X2000

AIoT Application Processor

Data Sheet

Release Date: June 21, 2022

北京君正集成电路股份有限公司
Ingenic Semiconductor Co.,Ltd.

X2000 AIoT Application Processor

Data Sheet

Disclaimer

Ingenic Semiconductor Co., Ltd.

Ingenic Headquarters, East Bldg. 14, Courtyard #10,
Xibeiwang East Road, Haidian District, Beijing 100193, China
Tel: 86-10-56345000
Fax: 86-10-56345001
Http: //www.ingenic.com

CONTENTS

1 Overview

X2000 is a low power consumption, high performance and high integrated application processor, the application is focus on AIoT devices. And it can match the requirements of many other embedded products.

1.1 Block Diagram

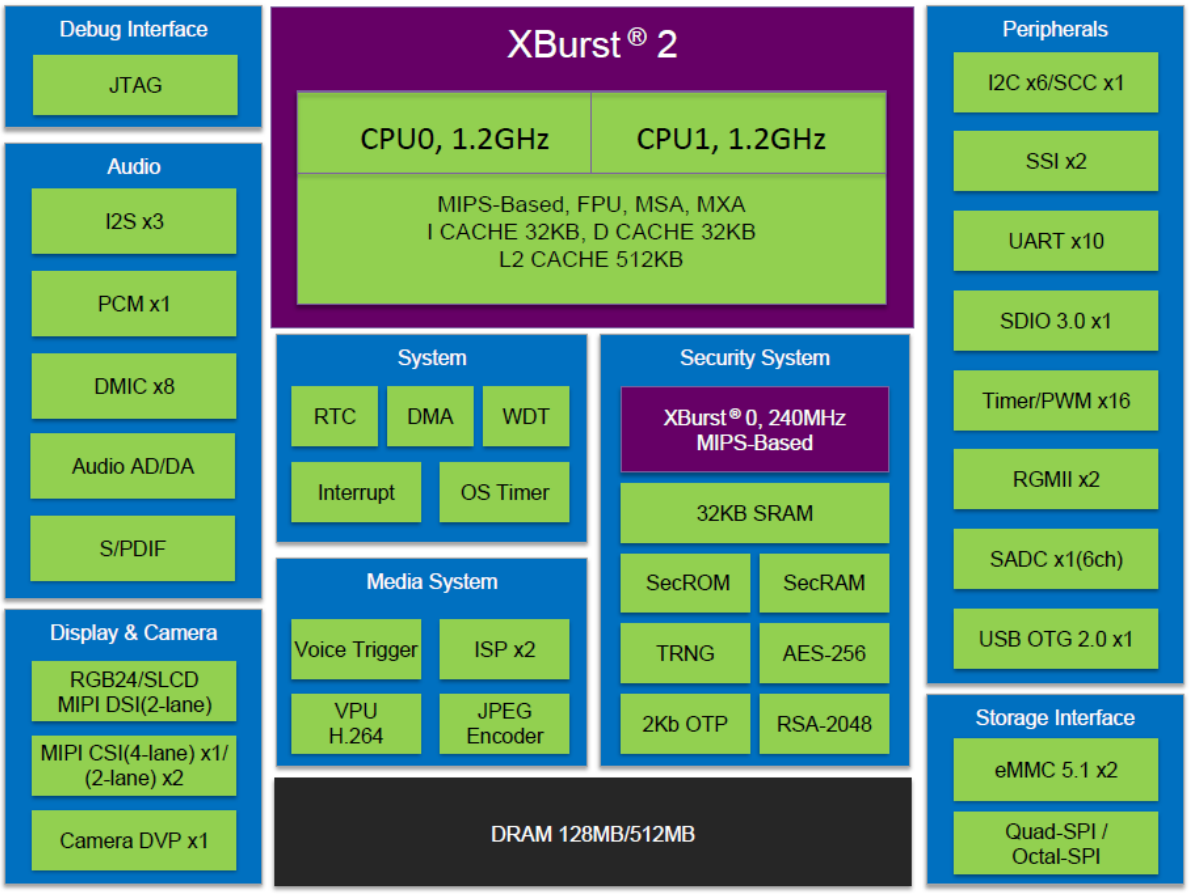


Figure 1-1 X2000 Diagram

1.2 Features

1.2.1 CPU Core

- XBurst® 2, at 1.2GHz, Dual Core, Dual-issue, high performance and low power implementation of MIPS32 ISA R5
- MIPS32 ISA R5 plus MIPS SIMD instruction set architecture:128bit MSA
- Ingenic SIMD instruction set architecture: 128bit MXA
- Dual-issue, superscalar, super pipeline with Simultaneous Multi-Threading (SMT)
  - 2 hardware threads per physical core
  - Quad instruction fetches per cycle
  - Dual issue instructions per cycle per thread
- 32KB L1 D cache +32K L1 I cache，512 KB L2 cache，32KB SRAM
- High-performance Floating-point Unit and SIMD Engine: FSE
  - 32 x 128-bit register set, 128-bit loads/stores to/from SIMD unit
  - IEEE-754 2008 compliant
- Programmable Memory Management Unit (MMU)
  - 1st level mini-TLBs (MTLBs) – 8 x 2 entry instruction TLB, 16 x 2 entry data TLB
  - 2nd level TLBs: 32 × 2 entry VTLB, 256 × 2 entry 4-way set associative FTLB
- The XBurst® processor system supports little endian only

1.2.2 Video Process Unit(VPU)

- H.264 Encoder
  - Input data format NV12/NV21
  - Encoding resolution and frame rate up to 1920x1080@30fps
  - Support hardware RBSP bytes insertion
  - Support auto-read of slice header
  - Support reference frame lossless compression
- H.264 Decoder
  - Output data format NV12/NV21
  - Decoding resolution and frame rate up to 1920x1080@30fps
  - Support hardware RBSP bytes eliminate
- JPEG Codec
  - JPEG compressing/decompressing up to 70Mega-pixels per second
  - Baseline ISO/IEC 10918-1 JPEG compliant
  - 8-bit pixel depth support
  - Up to four programmable Quantization tables
  - Fully programmable Huffman tables

1.2.3 MIPI-CSI

- MIPI-CSI2(v1.0) interface, resolution up to 1080P@120fps
  – Support dual 2-lane mode and single 4-lane mode
  – Support 1-lane, 2-lane and 4-lane mode

1.2.4 Video Input Control(VICx2)

The VIC module is a video input image preprocessing module to reorder the different kinds of input images to a uniform type then output to TIZIANO or write to DDR.

Work mode: image mode

Maximum working freq: 350Mhz

input interface: BT、DVP、MIPI

Maximum input image size:

- MIPI: 8M@30fps、6M@30fps、1080p@60fps
- BT/DVP: 1080p@30fps、720p@60fps

Minimum input image size: 128*128

Image format

- sensor port support
  DVP: RAW8、RAW10、RAW12、YUV422 (Serial 8bit)
  BT601: YUV422 (Parallel 16bit)、YUV422 (Serial 8bit)
  BT656: YUV422 (Serial 8bit)
  BT1120: YUV422 (Parallel 16bit)、YUV422 (Serial 8bit)
  MIPI: RAW8、RAW10、RAW12
- VIC output port format
  Tiziano: RAW8、RAW10、RAW12
  Scaler: YUV422 (8bit)
  DMA: RAW8、RAW10、RAW12、YUV422 (8bit)
- MIPI: RAW8、RAW10、RAW12

Fault tolerance

- DVP、BT601: frame start reset、every line of data within a fixed
- BT656、BT1120: error reset、every line of data within a fixed

Support DVP8bit port flexible connection

VIC DMA output format : RAW16、NV12、NV21

1.2.5 Image Signal Processor(ISPx2)

- Data stream feature
  - DVP： raw8 / 10 / 12 / YUV422 input
  - MIPI： up to 1080P@60fps
  - Support dual-camera sync
  - Frame data check, make up for lost data and drop redundant data
- Advanced feature
  - 2A(Auto Exposure/Auto White Balance) supported
  - Advanced demosaic, color processing, lens shading, sharpen, static/dynamic defect pixel and other modules provide high image quality
  - 2-D noise reduction filter

1.2.6 Lite Camera

- Camera interface module(CIM)
  - Support DVP 8bit / MIPI input ,resolution up to 1280x720@30fps
  - Support snapshot control
  - Supported data format: RGB888, RGB565, YCbCr 4:2:2
  - Supports ITU656 (YCbCr 4:2:2) input

Support histogram output

1.2.7 Memory Interface

- DDR Controller
  - Support LPDDR3, 16Bit bus width, clock up to 800MHz
  - 128MB memory in package.
- SFC Controller
  - 1 group clock and CE pad
  - Two Quad SPI, one Octal SPI (SFC0/1)
  - Support Standard, Dual, Quad SPI and Octal DDR protocol
  - Clock frequency up to 80MHz in SDR mode
  - Support multiple transfer modes, standard SPI, dual-output/dual-Input SPI, Quad-Output/Quad-Input SPI, Dual-I/O SPI, Quad-I/O SPI, Full Dual-I/O SPI, Full Quad-I/O SPI, and Octal-I/O

1.2.8 Audio

- Digital Microphone Array Controller
  - Support 8 channels digital MIC
  - 24/16bit precision internal controller, sample rate support 8K, 16K, 32K, 48K and 96K
  - SNR: 90dB, THD: -90dB @ FS -20dB
  - Linear high pass filter included. Attenuation: -2.9dB@100Hz, -22dB@27Hz. -36dB@10Hz
  - Low power voice trigger when waiting to start talking.
  - Support voice data pre-fetch when trigger enable and the data interface disable, but do not increase the power dissipation.
  - Support low power voice trigger enable
- I2S(1~3) / I2S0
  - DMA transfer mode supported
  - Support share clock mode and split clock mode.
  - I2S0: Internal I2S CODEC supported
  - Support master mode and slave mode
  - Support number of data pin from 1 to 4
  - Support six modes of operation for TDM protocol
- PCM interface
  - Support master mode and slave mode
  - Support four modes of operation for PCM
    - DSP NORMAL \ LEFT MODE

- PCM NORMAL \ LEFT MODE

- S/PDIF(IN and OUT)
  - Support IEC 60958-3 compliant, up to 2 channels
  - Sample bit support 20-bit and 24-bit two mode
  - Sample rate support, all of IEC60958-3 sample rate (44.1k up to 192k)
- Internal Audio Codec (**DAC and ADC working together)**
  - 24 bits DAC / ADC
  - Sample rate supported: 8k, 12k, 16k, 24k, 32k, 44.1k,48k,96k
  - **Mono Differential input/output**
  - DAC : SNR: 90dB A-Weighted, THD: -80dB @FS，-1dB ; ADC: SNR 90dB
  -

1.2.9 Display

- MIPI-DSI2(v1.0) interface
  Display size up to 1920x1080@40Hz
- SLCD controller
  - Display size up to 640x480@60Hz, 24BPP
  - Supports different size of display panel
- RGB controller
  - Display size up to 1280x720@60Hz, 24BPP
  - Support input format, ARGB8888, ARGB1555, RGB888, RGB565, RGB555, YUV422, YUV420
  - Support 4 modes parallel interface, 24-bit, 18-bit, 16-bit and 8-bit(third times)
  - Support frame buffer crop and dither

1.2.10 System Functions

- Clock generation and power management
  - On-chip oscillator circuit (support 24MHz)
  - Two phase-locked loops (PLL) with programmable multiplier
  - CCLK, HHCLK, H2CLK, PCLK, H0CLK, DDR_CLK frequency can be changed separately for software by setting registers
  - Functional-unit clock gating
  - Supply block power shut down
- TCU
  - 8 channels each channel has two pins
  - Support posedge / negedge / dualedge clock counting
  - Support gate counting(only count for gating signal)
  - Support quadrature counting
  - Support direction counting(add / sub because of input signal)
  - Support counting after posedge / negedge signal
  - Support capture counting, output signal high-level time and total cycle time
  - Support exclk / pclk two clock source
- PWM

  - 16 channels, output signal ~50MHz, signal precision ~500MHz
  - CPU / dma mode to update config
- OS timer
  - One event timer for one logical core
  - One global timer for system time

- Interrupt controller
  - Total 64 interrupt sources
  - Each interrupt source can be independently enabled

- Watchdog timer
  - A 16-bit Data register and a 16-bit counter
  - Programmable interrupt generation prior to timeout
  - Counter clock uses the input clock selected by software
    - EXTAL / RTCCLK can be used as the clock for counter
    - The division ratio of the clock can be set to 1, 4, 16, 64, 256 and 1024 by software

- PDMA Controller
  - Support up to 32 independent DMA channels
  - Descriptor or No-Descriptor Transfer mode
  - Transfer data units: 1-byte, 2-byte, 4-byte, 16-byte, 32-byte, 64-byte, 128-byte
  - Transfer number of data unit: 1 ~ 2^{24} - 1
  - Independent source and destination port width: 8-bit, 16-bit, 32-bit
  - Fixed three priorities of channel groups: 0~3, highest; 4~11: mid; 12~31: lowest

- SAR A/D Controller
  - 6 Channels
  - Resolution: 10-bit

- RTC (Real Time Clock)
  - Need external 32768Hz oscillator for 32KHz clock generation.
  - 32-bits second counter
  - Programmable and adjustable counter to generate accurate 1 Hz clock
  - Alarm interrupt, 1Hz interrupt
  - Stand alone power supply, work in hibernating mode
  - Power down controller
  - Alarm wakeup
  - External pin wakeup with up to 2s glitch filter
  - Power Detect to Shut down PMU (find Core without voltage then shut PMU other voltage)

1.2.11 Peripherals

- General-Purpose I/O ports
  - Input / output / function port configurable
  - Low/high, rising/falling edge triggering. Every interrupt source can be masked independent
- Six I2C Controller (I2C0~5)
  - Two-wire I2C serial interface – consists of a serial data line (SDA) and a serial clock (SCL)
  - Three speeds mode
    - Standard mode (100 Kb/s)
    - Fast mode (400 Kb/s)
    - High speed mode (3.4Mb/s)
  - Programmable SCL generator
  - Master or slave I2C operation
  - 7-bit addressing/10-bit addressing
  - The number of devices that you can connect to the same I2C-bus is limited only by the maximum bus capacitance of 400pF

- One Smart Card Controller (SCC)
  - Supports normal card and UIM card.
  - Supports asynchronous character (T=0) communication modes.
  - Supports asynchronous block (T=1) communication modes.
  - Supports setting of clock-rate conversion factor F (372, 512, 558, etc.), and bit-rate adjustment factor D (1, 2, 4, 8, 16, 32, 12, 20, etc.).
  - Supports extra guard time waiting.
  - Auto-error detection in T=0 receive mode.
  - Auto-character repeat in T=0 transmit mode.
  - Transforms inverted format to regular format and vice versa.
  - Support stop clock function in some power consuming sensitive applications.

