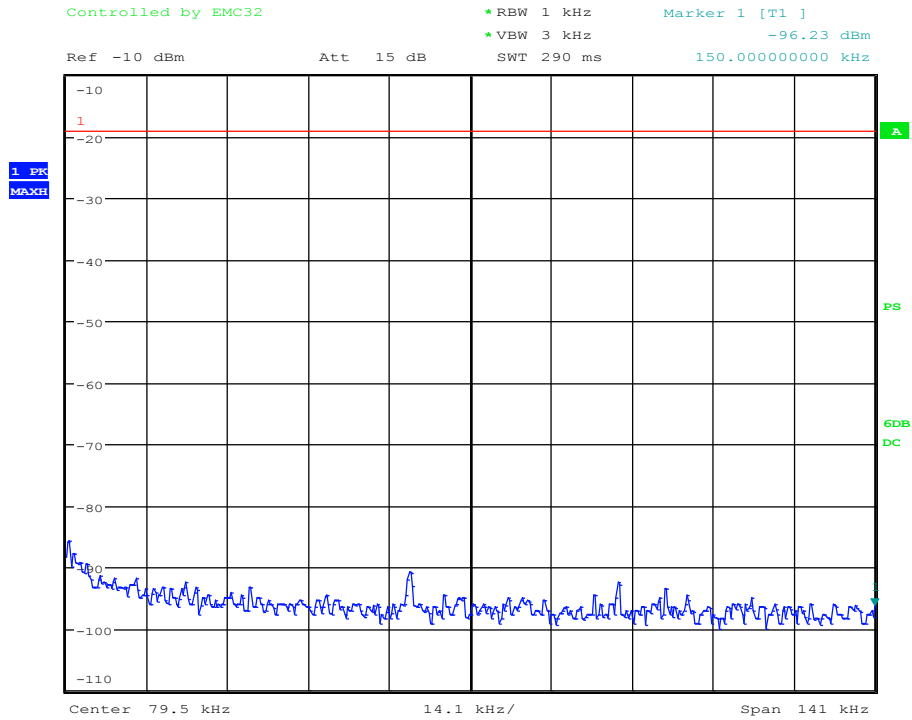


Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

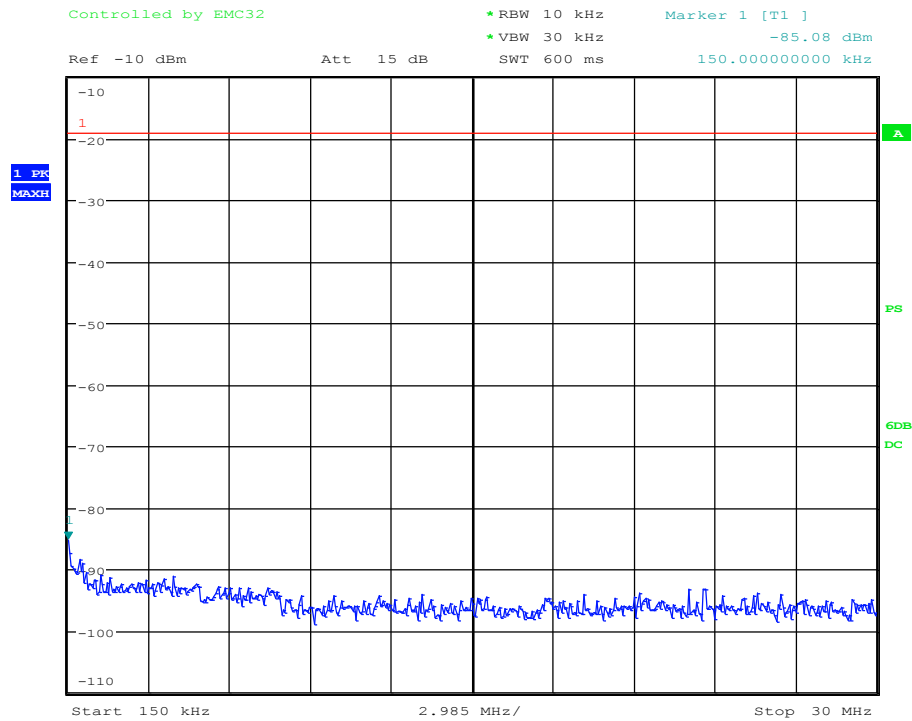
High Channel



Date: 8.NOV.2016 13:28:05



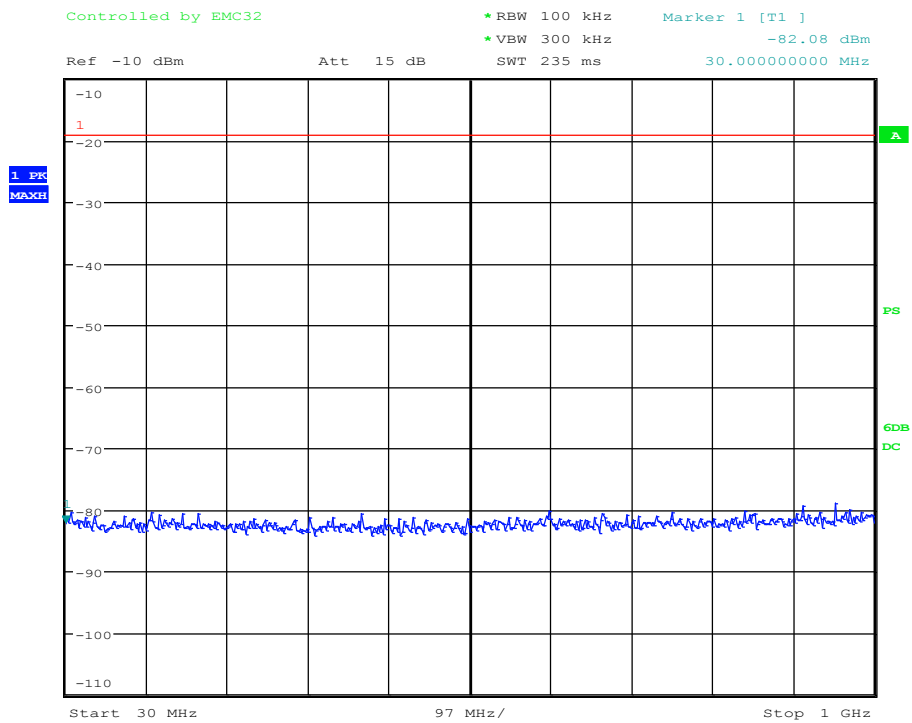
High Channel, cont'd



Date: 8.NOV.2016 13:28:28



