

# MIMXRT1050 EVKB Board Hardware User's Guide



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# Chapter 1

## Introduction

This document is a Hardware User's Guide for the IMXRT1050 Evaluation Kit (EVKB) based on the NXP Semiconductor i.MX RT1050 Processor. This board is fully supported by NXP Semiconductor. The manual includes system setup and debugging, and provides detailed information on the overall design and usage of the EVKB 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 IMXRT1050 EVKB 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.

[Table 1](#) describes features of the IMXRT1050 EVKB board.

**Table 1. Board features**

<b>Processor</b>	NXP Processor	MIMXRT1052DVL6B (A1 silicon)
<b>DRAM Memory</b>	SDRAM 256 Mb, 166 MHz	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, Reset, USER Button	
<b>Led Indicator</b>	Power Status, Reset, OpenSDA, USER LED	

*Table continues on the next page...*

**Table 1. Board features (continued)**

<b>Expansion Port</b>	Arduino Interface
<b>PCB</b>	3.937-inch × 5.9055-inch (10 cm × 15 cm), 4-layer board

## 1.2 IMXRT1050 EVKB contents

The IMXRT1050 EVKB contains the following items:

- IMXRT1050 EVKB board
- USB cable (Micro B)

## 1.3 IMXRT1050 EVKB board revision history

- EVKB: Mass product

**NOTE**

1. EVKB boards are based on A1 silicon.
2. Change C88 to 2.2 uf/35 V or 1.0 uf/35 V to ensure the back light control circuits working normally. This change is only for Rev A, A1 and B, but not for Rev B1. For details, see [Figure 1](#).

Rev. Code	Date	By	Description
A	2017-12-22	Shawn Shi	Initial Version
A1	2017-12-22	Shawn Shi	Update BOM: change J22~J25 from DNP to populate, change C245 from populate to DNP
B	2018-11-6	Shawn Shi	Replace K20 OPENSDA with LPC FREELINK, add SWO trace, correct Arduino I2C pinout
B1	2019-2-21	Shawn Shi	Update BOM: change R126 to R129 from populate to DNP, Change C88 to 2.2uF/35V. Add notes for DQS PIN

**Figure 1. EVKB board revision history**

# Chapter 2 Specifications

This chapter provides detailed information about the electrical design and practical considerations of the EVKB Board. Each block of the EVKB board, as shown in [Figure 2](#), will be discussed.

