

# FRWY-LS1046AGSG

## Layerscape FRWY-LS1046A Board Getting Started Guide

Supports FRWY-LS1046A Board Revision B

Rev. 1 — 05/2020

User's Guide

## 1 Introduction

The Layerscape® LS1046A Freeway (FRWY-LS1046A) board is a high-performance development platform that supports the QorIQ® LS1046A architecture processor capable of supporting more than 32000 CoreMark® performance. This document describes different board components and explains how to set up and boot the board.

The FRWY-LS1046A functions with an integrated development environment (IDE), such as CodeWarrior Development Studio. For instructions on how to work with the CodeWarrior Development Studio IDE, see [CodeWarrior Development Studio for QorIQ LS series - ARM V8 ISA, Targeting Manual](#).

## 2 Related documentation

The table below lists and explains the additional documents and resources that you can refer to for more information on the FRWY-LS1046A. Some of the documents listed below may be available only under a non-disclosure agreement (NDA). To request access to these documents, contact your local field applications engineer (FAE) or sales representative.

Table 1. Related documentation

Document	Description	Link / how to access
Layerscape FRWY-LS1046A Board Reference Manual	Provides a detailed description of the FRWY-LS1046A board	<a href="#">FRWY-LS1046ARM.pdf</a>
Layerscape FRWY-LS1046A Board Errata	Describes known errata and workarounds for the FRWY-LS1046A board	Contact FAE / sales representative
QorIQ LS1046A Product Brief	Provides a brief overview of the LS1046A processor	<a href="#">LS1046APB.pdf</a>
QorIQ LS1046A Data Sheet	Provides information about LS1046A electrical characteristics, hardware design considerations, and ordering information	<a href="#">LS1046A.pdf</a>
QorIQ LS1046A Reference Manual	Provides a detailed description about the QorIQ LS1046A multicore processor and its features, such as memory map, serial interfaces, power supply, chip features, and clock information	<a href="#">LS1046ARM.pdf</a>
QorIQ LS1046A Chip Errata	Lists the details of all known silicon errata for the LS1046A	Contact FAE / sales representative
QorIQ LS1046A Design Checklist (AN5252)	This document provides recommendations for new designs based on the LS1046A. This document can also be used to	<a href="#">AN5252.pdf</a>

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**Table 1. Related documentation (continued)**

Document	Description	Link / how to access
	debug newly designed systems by highlighting those aspects of a design that merit special attention during initial system startup.	
Layerscape Software Development Kit User Guide	This document describes how to work with LSDK, which is a complete Linux kit for NXP QorIQ Arm-based SoCs and the reference and evaluation boards available for them.	<a href="#">LSDKUG.pdf</a>
CodeWarrior Development Studio for QorIQ LS series - ARM V8 ISA, Targeting Manual	This manual explains how to use the CodeWarrior Development Studio for QorIQ LS series - ARM V8 ISA product.	<a href="#">CWARMv8TM.pdf</a>
CodeWarrior TAP Probe User Guide	Provides details of CodeWarrior® TAP, which enables target system debugging through a standard debug port (usually JTAG) while connected to a developer workstation through Ethernet or USB	<a href="#">CWTAPUG.pdf</a>

### 3 Hardware kit contents

The FRWY-LS1046A board is available for purchase in the following three kits:

- FRWY-LS1046A-TP
- FRWY-LS1046A-AC
- FRWY-LS1046A-PA

The table below lists the items included in each of the above kits.

**Table 2. Hardware kit contents**

FRWY-LS1046A-TP	FRWY-LS1046A-AC	FRWY-LS1046A-PA
FRWY-LS1046A board hardware assembly with enclosure. The board comes with the following M.2 cards installed: <ul style="list-style-type: none"> <li>• Google Coral TPU module</li> <li>• SparkLAN dual-band Wi-Fi + Bluetooth NGFF card</li> </ul>	FRWY-LS1046A board hardware assembly with enclosure. The board comes with the following M.2 card installed: <ul style="list-style-type: none"> <li>• SparkLAN dual-band Wi-Fi + Bluetooth NGFF card</li> </ul>	FRWY-LS1046A board hardware assembly. No M.2 card is installed on the board.
12 V, 5 A DC power adapter	12 V, 5 A DC power adapter	12 V, 5 A DC power adapter
Universal AC input adapter <sup>1</sup>	Universal AC input adapter <sup>1</sup>	Universal AC input adapter <sup>1</sup>
USB Type A to micro-B cable	USB Type A to micro-B cable	USB Type A to micro-B cable
32 GB TF (micro-SD) card, programmed for FRWY-LS1046A-TP	32 GB TF (micro-SD) card, programmed for FRWY-LS1046A-AC	32 GB TF (micro-SD) card, programmed for FRWY-LS1046A-PA
Shunt jumpers (5)	Shunt jumpers (10)	Shunt jumpers (5)
Antennas (2)	Antennas (2)	
Quick reference card <sup>2</sup>	Quick reference card <sup>2</sup>	Quick reference card <sup>2</sup>

