Test Report No. 7191118777-EEC15/01
dated 12 Nov 2015

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
47 CFR FCC Parts 15B & C
OF A
INTELLIGENT VEHICLE GATEWAY
[Model : CV90-JC339]
[FCC ID : 2AE8ZIVG]

TEST FACILITY	TÜV SÜD PSB Pte Ltd Electrical & Electronics Centre (EEC), Product Services, No. 1 Science Park Drive, Singapore 118221
FCC REG. NO.	99142 (3m and 10m Semi-Anechoic Chamber, Science Park)
IND. CANADA REG. NO.	2932I-1 (3m and 10m Semi-Anechoic Chamber, Science Park)
PREPARED FOR	PCI Limited 35 Pioneer Road North Singapore 628475 Tel : (65) 66638312 Fax : Nil
QUOTATION NUMBER	2191016627
JOB NUMBER	7191118777
TEST PERIOD	05 Sep 2015 – 11 Nov 2015

PREPARED BY

Quek Keng Huat
Higher Associate Engineer

APPROVED BY

Lim Cher Hwee
Assistant Vice President

TÜV SÜD PSB

ilac-MRA

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LA-2007-0381-F
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LA-2007-0384-G
LA-2007-0385-E
LA-2007-0386-C
LA-2010-0464-D

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

Laboratory:
TÜV SÜD PSB Pte. Ltd.
No.1 Science Park Drive
Singapore 118221

Phone : +65-6885 1333
Fax : +65-6776 8670
E-mail: testing@tuv-sud-psb.sg
www.tuv-sud-psb.sg
Co. Reg : 199002667R

Regional Head Office:
TÜV SÜD Asia Pacific Pte. Ltd.
1 Science Park Drive, #02-01
Singapore 118221

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TEST SUMMARY

The product was tested in accordance with the customer's specifications.

Test Results Summary

Test Standard	Description	Pass / Fail
47 CFR FCC Part 15		
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 7
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.247(a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Not Tested *See Note 8
15.247(b)(3)	Maximum Peak Power	Pass
15.247(d)	RF Conducted Spurious Emissions (Non-Restricted Bands)	Not Tested *See Note 8
15.247(d)	RF Conducted Spurious Emissions (Restricted Bands)	Not Tested *See Note 8
15.247(d)	Band Edge Compliance (Conducted)	Not Tested *See Note 8
15.247(d)	Band Edge Compliance (Radiated)	Not Tested *See Note 8
15.247(e)	Peak Power Spectral Density	Not Tested *See Note 8
1.1310	Maximum Permissible Exposure	Refer to page 15 for details

Notes

1. The channels as listed below, under the different configurations were tested for 802.11b WLAN.

Transmit Channel	Frequency (GHz)	Modulation	Data Rate
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	DBPSK DBPSK DBPSK	1Mbps 1Mbps 1Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	DQPSK DQPSK DQPSK	2Mbps 2Mbps 2Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	CCK CCK CCK	11Mbps 11Mbps 11Mbps

2. The channels as listed below, under the different configurations were tested for 802.11g WLAN.

Transmit Channel	Frequency (GHz)	Modulation	Data Rate
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	BPSK BPSK BPSK	9Mbps 9Mbps 9Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	QPSK QPSK QPSK	18Mbps 18Mbps 18Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	16QAM 16QAM 16QAM	36Mbps 36Mbps 36Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	64QAM 64QAM 64QAM	54Mbps 54Mbps 54Mbps

3. The channels as listed below, under the different configurations were tested for 802.11n WLAN.

Transmit Channel	Frequency (GHz)	Modulation	Data Rate
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	BPSK BPSK BPSK	13Mbps 13Mbps 13Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	QPSK QPSK QPSK	39Mbps 39Mbps 39Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	16QAM 16QAM 16QAM	78Mbps 78Mbps 78Mbps
Channel 1 (Lower Channel) Channel 6 (Middle Channel) Channel 11 (Upper Channel)	2.412 2.437 2.462	64QAM 64QAM 64QAM	65Mbps 130Mbps 130Mbps

Notes

4. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.

5. All test measurement procedures are according to ANSI C63.4: 2014, ANSI C63.10: 2013 and KDB 558074 D01 DTS Measurement Guidance V03R03.

6. The maximum measured RF power of the Equipment Under Test is 18.96dBm.

7. The Equipment Under Test (EUT) is a battery operated device / DC operated device and contains no provision for public utility connections.

