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Amended

Test Report

Includes NCEE Labs report R20151016-21E and its amendment in full

Client: **Appareo Systems**
1810 NDSU Research Circle N.
Fargo, ND 58102

EUT: **Stratus ESG**

FCC ID: **2AETC-1505005**

Test Report No.: **R20151016-21F**

Approved By:

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Date: **8 April 2016**

Total Pages: **48**

ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

Revision Page

Rev. No.	Date	Description
Original	31 December 2015	Original – Njohnson Prepared by KVepuri
A	13 January 2016	Output power at 10MHz was measured and will be used as the rated power. Output power at 100 kHz was kept in the report to use as a delta reference with emissions limits as emissions measurements were performed with a 100 kHz RBW.
B	20 January 2016	To more clearly explain the operating modes, “Mode A” was changed to “Mode A (7777)” “Mode ATCRBS” was changed to “Mode A (0000)” “Mode S” was changed to “Mode S Long”
C	20 January 2016	Corrections were made to properly label Mode S Long vs Short and Mode A(0000).
D	20 January 2016	Plots were corrected to indicate the correct mode
E	22 March 2016	Added notes about pulse desensitization to test descriptions. Added duty cycle measurements for “Spy Pulse”, which is the worst-case transmitter mode. Delete receive mode measurement section.
F	8 April 2016	Added power measurements made using peak power meter. Added occupied BW measurement when operating in all modes.

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1 Summary of Test Results

The equipment under test (EUT) was tested for compliance to FCC Part 87 and Part 2. Below is a summary of the test results. Complete results can be found in Section 3.

Report Section	47 CFR FCC Rule Part	Description	Result
3.1	§ 2.1046, §87.131	Power and emissions	Compliant
3.2	§ 2.1049, §87.135	Occupied Bandwidth	Compliant
3.3	§ 2.1051, §87.139	Spurious Emissions at Antenna Terminals	Compliant
3.4	§ 2.1055, §87.133	Frequency Stability	Compliant
3.5	§87.141	Modulation Requirements	Compliant
3.6	§ 2.1053 and § 15.109	Field Strength of Spurious Emissions	Compliant

Test Methods:

(1) TIA/EIA-603-D:2010

Note: NCEE Labs' accreditation covers the test methods as listed above, but not all of the specific FCC rule parts. Since the rule parts specify only requirements and limits, the required measurements were performed only using test methods to which the lab is accredited.

1.1 Reason for amendment:

Output power at 10MHz was measured and will be used as the rated power. Output power at 100 kHz was kept in the report to use as a delta reference with emissions limits as emissions measurements were performed with a 100 kHz RBW.

To more clearly explain the operating modes,

"Mode A" was changed to "Mode A (7777)"
"Mode ATCRBS" was changed to "Mode A (0000)"
"Mode S" was changed to "Mode S Long"

2 EUT Description

The Equipment Under Test (EUT) was an Automatic Dependent Surveillance Broadcast (ADS-B) Transponder from Appareo Systems, Inc. These types of transponders help Air Traffic Control locate and track aircraft in airspace. Stratus ESG responds to legacy Mode A (7777)/C interrogations and Mode S Long interrogations from both ground radar and airborne collision avoidance systems. Stratus ESG will also transmit aircraft status periodically without being interrogated.

2.1 Equipment under Test (EUT)

Table 1 – Equipment under Test (EUT)

PRODUCT	Stratus ESG
PART NUMBER	153510-000017 (fully certified transponder), 153510-000018 (experimental aircraft transponder)
POWER INPUT	28 VDC (nominal)
MODULATION TYPE	Mode A (7777)/C and Mode S Long
FREQUENCY RANGE	1090
NUMBER OF CHANNELS	1
MAXIMUM OUTPUT POWER	308.32 W
SERIAL NUMBER OF TEST UNIT	030113
POWER SUPPLY	Aircraft battery

2.2 Testing Location

All testing was performed at the NCEE Lincoln facility, which is an A2LA accredited EMC test laboratory accredited per scope 1953.01.

2.3 EUT Setup

The EUT was powered by 28VDC power supply. The EUT was connected through 50 dB attenuator to the receiver for all the conducted measurements.

For radiated emissions measurements, the antenna output was connected to a 50ohm load. For spurious emissions testing, the output was a mixture of all of the different modes to produce a worst-case of all modes.

3 Test Results

3.1 Rated Power

Test: CFR 47 FCC § 2.1046, §87.131

Test Result: *Complies* Date: 6 January 2016

Test Description
Per FCC §2.1046, "For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated."

Per §87.131, "Power must be determined by direct measurement."

Test Environment
Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of 35 ± 5%
Temperature of 22 ± 2º C

Test Setup
The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuators. The spectrum analyzer was used to make power measurements using the channel power function. The resolution bandwidth was set to 1 MHz and the channel bandwidth was set to match the occupied bandwidth as measured in Section 3.3.

Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
100037	Rhode & Schwarz	ES126	EMI Test Receiver	20 Jan 2015
BG1808	Weinschel	48-30-43	30 dB Attenuator	15 Dec 2015*
00319	Mini-Circuits	UNAT-20	20 dB Attenuator	15 Dec 2015*
42-000429	Wavetek	16936	Power detector	12 May 2015
1509873	Wavetek	8502	Peak power meter	12 May 2015

*Verification date

Test Results

The power measurements were found to comply

Table 1 - Output Power Results FCC §2.1046 and §87.131

Frequency	Modulation/ Message Type	Cable and Attenuation Correction Factor	Corrected Measurement	Corrected Measurement	Measurement type
MHz		dB	dBm	watts	
1090	All modes together	50.10	54.89	308.32	Integrated channel power with SA
1090	All modes together	50.10	54.56*	286.00	Peak power detector

*Note: to ensure no pulse sensitization was present, the measurment was performed both with a peak power detector and a spectrum analyzer. The results were within 0.5 dB of each other. It was therefore determined that pulse desensitization was not present and the Integrated channel power measurement was as the reported power measurement.

To measure the peak output power in order to apply a rating to the device, the EUT was set so that all modes of operation were being transmitted together. The oocupied bandwidth of this mode was measured and the integrated channel power was measured across this bandwidth.

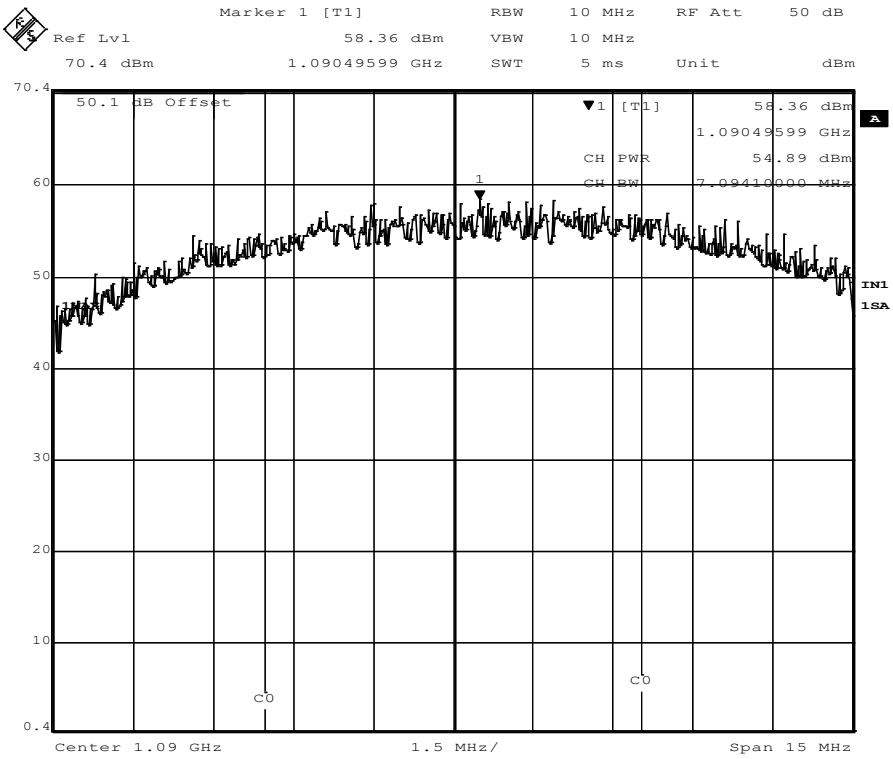


Figure 1 - Output Power, All Modes

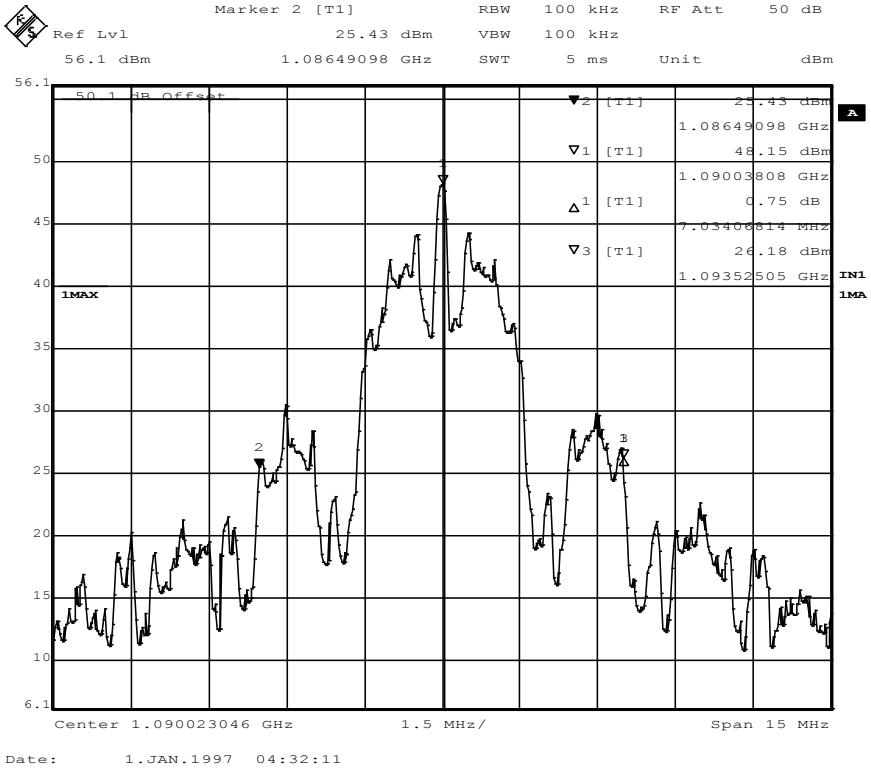


Figure 2 – Occupied Bandwidth, All Modes

3.2 Power and emissions

Test: CFR 47 FCC § 2.1046, §87.131

Test Result: *Complies* Date: 17 December 2015

Test Description
Per FCC §2.1046, "For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated."

Per §87.131, "Power must be determined by direct measurement."

The RF output power was measured with a 100kHz resolution bandwidth in order to calculate delta values with out of band measurements using a 100 kHz resolution bandwidth. The power values listed here are used to calculate spurious emissions limits only.

Test Environment
Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of 30 ± 5%
Temperature of 22 ± 2º C

Test Setup
The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuators. The spectrum analyzer was used to make power measurements using the channel power function. The resolution bandwidth was set to 1 MHz and the channel bandwidth was set to match the occupied bandwidth as measured in Section 3.3.

Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
100037	Rhode & Schwarz	ES126	EMI Test Receiver	20 Jan 2015
BG1808	Weinschel	48-30-43	30 dB Attenuator	15 Dec 2015*
00319	Mini-Circuits	UNAT-20	20 dB Attenuator	15 Dec 2015*

*Verification date

Test Results

The power measurements were found to comply

Table 1 – 100kHz RBW Power Results FCC §2.1046 and §87.131

Frequency	Modulation/ Message Type	Cable and Attenuation Correction Factor	Corrected Measurement
MHz		dB	dBm
1090	Mode A (7777)	50.10	51.59
1090	Mode A (0000)	50.10	43.84*
1090	Mode S Long	50.10	52.97
1090	Mode S Short	50.10	52.97

The EUT was set to transmit in all modes together for the emissions testing. Mode S Long was used to calculate the limits.

*Mode A(0000) has a larger bandwidth than the measurement resolution bandwidth, so the power measurement with a 100kHz RBW is lower. When measured with a 1 MHz bandwidth was within 0.25 dB of Mode A (7777). Mode S Long was used to calculate the limits.

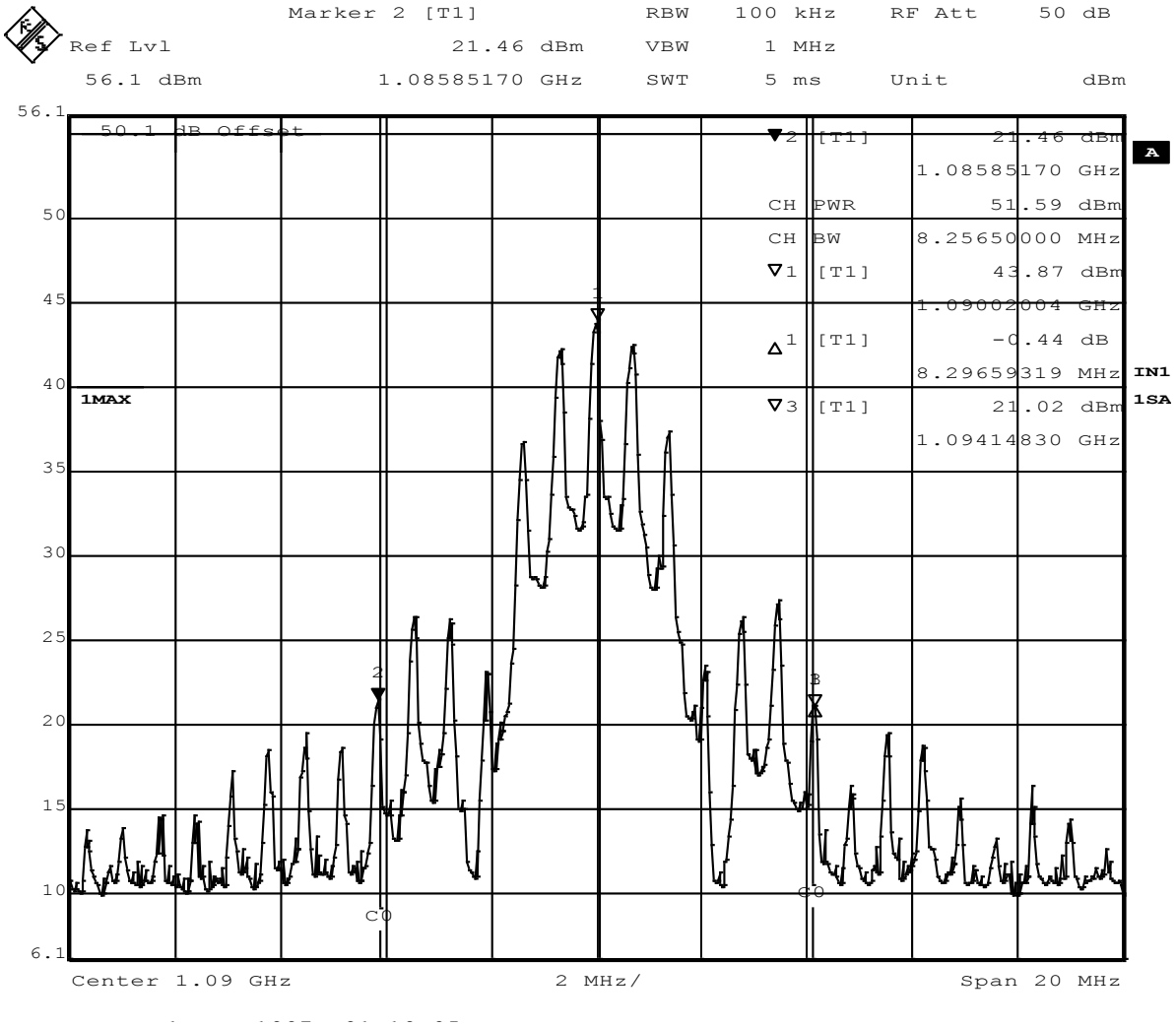


Figure 3 - Output Power, Mode A (7777)

Channel BW = 8.26 MHz. This corresponded to the 99.5% BW as calculated in Figure 6.

