

# Co-Located RF Exposure Condition MPE Report for Mobile Fujitsu Laptops

## Radio Modules:

**WLAN Radio Module: FCC ID: PD9622ANH (IC ID: 1000M-622ANH)**  
**WLAN Radio Module: FCC ID: PPD-AR5B97 (IC ID: 4104A-AR5B97)**  
**WLAN Radio Module : FCC ID: PPD-AR5B92 (IC ID: 4104A-AR5B92)**  
**Bluetooth Radio Module: FCC ID: PIWBSMAN (IC ID: 5255A-BSMAN)**  
**EV-DO Radio Module: FCC ID: N7NGOBI2 (IC ID: 2417C-GOBI2)**

## Introduction:

The intention of this report is to evaluate RF exposure condition and enable the original manufacturer certified Sierra Wireless EV-DO (WWAN) radio module Gobi2000 to be co-located with original manufacturer certified WLAN radio modules Intel Puma Peak 622ANH and Atheros HB92/HB97 in mobile Fujitsu laptops (non-tablet conditions) using the above radio modules. Independent antennas used for each of the Radio modules and simultaneous transmission is possible between the collocated transmitters.

Each laptop will have an option of either one Intel WLAN or one Atheros WLAN and not both WLANs simultaneously.

SAR testing is not required as the WLAN and EVDO transmitting antennas are located more than 20 cms from the body of user in a host Fujitsu notebook. This MPE report evaluates the RF Exposure condition of the collocated antennas within 5cms of each other in the case of a WLAN and WWAN.

Antenna location and Antenna Gain details are provided in Appendix A of this document. The Bluetooth antenna is >20cms from other radio antennas and also the output power is low (<4mW) and hence SAR evaluation is not required pursuant to the FCC KDB616217.

## FCC Limits:

In accordance with Section 1.1310, the Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure of  $1\text{mW}/\text{cm}^2$  has been applied.

Friis transmission formula:  $P_d = (P \cdot G) / (4 \cdot \pi \cdot r^2)$

where:  $P_d$  = power density ( $\text{mW}/\text{cm}^2$ )

$P$  = power input to the antenna (mW)

$G$  = antenna gain (numeric)

$r$  = distance to the center of radiation of the antenna (cm)

For frequency dependent limits, the lowest transmitter frequency of UMTS/EV-DO module was used to represent the lowest MPE limit (e.g. 824MHz =  $0.549\text{mW}/\text{cm}^2$ ).

## Radio Modules:

WLAN = Intel Puma Peak 2x2 model 622ANH / Atheros AR5B92 / Atheros AR5B97

WWAN = Sierra EV-DO model GOBI2000

Bluetooth = CSR BSMAN3

## Antenna Details:

Refer to Appendix A for Antenna details

WLAN Antenna: NISSEI Electric PIFA Antenna

WWAN Antenna: NISSEI Electric PIFA Antenna

**MPE Calculations:**

WWAN Standalone Configuration (from original Radio manufacturer certification)

Technology	Freq (MHz)	Maximum Conducted Power (dBm)	Maximum Antenna Gain (dBi)	Power Density @ 20cm (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )
EV-DO	824	24.6	2.22	0.096	0.549
EV-DO	1850	24.61	4.49	0.162	1.000

Intel WLAN Standalone Configuration (from original Radio manufacturer certification)

Technology	Freq (MHz)	Maximum Conducted Power (dBm)	Maximum Antenna Gain (dBi)	Power Density @ 20cm (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )
802.11b/g/n	2400	29.85	2.46	0.339	1.000
802.11a/n	5150	29.85	3.17	0.398	1.000

Atheros WLAN (Worst case of HB92/HB97) Standalone Configuration (from original Radio manufacturer)

