

# MIMXRT1050 EVK Board Hardware User's Guide

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### 1. Introduction

This document is a Hardware User's Guide for the MIMXRT1050 Evaluation Kit (EVK) based on the NXP Semiconductor i.MX RT1050 Processor. This board is fully supported by NXP Semiconductor. This manual includes system setup and debugging, and provides detailed information on the overall design and usage of the EVK board from a hardware systems perspective.

#### 1.1. Board overview

This EVK board is a platform designed to showcase the most commonly used features of the i.MX RT1050 Processor in a small, low cost package. The MIMXRT1050 EVK board is an entry level development board, which gives the developer the option of becoming familiar with the processor before investing a large amount of resources in more specific designs.

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Features of the MIMXRT1050 EVK board are shown in [Table 1](#)

**Table 1. Board features**

<b>Processor</b>	NXP Processor	MIMXRT1052DVL6A
<b>DRAM Memory</b>	SDRAM 256 Mb, 166MHz	MT48LC16M16A2B4-6AIT: G
<b>DCDC</b>	MPS	MP2144GJ
<b>LDO</b>	UNION	UM1550S-18 UM1750S-00
<b>Mass Storage</b>	TF Card Slot	
	64 Mbit Quad SPI Flash	
	512 Mbit Hyper Flash	
<b>Display Interface</b>	LCD Connector	
<b>Ethernet</b>	10/100 Mbit/s Ethernet Connector. PHY Chip: KSZ8081RNB	
<b>USB</b>	USB 2.0 OTG Connector	
	USB 2.0 Host Connector	
<b>Audio Connector</b>	3.5 mm Audio Stereo Headphone Jack	
	Board-Mounted Microphone	
	Left & Right Speaker Out Connectors	
	SPDIF Interface(unpopulated)	
<b>Power Connector</b>	5V DC-Jack	
<b>Debug Connector</b>	JTAG 20-pin Connector (SWD by default)	
	OpenSDA with DAP-Link	
<b>Sensor</b>	FXOS8700CQ: 6-Axis Ecompass (3-Axis Mag, 3-Axis Accel)	
<b>Camera</b>	CMOS Sensor Interface	
<b>CAN</b>	CAN Bus Connector	
<b>User Interface Button</b>	ON/OFF, POR Reset, POWER Reset, USER Button	
<b>Led Indicator</b>	Power Status, Reset, OpenSDA, USER LED	
<b>Expansion Port</b>	Arduino Interface	
<b>PCB</b>	3.937-inch x 5.9055-inch (10cm x 15cm), 4-layer board	

## 1.2. MIMXRT1050 EVK Contents

The MIMXRT1050 EVK contains the following items:

- MIMXRT1050 EVK Board
- USB Cable (Micro B)

## 1.3. MIMXRT1050 EVK Board revision history

- Rev A: Prototype.
- Rev A1/2: Pilot Board

## 2. Specifications

This chapter provides detailed information about the electrical design and practical considerations of the EVK Board, and is organized to discuss each block in the following block diagram of the EVK board.

