



User Guide

AI/ML AppKit Gen 2 (AK-E7-AIML)

Version 1.3

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Introduction

This user guide will take you through the steps of initial setup to power up the Ensemble AI/ML AppKit (Gen 2) and observe the factory facial detection model results on the display.

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 the optional camera position connector.

The Ensemble AI/ML AppKit contains an Ensemble E7 device with a Cortex M55_HE high efficiency processor and a M55_HP high performance processor, both of which contain an Ethos U55 micro-NPU, or Neural Processor Unit, and two Cortex-A32 application processors. The M55_HE has a 128 MAC wide U55 NPU and the M55_HP has a 256 MAC wide U55 NPU associated with it.

The E7 Family MCU device also contains large on-chip RAM and non-volatile memory, as well as analog and digital peripherals supporting wired connectivity. The range of computational performance, power efficiency, and their rich peripheral set make them suitable for a wide range of embedded IoT applications.

Details of the E7 MCU architecture are discussed in the white paper "[Fusion Processors System Architecture Introduction](#)".

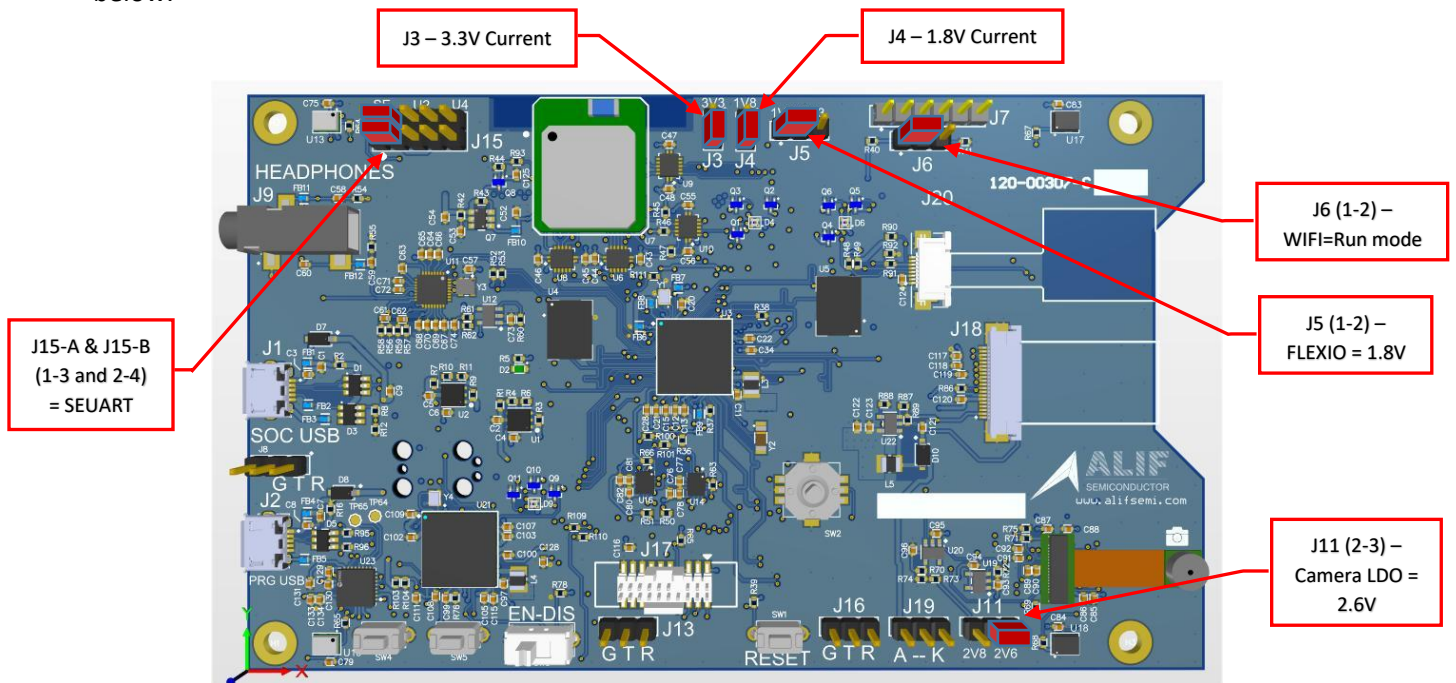
Target Setup Requirements

- Ensemble AI/ML AppKit (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 (optional for program debugging)

