

Maximum Permissible Exposure Report

1. Product Information

FCCID	: 2AU8X-ST156
EUT	: All-in-one Tablet
Test Model	: ST156
Additional Model No.	: ST116, ST185, ST215, ST320, ST430, ST550, ST101M, ST116M, ST156M
Model Declaration	: PCB board, structure and internal of these model(s) are the same, So no additional models were tested.
Power Supply	: DC 12V/3.33A by AC ADAPTOR ADAPTOR INPUT: AC 100-240V, 50/60Hz, 1.1A Max
Hardware Version	: V1.X
Software Version	: A4R-ScalaST-Tab-RK3399-1.0.1-final+20191106.091858
Bluetooth	:
Frequency Range	: 2402MHz ~ 2480MHz
Channel Number	: 79 channels for Bluetooth V4.0 (DSS) 40 channels for Bluetooth V4.0 (DTS)
Channel Spacing	: 1MHz for Bluetooth V4.0 (DSS) 2MHz for Bluetooth V4.0 (DTS)
Modulation Type	: GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth V4.0 (DSS) GFSK for Bluetooth V4.0 (DTS)
Bluetooth Version	: V4.0
2.4G WLAN	:
Frequency Range	: 2412MHz ~ 2462 MHz
Channel Spacing	: 5MHz
Channel Number	: 11 channels for 20MHz bandwidth (2412~2462MHz)
Modulation Type	: IEEE 802.11b: DSSS (CCK,DQPSK,DBPSK); IEEE 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
5.2G WLAN	:
Frequency Range	: 5180MHz-5240MHz 4 Channels for 20MHz bandwidth(5180-5240MHz)
Channel Number	: 2 channels for 40MHz bandwidth(5190~5230MHz) 1 Channels for 80MHz bandwidth(5210MHz)
Modulation Type	: IEEE 802.11a/n/ac: OFDM (64QAM, 16QAM, QPSK, BPSK)
5.3G WLAN	:
Frequency Range	: 5260MHz-5320MHz 4 channels for 20MHz bandwidth (5260-5320MHz)
Channel Number	: 2 channels for 40MHz bandwidth (5270~5310MHz) 1 channels for 80MHz bandwidth (5290MHz)
Modulation Type	: IEEE 802.11a/n/ac: OFDM (64QAM, 16QAM, QPSK, BPSK)
5.5G WLAN	:
Frequency Range	: 5500MHz-5700MHz

Channel Number : 11 channels for 20MHz bandwidth (5500-5700MHz)
: 5 channels for 40MHz bandwidth (5510~5670MHz)
: 3 Channels for 80MHz bandwidth(5530-5690MHz)

Modulation Type : IEEE 802.11a/n/ac: OFDM (64QAM, 16QAM, QPSK, BPSK)

5.8G WLAN :

Frequency Range : 5745-5825MHz

Channel Number : 5 channels for 20MHz bandwidth(5745-5825MHz)
: 2 channels for 40MHz bandwidth(5755~5795MHz)
: 1 channels for 80MHz bandwidth(5775MHz)

Modulation Type : IEEE 802.11a/n/ac: OFDM (64QAM, 16QAM, QPSK, BPSK)

Antenna Description : External Antenna, used for WIFI/Bluetooth TX/RX, 4.5dBi(Max.)

Exposure category : General population/uncontrolled environment

EUT Type : Production Unit

Device Type : Mobile Device

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 C95.1-2019](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz 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

ST156 can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna	2.4G/5G Wifi	External Antenna	2.4GHz – 2.5 GHz 5GHz – 6 GHz	4.5 dBi

6. Conducted Power

6.1 Test Setup Block Diagram



6.2 Test Procedure

- 1) The EUT was directly connected to the power meter and antenna output port as show in the Block diagram;
- 2) Reading average power in RMS detector.