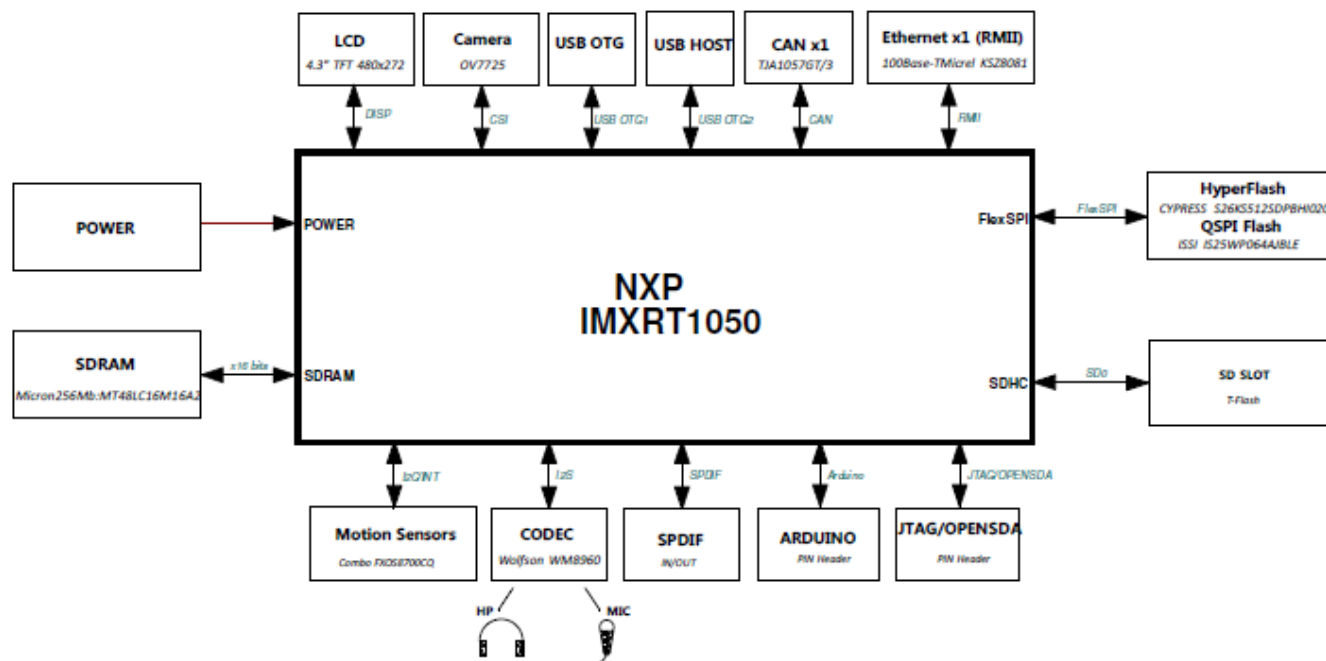


Figure 1. Block diagram

The overview of the MIMXRT1050 EVK Board is shown in *Figure 1* & *Figure 2*.

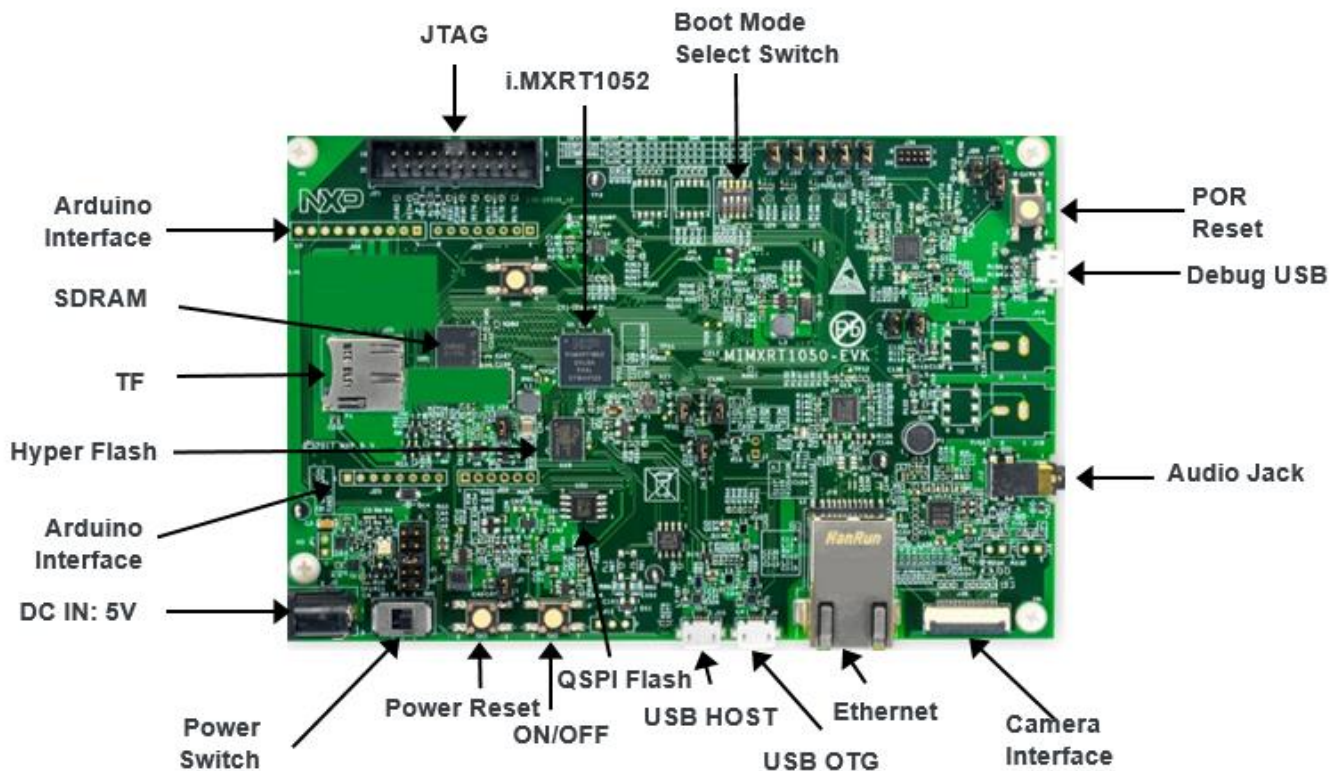


Figure 2. Overview of the MIMXRT1050 EVK Board (Front side)

