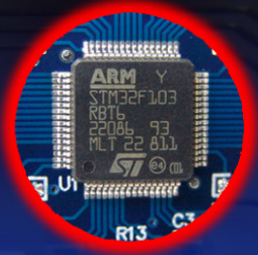


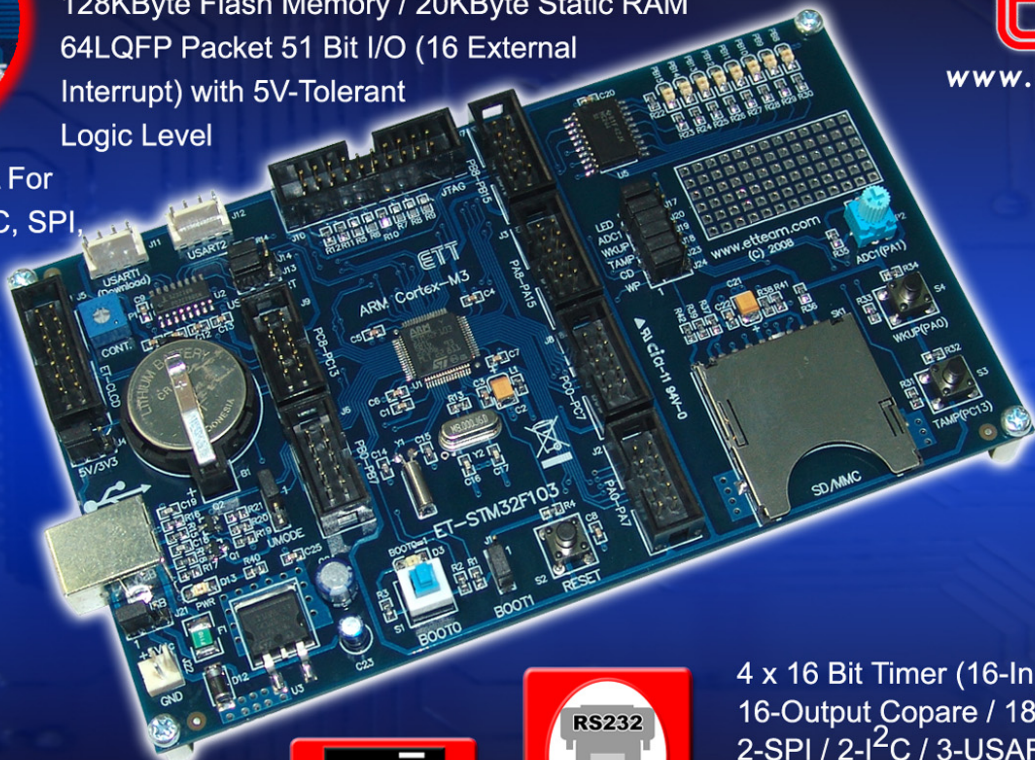
คู่มือการใช้งาน User's manual ET-STM32F103

STM32
ARM Cortex-M3



32 Bit ARM Cortex-M3 Processor
Run 72MHz Clock / 90MIPS (1.25DMIPS/MHz)
128KByte Flash Memory / 20KByte Static RAM
64LQFP Packet 51 Bit I/O (16 External
Interrupt) with 5V-Tolerant
Logic Level

7-Channel DMA For
Peripherals ADC, SPI,
I²C, USART
16 CH / 12 Bit
ADC Converter



ETT

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4 x 16 Bit Timer (16-Input Capture /
16-Output Copare / 18-PWM)
2-SPI / 2-I²C / 3-USART / 1-USB /
1-CAN / 2-WDG / RTC

★ Support Debug with Serial wire
Debugger (SWD) & JTAG Interface

ETT

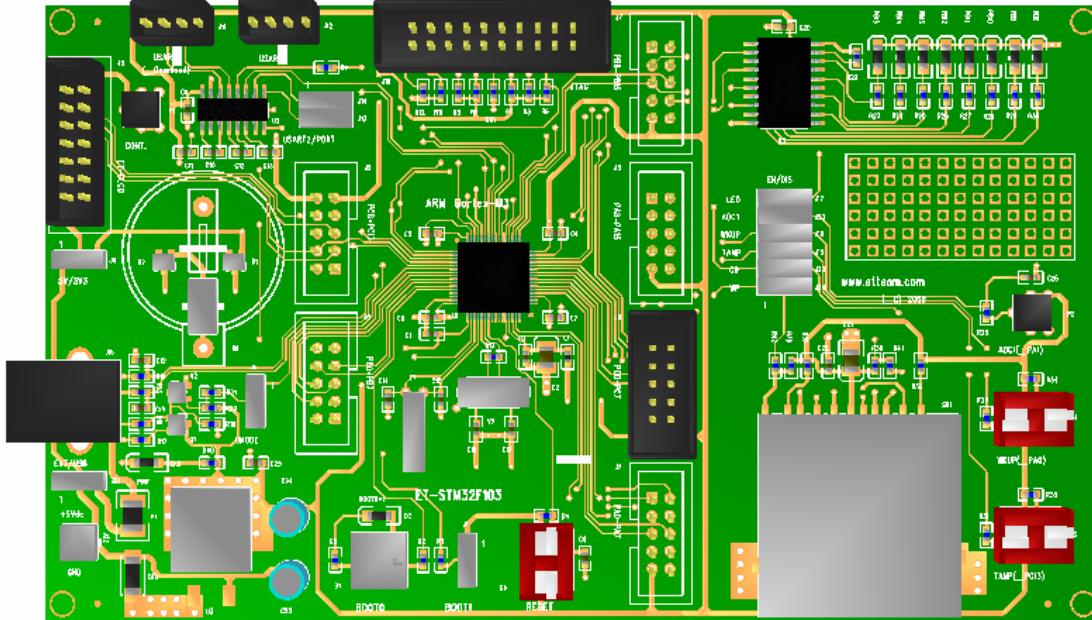
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ET-STM32F103



ET-STM32F103 is ARM Cortex-M3 Board Microcontroller that uses 32-Bit 64PIN (LQFP) Microcontroller No. STM32F103RBT6 from STMicroelectronics. Resource systems internal STM32F103RBT6 are quite perfect and suitable for learning or applying to many projects well. If user can learn and understand how to use resources internal MCU well, it makes user can additionally modify and develop more applications because hardware system of STM32F103RBT6 have already included the necessary components in the single MCU such as USB, SPI, I2C, ADC, Timer/Counter, PWM, Capture, UART and etc.

