Maximum Permissible Exposure Report

Product Information

EUT	:	CPE
Model Number	:	TR251
Model Declaration	:	All the same except for the model name
Test Model	:	VIMOQ
Power Supply	:	See Table 2.1
Hardware version	:	N/A
Software version	:	V1.1
WiFi		
WLAN	:	Supported IEEE 802.11a/b/g/n
WLAN FCC Operation Frequency	:	IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz / 5180-5240MHz / 5745-5825MHz IEEE 802.11n HT40:2422-2452MHz / 5190-5230MHz / 5755-5795MHz IEEE 802.11a: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT20: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT40: 5190-5230MHz / 5755-5795MHz IEEE 802.11ac VHT80: 5210MHz / 5775MHz
WLAN Channel Number	:	11 Channels for 2412-2462MHz(IEEE 802.11b/g/n HT20) 7 Channels for 2422-2452MHz(IEEE 802.11n HT40) 4 Channels for 5180-5240MHz (IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5190-5230MHz (IEEE 802.11ac VHT40/n HT40) 1 Channels for 5210MHz (IEEE 802.11ac VHT80) 5 Channels for 5745-5825MHz(IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5755-5795MHz(IEEE 802.11ac VHT40/n HT40) 1 Channels for 5775MHz(IEEE 802.11ac VHT80)
WLAN Modulation Technology	:	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Type And Gain	:	Internal Antenna : 5.87dBi(Max.), for TX/RX (WLAN 2.4G Band), 5.96dBi(Max.), for TX/RX (WLAN 5.8G/5.2G Band)
E-UTRA		
E-UTRA FCC Operation Frequency	:	☒FDD Band 4 (UL: 1710 – 1755 MHz/DL: 2110 – 2155 MHz) ☒FDD Band 5 (UL: 824 –849 MHz/DL: 869 –894MHz) ☒FDD Band 7 (UL: 2500 – 2570 MHz/DL: 2620 – 2690 MHz) ☒FDD Band 66 (UL: 1710 –1780 MHz/DL: 2110–2719.9 MHz) ☒NR Band N78 (UL: 3450 –3550 MHz/DL: 3450 –3550 MHz) ☒NR Band N78 (UL: 3700 –3800 MHz/DL: 3700 –3800 MHz)
Channel Separation	:	N/A
Modulation Technology	:	OFDM (16QAM, QPSK)

		Internal Antenna Main Antenna
Antenna Type And Gain	:	FDD Band 4: 4.21dBi FDD Band 5: 3.57dBi FDD Band 7: 4.85dBi FDD Band 66: 4.53dBi NR Band N78: 4.67dBi

Note: Antenna position refer to EUT Photos.

2. Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3. Limit

3. 1 Refer evaluation method

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.
FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.
FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

3. 2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	6
3.0 – 30	1842/f	4.89/f	($900/f^2$)*	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	($180/f^2$)*	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	/	/	f/1500	30
1500 – 100,000	/	/	1.0	30

F=frequency in MHz
*=Plane-wave equivalent power density

4. MPE Calculation Method

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S=power density
P=power input to antenna
G=power gain of the antenna in the direction of interest relative to an isotropic radiator
R=distance to the center of radiation of the antenna

5. Antenna Information

This Product can only use antennas certificated as follows provided by manufacturer;

Antenna Gain and type refer to Product information

6. Conducted Power

2.4G Band:

WiFi 2.4GHz Band

MAIN ANT1

Mode	Frequency (MHz)	Total Power (dBm)	Limit (dBm)	Verdict
b	2412	19.87	30	Pass
b	2437	20.94	30	Pass
b	2462	20.95	30	Pass
g	2412	21.26	30	Pass
g	2437	21.43	30	Pass
g	2462	21.41	30	Pass
n/ax20	2412	21.70	30	Pass
n/ax20	2437	21.90	30	Pass
n/ax20	2462	21.99	30	Pass
n/ax40	2422	21.83	30	Pass
n/ax40	2437	22.03	30	Pass
n/ax40	2452	**22.03**	30	Pass

AUX ANT2

Mode	Frequency (MHz)	Total Power (dBm)	Limit (dBm)	Verdict
b	2412	20.86	30	Pass
b	2437	21.10	30	Pass
b	2462	20.97	30	Pass
g	2412	21.32	30	Pass
g	2437	21.66	30	Pass
g	2462	21.52	30	Pass
n/ax20	2412	22.03	30	Pass
n/ax20	2437	22.35	30	Pass
n/ax20	2462	22.25	30	Pass
n/ax40	2422	22.23	30	Pass
n/ax40	2437	22.34	30	Pass
n/ax40	2452	**22.40**	30	Pass

MIMO Mode

Mode	Frequency (MHz)	Total Power (dBm)	Limit (dBm)	Verdict
n/ax20	2412	24.88	30	Pass
n/ax20	2437	25.14	30	Pass
n/ax20	2462	25.13	30	Pass
n/ax40	2422	25.04	30	Pass
n/ax40	2437	25.20	30	Pass
n/ax40	2452	**25.23**	30	Pass

