KBox A-251-AML/ADN

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KBox A-251-AML/ADN – User Guide

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Intended Use

This device and associated software are not designed, manufactured or intended for use or resale for the operation of nuclear facilities, the navigation, control or communication systems for aircraft or other transportation, air traffic control, life support or life sustaining applications, weapons systems, or any other application in a hazardous environment, or requiring fail-safe performance, or in which the failure of products could lead directly to death, personal injury, or severe physical or environmental damage (collectively, “high risk applications”).

You understand and agree that your use of Kontron devices as a component in High Risk Applications is entirely at your risk. To minimize the risks associated with your products and applications, you should provide adequate design and operating safeguards. You are solely responsible for compliance with all legal, regulatory, safety, and security related requirements concerning your products. You are responsible to ensure that your systems (and any Kontron hardware or software components incorporated in your systems) meet all applicable requirements. Unless otherwise stated in the product documentation, the Kontron device is not provided with error-tolerance capabilities and cannot therefore be deemed as being engineered, manufactured or setup to be compliant for implementation or for resale as device in High Risk Applications. All application and safety related information in this document (including application descriptions, suggested safety measures, suggested Kontron products, and other materials) is provided for reference only.

NOTICE	You find the most recent version of the “General Safety Instructions“ online in the download area of this product.

NOTICE	This product is not intended for use or suited for storage or operation in corrosive environments, in particular under exposure to sulfur and chlorine and their compounds. For information on how to harden electronics and mechanics against these stress conditions, contact Kontron Support.

Revision History

Revision	Brief Description of Changes	Date of Issue	Author
0.1	Initial preliminary Issue	2024-Oct-14	CW
0.2	New photos, new symbols, new disposal, new hardware input	2024-Dec-09	CW
0.3	DIN SAP number and name change to AML/ADN	2025-Jan-08	CW
0.4	Hardware changes	2025-Feb-24	CW
0.5	Replaced micro SIM card with SIM cards (standard size 15 mm x 25 mm)	2025-Feb-25	CW
0.6	New diagrams and dimension diagram with new connector numbers. Updated clearance diagram and text. Added new type label, added Automated BIOS Description and update maintenance.	2025-Mar-31	CW
0.7	Added BIOS screen shots from the motherboard.	2025-Apr-01	CW

Terms and Conditions

Kontron warrants products in accordance with defined regional warranty periods. For more information about warranty compliance and conformity, and the warranty period in your region, visit www.kontron.com/terms-and-conditions.
Kontron sells products worldwide and declares regional General Terms & Conditions of Sale, and Purchase Order Terms & Conditions. Visit www.kontron.com/terms-and-conditions.
For contact information, refer to the corporate offices contact information on the last page of this user guide or visit our website CONTACT US.

Customer Support

Find Kontron contacts by visiting www.kontron.com/support-and-services.

Customer Service

As a trusted technology innovator and global solutions provider, Kontron extends its embedded market strengths into a services portfolio allowing companies to break the barriers of traditional product lifecycles. Proven product expertise coupled with collaborative and highly-experienced support enables Kontron to provide exceptional peace of mind to build and maintain successful products.
For more details on Kontron's service offerings such as: enhanced repair services, extended warranty, Kontron training academy, and more visit www.kontron.com/support-and-services.

Customer Comments

If you have any difficulties using this user guide, discover an error, or just want to provide some feedback, contact Kontron support. Detail any errors you find. We will correct the errors or problems as soon as possible and post the revised user guide on our website.

Symbols

The following symbols may be used in this user guide

⚠DANGER	**DANGER** indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠WARNING	**WARNING** indicates a hazardous situation which, if not avoided, could result in death or serious injury.
NOTICE	**NOTICE** indicates a property damage message.
⚠CAUTION	**CAUTION** indicates a hazardous situation which, if not avoided, may result in minor or moderate injury **ATTENTION** indique une situation dangereuse qui, si elle n'est pas évitée, peut entraîner des blessures mineures ou modérées.
	**Electric Shock!** This symbol and title warn of hazards due to electrical shocks (> 60 V) when touching products or parts of products. Failure to observe the precautions indicated and/or prescribed by the law may endanger your life/health and/or result in damage to your material.
	**ESD Sensitive Device!** This symbol and title inform that the electronic boards and their components are sensitive to static electricity. Care must therefore be taken during all handling operations and inspections of this product in order to ensure product integrity at all times.
	**Caution: HOT Surface!** Do NOT touch! Allow to cool before servicing. **Attention : Surface CHAUDE !** Ne pas toucher ! Laissez refroidir avant de procéder à l'entretien.
	**Caution: Laser!** This symbol inform of the risk of exposure to laser beam and light emitting devices (LEDs) from an electrical device. Eye protection per manufacturer notice shall review before servicing.
	**High sound pressure!** High sound pressure possible with headphones. There is a risk of hearing damage. Do not listen at high volume levels for long periods of time.

Security

This symbol indicates general information and guidelines regarding the product's cyber security to ensure secure installation, operation, maintenance and disposal of the product within the user's end environment.

This symbol indicates general information about the product and the user guide.

This symbol also indicates detail information about the specific product configuration.

This symbol precedes helpful hints and tips for daily use.

For Your Safety

Your new Kontron product was developed and tested carefully to provide all features necessary to ensure its compliance with electrical safety requirements. It was also designed for a long fault-free life. However, the life expectancy of your product can be drastically reduced by improper treatment during unpacking and installation. Therefore, in the interest of your own safety and of the correct operation of your new Kontron product, you are requested to conform with the following guidelines.

High Voltage Safety Instructions

As a precaution and in case of danger, the power connector must be easily accessible. The power connector is the product's main disconnect device.

⚠CAUTION

Warning

All operations on this product must be carried out by sufficiently skilled personnel only.

⚠CAUTION

Electric Shock!

Before installing a non hot-swappable Kontron product into a system always ensure that your mains power is switched off. This also applies to the installation of piggybacks. Serious electrical shock hazards can exist during all installation, repair, and maintenance operations on this product. Therefore, always unplug the power cable and any other cables which provide external voltages before performing any work on this product.

Earth ground connection to vehicle's chassis or a central grounding point shall remain connected. The earth ground cable shall be the last cable to be disconnected or the first cable to be connected when performing installation or removal procedures on this product.

Special Handling and Unpacking Instruction

NOTICE

ESD Sensitive Device!

Electronic boards and their components are sensitive to static electricity. Therefore, care must be taken during all handling operations and inspections of this product, in order to ensure product integrity at all times.

⚠CAUTION

Handling and operation of the product is permitted only for trained personnel within a work place that is access controlled. Follow the "General Safety Instructions" supplied with the product.

Do not handle this product out of its protective enclosure while it is not used for operational purposes unless it is otherwise protected.

Whenever possible, unpack or pack this product only at EOS/ESD safe work stations. Where a safe work station is not guaranteed, it is important for the user to be electrically discharged before touching the product with his/her hands or tools. This is most easily done by touching a metal part of your system housing.

It is particularly important to observe standard anti-static precautions when changing piggybacks, ROM devices, jumper settings etc. If the product contains batteries for RTC or memory backup, ensure that the product is not placed on conductive surfaces, including anti-static plastics or sponges. They can cause short circuits and damage the batteries or conductive circuits on the product.

Lithium Battery Precautions

If your product is equipped with a lithium battery, take the following precautions when replacing the lithium battery.

⚠CAUTION	Risk of Explosion if the lithium Battery is replaced by an incorrect Type. Dispose of used lithium batteries according to the instructions. Risque d'explosion si la pile au lithium est remplacée par une pile de type incorrect. Éliminez les piles au lithium usagées conformément aux instructions.

General Instructions on Usage

In order to maintain Kontron's product warranty, this product must not be altered or modified in any way. Changes or modifications to the product, that are not explicitly approved by Kontron and described in this user guide or received from Kontron Support as a special handling instruction, will void your warranty.

This product should only be installed in or connected to systems that fulfill all necessary technical and specific environmental requirements. This also applies to the operational temperature range of the specific board version that must not be exceeded. If batteries are present, their temperature restrictions must be taken into account.

In performing all necessary installation and application operations, only follow the instructions supplied by the present user guide.

Keep all the original packaging material for future storage or warranty shipments. If it is necessary to store or ship the product then re-pack it in the same manner as it was delivered.

Special care is necessary when handling or unpacking the product. See Special Handling and Unpacking Instruction.

Quality and Environmental Management

Kontron aims to deliver reliable high-end products designed and built for quality, and aims to complying with environmental laws, regulations, and other environmentally oriented requirements. For more information regarding Kontron's quality and environmental responsibilities, visit www.kontron.com/about-kontron/corporate-responsibility/quality-management.

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1/Introduction

This user guide describes the KBox A-251-AML/ADN, also known as product within this user guide. This user guide focuses on describing the product's special features and how to assemble, install, operate, maintain and dispose of the product properly. New users are recommended to study the instructions within this user guide before switching on the product.

The KBox A-251-AML/ADN is a flexible fanless industrial grade DIN Rail embedded box PC designed for use in performance demanding applications requiring flexible DIN Rail mounting in limited space, 24/7 continuous operation and longtime industrial deployment.

Based on Kontron's 2.5" Single Board Computer (SBC) using the Intel® Atom® x7000(R)E, Core™ i3 N & Intel® N-series of processors, the KBox A-251-AML/ADN features a variety of external interfaces to enable extensive connectivity and allows for additional storage and wireless features such as Wi-Fi/Bluetooth(BT)® and cellular LTE. The product expands via the use of a wide choice of system expansion modules supporting a variety of interface options. All components are selected to ensure a long lifetime and the fanless design ensures a significantly prolonged lifespan and high system availability.

Figure 1: KBox A-251-AML/ADN

The main features are:

- Mainboard 2.5" SBC-AML/ADN
- Intel® Atom® x7000(R)E, Core™ i3 N & Intel® N-series of processors
- System memory up to 16 GByte LPDDR5 4800 Mt/s memory down
- Storage
  - Up to 128 GByte eMMC Storage (option)
  - Up to 2 TByte via M.2 Key B SSD (option)
- Front Panel Interfaces
  - 1x Display Ports (DP)

- 2x USB 3.2 Gen 2 Ports
- 1x USB-C Port, with DP & PD 5 V/3 A
  - USB-C 3.2 Gen 2 for (Core™ i3 N & Intel® N-series of processors)
  - USB-C 3.2 Gen 1 for (Atom® x7000(R)E)
- 2x 2.5 GbE Ports
- 1x COM Port RS232
- 1x COM Port RS232 (option)
- Wi-Fi 6E/Bluetooth® 5.2 (option)

- System Expansion Module (options)
  - Cellular LTE
  - Dual LAN (2.5 GbE)
  - Dual CAN
  - EtherCAT
  - Dual COM ports (RS232)
  - Dual COM ports (RS232/422/485 configurable)
  - 8- channel GPIO/DIO
- Chassis
  - Metal chassis with heatsink
  - Fanless passive cooling
- Power IN
  - 24 VDC
  - 12 VDC (option)

To ensure you have the latest version of this user guide, visit KBox A-251-AML/ADN | Kontron.

Preliminary Version of the User Guide!

This preliminary version of the user guide may contain information requiring rework. Yellow highlighted item may be subject to change, information may be TBD and figures may not represent the final product.

2/General Safety Instructions

Please read this passage carefully and take careful note of the instructions, which have been compiled for your safety and to ensure to apply in accordance with intended regulations. If the following general safety instructions are not observed, it could lead to injuries to the operator and/or damage of the product; in cases of non-observance of the instructions Kontron Europe is exempt from accident liability, this also applies during the warranty period.

The product has been built and tested according to the basic safety requirements for low voltage (LVD) applications and has left the manufacturer in safety-related, flawless condition. To maintain this condition and to also ensure safe operation, the operator must not only observe the correct operating conditions for the product but also the following general safety instructions:

- The product must be used as specified in the product documentation, in which the instructions for safety for the product and for the operator are described. These contain guidelines for setting up, installation and assembly, maintenance, transport or storage.
- The on-site electrical installation must meet the requirements of the country's specific local regulations.
- If a power cable comes with the product, only this cable should be used. Do not use an extension cable to connect the product.
- To guarantee that sufficient air circulation is available to cool the product, please ensure that the ventilation openings are not covered or blocked. If a filter mat is provided, this should be cleaned regularly. Do not place the product close to heat sources or damp places. Make sure the product is well ventilated.
- Only connect the product to an external power supply providing the voltage type (AC or DC) and the input power (max. current) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1 .
- Only products or parts that meet the requirements for Power Source (PS1) of UL/IEC 62368-1 may be connected to the product's available interfaces (I/O).
- Before opening the product, make sure that the product is disconnected from the mains.
- Switching off the product by its power button does not disconnect it from the mains. Complete disconnection is only possible if the power cable is removed from the wall plug or from the product. Ensure that there is free and easy access to enable disconnection.
- The product may only be opened for the insertion or removal of add-on cards (depending on the configuration of the product). This may only be carried out by qualified operators.
- If extensions are being carried out, the following must be observed:
  - all effective legal regulations and all technical data are adhered to
  - the power consumption of any add-on card does not exceed the specified limitations
  - the current consumption of the product does not exceed the value stated on the product label
- Only original accessories that have been approved by Kontron Europe can be used.
- Please note: safe operation is no longer possible when any of the following applies:
  - the product has visible damages or
  - the product is no longer functioning
    In this case the product must be switched off and it must be ensured that the product can no longer be operated.
- Handling and operation of the product is permitted only for trained personnel within a work place that is access controlled.
- CAUTION: Risk of explosion if the lithium battery is replaced incorrectly (short-circuited, reverse-poled, wrong lithium battery type). Dispose of used lithium batteries according to the manufacturer's instructions.
- This product is not suitable for use in locations where children are likely to be present

2.1. Additional Safety Instructions for DC Power Supply Circuits

- To guarantee safe operation, please observe that:
  - the external DC power supply must meet the criteria for LPS and PS2 (UL/IEC 62368-1)
  - no cables or parts without insulation in electrical circuits with dangerous voltage or power should be touched directly or indirectly
  - a reliable functional earth connection is provided
  - a suitable, easily accessible disconnecting device is used in the application (e.g. overcurrent protective device), if the product itself is not disconnect able
  - a disconnect device, if provided in or as part of the product, shall disconnect both poles simultaneously
  - interconnecting power circuits of different products cause no electrical hazards
- A sufficient dimensioning of the power cable wires must be selected – according to the maximum electrical specifications on the product label – as stipulated by EN62368-1 or VDE0100 or EN60204 or UL61010-1 regulations.

For the General Safety Instruction in German or French, visit Kontron's product web page> Downloads> Manuals> General Safety Instructions.

2.2. Instructions générales de sécurité

Veuillez lire attentivement ce passage et prendre bonne note des instructions, qui ont été compilées pour votre sécurité et pour assurer une application conforme aux réglementations prévues. Le non-respect des consignes de sécurité générales suivantes peut entraîner des blessures pour l'utilisateur et/ou des dommages pour le produit. En cas de non-respect des consignes, Kontron Europe est exonéré de la responsabilité en cas d'accident, ceci s'applique également pendant la période de garantie.

Le produit a été construit et testé conformément aux exigences de sécurité de base pour les applications basse tension (DBT) et a quitté le fabricant dans un état impeccable en matière de sécurité. Pour maintenir cet état et pour garantir également un fonctionnement sûr, l'opérateur doit non seulement respecter les conditions d'utilisation correctes du produit, mais aussi les consignes de sécurité générales suivantes :

- Le produit doit être utilisé conformément à la documentation du produit, dans laquelle sont décrites les instructions de sécurité pour le produit et pour l'opérateur. Celles-ci contiennent des directives pour la mise en place, l'installation et le montage, la maintenance, le transport ou le stockage.
- L'installation électrique sur place doit répondre aux exigences des réglementations locales spécifiques du pays.
- Si un câble d'alimentation est fourni avec le produit, seul ce câble doit être utilisé. N'utilisez pas de rallonge pour connecter le produit.
- Afin de garantir une circulation d'air suffisante pour refroidir le produit, veuillez vous assurer que les ouvertures de ventilation ne sont pas couvertes ou obstruées. Si un élément filtrant est fourni, celui-ci doit être nettoyé régulièrement. Ne placez pas le produit à proximité de sources de chaleur ou d'endroits humides. Veillez à ce que le produit soit bien ventilé.
- Ne connectez le produit qu'à une alimentation externe fournissant le type de tension (AC ou DC) et la puissance d'entrée (courant max.) spécifiés sur le Label Produit Kontron et répondant aux exigences de la source d'alimentation limitée (LPS) et de la source d'alimentation (PS2) de la norme UL/IEC 62368-1 .
- Seuls les produits ou les pièces qui répondent aux exigences de la source d'alimentation (PS1) de la norme UL/IEC 62368-1 peuvent être connectés aux interfaces (E/S) disponibles du produit.
- Avant d'ouvrir le produit, assurez-vous qu'il est bien débranché du secteur.
- Le fait d'éteindre le produit par son bouton de mise en marche ne le déconnecte pas du secteur. Une déconnexion complète n'est possible que si le câble d'alimentation est retiré de la prise murale ou du produit. Veillez à ce que l'accès soit libre et facile pour permettre la déconnexion.
- Le produit ne peut être ouvert que pour l'insertion ou le retrait de cartes supplémentaires (selon la configuration du produit). Cette opération ne peut être effectuée que par des opérateurs qualifiés.

- Si des extensions sont effectuées, les points suivants doivent être respectés :
  - toutes les réglementations légales en vigueur et toutes les données techniques sont respectées
  - la consommation électrique d'une carte supplémentaire ne dépasse pas les limites spécifiées
  - la consommation actuelle du produit ne dépasse pas la valeur indiquée sur l'étiquette du produit.
- Seuls les accessoires d'origine approuvés par Kontron Europe peuvent être utilisés.
- Veuillez noter que la sécurité des opérations n'est plus possible lorsque l'une des conditions suivantes s'applique.
  - le produit présente des dommages visibles ou
  - le produit ne fonctionne plus. Dans ce cas, le produit doit être éteint et il faut s'assurer que le produit ne puisse plus être utilisé.
- La manipulation et le fonctionnement du produit ne sont autorisés que pour le personnel formé dans un lieu de travail dont l'accès est contrôlé.
- ATTENTION: Risque d'explosion en cas de remplacement incorrect de la pile au lithium (court-circuit, inversion de polarité, mauvais type de pile au lithium). Éliminez les piles au lithium usagées conformément aux instructions du fabricant.
- Ce produit n'est pas adapté à une utilisation dans des endroits où des enfants sont susceptibles d'être présents
- Instructions de sécurité supplémentaires pour les circuits d'alimentation en courant continu
- Pour garantir un fonctionnement sûr, veuillez observer ce qui suit:
  - l'alimentation électrique externe en courant continu doit répondre aux critères des LPS et PS2 (UL/IEC 62368-1)
  - aucun câble ou pièce non isolée dans les circuits électriques ayant une tension ou une puissance dangereuse ne doit être touché directement ou indirectement
  - une connexion à la terre fonctionnelle fiable est fournie
  - un dispositif de déconnexion approprié et facilement accessible est utilisé dans l'application (par exemple, un dispositif de protection contre les surintensités), si le produit lui-même n'est pas en mesure d'être déconnecté.
  - un dispositif de déconnexion, s'il est prévu dans le produit ou s'il en fait partie, doit déconnecter les deux pôles simultanément
  - l'interconnexion des circuits électriques de différents produits ne présente aucun risque électrique
- Un dimensionnement suffisant des fils du câble d'alimentation doit être choisi - en fonction des spécifications électriques maximales figurant sur l'étiquette du produit - comme stipulé par les réglementations EN62368-1 ou VDE0100 ou EN60204 ou UL61010-1.

