TEST REPORT

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DT&C Co., Ltd.

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- 1. Report No: DRTFCC1802-0038
- 2. Customer
 - Name : Phychips Inc.
 - Address : (Yongsan-dong), Migun Technoworld 2, A-104, 187, Techno 2-ro, Yuseong-gu, Daejeon, South Korea
- 3. Use of Report : FCC Original Grant
- 4. Product Name / Model Name : RFID Module / RED4S
 - FCC ID : Y3D-RED4S
- 5. Test Method Used : ANSI C63.10-2013 Test Specification : FCC Part 15.247
- 6. Date of Test : 2018.01.18 ~ 2018.02.13
- 7. Testing Environment : See appended test report.
- 8. Test Result : Refer to the attached test result.

Affirmation	Tested by		Reviewed by	(ind
Ammalion	Name : Jaehyeok Bang	(5/91)	Name : GeunKi Son	Signature)
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	except in full, withou	t the written appr	oval of DT&C Co., Ltd.	
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Test Report Version

Test Report No.	Date	Description
DRTFCC1802-0038	Feb. 13, 2018	Initial issue

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1.General Information

1.1 Testing Laboratory

DT&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The site is constructed in conformance with the requirements. - FCC MRA Accredited Test Firm No. : KR0034

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1.2 Details of Applicant

Applicant	: Phychips Inc.
Address	. (Yongsan-dong), Migun Technoworld 2, A-104, 187, Techno 2-ro, Yuseong-gu, Daejeon, South Korea
Contact person	: Khyungjoo Min

1.3 Description of EUT

EUT	RFID Module
Model Name	RED4S
Add Model Name	NA
Serial Number	Identical prototype
Hardware version	1.0
Software version	1.0
Power Supply	DC 3.3 V
Frequency Range	917.10 ~ 926.90 MHz
Modulation Technique	ASK
Number of Channels	50(Channel Spacing 200kHz)
Antenna Type	External Antenna (Max. PK 3.72 dBi)

1.4 Declaration by the manufacturer

- N/A

1.5 Test conditions

Ambient Condition		
 Temperature 	+23 °C ~ +27 °C	
 Relative Humidity 	43 % ~ 46 %	

1.6 Test Equipment List

Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	17/12/26	18/12/26	MY50200828
Digital Multimeter	FLUKE	17B+	17/12/26	18/12/26	36390701WS
DC Power Supply	SM techno	SDP30-5D	17/12/26	18/12/26	305DLJ204
Attenuator	SMAJK	SMAJK-50-10	17/09/06	18/09/06	15081901
Signal Generator	Rohde Schwarz	SMBV100A	17/12/27	18/12/27	255571
Signal Generator	Rohde Schwarz	SMF100A	17/12/27	18/12/27	102341
Thermohygrometer	BODYCOM	BJ5478	17/04/11	18/04/11	120612-2
Loop Antenna	Schwarzbeck	FMZB1513	18/01/30	20/01/30	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	16/08/05	18/08/05	9160-3362
Horn Antenna	ETS-LINDGREN	3117	16/05/03	18/05/03	00140394
PreAmplifier	Agilent	8449B	17/09/05	18/09/05	3008A02108
PreAmplifier	TSJ	MLA-010K01- B01-27	17/03/06	18/03/06	1844539
EMI Test Receiver	Rohde Schwarz	ESR7	17/02/16	18/02/16	101061
EMI TEST RECEIVER	Rohde Schwarz	ESCI	17/02/16	18/02/16	100364
Band Reject Filter	Wainwright Instruments	WRCA810/970- 0.2/40-6SSK	17/12/26	18/12/26	1
Highpass Filter	Wainwright Instruments	WHKX12-935- 1000-15000- 40SS	17/09/05	18/09/05	7
EMI TEST RECEIVER	Rohde Schwarz	ESCI7	17/02/26	18/02/16	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	17/09/29	18/09/29	101333
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A MA2411B	17/04/11	18/04/11	1338004 1306053

