



RF Exposure evaluation

**Test report
On Behalf of
Sweam AB
For
Sweam
Model No.: EN01-180515**

FCC ID: 2AQJUN01-180515

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1.1 Applicable Standard

According to §1.1307(b)(1), systems operating under the provisions of this 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.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

1.2 Requirement

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 modeled 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.

1.3 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

Manufacturing tolerance

GSM Speech

GSM 850 (GMSK) (Burst Average Power)			
Channel	Channel 128	Channel 190	Channel 251
Target (dBm)	31.50	31.50	31.50
Tolerance ±(dB)	1.0	1.0	1.0
GSM 1900 (GMSK) (Burst Average Power)			
Channel	Channel 512	Channel 661	Channel 810
Target (dBm)	29.50	29.50	29.50
Tolerance ±(dB)	1.0	1.0	1.0

GSM 850 GPRS (GMSK) (Burst Average Power)				
Channel		128	190	251
1 Txslot	Target (dBm)	31.50	31.50	31.50
	Tolerance ±(dB)	1.0	1.0	1.0
2 Txslot	Target (dBm)	30.0	30.0	30.2
	Tolerance ±(dB)	1.0	1.0	1.0
3 Txslot	Target (dBm)	28.0	28.0	28.0
	Tolerance ±(dB)	1.0	1.0	1.0
4 Txslot	Target (dBm)	27.0	27.0	27.0



	Tolerance \pm (dB)	1.0	1.0	1.0
GSM 1900 GPRS (GMSK) (Burst Average Power)				
Channel		512	661	810
1 Txslot	Target (dBm)	29.50	29.50	29.50
	Tolerance \pm (dB)	1.0	1.0	1.0
2 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance \pm (dB)	1.0	1.0	1.0
3 Txslot	Target (dBm)	26.0	26.0	26.0
	Tolerance \pm (dB)	1.0	1.0	1.0
4 Txslot	Target (dBm)	25.0	25.0	25.0
	Tolerance \pm (dB)	1.0	1.0	1.0

UMTS

UMTS Band V				
Channel	Channel 4132	Channel 4182	Channel 4233	
Target (dBm)	22.5	22.5	22.5	
Tolerance \pm (dB)	1.0	1.0	1.0	
UMTS Band V HSDPA(sub-test 1)				
Channel	Channel 4132	Channel 4182	Channel 4233	
Target (dBm)	22.0	22.0	22.0	
Tolerance \pm (dB)	1.0	1.0	1.0	
UMTS Band V HSDPA(sub-test 2)				
Channel	Channel 4132	Channel 4182	Channel 4233	
Target (dBm)	22.0	22.0	22.0	
Tolerance \pm (dB)	1.0	1.0	1.0	
UMTS Band V HSDPA(sub-test 3)				
Channel	Channel 4132	Channel 4182	Channel 4233	
Target (dBm)	22.0	22.0	22.0	
Tolerance \pm (dB)	1.0	1.0	1.0	
UMTS Band V HSDPA(sub-test 4)				
Channel	Channel 4132	Channel 4182	Channel 4233	
Target (dBm)	21.0	21.0	21.0	
Tolerance \pm (dB)	1.0	1.0	1.0	
UMTS Band V HSUPA(sub-test 1)				
Channel	Channel 4132	Channel 4182	Channel 4233	
Target (dBm)	20.50	20.50	20.50	
Tolerance \pm (dB)	1.0	1.0	1.0	
UMTS Band V HSUPA(sub-test 2)				
Channel	Channel 4132	Channel 4182	Channel 4233	



Target (dBm)	20.0	20.2	20.2
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 3)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	20.5	20.5	20.5
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 4)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	20.0	20.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 5)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	20.50	20.50	20.50
Tolerance ±(dB)	1.0	1.0	1.0

UMTS Band 2			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.5	22.5	22.5
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band 2 HSDPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band 2 HSDPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band 2 HSDPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band 2 HSDPA(sub-test 4)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.5	21.5	21.5
Tolerance ±(dB)	1.0	1.0	1.0
UMTS Band 2 HSUPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0



Tolerance \pm (dB)	1.0	1.0	1.0
UMTS Band 2 HSUPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	20.0	20.0	20.0
Tolerance \pm (dB)	1.0	1.0	1.0
UMTS Band 2 HSUPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	221.0
Tolerance \pm (dB)	1.0	1.0	1.0
UMTS Band 2 HSUPA(sub-test 4)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	20.0	20.0	20.0
Tolerance \pm (dB)	1.0	1.0	1.0
UMTS Band 2 HSUPA(sub-test 5)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0
Tolerance \pm (dB)	1.0	1.0	1.0

LTE

LTE Band 2			
Channel	Channel 19100	Channel 18900	Channel 18700
Target (dBm)	22	22	22
Tolerance \pm (dB)	1.0	1.0	1.0
LTE Band 7			
Channel	Channel 20300	Channel 20175	Channel 20050
Tune-up(dB)	22	22	22
Tolerance \pm (dB)	1.0	1.0	1.0

