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Test Report

Prepared for: JDTECK Inc.

Model: JDIR-LPCA-DR27

Description: Quad Band Industrial Digital Repeater with Remote Access

Serial Number: WBTDR27S16040002

FCC ID: SQX- JDIR-LPCA27

To

FCC Part 20

Date of Issue: June 17, 2016

On the behalf of the applicant:

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Attention of:

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Project Test Engineer

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	June 2, 2016	Alex Macon	Original Document
2.0	June 16, 2016	Greg Corbin	Updated AGC Threshold table page 9, updated output power and gain tables on pages 12 and 13.



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ILAC / A2LA

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Non-accredited tests contained in this report:

N/A



The Applicant has been cautioned as to the following:

15.21: Information to the User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a): Special Accessories

Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.



Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, KDB 935210 D05 Indus Booster Basic Measurements v01 and FCC Part 2, Part 20.21, Part 22, Part 24, Part 27 and C63-26D13 where appropriate.

Standard Test Conditions and Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing.

In accordance with ANSI/TIA 603C, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specify testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Environmental Conditions		
Temp (°C)	Humidity (%)	Pressure (mbar)
23.2 – 24.5	26.1 – 32.5	965.1 – 967.4

Measurement results, unless otherwise noted, are worst-case measurements.

Model: JDIR-LCPA-D27

Description: Quad Band Industrial Digital Repeater with Remote Access

Firmware: N/A

Software: N/A

Serial Number: WBTDR27S16040002

Additional Information:

The EUT is a bi-directional amplifier for the boosting of cellular phone signals and data communication devices. The following frequency bands and emission types are utilized.

EUT Operation during Tests

The EUT was in normal operation mode and controlled using the JDTEK GUI which was supplied by the manufacturer.

Accessories: None

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Termination
1	USB Cable	<3m	Y	Y	N/A
1	Power Cable	<3m	Y	Y	N/A

Modifications: None



The signal booster uses the following frequency bands.

The emission designators listed are representative emission designators used by transmitters whose signal is amplified by this booster.

Frequency Band (MHz)					
Uplink	698 - 716	776 - 787	824 - 849	1850 - 1915	1710 – 1780
Downlink	728 - 746	746 - 757	869 - 894	1930 - 1995	2110 - 2180
Modulation Type	LTE		GSM, CDMA, EDGE, HSPA, EVDO, LTE		CDMA, HSPA, LTE, EDGE, EVDO

Emission Designators					
CDMA	HSPA	LTE	EVDO	EDGE	GSM
F9W	F9W	G7D	F9W	G7W	GXW



Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
935210 D05	AGC Threshold	Pass	
935210 D05	Out-of-Band Rejection	Pass	
935210 D05	Input-Versus-Output Signal Comparison	Pass	
935210 D05	Mean Output Power and Amplifier gain	Pass	
935210 D05	Out-Of-Band/Block Emissions Conducted	Pass	
935210 D05	Spurious Emissions Conducted	Pass	
935210 D05	Frequency Stability	N/A	Does not have Frequency translation
935210 D05	Spurious Emissions Radiated	Pass	



AGC Threshold

Engineer: Alex Macon

Test Date: 5/24/16

Test Procedure

A signal generator was connected to the input of the EUT. A spectrum analyzer was connected to the EUT in order to monitor the output power levels. The Signal Generator was configured to produce the necessary broadband and narrow band signals. The input power level was increase in 1 dB increments until the power no longer increased. The input levels were recorded in the table below.

Spectrum Analyzer settings

Power Channel integration

RBW = 1-5% of EBW

Video BW = 3x RBW

Test Setup



Downlink

Tuned Frequency (MHz)	AGC Threshold (dBm)	
	AWGN	GSM
737.23	-63.6	-63.7
750.46	-63	-63.1
882.92	-62.9	-63.0
1991.05	-58	-59.2
2120.88	-59.5	-58

Uplink

Tuned Frequency (MHz)	AGC Threshold (dBm)	
	AWGN	GSM
711.26	-69.1	-69.2
785.63	-68.6	-69.5
846.46	-69.5	-69.4
1902.15	-66.5	-66.4
1762.64	-66.2	-66.6



Out-Of-Band Rejection

Engineer: Alex Macon

Test Date: 5/24/16

Test Procedure

The test equipment was set with the following parameters:

Signal Generator:

CW Signal

Dwell time = approx. 10 ms

Frequency range = $\pm 250\%$ of the passband from the center of the passband.

