



Maximum Permissible Exposure Study - Engineering Analysis

For

Model: **SPK-SHARE**

2.4 GHz /5.0 GHz Wi-Fi Radio 802.11a/ac/b/g/n + Bluetooth v2.1 + BTLE v4.0

**FCC ID: LDKSPKSH1576**

**ISED ID: 2461L-SPKSH1576**

**Against the following Specifications:**

**47 Code of Federal Regulations 2.1091**

**Industry Canada RSS-102 Issue 5**

**Cisco Systems**

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This report replaces any previously entered test report under EDCS –. This test report has been electronically authorized and archived using the CISCO Doc Central. Test Report Template EDCS# 11556830 & EDCS# 11556831.

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## 1.0 Attestation Statement of Compliance

The Cisco Systems SPK-SHARE dongle with integrated 802.11a/b/g/n/ac and 802.15 radios have been evaluated for Maximum Permissible Exposure in compliance with 47 Code of Federal Regulations 2.1093. The evaluation was in accordance with methodology as referenced in FCC KDB 447498 D01 General RF Exposure Guidance v06  
This report serves as the additional technical analysis of the Cisco radio modules

The limits used for this evaluation are in line with the recommendations of the World Health Organizations (WHO) International Committee on Non Ionizing Radiation Protection (ICNIRP) as well as the American National Standards Institute (ANSI) C95.1.

The limits chosen are of **General Population/Uncontrolled Exposure**.

This analysis also complies with the requirements stated in Industry Canada RSS-102 as well as the applicable Australian and New Zealand regulations.

Only the following case scenario was used which are:

**2.4GHz WLAN Radio: FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576**

**5250-5350MHz WLAN Radio: FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576**

**5470-5725MHz WLAN Radio: FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576**

Output power listed is conducted. The antenna(s) used for this device must be installed to provide a separation distance of at least 20 cm from all persons. Installers must be provided with antenna installation and transmitter operating conditions for satisfying RF exposure compliance.

Based on the study this case scenario, the General Population/Uncontrolled Exposure and the minimum recommended distance is around 20cm (8 inches) from the antenna.

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The **SPK\_SHARE** dongle radio has been evaluated for Maximum Permissible Exposure in compliance with 47 Code of Federal Regulations 2.1091 and RSS-102 Issue 5. The evaluation was in accordance with methodology as referenced in FCC Bulletin OET 65C (rev 01-01) along with KDB 447498 D01 General RF Exposure Guidance. This report serves as the additional technical analysis of the Cisco radio modules

The limits chosen are of **General Population/Uncontrolled Exposure**.

The limits used for this evaluation are in line with the recommendations of the World Health Organizations (WHO) International Committee on Non Ionizing Radiation Protection (ICNIRP) as well as the American National Standards Institute (ANSI) C95.1.

This analysis also complies with the requirements stated in Industry Canada RSS-102 as well as the applicable Australian and New Zealand regulations.

The following case scenarios were used:

Bluetooth Low Energy report	<b>FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576</b>
Bluetooth Basic Rate/ EDR report	<b>FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576</b>
2.4GHz DTS report	<b>FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576</b>
5GHz UNII-1 report	<b>FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576</b>
5GHz UNII-2A report	<b>FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576</b>
5GHz UNII-2C report	<b>FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576</b>
5GHz UNII-3 report	<b>FCC ID: LDKSPKSH1576, IC: 2461L-SPKSH1576</b>

This device must be installed to provide a separation distance of at least 20 cm from all persons. Installers must be provided with antenna installation and transmitter operating conditions for satisfying RF exposure compliance.

Based on the study this case scenario, the General Population/Uncontrolled Exposure and the minimum recommended distance is around 20cm (8 inches) from the antenna.

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## 2.0 EUT Description.

### SPK\_SHARE wireless dongle

Cisco SPK-SHARE dongle is the next generation cloud collaboration platform that unifies messaging, meeting and calling and content-sharing. Cisco SPK-Share provides HDMI support for connection to a display and USB Type-C interface to receive 5V power. Cisco SPK-Share offers both wired and wireless solution with Ethernet via USB 2.0 external adapter and 802.11a/b/g/n/ac, Bluetooth classic and Bluetooth LE radios.