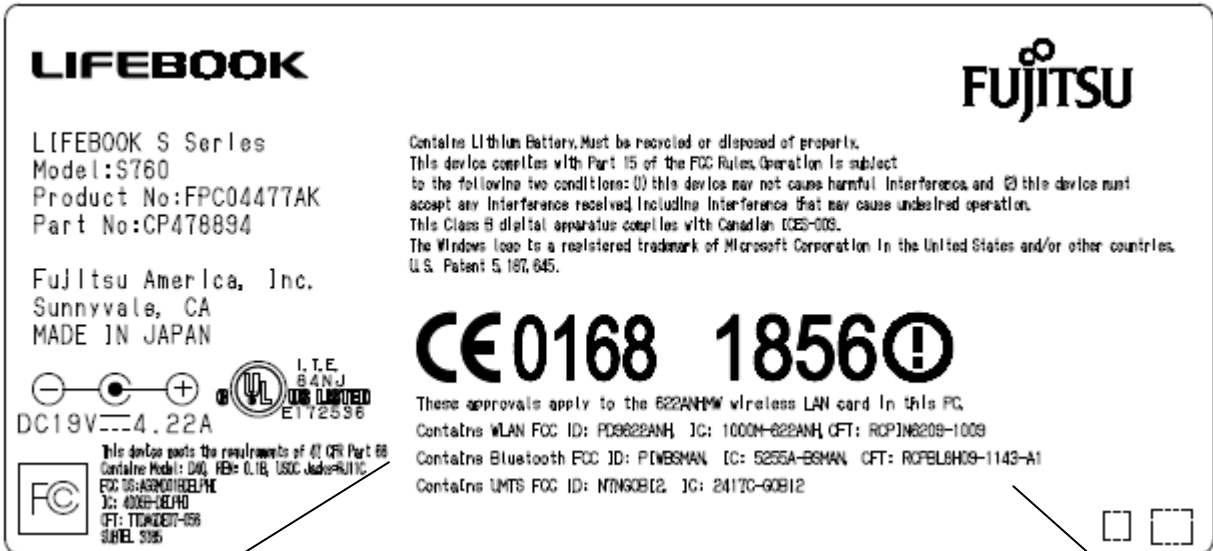
Technology	Freq (MHz)	Maximum Conducted Power (dBm)	Maximum Antenna Gain (dBi)	Power Density @ 20cm (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )
802.11b/g/n	2400	29.58	3.62	0.416	1.000
802.11a	5300	29.85	5.56	0.693	1.000

**Aggregate Collocated MPE Calculations:**

Worst case Power Densities shown for respective frequency bands

Transmitter Modules	FCC ID	Frequency GHz	Antenna Type	Antenna Gain (dBi)	Power Density @ 20 cm mW/cm <sup>2</sup>	MPE Limit mW/cm <sup>2</sup>
WWAN EVDO	N7NGOBI2	0.8	Nissei Electric Inverted-F	2.22	0.096	0.55
		<b>1.8</b>		<b>4.49</b>	<b>0.162</b>	1.0
*WLAN (802.11abgn)	P9D622ANH	2.4		2.46	0.339	1.0
		5.0		3.17	0.399	1.0
*WLAN (802.11bgn)	AR5B97	2.4		2.46	0.179	1.0
*WLAN (802.11abgn)	AR5B92	2.4		3.62	0.416	1.0
		<b>5.0</b>		<b>5.56</b>	<b>0.693</b>	1.0
<b>Sum of Worst Case Power Densities (WWAN 1.8GHz and WLAN 5GHz) of Collocated Transmitters</b>					<b>0.854</b>	<b>1.0</b>

