HT32 Implementation I

32位元產品應用開發處
CG10

Overview

- Software Tools
  - Installation & Activation Flow
  - Keil MDK-ARM
  - Keil uVision DFP Pack Install
- HT32 Firmware Library
  - FWLib - 架構
  - FWLib - 資料夾結構
  - FWLib - 使用
- Development Platforms
- Play Examples
- HT32 Flash Programming
- HT32 Resource

Software Tool

Download Link:

Keil MDK-ARM Installer: https://www.keil.com/download/product/

Holtek Licenses: https://www2.keil.com/holtek/ht-edition/

Pack Installer: https://mcu.holtek.com.tw/pack/Holtek.HT32_DFP.latest.pack.zip

Installation & Activation Flow

- For users of Holtek devices, Keil MDK is now available as a free edition for programming Holtek's Arm Cortex-M0+ based microcontrollers.

1. Download MDK Core

- Install MDK-ARM Version after 5.28a

2. Serial Number

- E-mail receive free serial number

3. License Generation

- Go to Arm Developer Support
- Select Licensing Generate
- Enter serial number & Host ID
- Download license file

4. Activation

- Run MDK-ARM
- Open License Management

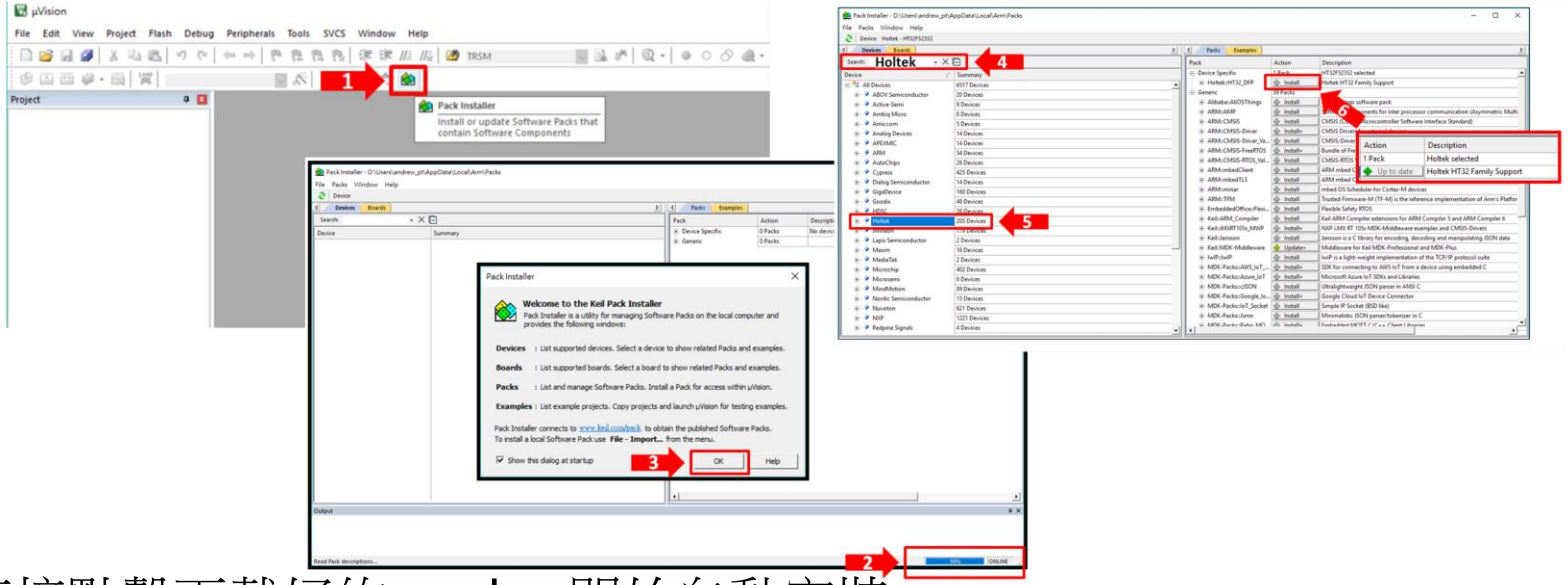
Keil MDK-ARM

- Download Link: https://www.keil.com/download/product/

!試用版有Code size 32KB限制，如果有Code Size需求可參考下方連結第3章，提供免費版 Keil MDK Holtek Lience:
https://www.holtek.com.tw/documents/10179/6393504/Keil_MDK_Holtek_Edition(InstallationGuide)v110.pdf

Keil uVision DFP Pack Install

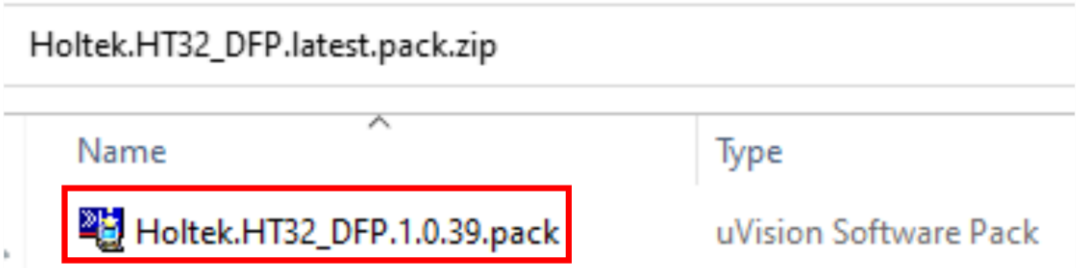
1) 在Keil uVision主畫面，按下方圖示進行Pack Install



2) 直接點擊下載好的.pack，開始自動安裝

- Download Link: https://mcu.holtek.com.tw/pack/Holtek.HT32_DFP.latest.pack.zip

(Holtek.HT32_DFP.m.n.r.pack, m.n.r is software version)



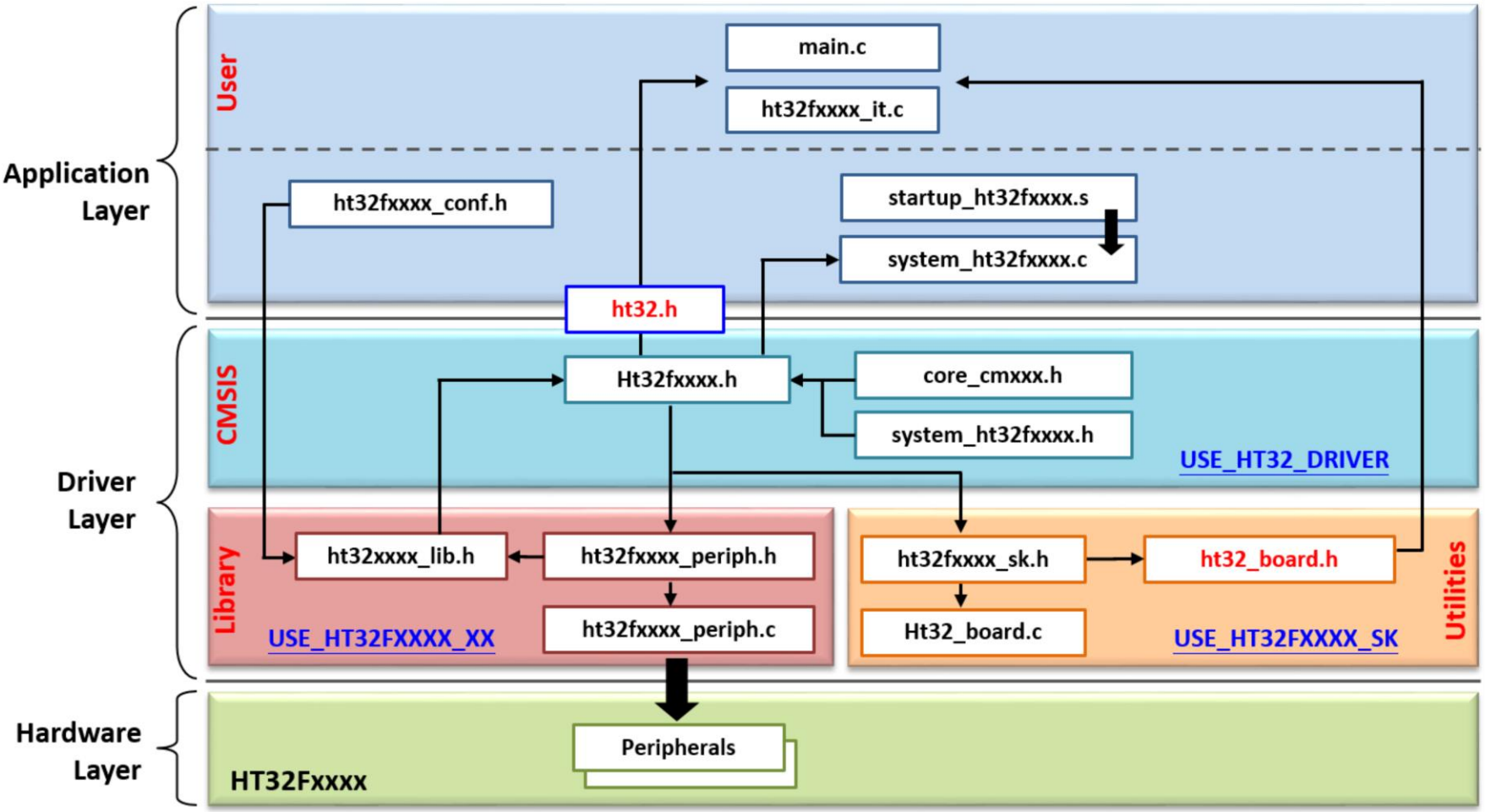
HT32 Firmware Library

Download:

https://www.holtek.com.tw/esk32-30501 ，點選HT32 Firmware Library。

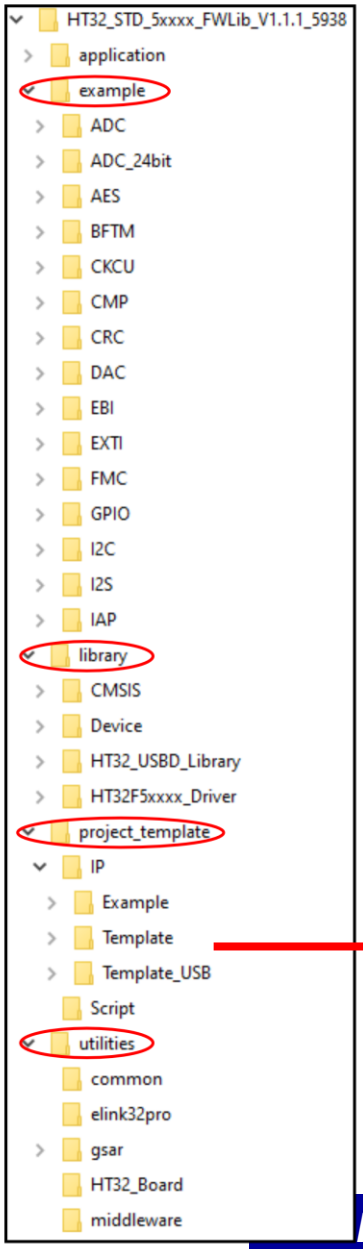
HT32_STD_xxxxx_FWLib_Vm.n.r_s，“m.n.r”表示版本號。

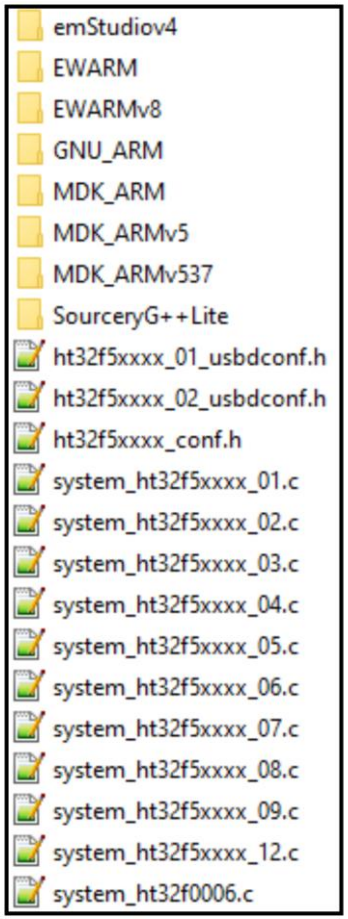
FWLib - 架構


Application Layer
User
main.c
ht32fxxxx_it.c
ht32fxxxx_conf.h
startup_ht32fxxxx.s
system_ht32fxxxx.c
ht32.h
Driver Layer
CMSIS
Ht32fxxxx.h
core_cmxxx.h
system_ht32fxxxx.h
USE_HT32_DRIVER
Library
ht32xxxx_lib.h
ht32fxxxx_periph.h
ht32fxxxx_periph.c
USE_HT32FXXXX_XX
ht32fxxxx_sk.h
ht32_board.h
Ht32_board.c
USE_HT32FXXXX_SK
Utilities
Hardware Layer
Peripherals
HT32Fxxxx

