GigaDevice Semiconductor Inc.

GD32F101xx
ARM® Cortex™-M3 32-bit MCU

Datasheet

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1 General description

The GD32F101xx 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 GD32F101xx device incorporates the ARM® Cortex™-M3 32-bit processor core operating at 56 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 80 KB SRAM memory. An extensive range of enhanced I/Os and peripherals connected to two APB buses. The devices offer up to two 12-bit ADCs, up to ten general-purpose 16-bit timers and two basic timers, as well as standard and advanced communication interfaces: up to three USARTs, two UARTs, three SPIs and two I^2Cs,

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 GD32F101xx devices suitable for a wide range of applications, especially in areas such as industrial control, user interface, power monitor and alarm systems, consumer and handheld equipment, touch panel, PC peripherals and so on.

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2 Device overview

2.1 Device information

Table 1. GD32F101xx devices features and peripheral list

Part Number		GD32F101xx													
		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)		4	6	10	16	4	6	10	16	4	6	10	16	10	16
Timers	GPTM	2	2	3	3	2	2	3	3	2	2	3	3	3	3
	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	2	2	2	2	2	3	3	2	2	3	3	3	3
	I2C	1	1	1	1	1	1	2	2	1	1	2	2	2	2
	SPI	1	1	1	1	1	1	2	2	1	1	2	2	2	2
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	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Channels	10	10	10	10	10	10	10	10	16	16	16	16	16	16
Package		QFN36				LQFP48				LQFP64				LQFP100	

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Table 1. GD32F101xx devices features and peripheral list (continued)

Part Number		GD32F101xx													
		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)		32	48	48	80	80	80	80	32	48	48	80	80	80	80
Timers	GPTM	4	4	4	10	10	10	10	4	4	4	10	10	10	10
	SysTick	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Basic Timer	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	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	3	3	3	3	3	3	3	3	3	3	3	3	3
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	1	1	1	2	2	2	2	1	1	1	2	2	2	2
	Channels	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Package		LQFP64							LQFP100						

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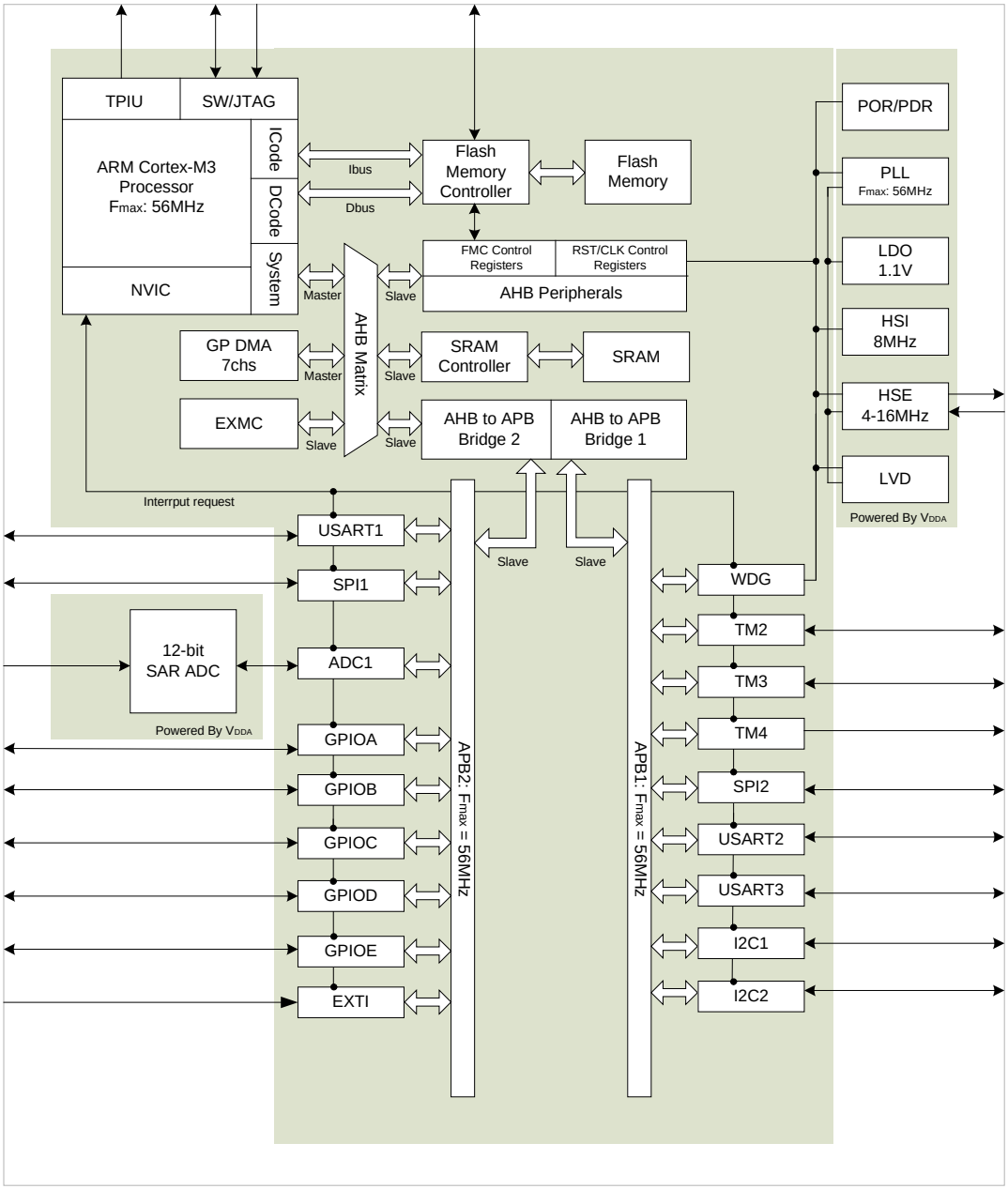
Table 1. GD32F101xx devices features and peripheral list (continued)

Part Number		GD32F101xx						
		ZC	ZD	ZE	ZF	ZG	ZI	ZK
Flash (KB)		256	384	512	768	1024	2048	3072
SRAM (KB)		32	48	48	80	80	80	80
Timers	GPTM	4	4	4	10	10	10	10
	SysTick	1	1	1	1	1	1	1
	Basic Timer	2	2	2	2	2	2	2
	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	3	3	3	3	3	3
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	1	1	1	2	2	2	2
	Channels	16	16	16	16	16	16	16
Package		LQFP144						

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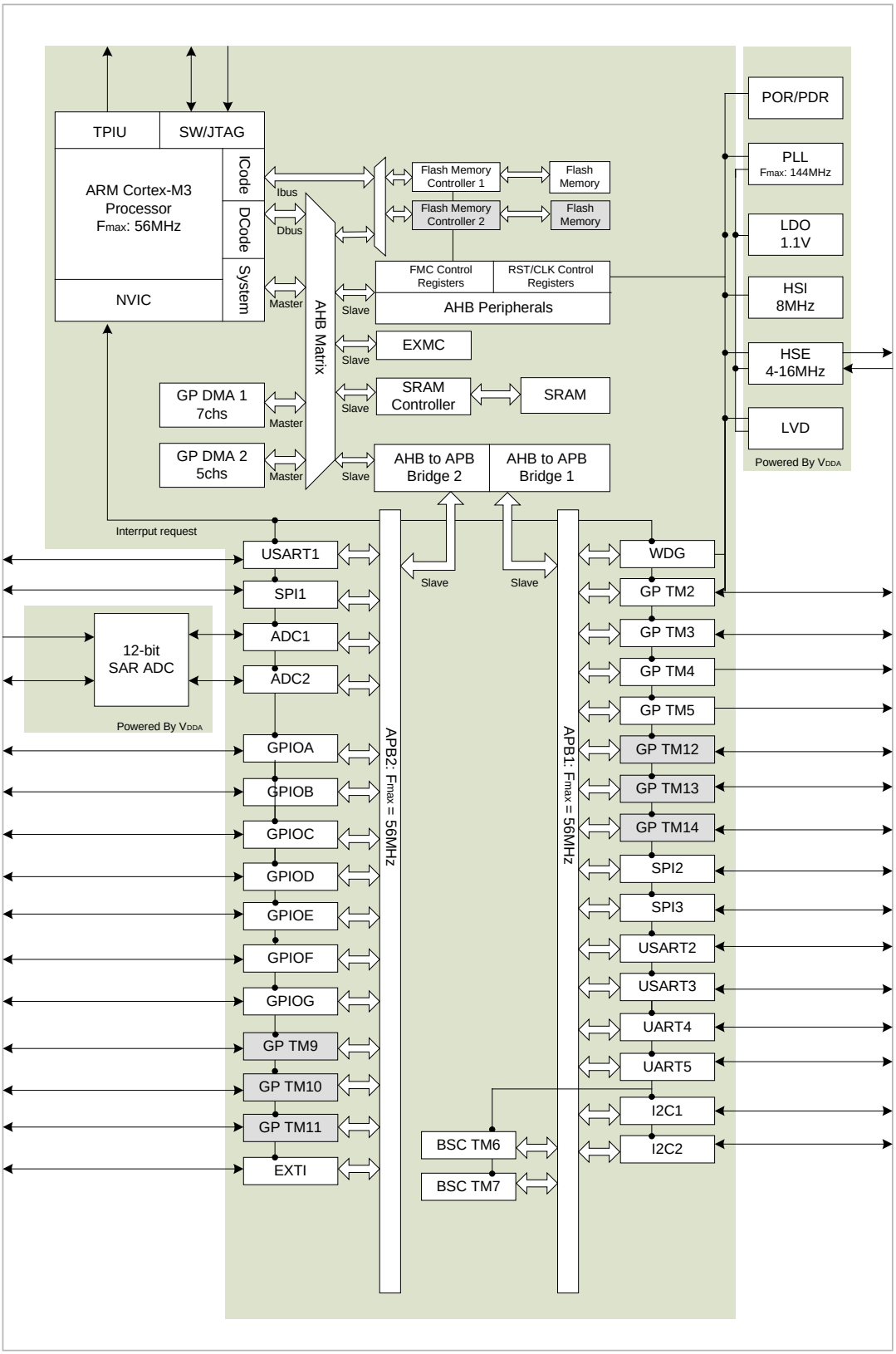
2.2 Block diagram