- Two Synchronous serial interfaces (SSI0~1)
  - 3 protocols support: National's Microwire, TI's SSP, and Motorola's SPI
  - Full-duplex or transmit-only or receive-only operation
  - Programmable transfer order: MSB first or LSB first
  - Configurable normal transfer mode or Interval transfer mode
  - Programmable clock phase and polarity for Motorola's SSI format
  - Two slave select signal (SSI0_CE0_ / SSI1_CE0_) supporting up to 2 slave devices
  - Back-to-back character transmission/reception mode
  - Loop back mode for testing
  - Data transfer up to 30Mbits/s

- Ten UARTs (UART0~9)
  - Full-duplex operation

- Baud rate supports 4800, 9600, 19200, 38400, 43000, 56000, 57600, 115200, 230400, 460800, 576000, 921600, 1000000, 1152000, 1500000, 2000000, 2500000, 3000000, 3500000, 4000000, 6000000, 8000000, 12000000
- 5-, 6-, 7- or 8-bit characters with optional no parity or even or odd parity and with 1, 1½, or 2 stop bits
- Internal diagnostic capability Loopback control and break, parity, overrun and framing-error is provided
- Separate DMA requests for transmit and receive data services in FIFO mode
- Supports modem flow control by software or hardware

- Three MMC/SD/SDIO controllers (MSC0, SDIO, MSC2)
  - All support eMMC 5.1 (command queueing)
  - Support SD Specification 3.0
  - Support SD I/O Specification 1.0 with 1 command channel and 4 data channels
  - Maximum clock speed is 104MHz
  - Both support MMC data width 1bit ,4bit, only MSC0 support 8bit
  - Single or multi block access to the card including erase operation
  - The maximum block length is 4096bytes

- USB 2.0 OTG interface
  - Complies with the USB 2.0 standard for high-speed (480 Mbps) functions and with the On-The-Go supplement to the USB 2.0 specification
  - Support operating as USB peripheral, as USB host
  - Support split transmission
  - Support hub
  - Support remote-wakeup

- GMAC controller
  - 10/100 Mbps and 1000Mbps operation
  - Supports RMII and RGMII PHY interfaces
  - Support IEEE 1588-2002

- Security System
  - XBurst®, 240MHz
  - Secret ROM and RAM
  - Up to 32KB SRAM
  - True Random Number Generator
  - Encryption Engine
    - MD5, SHA, SHA2
    - AES, support 256-bit, 192-bit, 128-bit key size Algorithm
    - RSA, support 1024/2048-bit key size
  - Support secure boot

- OTP Slave Interface
  - Total 2Kb.

1.2.12 Bootrom

16KB Boot ROM memory and 16KB Security Boot ROM

2 PAD Information

2.1 Pin Map

X2000 Ball Assignment Ver1.0

BGA270, 12mm X 12mm X 1.2mm, 0.65pitch, top view

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
A	MSC0_D6_SFC1_DQ2_WP__UART0_CTS__PD25	SDIO_CMD_SSIO_DT_PD09	SDIO_D1_I2C1_SCK_PD11	SDIO_D2_I2C1_SDA_PD12		UART3_TXD_PCM_DO_TCK_PD03	I2C5_SCK_PCM_DI_TMS_PD04	VSS	VDDMEM	VREF	DDR_VDD1	DDRPLL_VCCA	VSS		UART3_RTS__I2C5_SDA_PC28	SD15_SSIO_CLK_UART9_TXD_PB31	SD9_LCD_VSYNC_SLCD_DC_PB25	SD3_LCD_D19_RGMAC1_MDC_PB19	A
B	MSC0_CMD_SFC0_CE__SSI1_DT_PD18	SDIO_CLK_SSIO_CLK_PD08	SDIO_D0_SSIO_DR_PD10	UART2_RXD_I2C3_SCK_PWM0_TCU0_IN0_PD30	UART3_CTS__I2C4_SCK_PD00	UART3_RXD_PCM_CLK_TDI_PD02	I2C5_SDA_PCM_SYNC_PD05	VDDMEM	VDDMEM	VSS	DDR_VDD1	DDR_VSSA	VSS	UART3_RXD_I2C4_SCK_PC25	UART3_TXD_I2C4_SDA_PC26	SDIO_LCD_HSYNC_SLCD_WR_PB26	SD8_LCD_PCLK_SLCD_CE__PB24	SD2_LCD_D18_RGMAC1_RX_DV_PB18	B
C	MSC0_D1_SFC0_DQ1_I2C2_SCK_PD20	MSC0_D0_SFC0_DQ0_SSI1__DR_PD19	MSC0_D7_SFC1_DQ3_HOLD__UART0_RTS__PD26	SDIO_D3_SSIO_CE0__PD13	UART2_TXD_I2C3_SDA_PWM1_TCU0_IN1_PD31	UART3_RTS__I2C4_SDA_TDO_PD01	VSS	VDDMEM	VDDMEM	ZQ	VSS	VDDMEM	VDDMEM	UART3_CTS__I2C5_SCK_PC27	SD14_SSIO_DT_UART9_RXD_PB30	SD0_LCD_D16_PB16	SD7_LCD_D23_I2C2_SDA_RGMAC1_PHY_CLK_PB23	SD4_LCD_D20_RGMAC1_MDIO_PB20	C
D	MSC0_CLK_SFC0_CLK_SSI1_CLK_PD17	MSC0_D2_SFC0_DQ2_WP__I2C2_SDA_PD21	MSC0_D4_SFC1_DQ0_UART0_RXD_PD23	MSC0_D3_SFC0_DQ3_HOLD__SSI1_CE0__PD22	AVDEFUSE	TRST	VSS	VSS	VSS	VSS	VSS	VDDMEM	VDDMEM	SD12_SSIO_CE0__UART8_RXD_PB28	SD13_SSIO_DR_UART8_TXD_PB29	SD11_LCD_DE_SLCD_TE_PB27	WE__LCD_D14_SLCD_D14_RGMAC1_RXD2_PB14	SA12_LCD_D12_SLCD_D12_RGMAC1_RXD0_PB12	D
E		RTC32K_PE23	EXCLK_CIM_VIC_MCLK_PE24	MSC0_D5_SFC1_DQ1_UART0_TXD_PD24											WAIT__LCD_D15_SLCD_D15_RGMAC1_RXD3_PB15	SD6_LCD_D22_I2C2_SCK_RGMAC1_RX_CLK_PB22	RD__LCD_D13_SLCD_D13_RGMAC1_RXD1_PB13		E
F	VDDIO_RTC	WKUP__PE31	PWRON	DRV_VBUS_PE22		VSS	VSS	VDD	VDD	VSS	VDD	VDD	VSS		SD1_LCD_D17_RGMAC1_TX_EN_PB17	SA11_LCD_D11_SLCD_D11_RGMAC1_TXD3_PB11	SA10_LCD_D10_SLCD_D10_RGMAC1_TXD2_PB10	SA9_LCD_D9_SLCD_D9_RGMAC1_TXD1_PB09	F
G	OSC32_XO	OSC32_XI	PPRST_	TEST_TE		VDDIO	VSS	VDD	VDD	VSS	VDD	VDD	VSS		SA6_LCD_D6_SLCD_D6_PB06	SA3_LCD_D3_SLCD_D3_PB03	SD5_LCD_D21_RGMAC1_TX_CLK_PB21	SA8_LCD_D8_SLCD_D8_RGMAC1_TXD0_PB08	G
H		PLL_AVDD	VDD_RTC	VSS_RTC		VDDIO	VSS	VSS	VSS	VSS	VDD	VDD	VDDIO33		SA5_LCD_D5_SLCD_D5_PB05	SA1_LCD_D1_SLCD_D1_PB01	SA2_LCD_D2_SLCD_D2_PB02		H
J	EXCLK_XI	EXCLK_XO	PLL_VDD	PLL_AVSS		VSS	VSS	VSS			VSS	VSS	VDDIO18		SA7_LCD_D7_SLCD_D7_PB07	SA4_LCD_D4_SLCD_D4_PB04	TX_DATAP1	TX_DATAN1	J
K	I2C3_SCK_I2S3_TX_BCLK_PA16	BOOT_SEL2_PE27	PLL_VSS	BOOT_SEL1_PE26		VSS	VDD	VDD			VDD	VDD	VSS		SA0_LCD_D0_SLCD_D0_PB00	TX_DATAP0	TX_CLKP	TX_CLKN	K
L		CIM_EXPOSURE_PA15	I2C3_SDA_I2S2_RX_BCLK_PA17	BOOT_SEL0_PE25		VSS	VDD	VDD	VSS	VSS	VDD	VDD	VSS		DSI_AVSS	DSI_AVD09	TX_DATAN0		L
M	CIM_VIC_VSYNC_I2S2_RX_DATA3_PA13	CIM_VIC_HSYNC_I2S2_RX_DATA2_PA12	CIM_VIC_PCLK_PA14	VIC_D10_I2S2_RX_DATA0_PA10		VDDIO33_CIM	VSS	VSS	VSS	VSS	VDD	VDD	VSS		CSI_AVSS	DSI_AVD18	RX_DATAP0	RX_DATAN0	M
N	VIC_D11_I2S2_RX_DATA1_PA11	VIC_D9_UART7_TXD_I2S2_RX_LRCK_PA09	VIC_D8_UART7_RXD_PA08	CIM_VIC_D7_UART6_TXD_I2S2_RX_MCLK_PA07		VDDIO18_CIM	VSS	VDDIO18_SD	VDDIO33_SD	VSS	VSS	VDDIO18	VDDIO33		CSI_AVD09	RX_CLKP0	RX_DATAP1	RX_DATAN1	N
P		CIM_VIC_D4_UART5_RXD_I2S3_TX_DATA1_PA04	CIM_VIC_D5_UART5_TXD_I2S3_TX_DATA2_PA05	CIM_VIC_D6_UART6_RXD_I2S3_TX_DATA3_PA06											PWM0_TCU0_IN0_PC00	CSI_AVD18	RX_CLKN0		P
R	CIM_VIC_D3_UART4_TXD_I2S3_TX_DATA0_PA03	CIM_VIC_D2_UART4_RXD_I2S3_TX_LRCK_PA02	CIM_VIC_D1_UART4_RTS__PA01	CIM_VIC_D0_UART4_CTS__I2S3_TX_MCLK_PA00	USB_AVSS	USB_ID	USB_BIAS	CODEC_AVSS	MSC2_D3_PWM7_TCU3_IN1_PE05	MSC2_CLK_PWM2_TCU1_IN0_PE00	PWM4_TCU2_IN0_RGMAC0_TXD2_I2S1_RX_DATA_SCC_SDA_PC04	PWM10_TCU5_IN0_RGMAC0_TX_EN_SSI1_DR_UART4_RTS__PC10	PWM11_TCU5_IN1_RGMAC0_RX_DV_SSI1_DT_UART4_RXD_PC11	PWM9_TCU4_IN1_RGMAC0_RXD3_SSI1_CE0__UART4_CTS__PC09	PWM12_TCU6_IN0_RGMAC0_MDC_SSI1_CLK_UART4_TXD_PC12	DMIC_IN3_UART1_TXD_I2C1_SDA_NEMC_CS2__PC24	RX_DATAN2	RX_DATAP2	R
T	AUX4	AUX2	AUX0	SADC_AVSS	USB_VBUS	USB_AVD33	CODEC_MICBIAS	CODEC_HPOUTN	MSC2_D2_PWM6_TCU3_IN0_PE04	SFC0_CLK_SSI1_CLK_PE16	SFC0_DQ0_SSI1_DR_PE18	PWM14_TCU7_IN0_RGMAC0_TX_CLK_SPDIF_OUT_I2C0_SDA_PC14	PWM7_TCU3_IN1_RGMAC0_RXD1_I2S1_TX_DATA_UART6_RXD_PC07	PWM6_TCU3_IN0_RGMAC0_RXD0_I2S1_TX_LRCK_UART5_TXD_PC06	PWM13_TCU6_IN1_RGMAC0_MDIO_SPDIF_IN_I2C0_SCK_PC13	DMIC_IN2_UART1_RXD_I2C1_SCK_NEMC_CS1__PC23	RX_DATAP3	RX_DATAN3	T
U	SADC_VREFP	AUX3	AUX5	USB_DM0	USB_AVD18	CODEC_MICLN	CODEC_AVDD	CODEC_HPOUTP	MSC2_D1_PWM5_TCU2_IN1_PE03	SFC0_CE_SSI1_DT_PE17	SFC0_DQ1_I2C2_SCK_PE19	SFC0_DQ3_HOLD__SSI1_CE0__PE21	PWM3_TCU1_IN1_RGMAC0_TXD1_I2S1_RX_LRCK_SCC_SCK_PC03	PWM5_TCU2_IN1_RGMAC0_TXD3_I2S1_TX_BCLK_UART5_RXD_PC05	PWM8_TCU4_IN0_RGMAC0_RXD2_I2S1_TX_MCLK_UART6_TXD_PC08	DMIC_IN0_UART1_CTS__PC21	RX_CLKN1	RX_CLKP1	U
V	AUX1	SADC_AVDD	USB_DP0	USB_AVD09		CODEC_MICLP	CODEC_VCM		MSC2_D0_PWM4_TCU2_IN0_PE02	MSC2_CMD_PWM3_TCU1_IN1_PE01		SFC0_DQ2_WP__I2C2_SDA_PE20	PWM2_TCU1_IN0_RGMAC0_TXD0_I2S1_RX_BCLK_UART7_TXD_PC02		PWM15_TCU7_IN1_RGMAC0_RX_CLK_CIM_VIC_MCLK_PC15	PWM1_TCU0_IN1_RGMAC0_PHY_CLK_I2S1_RX_MCLK_UART7_RXD_PC01	DMIC_CLK_PC20	DMIC_IN1_UART1_RTS__PC22	V
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

