User Guide

Ensemble DevKit Gen 2

Version 1.3

Table of Contents

Introduction

This user guide will take you through the steps of initial setup to power up the Alif Semiconductor$^®$ Ensemble$^®$ Development Kit (DevKit) Gen 2 and observe the factory LED blinky application.

We will then go through the possible options for setting up options for things such as access to one of the user UART ports of the device, where to connect a JTAG debugger, and how to use other optional signal connections.

The Ensemble DevKit Gen 2 contains an Ensemble E7 device with **Application Processor cores** consisting of dual-core Arm Cortex$^®$-A32 processors and **Real Time Processor Cores** consisting of Cortex-M55 processors. The Real-Time Processor cores implement the Arm v8.1 instruction set, including Helium M-Profile Vector Extension (MVE).
The Real Time Processor cores are:
- High-Performance Arm Cortex-M55 (M55-HP) operating at up to 400 MHz with a 256 MAC wide Ethos$^®$ U55 NPU
- High-Efficiency Arm Cortex-M55 (M55-HE) operating at up to 160 MHz with a 128 MAC wide Ethos$^®$ U55 NPU

The Alif Semiconductor Ensemble family of Fusion Processors incorporate multiple CPU and NPU cores, large on-chip RAM and non-volatile memory, and analog and digital peripherals supporting wired connectivity. Their range of computational performance, power efficiency, and rich peripheral set make them suitable for a wide range of embedded IoT applications.

Each CPU subsystem can execute code independently of others but may share a power domain and memory and peripherals can be shared between subsystems.

Details of the E7 MCU architecture are discussed in the white paper "Fusion Processors System Architecture Introduction".

Target Setup Requirements
- Ensemble DevKit Gen 2
- Micro-USB Cable (included in the kit)
- Windows PC with terminal emulation software
- JTAG debugger such as Segger J-Link or Arm ULINKpro

DevKit Quick Start

Check Board Jumpers

Before powering up your board, check the jumpers to ensure they are in the default positions as shown in the diagram below.

