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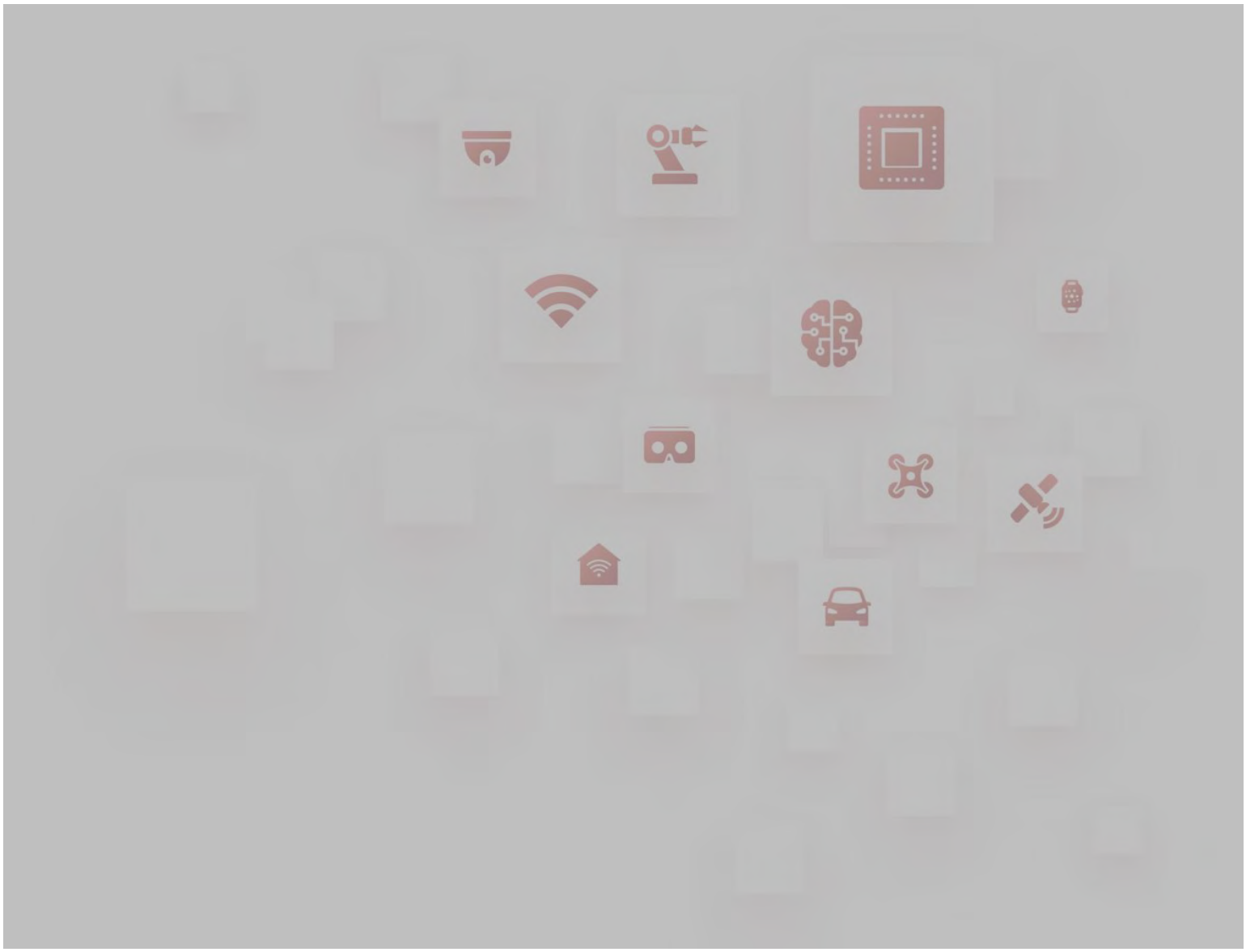


Thundercomm TurboX C40x SOM

Datasheet

Rev. V1.0
Sep 22, 2021

Model Name: TurboX C404
FCC ID:2AOHH-TURBOXC404
IC:23465-TURBOXC400

Revision History

Version	Date	Description
V1.0	Sep 22, 2021	Initial release.

Table List

About This Document

- Illustrations in this documentation might look different from your product.
- Depending on the model, some optional accessories, features, and software programs might not be available on your device.
- Depending on the version of operating systems and programs, some user interface instructions might not be applicable to your device.
- Documentation content is subject to change without notice. Thundercomm makes constant improvements on the documentation of your computer, including this guidebook.

Table of Contents

Chapter 1. Overview

TurboX C40x is high level performance intelligent module, integrating Linux system, based on Qualcomm QCS40x processor. It includes a 64-bit Arm Cortex-A53 qual-core (dual-core for C403) 1.4 GHz application processor, two Qualcomm® Hexagon™ QDSP6 v66 with Low Power Island and Voice accelerators.

➲ **NOTE:** "TurboX" referred to herein is the English text of our registered trademark TURBOX.

TurboX C40x integrated 2 × 2 WCN3999 (or 1 × 1 WCN3980) WLAN 802.11 a/b/g/n/ac, Bluetooth v5.x specification.

TurboX C40x provides a variety of GPIO, I2C, UART and SPI standard interfaces. In addition, SOM common standard protocol interfaces such as USB3.0, USB2.0, SPI, RGMII, I2S and SLIMBUS.

TurboX C40x provide convenient and stable system software solution for use in the Smart Speaker, Smart Assistant, Mesh router, and Sound bar markets.

The size of TurboX C40x module is 33.8mm*33.8mm*2.6mm, weight 18g, with 287pins.

1.1. Key features

Table 1-1: Key features and performance of TurboX C40x SOM

Processors	
Applications Processor	Arm Cortex-A53 microprocessor cores, 64-bit processor, Quad-core (Dual-core for C403) 1.4 GHz.
Digital signal processing	Two Qualcomm® Hexagon™ QDSP6 v66 with Low Power Island and Voice accelerators.
Operating System	LE (Linux Enablement): QCS40X_2019.SPF.1.1.
Memory	• eMCP,8GB eMMC5.1 + 8Gb LPDDR3. • eMCP,4GB eMMC + LPDDR3 512GB (validating).
Multimedia	
Display	• **TurboX C404 and TurboX C403:** General display interfaces: SPI. • **TurboX C405:** General display interfaces: One 4-lane MIPI DSI ports, DSI support up to 720P, HDMI support up to 1080p 30fps. Graphics: Adreno 306 at 600 MHz
Audio	
Audio	MP3, AAC, ALAC, FLAC, He-AAC v1/v2, WMA 9/Pro, Dolby Digital, Dolby Digital Plus, Dolby TruHD, DTS:X

Wireless connectivity	
WLAN	• 2.4G/5G, support 802.11 a/b/g/n/ac, 2 X 2 MIMO(WCN3999) • 2.4G/5G, support 802.11 a/b/g/n/ac, 1 X 1 SISO(WCN3980) • Support SoAP mode
Bluetooth	• Support Bluetooth 5.x + HS • BLE • Backwards compatible with Bluetooth 1.2, 2.X + enhanced data rate.
Connectivity	
USB	One USB 2.0 high-speed and one USB 3.0 super-speed.
PCIe	1x PCIe, PCIe v2 PHY and 2.1 controller.
Ethernet RGMI	1x Ethernet RGMII.
SDIO	• 4-bit, SD 3.0. • SDC2 is Dual-V. • SD/MMC card, eMMC NAND, eSD/eMMC boot.
BLSP	Can be configured as 2x SPI or 3x I2C or 5x UART.
UART	Up to 4 MHz
I2C	Sensors etc.
SPI	Sensors etc.
SLIMbus	One, highly multiplexed, high-speed, baseline WCD9335.
MI2S	• Full duplex stereo or up to quad channel TX/Rx MI2S (x1). • Up to 2 channels for multi-channel audio applications (x1).
PCM	Short and long sync PCM support.
Sleep Clock	32.768 KHz sleep clock output.
SPMI	Dedicated power management interface for external charging system.
GPIOs	10+ general GPIO, LPI GPIO and PM GPIO ports.
Others	
ADC Interface	• Support ADC interface. • Used for input voltage sense, battery temperature detection and general-purpose ADC.
Touchscreen support	Capacitive panels via exit IC (I2C, SPI, and interrupts).
Physical size	• Size: 33.8mm x 33.8mm x 2.6mm. • Weight: approx.18g.
Working temperature	-20℃ ~ +70℃
RoHS	All hardware components are fully compliant with EU RoHS directive.

1.2. Hardware block diagram

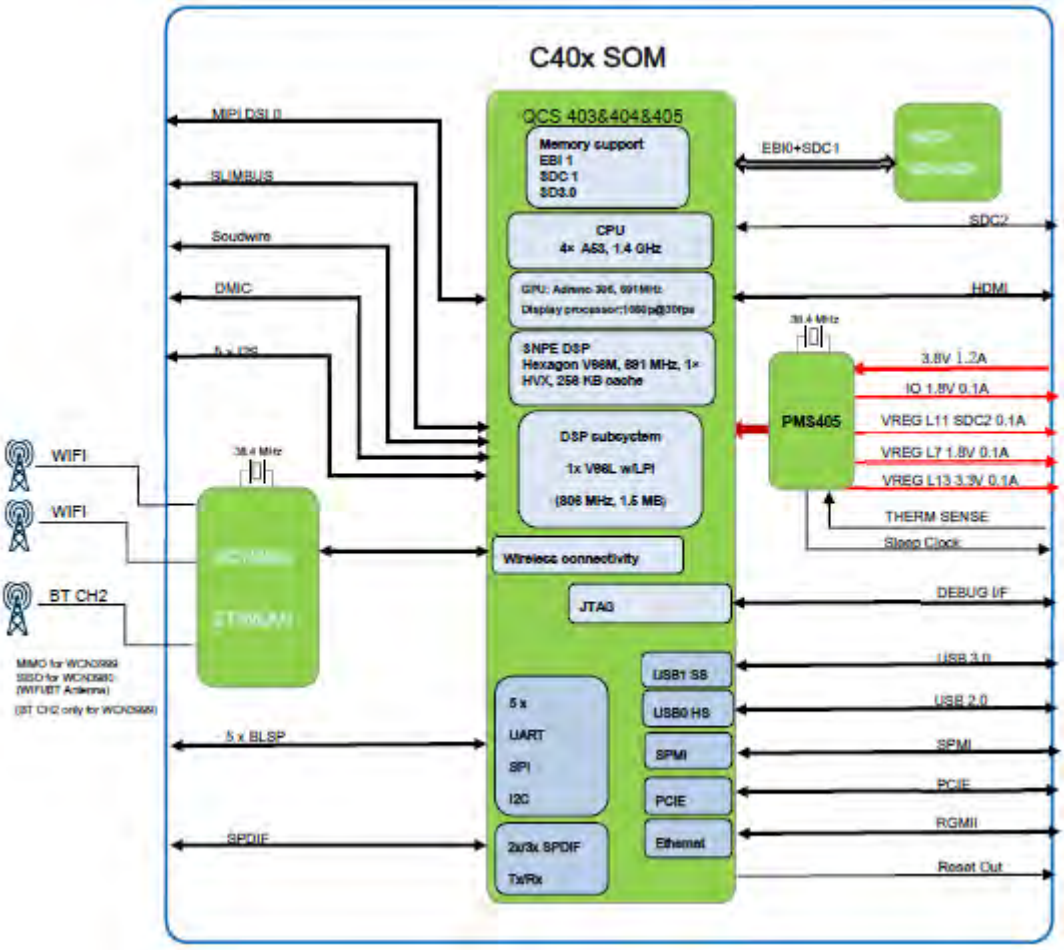


Figure 1-1. TurboX C40x SOM Hardware System Block Diagram

1.3. Major component location

Table 1-2. Major components information

Part Number	Description	Manufacturer
U500	QCS403/404/405, Arm cortex-A53 processor.	QUALCOMM
U1100	PMS405, power management.	QUALCOMM
U1300	WCN3999 or WCN3980, single-die wireless local area network.	QUALCOMM
U1200	eMMC+ LPDDR3 memory.	

1.4. Mechanical size

Size: 33.8mm X 33.8mm.

Thickness: 2.6mm.

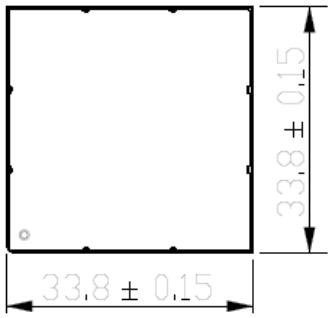


Figure 1-3. Top View

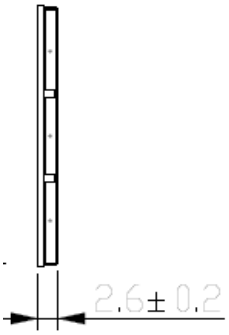


Figure 1-4. Side View

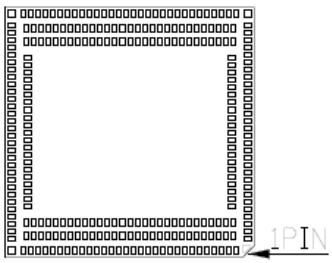


Figure 1-5. Bottom View

1.5. Package dimensions

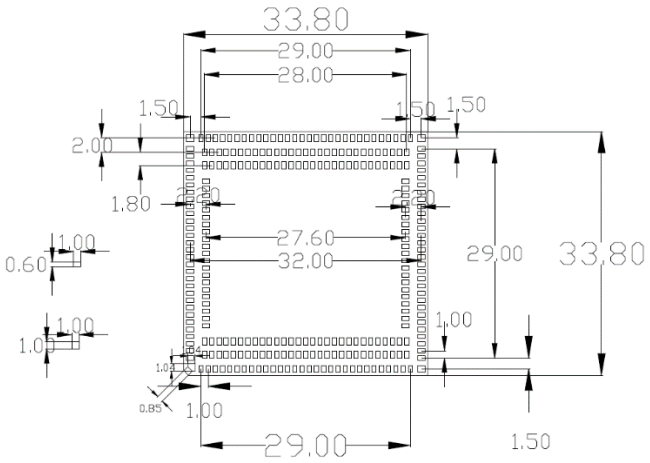


Figure 1-6. Package Dimensions

1.6. SOM ID

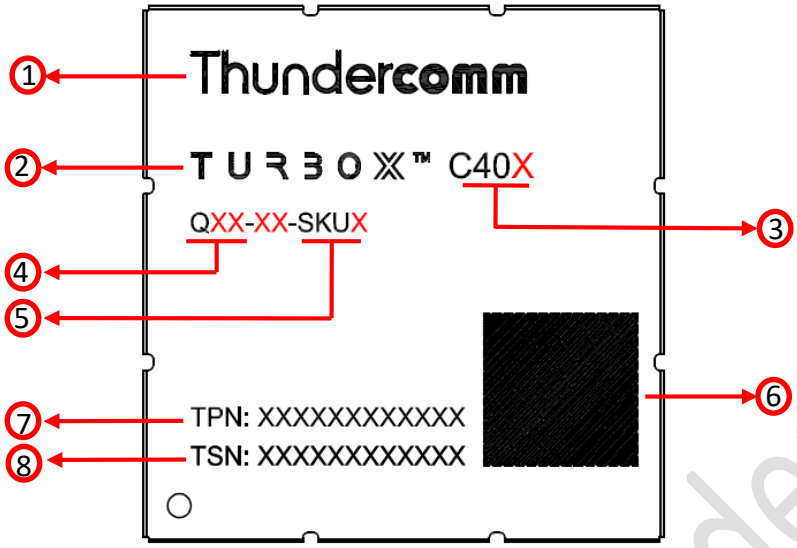


Figure 1-7. Silk Print on SOM

① Thundercomm Logo.
② Product Logo.
③④⑤ Product Configuration Code. (Refer to Table 1-3)
⑥ QR Code.
⑦ Thundercomm Part Number.
⑧ Thundercomm Serial Number.

