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SPURIOUS EMISSIONS TEST REPORT

Manufacturer: Knox Company
1601 West Deer Valley Road
Phoenix, Arizona 85027 USA

Applicant: Same as Above

Product Name: Radio Module

Product Description: Radio Module

Model: CC3100MODR11MAMOB

FCC ID: 2AOVI-KNOX-RAS

**Operating Voltage/Freq.
of EUT During Testing:** USB-5V

Testing Commenced: 2021-12-14

Testing Ended: 2021-12-15

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 and/or manufacturer's statement. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Note: Test report reflects a check to verify that spurious emissions levels have not increased from the module's certification. Wireless transmitter is pre-certified; testing was performed due to change in antenna.

Standards:

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



Order Number: F2P26850B

Applicant: Knox Company
Model: CC3100MODR11MAMOB

Evaluation Conducted by:

Julius Chiller, EMC/Wireless Engineer

Report Reviewed by:

Ken Littell, Vice President of EMC

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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	±5.07dB	±2.54
Radiated Emissions <1 GHz @10m	±5.09dB	±2.55
Radiated Emissions 1 GHz to 2.7 GHz	±3.62dB	±1.81
Radiated Emissions 2.7 GHz to 18 GHz	±3.10dB	±1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	±2.76dB	±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
F2P26850B-01E	First Issue	2021-12-16	K. Littell



2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
Radiated Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies

Modifications Made to the Equipment
None



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Model: CC3100MODR11MAMOB

3 ENGINEERING STATEMENT

This report has been prepared on behalf of Knox Company 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.



4 EUT INFORMATION AND DATA

4.1 Equipment Under Test:

Product: Radio Module

Model: **CC3100MODR11MAMOB**

Serial No.: 001-A04798

FCC ID: **2AOVI-KNOX-RAS**

4.2 Trade Name:

Knox Company

4.3 Power Supply:

FSP Group Inc. FSPO84-DIBAN2

4.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

4.5 Equipment Category:

Radio Transmitter-DTS

4.6 Antenna:

Dipole:

Laird CAF94505, 2dBi gain

Taoglas FXP840.07.0055B, 3.3dBi gain

4.7 Accessories:

Device	Manufacturer	Model Number	Serial Number
Laptop	Dell	Latitude 7490	10075

4.8 Test Item Condition:

The equipment to be tested was received in good condition.

4.9 Testing Algorithm:

EUT was tested for spurious emission from 9kHz to 26 GHz. Measurements were made with the radio continuously transmitting on channels 1, 6 and 11 of the 2.4 GHz Wi-Fi, using two different antennas.

**5 LIST OF MEASUREMENT INSTRUMENTATION**

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166-E	Albatross Projects	B83117-DF435-T261	US140023	2022-03-09
Temp/Hum. Recorder	CL232	Extech	445814	01	2022-03-04
Receiver	CL151	Rohde & Schwarz	ESU40	100319	2022-07-08
Low Loss Cable Set	--	Pasternack	PE3C0666-252 / PE3C066-50CM	None Spec.	2023-10-12
Antenna, Horn	CL114	A. H. Systems, Inc.	SAS-572	237	2023-07-30
Pre-Amplifier	CL153	Keysight Tech.	83006A	MY39500791	2022-02-12
Pre-Amplifier	CL285	Com-Power	PAM-0207	322	2022-07-08
Active 18" Loop Antenna	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	2022-09-14
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	2022-09-14
Horn Antenna	CL098	Emco	3115	9809-5580	2022-01-08
Software:	Tile Version 3.4.B.3		Software Verified: 2021-12-14 to 2021-12-15		
Software:	EMC 32, Version 8.53.0		Software Verified: 2021-12-14 to 2021-12-15		



6 RADIATED SPURIOUS EMISSION

The EUT antenna port was fitted with a Dipole Antenna, 2dBi Gain; and then with a Dipole Antenna, 3.3dBi Gain. 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.

6.1 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).



6.2 Radiated Spurious Emission Test Data

Test Date(s):	2021-12-14	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	Air Temperature:	22.2°C
		Relative Humidity:	30%

Notes: Plots are peak, max hold prescan data included only to determine what frequencies to investigate and measure. The EUT was initially placed in a semi-anechoic chamber, and rotated in all three orthogonal positions to maximize the emissions. Characterization measurements were then performed to determine at which frequencies significant emissions occurred. These graphs follow.

The equipment was fully exercised with all cabling attached to the EUT and was positioned on the semi-anechoic chamber 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 while the turntable was adjusted 360 degrees to determine the maximum field strength. The tables of measured results follow.

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.

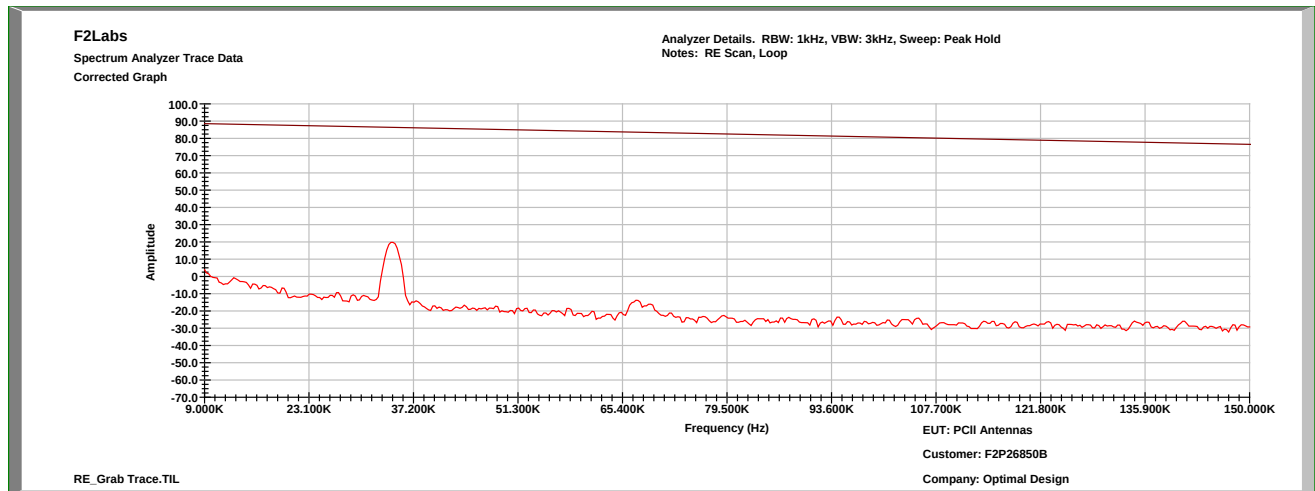
In the following plots, the black line indicates ambient noise and the red line indicates the measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables. The plots are for reference only and the limit lines are not actual limit lines but merely a guide. A scan of high, mid, and low channels were performed and the following graphs are of worse case.



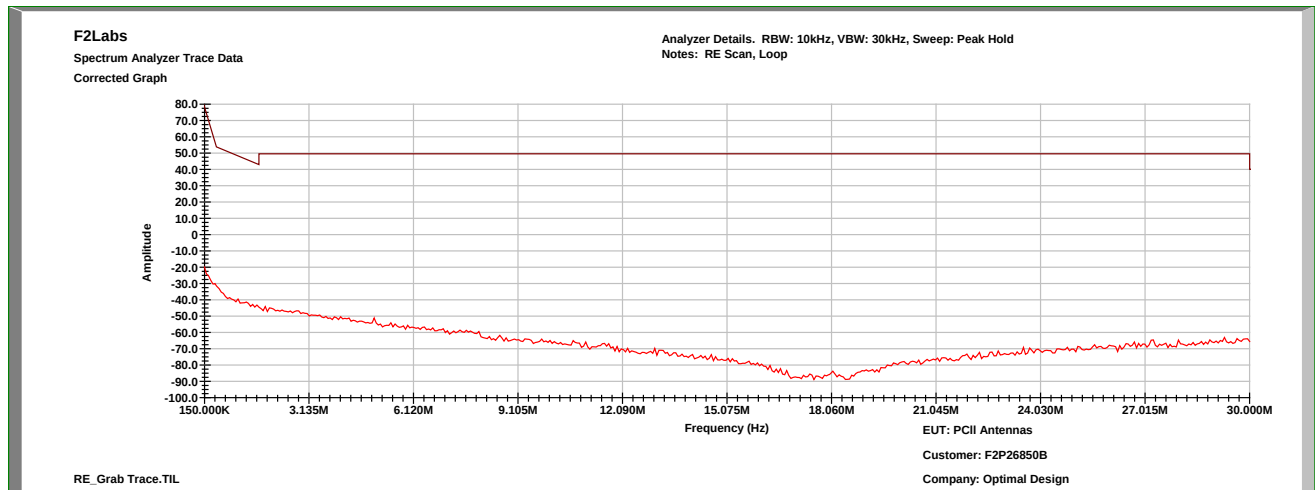
Order Number: F2P26850B

Applicant: Knox Company
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Characterization Scan, 0.009 MHz to 0.15 MHz