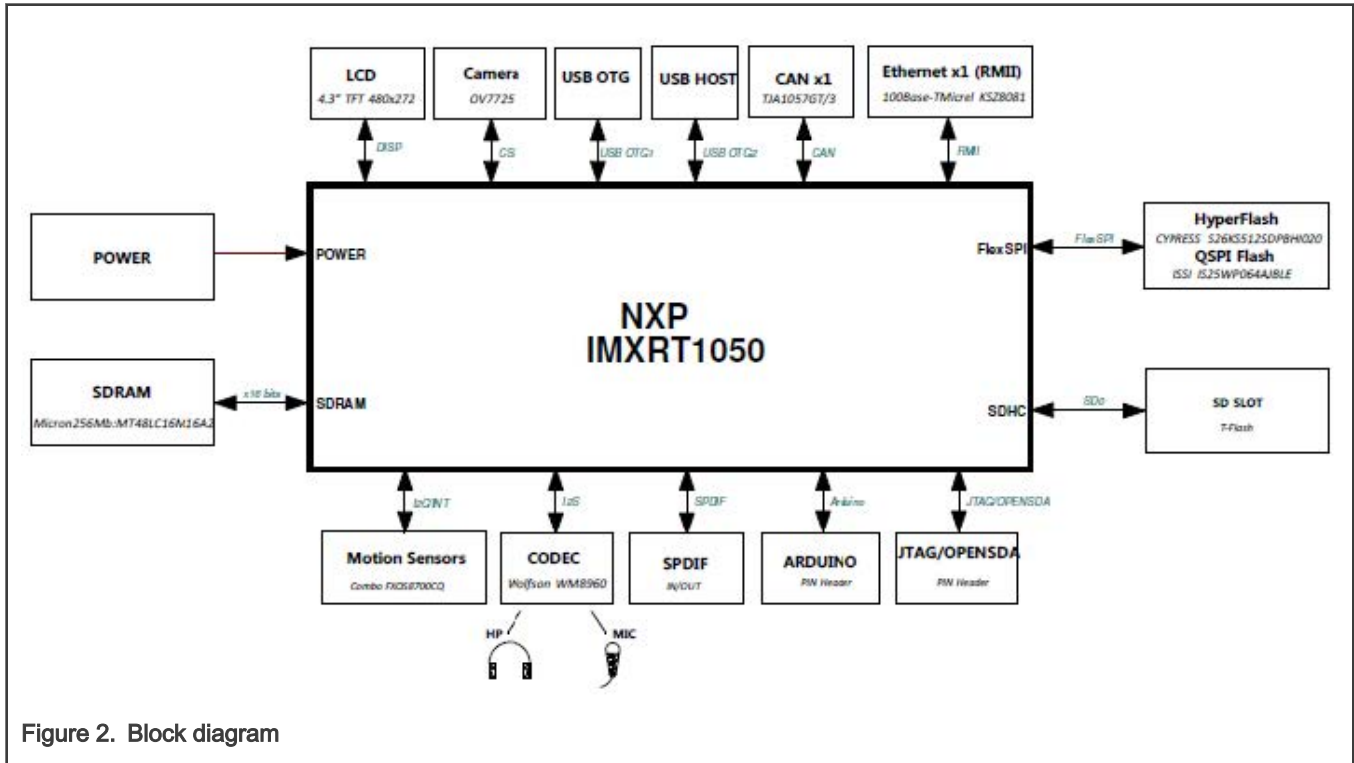


Figure 2. Block diagram

The overview of the IMXRT1050 EVKB board is as shown in [Figure 3](#) and [Figure 4](#).

