



Mango system on module (SOM) is based on IPQ6010 SoC from Qualcomm, which incorporates a powerful quad-core ARM Cortex A53 processor with NEON SIMD DSP extension for each core. It comes with a high-power dual-band concurrent radio supporting WIFI 6 (802.11ax) technology 2x2 MIMO. Two Ethernet SerDes to connect to external multi-GbE PHYs. Advanced power management for low active standby power consumption. SOM supports one USB3.0, USB2.0, PCIe 3.0, miscellaneous interfaces, which can be configured as general-purpose I/O pins and other. SoC has hardware NAT engine and high-end security features like crypto engine and others. The module is in a surface mountable form. Commercial temperature range: 0-65°C, industrial temperature range: -40-85°C.

Quick specs

- Wi-Fi 6 (802.11a/n/ac/ax) 5GHz with 2x2 MU-MiMo, 1201Mbps data-rate
- Wi-Fi 6 (802.11b/g/n/ax) 2.4GHz with 2x2 MU-MiMo, 573,5Mbps data-rate
- MIPI DBI v2.0 type B display interface
- CPU – IPQ6010 (1.8GHz)
- OpenWRT Linux flash image
- Size – 38,3 by 61,7 mm
- Available interfaces:
50 GPIOs, 1 x PCIe 3.0, 1 x USB3.0, 1 x USB2.0, 6 x BLSP ports for UART, 2C and SPI interfaces, 4 x PWM, 1 x JTAG, 2 x multi-GbE ethernet SerDes, dual SDIO for eMMC and SD card, PTA QPIC for parallel NAND device and LCD support.

Table of Contents

1. Features	3
1.1. Features	3
2. Module pinout and Pin description	4
3. Electrical characteristics	14
4. Power management	14
4.1. Power consumption	14
5. Radio characteristics	15
6. Reflow profile recommendations	16
6.1. Reflow profile recommendation	16
6.2. Reflow profile	16
7. Design considerations	17
7.1. Ethernet interface	17
7.2. USB	17
7.3. Parallel NAND flash / LCD	18
7.4. SD/eMMC	18
7.5. PCIe	19
8. Thermal considerations	20
8.1. Heatsink	20
9. Laminate Conditions	21
10 . Mango packaging and ordering info	22
11. Document Revision History	23

1. Features

1.1. Features

TABLE 1-1. MANGO FEATURES

Feature list			MAN_100 Mango
Integrated core	Core type		IPQ-6010 ARM Cortex-A53
	Core clock frequency		1.8GHz
	Cache		
Memory	DRAM		DDR3L 512MB (up to 1GB)
	NOR FLASH		32MB
WIFI	IEEE 802.11 b/g/n/ax 2x2 MU-MIMO 2.4GHz 20/40 MHz 1024 QAM		2412-2462MHz
	IEEE 802.11 a/n/ac/ax 2x2 MU-MIMO 5GHz 20/40/80 MHz 1024 QAM		5150-5350MHz, 5470-5850MHz
RF pin	RF signal is fed to 2 external module pins		2
Display	LCD controller		1
Peripherals	PCIe	PCIe 3.0	1
	USB	USB 3.0	1
		USB 2.0	1
	BLSP	SPI/UART/I ² C configuration ports	6
	GPIO	IN/OUT/INT	64
	PWM	Audio Pulse Width Modulation interface	4
	Parallel	For parallel NAND flash memory	1
	Ethernet	SerDes supports 6.25/5/3.125/1.25 Gbps Ethernet 5*1/4*1/2.5/1 GbE PHYs. PSGMII, QSGMII, SGMII/+	1
	Reset	Reset controlled via voltage monitor	1
	SDIO3.0/eMMC	Secure Digital Input Output / Embedded Multi Media Card	1

2. Module pinout and Pin description

FIGURE 2-1. PIN ASSIGNMENTS



TABLE 2-1. 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 2-2. POWER, GROUND AND RESET

Pin ID	Pin name	Type	Description
A83, A84, A85,B76,B77	3V3	I	3.3V digital power
A36,A39,A45,A49, B33, B36, B42, B45	3V3_RF	I	3.3V digital power for RF
A1, A2, A12, A24, A32, A34, A35, A37, A38, A40, A41, A42, A43, A44, A46, A47, A48, A50, A52, A76, A79, A82, A86, A87, A88, A97, A100, A102, B1, B18, B20, B30, B31, B32, B34, B35, B37, B38, B39, B40, B41, B43, B44, B46, B47, B55, B56, B58, B59, B60, B61, B62, B63, B64, B65, B66, B67, B68, B69, B72, B75, B78, B79, B90	GND	GND	Ground
A81	PBIN_N	I	Power off/on the device
B10	RESET_OUT_N	O	Reset output
A20	PMIC_RST_O	O	Hardware reset

TABLE 2-3. RADIO

Pin ID	Pin name	Type	Description
A51	TX0	RF In/Out	Signal line for antenna
A33	TX1	RF In/Out	Signal line for antenna

TABLE 2-4. USB 3.0

Pin ID	Pin name	Type	Description
B70	USB_0_D_P	AI, AO	USB HS data positive
A75	USB_0_D_N	AI, AO	USB HS data negative
B73	USB_0_SS_RX_P	AI	USB SS receive data positive
A78	USB_0_SS_RX_N	AI	USB SS receive data negative
A77	USB_0_SS_TX_P	AO	USB SS transmit data positive
B71	USB_0_SS_TX_N	AO	USB SS transmit data negative

TABLE 2-5. USB 2.0

Pin ID	Pin name	Type	Description
A80	USB_1_D_P	AI, AO	USB HS data positive
B74	USB_1_D_N	AI, AO	USB HS data negative

TABLE 2-6. PCIE GEN3

Pin ID	Pin name	Type	Description
A95	PCIE_W_DISABLE	IO	
B87	PCIE_CLK_REQn	IO	PCle clock request
A96	PCIE_RSTn	I	PCle reset
B88	PCIE_WAKE	I	PCle wake
B89	PCIE_TX_N	AO	PCle transmitter differential signal
A98	PCIE_TX_P	AO	
A99	PCIE_RX_P	AI	PCle receiver differential signal
B91	PCIE_RX_N	AI	
B92	PCIE_REFCLK_N	AO	Reference clock
A101	PCIE_REFCLK_P	AO	

TABLE 2-7. ETHERNET

Pin ID	Pin name	Type	Description
A74	CLK_50M_NAPA_P	AO	50 MHz differential output clock
A73	CLK_50M_NAPA_N	AO	
A72	USXGMII0_TX_P	O	Transmitter differential signal
A71	USXGMII0_TX_N	O	
A70	USXGMII0_RX_P	I	Receiver differential signal
A69	USXGMII0_RX_N	I	
A68	CLK_50M_NAPA2_P	AO	50 MHz differential output clock
A67	CLK_50M_NAPA2_N	AO	
A66	MDC	AO	MDIO interface clock
A65	MDIO	IO	Management data input/output
A64	USXGMII1_RX_N	I	Receiver differential signal
A63	USXGMII1_RX_P	I	
B57	CLK_25M_OUT	AO	25 MHz output clock
A62	USXGMII1_TX_N	O	Transmitter differential signal
A61	USXGMII1_TX_P	O	