Table 1-3. SOM ID information

Configuration		
③ Processor Configuration	④ Wi-Fi/BT	⑤ Memory Configuration
QCS403	WCN3980	eMCP, 8GB eMMC5.1+8Gb LPDDR3
QCS404	WCN3999	eMCP, 8GB eMMC5.1+8Gb LPDDR3
QCS405	WCN3999	eMCP, 8GB eMMC5.1+8Gb LPDDR3
QCS405-2	WCN3999	eMCP, 8GB eMMC5.1+8Gb LPDDR3
QCS403	WCN3999	eMCP, 4+4

1.7. Stencil design and aperture

To supply sufficient soldering paste and keep reliable soldering joints, add the thickness of stencil partly on the top surface. The stencil aperture for single sheet cannot be greater than 3.0mm×4.0mm and the exceeded part should be divided into smaller apertures with applicable shelves. A clearance of over 2.0mm should be kept between the outward end of the aperture and the component if there are components around the module.

➲ **NOTE**:

- For the convenience of heating and repairing, it is recommended that no components should be placed in the area at the backside of the module on PCB.
- In order to avoid reverse polarity of the module, it is recommended to use asymmetric pads at the bottom of the module to identify the module polarity during module placement.
- It is not recommended to add any silkscreen in the area where the module is mounted to avoid the height that may influence the solder paste printing and soldering quality.
- When there is a need to step-up the stencil, all 01005/0201, 0.4mm-pitch and 0.5mm-pitch components should be kept over 5.0mm away from the stepped-up area to avoid solder bridging that is caused by thicker solder paste.

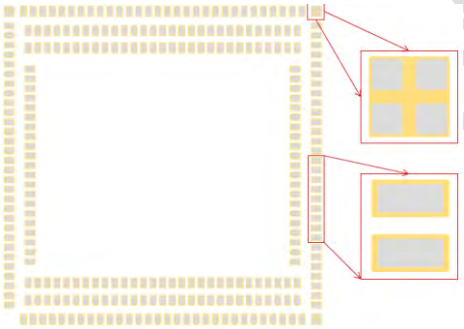


Figure 1-8. Stencil Aperture

- **Stencil thickness**

  Area of the module should be partly stepped-up to 0.13mm-0.15mm.

- **Pads on four sides**

  The aperture for each single pad should be centered with area reduced to 75%-85%. And the shape should be rectangle with round chamfers (as shown in Figure 1-8).

- **Pads at four corners**

  The stencil aperture should be designed with 60%~65% area of the corresponding pad (as shown in Figure 1-8).

For more information on surface mounted technology of Thundercomm, refer to the *SMT Assembly Guideline* of your product.

Chapter 2. Interfaces Description

This chapter introduces all the interfaces definition, purpose to guide developer easy to design and verification on TurboX C40x SOM module.

2.1. Interfaces parameter definitions

Table 2-1. Interfaces parameter definitions

Symbol	Description
AI	Analog input
AO	Analog output
B	Bidirectional digital with CMOS input
DI	Digital input (CMOS)
DSI	Supply voltage for MIPI_DSI I/Os; tied to VDD_MIPI (1.2 V only)
DO	Digital output (CMOS)
H	High-voltage tolerant
KP	Contains an internal weak keeper device (keepers cannot drive external buses)
MIPI	Mobile industry processor interface
NP	Contains no internal pull
OD	Open drain
PD	Contains an internal pull-down device
PI	Power input
PO	Power output
PD	Contains an internal pull-down device
PU	Contains an internal pull-up device
P3	Power group 3，it is 1.8V.
P2	SDC Power group 2，it is 1.8V or 2.95V.
P12	SSC Power group 12，it is 1.8V.
V_Internal	Internally generated supply voltage for some power-on circuits
V_Config	Software configurable (3.6V or 1.8V)

2.2. Pin description

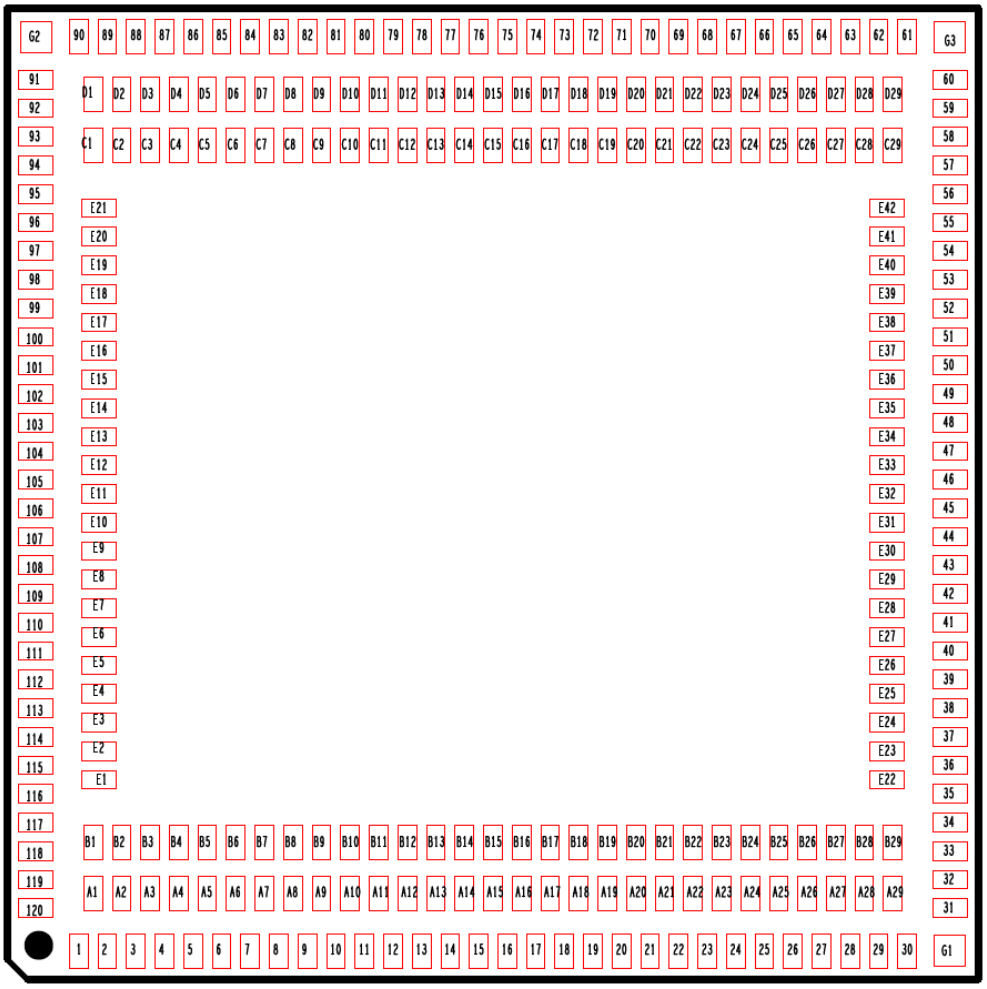


Figure 2-1 TurboX C40x PIN Map (Top View)

Table 2-2. Pin List

Pad#	Function	Voltage	Type	Function description
1	MIPI_DSI0_CLK_M	-	-	MIPI display serial interface 0 clock negative. For TurboX C404 and C403 do not connect.
2	MIPI_DSI0_CLK_P	-	-	MIPI display serial interface 0 clock positive. For TurboX C404 and C403 do not connect.
3	GND	-	-	-
4	MIPI_DSI0_L2_M	-	-	MIPI display serial interface 0 lane 2 negative For TurboX C404 and C403 do not connect.
5	MIPI_DSI0_L2_P	-	-	MIPI display serial interface 0 lane 2 positive. For TurboX C404 and C403 do not connect.
6	GND	-	-	-
7	MIPI_DSI0_L3_M	-	-	MIPI display serial interface 0 lane 3 negative For TurboX C404 and C403 do not connect.
8	MIPI_DSI0_L3_P	-	-	MIPI display serial interface 0 lane 3 positive. For TurboX C404 and C403 do not connect.
9	GND	-	-	-
10	PCIE0_TX_P	-	DO	PCIE transmitter plus
11	PCIE0_TX_M	-	DO	PCIE transmitter minus
12	GND	-	-	-
13	USB0_HS_DM	-	IO	USB0 HS data minus
14	USB0_HS_DP	-	IO	USB0 HS data plus
15	GND	-	-	-

Pad#	Function	Voltage	Type	Function description
16	GPIO_35	1.8V	IO	Can be configured as GPIO
17	GPIO_34	1.8V	IO	Can be configured as GPIO
18	GND	-	-	-
19	SPDIF_RX_COAX_RCA	-	DI	SPDIF receive port for electrical input
20	SPDIF_RX_COAX_EP	-	DI	SPDIF receive port for optical input
21	GND	-	-	-
22	GPIO_26	1.8V	IO	Can be configured as GPIO
23	GPIO_27	1.8V	IO	Can be configured as GPIO
24	GPIO_28	1.8V	IO	Can be configured as GPIO
25	GPIO_29	1.8V	IO	Can be configured as GPIO
26	GND	-	-	-
27	GPIO_39	1.8V	IO	Can be configured as GPIO
28	GPIO_40	1.8V	IO	Can be configured as GPIO
29	GPIO_41	1.8V	IO	Can be configured as GPIO
30	GPIO_42	1.8V	IO	Can be configured as GPIO
31	GND	-	-	-
32	LPI_GPIO_1	1.8V	IO	Can be configured as GPIO
33	LPI_GPIO_2	1.8V	IO	Can be configured as GPIO
34	LPI_GPIO_3	1.8V	IO	Can be configured as GPIO
35	LPI_GPIO_4	1.8V	IO	Can be configured as GPIO
36	GND	-	-	-
37	LPI_GPIO_15	1.8V	IO	Can be configured as GPIO
38	LPI_GPIO_14	1.8V	IO	Can be configured as GPIO
39	LPI_GPIO_13	1.8V	IO	Can be configured as GPIO
40	LPI_GPIO_12	1.8V	IO	Can be configured as GPIO
41	LPI_GPIO_11	1.8V	IO	Can be configured as GPIO
42	GND	-	-	-
43	GPIO_97	1.8V	IO	Can be configured as GPIO
44	GPIO_98	1.8V	IO	Can be configured as GPIO
45	GPIO_99	1.8V	IO	Can be configured as GPIO
46	GPIO_100	1.8V	IO	Can be configured as GPIO
47	GPIO_101	1.8V	IO	Can be configured as GPIO
48	GPIO_102	1.8V	IO	Can be configured as GPIO
49	GND	-	-	-
50	ANT_WL_Chain 1	-	RF IO	Antenna port for WCN3999 TX/Rx chain 1
51	GND	-	-	-
52	GND	-	-	-
53	NC	-	-	Do not connect
54	GND	-	-	-
55	GND	-	-	-
56	NC	-	-	Do not connect
57	GND	-	-	-
58	GND	-	-	-
59	ANT_WL_Chain 0	-	RF IO	Antenna port for WCN3999 and WCN3980 Tx/Rx chain 0
60	GND	-	-	-
61	GND	-	-	-
62	GND	-	-	-
63	GND	-	-	-

Pad#	Function	Voltage	Type	Function description
64	GPIO_30	1.8V	IO	Can be configured as GPIO
65	GPIO_31	1.8V	IO	Can be configured as GPIO
66	GPIO_32	1.8V	IO	Can be configured as GPIO
67	GPIO_33	1.8V	IO	Can be configured as GPIO
68	GND	-	-	-
69	GPIO_37	1.8V	IO	Can be configured as GPIO
70	GPIO_38	1.8V	IO	Can be configured as GPIO
71	GND	-	-	-
72	GND	-	-	-
73	GND	-	-	-
74	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
75	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
76	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
77	GND	-	-	-
78	GND	-	-	-
79	GND	-	-	-
80	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
81	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
82	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
83	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
84	GND	-	-	-
85	GND	-	-	-
86	GND	-	-	-
87	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
88	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
89	VPH_PWR	3.8V	PI	Power supply input for SOM all operations.
90	VREG_L6_1P8	1.8V	PO	Low voltage switch supply output 1.8V for IO and pull up voltage;
91	GPIO_116	1.8V	IO	Can be configured as GPIO
92	GPIO_115	1.8V	IO	Can be configured as GPIO
93	GPIO_114	1.8V	IO	Can be configured as GPIO
94	GPIO_113	1.8V	IO	Can be configured as GPIO
95	GPIO_112	1.8V	IO	Can be configured as GPIO
96	GPIO_111	1.8V	IO	Can be configured as GPIO
97	GPIO_110	1.8V	IO	Can be configured as GPIO
98	LPI_GPIO_18	1.8V	IO	Can be configured as GPIO
99	LPI_GPIO_19	1.8V	IO	Can be configured as GPIO
100	GND	-	-	-
101	GPIO_96	1.8V	IO	Can be configured as GPIO
102	GPIO_95	1.8V	IO	Can be configured as GPIO
103	GPIO_94	1.8V	IO	Can be configured as GPIO
104	GPIO_93	1.8V	IO	Can be configured as GPIO
105	GPIO_92	1.8V	IO	Can be configured as GPIO
106	GPIO_91	1.8V	IO	Can be configured as GPIO
107	GPIO_90	1.8V	IO	Can be configured as GPIO
108	GPIO_89	1.8V	IO	Can be configured as GPIO
109	GPIO_88	1.8V	IO	Can be configured as GPIO
110	GPIO_87	1.8V	IO	Can be configured as GPIO
111	GND	-	-	-