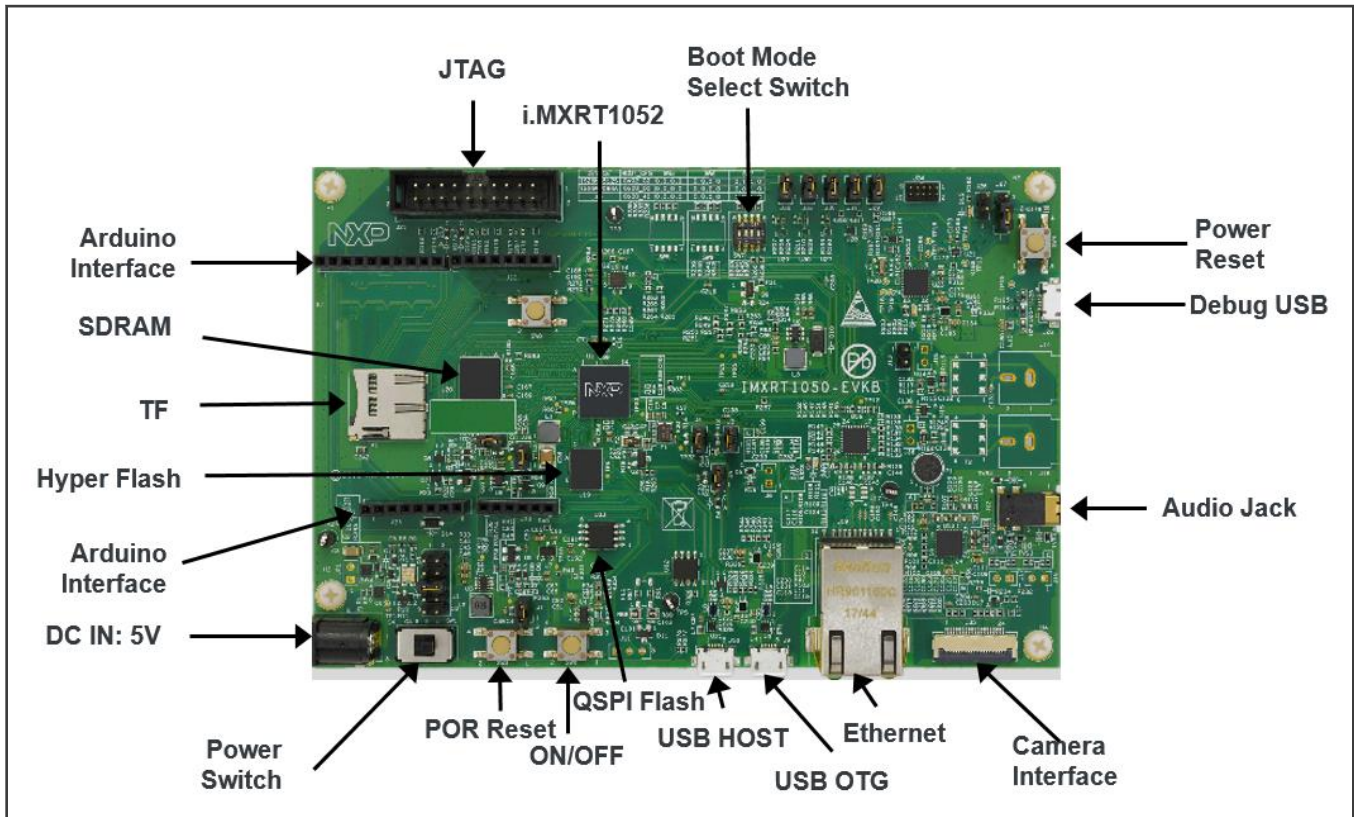


Figure 3. Overview of the IMXRT1050 EVKB board (Front side)