2.3. Electrostatic Discharge (ESD)

A sudden discharge of electrostatic electricity can destroy static-sensitive devices or micro-circuitry. Therefore, proper packaging and grounding techniques are necessary precautions to prevent damage.
Always take the following precautions:

ESD Sensitive Device!
Keep electrostatic sensitive parts in their containers until they arrive at the ESD-safe workplace. Always be properly grounded when touching a sensitive board, component, or assembly.

For more Information, see the Special Handling and Unpacking Instruction within this user guide and Chapter 2.4: Grounding Methods.

2.4. Grounding Methods

The following measures help to avoid electrostatic damages to the device:

- Cover workstations with approved antistatic material. Always wear a wrist strap connected to the workplace, as well as properly grounded tools and equipment.
- Use antistatic mats, heel straps, or air ionizers for more protection.
- Always handle electrostatically sensitive components by their edge or by their casing.
- Avoid contact with pins, leads, or circuitry.
- Switch off power and input signals before inserting and removing connectors or connecting test equipment.
- Keep the work area free of non-conductive materials such as ordinary plastic assembly aids and styrofoam.
- Use field service tools such as cutters, screwdrivers, and vacuum cleaners that are conductive.
- Always place drives and boards with the PCB-assembly-side down on the foam.

2.5. Instructions for Lithium Battery

The product is equipped with a lithium battery and is not designed to operate without a lithium battery. If the lithium battery is empty or disconnected, the BIOS settings will be set to the factory defaults. There is a risk of explosion if the lithium battery is replaced incorrectly (short-circuited, reverse-poled, wrong lithium battery type).

The BR2032 lithium battery must be replaced with an identical three Volt lithium battery or a Kontron recommended lithium battery, see Table 3: Accessories. To replace the lithium battery, observe the instructions, see Chapter 14.3: Changing the RTC Lithium Battery.

After removing the lithium battery, dispose of the lithium battery according to the regulations within your region.

⚠CAUTION

Danger of Explosion if the lithium battery is incorrectly placed!

- Replace only with the same or equivalent type recommended by the manufacturer
- Dispose of used batteries according to the manufacture's instructions

ATTENTION- Risque d'explosion avec l'échange inadéquat de la batterie!

- Remplacement seulement par le même ou un type équivalent recommandé par le producteur
- L'évacuation des batteries usagées conformément à des indications du fabricant

VORSICHT- Explosionsgefahr bei unsachgemäßem Austausch der Batterie!

- Ersatz nur durch denselben oder einen vom Hersteller empfohlenen gleichwertigen Typ
- Entsorgung gebrauchter Batterien nach Angaben des Herstellers

The product is not designed to operate without a lithium battery. If the lithium battery is empty or disconnected, the BIOS settings will be set to the factory defaults.

Do not dispose of lithium batteries in general trash collection. Dispose of the lithium battery according to the local regulations dealing with the disposal of these special materials, (e.g. to the collecting points for dispose of batteries).

2.6. Thermal Conditions

The product is passively cooled using a heatsink. There is a risk of burns or injury when touching the heatsink.

Hot Surface

The heatsink can get very hot. To avoid burns and personal injury when handling the heatsink:

- Do not touch while in operation
- Allow to cool before handling
- Wear protective gloves

Surface chaude

Le dissipateur thermique peut devenir très chaud. Pour éviter les brûlures et les blessures lors de la manipulation du dissipateur thermique :

- Ne pas toucher pendant le fonctionnement
- Laisser refroidir avant la manipulation
- Portez des gants de protection

Heiße Oberfläche

Der Kühlkörper kann sehr heiß werden. Um Verbrennungen und Verletzungen beim Umgang mit dem Kühlkörper zu vermeiden:

- Während des Betriebs nicht berühren
- Vor der Handhabung abkühlen lassen
- Schutzhandschuhe tragen

3/Shipment and Unpacking

3.1. Packaging

The KBox A-251-AML/ADN is packaged together with all parts, in a product specific cardboard package designed to provide adequate protection and absorb shock.

3.2. Unpacking

To unpack the product perform the following:

1. Remove packaging.
2. Do not discard the original packaging. Keep the original packaging for future transportation or storage.
3. Check the delivery for completeness by comparing the delivery with the original order.
4. Keep the associated paperwork. It contains important information for handling the product.
5. Check the product for visible shipping damage.

If you notice shipping damage or inconsistencies between the contents and the original order, contact your dealer.

3.3. Scope of Delivery

The scope of delivery describes the parts included in your delivery. Check that the delivery is complete, and contains the items listed. If damaged or missing items are discovered, contact your dealer.

Table 1: Scope of Delivery- KBox A-251-AML/AND-24 VDC

Product	Description
KBox A-251-AML/ADN-24 V	KBox A-251-AML/ADN-24 V with hardware configurations (processor and system expansion) and 24 VDC.
24 VDC Power Connector	3-pin Phoenix power connector (1.5/ 3-STF-3.5) mating connector.
General Safety Instructions	General safety instructions when operating or handling IT equipment

Table 2: Scope of Delivery - KBox A-251-AML/AND-12 VDC

Product	Description
KBox A-251-AML/ADN-12V	KBox A-251-AML/ADN 12 VDC with hardware configurations (processor and system expansion).
General Safety Instructions	General safety instructions when operating or handling IT equipment

3.4. Accessories

Table 3: Accessories

Part Number	Part	Description
1074-8461	Power connector	3-pin mating Phoenix power connector (1.5/ 3-STF-3.5)
1070-4091	AC/DC Power Supply Unit (PSU) 12 V	External AC/DC PSU 12 VDC, 60 W at 40°C, with 1.0 m cable and DC-Jack connector (Ø5.5 mm/Ø2.1 mm)
1057-7077	AC/DC Power Supply Unit (PSU) 24 V	External AC/DC PSU 24 VDC, 60 W at 40°C, with 1.5 m cable and wire end ferrule (1.0 mm^2)

Part Number	Part	Description
840-0059	Power cable EU	Power cable AC mains (2 m) to external Europe plug
840-0115	Power cable UK	Power cable AC mains (1.8 m) to external UK plug
840-0405	Power cable US	Power cable AC mains (1.8 m) to external USA plug
0-0064-4317	Power cable US	Power cable AC mains (2 m) to external USA plug
1068-4995	BR2032 3V Lithium battery	BR2032 3V Lithium battery with cable
9-4601-0023	DIN Rail Rear	DIN Rail clamp & two M4x6 Torx screws
9-4701-0074	DIN Rail Rear Rugged	DIN Rail Rugged clamp & two M4x6 Torx screws

3.5. Product Identification Type Label

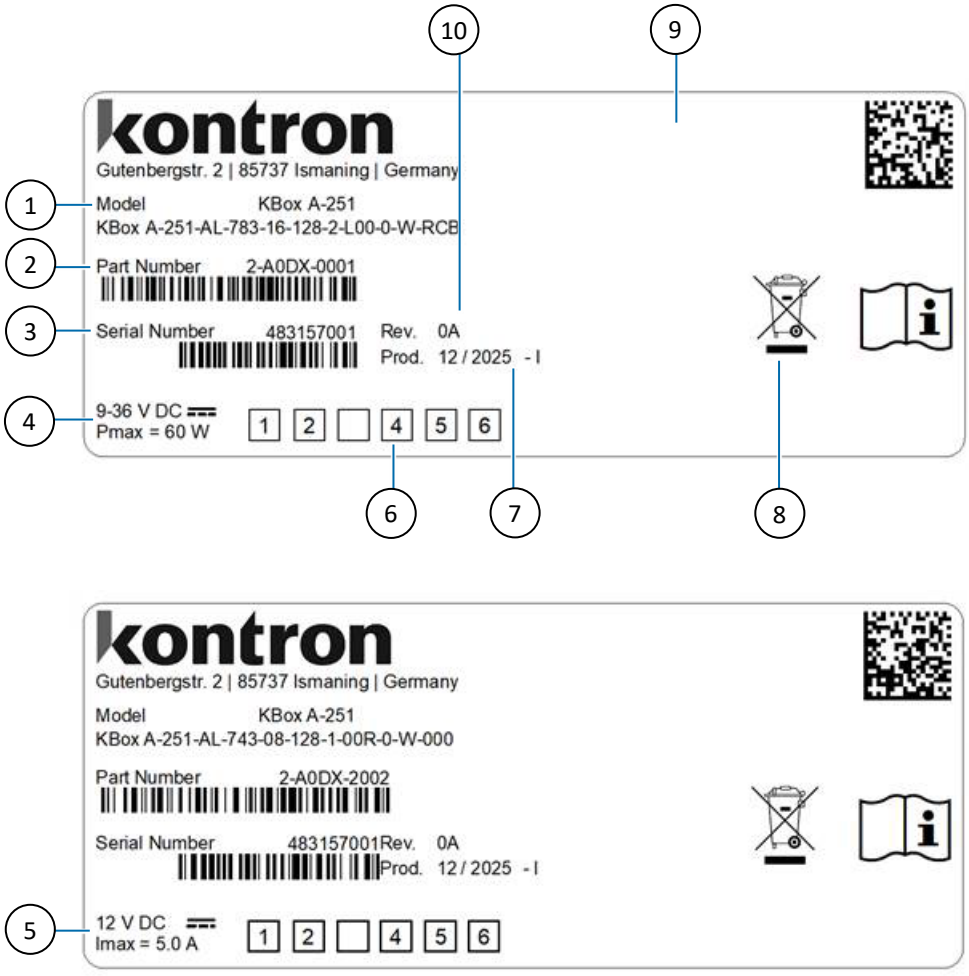
The KBox A-251-AML/ADN is part of Kontron's A-Series is intended for control cabinet applications.

Table 4: Product Identification

System Type	Product Designation	Model	Description
KBox A	KBox A-251	KBox A-251-AML/ADN-24V	Corresponds to hardware configurations based on Kontron's 2.5"-SBC-ADN/AML with Intel® Atom® x7000(R)E Series, Core™ i3 N-Series and Intel® N-Series processors and an internal 24V DC/DC.
KBox A	KBox A-251	KBox A-251-AML/ADN-12V	Corresponds to hardware configurations based on Kontron's 2.5"-SBC-ADN/AML with Intel® Atom® x7000(R)E Series, Core™ i3 N-Series and Intel® N-Series processors.

The type label includes important product specific Information such as the electrical specification and the compliance of the ordered product variant.

Figure 2: Type Label Example 24 VDC and 12 VDC



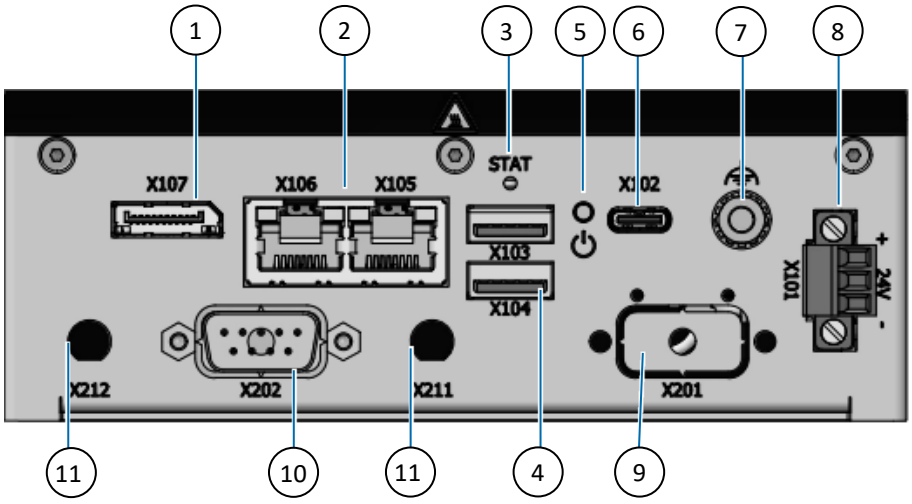
1	Model/Product family	6	For Internal use
2	Part Number with bar code	7	Production date
3	Serial Number and bar code	8	Dispose of correctly
4	Electrical specification 24 VDC	9	Compliance Info
5	Electrical Specification 12 VDC	10	Revision

4/Product Features

4.1. Front Panel

The front panel features I/O interfaces, status LEDs, functional earth bolt and power connection (24 VDC or 12 VDC).

Figure 3: Front Panel



1	Display port (X107)	7	Functional earth bolt
2	2x 2.5 GBE LAN (X105/106)	8	Power IN connector (X101)
3	Power LED (STAT)	9	Breakout (X201) for SIM card for Cellular LTE or COM RS232
4	2x USB 3.2 Gen 2 (X103/104)	10	Breakout (X202) for COM RS232
5	Power Button	11	Wi-Fi Antenna (X211/X212)
6	1x USB-C (X102)		

4.1.1. Power IN 24 VDC (X101) (default)

The Power IN 3-pin 24 VDC connector (X101) connects to an external 24 VDC power supply that meets the product's electrical specification displayed on the product's type label and within this user guide, and the power consumption, power limitation and power protection requirements specified in this user guide.

The mating power connector (3-pin, 1.5/ 3-STF-3.5) is delivered with the product, to be wired suitably by the user as described in Chapter 9.2.1: Wiring the Power IN Connector.

For the pin assignment of the Power IN connector, see Chapter 13.1: Power IN 24 VDC (X101)(default).

⚠CAUTION	Only connect to an external 24 VDC power supply that meets the product's electrical specification displayed on the product type label, and the power consumption, power limitation and power protection requirements specified in this user guide.

4.1.2. Power IN 12 VDC (X101)(option)

The Power IN 12 VDC Jack (X101) connects to an external 12 VDC power supply that meets the product's electrical specification displayed on the product's type label, and the power consumption, power limitation and power protection requirements specified in this user guide.

The mating Power Jack must be sources by the user. For more information on the Power IN Jack and mating connector, see Chapter 13.2: Power IN 12 VDC Jack (X101) (option).

⚠CAUTION	Only connect to an external 12 VDC power supply that meets the product's electrical specification displayed on the product type label, and the power consumption, power limitation and power protection requirements specified in this user guide.

4.1.3. Power Button

The power button switches on or switches off the product. Switched on by press the power button once and switched off by pressing the power button again to perform an orderly shutdown.

Pressing the power button for more than four seconds switches the product from the 'on' to 'off' state and performs a forces shutdown.

4.1.4. Functional Earth Bolt

The functional earth bolt connects to the internal chassis ground. There is no isolation between the Power IN GND (-) and the system chassis. Always include a functional earth connection.

⚠CAUTION	Always include a functional earth connection!

4.1.5. LAN Ports (X106, X105)

The Ethernet ports (X106 and X105) each supports one channel of 10/100/1000/2500 Mbit Ethernet. To achieve the specified Ethernet port performance, Category 5 twisted pair cables must be used with 10/100 Mbit and Category 5E, 6 or 6E with 1 GbE/2.5 GbE networks.

For the pin assignment of the Ethernet LAN ports and information regarding the Ethernet status LEDs, see Chapter 13.3: LAN Connectors (X106, X105).

	To achieve the specified performance of the Ethernet port, Category 5 twisted pair cables must be used with 10/100 MByte and Category 5E, 6 or 6E with 1 GbE/2.5 GbE networks.

4.1.6. State LED

The green State LED indicates the product's current state.

Table 5: State LED Description

STAT LED (green)	Description
On	Power on (fully operational)
Blinking	Sleeping/suspended
Off	Power off

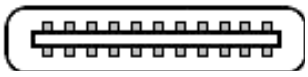
4.1.7. Display Ports (X107)

The Display Port (DP) (X107) supports full-size DP, with a resolution of 4096 x 2160 @ 60 Hz.

4.2. For the pin assignment of the DP connector, see Chapter 13.5: USB-C Port (X102)

The USB-C port connector (X102) supports DP Alternate Mode to carry video audio, data & power over a single port.

Table 37: USB-C Connector Pin Assignment

USB-C	Pin	Signal	Pin	Signal
B1 B12  A12 A1	A1	GND	B12	GND
	A2	CON_TX1P_C	B11	CON_RX1P_C
	A3	CON_TX1N_C	B10	CON_RX1N_C
	A4	+5V_VBus	B9	+5V_VBUS
	A5	CC1	B8	SBU2
	A6	USB2_P	B7	USB2_N
	A7	USB2_N	B6	USB2_P
	A8	SBU1	B5	CC2
	A9	+5V_VBUS	B4	+5V_VBUS
	A10	CON_RX2N_C	B3	CON_TX2N_C
	A11	CON_RX2P_C	B2	CON_TX2P_C
	A12	GND	B1	GND

Signal Name	Description
CON_TX#P/N_C	USB3_TX#+/-/DP Lane # TX+/-
CON_RX#P/N_C	Highspeed data path (RX (+/-) for USB or TX for DP Alt mode)
USB2_P/N	USB 2.0 interface differential pair (+/-)
CC#	Configuration channel signal for cable orientation detection, dedicated biphase mark code (BMC) configuration data channel, and VCONN +5 V power for active cables. Used for USB Power Delivery (PD) communication.
SBU#	Side Band Use signal #. DP Auxiliary channel differential pair(-)
+5V_VBus	+5 V Bus power
GND	Ground

Display Port Connectors (X107).

4.2.1. USB 3.2 Gen 2 ports (X103, X104)

The two USB 3.2 ports (X103 and X104) support USB 3.2 Gen 2 compatible devices.

For the pin assignment of the USB 3.2 Gen 2 ports, see Chapter 13.4: USB 3.2 Gen 2 Port Connectors (X104, X103).

The USB 3.2 Gen 2 ports are backwards compatible with USB 3.2 Gen 1 and USB 2.0 ports.

To achieve the specified performance for USB 3.2 Gen 2 performance use cabling that complies with the USB 3.2 standard.

4.2.2. USB-C Port (X102)

The USB-C port (X102) supports USB 3.2 Gen 2 (variants with Intel® Core™ i3 N-Series & Intel® N-Series processors) or USB 3.2 Gen 1 (variants with Intel® Atom® x7000RE Series processors), and DP Alternate Mode to carry video, audio, data & power (PD 5V/3A) over a single port, to enable the direct connection of a monitor.

For the pin assignment of the USB-C Port, see Chapter 13.5: USB-C Port (X102).

Product variants with the:

- Intel® Atom® x7000RE series processors support USB-C 3.2 Gen 1
- Intel® Core™ i3 N-series & Intel® N-series processors support USB-C 3.2 Gen 2

The USB-C /DP Alt-Mode Port can power a device with 5V and 3A or connect a display as an additional DP port

4.2.3. Wi-Fi/BT® Antenna (X211, X212) (option)

The two Wi-Fi antennas breakouts (X211 and X212) support a Wi-Fi/BT®. The Wi-Fi/BT® antenna connectors are RP-SMA (female) connectors and require a RP-SMA (male) antenna.

