The Carambola3 is a System on Module (SoM) based on the Qualcomm QCA4531 chipset. It is pin-to-pin compatible with the Carambola2 module, meaning that it has the same physical dimensions and pinout as the Carambola2. This allows for easy integration of the Carambola3 into existing systems that use the Carambola2 module. It is a compact and powerful module that integrates a variety of features, including Wi-Fi as well as a range of other interfaces and peripherals. The module is designed for use in a wide range of embedded applications, including Internet of Things (IoT) devices, industrial automation systems, and smart home devices. The QCA4531 chipset provides high performance and low power consumption. The Carambola3 SoM is designed to be easily integrated into a wide range of platforms and products, reducing development time and costs.

Quick specs

- 802.11b/g/n, 2.4GHz, 150 Mbps data rate, 21 dBm per chain output power;
- U.FI connector or external pin for external antenna;
- 32 MB Flash, 128MB DDR2 300MHz RAM;
- CPU: QCA-4531, 650 MHz clock speed;
- Same pinout and form factor as Carambola2;
- Size: 28 by 38 mm;
- Available interfaces – USB 2.0 host port, 115200 Kbps serial port, 2x 100 Mbps Ethernet, 11x GPIOs;
- Low power consumption, up to 2W.

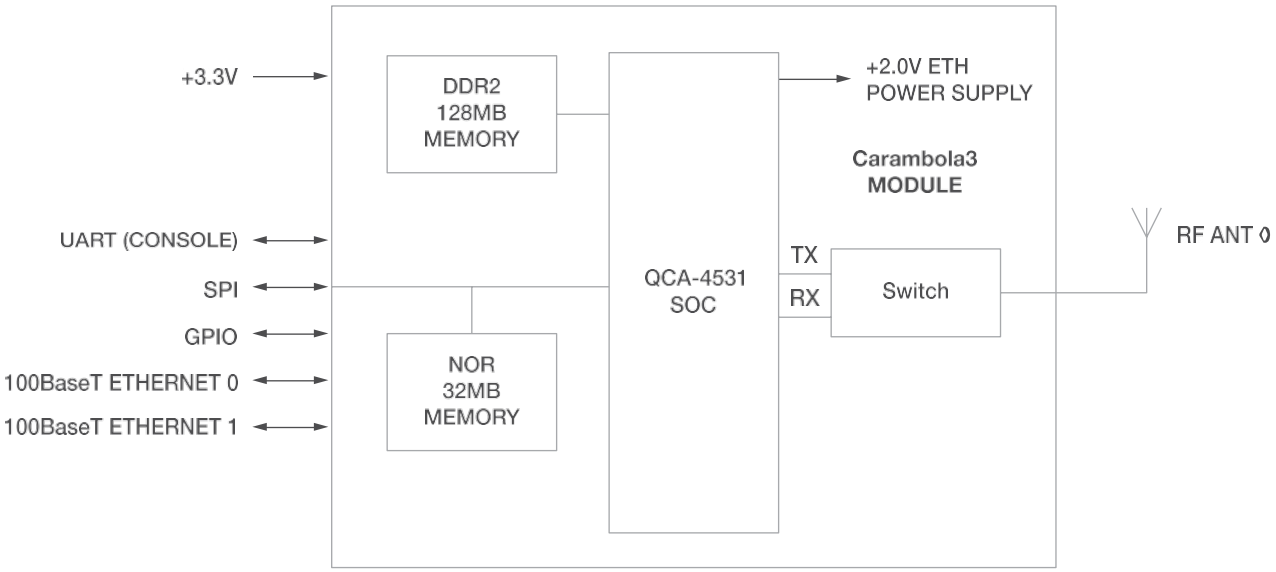
Difference between the original Carambola 2

- 250 MHz faster CPU;
- 16 MB larger flash;
- Four GPIO less than Carambola 2;
- 64 MB larger RAM;
- 100MHz faster RAM controller.

