

# WNFQ-291BEI

WiFi 7 2x2 MU-MIMO

802.11be Tri-band 2.4GHz/5GHz/6GHz

Industrial-Grade, 2T2R Wi-Fi M.2 module



## Industrial-Grade Wi-Fi Combo Solution M.2 Module

WNFQ-291BEI, first Qualcomm based WiFi-7 (802.11be) module in M.2 2230 E key formfactor, running PCIe (Wifi) and USB, supports DBDC (Dual-band, Dual-concurrent) mode, but with Tri-band capability (2.4GHz, 5GHz, and 6GHz). WNFQ-291BEI is able to concurrently run 2.4GHz with 5GHz, or 6GHz, and support full IEEE802.11 be/ax/ac/a/b/g/n protocol, up to 320MHz mode.

WNFQ-291BEI designed with 2 spatial streams (2T2R, or 2x2) in MU-MIMO mode. With a standard M.2 E key 2230 formfactor, WNFQ-291BEI can accommodate to all existing platform that has M.2 Adaptor pre-integrated, no extra work with platform design.

Software wise WNFQ-291BEI support Windows, with Linux (Open Source) in the near future. The module is capable to run on both x86 platform and ARM based platform, and supports STA mode and Soft AP Mode\*, recommend to run on application includes: digital signage/POS, rugged computer / tablets, fanless automation PC and other industrial environment applications that requires high speed data transmission.

### Embedded Application

Applications include IPC/ Advertising machine/ OTT/ IPTV/ DVB/ STB / DV/ Mini Driving Recorder/ Intelligent Projector Pico/ VR/ AR terminal/ POS machine/ Vehicle mounted front/ Rear Terminal UAV/ Robot/ Intelligent Gateway/ Smart city and other electronic products.

### Key Feature

- WLAN Tri-band 2X2 802.11 be/ax/ac/a/b/g/n WiFi 7
- Support Multi-link Operation (MLO)
- Supports WLAN 20/40MHz at 2.4GHz and 20/40/80/160 MHz at 5GHz/ up to 320 MHz at 6 GHz
- Dual Band Simultaneous (DBS) up to 2.4 GHz 2x2 40 MHz + 5 GHz 2x2 160 MHz / 6 GHz 2x2 160 MHz
- High Band Simultaneous (HBS) up to 5 GHz/6 GHz 2x2 160MHz + 5 GHz/6 GHz 2x2 160 MHz
- Supports PCIe Gen3 2-lane interface for WLAN

**Specification**

<b>Standards</b>	IEEE 802.11be/ax/ac/a/b/g/n (2T2R)
<b>Chipset</b>	Qualcomm WCN7851
<b>Data Rate</b>	802.11b: 11Mbps 802.11a/g: 54Mbps 802.11n: MCS0~15 802.11ac: MCS0~9 802.11ax: MCS0~13 802.11be: MCS0~13
<b>Operating Frequency</b>	IEEE 802.11 be/ax/ac/a/b/g/n ISM Band, 2.412GHz~2.483GHz, 5.150GHz~5.850GHz, 5.925~7.125GHz *Subject to local regulations
<b>Interface</b>	WLAN: PCIe/ USB
<b>Form Factor</b>	M.2 2230 E Key
<b>Antenna</b>	2 x IPEX MHF4 connectors Ant 1: WiFi Ant 2 : WiFi
<b>Modulation</b>	Wi-Fi: 802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g: OFDM (BPSK, QPSK, 16-QAM, 64-QAM) 802.11n: OFDM (BPSK, QPSK, 16-QAM, 64-QAM) 802.11a: OFDM (BPSK, QPSK, 16-QAM, 64-QAM) 802.11ac: OFDM (BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM) 802.11ax: OFDMA (BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM, 4096-QAM) 802.11be: OFDMA (BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM, 4096-QAM)
<b>Power Consumption(TBD)</b>	TX mode: mA (MAX) RX mode: mA (MAX)
<b>Operating Voltage</b>	DC 3.3V
<b>Operating Temperature Range</b>	-40°~+85°C (Operating)(TBD)
<b>Storage Temperature Range</b>	-45°C~90°C (TBD)
<b>Humidity (Non-Condensing)</b>	5%~90% (Operating) 5%~90% (Storing)

