GigaDevice Semiconductor Inc.

GD32F103xx
Arm® Cortex®-M3 32-bit MCU

Datasheet

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1. General description

The GD32F103xx device is a 32-bit general-purpose microcontroller based on the Arm® Cortex®-M3 RISC core with best ratio in terms of processing power, reduced power consumption and peripheral set. The Cortex®-M3 is a next generation processor core which is tightly coupled with a Nested Vectored Interrupt Controller (NVIC), SysTick timer and advanced debug support.

The GD32F103xx device incorporates the Arm® Cortex®-M3 32-bit processor core operating at 108 MHz frequency with Flash accesses zero wait states to obtain maximum efficiency. It provides up to 3 MB on-chip Flash memory and up to 96 KB SRAM memory. An extensive range of enhanced I/Os and peripherals connected to two APB buses. The devices offer up to three 12-bit ADCs, up to two 12-bit DACs, up to ten general 16-bit timers, two basic timers plus two PWM advanced timer, as well as standard and advanced communication interfaces: up to three SPIs, two I2Cs, three USARTs, two UARTs, two I2Ss, an USBD, a CAN and a SDIO.

The device operates from a 2.6 to 3.6 V power supply and available in –40 to +85 °C temperature range. Several power saving modes provide the flexibility for maximum optimization between wakeup latency and power consumption, an especially important consideration in low power applications.

The above features make the GD32F103xx devices suitable for a wide range of applications, especially in areas such as industrial control, motor drives, power monitor and alarm systems, consumer and handheld equipment, POS, vehicle GPS, video intercom, PC peripherals and so on.

2. Device overview

2.1. Device information

Table 2-1. GD32F103xx devices features and peripheral list

Part Number		GD32F103xx													
		T4	T6	T8	TB	C4	C6	C8	CB	R4	R6	R8	RB	V8	VB
Flash (KB)		16	32	64	128	16	32	64	128	16	32	64	128	64	128
SRAM (KB)		6	10	20	20	6	10	20	20	6	10	20	20	20	20
Timers	General timer(16-bit)	2 (1-2)	2 (1-2)	3 (1-3)	3 (1-3)	2 (1-2)	2 (1-2)	3 (1-3)	3 (1-3)	2 (1-2)	2 (1-2)	3 (1-3)	3 (1-3)	3 (1-3)	3 (1-3)
	Advanced timer(16-bit)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
	SysTick	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Watchdog	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	RTC	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Connectivity	USART	2 (0-1)	2 (0-1)	2 (0-1)	2 (0-1)	2 (0-1)	2 (0-1)	3 (0-2)	3 (0-2)	2 (0-1)	2 (0-1)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)
	I2C	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	2 (0-1)	2 (0-1)	1 (0)	1 (0)	2 (0-1)	2 (0-1)	2 (0-1)	2 (0-1)
	SPI	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	2 (0-1)	2 (0-1)	1 (0)	1 (0)	2 (0-1)	2 (0-1)	2 (0-1)	2 (0-1)
	CAN	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	USBD	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GPIO		26	26	26	26	37	37	37	37	51	51	51	51	80	80
EXMC		0	0	0	0	0	0	0	0	0	0	0	0	1	1
EXTI		16	16	16	16	16	16	16	16	16	16	16	16	16	16
ADC	Units	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Channels	10	10	10	10	10	10	10	10	16	16	16	16	16	16
Package		QFN36				LQFP48				LQFP64				LQFP100	

Table 2-2. GD32F103xx devices features and peripheral list (continued)

Part Number		GD32F103xx													
		RC	RD	RE	RF	RG	RI	RK	VC	VD	VE	VF	VG	VI	VK
Flash (KB)		256	384	512	768	1024	2048	3072	256	384	512	768	1024	2048	3072
SRAM (KB)		48	64	64	96	96	96	96	48	64	64	96	96	96	96
Timers	General timer(16-bit)	4 (1-4)	4 (1-4)	4 (1-4)	10 (1-4,8-13)	10 (1-4,8-13)	10 (1-4,8-13)	10 (1-4,8-13)	4 (1-4)	4 (1-4)	4 (1-4)	10 (1-4,8-13)	10 (1-4,8-13)	10 (1-4,8-13)	10 (1-4,8-13)
	Advanced timer(16-bit)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)
	SysTick	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Basic timer(16-bit)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)
	Watchdog	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	RTC	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Connectivity	USART	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	UART	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	I2C	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	SPI	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)
	CAN	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	USBD	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	I2S	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)
	SDIO	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GPIO		51	51	51	51	51	51	51	80	80	80	80	80	80	80
EXMC		0	0	0	0	0	0	0	1	1	1	1	1	1	1
EXTI		16	16	16	16	16	16	16	16	16	16	16	16	16	16
ADC	Units	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Channels	16	16	16	16	16	16	16	16	16	16	16	16	16	16
DAC		2	2	2	2	2	2	2	2	2	2	2	2	2	2
Package		LQFP64							LQFP100						

Table 2-3. GD32F103xx devices features and peripheral list (continued)

Part Number		GD32F103xx						
		ZC	ZD	ZE	ZF	ZG	ZI	ZK
Flash (KB)		256	384	512	768	1024	2048	3072
SRAM (KB)		48	64	64	96	96	96	96
Timers	General timer(16-bit)	4 (1-4)	4 (1-4)	4 (1-4)	10 (1-4,8-13)	10 (1-4,8-13)	10 (1-4,8-13)	10 (1-4,8-13)
	Advanced timer(16-bit)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)	2 (0,7)
	SysTick	1	1	1	1	1	1	1
	Basic timer(16-bit)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)	2 (5-6)
	Watchdog	2	2	2	2	2	2	2
	RTC	1	1	1	1	1	1	1
Connectivity	USART	3	3	3	3	3	3	3
	UART	2	2	2	2	2	2	2
	I2C	2	2	2	2	2	2	2
	SPI	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)	3 (0-2)
	CAN	1	1	1	1	1	1	1
	USBD	1	1	1	1	1	1	1
	I2S	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)
	SDIO	1	1	1	1	1	1	1
GPIO		112	112	112	112	112	112	112
EXMC		1	1	1	1	1	1	1
EXTI		16	16	16	16	16	16	16
ADC	Units	3	3	3	3	3	3	3
	Channels	21	21	21	21	21	21	21
DAC		2	2	2	2	2	2	2
Package		LQFP144						

2.2. Block diagram

Figure 2-1. GD32F103x4/6/8/B block diagram

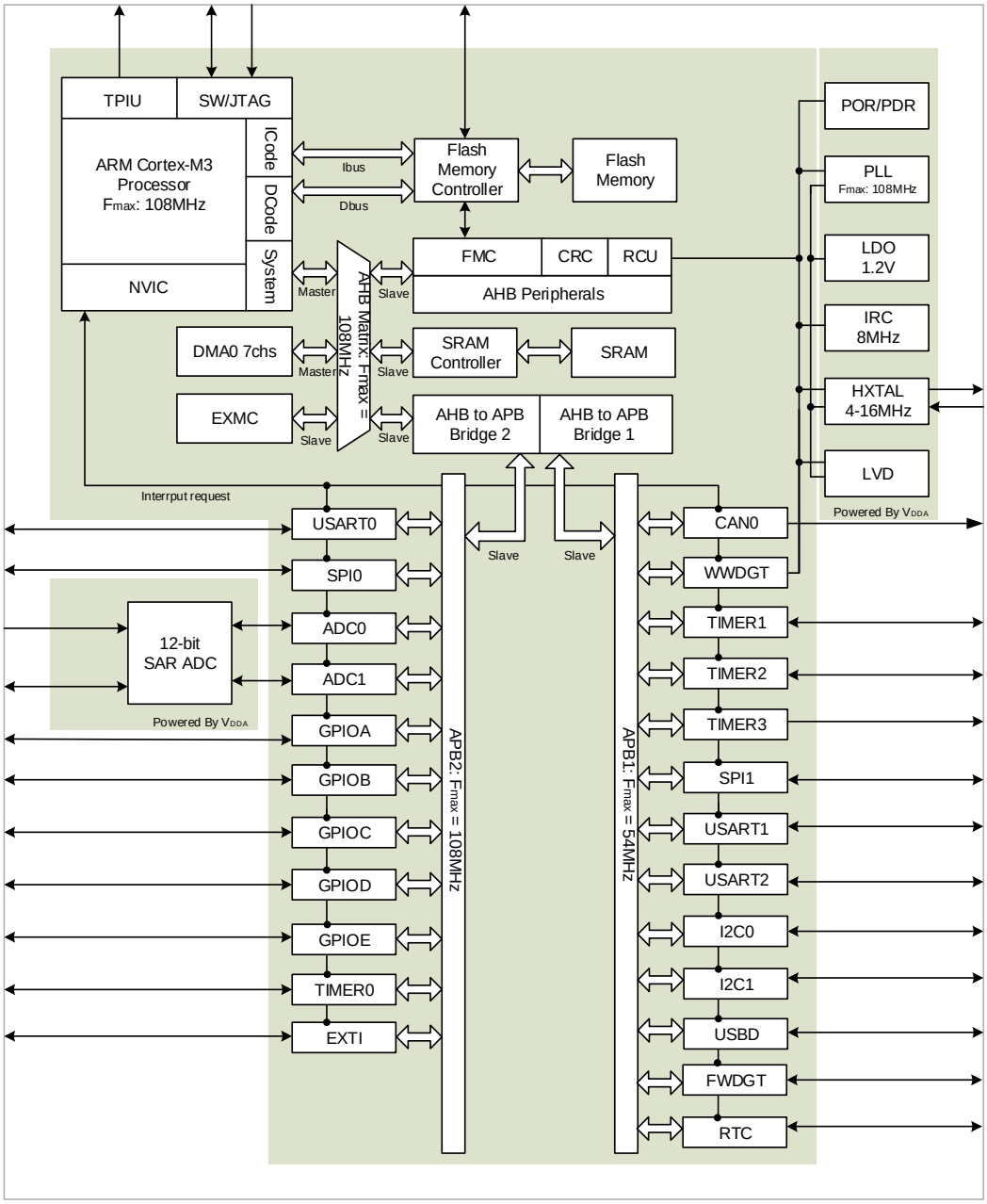
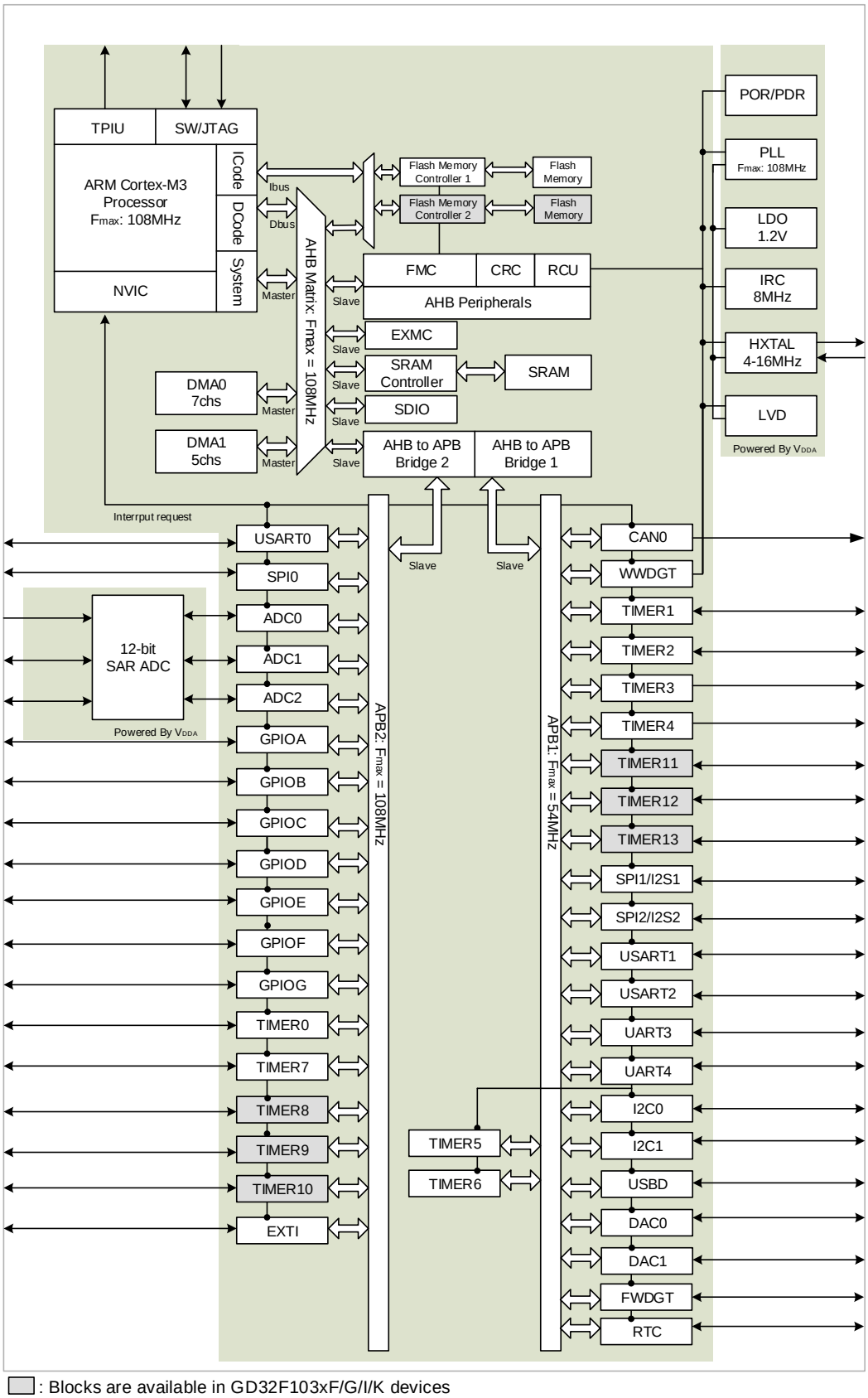


