



# PCTEST ENGINEERING LABORATORY, INC.

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## RF EXPOSURE EVALUATION (MAXIMUM PERMISSIBLE EXPOSURE)

**Applicant Name:**  
Panasonic Corporation of North America  
One Panasonic Way, 4B-8  
Secaucus, NJ 07094  
United States

**Date of Testing:**  
July 12-13, 2010  
**Test Site/Location:**  
PCTEST Lab, Columbia, MD, USA  
**Test Report Serial No.:**  
0Y1006151051.ACJ


<b>FCC ID:</b>	<b>ACJ9TGCF-S91</b>
<b>IC CERTIFICATION NO.:</b>	<b>216A-CFS91</b>
<b>APPLICANT:</b>	<b>Panasonic Corporation of North America</b>

**EUT Type:** Toughbook Model: CF-S9  
**FCC Rule Part(s):** FCC Part 1 (§1.1310) and Part 2 (§2.1091)  
**FCC Classification:** PCS Licensed Transmitter (PCB)  
**Test Procedure:** OET Bulletin 65



The device bearing the FCC Identifier specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in FCC OET Bulletin 65 (See Test Report). These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

I authorize and attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

*PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.*

  
Randy Ortanez  
President





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# 1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)



## 1.1 Introduction

This document is prepared on behalf of Panasonic Corporation of North America to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations and RSS-102 of Industry Canada.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310 and RSS-102: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

**Table 1-1. Limits for Maximum Permissible Exposure (MPE)**

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## 1.2 EUT Description

The Panasonic Model: CF-S9 is a Toughbook containing Sierra Wireless GSM/WCDMA/CDMA/EvDO WWAN, Intel PRO/Wireless WLAN and UNII, and Alps Bluetooth modules. For this MPE evaluation the device is set to transmit from the antenna of each transmitter and the RF exposure of each transmitter is evaluated individually. All antennas are internal. There are no provisions for external antennas.

### EUT:

Model: CF-S9  
 Grantee: Panasonic Corporation of North America  
 FCC ID: ACJ9TGCF-S91  
 Antenna Gains: Intel WLAN abgn



	Main	Aux
2.4 GHz	0.86 dBi	-0.07 dBi
5.15-5.35 GHz	1.61 dBi	3.04 dBi
5.5-5.7 GHz	1.58 dBi	3.31 dBi
5.7-5.825 GHz	1.07 dBi	3.70 dBi

### Sierra WWAN (Gobi2000)

	Main
850 MHz	-0.15 dBi
1900 MHz	-0.56 dBi

### Output Power:

Cellular GSM	1.114 W ERP
PCS GSM	1.445 W EIRP
Cellular WCDMA	0.301 W ERP
PCS WCDMA	0.603 W EIRP
Cellular CDMA	0.336 W ERP
PCS CDMA	0.514 W EIRP
UNII Chain A Band I	14.46 dBm
UNII Chain A Band II	14.31 dBm
UNII Chain A Band III	13.79 dBm
UNII Chain B Band I	13.11 dBm
UNII Chain B Band II	13.24 dBm
UNII Chain B Band III	13.32 dBm
WLAN Chain A (2.4GHz)	14.72 dBm
WLAN Chain B (2.4 GHz)	14.22 dBm
WLAN Chain A (5.8 GHz)	14.35 dBm
WLAN Chain B (5.8 GHz)	12.92 dBm

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**Aggregate Powers – MIMO Operation:**

Summed Powers for 2 x 2 MIMO operation (Worst Case)

WLAN:

2.4GHz = 264.24mW (24.22dBm)



5.8GHz = 161.436mW (22.08 dBm)

UNII:

Band I = 21.83mW (13.39 dBm)

Band II = 28.44mW (14.54 dBm)

Band III = 28.84mW (14.6dBm)

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### 1.3 MPE Requirements Overview



Three different categories of transmitters are defined by the FCC in OET Bulletin 65. These categories are fixed installation, mobile, and portable and are defined as follows:

- **Fixed Installations:** fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.
- **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.
- **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

- **Occupational/Controlled Exposure:** In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.
- **General Population/Uncontrolled Exposure:** The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

The Panasonic Toughbook Model: CF-S9 FCC ID: ACJ9TGCF-S91 is evaluated to the Mobile Device requirements and is considered a device to be used by the General Population/Uncontrolled Exposure.

