Rockchip RK3588S2 Datasheet

Revision History

Date	Revision	Description
2023-11-01	1.0	Initial Release

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Chapter 1 Introduction

1.1 Overview

RK3588S2 is a low power, high performance processor for ARM-based PC and Edge Computing device, personal mobile internet device and other digital multimedia applications, and integrates quad-core Cortex-A76 and quad-core Cortex-A55 with separately NEON coprocessor.

Many embedded powerful hardware engines provide optimized performance for high-end application. RK3588S2 supports H.265 and VP9 decoder by 8K@60fps, H.264 decoder by 8K@30fps, and AV1 decoder by 4K@60fps, also support H.264 and H.265 encoder by 8K@30fps, high-quality JPEG encoder/decoder, specialized image preprocessor and postprocessor.

Embedded 3D GPU makes RK3588S2 completely compatible with OpenGLES 1.1, 2.0, and 3.2, OpenCL up to 2.2 and Vulkan1.2. Special 2D hardware engine with MMU will maximize display performance and provide very smoothly operation.

RK3588S2 introduces a new generation totally hardware-based maximum 48-Megapixel ISP (image signal processor). It implements a lot of algorithm accelerators, such as HDR, 3A, LSC, 3DNR, 2DNR, sharpening, dehaze, fisheye correction, gamma correction and so on.

The build-in NPU supports INT4/INT8/INT16/FP16 hybrid operation and computing power is up to 6TOPs. In addition, with its strong compatibility, network models based on a series of frameworks such as TensorFlow/MXNet/PyTorch/Caffe can be easily converted.

RK3588S2 has high-performance quad channel external memory interface (LPDDR4/LPDDR4X/LPDDR5) capable of sustaining demanding memory bandwidths, also provides a complete set of peripheral interface to support very flexible applications.

1.2 Features

1.2.1 Microprocessor

- Quad-core ARM Cortex-A76 MPCore processor and quad-core ARM Cortex-A55 MPCore processor, both are high-performance, low-power and cached application processor
- DSU (DynamIQ Shared Unit) comprises the L3 memory system, control logic, and external interfaces to support a DynamIQ cluster
- Full implementation of the ARM architecture v8-A instruction set, ARM Neon Advanced SIMD (single instruction, multiple data) support for accelerating media and signal processing
- ARMv8 Cryptography Extensions
- Trustzone technology support
- Integrated 64KB L1 instruction cache, 64KB L1 data cache and 512KB L2 cache for each Cortex-A76
- Integrated 32KB L1 instruction cache, 32KB L1 data cache and 128KB L2 cache for each Cortex-A55
- Quad-core Cortex-A76 and Quad-core Cortex-A55 share 3MB L3 cache
- Eight separate power domains for CPU core system to support internal power switch and externally turn on/off based on different application scenario
  - PD_CPU_0: 1st Cortex-A55 + Neon + FPU + L1/L2 I/D Cache
  - PD_CPU_1: 2nd Cortex-A55 + Neon + FPU + L1/L2 I/D Cache
  - PD_CPU_2: 3rd Cortex-A55 + Neon + FPU + L1/L2 I/D Cache
  - PD_CPU_3: 4th Cortex-A55 + Neon + FPU + L1/L2 I/D Cache
  - PD_CPU_4: 1st Cortex-A76 + Neon + FPU + L1/L2 I/D Cache
  - PD_CPU_5: 2nd Cortex-A76 + Neon + FPU + L1/L2 I/D Cache
  - PD_CPU_6: 3rd Cortex-A76 + Neon + FPU + L1/L2 I/D Cache

- PD_CPU_7: 4th Cortex-A76 + Neon + FPU + L1/L2 I/D Cache
- Three isolated voltage domains to support DVFS, one for A76_0 and A76_1, one for A76_2 and A76_3, the other for DSU and Cortex-A55.

1.2.2 Memory Organization

- Internal on-chip memory
  - BootRom
    - Support system boot from the following device:
      - SPI interface
      - eMMC interface
      - SD/MMC interface
    - Support system code download by the following interface:
      - USB OTG interface
  - Share Memory in the voltage domain of VD_LOGIC
  - PMU SRAM in VD_PMU for low power application
- External off-chip memory
  - Dynamic Memory Interface
    - Compatible with JEDEC standards LPDDR4/LPDDR4X/LPDDR5
    - Support four channels, each channel 16bits data widths
    - Support up to 2 ranks (chip selects) for each channel
    - Totally up to 32GB address space
    - Low power modes, such as power-down and self-refresh for SDRAM
  - eMMC Interface
    - Fully compliant with JEDEC eMMC 5.1 and eMMC 5.0 specification
    - Backward compliant with eMMC 4.51 and earlier versions specification.
    - Support HS400, HS200, DDR50 and legacy operating modes
    - Support three data bus width: 1bit, 4bits or 8bits
  - SD/MMC Interface
    - Compatible with SD3.0, MMC ver4.51
    - Data bus width is 4bits
  - Flexible Serial Flash Interface(FSPI)
    - Support transfer data from/to serial flash device
    - Support 1bit, 2bits or 4bits data bus width
    - Support 2 chips select

1.2.3 System Component

- MCU
  - Three Cortex-M0 MCUs inside RK3588S2
  - MCU in VD_PMU integrate 16KB Cache and 16KB TCM
  - MCU in VD_NPU integrate 16KB Cache and 64KB TCM
  - MCU in PD_CENTER integrate 32KB TCM
  - Integrated Programmable Interrupt Controller, all IRQ lines connected to GIC for CPU also connect to MCU in VD_PMU(PMU_M0) and PD_CENTER(DDR_M0)
  - Integrated Debug Controller with JTAG interface
- CRU (clock & reset unit)
  - Support total 18 PLLs to generate all clocks
  - One oscillator with 24MHz clock input
  - Support clock gating control for individual components
  - Support global soft-reset control for whole chip, also individual soft-reset for each component
- PMU(power management unit)
  - Multiple configurable work modes to save power by different frequency or automatic clock gating control or power domain on/off control
  - Lots of wakeup sources in different mode
  - Support 10 separate voltage domains
  - Support 45 separate power domains, which can be power up/down by software based on different application scenes
- Timer
  - Support 12 secure timers with 64bits counter and interrupt-based operation

- Support 18 non-secure timers with 64bits counter and interrupt-based operation
- Support two operation modes: free-running and user-defined count for each timer
- Support timer work state checkable

- PWM
  - Support 16 on-chip PWMs(PWM0~PWM15) with interrupt-based operation
  - Programmable pre-scaled operation to bus clock and then further scaled
  - Embedded 32-bit timer/counter facility
  - Support capture mode
  - Support continuous mode or one-shot mode
  - Provides reference mode and output various duty-cycle waveform
  - Optimized for IR application for PWM3, PWM7, PWM11, PWM15
- Watchdog
  - 32-bit watchdog counter
  - Counter counts down from a preset value to 0 to indicate the occurrence of a timeout
  - WDT can perform two types of operations when timeout occurs:
    - Generate a system reset
    - First generate an interrupt and if this is not cleared by the service routine by the time a second timeout occurs then generate a system reset
  - Totally five Watchdog for CPU and MCU
- Interrupt Controller
  - Support 12 PPI interrupt source and 480 SPI interrupt sources input from different components inside RK3588S2
  - Support 16 software-triggered interrupts
  - Input interrupt level is fixed, high-level sensitive for SPI and low-level sensitive for PPI
  - Support different interrupt priority for each interrupt source, and they are always software-programmable
- DMAC
  - Micro-code programming based DMA
  - Linked list DMA function is supported to complete scatter-gather transfer
  - Support data transfer types including memory-to-memory, memory-to-peripherals, peripherals-to-memory
  - Totally three embedded DMA controllers for peripheral system
  - Each DMAC features:
    - Support 8 channels
    - 32 hardware request from peripherals
    - 2 interrupt output
    - Support TrustZone technology and programmable secure state for each DMA channel
- Secure System
  - Embedded two cipher engine
    - Support Link List Item (LLI) DMA transfer
    - Support SHA-1, SHA-256/224, SHA-512/384, MD5, SM3 with hardware padding
    - Support HMAC of SHA-1, SHA-256, SHA-512, MD5, SM3 with hardware padding
    - Support AES-128, AES-192, AES-256 encrypt & decrypt cipher
    - Support AES ECB/CBC/OFB/CFB/CTR/CTS/XTS/CCM/GCM/CBC-MAC/CMAC mode
    - Support SM4 ECB/CBC/OFB/CFB/CTR/CTS/XTS/CCM/GCM/CBC-MAC/CMAC mode
    - Support DES & TDES cipher, with ECB/CBC/OFB/CFB mode
    - Support up to 4096 bits PKA mathematical operations for RSA/ECC/SM2
    - Support generating random numbers
  - Support keyladder to guarantee key secure
  - Support data scrambling for all DDR types
  - Support secure OTP
  - Support secure debug

- Support secure DFT test
- Support secure OS
- Except CPU, the other masters in the SoC can also support security and non-security mode by software-programmable
- Some slave components in SoC can only be addressed by security master and the other slave components can be addressed by security master or non-security master by software-programmable
- System SRAM(share memory), part of space is addressed only in security mode
- External DDR space can be divided into 16 parts, each part can be software-programmable to be enabled by each master

- Mailbox
  - Three Mailbox in SoC to service CPU and MCU communication
  - Support four mailbox elements per mailbox, each element includes one data word, one command word register and one flag bit that can represent one interrupt
  - Provide 32 lock registers for software to use to indicate whether mailbox is occupied
- Decompression
  - Support for decompressing GZIP files
  - Support for decompressing LZ4 files, including the General Structure of LZ4 Frame format and the Legacy Frame format.
  - Support for decompressing data in DEFLATE format
  - Support for decompressing data in ZLIB format
  - Support Hash32 check in LZ4 decompression process
  - Support the limit size function of the decompressed data to prevent the memory from being maliciously destroyed during the decompression process

1.2.4 Video CODEC

- Video Decoder
  - Real-time video decoder of MPEG-1, MPEG-2, MPEG-4, H.263, H.264, H.265, VC-1, VP9, VP8, MVC, AV1
  - MMU Embedded
  - Multi-channel decoder in parallel for less resolution
  - H.264 AVC/MVC Main10 L6.0 : 8K@30fps (7680x4320)②
  - VP9 Profile0/2 L6.1 : 8K@60fps (7680x4320)
  - H.265 HEVC/MVC Main10 L6.1 : 8K@60fps (7680x4320)
  - AVS2 Profile0/2 L10.2.6 : 8K@60fps (7680x4320)
  - AV1 Main Profile 8/10bit L5.3 : 4K@60fps (3840x2160)
  - MPEG-2 up to MP : 1080p@60fps (1920x1088)
  - MPEG-1 up to MP : 1080p@60fps (1920x1088)
  - VC-1 up to AP level 3 : 1080p@60fps (1920x1088)
  - VP8 version2 : 1080p@60fps (1920x1088)
- Video Encoder
  - Real-time H.265/H.264 video encoding
  - Support up to 8K@30fps
  - Multi-channel encoder in parallel for less resolution

1.2.5 JPEG CODEC

- JPEG Encoder
  - Baseline (DCT sequential)
  - Encoder size is from 96x96 to 8192x8192(67Mpixels)
  - Up to 90 million pixels per second
  - Embedded four encoder units
- JPEG Decoder
  - Decoder size is from 48x48 to 65536x65536
  - Support YUV400/YUV411/YUV420/YUV422/YUV440/YUV444
  - Support up to 1080P@280fps, and 560 million pixels per second
  - Support MJPEG
  - Embedded four encoder units

1.2.6 Neural Process Unit

- Neural network acceleration engine with processing performance up to 6 TOPS
- Include triple NPU core, and support triple core co-work, dual core co-work, and work independently
- Support integer 4, integer 8, integer 16, float 16, Bfloat 16 and tf32 operation
- Embedded 384KBx3 internal buffer
- Multi-task, multi-scenario in parallel
- Support deep learning frameworks: TensorFlow, Caffe, Tflite, Pytorch, Onnx NN, Android NN, etc.
- One isolated voltage domain to support DVFS

1.2.7 Graphics Engine

- 3D Graphics Engine
  - ARM Mali-G610 MP4
  - High performance OpenGLES 1.1, 2.0 and 3.2, OpenCL 2.2, Vulkan1.2 etc.
  - Embedded 4 shader cores with shared hierarchical tiler
  - Provide MMU and L2 Cache with 4x 256KB size
  - The latest Valhall architecture
  - ARM Frame Buffer Compression(AFBC) 1.3
  - Support Serial Wire debug for embedded MCU
  - One isolated voltage domain to support DVFS
- 2D Graphics Engine
  - Source format: ARGB/RGB888/RGB565/YUV420/YUV422/BPP
  - Destination formats: ARGB/RGB888/RGB565/YUV420/YUV422
  - Max resolution: 8192x8192 source, 4096x4096 destination
  - Block transfer and Transparency mode
  - Color fill with gradient fill, and pattern fill
  - Alpha blending modes including global alpha, per pixel alpha (color/alpha channel separately) and fading
  - Arbitrary non-integer scaling ratio, from 1/8 to 8
  - 0, 90, 180, 270 degree rotation, x-mirror, y-mirror & rotation operation
  - ROP2, ROP3, ROP4
  - Support 4k/64k page size MMU
- Image Enhancement Processor
  - Image format
    - Input data: YUV420/YUV422, semi-planar/planar, UV swap
    - Output data: YUV420/YUV422, semi-planar, UV swap, Tile mode
    - YUV down sampling conversion from 422 to 420
    - Max resolution for dynamic image up to 1920x1080
  - De-interlace

1.2.8 Video Input Interface

- MIPI Interface
  - One MIPI DC(DPHY/CPHY) combo PHY
    - Support to use DPHY or CPHY
    - Each MIPI DPHY V1.2, 4lanes, 2.5Gbps per lane
    - Each MIPI CPHY V1.1, 3lanes, 2.5Gsps per lane
  - Four MIPI CSI DPHY
    - Each MIPI DPHY V1.2, 2lanes, 2.5Gbps per lane
    - Support to combine 2 DPHY together to one 4lanes
  - Support camera input combination:
    - 1 MIPI DCPHY + 4 MIPI CSI DPHY(2 lanes), totally support 5 cameras input
    - 1 MIPI DCPHY + 2 MIPI CSI DPHY(4 lanes), totally support 3 cameras input
- DVP interface
  - One 8/10/12/16-bit standard DVP interface, up to 150MHz input data
  - Support BT.601/BT.656 and BT.1120 VI interface
  - Support the polarity of pixel_clk, hsync, vsync configurable

1.2.9 Image Signal Processor

- Video Capture(VICAP)