**Product Label for a typical Fujitsu Laptop (eg S760) with Intel WLAN, Sierra WWAN and CSR Bluetooth radio modules:**



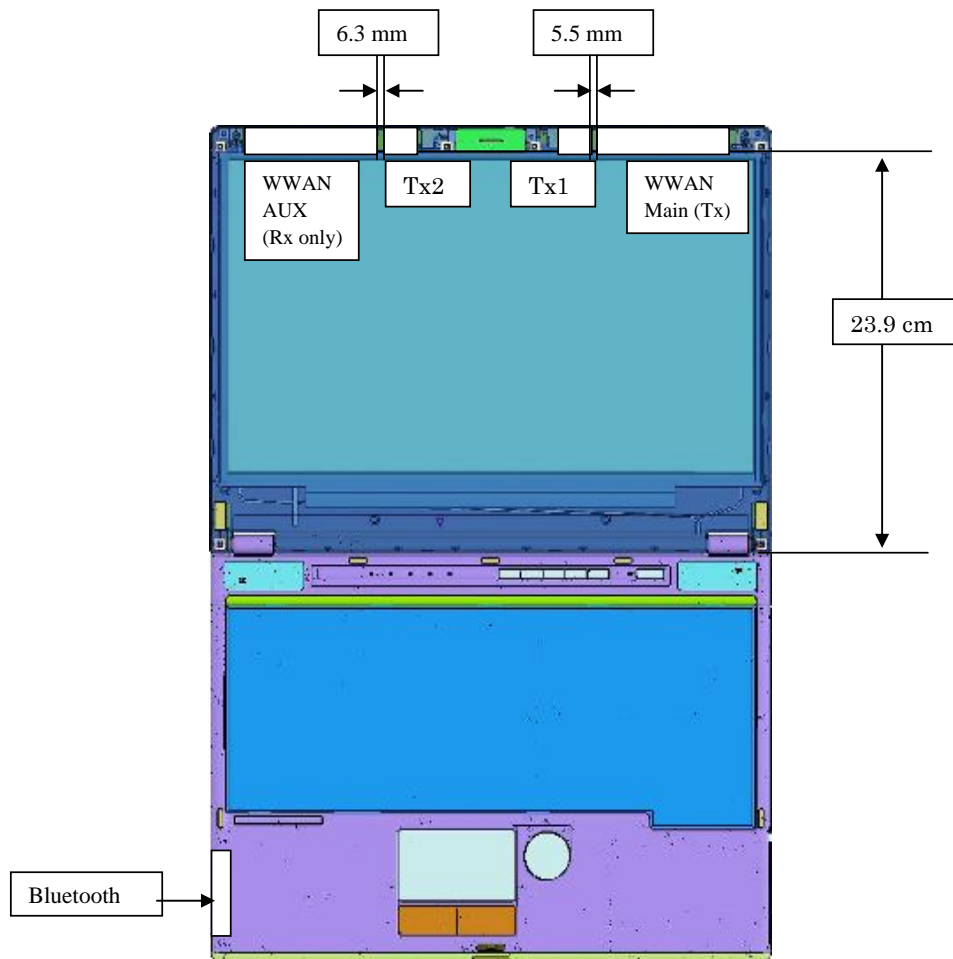
Contains WLAN FCC ID: PD9622ANH, IC: 1000M-622ANH, CF  
 Contains Bluetooth FCC ID: PIWBSMAN, IC: 5255A-BSMAN  
 Contains EVDO FCC ID: N7NG0B12, IC: 2417C-G0B12

**Conclusion:**

Calculations show that the Fujitsu laptops for the specified radio modules and their antenna gains are less than what is listed in the MPE calculation tables above comply with Maximum Permissible Exposure (MPE) limit for the General Population/Uncontrolled Exposure.

## APPENDIX A

### Antenna Location and Antenna Gain Details



WLAN and WWAN Ant to User >20cms

WLAN(Tx1) - BT Ant. : 345.8mm

WLAN(Tx2) - BT Ant. : 307.1mm

WWAN(Main) - BT Ant. : 364.2mm

BT (Bluetooth) has very low power of 4mW

Note:

Above distances are measured when LCD opened at 90 degree.