Spectrum analyzer:

Span $\pm 250\%$ of the passband from the center of the passband

Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor

Number of points = SPAN/(RBW/2)

RBW 1 % to 5 % of the passband

VBW to $\geq 3 \times$ RBW

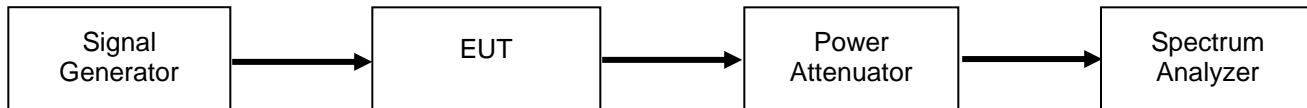
Peak detector with Max Hold

Procedure:

The peak of the frequency response was found and recorded below as f_0 .

Two markers were placed at the -20 dB down amplitude point to determine the 20 dB bandwidth. The Band Pass width was recorded below:

Test Setup



See Annex A for test results



Input-Versus-Output Signal Comparison

Engineer: Alex Macon

Test Date: 5/24/16

Test Procedure

A signal generator was connected to the input of the EUT and was configured to transmit an AWGN signal. The amplitude was set to be just below the AGC threshold level but not more than 0.5 dB.

Spectrum analyzer setting:

Span 2 times to 5 times the EBW or alternatively the OBW.

Frequency set to the center frequency of the operational band under test.

RBW to 1% to 5 % of the anticipated OBW

VBW $\geq 3 \times$ RBW

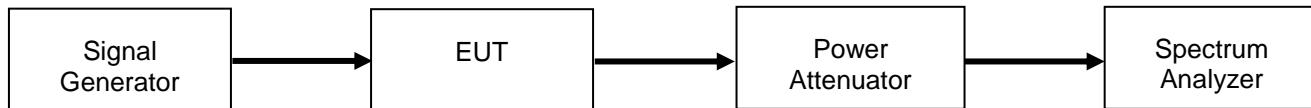
Reference Level 10 log (OBW / RBW) below the reference level

Positive Peak Detector

Max Hold

The -26dB bandwidth was compared between the input and the output of the EUT. All carries applicable to the EUT were investigated. The input level was then increased by 3 dB above and the comparison repeated.

Test Setup



See Annex B for test results



Mean Output and Amplifier Gain

Engineer: Alex Macon

Test Date: 5/25/16

Test Procedure

A signal generator was connected to the input of the EUT. A spectrum analyzer was connected to the EUT in order to monitor the output power levels. The Signal Generator was configured to produce the necessary broadband and narrow band signals. The input power level was increased in 1 dB increments until the power no longer increased. The input and output levels were recorded in the table below. The amplifier gain was determined from the delta between the input and output levels.

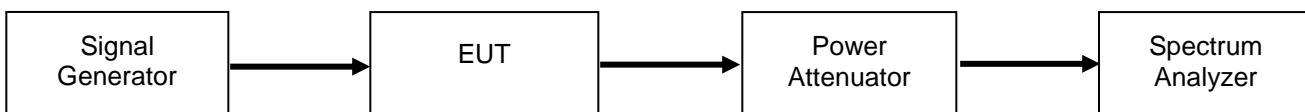
Spectrum Analyzer settings

Power Channel integration

RBW = 1-5% of EBW

Video BW = 3x RBW

Test Setup



Uplink Output Power and Gain

GSM

Frequency Range (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
698 - 716	711.26	-69.2	23.1	92.3	23.2
776 - 787	785.63	-69.5	23.1	92.6	23.1
824 - 849	846.46	-69.4	17.6	87	17.5
1850 - 1915	1902.15	-66.4	20.7	87.1	20.6
1710 - 1780	1762.64	-66.6	20.8	87.4	20.7

AWGN

Frequency Range (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
698 - 716	711.26	-69.1	22.9	92	23
776 - 787	785.63	-68.6	18.5	87.1	18.4
824 - 849	846.46	-69.5	17.4	86.9	17.3
1850 - 1915	1902.15	-66.5	20.7	87.2	20.7
1710 - 1780	1762.64	-66.2	20.5	86.7	20.4



