

RDK X3 Module Datasheet

v1.0

RDK X3 Module，搭载地平线旭日®3 系列高性能的智能芯片，提供强大的端侧通用与人工智能算力。硬件设计兼容树莓派 CM4，方便用户快速集成和产品化落地。

1. 概述



RDK X3 Module 主要特性包括四核 Cortex® A53 处理器、5Tops 算力、最高 4GB 内存、支持 4K@60 帧视频编解；主要接口包括 HDMI、千兆以太网、USB 3.0、MIPI CSI、MIPI DSI 等。

部分型号模组搭载双频 2.4/5.0GHz 无线局域网和蓝牙 4.2 模块。搭配外部天线套件使用，能够实现无线连接，降低用户开发和测试成本，缩短上市时间。

RDK X3 Module 可选的板载 RAM 容量包括 2GB、4GB，板载 eMMC 容量包括 16GB、32GB、64GB。

2. 规格

尺寸： 55 mm x 40 mm

处理器： 四核 Arm® Cortex® A53 64-bit @ 1.5GHz

内存： 2GB or 4GB LPDDR4

外围接口：

- 可选板载 2.4 GHz 和 5 GHz IEEE 802.11a/b/g/n/ac WLAN , Bluetooth 4.2 模组及外接天线
- 1 x 千兆以太网 PHY
- 1 x USB 3.0 接口
- 32 GPIOs
- 1 x Micro SD 卡接口

图像：

- 1 x 4-lane MIPI CSI 接口
- 2 x 2-lane MIPI CSI 接口

显示：

- 1 x HDMI 接口，最大支持 1080p60
- 1 x MIPI DSI 接口，最大支持 1080p60

多媒体：

- 支持 H.265 / H.264 编解码，最大 4K@60 帧
- 支持 MJPEG 编解码

电源输入： 5V/3A DC

工作温度： -20 到 60°C

生命周期： 维持量产状态至少到 2028 年

3. 功能介绍

3.1 CPU

- 四核 Arm® Cortex® A53, 具有 32 KB/32 KB L1 缓存 和 512 KB L2 缓存
- 典型工作频率: 1.2GHz
- 最大工作频率: 1.5GHz
- 支持动态电压和频率调节 (DVFS)

3.2 BPU

- 双核伯努利架构 BPU, 由 BPU0 和 BPU1 组成, 等效 5Tops 算力
- 典型工作频率: 1.0GHz

3.3 内存

- 支持 2GB or 4GB LPDDR4
- 最高速度可达 3200 MT/s

3.4 存储

- 支持 16GB/32GB/64GB eMMC
- 支持 Micro SD 存储卡接口

3.5 摄像头接口

- 3x MIPI CSI 接口: 1x 4-lane, 2x 2-lane
- 每个数据通道高达 2.0 Gbps
- 最大接入能力 4096x2160@60fps
- 支持 RAW 8-/10-/12-/14-/16 位格式和 8-/10 位 YUV 格式

PIN#	Signal Name	Description	Direction	Pin Type
128	CAM0_D0_N	Input Camera0 D0 negative	I	/
130	CAM0_D0_P	Input Camera0 D0 positive	I	
134	CAM0_D1_N	Input Camera0 D1 negative	I	
136	CAM0_D1_P	Input Camera0 D1 positive	I	
140	CAM0_C_N	Input Camera0 clock negative	I	
142	CAM0_C_P	Input Camera0 clock positive	I	

PIN#	Signal Name	Description	Direction	Pin Type
115	CAM1_D0_N	Input Camera1 D0 negative	I	/
117	CAM1_D0_P	Input Camera1 D0 positive	I	
121	CAM1_D1_N	Input Camera1 D1 negative	I	
123	CAM1_D1_P	Input Camera1 D1 positive	I	
127	CAM1_C_N	Input Camera1 clock negative	I	
129	CAM1_C_P	Input Camera1 clock positive	I	
133	CAM1_D2_N	Input Camera1 D2 negative	I	
135	CAM1_D2_P	Input Camera1 D2 positive	I	
139	CAM1_D3_N	Input Camera1 D3 negative	I	
141	CAM1_D3_P	Input Camera1 D3 positive	I	
157	CAM2_D0_N	Input Camera2 D0 negative	I	/
159	CAM2_D0_P	Input Camera2 D0 positive	I	
163	CAM2_D1_N	Input Camera2 D1 negative	I	
165	CAM2_D1_P	Input Camera2 D1 positive	I	
169	CAM2_C_N	Input Camera2 clock negative	I	
171	CAM2_C_P	Input Camera2 clock positive	I	

3.6 ISP

- 内置图像信号处理器 (ISP)，支持 RAW 到 YUV 的转换
- 支持高动态范围 (HDR) 传感器：
 - 支持数字重叠 (DOL) HDR 传感器
 - 支持线性化 HDR 传感器
 - 支持原生（在传感器上）压扩 HDR 传感器
- 支持自动曝光、自动白平衡和自动对焦 (3A) 直方图统计数据
- 支持镜头阴影校正
- 支持缺陷像素校正 (DPC)
- 支持空间降噪
- 支持暂时降噪 (3DNR)
- 支持色彩降噪
- 支持紫边校正
- 支持镜头畸变校正 (LDC)
- 支持从输入图像裁剪
- 支持 3D 颜色查找表 (LUT)
- 支持 RGB 锐化和边缘增强

- 支持伽玛校正
- 镜头 GDC 和鱼眼校正
- PC 上的 ISP 调整工具
- 最大处理能力 4096x2160@60fps

3.7 显示接口

模组支持 HDMI、MIPI DSI 两种显示接口，功能上分时复用。

3.7.1 HDMI 接口

- 支持一路 HDMI 输出
- 兼容 HDMI1.4 和 HDCP1.4
- 最大支持 1080P 分辨率输出
- 集成 CEC 控制器
- 集成 EDID 影子 RAM 和嵌入式 EDID
- 5V 容限 DDC/HPD I/O