**Mobile Condition  
NOTEBOOK PC (Not a Tablet)**

Antenna Gain Table

WWAN Bands	Laptop Models	Main Ae				Aux Ae			
		S760 (Mg)	S760 (ABS)	T900 Laptop mode only	T730 Laptop mode only	S760 (Mg)	S760 (ABS)	T900 Laptop mode only	T730 Laptop mode only
Frequency (MHz)	Peak Gain (dBi)								
GSM850 Tx	824	-2.73	-2.14	0.88	-0.43	-1.82	-2.21	-1.84	-1.50
	836	-1.82	-1.25	1.05	-0.38	-1.05	-1.19	-1.65	-1.26
	849	-1.24	-1.08	0.96	-0.56	-0.61	-1.15	-1.75	-1.08
GSM900 Tx	880	0.22	-1.16	1.45	-0.89	-0.38	-0.74	-1.96	-0.98
	900	0.33	-1.36	2.12	-0.57	-0.60	-1.33	-2.01	0.53
	915	0.08	-0.89	2.22	-0.67	-0.81	-1.71	-2.02	0.66
DCS1800 Tx	1710	-0.19	0.18	0.81	0.61	-0.08	1.31	1.76	0.79
	1750	-0.62	-0.06	0.38	0.34	0.20	0.87	1.35	0.87
	1785	-0.75	0.12	0.68	0.34	0.53	1.44	1.24	1.21
PCS1900 Tx	1850	0.20	1.26	0.63	-0.57	0.48	1.93	1.42	0.81
	1880	0.10	0.28	-0.05	-0.35	0.15	1.82	0.83	-0.50
	1910	0.61	0.47	0.29	-0.18	0.50	1.99	0.37	0.29
IMT-2000 Tx	1920	0.55	0.39	0.28	-0.31	0.53	1.63	-0.70	0.10
	1950	0.28	0.07	-0.23	-0.74	0.26	0.84	0.51	0.36
	1980	0.64	0.20	0.14	0.00	0.58	0.81	1.02	1.12
UMTS 2100 Tx (Band I)	1920	0.55	0.39	0.28	-0.31	0.53	1.63	-0.89	0.10
	1930	0.46	0.29	0.16	-0.49	0.43	1.22	-0.70	0.00
	1940	0.53	0.32	0.13	-0.51	0.41	1.14	-0.81	0.32
	1950	0.28	0.07	-0.23	-0.74	0.26	0.84	0.13	0.36
	1960	0.27	0.01	-0.40	-0.71	0.29	0.74	0.51	0.52
	1970	0.47	0.10	-0.26	-0.41	0.43	0.84	0.81	0.88
UMTS 1900 Tx (Band II)	1980	0.64	0.20	0.14	0.00	0.58	0.81	0.99	1.12
	1850	0.20	1.26	0.63	-0.57	0.48	1.93	-0.67	0.81
	1880	0.10	0.28	-0.05	-0.35	0.15	1.82	1.42	-0.50
UMTS 1800 Tx (Band III)	1910	0.61	0.47	0.29	-0.18	0.50	1.99	0.83	0.29
	1710	-0.19	0.18	0.81	0.61	-0.08	1.31	0.82	0.79
	1750	-0.62	-0.06	0.38	0.34	0.20	0.87	1.76	0.87
UMTS 1700/2100 Tx (Band IV)	1785	-0.75	0.12	0.68	0.34	0.53	1.44	1.35	1.21
	1710	-0.19	0.18	0.81	0.61	-0.08	1.31	0.83	0.79
	1730	0.04	0.36	0.69	0.47	0.25	1.25	1.76	1.05
UMTS 850 Tx (Band V)	1755	-0.60	0.01	0.49	0.46	0.34	1.04	1.77	0.95
	824	-2.73	-2.14	0.88	-0.43	-1.82	-2.21	-1.84	-1.50
	836	-1.82	-1.25	1.05	-0.38	-1.05	-1.19	-1.65	-1.26
UMTS 850 Tx (Band VI)	849	-1.24	-1.08	0.96	-0.56	-0.61	-1.15	-1.75	-1.08
	830	-2.23	-1.64	0.97	-0.36	-1.44	-1.48	-1.64	-1.16
	835	-1.98	-1.51	0.94	-0.47	-1.20	-1.32	-1.73	-1.40
UMTS 900 Tx (Band VIII)	840	-1.55	-1.21	1.11	-0.35	-0.81	-1.13	-1.61	-1.10
	880	0.22	-1.16	1.45	-0.89	-0.38	-0.74	-1.96	-0.98
	900	0.33	-1.36	2.12	-0.57	-0.60	-1.33	-2.01	0.53
UMTS 1700 Tx (Band IX)	915	0.08	-0.89	2.22	-0.67	-0.81	-1.71	-2.02	0.66
	1750	-0.62	-0.06	0.38	0.34	0.20	0.87	1.35	0.87
	1770	-0.73	0.04	0.59	0.63	0.51	1.33	0.85	1.17
UMTS 1700/2100 Tx (Band X)	1785	-0.75	0.12	0.68	0.34	0.53	1.44	1.24	1.21
	1710	-0.19	0.18	0.81	0.61	-0.08	1.31	1.76	0.79
	1740	0.03	0.33	0.65	0.56	0.39	1.24	1.73	1.14
UMTS 1700/2100 Rx (Band X)	1770	-0.73	0.04	0.59	0.63	0.51	1.33	0.85	1.17
	2110	0.31	-0.72	0.29	0.01	0.29	-1.04	-0.21	0.11
	2140	0.03	-0.91	0.17	0.90	0.16	-1.37	-0.72	-0.13
	2170	-0.23	-1.06	0.22	0.98	0.16	-1.41	-0.67	-0.53

