

BLACK bean is a Wi-Fi 5 (IEEE 802.11b/g/n/a/ac Wave2) dual-band wireless LAN and Bluetooth 5.0 PCIE M.2 card optimized for small size and low power consumption. The card is based on a Qualcomm QCA9377-5 chipset which has an integrated dual-band (2.4 and 5 GHz) 1x1 Wi-Fi 5 radio (supporting MU-MIMO) and Bluetooth® 5.0 transceivers combined in to a very small form factor (30 x 16.5mm). The radio supports advanced power saving techniques. Bluetooth supports both Class1 and Class2 transmissions. Advanced coexistence mechanisms allow it to work seamlessly with Wi-Fi ensuring good transmission quality and high performance. BLACK bean drivers are available for Linux, Windows 10 and Android operating systems.

## Quick specs

- Wi-Fi 5 (802.11a/b/g/n/ac), 2.4 and 5 GHz, 1x1 SISO, 433 Mbps data rate, up to 20 dBm output power
- 20/40/80 MHz channel size support
- MU-MIMO
- Bluetooth v5.0, BLE, ANT+ and backwards compatibility with BT v1.x and BT v2.x + enhanced data rate
- Connector: Murata HSC type P/N MM4829-2702RB, compatible with I-PEX MHF4 P/N 20449-001E
- Linux, Windows and Android drivers available
- Based on QCA9377-5 chipset
- Commercial temperature range 0 to +70 C°
- Very small form factor (30 by 16.5 mm)
- M.2 16530 A+E key WIFI/ BT card
- Available interfaces - Bluetooth USB1.1, WLAN PCIE

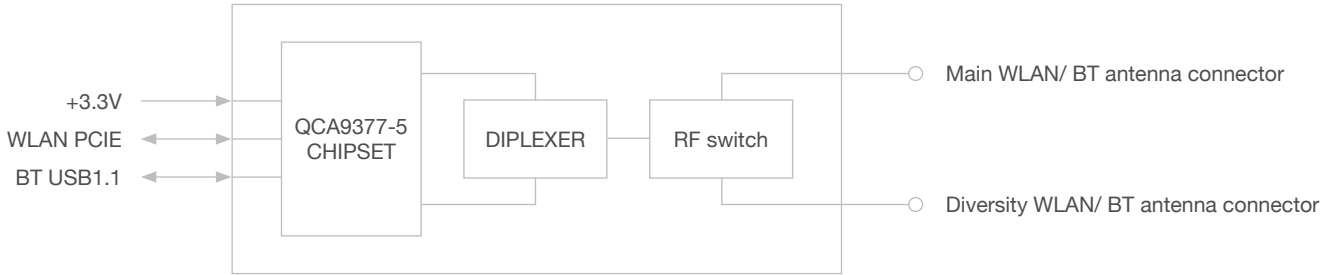
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# 1. Block diagram

