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# MIMXRT1050 EVK Board Hardware User's Guide

# 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 or resources in more specific designs.

## Contents

Features of the MIMXRT1050 EVK board are shown in *Table 1*

**Table 1.    Board features**

| Processor | NXP Processor | MIMXRT1052DVL6A(A0 silicon)<br>MIMXRT1052DVL6B(A1 silicon) |
|---|---|---|
| DRAM Memory | SDRAM 256 Mb, 166MHz | MT48LC16M16A2B4-6AIT: G |
| DCDC | MPS | MP2144GJ |
| LDO | UNION | UM1550S-18<br>UM1750S-00 |
| Mass Storage | TF Card Slot | |
| | 64 Mbit Quad SPI Flash | |
| | 512 Mbit Hyper Flash | |
| Display Interface | LCD Connector | |
| Ethernet | 10/100 Mbit/s Ethernet Connector. PHY Chip: KSZ8081RNB | |
| USB | USB 2.0 OTG Connector | |
| | USB 2.0 Host Connector | |
| Audio Connector | 3.5 mm Audio Stereo Headphone Jack | |
| | Board-Mounted Microphone | |
| | Left & Right Speaker Out Connectors | |
| | SPDIF Interface(unpopulated) | |
| Power Connector | 5V DC-Jack | |
| Debug Connector | JTAG 20-pin Connector (SWD by default) | |
| | OpenSDA with DAP-Link | |
| Sensor | FXOS8700CQ: 6-Axis Ecompass (3-Axis Mag, 3-Axis Accel) | |
| Camera | CMOS Sensor Interface | |
| CAN | CAN Bus Connector | |
| User Interface Button | ON/OFF, POR Reset, Reset, USER Button | |
| Led Indicator | Power Status, Reset, OpenSDA, USER LED | |
| Expansion Port | Arduino Interface | |
| PCB | 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

- EVK Rev A: Prototype.
- EVK Rev A1/2: Pilot Board.
- EVK Rev A3/4/5:Mass Product.

### NOTE

EVK Rev A, Rev A1/2/3/4/5 Boards are based on A0 silicon.

- EVKB: Mass Product.

### NOTE

EVKB Boards are based on A1 silicon.