Figure 2-2. GD32F103xC/D/E/F/G/I/K block diagram



: Blocks are available in GD32F103xF/G/I/K devices

2.3. Pinouts and pin assignment

Figure 2-3. GD32F103Zx LQFP144 pinouts

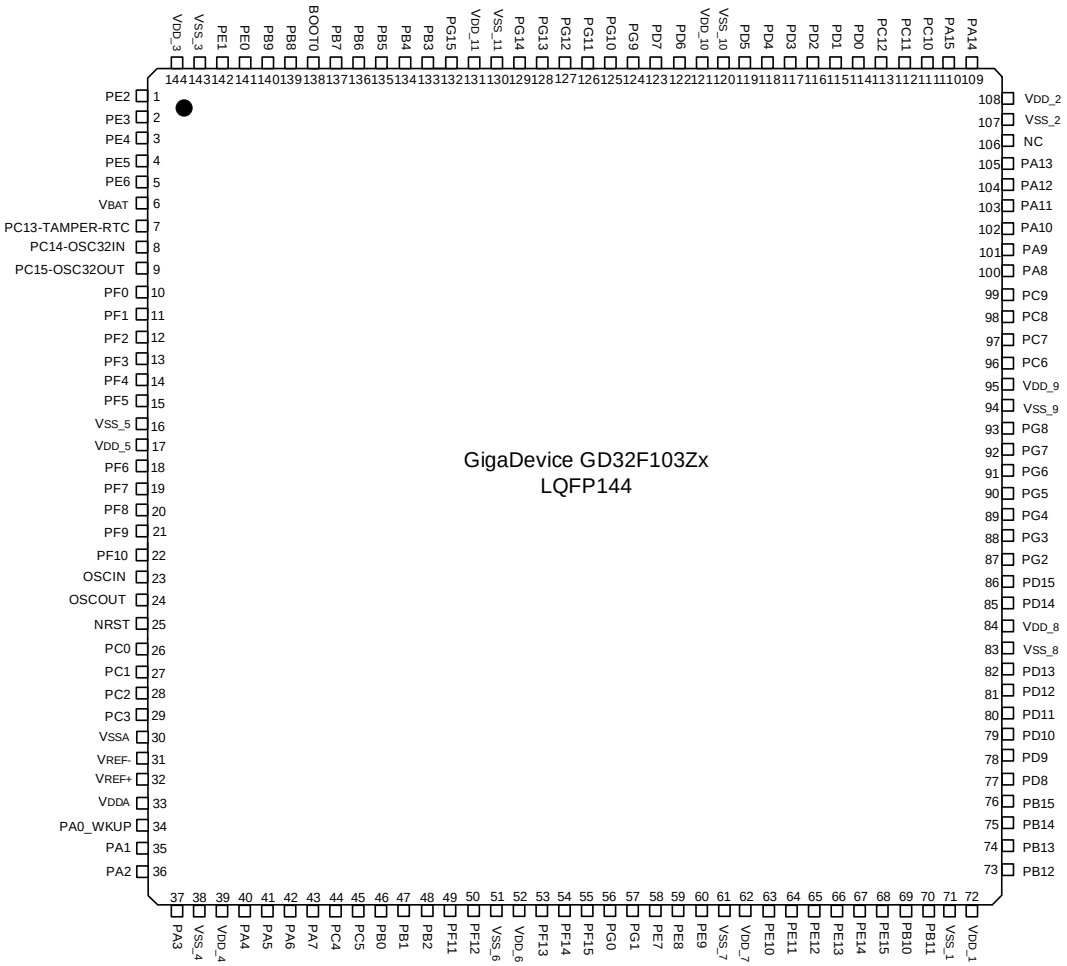


Figure 2-4. GD32F103Vx LQFP100 pinouts

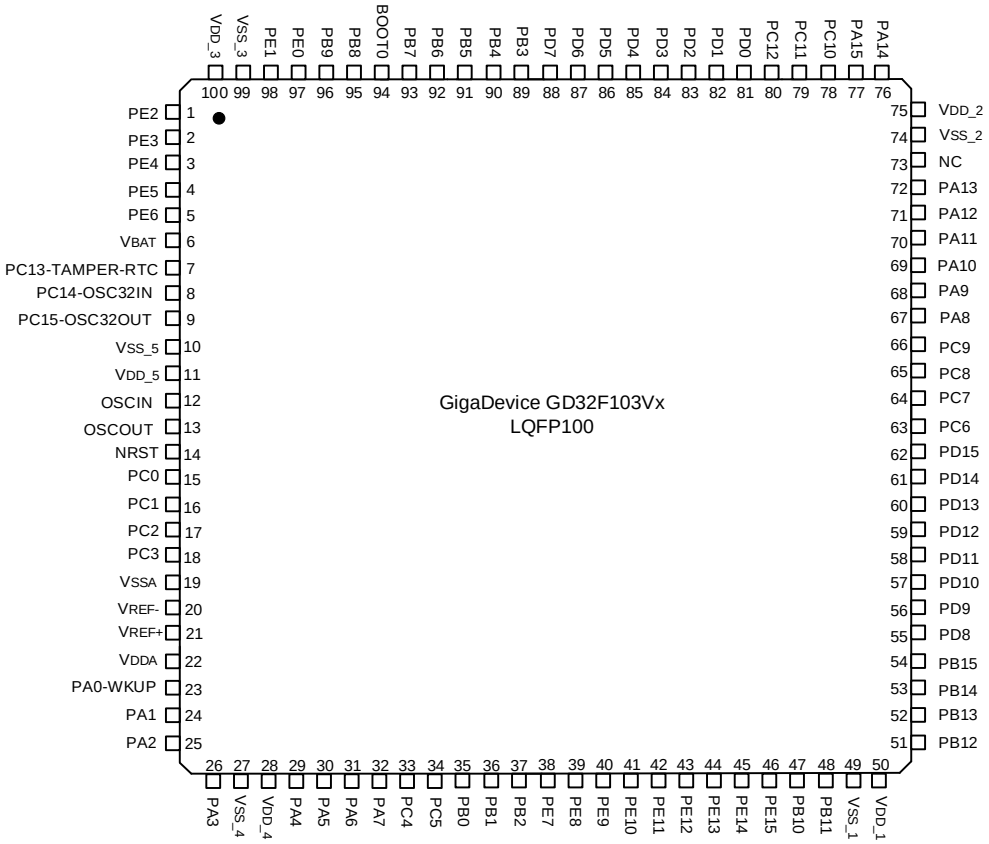


Figure 2-5. GD32F103Rx LQFP64 pinouts

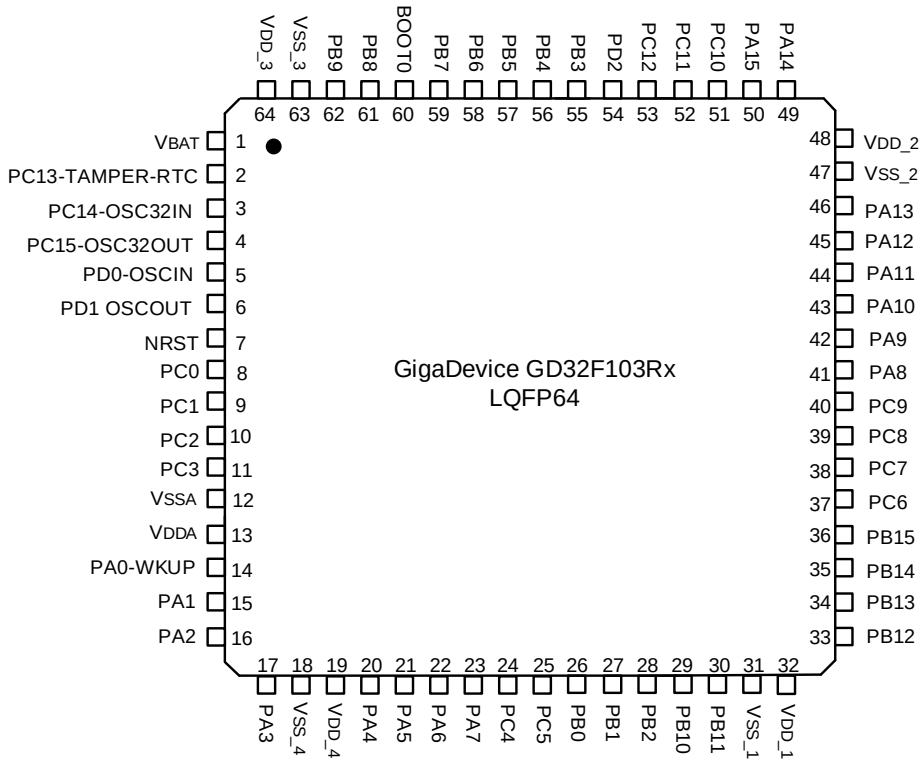


Figure 2-6. GD32F103Cx LQFP48 pinouts

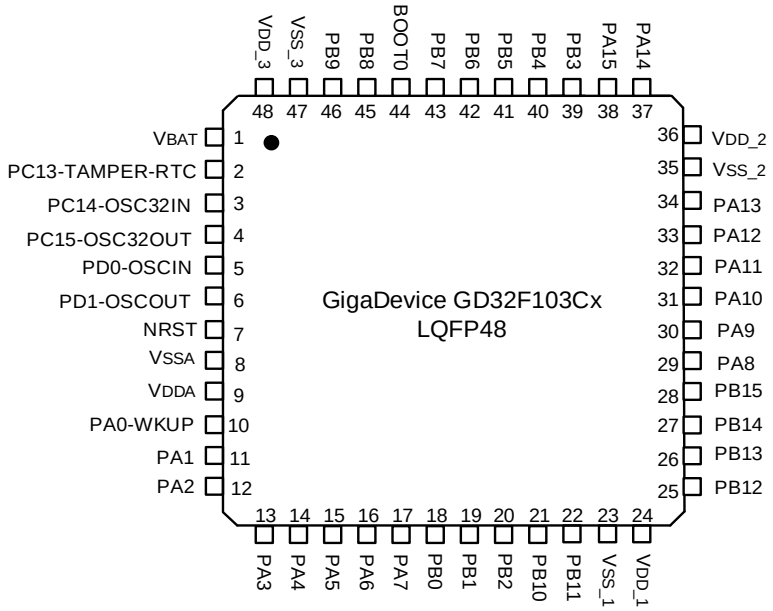
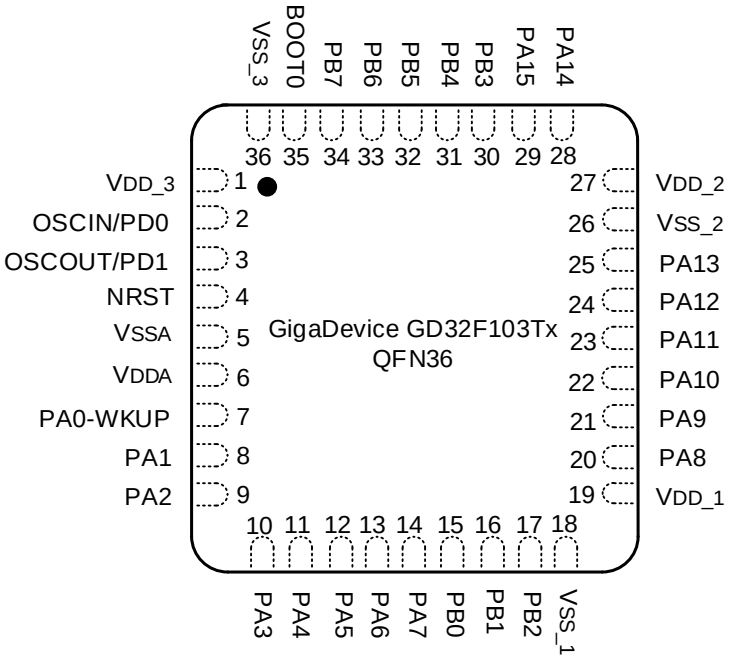


Figure 2-7. GD32F103Tx QFN36 pinouts



2.4. Memory map

Table 2-4. GD32F103xx memory map

Pre-defined Regions	Bus	Address	Peripherals
External device	AHB	0xA000 0000 - 0xA000 0FFF	EXMC - SWREG
External RAM		0x9000 0000 - 0x9FFF FFFF	EXMC - PC CARD
		0x7000 0000 - 0x8FFF FFFF	EXMC - NAND
		0x6000 0000 - 0x6FFF FFFF	EXMC - NOR/PSRAM/SRAM
Peripheral	AHB	0x5000 0000 - 0x5003 FFFF	Reserved
		0x4008 0000 - 0x4FFF FFFF	Reserved
		0x4004 0000 - 0x4007 FFFF	Reserved
		0x4002 BC00 - 0x4003 FFFF	Reserved
		0x4002 B000 - 0x4002 BBFF	Reserved
		0x4002 A000 - 0x4002 AFFF	Reserved
		0x4002 8000 - 0x4002 9FFF	Reserved
		0x4002 6800 - 0x4002 7FFF	Reserved
		0x4002 6400 - 0x4002 67FF	Reserved
		0x4002 6000 - 0x4002 63FF	Reserved
		0x4002 5000 - 0x4002 5FFF	Reserved
		0x4002 4000 - 0x4002 4FFF	Reserved
		0x4002 3C00 - 0x4002 3FFF	Reserved
		0x4002 3800 - 0x4002 3BFF	Reserved
		0x4002 3400 - 0x4002 37FF	Reserved
		0x4002 3000 - 0x4002 33FF	CRC
		0x4002 2C00 - 0x4002 2FFF	Reserved
		0x4002 2800 - 0x4002 2BFF	Reserved
		0x4002 2400 - 0x4002 27FF	Reserved
		0x4002 2000 - 0x4002 23FF	FMC
		0x4002 1C00 - 0x4002 1FFF	Reserved
		0x4002 1800 - 0x4002 1BFF	Reserved
		0x4002 1400 - 0x4002 17FF	Reserved
		0x4002 1000 - 0x4002 13FF	RCU
		0x4002 0C00 - 0x4002 0FFF	Reserved
		0x4002 0800 - 0x4002 0BFF	Reserved
		0x4002 0400 - 0x4002 07FF	DMA1
		0x4002 0000 - 0x4002 03FF	DMA0
		0x4001 8400 - 0x4001 FFFF	Reserved

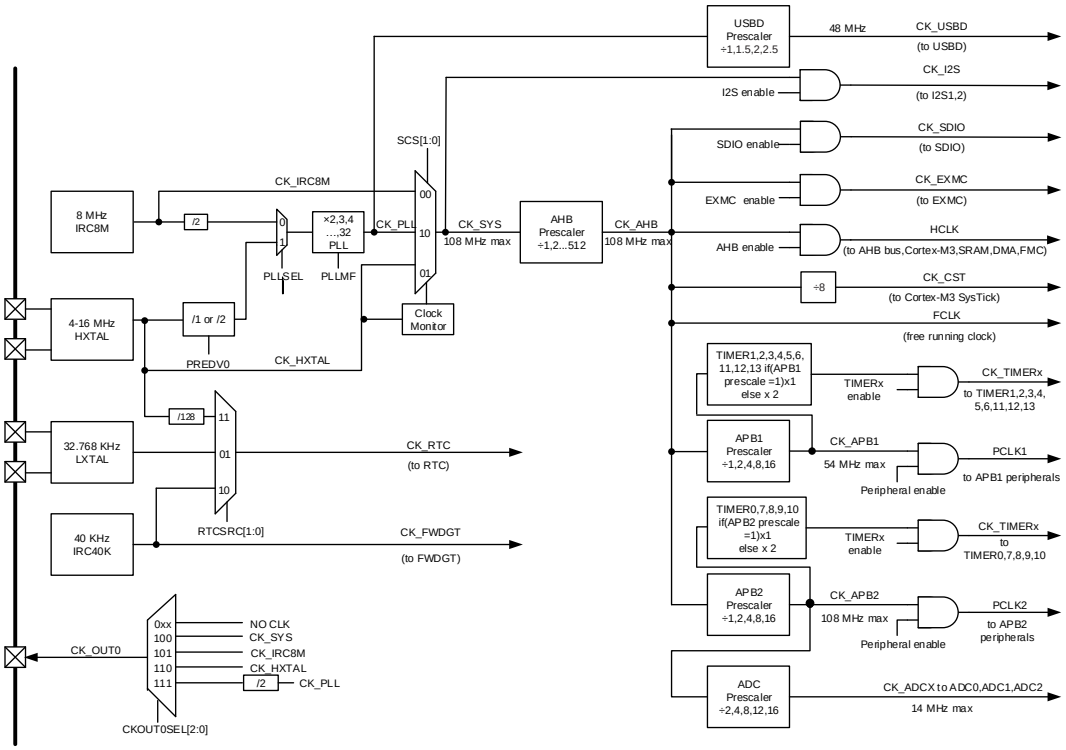
Pre-defined Regions	Bus	Address	Peripherals
		0x4001 8000 - 0x4001 83FF	SDIO
	APB2	0x4001 7C00 - 0x4001 7FFF	Reserved
		0x4001 7800 - 0x4001 7BFF	Reserved
		0x4001 7400 - 0x4001 77FF	Reserved
		0x4001 7000 - 0x4001 73FF	Reserved
		0x4001 6C00 - 0x4001 6FFF	Reserved
		0x4001 6800 - 0x4001 6BFF	Reserved
		0x4001 5C00 - 0x4001 67FF	Reserved
		0x4001 5800 - 0x4001 5BFF	Reserved
		0x4001 5400 - 0x4001 57FF	TIMER10
		0x4001 5000 - 0x4001 53FF	TIMER9
		0x4001 4C00 - 0x4001 4FFF	TIMER8
		0x4001 4800 - 0x4001 4BFF	Reserved
		0x4001 4400 - 0x4001 47FF	Reserved
		0x4001 4000 - 0x4001 43FF	Reserved
		0x4001 3C00 - 0x4001 3FFF	ADC2
		0x4001 3800 - 0x4001 3BFF	USART0
		0x4001 3400 - 0x4001 37FF	TIMER7
		0x4001 3000 - 0x4001 33FF	SPI0
		0x4001 2C00 - 0x4001 2FFF	TIMER0
		0x4001 2800 - 0x4001 2BFF	ADC1
		0x4001 2400 - 0x4001 27FF	ADC0
		0x4001 2000 - 0x4001 23FF	GPIOG
		0x4001 1C00 - 0x4001 1FFF	GPIOF
		0x4001 1800 - 0x4001 1BFF	GPIOE
		0x4001 1400 - 0x4001 17FF	GPIOD
		0x4001 1000 - 0x4001 13FF	GPIOC
		0x4001 0C00 - 0x4001 0FFF	GPIOB
		0x4001 0800 - 0x4001 0BFF	GPIOA
		0x4001 0400 - 0x4001 07FF	EXTI
		0x4001 0000 - 0x4001 03FF	AFIO
	APB1	0x4000 CC00 - 0x4000 FFFF	Reserved
		0x4000 C800 - 0x4000 CBFF	Reserved
		0x4000 C400 - 0x4000 C7FF	Reserved
		0x4000 C000 - 0x4000 C3FF	Reserved
		0x4000 8000 - 0x4000 BFFF	Reserved
		0x4000 7C00 - 0x4000 7FFF	Reserved
		0x4000 7800 - 0x4000 7BFF	Reserved
		0x4000 7400 - 0x4000 77FF	DAC
		0x4000 7000 - 0x4000 73FF	PMU

