

ROGERS LABS, INC.

4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Application For Grant of Certification FCC CFR47 Part 87

Airtel ATN

3 Bethesda Metro Center Suite 700
Bethesda, MD 20814

Model: MTP-100 (Multi Test Platform)

FCC ID: 2ATN6-MTP100

Aircraft data link land test Transceiver 131, 136 MHz

FCC Designation: US5305

ISED Registration: 3041A-1

Test Report Number: 190709

Test Date: July 9, 2019

Authorized Signatory: *Scot D. Rogers*

Scot D. Rogers
Rogers Labs, Inc.
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Rogers Labs, Inc.

4405 West 259th Terrace

Louisburg, KS 66053

Phone/Fax: (913) 837-3214

Revision 1

Airtel ATN

Model: MTP-100 (Multi Test Platform)

Test: 190709

Test to: 47CFR Parts 2, 87

File: Airtel MTP100 Tx TstRpt 190709 r1

SN: A040

FCC ID: 2ATN6-MTP100

Date: September 16, 2019

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Revision History

Revision 1 Issued September 16, 2019

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Forward

In accordance with the Federal Communications, Code of Federal Regulations dated July 9, 2019, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.915, 2.925, 2.926, 2.1031 through 2.1057, and Part 87, Subchapter D, Paragraphs 87.131 through 87.147 the following information is submitted for consideration on obtaining Grant of Certification for the radio navigation land test (RLT) equipment.

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Requirements per CFR47 paragraphs 2.1031-2.1057	Complies
Requirements per CFR47 paragraphs 87.131	Complies
Requirements per CFR47 paragraphs 87.133	Complies
Requirements per CFR47 paragraphs 87.135	Complies
Requirements per CFR47 paragraphs 87.139	Complies
Requirements per CFR47 paragraphs 87.141	Complies

Applicable Standards & Test Procedures

In accordance with the Federal Communications Code of Federal Regulations Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable paragraphs of Part 87 the following is submitted for consideration in obtaining Grant of Certification. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.4-2014 and ANSI C63.26-2015.

Application for Certification

(1) The full name and mailing address of the manufacturer of the device and the applicant for certification.

Airtel ATN
3 Bethesda Metro Center Suite 700
Bethesda, MD 20814

(2) FCC identifier. FCC ID: 2ATN6-MTP100

(3) A copy of the installation and operating instructions to be furnished the user. A draft copy of the instructions may be submitted if the actual document is not available. The actual document shall be furnished to the FCC when it becomes available.

Refer to exhibit for Draft Instruction Manual.

(4) Type or types of emission. 13K0A2D (VDL 131 and 136.850 MHz) and 6K00G1D (ACARS 136 MHz)

(5) Frequency range. 131, 136 MHz (on as defined channels in 47CFR 87.131 for RLT)

(6) Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power.

0.0001 W maximum, -13 dBm

(7) Maximum power rating as defined in the applicable part(s) of the rules.

Maximum allowable power output of one hundred microwatts as defined per CFR47 paragraph 87.131.

(8) The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

Power delivered into final amplifier 7.00 volts @ 0.1 amps (0.7 watts)

(9) Tune-up procedure over the power range, or at specific operating power levels.

Refer to Exhibit for Transceiver Alignment Procedure.

(10) A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power.

Refer to Exhibit for Circuit information and theory of operation.

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(11) A photograph or drawing of the equipment identification plate or label showing the information to be placed thereon.

Refer to Exhibit for Photograph or Drawing.

(12) Photographs (8" x 10") of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, if any, and labels for controls and meters and sufficient views of the internal construction to define component placement and chassis assembly. Insofar as these requirements are met by photographs or drawings contained in instruction manuals supplied with the certification request, additional photographs are necessary only to complete the required showing.

Refer to Exhibit for Drawings of Components Layout and Chassis Drawings.

(13) For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including the response characteristics (frequency, phase and amplitude) of any filters provided, and a description of the modulating wave train, shall be submitted for the maximum rated conditions under which the equipment will be operated.

Not applicable

(14) The data required by §§2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in §2.1041.

Data is contained in this application

(15) The application for certification of an external radio frequency power amplifier under part 97 of this chapter need not be accompanied by the data required by paragraph (b)(14) of this section. In lieu thereof, measurements shall be submitted to show compliance with the technical specifications in subpart C of part 97 of this chapter and such information as required by §2.1060 of this part.

Does not apply to this device or application.

(16) An application for certification of an AM broadcast stereophonic exciter-generator intended for interfacing with existing certified, or formerly type accepted or notified transmitters must include measurements made on a complete stereophonic transmitter. The instruction book must include complete specifications and circuit requirements for interconnecting with existing transmitters. The instruction book must also provide a full description of the equipment and measurement procedures to monitor modulation and to verify that the combination of stereo exciter-generator and transmitter meet the emission limitations of §73.44.

Does not apply to this device or application.

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(17) Applications for certification required by §25.129 of this chapter shall include any additional equipment test data required by that section.

Does not apply to this device or application.

(18) An application for certification of a software defined radio must include the information required by §2.944.

Does not apply to this device or application.

(19) Applications for certification of equipment operating under part 27 of this chapter, that a manufacturer is seeking to certify for operation in the:

(i) 1755-1780 MHz, 2155-2180 MHz, or both bands shall include a statement indicating compliance with the pairing of 1710-1780 and 2110-2180 MHz specified in §§27.5(h) and 27.75 of this chapter.

(ii) 1695-1710 MHz, 1755-1780 MHz, or both bands shall include a statement indicating compliance with §27.77 of this chapter.

(iii) 600 MHz band shall include a statement indicating compliance with §27.75 of this chapter.

Does not apply to this device or application.

(20) Before equipment operating under part 90 of this chapter and capable of operating on the 700 MHz interoperability channels (See §90.531(b)(1) of this chapter) may be marketed or sold, the manufacturer thereof shall have a Compliance Assessment Program Supplier's Declaration of Conformity and Summary Test Report or, alternatively, a document detailing how the manufacturer determined that its equipment complies with §90.548 of this chapter and that the equipment is interoperable across vendors. Submission of a 700 MHz narrowband radio for certification will constitute a representation by the manufacturer that the radio will be shown, by testing, to be interoperable across vendors before it is marketed or sold.

Does not apply to this device or application.

(21) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used.

Data is contained in this application or application exhibits.

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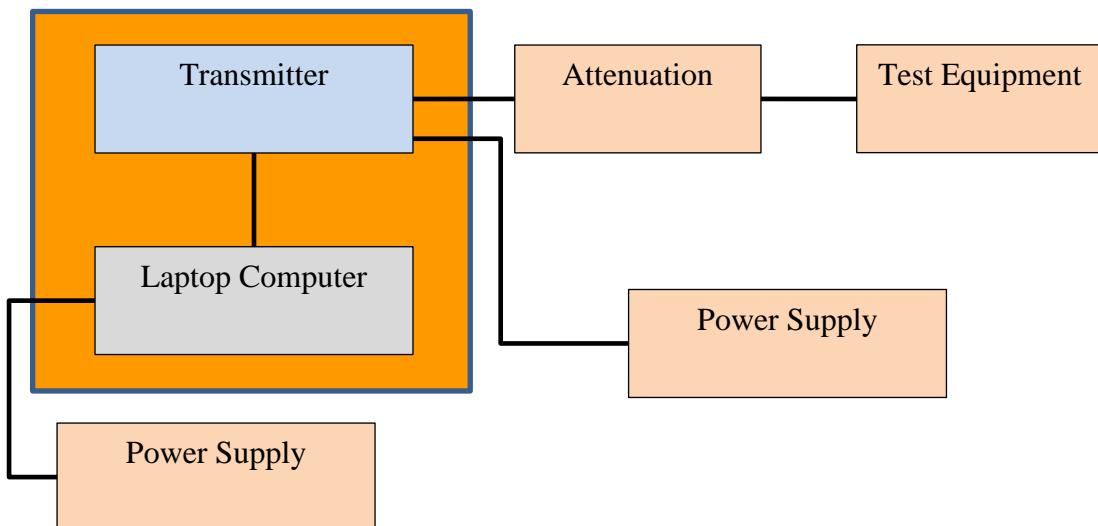
Equipment Tested

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT	MTP-100 (Multi Test Platform)	A040

System Description

The MTP-100 (Multi Test Platform) is a radio navigation land test (RLT) equipment transceiver. The authorized transmitter operational frequency band is defined in 47CFR 87.131 for VHF Data Link (VDL) operation. The VDL provides operation in two modes VDL and ACAR with each operating on designated channels. VDL operates on channel frequencies 131.450 MHz, 131.550 MHz, 131.725 MHz, 131.825 MHz, 136.850 MHz. The VDL ACARS operates on channel frequencies of 136.900 MHz, 136.925 MHz, 136.950 MHz, 136.975 MHz. The device is marketed as Aircraft Data Link Land Multi Test Based test equipment to service Aircraft mounted data communications transceiver equipment. The design provides land-based communication capability in the Aviation VHF Band with channel operational capability as defined. This report documents operation for this application and authorization as provided in 47CFR 87 subpart D.