TABLE 2-8. NAND

Pin ID	Pin name	Type	Description
B23	NAND_FLASH_ALE	IO	NAND controller ALE
A25	NAND_DATA_0	IO	NAND/Display controller data
B24	NAND_DATA_3	IO	NAND/Display controller data
A26	NAND_DATA_2	IO	NAND/Display controller data
B25	NAND_DATA_1	IO	NAND/Display controller data
A27	NAND_FLASH_CS	IO	NAND controller select
B26	NAND_FLASH_CLE	IO	NAND controller CLE. Boot up interface select
A28	NAND_DATA_7	IO	NAND/Display controller data
B27	NAND_DATA_6	IO	NAND/Display controller data
A29	NAND_DATA_5	IO	NAND/Display controller data
B28	NAND_DATA_4	IO	NAND/Display controller data
A30	NAND_FLASH_OE	IO	NAND/Display controller read enable
B29	NAND_FLASH_WE	IO	NAND/Display controller write enable
A31	NAND_FLASH_BUSY	IO	NAND controller busy input

TABLE 2-9. EMMC/SD

Pin ID	Pin name	Type	Description
B80	SD_MODE	I	eMMC/SD enable
A89	EMMC_DATA2	IO	Data2 for eMMC/SD
B81	EMMC_DATA3	IO	Data3 for eMMC/SD
A90	EMMC_CMD	IO	Command for eMMC/SD
B82	EMMC_CLK	IO	Clock for eMMC/SD
A91	EMMC_DATA0	IO	Data0 for eMMC/SD
B83	EMMC_DATA1	IO	Data1 for eMMC/SD
A92	SD_CARD_DETECT	I	SD card detect
B84	SD_WRITE_PROTECT	I	SD card write protection
A93	EMMC_DATA7	IO	Data7 only for eMMC
B85	EMMC_DATA6	IO	Data6 only for eMMC
A94	EMMC_DATA5	IO	Data5 only for eMMC
B86	EMMC_DATA4	IO	Data4 only for eMMC

TABLE 2-10. GPIO

Pad #	Pad Name	Voltage	Type	GPIO CFG. FUNC_SEL	Function	Functional Description
B22	GPIO[0]	1.8 V	IO	0	GPIO_IN_OUT(0)	Configurable I/O
			I	1	QPIC_PAD_TE	LCDC TE, VSYNC
			I	2	WCI2_RXD(0)	input
A31	GPIO[1]	1.8 V	IO	0	GPIO_IN_OUT(1)	Configurable I/O
			I	1	QPIC_PAD_BUSY_N	NAND BUSY_NOT_READY input. Active low.
			O	2	MAC1_SA0(2)	Wi-Fi MAC1 smart antenna
A23	GPIO[2]	1.8V	IO	0	GPIO_IN_OUT(2)	Configurable I/O
			O	1	QPIC_PAD_LCD_RS_N	LCDC RESX, reset signal. Active low.
			O	2	WCI2_TXD(0)	Wi-Fi WCI 2.0 transmit data
B29	GPIO[3]	1.8 V	IO	0	GPIO_IN_OUT(3)	Configurable I/O
			O	1	QPIC_PAD_WE_N	NAND/LCDC write enable
			O	2	MAC0_SA0(1)	Wi-Fi MAC0 smart antenna
A30	GPIO[4]	1.8 V	IO	0	GPIO_IN_OUT(4)	Configurable I/O
			O	1	QPIC_PAD_OE_N	NAND/LCDC read enable
			O	2	MAC0_SA1(1)	Wi-Fi MAC0 smart antenna
B28	GPIO[5]	1.8 V	IO	0	GPIO_IN_OUT(5)	Configurable I/O
			O	1	QPIC_PAD_DAT(4)	NAND/LCDC data[4]
			O	2	MAC2_SA0(1)	Wi-Fi MAC2 smart antenna
A29	GPIO[6]	1.8 V	IO	0	GPIO_IN_OUT(6)	Configurable I/O
			O	1	QPIC_PAD_DAT(5)	NAND/LCDC data[5]
			O	2	MAC2_SA1(1)	Wi-Fi MAC2 smart antenna
B27	GPIO[7]	1.8 V	IO	0	GPIO_IN_OUT(7)	Configurable I/O
			O	1	QPIC_PAD_DAT(6)	NAND/LCDC data[6]
A28	GPIO[8]	1.8 V	IO	0	GPIO_IN_OUT(8)	Configurable I/O
			O	1	QPIC_PAD_DAT(7)	NAND/LCDC data[7]
B21	GPIO[9]	1.8 V	IO	0	GPIO_IN_OUT(9)	Configurable I/O
			O	1	QPIC_PAD_LCD_CS_N	LCD chip select
			O	3	CXC_CLK(0)	Wi-Fi WSI 1.0 clock
			O	4	MAC1_SA0(3)	Wi-Fi MAC1 smart antenna
B26	GPIO[10]	1.8 V	IO	0	GPIO_IN_OUT(10)	Configurable I/O
			O	1	QPIC_PAD_CLE_LB_N	NAND CLE/LCDC DCX. CLE is commend latch enable. Active high. DCX is data/commend. 1 is data, 0 is commend.
A27	GPIO[11]	1.8 V	IO	0	GPIO_IN_OUT(11)	Configurable I/O
			O	1	QPIC_PAD_NAND_CS_N	NAND chip select
			I	2	WCI2_RXD(2)	Wi-Fi WCI 2.0 receive data
			O	3	MAC1_SA1(2)	Wi-Fi MAC1 smart antenna
B25	GPIO[12]	1.8 V	IO	0	GPIO_IN_OUT(12)	Configurable I/O
			O	1	QPIC_PAD_DAT(1)	NAND/LCDC data[1]

