

RF Exposure evaluation for MPE/MPE configuration in co-locating with other transmitters

1. Outline

The Figure-1 shows the new host PC device to be added in this application. And the applying WWAN modular device (FCC ID: **VV7-MBMF3507G-L**, IC: **287AG-MBMF3507G**) transmits RF with the three kinds of transmitters listed below simultaneously.

- | | | |
|-----------------------|------------------------------|--------------------------|
| 1. Bluetooth: | FCC ID: QDS-BRCM1033 | IC: 4324A-BRCM1033 |
| 2. UWB: | FCC ID: TX2RTU7305BG13HMC | N/A |
| 3. one of WLAN/WiMAX: | FCC ID: PD9533ANMU | IC: 1000M-533ANMU |
| | FCC ID: PD9533ANXMU | N/A |
| | FCC ID: PD9LEN512ANMU | IC: 1000M-L512ANMU |
| | FCC ID: PPD-AR5BHB63-L | IC: 4104A-ARBHB63L |
| | FCC ID: PD9533ANHU | IC: 1000M-533ANHU |
| | FCC ID: PD9512ANHU | IC: 1000M-512ANHU |
| | FCC ID: PD9512ANXMU | N/A |
| | FCC ID: PD9512ANXHU | N/A |
| | FCC ID: TX2-RTL8191SE-L | IC: 6317A-RTL8191SE |
| | *1 FCC ID: PD9112BNHU | IC: 1000M-112BNHU |

