

i.MX 6ULL EVK Board Hardware User's Guide

1. Introduction

This document is the Hardware User's Guide for the i.MX 6ULL Evaluation Kit (EVK) based on the NXP Semiconductor i.MX 6ULL Applications 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

The EVK board is a platform designed to showcase many of the most commonly used features of the i.MX 6ULL Applications Processor in a small, low cost package. The i.MX 6ULL 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.

The features of the i.MX 6ULL EVK board are shown in [Table 1](#).

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Table 1. Board features

Processor:	NXP Applications Processor	MCIMX6Y2DVM05AA
DRAM Memory:	Micron 4Gb DDR3L SDRAM	MT41K256M16TW-107:P
DCDC:	MPS	MP2144GJ & MP2159GJ
LDO	RICHTECK	RT9169-33GVL RT9169-18GVL RT9193-33GB
	UNION	UM1750S-00
Mass storage	MicroSD card connector	
	256 Mbit QSPI Flash	
	32 GB NAND Flash (unpopulated)	
	32 GB eMMC (unpopulated)	
Display interface	LCD connector	
	HDMI connector (unpopulated)	
Ethernet	Dual RJ45 Connector for 10/100 Base-T	
USB	One USB 2.0 Standard-A host connector	
	One USB 2.0 Micro-B OTG connector	
Audio connectors:	3.5 mm Stereo Headphone output	
	Mono-Microphone input on board	
	Left & Right Speaker Out connectors	
Power connector:	5 V DC-Jack, 2.0 mm (Power supply: DC5V/4A, 2.1 mm X 5.5 mm)	
Debug connectors:	UART to USB connector	
	RJ-45 connector for 10/100 Base-T	
	20-pin Standard JTAG connector	
Sensor	eCOMPASS	
	Accelerometer	
	Gyroscope (unpopulated)	
Camera	CMOS Camera connector(unpopulated)	
CAN	CAN bus connector	
Bluetooth	20-pin Bluetooth Connector	
User Interface Buttons	ON/OFF, Reset button	
LED Indicators	Power status, UART	
Coin Cell	Connection point for ML414 Coin Cell (unpopulated) for RTC Operation	

Table 1. Board features

Coin Cell	Connection point for ML414 Coin Cell (unpopulated) for RTC Operation
Expansion Port	ARDUINO Headers
PCB	Main board: 2.66-inch x 1.27-inch (6.76cm x 4.24 cm), 4-layer board
	Base board: 5.12-inch x 4.25-inch (13.0cm x 10.8 cm), 4-layer board

1.2. i.MX 6ULL EVK contents

The i.MX 6ULL EVK contains the following items:

- i.MX 6ULL Main board & Base board
- Quick Start Guide

1.3. i.MX 6ULL EVK board revision history

- Rev A: Production (For Customer)

The board assembly version will be printed on a label, usually attached to the bottom side. The assembly version will be the letter designation following the schematic revision: base board is 700-28616 REVC, main board is 700-29364 REVA.

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.