<b>Dimension L x W x H (in mm)</b>	30mm( $\pm 0.15$ mm) x 22mm( $\pm 0.15$ mm) x mm( $\pm 0.3$ mm) (TBD)
<b>Weight (g)</b>	3.2g(TBD)
<b>Driver Support</b>	Win11/Linux (Open Source) (TBD)
<b>Security</b>	WPS2.0, WAPI, WPA, WPA2, WPA3

PRELIMINARY

OUTPUT POWER & SENSITIVITY (TBD)		
802.11b		
Data Rate	Tx $\pm$ 1.5 dBm	Rx Sensitivity
11Mbps	18 dBm	$\leq$ -91 dBm (TBD)

802.11g		
Data Rate	Tx $\pm$ 1.5dBm	Rx Sensitivity
54Mbps	16 dBm	$\leq$ -77.5 dBm(TBD)

802.11n / 2.4GHz				
	Data Rate	Tx $\pm$ 1.5 dBm (1TX)	Tx $\pm$ 1.5 dBm (2TX)	Rx Sensitivity
HT20	MCS7	16 dBm	19dBm	$\leq$ -76.5 dBm (TBD)
	MCS7	16 dBm	19 dBm	$\leq$ -74 dBm(TBD)

802.11a		
Data Rate	Tx $\pm$ 2dBm	Rx Sensitivity
54Mbps	13 dBm	$\leq$ -76.5 dBm(TBD)

802.11n / 5GHz				
	Data Rate	Tx $\pm$ 2 dBm (1TX)	Tx $\pm$ 2 dBm (2TX)	Rx Sensitivity
HT20	MCS7	11.5dBm	14.5 dBm	$\leq$ -76 dBm(TBD)
	MCS7	11 dBm	14 dBm	$\leq$ -73.5 dBm(TBD)

802.11ac				
	Data Rate	Tx $\pm$ 2 dBm (1TX)	Tx $\pm$ 2 dBm (2TX)	Rx Sensitivity
VHT80	MCS9	9.5 dBm	12.5 dBm	$\leq$ -64 dBm(TBD)
VHT160	MCS9	9.5 dBm	12.5 dBm	$\leq$ -62 dBm(TBD)

802.11ax / 2.4 GHz				
	Data Rate	Tx $\pm$ 1.5 dBm (1TX)	Tx $\pm$ 1.5 dBm (2TX)	Rx Sensitivity
HE40	MCS11	12.5 dBm	15.5 dBm	$\leq$ -62 dBm(TBD)

802.11ax / 5GHz				
	Data Rate	Tx $\pm$ 2 dBm (1TX)	Tx $\pm$ 2 dBm (2TX)	Rx Sensitivity
HE20	MCS11	9 dBm	12 dBm	$\leq$ -64 dBm(TBD)
	MCS11	9 dBm	12 dBm	$\leq$ -61.5 dBm(TBD)

<b>HE80</b>	MCS11	9 dBm	12 dBm	$\leq -58.5$ dBm(TBD)
<b>HE160</b>	MCS11	9 dBm	12 dBm	$\leq -55.5$ dBm(TBD)