ETT Team studies and researches on details of STM32F103RBT6 and then designs it to be Board Microcontroller version "ET-STM32F103". We hope that user who purchases this board can learn, modify, and develop additionally as required under the reasonable price. The main purpose to design the Board ET-STM32F103 is to support user who needs to learn, modify, and develop the board actually. The board structure consists of the basic components that are necessary to simply learn and test

such as LED to display Output Logic value, Push Button Switch to test Logic Input, Volume to adjust the voltage to test A/D. Moreover, it provides components for advanced learning to support applications such as Port USB, SD Card, Dot-Matrix LCD, and RS232. Besides, there are many available GPIO that are designed and can be used with other components suitably. So, Board ET-STM32F103 is one of the multipurpose boards that should not be missed.

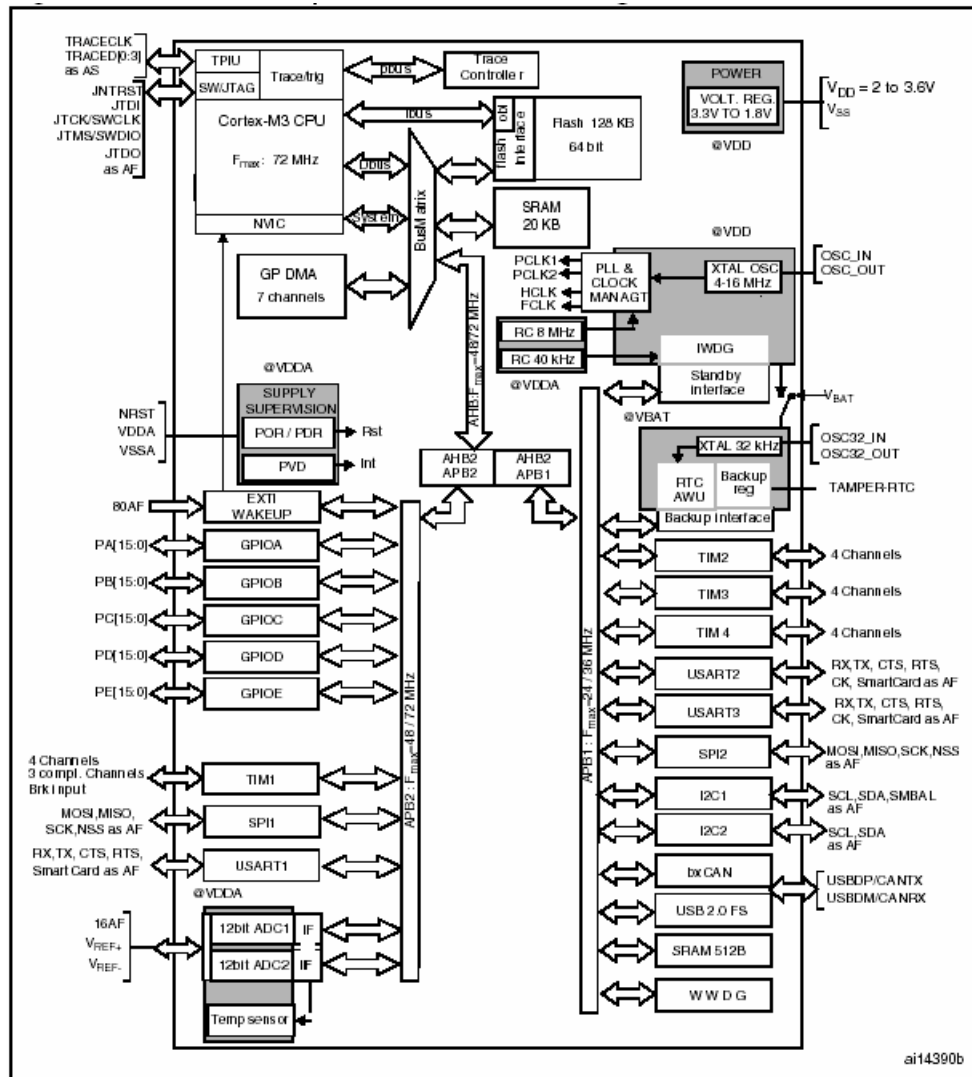
Specifications of Board

1. Use ARM Cortex-M3 32Bit MCU No.STM32F103RBT6 from STMicroelectronics.
2. Has 128 KB Flash Memory and 20KB Static RAM Internal MCU
3. Use Crystal 8.00MHz + Phase-Locked Loop (PLL), run 72MHz Frequency and process data with 1.25 DMIPS/MHz speed that is equal to 90 MIPS
4. Has RTC (Real Time Clock) Circuit with XTAL 32.768KHz and Battery Backup
5. Support In-System Programming (ISP) and In-Application Programming (IAP) through ON-Chip Boot-Loader via Port USART-1 (RS232)
6. Has circuit to connect with standard 20 PIN JTAG ARM to Debug as Real Time
7. Use +5VDC Power Supply that can be selected either from USB Port or from external CPA-2PIN Connector with +3V3/3A Regulate internal Board
8. Has Standard USB 2.0 as Full Speed insides
9. Has circuit to interface SD Card by using SPI Mode 1 Channel
10. Has RS232 Communication Circuit by using standard ETT 4-PIN Connector 2 Channel
11. Has circuit to interface with Dot Matrix LCD with circuit to adjust the brightness by using standard ETT 14 PIN Connector with Jumper to set Power Supply for LCD either +3.3V or +5V
12. Has 2 Push Button Switch Circuits
13. Has 8 LED Circuits to display status of testing Output
14. Has circuit to create 0-3V3 voltage by using adjustable Resistor to test A/D

15. Has independent 46 Bit GPIO to apply to many applications such as A/D, I2C, SPI and Input/ Output with Jumper to ON/OFF signal. User can set Jumper to use it either GPIO or Hardware Self-Test such as 8 Bit LED, Push Button SW, Volume, USART2 and SD Card. So, user is free to select functions independent without unlimited hardware system of board.

