ARM® Cortex®-M

32-bit Microcontroller

NuMicro™ Family
Nu-LB-M451
User Manual

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www.nuvoton.com

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1 OVERVIEW

The Nu-LB-M451 is a specific evaluation board for NuMicro™ M451 series, and integrates ICE equipment, SPI flash, I2C EEPROM, SPI LCD panel, WAU8822, CAN transceiver, RS485 transceiver, MPU6050 and so on to provide a complete development environment. User can use Nu-LB-M451 to learn and verify the application program and peripherals easily. Therefore, user does not need other additional ICE or debug equipment.

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2 INTRODUCTION TO NU-LB-M451

The Nu-LB-M451 uses the M453VG6AE as the target microcontroller. Figure 2-1 shows the Nu-LB-M451 for M451 series which includes Nu-Link and versatile external devices.

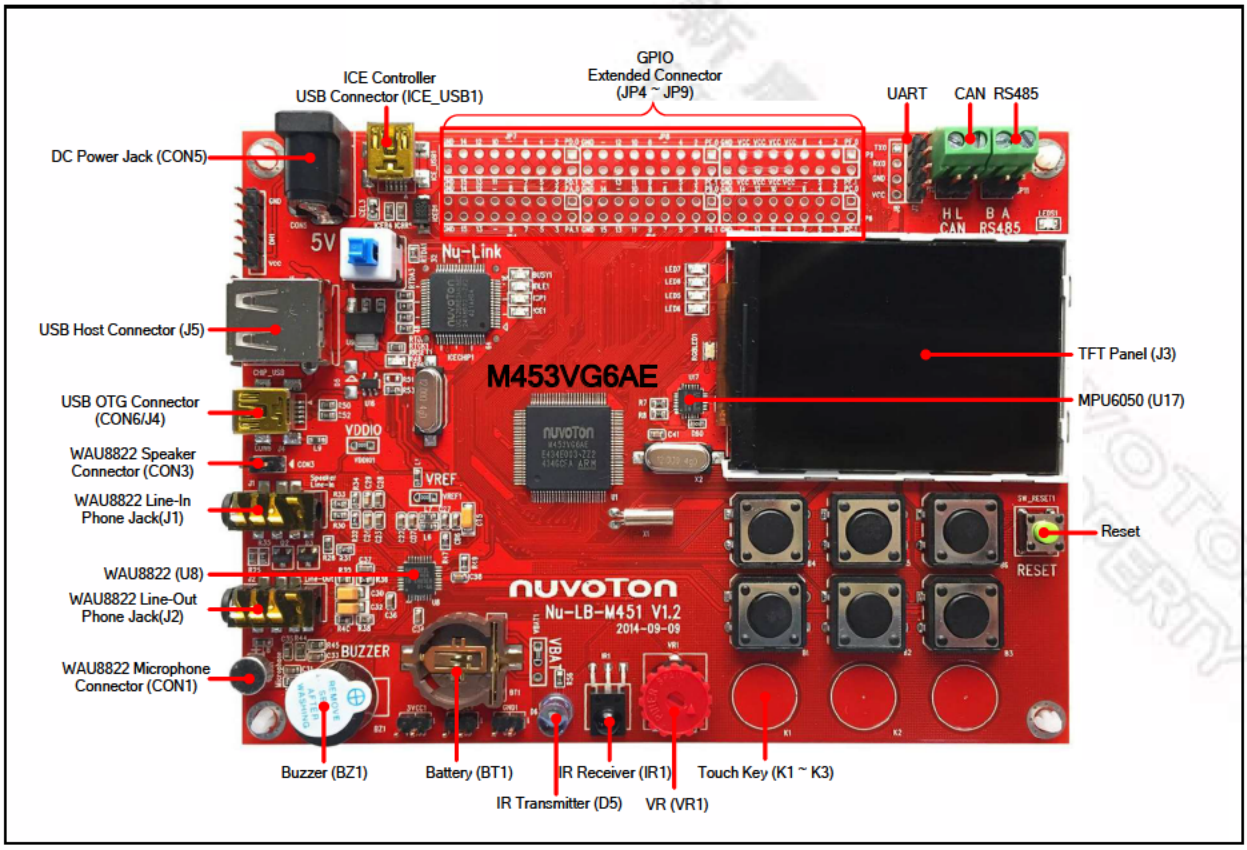


Figure 2-1 Nu-LB-M451 (Red PCB Board)

The Nu-Link is a Debug Adaptor, which connects your PC's USB port to your target system (via Serial Wired Debug port) and allows you to program and debug embedded programs on the target hardware. To use the Nu-Link Debug Adaptor with IAR or Keil, please refer to the "*Nuvoton NuMicro™ IAR ICE Driver User Manual*" or "*Nuvoton NuMicro™ Keil ICE Driver User Manual*" for details. The two documents will be stored in the local hard disk when each driver is installed.

The following lists the main external devices and connectors of the Nu-LB-M451 board:

(1) Target Chip: M453VG6AE, which can run up to 72MHz operating speed.

(2) Nu-Link ICE Bridge, which supports Keil RVMDK, IAR EWARM and Coocox CoIDE.

(3) 5V DC Power Jack, which is only connected to 5V power adapter.

(4) 3.3V LDO, which supports M453VG6AE and on-board devices.

(5) GPIO Extended Connector, which supports all the GPIO pins interface.

(6) Audio Connectors, which are connected to WAU8822 audio CODEC for I2S application.

(7) I2C EEPROM, which is 24LC64 I2C EEPROM.

(8) G and GYRO Sensor, which is MPU6050 for Motion Tracking

(9) SPI Flash, which is 25Q16 SPI serial FLASH for data storage.

(10) SD Card Slot, which is connected to SPI interface for SD card access.

(11) TFT LCM panel, which supports 320*240 dots color display via SPI interface.

(12) Touch Pads, which has 3 touch pads on PCB.

(13) Button, which has 6 buttons

(14) CAN connector, which is connected to CAN transceiver for CAN application.

(15) RS485 connector, which is connected to RS485 transceiver for RS485 application.

(16) USB Host connector, which is connected 5V power switch and target chip except USB_ID for USB Host application.

(17) USB OTG connector, which is connected 5V power switch and target chip for USB device, Host and OTG application.

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2.1 Nu-LB-M451 System Description

2.1.1 Power setting

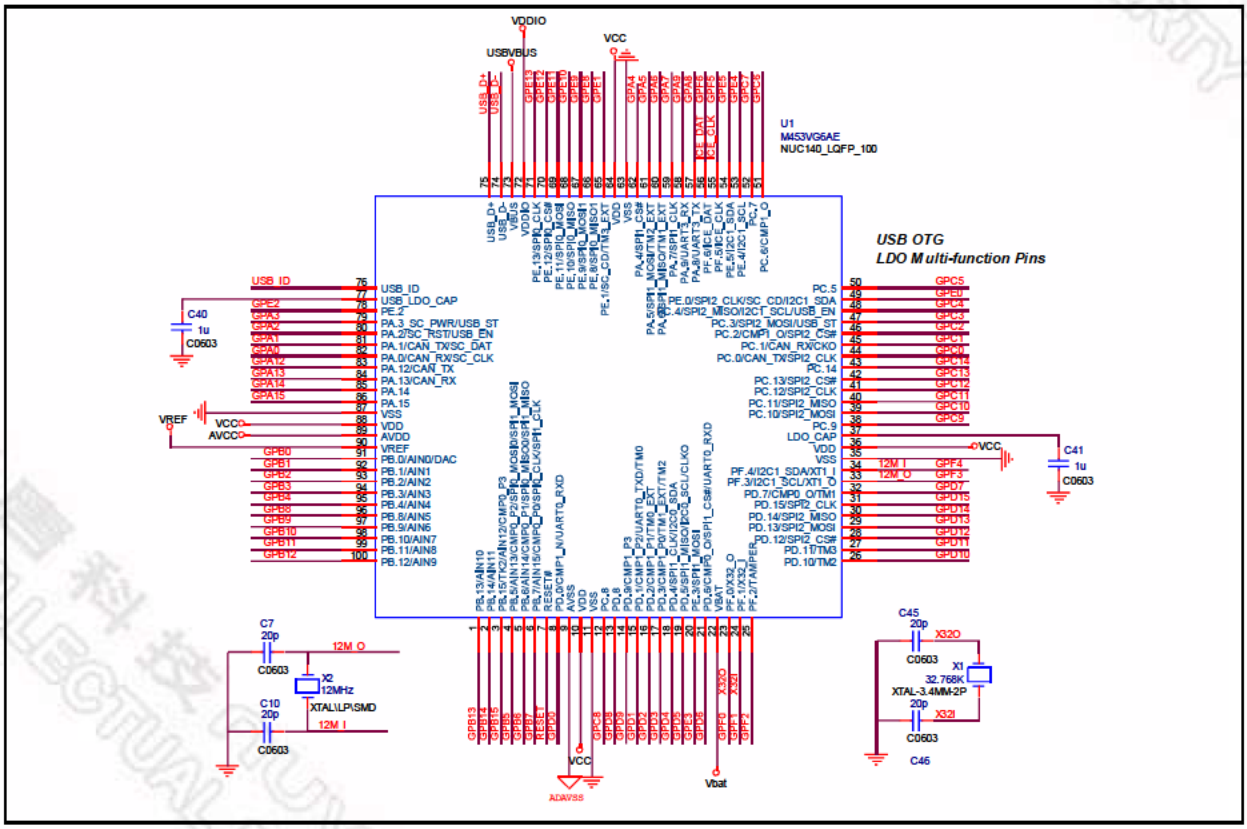
- **ICE_USB1**: The USB port of Nu-Link-Me.
- **CON6/J4**: The USB port of M453VG6AE.
- **CON5**: The 5V voltage connector.

Power Mode	ICE_USB1 USB Port (Mini)	CON6/J4 USB Port (Mini/Micro)	CON5	MCU Voltage	Comment
Mode 1	Connected to PC	Connected to USB Device or Host.	X	DC 3.3V	Nu-LB-M451 includes a 3.3v LDO to supply system voltage for 3.3v device.
Mode 2	X	Connected to PC (USB port is device)	X	DC 3.3V	
Mode 3	X	Connected to USB Device or Host.	DC 5V Input	DC 3.3V	

X: Unused.