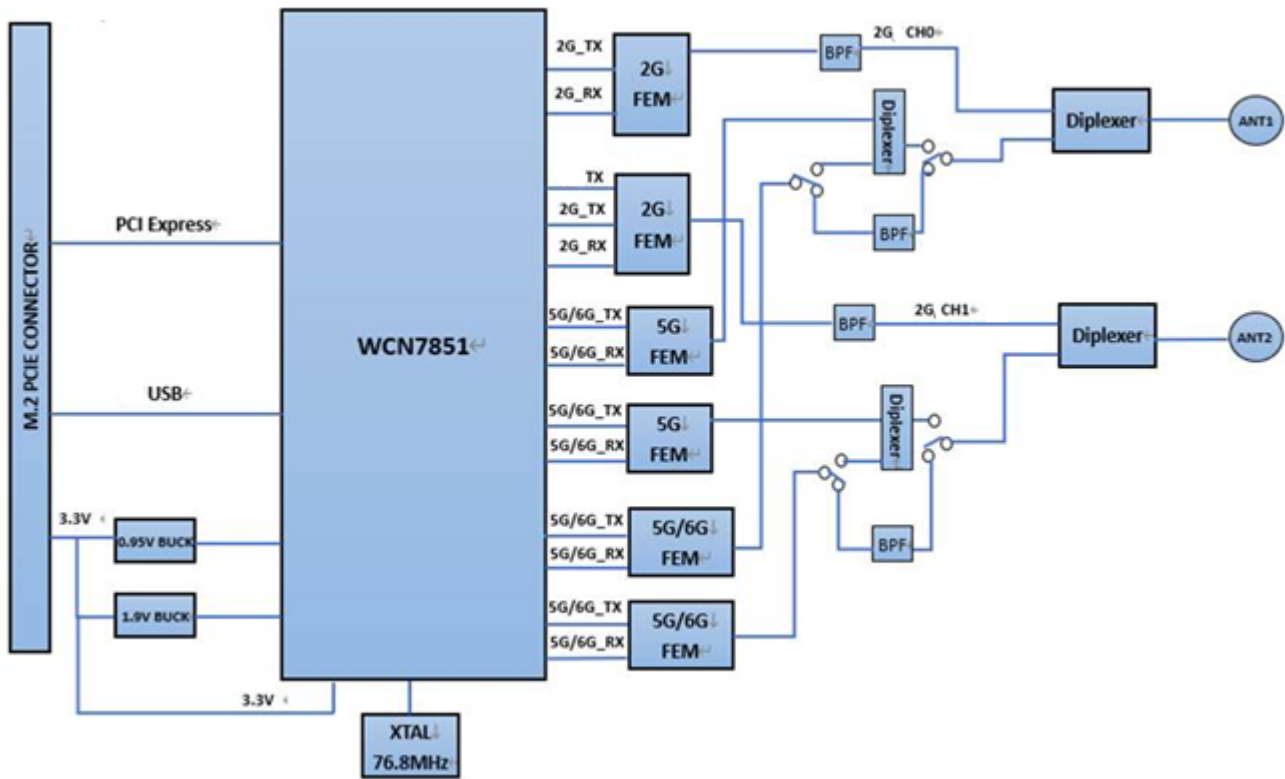
<b>802.11ax / 6GHz</b>				
<b>HE20</b>	<b>Data Rate</b>	<b>Tx <math>\pm</math> 2 dBm (1TX)</b>	<b>Tx <math>\pm</math> 2 dBm (2TX)</b>	<b>Rx Sensitivity</b>
	MCS11	9 dBm	12 dBm	$\leq -63$ dBm(TBD)
<b>HE40</b>	MCS11	9 dBm	12 dBm	$\leq -60.5$ dBm(TBD)
<b>HE80</b>	MCS11	9 dBm	12 dBm	$\leq -57.5$ dBm(TBD)
<b>HE160</b>	MCS11	9 dBm	12 dBm	$\leq -54.5$ dBm(TBD)

<b>802.11be / 2.4 GHz</b>				
<b>EHT40</b>	<b>Data Rate</b>	<b>Tx <math>\pm</math> 1.5 dBm (1TX)</b>	<b>Tx <math>\pm</math> 1.5 dBm (2TX)</b>	<b>Rx Sensitivity (TBD)</b>
	MCS13	11.5 dBm	14.5 dBm	$\leq -62$ dBm

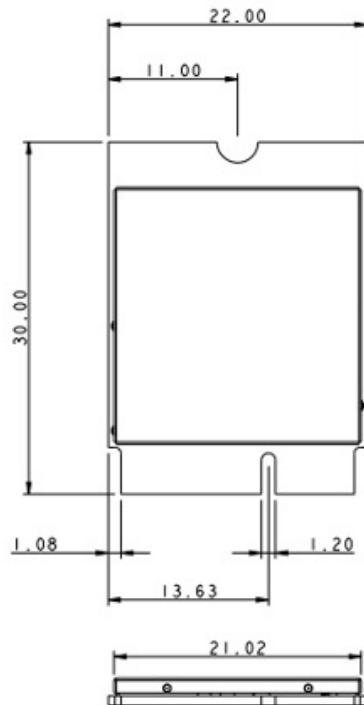
<b>802.11be / 5GHz</b>				
<b>EHT20</b>	<b>Data Rate</b>	<b>Tx <math>\pm</math> 2 dBm (1TX)</b>	<b>Tx <math>\pm</math> 2 dBm (2TX)</b>	<b>Rx Sensitivity(TBD)</b>
	MCS13	8.5 dBm	11.5 dBm	$\leq -64$ dBm
<b>EHT40</b>	MCS13	8.5 dBm	11.5 dBm	$\leq -61.5$ dBm
<b>EHT80</b>	MCS13	8.5 dBm	11.5 dBm	$\leq -58.5$ dBm
<b>EHT160</b>	MCS13	8.5 dBm	11.5 dBm	$\leq -55.5$ dBm