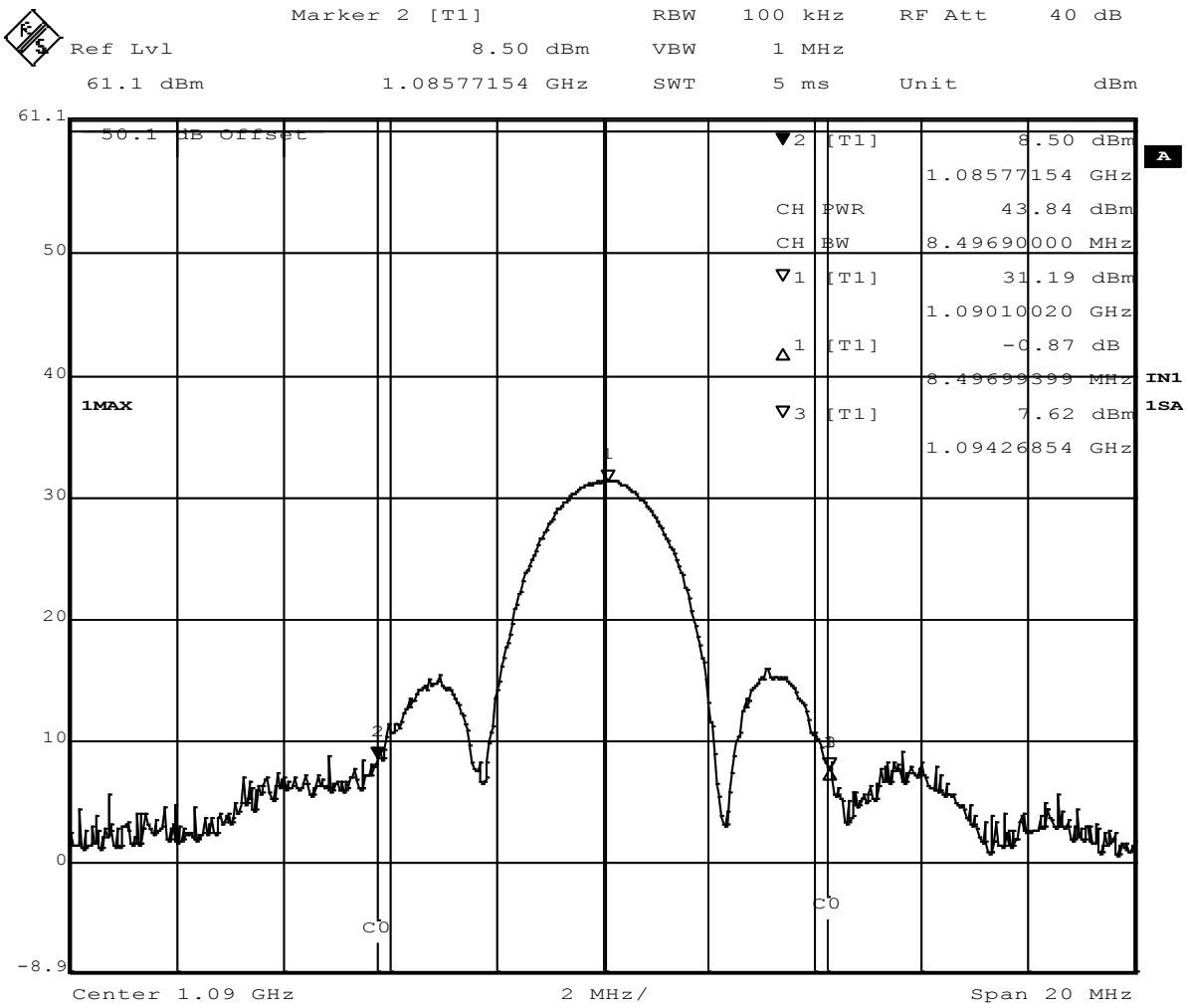


Figure 4 - Output Power, Mode A (0000)

Channel BW = 8.50 MHz. This corresponded to the 99.5% BW as calculated in Figure 7.

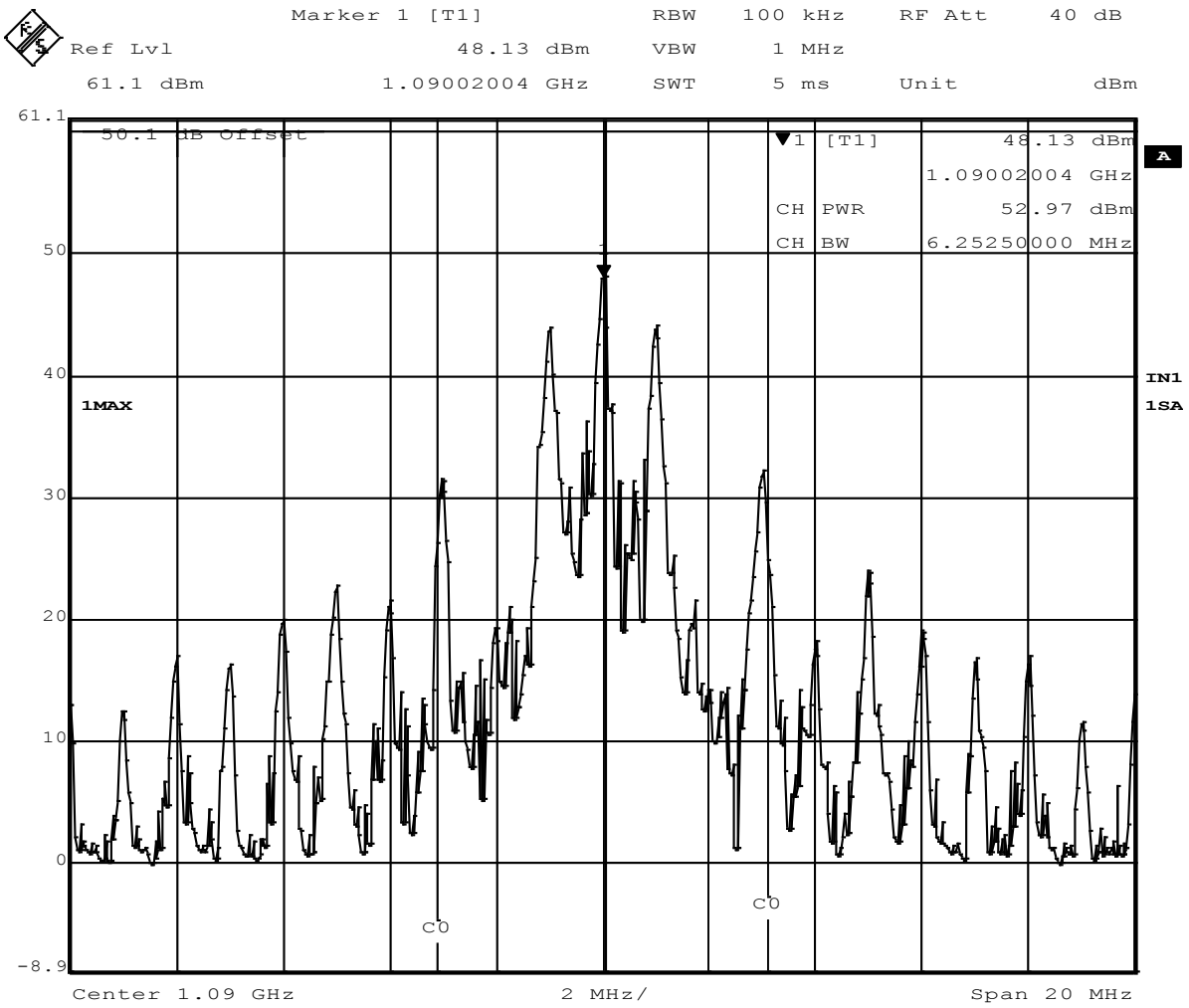


Figure 5 - Output Power, Mode S Long

Channel BW = 6.25 MHz. This corresponded to the 99.5% BW as calculated in Figure 8.

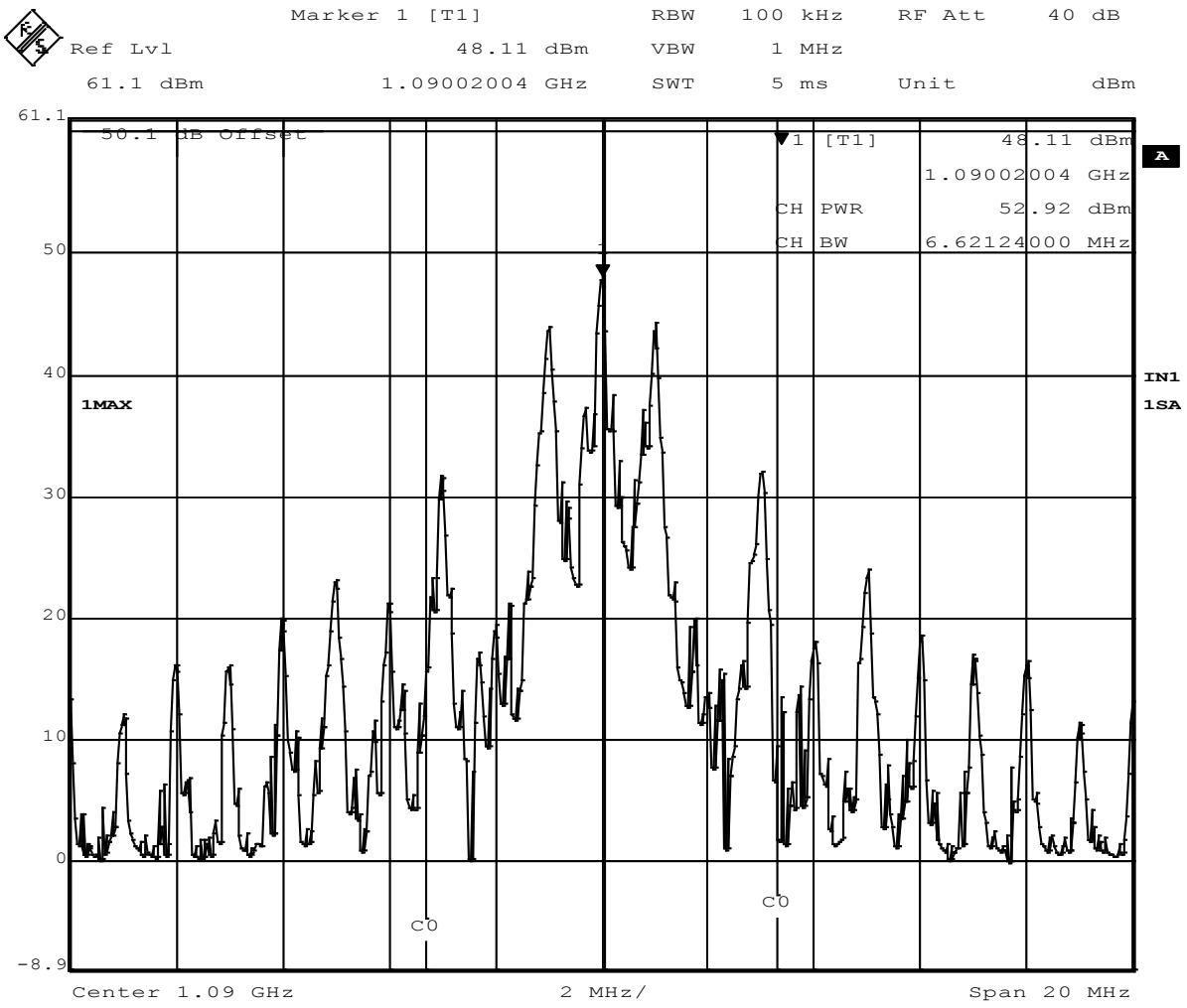


Figure 6 - Output Power, Mode S Short

Channel BW = 6.21 MHz. This corresponded to the 99.5% BW as calculated in Figure 9.

3.3 Frequency Stability

Test: CFR 47 FCC Part § 2.1055 and §87.133

Test Method: TIA-603-C, Section 3.2.2

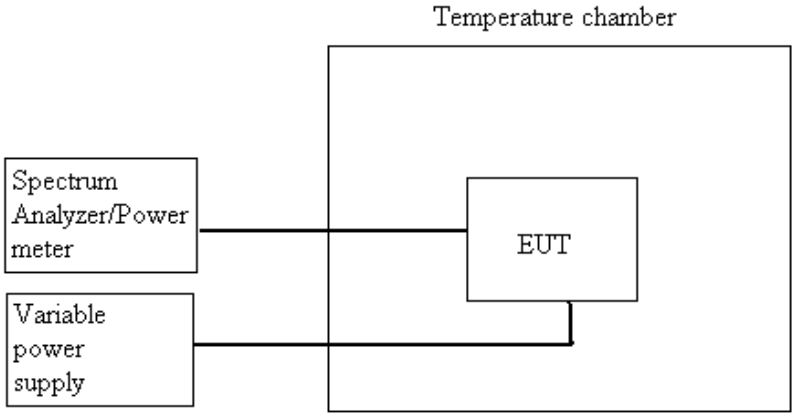
Result: *Complies* Date: 16 December 2015

Test Description:

Conducted power was measured on a spectrum analyzer with resolution bandwidth and video bandwidth set to 100 kHz. The center frequency was found by measuring the frequency of the signal 10dB below the peak on the high and low end of the signal. The frequency half way in between these frequencies was recorded as the center frequency. The EUT is supplied by 28 VDC. This input voltage was varied by (+/-) 15% for the highest and lowest temperature setting.

CFR Paragraph Part 87.133(a) requires a minimum deviation of 20ppm for radio navigation stations from 960 – 1215MHzz

Test Setup:



Test Procedure:

See the standard for test procedures.

Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
100007	Rhode & Schwarz	ESIB7	EMI Test Receiver	22 Jun 2015
2130154	Omega	ITHX-SD	Temp/humid meter	21 Jan 2015
00319	Mini-Circuits	UNAT-20	20 dB Attenuator	CNR
31373	Thermotron	SE1000-5-5	Temp chamber	CNR*

*Omega temp/humidity meter used to measure temperature

Table 2 - 1090 MHz Frequency Stability

Temperature (°C)	Input Voltage (VDC)	Center Frequency (GHz)	Change (kHz)	Spec Limit - 20ppm (+/- kHz)
-20.00	28.00	1.089991	9.02	21.8
-20.00	25.20	1.089987	13.03	21.8
-20.00	30.80	1.089987	13.03	21.8
-10.00	28.00	1.089987	13.03	21.8
0.00	28.00	1.090005	5.01	21.8
10.00	28.00	1.089999	1.00	21.8
20.00	28.00	1.089995	5.01	21.8
30.00	28.00	1.090017	17.03	21.8
40.00	28.00	1.089993	7.01	21.8
50.00	28.00	1.089989	11.02	21.8
50.00	30.80	1.089999	1.10	21.8

3.4 Bandwidth of Emissions

Test: CFR 47 FCC Part § 2.1049 and §87.135

Result: *Complies* Date: 17 December 2015

Test Description

(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.

(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Test Environment

Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of 30 ± 5%
Temperature of 22 ± 2º C

Test Setup

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to the 10th harmonic. The test setup can be seen in Figures 2 through 4 of appendix A.

Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
100037	Rhode & Schwarz	ES126	EMI Test Receiver	20 Jan 2015
BG1808	Weinschel	48-30-43	30 dB Attenuator	15 Dec 2015
00319	Mini-Circuits	UNAT-20	20 dB Attenuator	15 Dec 2015

*Verification date

Test Results

The spurious emissions at the antenna terminals were found to comply.