***1:** New co-located WLAN transmitter device to be added in this Class II application

***2:** additional 'Mobile' Host PC devices (See Figure-1.)

***3** : additional **MPE/MPE** co-location with WWAN and WLAN/WiMAX transmitter devices in this application

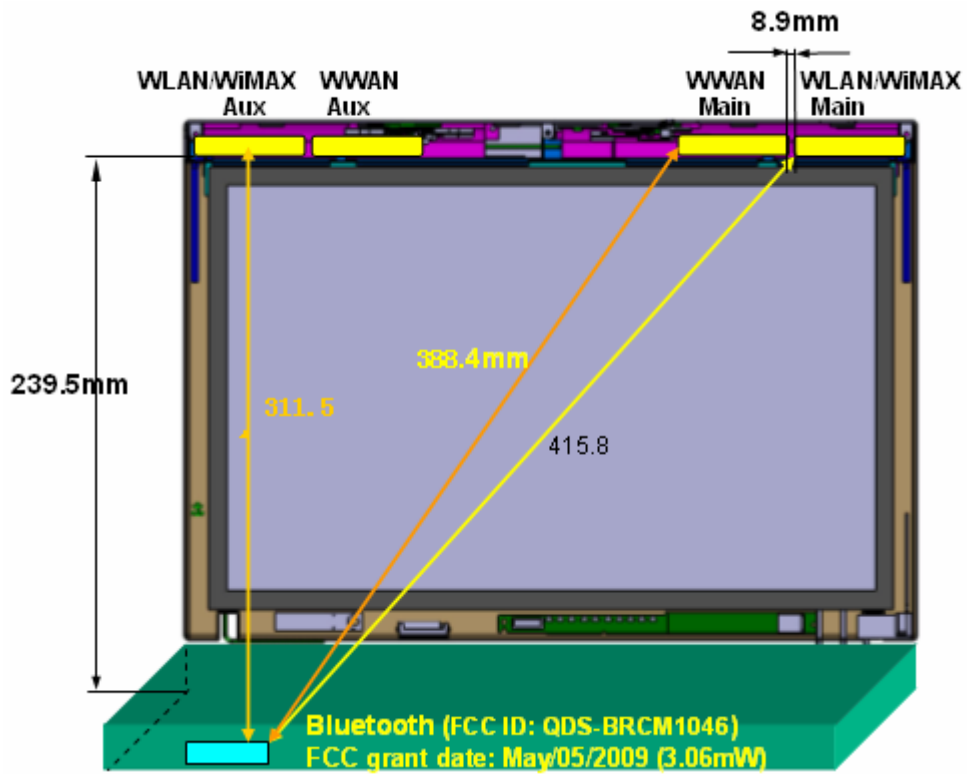
as of June/2009

	MPE / MPE config.		
Co-located WLAN/WiMAX modules	ThinkPad X200/X200s X300/X301 SL300/SL400/SL500	ThinkPad T400s	ThinkPad L410 / SL410 L510 / SL510 *2
FCC ID: PD9533ANMU IC: 1000M-533ANMU	granted FCC: 07/ 18/ 2008 IC: 02/ 06/ 2009	Granted FCC: 04/ 27/ 2009 IC: 05/ 04/ 2009	*3
FCC ID: PD9LEN512ANMU IC: 1000M-L512ANMU			
FCC ID: PPD-AR5BHB63-L IC: 4104A-ARBHB63L			
FCC ID: PD9533ANXMU IC: N/A	Granted FCC: 09/ 17/ 2008		
FCC ID: PD9533ANHU IC: 1000M-533ANHU	Granted FCC: 04/ 27/ 2009 IC: 05/ 04/ 2009		
FCC ID: PD9512ANHU IC: 1000M-512ANHU			
FCC ID: PD9512ANXMU IC: N/A			
FCC ID: PD9533ANHMU IC: N/A			
FCC ID: TX2-RTL8191SE-L IC: 6317A-RTL8191SE			
FCC ID: PD9112BNHU *1 IC: 1000M-112BNHU	*3		

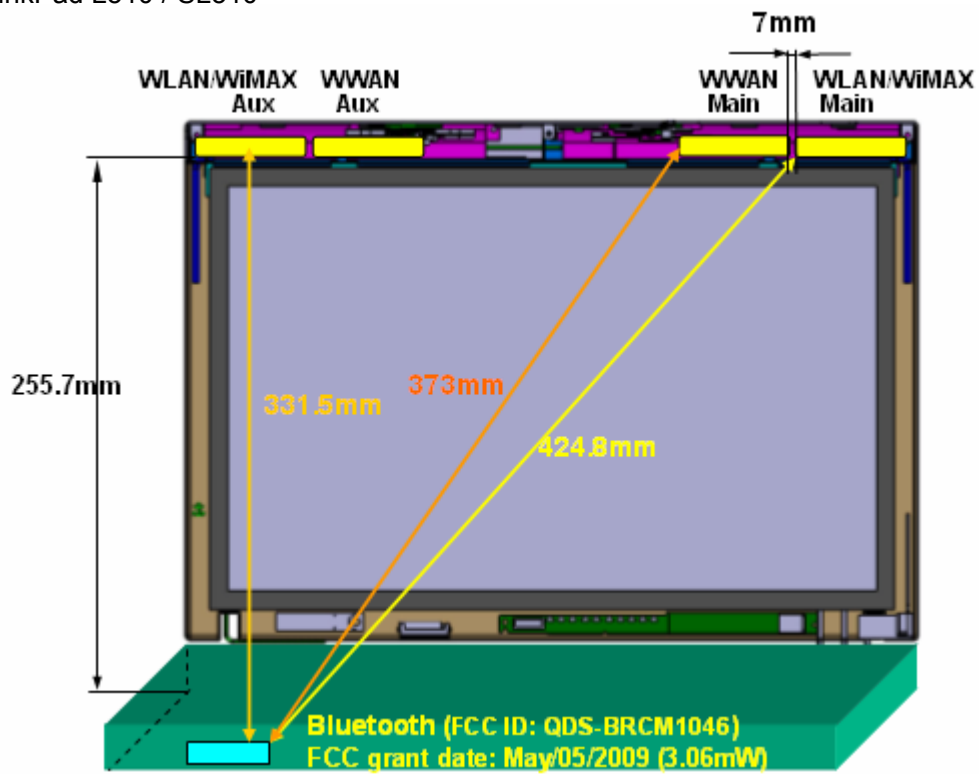
See **Annex-1** in more details for the grant history.

Figure-1: the new host PC devices

ThinkPad L410 / SL410



ThinkPad L510 / SL510



The separation distance between human body and the WWAN Tx antenna of the new host PC device is ≥ 20 cm. Therefore the applying WWAN transmitter module (Model: **F3507G**) and the antenna system are subjected to “Mobile device” pursuant to FCC CFR 47 Section 2.1091 and “RF Exposure Evaluation” category pursuant to IC RSS-102e clause 2.5.2.