2.1.2 Target Chip

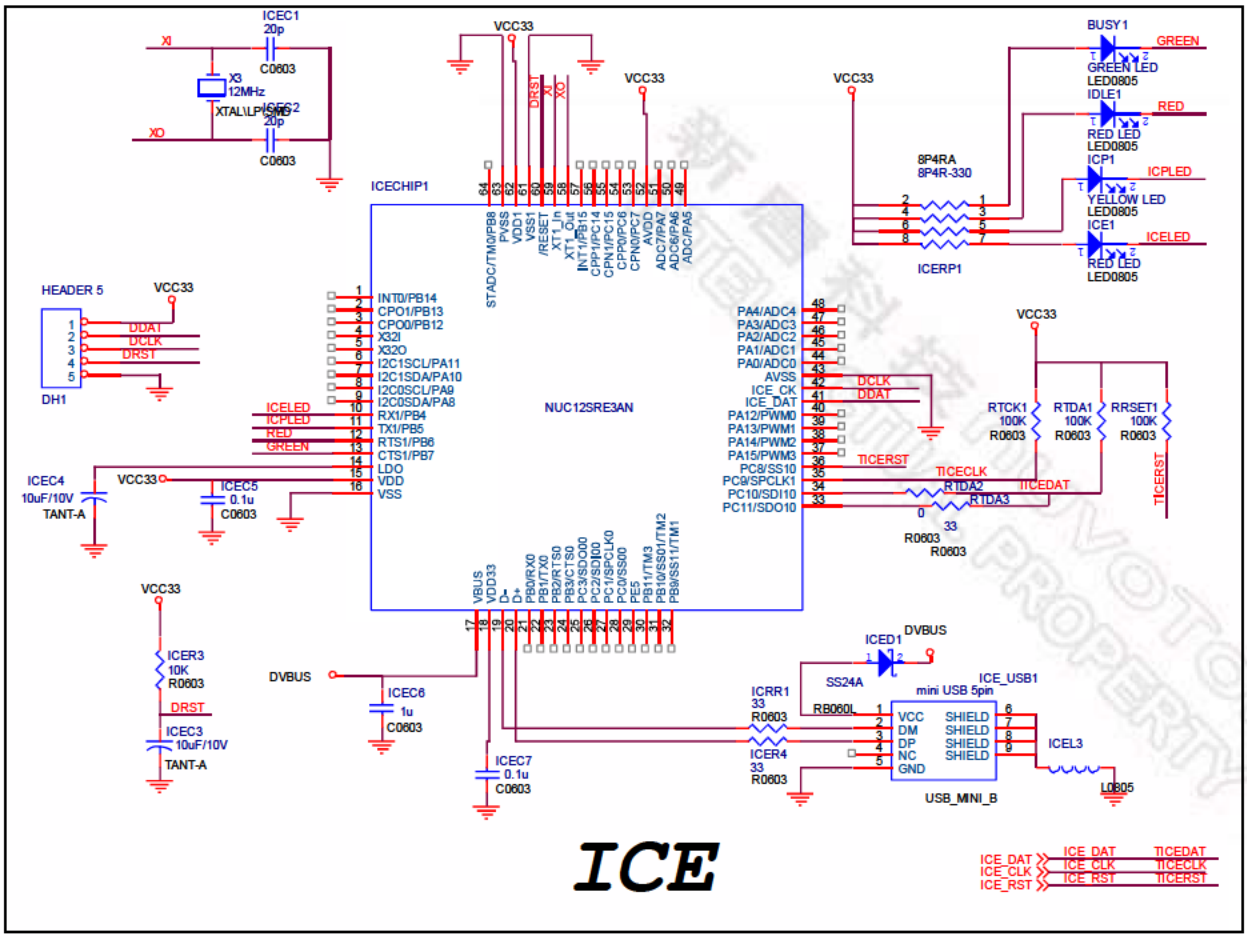
- **U1**: M453VG3AE.



2.1.3 USB connector of Nu-Link

- **ICE_USB1**: The Mini USB connector of Nu-Link connected to a PC USB port.

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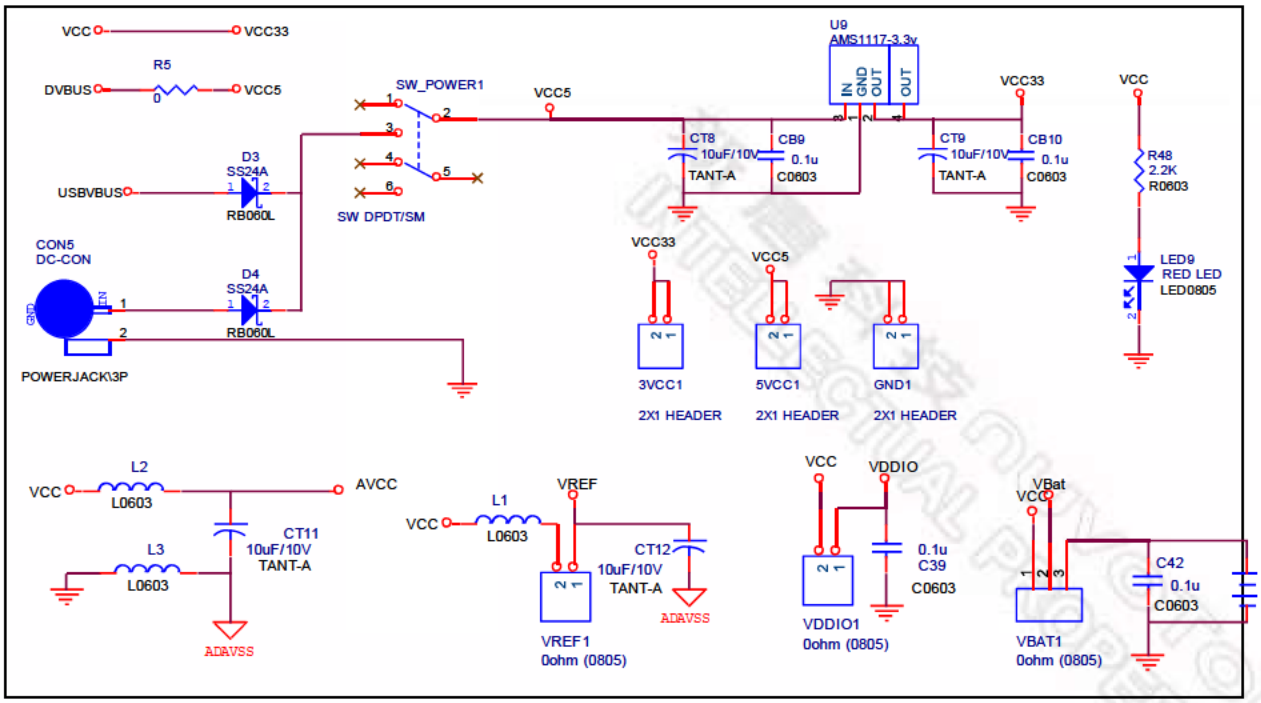


2.1.4 Power Connectors

- **CON6/J4**: The USB OTG connector of target chip to supply target chip voltage from USB line for device mode.
- **VBAT**: The VBAT connector to supply an extra battery power for PF.0, PF.1, PF.2 and RTC application. The default is shorted with VCC33.
- **VREF**: The VREF connector to supply an external reference voltage for analog peripherals. The default is shorted with VCC33.
- **VDDIO**: The VDDIO connector to supply a special voltage for PE.8 - PE.13. The default is shorted with VCC33.
- **CON5**: The VCC5V connector to supply target chip voltage from an extra power supplier.

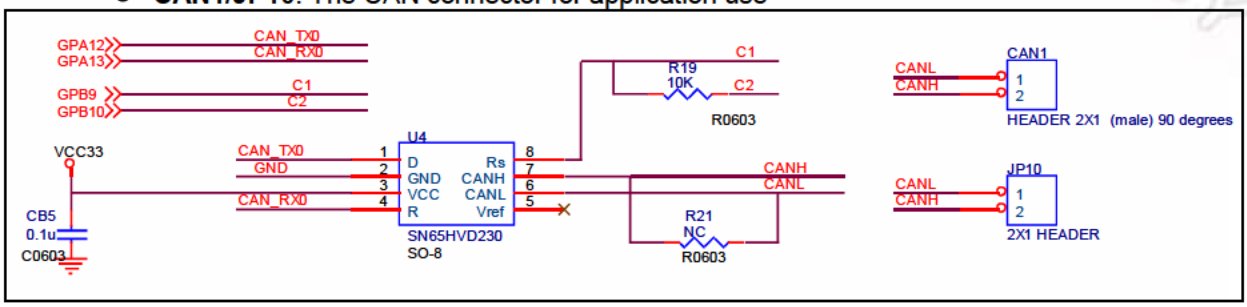
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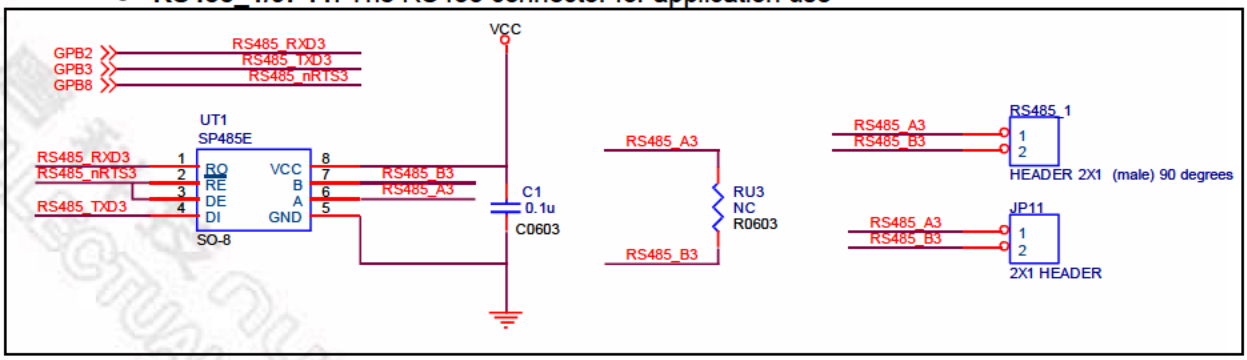
2.1.5 CAN Connector