Figure 4: Wi-Fi, RP-SMA Antenna Connectors

RP-SMA (female) connector

center pin &outer thread

RP-SMA (male) antenna

pin socket and inner thread

The antenna position may affect the performance. Do not place the antenna close to a noise source that may cause interference. Kontron recommends using Kontron's reference antenna, included in the delivery, and chosen to meet RF performance requirements and supporting a nominal impedance of 50 ohms, see Table 3: Accessories.

For more information regarding the delivered antenna and the antenna requirements, see Chapter 13.7: Wi-Fi/BT® Antenna Connectors (X211, X212).

Antenna RF exposure

⚠CAUTION

Avoid RF antenna exposure by:

- Avoid placing the antenna near people, minimum distance 20 cm.
- Avoid pointing the antenna at people.
- Keep a safe distance from the antenna especially when transmitting.

NOTICE

SMA and RP-SMA are not Interchangable!

SMA and RP-SMA connectors and antenna are not electrically compatible and not interchangeable. If your product configuration includes a mixture of Wi-Fi RP-SMA connectors and antennas and cellular LTE SMA connectors and antennas, ensure you have use the correct antenna type.

If RP-SMA connector and antenna are mixed with SMA connector and antenna (or vice versa), they may destroy the center pin or mate without the center pin contacts touching (minimal signal gets through).

4.2.4. COM Port (X202)

The COM port (X202) supports RS232 port with RX/TX support and no handshaking.

For the pin assignment of the COM RS232 port, see Chapter 13.8: COM Connectors (X202) and (X201 option).

4.2.5. COM Port (X201)(option)

The breakout (X201) may support one RS232 port with RX/TX support and no handshaking.

For the pin assignment of the COM RS232 port, see Chapter 13.8: COM Connectors (X202) and (X201 option).

4.2.6. SIM Slot (X201)(option)

The breakout X201 may supports a SIM card slot for a standard SIM card (15 mm x 25 mm) for use in combination with the cellular LTE system expansion module only and not available for storage.

For the pin assignment of the SIM slot, see Chapter 13.9: SIM Slot Card Holder.

NOTICE

Switch off to Insert/Extract SIM

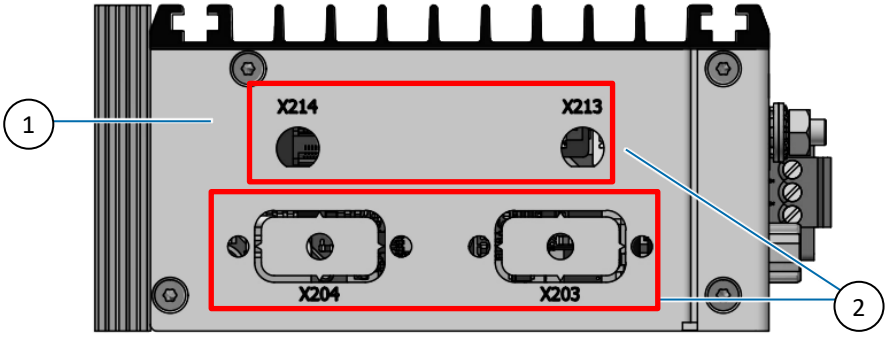
Only insert or extract the SIM cards if the product is switched off properly.

A SIM card is not part of the delivery and must be provided by the operator, to support the require network.

4.3. Left Side

The left side supports system expansion modules with various interface options. For more information regarding the possible system configuration options, see Chapter 5.4: System Expansion Module.

Figure 5: Left Side



1	System Expansion Module plate (four different plates are available)	2	System Expansion Module connectors

For more information regarding the system expansion modules, see Chapter 5.4System Expansion Module.

4.4. Right Side

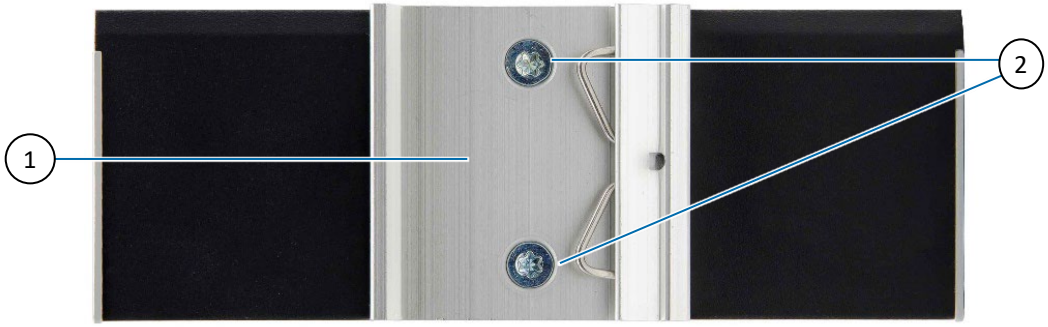
The right side features the product's type label with the electrical specification.

Figure 6: Right Sides

4.5. Rear Side

The rear side features two-threaded openings used to mount the reversible DIN Rail clamp (50 mm x 50 mm).

Figure 7: Rear Side (shown with DIN Rail clamp)



1	Din Rail clamp	2	DIN Rail clamp M4x6 screws

4.6. Top Side

The top side is a heatsink and can get hot. The front panel includes a Hot Surface warning label to warn users.

Figure 8: Top Side

Hot Surface

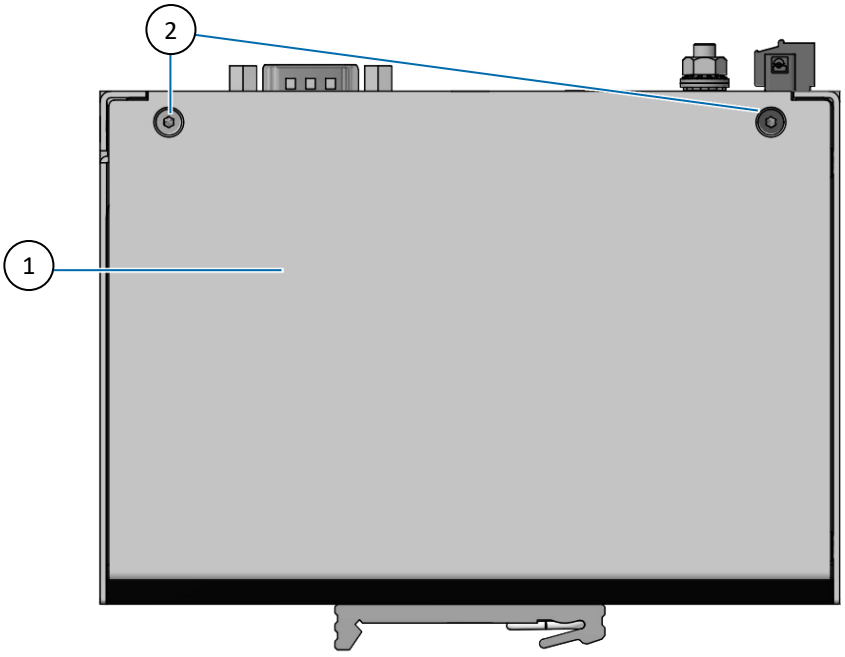
The heatsink can get very hot. To avoid burns and personal injury when handling the heatsink:

- Do not touch while in operation
- Allow to cool before handling
- Wear protective gloves

4.7. Bottom Side

The bottom side features a cover plate with two screws. Removing the cover plate accesses internal components.

Figure 9: Bottom Side



1	Cover plate	2	2x Screws

NOTICE

Protection Label

The product is factory configured to meet customer requirements and then sealed with a protection label. Opening the product invalidates the warranty.

4.8. Internal Features

To replace or install internal components, return the product to Kontron. Opening the product may damage to internal component and invalidates the warranty. For more information, refer to Chapter 15.1: Returning Defective Merchandise.

The internal 2.5” SBC AML/ADN Real Time Clock (RTC) lithium battery may require maintenance. To change the RTC Lithium battery, see Chapter 14.3: Changing the RTC Lithium Battery.

NOTICE

Protection Label

The product is factory configured to meet customer requirements and then sealed with a protection label. Opening the product invalidates the warranty.

For more information regarding the 2.5” SBC-AML/ADN single board computers on-board connectors, headers and jumpers, visit 2.5" Single Board Computer AML/ADN.

5/System Expansion

5.1. Before Expanding

The expansion options are factory configured and are not accessible in the field. Return the product to Kontron to replace or install internal components, see Chapter 15.1: Returning Defective Merchandise.

NOTICE

Protection label

The product is factory configured to meet customer requirements and then sealed with a protection label. Opening the product invalidates the warranty.

5.2. Storage Expansion (internal)

The internal M.2 2280 Key M socket provides storage using a M.2 2280 SSD module with up to 2 TByte. Configuration of the storage M.2 Key M SSD is always possible and independent of other expansion options.

Table 6: Storage SSD Module

Function	Description	
Storage	Module:	SSD
	Socket type:	M.2 Key B-M 2280
	Density:	Up to 2 TByte
	Interface:	SATA III 6Gb/s
	Type:	3D NAND Flash
	Features:	3000 P/E Cycles
	Power Consumption:	1.40 W max.

5.3. Wi-Fi Expansion

The internal M.2 2230 Key E socket provides Wi-Fi 6E and Bluetooth V5.2 using a M.2 2230 Key E Wi-Fi/BT® module. If the internal M.2 2230 key E socket is populated it is no longer free for expansion. Configuration of the Wi-Fi/BT® M.2 Key E module is always possible and independent of other Kontron expansion options.

Table 7: Wi-Fi/BT® Module

Function	Reference Modules	
Wi-Fi/ Bluetooth	Module:	Wi-Fi 6E
	Channels	2x2 160 MHz
	Bandwidth	2.4 Gbps
	Socket Type:	M.2 Key E 2230
	IEEE Standards:	Wi-Fi: 802.11a/b/g/n/ac R2/ax R2(Pre-Standard)
	Bluetooth standard:	V5.2
	Interface:	PCIe x1–Wi-Fi and USB 2.0 - BT
	MIMO Support:	2x2 MIMO
	Security levels:	WPA, WPA2, WPA3
	Power Consumption:	2.98 W max. (@Worst case TDP Wi-Fi 2.88 W / BT 0.1 W)
Connector	2x RP-SMA (female) Antenna connectors with center pin and outer thread. Front panel (X211, X212)	

The antenna position may affect the performance. Do not place the antenna close to a noise source that may cause interference. Kontron recommends the use of Kontron's Wi-Fi/BT reference antenna (included in the delivery). The reference Antenna have been chosen to meet RF performance requirements and supporting a nominal impedance of 50 ohms.

Table 8: Wi-Fi Reference Antenna

Part	Part Number	Description
Wi-Fi and Bluetooth® Antenna 	Manufacturer: SparkLan Article Number: R3410A10050	Manufacturer: SparkLan Product Name: AD-501AX Type: Dipole Wi-FI 6, including 6E and BT Antenna Frequency: 2.4 GHz/5 GHz/6 GHz Peak gain: 3.7 dbi/5 dBi/5 dBi Connector: RP-SMA plug (male) L x W x T: 162 x 22 x 6.8 mm Articulated hinge: 0° to 90° Impedance: 50 ohms

⚠CAUTION

Antenna RF exposure

Avoid RF antenna exposure by:

- Avoid placing the antenna near people, minimum distance 20 cm.
- Avoid pointing the antenna at people.
- Keep a safe distance from the antenna especially when transmitting.

NOTICE

SMA and RP-SMA are not Interchangable!

SMA and RP-SMA connectors and antenna are not electrically compatible and not interchangeable. If your product configuration includes a mixture of Wi-Fi RP-SMA connectors and antennas and cellular LTE SMA connectors and antennas, ensure you have use the correct antenna type.

If RP-SMA connector and antenna are mixed with SMA connector and antenna (or vice versa), they may destroy the center pin or mate without the center pin contacts touching (minimal signal gets through).

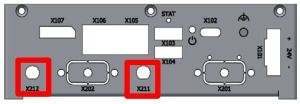
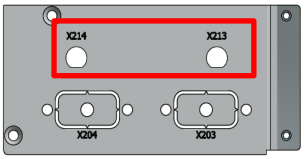
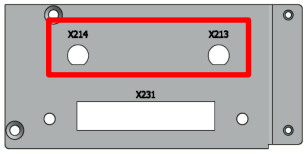
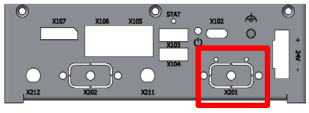
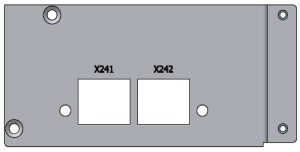
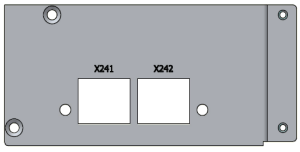
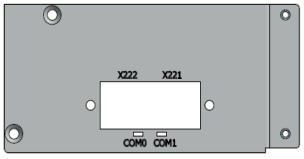
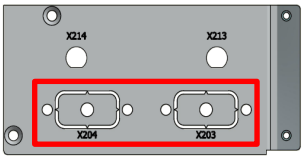
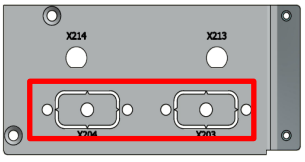
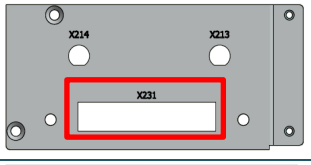
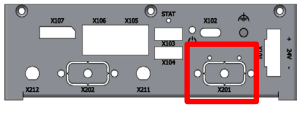
5.4. System Expansion Module

The System Expansion Modules on the left side of the product expand the product's functionality. Note that the Cellular LTE, dual CAN, EtherCAT and dual LAN System Expansion Modules can only be implemented individually, due to the common use of the internal M.2 Key B socket. However, they may be implemented in combination with other reference System Expansion Module options or internal devices that do not require the use of the M.2 Key B socket.

To implement a Cellular LTE, Dual CAN, EtherCAT or Dual LAN System Expansion Module, the internal M.2 Key B socket must be free for use.

For a description of the allowed expansion combinations, see Table 9: System Expansion Combinations Overview. The table shows that Wi-Fi/BT® can be implemented on all System Expansion Module IO combinations [1 to 6]. Whereby, Cellular LTE can only be implemented on the System Expansion Module IO combination 1 with dual COM RS232, combination 2 with dual COM RS232/422/485 and combination 3 with GPIO and one COM RS232.

Table 9: System Expansion Module IO Combinations Overview

Function	Location		Connector/Antenna Number	Combination Overview					
				1	2	3	4	5	6
Wi-Fi/BT®	Front panel		X211, X212 antenna	✓	✓	✓	✓	✓	✓
Cellular LTE	System Expansion Plate 1 System Expansion Plate 4 Front panel	  	X213, X214 antenna or X213, X214 antenna or X201 SIM Slot for Cellular LTE	✓	✓	✓			
Dual LAN 2.5 GbE	System Expansion plate 3		X241, X242				✓		
Dual CAN	System Expansion plate 3		X241, X242					✓	
EtherCAT	System Expansion plate 2		X221, X222						✓
Dual COM RS232	System Expansion plate 1		X203, X204	✓					
Dual COM RS232/ 422/485	System Expansion plate 1		X203, X204		✓				
GPIO 8-channel	System Expansion plate 4		X231			✓			
COM RS232	Front Panel		X201			✓	✓	✓	✓

5.5. Cellular LTE System Expansion Module

The Cellular LTE System Expansion Module is factory installed and requires a SIM slot on the front panel (X201).

Figure 10: Cellular LTE, SMA Antenna Connectors

SMA (female) connector

pin socket &outer thread

SMA (male) antenna

center pin and inner thread

The antenna position may affect the performance. Do not place the antenna close to a noise source that may cause interference. Kontron recommends using Kontron's Cellular LTE reference antenna, included in the delivery, and chosen to meet RF performance requirements and supporting a nominal impedance of 50 ohms.

CAUTION

Antenna RF exposure

Avoid RF antenna exposure by:

- Avoid placing the antenna near people, minimum distance 20 cm.
- Avoid pointing the antenna at people.
- Keep a safe distance from the antenna especially when transmitting.

NOTICE

SMA and RP-SMA are not Interchangable!

SMA and RP-SMA connectors and antenna are not electrically compatible and not interchangeable. If your product configuration includes a mixture of Wi-Fi RP-SMA connectors and antennas and cellular LTE SMA connectors and antennas, ensure you have use the correct antenna type.

If RP-SMA connector and antenna are mixed with SMA connector and antenna (or vice versa), they may destroy the center pin or mate without the center pin contacts touching (minimal signal gets through).

Table 10: Cellular LTE Module Description

Function	Description	
Cellular LTE Module	LTE:	LTE Cat. 4
	Antenna Connector:	SMA female
	Data Rate:	150 Mbps download; 50 Mbps upload
	Socket Type:	M.2 Key B 3042
	Freq. Bands :	B1/B3/B7/B8/B20/B28/B38/B41 (Europe)
	Interface:	USB 2.0
	Power Consumption:	2.5 W max.
	MIMO Support:	Yes
	Implements:	Quectel EM05-G Series (M.2 3042 Key B Module)
Connector	2x SMA (female) antenna connectors with pin socket and inner thread. Left side on the Cellular LTE system expansion module (X213, X214)	

Table 11: LTE Reference Antenna

Part	Part Number	Description
LTE Antenna 	Manufacturer: 2J Antenna Conceptor Article Number: 2JW0924-C952B	Type: 4G LTE Connector: SMA plug (male) Pattern: Omni - directional Standards 2 G / 3 G / 4G Frequency: 698-960 MHz / 1710-2170 MHz / 2500-2700 MHz Peak Gain: 0.6 dBi /2.6 dBi / 2.3 dBi L x W x T: 170 x 18 x 10 mm Articulated hinge: 0° to 90° Impedance: 50 ohms

5.6. Dual LAN System Expansion Module

The dual LAN system expansion module is factory installed. The Dual LAN system expansion module supports two 2.5 GbE LAN ports.

Table 12: Dual LAN Module

Function	Description
Dual 2.5 GbE LAN	Two 2.5 GbE LAN ports Two RJ45 Connectors, with speed and activity LEDs Power consumption: 3.08 W max. (@3.3 V/934.7 mA) Implements the EGPL-22S1-W1-U481 (M.2 2280 Key B module)

To achieve the specified performance of the Ethernet port, Category 5 twisted pair cables must be used with 10/100 MByte and Category 5E, 6 or 6E with 1 GbE/2.5 GbE networks.

5.7. Dual CAN System Expansion Module

The dual CAN system expansion module is factory installed. The Dual CAN bus system expansion module supports two CAN bus 2.0B ports that are both backwards compatible with CAN bus 2.0A and meet the requirements of ISO 11898-1.

Table 13: Dual CAN Module

Function	Description
Dual CAN	Dual CAN bus 2.0B ports (backwards compatible with CAN bus 2.0A) ISO 11898-1 compliant Baud rates of 10/20/50/100/250/500/800/1000K CAN message acceptance filter and J1939/CAN open high layer protocol Power Consumption: 2.834 W max. (@3.3 V/859 mA Implements the EGPC-B2S1 (M.2 2280 Key B module)

5.8. EtherCAT System Expansion Module

The EtherCAT system expansion module is factory installed. The EtherCAT system expansion module supports dual EtherCat ports with Auto Crossover and switching between RX and TX. The green Ethernet LEDs indicates the link status and the yellow Ethernet LEDs indicates network activity. Check the status of the LEDs to confirm a connection to the Ethernet.