Table of Contents

1. Block Diagram

FIGURE 1-1. BLOCK DIAGRAM



2. Module Pin Out and Pint Description

FIGURE 2-1. PIN ASSIGNMENTS

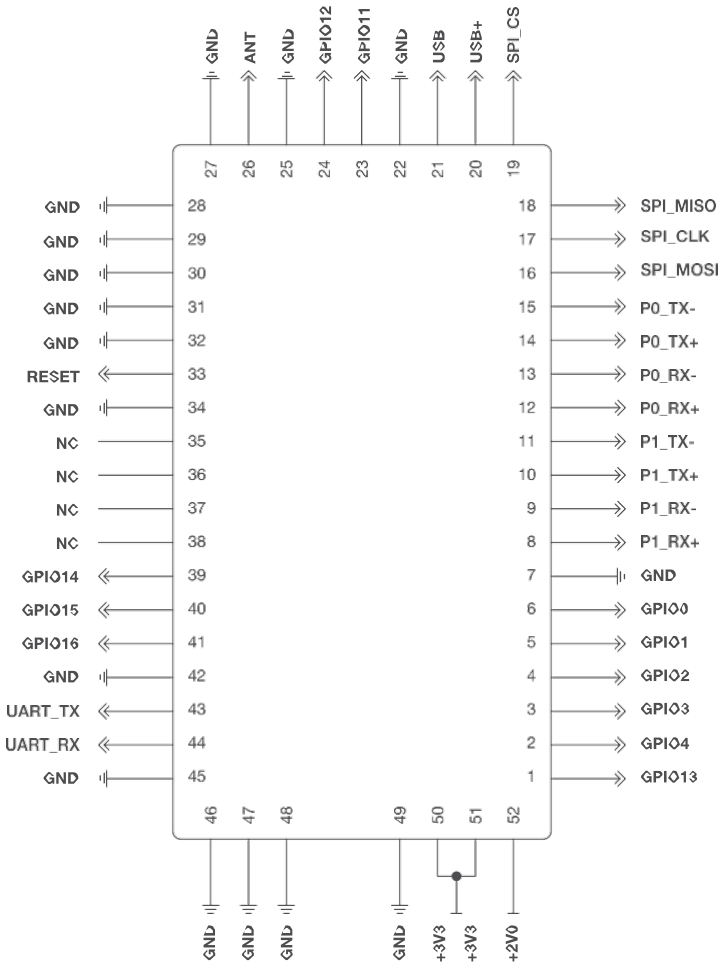


TABLE 2-1. PINOUT DIFFERENCES BETWEEN CARAMBOLA 2 AND CARAMBOLA 3

Pin	Carambola 2	Carambola 3
1	GPIO23	GPIO13
2	GPIO22	GPIO4
3	GPIO21	GPIO3
4	GPIO20	GPIO2
5	GPIO19	GPIO1
6	GPIO18	GPIO0
16	GPIO4 SPI MOSI	SPI MOSI GPIO7
17	GPIO3 SPI CLK	SPI CLK GPIO6
18	GPIO5 SPI MISO	SPI MISO GPIO8
19	GPIO2 SPI CS0	SPI CS GPIO5
35	LED6 GPIO17	NP
36	LED5 GPIO16	NP
37	LED4 GPIO15	NP
38	LED3 GPIO14	NP
39	LED2 GPIO13	GPIO14
40	LED1 GPIO1	GPIO15
41	LED0 GPIO0	GPIO16

TABLE 2-2. I/O DESCRIPTION (PAD TYPE) PARAMETERS

Symbol	Description
AI	Analog input
AO	Analog output
GND	Ground
RF In/Out	RF input/output
I	Digital input signal
O	Digital output signal
IO	Digital bidirectional signal
Z	High-impedance

TABLE 2.3. POWER, GROUND AND RESET

Pin	Pin name	Type	Description
50, 51	VDD33	I	3.3V digital power
52	2.0V	O	2.0V digital power for Ethernet
7, 22, 25, 27, 28, 29, 30, 31, 32, 34, 42, 45, 46, 47, 48, 49	GND	GND	Ground
33	RESET_H	I	Reboot the device

TABLE 2.4. RADIO

Pin	Pin name	Type	Description
26	ANT0	RF In/Out	Signal line for antenna

TABLE 2.5. USB

Pin	Pin name	Type	Description
20	USB+	IO	USB HS data positive
21	USB-	IO	USB HS data negative

TABLE 2.6. ETHERNET

Pin ID	Pin name	Type	Description
15	P0_TX-	O	ETH0 Transmitter differential signal
14	P0_TX+	O	
13	P0_RX-	I	ETH0 Receiver differential signal
12	P0_RX+	I	
11	P1_TX-	O	ETH1 Transmitter differential signal
10	P1_TX+	O	
9	P1_RX-	I	ETH1 Receiver differential signal
8	P1_RX+	I	

TABLE 2-7. SPI/UART

Pin ID	Pin name	Type	Description
16	SPI_MOSI	O	Data transmission from the Carambola3 to an external device
17	SPI_CLK	O	SPI serial interface clock
18	SPI_MISO	I	Data transmission from an external device to the Carambola3
19	SPI_CS	I/O	SPI chip select
43	UART_RX	I	Serial data in
44	UART_TX		Serial data out
			Bootstrap L: 1: DDR1 0: DDR2