Pad#	Function	Voltage	Type	Function description
112	GPIO_43	1.8V	IO	Can be configured as GPIO
113	GPIO_44	1.8V	IO	Can be configured as GPIO
114	GPIO_45	1.8V	IO	Can be configured as GPIO
115	GPIO_46	1.8V	IO	Can be configured as GPIO
116	GND	-	-	-
117	GPIO_50	1.8V	IO	Can be configured as GPIO
118	GPIO_49	1.8V	IO	Can be configured as GPIO
119	GPIO_48	1.8V	IO	Can be configured as GPIO
120	GPIO_47	1.8V	IO	Can be configured as GPIO
A1	MIPI_DSI0_L0_P	-	-	MIPI display serial interface 0 lane 0 positive. For TurboX C404 and C403 o not connect.
A2	MIPI_DSI0_L1_P	-	-	MIPI display serial interface 0 lane 1 positive. For TurboX C404 and C403 do not connect.
A3	GND	-	-	-
A4	PCIE0_REFCLK_M	-	-	PCIE reference clock output (-)
A5	HDMI_TX2_P	-	-	HDMI TMDS data 2 positive. For TurboX C404 and C403 o not connect.
A6	HDMI_TX1_P	-	-	HDMI TMDS data 1 positive. For TurboX C404 and C403 do not connect.
A7	HDMI_TCLK_P	-	-	HDMI clock positive. For TurboX C404 and C403 do not connect.
A8	HDMI_TX0_P	-	-	HDMI TMDS data 0 positive. For TurboX C404 and C403 do not connect.
A9	PCIE0_RX_M	-	DI	PCIE receiver minus
A10	USB_SS_TX_M	-	DO	USB 3.0 transmitter differential pair minus
A11	USB_SS_RX_P	-	DI	USB 3.0 receiver differential pair plus
A12	USB1_HS_DP	-	IO	USB1 HS data plus
A13	GND	-	-	-
A14	SDC2_CLK	SDC2	IO	Secure digital controller 2 clock
A15	SDC2_DATA_1	SDC2	IO	Secure digital controller 2 data bit 1
A16	SDC2_DATA_3	SDC2	IO	Secure digital controller 2 data bit 3
A17	GND	-	-	-
A18	GPIO_14	1.8V	IO	Can be configured as GPIO
A19	GPIO_16	1.8V	IO	Can be configured as GPIO
A20	USB1_HS_ID	1.8V	DI	USB1 ID Pin
A21	GPIO_21	1.8V	IO	Can be configured as GPIO
A22	GND	-	-	-
A23	GND	-	-	-
A24	GND	-	-	-
A25	GPIO_52	1.8V	IO	Can be configured as GPIO
A26	GPIO_54	1.8V	IO	Can be configured as GPIO
A27	GPIO_56	1.8V	IO	Can be configured as GPIO
A28	GPIO_58	1.8V	IO	Can be configured as GPIO
A29	GND	-	-	-
B1	MIPI_DSI0_L0_M	-	-	MIPI display serial interface 0 lane 0 negative For TurboX C404 and C403 do not connect.
B2	MIPI_DSI0_L1_M	-	-	MIPI display serial interface 0 lane 1 negative For TurboX C404 and C403 do not connect.
B3	GND	-	-	-
B4	PCIE0_REFCLK_P	-	-	PCIE reference clock output (+)
B5	HDMI_TX2_M	-	-	HDMI TMDS data 2 negative. For TurboX C404 and C430 do not connect.
B6	HDMI_TX1_M	-	-	HDMI TMDS data 1 negative. For TurboX C404 and C430 do not connect.

Pad#	Function	Voltage	Type	Function description
B7	HDMI_TCLK_M	-	-	HDMI clock negative. For TurboX C404 and C430 do not connect.
B8	HDMI_TX0_M	-	-	HDMI TMDS data 0 negative. For TurboX C404 and C430 do not connect.
B9	PCIE0_RX_P	-	DI	PCIE receiver plus
B10	USB_SS_TX_P	-	DO	USB 3.0 transmitter differential pair plus
B11	USB_SS_RX_M	-	DI	USB 3.0 receiver differential pair minus
B12	USB1_HS_DM	-	IO	USB1 HS data minus
B13	GND	-	-	-
B14	SDC2_DATA_2	SDC2	IO	Secure digital controller 2 data bit 2
B15	SDC2_DATA_0	SDC2	IO	Secure digital controller 2 data bit 0
B16	SDC2_CMD	SDC2	IO	Secure digital controller 2 command
B17	GND	-	-	-
B18	GPIO_15	1.8V	IO	Can be configured as GPIO
B19	GND	-	-	-
B20	USB0_HS_ID	1.8V	DI	USB0 ID Pin
B21	GND	-	-	-
B22	QCS_RESOUT_N	1.8V	DO	QCS reset output (active low)
B23	GND	-	-	-
B24	GPIO_51	1.8V	IO	Can be configured as GPIO
B25	GPIO_53	1.8V	IO	Can be configured as GPIO
B26	GPIO_55	1.8V	IO	Can be configured as GPIO
B27	GPIO_57	1.8V	IO	Can be configured as GPIO
B28	GPIO_59	1.8V	IO	Can be configured as GPIO
B29	GPIO_119	1.8V	IO	Can be configured as GPIO
C1	PON_1	V_Internal	DI	Level-high triggered power-on input (keep high)
C2	NC	-	-	Do not connect
C3	WCD_MCLK	1.8V	DO	Audio reference clock output for Qualcomm audio codec
C4	PM_GPIO_06	1.8V	IO	PMS405 GPIO, and can be configured as GPIO
C5	PM_RESIN_N	1.8V	DI	Power management reset in (active low)
C6	KPDPWR_N	V_Internal	DI	Power-on trigger, level trigger (active low)
C7	PM_GPIO_04	1.8V	IO	PMS405 GPIO, and can be configured as GPIO
C8	NC	-	-	Do not connect
C9	GND	-	-	-
C10	VREG_L11_SDC2	SDC2	PO	Power output for SD card pull up voltage;
C11	VREG_L13_3P3	3.3V	PO	3.3V LDO power output,100mA
C12	GND	-	-	-
C13	GPIO_61	1.8V	IO	Can be configured as GPIO
C14	GPIO_63	1.8V	IO	Can be configured as GPIO
C15	GPIO_65	1.8V	IO	Can be configured as GPIO
C16	GPIO_67	1.8V	IO	Can be configured as GPIO
C17	GND	-	-	-
C18	GPIO_70	1.8V	IO	Can be configured as GPIO
C19	GPIO_72	1.8V	IO	Can be configured as GPIO
C20	GPIO_74	1.8V	IO	Can be configured as GPIO
C21	GPIO_76	1.8V	IO	Can be configured as GPIO
C22	GND	-	-	-
C23	GPIO_22	1.8V	IO	Can be configured as GPIO
C24	GPIO_24	1.8V	IO	Can be configured as GPIO

Pad#	Function	Voltage	Type	Function description
C25	GND	-	-	-
C26	GPIO_17	1.8V	DO	MSM_UART_TX
C27	GPIO_19	1.8V	-	Can be configured as GPIO
C28	GND	-	-	-
C29	GPIO_118	1.8V	IO	Can be configured as GPIO
D1	PA_THERM1	-	AI	ADC for external temperature sensor
D2	SLEEP_CLK	1.8V	DO	32.7 KHZ sleep clock output
D3	PM_GPIO_12	V_Config	IO	PMS405 GPIO, and can be configured as GPIO
D4	PM_GPIO_03	V_Config	IO	PMS405 GPIO, and can be configured as GPIO
D5	NC	-	-	Do not connect
D6	NC	-	-	Do not connect
D7	GND	-	-	-
D8	QCS_PS_HOLD	1.8V	DI	Power supply hold control input (for debugging)
D9	GND	-	-	-
D10	VREG_L7_1P8	1.8V	PO	1.8V LDO power output,100mA
D11	GND	-	-	-
D12	GPIO_60	1.8V	IO	Can be configured as GPIO
D13	GPIO_62	1.8V	IO	Can be configured as GPIO
D14	GPIO_64	1.8V	IO	Can be configured as GPIO
D15	GPIO_66	1.8V	IO	Can be configured as GPIO
D16	GPIO_68	1.8V	IO	Can be configured as GPIO
D17	GPIO_69	1.8V	IO	Can be configured as GPIO
D18	GPIO_71	1.8V	IO	Can be configured as GPIO
D19	GPIO_73	1.8V	IO	Can be configured as GPIO
D20	GPIO_75	1.8V	IO	Can be configured as GPIO
D21	GPIO_77	1.8V	IO	Can be configured as GPIO
D22	GND	-	-	-
D23	GPIO_23	1.8V	IO	Can be configured as GPIO
D24	GPIO_25	1.8V	IO	Can be configured as GPIO
D25	GND	-	-	-
D26	GPIO_18	1.8V	DI	MSM_UART_RX
D27	GPIO_20	1.8V	IO	Can be configured as GPIO
D28	GPIO_117	1.8V	IO	Can be configured as GPIO
D29	GND	-	-	-
E1	GND	-	-	-
E2	GPIO_78	1.8V	IO	Can be configured as GPIO
E3	GPIO_79	1.8V	IO	Can be configured as GPIO
E4	GPIO_80	1.8V	IO	Can be configured as GPIO
E5	GPIO_81	1.8V	IO	Can be configured as GPIO
E6	SPMI_CLK_CON	1.8V	DO	System power management interface clock.
E7	SPMI_DATA_CON	1.8V	IO	System power management interface data
E8	LPI_GPIO_5	1.8V	IO	Can be configured as GPIO
E9	LPI_GPIO_20	1.8V	IO	Can be configured as GPIO
E10	GND	-	-	-
E11	GPIO_86	1.8V	IO	Can be configured as GPIO
E12	GND	-	-	-
E13	GPIO_103	1.8V	IO	Can be configured as GPIO
E14	GND	-	-	-

Pad#	Function	Voltage	Type	Function description
E15	GPIO_104	1.8V	IO	Can be configured as GPIO
E16	GPIO_105	1.8V	IO	Can be configured as GPIO
E17	GPIO_106	1.8V	IO	Can be configured as GPIO
E18	GPIO_107	1.8V	IO	Can be configured as GPIO
E19	GPIO_108	1.8V	IO	Can be configured as GPIO
E20	GPIO_109	1.8V	IO	Can be configured as GPIO
E21	GND	-	-	-
E22	GND	-	-	-
E23	LPI_GPIO_6	1.8V	IO	Can be configured as GPIO
E24	LPI_GPIO_7	1.8V	IO	Can be configured as GPIO
E25	GND	-	-	-
E26	LPI_GPIO_8	1.8V	IO	Can be configured as GPIO
E27	LPI_GPIO_9	1.8V	IO	Can be configured as GPIO
E28	LPI_GPIO_10	1.8V	IO	Can be configured as GPIO
E29	GND	-	-	-
E30	GND	-	-	-
E31	GND	-	-	-
E32	GND	-	-	-
E33	JTAG_SRST_N	/	DI	JTAG reset for debug
E34	JTAG_TCK	/	DI	JTAG clock input
E35	JTAG_TDI	/	DI	JTAG data input
E36	JTAG_TDO	/	DI	JTAG data output
E37	JTAG_TMS	/	B	JTAG mode-select input
E38	JTAG_TRST_N	/	DI	JTAG reset
E39	GND	-	-	-
E40	GPIO_36	1.8V	IO	Can be configured as GPIO
E41	GND	-	-	-
E42	GND	-	-	-
G1	GND	-	-	-
G2	GND	-	-	-
G3	GND	-	-	-

2.3. Interfaces detail description

2.3.1. Power supply interface

Below table describes all interfaces of SOM Power Supply. For the detail parameter request, please refer the chapter on Electrical specifications.

Table 2-3. Power supply definition

Pin Name	PIN Location	Type	Description
VPH_PWR	74,75,76,80,81,82,83,87,88,89	PI	Power supply input for SOM all operations.
VREG_L6_1P8	90	PO	Low voltage switch supply output 1.8V for IO and pull up voltage;
VREG_L11_SDC2	C10	PO	Power output for SD card pull up ;
VREG_L7_1P8	D10	PO	1.8V LDO power output, Max 100mA
VREG_L13_3P3	C11	PO	3.3V LDO power output, Max 100mA

Pin Name	PIN Location	Type	Description
GND	3, 6, 12, 15, 18, 21, 26, 31, 36, 42, 49, 51, 52, 54, 55, 57, 58, 60, 61, 61, 63, 68, 71, 72, 73, 77, 78, 79, 84, 85, 86, 100, 111, 116, A3, B3, D7, C9, D9, D11, D12, A13, B13, A17, B17, C17, B19, B21, A22, B22, C22, D22, A23, B23, A24, C25, D25, C28, A29, D29, E1, E6, E7, E10, E12, E14, E21, E22, E25, E29, E30, E31, E32, E39, E41, E42, G1, G2, G3	GND	

2.3.2. RGMII interfaces

The SOM supports RGMII interfaces can connect Ethernet transceiver.