Characterization Scan, 0.15 MHz to 30.0 MHz

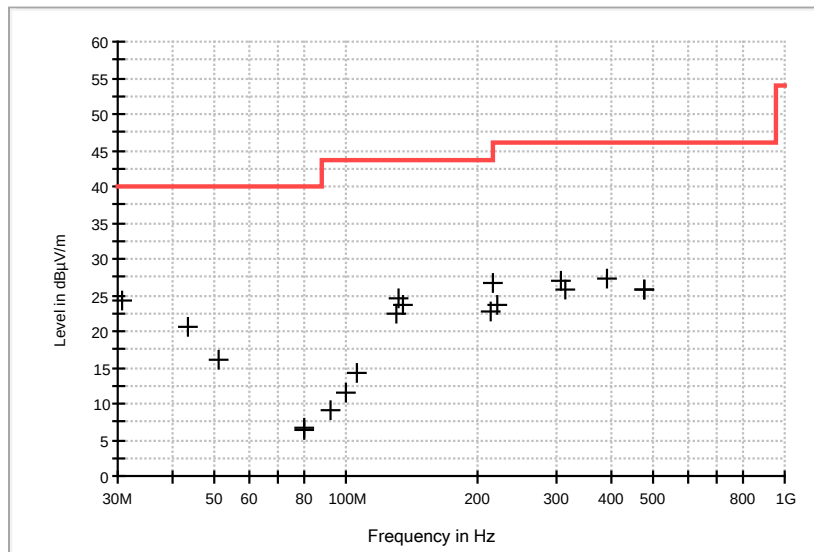




QuasiPeak*

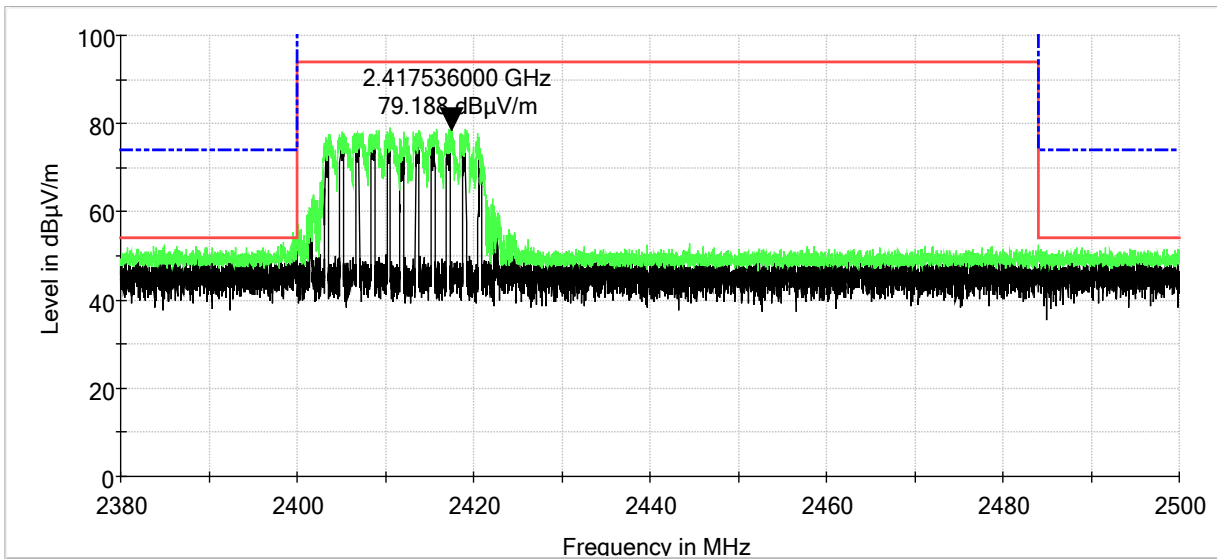
Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.760000	V	25.8	-1.7	24.10	40.0	-15.9
43.600000	V	31.8	-11.2	20.60	40.0	-19.4
50.960000	H	30.6	-14.4	16.20	40.0	-23.8
79.840000	H	21.1	-14.7	6.40	40.0	-33.6
79.840000	V	21.3	-14.7	6.60	40.0	-33.4
91.880000	V	23.7	-14.5	9.20	43.5	-34.3
99.440000	V	23.8	-12.2	11.60	43.5	-31.9
105.680000	V	24.4	-10.3	14.10	43.5	-29.4
129.120000	H	30.7	-8.3	22.40	43.5	-21.1
131.080000	H	32.9	-8.3	24.60	43.5	-18.9
133.800000	H	31.9	-8.4	23.50	43.5	-20.0
212.760000	V	33.4	-10.7	22.70	43.5	-20.8
214.680000	H	37.3	-10.5	26.80	43.5	-16.7
221.080000	V	33.8	-10.3	23.50	46.0	-22.5
309.360000	H	34.0	-7.0	27.00	46.0	-19.0
315.000000	V	21.4	-6.8	14.60	46.0	-31.4
392.600000	H	32.2	-4.9	27.30	46.0	-18.7
480.080000	H	28.0	-2.2	25.80	46.0	-20.2
480.080000	H	28.0	-2.2	25.80	46.0	-20.2

*Contains data from all channels

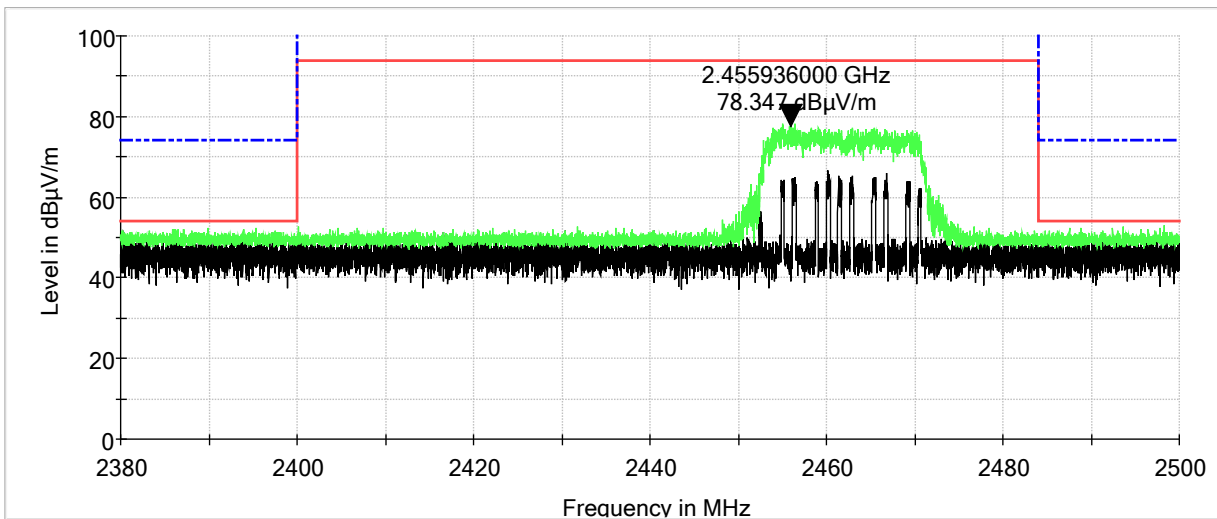




Laird, Band Edge: Vertical Low

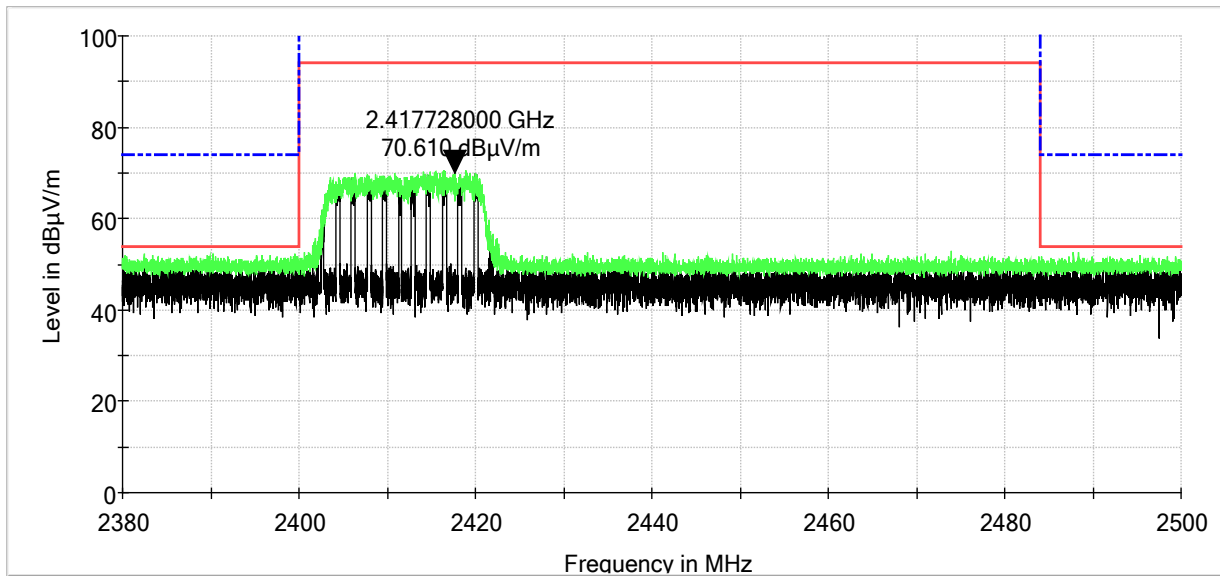


Laird, Band Edge: Vertical High

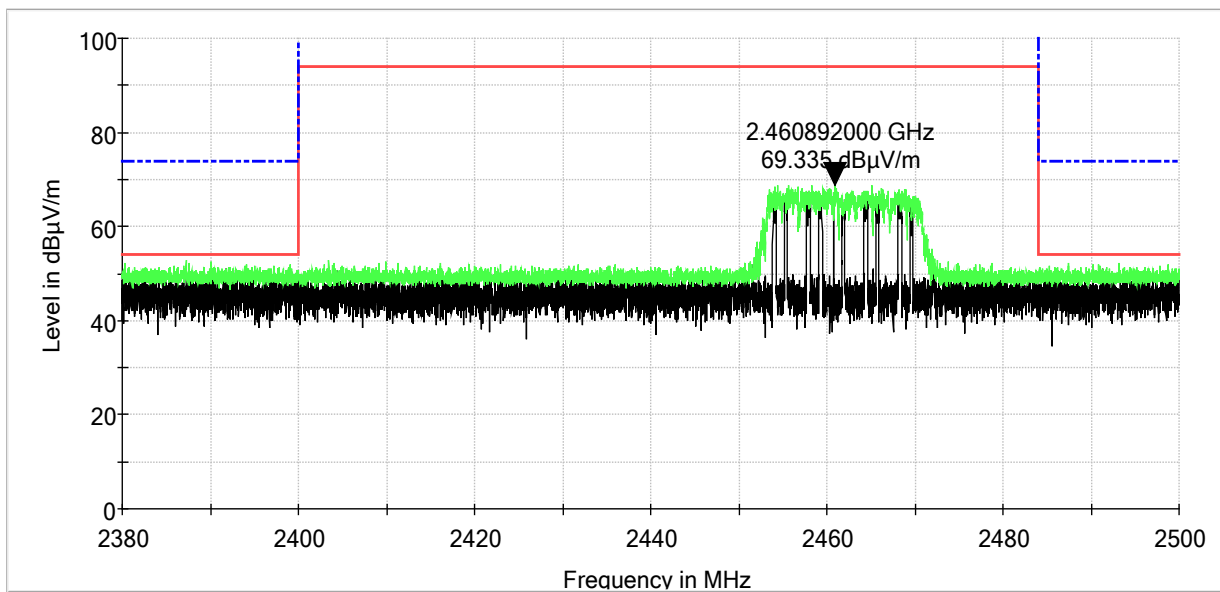




Laird, Band Edge: Horizontal Low



Laird, Band Edge: Horizontal High





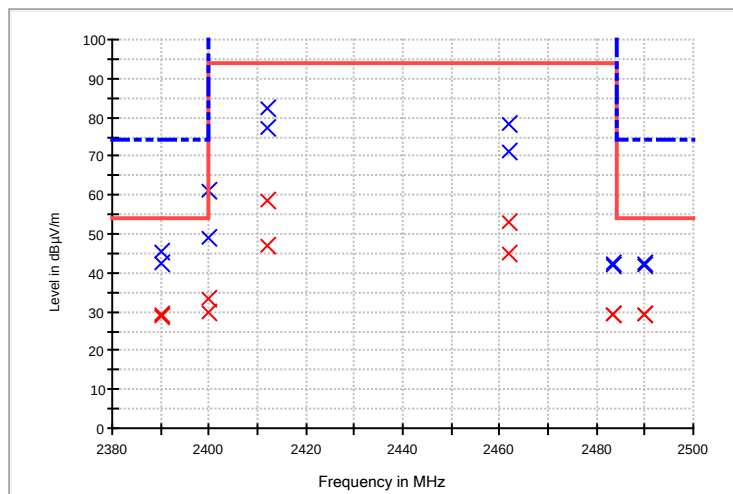
Laird, Band Edge: Measurements

MaxPeak

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	36.4	5.9	42.30	74.0	-31.7
2390.000000	H	39.4	5.9	45.30	74.0	-28.7
2400.000000	H	43.1	5.8	48.90	74.0	-25.1
2400.000000	V	55.6	5.8	61.40	74.0	-12.6
2412.000000	V	76.3	5.8	82.10	-	-
2412.000000	H	71.3	5.8	77.10	-	-
2462.000000	V	72.4	5.8	78.20	-	-
2462.000000	H	65.4	5.8	71.20	-	-
2483.500000	V	36.2	5.8	42.00	74.0	-32.0
2483.500000	H	36.5	5.8	42.30	74.0	-31.7
2490.000000	V	36.3	5.8	42.10	74.0	-31.9
2490.000000	H	36.8	5.8	42.60	74.0	-31.4