- Header 10Pin IDE (PA[0..7])
- Header 10Pin IDE (PA[8..15])
- Header 10Pin IDE (PB[0..7])
- Header 10Pin IDE (PB[8..15])
- Header 10Pin IDE (PC[0..7])
- Header 10Pin IDE (PC[8..13])

Specifications of MCU STM32F103RBT6



- 32 Bit ARM Cortex-M3 Processor, Run 72MHz Clock / 90MIPS(1.25DMIPS/MHz)
- 128KByte Flash Memory / 20KByte Static RAM
- 64LQPF Packet 51 Bit I/O + 16 External Interrupt with 5V-Tolerant Logic Level
- 7 Channel DMA For Peripherals ADC, SPI, I2C, USART
- 16 Channel / 12 Bit ADC Converter
- Support Debug with Serial wire Debugger(SWD) & JTAG Interface
- 3 x 16 Bit Timer(16-Input Capture / 16-Output Compare / 18-PWM)
- 2-SPI, 2-I2C, 3-USART, 1-USB, 1-CAN, 2-WDG, RTC

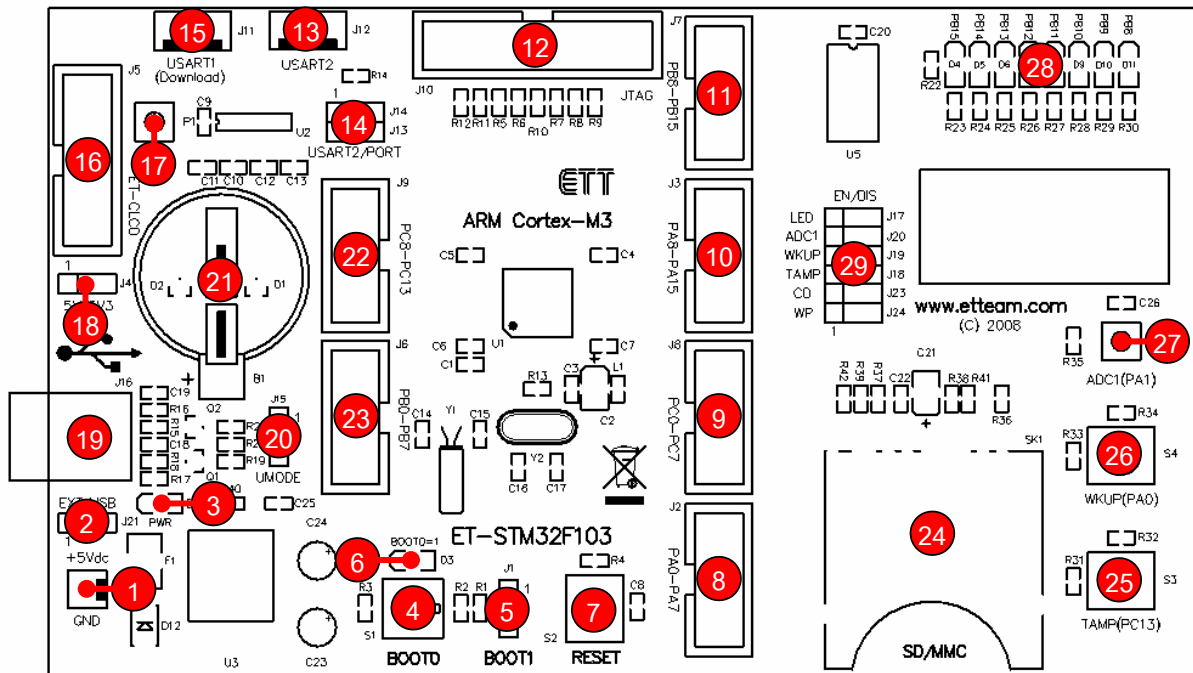


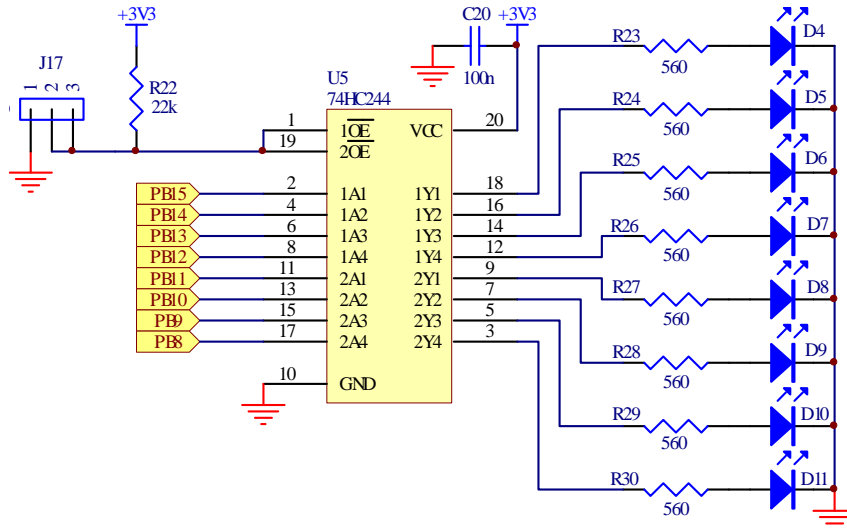
Figure Show the position of components on ET-STM32F103.

- **No.1** is an external +5V Power Supply Connector.
- **No.2** is Jumper J21 to select to use +5V either from USB Port or external Connector.
- **No.3** is LED Power to display status of Power Supply.
- **No.4** is Switch BOOT0 that is used with Jumper J1 to select operation mode of Board as Download type either from USART1 or Normal Run; in this case, ON is Download and OFF is Run.
- **No.5** is Jumper J1(BOOT1) that is used with Switch BOOT0 to select operation mode of Board as Download type whether from USART1 or Normal Run; in this case, it is always configured at BOOT1 position.
- **No.6** is LED to display operation mode of board. If it is ON, it means that SW-BOOT0 is in the ON position and can download through USART1; on the other hand, if it is OFF, it means that it is in Normal Run.
- **No.7** is Switch RESET to reset operation of MCU.
- **No.8** is GPIO (PA[0..7]) Connector.
- **No.9** is GPIO (PC[0..7]) Connector.
- **No.10** is GPIO (PA[8..15]) Connector.
- **No.11** is GPIO (PB[8..15]) Connector.
- **No.12** is JTAG ARM Connector to Debug as Real Time.

