ARM Cortex®-M

32-bit Microcontroller

NuMicro™ Family
NuTiny-SDK-NUC505
User Manual

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

www.nuvoton.com

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1 OVERVIEW

NuTiny-SDK-NUC505 is the specific development tool for NuMicro NUC505 series. Users can use NuTiny-SDK-NUC505 to develop and verify the application program easily.

NuTiny-SDK-NUC505 includes two portions. One is NuTiny-EVB-NUC505 and the other is Nu-Link-Me. NuTiny-EVB-NUC505 is the evaluation board and Nu-Link-Me is its Debug Adaptor. Thus, users do not need other additional ICE or debug equipment.

The NuMicro™ NUC505 series 32-bit microcontrollers are embedded with ARM® Cortex®-M4F core for consumer and industrial applications which need high computing power and rich communication interfaces.

The ARM® Cortex®-M4F core within NuMicro™ NUC505 series can run up to 100 MHz and support DSP extensions and Floating Point Unit (FPU) function. The NuMicro™ NUC505 series supports 128 Kbytes embedded SRAM with zero-wait state and 2 Mbytes embedded SPI Flash memory, and is equipped with plenty of high performance peripheral devices, such as 24-bit Audio CODEC, USB2.0 High-speed Device, USB2.0 Full-speed Host, and other peripheral.

2 NUTINY-SDK-NUC505 INTRODUCTION

NuTiny-SDK-NUC505 uses the NUC505YO13Y as the target microcontroller. Figure 2-1 is NuTiny-SDK-NUC505 for NUC505 series, the left portion is called NuTiny-EVB-NUC505 and the right portion is Debug Adaptor called Nu-Link-Me.

NuTiny-EVB-NUC505 is similar to other development boards. Users can use it to develop and verify applications to emulate the real behavior. The on board chip covers NUC505 series features. The NuTiny-EVB-NUC505 can be a real system controller to design users' target systems, supports usb high speed interface, audio headphone out, audio line in and sdcad slot.

Nu-Link-Me is a Debug Adaptor. The Nu-Link-Me Debug Adaptor 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 Nu-Link-Me Debug adaptor with IAR or Keil, please refer to "Nuvoton NuMicro™ IAR ICE driver user manual "or Nuvoton NuMicro™ Keil ICE driver user manual" in detail. These two documents will be stored in the local hard disk when the user installs each driver.

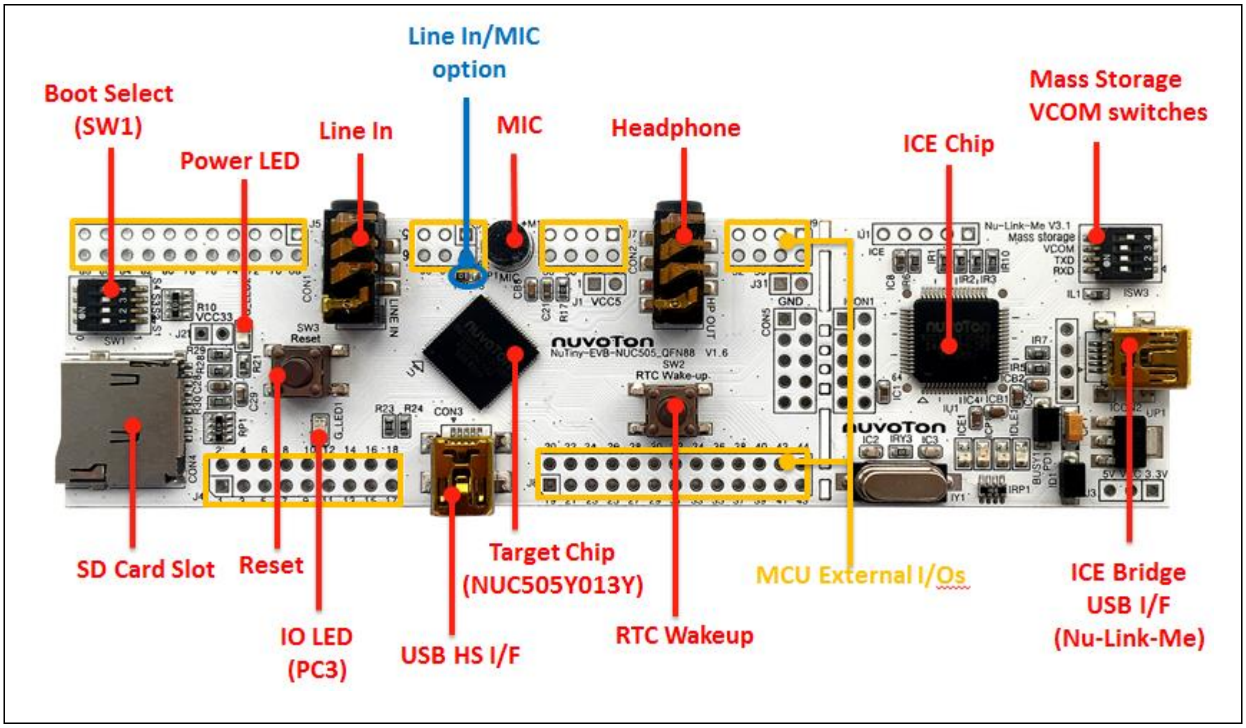


Figure 2-1 NuTiny-SDK-NUC505 (PCB Board)

2.1 NuTiny -SDK-NUC505 Jumper Description

NuTiny-SDK-NUC505 is the specific development tool for NuMicro NUC505 series. Users can use NuTiny-SDK-NUC505 to develop and verify the application program easily.

NuTiny-SDK-NUC505 includes two portions. One is NuTiny-EVB-NUC505 and the other is Nu-Link-Me. NuTiny-EVB-NUC505 is the evaluation board and Nu-Link-Me is its Debug Adaptor. Thus, users do not need other additional ICE or debug equipment.

2.1.1 Power Setting

- ICON2: USB port in Nu-Link-Me
- CON3: USB port in NuTiny-EVB-NUC505
- J1: VCC5 Voltage connecter in NuTiny-EVB-NUC505
- J2: VCC33 Voltage connecter in NuTiny-EVB-NUC505

POWER model	ICON2 USB port	CON3 USB port	J1 VCC5	J2 VCC33
Model 1	**Connect to PC USB**	**X**	**X**	**X**
Model 2	**X**	**Connect to PC USB**	**X**	**X**
Model 3	**X**	**X**	**External 5V power**	**X**
Model 3	**X**	**X**	**X**	**External 3.3V power**

X: Unused.

Boot Select (SW1)

S4	S3	S2	S1	Boot From	Descriptions
0	1	1	0	ICE SPI EXT	ICE Mode with External SPI Flash
0	1	1	1	ICE-SPI	ICE Mode with Internal SPI Flash
1	0	1	1	ICP	Boot from ICP Mode
1	1	0	1	SPI EXT	Boot from External SPI Flash
1	1	1	0	USB	Boot from USB
1	1	1	1	SPI	Boot from Internal SPI Flash

2.1.2 Debug Connector

- CON5: Connector in target board (NuTiny-EVB-NUC505) for connecting with Nuvoton ICE adaptor (Nu-Link-Me)
- ICON1: Connector in ICE adaptor (Nu-Link-Me) for connecting with a target board (for example NuTiny-EVB-NUC505)

2.1.3 ICE USB Connector

- ICON2: Mini USB Connector in Nu-Link-Me connected to a PC USB port

2.1.4 USB High Speed Device Connector

- CON3: Mini USB Connector in NUC505 USB device high speed function connected to PC USB port

  (Note) using the USB high speed device need external stable power from J1.

2.1.5 Extended Connector

- J4, J5, J6, J7, J8 and J9: Show all chip pins in NuTiny-EVB-NUC505

2.1.6 Line In or MIC pin selection

- For audio application, JP1 is bais voltage select for MIC(2-3 short) or line in(1-2 short).