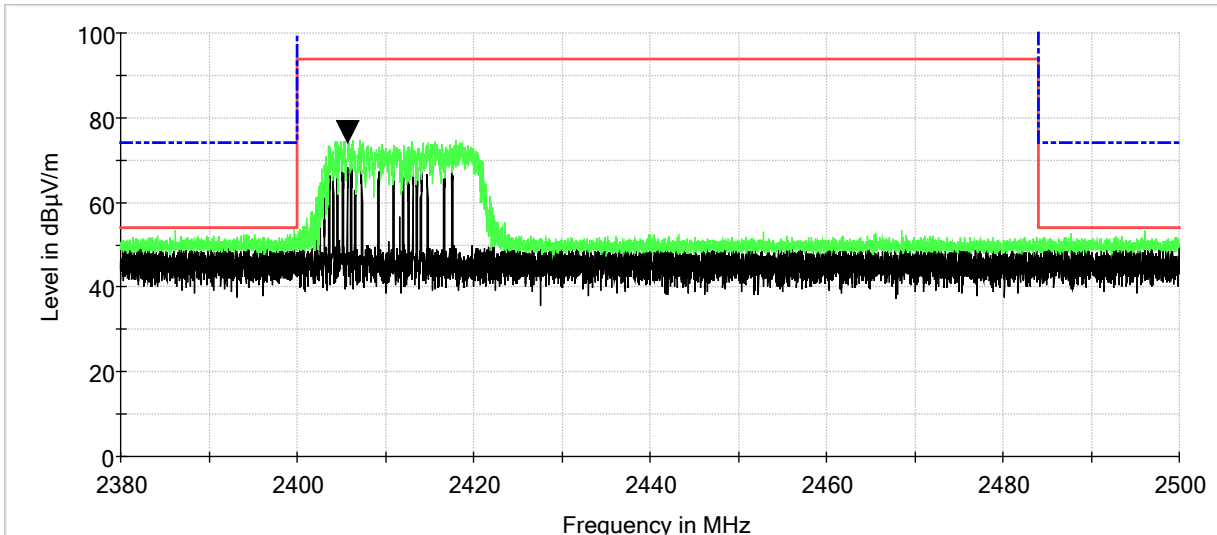
Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	23.4	5.9	29.30	54.0	-24.7
2390.000000	H	23.1	5.9	29.00	54.0	-25.0
2400.000000	H	23.9	5.8	29.70	54.0	-24.3
2400.000000	V	27.6	5.8	33.40	54.0	-20.6
2412.000000	V	52.9	5.8	58.70	-	-
2412.000000	H	41.3	5.8	47.10	-	-
2462.000000	V	47.3	5.8	53.10	-	-
2462.000000	H	39.2	5.8	45.00	-	-
2483.500000	V	23.3	5.8	29.10	54.0	-24.9
2483.500000	H	23.3	5.8	29.10	54.0	-24.9
2490.000000	V	23.3	5.8	29.10	54.0	-24.9
2490.000000	H	23.3	5.8	29.10	54.0	-24.9

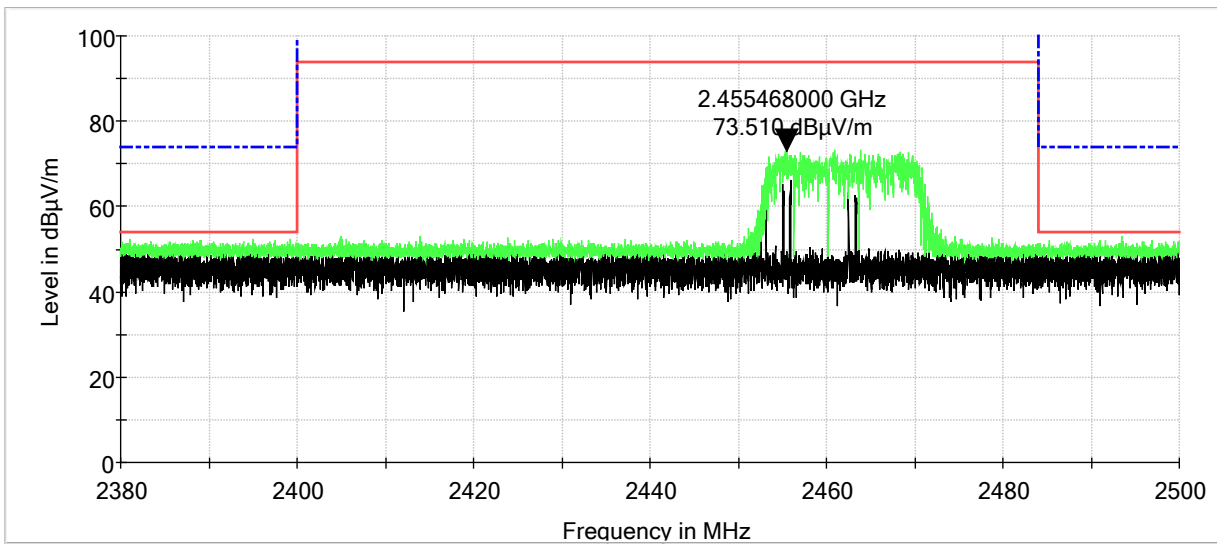




Taoglas, Band Edge: Vertical Low

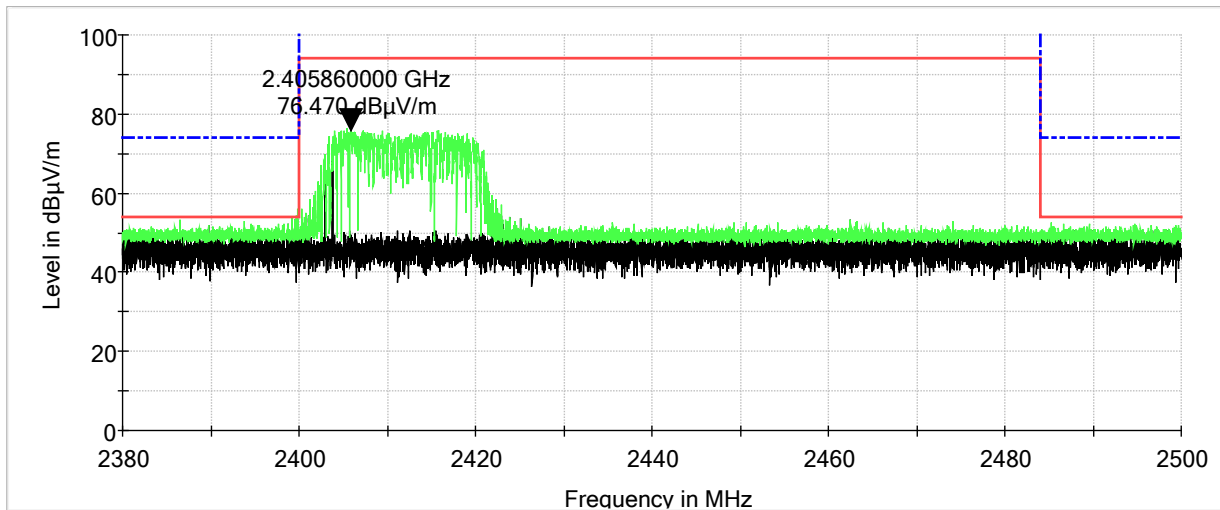


Taoglas, Band Edge: Vertical High

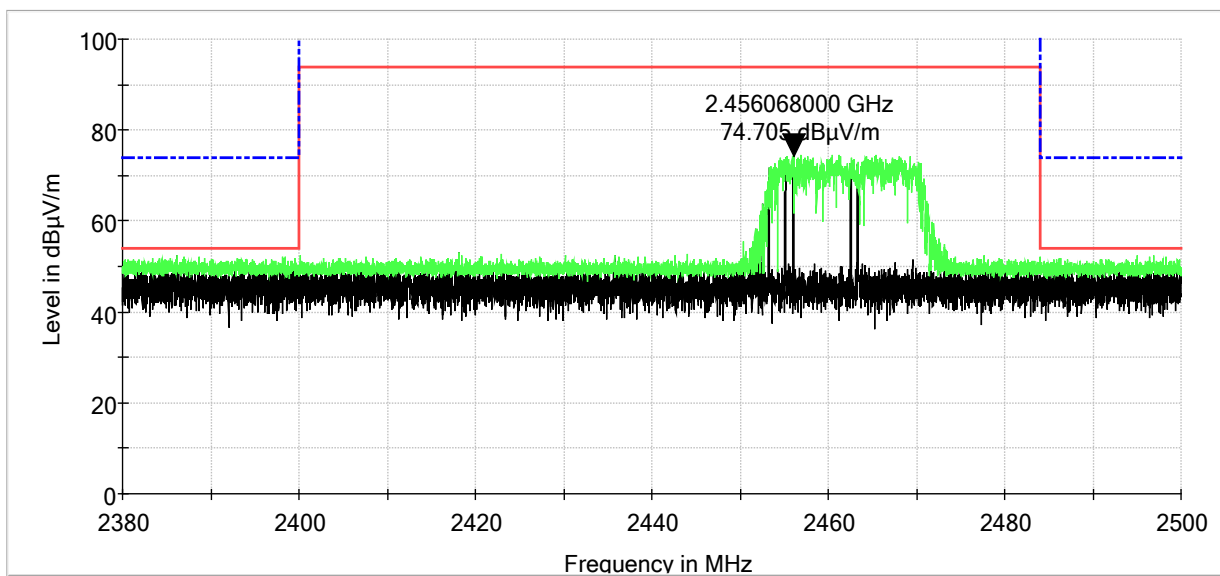




Taoglas, Band Edge: Horizontal Low



Taoglas, Band Edge: Horizontal High





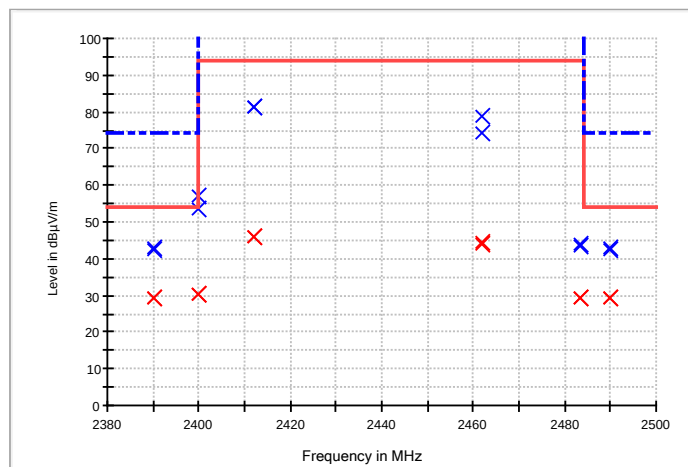
Taoglas, Band Edge: Measurements

MaxPeak

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	36.6	5.9	42.50	74.0	-31.5
2390.000000	H	37.3	5.9	43.20	74.0	-30.8
2400.000000	H	47.5	5.8	53.30	74.0	-20.7
2400.000000	V	51.2	5.8	57.00	74.0	-17.0
2412.000000	V	75.4	5.8	81.20	-	-
2412.000000	H	75.5	5.8	81.30	-	-
2462.000000	V	72.8	5.8	78.60	-	-
2462.000000	H	68.4	5.8	74.20	-	-
2483.500000	V	37.6	5.8	43.40	74.0	-30.6
2483.500000	H	37.9	5.8	43.70	74.0	-30.3
2490.000000	V	36.4	5.8	42.20	74.0	-31.8
2490.000000	H	37.0	5.8	42.80	74.0	-31.2