6.3 Measurement Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1	Power Meter	R&S	NRVS	100444	2019-06-11	2020-06-10
2	Power Sensor	R&S	NRV-Z32	10057	2019-06-11	2020-06-10

[Bluetooth]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	0	2402	3.656
	39	2441	2.187
	78	2480	1.702
$\pi/4$ DQPSK	0	2402	1.372
	39	2441	-0.037
	78	2480	-1.076
8DPSK	0	2402	1.692
	39	2441	0.242
	78	2480	-0.731
BT-LE	0	2402	3.165
	19	2440	1.66
	39	2480	1.132

[2.4GHz WLAN]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
IEEE 802.11b	1	2412	17.29
	6	2437	16.68
	11	2462	16.24
IEEE 802.11g	1	2412	16.91
	6	2437	16.32
	11	2462	15.6
IEEE 802.11n HT20	1	2412	15.25
	6	2437	14.87
	11	2462	14.15

[5.2G WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	36	5180	11.27
	40	5200	11.73
	48	5240	12.12
IEEE 802.11n HT20	36	5180	11.09
	40	5200	11.39
	48	5240	11.7
IEEE 802.11n HT40	38	5190	11.45
	46	5230	11.87
IEEE 802.11ac VHT20	36	5180	10.94
	40	5200	11.38
	48	5240	11.82
IEEE 802.11ac VHT40	38	5190	11.4
	46	5230	11.87
IEEE 802.11ac VHT80	42	5210	11.72

[5.3G WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	52	5260	11.15
	56	5280	10.69
	64	5320	9.07
IEEE 802.11n HT20	52	5260	10.93
	56	5280	10.27
	64	5320	8.74
IEEE 802.11n HT40	54	5270	10.32
	62	5310	9.12
IEEE 802.11ac VHT20	52	5260	10.36
	56	5280	10.35
	64	5320	8.73
IEEE 802.11ac VHT40	54	5270	10.21
	62	5310	9.04
IEEE 802.11ac VHT80	58	5290	10.36

[5.5G WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	100	5500	8.38
	120	5600	10.46
	140	5700	7.8
IEEE 802.11n HT20	100	5500	8.22
	120	5600	10.13
	140	5700	7.45
IEEE 802.11n HT40	149	5510	8.53
	157	5590	10.35
	165	5670	8.29
IEEE 802.11ac VHT20	100	5500	8.38
	120	5600	10
	140	5700	7.62
IEEE 802.11ac VHT40	149	5510	8.73
	157	5590	10.34
	165	5670	8.37
IEEE 802.11ac VHT80	106	5530	9.93
	122	5610	9.78
	138	5690	8.37

[5.8G WLAN]

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a	149	5745	7.92
	157	5785	7.64
	165	5825	7.67
IEEE 802.11n HT20	149	5745	7.53
	157	5785	7.18
	165	5825	7.35
IEEE 802.11n HT40	151	5755	7.6
	159	5795	7.44
IEEE 802.11ac VHT20	149	5745	10.94
	157	5785	11.38
	165	5825	11.82
IEEE 802.11ac VHT40	151	5755	11.4
	159	5795	11.87
IEEE 802.11ac VHT80	155	5775	7.93

7. Manufacturing Tolerance

Bluetooth

GFSK			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	3.0	2.0	1.0
Tolerance \pm (dB)	1.0	1.0	1.0
$\pi/4$ DQPSK			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	1.0	-1.0	-1.0
Tolerance \pm (dB)	1.0	1.0	1.0
8DPSK			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	1.0	0.0	-1.0
Tolerance \pm (dB)	1.0	1.0	1.0
BT LE			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	3.0	1.0	1.0
Tolerance \pm (dB)	1.0	1.0	1.0

2.4GHz WLAN

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	17.0	16.0	16.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16.0	16.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.0	14.0	14.0
Tolerance \pm (dB)	1.0	1.0	1.0

5.2G WLAN

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.0	11.0	12.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	11.0	11.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	11.0	11.0	
Tolerance \pm (dB)	1.0	1.0	
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	10.0	11.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	11.0	11.0	
Tolerance \pm (dB)	1.0	1.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42		
Target (dBm)	11.0		
Tolerance \pm (dB)	1.0		

5.3G WLAN

<i>IEEE 802.11a (Average)</i>			
Channel	Channel 36	Channel 56	Channel 64
Target (dBm)	11.0	10.0	9.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11n HT20 (Average)</i>			
Channel	Channel 36	Channel 56	Channel 64
Target (dBm)	10.0	10.0	8.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11n HT40 (Average)</i>			
Channel	Channel 54	Channel 62	
Target (dBm)	10.0	9.0	
Tolerance \pm (dB)	1.0	1.0	
<i>IEEE 802.11ac VHT20 (Average)</i>			
Channel	Channel 36	Channel 56	Channel 64
Target (dBm)	10.0	10.0	8.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11ac VHT40 (Average)</i>			
Channel	Channel 54	Channel 62	
Target (dBm)	10.0	9.0	
Tolerance \pm (dB)	1.0	1.0	
<i>IEEE 802.11ac VHT80 (Average)</i>			
Channel	Channel 58		
Target (dBm)	10.0		
Tolerance \pm (dB)	1.0		