Note: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017

1.7 Summary of Test Results

FCC Part RSS Std.	Parameter	Limit (Using in 902-928 MHz)	Test Condition	Status Note 1
	Carrier Frequency Separation	>= 25 kHz or >= 20 dB BW, whichever is greater.		с
15.247(a) RSS-247(5.1)	Number of Hopping Frequencies	>= 50 hops, if 20 dB BW < 250kHz >= 25 hops, if 20 dB BW >= 250kHz		С
	20 dB Bandwidth	< 500 kHz		С
	Dwell Time =< 0.4 seconds			С
15.247(b) RSS-247(5.4)	b) Transmitter Output Power Transmitter Output Power $For FCC = < 1 Watt, if CHs >= 50 = < 0.25 W, if CHs >= 25, < 50 For IC if CHs >= 50 Complete to the test of test of$		Conducted	С
15.247(d) RSS-247(5.5)	Conducted Spurious Emissions	The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density.		С
RSS Gen(6.6)	Occupied Bandwidth (99 %)	N/A		NA
15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10)	5 & 209 (47(5.5)) Radiated Spurious Emissions FCC 15.209 Limits		Radiated	C Note2, 3
15.207 RSS-Gen(8.8)	AC Conducted Emissions	FCC 15.207 Limits	AC Line Conducted	С
15.203 RSS-Gen(8.3)	Antenna Requirements	FCC 15.203	-	С

Note 2 : For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.

Note 3 : This test item was performed in each axis and the worst case data was reported.

1.8 Conclusion of worst-case and operation mode

The field strength of spurious emission was measured in three orthogonal EUT positions(X-axis, Y-axis and Z-axis).

Tested frequency information,

- Hopping Function: Enable

	TX Frequency (MHz)	RX Frequency (MHz)
Hopping Band	917.10 ~ 926.90 MHz	917.10 ~ 926.90 MHz

- Hopping Function: Disable

Channel	TX Frequency (MHz)	RX Frequency (MHz)	
Lowest Channel	917.10	917.10	
Middle Channel	921.90	921.90	
Highest Channel	926.90	926.90	



2. Maximum Peak Output Power Measurement

2.1 Test Setup

Refer to the APPENDIX I.

2.2 Limit

FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following :

 §15.247(b)(2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

IC Requirements

 RSS-247(5.4)(a), For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

2.3 Test Procedure

- 1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
- 2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using;

Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel

 $RBW \ge 20 \text{ dB BW}$ $VBW \ge RBW$ Sweep = auto Detector function = peak Trace = max hold

2.4 Test Results

Tested Channel	Frame Average	Output Power	Peak Output Power		
	dBm	mW	dBm	mW	
Lowest	24.13	258.82	25.90	389.05	
Middle	24.42	276.69	25.88	387.26	
Highest	24.67	293.09	26.41	437.52	

Note 1 : The frame average output power was tested using an average power meter for reference only.

Note 2 : See next pages for actual measured spectrum plots.

Lowest Channel

Peak Output Power

ian 36, 2 Frequency Avg Type: Log-Pur TYPE PNO: Fast Trig: Free Run FGain:Low Atten: 40 dB Auto Tune Mkr1 917.075 MHz 25.90 dBm Ref Offset 10.13 dB Ref 40.13 dBm Center Freq 917.100000 MHz ٠ Start Freq 914.600000 MHz Stop Freq 919 600000 MHz CF Step 500.000 kHz Man (Laura) Freq Offset OHz Center 917.100 MHz #Res BW 1.0 MHz Span 5.000 MHz Sweep 1.000 ms (1001 pts) #VBW 3.0 MHz

Peak Output Power

Middle Channel



Peak Output Power

Highest Channel





3. 20dBc BW

3.1 Test Setup

Refer to the APPENDIX I.