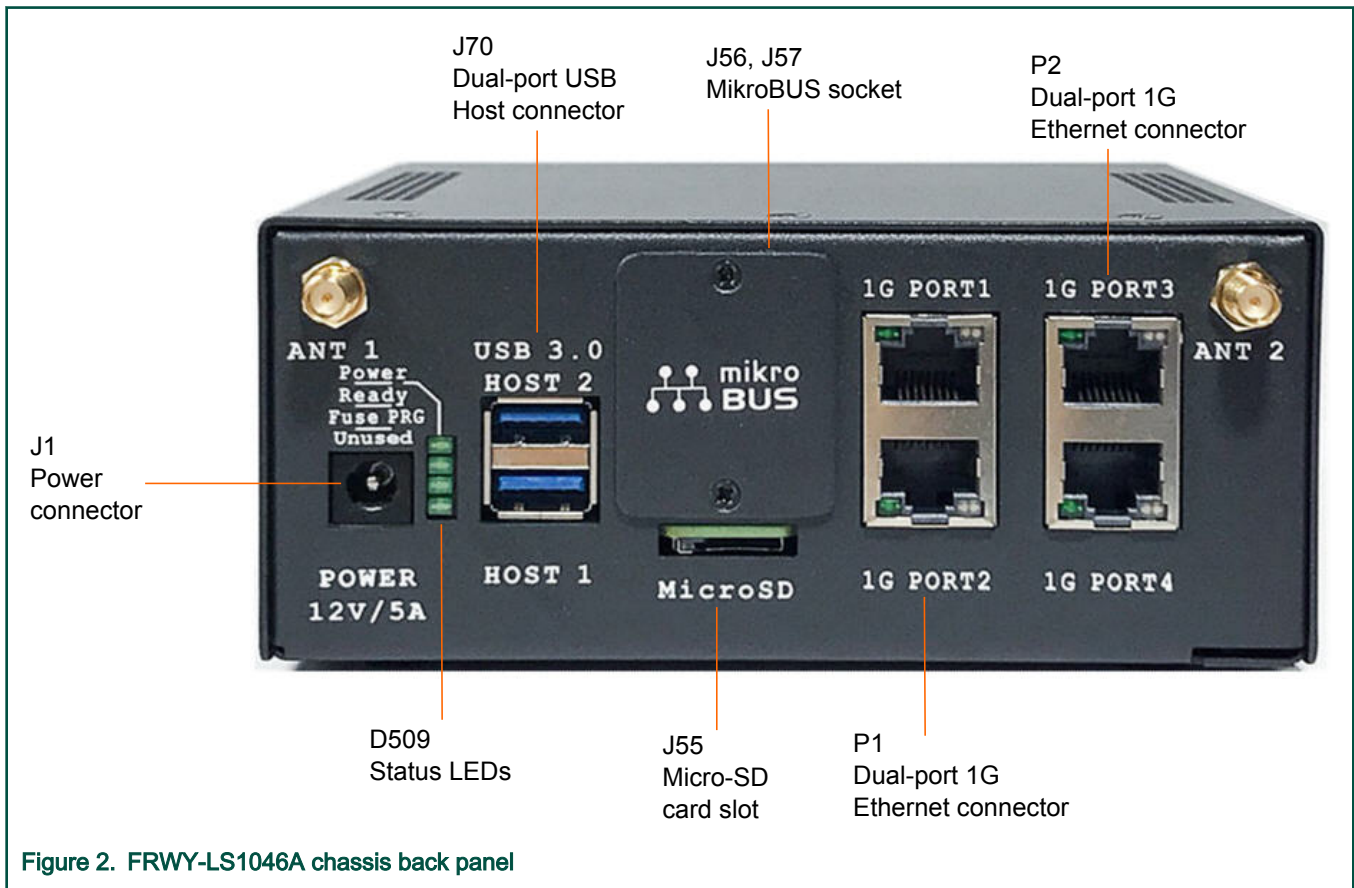
1. It helps to convert the AC adapter plug to any standard plug.  
 2. It is a colored, printed card with quick link to the FRWY-LS1046A product summary page.

## 4 Chassis and board pictures

The figure below shows the front panel of the FRWY-LS1046A chassis.



The figure below shows the back panel of the FRWY-LS1046A chassis.



The figure below shows the top-side view of the board, with all major connectors highlighted.