Average

Frequency (MHz)	Antenna Polarization	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.000000	V	23.4	5.9	29.30	54.0	-24.7
2390.000000	H	23.5	5.9	29.40	54.0	-24.6
2400.000000	H	24.4	5.8	30.20	54.0	-23.8
2400.000000	V	24.4	5.8	30.20	54.0	-23.8
2412.000000	V	40.1	5.8	45.90	54.0	-8.1
2412.000000	H	40.0	5.8	45.80	54.0	-8.2
2462.000000	V	37.9	5.8	43.70	54.0	-10.3
2462.000000	H	38.5	5.8	44.30	54.0	-9.7
2483.500000	V	23.6	5.8	29.40	54.0	-24.6
2483.500000	H	23.7	5.8	29.50	54.0	-24.5
2490.000000	V	23.6	5.8	29.40	54.0	-24.6
2490.000000	H	23.7	5.8	29.50	54.0	-24.5

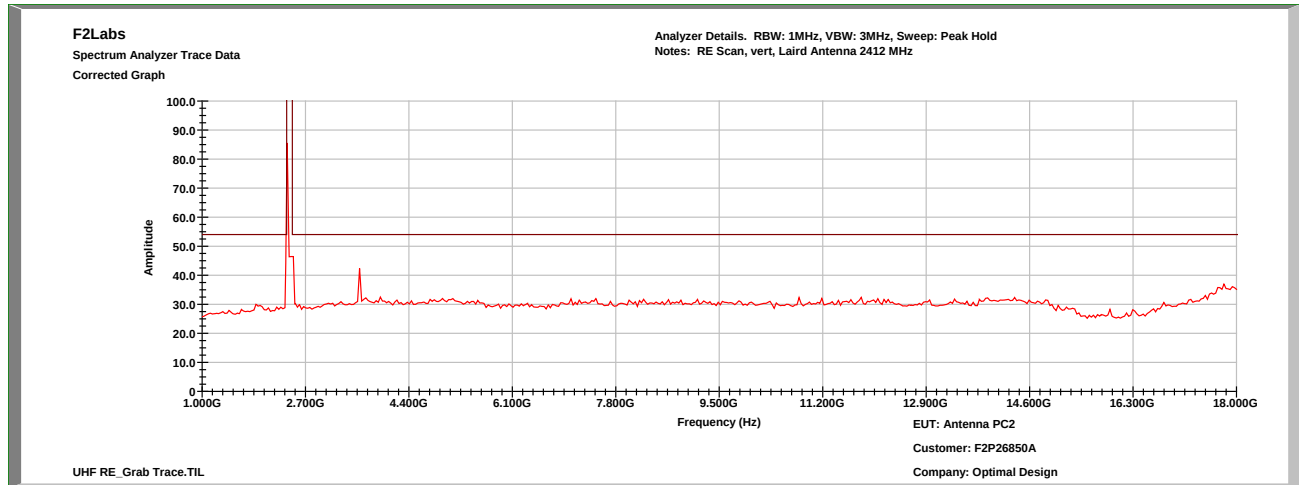




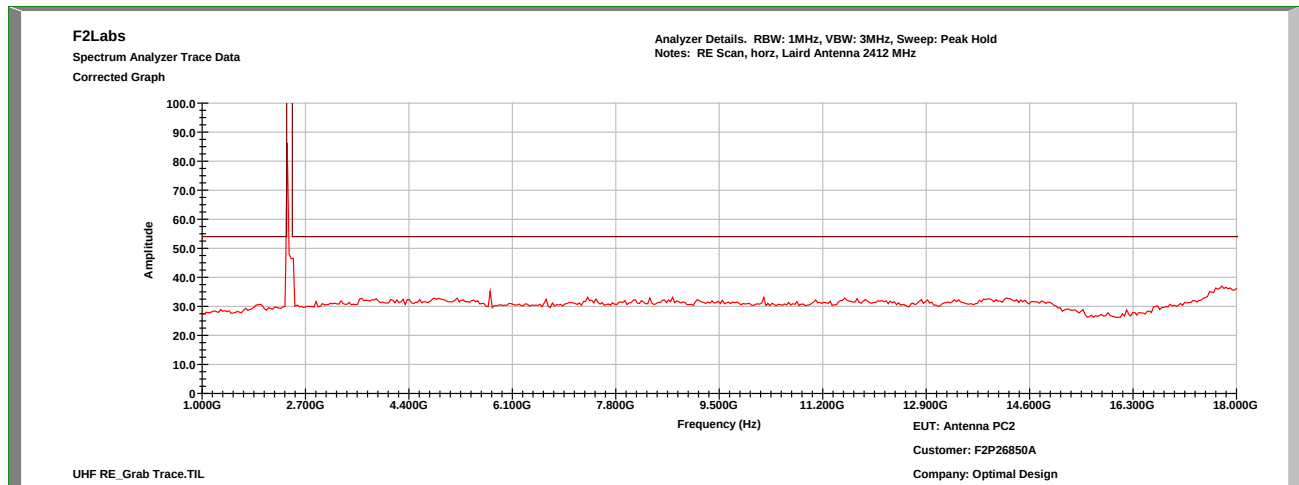
Order Number: F2P26850B

Applicant: Knox Company
Model: CC3100MODR11MAMOB

Laird, 2412 MHz: Characterization Scan, 1 GHz to 18 GHz, Vertical



Laird, 2412 MHz: Characterization Scan, 1 GHz to 18 GHz, Horizontal

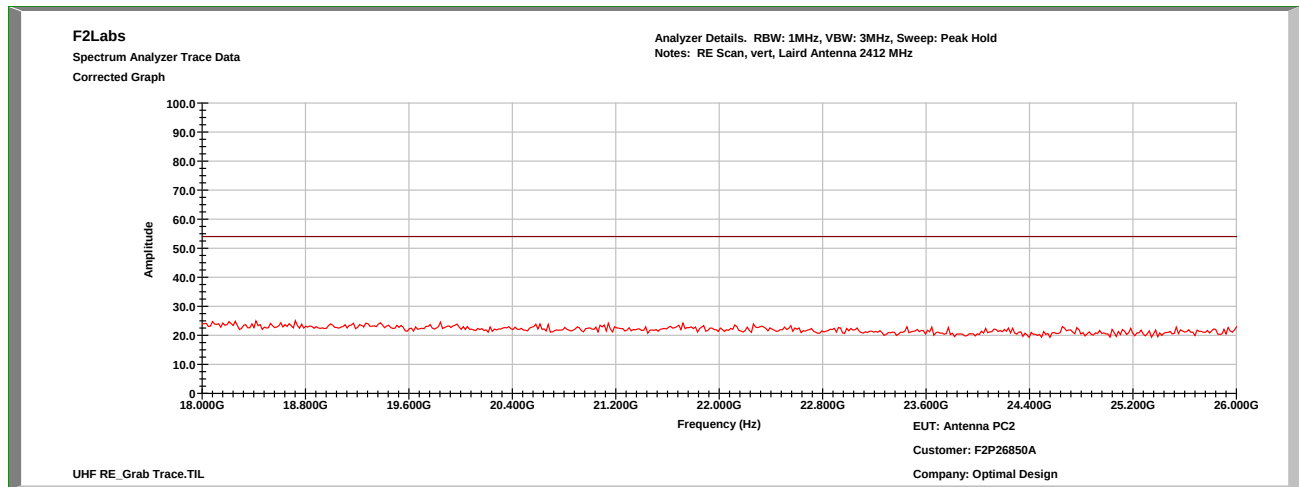




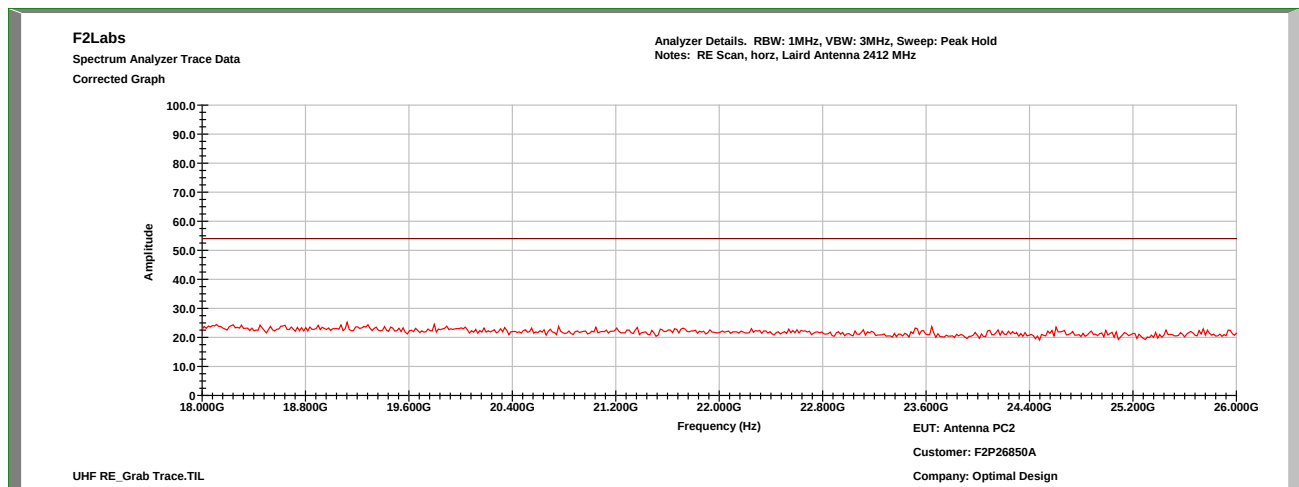
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Laird, 2412 MHz: Characterization Scan, 18 GHz to 26 GHz, Vertical