2.2 Pin Description

2.2.1 GPIO Group A

Ball No.	Ball Name	In/Out	Pull	Slew Rate	Schmitt	GPIO	Func0	Func1	Func2	Power
R4	CIM_VIC_D0_ UART4_CTS__ I2S3_TX_MCLK_PA00	IO	PU	Yes	Yes	GPA[0]	CIM/VIC_D0	UART4_CTS_	I2S3_TX_MCLK	VDDIO33_CIM
R3	CIM_VIC_D1_UART4_RTS__PA01	IO	PU	Yes	Yes	GPA[1]	CIM/VIC_D1	UART4_RTS_		VDDIO33_CIM
R2	CIM_VIC_D2_UART4_RXD_I2S3_TX_LRCK_PA02	IO	PU	Yes	Yes	GPA[2]	CIM/VIC_D2	UART4_RXD	I2S3_TX_LRCK	VDDIO33_CIM
R1	CIM_VIC_D3_UART4_TXD_I2S3_TX_DATA0_PA03	IO	PU	Yes	Yes	GPA[3]	CIM/VIC_D3	UART4_TXD	I2S3_TX_DATA0	VDDIO33_CIM
P2	CIM_VIC_D4_UART5_RXD_I2S3_TX_DATA1_PA04	IO	PU	Yes	Yes	GPA[4]	CIM/VIC_D4	UART5_RXD	I2S3_TX_DATA1	VDDIO33_CIM
P3	CIM_VIC_D5_UART5_TXD_I2S3_TX_DATA2_PA05	IO	PU	Yes	Yes	GPA[5]	CIM/VIC_D5	UART5_TXD	I2S3_TX_DATA2	VDDIO33_CIM
P4	CIM_VIC_D6_UART6_RXD_I2S3_TX_DATA3_PA06	IO	PU	Yes	Yes	GPA[6]	CIM/VIC_D6	UART6_RXD	I2S3_TX_DATA3	VDDIO33_CIM
N4	CIM_VIC_D7_UART6_TXD_I2S2_RX_MCLK_PA07	IO	PU	Yes	Yes	GPA[7]	CIM/VIC_D7	UART6_TXD	I2S2_RX_MCLK	VDDIO33_CIM
N3	VIC_D8_UART7_RXD_PA08	IO	PU	Yes	Yes	GPA[8]	VIC_D8	UART7_RXD		VDDIO33_CIM
N2	VIC_D9_UART7_TXD_I2S2_RX_LRCK_PA09	IO	PU	Yes	Yes	GPA[9]	VIC_D9	UART7_TXD	I2S2_RX_LRCK	VDDIO33_CIM
M4	VIC_D10_I2S2_RX_DATA0_PA10	IO	PU	Yes	Yes	GPA[10]	VIC_D10		I2S2_RX_DATA0	VDDIO33_CIM
N1	VIC_D11_I2S2_RX_DATA1_PA11	IO	PU	Yes	Yes	GPA[11]	VIC_D11		I2S2_RX_DATA1	VDDIO33_CIM
M2	CIM_VIC_HSYNC_I2S2_RX_DATA2_PA12	IO	PD	Yes	Yes	GPA[12]	CIM_VIC_HSYNC		I2S2_RX_DATA2	VDDIO33_CIM
M1	CIM_VIC_VSYNC_I2S2_RX_DATA3_PA13	IO	PD	Yes	Yes	GPA[13]	CIM_VIC_VSYNC		I2S2_RX_DATA3	VDDIO33_CIM
M3	CIM_VIC_PCLK_PA14	IO	PD	Yes	Yes	GPA[14]	CIM/VIC_PCLK			VDDIO33_CIM
L2	CIM_EXPOSURE_PA15	IO	PD	Yes	Yes	GPA[15]	CIM_EXPOSURE			VDDIO33_CIM
K1	I2C3_SCK_I2S3_TX_BCLK_PA16	IO	PU	Yes	Yes	GPA[16]	I2C3_SCK		I2S3_TX_BCLK	VDDIO33_CIM
L3	I2C3_SDA_I2S2_RX_BCLK_PA17	IO	PU	Yes	Yes	GPA[17]	I2C3_SDA		I2S2_RX_BCLK	VDDIO33_CIM

2.2.2 GPIO Group B

Ball No.	Ball Name	In/ Out	Pull	Slew Rate	Schmitt	GPIO	Func0	Func1	Func2	Func3	Power
K15	SA0_LCD_D0_SLCD_D0_PB00	IO	PD	No	Yes	GPB[0]	SA0	LCD_D0	SLCD_D0		VDDIO33
H16	SA1_LCD_D1_SLCD_D1_PB01	IO	PD	No	Yes	GPB[1]	SA1	LCD_D1	SLCD_D1		VDDIO33
H17	SA2_LCD_D2_SLCD_D2_PB02	IO	PD	No	Yes	GPB[2]	SA2	LCD_D2	SLCD_D2		VDDIO33
G16	SA3_LCD_D3_SLCD_D3_PB03	IO	PD	No	Yes	GPB[3]	SA3	LCD_D3	SLCD_D3		VDDIO33
J16	SA4_LCD_D4_SLCD_D4_PB04	IO	PD	No	Yes	GPB[4]	SA4	LCD_D4	SLCD_D4		VDDIO33
H15	SA5_LCD_D5_SLCD_D5_PB05	IO	PD	No	Yes	GPB[5]	SA5	LCD_D5	SLCD_D5		VDDIO33
G15	SA6_LCD_D6_SLCD_D6_PB06	IO	PD	No	Yes	GPB[6]	SA6	LCD_D6	SLCD_D6		VDDIO33
J15	SA7_LCD_D7_SLCD_D7_PB07	IO	PD	No	Yes	GPB[7]	SA7	LCD_D7	SLCD_D7		VDDIO33
G18	SA8_LCD_D8_SLCD_D8_RGMAC1_TXD0_PB08	IO	PD	No	Yes	GPB[8]	SA8	LCD_D8	SLCD_D8	RGMAC1_TXD0	VDDIO33
F18	SA9_LCD_D9_SLCD_D9_RGMAC1_TXD1_PB09	IO	PD	No	Yes	GPB[9]	SA9	LCD_D9	SLCD_D9	RGMAC1_TXD1	VDDIO33
F17	SA10_LCD_D10_SLCD_D10_RGMAC1_TXD2_PB10	IO	PD	No	Yes	GPB[10]	SA10	LCD_D10	SLCD_D10	RGMAC1_TXD2	VDDIO33
F16	SA11_LCD_D11_SLCD_D11_RGMAC1_TXD3_PB11	IO	PD	No	Yes	GPB[11]	SA11	LCD_D11	SLCD_D11	RGMAC1_TXD3	VDDIO33
D18	SA12_LCD_D12_SLCD_D12_RGMAC1_RXD0_PB12	IO	PD	No	Yes	GPB[12]	SA12	LCD_D12	SLCD_D12	RGMAC1_RXD0	VDDIO33
E17	RD__LCD_D13_SLCD_D13_RGMAC1_RXD1_PB13	IO	PU	No	Yes	GPB[13]	RD_	LCD_D13	SLCD_D13	RGMAC1_RXD1	VDDIO33
D17	WE__LCD_D14_SLCD_D14_RGMAC1_RXD2_PB14	IO	PU	No	Yes	GPB[14]	WE_	LCD_D14	SLCD_D14	RGMAC1_RXD2	VDDIO33
E15	WAIT__LCD_D15_SLCD_D15_RGMAC1_RXD3_PB15	IO	PU	No	Yes	GPB[15]	WAIT_	LCD_D15	SLCD_D15	RGMAC1_RXD3	VDDIO33
C16	SD0_LCD_D16_PB16	IO	PU	No	Yes	GPB[16]	SD0	LCD_D16	SLCDRD		VDDIO33
F15	SD1_LCD_D17_RGMAC1_TX_EN_PB17	IO	PU	No	Yes	GPB[17]	SD1	LCD_D17		RGMAC1_TX_EN	VDDIO33
B18	SD2_LCD_D18_RGMAC1_RX_	IO	PU	No	Yes	GPB[18]	SD2	LCD_D18		RGMAC1_RX_D	VDDIO33

	DV_PB18									V	
A18	SD3_LCD_D19_RGMAC1_MDC_PB19	IO	PU	No	Yes	GPB[19]	SD3	LCD_D19		RGMAC1_MDC	VDDIO33
C18	SD4_LCD_D20_RGMAC1_MDIO_PB20	IO	PU	No	Yes	GPB[20]	SD4	LCD_D20		RGMAC1_MDIO	VDDIO33
G17	SD5_LCD_D21_RGMAC1_TX_CLK_PB21	IO	PU	No	Yes	GPB[21]	SD5	LCD_D21		RGMAC1_TX_CLK_O	VDDIO33
E16	SD6_LCD_D22_I2C2_SCK_RGMAC1_RX_CLK_PB22	IO	PU	No	Yes	GPB[22]	SD6	LCD_D22	I2C2_SCK	RGMAC1_RX_CLK_I	VDDIO33
C17	SD7_LCD_D23_I2C2_SDA_RGMAC1_PHY_CLK_PB23	IO	PU	No	Yes	GPB[23]	SD7	LCD_D23	I2C2_SDA	RGMAC1_PHY_CLK_O	VDDIO33
B17	SD8_LCD_PCLK_SLCD_CE__PB24	IO	PU	No	Yes	GPB[24]	SD8	LCD_PCLK	SLCD_CE_		VDDIO33
A17	SD9_LCD_VSYNC_SLCD_DC_PB25	IO	PU	No	Yes	GPB[25]	SD9	LCD_VSYNC	SLCD_DC		VDDIO33
B16	SD10_LCD_HSYNC_SLCD_WR_PB26	IO	PU	No	Yes	GPB[26]	SD10	LCD_HSYNC	SLCD_WR		VDDIO33
D16	SD11_LCD_DE_SLCD_TE_PB27	IO	PU	No	Yes	GPB[27]	SD11	LCD_DE	SLCD_TE		VDDIO33
D14	SD12_SSI0_CE0__UART8_RXD_PB28	IO	PU	No	Yes	GPB[28]	SD12	SSI0_CE0_		UART8_RXD	VDDIO33
D15	SD13_SSI0_DR_UART8_TXD_PB29	IO	PU	No	Yes	GPB[29]	SD13	SSI0_DR		UART8_TXD	VDDIO33
C15	SD14_SSI0_DT_UART9_RXD_PB30	IO	PU	No	Yes	GPB[30]	SD14	SSI0_DT		UART9_RXD	VDDIO33
A16	SD15_SSI0_CLK_UART9_TXD_PB31	IO	PU	No	Yes	GPB[31]	SD15	SSI0_CLK		UART9_TXD	VDDIO33

2.2.3 GPIO Group C

Ball No.	Ball Name	In/ Out	Pull	Slew Rate	Sch mitt	GPIO	Func0	Func1	Func2	Func3	Power
P15	PWM0_TCU0_IN0_PC00	IO	PD	No	Yes	GPC[0]	PWM0_TCU0_IN0				VDDIO33
V16	PWM1_TCU0_IN1_RGMAC0_PHY_CLK_I2S1_RX_MCLK_UART7_RXD_PC01	IO	PU	No	Yes	GPC[1]	PWM1_TCU0_IN1	RGMAC0_PHY_CLK	I2S1_RX_MCLK	UART7_RXD	VDDIO33
V13	PWM2_TCU1_IN0_RGMAC0_TXD0_I2S1_RX_BCLK_UART7_TXD_PC02	IO	PU	No	Yes	GPC[2]	PWM2_TCU1_IN0	RGMAC0_TXD0	I2S1_RX_BCLK	UART7_TXD	VDDIO33
U13	PWM3_TCU1_IN1_RGMAC0_TXD1_I2S1_RX_LRCK_SCC_SCK_PC03	IO	PU	No	Yes	GPC[3]	PWM3_TCU1_IN1	RGMAC0_TXD1	I2S1_RX_LRCK	SCC_SCK	VDDIO33
R11	PWM4_TCU2_IN0_RGMAC0_TXD2_I2S1_RX_DATA_SCC_SDA_PC04	IO	PU	No	Yes	GPC[4]	PWM4_TCU2_IN0	RGMAC0_TXD2	I2S1_RX_DATA	SCC_SDA	VDDIO33
U14	PWM5_TCU2_IN1_RGMAC0_TXD3_I2S1_TX_BCLK_UART5_RXD_PC05	IO	PU	No	Yes	GPC[5]	PWM5_TCU2_IN1	RGMAC0_TXD3	I2S1_TX_BCLK	UART5_RXD	VDDIO33
T14	PWM6_TCU3_IN0_RGMAC0_RXD0_I2S1_TX_LRCK_UART5_TXD_PC06	IO	PU	No	Yes	GPC[6]	PWM6_TCU3_IN0	RGMAC0_RXD0	I2S1_TX_LRCK	UART5_TXD	VDDIO33
T13	PWM7_TCU3_IN1_RGMAC0_RXD1_I2S1_TX_DATA_UART6_RXD_PC07	IO	PU	No	Yes	GPC[7]	PWM7_TCU3_IN1	RGMAC0_RXD1	I2S1_TX_DATA	UART6_RXD	VDDIO33
U15	PWM8_TCU4_IN0_RGMAC0_RXD2_I2S1_TX_MCLK_UART6_TXD_PC08	IO	PU	No	Yes	GPC[8]	PWM8_TCU4_IN0	RGMAC0_RXD2	I2S1_TX_MCLK	UART6_TXD	VDDIO33
R14	PWM9_TCU4_IN1_RGMAC0_RXD3_SSI1_CE0__UART4_CTS__PC09	IO	PU	No	Yes	GPC[9]	PWM9_TCU4_IN1	RGMAC0_RXD3	SSI1_CE0_	UART4_CTS_	VDDIO33
R12	PWM10_TCU5_IN0_RGMAC0_TX_EN_SSI1_DR_UART4_RTS	IO	PU	No	Yes	GPC[10]	PWM10_TCU5_IN0	RGMAC0_TX_EN	SSI1_DR	UART4_RTS_	VDDIO33