5.5G WLAN

<i>IEEE 802.11a (Average)</i>			
Channel	Channel 100	Channel 120	Channel 140
Target (dBm)	8.0	10.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11n HT20 (Average)</i>			
Channel	Channel 100	Channel 120	Channel 140
Target (dBm)	8.0	10.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11n HT40 (Average)</i>			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	8.0	10.0	8.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11ac VHT20 (Average)</i>			
Channel	Channel 100	Channel 120	Channel 140
Target (dBm)	8.0	10.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11ac VHT40 (Average)</i>			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	8.0	10.0	8.0
Tolerance \pm (dB)	1.0	1.0	1.0
<i>IEEE 802.11ac VHT80 (Average)</i>			
Channel	Channel 106	Channel 122	Channel 138
Target (dBm)	9.0	9.0	8.0
Tolerance \pm (dB)	1.0	1.0	1.0

5.8G WLAN

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	7.0	7.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	7.0	7.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	7.0	7.0	
Tolerance \pm (dB)	1.0	1.0	
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	10.0	11.0	11.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	11.0	11.0	
Tolerance \pm (dB)	1.0	1.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155		
Target (dBm)	7.0		
Tolerance \pm (dB)	1.0		

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, $r=20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Bluetooth

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
GFSK	4.0	2.5119	4.5	2.8184	0.001409	1.0000
$\pi/4$ DQPSK	2.0	1.5849	4.5	2.8184	0.000889	1.0000
8DPSK	2.0	1.5849	4.5	2.8184	0.000889	1.0000
BT LE	4.0	2.5119	4.5	2.8184	0.001409	1.0000

2.4GHz WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)	MPE Limits (mW/cm^2)
	dBm	mW				
IEEE 802.11b	18.0	63.0957	4.5	2.8184	0.035396	1.0000
IEEE 802.11g	17.0	50.1187	4.5	2.8184	0.028116	1.0000
IEEE 802.11n HT20	16.0	39.8107	4.5	2.8184	0.022333	1.0000

5.2G WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	13.0	19.9526	4.5	2.8184	0.011193	1.0000
IEEE 802.11n HT20	12.0	15.8489	4.5	2.8184	0.008891	1.0000
IEEE 802.11n HT40	12.0	15.8489	4.5	2.8184	0.008891	1.0000
IEEE 802.11ac VHT20	12.0	15.8489	4.5	2.8184	0.008891	1.0000
IEEE 802.11ac VHT40	12.0	15.8489	4.5	2.8184	0.008891	1.0000
IEEE 802.11ac VHT80	12.0	15.8489	4.5	2.8184	0.008891	1.0000

5.3G WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	12.0	15.8489	4.5	2.8184	0.008891	1.0000
IEEE 802.11n HT20	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11n HT40	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11ac VHT20	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11ac VHT40	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11ac VHT80	11.0	12.5893	4.5	2.8184	0.007062	1.0000

5.5G WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11n HT20	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11n HT40	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11ac VHT20	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11ac VHT40	11.0	12.5893	4.5	2.8184	0.007062	1.0000
IEEE 802.11ac VHT80	10.0	10.0000	4.5	2.8184	0.005610	1.0000

5.8G WLAN

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	8.0	6.3096	4.5	2.8184	0.003540	1.0000
IEEE 802.11n HT20	8.0	6.3096	4.5	2.8184	0.003540	1.0000
IEEE 802.11n HT40	8.0	6.3096	4.5	2.8184	0.003540	1.0000
IEEE 802.11ac VHT20	12.0	15.8489	4.5	2.8184	0.008891	1.0000
IEEE 802.11ac VHT40	12.0	15.8489	4.5	2.8184	0.008891	1.0000
IEEE 802.11ac VHT80	8.0	6.3096	4.5	2.8184	0.003540	1.0000

Remark:

1. Output power (Average) including turn-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer.

8.2 Simultaneous Transmission MPE

The sample only support one modular and one antenna, no need consider simultaneous transmission;

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-----