PIN#	Signal Name	Description	Direction	Pin Type
188	HDMI0_CLK_P	Output HDMI1 clock positive	O	/
190	HDMI0_CLK_N	Output HDMI1 clock negative		
182	HDMI0_TX0_P	Output HDMI0 TX0 positive		
184	HDMI0_TX0_N	Output HDMI0 TX0 negative		
176	HDMI0_TX1_P	Output HDMI0 TX1 positive		
178	HDMI0_TX1_N	Output HDMI0 TX1 negative		
170	HDMI0_TX2_P	Output HDMI0 TX2 positive		
172	HDMI0_TX2_N	Output HDMI0 TX2 negative		
200	HDMI0_SCL	Bidirectional HDMI0 SCL. Internally pulled up with a 2kΩ. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)	O	5V0
199	HDMI0_SDA	Bidirectional HDMI0 SDA. Internally pulled up with a 2kΩ. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)	I/O	5V0
151	HDMI0_CEC	Input HDMI0 CEC. 5V tolerant (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)	I/O	5V0

PIN#	Signal Name	Description	Direction	Pin Type
153	HDMI0_HPD	Input HDMI0 hotplug. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)	I	5V0

3.7.2 MIPI DSI

- 支持一路 MIPI DSI 输出
- 1 个时钟通道和最多 4 个数据通道
- 最大支持 1080P 分辨率输出
- 支持 24 位 RGB888 格式

PIN#	Signal Name	Description	Direction	Pin Type
175	DSI1_D0_N	Output Display1 D0 negative	0	/
177	DSI1_D0_P	Output Display1 D0 positive		
181	DSI1_D1_N	Output Display1 D1negative		
183	DSI1_D1_P	Output Display1 D1 positive		
187	DSI1_C_N	Output Display1 clock negative		
189	DSI1_C_P	Output Display1 clock positive		
193	DSI1_D2_N	Output Display1 D2 negative		
195	DSI1_D2_P	Output Display1 D2 positive		
194	DSI1_D3_N	Output Display1 D3 negative		
196	DSI1_D3_P	Output Display1 D3 positive		

3.8 视频编解码

- 支持 H.265 (HEVC) 编码和解码：
 - Main profile @ L5.1
 - 支持 I/P/B 帧
- 支持 H.264 编码和解码：
 - Baseline/Main/High profiles @ L5.1
 - H.264 支持 SVC-T 编码
- H265/H264 编解码性能：
 - 3840 x 2160p @ 60fps 编码/解码 + 1280 x 720p @ 30fps 编码/解码
 - 4096 x 2160p @ 60fps 编码/解码
 - 3840 x 2160p @ 30fps 编码/解码 + 1920 x 1080p @ 30fps 编码/解码 +

1280 x 720p @ 30fps 编码/解码

- 3840 x 2160p @ 30fps 编码/解码 + 3840 x 2160p @ 30fps 编码/解码
- 支持 JPEG 编码和解码：
 - Baseline profile
 - 支持 CBR、VBR、AVBR、FixQp 和 QpMap 比特率控制模式

3.9 无线网络

模组集成 WIFI&BT 模块。

- 支持 WLAN 2.4GHz 和 5GHz 频段信道
- 支持 BT 4.2+HS、BLE 和 ANT+，并兼容 BT 1.x 和 BT 2.x+增强型数据速率
- 支持 1x1 IEEE 802.11a/b/g/n/ac WLAN
- 提供单端 ipex 射频连接器，用户可根据应用需求外扩天线，实现易用、低成本的设计。
- 天线配置参数：

频率范围	2400-2500/5150-5850 MHz	最大功率	10 W
工作频段	100-700 MHz	天线尺寸	109 × 10 mm
驻波比	≤1.92	连接器类型	SMA 内针
峰值增益	2±0.5 dBi	外壳材料	TPEE
输出阻抗	50 Ω	工作温度	-20°C ~ + 70°C
极化方式	垂直	辐射方向	全向

- 支持低功耗管理

PIN#	Signal Name	Description	Direction	Pin Type
89	WL_ndisable	Can be left floating; if driven low the wireless interface will be disabled. Internally pulled up via 4kΩ to 3.3V	I	MD_3.3V
91	BT_ndisable	Can be left floating; if driven low the Bluetooth interface will be disabled. Internally pulled up via 4kΩ to 3.3V	I	MD_3.3V

3.10 接口描述

3.10.1 USB 3.0

模组支持 1 路 USB3.0 DRD，速率最高达 5Gbps；支持主从模式配置。

PIN#	Signal Name	Description	Direction	Pin Type
103	USB_N	USB D-	I/O	/
105	USB_P	USB D+	I/O	
116	USB_RX_P	USB3.0 RX positive	I	
118	USB_RX_N	USB3.0 RX negative	I	
122	USB_TX_P	USB3.0 TX positive	O	
124	USB_TX_N	USB3.0 TX negative	O	
101	USB_OTG_ID	Input (3.3V signal) USB OTG Pin. Internally pulled up 4K to MD_3.3V. When grounded the Module becomes a USB host but the correct OS driver also needs to be used	I	MD_3.3V

3.10.2 SPI

模组支持两路 SPI 接口，特性如下：

- 主机模式下，MOSI 和 MISO 全双工同步串行数据传输，仅限主机模式。
- 可编程 SCLK 频率、极性和相位，最高可达 48MHz。
- 仅支持一个 CSN 信号，具有可编程的极性。
- 支持 MSB 或 LSB 8 位或 16 位数据长度传输模式，
- 支持 TX 和 RX 寄存器发送和接收数据。
- 支持嵌入式 DMA 控制器进行数据发送和接收，具有 32 字节 TX FIFO 和 32 字节 RX FIFO。
- DMA 支持在实时应用程序的超时条件下进行 RX FIFO 刷新操作。
- 全面的状态和中断报告。