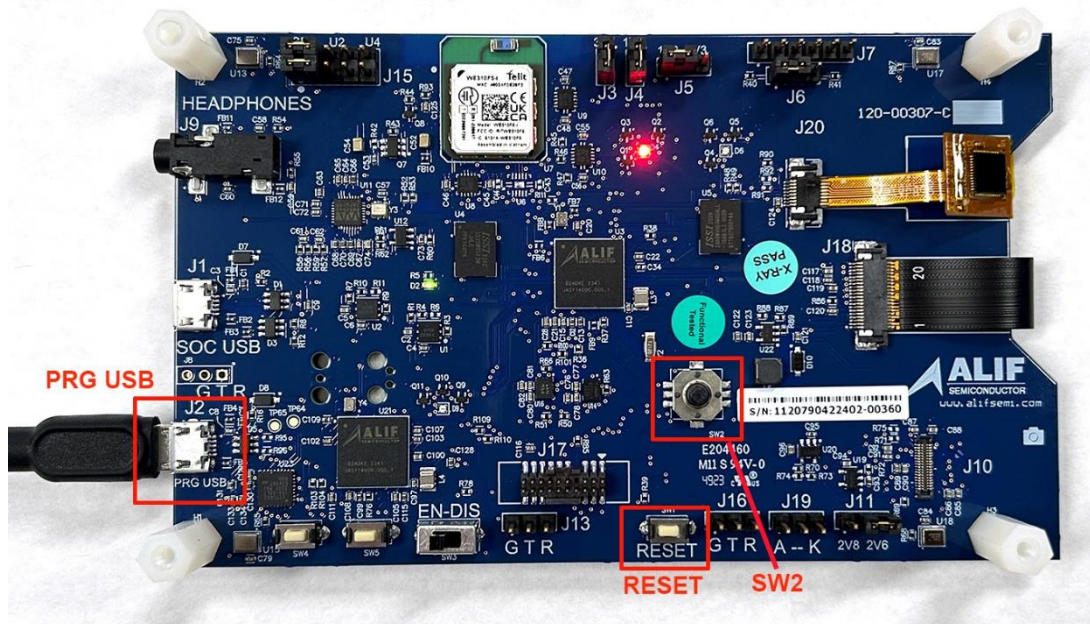
NOTE: Equipment is supplied by an external power source that meets limits of ES1 and PS1 according to IEC 62368-1.

Verifying Configuration Jumpers

Before powering up your AppKit, you should verify that the configuration jumpers are set as shown below.

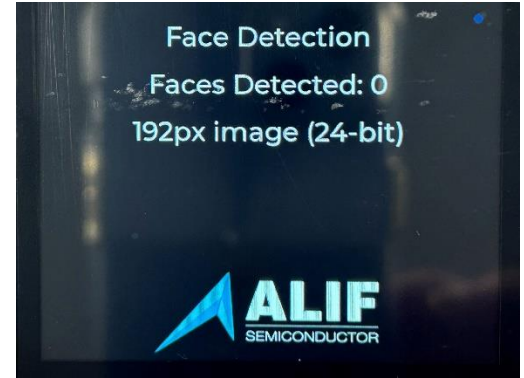


Booting the AppKit



To power your AppKit, connect a USB cable from your computer to the “PRG USB” micro-USB socket on the board.

Upon powering the board, a boot message will be displayed and then the default face detection application will start with the message shown to the right.



To start a continuous inference process, press the center of joystick SW2. Pressing it again will stop inferencing.