Equipment Configuration



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Units of Measurements

AC Line Conducted EMI Data is in dB μ V; dB referenced to one microvolt.

Radiated EMI Data is in dB μ V/m; dB/m referenced to one microvolt per meter

Antenna Conducted Data is in dBm, dB referenced to one milliwatt

Test Site Locations

Conducted EMI Antenna Port conducted emissions testing was performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS.

Radiated EMI The radiated emissions testing performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS.

Registered Site information: FCC Site: US5305 and ISED: 3041A, CAB Identifier: US0096

NVLAP Accreditation Lab code 200087-0

Environmental Conditions

Ambient Temperature 24.8° C

Relative Humidity 38%

Atmospheric Pressure 1014.6 mb

Rogers Labs, Inc.	Airtel ATN	SN: A040
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List of Test Equipment

<u>Equipment</u>	<u>Manufacturer</u>	<u>Model (SN)</u>	<u>Band</u>	<u>Cal Date(m/d/y)</u>	<u>Due</u>
<input checked="" type="checkbox"/> LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	4/18/2019	4/18/2020
<input type="checkbox"/> LISN	Compliance Design	FCC-LISN-2.Mod.cd.(126)	.15-30MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)9kHz-40 GHz	10/16/2018	10/16/2019	
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)9kHz-40 GHz	10/16/2018	10/16/2019	
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)9kHz-40 GHz	10/16/2018	10/16/2019	
<input checked="" type="checkbox"/> Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Antenna	ARA	BCD-235-B (169)	20-350MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Antenna	EMCO	3147 (40582)	200-1000MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/2/2018	5/2/2020
<input type="checkbox"/> Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/16/2018	10/24/2019
<input type="checkbox"/> Antenna	Com Power	AH-840 (101046)	18-40 GHz	4/18/2019	4/18/2021
<input checked="" type="checkbox"/> Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	4/18/2019	4/18/2020
<input checked="" type="checkbox"/> Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/31/2019	1/31/2020
<input type="checkbox"/> Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/16/2018	10/16/2019
<input type="checkbox"/> Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/16/2018	10/16/2019
<input type="checkbox"/> Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	4/18/2019	4/18/2020
<input checked="" type="checkbox"/> Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	4/18/2019	4/18/2020
<input type="checkbox"/> Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Fairview	SA6NFNF100W-14 (1625)	30-1800 MHz	4/18/2019	4/18/2020
<input checked="" type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	4/18/2019	4/18/2020
<input checked="" type="checkbox"/> Weather station	Davis	6312 (A81120N075)		10/26/2018	10/26/2019

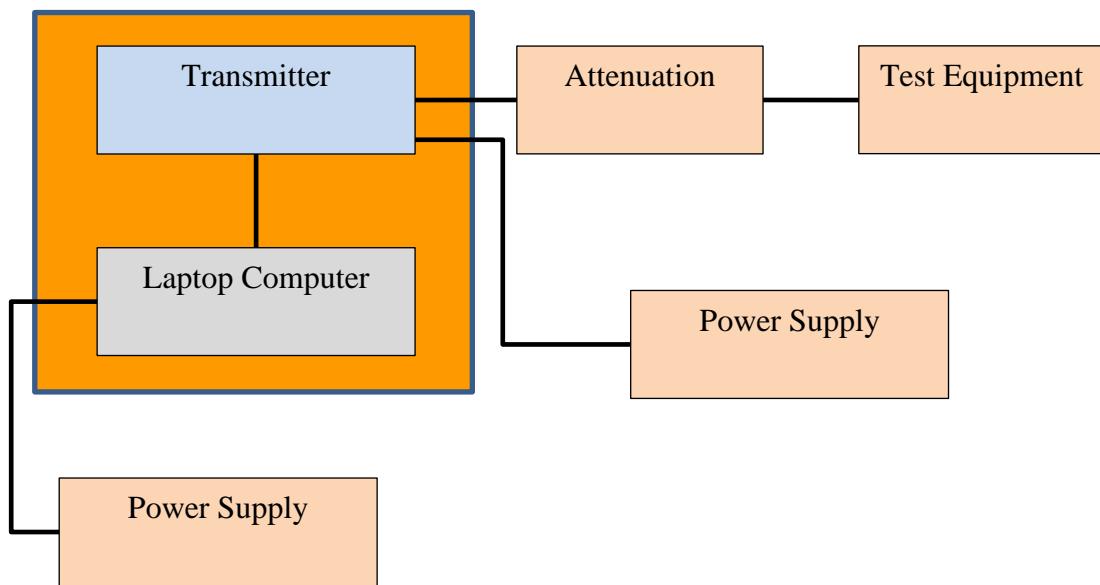
Transmitter Power Output

Measurements Required

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded, and no adjustment shall be made to the transmitter after the test has begun, except as noted below:

If the power output is adjustable, measurements shall be made for the highest and lowest power levels. Output transmitter power is not user selectable.

Test Arrangement



The radio frequency power output was measured at the antenna terminal by placing appropriate attenuation in the antenna line and observing the emission with the spectrum analyzer. The spectrum analyzer and attenuation offered an impedance of 50Ω to match the impedance of the standard antenna. A Rohde & Schwarz ESU40 Spectrum Analyzer was used to measure the radio frequency power at the antenna port. Data was taken in dBm and converted to watts as shown in the following Table. Refer to Figures 1 and 2 showing plots of output power of the transmitter across the frequency band. Data was taken per CFR47 Paragraph 2.1046(a) and applicable paragraphs of Part 87.

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P_{dBm} = power in dB above 1 milliwatt
 Milliwatts = $10^{(P_{dBm}/10)}$
 Watts = $(\text{Milliwatts})(0.001)(W/mW)$
 Milliwatts = $10^{(-13/10)}$
 = 0.0501 mW
 = 0.00005 Watts power

Table 1 Transmitter Power Results

Frequency (MHz)	P_{dBm}	P_{mw}	P_w
VDL Communications			
131.450	-12.79	0.05	0.0001
131.550	-12.79	0.05	0.0001
131.725	-12.49	0.06	0.0001
131.825	-12.49	0.06	0.0001
136.850	-12.19	0.06	0.0001
ACARS Communications			
136.900	-14.02	0.04	0.00004
136.925	-14.00	0.04	0.00004
136.950	-14.00	0.04	0.00004
136.975	-13.97	0.04	0.00004

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.131. There are no deviations to the specifications.