Figure 1. GD32F101x4/6/8/B block diagram



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Figure 2. GD32F101xC/D/E/F/G/I/K block diagram

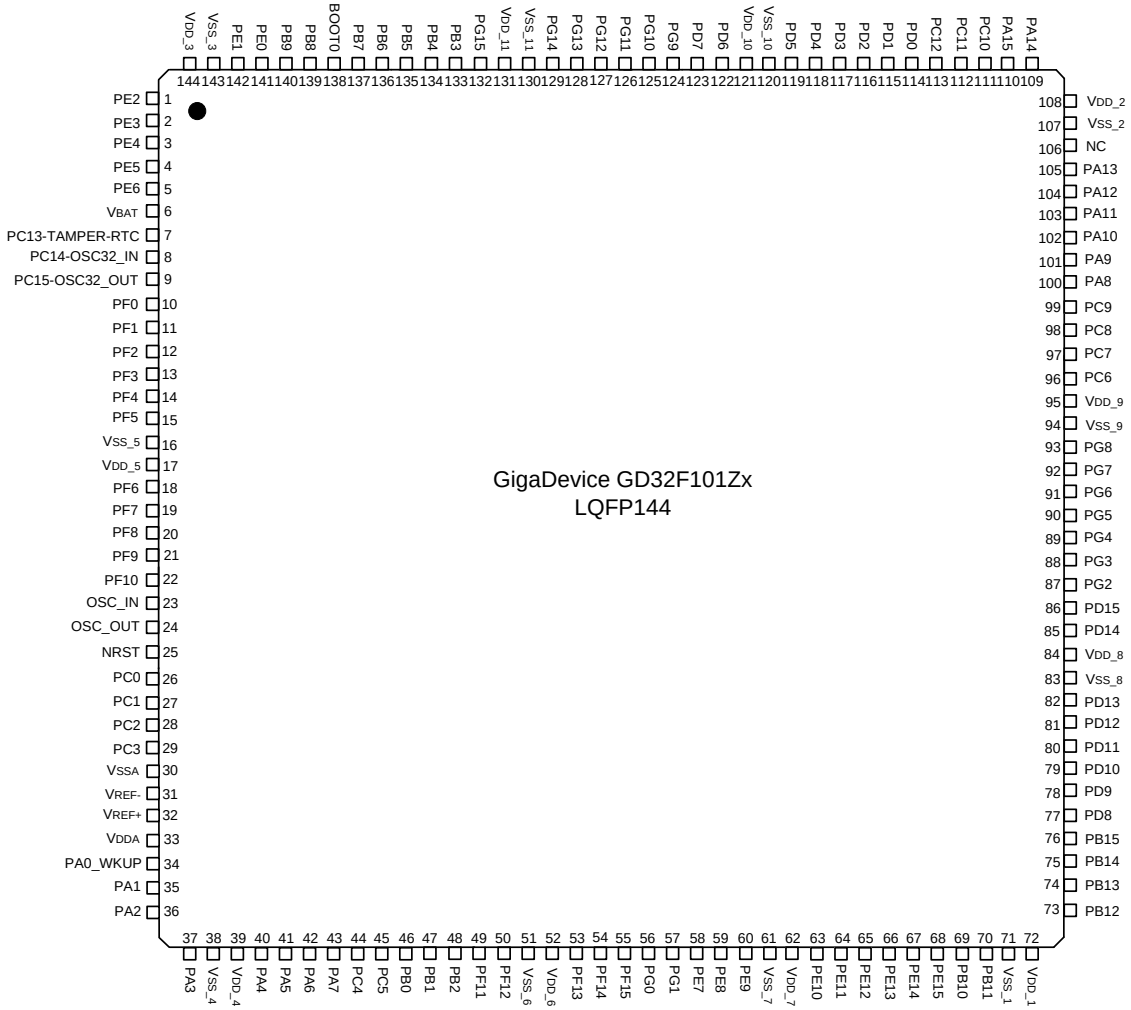


: Blocks are available in GD32F101xF/G/I/K devices

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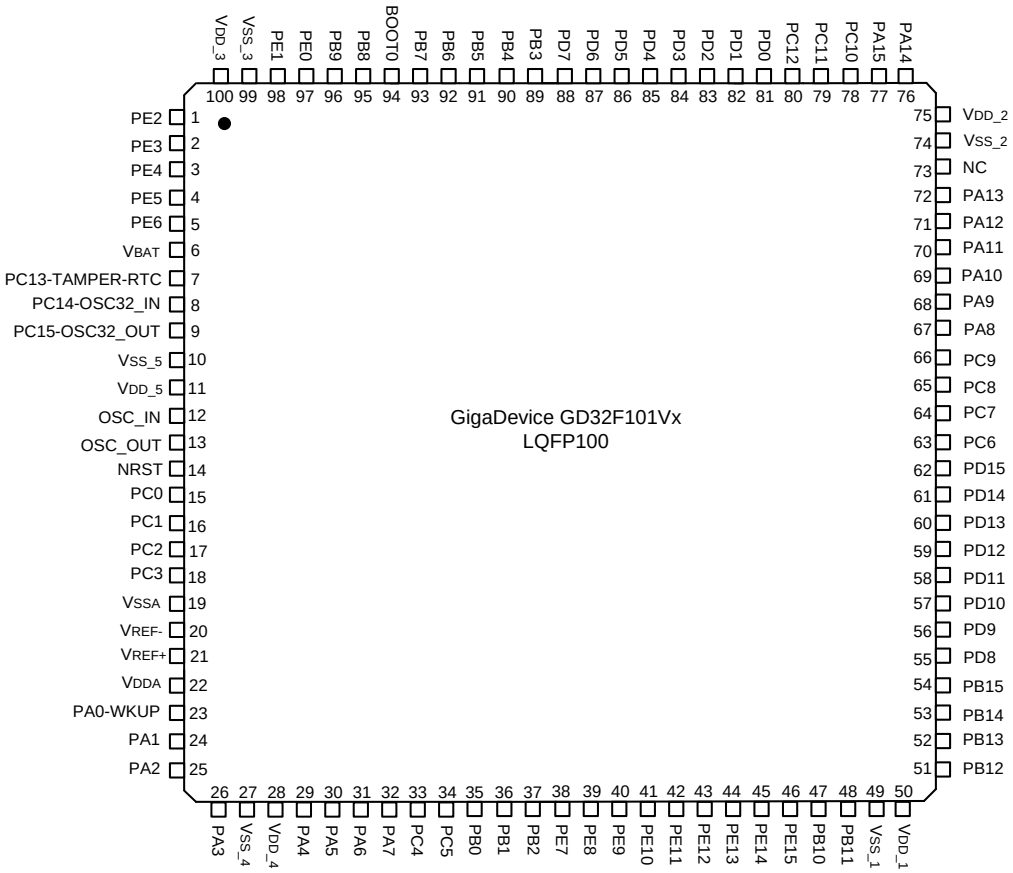
2.3 Pinouts and pin assignment