PIN#	Signal Name	Description	Direction	Pin Type
38	SPI1_SCLK	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
39	SPI1_CSN	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
44	SPI1_MOSI	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
40	SPI1_MISO	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I	GPIO_VREF

PIN#	Signal Name	Description	Direction	Pin Type
50	SPI2_MOSI	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
48	SPI2_MISO	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I	GPIO_VREF
35	SPI2_SCLK	(BCM2711 GPIO 1) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
36	SPI2_CSN	(BCM2711 GPIO 0) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF

具体接口复用关系请参考《RDK X3 Module PINMUX》。

3.10.3 UART

模组支持 3 路 UART 接口，特性如下：

- 使用 TXD 和 RXD 的全双工操作。
- 数据接收具备 x16 过采样和噪声过滤功能。
- 可配置的帧格式：
 - 数据位：7 或 8 位。
 - 奇偶校验位：无、偶数或奇数。
 - 停止位：1 或 2 位。
- 带有整数和小数除数的可编程波特率发生器。
- 支持标准波特率 921600 (x 16 过采样)。
- 支持通过 UART_RDR 和 UART_TDR 寄存器发送和接收数据。
- 支持嵌入式 DMA Controller 进行数据传输和接收，具有 64 字节 TX FIFO 和 64 字节 RX FIFO。
- DMA 支持实时应用程序在超时条件下进行 RX FIFO 刷新操作。
- 全面的状态和中断报告。
- 通过可编程的 XON/XOFF 字符支持软件流控制能力。

PIN#	Signal Name	Description	Direction	Pin Type
55	UART3_TXD	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
51	UART3_RXD	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I	GPIO_VREF

PIN#	Signal Name	Description	Direction	Pin Type
64	UART2_TXD	Uart Data TX pin: Internal 4kΩ pull up to GPIO_VREF	O	GPIO_VREF
68	UART2_RXD	Uart Data RX pin: Internal 4kΩ pull up to GPIO_VREF	I	GPIO_VREF
18	DEBUG_UART0_TX	Uart Data TX pin: Debug, a 1.8V signal	O	MD_1.8V
16	DEBUG_UART0_RX	Uart Data RX pin: Debug, a 1.8V signal	I	MD_1.8V

具体接口复用关系请参考《RDK X3 Module PINMUX》。

3.10.4 I2C

模组支持 4 路 i2c 接口，特性如下：

- 符合 Philips I2C 总线规范 2.1 版。
- 仅支持主机模式，用于单主多从系统。
- 支持标准模式（最高 100Kbps）和快速模式（最高 400Kbps）。
- 支持 7 位和 10 位设备寻址模式。
- 全面的状态和中断报告。

PIN#	Signal Name	Description	Direction	Pin Type
56	I2C0_SCL	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V. Internal 1.8kΩ pull up to GPIO_VREF	O	GPIO_VREF
58	I2C0_SDA	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V. Internal 1.8kΩ pull up to GPIO_VREF	I/O	GPIO_VREF
50	I2C2_SCL	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
48	I2C2_SDA	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I/O	GPIO_VREF
35	I2C3_SCL	(BCM2711 GPIO 1) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
36	I2C3_SDA	(BCM2711 GPIO 0) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I/O	GPIO_VREF

PIN#	Signal Name	Description	Direction	Pin Type
80	I2C1_SCL	I2C clock pin: typically used for Camera and Display. Internal 4kΩ pull up to MD_3.3V	O	MD_3.3V
82	I2C1_SDA	I2C Data pin: typically used for Camera and Display. Internal 4kΩ pull up to MD_3.3V	I/O	MD_3.3V

具体接口复用关系请参考《RDK X3 Module PINMUX》。

3.10.5 PCM

模组支持 1 路 PCM 接口，特性如下：

- 支持主/从模式。
- 全双工模式。
- RX 支持 1/2/4/8/16 路音频输入。
- TX 支持 1/2 声道音频输出。
- 支持 8 位/16 位采样精度。
- 支持 8/16/32/44.1/48/64 KHz 采样率。
- 支持 I2S/DSP 模式。
- I2S 模式的可配置 LRCK 极性。
- 全面的状态和中断报告。

PIN#	Signal Name	Description	Direction	Pin Type
54	PCM_MCLK	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
49	PCM_BCLK	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
26	PCM_LRCK	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
25	PCM_OUT	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
27	PCM_IN	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I	GPIO_VREF

3.10.6 以太网

模组支持一路千兆以太网口，特性如下：

- 支持 100BASE-TX IEEE802.3u /1000Base-T IEEE 802.3ab 标准。
- 支持 IEEE 802.3az-2010 (节能以太网)。
- 内置网络唤醒。
- 支持并行检测、交叉检测和自动校正、自动极性校正、中断功能、基线漂移校正。
- 支持 1000Base-T 的 CAT.5 电缆 120m。
- 提供 2 个网络状态 LED。

PIN#	Signal Name	Description	Direction	Pin Type
4	Ethernet_Pair1_P	Ethernet pair 1 positive (connect to transformer or MagJack)	I/O	/
6	Ethernet_Pair1_N	Ethernet pair 1 negative (connect to transformer or MagJack)		
3	Ethernet_Pair3_P	Ethernet pair 3 positive (connect to transformer or MagJack)		
5	Ethernet_Pair3_N	Ethernet pair 3 negative (connect to transformer or MagJack)		
10	Ethernet_Pair0_N	Ethernet pair 0 negative (connect to transformer or MagJack)		
12	Ethernet_Pair0_P	Ethernet pair 0 positive (connect to transformer or MagJack)		
9	Ethernet_Pair2_N	Ethernet pair 2 negative (connect to transformer or MagJack)		
11	Ethernet_Pair2_P	Ethernet pair 2 positive (connect to transformer or MagJack)		
15	Ethernet_nLED3	Active-low Ethernet speed indicator (3.3V signal): typically a yellow LED is connected to this pin. A low state indicates the 1Gbit or 100Mbit link: IOL = 8mA @ VOL < 0.4V	O	MD_3.3V
17	Ethernet_nLED2	Active-low Ethernet speed indicator (3.3V signal): typically a yellow LED is connected to this pin. A low state indicates the 1Gbit or 100Mbit link: IOL = 8mA @ VOL < 0.4V	O	MD_3.3V