  - Support BT601, BT656, BT1120
  - Support receiving six interfaces of MIPI CSI/DSI, up to four IDs for each interface
  - Support five CSI data formats: RAW8/10/12/14, YUV422
  - Support three modes of HDR: virtual channel mode, identification code mode, line counter mode
  - Support RAW data through to ISP0/1
- Maximum input
  - 48M：8064x6048@15 dual ISP
  - 32M：6528x4898@30 dual ISP
  - 16M：4672x3504@30 single ISP
- 3A: include AE/Histogram, AF, AWB statistics output
- FPN: Fixed Pattern Noise removal
- BLC: Black Level Correction
- DPCC: Static/Dynamic defect pixel cluster correction
- PDAF: Phase Detection Auto Focus
- LSC: Lens shading correction
- Bayer-2DNR: Spatial Bayer-raw De-noising
- Bayer-3DNR: Temporal Bayer-raw De-noising
- CAC: Chromatic Aberration Correction
- HDR: 3-Frame Merge into High-Dynamic Range
- DRC: HDR Dynamic Range Compression, Tone mapping
- GIC: Green Imbalance Correction
- Debayer: Advanced Adaptive Demosaic with Chromatic Aberration Correction
- CCM/CSM: Color correction matrix; RGB2YUV etc
- Gamma: Gamma out correction
- Dehaze/Enhance: Automatic Dehaze and Effect enhancement
- 3DLUT: 3D-Lut Color Palette for Customer
- LDCH: Lens-distortion only in the horizontal direction
- YUV-2DNR: Spatial YUV De-noising
- Sharp: Image Sharpening and boundary filtering
- CMSK: privacy mask
- GAIN: image local gain
- Support multi-sensor reuse ISP
- FishEye Correction(FEC)
  - Input mode and data format
    - Support RASTER: YUV422SP, YUV422I, YUV420SP
  - Output mode and data format
    - RASTER: YUV422SP, YUV422I, YUV420SP
    - FBCE: YUV422SP, YUV420SP
  - Support 16x8, 32x16 two density
  - Support up to 4 times reduction factor
  - Resolution 128x128~4095x4095
  - Y Interpolation: Bicubic; C Interpolation: Biliner

1.2.10 Display interface

- HDMI/eDP TX interface
  - Support one HDMI/eDP TX combo interface, but HDMI and eDP can not work at the same time for each interface
  - Support x1, x2 and x4 configuration for each interface
  - Support all the data rates for HDMI FRL: 3, 6, 8, 10 and 12Gbps
  - Support 1.62Gbps, 2.7Gbps and 5.4Gbps for eDP
  - Support up to 7680x4320@60Hz for HDMI TX, and 4K@60Hz for eDP
  - Support RGB/YUV(up to 10bit) format for HDMI TX
  - Support RGB, YCbCr 4:4:4, YCbCr 4:2:2 and 8/10 bit per component video format for eDP
  - Support DSC 1.2a for HDMI TX
  - Support HDCP2.3 for HDMI TX, and HDCP1.3 for eDP
- DP TX interface

- Support one DP TX 1.4a interface which combo with USB3.1 Gen1
- Support 1/2/4lanes for each interface
- Support 1.62Gbps, 2.7Gbps, 5.4Gbps and 8.1Gbps Serializer
- Support up to 7680x4320@30Hz
- Support RGB/YUV(up to 10bit) format
- Support Single Stream Transport(SST)
- Support DP Alt mode on USB Type-C
- Support HDCP2.3, HDCP 1.3

- MIPI DSI interface
  - Support 2 MIPI DPHY 2.0 or CPHY 1.1 interface
  - Support 4 data lanes and 4.5Gbps maximum data rate per lane for DPHY
  - Support 3 data trios and 2.0Gsps maximum data rate per trio for CPHY
  - Support max resolution 4K@60Hz
  - Support dual MIPI display: left-right mode
  - Support RGB(up to 10bit) format
  - Support DSC 1.1/1.2a
- BT.1120 video output interface
  - Support up to 1920x1080@60Hz
  - Support RGB(up to 8bit) format
  - Up to 150MHz data rate

1.2.11 Video Output Processor

- Video ports
  - Video Port0, max output resolution: 7680x4320@60Hz
  - Video Port1, max output resolution: 4096x4320@60Hz
  - Video Port2, max output resolution: 4096x4320@60Hz
  - Video Port3, max output resolution: 2048x1080@60Hz
- Cluster 0/1/2/3
  - Max input and output resolution 4096x4320
  - Support AFBCD
  - Support RGB/YUV/YUYV format
  - Support scale up/down ratio 4~1/4
  - Support rotation
- ESMART 0/1/2/3
  - Max input and output resolution 4096x4320
  - Support RGB/YUV/YUYV format
  - Support scale up/down ratio 8~1/8
  - Support 4 region
- Overlay
  - Support up to 8 layers overlay: 4 cluster/4 esmart
  - Support RGB/YUV domain overlay
- Post process
  - HDR
    - HDR10/HDR HLG
    - HDR2SDR/SDR2HDR
  - 3D-LUT/P2I/CSC/BCSH/DITHER/CABC/GAMMA/COLORBAR
- Write back
  - Format: ARGB8888/RGB888/RGB565/YUV420
  - Max resolution: 1920x1080

1.2.12 Audio Interface

- I2S0/I2S1 with 8 channels
  - Up to 8 channels TX and 8 channels RX path
  - Audio resolution from 16bits to 32bits
  - Sample rate up to 192KHz
  - Provides master and slave work mode, software configurable
  - Support 3 I2S formats (normal, left-justified, right-justified)
  - Support 4 PCM formats (early, late1, late2, late3)

  - Support TDM normal, 1/2 cycle left shift, 1 cycle left shift, 2 cycle left shift, right shift mode serial audio data transfer
  - I2S, PCM and TDM mode cannot be used at the same time
- I2S2/I2S3 with 2 channels
  - Up to 2 channels for TX and 2 channels RX path
  - Audio resolution from 16bits to 32bits
  - Sample rate up to 192KHz
  - Provides master and slave work mode, software configurable
  - Support 3 I2S formats (normal, left-justified, right-justified)
  - Support 4 PCM formats (early, late1, late2, late3)
  - I2S and PCM cannot be used at the same time
- SPDIF0/SPDIF1
  - Support two 16-bit audio data store together in one 32-bit wide location
  - Support biphase format stereo audio data output
  - Support 16 to 31 bit audio data left or right justified in 32-bit wide sample data buffer
  - Support 16, 20, 24 bits audio data transfer in linear PCM mode
  - Support non-linear PCM transfer
- PDM0/PDM1
  - Up to 8 channels
  - Audio resolution from 16bits to 24bits
  - Sample rate up to 192KHz
  - Support PDM master receive mode
- Digital Audio Codec
  - Support 2 channels digital DAC
  - Support I2S/PCM interface, master and slave mode
  - Support 16 bit sample resolution
  - Support three modes of mixing for every digital DAC channel
  - Support volume control
- VAD(Voice Activity Detection)
  - Support read voice data from I2S/PDM
  - Support voice amplitude detection
  - Support Multi-Mic array data storing
  - Support a level combined interrupt

1.2.13 Connectivity

- SDIO interface
  - Compatible with SDIO3.0 protocol
  - 4-bit data bus widths
- GMAC 10/100/1000M Ethernet controller
  - Support one Ethernet controllers
  - Support 10/100/1000-Mbps data transfer rates with the RGMII interfaces
  - Support 10/100-Mbps data transfer rates with the RMII interfaces
  - Support both full-duplex and half-duplex operation
- USB3.1 Gen1
  - Support USB3.1 Gen1,equal to USB3.2 Gen1 and USB3.0,up to 5Gbps datarate
  - Embedded 1 USB3.1 OTG interfaces which combo with DP TX (USB3OTG_0)
  - Embedded 1 USB3.1 Host interface which combo with Combo PIPE PHY2 (USB3OTG_2)
  - Compatible Specification
    - Universal Serial Bus 3.0 Specification, Revision 1.0
    - Universal Serial Bus Specification, Revision 2.0 (exclude USB3OTG_2)
    - eXtensible Host Controller Interface for Universal Serial Bus (xHCI), Revision 1.1
  - Support Control/Bulk (including stream)/Interrupt/Isochronous Transfer
  - Simultaneous IN and OUT transfer for USB3.1 Gen1
  - Descriptor caching and data pre-fetching used to improve system performance in

high-latency systems
- LPM protocol in USB 2.0 (exclude USB3OTG_2) and U0, U1, U2, and U3 states for USB3.1 Gen1
- USB3.1 Gen1 Device Features
  - Up to 10 IN endpoints, including control endpoint 0
  - Up to 6 OUT endpoints, including control endpoint 0
  - Up to 16 endpoint transfer resources, each one for each endpoint
  - Flexible endpoint configuration for multiple applications/USB set-configuration modes
  - Hardware handles ERDY and burst
  - Stream-based bulk endpoints with controller automatically initiating data movement
  - Isochronous endpoints with isochronous data in data buffers
  - Flexible Descriptor with rich set of features to support buffer interrupt moderation, multiple transfers, isochronous, control, and scattered buffering support
- USB3.1 Gen1 xHCI Host Features
  - Support up to 64 devices
  - Support 1 interrupter
  - Support 1 USB2.0 port (exclude USB3OTG_2) and 1 Super-Speed port
  - Support standard or open-source xHCI and class driver
- USB3.1 Gen1 Dual-Role Device (DRD) Features
  - Static Device Operation
  - Static Host Operation
  - USB3.1/USB2.0 OTG A device and B device basing on ID, USB3OTG_2 only support USB3.1 Gen1
  - Not Support USB3.1/USB2.0 OTG session request protocol (SRP), host negotiation protocol (HNP) and Role Swap Protocol (RSP)
- Miscellaneous Features
  - USB2.0 PHY support Battery Charge detection
  - USB3OTG_0 support USB Type-C and DP Alt Mode
  - USB3OTG_2 PHY combos with PCIE and SATA

- USB 2.0 Host
  - Compatible with USB 2.0 specification
  - Support two USB 2.0 Host
  - Supports high-speed(480Mbps), full-speed(12Mbps) and low-speed(1.5Mbps) mode
  - Support Enhanced Host Controller Interface Specification (EHCI), Revision 1.0
  - Support Open Host Controller Interface Specification (OHCI), Revision 1.0a
- Combo PIPE PHY Interface
  - Support two Combo PIPE PHYs with PCIe2.1/SATA3.0/USB3.1 controller
  - Combo PIPE PHY0 support one of the following interfaces
    - SATA
    - PCIe2.1
  - Combo PIPE PHY2 support one of the following interfaces
    - SATA
    - PCIe2.1
    - USB3.1 Gen1
  - PCIe2.1 Interface
    - Compatible with PCI Express Base Specification Revision 2.1
    - Support 1 lane for each PCIe2.1 interface
    - Support Root Complex(RC) only
    - Support 5Gbps data rate
  - SATA Interface
    - Compatible with Serial ATA 3.1 and AHCI revision 1.3.1
    - Support eSATA
    - Support 1 port for each SATA interface
    - Support 6Gbps data rate

- SPI interface
  - Support 5 SPI Controllers(SPI0-SPI4)
  - Support two chip-select output
  - Support serial-master and serial-slave mode, software-configurable
- I2C Master controller
  - Support 9 I2C Master(I2C0-I2C8)
  - Support 7bits and 10bits address mode
  - Software programmable clock frequency
  - Data on the I2C-bus can be transferred at rates of up to 100k bits/s in the Standard-mode, up to 400k bits/s in the Fast-mode
- UART interface
  - Support 10 UART interfaces(UART0-UART9)
  - Embedded two 64-byte FIFO for TX and RX operation respectively
  - Support 5bit, 6bit, 7bit, 8bit serial data transmit or receive
  - Standard asynchronous communication bits such as start, stop and parity
  - Support different input clock for UART operation to get up to 4Mbps baud rate
  - Support auto flow control mode for all UART

1.2.14 Others

- Multiple group of GPIO
  - All of GPIOs can be used to generate interrupt
  - Support level trigger and edge trigger interrupt
  - Support configurable polarity of level trigger interrupt
  - Support configurable rising edge, falling edge and both edge trigger interrupt
  - Support configurable pull direction(a weak pull-up and a weak pull-down)
  - Support configurable drive strength
- Temperature Sensor (TS-ADC)
  - Support User-Defined Mode and Automatic Mode
  - In User-Defined Mode, start_of_conversion can be controlled completely by software, and also can be generated by hardware.
  - In Automatic Mode, the temperature of alarm(high/low temperature) interrupt can be configurable
  - In Automatic Mode, the temperature of system reset can be configurable
  - Support to 7 channel TS-ADC, the temperature criteria of each channel can be configurable
  - -40~125°C temperature range and 1°C temperature resolution
- Successive approximation ADC (SARADC)
  - 12-bit resolution
  - Up to 1MS/s sampling rate
  - 6 single-ended input channels
- OTP
  - Support 32Kbit space and higher 4k address space is non-secure part.
  - Support read and program word mask in secure model
  - Support maximum 32 bit OTP program operation
  - Support maximum 16 word OTP read operation
  - Program and Read state can be read
  - Program fail address record
- Package Type
  - FCCSP1253L (body: 17mm x 17mm; ball size: 0.26mm; ball pitch: 0.4mm)

1.3 Block Diagram

The following figure shows the basic block diagram.

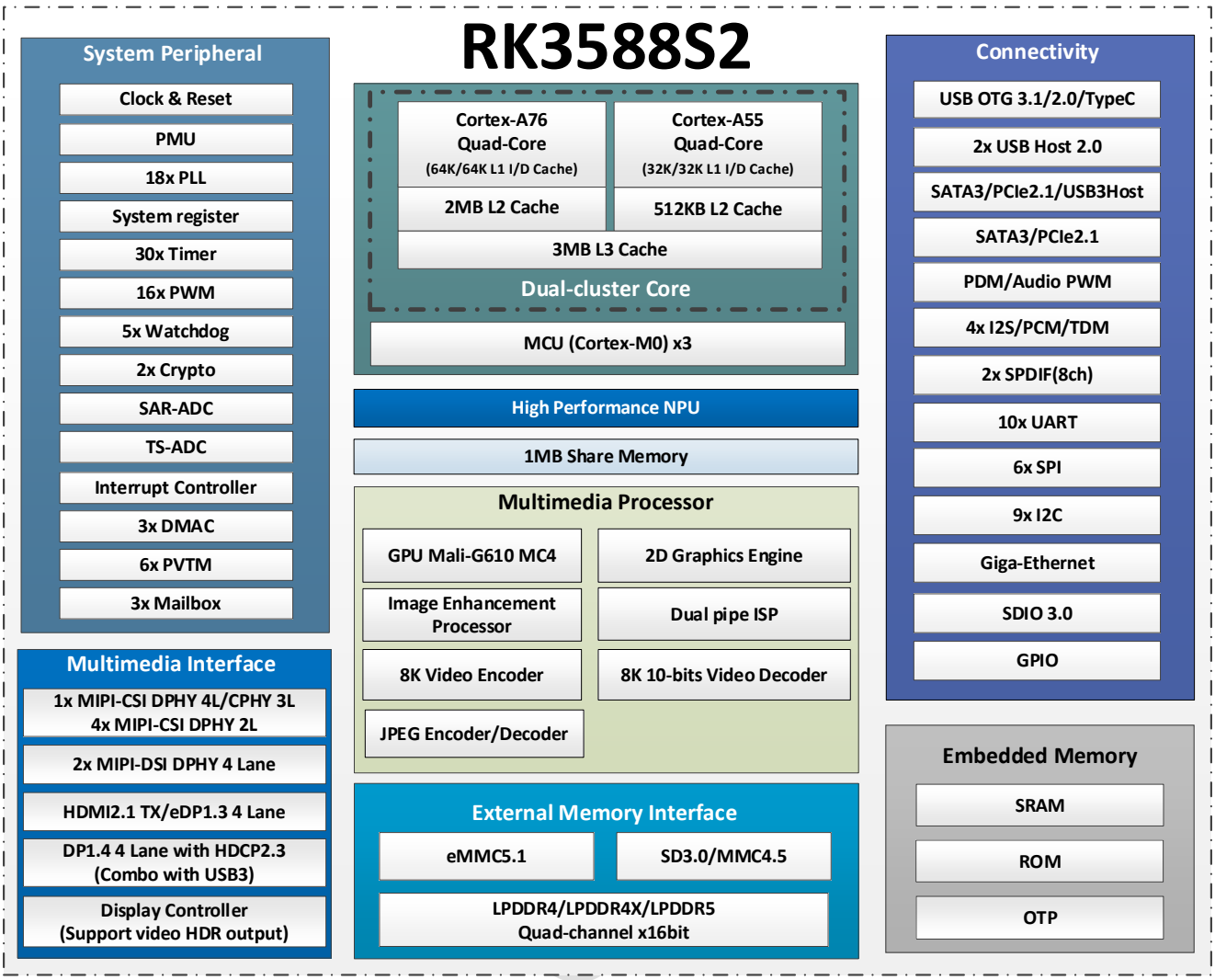

Fig.1-1 Block Diagram

Chapter 2 Package Information

2.1 Order Information

Orderable Device	RoHS status	Package	Package Q'ty	Device Feature
RK3588S2	RoHS	FCCSP1253L	900pcs by tray	Application processor

