

FCC - TEST REPORTReport Number : **60.790.18.001.01R01** Date of Issue : May 16, 2018Model : **SBC-D04, SBC-D03**Product Type : **LEVO TT HMI-GPS, LEVO TT HM**Applicant : **DAYTON INDUSTRIAL CO., LTD**Address : **2-12 Kwai Fat Road, 11-A Kwai Chung, New Territories, Hong Kong**Production Facility : **KENDY ENTERPRISE LTD**Address : **2-12 Kwai Fat Road, 11-A Kwai Chung, New Territories, Hong Kong**Test Result : ☒ **Positive** ☐ **Negative**Total pages
including
Appendices : **37**

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2 Description of Equipment Under Test

Description of the Equipment Under Test

Product:	LEVO TT HMI-GPS, LEVO TT HM
Model no.:	SBC-D04, SBC-D03
FCC ID:	O4GTTHMI
Rating:	12 VDC
Frequency:	2457MHz, 2402MHz-2480MHz
Antenna gain:	0 dBi
Number of operated channel:	40
Modulation:	GFSK

3 Summary of Test Standards

Test Standards
FCC Part 15 Subpart C 10-1-17 Edition Federal Communications Commission, PART 15 — Radio Frequency Devices, Subpart C — Unintentional Radiators

4 Details about the Test Laboratory

Site 1

Company name: TÜV SÜD Hong Kong Ltd.
3/F, West Wing, Lakeside 2,
10 Science Park West Avenue,
Science Park, Shatin, Hong Kong

Site 2

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12&13 Zhiheng Wisdomland Business Park,
Nantou Checkpoint Road 2,
Shenzhen 518052, P.R.China
FCC Registration Number: 502708

Emission Tests	
Test Item	Test Site
FCC Part 15 Subpart C	
FCC Title 47 Part 15.205, 15.209 & 15.247(d) Spurious Radiated Emission	Site 2
FCC Title 47 Part 15.207 Conduct Emission	NIL
FCC Title 47 Part 15.247 Bandedge Emission	Site 2
FCC Title 47 Part 15.247(a)(1) 6dB & 99% Bandwidth	Site 2
FCC Title 47 Part 15.247(b) Peak Output Power	Site 2
FCC Title 47 Part 2.1051 & 15.247(d) Spurious Emissions at Antenna Terminals	Site 2
FCC Title 47 Part 15.247(d) 100kHz Bandwidth of band edges	Site 2
FCC Title 47 Part 15.247(e) Power Spectral Density	Site 2
FCC Title 47 Part 15.203 & 15.247(b) Antenna Requirement	Site 2

4.1 Test Equipment Site List

Radiated emission Test – Site 2

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2018-7-14
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2018-7-14
Horn Antenna	Rohde & Schwarz	HF907	102294	2018-7-14
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2018-7-14
Signal Generator	Rohde & Schwarz	SMY01	839369/005	2018-7-7
Attenuator	Agilent	8491A	MY39264334	2018-7-7
3m Semi-anechoic chamber	TDK	9X6X6	----	2020-7-7
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

Bandwidth, Peak Output Power, Spurious Emissions at Antenna Terminals, 100kHz Bandwidth of band edges, Power Spectral Density – Site 2

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Generator	Rohde & Schwarz	SMB100A	108272	2018-7-7
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2018-7-7
Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2018-7-7
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2018-7-7

4.2 Measurement System Uncertainty

Measurement System Uncertainty Emissions

System Measurement Uncertainty	
Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 9kHz-30MHz	4.54dB
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.83dB; Vertical: 4.91dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-25000MHz	Horizontal: 4.89dB; Vertical: 4.88dB;
Uncertainty for Conducted RF test	2.04dB

5 Summary of Test Results

Emission Tests				
FCC Part 15 Subpart C				
Test Condition	Pages	Test Result		
		Pass	Fail	N/A
FCC Title 47 Part 15.205, 15.209 & 15.247(d) Spurious Radiated Emission	10-15	☒	☐	☐
FCC Title 47 Part 15.207 Conduct Emission	NIL	☐	☐	☒
FCC Title 47 Part 15.247Bandedge Emission	16-17	☒	☐	☐
FCC Title 47 Part 15.247(a)(2) 6dB & 99% Bandwidth	18-20	☒	☐	☐
FCC Title 47 Part 15.247(b) Peak Output Power	21-23	☒	☐	☐
FCC Title 47 Part 2.1051 & 15.247(d) Spurious Emissions at Antenna Terminals	24-26	☒	☐	☐
FCC Title 47 Part 15.247(d) 100kHz Bandwidth of band edges	27-28	☒	☐	☐
FCC Title 47 Part 15.247(e) Power Spectral Density	29-31	☒	☐	☐
FCC Title 47 Part 15.203 & 15.247(b) Antenna Requirement	32	☒	☐	☐

6 General Remarks

Remarks

Client informs that the product LEVO TT HM, model SBC-D03 has the same technical construction including circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction, with LEVO TT HMI-GPS, model SBC-D04. The only difference lies on that, SBC-D04 has GPS receiving feature, while SBC-D03 not has. (Client's conformation letter shown at appendix C)

EMC Tests were performed on model: SBC-D04.

SUMMARY:

- All tests according to the regulations cited on page 5 were

■ - Performed

□ - **Not** Performed

- The Equipment Under Test

■ - **Fulfills** the general approval requirements.

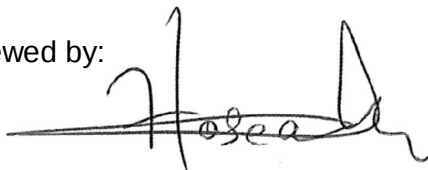
□ - **Does not** fulfill the general approval requirements.

Sample Received Date: February 28, 2018

Testing Start Date: March 7, 2018

Testing End Date: April 9, 2018

Reviewed by:



Hosea CHAN
EMC Project Engineer

Prepared by:



Eric LI
EMC Senior Project Engineer

7 Emission Test Results

7.1 Spurious Radiated Emission

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2402MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d) Antenna: Horizontal
 Comment:
 Remark: 9kHz to 25GHz

Test Result	
☒	Passed
☐	Not Passed

Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Detector
57.214	14.53	40	-25.47	Quasi Peak
197.594	21.69	43.5	-21.81	Quasi Peak
324.017	29.11	46	-16.89	Quasi Peak
875.409	30.75	46	-15.25	Quasi Peak
1257.600	32.67	54	-21.33	Peak
2400.000	55.78	74	-18.22	Peak
2400.000	42.86	54	-11.14	Average
4804.000	58.65	74	-15.35	Peak
4804.000	41.98	54	-12.02	Average
7206.000	41.89	54	-12.11	Peak

Spurious Radiated Emission

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2402MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d) Antenna: Vertical
 Comment: 12 VDC
 Remark: 9kHz to 25GHz

Test Result	
☒	Passed
☐	Not Passed

Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Detector
37.564	18.26	40	-21.74	Quasi Peak
197.593	21.45	43.5	-22.05	Quasi Peak
252.026	23.86	46	-22.14	Quasi Peak
875.402	31.38	46	-14.62	Quasi Peak
1257.500	32.87	54	-21.13	Peak
4880.000	53.08	74	-20.92	Peak
4880.000	41.67	54	-12.33	Average
7320.000	43.65	74	-30.35	Peak
7320.000	35.32	54	-18.68	Average

Spurious Radiated Emission

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2440MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d) Antenna: Horizontal
 Comment: 12 VDC
 Remark: 9kHz to 25GHz

Test Result	
☒	Passed
☐	Not Passed

Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Detector
60.610	20.17	40	-19.83	Quasi Peak
252.023	22.19	46	-23.81	Quasi Peak
324.018	25.68	46	-20.32	Quasi Peak
874.285	25.98	46	-20.02	Quasi Peak
1254.500	31.78	54	-22.22	Peak
4880.000	50.76	74	-23.24	Peak
4880.000	38.47	54	-15.53	Average
7320.000	44.17	74	-29.83	Peak
7320.000	34.96	54	-19.04	Average

Spurious Radiated Emission

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2440MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d) Antenna: Vertical
 Comment: 12 VDC
 Remark: 9kHz to 25GHz

Test Result	
☒	Passed
☐	Not Passed

Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Detector
44.175	17.87	40	-22.13	Quasi Peak
253.343	24.16	46	-21.84	Quasi Peak
687.549	19.39	46	-26.61	Quasi Peak
875.408	31.14	46	-14.86	Quasi Peak
1257.589	33.38	54	-20.62	Peak
2483.500	44.87	74	-29.13	Peak
2483.500	37.35	54	-16.65	Average
4960.000	55.64	74	-18.36	Peak
4960.000	41.32	54	-12.68	Average
7439.375	39.85	54	-14.15	Peak

Spurious Radiated Emission

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2480MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d) Antenna: Horizontal
 Comment: 12 VDC
 Remark: 9kHz to 25GHz

Test Result	
☒	Passed
☐	Not Passed

Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Detector
47.215	18.58	40	-21.42	Quasi Peak
252.021	23.48	46	-22.52	Quasi Peak
324.018	25.09	46	-20.91	Quasi Peak
874.335	27.18	46	-18.82	Quasi Peak
1254.896	35.78	74	-38.22	Peak
2483.500	46.82	74	-27.18	Peak
2483.500	39.16	54	-14.84	Average
4960.625	50.44	74	-23.56	Peak
4960.625	38.35	54	-15.65	Average
7440.000	46.82	74	-27.18	Peak
7440.000	33.57	54	-20.43	Average

Spurious Radiated Emission

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2480MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d) Antenna: Vertical
 Comment: 12 VDC
 Remark: 9kHz to 25GHz

Test Result	
☒	Passed
☐	Not Passed

Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Detector
37.556	17.86	40	-22.14	Quasi Peak
197.595	21.87	43.5	-21.63	Quasi Peak
324.016	28.89	46	-17.11	Quasi Peak
875.409	31.04	46	-14.96	Quasi Peak
1257.563	33.61	54	20.39	Peak
2457.000	92.16	114	-21.84	Peak
2457.000	84.98	94	-9.02	Average
2561.625	43.07	54	-10.93	Peak
4913.906	57.36	74	-16.64	Peak
4913.906	40.10	54	-13.9	Average
7050.469	38.32	54	-15.68	Peak

7.2 Bandedge Emission

EUT: SBC-D04
 Op Condition: Operated, TX Mode
 Test Specification: FCC15.247, Antenna: Horizontal
 Comment: 12 VDC

Test Result	
☒	Passed
☐	Not Passed

Band	Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Detector
Low	2398.350	33.22	74	-40.78	Peak
Low	2398.350	26.56	54	-27.44	Average
High	2494.000	31.55	74	-42.45	Peak
High	2494.000	25.28	54	-28.72	Average

Bandedge Emission

EUT: SBC-D04
Op Condition: Operated, TX Mode
Test Specification: FCC15.247, Antenna: Vertical
Comment: 12 VDC

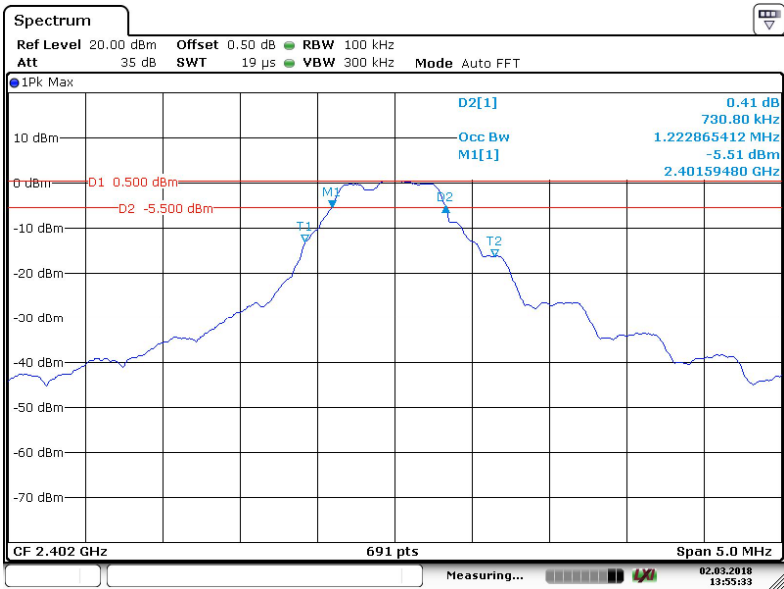
Test Result	
☒	Passed
☐	Not Passed

Band	Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Detector
Low	2398.350	30.36	74	-43.64	Peak
Low	2398.350	26.12	54	-27.88	Average
High	2494.000	29.89	74	-44.11	Peak
High	2494.000	25.09	54	-28.91	Average

7.3 6dB & 99% Bandwidth

EUT: SBC-D04
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



Date: 2 MAR 2018 13:55:33

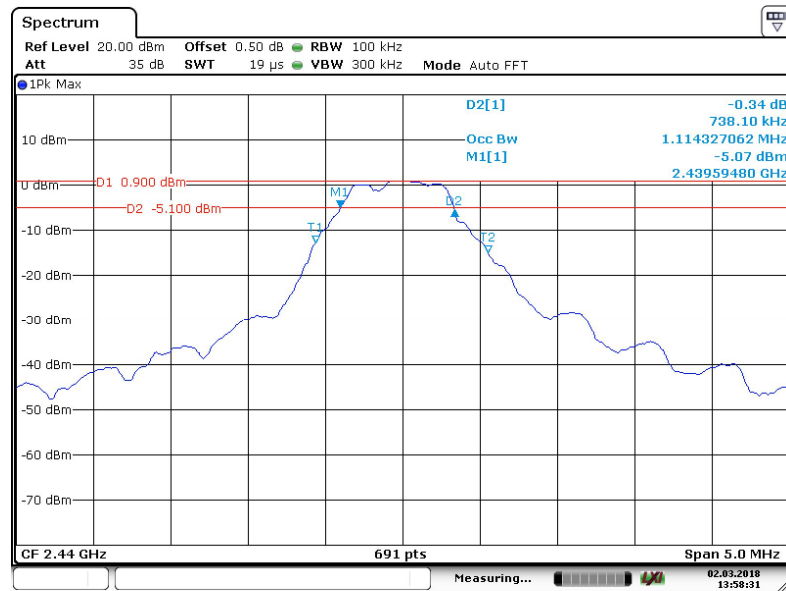
6dB bandwidth	Limit
730.800 kHz	> 500 kHz

99% bandwidth
1222.865 kHz

6dB & 99% Bandwidth

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2440MHz)
 Test Specification: FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
 Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



Date: 2 MAR 2018 13:58:31

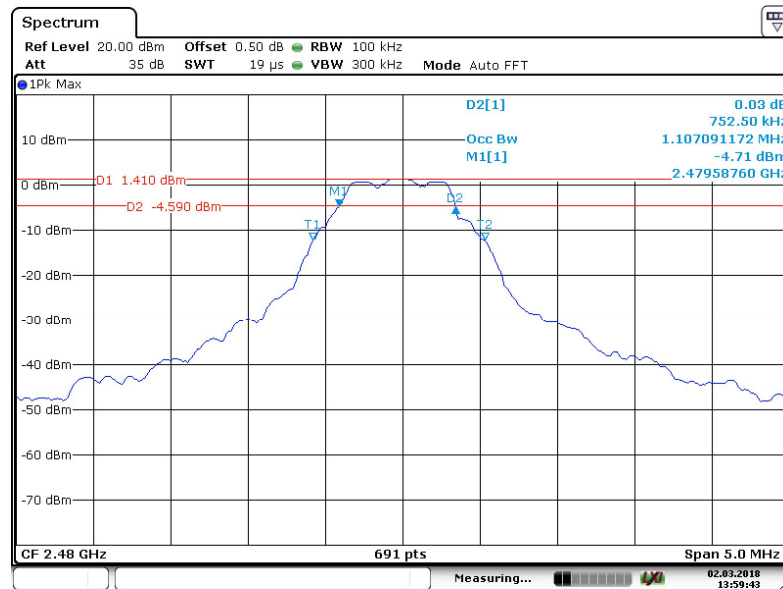
6dB bandwidth	Limit
738.100 kHz	> 500 kHz

99% bandwidth
1114.327 kHz

6dB & 99% Bandwidth

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2480MHz)
 Test Specification: FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
 Comment: 12 VDC

Test Result	
☒	Passed
☐	Not Passed



Date: 2 MAR 2018 13:59:43

6dB bandwidth	Limit
752.500 kHz	>500 kHz

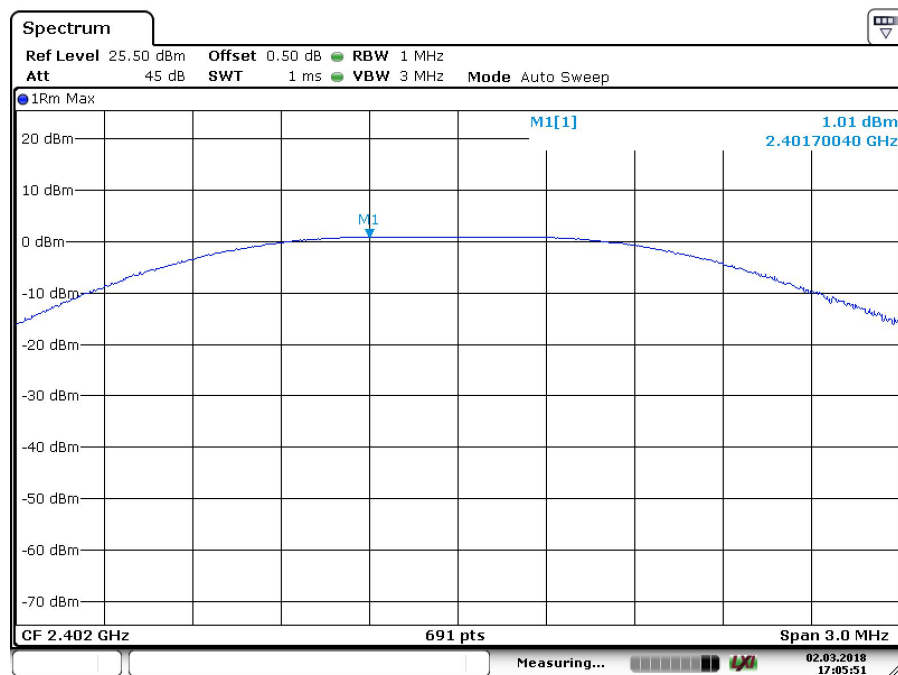
99% bandwidth
1107.091 kHz

7.4 Peak Output Power

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2402MHz)
 Test Specification: FCC15.247(b)
 Comment: 12 VDC, Antenna gain: 0 dBi,
 Cable Loss: 0.5 dB

Test Result

☒ Passed
☐ Not Passed



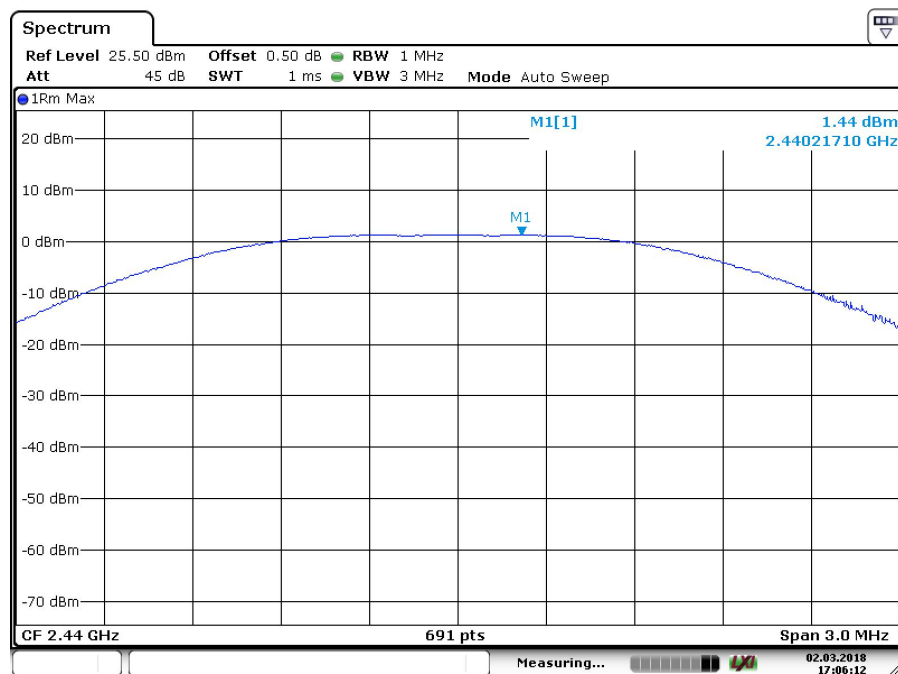
Date: 2.MAR.2018 17:05:51

Conducted Output Power	Limit
1.01 dBm	< 30dBm

Peak Output Power

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2440MHz)
 Test Specification: FCC15.247(b)
 Comment: 12 VDC, Antenna gain: 0 dBi,
 Cable Loss: 0.5 dB

Test Result	
☒	Passed
☐	Not Passed



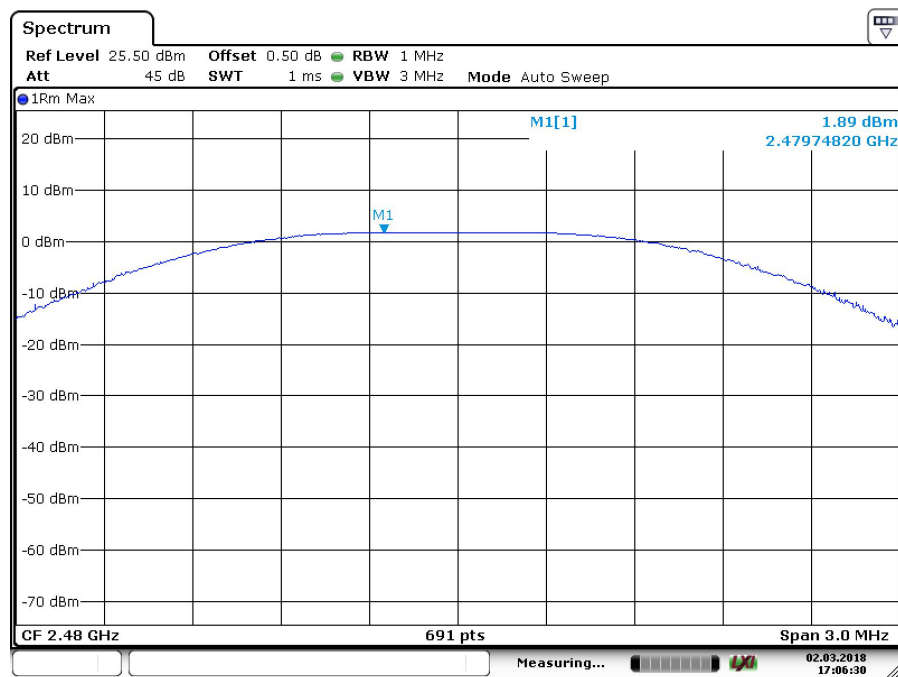
Date: 2.MAR.2018 17:06:12

Conducted Output Power	Limit
1.44 dBm	< 30dBm

Peak Output Power

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2480MHz)
 Test Specification: FCC15.247(b)
 Comment: 12 VDC, Antenna gain: 0 dBi,
 Cable Loss: 0.5 dB

Test Result	
☒	Passed
☐	Not Passed



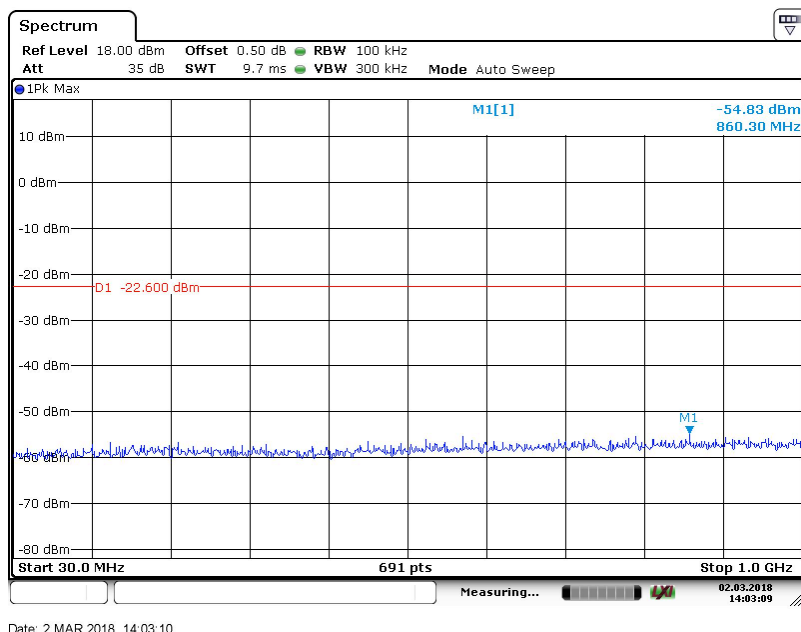
Date: 2.MAR.2018 17:06:30

Conducted Output Power	Limit
1.89 dBm	< 30dBm

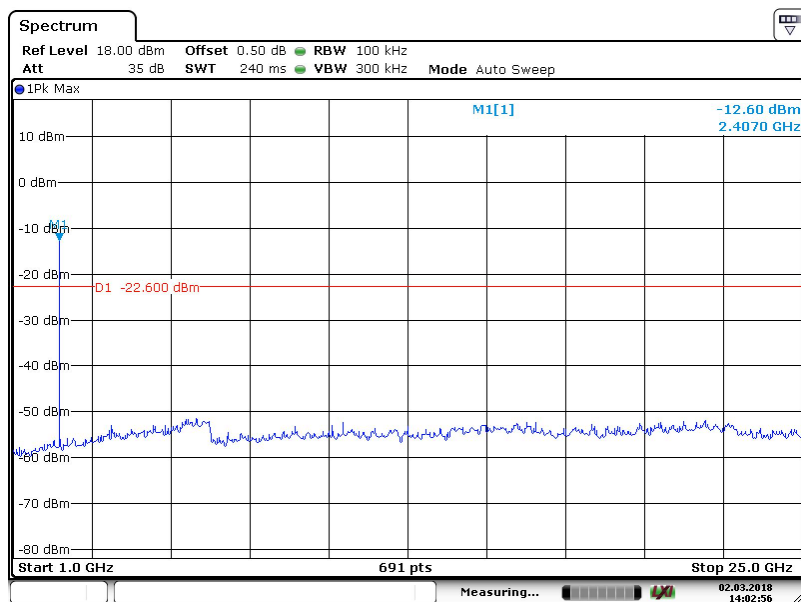
7.5 Spurious Emissions at Antenna Terminals

EUT: SBC-D04
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



Date: 2.MAR.2018 14:03:10

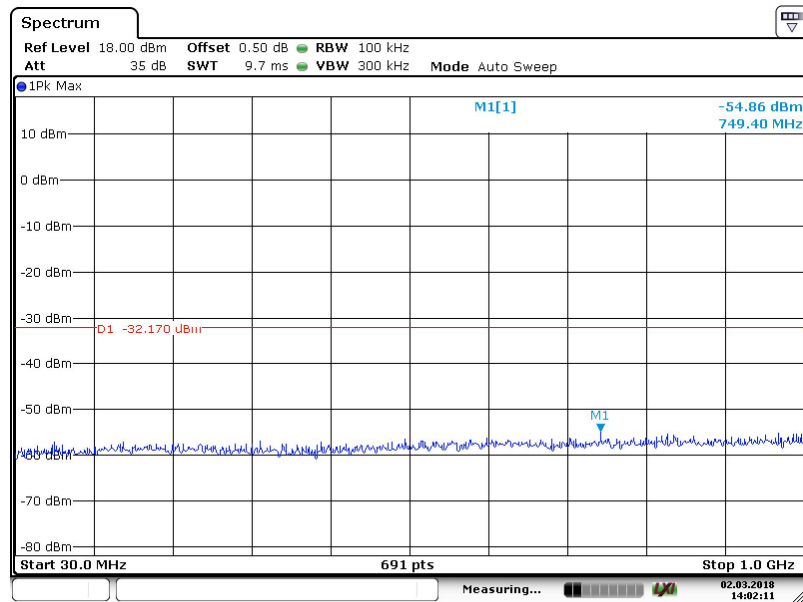


Date: 2.MAR.2018 14:02:56

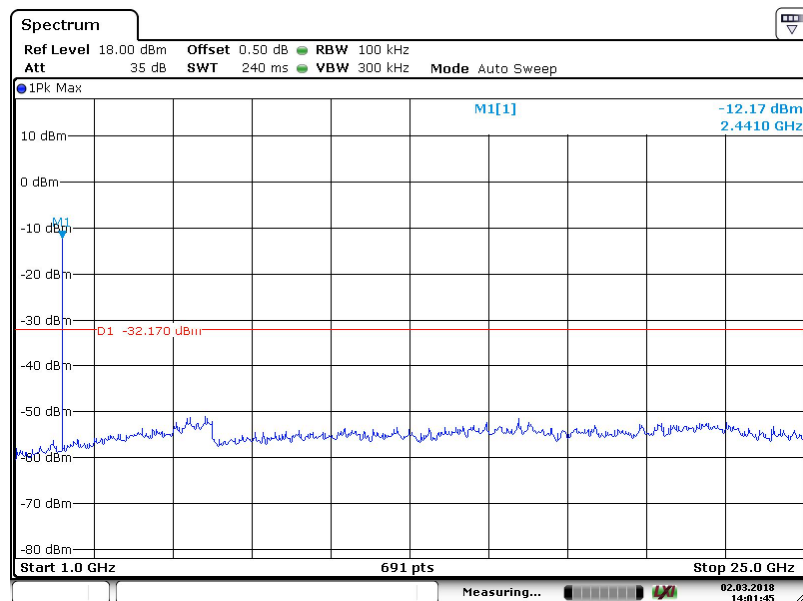
Spurious Emissions at Antenna Terminals

EUT: SBC-D04
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



Date: 2.MAR.2018 14:02:11

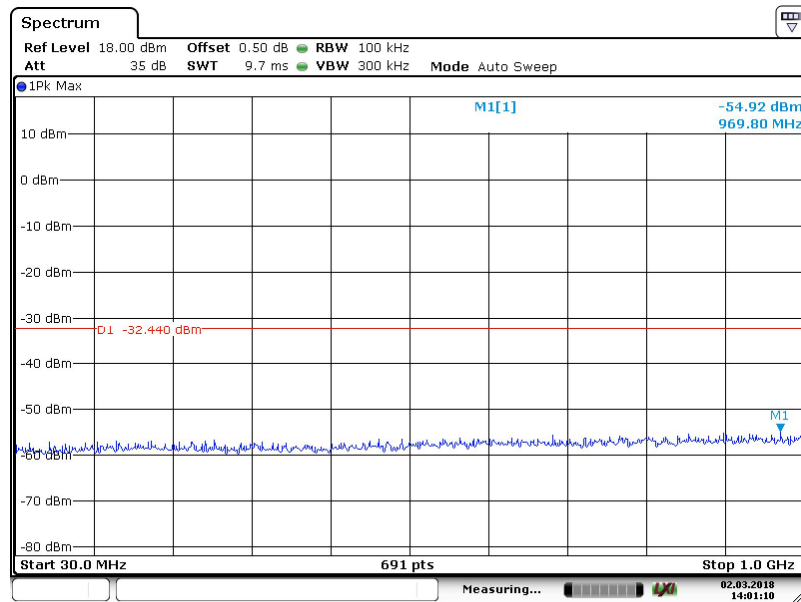


Date: 2.MAR.2018 14:01:45

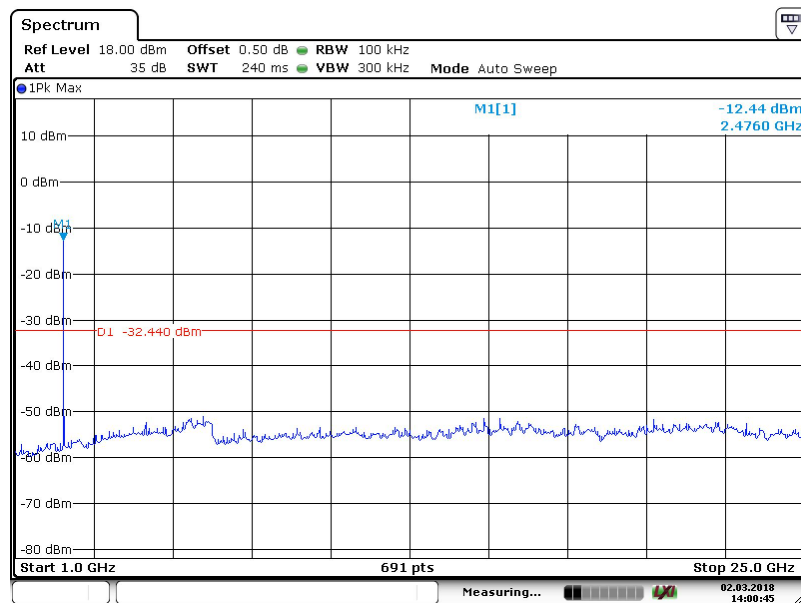
Spurious Emissions at Antenna Terminals

EUT: SBC-D04
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



Date: 2.MAR.2018 14:01:10

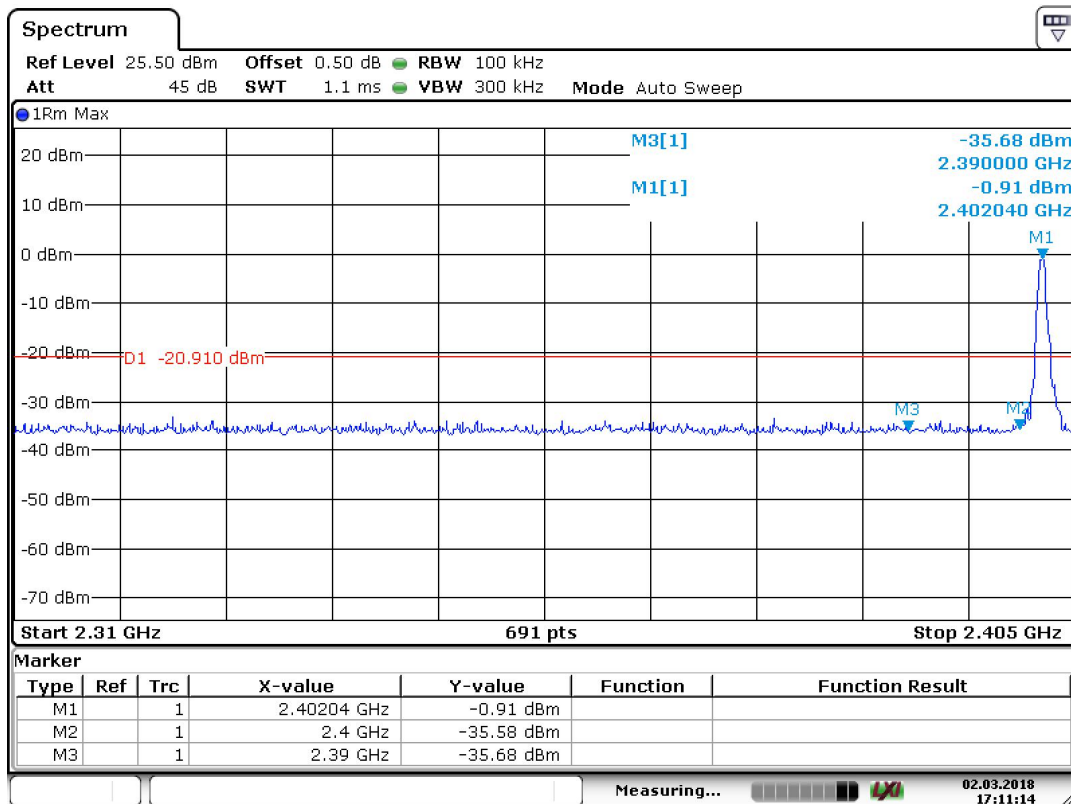


Date: 2.MAR.2018 14:00:46

7.6 100kHz Bandwidth of band edges

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2402MHz)
 Test Specification: FCC15.247(d), Conducted
 Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



