USER GUIDE

KBox R-101

User Guide Rev. 1.0

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KBOX R-101 USER GUIDE

Disclaimer

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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 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
1.0	Initial Version	2024-Apr-22	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 https://www.kontron.com/terms-and-conditions.

Kontron sells products worldwide and declares regional General Terms & Conditions of Sale, and Purchase Order Terms & Conditions. Visit https://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: https://www.kontron.com/en/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 https://www.kontron.com/en/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.
	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.
	HOT Surface! Do NOT touch! Allow to cool before servicing.
	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.
	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. Please follow the "General Safety Instructions" supplied with the system.

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 battery.

⚠CAUTION

Danger of explosion if the battery is replaced incorrectly.

- Replace only with same or equivalent battery type recommended by the manufacturer.
- Dispose of used batteries according to the manufacturer's 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 https://www.kontron.com/about-kontron/corporate-responsibility/quality-management.

Disposal and Recycling

Kontron's products are manufactured to satisfy environmental protection requirements where possible. Many of the components used are capable of being recycled. Final disposal of this product after its service life must be accomplished in accordance with applicable country, state, or local laws or regulations.

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.

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1/ Introduction

This user guide describes the KBox R-101 series of embedded Box PCs designed and certified for railway applications and also known as product within this user guide. This user guide focuses on describing the special features of the KBox R-101 series variants (KBox R-101-TGL & KBox R-101-EKL) and how to assemble, install, operate and maintain the KBox R-101 series properly. Operators are recommended to study the instructions within this user guide before switching on the product.

Figure 1: KBox R-101

The KBox R-101 series supports a COMe module on a baseboard with standardized open platform interface connectors, optional storage and optional network connectivity (Wi-Fi and LTE/5G). The KBox R-101 series variants are the KBox R-101-TGL based on the 11th Gen. Intel® Core™ i7/i5 family of processors and the KBox R-101-EKL based on the Intel® Atom® x6000E family of processors. All selected components ensure a long lifetime.

The KBox R-101 series supports a robust modular fanless PC Box optimized for transportation and harsh industrial applications with EN 50155 compliance, IP54 protection, M12 connectors and an extended temperature range. The passively cooled KBox R-101 series uses a u-form cover as a heatsink encompassing the top, and left and right sides. The fanless design ensures a significantly prolonged lifespan and high system availability.

The wall mount brackets or 19" rack mount brackets attach on both sides of the KBox R-101 series to enable installation in different operational environments.

Main features are:

- Processor:
  - 11th Generation Intel® Core™ i7-1185GRE and i5-1145GRE (KBox R-101-TGL)
  - Intel® Atom® X6425RE and X6212RE (KBox R-101-EKL)
- Storage:
  - SODIMM up to 32 GByte
  - M.2 NVMe SSD (up to 512 GByte)
- Front connectors:
  - 1x RS232 (isolated)
  - 1x RS422/RS485 (isolated)
  - 1x USB-C, (display functionality, no power delivery)
  - Ethernet:
    - 3x 2.5 GbE (KBox R-101-TGL)
    - 2x 2.5 GbE and 1x 1 GbE (KBox R-101-EKL)
  - Antenna: (depending on configuration)
    - 4x antenna (SMA)
    - 2x antenna (RPSMA)

- Rear connectors (available behind the service cover):
  - 1x DP++
  - 2x USB 2.0
  - 1x CFexpress card Type B
  - 2x micro SIM cards (for 5G or LTE only)
- Network Connectivity
  - Wi-Fi 6E and Bluetooth® 5.3
  - 5G or LTE
- Chassis:
  - Aluminum chassis with u-form heatsink
  - Passive cooling
  - IP54 protection
  - Installation with wall mount brackets or 19" rack mount brackets
- Power IN 24 VDC to 110 VDC:
  - Without internal fuse (Prerequisite: DC power supply with mandatory external 5AT fuse or safety device)
  - With internal fuse

To ensure you have the latest version of this user guide, visit Kontron's Embedded Box PC, KBox R-Series website.

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 battery is replaced incorrectly (short-circuited, reverse-poled, wrong battery type). Dispose of used batteries according to the manufacturer's instructions.
- This product is not suitable for use in locations where children are likely to be present

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 protective earthing 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.

2.1.1. 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 fiable à la terre de protection 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.

2.2. Electrostatic Discharge (ESD) Precautions

A sudden discharge of electrostatic electricity can destroy static-sensitive devices or micro-circuitry.

Proper packaging and grounding techniques are necessary precautions to prevent damage. Always take the following precautions:

1. Transport boards in ESD-safe containers such as boxes or bags.
2. Keep electrostatic sensitive parts in their containers until they arrive at the ESD-safe workplace.
3. Always be properly grounded when touching a sensitive board, component, or assembly.
4. Store electrostatic-sensitive boards in protective packaging or on antistatic mats.

2.3. Grounding Methods

By observing the guidelines below, electrostatic damage to the product can be avoided:

1. Cover workstations with approved antistatic material. Always wear a wrist strap connected to workplace. Always use properly grounded tools and equipment.
2. Use antistatic mats, heel straps, or air ionizers for more protection.
3. Always handle electrostatically sensitive components by their edge or by their casing.

4. Avoid contact with pins, leads, or circuitry.
5. Switch off power and input signals before inserting and removing connectors or connecting test equipment.
6. Keep work area free of non-conductive materials such as ordinary plastic assembly aids and Styrofoam.
7. Use only field service tools that are conductive, such as cutters, screwdrivers, and vacuum cleaners.
8. Always place drives and boards PCB-assembly-side down on the foam.

3/ Shipment and Unpacking

3.1. Packaging

The KBox R-101 series is packaged with all parts, in a product specific cardboard package designed to provide adequate protection and absorb shock.