3.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

3.3 Test Procedure

- 1. The 20 dB bandwidth were measured with a spectrum analyzer connected to RF antenna Connector (conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
- 2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting: RBW shall be in the range of 1% to 5% of the 20 dB bandwidth and VBW ≥ 3 × RBW, Span = between two times and five times the 20 dB bandwidth.

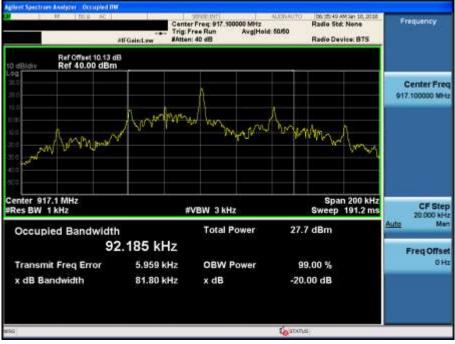
3.4 Test Results

Frequency (MHz)	Tested Channel	20dBc BW (kHz)
917.10	Lowest	81.80
921.90	Middle	81.64
926.90	Highest	81.53

Note 1: See next pages for actual measured spectrum plots.

20dBc Bandwidth

Lowest Channel



20dBc Bandwidth

Middle Channel



20dBc Bandwidth

Highest Channel





4. Carrier Frequency Separation

4.1 Test Setup

Refer to the APPENDIX I.

4.2 Limit

Limit : \geq 25 kHz or \geq 20 dB BW whichever is greater.

4.3 Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to :

Span = wide enough to capture the peaks of two adjacent channels

RBW = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to

best identify the center of	of each individual channel.
VBW ≥ RBW	Sweep = auto
Detector function = peak	Trace = max hold

4.4 Test Results:

Hopping	Peak of center channel	Peak of adjacent Channel	Test Result	
Mode	(MHz)	(MHz)	(kHz)	
Enable	921.90	922.10		

Carrier Frequency Separation

Hopping mode : Enable

glient Spectrum Analyzer Huept SA BF 150.0 AC		Trig: Free Run		ALEXANTO Type: Leg-Pwr	In 10:40 AM am 16, 2018 The CT The Control of The C	Frequency
	PNO: Wide 😱 IF Gain:Low	Atten: 40 dB			DET DISTURBUT	100020
Ref Offset 10.13 dB 0 dBidiv Ref 40.13 dBm				Δ1	0.38 dB	Auto Tur
	X2		/	142		Center Fra 922.000000 MP
1100 9 UT 111 5						Start Fre 921.750000 MP
929 89 01						Stop Fr 922 250000 M
enter 922.0000 MHz Res BW 62 kHz	#VBW	180 kHz		Sweep 1	Span 500.0 kHz 000 ms (1001 pts)	CF Ste 10.000 ki
NR MODE TRO SEL R	200.0 kHz (Δ)	V 0.30 dB	FUNCTION	FUNCTION WIDTH.	RUNCTION VALUE	Auto Mi
	O1 0 MHz	25.02 dBm				FreqOffs
9 9 10						
				(anatus		



5. Number of Hopping Frequencies

5.1 Test Setup

Refer to the APPENDIX I.

5.2 Limit

Limit: >= 50 hops

5.3 Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while

EUT had its hopping function enabled.

To get higher resolution, two frequency ranges for FH mode within the 902 ~ 928 MHz were examined.

The spectrum analyzer is set to :

Span = 20 MHz Start Frequency = 911.9 MHz, Stop Frequency = 931.9 MHz RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW ≥ RBW