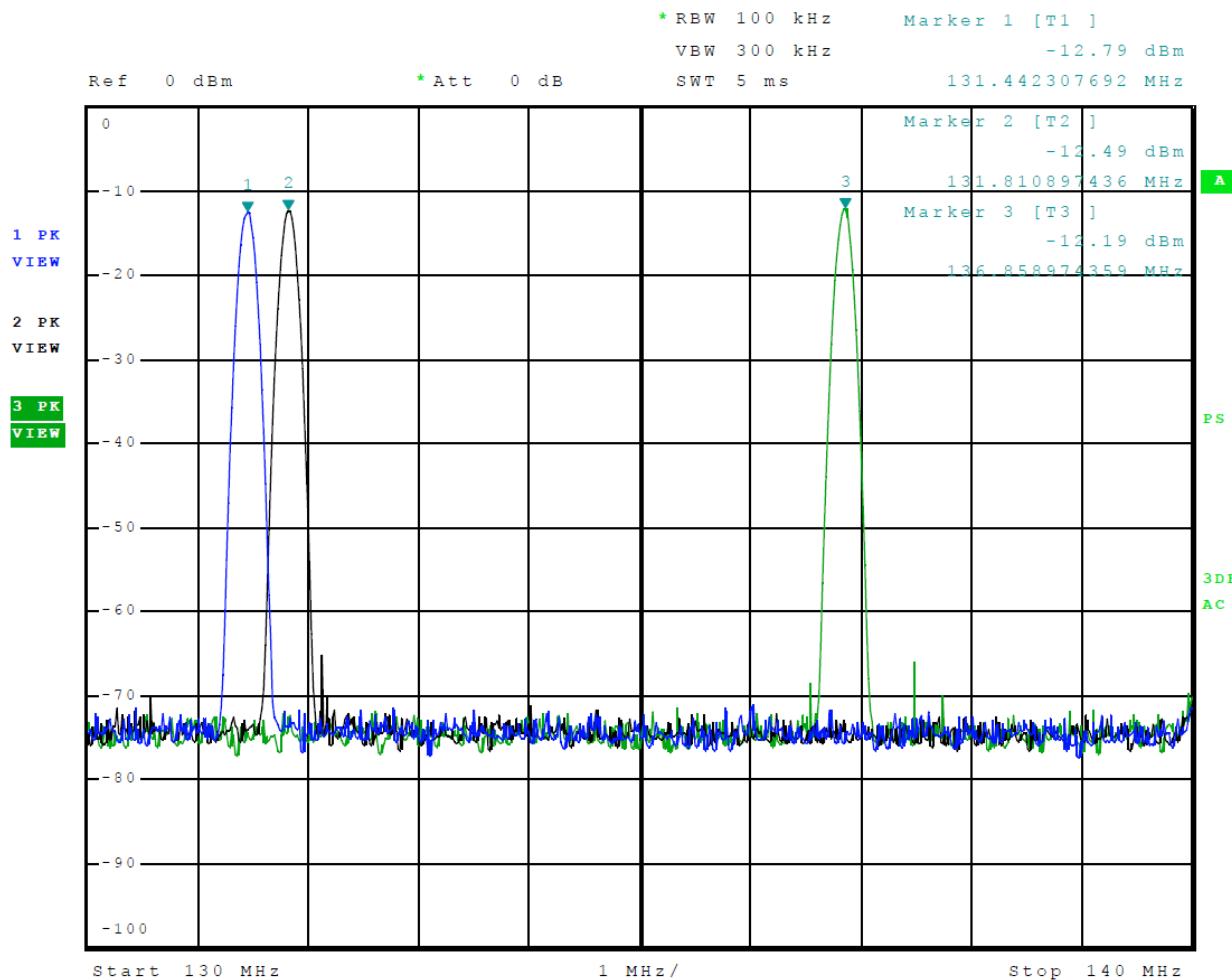


Figure 1 Power Output Across Frequency Band 131 and 136.850 MHz (VDL)

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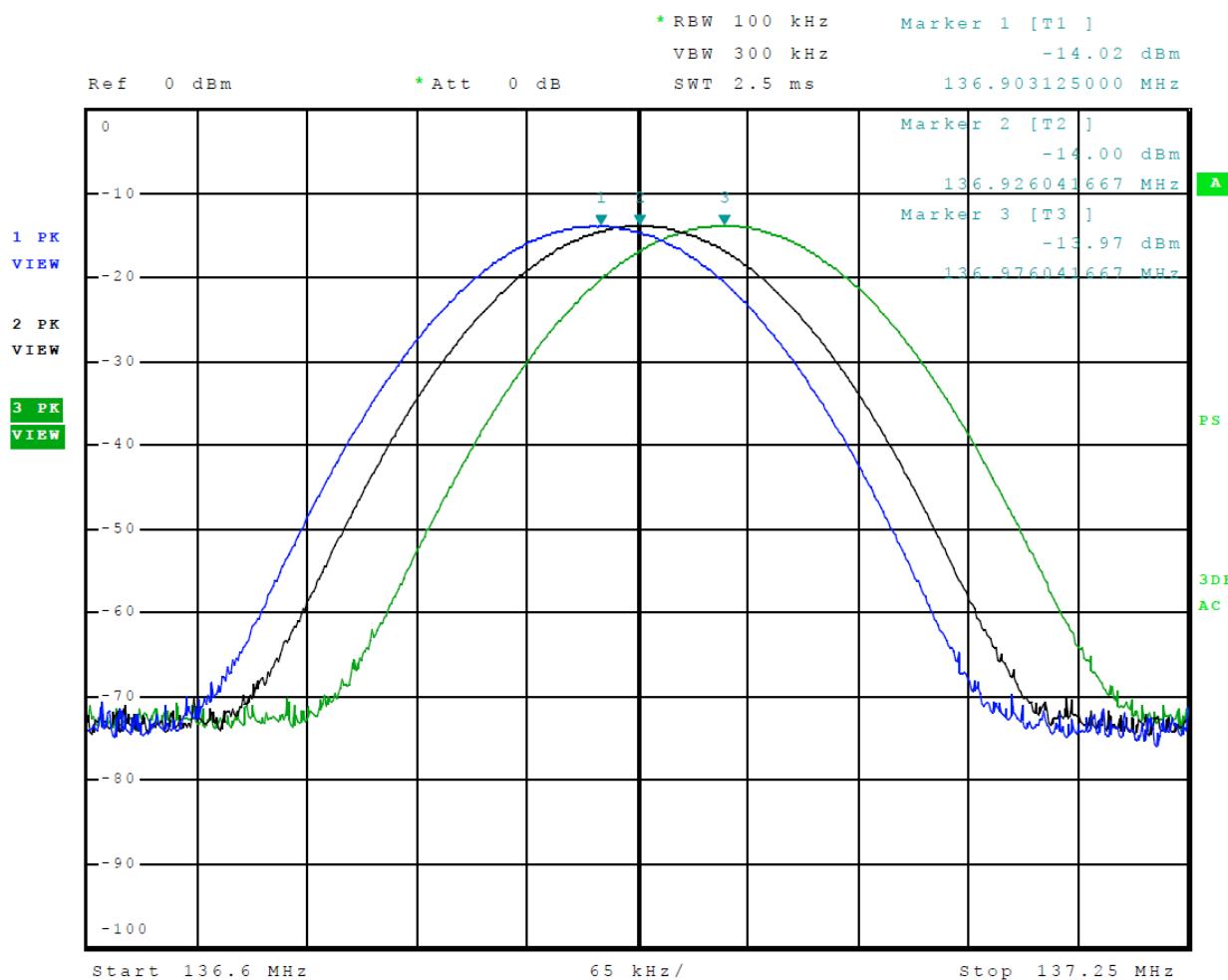


Figure 2 Power Output Across Frequency Band 136.0 MHz (ACARS)

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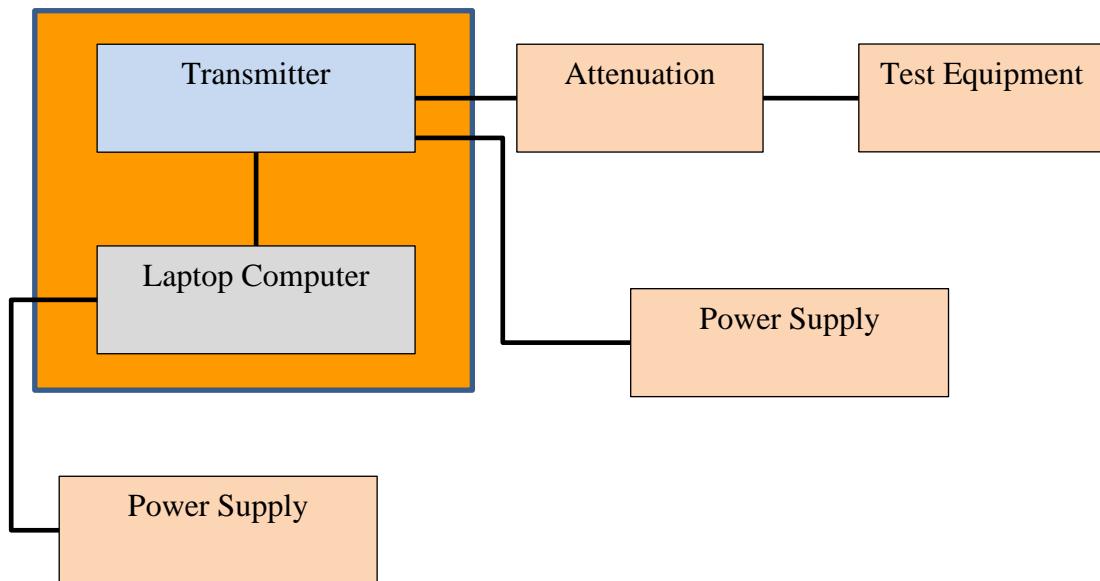
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Modulation Characteristics

Measurements Required

A curve or equivalent data, which shows that the equipment will meet the modulation requirements of the rules, under which the equipment is licensed, shall be submitted. The modulation specifications are defined by the Aviation Data Link standard. The Controlling Laptop computer supplied the defined data stream to the transmitter during testing.