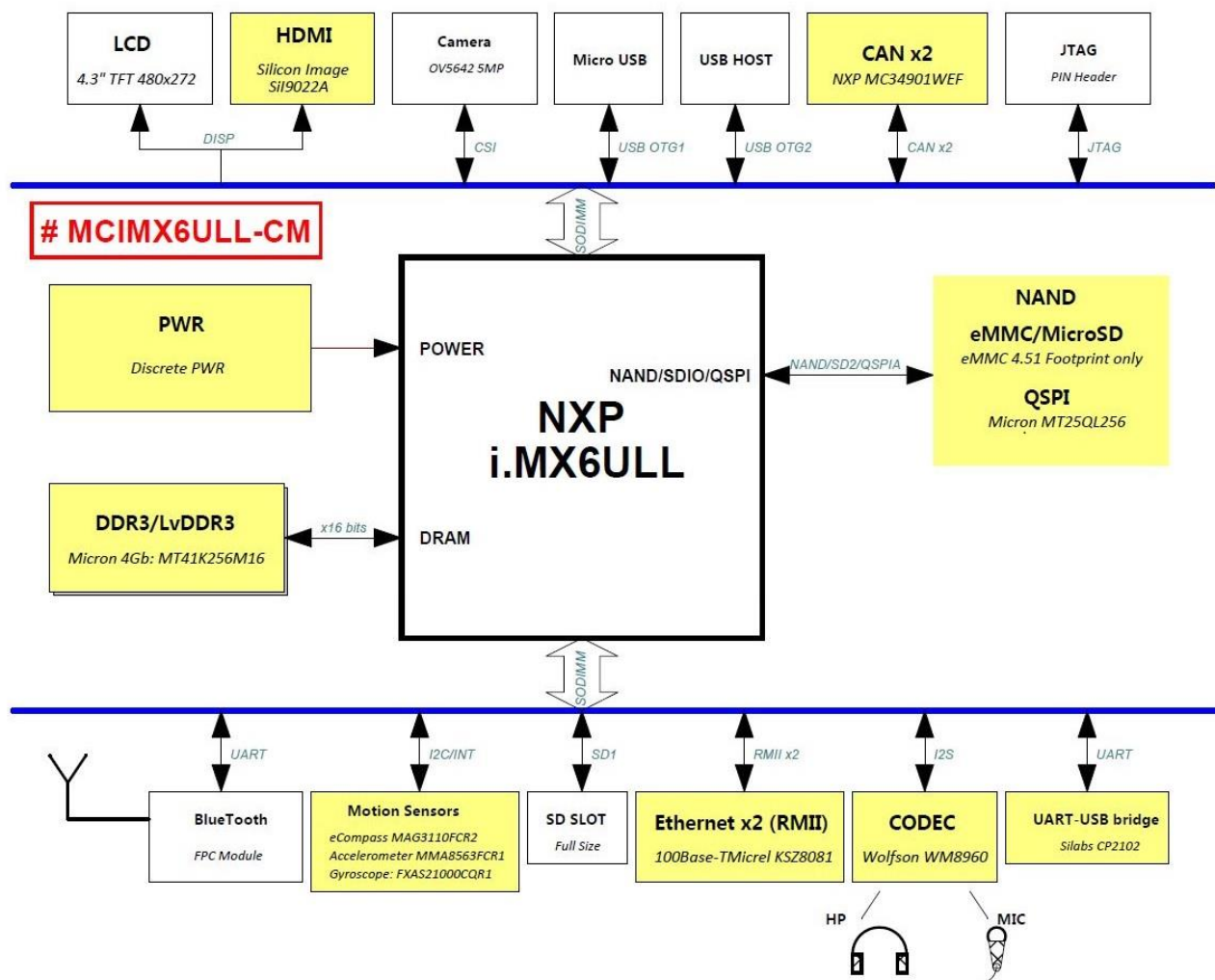


Figure 1. Block diagram

The overview of the i.MX 6ULL EVK board is shown in [Figure 2](#).