Pre-defined Regions	Bus	Address	Peripherals
		0x4000 6C00 - 0x4000 6FFF	BKP
		0x4000 6800 - 0x4000 6BFF	Reserved
		0x4000 6400 - 0x4000 67FF	CAN0
		0x4000 6000 - 0x4000 63FF	Shared USBD/CAN SRAM 512 bytes
		0x4000 5C00 - 0x4000 5FFF	USBD
		0x4000 5800 - 0x4000 5BFF	I2C1
		0x4000 5400 - 0x4000 57FF	I2C0
		0x4000 5000 - 0x4000 53FF	UART4
		0x4000 4C00 - 0x4000 4FFF	UART3
		0x4000 4800 - 0x4000 4BFF	USART2
		0x4000 4400 - 0x4000 47FF	USART1
		0x4000 4000 - 0x4000 43FF	Reserved
		0x4000 3C00 - 0x4000 3FFF	SPI2/I2S2
		0x4000 3800 - 0x4000 3BFF	SPI1/I2S1
		0x4000 3400 - 0x4000 37FF	Reserved
		0x4000 3000 - 0x4000 33FF	FWDGT
		0x4000 2C00 - 0x4000 2FFF	WWDGT
		0x4000 2800 - 0x4000 2BFF	RTC
		0x4000 2400 - 0x4000 27FF	Reserved
		0x4000 2000 - 0x4000 23FF	TIMER13
		0x4000 1C00 - 0x4000 1FFF	TIMER12
		0x4000 1800 - 0x4000 1BFF	TIMER11
		0x4000 1400 - 0x4000 17FF	TIMER6
		0x4000 1000 - 0x4000 13FF	TIMER5
		0x4000 0C00 - 0x4000 0FFF	TIMER4
		0x4000 0800 - 0x4000 0BFF	TIMER3
		0x4000 0400 - 0x4000 07FF	TIMER2
		0x4000 0000 - 0x4000 03FF	TIMER1
SRAM	AHB	0x2007 0000 - 0x3FFF FFFF	Reserved
		0x2006 0000 - 0x2006 FFFF	Reserved
		0x2003 0000 - 0x2005 FFFF	Reserved
		0x2002 0000 - 0x2002 FFFF	Reserved
		0x2001 C000 - 0x2001 FFFF	Reserved
		0x2001 8000 - 0x2001 BFFF	Reserved
		0x2000 0000 - 0x2001 7FFF	SRAM
Code	AHB	0x1FFF F810 - 0x1FFF FFFF	Reserved
		0x1FFF F800 - 0x1FFF F80F	Option Bytes
		0x1FFF B000 - 0x1FFF F7FF	Boot loader
		0x1FFF 7A10 - 0x1FFF AFFF	Reserved

Pre-defined Regions	Bus	Address	Peripherals
		0x1FFF 7800 - 0x1FFF 7A0F	Reserved
		0x1FFF 0000 - 0x1FFF 77FF	Reserved
		0x1FFE C010 - 0x1FFE FFFF	Reserved
		0x1FFE C000 - 0x1FFE C00F	Reserved
		0x1001 0000 - 0x1FFE BFFF	Reserved
		0x1000 0000 - 0x1000 FFFF	Reserved
		0x083C 0000 - 0x0FFF FFFF	Reserved
		0x0830 0000 - 0x083B FFFF	Reserved
		0x0800 0000 - 0x082F FFFF	Main Flash
		0x0030 0000 - 0x07FF FFFF	Reserved
		0x0000 0000 - 0x002F FFFF	Aliased to Main Flash or Boot loader

2.5. Clock tree

Figure 2-8. GD32F103xx clock tree



Legend:

HXTAL: High speed external clock

LXTAL: Low speed external clock

IRC8M: High speed internal clock

IRC40K: Low speed internal clock

2.6. Pin definitions

2.6.1. GD32F103Zx LQFP144 pin definitions

Table 2-5. GD32F103Zx LQFP144 pin definitions

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
PE2	1	I/O	5VT	Default: PE2 Alternate: TRACECK, EXMC_A23
PE3	2	I/O	5VT	Default: PE3 Alternate: TRACED0, EXMC_A19
PE4	3	I/O	5VT	Default: PE4 Alternate:TRACED1, EXMC_A20
PE5	4	I/O	5VT	Default: PE5 Alternate:TRACED2, EXMC_A21 Remap: TIMER8_CH0(3)
PE6	5	I/O	5VT	Default: PE6 Alternate:TRACED3, EXMC_A22 Remap: TIMER8_CH1(3)
V_{BAT}	6	P		Default: V_{BAT}
PC13-TAMPER-RTC	7	I/O		Default: PC13 Alternate: TAMPER-RTC
PC14-OSC32IN	8	I/O		Default: PC14 Alternate: OSC32IN
PC15-OSC32OUT	9	I/O		Default: PC15 Alternate: OSC32OUT
PF0	10	I/O	5VT	Default: PF0 Alternate: EXMC_A0
PF1	11	I/O	5VT	Default: PF1 Alternate: EXMC_A1
PF2	12	I/O	5VT	Default: PF2 Alternate: EXMC_A2
PF3	13	I/O	5VT	Default: PF3 Alternate: EXMC_A3
PF4	14	I/O	5VT	Default: PF4 Alternate: EXMC_A4
PF5	15	I/O	5VT	Default: PF5 Alternate: EXMC_A5
V_{SS_5}	16	P		Default: V_{SS_5}
V_{DD_5}	17	P		Default: V_{DD_5}
PF6	18	I/O		Default: PF6

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: ADC2_IN4, EXMC_NIORD Remap: TIMER9_CH0(3)
PF7	19	I/O		Default: PF7 Alternate: ADC2_IN5, EXMC_NREG Remap: TIMER10_CH0(3)
PF8	20	I/O		Default: PF8 Alternate: ADC2_IN6, EXMC_NIOWR Remap: TIMER12_CH0(3)
PF9	21	I/O		Default: PF9 Alternate: ADC2_IN7, EXMC_CD Remap: TIMER13_CH0(3)
PF10	22	I/O		Default: PF10 Alternate: ADC2_IN8, EXMC_INTR
OSCIN	23	I		Default: OSCIN Remap: PD0
OSCOUT	24	O		Default: OSCOUT Remap: PD1
NRST	25	I/O		Default: NRST
PC0	26	I/O		Default: PC0 Alternate: ADC012_IN10
PC1	27	I/O		Default: PC1 Alternate: ADC012_IN11
PC2	28	I/O		Default: PC2 Alternate: ADC012_IN12
PC3	29	I/O		Default: PC3 Alternate: ADC012_IN13
V_{SSA}	30	P		Default: V_{SSA}
V_{REF-}	31	P		Default: V_{REF-}
V_{REF+}	32	P		Default: V_{REF+}
V_{DDA}	33	P		Default: V_{DDA}
PA0-WKUP	34	I/O		Default: PA0 Alternate: WKUP, USART1_CTS, ADC012_IN0, TIMER1_CH0, TIMER1_ETI, TIMER4_CH0, TIMER7_ETI
PA1	35	I/O		Default: PA1 Alternate: USART1_RTS, ADC012_IN1, TIMER1_CH1, TIMER4_CH1
PA2	36	I/O		Default: PA2 Alternate: USART1_TX, ADC012_IN2, TIMER1_CH2, TIMER4_CH2, TIMER8_CH0(3)
PA3	37	I/O		Default: PA3 Alternate: USART1_RX, ADC012_IN3, TIMER1_CH3, TIMER4_CH3, TIMER8_CH1(3)

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
V_{SS_4}	38	P		Default: V_{SS_4}
V_{DD_4}	39	P		Default: V_{DD_4}
PA4	40	I/O		Default: PA4 Alternate: SPI0_NSS, USART1_CK, ADC01_IN4, DAC_OUT0 Remap:SPI2_NSS, I2S2_WS
PA5	41	I/O		Default: PA5 Alternate: SPI0_SCK, ADC01_IN5, DAC_OUT1
PA6	42	I/O		Default: PA6 Alternate: SPI0_MISO, ADC01_IN6, TIMER2_CH0, TIMER7_BRKIN, TIMER12_CH0(3) Remap: TIMER0_BRKIN
PA7	43	I/O		Default: PA7 Alternate: SPI0_MOSI, ADC01_IN7, TIMER2_CH1, TIMER7_CH0_ON, TIMER13_CH0(3) Remap: TIMER0_CH0_ON
PC4	44	I/O		Default: PC4 Alternate: ADC01_IN14
PC5	45	I/O		Default: PC5 Alternate: ADC01_IN15
PB0	46	I/O		Default: PB0 Alternate: ADC01_IN8, TIMER2_CH2, TIMER7_CH1_ON Remap: TIMER0_CH1_ON
PB1	47	I/O		Default: PB1 Alternate: ADC01_IN9, TIMER2_CH3, TIMER7_CH2_ON Remap: TIMER0_CH2_ON
PB2	48	I/O	5VT	Default: PB2, BOOT1
PF11	49	I/O	5VT	Default: PF11 Alternate: EXMC_NIOS16
PF12	50	I/O	5VT	Default: PF12 Alternate: EXMC_A6
V_{SS_6}	51	P		Default: V_{SS_6}
V_{DD_6}	52	P		Default: V_{DD_6}
PF13	53	I/O	5VT	Default: PF13 Alternate: EXMC_A7
PF14	54	I/O	5VT	Default: PF14 Alternate: EXMC_A8
PF15	55	I/O	5VT	Default: PF15 Alternate: EXMC_A9
PG0	56	I/O	5VT	Default: PG0 Alternate: EXMC_A10
PG1	57	I/O	5VT	Default: PG1

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: EXMC_A11
PE7	58	I/O	5VT	Default: PE7 Alternate: EXMC_D4 Remap: TIMER0_ETI
PE8	59	I/O	5VT	Default: PE8 Alternate: EXMC_D5 Remap: TIMER0_CH0_ON
PE9	60	I/O	5VT	Default: PE9 Alternate: EXMC_D6 Remap: TIMER0_CH0
V_{SS_7}	61	P		Default: V_{SS_7}
V_{DD_7}	62	P		Default: V_{DD_7}
PE10	63	I/O	5VT	Default: PE10 Alternate: EXMC_D7 Remap: TIMER0_CH1_ON
PE11	64	I/O	5VT	Default: PE11 Alternate: EXMC_D8 Remap: TIMER0_CH1
PE12	65	I/O	5VT	Default: PE12 Alternate: EXMC_D9 Remap: TIMER0_CH2_ON
PE13	66	I/O	5VT	Default: PE13 Alternate: EXMC_D10 Remap: TIMER0_CH2
PE14	67	I/O	5VT	Default: PE14 Alternate: EXMC_D11 Remap: TIMER0_CH3
PE15	68	I/O	5VT	Default: PE15 Alternate: EXMC_D12 Remap: TIMER0_BRKIN
PB10	69	I/O	5VT	Default: PB10 Alternate: I2C1_SCL, USART2_TX Remap: TIMER1_CH2
PB11	70	I/O	5VT	Default: PB11 Alternate: I2C1_SDA, USART2_RX Remap: TIMER1_CH3
V_{SS_1}	71	P		Default: V_{SS_1}
V_{DD_1}	72	P		Default: V_{DD_1}
PB12	73	I/O	5VT	Default: PB12 Alternate: SPI1_NSS, I2C1_SMBA, USART2_CK, TIMER0_BRKIN, I2S1_WS
PB13	74	I/O	5VT	Default: PB13

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: SPI1_SCK, USART2_CTS, TIMER0_CH0_ON, I2S1_CK
PB14	75	I/O	5VT	Default: PB14 Alternate: SPI1_MISO, USART2_RTS, TIMER0_CH1_ON, TIMER11_CH0(3)
PB15	76	I/O	5VT	Default: PB15 Alternate: SPI1_MOSI, TIMER0_CH2_ON, I2S1_SD, TIMER11_CH1(3)
PD8	77	I/O	5VT	Default: PD8 Alternate: EXMC_D13 Remap: USART2_TX
PD9	78	I/O	5VT	Default: PD9 Alternate: EXMC_D14 Remap: USART2_RX
PD10	79	I/O	5VT	Default: PD10 Alternate: EXMC_D15 Remap: USART2_CK
PD11	80	I/O	5VT	Default: PD11 Alternate: EXMC_A16 Remap: USART2_CTS
PD12	81	I/O	5VT	Default: PD12 Alternate: EXMC_A17 Remap: TIMER3_CH0, USART2_RTS
PD13	82	I/O	5VT	Default: PD13 Alternate: EXMC_A18 Remap: TIMER3_CH1
V_{SS_8}	83	P		Default: V_{SS_8}
V_{DD_8}	84	P		Default: V_{DD_8}
PD14	85	I/O	5VT	Default: PD14 Alternate: EXMC_D0 Remap: TIMER3_CH2
PD15	86	I/O	5VT	Default: PD15 Alternate: EXMC_D1 Remap: TIMER3_CH3
PG2	87	I/O	5VT	Default: PG2 Alternate: EXMC_A12
PG3	88	I/O	5VT	Default: PG3 Alternate: EXMC_A13
PG4	89	I/O	5VT	Default: PG4 Alternate: EXMC_A14
PG5	90	I/O	5VT	Default: PG5 Alternate: EXMC_A15

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
PG6	91	I/O	5VT	Default: PG6 Alternate: EXMC_INT1
PG7	92	I/O	5VT	Default: PG7 Alternate: EXMC_INT2
PG8	93	I/O	5VT	Default: PG8
V_{SS_9}	94	P		Default: V_{SS_9}
V_{DD_9}	95	P		Default: V_{DD_9}
PC6	96	I/O	5VT	Default: PC6 Alternate: I2S1_MCK, TIMER7_CH0, SDIO_D6 Remap: TIMER2_CH0
PC7	97	I/O	5VT	Default: PC7 Alternate: I2S2_MCK, TIMER7_CH1, SDIO_D7 Remap: TIMER2_CH1
PC8	98	I/O	5VT	Default: PC8 Alternate: TIMER7_CH2, SDIO_D0 Remap: TIMER2_CH2
PC9	99	I/O	5VT	Default: PC9 Alternate: TIMER7_CH3, SDIO_D1 Remap: TIMER2_CH3
PA8	100	I/O	5VT	Default: PA8 Alternate: USART0_CK, TIMER0_CH0, CK_OUT0
PA9	101	I/O	5VT	Default: PA9 Alternate: USART0_TX, TIMER0_CH1
PA10	102	I/O	5VT	Default: PA10 Alternate: USART0_RX, TIMER0_CH2
PA11	103	I/O	5VT	Default: PA11 Alternate: USART0_CTS, CAN0_RX, USBDM, TIMER0_CH3
PA12	104	I/O	5VT	Default: PA12 Alternate: USART0_RTS, CAN0_TX, TIMER0_ETI, USBDP
PA13	105	I/O	5VT	Default: JTMS, SWDIO Remap: PA13
NC	106			-
V_{SS_2}	107	P		Default: V_{SS_2}
V_{DD_2}	108	P		Default: V_{DD_2}
PA14	109	I/O	5VT	Default: JTCK, SWCLK Remap: PA14
PA15	110	I/O	5VT	Default: JTDI Alternate: SPI2_NSS, I2S2_WS Remap: TIMER1_CH0, TIMER1_ETI, PA15, SPI0_NSS
PC10	111	I/O	5VT	Default: PC10 Alternate: UART3_TX, SDIO_D2

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Remap: USART2_TX, SPI2_SCK, I2S2_CK
PC11	112	I/O	5VT	Default: PC11 Alternate: UART3_RX, SDIO_D3 Remap: USART2_RX, SPI2_MISO
PC12	113	I/O	5VT	Default: PC12 Alternate: UART4_TX, SDIO_CK Remap: USART2_CK, SPI2_MOSI, I2S2_SD
PD0	114	I/O	5VT	Default: PD0 Alternate: EXMC_D2 Remap: CAN0_RX
PD1	115	I/O	5VT	Default: PD1 Alternate: EXMC_D3 Remap: CAN0_TX
PD2	116	I/O	5VT	Default: PD2 Alternate: TIMER2_ETI, SDIO_CMD, UART4_RX
PD3	117	I/O	5VT	Default: PD3 Alternate: EXMC_CLK Remap: USART1_CTS
PD4	118	I/O	5VT	Default: PD4 Alternate: EXMC_NOE Remap: USART1_RTS
PD5	119	I/O	5VT	Default: PD5 Alternate: EXMC_NWE Remap: USART1_TX
V_{SS_10}	120			Default: V_{SS_10}
V_{DD_10}	121			Default: V_{DD_10}
PD6	122	I/O	5VT	Default: PD6 Alternate: EXMC_NWAIT Remap: USART1_RX
PD7	123	I/O	5VT	Default: PD7 Alternate: EXMC_NE0, EXMC_NCE1 Remap: USART1_CK
PG9	124	I/O	5VT	Default: PG9 Alternate: EXMC_NE1, EXMC_NCE2
PG10	125	I/O	5VT	Default: PG10 Alternate: EXMC_NCE3_0, EXMC_NE2
PG11	126	I/O	5VT	Default: PG11 Alternate: EXMC_NCE3_1
PG12	127	I/O	5VT	Default: PG12 Alternate: EXMC_NE3
PG13	128	I/O	5VT	Default: PG13 Alternate: EXMC_A24

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
PG14	129	I/O	5VT	Default: PG14 Alternate: EXMC_A25
V_{SS_11}	130	P		Default: V_{SS_11}
V_{DD_11}	131	P		Default: V_{DD_11}
PG15	132	I/O	5VT	Default: PG15
PB3	133	I/O	5VT	Default: JTDO Alternate:SPI2_SCK, I2S2_CK Remap: PB3, TRACESWO, TIMER1_CH1, SPI0_SCK
PB4	134	I/O	5VT	Default: NJTRST Alternate: SPI2_MISO Remap: TIMER2_CH0, PB4, SPI0_MISO
PB5	135	I/O		Default: PB5 Alternate: I2C0_SMBA, SPI2_MOSI, I2S2_SD Remap: TIMER2_CH1, SPI0_MOSI
PB6	136	I/O	5VT	Default: PB6 Alternate: I2C0_SCL, TIMER3_CH0 Remap: USART0_TX
PB7	137	I/O	5VT	Default: PB7 Alternate: I2C0_SDA , TIMER3_CH1, EXMC_NADV Remap: USART0_RX
BOOT0	138	I		Default: BOOT0
PB8	139	I/O	5VT	Default: PB8 Alternate: TIMER3_CH2, SDIO_D4, TIMER9_CH0(3) Remap: I2C0_SCL, CAN0_RX
PB9	140	I/O	5VT	Default: PB9 Alternate: TIMER3_CH3, SDIO_D5, TIMER10_CH0(3) Remap: I2C0_SDA, CAN0_TX
PE0	141	I/O	5VT	Default: PE0 Alternate: TIMER3_ETI, EXMC_NBL0
PE1	142	I/O	5VT	Default: PE1 Alternate: EXMC_NBL1
V_{SS_3}	143	P		Default: V_{SS_3}
V_{DD_3}	144	P		Default: V_{DD_3}

Notes:

(1) Type: I = input, O = output, P = power.

