MG0022
Migration Guide

Migrating from GX32E230 to AT32L021

Introduction

This migration guide is written to help users with the analysis of the steps required to migrate from an existing GX32E230 series to AT32L021 series. It brings together the most important information and lists the vital aspects that need to be taken into account.

To move an application from GX32E230 series to AT32L021 series, users have to analyze the hardware and software migration.

Applicable products:

Part number	AT32L021xx

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1 Similarities and differences between AT32L021 and GX32E230

AT32L021series microcontrollers are basically compatible with the GX32E230 series, and provide many enhanced features, some of which are different from GX32E230. The differences between them are detailed in this document.

1.1 Overview of similarities

- Pin definition: Pin definitions are identical for the same packages. For extended peripherals, define the alternate functions of the pins.
- Compiler tools: identical, for example, Keil and IAR.

1.2 Overview of differences

Table 1. Differences between AT32L021 and GX32E230

	AT32L021	GX32E230
Core	Cortex-M0+	Cortex-M23
Voltage range	1.71 V~3.6 V	1.8 V~3.6 V
System clock	Max. frequency 80 MHz, APB1 80 MHz, APB2 80 MHz	Max. frequency 72 MHz, APB1 72 MHz, APB2 72 MHz
Boot Memory	4 KB, support Flash memory content CRC	3 KB
Flash memory sector erase time	6.4 ms	1.1 ms
Flash memory mass erase time	8 ms	4 ms
SRAM size	All 8 KB, extendable up to 9 KB	4/6/8 KB by part number
GPIO controller	Dedicated GPIO bus	AHB bus
GPIO locking	All GPIOs can be locked.	Only PA and PB can be locked.
PLL	Frequency multiplication factors from 31x to 500x; frequency division factor from 1 to 15.	Integer multiplication
Quad SPI interface in master mode	NA	1
I^2S	Up to 2	1
CAN	1	NA
USART	4	2
Comparator (CMP)	NA	1
Temperature sensor	NA	Support
I^2C wakeup from Deepsleep mode	Support	Not support
Wake up from Deepsleep mode	17 us	17.1 us
Wake up from Standby mode	72 us	77.5 us

	AT32L021	GX32E230
Run mode	12.7 mA@80 MHz	8.5 mA@72 MHz
Power consumption in Sleep mode	10.2 mA@80 MHz	7.4 mA@72 MHz
Power consumption in Deepsleep mode	9.24 uA	25.5 uA
Power consumption in Standby mode	1.24 uA	3.8 uA
Operating temperature	-40 to +105 °C	-40 to +85 °C
Packages	Support QFN20, not support LGA20	Support LGA20, not support QFN20

2 Hardware migration

The migration from GX32E230 to AT32L021 series is simple as they are pin-to-pin compatible for the same packages.

3 Software migration

3.1 Peripheral comparison

There are some differences between AT32L021 and GX32E230 in terms of peripherals, some of which are new designs for AT32L021 series. Therefore, it is necessary to modify these peripherals or use a new peripheral driver for brand-new design during the application-level program development.

Table 2. Peripheral compatibility analysis

Peripheral	AT32L021	GX32E230	Compatibility	
			Pinout	Firmware driver
SPI	Y	Y	Partially same	Partial compatibility
WWDT	Y	Y	NA	Full compatibility
WDT	Y	Y	NA	Full compatibility
DEBUG	Y	Y	NA	Partial compatibility
CRC	Y	Y	NA	Full compatibility
EXINT	Y	Y	Identical	Partial compatibility
DMA	Y	Y	NA	Partial compatibility
TMR	Y	Y	Identical	Partial compatibility
PWC	Y	Y	NA	Partial compatibility
USART	Y	Y	Identical	Incompatible
I^2C	Y	Y	Identical	Partial compatibility
ADC	Y	Y	Identical	Partial compatibility
RTC	Y	Y	Identical	Partial compatibility
FLASH	Y	Y	NA	Partial compatibility
GPIO	Y	Y	Identical	Partial compatibility
CMP	NA	Y	NA	Incompatible
CAN	Y	NA	NA	Partial compatibility
HWDIV	Y	NA	NA	Incompatible
SCFG	Y	Y	NA	Partial compatibility

3.2 Memory mapping

AT32L021 architecture is highly compatible with GX32E230, except the distribution of peripheral addresses and buses as shown in Table 3.