Pad #	Pad Name	Voltage	Type	GPIO CFG. FUNC_SEL	Function	Functional Description
A26	GPIO[13]	1.8 V	IO	0	GPIO_IN_OUT(13)	Configurable I/O
			O	1	QPIC_PAD_DAT(2)	NAND/LCDC data[2]
B24	GPIO[14]	1.8 V	IO	0	GPIO_IN_OUT(14)	Configurable I/O
			O	1	QPIC_PAD_DAT(3)	NAND/LCDC data[3]
A25	GPIO[15]	1.8 V	IO	0	GPIO_IN_OUT(15)	Configurable I/O
			O	1	QPIC_PAD_DAT(0)	NAND/LCDC data[0]
A22	GPIO[16]	1.8 V	IO	0	GPIO_IN_OUT(16)	Configurable I/O
			O	1	QPIC_PAD_DAT(8)	NAND/LCDC data[8]
			O	2	CXC_DATA(0)	Wi-Fi WSI 1.0 data
			O	3	MAC1_SA1(3)	Wi-Fi MAC1 smart antenna
B23	GPIO[17]	1.8 V	IO	0	GPIO_IN_OUT(17)	Configurable I/O
			O	1	QPIC_PAD_ALE_LB_N	NAND ALE. Active high.
			O	3	WCI2_TXD(2)	Wi-Fi WCI 2.0 transmit data
A19	GPIO[18]	1.8 V	IO	0	GPIO_IN_OUT(18)	Configurable I/O
			O	1	PWM0(0)	Audio Pulse Width Modulation interface 0
			I	3	WCI2_RXD(3)	Wi-Fi WCI 2.0 receive data
			O	4	MAC1_SA0(1)	Wi-Fi MAC1 smart antenna
B17	GPIO[19]	1.8 V	IO	0	GPIO_IN_OUT(19)	Configurable I/O
			O	1	PWM1(0)	Audio Pulse Width Modulation interface 1
			O	3	WCI2_TXD(3)	Wi-Fi WCI 2.0 transmit data
			O	4	MAC1_SA1(1)	Wi-Fi MAC1 smart antenna
A18	GPIO[20]	1.8 V	IO	0	GPIO_IN_OUT(20)	Configurable I/O
			O	1	PWM2(0)	Audio Pulse Width Modulation interface 2
B16	GPIO[21]	1.8 V	IO	0	GPIO_IN_OUT(21)	Configurable I/O
			O	1	PWM3(0)	Audio Pulse Width Modulation interface 3
A17	GPIO[22]	1.8 V	IO	0	GPIO_IN_OUT(22)	Configurable I/O
			O	3	PWM0(2)	Audio Pulse Width Modulation interface 0
B15	GPIO[23]	1.8 V	IO	0	GPIO_IN_OUT(23)	Configurable I/O
			O	2	PWM1(2)	Audio Pulse Width Modulation interface 1
A16	GPIO[24]	1.8 V	IO	0	GPIO_IN_OUT(24)	Configurable I/O
			O	2	PWM2(2)	Audio Pulse Width Modulation interface 2
B14	GPIO[25]	1.8 V	IO	0	GPIO_IN_OUT(25)	Configurable I/O
			O	2	PWM3(2)	Audio Pulse Width Modulation interface 3
A15	GPIO[26]	1.8 V	IO	0	GPIO_IN_OUT(26)	Configurable I/O
			O	2	PWM0(4)	Audio Pulse Width Modulation interface 0

Pad #	Pad Name	Voltage	Type	GPIO CFG. FUNC_SEL	Function	Functional Description
B13	GPIO[27]	1.8 V	IO	0	GPIO_IN_OUT(27)	Configurable I/O
			O	2	PWM1(4)	Audio Pulse Width Modulation interface 1
A14	GPIO[28]	1.8 V	IO	0	GPIO_IN_OUT(28)	Configurable I/O
			O	2	PWM2(4)	Audio Pulse Width Modulation interface 2
B12	GPIO[29]	1.8 V	IO	0	GPIO_IN_OUT(29)	Configurable I/O
			O	3	PWM0(3)	Audio Pulse Width Modulation interface 0
A13	GPIO[30]	1.8 V	IO	0	GPIO_IN_OUT(30)	Configurable I/O
			O	2	PWM1(3)	Audio Pulse Width Modulation interface 1
B11	GPIO[31]	1.8 V	IO	0	GPIO_IN_OUT(31)	Configurable I/O
			O	2	PWM2(3)	Audio Pulse Width Modulation interface 2
A11	GPIO[32]	1.8 V	IO	0	GPIO_IN_OUT(32)	Configurable I/O
			O	2	PWM3(3)	Audio Pulse Width Modulation interface 3
B9	GPIO[33]	1.8 V	IO	0	GPIO_IN_OUT(33)	Configurable I/O
A10	GPIO[34]	1.8 V	IO	0	GPIO_IN_OUT(34)	Configurable I/O
			O	2	MAC1_SA0(0)	Wi-Fi MAC1 smart antenna
			O	3	MAC0_SA0(0)	Wi-Fi MAC0 smart antenna
B8	GPIO[35]	1.8 V	IO	0	GPIO_IN_OUT(35)	Configurable I/O
			O	2	MAC1_SA1(0)	Wi-Fi MAC1 smart antenna
			O	3	MAC0_SA1(0)	Wi-Fi MAC0 smart antenna
A9	GPIO[36]	1.8 V	IO	0	GPIO_IN_OUT(36)	Configurable I/O
			O	2	MAC2_SA0(0)	Wi-Fi MAC2 smart antenna
B7	GPIO[37]	1.8 V	IO	0	GPIO_IN_OUT(37)	Configurable I/O
			O	2	MAC2_SA1(0)	Wi-Fi MAC2 smart antenna
B4	GPIO[42]	1.8 V	IO	0	GPIO_IN_OUT(42)	Configurable I/O
			O	1	BLSP2_UART_RFR_N	UART2 ready for receiving
			O	2	BLSP2_I2C_SCL	I ² C clock
			O	3	BLSP2_SPI_CLK	SPI2 clock
A6	GPIO[43]	1.8 V	IO	0	GPIO_IN_OUT(43)	Configurable I/O
			I	1	BLSP2_UART_CTS_N	UART2 clear to send
			O	2	BLSP2_I2C_SDA	I ² C data
			O	3	BLSP2_SPI_CS_N	SPI2 chip select
A21	GPIO[44]	1.8 V	I	1	BLSP2_UART_RX	UART2 receive serial data
			IO	2	BLSP2_SPI_MISO	SPI2 master-in slave-out data
			IO	0	GPIO_IN_OUT(45)	Configurable I/O
B19	GPIO[45]	1.8V	O	1	BLSP2_UART_TX	UART2 transmit serial data
			O	2	BLSP2_SPI_MOSI	SPI2 master-out slave-in data