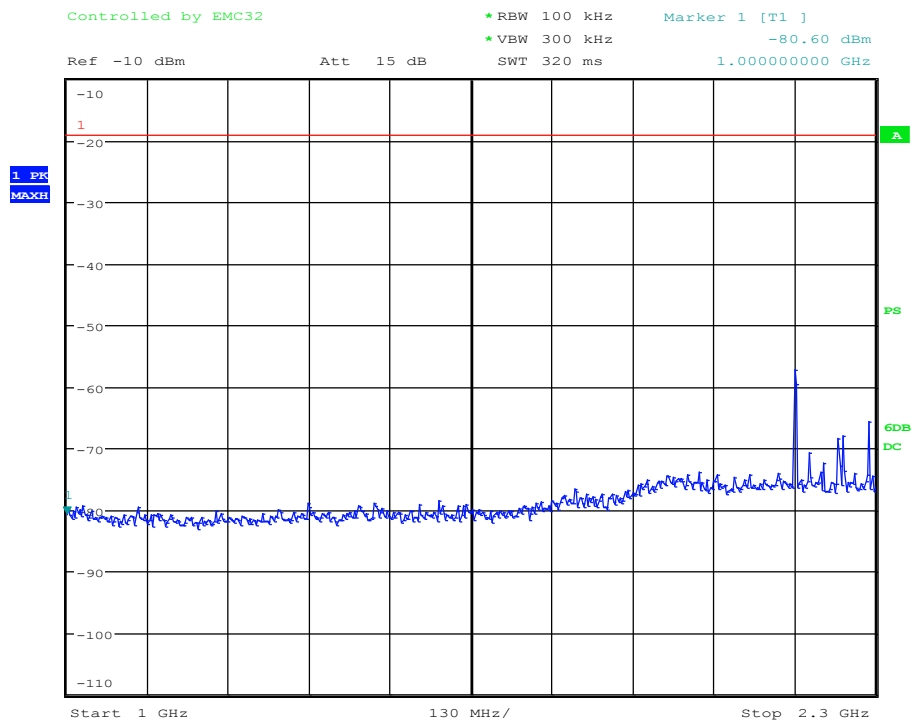
High Channel, cont'd



Date: 8.NOV.2016 13:28:46



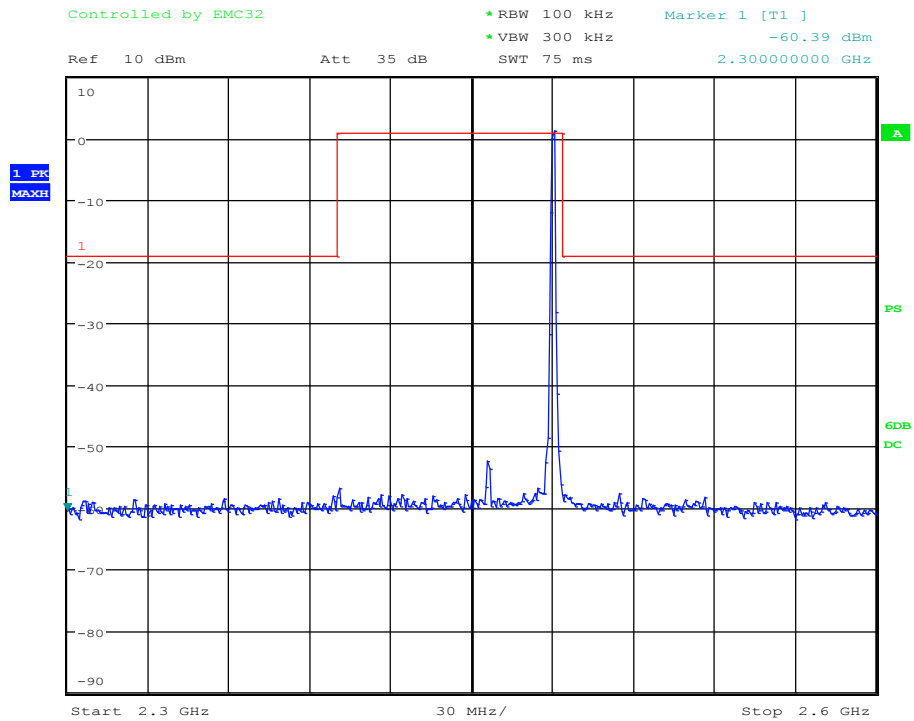
High Channel, cont'd



Date: 8.NOV.2016 13:28:55



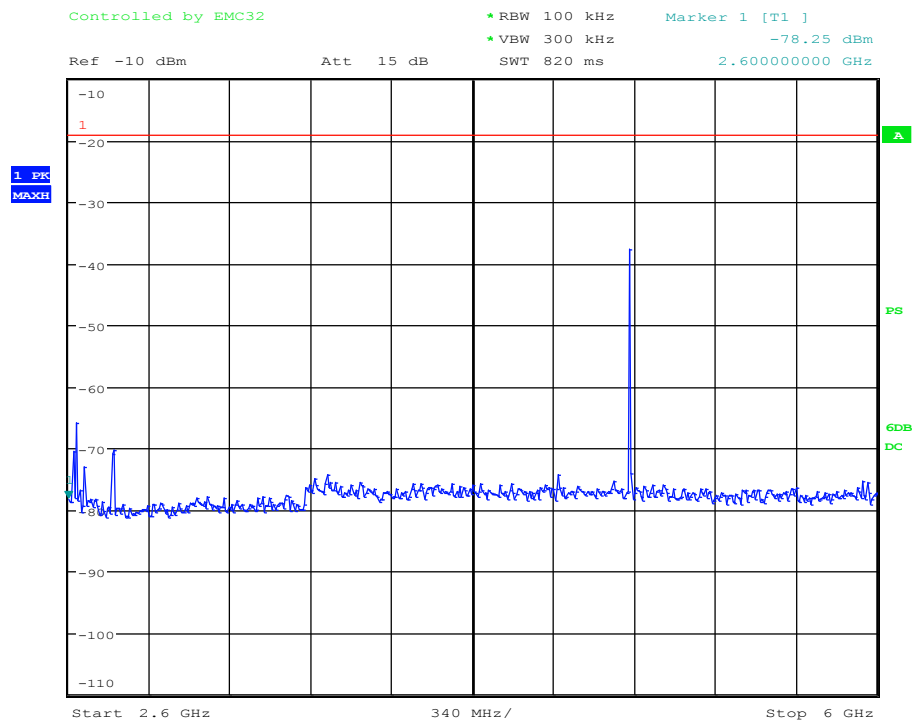
High Channel, cont'd



Date: 8.NOV.2016 13:29:11