2.1.7 Reset Button

- SW3: Reset button in NuTiny-EVB-NUC505

2.1.8 RTC wakeup Button

- SW2: RTC wakeup button in NuTiny-EVB-NUC505

2.1.9 Headphone

- CON2: NUC505 audio headphones connector.

2.1.10 Line In

- CON1: NUC505 audio line in connector.

2.1.11 Power Connectors

- J1: 5 VCC connector in NuTiny-EVB-NUC505
- J2: 3.3 VCC connector in NuTiny-EVB-NUC505
- J3: GND connector in NuTiny-EVB-NUC505

2.2 Pin Assignment for Extended Connector

NuTiny-EVB-NUC505 provides NUC505YO13Y on board and the extended connector for QFN-88 pin. Table 2-1 is the pin assignment for NUC505YO13Y

Pin No	Pin Name	Pin No	Pin Name	Pin No	Pin Name	Pin No	Pin Name
01	RESETn	23	RTC_VDD33	45	GPB5	67	SAR_VDD33
02	GPD0	24	RTC_RPWR	46	GPB5	68	SAR_VSS33
03	GPD1	25	RTC_RWAKEn	47	GPB6	69	GPA0
04	GPB13	26	RTX_XIN	48	GPB7	70	GPA1
05	GPB14	27	RTC_XOUT	49	UD_CDET	71	GPA2
06	GPB15	28	GPA8	50	GPB8	72	GPA3
07	GPB15	29	GPA9	51	GPB9	73	GPA4
08	GPC1	30	GPA10	52	VDD33	74	GPA5
09	GPC2	31	GPA11	53	HP_VDD33	75	GPA6
10	VDD33	32	GPA12	54	LHP_OUT	76	GPA7
11	GPC3	33	GPA13	55	VCMBF	77	VDD12
12	GPC4	34	GPA14	56	RHP_OUT	78	GPB10
13	GPC5	35	GPA15	57	HP_VSS33	79	GPB11
14	GPC6	36	GPC7	58	VMID	80	GPB12
15	VDD12	37	GPC8	59	AVDD33	81	VDD33
16	XIN	38	GPC9	60	MIC1P	82	GPC11
17	XOUT	39	GPC10	61	MIC1N	83	GPC12
18	PLL_UD_VDD12	40	VDD33	62	LLINEIN/MICBIAS	84	GPC13
19	UD_DM	41	GPB0	63	VDD12	85	GPC14
20	UD_DP	42	GPB1	64	GPD2	86	AVDD
21	UD_VDD33	43	GPB2	65	GPD3	87	VOUT
22	UD_REXT	44	GPB3	66	GPD4	88	AGND

Table 2-1 Pin Assignment for NUC505YO13Y

2.3 NuTiny-SDK-NUC505 PCB Placement

Users can refer to Figure 2-2 for the NuTiny-SDK-NUC505 PCB placement.

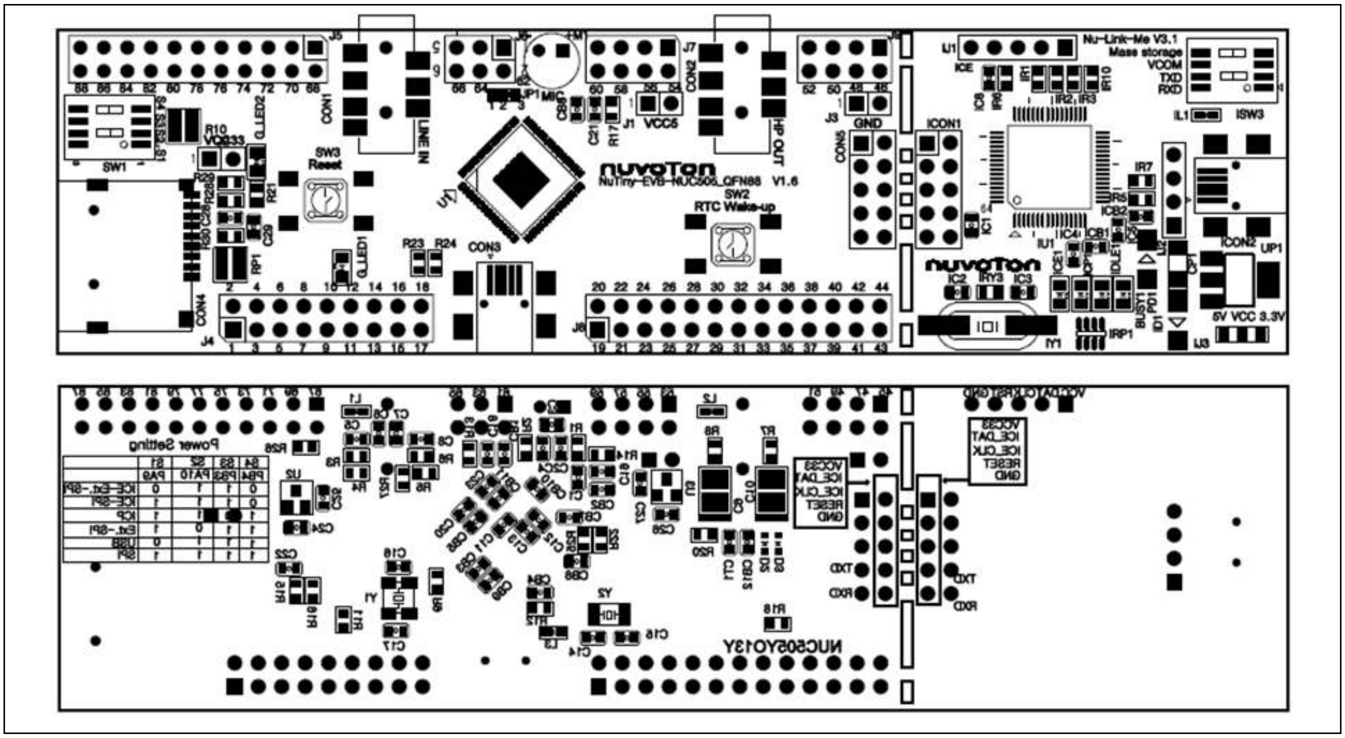


Figure 2-2 NuTiny-SDK-NUC505 PCB Placement

3 HOW TO START NUTINY-SDK-NUC505 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. 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