- **CAN1/JP10**: The CAN connector for application use



2.1.6 RS485 Connector

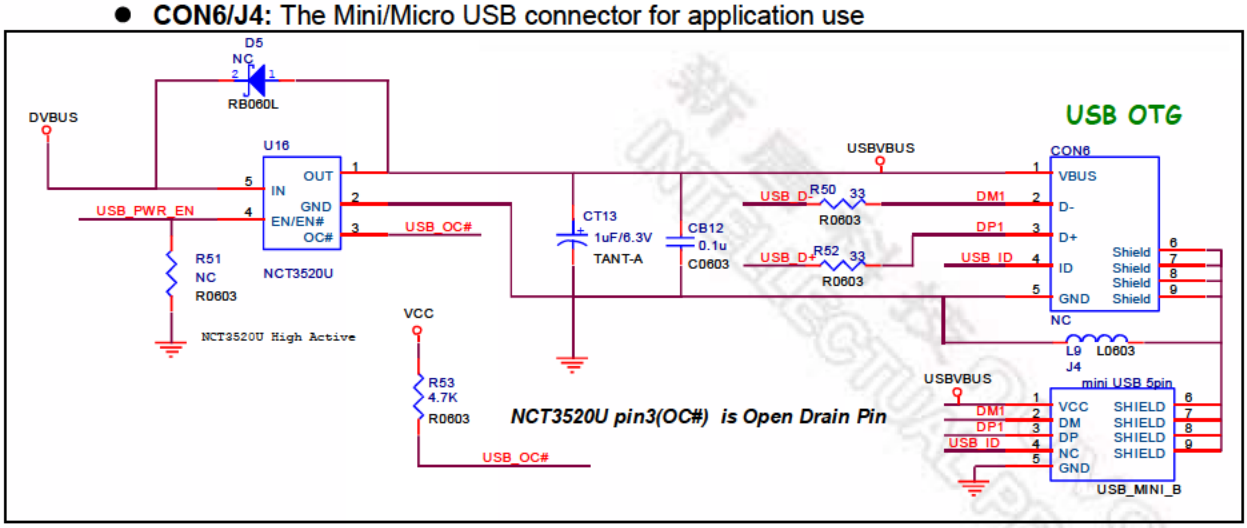
- **RS485_1/JP11**: The RS485 connector for application use



NU-LB-M451 USER MANUAL

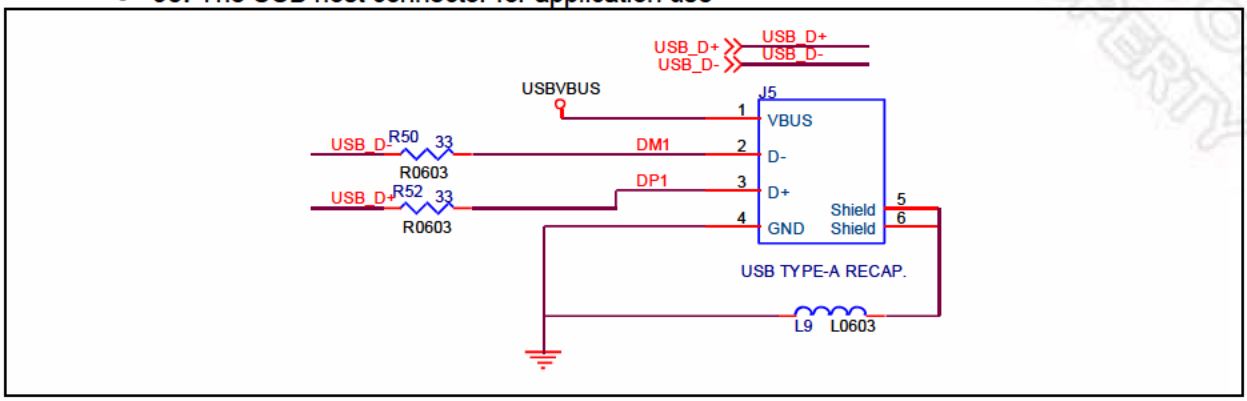
2.1.7 USB OTG Host/Device Connector

- **CON6/J4:** The Mini/Micro USB connector for application use



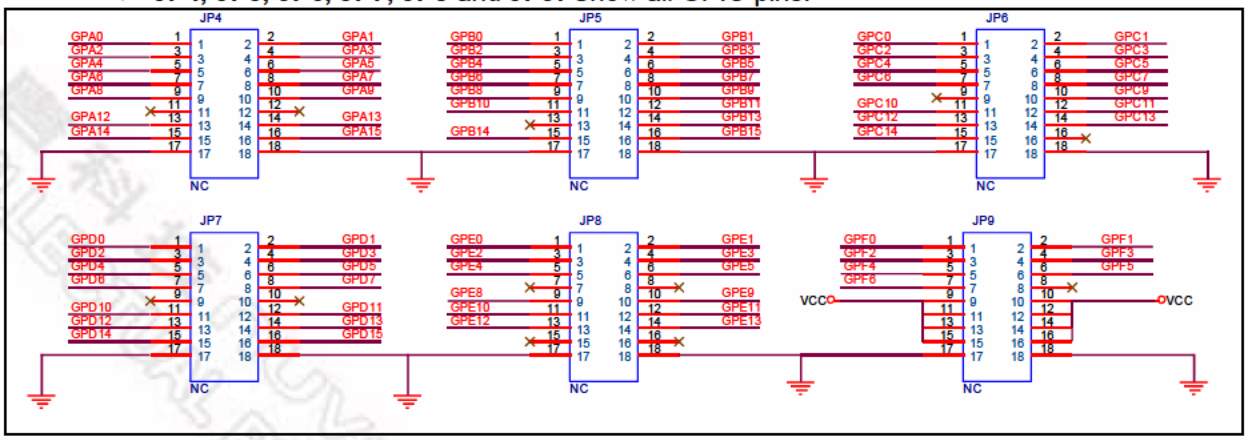
2.1.8 USB Host Connector

- **J5:** The USB host connector for application use



2.1.9 Extended Connectors

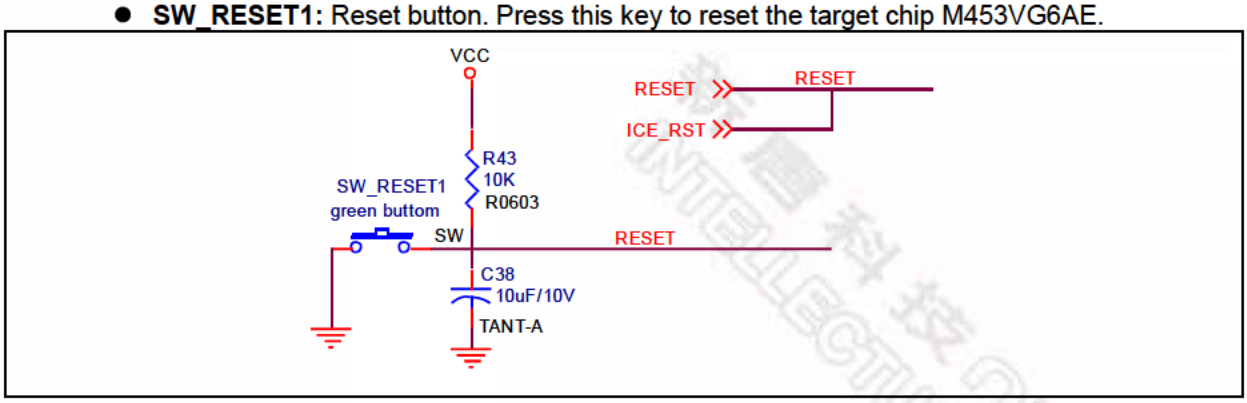
- **JP4, JP5, JP6, JP7, JP8** and **JP9:** Show all GPIO pins.



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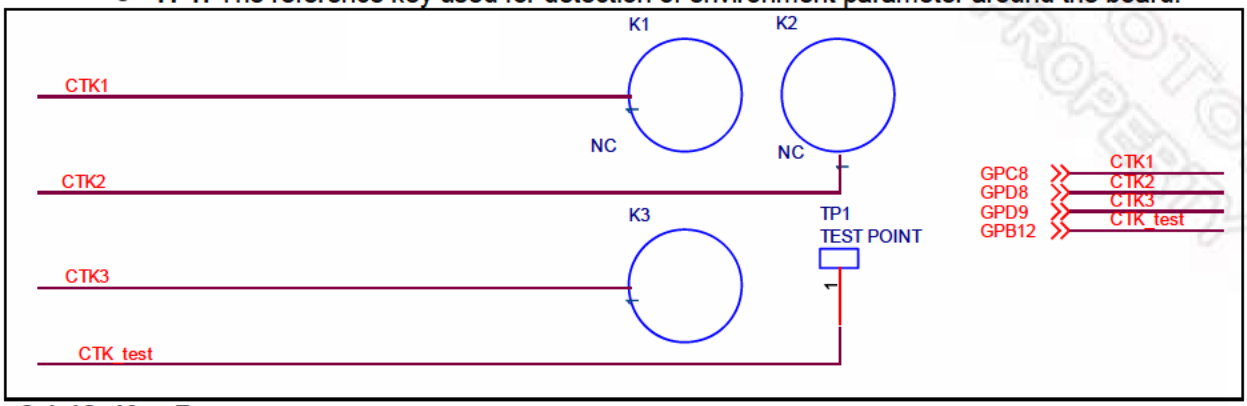
2.1.10 Reset Button

- **SW_RESET1:** Reset button. Press this key to reset the target chip M453VG6AE.



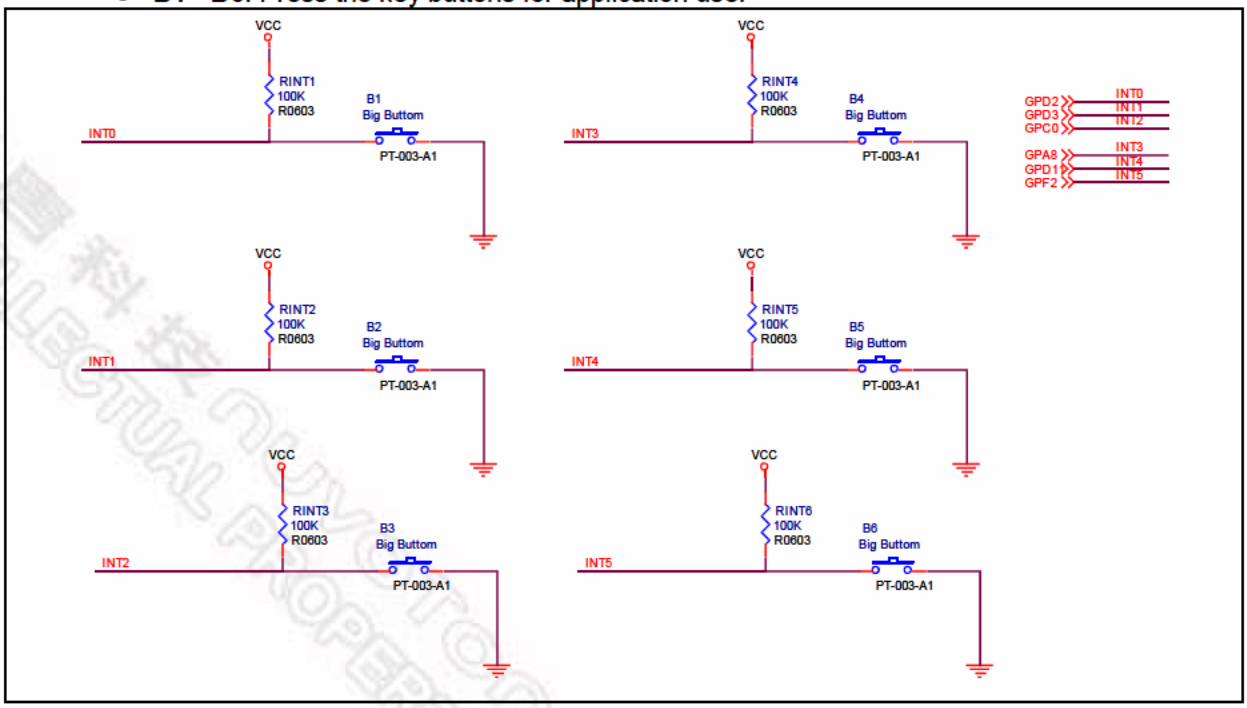
2.1.11 Touch Key

- **K1 - K3**: The touch keys used for detection of M453VG6AE touch key peripheral.
- **TP1:** The reference key used for detection of environment parameter around the board.