Figure 3. GD32F101Zx LQFP144 pinouts



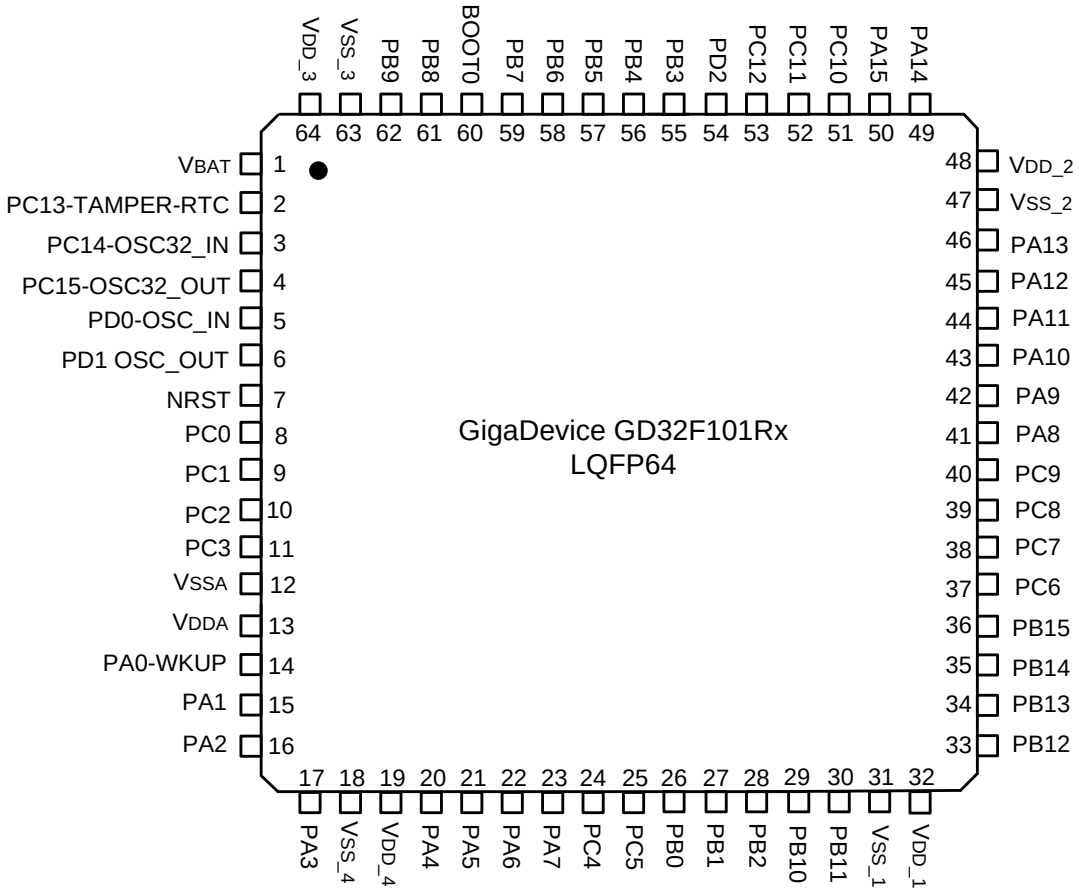
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Figure 4. GD32F101Vx LQFP100 pinouts



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Figure 5. GD32F101Rx LQFP64 pinouts



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Figure 6. GD32F101Cx LQFP48 pinouts

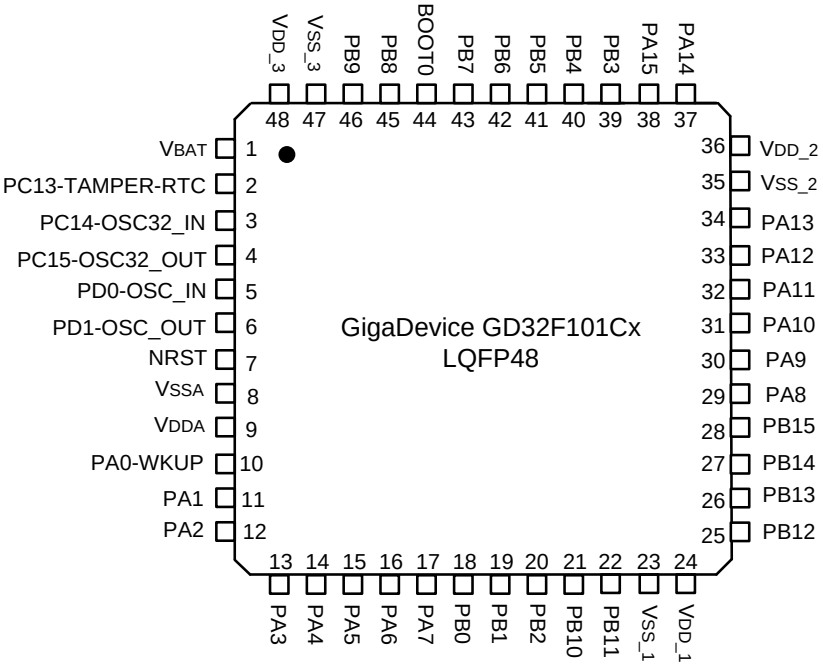
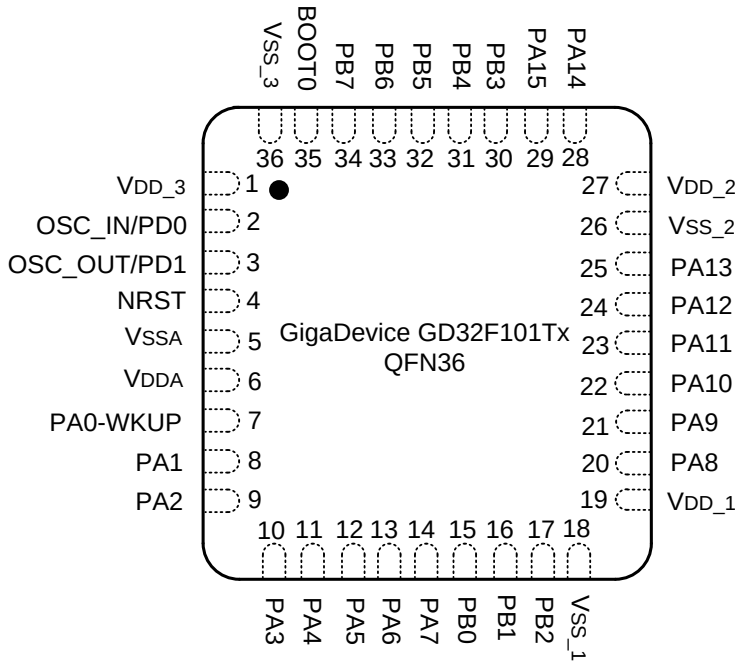


