Confirmation for SAR test exclusion
Time Average Procedure for NIHON KOHDEN CORPORATION, Model SX-SDMAC, FCC ID: B6BGZ-1XXP2

June 24, 2022

Product description:

The device is an IEEE.802.11a/b/g/n Wireless LAN module.

Proposal for SAR test exclusion

The device operates in low duty cycle when installed in the specific host device (Telemeter). Therefore, we measure the power value in time-averaging based on Section 6.3 of KDB 447498 D01 v06. We propose the exclusion of SAR test by confirming the satisfaction with SAR Test Exclusion Thresholds based on the formula specified in Section 4.3.1 1) of KDB 447498 D01 v06

Confirmation method of time average power:

The WLAN Module is installed in the host device. Communication between the device and the opposite master device is established in the maximum duty factor. In this condition, time averaged power including the transmission period of ON-OFF is obtained using Power meter.

General test setup procedure:

1) Communication between the host device in which the WLAN Module (telemeter) is installed and the master access point with the maximal load configuration is established.

2) Mode of WLAN and data rate is set so that the duty factor is the maximum. The duty factor is determined based on the following information provided by the customer.

- Standards: IEEE802.11 a/b/g/n
- Data Rates: 11b   5.5/11.0 (Mbps)
                 11g   6.0/9.0/12.0/18.0/24.0/36.0/48.0/54.0 (Mbps)
                 11a   6.0/9.0/12.0/18.0/24.0/36.0/48.0/54.0 (Mbps)
                 11n   MCS0/1/2/3/4/5/6
- Data Size: 1500 (max) [IP Packet] + (30 [802.11 MAC] + 6 [SNAP] + 2 [Type] + 4 [FSC]) * 2 = 1584 Byte
- Destinations: 4
- Transmission Duration: 1584(byte)*8 (bit)*4(Destinations) This is Maximum Specification
- Duty Factor = Transmission Duration / Date Rate * (1/Transmission Interval) * 100 (%)
- Transmission Interval: 256 ms This is Minimum Specification

Note: Details are shown in Table 1.

3) The output power transmitted from the host device (telemeter) is measured by Power meter via Directional Coupler. The test is performed with the rate which has the worst duty factor on each mode in Table 1.

4) The average value including the transmission period of ON-OFF is obtained, setting the detector of Power Meter to Average. Observing time is long enough (1 min.) in consideration of variability.
The test is set based on the specification value of RF output power provided by the customer in Table 2.

Table 1: Duty Factor (Maximum Specification) on each Rate

Mode	Duty Factor [%]							
11b	5.5 Mbps	11 Mbps	-	-	-	-	-	-
	4	2	-	-	-	-	-	-
11a/11g	6 Mbps	9 Mbps	12 Mbps	18 Mbps	24 Mbps	36 Mbps	48 Mbps	54 Mbps
	3	2	2	1	1	1	< 0.5	< 0.5
11n	MCS0 (6.5 Mbps)	MCS1 (13 Mbps)	MCS2 (19.5 Mbps)	MCS3 (26 Mbps)	MCS4 (39 Mbps)	MCS5 (52 Mbps)	MCS6 (58.5 Mbps)	-
	3	2	1	1	1	< 0.5	< 0.5	-

Duty Factor = Transmission Duration / Transmission Interval * 100 [%] *refer to 2)

Table 2: Specification of RF output power

Band	Mode	Rate	Specification of RF output power	
			[dBm]	[mW]
2.4 GHz	11b	5.5 Mbps	18	63.1
	11g	6 Mbps	15	31.6
	11n-HT20	MCS0	15	31/6
5 GHz	11a (W52/W53)	6 Mbps	10	10
	11n-HT20 (W52/W53)	MCS0	11	12.6
	11a (W56)	6 Mbps	8.5	7.1
	11n-HT20 (W56)	MCS0	8.5	7.1
	11a (W58)	6 Mbps	9	7.9
	11n-HT20 (W58)	MCS0	9	7.9

Results:

KDB 447498 D01 v06 has the following exclusion for portable devices:

The 1 g and 10 g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances < 50 mm are determined by:

[(measured maximum average output power(mW))/(Minimum separation distance(mm))] · [$\sqrt{}$ f (GHz)]

< 3.0 for 1g SAR and < 7.5 for 10g extremity SAR where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is < 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Table 3: Results of testing in each mode for confirmation for exclusion of SAR