Below are brief summary of the SPK-SHARE hardware specifications:

#### Wired Protocol support

- USB C main interface (Power, Ethernet via USB2)
- External POE Ethernet adapter (Ethernet Injector accessory connected via USB type C)
  - Ethernet: 10/100/1000BASE-T Ethernet network (IEEE 802.3i/802.3u/802.3ab/802.3az)
- External 18W power supply (Direct connected via USB)

#### Wireless Protocols support

- Wi-Fi: IEEE 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac
- Bluetooth: IEEE 802.15 Basic Rate + EDR v3.0, Low Energy v4.1

##### **2.4GHz FHSS Radio Supported Modes:**

- 802.15 BlueTooth ver 2.1+EDR (1Mbps – 3Mbps)

##### **2.4GHz BTLE Radio Supported Modes:**

- 802.15 BlueTooth ver 4.1 (1Mbps)

##### **2.4GHz WLAN Radio Supported Modes:**

- 802.11b (1Mbps – 11Mbps)
- 802.11g (6Mbps - 54Mbps)
- 802.11n (HT20, MCS0 – MCS7)
- 802.11n (HT40, MCS0 – MCS9)

##### **5GHz WLAN Radio Supported Modes:**

- 802.11a (6Mbps – 54Mbps)
- 802.11n (HT20, MCS0 – MCS15)
- 802.11n (HT40, MCS0 – MCS15)
- 802.11ac (VHT40, MCS0 – MCS19)
- 802.11ac (VHT80, MCS0 – MCS19)

The following antennas are supported by this product series.  
The data included in this report represent the worst case data for all antennas.

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain Peak (dBi)
<b>2400 – 2500</b>	CI8847-11-000-R-FA	PIFA	1.24
<b>5150 – 5250</b>	CI8847-11-000-R-FA	PIFA	4.26
<b>5250 – 5350</b>	CI8847-11-000-R-FA	PIFA	4.26
<b>5470 – 5725</b>	CI8847-11-000-R-FA	PIFA	3.77
<b>5725 – 5850</b>	CI8847-11-000-R-FA	PIFA	2.85

### 3.0 Methodology

All calculations were made in accordance with ANSI C95.1, and FCC 447498 D01 General RF Exposure Guidance v06.

#### Measurement Uncertainty Values

Parameter	Max MU from standard	Declared MU
Occupied Channel Bandwidth	+/- 5%	+/-2%
RF Output Power, conducted	+/- 1,5dB	+/-1.4dB
Power Spectral Density, conducted	+/- 3dB	+/- 2dB
Unwanted emissions, conducted	+/- 3dB	+/- 2dB
All emissions, radiated	+/- 6dB	+/- 3.2dB
Temperature	+/- 3C	+/- 0.7C
Supply Voltages	+/- 3%	+/- 2.5%
Time	+/- 5%	+/-2%

## 4.0 Technical Requirements

### 4.1 Single Band Operation – Limits

#### *FCC Limits for Maximum Permissible Exposure (MPE)*

##### (A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f <sup>2</sup> )*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

##### (B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f <sup>2</sup> )*	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

**NOTE 1:** See Section 1 for discussion of exposure categories.

**NOTE 2:** The averaging time for General Population/Uncontrolled exposure to fixed transmitters is not applicable for mobile and portable transmitters. See 47 CFR §§2.1091 and 2.1093 on source-based time-averaging requirements for mobile and portable transmitters.

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Devices are subject to the radio frequency radiation exposure requirements specified in RSS-102 Issue 5. All equipment shall be considered to operate in a “general population/uncontrolled” environment.

### Limit for RF Exposure

RSS-102, issue 5, section 2.5.2 or from section 4, table 4

Frequency Range	Electric Field	Magnetic Field	Power Density	Reference Period
(MHz)	(V/m rms)	(A/m rms)	(W/m <sup>2</sup> )	(minutes)
300-6000	—	—	$0.02619 f^{0.6834}$	6

**Note:**  $f$  is frequency in MHz.

## 5.0 Calculations

The RSS RF Exposure limits (**W/m<sup>2</sup>**) are calculated as follows:

Limit calculation

Worst case **2.4GHz DTS** channel is channel 11 (2462MHz)

$$0.02619 f^{0.6834} = 0.02619 \times (2462^{0.6834}) = 0.02619 \times 207.78 = 5.44 \text{ W/m}^2$$

Worst case **2.4GHz FHSS** channel is channel 79 (2480MHz)

$$0.02619 f^{0.6834} = 0.02619 \times (2480^{0.6834}) = 0.02619 \times 208.82 = 5.47 \text{ W/m}^2$$

Worst case **2.4GHz BTLE** channel is channel 39 (2480MHz)

$$0.02619 f^{0.6834} = 0.02619 \times (2480^{0.6834}) = 0.02619 \times 208.82 = 5.47 \text{ W/m}^2$$