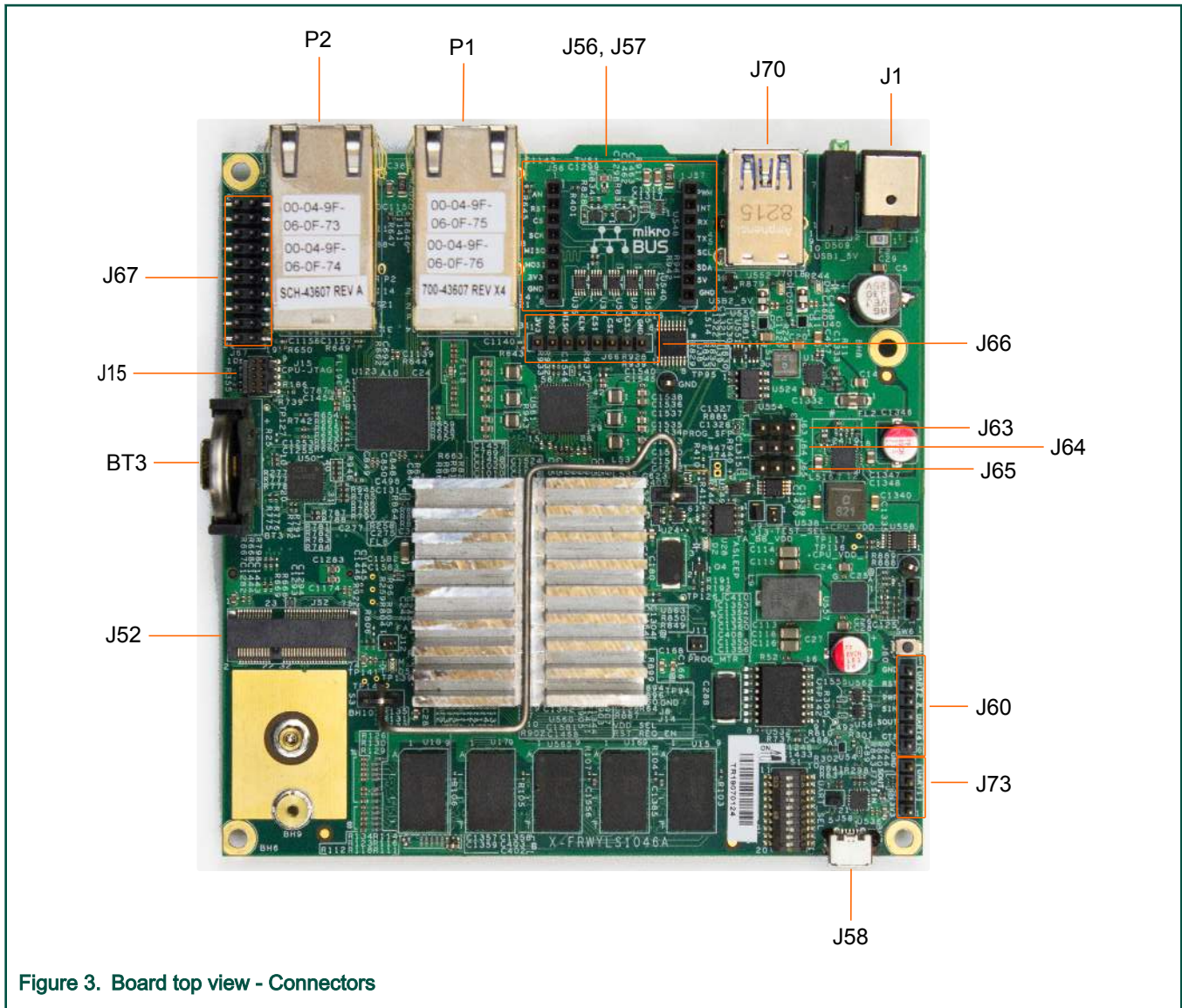


Figure 3. Board top view - Connectors

The figure below shows important jumpers, DIP switch, and LEDs available on board top view.