A table of the jumper setting definitions is included at the end of this user guide.
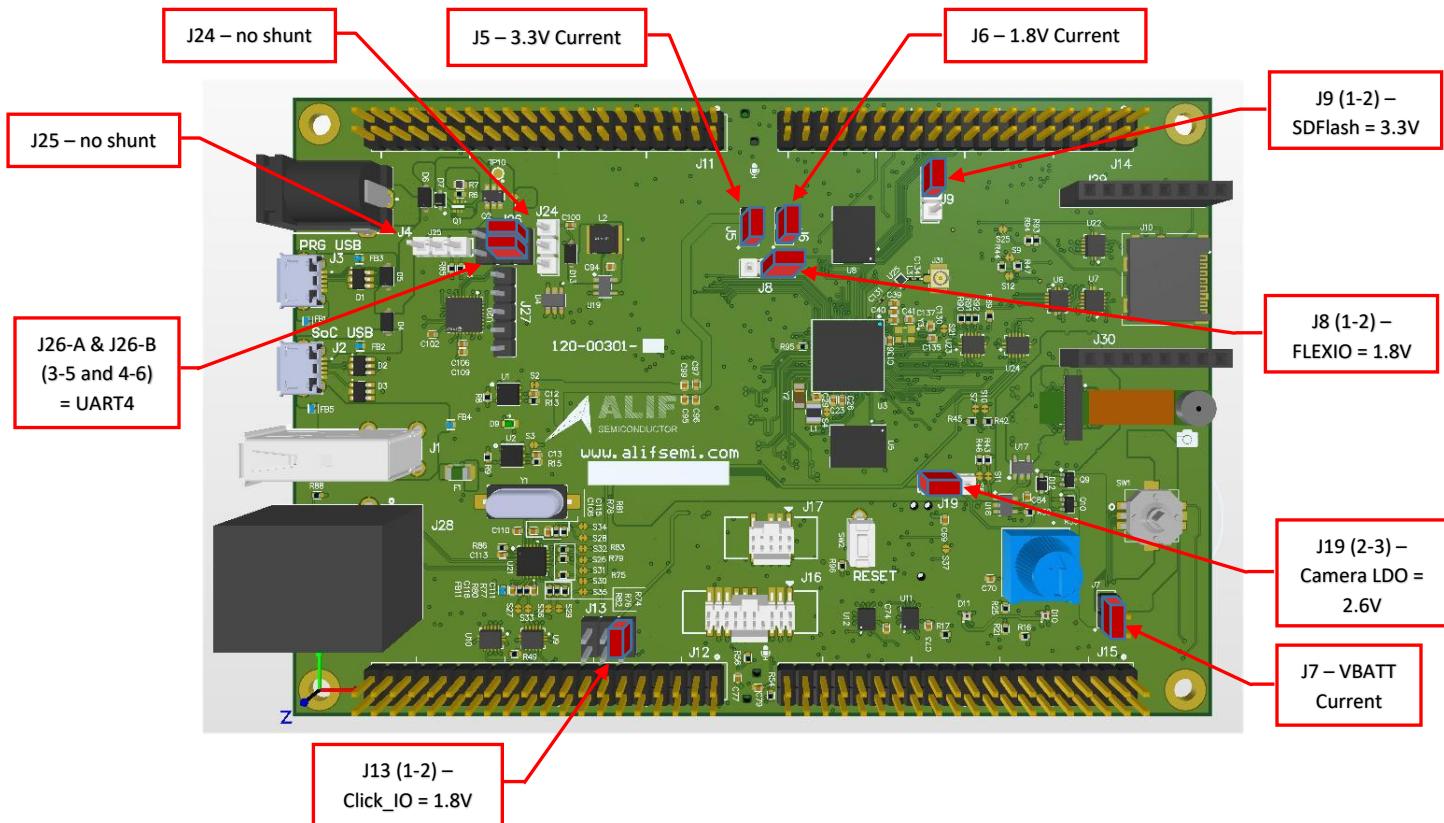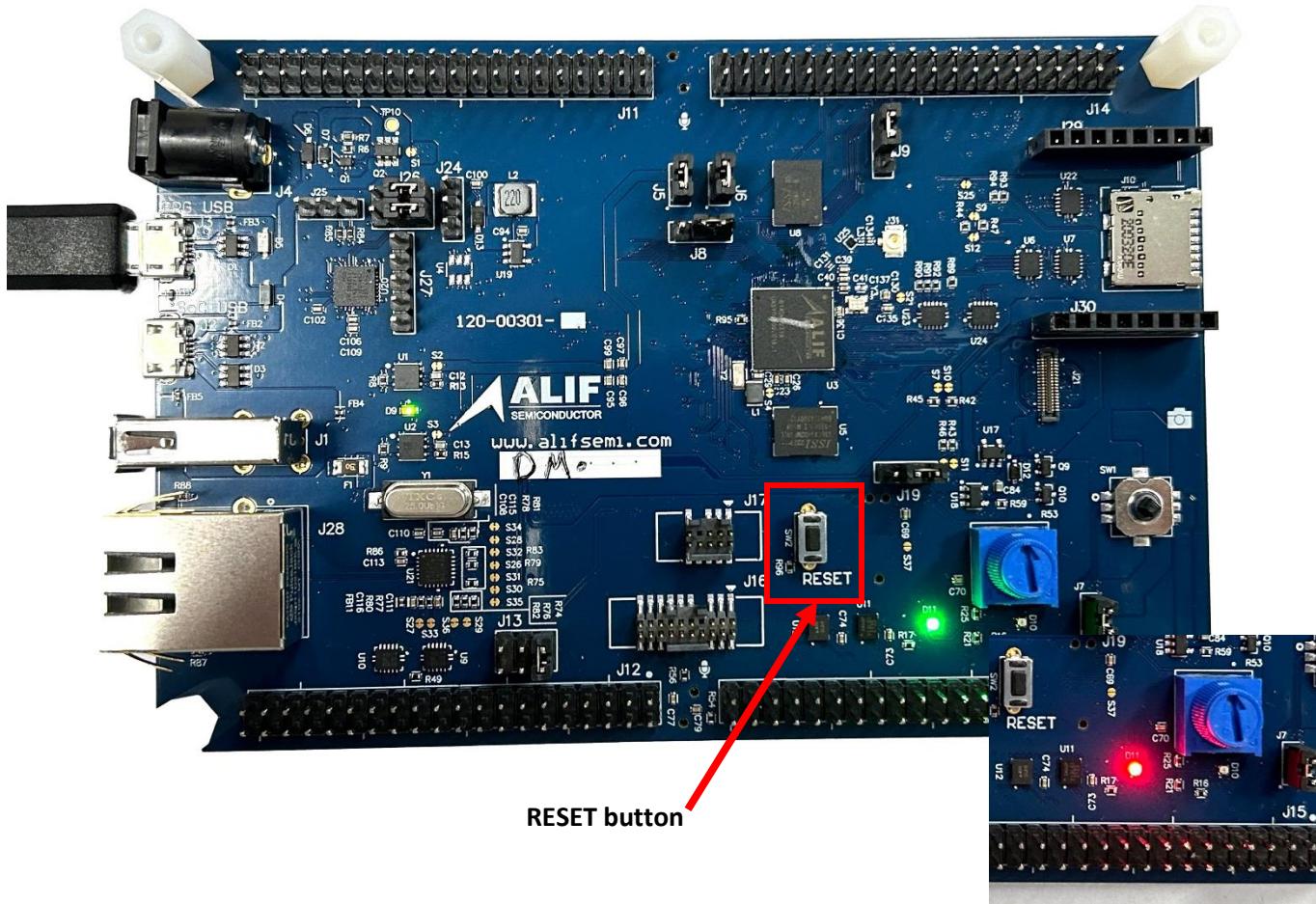
Figure 1 – Configuration Jumpers – Factory Default Settings

Powering The Board

To power your DevKit, connect a USB cable from your computer to the "PRG USB" micro-USB socket on the board.