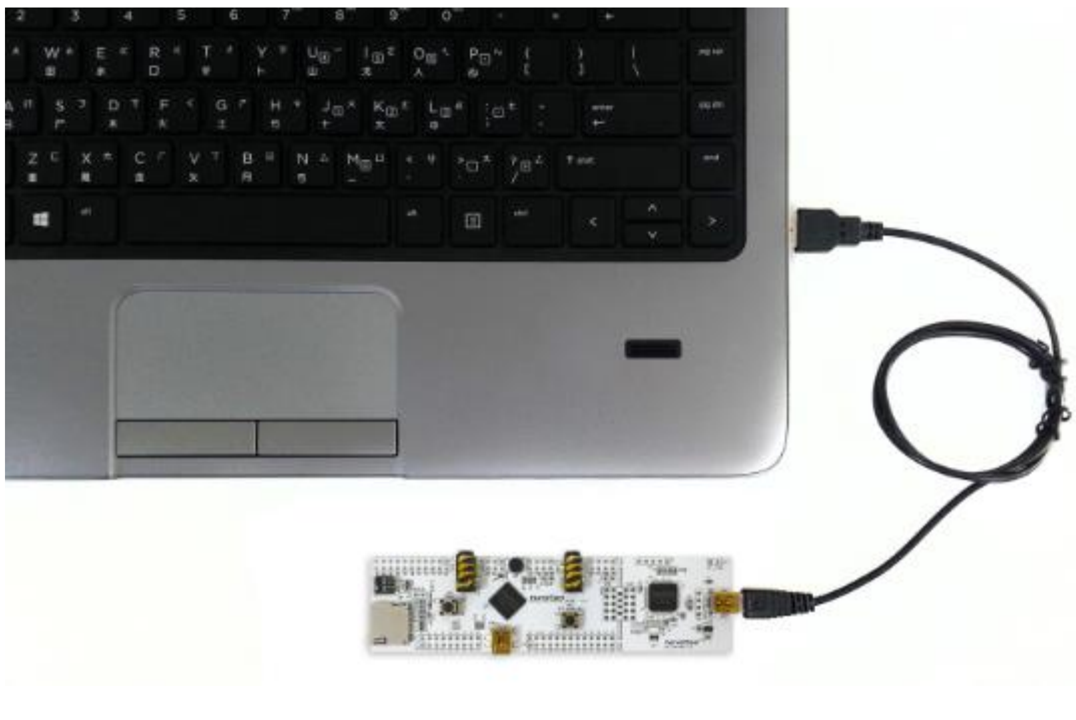


Figure 3-1 NuTiny-SDK-NUC505 Hardware Setup

Boot from ICE-SPI mode to select ICE Mode with Internal SPI Flash

S4	S3	S2	S1	Boot From	Descriptions
0	1	1	0	ICE SPI EXT	ICE Mode with External SPI Flash
0	1	1	1	ICE-SPI	ICE Mode with Internal SPI Flash
1	0	1	1	ICP	Boot from ICP Mode
1	1	0	1	SPI EXT	Boot from External SPI Flash
1	1	1	0	USB	Boot from USB
1	1	1	1	SPI	Boot from Internal SPI Flash

3.4 Smpl_NuTiny-NUC505 Example Program

This example demonstrates the ease of downloading and debugging an application on a NuTiny-SDK-NUC505 board. It can be found on Figure 3-2 list directory and downloaded from Nuvoton NuMicro™ website.

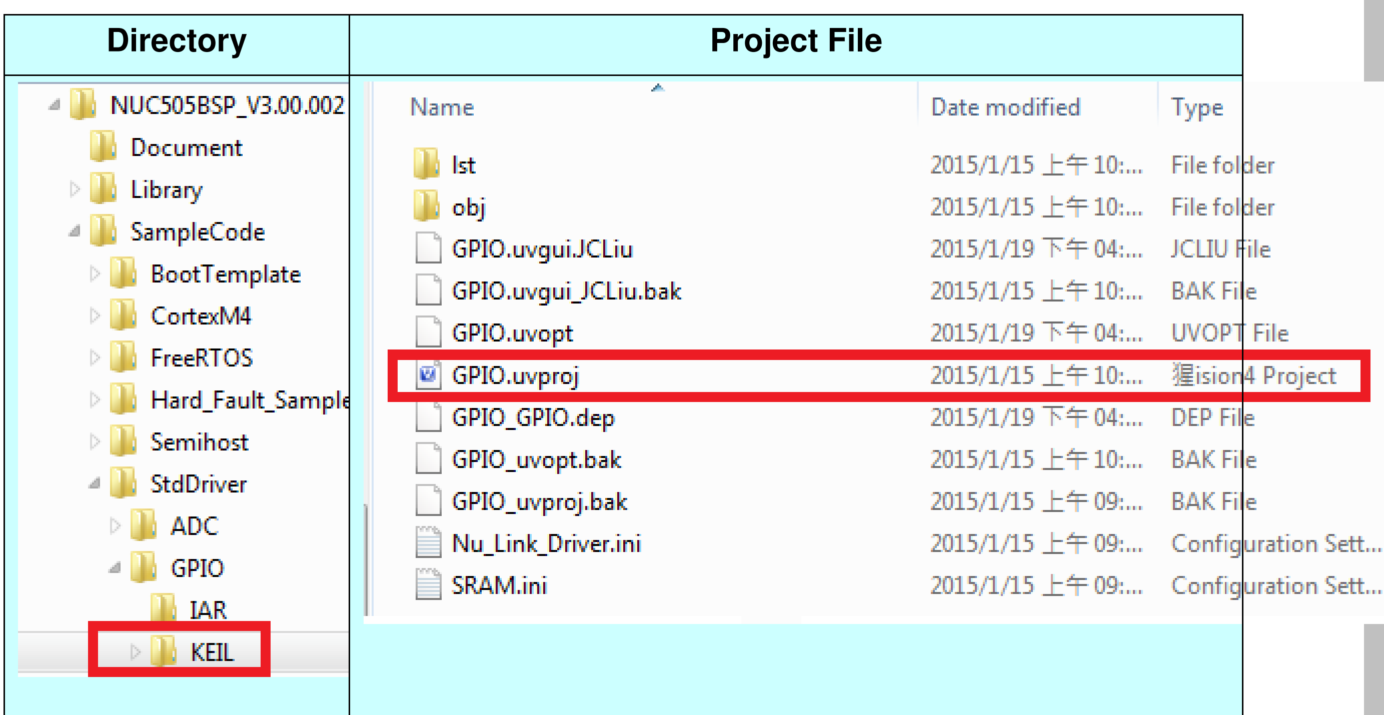


Figure 3-2 Smpl_NuTiny_NUC505 Example Directory

To use this example:

The LED will toggle on the NuTiny-EVB-NUC505 board.

- **Start µVision®**

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

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

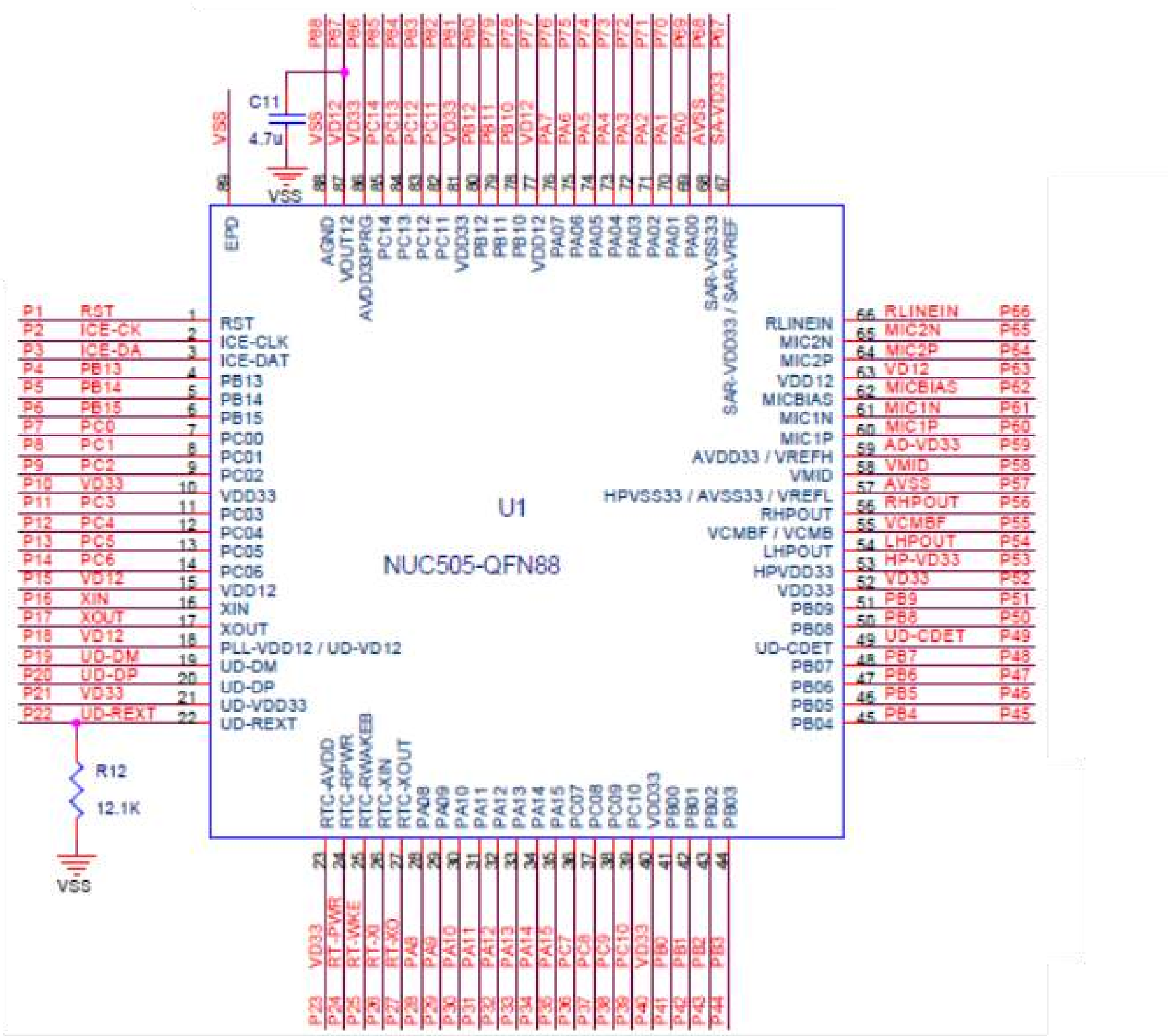
- **Flash – Download**
  Program the application code into on-chip Flash ROM