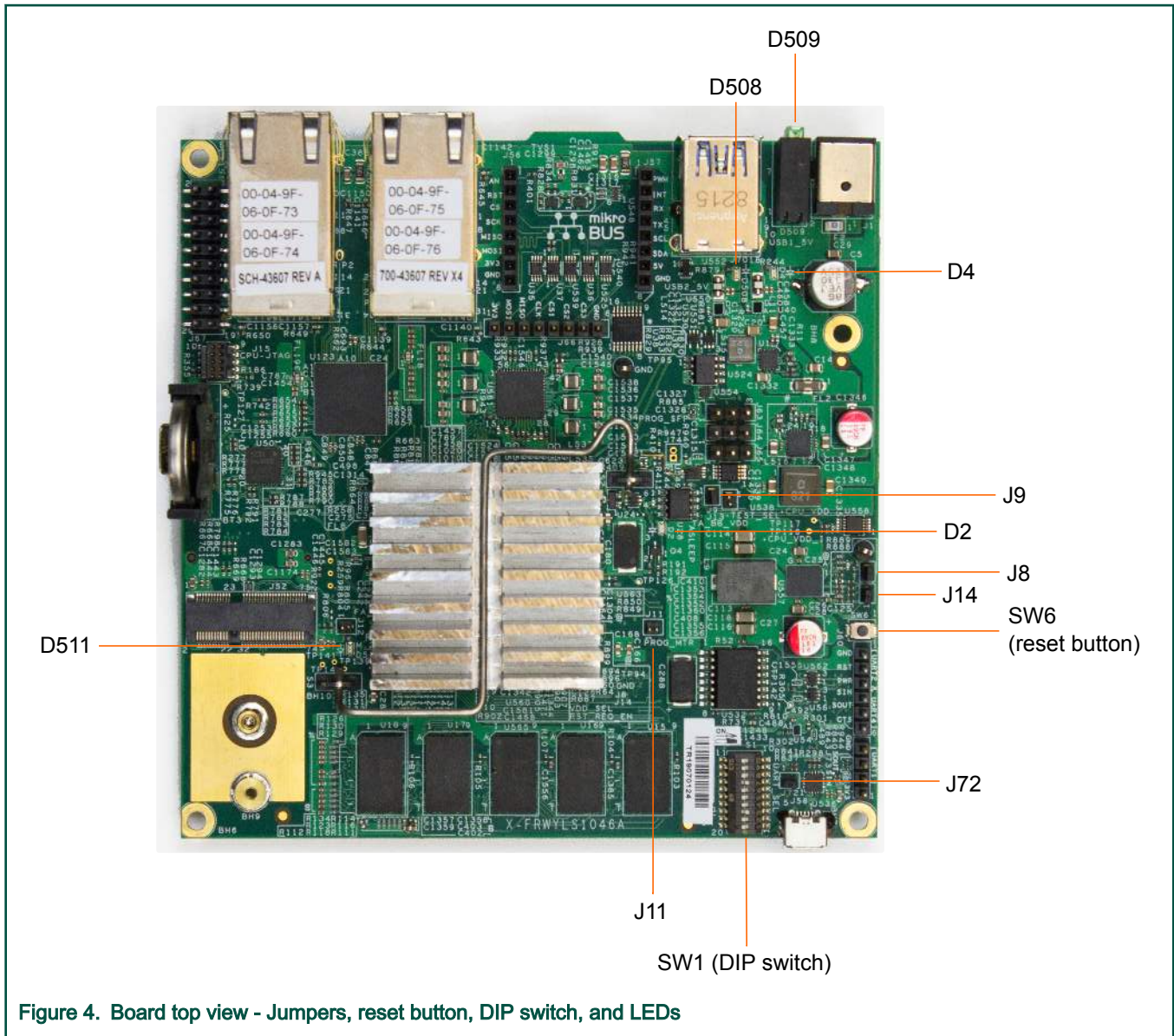


Figure 4. Board top view - Jumpers, reset button, DIP switch, and LEDs

The figure below shows the bottom-side view of the board, with two connectors and one LED highlighted.