Upon powering the board, the green power LED next to the Alif Semiconductor logo will illuminate and the factory default application will begin blinking the RGB LED near the lower edge of the board in an alternating red and green pattern.

RESET button

Install Alif Security Toolkit

The next step is to install the latest release of the Alif Security Toolkit (SETOOLS). Refer to the Alif Security Toolkit Quick Start Guide [click here] for installation instructions.

You should download the latest version of the SETOOLS (the filename begins with "app-release-exec") that is Version 1.0.0 or higher. It is available on the Ensemble DevKit Gen 2 page at https://alifsemi.com/support/kits/ensemble-devkit-gen2/

For example, version 1.0.0 for Windows is filename "app-release-exec-windows-SE_FW_1.0.0".

Determining UART Port Assignments

The DevKit has a 2-channel USB UART adapter on the board. It is connected to the SEUART that is used by the SETOOLS applications to query device status and program images into the MRAM. The other channel can be connected to either the UART2 or the UART4 general-purpose UART ports of the Ensemble device.

SETOOLS Port Discovery
The first time you execute one of the SETOOLS scripts you will be prompted for the required serial port. When the ports are presented, just enter the port name and press [ENTER].

This port data is saved in a local configuration file (isp_config_data.cfg). The next time a command is invoked and this configuration file is present, it will use the parameters from this file.

To override this option simply use the -d option:
This will force a re-discovery of the Serial ports.

```
c:\app-release-exec-73>maintenance -d
Discover
COM ports detected = 2
-> COM6
-> COM8
Enter port name:COM6
[INFO] COM6 open Serial port success
[INFO] baud rate 55000

Available options:

 1 - Device Control
 2 - Device Information
 3 - MRAM
 4 - Utilities
 5 - Setting capabilities
 6 - ROM

Select an option (Enter to exit):
```

UART Errors

There is only one SE-UART on the device. When running the SETOOLS, please ensure you have no other Tera term or putty sessions using the same SE-UART. The following shows the output if the SE-UART is already being used by another program:

```
c:\app-release-exec-65>maintenance -d
COM ports detected = 2
-> COM6
-> COM8
Enter port name:COM6
[ERROR] openSerial could not open port 'COM6': PermissionError(13, 'Access is denied.', None, 5)
[ERROR] isp openSerial failed for COM6

c:\app-release-exec-65>
```

Determining SEUART Port Assignment

The SEUART port will usually appear as the lowest numbered port available from the USB UART adapter chip on the board but depending on other USB port assignments in the system, it sometimes is the higher numbered port.

With the SEUART connected to your PC, open a Windows command prompt and navigate to the SETOOLS release directory.

Run "maintenance -d" and select the lower numbered COM port.

Then, from the available options in the maintenance program menu:
1. select "4 – Utilities"
2. select "1 – Terminal Mode"
3. press the RESET button

```
c:\app-release-exec-73>maintenance -d
Discover
COM ports detected = 2
-> COM6
-> COM8
Enter port name:COM6
[INFO] COM6 open Serial port success
[INFO] baud rate 55000

Available options:

 1 - Device Control
 2 - Device Information
 3 - MRAM
 4 - Utilities
 5 - Setting capabilities
 6 - ROM

Select an option (Enter to exit): 4

Available options:

 1 - Terminal mode
 2 - Get SERAM metrics
 3 - Get address
 4 - Set address

Select an option (Enter to return): 1
[TERMINAL] Ctrl-C to exit
/
```

If you are connected to the SEUART port, you will see a log file as shown below.

```
SEROM v0.47.68 0x0000B200

[SES] Cold boot detected

[SES] MRAM error bypass is Enabled


SES B0 EVALUATION_BOARD v1.0.0 Nov 15 2023 20:24:20
[SES] Device ID = 0x0000B200
[SES] PLL code version 0.0.4
[SES] LCS=1
[SES] System partition address  0x80580000
[DEV] Wounding Data: 0x00C0FFFB
[SES] System      device configuration processed (0x00000000) BL_STATUS_OK
[SES] Application device configuration processed (0x00000000) BL_STATUS_OK
[SES] System       partition processed (0x00000000) BL_STATUS_OK
[SES] Application partition processed (0x00000000) BL_STATUS_OK
[SES] FC:Rgn - 7:0 8:0 13:0 13:1 13:2

+----------+--------+------------+------------+------------+------------+----------+----------+--------+----------+
|   Name   |  CPU   | Store Addr |  Obj Addr  | Dest Addr  | Boot Addr  |   Size   | Version  | Flags  | Time (ms)|
+----------+--------+------------+------------+------------+------------+----------+----------+--------+----------+
|   DEVICE |  CM0+  | 0x805C1EE0 | 0x805C14E0 | ---------- | ---------- |    404   |   0.5.0| u V    |   14.04  |
|   DEVICE |  CM0+  | 0x8057FF30 | 0x8057F530 | ---------- | ---------- |     88   |   0.5.0| u V    |   13.57  |
| * SERAM0 |  CM0+  | ---------- | 0x000000E0 | ---------- | ---------- |   90204  |   1.0.0| ------ |    0.00  |
|   SERAM1 |  CM0+  | ---------- | 0x00020AE0 | ---------- | ---------- |   90204  |   1.0.0| ------ |    0.00  |
|   HE_DBG | M55-HE | ---------- | 0x805C2080 | ---------- | ---------- |    2256  |   1.0.0| uLs    |    0.00  |
| BLINK-HE | M55-HE | 0x8057CF40 | 0x8057C540 | 0x58000000 | 0x58000000 |    9708  |   1.0.0| uLVB   |   15.26  |
+----------+--------+------------+------------+------------+------------+----------+----------+--------+----------+
Legend: (u)(C)ompressed,(L)oaded,(V)erified,(s)kipped verification,(B)ooted,(E)ncrypted,(D)eferred


[SES] CM0+ frequency is 100.02 MHz

[SES] SERAM bank 0x0 is booted
[SES] Wounding register Peripheral 0x00C5FFFB
[SES] os Kernel V10.4.2 (Tickless)
[SES] Main Task - looping forever...
/
```