- **No.13** is UASRT2 (RS232) Connector for usage.
- **No.14** is Jumper J13 and J14 to select and set signal of PA2 and PA3 to be used as either USART2 or GPIO.
- **No.15** is USART1(RS232) Connector for usage and Download.
- **No.16** is Character LCD Connector by using with LCD that is either +3.3V Supply or +5V Supply.
- **No.17** is VR to adjust the brightness of Character LCD.
- **No.18** is Jumper J4 to select Power Supply of LCD to be either +3.3V or +5V.
- **No.19** is USB Connector to connect with USB Hub version 2.0.
- **No.20** is Jumper to select connection mode of USB.
- **No.21** is 3V Battery for Backup the time of RTC.
- **No.22** is GPIO(PC[8..13]) Connector.
- **No.23** is GPIO(PB[0..7]) Connector.
- **No.24** is socket to insert SD Card.
- **No.25** is S3 to test Logic Input of PC[13].
- **No.26** is S4 to test Logic Input of PA[0].
- **No.27** is VR to adjust the 0-3V3 voltage to test A/D(PA[1]).
- **No.28** is LED to test Logic Output of PB [8..15].
- **No.29** is Jumper J17, J20, J19, J18, J23, J24 to select Enable or Disable for the connection between GPIO Pin and component that is tested.
 - J17 is used to ENABLE (EN) or DISABLE (DIS) the display of LED follow the control of PB[8..15]
 - J20 is used to ENABLE (EN) or DISABLE (DIS) the connection between Pin PA1 of MCU and VR.
 - J19 is used to ENABLE (EN) or DISABLE (DIS) the connection between Pin PA0 of MCU and Switch S4.
 - J18 is used to ENABLE (EN) or DISABLE (DIS) the connection between Pin PC13 of MCU and Switch S3.
 - J23 is used to ENABLE (EN) or DISABLE (DIS) the connection between Pin PA8 of MCU and CD of SD Card.
 - J24 is used to ENABLE (EN) or DISABLE (DIS) the connection between Pin PC6 of MCU and WP of SD Card.

Application of LED Display Circuit

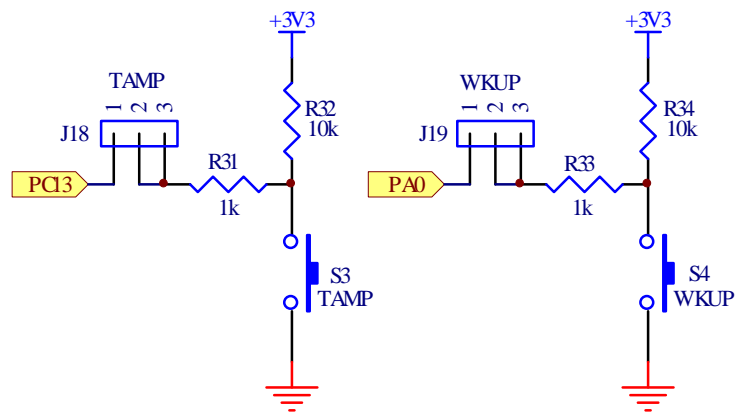
There are 8 LED Displays of Board ET-STM32F130 and the circuit that drives LED is connected as Source Current. It uses Buffer No.74HC244 to drive current into LED and then uses signal from Port PB[8..15] to run. In this case, it runs with Logic "1" and stop running with Logic "0". User can select to ON/OFF operation of Buffer No.74HC244 by setting Jumper J17 as shown in the picture below.



Application of Push Button Switch Circuit

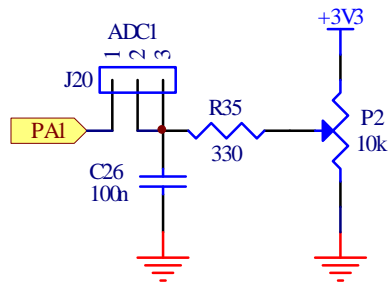
Push Button Switch Circuit uses the Push Switch type with Pull-Up Circuit and is used with +3.3V Power Supply. If this switch is not pressed, its logic status is "1"; on the other hand, if this switch is pressed, its logic status is "0". It is used to test operation of Input Logic. There are 2 sets for this circuit as follows;

- S3 (PC[13]) tests Logic Input or TAMP (Tamper Detection).
- S4 (PA[0]) tests Logic Input or WKUP (Wakeup Interrupt).



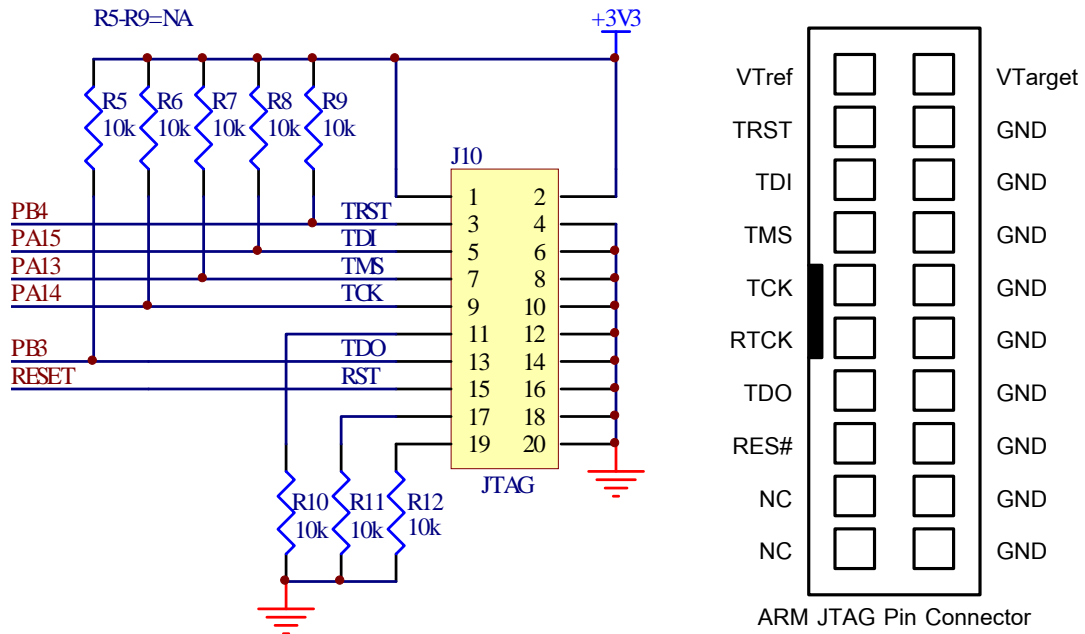
Application of VR Circuit (0-3V3)

VR circuit uses VR Resistor to adjust values. This circuit is used with +3.3V Power Supply and user will get the Output value that is voltage in the range of 0V to +3.3V follows the adjustment of the Resistor. The Output will be inputted into Pin PA[1] to create Input voltage for testing operation of A/D (PA[1]) circuit. User can remove the connection between signal PA[1] and VR circuit by using Jumper J20 as shown in the circuit below.



Application of JTAG ARM

JTAG or JTAG ARM is IDE 20 Pin Connector to interface with JTAG Debugger. The method to arrange circuit and signal under the standard of JTAG is shown in the figure below.