3.10.7 SDIO

1.10.7.1 介绍

模组对外提供了 1 个支持 eMMC/SD 协议的 MMC Host Controller，控制器控制符合 SD 内存规范 3.0 版和 SDIO 规范 3.0 版的设备。

MMC Controller 支持 SD 3.0 超高速 (UHS-1)，提供最高 SDR104 模式。

1.10.7.2 特征

SDIO 模块具有以下主要特点：

- 最多支持 4 线数据总线
- SD/SDIO 支持高达 SDR104 模式，传输时钟高达 192 MHz。
- 全面的中断和状态报告。

PIN#	Signal Name	Description	Direction	Pin Type
57	SD_CLK	SD card clock signal	O	MD_3.3V/MD_1.8V
62	SD_CMD	SD card/eMMC Command signal	I/O	
63	SD_DATA0	SD card/eMMC Data0 signal	I/O	
67	SD_DATA1	SD card/eMMC Data1 signal	I/O	
69	SD_DATA2	SD card/eMMC Data2 signal	I/O	
61	SD_DATA3	SD card/eMMC Data3 signal	I/O	
75	SD_PWR_ON	Output to power-switch for the SD card. The Module sets this pin high (3.3V) to signal that power to the SD card should be turned on.defaults Output low. If booting from the SD card is required then a pullup should also be fitted so the power-switch defaults to on.	O	MD_3.3V

1.10.8 PWM

1.10.8.1 介绍

脉冲宽度调制 (PWM) 模块用于生成具有可变脉冲宽度和频率的方波。 PWM(Pulse-Width Modulation)广泛应用于电机调速、LED 亮度调节、整流器、音频输出等。

1.10.8.2 特征

PWM 模块具有以下主要特点：

- 5 路 PWM 信号
- 频率支持范围 46.8KHz—192MHz

PIN#	Signal Name	Description	Direction	Pin Type
13	PWM0	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF
45	PWM1	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	O	GPIO_VREF

PIN#	Signal Name	Description	Direction	Pin Type
31	PWM4	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	0	GPIO_VREF
50	PWM7	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	0	GPIO_VREF
48	PWM8	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	0	GPIO_VREF

1.10.9 nPRIBOOT

此引脚用于控制 fastboot 烧录模式的进入。在启动过程中拉低此引脚，系统将会进入到 USB fastboot 模式，此时可以通过 hbootupdate 工具烧写 eMMC 的系统镜像。

1.10.10 LED_nACT

此引脚用于指示系统的运行状态，正常运行时会处于闪烁或者熄灭的状态。如果系统启动过程中发生任何错误，则此 LED 将会保持常亮状态。

1.10.11 PI_LED_nPWR

此引脚用于指示系统的供电状态，正常供电的情况下即常亮。

4. 电源和系统管理

PIN#	Signal Name	Description	Direction	Pin Type
77	+5V (Input)	Main power input.	Input	4.75V-5.25V
79				
81				
83				
85				
87				
88	MD_1.8V (Output)	Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low	Output	1.8V $\pm$ 2.5%
90				
84	MD_3.3V (Output)	Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low	Output	3.3V $\pm$ 2.5%
86				
99	GLOBAL_EN	Input. Drive low to power off RDK X3 Module. Internally pulled up with a 100k Ω to +5V	Input	CMOS-5V

PIN#	Signal Name	Description	Direction	Pin Type
78	GPIO_VREF	Must be connected to MD_3.3V (pins 84 and 86) for 3.3V GPIO or MD_1.8V (pins 88 and 90) for 1.8V GPIO. This pin can not be floating or connected to ground.	Input	MD_1.8V or MD_3.3V
92	RUN_PG	Bidirectional pin. Can be driven low (via a 220Ω resistor) to reset the RDK X3 Module CPU. As an output, a high signals that power is good and CPU is running. Internally pulled up to +3.3V via 10kΩ	Input/Output	MD_3.3V

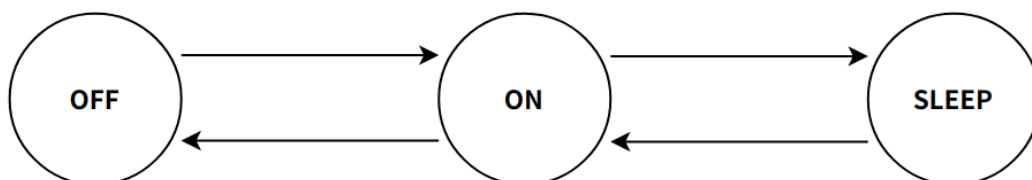
4.1 电源轨

+5V 输入由模组配套的底板提供

GPIO_VREF 由模组 MD_1.8V or MD_3.3V 提供

4.2 电源管理

模组支持动态调压，充分发挥 CPU&BPU 性能。同时 SOC 支持深度睡眠，模组进入低功耗模式。当进入低功耗模式时，GPIO（任选 4 个 GPIO）或者 RTC 可作为唤醒源。



