# Introduction

This document describes a proposed test plan with regards to rf exposure for the DAP WiFi module (FCC ID: T5MFCE060) when co-located with a WiFi/Bluetooth module (FCC ID: HDWF10040) in the DAP systems hand-operated / hand-held host systems, specifically the CE8640B, CE8810B and CE8820B. Both modules have limited modular approvals.

The host systems can be configured with just the WiFi/Bluetooth module HDWF10040 (a configuration already covered under the modular approval for HDWF10040), with just the WiFi module T5MFCE060 or with both modules. In all three of the system configurations containing both modules the HDWF10040 WiFi/Bluetooth module is limited to operating only in the Bluetooth mode (refer to attestation letter provided with this application).

| Host System | T5MFCE060 installed? | HDWF10040 installed? | Comments |
|---|---|---|---|
| CE8640B | NO | YES | HDWF10040 module has both WiFi and Bluetooth functions enabled. Only one mode operates at a time (no simultaneous WiFi and Bluetooth transmissions). |
| CE8810B | NO | YES | |
| CE8820B | NO | YES | |
| CE8640B | YES | NO | T5MFCE060 module providing a WiFi interface. No collocation in these models. |
| CE8810B | YES | NO | |
| CE8820B | YES | NO | |
| CE8640B | YES | YES | WiFi functionality of the HDWF10040 module is disabled by software. Bluetooth functionality for HDWF10040 is enabled and may simultaneously transmit with T5MFCE060. |
| CE8810B | YES | YES | |
| CE8820B | YES | YES | |
| This configuration is outside the scope of the rf exposure evaluation and associated request for a Class II Permissive change. The modular approval for HDWF10040 allows for use in hand-held/hand operated host systems. | | | |

RF exposure evaluations were limited to MPE calculations based on the following:

- The host systems are for hand-held use with no body-worn accessories;
- The expected operating conditions would ensure at least a 20cm separation from the WLAN and Bluetooth antennas from the body;
- The WLAN/Bluetooth module's output power is below the (60/f) threshold and Pref thresholds when operating in Bluetooth mode ;
- The WLAN output power is below the $300 \cdot [f(GHz)]^{-0.5}$ threshold detailed in KDB 447498 v04 section 4(c)(iii);

## Antenna Separation Distances

The three host systems share a common form factor. The major differences between them are the type of LCD screen and whether or not the system has a keyboard. The CE8640B has a smaller screen and a keyboard while the CE8810B and CE8820B have a full screen and no keyboard. The CE8810B and CE8820B use different screen technologies.



Full screen system (CE8810B and CE8820B) and System with Keyboard (CE8640B)

All separation distances are greater than 2.5cm. The antennas are integrated into the system and not externally accessible. The antennas used are:

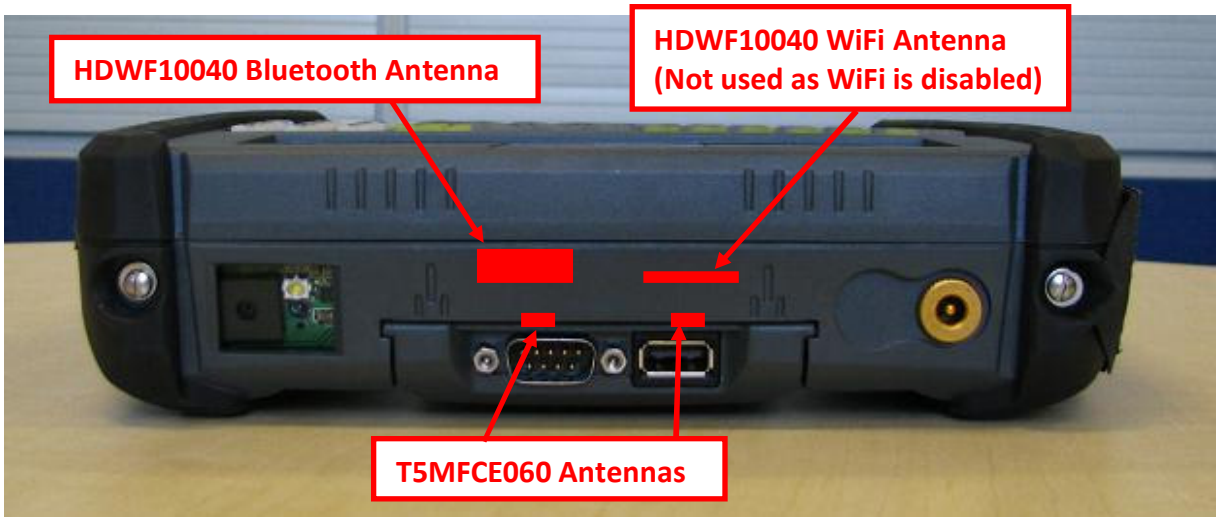
| Module | Antenna manufacturer / part # | Type | Gain |
|---|---|---|---|
| WiFi module T5MFCE060 | Johanson Industries 2450AT42B100 | Dipole | 0 dBi |
| WIFI/BT module HDWF10040 | Antenova 030A5645-01 | Mica 2.4GHz, SMD | 1.8 dBi |

