

Nemko Test Report:

10227668RUS1rev1

Applicant:

Stemco LP 300 Industrial Blvd. Longview, TX 75062 USA

Equipment Under Test: (E.U.T.)

FCC ID.: SRA-830 IC: 7413A-830

In Accordance With:

FCC Part 15, Subpart C, 15.247 and Industry Canada RSS-210, Issue 8 Digital Transmission Systems

Tested By:

Nemko USA, Inc. 802 N. Kealy Lewisville, Texas 75057-3136

830

DATE: 21 August 2012

TESTED BY:

David Light, Senior Wireless Engineer

Mic

APPROVED BY:

DATE: 21 August 2012

Mike Cantwell

Number of Pages: 29

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Section 1. Summary of Test Results

Manufacturer: Stemco LP

Model No.: 830

Serial No.: None

General: All measurements are traceable to national standards.

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 and Industry Canada RSS-210, Issue 8 for Digital Transmission Systems. Radiated tests were conducted is accordance with ANSI C63.4-2003. Conducted tests were made in accordance with FCC OET Bulletin 558074 D01 v01. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC and Industry Canada.

\bowtie	New Submission	\boxtimes	Production Unit	
\Box	Class II Permissive Change		Pre-Production Unit	

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. See "Summary of Test Data".



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Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
Powerline Conducted Emissions	15.207(a) / RSS-Gen 7.2.4	NA
Minimum 6 dB Bandwidth	15.247(a)(2) / RSS-210 A8.2(a)	Complies
Maximum Peak Power Output	15.247(b)(3) / RSS-210 A8.4(4)	Complies
Spurious Emissions (Antenna Conducted)	15.247(d) / RSS-210 A8.5	Complies
Spurious Emissions (Restricted Bands)	15.247(d)/15.209(a) / RSS-Gen 7.2.2	Complies
Peak Power Spectral Density	15.247(e) / RSS-210 A8.2(b)	Complies

Footnotes:

The EUT is battery powered.

Revisions:

Revision1 Recalculated EIRP using field strength method.

Nemko USA, Inc.	FCC PART 15, SUBPART C &								
	Industry Canada RSS-210, Issue 8								
	Test	Digital I	ransmission Systems						
EQUIPMENT: SRA-830		eport No.:	10227668RUS1rev1						
Section 2. Equipment Une	der Test (E.U	J.T.)							
General Equipment Information									
Frequency Band (MHz):	902-928	2400-248	3.5 5725-5850						
		\boxtimes							
Operating Frequency of Test Sample:	2404.25 to 248	0.25 MHz							
User Frequency Adjustment:	Factory set								
Input Power:	12 Vdc automo	tive battery.							
Description of EUT									
Wireless air flow monitor for automotive use.									

Section 3. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)
	RSS-210 A8.2(a)
TESTED BY: David Light	DATE: 13 July 2012

Test Results: Complies.

Measurement Data: See attached plots

 Test Conditions:
 54
 %RH

 22
 °C

Measurement Uncertainty: +/-1x10⁻⁷ ppm

Test Equipment Used: 1036-1783-1480-1016

Test Data – Occupied Bandwidth

Low Channel



Test Data – Occupied Bandwidth

Mid Channel



Test Data – Occupied Bandwidth

20 dB BW for IC



Test Data - Occupied Bandwidth

Upper Channel



Section 4. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(3)
	RSS-210 A8.4(4)
TESTED BY: David Light	DATE: 13 July 2012

Test Results: Complies.

Measurement Data: Refer to attached data

 Test Conditions:
 54
 %RH

 22
 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 1036-1783-1480-1016

This device was tested at +/- 15% input power per 15.31(e), with no variation in output power.

For battery powered equipment, the device was tested with a fresh battery per 15.31(e).

The device was tested on three channels per 15.31(I).

 \square This test was performed radiated.