Table 2-4. RGMII interface definition

Pin Name	PIN Location	Voltage	Type	Description
GPIO_61	C13	1.8V	DI	Ethernet transceiver interrupt input
GPIO_63	C14	1.8V	DO	RGMII transmit clock output
GPIO_64	D14	1.8V	DO	RGMII transmit data 3 output
GPIO_65	C15	1.8V	DO	RGMII transmit data 2 output
GPIO_66	D15	1.8V	DO	RGMII transmit data 1 output
GPIO_67	C16	1.8V	DO	RGMII transmit data 0 output
GPIO_68	D16	1.8V	DO	RGMII transmit enable output
GPIO_69	D17	1.8V	DI	RGMII receive clock input
GPIO_70	C18	1.8V	DI	RGMII receive data 3 input
GPIO_71	D18	1.8V	DI	RGMII receive data 2 input
GPIO_72	C19	1.8V	DI	RGMII receive data 1 input
GPIO_73	D19	1.8V	DI	RGMII receive data 0 input
GPIO_74	C20	1.8V	DI	RGMII receive data valid, RGMII input
GPIO_75	D20	1.8V	IO	Management data
GPIO_76	C21	1.8V	DO	Management data clock reference

2.3.3. SPDIF interface

The SOM has a digital audio dedicated interface SPDIF. It's an input port only, and receiving audio signals in SPDIF format.

Table 2-5. SPDIF interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
SPDIF_RX_COAX_RCA	19	-	DI	SPDIF receive port for electrical input	
SPDIF_RX_COAX_EP	20	-	DI	SPDIF receive port for optical input	QCS403 not support

2.3.4. Audio interface

The SOM provides the audio system digital processing functions.

The SOM provide SLIMBUS, I2S, SWR and DMIC interfaces for audio system. The multiplexing of these interfaces is as follows.

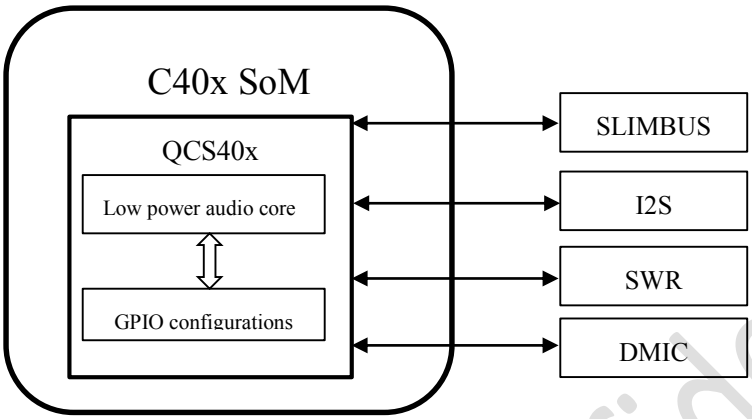


Figure 2-2. Audio Interface

One port Serial low-power inter chip media bus (SLIMBUS) interface is dedicate for external codec IC, which can build system's audio functions.

Table 2-6. SLIMBUS interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
LPI_GPIO_2	33	1.8V	DO	Audio SLIMBUS clock	
LPI_GPIO_3	34	1.8V	IO	Audio SLIMBUS data0	
LPI_GPIO_4	35	1.8V	IO	Audio SLIMBUS data1	

Six ports inter-IC sound (I2S) interfaces can connect audio devices.

Table 2-7. I2S interface definition

Pin Name	PIN Location	Voltage	Type	Description
GPIO_87	110	1.8V	DO	I2S 1 SCK
GPIO_88	109	1.8V	DO	I2S 1 WS
GPIO_89	108	1.8V	IO	I2S 1 Data0
GPIO_90	107	1.8V	IO	I2S 1 Data1
GPIO_91	106	1.8V	IO	I2S 1 Data2
GPIO_92	105	1.8V	IO	I2S 1 Data3
GPIO_93	104	1.8V	IO	I2S 1 Data4
GPIO_94	103	1.8V	IO	I2S 1 Data5
GPIO_95	102	1.8V	IO	I2S 1 Data6
GPIO_96	101	1.8V	IO	I2S 1 Data7
GPIO_97	43	1.8V	DO	I2S 2 SCK
GPIO_98	44	1.8V	DO	I2S 2 WS
GPIO_99	45	1.8V	IO	I2S 2 Data0
GPIO_100	46	1.8V	IO	I2S 2 Data1
GPIO_101	47	1.8V	IO	I2S 2 Data2

Pin Name	PIN Location	Voltage	Type	Description
GPIO_102	48	1.8V	IO	I2S 2 Data3
GPIO_104	E15	1.8V	DO	I2S 3A SCK
GPIO_105	E16	1.8V	DO	I2S 3A WS
GPIO_106	E17	1.8V	IO	I2S 3A Data0
GPIO_107	E18	1.8V	IO	I2S 3A Data1
GPIO_108	E19	1.8V	IO	I2S 3A Data2
GPIO_109	E20	1.8V	IO	I2S 3A Data3
GPIO_52	A25	1.8V	DO	I2S 3B SCK
GPIO_53	B25	1.8V	DO	I2S 3B WS
GPIO_54	A26	1.8V	IO	I2S 3B Data0
GPIO_55	B26	1.8V	IO	I2S 3B Data1
GPIO_56	A27	1.8V	IO	I2S 3B Data2
GPIO_57	B27	1.8V	IO	I2S 3B Data3
GPIO_110	97	1.8V	DO	I2S 4 SCK
GPIO_111	96	1.8V	DO	I2S 4 WS
GPIO_112	95	1.8V	IO	I2S 4 Data0
GPIO_113	94	1.8V	IO	I2S 4 Data1
GPIO_114	93	1.8V	IO	I2S 4 Data2
GPIO_115	92	1.8V	IO	I2S 4 Data3
LPI_GPIO_8	E26	1.8V	DO	I2S 5 SCK
LPI_GPIO_9	E27	1.8V	DO	I2S 5 WS
LPI_GPIO_10	E28	1.8V	IO	I2S 5 Data0
LPI_GPIO_11	41	1.8V	IO	I2S 5 Data1
LPI_GPIO_12	40	1.8V	IO	I2S 5 Data2
LPI_GPIO_13	39	1.8V	IO	I2S 5 Data3

One port Sound wire (SWR) interface is dedicate for external audio amplify of Qualcomm.

Table 2-8. SWR interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
LPI_GPIO_5	E8	1.8V	DO	Sound wire interface clock	
LPI_GPIO_20	E9	1.8V	IO	Sound wire interface data	

Four ports digital microphone (DMIC) interfaces can connect 8x digital microphones.

Table 2-9. DMIC interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
LPI_GPIO_8	E26	1.8V	DO	Digital MIC0/1 clock	
LPI_GPIO_9	E27	1.8V	IO	Digital MIC0/1 data	
LPI_GPIO_10	E28	1.8V	DO	Digital MIC2/3 clock	
LPI_GPIO_11	41	1.8V	IO	Digital MIC2/3 data	
LPI_GPIO_12	40	1.8V	DO	Digital MIC4/5 clock	
LPI_GPIO_13	39	1.8V	IO	Digital MIC4/5 data	
LPI_GPIO_14	38	1.8V	DO	Digital MIC6/7 clock	
LPI_GPIO_15	37	1.8V	IO	Digital MIC6/7 data	

2.3.5. USB interface

The SOM support USB host and slave. Dual USB port support, one is USB 2.0 high-speed, the other is USB 3.0 super-speed/USB 2.0 high-speed compliant. The USB1 support host mode only.

Table 2-10. USB interface definition

SS/HS USB1 (3.0/2.0) Interface					
Pin Name	**PIN Location**	**Voltage**	**Type**	**Description**	**Notes**
USB_SS_TX_M	A10	-	DO	USB 3.0 transmitter differential pair minus	
USB_SS_TX_P	B10	-	DO	USB 3.0 transmitter differential pair plus	
USB_SS_RX_P	A11	-	DI	USB 3.0 receiver differential pair plus	
USB_SS_RX_M	B11	-	DI	USB 3.0 receiver differential pair minus	
USB1_HS_DP	A12	-	IO	USB1 HS data plus	Require differential impedance of 90Ω.
USB1_HS_DM	B12	-	IO	USB1 HS data minus	
PM_GPIO_12	D3	1.8V	DI	VBUS1 insertion detection	
USB0_HS_ID	A20	1.8V	DI	USB0 ID Pin	
HS USB0 (2.0) Interface					
Pin Name	**PIN Location**	**Voltage**	**Type**	**Description**	**Notes**
USB0_HS_ID	B20	1.8V	AI	USB0 ID Pin	
USB0_HS_DM	13	-	IO	USB0 HS data plus	
USB0_HS_DP	14	-	IO	USB0 HS data minus	
PM_GPIO_06	C4	1.8V	DI	VBUS0 insertion detection	

2.3.6. PCIe interface

The SOM support one Peripheral Component Interconnect Express (PCIe) interfaces, which can be used for general-purpose peripherals.

Table 2-11. PCIe interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
PCIE0_REFCLK_M	A4	-	-	PCIE reference clock output (-)	
PCIE0_REFCLK_P	B4	-	-	PCIE reference clock output (+)	
PCIE0_RX_M	A9	-	DI	PCIE receiver minus	
PCIE0_RX_P	B9	-	DI	PCIE receiver plus	
PCIE0_TX_M	11	-	DO	PCIE transmitter minus	
PCIE0_TX_P	10	-	DO	PCIE transmitter plus	

2.3.7. MIPI DSI interface

SOM support MIPI of display, and can be up to FHD 30 fps. This is one 4-lane MIPI DSI port, and supported only for TurboX C405.

Table 2-12. MIPI DSI interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
MIPI_DSI0_CLK_P	2	-	DO	MIPI display serial interface 0 clock positive	
MIPI_DSI0_CLK_M	1	-	DO	MIPI display serial interface 0 clock negative	
MIPI_DSI0_L0_P	A1	-	DO	MIPI display serial interface 0 lane 0 positive	
MIPI_DSI0_L0_M	B1	-	DO	MIPI display serial interface 0 lane 0 negative	
MIPI_DSI0_L1_P	A2	-	DO	MIPI display serial interface 0 lane 1 positive	
MIPI_DSI0_L1_M	B2	-	DO	MIPI display serial interface 0 lane 1 negative	
MIPI_DSI0_L2_P	5	-	DO	MIPI display serial interface 0 lane 2 positive	
MIPI_DSI0_L2_M	4	-	DO	MIPI display serial interface 0 lane 2 negative	
MIPI_DSI0_L3_P	8	-	DO	MIPI display serial interface 0 lane 3 positive	
MIPI_DSI0_L3_M	7	-	DO	MIPI display serial interface 0 lane 3 negative	

2.3.8. HDMI interface

HDMI support up to 1080p 30 fps, and supported only for TurboX C405.

Table 2-13. HDMI interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
HDMI_TCLK_P	A7	-	DO	HDMI TMDS clock positive	
HDMI_TCLK_M	B7	-	DO	HDMI TMDS clock negative	
HDMI_TX0_P	A8	-	DO	HDMI TMDS data 0 positive	
HDMI_TX0_M	B8	-	DO	HDMI TMDS data 0 negative	
HDMI_TX1_P	A6	-	DO	HDMI TMDS data 1 positive	
HDMI_TX1_M	B6	-	DO	HDMI TMDS data 1 negative	
HDMI_TX2_P	A5	-	DO	HDMI TMDS data 2 positive	
HDMI_TX2_M	B5	-	DO	HDMI TMDS data 2 negative	
GPIO_14	A18	-	DO	HDMI_TX_CEC	
GPIO_15	B18	-	DO	HDMI_DDC_CLK	
GPIO_16	A19		IO	HDMI_DDC_DATA	
GPIO_77	D21		DI	HDMI_Hot_plug	

2.3.9. JTAG interface

The SOM has a JTAG interface for debug.

Table 2-14. JTAG interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
JTAG_SRST_N	E33	-	DI,PU	JTAG reset for debug	
JTAG_TCK	E34	-	DI,PU	JTAG clock input	
JTAG_TDI	E35	-	DI,PU	JTAG data input	
JTAG_TDO	E36	-	-	JTAG data output	
JTAG_TMS	E37	-	B,PU	JTAG mode-select input	
JTAG_TRST_N	E38	-	DI,PD	JTAG reset	
QCS_RESIN_N	C2	1.8V	DI	System reset input	
QCS_PS_HOLD	D8	1.8V	DI	Power supply hold control input	

2.3.10. SDIO interface

The SOM support dual 4-laneSDIO, SDC2 connect to SD-card.

The SDIO is high-speed signal group. It should protect other sensitive signals/circuits from SD corruption, and protect SD signals from noisy signals (clock, RF and so on).

- The clock can be up to 50 Mhz.
- The signals routing should be 36-50ohm impedance control.
- CLK to DATA/CMD length matching less than 2mm.
- The spacing to all other signals should 2X line width
- Maximum bus capacitance less than 1.0pF.
- Each trace needs to be next to a ground plane.

Table 2-15. SDIO (SDC2) interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
SDC2 _CLK	A14	P2	DO	Secure digital controller 2 clock	
SDC2 _CMD	B16	P2	IO	Secure digital controller 2 command	
SDC2_DATA_3	A16	P2	IO	Secure digital controller 2 data bit 3	
SDC2_DATA_2	B14	P2	IO	Secure digital controller 2 data bit 2	
SDC2_DATA_1	A15	P2	IO	Secure digital controller 2 data bit 1	
SDC2_DATA_0	B15	P2	IO	Secure digital controller 2 data bit 0	
GPIO_59	B28	P3	DI	SD_CARD_DET_N need pull up to P3	

2.3.11. BLSP interface

These GPIOs are available as BAM-based low-speed peripheral (BLSP) interface ports that can be configured for UART, SPI, or I2C operation.

I2C is a two-wire bus that can be routed to multiple devices; each line of each bus is supplemented by a 2.2kΩ pull-up resistor.

2-wire UART TX/Rx and I2C SDA/SCL ports can be used simultaneously.