(2) I/O Level: 5VT = 5 V tolerant.

(3) Functions are available in GD32F103ZF/G/I/K devices.

2.6.2. GD32F103Vx LQFP100 pin definitions

Table 2-6. GD32F103Vx LQFP100 pin definitions

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
PE2	1	I/O	5VT	Default: PE2 Alternate: TRACECK, EXMC_A23
PE3	2	I/O	5VT	Default: PE3 Alternate: TRACED0, EXMC_A19
PE4	3	I/O	5VT	Default: PE4 Alternate:TRACED1, EXMC_A20
PE5	4	I/O	5VT	Default: PE5 Alternate:TRACED2, EXMC_A21 Remap: TIMER8_CH0(3)
PE6	5	I/O	5VT	Default: PE6 Alternate:TRACED3, EXMC_A22 Remap: TIMER8_CH1(3)
V_{BAT}	6	P		Default: V_{BAT}
PC13-TAMPER-RTC	7	I/O		Default: PC13 Alternate: TAMPER-RTC
PC14-OSC32IN	8	I/O		Default: PC14 Alternate: OSC32IN
PC15-OSC32OUT	9	I/O		Default: PC15 Alternate: OSC32OUT
V_{SS_5}	10	P		Default: V_{SS_5}
V_{DD_5}	11	P		Default: V_{DD_5}
OSCIN	12	I		Default: OSCIN Remap: PD0
OSCOUT	13	O		Default: OSCOUT Remap: PD1
NRST	14	I/O		Default: NRST
PC0	15	I/O		Default: PC0 Alternate: ADC012_IN10(5)
PC1	16	I/O		Default: PC1 Alternate: ADC012_IN11(5)
PC2	17	I/O		Default: PC2 Alternate: ADC012_IN12(5)
PC3	18	I/O		Default: PC3 Alternate: ADC012_IN13(5)
V_{SSA}	19	P		Default: V_{SSA}
V_{REF-}	20	P		Default: V_{REF-}
V_{REF+}	21	P		Default: V_{REF+}

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
V_{DDA}	22	P		Default: V_{DDA}
PA0-WKUP	23	I/O		Default: PA0 Alternate: WKUP, USART1_CTS, ADC012_IN0(5), TIMER1_CH0, TIMER1_ETI, TIMER4_CH0(4), TIMER7_ETI(4)
PA1	24	I/O		Default: PA1 Alternate: USART1_RTS, ADC012_IN1(5), TIMER1_CH1, TIMER4_CH1(4)
PA2	25	I/O		Default: PA2 Alternate: USART1_TX, ADC012_IN2(5), TIMER1_CH2, TIMER4_CH2(4), TIMER8_CH0(3)
PA3	26	I/O		Default: PA3 Alternate: USART1_RX, ADC012_IN3(5), TIMER1_CH3, TIMER4_CH3(4), TIMER8_CH1(3)
V_{SS_4}	27	P		Default: V_{SS_4}
V_{DD_4}	28	P		Default: V_{DD_4}
PA4	29	I/O		Default: PA4 Alternate: SPI0_NSS, USART1_CK, ADC01_IN4, DAC_OUT0(4) Remap:SPI2_NSS(4), I2S2_WS(4)
PA5	30	I/O		Default: PA5 Alternate: SPI0_SCK, ADC01_IN5, DAC_OUT1(4)
PA6	31	I/O		Default: PA6 Alternate: SPI0_MISO, ADC01_IN6, TIMER2_CH0, TIMER7_BRKIN(4), TIMER12_CH0(3) Remap: TIMER0_BRKIN
PA7	32	I/O		Default: PA7 Alternate: SPI0_MOSI, ADC01_IN7, TIMER2_CH1, TIMER7_CH0_ON(4), TIMER13_CH0(3) Remap: TIMER0_CH0_ON
PC4	33	I/O		Default: PC4 Alternate: ADC01_IN14
PC5	34	I/O		Default: PC5 Alternate: ADC01_IN15
PB0	35	I/O		Default: PB0 Alternate: ADC01_IN8, TIMER2_CH2, TIMER7_CH1_ON(4) Remap: TIMER0_CH1_ON
PB1	36	I/O		Default: PB1 Alternate: ADC01_IN9, TIMER2_CH3, TIMER7_CH2_ON(4) Remap: TIMER0_CH2_ON

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
PB2	37	I/O	5VT	Default: PB2, BOOT1
PE7	38	I/O	5VT	Default: PE7 Alternate: EXMC_D4 Remap: TIMER0_ETI
PE8	39	I/O	5VT	Default: PE8 Alternate: EXMC_D5 Remap: TIMER0_CH0_ON
PE9	40	I/O	5VT	Default: PE9 Alternate: EXMC_D6 Remap: TIMER0_CH0
V_{SS_7}	-	P		Default: V_{SS_7}
V_{DD_7}	-	P		Default: V_{DD_7}
PE10	41	I/O	5VT	Default: PE10 Alternate: EXMC_D7 Remap: TIMER0_CH1_ON
PE11	42	I/O	5VT	Default: PE11 Alternate: EXMC_D8 Remap: TIMER0_CH1
PE12	43	I/O	5VT	Default: PE12 Alternate: EXMC_D9 Remap: TIMER0_CH2_ON
PE13	44	I/O	5VT	Default: PE13 Alternate: EXMC_D10 Remap: TIMER0_CH2
PE14	45	I/O	5VT	Default: PE14 Alternate: EXMC_D11 Remap: TIMER0_CH3
PE15	46	I/O	5VT	Default: PE15 Alternate: EXMC_D12 Remap: TIMER0_BRKIN
PB10	47	I/O	5VT	Default: PB10 Alternate: I2C1_SCL, USART2_TX Remap: TIMER1_CH2
PB11	48	I/O	5VT	Default: PB11 Alternate: I2C1_SDA, USART2_RX Remap: TIMER1_CH3
V_{SS_1}	49	P		Default: V_{SS_1}
V_{DD_1}	50	P		Default: V_{DD_1}
PB12	51	I/O	5VT	Default: PB12 Alternate: SPI1_NSS, I2C1_SMBA, USART2_CK, TIMER0_BRKIN, I2S1_WS(4)
PB13	52	I/O	5VT	Default: PB13

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: SPI1_SCK, USART2_CTS, TIMER0_CH0_ON, I2S1_CK(4)
PB14	53	I/O	5VT	Default: PB14 Alternate: SPI1_MISO, USART2_RTS, TIMER0_CH1_ON, TIMER11_CH0(3)
PB15	54	I/O	5VT	Default: PB15 Alternate: SPI1_MOSI, TIMER0_CH2_ON, I2S1_SD(4), TIMER11_CH1(3)
PD8	55	I/O	5VT	Default: PD8 Alternate: EXMC_D13 Remap: USART2_TX
PD9	56	I/O	5VT	Default: PD9 Alternate: EXMC_D14 Remap: USART2_RX
PD10	57	I/O	5VT	Default: PD10 Alternate: EXMC_D15 Remap: USART2_CK
PD11	58	I/O	5VT	Default: PD11 Alternate: EXMC_A16 Remap: USART2_CTS
PD12	59	I/O	5VT	Default: PD12 Alternate: EXMC_A17 Remap: TIMER3_CH0, USART2_RTS
PD13	60	I/O	5VT	Default: PD13 Alternate: EXMC_A18 Remap: TIMER3_CH1
PD14	61	I/O	5VT	Default: PD14 Alternate: EXMC_D0 Remap: TIMER3_CH2
PD15	62	I/O	5VT	Default: PD15 Alternate: EXMC_D1 Remap: TIMER3_CH3
PC6	63	I/O	5VT	Default: PC6 Alternate: I2S1_MCK(4), TIMER7_CH0(4), SDIO_D6(4) Remap: TIMER2_CH0
PC7	64	I/O	5VT	Default: PC7 Alternate: I2S2_MCK(4), TIMER7_CH1(4), SDIO_D7(4) Remap: TIMER2_CH1
PC8	65	I/O	5VT	Default: PC8 Alternate: TIMER7_CH2(4), SDIO_D0(4) Remap: TIMER2_CH2
PC9	66	I/O	5VT	Default: PC9

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: TIMER7_CH3(4), SDIO_D1(4) Remap: TIMER2_CH3
PA8	67	I/O	5VT	Default: PA8 Alternate: USART0_CK, TIMER0_CH0, CK_OUT0
PA9	68	I/O	5VT	Default: PA9 Alternate: USART0_TX, TIMER0_CH1
PA10	69	I/O	5VT	Default: PA10 Alternate: USART0_RX, TIMER0_CH2
PA11	70	I/O	5VT	Default: PA11 Alternate: USART0_CTS, CAN0_RX, USBDM, TIMER0_CH3
PA12	71	I/O	5VT	Default: PA12 Alternate: USART0_RTS, CAN0_TX, TIMER0_ETI, USBDP
PA13	72	I/O	5VT	Default: JTMS, SWDIO Remap: PA13
NC	73			-
V_{SS_2}	74	P		Default: V_{SS_2}
V_{DD_2}	75	P		Default: V_{DD_2}
PA14	76	I/O	5VT	Default: JTCK, SWCLK Remap: PA14
PA15	77	I/O	5VT	Default: JTDI Alternate: SPI2_NSS(4), I2S2_WS(4) Remap: TIMER1_CH0, TIMER1_ETI, PA15, SPI0_NSS
PC10	78	I/O	5VT	Default: PC10 Alternate: UART3_TX(4), SDIO_D2(4) Remap: USART2_TX, SPI2_SCK(4), I2S2_CK(4)
PC11	79	I/O	5VT	Default: PC11 Alternate: UART3_RX(4), SDIO_D3(4) Remap: USART2_RX, SPI2_MISO(4)
PC12	80	I/O	5VT	Default: PC12 Alternate: UART4_TX(4), SDIO_CK(4) Remap: USART2_CK, SPI2_MOSI(4), I2S2_SD(4)
PD0	81	I/O	5VT	Default: PD0 Alternate: EXMC_D2 Remap: CAN0_RX
PD1	82	I/O	5VT	Default: PD1 Alternate: EXMC_D3 Remap: CAN0_TX
PD2	83	I/O	5VT	Default: PD2 Alternate: TIMER2_ETI, SDIO_CMD(4), UART4_RX(4)
PD3	84	I/O	5VT	Default: PD3

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: EXMC_CLK Remap: USART1_CTS
PD4	85	I/O	5VT	Default: PD4 Alternate: EXMC_NOE Remap: USART1_RTS
PD5	86	I/O	5VT	Default: PD5 Alternate: EXMC_NWE Remap: USART1_TX
PD6	87	I/O	5VT	Default: PD6 Alternate: EXMC_NWAIT Remap: USART1_RX
PD7	88	I/O	5VT	Default: PD7 Alternate: EXMC_NE0, EXMC_NCE1 Remap: USART1_CK
PB3	89	I/O	5VT	Default: JTDO Alternate:SPI2_SCK(4), I2S2_CK(4) Remap: PB3, TRACESWO, TIMER1_CH1, SPI0_SCK
PB4	90	I/O	5VT	Default: NJTRST Alternate: SPI2_MISO(4) Remap: TIMER2_CH0, PB4, SPI0_MISO
PB5	91	I/O		Default: PB5 Alternate: I2C0_SMBA, SPI2_MOSI(4), I2S2_SD(4) Remap: TIMER2_CH1, SPI0_MOSI
PB6	92	I/O	5VT	Default: PB6 Alternate: I2C0_SCL, TIMER3_CH0 Remap: USART0_TX
PB7	93	I/O	5VT	Default: PB7 Alternate: I2C0_SDA , TIMER3_CH1, EXMC_NADV Remap: USART0_RX
BOOT0	94	I		Default: BOOT0
PB8	95	I/O	5VT	Default: PB8 Alternate: TIMER3_CH2, SDIO_D4(4), TIMER9_CH0(3) Remap: I2C0_SCL, CAN0_RX
PB9	96	I/O	5VT	Default: PB9 Alternate: TIMER3_CH3, SDIO_D5(4), TIMER10_CH0(3) Remap: I2C0_SDA, CAN0_TX
PE0	97	I/O	5VT	Default: PE0 Alternate: TIMER3_ETI, EXMC_NBL0
PE1	98	I/O	5VT	Default: PE1 Alternate: EXMC_NBL1
V_{SS_3}	99	P		Default: V_{SS_3}

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
V_{DD_3}	100	P		Default: V_{DD_3}

Notes:

(1) Type: I = input, O = output, P = power.

(2) I/O Level: 5VT = 5 V tolerant.

(3) Functions are available in GD32F103VF/G/I/K devices.

(4) Functions are available in GD32F103VC/D/E/F/G/I/K devices.

(5) ADC2 functions are available in GD32F103VC/D/E/F/G/I/K devices.

2.6.3. GD32F103Rx LQFP64 pin definitions

Table 2-7. GD32F103Rx LQFP64 pin definitions

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
V_{BAT}	1	P		Default: V_{BAT}
PC13-TAMPER-RTC	2	I/O		Default: PC13 Alternate: TAMPER-RTC
PC14-OSC32IN	3	I/O		Default: PC14 Alternate: OSC32IN
PC15-OSC32OUT	4	I/O		Default: PC15 Alternate: OSC32OUT
OSCIN	5	I		Default: OSCIN Remap: PD0
OSCOUT	6	O		Default: OSCOUT Remap: PD1
NRST	7	I/O		Default: NRST
PC0	8	I/O		Default: PC0 Alternate: ADC012_IN10(5)
PC1	9	I/O		Default: PC1 Alternate: ADC012_IN11(5)
PC2	10	I/O		Default: PC2 Alternate: ADC012_IN12(5)
PC3	11	I/O		Default: PC3 Alternate: ADC012_IN13(5)
V_{SSA}	12	P		Default: V_{SSA}
V_{DDA}	13	P		Default: V_{DDA}
PA0-WKUP	14	I/O		Default: PA0 Alternate: WKUP, USART1_CTS, ADC012_IN0(5), TIMER1_CH0, TIMER1_ETI, TIMER4_CH0(4), TIMER7_ETI(4)
PA1	15	I/O		Default: PA1 Alternate: USART1_RTS, ADC012_IN1(5), TIMER1_CH1, TIMER4_CH1(4)
PA2	16	I/O		Default: PA2 Alternate: USART1_TX, ADC012_IN2(5), TIMER1_CH2, TIMER4_CH2(4), TIMER8_CH0(3)
PA3	17	I/O		Default: PA3 Alternate: USART1_RX, ADC012_IN3(5), TIMER1_CH3, TIMER4_CH3(4), TIMER8_CH1(3)
V_{SS_4}	18	P		Default: V_{SS_4}
V_{DD_4}	19	P		Default: V_{DD_4}

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
PA4	20	I/O		Default: PA4 Alternate: SPI0_NSS, USART1_CK, ADC01_IN4, DAC_OUT0(4) Remap:SPI2_NSS(4), I2S2_WS(4)
PA5	21	I/O		Default: PA5 Alternate: SPI0_SCK, ADC01_IN5, DAC_OUT1(4)
PA6	22	I/O		Default: PA6 Alternate: SPI0_MISO, ADC01_IN6, TIMER2_CH0, TIMER7_BRKIN(4), TIMER12_CH0(3) Remap: TIMER0_BRKIN
PA7	23	I/O		Default: PA7 Alternate: SPI0_MOSI, ADC01_IN7, TIMER2_CH1, TIMER7_CH0_ON(4), TIMER13_CH0(3) Remap: TIMER0_CH0_ON
PC4	24	I/O		Default: PC4 Alternate: ADC01_IN14
PC5	25	I/O		Default: PC5 Alternate: ADC01_IN15
PB0	26	I/O		Default: PB0 Alternate: ADC01_IN8, TIMER2_CH2, TIMER7_CH1_ON(4) Remap: TIMER0_CH1_ON
PB1	27	I/O		Default: PB1 Alternate: ADC01_IN9, TIMER2_CH3, TIMER7_CH2_ON(4) Remap: TIMER0_CH2_ON
PB2	28	I/O	5VT	Default: PB2, BOOT1
PB10	29	I/O	5VT	Default: PB10 Alternate: I2C1_SCL(6), USART2_TX(6) Remap: TIMER1_CH2
PB11	30	I/O	5VT	Default: PB11 Alternate: I2C1_SDA(6), USART2_RX(6) Remap: TIMER1_CH3
V_{SS_1}	31	P		Default: V_{SS_1}
V_{DD_1}	32	P		Default: V_{DD_1}
PB12	33	I/O	5VT	Default: PB12 Alternate: SPI1_NSS(6), I2C1_SMBA(6), USART2_CK(6), TIMER0_BRKIN, I2S1_WS(4)
PB13	34	I/O	5VT	Default: PB13 Alternate: SPI1_SCK(6), USART2_CTS(6), TIMER0_CH0_ON, I2S1_CK(4)
PB14	35	I/O	5VT	Default: PB14 Alternate: SPI1_MISO(6), USART2_RTS(6), TIMER0_CH1_ON, TIMER11_CH0(3)

