GigaDevice Semiconductor Inc.

Migration from GD32E50x series to GD32E51x series

Application Note

AN262

Table of Contents

1. Introduction 4
2. Pin compatibility 5
  2.1. GD32E5 Series Description 5
  2.2. Pin Compatible Description 5
3. Internal Resource Compatibility 9
4. Program porting 9
5. Peripheral differences 9
  5.1. Flash Memory Controller（FMC） 10
  5.2. TIMER 10
6. Revision history 11

List of Tables

TABLE 2-1 DESCRIPTION OF THE GD32E51X SERIES.. 5
TABLE 2-2 PIN COMPARISON BETWEEN GD32E503Z AND GD32E513Z... 5
TABLE 3-1 OVERVIEW OF THE DIFFERENCES IN RESOURCES BETWEEN THE GD32E51X AND GD32E50X SERIES 9
TABLE 5-1 DIFFERENCES IN FMC FUNCTIONS 10
TABLE 5-2 ADDED TIMER AND FUNCTION 10
TABLE 6-1 REVISION HISTORY 11

1. Introduction

This application note is designed to help you quickly migrate your application from the GD32E50x series microcontrollers to the GD32E51x series microcontrollers.

In order to make better use of the information in this application note, you need to download the GD32 series microcontroller data from the official website www.GD32MCU.com, such as Datasheet, user manual, official routines and various development tools.

2. Pin compatibility

2.1. GD32E5 Series Description

GD32E50x series includes GD32E502xx, GD32E503xx, GD32E505xx, GD32E507xx, GD32E508xx; GD32E51x series includes GD32E513xx, GD32E515xx ,GD32E517xx, GD32E518xx;

As shown in ***Table 2-1 Description of the GD32E51x Series***.

Table 2-1 Description of the GD32E51x Series

Series	Corresponding sub-series	Corresponding sub-series	Corresponding sub-series	Corresponding sub-series
GD32E50x	GD32E503C/R/V/Z	GD32E505 R/V/Z	GD32E507 R/V/Z	GD32E508 C/R/V/Z
GD32E51x	GD32E513C/R/V/Z	GD32E515 C/R	GD32E517 R/V/Z	GD32E518 C/R/V/Z

2.2. Pin Compatible Description

GD32E50x and GD32E51x series are pin-to-pin compatible under the same package. Taking GD32E503Z and GD32E513Z as examples, the pin compatibility comparison is shown in ***Table 2-2 Pin Comparison between GD32E503Z and GD32E513Z***.

Table 2-2 Pin Comparison between GD32E503Z and GD32E513Z

Pin Name	GD32E503Z Functions description	GD32E513Z Functions description
PA1	Default: PA1 Alternate2: USART1_RTS, ADC012_IN1, TIMER4_CH1, TIMER1_CH1	Default: PA1 Alternate1: TIMER14_CH0_ON Alternate2: USART1_RTS, ADC012_IN1, TIMER4_CH1, TIMER1_CH1
PA2	Default: PA2 Alternate2: USART1_TX, TIMER4_CH2, ADC012_IN2, TIMER8_CH0(4), TIMER1_CH2, SPI0_IO2, WKUP3	Default: PA2 Alternate1: CMP1_OUT, TIMER14_CH0 Alternate2: USART1_TX, TIMER4_CH2, ADC012_IN2, TIMER8_CH0(4), TIMER1_CH2, SPI0_IO2, WKUP3, CMP1_IM6
PA3	Default: PA3 Alternate2: USART1_RX, TIMER4_CH3, ADC012_IN3, TIMER1_CH3, TIMER8_CH1(4), SPI0_IO3	Default: PA3 Alternate1: TIMER14_CH1 Alternate2: USART1_RX, TIMER4_CH3, ADC012_IN3, TIMER1_CH3, TIMER8_CH1(4), SPI0_IO3
PA4	Default: PA4 Alternate2: SPI0_NSS, USART1_CK, DAC_OUT0, ADC01_IN4	Default: PA4 Alternate2: SPI0_NSS, USART1_CK, DAC_OUT0, ADC01_IN4, CMP1_IM4, CMP3_IM4, CMP5_IM4