The locations of the antennas are consistent with the expected separation distances of more than 20cm form the body, with the exception of the hands and wrists.

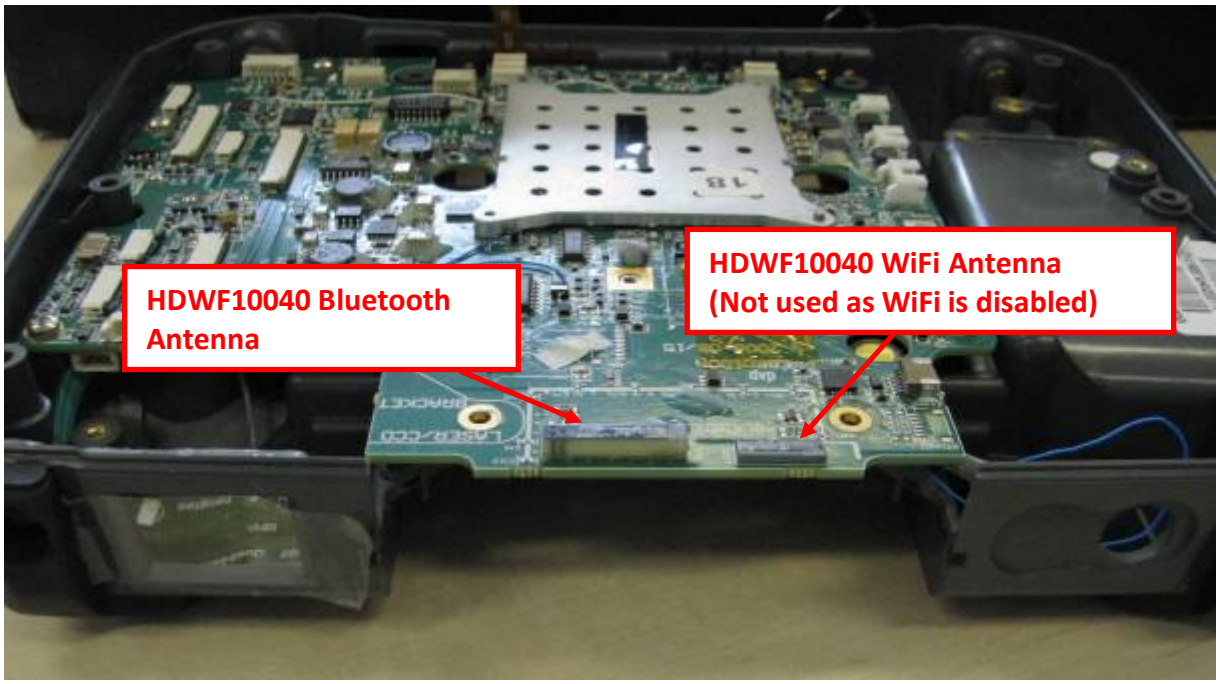
In all three host system the F10040 module antennas & T5MFCE060 module antennas are going to be at the same location. The following photographs show the separation distances between the antennas for the two modules in the host enclosures.