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
PB15	36	I/O	5VT	Default: PB15 Alternate: SPI1_MOSI(6), TIMER0_CH2_ON, I2S1_SD(4), TIMER11_CH1(3)
PC6	37	I/O	5VT	Default: PC6 Alternate: I2S1_MCK(4), TIMER7_CH0(4), SDIO_D6(4) Remap: TIMER2_CH0
PC7	38	I/O	5VT	Default: PC7 Alternate: I2S2_MCK(4), TIMER7_CH1(4), SDIO_D7(4) Remap: TIMER2_CH1
PC8	39	I/O	5VT	Default: PC8 Alternate: TIMER7_CH2(4), SDIO_D0(4) Remap: TIMER2_CH2
PC9	40	I/O	5VT	Default: PC9 Alternate: TIMER7_CH3(4), SDIO_D1(4) Remap: TIMER2_CH3
PA8	41	I/O	5VT	Default: PA8 Alternate: USART0_CK, TIMER0_CH0, CK_OUT0
PA9	42	I/O	5VT	Default: PA9 Alternate: USART0_TX, TIMER0_CH1
PA10	43	I/O	5VT	Default: PA10 Alternate: USART0_RX, TIMER0_CH2
PA11	44	I/O	5VT	Default: PA11 Alternate: USART0_CTS, CAN0_RX, USBDM, TIMER0_CH3
PA12	45	I/O	5VT	Default: PA12 Alternate: USART0_RTS, CAN0_TX, TIMER0_ETI, USBDP
PA13	46	I/O	5VT	Default: JTMS, SWDIO Remap: PA13
V_{SS_2}	47	P		Default: V_{SS_2}
V_{DD_2}	48	P		Default: V_{DD_2}
PA14	49	I/O	5VT	Default: JTCK, SWCLK Remap: PA14
PA15	50	I/O	5VT	Default: JTDI Alternate: SPI2_NSS(4), I2S2_WS(4) Remap: TIMER1_CH0, TIMER1_ETI, PA15, SPI0_NSS
PC10	51	I/O	5VT	Default: PC10 Alternate: UART3_TX(4), SDIO_D2(4) Remap: USART2_TX(6), SPI2_SCK(4), I2S2_CK(4)
PC11	52	I/O	5VT	Default: PC11 Alternate: UART3_RX(4), SDIO_D3(4) Remap: USART2_RX(6), SPI2_MISO(4)
PC12	53	I/O	5VT	Default: PC12

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: UART4_TX(4), SDIO_CK(4) Remap: USART2_CK(6), SPI2_MOSI(4), I2S2_SD(4)
PD2	54	I/O	5VT	Default: PD2 Alternate: TIMER2_ETI, SDIO_CMD(4), UART4_RX(4)
PB3	55	I/O	5VT	Default: JTDO Alternate:SPI2_SCK(4), I2S2_CK(4) Remap: PB3, TRACESWO, TIMER1_CH1, SPI0_SCK
PB4	56	I/O	5VT	Default: NJTRST Alternate: SPI2_MISO(4) Remap: TIMER2_CH0, PB4, SPI0_MISO
PB5	57	I/O		Default: PB5 Alternate: I2C0_SMBA, SPI2_MOSI(4), I2S2_SD(4) Remap: TIMER2_CH1, SPI0_MOSI
PB6	58	I/O	5VT	Default: PB6 Alternate: I2C0_SCL, TIMER3_CH0(6) Remap: USART0_TX
PB7	59	I/O	5VT	Default: PB7 Alternate: I2C0_SDA , TIMER3_CH1(6) Remap: USART0_RX
BOOT0	60	I		Default: BOOT0
PB8	61	I/O	5VT	Default: PB8 Alternate: TIMER3_CH2(6), SDIO_D4(4), TIMER9_CH0(3) Remap: I2C0_SCL, CAN0_RX
PB9	62	I/O	5VT	Default: PB9 Alternate: TIMER3_CH3(6), SDIO_D5(4), TIMER10_CH0(3) Remap: I2C0_SDA, CAN0_TX
V_{SS_3}	63	P		Default: V_{SS_3}
V_{DD_3}	64	P		Default: V_{DD_3}

Notes:

(1) Type: I = input, O = output, P = power.

(2) I/O Level: 5VT = 5 V tolerant.

(3) Functions are available in GD32F103RF/G/I/K devices.

(4) Functions are available in GD32F103RC/D/E/F/G/I/K devices.

(5) ADC2 functions are available in GD32F103RC/D/E/F/G/I/K devices.

(6) Functions are available in GD32F103R8/B/C/D/E/F/G/I/K devices.

2.6.4. GD32F103Cx LQFP48 pin definitions

Table 2-8. GD32F103Cx LQFP48 pin definitions

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
V_{BAT}	1	P		Default: V_{BAT}
PC13-TAMPER-RTC	2	I/O		Default: PC13 Alternate: TAMPER-RTC
PC14-OSC32IN	3	I/O		Default: PC14 Alternate: OSC32IN
PC15-OSC32OUT	4	I/O		Default: PC15 Alternate: OSC32OUT
OSCIN	5	I		Default: OSCIN Remap: PD0
OSCOUT	6	O		Default: OSCOUT Remap: PD1
NRST	7	I/O		Default: NRST
V_{SSA}	8	P		Default: V_{SSA}
V_{DDA}	9	P		Default: V_{DDA}
PA0-WKUP	10	I/O		Default: PA0 Alternate: WKUP, USART1_CTS, ADC012_IN0(3), TIMER1_CH0, TIMER1_ETI, TIMER4_CH0
PA1	11	I/O		Default: PA1 Alternate: USART1_RTS, ADC012_IN1(3), TIMER1_CH1
PA2	12	I/O		Default: PA2 Alternate: USART1_TX, ADC012_IN2(3), TIMER1_CH2
PA3	13	I/O		Default: PA3 Alternate: USART1_RX, ADC012_IN3(3), TIMER1_CH3
PA4	14	I/O		Default: PA4 Alternate: SPI0_NSS, USART1_CK, ADC01_IN4
PA5	15	I/O		Default: PA5 Alternate: SPI0_SCK, ADC01_IN5
PA6	16	I/O		Default: PA6 Alternate: SPI0_MISO, ADC01_IN6, TIMER2_CH0 Remap: TIMER0_BRKIN
PA7	17	I/O		Default: PA7 Alternate: SPI0_MOSI, ADC01_IN7, TIMER2_CH1 Remap: TIMER0_CH0_ON
PB0	18	I/O		Default: PB0 Alternate: ADC01_IN8, TIMER2_CH2 Remap: TIMER0_CH1_ON
PB1	19	I/O		Default: PB1

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: ADC01_IN9, TIMER2_CH3 Remap: TIMER0_CH2_ON
PB2	20	I/O	5VT	Default: PB2, BOOT1
PB10	21	I/O	5VT	Default: PB10 Alternate: I2C1_SCL(4), USART2_TX(4) Remap: TIMER1_CH2
PB11	22	I/O	5VT	Default: PB11 Alternate: I2C1_SDA(4), USART2_RX(4) Remap: TIMER1_CH3
V_{SS_1}	23	P		Default: V_{SS_1}
V_{DD_1}	24	P		Default: V_{DD_1}
PB12	25	I/O	5VT	Default: PB12 Alternate: SPI1_NSS(4), I2C1_SMBA(4), USART2_CK(4), TIMER0_BRKIN
PB13	26	I/O	5VT	Default: PB13 Alternate: SPI1_SCK(4), USART2_CTS(4), TIMER0_CH0_ON
PB14	27	I/O	5VT	Default: PB14 Alternate: SPI1_MISO(4), USART2_RTS(4), TIMER0_CH1_ON
PB15	28	I/O	5VT	Default: PB15 Alternate: SPI1_MOSI(4), TIMER0_CH2_ON
PA8	29	I/O	5VT	Default: PA8 Alternate: USART0_CK, TIMER0_CH0, CK_OUT0
PA9	30	I/O	5VT	Default: PA9 Alternate: USART0_TX, TIMER0_CH1
PA10	31	I/O	5VT	Default: PA10 Alternate: USART0_RX, TIMER0_CH2
PA11	32	I/O	5VT	Default: PA11 Alternate: USART0_CTS, CAN0_RX, USBDM, TIMER0_CH3
PA12	33	I/O	5VT	Default: PA12 Alternate: USART0_RTS, CAN0_TX, TIMER0_ETI, USBDP
PA13	34	I/O	5VT	Default: JTMS, SWDIO Remap: PA13
V_{SS_2}	35	P		Default: V_{SS_2}
V_{DD_2}	36	P		Default: V_{DD_2}
PA14	37	I/O	5VT	Default: JTCK, SWCLK Remap: PA14
PA15	38	I/O	5VT	Default: JTDI Remap: TIMER1_CH0, TIMER1_ETI, PA15, SPI0_NSS
PB3	39	I/O	5VT	Default: JTDO

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Remap: PB3, TRACESWO, TIMER1_CH1, SPI0_SCK
PB4	40	I/O	5VT	Default: NJTRST Remap: TIMER2_CH0, PB4, SPI0_MISO
PB5	41	I/O		Default: PB5 Alternate: I2C0_SMBA Remap: TIMER2_CH1, SPI0_MOSI
PB6	42	I/O	5VT	Default: PB6 Alternate: I2C0_SCL, TIMER3_CH0(4) Remap: USART0_TX
PB7	43	I/O	5VT	Default: PB7 Alternate: I2C0_SDA , TIMER3_CH1(4) Remap: USART0_RX
BOOT0	44	I		Default: BOOT0
PB8	45	I/O	5VT	Default: PB8 Alternate: TIMER3_CH2(4) Remap: I2C0_SCL, CAN0_RX
PB9	46	I/O	5VT	Default: PB9 Alternate: TIMER3_CH3(4) Remap: I2C0_SDA, CAN0_TX
V_{SS_3}	47	P		Default: V_{SS_3}
V_{DD_3}	48	P		Default: V_{DD_3}

Notes:

(1) Type: I = input, O = output, P = power.

(2) I/O Level: 5VT = 5 V tolerant.

(3) ADC2 functions are not available in GD32F103C4/6/8/B devices.

(4) Functions are available in GD32F103C8/B devices.

2.6.5. GD32F103Tx QFN36 pin definitions

Table 2-9. GD32F103Tx QFN36 pin definitions

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
OSCIN	2	I		Default: OSCIN Remap: PD0
OSCOUT	3	O		Default: OSCOUT Remap: PD1
NRST	4	I/O		Default: NRST
V_{SSA}	5	P		Default: V_{SSA}
V_{DDA}	6	P		Default: V_{DDA}
PA0-WKUP	7	I/O		Default: PA0 Alternate: WKUP, USART1_CTS, ADC012_IN0(3), TIMER1_CH0, TIMER1_ETI
PA1	8	I/O		Default: PA1 Alternate: USART1_RTS, ADC012_IN1(3), TIMER1_CH1
PA2	9	I/O		Default: PA2 Alternate: USART1_TX, ADC012_IN2(3), TIMER1_CH2
PA3	10	I/O		Default: PA3 Alternate: USART1_RX, ADC012_IN3(3), TIMER1_CH3
PA4	11	I/O		Default: PA4 Alternate: SPI0_NSS, USART1_CK, ADC01_IN4
PA5	12	I/O		Default: PA5 Alternate: SPI0_SCK, ADC01_IN5
PA6	13	I/O		Default: PA6 Alternate: SPI0_MISO, ADC01_IN6, TIMER2_CH0 Remap: TIMER0_BRKIN
PA7	14	I/O		Default: PA7 Alternate: SPI0_MOSI, ADC01_IN7, TIMER2_CH1 Remap: TIMER0_CH0_ON
PB0	15	I/O		Default: PB0 Alternate: ADC01_IN8, TIMER2_CH2 Remap: TIMER0_CH1_ON
PB1	16	I/O		Default: PB1 Alternate: ADC01_IN9, TIMER2_CH3 Remap: TIMER0_CH2_ON
PB2	17	I/O	5VT	Default: PB2, BOOT1
V_{SS_1}	18	P		Default: V_{SS_1}
V_{DD_1}	19	P		Default: V_{DD_1}
PA8	20	I/O	5VT	Default: PA8 Alternate: USART0_CK, TIMER0_CH0, CK_OUT0
PA9	21	I/O	5VT	Default: PA9

Pin Name	Pins	Pin Type(1)	I/O Level(2)	Functions description
				Alternate: USART0_TX, TIMER0_CH1
PA10	22	I/O	5VT	Default: PA10 Alternate: USART0_RX, TIMER0_CH2
PA11	23	I/O	5VT	Default: PA11 Alternate: USART0_CTS, CAN0_RX, USBDM, TIMER0_CH3
PA12	24	I/O	5VT	Default: PA12 Alternate: USART0_RTS, CAN0_TX, TIMER0_ETI, USBDP
PA13	25	I/O	5VT	Default: JTMS, SWDIO Remap: PA13
V_{SS_2}	26	P		Default: V_{SS_2}
V_{DD_2}	27	P		Default: V_{DD_2}
PA14	28	I/O	5VT	Default: JTCK, SWCLK Remap: PA14
PA15	29	I/O	5VT	Default: JTDI Remap: TIMER1_CH0, TIMER1_ETI, PA15, SPI0_NSS
PB3	30	I/O	5VT	Default: JTDO Remap: PB3, TRACESWO, TIMER1_CH1, SPI0_SCK
PB4	31	I/O	5VT	Default: NJTRST Remap: TIMER2_CH0, PB4, SPI0_MISO
PB5	32	I/O		Default: PB5 Alternate: I2C0_SMBA Remap: TIMER2_CH1, SPI0_MOSI
PB6	33	I/O	5VT	Default: PB6 Alternate: I2C0_SCL, TIMER3_CH0(4) Remap: USART0_TX
PB7	34	I/O	5VT	Default: PB7 Alternate: I2C0_SDA , TIMER3_CH1(4) Remap: USART0_RX
BOOT0	35	I		Default: BOOT0
V_{SS_3}	36	P		Default: V_{SS_3}
V_{DD_3}	1	P		Default: V_{DD_3}

Notes:

(1) Type: I = input, O = output, P = power.

(2) I/O Level: 5VT = 5 V tolerant.

(3) ADC2 functions are not available in GD32F103T4/6/8/B devices.

(4) Functions are available in GD32F103T8/B devices.

3. Functional description

3.1. Arm® Cortex®-M3 core

The Cortex®-M3 processor is the latest generation of Arm® processors for embedded systems. It has been developed to provide a low-cost platform that meets the needs of MCU implementation, with a reduced pin count and low-power consumption, while delivering outstanding computational performance and an advanced system response to interrupts.

- 32-bit Arm® Cortex®-M3 processor core
- Up to 108 MHz operation frequency
- Single-cycle multiplication and hardware divider
- Integrated Nested Vectored Interrupt Controller (NVIC)
- 24-bit SysTick timer

The Cortex®-M3 processor is based on the ARMv7 architecture and supports both Thumb and Thumb-2 instruction sets. Some system peripherals listed below are also provided by Cortex®-M3:

- Internal Bus Matrix connected with I-Code bus, D-Code bus, System bus, Private Peripheral Bus (PPB) and debug accesses.
- Nested Vectored Interrupt Controller (NVIC).
- Flash Patch and Breakpoint (FPB).
- Data Watchpoint and Trace (DWT).
- Instrumentation Trace Macrocell (ITM).
- Embedded Trace Macrocell (ETM).
- Serial Wire JTAG Debug Port (SWJ-DP).
- Trace Port Interface Unit (TPIU).
- Memory Protection Unit (MPU).

3.2. On-chip memory

- Up to 3072 Kbytes of Flash memory
- Up to 96 Kbytes of SRAM

The Arm® Cortex®-M3 processor is structured in Harvard architecture which can use separate buses to fetch instructions and load/store data. 3072 Kbytes of inner Flash and 96 Kbytes of inner SRAM at most is available for storing programs and data, both accessed (R/W) at CPU clock speed with zero wait states. The ***Table 2-4. GD32F103xx memory map*** shows the memory map of the GD32F103xx series of devices, including code, SRAM, peripheral, and other pre-defined regions.

3.3. Clock, reset and supply management

- Internal 8 MHz factory-trimmed RC and external 4 to 16 MHz crystal oscillator
- Internal 40 KHz RC calibrated oscillator and external 32.768 KHz crystal oscillator
- Integrated system clock PLL
- 2.6 to 3.6 V application supply and I/Os
- Supply Supervisor: POR (Power On Reset), PDR (Power Down Reset), and low voltage detector (LVD)

The Clock Control unit provides a range of frequencies and clock functions. These include an Internal 8M RC oscillator (IRC8M), a High Speed crystal oscillator (HXTAL), a Low Speed Internal 40K RC oscillator (IRC40K), a Low Speed crystal oscillator (LXTAL), a Phase Lock Loop (PLL), a HXTAL clock monitor, clock prescalers, clock multiplexers and clock gating circuitry. The frequency of AHB, APB2 and the APB1 domains can be configured by each prescaler. The maximum frequency of the AHB, APB2 and APB1 domains is 108 MHz/108 MHz/54 MHz. See ***Figure 2-8. GD32F103xx clock tree*** for details.

GD32F10x Reset Control includes the control of three kinds of reset: power reset, system reset and backup domain reset. The system reset resets the processor core and peripheral IP components except for the SW-DP controller and the Backup domain. Power-on reset (POR) and power-down reset (PDR) are always active, and ensures proper operation starting from/down to 2.6 V. The device remains in reset mode when V_{DD} is below a specified threshold. The embedded low voltage detector (LVD) monitors the power supply, compares it to the voltage threshold and generates an interrupt as a warning message for leading the MCU into security.

Power supply schemes:

- V_{DD} range: 2.6 to 3.6 V, external power supply for I/Os and the internal regulator. Provided externally through V_{DD} pins.
- V_{SSA}, V_{DDA} range: 2.6 to 3.6 V, external analog power supplies for ADC, reset blocks, RCs and PLL. V_{DDA} and V_{SSA} must be connected to V_{DD} and V_{SS}, respectively.
- V_{BAT} range: 1.8 to 3.6 V, power supply for RTC, external clock 32 KHz oscillator and backup registers (through power switch) when V_{DD} is not present.

3.4. Boot modes

At startup, boot pins are used to select one of three boot options:

- Boot from main flash memory (default)
- Boot from system memory
- Boot from on-chip SRAM

The boot loader is located in the internal boot ROM memory (system memory). It is used to reprogram the Flash memory by using USART0 (PA9 and PA10), if devices are GD32F103xF/G/I/K, USART1 (PA2 and PA3) is also available for boot functions. It also can

be used to transfer and update the Flash memory code, the data and the vector table sections. In default condition, boot from bank 0 of Flash memory is selected. It also supports to boot from bank 1 of Flash memory by setting a bit in option bytes.

3.5. Power saving modes

The MCU supports three kinds of power saving modes to achieve even lower power consumption. They are sleep mode, deep-sleep mode, and standby mode. These operating modes reduce the power consumption and allow the application to achieve the best balance between the CPU operating time, speed and power consumption.

- **Sleep** mode
  In sleep mode, only clock of Cortex®-M3 is off. All peripherals continue to operate and any interrupt/event can wake up the system.
- **Deep-sleep** mode
  In deep-sleep mode, all clocks in the 1.2V domain are off, and all of IRC8M, HXTAL and PLLs are disabled. Only the contents of SRAM and registers are retained. Any interrupt or wakeup event from EXTI lines can wake up the system from the deep-sleep mode including the 16 external lines, the RTC alarm, the LVD output, USB Wakeup and Ethernet Wakeup. When exiting the deep-sleep mode, the IRC8M is selected as the system clock.
- **Standby** mode
  In standby mode, the whole 1.2V domain is power off, the LDO is shut down, and all of IRC8M, HXTAL and PLL are disabled. The contents of SRAM and registers (except Backup registers) are lost. There are four wakeup sources for the Standby mode, including the external reset from NRST pin, the RTC alarm, the FWDGT reset, and the rising edge on WKUP pin.

3.6. Analog to digital converter (ADC)

- 12-bit SAR ADC
- Up to 1 MSPS for 12-bit resolution
- Analog input signal voltage range: V_{SSA} to V_{DDA} (2.6 to 3.6 V)
- Temperature sensor

Up to three 12-bit multi-channel ADCs are integrated in the device. Each has a total of up to 21 multiplexed external channels. An analog watchdog block can be used to detect the channels, which are required to remain within a specific threshold window. A configurable channel management block of analog inputs also can be used to perform conversions in single, continuous, scan or discontinuous mode.

The ADCs can be triggered from the events generated by the general level 0 timers (TIMERx) or the advanced timers (TIMER0 and TIMER7) with internal connection. The temperature sensor generates a voltage that varies linearly with temperature. The analog supply voltage V_{DDA} can vary from 2.6 V to 3.6 V. The output voltage of temperature sensor is internally connected to the ADC_IN16 input channel.

To ensure a high accuracy on ADC and DAC, the ADC/DAC independent external reference voltage should be connected to V_{REF+}/V_{REF-} pins. According to the different packages, V_{REF+}

pin can be connected to V_{DDA} pin, or external reference voltage, V_{REF-} pin must be connected to VSSA pin. The V_{REF+} pin is only available on no less than 100-pin packages. On less than 100-pin packages, the V_{REF+} pin is not available and it is internally connected to V_{DDA}. The V_{REF-} pin is internally connected to V_{SSA}.

3.7. Digital to analog converter (DAC)

- Two 12-bit DACs with independent output channels
- 8-bit or 12-bit mode in conjunction with the DMA controller

The two 12-bit buffered DACs are used to generate variable analog outputs. The DAC channels can be triggered by the timer or EXTI with DMA support. In dual DAC channel operation, conversions could be done independently or simultaneously. The maximum output value of the DAC is V_{REF+}.

3.8. DMA

- 7 channel DMA0 controller and 5 channel DMA1 controller
- Peripherals supported: Timers, ADC, SPIs, I2Cs, USARTs, DAC, I2S and SDIO

The direct memory access (DMA) controllers provide a hardware method of transferring data between peripherals and/or memory without intervention from the CPU, thereby freeing up bandwidth for other system functions. Three types of access method are supported: peripheral to memory, memory to peripheral, memory to memory.

Each channel is connected to fixed hardware DMA requests. The priorities of DMA channel requests are determined by software configuration and hardware channel number. Transfer size of source and destination are independent and configurable.

3.9. General-purpose inputs/outputs (GPIOs)

- Up to 112 fast GPIOs, all mappable on 16 external interrupt lines
- Analog input/output configurable
- Alternate function input/output configurable

There are up to 112 general purpose I/O pins (GPIO), named PA0 ~ PA15, PB0 ~ PB15, PC0 ~ PC15, PD0 ~ PD15, PE0 ~ PE15, PF0 ~ PF15 and PG0 ~ PG15 for the device to implement logic input/output functions. Each GPIO port has related control and configuration registers to satisfy the requirements of specific applications. The external interrupt on the GPIO pins of the device have related control and configuration registers in the Interrupt/event Controller Unit (EXTI). The GPIO ports are pin-shared with other alternative functions (AFs) to obtain maximum flexibility on the package pins. The GPIO pins can be used as alternative functional pins by configuring the corresponding registers regardless of the AF input or output pins. Each

of the GPIO pins can be configured by software as output (push-pull or open-drain), input, peripheral alternate function or analog mode. Each GPIO pin can be configured as pull-up, pull-down or no pull-up/pull-down. All GPIOs are high-current capable except for analog mode.

3.10. Timers and PWM generation

- Up to two 16-bit advanced timer (TIMER0 & TIMER7), ten 16-bit general timers, and two 16-bit basic timer (TIMER5 & TIMER6)
- Up to 4 independent channels of PWM, output compare or input capture for each and external trigger input
- 16-bit, motor control PWM advanced timer with programmable dead-time generation for output match
- Encoder interface controller with two inputs using quadrature decoder
- 24-bit SysTick timer down counter
- 2 watchdog timers (Free watchdog timer and window watchdog timer)

The advanced timer (TIMER0 & TIMER7) can be seen as a three-phase PWM multiplexed on 6 channels. It has complementary PWM outputs with programmable dead-time generation. It can also be used as a complete general timer. The 6 independent channels can be used for

- Input capture
- Output compare
- PWM generation (edge-aligned or center-aligned counting modes)
- Single pulse mode output

If configured as a general 16-bit timer, it can be synchronized with external signals or to interconnect with other general timers together which have the same architecture and features.

The general timer, known as TIMER1 ~ TIMER4, TIMER8 ~ TIMER10, TIMER11 ~ TIMER13 can be used for a variety of purposes including general timer, input signal pulse width measurement or output waveform generation such as a single pulse generation or PWM output, up to 4 independent channels for input capture/output compare. The general timer also supports an encoder interface with two inputs using quadrature decoder.

The basic timer, known as TIMER5 and TIMER6 are mainly used for DAC trigger generation. They can also be used as a simple 16-bit time base.

The GD32F103xx have two watchdog peripherals, free watchdog timer and window watchdog timer. They offer a combination of high safety level, flexibility of use and timing accuracy.

The free watchdog timer consists of an 8-stage prescaler and a 12-bit down-counter, it is clocked from an independent 40 KHz internal RC and as it operates independently of the main clock, it can operate in deep-sleep and standby modes. It can be used either as a watchdog to reset the device when a problem occurs, or as a free-running timer for application

timeout management.

The window watchdog timer is based on a 7-bit down counter that can be set as free-running. It can be used as a watchdog to reset the device when a problem occurs. It is clocked from the main clock. It has an early wakeup interrupt capability and the counter can be frozen in debug mode.

The SysTick timer is dedicated for OS, but could also be used as a standard down counter. The features are shown below:

- A 24-bit down counter
- Auto reload capability
- Maskable system interrupt generation when the counter reaches 0
- Programmable clock source

3.11. Real time clock (RTC)

- 32-bit up-counter with a programmable 20-bit prescaler
- Alarm function
- Interrupt and wake-up event

The real time clock is an independent timer which provides a set of continuously running counters which can be used with suitable software to provide a clock calendar function, and provides an alarm interrupt and an expected interrupt. The RTC features a 32-bit programmable counter for long-term measurement using the compare register to generate an alarm. A 20-bit prescaler is used for the time base clock and is by default configured to generate a time base of 1 second from a clock at 32.768 KHz from external crystal oscillator.

3.12. Inter-integrated circuit (I2C)

- Up to two I2C bus interfaces can support both master and slave mode with a frequency up to 400 KHz
- Provide arbitration function, optional PEC (packet error checking) generation and checking
- Supports 7-bit and 10-bit addressing mode and general call addressing mode

The I2C interface is an internal circuit allowing communication with an external I2C interface which is an industry standard two line serial interface used for connection to external hardware. These two serial lines are known as a serial data line (SDA) and a serial clock line (SCL). The I2C module provides transfer rate of up to 100 KHz in standard mode and up to 400 KHz in fast mode. The I2C module also has an arbitration detect function to prevent the situation where more than one master attempts to transmit data to the I2C bus at the same time. A CRC-8 calculator is also provided in I2C interface to perform packet error checking for I2C data.

3.13. Serial peripheral interface (SPI)

- Up to three SPI interfaces with a frequency of up to 18 MHz
- Support both master and slave mode
- Hardware CRC calculation and transmit automatic CRC error checking

The SPI interface uses 4 pins, among which are the serial data input and output lines (MISO & MOSI), the clock line (SCK) and the slave select line (NSS). Both SPIs can be served by the DMA controller. The SPI interface may be used for a variety of purposes, including simplex synchronous transfers on two lines with a possible bidirectional data line or reliable communication using CRC checking.

3.14. Universal synchronous asynchronous receiver transmitter (USART)

- Up to three USARTs and two UARTs with operating frequency up to 6.75 MHz
- Supports both asynchronous and clocked synchronous serial communication modes
- IrDA SIR encoder and decoder support
- LIN break generation and detection
- USARTs support ISO 7816-3 compliant smart card interface

The USART (USART0, USART1 and USART2) and UART (UART3 & UART4) are used to translate data between parallel and serial interfaces, provides a flexible full duplex data exchange using synchronous or asynchronous transfer. It is also commonly used for RS-232 standard communication. The USART includes a programmable baud rate generator which is capable of dividing the system clock to produce a dedicated clock for the USART transmitter and receiver. The USART also supports DMA function for high speed data communication except UART4.

3.15. Inter-IC sound (I2S)

- Two I2S bus Interfaces with sampling frequency from 8 KHz to 192 KHz
- Support either master or slave mode

The Inter-IC sound (I2S) bus provides a standard communication interface for digital audio applications by 3-wire serial lines. GD32F103xx contain two I2S-bus interfaces that can be operated with 16/32 bit resolution in master or slave mode, pin multiplexed with SPI1 and SPI2. The audio sampling frequency from 8 KHz to 192 KHz is supported with less than 0.5% accuracy error.

3.16. Secure digital input and output card interface (SDIO)

- Support SD2.0/SDIO2.0/MMC4.2 host interface

The Secure Digital Input and Output Card Interface (SDIO) provides access to external SD memory cards specifications version 2.0, SDIO card specification version 2.0 and multi-media card system specification version 4.2 with DMA supported. In addition, this interface is also compliant with CE-ATA digital protocol rev1.1.

3.17. Universal serial bus full-speed device (USBD)

- One full-speed USB Interface with frequency up to 12 Mbit/s
- Internal main PLL for USB CLK compliantly

The Universal Serial Bus (USB) is a 4-wire bus that supports communication between one or more devices. Full-speed peripheral is compliant with the USB 2.0 specification. The device controller enables 12 Mbit/s data exchange with a USB Host controller. Transaction formatting is performed by the hardware, including CRC generation and checking. The status of a completed USB transfer or error condition is indicated by status registers. An interrupt is also generated if enabled. The dedicated 48 MHz clock is generated from the internal main PLL (the clock source must use a HSE crystal oscillator) and the operating frequency divided from APB1 should be 12 MHz above.

3.18. Controller area network (CAN)

- One CAN2.0B interface with communication frequency up to 1 Mbit/s
- Internal main PLL for USB CLK compliantly

Controller area network (CAN) is a method for enabling serial communication in field bus. The CAN protocol has been used extensively in industrial automation and automotive applications. It can receive and transmit standard frames with 11-bit identifiers as well as extended frames with 29-bit identifiers. It has three mailboxes for transmission and two FIFOs of three message deep for reception. It also provides 14 scalable/configurable identifier filter banks for selecting the incoming messages needed and discarding the others.

3.19. External memory controller (EXMC)

- Supported external memory: SRAM, PSRAM, ROM and NOR-Flash, NAND Flash and CF card
- Up to 16-bit data bus
- Support interface with Motorola 6800 and Intel 8080 type LCD directly

External memory controller (EXMC) is an abbreviation of external memory controller. It is divided in to several sub-banks for external device support, each sub-bank has its own chip selection signal but at one time, only one bank can be accessed. The EXMC support code execution from external memory except NAND Flash and CF card. The EXMC also can be configured to interface with the most common LCD module of Motorola 6800 and Intel 8080 series and reduce the system cost and complexity.

3.20. Debug mode

- Serial wire JTAG debug port (SWJ-DP)

The Arm® SWJ-DP Interface is embedded and is a combined JTAG and serial wire debug port that enables either a serial wire debug or a JTAG probe to be connected to the target.

3.21. Package and operation temperature

- LQFP144 (GD32F103Zx), LQFP100 (GD32F103Vx), LQFP64 (GD32F103Rx), LQFP48 (GD32F103Cx) and QFN36 (GD32F103Tx)
- Operation temperature range: -40°C to +85°C (industrial level)

4. Electrical characteristics

4.1. Absolute maximum ratings

The maximum ratings are the limits to which the device can be subjected without permanently damaging the device. Note that the device is not guaranteed to operate properly at the maximum ratings. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

Table 4-1. Absolute maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{DD}	External voltage range	V_{SS} - 0.3	V_{SS} + 3.6	V
V_{DDA}	External analog supply voltage	V_{SSA} - 0.3	V_{SSA} + 3.6	V
V_{BAT}	External battery supply voltage	V_{SS} - 0.3	V_{SS} + 3.6	V
V_{IN}	Input voltage on 5V tolerant pin	V_{SS} - 0.3	V_{DD} + 4.0	V
	Input voltage on other I/O	V_{SS} - 0.3	4.0	V
I_{IO}	Maximum current for GPIO pins	—	25	mA
I_{INJ}	Injected current on 5V tolerant pin	—	±5	mA
	Injected current on other I/O	—	±5	mA
ΣI_{INJ}	Injected current on all I/O	—	±25	mA
T_A	Operating temperature range	-40	+85	°C
T_{STG}	Storage temperature range	-55	+150	°C
T_J	Maximum junction temperature	—	125	°C

4.2. Recommended DC characteristics

Table 4-2. DC operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	Supply voltage	—	2.6	3.3	3.6	V
V_{DDA}	Analog supply voltage	Same as V_{DD}	2.6	3.3	3.6	V
V_{BAT}	Battery supply voltage	—	1.8	—	3.6	V

4.3. Power consumption

The power measurements specified in the tables represent that code with data executing from on-chip Flash with the following specifications.