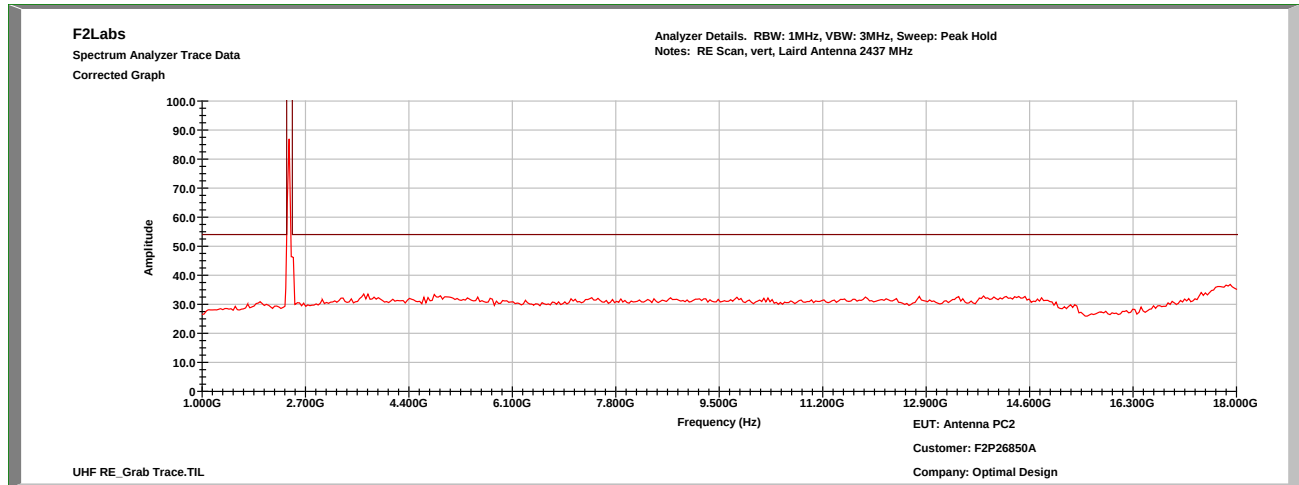


Laird, 2412 MHz: Characterization Scan, 18 GHz to 26 GHz, Horizontal

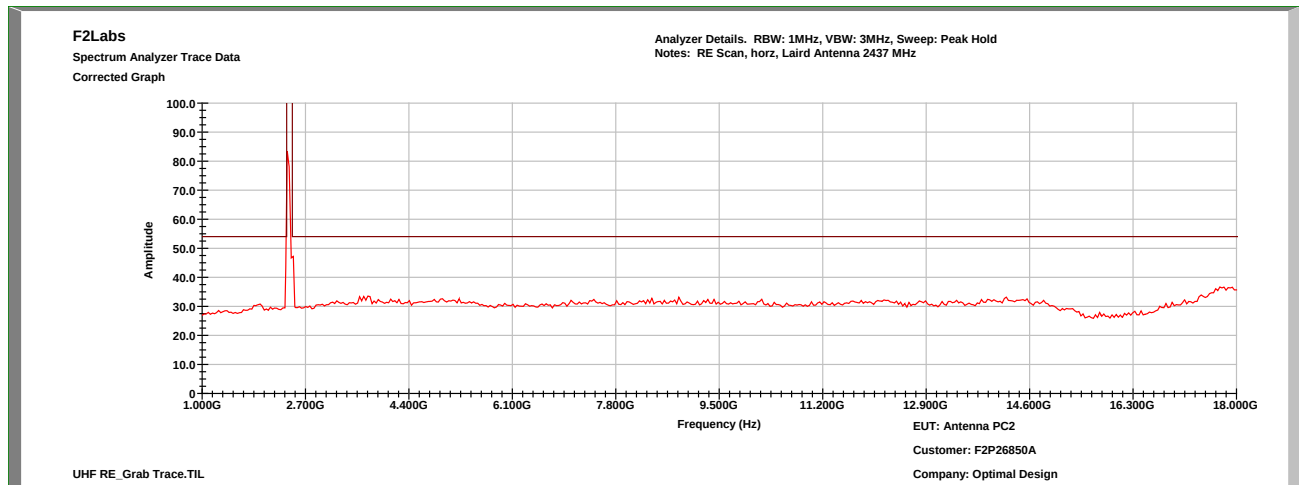




Laird, 2437 MHz: Characterization Scan, 1 GHz to 18 GHz, Vertical



Laird, 2437 MHz: Characterization Scan, 1 GHz to 18 GHz, Horizontal

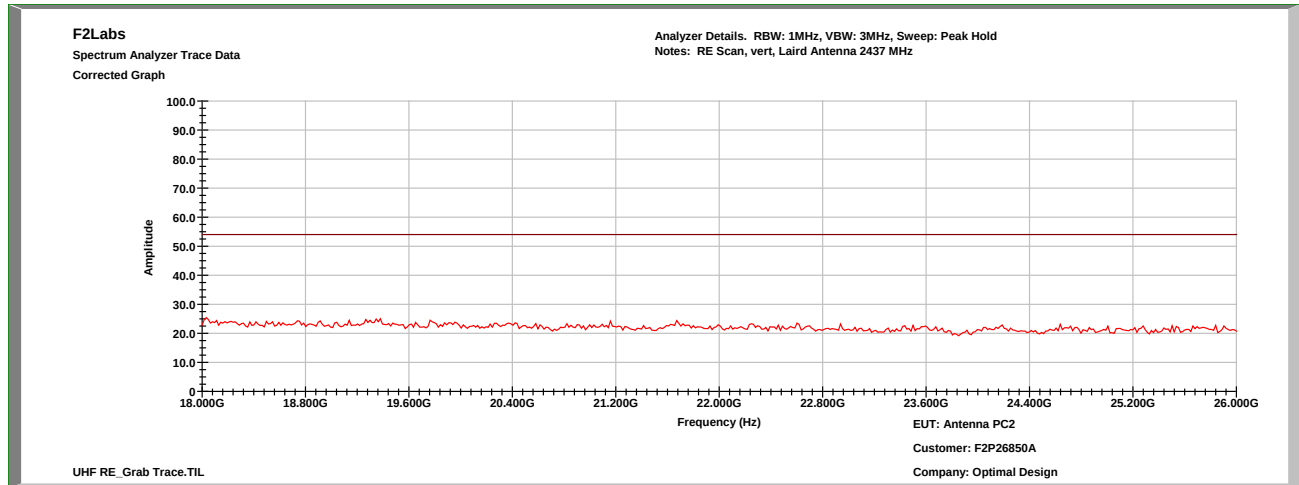




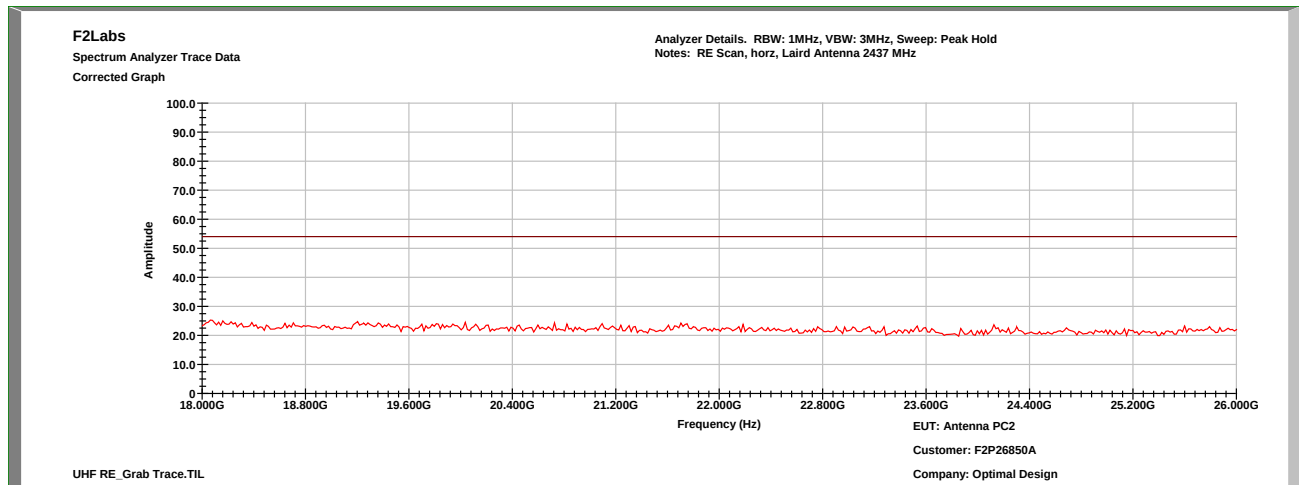
Order Number: F2P26850B

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Laird, 2437 MHz: Characterization Scan, 18 GHz to 26 GHz, Vertical