	Remap: SPI2_NSS, I2S2_WS	Remap: SPI2_NSS, I2S2_WS
PA5	Default: PA5 Alternate2: SPI0_SCK, ADC01_IN5, DAC_OUT1	Default: PA5 Alternate2: SPI0_SCK, ADC01_IN5, DAC_OUT1, CMP1_IM5, CMP3_IM5, CMP5_IM5
PA6	Default: PA6 Alternate2: SPI0_MISO, TIMER7_BRKIN, ADC01_IN6, TIMER2_CH0, TIMER12_CH0(4) Remap: TIMER0_BRKIN	Default: PA6 Alternate1: TIMER15_CH0 Alternate2: SPI0_MISO, TIMER7_BRKIN, ADC01_IN6, TIMER2_CH0, TIMER12_CH0(4), DAC1_OUT0 Remap: TIMER0_BRKIN
PA7	Default: PA7 Alternate2: SPI0_MOSI, TIMER7_CH0_ON, ADC01_IN7, TIMER2_CH1, TIMER13_CH0(4) Remap: TIMER0_CH0_ON	Default: PA7 Alternate1: TIMER16_CH0 Alternate2: SPI0_MOSI, TIMER7_CH0_ON, ADC01_IN7, TIMER2_CH1,TIMER13_CH0(4), CMP1_IP Remap: TIMER0_CH0_ON
PB1	Default: PB1 Alternate1: SHRTIMER_SCOUT Alternate2: ADC01_IN9, TIMER2_CH3, TIMER7_CH2_ON Remap: TIMER0_CH2_ON	Default: PB1 Alternate1: CMP3_OUT, SHRTIMER_SCOUT Alternate2: ADC01_IN9, TIMER2_CH3, TIMER7_CH2_ON Remap: TIMER0_CH2_ON
PB2	Default: PB2, BOOT1 Alternate1: SHRTIMER_SCIN	Default: PB2, BOOT1 Alternate1: SHRTIMER_SCIN Alternate2: CMP3_IM7
PE8	Default: PE8 Alternate2: EXMC_D5 Remap: TIMER0_CH0_ON	Default: PE8 Alternate1: CMP1_OUT Alternate2: EXMC_D5 Remap: TIMER0_CH0_ON
PE9	Default: PE9 Alternate2: EXMC_D6 Remap: TIMER0_CH0	Default: PE9 Alternate1: CMP3_OUT Alternate2: EXMC_D6 Remap: TIMER0_CH0
PE10	Default: PE10 Alternate2: EXMC_D7 Remap: TIMER0_CH1_ON	Default: PE10 Alternate1: CMP5_OUT Alternate2: EXMC_D7 Remap: TIMER0_CH1_ON
PE11	Default: PE11 Alternate2: EXMC_D8 Remap: TIMER0_CH1	Default: PE11 Alternate1: CMP5_OUT Alternate2: EXMC_D8 Remap: TIMER0_CH1

PE12	Default: PE12 Alternate2: EXMC_D9 Remap: TIMER0_CH2_ON	Default: PE12 Alternate1: CMP3_OUT Alternate2: EXMC_D9 Remap: TIMER0_CH2_ON
PE13	Default: PE13 Alternate2: EXMC_D10 Remap: TIMER0_CH2	Default: PE13 Alternate1: CMP1_OUT Alternate2: EXMC_D10 Remap: TIMER0_CH2
PB10	Default: PB10 Alternate1: SHRTIMER_FLT2 Alternate2: I2C1_SCL,USART2_TX Remap: TIMER1_CH2	Default: PB10 Alternate1: CAN2_RX, SHRTIMER_FLT2 Alternate2: I2C1_SCL, USART2_TX Remap: TIMER1_CH2
PB11	Default: PB11 Alternate1: SHRTIMER_FLT3 Alternate2: I2C1_SDA, USART2_RX Remap: TIMER1_CH3	Default: PB11 Alternate1: CAN2_TX, SHRTIMER_FLT3 Alternate2: I2C1_SDA, USART2_RX, CMP5_IP Remap: TIMER1_CH3
PB15	Default: PB15 Alternate1: SHRTIMER_ST3CH1 Alternate2: SPI1_MOSI, TIMER0_CH2_ON, I2S1_SD, TIMER11_CH1(4), WKUP6	Default: PB15 Alternate1: SHRTIMER_ST3CH1, TIMER14_CH1,TIMER14_CH0_ON Alternate2: SPI1_MOSI, TIMER0_CH2_ON, I2S1_SD, TIMER11_CH1(4), WKUP6, CMP5_IM7
PA9	Default: PA9 Alternate1: SHRTIMER_ST0CH1, I2C2_SMBA Alternate2: USART0_TX, TIMER0_CH1	Default: PA9 Alternate1: CAN2_RX, SHRTIMER_ST0CH1, I2C2_SMBA, TIMER14_BRKIN Alternate2: USART0_TX, TIMER0_CH1
PA10	Default: PA10 Alternate1: SHRTIMER_ST1CH0 Alternate2: USART0_RX, TIMER0_CH2	Default: PA10 Alternate1: CAN2_TX, CMP5_OUT, SHRTIMER_ST1CH0, TIMER16_BRKIN Alternate2: USART0_RX, TIMER0_CH2
PA12	Default: PA12 Alternate1: SHRTIMER_FLT0, USART5_RX Alternate2: USART0_RTS, CAN0_TX, USBDP, TIMER0_ETI	Default: PA12 Alternate1: CMP1_OUT, SHRTIMER_FLT0, USART5_RX, TIMER15_ CH0 Alternate2: USART0_RTS, CAN0_TX, TIMER0_ETI, USBDP
PA13	Default: JTMS, SWDIO Remap: PA13	Default: JTMS, SWDIO Alternate1: TIMER15_ CH0_ON, Remap: PA13
PB4	Default: NJTRST Alternate1: SHRTIMER_EXEV6,	Default: NJTRST Alternate1: SHRTIMER_EXEV6,