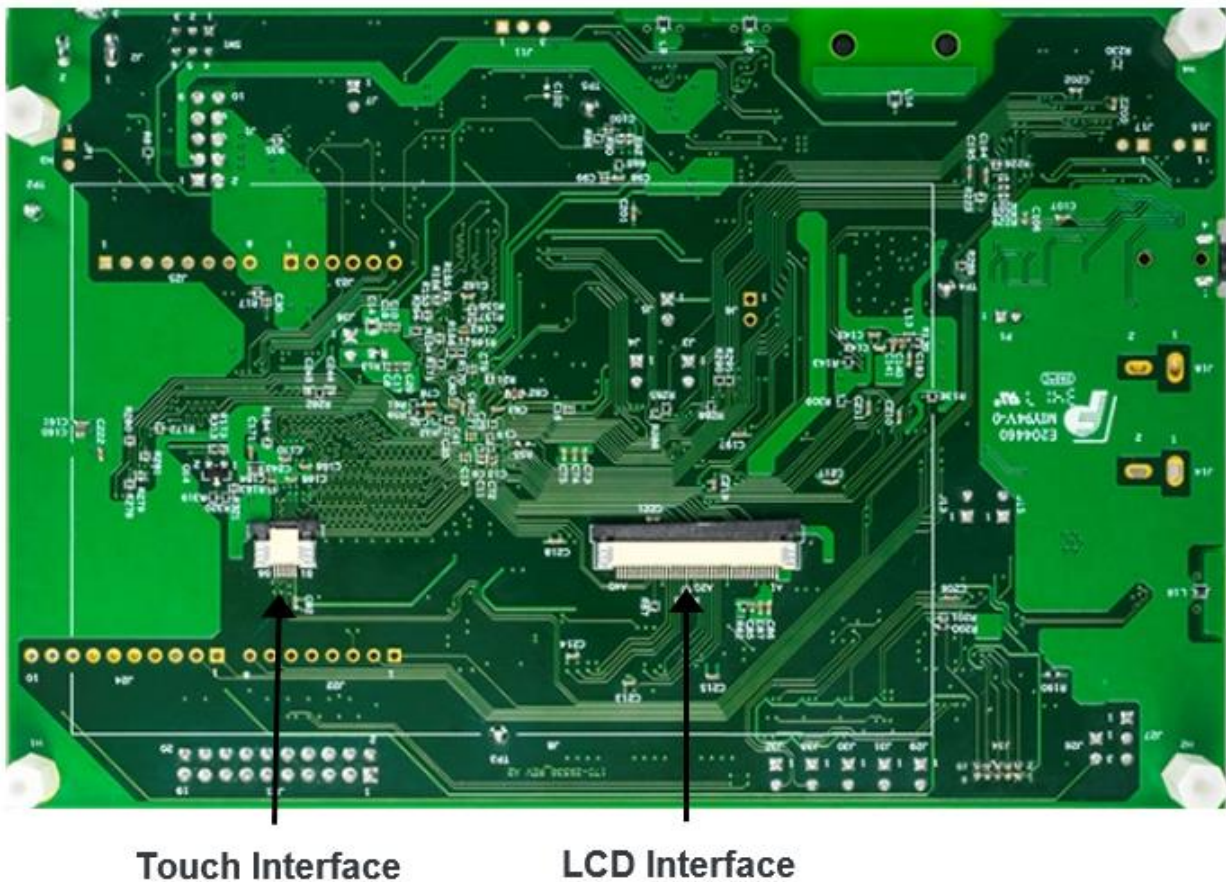


Figure 3. Overview of the MIMXRT1050 EVK Board (Back side)

## 2.1. i.MX RT1050 Processor

The i.MX RT1050 is a new processor family featuring NXP's advanced implementation of the ARM Cortex-M7 Core. It provides high CPU performance and best real-time response. The i.MX RT1050 provides various memory interfaces, including SDRAM, Raw NAND FLASH, NOR FLASH, SD/eMMC, Quad SPI, HyperBus and a wide range of other interfaces for connecting peripherals, such as WLAN, Bluetooth™, GPS, displays, and camera sensors. Same as other i.MX processors, i.MX RT1050 also has rich audio and video features, including LCD display, basic 2D graphics, camera interface, SPDIF and I2S audio interface.

The i.MX RT1050 applications processor can be used in areas such as industrial HMI, IoT, motor control and home appliances. The architecture's flexibility enables it to be used in a wide variety of other general embedded applications too. The i.MX processor provides all interfaces necessary to connect peripherals such as WLAN, Bluetooth™, GPS, camera sensors, and multiple displays.

The more detail information about i.MX RT1050 can be found in the [Datasheet and Reference manual](#).