Table 2-16. BLSP interface-1 definition

BLSP Number	GPIO	PIN Location	Voltage	Type	Description			Notes
					SPI	UART	I2C	
0	30	64	P3	IO	MOSI	TX	-	
	31	65	P3	IO	MISO	RX	-	
	32	66	P3	IO	CS_N	CTS_N	SDA	
	33	67	P3	IO	CLK	RFR_N	SCL	
1	22	C23	P3	IO	MOSI_A	TX	-	
	23	D23	P3	IO	MISO_A	RX	-	
	24	C24	P3	IO	CS_N_A	CTS_N	SDA	
	25	D24	P3	IO	CLK_A	RFR_N	SCL	
2	17	C26	P3	IO	MOSI	TX	-	
	18	D26	P3	IO	MISO	RX	-	
	19	C27	P3	IO	CS_N	CTS_N	SDA	
	20	D27	P3	IO	CLK	RFR_N	SCL	
4	37	69	P3	IO	MOSI	TX	-	
	38	70	P3	IO	MISO	RX	-	
	117	D28	P3	IO	CS_N	CTS_N	SDA	
	118	C29	P3	IO	CLK	RFR_N	SCL	

Table 2-17. BLSP interface-2 definition

BLSP Number	GPIO	PIN Location	Voltage	Type	Description			Notes
					SPI	UART	I2C	
5	26	22	P3	IO	MOSI	TX	-	
	27	23	P3	IO	MISO	RX	-	
	28	24	P3	IO	CS_N	CTS_N	SDA	
	29	25	P3	IO	CLK	RFR_N	SCL	
	44	113	P3	IO	CS1_N	-	-	
	45	114	P3	IO	CS2_N	-	-	
	46	115	P3	IO	CS3_N	-	-	

2.3.12. Power on interface

Dedicated PMIC circuits continuously monitor events that might trigger a power-on sequence. If an event occurs, these circuits power on the IC, determine the device's available power sources, enable the correct source.

There are two events that will be triggered.

When a battery or other power supply is inserted and pulled down KPDPWR_N to ground up to 1s and released, SOM will be power on automatically.

Another power-on event, when pulled up PON_1 pin SOM will be power on automatically with the battery or power supply inserted, and high-level triggered with a valid trigger range between 1.17 V to VPH_PWR.

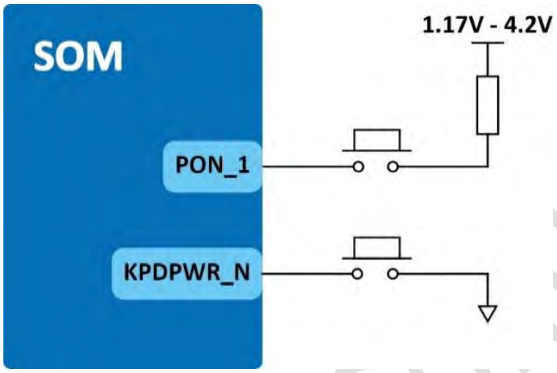


Figure 2-3. Power on Signal

Table 2-18. Power on interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
KPDPWR_N	C6	V_INT	DI	Power-on trigger, level trigger (active low)	
PON_1	C1	1.17V - 4.2V	DI	Level-high triggered power-on input(keep high)	

2.3.13. Reset interface

Three stage reset and external resets.

- Stage 1 reset – software-configurable bark

  PMIC generates interrupt, giving the QCS device the opportunity to fix the problem or gracefully reset the system. Example events can cause a bark: over temperature indicates system is getting too hot. PMIC watchdog indicates that it has not kicked.

- Stage 2 – software-configurable bite

  If reset is ignored, PMIC will force a reset event (selectable by software).

- Stage 3 – hardware mandatory bite

  The user can generate a mandatory reset by a long key press of KYPD_PWR.

Table 2-19. Reset interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
KPDPWR_N	C6	V_INT	DI	Long press to reset PMIC. (active low)	

These reset triggers each have individual debounce and delay timers. Their default values are 10.256 seconds for stage 1 and 2 seconds for stage 2, respectively, and they share the stage 3 reset timer. Stage 1 and stage 2 timers run in series, and stage 3 timer runs independently (parallel) of stage 1 and stage 2 timers. If the stage 3 timer is set to a lower value than that of stage 1 and stage 2 combined, then the stage 3 reset happens first. The stage 3 default value is 128 seconds.

2.3.14. Boot configuration interface

Configure fuses or BOOT_CONFIG pins.

- BOOT_CONFIG pins provide flexibility during product development.
- Fuses should be blown for production devices.
- BOOT_CONFIG [3:1] is MSB-aligned with Fast_Boot [2:0].

Boot Configurations:

BOOT_CONFIG[3:1]	Boot Options	Notes
0b000	Try SDC1 --> SDC2 --> USB2.0	default
0b001	Try SDC2 --> SDC1	
0b010	Try SDC1	
0b011	Try USB2.0	

Default boot configuration (0b000) is eMMC on SDC1.

Special boot-related GPIO features:

- They are sensed for boot-purposes during IC reset (during fuse sense).
- After boot up, use them for normal GPIO functions.
- Do not have pull-ups on GPIO_55, GPIO_56, GPIO_57, and GPIO_49 prior to blowing FAST_BOOT fuses.

The boot configuration function of the preceding GPIOs is sampled at the rising edge of RESOUT_N reassertion.

Table 2-20. Boot Configuration GPIO definition

Boot Configuration Interface					
Pin Name	**PIN Location**	**Voltage**	**Type**	**Description**	**Notes**
GPIO_45	114	P3	IO	Forced USB boot; Configurable I/O	
GPIO_55	B26	P3	IO	Fast boot select bit 0 (configure external boot device); WDOG_DISABLE. Configurable I/O	
GPIO_56	A27	P3	IO	Fast boot select bit 1 (configure external boot device); Configurable I/O	
GPIO_57	B27	P3	IO	Fast boot select bit 2 (configure external boot device); Configurable I/O	
GPIO_49	118	P3	IO	Fast boot select bit 3 (configure external boot device); Configurable I/O	

Forced USB boot

During development or factory production, boot from USB_HS port are forced by using GPIO_45.

- FORCED_USB_BOOT (GPIO_45) always takes precedence, regardless of the state of the BOOT_CONFIG
- FORCED_USB_BOOT is checked first during the boot device detection prior to BOOT_CONFIG GPIOs.
- GPIO_45 = 1 forces the SDM device to boot from USB_HS port.

Blow the FORCE_USB_BOOT_DISABLE fuse to disable the feature that forces USB boot using GPIO_45.

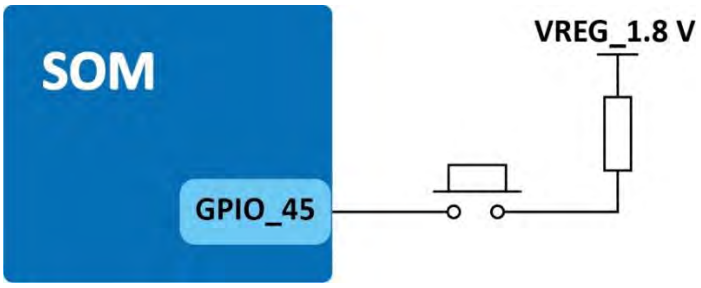


Figure 2-4. Power on Signal

Other boot configuration bits are listed in the table below, and do not have pull up on these IOs also.

Table 2-21. Other Boot Configuration interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
GPIO_54	A26	P3	IO	Fast boot select bit 4 (configure external boot device); Configurable I/O	
GPIO_52	A26	P3	IO	Fast boot select bit 5 (configure external boot device); Configurable I/O	
GPIO_51	B24	P3	IO	Fast boot select bit 6 (configure external boot device); Configurable I/O	
GPIO_48	119	P3	IO	Fast boot select bit 7 (configure external boot device); Configurable I/O	
GPIO_59	B28	P3	IO	Fast boot select bit 8 (configure external boot device); Configurable I/O	
GPIO_46	115	P3	IO	Fast boot select bit 9 (configure external boot device); Configurable I/O	
GPIO_79	E3	P3	IO	Fast boot select bit 10 (configure external boot device); Configurable I/O	
GPIO_78	E2	P3	IO	Fast boot select bit 11 (configure external boot device); Configurable I/O	
GPIO_47	120	P3	IO	Fast boot select bit 12 (configure external boot device); Configurable I/O	
GPIO_50	117	P3	IO	Fast boot select bit 13 (configure external boot device); Configurable I/O	
GPIO_80	E4	P3	IO	Fast boot select bit 14 (configure external boot device); Configurable I/O	

2.3.15. Debug UART interface

This is interface dedicate for debug.

Table 2-22. Debug UART interface definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
GPIO_17	C26	P3	DO	MSM_UART_TX	
GPIO_18	D26	P3	DI	MSM_UART_RX	

2.3.16. PWM

The GPIO_03 can be configured to send the output of the PWM waveform through special functions that can control the external current drivers for LED.

Table 2-23. PWM definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
PM_GPIO_03	D4	Software configurable: VIN0 = 3.6V (Nominal) VIN1 = 1.8V	DO	Configurable GPIO	

2.3.17. Sleep clock

The sleep-clock output from PMS405, and it is generated following ways:

- Calibrated low-frequency RC oscillator, periodically uses the 38.4 MHz XO signal for calibration, achieving accuracy suitable for the real-time clock.
- Using the 38.4 MHz XO circuit and dividing its output by 1172 to create a 32.7645 KHz signal. This signal is used as the start-up sleep clock.

Table 2-24. SLEEP_CLK definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
SLEEP_CLK	D2	1.8V	DO	32.7 KHZ sleep clock output.	

2.3.18. SPMI

The SPMI is a bidirectional, two-line digital interface for communication between Qualcomm chipsets, which meets the relevant information for voltage and current level requirements.

Table 2-25. SPMI definition

Pin Name	PIN Location	Voltage	Type	Description	Notes
SPMI_CLK_CON	E6	1.8v	DO	System power management interface clock	
SPMI_DATA_CON	E7	1.8v	IO	System power management interface data	

2.3.19. Antenna interface

The SOM provides the fully-integrated WLAN, Bluetooth function.

- WLAN supports 2 × 2 (WCN3999) and 1 × 1 (WCN3980) multiple input, multiple output (MIMO) with two spatial streams IEEE802.11 a/b/g/n/ac WLAN standards.
- Supports Bluetooth +LE5.x + HS enabling seamless integration of WLAN/Bluetooth and low energy technology.
- Concurrent operation for WLAN and BT.

Table 2-26. Antenna interface definition

Pin Name	PIN Location	Voltage	Type	Description
ANT_WL_Chain 1	50	-	RF IO	Antenna port for WIFI TX/Rx chain 1 of WCN3999
ANT_WL_Chain 0	59	-	RF IO	Antenna port for WIFI/BT TX/Rx chain 0 of WCN3999 and WCN3980
ANT_BT	56	-	RF IO	Antenna port for BT Tx/Rx chain 2 of WCN3999

Chapter 3. Electrical Characteristics

3.1. Absolute maximum ratings

The SOM needs to be designed in the operating conditions which is shown as below table beyond its absolute maximum ratings may damage the device.

Table 3-1. Absolute rating condition

Parameter	Min	Max	Units
Input Power voltage			
Voltage on any input or output pin	-0.5	VPH_PWR+0.5	V
VPH_PWR	-0.5	6.0	V

3.2. Operating conditions

The SOM needs to be designed in the operating conditions which is shown as below table.

Table 3-2. Operating condition

Parameters	Min	Typical	Max	Units
Input Power Voltage				
VPH_PWR	+3.50	3.8	+5.0	V
Supply voltage, digital I/O	+1.75	-	+1.85	V
VPH_PWR	0.8			A
Thermal conditions				
Operating temperature	-20	25	70	℃
Storage temperature	-20	-	70	℃

➲ **NOTE:** For the thermal conditions, operating and storage min and max temperature is only when the module is fully tested and approved in the Initial Production stage.

3.3. Output power

The SOM provide power supply for external device. Below map show the details.

Table 3-3. Output power

Function	Default voltage(V)	Programmable range(V)	Rated current(mA)	Default ON	Expected use
VREG_L6_1P8	+1.8	-	100	Y	1.8V IO pull up voltage;
VREG_L11_SDC2	+2.95	+1.8--+3.3	100	Y	Power output for SD card data pull up
VREG_L7_1P8	+1.8	+1.7--+1.89	100	N	1.8V LDO power output,100mA
VREG_L13_3P3	+3.3	+1.8--+3.3	100	N	3.3V LDO power output,100mA

3.4. Digital-logic characteristics

The digital I/O's performance depends on its pad type, usage, and power supply voltage.

The SOM IO voltage level is the same with P3 except the SD card and analog input/output.

The I2C, USB, MIPI and UART comply with the standards, and additional specifications are not required.

All other digital I/Os require performance specifications and are organized within this section.

3.4.1. Digital GPIO characteristics

The GPIO ports are digital I/Os that can be programmed for a variety of configurations. General performance specifications for are the different configurations.