3.2. Unpacking

To unpack the KBox R-101 series, 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 KBox R-101 series 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

Part Number	Description
KBox R-101-TGL	KBox R-101-TGL (hardware configured as ordered) • M12 mating power connector • Wall mount bracket set • Antenna (quantity and article number as ordered)
KBox R-101-EKL	KBox R-101-EKL (hardware configured as ordered) • M12 mating power connector • Wall mount bracket set • Antenna (quantity and article number as ordered)

3.4. Accessories and Spare Parts

The KBox R-101 series comes hardware configured as ordered. No further internal configuration of additional components is required.

Some external additional devices may be required for operation or spare part may be required for maintenance. In these cases, Kontron recommends the use of Kontron's reference accessories and spare parts, see Table 2: Accessories and Spare Parts. This user guide provides purchase information for reference accessories or spare parts from a third party company (manufacturer and article number) or provides the Kontron article number to purchase the accessories or spare parts directly from Kontron.

For more information, contact your local Kontron sales representative or Kontron Inside Sales.

Table 2: Accessories and Spare Parts

Part	Order Information	Description
LTE/5G Antenna		
	Manufacturer: Panorama Antennas Article Number: PWB-6-60-RSMAP	Part Name: PWB-6-60-RSMAP Type 2G, 3G, 4G & 5G Terminal Antenna Frequency: 698-960 MH /1710-3800 MHz/4900-6000 MHz Peak gain:~2dBi /~4dBi/~6dBi Connector: SMA plug (male) L x W x T: 230 x 50 x 13 mm Articulated hinge: 0° to 90° Impedance: 50 ohms
Wi-Fi and Bluetooth® Antenna		
	Manufacturer: SparkLan Article Number: R3410A10050	Product Name: AD-501AX Type: Dipole Antenna Frequency: 2.4 GHz/5 GHz/6 GHz Peak gain: 3.7dbi/5dBi/5dBi Connector: RPSMA plug (male) L x W x T: 162 x 22 x 13.6 mm Articulated hinge: 0° to 90° Impedance: 50 ohms
M12 Power Connector		
	Manufacturer: Binder Article number: 99 0700 29 05	Product Name: M12 Connector, 4+PE poles, unshielded, screw terminal Type: M12 5-pin female, Coding K-power Screw terminal wires : • cross section (max.) 1.5 mm^2 with ferrules or 2.5 mm^2 without ferrules • AWG 16 with ferrules or AWG 14 without ferrules Cable: Outer diameter 8 mm to 13 mm
Set KBox R-101 Service Cover Seal Loop		
	Manufacturer: Kontron Article Number: 1073-6233	Silicon service cover seal loop cord (seal EMI/RFI)
Set KBox R-101 Wall Mount Bracket		
	Manufacturer: Kontron Article Number: 1073-6236	The wall mount bracket kit includes: • Two brackets • Four M3x6 screws
Set KBox R-101 19" Rackmount Bracket		
	Manufacturer: Kontron Article Number: 1073-6234	The rack mount bracket kit includes: • Two brackets • Four M3x6 screws

3.5. Product Identification - Type Label

The product's type label is located on the product's base. The type label includes important product identification information such as part number, serial number, electrical specification and compliance.

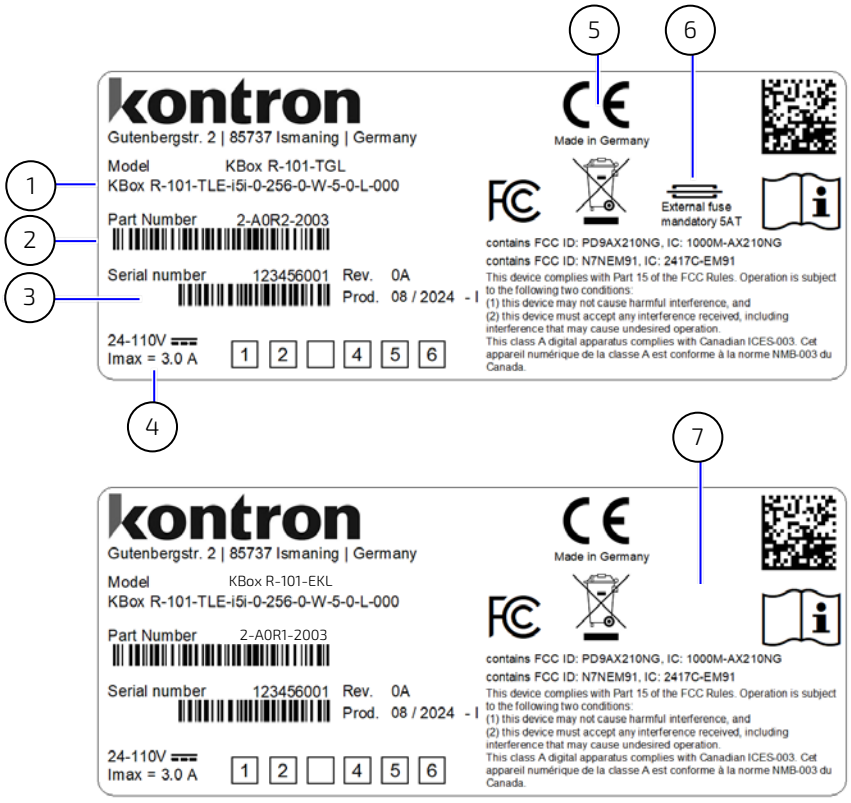
A no fuse symbol with warning text on the type label (Figure 2, pos. 6) stipulates the use of a DC power supply with mandatory 5AT fuse or safety device. When the no fuse symbol with warning text is not present (Figure 2, pos. 7) the use of a DC power supply with fuse or safety device is not a requirement.