TABLE 2-8. GPIO

Pin ID	Pad name	Voltage	Type	Function	Description
6	GPIO[0]	2.62 V	IO	GPIO_IN_OUT(0)	Configurable I/O
			O	JTAG_TCK	Test Clock
5	GPIO[1]	2.62 V	IO	GPIO_IN_OUT(1)	Configurable I/O
			O	JTAG_TDI	Test Data In
4	GPIO[2]	2.62 V	IO	GPIO_IN_OUT(2)	Configurable I/O
			IO	JTAG_TDO	Test Data Out
3	GPIO[3]	2.62 V	IO	GPIO_IN_OUT(3)	Configurable I/O
			O	JTAG_TMS	Test Mode Select
2	GPIO[4]	2.62 V	IO	GPIO_IN_OUT(4)	Configurable I/O
			I	Bootstrap L	**Do not pull up while booting**
23	GPIO[11]	2.62 V	IO	GPIO_IN_OUT(11)	Configurable I/O
24	GPIO[12]	2.62 V	IO	GPIO_IN_OUT(12)	Configurable I/O
1	GPIO[13]	2.62 V	IO	GPIO_IN_OUT(13)	Configurable I/O
			O	Bootstrap L	**Do not pull up while booting**
39	GPIO[14]	2.62 V	IO	GPIO_IN_OUT(14)	Configurable I/O
40	GPIO[15]	2.62 V	IO	GPIO_IN_OUT(15)	Configurable I/O
			I	Bootstrap L	Clock: 0 :25 MHz XTAL (default) 1: 40 MHz XTAL
41	GPIO[16]	2.62 V	IO	GPIO_IN_OUT(16)	Configurable I/O
			I	Bootstrap L	JTAG Mode: 0: JTAG (Default) 1: EJTAG

NOTE: Bootstrap pins are for boot configuration, use them cautiously.

3. Electrical Characteristics

TABLE 3-1. POWER SUPPLY DC CHARACTERISTICS

Symbol	Parameter	Minimum	Typical	Maximum	Units
VDD33	3.3V Supply Voltage	3.13	3.3	3.46	V
2.0V	Network transformer voltage	1.9	2.0	2.15	V

TABLE 3-2. TEMPERATURE LIMIT RATINGS

Parameter	Minimum	Maximum	Units
Storage Temperature	-65	+150	°C
Commercial Operating Temperature	0	+65	°C
Industrial Operating Temperature	-40	+85	°C
Humidity	10	90	%RH
Storage humidity	5	90	%RH

4. Power Management

TABLE 4-1. POWER CONSUMPTION

Scenario	Voltage,	Current	Total power
TPC duplex throughput and 95% CPU load	5V	0.35A	1.75W
Boot	5V	0.2A	1W
Idle	5V	0.15A	0.95W