Laird, 2437 MHz: Characterization Scan, 18 GHz to 26 GHz, Horizontal

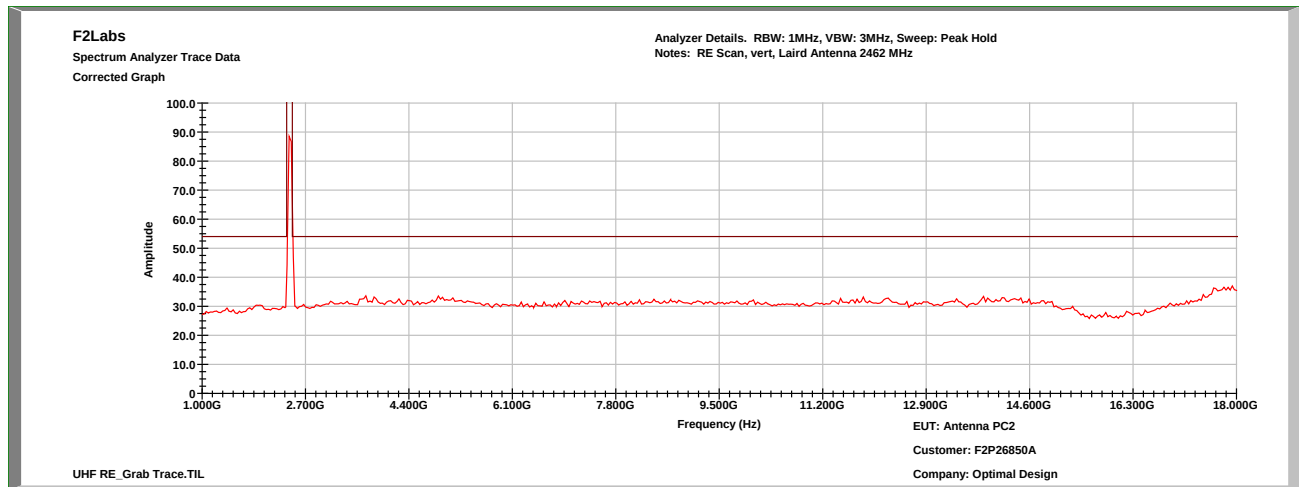




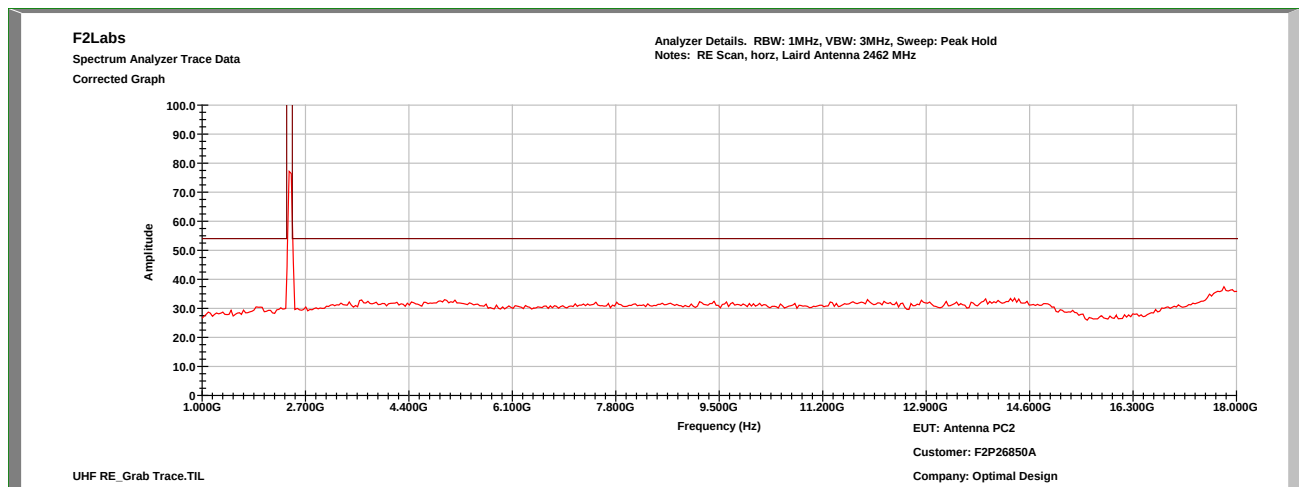
Order Number: F2P26850B

Applicant: Knox Company
Model: CC3100MODR11MAMOB

Laird, 2462 MHz: Characterization Scan, 1 GHz to 18 GHz, Vertical



Laird, 2462 MHz: Characterization Scan, 1 GHz to 18 GHz, Horizontal

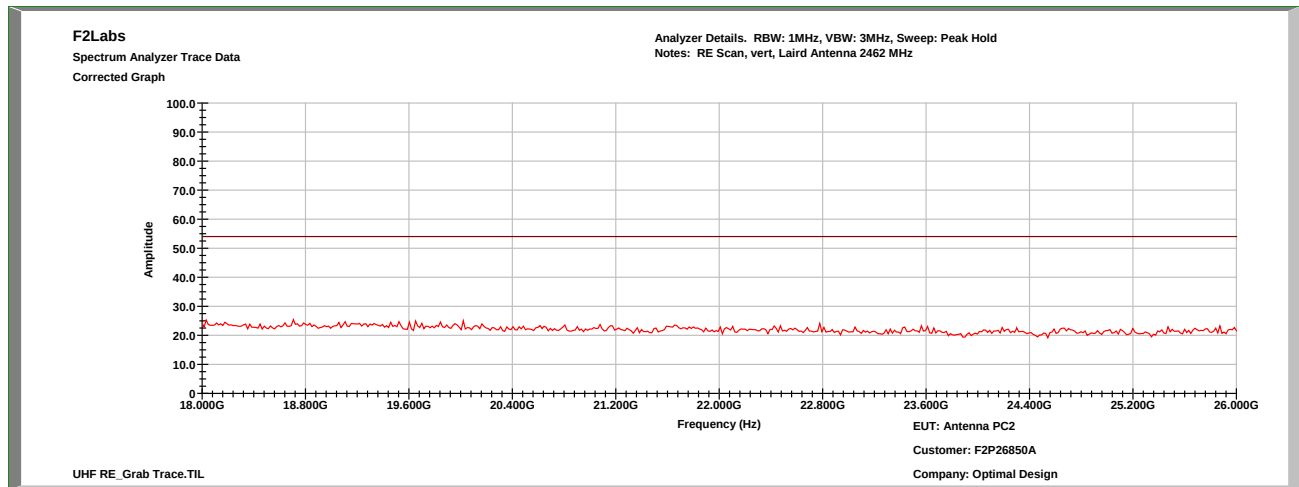




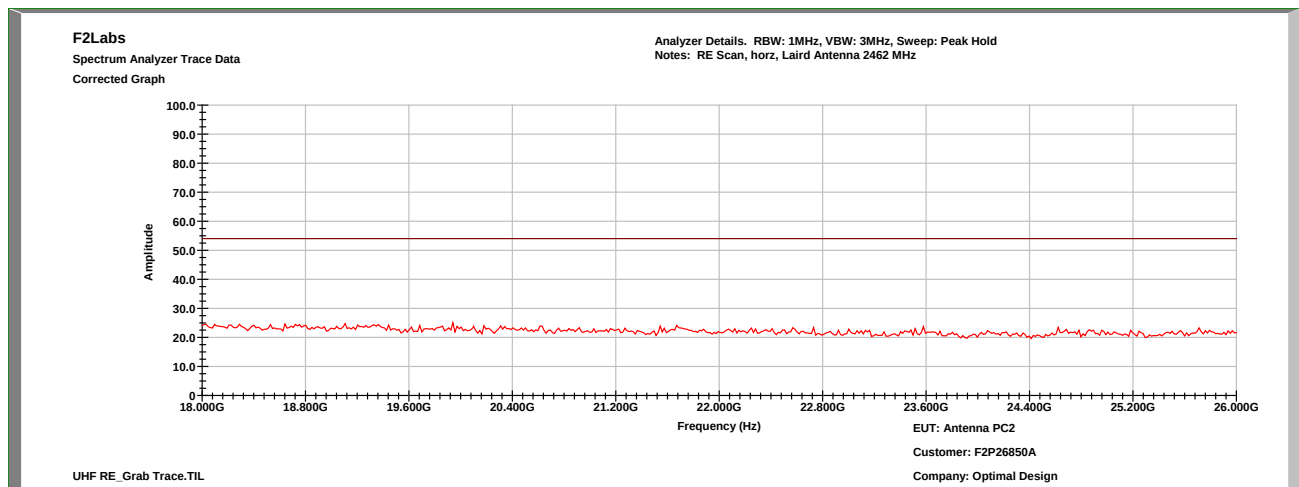
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Laird, 2462 MHz: Characterization Scan, 18 GHz to 26 GHz, Vertical