<b>802.11be/ 6GHz</b>				
<b>EHT20</b>	<b>Data Rate</b>	<b>Tx <math>\pm</math> 2 dBm (1TX)</b>	<b>Tx <math>\pm</math> 2 dBm (2TX)</b>	<b>Rx Sensitivity(TBD)</b>
	MCS13	8.5 dBm	11.5 dBm	$\leq -63$ dBm
<b>EHT40</b>	MCS13	8.5 dBm	11.5 dBm	$\leq -60.5$ dBm
<b>EHT80</b>	MCS13	8.5 dBm	11.5 dBm	$\leq -57.5$ dBm
<b>EHT160</b>	MCS13	8.5 dBm	11.5 dBm	$\leq -54.5$ dBm
<b>EHT320</b>	MCS13	7.5 dBm	10.5 dBm	$\leq -54.5$ dBm

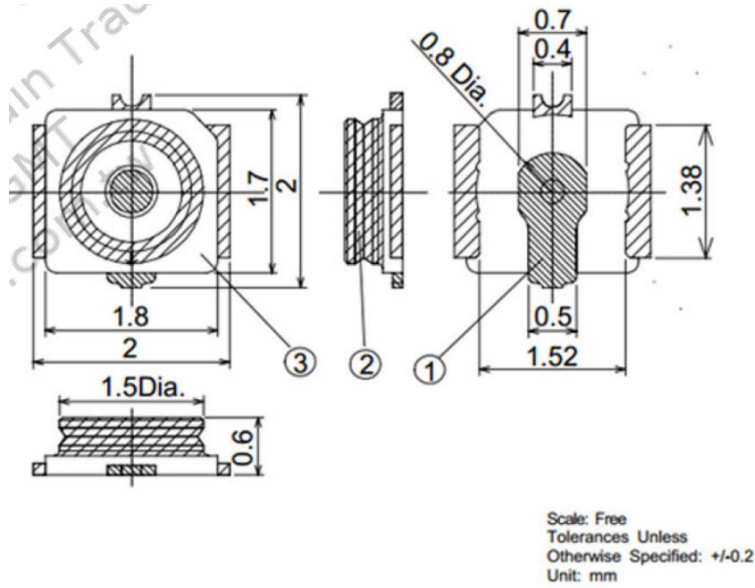
## Block Diagram(TBD)



## Mechanical Dimension (mm) (TBD)



### MHF4 connector spec.(TBD)



### Pin Assignment (TBD)

The following section illustrate signal pin-outs for the module connector.

TOP			
Pin#	Pin Name	Type	Description
1	GND	G	Ground connections
3	USB_D+	I/O	USB serial differential data Positive
5	USB_D-	I/O	USB serial differential data Negative
7	GND	G	Ground connections
9	SDIO_CLK/SYSCLK	NC	No Connection
11	SDIO_CMD	NC	No Connection
13	SDIO_DATA0	NC	No Connection
15	SDIO_DATA1	NC	No Connection
17	SDIO_DATA2	NC	No Connection
19	SDIO_DATA3	NC	No Connection
21	SDIO_WAKE#	NC	No Connection
23	SDIO_RESET#/TX_BLANKING	NC	No Connection
25	NOTCH FOR KEY E	NC	No Connection
27	NOTCH FOR KEY E	NC	No Connection
29	NOTCH FOR KEY E	NC	No Connection
31	NOTCH FOR KEY E	NC	No Connection
33	GND	G	Ground connections
35	PERp0	I	PCI Express receive data-Positive