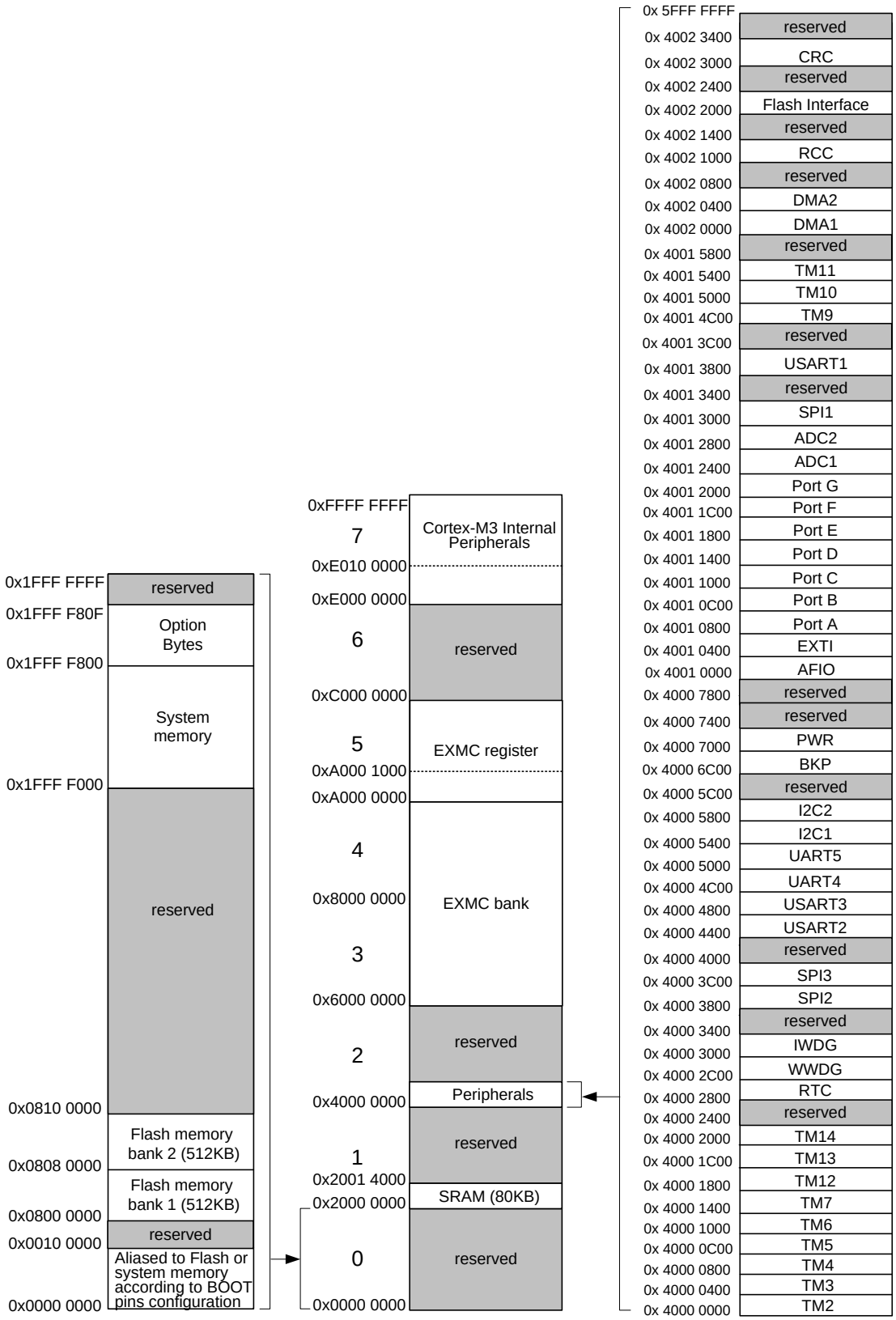
Figure 7. GD32F101Tx QFN36 pinouts



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2.4 Memory map

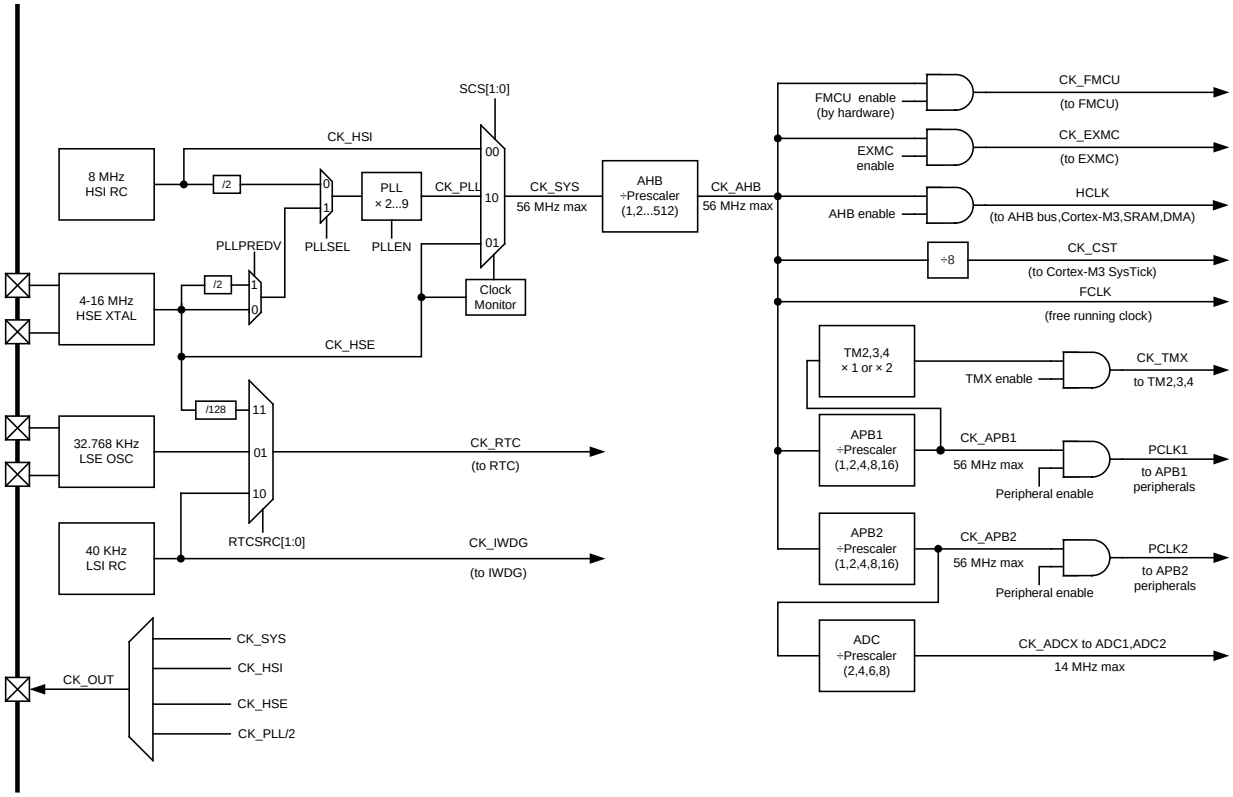
Figure 8. GD32F101xx memory map



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2.5 Clock tree

Figure 9. GD32F101xx clock tree



Legend:

HSE = High speed external clock

HSI = High speed internal clock

LSE = Low speed external clock

LSI = Low speed internal clock

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2.6 Pin definitions

Table 2. GD32F101xx pin definitions

Pin Name	Pins					Pin Type(1)	I/O(2) Level	Functions description
	LQFP144	LQFP100	LQFP64	LQFP48	QFN36			
PE2	1	1	-	-	-	I/O	5VT	Default: PE2 Alternate: TRACECK, EXMC_A23
PE3	2	2	-	-	-	I/O	5VT	Default: PE3 Alternate: TRACED0, EXMC_A19
PE4	3	3	-	-	-	I/O	5VT	Default: PE4 Alternate:TRACED1, EXMC_A20
PE5	4	4	-	-	-	I/O	5VT	Default: PE5 Alternate:TRACED2, EXMC_A21 Remap: TM9_CH1(4)
PE6	5	5	-	-	-	I/O	5VT	Default: PE6 Alternate:TRACED3, EXMC_A22 Remap: TM9_CH2(4)
V_{BAT}	6	6	1	1	-	P		Default: V_{BAT}
PC13-TAMPER-RTC	7	7	2	2	-	I/O		Default: PC13 Alternate: TAMPER-RTC
PC14-OSC32_IN	8	8	3	3	-	I/O		Default: PC14 Alternate: OSC32_IN
PC15-OSC32_OUT	9	9	4	4	-	I/O		Default: PC15 Alternate: OSC32_OUT
PF0	10					I/O	5VT	Default: PF0(3) Alternate: EXMC_A0(3)
PF1	11					I/O	5VT	Default: PF1(3) Alternate: EXMC_A1(3)
PF2	12					I/O	5VT	Default: PF2(3) Alternate: EXMC_A2(3)
PF3	13					I/O	5VT	Default: PF3(3) Alternate: EXMC_A3(3)
PF4	14					I/O	5VT	Default: PF4(3) Alternate: EXMC_A4(3)
PF5	15					I/O	5VT	Default: PF5(3) Alternate: EXMC_A5(3)
V_{SS_5}	16	10	-	-	-	P		Default: V_{SS_5}
V_{DD_5}	17	11	-	-	-	P		Default: V_{DD_5}
PF6	18					I/O		Default: PF6(3) Alternate: EXMC_NIORD(3) Remap: TM10_CH1(4)
PF7	19					I/O		Default: PF7(3) Alternate: EXMC_NREG(3)