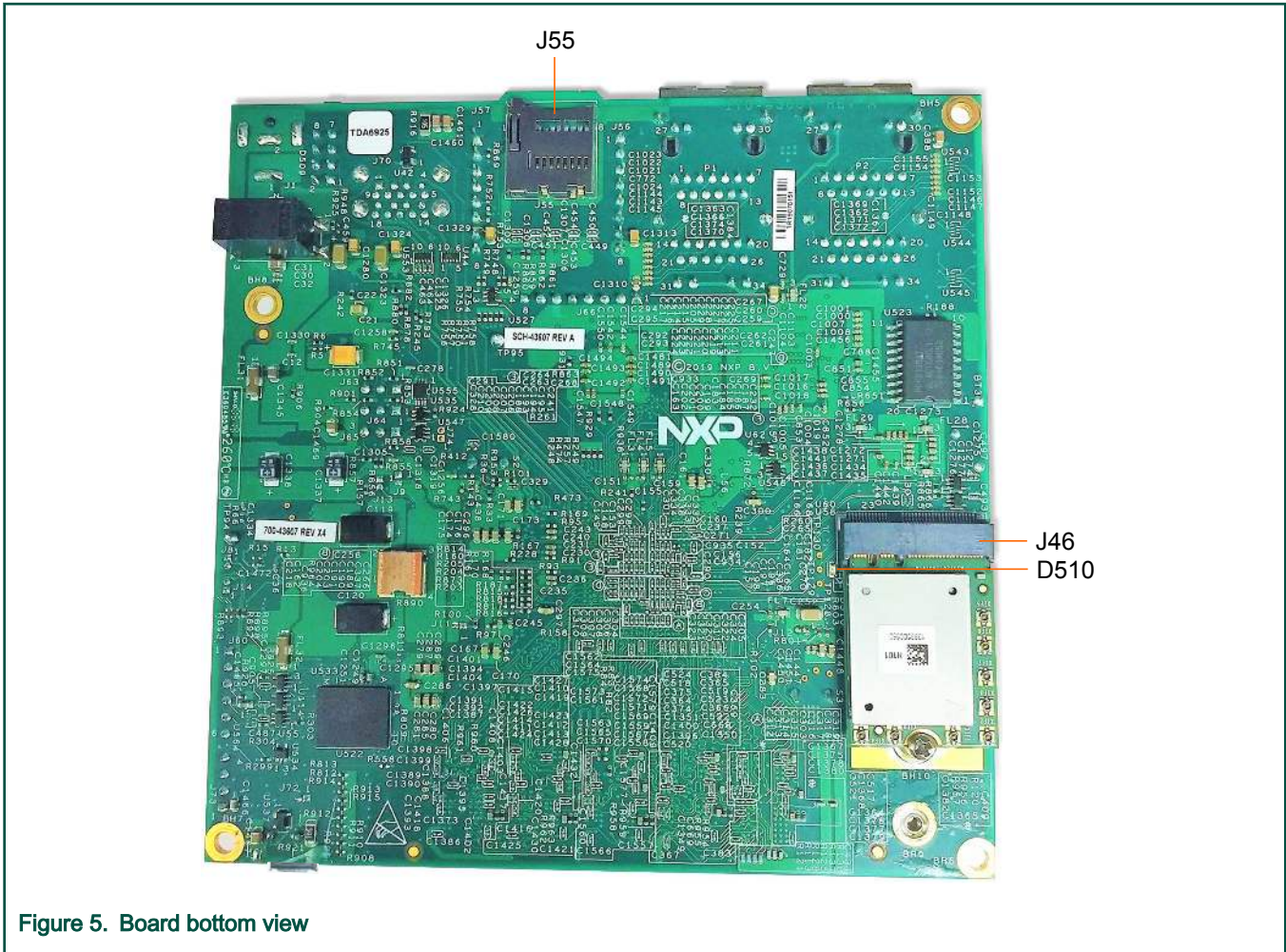


Figure 5. Board bottom view

## 5 Reset button

The FRWY-LS1046A has a reset button for manually triggering a system reset. The reset button is highlighted in [Figure 4](#). The table below describes the reset button.

Table 3. Reset button

Part identifier	Switch type	Location	Description
SW6	Push button	On top side of PCB next to UART2/UART4 header (not visible on chassis)	When pressed, resets the board and attached peripherals

**NOTE**

The board does not have a power ON/OFF switch. It is powered ON automatically when connected to external power supply.

## 6 Connectors

Connectors are onboard devices that allow to connect external devices to the board. [Figure 3](#) and [Figure 5](#) show FRWY-LS1046A connectors. The table below describes the connectors.

Table 4. FRWY-LS1046A connectors

Part identifier	Connector type	Description	Typical connection
BT3	3-pin battery holder	RTC battery	Connects to 3 V standby CR2032 lithium coin cell battery
J1	DC power jack	Power connector (available on chassis back panel)	Connects to 12 V, 5 A power adapter. It is available on the chassis back panel.
J58	USB 2.0 micro-B connector	Console port (port for connection with host computer)	Connects to USB Type A to micro-B cable to connect to host computer. It is available on the chassis front panel.
J70	USB 3.0 Type A connector (2)	Dual-port (stacked) USB Type A connector (Host mode only)	Connects to USB 2.0 / USB 3.0 - compatible device. It is available on the chassis back panel.
J55	Micro-SDHC connector	Micro-SD card slot	Supports a micro-SD card
P1	RJ45 connector (2)	Dual-port (stacked) 1 Gbit Ethernet connector	Two 1 Gbit Ethernet ports from LS1046A QSGMII. It is available on the chassis back panel.
P2	RJ45 connector (2)	Dual-port (stacked) 1 Gbit Ethernet connector	Two 1 Gbit Ethernet ports from LS1046A QSGMII. It is available on the chassis back panel.
J46 <sup>1</sup>	M.2 PCIe connector	PCIe x1 M.2 Key-E slot 1	Supports a Wi-Fi capable Key-E 1630/2230 module
J52	M.2 PCIe connector	PCIe x1 M.2 Key-E slot 2	Supports a Wi-Fi capable Key-E 1630/2230 module
J56, J57	1×8 female header (2)	MikroBUS socket	Allow connection to a click board plugged-in into mikroBUS socket
J15	2x5 connector	Arm JTAG header	Connects to CodeWarrior TAP using a 10-pin cable
J73	1x4 connector	UART1 header	UART1 expansion header for remote access
J60	1x6 connector	UART2/UART4 header	UART2/UART4 expansion header for remote access
J66	1×8 connector	SPI header	SPI expansion header for remote access
J65	1x3 connector	I2C1 header	I2C1 expansion header for remote access
J64	1x3 connector	I2C3 header	I2C3 expansion header for remote access
J63	1x3 connector	I2C4 header	I2C4 expansion header for remote access
J67	2x10 connector	GPIO header	GPIO expansion header for remote access

1. It is placed on the bottom side of the PCB.

## 7 Jumpers

Jumpers (or shorting headers) are small connectors that allow to choose from two or more options available. Jumpers are usually installed during board assembly and do not require any changes. In the FRWY-LS1046A, all jumpers are 2-pin connectors with two settings: open and shorted. [Figure 4](#) highlights the FRWY-LS1046A jumpers available for use. The table below describes the jumpers.