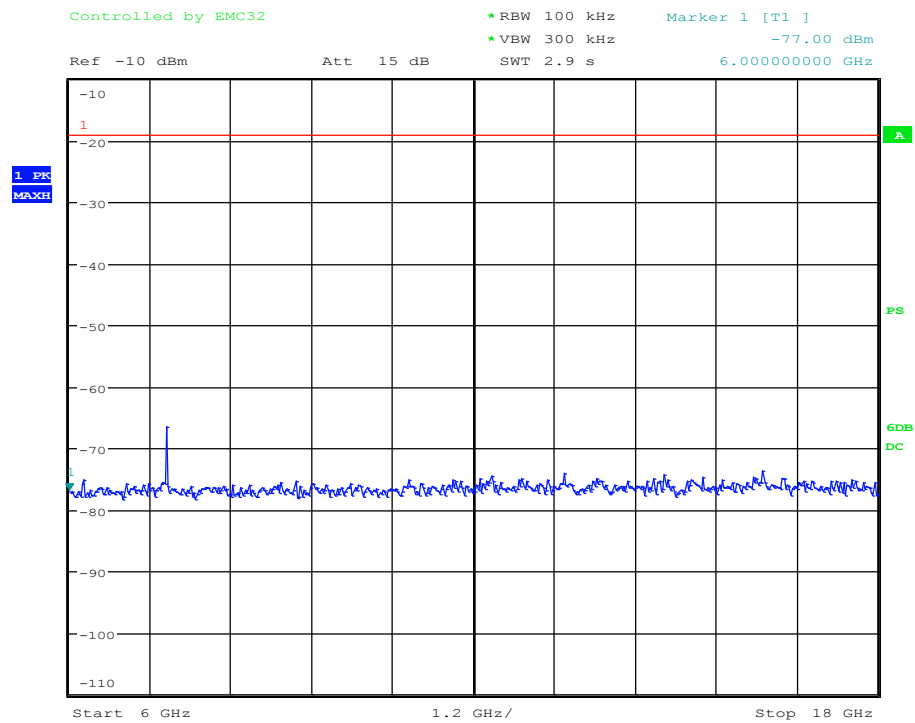
High Channel, cont'd



Date: 8.NOV.2016 13:29:24



High Channel, cont'd



Date: 8.NOV.2016 13:29:40

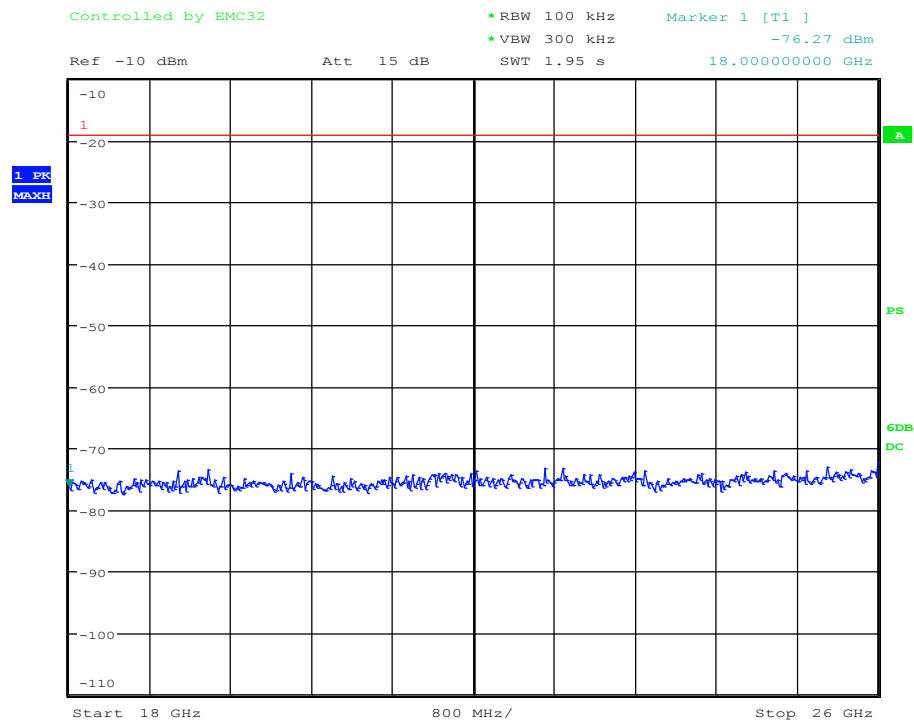


Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

High Channel, cont'd



Date: 8.NOV.2016 13:29:55



10 RADIATED SPURIOUS EMISSION

The EUT antenna port was fitted with its integral/internal chip antenna. Radiated emissions were measured in a Semi-Anechoic Chamber. All emissions generated that fall in the restricted bands per FCC Part 15.205 were examined.