Test Arrangement



Modulation Characteristic Results

The modulation characteristics are defined in aviation standards and regulations. The regulation requires the VDL use D8PSK modulation, using a raised cosine filter with $\alpha=0.6$ (where α is the excess bandwidth). The data rate is 31500 bits per second, which using D8PSK translates to 10500 symbols per second. The input data stream is divided into groups of 3 consecutive bits with LSB first and zeros are padded at the end if it is needed for the final channel symbol. The bits are Gray coded into the D8PSK constellation. ACARS uses 2400 bps NRZI coded coherent audio frequency MSK (Minimum Shift Keying) on AM. This equipment complies with the modulation requirements as defined. The requirements of 47CFR 2.1047(d) and applicable paragraphs of Part 87.141 are met. There are no deviations to the specifications.

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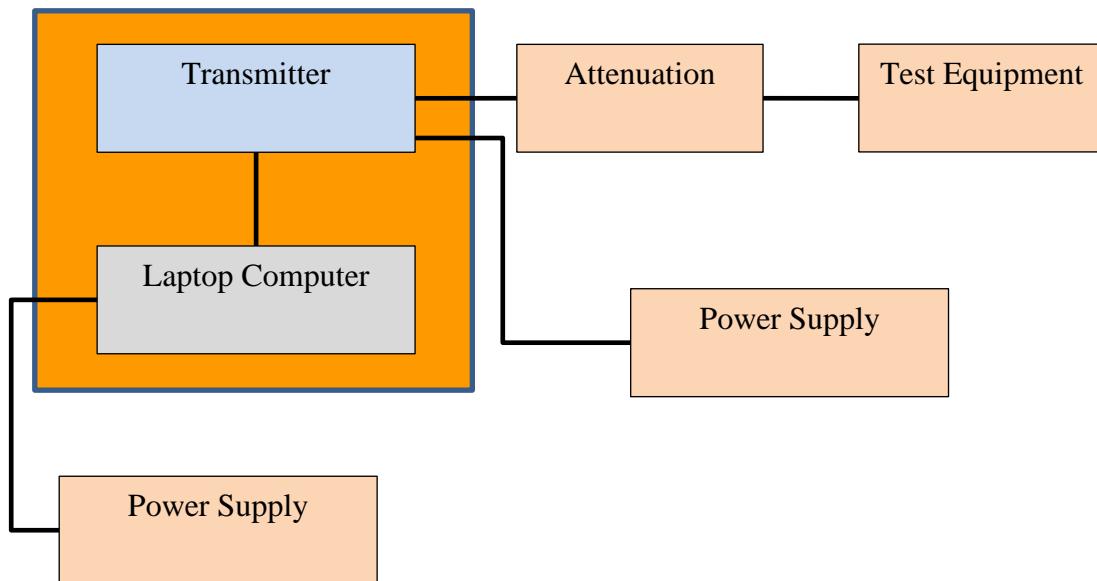
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Occupied Bandwidth

Measurements Required

The occupied bandwidth, that is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission.

Test Arrangement



A Rohde & Schwarz ESU 40 spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in normal modes. Characteristics for the data link communications were obtained with the EUT modulated by the data stream provided by the associated laptop computer. The power ratio in dB representing 99% of the total mean power was recorded from the spectrum analyzer measurements. Refer to figures 3 and 4 displaying plots of 99% power occupied bandwidth measurements.

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Table 2 Occupied Bandwidth Results

Frequency (MHz)	Occupied bandwidth (kHz)
VDL Communications	
131.825	12.901
ACARS Communications	
136.925	6.186

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.135. There are no deviations to the specifications.

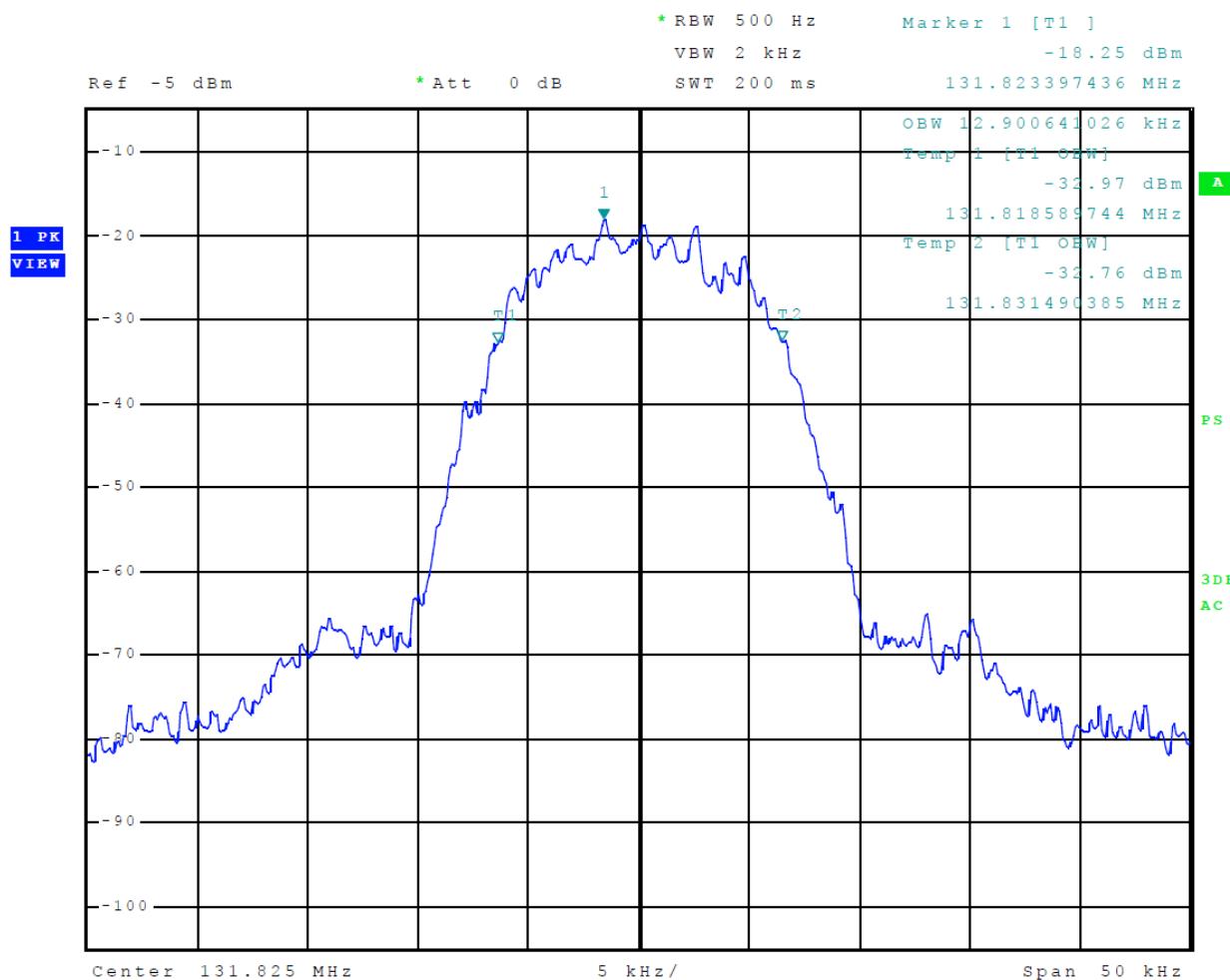


Figure 3 Occupied Band Width VDL

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Revision 1

Airtel ATN
Model: MTP-100 (Multi Test Platform)
Test: 190709
Test to: 47CFR Parts 2, 87
File: Airtel MTP100 Tx TstRpt 190709 r1