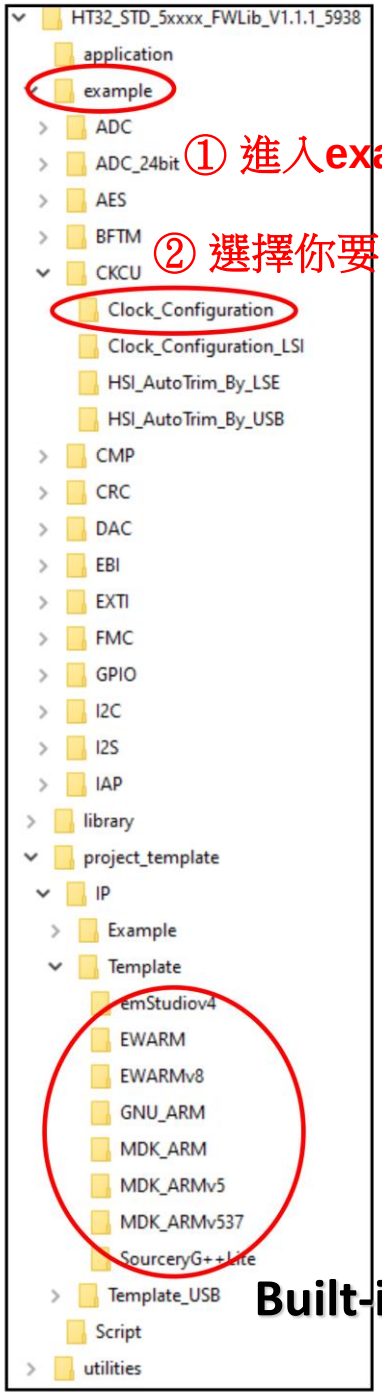
FWLib - 資料夾結構

- **Examples**
  - Support for each peripheral
  - Running on HT32 Board
- **Libraries**
  - CMSIS compliant
  - USBD Library
  - Support for all the peripherals
- **Project Templates**
  - Empty projects for IDEs
    - emStudiov4
    - EWARM
    - EWARMv8
    - MDK_ARM
    - MDK_ARMv5
    - MDK_ARMv537
    - SourceryG++Lite
- **Utilities**
  - HT32 Board configurations





FWLib - 使用

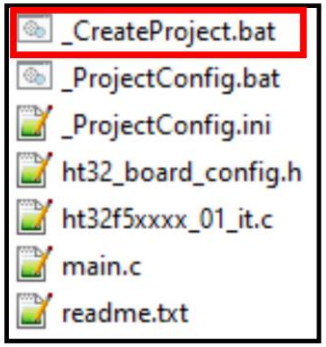


① 進入example

② 選擇你要的範例

Built-in

③ 執行該資料夾中的 _CreateProject.bat



④ 選擇Compiler/IDE與IC model

第一次設定後會被存於FWLib根目錄的 ”_CreateProjectConfig.bat”中

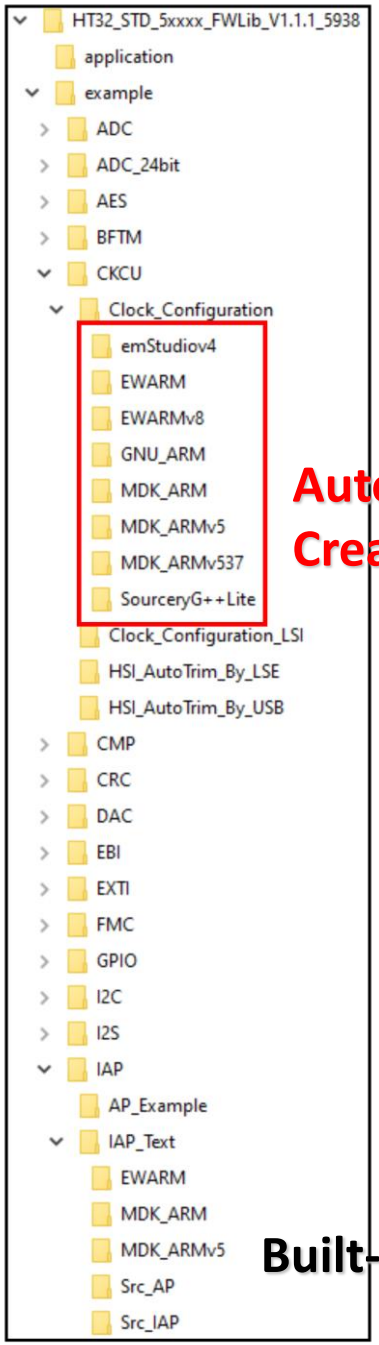
```
Please choose the Compiler/IDE you are using for create project script (N for next step):
 # - [1] Keil MDK-ARM v5
 # - [2] Keil MDK-ARM v4
 # - [3] IAR EWARM v8
 # - [4] IAR EWARM v6/v7
 # - [5] SEGGER Embedded Studio
 # - [6] GNU (with Keil and GNU make)
 # - [7] SourceryG++Lite (with Keil)
 #   [A] All Compiler/IDE
 #   [N] OK, go next step
?
```

```
Supported Device List:

- HT32 Series:
-      502*, 503*, 522*, 523*, 542*, 573*, 611*, 613*, 652*, 677*,
-

- HT32 Single Device:
-      50230, 50241, 50343, 52142, 52230, 52241, 52253, 52341, 52352, 52354,
-      52367, 53a367a, 54241, 54253, 57341, 57352, 59041, 59741, 61141, 61352,
-      61355, 61356, 61357, 65232, 65240, 67741, 32002, 32003, 5032, 0006,
-      0008, 5828, 6306,

Please input the IC name (Example: 52352), "*" for all models:
```



Auto Created

Built-in

Development Platforms

Overview

IDE

USB

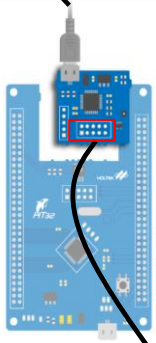
Software Development

- Compiler / Linker
- Debugger
- Flash Loader

KEIL An ARM® Company

IAR SYSTEMS

ICE



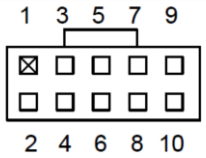
e-Link32 Lite USB Debug Adapter

- Interface between IDE & Board

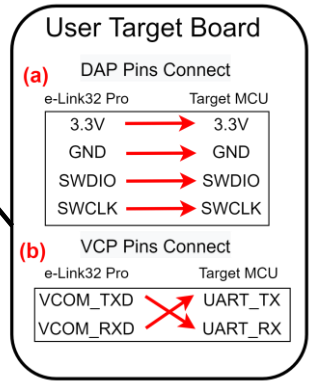
Board

User Target Board

Serial Wire

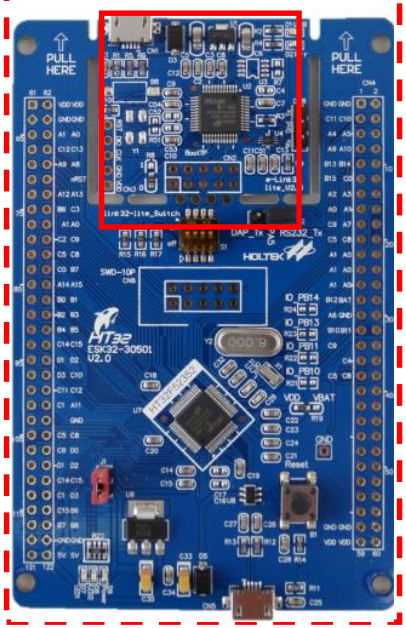


Pin#	Description	Pin#	Description
1	3.3V	2	SWDIO
3	GND	4	SWCLK
5	GND	6	Reserved
7	VCOM_RXD	8	VCOM_TXD
9	GND	10	Reset



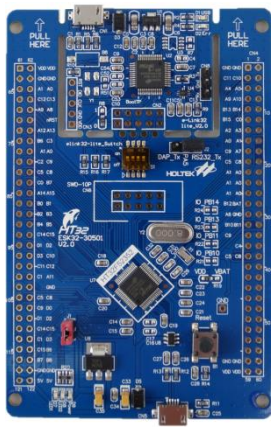
Starter Kit

•Build-in Debugger

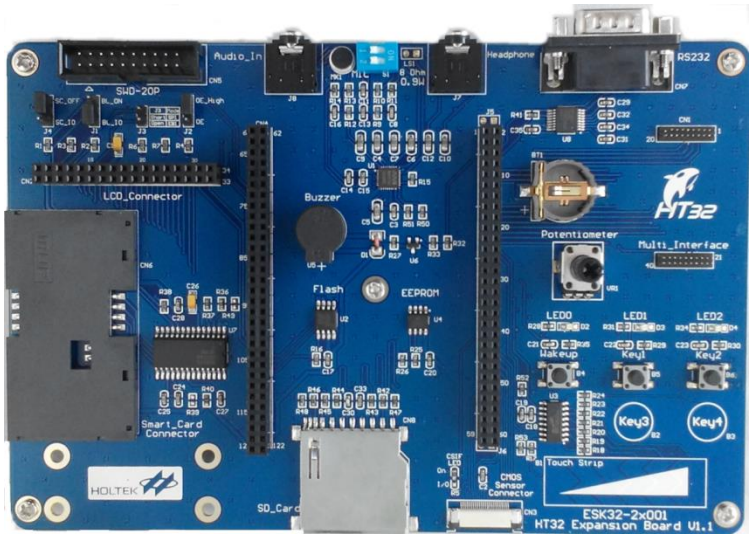


實作環境

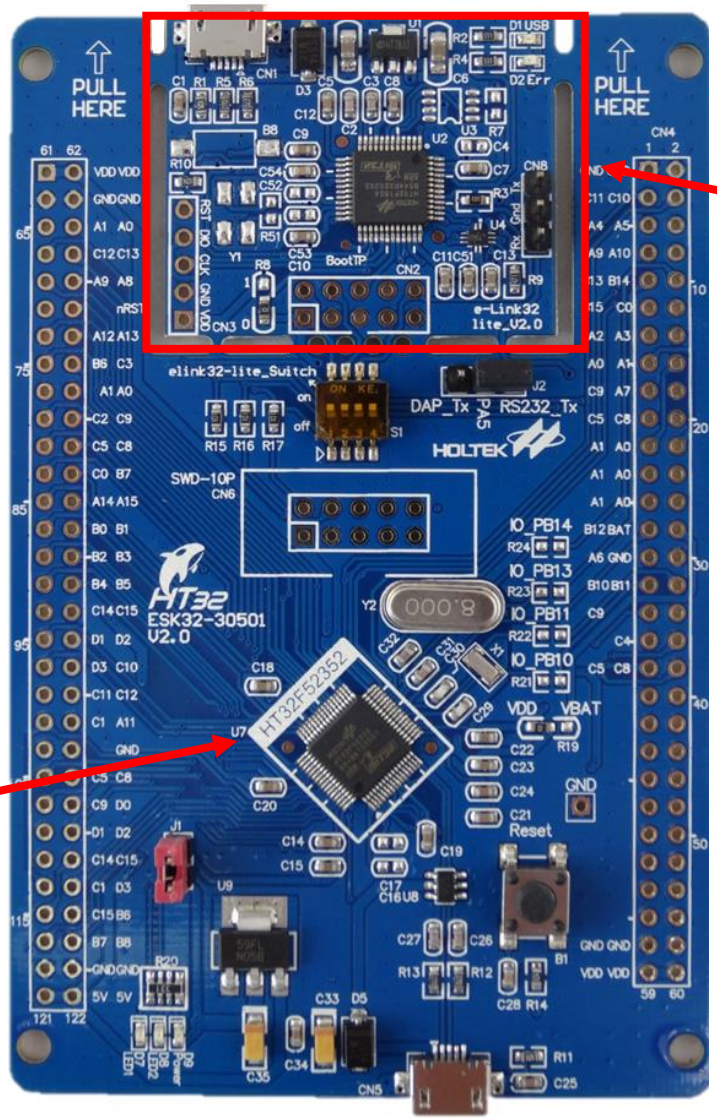
- **Hardware**
  - Starter Kit for HT32F52352
    - ESK32-30501
  - Expansion Board for HT32 Series
    - ESK32-21001