- **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

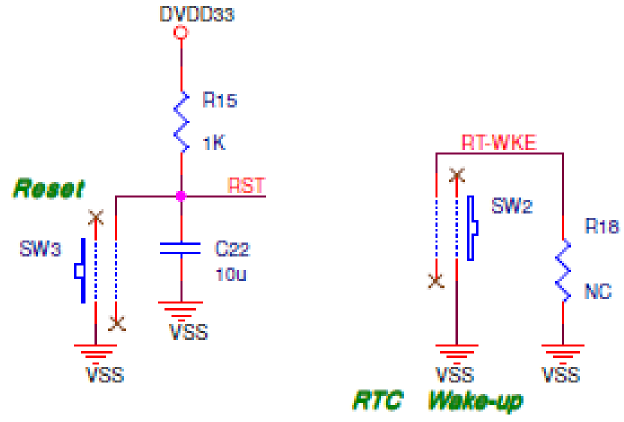
4 NUTINY-EVB-NUC505 SCHEMATIC

4.1 NUC505



4.2 RESET and RTC_WAKEUP Button

The reset need R 1k ohm and C 10uf for reset circuit.



4.3 Crystal

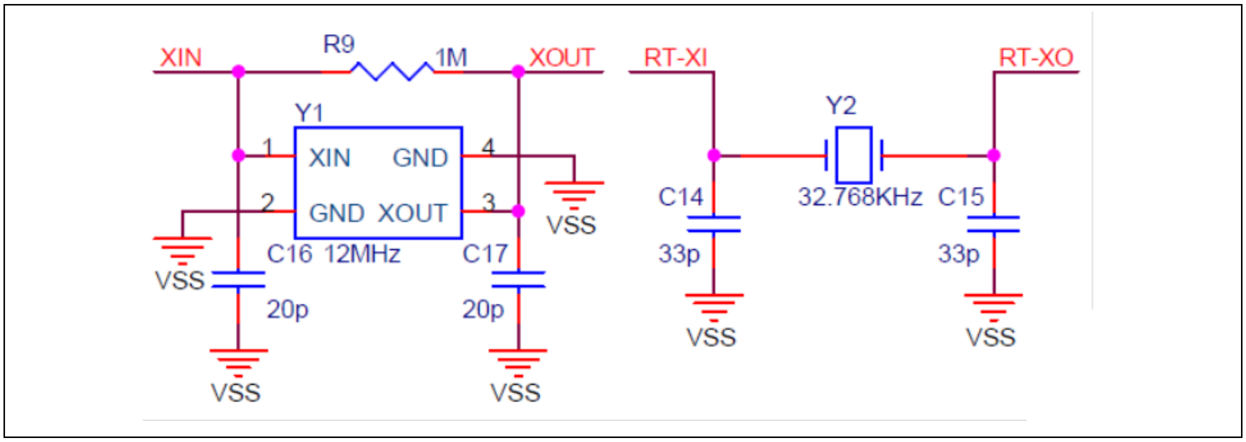
4.3.1 HXT:High Speed Crystal (12 MHz)

For C16 and C17 is recommended to use high-quality ceramic capacitors in the 5pF~20pF range, designed for high-frequency applications and selected to meet the requirements of the crystal or resonator. C16 and C17 are usually the same value. The crystal manufacturer typically specifies a load capacitance that is the series combination of C16 and C17. The PCB and MCU pin capacitances must be included when sizing C16 and C17 (20pF can be used as a rough estimation of the combined pin and board capacitance), external resister need 1 MHz.

4.3.2 LXT: Low Speed Crystal (32.768 kHz)

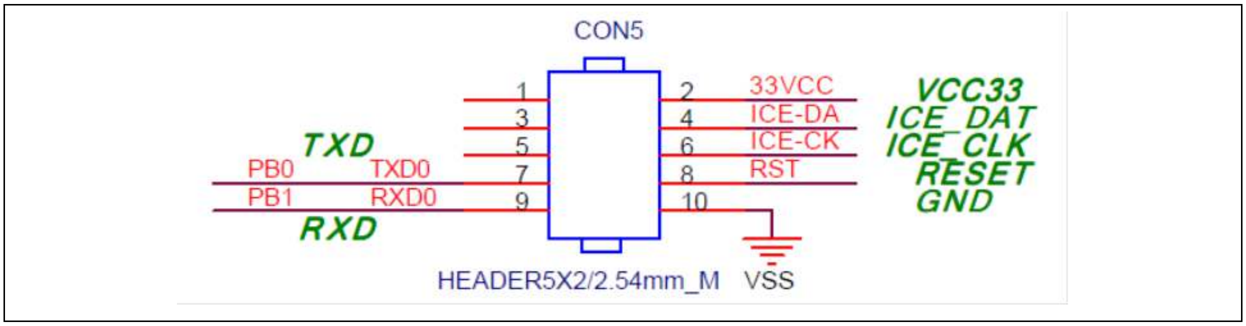
For C14 and C15 is recommended to use high-quality ceramic capacitors in the 5~33 pF range, designed for RTC applications and selected to meet the requirements of the crystal or resonator, external resister need 10 MHz

Applications requiring oscillators on NUC505 series MCUs must take PCB layout into consideration. The oscillators on NUC505 series MCUs consume very little current, and it sometimes makes the oscillator circuit sensitive to neighboring circuits. The following lists some PCB design guidelines:



4.4 ICE Interface

For ICE Mode debug or ICP Mode download code to flash

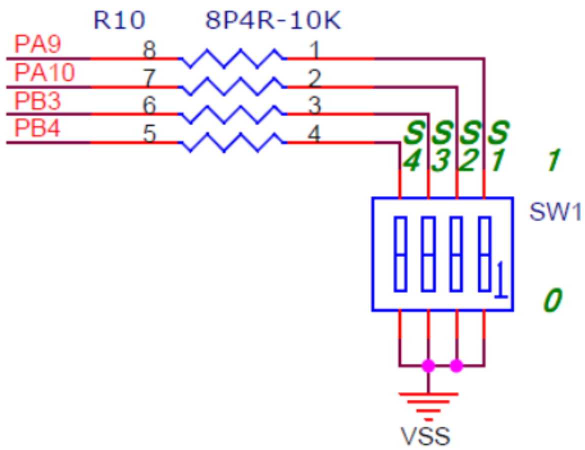


4.5 Boot Select

The power-on setting is used to configure the chip to enter the specified state when the chip is powered up or reset. Since each pin of power on setting has an internal pulled-up resistor when in reset period. If the application needs to set the configuration to “0”, the proper pull-down resistor of 10K-ohm must be added for the corresponding configuration pins.

