

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

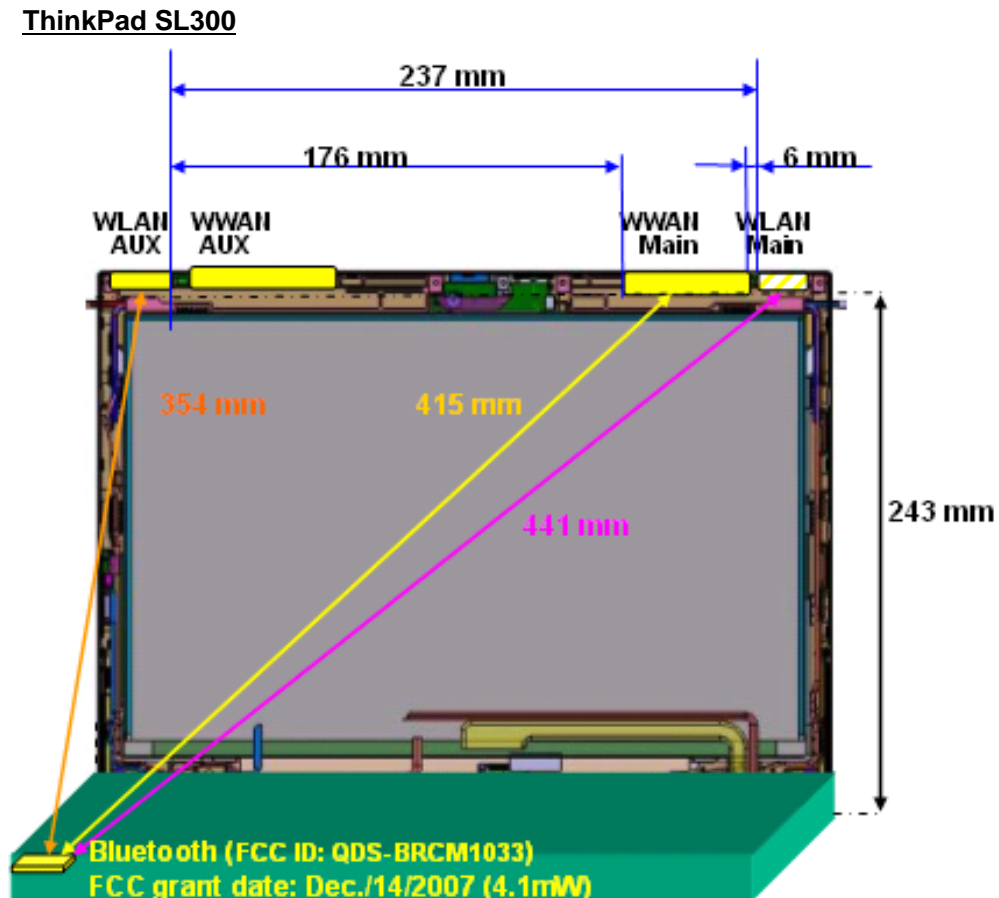
1. Outline

The Figure-1 shows the new host PC devices to be added in this application. And the applying WWAN modular device (FCC ID: **J9CUNDP-1L**, IC: **2723A-UNDP1**) transmits RF with the three kinds of transmitters listed below simultaneously.

