

# MOVON CORPORATION



# Product Specification

Item	Wi-Fi6 and Bluetooth 5.x SOM
Customer	BIXOLON
Model	WBT-MSB
Version	2.0
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## Revision History

Revision	Date	Changes	Written by
Rev1.0	12/26/2022	First Release (EVT)	Yanim SON
Rev2.0	12/08/2023	2nd Release (DVT)	Yanim SON

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## Reference document

*NXP 88W9098 (Concurrent Dual Wi-Fi (CDW) and Bluetooth 5.3 Combo SoC) - Data sheet*

*NXP 88W9098\_UM11471\_Design Guide for 88Q9098 and 88W9098*

*SD-WLAN-UART-BT-9098-LNX\_5\_15\_71-IMX8-17.92.1.p136.13-17.92.1.p136.13-MM*

*88W9098\_A1\_RF\_Performance\_Report\_WLAN*

*88W9098\_A1\_RF\_Performance\_Report\_BT\_BLE*

## 1. Product description

The module is that the System on Module (SOM) designed according as the BIXOLON board to board specification for use with Wi-Fi6/Bluetooth 5.3 networks that provides IEEE 802.11a/b/g/n/ac/ax and Bluetooth SIG 5.x mobile connectivity. This module is applicable to dedicated to BIXOLON POS, KIOSK and other portable device.

The purpose of this document is to describe the Wi-Fi/Bluetooth features and specifications of the SOM and to provide BIXOLON with the information required to integrate them into products.

So, in this document, only the specifications related to Wi-Fi and Bluetooth are specified, and specification related the host part (SAM9x60D1G, NAND Flash and MFI) is excluded.

But a block diagram, pin maps and power distribution network of whole SOM including SAM9x60D5M-I/4FB are provided for system integration.

Application and hardware interface requirements are discussed at a high level only; for more detail, see the following chapter.

### A. Overview

- Board to board Wi-Fi6 and Bluetooth 5.x combo system on module (SOM type)
- Compact size as 40.5mm x 29.8mm x 5.9mm
- Compliance IEEE 802.11a/b/g/n/ac/ax standard the module uses DSSS, OFDM, DBPSK, DQPSK and QAM baseband modulation technologies
- Compliance Bluetooth 5.3 SIG standard

### B. Key Feature

- **Wi-Fi**
  - Supports Wi-Fi6 dual MACs, independent MACs support true
  - Not support dual band CDW (Only support 1x1 Wi-Fi RF front-end and RF PHY)
  - Supports a 1X1 MISO configuration in both the Wi-Fi 2.4GHz and 5GHz bands
  - Two independent basebands, each band supporting independent Wi-Fi operation at 2.4GHz and 5GHz
  - 5GHz PHY data rates up to 350Mbps@HE80, 2.4GHz PHY data rates up to 180Mbps@HE20  
Based on TCP/SDIO3.0
  - Uplink and downlink OFDMA and MU-MISO
  - Supports WPA3

- Supports OFDMA up to 1024QAM and Target Wake Time (TWT)
- Instantaneous 0-DFS
- **Bluetooth**
  - Bluetooth 5.3 SIG standard/specifications compliant
  - Supports up to EDR 3Mbps
  - Supports Low Energy 2Mbps and Long Range
  - Up to 16 Bluetooth LE links in the connection mode
- **Antenna and Co-existence**
  - Integrated two antennas as Wi-Fi and Bluetooth
  - Implements advanced Wi-Fi and Bluetooth co-existence hardware in conjunction with algorithms to optimize collaborative performance
  - Wi-Fi/Bluetooth co-existence protocol support
- **Host interface**
  - Supports SDIO3.0 for Wi-Fi host interface and high-speed UART for Bluetooth host interface

## **C. Standard Compliance**

- IEEE 802.11 a/b/g/n/ac/ax
- Bluetooth V5.3 SIG conformance

## **D. Application**

- Dedicated BIXOLON portable devices (POS, fixed printer and portable printer)

# **2. Product Specifications**

## **A. SW Block Diagram**

(Software structure is depended on Operating Systems)