Pad #	Pad Name	Voltage	Type	GPIO CFG. FUNC_SEL	Function	Functional Description
A60	GPIO[49]	1.8 V	IO	0	GPIO_IN_OUT(49)	Configurable I/O
			O	1	BLSP5_UART_TX	UART5 transmit serial data
A8	GPIO[50]	1.8 V	IO	0	GPIO_IN_OUT(50)	Configurable I/O
			O	1	PWM0(1)	Audio Pulse Width Modulation interface 0
			O	2	GP0_CLK(1)	General Purpose clock
B6	GPIO[51]	1.8 V	IO	0	GPIO_IN_OUT(51)	Configurable I/O
			I	1	PTA1_1	Wi-Fi Co-exist PTA 1
			O	2	PWM1(1)	Audio Pulse Width Modulation interface 1
			O	3	GP1_CLK(1)	General Purpose clock
			I	4	RX_LOS(1)	Ethernet Loss of Signal
A7	GPIO[52]	1.8 V	IO	0	GPIO_IN_OUT(52)	Configurable I/O
			O	1	PTA1_2	Wi-Fi Co-exist PTA 1
			O	2	PWM2(1)	Audio Pulse Width Modulation interface 2
			O	3	GP2_CLK(1)	General Purpose clock
B5	GPIO[53]	1.8 V	IO	0	GPIO_IN_OUT(53)	Configurable I/O
			I	1	PTA1_0	Wi-Fi Co-exist PTA 1
			O	2	PWM3(1)	Audio Pulse Width Modulation interface 3
A5	GPIO[54]	1.8 V	IO	0	GPIO_IN_OUT(54)	Configurable I/O
B3	GPIO[55]	1.8 V	IO	0	GPIO_IN_OUT(55)	Configurable I/O
			O	1	BLSP4_UART_RFR_N	UART4 ready for receiving
			O	2	BLSP4_I2C_SCL	I ² C4 clock
			O	3	BLSP4_SPI_CLK	SPI4 clock
A4	GPIO[56]	1.8 V	IO	0	GPIO_IN_OUT(56)	Configurable I/O
			I	1	BLSP4_UART_CTS_N	UART4 clear to send
			O	2	BLSP4_I2C_SDA	I ² C4 data
			O	3	BLSP4_SPI_CS_N	SPI4 chip select
B2	GPIO[57]	1.8 V	IO	0	GPIO_IN_OUT(57)	Configurable I/O
			I	1	BLSP4_UART_RX	UART4 receive serial data
			IO	2	BLSP4_SPI_MISO	SPI4 master-in slave- out data
A3	GPIO[58]	1.8 V	IO	0	GPIO_IN_OUT(58)	Configurable I/O
			O	1	BLSP4_UART_TX	UART4 transmit serial data
			O	2	BLSP4_SPI_MOSI	SPI4 master-out slave- in data
B54	GPIO[66]	1.8 V	IO	0	GPIO_IN_OUT(66)	Configurable I/O
			I	1	PTA2_0	Wi-Fi Co-exist PTA 2
			I	2	WCI2_RXD(1)	Wi-Fi WCI 2.0 transmit data
			O	3	CXC_CLK(1)	Wi-Fi WSI 1.0 clock

Pad #	Pad Name	Voltage	Type	GPIO CFG. FUNC_SEL	Function	Functional Description
A59	GPIO[67]	1.8 V	IO	0	GPIO_IN_OUT(67)	Configurable I/O
			I	1	PTA2_1	Wi-Fi Co-exist PTA 2
B53	GPIO[68]	1.8 V	IO	0	GPIO_IN_OUT(68)	Configurable I/O
			O	1	PTA2_2	Wi-Fi Co-exist PTA 2
			O	2	WCI2_TXD(1)	Wi-Fi WCI 2.0 transmit data
			O	3	CXC_DATA(1)	Wi-Fi WSI 1.0 data
A58	GPIO[69]	1.8 V	IO	0	GPIO_IN_OUT(69)	Configurable I/O
			O	1	BLSP1_UART_RFR_N	UART1 ready for receiving
			O	2	BLSP1_I2C_SCL	I ² C1 clock
			O	3	BLSP1_SPI_CLK	SPI1 clock
B52	GPIO[70]	1.8 V	IO	0	GPIO_IN_OUT(70)	Configurable I/O
			I	1	BLSP1_UART_CTS_N	UART1 clear to send
			O	2	BLSP1_I2C_SDA	I ² C1 data
			O	3	BLSP1_SPI_CS_N	SPI1 chip select
A57	GPIO[71]	1.8 V	IO	0	GPIO_IN_OUT(71)	Configurable I/O
			I	1	BLSP1_UART_RX	UART1 receive serial data
			IO	2	BLSP1_SPI_MISO	SPI1 master-in slave- out data
B51	GPIO[72]	1.8 V	IO	0	GPIO_IN_OUT(72)	Configurable I/O
			O	1	BLSP1_UART_TX	UART1 transmit serial data
			O	2	BLSP1_SPI_MOSI	SPI1 master-out slave- in data
A56	GPIO[73]	1.8 V	IO	0	GPIO_IN_OUT(73)	Configurable I/O
			O	1	BLSP3_UART_RFR_N	UART3 ready for receiving
			O	2	BLSP3_I2C_SCL	I ² C3 clock
			O	3	BLSP3_SPI_CLK	SPI3 clock
B50	GPIO[74]	1.8 V	IO	0	GPIO_IN_OUT(74)	Configurable I/O
			I	1	BLSP3_UART_CTS_N	UART3 clear to send
			O	2	BLSP3_I2C_SDA	I ² C3 data
			O	3	BLSP3_SPI_CS_N	SPI3 chip select
A55	GPIO[75]	1.8 V	IO	0	GPIO_IN_OUT(75)	Configurable I/O
			I	1	BLSP3_UART_RX	UART3 receive serial data
			IO	2	BLSP3_SPI_MISO	SPI3 master-in slave- out data
B49	GPIO[76]	1.8 V	IO	0	GPIO_IN_OUT(76)	Configurable I/O
			O	1	BLSP3_UART_TX	UART3 transmit serial data
			O	2	BLSP3_SPI_MOSI	SPI3 master-out slave- in data
A54	GPIO[77]	1.8 V	IO	0	GPIO_IN_OUT(77)	Configurable I/O
			Z	1	BLSP3_SPI_CS1_N	SPI3 additional CS[1]
B48	GPIO[78]	1.8 V	IO	0	GPIO_IN_OUT(78)	Configurable I/O
			Z	1	BLSP3_SPI_CS2_N	SPI3 additional CS[2]
A53	GPIO[79]	1.8 V	IO	0	GPIO_IN_OUT(79)	Configurable I/O
			Z	1	BLSP3_SPI_CS3_N	SPI3 additional CS[3]

TABLE 2-11. PIN STATUS ON BOOT

Pin #	Pin name	Pin name	Voltage	Internal Pull-down(PD)/ Pull-up(PU)	Type	Description
A23	BOOT_CONFIG[0]	GPIO_2	1.8 V	PD	I	Auth enable: 0: No auth 1: Auth is required
B29	BOOT_CONFIG[1]	GPIO_3	1.8 V	PD	I	Fast boot (boot interface select): 000: SPI-NOR 001: eMMC 010: Para NAND 011: USB 2.0 100: SPI-NOR-GPT
B26	BOOT_CONFIG[2]	GPIO_10	1.8 V	PD	I	
B23	BOOT_CONFIG[3]	GPIO_17	1.8 V	PD	I	
B16	BOOT_CONFIG[4]	GPIO_21	1.8 V	PD	I	Hash in fuse (SW use only) 0: PK hash is stored in boot ROM 1: PK hash is stored in OTP
B17	BOOT_CONFIG[5]	GPIO_19	1.8 V	PU	I	Boot from ROM: 0: boot from code ram 1: boot from rom
A18	BOOT_CONFIG[6]	GPIO_20	1.8 V	PD	I	Boot ROM boot speed: 00: Uniphy CMN clock - 24MHz 01: GPLLO- 200MHz 10: GPLLO- 400MHz 11: GPLLO- 800MHz
A60	BOOT_CONFIG[7]	GPIO_49	1.8 V	PD	I	
A8	BOOT_CONFIG[8]	GPIO_50	1.8 V	PD	I	IMAGE_ENCRYPTION_ENABLE 0: UIE Disable 1: UIE Enable
A7	BOOT_CONFIG[9]	GPIO_52	1.8 V	PD	I	watchdog_enable 0: watchdog enable. 1: watchdong disable
A5	BOOT_CONFIG[10]	GPIO_54	1.8 V	PD	I	Use Serial Num: 0: Use Serial Num 1: Use OEM ID
A66	BOOT_CONFIG[11]	GPIO_64	1.8 V	PD	I	Board Type[2:0] detect the board and autoload the Configuration data table 000: CP01 001: CP02 010: CP03
B13	BOOT_CONFIG[12]	GPIO_27	1.8 V	PU	I	
A14	BOOT_CONFIG[13]	GPIO_28	1.8 V	PD	I	
A15	forced_usb_boot	GPIO_26	1.8 V	PD	I	0: Not force boot from USB 1: Force boot from USB