Table 14: EtherCAT Module

Function	Description
EtherCAT	Two RJ45 EtherCat ports Auto Crossover and switching between RX and TX. Power Consumption: 2.15 W max. (@ 3.3 V/650 mA) Implements the CIFX M3042100BM-RE/F (M.2 3042 Key B module)

5.9. Dual COM RS232 System Expansion Module

The dual COM system expansion module is factory installed. The dual COM RS232 system expansion module supports two RS232 outputs

Table 15: Dual COM Module

Function	Description
Dual COM RS232	Two RS232 serial outputs DB9 connectors Power Consumption: 1.55 W max. (@ 3.3 V/472 mA) Implements the EGP2-X203 (M.2 2242 Key B module)

5.10. Dual COM RS232/422/485 System Expansion Module

The dual COM RS232/422/485 system expansion module is factory installed. The dual COM system expansion module supports two RS232/422/485 configurable outputs.

Table 16: DUAL COM RS232/422/485 Module

Function	Description
Dual COM RS232/422/485	Dual RS 232/422/484 ports (Default RS232 and configurable to RS422 and RS485) 9-pin D-Sub connectors (non-isolated) Power Consumption: 0.5 W max. Implements the USB to Serial Controller FT231X

To reconfigure the default RS232 mode by software under Windows or Linux, perform the following:

1. Reprogram the FT230x with FTDI software FT-PROG.
2. For Windows download from FTDI Website https://ftdichip.com/wp-content/uploads/2021/01/FT_PROG.zip and for Linux use the utility on Github: https://github.com/richardeoin/ftx-prog
3. Set the CBUS signals to the parameters shown in Table 17: RS Mode Configuration, and perform a power cycle by restarting the product after successful programming.

Table 17: RS Mode Configuration

CBUS Signal	RS232 (default)	RS422	RS485
C0 (direction)	TXDEN	TXDEN	TXDEN
C1 (mode0)	Drive_1	Drive_0	Drive_1
C2 (mode1)	Drive_0	Drive_1	Drive_1
C3 (termination)	Drive_0	Drive_[X]	Drive_[X]

[X] 0=Off/1=On

5.11. 8-Channel GPIO/DIO System Expansion Module

The 8-Channel GPIO/DIO system expansion module is factory installed on the left side of the product. The GPIO expansion option supports eight GPIO bi-directional digital IO signals. The mating connector for the GPIO interface is not supplied with the product. For mating connector information, see Chapter 13.10.7: 8-Channel GPIO/DIO Connector (option).

Table 18. 8-Channel GPIO System Expansion Module

Function	Description
8- channel GPIO/ Digital IO module	Eight GPIO bi-directional digital IO signals Each GPIO can be selected as output or input channel. Power Consumption: 0.5 W max. (@ 5 V/100 mA)

Both resistive and inductive loads can be connected to the GPIO interface.

For the GPIO/DIO connector pin assignment, see Chapter 13.10.7: 8-Channel GPIO/DIO Connector (option). The GPIO input and output specification supports the following GP Input and GP Output

Table 19: GPIO Input and Output Channels

GP Input Channel	Description
Input Type	Input with integrated Pulldown
Input Voltage	10 VDC to 30 VDC[1]
Input Pulldown Resistor	20 kOhm approx.
Input High level	>8.8 V
Input Low Level	<4.2 V
Input Hysteresis	>2.5 V

GP Output Channel	Description
Output Type	High side switch
Output Voltage	10 VDC to 30 VDC
Output Current	250 mA (500 mA max.)
Inductive load switch-off energy dissipation	40 mJ
Output Protection	Short to GND protection by current limit Thermal shutdown with output auto-retry Inductive Load negative Voltage Clamp

[1] Maximum allowed input voltage depends on external voltage at Power IN connector (GPIOx ≤ Power IN)

Figure 11: Output Application Connected to GPIO

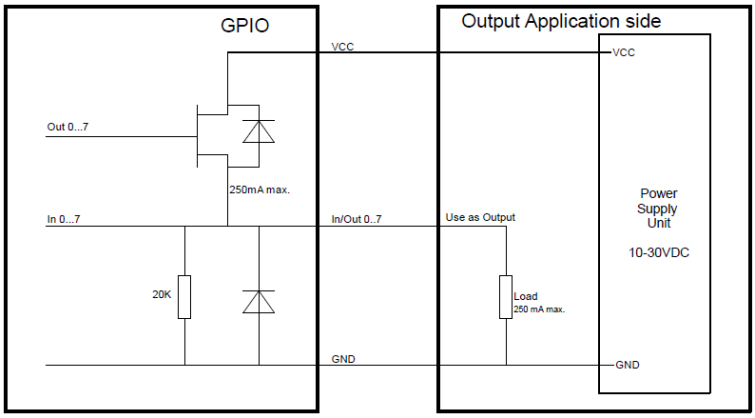
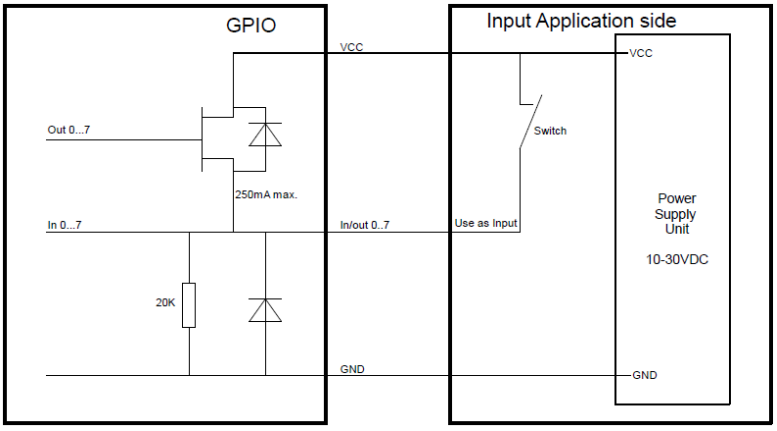


Figure 12: Input Application Connected to GPIO



6/Thermal Management

6.1. Passive Cooling

The KBox A-251-AML/ADN is passively cooled and fanless, using a heatsink. The critical internal components have their own passive cooling solutions or are directly connected to the outer chassis to optimize heat transfer. The heatsink on the top side can get very hot and precautions must be taken before handling or touching.

Do not obstruct the airflow around the heatsink as this may cause a build-up of heat. Observe a minimum clearance distance around the product.

⚠CAUTION

Ensure Sufficient Airflow

Operate only in a well-ventilated environment that does not obstruct the airflow over the heatsink or obstruct the product from dissipating heat.

6.2. Heatsink

The heatsink is located on the top side. For additional heatsink mechanical information, see Chapter 12.6: Mechanical Specification.

Hot Surface

The heatsink can get very hot. To avoid burns and personal injury when handling the heatsink:

- Do not touch while in operation
- Allow to cool before handling
- Wear protective gloves

6.3. Mount Orientation

When mounting the product unto the control cabinet take care not to obstruct the airflow over the heatsink, as this can stop sufficient heat dissipating into the ambient environment and cause a build-up of heat. Kontron offers options for DIN Rail clamps for mounting on the rear side of the product. For more information, see Table 3: Accessories.

6.4. Minimum Clearance

To provide maximum heat dissipation away from the heatsink a minimum clearance distance of 12 mm (0.47 inch) to the surrounding environment must be observed, also known as keep out area in this user guide.

For sufficient air circulation around the product, Kontron recommends users not to mount or operate any other devices within the specified keep out area around the product.

⚠CAUTION

Leave a sufficient clearance (keep out area) to prevent the product from overheating!
To ensure proper operation observe the specified minimum clearance for the heatsink of 12 mm (0.47 inch).

Figure 13: Heatsink Clearance

12 mm (0.47 inch)

6.5. Maximum Processor Temperatures

The Intel® processors provide only certain settings for maximal power consumption. Table 20provides some typical values as a guideline. The maximum ambient temperature depends mainly on the power consumption of the processor and chipset.

Table 20: Maximum Processor Temperatures

Processor	Description	TDP	DTR	TCC/TSN
Intel® N97	Quad Core, 6M Cache, 2.0 / 3.6 GHz	12 W	+70°C	
Intel® Core i3-N305	Octa Core, 6M Cache, 1.8 / 3.8 GHz	15 W	+70°C	
Intel® Atom X7211RE	Dual Core, 6M Cache, 1.0 / 3.2 GHz	6 W	+70°C	✓
Intel® Atom X7433RE	Quad Core, 6M Cache, 1.5 / 3.4 GHz	9 W	+70°C	✓
Intel® Atom X7835RE	Octa Core, 6M Cache, 1.3 / 3.6 GH	12 W	+70°C	✓

The Dynamic Temperature Range (DTR) defines the maximum temperature range during operation starting from boot time temperature and within the T-junction limits.

For Dynamic Temperature Range (DTR) information for your processor or a higher DTR-value, contact Kontron Support.

7/Assembly

The KBox A-251-RPL is factory configured and requires no further internal assembly.

NOTICE

Protection label

The product is factory configured to meet customer requirements and then sealed with a protection label. Opening the product invalidates the warranty and may cause damage to internal components.

NOTICE

The internal components are not accessible in the field. For replacement or installation, the product must be returned to Kontron, see Chapter 15.1: Returning Defective Merchandise.

8/Installation

8.1. Before Installing

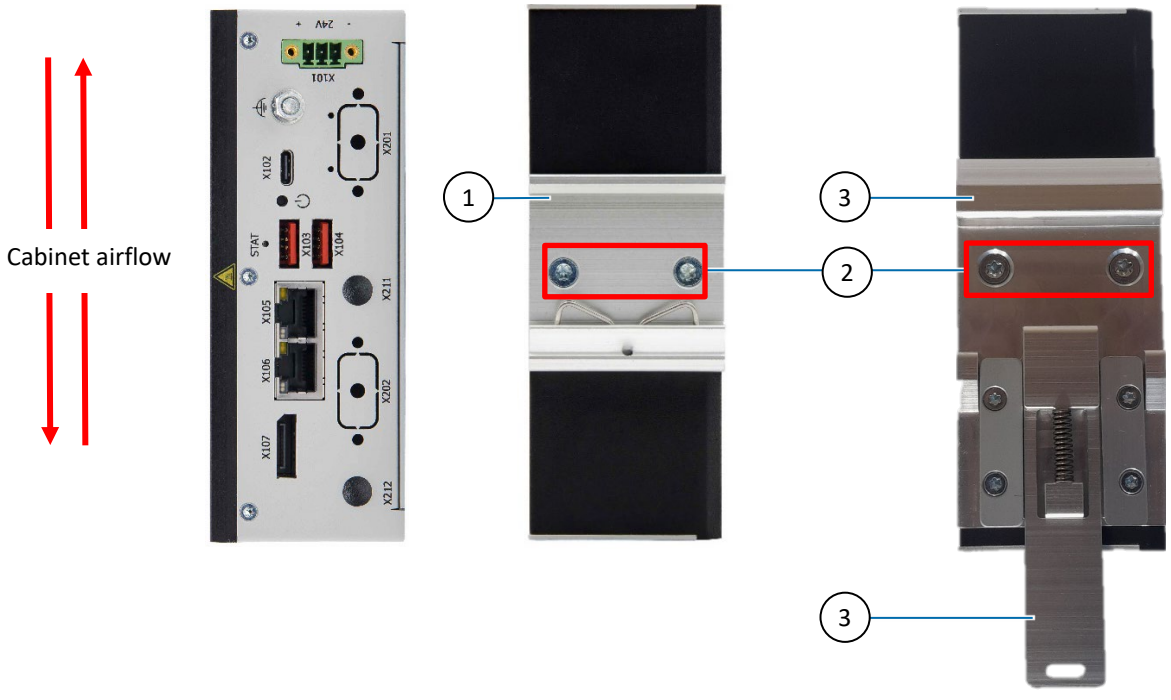
Before installing the KBox A-251-AML/ADN in the field, ensure that the operating environment meets the specification stated within this user guide, and that there is sufficient access to the Power IN connector, and the front panel and system expansion module connectors. The product is design for installation vertically in an industrial control cabinet.

⚠CAUTION	**Ensure Sufficient Airflow** Install only in a well-ventilated environment that does not obstruct the airflow over the heatsink or obstruct the product from dissipating heat.
⚠CAUTION	Do not install the product close to heat sources or damp places.
NOTICE	Support the power and I/O cables to minimize the strain on the product's connectors.

8.2. Control Cabinet Mounting

The product mounts directly into an industrial control cabinet on a DIN Rail. The DIN Rail enables mounting of the product in a control cabinet with the heatsink (as seen from the front) on the left or right side. This supports the vertical airflow within a control cabinet and enables maximum heat dissipation.

Figure 14: DIN Rail Clamp (default position)



1	DIN Rail Clamp (50 mm x 50 mm)	3	Rugged DIN Rail
2	2x M4x6 Screws	4	Rugged DIN Rail leaver

8.3. DIN Rail Clamp

The DIN Rail clamp 50 mm x 50 mm option mounts on the rear side. The default position is for vertical operation with the heatsink on the left side. The DIN Rail clamp is reversible. For a replacement DIN Rail Clamp, see Table 3: Accessories.

To attach the DIN Rail clamp to a DIN Rail, perform the following:

1. Fasten the DIN Rail clamp (Figure 14, pos. 1) firmly using the supplied two M4x6 screws (Figure 14, pos. 2) and a thread locking compound to secure the two screws.
2. Clip the bottom of the DIN Rail clamp onto the DIN Rail and push upwards. Slot the top of the DIN Rail clamp firmly onto the top of the DIN Rail.

NOTICE Always mounting using the two M4x6 screws supplied with the DIN Rail Clamp.

8.4. Rugged DIN Rail Clamp (rear side)

The Rugged DIN Rail clamp option mounts on the rear side. The default position is for vertical operation with the heatsink on the left side. The Rugged DIN Rail clamp is reversible. For a replacement Rugged DIN Rail Clamp, see Table 3: Accessories.

To attach the Rugged DIN Rail clamp, perform the following:

1. Fasten the rugged DIN Rail clamp (Figure 14, pos. 3) firmly using the supplied two M4x6 screws (Figure 14, pos. 2) and a thread locking compound to secure the two screws.
2. Clip the bottom of the rugged DIN Rail clamps onto the DIN Rail and push the rugged DIN Rail upwards while pulling the leaver, Slot the top of the rugged DIN Rail clamp firmly onto the top of the DIN Rail and release the leaver.

NOTICE Always mounting using the two M4x6 screws supplied with the Rugged DIN Rail Clamp.

8.5. Connector Clearance

The connectors and antenna are attached to the front panel and to the left side of the product depending on the assembled System Expansion Module . The required connector clearance depends on the connected cables and antennas and is therefore user depended and cannot be specified within this user guide.

When installing the product user must consider that connector clearance may also be required at the bottom side of the product, see Figure 15: Connector Clearance.

Cable clearance is user dependent and not specified in this user guide.

Figure 15: Connector Clearance

12 mm (0.47 inch)

9/Starting UP

9.1. Before Starting

Before connecting the KBox A-251 AML/ADN to power, read the instructions in this user guide and observe the safety instructions in Chapter 2/General Safety Instructions.

⚠CAUTION	**External Power Supply Specification** Only connect the product to an external power supply providing the voltage type (AC or DC) and the input power (max. current or max. power) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1.
⚠CAUTION	**Switch off Properly!** Even when switched off using the power button, parts of the product are still energized. The product is only completely switched off when the power has been switched off using the power button and the power cable is disconnected from the Power IN connector.
⚠CAUTION	**Protection** Observe that wiring and short-circuit/overcurrent protection is performed according to the applicable standards, regulations and in respect to the product's electrical specification.
⚠CAUTION	**Disconnection Device** If these is limited access to the Power Cable use a disconnecting device, (fuse/circuit breaker) rated in accordance with the product wire cross-section.
⚠CAUTION	**Cable Damage** Ensure that the power cable has no visible damage.
NOTICE	**Proper Cabling Procedure** To prevent a false power-on condition, that could result in operational failure. When installing or disconnecting cables ensure that: › The functional earth connection is made first and disconnected last. › The last connection made is to the Power IN Connector.
NOTICE	**Forced Shutdown** Disconnecting the power while the product is operating, performs a forced shut down and can lead to loss of data or other undesirable effects! To shutdown properly without data loss, switch off using the power button.

9.2. Starting Up with an External 24 VDC Power Supply

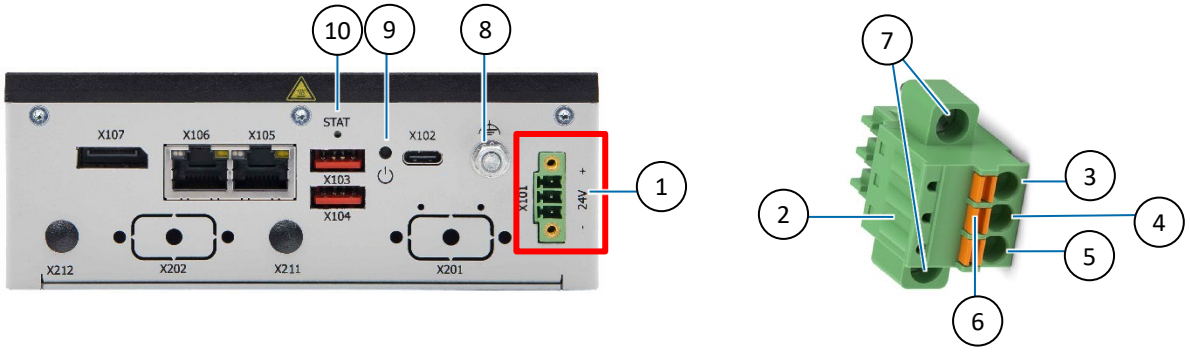
The Power IN 24 VDC 3-pin connector connects to an external 24 VDC power supply using the mating connector include in the delivery. Only connect to a power supply unit within the specified voltage range that meets the product's electrical specification as stated in this user guide and on the product's type label and provides the required safety and protection features.

External Power Supply Specification

⚠CAUTION

Only connect the product to an external power supply providing the voltage type (AC or DC) and the input power (max. power) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1.

Figure 16: 24 VDC Power IN Connector and Mating Power Connector



1	24 VDC Power IN connector	5	Clamp for GND wire
2	3-pin mating power connector Phoenix type: 1.5/ 3-STF-3.5 (included in the delivery)	6	Three orange lock clips
3	Clamp for +24 VDC	7	Two screws
4	Clamp for GND wire	8	Functional Earth (FE) bolt
		9	Power Button
		10	STAT LED

To connect to the external 24 VDC power supply and switch on the product, perform the following:

1. Wire the mating power connector (1.5/ 3-STF-3.5) included in the delivery, as described in Chapter 9.2.1: Wiring the Power IN Connector.
2. Switch off the external 24 VDC power supply via a disconnecting device (fuse/circuit breaker), to ensure that no power flows during the connection procedure.
3. Connect the functional earth bolt (Figure 16, pos. 8) to an appropriate common earth connection.
4. Connect the wired mating power connector to the 3-pin Power IN connector (Figure 16, pos. 1). Pay attention to the polarity of the connections and secure with the two screws (Figure 16, pos. 7).
5. Connect the other end of the wired mating power connector to the external 24 VDC power supply.
6. Switched on by press the power button (Figure 16, pos. 9) once and the STAT LED (Figure 16, pos. 10) illuminates.