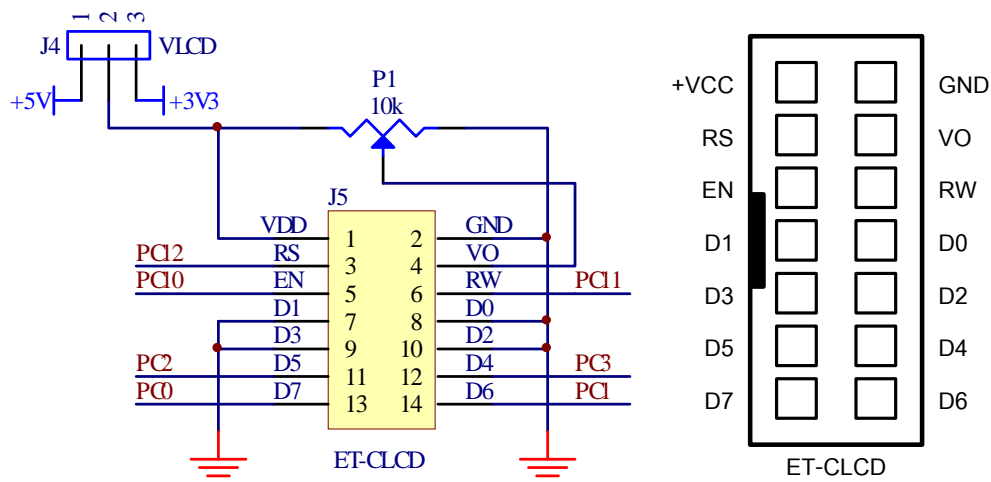


Application of Character LCD

LCD can be interfaced with Character Dot-Matrix LCD only in the format of 4 Bit Data Interface. It uses 7 Bit that is signal from PC[0..3] and PC[10..12] to interface with LCD. The method to connect signal cable from connector of Port LCD to LCD Display is to use the name of signal to be reference; moreover, user must connects all 14 signal cables corresponding with their names as shown in the picture below.

Connection between Signals and LCD

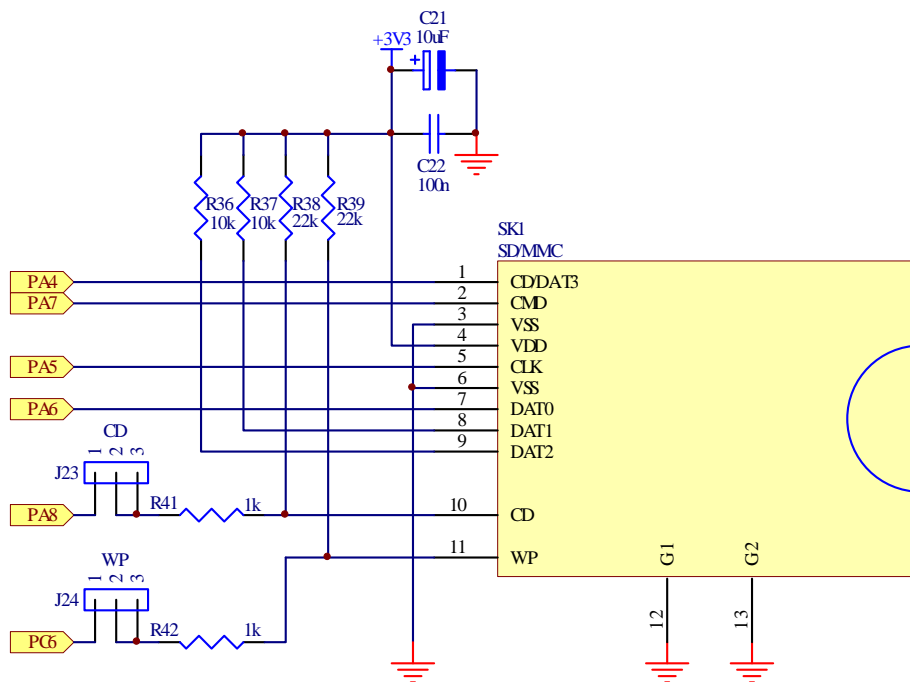
- DB4 = PC[3]
- DB5 = PC[2]
- DB6 = PC[1]
- DB7 = PC[0]
- RS = PC[12]
- RW = PC[11]
- EN = PC[10]



Application of SD Card Memory

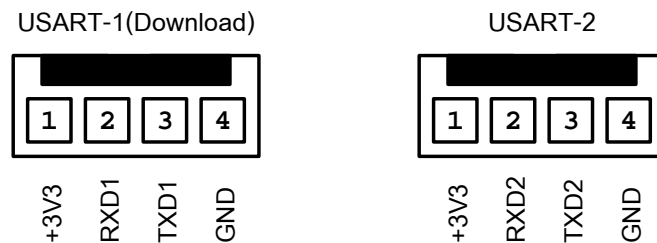
Board ET-STM32F103 supports the connection of SD Card Memory by using SPI Mode Interface; moreover, all circuits that are connected with SD Card use signal pins of function SPI1 and GPIO from MCU as follows;

- CD/DAT3 uses PA4(SPI1-SS).
- CLK uses PA5(SPI1-SCK).
- DAT0 uses PA6(SPI1-MISO).
- CMD uses PA7(SPI1-MOSI).
- CD uses PA8(GPIO) to check the insertion of memory card; if user does not need to use this pin, can set Jumper J23 on [2-3] to remove the connection between Pin PA8 and Pin CD(Card Detection) of SD Card.
- WP uses PC6 (GPIO) to check the setting of Write Protect of memory card; if user does not need to use this pin, can set Jumper J24 on [2-3] to remove the connection between Pin PC6 and Pin WP (Write Protect) of SD Card.



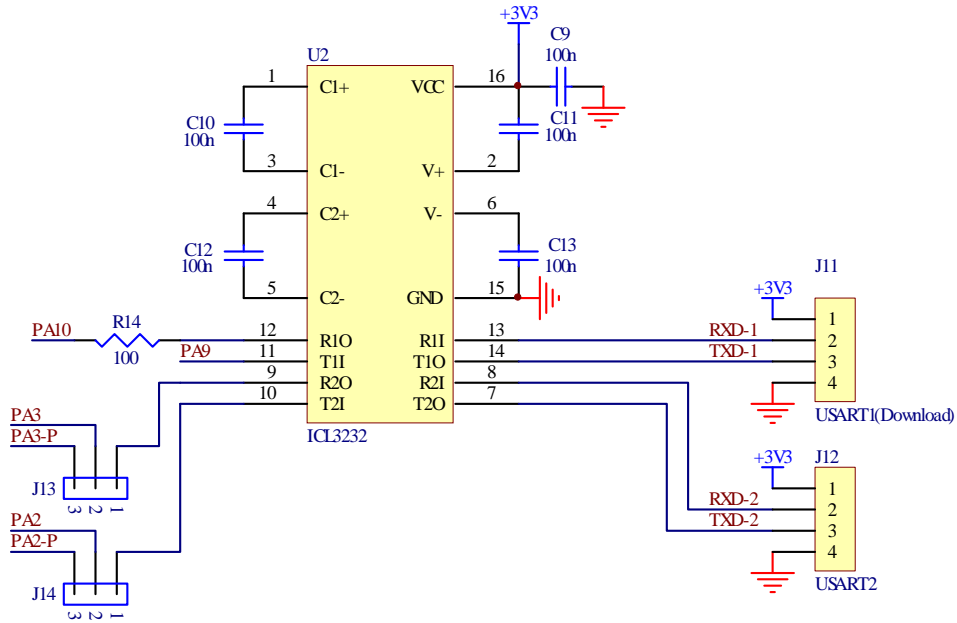
Application of RS232

Port RS232 is signal RS232 that has converted signal level of MAX3232. There are 2 channels; USART-1 and USART-2. Both channels can be used to connect with Signal RS232 to transmit-receive data. Moreover, USART-1 can be used to be ISP Download to download Hex File into MCU; in this case, it must be used with Jumper J1(BOOT1) SW-S1 (BOOT0) and SW-S2 (RESET) to reset CPU to start running in Boot Loader Mode to download Hex File into MCU (see more detail of "How to Download Hex File into MCU of Board").



- USART-1 uses signal pin from PA9(TXD1) and PA10(RXD1).
- USART-2 uses signal pin from PA2(TXD2) and PA3(RXD2).

PA2 and PA3 has Jumper J14 and J13 to select signal for using as either function USART2 or GPIO as shown in the figure below.



Cable that is used to connect signal RS232 between Comport of computer PC and USART-1 Connector and USART-2 Connector of Board ET-STM32F103 is shown as below;

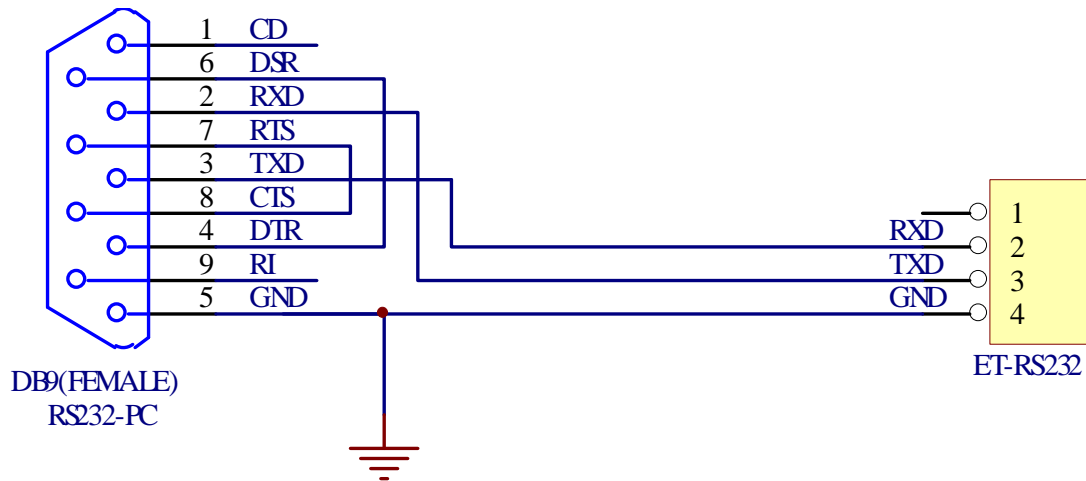
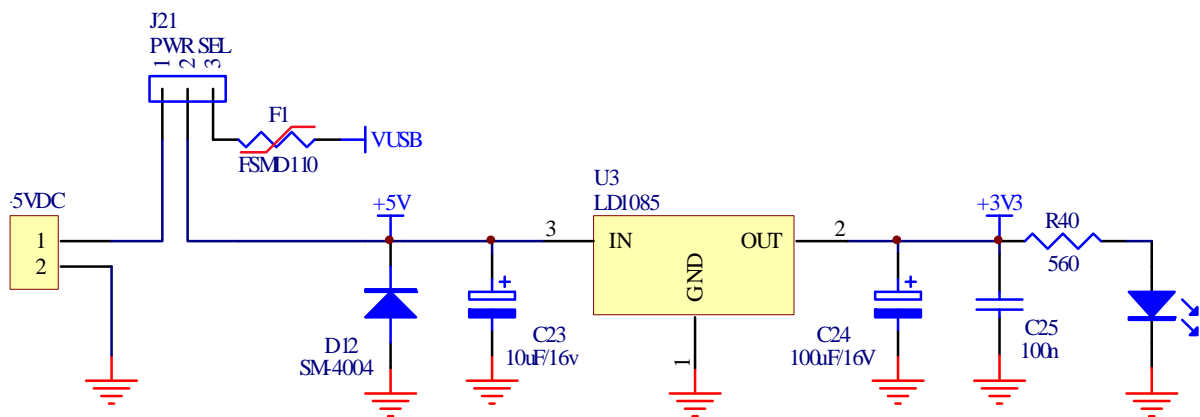


Figure displays circuit of signal cable for RS232.

Application of Power Supply

Power Supply Circuit can be used with +5VDC that can be set by Jumper J21 to use +5V either from USB or from external CPA-2PIN Connector. The Power Supply that is connected will be sent to +3V3/3A Regulate Circuit.

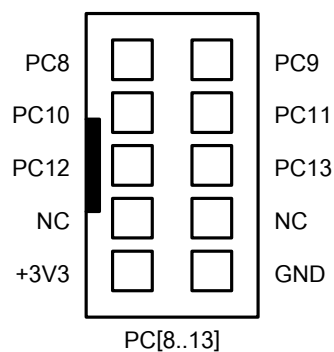
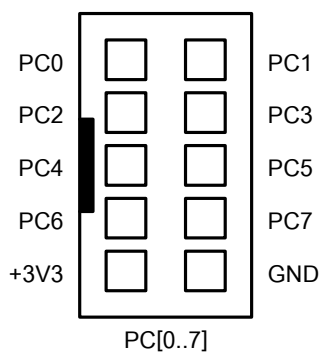
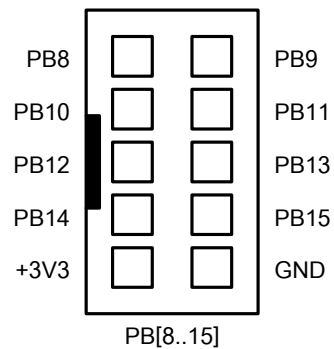
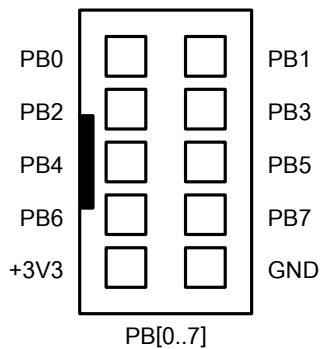
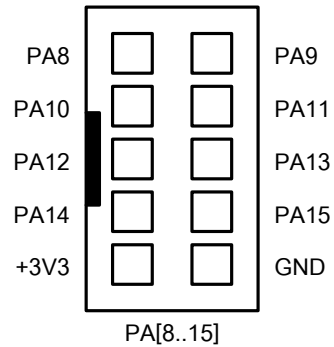
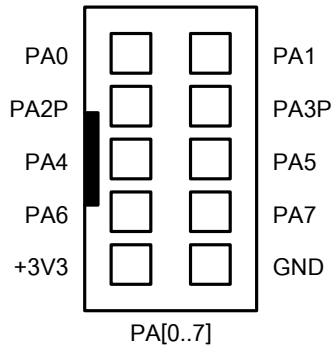
Power Supply Circuit in the part of 3.3V Regulate circuit must be supplied to CPU and all I/O circuits of board, except LCD that has Jumper J4, so it can be set to use Power supply either +3.3V or +5VDC.



Application of Port I/O Connectors on Board

Port I/O Connectors of CPU will be externally arranged to connector types, so it makes user can select and interface them easily. There are 6 sets as follows;

- 6 IDE 10 Pin Connectors and there are 8 Bit per each set. Signals are arranged as follows;

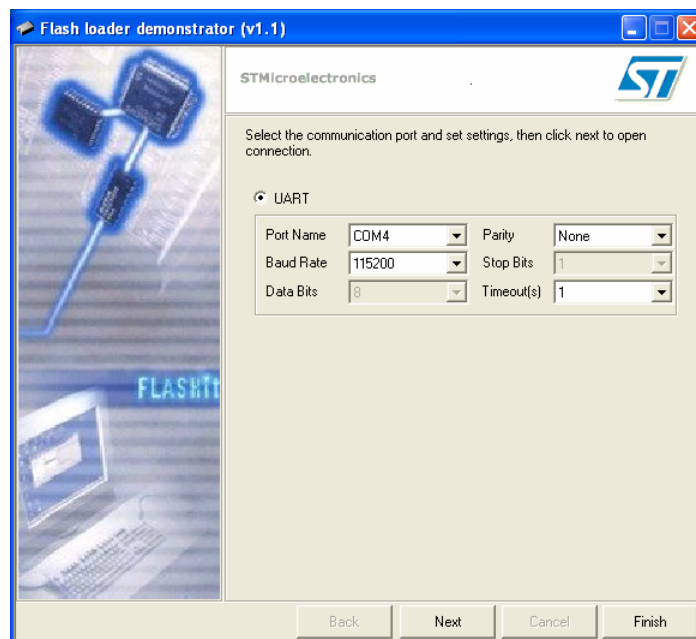


How to download Hex File into MCU of Board

The method to download Hex File into Flash Memory of MCU internal board is to use Program "Flash Loader" of "STMicroelectronics" that is connected with MCU through Serial Port of computer PC. This program can be downloaded free without any charge from www.st.com.

Procedures to download Hex File into MCU

1. Connect RS232 Cable between RS232 Serial Port Communication of PC and Board USART-1.
2. Supply power into board; in this case, LED PWR is in status ON.
3. Run Program Flash Loader; if it is version demo 1.1, it will display results as follows;



4. Set initial values for program as required; if using with STM32F103RBT6 of Board ET-STM32F103 from ETT, please set the values into program as follows;
 - 4.1 Set COM Port corresponding with the COM Port that is actually used (in the example, it is COM4).

4.2 Set Baud Rate in the range of 1200 - 115200; if computer has the problem or ERROR when setting the high Baud Rate, please reduce the Baud Rate. In this example, it uses 115200.

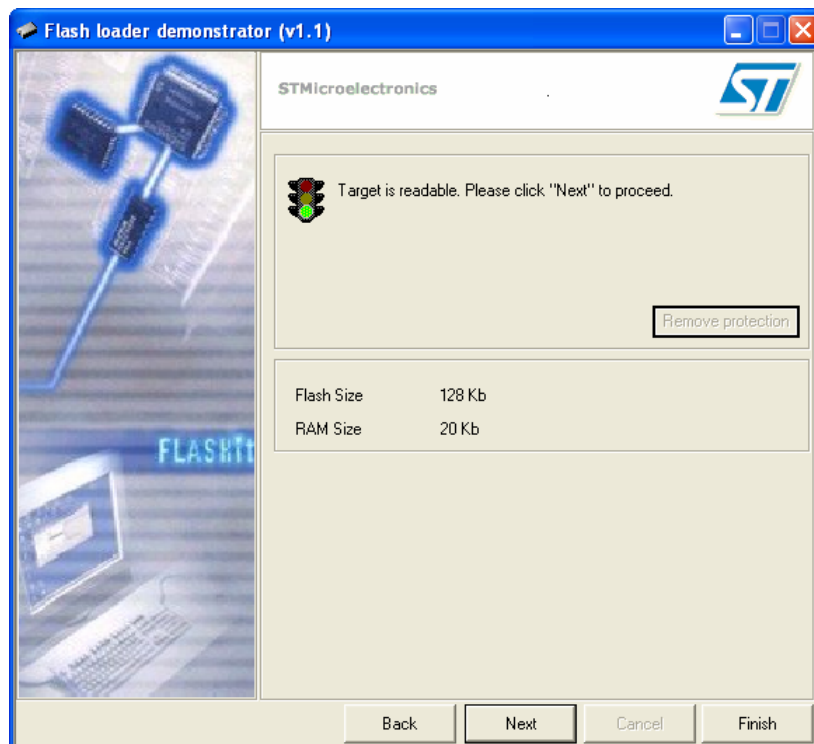
4.3 Set Parity Bit of Serial Port; in this case, we recommend setting it as None.