⚠CAUTION

Mandatory 5AT Fuse or Safety Device Requirement

It is prohibited to connect the product to an external DC power supply without a 5AT fuse or safety device, if the product is configured with no internal fuse as stipulated on the type label (no-fuse symbol and warning text "External fuse mandatory 5AT").

Figure 2: Type label Examples



1	Product variant name	4	Electrical specification
2	Part Number with bar code	5	Compliance
3	Serial Number with bar code	6	Symbol "External fuse mandatory 5AT"
		7	No symbol

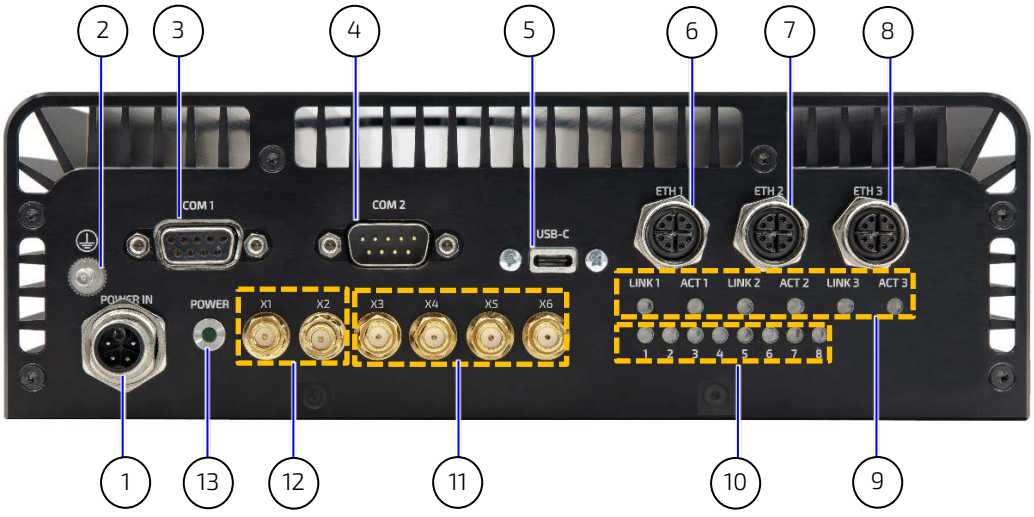
4/ Product Features

The KBox R-101 series metal chassis is equipped with interfaces at the front and rear. The cover (u-form) functions as a heatsink encompassing the top, and left and right sides.

4.1. Front Panel

The KBox R-101 series features the following interfaces on the front panel.

Figure 3: Front Panel Interfaces



1	1x Power IN	7	1x 2.5 GbE (ETH2)
2	1x Protective earth bolt	8	1x 2.5 GbE (ETH3)
3	1x Serial port RS422/RS485 (COM1)	9	3x Ethernet Link & Activity LED pairs
4	1x Serial port RS232 (COM2)	10	8x Configurable LEDs
5	1x USB-C	11	4x Antenna LTE/5G (Type SMA)
6	1x 2.5 GbE (ETH1) KBox R-101-TGL 1x 1 GbE (ETH1) KBox R-101-EKL	12	2x Antenna Wi-Fi (Type RPSMA)
		13	1x Power LED

4.1.1. Power IN

The Power IN connector supports 24 VDC to 110 VDC. Only connect the Power IN connector to an external DC power supply that meets the requirements specified in this user guide (Table 15: Electrical Specification). A no fuse symbol with warning text on the type label (Figure 2, pos. 6) stipulates the use of a DC power supply with mandatory 5AT fuse or safety device. When the no fuse symbol with warning text is not present (Figure 2, pos. 7) the use of a DC power supply with fuse or safety device is not a requirement. Whether either a 5AT fuse or a safety device is implemented must be decided by the operator to meet the requirements in the field.

⚠CAUTION

Mandatory 5AT Fuse or Safety Device Requirement

It is prohibited to connect the product to an external DC power supply without a 5AT fuse or safety device, if the product is configured with no internal fuse as stipulated on the type label (no-fuse symbol and warning text "External fuse mandatory 5AT").

The M12 mating power connector is included in the product's delivery. For information on how to wire the M12 mating power connector, see Chapter 8.2: Wiring the M12 Mating Power Connector.

The product's delivery includes a M12 mating power connector. To order a replacement M12 power connector, see Table 2: Accessories and Spare Parts.

For the Power IN pin assignment, see Chapter 13.1.1: M12 Power IN Connector.

4.1.2. Power LED

The Power LED (Figure 3, pos. 13) illuminates green to indicate the power on status. The Power LED indicates the various bootloader states (Table 11) and the firmware application states (Table 12) of the Board Management Controller (BMC), see Chapter 11/: Board Management Controller (BMC).

4.1.3. Protective Earth

The protective earth bolt (Figure 3, pos. 2) connects to the terminal of a protective earth (ground electrode).

4.1.4. Serial Ports (COM1, COM2)

The two isolated serial ports COM1 and COM2 (Figure 3, pos. 3 & 4) enable the connection of up to two serial devices. The COM2 uses the RS232 protocol. COM1 is RS422/RS485 configurable with RS422 as default. To reconfigured COM1 from the default RS422 protocol to RS485 protocol use the Linux OS driver.

The drivers to configure the COM1 port are available from the FTDI Chip website for the USB to Serial Controller FT231XQ serial controller: D2XX Drivers - FTDI (ftdichip.com).

For the pin assignment, see Chapter 13.1.3: Serial Port Connectors (COM1, COM2).

4.1.5. USB Type C Port (USB-C)

The USB-C port (Figure 3, pos. 5) supports a USB 3.1 data connection and power delivery (max. 5 V, 2 A).