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## 1.4 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements.

The power generated by each transmitter used in this product was initially measured by a power meter and the powers were recorded. Through use of the Friis transmission formula and knowledge of the maximum antenna gain to be used, the power density level is calculated at a distance of 20cm.

The antenna gains of each antenna to be used with the different available transmitters were used to calculate the MPE in all relevant bands of operation.

### Friis Transmission Formula

Friis transmission formula:  $P_d = (P_{out} * G) / (4\pi r^2)$

Where,

$P_d$  = Power Density (mW/cm<sup>2</sup>)                       $\rho = 3.1416$   
 $P_{out}$  = output power to antenna (mW)             $r$  = distance between observation point and center of the radiator (cm)  
 $G$  = gain of antenna in linear scale



### Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1.

The following power densities are calculated for each individual transmitter by frequency at 20cm spacing. In addition there is co-location operation that is possible between the WWAN and WLAN transmitters. To evaluate this, the MPE was calculated for the worst case conditions (highest powers) between these operations. Additionally, MPE values are provided for MMO operation with the output powers of each transmit chain summed together.

<b>Frequency</b>	836.6 MHz	
<b>Limit</b>	0.558 mW/cm <sup>2</sup>	
<b>Distance (cm), R =</b>	20 cm	
<b>Power (dBm), P (ERP) =</b>	30.47 dBm	1114.29 mW
<b>Power (dBm), P (EIRP) =</b>	32.61 dBm	1823.90 mW
<b>Power Density (S) =</b>	0.363 mW/cm <sup>2</sup>	(at 20cm)
<b>Minimum Distance =</b>	16.1 cm	

Table 1-2. Calculated MPE Data for Cellular Band

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Frequency:	1880 MHz	
Limit:	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	31.6 dBm	1445.44 mW
Power Density (S) =	0.2876 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	10.7 cm	

Table 1-3. Calculated MPE Data for PCS Band

Frequency	2400 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	14.72 dBm	29.65 mW
TX Ant Gain (dB), G =	0.86 dBi	
Power Density (S) =	0.007 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.7 cm	

Table 1-4. Calculated MPE Data for 2.4GHz Band (Chain A)

Frequency	2400 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	14.22 dBm	26.42 mW
TX Ant Gain (dB), G =	-0.07 dBi	
Power Density (S) =	0.005 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.4 cm	



Table 1-5. Calculated MPE Data for 2.4GHz Band (Chain B)

Frequency	5240 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	14.46 dBm	27.93 mW
TX Ant Gain (dB), G =	1.61 dBi	
Power Density (S) =	0.008 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.8 cm	

Table 1-6. Calculated MPE Data for 5.15-5.35GHz Band (Chain A)

Frequency	5260 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	13.24 dBm	21.09 mW
TX Ant Gain (dB), G =	3.04 dBi	
Power Density (S) =	0.008 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.8 cm	

Table 1-7. Calculated MPE Data for 5.15-5.35GHz Band (Chain B)

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Frequency	5600 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	13.79 dBm	23.93 mW
TX Ant Gain (dB), G =	1.58 dBi	
Power Density (S) =	0.007 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.7 cm	

Table 1-8. Calculated MPE Data for 5.5-5.7GHz Band (Chain A)

Frequency	5500 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	13.32 dBm	21.48 mW
TX Ant Gain (dB), G =	3.31 dBi	
Power Density (S) =	0.009 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.9 cm	



Table 1-9. Calculated MPE Data for 5.5-5.7GHz Band (Chain B)

Frequency	5785 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	14.35 dBm	27.23 mW
TX Ant Gain (dB), G =	1.07 dBi	
Power Density (S) =	0.007 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.7 cm	

Table 1-10. Calculated MPE Data for 5.7-5.825GHz Band (Chain A)

Frequency	5825 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	12.92 dBm	19.59 mW
TX Ant Gain (dB), G =	3.7 dBi	
Power Density (S) =	0.009 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	1.9 cm	

Table 1-11. Calculated MPE Data for 5.7-5.825GHz Band (Chain B)

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**MIMO Operation – Summed Powers:**

Frequency	2437 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	24.22 dBm	264.24 mW
TX Ant Gain (dB), G =	0.79 dBi	
Power Density (S) =	<b>0.063</b> mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	<b>5.0</b> cm	

**Table 1-12. Calculated MPE Data for WLAN (2.4GHz) Band - MIMO**

Frequency	5795 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	22.08 dBm	161.44 mW
TX Ant Gain (dB), G =	4.77 dBi	
Power Density (S) =	<b>0.096</b> mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	<b>6.2</b> cm	

**Table 1-13. Calculated MPE Data for WLAN (5.8GHz) Band - MIMO**

Frequency	5320 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	14.54 dBm	28.44 mW
TX Ant Gain (dB), G =	4.65 dBi	
Power Density (S) =	<b>0.017</b> mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	<b>2.6</b> cm	

**Table 1-14. Calculated MPE Data for UNII Band I (5.15-5.35 GHz) Band - MIMO**

Frequency	5500 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	14.6 dBm	28.84 mW
TX Ant Gain (dB), G =	4.89 dBi	
Power Density (S) =	<b>0.018</b> mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	<b>2.7</b> cm	

**Table 1-15. Calculated MPE Data for UNII Band II (5.5-5.7 GHz) Band - MIMO**



Frequency	5785 MHz	
Limit	1.000 mW/cm <sup>2</sup>	
Distance (cm), R =	20 cm	
Power (dBm), P =	16.57 dBm	45.39 mW
TX Ant Gain (dB), G =	4.77 dBi	
Power Density (S) =	0.027 mW/cm <sup>2</sup>	(at 20cm)
Minimum Distance =	3.3 cm	

Table 1-16. Calculated MPE Data for UNII Band III (5.7-5.825 GHz) Band - MIMO

Co-location Operation: Worst case WLAN/UNII and Cellular:

	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Percent MPE Used (%)
Cellular	0.363	0.558	65.06
WLAN/UNII	0.0963	1.000	9.63
<b>Total</b>			<b>74.69</b>



The Co-location operation of this cellular radio and the WLAN/UNII radio complies with the maximum allowed RF exposure requirements.

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## 1.5 Summary of Results



Frequency Band [MHz]	Maximum Antenna Gain [dBi]	MPE @ 20cm (mW/cm <sup>2</sup> )	Test Result
848.8	n/a	0.363	PASS
1850.2	n/a	0.2876	PASS
2400 (Chain A)	0.86	0.007	PASS
2400 (Chain B)	-0.07	0.005	PASS
5240 (Chain A)	1.61	0.008	PASS
5260 (Chain B)	3.04	0.008	PASS
5600 (Chain A)	1.58	0.007	PASS
5500 (Chain B)	3.31	0.009	PASS
5785 (Chain A)	1.07	0.007	PASS
5825 (Chain B)	3.70	0.009	PASS
2400 (Aggregate powers)	0.86	0.064	PASS
5800 (Aggregate powers)	3.70	0.075	PASS
5240 (Aggregate powers)	1.61	0.011	PASS
5600 (Aggregate powers)	1.58	0.012	PASS
5785 (Aggregate powers)	1.07	0.021	PASS

**Table 1-17. Maximum Permissible Exposure Summary Table**

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## 2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations and Health Canada Safety Code 6. An appropriate RF exposure compliance statement will be placed in the user's manual.

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