Band	Mode	Rate	Duty Factor*1 [%]	Time average power*2 [dBm]	Time average power*2 [mW]	Separation distance [mm]	Frequency [GHz]	**Result** *3	**Result with tolerance** *4	no SAR required
2.4 GHz	11b	5.5 Mbps	3.7	2.62	1.83	5	2.48	**0.6**	**1.0**	
	11g	6 Mbps	3.0	-1.57	0.70	5	2.48	**0.2**	**0.4**	
	11n-HT20	MCS0	3.3	-1.80	0.66	5	2.48	**0.2**	**0.4**	
5 GHz	11a (W52/W53)	6 Mbps	2.7	-6.80	0.21	5	5.35	**0.1**	**0.2**	< 3.0
	11n-HT20 (W52/W53)	MCS0	2.8	-6.81	0.21	5	5.35	**0.1**	**0.2**	
	11a (W56)	6 Mbps	2.7	-7.80	0.17	5	5.70	**0.1**	**0.1**	
	11n-HT20 (W56)	MCS0	2.8	-7.53	0.18	5	5.70	**0.1**	**0.1**	
	11a (W58)	6 Mbps	2.9	-7.20	0.19	5	5.85	**0.1**	**0.2**	
	11n-HT20 (W58)	MCS0	2.8	-7.25	0.19	5	5.85	**0.1**	**0.2**	

Duty factor is calculated from the typical waveform since the waveform of the maximum duty factor is difficult to be measured. Total ON Time in 1 Period varies. Therefore, observing time is long enough to capture the period which has the maximum duty factor and the maximum average value is measured.
*1 Duty Factor was calculated from the measured period and total on time on each mode.
*2 Time average power is the measured value.
*3 Result was calculated based on section 4.3.1 a) of KDB 447498 D01 v06 below.
[(measured Time average output power (mW))/(Minimum separation distance(mm))] · [$\sqrt{}$ f (GHz)] < 3.0
*4 Result with tolerance was calculated based on section 4.3.1 a) of KDB 447498 D01 v06 using the value of Time average power +tolerance (2.5 dB) of the specification provided by the customer.
[(measured Time average output power+2.5 dB (mW))/(Minimum separation distance(mm))] · [$\sqrt{}$ f (GHz)] < 3.0

Table 4: Results of simulation in each mode for confirmation for exclusion of SAR of based on the provided specification by the customer.

Band	Mode	Rate	Duty Factor*1 [%]	Time average power*2 [mW]	Separation distance [mm]	Frequency [GHz]	**Result** *3	**Result with tolerance** *4	no SAR required
2.4 GHz	11b	5.5 Mbps	4	2.5	5	2.48	**0.8**	**1.4**	
	11g	6 Mbps	3	0.9	5	2.48	**0.3**	**0.5**	
	11n-HT20	MCS0	3	0.9	5	2.48	**0.3**	**0.5**	
5 GHz	11a (W52/W53)	6 Mbps	3	0.3	5	5.35	**0.1**	**0.2**	< 3.0
	11n-HT20 (W52/W53)	MCS0	3	0.3	5	5.35	**0.1**	**0.2**	
	11a (W56)	6 Mbps	3	0.2	5	5.70	**0.1**	**0.2**	
	11n-HT20 (W56)	MCS0	3	0.2	5	5.70	**0.1**	**0.2**	
	11a (W58)	6 Mbps	3	0.2	5	5.85	**0.1**	**0.2**	
	11n-HT20 (W58)	MCS0	3	0.2	5	5.85	**0.1**	**0.2**	

Duty factor is calculated from the typical waveform since the waveform of the maximum duty factor is difficult to be measured. Total ON Time in 1 Period varies. Therefore, observing time is long enough to capture the period which has the maximum duty factor and the maximum average value is measured.

*1 Duty Factor was used from the Table 1.

*2 Time average power: Set up value for RF output power of Table 2 [mW] * Duty Factor / 100.

*3 Result was calculated based on section 4.3.1 a) of KDB 447498 D01 v06 below.

[(measured Time average output power (mW))/(Minimum separation distance(mm))]·[$\sqrt{f(GHz)}$] < 3.0

*4 Result with tolerance was calculated based on section 4.3.1 a) of KDB 447498 D01 v06 using the value of Time average power +tolerance (2.5 dB) of the specification provided by the customer.

[(measured Time average output power +2.5 dB (mW))/(Minimum separation distance(mm))]·[$\sqrt{f(GHz)}$] < 3.0
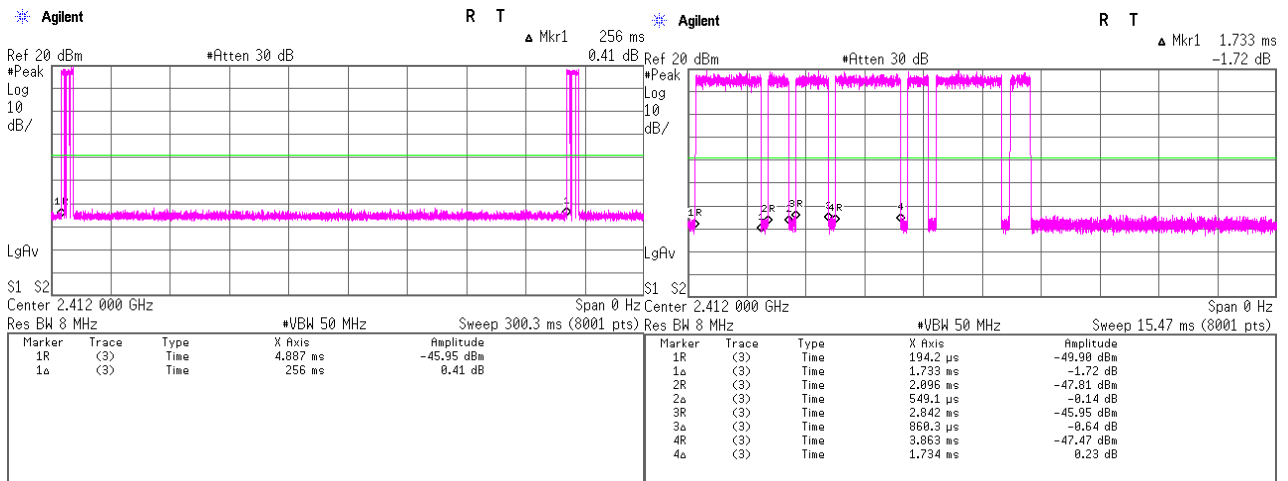
Figure
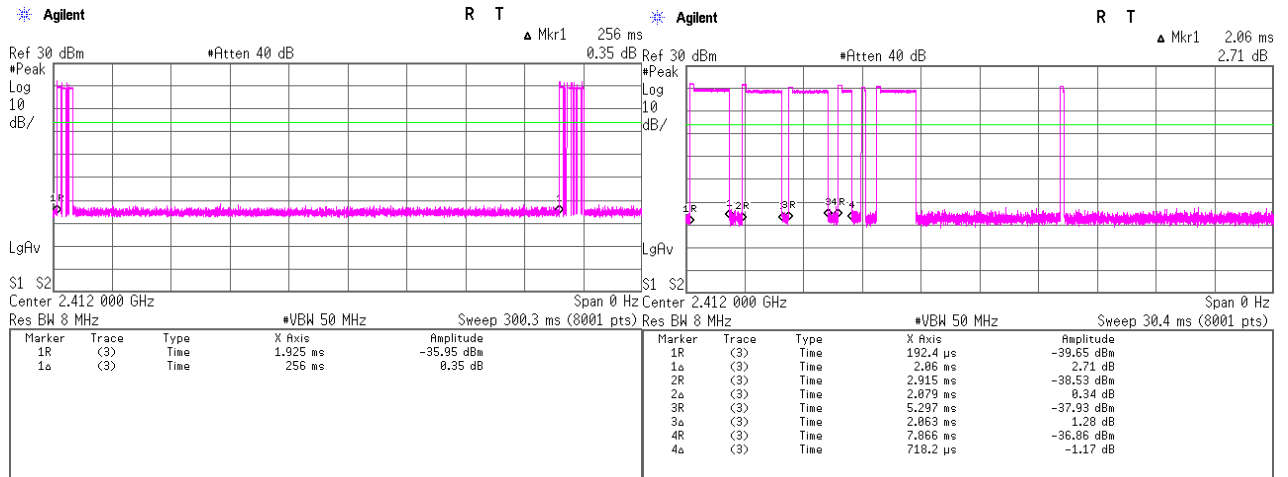
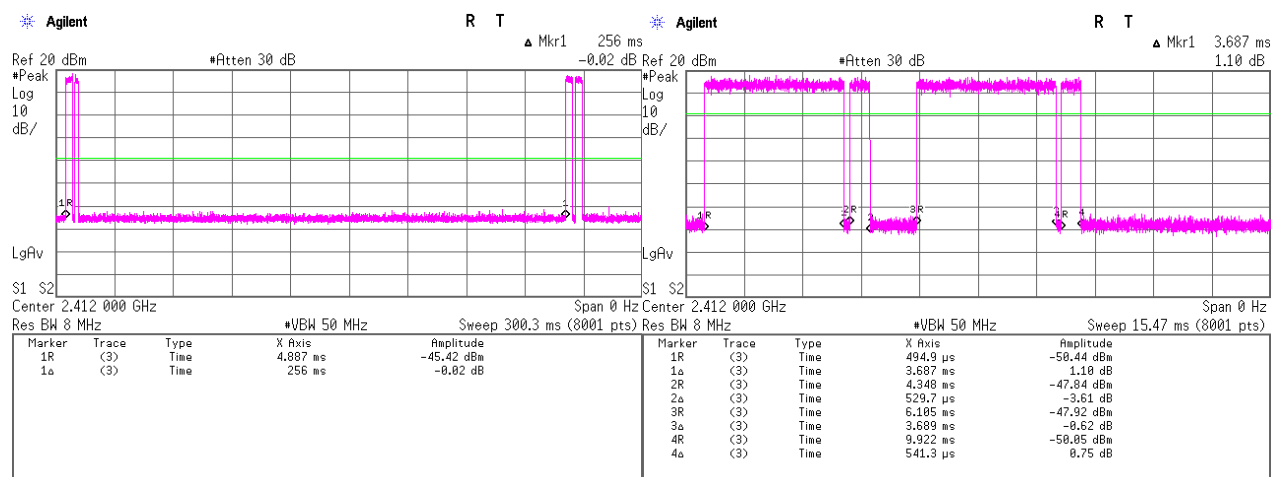(1Period: 256 ms) (Total On Time: 9.4666 ms)
Figure 1 – WLAN Traffic at 2.4 GHz / 11b, 5.5 Mb/s (Duty Factor: 3.7 %)
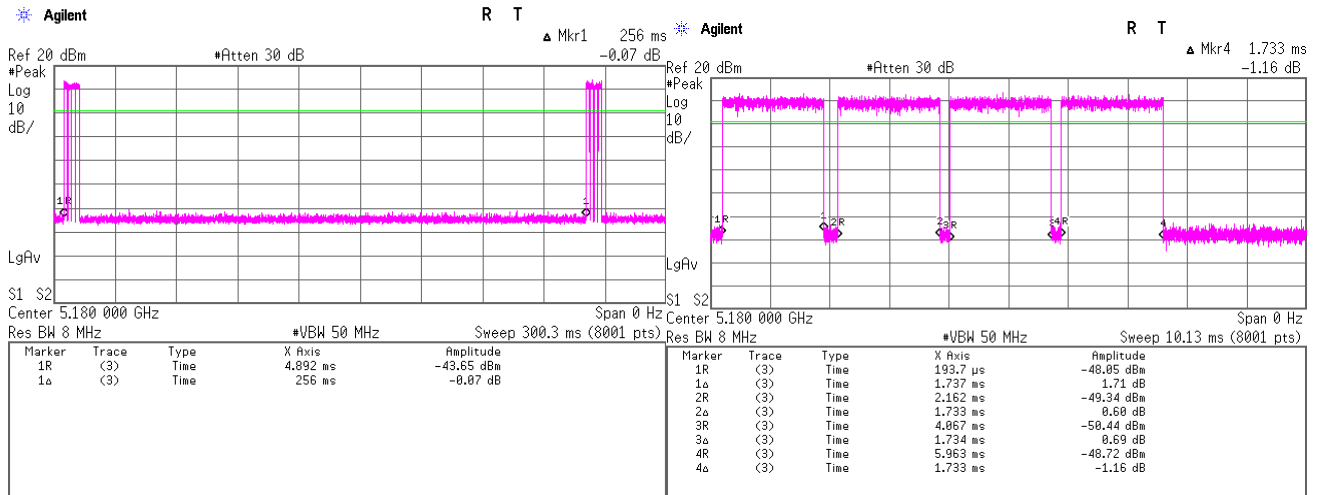
(1Period: 256 ms) (Total On Time: 7.7105 ms)
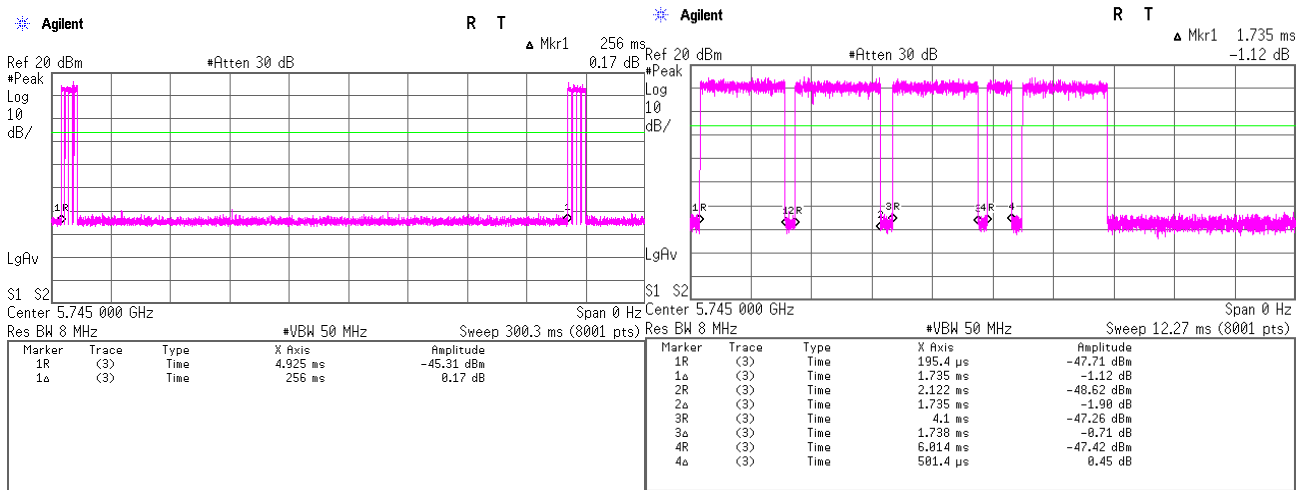**Figure 2 – WLAN Traffic at 2.4 GHz / 11g, 6 Mb/s (Duty Factor: 3.0 %)**