Detector function = peak

Sweep = auto Trace = max hold

5.4 Test Results:

Hopping mode	Test Result (Total Hops)
Enable	50

Carrier Frequency Separation

Hopping mode : Enable

1 M (50.0 HC)	PNO: Fast	Trig: Free Run Atten: 40 dB	Aug Type: Leg-Pur	Dis 25:06 AM Sen 30, 2038 TRACE 10 25:04 TVRE 10 25:04 CET 10 20 20 20	Frequency
Ref Offset 10.13 dB dBldiv Ref 40.13 dBm			M	kr2 926.90 MHz 27.15 dBm	Auto Tune
99 811 911	8 ¹ Millionnan				Center Fred 921.900000 MHz
00 67					Start Free 911 900000 MH
2.9 29 29			<u>,</u>	analan la Kanapanci a Ingana Ingana	Stop Free 931,900000 MH
enter 921.90 MHz Res BW 62 kHz R MODE TRO SCL R			Sweep 5 NETION FUNCTION WIDTH	Span 20.00 MHz .000 ms (1001 pts) RINCTION VALUE	CF Step 2.000000 MH Auto Ma
	917.10 MHz 926.90 MHz	25.61 dBm 27.15 dBm			Freq Offse 0H
7 9 9 0 1					
4j			(anana		

6. Time of Occupancy (Dwell Time)

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

6.3 Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to :

Center frequency = 921.9 MHz

```
Span = zero
```

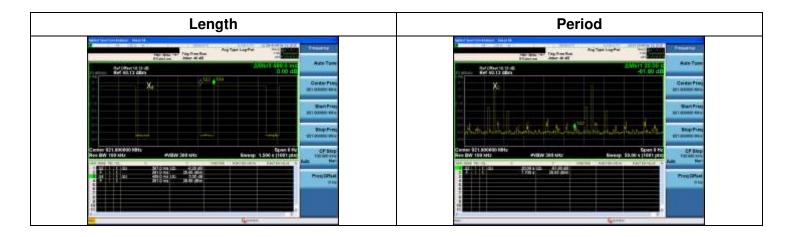
RBW = 100 kHz (RBW shall be \leq channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel) Detector function = peak

VBW ≥ RBW

Trace = max hold

6.4 Test Results

Channel Frequency	Length	Number	Dwell Time	
(MHz)	(ms)		(ms)	
921.9	381	1	381.000	





7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

7.1 Test Setup

Refer to the APPENDIX I.

7.2 Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

^t Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 - 72 MHz, 76 - 88 MHz, 174 - 216 MHz or 470 - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~ 156.52525	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.7 ~ 156.9	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	162.0125 ~ 167.17	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	167.72 ~ 173.2	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	240 ~ 285	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	322 ~ 335.4	2655 ~ 2900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	960 ~ 1240	3345.8 ~ 3358		
			3600 ~ 4400		

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.



7.3 Test Procedures

7.3.1 Test Procedures for Radiated Spurious Emissions

- The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
- For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
- 4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 6. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 7. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- NOTE 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
- NOTE 2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
- NOTE 3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz for Average detection (AV) at frequency above 1 GHz.

7.3.2 Test Procedures for Conducted Spurious Emissions

- 1. The transmitter output was connected to the spectrum analyzer.
- 2. The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
- 3. The conducted spurious emission was tested each ranges were set as below.

Frequency range : 9 kHz ~ 30 MHz RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

Frequency range : 30 MHz ~ 10 GHz RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.

7.4 Test Results

7.4.1 Radiated Emission

Note 1: Attached plot of worst data, refer to the APPENDIX II.

9kHz ~ 10GHz Data

Lowest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F. (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2751.404	V	Z	PK	52.97	1.52	N/A	54.49	74.00	19.51
2751.314	V	Z	AV	50.05	1.52	N/A	51.57	54.00	2.43
3668.500	Н	Z	PK	50.17	2.45	N/A	52.62	74.00	21.38
3668.390	Н	Z	AV	45.11	2.45	N/A	47.56	54.00	6.44

Middle Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F. (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2765.882	V	Z	PK	51.61	1.51	N/A	53.12	74.00	20.88
2765.752	V	Z	AV	48.33	1.51	N/A	49.84	54.00	4.16
3687.544	Н	Z	PK	50.97	2.50	N/A	53.47	74.00	20.53
3687.610	Н	Z	AV	45.82	2.50	N/A	48.32	54.00	5.68

Highest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F. (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2780.536	V	Z	PK	48.12	1.51	N/A	49.63	74.00	24.37
2780.700	V	Z	AV	40.97	1.51	N/A	42.48	54.00	11.52
3707.590	Н	Z	PK	48.93	2.55	N/A	51.48	74.00	22.52
3707.644	Н	Z	AV	43.57	2.55	N/A	46.12	54.00	7.88

Note.