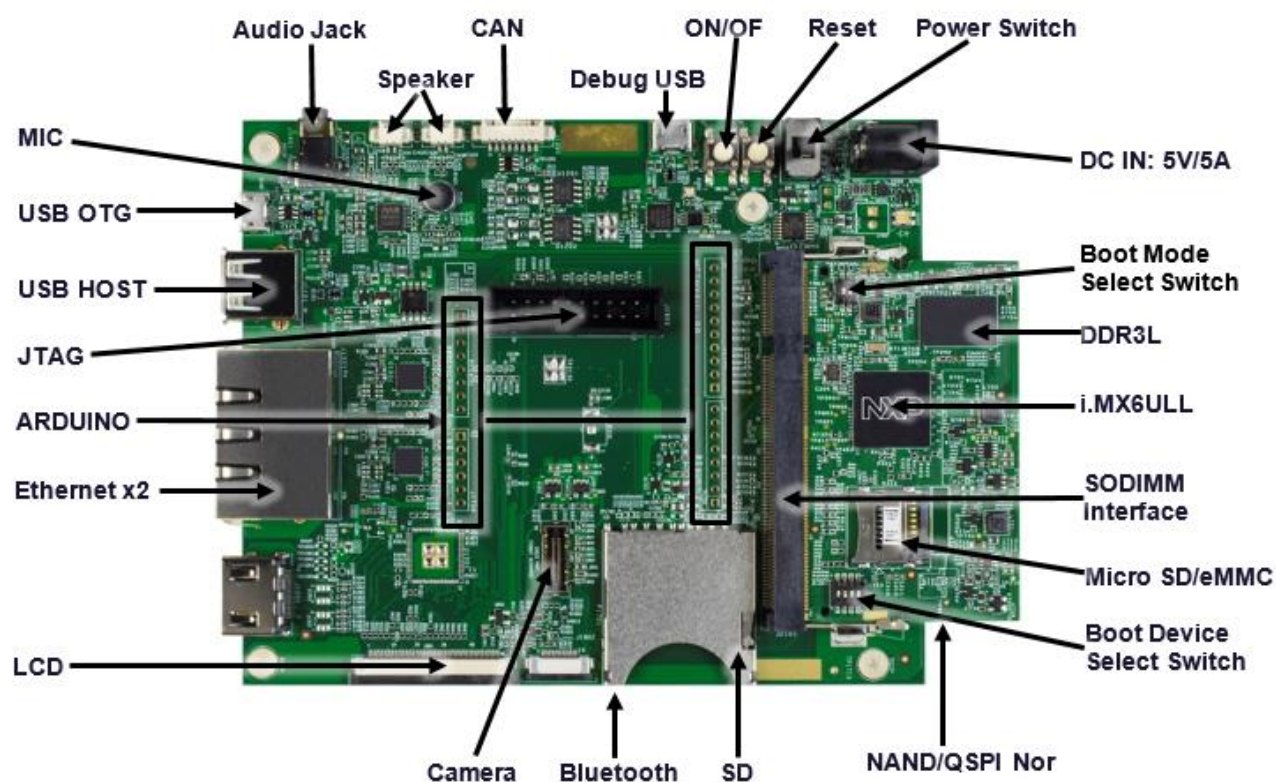


Figure 2. Overview of the i.MX 6ULL EVK board



Figure 3. Overview of the i.MX 6ULL EVK board connection

2.1. i.MX 6ULL processor

The i.MX 6ULL processor represents NXP Semiconductor's latest achievement in integrated multimedia-focused products offering high performance processing with a high degree of functional integration, targeted towards the growing market of connected devices. The i.MX 6ULL processor features NXP's advanced implementation of the single ARM[®]Cortex[®]-A7 core, which operates at speeds up to 900 MHz. The i.MX 6ULL includes integrated power management module that reduces the complexity of external power supply and simplifies the power sequencing. Each processor provides a 16-bit DDR3/LVDDR3/LPDDR2 memory interface and several other interfaces for connecting peripherals, such as WLAN, Bluetooth, GPS and displays.

More detailed information about the processor can be found in the data sheets i.MX 6ULL Applications Processors for Consumer Products (document [IMX6ULLCEC](#)) and i.MX 6ULL Applications Processors for Industrial Products (document [IMX6ULLIEC](#)), and the i.MX 6ULL Applications Processor Reference Manual (document [IMX6ULLRM](#)).

2.2. Boot mode configurations

BOOT_MODE [1:0] is used to select system boot mode. On the i.MX 6ULL EVK board, a dual-switch (SW602) is used to select the input voltage of these two pins, either 0 V or 3.3 V.

Table 2. SW602 boot mode pin settings

D1/MODE1	D2/MODE0	Boot Mode
OFF	OFF	Boot from Fuses
OFF	ON	Serial Downloader
ON	OFF	Internal Boot
ON	ON	Reserved

**Figure 4. SW602 boot mode settings**

Typically, the internal boot is selected for normal boot, which is configured by external BOOT_CFG GPIOs. Then the developer must set the switch SW602: D2(MODE0) to OFF, D1(MODE1) to ON, and use SW601 to select the boot device. This is shown in [Table 3](#) and [Figure 5](#).

Table 3. SW601 boot device settings

D1	D2	D3	D4	Boot Device
OFF	OFF	ON	OFF	MicroSD
OFF	OFF	OFF	OFF	QSPI
OFF	ON	ON	OFF	EMMC
ON	ON	OFF	ON	NAND

**Figure 5. SW601 boot device settings**

On the i.MX 6ULL EVK board, the default boot device is USDHC interface. There are two SD slots on the board, one MicroSD (USDHC-2) on the Main board, one standard SD (USDHC-1) on the Base board, MicroSD (USDHC-2) is the default boot device. To boot from the SD (USDHC-1) by default, R613 (10K) must be removed and R642 (10K) must be installed. The location of the R613 and R642 is on the bottom side as shown in [Figure 6](#).



Figure 6. Location of the R613 and R642

NOTE

For more information about boot mode configuration, see the System Boot chapter of the i.MX 6ULL Reference Manual.

For more information about i.MX 6ULL EVK boot device selection and configuration, see the main board schematic.

2.3. Power tree

A DC 5 V/4 A external power supply with a 2.1 mm x 5.5 mm plug is used to supply the i.MX 6ULL EVK board at connector J2001, and a slide switch SW2001 is used to turn the power ON/OFF. There is an over-voltage protection circuit at the input power rail, so if the output voltage of the power supply exceeds 5.6 V, the circuit will shut the system down. Discrete regulators are used to generate different power rails for the whole system.

The power tree is shown in Figure 7.