With the evaluation hereafter, the applying modular transmitter (FCC ID: VV7-MBMF3507G-L, IC: 287AG-MBMF3507G) has found to comply with the MPE limit (1.0 mW/cm^2) pursuant to FCC CFR 47 section 1.1310 for general Population/Uncontrolled exposure, and IC RSS-102e clause 4.2.

2. RF Exposure justification regarding Bluetooth co-location

The co-location evaluation with the Bluetooth device is not required because of the sufficient antenna separation distance (373 mm or more) and its low power (3.06 mW) pursuant to FCC KDB 616217 and 447498.

3. RF Exposure justification regarding UWB co-location

UWB transmitter is not mentioned in FCC CFR 47 Section 2.1091 and 2.1093, so it does not subject to RF exposure requirement. Therefore, no additional SAR testing or RF Exposure evaluation is required for any combination with UWB transmitter.

4. RF Exposure evaluation regarding WWAN & WLAN co-location

The both WWAN and WLAN (or WiMAX) antennas fall in Mobile category and co-locate with 7mm of antenna to antenna separation distance (See Fig-1.) Therefore, the summation of the highest MPE of WWAN and WLAN (or WiMAX) devices is required. The MPE summation is calculated as below.

1) Part 22H (Cellular) & Part 15C/E or Part 27:

Per OET Bulletin 65, Section 3 for frequency bands with different limits, the MPEs are calculated separately for each band, then divided by the limit for the band and the results are summed. The summation must be less than 1.

$$0.090 / 0.533 \text{ (Table-1)} + 0.197 / 1.0 \text{ (Table-2)} = 0.366 < 1.0 \quad \text{..... Pass}$$

2) Part 24E (PCM) & Part 15C/E or Part 27:

$$0.076 \text{ (Table-1)} + 0.197 \text{ (Table-2)} = 0.273 \text{ mW/cm}^2 \text{ (Limit=1.0)} \quad \text{..... Pass}$$

Table-1: MPE of WWAN (Model: F3507G) MPE

Host PC model	Grant date	FCC CFR	Max. Conducted power (P) (mW)	Max. Host PC antenna gain (G)	Distance (D)	MPE *4 (mW/cm ²)	limit (mW/cm ²)	
ThinkPad 200/X200s	FCC: 07/18/2008 IC : 02/06/2009	Part 22H	498.82	Table-1a	-1.17 dBi	21.1 cm	0.068	0.533 (=800/1500)
ThinkPad 300/X301					-0.04 dBi	23.5 cm	0.071	
ThinkPad SL300					-1.97 dBi	24.3 cm	0.043	
ThinkPad SL400					-1.08 dBi	26.5 cm	0.044	
ThinkPad SL500					-0.52 dBi	27.7 cm	0.046	
ThinkPad T400s	FCC: 04/27/2009 IC : 05/04/2009	RSS -132			-0.10 dBi	25.0 cm	0.062	
ThinkPad L410/SL410	New host PC				1.10 dBi	23.9 cm	0.090	
ThinkPad L510/SL510					0.70 dBi	25.5 cm	0.072	
ThinkPad 200/X200s	FCC: 07/18/2008 IC : 02/06/2009	Part 24E	212.78	Table-1b	1.34 dBi	21.1 cm	0.052	1.0
ThinkPad 300/X301					3.92 dBi	23.5 cm	0.076	
ThinkPad SL300					0.12 dBi	24.3 cm	0.029	
ThinkPad SL400					-1.16 dBi	26.5 cm	0.018	
ThinkPad SL500					2.10 dBi	27.7 cm	0.036	
ThinkPad T400s	FCC: 04/27/2009 IC : 05/04/2009	RSS -133			1.91 dBi	25.0 cm	0.042	
ThinkPad L410/SL410	New host PC				0.90 dBi	23.9 cm	0.037	
ThinkPad L510/SL510					1.20 dBi	25.5 cm	0.034	

$$*4: \text{MPE} = (P \times 1000) \times (10^{G/10}) / (4 \times \pi \times D^2)$$