- **Application Code (ESK32-21001)**
  - ESK32-21001 with FWLib_Vm.n.r_s，“m.n.r”表示版本號。
  - ESK32-21001
    - 0_Start_1_Example_SK
    - 1_GPIO_1_LED
    - 1_GPIO_2_Key
    - 1_GPIO_3_Key_Interrupt
    - 2_Timer_1_SysTick
    - …



ESK32-30501



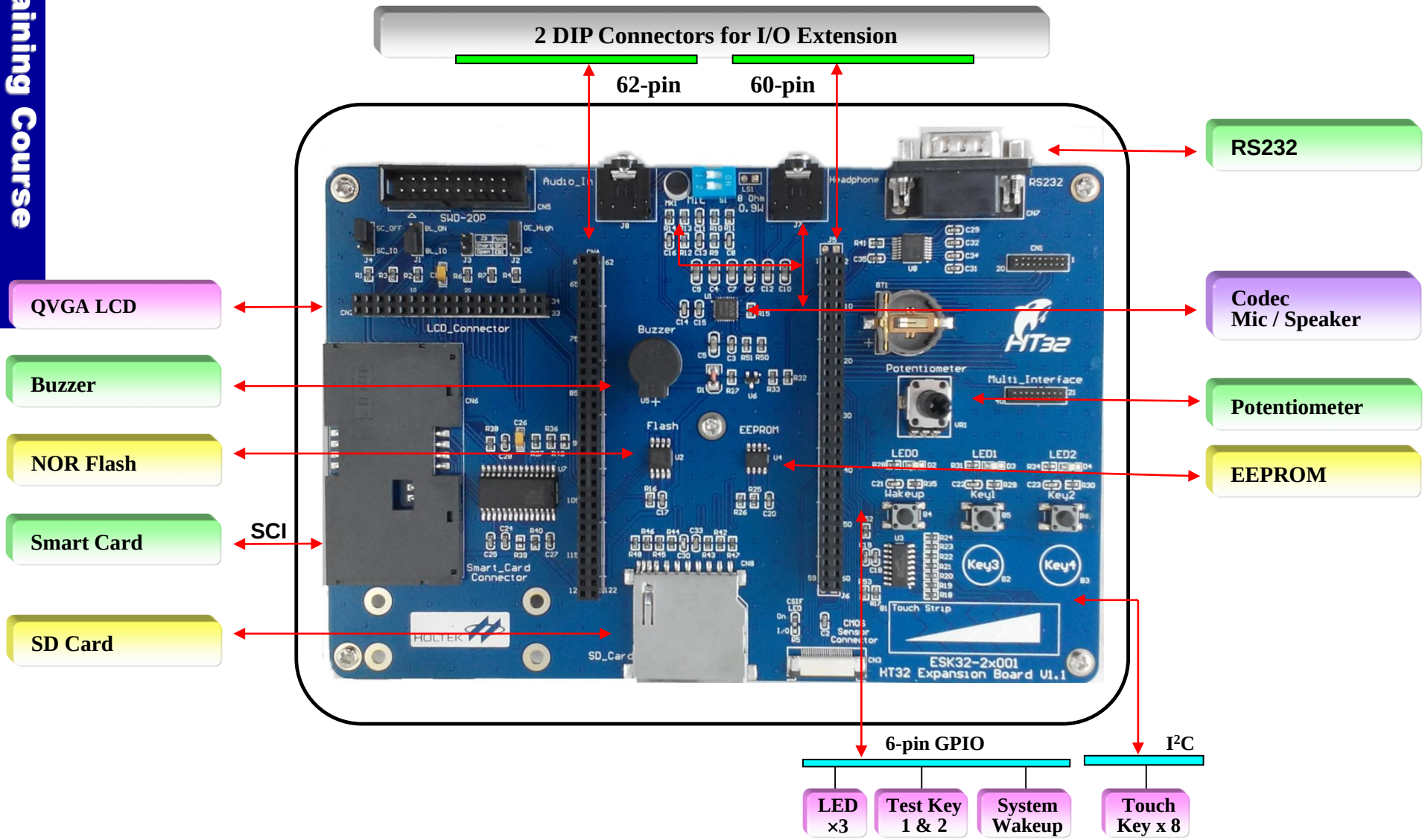
e-Link32 Lite

燒錄 / 除錯 / VCP

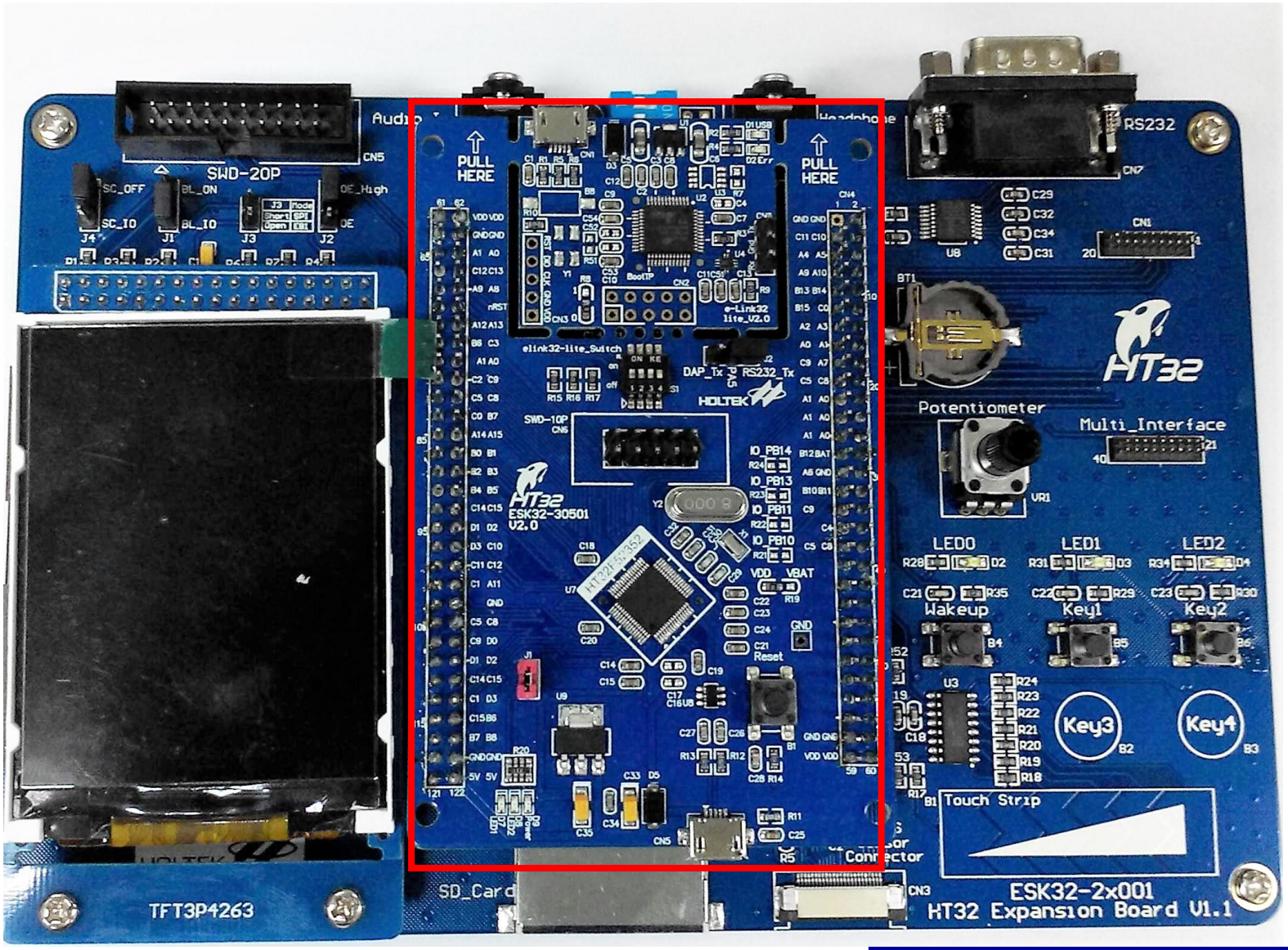
主控MCU

HT32F52352

ESK32-21001


2 DIP Connectors for I/O Extension
62-pin
60-pin
QVGA LCD
Buzzer
NOR Flash
Smart Card
SCI
SD Card
RS232
Codec
Mic / Speaker
Potentiometer
EEPROM
6-pin GPIO
I²C
LED
×3
Test Key
1 & 2
System
Wakeup
Touch
Key x 8
ESK32-2x001
HT32 Expansion Board V1.1

ESK32-30501 + ESK32-21001



Play Examples

Download:

ESK32-30501 User Manual: https://www.holtek.com.tw/ESK32-30501
ESK32-21001使用手冊: https://www.holtek.com.tw/ESK32-21001

HT32F52352 Peripherals

Property	Peripheral Name
System	FMC, PWRCU, CKCU, RSTCU, PDMA
IO	GPIO, AFIO, EXTI
Functional	ADC, OPA/CMP, I²S, CRC
Timer	SCTM, BFTM, GPTM, MCTM, RTC, WDT
Communication	I²C, SPI, USART, UART, USB, SCI, EBI

培訓範例準備

- **下載ESK32-21001 Application Code壓縮檔**

  1. HT32_APPFW_xxxxx_ESK32-21001_Vm.n.r_s.zip

- **將ESK32-21001文件夾，複製到**

  HT32_STD_5xxxx_FWLib 根目錄 \application\之下

0_Start

Download:

1. HT32_VCP_Driver_Vm.n.r.exe: https://www.holtek.com/home
   (Home -> MCU Tool -> ICE -> HT32_VCP_Driver_Vm.n.r.exe)
1. Tera Term: https://ttssh2.osdn.jp/index.html.en

Overview

- **目的**
  1. 了解 Keil ARM 開發環境
  2. 了解 HT32 Firmware Library 基本架構
  3. 幫助程式開發過程除錯

- **說明**
  1. 在程式開發過程, 與程式做互動
  2. FW 設定 Retarget port 為 COM1

- **練習**
  1. 連接 PC 端和 (SK) ESK32-30501 e-Link32 Lite USB Port
  2. PC 端安裝 HT32_VCP_Driver_Vm.n.r.exe 和 Tera Term 工具
  3. Download 範例程式, 執行顯示或輸入訊息

Keil 環境介紹 與 Console Tool設置

- **Keil V5 環境**

  - Build  , Rebuild  , Download  , Options for Target 
  (C/C++, Linker, Debug, Utilities, …)

  - Debug mode  (Breakpoints, Reset, Run, Step, View ...)