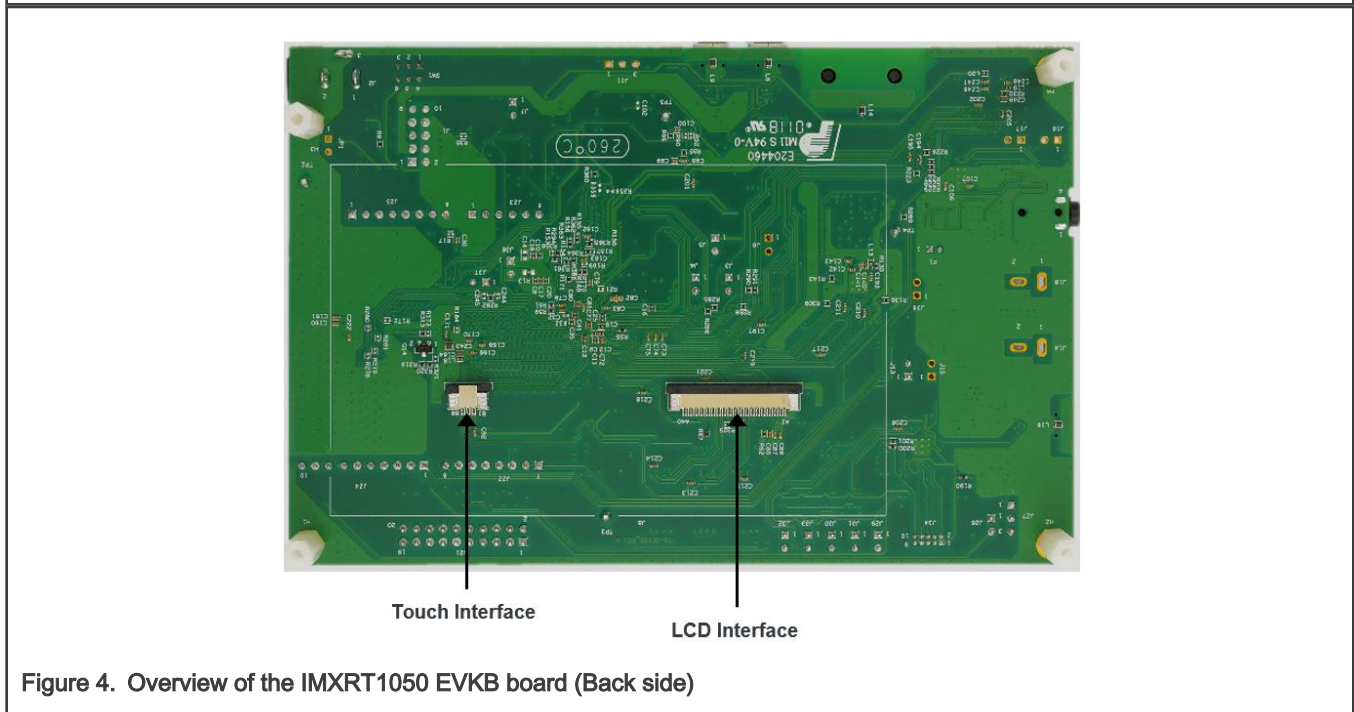


Figure 4. Overview of the IMXRT1050 EVKB board (Back side)

## 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 I<sup>2</sup>S 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.

For more detailed information about i.MX RT1050, see [i.MX RT1050 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 IMXRT1050 EVKB 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. [Table 3](#) describes 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 in *i.MX RT1050 Processor Reference Manual* (document [IMXRT1050RM](#)).

For more information about IMXRT1050 EVKB boot device selection and configuration, see [Main board schematic](#).

## 2.3 Power tree

A DC 5 V external power supply is used to supply the IMXRT1050 EVKB Board at J2, and a slide switch SW1 is used to turn the Power ON/OFF. J28 and J9 can also be used to supply the EVKB Board. Different power supply need to configure different Jumper setting of J1. [Table 4](#) describes the details.