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Pin Name	Pins					Pin Type(1)	I/O(2) Level	Functions description
	LQFP144	LQFP100	LQFP64	LQFP48	QFN36			
PF8	20					I/O		Default: PF8(3) Alternate: EXMC_NIOWR(3) Remap: TM13_CH1(4)
PF9	21					I/O		Default: PF9(3) Alternate: EXMC_CD(3) Remap: TM14_CH1(4)
PF10	22					I/O		Default: PF10(3) Alternate: EXMC_INTR(3)
OSC_IN	23	12	5	5	2	I		Default: OSC_IN Remap: PD0(4)
OSC_OUT	24	13	6	6	3	O		Default: OSC_OUT Remap: PD1(4)
NRST	25	14	7	7	4	I/O		Default: NRST
PC0	26	15	8	-	-	I/O		Default: PC0 Alternate: ADC_IN10
PC1	27	16	9	-	-	I/O		Default: PC1 Alternate: ADC_IN11
PC2	28	17	10	-	-	I/O		Default: PC2 Alternate: ADC_IN12
PC3	29	18	11	-	-	I/O		Default: PC3 Alternate: ADC_IN13
V_{SSA}	30	19	12	8	5	P		Default: V_{SSA}
V_{REF-}	31	20	-	-	-	P		Default: V_{REF-}
V_{REF+}	32	21	-	-	-	P		Default: V_{REF+}
V_{DDA}	33	22	13	9	6	P		Default: V_{DDA}
PA0-WKUP	34	23	14	10	7	I/O		Default: PA0 Alternate: WKUP, USART2_CTS, ADC_IN0, TM2_CH1_ETR, TM5_CH1(3)
PA1	35	24	15	11	8	I/O		Default: PA1 Alternate: USART2_RTS, ADC_IN1, TM2_CH2, TM5_CH2(3)
PA2	36	25	16	12	9	I/O		Default: PA2 Alternate: USART2_TX, ADC_IN2, TM2_CH3, TM5_CH3(3) , TM9_CH1(4)
PA3	37	26	17	13	10	I/O		Default: PA3 Alternate: USART2_RX, ADC_IN3, TM2_CH4, TM5_CH4(3) , TM9_CH2(4)
V_{SS_4}	38	27	18	-	-	P		Default: V_{SS_4}
V_{DD_4}	39	28	19	-	-	P		Default: V_{DD_4}
PA4	40	29	20	14	11	I/O		Default: PA4 Alternate: SPI1_NSS, USART2_CK, ADC_IN4
PA5	41	30	21	15	12	I/O		Default: PA5 Alternate: SPI1_SCK, ADC_IN5

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Pin Name	Pins					Pin Type(1)	I/O(2) Level	Functions description
	LQFP144	LQFP100	LQFP64	LQFP48	QFN36			
PA6	42	31	22	16	13	I/O		Default: PA6 Alternate: SPI1_MISO, ADC_IN6, TM3_CH1, TM13_CH1(4)
PA7	43	32	23	17	14	I/O		Default: PA7 Alternate: SPI1_MOSI, ADC_IN7, TM3_CH2, TM14_CH1(4)
PC4	44	33	24	-	-	I/O		Default: PC4 Alternate: ADC_IN14
PC5	45	34	25	-	-	I/O		Default: PC5 Alternate: ADC_IN15
PB0	46	35	26	18	15	I/O		Default: PB0 Alternate: ADC_IN8, TM3_CH3
PB1	47	36	27	19	16	I/O		Default: PB1 Alternate: ADC_IN9, TM3_CH4
PB2	48	37	28	20	17	I/O	5VT	Default: PB2/BOOT1
PF11	49					I/O	5VT	Default: PF11(3) Alternate: EXMC_NIOS16(3)
PF12	50					I/O	5VT	Default: PF12(3) Alternate: EXMC_A6(3)
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(3) Alternate: EXMC_A7(3)
PF14	54					I/O	5VT	Default: PF14(3) Alternate: EXMC_A8(3)
PF15	55					I/O	5VT	Default: PF15(3) Alternate: EXMC_A9(3)
PG0	56					I/O	5VT	Default: PG0(3) Alternate: EXMC_A10(3)
PG1	57					I/O	5VT	Default: PG1(3) Alternate: EXMC_A11(3)
PE7	58	38	-	-	-	I/O	5VT	Default: PE7 Alternate: EXMC_D4
PE8	59	39	-	-	-	I/O	5VT	Default: PE8 Alternate: EXMC_D5
PE9	60	40	-	-	-	I/O	5VT	Default: PE9 Alternate: EXMC_D6
V_{SS_7}	61					P		Default: V_{SS_7}
V_{DD_7}	62					P		Default: V_{DD_7}
PE10	63	41	-	-	-	I/O	5VT	Default: PE10 Alternate: EXMC_D7
PE11	64	42	-	-	-	I/O	5VT	Default: PE11 Alternate: EXMC_D8
PE12	65	43	-	-	-	I/O	5VT	Default: PE12 Alternate: EXMC_D9

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Pin Name	Pins					Pin Type(1)	I/O(2) Level	Functions description
	LQFP144	LQFP100	LQFP64	LQFP48	QFN36			
PE13	66	44	-	-	-	I/O	5VT	Default: PE13 Alternate: EXMC_D10
PE14	67	45	-	-	-	I/O	5VT	Default: PE14 Alternate: EXMC_D11
PE15	68	46	-	-	-	I/O	5VT	Default: PE15 Alternate: EXMC_D12
PB10	69	47	29	21	-	I/O	5VT	Default: PB10 Alternate: I2C2_SCL, USART3_TX Remap: TM2_CH3
PB11	70	48	30	22	-	I/O	5VT	Default: PB11 Alternate: I2C2_SDA, USART3_RX Remap: TM2_CH4
V_{SS_1}	71	49	31	23	18	P		Default: V_{SS_1}
V_{DD_1}	72	50	32	24	19	P		Default: V_{DD_1}
PB12	73	51	33	25	-	I/O	5VT	Default: PB12 Alternate: SPI2_NSS, I2C2_SMBAI, USART3_CK
PB13	74	52	34	26	-	I/O	5VT	Default: PB13 Alternate: SPI2_SCK, USART3_CTS
PB14	75	53	35	27	-	I/O	5VT	Default: PB14 Alternate: SPI2_MISO, USART3_RTS, TM12_CH1(4)
PB15	76	54	36	28	-	I/O	5VT	Default: PB15 Alternate: SPI2_MOSI, TM12_CH2(4)
PD8	77	55	-	-	-	I/O	5VT	Default: PD8 Alternate: EXMC_D13 Remap: USART3_TX
PD9	78	56	-	-	-	I/O	5VT	Default: PD9 Alternate: EXMC_D14 Remap: USART3_RX
PD10	79	57	-	-	-	I/O	5VT	Default: PD10 Alternate: EXMC_D15 Remap: USART3_CK
PD11	80	58	-	-	-	I/O	5VT	Default: PD11 Alternate: EXMC_A16 Remap: USART3_CTS
PD12	81	59	-	-	-	I/O	5VT	Default: PD12 Alternate: EXMC_A17 Remap: TM4_CH1, USART3_RTS
PD13	82	60	-	-	-	I/O	5VT	Default: PD13 Alternate: EXMC_A18 Remap: TM4_CH2
V_{SS_8}	83					P		Default: V_{SS_8}
V_{DD_8}	84					P		Default: V_{DD_8}
PD14	85	61	-	-	-	I/O	5VT	Default: PD14

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Pin Name	Pins					Pin Type(1)	I/O(2) Level	Functions description
	LQFP144	LQFP100	LQFP64	LQFP48	QFN36			
								Alternate: EXMC_D0 Remap: TM4_CH3
PD15	86	62	-	-	-	I/O	5VT	Default: PD15 Alternate: EXMC_D1 Remap: TM4_CH4
PG2	87					I/O	5VT	Default: PG2(3) Alternate: EXMC_A12(3)
PG3	88					I/O	5VT	Default: PG3(3) Alternate: EXMC_A13(3)
PG4	89					I/O	5VT	Default: PG4(3) Alternate: EXMC_A14(3)
PG5	90					I/O	5VT	Default: PG5(3) Alternate: EXMC_A15(3)
PG6	91					I/O	5VT	Default: PG6(3) Alternate: EXMC_INT2(3)
PG7	92					I/O	5VT	Default: PG7(3) Alternate: EXMC_INT3(3)
PG8	93					I/O	5VT	Default: PG8(3)
V_{SS_9}	94					P		Default: V_{SS_9}
V_{DD_9}	95					P		Default: V_{DD_9}
PC6	96	63	37	-	-	I/O	5VT	Default: PC6 Remap: TM3_CH1
PC7	97	64	38	-	-	I/O	5VT	Default: PC7 Remap: TM3_CH2
PC8	98	65	39	-	-	I/O	5VT	Default: PC8 Remap: TM3_CH3
PC9	99	66	40	-	-	I/O	5VT	Default: PC9 Remap: TM3_CH4
PA8	100	67	41	29	20	I/O	5VT	Default: PA8 Alternate: USART1_CK, MCO
PA9	101	68	42	30	21	I/O	5VT	Default: PA9 Alternate: USART1_TX
PA10	102	69	43	31	22	I/O	5VT	Default: PA10 Alternate: USART1_RX
PA11	103	70	44	32	23	I/O	5VT	Default: PA11 Alternate: USART1_CTS
PA12	104	71	45	33	24	I/O	5VT	Default: PA12 Alternate: USART1_RTS
PA13	105	72	46	34	25	I/O	5VT	Default: JTMS, SWDIO Remap: PA13
NC	106	73	-	-	-			-
V_{SS_2}	107	74	47	35	26	P		Default: V_{SS_2}