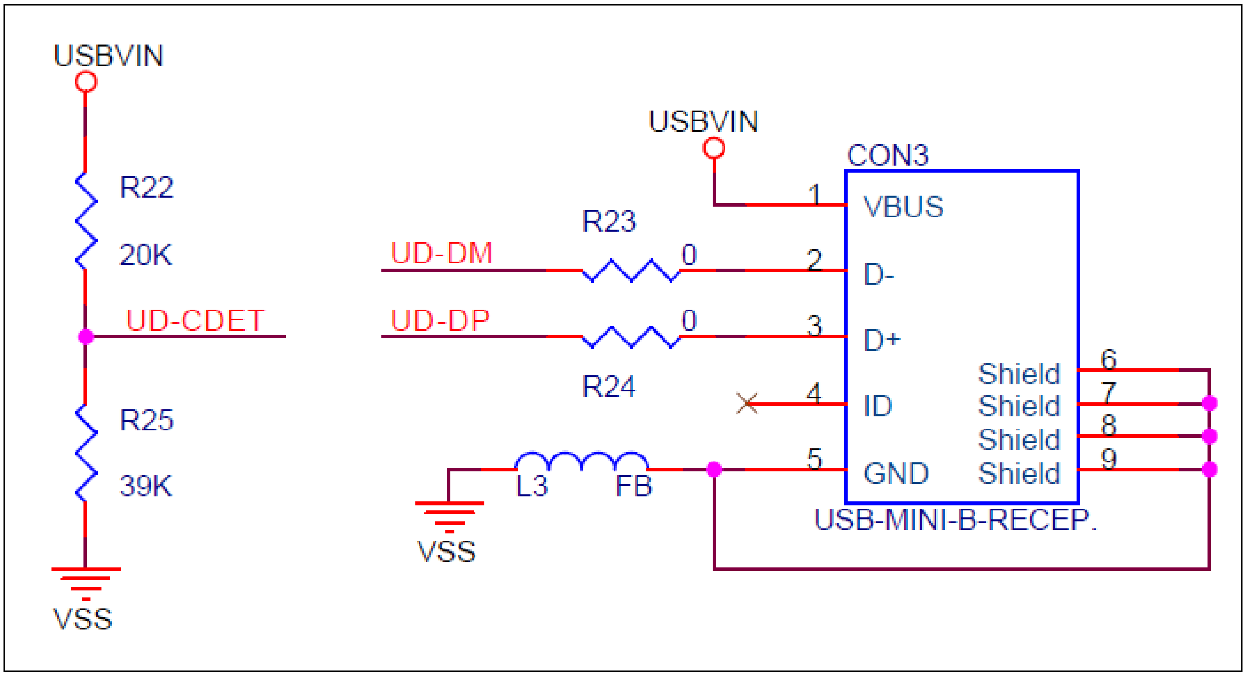
Power Setting

S4	S3	S2	S1	
PB4	PB3	PA10	PA9	
0	1	1	0	ICE-Ext.-SPI
0	1	1	1	ICE-SPI
1	0	1	1	ICP
1	1	0	1	Ext.-SPI
1	1	1	0	USB
1	1	1	1	SPI



4.6 USB 2.0 High Speed Device

The layout rule needs to take USB 2.0 high speed device.



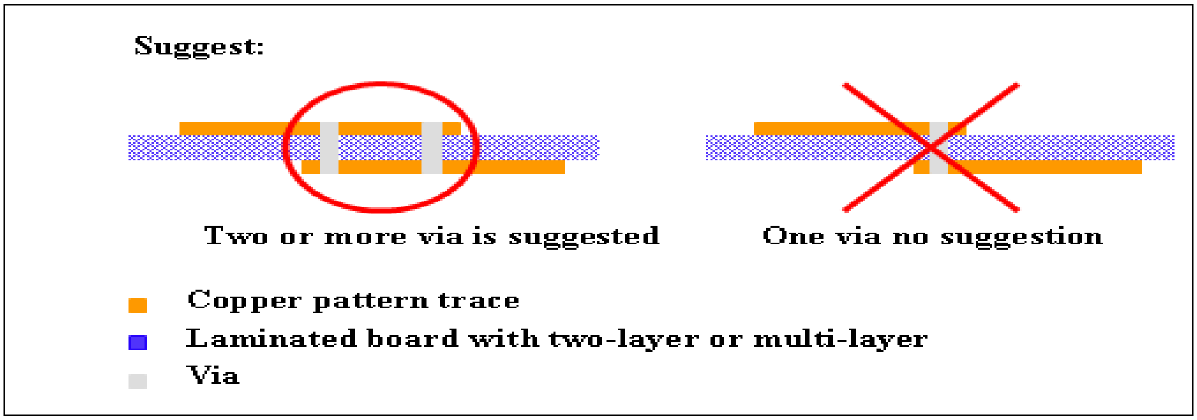
4.6.1 PCB Layer Stack-up

For a USB 2.0 high-speed design, recommend to use at least a four-layer PCB for best signal characteristics. The majority of signal traces should run on a single layer, next to this layer should be the GND plane, which is solid with no cuts. Avoid running signal traces across a split in the ground or power plane. Minimizing the number of signal vias reduces EMI by reducing inductance at high frequencies.

If you attempt a two-layer board, you will need to reduce the thickness of the PCB along with increasing separation of traces and increased trace widths to maintain the impedance match of the D+ and D- data lines. To put things in perspective, what would be D+ and D- lines at 6mil trace and 6mil space in a four layer board become 18mils wide with 8mil spacing in a two-layer board.

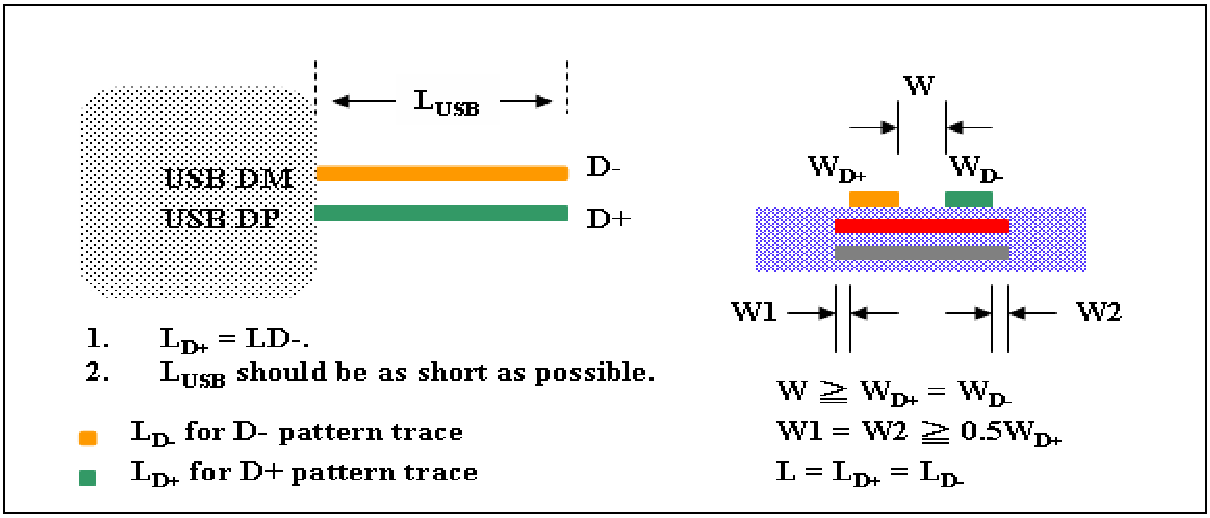
4.6.2 Through Hole for D+ and D-

For the two-layer or multi-layer of PCB, when the signals of D+ and D- need to be through another layer, in which the resistively of through hole should be concerned. To lower the resistively issue for the sensitivity case, the two-via or multi-via should be adapted, as shown in the following figure.