Laird, 2462 MHz: Characterization Scan, 18 GHz to 26 GHz, Horizontal

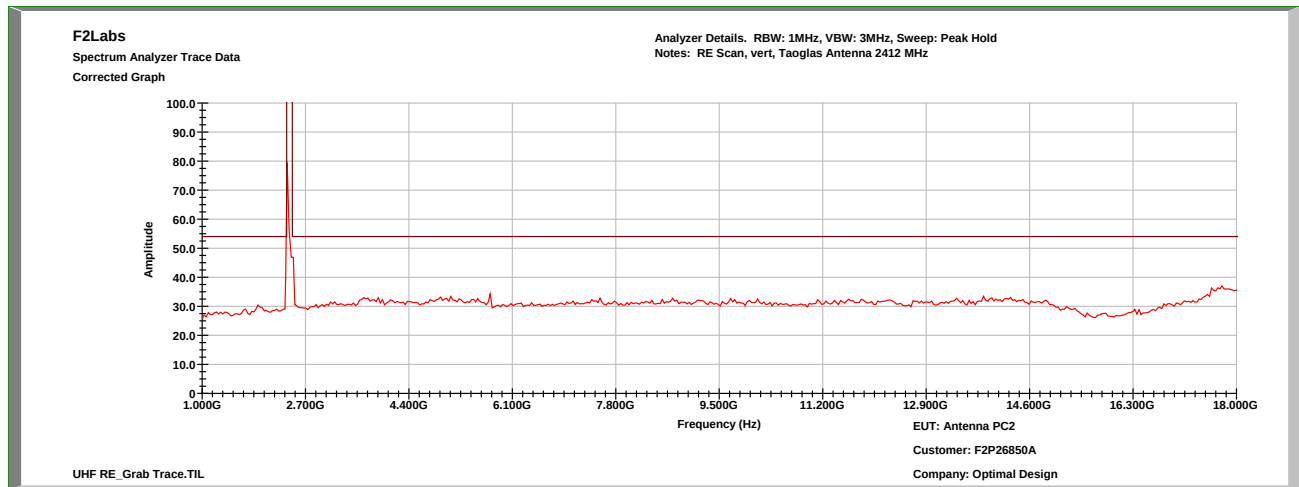




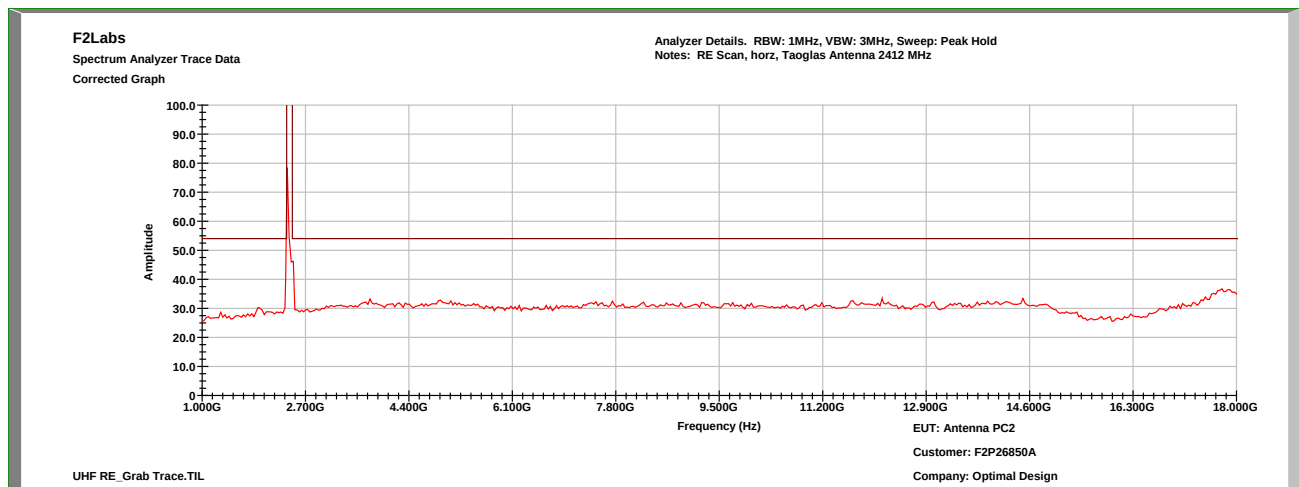
Order Number: F2P26850B

Applicant: Knox Company
Model: CC3100MODR11MAMOB

Taoglas, 2412 MHz: Characterization Scan, 1 GHz to 18 GHz, Vertical



Taoglas, 2412 MHz: Characterization Scan, 1 GHz to 18 GHz, Horizontal

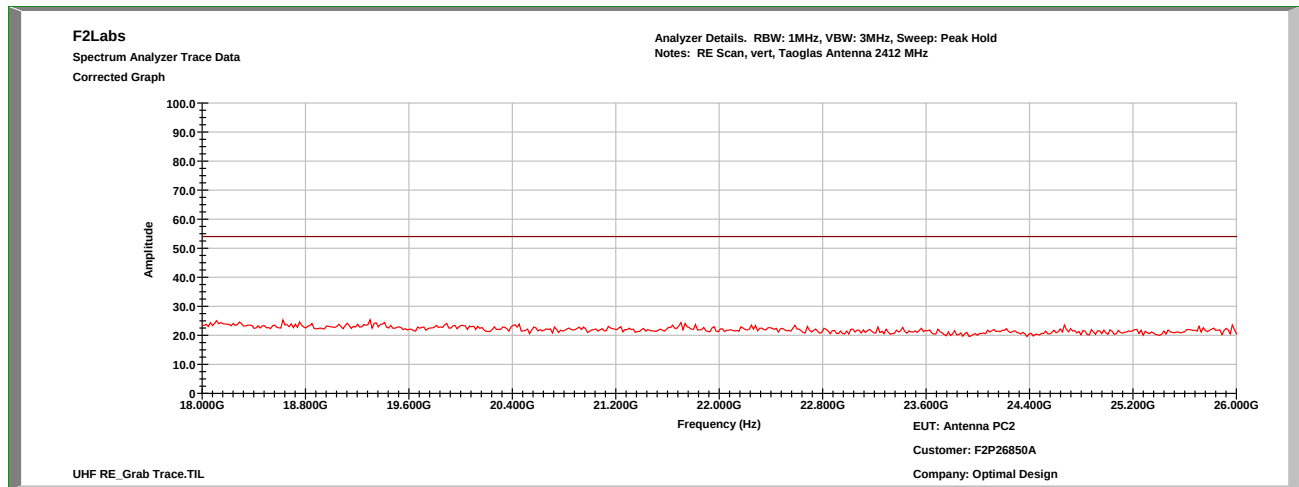




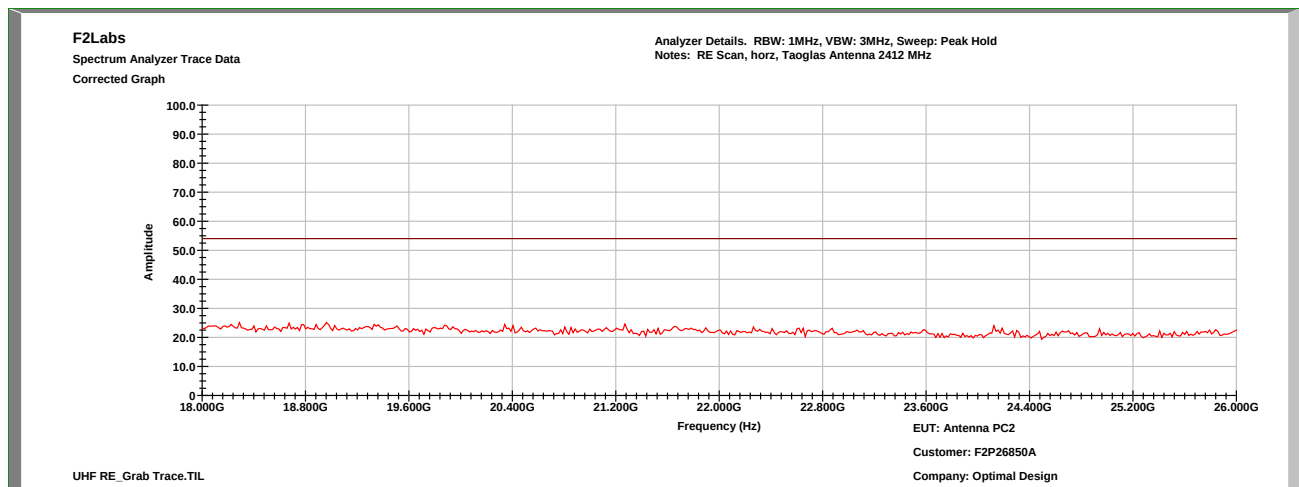
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Taoglas, 2412 MHz: Characterization Scan, 18 GHz to 26 GHz, Vertical



Taoglas, 2412 MHz: Characterization Scan, 18 GHz to 26 GHz, Horizontal

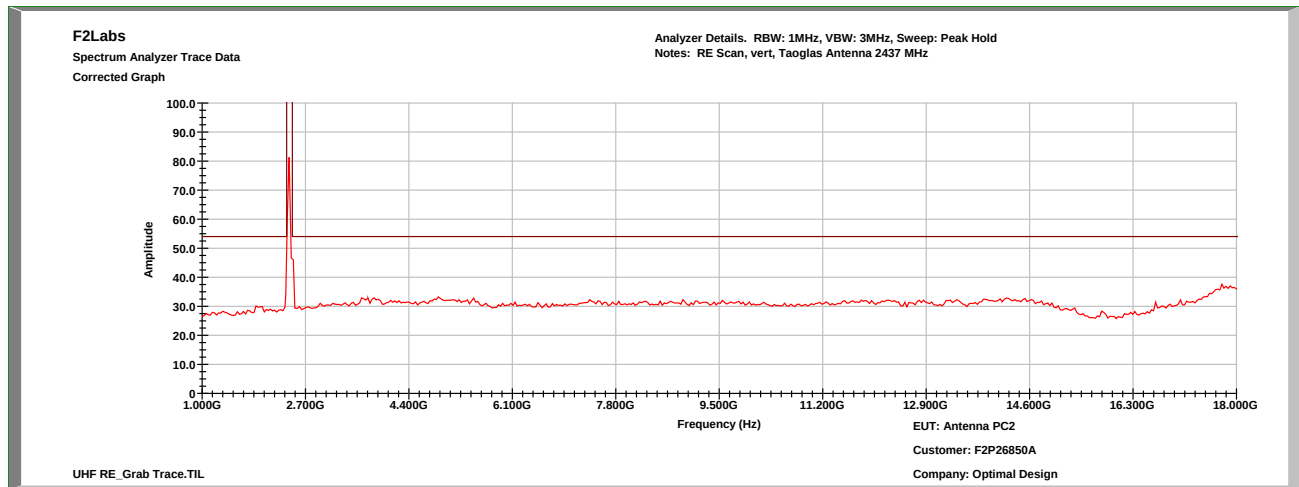




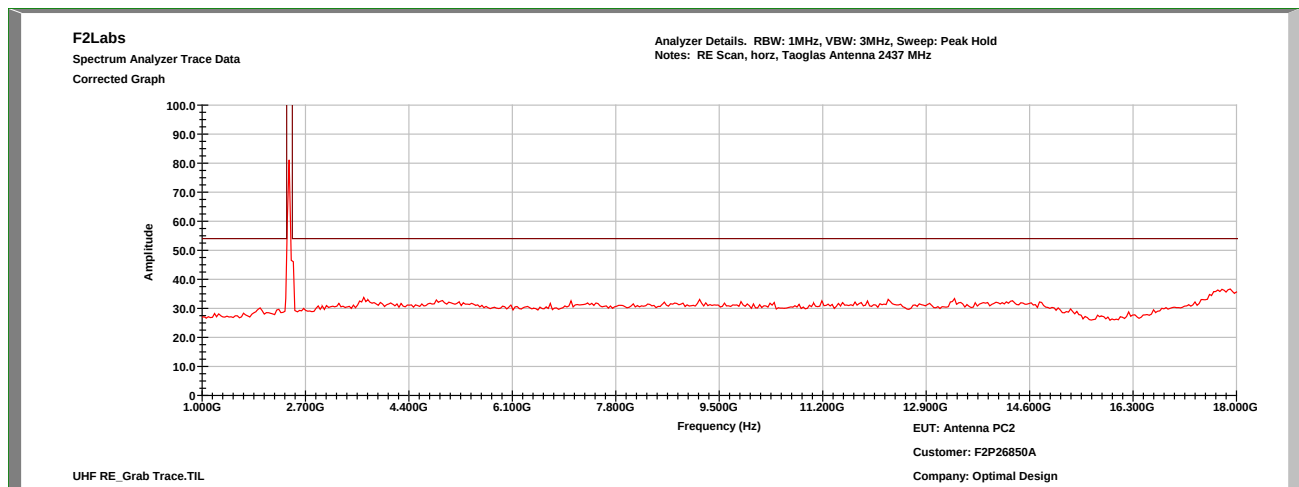
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Taoglas, 2437 MHz: Characterization Scan, 1 GHz to 18 GHz, Vertical