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	LQFP144	LQFP100	LQFP64	LQFP48	QFN36			
V_{DD_2}	108	75	48	36	27	P		Default: V_{DD_2}
PA14	109	76	49	37	28	I/O	5VT	Default: JTCK, SWCLK Remap: PA14
PA15	110	77	50	38	29	I/O	5VT	Default: JTDI Alternate: SPI3_NSS(3) Remap: TM2_CH1_ETR, PA15, SPI1_NSS
PC10	111	78	51	-	-	I/O	5VT	Default: PC10 Alternate: UART4_TX(3) Remap: USART3_TX
PC11	112	79	52	-	-	I/O	5VT	Default: PC11 Alternate: UART4_RX(3) Remap: USART3_RX
PC12	113	80	53	-	-	I/O	5VT	Default: PC12 Alternate: UART5_TX(3) Remap: USART3_CK
PD0	114	81	5	5	2	I/O	5VT	Default: PD0 Alternate: EXMC_D2
PD1	115	82	6	6	3	I/O	5VT	Default: PD1 Alternate: EXMC_D3
PD2	116	83	54			I/O	5VT	Default: PD2 Alternate: TM3_ETR, UART5_RX(3)
PD3	117	84	-	-	-	I/O	5VT	Default: PD3 Alternate: EXMC_CLK Remap: USART2_CTS
PD4	118	85	-	-	-	I/O	5VT	Default: PD4 Alternate: EXMC_NOE Remap: USART2_RTS
PD5	119	86	-	-	-	I/O	5VT	Default: PD5 Alternate: EXMC_NWE Remap: USART2_TX
V_{SS_10}	120							Default: V_{SS_10}
V_{DD_10}	121							Default: V_{DD_10}
PD6	122	87	-	-	-	I/O	5VT	Default: PD6 Alternate: EXMC_NWAIT Remap: USART2_RX
PD7	123	88	-	-	-	I/O	5VT	Default: PD7 Alternate: EXMC_NE1/EXMC_NCE2 Remap: USART2_CK
PG9	124					I/O	5VT	Default: PG9(3) Alternate: EXMC_NE2(3), EXMC_NCE3(3)
PG10	125					I/O	5VT	Default: PG10(3) Alternate: EXMC_NCE4_1(3), EXMC_NE3(3)
PG11	126					I/O	5VT	Default: PG11(3)

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Pin Name	Pins					Pin Type(1)	I/O(2) Level	Functions description
	LQFP144	LQFP100	LQFP64	LQFP48	QFN36			
								Alternate: EXMC_NCE4_2(3)
PG12	127					I/O	5VT	Default: PG12(3) Alternate: EXMC_NE4(3)
PG13	128					I/O	5VT	Default: PG13(3) Alternate: EXMC_A24(3)
PG14	129					I/O	5VT	Default: PG14(3) Alternate: EXMC_A25(3)
V_{SS_11}	130					P		Default: V_{SS_10}
V_{DD_11}	131					P		Default: V_{DD_10}
PG15	132					I/O	5VT	Default: PG15
PB3	133	89	55	39	30	I/O	5VT	Default: JTDO Alternate:SPI3_SCK(3) Remap: PB3, TRACESWO, TM2_CH2, SPI1_SCK
PB4	134	90	56	40	31	I/O	5VT	Default: NJTRST Alternate: SPI3_MISO(3) Remap: TM3_CH1, PB4, SPI1_MISO
PB5	135	91	57	41	32	I/O		Default: PB5 Alternate: I2C1_SMBAI, SPI3_MOSI(3) Remap: TM3_CH2, SPI1_MOSI
PB6	136	92	58	42	33	I/O	5VT	Default: PB6 Alternate: I2C1_SCL, TM4_CH1, Remap: USART1_TX
PB7	137	93	59	43	34	I/O	5VT	Default: PB7 Alternate: I2C1_SDA , TM4_CH2, EXMC_NADV(3) Remap: USART1_RX
BOOT0	138	94	60	44	35	I		Default: BOOT0
PB8	139	95	61	45	-	I/O	5VT	Default: PB8 Alternate: TM4_CH3, TM10_CH1(4) Remap: I2C1_SCL
PB9	140	96	62	46	-	I/O	5VT	Default: PB9 Alternate: TM4_CH4, TM11_CH1(4) Remap: I2C1_SDA
PE0	141	97	-	-	-	I/O	5VT	Default: PE0 Alternate: TM4_ETR, EXMC_NBL0
PE1	142	98	-	-	-	I/O	5VT	Default: PE1 Alternate: EXMC_NBL1
V_{SS_3}	143	99	63	47	36	P		Default: V_{SS_3}
V_{DD_3}	144	100	64	48	1	P		Default: V_{DD_3}

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Notes:

1. Type: I = input, O = output, P = power.
2. I/O Level: 5VT = 5 V tolerant.
3. Functions are available in GD32F101xC, GD32F101xD, GD32F101xE, GD32F101xF, GD32F101xG, GD32F101xI, GD32F101xK devices.
4. Functions are available in GD32F101xF, GD32F101xG, GD32F101xI, GD32F101xK devices.

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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 ICode bus, DCode bus, system bus, Private Peripheral Bus (PPB) and debug accesses (AHB-AP)
- Nested Vectored Interrupt Controller (NVIC)
- Flash Patch and Breakpoint (FPB)
- Data Watchpoint and Trace (DWT)
- Instrument Trace Macrocell (ITM)
- Memory Protection Unit (MPU)
- Serial Wire JTAG Debug Port (SWJ-DP)
- Trace Port Interface Unit (TPIU)

3.2 On-chip memory

- Up to 3072 Kbytes of Flash memory
- Up to 80 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 80 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 Figure 8. GD32F101xx memory map shows the memory map of the GD32F101xx series of devices, including code, SRAM, peripheral, and other pre-defined regions.

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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 (CCU) provides a range of oscillator and clock functions. These include speed internal RC oscillator and external crystal oscillator, high speed and low speed two types. Several prescalers allow the configuration of the AHB frequency, the high-speed APB (APB2) and the low-speed APB (APB1) domains. The maximum allowed frequency of the AHB and APB domain is 56 MHz. See Figure 9 for details on the clock tree.

The Reset Control Unit (RCU) controls three kinds of reset: system reset resets the processor core and peripheral IP components. 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 USART1 in device mode. 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 1 of Flash memory is selected. It also supports to boot from bank 2 of Flash memory by setting a bit in option bytes.

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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 the clock of CPU core 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 1.1V domain are off, and all of the high speed crystal oscillator (HSI, HSE) and PLL 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. When exiting the Deep-sleep mode, the HSI is selected as the system clock.
- **Standby** mode
  In Standby mode, the whole 1.1V domain is power off, the LDO is shut down, and all of HSI, HSE 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 IWDG reset, and the rising edge on WKUP pin.

3.6 Analog to digital converter (ADC)

- 12-bit SAR ADC engine
- Up to 1 MSPS conversion rate
- Conversion range: V_{SSA} to V_{DDA} (2.6 to 3.6 V)
- Temperature sensor

Up to two 12-bit 1 μs multi-channel ADCs are integrated in the device. Each is a total of up to 16 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 to support more advanced usages.

The ADCs can be triggered from the events generated by the general-purpose timers (TMx) with internal connection. The temperature sensor has to generate a voltage that varies linearly with temperature. The conversion range is between 2.6 V < V_{DDA} < 3.6 V. The temperature sensor is internally connected to the ADC_IN16 input channel which is used to convert the sensor output voltage into a digital value.

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3.7 DMA

- 7 channel DMA 1 controller and 5 channel DMA 2 controller
- Peripherals supported: Timers, ADC, SPIs, I^2Cs, USARTs

The flexible general-purpose 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. Four types of access method are supported: peripheral to peripheral, 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.

3.8 General-purpose inputs/outputs (GPIOs)

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

There are up to 112 general purpose I/O pins (GPIO) in GD32F101xx, named PA0 ~ PA15 and PB0 ~ PB15, PC0 ~ PC15, PD0 ~ PD15, PE0 ~ PE15, PF0-PF15, PG0-PG15 to implement logic input/output functions. Each of the GPIO ports has related control and configuration registers to satisfy the requirements of specific applications. The external interrupts on the GPIO pins of the device have related control and configuration registers in the External Interrupt Control Unit (EXTI). The GPIO ports are pin-shared with other alternative functions (AFs) to obtain maximum flexibility on the package pins. Each of the GPIO pins can be configured by software as output (push-pull or open-drain), as input (with or without pull-up or pull-down) or as peripheral alternate function. Most of the GPIO pins are shared with digital or analog alternate functions. All GPIOs are high-current capable except for analog inputs.

