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CH2601 数据手册



芯片开放社区
Open Chip Community

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一 概述

CH2601 是基于平头哥 32 位玄铁 CPU E906 的 RISC-V 生态芯片，它配置 512KB Flash，256KB SRAM 及丰富的片上外设，最高主频 220MHz，支持 AliOS Things 物联网操作系统、平头哥 YoC 软件平台及平头哥剑池开发工具(CDK)。

二 主要功能概述

- CPU
 - 32 位 CPU 玄铁 E906
 - 支持 48 个可嵌套中断源
- 存储资源
 - 512KB XIP Flash
 - 64KB(DSRAM)+64KB(DSRAM)+64KB(DSRAM)+32KB(ISRAM)+32KB(ISRAM)
 - 8KB BOOTROM
 - 1KB EFuse
- 外设及特性
 - DMAC
 - ◆ 8 通道
 - ◆ 8 硬件触发源
 - ◆ 支持单次/组合/区块不同的触发模式
 - RTC
 - ◆ 32 位计数器
 - ◆ 可产生中断
 - PWM
 - ◆ 12 输出/捕获通道
 - ◆ 6 组 PWM 发生器，每组配置 1 个 16 位计数器，2 个 PWM 比较器，1 个中断产生器
 - ◆ 每组 PWM 发生器包括 2 通道输出信号
 - ◆ 输入时钟分频系数支持 1, 2, 4, 8, 16, 32, 64 or 128
 - ◆ 每路 PWM 信号可单独使能/禁止

-
- ◆ 每路 PWM 输出信号极性可配置
 - ◆ 16 位 PWM 计数器支持上升/下降技术模式
 - ◆ 支持边缘捕获模式
 - ◆ 可触发 ADC 采样
 - 32 位看门狗计数器
 - USB1.1 Device
 - GPIO
 - ◆ 每个 GPIO 可产生中断
 - ◆ 每个 GPIO 可单独配置上下拉
 - 7 路 I2S
 - 12bit ADC
 - ◆ 最高采样速率 2MSPS
 - ◆ 采样电压输入范围： $AGND \leq V_{in} \leq AVDD$
 - ◆ 支持单次采样、连续采样及外部信号触发采样模式
 - ◆ 采样结束可产生中断、可触发 DMA 传输
 - 4 路 32 位定时器
 - 2 路 SPI 串行接口
 - ◆ 支持主/从模式
 - ◆ 可触发 DMA 传输
 - 1 路 I2C 串行接口
 - ◆ 支持主/从模式
 - ◆ 可触发 DMA 传输
 - 2 路 UART 串行接口
 - ◆ 可触发 DMA 传输
 - 复位电路
 - 外部复位电路
 - 看门狗复位
 - 上电复位
 - 掉电复位
 - CPU 软复位
 - 物理特性
 - SMIC 55nm ULL 生产工艺
 - 220MHz 主频

三 存储器及外设地址引射

3.1 存储器地址映射

Table 3-1 存储器地址映射表

Address Range	Size	Usage
0x0000_0000~0x0000_1FFF	8KB	ROM for boot
0x0800_0000~0x0800_FFFF	64KB	Internal SRAM
0x1800_0000~0x1FFF_FFFF	128MB	QSPI0
0x2000_0000~0x2002_FFFF	192KB	Internal SRAM
0x4000_0000~0x4003_0FFF	196KB	AHB Peripherals
0x5000_0000~0x5004_FFFF	320KB	APB0 Peripherals
0x5005_0000~0x5FFF_FFFF	256MB-320KB	Reserved
0x6000_0000~0x6004_FFFF	320KB	APB1 Peripherals
0x6005_0000~0x6FFF_FFFF	256MB-320KB	Reserved
0x7000_0000~0x7FFF_FFFF	256MB	Reserved
0x8000_0000~0xAFFF_FFFF	768MB	Bit Banding Controller
0xB000_0000~0xDFFF_FFFF	768MB	Reserved
0xE000_0000~0xE000_DFFF	56KB	Reserved
0xE000_E000~0xE000_EFFF	4KB	TCIP
0xE000_F000~0xFFFF_FFFF	512MB-60KB	Reserved