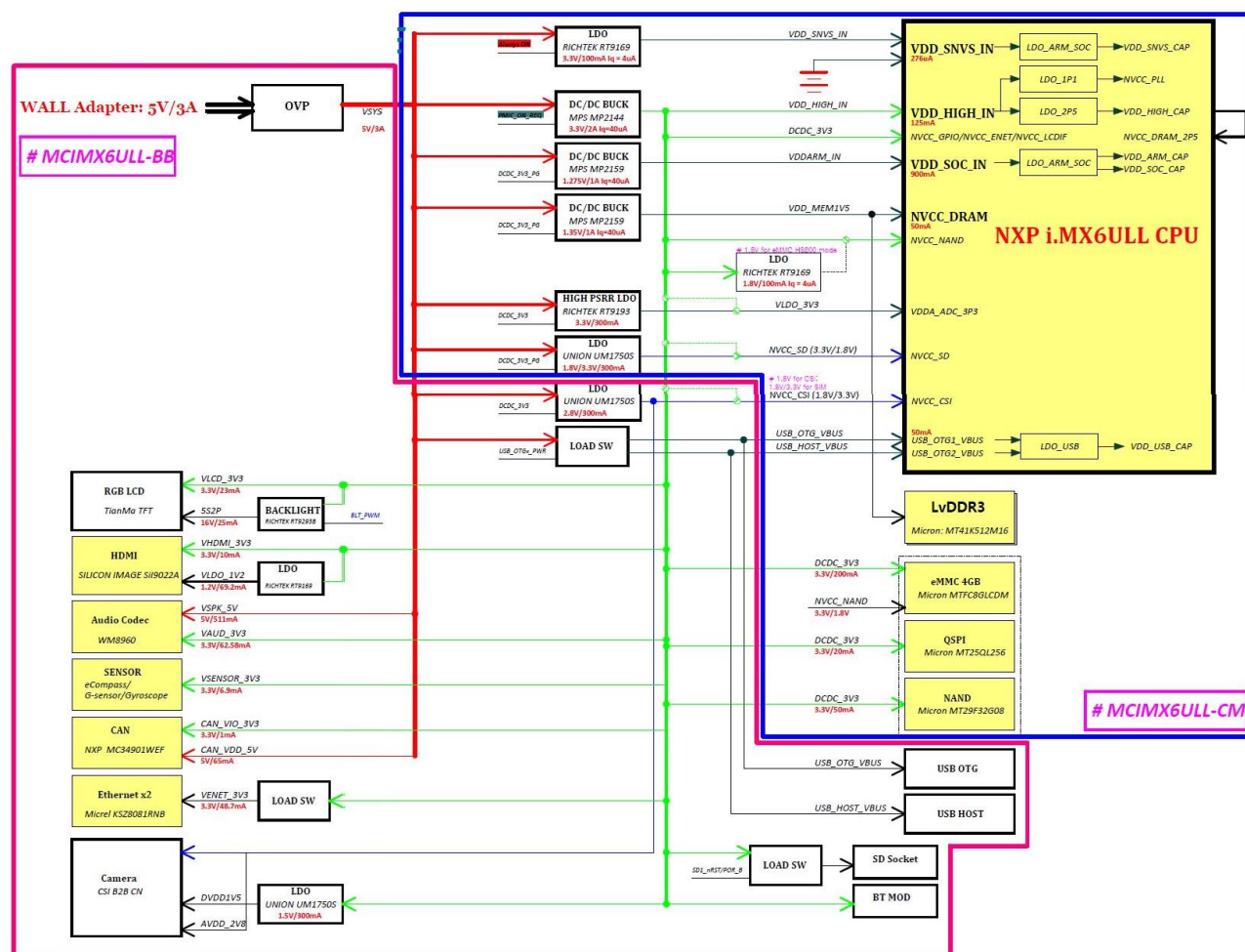


Figure 7. Power tree

The power tree displays all the power supply rails used on the EVK board.

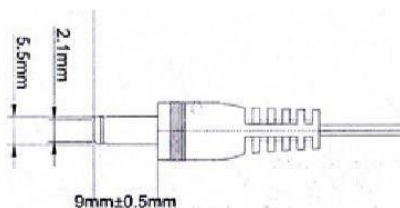


Figure 8. Plug size for DC5V power supply

The power control logic of the i.MX 6ULL EVK board is shown in [Figure 9](#).