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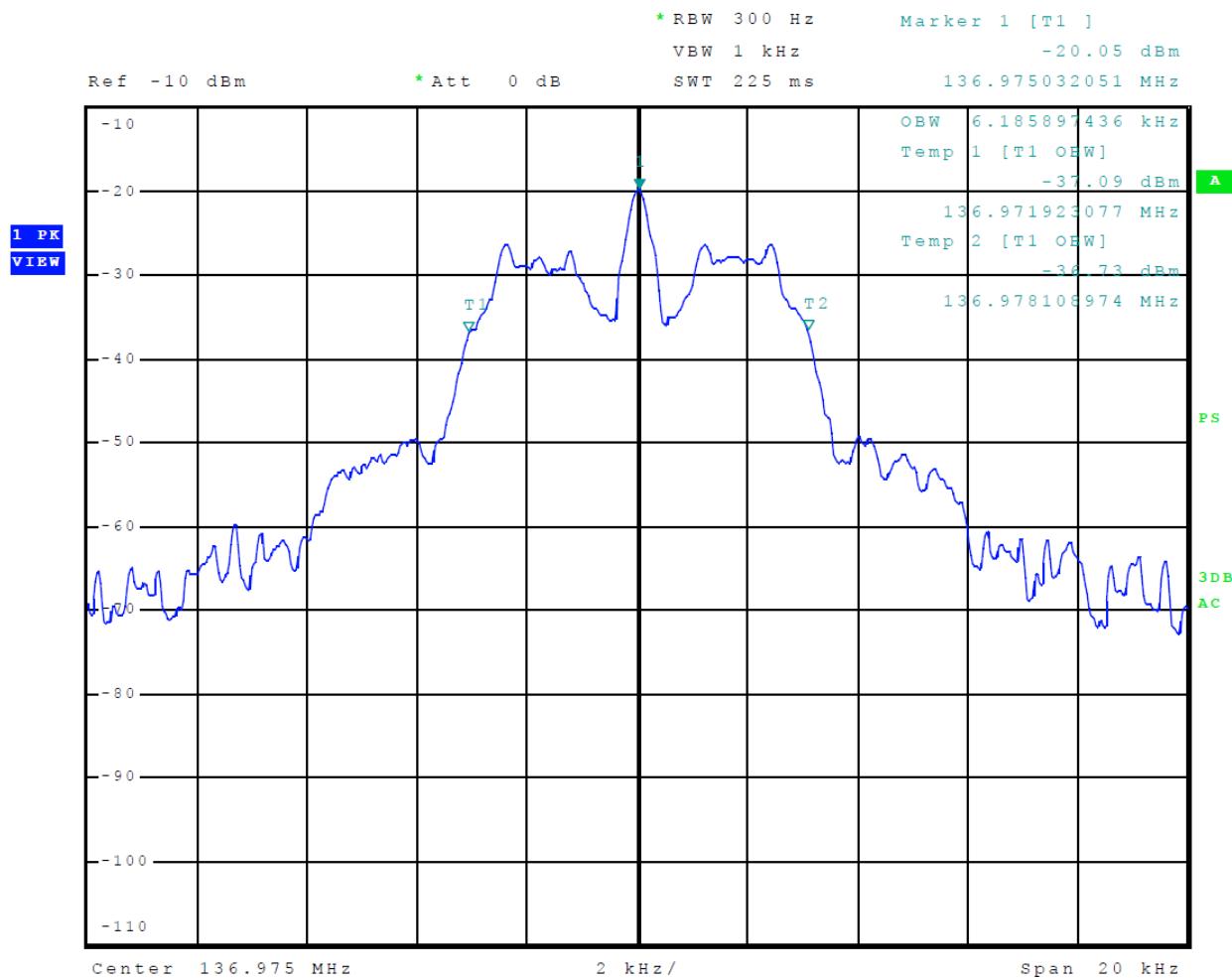


Figure 4 Occupied Band Width ACARS

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Spurious Emissions at Antenna Terminals

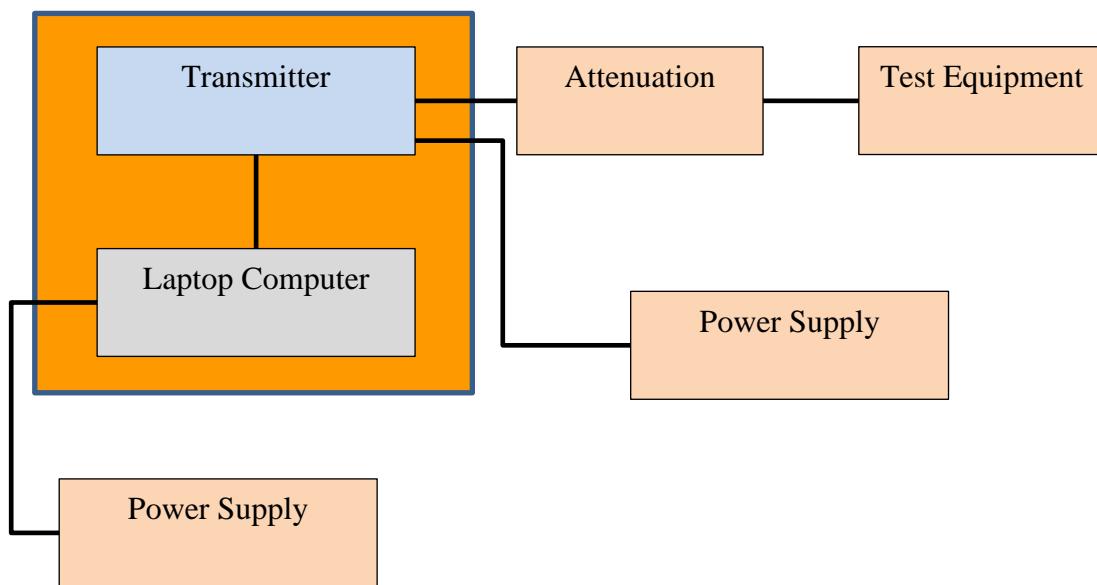
Measurements Required

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. All spurious emissions must be attenuated at least $43 + 10\log(P_o)$ below the fundamental emission power level. The following equations represent the calculated attenuation offset level for the equipment operating with rated output power of 0.0001-Watt.

Limit for 0.0001-Watt transmitter

$$\begin{aligned}
 \text{Limit (dBc)} &= 43 + 10 \log(P_o) \\
 &= 43 + 10 \log(0.0001) \\
 &= 3.0 \text{ dBc}
 \end{aligned}$$

Test Arrangement



The radio frequency output was coupled to a Rohde & Schwarz ESU40 Spectrum Analyzer during antenna port conducted emissions measurements. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter modulated per section 2.1049 and operated in all normal modes. The frequency spectrum from 30 MHz to 1,500 MHz was observed and plot produced of the frequency spectrum displayed on the test equipment. Data was taken per CFR47 2.1051, 2.1057, and applicable paragraphs of Part 87.139. There are no deviations to the specifications.

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Refer to figure 5 for plot of spurious emissions at antenna port and figures 6 and 7 for plots of Spectral Emission Mask.