FIGURE 1-1. BLACK BEAN MODULE BLOCK DIAGRAM



# 2. Module pinout and Pin description

FIGURE 2-1. BLACK BEAN PIN OUT, TOP SIDE

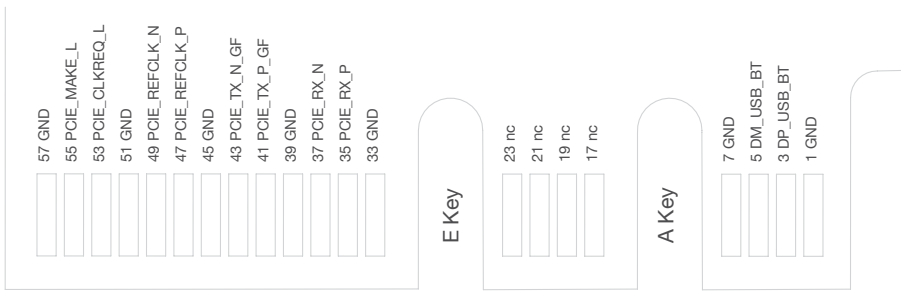


FIGURE 2-2. BLACK BEAN PIN OUT, BOTTOM SIDE

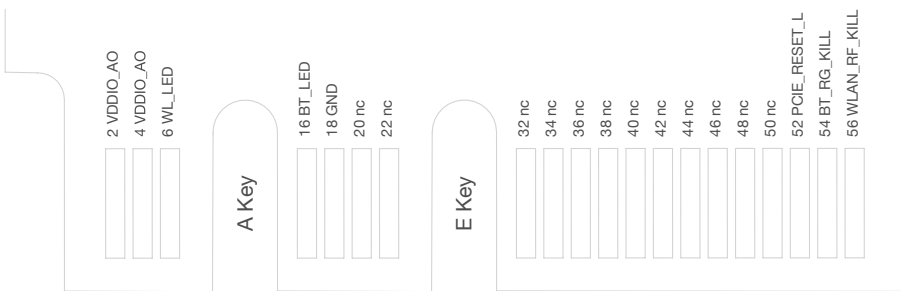
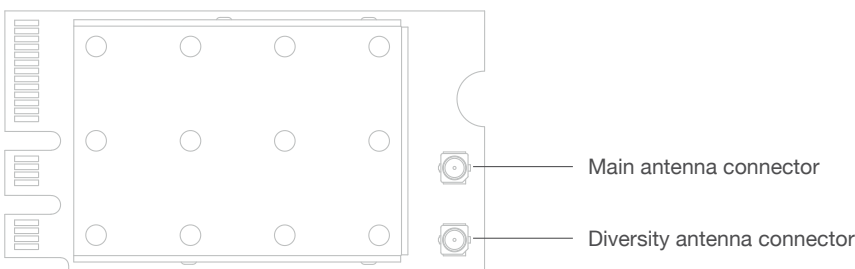


FIGURE 2-3. BLACK BEAN WLAN/BT OUT



**TABLE 2-4. PIN ASSIGNMENTS**

Pin	Name	I/O	Description
1	GND	-	Ground connection
2	VDDIO_AO	O	3.3V power supply
3	DP_USB_BT	I/O	Bluetooth USB 1.1 differential pair
4	VDDIO_AO	O	3.3V power supply
5	DM_USB_BT	I/O	Bluetooth USB 1.1 differential pair
6	WL_LED	O	This signal can be used to enable for external Wireless charging UART circuit.
7	GND	-	Ground connection
16	BT_LED	O	This signal can be used to enable for external Bluetooth charging UART circuit.
17	N.C.	-	Not connected
18	GND	-	Ground connection
19 - 23	N.C.	-	Not connected
32	N.C.	-	Not connected
33	GND	-	Ground connection
34	N.C.	-	Not connected
35	PCIE_RX_P	I	PCIe differential receive pin; positive
36	N.C.	-	Not connected
37	PCIE_RX_N	I	PCIe differential receive pin; negative
38	N.C.	-	Not connected
39	GND	-	Ground connection
40	N.C.	-	Not connected
41	PCIE_TX_P_GF	O	PCIe differential transmit pin; positive
42	N.C.	-	Not connected
43	PCIE_TX_N_GF	O	PCIe differential transmit pin; negative
44	N.C.	-	Not connected
45	GND	-	Ground connection
46	N.C.	-	Not connected
47	PCIE_REFCLK_P	I	Differential reference clock; positive
48	N.C.	-	Not connected
49	PCIE_REFCLK_N	I	Differential reference clock; negative
50	N.C.	-	Not connected
51	GND	-	Ground connection
52	PCIE_RESET_L		PCIe reset with weak pull-down
53	PCIE_CLKREQ_L	O	PCIe Reference to clock request
54	BT_RF_KILL		Turn off Bluetooth RF analog and front-end. Active low.
55	PCIE_WAKE_L		Request to service a function-initiated wake event
56	WLAN_RF_KILL		Turn off WLAN RF analog and front-end. Active low.
57	GND	-	Ground connection

## 3. Electrical characteristics

### 3.1. Power consumption

**TABLE 3-1. TYPICAL POWER CONSUMPTION FOR LOW-POWER STATES**

Mode	State	PCIe (mA)
Standby	Deep sleep	0,17
Power save, 2.4 GHz	DTIM = 1	1,01
	DTIM = 3	0,62
	DTIM = 10	0,41
Power save, 5 GHz	DTIM = 1	1,15
	DTIM = 3	0,69
	DTIM = 10	0,49