2.2 Top Marking

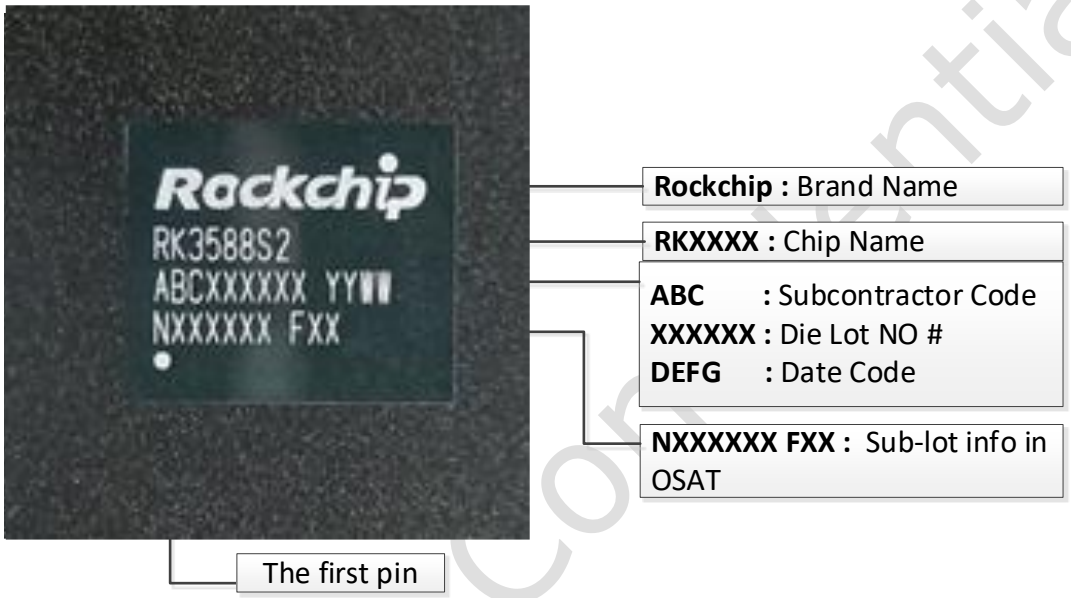

Fig.2-1 Package definition

2.3 Package Dimension

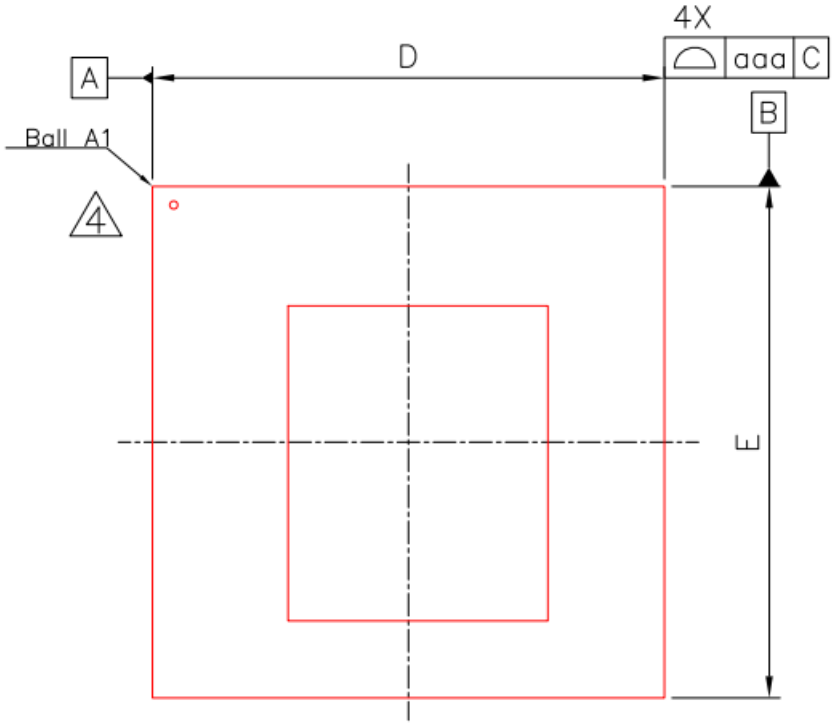

Fig.2-2 Package Top View

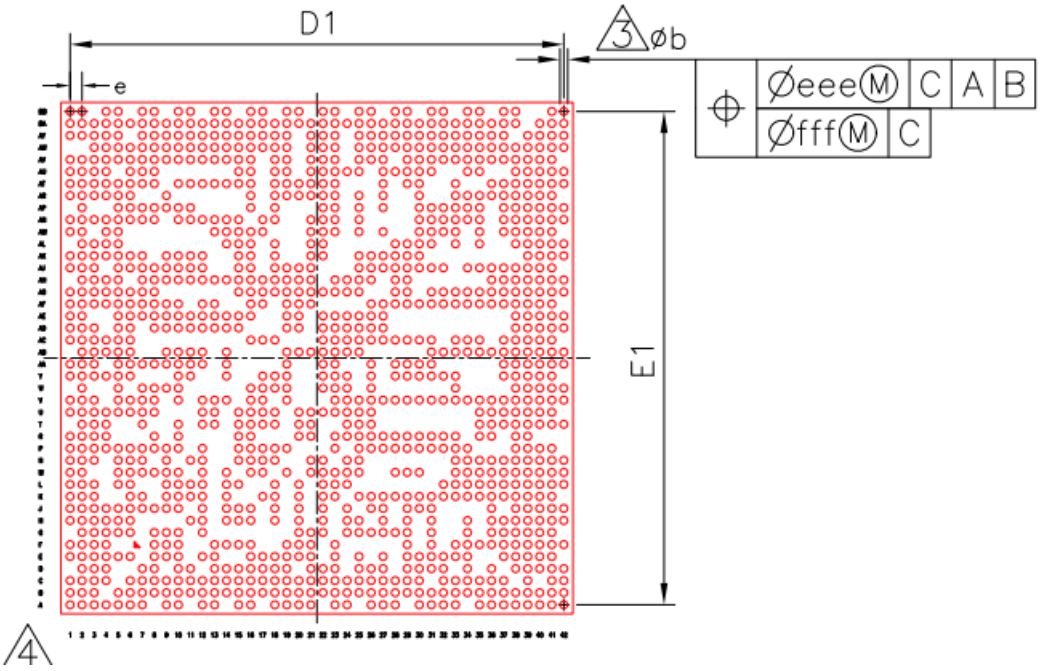

Fig.2-3 Package Bottom View

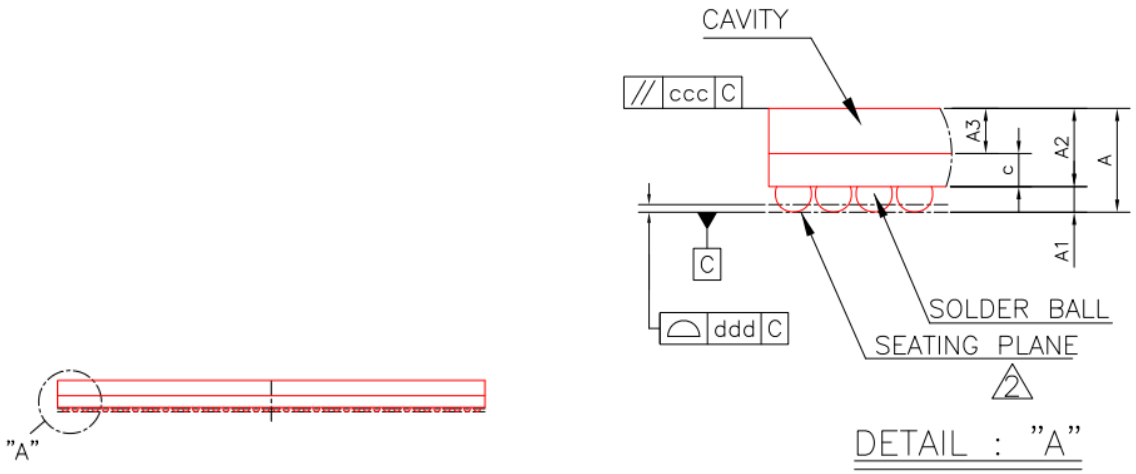

Fig.2-4 Package Side View

Symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.163	1.240	1.317	0.046	0.049	0.052
A1	0.120	0.170	0.220	0.005	0.007	0.009
A2	1.012	1.070	1.128	0.040	0.042	0.044
A3	0.570	0.600	0.630	0.022	0.024	0.025
c	0.420	0.470	0.520	0.017	0.019	0.020
D	16.900	17.000	17.100	0.665	0.669	0.673
E	16.900	17.000	17.100	0.665	0.669	0.673
D1	---	16.400	---	---	0.646	---
E1	---	16.400	---	---	0.646	---
e	---	0.400	---	---	0.016	---
b	0.210	0.260	0.310	0.008	0.010	0.012
aaa	0.100			0.004		
ccc	0.150			0.006		
ddd	0.130			0.005		
eee	0.150			0.006		
fff	0.050			0.002		
MD/ME	42/42					

Fig.2-5 Package Dimension

2.4 MSL Information

Moisture sensitivity level：MSL3

2.5 Lead Finish/Ball Material Information

Lead finish/Ball material：SnAgCu

2.6 Pin Number List

Table 2-1 Pin Number Order Information

Pin Name	Pin	Pin Name	Pin
VSS_1	A1	AVSS_98	AY9
VSS_2	A2	DDR_CH0_DQS0N_B	B1
DDR_CH1_DQS1P_C	A3	DDR_CH0_DQS0P_B	B2
DDR_CH1_DQS1N_C	A4	VSS_4	B3
DDR_CH1_ZQ_C	A5	VSS_5	B5
DDR_CH1_WCK1N_C	A6	DDR_CH1_WCK1P_C	B6
DDR_CH1_A3_C	A7	DDR_CH1_A6_C	B7
DDR_CH1_DQS0P_C	A9	VSS_6	B8
DDR_CH1_A4_C	A10	DDR_CH1_DQS0N_C	B9
DDR_CH1_DQ10_C	A12	VSS_7	B10
DDR_CH1_LP4/4X_CKE1/LP5_CS1_C	A13	VSS_8	B11
DDR_CH1_A5_C	A15	DDR_CH1_DQ9_C	B12
DDR_CH1_DQ14_C	A16	DDR_CH1_RESET_C	B13
DDR_CH1_LP4/4X_CKE0/LP5_CS0_C	A18	VSS_9	B14
DDR_CH1_LP4/4X_CS1_C	A19	DDR_CH1_LP4/4X_CS0_C	B15
DDR_CH1_DQ2_C	A20	DDR_CH1_DQ15_C	B16
DDR_CH1_A1_C	A21	VSS_10	B17
DDR_CH1_LP4/4X_CS1_D	A23	DDR_CH1_A0_C	B18
DDR_CH1_DQ0_D	A24	VSS_11	B19
DDR_CH1_A0_D	A26	DDR_CH1_DQ0_C	B20
DDR_CH1_A1_D	A27	VSS_12	B21
DDR_CH1_DQ3_D	A28	DDR_CH1_A2_C	B22
DDR_CH1_A2_D	A30	VSS_13	B23
DDR_CH1_LP4/4X_CKE1/LP5_CS1_D	A31	DDR_CH1_DQ2_D	B24
DDR_CH1_DQ15_D	A32	DDR_CH1_RESET_D	B25
DDR_CH1_A6_D	A33	VSS_14	B26
DDR_CH1_LP4/4X_CKE0/LP5_CS0_D	A35	VSS_15	B27
DDR_CH1_A3_D	A36	DDR_CH1_DQ5_D	B28
DDR_CH1_WCK1P_D	A37	VSS_16	B29
DDR_CH1_A5_D	A38	DDR_CH1_LP4/4X_CS0_D	B30
DDR_CH1_WCK0N_D	A39	VSS_17	B31
DDR_CH1_ZQ_D	A40	DDR_CH1_DQ12_D	B32
DDR_CH1_DQS0N_D	A41	DDR_CH1_A4_D	B33
VSS_3	A42	VSS_18	B34
DDR_CH0_CKB_A	AA1	VSS_19	B35
DDR_CH0_CK_A	AA2	VSS_20	B36
VSS_296	AA3	DDR_CH1_WCK1N_D	B37
DDR_CH0_DQ1_B	AA5	VSS_21	B38
VSS_297	AA6	DDR_CH1_WCK0P_D	B39
VSS_298	AA7	VSS_22	B40
VSS_299	AA8	DDR_CH1_DQS0P_D	B41
VSS_300	AA9	VSS_23	B42
VSS_301	AA10	HDMI_TX0_SBDP/EDP_TX0_AUXP	BA1
VSS_302	AA11	HDMI_TX0_D3P/EDP_TX0_D3P	BA2
VSS_303	AA12	AVSS_116	BA3
DDR_CH0_PLL_AVSS	AA14	HDMI_TX0_D0N/EDP_TX0_D0N	BA4
VSS_304	AA19	HDMI_TX0_D1P/EDP_TX0_D1P	BA5
VSS_305	AA22	AVSS_117	BA6
VSS_306	AA23	HDMI_TX0_D2N/EDP_TX0_D2N	BA7
PLL_AVSS	AA26	TYPEC0_SBU1/DP0_AUXP	BA8
VDD_CPU_LIT_MEM_1	AA28	AVSS_118	BA9
VDD_CPU_LIT_MEM_2	AA29	TYPEC0_SSRX1N/DP0_TX0N	BA10
VDD_CPU_LIT_MEM_3	AA30	TYPEC0_SSTX1N/DP0_TX1N	BA11
VSS_307	AA31	AVSS_119	BA12
VSS_308	AA37	TYPEC0_SSRX2N/DP0_TX2N	BA13
VSS_309	AA38	TYPEC0_SSTX2N/DP0_TX3N	BA14
VSS_310	AA39	AVSS_120	BA15
VSS_311	AA40	MIPI_DPHY1_TX_D0N/MIPI_CPHY1_TX_TRIO0_A	BA16
EMMC_D2/FSPI_D2_M0/GPIO2_D2_u	AA41	MIPI_DPHY1_TX_D1P/MIPI_CPHY1_TX_TRIO1_A	BA17
EMMC_D3/FSPI_D3_M0/GPIO2_D3_u	AA42	AVSS_121	BA18
VSS_312	AB2	MIPI_DPHY1_TX_CLKN/MIPI_CPHY1_TX_TRIO1_B	BA19
DDR_CH0_DQ3_A	AB3	MIPI_DPHY1_TX_D2P/MIPI_CPHY1_TX_TRIO2_B	BA20
DDR_CH0_DQ1_A	AB4	AVSS_122	BA21
DDR_CH0_DQ4_A	AB5	MIPI_DPHY1_TX_D3N/MIPI_CPHY1_TX_TRIO2_C	BA22
VSS_313	AB6	MIPI_DPHY1_RX_D0P/MIPI_CPHY1_RX_TRIO0_B	BA23
VSS_314	AB9	AVSS_123	BA24
VSS_315	AB10	MIPI_DPHY1_RX_D1N/MIPI_CPHY1_RX_TRIO0_C	BA25
VSS_316	AB11	MIPI_DPHY1_RX_CLKP/MIPI_CPHY1_RX_TRIO1_C	BA26
VSS_317	AB12	AVSS_124	BA27