The following table shows the digital GPIO characteristics:

Table 3-4. Digital IO voltage performance

Parameter	Description	Min	Max	Units
VIH	High-level input voltage, CMOS/Schmitt,	0.65* P3	-	V
VIL	Low-level input voltage, CMOS/Schmitt,	-	0.35* P3	V
VSHYS	Schmitt hysteresis voltage	100	-	mV
VOH	High-level output voltage, CMOS	P3-0.45	-	V
VOL	Low-level output voltage, CMOS	-	0.45	V
RPULL-UP	Pull-up and Pull-down resistance	55	390	KΩ
Rk	Keeper resistance	30	150	KΩ

3.4.2. SD card digital I/O characteristics

The SD card is powered by P2; the power is 1.8V and 2.95V.the following table shows the SD card digital I/O characteristics:

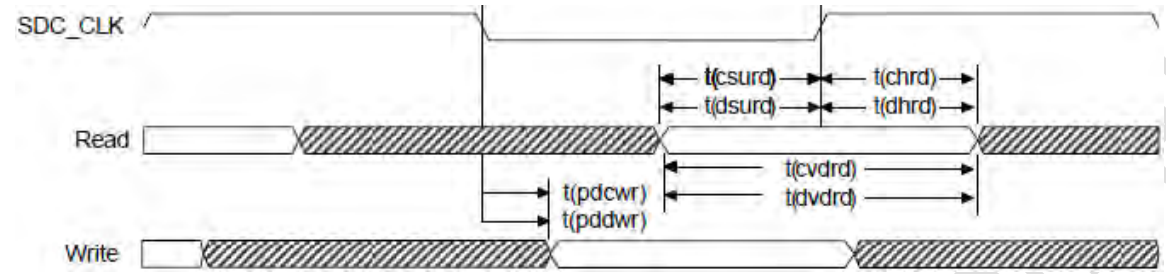
Table 3-5. SD digital IO voltage performance (1.8V/2.95V)

Parameter	Description	Min	Typical	Max	Units
VIH	High-level input voltage	1.27V/1.84V	-	2.0V/2.98V	V
VIL	Low-level input voltage	-0.3	-	0.58/0.74	V
VHYS	Schmitt hysteresis voltage	100	-	-	mV
RPULL-UP	Pull-up resistance	10 K	-	100K	Ω
RPULL-DOWN	Pull-down resistance	10 K	-	100K	Ω
RKEEPER-UP	Keeper-up resistance	10 K	-	100K	Ω
RKEEPER-DOWN	Keeper-down resistance	10 K	-	100K	Ω
VOH	High-level output voltage	1.4/2.21	-	-	V
VOL	Low-level output voltage	0/0	-	0.45/0.36	V

Table 3-6. SD standards and exceptions

Applicable standard	Feature exceptions	Device variations
Multi Media Card Host Specification, version 5.1 (JESD84-B51 - JEDEC)	None	Timing specifications as below pictures
Secure Digital: Physical Layer Specification version 3.0	None	
SDIO Card Specification version 2.0	None	

Single data rate – SDR mode:



Double data rate – DDR mode:

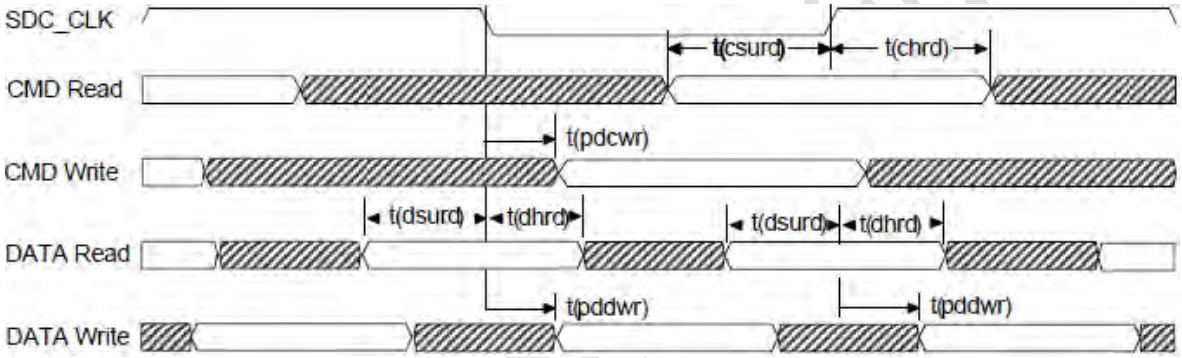


Figure 3-1. Secure Digital Interface Timing Diagram

Table 3-7. SD digital IO timing characteristics

Parameter	Description	Min	Typical	Max	Units
DDR mode – SDC2, up to 50 MHz					
tchrd	Command hold	1.50	-	-	ns
tcsurd	Command setup	6.30	-	-	ns
tdhrd	Data hold	1.50	-	-	ns
tdsurd	Data setup	2.00	-	-	ns
tpddwr	Propagation delay on data write	0.80	-	6.00	ns
tpdcwr	Propagation delay on command write	-8.20	-	3.00	ns

3.5. USB

The SOM supports USB standards and exceptions.

Table 3-8. USB standards and exceptions

Applicable standard	Feature exceptions	APQ variation
Universal Serial Bus Specification, Revision 2.0 (April 27, 2000 or later)	None	Operating voltages, system clock, and VBUS
On-The-Go Supplement to the USB 2.0 Specification (June 24, 2003, Revision 1.0 or later)	Supports the host mode aspect of OTG only	None

3.6. SLIMbus

Table 3-9. SLIMbus standards and exceptions

Applicable standard	Feature exceptions	APQ variation
MIPI Alliance Specification for Serial Low-power Inter chip Media Bus, Version 1.01.011	• No support of the CHANGE_CONTENT message by any of the devices in the component. Only the manager is given the ability to manage data channels in the system. • No support for the elemental access mode for information and value elements. • No support for the following transport protocols. ▪ Asynchronous half-duplex ▪ Extended asynchronous half-duplex • No support for the locked transport protocol. • No support of a partial mask in CHANGE_VALUE message.	The maximum clock output slew rate might be greater than 20% * VDD [V/ns] for the 15 pF load condition.

Table 3-10. SLIMbus frequencies

SLIMbus	SVS	Normal	Turbo	Units
Slimbus1 (IFM)	24.57	24.57	24.57	MHz
Slimbus2 (QCA) (IFM)	24.57	24.57	24.57	MHz
Slimbus1 (XFM)	23.1	23.1	23.1	MHz
Slimbus2 (XFM)	22.4	22.4	22.4	MHz

3.7. I2S

Legacy I2S interfaces for primary and secondary microphones and speakers.

The multiple I2S (MI2S) interface for microphone and speaker functions, including audio for HDMI.

Table 3-11. I2S standards and exceptions

Applicable standard	Feature exceptions	Device variations
Philips I2S Bus Specifications revised June 5, 1996	None	Timing – When an external SCK clock is used, a duty cycle between 45% to 55% is required.

High-level I2S timing

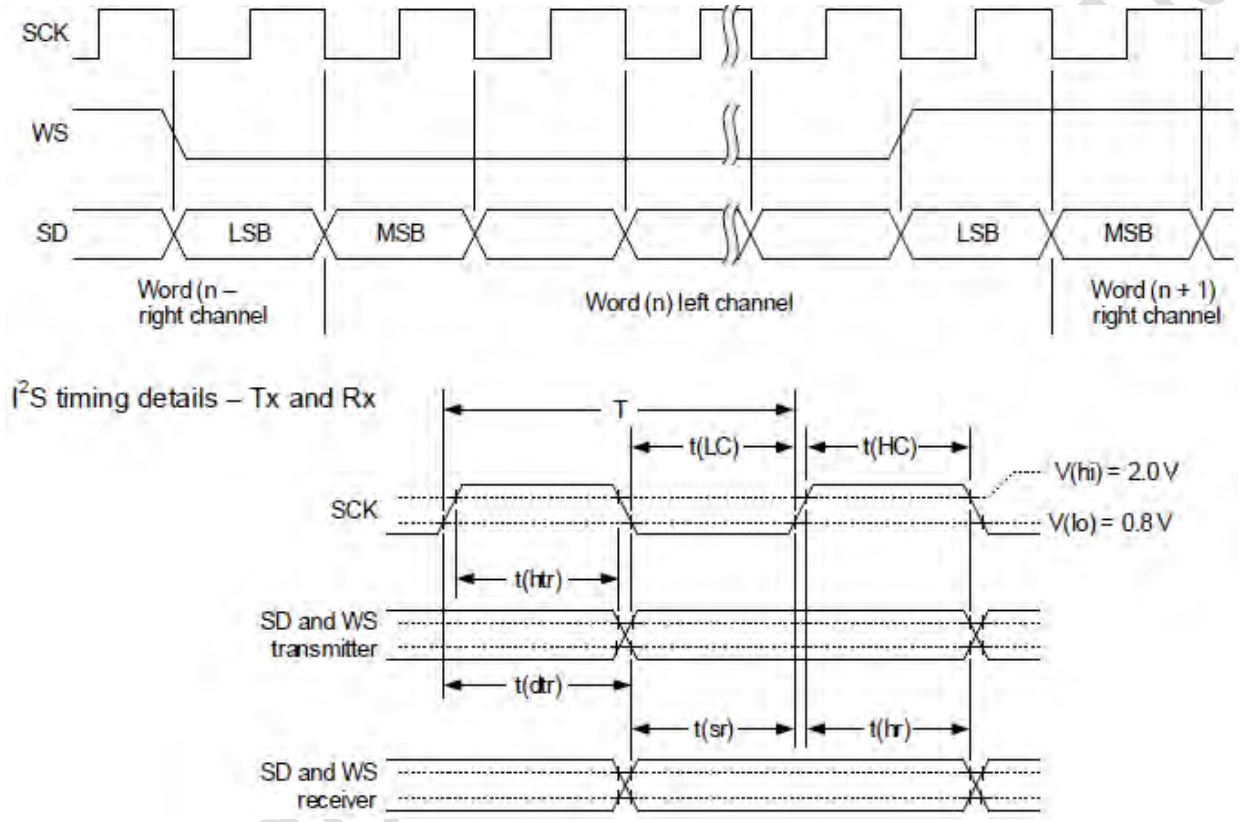


Figure 3-2. I2S Interface Timing

Table 3-12. I2S interface timing characteristics

Parameter	Description	Min	Typical	Max	Units
Using internal SCK					
F	Frequency. Load capacitance is between 10 and 40pF.			12.288	MHz
T	Clock period. Load capacitance is between 10 and 40pF.	81.380	-	-	ns
t(HC)	Clock high. Load capacitance is between 10 and 40pF.	0.45 x T		0.55 x T	ns
t(LC)	Clock low. Load capacitance is between 10 and 40pF.	0.45 x T		0.55 x T	ns
t(sr)	SD and WS input setup time. Load capacitance is between 10 and 40pF.	16.276	-	-	ns
t(hr)	SD and WS input hold time. Load capacitance is between 10 and 40pF.	0	-	-	ns
t(dtr)	SD and WS output delay. Load capacitance is between 10 and 40pF.	-	-	65.100	ns
t(htr)	SD and WS output hold time. Load capacitance is between 10 and 40pF.	0	-	-	ns

Using external SCK					
F	Frequency. Load capacitance is between 10 and 40pF.			12.288	MHz
T	Clock period. Load capacitance is between 10 and 40pF.	81.380	-	-	ns
t(HC)	Clock high. Load capacitance is between 10 and 40pF.	0.45 x T		0.55 x T	ns
t(LC)	Clock low. Load capacitance is between 10 and 40pF.	0.45 x T		0.55 x T	ns
t(sr)	SD and WS input setup time. Load capacitance is between 10 and 40pF.	16.276	-	-	ns
t(hr)	SD and WS input hold time. Load capacitance is between 10 and 40pF.	0	-	-	ns
t(dtr)	SD and WS output delay. Load capacitance is between 10 and 40pF.	-	-	65.100	ns
t(htr)	SD and WS output hold time. Load capacitance is between 10 and 40pF.	0	-	-	ns

Table 3-13. I2S interface frequencies

Interface	Frequency achieved
I2S1	24.57 MHz
I2S2	12.288 MHz
I2S3A	12.288 MHz
I2S3B	12.288 MHz
I2S5	24.57 MHz
I2S6	12.288 MHz

3.8. PDM

THE SOM PDM interfaces for primary and secondary digital microphones. DMIC interfaces running at 9.6 MHz clock.

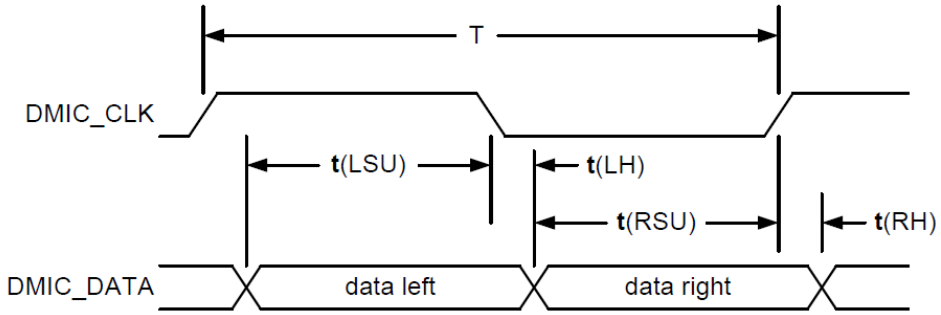


Figure 3-3. PDM Interface Timing Diagram

Table 3-14. PDM interface timing characteristics

Parameter	Description	Min	Typical	Max	Units
Using internal SCK					
T	DMIC clock period	163	-	1666	ns
t(LSU)	Data left setup time to the clock falling edge	5	-	-	ns
t(LH)	Data left hold time to the clock falling edge	0	-	-	ns
t(RSU)	Data right setup time to the clock rising edge	5	-	-	ns
t(RH)	Data right hold time to the clock falling edge	0	-	-	ns

3.9. I2C

Table 3-15. I2C standards and exceptions

Applicable standard	Feature exceptions
I²C Specification, version 5.0, October 2012	None

3.10. SPI

The following are the SPI features and comparisons:

- Supports 4-bit (MISO, MOSI, CS, CLK) synchronous serial data link.
- Support for master-only mode, up to 50 MHz on all SPI interfaces.
- Master device initiates data transfers; Multiple slave devices are supported by using chip-selects.
- No explicit communication framing, error-checking, or defined data word lengths; The transfers are strictly at the raw bit level.
- As an SPI master, the core supports several SPI system configurations (as defined by the SPI protocol).

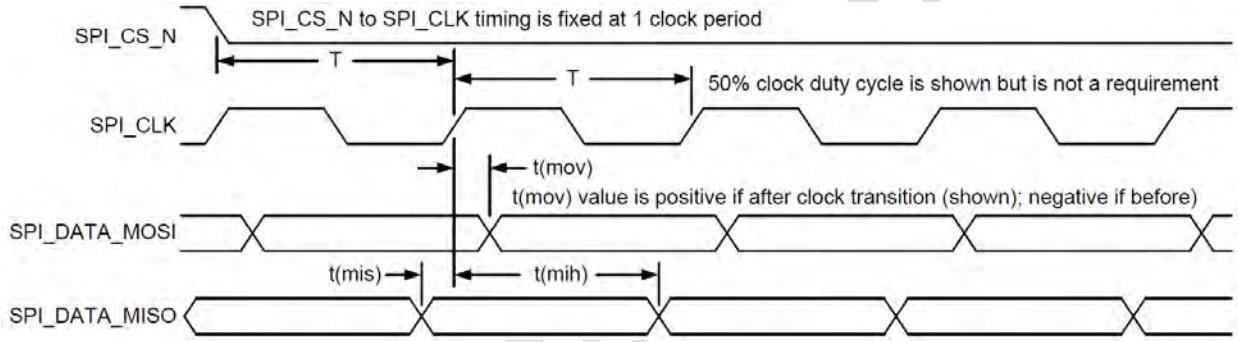


Figure 3-4. SPI Master Timing Diagram

Table 3-16. SPI master timing characteristics

Parameter	Description	Min	Typical	Max	Units
T	SPI clock period: 50 MHz maximum	20	-	-	ns
t(ch)	Clock high	9.0	-	-	ns
t(cl)	Clock low	9.0	-	-	ns
t(mov)	Master output valid	-5.0	-	5.0	ns
t(mis)	Master input setup	5.0	-	-	ns
t(mih)	Master input hold	1.0	-	-	ns
T	SPI clock period: 26 MHz maximum	38	-	-	ns
t(ch)	Clock high	17	-	-	ns
t(cl)	Clock low	17	-	-	ns
t(mov)	Master output valid	-5.0	-	5.0	ns
t(mis)	Master input setup	5.0	-	-	ns
t(mih)	Master input hold	1.0	-	-	ns

3.11. Current sink

PM_GPIO_03 is capable of sinking current (up to 12 mA). In addition, since the PWM module can be routed to the current sink, different blinking and dimming patterns can be achieved.