5. Radio Characteristics

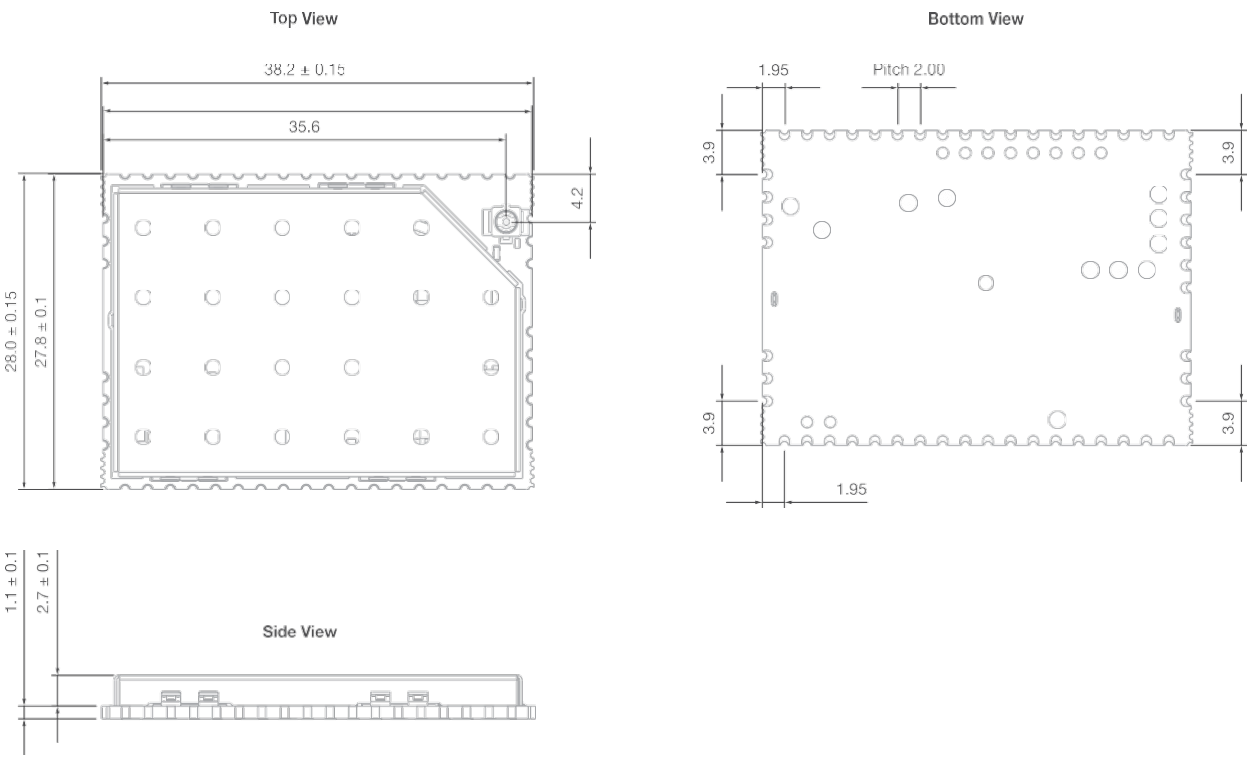
TABLE 5-1. 2.4GHZ 802.11N 20MHZ

	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Data rate (Mbps)	7.2	14.4	21.7	28.9	43.3	57.8	65	72.2
TX power (dBm)	20	19	19	19	18	17	16	14
RX sensitivity (dB)	-85	-83	-80	-76	-74	-70	-69	-67

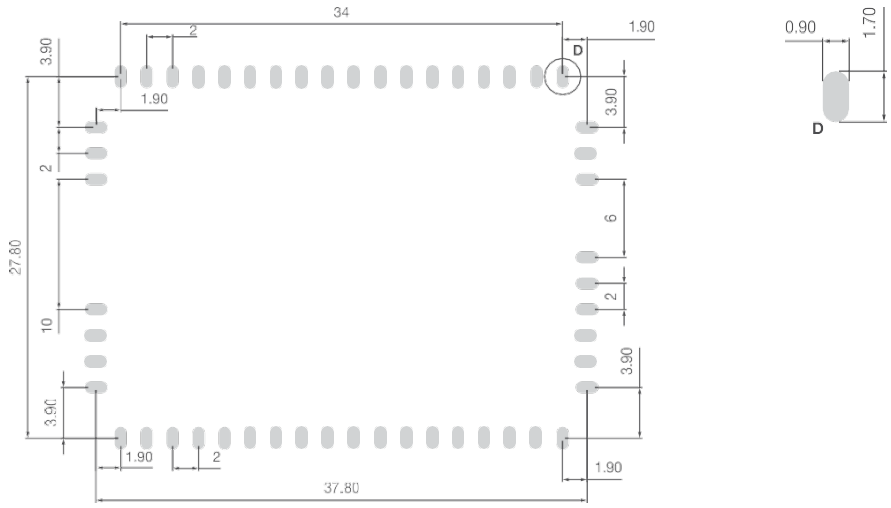
TABLE 5-2. 2.4 GHZ 802.11N 40MHZ

	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Data rate (Mbps)	15	30	45	60	90	120	135	150
TX power (dBm)	20	19	19	19	18	17	16	14
RX sensitivity (dB)	-83	-81	-79	-75	-72	-69	-67	-65

