

## FCC RF Exposure Evaluation

### 1. Product Information

EUT	: Laptop
Model Number	: G137, G1162, G1163, G131, G133, G136, G139, G142, G146, G156
Model Declaration	: PCB board, structure and internal of these model(s) are the same, Only the model name is different for these models.
Test Model	: G137
Power Supply	: DC 7.6V by Rechargeable Li-ion Battery (4600mAh) Recharged by DC 12V/2000mA AC/DC ADAPTER
Hardware Version	: X313J-REV11
Software Version	: V1.1.6
Bluetooth	:
Frequency Range	: 2402-2480MHz
Channel Number	: 79 channels for Bluetooth V4.2 (BDR/EDR) 40 channels for Bluetooth V4.2 (BT LE)
Channel Spacing	: 1MHz for Bluetooth V4.2 (BDR/EDR) 2MHz for Bluetooth V4.2 (BT LE)
Modulation Type	: GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth V4.2 (BDR/EDR) GFSK for Bluetooth V4.2 (BT LE)
Bluetooth Version	: V4.2
WIFI(2.4G Band)	:
Frequency Range	: 2412-2462MHz
Channel Spacing	: 5MHz
Channel Number	: 11 channels for 20MHz bandwidth(2412~2462MHz) 7 channels for 40MHz bandwidth(2422~2452MHz)
Modulation Type	: IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK); IEEE 802.11g/n: OFDM(64QAM, 16QAM, QPSK, BPSK)
WIFI(5G Band 3)	:
Frequency Range	: 5745-5825MHz
Channel Number	: 5 channels for 20MHz bandwidth(5745-5825MHz)
Modulation Type	: IEEE 802.11a/ac: OFDM(64QAM, 16QAM, QPSK, BPSK)
Antenna Description	:
	Two same PIFA Antenna, but not support MIMO technology ANT0(MAIN) used for WIFI TX/RX, 1.4dBi(Max.) for 2.4G Band and 1.98dBi(Max.) for 5G Band ANT1(AUX) used for WIFI/Bluetooth TX/RX, 1.4dBi(Max.) for 2.4G Band and 1.98dBi(Max.) for 5G Band
Exposure category	: General population/uncontrolled environment
EUT Type	: Production Unit
Device Type	: Portable Device

## 2. Evaluation Method and Limit

According to KDB447498 D01 General RF Exposure Guidance v06 Section 4.3.1 Standalone SAR test exclusion considerations: "Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.<sup>22</sup> The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.<sup>23</sup> "

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [V_f (\text{GHz})] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where:}$$

- $f$  (GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is  $\leq 50$  mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm according to  $f$  in section 4.1 is applied to determine SAR test exclusion.

When one of the following test exclusion conditions is satisfied for all combinations of simultaneous transmission configurations, further equipment approval is not required to incorporate transmitter modules in host devices that operate in the mixed mobile and portable host platform exposure conditions. The grantee is responsible for documenting this according to Class I permissive change requirements. Antennas that qualify for standalone SAR test exclusion must apply the estimated standalone SAR to determine simultaneous transmission test exclusion.

- a) The  $[\sum \text{of (the highest measured or estimated SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance) / 1.6 W/kg}] + [\sum \text{of MPE ratios}] \leq 1.0$ .
- b) The SAR to peak location separation ratios of all simultaneously transmitting antenna pairs operating in portable device exposure conditions are all  $\leq 0.04$ , and the  $[\sum \text{of MPE ratios}] \leq 1.0$ .

## 3. 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 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 2.1093](#): Radiofrequency radiation exposure evaluation: portable devices

## 4. Conducted Power Results

#### 4.1 Test Setup Block Diagram



#### 4.2 Test Equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Power Meter	R&S	NRVS	100444	2019-06-15
2	Power Sensor	R&S	NRV-Z32	10057	2019-06-15

Remark: all calibration period of equipment list is one year.