2.1.12 Key Buttons

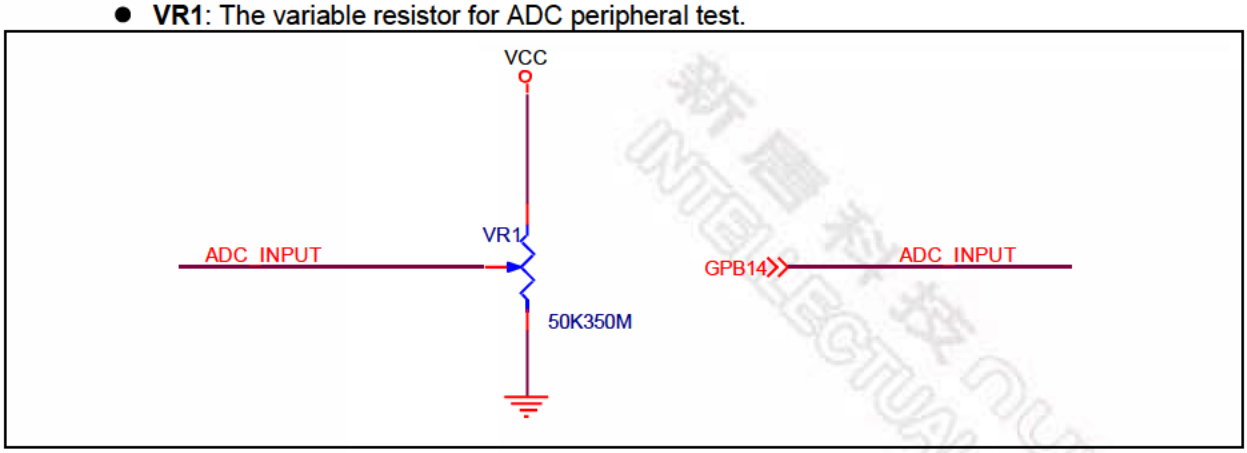
- **B1 - B6**: Press the key buttons for application use.



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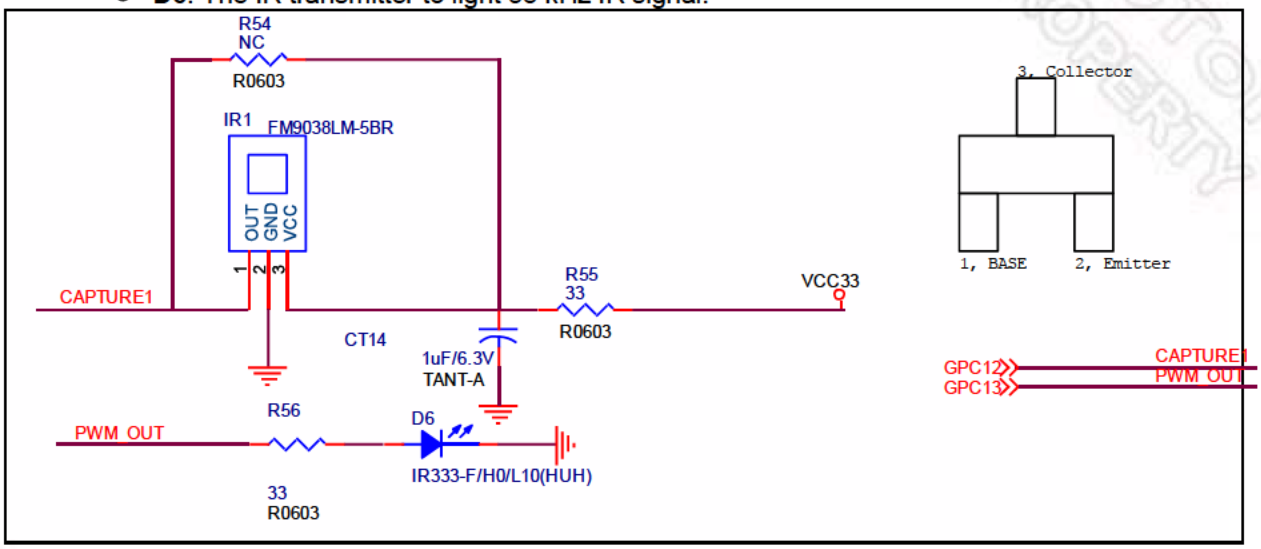
2.1.13 Variable Resistor

- **VR1**: The variable resistor for ADC peripheral test.



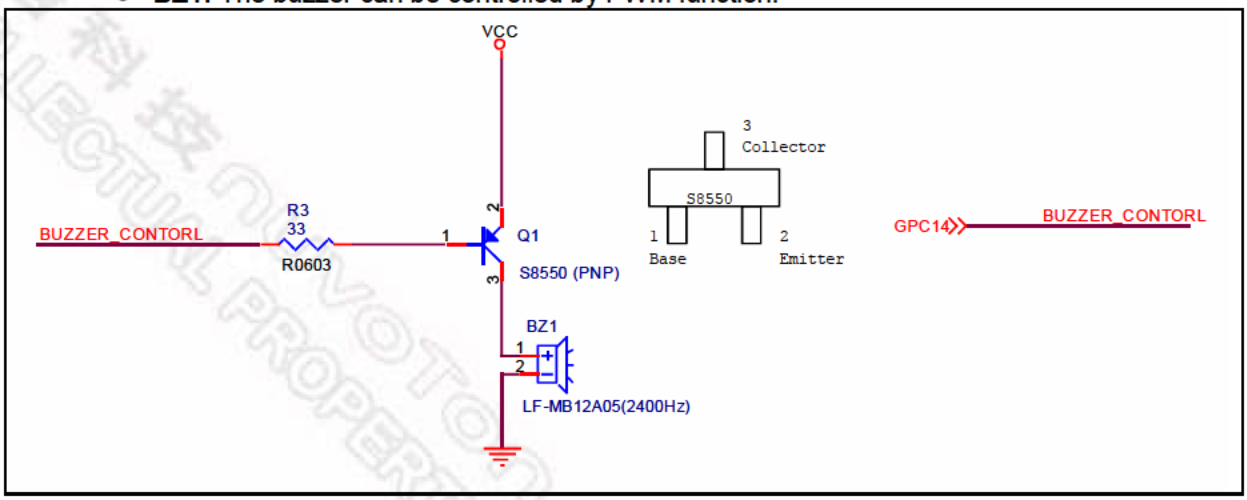
2.1.14 IR Transmitter and Receiver

- **IR1**: The IR receiver to get 38 kHz IR signal.
- **D6**: The IR transmitter to light 38 kHz IR signal.



2.1.15 Debug Buzzer

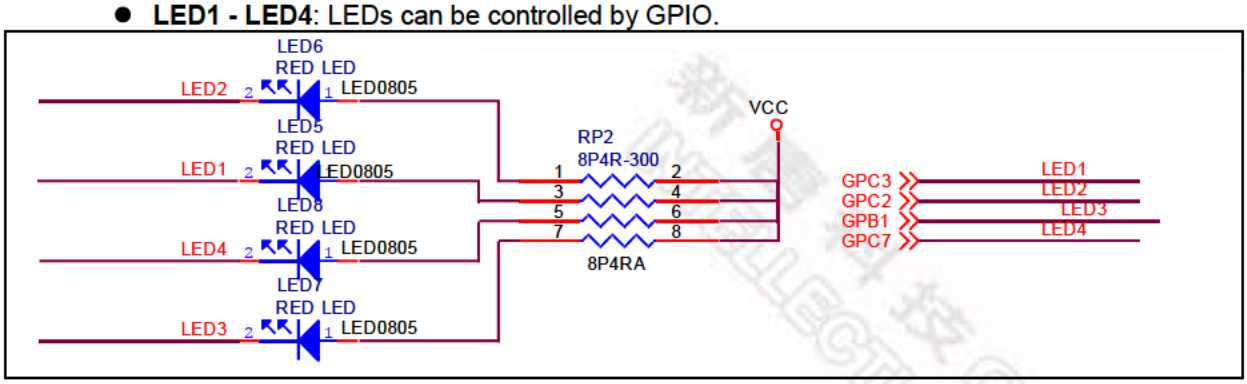
- **BZ1**: The buzzer can be controlled by PWM function.



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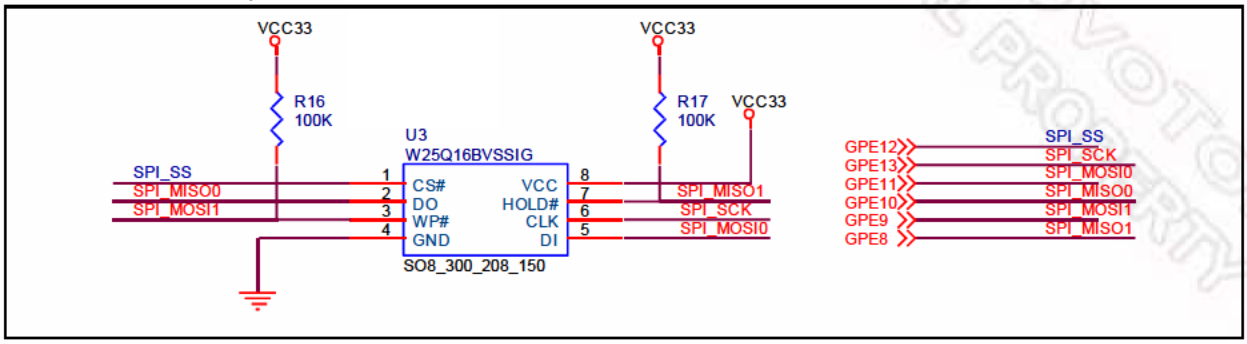
2.1.16 LED

- **LED1 - LED4**: LEDs can be controlled by GPIO.