**TABLE 3-2. POWER CONSUMPTION FOR BT**

Description	USB 1.1 (mA)
Continuous Rx burst	22,5
Continuous Tx Class 2 (+4 dBm)	38,5
Continuous Tx Class 2 (+12.5 dBm)	64,5
1.28 sec page scan (non-interlaced)	0,36
1.28 sec LE ADV	0,23
1.28 sec Sniff as master	0,22
1.28 sec Sniff as slave	0,27

**TABLE 3-3. POWER CONSUMPTION FOR CONTINUOUS RX/TX 2.4GHZ**

Rate	PCIe (mA), RX/TX
802.11b, 1 Mbps	67 / 366
802.11g, 54 Mbps	68 / 342
802.11n, MCS0 HT20	74 / 351
802.11n, MCS7 HT20	78 / 336

**TABLE 3-4. POWER CONSUMPTION FOR CONTINUOUS RX/TX 2.4GHZ**

Rate	PCIe (mA), RX/TX
802.11n, MCS0 HT20	97 / 497
802.11n, MCS7 HT20	101 / 432
802.11ac, MCS9 VHT40	107 / 427
802.11ac, MCS7 VHT80	136 / 438
802.11ac, MCS9 VHT80	135 / 430

### 3.2. Radio characteristics

2.4 GHz 802.11AC (20 MHz)	Data rate (Mbps)	7.2	14.4	21.7	28.9	43.3	57.8	65	72.2	86.7	
	Sensitivity (dBm)	-92	-89	-87	-83	-80	-76	-75	-73	-69	
	Output power (dBm)	18	18	18	18	18	16	16	16	15	
2.4 GHz 802.11AC (40 MHz)	Data rate (Mbps)	15	30	45	60	90	120	135	150	180	200
	Sensitivity (dBm)	-88	-86	-84	-81	-77	-73	-72	-70	-66	-64
	Output power (dBm)	17	17	17	17	17	15	15	15	13	13
5 GHz 802.11AC (20 MHz)	Data rate (Mbps)	7.2	14.4	21.7	28.9	43.3	57.8	65	72.2	86.7	
	Sensitivity (dBm)	-91	-87	-85	-82	-78	-74	-73	-71	-67	
	Output power (dBm)	15	15	15	14	14	12	11	10	10	
5 GHz 802.11AC (40 MHz)	Data rate (Mbps)	15	30	45	60	90	120	135	150	180	200
	Sensitivity (dBm)	-87	-85	-82	-79	-76	-72	-70	-68	-65	-63
	Output power (dBm)	14	14	14	13	13	12	11	9	9	8
5 GHz 802.11AC (80 MHz)	Data rate (Mbps)	32.5	65	97.5	130	195	260	292.5	325	390	433.3
	Sensitivity (dBm)	-84	-81	-78	-76	-72	-68	-67	-65	-61	-59
	Output power (dBm)	13	13	13	12	12	11	11	9	9	8

Bluetooth	Frequency range	2.402 - 2.480 GHz
	Supported modes	BT and BLE
	Max TX power	14 dBm (4 dBm BLE)
	RX sensitivity (BER >= 0.1%)	-95 dBm (-99 dBm BLE)