**Table 4. Jumper settings of power supply**

Power supply	J1 settings
J2	1-2

*Table continues on the next page...*

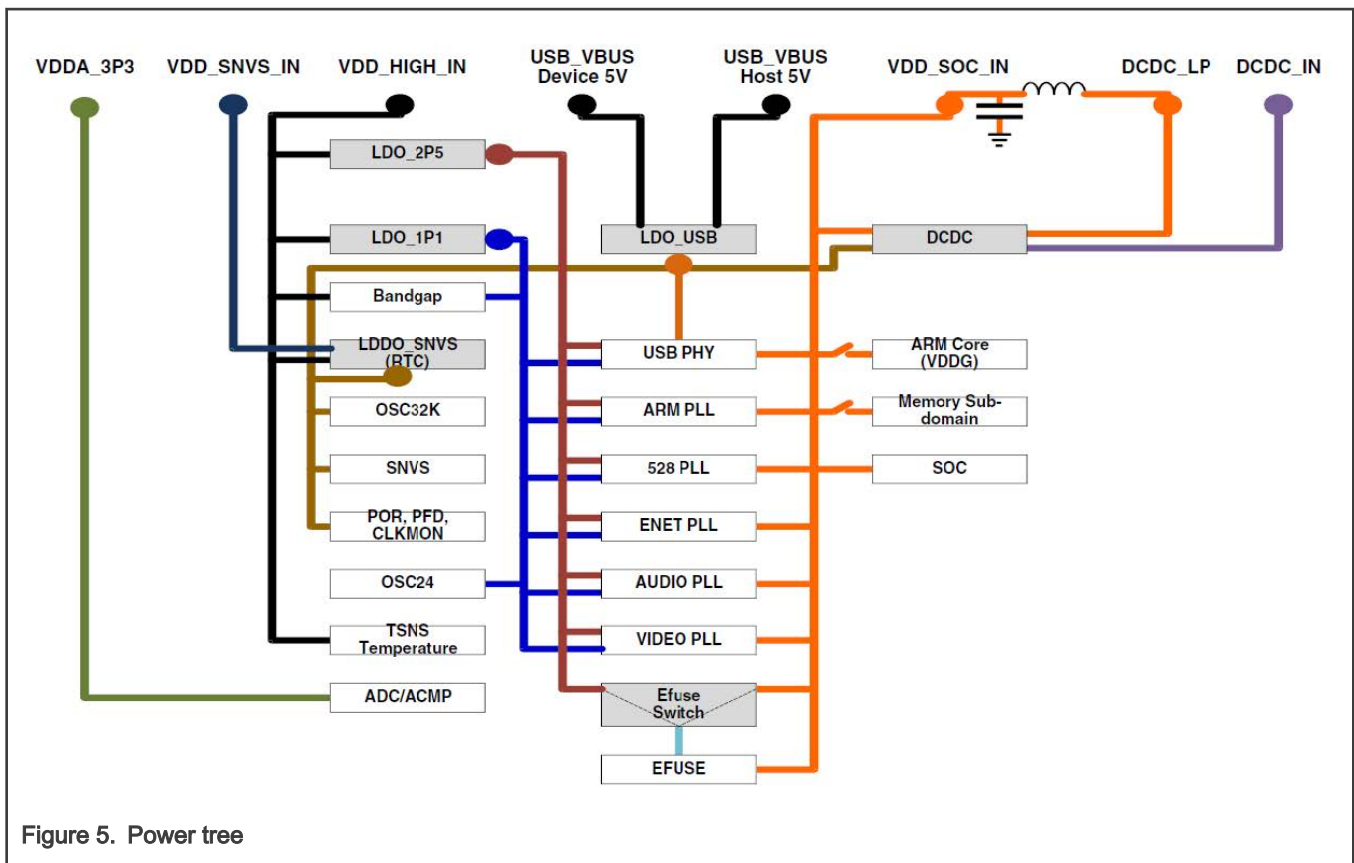
**Table 4. Jumper settings of power supply (continued)**

Power supply	J1 settings
J9	3-4
J28	5-6

**NOTE**

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

Figure 5 shows the power tree.



**Figure 5. Power tree**

Figure 6 shows the power control logic of the IMXRT1050 EVKB board.

- It will power up SNVS 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.
- The RESET button and WDOG output are used to reset the system power.