10.1 Requirements:

All emissions that fall in the restricted bands defined in FCC Part 15.205 shall not exceed the maximum field strength listed in FCC Part 15.209(a).



10.2 Radiated Spurious Emission Test Data

Test Date(s):	Nov. 7-9, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	Air Temperature:	20.2°C
		Relative Humidity:	46%

The equipment was fully exercised w and was positioned in a 3-meter semi-anechoic chamber and rotated in all 3 orthogonal positions for maximum emissions. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities for frequencies above 30MHz, and all three orientations of the loop antenna were scanned to determine worst case emission while the turntable was adjusted 360 degrees to determine the maximum field strength. The tables of measured results can be found below.

Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit.

**Measurements****Low Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	200.00	92.00	38.0	-4.4	33.60	74.0	-40.4
2483.500000	V	200.00	92.00	38.7	-4.2	34.50	74.0	-39.5
4804.000000	V	200.00	92.00	43.8	-3.8	40.00	74.0	-34.0
7206.000000	V	200.00	92.00	40.8	-3.9	36.90	74.0	-37.1
2390.000000	H	174.00	50.00	38.4	-4.4	34.00	74.0	-40.0
2483.500000	H	174.00	50.00	38.7	-4.2	34.50	74.0	-39.5
4804.000000	H	174.00	50.00	42.4	-3.8	38.60	74.0	-35.4
7206.000000	H	174.00	50.00	40.8	-3.9	36.90	74.0	-37.1

Low Channel - Average

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	200.00	92.00	25.0	-4.4	20.60	54.0	-33.4
2483.500000	V	200.00	92.00	25.3	-4.2	21.10	54.0	-32.9
4804.000000	V	200.00	92.00	32.9	-3.8	29.10	54.0	-24.9
7206.000000	V	200.00	92.00	27.8	-3.9	23.90	54.0	-30.1
2390.000000	H	174.00	50.00	25.2	-4.4	20.80	54.0	-33.2
2483.500000	H	174.00	50.00	25.2	-4.2	21.00	54.0	-33.0
4804.000000	H	174.00	50.00	29.8	-3.8	26.00	54.0	-28.0
7206.000000	H	174.00	50.00	27.6	-3.9	23.70	54.0	-30.3



Mid Channel - MaxPeak

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2390.000000	H	100.00	0.00	39.1	-4.4	34.70	74.0	-39.3
2483.500000	H	100.00	0.00	38.7	-4.2	34.50	74.0	-39.5
4880.000000	H	100.00	4.00	42.4	-3.5	38.90	74.0	-35.1
7320.000000	H	100.00	0.00	41.5	-3.6	37.90	74.0	-36.1
2390.000000	V	320.00	85.00	38.4	-4.4	34.00	74.0	-40.0
2483.500000	V	320.00	85.00	38.1	-4.2	33.90	74.0	-40.1
4880.000000	V	320.00	85.00	42.1	-3.5	38.60	74.0	-35.4
7320.000000	V	320.00	85.00	41.2	-3.6	37.60	74.0	-36.4

Mid Channel - Average

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dB μ V)	Cable Loss & Antenna Factor (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2390.000000	H	100.00	0.00	25.1	-4.4	20.70	54.0	-33.3
2483.500000	H	100.00	0.00	25.3	-4.2	21.10	54.0	-32.9
4880.000000	H	100.00	4.00	30.2	-3.5	26.70	54.0	-27.3
7320.000000	H	100.00	0.00	27.7	-3.6	24.10	54.0	-29.9
2390.000000	V	320.00	85.00	25.0	-4.4	20.60	54.0	-33.4
2483.500000	V	320.00	85.00	25.3	-4.2	21.10	54.0	-32.9
4880.000000	V	320.00	85.00	28.3	-3.5	24.80	54.0	-29.2
7320.000000	V	320.00	85.00	27.7	-3.6	24.10	54.0	-29.9

**High Channel - MaxPeak**

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2483.500000	H	280.00	45.00	38.1	-4.2	33.90	74.0	-40.1
2390.000000	H	280.00	45.00	38.1	-4.4	33.70	74.0	-40.3
4960.000000	H	280.00	45.00	41.1	-3.2	37.90	74.0	-36.1
7440.000000	H	280.00	45.00	40.1	-3.3	36.80	74.0	-37.2
2390.000000	V	200.00	92.00	38.0	-4.4	33.60	74.0	-40.4
2483.500000	V	200.00	92.00	38.0	-4.2	33.80	74.0	-40.2
4960.000000	V	200.00	92.00	44.8	-3.2	41.60	74.0	-32.4
7440.000000	V	200.00	92.00	40.6	-3.3	37.30	74.0	-36.7