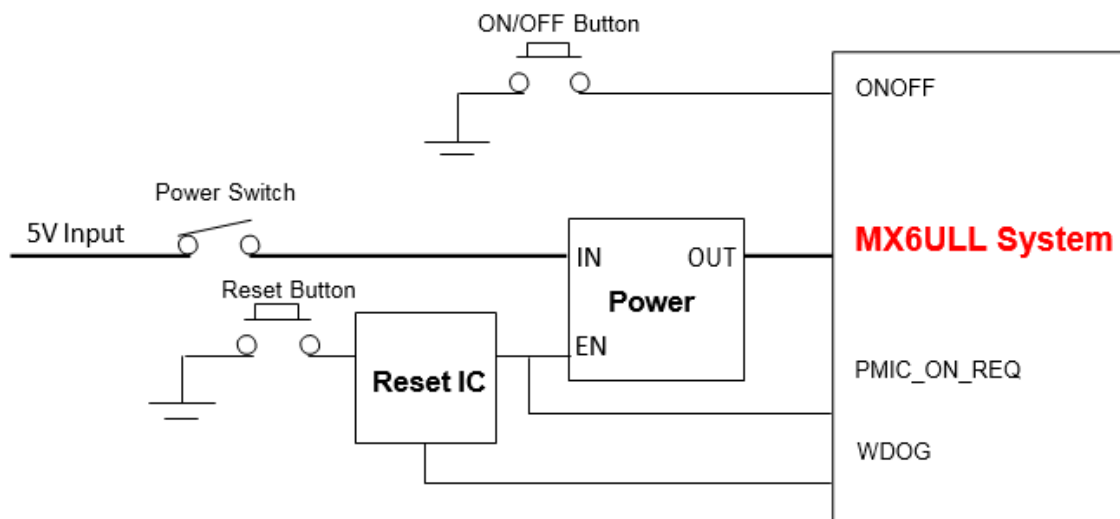


Figure 9. Power Control Diagram

The power rails on the board are shown in [Table 4](#).

Table 4. Power rails

Regulator	Voltage /max-current	Power domains	Modules
DC/DC BUCK MP2159	1.3 V / 1 A	VDD_ARM_SOC_IN	VDDSOC
DC/DC BUCK MP2159	1.35 V / 1 A	NVCC_DRAM	NVCC_DRAM DDR3L SDRAM
DC/DC BUCK MP2144	3.3 V / 2 A	VDD_HIGH_IN DCDC_3V3	VDD_HIGH GPIO ENET module LCD module NAND module QSPI module CAN module Audio module HDMI module Camera module Bluetooth module
LDO RT9169	3.3 V / 100 mA	VDD_SNVS_IN	VDD_SNVS_IN
LDO RT9193	3.3 V / 300 mA	VLDO_3V3	ADC module
LDO UM1750	1.8 V or 3.3 V / 300 mA	NVCC_SD	SD module
LDO UM1750	2.8 V / 300 mA	NVCC_CSI	CSI module
LDO UM1750	1.5 V / 300 mA	DVDD_1V5	Camera module
LDO RT9169	1.2 V / 100 mA	VLDO_1V2	HDMI module

2.4. DDR3L DRAM memory

The i.MX 6ULL EVK board has one 256 Meg x 16 DDR3L SDRAM (MT41K256M16TW-107:P) for a total of 512 MB RAM memory.

The DDR_VREF is created by a simple voltage divider using 1.5K Ohm 1% resistors and 0.1 μ F capacitors for stability. The relatively small value resistors provide enough current to maintain a steady midpoint voltage. The calibration resistors used by the DDR3L chips and the processor are 240 Ohm 1 % resistors. These resistor values are specified by the DDR3L specifications.

2.5. SD card slots (J301, P1701)

There are two SD card connectors (J301, P1701) on the i.MX 6ULL EVK board.

- J301 on the i.MX 6ULL EVK Main board is the Micro SD slot for USDHC2 interface.
- P1701 on the i.MX 6ULL EVK base board is a standard SD slot for USDHC1. It can also support accessories such as a WiFi card, and so on.

2.6. eMMC

The eMMC interface is connected to USDHC2 of i.MX 6ULL. It can support up to eMMC 4.5, the eMMC device is not populated by default on the EVK board. To boot from eMMC, remove the Micro SD socket and populate the eMMC device, and then change the boot device switch (SW601) settings (OFF, ON, ON, OFF) as shown in [Table 3](#).

Additionally, the BOOT_CFG settings must be adjusted for the specified eMMC device by exchanging the pull up/down resistors. See the main board schematic for more information.

2.7. QSPI Nor flash

On the 6ULL EVK board, there is one 256 MB QSPI Nor Flash device. To boot from the QSPI flash, the boot device switch (SW601) settings must be changed to OFF, OFF, OFF, OFF, as shown in [Table 3](#).

Additionally, the developer should adjust the BOOT_CFG settings for specified QSPI Nor Flash device, by exchanging the pull up/down resistors. See the main board schematic for more information.

2.8. NAND flash

NAND flash is not populated by default on the i.MX 6ULL EVK board. To boot from the NAND flash, the following reworks should be implemented:

1. Remove the QSPI Nor flash device
2. Populate the NAND device
3. Change the Boot-mode switch (SW601) settings to ON, ON, OFF, ON
4. The developer should adjust the BOOT_CFG settings for specified NAND Flash device, by exchanging the pull up/down resistors. See the main board schematic for more information.

NOTE

The data lines of NAND flash are multiplexed with the eMMC and MicroSD, so they cannot be used at the same time.