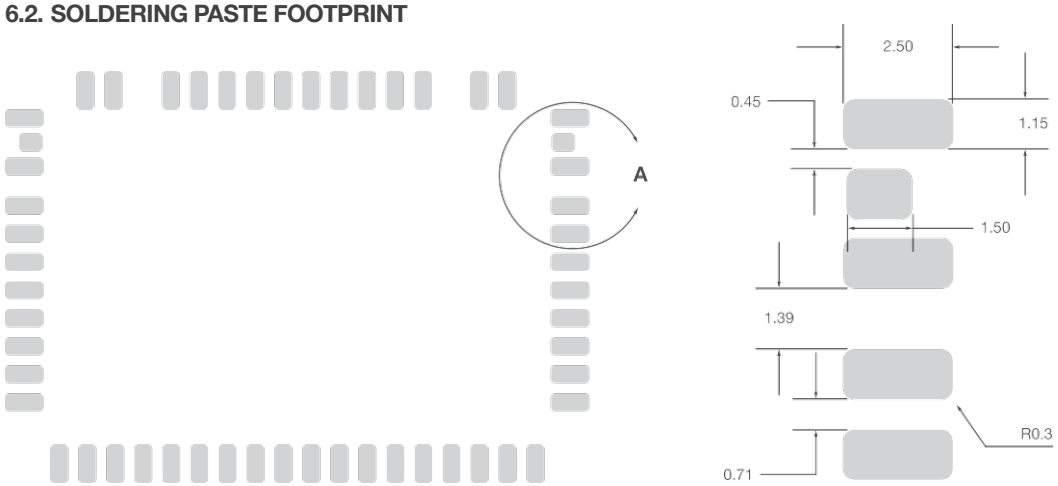
6. Mechanical Characteristics



6.1. PCB FOOTPRINT



6.2. SOLDERING PASTE FOOTPRINT

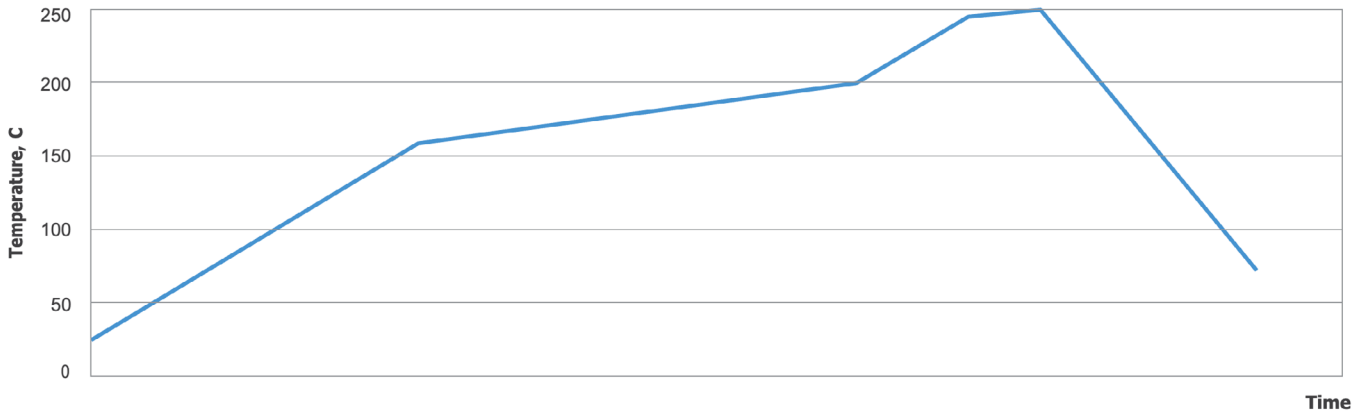


7. Reflow Profile Recommendations

7.1 REFLOW PROFILE PARAMETERS

Reflow Profile Recommendations	
Ramp up rate	3°C/second max
Maximum time maintained above 217°C	120 seconds
Peak temperature	250°C
Maximum time within 5°C of peak temperature	20 seconds
Ramp down rate	6°C/second max

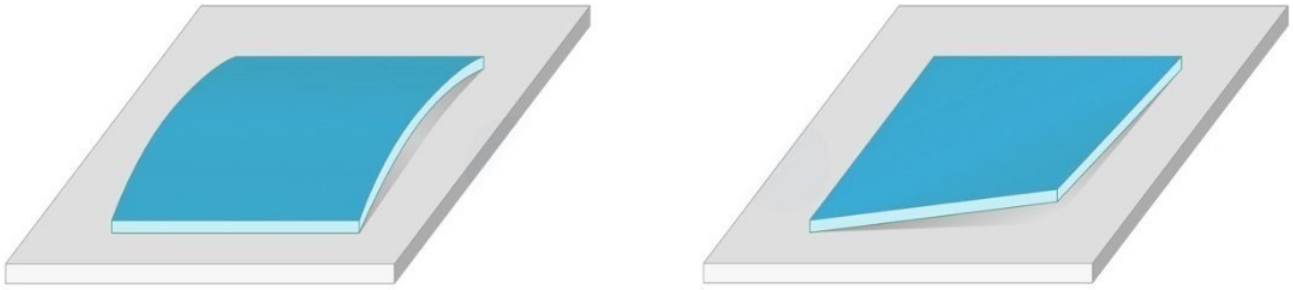
7.2 REFLOW PROFILE



8. Laminate Conditions

8devices modules are manufactured according to the standard IPC-A-610 Norm Class 2. Standard states: Bow/twist after solder should not exceed 1.5% for through-hole and 0.75% for surface mount printed board applications". According to this statement, Carambola3 module can be bowed and twisted up to 0.285mm. To avoid negative effects of bow and twist we recommend to increase the paste thickness for the module pads to achieve better co-planarity.

