

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

1. Outline

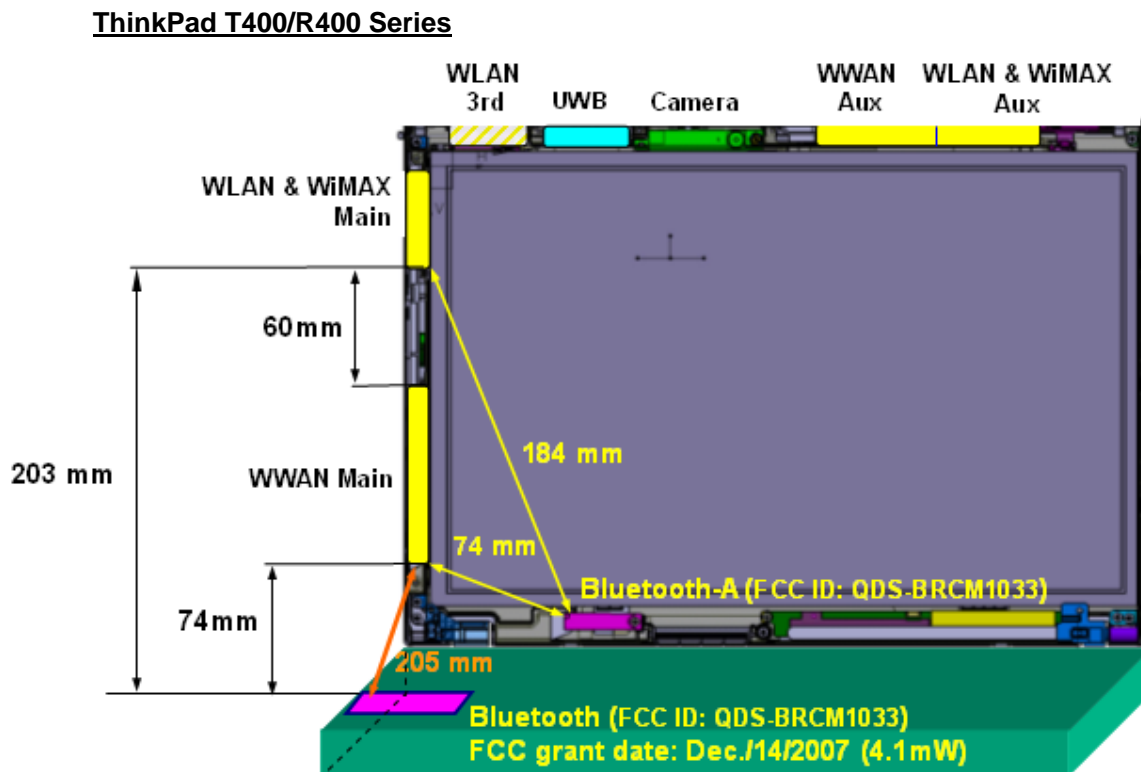
The Figure-1 indicates the specific host PC devices in this application which were already certified by the Commission for the applying WWAN modular device (FCC ID: **J9CUNDP-1L**, IC: **2723A-UNDP1**) on October 16, 2008 under the Portable category regarding FCC CFR 47 Section 2.1093.

The applying WWAN modular device transmits RF simultaneously with the three kinds of transmitters listed below.