8. The RF module (FCC ID: PV7-WIBEAR11N-SF2) used in this product is a FCC certified module and PCI Limited declares that no modification has been done on the RF module in integrating the RF module to this product.

Modifications

No modifications were made.

PRODUCT DESCRIPTION

Description	:	The Equipment Under Test (EUT) is a **INTELLIGENT VEHICLE GATEWAY.**
Applicant	:	Omnitracs, LLC 10182 Telesis Court Suite 100 San Diego, CA. 92121
Manufacturer	:	PCI Limited 35 Pioneer Road North Singapore 628475
Factory (ies)	:	PT PCI Elektronik Internasional Panbil Industrial Estate Factory C Lot 2-3 Jalan Ahmad Yani Muka Kuning Indonesia 29433
Model Number	:	CV90-JC339
FCC ID	:	2AE8ZIVG
Serial Number	:	108000468
Microprocessor	:	Refer To Electrical Specification
Operating / Transmitting Frequency	:	2.412GHz (lower channel) to 2.462GHz (upper channel) 11 channels
Clock / Oscillator Frequency	:	792MHz
Modulation	:	Differential Binary Phase Shift Keying (DBPSK) Differential Quadrature Phase Shift Keying (DQPSK) Complementary Code Keying (CCK) Binary Phase Shift Keying (BPSK) Quadrature Phase Shift Keying (QPSK) 16-Quadrature Amplitude Modulation (16QAM) 64-Quadrature Amplitude Modulation (64QAM)
Antenna Gain	:	Refer To Antenna Specification
Port / Connectors	:	Refer to manufacturer's user manual / operating manual
Rated Input Power	:	12Vdc
Accessories	:	Refer to manufacturer's user manual / operating manual

Antenna Specification					
Description	**GSM**	**WCDMA**	**CDMA**	**Bluetooth**	**WLAN 2.4G**
Antenna Brand Name	Customized Antenna	Customized Antenna	Customized Antenna	Yageo	Yageo
Antenna Model Name	GA-OTIS-USDB	GA-OTIS-USDB	GA-OTIS-USDB	ANT3216A063R2400A	ANT3216A063R2400A
Antenna Type	Inverted-F	Inverted-F	Inverted-F	Ceramic Chip	Ceramic Chip
Antenna Gain	Max peak gain 2.55dBi at 859MHz, Max peak gain 1.45dBi at 1910MHz			Max peak gain 2.14dBi	Max peak gain 2.51dBi

Electrical specifications

Microprocessor Information 1	
Manufacturer 1	Freescale Semiconductor
Part Number 1	MCIMX6Q7CVT08AD
Part Description	IC ARM CORTEX A9 i.MX6 QUAD IND GRADE
Microprocessor Information 2	
Manufacturer 2	NXP Semiconductors
Part Number 2	LPC1833JET256,551
Part Description	IC ARM CORTEX-M3 32-bit TFBGA256
Clock/Oscillator	
Highest frequency generated by Freescale MCIMX6Q7CVT08AD	792MHz
Port / Connectors 1	
Manufacturer	JST
Part Number	S20B-J11DK-GWXR (LF)
Part Description	20 POS 2.5P AWG 20-28 CONNECTOR
Quantity per	1
Port / Connectors 2	
Manufacturer	WIESON
Part Number	G3505B135-DJ-A06
Part Description	USB TYPE A REVERSED CONNECTOR
Quantity per	2
Port / Connectors 3	
Manufacturer	MOLEX
Part Number	502774-0891
Part Description	MICRO SD CARD REV PUSH-PUSH CONNECTOR
Quantity per	1

SUPPORTING EQUIPMENT DESCRIPTION

The EUT was tested as a stand-alone unit without any supporting equipment.

EUT OPERATING CONDITIONS

47 CFR FCC Part 15
1. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement) **2. Maximum Peak Power** **3. Maximum Permissible Exposure**
The EUT was exercised by operating in maximum continuous transmission in test mode, i.e transmitting at lower, middle and upper channels respectively at one time.