## B. Specification Overview

Item		Description
<b>Hardware</b>		
<b>Wi-Fi6 and Bluetooth5.3 SoC</b>		
Wi-Fi6 and Bluetooth SoC	NXP 88W9098-A2-NYGC/MP	Independent ARM-based Wi-Fi and Bluetooth CPUs Integrated Buck regulator for core power supply Separate power block for independent of Wi-Fi/Bluetooth OFDMA 1024QAM and Fully MU-MIMO Target Wake Time (TWT) WPA3 Bluetooth 5.3 BDR and EDR: 1Mbps, 2Mbps and 3Mbps Bluetooth Low Energy (LE): 1Mbps and 2Mbps Bluetooth Low Energy Long Range Bluetooth Two wide-bands speech links Up to 16 Bluetooth links Wi-Fi/Bluetooth coexistence protocol 148-pins 11.0mm x 11.0mm x 0.85mm HVQFN
Interface	Wi-Fi	SDIO3.0
	Bluetooth	High speed UART
	GPIOs	BT/Wi-Fi RST for each network independent reset BT/Wi-Fi HOST WKU for control Host wakes up or sleep PDN for control module power turns on or off
<b>Host AP SoC/Memory/Power</b>		
Host AP SoC	Microchip SAM9x60D5M-I/4FB	ARM926EJ-S Arm Thumb processor running up to 600 MHz Integrates with up to 64Mb SDR-SDRAM in package High Bandwidth Multi-port DDR2/LPDDR Controller 8bit EBI supporting 8bit NAND Flash connected on D16-D23 One USB Device High Speed, three USB Host High Speed with dedicated On-Chip Transceivers One dual-port 16-channel DMA Controller Two 10/100 Mbps Ethernet Mac Controller Thirteen FLEXCOMs (USART, SPI and TWI) Up to 112 programmable I/O Lines multiplexed with up to three peripheral I/Os TFBGA 233-ball 14mmx14mmx1.2mm
Power supply	DC 3.3V, DC 1.8V	Please refer to page.17 in this document for details
Memory	NAND Flash	Voltage Supply: 3.3V (2.7V~3.6V)

	F59L1GB1A-25BIG	Memory Cell Array: (128M + 4M) x 8bit Data Register: (2K + 64) x 8bit Program/Erase Lockout During Power Transitions ECC Requirement: - 1bit/528Byte Boot from NAND support Automatic Memory Download BGA 63-ball 9mmx11mmx1.0mm
MFI	MFI343S00177	Apple MFI CP3.0 signal communication codec chip
<b>Radio Interface</b>		
RF PHY / Front-end	Wi-Fi and Bluetooth	Supports concurrent use 1X1 Wi-Fi and Bluetooth as 2 antennas. Diplexers, bandpass filters, PAMs, LNAs and SPDT switches are assembled for simultaneous use of Wi-Fi and Bluetooth.
Baseband/MACs	Wi-Fi	Two independent direct conversion Wi-Fi radios to support true independent operation in the 2.4 GHz and 5 GHz Bands. Supports Wi-Fi6 1x1 MU-MISO DL and UL as just 1 spatial stream. Up to 1x1 802.11ax 80MHz 1024QAM.
	Bluetooth	Supports Bluetooth 5.3 Supports up to Bluetooth power class 1.5 Packet types: 1Mbps (GFSK), 2Mbps(pi/4-DQPSK), 3Mbps (8DPSK). Fully functional AFH using Packet Error Rate.
<b>System interface</b>		
Board to board connector	NLWBS05-30C-2.2H	30pin, 2.2T B2B socket
<b>System environment</b>		
Operating condition	Operating temperature	-40°C ~ +85°C
	Storage temperature	-40°C ~ +85°C
	Humidity	10~90% Relative/Non-condensing
Certification	Alliance	
<b>Appearance</b>		
Dimension	Length	40.5mm±0.1mm
	Width	29.8mm±0.1mm
	Height	5.9mm±0.3mm
Package		Board to Board connection
<b>Software</b>		
<i>System SW</i>		



OS		Linux, Android
Protocol	Wi-Fi	802.11 a/b/g/n/ac/ax
	Bluetooth	Bluetooth 5.3 Classic/BLE
Networking	Wi-Fi	2.4Ghz / 5Ghz
	Bluetooth	BR and EDR 1Mbps, 2Mbps and 3Mbps LE 1Mbps/2Mbps, Long Range Power class 1.5
Encryption	Wi-Fi	AES, TKIP
	Bluetooth	AES
Security	Wi-Fi	WEP, WPA2, WPA3
	Bluetooth	Security Mode 4
Management	Wi-Fi	Station mode / Access Point mode / P2P (Wi-Fi direct) mode
	Bluetooth	TBD
Supported OS and Browser		Linux, Android
Indication		Not support
OTA		None