Channel Frequency	99.5% Occupied Bandwidth
MHz	MHz
Mode A (7777)	8.25
Mode A (0000)	8.50
Mode S Long	6.25
Mode S Short	6.21

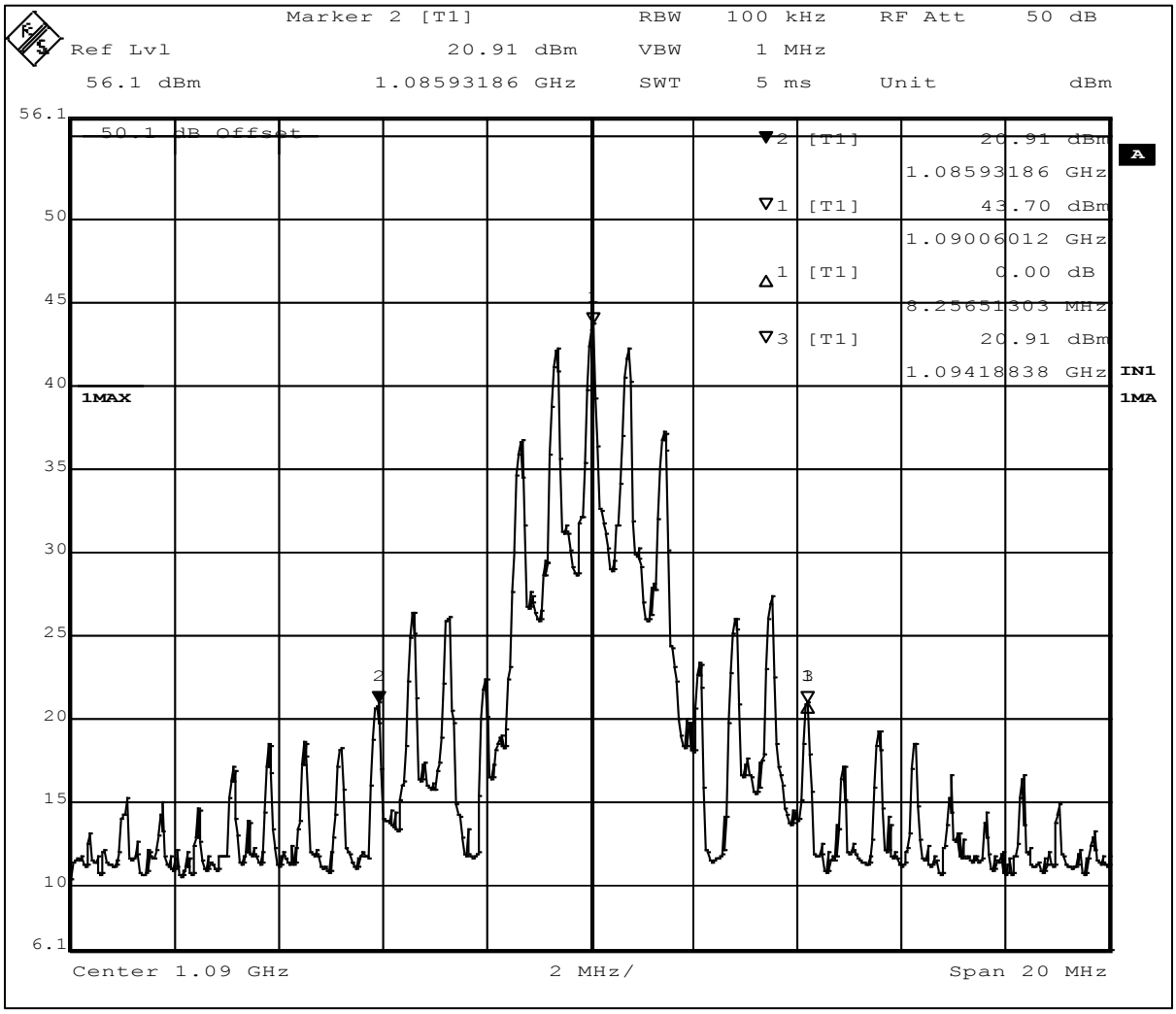


Figure 7 – Radio Mode A (7777), 99.5% Occupied Bandwidth, 8.26 MHz

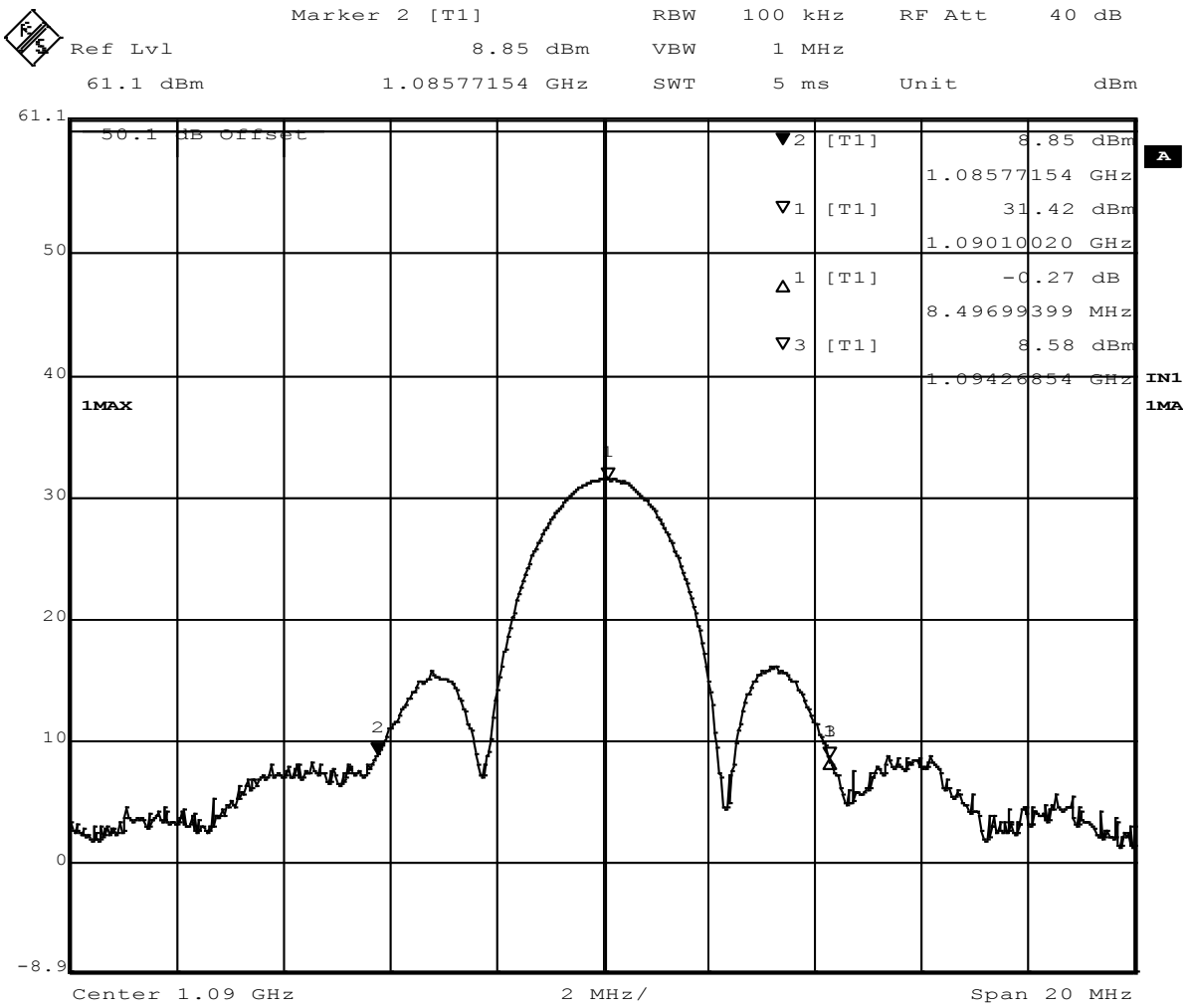


Figure 8 – Radio Mode A (0000), 99.5% Occupied Bandwidth, 8.50 MHz

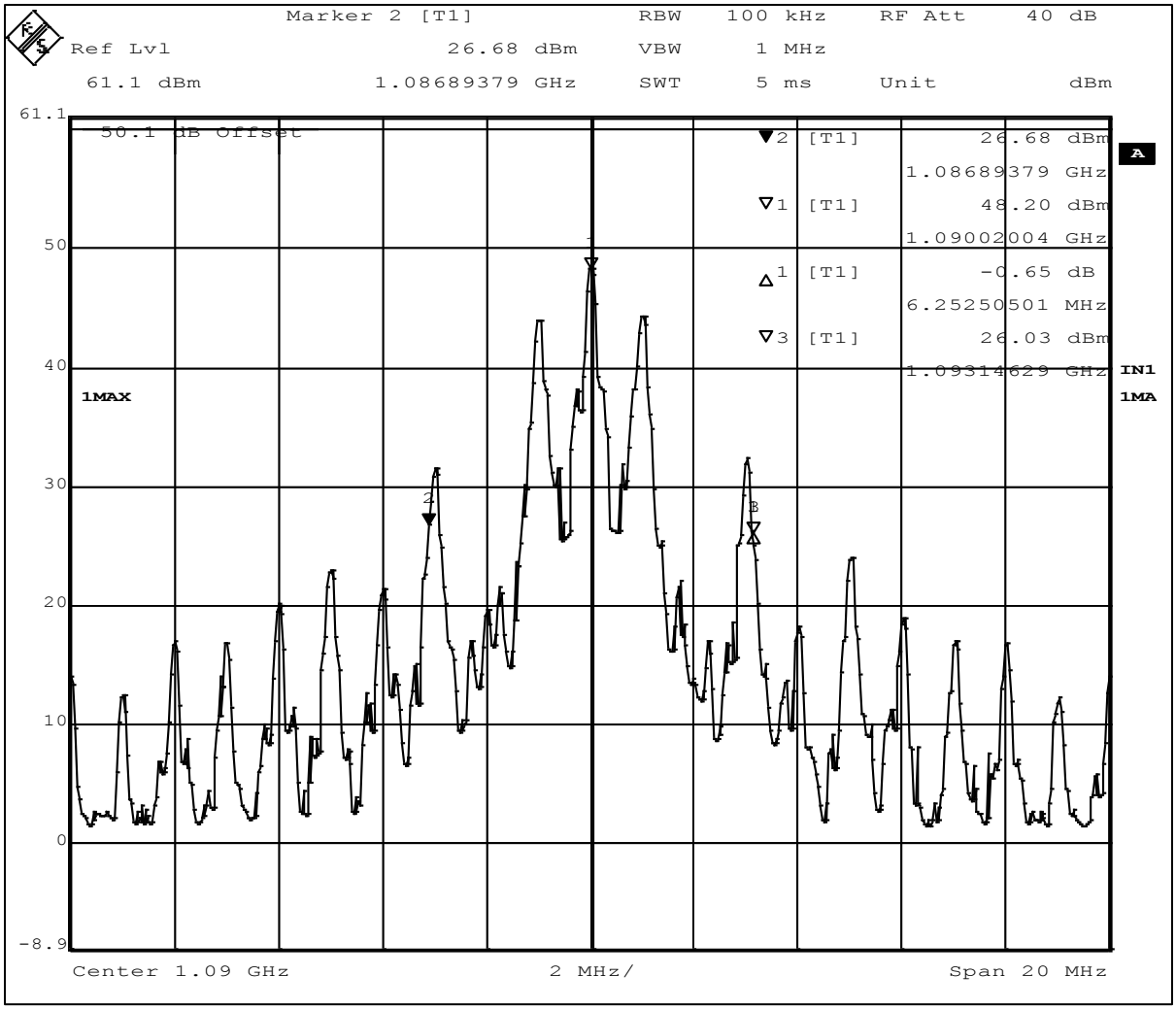


Figure 9 – Radio Mode S Long, 99.5% Occupied Bandwidth, 6.25 MHz

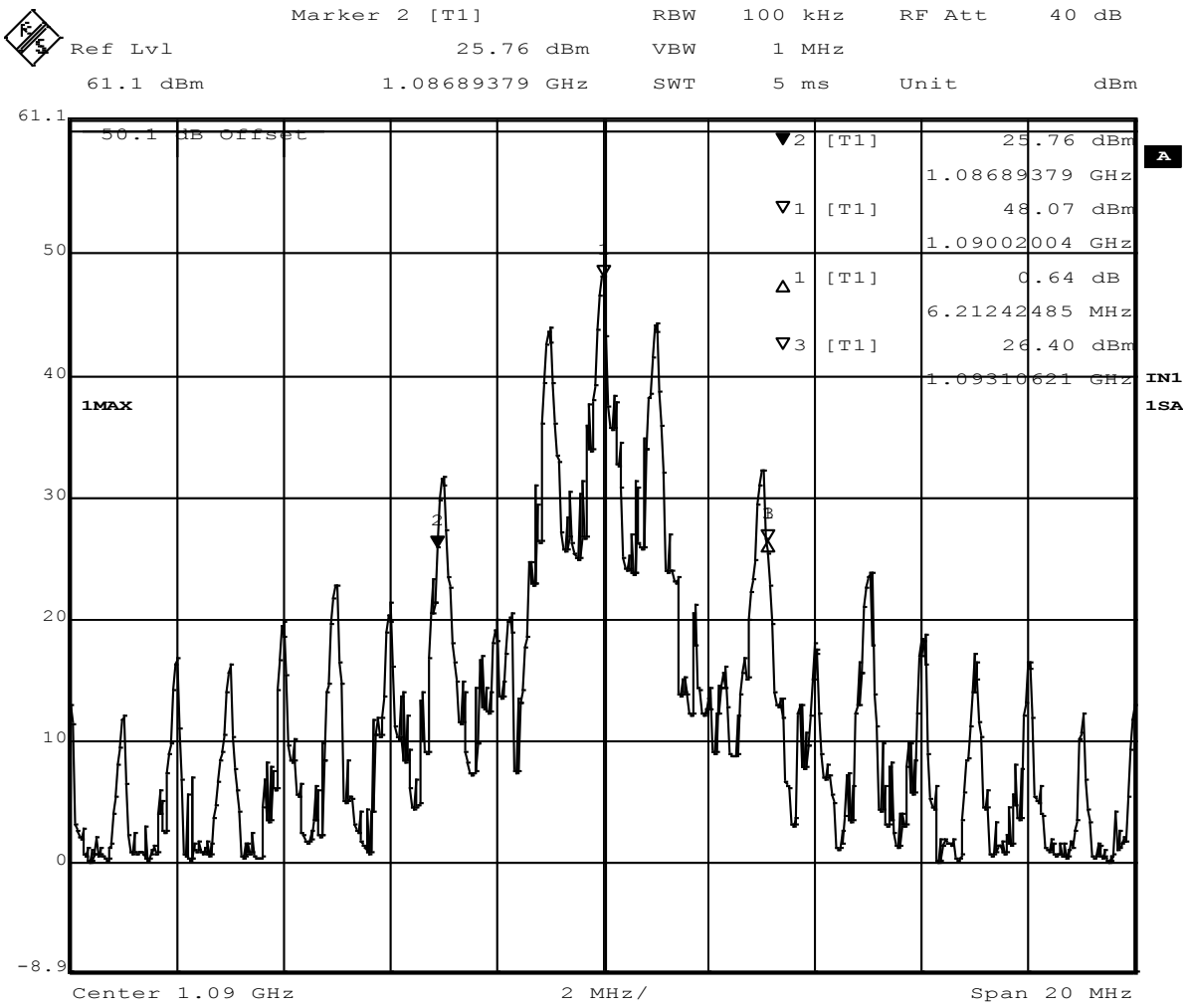


Figure 10 – Radio Mode S Short, 99.5% Occupied Bandwidth, 6.21 MHz

3.5 Emission Limitations

Test: CFR 47 FCC Part §2.1051 and §87.139

Result: *Complies* Date: 15 December 2015

Test Description

(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10}$ pY dB.

All harmonics measurements must be at least 40 dB below the carrier. The highest measured power measurement was 52.97 dBm, so the limit applied was 12.97 dBm. The attenuation and cable attenuation was the same as used in section 3.1.