	__PC10										
R13	PWM11_TCU5_IN1_RGMAC0_RX_DV_SSI1_DT_UART4_RXD_PC11	IO	PU	No	Yes	GPC[11]	PWM11_TCU5_IN1	RGMAC0_RX_DV	SSI1_DT	UART4_RXD	VDDIO33
R15	PWM12_TCU6_IN0_RGMAC0_MDC_SSI1_CLK_UART4_TXD_PC12	IO	PU	No	Yes	GPC[12]	PWM12_TCU6_IN0	RGMAC0_MDC	SSI1_CLK	UART4_TXD	VDDIO33
T15	PWM13_TCU6_IN1_RGMAC0_MDIO_SPDIF_IN_I2C0_SCK_PC13	IO	PU	No	Yes	GPC[13]	PWM13_TCU6_IN1	RGMAC0_MDIO	SPDIF_IN	I2C0_SCK	VDDIO33
T12	PWM14_TCU7_IN0_RGMAC0_TX_CLK_SPDIF_OUT_I2C0_SDA_PC14	IO	PU	No	Yes	GPC[14]	PWM14_TCU7_IN0	RGMAC0_TX_CLK	SPDIF_OUT	I2C0_SDA	VDDIO33
V15	PWM15_TCU7_IN1_RGMAC0_RX_CLK_CIM_VIC_MCLK_PC15	IO	PU	No	Yes	GPC[15]	PWM15_TCU7_IN1	RGMAC0_RX_CLK	CIM/VIC_MCLK		VDDIO33
V17	DMIC_CLK_PC20	IO	PD	No	Yes	GPC[20]	DMIC_CLK				VDDIO33
U16	DMIC_IN0_UART1_CTS__PC21	IO	PU	No	Yes	GPC[21]	DMIC_IN0	UART1_CTS_			VDDIO33
V18	DMIC_IN1_UART1_RTS__PC22	IO	PU	No	Yes	GPC[22]	DMIC_IN1	UART1_RTS_			VDDIO33
T16	DMIC_IN2_UART1_RXD_I2C1_SCK_NEMC_CS1__PC23	IO	PU	No	Yes	GPC[23]	DMIC_IN2	UART1_RXD	I2C1_SCK	NEMC_CS1_	VDDIO33
R16	DMIC_IN3_UART1_TXD_I2C1_SDA_NEMC_CS2__PC24	IO	PU	No	Yes	GPC[24]	DMIC_IN3	UART1_TXD	I2C1_SDA	NEMC_CS2_	VDDIO33
B14	UART3_RXD_I2C4_SCK_PC25	IO	PU	No	Yes	GPC[25]	UART3_RXD	I2C4_SCK			VDDIO33
B15	UART3_TXD_I2C4_SDA_PC26	IO	PU	No	Yes	GPC[26]	UART3_TXD	I2C4_SDA			VDDIO33
C14	UART3_CTS__I2C5_SCK_PC27	IO	PU	No	Yes	GPC[27]	UART3_CTS_	I2C5_SCK			VDDIO33
A15	UART3_RTS__I2C5_SDA_PC28	IO	PU	No	Yes	GPC[28]	UART3_RTS_	I2C5_SDA			VDDIO33

2.2.4 GPIO Group D

Ball No.	Ball Name	In/ Out	Pull	Slew Rate	Sch mitt	GPIO	Func0	Func1	Func2	Func 3	Power
B5	UART3_CTS__I2C4_SCK_PD00	IO	PU	No	No	GPD[0]		UART3_CTS_	I2C4_SCK		VDDIO
C6	UART3_RTS__I2C4_SDA_TDO_PD01	IO	PU	No	No	GPD[1]		UART3_RTS_	I2C4_SDA	TDO	VDDIO
B6	UART3_RXD_PCM_CLK_TDI_PD02	IO	PU	No	No	GPD[2]		UART3_RXD	PCM_CLK	TDI	VDDIO
A6	UART3_TXD_PCM_DO_TCK_PD03	IO	PU	No	No	GPD[3]		UART3_TXD	PCM_DO	TCK	VDDIO
A7	I2C5_SCK_PCM_DI_TMS_PD04	IO	PU	No	No	GPD[4]		I2C5_SCK	PCM_DI	TMS	VDDIO
B7	I2C5_SDA_PCM_SYNC_PD05	IO	PU	No	No	GPD[5]		I2C5_SDA	PCM_SYNC		VDDIO
B2	SDIO_CLK_SSI0_CLK_PD08	IO	PU	No	No	GPD[8]	SDIO_CLK	SSI0_CLK			VDDIO
A2	SDIO_CMD_SSI0_DT_PD09	IO	PU	No	No	GPD[9]	SDIO_CMD	SSI0_DT			VDDIO
B3	SDIO_D0_SSI0_DR_PD10	IO	PU	No	No	GPD[10]	SDIO_D0	SSI0_DR			VDDIO
A3	SDIO_D1_I2C1_SCK_PD11	IO	PU	No	No	GPD[11]	SDIO_D1	I2C1_SCK			VDDIO
A4	SDIO_D2_I2C1_SDA_PD12	IO	PU	No	No	GPD[12]	SDIO_D2	I2C1_SDA			VDDIO
C4	SDIO_D3_SSI0_CE0__PD13	IO	PU	No	No	GPD[13]	SDIO_D3	SSI0_CE0_			VDDIO
D1	MSC0_CLK_SFC0_CLK_SSI1_CLK_PD17	IO	PU	No	No	GPD[17]	MSC0_CLK	SFC0_CLK	SSI1_CLK		VDDIO
B1	MSC0_CMD_SFC0_CE__SSI1_DT_PD18	IO	PU	No	No	GPD[18]	MSC0_CMD	SFC0_CE_	SSI1_DT		VDDIO
C2	MSC0_D0_SFC0_DQ0_SSI1_DR_PD19	IO	PU	No	No	GPD[19]	MSC0_D0	SFC0_DQ0	SSI1_DR		VDDIO
C1	MSC0_D1_SFC0_DQ1_I2C2_SCK_PD20	IO	PU	No	No	GPD[20]	MSC0_D1	SFC0_DQ1	I2C2_SCK		VDDIO
D2	MSC0_D2_SFC0_DQ2_WP__I2C2_SDA_PD21	IO	PU	No	No	GPD[21]	MSC0_D2	SFC0_DQ2_WP_	I2C2_SDA		VDDIO
D4	MSC0_D3_SFC0_DQ3_HOLD__SSI1_CE0__PD22	IO	PU	No	No	GPD[22]	MSC0_D3	SFC0_DQ3_HOLD_	SSI1_CE0_		VDDIO
D3	MSC0_D4_SFC1_DQ0_UART0_RXD_PD23	IO	PU	No	No	GPD[23]	MSC0_D4	SFC1_DQ0	UART0_RXD		VDDIO
E4	MSC0_D5_SFC1_DQ1_UART0_TXD_PD24	IO	PU	No	No	GPD[24]	MSC0_D5	SFC1_DQ1	UART0_TXD		VDDIO
A1	MSC0_D6_SFC1_DQ2_WP__UART0_CTS__PD25	IO	PU	No	No	GPD[25]	MSC0_D6	SFC1_DQ2_WP_	UART0_CTS_		VDDIO
C3	MSC0_D7_SFC1_DQ3_HOLD__UART0_RTS__PD26	IO	PU	No	No	GPD[26]	MSC0_D7	SFC1_DQ3_HOLD_	UART0_RTS_		VDDIO
B4	UART2_RXD_I2C3_SCK_PWM0_TCU0_IN0_PD30	IO	PU	No	No	GPD[30]	UART2_RXD	I2C3_SCK	PWM0_TCU0_IN0		VDDIO
C5	UART2_TXD_I2C3_SDA_PWM1_TCU0_IN1_PD31	IO	PU	No	No	GPD[31]	UART2_TXD	I2C3_SDA	PWM1_TCU0_IN1		VDDIO

2.2.5 GPIO Group E

Ball No.	Ball Name	In/ Out	Pull	Slew Rate	Schmitt	GPIO	Func0	Func1	Power
R10	MSC2_CLK_PWM2_TCU1_IN0_PE00	IO	PU	Yes	Yes	GPE[0]	MSC2_CLK	PWM2/TCU1_IN0	VDDIO33_SD
V10	MSC2_CMD_PWM3_TCU1_IN1_PE01	IO	PU	Yes	Yes	GPE[1]	MSC2_CMD	PWM3/TCU1_IN1	VDDIO33_SD
V9	MSC2_D0_PWM4_TCU2_IN0_PE02	IO	PU	Yes	Yes	GPE[2]	MSC2_D0	PWM4/TCU2_IN0	VDDIO33_SD
U9	MSC2_D1_PWM5_TCU2_IN1_PE03	IO	PU	Yes	Yes	GPE[3]	MSC2_D1	PWM5/TCU2_IN1	VDDIO33_SD
T9	MSC2_D2_PWM6_TCU3_IN0_PE04	IO	PU	Yes	Yes	GPE[4]	MSC2_D2	PWM6/TCU3_IN0	VDDIO33_SD
R9	MSC2_D3_PWM7_TCU3_IN1_PE05	IO	PU	Yes	Yes	GPE[5]	MSC2_D3	PWM7/TCU3_IN1	VDDIO33_SD
T10	SFC0_CLK_SSI1_CLK_PE16	IO	PU	No	Yes	GPE[16]	SFC0_CLK	SSI1_CLK	VDDIO33
U10	SFC0_CE__SSI1_DT_PE17	IO	PU	No	Yes	GPE[17]	SFC0_CE_	SSI1_DT	VDDIO33
T11	SFC0_DQ0_SSI1_DR_PE18	IO	PU	No	Yes	GPE[18]	SFC0_DQ0	SSI1_DR	VDDIO33
U11	SFC0_DQ1_I2C2_SCK_PE19	IO	PU	No	Yes	GPE[19]	SFC0_DQ1	I2C2_SCK	VDDIO33
V12	SFC0_DQ2_WP__I2C2_SDA_PE20	IO	PU	No	Yes	GPE[20]	SFC0_DQ2_WP_	I2C2_SDA	VDDIO33
U12	SFC0_DQ3_HOLD__SSI1_CE0__PE21	IO	PU	No	Yes	GPE[21]	SFC0_DQ3_HOLD_	SSI1_CE0_	VDDIO33
F4	DRV_VBUS_PE22	IO	PD	No	No	GPE[22]	DRV_VBUS		VDDIO
E2	RTC32K_PE23	IO	PD	No	No	GPE[23]	RTC32K		VDDIO
E3	EXCLK_CIM_VIC_MCLK_PE24	IO	PD	No	No	GPE[24]	EXCLK	CIM/VIC_MCLK	VDDIO
L4	BOOT_SEL0_PE25	IO	PD	No	No	GPE[25]	BOOT_SEL0		VDDIO
K4	BOOT_SEL1_PE26	IO	PD	No	No	GPE[26]	BOOT_SEL1		VDDIO
K2	BOOT_SEL2_PE27	IO	PD	No	No	GPE[27]	BOOT_SEL2		VDDIO
F2	WKUP_PE31	IO	PU	No	No	GPE[31]	WKUP_PE31		VDDIO_RTC

2.3 X2000 Analog PAD DESCRIPTION

Table 2-1 X2000 function pin description

Ball No.	Pin Names	IO	Power	Pin Description
Debug				
D6	TRST	I	VDDIO	JTAG reset
Memory				
A11	DDR_VDD1	P	DDR_VDD1	For DDR supply
B11	DDR_VDD1	P	-	For DDR supply
A12	DDRPLL_VCCA	P	-	DDR PHY PLL supply 1.8v
B12	DDR_VSSA	P	-	ground
A10	VREF	P		for DDR, reference voltage
C10	ZQ	I		for DDR, external reference resistor for output calibrating
Power and Ground				
A9	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
B8	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
B9	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
C8	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
C9	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
C12	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
C13	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
D12	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
D13	VDDMEM	P	-	DDR PHY LPDDR2/3 IO 1.2v supply
G6	VDDIO	P	-	GPIO 1.8v supply
H6	VDDIO	P	-	GPIO 1.8v supply
J13	VDDIO18	P	-	GPIO 1.8V supply for 3.3v PAD
N12	VDDIO18	P	-	GPIO 1.8V supply for 3.3v PAD
N6	VDDIO18_CIM	P	-	CIM Type PAD1.8V supply

N8	VDDIO18_SD	P	-	Connect to 1uf capacity for SD type PAD
H13	VDDIO33	P	-	GPIO 3.3V supply for 3.3v PAD
N13	VDDIO33	P	-	GPIO 3.3V supply for 3.3v PAD
M6	VDDIO33_CIM	P	-	CIM GPIO 3.3V /1.8Vsupply
N9	VDDIO33_SD	P	-	SD GPIO 3.3V/1.8V supply
A8	VSS	P	-	Digital Ground
A13	VSS	P	-	Digital Ground
B10	VSS	P	-	Digital Ground
B13	VSS	P	-	Digital Ground
C7	VSS	P	-	Digital Ground
C11	VSS	P	-	Digital Ground
D7	VSS	P	-	Digital Ground
D8	VSS	P	-	Digital Ground
D9	VSS	P	-	Digital Ground
D10	VSS	P	-	Digital Ground
D11	VSS	P	-	Digital Ground
F6	VSS	P	-	Digital Ground
F7	VSS	P	-	Digital Ground
F10	VSS	P	-	Digital Ground
F13	VSS	P	-	Digital Ground
G7	VSS	P	-	Digital Ground
G10	VSS	P	-	Digital Ground
G13	VSS	P	-	Digital Ground
H7	VSS	P	-	Digital Ground
H8	VSS	P	-	Digital Ground
H9	VSS	P	-	Digital Ground
H10	VSS	P	-	Digital Ground
J6	VSS	P	-	Digital Ground
J7	VSS	P	-	Digital Ground
J8	VSS	P	-	Digital Ground
J11	VSS	P	-	Digital Ground