– **Wi-Fi RF performance**

Wi-Fi 2.4GHz				
Item	Functional Item		Detailed Specification	Remark
Standard	IEEE802.11		b/g/n/ax	
Band Class	Frequency range		2.401~2.483GHz	
	Channels		1~13ch	
Channel BW	802.11b/g		20MHz	
	802.11n/ax		20MHz/40MHz	
RF	802.11b	Modulation	DSSS/CCK	
		Rate	11/5.5/2/1Mbps	Auto fallback
		Max. Sensitivity	-84dBm	Conducted, 11M
		Output power	16dBm	Conducted, 11M @EVM<35%
	802.11g	Modulation	OFDM	
		Rate	54/48/36/24/18/12/9/6Mbps	Auto fallback
		Max. Sensitivity	-71dBm	Conducted, 54M
		Output power	14dBm	Conducted, 54M @EVM<-27dB
	802.11n	Modulation	OFDM	
		Rate	MCS0 ~ MCS7	
		Max. Sensitivity	-68dBm	Conducted, HT20 MCS7
		Output power	HT20: 12dBm HT40: 12dBm	Conducted, HT20 MCS7 @EVM-28dB
		Max. throughput	30Mbps	HT20 MCS7/DL/AP mode
	802.11ax	Modulation	OFDM	
		Rate	MCS0 ~ MCS9	
		Max. Sensitivity	-55dBm	Conducted, HE20 MCS11
		Output power	HE20: 12dBm HE40: 10dBm	Conducted, HE40 MCS11 @EVM<-32dB
		Max. throughput	55Mbps	VHT40 MCS9/DL/AP mode
Wi-Fi 5GHz				
Item	Functional Item		Detailed Specification	Remark
Standard	IEEE802.11		a/n/ac/ax	
Band Class	Frequency range		5.150~5.825GHz	Support all DFS bands
	Channels		36~165ch	
Channel	802.11a		20MHz	
BW	802.11n		20MHz/40MHz	

	802.11ac/ax		20MHz/40MHz/80MHz	
RF	802.11a	Modulation	OFDM	
		Rate	54/48/36/24/18/12/9/6Mbps	Auto fallback
		Max. Sensitivity	-68dBm	Conducted, 54M
		Output power	14dBm	Conducted, 54M @EVM<-27dB
	802.11n	Modulation	OFDM	
		Rate	MCS0 ~ MCS7	
		Max. Sensitivity	-65dBm	Conducted, HT20 MCS7
		Output power	HT20: 12dBm HT40: 12dBm	Conducted, HT20 MCS7 @EVM<-28dB
		Max throughput	58Mbps	HT40 MCS7/DL/AP mode
	802.11ac	Modulation	OFDM	
		Rate	MCS0 ~ MCS9	
		Max. Sensitivity	-63dBm	Conducted, VHT20 MCS8
		Output power	VHT20:12dBm VHT40: 10dBm VHT80: 5dBm	Conducted, VHT20 MCS8 @EVM<-32dB
		Max throughput	65Mbps	VHT80 MCS9/DL/AP mode
	802.11ax	Modulation	OFDM	
		Rate	MCS0 ~ MCS11	
		Max. Sensitivity	-52dBm	Conducted, HE20 MCS11
		Output power	HE20: 12dBm HE40: 10dBm HE80: 5dBm	Conducted, HE20 MCS11 @EVM<-35dB
		Max throughput	68Mbps	HE80 MCS11/DL/AP mode