1. No other spurious and harmonic emissions were reported greater than listed emissions above table.

2. Above listed point data is the worst case data.

3. The limit is applied as below, Restricted band = FCC Part 15.209 Non-restricted band = Fundamental level – 20dB *= Non-restricted band

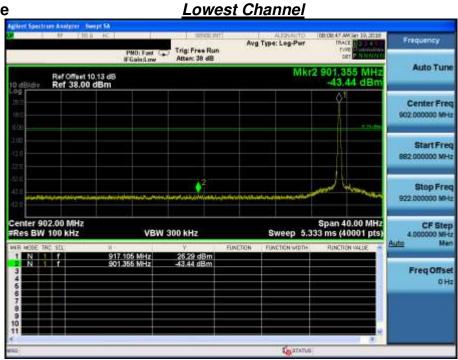
4. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F + DCF / T.F = AF + CL – AG Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, DCF = Duty Cycle Correction Factor



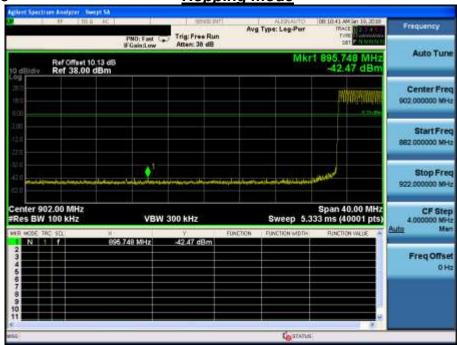
7.4.2 Conducted Spurious Emissions

Low Band-edge



Low Band-edge

Hopping mode



Conducted Spurious Emissions

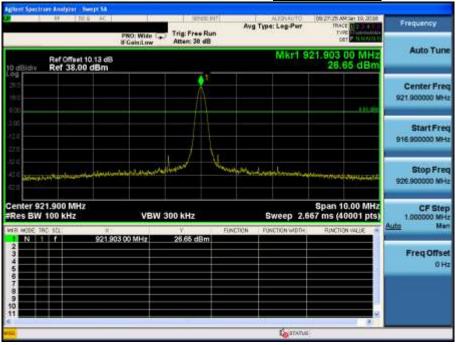
Lowest Channel

87 150 0	PNO: Fast FGaint.ow		Avg Type: Log-Pwr	THE 12:00 AM Ian 10, 2038 TRACE D 204 AM Ian TYPE D 100 AM Ian OFT D 100 AM IAN	Frequency
Ref Offset 9. 10 dBldiv Ref 38.00	47 dB		Mkr	2 21.478 1 MHz -40.66 dBm	Auto Tuni
100 0(0)					Center Fre 15.004500 MH
1m (10 770 ÅJ					Start Fre 9,000 kH
	والمتحدث والمراجع والمتحادث	ورورية المارية والمحادثين والمعادي		ad an option of the state of the	Stop Fre 20.000000 MH
Start 9 kHz Res BW 100 kHz	VBV	V 300 kHz		Stop 30.00 MHz 333 ms (40001 pts)	CF Ste 2.999100 MH Auto Me
WER WODE THO SEL	201.9 kHz 21.476 1 MHz	27.90 dBm -40.65 dBm	NETION FUNCTION WIDTH	RUNCTION VALUE	Freq Offse
6 7 8 9					
50 C			Garme	L DC Coupled	