Install Alif Security Toolkit

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

The latest version of the Alif Security Toolkit is available from the Alif Semiconductor web site at:

Windows ZIP format: <https://alifsemi.com/download/APFW0001>

Linux tar format: <https://alifsemi.com/download/APFW0002>

MacOS tar format: <https://alifsemi.com/download/APFW0003>

Your AI/ML AppKit has been provisioned at the factory with Version 1.0.86 firmware, so it is not necessary to update the device firmware before proceeding.

Determining UART Port Assignments

The AI/ML AppKit 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 is reserved for an on-board debugging interface in the future and is not used at this time.

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>maintenance.exe -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 Version 0.65.0 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>maintenance.exe -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 ECC key

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 path

[SES] MRAM error bypass is Enabled

SES B0 EVALUATION_BOARD v1.0.86 Dec  1 2023 17:42:45
[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 (0x0000001b) BL_TOC_OBJECT_NOT_FOUND
[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 |
| * SERAM0 | CM0+ | ----- | 0x000000E0 | ----- | ----- | 91812 | 1.0.0 | ----- | 0.00 |
| SERAM1 | CM0+ | ----- | 0x00020AE0 | ----- | ----- | 91812 | 1.0.0 | ----- | 0.00 |
| HE_DBG | M55-HE | ----- | 0x805C2080 | ----- | ----- | 2256 | 1.0.0 | uLs | 0.00 |
| OD | M55-HP | 0x80008000 | 0x8057FC40 | ----- | 0x80008000 | 1190384 | 1.0.0 | u sB | 0.72 |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
Legend: (u)(C)ompressed, (L)oaded, (V)erified, (s)kipped verification, (B)ooted, (E)ncrypted, (D)efered

