

# User Manual

**APM32F051 EVAL Board**

**Version: V1.0**

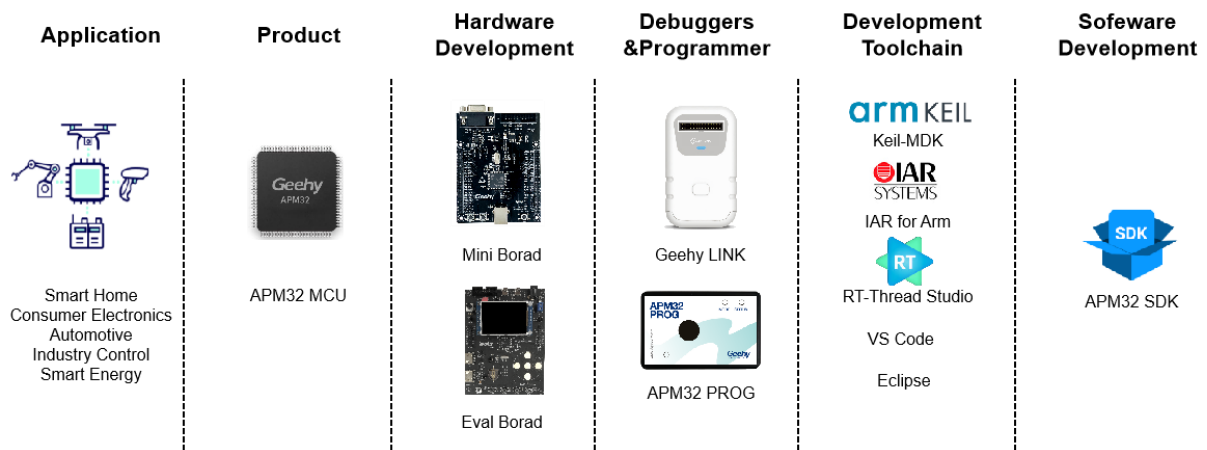
# 1 Introduction

This User Manual mainly describes the functions, on-board resources and supporting SDK of APM32F051 EVA Board. The SDK and related data mentioned in the document can be obtained from the official website of Geehy ([www.geehy.com](http://www.geehy.com)).

## 1.1 APM32 Ecosystem

The APM32 ecosystem includes product application solution, hardware development board, download simulation tool, development tool chain and SDK. Moreover, the development tool chain is suitable for many development tools at home and abroad, such as Keil-MDK, IAR for Arm, Eclipse, etc., and all of them are equipped with relevant engineering in the SDK to meet the needs of different users in different platforms.