Table-1a: WWAN Maximum Power consideration at 850MHz frequency band

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	33,00	*5 1995,26	25%	498,82
EDGE	31,00	1258,93	25%	314,73
WCDMA	23,62	230,14	100%	230,14
HSDPA	23,49	223,36	100%	223,36
HSUPA	23,08	203,24	100%	203,24

*5: 2W is the peak output power listed in the original grant (VV7-MBMF3507G). However, based upon the original test report, 1.955W of the peak output power is used here.

Table-1b: WWAN Maximum Power consideration at 1900MHz frequency band

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	29,30	*6 851,14	25%	212,78
EDGE	28,70	741,31	25%	185,33
WCDMA	22,80	190,55	100%	190,55
HSDPA	23,00	199,53	100%	199,53
HSUPA	22,80	190,55	100%	190,55

*6: 871 mW is the peak output power listed in the original test report (VV7-MBMF3507G). However, 851 mW of the burst-averaged output power in the original test report is used here.

Table-2: MPE of WLAN&WiMAX modules

		Max. Conducted power (See Table-3) (Py)	Max. Host PC antenna gain (See Table-4.) (G)	MPE *7 (mW/cm ²)	limit (mW/cm ²)
Part 15C	2.4GHz band	0.632 W	1.94 dBi	0.197	1.0
Part 15E	5.18 – 5.32GHz	0.110 W	2.61 dBi	0.040	
Part 15E	5.50 – 5.70GHz	0.110 W	2.98 dBi	0.043	
Part 15C	5.745 – 5.825GHz	0.441 W	2.93 dBi	0.172	
Part 27	2.496 – 2.690GHz	0.254 W	1.72 dBi	0.075	

$$*7: MPE = (1000 \times P_y) \times (10^{G/10}) / (4 \times \pi \times 20^2)$$

Table-3: Conducted peak power of WLAN&WiMAX modules

FCC ID	Original Grant date	WLAN				WiMAX
		Part 15C 2.4GHz band	Part 15E 5.18 – 5.32GHz	Part 15E 5.50 – 5.70GHz	Part 15C 5.745 – 5.825GHz	Part 27 2.496 – 2.690GHz
PPD-AR5BHB63-L	03 / 24 /2008	0.1977W	N/A	N/A	N/A	N/A
PD9LEN512ANMU	06 / 24 /2008	0.091 W	0.028 W	0.054 W	0.021 W	N/A
PD9533ANMU	07 / 07 /2008	0.130 W	0.110 W	0.110 W	0.068 W	N/A
PD9533ANXMU	07 / 18 /2008	0.470 W	0.048 W	0.048 W	0.436 W	0.211 W
PD9512ANHU	12 / 11 /2008	0.072 W	0.045 W	0.071 W	0.062 W	N/A
PD9533ANHU	12 / 04 /2008	0.438 W	0.045 W	0.045 W	0.441 W	N/A
PD9512ANXMU	11 / 03 /2008	0.632 W	0.048 W	0.047 W	0.338 W	0.242 W
PD9512ANXHU	12 / 09 /2008	0.585 W	0.047 W	0.048 W	0.328 W	0.254 W
TX2-RTL8191SE-L	02 / 25 /2009	0.0667W	N/A	N/A	N/A	N/A
PD9112BNHU	06 / 04 /2009	0.048 W	N/A	N/A	N/A	N/A