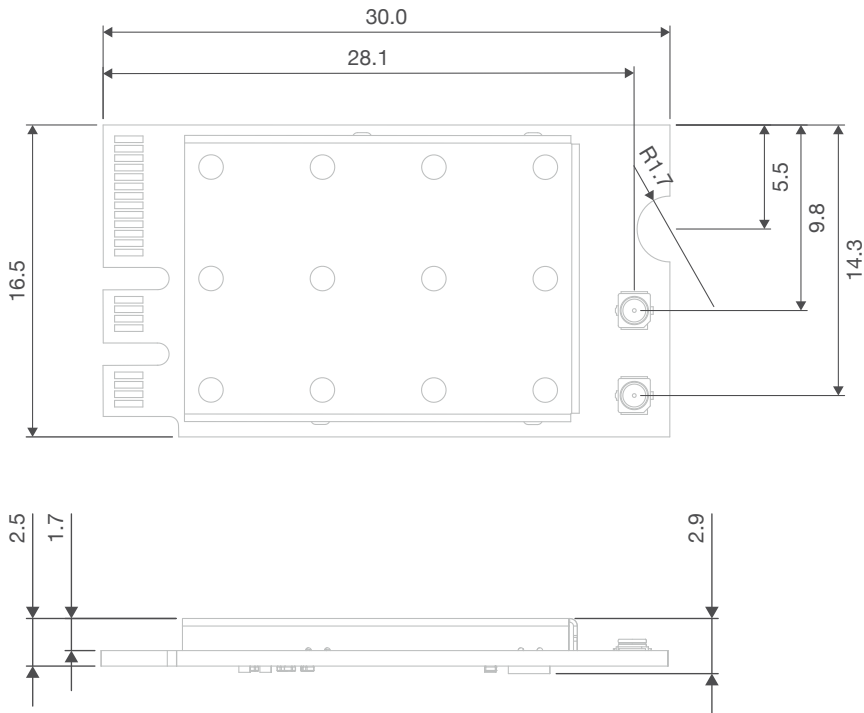
### 3.3 Power supply ratings

Parameter	Units	Min	Nominal	Max
Supply voltage (VDD33)	V	3.135	3.3	3.465

## 4. Software

Drivers for BLACK bean SDIO module (based on QCA9377-5) are available for Windows 7, Windows 10, Linux and Android operating systems.

## 5. Mechanical characteristics

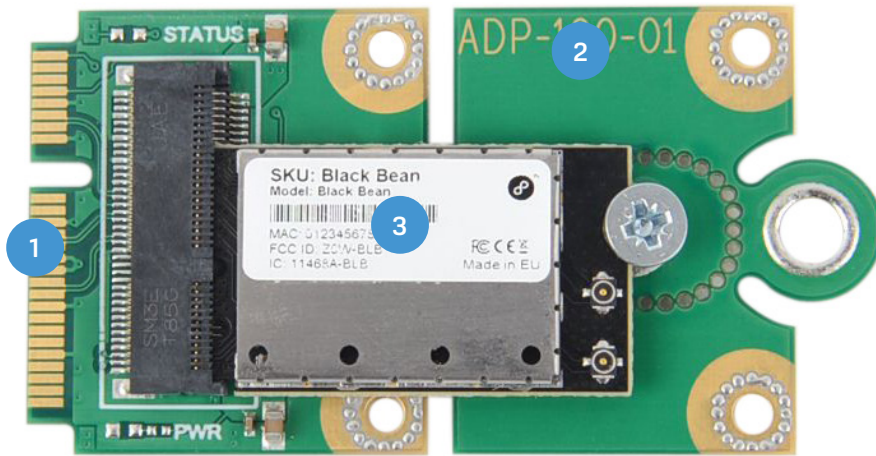


### 5.1. Thermal characteristics

TABLE 5-1. TEMPERATURE LIMIT RATINGS

Parameter	Minimum	Maximum	Units
Working temperature	0	70	°C
Storage temperature	-40	90	°C
Humidity	10	90	%RH
Storage humidity	5	90	%RH