3.2 外设地址映射

Table 3-2 外设地址映射表

地址范围	IP 名	大小	描述
AHB			
0x0000_0000~0x0000_1FFF	ROM	8KB	ROM
0x0000_2000~0x0FFF_FFFF	-	256MB-8KB	Reserved
0x0800_0000~0x0800_7FFF	ISRAM0	32KB	Internal Inst SRAM
0x0800_8000~0x0800_FFFF	ISRAM1	32KB	Internal Inst SRAM

0x1000_0000~0x17FF_FFFF	-	128MB	Reserved
0x1800_0000~0x1FFF_FFFF	SUB1/QSPIC0	128MB	SUB1/QSPI0 MEM
0x2000_0000~0x2000_FFFF	DSRAM0	64KB	Internal data SRAM
0x2001_0000~0x2001_FFFF	DSRAM1	64KB	Internal data SRAM
0x2002_0000~0x2002_FFFF	DSRAM2	64KB	Internal data SRAM
0x2001_0000~0x3FFF_FFFF	-	512MB-64KB	Reserved
0x4000_0000~0x4000_OFFF	PMU	4KB	Power Management
0x4000_1000~0x4000_1FFF	DMA0	4KB	DMA0 Controller
0x4000_1000~0x4003_FFFF	-	256KB-8KB	Reserved
0x4004_0000~0x4004_OFFF	USB	4KB	USB
0x4004_1000~0x4FFF_FFFF	-	256MB-260KB	Reserved
0x5000_0000~0x5004_FFFF	APB0	256KB	APB0
0x5005_0000~0x5FFF_FFFF	-	256MB-256KB	Reserved
0x6000_0000~0x6004_FFFF	APB1	256KB	APB1
0x6005_0000~0x7FFF_FFFF	-	512MB-256KB	Reserved
0x8000_0000~0xAFFF_FFFF	BBC	512MB	Bit Banding Controller
0xB000_0000~0xDFFF_FFFF	-	768MB	Reserved
0xE000_0000~0xE000_DFFF	-	56KB	Reserved
0xE000_E000~0xE000_EFFF	TCIP	4KB	TCIP
0xE000_F000~0xFFFF_FFFF	-	512MB-60KB	Reserved
SUB1			
0x1800_0000~0x1FFF_FFFF	QSPIC0	128MB	QSPI MEM
APB0			
0x5000_0000~0x5000_03FF	TIM0	1KB	Timer 0
0x5000_0400~0x5000_07FF	TIM1	1KB	Timer 1
0x5000_0800~0x5000_3FFF	-	14K	Reserved
0x5000_4000~0x5000_43FF	RTC	1KB	Real Time Clock
0x5000_4400~0x5000_7FFF	-	15K	Reserved
0x5000_8000~0x5000_83FF	WDT	1KB	Watch Dog
0x5000_8400~0x5000_BFFF	-	15KB	Reserved

0x5000_C000~0x5000_C3FF	SPI0	1KB	SPI0
0x5000_C400~0x5000_FFFF	-	15KB	Reserved
0x5001_0000~0x5001_03FF	UART0	1KB	UART 0
0x5001_0800~0x5001_3FFF	-	15KB	Reserved
0x5001_4000~0x5001_43FF	I2C0	1KB	I2C 0
0x5001_4400~0x5001_7FFF	-	15KB	Reserved
0x5001_8000~0x5001_83FF	GPIO0	1KB	GPIO0
0x5001_8400~0x5001_BFFF	-	15KB	Reserved
0x5001_C000~0x5001_C3FF	PWM	1KB	PWM
0x5001_C400~0x5002_BFFF	-	63KB	Reserved
0x5002_C000~0x5002_C3FF	QSPIC0	1KB	QSPIC0
0x5002_C400~0x5003_7FFF	-	47KB	Reserved
0x5003_8000~0x5003_83FF	PWMR	1KB	PWMR
0x5003_8400~0x5003_BFFF	-	15KB	Reserved
0x5003_C000~0x5003_C3FF	EFUSE	1KB	EFUSE
0x5003_C400~0x5003_FFFF	-	15KB	Reserved
0x5004_0000~0x5004_03FF	I2S0	1K	I2S0
0x5004_0400~0x5004_07FF	I2S1	1K	I2S1
0x5004_0800~0x5002_3FFF	Reserved	15K	Reserved
APB1			
0x6000_0000~0x6000_03FF	TIM2	1KB	Timer 2
0x6000_0400~0x6000_07FF	TIM3	1KB	Timer 3
0x6000_1000~0x6000_3FFF	-	14KB	Reserved
0x6000_C000~0x6000_C3FF	SPI1	1KB	SPI1
0x6000_C400~0x6000_FFFF	-	15KB	Reserved
0x6001_0000~0x6001_03FF	UART1	1KB	UART 1
0x6001_0800~0x6001_3FFF	-	15KB	Reserved
0x6001_4000~0x6001_40FF	I2S4	1KB	Reserved
0x6001_4100~0x6001_41FF	I2S5	1KB	Reserved