[SES] CM0+ frequency is 100.04 MHz

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

```

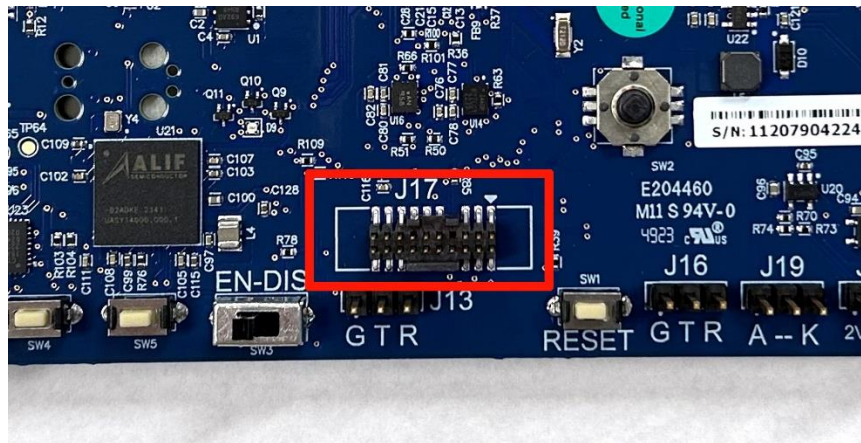
If you see no output, you should exit the maintenance program terminal mode by pressing Ctrl-C, then press RETURN twice to exit maintenance mode.

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.

Optional Connections

JTAG Debugger Connection:

If you are doing program development and need to do interactive debugging, you can connect a debugger such as the Segger J-Link or Arm ULINKpro to the 19-pin JTAG connector J17. That connector is on the component of the board near the RESET button. The keyway for the tab on the JTAG connector is on the side of the connector closest to the display.

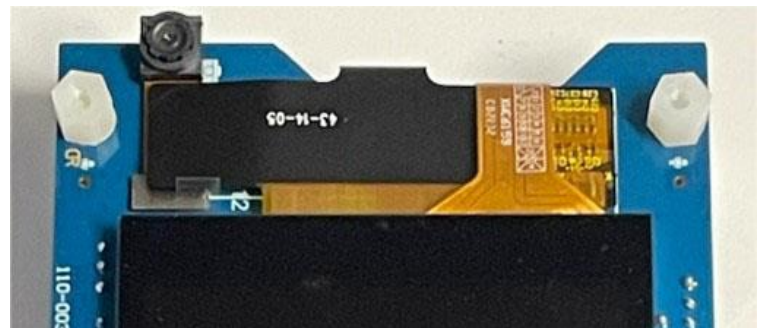


Display Side Camera Connection:

For applications requiring a display-side camera that views towards the person holding the board, there is an alternate camera connector on the display side of the board.

You can remove the camera from the back-side “viewfinder mode” connector and plug it into the front side connector.

The two connectors are wired in parallel and only one camera can be connected to the board at one time.



You have now updated your internal system image and can proceed with design and debug.

A complete step-by-step tutorial on doing bare metal design is available in the documents “Getting Started with VS Code, GCC, & J-Link Using CMSIS Toolbox (Gen 2)” [\[click here\]](#) or “Getting Started With Bare Metal Design Using Keil MDK (Gen 2)” [\[click here\]](#)

Major Components

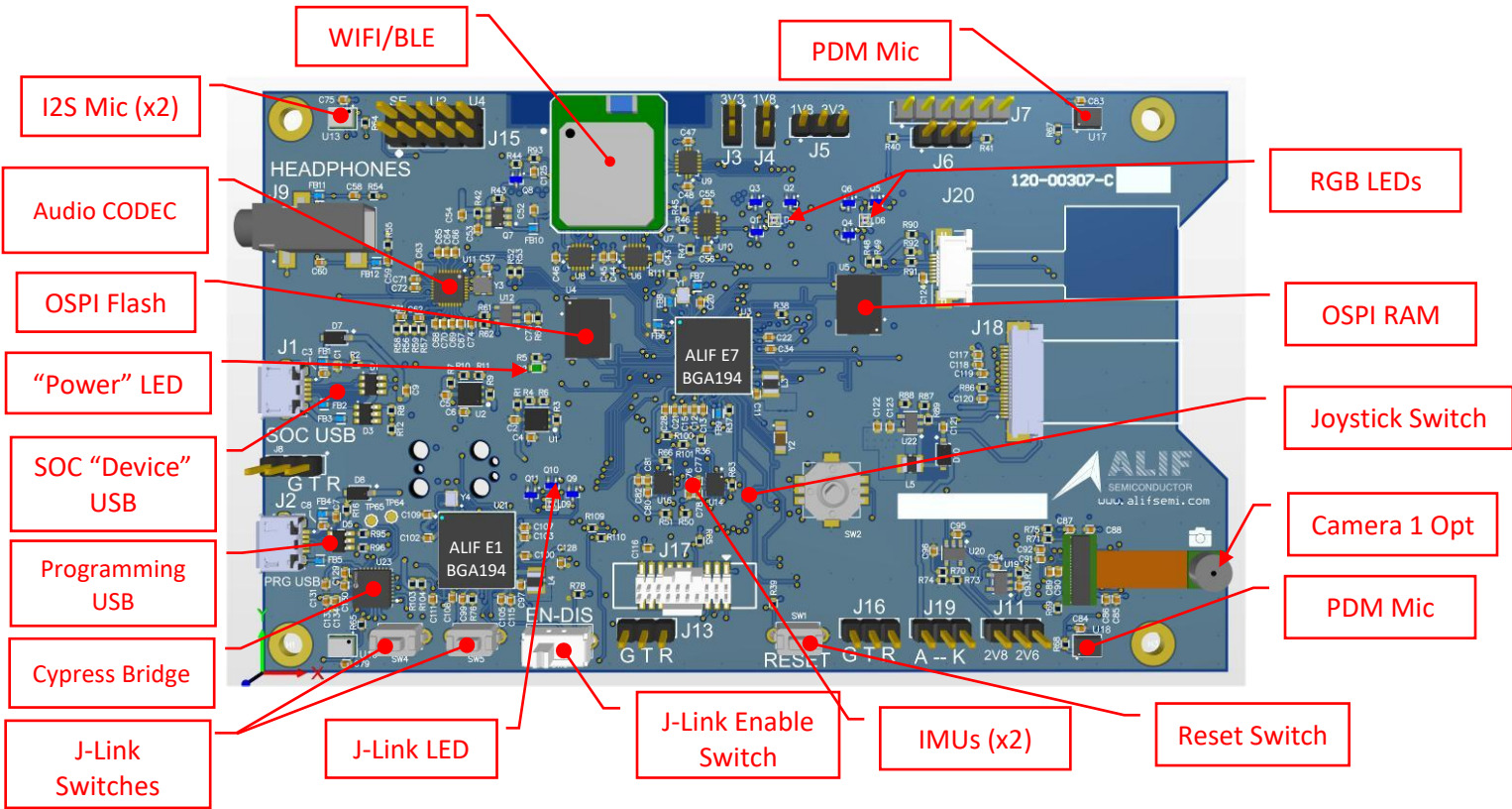


Figure 1A – Key Components (Top Side)

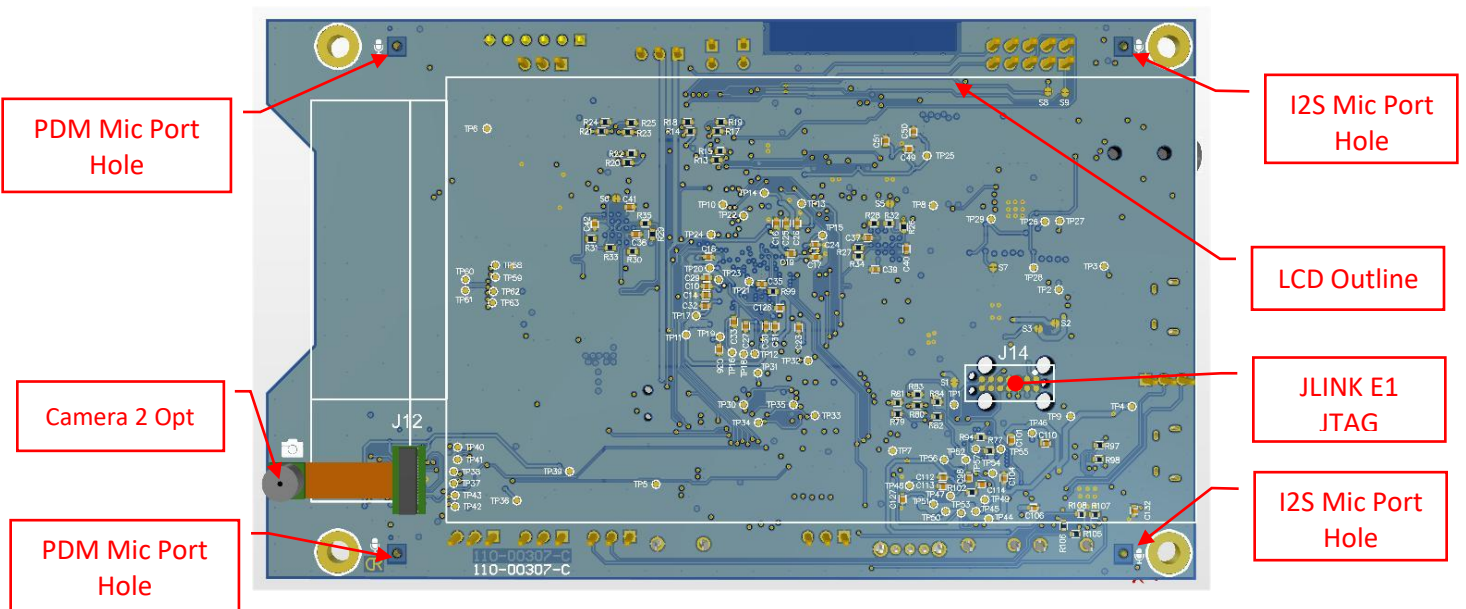


Figure 1B – Key Components (Bottom Side)

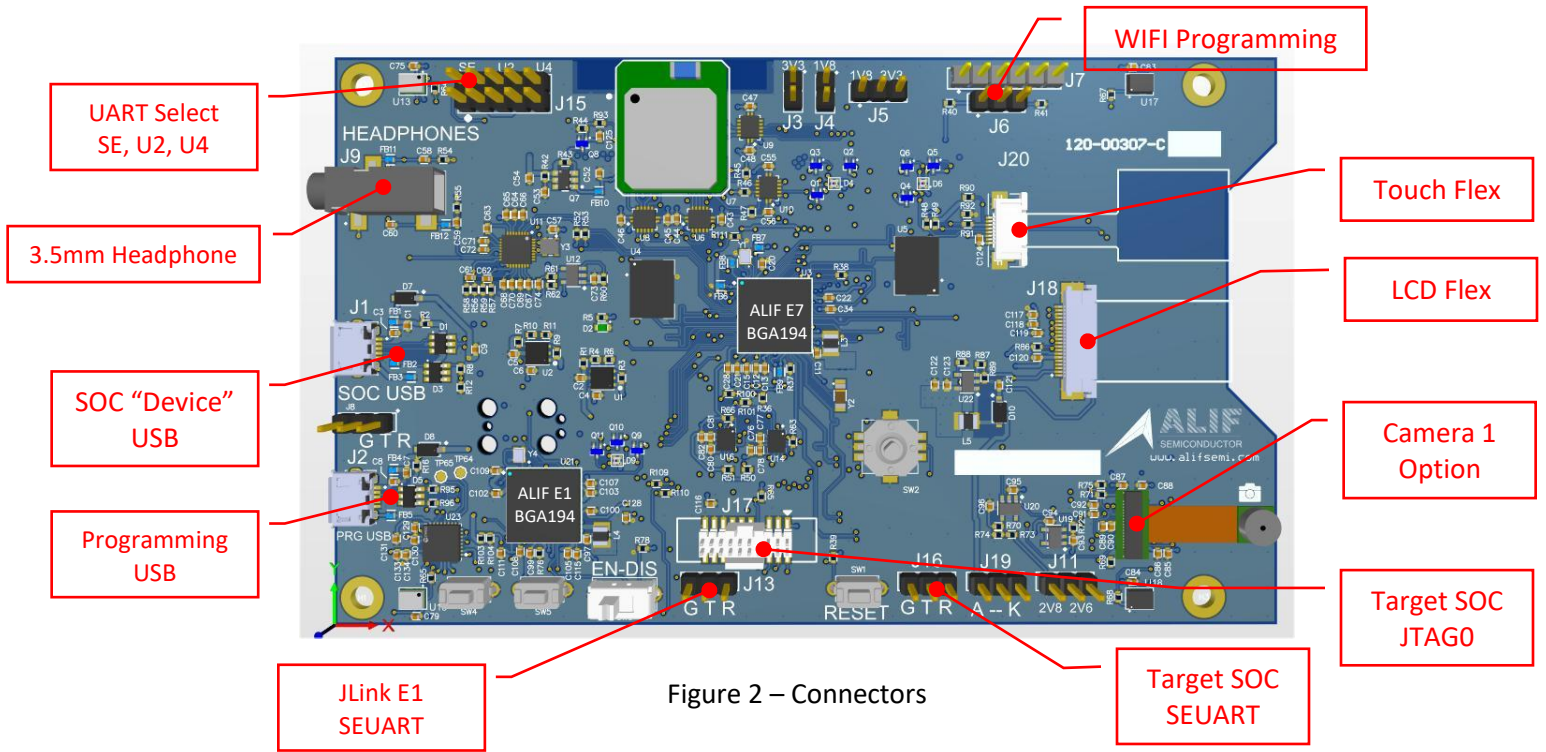


Figure 2 – Connectors

Pre-Built Demos

There is an archive of pre-built demo images and the files necessary to create a loadable image for the AI/ML AppKit Gen 2. With these files, you can easily load demos for your AI/ML AppKit.