# 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.
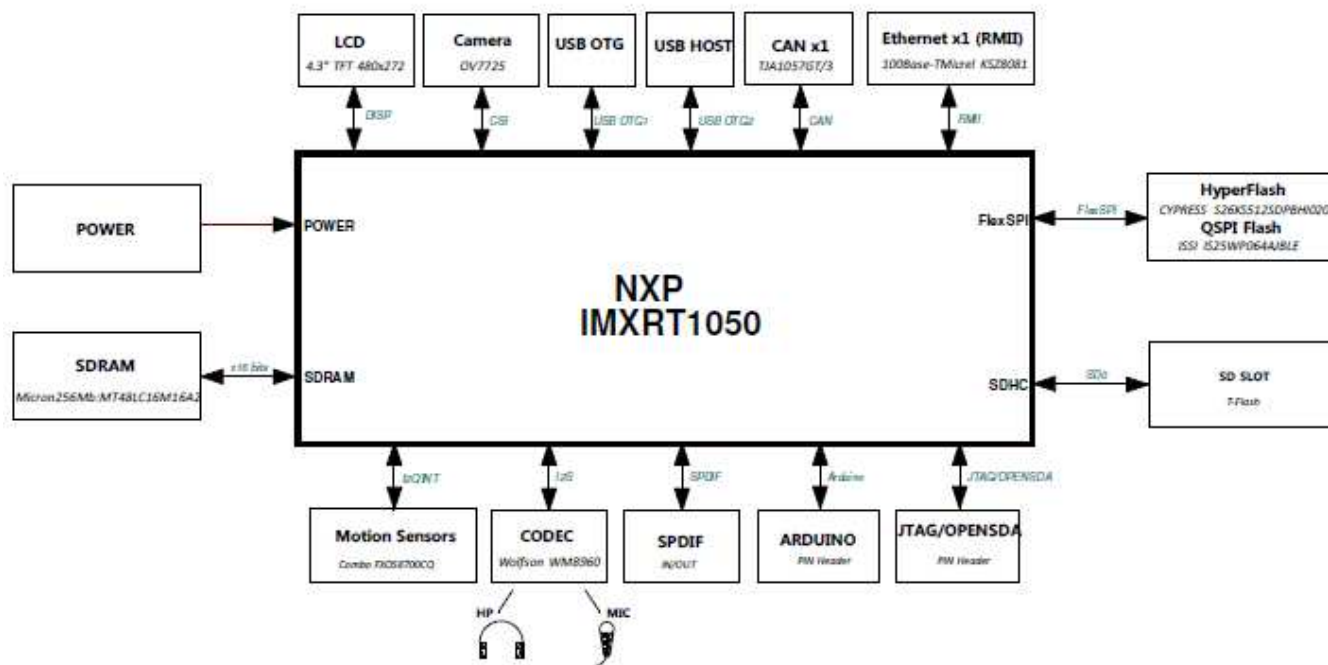


**Figure 1.  Block diagram**

The overview of the MIMXRT1050 EVK Board is shown in *Figure 1* & *Figure 2*.
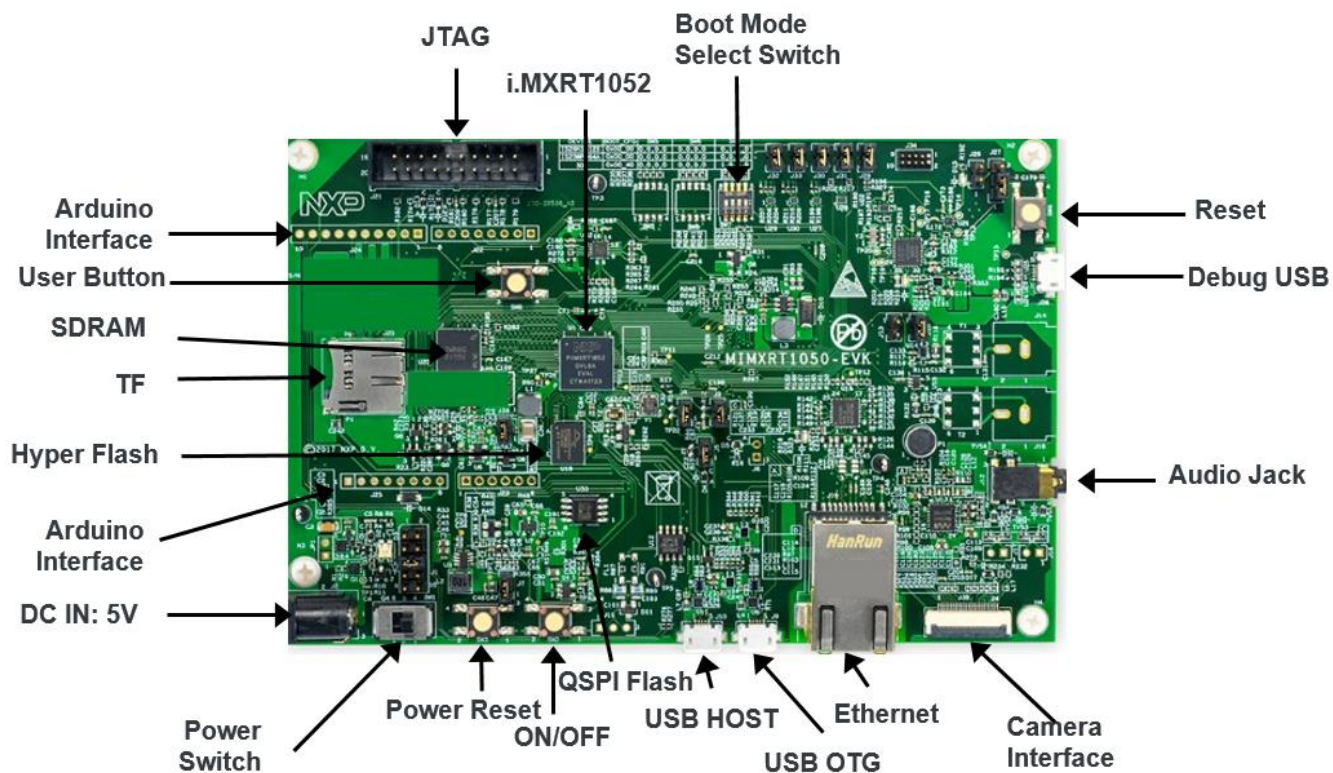
**Figure 2. Overview of the MIMXRT1050 EVK Board (Front side)**