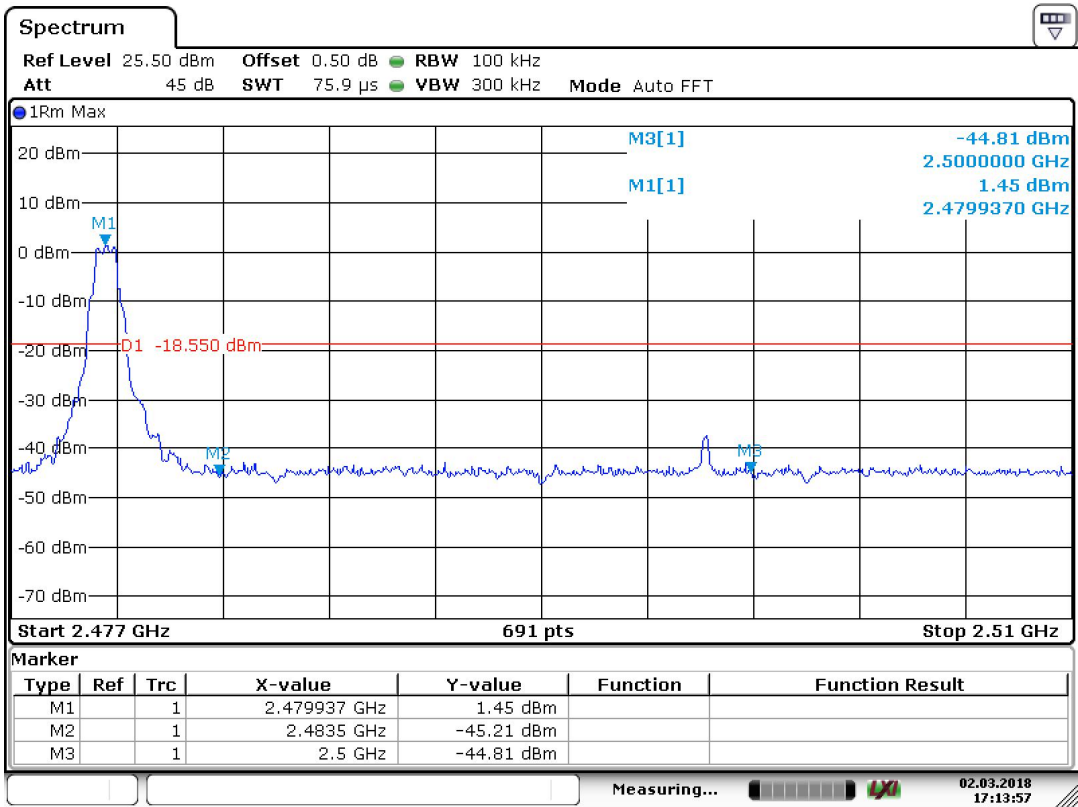
Date: 2.MAR.2018 17:11:14

Band edges	Limit
34.67 dB	> 20dB

100kHz Bandwidth of band edges

EUT: SBC-D04
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.247(d), Conducted
Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



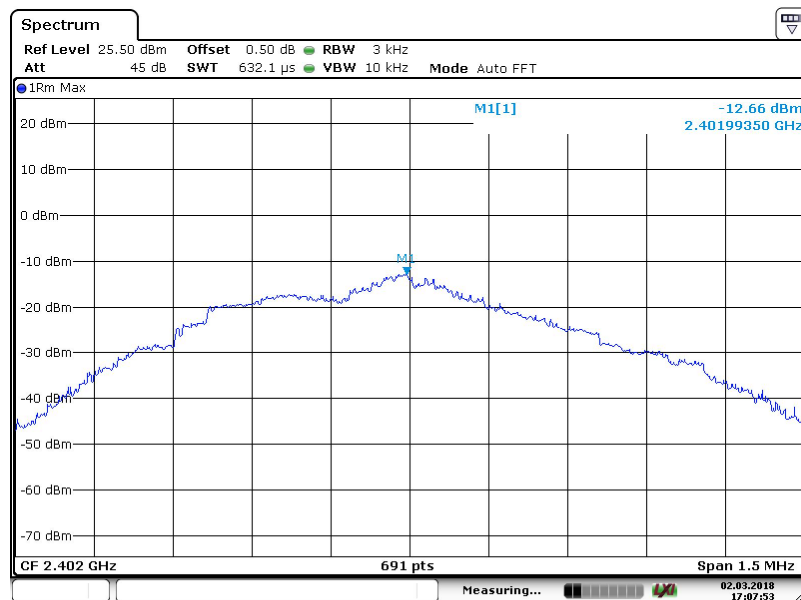
Date: 2.MAR.2018 17:13:58

Band edges	Limit
46.66 dB	> 20dB

7.7 Power Spectral Density

EUT: SBC-D04
 Op Condition: Operated, TX Mode (2402MHz)
 Test Specification: FCC15.247(e)
 Comment: 12 VDC