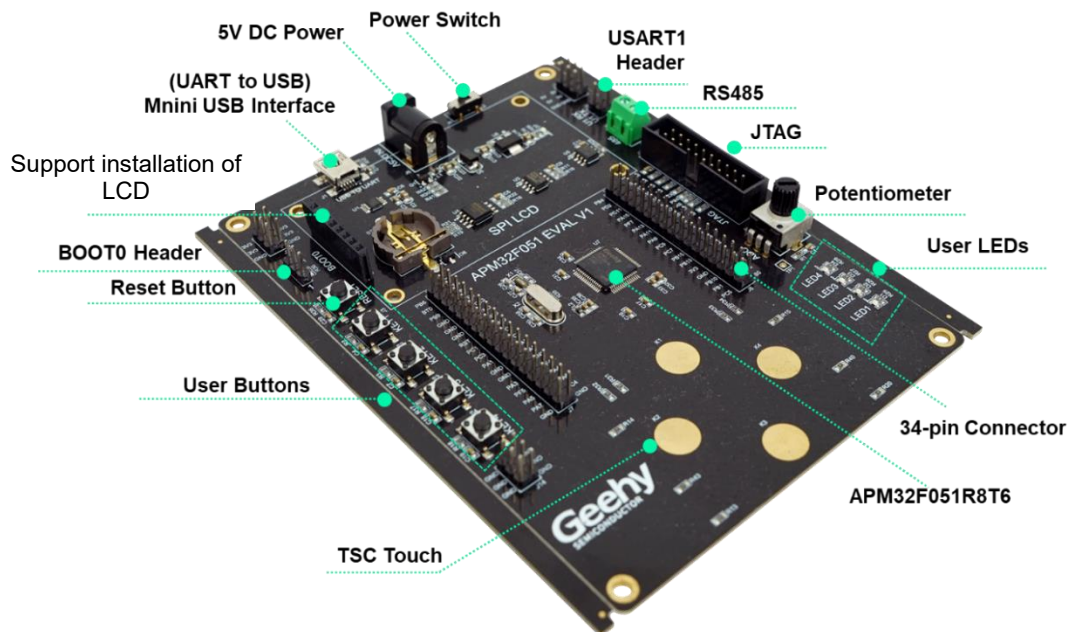
Figure 1 APM32 Ecosystem



## 1.2 Evaluation board

The APM32F051 EVAL Board is a complete demonstration and development platform for the basic APM32F0xx series MCU, which is used to demonstrate RS485, RTC, TSC and other peripheral functions. It carries an APM32F051R8T6 MCU chip, which is based on ARM Cortex-M0+core, with operating frequency 48MHz, Flash 64KB, and has a standard JTAG interface and supports users to simulate and download programs.

Figure 2 APM32F051 EVAL Board



## Contents

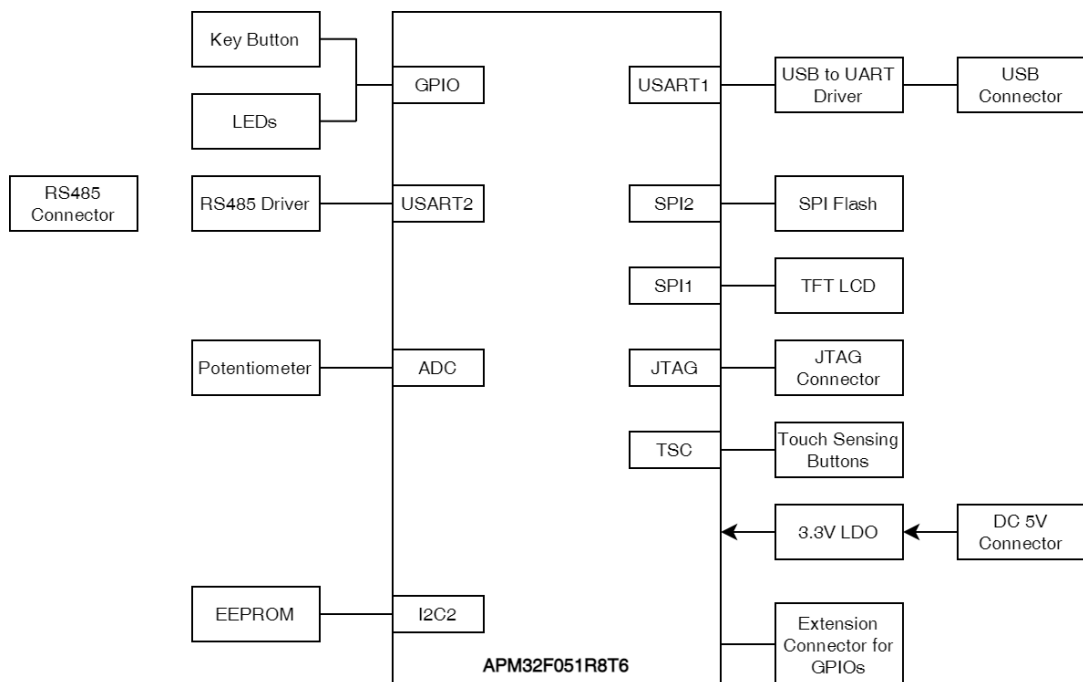
<b>1</b>	<b>Introduction.....</b>	<b>1</b>
1.1	APM32 Ecosystem .....	1
1.2	Evaluation board.....	2
<b>2</b>	<b>Function overview .....</b>	<b>4</b>
2.1	Power supply .....	5
2.2	Battery interface .....	5
2.3	Clock.....	5
2.4	Reset control .....	5
2.5	Simulation and download interface .....	5
2.6	LCD screen.....	6
2.7	LED lights .....	6
2.8	Keys.....	6
2.9	EEPROM .....	6
2.10	Flash .....	6
2.11	RS485 interface.....	6
2.12	Touch keys.....	6
<b>3</b>	<b>SDK Overview .....</b>	<b>7</b>
3.1	On-board driver .....	8
3.2	Library file .....	8
3.3	IDE support.....	8
3.4	Routine .....	8
<b>4</b>	<b>References .....</b>	<b>15</b>
<b>5</b>	<b>Revision History .....</b>	<b>16</b>