Test Environment

Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of 35 ± 5%; Temperature of 20 ± 2º C

Test Setup

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation and coupled to the receiver with a directional coupler. The output was terminated with a 50ohm load. The resolution bandwidth of the spectrum analyzer was set at 100 kHz and the video bandwidth was set to 1MHz to prevent pulse desensitization. Sufficient scans were taken to show any out of band emissions up to the 10th harmonic.

Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
100037	Rhode & Schwarz	ES126	EMI Test Receiver	20 Jan 2015
BG1808	Weinschel	48-30-43	30 dB Attenuator	15 Dec 2015
00319	Mini-Circuits	UNAT-20	20 dB Attenuator	15 Dec 2015

*Verification date

Test Results

The spurious emissions at the antenna terminals were found to comply.

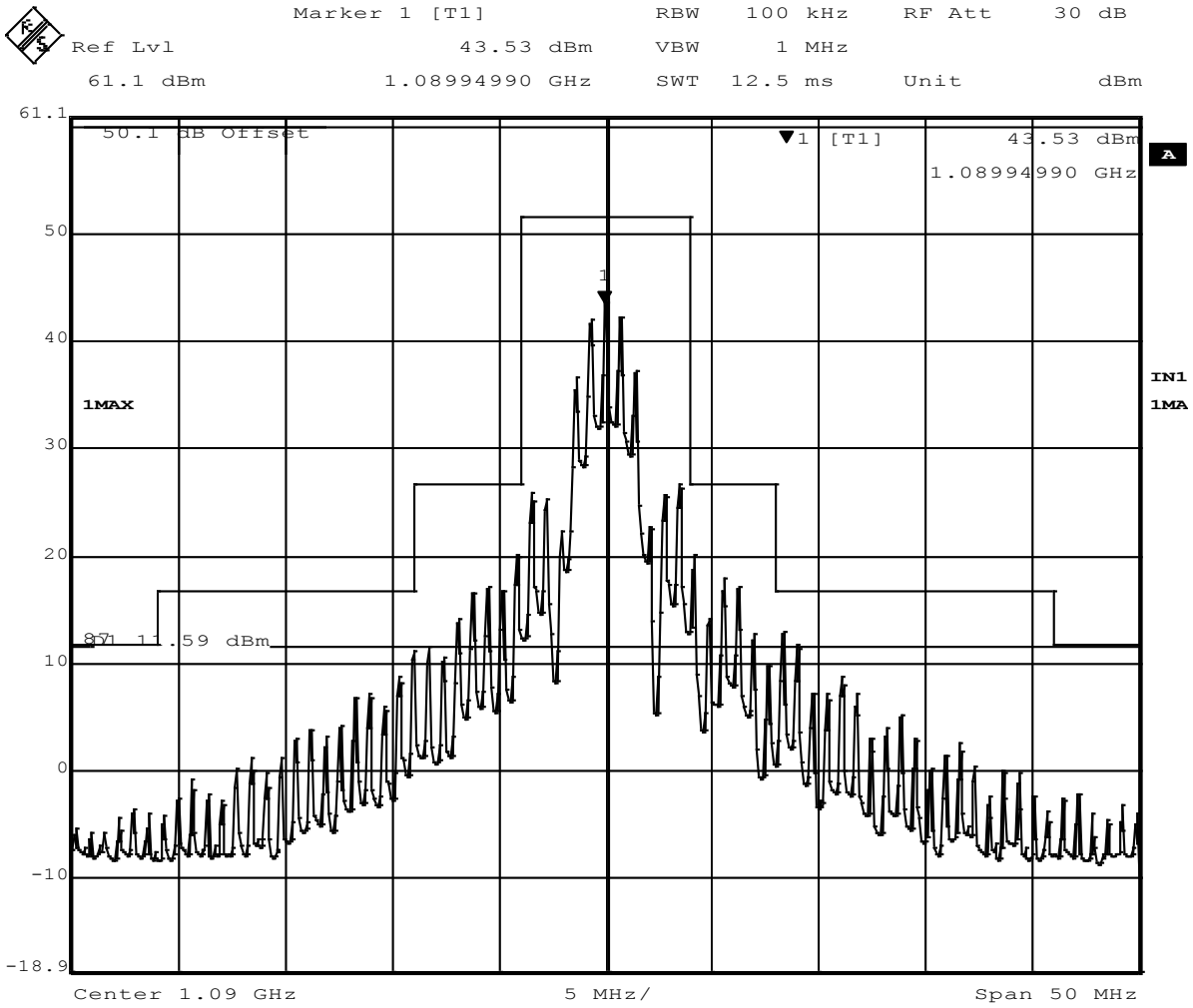


Figure 11 - Emissions Mask, Mode A (7777)

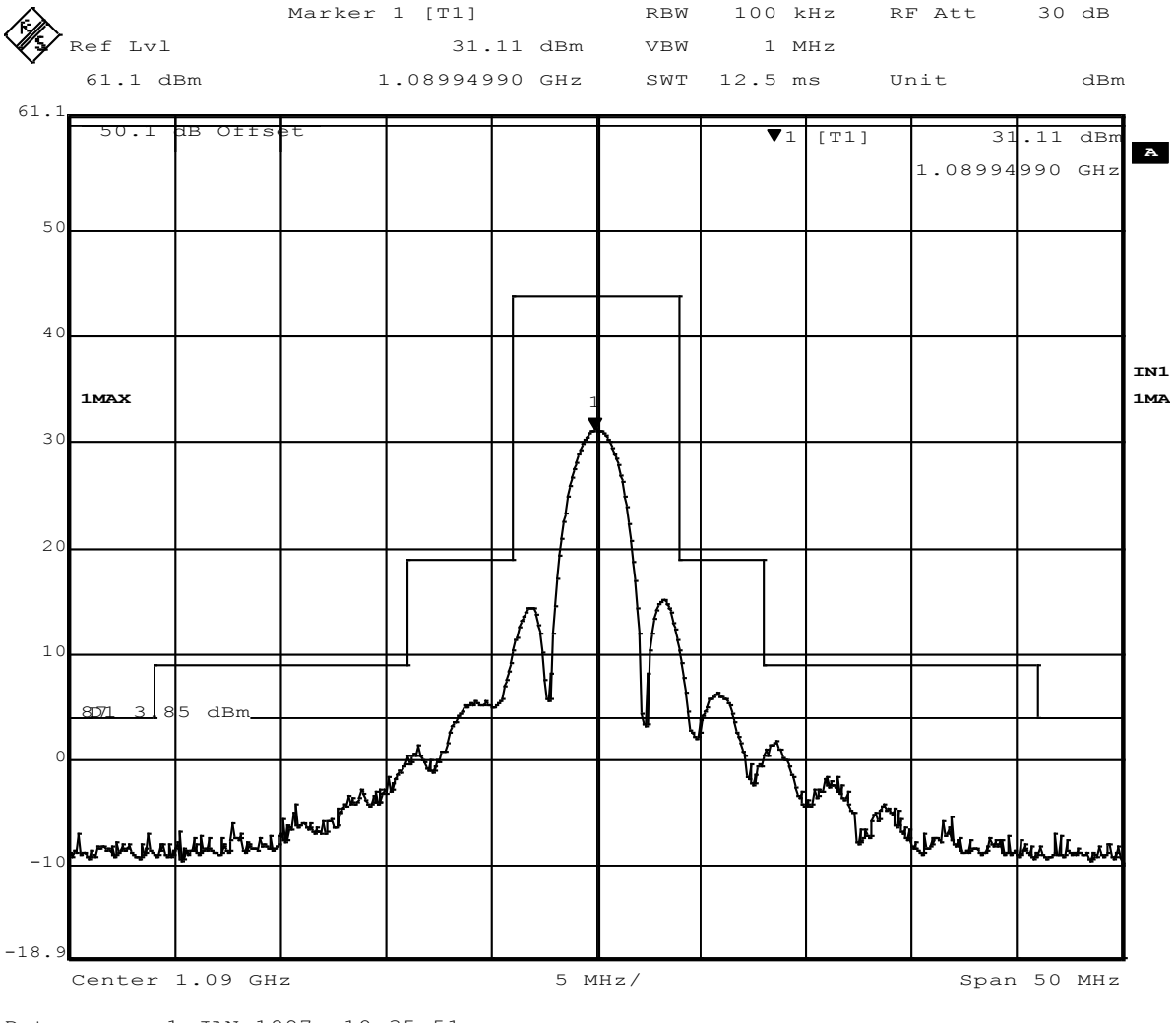


Figure 12 - Emissions Mask, Mode A (0000)