### *End and top views showing antenna locations*

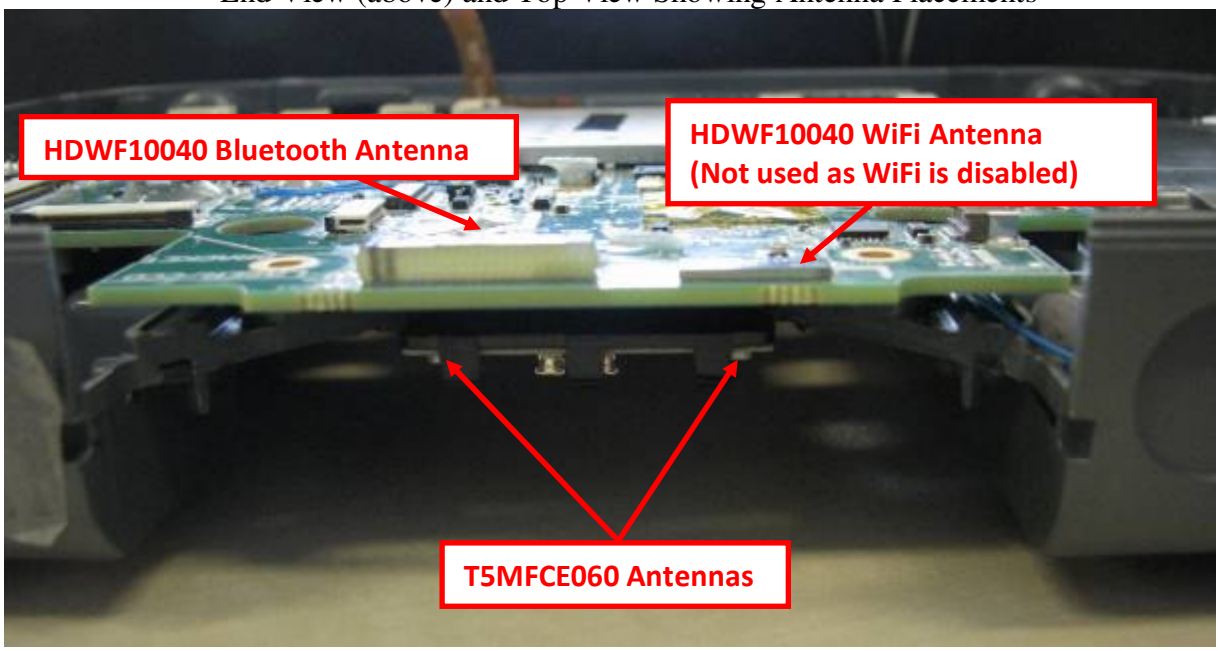
Version show is version with keyboard and small screen, antenna locations are the same within the enclosure of all three models.