The archive is available at <https://alifsemi.com/download/AAPK0002>

Download and open the archive and install the files according to the directions below.

First, note where you installed your Alif Security Toolkit (SETOOLS). The recommended directory is C:\app-release-exec but it can be in another location. We will refer to that directory at <SETOOLS_root>.

Open a file explorer window in <SETOOLS_root>

Open the archive into another file explorer window.

Copy all the files from the archive to <SETOOLS_root>. There will be 2 “.bat” batch files loaded into <SETOOLS_root>, 2 configuration “.json” files loaded into <SETOOLS_root>/build/config, and 2 image “.bin” files loaded into <SETOOLS_root>/build/images.

To load a demo, open a command prompt window and go to the <SETOOLS>_root directory

Execute the batch file for the desired demo according to the following table:

Batch File	Demo
ethos-u-alif_obj_detection_appkit.bat	Object detection (default factory app)
ethos-u-alif_img_class_appkit.bat	Object classification mobilenet-v2

Prior to this, you should execute the SETOOLS command “maintenance -d” and select the COM port corresponding to the SEUART.

Regulatory and Compliance Statements

Federal Communications Commission (FCC) and ISED Canada Compliance Statements

FCC

Identification of product: AK-E7-AIML

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.*

RF exposure safety

This device complies with the FCC RF exposure limits and has been evaluated in compliance with portable/mobile exposure conditions.

The equipment must be installed and operated and was evaluated with minimum distance of 20 cm of the human body. This distance or greater is maintained by vehicle design and ensures compliance by normal use of the vehicle.

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.

RF exposure safety

This device complies with the ISED RF exposure limits and has been evaluated in compliance with portable exposure conditions.

The equipment must be installed and operated and was evaluated with minimum distance of 20 cm of the human body. This distance or greater is maintained by vehicle design and ensures compliance by normal use of the vehicle.