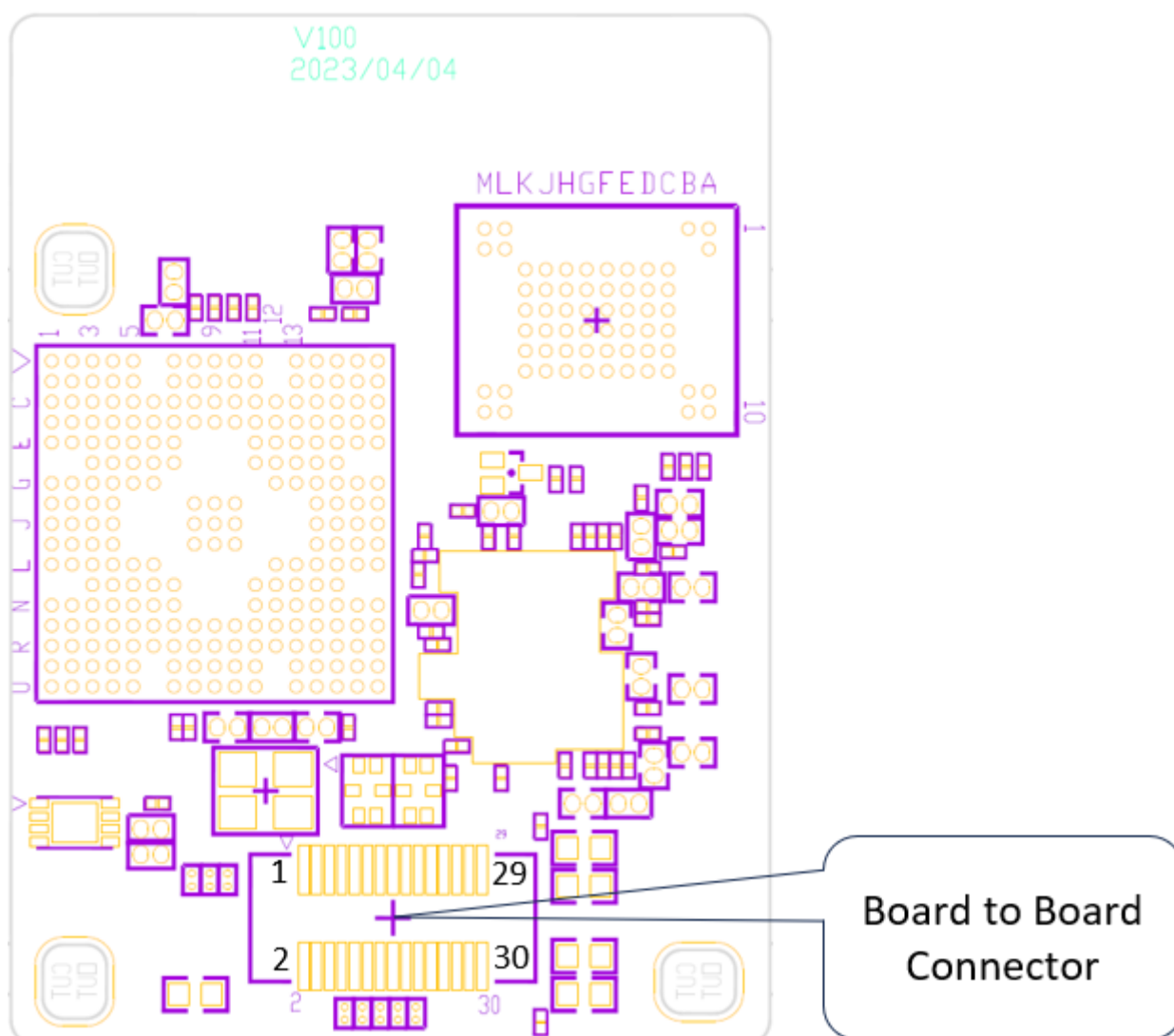
– **Bluetooth RF performance**

Item	Functional Item	Detailed Specification	Remark
Standard	IEEE802.15.1	Up to Bluetooth 5.3	
Band Class	Frequency range	2.401~2.480GHz	
	Channels	0~78ch	
Channel BW	LE, LE2M, BDR, EDR2 and EDR3		
RF	Power class	4dBm ~ 10dBm Typical. 8.0dBm	Conducted, Class 1.5
	Transmission Rate / Modulation	Header/GFSK 2Mbps/ $\pi$ /4-DQPSK	

		3Mbps/8DPSK	
	Max Rx. Sensitivity	0.001% @ -70dBm	Conducted
RF Spread	Frequency Hopping Spread Spectrum (FHSS)		1600hops/sec, 1MHz channel space
Profile	TBD		
Max	Classic	Max 3Mb/s	@ EDR3
throughput	LE	Max 2Mb/s	

## C. Pin Assignment

### Pin allocations



<Bottom side>

## Pin description

Pin #	Port name	Voltage level and I/O	When is signal needed	Description
1	DGND	Digital Ground	Always	
2	VCC_3.3V		Always	Power supply for Host chip
3	TXD	VCC_1.8V	Host UART	For Host chip UART Transmission interface
4	VCC_3.3V		Always	Power supply for Host chip
5	RXD	VCC_1.8V	Host UART	For Host chip UART Receive interface
6	VCC_3.3V		Always	Power supply for Host chip
7	CTS	VCC_1.8V	Host UART	For Host chip UART CTS interface
8	DGND	Digital Ground	Always	
9	DGND	Digital Ground	Always	
10	WIFI_GREEN	VCC_1.8V	Indicator	WiFi indicator
11	EMR_DM	VCC_3.3V	Host USB	For FW download/host USB data negative
12	WIFI_RED	VCC_1.8V	Debug UART	WiFi indicator
13	EMR_DP	VCC_3.3V	Host USB	For FW download/host USB data negative
14	NRESET	VCC_1.8V	reset	For SW reset
15	DGND	Digital Ground	Always	
16	EMR_DET	VCC_1.8V	Debug USB	For debugging USB detect
17	USBB_DP	VCC_3.3V	Debug USB	For debugging/RF calibration USB bridge data positive interface
18	EMR_SW	VCC_3.3V	Read/write to NAND	To enable/disable the NAND Flash
19	USBB_DM	VCC_3.3V	Debug USB	For debugging/RF calibration USB bridge data negative interface
20	DGND	Digital Ground	Always	
21	DGND	Digital Ground	Always	
22	DGND	Digital Ground	Always	
23	1.8V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply
24	3.3V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply
25	1.8V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply
26	3.3V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply
27	1.8V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply
28	3.3V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply
29	1.8V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply
30	3.3V_DUT		Wi-Fi/BT	88W9098 Wi-Fi/BT power supply