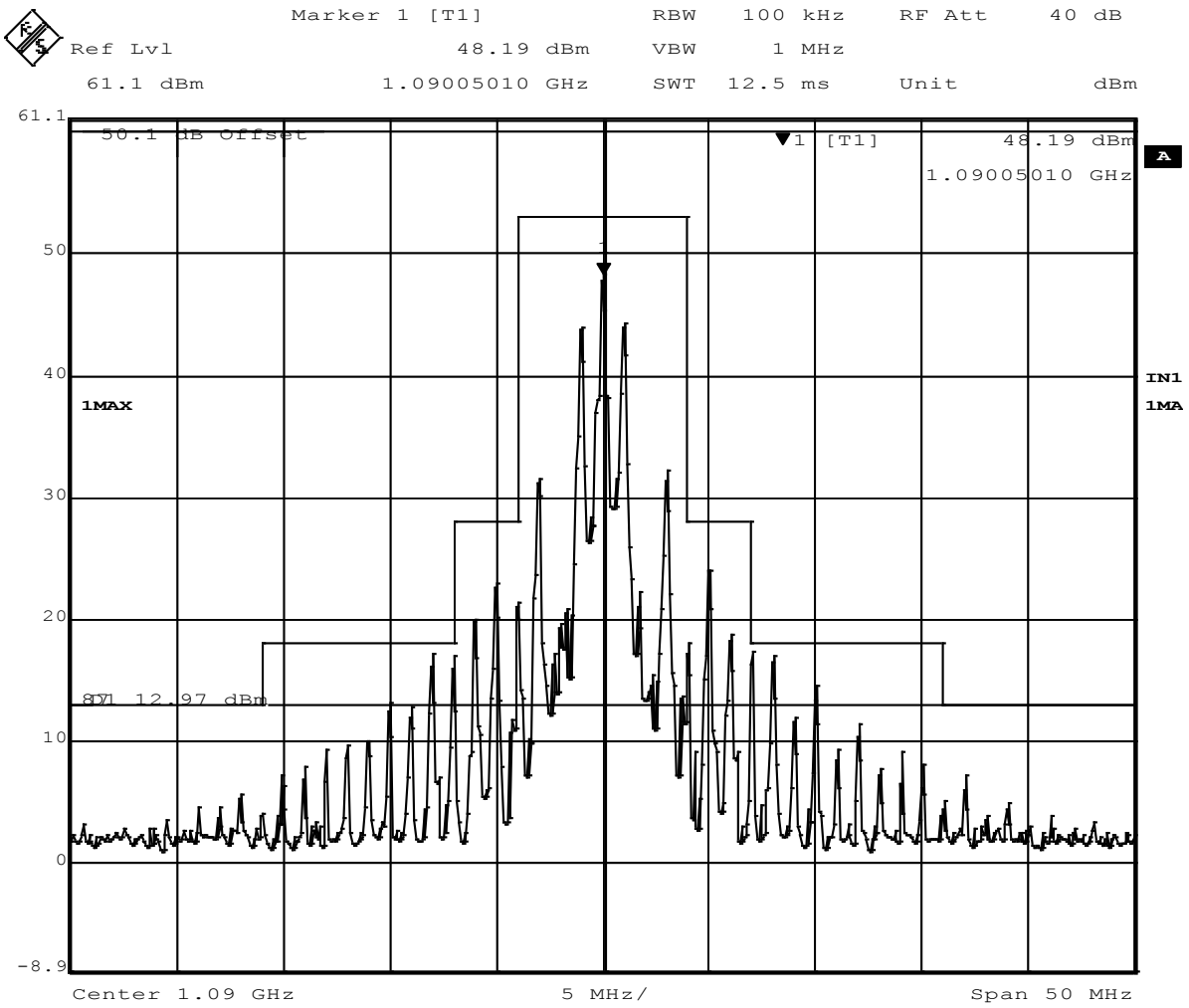


Figure 13 – Emission Mask, Mode S Long

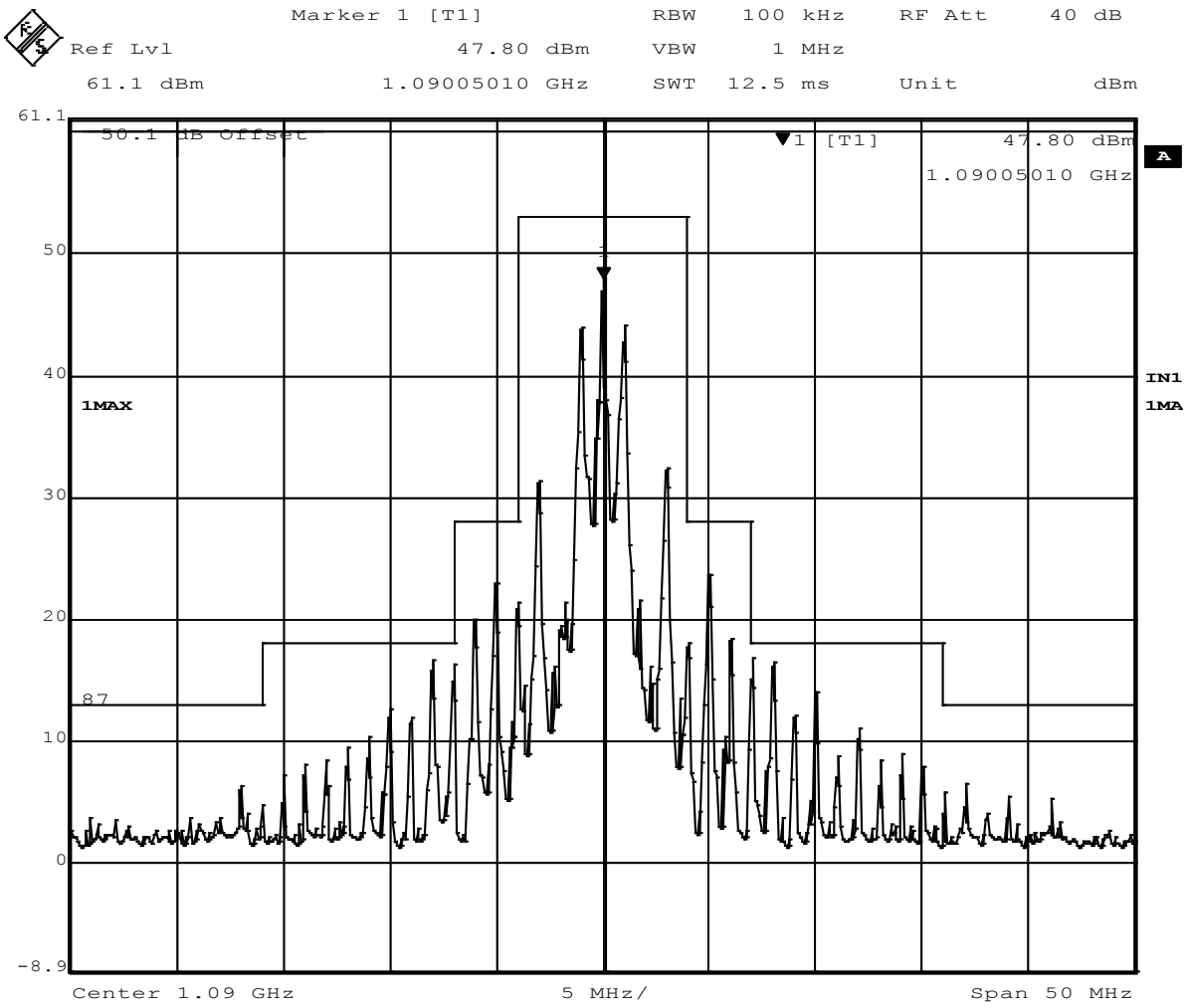


Figure 14 - Emissions Mask, Mode S Short

long

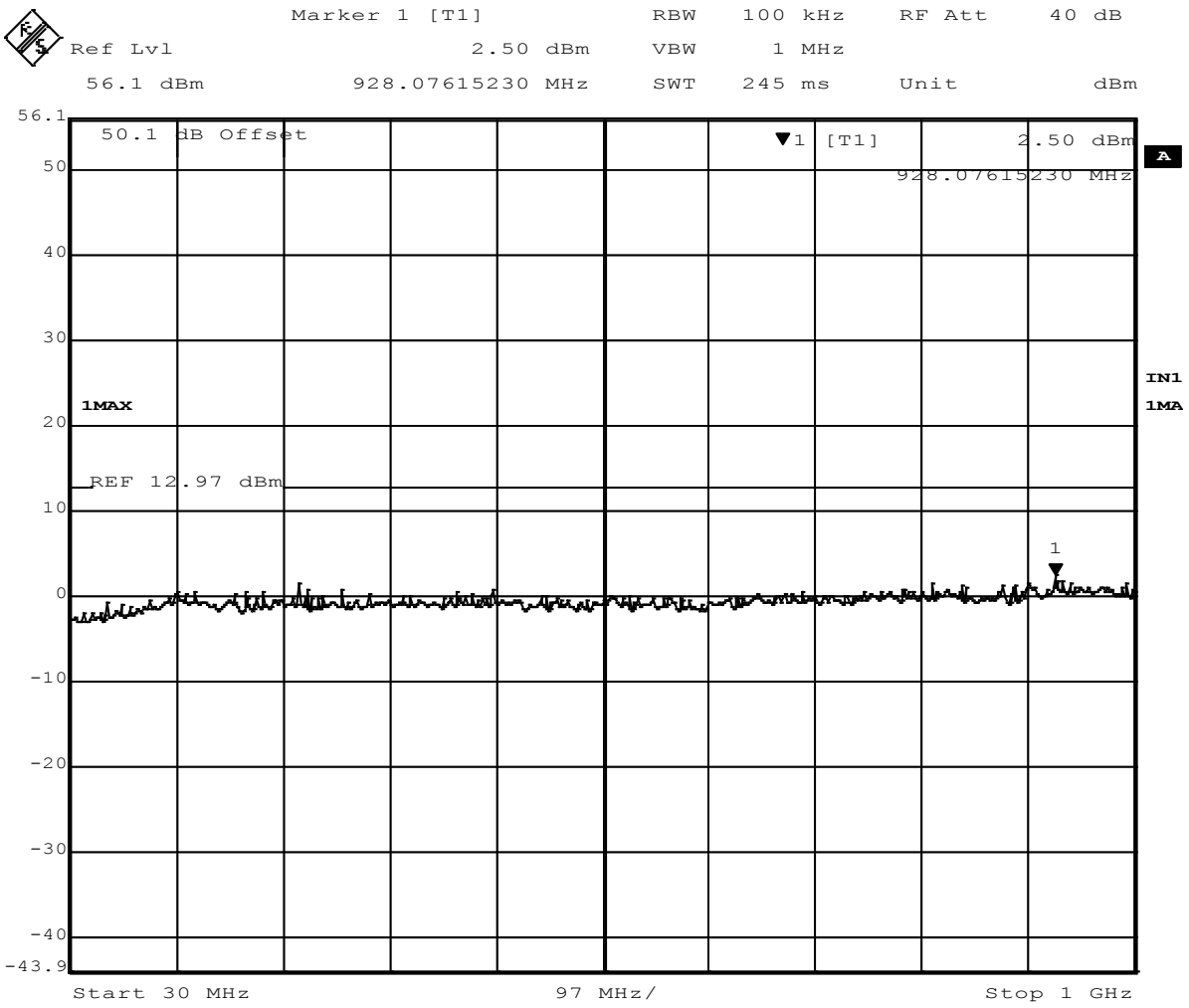


Figure 15 - Conducted Spurious Emissions, 30MHz - 1GHz

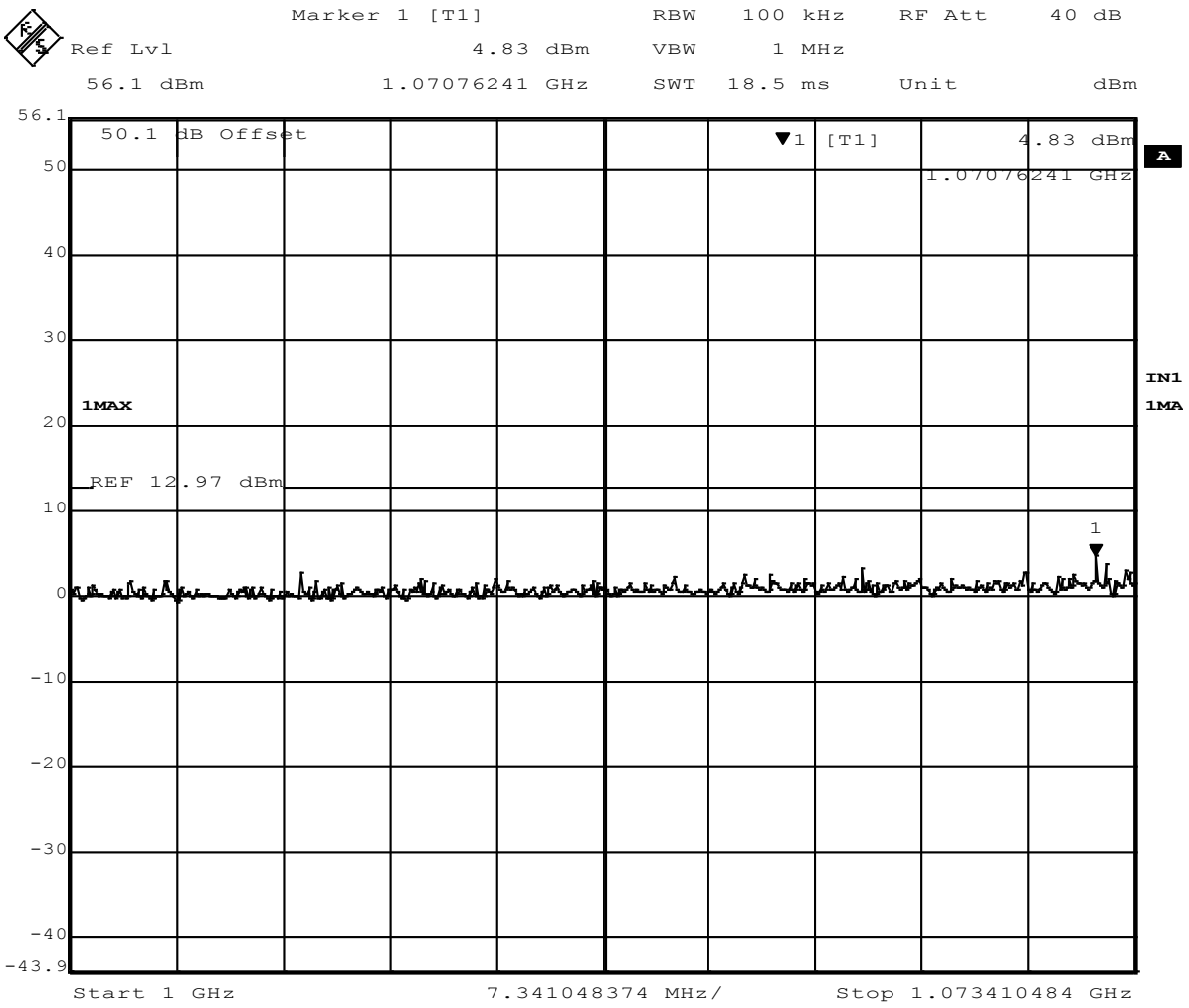


Figure 16 - Conducted Spurious Emissions, 1GHz – 1.073GHz

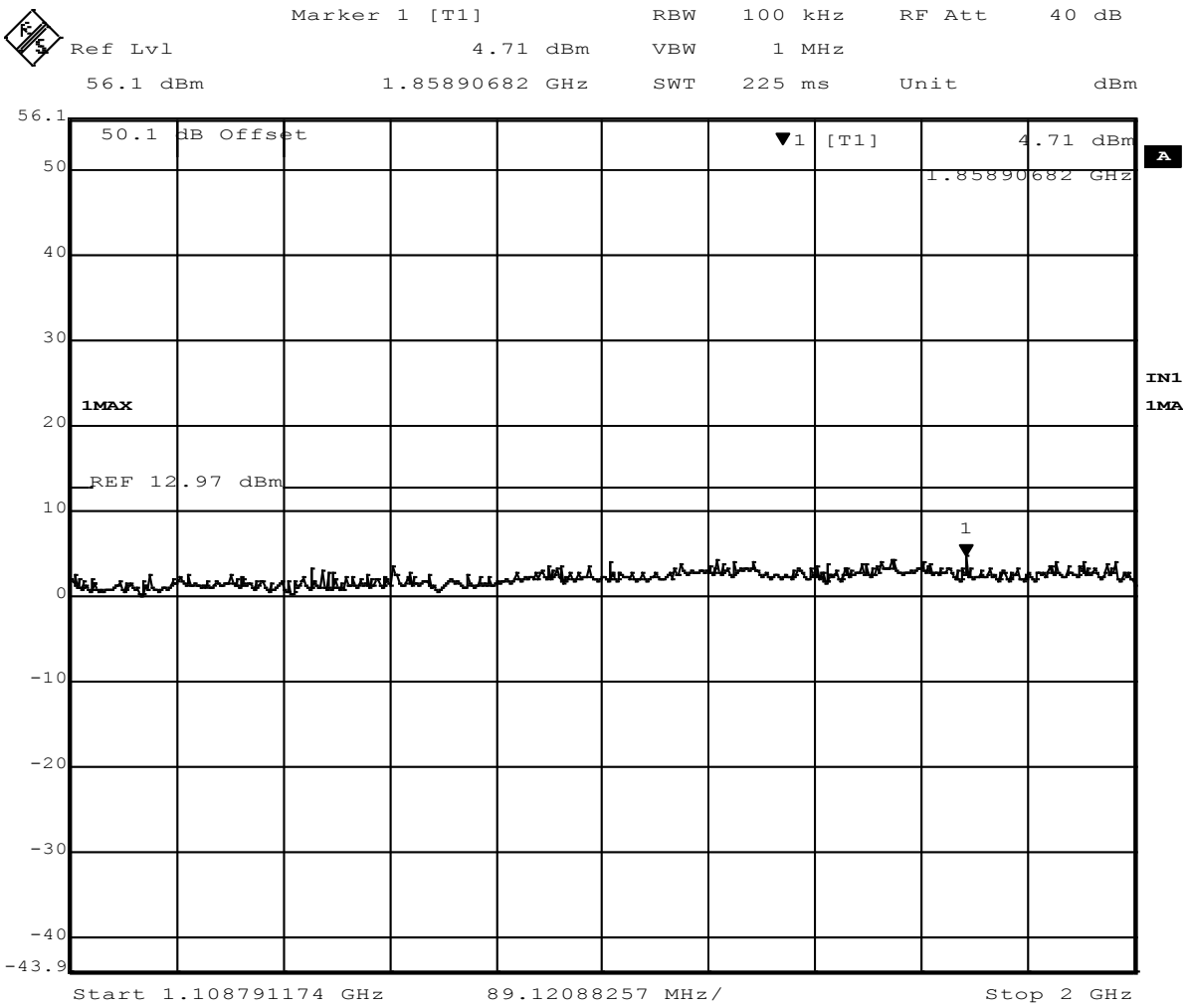


Figure 17 - Conducted Spurious Emissions, 1.108GHz – 2GHz

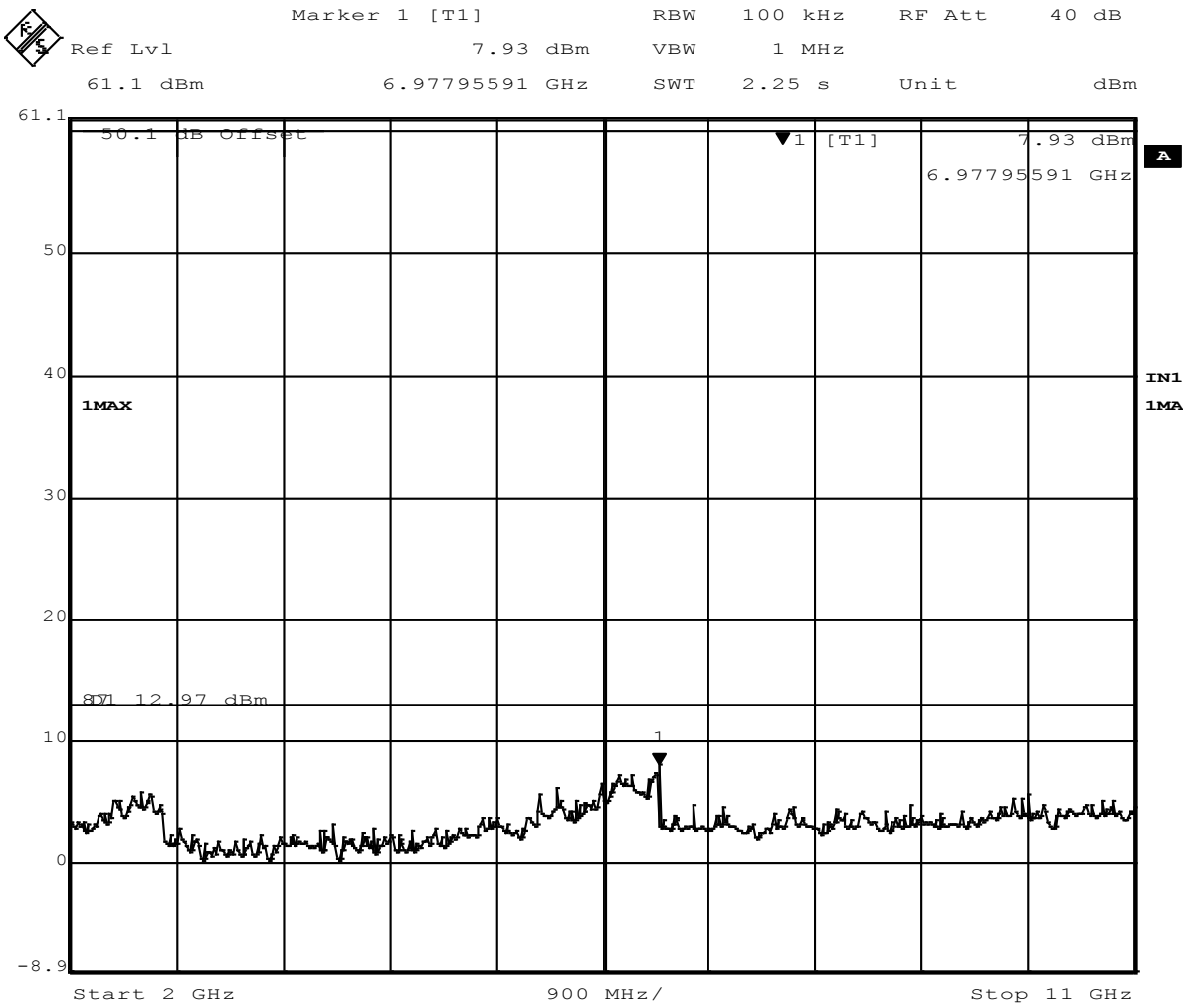


Figure 18 - Spurious Emissions at Antenna Terminals, 1090MHz, harmonics

3.6 Modulation Characteristics

Test: CFR 47 FCC Part §87.141

Result: *Complies* Date: 16 December 2015
7 March 2016

Test Description
The bandwidth was measured to support the following description of the modulation provided by the manufacturer:

There are 2 types of transmissions, Mode A (7777)/C and Mode S Long, both are described in RTCA DO-181E

- MODE A/C pulse train is 15 pulses long. Each pulse is 0.45 +/- 0.1 microseconds long with 0.10 microsecond maximum rise time and 0.20 microsecond maximum fall time. The 15 pulses are 12 information pulses spaced 1.45 microseconds between two framing pulses 20.3 microseconds apart. In addition to these 14 pulses there is "special position information" pulse that follows the last framing pulse by 4.35 microseconds.
- There are two types of Mode S Long pulse train, long and short, and are described as follows: The pulses are 0.5 +/- 0.05 microseconds long with 0.1 microsecond maximum rise times and 0.2 microsecond maximum fall time. The pulse train last for 120 microseconds and 62 microseconds for long and short message, respectively. There are 4 pulses in the first 8 microseconds, this is called the preamble. The remaining 112 microseconds or 56 microseconds is the data portion of the pulse train and it contains pulses that are 0.5 microseconds or 1.0 microseconds long. The data portion of the message has 112-bits or 56-bits of binary data. Each bit interval is 1 microsecond long.