	I2C2_SDA, I2S2_ADD_SD Alternate2: SPI2_MISO, I2C0_TXFRAME Remap: TIMER2_CH0, PB4, SPI0_MISO	I2C2_SDA, I2S2_ADD_SD, TIMER15_CH0, TIMER16_BRKIN Alternate2: SPI2_MISO, I2C0_TXFRAME Remap: TIMER2_CH0, PB4, SPI0_MISO
PB5	Default: PB5 Alternate1: SHRTIMER_EXEV5, I2C2_SCL Alternate2: I2C0_SMBA, SPI2_MOSI, I2S2_SD, WKUP5 Remap: TIMER2_CH1, SPI0_MOSI, CAN1_RX	Default: PB5 Alternate1: SHRTIMER_EXEV5, I2C2_SCL, TIMER15_BRKIN, TIMER16_CH0 Alternate2: I2C0_SMBA, SPI2_MOSI, I2S2_SD,WKUP5, Remap: TIMER2_CH1, SPI0_MOSI, CAN1_RX
PB7	Default: PB7 Alternate1: SHRTIMER_EXEV2 Alternate2: I2C0_SDA , TIMER3_CH1, EXMC_NADV Remap: USART0_RX, SPI0_IO3	Default: PB7 Alternate1: SHRTIMER_EXEV2, TIMER16_CH0_ON Alternate2: I2C0_SDA, TIMER3_CH1, EXMC_NADV Remap: USART0_RX, SPI0_IO3
PB8	Default: PB8 Alternate1: SHRTIMER_EXEV7, I2C2_SDA Alternate2: TIMER3_CH2, SDIO_D4, TIMER9_CH0(4) Remap: I2C0_SCL, CAN0_RX	Default: PB8 Alternate1: SHRTIMER_EXEV7, I2C2_SDA, TIMER15_CH0 Alternate2: TIMER3_CH2, SDIO_D4, TIMER9_CH0(4) Remap: I2C0_SCL, CAN0_RX
PB9	Default: PB9 Alternate1: SHRTIMER_EXEV4 Alternate2: TIMER3_CH3, SDIO_D5, TIMER10_CH0(4) Remap: I2C0_SDA, CAN0_TX	Default: PB9 Alternate1: CMP1_OUT, SHRTIMER_EXEV4, TIMER16_CH0 Alternate2: TIMER3_CH3, SDIO_D5, TIMER10_CH0(4) Remap: I2C0_SDA, CAN0_TX

3. Internal Resource Compatibility

GD32E51x series adds some peripheral resources on top of the GD32E50x series, including the following. For detailed specifications, please refer to the GD32E51x user manual.

TIMER: Added TIMER14, TIMER15, and TIMER16.
DAC: Added DAC0, a total of three DAC channel outputs.
ADC: Supports a maximum of 21 channels..
Package: Some models support the QFN48 package.