47 CFR FCC Part 15.205 Restricted Bands

MHz			MHz			MHz			GHz		
0.090	-	0.110	16.42	-	16.423	399.9	-	410	4.5	-	5.15
0.495	-	0.505	16.69475	-	16.69525	608	-	614	5.35	-	5.46
2.1735	-	2.1905	16.80425	-	16.80475	960	-	1240	7.25	-	7.75
4.125	-	4.128	25.5	-	25.67	1300	-	1427	8.025	-	8.5
4.17725	-	4.17775	37.5	-	38.25	1435	-	1626.5	9.0	-	9.2
4.20725	-	4.20775	73	-	74.6	1645.5	-	1646.5	9.3	-	9.5
6.215	-	6.218	74.8	-	75.2	1660	-	1710	10.6	-	12.7
6.26775	-	6.26825	108	-	121.94	1718.8	-	1722.2	13.25	-	13.4
6.31175	-	6.31225	123	-	138	2200	-	2300	14.47	-	14.5
8.291	-	8.294	149.9	-	150.05	2310	-	2390	15.35	-	16.2
8.362	-	8.366	156.52475	-	156.52525	2483.5	-	2500	17.7	-	21.4
8.37625	-	8.38675	156.7	-	156.9	2690	-	2900	22.01	-	23.12
8.41425	-	8.41475	162.0125	-	167.17	3260	-	3267	23.6	-	24.0
12.29	-	12.293	167.72	-	173.2	3332	-	3339	31.2	-	31.8
12.51975	-	12.52025	240	-	285	3345.8	-	3358	36.43	-	36.5
12.57675	-	12.57725	322	-	335.4	3600	-	4400	Above 38.6		
13.36	-	13.41									

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m)
0.009 - 0.490	20 log [2400 / F (kHz)] @ 300m
0.490 - 1.705	20 log [24000 / F (kHz)] @ 30m
1.705 - 30.0	30.0 @ 30m
30 - 88	40.0 @ 3m
88 - 216	43.5 @ 3m
216 - 960	46.0 @ 3m
Above 960	54.0* @ 3m
* For frequency bands 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.	

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver – ESI1	ESI40	100010	14 Jul 2016
Schaffner Bilog Antenna –(30MHz-2GHz) BL3 (Ref)	CBL6112D	2549	29 Jan 2016
ETS Horn Antenna(18GHz-40GHz)(Ref)	3116	0004-2474	02 Oct 2016
EMCO Horn Antenna(1GHz-18GHz)	3115	0003-6088	20 Apr 2016
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	13 Mar 2016
Agilent Preamplifier(1GHz-26.5GHz) (PA18)	8449D	3008A02305	06 Oct 2016
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441096	13 Oct 2016
Micro-Tronics Bandstop Filter (2.4-2.5 GHz)	BRM50701	017	13 Aug 2016

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table for measurement up to 1GHz. For measurement above 1GHz, 1.5m height table was used.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point in the range of 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10th harmonics of the EUT fundamental frequency, using the loop antenna for frequency below 30MHz, Bi-log antenna for frequencies from 30MHz up to 1GHz, and the Horn antenna above 1GHz.

Sample Calculation Example

At 300 MHz	Q-P limit (Class B) = 46.0 dBμV/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dBμV/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 46.0 - 40.0 = 6.0	i.e. 6.0 dB below Q-P limit

47 CFR FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results

Test Input Power	12Vdc	Temperature	24°C
Test Distance	3m (≥30MHz – 25GHz)	Relative Humidity	60%
Operating Mode	WiFi + Mobile File Transfer	Atmospheric Pressure	1030mbar
		Tested By	Lim Poh Huat

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)
31.0890	33.4	40.0	6.6	100	245	V
51.7710	31.2	40.0	8.8	100	135	V
58.3020	31.0	40.0	9.0	100	184	V
63.7450	31.2	40.0	8.8	100	342	V
65.9220	31.4	40.0	8.6	100	306	V
72.4540	31.6	40.0	8.4	100	52	V

Spurious Emissions above 1GHz – 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)
4.5462	45.3	74.0	28.7	34.2	54.0	19.8	400	241	V
4.9839	48.3	74.0	25.7	37.3	54.0	16.7	200	101	V
6.4979	43.9	74.0	30.1	41.5	54.0	12.5	100	318	H
7.3116	44.4	74.0	29.6	35.3	54.0	18.7	100	298	H
9.7526	45.7	74.0	28.3	40.9	54.0	13.1	100	256	H
14.6960	49.6	74.0	24.4	37.1	54.0	16.9	300	43	H

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
3. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a “negative” margin indicates a FAIL.
4. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
5. The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33(a) for intentional radiators & Section 15.33(b) for unintentional radiators.
6. The channel in the table refers to the transmit channel of the EUT.
7. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz is ±4.0dB.

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Limits

The EUT shows compliance to the requirements of this section, which states the maximum peak power of the EUT employing digital modulation shall not exceed 1W (30dBm).