Worst case **5GHz UNII-1** channel is channel 44 (5220MHz)

$$0.02619 f^{0.6834} = 0.02619 \times (5220^{0.6834}) = 0.02619 \times 347.26 = 9.09 \text{ W/m}^2$$

Worst case **5GHz UNII-2A** channel is channel 64 (5320MHz)

$$0.02619 f^{0.6834} = 0.02619 \times (5320^{0.6834}) = 0.02619 \times 351.79 = 9.21 \text{ W/m}^2$$

Worst case **5GHz UNII-2C** channel is channel 132 (5660MHz)

$$0.02619 f^{0.6834} = 0.02619 \times (5660^{0.6834}) = 0.02619 \times 367.01 = 9.61 \text{ W/m}^2$$

Worst case **5GHz UNII-3** channel is channel 157 (5785MHz)

$$0.02619 f^{0.6834} = 0.02619 \times (5785^{0.6834}) = 0.02619 \times 372.53 = 9.76 \text{ W/m}^2$$



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The Power Density (mW/cm<sup>2</sup>) is calculated as follows:

$$S = PG (\text{Duty Cycle}) / 4\pi R^2 \quad (\text{Equation 1})$$

Solve for R

$$R = \frac{\sqrt{PG (DC)}}{4 \pi S} \quad (\text{Equation 2})$$

Where:

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW)

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 (appropriate units, e.g., cm)

DC= Duty Cycle

## 6.0 Results

Test Reports used in evaluation are :

Bluetooth Low Energy report	<b>FCC ID:</b> LDKSPKSH1576, <b>ISED ID:</b> 2461L-SPKSH1576
Bluetooth Basic Rate/ EDR	<b>FCC ID:</b> LDKSPKSH1576, <b>ISED ID:</b> 2461L-SPKSH1576
2.4GHz DTS report	<b>FCC ID:</b> LDKSPKSH1576, <b>ISED ID:</b> 2461L-SPKSH1576
5GHz UNII-1 report	<b>FCC ID:</b> LDKSPKSH1576, <b>ISED ID:</b> 2461L-SPKSH1576
5GHz UNII-2A report	<b>FCC ID:</b> LDKSPKSH1576, <b>ISED ID:</b> 2461L-SPKSH1576
5GHz UNII-2C report	<b>FCC ID:</b> LDKSPKSH1576, <b>ISED ID:</b> 2461L-SPKSH1576
5GHz UNII-3 report	<b>FCC ID:</b> LDKSPKSH1576, <b>ISED ID:</b> 2461L-SPKSH1576

**MPE Calculations**

S=1mW/cm<sup>2</sup>maximum. The highest supported antenna gain is 1.24 dBi for 2.4GHz radio and 4.26 dBi for 5 GHz radio.

Table 1 below contains the calculated Power Density Level by applying the formula in Equation 1 above.

**Table 1**

<b>Power Density Level @ 20 cm Distance</b>							
<b>Frequency</b>	<b>Data Rate</b>	<b>Total Peak TX Power</b> Ant. Port0 +Port1	<b>Ant. Gain</b>	<b>FCC/RSS Min. Distance Allowed</b>	<b>Calculated Power Density</b>	<b>FCC PowerDensity Limit @20 cm</b>	<b>RSS PowerDensity Limit @20 cm</b>
<b>(MHz)</b>	<b>(Mbps)</b>	<b>(dBm)</b>	<b>(dBi)</b>	<b>(cm)</b>	<b>(mW/cm<sup>2</sup>)</b>	<b>(mW/cm<sup>2</sup>)</b>	<b>(mW/cm<sup>2</sup>)</b>
<b>Radio#1 Mode: 802.11b (2.4 GHz Wi-Fi)</b>							
2462	1	20.39	1.24	20	<b>0.029</b>	1	0.091
<b>Radio#2 Mode: 802.15 (2.4 GHz Bluetooth /FHSS)</b>							
2480	1	5.78	1.24	20	<b>0.001</b>	1	0.091
<b>Radio#3 Mode: 802.15 (2.4 GHz Bluetooth LE)</b>							
2480	1	2.30	1.24	20	<b>0.000</b>	1	0.091
<b>Radio#4 Mode: 802.11a (5 GHz Wi-Fi (UNII-1))</b>							
5220	6	16.37	4.26	20	<b>0.023</b>	1	0.091
<b>Radio#5 Mode: 802.11a (5 GHz Wi-Fi (UNII-2A))</b>							
5320	6	16.25	4.26	20	<b>0.022</b>	1	0.091
<b>Radio#6 Mode: 802.11a (5 GHz Wi-Fi (UNII-2C))</b>							
5660	6	14.54	3.77	20	<b>0.013</b>	1	0.091
<b>Radio#7 Mode: 802.11a (5 GHz Wi-Fi (UNII-3))</b>							
5785	6	15.69	2.85	20	<b>0.014</b>	1	0.091

**MPE Calculations (continue)**

To maintain compliance with the FCC / RSS power density limit (1mW/cm<sup>2</sup>), installations will assure a separation distance of at least 20cm or according to the calculated minimum distance entered in table 2.