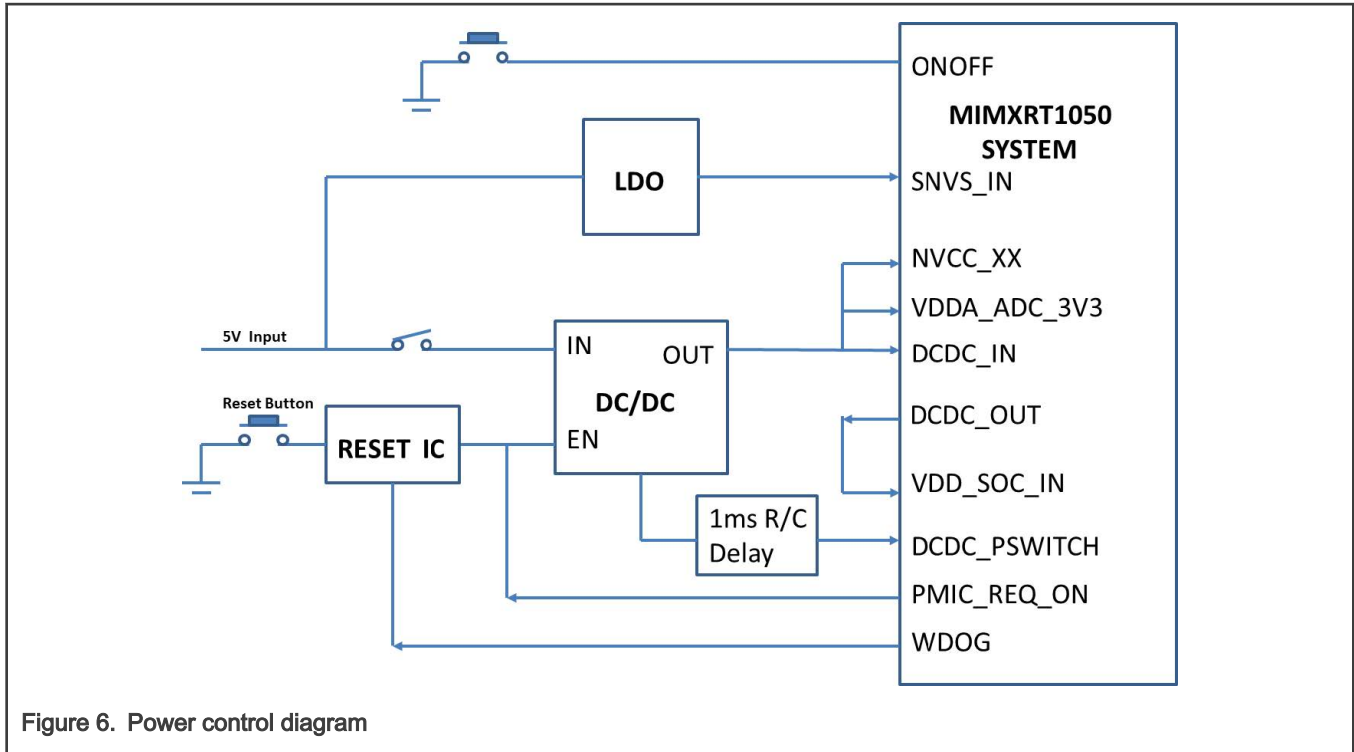


Figure 6. Power control diagram

Table 5 describes the power rails on the board.

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	3	3.3 <sup>1</sup>	3.6 <sup>1</sup>	Power for DCDC
VDD_SNVS_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
NVCC_SD0	3	3.3	3.6	Power for GPIO in SDIO1 bank (3.3 V mode)
	1.65	1.8	1.95	Power for GPIO in SDIO1 bank (1.8 V mode)
NVCC_SD1	3	3.3	3.6	Power for GPIO in SDIO2 bank (3.3 V mode)
	1.65	1.8	1.95	Power for GPIO in SDIO2 bank (1.8 V 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

1. For silicon A0, DCDC\_IN voltage domain is 2.9 - 3.1 V.

## 2.4 SDRAM memory

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

## 2.5 SD card slot

There is a SD card slot (J20) on the IMXRT1050 EVKB 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 IMXRT1050 EVKB Board, there is one 512 Mbit 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 [Table 3](#).

## 2.7 QSPI Flash

A 64Mbit QSPI Flash is used on the IMXRT1050 EVKB 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 [Table 3](#).

By default, this QSPI Flash is disabled on the EVKB. To enable the onboard QSPI Flash, the settings need to be changed.

1. Remove resistors R356 and R361 to R366.
2. Weld 0  $\Omega$  resistors: R153 to R158.

## 2.8 Ethernet connector

There is one Ethernet Mac controller in the MIMXRT1050 processor. The Ethernet subsystem of the IMXRT1050 EVKB board is provided by the KSZ8081RNB 10/100M Ethernet Transceiver (U16) and a RJ45 (J19) with integrated Magnetic.

## 2.9 USB PHY connector

The MIMXRT1050 contains two integrated USB 2.0 PHYs capable of connecting to USB host/device systems at the USB Low-Speed (LS) rate of 1.5 Mbits/s, Full-Speed (FS) rate of 12 Mbits/s or at the USB 2.0 High-Speed (HS) rate of 480 Mbits/s.