If you see no output, you should exit the maintenance program terminal mode by pressing Ctrl-C, then press RETURN twice to exit maintenance mode.

Then rerun the process while selecting the higher numbered COM port and you should see the SEUART boot screen shown above. The tools will remember the last port selection used, so once you have the correct port for the SEUART you will not have to go back through port discovery.

Updating Device Firmware

To update the device firmware image, go to the top level SETOOLS directory for the version you just downloaded (the default location is C:\app-release-exec) and execute the command "updateSystemPackage". The program will determine the correct baud rate and update your firmware.
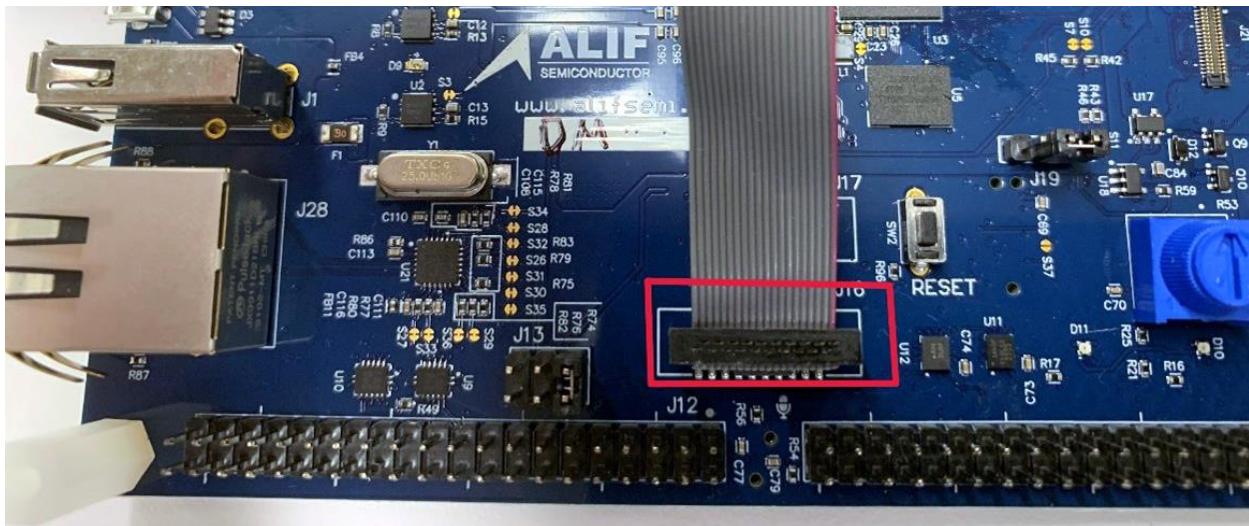
```
c:\app-release-exec-100>updateSystemPackage.exe
Burning: System Package in MRAM
Selected Device:
Part# E7 (AE722F80F55D5LS) - 5.5 MRAM / 13.5 SRAM - Rev: B2

Connecting to the target device...
[INFO] baud rate  55000
[INFO] dynamic baud rate change  Enabled
[INFO] COM6 open Serial port success
Bootloader stage: SERAM
[INFO] Detected Device:
Part# AE722F80F55D5LS - Rev: B2
- MRAM Base Address: 0x80580000
Maintenance Mode = Enabled
Authenticate Image:  True
Signature File:  alif\SP-AE722F80F55D5LS-rev-b2-dev.bin.sign
Auth Token:  0xebbc4223
Verify Image
alif\SP-AE722F80F55D5LS-rev-b2-dev.bin[###################]100%: 275280/275280 bytes
       6.30 seconds
Authenticate Image:  True
Signature File:  alif\offset-58-rev-b2-dev.bin.sign
Auth Token:  0xf95c2281
Verify Image
alif\offset-58-rev-b2-dev.bin   [###################]100%: 16/16 bytes
       0.00 seconds

c:\app-release-exec-100>
```

Connecting a JTAG Debugger

JTAG debugger connections are available in the middle of the board near the lower edge. The picture below shows a Segger J-Link with 19-pin Cortex-M adapter connected to J16 on the DevKit which is the 19-pin JTAG-0 connector.