**Table 5. FRWY-LS1046A jumpers**

Part identifier	Jumper type	Description	Jumper settings
J72	1x2 connector	UART selection header	<ul style="list-style-type: none"> <li>Open: UART1 port is accessed remotely through a 1x4 header (J73)</li> <li>Shorted: USB 2.0 micro-B connector (J58) is connected to UART1 port through a USB-to-UART bridge (default setting)</li> </ul>
J8	1x2 connector	VDD voltage selection header	<ul style="list-style-type: none"> <li>Open: VDD = 0.9 V</li> <li>Shorted: VDD = 1 V (default setting)</li> </ul>
J14	1x2 connector	Reset mode selection header	<ul style="list-style-type: none"> <li>Open: RESET_REQ_B pin of the processor is disconnected</li> <li>Shorted: RESET_REQ_B pin triggers system reset when asserted (default setting)</li> </ul>
J11	1x2 connector	PROG_MTR voltage control header (NXP use only)	<ul style="list-style-type: none"> <li>Open: PROG_MTR pin of the processor is powered off (default setting)</li> <li>Shorted: PROG_MTR pin is powered by OVDD (1.8 V)</li> </ul>
J9	1x2 connector	TA_BB_VDD voltage control header	<ul style="list-style-type: none"> <li>Open: TA_BB_VDD pin of the processor is powered off</li> <li>Shorted: TA_BB_VDD pin is powered by VDD (1/0.9 V) (default setting)</li> </ul>

## 8 DIP switch

The FRWY-LS1046A has a 10-pin dual inline package (DIP) switch, SW1, which helps to perform some most common board configuration tasks. For SW1:

- "ON" setting corresponds to 1
- "OFF" setting corresponds to 0

The DIP switch is highlighted in [Figure 4](#). The table below describes SW1 settings.

**Table 6. SW1 settings**

Switch	Supported function	Settings
SW1[1:9]	RCW fetch location	<ul style="list-style-type: none"> <li>• 0_0100_0100: QSPI NOR flash (default setting)</li> </ul>

*Table continues on the next page...*



**Table 6. SW1 settings (continued)**

Switch	Supported function	Settings
	CFG_RCW_SRC[0:8]	<ul style="list-style-type: none"> <li>0_0100_0000: Micro-SD card</li> <li>1_0000_01xx: NAND flash (8-bit bus, 2 KB page, 64 pages/block) (LS1043A only)<sup>1</sup></li> <li>0_1001_1110: Hard-coded RCW</li> </ul>
SW1[10]	System clock source CFG_ENG_USE0	<ul style="list-style-type: none"> <li>0: DIFF_SYSClk/DIFF_SYSClk_B (differential clock) - 100 MHz (fixed) (default setting)</li> <li>1: SYSClk (single-ended clock) - 100 MHz (fixed)</li> </ul>

1. The LS1046A processor does not support booting from NAND flash.

## 9 LEDs

The FRWY-LS1046A has light-emitting diodes (LEDs) to monitor system functions, such as power-on, reset, board faults, and so on. The information collected from LEDs can be used for debugging purposes. LEDs are highlighted in [Figure 4](#) and [Figure 5](#). The table below describes the FRWY-LS1046A LEDs.

**Table 7. FRWY-LS1046A LEDs**

Reference designator	LED color	LED name	Description (when LED is ON)
D2	Yellow	ASLEEP	The processor has not exited Sleep mode, which generally indicates: <ul style="list-style-type: none"> <li>Improper RCW source selection</li> <li>Boot memory does not contain a valid RCW/PBL</li> <li>PLL multipliers in the RCW data are not compatible with the fixed SYSClk, DDRClk, or SDClk values</li> </ul>
D4	Green	USB1_5V	USB1 port of the dual-port USB connector (J70) is powered with 5 V supply for external USB device
D508	Green	USB2_5V	USB2 port of the dual-port USB connector (J70) is powered with 5 V supply for external USB device
D510 <sup>1</sup>	Green	M.2 Card1	The M.2 PCIe module on M.2 PCIe slot 1 (J46) is powered properly and its transmitter is ready to transmit
D511	Green	M.2 Card2	The M.2 PCIe module on M.2 PCIe slot 2 (J52) is powered properly and its transmitter is ready to transmit
D509	Green	4_GRN_LED	Four stacked LEDs to indicate: <ul style="list-style-type: none"> <li>Power status</li> <li>System readiness</li> <li>PROG_SFP fuse programming power enable</li> </ul>

1. It is placed on the bottom side of PCB next to J46 connector.

## 10 Getting started with FRWY-LS1046A

This section explains:

- [Prerequisites](#)
- [Booting FRWY-LS1046A](#)

### 10.1 Prerequisites

To set up your FRWY-LS1046A board, you need the items listed in the table below.