9.2.1. Wiring the Power IN Connector

The mating power connector (Phoenix Type: 1.5/ 3-STF-3.5) included in the delivery is to be wired by the user. When wiring the mating power connector mark the supply wires (+/-) clearly to ensure a safe connection from the external 24 VDC power supply. The wiring is not part of the delivery and must be provided by the user. Use copper conductors only if the field wiring terminal is only for connection to copper wire and the field wiring terminals must have minimum temperature rating of 75° C.

To wire the supplied mating power connector (1.5/ 3-STF-3.5), perform the following:

1. Cut three (1 mm^2) AWG 18 isolated wires to the required length and strip each end 5 mm to 7 mm.
2. Twist the striped wire-ends and provide them with ferrules.
3. Insert the end of the prepared wires into the corresponding opening on the mating power connector (Figure 16, pos. 3, 4, 5) until they engage and secure the wires. Ensure correct polarity.

NOTICE

Mark the supply wires (+/-) clearly to ensure a safe connection from the Power IN connector to the DC power supply.

9.3. Starting Up with an External 12 VDC Power Supply

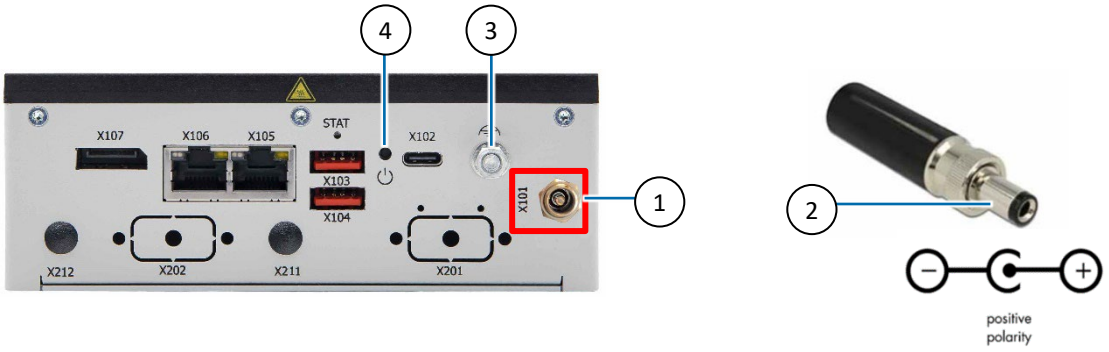
The Power IN 12 VDC Jack connects to a external 12 VDC power supply that meets the product's electrical specification as stated in this user guide and on the product's type label and provides the required safety and protection features.

⚠CAUTION

External Power Supply Specification

Only connect the product to an external power supply providing the voltage type (AC or DC) and the input power (max. current) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1.

Figure 17: Power IN 12 VDC Jack and Mating Power Connector



1	12 VDC Power IN jack	3	Functional earth bolt
2	12 VDC Jack (Ø5.5/Ø2.1)	4	Power Button
		5	STAT LED

To connect to an external 12 VDC power supply and switch on the product, perform the following:

1. Connect the Functional Earth (FE) bolt (Figure 17, pos. 3) to an appropriate common earth connection.
2. Connect the power supply's cable with a positive polarity (Ø5.5/Ø2.1) jack (Figure 17, pos. 2), to the Power IN 12 VDC connector (Figure 17, pos. 1).
3. Connect the other end of the power supply to the mains power outlet using the correct plug for your region.

4. Switched on by press the power button (Figure 17, pos. 4)once and the STAT LED(Figure 17, pos. 5) illuminates.

9.4. Operating System (OS) and Drivers

If ordered with a pre-installed operating system, all drivers are installed in accordance with the ordered configuration and the product is operational, when switched on for the first time.
If ordered without a pre-installed operating system, users will need to install the operating system and the appropriate drivers for the configuration ordered.

To download relevant drivers for the factory installed hardware components, visit Kontron's Customer section.

Pay attention to the manufacturer's OS specifications relating to the integrated hardware components.

10/ Mobile Network

10.1. Before Setting Up

All software installed by the user is at the user's own risk. Kontron is not responsible for any malfunction, data loss, outage of various services and other problems caused by software installed by the user. Kontron is not responsible for the loss of stored, transmitted, received and used data. It is the user's responsibility to consider access control and the protection measures required to prevent unwanted access.

10.2. Setting up the Mobile Network

Kontron provides a Board Support Package (BSP) including an installer with the required drivers for the supported Wi-Fi and/or mobile networks (LTE).

Kontron is not responsible for setup of the mobile network software and users must consider that setting up the product incorrectly can lead to the product becoming inaccessible. Kontron recommends testing the mobile network software in a safe test environment before installation in the field.

For the product's BSP and required drivers, visit Kontron's Customer Section and click on KBox A- > KBox A-251 to access the Board Support Package/ Drivers/ Tools.

10.3. SIM Card Inserting

The SIM card's push push insertion and extraction enables quick and easy insertion or extraction. The SIM card slot is only for use in combination with the cellular LTE system expansion module and is not available for storage.

NOTICE

Switch off to Insert/Extract SIM

Only insert or extract the SIM cards if the product is switched off properly.

A SIM card is not part of the delivery and must be provided by the operator, to support the require network.

Figure 18: SIM Card Holder

To cellular LTE network's SIM card inserts into the SIM slot (X201) on the front panel.

1. Ensure the product is switched off and disconnected from the power supply by removing the power cable.
2. Insert the SIM card with the terminal contacts facing forwards and on the underside (Figure 18) and push the SIM card carefully into the SIM slot (X201) until the card clicks acoustically.

11/ BIOS

The KBox A-251-AML/ADN uses the AMI Aptio V uEFI BIOS based on the Unified Extensible Firmware Interface (uEFI) specification and the Intel® Platform Innovation Framework for EFI. The uEFI BIOS preferences are preset and do not require further adjustment for operation.

The UEFI BIOS Setup menus and available selections may vary are are open to change. For specific information on the BIOS for your product, visit Kontron's Customer Section. and access the KBox A-251 information

UEFI only! No legacy support and no Master Boot Record (MBR) installation.

For the latest uEFI BIOS Information, visit Kontron's Customer Section.
If the BIOS information you require is not available within the Customer Section, contact Kontron Support.

11.1. Starting the uEFI BIOS

The uEFI BIOS's Setup program provides quick and easy access to the individual functions within the BIOS sub-menus for control or modification of the uEFI BIOS configuration.

Use the hot key navigation system, to navigate through the BIOS. The hot key legend bar is located at the bottom right of each Setup screen. For a list of navigation hot keys, see Table 21: Navigation Hot Keys.

Table 21: Navigation Hot Keys

Sub-screen	Description
<F1>	<F1> key invokes the General Help window
<->	<Minus> key selects the next lower value within a field
<+>	<Plus> key selects the next higher value within a field
<F2>	<F2> key loads previous values
<F3>	<F3> key loads optimized defaults
<F4>	<F4> key Saves and Exits
<→> or <←>	<Left/Right> arrows selects major Setup menus on menu bar, for example, Main or Advanced
<↑> or <↓>	<Up/Down> arrows select fields in the current menu, for example, Setup function or sub-screen
<ESC>	<ESC> key exits a major Setup menu and enters the Exit Setup menu Pressing the <ESC> key in a sub-menu displays the next higher menu level
<RETURN>	<RETURN> key executes a command or selects a submenu

To start the uEFI BIOS Setup program, follow the steps below:

1. Switch on the product.
2. Wait until the first characters appear on the screen (POST messages or splash screen).
3. Press the BIOS access key <DEL> repeatedly until the BIOS setup screen appears.
4. If the uEFI BIOS is password-protected, a request for password will appear. Enter either the "User Password" or the "Supervisor Password" and press <RETURN>.
5. The BIOS setup utility appears in the Main menu.

6. Use the Navigation Hot Keys arrow keys to navigate to the required Setup menu to “change,” or “reset,” settings.
7. Navigate using Navigation Hot Key arrow keys to the “Save & Exit” Setup menu and select “Save Changes”.

11.2. Setup Menus

The Setup menus in the products BIOS selection bar are:

- Main
- Advanced
- Chipset
- Security
- Boot
- Save & Exit

NOTICE

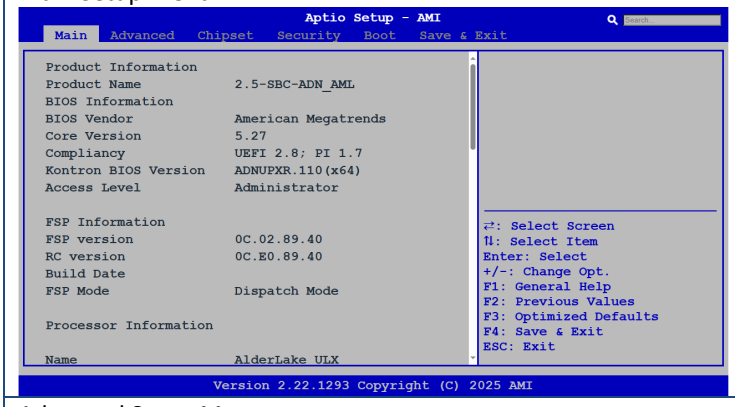
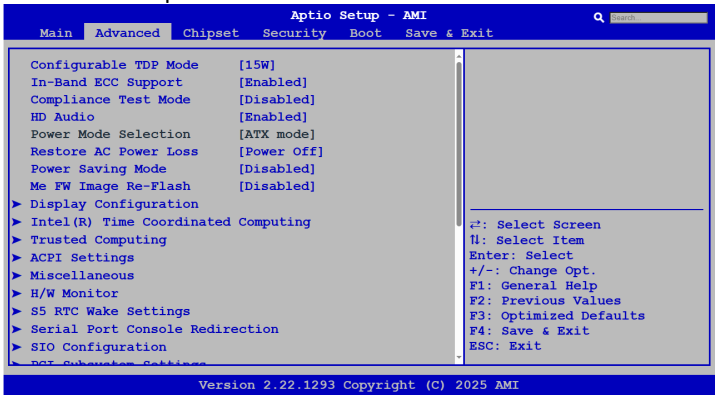
Advanced Setup Menu – Caution when Changing

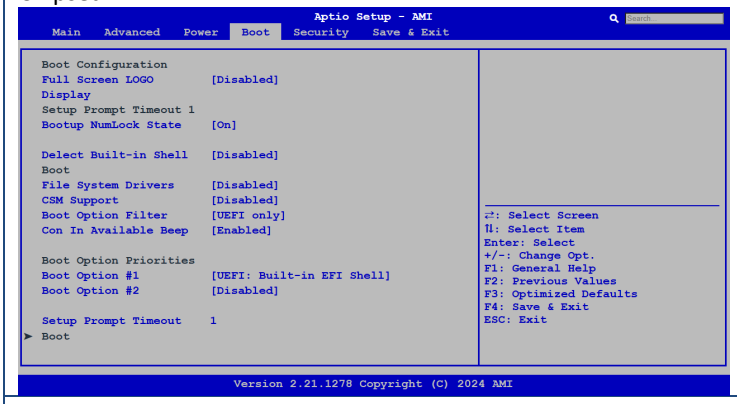
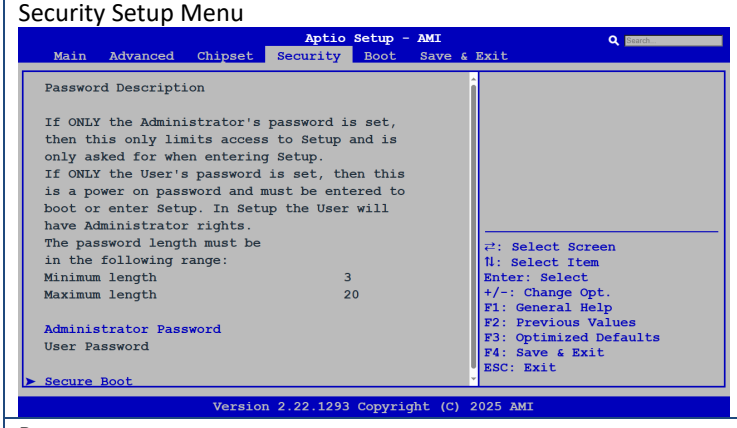
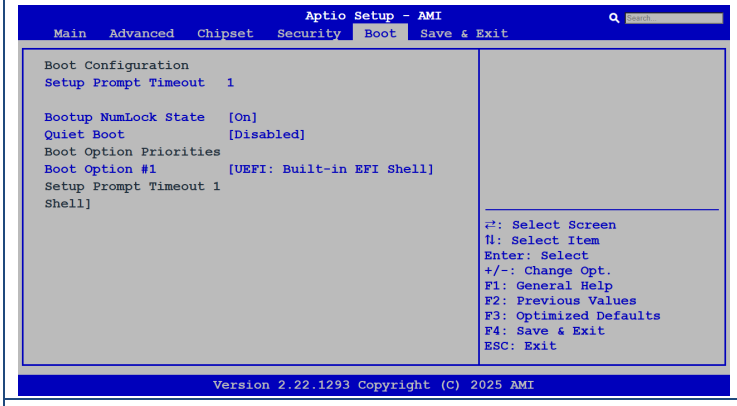
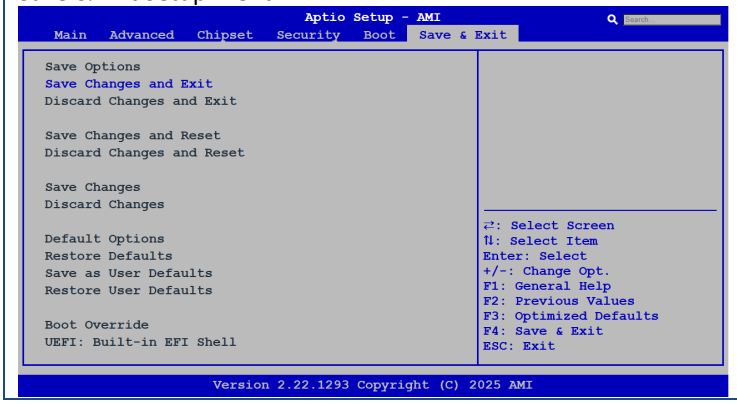
Making changes within the Advanced Setup menu without understanding the full implications may cause system malfunction.

Kontron recommends users to make changes only when the user is sure of the impact.

The following table provides an overview of the main features of the BIOS Setup screens.

Table 22: Setup Menu Overview

Setup Menu	Description
Main Setup Menu 	› Basic system configuration options › Functions for setting the system time and date
Advanced Setup Menu 	› CPU Chipset config. › LAN controllers, Intel® TCC › Display config. › SIO config. › USB config. › Network stack › NVMe config. › Trusted Computing config. › Serial port config. › HW Monitor setting › Power config. ACPI & power modes

Setup Menu	Description
Chipset 	› Sets the System Agent configuration › Graphic & audio settings › Sets the PCH-IO configuration › PCIE config. › SATA config. › USB config.
Security Setup Menu 	› Sets administrator password › Sets user password
Boot 	› Sets the Boot option priorities › Set the BIOS prompt timeout › Sets Numlock on bootup
Save & Exit Setup Menu 	› Saves or discards changes to the system › Exits or resets the system. › Saves or restores user defaults to the system

11.3. Automated BIOS Description

The Automated BIOS Description (ABD) enables users to step through a virtual BIOS setup for a specific product processor and interface version. Users can navigate around the automated BIOS description, to view the various BIOS Setup menus but no changes can be made. To access the automated BIOS description, visit Kontron's Customer Section.

The BIOS Setup menus within the Automated BIOS Description are examples of a specific product configuration. Features may differ or features may be hidden.

To access the Automated BIOS Description, visit Kontron's Customer Section.

To navigate around the automated BIOS description, perform the following:

1. Click on the required Setup menu item with the mouse.
2. Click on the required Sub-menu item.
   - A black Sub-menu item is read only and have no further information.
   - Clicking on a blue Sub-menu item turns the Sub-menu item white and the right frame displays an explanation of the function in a help window, and the options available for this Sub-menu.
3. Return to the Setup menu by pressing the <esc> key.

11.4. BIOS Update

To ensure compatibility with new OS, hardware, software or to integrate new BIOS functions Kontron recommends performing regular BIOS updates. Additionally, if a problem cannot be solved using a new driver, Kontron recommends updating the BIOS.

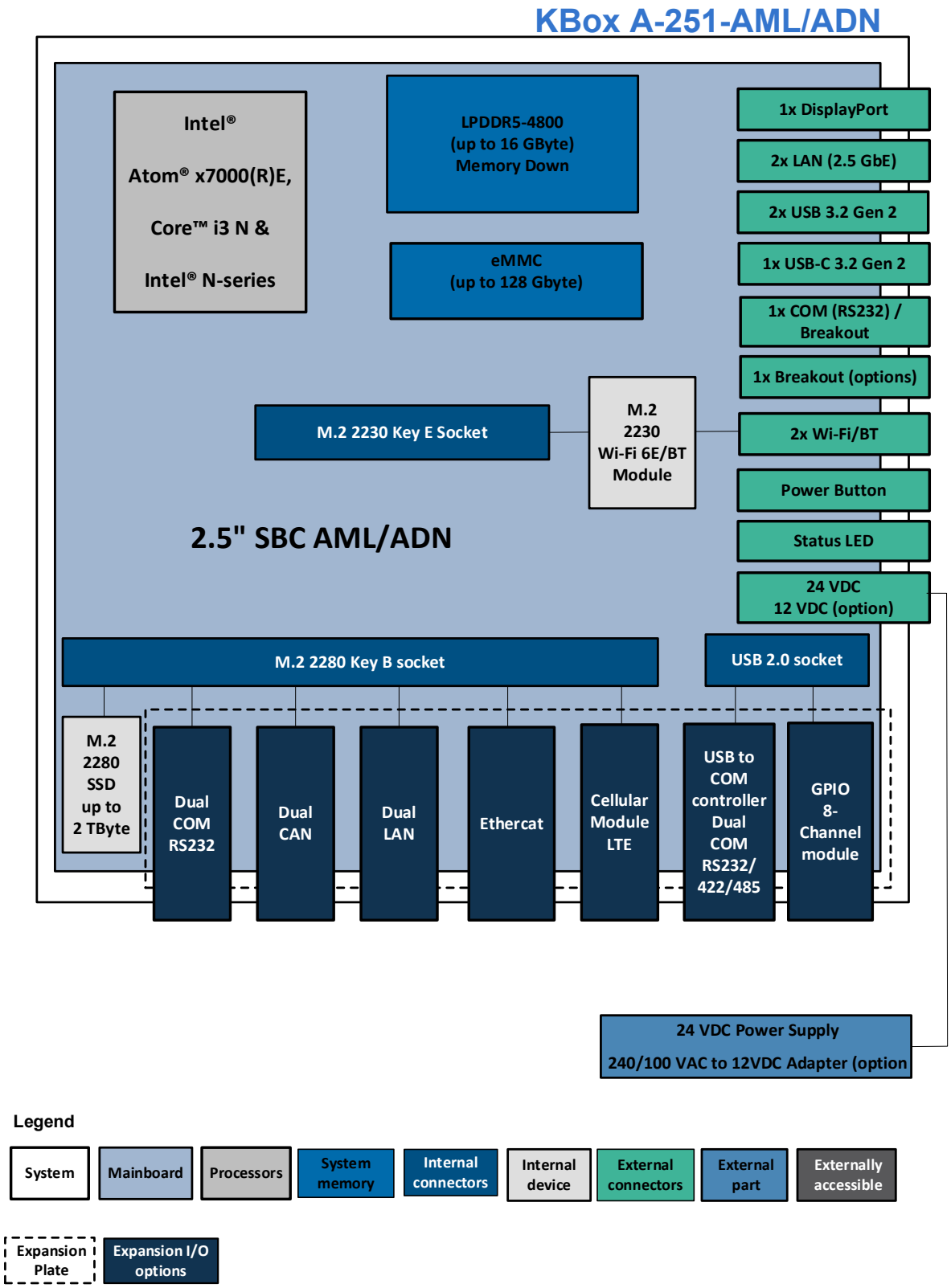
For the latest BIOS downloads and release information, visit Kontron's Customer Section. Select the latest version of the BIOS Update and the preferred method to update the BIOS with instructions.