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.

Sécurité d'exposition aux RF

Cet appareil est conforme aux limites d'exposition RF d'ISED et a été évalué conformément aux conditions d'exposition portable.

L'équipement doit être installé et utilisé à une distance minimale de 20 cm du corps humain. Cette distance ou plus est maintenue par la conception du véhicule et assure la conformité par l'utilisation normale du véhicule.

CAN NMB-003

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

CE Conformity

Brand: Alif Semiconductor, Inc.

Model: AK-E7-AIML

WiFi 2.4

Tx Power: 10 dBm

Antenna Type: Integral Antenna

Antenna Gain: -2.5 dBi

BLE

Tx Power: 10 dBm

Antenna Type: Integral Antenna

Antenna Gain: -2.5 dBi

Warning

ETSI EN 301 489-1 V2.2.3 (2019-11)

ETSI EN 301 489-17 V3.2.6(2023-06) for Class B

Warning: this device is compliant with Class B of

ETSI EN 301 489-1 V2.2.3 (2019-11)

ETSI EN 301 489-17 V3.2.6(2023-06)

EN 300 328 V2.2.2 (2019-07)

IEC 62368-1:2014 + COR1:2015 + COR2:2015

EN 62368-1:2014 + AC:2015 + AC:2017-03 + A11:2017

UNE EN 62368-1:2014 + AC:2015 + AC1:2015 + AC2:2015 + AC:2017-03 + A11:2017

EN62311

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 AK-E7-AIML 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/ai-ml-appkit-gen-2/
Česky CS	Tímto Alif Semiconductor, Inc. prohlašuje, že typ rádiového zařízení AK-E7-AIML je v souladu se směrnici 2014/53/EU. Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Dansk DA	Hermed erklærer Alif Semiconductor, Inc. , at radioudstyrstypen AK-E7-AIML er i overensstemmelse med direktiv 2014/53/EU. EU-overensstemmelseserklæringens fulde tekst kan findes på følgende internetadresse: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Deutsch DE	Hiermit erklärt Alif Semiconductor, Inc. , dass der Funkanlagentyp AK-E7-AIML 1 der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Greek EL	Με την παρούσα ο/η Alif Semiconductor, Inc. , δηλώνει ότι ο ραδιοεξοπλισμός AK-E7-AIML πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Eesti ET	Käesolevaga deklareerib Alif Semiconductor, Inc. , et käesolev raadioseadme tüüp AK-E7-AIML vastab direktiivi 2014/53/EU nõuetele. Eli vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