**Table 8. Prerequisites**

Item	Purpose / required action
<b>Hardware</b>	
Host computer system capable of running a terminal emulator	Host computer (for example, Windows PC, Linux system, or Mac) to control and monitor the FRWY-LS1046A from the serial console via a serial terminal emulator, such as Tera Term.  <div style="text-align: center;"><b>NOTE</b> You can also use a Linux machine to connect to the board console via a Linux utility, such as minicom.</div>
12 V AC-DC power adapter	To connect the board to external power supply
USB Type A to micro-B cable	To make a console connection from UART1 (Micro USB) port on chassis front panel
Micro-SD card (optional)	To boot the board from micro-SD card
Ethernet cable (optional)	To connect the board to network to get updated board software
CodeWarrior TAP (optional)	To debug and control the board using CodeWarrior Development Studio for QorIQ LS series - ARM V8 ISA. You can order a CodeWarrior TAP from <a href="http://nxp.com">nxp.com</a> .
<b>Software</b>	
USB-to-UART bridge virtual COM port (VCP) driver	To make the host computer allow a serial connection with the board. Download and install appropriate driver (based on Windows version) on the host computer from the following link:  <a href="https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers">https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers</a>
Tera Term (serial terminal emulator)	To configure serial connection and to see console prints. Download and install it on the host computer from Internet.
CodeWarrior Development Studio for QorIQ LS series - ARM V8 ISA (optional)	To debug and control the board. You can order it from <a href="http://nxp.com">nxp.com</a> .

### 10.2 Booting FRWY-LS1046A

When the FRWY-LS1046A is powered on, the boot loader (U-Boot) image in the QSPI NOR flash memory of the board runs, if the DIP switch has default settings.

Follow these steps to boot the board:

1. Ensure that you have met the prerequisites described in [Table 8](#).
2. Open the chassis top cover and ensure that the DIP switch has default settings, it means, SW1[1:10] = 0010001000.

**CAUTION**

Heatsink may become hot during operation. You are recommended not to touch it.

3. Ensure that the jumpers on the board have default settings (see [Jumpers](#)).
4. Connect the board to the external power supply using the 12 V AC-DC power adapter. The board gets powered ON and starts booting. The ASLEEP LED (D2) turns ON and turns OFF immediately, indicating that correct RCW has been loaded.
5. Connect one end (Type A) of the USB Type A to micro-B cable to the USB port of the host computer and other end (micro-B) to UART1 (Micro USB) port on the chassis front panel. The host computer will detect the USB device.
6. Set up Tera Term on the host computer:
  - a. Start Tera Term. The Tera Term console appears along with the **Tera Term: New connection** dialog.
  - b. On the **Tera Term: New connection** dialog, select the **Serial** option, and ensure that **Silicon Labs CP210x USB to UART Bridge** is selected in the **Port** menu.
  - c. Click **OK** to close the **Tera Term: New connection** dialog.
  - d. Choose **Setup > Serial port** from the Tera Term console menu bar. The **Tera Term: Serial port setup** dialog appears.
  - e. On the **Tera Term: Serial port setup** dialog, configure the serial port of the host computer with the following settings:
    - Baud rate: 115200
    - Data: 8 bit
    - Parity: none
    - Stop: 1 bit
    - Flow control: none
  - f. Click **OK** to close the **Tera Term: Serial port setup** dialog and complete setting up Tera Term. This configuration sets a console connection between the board and the host computer.
7. Optionally, connect an Ethernet cable if you want to connect your board to the network, for example, for obtaining latest board software and updating board images.
8. Optionally, connect the CodeWarrior TAP to the board by performing the following steps:

**NOTE**

Follow the instructions included with the CodeWarrior package to set up the environment and host attachment, such as USB and Ethernet.

- a. Connect the 10-pin micro adapter (CWH-CTP-CTX10-YE) to the CodeWarrior TAP.
- b. Connect one end of the 10-wire cable (gray ribbon cable) to the 10-pin micro adapter (both ends of the wire are keyed and can be connected on either side).
- c. Connect other end of the 10-wire cable to the 10-pin Arm JTAG header (J15) on the board.

**NOTE**

Pin 1 of the gray ribbon cable connector should align with pin 1 of the debug port header on the board.