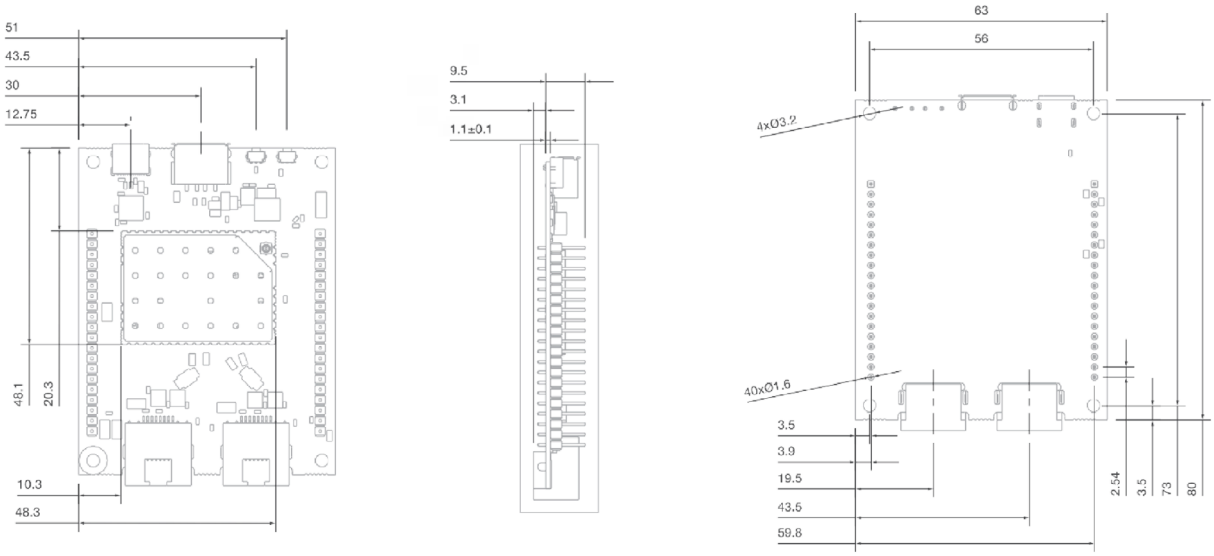
FIGURE 8-1. EXAMPLE OF BOW AND TWIST



BOW **TWIST**

9. Development Board

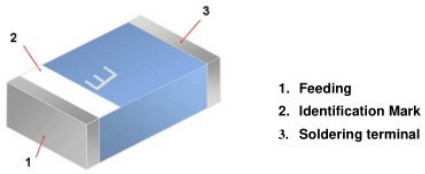
9.1. DEVELOPMENT BOARD



9.2. ANTENNA DESIGN

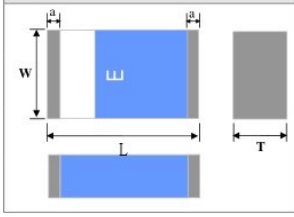
Directional ceramic chip antenna specification:

CONSTRUCTION

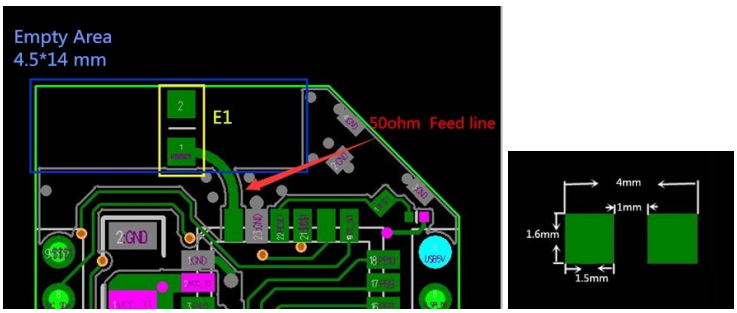


1. Feeding
2. Identification Mark
3. Soldering terminal

DIMENSIONS

Figure	Symbol	Dimension (mm)
	L	3.20 ± 0.20
	W	1.60 ± 0.10
	T	1.20 ± 0.10
	a	0.25 ± 0.15

Chip antenna location on PCB is E1, the RF feed line between the antenna and the module must be 50ohm. Wide of the feed line trace is recommended to be 0.5mm. The Empty Area around antenna should be 4.5*14mm. PCB Pad size for chip antenna(**E1**)



10. Carambola3 Packaging and Ordering Info

Carambola3 modules are packed into trays. Each tray fits 20 modules. Every 5 trays are vacuum sealed and one standard packaging box contains 500 modules.