Test Environment
Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:
Relative humidity of 35 ± 5%
Temperature of 22 ± 2º C

Test Setup
The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation.

Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
100037	Rhode & Schwarz	ES126	EMI Test Receiver	20 Jan 2015
BG1808	Weinschel	48-30-43	30 dB Attenuator	16 Dec 2015*
00319	Mini-Circuits	UNAT-20	20 dB Attenuator	16 Dec 2015*

*verification date

Test Results
Time and frequency domain plots have been provided to have been provided to support the manufacturer's stated modulation characteristics.

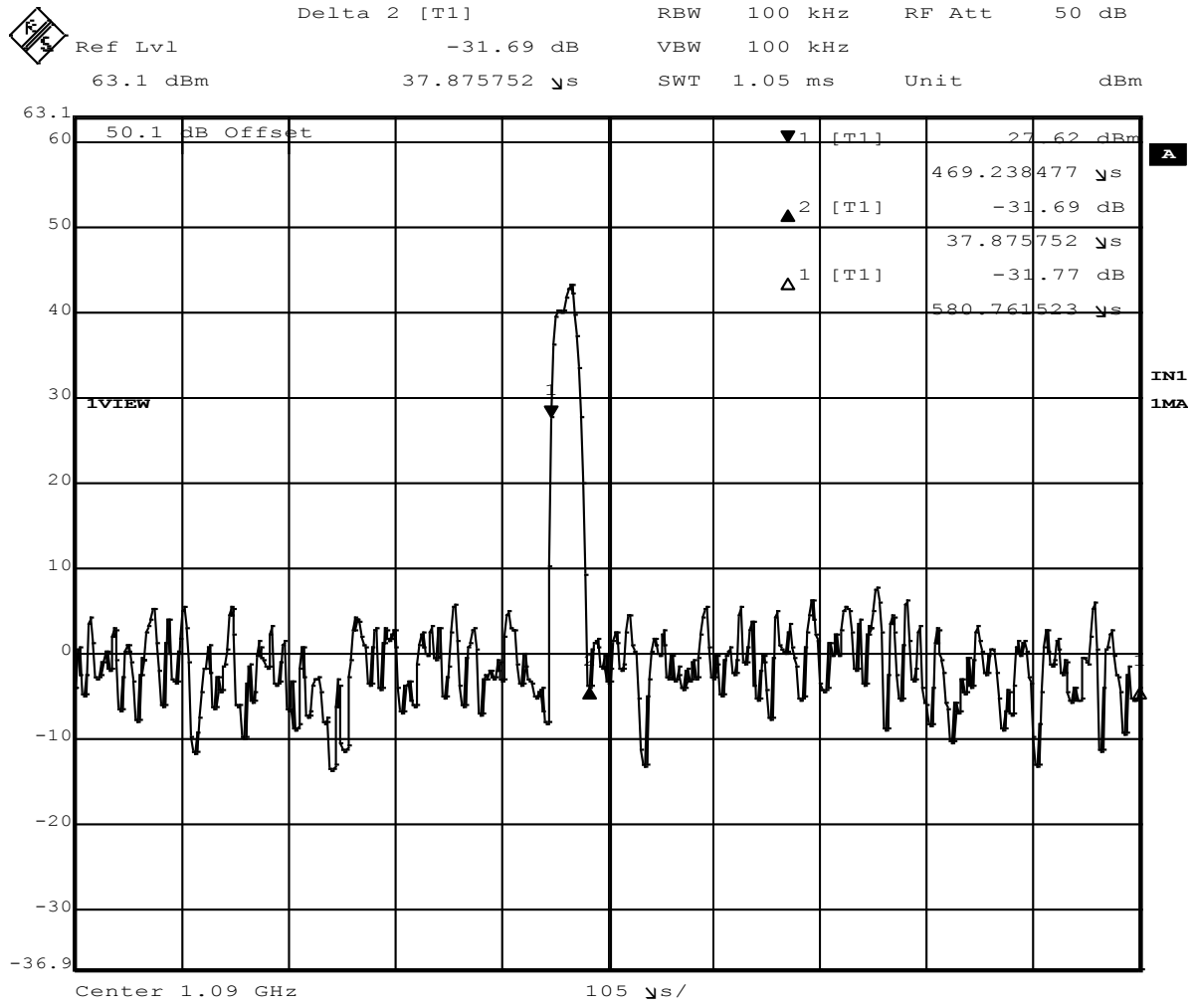


Figure 19 -Modulation Characteristics ON Time Mode A (7777)

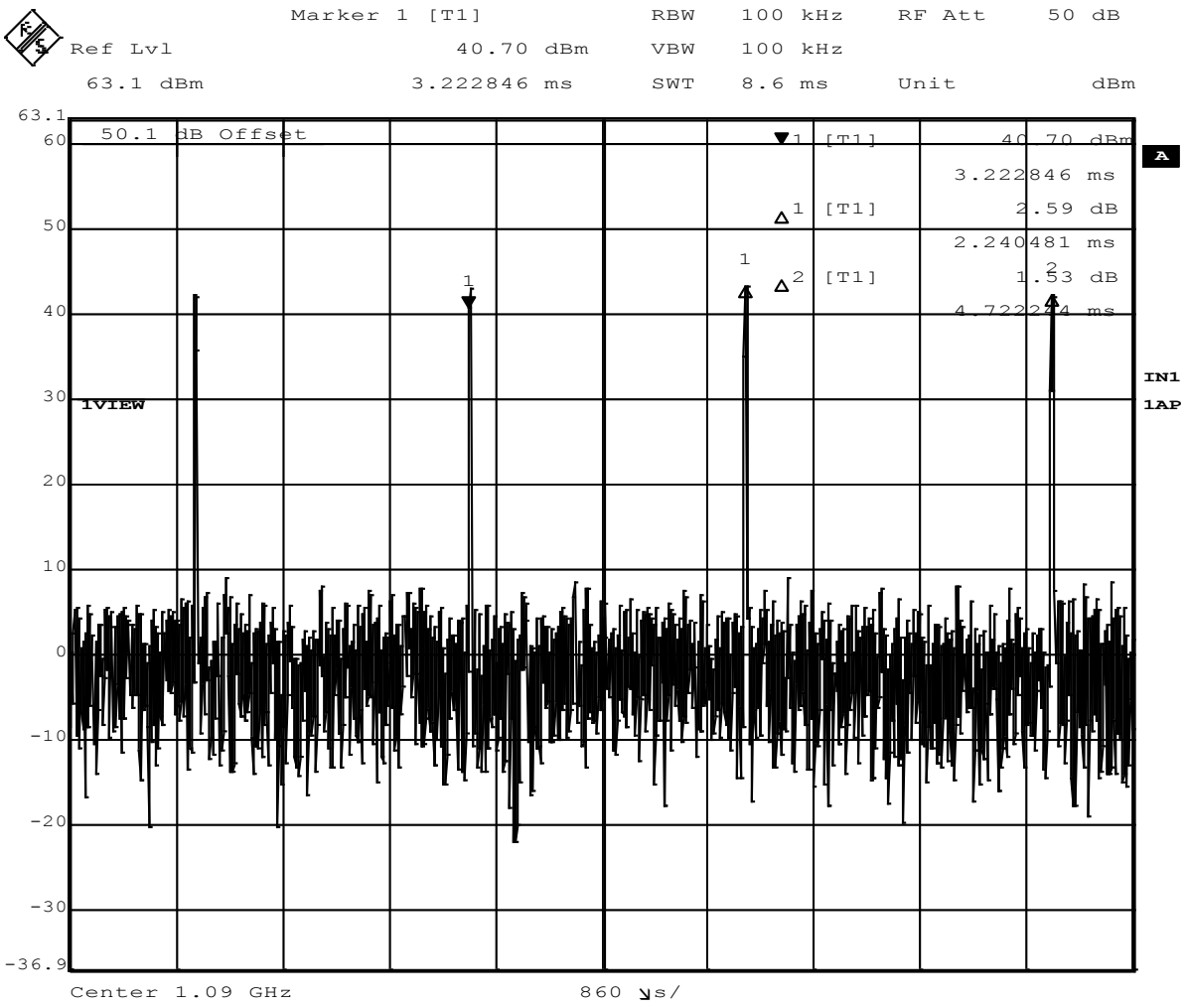


Figure 20 -Modulation Characteristics Period Mode A (7777)

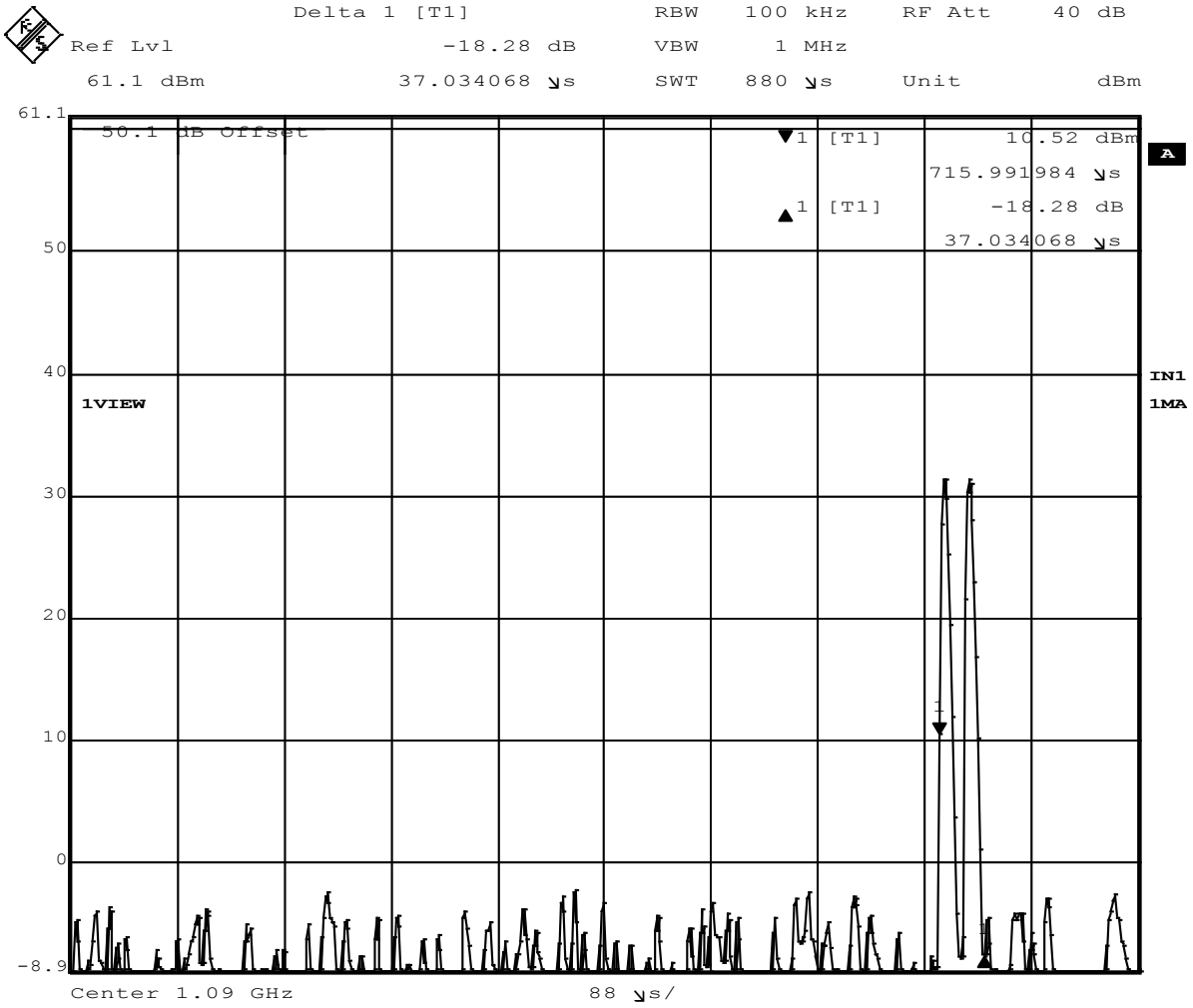


Figure 21 -Modulation Characteristics ON Time Mode A (0000)

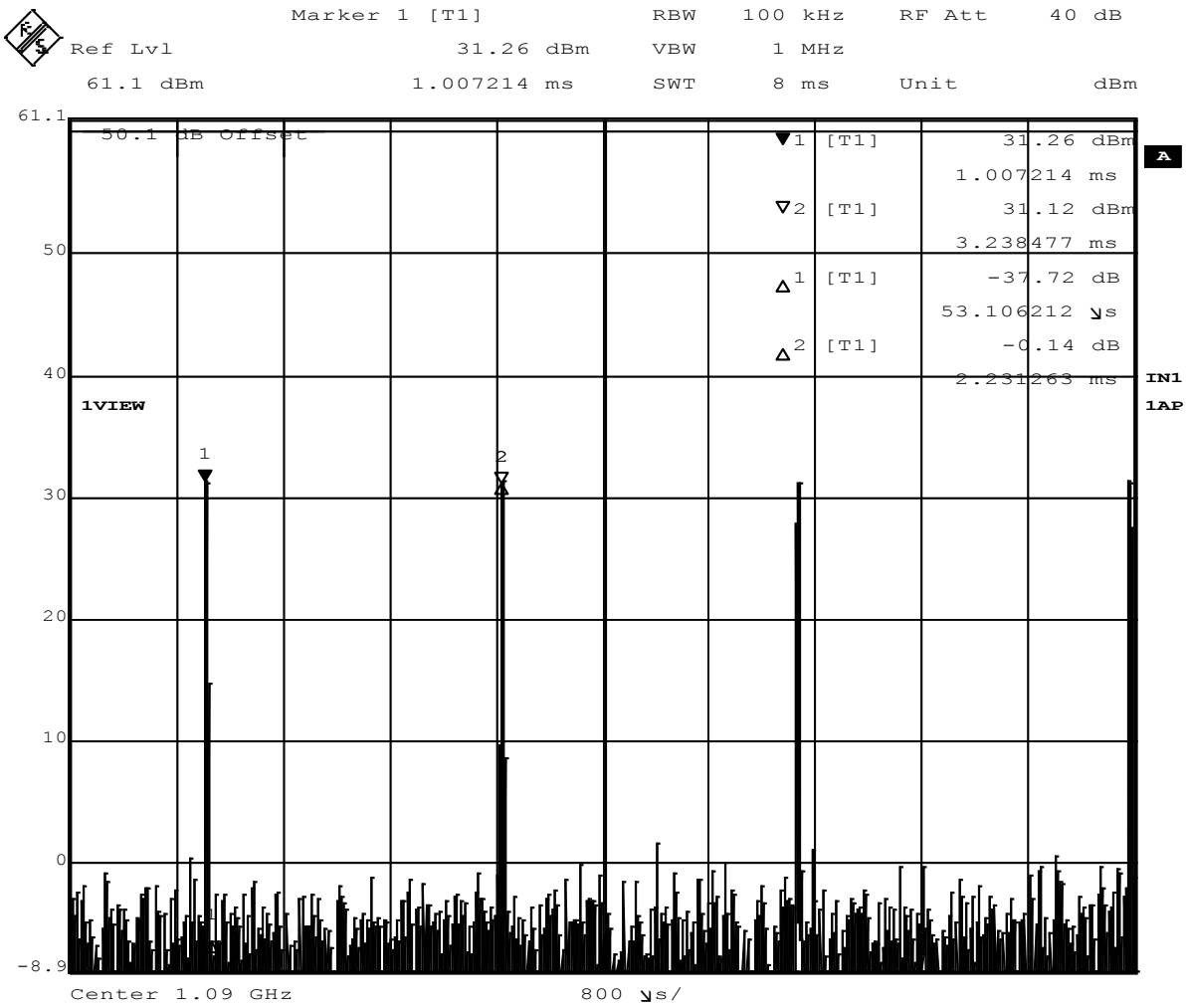


Figure 22 -Modulation Characteristics Period Mode A (0000)