## 2 Function overview

The APM32F051 EVAL Board includes the following peripheral functions, and is equipped with the EVAL SDK, which can help developers evaluate chip performance or develop related applications

- 1.TFT LCD
- 2.EEPROM
- 3.SPI FLASH
- 4.Touch Sensor Keyboard
- 5.Potentiometer
- 6.RS485
- 7.Button x 4
- 8.LED x 4

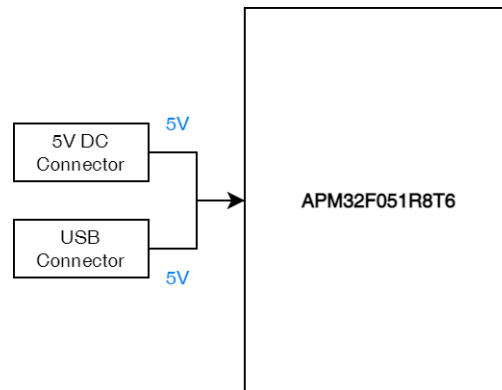
Figure 3 APM32F051 EVAL Board Overview



## 2.1 Power supply

APM32F051 EVAL Board can be powered by external 5V DC power supply or USB. JTAG interface can supply power to MCU, and other required voltages are provided by on-board voltage regulator.

Figure 4 Power Supply of Evaluation Board



## 2.2 Battery interface

On-board CR1220 standard battery interface.

## 2.3 Clock

APM32F051 EVAL Board carries two external clocks, including:

- X1, 32.768KHz clock for RTC
- X2, 8MHz clock is used for APM32F051R8T6. If the internal RC clock of the chip is used, the clock can be removed or the HSE can be disabled

## 2.4 Reset control

Two reset controls are provided:

- RESET key; press it to send a reset signal
- JTAG reset signal

## 2.5 Simulation and download interface

A standard 20-pin IDC JTAG connector on board.

## 2.6 LCD screen

A SPI LCD control interface is provided. The supporting routine is 2.4-inch TFT LCD screen with 240 x 320 pixels, and the control chip is ILI9341. The LCD screen is driven through MCU SPI interface.

## 2.7 LED lights

4 general red LED lights on board, which can be used for display.

## 2.8 Keys

4 keys provided, which can be used for LCD menu switching or other input purposes.

## 2.9 EEPROM

Onboard AT24C02 EEPROM chip, which can be driven by I2C peripheral.

## 2.10 Flash

A Flash chip on board, which provides 2MB external storage space and is driven by SPI.

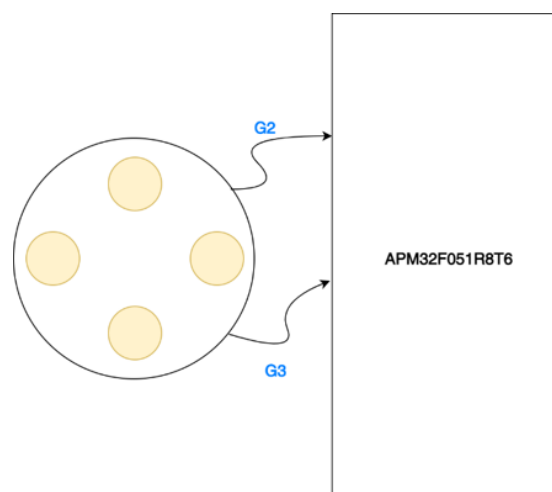
## 2.11 RS485 interface

Provide a 485 interface led from the connecting terminal.

## 2.12 Touch keys

4 touch keys on board, which are connected to two capacitive sensing channels in Group 2 and two capacitive sensing channels in Group 3.