Pin Name	Pin	Pin Name	Pin
DDR_CH0_PLL_DVDD	AB14	MIPI_DPHY1_RX_D2N/MIPI_CPHY1_RX_TRIO2_A	BA28
VSS_318	AB19	MIPI_DPHY1_RX_D3P/NO_USE	BA29
VSS_319	AB20	AVSS_125	BA30
VSS_320	AB21	MIPI_DPHY0_TX_D0N/MIPI_CPHY0_TX_TRIO0_A	BA31
VSS_321	AB22	MIPI_DPHY0_TX_D1P/MIPI_CPHY0_TX_TRIO1_A	BA32
VSS_322	AB23	AVSS_126	BA33
VSS_323	AB24	MIPI_DPHY0_TX_CLKN/MIPI_CPHY0_TX_TRIO1_B	BA34
PLL_AVDD1V8	AB25	MIPI_DPHY0_TX_D2P/MIPI_CPHY0_TX_TRIO2_B	BA35
VDD_CPU_LIT_1	AB31	AVSS_127	BA36
VSS_324	AB32	MIPI_DPHY0_TX_D3N/MIPI_CPHY0_TX_TRIO2_C	BA37
VSS_325	AB33	MIPI_CSI0_D0P	BA38
VSS_326	AB34	MIPI_CSI0_D1P	BA40
EMMCIO_1V8_1	AB35	MIPI_CSI0_CLK0N	BA41
VSS_327	AB36	MIPI_CSI0_D2N	BA42
VSS_328	AB37	AVSS_128	BB1
VSS_329	AB38	HDMI_TX0_D3N/EDP_TX0_D3N	BB2
VSS_330	AB39	HDMI_TX0_D0P/EDP_TX0_D0P	BB4
VSS_331	AB40	HDMI_TX0_D1N/EDP_TX0_D1N	BB5
EMMC_CLKOUT/GPIO2_A1_d	AB41	HDMI_TX0_D2P/EDP_TX0_D2P	BB7
EMMC_D4/I2C1_SCL_M3/UART5_RX_M2/GPIO2_D4_u	AB42	TYPEC0_SBU2/DP0_AUXN	BB8
DDR_CH0_LP4/4X_CS1_A	AC1	TYPEC0_SSRX1P/DP0_TX0P	BB10
DDR_CH0_A1_A	AC2	TYPEC0_SSTX1P/DP0_TX1P	BB11
VSS_332	AC3	TYPEC0_SSRX2P/DP0_TX2P	BB13
VSS_333	AC4	TYPEC0_SSTX2P/DP0_TX3P	BB14
VSS_334	AC5	MIPI_DPHY1_TX_D0P/MIPI_CPHY1_TX_TRIO0_B	BB16
VSS_335	AC6	MIPI_DPHY1_TX_D1N/MIPI_CPHY1_TX_TRIO0_C	BB17
VDD_VDENC_6	AC16	MIPI_DPHY1_TX_CLKP/MIPI_CPHY1_TX_TRIO1_C	BB19
VSS_336	AC17	MIPI_DPHY1_TX_D2N/MIPI_CPHY1_TX_TRIO2_A	BB20
VSS_337	AC18	MIPI_DPHY1_TX_D3P/NO_USE	BB22
VSS_338	AC22	MIPI_DPHY1_RX_D0N/MIPI_CPHY1_RX_TRIO0_A	BB23
VSS_339	AC23	MIPI_DPHY1_RX_D1P/MIPI_CPHY1_RX_TRIO1_A	BB25
VSS_340	AC24	MIPI_DPHY1_RX_CLKN/MIPI_CPHY1_RX_TRIO1_B	BB26
VSS_341	AC25	MIPI_DPHY1_RX_D2P/MIPI_CPHY1_RX_TRIO2_B	BB28
VSS_342	AC26	MIPI_DPHY1_RX_D3N/MIPI_CPHY1_RX_TRIO2_C	BB29
VDD_CPU_LIT_2	AC27	MIPI_DPHY0_TX_D0P/MIPI_CPHY0_TX_TRIO0_B	BB31
VDD_CPU_LIT_3	AC28	MIPI_DPHY0_TX_D1N/MIPI_CPHY0_TX_TRIO0_C	BB32
VDD_CPU_LIT_4	AC29	MIPI_DPHY0_TX_CLKP/MIPI_CPHY0_TX_TRIO1_C	BB34
VDD_CPU_LIT_5	AC30	MIPI_DPHY0_TX_D2N/MIPI_CPHY0_TX_TRIO2_A	BB35
VDD_CPU_LIT_6	AC31	MIPI_DPHY0_TX_D3P/NO_USE	BB37
VCCIO5_1	AC33	MIPI_CSI0_D0N	BB38
VCCIO5_2	AC34	MIPI_CSI0_CLK0P	BB41
EMMCIO_1V8_2	AC35	AVSS_129	BB42
SPI2_CS1_M2/I2C1_SCL_M1/UART0_RX_M1/GPIO0_B0_z	AC37	DDR_CH0_ZQ_B	C1
SDMMC_DET/GPIO0_A4_u	AC38	VSS_24	C2
TSADC_SHUT_ORG/TSADC_SHUT/GPIO0_A1_z	AC39	DDR_CH0_WCK0N_B	C3
EMMC_DATA_STROBE/I2C2_SDA_M2/UART5_CTSN_M1/GPIO2_A2_d	AC40	DDR_CH0_WCK0P_B	C4
VSS_343	AC41	VSS_25	C6
DDR_CH0_LP4/4X_CKE1/LP5_CS1_A	AD1	VSS_26	C7
VSS_344	AD2	DDR_CH1_WCK0P_C	C8
VSS_345	AD3	VSS_27	C9
VSS_346	AD5	DDR_CH1_DQ11_C	C10
VSS_347	AD6	VSS_28	C11
VSS_348	AD8	VSS_29	C12
VSS_349	AD9	DDR_CH1_DQ12_C	C13
VSS_350	AD10	VSS_30	C14
VSS_351	AD11	VSS_31	C15
VSS_352	AD12	DDR_CH1_DQ5_C	C16
VSS_353	AD13	DDR_CH1_DQ4_C	C17
VSS_354	AD14	VSS_32	C18
VDD_VDENC_7	AD15	VSS_33	C19
VSS_355	AD19	VSS_34	C20
VSS_356	AD20	DDR_CH1_CK_C	C21
VSS_357	AD22	VSS_35	C22
VSS_358	AD23	DDR_CH1_CK_D	C23
VSS_359	AD24	VSS_36	C24
VSS_360	AD25	DDR_CH1_DQ1_D	C25
VDD_CPU_LIT_7	AD26	VSS_37	C26
VDD_CPU_LIT_8	AD27	DDR_CH1_DQ6_D	C27
CLK32K_IN/CLK32K_OUT0/GPIO0_B2_u	AD38	VSS_38	C28
PMIC_SLEEP2/GPIO0_A3_d	AD39	DDR_CH1_DQ7_D	C29
EMMC_RSTN/I2C2_SCL_M2/UART5_RTSN_M1/GPIO2_A3_d	AD40	VSS_39	C30
EMMC_D6/FSPI_CS0N_M0/GPIO2_D6_u	AD41	DDR_CH1_DQ14_D	C32
EMMC_D5/I2C1_SDA_M3/UART5_TX_M2/GPIO2_D5_u	AD42	DDR_CH1_DM1_D	C33
DDR_CH0_DM0_A	AE1	DDR_CH1_DQ13_D	C34
DDR_CH0_DQ6_A	AE2	VSS_40	C35
DDR_CH0_DQ5_A	AE5	DDR_CH1_DQS1N_D	C36
VSS_361	AE6	VSS_41	C37
VSS_362	AE7	VSS_42	C39
VSS_363	AE8	AVSS_1	C41
VSS_364	AE9	PCIE20_2_RXN/SATA30_2_RXN/USB30_SSRXN	C42
VSS_365	AE10	DDR_CH0_A3_B	D2
VSS_366	AE11	VSS_43	D3
VSS_367	AE12	VSS_44	D4
VSS_368	AE13	VSS_45	D7
VSS_369	AE14	DDR_CH1_WCK0N_C	D8
VSS_370	AE15	DDR_CH1_DQ8_C	D10

Pin Name	Pin	Pin Name	Pin
VSS_371	AE16	VSS_46	D11
VSS_372	AE19	DDR_CH1_DM1_C	D13
VSS_373	AE20	VSS_47	D14
VSS_374	AE22	VSS_48	D15
VSS_375	AE23	DDR_CH1_DQ7_C	D16
VSS_376	AE24	DDR_CH1_DQ6_C	D17
VSS_377	AE25	VSS_49	D18
VSS_378	AE26	VSS_50	D19
VDD_CPU_LIT_9	AE27	DDR_CH1_CKB_C	D21
VSS_379	AE38	VSS_51	D22
VSS_380	AE39	DDR_CH1_CKB_D	D23
VSS_381	AE40	DDR_CH1_DQ4_D	D25
EMMC_D7/FSPI_CS1N_M0/GPIO2_D7_u	AE41	VSS_52	D26
EMMC_CMD/FSPI_CLK_M0/GPIO2_A0_u	AE42	DDR_CH1_DM0_D	D27
DDR_CH0_A2_A	AF1	DDR_CH1_DQ9_D	D29
VSS_382	AF2	VSS_53	D30
DDR_CH0_DQ7_A	AF3	VSS_54	D31
DDR_CH0_DQ14_A	AF4	VSS_55	D32
DDR_CH0_DQ15_A	AF5	DDR_CH1_DQ8_D	D34
VSS_383	AF6	DDR_CH1_DQS1P_D	D36
VSS_384	AF7	VOP_POST_EMPTY/I2C4_SDA_M3/UART6_RTSN_M1/PWM0_M2/SPI4_CLK_M2/GPIO1_A2_d	D38
VSS_385	AF8	SPI2_CLK_M0/GPIO1_A6_d	D39
VSS_386	AF9	UART7_TX_M2/SPI0_CS1_M2/GPIO1_B5_u	D40
VSS_387	AF10	PCIE20_2_TXN/SATA30_2_TXN/USB30_SSTXN	D41
VDD_LOGIC_5	AF12	PCIE20_2_RXP/SATA30_2_RXP/USB30_SSRXP	D42
VDD_LOGIC_6	AF13	DDR_CH0_A4_B	E1
VSS_388	AF16	VSS_56	E2
VSS_389	AF17	DDR_CH0_WCK1P_B	E3
VSS_390	AF19	DDR_CH0_WCK1N_B	E4
VSS_391	AF20	VSS_57	E5
VSS_392	AF21	VSS_58	E6
VSS_393	AF26	VSS_59	E8
VSS_394	AF27	VSS_60	E9
VSS_395	AF28	VSS_61	E10
VSS_396	AF29	VSS_62	E12
VSS_397	AF30	DDR_CH1_DQ13_C	E13
VSS_398	AF31	VSS_63	E16
VSS_399	AF32	DDR_CH1_DM0_C	E17
VSS_400	AF33	VSS_64	E18
VSS_401	AF34	VSS_65	E19
RESERVED	AF35	DDR_CH1_DQ1_C	E20
VCCIO5_1V8	AF36	VSS_66	E21
VSS_402	AF37	VSS_67	E23
VSS_403	AF38	VSS_68	E25
VSS_404	AF39	VSS_69	E27
VSS_405	AF40	DDR_CH1_DQ10_D	E29
VSS_406	AF41	VSS_70	E30
DDR_CH0_RESET_A	AG1	VSS_71	E31
DDR_CH0_A5_A	AG2	DDR_CH1_DQ11_D	E32
VSS_407	AG3	VSS_72	E33
VSS_408	AG4	VSS_73	E34
VSS_409	AG5	VSS_74	E37
VSS_410	AG6	VSS_75	E38
VSS_411	AG7	VSS_76	E39
VSS_412	AG8	AVSS_2	E40
VSS_413	AG15	PCIE20_2_TXP/SATA30_2_TXP/USB30_SSTXP	E41
VSS_414	AG16	DDR_CH0_LP4/4X_CKE1/LP5_CS1_B	F1
VSS_415	AG17	VSS_77	F2
VSS_416	AG18	VSS_78	F3
VSS_417	AG19	VSS_79	F4
VSS_418	AG20	VSS_80	F8
VSS_419	AG21	VSS_81	F9
VSS_420	AG22	VSS_82	F10
VSS_421	AG23	VSS_83	F13
VSS_422	AG24	VSS_84	F14
VSS_423	AG25	VSS_85	F15
VSS_424	AG28	VSS_86	F16
VSS_425	AG29	VSS_87	F19
VSS_426	AG31	DDR_CH1_DQ3_C	F20
VSS_427	AG32	VSS_88	F21
VSS_428	AG33	VSS_89	F23
VSS_429	AG34	VSS_90	F29
VSS_430	AG35	VSS_91	F31
PMIC_SLEEP4/GPIO0_C2_d	AG36	VSS_92	F33
LITCPU_AVS/SPI3_CLK_M2/GPIO0_D3_u	AG37	VSS_93	F34
I2S1_SDI0_M1/GPU_AVS/UART0_TX_M0/I2C4_SCL_M2/PWM4_M0/GPIO0_C5_u	AG38	VSS_94	F35
I2S1_SDI3_M1/PDM0_SDI1_M1/I2C6_SCL_M0/UART1_CTSN_M2/PWM7_IR_M0/SPI3_MISO_M2/GPIO0_D0_d	AG39	VSS_95	F36
VSS_431	AG40	MIPI_CAMERA2_CLK_M0/SPDIF1_TX_M0/SATA2_ACT_LED_M1/I2C5_SDA_M3/UART1_RX_M1/PWM13_M2/GPIO1_B7_u	F37
I2S1_SDO1_M1/I2C0_SDA_M2/UART1_RX_M2/SPI3_MOSI_M2/GPIO0_D2_u	AG41	VSS_96	F38
PMIC_SLEEP6/PDM0_SDI3_M1/GPIO0_D6_d	AG42	VSS_97	F39
VSS_432	AH2	AVSS_3	F40
VSS_433	AH3	PCIE20_2_REFCLKP	F41