Table 4-3. Power consumption characteristics (for GD32F103x4/6/8/B devices)

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
I_{DD}	Supply current (Run mode)	V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock=108 MHz, all peripherals enabled	—	45.5	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =108 MHz, all peripherals disabled	—	33.96	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =72MHz, all peripherals enabled	-—	30.72	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System Clock =72 MHz, all peripherals disabled	—	23.05	—	mA
	Supply current (Sleep mode)	V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =108 MHz, CPU clock off, all peripherals enabled	—	19.82	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =108 MHz, CPU clock off, all peripherals disabled	—	5.84	—	mA
	Supply current (Deep-Sleep mode)	V_{DD}=V_{BAT}=3.3V, All clock off, regulator in run mode, IRC40K on, RTC on, all GPIOs analog mode	—	347.1	—	μA
		V_{DD}=V_{BAT}=3.3V, All clock off, regulator in low power mode, IRC40K on, RTC on, all GPIOs analog mode	—	335.9	—	μA
	Supply current (Standby mode)	V_{DD}=V_{BAT}=3.3V, LDO off, LXTAL off, IRC40K on, RTC on	—	9.27	—	μA
		V_{DD}=V_{BAT}=3.3V, LDO off, LXTAL off, IRC40K on, RTC off	—	8.82	—	μA
		V_{DD}=V_{BAT}=3.3V, LDO off, LXTAL off, IRC40K off, RTC off	—	7.52	—	μA
I_{BAT}	Battery supply current (Standby mode)	V_{DD} not available, V_{BAT}=3.6V, LDO off, LXTAL on, IRC40K off, RTC on	—	13.03	—	μA
		V_{DD} not available, V_{BAT}=3.3 V, LDO off, LXTAL off, IRC40K on, RTC on	—	10.7	—	μA
		V_{DD} not available, V_{BAT}=2.6 V, LDO off, LXTAL off, IRC40K on, RTC on	—	5.79	—	μA
t_{SLEEP}	Wakeup from Sleep mode	system clock = IRC8M = 8MHz	—	4.5	—	μs

$t_{DEEPSLEEP}$	Wakeup from deep-sleep mode（regulator in run mode）	system clock = IRC8M = 8MHz	—	6.5	—	μs
	Wakeup from deep-sleep mode（regulator in low power mode）	system clock = IRC8M = 8MHz	—	6.5	—	μs
t_{STDBY}	Wakeup from Standby mode	system clock = IRC8M = 8MHz	—	59.4	—	ms

Table 4-4. Power consumption characteristics (for GD32F103xC/D/E/F/G/I/K devices)

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
I_{DD}	Supply current (Run mode)	V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock=108 MHz, all peripherals enabled	—	66.32	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =108 MHz, all peripherals disabled	—	41.18	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =72MHz, all peripherals enabled	-—	44.98	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System Clock =72 MHz, all peripherals disabled	—	28.21	—	mA
	Supply current (Sleep mode)	V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =108 MHz, CPU clock off, all peripherals enabled	—	37.91	—	mA
		V_{DD}=V_{BAT}=3.3V, HXTAL=8MHz, System clock =108 MHz, CPU clock off, all peripherals disabled	—	7.94	—	mA
	Supply current (Deep-Sleep mode)	V_{DD}=V_{BAT}=3.3V, All clock off, regulator in run mode, IRC40K on, RTC on, all GPIOs analog mode	—	716.5	—	μA
		V_{DD}=V_{BAT}=3.3V, All clock off, regulator in low power mode, IRC40K on, RTC on, all GPIOs analog mode	—	706.8	—	μA
	Supply current (Standby mode)	V_{DD}=V_{BAT}=3.3V, LDO off, LXTAL off, IRC40K on, RTC on	—	9.88	—	μA
		V_{DD}=V_{BAT}=3.3V, LDO off, LXTAL off, IRC40K on, RTC off	—	9.45	—	μA
		V_{DD}=V_{BAT}=3.3V, LDO off, LXTAL off, IRC40K off, RTC off	—	8.17	—	μA
I_{BAT}		V_{DD} not available, V_{BAT}=3.6V, LDO off, LXTAL on, IRC40K off, RTC on	—	12.79	—	μA

	Battery supply current (Standby mode)	V_{DD} not available, V_{BAT}=3.3 V, LDO off, LXTAL off, IRC40K on, RTC on	—	10.11	—	μA
		V_{DD} not available, V_{BAT}=2.6 V, LDO off, LXTAL off, IRC40K on, RTC on	—	5.62	—	μA
t_{SLEEP}	Wakeup from Sleep mode	system clock = IRC8M = 8MHz	—	4.5	—	μs
$t_{DEEPSLEEP}$	Wakeup from deep-sleep mode（regulator in run mode）	system clock = IRC8M = 8MHz	—	6	—	μs
	Wakeup from deep-sleep mode（regulator in low power mode）	system clock = IRC8M = 8MHz	—	6	—	μs
t_{STDBY}	Wakeup from Standby mode	system clock = IRC8M = 8MHz	—	118.8	—	ms

Table 4-5. Power consumption of peripherals (for GD32F103x4/6/8/B devices)

Peripheral		Typical consumption at 25℃ (TYP)	Unit
APB1	TIMER1	0.75	mA
	TIMER2	0.79	
	TIMER3	0.75	
	SPI1	0.1	
	USART1	0.18	
	USART2	0.18	
	I2C0	0.23	
	I2C1	0.23	
	USB	0.46	
	CAN	0.75	
APB2	GPIOA	0.3	
	GPIOB	0.3	
	GPIOC	0.3	
	GPIOD	0.3	
	GPIOE	0.3	
	ADC0(1)	0.34	
	ADC1(1)	0.35	
	TIMER0	1.33	
	SPI0	0.1	
	USART0	0.35	
AHB	EXMC	0.11	

Note:

(1) The condition of ADC measurement is： system clock = f_{HCLK} = 56MHz, f_{APB1} = f_{HCLK}/2, f_{APB2} = f_{HCLK}, f_{ADC} = f_{APB2}/4, ADCON bit is set to 1.

(2) HXTAL = 8MHz, system clock = f_{HCLK} = 108MHz, f_{APB1} = f_{HCLK}/2, f_{APB2} = f_{HCLK}.

Table 4-6. Power consumption of peripherals (for GD32F103xC/D/E/F/G/I/K devices)

Peripheral		Typical consumption at 25℃ (TYP)	Unit
APB1	TIMER1	0.93	mA
	TIMER2	0.88	
	TIMER3	1.03	
	TIMER4	0.99	
	TIMER5	0.34	
	TIMER6	0.31	
	TIMER11	0.93	
	TIMER12	0.78	
	TIMER13	1.02	
	SPI1	0.43	
	SPI2	0.4	
	USART1	0.36	
	USART2	0.44	
	UART3	0.46	
	USRT4	0.42	
	I2C0	0.47	
	I2C1	0.47	
	USB	0.46	
	CAN	0.75	
	DAC(1)	0.29	
APB2	GPIOA	0.47	
	GPIOB	0.59	
	GPIOC	0.63	
	GPIOD	0.59	
	GPIOE	0.62	
	GPIOF	0.65	
	GPIOG	0.79	
	ADC0(2)	1.42	
	ADC1(2)	1.44	
	ADC2(2)	1.39	
	TIMER0	1.52	
	TIMER7	1.53	
	TIMER8	1.04	
	TIMER9	0.95	

	TIMER10	0.97	
	SPI0	0.22	
	USART0	0.63	
AHB	EXMC	1.53	
	SDIO	0.61	

Note:

(1) The condition of DAC measurement is：DEN0, DEN1 bits in the DAC_CTL register are set to 1, and the converted value is set to 0x800.

(2) The condition of ADC measurement is：system clock = f_{HCLK} = 56MHz, f_{APB1} = f_{HCLK}/2, f_{APB2} = f_{HCLK}, f_{ADC} = f_{APB2}/4, ADCON bit is set to 1.

(3) HXTAL = 8MHz, system clock = f_{HCLK} = 108MHz, f_{APB1} = f_{HCLK}/2, f_{APB2} = f_{HCLK}.

4.4. EMC characteristics

EMS (electromagnetic susceptibility) includes ESD (Electrostatic discharge, positive and negative) and FTB (Burst of Fast Transient voltage, positive and negative) testing result is given in the ***Table 4-7. EMS characteristics***, based on the EMS levels and classes compliant with IEC 61000 series standard.

Table 4-7. EMS characteristics

Symbol	Parameter	Conditions	Level/Class
V_{ESD}	Voltage applied to all device pins to induce a functional disturbance	V_{DD} = 3.3 V, T_A = +25 °C conforms to IEC 61000-4-2	3B
V_{FTB}	Fast transient voltage burst applied to induce a functional disturbance through 100 pF on V_{DD} and V_{SS} pins	V_{DD}= 3.3 V, T_A = +25 °C conforms to IEC 61000-4-4	4A

EMI (Electromagnetic Interference) emission testing result is given in the ***Table 4-8. EMI characteristics***, compliant with IEC 61967-2 standard which specifies the test board and the pin loading.

Table 4-8. EMI characteristics

Symbol	Parameter	Conditions	Tested frequency band	Conditions			Unit
				56M	72M	108M	
S_{EMI}	Peak level	V_{DD} = 3.3 V, T_A = +25 °C, compliant with IEC 61967-2	0.1 to 2 MHz	<0	<0	<0	dBµV
			2 to 30 MHz	-3.7	-2.8	-1.6	
			30 to 130 MHz	-6.5	-8	-5.5	
			130 MHz to 1GHz	-7	-7	-5	

4.5. Power supply supervisor characteristics

Table 4-9. Power supply supervisor characteristics (for GD32F103x4/6/8/B devices)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{POR}	Power on reset threshold		2.32	2.40	2.48	V
V_{PDR}	power down reset threshold		2.27	2.35	2.43	V
V_{HYST}	PDR hysteresis		—	0.05	—	V
$T_{RSTTEMP}$	Reset temporization		—	2	—	ms

Table 4-10. Power supply supervisor characteristics (for GD32F103xC/D/E/F/G/I/K devices)

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
V_{POR}	Power on reset threshold	—	2.27	2.40	2.43	V

V_{PDR}	Power down reset threshold	—	—	1.90	—	V
V_{HYST}	PDR hysteresis	—	—	0.5	—	V
$T_{RSTTEMP}$	Reset temporization	—	—	2	—	ms

4.6. Electrical sensitivity

The device is strained in order to determine its performance in terms of electrical sensitivity. Electrostatic discharges (ESD) are applied directly to the pins of the sample. Static latch-up (LU) test is based on the two measurement methods.

Table 4-11. ESD characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{ESD(HBM)}$	Electrostatic discharge voltage (human body model)	T_A=25 °C; JESD22-A114	—	—	4000	V
$V_{ESD(CDM)}$	Electrostatic discharge voltage (charge device model)	T_A=25 °C; JESD22-C101	—	—	1000	V

Table 4-12. Static latch-up characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
LU	I-test	T_A=25 °C; JESD78	—	—	±100	mA
	V_{supply} over voltage		—	—	5.4	V

4.7. External clock characteristics

Table 4-13. High speed external clock (HXTAL) generated from a crystal/ceramic characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{HXTAL}	High Speed External oscillator (HXTAL) frequency	V_{DD}=3.3V	3	8	32	MHz
C_{HXTAL}	Recommended load capacitance on OSCIN and OSCOUT	—	—	20	30	pF
R_{FHXTAL}	Recommended external feedback resistor between XTALIN and XTALOUT	—	—	1	—	MΩ
D_{HXTAL}	HXTAL oscillator duty cycle	—	48	50	55	%
$I_{DDHXTAL}$	HXTAL oscillator operating current	V_{DD}=3.3V, T_A=25°C	—	4.5	8.5	mA
$t_{SUHSEHXTAL}$	HXTAL oscillator startup time	V_{DD}=3.3V, T_A=25°C	—	2	—	ms

Table 4-14. Low speed external clock (LXTAL) generated from a crystal/ceramic characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{LXTAL}	Low Speed External oscillator (LXTAL) frequency	V_{DD}=V_{BAT}=3.3V	—	32.768	—	KHz
C_{LXTAL}	Recommended load capacitance on OSC32IN and OSC32OUT	—	—	—	20	pF
R_{FLXTAL}	Recommended external feedback resistor between XTAL32IN and XTAL32OUT	—	—	5	—	MΩ
D_{LXTAL}	LXTAL oscillator duty cycle	—	48	50	55	%
$I_{DDLXTAL}$	LXTAL oscillator operating current	V_{DD}=V_{BAT}=3.3V	—	6	—	μA
$t_{SULXTAL}$	LXTAL oscillator startup time	V_{DD}=V_{BAT}=3.3V	—	2	—	s

4.8. Internal clock characteristics

Table 4-15. High speed internal clock (IRC8M) characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{IRC8M}	High Speed Internal Oscillator (IRC8M) frequency	V_{DD}=3.3V	—	8	—	MHz
ACC_{IRC8M}	IRC8M oscillator Frequency accuracy, Factory-trimmed	V_{DD}=3.3V, T_A=-40°C ~ +105°C	-2.5	—	+1.5	%
		V_{DD}=3.3V, T_A=0°C ~ +85°C	-1.2	—	+1.2	%
		V_{DD}=3.3V, T_A=25°C	-1	—	+1	%
D_{IRC8M}	IRC8M oscillator duty cycle	V_{DD}=3.3V, f_{IRC8M}=8MHz	48	50	52	%
$I_{DDIRC8M}$	IRC8M oscillator operating current	V_{DD}=3.3V, f_{IRC8M}=8MHz	—	80	100	μA
$t_{SUIRC8M}$	IRC8M oscillator startup time	V_{DD}=3.3V, f_{IRC8M}=8MHz	1	—	2	us

Table 4-16. Low speed internal clock (IRC40K) characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{IRC40K}	Low Speed Internal oscillator (IRC40K) frequency	V_{DD}=V_{BAT}=3.3V, T_A=-40°C ~ +85°C	30	40	60	KHz
$I_{DDIRC40K}$	IRC40K oscillator operating current	V_{DD}=V_{BAT}=3.3V, T_A=25°C	—	1	2	μA
$t_{SUIRC40K}$	IRC40K oscillator startup time	V_{DD}=V_{BAT}=3.3V, T_A=25°C	—	—	80	μs

4.9. PLL characteristics

Table 4-17. PLL characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{PLLIN}	PLL input clock frequency		1	8	25	MHz
f_{PLL}	PLL output clock frequency		16	—	108	MHz
t_{LOCK}	PLL lock time		—		300	μs

4.10. Memory characteristics

Table 4-18. Flash memory characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
PE_{CYC}	Number of guaranteed program/erase cycles before failure (Endurance)	T_A=-40°C ~ +85°C	100	—	—	kcycles
t_{RET}	Data retention time	T_A=125°C	20	—	—	years
t_{PROG}	Word programming time	T_A=-40°C ~ +85°C	200	—	400	us
t_{ERASE}	Page erase time	T_A=-40°C ~ +85°C	60	100	450	ms
t_{MERASE}	Mass erase time	T_A=-40°C ~ +85°C	3.2	—	9.6	s

4.11. GPIO characteristics

Table 4-19. I/O port characteristics (for GD32F103x4/6/8/B devices)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IL}	Standard IO Low level input voltage	2.6V≤V_{DD}≤3.6V	-0.3	—	0.35 V_{DD}-0.06	V
	5V-tolerant IO Low level input voltage	2.6V≤V_{DD}≤3.6V	-0.3	—	0.4 V_{DD}-0.04	V
V_{IH}	Standard IO High level input voltage	2.6V≤V_{DD}≤3.6V	0.6 V_{DD}+0.14	—	V_{DD}+0.3	V
	5V-tolerant IO High level input voltage	2.6V≤V_{DD}≤3.6V	0.45 V_{DD}+0.13	—	5.5	V
V_{OL}	Output low level voltage for an IO pin (I_{IO} = +8mA)	2.6V≤V_{DD}≤3.6V	—	—	0.2	V
V_{OH}	Output high level voltage for an IO pin (I_{IO} = +8mA)	2.6V≤V_{DD}≤3.6V	V_{DD}-0.2	—	—	V
V_{OL}	Output low level voltage for an IO pin (I_{IO} = +20mA)	2.6V≤V_{DD}≤3.6V	—	—	0.5	V
V_{OH}	Output high level voltage for an IO pin (I_{IO} = +20mA)	2.6V≤V_{DD}≤3.6V	V_{DD}-0.5	—	—	V

R_{PU}	Internal pull-up resistor	$V_{IN}=V_{SS}$	30	40	50	kΩ
R_{PD}	Internal pull-down resistor	$V_{IN}=V_{DD}$	30	40	50	kΩ