4.3 RUN_PG

RUN_PG 是一个双向引脚，模组上电完成，引脚输出高。该引脚也可作为输入引脚，拉低复位 SOC，拉低时间不超过 500ms。

4.4 GLOBAL_EN

Global_EN 是一个输入引脚，引脚外部拉低，拉低时间大于 400ms，模组进入断电状态。

4.5 上电时序

模组上电时序要求如下：

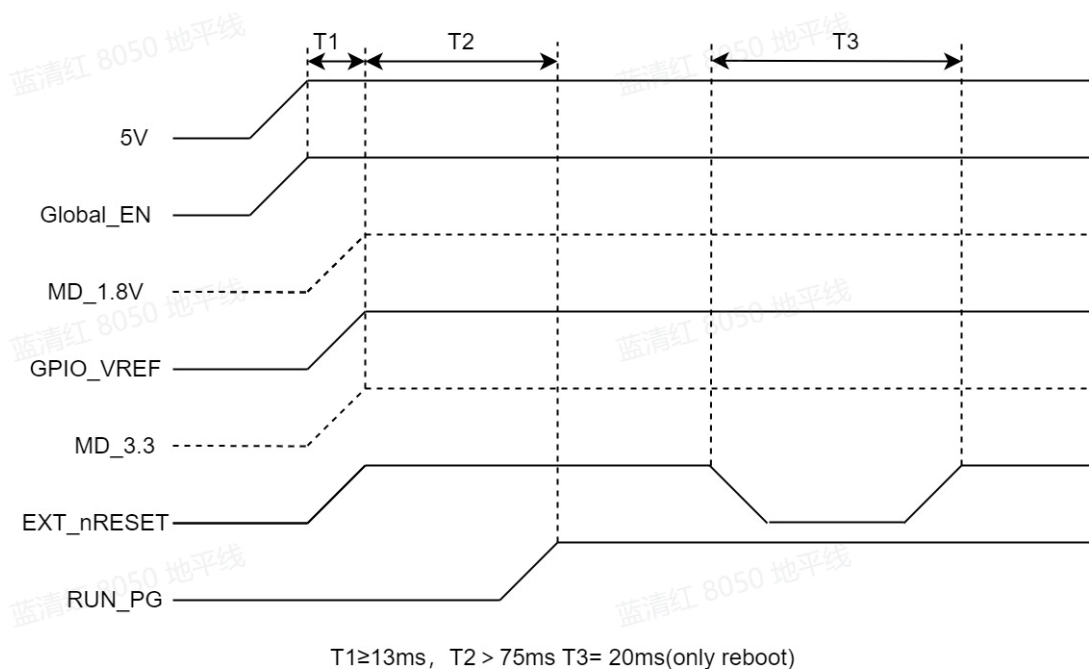
1.5V 上电

2.Global_EN 可与 5V 同时上电，也可以延后拉高

3.外部 IO 与模组相连接供电需要晚于 MD_3.3V & MD_1.8V 上电

4.RUN_PG 待系统电源上电完成后拉高

5.EXT_nRESET 信号作为芯片的看门狗信号，仅在系统 reboot 时会被拉低



4.6 掉电时序

模组掉电有两种工作模式，5V 输入直接掉电，也可以将 Global_EN 拉低。

掉电再次上电时间间隔需要控制大于 1s。

4.7 散热管理机制

为了能在各种工作负载和环境条件下稳定运行，为用户提供有源或无源散热器解决方案。通过硬件和软件方式，将模组的温度控制在限制范围内。有关详细信息请参阅《RDK X3 Module 热设计指南》。

5. 引脚功能定义

5.1 GPIO

SOM 模组有多路 GPIO 引脚，每个 GPIO 引脚除了能配置为输入、输出或者中断源外，部分引脚支持 SFIO 功能（UART, SPI, I2S, I2C etc.）。详细参考详见

《RDK X3 Module PINMUX》，如下列出部分 GPIO 功能：

PIN#	Signal Name	Description	Direction	Pin Type
38	GPI011	GPIO	I/O	GPIO_VREF
28	GPI013	GPIO	I/O	GPIO_VREF
39	GPI08	GPIO	I/O	GPIO_VREF
44	GPI010	GPIO	I/O	GPIO_VREF
40	GPI09	GPIO	I/O	GPIO_VREF
47	GPI023	GPIO	I/O	GPIO_VREF
37	GPI07	GPIO	I/O	GPIO_VREF
41	GPI025	GPIO	I/O	GPIO_VREF
46	GPI022	GPIO	I/O	GPIO_VREF
29	GPI016	GPIO	I/O	GPIO_VREF
45	GPI024	GPIO	I/O	GPIO_VREF
31	GPI012	GPIO	I/O	GPIO_VREF
24	GPI026	GPIO	I/O	GPIO_VREF
30	GPI06	GPIO	I/O	GPIO_VREF
34	GPI05	GPIO	I/O	GPIO_VREF
54	GPI04	GPIO	I/O	GPIO_VREF
49	GPI018	GPIO	I/O	GPIO_VREF
26	GPI019	GPIO	I/O	GPIO_VREF
25	GPI021	GPIO	I/O	GPIO_VREF
27	GPI020	GPIO	I/O	GPIO_VREF
56	GPI03	GPIO	I/O	GPIO_VREF
58	GPI02	GPIO	I/O	GPIO_VREF
55	GPI014	GPIO	I/O	GPIO_VREF
51	GPI015	GPIO	I/O	GPIO_VREF
50	GPI017	GPIO	I/O	GPIO_VREF
48	GPI027	GPIO	I/O	GPIO_VREF
35	GPI01	GPIO	I/O	GPIO_VREF
36	GPI00	GPIO	I/O	GPIO_VREF
97	Camera_GPIO	GPIO	I/O	MD_3.3V
76	SD0_DET_N	GPIO	I/O	MD_1.8V
70	SENSOR0_MCLK	GPIO	I/O	MD_1.8V
72	SENSOR1_MCLK	GPIO	I/O	MD_1.8V