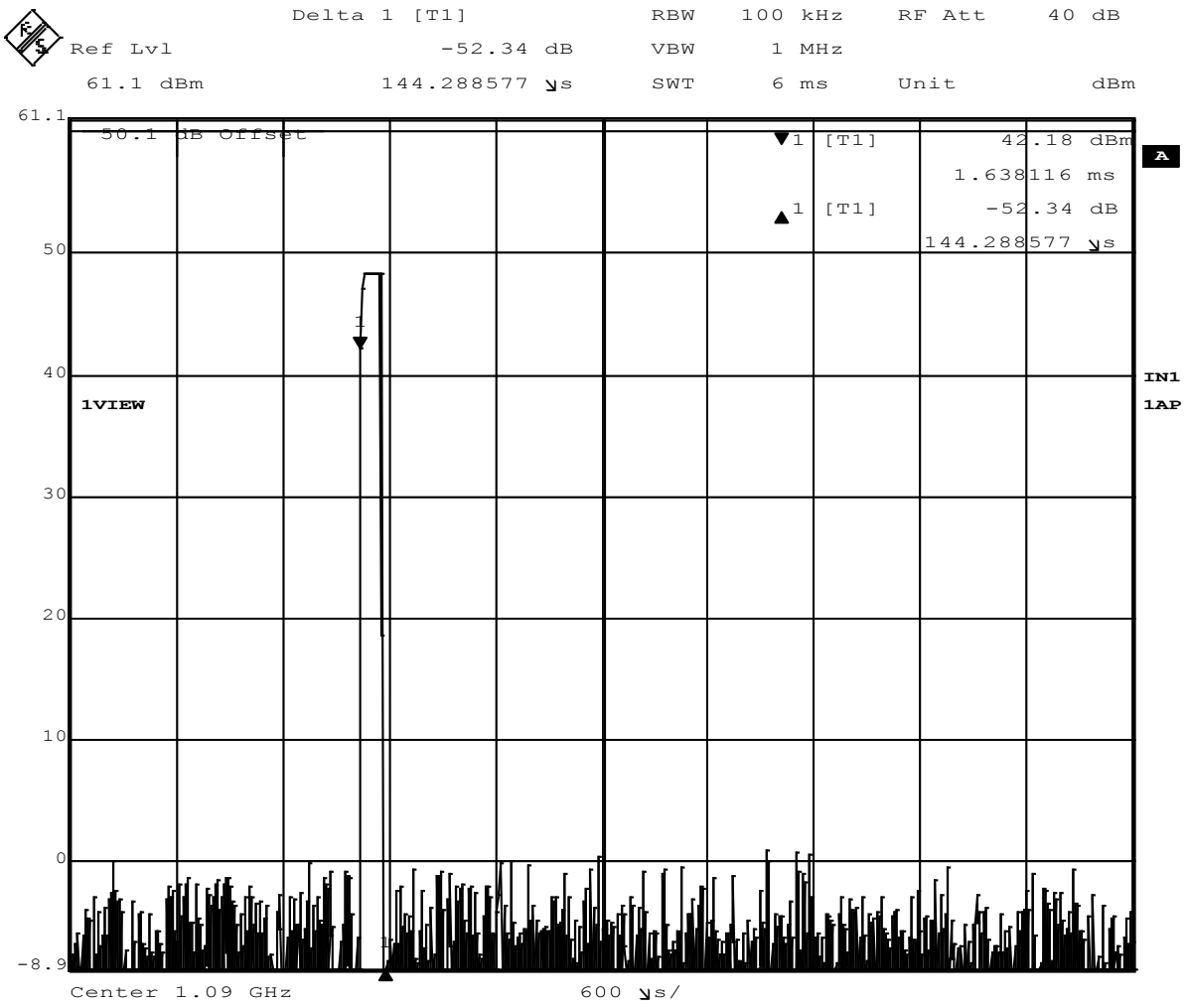


Figure 23 -Modulation Characteristics ON Time Mode S Long

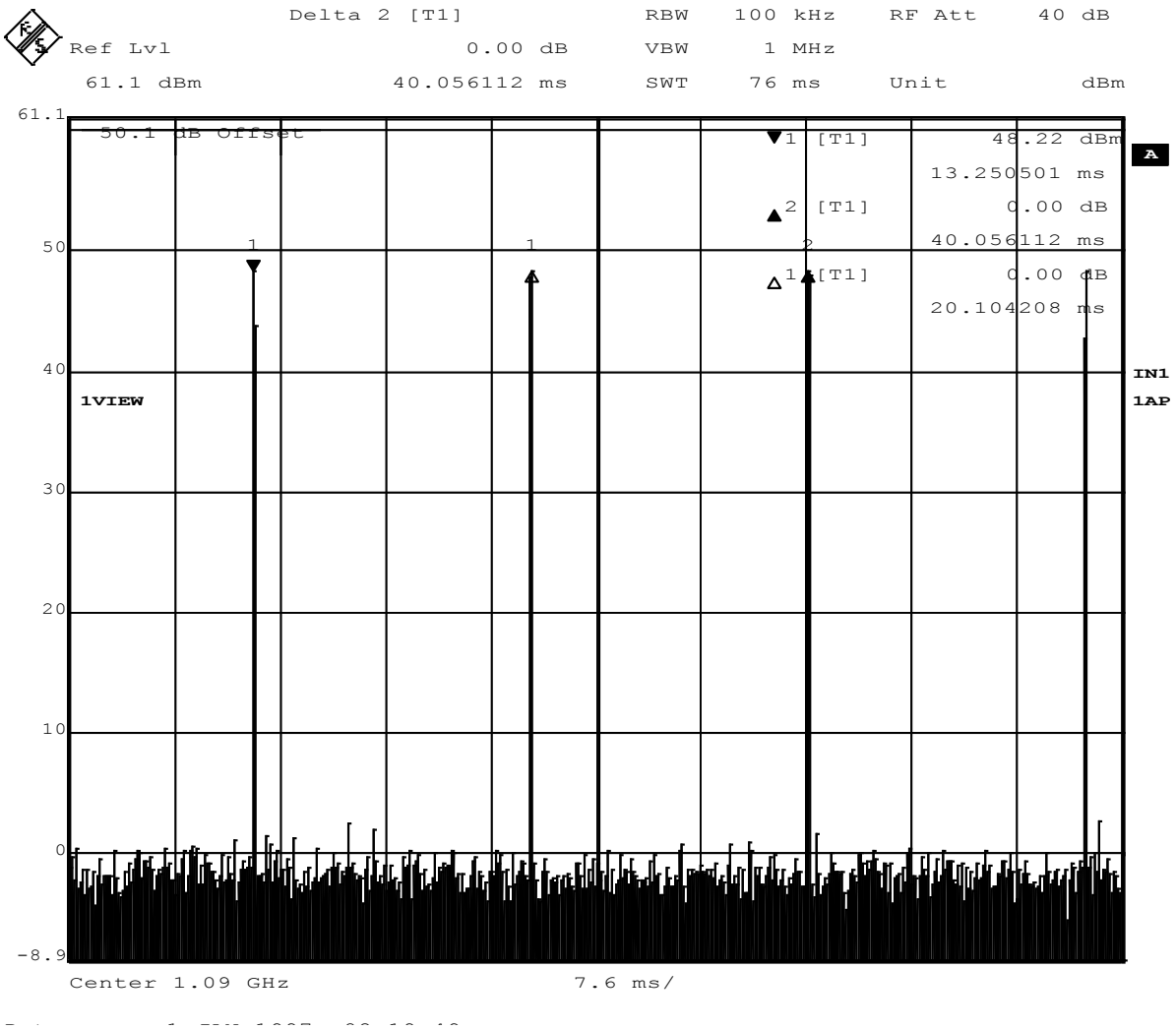


Figure 24 -Modulation Characteristics Period Mode S Long

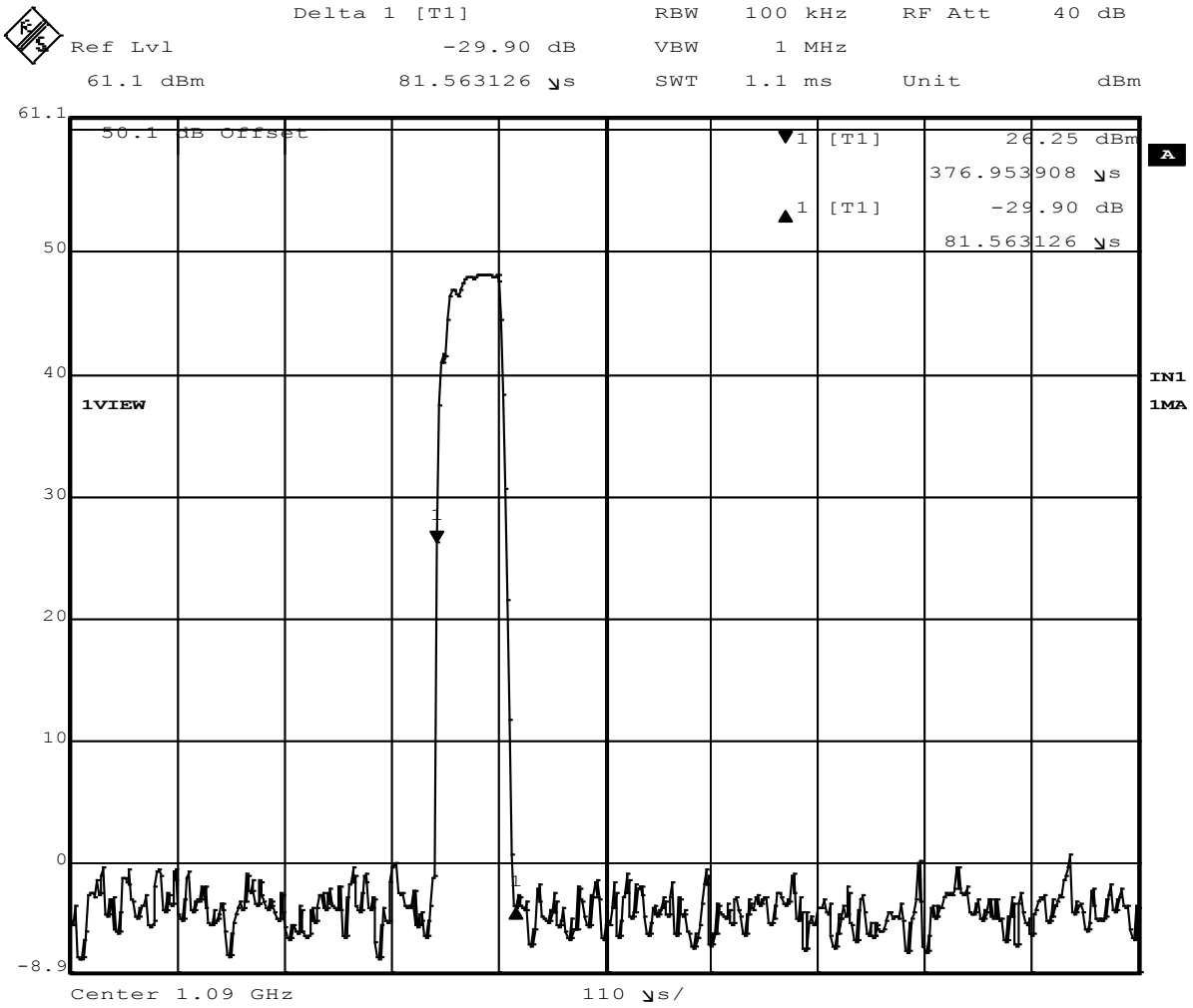


Figure 25 -Modulation Characteristics ON Time Mode S Short

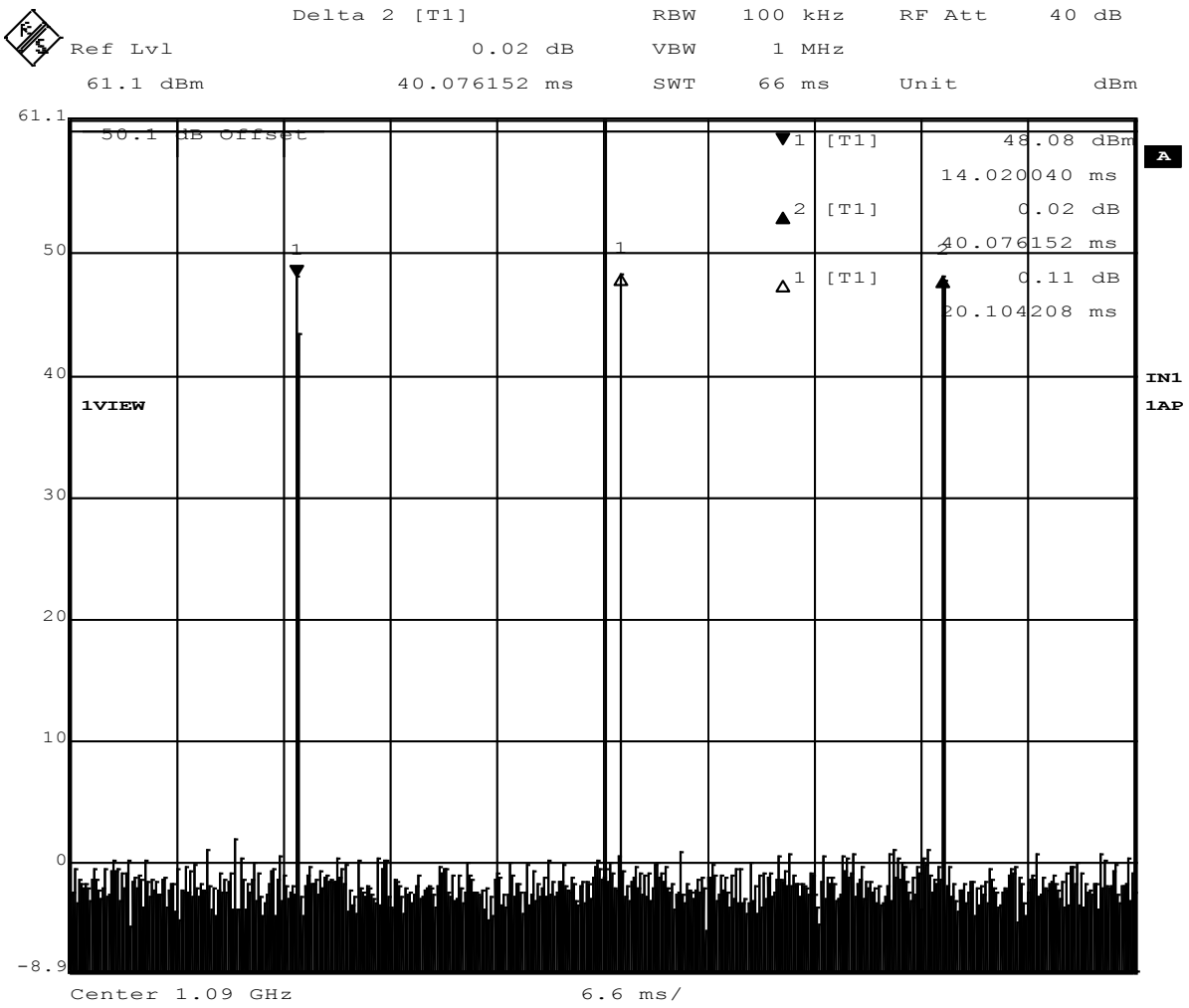


Figure 26 -Modulation Characteristics Period Mode S Short

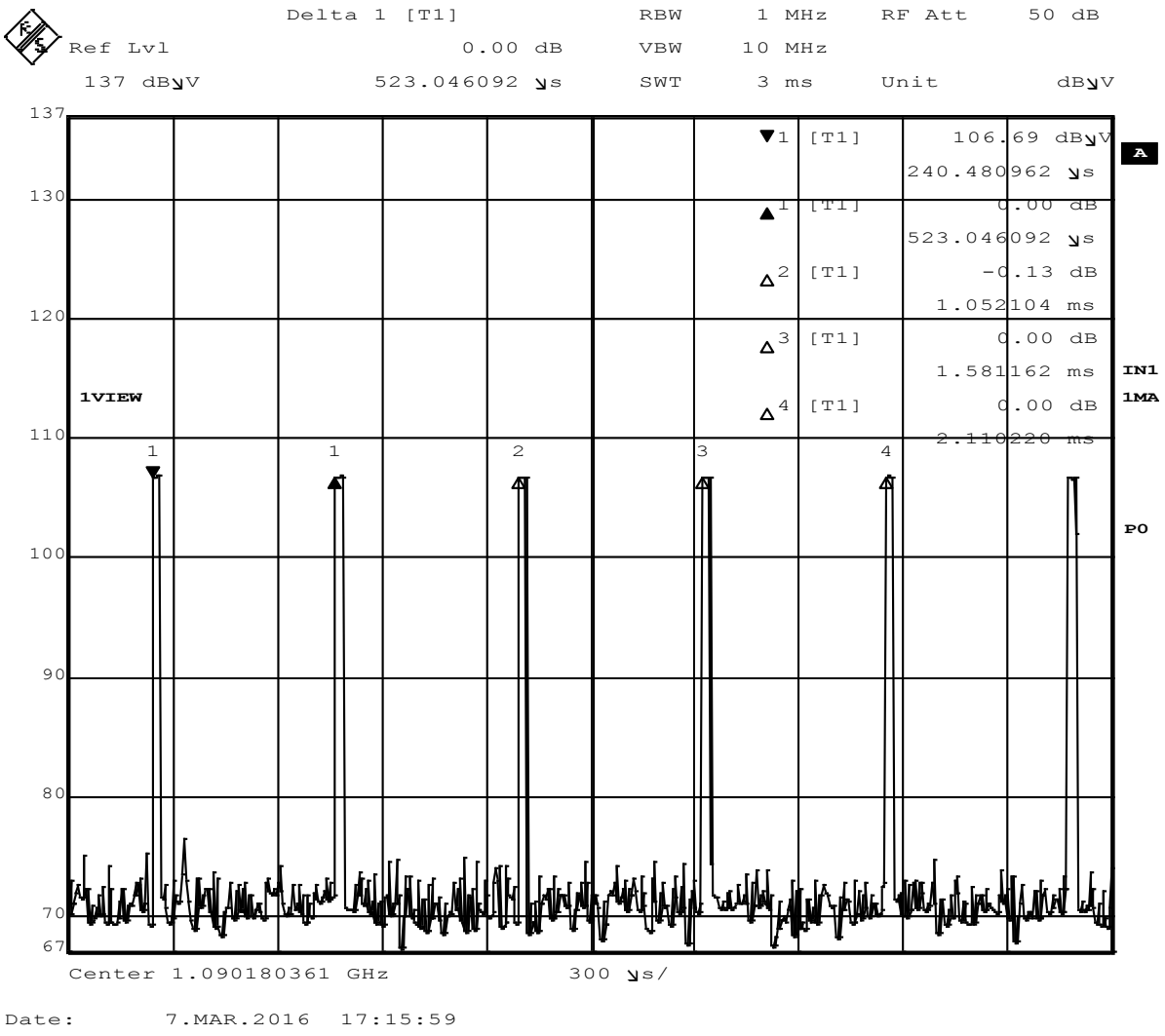


Figure 27 - Modulation Characteristics Period, Spy Pulse
523.05µs period

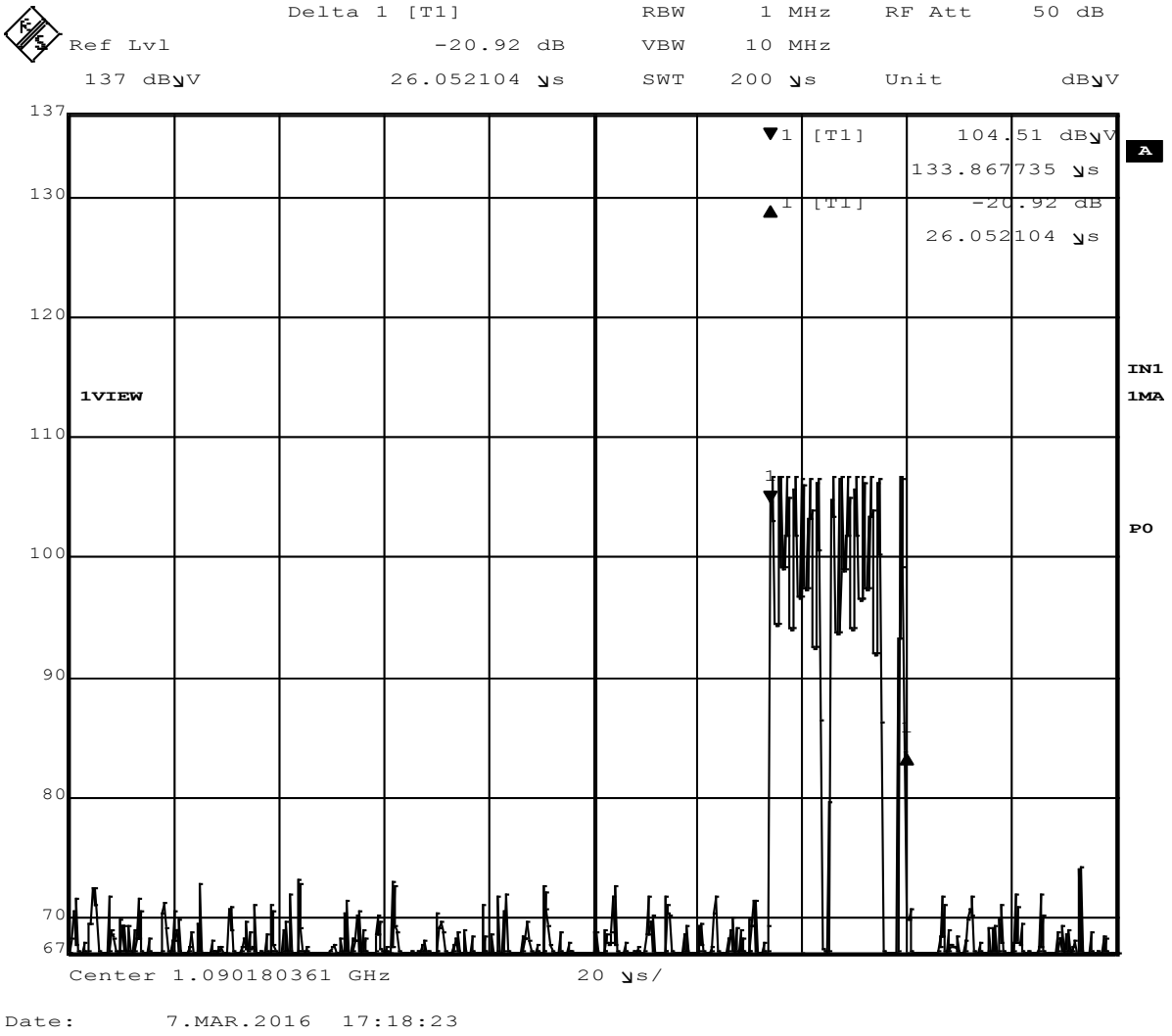


Figure 28 - Modulation Characteristics Period Spy Pulse
26.05µs pulse

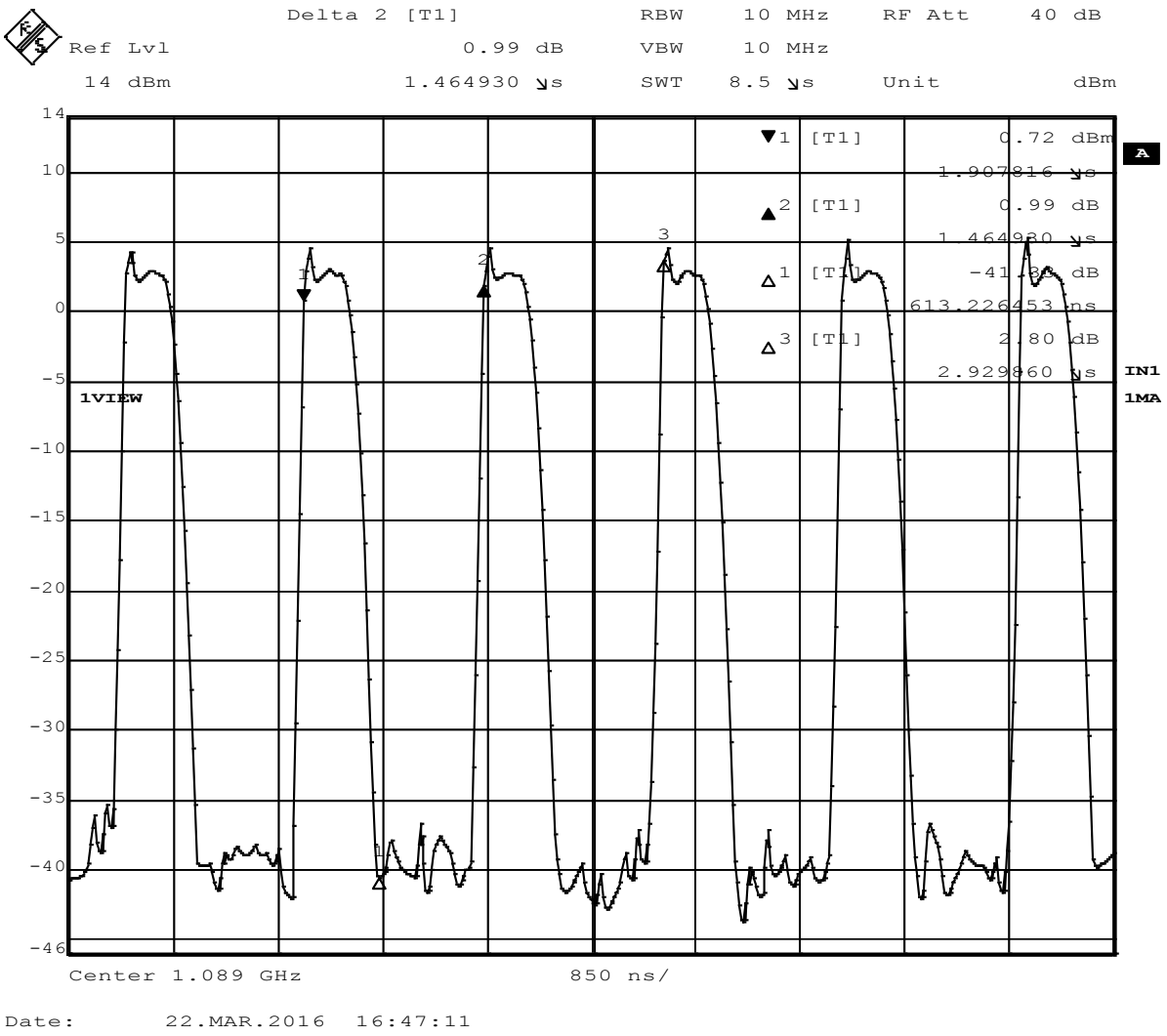


Figure 29 - Modulation Characteristics Spy Pulse - Duty-cycle within one pulse
Period = 1.465µs Pulse width = 613.23ns

Spy Pulse Duty Cycle = (26.05µs / 523.05µS) x (613.23 / 1465ms) = 0.021

3.7 Field Strength Spurious Emission

Test: CFR 47 FCC §2.1053

Result: *Complies* Date: 17 December 2015

Test Description
The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The frequency range up to tenth harmonic of the fundamental frequency was investigated.

The EUT was then removed and the replaced with a substitution antenna of the same model as the receiving antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution method measurements. Spurious emissions in dBm = 10 log (TXpwr in Watts/0.001) which is the absolute level.

The resolution bandwidth of the spectrum analyzer was set at 100 kHz and the video bandwidth was set to 1MHz to prevent pulse desensitization.

Test Environment
Testing was performed at the NCEE Labs Lincoln facility in the 10m semi-anechoic chamber. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of 30 ± 5%
Temperature of 22 ± 2º C

Test Setup
The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable. The test setup can be seen in Figure 1 of appendix A.

Test Results
The radiated spurious emissions were found to comply

Test Equipment Used

Serial No.	Manufacturer	Model	Description	Last Cal.
1647	EMCO	3142B	Bicon Antenna	23 Jun 2015
1654	EMCO	3142B	Bicon Antenna	26 Jan 2015
6415	EMCO	3115	DRG Horn	20 Jan 2015*
6416	EMCO	3115	DRG Horn	14 Jan 2014*
102152	Rohde & Schwarz	SML01	Signal Generator 1.1GH	18 Jun 2015