J12	VSS	P	-	Digital Ground
K6	VSS	P	-	Digital Ground
K13	VSS	P	-	Digital Ground
L6	VSS	P	-	Digital Ground
L9	VSS	P	-	Digital Ground
L10	VSS	P	-	Digital Ground
L13	VSS	P	-	Digital Ground
M7	VSS	P	-	Digital Ground
M8	VSS	P	-	Digital Ground
M9	VSS	P	-	Digital Ground
M10	VSS	P	-	Digital Ground
M13	VSS	P	-	Digital Ground
N7	VSS	P	-	Digital Ground
N10	VSS	P	-	Digital Ground
N11	VSS	P	-	Digital Ground
F8	VDD	P	-	CORE digital power, 0.9V
F9	VDD	P	-	CORE digital power, 0.9V
F11	VDD	P	-	CORE digital power, 0.9V
F12	VDD	P	-	CORE digital power, 0.9V
G8	VDD	P	-	CORE digital power, 0.9V
G9	VDD	P	-	CORE digital power, 0.9V
G11	VDD	P	-	CORE digital power, 0.9V
G12	VDD	P	-	CORE digital power, 0.9V
H11	VDD	P	-	CORE digital power, 0.9V
H12	VDD	P	-	CORE digital power, 0.9V
K7	VDD	P	-	CORE digital power, 0.9V
K8	VDD	P	-	CORE digital power, 0.9V
K11	VDD	P	-	CORE digital power, 0.9V
K12	VDD	P	-	CORE digital power, 0.9V
L7	VDD	P	-	CORE digital power, 0.9V
L8	VDD	P	-	CORE digital power, 0.9V

L11	VDD	P	-	CORE digital power, 0.9V
L12	VDD	P	-	CORE digital power, 0.9V
M11	VDD	P	-	CORE digital power, 0.9V
M12	VDD	P	-	CORE digital power, 0.9V
Audio Codec				
U7	CODEC_AVDD	P	CODEC_AVDD	1.8V supply
R8	CODEC_AVSS	P		Ground
T7	CODEC_MICBIAS	AO	CODEC_AVDD	Electric microphone biasing voltage
T8	CODEC_HPOUTN	AO	CODEC_AVDD	DAC Differential output N
U8	CODEC_HPOUTP	AO	CODEC_AVDD	DAC Differential output P
U6	CODEC_MICLN	AI	CODEC_AVDD	ADC Differential input N end
V6	CODEC_MICLP	AI	CODEC_AVDD	ADC Differential input P end
V7	CODEC_VCM	AO	CODEC_AVDD	Reference voltage output
SADC				
T3	AUX0	AI	SADC_AVDD	Analog input 0
V1	AUX1	AI	SADC_AVDD	Analog input 1
T2	AUX2	AI	SADC_AVDD	Analog input 2
U2	AUX3	AI	SADC_AVDD	Analog input 3
T1	AUX4	AI	SADC_AVDD	Analog input 4
U3	AUX5	AI	SADC_AVDD	Analog input 5
U1	SADC_VREFP	AI	SADC_AVDD	Positive reference voltage input
T4	SADC_AVSS	P	-	ground
V2	SADC_AVDD	P	SADC_AVDD	1.8v supply
DSI				
L17	TX_DATAN0	AO	DSI_AVD09	Lane0 negative end
K16	TX_DATAP0	AO	DSI_AVD09	Lane0 positive end
J18	TX_DATAN1	AO	DSI_AVD09	Lane1 negative end
J17	TX_DATAP1	AO	DSI_AVD09	Lane1 positive end
K18	TX_CLKN	AO	DSI_AVD09	CLK negative end
K17	TX_CLKP	AO	DSI_AVD09	CLK positive end
L15	DSI_AVSS	P	-	ground

L16	DSI_AVD09	P	DSI_AVD09	0.9V Analog supply
M16	DSI_AVD18	P	DSI_AVD18	1.8V Analog supply
CSI				
M18	RX_DATAN0	AI	CSI_AVD09	Lane0 negative end
M17	RX_DATAP0	AI	CSI_AVD09	Lane0 positive end
N18	RX_DATAN1	AI	CSI_AVD09	Lane1 negative end
N17	RX_DATAP1	AI	CSI_AVD09	Lane1 positive end
R17	RX_DATAN2	AI	CSI_AVD09	Lane2 negative end
R18	RX_DATAP2	AI	CSI_AVD09	Lane2 positive end
T18	RX_DATAN3	AI	CSI_AVD09	Lane3 negative end
T17	RX_DATAP3	AI	CSI_AVD09	Lane3 positive end
P17	RX_CLKN0	AI	CSI_AVD09	CLK lane0 negative end
N16	RX_CLKP0	AI	CSI_AVD09	CLK lane0 positive end
U17	RX_CLKN1	AI	CSI_AVD09	CLK lane1 negative end
U18	RX_CLKP1	AI	CSI_AVD09	CLK lane1 positive end
M15	CSI_AVSS	P	-	ground
N15	CSI_AVD09	P	CSI_AVD09	0.9V Analog supply
P16	CSI_AVD18	P	CSI_AVD18	1.8V Analog supply
USB OTG				
V3	USB_DP0(OTG_DP)	AIO	USB_AVD33	USB OTG data plus
U4	USB_DM0(OTG_DM)	AIO	USB_AVD33	USB OTG data minus
T5	USB_VBUS(OTG_VBUS)	AI	USB_AVD18	USB 3V power supply pin for USB OTG. An external charge pump must provide power to this pin.
R6	USB_ID(OTG_ID)	AI	USB_AVD18	Used to identify the device attached to the PHY. The state of the pin is one of: high impedance (>1M Ω), or low impedance (<10Ω to ground).
R7	USB_BIAS	AIO	USB_AVD09	Connect to 135 ohm +/- 1% resistor, all internal bias base on it
R5	USB_AVSS	P	-	USB analog ground
V4	USB_AVD09	P	USB_AVD09	USB analog power.0.9V
U5	USB_AVD18	P	USB_AVD18	USB analog power.1.8V
T6	USB_AVD33	P	USB_AVD33	USB analog power.3.3V

EFUSE				
D5	AVDEFUSE	P	AVDEFUSE	EFUSE programming power, 0V/1.8V
CPM				
G2	OSC32_XI	AI	VDDIO_RTC	RTC OSC input.
G1	OSC32_XO	AO	VDDIO_RTC	RTC OSC output.
J1	EXCLK_XI	AI	VDDIO	EXCLK OSC Input
J2	EXCLK_XO	AO	VDDIO	EXCLK OSC Output
J3	PLL_VDD	P	-	PLL digital power, 0.9V
K3	PLL_VSS	P	-	PLL digital ground
H2	PLL_AVDD	P	-	PLL analog power, 1.8V
J4	PLL_AVSS	P	-	PLL analog ground
RTC				
F3	PWRON	O	VDDIO_RTC	Power on/off control of main power
G3	PPRST_	I	VDDIO_RTC	RTC power on reset and RESET-KEY reset input
G4	TEST_TE	I	VDDIO_RTC	Manufacture test enable, program readable
F1	VDDIO_RTC	P	VDDIO_RTC	1.8V supply to RTC IO
H3	VDD_RTC	P	-	0.9V supply to RTC
H4	VSS_RTC	P	-	Ground

2.4 X2000 Digital PAD DESCRIPTION

Table 2-2 X2000 Function Description

Signal Name	In/Out	Description
SLCD(Smart LCD)		
SLCD_D0	Output	Smart LCD data output bit 0
SLCD_D1	Output	Smart LCD data output bit 1
SLCD_D2	Output	Smart LCD data output bit 2
SLCD_D3	Output	Smart LCD data output bit 3

SLCD_D4	Output	Smart LCD data output bit 4
SLCD_D5	Output	Smart LCD data output bit 5
SLCD_D6	Output	Smart LCD data output bit 6
SLCD_D7	Output	Smart LCD data output bit 7
SLCD_D8	Output	Smart LCD data output bit 8
SLCD_D9	Output	Smart LCD data output bit 9
SLCD_D10	Output	Smart LCD data output bit 10
SLCD_D11	Output	Smart LCD data output bit 11
SLCD_D12	Output	Smart LCD data output bit 12
SLCD_D13	Output	Smart LCD data output bit 13
SLCD_D14	Output	Smart LCD data output bit 14
SLCD_D15	Output	Smart LCD data output bit 15
SLCD_RD	Output	Smart LCD read signal
SLCD_WR	Output	Smart LCD write signal
SLCD_CE_	Output	Smart LCD chip select signal
SLCD_TE	Input	Smart LCD tearing effect signal
SLCD_DC	Output	Smart LCD data/command select signal
LCD		
LCD_Dn	Output	LCD data output bit n
LCD_PCLK	Output	LCD pixel clock
LCD_VSYNC	Output	LCD frame sync
LCD_HSYNC	Output	LCD line sync
LCD_DE	Output	LCD data enable
CIM(Camera Interface)		
CIM_EXPOSURE	Output	CIM exposure signal to sensor to generate snapshot
CIM_VIC_PCLK	Input	CIM pixel clock input
CIM_VIC_HSYNC	Input	CIM line horizontal sync input
CIM_VIC_VSYNC	Input	CIM vertical sync input
CIM_VIC_MCLK	Output	CIM master clock output
VIC_D11	Input	CIM data input bit 11
VIC_D10	Input	CIM data input bit 10

VIC_D9	Input	CIM data input bit 9
VIC_D8	Input	CIM data input bit 8
CIM_VIC_D7	Input	CIM/VIC data input bit 7
CIM_VIC_D6	Input	CIM/VIC data input bit 6
CIM_VIC_D5	Input	CIM/VIC data input bit 5
CIM_VIC_D4	Input	CIM/VIC data input bit 4
CIM_VIC_D3	Input	CIM/VIC data input bit 3
CIM_VIC_D2	Input	CIM/VIC data input bit 2
CIM_VIC_D1	Input	CIM/VIC data input bit 1
CIM_VIC_D0	Input	CIM/VIC data input bit 0
I2S		
I2Sn_MCLK	Output	I2S n master clock out
I2Sn_BCLK	Bidirection	I2S n bit clock
I2Sn_LRCLK	Bidirection	I2S n LR clock
I2Sn_DI	Input	I2S n data input
I2Sn_DO	Output	I2S n data output
PCM		
PCM_CLK	Bidirection	PCM clock
PCM_DO	Output	PCM data out
PCM_DI	Input	PCM data in
PCM_SYN	Bidirection	PCM sync
DMIC		
DMIC_IN0	Input	DMIC data in for DMIC 0/1
DMIC_IN1	Input	DMIC data in for DMIC 2/3
DMIC_IN2	Input	DMIC data in for DMIC 4/5
DMIC_IN3	Input	DMIC data in for DMIC 6/7
DMIC_CLK	Output	Digital MIC clock output
SFC		
SFC0_CLK	Output	Serial Flash clock output
SFC0_CE_	Output	Serial Flash chip enable
SFCn_DQ0	Bidirection	Serial Flash data (n=0,1)

SFCn_DQ1	Bidirection	Serial Flash data
SFCn_DQ2_WP_	Bidirection	Serial Flash n write protect signal
SRCn_DQ3_HOLD_	Bidirection	Serial Flash n hold signal
PWM		
PWM0/TCU0_IN0	Bidirection	PWM/TCU data output/input
PWM1/TCU0_IN1	Bidirection	PWM/TCU data output/input
PWM2/TCU1_IN0	Bidirection	PWM/TCU data output/input
PWM3/TCU1_IN1	Bidirection	PWM/TCU data output/input
PWM4/TCU2_IN0	Bidirection	PWM/TCU data output/input
PWM5/TCU2_IN1	Bidirection	PWM/TCU data output/input
PWM6/TCU3_IN0	Bidirection	PWM/TCU data output/input
PWM7/TCU3_IN1	Bidirection	PWM/TCU data output/input
PWM8/TCU4_IN0	Bidirection	PWM/TCU data output/input
PWM9/TCU4_IN1	Bidirection	PWM/TCU data output/input
PWM10/TCU5_IN0	Bidirection	PWM/TCU data output/input
PWM11/TCU5_IN1	Bidirection	PWM/TCU data output/input
PWM12/TCU6_IN0	Bidirection	PWM/TCU data output/input
PWM13TCU6_IN1	Bidirection	PWM/TCU data output/input
PWM14/TCU7_IN0	Bidirection	PWM/TCU data output/input
PWM15/TCU7_IN1	Bidirection	PWM/TCU data output/input
RTC		
RTC32K	Output	32768Hz clock output
I2C		
I2Cn_SCK	Bidirection	I2C n serial clock
I2Cn_SDA	Bidirection	I2C n serial data
SCC		
SCC_SCK	Bidirection	Smart Card clock
SCC_SDA	Bidirection	Smart Card data
SSI		
SSIn_CLK	Output	SSI n clock output
SSIn_CE0_	Output	SSI n chip enable 0