## D. Electrical Specification

### Power sequence

#### – Power up sequence

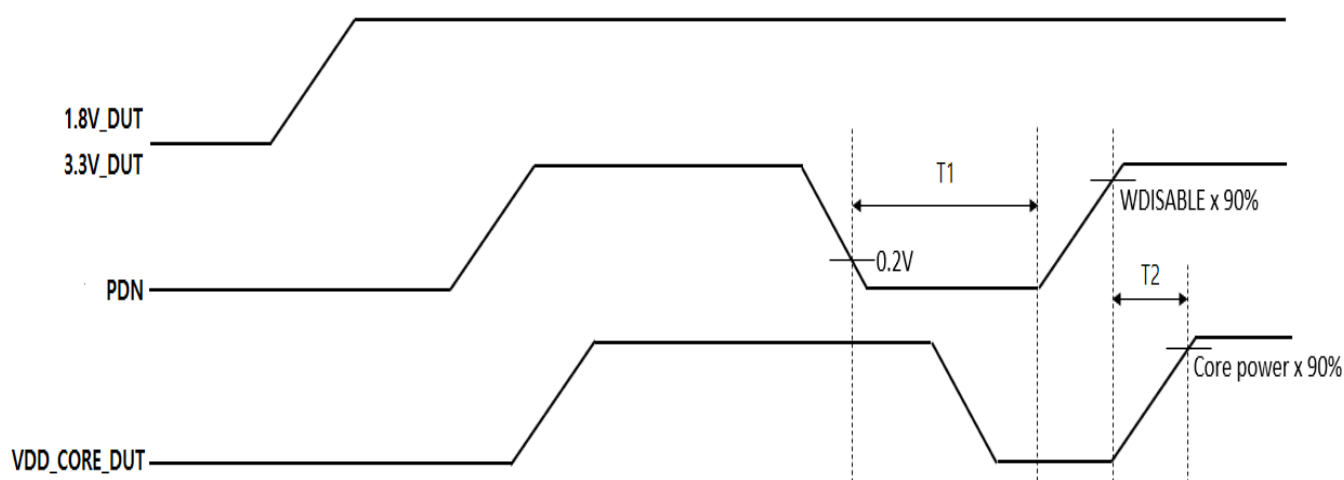
The external 1.8V\_DUT and 3.3V\_DUT shall not rise (10 - 90%) faster than 40 microseconds for minimize in-rush current and not slower than 100 milliseconds. PDN must be held low for at least 100 milliseconds after external 1.8V\_DUT and 3.3V\_DUT has reached specification level before pulled high.

Parameter		Min	Typ	Max	Unit
T1	Delay from 1.8V_DUT high (at least 90%) to start of 3.3V_DUT ramp-up	0	-	-	ms
T2	Delay from 3.3V_DUT high (at least 90%) to start of AVDD18 ramp-up	0	100	-	ms
T3	Delay from 1.8V_DUT high (at least 90%) to start of PDN ramp-up	0	-	-	ms
T4	Delay from AVDD18 high (at least 90%) to start of Boot ROM	-	10	-	ms

#### – Power down sequence

Parameter		Min	Typ	Max	Unit
T1	Recommended delay from PDN low (less than 0.2V) to start of AVDD18 ramp-down	0	-	-	ms
T2	Recommended delay from start of AVDD18 ramp-down to start of 3.3V_DUT ramp-down	0	-	-	ms

#### – Reset



Parameter		Min	Typ	Max	Unit
T1	Delay from PDN low (at least 0.2V) to time of VDD_CORE_DUT ramp-down	1	-	-	us
T2	Delay from PDN low (at least 0.2V) to time of VDD_CORE_DUT high (at least 90%)	0	-	-	us

## DC characteristics

### – Power Tree

The module utilizes VDD\_3.3V, 3.3V\_DUT and 1.8V\_DUT power sources.

Do not exceed minimum or maximum voltage. Module will be permanently damaged above this limit.