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

3. Electrical characteristics

TABLE 3-1. POWER SUPPLY DC CHARACTERISTICS

Symbol	Parameter	Minimum	Typical	Maximum	Units
DVDD33	3.3V Supply Voltage	3.13	3.3	3.46	V

TABLE 3-2. TEMPERATURE LIMIT RATINGS

Parameter	Minimum	Maximum	Units
Storage Temperature (Commercial)	-40	+70	°C
Storage Temperature (Industrial)	-40	+90	°C
Commercial Operating Temperature	0	+65	°C
Industrial Operating Temperature	-40	+85	°C
Humidity	10	90	%RH
Storage humidity	5	90	%RH

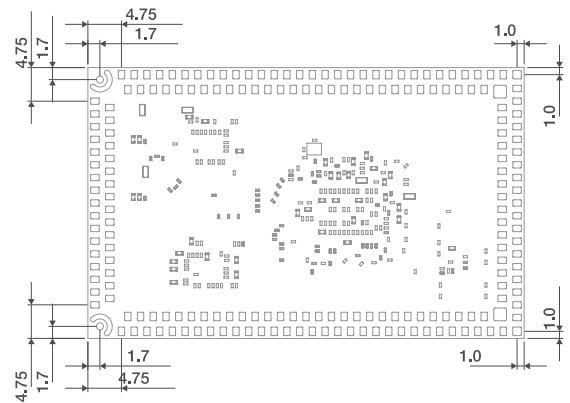
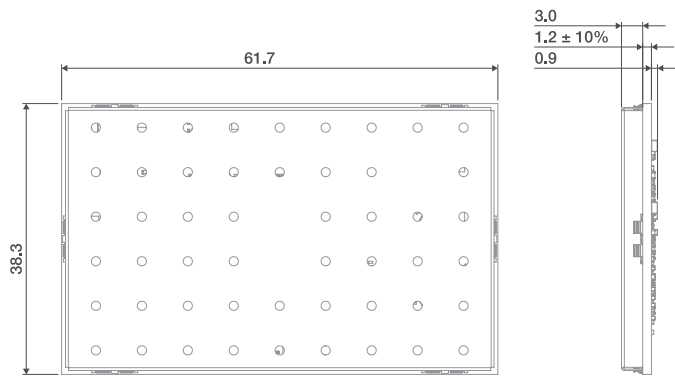
4. Power management

4.1. Power consumption

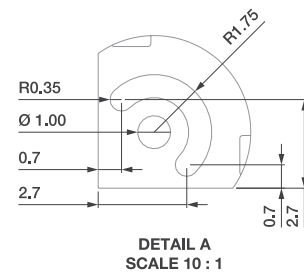
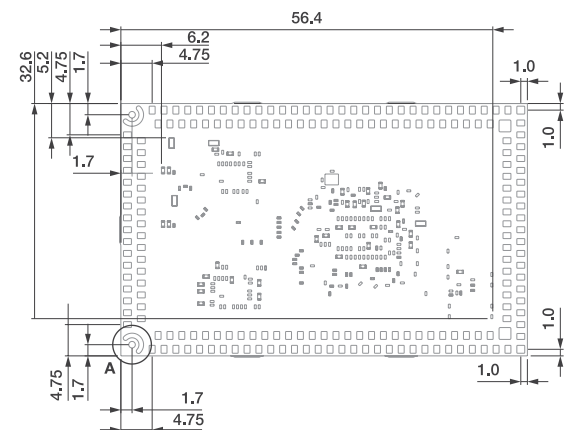
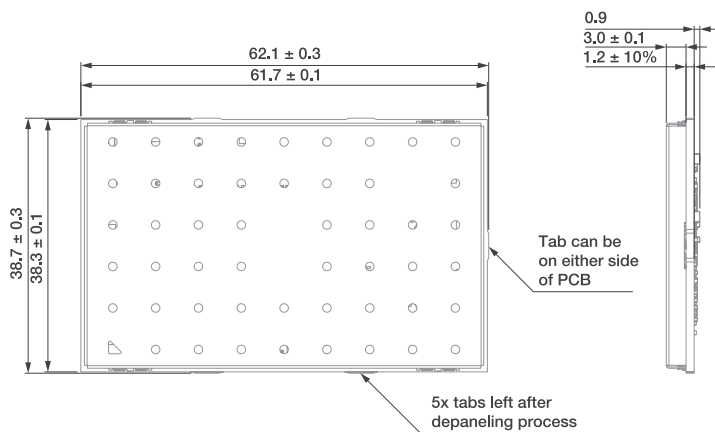
TABLE 4-1. POWER CONSUMPTION

Scenario	Rate	Voltage	Current	Total power
Throughput with iperf and 95% CPU load, 2x2	MCS0	24 V	0.4 A	9.6 W
	MCS11	24 V	0.42 A	10.1 W