0x6001_4200~0x6001_42FF	I2S6	1KB	Reserved
0x6001_4400~0x6001_7FFF	-	15KB	Reserved
0x6002_0000~0x6002_03FF	ADC	1KB	AD converter
0x6002_0400~0x6002_3FFF	-	15KB	Reserved
0x6002_4000~0x6002_43FF	ETB	1KB	Event Trigger Block
0x6002_4400~0x6002_7FFF	-	15KB	Reserved
0x6003_0000~0x6003_03FF	IOCTL	1KB	IO Ctrl
0x6003_0400~0x6003_43FF	-	16KB	Reserved
0x6004_0400~0x6004_07FF	I2S2(CODEC)	1K	I2S2(CODEC)
0x6004_0800~0x6004_0BFF	I2S3(CODEC)	1K	I2S3(CODEC)
0x6004_0C00~0x6004_3FFF	Reserved	13K	Reserved
0x6004_4000~0x6004_43FF	CODEC	1K	CODEC(dummy)
0x6004_4400~0x6004_7FFF	Reserved	15K	Reserved

3.3 TCIP 地址映射

Table 3-3 TCIP 地址映射表

Address Range	TCIP Name
0xE000E010~0xE000E0FF	Core Timer
0xE000E100~0xE000ECFF	Vector Interrupt Controller(VIC)

四 芯片中断源

Table 3-1 CH2601 中断源

Number	Interrupt Source
0	GPIO0
1	CoreTim
2	TIM0-0
3	TIM0-1
4	REV
5	WDT

6	UART0
7	UART1
8	USB
9	I2C0
10	I2C1
11	SPI1
12	SPI0
13	RTC
14	I2S0
15	ADC
16	I2S1
17	DMA0
18	PMU
19	PWM
20	PWMR
21	I2S2
22	I2S3
23	TIM1-0
24	TIM1-1
25	QSPIC0
26	TIM2-0
27	TIM2-1
28	TIM3-0
29	TIM3-1
30	USBPHY
31	Wake up request

五 时钟和复位

CH2601 时钟相关的管脚说明如下

Table 5-1 CH2601 外部时钟

Clock	I/O	Pin Name	Freq(Hz)
外部高速晶体时钟	I	EHSCCLK	12M~16M
外部低速晶体时钟	I	ELSCCLK	32.768K
JTAG 时钟	I	TCLK	<10M
I2C 时钟	I/O	I2C0_CLK	4M(Max)
SPI 主机时钟	O	SPIM_CLK	<1/2 pclk
SPI 从机时钟	I	SPIS_CLK	<1/10 Fpclk

由上述时钟源驱动的内部时钟如下

Table 5-2 CH2601 内部时钟

时钟源	描述	频率
EHS	External high speed clock	12M~16M
IHS	Internal high speed clock	48M
USBPHY CLK	USBPHY generate clock	12M
ILS	Internal low speed clock	32.768K
ELS	External low speed clock	32.768K
PLL clock	Generated by PLL clock	300M (Max)
CPU clock	Generated by HS clock	220M (Max)
AHB clock	Generated by CPU clock	220M (Max)
APB 0 clock	Generated by CPU clock	110M (Max)
APB 1 clock	Generated by CPU clock	110M (Max)
RTC clock	Driven by ELS clock	1Hz
Coretim clock	Driven by MCLK	220M (Max)
ADC clock	Driven by APB0 clock	APB0 clock
I2S clock	Driven by MCLK	300M(MAX)