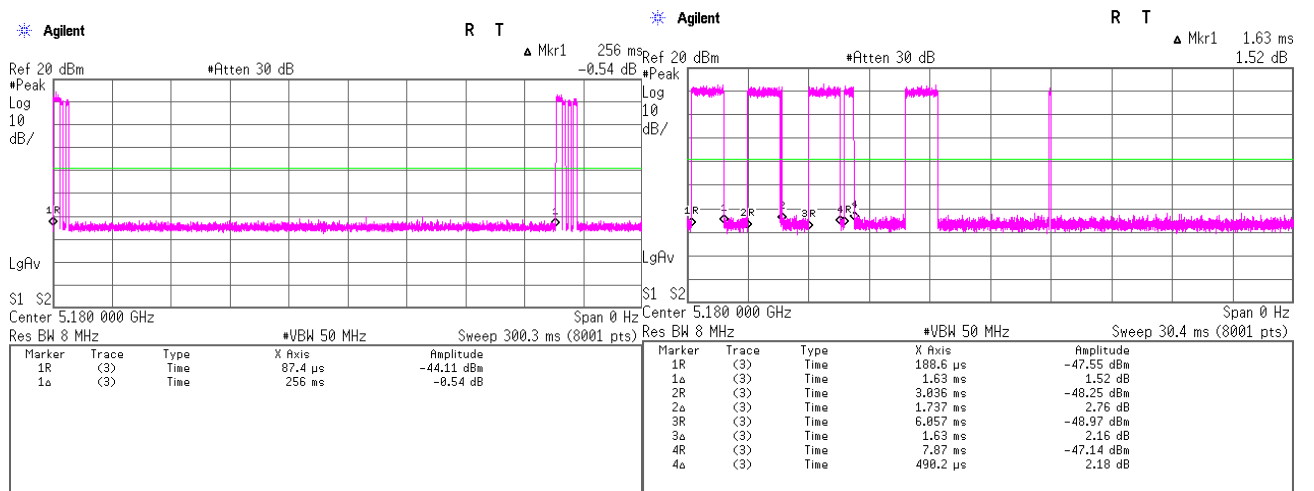(1Period: 256 ms) (Total On Time: 8.447 ms)
Figure 3 – WLAN Traffic at 2.4 GHz / 11n, MCS0 (Duty Factor: 3.3 %)

(1Period: 256 ms)   **(Total On Time: 6.937 ms)**

Figure 4 – WLAN Traffic at 5 GHz (W52/W53/W56) / 11a, 6 Mb/s (Duty Factor: 2.7 %)

(1Period: 256 ms)   **(Total On Time: 7.444 ms)**

Figure 4 – WLAN Traffic at 5 GHz (W58) / 11a, 6 Mb/s (Duty Factor: 2.9 %)

(1Period: 256 ms)   **(Total On Time: 7.1974 ms)**

Figure 5 – WLAN Traffic at 5 GHz (W52/W53/W56/W58) / 11n, MCS0 (Duty Factor: 2.8 %)

Conclusion:

From the measurement procedure for Time-Averaged Power we confirmed and the results, we consider SAR test can be excluded when the module is installed in the host device (telemeter).

Toyokazu Imamura

Leader

UL Japan, Inc.