FIGURE 10-1. CARAMBOLA3 TRAY DIMENSIONS

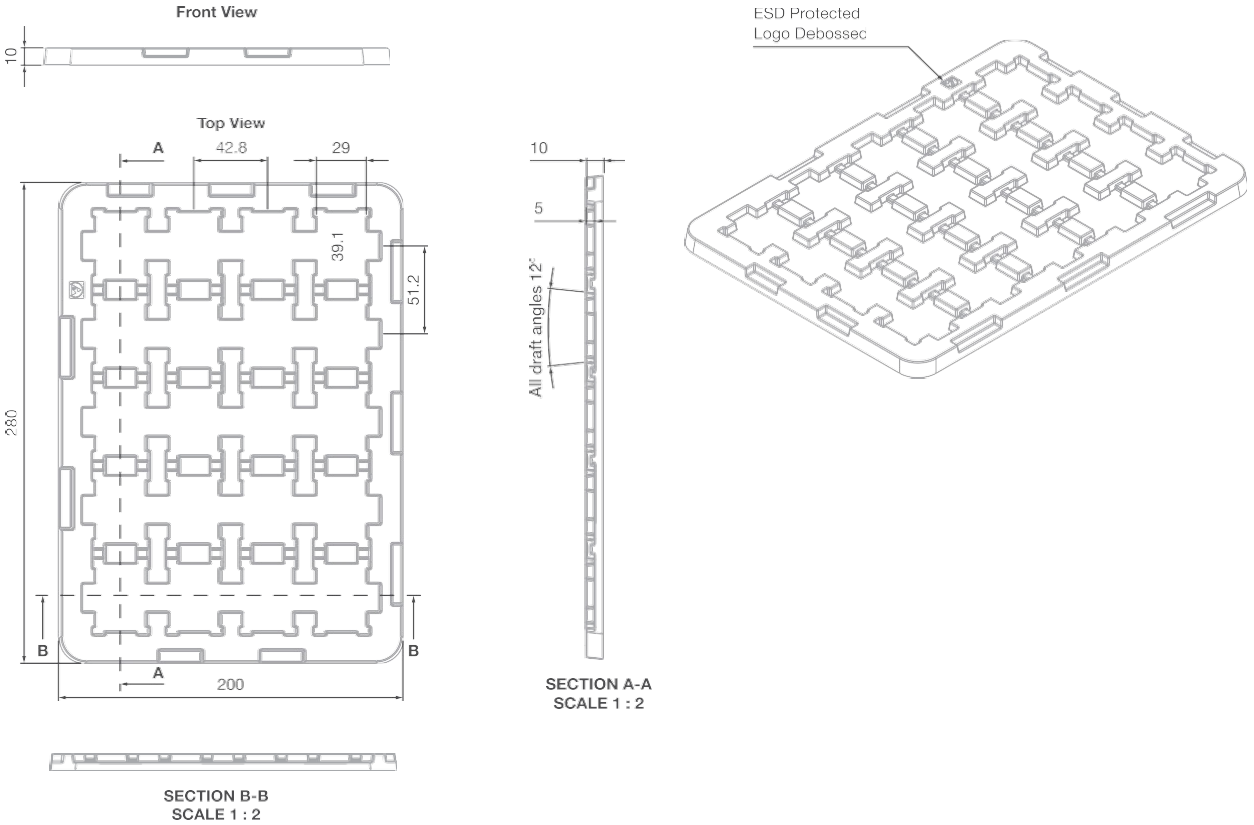


FIGURE 10-2. STANDARD PACKAGING BOX DIMENSIONS

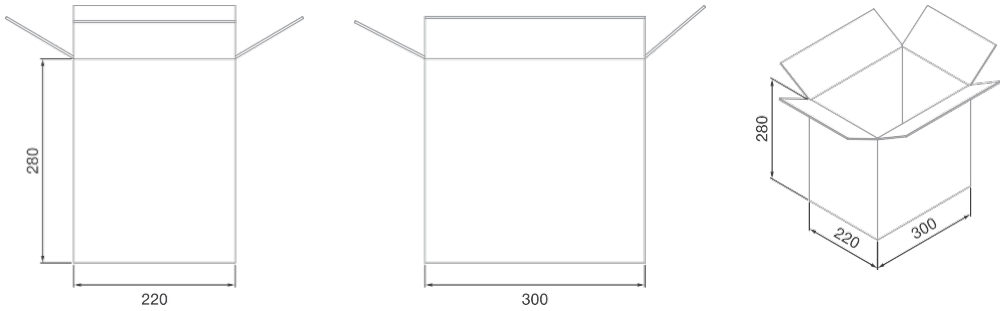


TABLE 10-3. ORDERING PART NUMBERS

Order Number	Description
Carambola3	Carambola3 module, commercial temperature range 0°C to 65°C, QCA-4531 SoC
Carambola3-I	Carambola3 module, industrial temperature range -40°C to 85°C, QCA-4531 SoC
Carambola3 DVK	Development kit, based on Carambola3 module, QCA-4531 SoC

11. FCC 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;
(2) This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 try to correct the interference by one or more 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 that to which the receiver is connected. Consult the dealer or an experienced radio/TV technician for help.