NF 150 B		Trig: Free Run	ALEXANTO Avg Type: Leg-Pwr	DB 13:20 AM Ian 19, 2038 MACE D 2014	Frequency
	PNO: Fast G IFGain:Low	Atten: 36 dB		CET C NIVERIO	100002000
Ref Offset 12 0 dBidiy Ref 38.00 d	66 d8 JBm		Mkr	3 2.791 19 GHz -28.45 dBm	Auto Tuni
				- A - T) (24	Center Fre 5.015000000 GH
100 110 170					Start Fre 30.000000 MH
210 - Anno - Anno - 1210 - Anno - 1210 - Anno -		and the second		a terreta de la desenta de	Stop Free 10.00000000 GH
itart 30 MHz Res BW 1.0 MHz	VBW	3.0 MHz	Sweep 18	Stop 10.000 GHz .67 ms (40001 pts)	CF Ste 997.000000 MH
WER MODE THE SEL	R		NETION FUNCTION WIDTH.	RUNCTION VALUE	Auto Me
1 N 1 f 2 N 1 f 4 5	917 33 MHz 3.195 25 GHz 2.791 19 GHz	28.61 dBm -27.75 dBm -28.45 dBm			Freq Offse
5 6 7 8 9					
			Costatus		

Reference for limit

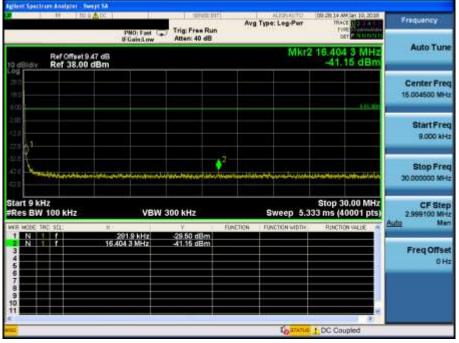
Dt&C



Middle Channel



Conducted Spurious Emissions



88 [50.0	HC I	bern and the bolt	Avg Type: Leg-Pur	09.29.19 AM Jan 19, 2018 TRACE 10 100 100	Frequency
	PMO: Fast IF Gain:Low			EVER DE STORE	1911/22180
Ref Offset 12 dBidiv Ref 38.00 d	66 dB IBm		Mkr	3 3.307 14 GHz -27.65 dBm	Auto Tune
eg Ot					Center Free 5.015000000 GHt
100 100 110	3				Start Freq 30.000000 MHz
				والمراجع والمحمود المراجع والمحمد المحمد	Stop Free 10.00000000 GH
tart 30 MHz Res BW 1.0 MHz	VB	W 3.0 MHz	Sweep 18	Stop 10.000 GHz 3.67 ms (40001 pts)	CF Step 997.000000 MH
RR MODE THE SEL	8 922.07 MHz	∨ 28.61 dBm	EUNETION FUNCTION WIDTH	RUNCTION VALUE	Auto Mer
2 N 1 7 3 N 1 7 4 5	2.700 22 GHz 3.307 14 GHz	-27.10 dBm -27.65 dBm			Freq Offset 0 Ha
5					
1					