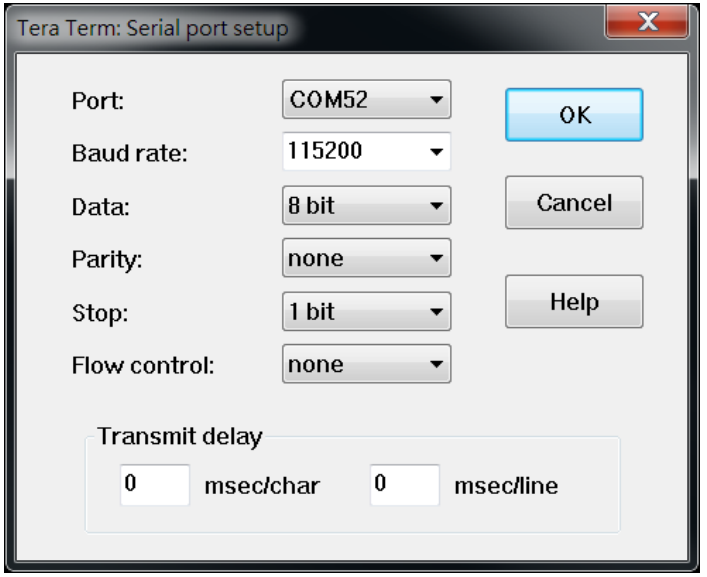
- **開發除錯 - Console Tool**

  -115200 bps, 8-N-1

  -SK Option: J2, DAP_Tx

  -Tera Term configuration:

  Setup > Serial Port



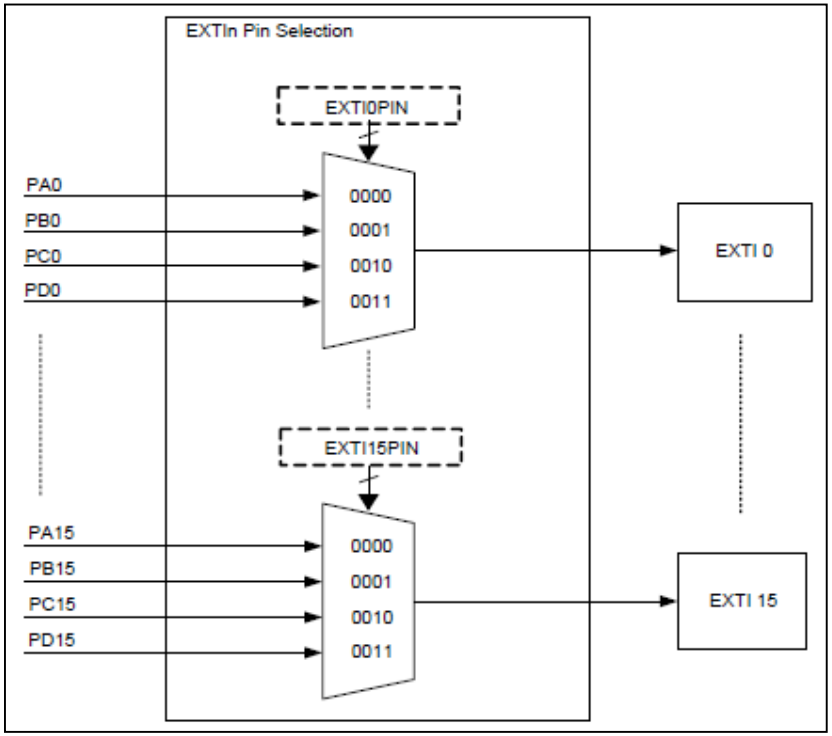
1_GPIO

Overview

- **目的**
  1. 了解 HT32 Firmware Library 基本使用方法
  2. 了解 GPIO / AFIO / CKCU / EXTI / NVIC 基本功能

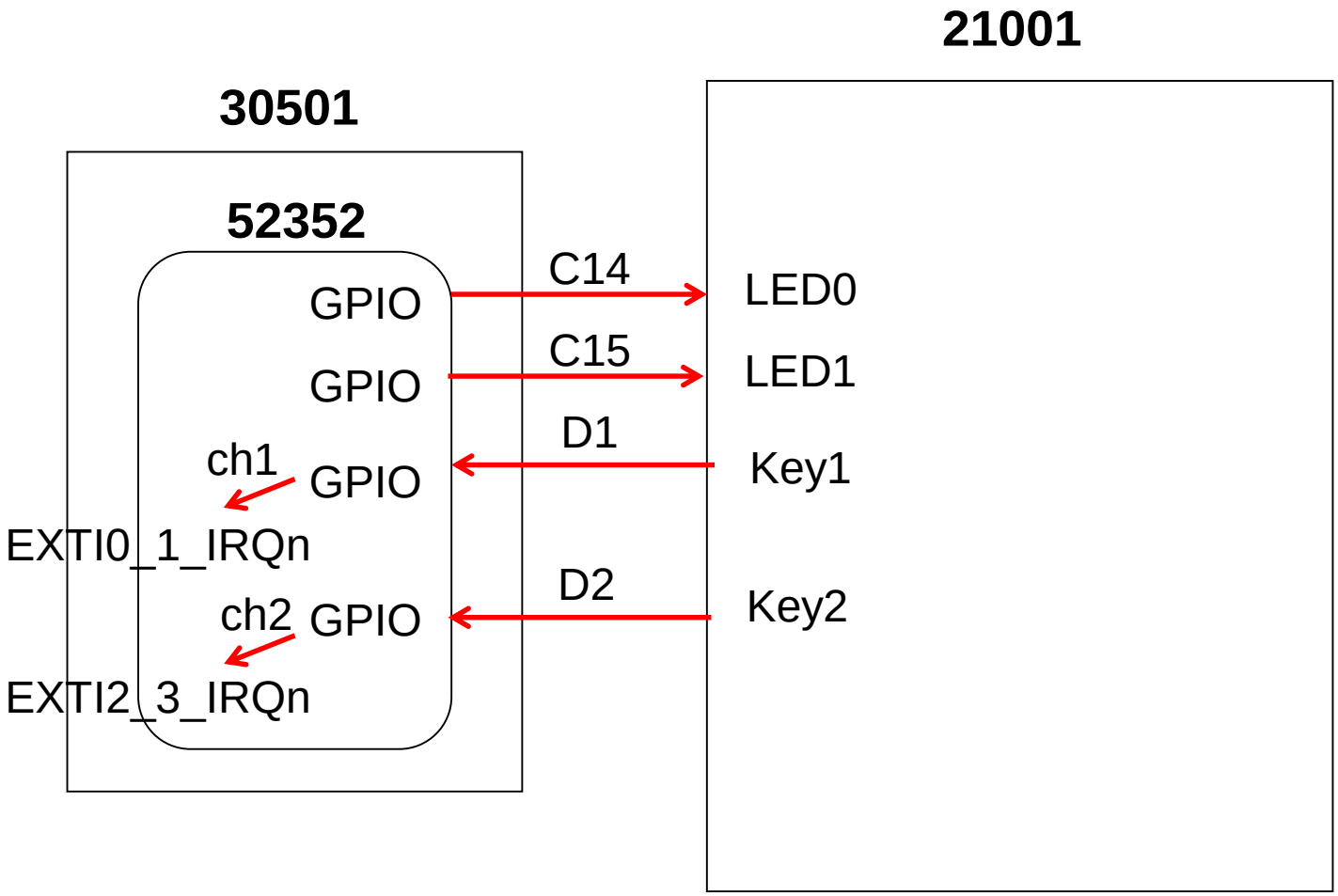
- **說明**
  1. 控制 LED (Output)
  2. 控制 Button (Input)

- **練習**
  1_ LED
  2_ Key
  3_ Key_Interrupt



Summary

- **Program Configuration**



2_Timer

Overview

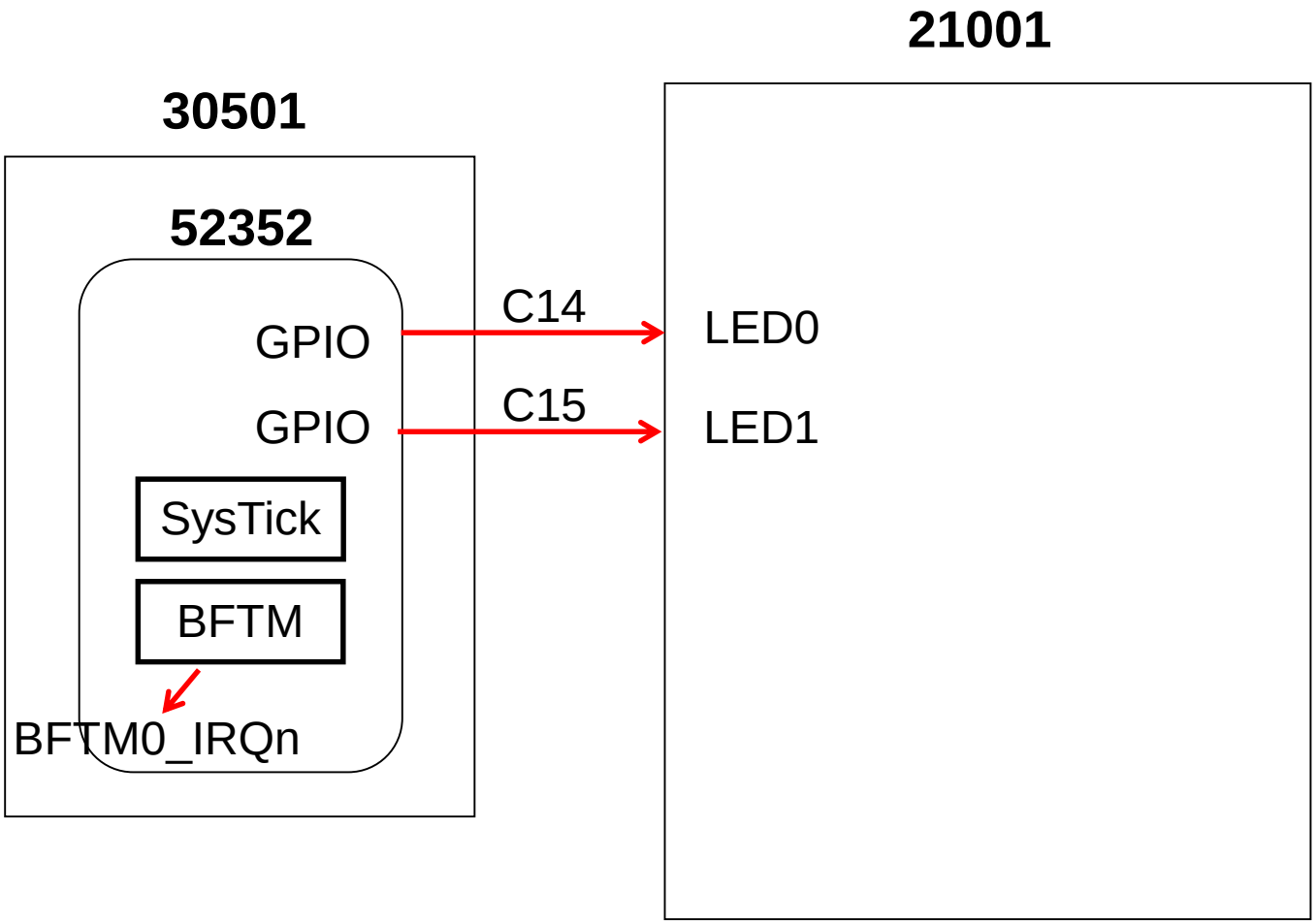
- **目的**
  1. 了解 SysTick 基本功能
  2. 了解 BFTM 基本功能

- **說明**
  1. SysTick 定時發中斷, 進入SysTick_Handler()
  2. BFTM 定時發中斷, 進入BFTM0_IRQHandler()