#### 4.3 Test Procedure

- The EUT was directly connected to the power meter and antenna output port as show in the block diagram Test Setup.
- Setup EUT work at duty cycle more than 98%;
- Read power sensor values in RMS detector;

##### <BT Classic>

Mode	Channel	Frequency(MHz)	Average Conducted Output Power [Antenna 1] (dBm)
GFSK	0	2402	1.15
	39	2441	0.86
	78	2480	1.38
$\pi/4$ DQPSK	0	2402	-0.57
	39	2441	-0.81
	78	2480	-0.06
8DPSK	0	2402	-0.12
	39	2441	-0.62
	78	2480	0.17

##### <BT LE>

Mode	Channel	Frequency(MHz)	Average Conducted Output Power [Antenna 1] (dBm)
GFSK	0	2402	-0.72
	19	2440	-0.79
	39	2480	-0.85

## &lt;2.4GWLAN &gt;

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)	
			[Antenna 0]	[Antenna 1]
IEEE 802.11b	1	2412	9.02	8.99
	6	2437	9.16	9.22
	11	2462	8.97	9.43
IEEE 802.11g	1	2412	8.78	9.40
	6	2437	9.15	9.19
	11	2462	9.47	8.80
IEEE 802.11n HT20	1	2412	8.83	8.83
	6	2437	9.44	8.54
	11	2462	8.86	8.97
IEEE 802.11n HT40	3	2422	9.09	9.16
	6	2437	9.07	9.18
	9	2452	9.15	9.16

## &lt;5.8GWLAN&gt;

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)	
			[Antenna 0]	[Antenna 1]
IEEE 802.11a	149	5745	7.12	7.07
	157	5785	7.22	7.11
	165	5825	7.37	7.43
IEEE 802.11ac VHT20	149	5745	7.18	7.01
	157	5785	7.45	7.12
	165	5825	7.41	7.08

## 5 Manufacturing Tolerance

## &lt;BT Classic&gt;

GFSK (Average) [Antenna 1]			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	1.0	1.0	1.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
$\pi/4$ DQPSK (Average) [Antenna 1]			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0	0	0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
8DPSK (Average) [Antenna 1]			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0	0	0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

## &lt;BT LE&gt;

GFSK (Average) [Antenna 1]			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	0	0	0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

## &lt;2.4GWLAN&gt;

IEEE 802.11b (Average)						
Channel	Channel 1		Channel 6		Channel 11	
	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]
Target (dBm)	8.5	8.5	8.5	8.5	8.5	8.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11g (Average)						
Channel	Channel 1		Channel 6		Channel 11	
	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]
Target (dBm)	8.5	8.5	8.5	8.5	8.5	8.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)						
Channel	Channel 1		Channel 6		Channel 11	
	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]
Target (dBm)	8.5	8.5	8.5	8.5	8.5	8.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)						
Channel	Channel 3		Channel 6		Channel 9	
	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]
Target (dBm)	8.5	8.5	8.5	8.5	8.5	8.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

## &lt;5.8GWLAN&gt;

IEEE 802.11a (Average)						
Channel	Channel 149		Channel 157		Channel 165	
	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]
Target (dBm)	6.5	6.5	6.5	6.5	6.5	6.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)						
Channel	Channel 149		Channel 157		Channel 165	
	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]	[Antenna 0]	[Antenna 1]
Target (dBm)	6.5	6.5	6.5	6.5	6.5	6.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

## 6 Antenna Information

G137 can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna type and antenna number	Maximum antenna gain (dBi)	
		2000 MHz – 2500 MHz	5000 – 6000 MHz
Antenna 0	PIFA Antenna	1.40	1.98
Antenna 1	PIFA Antenna	1.40	1.98

Synchronize transmit for antenna as follows;

Modulation Type	Frequency Band	Transmit Antenna		Antenna 0 + Antenna 1 synchronization transmit [BT+WLAN]	Antenna 0 + Antenna 1 synchronization transmit [WLAN+WLAN]
		Antenna 0	Antenna 1		
GFSK	2.4GHz	No	Yes	Yes	No
$\pi/4$ DQPSK	2.4GHz	No	Yes	Yes	No
8DPSK	2.4GHz	No	Yes	Yes	No
GFSK – BT LE	2.4GHz	No	Yes	Yes	No

IEEE 802.11b	2.4GHz	Yes	Yes	Yes	No
IEEE 802.11g	2.4GHz	Yes	Yes	Yes	No
IEEE 802.11n HT20	2.4GHz	Yes	Yes	Yes	No
IEEE 802.11n HT40	2.4GHz	Yes	Yes	Yes	No
IEEE 802.11a	5.8G	Yes	Yes	Yes	No
IEEE 802.11ac VHT20	5.8G	Yes	Yes	Yes	No