Table 3 Spurious Emissions at Antenna Terminal Results VDL

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
131.450	262.90	-69.80	-56.2
	394.35	-78.10	-64.5
	525.80	-80.20	-66.6
	657.25	-77.10	-63.5
	788.70	-79.90	-66.3
	920.15	-79.30	-65.7
131.825	263.65	-80.30	-67.0
	395.48	-80.10	-66.8
	527.30	-79.40	-66.1
	659.13	-74.60	-61.3
	790.95	-79.70	-66.4
	922.78	-79.60	-66.3
136.850	273.70	-80.40	-67.4
	410.55	-79.60	-66.6
	547.40	-79.80	-66.8
	684.25	-73.00	-60.0
	821.10	-79.80	-66.8
	957.95	-77.90	-64.9

Table 4 Spurious Emissions at Antenna Terminal Results ACARS

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
136.900	273.80	-77.30	-63.7
	410.70	-78.30	-64.7
	547.60	-77.60	-64.0
	684.50	-74.30	-60.7
	821.40	-76.90	-63.3
	958.30	-77.20	-63.6
136.925	273.85	-80.30	-65.0
	410.78	-80.10	-64.1
	547.70	-79.40	-63.1
	684.63	-74.60	-60.4
	821.55	-79.70	-64.2
	958.48	-79.60	-64.1
136.975	273.95	-77.40	-64.4
	410.93	-77.00	-64.0
	547.90	-77.50	-64.5
	684.88	-72.80	-59.8
	821.85	-77.60	-64.6
	958.83	-76.40	-63.4

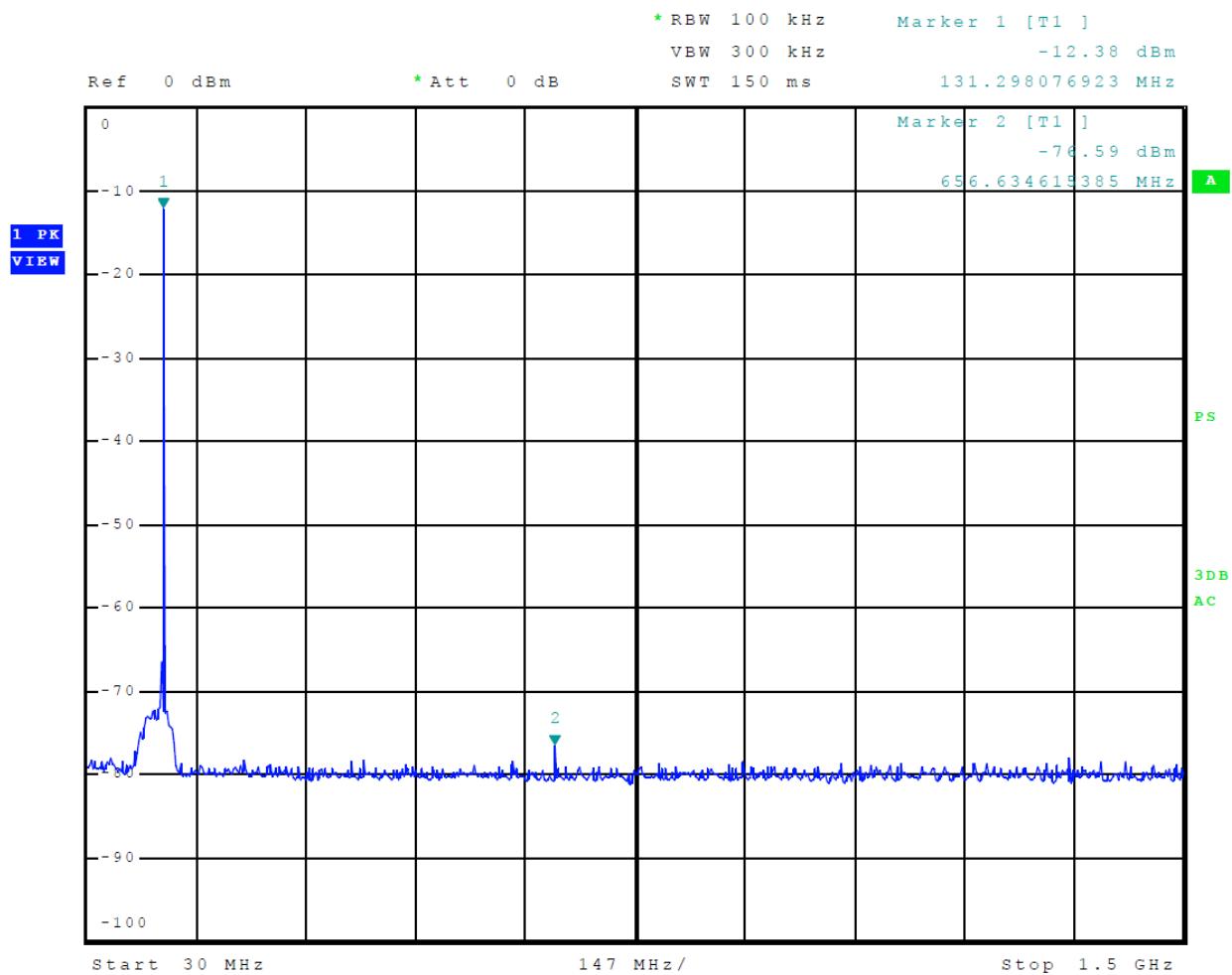
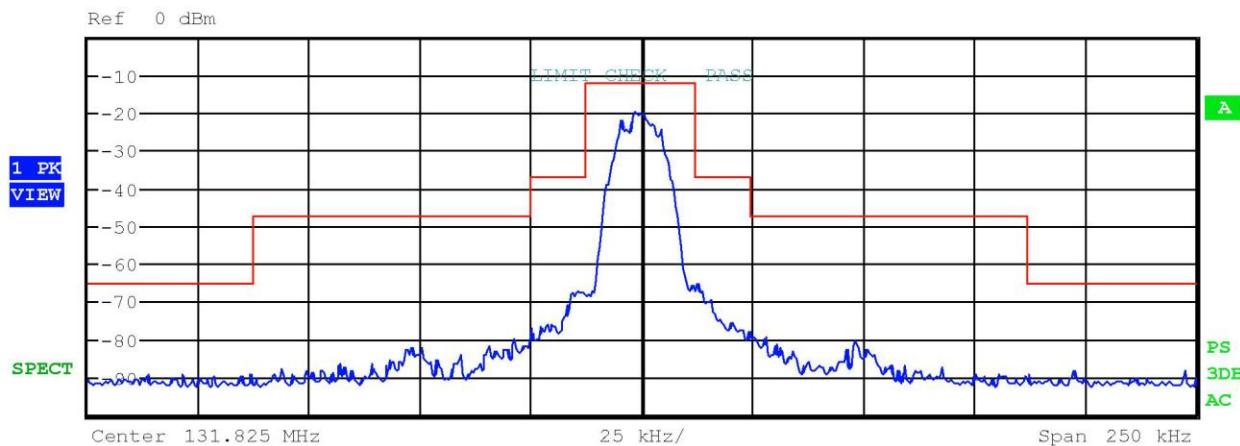


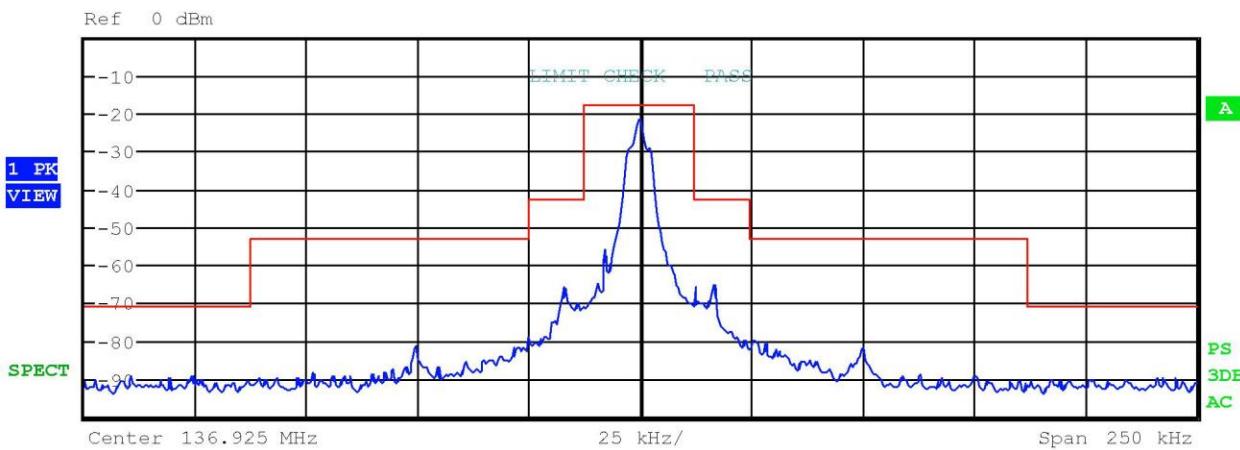
Figure 5 Spurious Emissions at Antenna Terminal



Tx Channel

Bandwidth	20 kHz			Power	Part 87_139 SEM		
start [Hz]	stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]	
-125.000 k	-87.500 k	1.00 k	131.736458 M	-89.22	-76.72	-23.72	
-87.500 k	-25.000 k	1.00 k	131.799760 M	-79.83	-67.33	-32.33	
-25.000 k	-12.500 k	1.00 k	131.810577 M	-67.53	-55.03	-30.03	
12.500 k	25.000 k	1.00 k	131.837821 M	-65.65	-53.15	-28.15	
25.000 k	87.500 k	1.00 k	131.853045 M	-79.51	-67.01	-32.01	

Figure 6 Spectral Emission Mask at Antenna Terminal VDL



Tx Channel

Bandwidth	20 kHz			Power	Part 87_139 SEM		
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]	
-125.000 k	-87.500 k	1.00 k	136.824038 M	-89.33	-71.19	-18.19	
-87.500 k	-25.000 k	1.00 k	136.899760 M	-79.15	-61.00	-26.00	
-25.000 k	-12.500 k	1.00 k	136.907772 M	-66.15	-48.01	-23.01	
12.500 k	25.000 k	1.00 k	136.941827 M	-65.65	-47.51	-22.51	
25.000 k	87.500 k	1.00 k	136.950240 M	-80.10	-61.96	-26.96	
87.500 k	125.000 k	1.00 k	137.045192 M	-89.95	-71.80	-18.80	

Figure 7 Spectral Emission Mask at Antenna Terminal ACARS

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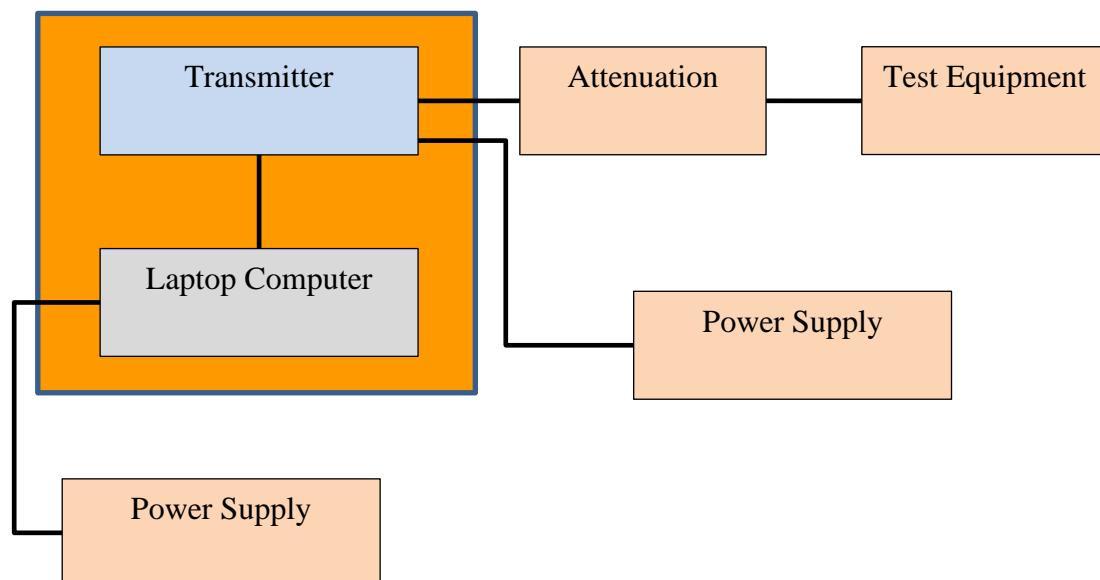
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Field Strength of Spurious Radiation (Unwanted Emissions)

Measurements Required

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. This equipment is typically remote mounted with interface cabling connecting the display control unit to the cabinet. The test sample offered for testing required interfacing with additional test control panels offering operation and communications with all functions of transmitter.

Test Arrangement



The test setup was assembled in a screen room for preliminary screening. The transmitter was placed on a supporting platform 0.8 meters above the ground plane and at a distance of 1 meter from the receive antenna, plots were taken of the general radiated emissions. A final radiated emission testing was performed with the transmitter placed on a supporting turntable platform 0.8 meters above the ground plane and at a distance of 3 meters from the Field Strength Measuring (FSM) antenna. The EUT was operational and radiating into a 50Ω load. The receiving antenna was raised and lowered from 1m to 4m in height to obtain the maximum

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reading of spurious radiation from the EUT, cabinet, and interface cabling. The turntable was rotated through 360 degrees to locate the position registering the highest amplitude of emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter, interface cabling, and test setup. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna, and rotating the turntable before final data was recorded. The frequency spectrum from 30 MHz to 1,500 MHz was investigated during radiated emissions testing. A Biconilog antenna was used for frequency measurements of 30 to 1000 MHz. A double-ridge horn antenna was used for frequencies of 1000 MHz to 1,500 MHz. Emission levels were measured and recorded from the spectrum analyzer in dB μ V. Data was taken at the Rogers Labs, Inc. 3 meters open area test site (OATS). The transmitter was then removed and replaced with a substitution antenna, amplification as required, and signal generator. The signal from the generator was then adjusted such that the amplitude received was the same as that previously recorded for each frequency. This step was repeated for both horizontal and vertical polarizations. The power in dBm required to produce the desired signal level was then recorded from the signal generator. The power in dBm was then calculated by reducing the previous readings by the gain in the substitution antenna.

All spurious emissions must be attenuated at least $43 + 10\log(P_o)$ below the fundamental emission power level. The following equations represent the calculated attenuation levels for the equipment.

Limit for 0.0001-Watt transmitter

$$\begin{aligned}
 \text{Limit (dBc)} &= 43 + 10 \log(P_o) \\
 &= 43 + 10 \log(0.0001) \\
 &= 3.0 \text{ dBc}
 \end{aligned}$$

Requirement 3.0 dBc below the fundamental of -13 dBm equates to an absolute level of -16 dBm.

Table 5 General Spurious Radiated Emission Results

Frequency	Amplitude of Emission (dB μ V)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
	MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
68.2	27.9	29.7	-67.33	-65.53	-54.33	-52.53	-16
74.2	29.6	29.7	-65.63	-65.53	-52.63	-52.53	-16
108.8	30.1	32.4	-65.13	-62.83	-52.13	-49.83	-16
110.5	27.1	30.2	-68.13	-65.03	-55.13	-52.03	-16
120.0	27.0	26.7	-68.23	-68.53	-55.23	-55.53	-16
125.0	28.6	23.4	-66.63	-71.83	-53.63	-58.83	-16
225.8	38.1	37.7	-57.13	-57.53	-44.13	-44.53	-16
240.0	29.5	31.2	-65.73	-64.03	-52.73	-51.03	-16
258.1	35.4	35.1	-59.83	-60.13	-46.83	-47.13	-16
290.3	36.9	34.0	-58.33	-61.23	-45.33	-48.23	-16
354.8	33.4	37.4	-61.83	-57.83	-48.83	-44.83	-16
419.3	29.3	32.4	-65.93	-62.83	-52.93	-49.83	-16

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequencies below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequencies above 1000 MHz.

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.139. There are no deviations to the specifications. There are no deviations or exceptions to the specifications.