Table 3-17. Current sink specification

Parameter	Description	Min	Typical	Max	Units
Rated current sink		9	-	12	mA

3.12. Sleep clock

The sleep clock output characteristics: (voltage levels, drive strength, and so on see Digital GPIO characteristics).

Table 3-18. Sleep clock specification

Parameter	Description	Min	Typical	Max	Units
Period jitter (rms)	38.4 MHz XO/1172	-	-	10	ns (RMS)
Frequency drift	Shift in frequency in any 2.5 sec window at constant temperature	-	-	2	ppm
RTC accuracy	CalRC provides a jittery clock that provides a long term averaged accurate RTC clock; time accuracy defined over long period	-	-	200	ppm

3.13. SPMI

Table 3-19. SPMI standards and exceptions

Applicable standard	Feature exceptions
MIPI Alliance Specification for System Power Management Interface (SPMI) version 1.0	None

3.14. MIPI DSI

Table 3-20. MIPI DSI standards and exceptions

Applicable standard	Feature exceptions
MIPI Alliance Specification v1.01 for Display Serial Interface	None
MIPI D-PHY Specification v0.65, v0.81, v0.90	

3.15. Power consumption

The following current consumption records are measured on TurboX C40x DK, and any specific equipment configuration or use different from DK may increase power consumption.

Table 3-21. Power Consumption

Test Condition: Room temperature (25°C). Measure power for 60 sec.	**QCS404/QCS405 PMS405 & 1GB LPDDR3 WCN3999 (mA)**
Test case	
Sleep mode	< 2.4
Airplane mode with display OFF, keyword detection OFF	33.5
Bluetooth paired (sniff + scan) Adder (from WCN399x, does not chane with QCS part)	34.1
WLAN DTIM3/DTIM1 Adder	44.1/44.9
Local MP3 audio playback in tunnel mode (excluding speaker PA)	51.3
WLAN PNO (preferred network order) scan (60s) Adder	48.2
WLAN [2.4 GHz 1x1 config] streaming MP3 [128 kps] audio playback in tunnel mode (excluding speaker PA)	201.2
Bluetooth A2DP Rx local audio playback (excluding speaker PA)	101.1
Bluetooth HFP voice call with Fluence Pro v2.1	34.7
Current leak while power off	< 0.2

3.16. RF performance

3.16.1. Wi-Fi performance

Both 2.4G and 5G Wi-Fi connections are supported, and the following table records the testing results of the conducted RF performance.

Table 3-22. WCN3999 2.4G Wi-Fi performance

TX Characteristics (*WCN3999*)					
Parameter	**Comments**	**Min**	**Typical**	**Max**	**Unit**
TX frequency range		2.412	-	2.472	GHz
1. Output Power					
802.11b@11Mbps	in ANT0 in ANT1	15.0	17.0	19.0	dbm
802.11g @54Mbps	in ANT0 in ANT1	12.0	14.0	16.0	dbm
802.11n,2.4G@HT20-MCS0	MIMO	14.0	16.0	18.0	dbm
802.11n,2.4G @HT40-MCS0	MIMO	14.5	16.5	18.0	dbm
2. Frequency Error		-20		+20	ppm

3.Modulation Accuracy (EVM)					
802.11b@11Mbps	in ANT0 in ANT1	-	-20	-9	db
802.11g@ 54Mbps	in ANT0 in ANT1	-	-30	-25	db
802.11n,2.4G, HT20-MCS15	MIMO	-	-30	-28	db
802.11n,2.4G, HT40-MCS15	MIMO	-	-30	-28	db
Rx Characteristics					
Rx input frequency range		2.412	-	2.472	GHz
Minimum Input Level Sensitivity					
802.11b@11Mbps (PER ≤ 8%)	in ANT0 in ANT1	- -	-87 -87	-85 -85	dbm
802.11g@54Mbps (PER ≤ 10%)	in ANT0 in ANT1	- -	-74 -74	-72 -72	dbm
802.11n, HT20-MCS15(PER ≤ 10%)	MIMO	-	-72	-71	dbm
802.11n, HT40-MCS15(PER ≤ 10%)	MIMO	-	-71	-70	dbm

Table 3-23. WCN3999 5.8G Wi-Fi performance

TX Characteristics (*WCN3999*)					
Parameter	**Comments**	**Min**	**Typical**	**Max**	**Unit**
TX frequency range		5.180	-	5.825	GHz
1. Output Power					
802.11a@54Mbps	in ANT0 in ANT1	12.5 13.5	14.5 15.5	16.0 16.5	dbm
802.11n @HT20-MCS0	MIMO	16.0	18.0	18.5	dbm
802.11n @HT40-MCS0	MIMO	16.0	18.0	19.0	dbm
802.11ac@VHT20-MCS0	MIMO	16.0	18.0	18.5	dbm
802.11ac@VHT40-MCS0	MIMO	16.0	18.0	19.0	dbm
802.11ac@VHT80-MCS0	MIMO	16.0	18.0	19.0	dbm
2. Frequency Error		-20	-	20	ppm
3. Modulation Accuracy(EVM)					
802.11a@54Mbps	in ANT0 in ANT1	- -	-35 -35	-25 -25	db
802.11n @HT20-MCS15	MIMO	-	-30	-28	db
802.11n @HT40-MCS15	MIMO	-	-30	-28	db
802.11ac@VHT20-MCS17	MIMO	-	-35	-30	db
802.11ac@VHT40-MCS19	MIMO	-	-33	-32	db
802.11ac@VHT80-MCS19	MIMO	-	-33	-32	db

Rx Characteristics					
Rx input frequency range		5.180	-	5.825	GHz
Minimum Input Level Sensitivity					
802.11a@54Mbps (PER ≤ 10%)	in ANT0 in ANT1	- -	-74 -74	-72 -72	dbm
802.11n @HT20-MCS15(PER ≤ 10%)	MIMO	-	-73	-69	dbm
802.11n @HT40-MCS15(PER ≤ 10%)	MIMO	-	-70	-66	dbm
802.11ac@VHT20-MCS17(PER ≤ 10%)	MIMO	-	-72	-59	dbm
802.11ac@VHT40-MCS19(PER ≤ 10%)	MIMO	-	-65	-56	dbm
802.11ac@VHT80-MCS19(PER ≤ 10%)	MIMO	-	-61	-54	dbm

Table 3-24. WCN3980 2.4G Wi-Fi performance

TX Characteristics (*WCN3980*)					
Parameter	**Comments**	**Min**	**Typical**	**Max**	**Unit**
TX frequency range		2.412	-	2.472	GHz
1. Output Power					
802.11b@11Mbps	in ANT0	15.0	16.5	17.5	dbm
802.11g @54Mbps	in ANT0	13.0	15.0	16.0	dbm
802.11n,2.4G@HT20-MCS0	in ANT0	12.0	13.0	14.0	dbm
802.11n,2.4G @HT40-MCS0	in ANT0	12.0	13.0	14.5	dbm
2. Frequency Error		-20		+20	ppm
3.Modulation Accuracy (EVM)					
802.11b@11Mbps	in ANT0	-	-20	-9	db
802.11g@ 54Mbps	in ANT0	-	-31	-25	db
802.11n,2.4G, HT20-MCS7	in ANT0	-	-32	-28	db
802.11n,2.4G, HT40-MCS7	in ANT0	-	-31	-28	db
Rx Characteristics					
Rx input frequency range		2.412	-	2.472	GHz
Minimum Input Level Sensitivity					
802.11b@11Mbps (PER ≤ 8%)	in ANT0	-	-88	-87	dbm
802.11g@54Mbps (PER ≤ 10%)	in ANT0	-	-74	-73	dbm
802.11n, HT20-MCS7(PER ≤ 10%)	in ANT0	-	-71	-70	dbm
802.11n, HT40-MCS7(PER ≤ 10%)	in ANT0	-	-68	-68	dbm

Table 3-25. WCN3980 5.8G Wi-Fi performance

TX Characteristics (*WCN3980*)					
Parameter	**Comments**	**Min**	**Typical**	**Max**	**Unit**
TX frequency range		5.180	-	5.825	GHz
1. Output Power					
802.11a@54Mbps	in ANT0	10.5	12.5	14.0	dbm
802.11n @HT20-MCS0	in ANT0	10.5	12.5	13.0	dbm
802.11n @HT40-MCS0	in ANT0	10.0	12.5	13.5	dbm
802.11ac@VHT20-MCS0	in ANT0	8.5	10.0	12.0	dbm
802.11ac@VHT40-MCS0	in ANT0	10.0	11.0	12.0	dbm
802.11ac@VHT80-MCS0	in ANT0	9.0	10.0	11.0	dbm

2. Frequency Error		-20	-	20	ppm
3. Modulation Accuracy(EVM)					
802.11a@54Mbps	in ANT0	-	-33	-25	db
802.11n @HT20-MCS7	in ANT0	-	-34	-28	db
802.11n @HT40-MCS7	in ANT0	-	-34	-28	db
802.11ac@VHT20-MCS8	in ANT0	-	-36	-30	db
802.11ac@VHT40-MCS9	in ANT0	-	-38	-32	db
802.11ac@VHT80-MCS9	in ANT0	-	-38	-32	db
Rx Characteristics					
Rx input frequency range		5.180	-	5.825	GHz
Minimum Input Level Sensitivity					
802.11a@54Mbps (PER ≤ 10%)	in ANT0	--	-75	-74	dbm
802.11n @HT20-MCS7(PER ≤ 10%)	in ANT0	-	-75	-74	dbm
802.11n @HT40-MCS7(PER ≤ 10%)	in ANT0	-	-73	-72	dbm
802.11ac@VHT20-MCS8(PER ≤ 10%)	in ANT0	-	-71	-70	dbm
802.11ac@VHT40-MCS9(PER ≤ 10%)	in ANT0	-	-67	-66	dbm
802.11ac@VHT80-MCS9(PER ≤ 10%)	in ANT0	-	-63	-62	dbm

➲ **NOTE:** Test data comes from TC Labs for FCC certification.

3.16.2. BT performance

The following table shows the results of the BT conducted RF performance test.

Table 3-26. WCN3999 2.4G Bluetooth performance

Parameter (*WCN3999*)	Comments	Min	Typical	Max	unit
Tx/RX frequency range		2.402	-	2.481	GHz
BLE					
Average RF output power		-1.0	2.0	4.0	dbm
Carrier frequency offset	FTX is the nominal TX frequency	-150	-	+150	KHz
Sensitivity(BER≤0.1%)	1Mbps 2Mbps	- -	-96 -94	-94 -91	dbm
BR					
Average RF output power		6.0	8.0	10.0	dbm
Frequency tolerance		-75	-	+75	KHz
DH5 Sensitivity(BER≤0.1%)		-	-92	-88	dbm
EDR					
2DH5 output power	Average RF output power	3.0	5.0	7.0	dbm
3DH5 output power	Average RF output power	3.0	5.0	7.0	dbm
2DH5 Sensitivity (BER≤0.1%)		-	-91	-89	dbm
3DH5 Sensitivity (BER≤0.1%)		-	-85	-83	dbm

Table 3-27. WCN3980 2.4G Bluetooth performance

Parameter (*WCN3980*)	Comments	Min	Typical	Max	unit
Tx/RX frequency range		2.402	-	2.481	GHz
BLE					
Average RF output power		4.0	6.0	8.0	dbm
Carrier frequency offset	FTX is the nominal TX frequency	-150	-	+150	KHz
Sensitivity(BER≤0.1%)	1Mbps 2Mbps	- -	-97 -94	-96 -93	dbm
BR					
Average RF output power		7.5	9.5	11.5	dbm
Frequency tolerance		-75	-	+75	KHz
DH5 Sensitivity(BER≤0.1%)		-	-92	-92	dbm
EDR					
2DH5 output power	Average RF output power	4.5	6.5	8.5	dbm
3DH5 output power	Average RF output power	4.5	6.5	8.5	dbm
2DH5 Sensitivity (BER≤0.1%)		-	-92	-91	dbm
3DH5 Sensitivity (BER≤0.1%)		-	-86	-84	dbm

➲ **NOTE:** Test data comes from TC Labs for FCC certification.

Appendix 1. Compliance and Certificate Information

This datasheet applies to the following models:

Trade/Brand Name	Model	FCC ID	IC Certification
TurboX	TurboX C404	2AOHH-TURBOXC404	23465-TURBOXC400
	TurboX C405	2OAHHTURBOXC405-D	23465-TURBOXC400
	TurboX C405-D	2OAHHTURBOXC405-D	23465-TURBOXC400
	TurboX C403-C	2AOHHTURBOXC403C	

The device has been evaluated to meet general RF exposure requirement.