– **Electrical characteristics**

Parameter		Minimum	Typical	Maximum	Unit
<b>External Power supply</b>					
DC 3.3V_9098	Voltage range	3.135	3.30	3.465	V
	* Current consumption	-	-	1.2	A
DC 1.8V	Voltage range	1.71	1.80	1.89	V
	* Current consumption	-	-	1.9	A
DC 3.3V_Host	Voltage range	3.0	3.30	3.6	V
	* Current consumption	-	-	2.0	A
<b>Internal PMU output power_88W9098</b>					
3.3V_DUT	AVDD33 VPA	3.135	3.30	3.465	
1.8V_DUT	VIO VIO_SD VIO_RF AVDD18 DCDC BUCK IN	1.71	1.80	1.89	V
System Core	Core power (Internal Buck out)	1.03	1.05	1.155	V
<b>Internal PMU output power_SAM9x60D1G/MFI343S00/F59L1G81A-25BIG</b>					
VCC_3.3V	VDDNF VDDSPI VDDANA VDDIOP1 VDDIN33 VDDBU VDDNAND VDDMFI	3.0	3.30	3.6	V
VCC_1.8V	VDDIOM DDRMVDD VDDIO_P0	1.70	1.80	1.90	V
VCC_1.15V	VDCCORE	1.12	1.15	1.21	V

*\* The power supply must be designed for this maximum current*



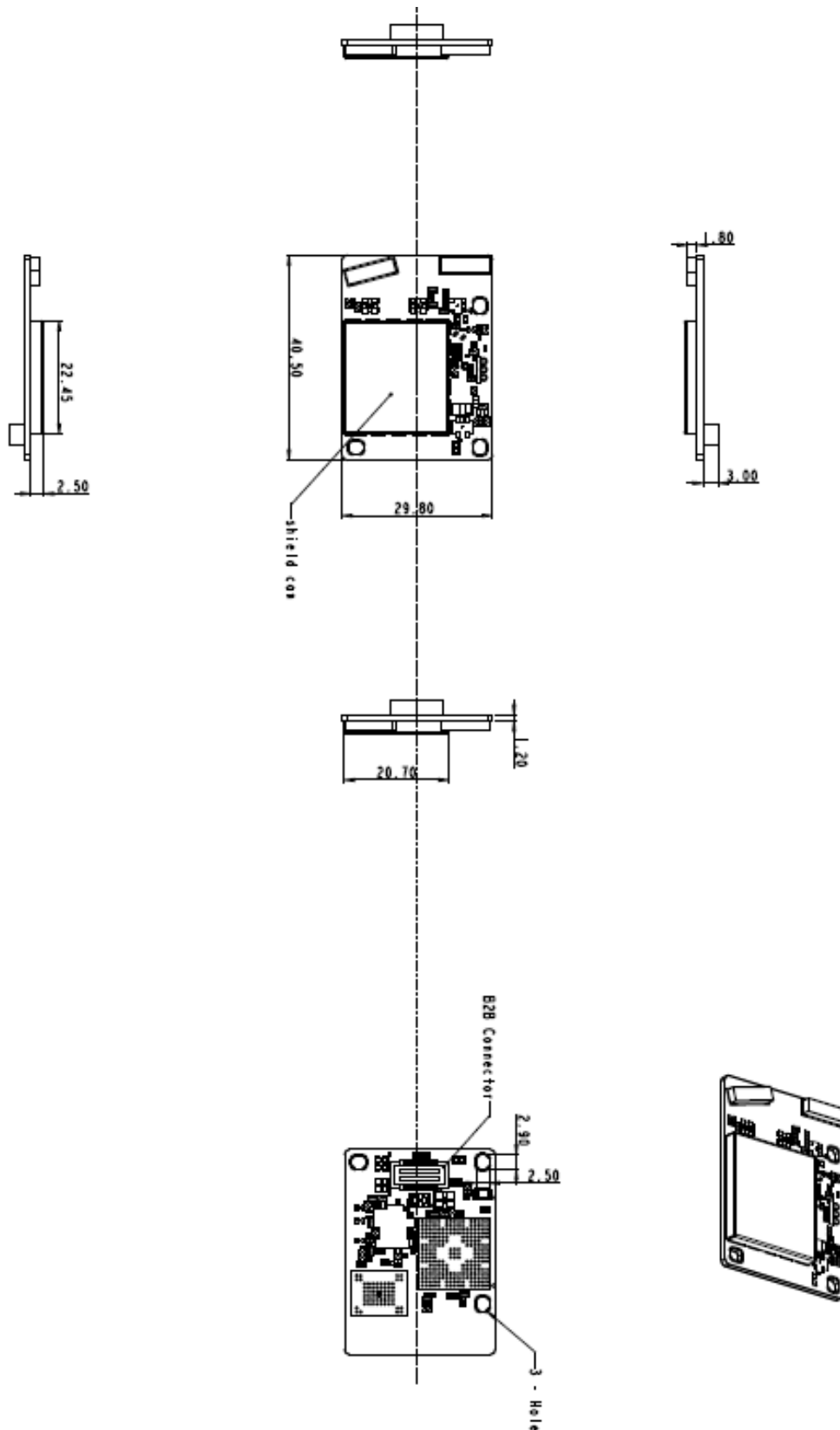
**Power dashboard according to Wi-Fi/Bluetooth use cases**