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Boonton Electronics RF Power Meter	4532	72901	27 Aug 2016
Boonton Electronics Peak Power Sensor	56218-S/1	1417	27 Aug 2016

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the power meter.
4. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel with specified modulation and data rate.
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. Repeat steps 1 to 2 with all possible modulations and data rates.
4. The steps 2 to 3 were repeated with the transmitting frequency was set to middle and upper respectively.

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Results

Test Input Power	12Vdc	Temperature	24°C
Antenna Gain	2.14 dBi	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Lim Poh Huat

802.11b

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)	Modulation @ Data Rate
1 *(lower ch)*	2.412	0.0678	1.0	DBPSK @ 1Mbps
		0.0683	1.0	DQPSK @ 2Mbps
		0.0707	1.0	CCK @ 11Mbps
6 *(mid ch)*	2.437	0.0761	1.0	DBPSK @ 1Mbps
		0.0615	1.0	DQPSK @ 2Mbps
		0.0799	1.0	CCK @ 11Mbps
11 *(upper ch)*	2.462	0.0761	1.0	DBPSK @ 1Mbps
		0.0758	1.0	DQPSK @ 2Mbps
		0.0787	1.0	CCK @ 11Mbps

802.11g

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)	Modulation @ Data Rate
1 *(lower ch)*	2.412	0.0160	1.0	BPSK @ 9Mbps
		0.0162	1.0	QPSK @ 18Mbps
		0.0156	1.0	16QAM @ 36Mbps
		0.0156	1.0	64QAM @ 54Mbps
6 *(mid ch)*	2.437	0.0184	1.0	BPSK @ 9Mbps
		0.0187	1.0	QPSK @ 18Mbps
		0.0158	1.0	16QAM @ 36Mbps
		0.0180	1.0	64QAM @ 54Mbps
11 *(upper ch)*	2.462	0.0182	1.0	BPSK @ 9Mbps
		0.0185	1.0	QPSK @ 18Mbps
		0.0178	1.0	16QAM @ 36Mbps
		0.0178	1.0	64QAM @ 54Mbps

47 CFR FCC Part 15.247(b)(3) Maximum Peak Power Results

Test Input Power	12Vdc	Temperature	24°C
Antenna Gain	2.14 dBi	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Lim Poh Huat

802.11n

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)	Modulation @ Data Rate
1 *(lower ch)*	2.412	0.0160	1.0	BPSK @ 6.5Mbps (MCS0)
		0.0160	1.0	QPSK @ 19.5Mbps (MCS2)
		0.0160	1.0	16QAM @ 39Mbps (MCS4)
		0.0159	1.0	64QAM @ 65Mbps (MCS7)
6 *(mid ch)*	2.437	0.0182	1.0	BPSK @ 6.5Mbps (MCS0)
		0.0183	1.0	QPSK @ 19.5Mbps (MCS2)
		0.0181	1.0	16QAM @ 39Mbps (MCS4)
		0.0182	1.0	64QAM @ 65Mbps (MCS7)
11 *(upper ch)*	2.462	0.0181	1.0	BPSK @ 6.5Mbps (MCS0)
		0.0181	1.0	QPSK @ 19.5Mbps (MCS2)
		0.0182	1.0	16QAM @ 39Mbps (MCS4)
		0.0182	1.0	64QAM @ 65Mbps (MCS7)

Notes

1. Nil.

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Limits

The EUT shows compliance to the requirements of this section, which states the MPE limits for general population / uncontrolled exposure are as shown below:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (min)
0.3 - 1.34	614	1.63	100 Note 2	30
1.34 - 30	824 / f	2.19 / f	$180 / f^2$ Note 2	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f / 1500	30
1500 - 100000	-	-	1.0	30
Notes				
1. f = frequency in MHz				
2. Plane wave equivalent power density				

47 CFR FCC Part 1.1310 Maximum Permissible Exposure Computation

The power density at 20cm distance was computed from the following formula:

$S = (30GP) / (377d^2)$

where S = Power density in W/m^2
P = 0.0787W
d = Test distance at 0.2m
G = Numerical isotropic gain, 1.64 (2.14dBi)

Substituting the relevant parameters into the formula:

$S = [(30GP) / 377d^2]$
$= 0.2568\ W/m^2$
$= 0.0257\ mW/cm^2$

∴ The power density of the EUT at 20cm distance is $0.0257 mW/cm^2$ based on the above computation and found to be lower than the power density limit of $1.0 mW/cm^2$.

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July 2011