After you have updated your internal system image and connected your debugger, you can proceed with design and debug.

A complete step-by-step tutorial on doing bare metal design using VSCode + GNU tools is available upon request from the Alif Semiconductor applications team.

Optional User UART Connections
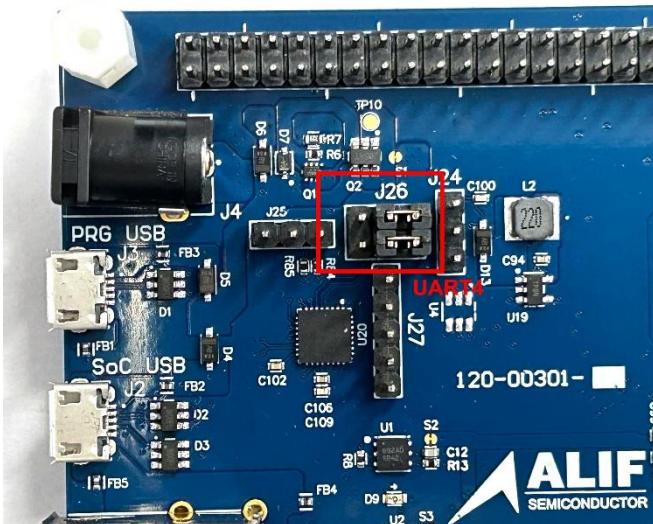
If an example application you are going to use specifies the need for additional UART connections, the instructions below will show you how to connect to UART2 or UART4.

When a micro-USB cable is plugged into the "PRG USB" port (the port closest to the corner of the board), power is applied to the board and there is access to 2 UART ports. One of these will be the SEUART that is used to access the Secure Enclave to get device status and to program application images into the non-volatile MRAM of the device. You determined how to select the SEUART port in a previous section.
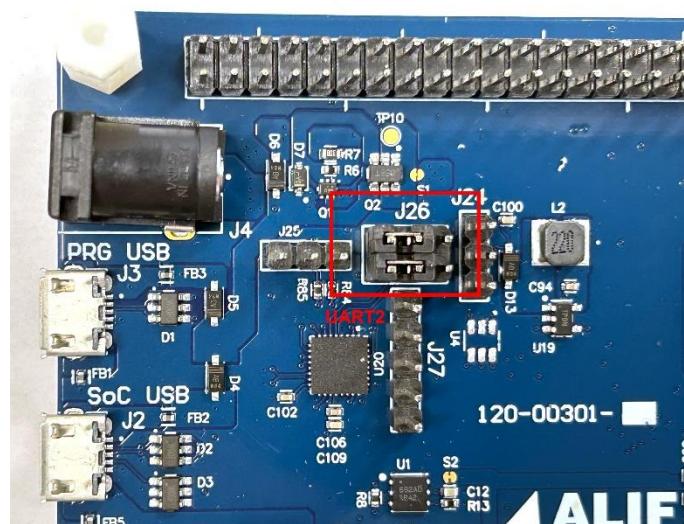
The other port is either the UART2 or UART4 general purpose peripheral port depending on jumper settings for header pins labeled "UART SEL SW" in between the 2 micro-USB sockets.