2.9. Dual ethernet connector (J1501)

There are two Ethernet MAC controllers in the i.MX 6ULL processor. The Ethernet subsystem of the i.MX 6ULL EVK board is provided by the MICREL KSZ8081RNB 10/100M Ethernet Transceiver (U1501, U1601) and a dual port RJ45 (J1501) with integrated Magnetic. The MAC addresses are shown on the sticks on the RJ45 connector.

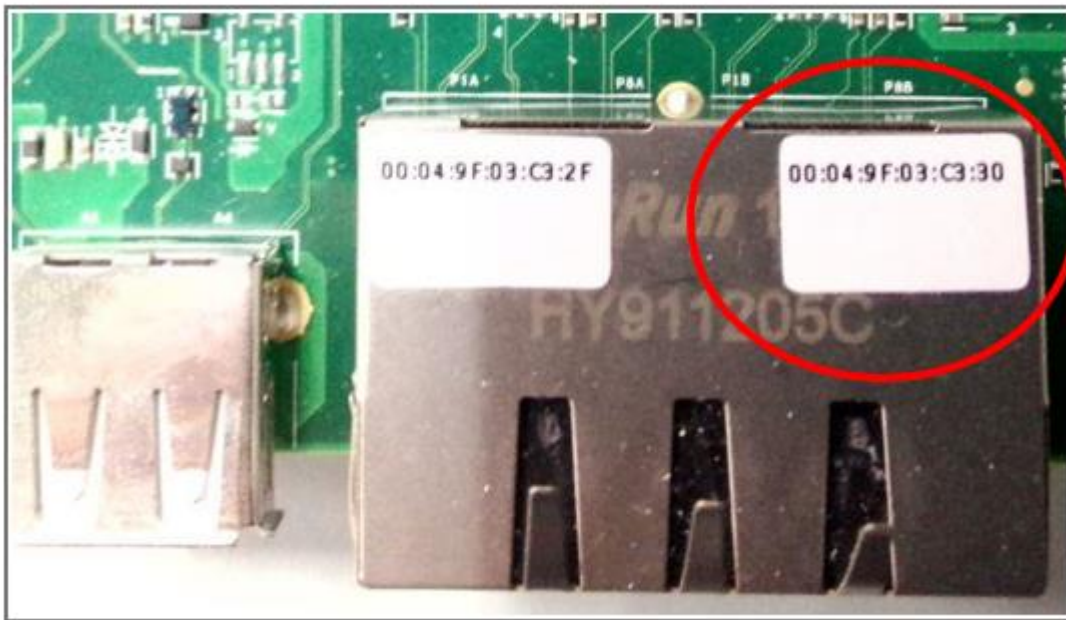


Figure 10. Dual Port RJ45

2.10. USB PHY connector (J1102, J1101)

The i.MX 6ULL Applications Processors contains two high speed (HS) USB 2.0 OTG (Up to 480 Mbps) controllers, with two integrated HS USB Phy. On the EVK board, J1101 is a Type-A connector for USB host port, J1102 is a Micro-B connector for USB OTG port. The OTG port J1102 is also used for downloading the boot image by MFGTool in Serial Download Mode.

2.11. Audio input/output connectors (J1401/P1401/J1402 & J1403)

The Audio CODEC used on the i.MX 6ULL EVK board is Wolfson's Low Power, high quality Stereo Codec, WM8960. The digital interface between i.MX 6ULL and WM8960 includes four signals:

- SYNC_CLK
- BCLK
- DACDAT

- ADCDAT

i.MX 6ULL also provides the MCLK to WM8960.

i.MX 6ULL EVK includes one headphone interface (J1401), one onboard MIC (P1401), and two speaker interfaces (J1402, J1403). J1401 is a 3.5 mm 4-pole (or TRRS) phone jack, which supports jack detect.

2.12. USB debug connector (J1901)

On the EVK board, CP2102, a USB to Serial UART IC is used to convert the UART signal to the USB signal. With the Micro-B USB connector J1901, the connection for debugging is simplified. A Micro-B to standard A USB cable can be used.

UART1 port is used as the default debug port. No RTS or CTS signals are sent from the processor to the debug connector because these signals are commonly ignored by most applications. The required terminal settings are shown in [Table 5](#).

Table 5. Terminal settings

Baud rate	115,200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

2.13. Bluetooth Connector (J1701)

On the EVK board, the J1701 is connected to i.MX 6ULL UART2 port, and can be used for Bluetooth. Silex Bluetooth module SX-SDCAN-2830BT is recommended. To verify other Bluetooth modules, a convert board may be needed.

