Maximum Permissible Exposure Report

1. Product Information

Name of EUT	Digital radio
Model No.	S6, S1, MDL, GDL20, N80, N80T, N80P
Model Declaration	PCB board, structure and internal of these model(s) are the same, so no additional models were tested
Test Model	S6
Power Supply	DC 9-16V by external power
Hardware version	Beaver7_35w_v1r2
Software version	1.09.190524.RG60GL.CUS
BT FCC Operation frequency	2402-2480MHz
BT FCC Modulation Type	GFSK, π/4-DQPSK, 8-DPSK
Bluetooth Version	V3.0
Antenna Type	Ceramic Antenna
Antenna Gain	2.0dBi (max.) for Bluetooth
WLAN FCC Operation frequency	IEEE 802.11b/g/n HT20:2412-2462MHz
WLAN FCC Modulation Type	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g/n: OFDM(64QAM, 16QAM, QPSK, BPSK)
Antenna Type	Ceramic Antenna
Antenna Gain	2.0dBi (max.) for WLAN
PMR FCC Operation frequency	410.125-469.625MHz
Channel Separation	25KHz
Modulation Type	GMSK
Emission Designator	16K0G1D for GMSK Modulation at 25KHz Channel Separation
Rate Power	30W/20W/10W
Antenna Type	SMA Antenna
Antenna Gain	5.0dBi (max.) for PMR
Extreme temp. Tolerance	-20°C to +55°C
Extreme Voltage Tolerance	DC 9V to 16V
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.

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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/cm²)	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/f²)*	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/cm²)	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/f²)*	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

The EUT can only use antennas certificated as follows provided by manufacturer;

External Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 0	Internal Antenna	600 MHz – 2500 MHz	2.0dBi (max.) For WLAN&Bluetooth
Antenna 1	External Antenna	400 MHz – 500 MHz	5.0dBi (max.) For PMR

6. Conducted Power

General Note:
1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing, further SAR test reduction and MPE.

<Bluetooth Max. Conducted Power>

Test Mode		Channel	Frequency (MHz)	Max. Conducted Power (dBm)
Bluetooth Classic	GFSK	LCH	2402	1.836
		MCH	2441	2.674
		HCH	2480	2.516
	π/4-DQPSK	LCH	2402	1.272
		MCH	2441	2.092
		HCH	2480	1.936
	8-DPSK	LCH	2402	1.359
		MCH	2441	2.218
		HCH	2480	2.050

<2.4GWLAN Max. Conducted Power>

Test Mode		Channel	Frequency (MHz)	Max. Conducted Power (dBm)
2.4GWLAN	IEEE 802.11b	LCH	2412	18.08
		MCH	2437	18.25
		HCH	2462	18.70
	IEEE 802.11g	LCH	2412	17.31
		MCH	2437	17.86
		HCH	2462	17.44
	IEEE 802.11n HT20	LCH	2412	16.62
		MCH	2437	16.06
		HCH	2462	16.77

<PMR Max. Conducted Power>

Test Mode	Channel Separation	Rate Power	Channel	Frequency (MHz)	Max. Conducted Power (dBm)
GMSK	25KHz	High	LCH	410.125	44.253
			MCH	456.125	44.442
			HCH	469.625	44.479
		Low	LCH	410.125	39.712
			MCH	456.125	39.876
			HCH	469.625	39.877

7. Manufacturing Tolerance

<Bluetooth>

Test Mode		Channel	Max. Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
Bluetooth Classic	GFSK	LCH	1.836	2±1.0
		MCH	2.674	2±1.0
		HCH	2.516	2±1.0
	π/4-DQPSK	LCH	1.272	2±1.0
		MCH	2.092	2±1.0
		HCH	1.936	2±1.0
	8-DPSK	LCH	1.359	2±1.0
		MCH	2.218	2±1.0
		HCH	2.050	2±1.0

<2.4GWLAN>

Test Mode		Channel	Max. Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
2.4GWLAN	IEEE 802.11b	LCH	18.08	18.0±1.0
		MCH	18.25	18.0±1.0
		HCH	18.70	18.0±1.0
	IEEE 802.11g	LCH	17.31	17.0±1.0
		MCH	17.86	17.0±1.0
		HCH	17.44	17.0±1.0
	IEEE 802.11n HT20	LCH	16.62	16.0±1.0
		MCH	16.06	16.0±1.0
		HCH	16.77	16.0±1.0

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<PMR>

Modulation Type	Channel Separation	Rate Power	Channel	Max. Conducted Power (dBm)	ANT Max. Tune Up Power (dBm)
GMSK	25KHz	High	LCH	44.253	44±1.0
			MCH	44.442	44±1.0
			HCH	44.479	44±1.0
		Low	LCH	39.712	39±1.0
			MCH	39.876	39±1.0
			HCH	39.877	39±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 100cm for BT&WLAN, 5m for PMR from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =100cm for BT and WLAN, 5.0m for PMR as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm²)	MPE Limits (mW/cm²)
	dBm	mW				
BT Classic GFSK	3.00	1.9953	2.0000	1.5849	0.0000	1.0000
BT Classic π/4-DQPSK	3.00	1.9953	2.0000	1.5849	0.0000	1.0000
BT Classic 8-DPSK	3.00	1.9953	2.0000	1.5849	0.0000	1.0000
IEEE 802.11b	19.00	79.4328	2.0000	1.5849	0.0010	1.0000
IEEE 802.11g	18.00	63.0957	2.0000	1.5849	0.0008	1.0000
IEEE 802.11n HT20	17.00	50.1187	2.0000	1.5849	0.0006	1.0000

Antenna 1

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm²)	MPE Limits (mW/cm²)
	dBm	mW				
GMSK (410-470MHz)	45.00	31622.7766	5.0000	3.1623	0.0160	0.2733

Remark:
1. Output power including turn-up tolerance;
2. Output power is burst average power;
3. MPE evaluate distance is 100cm for BT&WLAN and 5m for PMR from user manual provide by manufacturer;
4. MPE values = PG/4πR²
5. MPE limits for PMR refer 410MHz as it is lowest frequency.

8.2 Simultaneous Transmission MPE

The 2.4GWLAN and Bluetooth share the same antenna, so no need consider simultaneous transmission;
The PMR can only transmit stand alone, so 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----------------