5.2 模组接口定义

Pin	Signal	Description
1	GND	Ground (0V)
2	GND	Ground (0V)
3	Ethernet_Pair3_P	Ethernet pair 3 positive (connect to transformer or MagJack)
4	Ethernet_Pair1_P	Ethernet pair 1 positive (connect to transformer or MagJack)
5	Ethernet_Pair3_N	Ethernet pair 3 negative (connect to transformer or MagJack)
6	Ethernet_Pair1_N	Ethernet pair 1 negative (connect to transformer or MagJack)
7	GND	Ground (0V)
8	GND	Ground (0V)
9	Ethernet_Pair2_N	Ethernet pair 2 negative (connect to transformer or MagJack)
10	Ethernet_Pair0_N	Ethernet pair 0 negative (connect to transformer or MagJack)
11	Ethernet_Pair2_P	Ethernet pair 2 positive (connect to transformer or MagJack)
12	Ethernet_Pair0_P	Ethernet pair 0 positive (connect to transformer or MagJack)
13	GND	Ground (0V)
14	GND	Ground (0V)
15	Ethernet_nLED3	Active-low Ethernet speed indicator (3.3V signal): typically a yellow LED is connected to this pin. A low state indicates the 1Gbit or 100Mbit link: IOL = 8mA @ VOL < 0.4V
16	Debug_Uart0_RX	Uart Data RX pin: Debug, a 1.8V signal
17	Ethernet_nLED2	Active-low Ethernet speed indicator (3.3V signal): typically a yellow LED is connected to this pin. A low state indicates the 1Gbit or 100Mbit link: IOL = 8mA @ VOL < 0.4V
18	Debug_Uart0_TX	Uart Data TX pin: Debug, a 1.8V signal
19	NC	
20	NC	NC
21	Pi_nLED_Activity	Active-low Pi activity LED. 20mA Max 5V tolerant (VOL < 0.4V).
22	GND	Ground (0V)
23	GND	Ground (0V)
24	GPIO26	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
25	GPIO21	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
26	GPIO19	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
27	GPIO20	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
28	GPIO13	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
29	GPIO16	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
30	GPIO6	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
31	GPIO12	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
32	GND	Ground (0V)
33	GND	Ground (0V)
34	GPIO5	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
35	ID_SC	(BCM2711 GPIO 1) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
36	ID_SD	(BCM2711 GPIO 0) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
37	GPIO7	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
38	GPIO11	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
39	GPIO8	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
40	GPIO9	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
41	GPIO25	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
42	GND	Ground (0V)
43	GND	Ground (0V)
44	GPIO10	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V

Pin	Signal	Description
45	GPIO24	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
46	GPIO22	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
47	GPIO23	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
48	GPIO27	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
49	GPIO18	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
50	GPIO17	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
51	GPIO15	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
52	GND	Ground (0V)
53	GND	Ground (0V)
54	GPIO4	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
55	GPIO14	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V
56	GPIO3	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V. Internal 1.8kΩ pull up to GPIO_VREF
57	SD_CLK	SD card clock signal
58	GPIO2	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V. Internal 1.8kΩ pull up to GPIO_VREF
59	GND	Ground (0V)
60	GND	Ground (0V)
61	SD_DAT3	SD card/eMMC Data3 signal
62	SD_CMD	SD card/eMMC Command signal
63	SD_DAT0	SD card/eMMC Data0 signal
64	UART2_TXD	Uart Data TX pin: Internal 4kΩ pull up to GPIO_VREF
65	GND	Ground (0V)
66	GND	Ground (0V)
67	SD_DAT1	SD card/eMMC Data1 signal
68	UART2_RXD	Uart Data RX pin: Internal 4kΩ pull up to GPIO_VREF
69	SD_DAT2	SD card/eMMC Data2 signal
70	SENSOR0_MCLK	GPIO: typically a 1.8V signal
71	GND	Ground (0V)
72	SENSOR1_MCLK	GPIO: typically a 1.8V signal
73	NC	NC
74	GND	Ground (0V)
75	SD_PWR_ON	Output to power-switch for the SD card. The module sets this pin high (3.3V) to signal that power to the SD card should be turned on.defaults Output low. If booting from the SD card is required then a pullup should also be fitted so the power-switch defaults to on.
76	SD0_DET_N	GPIO: typically a 1.8V signal
77	+5V (Input)	4.75V-5.25V. Main power input
78	GPIO_VREF	Must be connected to MD_3.3V (pins 84 and 86) for 3.3V GPIO or MD_1.8V (pins 88 and 90) for 1.8V GPIO. This pin cannot be floating or connected to ground.
79	+5V (Input)	4.75V-5.25V. Main power input
80	SCL1	I2C clock pin: typically used for Camera and Display. Internal 4kΩ pull up to MD_3.3V
81	+5V (Input)	4.75V-5.25V. Main power input
82	SDA1	I2C Data pin: typically used for Camera and Display. Internal 4kΩ pull up to MD_3.3V
83	+5V (Input)	4.75V-5.25V. Main power input
84	MD_3.3V (Output)	3.3V ± 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low
85	+5V (Input)	4.75V-5.25V. Main power input
86	MD_3.3V (Output)	3.3V ± 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low
87	+5V (Input)	4.75V-5.25V. Main power input
88	MD_1.8V (Output)	1.8V ± 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low
89	WL_nDisable	Can be left floating; if driven low the wireless interface will be disabled. Internally pulled up via 4kΩ to 3.3V