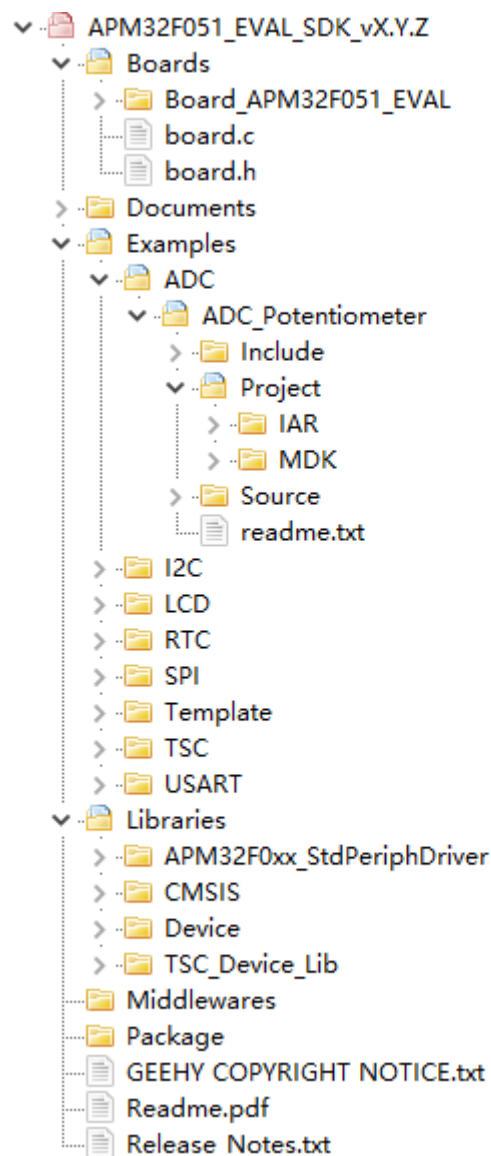
Figure 5 Touch Key Signal Connection



### 3 SDK Overview

The SDK<sup>[1]</sup> is provided in the form of compressed packages, including on-board driver packages, such as basic LED, Button and COM drivers, I2C for EEPROM driver packages, LCD screen driver packages and W25Q16 Flash driver packages, as well as multiple necessary libraries, such as APM32F0xx standard library, TSC device library and many applications that are easy to reuse, such as EEPROM reading and writing, LCD multi-level menu, RTC calendar, TSC, and RS485.

Figure 6 Directory Structure



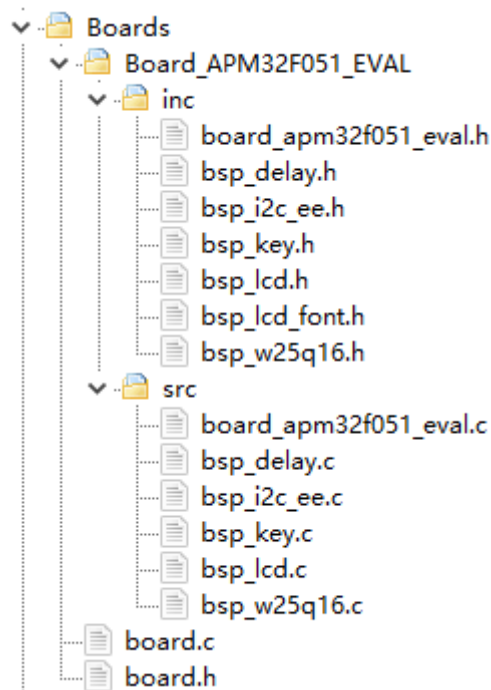
[1]. There is no package supported by IDE in the SDK of APM32xx EVALBoard. You need to obtain it on the official website of Geehy [www.geehy.com](http://www.geehy.com).



### 3.1 On-board driver

The on-board drivers contain basic LED, Button and COM drivers, I2C for EEPROM driver package, LCD screen driver package and W25Q16 Flash driver package.

Figure 7 On-board Driver



### 3.2 Library file

The library files contain the APM32F0xx standard library and TSC device library.

### 3.3 IDE support

This SDK routine is equipped with the engineering of two development tools of Keil-MDK and IAR for Arm.