NOTE

J1701 is a bottom-contact type connector for BT connection on the Rev. C board. 20-pin/0.5 mm pitch same side FFC/FPC should be used to connect with Silex Bluetooth module SX-SDCAN-2830BT, as shown in [Figure 11](#).



Figure 11. Connect the BT module

2.14. JTAG connector (J1902)

J1902 is a standard 20-pin/2.54 mm Box Header Connector for JTAG. The pin definitions are shown in Figure 12.

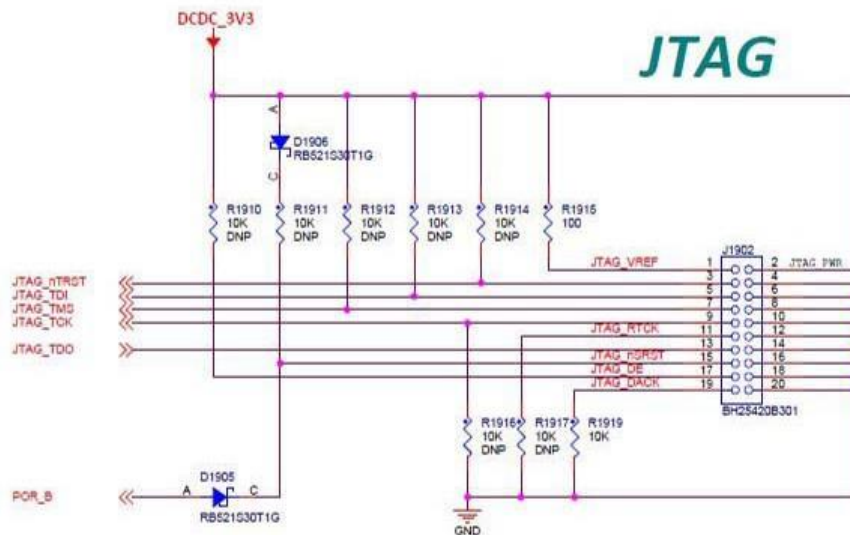


Figure 12. JTAG pin definitions

NOTE

JTAG is dedicated with Audio CODEC signals. Remove R1407, R1431~R1434 resistors while using JTAG debug.

2.15. ARDUINO expansion port (J1703-J1706)

J1703-J1706 (unpopulated) is defined as the ARDUINO Interface. To use the processor for ARDUINO development, the following rework should be implemented.

- Populate- R1717-R1732

The pin definitions of ARDUINO interface are shown in [Table 6](#).

Table 6. ARDUINO pin definitions

J1703	J1706
UART_RX/D0	A0
UART_TX/D1	A1
D2	A2
D3	A3
D4	A4
D5	A5
D6	
D7	

J1704	J1704
D8	NC
D9	3.3V
D10/SPI_CS	RESET
D11/SPI_MOSI	3.3V
D12/SPI_MISO	5V
D13/SPI_CLK	GND
GND	GND
3.3 V	3.3 V
D14/I2C_SDA	
D15/I2C_SCL	

2.16. User interface switches

There are three user interface switches on the EVK board. Their functionality is as follows.

2.16.1. ON/OFF button (SW2101)

SW2101 is the ON/OFF button for the i.MX 6ULL EVK board. The function of this button is listed below.

- In Yocto Project, short press and long press will only generate an interrupt, the usage is defined by upper software.
- Prolonged depress (>5 sec) will force an immediate hardware shutdown.
- If the board is in SHUTDOWN state, a short press of the button will restart (boot) the system.
- If the board is in STANDBY state, a short press of the button will bring the system out of standby (resume operations, no boot).

2.16.2. Reset

There are two ways to reset the i.MX6ULL EVK board:

1. Hardware way to reset system using SW2102:
 - Pressing the RESET button (SW2102) in the Power On state will force to reset almost all the power rails except the VDD_SNVS on the i.MX6ULL EVK board. The i.MX6ULL applications processor will be immediately turn off, and reinitiate a boot cycle from the Processor Power Off state.
2. Software way to reset system using WDOG signal:
 - When system assert nWDOG signal, U703 will be shut down, and the system will power down, and then nWDOG is released, then U703 will be power on by PMIC_ON_REQ, the system will then reboot. It is important that the system reset should be power down and then power on, which will avoid boot failure caused by DVFS or DRAM (LPDDR2 if used).

2.16.3. Power switch (SW2001)

SW2001 is a slide switch to control the power of the i.MX 6ULL EVK board. 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.

2.17. Sensors

The i.MX 6ULL EVK board has three sensors: Accelerometer (FXLS8471Q), eCOMPASS (MAG3110), and Gyroscope (FXAS21002CQ, unpopulated). These three sensors are connected to the i.MX 6ULL I2C1 port.