CH2601 芯片内部复位及外部复位说明如下

Table 5-3 CH2601 外部复位管脚

Reset	I/O	Pin Name	Description
外部复位	输入	MCURST	系统复位，低电平有效

Table 5-4 CH2601 内部复位管脚

复位源	描述
IP software reset	Software reset for function IP, generated by PMU
Low power reset	Reset power down domain, generated by low power mode
CPU software reset	Reset all chip, generated by CPU
WDT reset	Reset all chip, generated by WDT time out
POR reset	Reset all chip, generated by chip power on
BOD reset	Reset all chip, generated by chip voltage instability

六 电气特性

6.1 极限参数

Table 6-1 CH2601 极限电气参数

参数	最小值	典型值	最大值	单位
内核电压	-	1.32	-	V
端口电压	2.9	3.3	3.6	V
工作温度范围	-40	25	85	°C
贮存温度范围	-40	25	125	°C

6.2 电气规格

测试条件（除特别注明外）：CPU 主频 = 196.608MHz, 环境温度 (Ta) = 25°C。

6.2.1 模拟性能规格

电源供电 VDD = 3.3V

Table 6-2 CH2601 模拟性能规格表

测试项	参数	测试条件/描述	Min	Typ	Max	单位
VDD 总功耗	正常工作模式	Run	-	40	-	mA
LDO	AONLDO/PDLDO 输出电压	1.2V 模式	-	1.2	-	V
	AONLDO 电流输出能力	1.2V 模式 (drop 5%)	-	-	10	mA
	PDLDO 电流输出能力	1.2V 模式 (drop 5%)	-	-	70	mA
	NRST VIL	3.3V 供电	-	1.83	-	V
	NRST VIH	3.3V 供电	-	1.83	-	V