## 7 Evaluation Results

### 7.1 Standalone

#### Antenna 0

Communication Type	f (GHz)	Antenna Distance (mm)	RF output power		SAR Test Exclusion Threshold	SAR Test Exclusion
			dBm	mW		
GFSK	2.50	5	2.00	1.5849	$0.5 < 3.0$	Yes
$\pi/4$ DQPSK	2.50	5	1.00	1.2589	$0.4 < 3.0$	Yes
8DPSK	2.50	5	1.00	1.2589	$0.4 < 3.0$	Yes
GFSK – BT LE	2.50	5	1.00	1.2589	$0.4 < 3.0$	Yes
IEEE 802.11b	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11g	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11n HT20	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11n HT40	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11a	5.85	5	7.50	5.6234	$2.7 < 3.0$	Yes
IEEE 802.11ac VHT20	5.85	5	7.50	5.6234	$2.7 < 3.0$	Yes

#### Antenna 1

Communication Type	f (GHz)	Antenna Distance (mm)	RF output power		SAR Test Exclusion Threshold	SAR Test Exclusion
			dBm	mW		
IEEE 802.11b	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11g	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11n HT20	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11n HT40	2.50	5	9.50	8.9125	$2.8 < 3.0$	Yes
IEEE 802.11a	5.85	5	7.50	5.6234	$2.7 < 3.0$	Yes
IEEE 802.11ac VHT20	5.85	5	7.50	5.6234	$2.7 < 3.0$	Yes

Remark:

1. Output power including tune up tolerance;
2. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm according to f) in section 4.1 is applied to determine SAR test exclusion.

### 7.2 Simultaneous Transmission for SAR Exclusion

The sample support one BT/WLAN modular, and share two difference antenna, support simultaneous transmission, need consider simultaneous transmission;

### 7.2.1 Estimation Standalone SAR

#### Antenna 0

Communication Type	f (GHz)	Antenna Distance (mm)	RF output power		Estimation Standalone SAR (W/Kg)
			dBm	mW	
GFSK	2.50	5	2.00	1.5849	0.0668
$\pi/4$ DQPSK	2.50	5	1.00	1.2589	0.0531
8DPSK	2.50	5	1.00	1.2589	0.0531
GFSK – BT LE	2.50	5	1.00	1.2589	0.0531
IEEE 802.11b	2.50	5	9.50	8.9125	0.3758
IEEE 802.11g	2.50	5	9.50	8.9125	0.3758
IEEE 802.11n HT20	2.50	5	9.50	8.9125	0.3758
IEEE 802.11n HT40	2.50	5	9.50	8.9125	0.3758
IEEE 802.11a	5.85	5	7.50	5.6234	0.3627
IEEE 802.11ac VHT20	5.85	5	7.50	5.6234	0.3627

#### Antenna 1

Communication Type	f (GHz)	Antenna Distance (mm)	RF output power		Estimation Standalone SAR (W/Kg)
			dBm	mW	
IEEE 802.11b	2.50	5	9.50	8.9125	0.3758
IEEE 802.11g	2.50	5	9.50	8.9125	0.3758
IEEE 802.11n HT20	2.50	5	9.50	8.9125	0.3758
IEEE 802.11n HT40	2.50	5	9.50	8.9125	0.3758
IEEE 802.11a	5.85	5	7.50	5.6234	0.3627
IEEE 802.11ac VHT20	5.85	5	7.50	5.6234	0.3627

Remark:

1. Output power including tune up tolerance;
2. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to f) in section 4.1 is applied to determine SAR test exclusion.

### 7.2.2 Estimation simultaneous SAR

Estimation Standalone SAR <sub>BT</sub> (W/Kg)	Estimation Standalone SAR <sub>WLAN</sub> (W/Kg)	$\Sigma$ SAR/1.6	Limit	Results
0.0668	0.3758	< 0.3	1.0	PASS

*Remark:*

1. *Output power including tune up tolerance;*
2. *When the minimum test separation distance is < 5 mm, a distance of 5 mm according to f) in section 4.1 is applied to determine SAR test exclusion.*

**8 Conclusion**

The measurement results comply with the FCC Limit per 47 CFR 2.1093 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB 447498 v06.

.....THE END OF REPORT.....