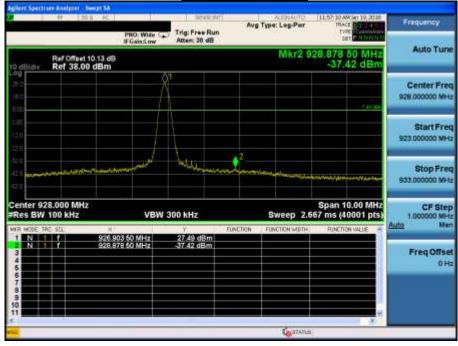
Middle Channel



High Band-edge

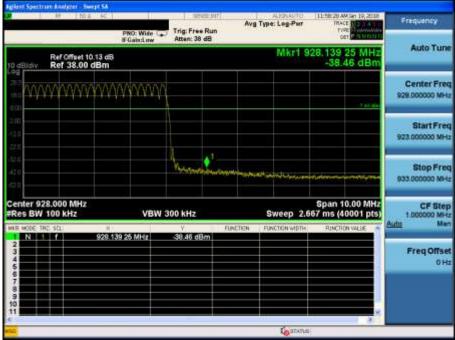
🛈 Dt&C

Highest Channel



High Band-edge

Hopping mode



🛈 Dt&C

Conducted Spurious Emissions



Frequency	12:00:50 PM an 19, 2038 TRACE D 2:04 4 Type D services Det C 19:00 (11)	ALEXANTO Type: Leg-Pur		Trig: Free Run Atten: 36 dB	PNO: Fast G	10 G AC	
Auto Tun	3.522 99 GHz -28.66 dBm	Mkr3				Ref Offset 12.66 dB Ref 38.00 dBm	0 dBldiv
Center Fre 5.015000000 GH	1.0.00					0n	og min min side
Start Fre 30.000000 MH					0 3 3		100
Stop Fre 10.00000000 GH						A CONTRACTOR OF THE OWNER	
CF Ste 967.000000 MH Auto Me	Stop 10.000 GHz 67 ms (40001 pts) Rection weak	Sweep 18. Function with	FUNCTION	0 MHz	VBW 3	0 MHz	Res BW
Freq Offse 0 H				28.75 dBm -28.18 dBm -28.66 dBm	7.05 MHz 11 90 GHz 12 99 GHz	f 3.30	1 N 1 1 2 N 1 1 1 1 1 1 1 1 1 1 1 1 1 1
							7 8 9 10
		atoria:					4

<u>Highest Channel</u>



8. Transmitter AC Power Line Conducted Emission

8.1 Test Setup

See test photo graphs for the actual connections between EUT and support equipment.

8.2 Limit

According to §15.207(a) 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 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

	Conducted Limit (dBuV)				
Frequency Range (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

8.3 Test Procedures

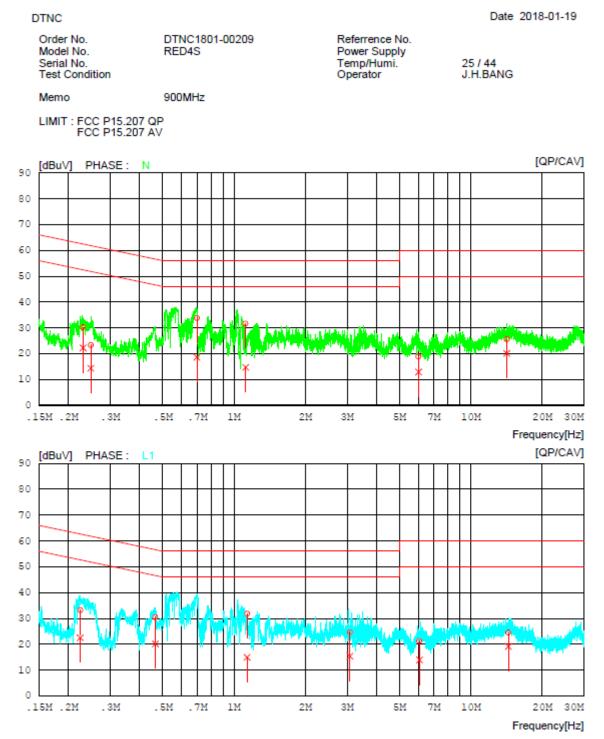
Conducted emissions from the EUT were measured according to the ANSI C63.10.

- 1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
- 2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
- 3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
- 4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4. Test Results

AC Line Conducted Emissions (Graph)

Results of Conducted Emission



DTNC

AC Line Conducted Emissions (List)