**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.
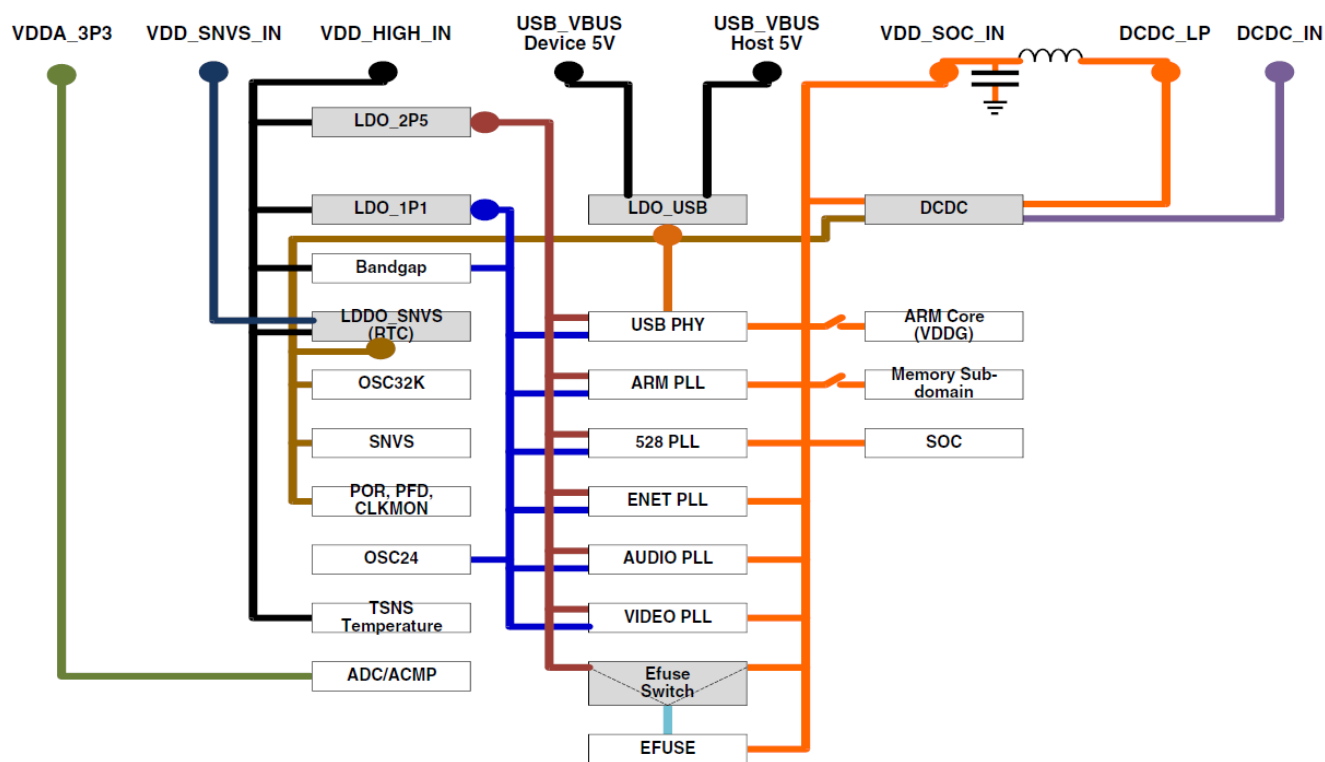
The power tree is shown in the following figure.



**Figure 4. Power Tree**

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

For A0 silicon:

- 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.