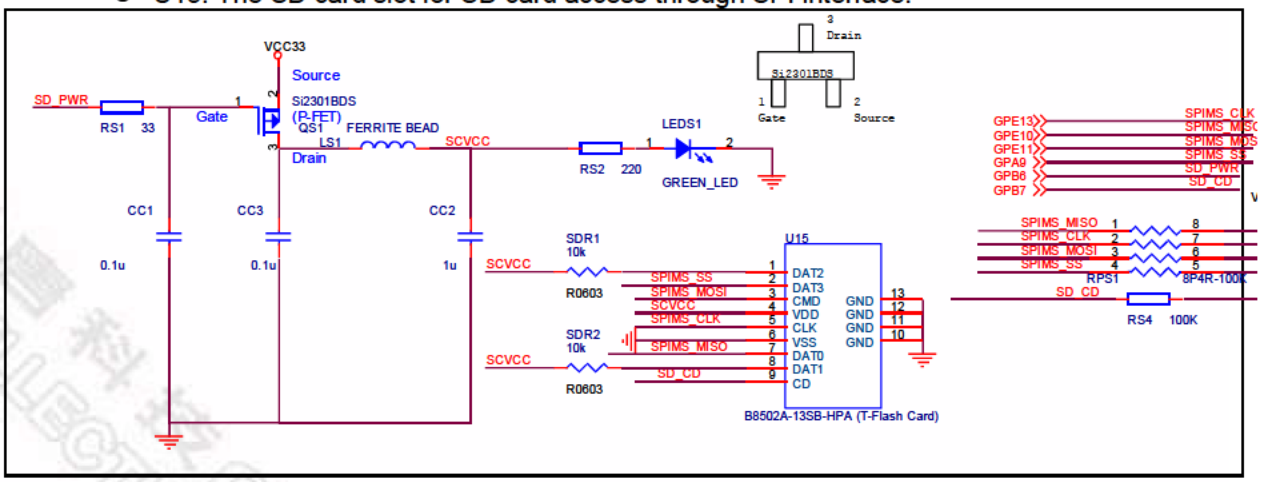
2.1.17 SPI Flash

- **U3:** 25Q16 SPI serial Flash.



2.1.18 SD Card Slot

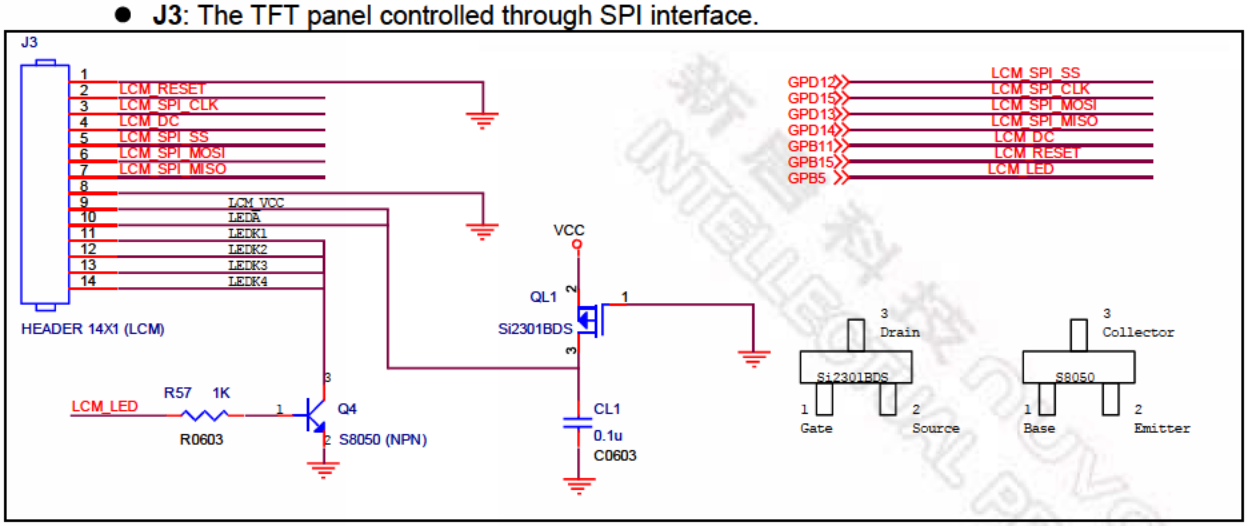
- U15: The SD card slot for SD card access through SPI interface.



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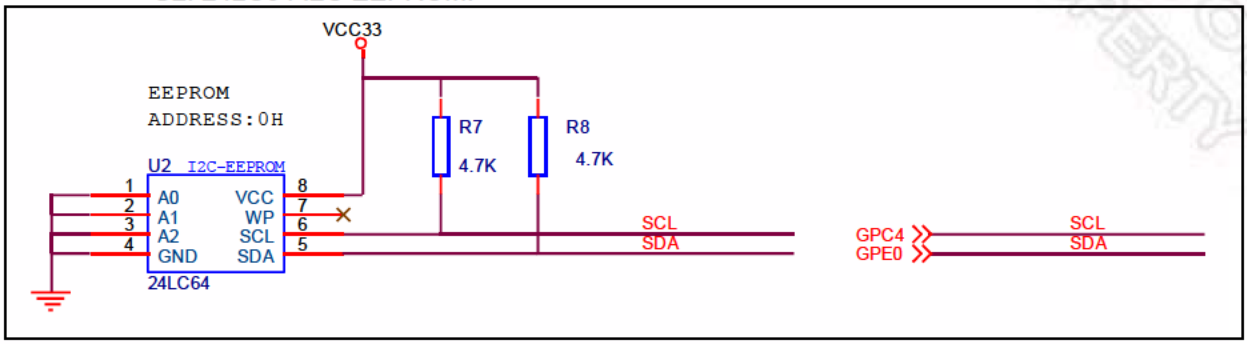
2.1.19 TFT Panel

- **J3**: The TFT panel controlled through SPI interface.



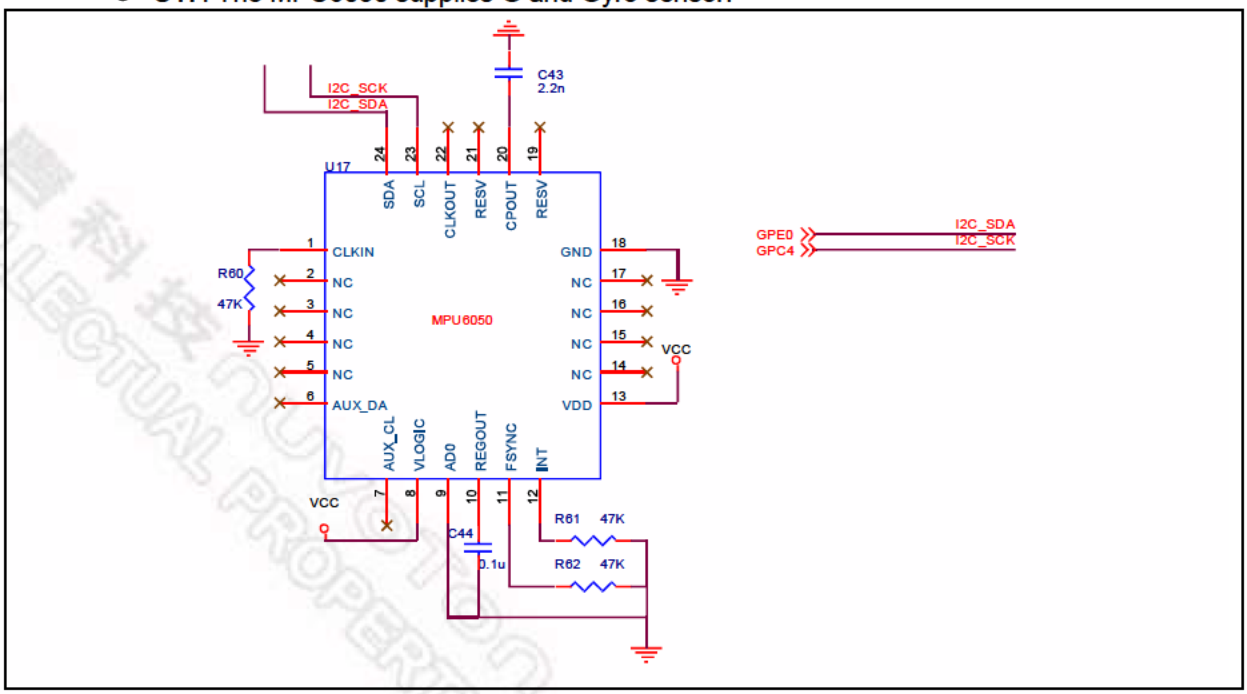
2.1.20 I2C EEPROM

- **U2**: 24LC64 I2C EEPROM.



2.1.21 G and Gyro Sensor

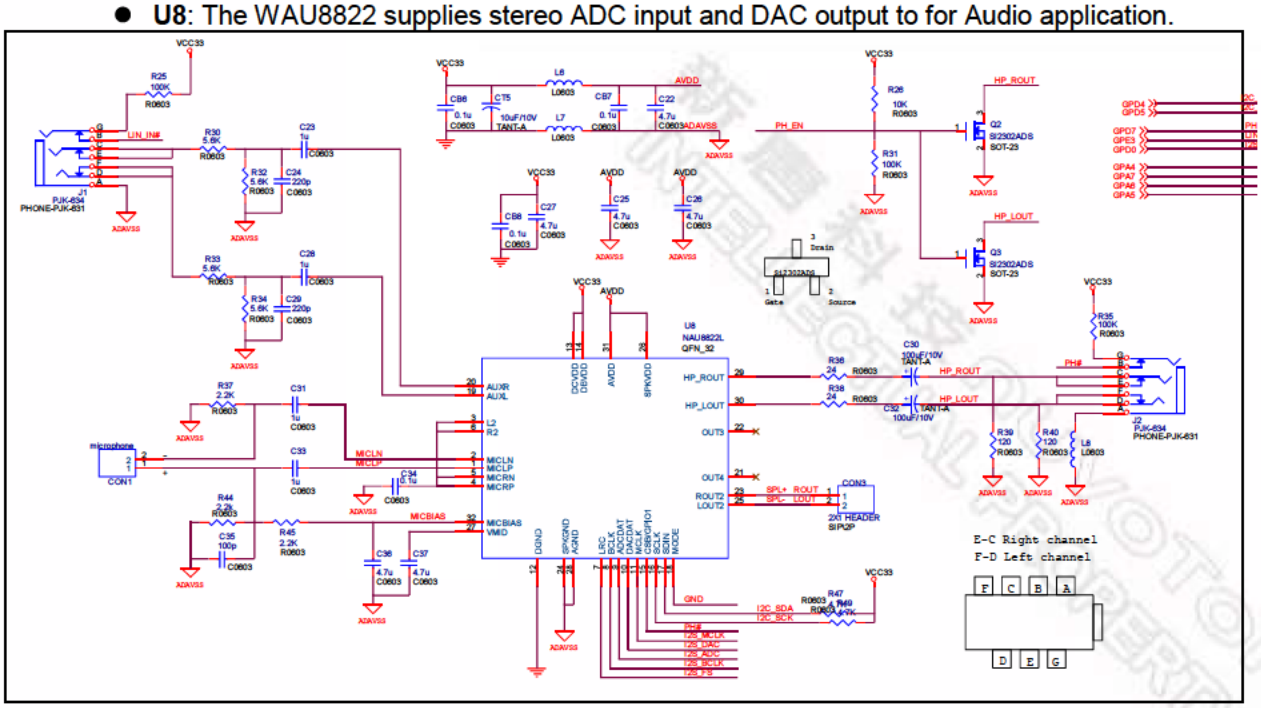
- **U17**: The MPU6050 supplies G and Gyro sensor.