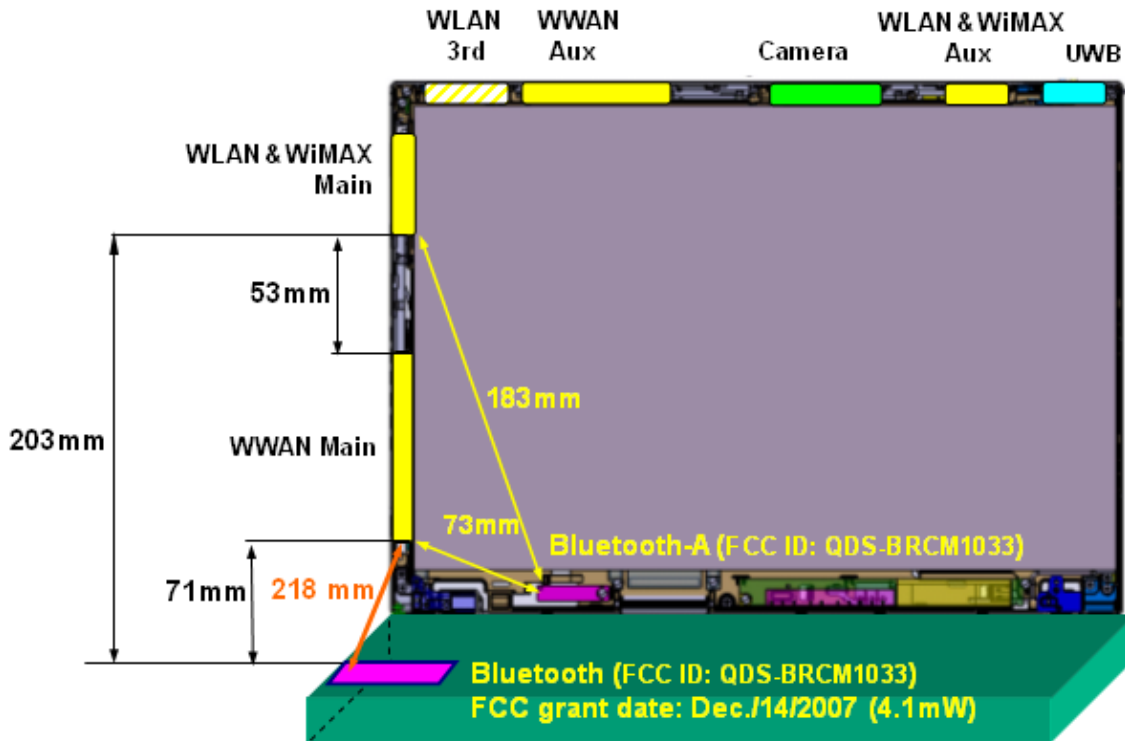
1. Bluetooth:	FCC ID: QDS-BRCM1033	IC: 4324A-BRCM1033
2. UWB:	FCC ID: TX2RTU7305BG13HMC	N/A
3. one of WLAN/WiMAX:	FCC ID: PD9533ANMU	IC: 1000M-533ANMU
	FCC ID: PD9533ANXMU	N/A
	FCC ID: PD9LEN512ANMU	IC: 1000M-L512ANMU
	FCC ID: PPD-AR5BHB63-L	IC: 4104A-ARBHB63L
	*1 FCC ID: PD9533ANHU	IC: 1000M-533ANHU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

*1: New co-located WLAN, WiMAX transmitter devices to be added in this application

Figure-1: Exterior views of the host PC devices



ThinkPad T500/W500 Series



The separation distance between human body and the WWAN Tx antenna of the host PC devices is 74mm or less. Therefore the applying WWAN transmitter module (Model: **UNDP-1**) and the antenna systems are subjected to "Portable device" pursuant to FCC CFR 47 Section 2.1093 and "SAR Evaluation" category pursuant to IC RSS-102e clause 2.5.1.

With the evaluation hereafter, the applying modular transmitter (FCC ID: **J9CUNDP-1L**, IC: **2723A-UNDP1**) has found to comply with the SAR limit pursuant to FCC CFR 47 section 2.1093 for general Population/Uncontrolled exposure and IC RSS-102e clause 4.1.

2. RF Exposure justification regarding Bluetooth co-location

The separation distance between the WWAN and Bluetooth antennas is 7.3 m (> 5cm) and the transmission power of Bluetooth is 4.1mW (< 60/ f_{GHz}), therefore the co-location evaluation for the Bluetooth device is not required 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 WWAN Main antenna falls in “**Portable**” category. On the other hand, the WLAN/WiMAX antennas are “**Mobile**” category.

Therefore, the “antenna-to-antenna separation distance” between the WWAN and WLAN/WiMAX antennas is required for the RF Exposure co-location evaluation pursuant to KDB 616217.

As shown by Table-1, the “antenna-to-antenna separation distance” is calculated as minimum 24 cm, and the actual separation distance between WWAN and WLAN/WiMAX antennas is 6 cm or less.