- **練習**
  1_SysTick
  2_BFTM

Summary

- **Program Configuration**



3_USART

Overview

- **目的**

  1. 了解 USART 基本功能

- **說明**

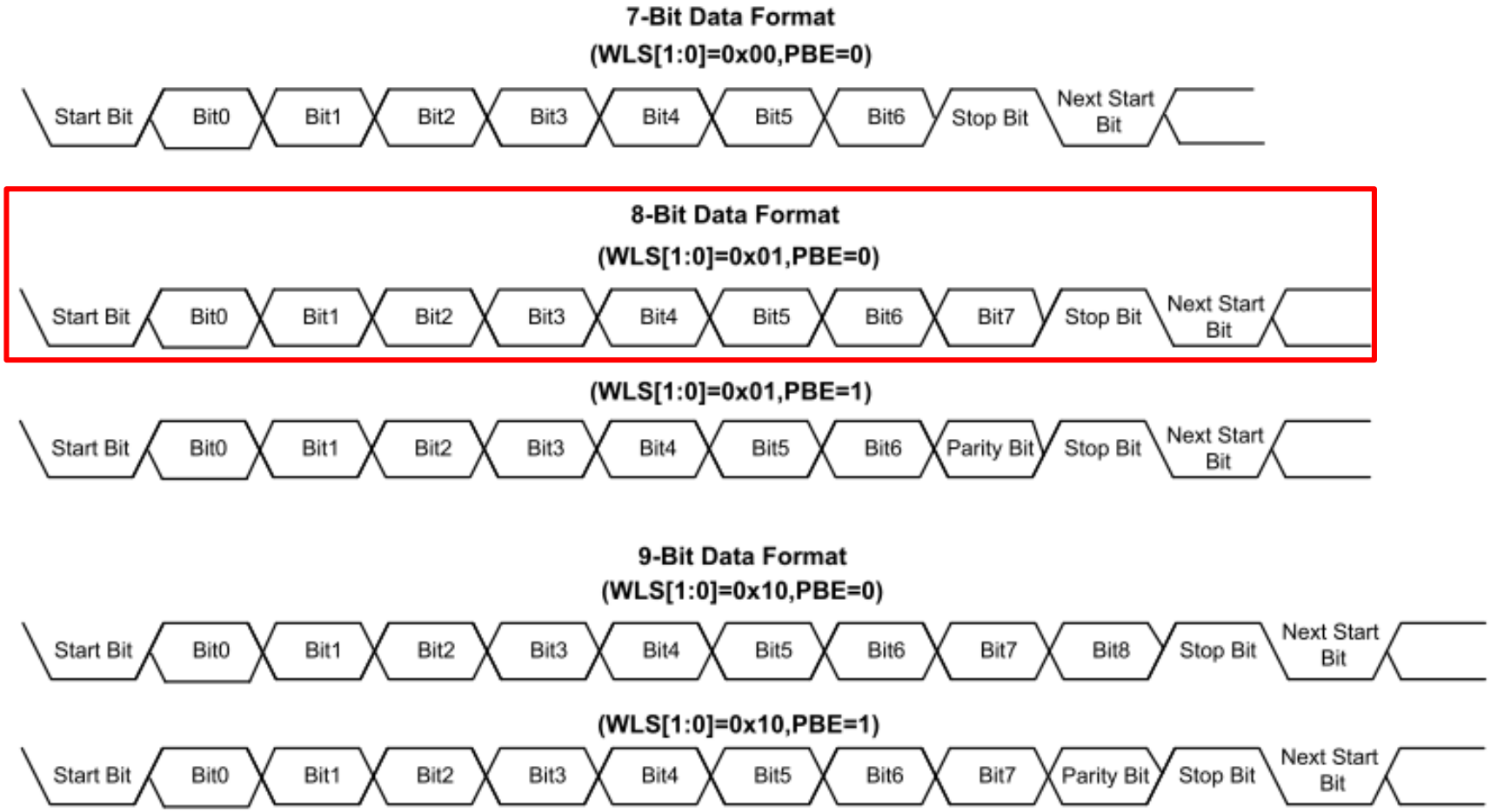
  1.搭配 Tera Term 做資料傳輸

- **練習**

  1_Polling

  2_Interrupt

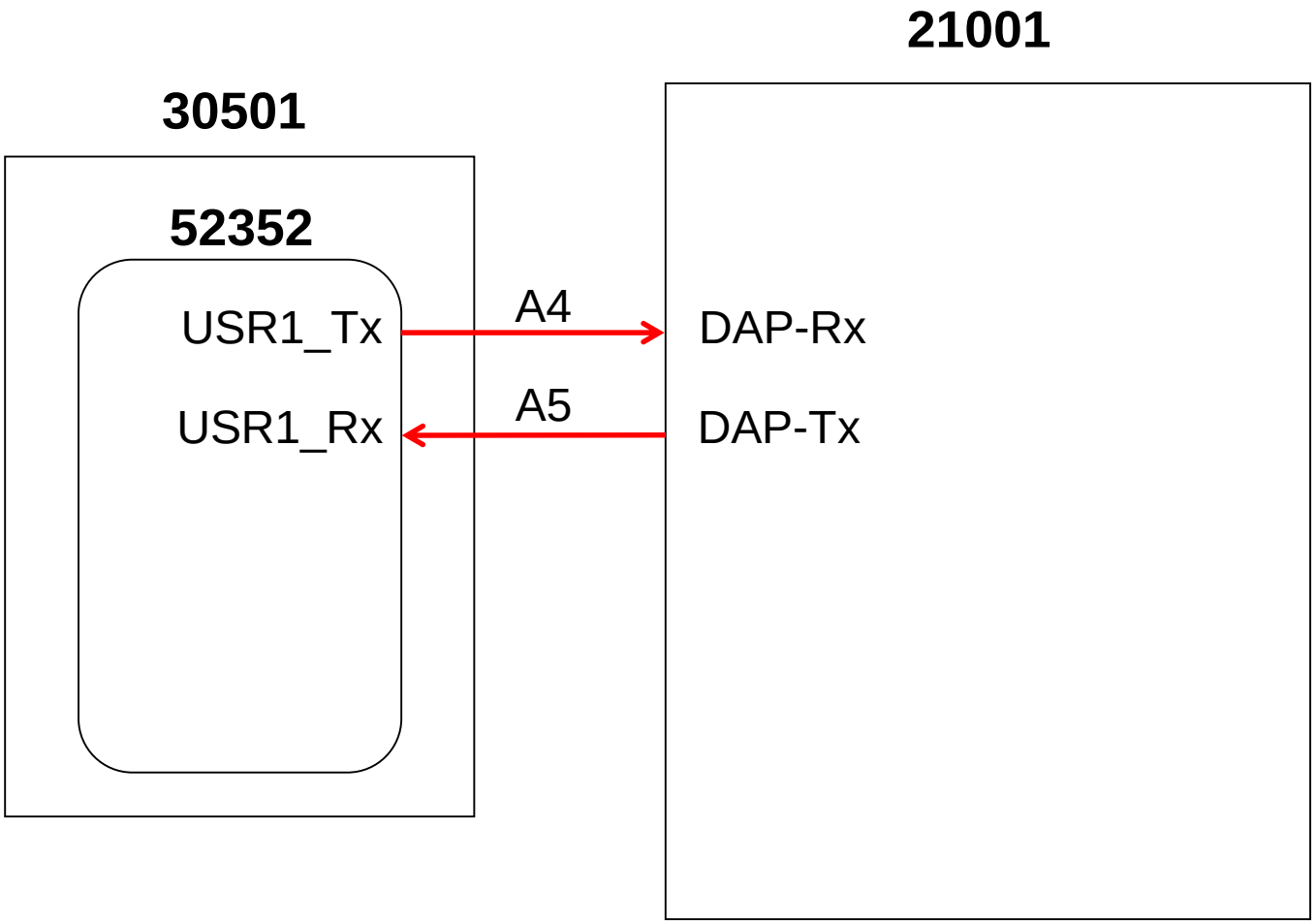
UART 串列數據格式



- START為必須，8 bit + 1 STOP格式較常用，故一筆資料共10-bit
- 如果Baud Rate誤差大於5%，則10-bit累積誤差超過50%，資料傳輸錯誤