## 6. Development kit



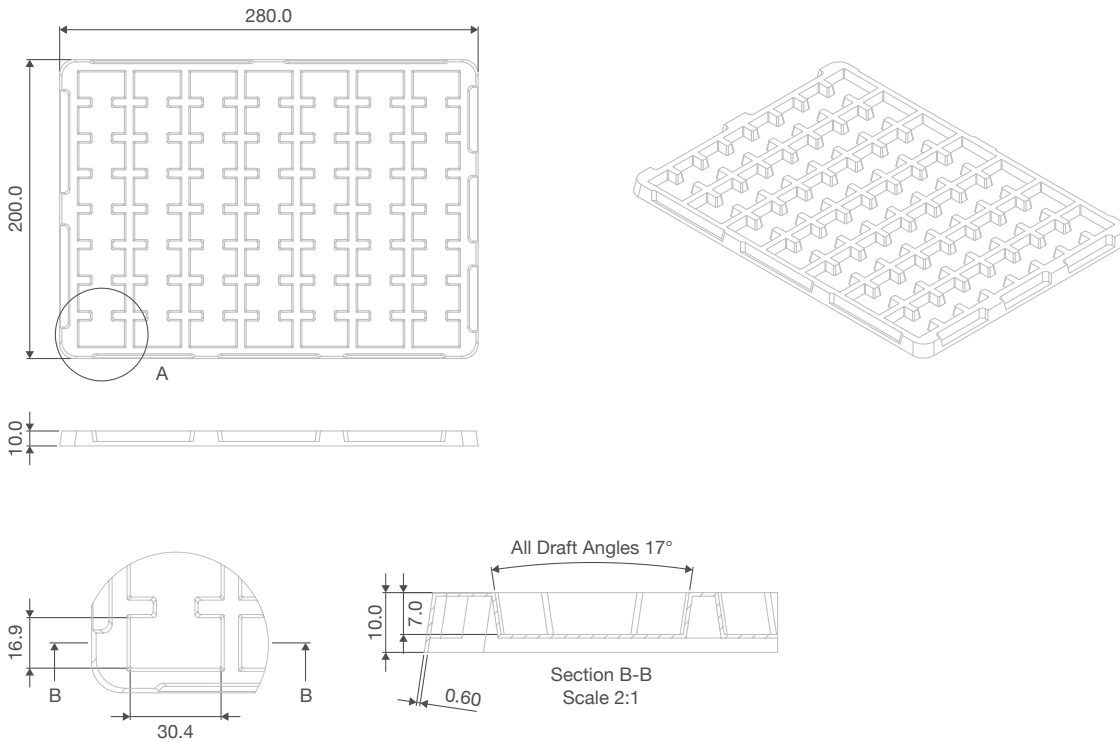
- 1 - PCIe mini interface
- 2 - M.2 to PCIe mini adapter
- 3 - BLACK bean card



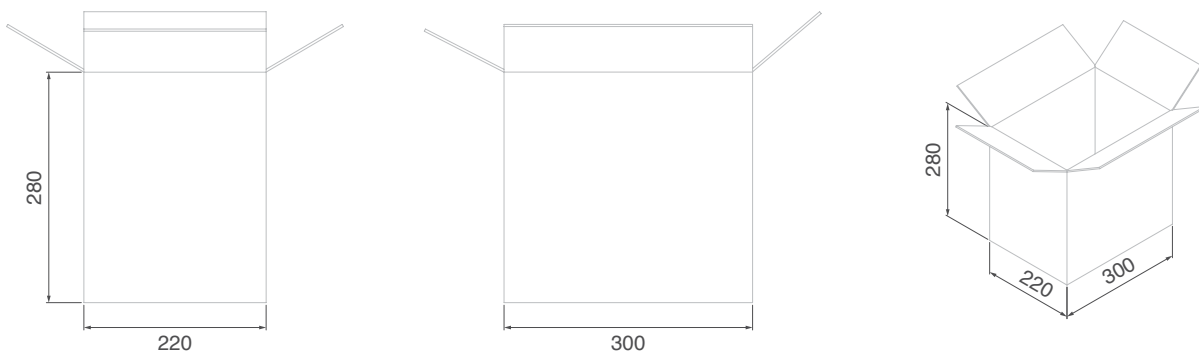
## 7. Packaging and ordering

BLACK bean radio modules are packed into vacuum sealed trays. A BLACK bean tray fits 56 radio modules. Every 5 trays are vacuum sealed packaging 280 of BLACK bean radios. One standard box holds 5 vacuum sealed packages or a total of 1,400 BLACK bean radio modules.

### 7.1 BLACK bean tray dimensions



### 7.2 Standard packing box dimensions



### 7.3 Ordering part number

BLACK-BEAN	M2-PCIE-ADP	BLACK-BEAN-DVK
BLACK bean module	M.2 PCI express adapter	BLACK bean development kit

## 11. Document Revision History

Revision	Revision Date	Description
1.0	2019.04.17	Initial release
1.1	2019.08.29	Removed STBC and transmit beam-forming
1.2	2020.02.24	Updated temperature range from -40 to 85 °C to 0 to 70 °C
1.3	2021.12.07	Updated PIN assignments table: 43 row, I/O PU to O and Description Turn off WLAN RF analog at front-end. Active low to PCIe differential transmit pin; negative