## 2.2. Boot Mode Configurations

The device has four boot modes (one is reserved for NXP use). The boot mode is selected based on the binary value stored in the internal BOOT\_MODE register. Switch (SW7-3 & SW7-4) is used to select the boot mode on the MIMXRT1050 EVK Board.

**Table 2. Boot Mode pin settings**

BOOT_MODE[1:0] (SW7-3 SW7-4)	BOOT Type
00	Boot From Fuses
01	Serial Downloader
10	Internal Boot
11	Reserved

Typically, the internal boot is selected for normal boot, which is configured by external BOOT\_CFG GPIOs. The following [Table 3](#) shows the typical Boot Mode and Boot Device settings.

**Table 3. Typical Boot Mode and Boot Device settings**

SW7-1	SW7-2	SW7-3	SW7-4	Boot Device
OFF	ON	ON	OFF	Hyper Flash
OFF	OFF	ON	OFF	QSPI Flash
ON	OFF	ON	OFF	SD Card

### NOTE

For more information about boot mode configuration, see the System Boot chapter of the [MIMXRT1050 Reference Manual](#).

For more information about MIMXRT1050 EVK boot device selection and configuration, see the [main board schematic](#).

## 2.3. Power Tree

A DC 5V external power supply is used to supply the MIMXRT1050 EVK Board at J2, and a slide switch SW1 is used to turn the Power ON/OFF. J28 and J9 also can be used to supply the EVK Board. Different power supply need to configure different Jumper setting of J1. [Table 4](#) shows the details:

**Table 4. Jumper settings of Power Supply**

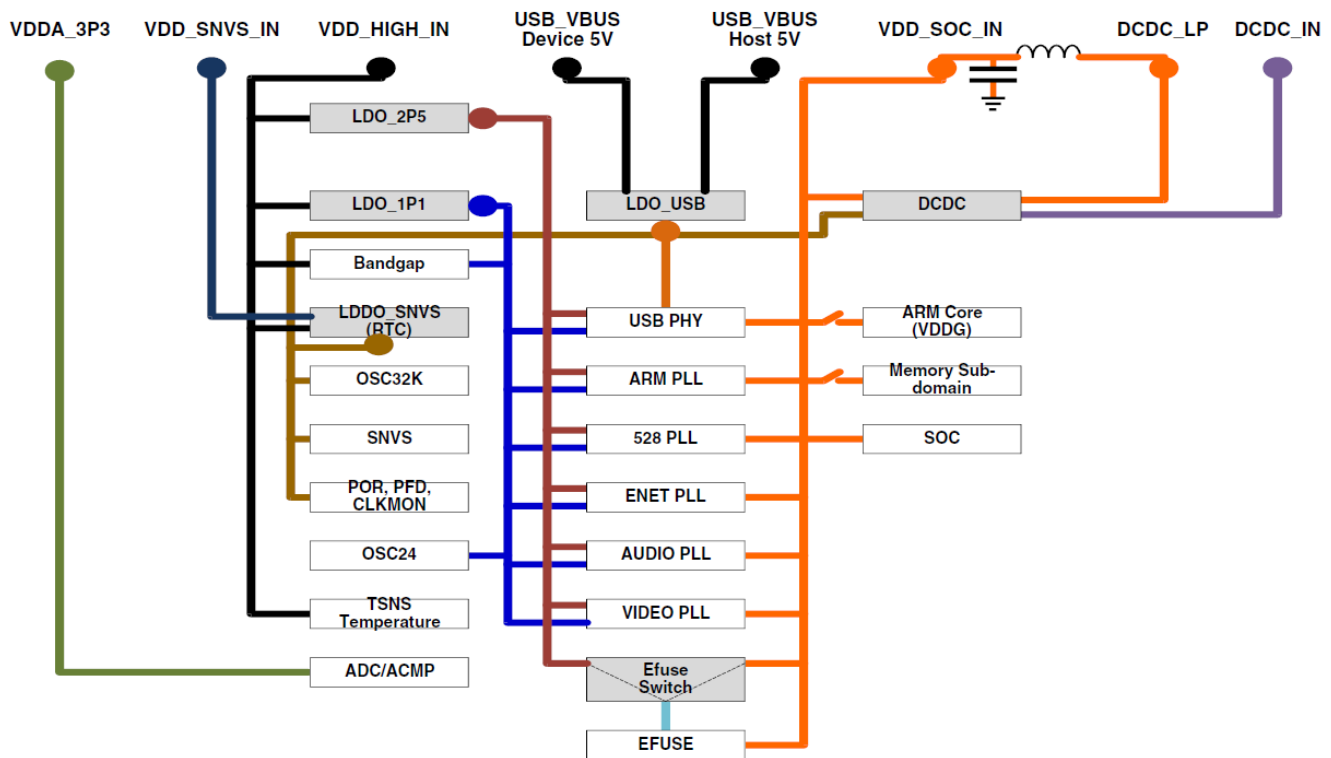
Power Supply	J1 Setting
J2	1-2
J9	3-4

J28	5-6
-----	-----

**NOTE**

For some computers' USB, it cannot support 500ma before establishing communication. In this case, it is recommended to replace the computer or use the power adapter(J2) to power the EVK Board.