Test Data – Peak Power

	P _{meas}	G _R	L _C	G _{amp}	P _R	L _P		G _T	P _T	P _T
		RX			Adjusted	Free-space		TX	Transmit	Transmit
	Meter	antenna	Cable	Pre-amp	RX	propogation		antenna	power at	power at
Frequency	reading	gain	loss	Gain	Power	loss	EIRP	gain	antenna port	antenna port
(MHz)	(dBm)	(dBi)	(dB)	(dB)	(dBm)	(dB)	(dBm)	(dBi)	(dBm)	(mW)
2480.25	-17.2	8.85	3.1	33.0	-56.0	49.9	-6.0	3.0	-9.0	0.125
2480.25	-14.8	8.85	3.1	33.0	-53.6	49.9	-3.6	3.0	-6.6	0.218
2442.25	-17.4	8.85	3.1	33.0	-56.2	49.8	-6.4	3.0	-9.4	0.116
2442.25	-15.7	8.85	3.1	33.0	-54.5	49.8	-4.7	3.0	-7.7	0.172
2404.25	-21.0	8.85	3.1	33.0	-59.8	49.7	-10.1	3.0	-13.1	0.049
2404.25	-18.6	8.85	3.1	33.0	-57.4	49.7	-7.7	3.0	-10.7	0.085

Spectrum analyzer settings:

RBW/VBW = 3 MHz, Detector = Positive Peak

Manufacturer' declared transmit antenna gain: 3 dBi

From FCC Guidance 412172 D01 Determining ERP and EIRP v01:

Received power level calculation:

RX Power = P_{meas} - G_R + L_C + L_{Atten} - G_{Amp}

where;

 $\mathbf{P}_{\mathbf{Measured}} =$ measured power level, in dBm;

 $\mathbf{GR} = \text{gain of the receive (measurement) antenna, in dBi;}$

LC = signal loss in the measurement cable, in dB;

 L_{Atten} = value of external attenuation (if used), in dB;

 G_{Amp} = value of external amplification (if used), in dB.

RX Power = -53.6 dBm

Free-space propagation loss calculation:

LP = 20 Log F + 20 Log D - 27.5

where:

 L_P = basic free space propagation path loss, in dB;

 \mathbf{F} = center frequency of radiated DUT signal, in MHz;

 \mathbf{D} = measurement distance, in meters.

EIRP calculation:

$\mathbf{EIRP} = \mathbf{PR} + \mathbf{LP}$

where;

EIRP = equivalent (or effective) isotropically radiated power (in dBm);

 $\mathbf{P}_{\mathbf{R}}$ = adjusted received power level, in dBm;

 $\mathbf{L}_{\mathbf{P}}$ = basic free space propagation path loss, in dB.

Transmit power calculation:

 $\mathbf{P}_{\mathrm{T}} = \mathbf{EIRP} - \mathbf{G}_{\mathrm{T}}$

Where;

 P_T = Transmit power at antenna terminal in dBm

 G_T = Manufacturer's declared transmitter antenna in dBi

Section 5 Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions at Antenna Terminals	PARA. NO.: 15.247 (d)
	RSS-210 AA8.5
TESTED BY: David Light	DATE: 13 July 2012

Test Results: Complies.

Measurement Data: See attached plots.

Test Conditions:54%RH22°C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 1036-1783-1480-1016

Test Data – Spurious Emissions at Antenna Terminals

Note: The EUT does not have an antenna port. Lower band edge plot is for reference.



Date: 13.JUL.2012 07:54:08

Section 6. Radiated Emissions

NAME OF TEST: Radiated Emissions	PARA. NO.: 15.247 (d)
	RSS-Gen 7.2.2
TESTED BY: David Light	DATE: 16 July 2012

Test Results: Complies.

Measurement Data: See attached table.

 Test Conditions:
 54
 %RH

 22
 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 1480-993-1025-1016-1783-1767

Notes:

For handheld devices, the EUT was tested
--

- The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency per 15.33
- The device was tested on three channels per 15.31(I).
- No emissions were detected within 20 dB of the specification limit therefore none are reported per 15.31(o).

RBW=VBW=100 kHz below 1000 MHz RBW=VBW=1 MHz above 1000 MHz (Peak) RBW= 1 MHz VBW=10Hz (Average)