6.2.2 晶振放大器规格

电源供电 VDD = 3.3V

Table 6-3 CH2601 晶体规格

测试项	测试条件/描述	最小	典型	最大	单位
频率范围		-	12	-	MHz
负载电容 (根据晶振推荐值)		-	22pF	-	pF

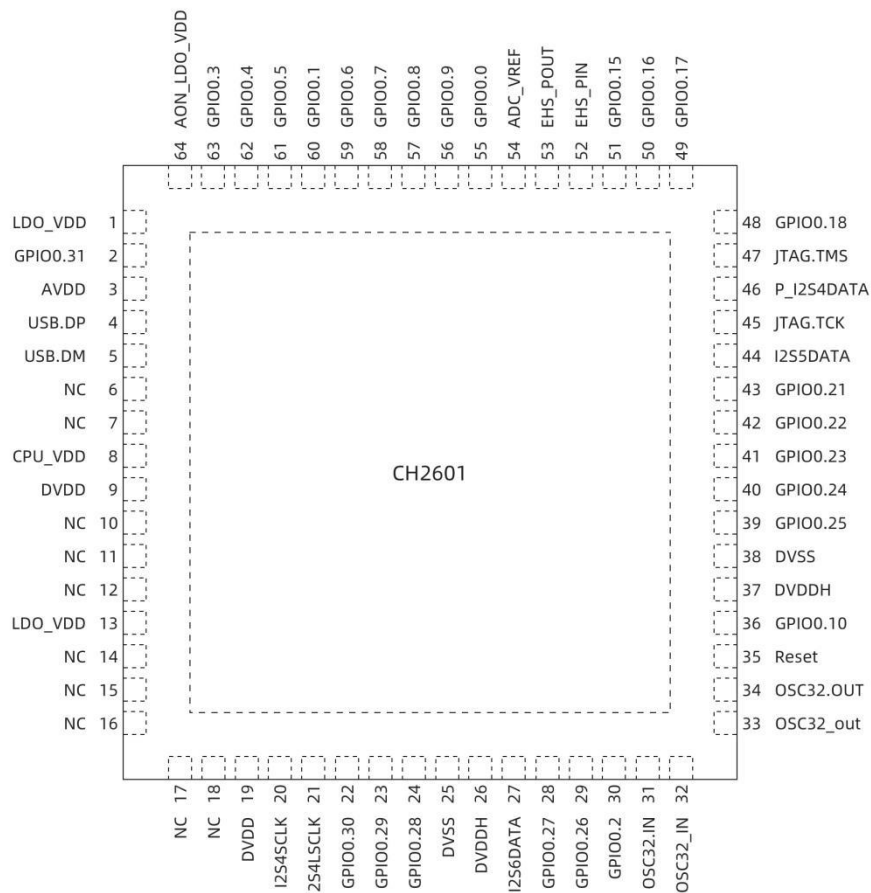
6.2.3 GPIO 输入输出规格

电源供电 VDD = 3.3V

Table 6-4 CH2601 GPIO 电气特性

测试项	参数	测试条件/描述	典型值	单位
GPIO	输入低电平电压	CMOS	1780	mV
		Schmitt	1720	
	输入高电平电压	CMOS	1820	mV
		Schmitt	1950	
	输入迟滞	Schmitt	230	mV
	灌电流驱动能力 (VSS+400mV)	4mA 配置	4	mA
		12mA 配置	12	mA
		20mA 配置	20	mA
		28mA 配置	28	mA
	拉电流驱动能力 (VDD-400mV)	4mA 配置	4	mA
		12mA 配置	12	mA
		20mA 配置	20	mA
		28mA 配置	28	mA
	输入高电平漏电流		14	nA
	输入低电平漏电流		20	nA
	上拉电阻	10K 配置	10	KΩ
100K 配置		100		
下拉电阻	10K 配置	10	KΩ	
	100K 配置	100		
翻转频率	CPU CLK=240MHz		MHz	

七 芯片管脚说明

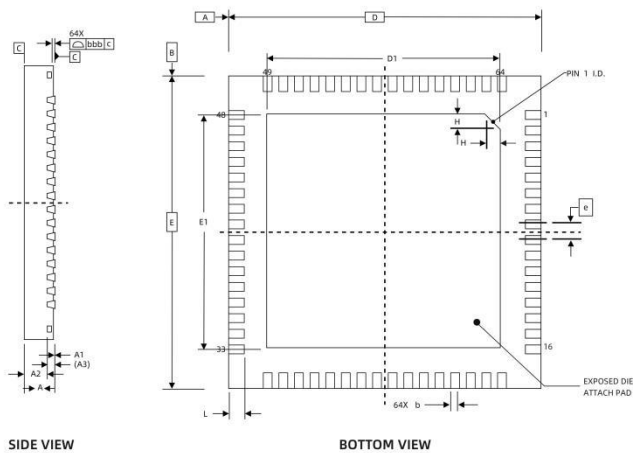


管脚编号	管脚名	默认功能	模拟功能
1	LDO_VDD		
2	PA31_I2S0SDA_PWM8_UART0TX	GPIO0.31	
3	AVDD		
4	PUSB_DP (PA13_USBDP)	USB.DP	
5	PUSB_DM (PA14_USBDM)	USB.DM	
6	NC		
7	NC		
8	CPU_VDD		
9	DVDD		
10	NC		
11	NC		
12	NC		
13	LDO_VDD		