Taoglas, 2437 MHz: Characterization Scan, 1 GHz to 18 GHz, Horizontal

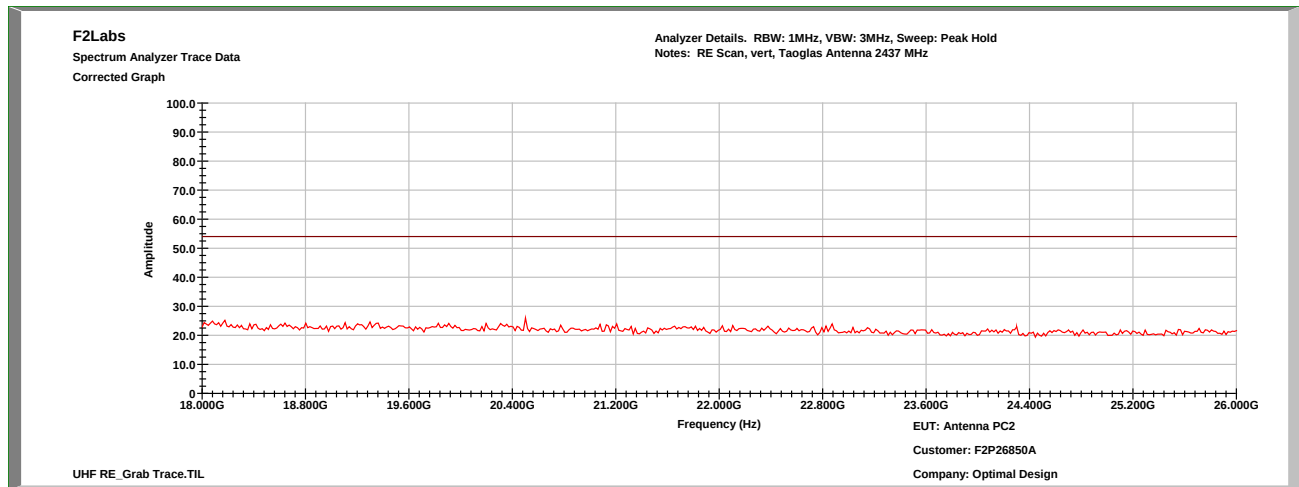




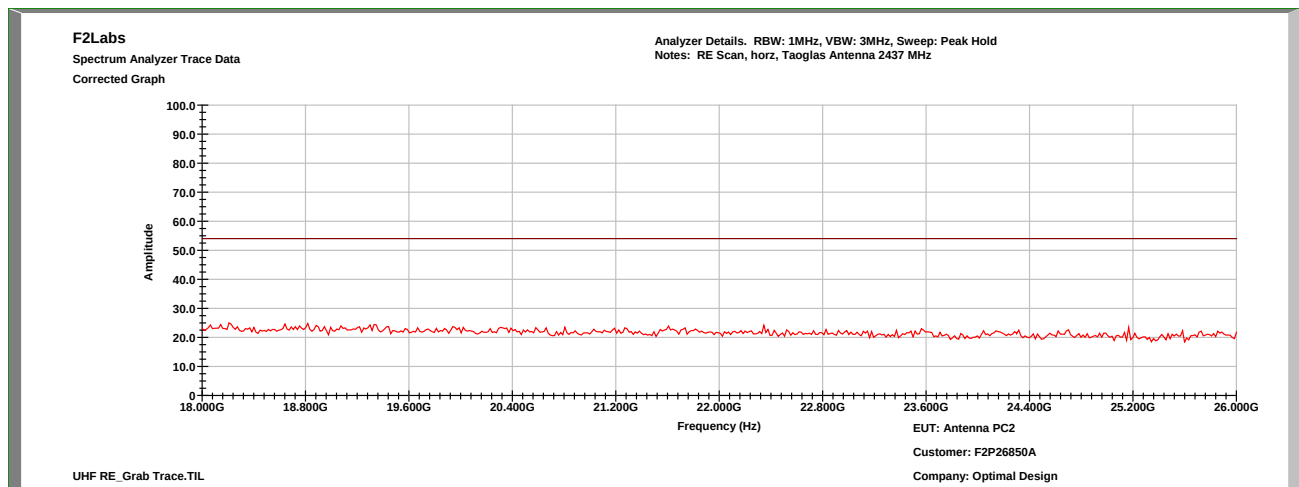
Order Number: F2P26850B

Applicant: Knox Company
Model: CC3100MODR11MAMOB

Taoglas, 2437 MHz: Characterization Scan, 18 GHz to 26 GHz, Vertical



Taoglas, 2437 MHz: Characterization Scan, 18 GHz to 26 GHz, Horizontal

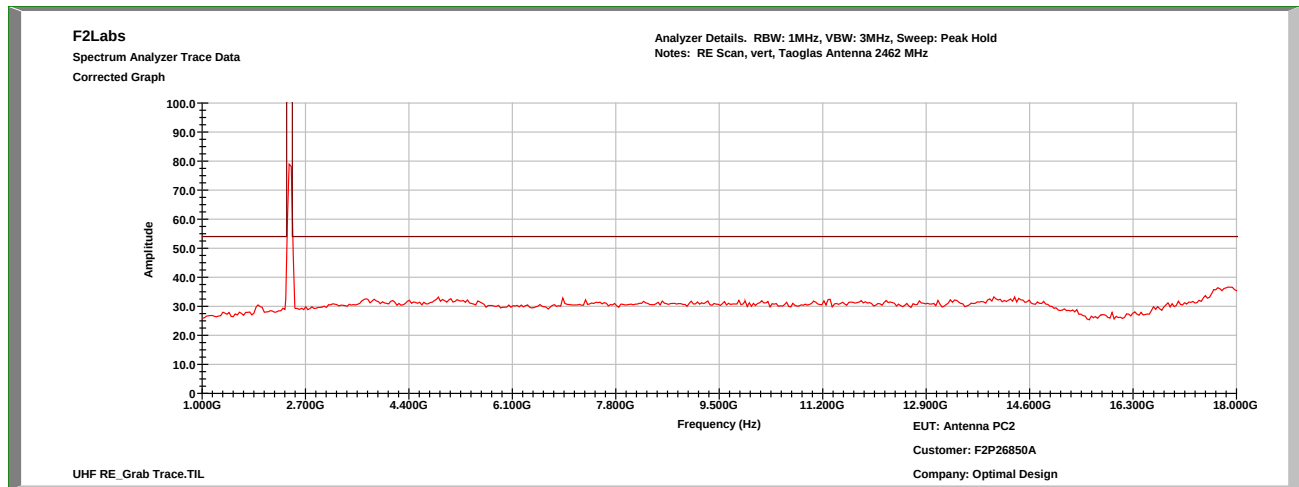




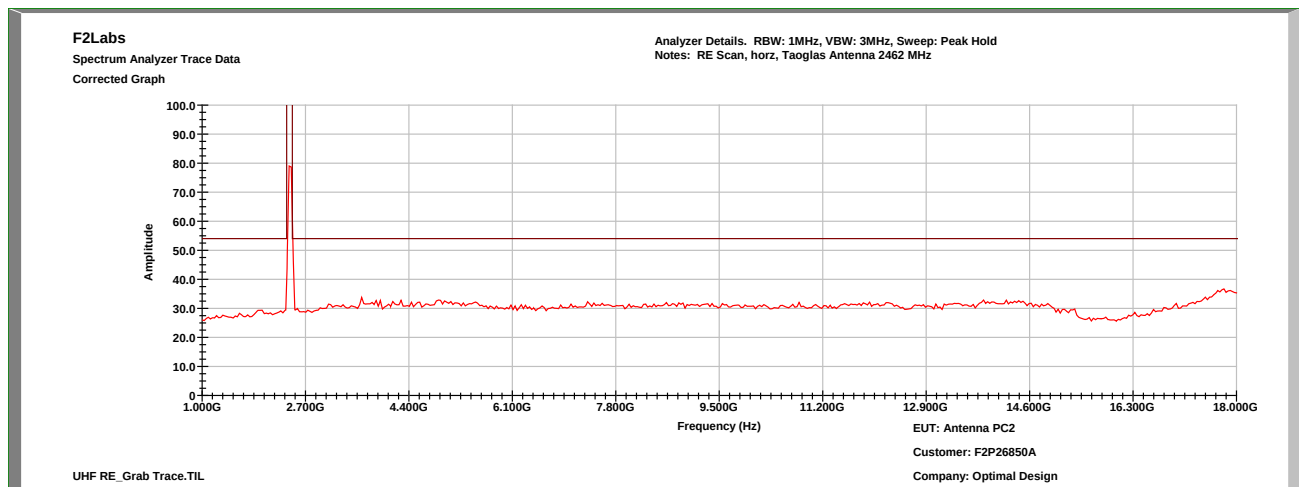
Order Number: F2P26850B

Applicant: Knox Company
Model: CC3100MODR11MAMOB

Taoglas, 2462 MHz: Characterization Scan, 1 GHz to 18 GHz, Vertical



Taoglas, 2462 MHz: Characterization Scan, 1 GHz to 18 GHz, Horizontal

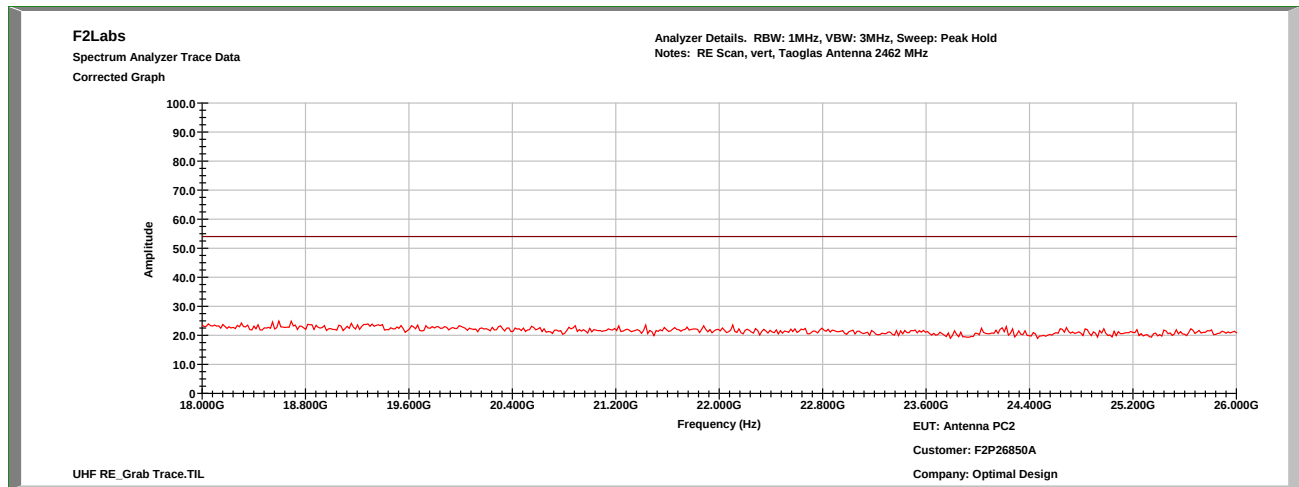




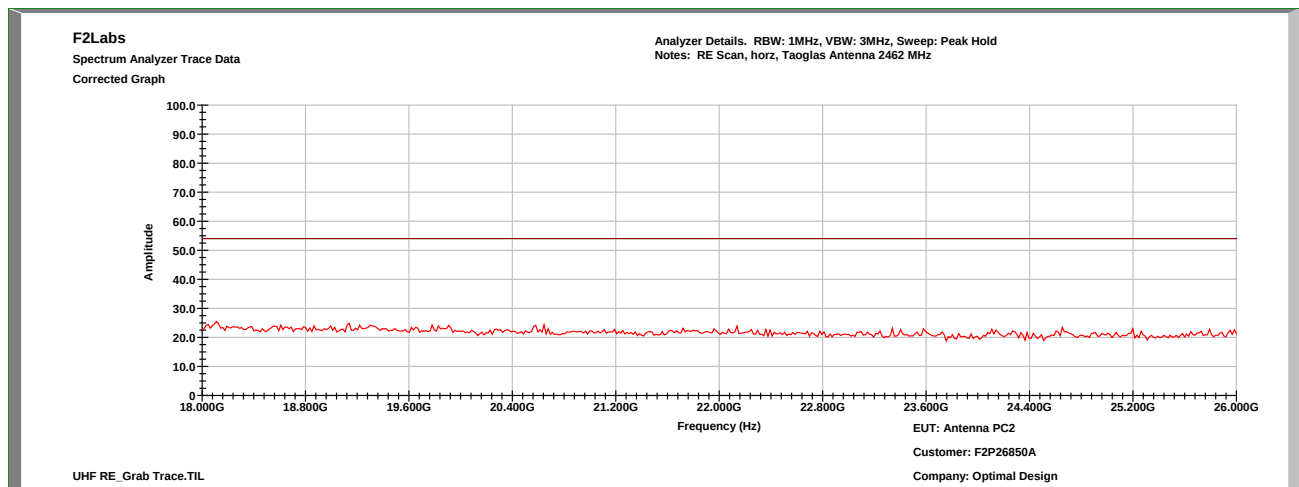
Order Number: F2P26850B

Applicant: Knox Company
Model: CC3100MODR11MAMOB

Taoglas, 2462 MHz: Characterization Scan, 18 GHz to 26 GHz, Vertical



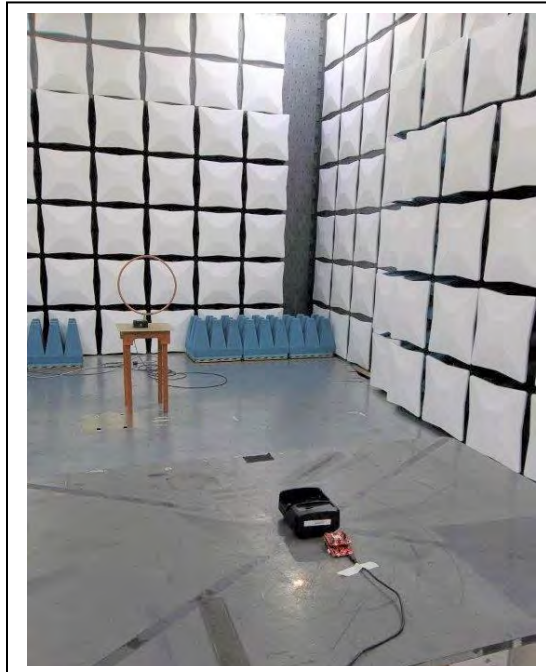
Taoglas, 2462 MHz: Characterization Scan, 18 GHz to 26 GHz, Horizontal



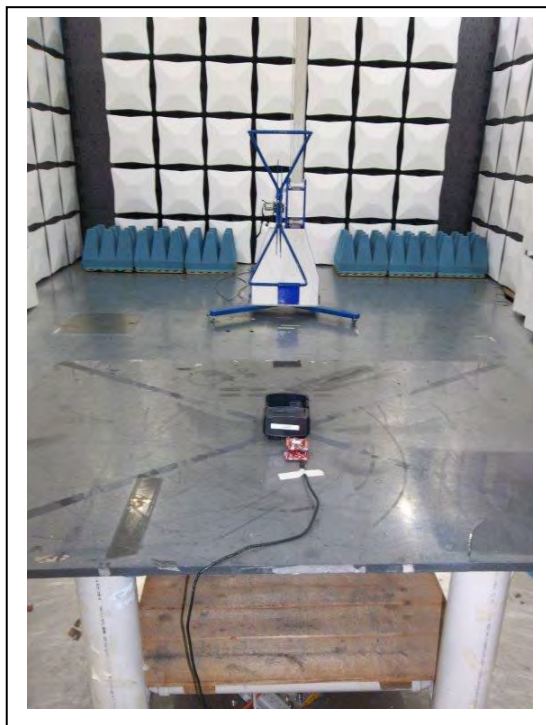


7 TEST SETUP PHOTOGRAPHS

0.009 MHz to 30 MHz



30 MHz to 1000 MHz





Greater Than 1 GHz