TurboX C40X series models are modules without antennas. The following types of antennas are recommended for related models:

Antenna Type A is Used For TurboX C404, TurboX C405, TurboX C405-D Models	
Antenna Manufacturer:	ANT1/ANT2: MOLEX ANT 3: INPAQ TECHNOLOGY CO., LTD
Brand Name:	N/A
Part No.:	ANT1/ANT2: 1461530100 ANT3: RFPCA292051IMAB901
Antenna Type:	ANT1/ANT2: Dipole Antenna ANT3: PIFA Antenna
Antenna Gain:	Bluetooth ANT3: 2.88dBi 2.4GWIFI ANT1/ANT2: 3.00dBi 5G WIFI ANT1/ANT2: 4.00dBi

or

Antenna Type B is Used For TurboX C404, TurboX C405, TurboX C405-D Models	
Antenna Manufacturer:	INPAQ TECHNOLOGY CO., LTD
Brand Name:	N/A
Part No.:	ANT1: RFPCA292034IMLB901 ANT2: RFPCA292016IMLB901 ANT3: RFPCA292051IMAB901
Antenna Type:	PIFA Antenna
Antenna Gain:	Bluetooth ANT3: 2.88dBi 2.4GWIFI ANT1: 3.49dBi 2.4GWIFIANT2: 3.51dBi 5G WIFI ANT1: 5.52dBi 5G WIFI ANT2: 5.55dBi

or

Antenna Type C is Used For TurboX C404, TurboX C405, TurboX C405-D Models	
Antenna Manufacturer:	INPAQ TECHNOLOGY CO., LTD
Brand Name:	N/A
Part No.:	ANT1: RFPCA302011IMLB401 ANT2: RFPCA302012IMLB401 ANT3: RFPCA302021IMAB401
Antenna Type:	PIFA Antenna
Antenna Gain:	Bluetooth ANT3: 2.94dBi 2.4G WIFI ANT1: 2.99dBi 2.4G WIFI ANT2: 2.69dBi 5G WIFI ANT1: 4.25dBi 5G WIFI ANT2: 4.23dBi

Antenna Type C is Used For TurboX C403-C Model	
Antenna Manufacturer:	MOLEX
Brand Name:	N/A
Part No.:	1461530100
Antenna Type:	Dipole Antenna
Antenna Gain:	Bluetooth: 3.00dBi 2.4GWIFI: 3.00dBi 5G WIFI: 4.00dBi

Manufacturer: Thundercomm Technology Co., Ltd

Manufacturer Address: No. 107, Middle Datagu Road, Xiantao Street, Yubei District, Chongqing, China, 401122

FCC statements:

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.

Federal Communication Commission (FCC) Radiation Exposure Statement

When using the product, maintain a distance of 20cm from the body to ensure compliance with RF exposure requirements.

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.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes 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.

This device is intended only for OEM integrators under the following conditions: 1. The antenna must be installed such that 20 cm is maintained between the antenna and users. 2. The transmitter module may not be co-located with any other transmitter or antenna. As long as the two conditions

above are met, additional transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required for the installed module.

Important Note: In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the Federal Communications Commission of the U.S. Government (FCC) and the Canadian Government authorizations are no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator shall be responsible for re-evaluating the end-product (including the transmitter) and obtaining a separate FCC authorization in the U.S. and Canada.

OEM Integrators - End Product Labeling Considerations: This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains, FCC ID: 2AOHH-TURBOXC404, 2OAHHTURBOXC405-D, 2AOHHTURBOXC403C”. The grantee's FCC ID can be used only when all FCC compliance requirements are met.

OEM Integrators - End Product Manual Provided to the End User: The OEM integrator shall not provide information to the end user regarding how to install or remove this RF module in end product user manual. The end user manual must include all required regulatory information and warnings as outlined in this document.

IC statements:

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.

Cet appareil est conforme avec Industrie Canada RSS exemptes de licence standard(s).
Son fonctionnement est soumis aux deux conditions suivantes:
(1) cet appareil ne peut pas provoquer d'interférences, et
(2) cet appareil doit accepter toute interférence, y compris celles pouvant causer un mauvais fonctionnement de l'appareil.

This Class B digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du 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 20cm 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.

The device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems.

CE statements:

Do not use the module in the environment at too high or too low temperature, never expose the module under strong sunshine or too wet environment.

The suitable temperature for the product and accessories is -20℃-70℃.

RF exposure information: The Maximum Permissible Exposure (MPE) level has been calculated based on a distance of d=20 cm between the device and the human body. To maintain compliance with RF exposure requirement, use product that maintain a 20cm distance between the device and human body.

Receiver category:1

Maximum output power:

Model	Frequency		Max. EIRP
TurboX C404, TurboX C405, TurboX C405-D	Bluetooth	BLE:2402-2480MHz	5.76dBm
		BR+EDR:2402-2480MHz	6.62dBm
	Wi-Fi	2412~2472MHz	19.43dBm
		5180-5240MHz	22.93dBm
		5260-5320MHz	19.79dBm
		5500-5700MHz	19.78dBm
		5745-5825MHz	13.76dBm
Model	**Frequency**		**Max. EIRP**
TurboX C403-C	Bluetooth	BLE:2402-2480MHz	9.79dBm
		BR+EDR:2402-2480MHz	9.85dBm
	Wi-Fi	2412~2472MHz	17.83dBm
		5180-5240MHz	12.38dBm
		5260-5320MHz	12.40dBm
		5500-5700MHz	14.11dBm
		5745-5825MHz	13.71dBm

EU Regulatory Conformance

Hereby, Thundercomm Technology Co., Ltd declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

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.

AT	BE	BG	CH	CY	CZ	DE	DK
EE	EL	ES	FI	FR	HR	HU	IE
IS	IT	LI	LT	LU	LV	MT	NL
PL	PT	RO	SE	SI	SK	TR	UK(NI)

EU Declaration of Conformity (DoC)

Hereby we,

Name of manufacturer:	***Thundercomm Technology Co., Ltd***
Address:	***No. 107, Middle Datagu Road, Xiantao Street, Yubei District, Chongqing, China, 401122***
Zip code & City:	***Chongqing***
Country:	***China***
Telephone number:	***18664928002***

declare that this DoC is issued under our sole responsibility and that this product:

Product description:	**Turbox C404 SOM**
Type designation(s):	**TurboX C404**
Trademark:	**TurboX**
Hardware version:	**TurboX C404 SOM V06**
Software version:	**LE1**

Software version note:Some software updates will be released by the manufacturer to fix some bug or enhance some function after placing on the market. All versions released by the manufacturer have been verified and still compliance with the related rules. All RF parameters (e.g.: frequency range, output power) are not accessible to the user, and can't be changed by the user.

Object of the declaration

TurboX C404 are Turbox C404 SOM and incorporate Wi-Fi, Bluetooth technologies.

is in conformity with the relevant Union harmonization legislation:

Radio Equipment directive: **2014 / 53 / EU**

and other Union harmonization legislation where applicable:

RoHS directive: **2011 / 65 / EU**

WEEE directive: **2012 / 19 / EU**

with reference to the following standards applied:

Health:EN 62311:2020;

Safety:EN IEC 62368-1:2020+A11:2020;

EMC:ETSI EN 301 489-1 V2.2.3; ETSI EN 301 893 V2.1.1; ETSI EN 300 440 V2.2.1;

The Notified Body Telefication with Notified Body number 0560 performed:

Applicable Modules: B+C

Where applicable: The issued the EU-type examination certificate: .

Description of accessories and components, including software, which allow the radio equipment to operate as intended and covered by the DoC:

	Antenna Type A	ANT3 Bluetooth : PIFA Antenna, 2.88dBi ANT1/ANT2 WIFI: Dipole Antenna, 3dBi(2.4GHz), 4dBi(5GHz) Manufacturer:ANT1/ANT2: MOLEX; ANT 3: INPAQ TECHNOLOGY CO., LTD Part No.:ANT1/ANT2: 1461530100; ANT3: RFPCA292051IMAB901
or	Antenna Type B	ANT3 Bluetooth : PIFA Antenna, 2.88dBi ANT1 WIFI: PIFA Antenna, 3.49dBi(2.4GHz), 5.52dBi(5GHz)
		ANT2 WIFI: PIFA Antenna, 3.51dBi(2.4GHz), 5.55dBi(5GHz) Manufacturer:INPAQ TECHNOLOGY CO., LTD Part No.:ANT1: RFPCA292034IMLB901; ANT2: RFPCA292016IMLB901; ANT3: RFPCA292051IMAB901
or	Antenna Type C	ANT3 Bluetooth : PIFA Antenna, 2.94dBi ANT1 WIFI: PIFA Antenna, 2.99dBi(2.4GHz), 4.25dBi(5GHz) ANT2 WIFI: PIFA Antenna, 2.69dBi(2.4GHz), 4.23dBi(5GHz) Manufacturer:INPAQ TECHNOLOGY CO., LTD Part No.: ANT1: RFPCA302011IMLB401; ANT2: RFPCA302012IMLB401; ANT3: RFPCA302021IMAB401

Note: This product will not be sold with the antenna. The above two types of antennas are only used for testing.

……

Signed for and on behalf of:

Qiyong Zhou

Chongqing 2022.04.26

Place and date of issue Name, Function, and signature

EU Declaration of Conformity (DoC)

Hereby we,

Name of manufacturer:	***Thundercomm Technology Co., Ltd***
Address:	***Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China***
Zip code & City:	***Chongqing***
Country:	***China***
Telephone number:	***18664928002***

declare that this DoC is issued under our sole responsibility and that this product:

Product description:	**TurboX C405 SOM**
Type designation(s):	**TurboX C405, TurboX C405-D**
Trademark:	**TurboX**
Hardware version:	**TurboX C405 V06, TurboX C405-D V06**
Software version:	**LE1**

Software version note:Some software updates will be released by the manufacturer to fix some bug or enhance some function after placing on the market. All versions released by the manufacturer have been verified and still compliance with the related rules. All RF parameters (e.g.: frequency range, output power) are not accessible to the user, and can't be changed by the user.

Object of the declaration

TurboX C405, TurboX C405-D are TurboX C405 SOM and incorporate Wi-Fi, Bluetooth technologies.

is in conformity with the relevant Union harmonization legislation:

Radio Equipment directive: **2014 / 53 / EU**

and other Union harmonization legislation where applicable:

RoHS directive: **2011 / 65 / EU**

WEEE directive: **2012 / 19 / EU**

with reference to the following standards applied:

Health:EN 62311:2020;

Safety:EN IEC 62368-1:2020+A11:2020;

EMC:ETSI EN 301 489-1 V2.2.3; ETSI EN 301 489-17 V3.2.4;

RF:ETSI EN 300 328 V2.2.2; ETSI EN 301 893 V2.1.1; ETSI EN 300 440 V2.2.1;

The Notified Body Telefication with Notified Body number 0560 performed:

Applicable Modules: B+C

Where applicable: The issued the EU-type examination certificate: .

Description of accessories and components, including software, which allow the radio equipment to operate as intended and covered by the DoC:

Antenna Type A	ANT3 Bluetooth : PIFA Antenna, 2.88dBi ANT1/ANT2 WIFI: Dipole Antenna, 3dBi(2.4GHz), 4dBi(5GHz) Manufacturer:ANT1/ANT2: MOLEX; ANT 3: INPAQ TECHNOLOGY CO., LTD Part No.:ANT1/ANT2: 1461530100; ANT3: RFPCA292051IMAB901

or

Antenna Type B	ANT3 Bluetooth : PIFA Antenna, 2.88dBi ANT1 WIFI: PIFA Antenna, 3.49dBi(2.4GHz), 5.52dBi(5GHz) ANT2 WIFI: PIFA Antenna, 3.51dBi(2.4GHz), 5.55dBi(5GHz) Manufacturer:INPAQ TECHNOLOGY CO., LTD Part No.:ANT1: RFPCA292034IMLB901; ANT2: RFPCA292016IMLB901; ANT3: RFPCA292051IMAB901

Note:This product will not be sold with the antenna. The above two types of antennas are only used for testing.

……

Qiyong Zhou

Signed for and on behalf of:

Chongqing 2021.09.17

Place and date of issue Name, Function, and signature

EU Declaration of Conformity (DoC)

Hereby we,

Name of manufacturer:	***Thundercomm Technology Co., Ltd***
Address:	***Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China***
Zip code & City:	***Chongqing***
Country:	***China***

Telephone number:	***18664928002***

declare that this DoC is issued under our sole responsibility and that this product:

Product description:	**TurboX C403 SOM**
Type designation(s):	**TurboX C403-C**
Trademark:	**TurboX**
Hardware version:	**TurboX C403-C V06**
Software version:	**LE1**

Software version note: Some software updates will be released by the manufacturer to fix some bug or enhance some function after placing on the market. All versions released by the manufacturer have been verified and still compliance with the related rules. All RF parameters (e.g.: frequency range, output power) are not accessible to the user, and can't be changed by the user.

This product can be used across EU member states.

Object of the declaration

TurboX C403-C are TurboX C403 SOM and incorporate Wi-Fi, Bluetooth technologies.

is in conformity with the relevant Union harmonization legislation:

Radio Equipment directive: **2014 / 53 / EU**

and other Union harmonization legislation where applicable:

RoHS directive: **2011 / 65 / EU**

WEEE directive: **2012 / 19 / EU**

with reference to the following standards applied:

Health: EN 50663:2017; EN 62311:2008;

Safety: EN 62368-1:2014+A11:2017;

EMC: ETSI EN 301 489-1 V2.2.3; ETSI EN 301 489-17 V3.2.4;

RF:ETSI EN 300 328 V2.2.2; ETSI EN 301 893 V2.1.1; ETSI EN 300 440 V2.2.1;

The Notified Body *Telefication* with Notified Body number *0560* performed:

Applicable Modules: B+C

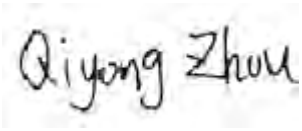
Where applicable: The issued the EU-type examination certificate: 212140131/AA/00.

Description of accessories and components, including software, which allow the radio equipment to operate as intended and covered by the DoC:

Antenna Type	Bluetooth: Dipole Antenna, 3dBi WIFI: Dipole Antenna, 3dBi(2.4GHz), 4dBi(5GHz) Manufacturer: MOLEX Part No.:1461530100

Note: This product will not be sold with the antenna. The above two types of antennas are only used for testing.

……



Signed for and on behalf of:

Chongqing 2021.03.09

Place and date of issue Name, Function, and signature

Appendix 2. Notices

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Appendix 3. Trademarks

Appendix 4. NCC Warning

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低功率射頻器材之使用不得影響飛航安全及干擾合法通信;

經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

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