SSIn_DT	Output	SSI n data output
SSIn_DR	Input	SSI n data input
UART		
UARTn_RXD	Input	UART n receiving data
UARTn_TXD	Output	UART n transmitting data
UARTn_CTS_	Input	UART Clear to send control
UARTn_RTS_	Output	UART Request to send control
MSC		
MSCn_D7	Bidirection	MSC(MMC/SD) n data bit 7
MSCn_D6	Bidirection	MSC(MMC/SD) n data bit 6
MSCn_D5	Bidirection	MSC(MMC/SD) n data bit 5
MSCn_D4	Bidirection	MSC(MMC/SD) n data bit 4
MSCn_D3	Bidirection	MSC(MMC/SD) n data bit 3
MSCn_D2	Bidirection	MSC(MMC/SD) n data bit 2
MSCn_D1	Bidirection	MSC(MMC/SD) n data bit 1
MSCn_D0	Bidirection	MSC(MMC/SD) n data bit 0
MSCn_CLK	Output	MSC(MMC/SD) n clock output
MSCn_CMD	Bidirection	MSC(MMC/SD) n command
USB 2.0 OTG		
DRV_VBUS	Output	USB OTG VBUS driver control signal
RGMAC		
RGMACn_PHY_CLK	Output	Ethernet n PHY clock (50MHz) (n=0，1)
RGMACn_RX_DV	Input	Rx data valid
RGMACn_RX_CLK	Input	Rx clk
RGMACn_RXD3	Input	receive data bit 3
RGMACn_RXD2	Input	receive data bit 2
RGMACn_RXD1	Input	receive data bit 1
RGMACn_RXD0	Input	receive data bit 0
RGMACn_TX_CLK	Output	Tx clk
RGMACn_TX_EN	Output	Ethernet n transmit enable

RGMACn_TXD3	Output	tx data bit 3
RGMACn_TXD2	Output	tx data bit 2
RGMACn_TXD1	Output	tx data bit 1
RGMACn_TXD0	Output	tx data bit 0
RGMACn_MDC	Output	Ethernet n management clock
RGMACn_MDIO	Bidirection	Ethernet n management data
NEMC		
SAn	Output	NEMC Address （n=12）
SDn	Bidirection	NEMC Data (n=16)
RD_	Output	NEMC read enable, low active
WE_	Output	NEMC write enable, low active
NEMC_CS1_	Output	NEMC chip select1
NEMC_CS2	Output	NEMC chip select2
WAIT_	Input	NEMC wait for external memory
DEBUG		
TDO	Output	JTAG serial data output
TDI	Input	JTAG serial data input
TCK	Input	JTAG clock
TMS	Input	JTAG mode select

NOTES:

1 The meaning of phases in IO cell characteristics are:

a PU: The IO cell contains a pull-up resistor.

b PD: The IO cell contains a pull-down resistor.

c Schmitt: The IO cell is Schmitt trig input.

2 All GPIO shared pins are reset to GPIO input.

3 Electrical Specifications

3.1 Absolute Maximum Ratings

The absolute maximum ratings for the processors are listed in Table 3-1. Do not exceed these parameters or the part may be damaged permanently. Operation at absolute maximum ratings is not guaranteed.

Table 3-1 Absolute Maximum Ratings

Parameter	Min	Max	Unit
Storage Temperature	-65	150	°C
Operation Temperature	-40	85	°C
VDDMEM power supplies voltage	-0.3	1.32	V
DDR_VDD1 power supplies voltage	-0.5	1.98	V
DDRPLL power supplies voltage	-0.5	1.98	V
VDDIO power supplies voltage	-0.5	1.98	V
VDDIO33 power supplies voltage	-0.5	3.63	V
VDDIO18 power supplies voltage	-0.5	1.98	V
VDDIO33_CIM power supplies voltage	-0.5	3.63	V
VDDIO18_CIM power supplies voltage	-0.5	1.98	V
VDDIO33_SD power supplies voltage	-0.5	3.63	V
VDD core power supplies voltage	-0.2	1.1	V
PLLVDD power supplies voltage	-0.2	1.1	V
PLLAVDD power supplies voltage	-0.5	1.98	V
AVDEFUSE power supplies voltage	-0.5	1.98	V
VDDIORTC power supplies voltage	-0.5	1.98	V
VDDRTC power supplies voltage	-0.2	1.1	V
USB_AVD33 power supplies voltage	-0.5	3.6	V
USB_AVD18 power supplies voltage	-0.5	1.98	V
USB_AVD09 power supplies voltage	-0.2	1.1	V
CODEC_AVDD power supplies voltage	-0.5	1.98	V
SADC_AVDD	-0.5	1.98	V
CSI_AVD18	-0.5	1.98	V
CSI_AVD09	-0.2	1.1	V
DSI_AVD18	-0.5	1.98	V
DSI_AVD09	-0.2	1.1	V
Input voltage to VDDMEM supplied non-supply pins	-0.3	1.32	V
Input voltage to VDDIO supplied non-supply pins	-0.3	1.98	V
Input voltage to VDDIO33 supplied non-supply pins	-0.3	3.6	V
Input voltage to VDDIO33_CIM supplied non-supply pins	-0.3	3.6	V
Input voltage to VDDIO33_SD supplied non-supply pins	-0.3	3.6	V
Input voltage to VDDIORTC supplied non-supply pins	-0.3	1.98	V
Input voltage to USB_AVD33 supplied non-supply pins	-0.3	3.6	V
Input voltage to CODEC_AVDD supplied non-supply pins	-0.3	1.98	V
Input voltage to SADC_AVDD supplied non-supply pins	-0.3	1.98	V
Input voltage to CSI_AVD18 supplied non-supply pins	-0.3	1.98	V
Output voltage from VDDMEM supplied non-supply pins	-0.3	1.32	V
Output voltage from VDDIO supplied non-supply pins	-0.3	1.98	V
Output voltage from VDDIO33 supplied non-supply pins	-0.3	3.6	V
Output voltage from VDDIO33_CIM supplied non-supply pins	-0.3	3.6	V

Output voltage from VDDIO18_CIM supplied non-supply pins	-0.3	1.98	V
Output voltage from VDDIORTC supplied non-supply pins	-0.3	1.98	V
Output voltage from USB_AVD33 supplied non-supply pins	-0.3	3.6	V
Output voltage from CODEC_AVDD supplied non-supply pins	-0.3	1.98	V
Output voltage from DSI_AVD18 supplied non-supply pins	-0.3	1.98	V
Maximum ESD stress voltage, Human Body Model; Any pin to any supply pin, either polarity, or Any pin to all non-supply pins together, either polarity. Three stresses maximum.		2000	V

3.2 Recommended operating conditions

Table 3-2 Recommended operating conditions for power supplies

Symbol	Description	Min	Typical	Max	Unit
VMEM	VDDMEM voltage for LPDDR3	1.14	1.2	1.3	V
	VDDMEM voltage for LPDDR2	1.08	1.2	1.32	V
VDDR	DDR_VDD1 voltage	1.7	1.8	1.95	V
VDDRPLL	DDRPLL voltage	1.62	1.8	1.98	V
VIO(1.8V)	VDDIO voltage	1.71	1.8	1.89	V
VIO18	VDDIO18 voltage	1.71	1.8	1.89	V
VIO33	VDDIO33 voltage	3.135	3.3	3.465	V
VCIM33(3.3V)	VDDIO33_CIM voltage, use as 3.3V	3.135	3.3	3.465	V
VCIM33(1.8V)	VDDIO33_CIM voltage, use as 1.8V	1.71	1.8	1.89	
VCIM18	VDDIO18_CIM voltage	1.71	1.8	1.89	V
VSD33(3.3V)	VDDIO33_SD voltage, use as 3.3V	3.135	3.3	3.465	V
VSD33(1.8V)	VDDIO33_SD voltage, use as 1.8V	1.71	1.8	1.89	V
VCORE	VDD core voltage	0.9	0.9	1	V
VPLLVDD	PLLVDD voltage	0.9	0.9	1	V
VPLLAVDD	PLLAVDD voltage	1.71	1.8	1.89	
VEFUSE	AVDEFUSE voltage	1.71	1.8	1.89	V
VRTCIO18	VDDIORTC voltage	1.71	1.8	1.89	V
VRTC	VDDRTC voltage	0.9	0.9	1	
VUSB33	USB_AVD33 voltage	3.135	3.3	3.465	V
VUSB18	USB_AVD18 voltage	1.71	1.8	1.89	
VUSB09	USB_AVD09 voltage	0.9	0.9	1	V
VCDC	CODEC_AVDD voltage	1.71	1.8	1.89	V
VADC	SADC_AVDD voltage	1.71	1.8	1.89	V
VCSI18	CSI_AVD18 voltage	1.62	1.8	1.98	V
VCSI09	CSI_AVD09 voltage	0.9	0.9	1	V
VDSI18	DSI_AVD18 voltage	1.71	1.8	1.89	V
VDSI09	DSI_AVD09 voltage	0.9	0.9	1	V

Table 3-3 Recommended operating conditions for VDDIO/VDDIO33/VDDIO33_SD/VDDIO33_CIM/VDDIO33_SD/VDDIORTC supplied pins

Symbol	Parameter	Min	Typical	Max	Unit
VIH18	Input high voltage for 1.8V I/O application	1.17	1.8	1.98	V
VIL18	Input low voltage for 1.8V I/O application	–0.3	0	0.63	V
VIH33	Input high voltage for 3.3V I/O application	2.0	3.3	3.465	V
VIL33	Input low voltage for 3.3V I/O application	–0.3	0	0.8	V

Table 3-4 Recommended operating conditions for others

Symbol	Description	Min	Typical	Max	Unit
TA	Ambient temperature	–40		85	°C

3.3 DC Specifications

The DC characteristics for each pin include input-sense levels and output-drive levels and currents. These parameters can be used to determine maximum DC loading, and also to determine maximum transition times for a given load. All DC specification values are valid for the entire temperature range of the device.

Table 3-5 DC characteristics for VREF

Symbol	Parameter	Min	Typical	Max	Unit
VREF	Reference voltage supply	0.49	0.5	0.51	VMEM

Table 3-6 DC characteristics for VDDIO/VDDIORTC supplied pins for 1.8V application

Symbol	Parameter	Min	Typical	Max	Unit
V_T	Threshold point	0.82	0.89	0.97	V
V_{T+}	Schmitt trig low to high threshold point	0.96	1.03	1.1	V
V_{T-}	Schmitt trig high to low threshold point	0.64	0.75	0.86	V
V_{TPU}	Threshold point with pull-up resistor enabled	0.81	0.88	0.97	V
V_{TPD}	Threshold point with pull-down resistor enabled	0.82	0.89	0.98	V
V_{TPU+}	Schmitt trig low to high threshold point with pull-up resistor enabled	0.95	1.02	1.09	V
V_{TPU-}	Schmitt trig high to low threshold point with pull-down resistor enabled	0.63	0.75	0.85	V
V_{TPD+}	Schmitt trig low to high threshold point with pull-down resistor enabled	0.96	1.05	1.11	V
V_{TPD-}	Schmitt trig high to low threshold point with pull-up resistor enabled	0.65	0.76	0.86	V
I_L	Input Leakage Current @ V_I=1.8V or 0V			±10	μA
I_{OZ}	Tri-State output leakage current @ V_I=1.8V or 0V			±10	μA
R_{PU}	Pull-up Resistor	60	89	137	kΩ
R_{PD}	Pull-down Resistor	61	104	196	kΩ
V_{OL}	Output low voltage			0.45	V
V_{OH}	Output high voltage	1.35			V
I_{OL}	Low level output current @ V_{OL}(max)	11.1	18.2	25.6	mA
I_{OH}	High level output current @ V_{OH}(min)	13.1	19.1	26.2	mA

Table 3-7 DC characteristics for VDDIO33_SD supplied pins for 1.8V application

Symbol	Parameter		Min	Typical	Max	Unit
V_T	Threshold point		0.76	0.94	1.24	V
V_{T+}	Schmitt trig low to high threshold point		0.94	1.09	1.36	V
V_{T-}	Schmitt trig high to low threshold point		0.68	0.89	1.2	V
V_{TPU}	Threshold point with pull-up resistor enabled		0.74	0.92	1.22	V
V_{TPD}	Threshold point with pull-down resistor enabled		0.76	0.95	1.25	V
V_{TPU+}	Schmitt trig low to high threshold point with pull-up resistor enabled		0.93	1.07	1.34	V
V_{TPU-}	Schmitt trig high to low threshold point with pull-down resistor enabled		0.66	0.88	1.18	V
V_{TPD+}	Schmitt trig low to high threshold point with pull-down resistor enabled		0.95	1.1	1.388	V
V_{TPD-}	Schmitt trig high to low threshold point with pull-up resistor enabled		0.68	0.9	1.22	V
I_L	Input Leakage Current @ V_I=1.8V or 0V				±10	μA
I_{OZ}	Tri-State output leakage current @ V_I=1.8V or 0V				±10	μA
R_{PU}	Pull-up Resistor		33	59	91	kΩ
R_{PD}	Pull-down Resistor		34	61	108	kΩ
V_{OL}	Output low voltage				0.225	V
V_{OH}	Output high voltage		1.35			V
I_{OL}	Low level output current @ V_{OL}(max)	(DS2,DS1,DS0) = 000	4.5	7.7	11.3	mA
		(DS2,DS1,DS0) = 001	6.7	11.4	16.7	mA
		(DS2,DS1,DS0) = 010	9	15.2	22.1	mA
		(DS2,DS1,DS0) = 011	11.2	18.8	27.3	mA
		(DS2,DS1,DS0) = 100	13.4	22.6	32.7	mA
		(DS2,DS1,DS0) = 101	15.6	26.2	37.8	mA
		(DS2,DS1,DS0) = 110	17.7	29.7	42.8	mA
		(DS2,DS1,DS0) = 111	19.9	33.2	47.7	mA
I_{OH}	High level output current @ V_{OH}(min)	(DS2,DS1,DS0) = 000	2.6	6.3	11.9	mA
		(DS2,DS1,DS0) = 001	3.8	9.4	17.7	mA
		(DS2,DS1,DS0) = 010	5.1	12.6	23.7	mA
		(DS2,DS1,DS0) = 011	6.4	15.7	29.4	mA
		(DS2,DS1,DS0) = 100	7.6	18.8	35.2	mA
		(DS2,DS1,DS0) = 101	8.9	21.8	40.9	mA
		(DS2,DS1,DS0) = 110	10.1	24.9	46.6	mA
		(DS2,DS1,DS0) = 111	11.4	27.9	52.2	mA