4.6.3 Signal Trace for D+ and D-

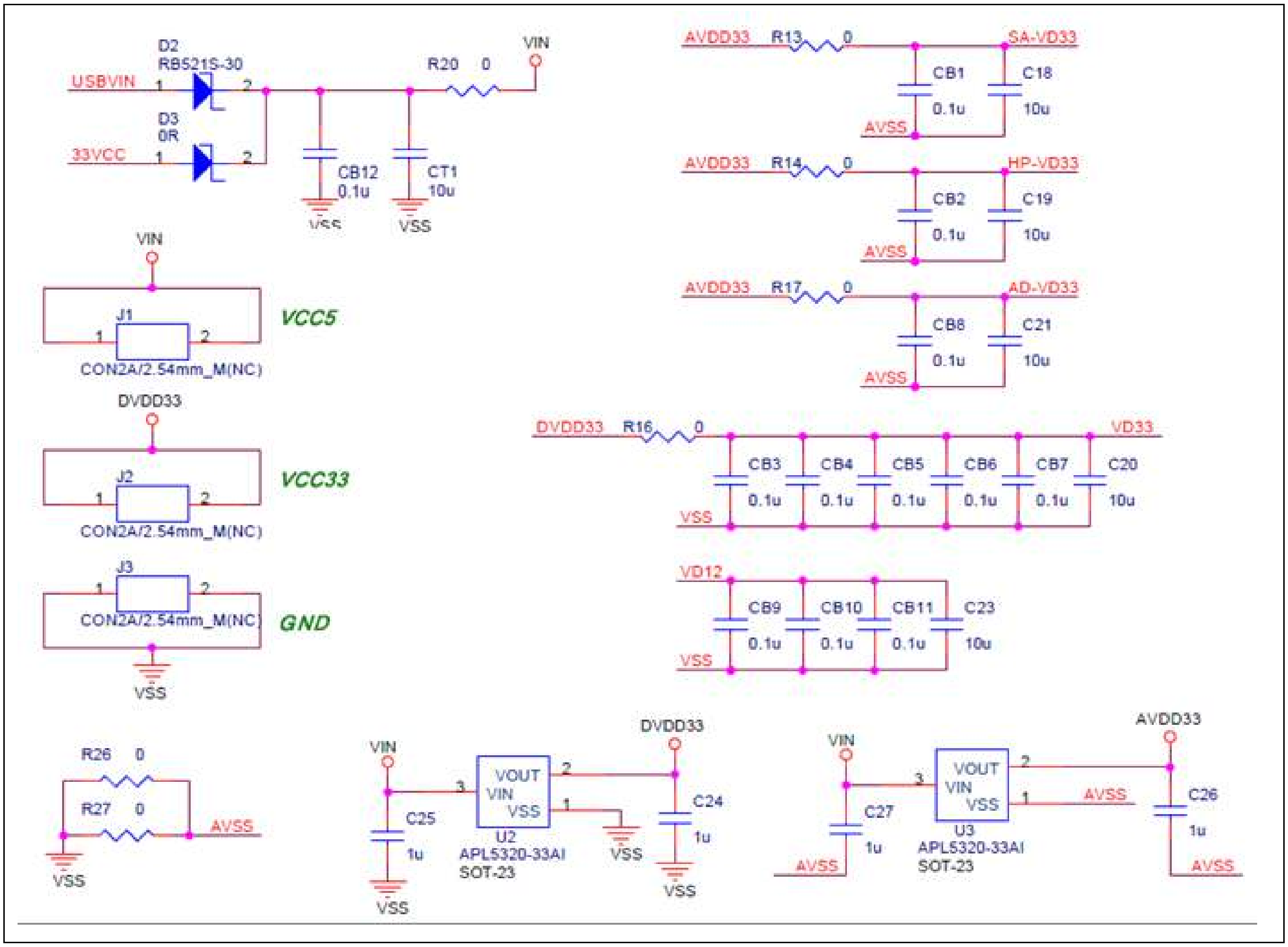
To avoid the trace effect signal for the eye diagram, the trace length should be almost the same of D+ and D-. Then, the characteristic impedance should be a symmetrical path for the differential end of the USB port. The characteristic impedance should be 90 Ω for USB 2.0 high speed. For reducing the trace length, the USB terminal should be as close as the USB port of NUC505 series MCUs.



4.6.4 Others PCB Design Guideline for USB 2.0

- Control differential impedance on USB traces (90 ohm)
- Isolate USB traces from other circuitry and signals
- Keep bulk capacitors for down-stream port's VBUS power close to connectors
- Isolate crystal and oscillator
- Isolate VRES resistor and keep short traces
- Bypass capacitors placed on bottom side to reduce board space

4.7 Power

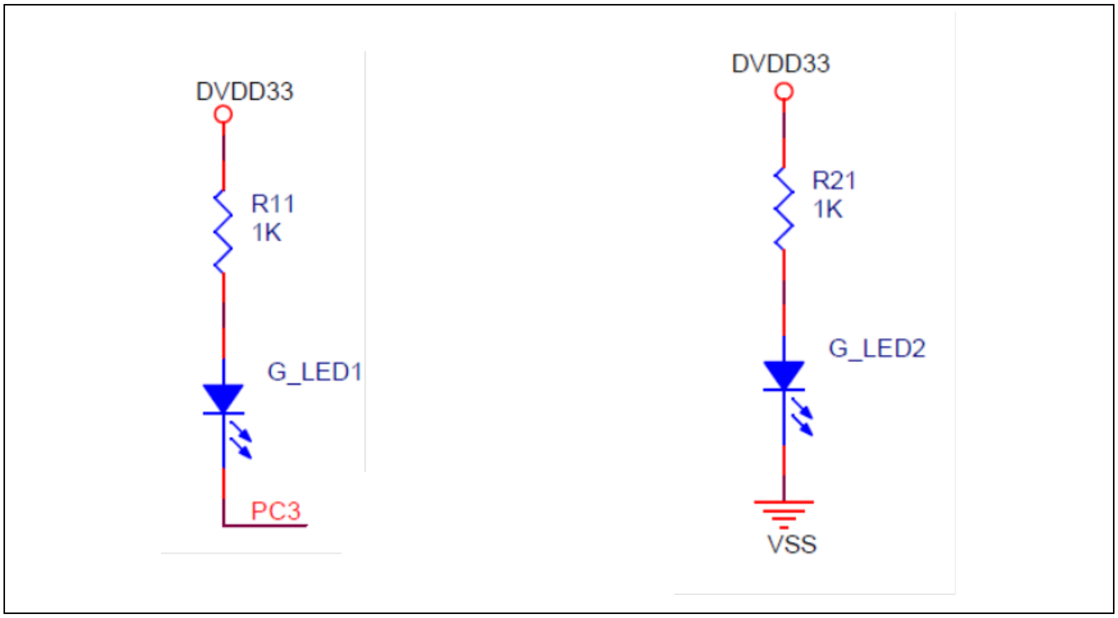


Note:The 0 ohm resister can short in user application.