Test Data – Radiated Emissions

Meas.	Ant.	Duty	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Cycle	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											Highest Channel
2483.50	V	0.0	66.9	29.0	3.1	31.8	67.2	74.0	-6.8	Pass	
2483.50	V	-20.0	66.9	29.0	3.1	31.8	47.2	54.0	-6.8	Pass	
4960.50	V	0.0	55.0	34.7	4.3	31.5	62.5	74.0	-11.5	Pass	
4960.50	V	-20.0	55.0	34.7	4.3	31.5	42.5	54.0	-11.5	Pass	
2483.50	Н	0.0	65.9	29.0	3.1	31.8	66.2	74.0	-7.8	Pass	
2483.50	Н	-20.0	65.9	29.0	3.1	31.8	46.2	54.0	-7.8	Pass	
4960.50	Н	0.0	62.9	34.7	4.3	31.5	70.4	74.0	-3.6	Pass	
4960.50	Н	-20.0	62.9	34.7	4.3	31.5	50.4	54.0	-3.6	Pass	
											Mid Channel
4884.50	V	0.0	53.6	34.7	4.3	31.5	61.1	74.0	-12.9	Pass	
4884.50	V	-20.0	53.6	34.7	4.3	31.5	41.1	54.0	-12.9	Pass	
4884.50	Н	0.0	60.4	34.7	4.3	31.5	67.9	74.0	-6.1	Pass	
4884.50	Н	-20.0	60.4	34.7	4.3	31.5	47.9	54.0	-6.1	Pass	
											Low Channel
4808.50	V	0.0	50.6	34.7	4.3	31.5	58.1	74.0	-15.9	Pass	
4808.50	V	-20.0	50.6	34.7	4.3	31.5	38.1	54.0	-15.9	Pass	
4808.50	Н	0.0	56.6	34.7	4.3	31.5	64.1	74.0	-9.9	Pass	
4808.50	Н	-20.0	56.6	34.7	4.3	31.5	44.1	54.0	-9.9	Pass	

All emissions within 20 dB of the specification limit are reported per FCC 15.31(o).

Section 7. Peak Power Spectral Density

NAME OF TEST: Peak Power Spectral Density	PARA. NO.: 15.247(e)
	RSS-210 A8.2(b)
TESTED BY: David Light	DATE: 13 July 2012

Test Results: Complies.

Measurement Data: See attached data..

Test Conditions:	51	%RH
	22	°C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 1036-1783-1480-1016

Frequenc				
ý	EIRP	Antenna	Correction	Conducted
		Gain		Density
(MHz)	(dBm)	(dBi)	(dB)	(dBm)
2404.25	-8.40	3.00	-15.20	-26.60
2442.25	-5.10	3.00	-15.20	-23.30
2480.25	-4.50	3.00	-15.20	-22.70

Section 8. Test Equipment List

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
993	Antenna,	A.H. Systems	SAS-200/571	162	22-Sep-2011	22-Sep-2013
	Horn					
1016	Preamplifier	Hewlett	8449A	2749A00159	20-Jul-2011	20-Jul-2012
		Packard				
1025	Preamplifier,	Nemko USA,	LNA25	399	27-Feb-2012	27-Feb-2013
	25dB	Inc.				
1036	Spectrum	Rohde &	FSEK30	830844/006	23-Dec-2011	23-Dec-2013
	Analyzer	Schwartz				
1480	Antenna,	Schaffner-	CBL6111C	2572	07-Feb-2012	07-Feb-2013
	Bilog	Chase				
1767	Receiver,	Rohde &	ESIB26	837491/0002	09-Dec-2011	09-Dec-2012
		Schwartz				
1783	Cable Assy,	Nemko	Chamber		26-Sep-2011	26-Sep-2012
	3m Chamber					

ANNEX A - TEST DETAILS

NAME OF TEST: Powerline Conducted Emissions PARA. NO.: 15.207(a)/7.2.4

Minimum Standard: Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 mH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Conducted	Limit (dBmV))
Emission (MHz)	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 mV within the frequency band 535-1705 kHz, as measured using a 50 mH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits as provided in §15.205 and §§15.209, 15.221, 15.223, 15.225 or 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging. AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

NAME OF TEST: Maximum Peak Output Power PARA. NO.: 15.247(b)(3)/A8.4(4)

Minimum Standard: The maximum peak output power shall not exceed 1 watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

5.2.1.1 Measurement Procedure PK1:

1. This procedure requires availability of a spectrum analyzer resolution bandwidth that is ≥ EBW.

- 2. Set the RBW \geq EBW.
- 3. Set VBW \ge 3 x RBW.
- 4. Set span = zero.
- 5. Sweep time = auto couple.
- 6. Detector = peak.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.

9. Use peak marker function to determine the peak amplitude level within the fundamental emission.

5.2.1.2 Measurement Procedure PK2:

1. This procedure provides an integrated measurement alternative when the maximum available RBW < EBW.

- 2. Set the RBW = 1 MHz.
- 3. Set the VBW = 3 MHz.
- 4. Set the span to a value that is 5-30 % greater than the EBW.
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.

9. Use the spectrum analyzer's integrated band power measurement function with band limits set equal to the EBW band edges (for some analyzers, this may require a manual override to ensure use of peak detector). If the spectrum analyzer does not have a band power function, sum the spectrum levels (in linear power units) at 1 MHz intervals extending across the EBW of the spectrum.