Downlink Output Power and Gain

GSM

Frequency Range (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
728 - 746	737.23	-63.7	24.4	88.1	24.3
746 - 757	750.46	-63.1	25	88.1	25.2
869 - 894	882.92	-63.0	24.3	87.3	24.2
1930 - 1995	1991.05	-59.2	28.0	87.2	27.9
2110 - 2180	2120.88	-58	28.1	86.1	28.1

AWGN

Frequency Range (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	(Input Power +3dB) Output Power (dBm)
728 - 746	737.23	-63.6	24.2	87.8	24.1
746 - 757	750.46	-63	24.9	87.9	24.8
869 - 894	882.92	-62.9	24.1	87	24.1
1930 - 1995	1991.05	-58	28.2	86.2	28.4
2110 - 2180	2120.88	-59.5	28.2	87.7	28.2



Out-Of-Band/Block Emission (Dual Carrier)

Engineer: Alex Macon

Test Date: 5/26/16

Test Procedure

A signal generator to the input of the EUT which was configured to produce two modulated AWGN carriers simultaneously. The center frequencies used were determined by the 3GPP standards and set to the lowest band edge and then to the highest band edge of each applicable band. The input power level was set to just below the AGC threshold but not more than 0.5dB. The composite power can be measured using the procedures provided in KDB 971168.

The spectrum analyzer was set with the following parameters

RBW = 1 % of the emission bandwidth, 100 kHz, or 1 MHz

VBW = $3 \times$ RBW

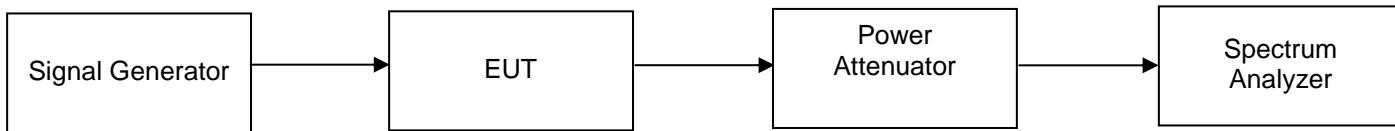
Average power detector

Sweep time = auto-couple

Trace average at least 100 traces in power averaging

Start frequency was set to the upper block edge frequency and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz for frequencies below and above 1 GHz, respectively. The traces were captured and recorded. The input level was increased by 3dB and recorded again. This was repeated for all carriers being used with the EUT. The stop frequency was then set to the lower block edge and the start frequency set to 300 kHz or 3 MHz for frequencies below and above 1 GHz respectively. This was repeated for all carriers being used with the EUT. This was applied to all bands being used with the EUT.

Test Setup



See Annex C for test results



Out-Of-Band/Block Emission (Single Carrier)

Engineer: Alex Macon

Test Date: 5/26/16

Test Procedure

A signal generator was connected to the input of the EUT which was configured to produce one modulated AWGN carrier. The center frequencies was set to the lowest available frequency within the band and then to the highest possible frequency in the band. The input power level was set to just below the AGC threshold but not more than 0.5dB.

The spectrum analyzer was set with the following parameters:

RBW = 1 % of the emission bandwidth, 100 kHz, or 1 MHz

VBW = $3 \times$ RBW.

Detector to power averaging (rms)

Sweep time = auto-couple

Number of points $\geq (2 \times \text{span}/\text{RBW})$

Trace average at least 10 traces in power averaging mode

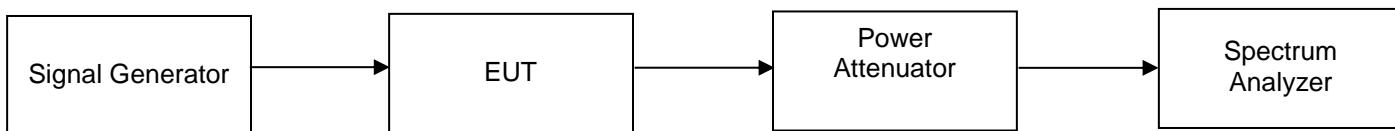
The start frequency was set to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 300 kHz or 3 MHz, as specified in the applicable rule part.

The start frequency was set to the upper band/block edge frequency plus 300 kHz or 3 MHz, as specified in the applicable rule part and the analyzer stop frequency to 10 times the highest frequency of the fundamental emission

All carriers and bands being used with the EUT were investigated.