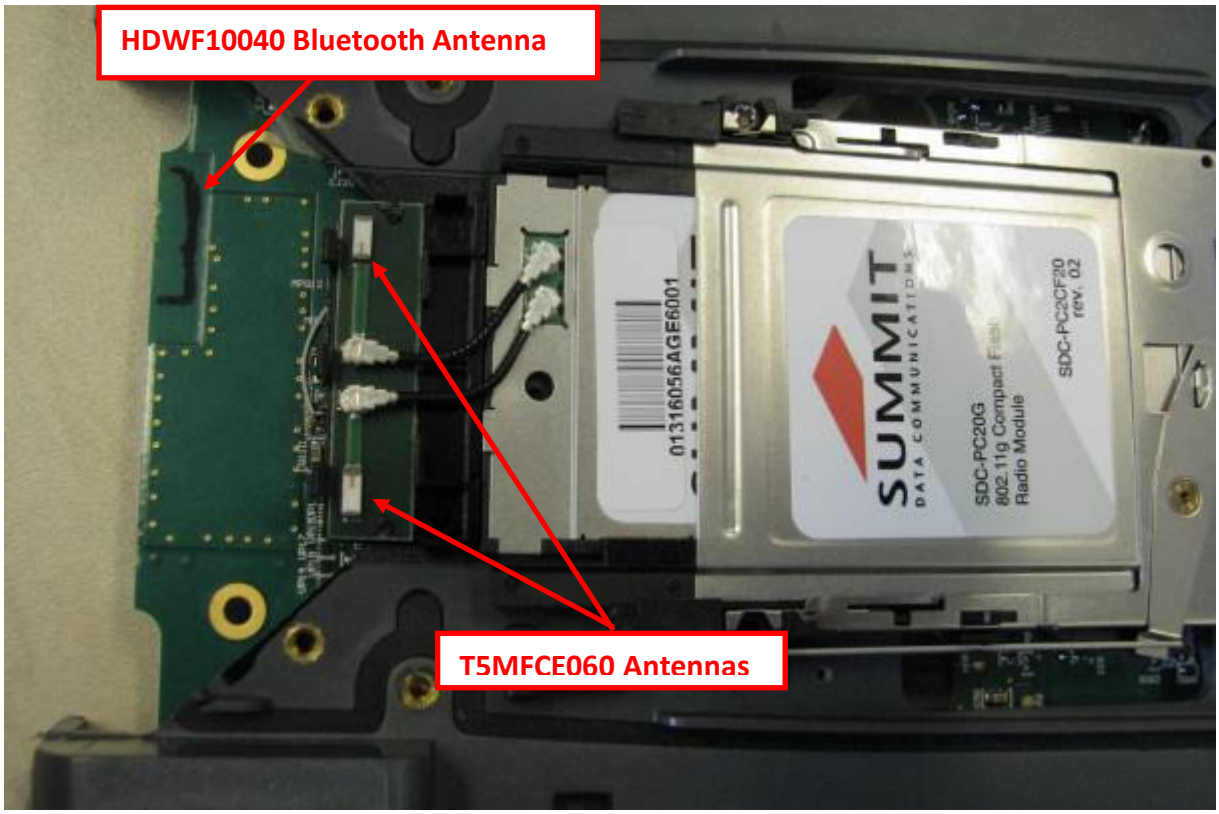



***Enclosure removed to show locations of antennas***




End View (above) and Top View Showing Antenna Placements






Bottom View Showing Antenna Placements

# SAR Thresholds

The host is a hand-held device, and has no accessories for the device to be body-worn during operation. Referencing FCC publication KDB447498 SAR is not required for a stand-alone device operating at P < 60/f (GHz) or for devices that operate simultaneously with other transmitters that operate at P< ½[60/f (GHz)].

Paragraph 4(c) of KDB447498 states that SAR evaluation is not required for hand-held transmitters that operate closer than 5 cm to the body when they have an output power that is < 300[f(GHz)] $^{-0.5}$ mW. For devices that could be within 5cm of the hand (but > 5cm from the body) the threshold increases to 1000 [f(GHz)]$^{-0.5}$ mW

The output power, antenna gains and the thresholds for each module are detailed in the tables on the next page. These show that:

- The Bluetooth module is below the 60/f, and both of the hand-held SAR thresholds when operating in Bluetooth mode.
- The WiFi module T5MFCE060 is below both of the hand-held SAR thresholds.

Output Power And Threshold for General SAR Exemption

| Device | Operating Frequency (MHz) | | Output power | SAR threshold (60/f) |
|---|---|---|---|---|
| | From | To | mW | mW |
| WiFi Module | 2412 | 2462 | 64 | 24.4 |
| Bluetooth Module | 2402 | 2480 | 1.77 | 24.2 |
| Only the Bluetooth module's output power falls below the power level threshold that exempts devices from SAR evaluation under any exposure condition. | | | | |