For A1 silicon:

- 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.
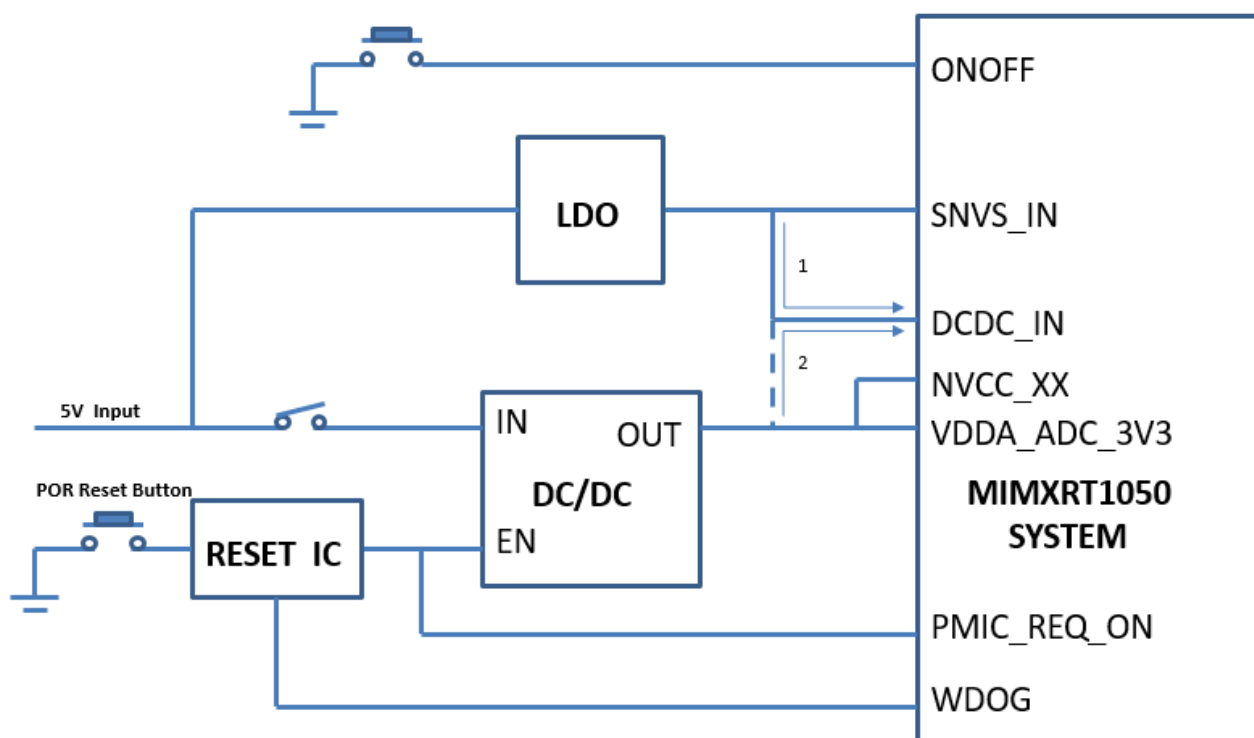- RESET button and WDOG output are used to reset the system power.

**Figure 5. Power Control Diagram**

**NOTE**

Power Control Diagram described in MIMXRT1050 EVK Board is true for A0 silicon For A1 silicon, DCDC_IN is expected to be powered with other domains together.

In the other word, for A0 silicon the DCDC_IN is powered with LDO (Path 1). And for A1 silicon, it is expected to be powered with DC/DC (Path 2).

For A0 silicon, 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 | 3[1] | 3.3[1] | 3.6[1] | Power for DCDC |

**MIMXRT1050 EVK Board Hardware User's Guide, User's Guide, Rev. 2, 03/2018**

| 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 (3.3V 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 |

1 **For silicon A0, DCDC_IN voltage domain is 2.9V~3.1V**

## 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 the onboard QSPI Flash, the settings need to be changed.

### 2.7.1. EVKA Settings

Step1:

The onboard HyperFlash should be removed, otherwise it will impact the QSPI Flash read and write timing.