Table 3-8 DC characteristics for VDDIO33_SD supplied pins for 3.3V application

Symbol	Parameter		Min	Typical	Max	Unit
V_T	Threshold point		1.39	1.5	1.65	V
V_{T+}	Schmitt trig low to high threshold point		1.62	1.75	1.9	V
V_{T-}	Schmitt trig high to low threshold point		1.18	1.29	1.44	V
V_{TPU}	Threshold point with pull-up resistor enabled		1.36	1.48	1.64	V
V_{TPD}	Threshold point with pull-down resistor enabled		1.4	1.52	1.66	V
V_{TPU+}	Schmitt trig low to high threshold point with pull-up resistor enabled		1.62	1.75	1.89	V
V_{TPU-}	Schmitt trig high to low threshold point with pull-down resistor enabled		1.16	1.28	1.43	V
V_{TPD+}	Schmitt trig low to high threshold point with pull-down resistor enabled		1.64	1.77	1.91	V
V_{TPD-}	Schmitt trig high to low threshold point with pull-up resistor enabled		1.19	1.31	1.45	V
I_L	Input Leakage Current @ VI=1.8V or 0V				±10	μA
I_{OZ}	Tri-State output leakage current @ VI=1.8V or 0V				±10	μA
R_{PU}	Pull-up Resistor		34	51	81	kΩ
R_{PD}	Pull-down Resistor		35	51	88	kΩ
V_{OL}	Output low voltage				0.413	V
V_{OH}	Output high voltage		2.475			V
I_{OL}	Low level output current @ V_{OL}(max)	(DS2,DS1,DS0) = 000	2.8	5.4	9.8	mA
		(DS2,DS1,DS0) = 001	4.1	8.0	14.6	mA
		(DS2,DS1,DS0) = 010	5.5	10.7	19.4	mA
		(DS2,DS1,DS0) = 011	6.8	13.2	23.9	mA
		(DS2,DS1,DS0) = 100	8.2	15.9	28.7	mA
		(DS2,DS1,DS0) = 101	9.6	18.4	33.2	mA
		(DS2,DS1,DS0) = 110	10.9	20.9	37.6	mA
		(DS2,DS1,DS0) = 111	12.2	23.4	42.0	mA
I_{OH}	High level output current @ V_{OH}(min)	(DS2,DS1,DS0) = 000	4.4	7.6	13.5	mA
		(DS2,DS1,DS0) = 001	6.6	11.4	20.2	mA
		(DS2,DS1,DS0) = 010	8.8	15.2	26.9	mA
		(DS2,DS1,DS0) = 011	10.9	18.9	33.5	mA
		(DS2,DS1,DS0) = 100	13.1	22.6	40.1	mA
		(DS2,DS1,DS0) = 101	15.2	26.3	46.7	mA
		(DS2,DS1,DS0) = 110	17.4	30.1	53.3	mA
		(DS2,DS1,DS0) = 111	19.6	23.7	59.7	mA

Table 3-9 DC characteristics for VDDIO33/VDDIO18 supplied pins for 3.3V application

Symbol	Parameter		Min	Typical	Max	Unit
V_T	Threshold point		1.02	1.17	1.36	V
V_{T+}	Schmitt trig low to high threshold point		1.22	1.34	1.5	V
V_{T-}	Schmitt trig high to low threshold point		0.96	1.13	1.33	V
V_{TPU}	Threshold point with pull-up resistor enabled		1	1.15	1.34	V
V_{TPD}	Threshold point with pull-down resistor enabled		1.03	1.19	1.38	V
V_{TPU+}	Schmitt trig low to high threshold point with pull-up resistor enabled		1.21	1.32	1.47	V
V_{TPU-}	Schmitt trig high to low threshold point with pull-down resistor enabled		0.94	1.1	1.3	V
V_{TPD+}	Schmitt trig low to high threshold point with pull-down resistor enabled		1.23	1.35	1.52	V
V_{TPD-}	Schmitt trig high to low threshold point with pull-up resistor enabled		0.97	1.14	1.34	V
I_L	Input Leakage Current @ VI=1.8V or 0V				±10	μA
I_{OZ}	Tri-State output leakage current @ VI=1.8V or 0V				±10	μA
R_{PU}	Pull-up Resistor		26	46	71	kΩ
R_{PD}	Pull-down Resistor		27	48	103	kΩ
V_{OL}	Output low voltage				0.4	V
V_{OH}	Output high voltage		2.4			V
I_{OL}	Low level output current @ V_{OL}(max)	(DS2,DS1,DS0) = 000	4	6.3	8.9	mA
		(DS2,DS1,DS0) = 001	6	9.4	13.3	mA
		(DS2,DS1,DS0) = 010	8	12.5	17.6	mA
		(DS2,DS1,DS0) = 011	9.9	15.5	21.8	mA
		(DS2,DS1,DS0) = 100	11.9	18.6	26.1	mA
		(DS2,DS1,DS0) = 101	13.9	21.6	30.2	mA
		(DS2,DS1,DS0) = 110	15.8	24.5	34.2	mA
		(DS2,DS1,DS0) = 111	17.7	27.4	38.1	mA
I_{OH}	High level output current @ V_{OH}(min)	(DS2,DS1,DS0) = 000	5.9	9.3	14.2	mA
		(DS2,DS1,DS0) = 001	8.8	13.9	21.2	mA
		(DS2,DS1,DS0) = 010	11.7	18.5	28.2	mA
		(DS2,DS1,DS0) = 011	14.6	23.1	35.2	mA
		(DS2,DS1,DS0) = 100	17.5	27.7	42.2	mA
		(DS2,DS1,DS0) = 101	20.3	32.2	49.1	mA
		(DS2,DS1,DS0) = 110	23.2	36.8	56	mA
		(DS2,DS1,DS0) = 111	26.1	41.3	62.8	mA

Table 3-10 DC characteristics for VDDIO33_CIM/VDDIO18_CIM supplied pins for 3.3V application

Symbol	Parameter		Min	Typical	Max	Unit
V_T	Threshold point		0.76	0.94	1.24	V
V_{T+}	Schmitt trig low to high threshold point		0.94	1.09	1.37	V
V_{T-}	Schmitt trig high to low threshold point		0.68	0.89	1.21	V
V_{TPU}	Threshold point with pull-up resistor enabled		0.74	0.93	1.22	V
V_{TPD}	Threshold point with pull-down resistor enabled		0.76	0.95	1.26	V
V_{TPU+}	Schmitt trig low to high threshold point with pull-up resistor enabled		0.93	1.08	1.34	V
V_{TPU-}	Schmitt trig high to low threshold point with pull-down resistor enabled		0.67	0.88	1.18	V
V_{TPD+}	Schmitt trig low to high threshold point with pull-down resistor enabled		0.95	1.1	1.38	V
V_{TPD-}	Schmitt trig high to low threshold point with pull-up resistor enabled		0.68	0.9	1.22	V
I_L	Input Leakage Current @ VI=1.8V or 0V				±10	μA
I_{OZ}	Tri-State output leakage current @ VI=1.8V or 0V				±10	μA
R_{PU}	Pull-up Resistor		33	59	91	kΩ
R_{PD}	Pull-down Resistor		34	61	108	kΩ
V_{OL}	Output low voltage				0.4	V
V_{OH}	Output high voltage		2.4			V
I_{OL}	Low level output current @ V_{OL}(max)	(DS1,DS0) = 00	2.8	5.4	9.8	mA
		(DS1,DS0) = 01	4.1	8.0	14.6	mA
		(DS1,DS0) = 10	5.5	10.6	19.3	mA
		(DS1,DS0) = 11	6.8	13.2	23.8	mA
I_{OH}	High level output current @ V_{OH}(min)	(DS1,DS0) = 00	4.4	7.6	13.5	mA
		(DS1,DS0) = 01	6.6	11.4	20.2	mA
		(DS1,DS0) = 10	8.8	15.2	26.9	mA
		(DS1,DS0) = 11	10.9	18.9	33.6	mA

Table 3-11 DC characteristics for VDDIO33_CIM/VDDIO18_CIM supplied pins for 1.8V application

Symbol	Parameter		Min	Typical	Max	Unit
V_T	Threshold point		0.85	0.95	1.08	V
V_{T+}	Schmitt trig low to high threshold point		0.97	1.06	1.17	V
V_{T-}	Schmitt trig high to low threshold point		0.7	0.82	0.94	V
V_{TPU}	Threshold point with pull-up resistor enabled		0.85	0.95	1.07	V
V_{TPD}	Threshold point with pull-down resistor enabled		0.86	0.96	1.09	V
V_{TPU+}	Schmitt trig low to high threshold point with pull-up resistor enabled		0.97	1.06	1.16	V
V_{TPU-}	Schmitt trig high to low threshold point with pull-down resistor enabled		0.69	0.81	0.93	V
V_{TPD+}	Schmitt trig low to high threshold point with pull-down resistor enabled		0.98	1.07	1.18	V
V_{TPD-}	Schmitt trig high to low threshold point with pull-up resistor enabled		0.7	0.82	0.95	V
I_L	Input Leakage Current @ VI=1.8V or 0V				±10	μA
I_{OZ}	Tri-State output leakage current @ VI=1.8V or 0V				±10	μA
R_{PU}	Pull-up Resistor		33	59	90	kΩ
R_{PD}	Pull-down Resistor		34	61	95	kΩ
V_{OL}	Output low voltage				0.45	V
V_{OH}	Output high voltage		1.4			V
I_{OL}	Low level output current @ V_{OL}(max)	(DS1,DS0) = 00	4.5	7.6	11.2	mA
		(DS1,DS0) = 01	6.7	11.4	16.6	mA
		(DS1,DS0) = 10	8.9	15.1	22	mA
		(DS1,DS0) = 11	11.1	18.7	27.2	mA
I_{OH}	High level output current @ V_{OH}(min)	(DS1,DS0) = 00	2.6	6.3	11.9	mA
		(DS1,DS0) = 01	3.8	9.5	17.8	mA
		(DS1,DS0) = 10	5.1	12.6	23.7	mA
		(DS1,DS0) = 11	6.4	15.7	29.4	mA

3.4 Audio codec

Measurement conditions: T = 25°C, AVDD = 1.8 V, DVDD = 0.9V, 1KHz Sine Input, FS = 48KHZ					
Parameter	Test conditions	Min.	Type	Max.	Unit
Analog Supply		1.62	1.8	1.98	V
Digital Supply		0.81	0.9	0.99	V
Temperature		-40		125	℃
ADC					
SNR	A-weighted		92		
THD			-81		
Bias Voltage		0.5*AVDD		0.85*AVDD	V
Bias Current				3	mA
Mic Gain		0		20	dB
ALC Gain		-18		28.5	dB
Gain Step Size			1.5		dB
input Resistance		8		88	KΩ
input Capacitance			10		pF
DAC					
SNR	A-weighted		93		dB
THD	60mWΩ		-70		dB
	30mWΩ		-75		dB
	600Ω		-80		dB
Programmable Gain		-39		6	dB
Gain Step Size			1.5		
Output Resistance				1	Ω
Output Capacitance			20		pF
Power Supply Rejection	1KHZ		55		dB
Power Consumption					
Standby			0.1		mA

3.5 Power On, Reset and BOOT

3.5.1 Power-On Timing

The external voltage regulator and other power-on devices must provide the X2000 processor with a specific sequence of power and reset to ensure proper operation. Figure 3-1 shows this sequence and Table 3-12 gives the timing parameters. Following are the name of the power.

VDDIORTC: VDDIORTC

VDDRTC: VDDRTC

VDDIO18: all other 1.8V power supplies, include VDDIO, VDDIO18, PLLAVDD, VDDIO18_CIM, CSI_AVD18, DSI_AVD18, USB_AVD18, CODEC_AVDD, SADC_AVDD, DDRPLL, DDR_VDD1

VMEM: VDDMEM

VDDIO33: all 3.3V power supplies, include VDDIO33, VDDIO33_CIM, VDDIO33_SD, AVDUSB33

VDD: all other 0.9V power supplies: VDD, PLLVDD, DSI_AVD09, CSI_AVD09, USB_AVD09

AVDEFUSE: AVDEFUSE

Table 3-12 Power-On Timing Parameters

Symbol	Parameter	Min	Max	Unit
t_{D_VDDRTC}	Delay between VDDIORTC arriving 50% to VDDRTC arriving 90%[1]	0	–	ms
$t_{D\_VDDIO18}$	Delay between VDDIORTC arriving 50% to VDDIO18 arriving 50%[1]	0	–	ms
t_{D_VMEM}	Delay between VDDIO18 arriving 90% to VMEM to be turned on	0	–	ms
$t_{D\_VDDIO33}$	Delay between VDDIO18 arriving 90% to VDDIO33 to be turned on	20	–	us
t_{D_VDD}	Delay between VDDIO18 arriving 50% to VDD arriving 90%[1]	0	–	ms
$t_{D\_PPRST\_}$	Delay between all power rails get stable and power-on reset PPRST_ de-asserted[2]	TBD[3]	–	ms[2]
$t_{D\_AVDEFUSE}$	Delay between PPRST_ finished and E-fuse programming power apply	0	–	ms
$t_{H\_AVDEFUSE}$	E-fuse programming time	–	200	ms

NOTES:

1 The power rails have same skew.

2 The PPRST_ must be kept at least 1ms. After PPRST_ is deasserted, the corresponding chip reset will be extended at least 10ms.