4.8 LED

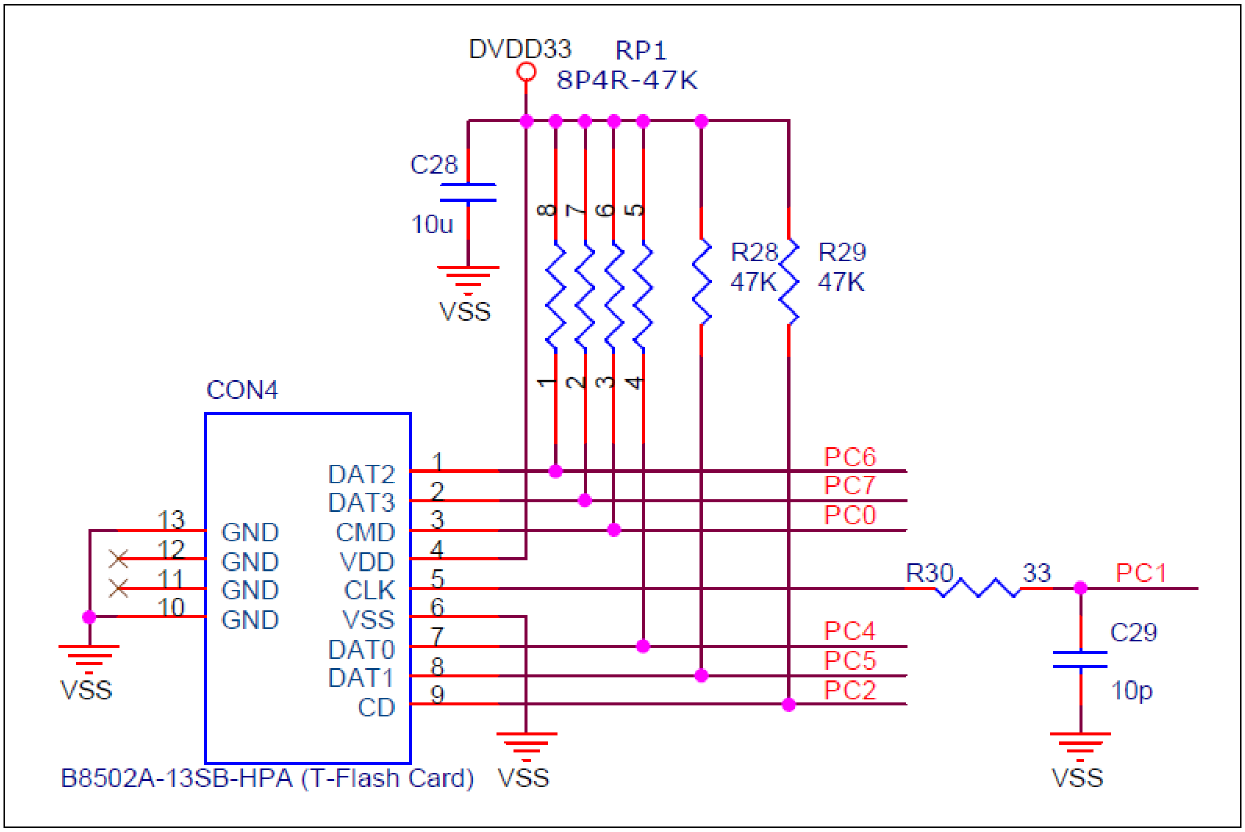
The G_LED2 shows when VDD33 has been supplied.

GPIO PC3 can control G_LED1 to toggle LED.



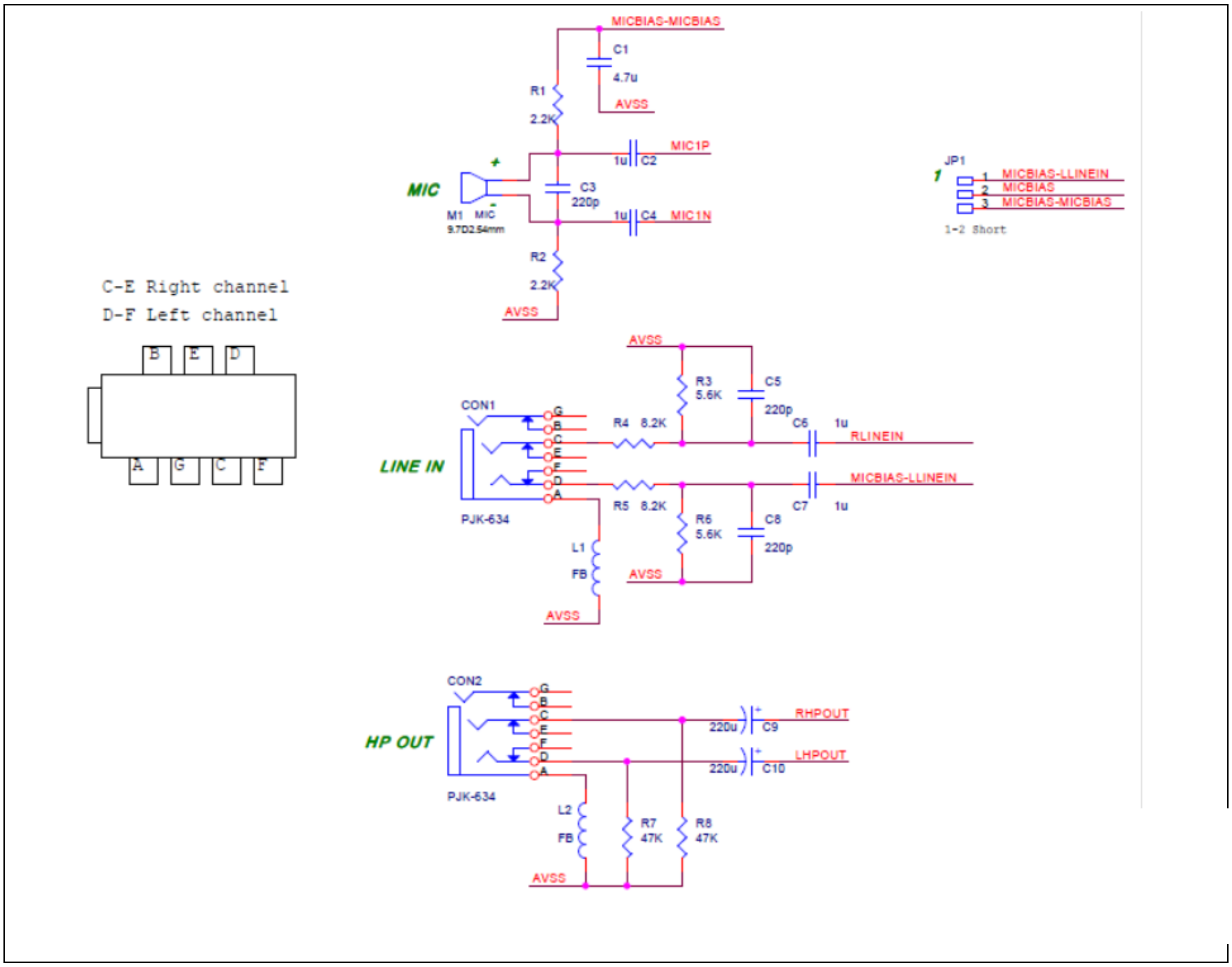
4.9 Micro SD Card Slot

CON4 is micro SD Card Slot, it is access by SHDC mode, Max clock can run 50 MHz



4.10 Audio Line In, Headphone Out and MIC

For audio application, the headphone out for audio out, JP1 is bais voltage select for MIC(2-3 short) or line in(1-2 short).