To update the BIOS move the internal Flash Descriptor jumper from the "default" to the "Override" position. For more information on any restrictions, see Chapter 14.4: BIOS Update - Flash Descriptor Read/Write Access, within the Maintenance chapter of this User Guide.

12/ Product Specification

12.1. Block Diagram

Figure 19: Block Diagram KBox A-251-AML/ADN



12.2. Hardware Specification

Table 23: Hardware Specification

KBox A-251-AML/ADN	Description				
Processor Board	2.5” SBC AML/ADN				
Processor	Intel® Atom® x7211RE	6 MB Cache	1.0 / up to 3.2 GHz	TCC/TSN	6 W TDP
	Intel® Atom® x7433RE	6 MB Cache	1.5 GHz/up to 3.4 GHz	TCC/TSN	9 W TDP
	Intel® Atom® x7835RE	6 MB Cache	1.3 GHz/up to 3.6 GHz	TCC/TSN	12 W TDP
	Intel® Core™ i3-N305	6 MB Cache	2 GHz / up to 3.8 GHz		15 W TDP
	Intel® N97	6 MB Cache	1.8 / 3.6 GHz		12 W TDP
System Memory	Up to 16 GByte, LPDDR5 4800MT/s memory down With 4 GByte, 8 GByte, 16 GByte				
	Up to 128 GByte max. eMMC (option) With 32 GByte, 64GByte, 128 GByte				
External Connectors	Ethernet	2x 2.5 GbE			
	USB	2x USB 3.2 Gen 2 Type 1x USB-C 3.2 Gen 2 with Alt-mode			
	Display port	1x full size DP			
	Serial Port	1x RS232 1x RS232 (option)			
Internal Expansion Sockets	M.2 Key E 2230 Wi-Fi 6E GHz 2.4 Gbps/Interface: PCIe 2.1 BT® V5.2 /Interface: USB 2.0				
	M.2 Key B 2280 SSD (SATA III, 6Gb/s) With 256 GB, 512 Gb, 1 TB, 2 TB				
System Expansion Modules	Cellulat LTE Cat 4 Dual LAN ports with 2x 1GbE with Speed and Activity LEDs Dual CAN with 2x CAN bus 2.0B ports Dual EtherCat with 2x RJ45 EtherCat ports Dual COM with 2xRS232 serial ports Dual COM with 2xRS232/RS422/RS485 Serial ports 8-Channel GPIO/DIO (option)				
RTC	3V RTC lithium battery				
Power	Standard: 24 VDC (Range: 9.6 VDC to 36 VDC) Option: 12 VDC				
	Power Button				
LEDs	STA LED- indicates the current status.				

12.3. Software Specification

Table 24: Software Specification

KBox A-251-AML/ADN	Description
Operating System (OS)	Windows 11 IoT Enterprise BSP and Image Linux Debian
BIOS	AMI Aptio V

12.4. Power Specifications

The default power solution is an external 24 VDC power supply connected via the mating power connector included in the delivery or an optional external 12 VDC power solution, connected using a suitable power jack. Ensure that the external power supply meets the required electrical specification for the product, and takes protection and supply limitation into consideration.

12.4.1. External 24 VDC Power Supply

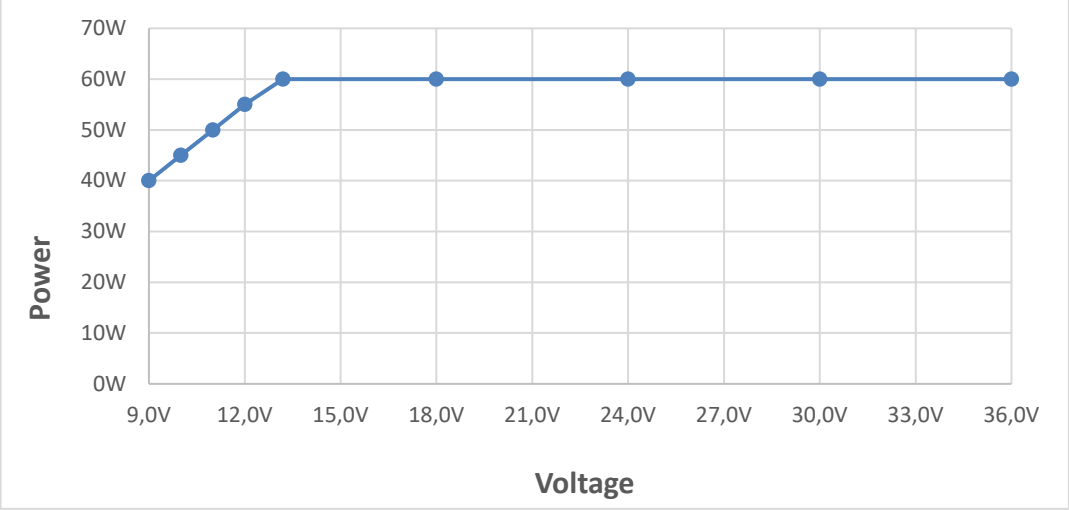
Ensure that the external 24 VDC power supply meets the required electrical specification for the product, and takes protection and supply limitation into consideration.

⚠CAUTION	Only connect the product to an external 24 VDC power supply providing the input power (max. current) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1.
⚠CAUTION	Only connect the product to Power IN using the delivered mating power connector
⚠CAUTION	Observe that wiring and short-circuit/overcurrent protection is performed according to the applicable standards, regulations and in respect to the product's electrical specification. If implemented the disconnecting device (fuse/circuit breaker) rating must be in accordance with the product's wire cross-section.
NOTICE	Ensure that the external 24 DC power supply is used according to the manufacturer's instructions and has been fully tested to meet the minimum immunity of AC inputs requirements, as stipulated in IEC 55024.
NOTICE	To protect the product and any connected peripherals, make sure that the power cables have the right diameter to withstand the maximum available current.

Table 25: Electrical Specification External 24 VDC Power Supply (default)

Power Source	24 VDC Connector
Output Voltage	24 VDC Range: 9 VDC to 36 VDC (wide range)
Output Power (max.)	60 W

Table 26: Voltage Power Derating (24 VDC Power Supply)



12.4.2. External 12 VDC Power Supply

Ensure that the external 12 VDC power supply meets the required electrical specification for the product, and takes protection and supply limitation into consideration. The external 12VDC power supply must automatically recover from AC power loss and start up under peak loading. Connect the product only to an external 12 VDC power supply designed to achieve NEC Class-2 and Limited Power Source (LPS).

⚠CAUTION	Only connect the product to an external 12 VDC power supply providing the input power (max. current) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1
⚠CAUTION	Only connect the product to the Power IN jack using a suitable mating power jack.
⚠CAUTION	Observe that wiring and short-circuit/overcurrent protection is performed according to the applicable standards, regulations and in respect to the product's electrical specification. If implemented the disconnecting device (fuse/circuit breaker) rating must be in accordance with the product's wire cross-section.
NOTICE	Ensure that the external 12 DC power supply is used according to the manufacturer's instructions and has been fully tested to meet the minimum immunity of AC inputs requirements, as stipulated in IEC 55024.
NOTICE	To protect the product and any connected peripherals, make sure that the power cables have the right diameter to withstand the maximum available current.

Table 27: Electrical Specification External 12 VDC Power Supply (option)

Power Source	External 12 VDC Power Supply
Output Voltage	12 VDC (+10%/-5%)
Output Current	5 A max.

12.4.3. Power Supply Protection Requirements

The external power supply (24 VDC/12 VDC) is required to incorporate protection and supply features such as over current protection, inrush current protection, over voltage protection and under voltage (brownout) protection, to protect the product against fluctuations and interruptions in the delivered DC power supply. Be aware that the DC power supply must be able to handle peak currents for several seconds.

NOTICE

If an under voltage (brownout) condition occurs the used power supply must remain in the "off state" long enough to allow internal voltages to discharge sufficiently. Failure to observe this "off state" may mean that parts of the product or peripherals work incorrectly or suffer a reduction of MTBF. The minimum "off state", to allow internal voltages to discharge sufficiently, is dependent on the power supply and additional electrical factors. To determine the required "off state", each case must be considered individually. For more information, contact Kontron Support.

12.4.4. Power Consumption

The external power supply (24 VDC/12 VDC) must be capable of delivering the product with the specified power of 60 W. The product's power consumption of 33.4 W depends on factors such as 2.5" SBC board, processor and standard interfaces and defines the power capacity available for expansion (USB devices, and expansion options), see Table 28: Power Capacity for USB and Expansion.

Table 28: Power Capacity for USB and Expansion Option(s)

	Power
Power Capacity of KBox A-251-AML/ADN	60 W
Power Consumption of 2.5" SBC-Board, Processor, DC/DC, 2x LAN, 1x DP and 1x COM	33.4 W
Power Capacity available for USB interfaces and expansion options	26.6 W

It is the user's responsibility to ensure that the theoretical available power capacity of 26.6 W is not exceeded. In some cases, this could require limiting the power consumption of the USB ports. For information on the power consumption of the USB ports and the expansion options, see Table 29: Power Consumption USB and Expansion Option(s.

Table 29: Power Consumption USB and Expansion Option(s)

Expansion Option	Power Consumption
USB Type A	4.5 W
USB Type A	4.5 W
USB Type C	15 W
M.2 2280 SSD	1.40 W
Wi-Fi/BT®	2.98 W
System Expansion Module Cellular LTE	2.5 W
System Expansion Module Dual COM RS232	1.55 W
System Expansion Module Dual CAN	2.83 W
System Expansion Module Dual LAN 2.5 GbE	3.08 W
System Expansion Module EtherCAT	2.15 W
System Expansion Module GPIO 8-channel	0.5 W
System Expansion Module Dual COM (RS232/4227485)	0.5 W

12.4.5. Functional Earth

The functional earth bolt connects to the internal chassis ground. There is no isolation between the Power IN GND (-) and the system chassis. Always include a functional earth connection.

To avoid damage to the product, observe proper grounding methods:

1. Connect the product to ground before switching on the product.
2. Only connect the product to an applied ground that meets all applicable local, national and international grounding requirements.
3. When assembling the product, connect the ground cable first and when disassembling removed the ground cable last.

⚠CAUTION

Ground Properly

The installation sites applied ground must meet your local, national and international region grounding requirements.

12.5. Environmental Specification

Table 30: Environmental Specification

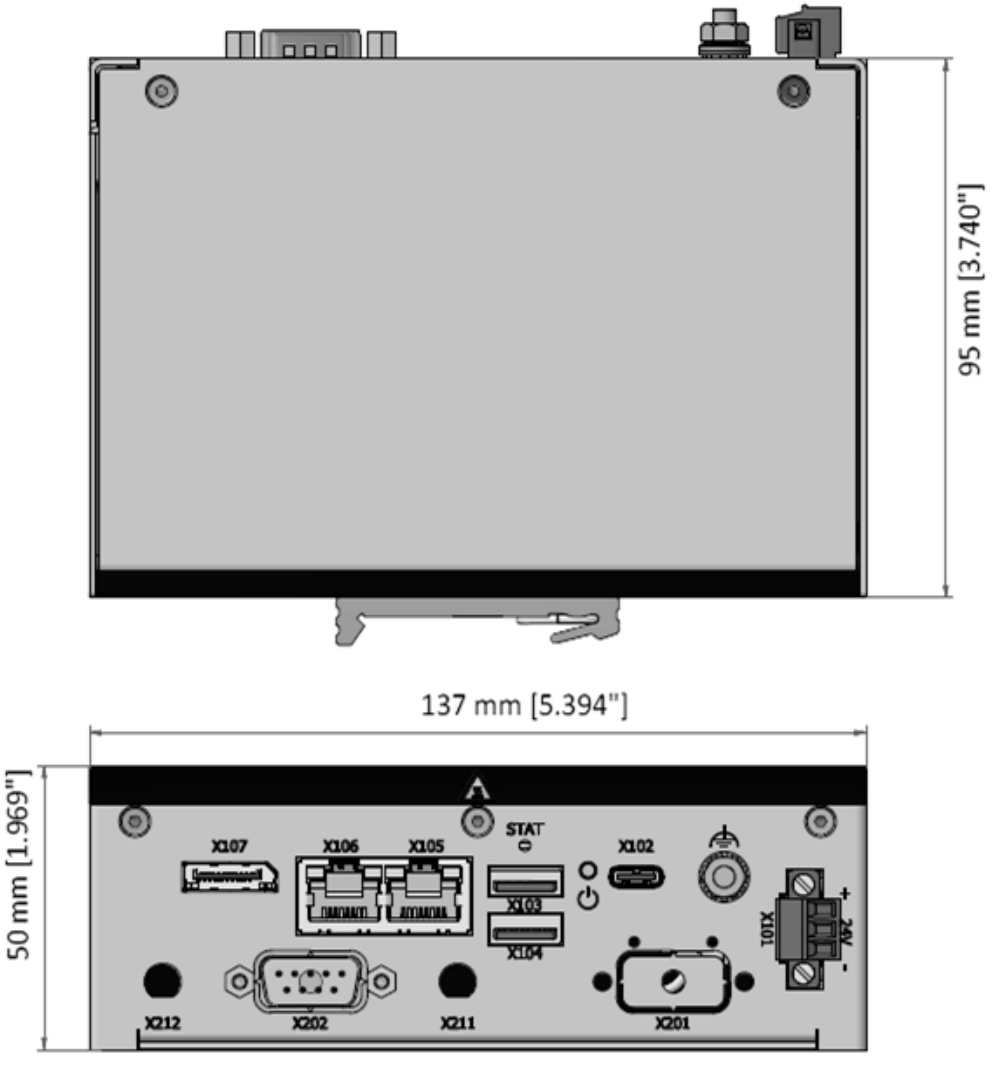
Environmental	Description
Temperature (Operating) Accourding to IEC 60068-2-1/-2-2	Standard: 0°C to 60°C (32°F to 140°F) Extended: -40°C to 60° (-40°F to 140°F)
Temperature (Non-Operating) Accourding to IEC 60068-2-1/-2-2	-40°C to +85°C (-40°F to 121°F)
Humidity According to IEC 60068-2-78	93% RH at 40°C (104°F), non-condensing
Shock (Operating) According to IEC 60068-2-27	Peak Acceleration.: 15 g, Shock Duration.: 11 ms half sine, Shock Count: 3/direction, total 18
Shock (Non-Operating) According to IEC 60068-2-27	Peak Acceleration. 30 g, Shock Duration. 11 ms half sine, Shock Count: 3/direction, total 18
Vibration According to IEC 60068-2-6	Frequency: 10 Hz - 150 Hz Acceleration: 1 g
Altitude (Operating)	3000 m max. (9800 ft. max.)
Altitude (Non-Operating)	10,000 m max. (32800 ft. max.)
Cooling Solution	Passive cooling solution via heatsink
MTBF	200,000 hours At 30°C (86°F) Ground Benign (GB)

12.6. Mechanical Specification

Table 31: Mechanical Specification

Mechanical	Description
Material	Chassis: Steel Heatsink: Aluminium
Dimension (W x H x D)	137 mm x 50 mm x 95 mm (5.394“ x 1.969“ x 3.740“)
Color	RAL7035 (front panel and main chassis) Black (rear panel and heatsink)
Mounting	DIN Rail options (rear side)
Weight	< 1 kg approx. (2.2 lbs. approx.)
Protection Class	IP20

Figure 20: Mechanical Dimensions Front (mm)



To access the KBox A 251-AML/ADN STEP files, visit Kontron’s Customer Section.

12.7. Compliance

The KBox A-251-AML/ADN plans to comply with the relevant requirements and the approximation of the laws relating to the following standards (or later thereof) that are constitutional parts of the declaration.

Table 32: Compliance

KBox A-251-AML/ADN	Compliance
EMC	CE / FCC / IC
Radio	CE / FCC / IC
Safety	UL

For the product's Declaration of Conformity (DoC), visit Kontron's Customer Section.

If the product is modified, the prerequisites for specific approvals may no longer apply.

For compliance with Wi-Fi or LTE modules, use the Kontron reference antenna provided in the delivery and chosen to comply with the manufacture's requirements.

Kontron is not responsible for any radio television interference caused by unauthorized modifications of the delivered product or the substitution or attachment of connecting cables and equipment other than those specified by Kontron. The correction of interference caused by unauthorized modification, substitution or attachment is the user's responsibility.

13/ Connectors and LEDs

This chapter describes the KBox A-251-AML/ADN's external connectors, status LED, slots.

13.1. Power IN 24 VDC (X101)(default)

The Power IN connector connects to a 24 VDC DC power supply using the supplied mating power connector and the corresponding wiring.

Table 33: Power IN Connector Pin Assignment

3-Pin Phoenix Power Connector	Pin	Signal Name	Description
 1 2 3	1	VCC (+)	24 VDC (Range: 9 VDC to 36 VDC)
	2	GND (-)	Ground
	3	GND (-)	Ground
Mating Power Connector	3-pin 1.5/ 3-STF-3.5 		

⚠CAUTION

There is no isolation between the Power IN GND (-) and the system chassis.
Always include a functional earth connection.

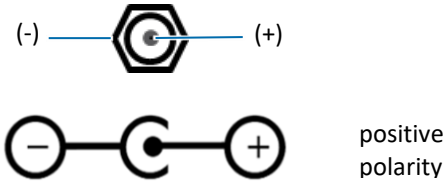
⚠CAUTION

Only connect the product to an external 24 VDC power supply providing the input power (max. current) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1.

13.2. Power IN 12 VDC Jack (X101) (option)

The optional 12 VDC Power IN connector connects to a 12 VDC power supply using the mating connector and the necessary wiring. The mating power connector is to be provided by the user and must be of type positive polarity.