The power tree is shown in the following figure.



**Figure 4. Power Tree**

The power control logic of the MIMXRT1050 EVK board is shown in the following figure:

- It will power up SNVS and DCDC\_IN together firstly, then PMIC\_REQ\_ON will be switched on to enable external DC/DC to power up other power domains.
- ON/OFF button is used to switch ON/OFF PMIC\_REQ\_ON to control power modes.
- RESET button and WDOG output are used to reset the system power.

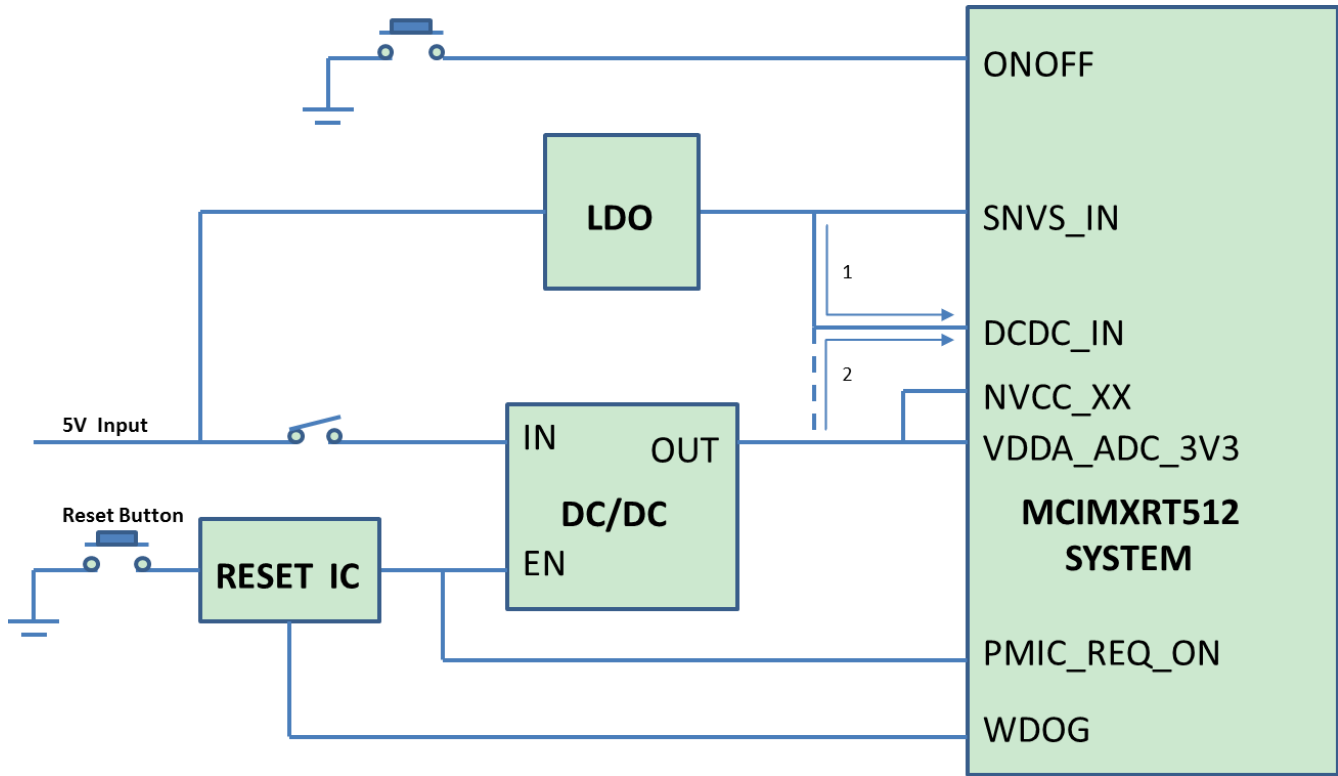


Figure 5. Power Control Diagram

**NOTE**

Power Control Diagram described in MIMXRT1050 EVK Board is true for TO1.0 For TO2.0, DCDC\_IN is expected to be powered with other domains together.

In the other word, for TO1.0 the DCDC\_IN is powered with LDO (Path 1). And for TO2.0, it is expected to be powered with DC/DC (Path 2).

For silicon TO1.0, please following above power logic as if not power the SNVS together with DCDC\_IN, the on chip DCDC module will not power up correctly.