Table 3. Memory map differences

Peripheral	AT32L021		GX32E230	
	Bus	Base address	Bus	Base address
HWDIV	AHB	0x40030000	NA	NA
CMP	NA	NA	APB2	0x40010000
CAN	APB1	0x40006400	NA	NA
USART4		0x40004C00		
USART3		0x40004800		

3.3 Functional differences

This section describes the peripheral differences between AT32L021 and GX32E230.

3.3.1 CRM

- The differences related to CRM in the AT32L021 series versus GX32E230 are listed below.

Table 4. CRM differences

Clock source	AT32L021	GX32E230
HICK	48 MHz RC divided by 6	8 MHz RC
HEXT	4-25 MHz	4-32 MHz
HICK28	NA	28 MHz RC for ADC
HICK48	48 MHz RC	NA
CLKOUT	ADCCLK, SYSCLK, LICK, LEXT, HICK, HEXT, PLL/2, PLL/4	HICK28, LICK, LEXT, HICK, HEXT, PLL, PLL/2

3.3.2 PLL

- Configure the PLL_FREF parameters (CRM_PLL[26:24]) according to the actually selected PLL clock source before configuring and enabling PLL.
- AT32L021 series supports flexible PLL frequency configuration (multiplication factor ranging from 31x to 500x, and division factor ranging from 1 to 15), while the GX32E230 series only supports integer multiplication.

3.3.3 DMA

- The difference related to DMA in AT32L021 series versus GX32E230 series is the DMA request mapping. AT32L021 supports flexible DMA request mapping, which makes DMA channel configuration more flexible, while GX32E230 supports fixed DMA request mapping, which means that each peripheral has a fixed DMA channel to manage requests.

3.3.4 ADC

- The differences related to ADC in AT32L021 series versus GX32E230 series are listed below.

Table 5. ADC differences

ADC	AT32L021	GX32E230
Clock	APB clock	Dual clock domains (APB and HSI28)
Precharge	Support	Not support
Temperature sensor	No internal temperature sensor	With an internal temperature sensor

3.3.5 USART

- There are big differences between the embedded USART peripheral of AT32L021 versus GX32E230. The architecture, features and programming interface are different. Therefore, any code written for the GX32E230 series using the I^2C needs to be rewritten to run on the

AT32L021 series.

3.3.6 Flash memory

- The Flash memory differences between AT32L021 and GX32E230 are shown below.

Table 6. Flash memory differences

SYSCLK range	AT32L021	GX32E230
Zero wait	0 MHz < SYSCLK <= 32 MHz	0 MHz < SYSCLK <= 24 MHz
One wait	32 MHz < SYSCLK <= 64 MHz	24 MHz < SYSCLK <= 48 MHz
Two waits	64 MHz < SYSCLK <= 80 MHz	48 MHz < SYSCLK <= 72 MHz

3.3.7 SPI

- AT32L021 removes the following SPI features versus GX32E230:
  1. NSSP mode configuration
  2. TX/RX buffers
  3. SPI1 master mode extended QSPI
  4. Configurable frame size

  AT32L021 has additional features as follows:
  1. SPI can be used as I^2S feature
  2. Support real-time synchronization between I^2S WS and Data
  3. SPI speed up to 36 MHz
  4. PCLK/3 for SPI

3.3.8 RTC

- AT32L021 only supports tamper detection 0 (tamper0), not tamper1, compared to GX32E230.

3.3.9 I2C

- There are big differences between the I^2C interface of AT32L021 versus GX32E230. The architecture, features and programming interface are different.
- AT32L021 supports Deepsleep wakeup through I^2C1 interface.

3.3.10 PWC

- The PWC module of AT32L021 is basically the same as GX32E230 PWC, except that AT32L021 has an additional WKUP4 pin.

3.3.11 Security library (sLib)

- Security library (sLib) feature is provided to prevent important IP-code from being modified or read by end applications so as to enhance security level.

3.3.12 GPIO

- AT32L021 provides more 5V-tolerant input pins compared to GX32E230, except PC14 and PC15 pins (the input level of these pins should not exceed V_{DD} + 0.3 V).

3.4 Peripheral enhancement

This section introduces enhanced peripherals of AT32L021 series compared to GX32E230.

3.4.1 CAN

- The AT32L021 series has one CAN interface (2.0B Active), with 256 bytes of dedicated SRAM.

3.4.2 USART

- Add USART3 and USART4.

4 Revision history

Table 7. Document revision history

Date	Version	Revision note
2024.01.25	2.0.0	Initial release.

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