Table 34: 12 VDC Power Connector Pin Assignment

Pin	Signal Name	Barrel Jack (5.5 mm/ 2.1 mm) with Center Pole
Centre pole	+12 VDC	
Outer ring	Ground (-)	
Mating Power Connector		

⚠CAUTION

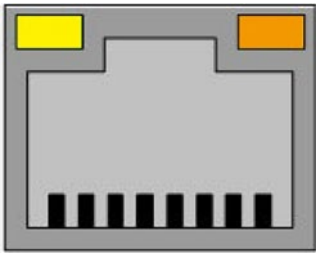
There is no isolation between the Power IN GND (-) and the system chassis.
Always include a functional earth connection.

⚠CAUTION Only connect the product to an external 12 VDC power supply providing the input power (max. current) specified on the Kontron Product Label and meeting the requirements of the Limited Power Source (LPS) and Power Source (PS2) of UL/IEC 62368-1.

13.3. LAN Connectors (X106, X105)

The two Ethernet port RJ45 connectors support 10/100/1000/2500 Mbit Ethernet. Each RJ45 Ethernet port connector has two LEDs indicating speed and activity.

Table 35: 2.5 GbE LAN Connector Pin Assignment (X102)

RJ45 (female) X106/X105	Pin	Signal Name
	1	BI_D1+
	2	BI_D1-
	3	BI_D2+
	4	BI_D3+
	5	BI_D3-
	6	BI_D2-
	7	BI_D4+
	8	BI_D4-

LED Link Status (left)		LED Speed (right)	
Off	Link down	Off	10/100 Mbit/s link established
Yellow Flashing	Link up and active	Orange	1000 Mbit/s link established
Yellow	Link up and no activity	Green	2.5 Gbit/s link established

Signal	Description
BI_D1+ / BI_D1-	In MDI mode, this is the first pair in 2.5GBase-T and 1000Base-T, i.e. the BI_DA+/- pair, and is the transmit pair in 10Base-T and 100Base-TX. In MDI crossover mode, this pair acts as the BI_DB+/- pair, and is the receive pair in 10Base-T and 100Base-TX.
BI_D2+ / BI_D2-	In MDI mode, this is the second pair in 2.5GBase-T and 1000Base-T, i.e. the BI_DB+/- pair, and is the receive pair in 10Base-T and 100Base-TX. In MDI crossover mode, this pair acts as the BI_DA+/- pair, and is the transmit pair in 10Base-T and 100Base-TX.
BI_D3+ / BI_D3-	In MDI mode, this is the third pair in 2.5GBase-T and 1000Base-T, i.e. the BI_DC+/- pair. In MDI crossover mode, this pair acts as the BI_DD+/- pair.
BI_D4+ / BI_D4-	In MDI mode, this is the fourth pair in 2.5GBase-T and 1000Base-T, i.e. the BI_DD+/- pair. In MDI crossover mode, this pair acts as the BI_DC+/- pair.

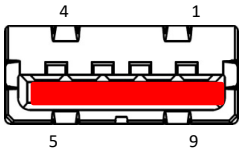
To achieve the specified performance of the Ethernet port, Category 5 twisted pair cables must be used with 10/100 MByte and Category 5E, 6 or 6E with 1 Gbit/2.5 Gbit LAN networks.

The product is to be connected only to internal Ethernet networks without exiting a facility and being subjected to TNVs.

13.4. USB 3.2 Gen 2 Port Connectors (X104, X103)

The two USB ports connectors (X104, X103) support USB 3.2 Gen 2 compatible devices.

Table 36: USB 3.2 Gen 2 Type A Pin Assignment (USB)

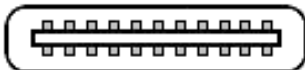
USB Type A	Pin	Signal Name	Description
	1	+USB_VCC	+5 V power supply for USB device
	2	USB_D-	USB 2.0 differential pair (-)
	3	USB_D+	USB 2.0 differential pair (+)
	4	GND	Ground
	5	USB_RX-	USB 3.2 receiver differential pair (-)
	6	USB_RX+	USB 3.2 receiver differential pair (+)
	7	GND	Ground
	8	USB_TX-	USB 3.2 transmitter differential pair (-)
	9	USB_TX+	USB 3.2 transmitter differential pair (+)

The USB 3.2 Gen 2 ports are backwards compatible with USB 3.2 Gen 1 and USB 2.0 ports.

13.5. USB-C Port (X102)

The USB-C port connector (X102) supports DP Alternate Mode to carry video audio, data & power over a single port.

Table 37: USB-C Connector Pin Assignment

USB-C	Pin	Signal	Pin	Signal
B1 B12  A12 A1	A1	GND	B12	GND
	A2	CON_TX1P_C	B11	CON_RX1P_C
	A3	CON_TX1N_C	B10	CON_RX1N_C
	A4	+5V_VBus	B9	+5V_VBUS
	A5	CC1	B8	SBU2
	A6	USB2_P	B7	USB2_N
	A7	USB2_N	B6	USB2_P
	A8	SBU1	B5	CC2
	A9	+5V_VBUS	B4	+5V_VBUS
	A10	CON_RX2N_C	B3	CON_TX2N_C
	A11	CON_RX2P_C	B2	CON_TX2P_C
	A12	GND	B1	GND

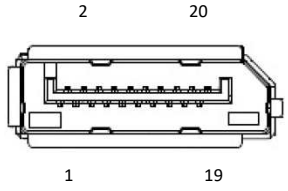
Signal Name	Description
CON_TX#P/N_C	USB3_TX#+/-/DP Lane # TX+/-
CON_RX#P/N_C	Highspeed data path (RX (+/-) for USB or TX for DP Alt mode)
USB2_P/N	USB 2.0 interface differential pair (+/-)

Signal Name	Description
CC#	Configuration channel signal for cable orientation detection, dedicated biphase mark code (BMC) configuration data channel, and VCONN +5 V power for active cables. Used for USB Power Delivery (PD) communication.
SBU#	Side Band Use signal #. DP Auxiliary channel differential pair(-)
+5V_VBus	+5 V Bus power
GND	Ground

13.6. Display Port Connectors (X107)

The Display Port (DP) connector (X107) is a standard DP port.

Table 38: Display Port Connector Pin Assignment

20-pin Standard DP Connector (female)	Pin	Signal Name	Pin	Signal Name
	1	ML_Lane0p	11	GND
	2	GND	12	ML_Lane3n
	3	ML_Lane0n	13	Config1
	4	ML_Lane1p	14	Config2
	5	GND	15	AUX_CHp
	6	ML_Lane1n	16	GND
	7	ML_Lane2p	17	AUX CHn
	8	GND	18	Hot-Plug
	9	ML_Lane2-	19	GND
	10	ML_Lane3p	20	DP_PWR

Signal Name	Description
ML_Lane#p/n	DisplayPort Lane # transmitter differential pair (+/-)
Aux +/-	Auxiliary channel differential pair (+)
Hot-Plug	Hot plug detect
Config#	Connect to Ground directly or via a pulldown device
GND	Ground signal
DP_PWR	Power supply signal for connector

13.7. Wi-Fi/BT® Antenna Connectors (X211, X212)

The two Wi-Fi/BT® antenna connector on the front panel are RP-SMA (female) and require RP-SMA (male) plug antenna only. The two RP-SMA antenna are included in the delivery.

Table 39: Antenna Type

Type	Antenna Connector	Mating Antenna
Wi-Fi/BT®	RP-SMA (female) With center pin and outer thread 	RP-SMA plug (male) With pin socket and inner thread 

⚠CAUTION

Antenna RF exposure

Avoid RF antenna exposure by:

- Avoid placing the antenna near people, minimum distance 20 cm.
- Avoid pointing the antenna at people.
- Keep a safe distance from the antenna especially when transmitting.

NOTICE

SMA and RP-SMA are not Interchangable!

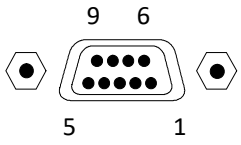
SMA and RP-SMA connectors and antenna are not electrically compatible and not interchangeable. If your product configuration includes a mixture of Wi-Fi RP-SMA connectors and antennas and cellular LTE SMA connectors and antennas, ensure you have use the correct antenna type.

If RP-SMA connector and antenna are mixed with SMA connector and antenna (or vice versa), they may destroy the center pin or mate without the center pin contacts touching (minimal signal gets through).

13.8. COM Connectors (X202) and (X201 option)

The COM port connector (X202) and the optional additional COM port (X201) both support RS232 with RX/TX support and no handshaking.

Table 40: RS232 Pin Assignment

9-pin D-SUB (male)	Pin	RS232	Description
	1	DCD	Data Carrier Detect
	2	Rx	Received Data, receives data from the link.
	3	Tx	Transmitted Data, sends data to the link.
	4	DTR	Data Terminal Ready, indicates the UART is ready to establish a link.
	5	GND	GND signal
	6	DSR	Data Set Ready, indicates that the modem is ready to establish a link.
	7	RTS	Request To Send, indicates to modem that the UART is ready
	8	CTS	Clear To Send authorization signal that data can be received.
	9	RI	Ring Indicator, indicates that the modem has received a ringing signal

13.9. SIM Slot Card Holder (option)

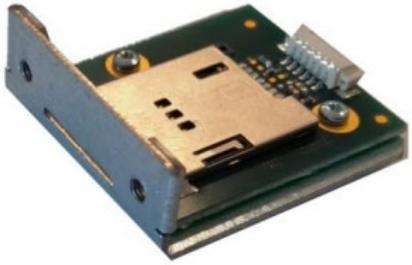
The SIM slot card holder supports a standard SIM card (15 mm x 25 mm) supplied by the user to support the user's cellular network.

NOTICE

Switch off to Insert/Extract SIM

Only insert or extract the SIM card if the product is switched off properly.

Table 41: SIM Card Holder Pin Assignment

SIM Card Holder	Pin	Signal	Description
	C1	VCC	Power +3.3 V
	C2	RST	Reset signal
	C3	CLK	Clock signal
	C4	NC	Not connected
	C5	GND	Ground
	C6	VPP	Programming voltage input
	C7	IO	Input or Output for serial data
	C8	NC	Not connected

13.10. System Expansion Modules

13.10.1. Cellular LTE System Expansion Module

The two Cellular LTE antenna connectors on the Cellular LTE System Expansion Module are SMA (female) and require SMA (male) plug antenna only. The two SMA antenna are included in the delivery.

Table 42: Cellular LTE Antenna Connectors

Type	Antenna Connector	Mating Antenna
Cellular LTE	SMA (female) With center pin socket and outer thread 	SMA plug (male) with center pin and inner thread 

⚠CAUTION

Antenna RF exposure

Avoid RF antenna exposure by:

- Avoid placing the antenna near people, minimum distance 20 cm.
- Avoid pointing the antenna at people.
- Keep a safe distance from the antenna especially when transmitting.

NOTICE

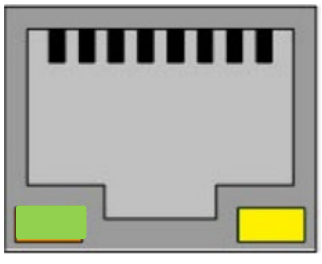
SMA and RP-SMA are not Interchangable!

SMA and RP-SMA connectors and antenna are not electrically compatible and not interchangeable. If your product configuration includes a mixture of Wi-Fi RP-SMA connectors and antennas and cellular LTE SMA connectors and antennas, ensure you have use the correct antenna type.

If RP-SMA connector and antenna are mixed with SMA connector and antenna (or vice versa), they may destroy the center pin or mate without the center pin contacts touching (minimal signal gets through).

13.10.2. Dual LAN Connectors (option)

Table 43: Dual (2.5 GbE) LAN Ports Pin Assignment

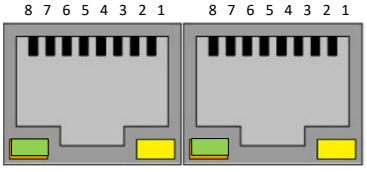
RJ45 (female)	Pin	Signal Name
1 2 3 4 5 6 7 8 	1	TX1+
	2	TX1-
	3	TX 2+
	4	TX 3+
	5	TX 3-
	6	TX 2-
	7	TX 4+
	8	TX 4-

Left LED: Link Activity		Right LED: Speed	
Off	Link down	Off	10/100 Mbit/s
Green Flashing	Link up and active	Orange	1000 Mbit/s
Green	Link up and no activity	Orange	

Signal	Description
TX1+ / TX1-	In MDI mode, this is the first pair in 1000Base-T, i.e. the BI_DA+/- pair, and is the transmit pair in 10Base-T and 100Base-TX. In MDI crossover mode, this pair acts as the BI_DB+/- pair, and is the receive pair in 10Base-T and 100Base-TX.
TX2+ / TX2-	In MDI mode, this is the second pair in 1000Base-T, i.e. the BI_DB+/- pair, and is the receive pair in 10Base-T and 100Base-TX. In MDI crossover mode, this pair acts as the BI_DA+/- pair, and is the transmit pair in 10Base-T and 100Base-TX.
TX3+ / TX3-	In MDI mode, this is the third pair in 1000Base-T, i.e. the BI_DC+/- pair. In MDI crossover mode, this pair acts as the BI_DD+/- pair.
TX4+ / TX4-	In MDI mode, this is the fourth pair in 1000Base-T, i.e. the BI_DD+/- pair. In MDI crossover mode, this pair acts as the BI_DC+/- pair.

13.10.3. Dual EtherCAT Connectors (option)

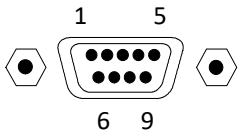
Table 44: EtherCAT Port Pin Assignment

RJ45 Port (female)	Pin	Signal Name	Description
	1	TX+	Transmit data + channel
	2	TX-	Transmit data - channel
	3	RX +	Receive data + channel
	4	Term 1	Bridged and terminated to PE via RC link
	5	Term 1	
	6	RX -	Receive data - channel
	7	Term 2	Bridged and terminated to PE via RC link
	8	Term 2	

Left LED: Link Green		Right LED Activity Yellow	
Off	No link to the Ethernet	Off	LED is not used
Green	Linked to the Ethernet but does not send or receive frames		
Green Flashing	Activity: Linked to the Ethernet and sends/receives Ethernet frames		

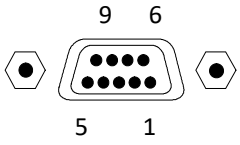
13.10.4. Dual CAN Bus Connectors (option)

Table 45: Dual CAN Ports Pin Assignment

9-pin D-SUB	Pin	Signal Name	Description	Pin	Signal Name	Description
	1	NC		6	NC	NC
	2	CAN-L	Dominant low line	7	CAN-H	Dominant high line
	3	GND	CAN Ground	8	NC	NC
	4	NC		9	NC	NC
	5	NC				

13.10.5. Dual COM Connectors RS232 (option)

Table 46: Dual COM Pin Assignment

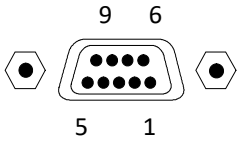
9-pin D-SUB (male)	Pin	RS232
	1	DCD
	2	RxD
	3	TxD
	4	DTR
	5	GND
	6	DSR
	7	RTS
	8	CTS
	9	RI

Signal Name	Description
DCD	Data Carrier Detect
RxD	Receive Data sends data to the communications link (straight-through connection)
TxD	Transmitted Data sends data to the communications link (straight-through connection)
DTR	Data Terminal Ready indicates that the on-board UART is ready to establish communication link.
DSR	Data Set Ready, indicates that the modem etc. is ready to establish a communications link.
RTS	Request To Send, indicates to the modem etc. that the on-board UART is ready to
CTS	Clear to send
RI	Ring Indicator, indicates that the modem has received a ringing signal from the telephone line.
TX+/-	Transmitted Data differential pair sends data to the communications link.
RX+/-	Received Data differential pair receives data from the communications link.
GND	GND signal

13.10.6. Dual COM Connectors RS232/422/485 (option)

The dual RS232/422/484 ports are default RS232 and configurable to RS422 and RS485. The 9-pin D-Sub connectors are (non-isolated). The default RS232 mode is software reconfigured. For more information, see Chapter 5.10: Dual COM RS232/422/485 System Expansion Module.

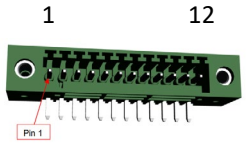
Table 47: Dual COM Pin Assignment

9-pin D-SUB (male)	Pin	RS232	RS422	RS485 (Full Duplex)
	1	DCD	Tx-	Tx-
	2	RxD	Tx+	Tx+
	3	TxD	Rx+	Rx+
	4	DTR	Rx-	Rx-
	5	GND	GND	GND
	6	DSR		
	7	RTS		
	8	CTS		
	9	RI		

Signal Name	Description
DCD	Data Carrier Detect
RxD	Receive Data sends data to the communications link (straight-through connection)
TxD	Transmitted Data sends data to the communications link (straight-through connection)
DTR	Data Terminal Ready indicates that the on-board UART is ready to establish communication link.
DSR	Data Set Ready, indicates that the modem etc. is ready to establish a communications link.
RTS	Request To Send, indicates to the modem etc. that the on-board UART is ready to
CTS	Clear to send
RI	Ring Indicator, indicates that the modem has received a ringing signal from the telephone line.
TX+/-	Transmitted Data differential pair sends data to the communications link.
RX+/-	Received Data differential pair receives data from the communications link.
GND	GND signal

13.10.7. 8-Channel GPIO/DIO Connector (option)

Table 48: GPIO/DIO Connector Pin Assignment

12-pin GPIO Connector	Pin	Signal Name	Direction	Description
	1	PWR_IN	Power	Power Input 10 V to 30 V (Power Inputs fused with 3A)
	2	PWR_IN	Power	
	3	NC		
	4	GPIO1	In/Out	GP Input /Output Channel
	5	GPIO2	In/Out	
	6	GPIO3	In/Out	
	7	GPIO4	In/Out	
	8	GPIO5	In/Out	
	9	GPIO6	In/Out	
	10	GPIO7	In/Out	
	11	GPIO8	In/Out	
	12	GND	Ground	Ground connected to system chassis (shield)
Mating Connector	691381030012 WR-TBL Serie 381 or equivalent from Würth Elekronik. 12-pin 2.50 mm vertical CAB entry plug screw less with Flanges and Stranded Wire: 24-16 AWG / 0.205-1.31 MM².			

14/ Maintenance

Kontron products require only minimum servicing and maintenance for problem-free operation.

CAUTION

Handling the Product

Handling and operation of the product is permitted only for skilled personnel aware of the associated dangers, within a work place that is access controlled and fulfills all necessary technical and environmental requirements.

NOTICE

Protection Label

The product is factory configured to meet customer requirements and then sealed with a protection label. Opening the product invalidates the warranty.

NOTICE

Return to Kontron

For replacement or installation of internal components, Kontron recommends users to return the product to Kontron to avoid damage. For more information, see Chapter 15.1: Returning Defective Merchandise.