Summary

- **Program Configuration**



4_I²C

Overview

- **目的**

  1. 了解 I²C 基本功能

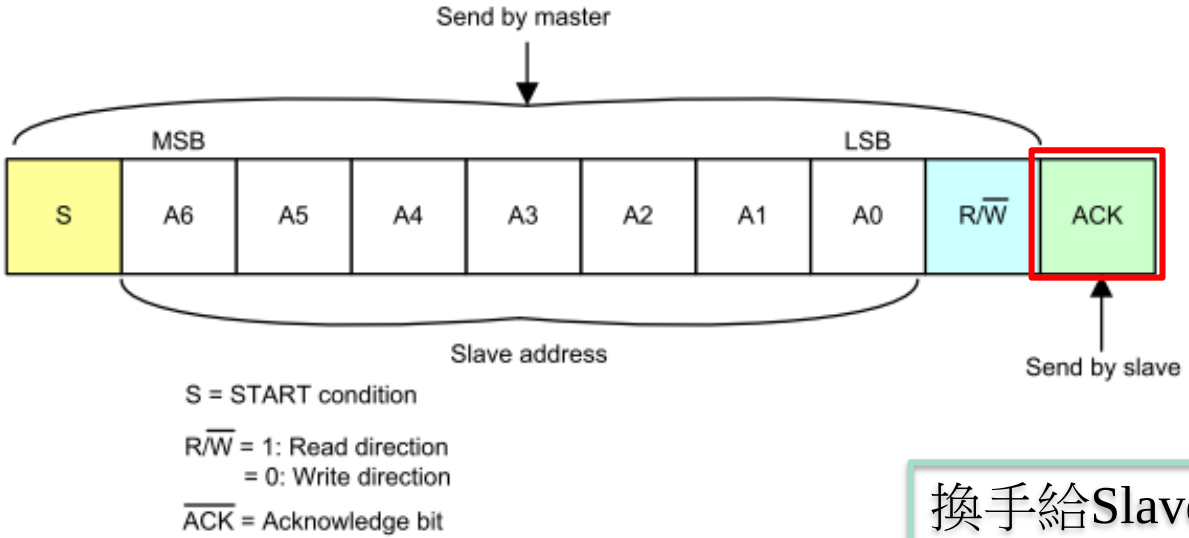
- **說明**

  1.搭配 Tera Term, 讀寫 Touch Key IC, BS8112A

- **練習**

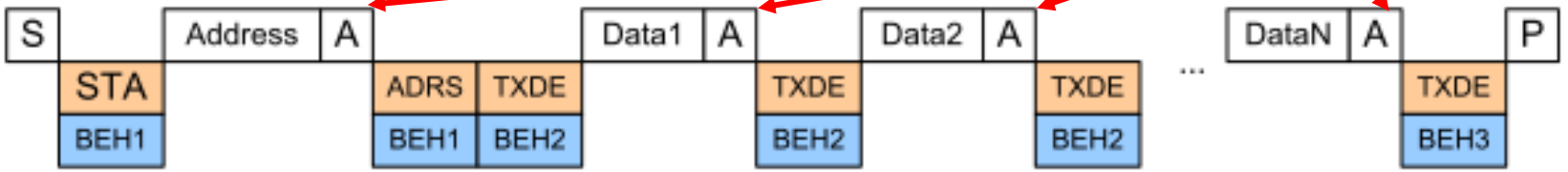
  1_TouchKey

I2C 主機發送接收時序

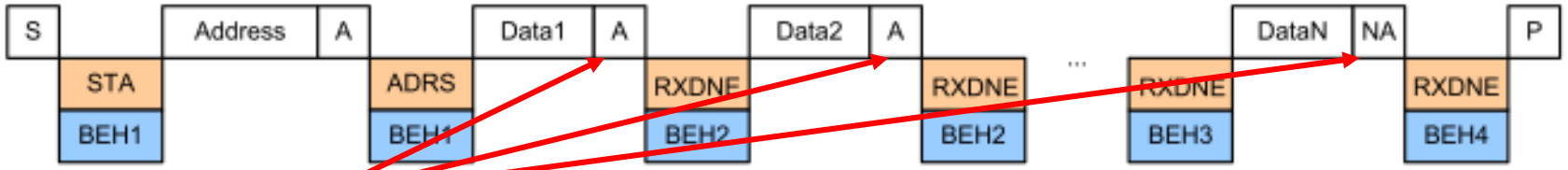


換手給Slave發送

7-bits Master Transmitter



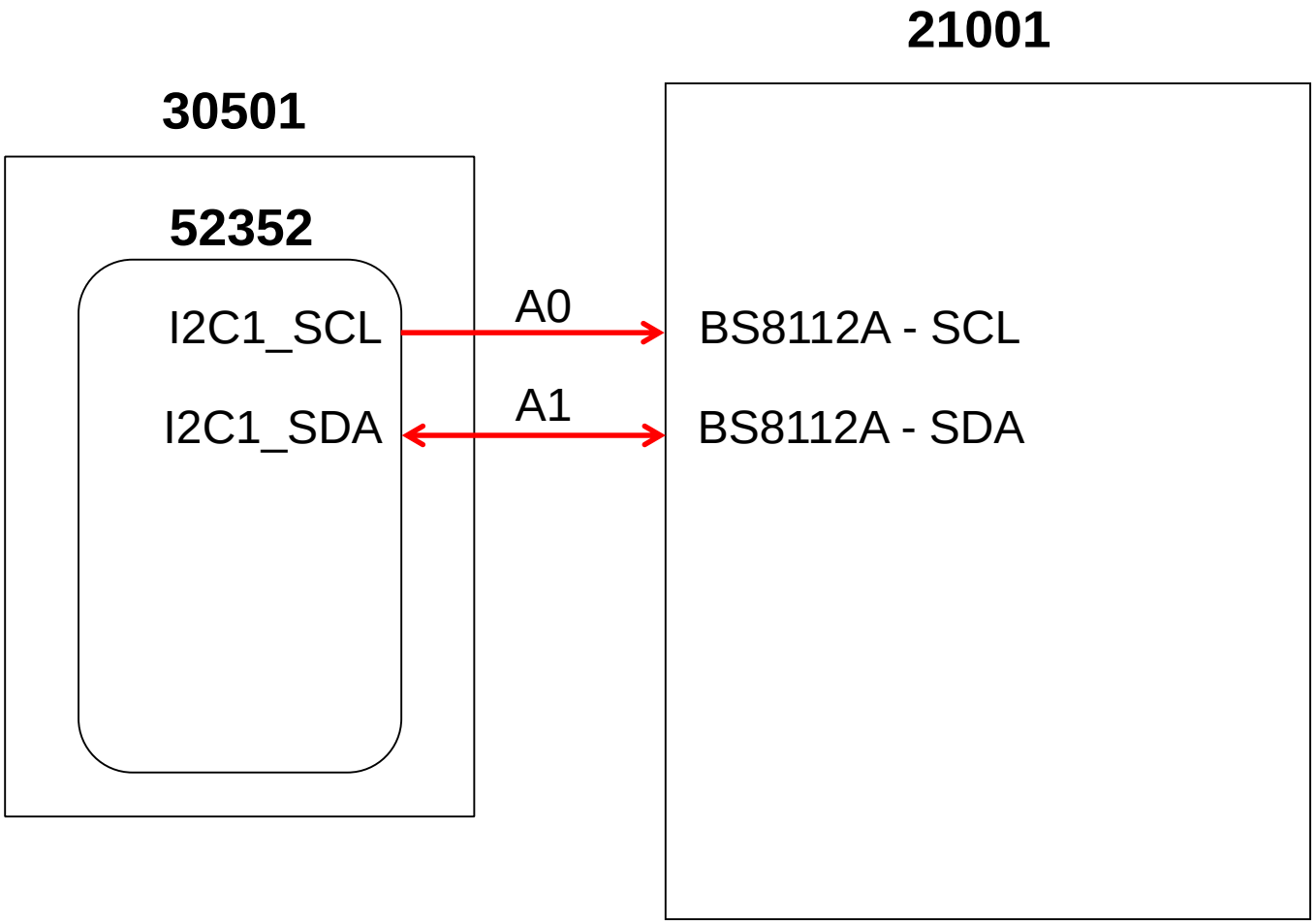
7-bits Master Receiver



換手給Master發送

Summary

- **Program Configuration**



5_ADC

Overview

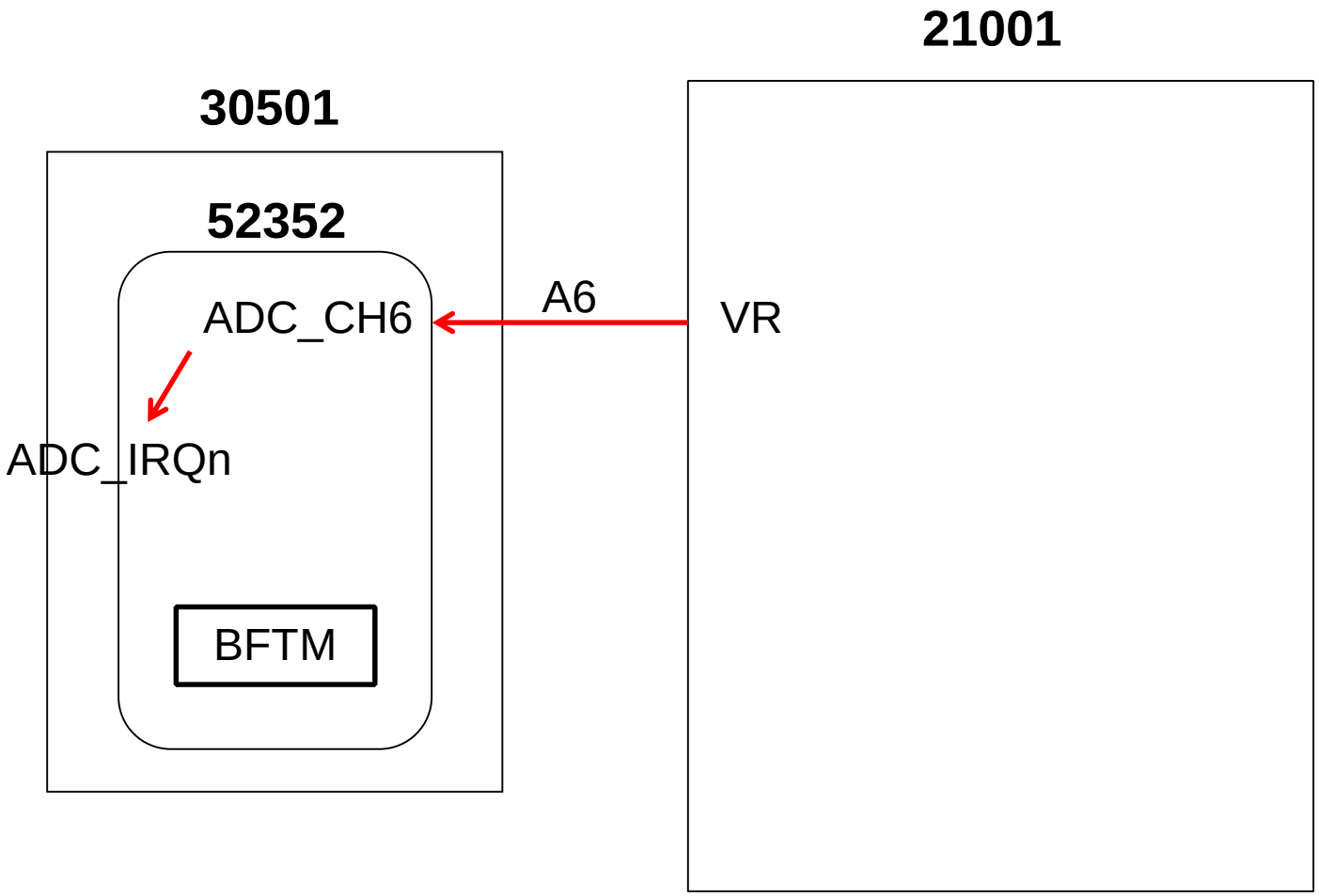
- **目的**
  1. 了解 ADC 基本功能

- **說明**
  1. 判斷可變電阻(VR)的類比電壓, 作為ADC輸入源
  2. 搭配 Tera Term 顯示 ADC 轉換值

- **練習**
  1_ADC_Continuous
  2_ADC_BFTM_Oneshot

Summary

- **Program Configuration**



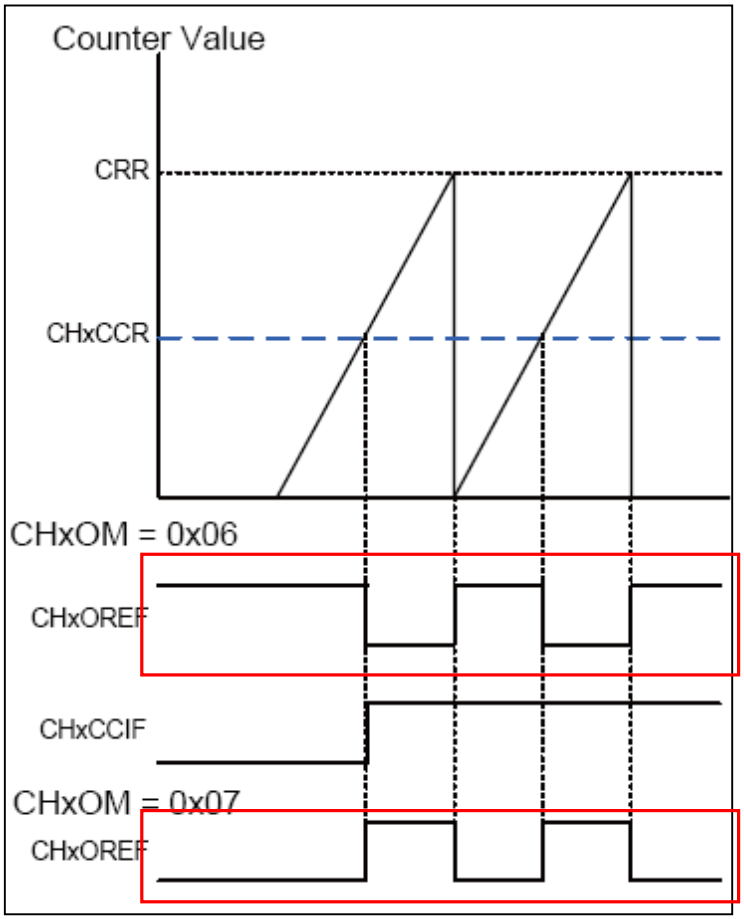
6_PWM

Overview

- **目的**
  1. 了解 GPTM / MCTM 基本功能
     - PWM 訊號輸出

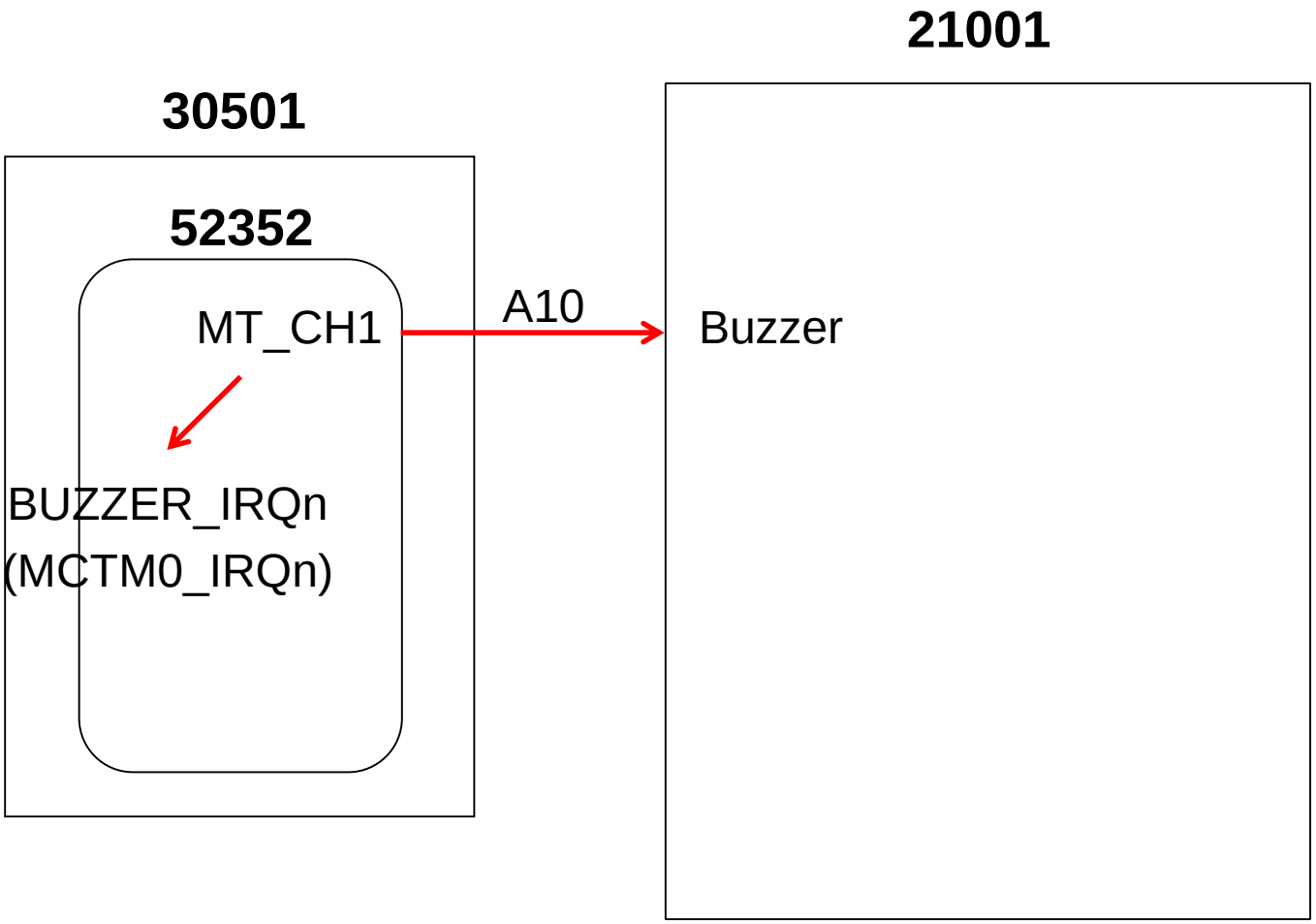
- **說明**
  1. 控制 Buzzer

- **練習**
  1_TM_PWMOutput
  2_TM_PWMOutput_Interrupt



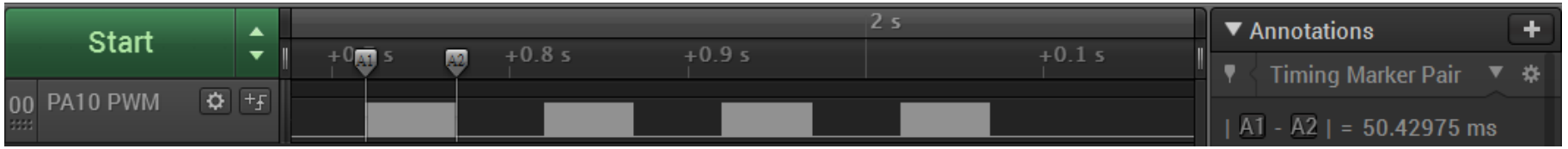
Summary I

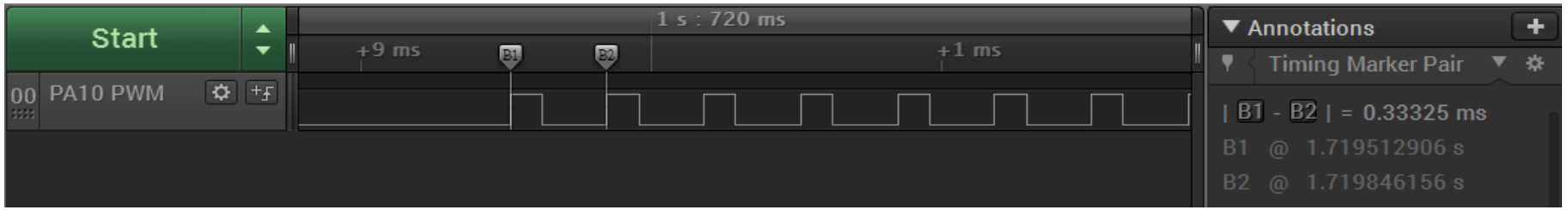
- **Program Configuration**



Summary II

- **Waveform**





HT32 Flash Programming

Download:

https://www.holtek.com.tw/development-kit

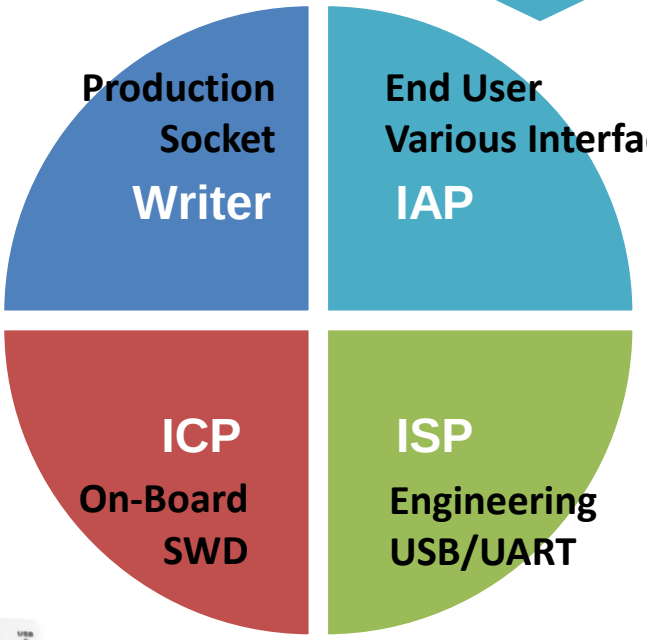