Pin Name	Pin	Pin Name	Pin
VSS_435	AH5	PCIE20_2_REFCLKN	F42
VSS_436	AH7	DDR_CH0_DM1_B	G2
VSS_437	AH8	VSS_98	G3
VSS_438	AH9	DDR_CH0_DQ10_B	G4
VSS_439	AH10	DDR_CH0_DQ8_B	G5
VDD_LOGIC_7	AH11	VSS_99	G6
VDD_LOGIC_8	AH12	VSS_100	G8
VDD_LOGIC_9	AH13	VSS_101	G9
VDD_LOGIC_10	AH14	VSS_102	G10
VDD_LOGIC_11	AH15	VSS_103	G12
VSS_440	AH16	VSS_104	G20
VSS_441	AH17	VSS_105	G21
VDD_GPU_1	AH18	VSS_106	G22
VDD_GPU_2	AH19	DDR_CH1_VDDQ_CKE	G24
VDD_GPU_3	AH20	VSS_107	G25
VDD_GPU_4	AH21	VSS_108	G26
VDD_LOGIC_12	AH23	VCCIO4_1V8_1	G27
VDD_LOGIC_13	AH24	VCCIO4_1V8_2	G28
VDD_NPU_MEM_1	AH25	VSS_109	G29
VDD_NPU_MEM_2	AH26	VCCIO4	G31
VSS_442	AH28	PCIE20_SATA30_0_AVDD_1V8	G34
VSS_443	AH29	AVSS_4	G36
VSS_444	AH36	SPI2_MISO_M0/GPIO1_A4_d	G37
TSADC_TEST_OUT_TS	AH37	MIPI_CAMERA4_CLK_M0/I2C8_SDA_M2/UART1_CTSN_M1/PWM15_IR_M3/GPIO1_D7_u	G38
PMIC_SLEEP5/GPIO0_C3_d	AH38	PDM1_SDI2_M1/SPI0_MISO_M2/GPIO1_B1_d	G39
I2S1_MCLK_M1/JTAG_TCK_M2/I2C1_SCL_M0/UART2_TX_M0/PCIE20X1_1_CLKREQN_M0/GPIO0_B5_d	AH39	PCIE20X1_1_CLKREQN_M2/DP0_HPDIN_M2/I2C2_SDA_M4/UART6_RX_M1/SPI4_MISO_M2/GPIO1_A0_d	G40
VSS_434	AH4	AVSS_5	G41
I2S1_SCLK_TX_M1/JTAG_TMS_M2/I2C1_SDA_M0/UART2_RX_M0/PCIE20X1_1_WAKEN_M0/GPIO0_B6_d	AH40	DDR_CH0_A6_B	H1
I2S1_SDO0_M1/CPU_BIG0_AVS/I2C0_SCL_M2/UART0_CTSN/UART1_TX_M2/SPI0_CS0_M0/HDMI_TX0_CEC_M1/GPIO0_D1_u	AH41	DDR_CH0_LP4/4X_CKE0/LP5_CS0_B	H2
I2S1_SDI1_M1/NPU_AVS/UART0_RTSN/PWM5_M1/SPI0_CLK_M0/SATA_CP_POD/GPIO0_C6_u	AH42	VSS_110	H3
DDR_CH0_DQ2_A	AJ1	VSS_111	H4
DDR_CH0_DQ0_A	AJ2	VSS_112	H5
DDR_CH0_DQ12_A	AJ3	VSS_113	H6
VSS_445	AJ5	VSS_114	H11
DDR_CH0_DQ11_A	AJ6	VSS_115	H12
VSS_446	AJ7	DDR_CH1_VDDQ_1	H14
VSS_447	AJ8	DDR_CH1_VDDQ_2	H15
VSS_448	AJ9	DDR_CH1_VDDQ_3	H16
VSS_449	AJ10	DDR_CH1_VDDQ_4	H18
VSS_450	AJ11	DDR_CH1_VDDQ_5	H20
VSS_451	AJ12	VSS_116	H22
VDD_LOGIC_14	AJ15	DDR_CH1_VDDQ_CK	H24
VSS_452	AJ16	VSS_117	H25
VDD_GPU_MEM_1	AJ18	VDD_LOGIC_1	H27
VDD_GPU_5	AJ19	VSS_118	H29
VDD_GPU_6	AJ20	VCCIO1_1V8	H31
VDD_GPU_7	AJ21	PCIE20_SATA30_USB30_2_AVDD_1V8	H34
VDD_NPU_MEM_3	AJ25	PCIE20_SATA30_0_AVDD_0V85	H36
VSS_453	AJ26	AVSS_6	H37
VSS_454	AJ27	PDM1_SDI0_M1/PCIE20X1_1_PERSTN_M2/PWM3_IR_M3/SPI2_CS0_M0/GPIO1_A7_u	H38
VSS_455	AJ28	PDM1_SDI1_M1/SPI2_CS1_M0/GPIO1_B0_u	H39
VSS_456	AJ29	AVSS_7	H40
VSS_457	AJ30	PCIE20_0_TXP/SATA30_0_TXP	H41
VDD_LOGIC_15	AJ31	PCIE20_0_TXN/SATA30_0_TXN	H42
VDD_LOGIC_16	AJ32	DDR_CH0_LP4/4X_CS0_B	J1
VCCIO6_1V8	AJ34	VSS_119	J2
VSS_458	AJ35	DDR_CH0_DQ9_B	J3
PMU_0V75_1	AJ36	DDR_CH0_DQ11_B	J4
PMU_0V75_2	AJ37	DDR_CH0_DQ14_B	J5
VSS_459	AJ38	VSS_120	J6
VSS_460	AJ39	VSS_121	J7
VSS_461	AJ40	VSS_122	J8
VSS_462	AJ41	VSS_123	J9
DDR_CH0_LP4/4X_CKE0/LP5_CS0_A	AK1	VSS_124	J10
VSS_463	AK2	VSS_125	J12
DDR_CH0_DQ13_A	AK3	VSS_126	J14
DDR_CH0_DM1_A	AK4	VSS_127	J15
DDR_CH0_DQ8_A	AK5	VSS_128	J16
VSS_464	AK6	DDR_CH1_VDD_1	J18
VSS_465	AK7	DDR_CH1_VDD_MIF_1	J20
NC	AK9	VSS_129	J22
VCCIO2	AK10	VSS_130	J24
VCCIO2_1V8	AK11	VSS_131	J26
HDMI/eDP_TX0_VDD_IO_1V8	AK12	VDD_LOGIC_2	J27
VDD_LOGIC_17	AK15	VSS_132	J29
VSS_466	AK16	VSS_133	J30
VDD_GPU_MEM_2	AK18	VSS_134	J31
VDD_GPU_8	AK21	PCIE20_SATA30_USB30_2_AVDD_0V85	J36
VSS_467	AK22	AVSS_8	J38
VDD_NPU_MEM_4	AK25	AVSS_9	J39
VSS_468	AK26	AVSS_10	J40

Pin Name	Pin	Pin Name	Pin
VDD_NPU_1	AK27	PCIE20_0_RXN/SATA30_0_RXN	J41
VDD_NPU_2	AK28	PCIE20_0_RXP/SATA30_0_RXP	J42
VDD_NPU_3	AK29	DDR_CH0_DQS1P_B	K1
VSS_469	AK30	DDR_CH0_DQS1N_B	K2
I2S1_LRCK_TX_M1/PWM0_M0/I2C2_SCL_M0/SPI0_CS1_M0/PCIE20X1_1_PERSTN_M0/GPIO0_B7_d	AK39	VSS_135	K3
VSS_470	AK40	VSS_136	K6
MIPI_CSI1_D1P	AK41	VSS_137	K7
MIPI_CSI1_D1N	AK42	DDR_CH0_VDDQ_CK_1	K9
DDR_CH0_A3_A	AL2	VSS_138	K10
VSS_471	AL3	VSS_139	K11
VSS_472	AL4	VSS_140	K12
VSS_473	AL5	VSS_141	K14
HDMI/eDP_TX0_VDD_CMN_1V8	AL14	VSS_142	K17
AVSS_24	AL15	DDR_CH1_VDD_2	K18
VSS_474	AL16	DDR_CH1_VDD_MIF_2	K20
VDD_GPU_MEM_3	AL18	VSS_143	K22
VDD_GPU_9	AL21	VSS_144	K23
VSS_475	AL22	VSS_145	K25
VDD_NPU_4	AL28	VSS_146	K26
VDD_NPU_5	AL29	VDD_CPU_BIG0_MEM_1	K27
VDD_NPU_6	AL30	VDD_CPU_BIG0_MEM_2	K28
VDD_LOGIC_18	AL31	VDD_CPU_BIG0_MEM_3	K29
VCCIO6_1	AL33	VDD_CPU_BIG0_MEM_4	K30
VSS_476	AL35	VSS_147	K31
I2S1_LRCK_RX_M1/PDM0_CLK1_M1/PWM2_M0/UART0_RX_M0/I2C4_SDA_M2/DP0_HPDIN_M1/GPIO0_C4_d	AL38	VSS_148	K32
I2S1_SDO2_M1/PDM0_SDI2_M1/PWM3_IR_M0/I2C1_SCL_M2/HDMI_TX0_SDA_M1/SPI3_CS0_M2/SATA_CPDET/GPIO0_D4_u	AL39	VSS_149	K33
I2S1_SDI2_M1/PDM0_SDI0_M1/I2C6_SDA_M0/UART1_RTSN_M2/PWM6_M0/SPI0_MISO_M0/GPIO0_C7_d	AL40	AVSS_11	K34
MIPI_CSI1_D0N	AL41	AVSS_12	K35
MIPI_CSI1_D0P	AL42	AVSS_13	K36
DDR_CH0_ZQ_A	AM1	AVSS_14	K37
DDR_CH0_A6_A	AM2	AVSS_15	K38
VSS_477	AM4	AVSS_16	K39
VSS_478	AM5	AVSS_17	K40
HDMI/eDP_TX0_VDD_0V75_1	AM13	PCIE20_0_REFCLKN	K41
AVSS_25	AM14	DDR_CH0_A5_B	L1
AVSS_26	AM15	VSS_150	L2
VSS_479	AM16	VSS_151	L3
VSS_480	AM17	VSS_152	L5
VDD_GPU_10	AM21	VSS_153	L6
VDD_GPU_11	AM22	DDR_CH0_VDDQ_CK_2	L9
VSS_481	AM23	VSS_154	L10
VSS_482	AM25	VSS_155	L11
VSS_483	AM27	VSS_156	L12
VDD_NPU_7	AM30	VSS_157	L14
VSS_484	AM31	DDR_CH1_PLL_AVDD1V8	L15
VSS_485	AM32	DDR_CH1_VDD_3	L18
VCCIO6_2	AM33	DDR_CH1_VDD_MIF_3	L20
MIPI_CSI0_AVCC1V8	AM35	VSS_158	L22
MIPI_CSI0_AVCC0V75	AM37	VSS_159	L23
PMIC_SLEEP3/GPIO0_C1_d	AM38	VSS_160	L24
I2S1_SDO3_M1/CPU_BIG1_AVS/I2C1_SDA_M2/HDMI_TX0_SCL_M1/SPI3_CS1_M2/SATA_MP_SWITCH/GPIO0_D5_u	AM39	VSS_161	L32
I2S1_SCLK_RX_M1/PDM0_CLK0_M1/PWM1_M0/I2C2_SDA_M0/ SPI0_MOSI_M0/GPIO0_C0_d	AM40	VSS_162	L33
VSS_486	AM41	AVSS_18	L34
DDR_CH0_DQS0P_A	AN1	AVSS_19	L35
DDR_CH0_DQS0N_A	AN2	VSS_163	L36
VSS_487	AN3	MIPI_CAMERA3_CLK_M0/I2C8_SCL_M2/UART1_RTSN_M1/PWM14_M2/GPIO1_D6_u	L37
DDR_CH0_DQ10_A	AN4	MIPI_CAMERA1_CLK_M0/SPDIF0_TX_M0/I2C5_SCL_M3/UART1_TX_M1/GPIO1_B6_u	L38
DDR_CH0_DQ9_A	AN5	I2C4_SCL_M3/UART6_CTSN_M1/PWM1_M2/SPI4_CS0_M2/GPIO1_A3_d	L39
VSS_488	AN6	PCIE20X1_1_WAKEN_M2/I2C2_SCL_M4/UART6_TX_M1/SPI4_MOSI_M2/GPIO1_A1_d	L40
VSS_489	AN7	AVSS_20	L41
OTP_VDDOTP_0V75	AN8	PCIE20_0_REFCLKP	L42
HDMI/eDP_TX0_AVDD_0V75	AN10	DDR_CH0_LP4/4X_CS1_B	M1
AVSS_27	AN11	VSS_164	M2
HDMI/eDP_TX0_VDD_0V75_2	AN12	VSS_165	M5
AVSS_28	AN13	DDR_CH0_VDDQ_CKE_1	M6
AVSS_29	AN14	DDR_CH0_VDDQ_CKE_2	M7
AVSS_30	AN15	VSS_166	M8
VSS_490	AN17	VSS_167	M9
AVSS_31	AN18	VSS_168	M10
VDD_GPU_12	AN21	VSS_169	M12
VDD_GPU_13	AN22	VSS_170	M14
VSS_491	AN23	DDR_CH1_PLL_DVDD	M16
VSS_492	AN25	VSS_171	M17
VDD_NPU_8	AN30	VSS_172	M19
VSS_493	AN31	VSS_173	M21
VSS_494	AN32	VSS_174	M22
VSS_495	AN33	VSS_175	M23