Putting jumpers on the two pairs of pins closer to the center of the board selects UART4 which is the default selection, while putting jumpers on the two pairs of pins closer to the edge of the board selects UART2.
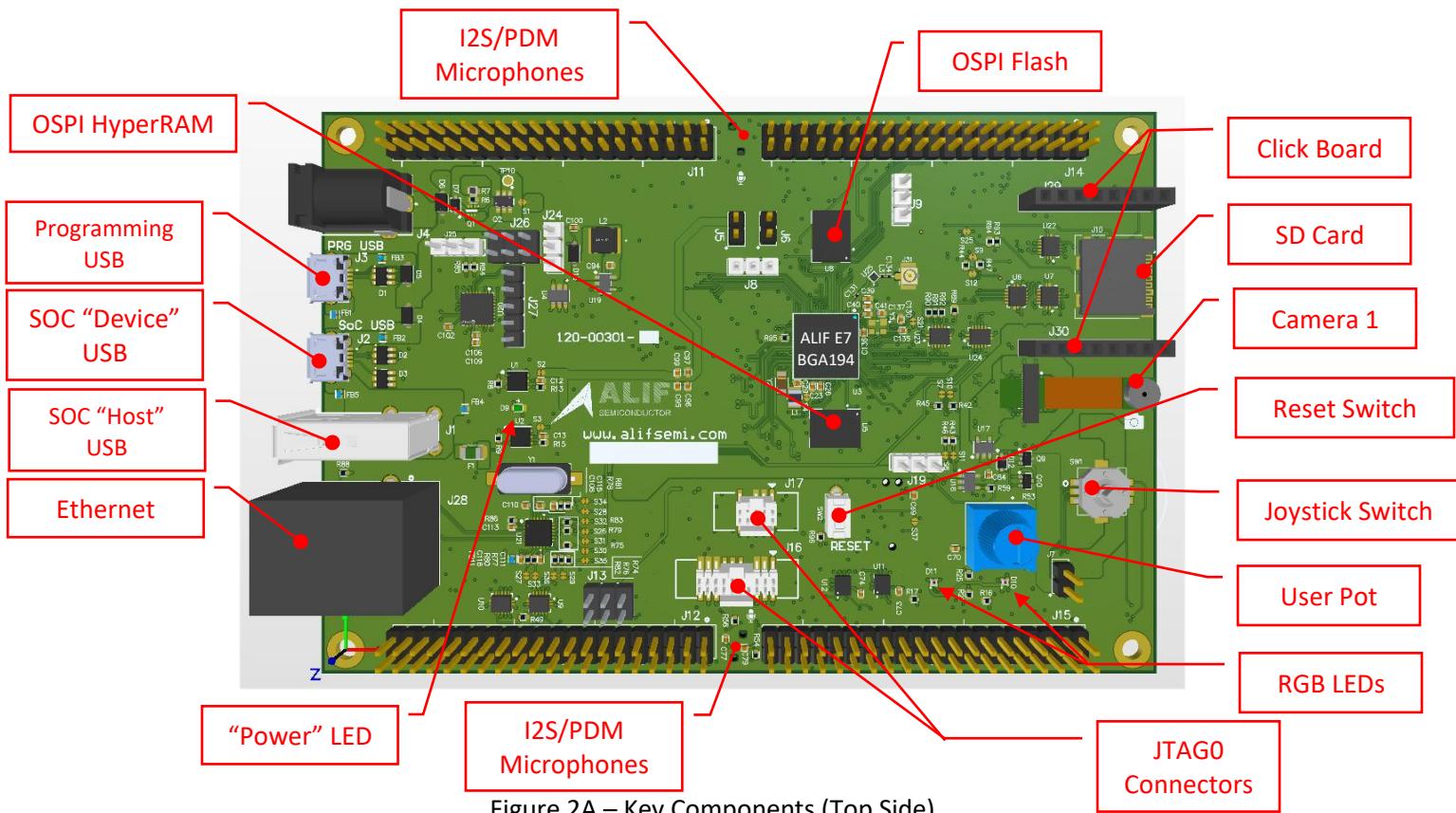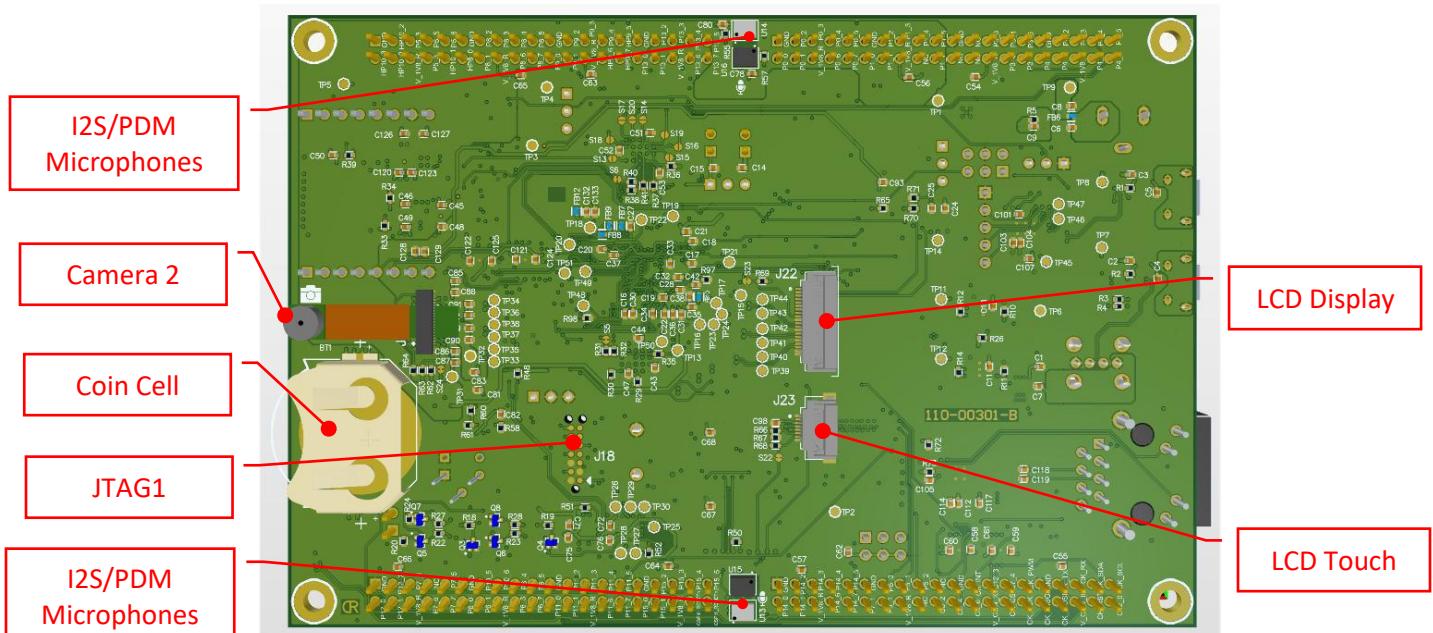
UART4 Selection (default)   UART2 Selection

The SoC USB connector is connected directly to the USB peripheral output pins of the Ensemble E7 SoC device and can be used in program development.