WiFi 5G Band

Ant1

Band	Channel	Frequency (MHz)	Total Power (dBm)	Limit (dBm)	Verdict
20MHz(IEEE 802.11a/n/ac/ax)-worst					
1	Low	5180	10.94	24	Pass
	High	5240	11.09	24	Pass
2	Low	5260	11.84	24	Pass
	High	5320	13.06	24	Pass
3	Low	5500	12.67	24	Pass
	High	5700	18.58	24	Pass
4	Low	5745	11.83	30	Pass
	High	5825	**12.46**	30	Pass
40MHz(IEEE 802.11n/ac/ax)-worst					
1	Low	5190	10.83	24	Pass
	High	5230	**11.36**	24	Pass
2	Low	5270	11.91	24	Pass
	High	5310	**13.13**	24	Pass
3	Low	5510	13.31	24	Pass
	High	5670	**18.71**	24	Pass
4	Low	5755	11.73	30	Pass
	High	5795	11.05	30	Pass
80MHz(IEEE 802.11ac/ax)-worst					
1	Low	5210	10.96	24	Pass
2	Low	5290	12.52	24	Pass
3	Low	5530	12.65	24	Pass
	High	5610	17.41	24	Pass
4	Low	5775	10.74	30	Pass

Ant2

Band	Channel	Frequency (MHz)	Total Power (dBm)	Limit (dBm)	Verdict
20MHz(IEEE 802.11a/n/ac/ax)-worst					
1	Low	5180	11.11	24	Pass
	High	5240	11.23	24	Pass
2	Low	5260	11.55	24	Pass
	High	5320	12.08	24	Pass
3	Low	5500	11.01	24	Pass
	High	5700	**16.81**	24	Pass
4	Low	5745	**11.3**	30	Pass
	High	5825	10.44	30	Pass
40MHz(IEEE 802.11n/ac/ax)-worst					
1	Low	5190	11.24	24	Pass
	High	5230	**11.38**	24	Pass
2	Low	5270	11.7	24	Pass
	High	5310	**12.23**	24	Pass
3	Low	5510	10.93	24	Pass
	High	5670	16.2	24	Pass
4	Low	5755	11.29	30	Pass
	High	5795	11.25	30	Pass
80MHz(IEEE 802.11ac/ax)-worst					
1	Low	5210	10.51	24	Pass
2	Low	5290	11.12	24	Pass
3	Low	5530	10.35	24	Pass
	High	5610	14.98	24	Pass
4	Low	5775	10.65	30	Pass

LTE/NR
refer to WSCT-A2LA-R&E230700012A-RF Report.

7. Manufacturing Tolerance

WiFi 2.4GHz Band – Antenna 1

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	19.5	20.5	20.5
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20/ax20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	21.0	21.5	21.5
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40/ax40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	21.5	21.5	21.5
Tolerance ±(dB)	1.0	1.0	1.0

WiFi 2.4GHz Band – Antenna 1

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	20.5	21.0	20.5
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40/ax40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0

WiFi 5G Band - Antenna 1

20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5180	5240	5260
Target (dBm)	11.0	11.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5320	5500	5700
Target (dBm)	13.0	13.0	19.0
Tolerance ±(dB)	1.0	1.0	1.0
20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5745	5825	
Target (dBm)	12.0	12.0	
Tolerance ±(dB)	1.0	1.0	
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5190	5230	5270
Target (dBm)	11.0	11.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5310	5510	5670
Target (dBm)	13.0	13.0	19.0
Tolerance ±(dB)	1.0	1.0	1.0
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5755	5795	--
Target (dBm)	12.0	11.0	--
Tolerance ±(dB)	1.0	1.0	--
80MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5210	5290	5530
Target (dBm)	11.0	13.0	13.0
Tolerance ±(dB)	1.0	1.0	1.0
80MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5610	5775	--
Target (dBm)	18.0	11.0	--
Tolerance ±(dB)	1.0	1.0	--

UNII-1 Band – Antenna 1

20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5180	5240	5260
Target (dBm)	11.0	11.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5320	5500	5700
Target (dBm)	12.0	11.0	17.0
Tolerance ±(dB)	1.0	1.0	1.0
20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5745	5825	
Target (dBm)	11.0	11.0	
Tolerance ±(dB)	1.0	1.0	
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5190	5230	5270
Target (dBm)	11.0	11.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5310	5510	5670
Target (dBm)	12.0	11.0	16.0
Tolerance ±(dB)	1.0	1.0	1.0
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5755	5795	--
Target (dBm)	11.0	11.0	--
Tolerance ±(dB)	1.0	1.0	--
80MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5210	5290	5530
Target (dBm)	11.0	11.0	10.0
Tolerance ±(dB)	1.0	1.0	1.0
80MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5610	5775	--
Target (dBm)	15.0	11.0	--
Tolerance ±(dB)	1.0	1.0	--