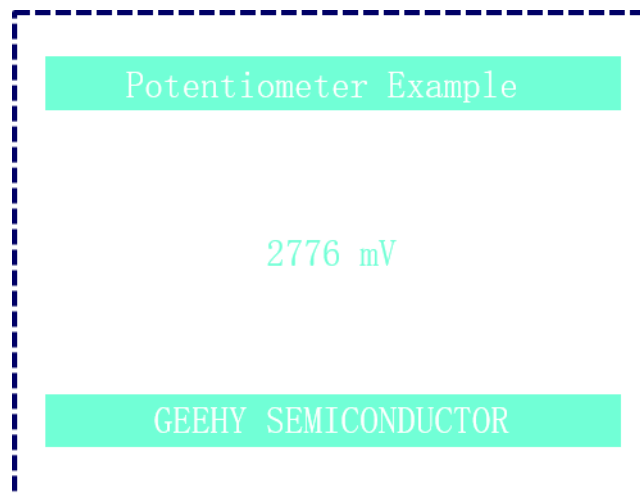
### 3.4 Routine

The routine folder contains many applications that are easy to reuse, such as EEPROM reading and writing, LCD multi-level menu, RTC calendar, TSC, and RS485 communication.

### 3.4.1 ADC

The ADC uses a 10K potentiometer as the sampling source, which can be adjusted by the knob. The AD sampling channel is channel 10. After downloading and running of the routine, the change of the voltage value sampled by ADC will be displayed in real time on the on-board LCD.

Figure 8 ADC Menu



### 3.4.2 I2C EEPROM

EEPROM adopts AT24C02, the device address is 0xA0, and the addressing address is 8bit. After downloading and running of the routine, the routine test process is to write and read 255 data to EEPROM and compare them.

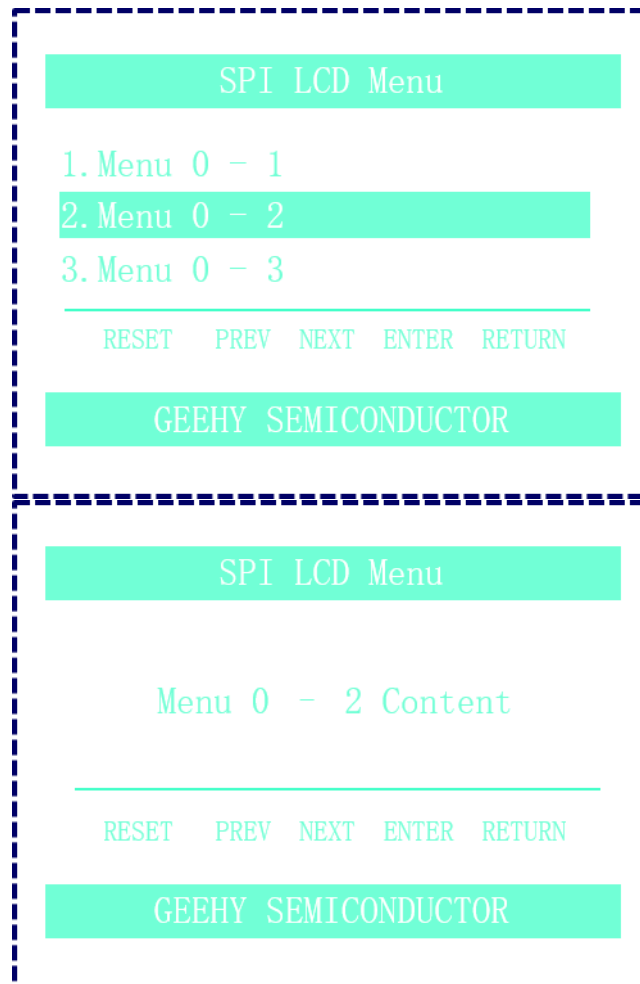
Figure 9 I2C EEPROM Menu



### 3.4.3 LCD Menu

This routine uses SPI to drive a 2.4- inch LCD screen to display a sample of multi-level menu.

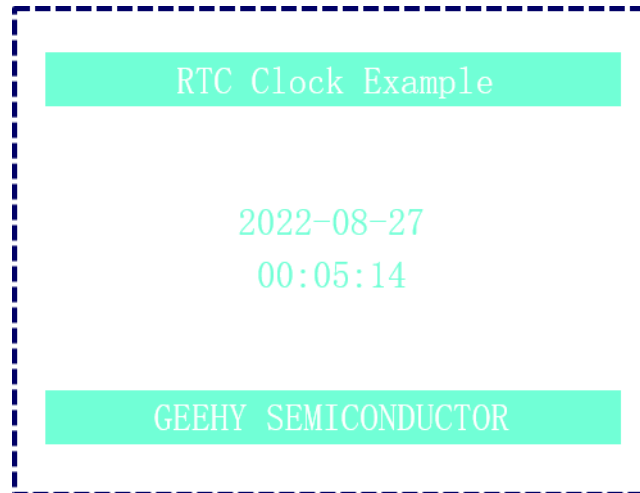
Figure 10 LCD Menu



### 3.4.4 RTC Clock

This routine uses RTC and displays an example of RTC calendar in combination with LCD screen.