# Ensemble DevKit Key Components

I2S/PDM Microphones

OSPI Flash

OSPI HyperRAM

Click Board

Programming USB

SD Card

SOC "Device" USB

Camera 1

SOC "Host" USB

Reset Switch

Ethernet

Joystick Switch

User Pot

"Power" LED

I2S/PDM Microphones

RGB LEDs

JTAG0 Connectors

Figure 2A – Key Components (Top Side)

I2S/PDM Microphones

LCD Display

Camera 2

Coin Cell

JTAG1

LCD Touch

I2S/PDM Microphones

Figure 2B – Key Components (Bottom Side)

Ensemble DevKit Connectors

GPIO Headers (4)

2.1mm DC Jack

Programming USB

SOC "Device" USB

SOC "Host" USB

Ethernet

Click Board

SD Card

Camera 1 Option

JTAG0 Connectors
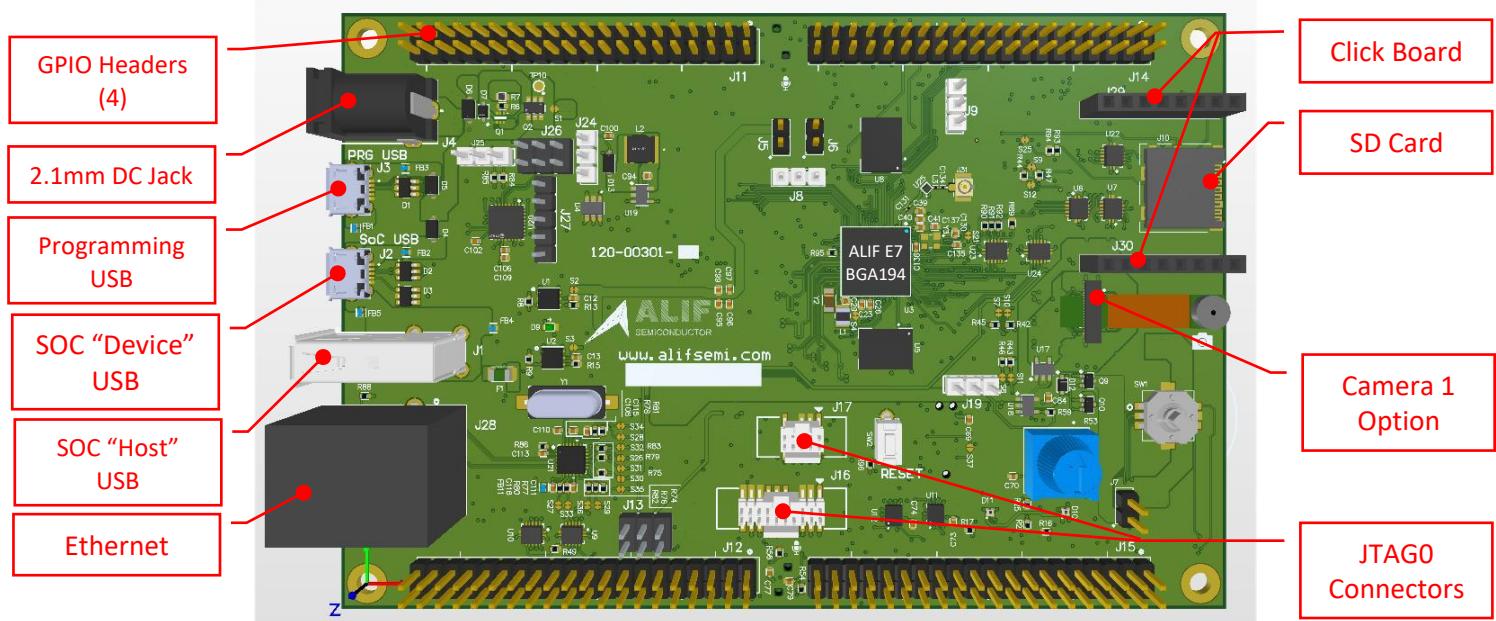
Figure 3 – Connectors

See Figure 2B for Bottom Side Connectors

Ensemble DevKit Configuration Jumpers

J5 – SOC 3.3V Current Measurement

J6 – SOC 1.8V Current Measurement

J7 – SOC Coin Cell (VBATT) Current Measurement

J8 – FLEXIO Voltage Selection

Pin 1-2 FLEXIO = 1.8V **

Pin 2-3 FLEXIO = 3.3V

J9 – SD Flash Card Voltage Selection

Pins 1-2 SD Flash = 3.3V **

Pins 2-3 SD Flash = 1.8V

J13 – Click Board and a Few Other GPIOs Voltage selection

Pins 1-2 Click I/O = 1.8V **

Pins 3-4 Click I/O = 3.3V

Pins 5-6 Click I/O = 5.0V

J19 – MIPI Camera LDO Analog Voltage Selection

Pins 1-2 Analog Voltage = 2.8V

Pins 2-3 Analog Voltage = 2.6V **

J26 – UART Selection between SOC and Cypress UART / USB Bridge

Pins 1-3 and 2-4 = UART2

Pins 3-5 and 4-6 = UART4 **

All Configuration Jumpers are male headers, 2.54mm pin spacing. Factory default settings are denoted with **.