Conclusion: Thus, the FCC [Permit-but-Ask process is required](#) to this application for evaluation of simultaneous transmission.

See [Table-3](#) for SAR measurement results of the applying WWAN device, and [Table-4](#) for MPE evaluation concerning the co-located WLAN/WiMAX devices.

Table-1: Antenna to Antenna separation distance of WWAN & WLAN/WiMAX modules

$1/2 n_x = 1/2 [P_x / (60/f) - 1]$ (cm) Px: Max. Conducted power of F3507g			$1/2 n_y = 1/2 [P_y / (60/f) - 1]$ (cm) Py: See Table-2 .			5cm + $1/2 n_x +$ $1/2 n_y$	WLAN to WWAN (cm)	Simul Eval?
WWAN: Cellular	$1/2[1986/(60/0.836)-1]$	14	WLAN 2400MHz	$1/2[632/(60/2.45)-1]$	13	32	5.3 or 6.0	Yes
			WLAN 5250MHz	$1/2[110/(60/5.25)-1]$	5	24		Yes
			WLAN 5600MHz	$1/2[110/(60/5.60)-1]$	5	24		Yes
			WLAN 5785MHz	$1/2[441/(60/5.785)-1]$	21	40		Yes
			WiMAX 2590MHz	$1/2[254/(60/2.59)-1]$	5	24		Yes
WWAN: PCS	$1/2[885/(60/1.880)-1]$	14	WLAN 2400MHz	$1/2[632/(60/2.45)-1]$	13	32		Yes
			WLAN 5250MHz	$1/2[110/(60/5.25)-1]$	5	24		Yes
			WLAN 5600MHz	$1/2[110/(60/5.60)-1]$	5	24		Yes
			WLAN 5785MHz	$1/2[441/(60/5.785)-1]$	21	40		Yes
			WiMAX 2590MHz	$1/2[254/(60/2.59)-1]$	5	24		Yes

Table-2: 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

Table-3: WWAN (Model: F3507G) SAR info.

F3507G Previous Grant date	Host PC model	FCC CFR	Max. Conducted power (P)	SAR Distance (D)	SAR (W/Kg)	limit (W/Kg)
10/16/2008 (with WLAN/WiMAX co-location)	ThinkPad T400/R400	Part 22H	2.0 W	7.4 cm	0.173	1.6
	ThinkPad T500/W500			7.1 cm	0.161	
	ThinkPad T400/R400	Part 24E	0.871 W	7.4 cm	0.112	1.6
	ThinkPad T500/W500			7.1 cm	0.064	

Table-4: MPE of WLAN&WiMAX modules

		Max. Conducted power (See Table-2.) (Py)	Max. Host PC antenna gain (See Table-5.) (G)	MPE *2 (mW/cm ²)	limit (mW/cm ²)
Part 15C	2.4GHz band	0.632 W	1.99 dBi	0.199	1.0
Part 15E	5.18– 5.32GHz	0.110 W	2.59 dBi	0.040	
Part 15E	5.50 – 5.70GHz	0.110 W	2.79 dBi	0.042	
Part 15C	5.745 – 5.825GHz	0.441 W	2.46 dBi	0.155	
Part 27	2.496 – 2.690GHz	0.254 W	1.94 dBi	0.079	

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

Table-5: WLAN & WiMAX Antenna Gains of new host PC devices

	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	
T400/R400	NISSEI	0.54	0.90	1.93	1.47	0.67	1.80	-0.17	0.46	0.46	1.99	0.97	0.67	1.29	
	Amphenol	1.47	0.26	-0.36	-0.30	1.94	1.68	1.65	1.58	1.08	-0.60	1.78	2.79	2.46	
	FOXCONN	-0.40	2.59	1.62	1.38	N/A	1.10	1.22	0.00	-0.69	1.85	0.70	0.20	-0.42	
T500/W500	NISSEI	1.35	1.76	0.09	-1.66	1.55	1.99	0.77	2.04	2.42	1.97	0.20	0.82	-1.01	
	Amphenol	1.61	0.75	1.75	1.75	1.32	1.57	1.47	1.73	2.33	1.18	1.53	0.84	0.67	