Output Power And Threshold for Hand-Held Use, Antenna Within 5cm of Body

| Device | Operating Frequency (MHz) | | Output power for rf exposure | Hand-held, < 5cm from body threshold 300·[f(GHz)]$^{-0.5}$ | |
|---|---|---|---|---|---|
| | From | To | mW | Threshold | % of Threshold |
| WiFi Module | 2412 | 2462 | 64.0 | 191.2 mW | 33.47% |
| Bluetooth Module | 2402 | 2480 | 1.77 | 190.5 mW | 0.93% |
| All output powers fall below the power level threshold that exempts devices from SAR evaluation when used in hand-held devices that might come within 5cm of the body. In addition the sum of the two ratios (33.47% + 0.93%) is also well below 100% of the threshold values. | | | | | |

# RF Exposure Evaluation

KDB 447498 states that the simultaneous transmission SAR evaluation procedures for cell phones in KDB 648474 may be applied to antennas that are built-in within a PDA or UMPC. The host systems should be considered as similar to Ultra mobile PC (UMPC) and PDA systems.

### *WiFi Module – Stand Alone*

As the WiFi module T5MFCE060 is well below the hand-held, within 5cm of the body (300[f(GHz)] -0.5 mW) threshold the WiFi module is exempt from a stand-alone SAR assessment.

An MPE assessment is required to demonstrate that the rf exposure hazard 20cm from the device is below the relevant limit.

### *Co-Located Simultaneous Transmissions*

As both modules can operate simultaneously, the effects of simultaneous transmissions must be taken into consideration.

For whole-body exposure an MPE calculation to demonstrate compliance with the limits, based on summing the percentage of the limit for each transmitter and verifying that the total is less than 100%, will be performed and is included at the end of this document.

The WiFi module does not need to be evaluated for SAR because its output power is below the $300[f(GHz)]^{-0.5}$ threshold for hand-held and hand operated devices with the hand closer than 5cm to the antennas.

For localized rf exposure, SAR evaluations are expected. KDB 648474 states: *When the output of an unlicensed transmitter is ≤ PRef and its antenna(s) is ≥ 2.5 cm from other antennas, stand-alone SAR evaluation is not required for that unlicensed transmitter.* In this statement Pref is ½ of the 60/f threshold and as the Bluetooth device's output power is significantly lower than this (1.77mW output power versus Pref = 12.1mW) SAR is not required for the Bluetooth device.

# *MPE Calculations*

The device can operate in a portable exposure condition because it comes within 20cm of the hand. The previous sections have evaluated the rf exposure with respect to the extremities and concluded that SAR measurements are not required based on the output powers of the three rf modules used within the system. An MPE estimation has been made to address exposures to persons' bodies due to operation of the hand-operated device..

FCC part 1.1310, Table 1 limits the power density for uncontrolled exposure. The power density, $P_d$ ($mW/cm^2$ ) calculated from the maximum EIRP, $P_t$ (mW) and the distance, d (m), between the transmitting antenna and the closest person, can be calculated using:

$$P_d = P_t/(4 \pi d^2)$$

### *Bluetooth and WiFi Modules Operating Simultaneously*

| Frequency | MPE Limit ($mW/cm^2$) | Output Power (mW) | Max. Antenna Gain (dBi) | EIRP (mW) | Pd at 20cm ($mW/cm^2$) | % of limit |
|---|---|---|---|---|---|---|
| 2412 to 2462 MHz | 1.0 | 64.0 | 0 | 64.0 | 0.0127 | 1.3% |
| 2402 to 2480 MHz | 1.0 | 1.77 | 1.8 | 2.679 | 0.0005 | 0.1% |

The total of the rf exposure power density of each device, expressed as a percentage of their respective limits, is 1.4% (1.3% plus 0.1%). As this total is below 100%, the total power density at 20cm from the device is below the levels permitted for uncontrolled exposure.

### *WiFi (T5MFCE060) Module Operating Alone*

| Frequency | MPE Limit ($mW/cm^2$) | Output Power (mW) | Max. Antenna Gain (dBi) | EIRP (mW) | Pd at 20cm ($mW/cm^2$) | % of limit |
|---|---|---|---|---|---|---|
| 2412 to 2462 MHz | 1.0 | 64.0 | 0 | 64.0 | 0.0127 | 1.3% |

The power density 20cm from the device is below the levels permitted for uncontrolled exposure.