Table 4-20. I/O port characteristics (for GD32F103xC/D/E/F/G/I/K devices)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IL}	Standard IO Low level input voltage	2.6V≤V_{DD}≤3.6V	-0.3	—	0.8	V
	5V-tolerant IO Low level input voltage	2.6V≤V_{DD}≤3.6V	-0.3	—	0.8	V
V_{IH}	Standard IO High level input voltage	2.6V≤V_{DD}≤3.6V	2	—	V_{DD}+0.3	V
	5V-tolerant IO High level input voltage	2.6V≤V_{DD}≤3.6V	2	—	5.5	V
V_{OL}	Output low level voltage for an IO pin (I_{IO} = +8mA)	2.6V≤V_{DD}≤3.6V	—	—	0.3	V
V_{OH}	Output high level voltage for an IO pin (I_{IO} = +8mA)	2.6V≤V_{DD}≤3.6V	V_{DD}-0.3	—	—	V
V_{OL}	Output low level voltage for an IO pin (I_{IO} = +20mA)	2.6V≤V_{DD}≤3.6V	—	—	0.7	V
V_{OH}	Output high level voltage for an IO pin (I_{IO} = +20mA)	2.6V≤V_{DD}≤3.6V	V_{DD}-0.8	—	—	V
R_{PU}	Internal pull-up resistor	$V_{IN}=V_{SS}$	30	40	50	kΩ
R_{PD}	Internal pull-down resistor	$V_{IN}=V_{DD}$	30	40	50	kΩ

4.12. ADC characteristics

Table 4-21. ADC characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DDA}	Operating voltage		2.6	3.3	3.6	V
V_{IN}	ADC input voltage range		0	—	V_{REF+}	V
f_{ADC}	ADC clock		0.6	—	14	MHz
f_S	Sampling rate		—	—	1	MHz
$f_{ADCCONV}$	ADC conversion time	f_{ADC}=14MHz	1	—	18	μs
R_{ADC}	Input sampling switch resistance	(For GD32F103x4/6/8/B)	—	—	0.2	kΩ
		(For GD32F103xC/D/E/F/G/I/K)	—	—	0.5	kΩ
C_{ADC}	Input sampling capacitance	(For GD32F103x4/6/8/B)	—	32	—	pF
		(For GD32F103xC/D/E/F/G/I/K)	—	8	—	pF
t_{SU}	Startup time		—	—	1	μs

4.13. DAC characteristics

Table 4-22. DAC characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DDA}	Operating voltage		2.6	3.3	3.6	V
V_{REF+}	Reference supply voltage	V_{REF+} should always below V_{DDA}	2.6	—	3.6	V
R_{LOAD}	Load resistance	Resistive load vs. V_{SSA} with buffer ON	5	—	—	kΩ
C_{LOAD}	Load capacitance	No pin/pad capacitance included	—	—	50	pF
DNL	Differential non-linearity error	DAC in 12-bit mode	—	—	±3	LSB
INL	Integral non-linearity	DAC in 12-bit mode	—	—	±4	LSB
Offset	Offset error	DAC in 12-bit mode	—	—	±12	LSB
GE	Gain error	DAC in 12-bit mode	—	—	±0.5	%

4.14. I2C characteristics

Table 4-23. I2C characteristics

Symbol	Parameter	Conditions	Standard mode		Fast mode		Unit
			Min	Max	Min	Max	
f_{SCL}	SCL clock frequency		0	100	0	400	KHz
$t_{SCL(H)}$	SCL clock high time		4.0	—	0.6	—	ns
$t_{SCL(L)}$	SCL clock low time		4.7	—	1.3	—	ns

4.15. SPI characteristics

Table 4-24. Standard SPI characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{SCK}	SCK clock frequency		—	—	18	MHz
$t_{SCK(H)}$	SCK clock high time		19	—	—	ns
$t_{SCK(L)}$	SCK clock low time		19	—	—	ns
SPI master mode						
$t_{V(MO)}$	Data output valid time		—	—	25	ns
$t_{H(MO)}$	Data output hold time		2	—	—	ns
$t_{SU(MI)}$	Data input setup time		5	—	—	ns
$t_{H(MI)}$	Data input hold time		5	—	—	ns
SPI slave mode						
$t_{SU(NSS)}$	NSS enable setup time	f_{PCLK}=54MHz	74	—	—	ns
$t_{H(NSS)}$	NSS enable hold time	f_{PCLK}=54MHz	37	—	—	ns
$t_{A(SO)}$	Data output access time	f_{PCLK}=54MHz	0	—	55	ns
$t_{DIS(SO)}$	Data output disable time		3	—	10	ns
$t_{V(SO)}$	Data output valid time		—	—	25	ns
$t_{H(SO)}$	Data output hold time		15	—	—	ns
$t_{SU(SI)}$	Data input setup time		5	—	—	ns
$t_{H(SI)}$	Data input hold time		4	—	—	ns

5. Package information

5.1. QFN package outline dimensions

Figure 5-1. QFN package outline

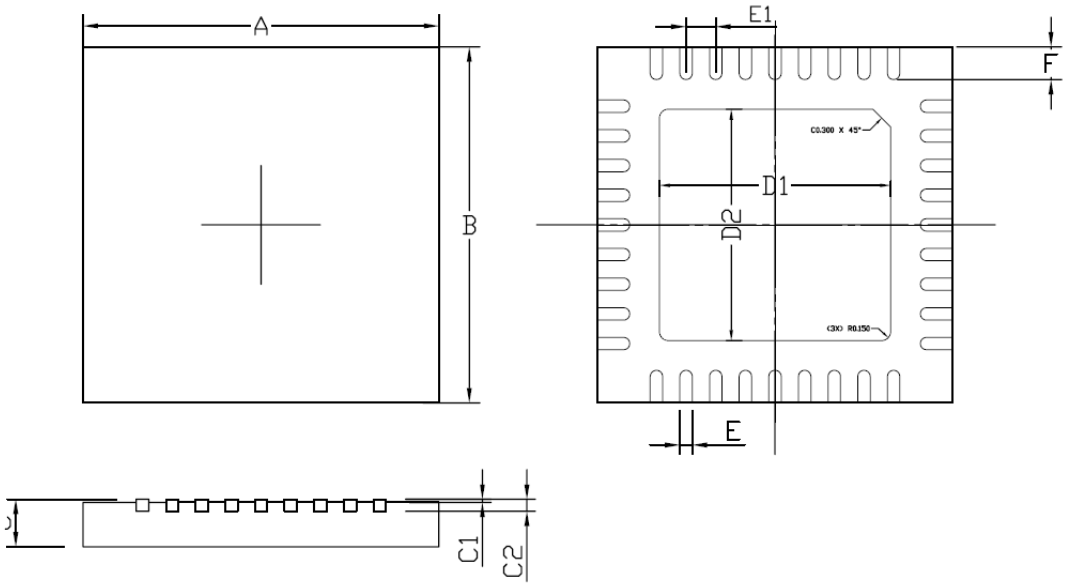


Table 5-1. QFN package dimensions

Symbol	Dimensions (mm)		Symbol	Dimensions (mm)	
	min	max		min	max
A	6.0 ± 0.1		D1	3.90 Typ	
B	6.0 ± 0.1		D2	3.90 Typ	
C	0.85	0.95	E	0.210 ± 0.025	
C1	0～0.050		E1	0.500 Typ	
C2	0.203 Typ		F	0.550 Typ	

Notes:

1. Formed lead shall be planar with respect to one another within 0.004 inches.
2. Both package length and width do not include mold flash and metal burr.

5.2. LQFP package outline dimensions

Figure 5-2. LQFP package outline

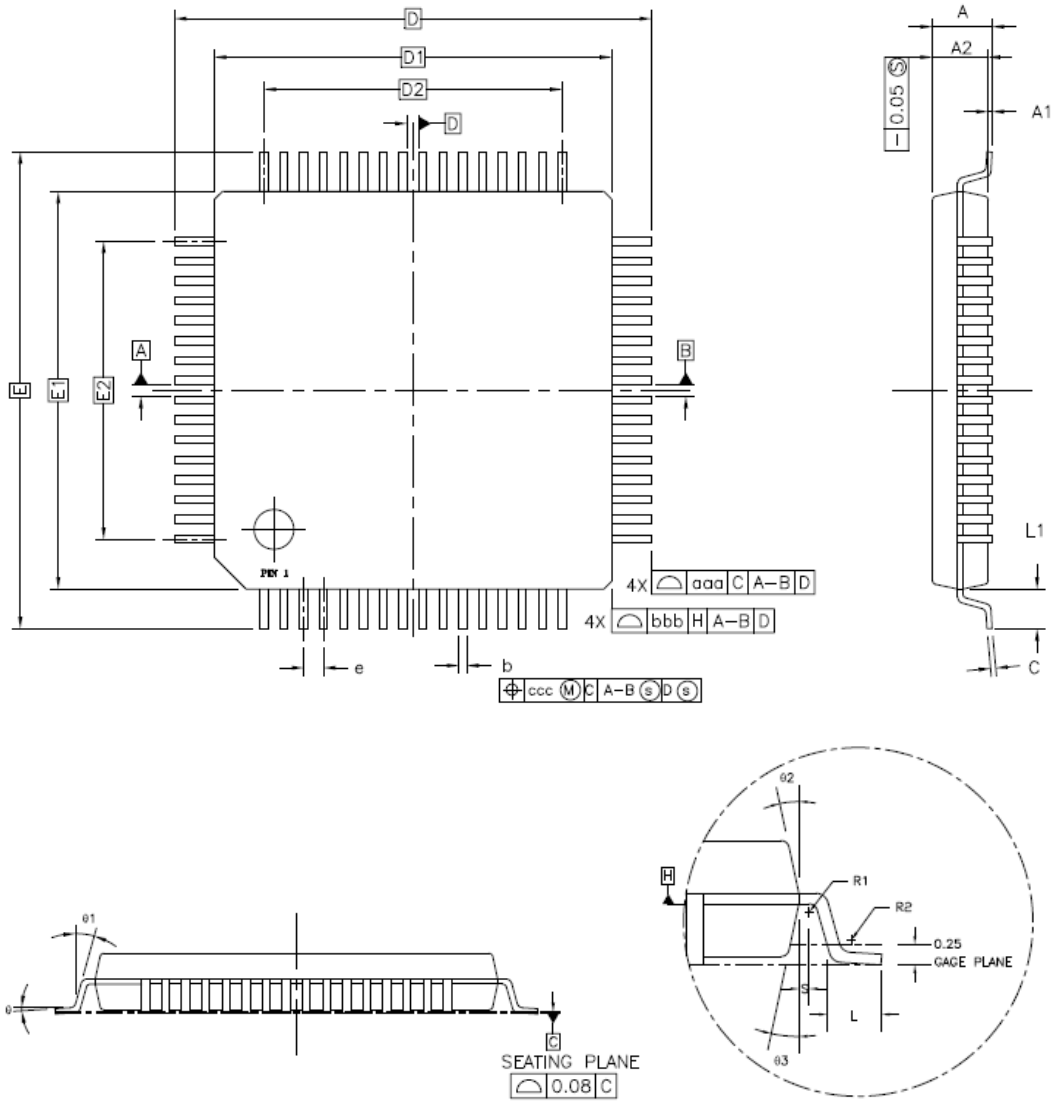


Table 5-2. LQFP package dimensions

Symbol	LQFP48			LQFP64			LQFP100			LQFP144		
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max
A	1.20	-	1.60	-	-	1.60	-	-	1.60	-	-	1.60
A1	0.05	-	0.15	0.05	-	0.15	0.05	-	0.15	0.05	-	0.15
A2	0.95	1.00	1.05	1.35	1.40	1.45	1.35	1.40	1.45	1.35	1.40	1.45
D	-	9.00	-	-	12.00	-	-	16.00	-	-	22.00	-
D1	-	7.00	-	-	10.00	-	-	14.00	-	-	20.00	-
E	-	9.00	-	-	12.00	-	-	16.00	-	-	22.00	-
E1	-	7.00	-	-	10.00	-	-	14.00	-	-	20.00	-
R1	0.08	-	-	0.08	-	-	0.08	-	-	0.08	-	-
R2	0.08	-	0.20	0.08	-	0.20	0.08	-	0.20	0.08	-	0.20
θ	0°	3.5°	7°	0°	3.5°	7°	0°	3.5°	7°	0°	3.5°	7°
θ1	0°	-	-	0°	-	-	0°	-	-	0°	-	-
θ2	11°	12°	13°	11°	12°	13°	11°	12°	13°	11°	12°	13°
θ3	11°	12°	13°	11°	12°	13°	11°	12°	13°	11°	12°	13°
c	0.09	-	0.20	0.09	-	0.20	0.09	-	0.20	0.09	-	0.20
L	0.45	0.60	0.75	0.45	0.60	0.75	0.45	0.60	0.75	0.45	0.60	0.75
L1	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-
S	0.20	-	-	0.20	-	-	0.20	-	-	0.20	-	-
b	0.17	0.22	0.27	0.17	0.20	0.27	0.17	0.20	0.27	0.17	0.20	0.27
e	-	0.50	-	-	0.50	-	-	0.50	-	-	0.50	-
D2	-	5.50	-	-	7.50	-	-	12.00	-	-	17.50	-
E2	-	5.50	-	-	7.50	-	-	12.00	-	-	17.50	-
aaa	0.20			0.20			0.20			0.20		
bbb	0.20			0.20			0.20			0.20		
ccc	0.08			0.08			0.08			0.08		

(Original dimensions are in millimeters)

6. Ordering Information

Table 6-1. Part ordering code for GD32F103xx devices

Ordering code	Flash (KB)	Package	Package type	Temperature operating range
GD32F103T4U6	16	QFN36	Green	Industrial -40°C to +85°C
GD32F103T6U6	32	QFN36	Green	Industrial -40°C to +85°C
GD32F103T8U6	64	QFN36	Green	Industrial -40°C to +85°C
GD32F103TBU6	128	QFN36	Green	Industrial -40°C to +85°C
GD32F103C4T6	16	LQFP48	Green	Industrial -40°C to +85°C
GD32F103C6T6	32	LQFP48	Green	Industrial -40°C to +85°C
GD32F103C8T6	64	LQFP48	Green	Industrial -40°C to +85°C
GD32F103CBT6	128	LQFP48	Green	Industrial -40°C to +85°C
GD32F103R4T6	16	LQFP64	Green	Industrial -40°C to +85°C
GD32F103R6T6	32	LQFP64	Green	Industrial -40°C to +85°C
GD32F103R8T6	64	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RBT6	128	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RCT6	256	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RDT6	384	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RET6	512	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RFT6	768	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RGT6	1024	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RIT6	2048	LQFP64	Green	Industrial -40°C to +85°C
GD32F103RKT6	3072	LQFP64	Green	Industrial -40°C to +85°C
GD32F103V8T6	64	LQFP100	Green	Industrial -40°C to +85°C
GD32F103VBT6	128	LQFP100	Green	Industrial -40°C to +85°C
GD32F103VCT6	256	LQFP100	Green	Industrial -40°C to +85°C
GD32F103VDT6	384	LQFP100	Green	Industrial -40°C to +85°C
GD32F103VET6	512	LQFP100	Green	Industrial -40°C to +85°C

Ordering code	Flash (KB)	Package	Package type	Temperature operating range
GD32F103VFT6	768	LQFP100	Green	Industrial -40°C to +85°C
GD32F103VGT6	1024	LQFP100	Green	Industrial -40°C to +85°C
GD32F103VIT6	2048	LQFP100	Green	Industrial -40°C to +85°C
GD32F103VKT6	3072	LQFP100	Green	Industrial -40°C to +85°C
GD32F103ZCT6	256	LQFP144	Green	Industrial -40°C to +85°C
GD32F103ZDT6	384	LQFP144	Green	Industrial -40°C to +85°C
GD32F103ZET6	512	LQFP144	Green	Industrial -40°C to +85°C
GD32F103ZFT6	768	LQFP144	Green	Industrial -40°C to +85°C
GD32F103ZGT6	1024	LQFP144	Green	Industrial -40°C to +85°C
GD32F103ZIT6	2048	LQFP144	Green	Industrial -40°C to +85°C
GD32F103ZKT6	3072	LQFP144	Green	Industrial -40°C to +85°C

7. Revision History

Table 7-1. Revision history

Revision No.	Description	Date
1.0	Initial Release	Mar.8, 2013
2.2	1. Characteristics values modified and package data updated, refers to ***Electrical characteristics*** and ***Package information***.	Oct.10, 2013
2.3	1. Maximum HXTAL frequency value corrected in ***Table 4-13. High speed external clock (HXTAL) generated from a crystal/ceramic characteristics***.	Oct.20, 2014
2.4	1. Repair history accumulation error.	Jan.24, 2018
2.5	1. Add missing pin definitions for GD32F103Rx, 8 to 11,18 and 19 pins in ***Table 2-7. GD32F103Rx LQFP64 pin definitions***.	Dec.10, 2018
2.6	1. Delete EXMC_NADV in PB7 of ***Table 2-7. GD32F103Rx LQFP64 pin definitions***.	July 22, 2019
2.7	1. Delete the PD0,PD1 remap to OSC pins information in packages no less than100 pins, refers to ***Pin definitions***.	Feb.15, 2020
2.8	1. Integrate the boot loader address in chapter ***Memory map*** together. 2. Add description of V_{REF+} and V_{REF-} connection in chapter ***Analog to digital converter (ADC)***. 3. Arm® Cortex® written format modification.	Sep.18, 2020

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