Mode	Conditions	3.3V_DUT (Avg)	1.8V_DUT (Avg)	Unit
<b>Power down</b>				
Power down	-	0.03	0.26	mA
<b>Deep sleep</b>				
Bluetooth only		0.6	2.1	mA
Wi-Fi only		0.6	2.0	mA
Wi-Fi + Bluetooth		0.4	2.0	mA
<b>Wi-Fi Uplink (1X1 Tx)</b>				
2.4GHz 802.11b, 20MHz	Tx power=16dBm, 11Mbps	133.5	193.3	mA
2.4GHz 802.11g, 20MHz	Tx power=14dBm, 54Mbps	122.9	218.3	mA
2.4GHz 802.11n, 20MHz	Tx power=12dBm, MCS7	135.2	239.3	mA
2.4GHz 802.11ax, 20MHz	Tx power=5dBm, MCS9	136.4	247.9	mA
5GHz 802.11a, 20MHz	Tx power=14dBm, 54Mbps	149.4	293.5	mA
5GHz 802.11n, 20MHz	Tx power=12dBm, MCS7	187.1	316.5	mA
5GHz 802.11n, 40MHz	Tx power=10dBm, MCS7	138.5	300.2	mA
5GHz 802.11ac, 20MHz	Tx power=10dBm, MCS9	190.4	306.3	mA
5GHz 802.11ac, 40MHz	Tx power=10dBm, MCS9	114.8	289.6	mA
5GHz 802.11ax, 80MHz	Tx power=5dBm, MCS11	65.1	288.8	mA
<b>Wi-Fi Downlink (1X1 Rx)</b>				
2.4GHz 802.11b, 20MHz	11Mbps	14.67	170.7	mA
2.4GHz 802.11ax, 20MHz	MCS9	7.08	261.2	mA
5GHz 802.11a, 20MHz	54Mbps	17.17	270.4	mA
5GHz 802.11ax, 80MHz	MCS11	24.91	335.8	mA

80MHz				
<b>Bluetooth LE</b>				
LE advertise	Interval=1.28s	1.72	0.3	mA
LE scan	Interval=1.28s Window=11.25ms	1.93	0.3	mA
LE link	Interval=1.28s	1.98	0.3	mA
LE Peak transmit	@ 4dBm, 1Mbps	71	0.56	mA
LE Peak receive	1Mbps	41	0.56	mA
<b>Bluetooth BR/EDR</b>				
Idle		20.11	0.56	mA
Page scan		2.01	0.3	mA
ACL link	Master sniff mode Interval=500ms	2.74	0.3	mA
SCO HV3 peak Tx	@ 4dBm	71	0.56	mA
SCO HV3 peak Rx		38	0.56	mA
Peak Tx	@ 4dBm	73	0.56	mA
Peak Rx		36	0.56	mA