The USB-C port supports up to two independent displays simultaneously, with a maximum display resolution and refresh rate of:

- Two displays - 1920x1080@60Hz each
- One display - 3840x2160@30Hz

If a third display is connected, the third display is a clone and the maximum display resolution and refresh rate is 1920x1080@60Hz each.

Using the USB-C port as a service interface, the operator is able to realize a Display Port and a power supply for e.g. touch panels to facilitate debugging as well as commissioning.

The USB-C port's maximum power delivery is 5 V, 2 A.

For the pin assignment, see Chapter 13.1.4: USB-C Port Connector (USB-C).

4.1.6. Ethernet Ports (ETH1, ETH2, ETH3)

The three Ethernet ports (Figure 3, pos. 6, 7, 8) include link and activity status LEDs (Link1/2/3) and (Act1/2/3) (Figure 3, pos. 9). The connection speed of the three Ethernet ports depends on the KBox R-101 series variant (KBox R-101-TGL & KBox R-101-EKL).

Table 3: Ethernet Port Connection Speeds

KBox R-101 Series Variant	ETH1	ETH2	ETH3
KBox R-101-TGL	2.5 GbE	2.5 GbE	2.5 GbE
KBox R-101-EKL	1 GbE	2.5 GbE	2.5 GbE

For technical reasons, the LEDs, especially the activity LEDs, may flash at different rhythms.

For the pin assignment, see Chapter 13.1.7: M12 Ethernet Port Connectors (ETH1, ETH2, ETH3).

4.1.7. Configurable LEDS (1, 2, 3, 4, 5, 6, 7, 8)

The eight configurable GPIO LEDs (Figure 3, pos. 10) are operator definable, enabling operators to display the status of specific activities on the front panel by activating the LEDs to illuminate (yellow) in a set state. For configuration information, see Chapter 9.3: Setting Up the Indicator LED.

4.1.8. Antenna (X1, X2, X3, X4, X5, X6).

The antenna connectors X1 and X2 are Type RPSMA and support Wi-Fi (Figure 3, pos. 12). The antenna connectors X3, X4, X5 and X6 are Type SMA and support 5G or LTE mobile communication (Figure 3, pos. 11).

The antenna connectors connect to external antennas positioned remotely using a cable. The cable is not provided within the delivery and must be provided by the operator to meet the operator's special requirements such as length. The location of the antenna may also affect the performance. Do not place the antenna close to a noise source that may cause interference.

The antenna cabling connector requirements are:

- Wi-Fi: RPSMA (male) to RPSMA (female) connectors
- 5G or LTE: SMA (male) to SMA (female) connectors

The delivery includes antenna (if ordered). Kontron recommends the use of Kontron's reference antenna chosen to meet RF performance requirements and supporting a nominal impedance of 50 ohms, see Chapter Table 2: Accessories and Spare Parts.

⚠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

To minimize RF cable losses, Kontron recommends using a cable with a maximum cable loss of 0.5 dB.

4.1.8.1. Wi-Fi and Bluetooth® Module Specification (option)

The Wi-Fi and Bluetooth® module is an option and if ordered implemented using the Intel® Wi-Fi 6E AX210 M.2 module supporting dual stream Wi-Fi in the 2.4 GHz, 5 GHz and 6 GHz bands and Bluetooth® 5.3.

Wi-Fi and Bluetooth® implemented using the Intel® Wi-Fi 6E AX210 M.2 2230 module.
For more information, visit the manufacture's website for Wi-Fi 6E AX210 module.

Table 4: Wi-Fi and Bluetooth Module Specification Overview

Wi-Fi Module	Description
Wi-Fi	Wi-Fi 6E, 6, 5 and 4 / Bluetooth® 5.3
IEEE WLAN Standards	IEEE 802.11-2016 IEEE 802.11a, b, d, e, g, h, i, k, n, r, u, v, w, ac, ax
Bands	2.4 GHz, 5 GHz, 6 GHz dual band 2x2 160 MHz
Form Factor	M.2 2230

Kontron recommends the use of Kontron's Wi-Fi reference antenna chosen to meet RF performance requirements and with a nominal impedance of 50 ohms, see Table 2: Accessories and Spare Parts.

4.1.8.2. 5G Module Specification (option)

The 5G module is an option and if ordered implemented using the SEMTECH/Sierra Wireless EM9191 M.2 3052 module supporting 5G NR Sub-6GHz with automatic fallback to 4G LTE and 3G networks, and up to 4.5 Gbps downlink and up to 660 Mbps uplink speeds.

The 5G module requires a valid SIM card(s) inserted into the designated SIM slots on the service panel. After inserting the SIM card(s), set up the mobile network for the 5G module using the AT Command Interface. For more information, see Chapter 9.2: Setting up the Mobile Network.

5G implemented using the SEMTECH/ Sierra Wireless EM9191 M.2 3052 module.
Visit the manufacture's website for the EM9191 modules data sheet.

The 5G module and LTE modules use the same M.2 socket. The 5G module can only be implemented in the absence of the LTE module.

Kontron recommends the use of Kontron's 5G reference antenna, chosen to meet RF performance requirements and with a nominal impedance of 50 ohms, see Table 2: Accessories and Spare Parts.