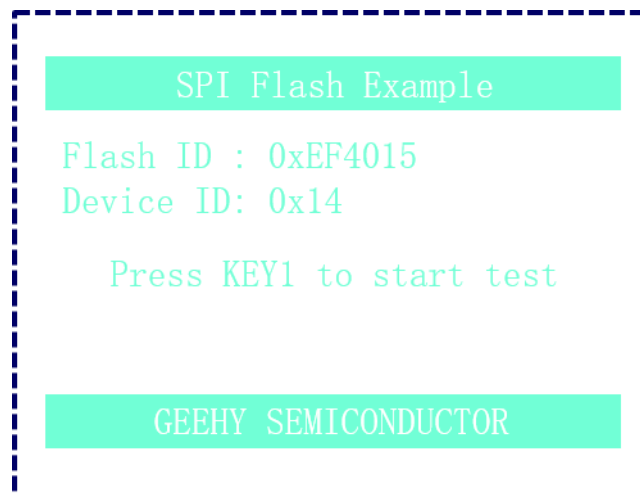
Figure 11 RTC Menu



### 3.4.5 SPI Flash

This routine uses SPI to access the external flash chip W25Q16, with a size of 2MB. The test process is to write and read data to Flash and compare them.

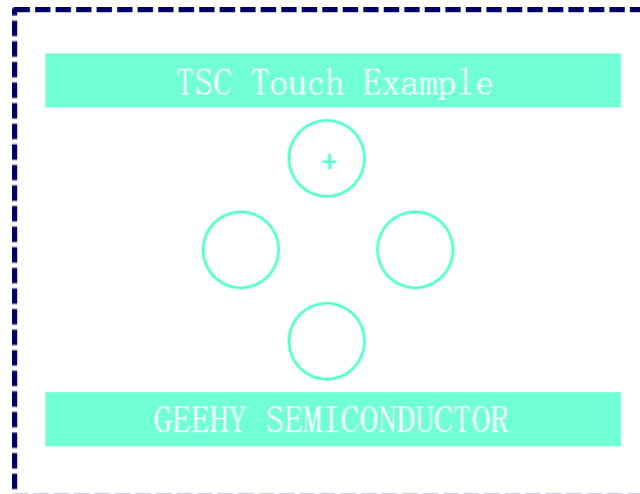
Figure 12 SPI Flash Menu



### 3.4.6 TSC

The TSC Key Liner Rotate routine mainly displays the response results of touch keys.

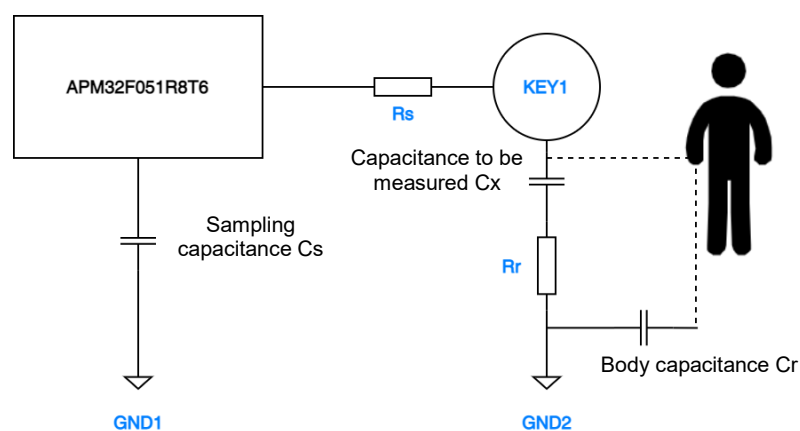
Figure 13 TSC Key Liner Rotate Menu



The touch sensing function of APM32 is implemented based on the principle of surface charge transfer and acquisition. The principle is to charge the sensor capacitor  $C_x$  and transfer the accumulated charge to the sampling capacitor  $C_s$ . This process will be repeated until the voltage at both ends of the sampling capacitor  $C_s$  reaches the threshold. The number of charge transfer times required to reach the threshold is used to indicate the size of the capacitance  $C_x$  to be measured.