Results of Conducted Emission

Date 2018-01-19

Order No. DTNC1801-00209 Model No. RED4S Serial No. Test Condition		Referrence No. Power Supply Temp/Humi. Operator	25 / 44 J.H.BANG	
Memo	900MHz			
LIMIT : FCC P1 FCC P1	5.207 QP 5.207 AV			
NO FREQ	READING C.FACTOR	RESULT LIMIT	MARGIN	PHASE
[MHz]	QP CAV [dBuV][dBuV] [dB]	QP CAV QP CA [dBuV][dBuV] [dBuV][dB	~	L
1 0.2303	3 20.27 12.28 9.95	30.2222.23 62.44 52.	44 32.22 30.21	N
2 0.2486	5 13.39 4.45 9.95	23.3414.40 61.80 51.	80 38.4637.40	N
3 0.6962	7 23.78 8.59 9.96	33.7418.55 56.00 46.	00 22.2627.45	N
4 1.1182	0 21.64 4.73 10.00	31.6414.73 56.00 46.	00 24.3631.27	N
5 6.00800	0 8.76 2.82 10.11	18.8712.93 60.00 50.	00 41.13 37.07	N
6 14.1734	0 15.25 9.82 10.29	25.5420.11 60.00 50.	00 34.4629.89	N
7 0.2242	7 23.14 12.51 9.94	33.08 22.45 62.66 52.	66 29.58 30.21	L1
8 0.4655	0 20.40 10.18 9.98	30.3820.16 56.59 46.	59 26.21 26.43	L1
9 1.1356	0 21.75 4.86 10.00	31.7514.86 56.00 46.	00 24.25 31.14	L1
10 3.0868	0 14.59 5.33 10.05	24.6415.38 56.00 46.	00 31.36 30.62	L1
11 6.0688	0 11.04 3.77 10.11	21.1513.88 60.00 50.	00 38.85 36.12	L1
12 14.3988	0 14.16 8.82 10.30	24.4619.12 60.00 50.	00 35.54 30.88	L1

9. Antenna Requirement

9.1 Procedure

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

9.2 Conclusion

: Comply

The antenna employs a unique antenna connector.

Minimum Standard:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions.

10. Occupied Bandwidth (99 %)

10.1 Test Setup

Refer to the APPENDIX I.

10.2 Limit

Limit : Not Applicable

10.3 Test Procedure

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.

The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately $3 \times RBW$.

Spectrum analyzer plots are included on the following pages.

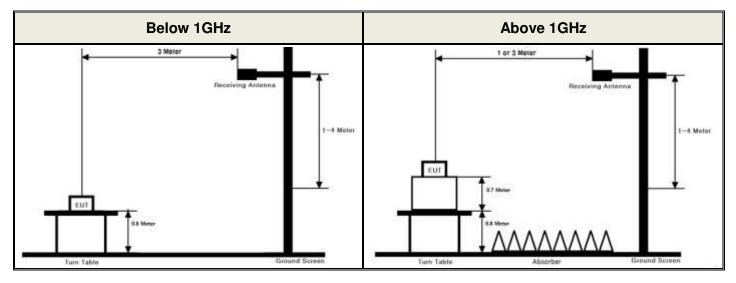
10.4 Test Results

Not Applicable

APPENDIX I

Test set up diagrams

Radiated Measurement



Conducted Measurement



Path loss information

Frequency (MHz)	Path Loss (dB)	Frequency (MHz)	Path Loss (dB)
30	9.47	1000	10.20
500	9.88	5000	11.47
917.1 & 921.9 & 926.9	10.13	10000	12.66
-	-	-	-

Note 1 : The path loss from EUT to Spectrum analyzer were measured and used for test.

Path loss (S/A's Correction factor) = Cable A + Attenuator



APPENDIX II

Unwanted Emissions (Radiated) Test Plot

Lowest & Z & Ver Frequency Myg Type: Veltage Avg/Hold: 200/200 PNO: Fast ---- Trig: Free Run IFGainLaw Atten: 6 dB TVP DF Auto Tune Mkr1 2.751 314 GHz 50.045 dBµV Ref 96.99 dBµV Center Freq 2.751300000 GHz Start Freq 2.746300000 GHz Stop Freq 2.756300000 GHz CF Step 917.100000 MHz no Man Auto Freq Offsel OH Center 2.751300 GHz #Res BW 1.0 MHz Span 10.00 MHz Sweep 8.00 ms (5001 pts) #VBW 1.0 kHz

Detector Mode : AV