The traces were captured and recorded.

Test Setup



See Annex C for test results



Conducted Spurious Emissions

Engineer: Alex Macon

Test Date: 5/27/16

Test Procedure

A signal generator was connected to the input of the EUT and configured to produce one modulated AWGN carrier. The center frequencies was set to the lowest available frequency within the band and then to the highest possible frequency in the band. The input power level was set to just below the AGC threshold but not more than 0.5dB.

The spectrum analyzer was set with the following parameters:

RBW = 100 kHz < 1 GHz, 1 MHz > 1 GHz

VBW = 3 x RBW.

Detector to power averaging (rms)

Sweep time = auto-couple

Number of points $\geq (2 \times \text{span}/\text{RBW})$

Trace average at least 10 traces in power averaging mode

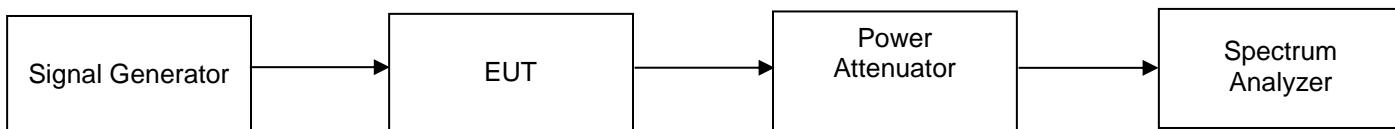
The start frequency was set to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The start frequency was set to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part and the analyzer stop frequency to 10 times the highest frequency of the fundamental emission

All carriers and bands being used with the EUT were investigated.

The traces were captured and recorded.

Test Setup



Refer to Annex D for Conducted Spurious Emission plots



Radiated Spurious Emissions

Engineer: Alex Macon

Test Date: 5/31/16

Test Procedure

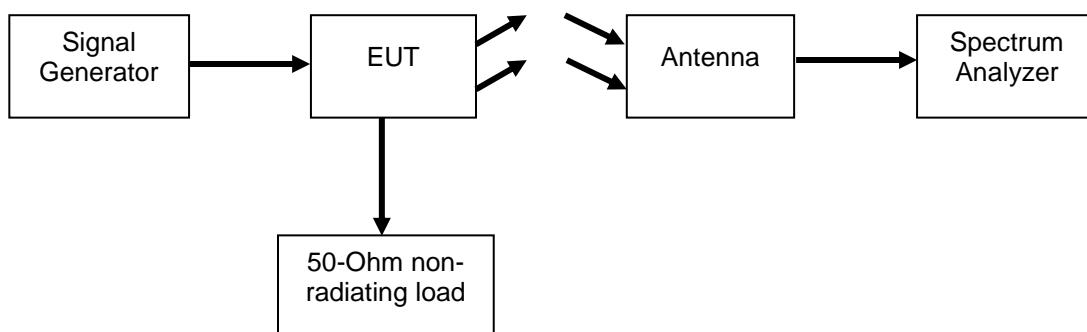
The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure that the signal levels were maximized. All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm. A signal generator was used to provide a CW signal. The EUT output was terminated into a 50 Ohm non-radiating load.

The RBW was set to 100 kHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz. The VBW was set to 3 times the RBW.

The following formula was used for calculating the limits:

$$\text{Radiated Spurious Emissions Limit} = P1 - (43 + 10\log(P2)) = -13\text{dBm}$$

Test Setup



See Annex E for test results



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
*Horn Antenna, Amplified	ARA	DRG-118/A	i00271	5/8/14	5/8/16
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/19/15	10/19/17
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	5/26/16	5/26/17
Voltmeter	Fluke	87III	i00319	4/11/16	4/11/19
Spectrum Analyzer	Agilent	E4407B	i00331	9/18/15	9/18/16
Non-radiating load	Termaline	8201	i00334	Verified on: 5/23/16	
Signal Generator	Rohde & Schwarz	SMU200A	i00405	1/22/16	1/22/17
Signal Generator	Keysight (Agilent)	E4438C	i00457	9/26/2014	9/26/2016
PSA Spectrum Analyzer	Agilent	E4445A	i00471	8/26/15	8/26/16

*Note: Equipment is under a 30 day calibration extension per Lab Manager.

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT