1T 8051

8-bit Microcontroller

NuTiny-ML51EB User Manual

NuMicro® 8051 Series

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

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1 OVERVIEW

NuTiny-ML51EB is the specific development tool for 8-bit high performance 1T 8051-based microcontroller ML51 16K Flash size series. User can use NuTiny-ML51EB to develop and verify the application program easily.

The ML51 runs up to 24 MHz at a wide voltage range from 1.8V to 5.5V, and contains up to 64/32/16/8 Kbytes Flash called APROM for programming code. The ML51 Flash supports In-Application-Programming (IAP) function, which enables on-chip firmware updates. Partial Flash can be optionally configured as Data Flash programmed by IAP and read by IAP or MOVC instruction. The ML51 includes an additional configurable up to 4/3/2/1 Kbytes Flash area called LDROM, in which the Boot Code normally resides for carrying out the In-System-Programming (ISP). To facilitate mass production programming and verification, the Flash is allowed to be programmed and read electronically by parallel Writer/Programmer or In-Circuit-Programming (ICP) with Nu-Link. Once programmed and verified, the programmed code can be protected by the Flash lock mechanism for not being read out by any external programming tool.

The ML51 provides rich peripherals including 256 bytes of SRAM, 4/2/1 Kbytes of auxiliary RAM (XRAM), up to 43 general purpose I/O, two 16-bit Timers/Counters 0/1, one 16-bit Timer2 with three-channel input capture module, one Watchdog Timer (WDT), one Self Wake-up Timer (WKT), one 16-bit auto-reload Timer3 for general purpose or baud rate generator, two UARTs with frame error detection and automatic address recognition, two ISO7816 Smartcard interface, two SPI, two I^2C, 12 enhanced PWM output channels with dead zone control, two analog comparators, eight-channel shared pin interrupt for all I/O ports, and one 12-bit ADC at 500 ksps. There are a total of 30 sources with 4-level-priority interrupts capability.

The ML51 is equipped with four clock sources and supports on-the-fly clock switching via software control. The four clock sources include two sets of external crystal inputs (HXT, LXT), 38.4 kHz internal oscillator, and one 24 MHz internal high-precision ±2% oscillator. The ML51 provides additional power monitoring detection such as power-on reset and 7-level brown-out detection, which stabilizes the power-on/off sequence for a high reliability system design.

Through the high performance of 1T 8051 core, low power performance of ML51 and rich well-designed peripherals, the ML51 benefits for low-power, battery powered devices, general purpose, home appliances, or motor control system.

2 NUTINY-ML51EB INTRODUCTION

NuTiny-ML51EB uses the ML51EB9AE as the target microcontroller. Figure 2.1-1 is NuTiny-ML51EB for the ML51 16K Flash size series, the left portion is called NuTiny-EVB-ML51 and the right portion is Debug Adaptor called Nu-Link-Me.

NuTiny-EVB-ML51 is similar to other development boards. User can use it to develop and verify applications to emulate the real behavior. The on-board chip covers ML51 series features. The NuTiny-EVB-ML51 can be a real system controller to design user's target systems.

Nu-Link-Me is a Debug Adaptor. The Nu-Link-Me Debug Adaptor connects your PC's USB port to the user's target system (via Serial Wired Debug Port) and allows user to program and debug embedded programs on the target hardware. To use Nu-Link-Me Debug adaptor with Keil, please refer to "Nuvoton Nu-Link debug adapter user manual" in detail. This document will be stored in the local hard disk when user installs each driver. Nu-Link-Me also supports virtual COM port function. User can use Nu-Link-Me as a USB to UART virtual COM port, which connects to on-board ML51EB9AE UART0.

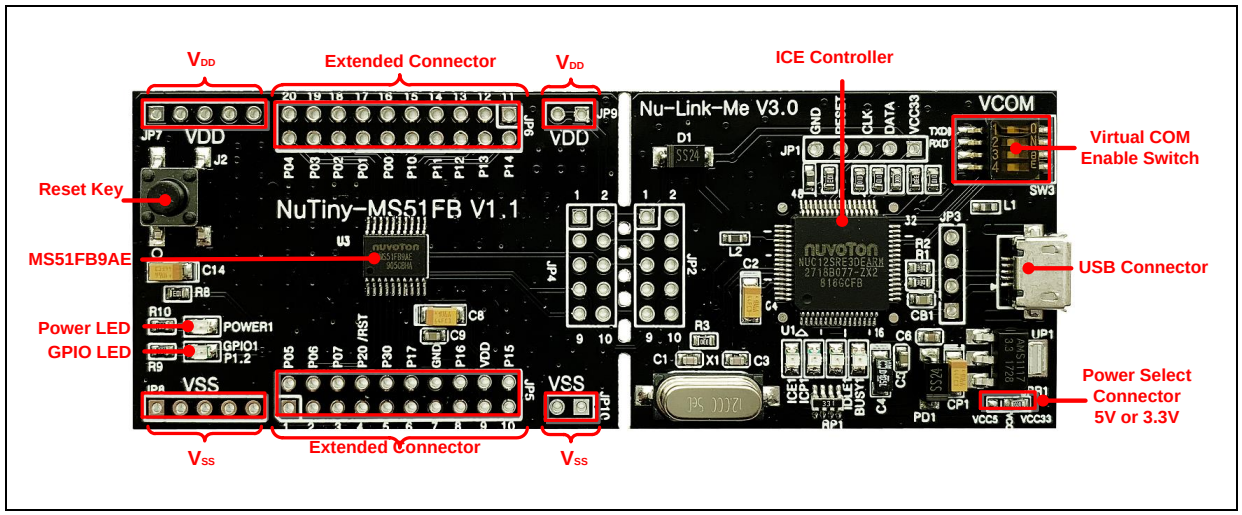


Figure 2.1-1 NuTiny-ML51EB (PCB Board)

2.1 Virtual COM Port Switch Description

The switch in Nu-Link-Me, SW3, determines that the virtual COM port function is enabled or disabled. When user turns on all of the positions of switch, the virtual COM port function will be enabled. By using virtual COM port function, user can access the USB device in the same way as it would access a standard COM port to ML51EB9AE UART0 (P3.1 and P3.0) . To use this function, user needs to install "VCOM Driver" at first. User can get "Nuvoton USB driver" from NuMicroDVD www.nuvoton.com\NuMicroDVD in folder "Software Utilities" or from website: Nu-Link_USB_Driver

2.2 NuTiny-ML51EB Power Setting and Connector

2.2.1 Power Setting

- J1: USB port in Nu-Link-Me
- J5 and J2: V_{DD} in Voltage connector in NuTiny-ML51EB

Model	JPR1	J1USB Port	JP7 & JP9 VCC33	MCU Voltage
Model 1	Select VCC33 (default)	Connect to PC	DC 3.3V output	DC 3.3V
Model 2	Select VCC5	Connect to PC	DC 5V output	DC 5V
Model 3	X	X	DC 1.8 V ~ 5.5 V Input	Voltage from J5 & J2 input

2.2.2 Debug Connector

- JP5: Connector in target board (NuTiny-EVB-ML51) for connecting with Nuvoton ICE adaptor (Nu-Link-Me)
- JP6: Connector in ICE adaptor (Nu-Link-Me) for connecting with a target board (for example NuTiny-EVB-ML51)

2.2.3 ICE USB Connector

- J1: Mini USB Connector in Nu-Link-Me connected to a PC USB port

2.2.4 Extended Connector

- JP5 and JP7: Show all chip pins in NuTiny-EVB-ML51

2.2.5 Reset Button

- SW1: Reset button in NuTiny-EVB-ML51

2.2.6 Power Connector

- J5:1.8V ~ 5.5V VCC connector in NuTiny-EVB-ML51
- J2: V_{SS} connector in NuTiny-EVB-ML51

2.2.7 Virtual COM Port Function Switch

- SW3: Switch ON/OFF to enable or disable Nu-Link-Me virtual COM port function.

Function	Switch				Descriptions
	1	2	3	4	
Enable	ON	ON	ON	ON	Enable Nu-Link-Me virtual COM port function
Disable	OFF	OFF	OFF	OFF	Disable Nu-Link-Me virtual COM port function

2.3 Pin Assignment for Extended Connector

NuTiny-EVB-ML51 provides ML51EB9AE on board and the extended connector for TSSOP-20 pin. is the pin assignment for ML51AT20.