## 2.10 Audio input/output connector

The Audio CODEC used on the IMXRT1050 EVKB Board is Wolfson's Low Power, high quality Stereo Codec, WM8960. The IMXRT1050 EVKB board includes:

- One headphone interface (J12)
- One onboard MIC (P1)
- Two speaker interfaces (J16, J17)
- The SPDIF interface (J14 & J18, DNP)

J12 is a 3.5 mm 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 IMXRT1050 EVKB 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.

1. Use the serial downloader mode and drag/drop the image file to U-Disk.
2. Select **Hyper Flash** as boot device and reset the board.

Now, the image will run.

## 2.12 JTAG connector

J21 is a standard 20-pin/2.54 mm Box Header Connector for JTAG. [Figure 7](#) shows the pin definitions. SWD is supported by default.

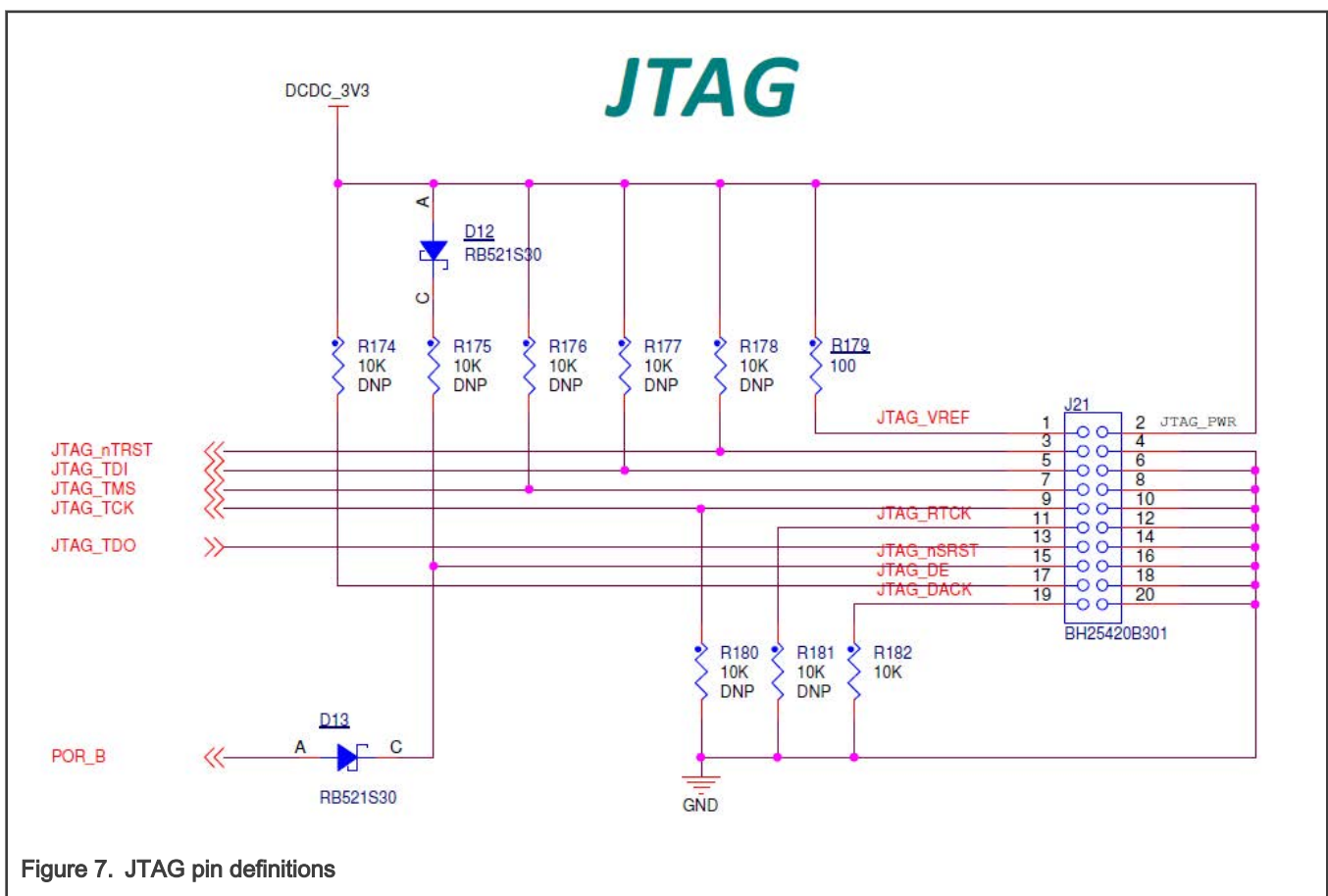


Figure 7. JTAG pin definitions

## 2.13 Arduino expansion port

J22 to J25 is defined as Arduino interface. [Table 6](#) describes the pin definitions of Arduino interface.

Table 6. Arduino interface pin definitions

J22	J23	J24	J25
UART_RX/D0	A0/ADC0	D8/CLKO/ICP1	NC

Table continues on the next page...

**Table 6. Arduino interface pin definitions (continued)**

J22	J23	J24	J25
UART_TX/D1	A1/ADC1	D10/SPI_CS	RESET
D2/INT0	A2/ADC2	D9/OC1A/PWM	IOREF
D3/INT1/PWM/OC2B	A3/ADC3	D11/OC2A/PWM/SPI_MOSI	3.3 V
D4/T0/XCK	A4/ADC4/SDA	D12/SPI_MISO	5 V
D5/TI/PWM	A5/ADC5/SCL	D13/SPI_CLK	GND
D6/AIN0/PWM/OC0A	—	GND	GND
D7/AIN1/PWM	—	AREF	VIN
—	—	D14/I2C_SDA	
—	—	D15/I2C_SCL	—

**NOTE**

J24 PIN9&PIN10 are not compatible with ARDUINO I2C, please use or wire to J23 PIN5&PIN6 instead and it will correct in next revision.

## 2.14 Camera module connector

One parallel Camera Sensor Interface (CSI) is supported by the i.MX RT1050. There is a Camera Module Connector (J35) on the IMXRT1050 EVKB Board. The CA031C based on OV7725 and CA111C based on MT9M114 can be used directly.