LTE MP R will follow up 3GPP settings as below:

Modulation	Channel bandwidth / Transmission bandwidth (NRB)						MP R (dB)
	1.4MHz	3.0MHz	5MHz	10MHz	15MHz	20MHz	
QPSK	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	0
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	2

**2.4G WiFi**

IEEE 802.11b (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	7.0	7.0	7.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	6.0	6.0	6.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	4.50	4.50	4.50
Tolerance \pm (dB)	1.0	1.0	1.0

5G WiFi (5150-5250)

IEEE 802.11a (Average)			
Channel	Channel 5180	Channel 5200	Channel 5240
Target (dBm)	16.0	16.0	16.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 5180	Channel 5200	Channel 5240
Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 5190	Channel 5230	
Target (dBm)	15.0	15.0	
Tolerance \pm (dB)	1.0	1.0	

5G WiFi (5725-5850)

IEEE 802.11a (Average)			
Channel	Channel 5745	Channel 5785	Channel 5825
Target (dBm)	16.0	16.0	16.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 5745	Channel 5785	Channel 5825



Target (dBm)	15.0	15.0	15.0
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 5755	Channel 5795	
Target (dBm)	15.0	15.0	
Tolerance \pm (dB)	1.0	1.0	

Bluetooth

GFSK (Average)			
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 (Average)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0.0	0.0	0.0
Tolerance \pm (dB)	1.0	1.0	1.0
π/4DQPSK (Average)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0.0	0.0	0.0
Tolerance \pm (dB)	1.0	1.0	1.0
BLE (Average)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-3.0	-3.0	-3.0
Tolerance \pm (dB)	1.0	1.0	1.0



1.5 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

As declared by the Applicant, the EUT transmits with the maximum source-based Duty Cycle of 100%-see the User manual, and the EUT is a wireless device used in a mobile application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum mobile separation distance, $r = 20\text{cm}$, as well as the gain of the used antenna is 1.00 dBi for 2.4GWLAN/BT, the gain of the used antenna is 2.00 dBi for 5.2GWLAN/5.8GWLAN. the gain of the used antenna is -0.85dBi for GSM850. the gain of the used antenna is -1.07dBi for GSM1900. the gain of the used antenna is -0.85dBi for WCDMA Band 5. the gain of the used antenna is -1.01dBi for WCDMA Band 2, the gain of the used antenna is -1.01dBi for LTE Band 2. the gain of the used antenna is -1.26dBi for LTE Band 7 and the power drift from Turn-up Procedure provide by manufacturer as following states, the RF power density can be obtained..



1.6 Evaluation Result

1.6.1 Standalone MPE

Mode	Minimum Separation Distance (cm)	Output Power (Turn-up Procedure)		Antenna Gain (Numeric)	Power Density At 20 cm (mW/cm ²)	Power Density Limit (mW/cm ²)	Test Results
		dBm	mW				
2.4G WIFI	20.00	9.0	7.943	1.259	0.0020	1.0000	PASS
2.4G BT	20.00	2.0	1.585	1.259	0.0004	1.0000	PASS
5.2G WIFI	20.00	17.0	50.119	1.585	0.0158	1.0000	PASS
5.8G WIFI	20.00	17.0	50.119	1.585	0.0158	1.0000	PASS
GSM850	20.00	32.50	1778.279	0.822	0.2910	0.5495	PASS
GSM1900	20.00	30.50	1122.018	0.782	0.1746	1.0000	PASS
WCDMA Band 2	20.00	23.50	223.872	0.793	0.0353	1.0000	PASS
WCDMA Band 5	20.00	23.50	223.872	0.822	0.0366	0.5509	PASS
LTE Band 2	20.00	23.0	199.526	0.793	0.0315	1.0000	PASS
LTE Band 7	20.00	23.0	199.526	0.748	0.0297	1.0000	PASS

1.6.2 Simultaneous transmission MPE Considerations

According to KDB447498 :For mobile exposure host platform to qualify for simultaneous transmission MPE test exclusion, all transmitters and antennas in the host must be either evaluated for MPE compliance, by measurement or computational modeling, or qualify for the standalone MPE test exclusion in section 7.1.

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 modeled or measured field strengths or power density, is ≤ 1.0 .

This means that:

\sum of MPE ratios ≤ 1.0



The GSM/WCDMA/LTE share an ANT,So GSM/WCDMA/LTE can not Simultaneous transmitting.

The WIFI/BT share an ANT,So WIFI/BT can not Simultaneous transmitting.

$$\text{Power density(max GSM/WCDMA/LTE)+ Power density(max WIFI/BT)=} \\ 0.0366+0.0158=0.524 < 1$$

So the Simultaneous transmission of the GSM/WCDMA/LTE and WIFI/BT conform the requirements

1.7Conclusion

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

.....**End of Report**.....