## T730 WLAN Antenna Data

Doc.No.:3.8.05 Rev – 6.8

### Antenna Peak Gain Table:

Frequency (MHz)	Tx1 antenna		Tx2 (or Rx2) Antenna	
	Horizontal (dBi)	Vertical (dBi)	Horizontal (dBi)	Vertical (dBi)
2400	1.92	-2.04	2.17	-1.57
2450	2.38	-1.96	1.88	-0.72
2500	2.33	0.06	1.83	-0.48
2501				
2593	1.79	-1.78	1.59	-1.26
2685	1.69	-2.03	1.33	-0.84
5150	1.04	1.09	1.78	1.51
5250	1.00	0.56	0.35	0.02
5350	-0.08	0.31	1.18	0.50
5470	0.02	0.01	1.67	0.95
5600	0.51	-0.27	1.17	0.02
5725	0.50	-0.40	0.44	-1.23
5785	0.96	0.55	0.28	-1.72
5850	0.47	0.91	0.23	-2.23

- Antenna Peak Gain required being test in system basis.

## T900 WLAN Antenna Data

### Antenna Peak Gain Table:

Frequency (MHz)	Tx1 antenna		Tx2 (or Rx2) Antenna		Tx3 (or Rx3) Antenna	
	Horizontal (dBi)	Vertical (dBi)	Horizontal (dBi)	Vertical (dBi)	Horizontal (dBi)	Vertical (dBi)
2400	-1.54	-2.76	0.86	-0.93	-2.01	-3.00
2450	-1.73	-2.58	0.65	-0.91	-1.87	-2.79
2500	-1.36	-2.8	0.27	-0.94	-1.21	-2.72
2593	-1.7	-3.12	-0.91	-2.64		
2685	-1.84	-4.26	-1.69	-3.06		
2700						
3300						
3400						
3500						
3600						
3700						
5150	-0.49	0.42	-2.1	-1.69	-1.56	-6.38
5250	-0.5	1.05	-2.13	-1.53	-0.88	-6.06
5350	-1.3	-0.35	-0.75	-0.33	-1.96	-6.37
5470	0.47	-0.66	-1.34	-0.01	-2.63	-2.16
5600	-1.32	-0.88	-2.35	-1.07	-0.29	-0.61
5725	-2.04	0.91	-3.08	-2.21	2.15	3.39
5785	-2.41	-0.62	-3.49	-1.71	1.78	3.09
5850	-2.92	-3.2	-2.56	-1.62	-0.71	1.14

- Antenna Peak Gain required being test in system basis.