Pin	Signal	Description
90	MD_1.8V (Output)	1.8V $\pm$ 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low
91	BT_nDisable	Can be left floating; if driven low the Bluetooth interface will be disabled. Internally pulled up via 4k Ω to 3.3V
92	RUN_PG	Bidirectional pin. Can be driven low (via a 220 Ω resistor) to reset the CPU. As an output, a high signals that power is good and CPU is running. Internally pulled up to 3.3V via 2k Ω
93	nRPIBOOT	A low on this pin forces booting from an RPI server (e.g. PC or a Raspberry Pi); if not used leave floating. Internally pulled up via 4k Ω to 3.3V
94	NC	NC
95	PI_LED_nPWR	Active-low output to drive Power On LED. This signal needs to be buffered.
96	NC	NC
97	Camera_GPIO	Typically used to shut down the camera to reduce power. Reassigning this pin to another function isn't recommended. MD_3.3V signalling
98	GND	Ground (0V)
99	GLOBAL_EN	Input. Drive low to power off Module. Internally pulled up with a 47k Ω to +5V
100	nEXTRST	Output. Driven low during reset; Driven high (MD_3.3V) once Module CPU has started to boot. Internally pulled up via 4k Ω to 3.3V
101	USB_OTG_ID	Input (3.3V signal) USB OTG Pin. Internally pulled up 4K to MD_3.3V. When grounded the Module becomes a USB host but the correct OS driver also needs to be used
102	NC	NC
103	USB_N	USB D-
104	5V	4.75V-5.25V. Main power input
105	USB_P	USB D+
106	5V	4.75V-5.25V. Main power input
107	GND	Ground (0V)
108	GND	Ground (0V)
109	NC	NC
110	NC	NC
111	NC	NC
112	NC	NC
113	GND	Ground (0V)
114	GND	Ground (0V)
115	CAM1_D0_N	Input Camera1 D0 negative
116	USB_RX_P	USB3.0 RX positive
117	CAM1_D0_P	Input Camera1 D0 positive
118	USB_RX_N	USB3.0 RX negative
119	GND	Ground (0V)
120	GND	Ground (0V)
121	CAM1_D1_N	Input Camera1 D1 negative
122	USB_TX_P	USB3.0 TX positive
123	CAM1_D1_P	Input Camera1 D1 positive
124	USB_TX_N	USB3.0 TX negative
125	GND	Ground (0V)
126	GND	Ground (0V)
127	CAM1_C_N	Input Camera1 clock negative
128	CAM0_D0_N	Input Camera0 D0 negative
129	CAM1_C_P	Input Camera1 clock positive
130	CAM0_D0_P	Input Camera0 D0 positive
131	GND	Ground (0V)
132	GND	Ground (0V)
133	CAM1_D2_N	Input Camera1 D2 negative
134	CAM0_D1_N	Input Camera0 D1 negative
135	CAM1_D2_P	Input Camera1 D2 positive

Pin	Signal	Description
136	CAM0_D1_P	Input Camera0 D1 positive
137	GND	Ground (0V)
138	GND	Ground (0V)
139	CAM1_D3_N	Input Camera1 D3 negative
140	CAM0_C_N	Input Camera0 clock negative
141	CAM1_D3_P	Input Camera1 D3 positive
142	CAM0_C_P	Input Camera0 clock positive
143	NC	NC
144	GND	Ground (0V)
145	NC	NC
146	NC	NC
147	NC	NC
148	NC	NC
149	NC	NC
150	GND	Ground (0V)
151	HDMI0_CEC	Input HDMI0 CEC. 5V tolerant (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)
152	NC	NC
153	HDMI0_HPD	Input HDMI0 hotplug. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)
154	NC	NC
155	GND	Ground (0V)
156	GND	Ground (0V)
157	CAM2_D0_N	Input Camera2 D0 negative
158	NC	NC
159	CAM2_D0_P	Input Camera2 D0 positive
160	NC	NC
161	GND	Ground (0V)
162	GND	Ground (0V)
163	CAM2_D1_N	Input Camera2 D1 negative
164	NC	NC
165	CAM2_D1_P	Input Camera2 D1 positive
166	NC	NC
167	GND	Ground (0V)
168	GND	Ground (0V)
169	CAM2_C_N	Input Camera2 clock negative
170	HDMI0_TX2_P	Output HDMI0 TX2 positive
171	CAM2_C_P	Input Camera2 clock positive
172	HDMI0_TX2_N	Output HDMI0 TX2 negative
173	GND	Ground (0V)
174	GND	Ground (0V)
175	DSI1_D0_N	Output Display1 D0 negative
176	HDMI0_TX1_P	Output HDMI0 TX1 positive
177	DSI1_D0_P	Output Display1 D0 positive
178	HDMI0_TX1_N	Output HDMI0 TX1 negative
179	GND	Ground (0V)
180	GND	Ground (0V)
181	DSI1_D1_N	Output Display1 D1 negative
182	HDMI0_TX0_P	Output HDMI0 TX0 positive
183	DSI1_D1_P	Output Display1 D1 positive

Pin	Signal	Description
184	HDMI0_TX0_N	Output HDMI0 TX0 negative
185	GND	Ground (0V)
186	GND	Ground (0V)
187	DSI1_C_N	Output Display1 clock negative
188	HDMI0_CLK_P	Output HDMI0 clock positive
189	DSI1_C_P	Output Display1 clock positive
190	HDMI0_CLK_N	Output HDMI0 clock negative
191	GND	Ground (0V)
192	GND	Ground (0V)
193	DSI1_D2_N	Output Display1 D2 negative
194	DSI1_D3_N	Output Display1 D3 negative
195	DSI1_D2_P	Output Display1 D2 positive
196	DSI1_D3_P	Output Display1 D3 positive
197	GND	Ground (0V)
198	GND	Ground (0V)
199	HDMI0_SDA	Bidirectional HDMI0 SDA. Internally pulled up with a 2k Ω . 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)
200	HDMI0_SCL	Bidirectional HDMI0 SCL. Internally pulled up with a 2k Ω . 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the Module by an on-board HDMI05-CL02F3)

6. DC 特性

6.1 最大工作额定电压

Symbol	Description	Min	Typical	Max	Units
Vin	+5V (Input)	4.75	5	5.25	V
Vgpio_vref	MD_1.8V	1.71	1.8	1.88	V
	MD_3.3V	3.135	3.3	3.465	V

6.2 数字 IO 逻辑电平

数字 IO 电气性能：

Symbol	Description	Voltage	Min	Typical	Max	Units
Vil	Input Low Voltage	U	0		0.25xU	V
Vih	Input High Voltage		0.625xU		U	V
Voh	Output High Voltage	U	0.75xU			V
Vol	Output Low Voltage		0		0.125xU	V