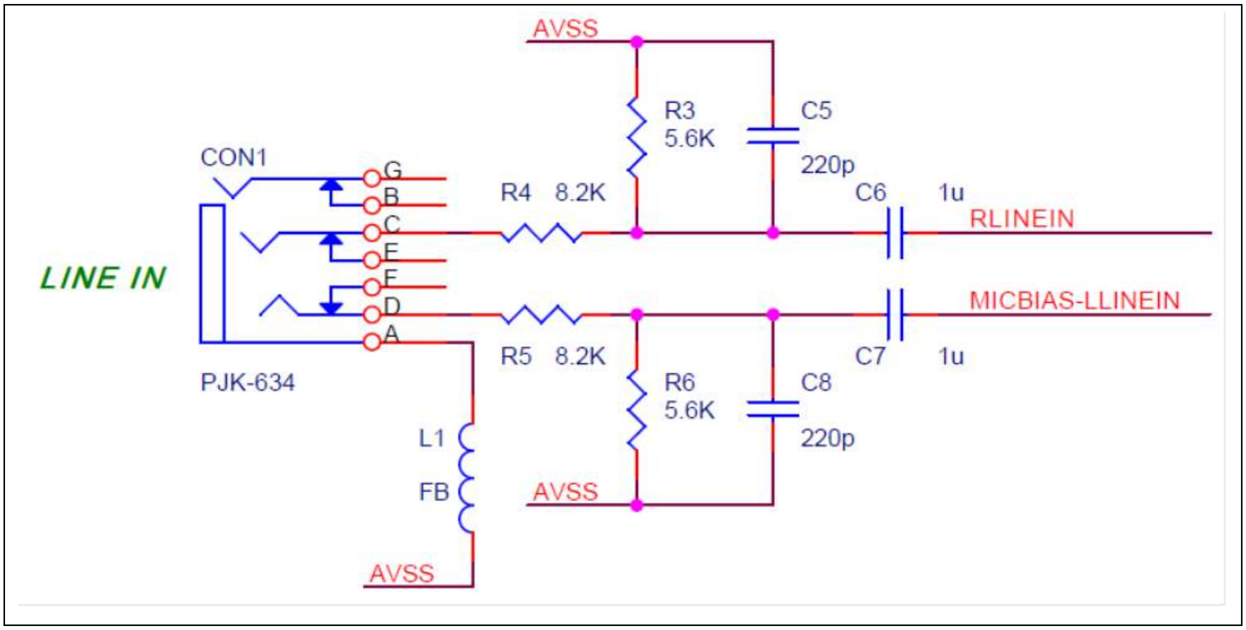


4.10.1 Audio Line In

The device provides left and right channel line-in inputs. The inputs are high impedance, low capacitance AC coupled.

All inputs include independent PGA (programmable gain amplifier) and mute function. Passive RF and active Anti-Alias filters are also incorporated within the line inputs to prevent high frequencies aliasing into the audio band or otherwise degrading performance.

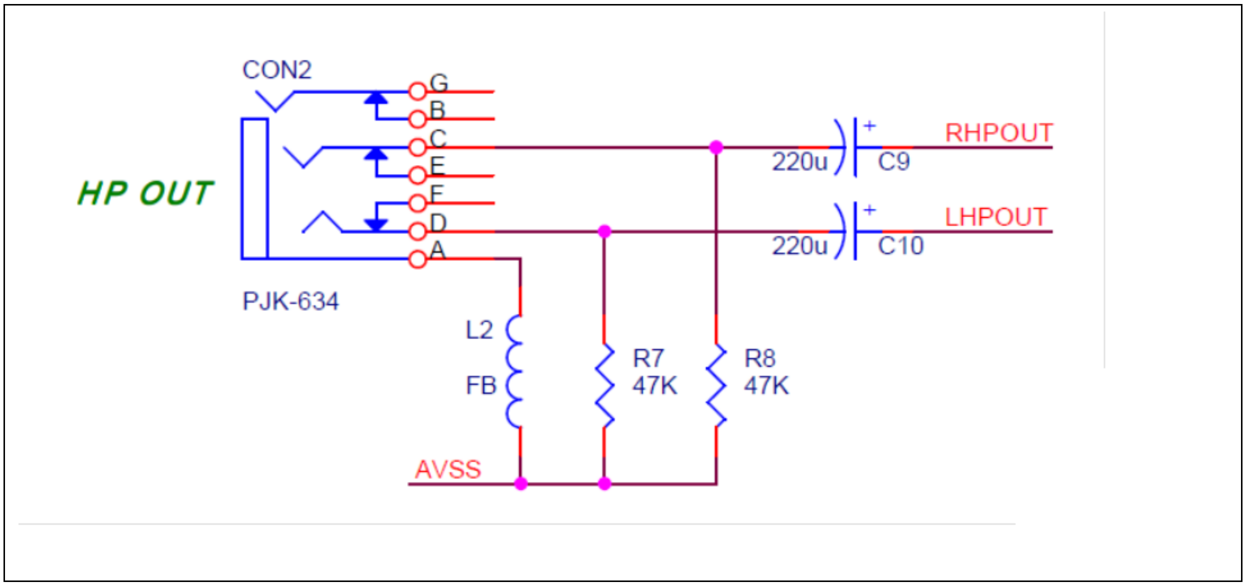
The inputs are biased internally through the operational amplifier to Bais. The external components required to complete the line input application are shown in the following figure.



4.10.2 Audio Headphone Out

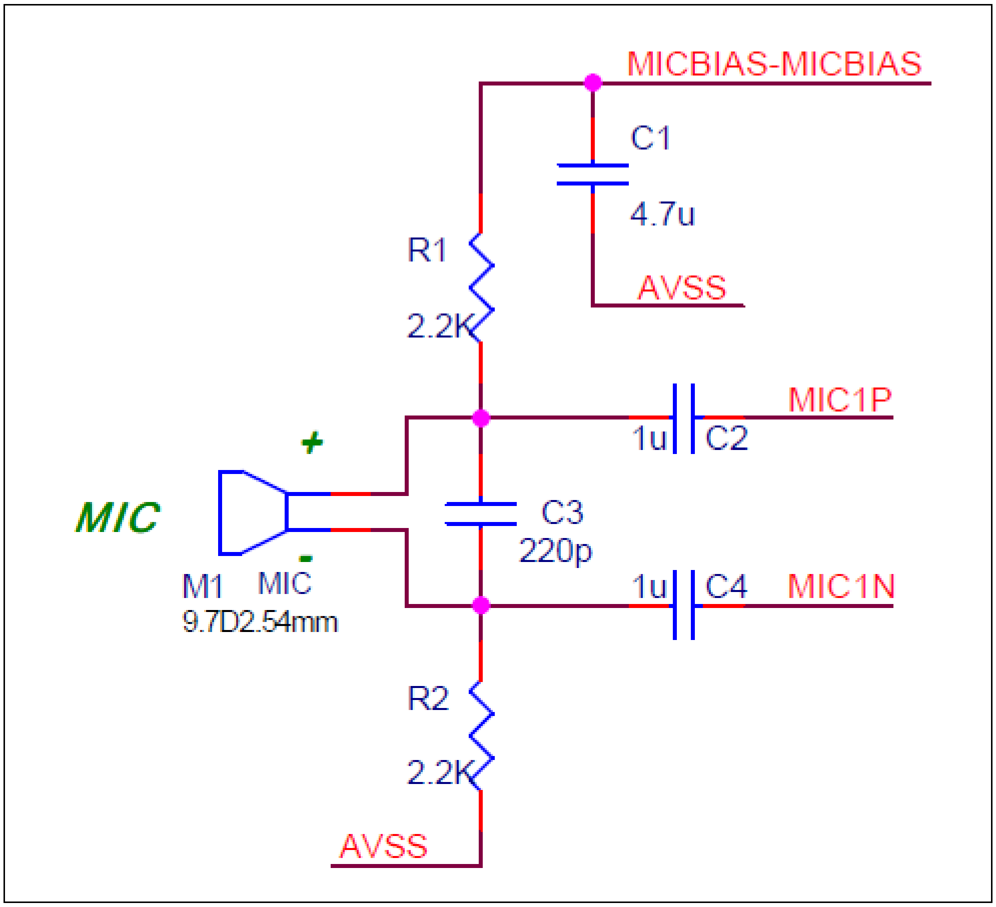
This device provides two low impedance line outputs (LHPOUT and RHPOUT), suitable for driving typical line loads of impedance 10k and capacitance 50pF.

The recommended external components are shown in the figure below:



4.10.3 Microphone In

The device supports 2 types of Microphone inputs that can be either differential or single-ended, The differential mode as shown below.



5 REVISION HISTORY

Date	Revision	Description
2015.2.8	1.00	1. Initially issued.
2015.12.1	1.01	1. Change the schematic, placement and layout.
2017. 11.11	1.02	1. Change the schematic, placement and layout.
2018.6.11	1.03	1. Fix in typo section 4.2.

Important Notice

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Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

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