Pin No	Pin Name And Function
01	I2C1_SCL / P1.4
02	I2C1_SDA / P1.5
03	UART0_TXD / P1.6
04	UART0_RXD / P1.7
05	VSS
06	INT0 / CLKO / TM0 / PWM0_CH0 / PWM1_BRAKE / P4.6
07	V_{DD}
08	CLKO / TM2_EXT1 / PWM1_CH1 / UART3_RXD / SPI1_CLK / ACMP1_N1 / ADC_CH7 / P3.2
09	TM2_EXT2 / PWM1_CH2 / UART0_TXD / UART3_TXD / SPI1_MISO / ACMP1_P3 / ACMP0_P3 / ADC_CH6 / P3.1
10	TM2_EXT0 / PWM1_CH3 / UART0_RXD / SPI1_MOSI / P3.0
11	V_{REF}
12	INT0 / T0 / UART2_TXD / PWM0_CH0 / I2C0_SCL / ACMP1_P0 / ACMP0_P0 / ADC_CH0 / P2.5
13	INT1 / T1 / UART2_RXD / PWM0_CH1 / I2C0_SDA / ACMP0_N0 / ADC_CH1 / P2.4
14	PWM0_BRAKE / PWM0_CH2 / UART1_TXD / I2C1_SCL / ACMP1_P1 / ACMP0_P1 / ADC_CH2 / P2.3
15	P2.2 / ADC_CH3 / ACMP1_N0 / I2C1_SDA / UART1_RXD / PWM0_CH3
16	P2.1 / ADC_CH4 / ACMP1_P2 / ACMP0_P2 / UART2_TXD / I2C1_SCL / PWM0_CH4 / PWM1_CH4 / PWM0_BRAKE
17	P2.0 / ADC_CH5 / ACMP0_N1 / UART2_RXD / I2C1_SDA / PWM0_CH5 / PWM1_CH5 / PWM0_BRAKE
18	P5.3 / UART0_TXD / I2C0_SCL / XT1_IN
19	P5.2 / UART0_RXD / I2C0_SDA / XT1_OUT
20	P0.3 / SPI0_SS / SPI1_SS / UART1_TXD / I2C1_SCL / PWM0_CH2 / CLKO / PWM1_BRAKE
21	P0.2 / SPI0_CLK / SPI1_CLK / UART1_RXD / I2C1_SDA / PWM0_CH3
22	P0.1 / SPI0_MISO / SPI1_MISO / UART0_TXD / PWM0_CH4
23	P0.0 / SPI0_MOSI / SPI1_MOSI / UART0_RXD / PWM0_CH5
24	nRESET
25	P5.0 / UART1_TXD / I2C1_SCL / UART0_TXD / ICE_DAT
26	P5.1 / UART1_RXD / I2C1_SDA / UART0_RXD / ICE_CLK
27	P4.1 / UART2_TXD / I2C0_SCL / PWM1_CH4 / ACMP0_O
28	P4.0 / UART2_RXD / I2C0_SDA / PWM1_CH5 / ACMP1_O

Table 2.3-1 Pin Assignment for ML51EB9AE

3 HOW TO START NUTINY-ML51EB ON THE KEIL

3.1 Downloading and Installing Keil C-51 µVision® IDE Software

Please connect to the Keil company website (http://www.keil.com) to download the Keil C-51 µVision® IDE and install the RVMDK.

3.2 Downloading and Installing Nuvoton Nu-Link Driver

Please connect to Nuvoton 8bit 8051 MCUs website (http://www.nuvoton.com/8bit-8051-mcus) to download the "Nu-Link_Keil-Driver" file. Please refer to section 5.1 for the detailed download flow. After the Nu-Link driver is downloaded, please unzip the file and execute the file to install the driver.

3.3 Hardware Setup

The hardware setup is shown as Figure 3.3-1

Figure 3.3-1 NuTiny-ML51EB Hardware Setup

3.4 Example Program

This example demonstrates the ease of downloading and debugging an application on a NuTiny-ML51EB board. It can be found on Figure 3.4-1 list directory and downloaded from Nuvoton 8bit 8051 MCUs website.

The example file can be found in the directory list shown in Figure 3.4-1.

Directory

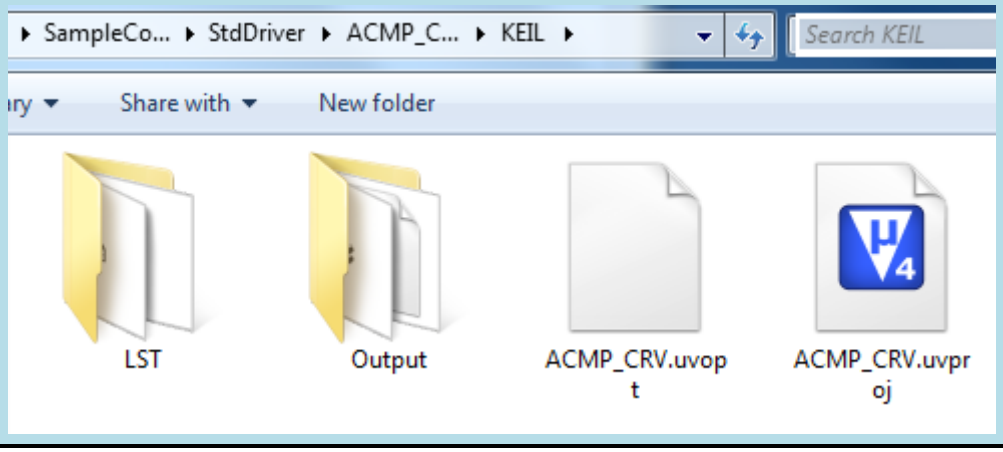


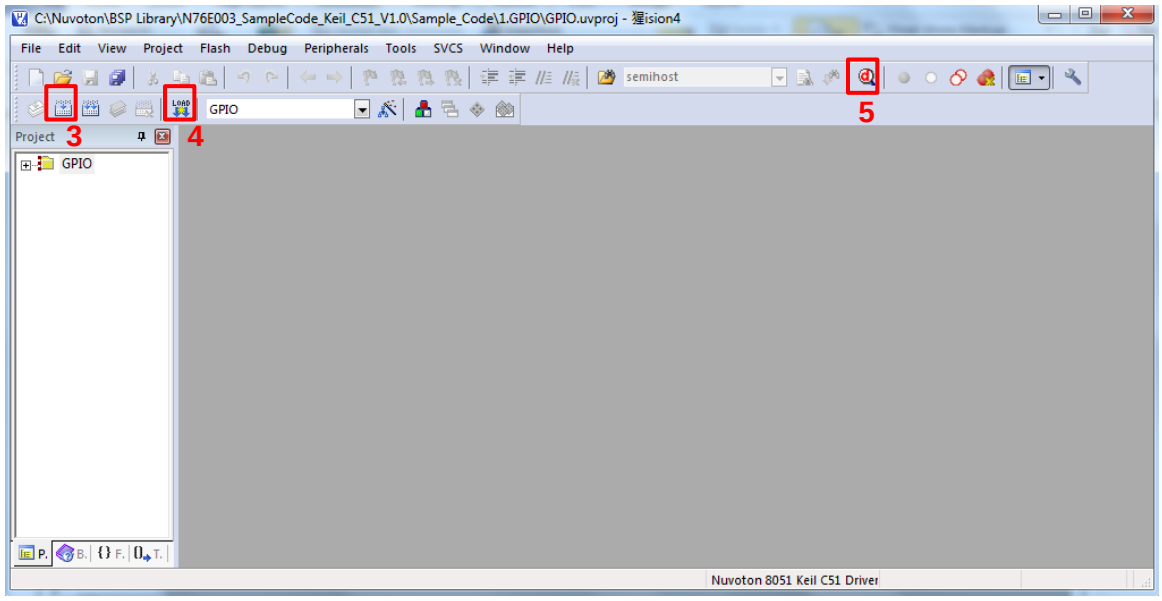
Figure 3.4-1 Example Directory

To use this example:

1. Open a project from the ML51 sample code installation folder (default as C:\Nuvoton) using the following path：

   \SampleCode\StdDriver\GPIO_InputOutput\KEIL\

2. Execute “**GPIO.uvproj**”

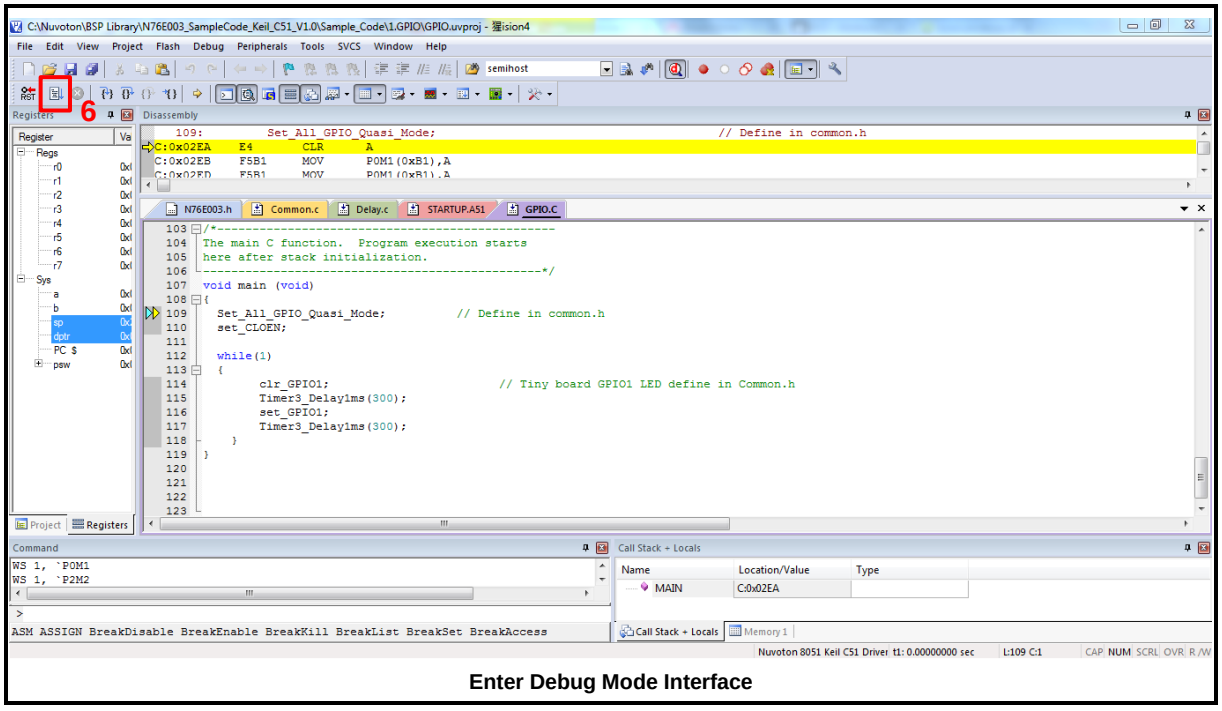


Enter Compile Mode Interface

3.  Compiler

4.  Download the program code to Flash

5.  Enter / Exit Debug mode

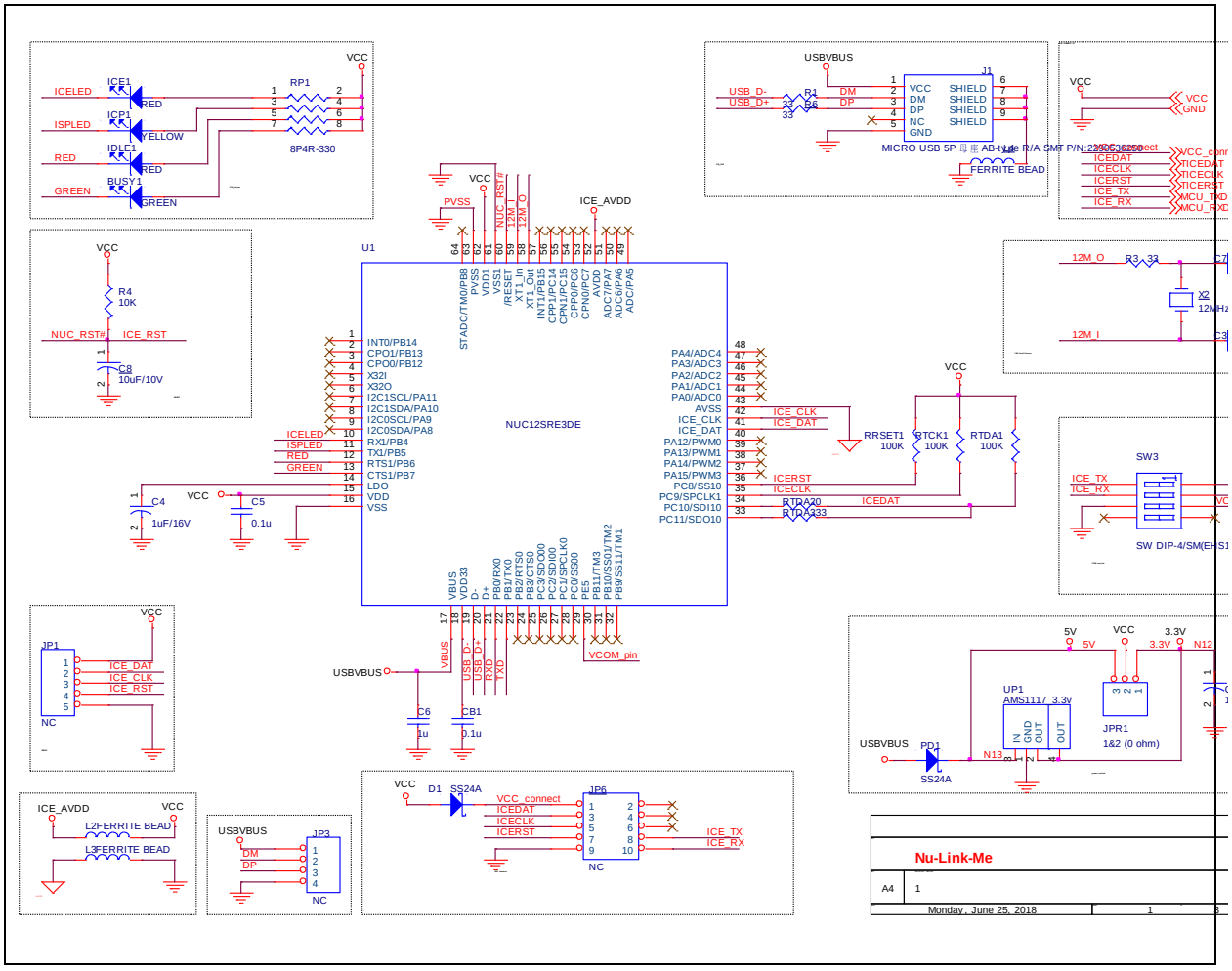


Enter Debug Mode Interface

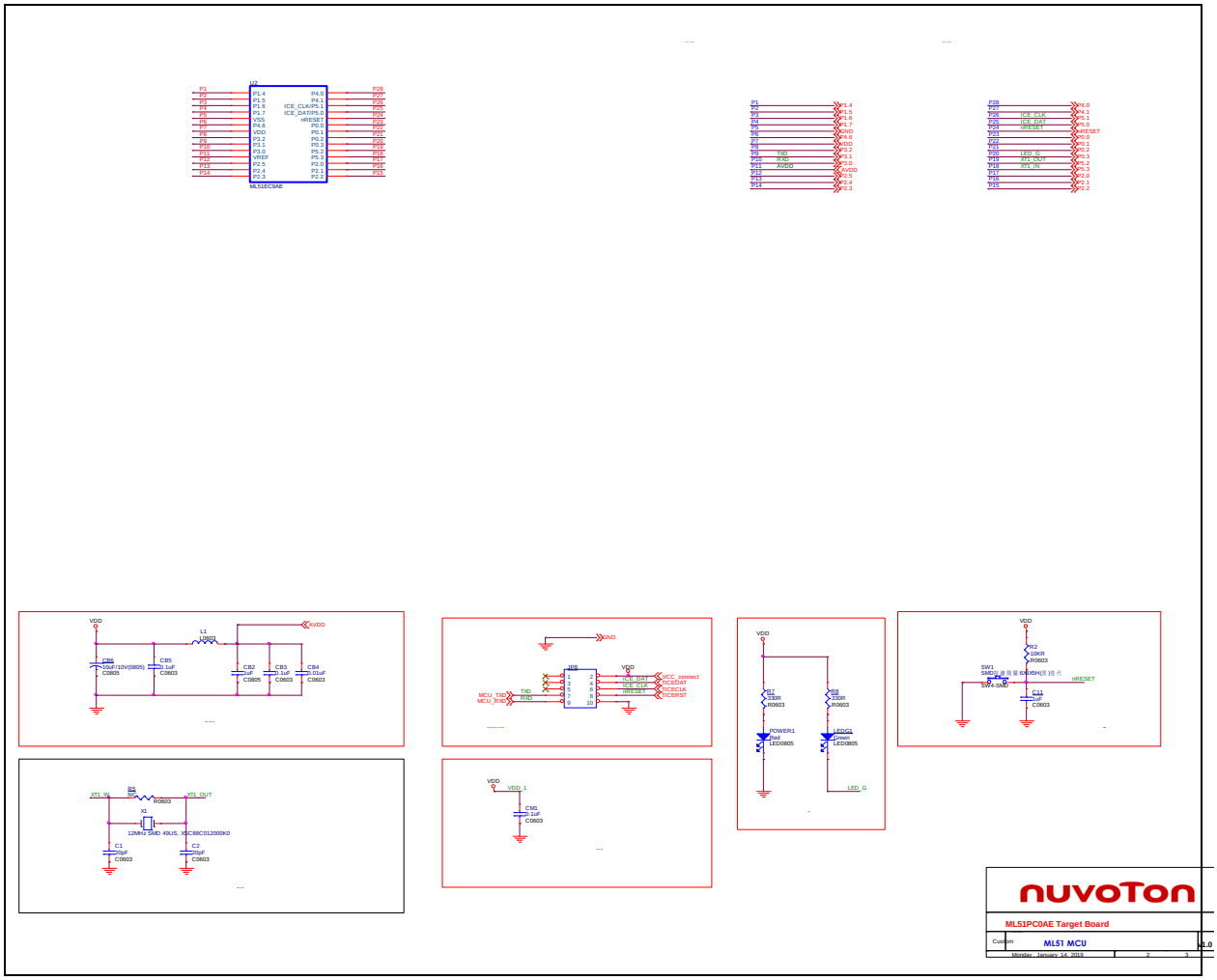
6.  Execute the program
7. The I/O LED on the NuTiny-ML51EB board will be toggled on.