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2.1.22 WAU8822 Code

- **U8**: The WAU8822 supplies stereo ADC input and DAC output to for Audio application.



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2.2 Pin Assignment

The Nu-LB-M451 uses the M453VG6AE as the target microcontroller whose pins are listed in the following table.

No	Pin Name	No	Pin Name
1	PB.13/EADC_CH10	23	PF.0/X32_OUT/INT5
2	PB.14/EADC_CH11	24	PF.1/X32_IN
3	PB.15/EADC_CH12/TK2/ACMP0_P3/EBI_nCS1	25	PF.2/TAMPER
4	PB.5/EADC_CH13/SPI0_MOSI0/SPI1_MOSI/TK3 /ACMP0_P2/EBI_AD6	26	PD.10/T2
5	PB.6/EADC_CH14/SPI0_MISO0/SPI1_MISO/TK4 /ACMP0_P1/EBI_AD5	27	PD.11/T3
6	PB.7/EADC_CH15/SPI0_CLK/SPI1_CLK/TK5 /ACMP0_P0/EBI_AD4	28	PD.12/SPI2_SS/UART3_TXD/PWM1_CH0/EBI_ADR16
7	nRESET	29	PD.13/SPI2_MOSI/UART3_RXD/PWM1_CH1 /EBI_ADR17
8	PD.0/SPI1_I2SMCLK/UART0_RXD/TK6/ACMP1_N /INT3	30	PD.14/SPI2_MISO/UART3_nCTS/PWM1_CH2 /EBI_ADR18
9	AV_{SS}	31	PD.15/SPI2_CLK/UART3_nRTS/PWM1_CH3 /EBI_ADR19
10	V_{DD}	32	PD.7/PWM0_SYNC_IN/T1/ACMP0_O/PWM0_CH5 /EBI_nRD
11	V_{SS}	33	PF.3/XT1_OUT/I2C1_SCL
12	PC.8/TK7	34	PF.4/XT1_IN/I2C1_SDA
13	PD.8/TK8/EBI_nCS0	35	V_{SS}
14	PD.9/TK9/ACMP1_P3/EBI_ALE	36	V_{DD}
15	PD.1/PWM0_SYNC_IN/UART0_TXD/TK10 /ACMP1_P2/T0/EBI_nRD	37	LDO_CAP
16	PD.2/STADC/T0_EXT/TK11/ACMP1_P1 /PWM0_BRAKE0/EBI_nWR/INT0	38	PC.9/SPI2_I2SMCLK/PWM1_CH0
17	PD.3/T2/T1_EXT/TK12/ACMP1_P0 /PWM0_BRAKE1/EBI_MCLK/INT1	39	PC.10/SPI2_MOSI/PWM1_CH1
18	PD.4/SPI1_CLK/I2C0_SDA/TK13/PWM0_BRAKE0/T0	40	PC.11/SPI2_MISO/PWM1_CH2
19	PD.5/CLKO/SPI1_MISO/I2C0_SCL/TK14 /PWM0_BRAKE1/T1	41	PC.12/SPI2_CLK/PWM1_CH3
20	PE.3/SPI1_MOSI/TK15/PWM0_CH3	42	PC.13/SPI2_SS/PWM1_CH4
21	PD.6/CLKO/SPI1_SS/UART0_RXD/TK16/ACMP0_O /PWM0_CH5/EBI_nWR/	43	PC.14/PWM1_CH5
22	V_{BAT}	44	PC.0/SPI2_CLK/UART2_nCTS/CAN0_TXD /PWM0_CH0/EBI_AD8/INT2

45	PC.1/CLKO/STDAC/UART2_nRTS/CAN0_RXD /PWM0_CH1/EBI_AD9	69	PE.11/SPI1_MOSI/SPI0_MOSI0/UART1_nRTS /I2C0_SMBSUS/SC0_CLK
46	PC.2/SPI2_SS/UART2_TXD/ACMP1_O /PWM0_CH2/EBI_AD10	70	PE.12/SPI1_SS/SPI0_SS/UART1_TXD/I2C0_SCL
47	PC.3/SPI2_MOSI/UART2_RXD/USB_VBUS_ST /PWM0_CH3/EBI_AD11	71	PE.13/SPI1_CLK/SPI0_CLK/UART1_RXD/I2C0_SDA
48	PC.4/SPI2_MISO/I2C1_SCL/USB_VBUS_EN /PWM0_CH4/EBI_AD12	72	VDDIO
49	PE.0/SPI2_CLK/I2C1_SDA/T2_EXT/SC0_CD /PWM0_CH0/EBI_nCS1/INT4	73	USB_VBUS
50	PC.5/SPI2_I2SMCLK/PWM0_CH5/EBI_AD13	74	USB_D-
51	PC.6/I2C1_SMBAL/ACMP1_O/PWM1_CH0 /EBI_AD14	75	USB_D+
52	PC.7/I2C1_SMBSUS/PWM1_CH1/EBI_AD15	76	USB_ID
53	PE.4/I2C1_SCL/SC0_PWR/PWM1_BRAKE0 /EBI_nCS0/INT0	77	USB_VDD33_CAP
54	PE.5/I2C1_SDA/SC0_RST/PWM1_BRAKE1 /EBI_ALE/INT1	78	PE.2/PWM1_CH1
55	PF.5/ICE_CLK	79	PA.3/USB_VBUS_ST/UART0_RXD/UART0_nRTS /I2C0_SCL/SC0_PWR/PWM1_CH2/EBI_AD3
56	PF.6/ICE_DAT	80	PA.2/USB_VBUS_EN/UART0_TXD/UART0_nCTS /I2C0_SDA/SC0_RST/PWM1_CH3/EBI_AD2
57	PA.8/UART3_TXD	81	PA.1/UART1_nRTS/UART1_RXD/CAN0_TXD /SC0_DAT/PWM1_CH4/EBI_AD1
58	PA.9/UART3_RXD	82	PA.0/UART1_nCTS/UART1_TXD/CAN0_RXD /SC0_CLK/PWM1_CH5/EBI_AD0/INT0
59	PA.7/SPI1_CLK/T0_EXT/EBI_AD7	83	PA.12/SPI1_I2SMCLK/CAN0_TXD
60	PA.6/SPI1_MISO/T1_EXT/EBI_AD6	84	PA.13/CAN0_RXD
61	PA.5/SPI1_MOSI/T2_EXT/EBI_AD5	85	PA.14/UART2_nCTS/I2C0_SMBAL
62	PA.4/SPI1_SS/EBI_AD4	86	PA.15/UART2_nRTS/I2C0_SMBSUS
63	V_{SS}	87	V_{SS}
64	V_{DD}	88	V_{DD}
65	PE.1/T3_EXT/SC0_CD/PWM0_CH1	89	AV_{DD}
66	PE.8/UART1_TXD/SPI0_MISO1/I2C1_SCL /SC0_PWR	90	V_{REF}
67	PE.9/UART1_RXD/SPI0_MOSI1/I2C1_SDA /SC0_RST	91	PB.0/EADC_CH0/SPI0_MOSI1/UART2_RXD/ T2/DAC/EBI_nWRL/INT1
68	PE.10/SPI1_MISO/SPI0_MISO0/UART1_nCTS /I2C0_SMBAL/SC0_DAT	92	PB.1/EADC_CH1/SPI0_MISO1/UART2_TXD/T3/SC0_RST/PWM0_SYNC_OUT/EBI_nWRH

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93	PB.2/EADC_CH2/SPI0_CLK/SPI1_CLK/ UART1_RXD/SC0_CD	97	PB.9/EADC_CH6
94	PB.3/EADC_CH3/SPI0_MISO0/SPI1_MISO /UART1_TXD	98	PB.10/EADC_CH7
95	PB.4/EADC_CH4/SPI0_SS/SPI1_SS/UART1_nCTS /ACMP0_N/EBI_AD7	99	PB.11/EADC_CH8/TK0
96	PB.8/EADC_CH5/UART1_nRTS/PWM0_CH2	100	PB.12/EADC_CH9/TK1

Table 2-1 Pin Assignment for M453VG6AE

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2.3 Nu-LB-M451 PCB Placement

The following figure shows the Nu-LB-M451 PCB placement.