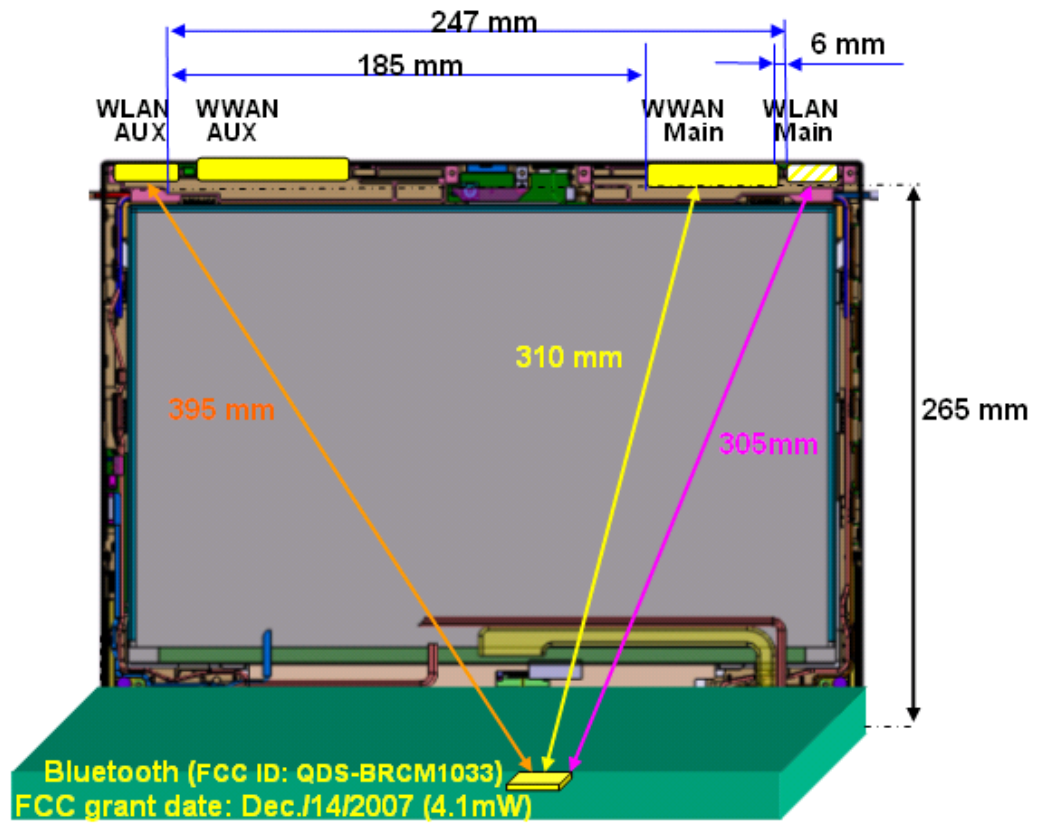
1. Bluetooth:	FCC ID: QDS-BRCM1033	IC: 4324A-BRCM1033
2. UWB:	FCC ID: TX2RTU7305BG13HMC	N/A
3. one of WLAN/WiMAX:	FCC ID: PD9533ANMU	IC: 1000M-533ANMU
	FCC ID: PD9533ANXMU	N/A
	FCC ID: PD9LEN512ANMU	IC: 1000M-L512ANMU
	FCC ID: PPD-AR5BHB63-L	IC: 4104A-ARBHB63L
	*1 FCC ID: PD9533ANHU	IC: 1000M-533ANHU
	*1 FCC ID: PD9512ANHU	IC: 1000M-512ANHU
	*1 FCC ID: PD9512ANXMU	N/A
	*1 FCC ID: PD9533ANHMU	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