14.1. Cleaning

Hot Surface

The heatsink can get very hot. To avoid burns and personal injury when handling the heatsink:

- Do not touch while in operation
- Allow to cool before handling
- Wear protective gloves

To clean the surface of the product, perform the following:

1. Close all applications. Shut down properly using the power button and disconnect the power cable from the Power IN connector or the DC power supply. Disconnect all peripherals.
2. Allow the product to cool before handling and do not touch the heatsink when the product is in operation.
3. Carefully remove dust using a clean soft brush and if light soiling clean the product with a dry cloth.
4. Remove stubborn dirt using a mild detergent and a soft cloth.

14.2. Extracting/Exchanging the SIM CARD

NOTICE

Switch off to Insert/Extract SIM

Only insert or extract the SIM cards if the product is switched off properly.

A SIM card is required when using the Cellular LTE system expansion modules only and is not part of the delivery and must be provided by the user, to support the require network.

To extract a SIM and insert a new SIM card, perform the following:

1. Ensure the product is switched off and disconnected from the power source by removing the power cable.
2. Push the inserted SIM card lightly to release the SIM from the SIM slot (X201) on the front panel.
3. Pull the SIM card carefully out of the SIM slot.
4. Insert the SIM card with the terminal contacts facing forwards and on the underside (Figure 18) and push the SIM card carefully into the SIM slot (X201) until the card clicks acoustically.

14.3. Changing the RTC Lithium Battery

⚠CAUTION

CAUTION: Risk of Explosion

If the lithium battery is replaced by an incorrect type. Dispose of used lithium batteries according to the Instructions.

Do not dispose of lithium batteries in general trash collection. Dispose of the lithium battery according to the local regulations dealing with the disposal of these special materials, (e.g. to the collecting points for dispose of batteries).

The product is not designed to operate without a lithium battery. If the lithium battery is empty or disconnected, the BIOS settings will be set to the factory defaults.

The BR2032 lithium battery must be replaced with an identical three Volt lithium battery or a Kontron recommended lithium battery.

Table 49: Battery Header

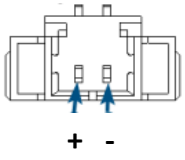
Pins	State	2-pin BAT Header
1	VBAT +	
2	GND (-)	

Table 50: BR2032 Lithium Battery with Connector

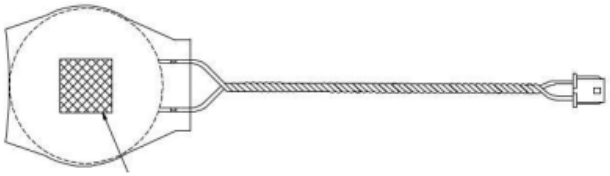
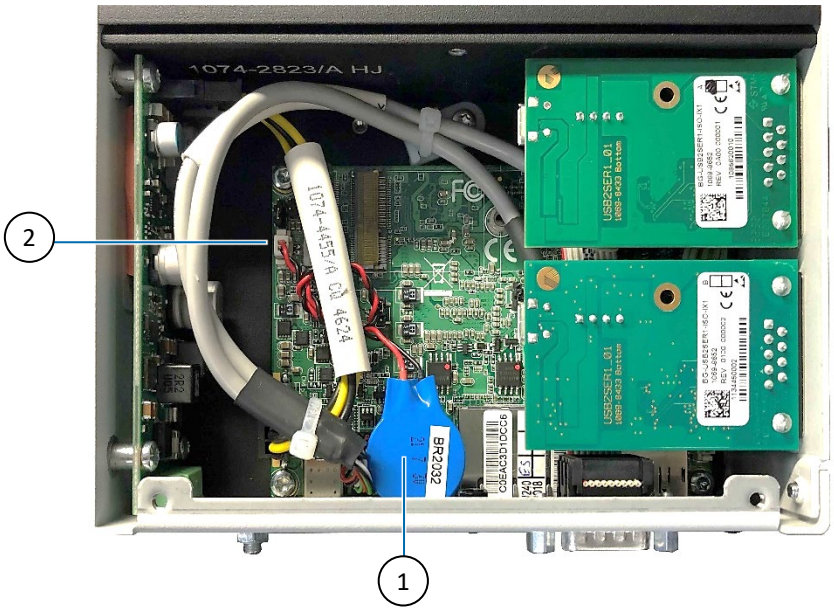
Pins	State	3V BR2032
Red	+	
Black	-	

Figure 21: Lithium Battery and Battery Header



1 BR2032 RTC Lithium battery 2 Battery (BAT) header

To change the lithium battery at the end of the battery lifetime, perform the following:

1. Ensure the product is switched off and disconnected from the power source by removing the power cable.
2. Place the product on a soft ESD mat, with the heatsink facing downwards.
3. Remove the two screws fastening the cover plate on the bottom side to the main chassis. Retain the screw for later use.
4. Lift the cover plate slightly and slide the cover plate out of the restraining bracket.
5. Remove the lithium battery connector from the 2.5” SBC-AML/ADN’s battery header (Figure 21, pos. 2).
6. Pull firmly to detach the lithium battery’s adhesive pad from the internal connector housing (Figure 21, pos. 1).
7. Insert the new lithium battery connector into the 2.5” SBC-AML/ADN’s battery header. Ensure correct polarity.
8. Attach the new lithium battery to the internal connectors housing using a new adhesive pad.
9. Close the product by replacing the cover plate on the bottom side and securing the cover plate with two screws from step 2.

14.4. BIOS Update - Flash Descriptor Read/Write Access

To update the BIOS move the internal Flash Descriptor jumper from the “Default” to the “Override” position. This unlocks the Flash Descriptor and enables BIOS read/write access. After performing the BIOS update, always move the Flash Descriptor jumper back to the “Default” position.

For the latest BIOS downloads and release information, visit Kontron’s Customer Section access the following: Motherboards & SBC > 2.5”-SBC > 2.5”-SBC-AML/ADN BIOS, to access the latest version of the BIOS and the preferred method to update the BIOS with instructions. Before updating the BIOS, Kontron’s recommends making a backup of the current BIOS setting.

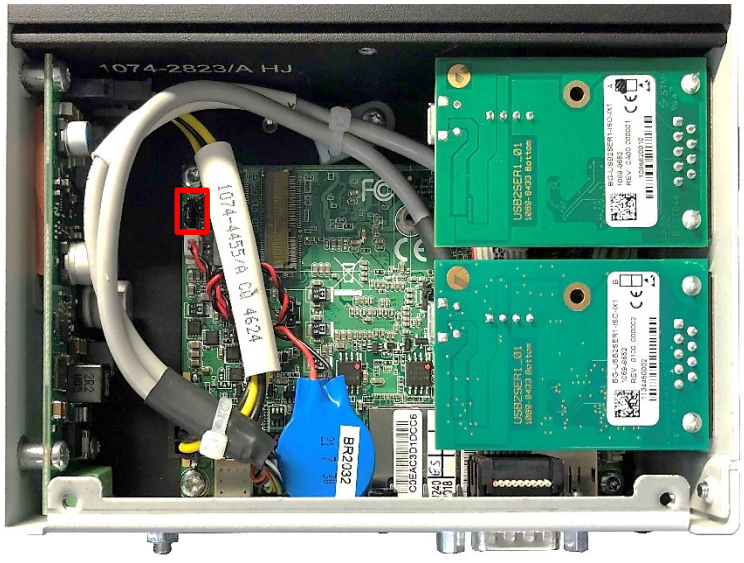
	All BIOS settings and some data is lost during the BIOS recovery process! Before updating the BIOS, Kontron’s recommends making a backup of the current BIOS setting.
	During a BIOS update, do not switch off, reset or interrupt the process. If interrupted, the BIOS update process must be restarted
	After a BIOS update, additional modifications must be made manually.
	If the product fails to boot after a BIOS update, the updated BIOS maybe damaged.

Table 51: Flash Descriptor Security Override Selection Jumper

Flash Descriptor Jumper	Jumper Position		Flash Descriptor Security Override Selection
	Pins 1-2	Pins 2-3	
 3 2 1	X	-	Default (Controlled by Embedded Controller)
	-	X	Override (Flash Security Override)

“X’’ = Jumper set (short) and ‘‘-’’ = jumper not set (open)

Figure 22: Flash Descriptor Security Override Selection Jumper



To unlock the Flash Descriptor to enable BIOS read/write access, perform the following:

1. Ensure the product is switched off and disconnected from the power source by removing the power cable.
2. Place the product on a soft ESD mat, with the heatsink facing downwards.
3. Remove the two screws fastening the cover plate on the bottom side to the main chassis. Retain the screw for later use.
4. Lift the cover plate slightly and slide the cover plate out of the restraining bracket.
5. Move the Flash Descriptor jumper from the “Default” position (Pins 1-2) to the “Override” position (Pins 2-3).
6. Place the Cover plate on the bottom side of the main chassis and secure with the screws removed in step 3.
7. Reconnect the product to power and the BIOS is read/write accessible and available for updates.
8. Once the necessary BIOS updates have been made to the product; the Flash Descriptor jumper must be returned to the Default position by performing steps 1 to 4 again and moving the Flash Descriptor jumper from the “Override” position (Pins 2-3) to the “Default” position (Pins 1-2). Place the cover on the bottom side of the main chassis and secure with the screws removed in step 8.
9. Connect the product to power and the BIOS updates are available.

All BIOS settings and some data is lost during the BIOS recovery process! Before updating the BIOS, Kontron’s recommends making a backup of the current BIOS setting.

During a BIOS update, do not switch off, reset or interrupt the process. If interrupted, the BIOS update process must be restarted

After a BIOS update, additional modifications must be made manually.

If the product fails to boot after a BIOS update, the updated BIOS maybe damaged.

15/ Technical Support

Should a problem occur that cannot be solved using the trouble shooting information above, contact Kontron's Support Department:

- Email: support@kontron.com
- Phone: +49-821-4086-888

Make sure you have the following information available when you call:

- Product ID Number (PN)
- Serial Number (SN)

The serial number can be found on the product's type label..

Be ready to explain the nature of your problem to the service technician.

15.1. Returning Defective Merchandise

All equipment returned to Kontron must have a Return of Material Authorization (RMA) number assigned exclusively by Kontron. Kontron cannot be held responsible for any loss or damage caused to the equipment received without an RMA number. The buyer accepts responsibility for all freight charges for the return of goods to Kontron's designated facility. Kontron will pay the return freight charges back to the buyer's location in the event that the equipment is repaired or replaced within the stipulated warranty period.
Follow these steps before returning any product to Kontron.

Follow these steps before returning any product to Kontron.

1. Visit the RMA Information website: http://www.kontron.com/support-and-services/support/rma-information.
2. Download the RMA Request sheet for Kontron Europe GmbH and fill out the form. Take care to include a short detailed description of the observed problem or failure and to include the product identification Information (Name of product, Product number and Serial number). If a delivery includes more than one product, fill out the above information in the RMA Request form for each product.
3. Send the completed RMA-Request form to the fax or email address given below at Kontron Europe GmbH. Kontron will provide an RMA-Number.
4. Kontron Europe GmbH
   RMA Support
   Phone: +49 (0) 821 4086-0
   Fax: +49 (0) 821 4086 111
   Email: service@kontron.com
5. The goods for repair must be packed properly for shipping, considering shock and ESD protection.

Goods returned to Kontron Europe GmbH in non-proper packaging will be considered as customer caused faults and cannot be accepted as warranty repairs.

6. Include the RMA-Number with the shipping paperwork and send the product to the delivery address provided in the RMA form or received from Kontron RMA Support.

16/ Storage and Transportation

16.1. Storage

If the product is not in use for an extended period of time, disconnect the product from the main power supply. If it is necessary to store the product, then repack the product as originally delivered to avoid damage. The storage facility must meet the product's environmental storage requirements as stated within this user guide. Kontron recommends keeping the original packaging material for future storage or warranty shipments.

16.2. Transportation

To ship the product, use the original packaging, designed to withstand impact and adequately protect the product. When packing or unpacking the product always take shock and ESD protection into consideration and use an EOS/ESD safe working area.

17/ Warranty

Due to their limited service life, parts that by their nature are subject to a particularly high degree of wear (wearing parts) are excluded from the warranty beyond that provided by law. This applies to the lithium battery, for example.

If there is a protection label on your product, then the warranty is lost if the product is opened.

18/ Disposal

18.1. Disposal

Dispose of the product in accordance with country, state, or local regulations and requirements as part of your disposal and decommissioning policies, or recycle the product or parts of the product for re-use after performing data sanitization to erase sensitive data stored on the product's memory devices.

When disposing of the product

- Remove any product labels from the product that could indicted ownership and provide a clue to the type of data stored on the memory device.
- Comply with your company's environmental requirements and the requirements of Waste Electrical and Electronic Equipment (WEEE) directive.
- Use data sanitization guidelines to ensure that data sensitive to your business and/or confidential or proprietary data and software is removed from the product using a data sanitization method that stops the data from being retrieved or reconstructed.

18.2. WEEE Compliance

The Waste Electrical and Electronic Equipment (WEEE) Directive aims to:

- Reduce waste arising from electrical and electronic equipment (EEE).
- Make producers of EEE responsible for the environmental impact of their products, especially when the product become waste.
- Encourage separate collection and subsequent treatment, reuse, recovery, recycling and sound environmental disposal of EEE.
- Improve the environmental performance of all those involved during the lifecycle of EEE.

Environmental protection is a high priority with Kontron.
Kontron follows the WEEE directive
You are encouraged to return our products for proper disposal.

18.3. Data Sanitization

Data sanitization is the process of permanently erasing or destroying sensitive data on the product's memory devices to prevent unauthorized access to data sensitive to your business and/or confidential/proprietary data stored on the memory devices.

When designing a system the user must plan for data sanitization and design in memory devices that are easier to sanitize, memory devices from manufactures that provide an effective data erasure tool or a return to factory default command.

When performing data sanitization the user must consider if the product's memory devices contain sensitive data and develop a data sanitization plan to erase all sensitive data in accordance with country, state, or local data sanitization regulations and requirements or as part of your disposal and decommissioning policies.

Data Sanitization

Users are responsible for erasing sensitive data on memory devices in accordance with country, state, or local data sanitization regulations and requirements, or as part of your disposal and decommissioning policies.

Kontron recommends performing data sanitization when reusing the product in a different user environment, sending the product in for repair, disposing of the product or decommissioning the product.

General guidelines when performing data sanitization on memory devices containing data sensitive to your business and/or confidential/proprietary data:

- Before powering down, consider if power is required to perform data sanitization on the product's memory devices.
- When disconnected from the power source, dismantle all removable memory devices from the product and erase sensitive data.
- Volatile memory devices only store data temporarily. Data on volatile memory can be erased easily by disconnecting the power/removing the battery for approximately 24 hours.
- Non-volatile memory devices store data permanently and retain information when disconnected from power. Data on von-volatile memory and must be actively erased using one of the following methods:
  - Use an accredited third party software tool that provides an audit trail, capable of performing a complete data clean including areas such as hidden data and bad blocks not accessed by general service-based utilities.
  - Use the physical destruction methods on memory devices that cannot be securely software erased. The aim of the destruction is to break the silicon die within the chips package into two or more parts to prevent reading data from the die. Fragments should be no longer than 6 mm. If this service is performed by a third party obtain destruction certificates for confirmation.
  - Use the manufacture's data erasure tool for sanitization or return to factory default command (if provided by the manufacturer). The manufactures tools and commands have been designed to fulfil the data sanitization requirement of the manufacture's specific memory device(s).
- Always verify that all sensitive data has been effectively sanitized.

Dismantle Removable Memory

Dismantle all removable memory devices and erase sensitive data for reuse by using:

- An accredited third party software tool.
- Manufacture's data erasure tool' or 'return to factory default command'. (if provided)

If the removable memory is not for reuse, physically destruct the memory according to data sanitization guidelines.

Erase Data

To ensures that forensic tools cannot be used to recovered sensitive data:

- Use an accredited third party software tool, with an audit trail, capable of performing a complete data clean including areas such as hidden data and bad blocks not accessed by general service-based utilities.
- Use the manufacture's data erasure tool or return to factor default command designed to fulfil the data sanitization requirement of the manufacture's specific memory device(s).

Physical Destruction

When physically destructing the memory:

- Follow proper safety protocols.
- Break the chip packaged silicon die into two or more parts, fragments <= 6 mm.
- Check both sides as memory devices may be position on the rear side.
- Use a third party destruction company providing certificates for confirmation.

19/ Cyber Security

Cyber security is an important aspect to consider when installing, operating, maintaining and disposing the product. This chapter provides cyber security guidelines for the user.

Security White Paper

For cyber security guidelines to protect your Kontron product from potential cyber security threats, visit the Kontron Customer Section and refer to Kontron's Security White paper within General/Security Guidelines.

Security Measures

Kontron is not aware of the final target end user environment in which the product operates. It is not possible for Kontron to provide precise instructions for your cyber security measures. Kontron strives to provide hints for considerations for your threat analysis and to point out particular security mechanisms implemented in Kontron products.

19.1. Security Defense Strategy

When developing your security defense strategy consider implementing the following guidelines to help you effectively secure the product:

- Policies and procedures developed in association with the product's/end environment's security.
- Instructions and recommendations for periodic security maintenance activities and reporting product security incidents.
- Security network controls/setting such as firewall rules.
- Third party software tools that further protect the product.
- Authentication to access the product, limit user privileges and managing user accounts.
- Data encryption.
- Reduced number of potential security entry points.
- BIOS/OS and security updates when available that do not compromise the product's operation or defense in depth strategy.
- User accounts with length and complexity requirements.
- Supplied default passwords are changed.
- Limited network access (IP address range).
- Installation of anti-virus and malware software.
- Network access requirements such as VPN.

Appendix: List of Acronyms

ABD	Automated BIOS Description
AC	Alternating Current
BIOS	Basic Input Output System
BMC	Biphase Mark Code
BT®	Bluetooth®
CAN	Controller Area Network
CE	Conformitè Europëenne
COM	Communication port
DC	Direct Current
DOC	Declaration of Conformity
DP	Display Port
EMC	ElectroMagnetic compatibility
ESD	ElectroStatic Discharge
FCC	Federal Communications Commission
GbE	Giga Bit Ethernet
GPIO	General Purpose Input Output
HD	High Definition
HDMI	High Definition Multimedia Interface
IEC	International Electrotechnical Commission
IOT	Internet of Things
LAN	Local Area Network
IP	International Protection
LED	Light Emitting Diode
LPC	Limited Power Source
LTE	Long-Term Evolution
MBR	Master Boot Record
MDI	Media Dependent Interface
MTBF	Mean Time Before Failure
PS	Power Source
PSU	Power Supply Unit
RED	Radio Equipment Directive
RMA	Return of Material Authorization
RoHS	Restriction of Hazardous Substances
RTC	Real Time Clock
RX	Receive
SD card	Secure Digital Card
SIM	Subscriber Identity Module
TPM	Trusted Platform Module
TX	Transmit
UEFI	Unified Extensible Firmware Interface
UL	Underwriters Laboratories
USB	Universal Serial Bus

About Kontron

Kontron is a global leader in IoT/Embedded Computing Technology (ECT) and offers individual solutions in the areas of Internet of Things (IoT) and Industry 4.0 through a combined portfolio of hardware, software and services. With its standard and customized products based on highly reliable state-of-the-art technologies, Kontron provides secure and innovative applications for a wide variety of industries. As a result, customers benefit from accelerated time-to-market, lower total cost of ownership, extended product lifecycles and the best fully integrated applications.

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The Power of IoT