Test Result	
☒	Passed
☐	Not Passed



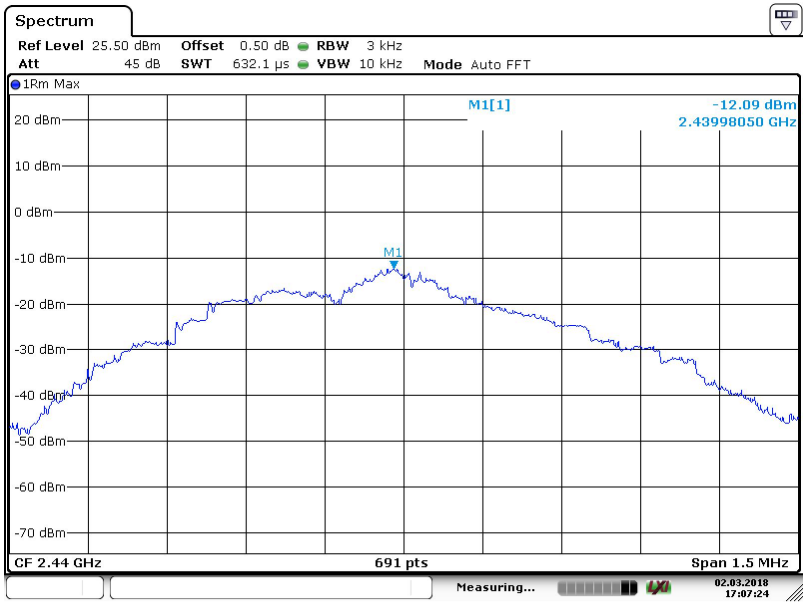
Date: 2.MAR.2018 17:07:53

PSD	Limit
-12.66 dBm	< 8 dBm

Power Spectral Density

EUT: SBC-D04
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC15.247(e)
Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



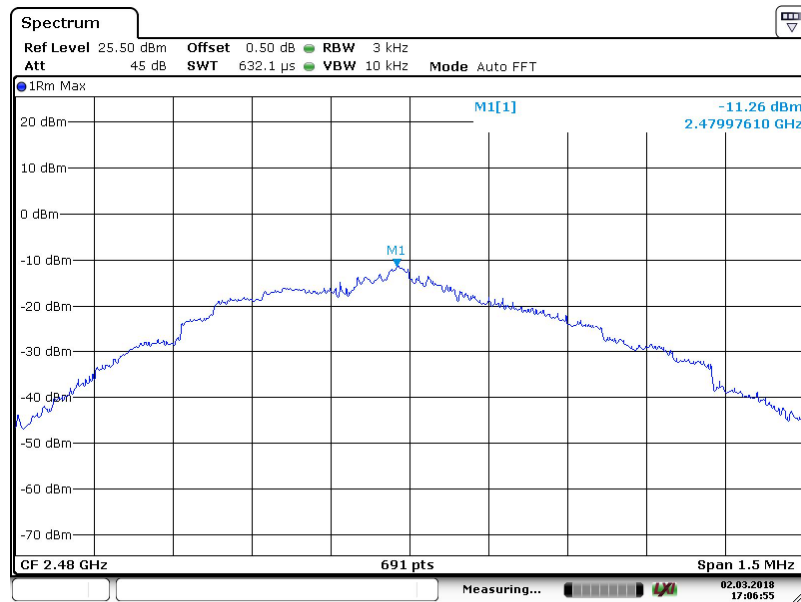
Date: 2.MAR.2018 17:07:24

PSD	Limit
-12.09 dBm	< 8 dBm

Power Spectral Density

EUT: SBC-D04
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.247(e)
Comment: 12 VDC

Test Result
☒ Passed
☐ Not Passed



Date: 2.MAR.2018 17:06:55

PSD	Limit
-11.26 dBm	< 8 dBm

7.8 Antenna Requirement

EUT: SBC-D04
Op Condition: Operated, TX Mode
Test Specification: FCC15.203 & 15.247(b)
Comment: 12 VDC

Test Result	
☒	Passed
☐	Not Passed

Limit

For intentional device, according to FCC Title 47 Part 15.203, 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. And according to FCC Title 47 Part 15.247(b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The antenna used in this product is PCB antenna, and the maximum gain of this antenna is 0.0 dBi.

8 Appendix A - General Product Information

Radiofrequency radiation exposure evaluation

According to KDB 447498 D01v06 section 4.3.1, For frequencies between 100 MHz to 6GHz and test separation distances ≤ 50 mm, the Numeric threshold is determined as:

Step a)

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]
· $[\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR

>> The fundamental frequency of the EUT is 2402-2480MHz,
the test separation distance is ≤ 50 mm.
(Manufacturer specified the separation distance is: 20mm)

Step a)

>> Numeric threshold (2402MHz), $\text{mW} / 20\text{mm} * \sqrt{2.402\text{GHz}} \leq 3.0$
Numeric threshold (2402MHz) $\leq 38.713\text{mW}$

>> Numeric threshold (2440MHz), $\text{mW} / 20\text{mm} * \sqrt{2.440\text{GHz}} \leq 3.0$
Numeric threshold (2440MHz) $\leq 38.411\text{mW}$

>> Numeric threshold (2480MHz), $\text{mW} / 20\text{mm} * \sqrt{2.480\text{GHz}} \leq 3.0$
Numeric threshold (2480MHz) $\leq 38.100\text{mW}$

>> The power of EUT measured (2402MHz) is: $1.01\text{dBm} = 1.262\text{mW}$
The power of EUT measured (2440MHz) is: $1.44\text{dBm} = 1.393\text{mW}$
The power of EUT measured (2480MHz) is: $1.89\text{dBm} = 1.545\text{mW}$

Which is smaller than the Numeric threshold.

Therefore, the device is exempt from stand-alone SAR test requirements.

Appendix A

To: TÜV SÜD HKG Ltd.

Attention: **Mr. Edmond Fung**

From:

Date: May 11, 2018

Fax No:

Total Page (Cover Included): 1

Declaration Letter

Subject:

We: **DAYTON INDUSTRIAL CO., LTD**

Officially notify TÜV SÜD HKG Ltd. that the product LEVO TT HMI, model SBC-D03 has the same technical construction including circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction, with LEVO TT HMI-GPS, model SBC-D04. The only difference lies on that, SBC-D04 has GPS receiving feature, while SBC-D03 not has.

<<Additional Model >>: SBC-D03

<<Main Test Model >>: SBC-D04

<<Product>>: LEVO TT HMI-GPS, LEVO TT HMI

Applicant: DAYTON INDUSTRIAL CO., LTD

11 May 2018

(Date)

(Applicant's authorized signature and company stamp)

Name: LF Wong

Job title: Project Manager