Table 5: Supported Frequency Bands RAT (5G, LTE, 3G)

Bands	5G (n<band#)	LTE (B<band#)	3G (HSPA+WCDMA)	Frequency (Tx)	Frequency (Rx)
1	✓	✓	✓	1920–1980 MHz	2110–2170 MHz
2	✓	✓	✓	1850–1910 MHz	1930–1990 MHz
3	✓	✓		1710–1785 MHz	1805–1880 MHz
4		✓	✓	1710–1755 MHz	2110–2155 MHz
5	✓	✓	✓	824–849 MHz	869–894 MHz
6			✓	830–840 MHz	875–885 MHz
7	✓[a]	✓		2500–2570 MHz	2620–2690 MHz
8	✓[a]	✓	✓	880–915 MHz	925–960 MHz
9			✓	1749.9–1784.9 MHz	1844.9–1879.9 MHz
12	✓[a]	✓		699–716 MHz	729–746 MHz
13		✓		777–787 MHz	746–756 MHz
14		✓		788–798 MHz	758–768 MHz
17		✓		704–716 MHz	734–746 MHz
18		✓		815–830 MHz	860–875 MHz
19		✓	✓	830–845 MHz	875–890 MHz
20	✓[a]	✓		832–862 MHz	791–821 MHz
25	✓[a]	✓		1850–1915 MHz	1930–1995 MHz
26		✓		814–849 MHz	859–894 MHz
28	✓	✓		703–748 MHz	758–803 MHz
29		✓		n/a	717–728 MHz
30[b]		✓		2305–2315 MHz Note: B30 Tx is disabled	2350–2360 MHz
32		✓		n/a	1452–1496 MHz
34		✓		2010–2025 MHz (TDD)	
38	✓[a]	✓		2570–2620 MHz (TDD	
39		✓		1880–1920 MHz (TDD)	
40	✓[a]	✓		2300–2400 MHz (TDD)	
41	✓	✓		2496–2690 MHz (TDD)	
42		✓		3400–3600 MHz (TDD)	
43		✓[a]		3600–3800 MHz (TDD)	
46[b]		✓		n/a	5150–5925 MHz (TDD)
48	✓[a]	✓		3550–3700 MHz (TDD)	
66	✓	✓		1710–1780 MHz	2110–2200 MHz
71	✓	✓		663–698	617–65
77	✓			3300–4200 MHz (TDD)	
78	✓			3300–3800 MHz (TDD)	
79	✓			4400–5000 MHz (TDD)	

[a] Band support is firmware and type dependent

[b] Downlink only

Table 6: 5G Module Specification (SA & NSA) Overview

5G FR1 (sub-6G) Specification	
Bands	n1[a], n2[a], n3[a], n5, n7[b], n8[b], n12[b], n20[b], n25[b], n28[a], n38[b], n40[b], n41[a], n48[b], n66[a], n71[a], n77[a], n78, n79
Data rates	SA Downlink: ▶ 5G NR TDD 2CC (up to 200 MHz aggregate BW max) ▶ Older firmware releases limited to TDD 1CC (100 MHz BW max) ▶ 5G NR FDD 1CC (40 MHz BW max) ▶ Older firmware releases limited to FDD 1CC (20 MHz BW max) ▶ 256QAM, 4x4 or 2x2 MIMO SA Uplink: ▶ 5G NR TDD 1CC (100 MHz BW max) ▶ 5G NR FDD 1CC (40 MHz BW max) ▶ Older firmware releases limited to FDD 1CC (20 MHz BW max) ▶ 256QAM, SISO
	NSA Downlink: ▶ LTE 7CC (12 layers max) + 5G NR TDD 1CC (100 MHz BW max) ▶ LTE 7CC (16 layers max) + 5G NR FDD 1CC (40 MHz BW max) ▶ 256QAM, 4x4 or 2x2 MIMO NSA Uplink: ▶ LTE 1CC + 5G NR FR1 TDD 1CC (100 MHz BW max) • ▶ LTE 1CC + 5G NR FR1 FDD 1CC (40 MHz BW max) ▶ 256QAM, SISO
MIMO	5G MIMO support
Interface	USB 3.1 Gen 2, PCIe Gen 3
Form Factor	M.2 3052

[a] Band supports NSA mode and SA mode is firmware and Type dependent

[b] Band support is firmware and type dependent

4.1.8.3. LTE Module Specification (option)

The LTE module is an option and if ordered implemented using the SEMTECH/Sierra Wireless AirPrime EM7565 M.2 module supporting 4G LTE with automatic fallback to 3G networks, and up to 600 Mbps downlink and up to 150 Mbps uplink speeds

The LTE module requires a valid SIM card(s) inserted into the designated SIM slot(s) on the service panel. After inserting the SIM card(s), set up the mobile network for the LTE module using the AT Command Interface. For more information, see Chapter 9.2: Setting up the Mobile Network.

LTE is realized using the SEMTECH/Sierra Wireless AirPrime EM7565 M.2 3042 module. Visit the manufacture's website for the AirPrime EM7565 modules data sheet.

The LTE module and 5G module use the same M.2 socket. The LTE module can only be implemented in the absence of a 5G module.

Kontron recommends the use of Kontron LTE reference antenna, chosen to meet RF performance requirements and with a nominal impedance of 50 ohms, see Table 2: Accessories and Spare Parts.

Table 7: Supported Frequency Bands RAT (LTE, 3G)

Bands	LTE (B<band#)	3G (WCDMA -UMTS)	Frequency (Tx)	Frequency (Rx)
1	✓	✓	1920–1980 MHz	2110–2170 MHz
2	✓	✓	1850–1910 MHz	1930–1990 MHz
3	✓		1710–1785 MHz	1805–1880 MHz
4	✓	✓	1710–1755 MHz	2110–2155 MHz
5	✓	✓	824–849 MHz	869–894 MHz
6		✓	830–840 MHz	875–885 MH
7	✓		2500–2570 MHz	2620–2690 MHz
8	✓	✓	880–915 MHz	925–960 MHz
9		✓	1749.9–1784.9 MHz	1844.9–1879.9 MHz
12	✓		699–716 MHz	729–746 MHz
13	✓		777–787 MHz	746–756 MHz
18	✓		815–830 MHz	860–875 MHz
19	✓	✓	830–845 MHz	875–890 MHz
20	✓		832–862 MHz	791–821 MHz
26	✓		814–849 MHz	859–894 MHz
28	✓		703–748 MHz	758–803 MHz
29	✓[a]		n/a	717–728 MHz
30	✓[a]		n/a	2350–2360 MHz
32	✓[a]		n/a	1452–1496 MHz
41	✓		2496–2690 MHz (TDD)	
42	✓		3400–3600 MHz (TDD)	
43	✓		3600–3800 MHz (TDD)	
46	✓		n/a	5150–5925 MHz (TDD)
48	✓		3550–3700 MHz (TDD)	
66	✓		1710–1780 MHz	2110–2200 MHz