4 NUTINY-ML51EB SCHEMATIC

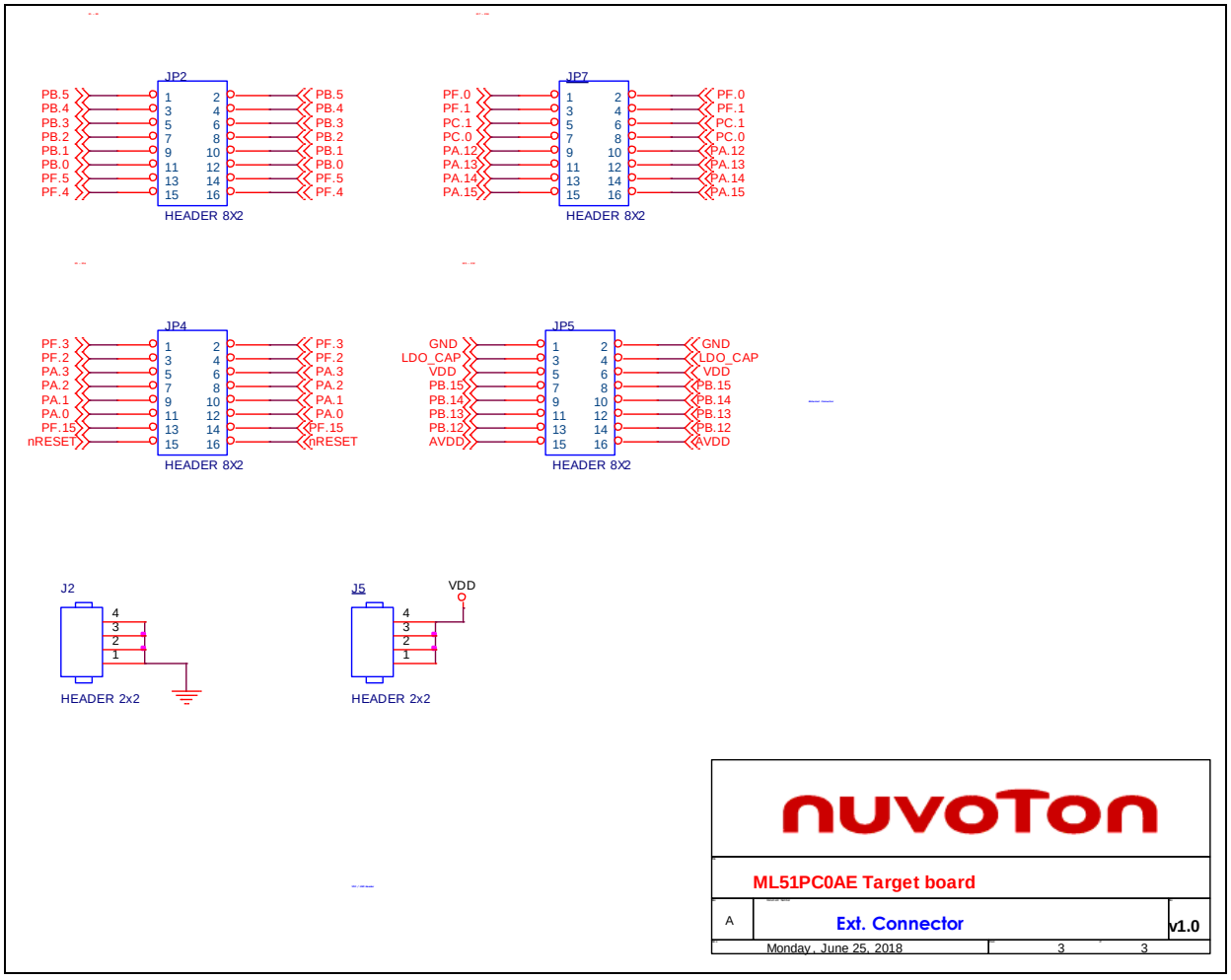
4.1 Nu-Link-Me Schematic



4.2 NuTiny-ML51EB Schematic

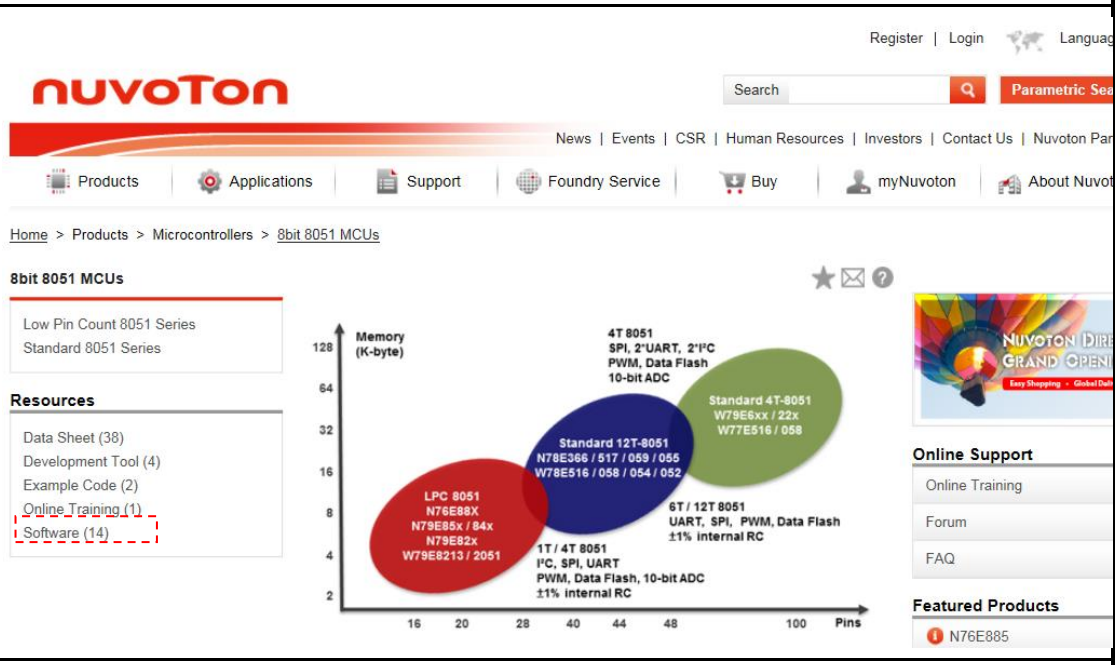


4.3 NuTiny-ML51EB Connector



5 DOWNLOAD RELATED FILES FROM NUVOTON WEBSITE

5.1 Downloading Nuvoton Keil C-51 µVision® IDE Driver

Step1	**Visit The Nuvoton 8bit 8051 MCUs Website: HTTP://WWW.NUVOTON.COM/8BIT-8051-MCUS**
Step2	
Step3	
Step4	Download the Nuvoton_Keil- Drive

5.2 Downloading Nuvoton 8bit 8051 MCUs ML51 Series Sample Code

Step1	**Visit The Nuvoton 8bit 8051 MCUs Website: HTTP://WWW.NUVOTON.COM/8BIT-8051-MCUS**
Step2	
Step3	Download the ML51_BSP_ C51_V1.0

6 REVISION HISTORY

Date	Revision	Description
2019.01.29	1.00	Initial release

Important Notice

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