Table 2 below contains the calculated minimum distance allowed by applying the formula in Equation 2 above.

**Table 2**

<b>Calculated Minimum Distance Allowed</b>							
<b>Frequency</b>	<b>Data Rate</b>	<b>Total Peak TX Power</b> <b>Ant. Port0 +Port1</b>	<b>Ant. Gain</b>	<b>Calculated Power Density</b>	<b>Calculated Closet Distance Allowed Without Going Over Limit</b>	<b>FCC/RSS Limit Distance</b>	<b>Margin</b>
<b>(MHz)</b>	<b>(Mbps)</b>	<b>(dBm)</b>	<b>(dBi)</b>	<b>(mW/cm<sup>2</sup>)</b>	<b>(cm)</b>	<b>(cm)</b>	<b>(mW/cm<sup>2</sup>)</b>
<b>Radio#1 Mode: 802.11b (2.4 GHz Wi-Fi)</b>							
2462	1	20.39	1.24	0.029	<b>3.41</b>	20	16.6
<b>Radio#2 Mode: 802.15 (2.4 GHz Bluetooth /FHSS)</b>							
2480	1	5.78	1.24	0.001	0.63	20	19.4
<b>Radio#3 Mode: 802.15 (2.4 GHz Bluetooth LE)</b>							
2480	1	2.30	1.24	0.000	0	20	20
<b>Radio#4 Mode: 802.11a (5 GHz Wi-Fi (UNII-1))</b>							
5220	6	16.37	4.26	0.023	<b>3.03</b>	20	17.0
<b>Radio#5 Mode: 802.11a (5 GHz Wi-Fi (UNII-2A))</b>							
5320	6	16.25	4.26	0.022	<b>2.97</b>	20	17.0
<b>Radio#6 Mode: 802.11a (5 GHz Wi-Fi (UNII-2C))</b>							
5660	6	14.54	3.77	0.013	<b>2.28</b>	20	17.7
<b>Radio#7 Mode: 802.11a (5 GHz Wi-Fi (UNII-3))</b>							
5785	6	15.69	2.85	0.014	<b>2.38</b>	20	17.6

**Calculations with simultaneous transmitters****Scenario1 :**

2400MHz to 2483.5MHz (DTS) radio

5150MHz to 5150MHz (UNII-1) radio

<b>Tx1</b>	<b>Tx2</b>	<b>Tx3</b>	<b>Tx4</b>	<b>Tx5</b>	<b>Tx6</b>	<b>Tx7</b>	<b>% of Standard</b>
0.029			0.023				0.052

$$\mathbf{Tx1 + Tx4 = \% \text{ of Standard}}$$

$$\mathbf{(0.029) + (0.023) = 0.052}$$

$$\mathbf{D \text{ (estimate)} = } 20 \sqrt{0.052}\%$$

$$\mathbf{D = 4.56 \text{ cm}}$$

**Scenario2 :**

2400MHz to 2483.5MHz (BT BR) radio

2400MHz to 2483.5MHz (DTS) radio

5250MHz to 5350MHz (UNII-2A) radio

<b>Tx1</b>	<b>Tx2</b>	<b>Tx3</b>	<b>Tx4</b>	<b>Tx5</b>	<b>Tx6</b>	<b>Tx7</b>	<b>% of Standard</b>
0.029	0.001		0.023				0.053

$$\mathbf{Tx1 + Tx2 + Tx4 = \% \text{ of Standard}}$$

$$\mathbf{(0.029) + (0.001) + (0.023) = 0.053}$$

$$\mathbf{D \text{ (estimate)} = } 20 \sqrt{0.053}\%$$

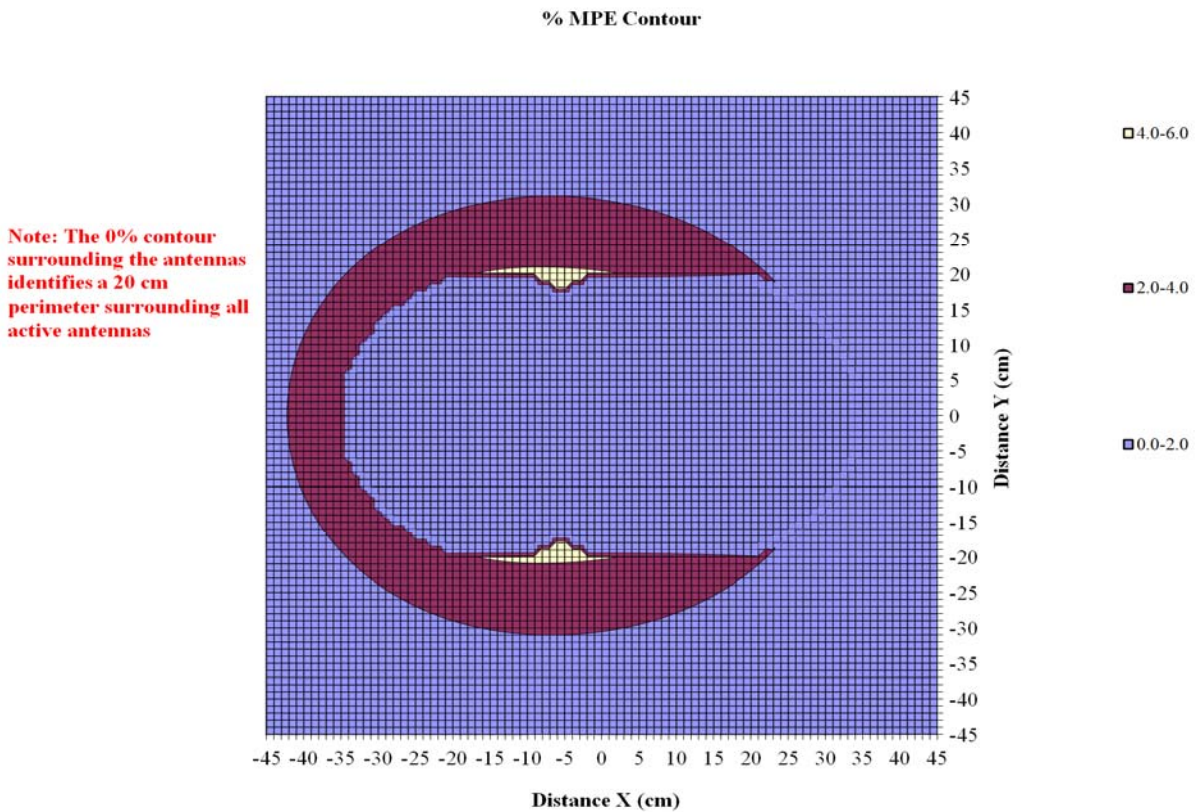
$$\mathbf{D = 4.60 \text{ cm}}$$

The configuration above co-location calculation is for **General Population/Uncontrolled exposure**. The minimum distance recommended is **20 cm (8 inches)** when all antennas are within 20 cm of each other.

Using the provided FCC MPE-Mobile.xls file, the “% MPE contour” summary tables and charts are given below for the simultaneous cases listed above.

**%MPE contour of 2462MHz (2.4GHz Wi-Fi), 2480MHz (2.4GHz BT BR) & 5220MHz (5 GHz Wi-Fi) radios**

Antenna No.		Total	1	2	3	4	5	6
Tx Status			On	On	Off	On	Off	Off
Frequency	MHz		2462	2480	1900	5220	2450	5800
MPE Limit	mW/cm <sup>2</sup>		1.00	1.00	0.00	1.00	0.00	0.00
Max % MPE	%	5.1	2.9	0.1	0.0	2.3	0.0	0.0
Power	(W)	0.156	0.109	0.004	0.000	0.043	0.000	0.000
Antenna Gain	dBi		1.24	1.24	3.00	4.26	0.50	1.00
EIRP	(W)	0.27	0.145	0.005	0.000	0.115	0.000	0.000



## **References**

**American National Standards Institute (ANSI), "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1-1992 (previously issued as IEEE C95.1-1991). Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, N.Y. 10017. For copies contact the IEEE: 1-800-678-4333 or 1-908-981-1393.**

**American National Standards Institute (ANSI), "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave". ANSI/IEEE C95.3-1992. Copyright 1992, The Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, NY 10017. For copies contact the IEEE: 1-800-678-4333 or 1-908-981-1393.**

**FCC OET 65C Evaluating Compliance with FCC Guidelines for Human Exposure to RF Fields from 9KHz to 40 GHz**

**FCC KDB 447498 D01 General RF Exposure Guidance v06**