3.9 Timers and PWM generation

- Up to ten 16-bit general-purpose timers (GPTM), and two 16-bit basic timer (TM6 & TM7)
- Up to 4 independent channels of PWM, output compare or input capture for each GPTM and external trigger input
- Encoder interface controller with two inputs using quadrature decoder
- 24-bit SysTick timer down counter
- 2 watchdog timers (Independent watchdog and window watchdog)

The general-purpose timer (GPTM), known as TM2 ~ TM5, TM9 ~ TM11, TM12 ~ TM14 can be used for a variety of purposes including general time, input signal pulse width measurement or output waveform generation such as a single pulse generation or PWM

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output, up to 4 independent channels for input capture/output compare. The GPTM also supports an encoder interface with two inputs using quadrature decoder.

The basic timer, known as TM6 and TM7, are mainly used to generate analog trigger and can also be used as simple 16-bit time base.

The GD32F101xx have two watchdog peripherals, Independent watchdog and window watchdog. They offer a combination of high safety level, flexibility of use and timing accuracy.

The independent watchdog timer includes a 12-bit down-counting counter and a 8-bit prescaler, It is clocked from an independent 40 kHz internal RC and as it operates independently of the main clock, it can operate in stop 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 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 warning 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. It features:

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

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3.10 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.

3.11 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 two data transfer rates: 100 kHz of standard mode or 400 kHz of the 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.

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3.12 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.

3.13 Universal synchronous asynchronous receiver transmitter (USART)

- Up to three USARTs and two UARTs with operating frequency up to 4.5 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 (USART1, USART2 and USART3) and UART (UART4 & UART5) 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 UART5.

3.14 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 to 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.

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3.15 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.

3.16 Package and operation temperature

- LQFP144 (GD32F101Zx), LQFP100 (GD32F101Vx), LQFP64 (GD32F101Rx), LQFP48 (GD32F101Cx) and QFN36 (GD32F101Tx)
- Operation temperature range: -40°C to +85°C (industrial level)

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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 3. 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
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. 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

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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 5. Power consumption characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{DD}	Supply current (Run mode)	V_{DD}=V_{BAT}=3.3V, HSE=8MHz, System clock=56 MHz, All peripherals enabled	—	24.2	—	mA
		V_{DD}=V_{BAT}=3.3V, HSE=8MHz, System clock =56 MHz, All peripherals disabled	—	18.7	—	mA
		V_{DD}=V_{BAT}=3.3V, HSE=8MHz, System clock =36MHz, All peripherals enabled	-—	17.8	—	mA
		V_{DD}=V_{BAT}=3.3V, HSE=8MHz, System Clock =36 MHz, All peripherals disabled	—	13.6	—	mA
	Supply current (Sleep mode)	V_{DD}=V_{BAT}=3.3V, HSE=8MHz, CPU clock off, All peripherals enabled	—	12.9	—	mA
		V_{DD}=V_{BAT}=3.3V, HSE=8MHz, CPU clock off, All peripherals disabled	—	8.9	—	mA
	Supply current (Deep-Sleep mode)	V_{DD}=V_{BAT}=3.3V, All clock off, LSI on, RTC on, All GPIOs analog mode	—	0.41	1.4	mA
	Supply current (Standby mode)	V_{DD}=V_{BAT}=3.3V, LDO off, LSE off, LSI on, RTC on	—	6.5	—	µA
I_{BAT}	Battery supply current (Standby mode)	V_{DD} not available, V_{BAT}=3.3V, LDO off, LSE on, LSI off, RTC on	—	4.6	—	µA
		V_{DD} not available, V_{BAT}=3.3 V, LDO off, LSE off, LSI on, RTC on	—	2.8	—	µA

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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 following table, based on the EMS levels and classes compliant with IEC 61000 series standard.

Table 6. EMS characteristics

Symbol	Parameter	Conditions	Level/Class
V_{ESD}	Voltage applied to all device pins to induce a functional disturbance	VDD = 3.3 V, TA = +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	VDD = 3.3 V, TA = +25 °C conforms to IEC 61000-4-4	4A

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

Table 7. EMI characteristics

Symbol	Parameter	Conditions	Tested frequency band	Conditions			Unit
				8M	36M	56M	
S_{EMI}	Peak level	VDD = 3.3 V, TA = +25 °C, compliant with IEC 61967-2	0.1 to 2 MHz	<0	<0	<0	dBµV
			2 to 30 MHz	-5.3	-4.1	-3.7	
			30 to 130 MHz	-8.5	-7	-6.5	
			130 MHz to 1GHz	-8	-7	-7	

4.5 Power supply supervisor characteristics

Table 8 Power supply supervisor characteristics

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	—	s

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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 9. 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 10. 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 11. High speed external clock (HSE) generated from a crystal/ceramic characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{HSE}	High Speed External oscillator (HSE) frequency	V_{DD}=3.3V	3	8	32	MHz
C_{HSE}	Recommended load capacitance on OSC_IN and OSC_OUT	—	—	20	30	pF
R_{FHSE}	Recommended external feedback resistor between XTALIN and XTALOUT	—	—	1	—	MΩ
D_{HSE}	HSE oscillator duty cycle	—	48	50	52	%
I_{DDHSE}	HSE oscillator operating current	V_{DD}=3.3V, T_A=25°C	—	1.4	—	μA
t_{SUHSE}	HSE oscillator startup time	V_{DD}=3.3V, T_A=25°C	—	2	—	ms

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Table 12. Low speed external clock (LSE) generated from a crystal/ceramic characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{LSE}	Low Speed External oscillator (LSE) frequency	V_{DD}=V_{BAT}=3.3V	—	32.768	1000	KHz
C_{LSE}	Recommended load capacitance on OSC32_IN and OSC32_OUT	—	—	—	15	pF
R_{FLSE}	Recommended external feedback resistor between XTAL32IN and XTAL32OUT	—	—	5	—	MΩ
D_{LSE}	LSE oscillator duty cycle	—	48	50	52	%
I_{DDLSE}	LSE oscillator operating current	V_{DD}=V_{BAT}=3.3V	—	1.4	—	µA
t_{SULSE}	LSE oscillator startup time	V_{DD}=V_{BAT}=3.3V	—	3	—	s

4.8 Internal clock characteristics

Table 13. High speed internal clock (HSI) characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{HSI}	High Speed Internal Oscillator (HSI) frequency	V_{DD}=3.3V	—	8	—	MHz
ACC_{HSI}	HSI 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_{HSI}	HSI oscillator duty cycle	V_{DD}=3.3V, f_{HSI}=8MHz	48	50	52	%
I_{DDHSI}	HSI oscillator operating current	V_{DD}=3.3V, f_{HSI}=8MHz	—	80	100	µA
t_{SUHSI}	HSI oscillator startup time	V_{DD}=3.3V, f_{HSI}=8MHz	1	—	2	us

Table 14. Low speed internal clock (LSI) characteristics

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

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4.9 PLL characteristics

Table 15. 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		—		100	µs

4.10 Memory characteristics

Table 16. 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 17. I/O port characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IL}	Standard IO Low level input voltage	V_{DD}=2.6V	-0.3	—	0.95	V
	5V-tolerant IO Low level input voltage	V_{DD}=2.6V	-0.3	—	0.9	V
V_{IH}	Standard IO High level input voltage	V_{DD}=2.6V	1.2	—	4.0	V
	5V-tolerant IO High level input voltage	V_{DD}=2.6V	1.5	—	5.5	V
V_{OL}	Low level output voltage	V_{DD}=2.6V	—	—	0.2	V
V_{OH}	High level output voltage	V_{DD}=2.6V	2.3	—	—	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

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4.12 ADC characteristics

Table 18. ADC characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DDA}	Operating voltage		2.6	3.3	3.6	V
V_{ADCIN}	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		—	—	0.2	kΩ
C_{ADC}	Input sampling capacitance	No pin/pad capacitance included	—	32	—	pF
t_{SU}	Startup time		—	—	1	µs