The power rails on the board are shown in [Table 5](#).

**Table 5. Power Rails**

Power Rail	MIN (V)	TYP (V)	MAX (V)	Description
VDD_SOC_IN	0.925	--	1.26	Core supplies input voltage
VDD_HIGH_IN	3	3.3	3.6	VDD_HIGH_IN supply voltage
DCDC_IN	2.9 <sup>1</sup>	3.0 <sup>1</sup>	3.1 <sup>1</sup>	Power for DCDC



VDD_SNV5_IN	2.4	3	3.6	Power for SNVS and RTC
USB_OTG1_VBUS USB_OTG2_VBUS	4.4	5	5.5	Power for USB VBUS
VDDA_ADC	3	3.3	3.6	Power for 12-bit ADC
VDDA_IN	3	3.3	3.6	Power for 12-bit ADC
NVCC_SD0	3	3.3	3.6	Power for GPIO in SDIO1 bank (3.3V mode)
	1.65	1.8	1.95	Power for GPIO in SDIO1 bank (1.8V mode)
NVCC_SD1	3	3.3	3.6	Power for GPIO in SDIO2 bank (3.3V mode)
	1.65	1.8	1.95	Power for GPIO in SDIO2 bank (1.8V mode)
NVCC_EMC	3	3.3	3.6	IO supply for GPIO in EMC bank (3.3 V mode)
	1.65	1.8	1.95	IO supply for GPIO in EMC bank (1.8 V mode)
NVCC_GPIO	3	3.3	3.6	IO power for GPIO

<sup>1</sup> For TO1.0, DCDC\_IN voltage domain is 2.9V~3.1V, while for TO1.1 and later DCDC\_IN voltage domain is 3.0~3.6V

## 2.4. SDRAM memory

One 256 Mb, 166MHz SDRAM (MT48LC16M16A2B4-6AIT: G) is used on the EVK Board.

## 2.5. SD Card Slot

There is a SD card slot(J20) on the MIMXRT1050 EVK Board.J20 is the Micro SD slot for USDHC1 interface. If the developer wants to boot from the SD Card, the boot device switch (SW7) settings should be: ON, OFF, ON, OFF, as shown in Table 3.

## 2.6. Hyper Flash

On the MIMXRT1050 EVK Board, there is one 512Mbit Hyper Flash device. If the developer wants to boot from the Hyper Flash, the boot device switch (SW7) settings should be: OFF, ON, ON, OFF, as shown in Table3.

## 2.7. QSPI Flash

A 64Mbit QSPI Flash is used on the MIMXRT1050 EVK Board. If the developer wants to boot from the QSPI Flash, the boot device switch(SW7) settings should be: OFF, OFF, ON, OFF, as shown in Table3.

By default, this QSPI Flash is disabled on the EVK. To enable it, Hyper Flash should be removed when the QSPI Flash is selected as the boot device. And R153, R154, R155, R156, R157, R158 should add 0 Ohm resistors.

## 2.8. Ethernet Connector

There is one Ethernet Mac controller in the MIMXRT1050 processor. The Ethernet subsystem of the MIMXRT1050 EVK Board is provided by the KSZ8081RNB 10/100M Ethernet Transceiver (U16) and a RJ45 (J19) with integrated Magnetic.

The MAC address is shown on the stick upon the RJ45 connector.



Figure 6. Ethernet Connector RJ45

## 2.9. USB PHY Connector

The MIMXRT1050 contains 2 integrated USB 2.0 PHYs capable of connecting to USB host/device systems at the USB low-speed (LS) rate of 1.5 Mb/s, full-speed (FS) rate of 12 Mb/s or at the USB 2.0 high-speed (HS) rate of 480 Mb/s.

## 2.10. Audio input / output Connector

The Audio CODEC used on the MIMXRT1050 EVK Board is Wolfson's Low Power, high quality Stereo Codec, WM8960. The MIMXRT1050 EVK Board include one headphone interface (J12), one

onboard MIC (P1), two speaker interfaces (J16, J17), and the SPDIF interface (J14 & J18, DNP). J12 is a 3.5mm audio stereo headphone jack, which supports jack detect.

## 2.11. OpenSDA circuit (DAP-Link)

The OpenSDA circuit (CMSIS–DAP) is an open-standard serial and debug adapter. It bridges serial and debug communications between a USB host and an embedded target processor.

CMSIS-DAP features a mass storage device (MSD) bootloader, which provides a quick and easy mechanism for loading different CMSIS-DAP Applications such as flash programmers, run-control debug interfaces, serial-to-USB converters, and more. Two or more CMSIS-DAP applications can run simultaneously. For example, run-control debug application and serial-to-USB converter runs in parallel to provide a virtual COM communication interface while allowing code debugging via CMSIS-DAP with just single USB connection.