Holtek官網 -> 開發工具首頁 -> 開發工具 -> 開發套件 -> ESK32-305xx -> HT32 Flash Programmer

Overview

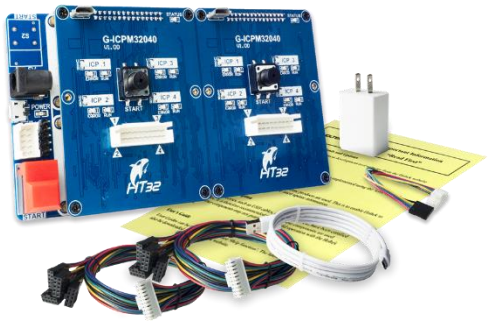
e-Writer32 (1 to 1)
HOPE3200for32-bit
On-line/Off-line

Application Code

Application (Image Sensor, SMBus, LAN, Wi-Fi, ….)
Functional (RTOS, FAT, Cryptography, DSP, …)
IP Middleware (UART, SPI, I²C)
IAP (HID, MSC, DFU, UART, SPI, I²C, SD, Dual Image, …)



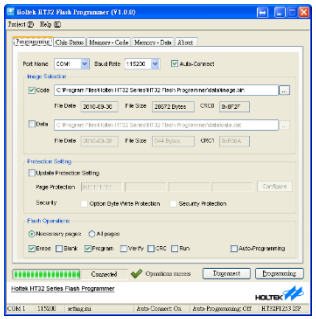
HT32 Flash Commander
Command line tool for ISP/IAP



Gang-Writer32-8 (1 to 8)
HT32 ICP Tool
Stand-alone mode

e-Link32 Pro / Lite
IDE: Keil/IAR/
Stand-alone: HT32 ICP Tool
Command line: e-Link32 Pro/Lite Commander

HT32 Flash Programmer
HT32 ISP Bootloader



e-Writer32

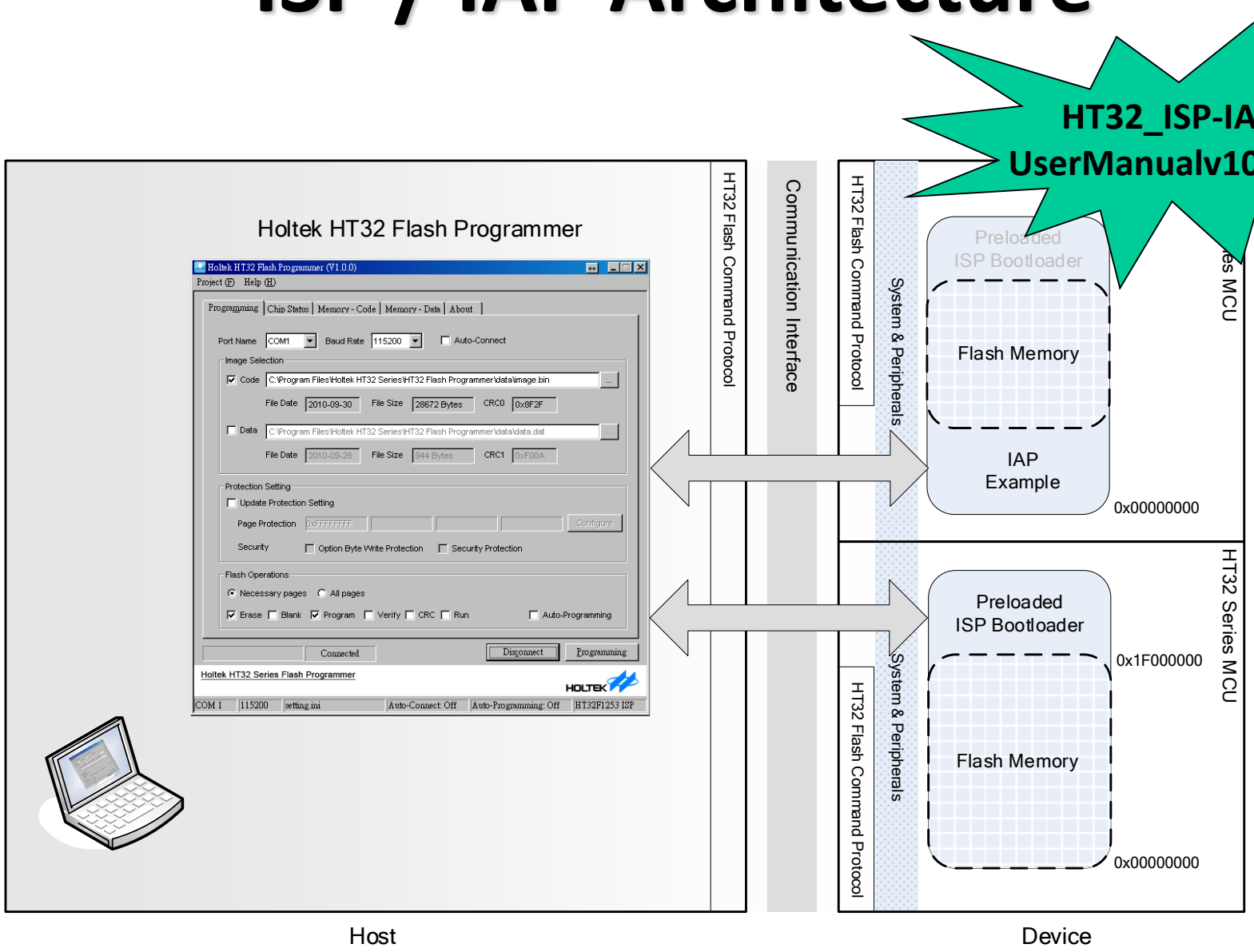
- **For mass production**
- **Programming via socket**
- **Two operation modes**
  - **On-line Mode**: Connect with PC via USB
  - **Off-line Mode:** Stand-alone programming (by button)
- **Support ICP mode** (ESKT32ICPB Adapter board required)

e-Socket32

e-Writer32

HOPE3200 For 32-Bit

ISP / IAP Architecture



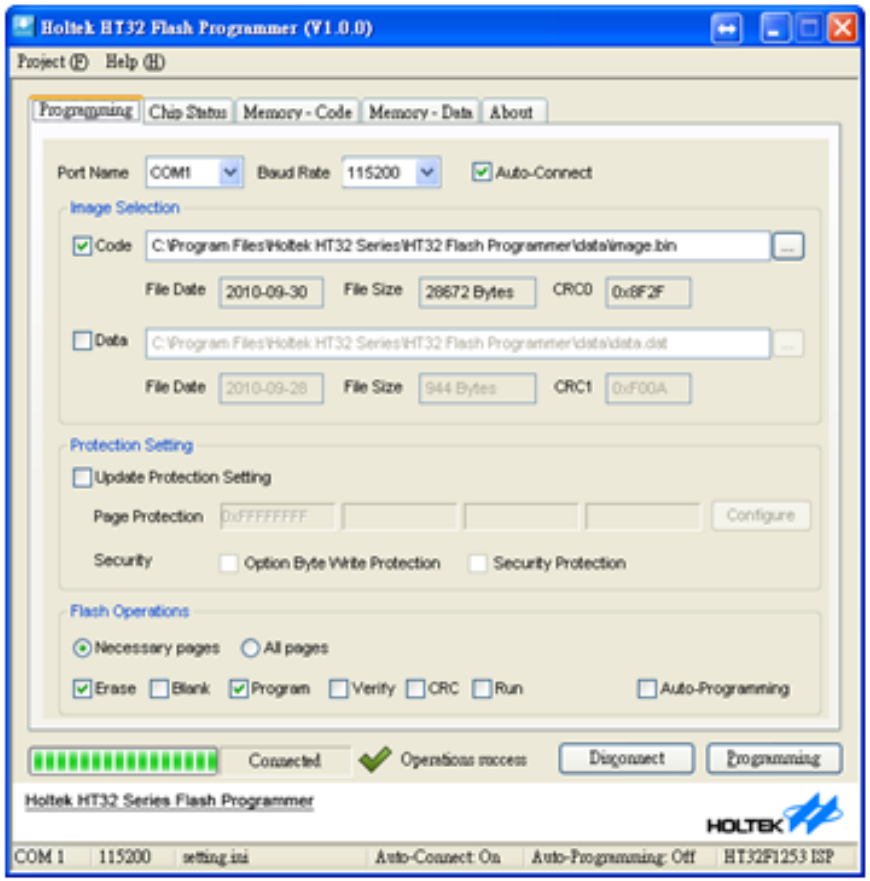
ISP / IAP Flash Programmer

ISP / IAP Standard UI

- Setting
- Programming Firmware
- Checking Status
- Reading Memory
- Interface : UART / USB