[a] Downlink only

Table 8: LTE Module Specification Overview

LTE Module- AirPrime EM7565	
Data rates	Downlink ▶ Cat 12 with 3CA, 256QAM=600 Mbps; Cat 9 with 3CA, 64QAM=450 Mbps Uplink ▶ Cat 13 with 2CA contiguous, 64QAM=150 Mbps
MIMO	2x2 MIMO, 4x2 MIMO
Interface	USB 3.0 / USB 2.0 high speed
Form Factor	M.2 3042

4.2. Service Cover

The KBox R-101 series features a removable service cover on the rear side. Removing the service cover gives operators access to the product's service panel. The service cover contains a replaceable seal loop on the inside for IP54 protection. Removing the service cover may damage the seal loop (Figure 4, pos. 3) or release the seal loop from the groove (Figure 4, pos. 2). When replacing the service cover care must be taken to ensure that the seal loop is positioned correctly in the groove and that there is no visibe damage to the seal loop.

The seal loop ages naturally over time but factors in the operational environement such as temperature and humidity may affect the seal loop's mechanical properties and reduce service life. Operators are responsible for checking for degradation of the seal loop such as cracking, hardness or reduced flexibility. If degration has occurred the seal loop must be replaced. Factors such as how often the service cover is removed, will also determin how often the seal loop must be replaced.

Kontron recommends that operators check the seal loop for visable damaged and degradation each time the service cover is opened. The seal loop is available as an accessory, see Table 2: Accessories and Spare Parts.

Service Cover Seal Loop

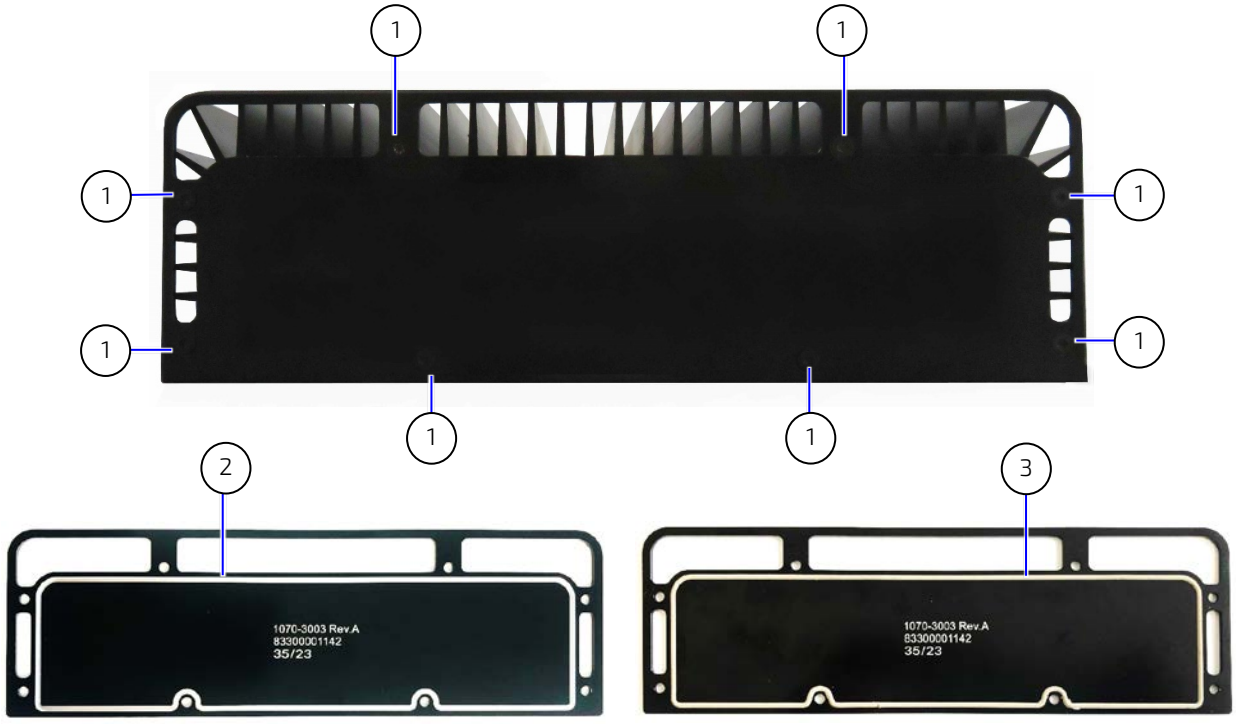
⚠CAUTION

The inside of the service cover includes a seal loop. Failure to install the seal loop properly may result is a broken seal and invalidate the product's IP54 protection or damage the product.

When reinstalling the service cover, operators must check that the seal loop:

- **Remains properly inserted within the service cover groove**
- **Has no visible damaged**
- **Has not suffered degradation such as cracking, hardness and reduced flexibility**

Figure 4: Service Cover



1 8x Service cover fastening screws
2 Service cover inside (groove empty)
3 Service cover inside (seal cord inserted)

4.3. Service Panel

The KBox R-101 series feature a service panel with the following interfaces, behind the service cover. Access the service panel by removing the service cover, see Chapter 6.1 Accessing the Service Panel.