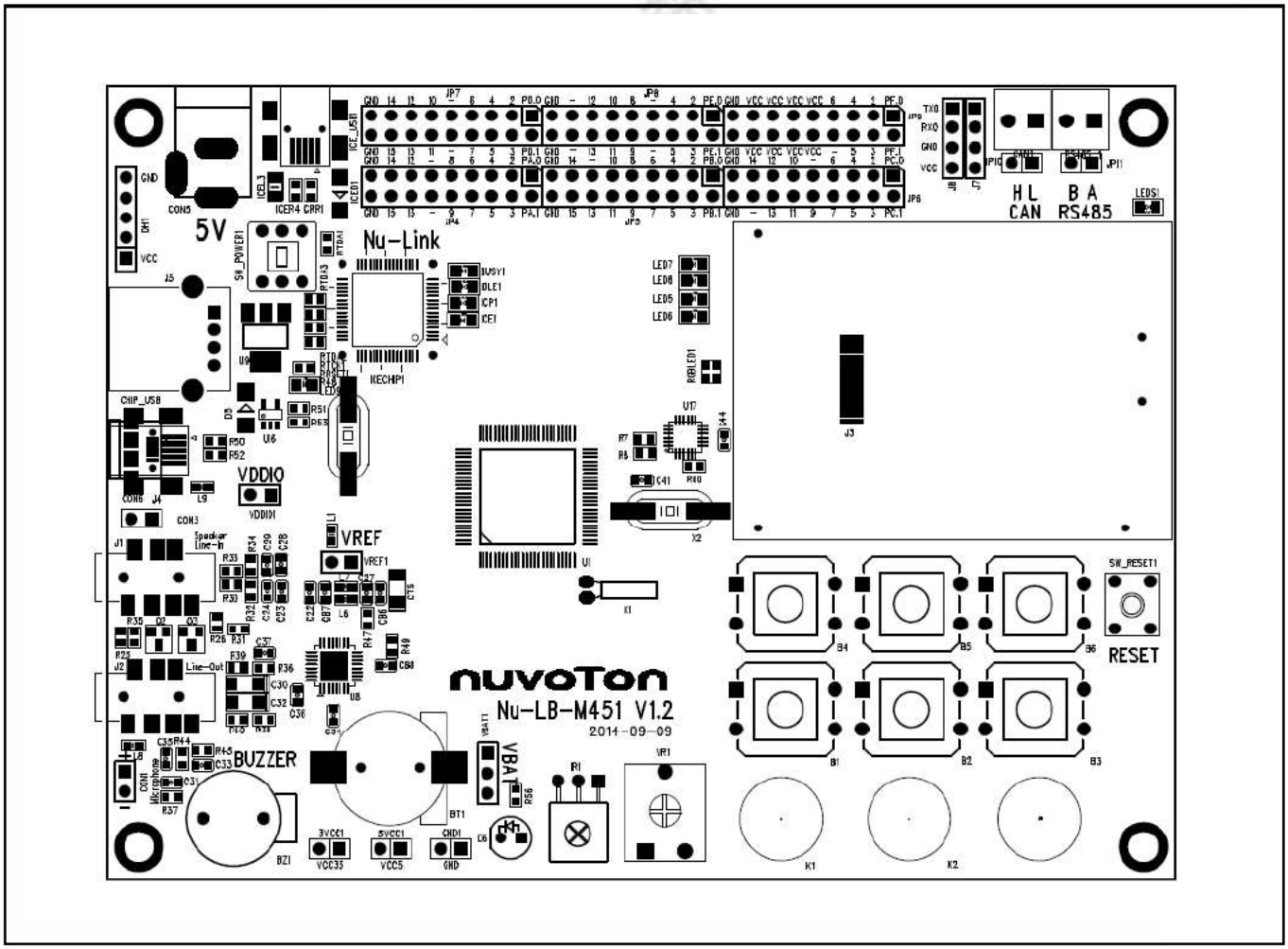


Figure 2-2 Nu-LB-M451 PCB Placement

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3 HOW TO START NU-LB-M451 ON THE KEIL MVISION® IDE

3.1 Keil uVision® IDE Software Download and Install

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

3.2 Nuvoton Nu-Link Driver Download and Install

Please visit the Nuvoton company NuMicro™ website (http://www.nuvoton.com/NuMicro) to download "NuMicro™ Keil µVision® IDE driver" file. Refer to section 4.1 for the detailed download flow. When the Nu-Link driver has been well downloaded, please unzip the file and execute the "Nu-Link_Keil_Driver.exe" to install the driver.

3.3 Hardware Setup

The hardware setup is shown as Figure 3-1

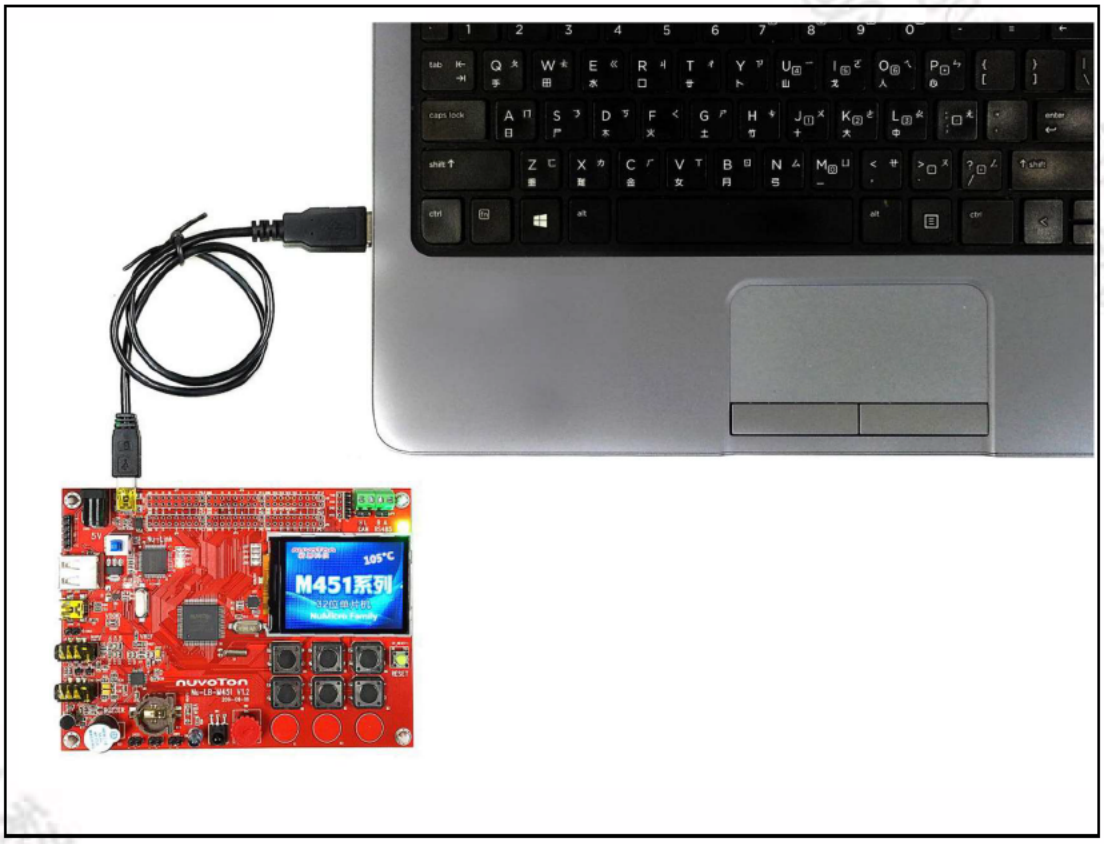


Figure 3-1 Nu-LB-M451 Hardware Setup

3.4 StartKit Example Program

This example, as shown in the directory in Figure 3-2, demonstrates downloading and debugging an application on a Nu-LB-M451 board. The example file can be downloaded from Nuvoton NuMicro™ website as described in section 4.2.

Directory	Project File

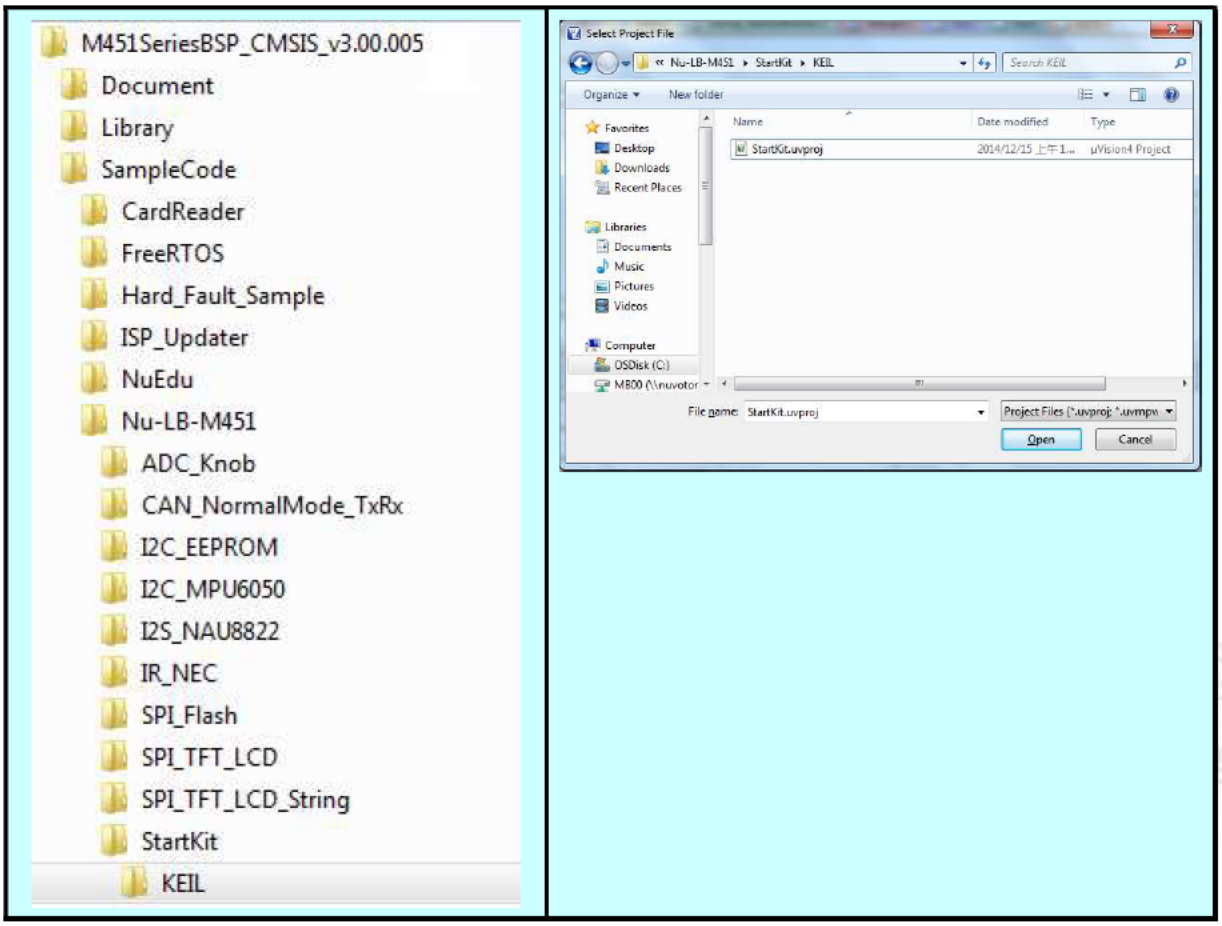


Figure 3-2 StartKit Example Directory

To use this example:

The TFT panel on the Nu-LB-M451 board will show M451 logo.