9. Press the reset button available on PCB (next to UART2/UART4 header) to reboot the board. The board boots up and U-Boot log appears on the Tera Term console as given below:

```
NOTICE: Fixed DDR on board
NOTICE: 4 GB DDR4, 64-bit, CL=15, ECC on
NOTICE: BL2: v1.5 (release):LX2160_UEFI_ACPI_EAR1-1-gbf83b558
```

```
NOTICE: BL2: Built : 12:46:37, Dec 17 2019
NOTICE: BL31: v1.5 (release):LX2160_UEFI_ACPI_EAR1-1-gbf83b558
NOTICE: BL31: Built : 12:46:42, Dec 17 2019
NOTICE: Welcome to LS1046 BL31 Phase

U-Boot 2019.10-00007-g0a7a4b0b3f (Dec 17 2019 - 12:45:40 +0800)

SoC: LS1046AE Rev1.0 (0x87070010)
Clock Configuration:
  CPU0 (A72):1600 MHz  CPU1 (A72):1600 MHz  CPU2 (A72):1600 MHz
  CPU3 (A72):1600 MHz
  Bus:      600 MHz  DDR:      2100 MT/s  FMAN:      700 MHz
Reset Configuration Word (RCW):
  00000000: 0c150010 0e000000 00000000 00000000
  00000010: 30400506 00800012 40025000 c1000000
  00000020: 00000000 00000000 00000000 00038800
  00000030: 20044100 24003101 00000096 00000001
Model: LS1046A FRWY Board
Board: LS1046AFRWY, Rev: A, boot from QSPI
SD1_CLK1 = 100.00MHZ, SD1_CLK2 = 100.00MHZ
I2C: ready
DRAM: 3.9 GiB (DDR4, 64-bit, CL=15, ECC on)
SEC0: RNG instantiated
Using SERDES1 Protocol: 12352 (0x3040)
Using SERDES2 Protocol: 1286 (0x506)
NAND: 512 MiB
MMC: FSL_SDHC: 0
Loading Environment from SPI Flash... SF: Detected mt25qu512a with page size 256 Bytes, erase
size 64 KiB, total 64 MiB
OK
EEPROM: NXID v1
In: serial
Out: serial
Err: serial
Net: SF: Detected mt25qu512a with page size 256 Bytes, erase size 64 KiB, total 64 MiB
Fman1: Uploading microcode version 106.4.18
PCIE0: pcie@3400000 disabled
PCIE1: pcie@3500000 Root Complex: no link
PCIE2: pcie@3600000 Root Complex: no link
FM1@DTSEC1, FM1@DTSEC5, FM1@DTSEC6, FM1@DTSEC9, FM1@DTSEC10
Error: FM1@DTSEC10 address not set.

Hit any key to stop autoboot: 0
=>
```

---

**NOTE**

The above U-Boot log is an example log; the actual U-Boot log may vary slightly depending on the LSDK version available on the board.

---

**NOTE**

By default, the FRWY-LS1046A board comes preloaded with LSDK composite firmware image. You can deploy Ubuntu userland on the board; however, due to limited NOR flash memory (64 MB), you need to use an external memory device, such as a micro-SD card or USB mass storage device for storing the LSDK images.

For steps to download and assemble updated LSDK images and then to deploy LSDK Ubuntu distribution on the FRWY-LS1046A board, see "LSDK Quick Start Guide for FRWY-LS1046A" section in [Layerscape Software Development Kit User Guide](#).

## 11 Troubleshooting

This section explains the basic troubleshooting tips for the FRWY-LS1046A.

### Console not showing any print

Perform the following steps in case console is not showing any print:

1. Ensure that USB-to-UART bridge VCP driver is installed correctly on the host computer.
2. Ensure that the DIP switch has default settings, it means, SW1[1:10] = 0010001000.
3. Ensure that the power adapter is connected properly to the board power jack and external power supply.
4. Ensure that the cable making console connection is properly connected as mentioned in [Booting FRWY-LS1046A](#).
5. Ensure that Tera Term has communication settings as mentioned in [Booting FRWY-LS1046A](#).
6. Press the reset button to reboot the board. The Tera Term console should display U-Boot log.
7. If boot log is still not showing on console, then the LSDK image available in the NOR flash memory may be corrupt. In this case, use CodeWarrior TAP to flash new images and recover the board. For details, see [CodeWarrior TAP Probe User Guide](#).

## 12 Revision history

The table below summarizes revisions to this document.

**Table 9. Revision history**

Revision	Date	Topic cross-reference	Change description
Rev. 1	05/2020		Replaced FRWY-LS1046A BSP references throughout the document with LSDK references
		<a href="#">Hardware kit contents</a>	Added information related to new FRWY-LS1046A part number, FRWY-LS1046A-TP
		<a href="#">Chassis and board pictures</a>	Added new chassis/board pictures
Rev. 0	04/2019		Initial public release

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The logo for Arm, consisting of the lowercase letters "arm" in a blue, sans-serif font.