Pin Name	Pin	Pin Name	Pin
VSS_496	AN34	VDD_CPU_BIG0_1	M24
VSS_497	AN35	VDD_CPU_BIG0_2	M25
MIPI_CSI0_CLK1P	AN37	VDD_CPU_BIG0_3	M28
MIPI_CSI0_CLK1N	AN38	VDD_CPU_BIG0_4	M29
VSS_500	AN39	VDD_CPU_BIG0_5	M30
VSS_501	AN40	AVSS_21	M33
MIPI_CSI1_CLK0N	AN41	AVSS_22	M34
MIPI_CSI1_CLK0P	AN42	VSS_176	M35
VSS_502	AP2	VSS_177	M36
VSS_503	AP5	PDM1_CLK1_M1/SATA0_ACT_LED_M1/UART4_TX_M2/SPI0_CLK_M2/GPIO1_B3_d	M37
VSS_504	AP6	PDM1_SDI3_M1/UART4_RX_M2/SPI0_MOSI_M2/GPIO1_B2_d	M38
AVSS_32	AP7	PDM1_CLK0_M1/UART7_RX_M2/SPI0_CS0_M2/GPIO1_B4_u	M39
AVSS_33	AP8	HDMI_TX0_HPD_M0/SPI2_MOSI_M0/GPIO1_A5_d	M40
AVSS_34	AP9	I2S0_LRCK_RX/PDM0_CLK0_M0/I2C4_SDA_M4/PWM15_IR_M2/GPIO1_C6_d	M41
AVSS_35	AP10	I2S0_SCLK_TX/I2C6_SCL_M1/UART3_CTSN/PWM7_IR_M2/SPI4_CS0_M0/GPIO1_C3_d	M42
AVSS_36	AP11	DDR_CH0_DQ2_B	N1
AVSS_37	AP16	DDR_CH0_DQ13_B	N2
TYPEC0_DP0_VDDA_0V85_1	AP18	VSS_178	N3
AVSS_38	AP22	DDR_CH0_DQ12_B	N5
SARADC_AVDD_1V8	AP23	DDR_CH0_DQ15_B	N6
VSS_505	AP25	VSS_179	N7
VSS_506	AP27	VSS_180	N9
VDD_NPU_9	AP30	VSS_181	N11
AVSS_39	AP31	VSS_182	N12
AVSS_40	AP32	DDR_CH1_PLL_AVSS	N15
VSS_507	AP33	VSS_183	N16
VSS_508	AP34	VSS_184	N17
VSS_509	AP35	VSS_185	N18
VSS_510	AP37	VSS_186	N21
VSS_511	AP38	VSS_187	N22
VSS_512	AP39	VDD_CPU_BIG0_6	N24
VSS_513	AP40	VDD_CPU_BIG0_7	N25
MIPI_CSI1_D3N	AP41	AVSS_23	N33
MIPI_CSI1_D3P	AP42	VSS_188	N34
SDMMC_CLK/PDM1_CLK0_M0/TEST_CLKOUT_M0/MCU_JTAG_TMS_M0/ UART5_TX_M0/GPIO4_D5_d	AR1	OSC_1V8_1	N35
SDMMC_D1/PDM1_SDI2_M0/JTAG_TMS_M1/I2C3_SDA_M4/UART2_RX_M1/PWM9_M1/GPIO4_D1_u	AR2	OSC_1V8_2	N36
VSS_514	AR3	PMUIO1_1V8_1	N37
VSS_515	AR4	VSS_189	N38
DDR_CH0_WCK0N_A	AR5	VSS_190	N39
DDR_CH0_WCK0P_A	AR6	VSS_191	N40
AVSS_41	AR9	I2C3_SCL_M0/UART3_TX_M0/SPI4_MOSI_M0/GPIO1_C1_z	N41
AVSS_42	AR16	I2S0_SDI0/GPIO1_D4_d	N42
AVSS_43	AR18	DDR_CH0_RESET_B	P1
TYPEC0_DP0_VDDA_0V85_2	AR19	VSS_192	P2
AVSS_44	AR20	DDR_CH0_DQ5_B	P3
AVSS_45	AR21	DDR_CH0_DQ4_B	P4
AVSS_46	AR22	DDR_CH0_DQ7_B	P5
TYPEC0_DP0_VDDH_1V8	AR23	VSS_193	P6
AVSS_47	AR25	VSS_194	P7
MIPI_D/C_PHY1_VDD	AR27	VSS_195	P8
MIPI_D/C_PHY1_VDD_1V8_1	AR30	VSS_196	P9
MIPI_D/C_PHY0_VDD	AR33	DDR_CH0_VDDQ_1	P10
MIPI_D/C_PHY1_VDD_1V2_1	AR34	VSS_197	P12
MIPI_D/C_PHY0_VDD_1V2_2	AR35	VDD_VDENC_1	P15
GMAC1_PPSTRIG/I2C3_SDA_M1/UART7_TX_M1/SPI1_MISO_M1/GPIO3_C0_d	AR36	VSS_198	P16
GMAC1_TXD3/SDIO_D1_M1/I2S3_SCLK/AUDDSM_LN/FSPI_D2_M2/I2C6_SCL_M4/PWM11_IR_M0/SPI4_MOSI_M1/GPIO3_A1_u	AR37	VSS_199	P17
GMAC1_TXD2/SDIO_D0_M1/I2S3_MCLK/FSPI_D0_M2/I2C6_SDA_M4/PWM10_M0/SPI4_MISO_M1/GPIO3_A0_u	AR38	VSS_200	P18
GMAC1_RXD1/I2S2_SCLK_RX_M1/MIPI_CAMERA3_CLK_M1/PWM9_M0/GPIO3_B0_u	AR39	VSS_201	P19
VSS_516	AR40	VDD_CPU_BIG0_8	P23
VSS_517	AR41	VSS_202	P25
SDMMC_D3/PDM1_SDI0_M0/JTAG_TMS_M0/I2C8_SDA_M0/UART5_RTSN_M0/PWM10_M1/GPIO4_D3_u	AT1	VSS_203	P26
VSS_518	AT2	VSS_204	P27
DDR_CH0_WCK1N_A	AT3	VSS_205	P28
DDR_CH0_WCK1P_A	AT4	VSS_206	P29
VSS_519	AT5	VSS_207	P30
VSS_520	AT6	VSS_208	P31
AVSS_48	AT7	VSS_209	P32
AVSS_49	AT8	VSS_210	P33
USB20_AVDD_3V3	AT10	VSS_211	P34
USB20_DVDD_0V75_1	AT11	PDM0_SDI0_M0/SPI1_CS1_M2/GPIO1_D5_d	P38
USB20_DVDD_0V75_2	AT12	I2S0_LRCK_TX/I2C2_SCL_M3/UART4_RTSN/GPIO1_C5_d	P39
USB20_AVDD_1V8_1	AT13	I2S0_SDO3/I2S0_SDI2/PDM0_SDI2_M0/I2C1_SCL_M4/UART4_TX_M0/PWM0_M1/SPI1_CLK_M2/GPIO1_D2_d	P40

Pin Name	Pin	Pin Name	Pin
USB20_AVDD_1V8_2	AT14	I2S0_SDO0/I2C4_SCL_M4/UART4_CTSN/GPIO1_C7_d	P41
CIF_HREF/BT1120_D8/I2S1_SDO1_M0/PCIE20X1_1_BUTTON_RSTN/I2C7_SCL_M3/UART8_RTSN_M0/PWM14_M1/SPI0_CS0_M1/ GPIO4_B2_u	AT15	DDR_CH0_A2_B	R1
AVSS_50	AT16	DDR_CH0_A1_B	R2
TYPEC0_DP0_VDD_0V85	AT18	VSS_212	R3
AVSS_51	AT19	VSS_213	R4
AVSS_52	AT20	VSS_214	R8
AVSS_53	AT21	DDR_CH0_VDDQ_2	R10
AVSS_54	AT22	VDD_VDENC_2	R15
AVSS_55	AT23	VSS_215	R16
MIPI_D/C_PHY1_VREG	AT27	VSS_216	R20
AVSS_56	AT29	VSS_217	R21
MIPI_D/C_PHY0_VDD_1V8_2	AT30	VDD_CPU_BIG0_9	R23
MIPI_D/C_PHY0_VREG	AT33	VDD_CPU_BIG0_10	R24
VSS_521	AT36	VSS_218	R25
GMAC1_RXD0/MIPI_CAMERA2_CLK_M1/PWM8_M0/GPIO3_A7_u	AT37	VDD_CPU_BIG1_1	R26
GMAC1_RXD2/SDIO_D2_M1/I2S3_LRCK/AUDDSM_LP/FSPI_D2_M2/UART8_TX_M1/SPI4_CLK_M1/GPIO3_A2_u	AT38	VDD_CPU_BIG1_2	R27
GMAC1_TXCLK/SDIO_CMD_M1/I2S3_SDI/AUDDSM_RP/UART8_RTSN_M1/SPI4_CS1_M1/GPIO3_A4_d	AT39	VDD_CPU_BIG1_3	R28
GMAC1_RXD3/SDIO_D3_M1/I2S3_SDO/AUDDSM_RN/FSPI_D3_M2/UART8_RX_M1/SPI4_CS0_M1/GPIO3_A3_u	AT40	VDD_CPU_BIG1_4	R29
MIPI_CSI1_D2P	AT41	VDD_CPU_BIG1_5	R30
MIPI_CSI1_D2N	AT42	VDD_CPU_BIG1_6	R31
SDMMC_CMD/PDM1_CLK1_M0/MCU_JTAG_TCK_M0/UART5_RX_M0/PWM7_IR_M1/GPIO4_D4_u	AU1	VDD_CPU_BIG1_7	R32
VSS_522	AU2	VDD_CPU_BIG1_8	R33
VSS_523	AU3	VSS_219	R35
VSS_524	AU4	PMUIO1_1V8_2	R36
USB20_HOST1_REXT	AU6	I2C3_SDA_M0/UART3_RX_M0/SPI4_MISO_M0/GPIO1_C0_z	R38
TYPEC0_USB20_OTG0_REXT	AU7	I2S0_SDI1/PDM0_SDI3_M0/I2C1_SDA_M4/UART4_RX_M0/PWM1_M1/SPI1_CS0_M2/GPIO1_D3_d	R39
AVSS_57	AU8	VSS_220	T2
CIF_D5/BT1120_D5/I2S1_SDI0_M0/I2C3_SDA_M2/UART3_TX_M2/SPI2_MOSI_M1/GPIO4_A5_d	AU15	VSS_221	T3
AVSS_58	AU16	VSS_222	T4
AVSS_59	AU18	DDR_CH0_VDDQ_3	T10
AVSS_60	AU19	DDR_CH0_VDD_1	T12
AVSS_61	AU21	DDR_CH0_VDD_2	T13
MIPI_CAMERA0_CLK_M0/SPDIF1_TX_M1/I2S1_SDO0_M0/SATA2_ACT_LED_M0/I2C6_SCL_M3/UART8_RX_M0/SPI0_CS1_M1/GPIO4_B1_u	AU22	VDD_VDENC_3	T15
BT1120_D11/UART9_RX_M1/PWM12_M1/SPI3_MISO_M1/GPIO4_B5_d	AU23	VSS_224	T16
AVSS_62	AU24	VSS_225	T17
AVSS_63	AU25	VSS_226	T18
AVSS_64	AU27	VSS_227	T20
AVSS_65	AU28	VSS_228	T21
AVSS_66	AU29	VSS_229	T24
CIF_D11/PCIE20X1_2_CLKREQN_M0/HDMI_TX0_SCL_M2/I2C5_SCL_M0/SPI3_MOSI_M3/GPIO3_C7_u	AU30	VSS_230	T25
AVSS_67	AU31	VDD_CPU_BIG1_9	T26
CIF_D8/FSPI_CS0N_M2/UART5_TX_M1/SPI3_CS0_M3/GPIO3_C4_u	AU34	VSS_231	T35
VSS_525	AU35	VSS_232	T36
VSS_526	AU38	VSS_233	T37
VSS_527	AU39	VSS_234	T38
VSS_528	AU40	VSS_235	T39
MIPI_CSI1_CLK1P	AU41	VSS_236	T40
MIPI_CSI1_CLK1N	AU42	XIN_24M	T41
SDMMC_D2/PDM1_SDI1_M0/JTAG_TCK_M0/I2C8_SCL_M0/UART5_CTSN_M0/GPIO4_D2_u	AV1	XOUT_24M	T42
SDMMC_D0/PDM1_SDI3_M0/JTAG_TCK_M1/I2C3_SCL_M4/UART2_TX_M1/PWM8_M1/GPIO4_D0_u	AV2	VSS_223	T7
DDR_CH0_DQS1N_A	AV3	DDR_CH0_A0_A	U1
DDR_CH0_DQS1P_A	AV4	DDR_CH0_A0_B	U2
VSS_529	AV5	DDR_CH0_DQ0_B	U3
USB20_HOST0_DM	AV6	DDR_CH0_DQ6_B	U4
USB20_HOST1_DP	AV7	DDR_CH0_DQ3_B	U5
AVSS_68	AV8	VSS_237	U6
AVSS_69	AV9	VSS_238	U7
TYPEC0_USB20_VBUSDET	AV10	VSS_239	U8
SARADC_IN2	AV11	DDR_CH0_VDD_3	U12
AVSS_70	AV12	DDR_CH0_VDD_4	U13
SARADC_IN3	AV13	VDD_VDENC_4	U15
AVSS_71	AV14	VSS_240	U16
AVSS_72	AV15	VSS_241	U17
AVSS_73	AV16	VSS_242	U18
CIF_D6/BT1120_D6/I2S1_SDI1_M0/I2C5_SCL_M2/UART3_RX_M2/SPI2_CLK_M1/GPIO4_A6_d	AV18	VSS_243	U20
CIF_D0/BT1120_D0/I2S1_MCLK_M0/PCIE20X1_1_CLKREQN_M1/UART9_RTSN_M1/SPI0_MISO_M1/GPIO4_A0_d	AV19	VSS_244	U21
AVSS_74	AV21	VSS_245	U22
BT1120_D13/PCIE20X1_2_CLKREQN_M1/HDMI_TX0_SCL_M0/I2C5_SDA_M1/SPI3_CLK_M1/GPIO4_B7_u	AV22	VSS_246	U23