■ **Start µVision®**

■ **Project-Open**
Open the Smpl_NuTiny.uvproj project file

■ **Project - Build**
Compile and link the Smpl_NuTiny application

■ **Flash – Download**
Program the application code into on-chip Flash ROM

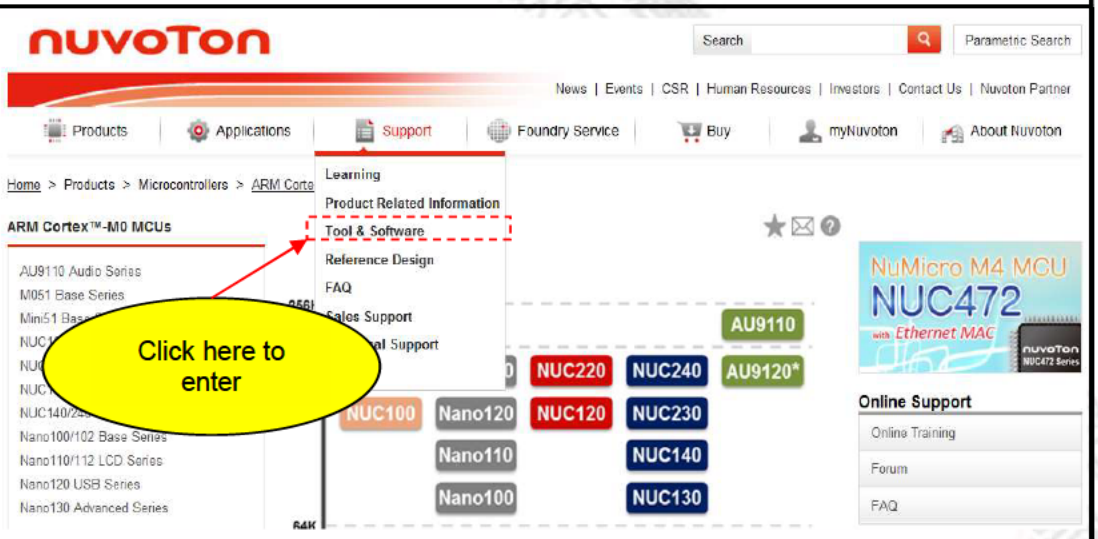
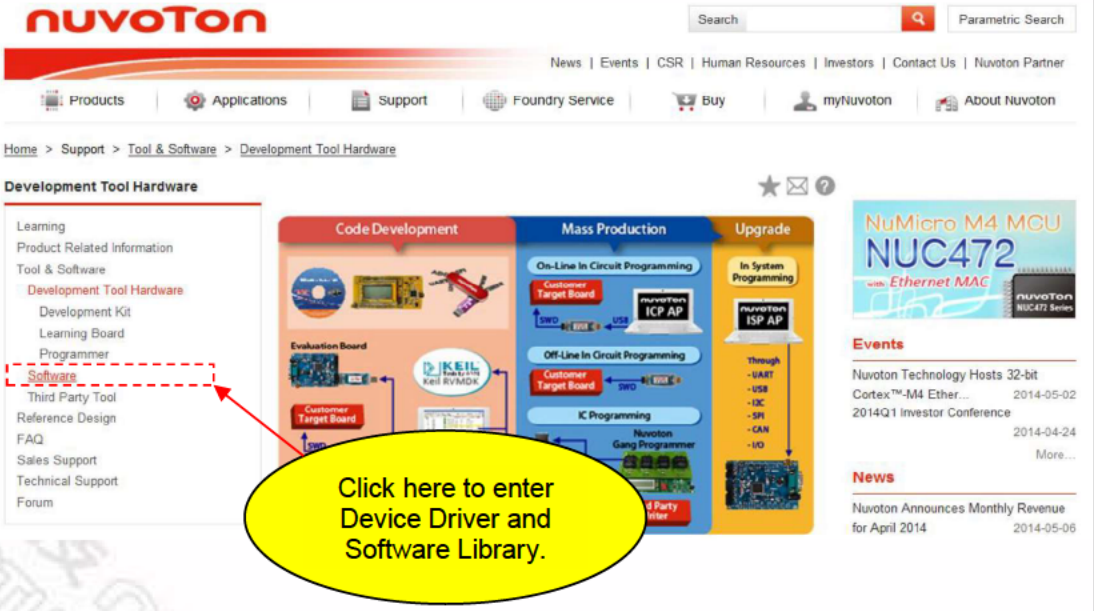
■ **Start debug mode**
Using the debugger commands, you may:

- Review variables in the watch window
- Single step through code
- Reset the device
- Run the application



4 DOWNLOADING RELATED FILES FROM NUVOTON WEBSITE

4.1 Downloading NuMicro™ Keil µVision® IDE Driver

Step1	Visit The Nuvoton NuMicro™ Website: HTTP://WWW.NUVOTON.COM/NUMICRO
Step2	
Step3	

Step4

Programmer Software Tools Package

File name	Description	Version	Date
ICP Programming Tool V1.25.6287.zip Revision History	NuMicro ICP tool & user manual	V1.25.6287	2014-01-16
ISP Programming Tool V1.44.zip Revision History	NuMicro ISP Programming Tool & user manual	V1.44	2014-01-20
NuGang Programmer V6.21.zip Revision History	NuGang Programmer software & user manual	V6.21	2014-01-24

Nu-Link Driver

File name	Description	Version	Date
Nu-Link Driver for Keil RVMDK V1.25.6287.zip Revision History	This driver is to support Nu-Link to work under Keil RVMDK Development E... NuMicro Family Devic...		2014-01-16
Nu-Link Driver for IAR EWARM V1.25.6287.zip Revision History	This driver is to supp... IAR EWARM Developm... NuMicro Family Devices.		...4-01-16

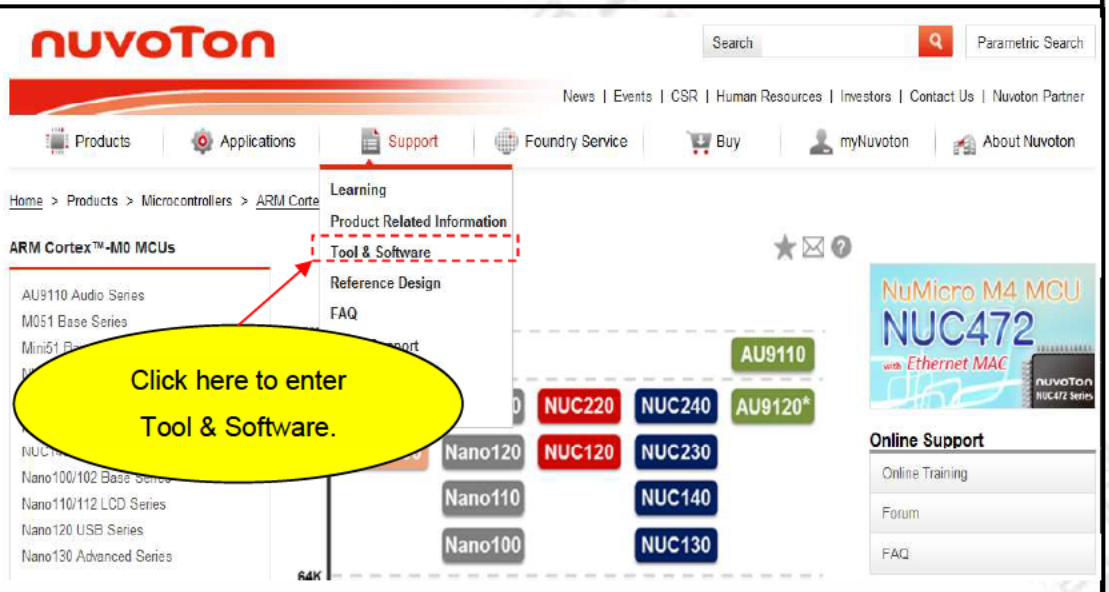
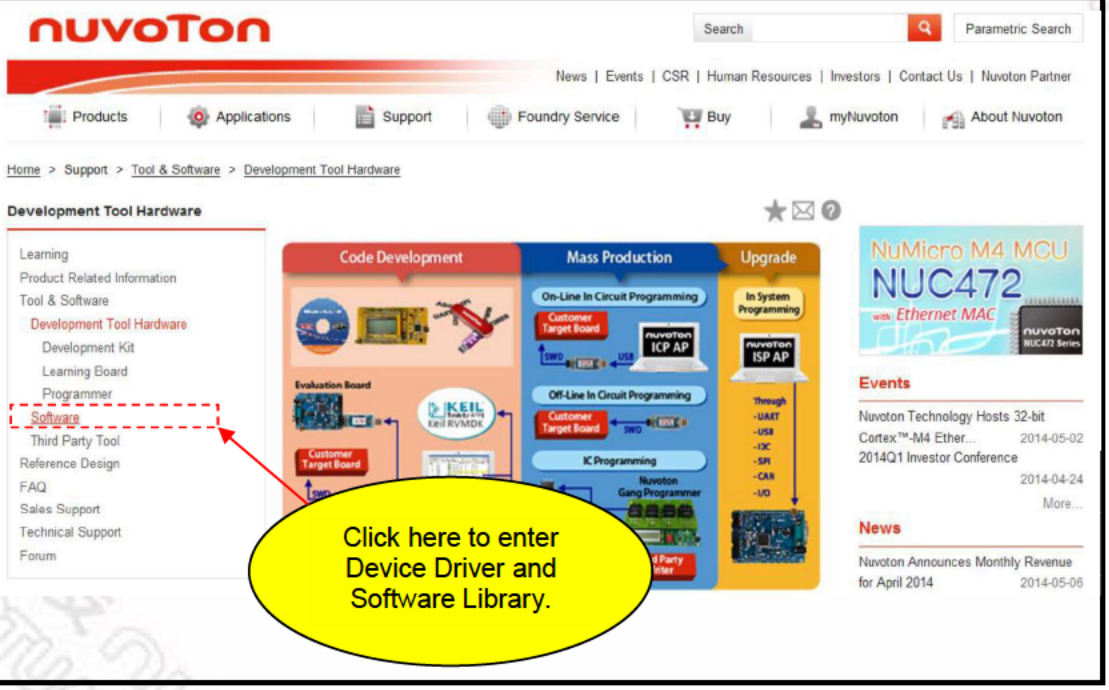
Click here to download the file.

User Feedback ↑ TOP

Step5 Download the NuMicro™ Keil µVision® IDE driver.

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4.2 Downloading NuMicro™ M451 Series BSP Software Library

Step1	Visit The Nuvoton NuMicro™ Website: HTTP://WWW.NUVOTON.COM/NUMICRO.
Step2	
Step3	

新唐科技 NUVOTON INTERNAL PROPERTY

Step 3	
Step 4	Download the NuMicro™ M451 Series CMSIS BSP.

新唐科技 NUVOTON INTELLECTUAL PROPERTY

5 REVISION HISTORY

Date	Revision	Description
2015.03.16	1.00	1. Initially issued.

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