2.17.1. Accelerometer

FXLS8471Q is a small, low-power, 3-axis, linear accelerometer in a 3 mm x 3 mm x 1 mm QFN package. FXLS8471Q has dynamically selectable acceleration full-scale ranges of ± 2 g/ ± 4 g/ ± 8 g and 14 bits of resolution.

2.17.2. eCOMPASS (U1302)

MAG3110 is a small, low-power, 3-axis digital magnetometer. It works by measuring the strength of a magnetic field, which is a combination of earth's magnetic field and the magnetic fields of nearby objects, including distortions. The device can be used in conjunction with a 3-axis accelerometer to produce orientation-independent, accurate compass heading information.

2.17.3. Gyroscope (U1303)

FXAS21002CQ is a small, low-power, yaw, pitch, and roll angular rate gyroscope with 16-bit ADC resolution. The full-scale range is adjustable from 250/s to 2000/s. It is not populated by default, to verify this feature the chip must first be purchased and soldered.

2.18. User interface LED indicators

There are two LED status indicators located on the board. The functions of these LEDs include:

- Main Power Supply (D2003)
 - Green: DC 5 V main supply (WALL_5V_DC_JACK) is normal.
 - Red: WALL_5V_DC_JACK is over 5.6 V.
 - Off: the board is not powered.
- UART (D1903)
 - Green flashing: Debug UART data are being transmitted to PC.
 - Orange flashing: Debug UART data are being received from PC.

2.19. Optional back-up coin cell holder (BT2101)

On the i.MX 6ULL EVK board, there is a connector (BT2101) for holding an ML414 Lithium coin cell battery. The coin cell provides an alternative power supply for i.MX 6ULL VDD_SNVS_IN power rail when the main VDD_SNVS_3V3 is off. When VDD_SNVS_3V3 is on, the coin cell can be charged through a current limit resistor R101. i.MX 6ULL has an internal LDO to regulate the VDD_SNVS_IN power to supply the RTC subsystem. When DC 5 V power supply is removed, the coin cell will provide power only to the VDD_SNVS_IN power rail of the EVK board. To increase the keep time of RTC, the developer should optimize the power consumption of the whole VDD_SNVS_IN power rail.

2.20. LCD daughter card

If developers want to use LCD, NXP provides an optional LCD module LCD8000-43T which has a 4.3-inch touch-screen and supports a resolution of up to 480X3(RGB)X272. This module contains a 50-pin

FPC cable, which can be inserted to connector J901 on the base board (the bottom contact). LCD modules can be purchased from the NXP website.

3. PCB Information

Both the base board and main board are made using standard 4-layer technology. The material used was FR-4.

The PCB stack-up information is shown in the following table.

Table 7. Board stack-up information

Base board				Main board			
Layer	Description	Copper (Oz)	Dielectric Thickness (mil)	Layer	Description	Copper (Oz)	Dielectric Thickness (mil)
1	Signal	1	—	1	Signal	1	—
	Dielectric	—	3.0		Dielectric	—	3
2	GND	1	—	2	GND	1	—
	Dielectric	—	36		Dielectric	—	28
3	Power	1	—	3	Power	1	—
	Dielectric	—	3.0		Dielectric	—	3
4	Signal	1	—	4	Signal	1	—

4. EVK Design Files

The schematics, layout files, and gerber files (including Silkscreen) can be downloaded from www.nxp.com/iMX6ULLEVK

5. Contents of the Evaluation Kit

Table 8. EVK contents

Item	Description
Main Board	CPU board with i.MX 6ULL applications processor, memory, discrete powers and microSD card slot
Base Board	Peripherals and connectivity board
Documentation	Quick Start Guide

NOTE

Power supply, USB Cable, MicroSD card, LCD Module are not standard parts of the Evaluation Kit.

Table 9. Required preparation equipment

Item	Description
Power Supply	Output: 5 V/4 A, Plug: 2.1 mm x 5.5 mm
USB Cable	USB cable (micro-B to standard-A)
MicroSD card	Bootable Linux image
LCD Module (optional)	LCD8000-43T is the recommended module, which has a 4.3-inch resistive touch screen and supports a resolution of up to 480X3(RGB)X272.

6. References

The following references can be found on www.nxp.com

1. i.MX 6ULL Applications Processor Reference Manual (document [IMX6ULLRM](#))
2. i.MX 6ULL Applications Processors for Consumer Products (document [IMX6ULLCEC](#))
3. i.MX 6ULL Applications Processors for Industrial Products (document [IMX6ULLIEC](#))

7. Revision History

Table 8. Revision history

Revision number	Date	Substantive changes
0	10/2016	Initial release
1	05/2017	Section 2: changed "500 MHz" to "900 MHz"

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Document Number: IMX6ULLEVKHUG

Rev. 1

05/2017