For the MIMXRT1050 EVK Board, J28 is the connector between the USB host and the target processor. Jumper to serial downloader mode to use stable DAP-Link debugger function. If developer wants to make OpenSDA going to the bootloader mode, J27 should jumper to 1-2, and press SW4 when power on. Meanwhile, the OpenSDA supports drag/drop feature for U-Disk. First, use the serial downloader mode and drag/drop the image file to U-Disk. Then select Hyper Flash as boot device and reset the Board, the image will run.

## 2.12. JTAG Connector

J21 is a standard 20-pin/2.54mm Box Header Connector for JTAG. The pin definitions are shown in the following figure. Support SWD by default.

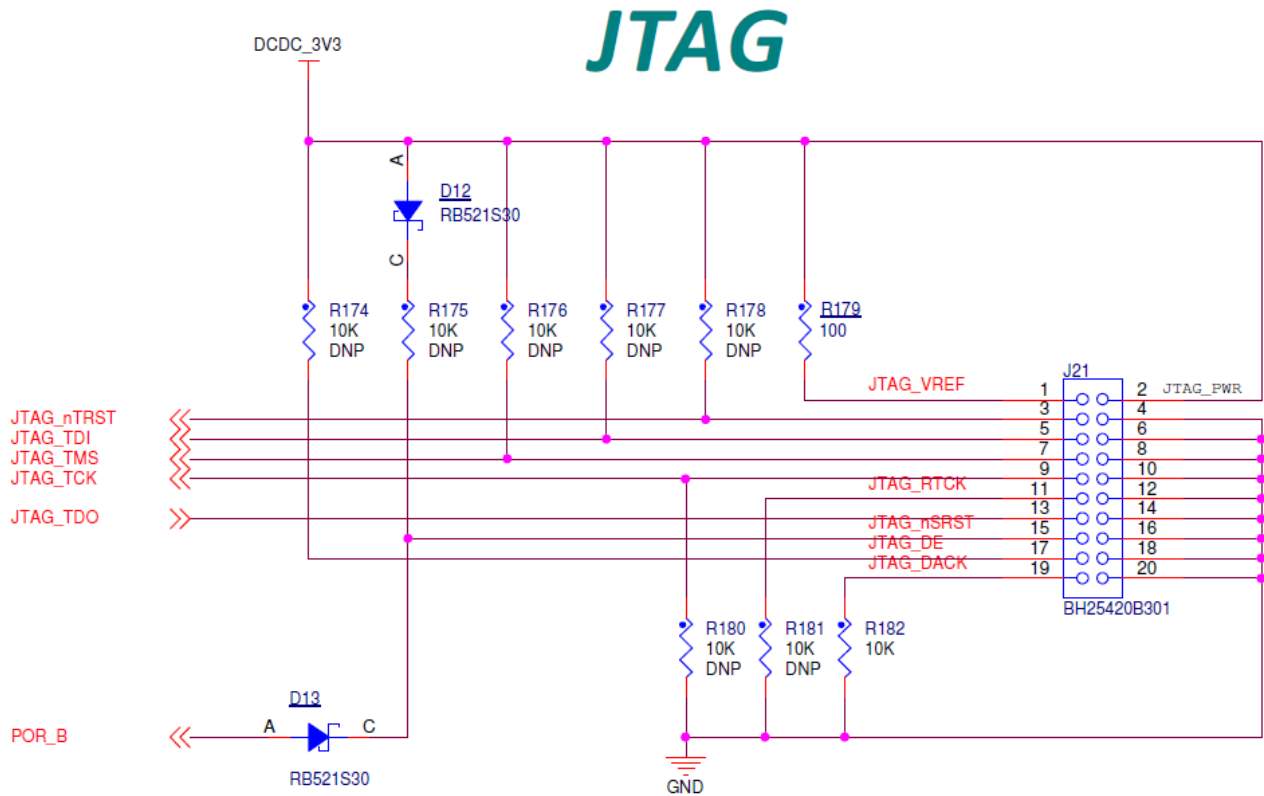


Figure 7. JTAG pin definitions

## 2.13. Arduino Expansion Port

J22 – J25 (unpopulated) is defined as Arduino Interface. The pin definitions of Arduino Interface are shown in [Table 6](#).