English EN	Hereby, Alif Semiconductor, Inc. declares that the radio equipment type AK-E7-AIML 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/ai-ml-appkit-gen-2/
Español ES	Por la presente, Alif Semiconductor, Inc. declara que el tipo de equipo radioeléctrico AK-E7-AIML 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/ai-ml-appkit-gen-2/
Estonian ET	Käesolevaga deklareerib Alif Semiconductor, Inc. , et käesolev raadioseadme tüüp AK-E7-AIML vastab direktiivi 2014/53/EU nõuetele. Eli vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Finnish FI	Alif Semiconductor, Inc. vakuuttaa, että radiolaitetyypin AK-E7-AIML on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Français FE	Le soussigné, Alif Semiconductor, Inc. , déclare que l'équipement radioélectrique du type AK-E7-AIML 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/ai-ml-appkit-gen-2/
Croatian HR	Alif Semiconductor, Inc. ovime izjavljuje da je radijska oprema tipa AK-E7-AIML u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Hungarian HU	Alif Semiconductor, Inc. igazolja, hogy a AK-E7-AIML típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Italiano IT	Il fabbricante, Alif Semiconductor, Inc. , dichiara che il tipo di apparecchiatura radio AK-E7-AIML 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/ai-ml-appkit-gen-2/
Lietuvių LT	Aš, Alif Semiconductor, Inc. , patvirtinu, kad radijo įrenginių tipas AK-E7-AIML atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Latvian LV	Ar šo Alif Semiconductor, Inc. deklarē, ka radioiekārta AK-E7-AIML atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/

Malti MT	B'dan, Alif Semiconductor, Inc. , niddikjara li dan it-tip ta' tagħmir tar-radju AK-E7-AIML 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/ai-ml-appkit-gen-2/