 New co-located WLAN transmitter device to be added in this Class II application

Table-4: WLAN & WiMAX Antenna Gains of new host PC devices

additional 'Mobile' Host PC devices in this Class II application

	Antenna Manufacturer	Main Antenna					Auxiliary antenna				3rd antenna			
		Frequency band (GHz)					Frequency band (GHz)				Frequency band (GHz)			
		2.4-2.5	5.15-5.35	5.47-5.725	5.725-5.85	WiMAX 2.49-2.69	2.4-2.5	5.15-5.35	5.47-5.725	5.725-5.85	2.4-2.5	5.15-5.35	5.47-5.725	5.725-5.85
L410/SL410	Quanta	0.10	-0.30	0.10	-1.80	-0.50	-0.40	0.10	-0.50	-1.30	-	-	-	-
L510/SL510	Quanta	-1.30	-0.30	-0.80	-2.50	-0.70	0.70	-0.80	0.20	-3.00	-	-	-	-
T400s	NISSEI	-0.83	1.19	1.81	1.63	-1.43	-0.61	2.27	2.98	2.64	1.22	2.61	2.95	2.93
	FOXCONN	1.16	0.65	1.01	-0.25	1.19	-0.88	1.63	0.67	-0.17	1.83	1.84	0.98	0.43
X300	NISSEI	1.88	2.12	2.34	2.31	1.72	1.26	-0.14	1.44	1.47	0.90	-0.14	-0.50	-0.64
X301														
SL300	ACON	0.96	-0.05	-1.73	-2.27	-0.96	-0.86	-2.97	-0.85	-0.69	-	-	-	-
	Amphenol	-1.85	0.96	0.56	-0.02	-2.01	-1.60	1.35	0.52	0.52	-	-	-	-
SL400	ACON	-1.32	-0.88	-3.22	-2.97	-3.61	-0.23	-1.77	-2.57	-2.74	-	-	-	-
	TYCO	-2.39	-0.55	-2.48	-2.66	-2.20	1.52	-0.96	-1.93	-1.93	-	-	-	-
SL500	ACON	-1.16	-1.83	-2.00	-2.00	-1.65	-0.74	-3.11	-2.68	-2.51	-	-	-	-
	TYCO	-0.58	-0.68	-2.08	-1.69	-0.67	-0.11	-1.50	-2.40	-3.11	-	-	-	-
X200	ACON	1.17	-1.19	-2.38	-2.36	1.51	1.04	-0.11	0.33	-1.06	-1.05	-1.39	-3.47	-4.61
	Wistron NW	1.94	0.16	0.61	0.29	0.90	0.59	-1.27	-0.33	-0.77	0.44	-1.77	-1.06	-1.01
X200s	ACON	-0.42	-1.06	-1.43	-2.08	-0.12	-0.13	-0.85	-1.36	-2.52	-0.81	-1.72	-2.56	-2.56
	Wistron NW	-0.52	-0.42	-0.31	-0.49	-0.72	0.31	-0.65	-0.24	-0.24	0.24	-0.71	-0.23	-0.37

Annex-1: FCC ID: VV7-MBMF3507G-L, FCC Regulatory Compliance History

1. Section 2.933 Change in Identification filing based upon VV7-MBMF3507G
 - a. Change in identification grant date:04/30/2008
 - b. Output power : Based upon VV7-MBMF3507G (original device)

FCC Rule Parts	Frequency Range (MHz)	Output Watts/Peak –Grant entries	Actual Peak Output power based upon the test report	Actual Bust-Averaged Power based upon the test report	Modulation
24E	1850.2 - 1909.8	0.871	0.871	0.851	GPRS/10
24E	1850.2 - 1909.8	0.742	0.742	0.617	EDGE/10
24E	1852.4 - 1907.6	0.387	0.524	0.191(RMS)	HSUPA
22H	824.2 - 848.8	2.0	1.995	1.908	GPRS/10
22H	824.2 - 848.8	1.259	1.259	0.617	EDGE/10
22H	826.4 - 846.6	0.435	0.499	0.203(RMS)	HSUPA

MPE Calculation as documented in VV7-MBMF3507G
 850 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	33,00	1995,26	25%	498,82
EDGE	31,00	1258,93	25%	314,73
WCDMA	23,62	230,14	100%	230,14
HSDPA	23,49	223,36	100%	223,36
HSUPA	23,08	203,24	100%	203,24

1900 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	29,30	851,14	25%	212,78
EDGE	28,70	741,31	25%	185,33
WCDMA	22,80	190,55	100%	190,55
HSDPA	23,00	199,53	100%	199,53
HSUPA	22,80	190,55	100%	190,55