When sensor KEY1 is touched, the capacitance of the sensor to the ground increases, the number of charge transfer times required for the voltage at both ends of the sampling capacitor  $C_s$  to reach the threshold decreases, and the measured value is reduced. When the measured value is lower than the threshold value, TSC Device Lib will generate a detection event.

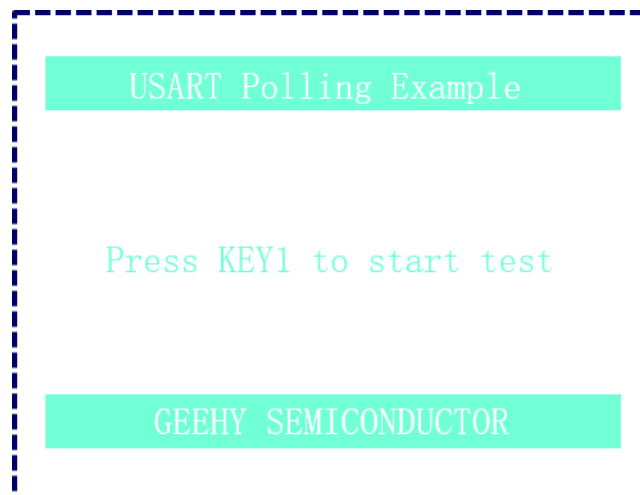
Figure 14 TSC Example



### 3.4.7 USART Polling

This routine shows how to transmit and receive serial port data by polling. The test process is to send the string '123456' to the upper computer through USART1, the upper computer returns the same string '123456', and then the lower computer checks and matches, and finally displays the matching results.

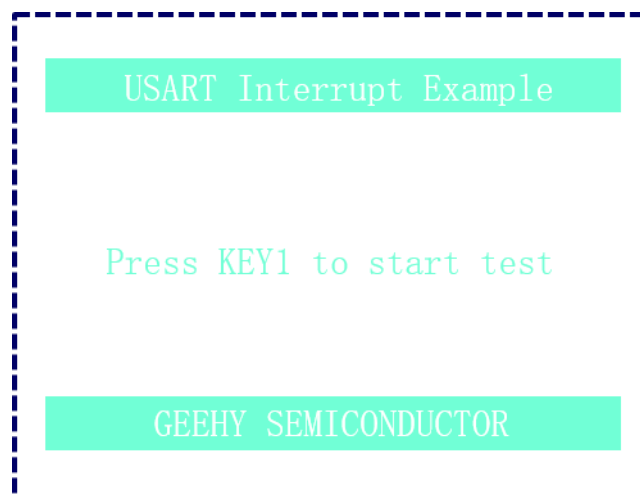
Figure 15 USART Polling Menu



### 3.4.8 USART Interrupt

This routine shows how to send serial port data by interrupt. The test process is to send a string to the upper computer through USART1.

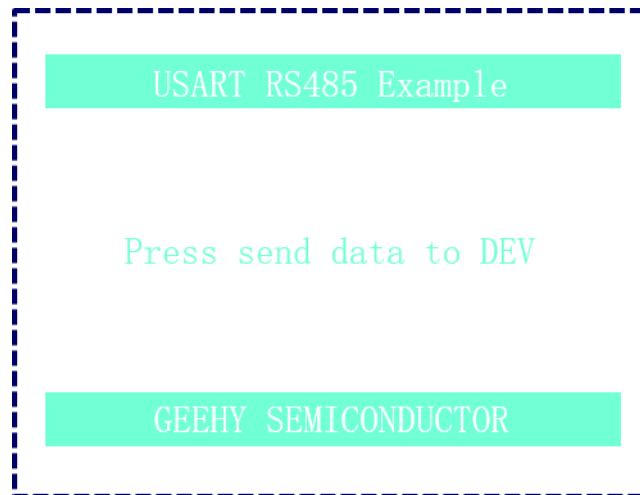
Figure 16 USART Interrupt Menu



### 3.4.9 USART RS485

This routine shows receiving RS485 data in interrupt mode. The test process is to wait for the upper computer through the USART2 to send data to the evaluation board through the USB to RS485 converter.