4.4 Set Timeout of communication; in the example, it is 1 second.

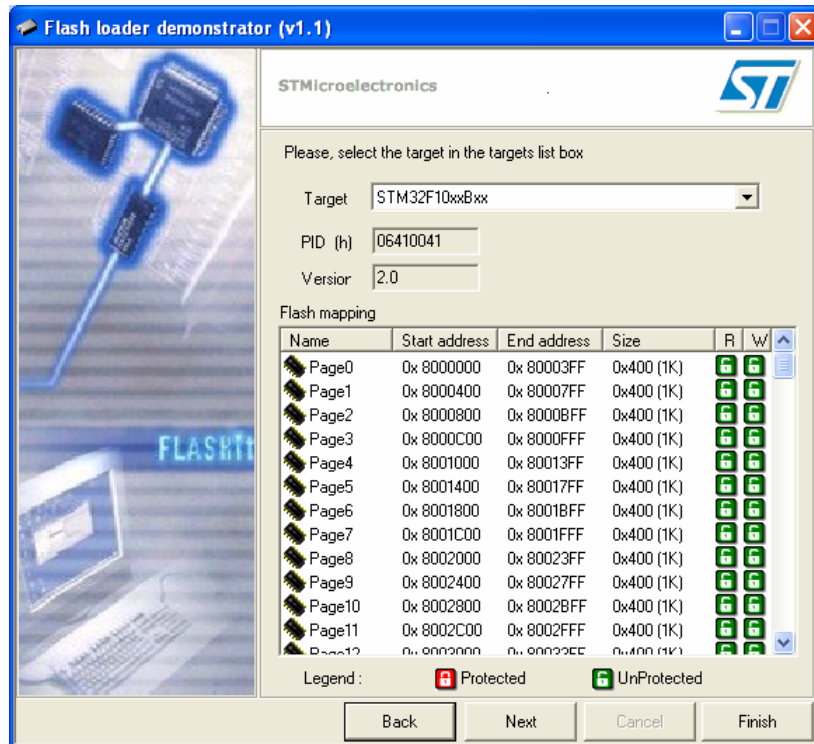
4.5 RESET MCU to run in Boot Loader, please follow these instructions;

- Set Jumper J1 on BOOT1 position.
- ON Switch S1(BOOT0), LED BL will be ON.
- Press Switch RESET and then remove, it makes CPU start running in Boot Loader.

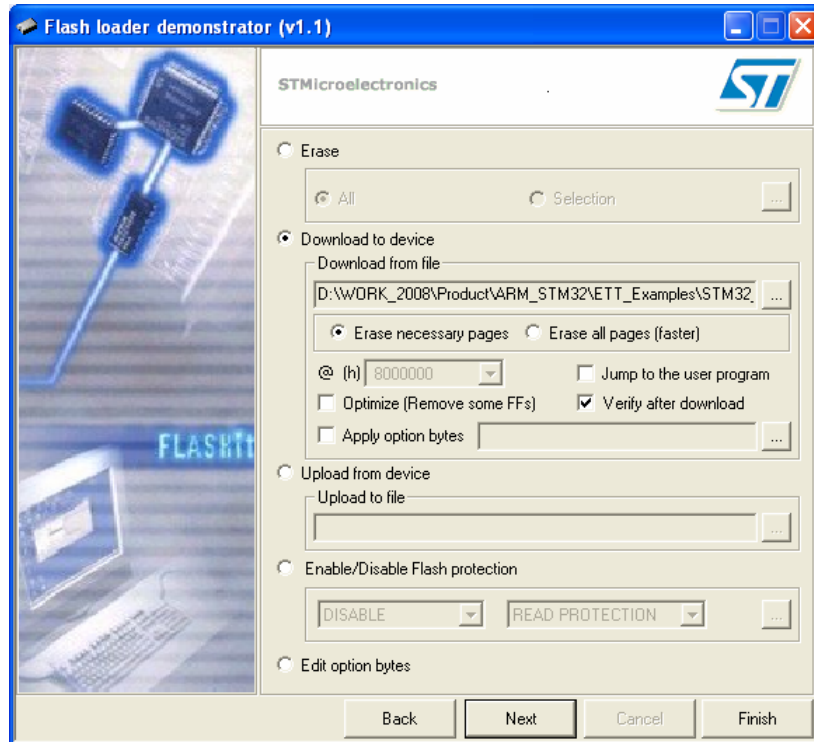
5. Click "**Next**" to start downloading; if everything is correct, program will read status from CPU and report the results. If using STM32F103RBT6, it displays result as shown in the picture below.



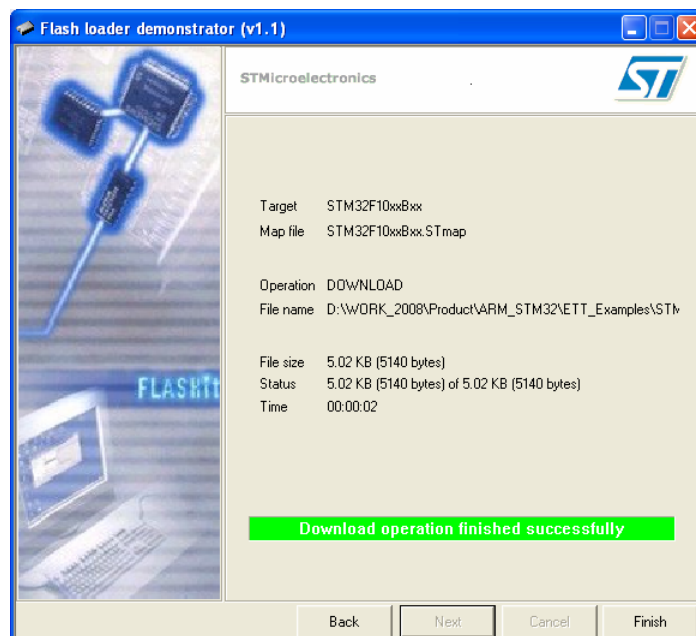
6. Click **"Next"**, Program Flash Loader starts displaying statuses that are read from MCU; if using STM32F103RBT6, it will display result as shown in the picture below;



7. Click **"Next"** to go to the next step.



8. Click **"Next"**, program starts downloading data into MCU instantly. User can notice the operation through Status Bar; in this case, user must wait until the operation of program is completely finished as shown in the picture below.



9. When the operation of program is completely, click "**Finish**" and OFF Switch BOOT0. In this case, LED BL is in status OFF, and then press Switch RESET on board, it makes MCU start running follows the downloaded program instantly.