High Channel - Average

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2483.500000	H	280.00	45.00	25.3	-4.2	21.10	54.0	-32.9
2390.000000	H	280.00	45.00	25.0	-4.4	20.60	54.0	-33.4
4960.000000	H	280.00	45.00	28.2	-3.2	25.00	54.0	-29.0
7440.000000	H	280.00	45.00	27.7	-3.3	24.40	54.0	-29.6
2390.000000	V	200.00	92.00	25.0	-4.4	20.60	54.0	-33.4
2483.500000	V	200.00	92.00	25.4	-4.2	21.20	54.0	-32.8
4960.000000	V	200.00	92.00	35.7	-3.2	32.50	54.0	-21.5
7440.000000	V	200.00	92.00	27.8	-3.3	24.50	54.0	-29.5



11 FCC PART 15.247(e) – PEAK POWER SPECTRAL DENSITY (PSD)

Peak power spectral density measurements were performed.

11.1 Requirements:

The peak power spectral density shall not exceed +8dBm in any 3 kHz band during any time interval of continuous transmission.

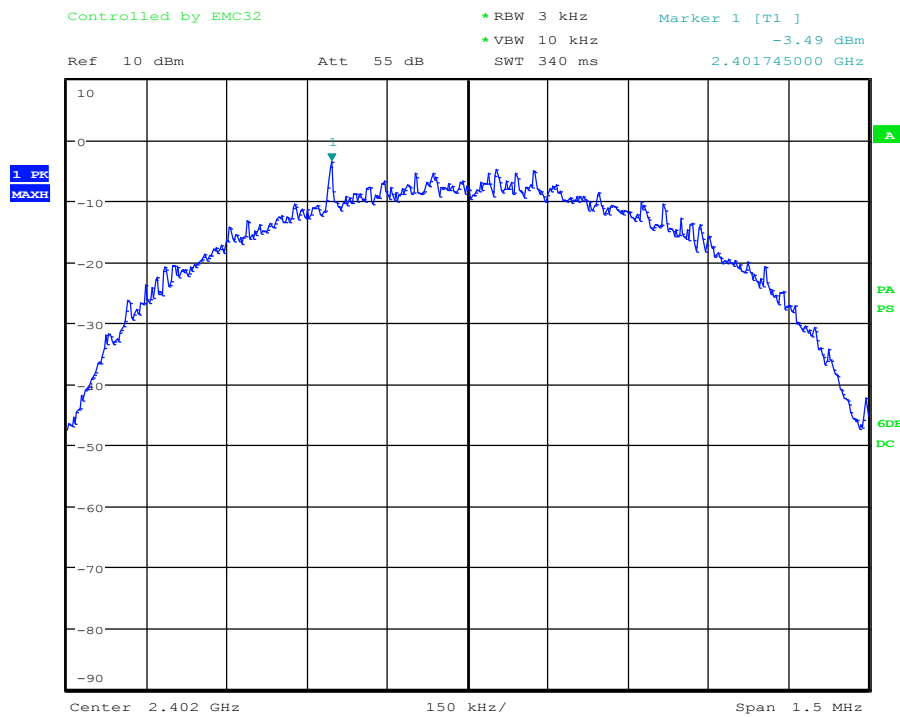
Power spectral density measurements were performed at a resolution bandwidth of 3 kHz (video bandwidth set at 10 kHz). The peak spectral densities were measured at the low, mid, and upper channels.



11.2 Peak Power Spectral Density Test Data

Test Date(s):	Nov. 8, 2016	Test Engineer:	J. Knepper
Standards:	CFR 47 Part 15.247(e); KDB558074	Air Temperature:	20.4°C
		Relative Humidity:	47%