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Table 6 Spurious Radiated Emission Results for 131.450 MHz Operation

Frequency	Amplitude of Emission (dB μ V)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
	MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
262.90	12.8	11.3	-82.43	-83.93	-69.43	-70.93	-16
394.35	11.2	15.1	-84.03	-80.13	-71.03	-67.13	-16
525.80	13.5	15.0	-81.73	-80.23	-68.73	-67.23	-16
657.25	23.0	22.0	-72.23	-73.23	-59.23	-60.23	-16
788.70	16.9	17.0	-78.33	-78.23	-65.33	-65.23	-16
920.15	18.1	18.2	-77.13	-77.03	-64.13	-64.03	-16

Table 7 Spurious Radiated Emission Results for 131.825 MHz Operation

Frequency	Amplitude of Emission (dB μ V)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
	MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
263.65	13.3	10.5	-81.93	-84.73	-68.93	-71.73	-16
395.48	13.1	12.8	-82.13	-82.43	-69.13	-69.43	-16
527.30	14.5	14.2	-80.73	-81.03	-67.73	-68.03	-16
659.13	16.0	16.2	-79.23	-79.03	-66.23	-66.03	-16
922.78	18.1	17.8	-77.13	-77.43	-64.13	-64.43	-16
889.00	18.0	18.3	-77.23	-76.93	-64.23	-63.93	-16

Table 8 Spurious Radiated Emission Results for 136.975 MHz Operation

Frequency	Amplitude of Emission (dB μ V)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
	MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
273.95	15.4	12.9	-79.83	-82.33	-66.83	-69.33	-16
410.93	12.8	14.5	-82.43	-80.73	-69.43	-67.73	-16
547.90	14.1	14.2	-81.13	-81.03	-68.13	-68.03	-16
684.88	16.9	17.0	-78.33	-78.23	-65.33	-65.23	-16
821.85	18.2	18.7	-77.03	-76.53	-64.03	-63.53	-16
958.83	19.1	19.4	-76.13	-75.83	-63.13	-62.83	-16

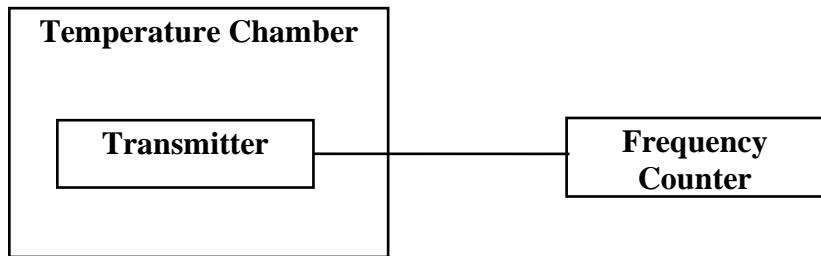
Frequency Stability

Measurements Required

The frequency stability shall be measured with variations of ambient temperature from -30° to $+50^{\circ}$ centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. In addition to temperature stability, the frequency stability shall be measured with variation of primary supply voltage as follows:

- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value.
- (2) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Test Arrangement



The measurement procedure outlined below shall be followed.

Step 1: The transmitter shall be installed in an environmental test chamber whose temperature is controllable. Provision shall be made to measure the frequency of the transmitter.

Step 2: With the transmitter inoperative (power switched “OFF”), the temperature of the test chamber shall be adjusted to $+25^{\circ}\text{C}$. After a temperature stabilization period of one hour at $+25^{\circ}\text{C}$, the transmitter shall be switched “ON” with standard test voltage applied.

Step 3: The carrier shall be keyed “ON”, and the transmitter shall be operated at full radio frequency power output at the duty cycle, for which it is rated, for duration of at least 5 minutes. The radio frequency carrier frequency shall be monitored, and measurements shall be recorded.

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Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -30°C to +50°C in 10-degree increments.

The frequency stability was measured with variations in the power supply voltage from 85 to 115 percent of the nominal value. The frequency was measured and the variation in parts per million calculated. Data was taken per CFR47 Paragraphs 2.1055 and applicable paragraphs of part 87.133.

Table 9 Frequency Stability vs. Temperature Results

Frequency 131.550 MHz)		Frequency Stability Vs. Temperature Ambient Frequency (131.5500)								
Temperature °C		-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)		-12	-12	-21	-21	-12	0	-17	-12	-12
PPM		-0.091	-0.091	-0.160	-0.160	-0.091	0.000	-0.129	-0.091	-0.091
%		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Limit (PPM)		5	5	5	5	5	5	5	5	5

Table 10 Frequency Stability vs. Input Power Supply Voltage Results

Frequency (131.5500 MHz)		Frequency Stability Vs. Voltage Variation 12-24 volts nominal; Results in Hz change		
Voltage V _{dc}		10.2	12.0	27.6
Change (Hz)		0	0	0
PPM		0	0	0
%		0	0	0
Limit (PPM)		5	5	5

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 87.133(a). There are no deviations or exceptions to the specifications.

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Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Additional Test Equipment List
- Annex C Rogers Qualifications
- Annex D Laboratory Certificate of Accreditation

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Annex A Measurement Uncertainty Calculations

The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16-4. Result of measurement uncertainty calculations are recorded below. Component and process variability of production devices similar to those tested may result in additional deviations. The manufacturer has the sole responsibility of continued compliance.

Measurement	Expanded Measurement Uncertainty $U_{(lab)}$
3 Meter Horizontal 0.009-1000 MHz Measurements	4.16
3 Meter Vertical 0.009-1000 MHz Measurements	4.33
3 Meter Measurements 1-18 GHz	5.14
3 Meter Measurements 18-40 GHz	5.16
10 Meter Horizontal Measurements 0.009-1000 MHz	4.15
10 Meter Vertical Measurements 0.009-1000 MHz	4.32
AC Line Conducted	1.75
Antenna Port Conducted power	1.17
Frequency Stability	1.00E-11
Temperature	1.6°C
Humidity	3%

Annex B Additional Test Equipment List

List of Test Equipment	Calibration	<u>Date (m/d/y)</u>	<u>Due</u>
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)		4/18/2019	4/18/2020
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)		4/18/2019	4/18/2020
Antenna: EMCO 6509		10/16/2018	10/16/2020
Antenna: EMCO 3143 (9607-1277) 20-1200 MHz		4/18/2019	4/18/2020
Antenna: EMCO Dipole Set 3121C		2/22/2019	2/22/2020
Antenna: C.D. B-101		2/22/2019	2/22/2020
Antenna: Solar 9229-1 & 9230-1		2/22/2019	2/22/2020
Cable: Belden 8268 (L3)		10/16/2018	10/16/2019
Cable: Time Microwave: 4M-750HF290-750		10/16/2018	10/16/2019
Frequency Counter: Leader LDC-825 (8060153		4/18/2019	4/18/2020
Oscilloscope Scope: Tektronix 2230		2/22/2019	2/22/2020
Wattmeter: Bird 43 with Load Bird 8085		2/22/2019	2/22/2020
R.F. Generators: HP 606A, HP 8614A, HP 8640B		2/22/2019	2/22/2020
R.F. Power Amp 65W Model: 470-A-1010		2/22/2019	2/22/2020
R.F. Power Amp 50W M185- 10-501		2/22/2019	2/22/2020
R.F. Power Amp A.R. Model: 10W 1010M7		2/22/2019	2/22/2020
R.F. Power Amp EIN Model: A301		2/22/2019	2/22/2020
LISN: Compliance Eng. Model 240/20		4/18/2019	4/18/2020
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08		4/18/2019	4/18/2020
Audio Oscillator: H.P. 201CD		2/22/2019	2/22/2020
ESD Test Set 2010i		2/22/2019	2/22/2020
Oscilloscope Scope: Tektronix MDO 4104		2/22/2019	2/22/2020
EMC Transient Generator HVT TR 3000		2/22/2019	2/22/2020
AC Power Source (Ametech, California Instruments)		2/22/2019	2/22/2020
Fast Transient Burst Generator Model: EFT/B-101		2/22/2019	2/22/2020
Field Intensity Meter: EFM-018		2/22/2019	2/22/2020
KEYTEK Ecat Surge Generator		2/22/2019	2/22/2020
ESD Simulator: MZ-15		2/22/2019	2/22/2020
Shielded Room not required			

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Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 31 years' experience in the field of electronics. Work experience includes six years working in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held:

Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background:

- 1) Bachelor of Science Degree in Electrical Engineering from Kansas State University
- 2) Bachelor of Science Degree in Business Administration Kansas State University
- 3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

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Louisburg, KS 66053	Test: 190709	
Phone/Fax: (913) 837-3214	Test to: 47CFR Parts 2, 87	Date: September 16, 2019
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Annex D Laboratory Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200087-0

Rogers Labs, Inc.
Louisburg, KS

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Electromagnetic Compatibility & Telecommunications

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communiqué dated January 2009).*

2019-03-27 through 2020-03-31

Effective Dates



For the National Voluntary Laboratory Accreditation Program

A handwritten signature in blue ink, appearing to read "Dana G. Lamm".

Rogers Labs, Inc. 4405 West 259 th Terrace Louisburg, KS 66053 Phone/Fax: (913) 837-3214 Revision 1	Airtel ATN Model: MTP-100 (Multi Test Platform) Test: 190709 Test to: 47CFR Parts 2, 87 File: Airtel MTP100 Tx TstRpt 190709 r1	SN: A040 FCC ID: 2ATN6-MTP100 Date: September 16, 2019 Page 36 of 36
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