Nederlands NL	Hierbij verklaar ik, Alif Semiconductor, Inc. , dat het type radioapparatuur AK-E7-AIML conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Polski PL	Alif Semiconductor, Inc. niniejszym oświadcza, że typ urządzenia radiowego AK-E7-AIML jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Português PT	O(a) abaixo assinado(a) Alif Semiconductor, Inc. declara que o presente tipo de equipamento de rádio AK-E7-AIML 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/ai-ml-appkit-gen-2/
Romanian RO	Prin prezenta, Alif Semiconductor, Inc. declară că tipul de echipamente radio AK-E7-AIML 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/ai-ml-appkit-gen-2/
Slovensky SK	Alif Semiconductor, Inc. týmto vyhlasuje, že rádiové zariadenie typu AK-E7-AIML 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/ai-ml-appkit-gen-2/
Slovensko SL	Alif Semiconductor, Inc. potrjuje, da je tip radijske opreme AK-E7-AIML skladen z Direktivo 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Swedish SV	Härmed försäkrar Alif Semiconductor, Inc. att denna typ av radioutrustning AK-E7-AIML överensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
Icelandic	Hér með lýsir Alif Semiconductor, Inc. yfir því að AK-E7-AIML er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 2014/53/EU. Allur texti samræmisýfirlýsingar ESB er að finna á eftirfarandi netfangi: https://alifsemi.com/support/kits/ai-ml-appkit-gen-2/
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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

For more information visit our website [Alif Semiconductor \(www.alifsemi.com\)](http://www.alifsemi.com) or contact us: contact@alifsemi.com

US HQ – Silicon Valley, CA
7901 Stoneridge Drive, Suite 300
Pleasanton, CA 94588

Document History

Version	Change Log
1.0	Initial public release for AI/ML AppKit Gen 2
1.1	Added instructions on downloading and installing pre-built demos
1.2	Minor text edits for clarity
1.3	Updated regulatory compliance statements

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