Table 6. Arduino Interface pin definitions

J22	J23
UART_RX/D0	A0/ADC0
UART_TX/D1	A1/ADC1
D2/INT0	A2/ADC2
D3/INT1/PWM/OC2B	A3/ADC3
D4/T0/XCK	A4/ADC4/SDA
D5/TI/PWM	A5/ADC5/SCL
D6/AIN0/PWM/OC0A	
D7/AIN1/PWM	

J24	J25
D8/CLKO/ICP1	NC
D9/OC1A/PWM	IOREF
D10/SPI_CS	RESET
D11/OC2A/PWM/SPI_MOSI	3.3V
D12/SPI_MISO	5V
D13/SPI_CLK	GND
GND	GND
AREF	VIN
D14/I2C_SDA	
D15/I2C_SCL	

## 2.14. Camera Module Connector

One parallel CSI (Camera Sensor Interface) is supported by the i.MX RT1050. There is a Camera Module Connector (J35) on the MIMXRT1050 EVK Board. The CA031C based on OV7725 can be used directly.



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**Figure 8. Camera module installation diagram****NOTE**

If developers want to use Camera Module, R217, R218, R220, R221, R222, R223, R224, R225, R226, R227, R228 and R229 should add 0 Ohm resistor.

## 2.15. User Interface Switch

There are four user interface switches on the MIMXRT1050 EVK Board. Their functionality is as below.

### 2.15.1. Power Switch

SW1 is a slide switch to control the power of the MIMXRT1050 EVK Board when the power supply is from J2. The function of this switch is listed below:

- Sliding the switch to the ON position connects the 5V power supply to the Evaluation board main power system.
- Sliding the switch to OFF position immediately removes all power from the board.

### 2.15.2. ON/OFF Button

SW2 is the ON/OFF button for MIMXRT1050 EVK Board. A short pressing in OFF mode causes the internal power management state machine to change state to ON. In ON mode, a short pressing generates an interrupt (intended to be a software-controllable(power-down)). An approximate 5 seconds or more pressing causes a forced OFF. Both boot mode inputs can be disconnected.

### 2.15.3. Reset Button

There are two Reset Button on the EVK Board. SW3 is the Power Reset Button. Pressing the SW3 in the Power On state will force to reset the system power except SNVS domain. The Processor will be immediately turn off and reinitiate a boot cycle from the Processor Power Off state. SW4 is POR Reset Button.

### 2.15.4. USER Button

SW8 is the USER Button(GPIO5-00) for developers using. Pressing can produce changes in high and low levels.

## 2.16. Sensor

U32 on the EVK Board is a 6-Axis Ecompass (3-Axis Mag, 3-Axis Accel) sensor FXOS8700CQ. The Ecompass is connected to i.MX RT1050 I2C1 port.

## 2.17. User Interface LED Indicator

There are four LED status indicators located on the EVK Board. The functions of these LEDs include:

- Main Power Supply(D3)  
Green: DC 5V main supply is normal.  
Red: J2 input voltage is over 5.6V.  
Off: the board is not powered.
- Reset RED LED(D15)
- OpenSDA LED(D16)
- USER LED(D18)

## 2.18. LCD Interface

The enhanced Liquid Crystal Display Interface (eLCDIF) is a general purpose display controller.

The eLCDIF block supports the following:

- Displays that support moving pictures and require the RGB interface mode (DOTCLK interface).

The eLCDIF provides fully programmable functionality to supported interfaces:

- Bus master interface to source frame buffer data for display refresh.
- 8/16/18/24/32 bit LCD data bus support available depending on I/O mux options.
- Programmable timing and parameters for DOTCLK LCD interfaces.

If developers want to use LCD, NXP provides an optional LCD module RK043FN02H-CT which has a 4.3 inches touch-screen and supports a resolution of up to 480\*3(RGB)\*272. This module contains two FPC cables. The LCD interface can be connected to J8(A1-A40) and the CPT interface can be connected to J8(B1-B6). LCD modules can be purchased from the NXP website.

## 3. PCB Information

The MIMXRT1050 EVK Board is made using standard 4-layer technology. The material used was FR-4. The PCB stack-up information is shown in [Table 7](#).

Table 7. Board stack-up information

Layer	Description	Copper(Oz)	Dielectric Thickness(mil)
1	Signal	1	—
	Dielectric	—	3
2	GND	1	—
	Dielectric	—	52
3	Power	1	—
	Dielectric	—	3
4	Signal	1	—

## 4. EVK Design Files

The schematics, layout files, and gerber files (including Silkscreen) can be downloaded from [nxp.com/MIMXRT1050-EVK](http://nxp.com/MIMXRT1050-EVK)

## 5. Contents of the Evaluation Kit

Table 8. EVK contents

Item	Description
EVK Board	EVK Board with processor, memory, interfaces, etc
USB Cable	USB cable (Micro-B to Standard-A)

### NOTE

Power adaptor, Micro SD Card, LCD Module and Camera Module are not standard parts of the Evaluation Kit.

## 6. Revision history

*Table 9* summarizes the changes made to this document since the initial release.

Table 9. Revision history

Revision number	Date	Substantive changes
0	08/2017	Initial release
1	11/2017	References/links have been completed





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