5. Mechanical characteristics



PCB footprint



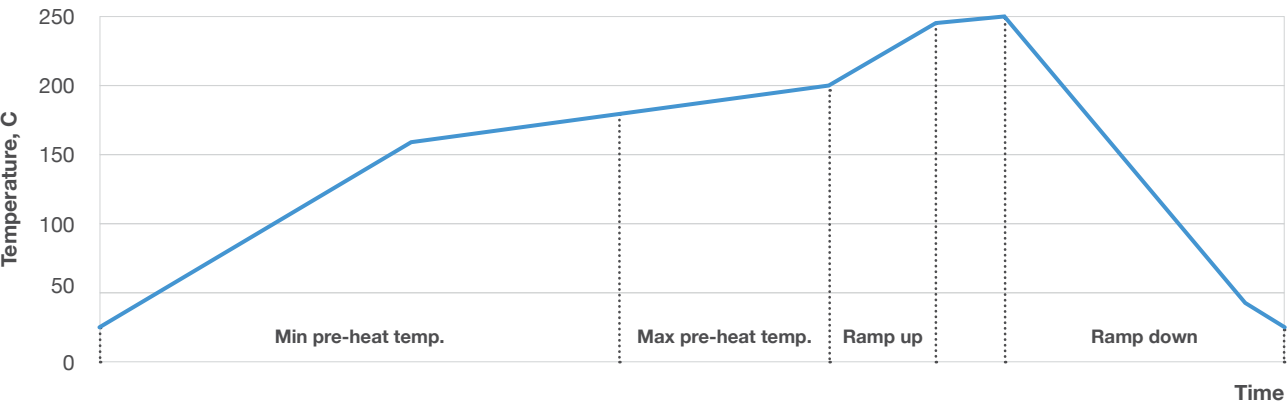
6. Reflow profile recommendations

6.1. Reflow profile recommendation

Process		Unit	Value
Pre-heat	Min pre-heat temperature	°C	150
	Max pre-heat temperature	°C	200
	Pre-heat time	s	150
	Ramp up rate	°C/s	3
Peak	Maximum time maintained above 220	s	120
	Peak temperature	°C	250
	Maximum time within 5°C of peak temperature	s	30
Cooling	Ramp down rate	°C/s	4

To solder Mango module properly thicker layer of solder paste have to be used. Minimum thickness of stencil is 100µm. It is also recommended to use TG index 170 on the carrier board, to get the best soldering performance.

6.2. Reflow profile



7. Design considerations

7.1. Ethernet interface

ETHERNET DESIGN GUIDELINES:

Category	Guidelines/Remarks
Groups	USXGMII[0..1]_TX_P, USXGMII[0..1]_RX_P, USXGMII[0..1]_TX_N, USXGMII[0..1]_RX_N
Route type	Differential pair, 100 Ohm impedance
Length	< 1.5 in., try to route as short as possible
Length match within pair	+/-5 mils
Length match across pairs	There is no requirement to length match the Tx and Rx pairs
Spacing requirements	3 W spacing between pairs and to other signals
Vias/layer transitions	Minimize layer transitions; where necessary limit to 2 vias per signal trace. Provide return vias interconnecting the GNDs in the immediate vicinity of signal vias
Other	Each pair needs magnetic module (or combo module for all pairs) between PHY and Ethernet port

7.2. USB

USB 3.0 DESIGN GUIDELINES:

Category	Guidelines/Remarks
Groups	USB_0_RX_P, USB_0_RX_N, USB_0_TX_P, USB_0_TX_N, USB_[0..1]_D_P, USB_[0..1]_D_N
USB_RXP, USB_RXN	Differential pair, 90 Ohm impedance for the super speed pairs according to USB3.0 specification
Route type	Ensure continuous and unbroken return path without voids. Differential pair, 90 Ohm impedance for the super speed pairs according to USB3.0 specification
Return path	Ensure continuous and unbroken return path without voids
Length	< 5 in.
Length match within pair	+/- 5 mils
Length match across pairs	There is no requirement to length match the Tx and Rx pairs
Spacing requirements	3 W spacing between pairs and to other signals
Vias/layer transitions	Avoid layer transitions and vias
AC coupling	Use 0.1 uF capacitors on each signal line of the Tx pair from Mango module; place them symmetrically at the same point on the pair
Other	Clear the GND pour under the signal pads of the connector where SMD connectors are used

7.3. Parallel NAND flash / LCD

NAND FLASH DESIGN GUIDELINES:

Category	Guidelines/Remarks
Signal/group	NAND_CS_N NAND_CLE_N NAND_ALE_N NAND_WE_N NAND_OE_N NAND_BUSY_N NAND_DATA_[7:0]
Route type	Single-ended
Return path	Ensure continuous and unbroken return path without voids
Length	< 5 in.
Length match	200 mils within group, 400 mils across groups
Spacing requirements	2 W spacing to other signals
GND shielding	Not required
Vias/layer transitions	Vias are acceptable
Voltage	3.3 V
Decoupling and power layout	Follow best design practices and provide decoupling close to the SDIO device. Allocate one 0201 decap per pin and locate it close to the pin. A bulk capacitor in the order of 1 MF or more is advised for the device.
Other	Some NAND controller output lines are used at power-up to sense boot configuration straps. Take care to minimize stubs in the path. A 10K pull-up is recommended on the NAND_CS signal at flash device

7.4. SD/eMMC

SDIO DESIGN GUIDELINES:

Category	Guidelines/Remarks
Signal/group	CARD_DETECT eMMC_CMD eMMC_CLK eMMC_DATA[7:0]
Route type	Single-ended 50 Ohm impedance
Return path	Ensure continuous and unbroken return path without voids
Length	< 4.5 in.
Length match	10 mils within group
Spacing requirements	2 W spacing to other signals
GND shielding	Not required
Vias/layer transitions	Vias are acceptable
Voltage	1.8 V / 3.3 V auto change according to SD card If configured as eMMC interface, it is fixed 1.8 V
Decoupling and power layout	Follow best design practices and provide decoupling close to the SDIO device. Allocate one 0201 decap per pin and locate it close to the pin A bulk capacitor in the order of 1 MF or more is advised for the device
Other	Pay attention to SDIO_CLK, add 22 Ohm damping resistor and 5 pF paralleled cap to GND

7.5. PCIe

PCIe DESIGN GUIDELINES FOR DATA SIGNALS:

Category	Guidelines/Remarks
Signal/group	PCIE_TXP, PCIE_TXN PCIE_RXP, PCIE_RXN
Route type	Differential pair 100 Ohm impedance
Return path	Ensure continuous and unbroken return path without voids
Length	< 5 in.
Length match within pair	+/- 5mils
Length match across pairs	There is no requirement to length match the Tx and Rx pairs
Spacing requirements	3 W spacing between pairs and other signals after the breakout from module
GND shielding	Provide GND shield at 3 W spacing away from the signal pairs. The GND shape must be stitched to the main GND in inner layers with vias at regular intervals of 100 mils
Vias/layer transitions	Avoid layer transitions
AC coupling	There are already 0.1 uF capacitors on each signal line of the Tx pair on the module; No additional coupling is needed
Voltage	The voltage rails for the PCIe interface are implemented with filters for the PLL (AVDDPLL_PCIE) and the I/O (AVDD) rails
Other	Clear the GND pour under the paired signal pads of the connector where SMD connectors are used

PCIe DESIGN GUIDELINES FOR REFCLK:

Category	Guidelines/Remarks
Signal/group	PCIE_CLK_M, PCIE_CLK_P
Route type	Differential pair 100 Ohm impedance
Return path	Ensure continuous and unbroken return path without voids
Length	< 5 in.
Length match within pair	+/- 5 mils
Length match across pairs	There is no specific requirements to match lengths across different REFCLK pairs
Spacing requirements	3 W spacing between pairs and to other signals after the breakout from the module
GND shielding	Minimize layer transitions. Where necessary, limit to 2 vias per signal trace. Provide return vias interconnecting the GNDs in the immediate vicinity of the signal vias. These vias should form a symmetric GSSG pattern and recommend clearing an oblong void at this transition point through layers
AC coupling	Should not be used. The REFCLK must be DC connected to the loads