Step2:

Weld 0 Ω resistor to the pad from R153 to R158.

### 2.7.2. EVKB Settings

For EVKB board, the onboard HyperFlash doesn't need to remove.

Step1:

Removed resistors: R356, R361 - R366.

Step2:

Weld 0Ωresistors: R153 - R158.

## 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.

## 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 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 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 seral 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.
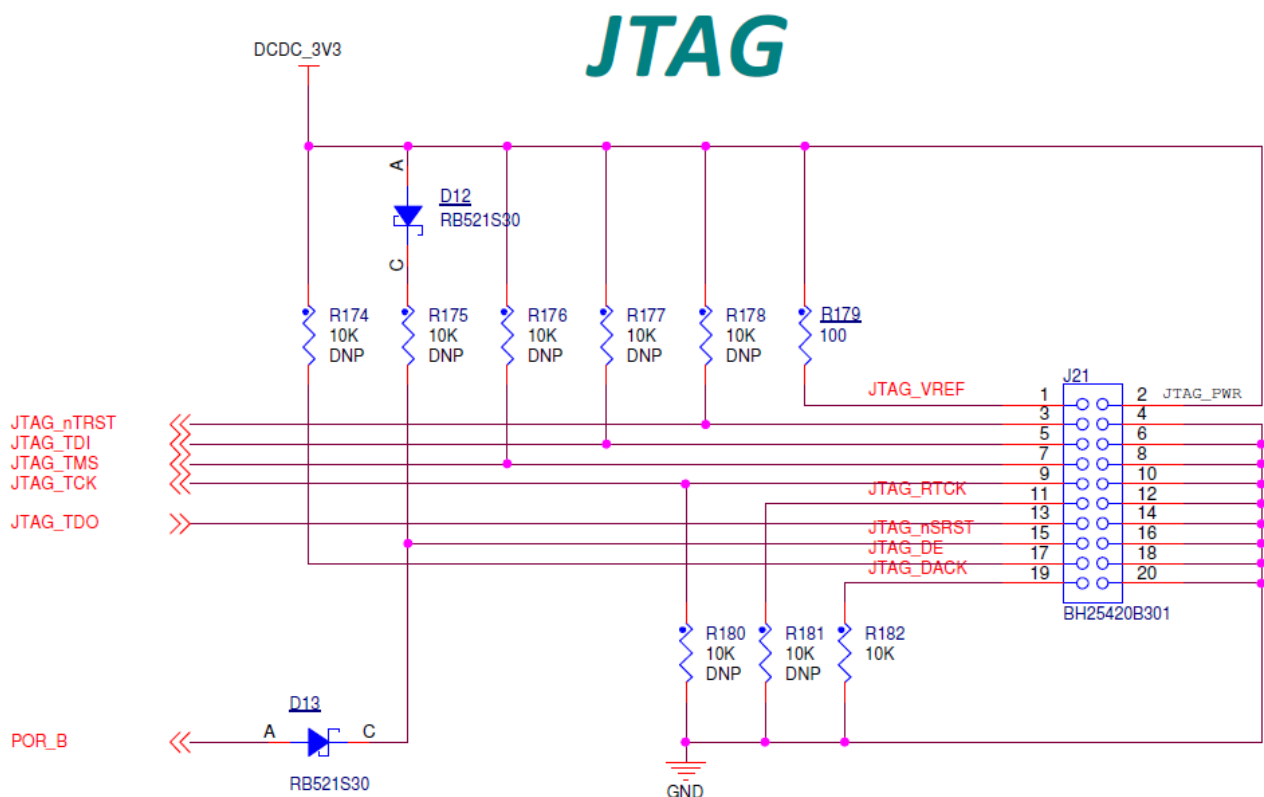
**Figure 6. JTAG pin definitions**

## 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 | |

**MIMXRT1050 EVK Board Hardware User's Guide, User's Guide, Rev. 2, 03/2018**

| 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.

## 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 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

# 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 |
| 2 | 03/2018 | Add(Update) information for RT1050 silicon A1 |

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