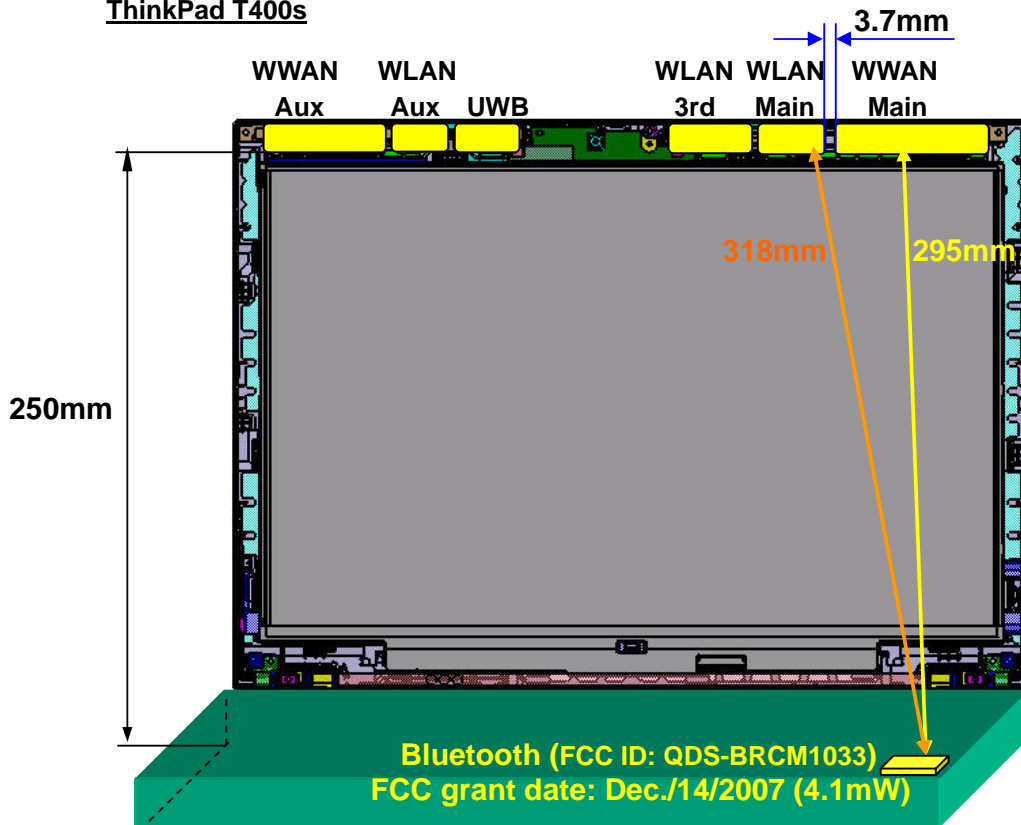
Figure-1: the new host PC devices



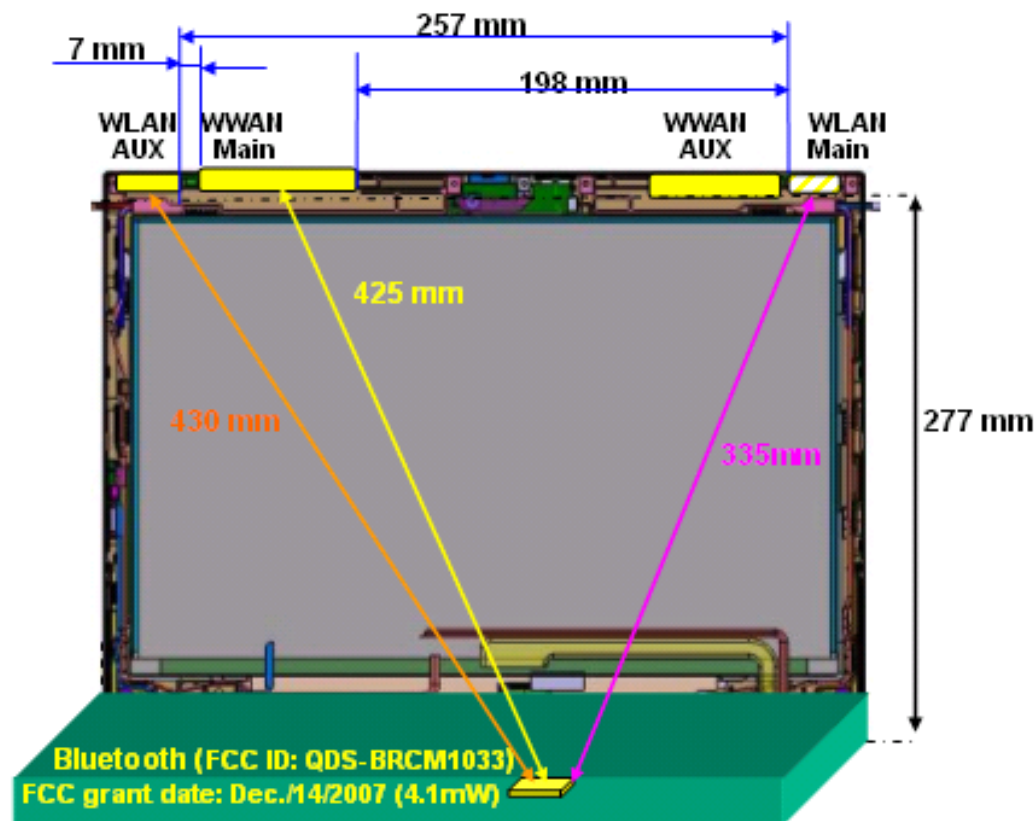
ThinkPad SL400



ThinkPad T400s



ThinkPad SL500



The separation distance between human body and the WWAN Tx antenna of the host PC devices is 243 mm or longer. Therefore the applying WWAN transmitter module (Model: **UNDP-1**) and the antenna systems 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 (Model: **UNDP-1**) 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 (295 mm or more) and its low power (4.1mW) 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 or less of antenna to antenna separation distance. 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.

$$0.284 / 0.533 \text{ (Table-1)} + 0.197 / 1.0 \text{ (Table-2)} = 0.730 < 1.0 \quad \dots\dots \text{ Pass}$$

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

$$0.315 \text{ (Table-1)} + 0.197 \text{ (Table-2)} = 0.512 \text{ mW/cm}^2 \text{ (Limit=1.0)} \quad \dots\dots \text{ Pass}$$

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

Host PC model	Grant date	FCC CFR	Max. Conducted power (P)	Max. Host PC antenna gain (G)	Distance (D)	MPE *2 (mW/cm ²)	limit (mW/cm ²)
ThinkPad 200/X200s	FCC: 9/16/2008	Part 22H	1.986 W	-1.17 dBi	21.1 cm	0.272	0.533 (=800/1500)
ThinkPad 300/X301	IC: 5/13/2008			-0.04 dBi	23.5 cm	0.284	
ThinkPad SL300	New host PCs			-1.97 dBi	24.3 cm	0.170	
ThinkPad SL400				-1.08 dBi	26.5 cm	0.176	
ThinkPad SL500				-0.52 dBi	27.7 cm	0.183	
ThinkPad T400s				-0.10 dBi	25.0 cm	0.247	
ThinkPad 200/X200s	FCC: 9/16/2008	Part 24E	0.885 W	1.34 dBi	21.1 cm	0.215	1.0
ThinkPad 300/X301	IC: 5/13/2008			3.92 dBi	23.5 cm	0.315	
ThinkPad SL300	New host PCs			0.12 dBi	24.3 cm	0.123	
ThinkPad SL400				-1.16 dBi	26.5 cm	0.077	
ThinkPad SL500				2.10 dBi	27.7 cm	0.149	
ThinkPad T400s				1.91 dBi	25.0 cm	0.175	

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

Table-2: MPE of WLAN&WiMAX modules

		Max. Conducted power (See Table-3.) (Py)	Max. Host PC antenna gain (See Table-4.) (G)	MPE *3 (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	

$$*3: \text{MPE} = (1000 \times \text{Py}) \times (10^{G/10}) / (4 \times \pi \times 20^2)$$

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

Table-4: 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
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