Service Cover Seal Loop

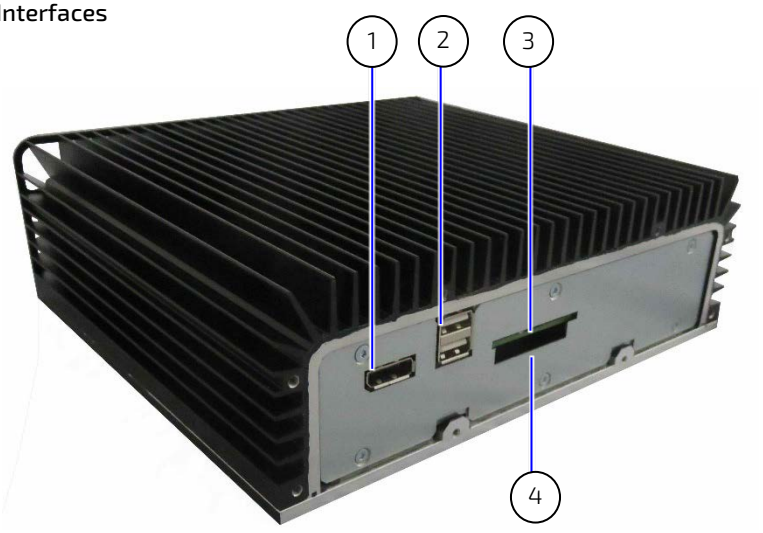
The inside of the service cover includes a seal loop. Failure to install the seal loop properly may result is a broken seal and invalidate the product's IP54 protection or damage the product.

When reinstalling the service cover, operators must check that the seal loop:

- **Remains properly inserted within the service cover groove**
- **Has no visible damaged**
- **Has not suffered degradation such as cracking, hardness and reduced flexibility**

⚠CAUTION

Figure 5: Service Panel Interfaces



1	1x Display Port DP++	3	2x micro SIM card slots
2	2x USB 2.0	4	1x CFexpress slot

4.3.1. Display Port (DP)

The DP port supports the Dual-mode (DP++) and provides compatibility with DVI and HDMI. This features the possibility of using DVI and HDMI adapters. The DP port is for service use.

The Display Port is for service use.

4.3.2. USB 2.0 Ports (USB 2.0)

The two USB ports support USB 2.0.

The two USB 2.0 porst are for service use.

4.3.3. micro SIM Card Slots (SIM1, SIM2)

The two micro SIM card slots are only for use in combination with 5G/LTE and are not available for storage.

NOTICE

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

The micro SIM cards are not part of the delivery and must be provided by the operator, to support the require network.

4.3.4. CFexpress Card Slot (CFexpress)

The CFexpress slot supports CFexpress Type B cards with a PCIe Gen3, 1 lane interface. The Kontron reference CFexpress card supports up to 128 GByte storage. The CFexpress card is not hotplug capable and the product must be switched off properly before inserting or extracting the CFexpress card.

Table 9: Storage Expansion

Slot	Location	Interface	Function	Reference Modules
CFexpress	Service Panel	PCIe	Storage	Transcend: TS128GCFE820I • Density: 128 GB • Type B • Interfaces: PCIe Gen 3, NVMe

NOTICE

Only insert or remove the CFexpress card if the product is switched off properly.

NOTICE

After changing a storage device, the partitioning of the memory may differ and require repartitioning.

Kontron reference CFexpress card is:

- Transcend: TS128GCFE820I
- Density: 128 GB
- Type B
- Interfaces: PCIe Gen 3, NVMe

4.4. Cover (u-form)

The KBox R-101 series features a cover (u-form) that functions as a heatsink with in-built cooling fins. On the left and right side of the cover are two threaded screw openings used to attach mounting brackets. The cover is sealed internally on all side. Opening the product by removing the base from the cover invalidates the warranty and may cause damage to internal components, and corrupt the product's seal and invalidate IP54 protection,

NOTICE

Seal label

The product is factory configured to meet customer requirements and closed with an adhesive seal label. Opening the product by removing the base, damages the seal label and invalidates the warranty and may cause damage to internal components, and corrupt the product's protection class IP54 seal.

Figure 6: Cover (u-form) (top)

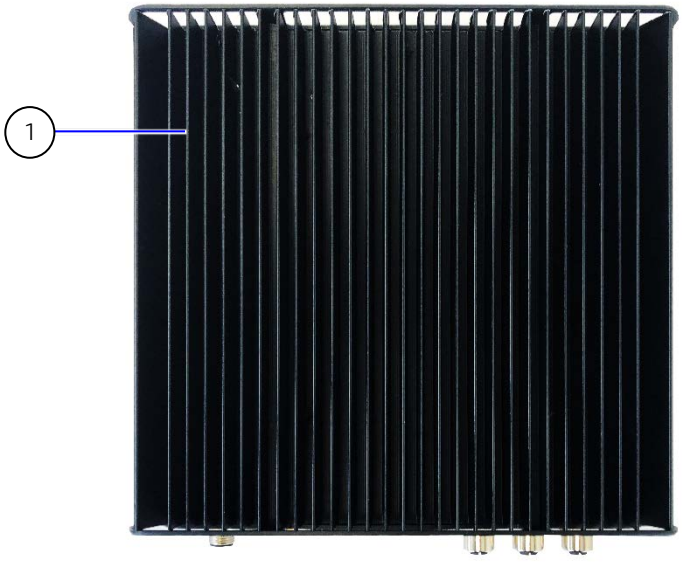


Figure 7: Cover (u-form) (left and right)