NAME OF TEST: Occu	pied Bandwidth	PARA. NO.: 15.247(a)(2)/	/A8.2(a)

Minimum Standard:Systems using digital modulation techniques may
operate in the 902-928 MHz, 2400-2483.5 MHz, and
5725-5850 MHz bands. The minimum 6 dB bandwidth
shall be at least 500 kHz.

Method Of Measurement:

5.1.1 EBW Measurement Procedure:

- 1. Set resolution bandwidth (RBW) = 1-5 % of the emission bandwidth (EBW).
- 2. Set the video bandwidth $(VBW) \ge 3 \times RBW$.
- 3. Detector = Peak.
- 4. Trace mode = max hold.
- 5. Sweep = auto couple.
- 6. Allow the trace to stabilize.

7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5 %.

5.1.2 Alternate EBW Measurement Procedure:

The automatic bandwidth measurement capability of a spectrum analyzer may be employed if it implements the functionality described above (*e.g.*, RBW = 1-5% of EBW, VBW \ge 3 x RBW, peak detector with maximum hold). When using this capability, care should be taken to ensure that the bandwidth measurement is not influenced by any nulls in the fundamental emission.

NAME OF TEST: Spurious Emissions(conducted) PARA. NO.: 15.247(d)/A8.5

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

5.4.1.1 Measurement Procedure – Reference Level

- 1. Set the RBW = 100 kHz.
- 2. Set the VBW \geq 300 kHz.
- 3. Set the span to 5-30 % greater than the EBW.
- 4. Detector = peak.
- 5. Sweep time = auto couple.
- 6. Trace mode = max hold.
- 7. Allow trace to fully stabilize.

8. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW. Next, determine the power in 100 kHz band segments outside of the authorized frequency band using the following measurement:

5.4.1.2 Measurement Procedure - Unwanted Emissions

- 1. Set RBW = 100 kHz.
- 2. Set VBW ≥ 300 kHz.
- 3. Set span to encompass the spectrum to be examined.
- 4. Detector = peak.
- 5. Trace Mode = max hold.
- 6. Sweep = auto couple.

7. Allow the trace to stabilize (this may take some time, depending on the extent of the span).

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified above.

NAME OF TEST: Radiated Spurious Emissions PARA. NO.: 15.247(c)/7.2.2

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (μV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

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MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

15.205 Restricted Bands

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Transmitter Power Density	PARA. NO.: 15.247(d)/A8.2(b)

Minimum Standard: The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

Method Of Measurement:

5.3.1 Measurement Procedure PKPSD:

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.

- 2. Set the RBW = 100 kHz.
- 3. Set the VBW \geq 300 kHz.
- 4. Set the span to 5-30 % greater than the EBW.
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- 7. Trace mode = max hold.

8. Allow trace to fully stabilize.

9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where

BWCF = 10log (3 kHz/100 kHz = -15.2 dB).

11. The resulting peak PSD level must be \leq 8 dBm.

5.3.2 Measurement Procedure AVGPSD:

1. Use this procedure when the maximum conducted output power in the fundamental emission is used to demonstrate compliance. The EUT must be configured to transmit continuously at full power over the measurement duration.

2. Set the analyzer span to 5-30% greater than the EBW.

- 3. Set the RBW = 100 kHz.
- 4. Set the VBW \geq 300 kHz.
- 5. Detector = power average (RMS).

6. Ensure that the number of measurement points in the sweep $\ge 2 \times \text{span/RBW}$ (use of a greater number of measurement points than this minimum requirement is recommended).

7. Manually set the sweep time to: \geq 10 x (number of measurement points in sweep) x (transmission symbol period).

8. Perform the measurement over a single sweep.

9. Use the peak marker function to determine the maximum level in any 100 kHz band segment within the fundamental EBW.

10. Scale the observed power level to an equivalent level in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where:

BWCF = 10log (3 kHz/100 kHz = -15.2 dB).

11. The resulting PSD level must be $\leq 8 \text{ dBm}$.

ANNEX B - TEST DIAGRAMS

Nemko USA, Inc.

EQUIPMENT: SRA-830

Test Site For Radiated Emissions



TO TEST RECEIVER/SPECTRUM ANALYZER. A high-pass filter and LNA is necessary to measure to the limits of 15.209.

Conducted Emissions



Peak Power At Antenna Terminals Minimum 6 dB Bandwidth Peak Power Spectral Density Spurious Emissions (conducted)