Low Channel



Date: 8.NOV.2016 12:58:52

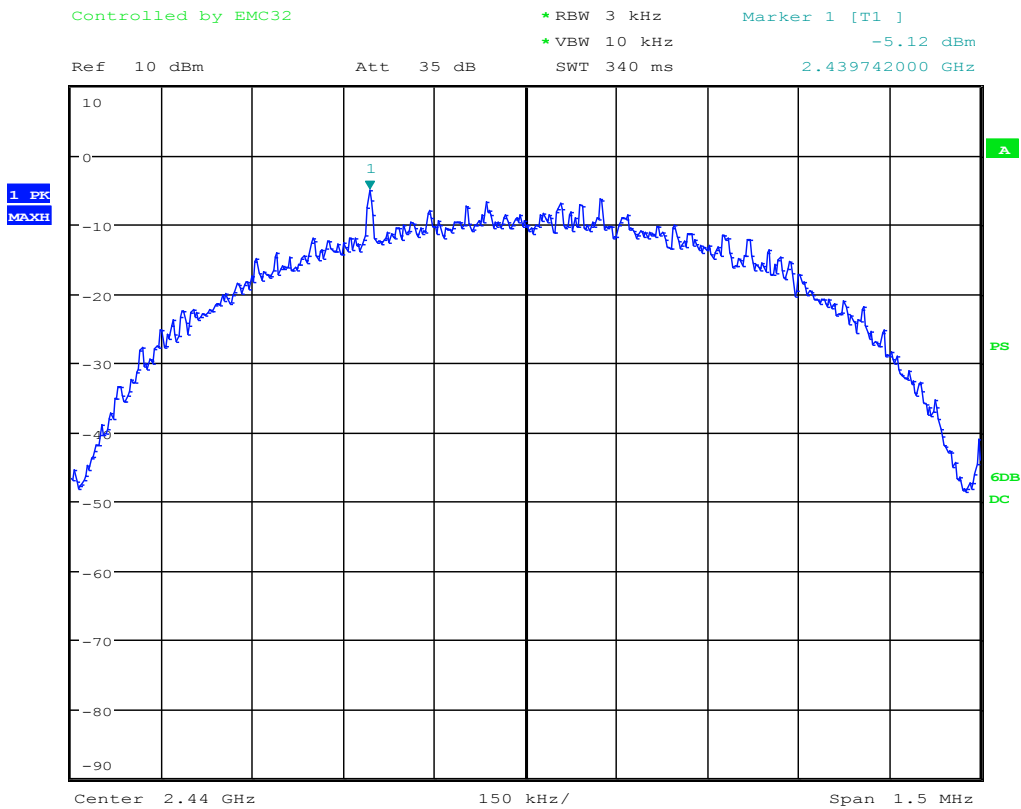


Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

Mid Channel



Date: 8.NOV.2016 13:11:19

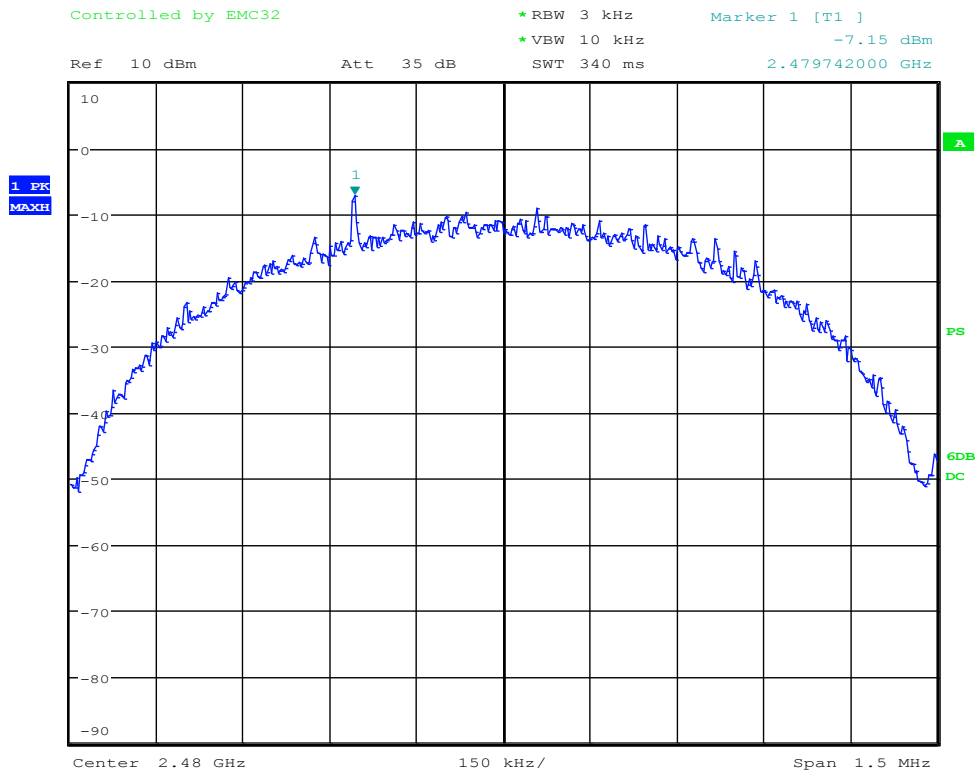


Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

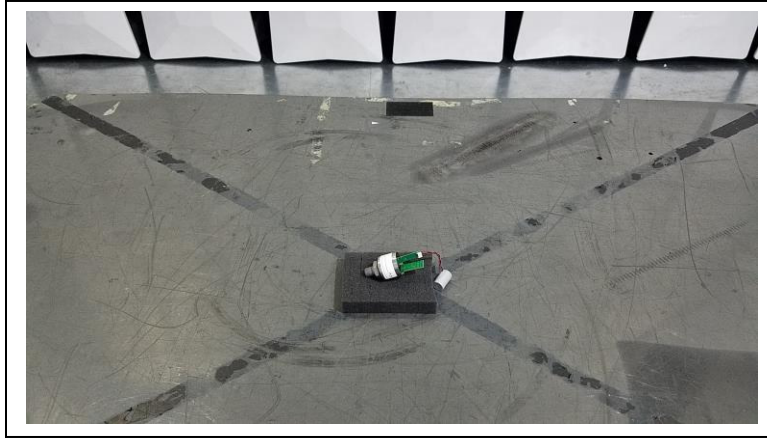
High Channel



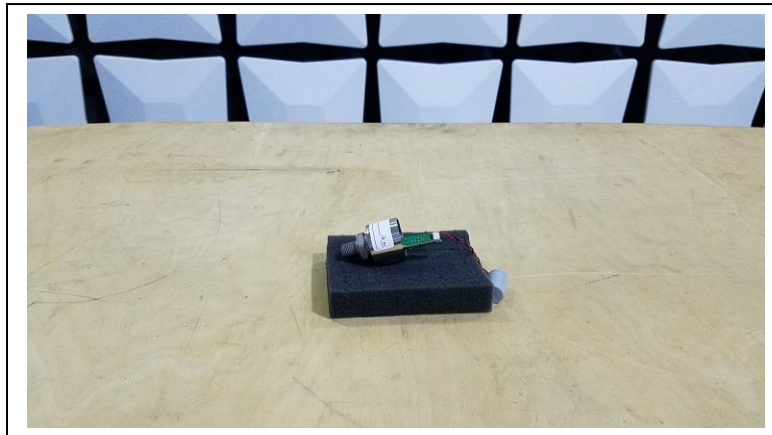
Date: 8.NOV.2016 13:25:58

12 PHOTOGRAPHS/EXHIBITS

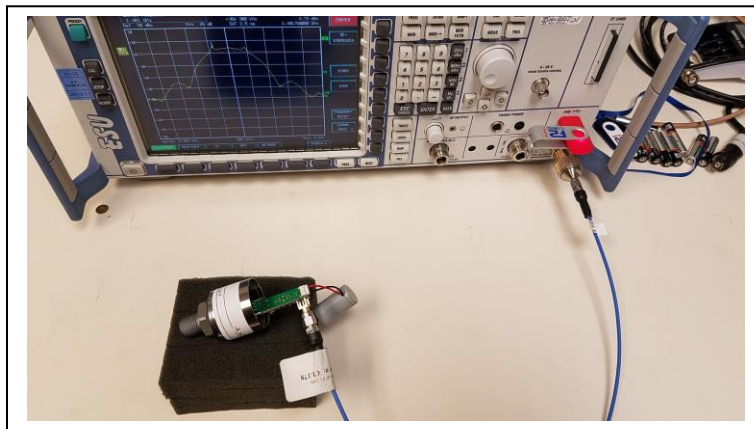
Radiated Spurious Emissions, <1 GHz



Radiated Spurious Emissions, >1 GHz



Conducted Output Power, Peak Power Spectral Density, Occupied Bandwidth, and Conducted Spurious Emissions





Order Number: F2LQ8686B

Applicant: Transducers Direct, LLC

Model: TDWLBG2

13.0 PRODUCT FAMILY IDENTIFICATION

Series	Pressure Range	Pressure Connection	Accuracy	
TDWLB	0100 (psi)	03	4	**
	0050	03= 1/4" NPT Male	4 = 1.0%	
	0100	09= 7/16-20 UNF Male	2 = 0.25%	
	0250	13= G1/4 Male		
	0500	42= 7/16-20 UNF		
	0650	Female		
	1000	w/ 45° flare & valve		
	3000	depressor		
	5000	(Schrader)		
	010K	**		
	**	**= Consult factory for further OEM options.		