以下功能引脚电气性能如下：

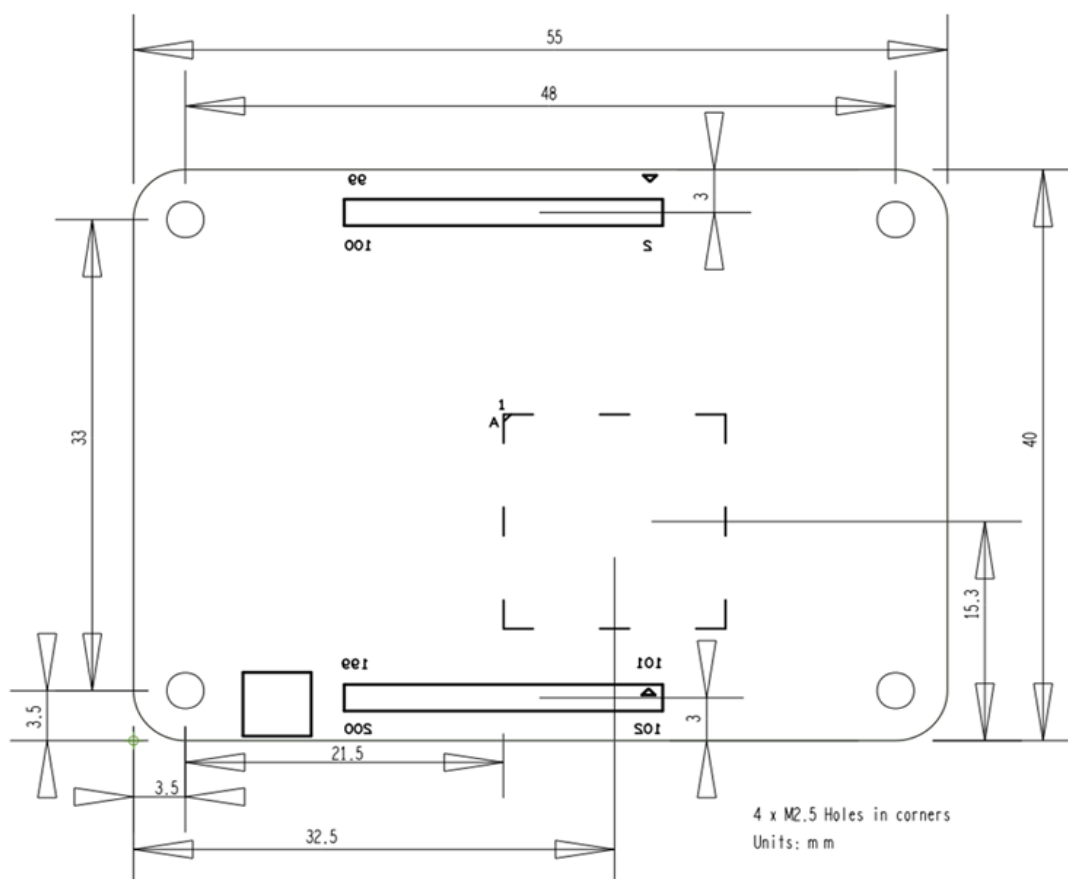
Symbol	Description	Voltage	Min	Typical	Max	Units
Vih	Input High Voltage	U=3.3V	U-0.4		U	V
Vil	Input Low Voltage		0		0.15	V
Vih	Input High Voltage	U=1.8V	U-0.4		U	V
Vil	Input Low Voltage		0		0.15	V
Voh	Output High Voltage	U=3.3V	0.75xU			V
Vol	Output Low Voltage		0		0.55	V
Voh	Output High Voltage	U=1.8V	0.75xU			V
Vol	Output Low Voltage		0		0.4	V

PIN#	Signal Name	Description	Direction	Pin Type
54	GPIO4	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I/O	GPIO_VREF
49	GPIO18	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I/O	GPIO_VREF
26	GPIO19	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I/O	GPIO_VREF
25	GPIO21	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I/O	GPIO_VREF
27	GPIO20	GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to 1.8V	I/O	GPIO_VREF
80	SCL1	I2C clock pin: typically used for Camera and Display. Internal 4kΩ pull up to MD_3.3V	I	MD_3.3V
82	SDA1	I2C Data pin: typically used for Camera and Display. Internal 4kΩ pull up to MD_3.3V	I/O	MD_3.3V
64	UART2_TXD	Uart Data TX pin: Internal 4kΩ pull up to GPIO_VREF	I	GPIO_VREF
68	UART2_RXD	Uart Data RX pin: Internal 4kΩ pull up to GPIO_VREF	O	GPIO_VREF
93	nRPIBOOT	A low on this pin forces booting from an RPI server (e.g. PC or a Raspberry Pi); if not used leave floating. Internally pulled up via 4kΩ to 3.3V	I	MD_3.3V
89	WL_ndisable	Can be left floating; if driven low the wireless interface will be disabled. Internally pulled up via 4kΩ to 3.3V	I	MD_3.3V
91	BT_ndisable	Can be left floating; if driven low the Bluetooth interface will be disabled. Internally pulled up via 4kΩ to 3.3V	I	MD_3.3V
100	nEXTRST	Output. Driven low during reset; Driven high (MD_3.3V) once Module CPU has started to boot. Internally pulled up via 4kΩ to 3.3V	O	MD_3.3V

PIN#	Signal Name	Description	Direction	Pin Type
101	USB_OTG_ID	Input (3.3V signal) USB OTG Pin. Internally pulled up 4K to MD_3.3V. When grounded the Module becomes a USB host but the correct OS driver also needs to be used	I	MD_3.3V
97	Camera_GPIO	Typically used to shut down the camera to reduce power. Reassigning this pin to another function isn't recommended. MD_3.3V signalling	O	MD_3.3V

7. 尺寸图

RDK X3 Module 模组 LxH:55x40, PCB 板厚为 1.2mm, 正面 SOC 为最高点 3.5mm



8. 修订记录

Version	Date	Description
v1.0	2023.05.23	初版文档