**NOTE**

J35 supports both MT9M114 and OV7725 camera module, but 3.3 V is a violation to MT9M114 spec 3.1 V. It proved fine for evaluation/demo with 3.3 V supply, but in product design, it is recommended to adjust DCDC output or add level shifter.

## 2.15 User interface switch

There are four user interface switches on the IMXRT1050 EVKB Board. Their functionality is as below.

### 2.15.1 Power switch

SW1 is a slide switch to control the power of the IMXRT1050 EVKB 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 5 V 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 IMXRT1050 EVKB 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** buttons on the EVK Board. **SW3** is the power-n 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 the 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 5 V main supply is normal.
  - Red: J2 input voltage is over 5.6 V.
  - 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](#).

At the same time, you need to change C88 to 2.2uf/35V or 1.0uf/35V to ensure the back light control circuits working normally. This change is only for Rev A, A1 and B, not required for Rev B1.

## Chapter 3

# PCB information

The IMXRT1050 EVKB board is made using standard 4-layer technology. The material used was FR-4. [Table 7](#) shows the PCB stack-up information.

**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	—

## Chapter 4

# EVKB design files

The schematics, layout files, and gerber files (including Silkscreen) can be downloaded from [MIMXRT1050-EVK](#).

# Chapter 5

## Contents of the Evaluation kit

Table 8. EVK contents

Item	Description
EVK board	EVKB 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.



# Chapter 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	04/2018	Initial release
1	11/2020	Updated <a href="#">Figure 1</a>

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Date of release: 11/2020

Document identifier: MIXRT1050EVKBHUG