8. Thermal considerations

Thermal flow equals GND current flow

- Greater copper cross section
- More heat flow, more current flow through Via and GND structure

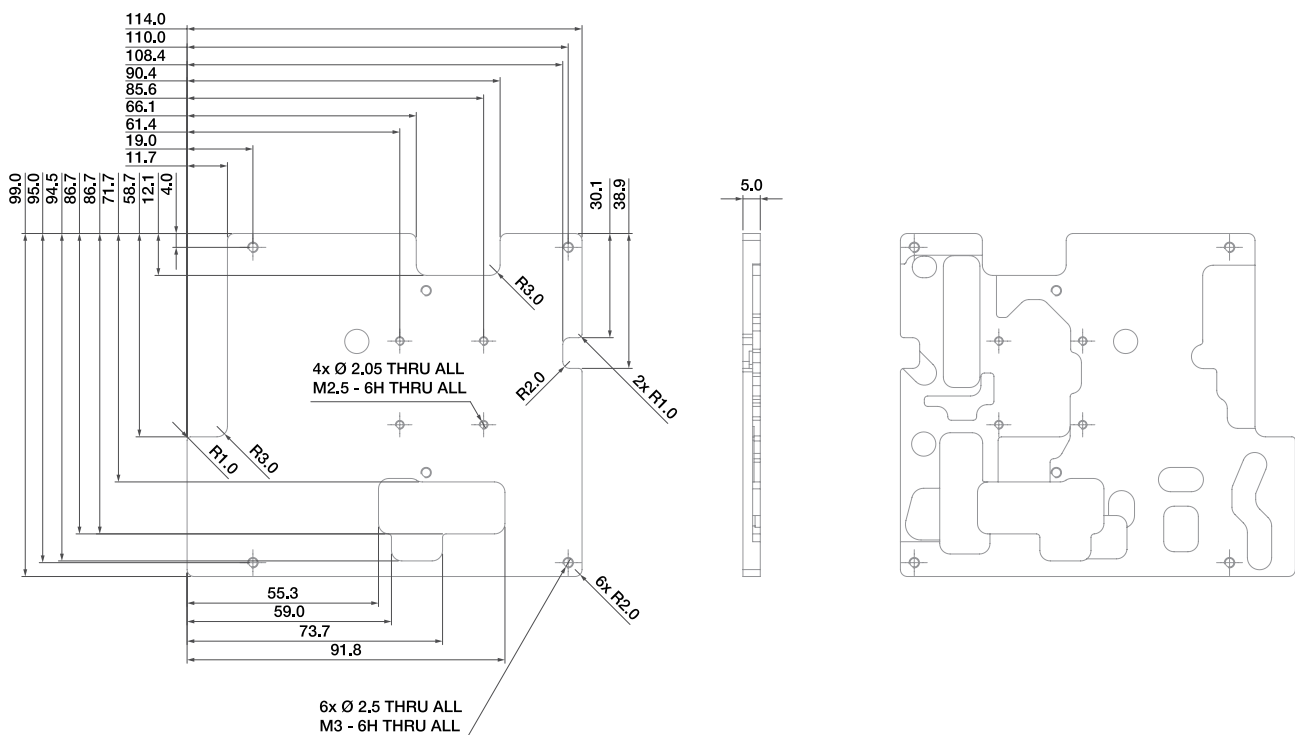
Vertical copper cross section

- Move the heat to other layers
- Internal layers conduct heat horizontally

Horizontal copper cross section

- Avoid fence of non-GND vias (reduce horizontal copper)
- Opening the solder mask in the top and bottom layers beneath the heat parts is the better way of radiating heat
- Also to have maximum GND copper possible with vertical copper (vias) to move heat from inner layers

8.1 Heatsink

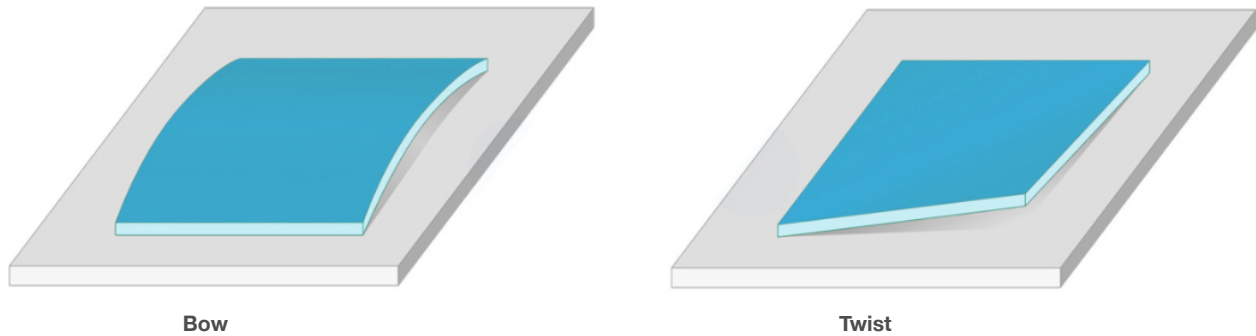


Heatsink surface area has to be at least 120cm² and made from aluminium (or different metal with a better thermal conductivity).

9. 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, Mango module can be bowed and twisted up to 0.465mm. 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 10-1. EXAMPLE OF BOW AND TWIST



10. Mango packaging and ordering info

Mango modules are packed into trays. Each tray fits 16 modules. Every 5 trays are vacuum sealed and one standard packaging box contains 400 modules.