Figure 17 USART RS485 Menu



## 4 References

For chip specifications and peripheral details, see *APM32F051x8xB Data Manual*, *APM32F051x8xB User Manual* and *APM32F051 EVAL Board Schematic Diagram*. For more technical support, please visit the official website of Geehy: [www.geehy.com](http://www.geehy.com).



---

## 5 Revision History

Table 1 Document Revision History

Date	Revision	Changes
2023.1.18	1.0	New

---

## Statement

This manual is formulated and published by Zhuhai Geehy Semiconductor Co., Ltd. (hereinafter referred to as "Geehy"). The contents in this manual are protected by laws and regulations of trademark, copyright and software copyright. Geehy reserves the right to correct and modify this manual at any time. Please read this manual carefully before using the product. Once you use the product, it means that you (hereinafter referred to as the "users") have known and accepted all the contents of this manual. Users shall use the product in accordance with relevant laws and regulations and the requirements of this manual.

### 1. Ownership of rights

This manual can only be used in combination with chip products and software products of corresponding models provided by Geehy. Without the prior permission of Geehy, no unit or individual may copy, transcribe, modify, edit or disseminate all or part of the contents of this manual for any reason or in any form.

The "Geehy" or "Geehy" words or graphics with "®" or "TM" in this manual are trademarks of Geehy. Other product or service names displayed on Geehy products are the property of their respective owners.

### 2. No intellectual property license

Geehy owns all rights, ownership and intellectual property rights involved in this manual.

Geehy shall not be deemed to grant the license or right of any intellectual property to users explicitly or implicitly due to the sale and distribution of Geehy products and this manual.

If any third party's products, services or intellectual property are involved in this manual, it shall not be deemed that Geehy authorizes users to use the aforesaid third party's products, services or intellectual property, unless otherwise agreed in sales order or sales contract of Geehy.

### 3. Version update

Users can obtain the latest manual of the corresponding products when ordering Geehy products.

If the contents in this manual are inconsistent with Geehy products, the agreement in Geehy sales order or sales contract shall prevail.

### 4. Information reliability

The relevant data in this manual are obtained from batch test by Geehy Laboratory or cooperative third-party testing organization. However, clerical errors in correction or errors caused by differences in testing environment may occur inevitably. Therefore, users should understand that Geehy does not bear any responsibility for such errors that may occur in this manual. The relevant data in this manual are only used to guide users as performance parameter reference and do not constitute Geehy's guarantee for any product performance.

Users shall select appropriate Geehy products according to their own needs, and effectively verify and test the applicability of Geehy products to confirm that Geehy products meet their own needs, corresponding standards, safety or other reliability requirements. If losses are caused to users due to the user's failure to fully verify and test Geehy products, Geehy will not bear any responsibility.

### 5. Compliance requirements

Users shall abide by all applicable local laws and regulations when using this manual and the matching Geehy products. Users shall understand that the products may be restricted by the export, re-export or other laws of the countries of the product suppliers, Geehy, Geehy distributors

and users. Users (on behalf of itself, subsidiaries and affiliated enterprises) shall agree and promise to abide by all applicable laws and regulations on the export and re-export of Geehy products and/or technologies and direct products.

#### 6. Disclaimer

This manual is provided by Geehy "as is". To the extent permitted by applicable laws, Geehy does not provide any form of express or implied warranty, including without limitation the warranty of product merchantability and applicability of specific purposes.

Geehy will bear no responsibility for any disputes arising from the subsequent design and use of Geehy products by users.

#### 7. Limitation of liability

In any case, unless required by applicable laws or agreed in writing, Geehy and/or any third party providing this manual "as is" shall not be liable for damages, including any general damages, special direct, indirect or collateral damages arising from the use or no use of the information in this manual (including without limitation data loss or inaccuracy, or losses suffered by users or third parties).

#### 8. Scope of application

The information in this manual replaces the information provided in all previous versions of the manual.

©2023 Zhuhai Geehy Semiconductor Co., Ltd. - All Rights Reserved