Pin Name	Pin	Pin Name	Pin
CIF_VSYNC/BT1120_D9/I2S1_SDO2_M0/PCIE20X1_2_BUTTON_RSTN/I2C7_SDA_M3/UART8_CTSN_M0/PWM15_IR_M1/GPIO4_B3_u	AV23	VSS_247	U24
AVSS_75	AV25	VSS_248	U25
CIF_D2/BT1120_D2/I2S1_LRCK_TX_M0/PCIE20X1_1_PERSTN_M1/SPI0_CLK_M1/GPIO4_A2_d	AV26	VDD_CPU_BIG1_10	U26
CIF_CLKOUT/BT1120_D10/I2S1_SDO3_M0/DP0_HPDIN_M0/SPDIF0_TX_M1/UART9_TX_M1/PWM11_IR_M1/GPIO4_B4_u	AV27	I2S0_SCLK_RX/PDM0_CLK1_M0/I2C2_SDA_M3/PWM11_IR_M2/SPI4_CS1_M0/GPIO1_C4_d	U35
AVSS_76	AV29	I2S0_MCLK/I2C6_SDA_M1/UART3_RTSN/PWM3_IR_M2/SPI4_CLK_M0/GPIO1_C2_d	U36
CIF_D10/SPI3_MISO_M3/GPIO3_C6_u	AV30	I2S0_SDO1/I2C7_SCL_M0/UART6_TX_M2/SPI1_MISO_M2/GPIO1_D0_d	U37
HDMI_TX0_HPD_M1/MCU_JTAG_TCK_M1/UART9_RX_M2/SPI0_CS0_M3/GPIO3_D4_d	AV31	I2S0_SDO2/I2S0_SDI3/PDM0_SDI1_M0/I2C7_SDA_M0/UART6_RX_M2/SPI1_MOSI_M2/GPIO1_D1_d	U38
AVSS_77	AV32	VSS_249	U39
AVSS_78	AV33	VSS_250	U40
CIF_D9/FSPI_CS1N_M2/UART5_RX_M1/SPI3_CS1_M3/GPIO3_C5_u	AV34	VSS_251	U41
GMAC1_TXD1/I2S2_MCLK_M1/UART2_CTSN/GPIO3_B4_u	AV35	DDR_CH0_CKB_B	V1
VSS_530	AV36	DDR_CH0_CK_B	V2
ETH1_REFCLKO_25M/MIPI_CAMERA1_CLK_M1/I2C4_SCL_M0/GPIO3_A6_d	AV37	VSS_252	V3
GMAC1_RXCLK/SDIO_CLK_M1/MIPI_CAMERA0_CLK_M1/FSPI_CLK_M2/I2C4_SDA_M0/UART8_CTSN_M1/GPIO3_A5_d	AV38	DDR_CH0_DM0_B	V5
GMAC1_RXDV_CRS/I2S2_LRCK_RX_M1/MIPI_CAMERA4_CLK_M1/UART2_TX_M2/PWM2_M1/GPIO3_B1_d	AV39	VSS_253	V6
GMAC1_MDC/MIPI_TE0/I2C8_SCL_M4/UART7_RTSN_M1/PWM14_M0/SPI1_CS0_M1/GPIO3_C2_d	AV40	VSS_254	V7
VSS_531	AV41	VSS_255	V8
VSS_532	AW3	DDR_CH0_VDDQ_4	V10
VSS_533	AW4	DDR_CH0_VDD_MIF_1	V12
USB20_HOST0_REXT	AW5	DDR_CH0_VDD_MIF_2	V13
USB20_HOST0_DP	AW6	DDR_CH0_VDD_MIF_3	V14
USB20_HOST1_DM	AW7	VSS_256	V16
AVSS_79	AW8	VSS_257	V17
AVSS_80	AW9	VSS_258	V19
TYPEC0_USB20_OTG_ID	AW10	VSS_259	V23
TYPEC0_DP0_REXT	AW11	VSS_260	V24
AVSS_81	AW12	VSS_261	V25
SARADC_IN5	AW13	VDD_CPU_BIG1_MEM_1	V26
AVSS_82	AW14	VDD_CPU_BIG1_MEM_2	V27
SARADC_IN0_BOOT	AW15	VDD_CPU_BIG1_MEM_3	V28
AVSS_83	AW16	VDD_CPU_BIG1_MEM_4	V29
AVSS_84	AW17	VSS_262	V30
CIF_D1/BT1120_D1/I2S1_SCLK_TX_M0/PCIE20X1_1_WAKEN_M1/UART9_CTSN_M1/SPI0_MOSI_M1/GPIO4_A1_d	AW18	VSS_263	V31
CIF_D4/BT1120_D4/I2S1_LRCK_RX_M0/I2C3_SCL_M2/UART0_RX_M2/SPI2_MISO_M1/GPIO4_A4_d	AW19	VSS_264	V32
AVSS_85	AW21	VSS_265	V33
BT1120_D12/SATA0_ACT_LED_M0/I2C5_SCL_M1/PWM13_M1/SPI3_MOSI_M1/GPIO4_B6_d	AW22	VSS_266	V34
BT1120_D14/PCIE20X1_2_WAKEN_M1/HDMI_TX0_SDA_M0/I2C8_SCL_M3/SPI3_CS0_M1/GPIO4_C0_u	AW23	PMUIO2_1	V35
AVSS_86	AW25	PMUIO2_2	V36
CIF_D7/BT1120_D7/I2S1_SDI2_M0/I2C5_SDA_M2/SPI2_CS0_M1/GPIO4_A7_d	AW26	PMUIO2_1V8_1	V37
CIF_CLKIN/BT1120_CLKOUT/I2S1_SDI3_M0/I2C6_SDA_M3/UART8_TX_M0/SPI2_CS1_M1/GPIO4_B0_d	AW27	VSS_267	V38
AVSS_87	AW28	VSS_268	V39
AVSS_88	AW29	VSS_269	V40
MCU_JTAG_TMS_M1/UART9_TX_M2/PWM11_IR_M3/SPI0_CS1_M3/GPIO3_D5_d	AW30	TVSS	V41
CIF_D12/PCIE20X1_2_WAKEN_M0/HDMI_TX0_SDA_M2/I2C5_SDA_M0/UART4_RX_M1/PWM8_M2/SPI3_CLK_M3/GPIO3_D0_u	AW31	NPOR	V42
AVSS_89	AW32	VSS_270	W2
AVSS_90	AW33	VSS_271	W5
GMAC1_TXER/I2S2_SDI_M1/UART2_RX_M2/PWM3_IR_M1/GPIO3_B2_d	AW34	VSS_272	W7
GMAC1_TXD0/I2S2_SDO_M1/UART2_RTSN/GPIO3_B3_u	AW35	VSS_273	W8
AVSS_91	AW36	VSS_274	W9
GMAC1_MCLKINOUT/I2S2_LRCK_TX_M1/UART3_RX_M1/PWM13_M0/GPIO3_B6_d	AW37	DDR_CH0_VDDQ_5	W10
GMAC1_PPSCLK/UART7_RX_M1/SPI1_CLK_M1/GPIO3_C1_d	AW38	VDD_VDENC_5	W16
GMAC1_MDIO/MIPI_TE1/I2C8_SDA_M4/UART7_CTSN_M1/PWM15_IR_M0/SPI1_CS1_M1/GPIO3_C3_d	AW39	VDD_VDENC_MEM_1	W17
AVSS_92	AW40	VSS_275	W18
MIPI_CSI0_D3P	AW41	VSS_276	W19
MIPI_CSI0_D3N	AW42	VSS_277	W22
HDMI_TX0_SBDN/EDP_TX0_AUXN	AY1	VSS_278	W23
AVSS_93	AY2	VSS_279	W24
HDMI/eDP_TX0_REXT	AY3	VSS_280	W26
AVSS_94	AY4	VDD_LOGIC_3	W33
AVSS_95	AY5	REFCLK_OUT/GPIO0_A0_d	W38
AVSS_96	AY7	SPI2_MOSI_M2/I2C0_SDA_M0/GPIO0_A6_z	W39
AVSS_97	AY8	SPI2_CS0_M2/I2C1_SDA_M1/PWM5_M0/UART0_TX_M1/GPIO0_B1_z	W40
TYPEC0_USB20_OTG_DM	AY10	PMIC_SLEEP1/GPIO0_A2_d	W41
TYPEC0_USB20_OTG_DP	AY11	PMIC_INT_L/GPIO0_A7_u	W42

Pin Name	Pin	Pin Name	Pin
AVSS_99	AY12	DDR_CH0_A4_A	Y1
SARADC_IN1	AY13	DDR_CH0_LP4/4X_CS0_A	Y2
AVSS_100	AY14	VSS_281	Y3
SARADC_IN4	AY15	VSS_282	Y4
AVSS_101	AY16	VSS_283	Y5
AVSS_102	AY17	VSS_284	Y6
AVSS_103	AY18	DDR_CH0_VDDQ_6	Y10
CIF_D3/BT1120_D3/I2S1_SCLK_RX_M0/UART0_TX_M2/GPIO4_A3_d	AY19	VSS_285	Y11
AVSS_104	AY21	DDR_CH0_PLL_AVDD1V8	Y14
AVSS_105	AY22	VDD_VDENC_MEM_2	Y17
AVSS_106	AY23	VSS_286	Y18
AVSS_107	AY25	VSS_287	Y19
BT1120_D15/SPDIF1_TX_M2/PCIE20X1_2_PERSTN_M1/HDMI_TX0_CEC_M0/I2C8_SDA_M3/PWM6_M1/SPI3_CS1_M1/GPIO4_C1_d	AY26	VSS_288	Y22
CIF_D13/PCIE20X1_2_PERSTN_M0/UART4_TX_M1/PWM9_M2/SPI0_MISO_M3/GPIO3_D1_d	AY27	VSS_289	Y23
AVSS_108	AY28	VSS_290	Y24
AVSS_109	AY29	PLL_DVDD0V75	Y26
CIF_D14/I2C7_SCL_M2/UART9_RTSN_M2/SPI0_MOSI_M3/GPIO3_D2_d	AY30	VSS_291	Y28
CIF_D15/I2C7_SDA_M2/UART9_CTSN_M2/PWM10_M2/SPI0_CLK_M3/GPIO3_D3_d	AY31	VSS_292	Y29
AVSS_110	AY32	VSS_293	Y30
AVSS_111	AY33	VSS_294	Y31
GMAC1_PTP_REF_CLK/I2C3_SCL_M1/SPI1_MOSI_M1/GPIO3_B7_d	AY34	VSS_295	Y32
GMAC1_TXEN/I2S2_SCLK_TX_M1/UART3_TX_M1/PWM12_M0/GPIO3_B5_u	AY35	VDD_LOGIC_4	Y33
AVSS_112	AY36	PMUIO2_1V8_2	Y37
AVSS_113	AY37	SPI2_MISO_M2/I2C0_SCL_M0/GPIO0_B3_z	Y38
AVSS_114	AY39	SPI2_CLK_M2/SDMMC_PWREN/PMU_DEBUG/GPIO0_A5_d	Y39
MIPI_CSI0_D1N	AY40	EMMC_D1/FSPI_D1_M0/GPIO2_D1_u	Y40
AVSS_115	AY41	EMMC_D0/FSPI_D0_M0/GPIO2_D0_u	Y41
MIPI_CSI0_D2P	AY42		

Chapter 3 Electrical Specification

3.1 Absolute Ratings

The below table provides the absolute ratings.

Absolute maximum or minimum ratings specify the values beyond which the device may be damaged permanently. Long-term exposure to absolute maximum ratings conditions may affect device reliability.

Table 3-1 Absolute ratings

Parameters	Related Power Group	Min	Max	Unit
Supply voltage for CPU	VDD_CPU_BIG0 VDD_CPU_BIG1 VDD_CPU_LIT	-0.3	1.1	V
Supply voltage for CPU memory	VDD_CPU_BIG0_MEM VDD_CPU_BIG1_MEM VDD_CPU_LIT_MEM	-0.3	1.1	V
Supply voltage for GPU	VDD_GPU	-0.3	1.1	V
Supply voltage for GPU memory	VDD_GPU_MEM	-0.3	1.1	V
Supply voltage for NPU	VDD_NPU	-0.3	1.1	V
Supply voltage for NPU memory	VDD_NPU_MEM	-0.3	1.1	V
Supply voltage for VCODEC	VDD_VDENC	-0.3	0.95	V
Supply voltage for VCODEC memory	VDD_VDENC_MEM	-0.3	0.95	V
Supply voltage for core logic	VDD_LOGIC	-0.3	0.95	V
0.75V supply voltage	PMU_0V75 PLL_DVDD0V75 USB20_DVDD_0V75 HDMI/eDP_TX0_VDD_0V75 HDMI/eDP_TX0_AVDD_0V75 MIPI_CSI0_AVCC0V75 OTP_VDDOTP_0V75	-0.3	0.95	V
0.85V supply voltage	DDR_CH0_VDD DDR_CH0_VDD_MIF DDR_CH0_PLL_DVDD DDR_CH1_VDD DDR_CH1_VDD_MIF DDR_CH1_PLL_DVDD TYPEC0_DP0_VDD_0V85 TYPEC0_DP0_VDDA_0V85 MIPI_D/C_PHY0_VDD MIPI_D/C_PHY1_VDD PCIE20_SATA30_0_AVDD_0V85 PCIE20_SATA30_USB30_2_AVDD_0V85	-0.3	1.00	V
1.2V supply voltage	MIPI_D/C_PHY_VDD_1V2	-0.3	1.35	V
1.8V supply voltage	DDR_CH0_PLL_AVDD1V8 DDR_CH1_PLL_AVDD1V8 PLL_AVDD1V8 USB20_AVDD_1V8 TYPEC0_DP0_VDDH_1V8 HDMI/eDP_TX0_VDD_CMN_1V8 HDMI/eDP_TX0_VDD_IO_1V8 MIPI_CSI0_AVCC1V8 MIPI_D/C_PHY_VDD_1V8 PCIE20_SATA30_0_AVDD_1V8 PCIE20_SATA30_USB30_2_AVDD_1V8 SARADC_AVDD_1V8 OSC_1V8	-0.5	1.98	V
3.3V supply voltage	USB20_AVDD_3V3	-0.5	3.63	V
1.8V only GPIO supply voltage	PMUIO1_1V8 EMMCIO_1V8 VCCIO1_1V8	-0.5	1.98	V
1.8V/3.3V GPIO supply voltage	PMUIO2_1V8 VCCIO2_1V8 VCCIO4_1V8 VCCIO5_1V8 VCCIO6_1V8	-0.5	3.63	V
Supply voltage for DDR IO (LPDDR4/4X 0.6V; LPDDR5 0.5V)	DDR_CH0_VDDQ DDR_CH0_VDDQ_CK DDR_CH1_VDDQ	-0.3	0.7	V

Parameters	Related Power Group	Min	Max	Unit
	DDR_CH1_VDDQ_CK			
Supply voltage for DDR IO (LPDDR4/4X 1.1V; LPDDR5 1.05V)	DDR_CH0_VDDQ_CKE DDR_CH1_VDDQ_CKE	-0.3	1.25	V
Storage Temperature	Tstg	-40	125	℃
Max Conjunction Temperature	Tj	NA	125	℃

3.2 Recommended Operating Conditions

The following table describes the recommended operating conditions.

Table 3-2 Recommended operating conditions

Parameters	Symbol	Min	Typ	Max	Unit
Voltage for CPU BigCore 0	VDD_CPU_BIG0	0.55	0.75	1.05	V
Voltage for CPU BigCore 0 Memory	VDD_CPU_BIG0_MEM	0.675	0.75	1.05	V
Voltage for CPU BigCore 1	VDD_CPU_BIG1	0.55	0.75	1.05	V
Voltage for CPU BigCore 1 Memory	VDD_CPU_BIG1_MEM	0.675	0.75	1.05	V
Voltage for CPU LitCore and DSU	VDD_CPU_LIT	0.55	0.75	0.95	V
Voltage for CPU LitCore and DSU Memory	VDD_CPU_LIT_MEM	0.675	0.75	0.95	V
Voltage for GPU	VDD_GPU	0.55	0.75	0.95	V
Voltage for GPU Memory	VDD_GPU_MEM	0.675	0.75	0.95	V
Voltage for NPU	VDD_NPU	0.55	0.75	0.95	V
Voltage for NPU Memory	VDD_NPU_MEM	0.675	0.75	0.95	V
Voltage for VCODEC	VDD_VDENC	0.675	0.75	0.825	V
Voltage for VCODEC Memory	VDD_VDENC_MEM	0.675	0.75	0.825	V
Voltage for Logic	VDD_LOGIC	0.675	0.75	0.825	V
Voltage for PMU	PMU_0V75	0.675	0.75	0.825	V
Digital GPIO Power (1.8V only)	PMUIO1_1V8, VCCIO1_1V8	1.65	1.8	1.95	V
Digital GPIO Power (3.3V/1.8V)	PMUIO2_1V8, VCCIO2_1V8, VCCIO4_1V8, VCCIO5_1V8, VCCIO6_1V8	2.7 1.65	3.3 1.8	3.6 1.95	V
eMMC IO Power (1.8V)	EMMCIO_1V8	1.65	1.8	1.95	V
DDR CH0 Logic power(0.85V)	DDR_CH0_VDD, DDR_CH0_VDD_MIF, DDR_CH1_VDD, DDR_CH1_VDD_MIF	0.675	0.85	0.935	V
DDR CH0_PLL power(0.85V)	DDR_CH0_PLL_DVDD, DDR_CH1_PLL_DVDD	0.675	0.75	0.8925	V
DDR CH0_PLL power(1.8V)	DDR_CH0_PLL_AVDD1V8, DDR_CH1_PLL_AVDD1V8	1.62	1.8	1.98	V
LPDDR4 IO VDDQ power	DDR_CH0_VDDQ, DDR_CH0_VDDQ_CK, DDR_CH1_VDDQ, DDR_CH1_VDDQ_CK	0.57	0.6	0.63	V
LPDDR4 Retention IO VDDQ Power	DDR_CH0_VDDQ_CKE, DDR_CH1_VDDQ_CKE	1.045	1.1	1.155	V
LPDDR5 IO VDDQ power	DDR_CH0_VDDQ, DDR_CH0_VDDQ_CK, DDR_CH1_VDDQ, DDR_CH1_VDDQ_CK	0.475	0.5	0.525	V
LPDDR5 Retention IO VDDQ Power	DDR_CH0_VDDQ_CKE, DDR_CH1_VDDQ_CKE	1.0	1.05	1.1	V
PLL Analog Power(0.75V)	PLL_DVDD0V75	0.675	0.75	0.8925	V
PLL Analog Power(1.8V)	PLL_AVDD1V8	1.62	1.8	1.98	V
USB 2.0 Analog Power (0.75V)	USB20_DVDD_0V75	0.6975	0.75	0.825	V
USB 2.0 Analog Power (1.8V)	USB20_AVDD_1V8	1.674	1.8	1.98	V
USB 2.0 Analog Power (3.3V)	USB20_AVDD_3V3	3.069	3.3	3.63	V
USB & DP Analog Power (0.85V)	TYPEC0_DP0_VDD_0V85, TYPEC0_DP0_VDDA_0V85	0.8075	0.85	0.8925	V
USB & DP Analog Power (1.8V)	TYPEC0_DP0_VDDH_1V8	1.71	1.8	1.89	V