UNII-1 Band –MIMO Mode

20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5180	5240	5260
Target (dBm)	14.0	14.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5320	5500	5700
Target (dBm)	16.0	15.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
20MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5745	5825	
Target (dBm)	15.0	15.0	
Tolerance ±(dB)	1.0	1.0	
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5190	5230	5270
Target (dBm)	14.0	14.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5310	5510	5670
Target (dBm)	16.0	15.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0
40MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5755	5795	--
Target (dBm)	15.0	14.0	--
Tolerance ±(dB)	1.0	1.0	--
80MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5210	5290	5530
Target (dBm)	14.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
80MHz IEEE 802.11a/n/ac/ax (Maximum)			
Frequency(MHz)	5610	5775	--
Target (dBm)	20.0	14.0	--
Tolerance ±(dB)	1.0	1.0	--

LTE

Band	Mode	Target Power		
		1RB	50%RB	100%RB
4	QPSK	23.0± 2	23.0± 2	23.0± 2
	16QAM	23.0± 2	23.0± 2	23.0± 2
5	QPSK	23.0± 2	23.0± 2	23.0± 2
	16QAM	23.0± 2	23.0± 2	23.0± 2
7	QPSK	23.0± 2	23.0± 2	23.0± 2
	16QAM	23.0± 2	23.0± 2	23.0± 2
66	QPSK	23.0± 2	23.0± 2	23.0± 2
	16QAM	23.0± 2	23.0± 2	23.0± 2

NR

Band	Mode	Target Power		
		1RB	50%RB	100%RB
N78(3450 –3550 MHz)	QPSK	23.0± 2	23.0± 2	23.0± 2
	16QAM	23.0± 2	23.0± 2	23.0± 2
N78(3450 –3550 MHz)	QPSK	23.0± 2	23.0± 2	23.0± 2
	16QAM	23.0± 2	23.0± 2	23.0± 2

8. Measurement Results

8.1 Standalone MPE

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

WiFi 2.4GHz Band – Ant 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
IEEE 802.11b	21.5	141.2538	5.87	3.8637	0.1086	1.0000
IEEE 802.11g	22.0	158.4893	5.87	3.8637	0.1219	1.0000
IEEE 802.11n HT20	22.5	177.8279	5.87	3.8637	0.1368	1.0000
IEEE 802.11n HT40	22.5	177.8279	5.87	3.8637	0.1368	1.0000

WiFi 2.4GHz Band – Ant 2

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
IEEE 802.11b	22.0	158.4893	5.87	3.8637	0.1219	1.0000
IEEE 802.11g	22.0	158.4893	5.87	3.8637	0.1219	1.0000
IEEE 802.11n HT20	23.0	199.5262	5.87	3.8637	0.1534	1.0000
IEEE 802.11n HT40	23.0	199.5262	5.87	3.8637	0.1534	1.0000

UNII-1 Band – Ant 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
20MHz IEEE 802.11a/n/ac/ax	20.0	100.0000	5.96	3.9446	0.0785	1.0000
40MHz IEEE 802.11a/n/ac/ax	20.0	100.0000	5.96	3.9446	0.0785	1.0000
80MHz IEEE 802.11a/n/ac/ax	19.0	79.4328	5.96	3.9446	0.0624	1.0000

UNII-1 Band – Ant 2

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
20MHz IEEE 802.11a/n/ac/ax	18.0	63.0957	5.96	3.9446	0.0495	1.0000
40MHz IEEE 802.11a/n/ac/ax	17.0	50.1187	5.96	3.9446	0.0394	1.0000
80MHz IEEE 802.11a/n/ac/ax	16.0	39.8107	5.96	3.9446	0.0313	1.0000

LTE

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
Band4	25.00	316.2278	4.21	2.6363	0.1659	1.0000
Band5	25.00	316.2278	3.57	2.2751	0.1432	0.5493
Band7	25.00	316.2278	4.85	3.0549	0.1923	1.0000
Band66	25.00	316.2278	4.53	2.8379	0.1786	1.0000

NR

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
N78(3450 –3550 MHz)	25.00	316.2278	4.67	2.9309	0.1845	1.0000
N78(3700 –3800 MHz)	25.00	316.2278	4.67	2.9309	0.1845	1.0000

Remark:
1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

8.2 Simultaneous Transmission MPE

LTE + Bluetooth + Wi-Fi

Maximum MPE Ratio LTE Ant.	Maximum MPE Ratio NR Ant.	Maximum MPE Ratio WIFI Ant.1	Maximum MPE Ratio WIFI Ant.2	∑MPE	Limit	Results
0.2607	0.1845	0.1368	0.1534	0.7354	1.0000	PASS

Remark:
1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

----------THE END OF REPORT----------