3 It must make sure the EXCLK is stable and all power(except AVDEFUSE) is stable.

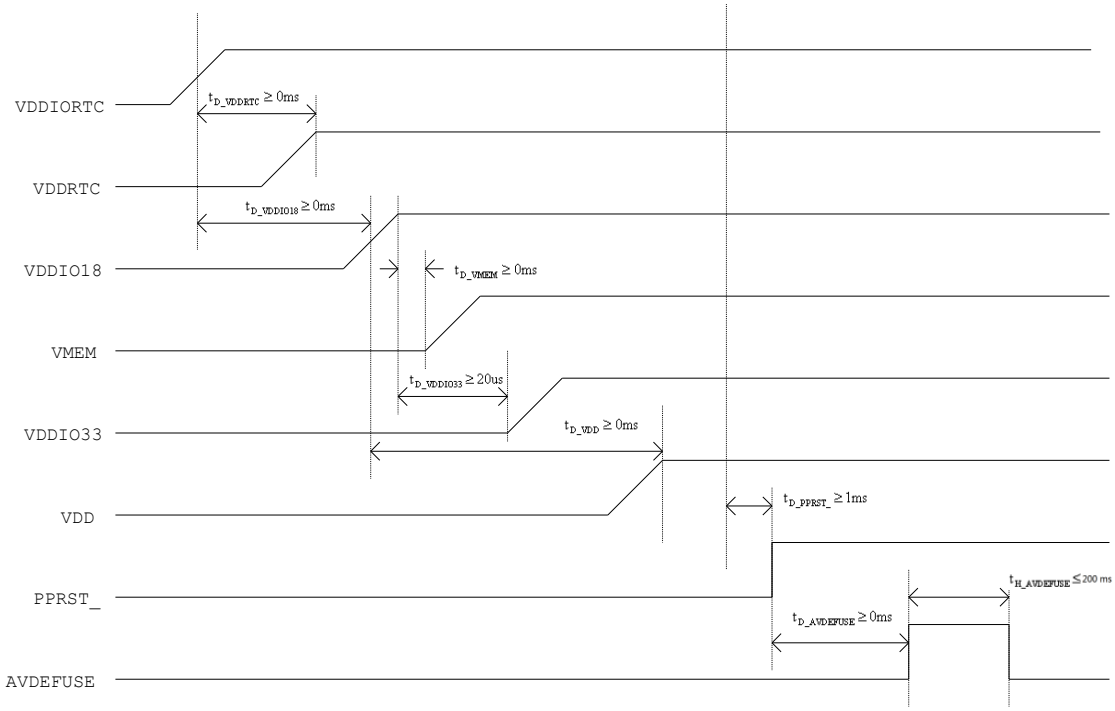


Figure 3-1 Power-On Timing Diagram

3.5.2 Reset procedure

There 3 reset sources: 1 PPRST_ pin reset; 2 WDT timeout reset; and 3 hibernating reset when exiting hibernating mode. After reset, program start from boot.

1 PPRST_ pin reset.
This reset is trigged when PPRST_ pin is put to logic 0. It happens in power on RTC power and RESET-KEY pressed to reset the chip from unknown dead state. The reset end time is about 10ms (512 clock whose frequence is exclk/512) after rising edge of PPRST_.

2 WDT reset.
This reset happens in case of WDT timeout.

3 Hibernating reset.
This reset happens in case of wakeup the main power from power down. The reset keeps for about 125ms as default and can be programed up to 1s, plus 10ms (512 clock whose frequence is exclk/512), start after WKUP_ signal is recognized.

After reset, all GPIO shared pins are put to GPIO input function，except JTAG relate TCK/TMS/TDI /TDO which reset to function mode, and most of their internal pull-up/down resistor are set to on. The PWRON is output 1. The oscillators are on.

3.5.3 BOOT

The boot sequence of the X2000 is controlled by boot_sel [2:0], GPIO PE27/26/25 PAD

Table 3-13 Boot Configuration of X2000

boot_sel[2]	boot_sel[1]	boot_sel[0]	Boot configuration
0	0	0	SFC0@PE 3.3v
0	0	1	MSC2@PE 3.3v
X	1	0	USB
0	1	1	Nor
1	0	0	SFC0@PD 1.8v
1	0	1	MSC0@PD 1.8v
1	1	1	MSC2@PE 1.8v

X: means "Don't Care"

After reset, the boot program on the internal boot ROM executes as follows:

1 Disable all interrupts, prepare the program running environment.

2 Read and save efuse values, efuse values to determine whether to improve system clock frequency, set MSC 4bit transmission data, gpio HI-Z, USB eye diagram.

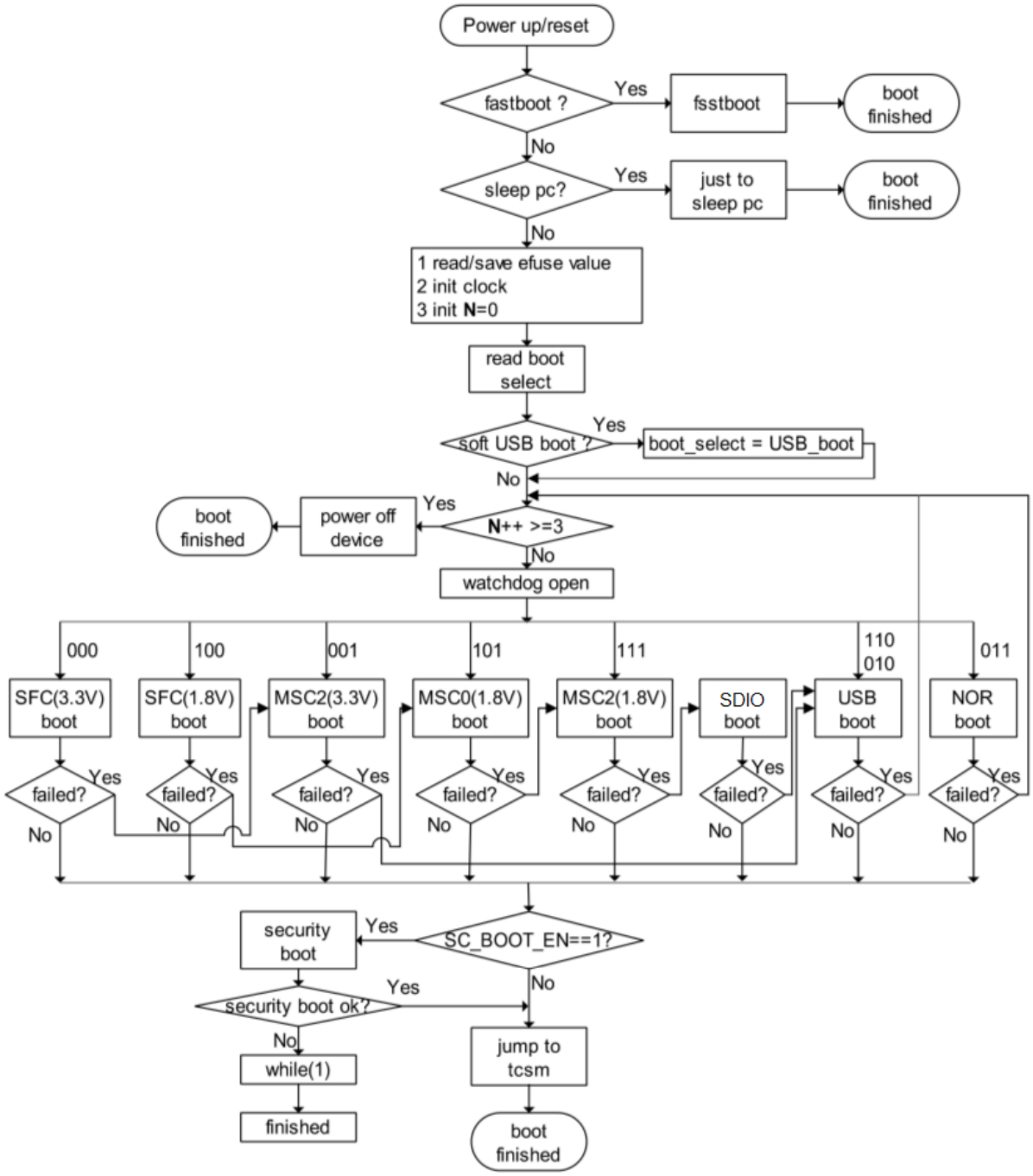
3 Initialize clock and read boot_sel[2:0] to determine the boot method.

4 If it is boot from MMC/SD card at MSC0/MSC2, its function pins MSC_D0, MSC_CLK, MSC_CMD are initialized, the boot program loads the 24KB data from MMC/SD card to SRAM and jump to it. Only one data bus which is MSC_D0 is used. The clock EXTCLK/122 is used initially. When reading data, the clock EXTCLK/4 is used. If the msc_bus_width_4 efuse values is set to 1, function pins MSC_D0, MSC_D1, MSC_D2, MSC_D3 are initialized for 4bit data transmission.

5 If it is boot from USB, a block of code will be received through USB cable connected with host PC and be stored in tcsm. Then branch to this area in tcsm.

6 If it is boot from SPI nor/nand at SFC, its function pins SFC_CLK, SFC_CE, SFC_DR, SFC_DT, SFC_WP, SFC_HOL are initialized, the boot program loads the spl size bytes code from nor/nand to SRAM and jump to it.

NOTE: The X2000's SRAM is 32KB, its address is from 0xB2400000 to 0xB2408000.

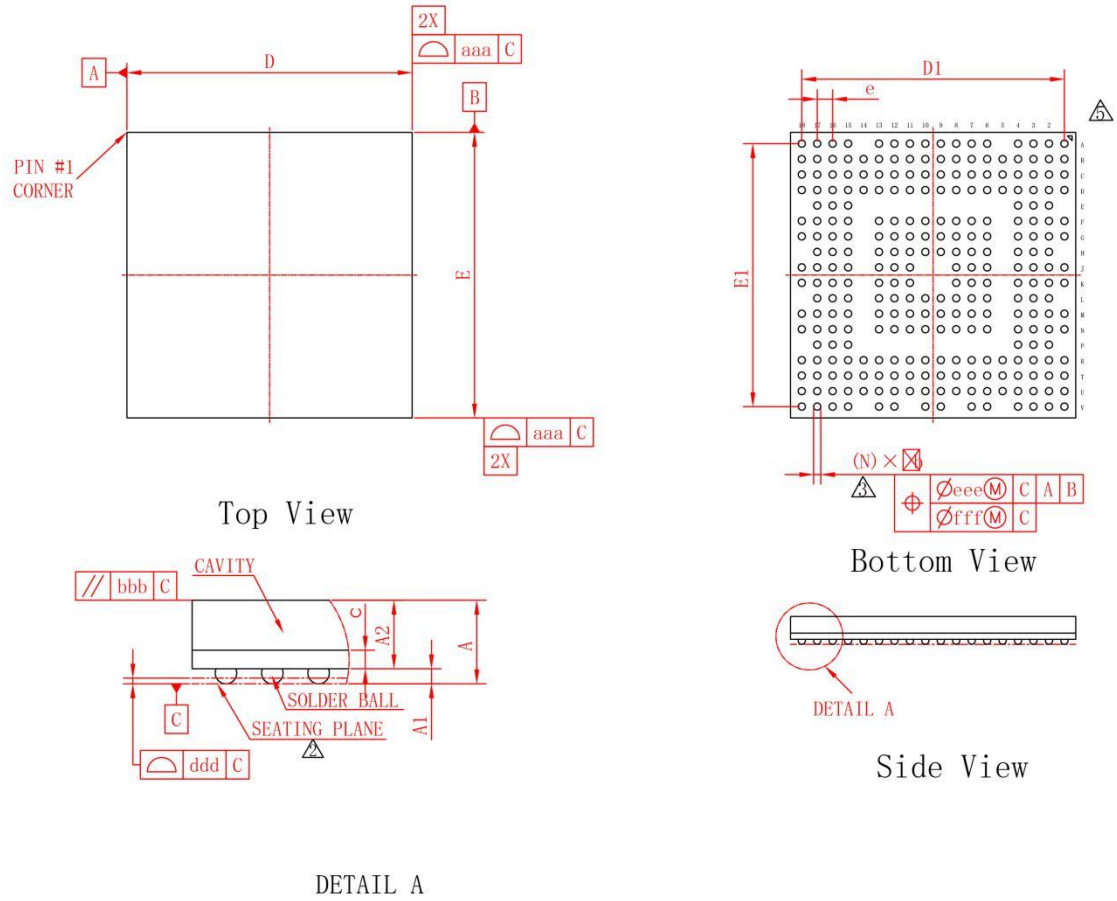


4 Packaging Information

4.1 Overview

X2000 processor is offered in 270-pin BGA package, which is 12mm x 12mm x 1.2mm outline, 18 x 18 matrix ball grid array and 0.65mm ball pitch, show in Figure 4-1.

4.2 Device Dimensions



symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.270	---	---	0.050
A1	0.160	0.210	0.260	0.006	0.008	0.010
A2	0.910	0.960	1.010	0.036	0.038	0.040
c	0.220	0.260	0.300	0.009	0.010	0.012
D	11.900	12.000	12.100	0.469	0.472	0.476
E	11.900	12.000	12.100	0.469	0.472	0.476
D1	---	11.050	---	---	0.435	---
E1	---	11.050	---	---	0.435	---
e	---	0.650	---	---	0.026	---
b	0.250	0.300	0.350	0.010	0.012	0.014
aaa	0.100			0.004		
bbb	0.100			0.004		
ddd	0.080			0.003		
eee	0.150			0.006		
fff	0.080			0.003		
Ball Diam	0.300			0.012		
N	270			270		
MD/ME	18/18			18/18		

Figure 4-1 X2000 package outline drawing

Notes:

1. BALL PAD OPENING: 0.270mm；
2. PRIMARY DATUM C AND SEATING PLANE ARE THE SOLDER BALLS；
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER,PARALLEL TO PRIMARY DATUM C；
4. SPECIAL CHARACTERISTICS C CLASS: bbb, ddd；
5. THE PATTERN OF PIN 1 FIDUCIAL IS FOR REFERENCE ONLY；
6. BAN TO USE THE LEVEL 1 ENVIRONMENT-RELATED SUBSTANCES；

4.3 Solder Ball Materials

Both the top (joint) and bottom solder ball materials of X2000 are SAC125.

4.4 Moisture Sensitivity Level

X2000 package moisture sensitivity is level 3.