As shown in ***Table 3-1 Overview of the Differences in Resources between the GD32E51x and GD32E50x Series***。

Table 3-1 Overview of the Differences in Resources between the GD32E51x and GD32E50x Series

Resources	TMU	CMP	TIMER (14 15 16)	SDIO	ADC Units(CHs)	DAC Units(CHs)	Package
GD32E503xx	×	3	×	√	3(21)	1(2)	Compatible
GD32E513xx	√	3	√	√	3(21)	2(3)	Compatible
GD32E505xx/ GD32E507xx	√	3	×	×	2(16)	1(2)	Compatible
GD32E515xx	√	3	√	√	3(16)	2(3)	Only QFN48、LQFP64
GD32E517xx	√	3	√	√	3(21)	2(3)	Compatible
GD32E508xx	√	3	×	×	2(16)	1(2)	×
GD32E518xx	√	3	√	√	3(21)	2(3)	Add LQFP48

4. Program porting

If using GD32E50x does not use FMC to flash, the code running on GD32E50x can basically run on GD32E51x;
If FMC is used, since GD32E51x flash programming only supports 64 bit width and GD32E50x supports 32-bit programming, it needs to be changed to 64 bit programming during the porting process. This can be achieved by upgrading the firmware library or using FMC C and FMC Replace the H file to resolve this discrepancy. The specific differences are detailed in section of 5.1.

5. Peripheral differences

GD32E50x and GD32E51x are generally compatible with registers on peripherals. The following are the differences between the peripherals, while unlisted peripherals indicate basic consistency.

5.1. Flash Memory Controller（FMC）

GD32E51x adds ECC check on the FMC compared to GD32E50x;

GD32E50x supports 32-bit width programming, while GD32E51x only supports 64-bit width programming.For specific functions and registers, refer to the GD32E51x user manual.

The differences in FMC functions are reflected in the programming width and ECC checking functions. For details, As shown in ***Table 5-1 Differences in FMC Functions***.

Table 5-1 Differences in FMC Functions

Series	Programming width	FLASH ECC function
GD32E50x	32-bit	Not Supported
GD32E51x	64-bit	Supported

5.2. TIMER

GD32E51x adds TIMER14, TIMER15, and TIMER16 compared to GD32E50x, as shown in ***Table 5-2 Added TIMER and Function***. If the relevant TIMER is not used, it can be ignored. If the software uses the relevant TIMER, update the latest GD32E51x firmware library. For detailed instructions, please refer to the TIMER section of the GD32E51x user manual.

Table 5-2 Added TIMER and Function

TIMER	TIMER **14**	TIMER **15/16**
TYPE	General-L3	General-L4
Prescaler	16-bit	16-bit
Counter	16-bit	16-bit
Count mode	UP ONLY	UP ONLY
Repetition	●	●
CH Capture/ Compare	2	1
Complementary & Dead-time	●	●
Break	●	●
Single Pulse	●	●
Quadrature Decoder	×	×
Master-slave management	●	×
Inter connection	●	×
DMA	●	●
Debug Mode	●	●

6. Revision history

Table 6-1 Revision history

Revision No.	Description	Date
1.0	Initial Release	Feb.25, 2026

Important Notice

This document is the property of GigaDevice Semiconductor Inc. and its subsidiaries (the "Company"). This document, including any product of the Company described in this document (the “Product”), is owned by the Company under the intellectual property laws and treaties of the People’s Republic of China and other jurisdictions worldwide. The Company reserves all rights under such laws and treaties and does not grant any license under its patents, copyrights, trademarks, or other intellectual property rights. The names and brands of third party referred thereto (if any) are the property of their respective owner and referred to for identification purposes only.

The Company makes no warranty of any kind, express or implied, with regard to this document or any Product, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The Company does not assume any liability arising out of the application or use of any Product described in this document. Any information provided in this document is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Except for customized products which has been expressly identified in the applicable agreement, the Products are designed, developed, and/or manufactured for ordinary business, industrial, personal, and/or household applications only. The Products are not designed, intended, or authorized for use as components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, atomic energy control instruments, combustion control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or Product could cause personal injury, death, property or environmental damage ("Unintended Uses"). Customers shall take any and all actions to ensure using and selling the Products in accordance with the applicable laws and regulations. The Company is not liable, in whole or in part, and customers shall and hereby do release the Company as well as it’s suppliers and/or distributors from any claim, damage, or other liability arising from or related to all Unintended Uses of the Products. Customers shall indemnify and hold the Company as well as it’s suppliers and/or distributors harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of the Products.

Information in this document is provided solely in connection with the Products. The Company reserves the right to make changes, corrections, modifications or improvements to this document and Products and services described herein at any time, without notice.

© 2022 GigaDevice – All rights reserved