2. Class II permissive change, Grant date :05/09/2008
 - a. Implementing Two-Way bios lock logic and qualified for portable hosts / (ThinkPad T400/R400 and ThinkPad T500/W500 Laptop Computers).
 - b. Highest SAR values: Part 22, 0.173W/kg.; Part 24, 0.112W/kg.
3. Class II permissive change, Grant date: 05/16/2008
 - a. Adding alternate WWAN antenna and co-located with Bluetooth (FCC ID:MCLJ07H081 and FCC ID: QDS-BRCM1033) in Mobile Hosts (MP1, KD1, KD2, and BX3)

4. Class II permissive change, Grant date: 07/18/2008
 - a. Enabling WWAN and WLAN to transmit simultaneously
 - b. Co-located with WLAN modules (FCC ID:PPD-AR5BHB63-L; PD9LEN512ANMU; and PD9533ANMU) in Mobile Hosts (ThinkPad X200/X200s; ThinkPad X300/X301, ThinkPad SL310/400 and SL500).
5. Class II permissive change, Grant date:07/29/2008
 - a. Installed WWAN module in Portable Tablet Computer (ThinkPad X200 Tablet) and co-located with Bluetooth (FCC ID: QDS-BRCM1033) and WLAN (FCC ID: PD9LEN512ANMU or FCC ID: PPD-AR5BHB63-L)
 - b. Highest SAR values: Part 22, 0.173W/kg.; Part 24, 0.112W/kg.
6. Class II permissive change, Grant date: 08/05/2008
 - a. Enable Simultaneously WLAN and WWAN simultaneously transmission in hosts (ThinkPad T400/R400 and ThinkPad T500/W500 Laptop Computers).
 - b. and co-located with Bluetooth (FCC ID: QDS-BRCM1033) and WLAN (FCC ID: PD9LEN512ANMU or FCC ID: PPD-AR5BHB63-L)
7. Class II permissive change, Grant date: 09/17/2008
 - a. Add new co-located WLAN/WiMAX module (FCC ID: PD9533ANXMU) in the mobile Hosts (ThinkPad X200/X200s; ThinkPad X300/X301, ThinkPad SL310/400 and SL500).
8. Class II permissive change, Grant date: 10/16/2008
 - a. Add new co-located WLAN/WiMAX module (FCC ID:PD9533ANXMU) in the portable host (ThinkPad T400/R400 and ThinkPad T500/W500 Laptop Computers).
9. Class II permissive change, Grant date: 03/20/2009
 - a. Enable simultaneously WLAN/WiMAX/WWAN transmission in Tablet Computer (ThinkPad X200 Tablet) and co-located with WLAN/WiMAX module (FCC ID:PD9533ANXMU), WLAN modules (FCC ID:PD9LEN512ANMU, FCC ID: PD9533ANMU or FCC ID: PPD-AR5BHB63-L) and Bluetooth Module (FCC ID:MCLJ07H081).
10. Class II permissive change, Grant date: 04/27/2009
 - a. Enable simultaneously WLAN/WiMAX/WWAN transmission in a new Mobile Host (ThinkPad T400s).
 - b. Co-located with FCC ID: PD9533ANHU, FCC ID: PD9512ANHU, FCC ID: PD9512ANXMU, FCC ID: PD9533ANHMU, FCC ID: TX2-RTL8191SE for both Mobile and Portable hosts.
11. Class II permissive change, Grant date: 06/15/2009
 - a. Add new co-located WLAN module (FCC ID: TX2-RTL8191SE-L) in Tablet Computer (ThinkPad X200 Tablet).
12. Class II permissive change, Pending application : (June, 2009)
 - a. Adding alternate WWAN antenna and co-located with Bluetooth (FCC ID: QDS-BRCM 1046) in Mobile Hosts (L410, SL410, L510, SL510).
 - b. Add new co-located WLAN module (FCC ID: PD9112BNHU) in the Portable host (ThinkPad T400/R400 and ThinkPad T500/W500 Laptop Computers) and the Mobile host (ThinkPad X200/X200s, ThinkPad X300/X301, ThinkPad T400s, ThinkPad SL300/SL400/ SL500, ThinkPad L410/SL410/L500 and SL510 Laptop Computers).