Parameters	Symbol	Min	Typ	Max	Unit
Combo PIPE PHY Analog Power(0.9V)	PCIE20_SATA30_0_AVDD_0V85, PCIE20_SATA30_USB30_2_AVDD_0V85	0.8	0.85	0.935	V
Combo PIPE PHY Analog Power(1.8V)	PCIE20_SATA30_0_AVDD_1V8, PCIE20_SATA30_USB30_2_AVDD_1V8	1.62	1.8	1.98	V
MIPI CSI DPHY Analog Power(0.75V)	MIPI_CSI0_AVCC0V75	0.675	0.75	0.825	V
MIPI CSI DPHY Analog Power(1.8V)	MIPI_CSI0_AVCC1V8	1.62	1.8	1.98	V
MIPI DCPHY Analog Power (0.85V)	MIPI_D/C_PHY_VDD, MIPI_D/C_PHY1_VDD	0.7125	0.85	0.8925	V
MIPI DCPHY Analog Power (1.2V)	MIPI_D/C_PHY_VDD_1V2	1.14	1.2	1.26	V
MIPI DCPHY Analog Power (1.8V)	MIPI_D/C_PHY_VDD_1V8	1.71	1.8	1.89	V
HDMI/eDP TX Digital Power (0.75V)	HDMI/eDP_TX0_VDD_0V75	0.675	0.75	0.85	V
HDMI/eDP TX Analog Power (0.75V)	HDMI/eDP_TX0_AVDD_0V75	0.675	0.75	0.85	V
HDMI/eDP TX Analog Power (1.8V)	HDMI/eDP_TX0_VDD_CMN_1V8	1.62	1.8	1.98	V
HDMI/eDP TX Analog Power (1.8V)	HDMI/eDP_TX0_VDD_IO_1V8	1.62	1.8	1.98	V
SARADC Analog Power(1.8V)	SARADC_AVDD_1V8	1.62	1.8	1.98	V
OTP Analog Power(0.75V)	OTP_VDDOTP_0V75	0.675	0.75	0.825	V
OSC Analog Power(1.8V)	OSC_1V8	1.65	1.8	1.95	V
OSC input clock frequency		NA	24	NA	MHz
Max CPU frequency		NA	NA	2.2-2.4	GHz
Max GPU frequency		NA	NA	1000	MHz
Max NPU frequency		NA	NA	1000	MHz
Ambient Operating Temperature	T_A	-20	NA	85	℃

3.3 DC Characteristics

Table 3-3 DC Characteristics

Parameters		Symbol	Min	Typ	Max	Unit
Digital 3.3V/1.8V GPIO @3.3V	Input Low Voltage	V_{IL}	VSS	NA	0.3*VDDO	V
	Input High Voltage	V_{IH}	0.7*VDDO	NA	VDDO	V
	Output Low Voltage	V_{OL}	VSS	NA	0.25*DVDD	V
	Output High Voltage	V_{OH}	0.75*DVDD	NA	DVDD	V
	Pullup Resistor	R_{RPU}	10	NA	100	Kohm
	Pulldown Resistor	R_{RPD}	10	NA	100	Kohm
Digital 3.3V/1.8V GPIO @1.8V	Input Low Voltage	V_{IL}	VSS	NA	0.3*VDDO	V
	Input High Voltage	V_{IH}	0.7*VDDO	NA	VDDO	V
	Output Low Voltage	V_{OL}	VSS	NA	0.25*DVDD	V
	Output High Voltage	V_{OH}	0.75*DVDD	NA	DVDD	V
	Pullup Resistor	R_{RPU}	10	NA	50	Kohm
	Pulldown Resistor	R_{RPD}	10	NA	50	Kohm
Digital 1.8V only GPIO @1.8V	Input Low Voltage	V_{IL}	VSS	NA	0.3*VDDO	V
	Input High Voltage	V_{IH}	0.7*VDDO	NA	VDDO	V
	Output Low Voltage	V_{OL}	VSS	NA	0.25*DVDD	V
	Output High Voltage	V_{OH}	0.75*DVDD	NA	DVDD	V
	Pullup Resistor	R_{RPU}	10	NA	50	Kohm
	Pulldown Resistor	R_{RPD}	10	NA	50	Kohm
eMMC IO @1.8V	Input Low Voltage	V_{IL}	VSS	NA	0.35*DVDD	V
	Input High Voltage	V_{IH}	0.65*DVDD	NA	DVDD	V
	Output Low Voltage	V_{OL}	VSS	NA	0.45	V
	Output High Voltage	V_{OH}	DVDD-0.45	NA	DVDD	V
	Pullup Resistor	R_{RPU}	10	NA	50	Kohm
	Pulldown Resistor	R_{RPD}	10	NA	50	Kohm

Parameters		Symbol	Min	Typ	Max	Unit
DDR IO	Input Low Voltage	V_{IL}	NA	NA	Vref-0.14	V
	Input High Voltage	V_{IH}	Vref+0.14	NA	NA	V
	Output Log Voltage	V_{OL}	NA	NA	0.2	V
	Output High Voltage	V_{OH}	0.25	NA	NA	V
	Input Low Current	I_{IL}	-100/-500	NA	100/500	Room/Hot uA
	Input High Current	I_{IH}	-100/-500	NA	100/500	Room/Hot uA

Note: VDDO and DVDD are both IO power Supply

3.4 Electrical Characteristics for General IO

Table 3-4 Electrical Characteristics for Digital General IO

Parameters		Symbol	Test condition	Min	Typ	Max	Unit
Digital 3.3V/1.8V GPIO @3.3V	Input leakage current	I_{PAD}	DVDD=Max, V_{PAD}=0V or DVDD	-10	NA	10	uA
	Input Hysteresis for Schmitt Trigger Operation	V_H		0.08* VDDO	NA	NA	V
	Input pullup resistor current	I_{RPU}	V_{PAD} = 0V	-20	NA	-180	uA
	Input pulldown resistor current	I_{RPD}	V_{PAD} = VDDO	20	NA	180	uA
Digital 3.3V/1.8V GPIO @1.8V	Input leakage current	I_{PAD}	DVDD=Max, V_{PAD}=0V or DVDD	-10	NA	10	uA
	Input Hysteresis for Schmitt Trigger Operation	V_H		0.1* VDDO	NA	NA	V
	Input pullup resistor current	I_{RPU}	V_{PAD} = 0V	-20	NA	-180	uA
	Input pulldown resistor current	I_{RPD}	V_{PAD} = VDDO	20	NA	180	uA
Digital 1.8V only GPIO @1.8V	Input leakage current	I_{PAD}	DVDD=Max, V_{PAD}=0V or DVDD	-10	NA	10	uA
	Input Hysteresis for Schmitt Trigger Operation	V_H		0.1* VDDO	NA	NA	V
	Input pullup resistor current	I_{RPU}	V_{PAD} = 0V	-20	NA	-170	uA
	Input pulldown resistor current	I_{RPD}	V_{PAD} = VDDO	20	NA	170	uA
eMMC IO @1.8V	Input leakage current	I_{PAD}	DVDD=Max, V_{PAD}=0V or DVDD	-10	NA	10	uA
	Input Hysteresis for Schmitt Trigger Operation	V_H		0.1* DVDD	NA	NA	V
	Input pullup resistor current	I_{RPU}	V_{PAD} = 0V	-20	NA	-170	uA
	Input pulldown resistor current	I_{RPD}	V_{PAD} = VDDO	20	NA	170	uA

Note: VDDO and DVDD are both IO power Supply

3.5 Electrical Characteristics for PLL

Table 3-5 Electrical Characteristics for INT PLL

Parameters	Symbol	Test condition	Min	Typ	Max	Unit
Input clock frequency	F_{FIN}		4.5	-	300	MHz
Reference frequency(F_{FIN}/p)	F_{FREE}		4.5	7	12	MHz
Frequency of PLL's output	F_{FOUT}		35.2	-	4500	MHz
Frequency of VCO's output	F_{FVCO}		2250	-	4500	MHz
Lock time	T_{LT}	Measured at all F_{FIN} and F_{FOUT} range. RESETB=High	-	-	150	Cycles

Table 3-6 Electrical Characteristics for FRAC PLL

Parameters	Symbol	Test condition	Min	Typ	Max	Unit
Input clock frequency	F_{FIN}		6	-	300	MHz
Reference frequency(F_{FIN}/p)	F_{FREE}		6	20	30	MHz
Frequency of PLL's output	F_{FOUT}		35.2	-	4500	MHz

Parameters	Symbol	Test condition	Min	Typ	Max	Unit
Frequency of VCO's output	F_{FVCO}		2250	-	4500	MHz
Lock time	T_{LT}	Measured at all F_{FIN} and F_{FOUT} range. RESETB=High	-	-	500	Cycles

Table 3-7 Electrical Characteristics for DDR PLL

Parameters	Symbol	Test condition	Min	Typ	Max	Unit
Input clock frequency	F_{FIN}		6	-	300	MHz
Reference frequency(F_{FIN}/p)	F_{FREE}		6	20	30	MHz
Frequency of PLL's output	F_{FOUT}		51.6	-	6600	MHz
Frequency of VCO's output	F_{FVCO}		3300	-	6600	MHz
Lock time	T_{LT}	Measured at all F_{FIN} and F_{FOUT} range. RESETB=High	-	-	500	Cycles

Notes:

① *p is the input divider value*

3.6 Electrical Characteristics for PCIe2/SATA Interface

Table 3-8 Electrical Characteristics for PCIe2/SATA Interface

Parameters	Symbol	Min	Typ	Max	Unit
Transmitter					
Differential Peak-Peak TX Output Voltage Swing	$V_{TX\_DIFF\_PP}$	800	1000	1200	mV
Differential Peak-Peak Low Power TX Output Voltage Swing	$V_{TX\_DIFF\_PP\_LOW}$	400	NA	1200	mV
The output impedance	$R_{TX\_DIFF\_DC}$	80	100	120	ohm
Single Ended Output Resistance Matching	$R_{TX\_DC\_OFFSET}$	NA	NA	5	%
Transmitter output common mode voltage	$V_{TX\_DC\_CM}$	400	NA	800	mV
Maximum mismatch between TXP and TXM for both time and amp	$V_{TX\_CM\_AC\_PP\_ACTIVE}$	NA	NA	50	mV
The amount of voltage change allowed during Receiver Detection	$V_{TX\_RCV\_DETECT}$	NA	NA	600	mV
TX de-emphasis	$V_{TX\_DE\_RATIO}$	3.0	3.5	4.0	dB
AC Coupling Capacitor(USB3.1/PCIe)	$C_{AC\_COUPLING}$	75	NA	200	nF
AC Coupling Capacitor(SATA)		6	NA	12	nF
Output rising time for 20% to 80%	T_r	25	NA	NA	ps
Output falling time for 20% to 80%	T_f	25	NA	NA	ps
Transmitter short circuit limit	I_{TX_SHORT}	NA	NA	20	mA
Output differential skew	T_{SKEW_DIFF}	-15	NA	15	ps
Receiver					
Input Voltage Swing	V_{RXDPP_C}	250	NA	1200	mVpp
The input differential impedance	R_{RXD_C}	80	100	120	Ohm
Single Ended input Resistance Matching	$R_{RXD\_C\_MS}$	NA	NA	5	%

3.7 Electrical Characteristics for MIPI CDPHY interface

Table 3-9 Electrical Characteristics for MIPI CDPHY interface

Parameters	Symbol	Description	Test condition	Min	Typ	Max	Unit
LP-RX	V_{IH}	Logic1 input voltage	All conditions	880	NA	NA	mV
	V_{IL}	Logic0 input voltage, not in ULPS state	All conditions	NA	NA	550	mV
Skew Calibration	$T_{skewcal}$ (initial)	Duration for which the transmitter drives the skew-calibration pattern in the initial skew calibration mode	>1.5Gbps	NA	NA	100	us
				2^15	NA	NA	UI
	$T_{skewcal}$ (periodic)	Duration for which the transmitter drives the skew-calibration pattern in the periodic skew calibration mode	>1.5Gbps (optional)	NA	NA	10	us
				2^13	NA	NA	UI

3.8 Electrical Characteristics for MIPI CSI DPHY interface

Table 3-10 Electrical Characteristics for MIPI CSI DPHY interface

Parameters	Symbol	Min	Typ	Max	Units
Common-mode interference beyond 450 MHz	ΔVCMRX(HF)	NA	NA	100	mV
		NA	NA	50	mV
Common-mode interference 50MHz-450MHz	ΔVCMRX(LF)	-50	NA	50	mV
		-25	NA	25	mV
Common-mode termination	CCM	NA	NA	60	pF
Input pulse rejection	eSPIKE	NA	NA	300	V.ps
Minimum pulse width response	TMIN-RX	20	NA	NA	ns
Peak interference amplitude	VINT	NA	NA	200	mV
Interference frequency	fINT	450	NA	NA	MHz

3.9 Electrical Characteristics for SARADC

Table 3-10 Electrical Characteristics for SARADC

Parameters	Symbol	Test condition	Min	Typ	Max	Unit
Resolution			NA	12	NA	Bit
Anglog Input Range	AIN		AVSS18	NA	AVDD18	V
Differential Non-Linearity	DNL	PD = Low F_s = 1MS/s F_{CLK} = 20MHz F_{SOC} = 1MHz F_{AIN} = 10kHz ramp wave	NA	±1.0	±3.0	LSB
Integral Non-Linearity	INL		NA	±2.0	±6.0	LSB
Top Offset Voltage Error	E_{OT}		NA	±10	±20	LSB
Bottom Offset Voltage Error	E_{OB}		NA	±10	±20	LSB

3.10 Electrical Characteristics for TSADC

Table 3-11 Electrical Characteristics for TSADC

Parameters	Symbol	Test condition	Min	Typ	Max	Unit
Accuracy from -40℃ to 125℃	T_{JACC}	Temp: -40 ~ 125℃ Supply: 1.62V ~ 1.98V	NA	±3	±5	℃
Sensing Temperature Range	T_{RANGE}		-40	25	125	℃
Resolution	T_{LSB}		NA	1	NA	℃

Chapter 4 Thermal Management

4.1 Overview

For reliability and operability concerns, the absolute maximum junction temperature has to be below 125℃.

4.2 Package Thermal Characteristics

Table 4-1 provides the thermal resistance characteristics for the package used on the SoC. The resulting simulation data for reference only, please prevail in kind test.

Table 4-1 Thermal Resistance Characteristics

Parameter	Symbol	Typical	Unit
Junction-to-ambient thermal resistance	$\boldsymbol{\theta_{JA}}$	8.2	(℃/$\boldsymbol{W}$)
Junction-to-board thermal resistance	$\boldsymbol{\theta_{JB}}$	3.7	(℃/$\boldsymbol{W}$)
Junction-to-case thermal resistance	$\boldsymbol{\theta_{JC}}$	0.01	(℃/$\boldsymbol{W}$)

*Note: The testing PCB is 10Layer，200*130mm, Ambient temperature is 25℃.*