RF Evaluation and co-located Justification and test plan

1. Objective

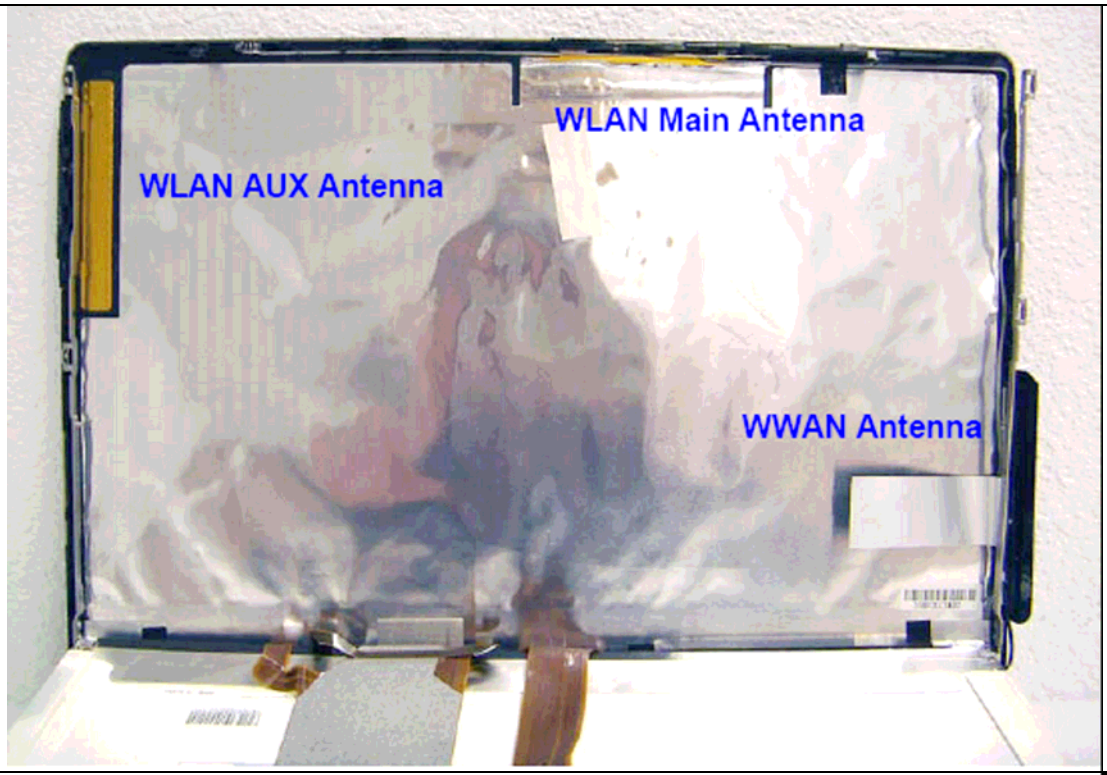
   Co-located approved WWAN module (FCC ID: N7N-MC5720) with approved WLAN module (FCC ID: PPD-AR5BXB72-L) in ThinkPad Z61p/Z61m/Z61t/T60/R60 and X60 laptop computer to address FCC Class II permissive change requirements.

2. Previously Approved Information

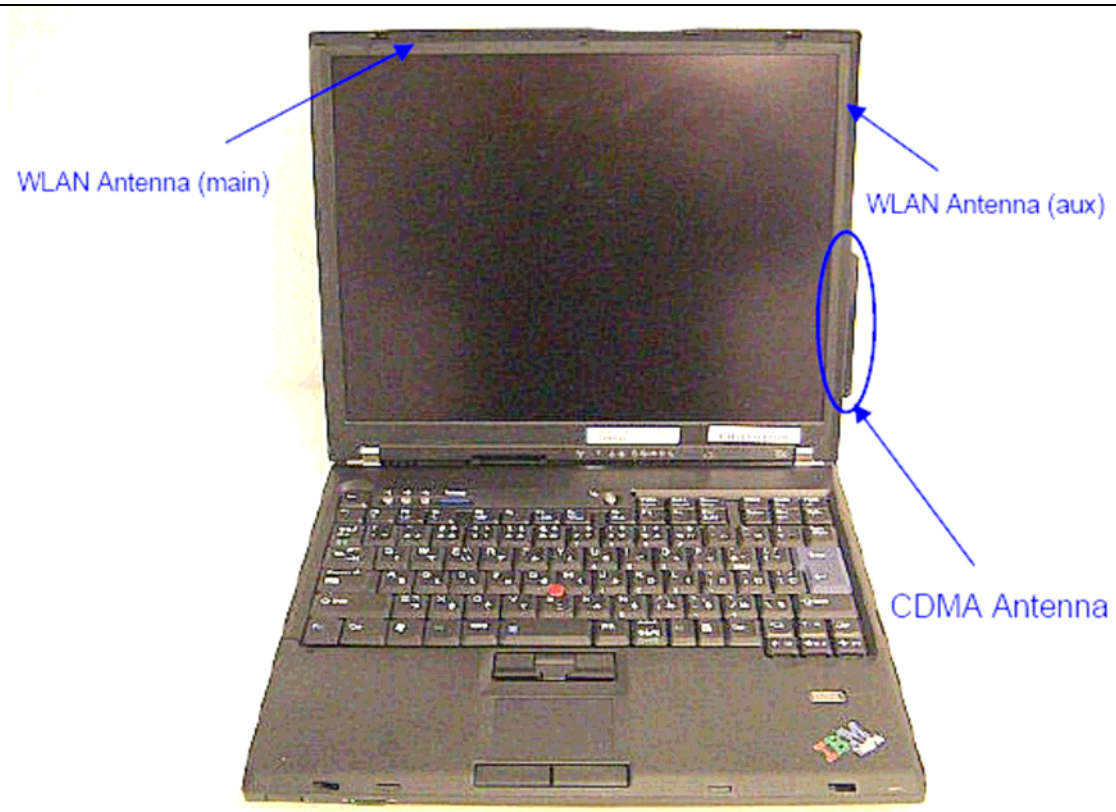
Granted PC models	ThinkPad Z61p/Z61m	ThinkPad Z61t	ThinkPad T60	ThinkPad R60	ThinkPad X60
	Granted data Co-located with WLAN FCC ID:PPD-AR5BXB6 Or Co-located with WLAN FCC ID:PD9LEN3945ABG				
FCC ID: N7N-MC5720	05/24/2006	05/24/2006	01/17/2006	05/03/2006	02/24/2006
22H	0.057W/Kg@ EVDO/Ch384/836.52 MHz (Alum ABS)	0.108W/Kg@ EVDO/CH 384/836.52 MHz (Hyb CFRP)	0.103W/Kg@14 inches/CH 384/836.52 MHz	0.071W/Kg@14 inches/CH 1013/824.7 MHz 0.042W/Kg@15 inches/CH 384/836.52 MHz	0.101W/Kg@CH 1013/836.52 MHz
24E	0.105W/Kg@ EVDO/CH 600/1880 MHz (Alum ABS)	0.167W/Kg@ EVDO/CH 25/1851.25 MHz (Alum CFRP)	0.115W/Kg@14 inches/CH 1175/1908.75 MHz	0.187W/Kg@14 inches/CH 25/1851.25 MHz 0.112W/Kg@15 inches/CH 25/1851.25 MHz	0.152W/Kg@CH 25/1851.25 MHz

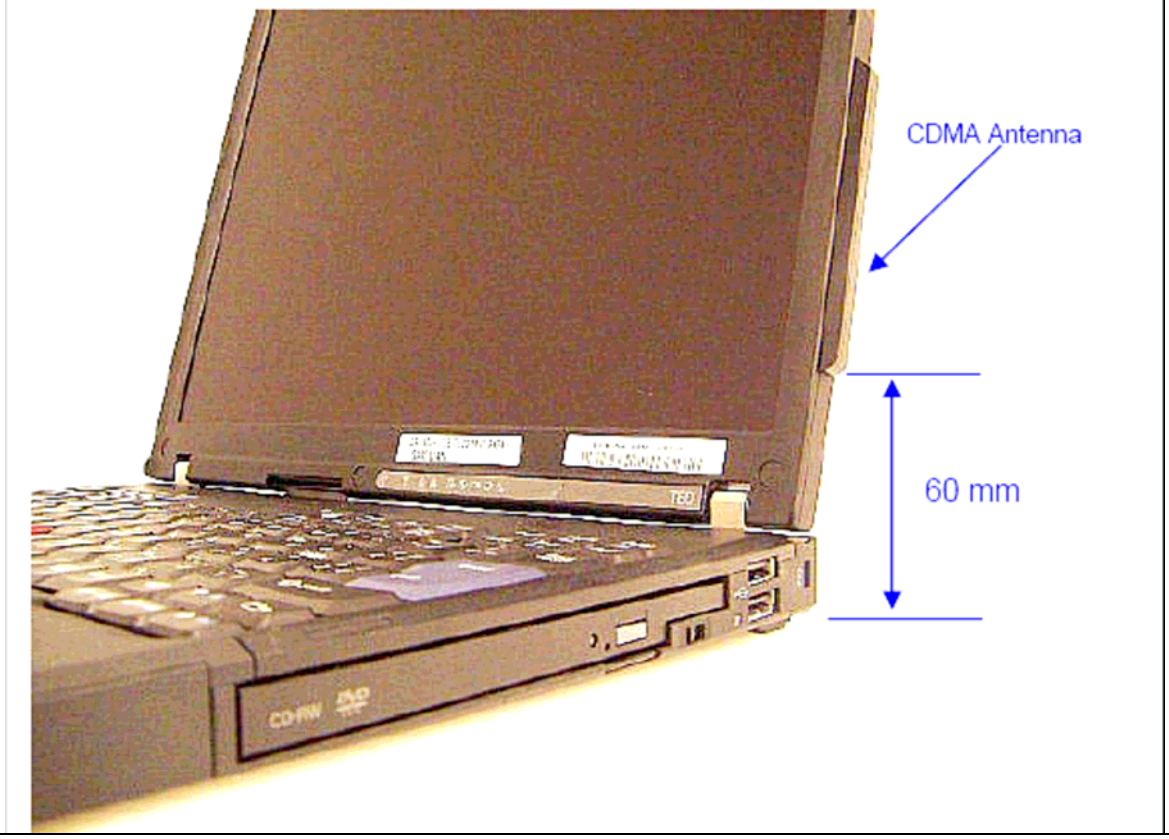
3. Antenna Location in the previous approved Hosts

ThinkPad Z61p/Z61m w/ Aluminum frame	
	
	

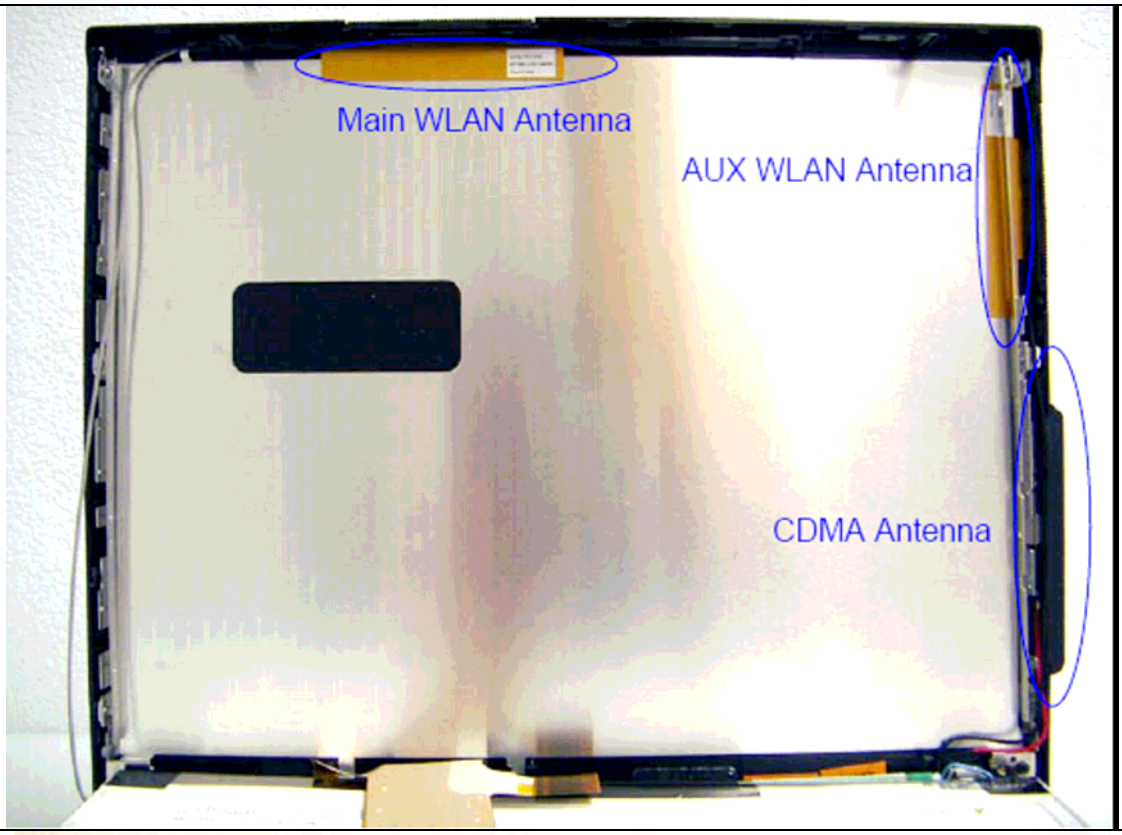
ThinkPad Z61t w/ Carbon fiber frame


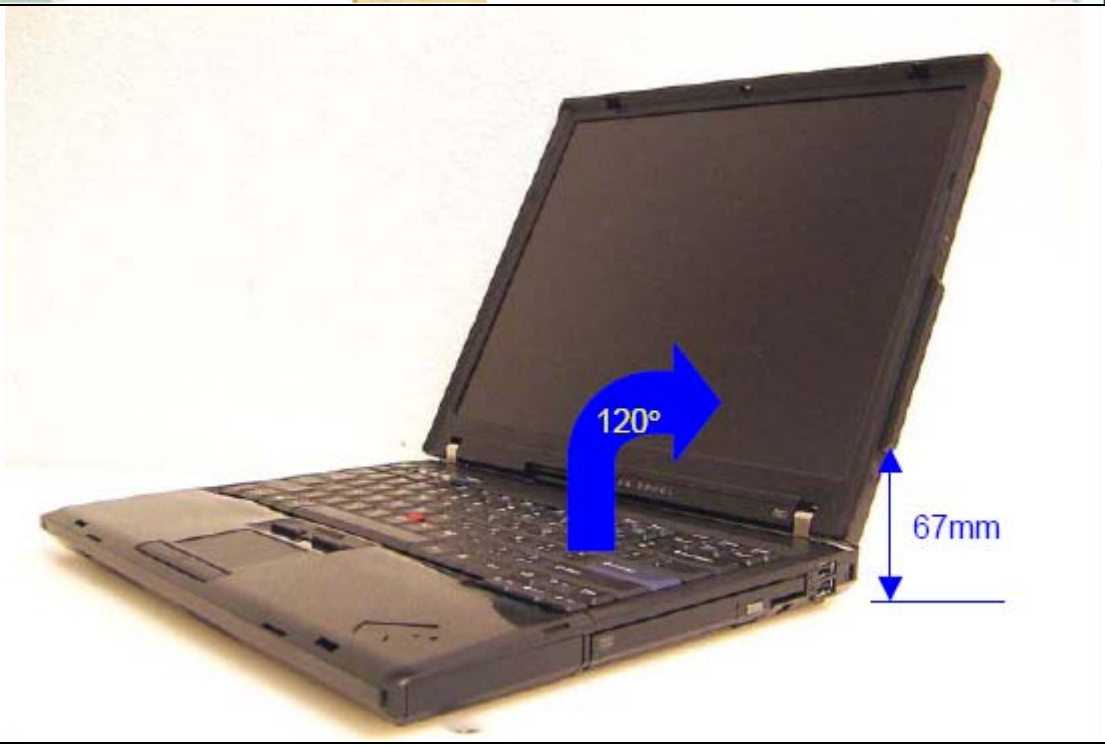

ThinkPad T60 14 inches



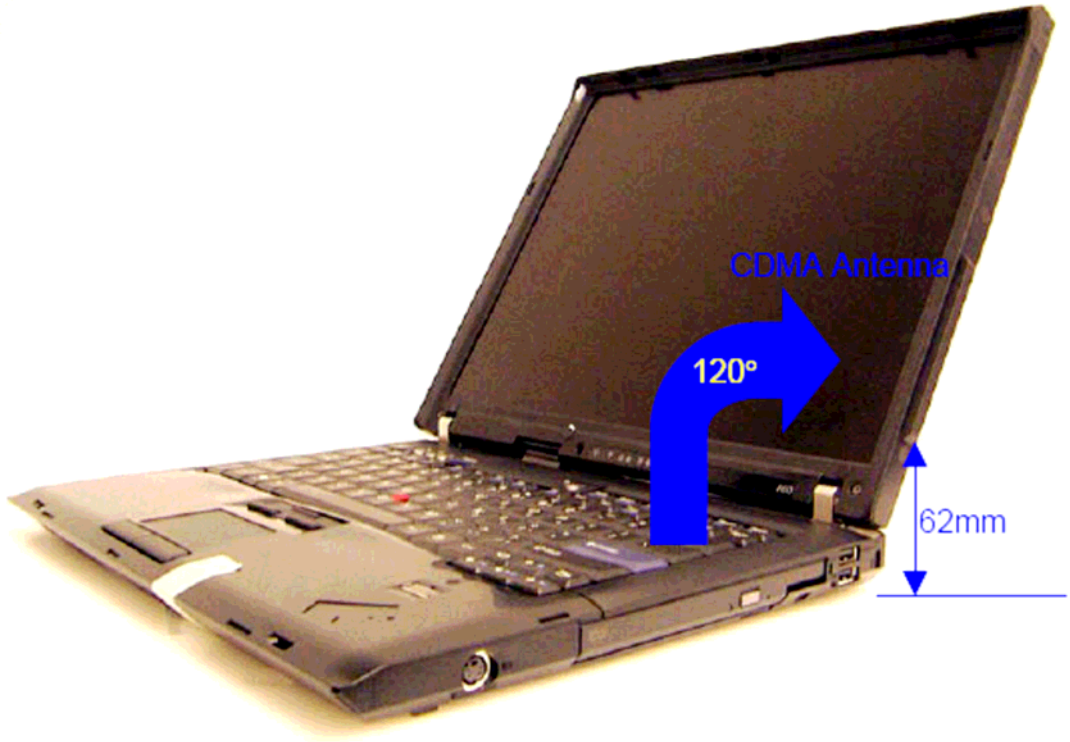


ThinkPad R60 14 inches

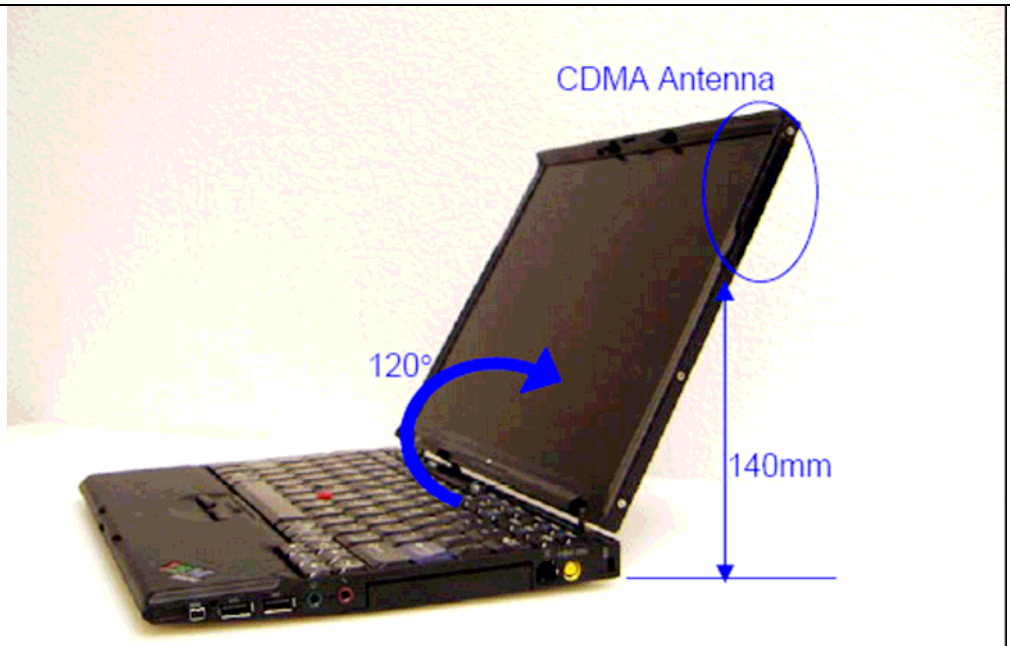




ThinkPad R60 15 inches



ThinkPad X60



4. Output power comparison

	WWAN Module	WLAN Module #1	WLAN Module #2	WLAN Module #3
	FCC ID:N7N-MC5720	FCC ID: PPD-AR5BXB6	FCC ID: PD9LEN3945ABG	FCC ID:PPD-AR5BXB72-L
850 MHz Cellular Band	0.964 W / Peak			
1900 MHz PCS Band	0.923 W / Peak			
2412-2462 MHz		0.19 W / Peak	0.318 W / Peak	0.2366 W / Average
5.15-5.35 GHz		0.041 W / Average	0.068 W / Average	0.1327 W / Average
5.725- 5.850 GHz		0.141 W / Peak	0.1 W / Peak	0.1052 W / Average
TCB Exclusion Consideration	**Dominant TX**	Non-Dominant TX	Non-Dominant TX	Non-Dominant TX
	Portable TX < 20 cm	Mobile TX > 20 cm	Mobile TX > 20 cm	Mobile TX > 20 cm

5. Class II permissive change request

A. FCC ID: PPD-AR5BXB72-L is a 802.11 a/b/g/n Mini-PCI Express MIMO module. The following antennas will be installed in Z61p/Z61m, Z61t, T60, R60 and X60 host laptop computer and co-located with previously approved WWAN module, FCC ID:N7N-MC5720

Host Unit			Antenna Manufacturer	LCD	Main Antenna: Antenna P/N	Main Antenna: Cable length	Main Antenna: Frequency band (GHz) 2.4 -2.5	5.15 -5.35	5.47 -5.73	5.725 -5.85	Auxiliary Antenna: Antenna P/N	Auxiliary Antenna: Cable length	Auxiliary Antenna: Frequency band (GHz) 2.4 -2.5	5.15 -5.35	5.47 -5.725	5.725 -5.85
D-note		T60/T60p	Hitachi	14"	HFT38	528mm	-0.54	2.77	1.77	1.69	HFT39	614mm	1.80	0.66	0.84	1.45
				15"		559mm	-0.42	1.20	1.41	1.87		484mm	-1.27	-1.91	-2.69	-0.49
			Hitachi	14"	HFT38D4	528mm	-1.01	1.88	2.99	2.99	HFT39D4	614mm	1.87	1.97	2.26	2.44
				15"	HFT38D5	559mm	-0.34	1.29	1.09	1.43	HFT39D5	484mm	1.94	1.02	0.36	-0.04
			FOXCONN	14"	023-0100-2400	528mm	0.20	1.45	-1.10	1.74	023-0100-2399	614mm	-1.00	0.80	0.40	0.10
				15"		559mm	-0.30	0.40	0.10	-1.10		484mm	-1.00	0.60	-0.30	-0.50
RP-note		R60/R60e	Hitachi	14"	HFT47	520mm	-0.14	1.74	2.86	2.95	HFT48	370mm	1.67	-1.08	-0.55	0.43
				15"		560mm	-1.04	2.36	1.22	1.23		435mm	1.83	2.14	0.75	1.46
			Tyco	14"	1770417-1	530mm	1.25	1.88	2.36	0.74	1770418-1	380mm	-1.12	0.69	1.26	0.25
				15"		535mm	1.18	1.30	1.70	2.42		435mm	-1.35	0.69	1.45	0.83
			Wistron NeWeb	14"	81.EEF15.001	550mm	1.20	2.86	2.84	2.60	81.EEF15.002	405mm	0.95	2.76	2.89	2.52
				15"	81.EEF15.003	580mm	1.10	2.34	2.55	2.70	81.EEF15.004	470mm	1.50	2.10	2.35	2.40
M-note	M2	Z61t	FOXCONN	14"	023-0100-2399	680mm	-0.37	1.93	0.49	0.72	023-0100-2400	507mm	-1.76	1.21	1.28	1.17
W-note	W2	Z61m	FOXCONN	15"	023-0100-4031	574mm	1.56	0.88	0.85	0.39	023-0100-4032	380mm	0.61	1.30	-0.30	-0.69
KS-note		X60/X60s	Wistron NeWeb	12" w MF	3A.EDU45.111	575mm	0.91	2.78	2.84	1.75	3A.EDU45.112	575mm	1.30	2.86	2.92	2.54
				12" w/o MF	3A.EDU45.114	575mm	1.10	2.82	2.84	2.57	3A.EDU45.115	575mm	1.40	2.90	2.94	2.73

Above WLAN antennas are the same type of antenna (PIFA/ Omni-directional) with lower gain by comparing to the antenna list as documented in the original certification (PPD-AR5BXB72).

B. Above antennas will be installed in the identical locations as previously approved co-located WLAN transmitters (PPD-AR5BXB6 or PD9LEN3945ABG).

C. WWAN Antenna will be the identical antenna as previously approved antenna

6. Justification for testing selected host

EMC consideration

The separation distance between WLAN(PPD-AR5BXB72-L) main and / or aux antenna are within 20 cm to the WWAN (N7N-MC5720) transmitting antenna. Based upon FCC RF exposure policy, when multiple transmitters are contained in a single enclosure and can transmit simultaneously via independent transmitting antenna, it is not necessary to file EMC evaluation test data during Class II permissive change but the responsible party must ensure continuous compliance.

RF Exposure consideration

Separation distance of 20 cm between transmitting antennas do not applicable to RF exposure compliance. When there are multiple transmitters contain in a single enclosure, responsible party must file Class II permissive change and submit applicable RF exposure evaluation as necessary.

As indicated in the section 4 of this document, by comparing the output power, WWAN transmitter is considered as dominant transmitter and WLAN transmitter is considered as non-dominant transmitter. The WLAN transmitting antennas are located more than 20 cm separation distance when the laptop is positioned at lap held position. WLAN module is considered as mobile device per section 2.1091 of FCC rules. WWAN transmitting antenna is located within 20 cm separation distance during the lap held position, WWAN module is considered as portable device per section 2.1093 of FCC rules.

As indicated in the section 2 of this document, the measured SAR values are way below the limits (1.6 W/Kg) in various laptop computer when co-located with WLAN. SAR evaluation is performed to address the co-located effects that are distributed by WLAN to the WWAN module. As indicated in the previous Class II permissive change filing, by activating dominant transmitter (WWAN) and non-dominant transmitter at the same time during co-located SAR evaluation, the SAR values of dominant transmitter only increased by 0.001 W/Kg.

Since the host platform does not change, WLAN and WWAN antennas are installed at identical position as pervious Class II permissive change. The following configurations were selected to evaluate the effect of newly added co-located WLAN transmitter with WWAN module. The test result should provide adequate information to justify RF exposure compliance in all PC platform.

PC models	ThinkPad Z61t	ThinkPad R60
	N7N-MC5720 WWAN module o-Located with PPD-AR5BXB72-L WLAN Module	
1XRTT Mode	**Call Parameter** **Radio config: FWD3, RVS3** **Service option: SO32 (+F-SCH)** **Power Ctrl Parameter: Active bits (Select "All Up bits" after linked to get maximum power)** **Protocol Rev.: 6 (IS-2000-0)**	
1xEVDO Mode	**Call Parameter:** **Application Config: RTAP** **FTAP Rate: 307.2 Kbps**	

	RTAP Rate: 153.6 Kbps **Power Ctrl Parameter: Active bits (Select "All Up bits" after linked to get maximum power)** **Protocol Rev.: 0 (1xEV-DO)** **Call Control:** **Cell Parameters** **Sector ID, Upper (Hex): 00800580** **Sector ID, Lower (Hex): 00000000** **AT Max Power: 23 dBm/1.23 MHz**			
	Part 22	WLAN	Part 22	WLAN
	Center Channel	**2437MHz@g CDD Mode**		
	Center Channel	**2437MHz @ H20**		
	Center Channel	**2437MHz @ H40**		
	Center Channel	**5260MHZ @a CDD Mode**		
	Center Channel	**5260 MHz @H20**		
	Center Channel	**5260 MHz @H40**		
	Part 24	WLAN	Part 24	WLAN
			Center Channel	**2437MHz@g CDD Mode**
			Center Channel	**2437MHz @ H20**
			Center Channel	**2437MHz @ H40**
			Center Channel	**5260MHZ @a CDD Mode**
			Center Channel	**5260 MHz @H20**
			Center Channel	**5260 MHz @H40**

7. RF Exposure evaluation with the WWAN and Bluetooth module

As shown by the Figure-1 thru Figure-5, the Bluetooth antennas integrated in the subjected ThinkPad Series are assembled apart from the WWAN and WLAN antennas with 20 cm or more.

Therefore, the Bluetooth transmitter is not considered as a co-located device, and is allowed to evaluate the RF exposure compliance independently of the applying WWAN modular transmitter or other co-located WLAN ones. In other word, the SAR testing for the applying WWAN device in simultaneous transmitting with the Bluetooth device is not required, when the Bluetooth device satisfies the RF exposure requirement with its own transmission power.

When a customer operates the Lenovo laptop PC on one's lap, the sufficient separation distance (minimum 20cm) between the above Bluetooth antenna and the person's body (lap) can not be maintained. However the footnote14 of the Section 3 in Supplement C to OET Bulletin 65 states:

> "[14] If a device, its antenna or other radiating structures are operating at closer than 2.5 cm from a person's body or in contact with the body, SAR evaluation may be necessary when the output is more than 50 – 100 mW, depending on the device operating configurations and exposure conditions."

The output power of the Bluetooth device is 3mW (far below 50mW). Therefore the BT transmitter satisfies the RF exposure requirement regarding CFR 47 Part 15.247(b)(4) without a SAR compliance test report, and can operate with the applying WWAN transmitter simultaneously.

Figure-1 Antenna assembly of T60 series

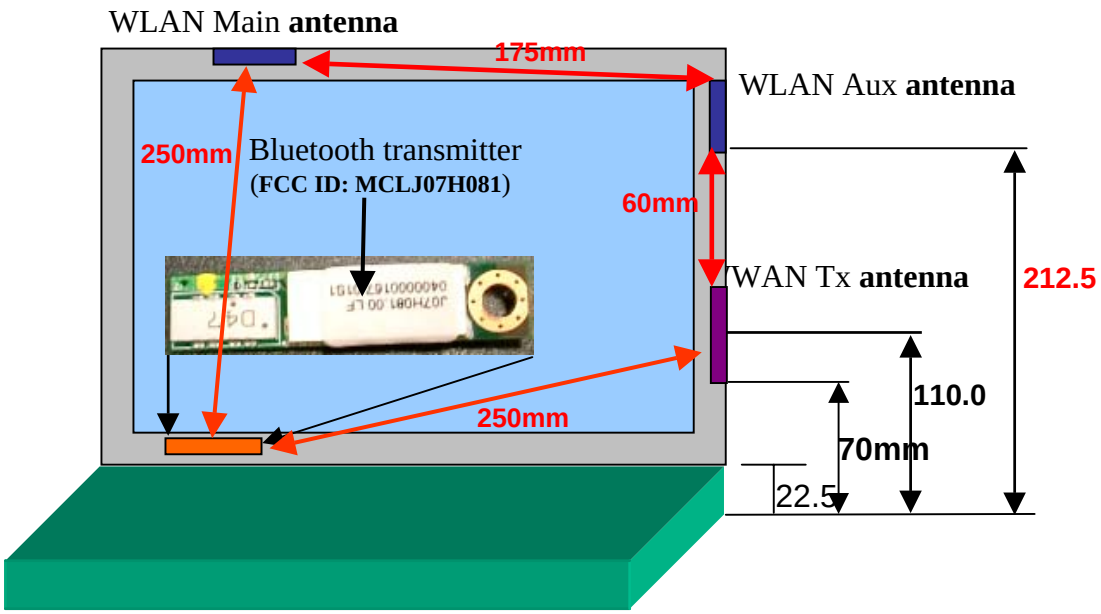


Figure-2 Antenna assembly of ThinkPad R60 series

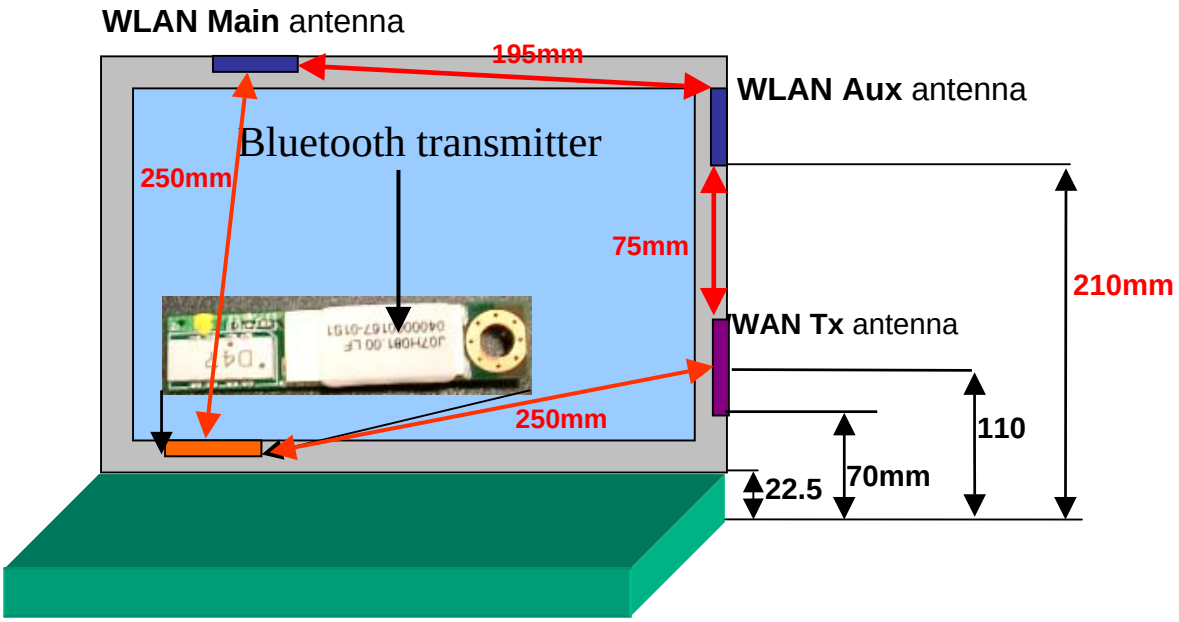


Figure-3 Antenna assembly of ThinkPad X60 series

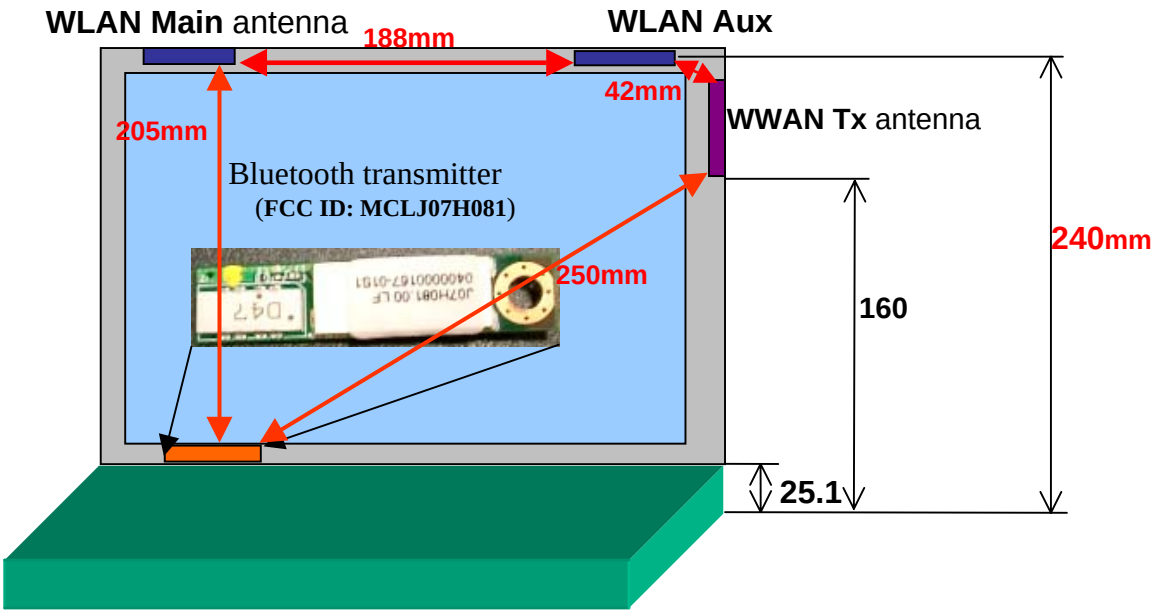


Figure-4 Antenna assembly of ThinkPad Z61m/Z61p Series

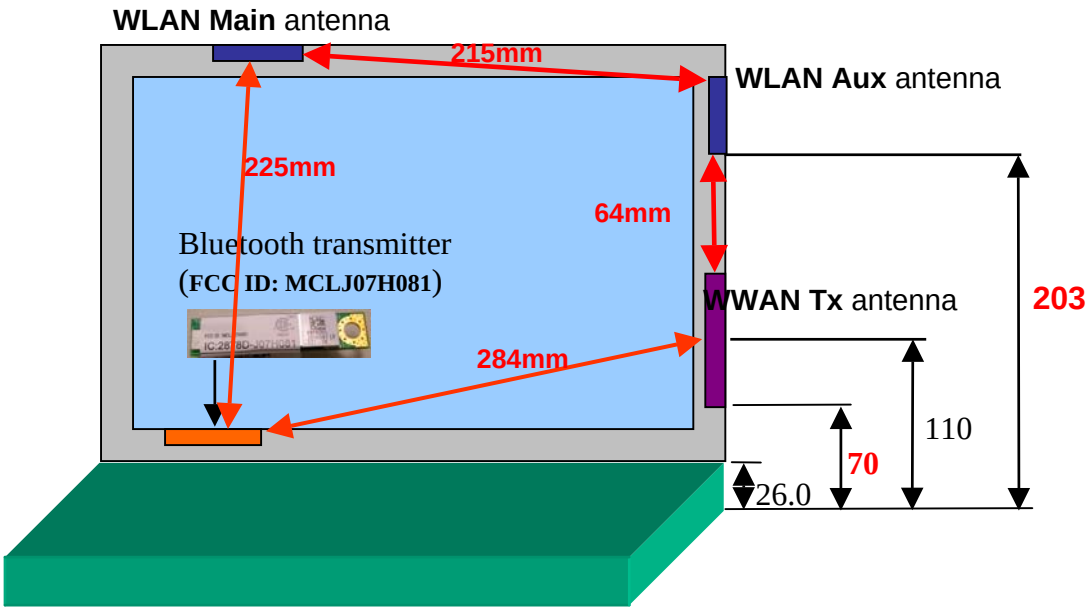


Figure-5 Antenna assembly of ThinkPad Z61t Series