12. IC Statement

This device complies with Industry Canada license-exempt RSS standard(s) Operation is subject to the following two conditions:

(1) This device may not cause interference;
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. End user must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

(3) This Class A digital apparatus complies with Canadian ICES-003 and RSS-210 rules.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. Ce dispositif est conforme aux normes autoriser-exemptes du Canada RSS d'industrie.
L'exploitation est autorisée aux deux conditions suivantes:

(1) L'appareil ne doit pas produire de brouillage, et;
(2) L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Cet équipement est conforme avec l'exposition aux radiations IC définies pour un environnement. Non contrôlé. L'utilisateur final doit respecter les instructions de fonctionnement spécifiques pour satisfaire la conformité aux expositions RF. Cet émetteur ne doit pas être colocalisées ou opérant en conjonction avec une autre antenne ou transmetteur.

(3) Cet appareil numérique de la classe A est conforme à la norme NMB-003 et CNR-210 du Canada.

13. Module Warning

13.1. FCC STATEMENT

Compliance list INTEGRATION INSTRUCTIONS for 996369 D03 OEM the and 996369 D03 OEM by Sections 2.2 through 2.10.

2.2 List of applicable FCC rules:
FCC standards: FCC CFR Title 47 Part 15 Subpart C Section 15.231

2.3 Summarize the specific operational use conditions:
Chip antenna with antenna gain 2.09dBi.

2.4 Limited module procedures:
Not applicable

2.5 Trace antenna designs:
Please refer to paragraph 9.2. on page 11.

2.6 RF exposure considerations:
This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

2.7 Antennas:
Chip antenna with antenna gain 2.09dBi.

2.8 Label and compliance information:
If the FCC identification 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. This exterior label can use wording such as the following: “Contains Transmitter Module FCC ID: Z9W-CM3

2.9 Information on test modes and additional testing requirements:
Any company of the host device which install this modular with limit modular approval should perform the test of radiated & conducted emission and spurious emission, etc. according to FCC part 15C: 15.209 &15.207 ,15B Class B requirement, only if the test result complies with FCC part 15C: 15.231 and 15.209 &15.207 ,15B Class B requirement, then the host can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer:
Any company of the host device which install this modular with limit modular approval should perform the test of radiated & conducted emission and spurious emission, etc. according to FCC part 15C: 15.209 &15.207 ,15B Class B requirement, only if the test result complies with FCC part 15C: 15.209 &15.207 ,15B Class B requirement, then the host can be sold legally.
When the module is installed inside another device, the user manual of the host must contain below warning statements;
Note: 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 try to correct the interference by one or more 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 that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

13.2. IC STATEMENT

This device contains license-exempt transmitter(s)/receiver(s) that comply with innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil contient des émetteurs / récepteurs exemptés de licence conformes aux RSS (RSS) d'Innovation, Sciences et Développement économique Canada, Le fonctionnement est soumis aux deux conditions suivantes:

(1) Cet appareil ne doit pas causer d'interférences.
(2) Cet appareil doit accepter toutes les interférences, y compris celles susceptibles de provoquer un fonctionnement indésirable de l'appareil.

IC RADIATION EXPOSURE STATEMENT:

This modular complies with IC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

If the 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. This exterior label can use wording such as the following:

Contains IC: 11468A-CM3 when the module is installed inside another device, the user manual of this device must contain below warning statements;

This device contains license-exempt transmitter(s)/receiver(s) that comply with innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil contient des émetteurs / récepteurs exemptés de licence conformes aux RSS(RSS) d'Innovation, Sciences et Développement économique Canada. Le fonctionnement est soumis aux deux conditions suivantes:

(1) Cet appareil ne doit pas causer d'interférences.
(2) Cet appareil doit accepter toutes les interférences, y compris celles susceptibles de provoquer un fonctionnement indésirable de l'appareil.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

14. Document Revision History

Revision	Revision Date	Description
v1.0	2022-11-25	Initial release
v1.1	2024-07-08	FCC & IC Statement added
v1.2	2024-07-11	Module Warning added