4.13 I2C characteristics

Table 19. 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

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4.14 SPI characteristics

Table 20. 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

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5 Package information

5.1 QFN package outline dimensions

Figure 10. QFN package outline

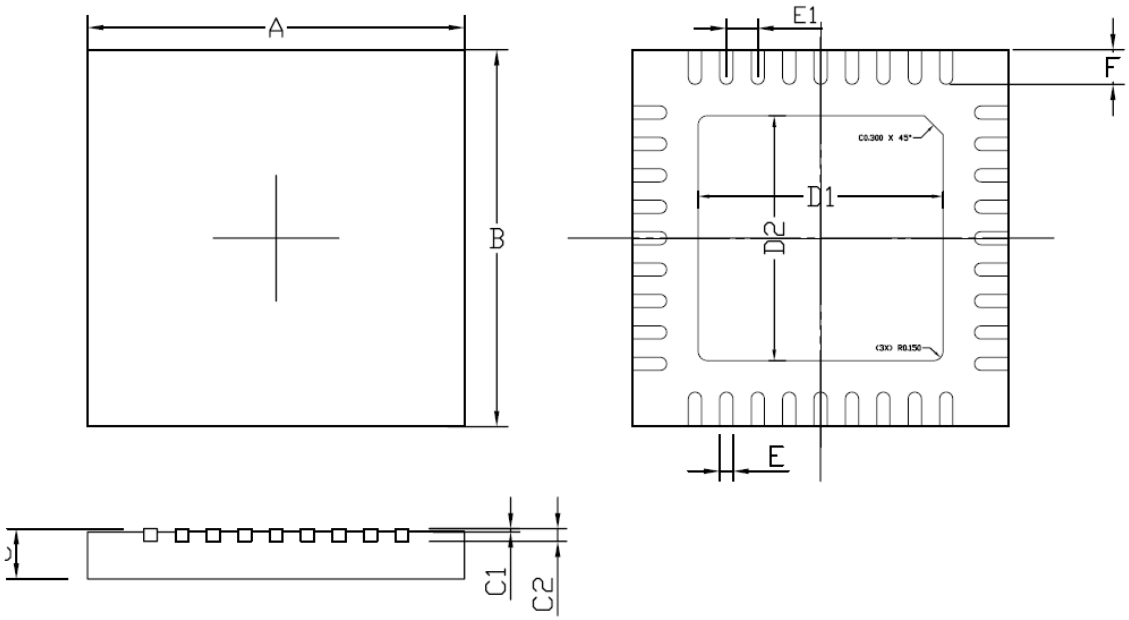


Table 21. QFN package dimensions

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	

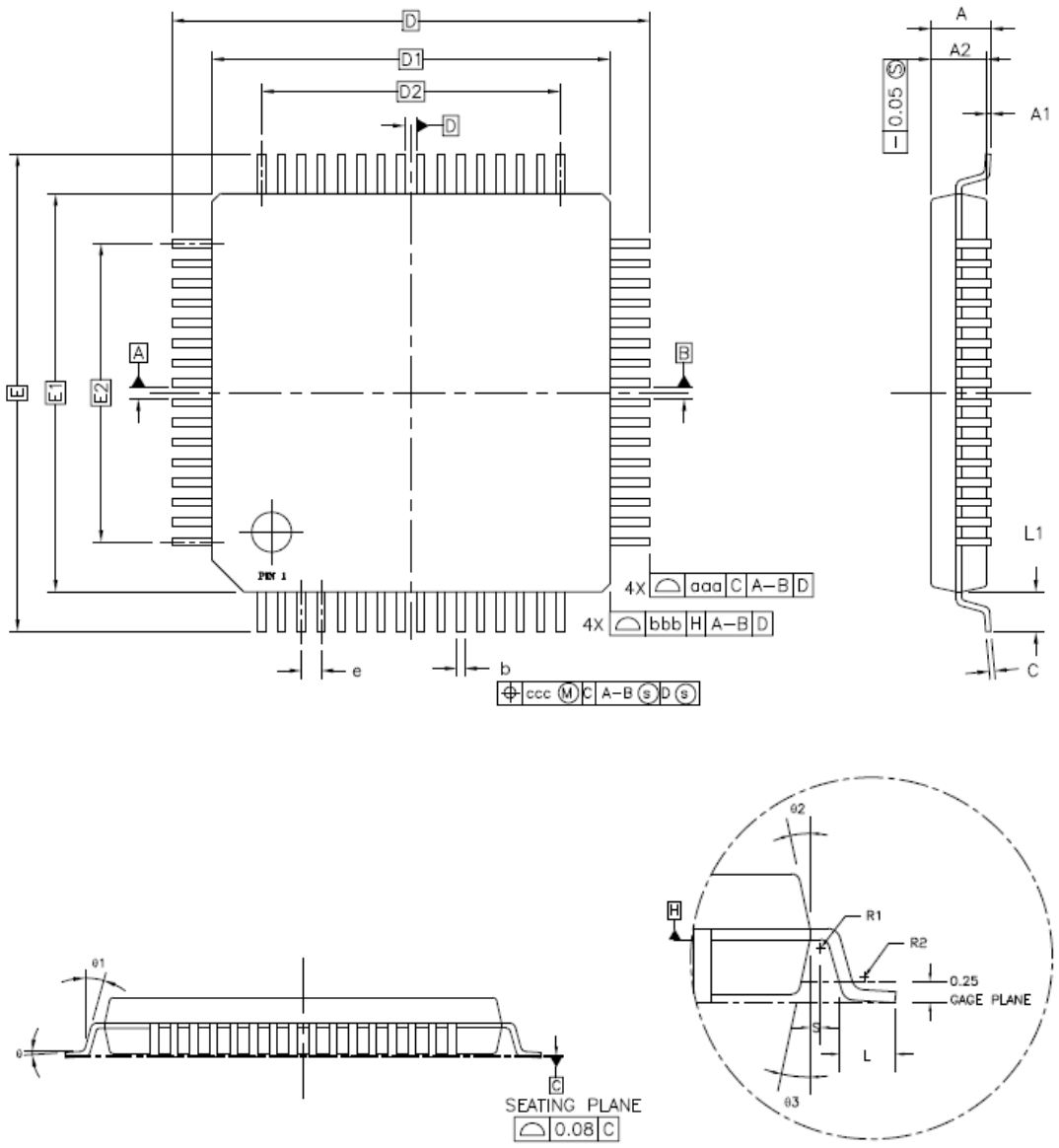
Note:

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.

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5.2 LQFP package outline dimensions

Figure 11. LQFP package outline



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Table 22. 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
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 millmeters)

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6 Ordering Information

Table 23. Part ordering code for GD32F101xx devices

Ordering code	Flash (KB)	Package	Package type	Temperature operating range
GD32F101T4U6	16	QFN36	Green	Industrial -40°C to +85°C
GD32F101T6U6	32	QFN36	Green	Industrial -40°C to +85°C
GD32F101T8U6	64	QFN36	Green	Industrial -40°C to +85°C
GD32F101TBU6	128	QFN36	Green	Industrial -40°C to +85°C
GD32F101C4T6	16	LQFP48	Green	Industrial -40°C to +85°C
GD32F101C6T6	32	LQFP48	Green	Industrial -40°C to +85°C
GD32F101C8T6	64	LQFP48	Green	Industrial -40°C to +85°C
GD32F101CBT6	128	LQFP48	Green	Industrial -40°C to +85°C
GD32F101R4T6	16	LQFP64	Green	Industrial -40°C to +85°C
GD32F101R6T6	32	LQFP64	Green	Industrial -40°C to +85°C
GD32F101R8T6	64	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RBT6	128	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RCT6	256	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RDT6	384	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RET6	512	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RFT6	768	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RGT6	1024	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RIT6	2048	LQFP64	Green	Industrial -40°C to +85°C
GD32F101RKT6	3072	LQFP64	Green	Industrial -40°C to +85°C
GD32F101V8T6	64	LQFP100	Green	Industrial -40°C to +85°C
GD32F101VBT6	128	LQFP100	Green	Industrial -40°C to +85°C
GD32F101VCT6	256	LQFP100	Green	Industrial -40°C to +85°C
GD32F101VDT6	384	LQFP100	Green	Industrial -40°C to +85°C
GD32F101VET6	512	LQFP100	Green	Industrial -40°C to +85°C

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Ordering code	Flash (KB)	Package	Package type	Temperature operating range
GD32F101VFT6	768	LQFP100	Green	Industrial -40°C to +85°C
GD32F101VGT6	1024	LQFP100	Green	Industrial -40°C to +85°C
GD32F101VIT6	2048	LQFP100	Green	Industrial -40°C to +85°C
GD32F101VKT6	3072	LQFP100	Green	Industrial -40°C to +85°C
GD32F101ZCT6	256	LQFP144	Green	Industrial -40°C to +85°C
GD32F101ZDT6	384	LQFP144	Green	Industrial -40°C to +85°C
GD32F101ZET6	512	LQFP144	Green	Industrial -40°C to +85°C
GD32F101ZFT6	768	LQFP144	Green	Industrial -40°C to +85°C
GD32F101ZGT6	1024	LQFP144	Green	Industrial -40°C to +85°C
GD32F101ZIT6	2048	LQFP144	Green	Industrial -40°C to +85°C
GD32F101ZKT6	3072	LQFP144	Green	Industrial -40°C to +85°C

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7 Revision History

Table 24. Revision history

Revision No.	Description	Date
1.0	Initial Release	Jun.2, 2013
2.0	Characteristics values modified and package data updated	Nov.15, 2013
2.1	Characteristics values modified	Aug.18, 2014

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