SDK

- For customized UI
- ISPCmd.dll DLL API
- Example code in VC++



HT32 Resources

Web or Download:

HT32F5 Series (Cortex-M0+): HT32_M0p_Vyyyymmdd.zip

https://mcu.holtek.com.tw/ht32/resource/

Documentation

Type	Item	Description
IC	Datasheet User Manual	IC Brief description IC Detailed description
Firmware	Programmer's Guide	F/W library guide in CHM format
Tools	Starter Kit User Manual Expansion Board User Manual e-Link32 User Manual Quick Start Guide	Starter Kit description Expansion board description e-Link32 installation guide Quick start guide of Keil / IAR
ISP / IAP	ISP / IAP User Manual	ISP / IAP description (UI & FW)
Application	Application Notes	Various application information

32-Bit Flash MCU

- Home > Products > 32-Bit Flash MCU > General Purpose MCU
  - Cortex-M0+ 32-Bit USB MCU

32-Bit Flash MCU | 8-Bit Flash MCU | High Supply Voltage Flash MCU | 8-Bit OTP MCU

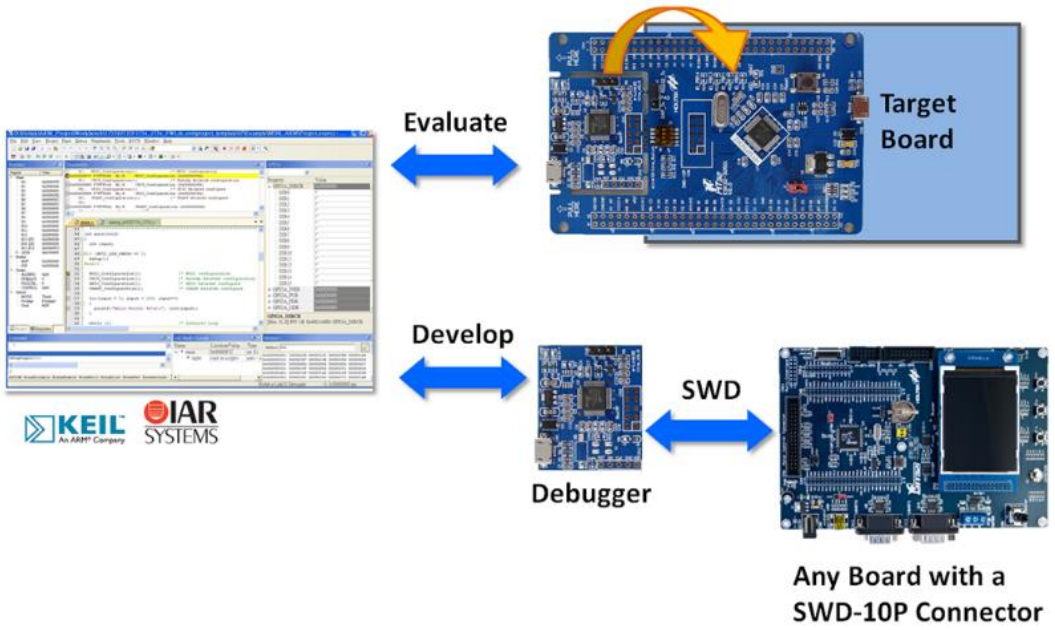
▶ Cortex-M0+ 32-Bit MCU

▼ Cortex-M0+ 32-Bit USB MCU

Part No.	Max. Freq.	VDD	Flash	SRAM	PDMA	ADC	CMP	DAC	Timers*1	Cap.*2 or PWM	Cpm. PWM*3	RTC	SCI*4	USB*5	EBI*6	I²S	Interface	Others	I/O	Packa
HT32F52331	48MHz	2.0V ~ 3.6V	32KB	4KB	--	1 Msps 12-bit ×12	--	--	BFTM×2 SCTM×4 GPTM×1 MCTM×1	12	3	√	1	√	--	--	USART×1 UART×2 SPI×2 I²C×2	CRC	24	33QI
HT32F52341			64KB	8KB															38	48LC
HT32F52342	48MHz	2.0V ~ 3.6V	64KB	8KB	6CH	1 Msps 12-bit ×12	2	--	BFTM×2 SCTM×2 GPTM×2 MCTM×1	14	3	√	2	√	√	√	USART×2 UART×2 SPI×2 I²C×2	CRC	26	33QI
HT32F52352			128KB	16KB															39 51	48LC 64LC
HT32F52344	60MHz	1.65V ~ 3.6V	64KB	8KB	6CH	1 Msps 12-bit ×12	2	--	BFTM×2 SCTM×2 GPTM×1 MCTM×1	10	3	√	--	√	√	--	UART×2 SPI×2 I²C×1	CRC DIV	26 38 40	33QI 46QI 48LC
HT32F52354			128KB	8KB															54	64LC
HT32F52357	60MHz	1.65V ~ 3.6V	128KB	16KB	6CH	1 Msps 12-bit ×12	2	500Ksps 12-bit×2	BFTM×2 SCTM×2 PWM×2 GPTM×1 MCTM×1	18	3	√	2	√	√	√	USART×2 UART×4 SPI×2 I²C×2 QSPI×1	AES CRC DIV	37 39 53	46QI 48LC 64LC
HT32F52367			256KB	32KB															67	80LC

Development Kit

- Home > MCU Tools > Development Kit



技術支援

- Data Sheet
- User Manual
- Firmware Library
- ESK32-30501 User Manual
- Schematics
- Tool chain Quick Start Guide
  - Keil™ MDK-ARM
  - IAR EWARM
- Keil MDK Holtek Edition (Free) Installation Guide

Software

- Home > MCU Tools > Software
  - ICE Software
  - Programmer Software
  - Development Kit Software

Model	Function	Support Hardware	No
HT32 Keil Support Package (New release V1.17)	Integrated Keil deve soft MCU		
HT32 IAR Support Package (New release V1.11Beta06)	Inte deve soft MCU		
e-Link32 Pro ICP Tool (New release V0.29)	Prog e-Lir stan		
e-Link32 Pro Commander (New release V1.00)	e-Lir (Cor		
HT32 Virtual COM Driver (New release V1.10)	HT3 Driv		

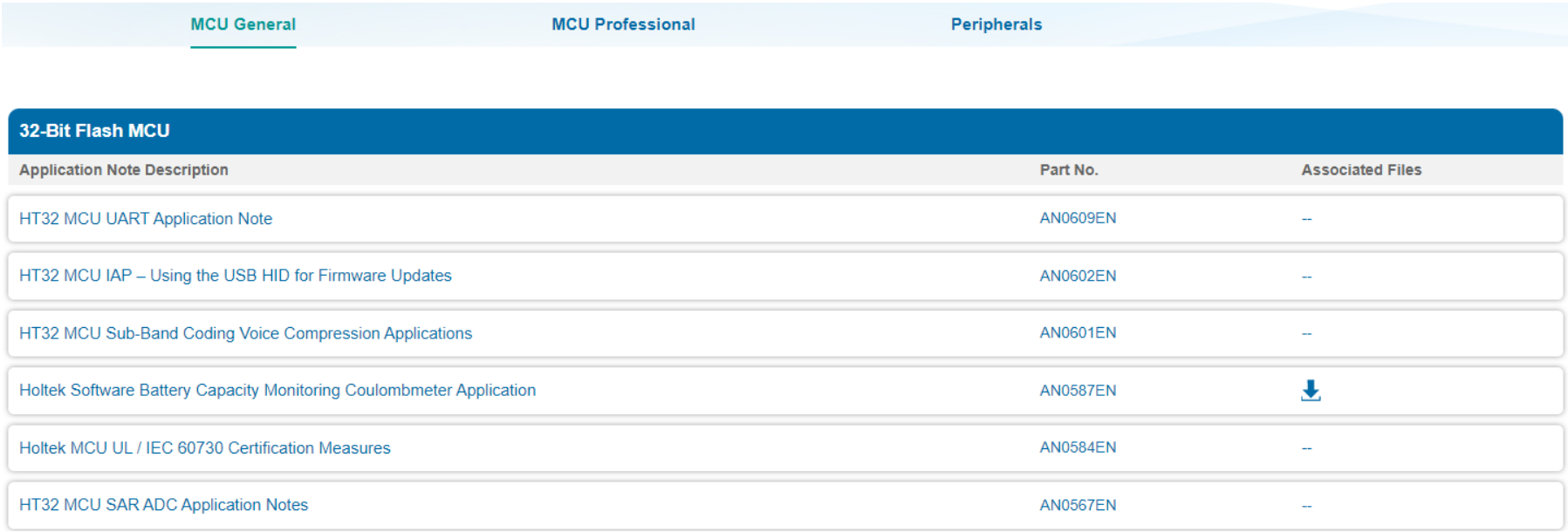
Model	Funct
HOPE3000 (New release V3.29)	Integr Writer
HOPE3000 For e-Link (New release V1.18)	Engin Flash
HOPE3000 For HT8051 (New release V1.64)	e-Writ Holtel
HOPE3000 For HT32 (New release V2.10)	e-Writ HT32
I3000 (New ReleaseV2.56)	HT8 F Progr

Model	Function	Support Hardware	Download
HT32 Flash Programmer	In-System / In-Application programmer software for HT32 series MCUs. The HT32 Flash Programmer UI uses the UART or USB interface for communication.	ESK32-xxx ESK32-301xx ESK32-305xx	V1.09a
HT32F1xxxx (M3) Standard Peripheral Firmware Library	HT32F1xxxx Standard Peripheral Firmware Library is a software package that contains peripheral driver, API Functions, macros, data types, structure types and examples of HT32F1xxxx peripherals.	ESK32-xxx ESK32-301xx ESK32-2xxxx	HT32_STD_1xxxx_FWLib_v004_2103
HT32F5xxxx (M0+) Standard Peripheral Firmware Library	HT32F5xxxx Standard Peripheral Firmware Library is a software package that contains peripheral driver, API Functions, macros, data types, structure types and examples of HT32F5xxxx peripherals.	ESK32-305xx ESK32-2xxxx	HT32_STD_5xxxx_FWLib_v014_4736

Bootloader) to each MCU's datasheet

Application Notes

- Home > Application Notes > 32-Bit Flash MCU
  - MCU: General
  - MCU: Professional



MCU General | MCU Professional | Peripherals

32-Bit Flash MCU

Application Note Description	Part No.	Associated Files
HT32 MCU UART Application Note	AN0609EN	--
HT32 MCU IAP – Using the USB HID for Firmware Updates	AN0602EN	--
HT32 MCU Sub-Band Coding Voice Compression Applications	AN0601EN	--
Holtek Software Battery Capacity Monitoring Coulombmeter Application	AN0587EN	
Holtek MCU UL / IEC 60730 Certification Measures	AN0584EN	--
HT32 MCU SAR ADC Application Notes	AN0567EN	--

Appendix …

Exception

- **目的**
  1. 增加程式開發的除錯能力

- **說明**
  1. 確認 Build Output window message
  2. 搭配 tera term 顯示 ExceptionTest 範例程式的執行結果

- **練習**
  1. Program compiling error
  2. Stack Overview: Stack Pointer Register (R13)
  3. Hard Fault: Clock is disabled before use
  4. Hard Fault: Unaligned memory access

The End