FIGURE 10-1. MANGO TRAY DIMENSIONS

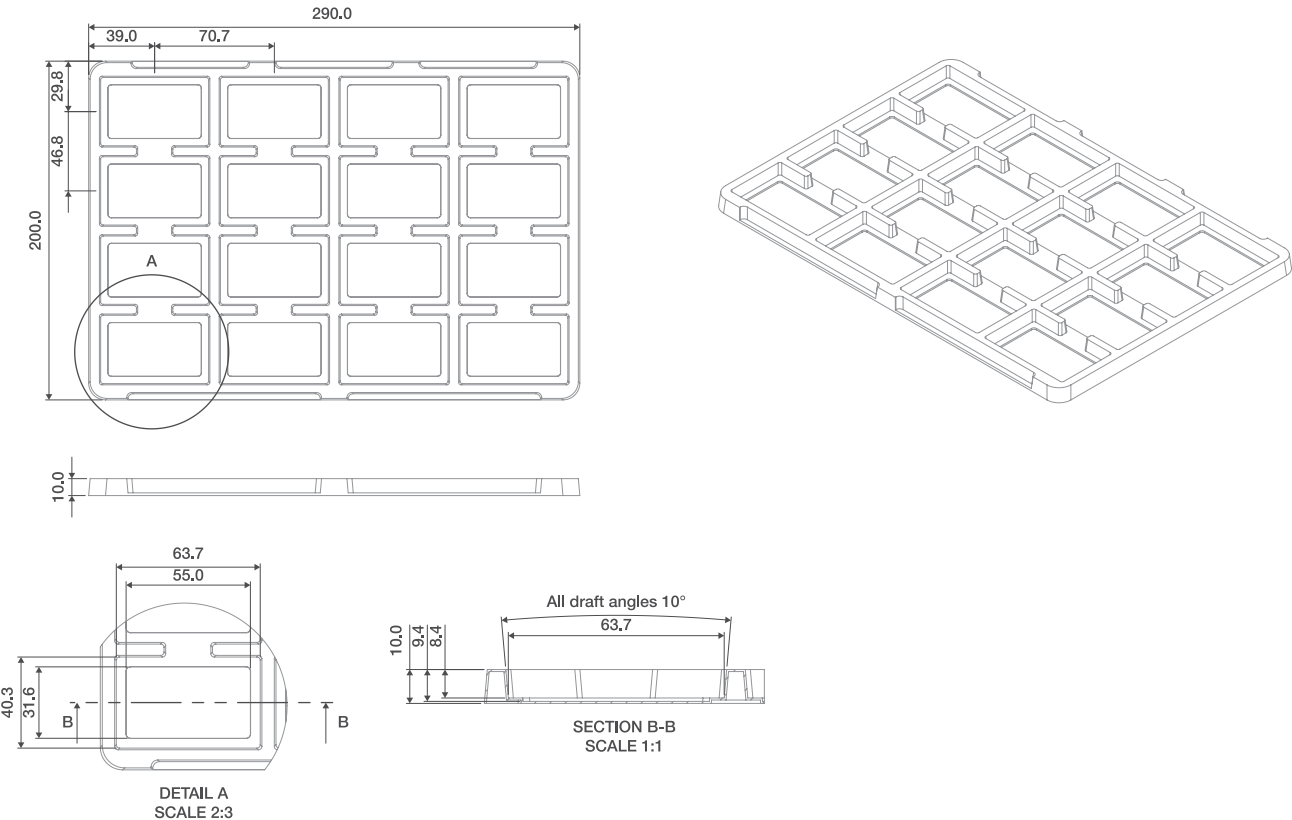


FIGURE 10-2. STANDARD PACKAGING BOX DIMENSIONS

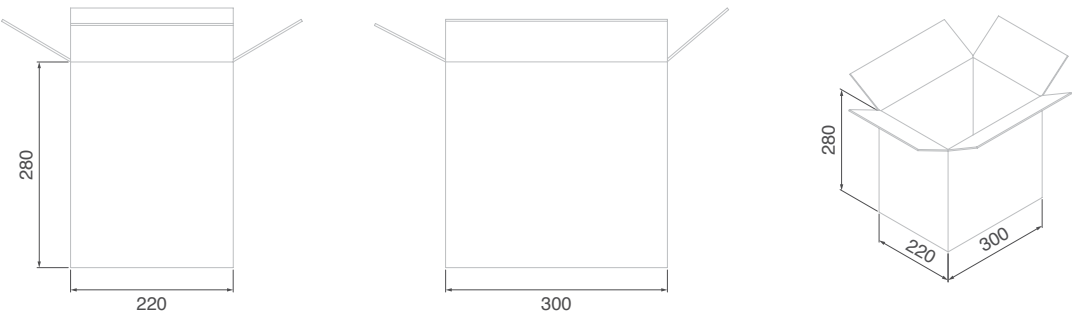


TABLE 10-3. ORDERING PART NUMBERS

Mango	Mango module, commercial temperature range 0°C to 65°C, IPQ 6010 SoC
Mango-I	Mango-I module, industrial temperature range -40°C to 85°C, IPQ 6010 SoC
Mango-DVK	Development kit, based on Mango module, IPQ 6010 SoC

11. Document Revision History

Revision	Revision Date	Description
v1.0	2020-11-09	Initial release
v1.1	2021-10-19	Added RF characteristics and power consumption, other minor changes
v1.2	2021-11-17	Added reflow recommendations
v1.3	2022-04-13	Renewed DVK dimensions and heatsink. Fixed BOOT_CONFIG[13] pin
v1.4	2022-12-21	Product drawings updated
v1.5	2023-01-10	Laminate conditions chapter added
V1.6	2023-04-11	2023-04-11 Minor updates on 1.1, 8.1, 10.1, 12.7
V1.7	2024-01-29	Incorrect Data rates for 5GHz 802.11ax 20MHz and 40MHz updated

FCC Caution:

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

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.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

IMPORTANT NOTE:

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.

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 20cm between the radiator& your body.

ISED Statement 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, and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. 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.

ISED Radiation Exposure Statement:

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

Cet appareil est

Conforme aux limites d'exposition de rayonnement RF ISED établies pour un environnement non contrôlé. Cet émetteur ne doit pas être co-implanté ou fonctionner en conjonction avec toute autre antenne ou transmetteur. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

The device for operation in the band 5150-5350 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems.

L'appareil destiné à fonctionner dans la bande 5150-5350 MHz est uniquement destiné à une utilisation à l'intérieur afin de réduire le risque d'interférence nuisible aux systèmes mobiles par satellite dans le même canal.

This device is intended only for OEM integrators under the following condition: The transmitter module may not be co-located with any other transmitter or antenna. As long as the condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Ce dispositif est destiné uniquement aux intégrateurs OEM, sous réserve des conditions suivantes : le module émetteur ne doit pas être placé à proximité d'un autre émetteur ou d'une autre antenne. Tant que cette condition est respectée, aucun test supplémentaire de l'émetteur n'est requis. Cependant, l'intégrateur OEM reste responsable de la vérification de son produit final pour vérifier la conformité de ce module avec les exigences supplémentaires requises.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the ISSED cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

Any company of the host device which install this modular with limit modular approval should perform the test of radiated emission and spurious emission according to RSS-247 and RSS Gen requirement, only if the test result comply with RSS-247 and RSS-Gen requirement, then the host can be sold legally.

Note Importante:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ISED ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada. toute entreprise de l'hôte qui installent ce dispositif modulaire avec limite approbation devrait effectuer l'essai des modules et des rayonnements non essentiels des émissions rayonnées selon RSS-247 et le cnr - gen, seulement si le résultat d'essai conforme RSS-247 et le cnr - gen, puis l'hôte peut être

End Product

The final end product must be labeled in a visible area with the following: Contains IC: 11468A-MAN.

Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: Contient des IC: 11468A-MAN.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C&E has been investigated. It is applicable to the modular.

Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

Limited module procedures

Not applicable

Trace antenna designs

Not applicable

RF exposure considerations

To maintain compliance with FCC's RF Exposure guidelines, this equipment should be installed and operated with minimum distance of 20cm from your body.

Antennas

This radio transmitter FCC ID: Z9WMAN has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna Type	Input Impedance (ohm)	Maximum Antenna Gain
Chip	50	2.4 GHz – 2.09 dBi 5 GHz – 4.32 dBi

Label and compliance information

The final end product must be labeled in a visible area with the following:
Contains FCC ID: Z9WMAN

Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.