14	NC		
15	NC		
16	NC		
17	NC		
18	NC		
19	DVDD		
20	I2S4SCLK		
21	I2S4LSCLK		
22	PA30_I2S1WSCLK_UART1RTS_PWM7_SPI1MISO	GPI00. 30	
23	PA29_I2S1SCLK_UART1CTS_PWM6_SPI1MOSI	GPI00. 29	
24	PA28_I2S0WSCLK_UART1TX_PWM5_SPI1SCK	GPI00. 28	
25	DVSS		
26	DVDDH		
27	I2S6DATA		
28	PA27_I2S0SCLK_UART1RX_PWM4_SPI1CS	GPI00. 27	
29	PA26_I2S1MCLK_UART0RTS_PWM3_SPI0MISO	GPI00. 26	
30	PA2_I2S1SCLK_I2C0SCL_SPI1CS_PWM2	GPI00. 2	
31	PA11_OSC32IN	OSC32. IN	
32	OSC32_IN		
33	OSC32_out		
34	PA12_OSC32OUT	OSC32. OUT	
35	Reset		
36	PA10_I2S0MCLK_UART0TX_SPI1MOSI_SPI1MISO	GPI00. 10	ADC. A8
37	DVDDH		
38	DVSS		
39	PA25_PWMR_UART0CTS_PWM2_SPI0MOSI	GPI00. 25	
40	PA24_I2C0SDA_UART0RX_PWM1_SPI0SCK	GPI00. 24	
41	PA23_I2C0SCL_UART0TX_PWM0_SPI0CS	GPI00. 23	
42	PA22_UART0RTS_UART1RTS_I2S1SDA_I2C0SDA	GPI00. 22	
43	PA21_UART0CTS_UART1CTS_I2S0SDA_I2C0SCL	GPI00. 21	ADC. A15
44	I2S5DATA		
45	PA20_JTGTCK_UART1TX_I2S1WSCLK_I2C0SDA	JTAG. TCK	ADC. A14
46	P_I2S4DATA		
47	PA19_JTGTMS_UART1RX_I2S1SCLK_I2C0SCL	JTAG. TMS	ADC. A13
48	PA18_UART0TX_SPI0MISO_I2S0WSCLK_PWM11	GPI00. 18	
49	PA17_UART0RX_SPI0MOSI_I2S0SCLK_PWM10	GPI00. 17	ADC. A11
50	PA16_I2C0SDA_SPI0SCK_UART1TX_PWM5	GPI00. 16	ADC. A10
51	PA15_I2C0SCL_SPI0CS_PWMR_PWM4	GPI00. 15	ADC. A9
52	EHS_PIN		
53	EHS_POUT		

54	ADC_VREF		
55	PA0_I2S0SCLK_SPIOCS_UARTORX_PWM0	GPIO0.0	ADC_VREFP
56	PA9_I2S1SDA_I2COSDA_PWMR_PWM9	GPIO0.9	ADC_A7
57	PA8_I2S0SDA_I2COSCL_UARTORX_PWM8	GPIO0.8	ADC_A6
58	PA7_I2S0WSCLK_PWMR_SPI1MISO_PWM7	GPIO0.7	ADC_A5
59	PA6_I2S0SCLK_UART0TX_SPI1MOSI_PWM6	GPIO0.6	ADC_A4
60	PA1_I2S0WSCLK_SPIOCS_USRT0TX_PWM1	GPIO0.1	ADC_VREFN
61	PA5_I2S1SDA_SPIOMISO_UART1RTS_PWM5	GPIO0.5	ADC_A3
62	PA4_I2S0SDA_SPIOMOSI_UART1CTS_PWM4	GPIO0.4	ADC_A2
63	PA3_I2S1WSCLK_I2COSDA_SPI1SCK_PWM3	GPIO0.3	ADC_A1
64	AON_LDO_VDD		

八 封装尺寸



FOR CUSTOMER ONLY				
PACKAGE TYPE	QFN			
PIN COUNT	64			
DESCRIPTION	SYMBOL	MILLIMETER		
		MIN	NOM	MAX
TOTAL THICKNESS	A	0.80	0.85	0.90
STAND. OFF	A1	–	0.035	0.05
MOLD THICKNESS	A2	–	0.65	0.67
MATERIAL THICKNESS	A3	–	0.203 _{REF}	–
PACKAGE SIZE	D	7.9	8.0	8.1
	E	7.9	8.0	8.1
EP SIZE	D1	5.9	6.0	6.1
	E1	5.9	6.0	6.1
LEAD LENGTH	L	0.3	0.4	0.5
LEAD PITCH	e		0.4 _{BSC}	
LEAD WIDTH	b	0.15	0.2	0.25
LEAD POSITION OFFSET	aaa		0.07	
LEAD COPLANARITY	bbb		0.08	
PACKAGE EDGE PROFILE	ccc		0.1	
MOLD FLATNESS	ddd		0.1	
EP POSITION OFFSET	eee		0.1	
	fff		0.05	
PIN 1 DIMENSION	H		0.35 _{REF}	

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