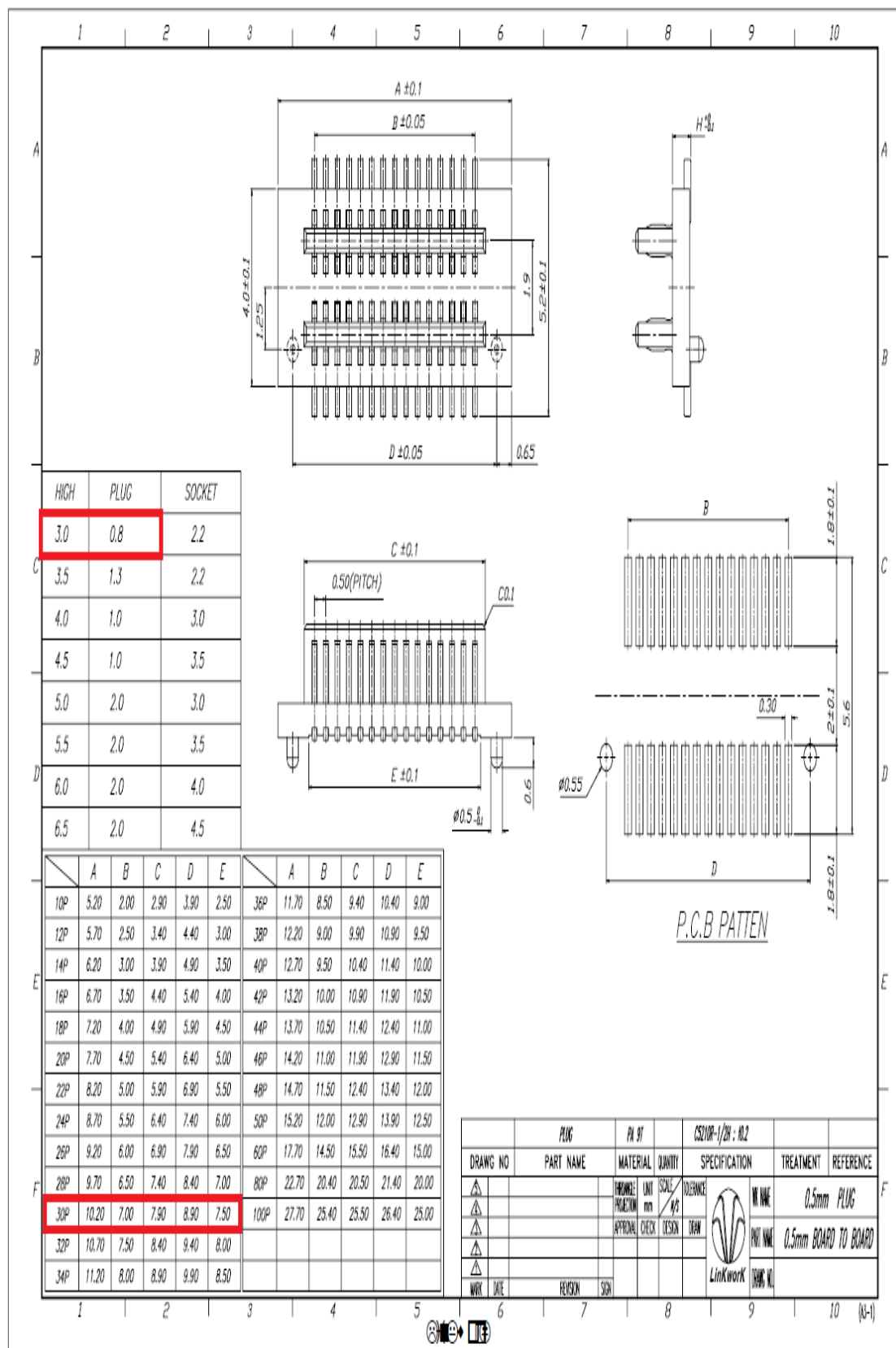
## E. Mechanical Specifications

### Product Drawing



Please refer to dimension in red box of figure below that is recommended plug dimension.





<Recommended B2B Plug>

### **3. Regulatory and compliance**

#### **FCC Compliance Statement**

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

#### **FCC Interference Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### **FCC Caution**

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

#### **FCC Radiation Exposure Statement**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

#### **Industry Canada Statement**

This device complies with RSS-247 of the Industry Canada Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Ce dispositif est conforme à la norme CNR-247 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

**Industry Canada Radiation Exposure Statement**

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

**Déclaration d'exposition aux radiations**

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

**Information on test modes and additional testing requirements**

a) The modular transmitter has been fully tested by the module grantee on the required number of channels, modulation types and modes, it should not be necessary for the host installer to retest all the available transmitter modes or settings. It is recommended that the host product manufacturer installing the modular transmitter, perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).

b) The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitter, digital circuitry, or due to physical properties of the host product (enclosure).

This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a standalone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not have any responsibility for final product compliance.

**Additional testing, Part 15 subpart B disclaimer**

The final host/module combination need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device. The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369.

This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter.

- OEM integrators must ensure that its product is electrically identical to the device, FCC ID: TDU-WBT-MSB reference designs . Any modifications to module reference designs may invalidate regulatory approvals in relation to the product, or may necessitate notifications to the relevant regulatory authorities.
  - OEM integrators are responsible for regression testing to accommodate changes to designs, new antennas, and host and submit for C2PC filings.
  - Colocation with other transmitter modules will be addressed through filings for those co-located transmitters when necessary or that colocation of other transmitters will be according to applicable KDB guidelines including those for RF exposure
  - Appropriate labels must be affixed to the product that complies with applicable regulations in all respects. The regulatory label on the final system must include the statement:  
"Contains FCC ID: TDU-WBT-MSB".  
"Contains IC Number: 6432A-WBTMSB".
1. The module is limited to OEM installation ONLY.
  2. OEM integrators are responsible for ensuring that the end-user has no manual instructions to remove or install module.
  3. The module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
  4. Separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations.

**End Product Labeling**

The module is labeled with its own FCC ID & IC Number. If the FCC ID & IC number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

- "Contains FCC ID: TDU-WBT-MSB"
- "Contains IC Number: 6432A-WBTMSB".