3545700803	Rohde & Schwarz	TS-PR18	Preamplifier	14 Dec 2015**
100037	Rhode & Schwarz	ES126	EMI Test Receiver	20 Jan 2015
2575	Rohde & Schwarz	ES-K1	Software v.1.60	N/A

*Two-year calibration cycle
**Internal Verification

Table 2- Radiated Spurious Emission Measurements

Frequency	Pre-scan Level	Antenna Height	Angle	Pol.	Signal Generator Level	Transmit Antenna Gain	Transmit Cable loss	Level	Limit	Margin
MHz	dBµV/m	cm	deg.		dBm	dBi	dB	dBm	dBm	
Tx Mode										
307.980000	37.06	99	70	HOR	-70.90	3.74	2.80	-69.96	11.59	81.55
3270.000000	67.25	101	213	VER	-29.30	9.197	8.60	-28.70	11.59	40.29
8719.800000	68.49	109	121	HOR	-17.90	14.072	14.40	-18.23	11.59	29.82

Annex A – Sample Field Strength Calculation

Radiated Emissions

The field strength is calculated in decibels (dB) by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = R + AF – (-CF + AG)

where FS = Field Strength

R = Receiver Amplitude Receiver reading in dBμV

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dBμV is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dBμV/m.

FS = 55.00 + 12.00 – (-1.10 + 20.00) = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20] = 254.1 μV/m

Conducted Emissions

Receiver readings are compared directly to the conducted emissions limits in decibels (dB) by adding the cable loss and LISN insertion loss to the receiver reading. The basic equations with a sample calculation is as follows;

FS = R + IL – (-CF)

where V = Conducted Emissions Voltage Measurement

R = Receiver reading in dBμV

IL = LISN Insertion Loss

CF = Cable Attenuation Factor

Assume a receiver reading of 52.00 dBμV is obtained. The LISN insertion loss of 0.80 dB and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBμV/m.

V = 52.00 + 0.80 – (-1.10) = 53.90 dBμV/m

The 53.90 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20] = 495.45 μV/m

*Note: NCEE Labs uses the Rohde and Schwarz ES-K1 software package. In this software, all cable losses are listed as negative. This is why cable loss is subtracting in the preceding equations.

Margin is calculated by taking the limit and subtracting the Field

Annex B – Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44

Expanded uncertainty values are calculated to a confidence level of 95%.