TOP			
Pin#	Pin Name	Type	Description
37	PERn0	I	PCI Express receive data-Negative
39	GND	G	Ground connections
41	PETp0	O	PCI Express transmit data- Positive
43	PETn0	O	PCI Express transmit data- Negative
45	GND	G	Ground connections
47	REFCLKp0	I	PCI Express differential clock input- Positive
49	REFCLKn0	I	PCI Express differential clock input- Negative
51	GND	G	Ground connections
53	CLKREQ0# (3.3V)	OD	PCIe clock request
55	PEWAKE0# (3.3V)	OD	PCIe wake signal
57	GND	G	Ground connections
59	RESERVED/PERp1	NC	No Connection
61	RESERVED/PERn1	NC	No Connection
63	GND	G	Ground connections
65	RESERVED/PETp1	NC	No Connection
67	RESERVED/PETn1	NC	No Connection
69	GND	G	Ground connections
71	RESERVED/REFCLKp1	NC	No Connection
73	RESERVED/REFCLKn1	NC	No Connection
75	GND	G	Ground connections

## Pin Assignment(TBD)

The following section illustrate signal pin-outs for the module connector.

BOTTOM			
Pin#	Pin Name	Type	Description
2	3.3 V	P	VDD system power supply input
4	3.3 V	P	VDD system power supply input
6	LED_1#	O	No Function
8	I2S_SCK (1.8V)	I	I2S Continuous Serial Clock (SCK).
10	I2S_WS (1.8V)	I	I2S Word Select.
12	I2S_SD_OUT (1.8V)	O	I2S Serial Data IN.
14	I2S_SD_IN (1.8V)	I	I2S Serial Data OUT.
16	LED_2#	O	No Function
18	GND	G	Ground connections



BOTTOM			
Pin#	Pin Name	Type	Description
20	UART_WAKE# (3.3V)	NC	No Connection
22	UART_TXD	NC	No Connection
24	NOTCH FOR KEY E	NC	No Connection
26	NOTCH FOR KEY E	NC	No Connection
28	NOTCH FOR KEY E	NC	No Connection
30	NOTCH FOR KEY E	NC	No Connection
32	UART_RXD	NC	No Connection
34	UART_RTS	NC	No Connection
36	UART_CTS	NC	No Connection
38	VENDOR DEFINED	NC	No Connection
40	VENDOR DEFINED	NC	No Connection
42	VENDOR DEFINED	NC	No Connection
44	COEX3	NC	No Connection
46	COEX_TXD	DNC	Do Not Connect
48	COEX_RXD	DNC	Do Not Connect
50	SUSCLK	NC	No Connection
52	PERST0#	I	PCIe host indication to reset the device Active low.
54	W_DISABLE2#	I	enable signal. (This pin is floating. Please set W_DISABLE2# pin to pull high on the platform side.) (TBD)
56	W_DISABLE1#	I	Reserved for W_DISABLE1 (This pin is floating. Please set W_DISABLE1# pin to pull high on the platform side.) (TBD)
58	I2C_DATA	NC	No Connection
60	I2C_CLK	NC	No Connection
62	ALERT#	NC	No Connection
64	RESERVED	NC	No Connection
66	UIM_SWP/PERST1#	NC	No Connection
68	UIM_POWER_SNK/CLKREQ1#	NC	No Connection
70	UIM_POWER_SRC/GPIO_1/PEWAKE1#	NC	No Connection
72	3.3 V	P	VDD system power supply input
74	3.3 V	P	VDD system power supply input

Note: Power (P), Ground (G), Open-Drain (OD), Input (I), Output (O), Do Not Connect (DNC), No Connection (NC)

**Certification (TBD)**

- |                              |   |
|------------------------------|---|
| <input type="checkbox"/> FCC | <input type="checkbox"/> CE (RED EN 300 328 V2.2.2 / EN 301 893 V2.1.1) |
| <input type="checkbox"/> IC  | <input type="checkbox"/> MIC  |
| <input type="checkbox"/> NCC | <input type="checkbox"/> ASNZS  |

**Ordering Information**

Product Name	Part Number	Description
WNFQ-291BEI	R9701B10003	11be/ax/ac/a/b/g/n 2T2R Wi-Fi M.2 Module

**Optional Accessory(TBD)**

Product Name	Part Number	Description
AD-510AX	R3410A10051	Dipole Antenna,2.27dBi/2.69dBi/3.52dBi/2.4G/5G/6GHz,RP-SMA(M)connector
CBIRF-NE150	R3470300025	RF Cable, I-PEXMHF4 to RP-SMA(F); L150mm; Coaxial 0.81 Black
CBIRF-NE250	R3470300026	RF Cable, I-PEXMHF4 to RP-SMA(F); L250mm; Coaxial 0.81 Black