Regulatory Compliance Statements

Federal Communications Commission (FCC) and ISED Canada Compliance Statements

FCC

<u>Identification of product: DK-E7</u>

This device complies with Part 15(B) of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) The device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

EMC

Class B
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

ISED CANADA

This device complies with Industry Canada License-exempt RSS standard(s). Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) The device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et,

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

CAN ICES-003
Les changements ou modifications non expressément approuvés par la partie responsable de la conformité peuvent annuler le droit de l'utilisateur à utiliser l'équipement.

CAN NMB-003
Cet appareil numérique de classe B est conforme à la norme canadienne NMB-003.

RoHS Compliant

DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011
DIRECTIVE (EU) 2017/2102 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 November 2017 amending Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment

Simplified DoFC

български BG	С настоящото **Alif Semiconductor, Inc.** декларира, че този тип радиосъоръжение **DK-E7** е в съответствие с Директива 2014/53/ЕС. Цялостният текст на ЕС декларацията за съответствие може да се намери на следния интернет адрес: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
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Deutsch DE	Hiermit erklärt **Alif Semiconductor, Inc.**, dass der Funkanlagentyp **DK-E7** 1 der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Greek EL	Με την παρούσα ο/η **Alif Semiconductor, Inc.**, δηλώνει ότι ο ραδιοεξοπλισμός **DK-E7** πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Eesti ET	Käesolevaga deklareerib **Alif Semiconductor, Inc.**, et käesolev raadioseadme tüüp **DK-E7** vastab direktiivi 2014/53/EL nõuetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
English EN	Hereby, **Alif Semiconductor, Inc.** declares that the radio equipment type **DK-E7** is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Español ES	Por la presente, **Alif Semiconductor, Inc.** declara que el tipo de equipo radioeléctrico **DK-E7** es conforme con la Directiva 2014/53/UE. El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Estonian ET	Käesolevaga deklareerib **Alif Semiconductor, Inc.**, et käesolev raadioseadme tüüp **DK-E7** vastab direktiivi 2014/53/EL nõuetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Finnish FI	**Alif Semiconductor, Inc.** vakuuttaa, että radiolaitetyyppi **DK-E7** on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Français FE	Le soussigné, **Alif Semiconductor, Inc.**, déclare que l'équipement radioélectrique du type **DK-E7** est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Croatian HR	**Alif Semiconductor, Inc.** ovime izjavljuje da je radijska oprema tipa **DK-E7** u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Hungarian HU	**Alif Semiconductor, Inc.** igazolja, hogy a **DK-E7** típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Italiano IT	Il fabbricante, **Alif Semiconductor, Inc.**, dichiara che il tipo di apparecchiatura radio **DK-E7** è conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE è disponibile al seguente indirizzo Internet: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Lietuvių LT	Aš, **Alif Semiconductor, Inc.**, patvirtinu, kad radijo įrenginių tipas **DK-E7** atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Latvian LV	Ar šo **Alif Semiconductor, Inc.** deklarē, ka radioiekārta **DK-E7** atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**

Malti MT	B'dan, **Alif Semiconductor, Inc.**, niddikjara li dan it-tip ta' tagħmir tar-radju **DK-E7** huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan l-indirizz tal-Internet li ġej: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
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Português PT	O(a) abaixo assinado(a) **Alif Semiconductor, Inc.** declara que o presente tipo de equipamento de rádio **DK-E7** está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Romanian RO	Prin prezenta, **Alif Semiconductor, Inc.** declară că tipul de echipamente radio **DK-E7** este în conformitate cu Directiva 2014/53/UE. Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
Slovensky SK	**Alif Semiconductor, Inc.** týmto vyhlasuje, že rádiové zariadenie typu **DK-E7** je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese: **https://alifsemi.com/support/kits/ensemble-devkit-gen2/**
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Related Documents and Tools

- Alif Semiconductor device series-specific Hardware Reference Manual (HWRM)
- Alif Semiconductor device series-specific Software Reference Manual (SWRM)
- Alif Semiconductor device series-specific Datasheet

For additional Alif Semiconductor technical documentation and software resources please visit:

- User Guides & App Notes
- Software & Tools

For managing software configurations of device resources, power, pins, clocks, DMA requests, interrupts, and various other additional settings, refer to the Alif Conductor tool.

Contact Information

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Document History

Version	Change Log
V0.91	Pre-release copy
V1.0	Initial production release
V1.1	Added Regulatory Compliance Statements
V1.2	Updated screenshots and minor edits
V1.3	Edited Regulatory Compliance Statements