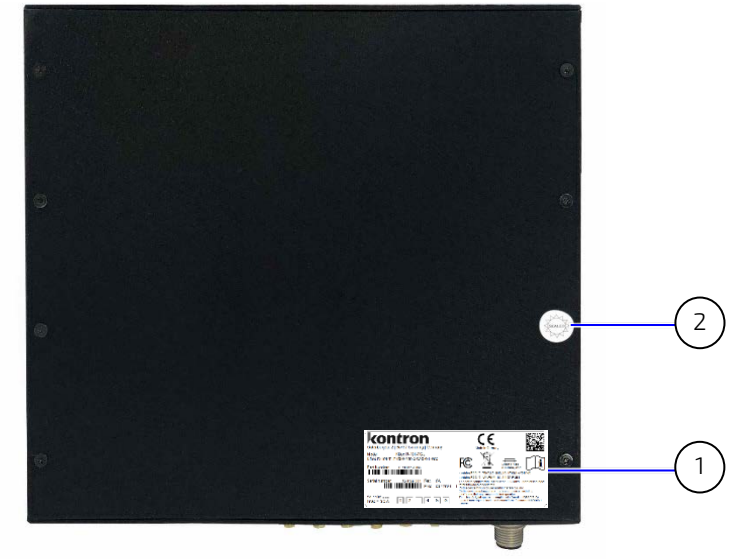
1 Cooling fins

2 2x Threaded screw openings for the mounting bracket (left and right sides)

4.5. Base

The KBox R-101 series features a base with no functional parts that may be installed directly on a flat surface. The type label is located on the product's base next to the power connector. The adhesive seal label is placed on top of the screw above the type label, to prevent the operator from opening the product and **in**validating the warranty.

Figure 8: Base Side



1 Type label

2 Adhesive Seal label

NOTICE

Seal label

The product is factory configured to meet customer requirements and closed with an adhesive seal label. Opening the product by removing the base, damages the seal label and invalidates the warranty and may cause damage to internal components, and corrupt the product's protection class IP54 seal.

4.6. Internal Features

4.6.1. RTC Supercap Buffer

The internal Real Time Clock (RTC) Supercap buffer charges during operation and tracks the time and saves the CMOS settings even when the product is disconnected from a power supply or switched off. The RTC Supercap buffer time may vary, as the Supercap buffer time depends on the ambient temperature in the operating environment and the connection time to a power supply. The Supercap buffer has an approximate lifetime of 72 hours when connected to a power supply for
1 hour and is fully charged.

To achieve the maximum RTC Supercap buffer time:

- **Supercap must be fully load this depends on how long the product has been connected to the power supply.**
- **The ambient temperature must remain within the temperature limits specified in this user guide.**

5/ Thermal Management

5.1. Passive Cooling

The KBox R-101 series is passively cooled and fanless, using a cover (u-form) with in-built heatsink.

5.2. Heatsink

The cover (u-form) functions as a heatsink with in-built cooling fins encompassing the maximum area (top, and left and right sides). Additionally, the thermal design promotes heat dissipation for critical internal components and optimizes the heat transfer.

Figure 9: Heatsink

Hot Surface

Heatsinks can get very hot. To avoid burns and personal injury:

- Do not touch the heatsink when the product is in operation
- Allow the product to cool before handling
- Wear protective gloves

Surface chaude

Les dissipateurs thermiques peuvent devenir très chauds. Pour éviter les brûlures et les blessures :

- Ne touchez pas le dissipateur thermique lorsque le produit est en fonctionnement
- Laisser refroidir le produit avant de le manipuler
- Portez des gants de protection

5.3. Installation Orientation

When installing the product take care not to obstruct the airflow over the heatsinks, as this can stop sufficient heat dissipating into the ambient environment and cause a build-up of heat.

⚠CAUTION

Installation Orientation

Installing the product with the cover (u-form) facing downward is prohibited!

Use the permitted installation orientations only:

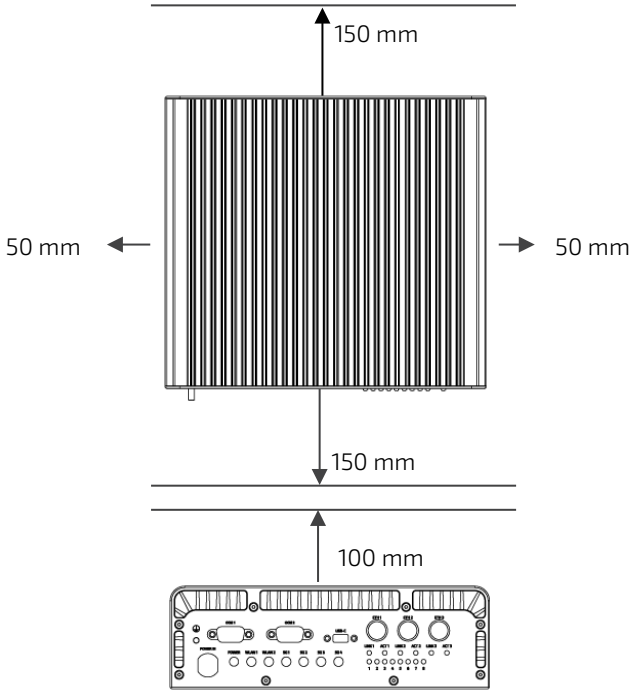
- Horizontally (cover (u-form) facing upwards)
- Vertically (all orientations)

5.4. Minimum Clearance

To provide a maximum airflow away from the product, observe the minimum distances to surrounding parts. Kontron recommends that operators not to install or operate other devices within the specified keep out area around the product. Operators must observe the specified clearance distances of 150 mm/5.9 inch front and rear, 50 mm/1.97 inch left and right sides, and 100 mm/3.94 inch cover.

The cable clearance for cables installed on the front panel depends on the installed connector types and is typically up to 100 mm/3.94 inch.

Figure 10: Minimum Clearance Distances



⚠CAUTION

Minimum Clearance Distance

Leave sufficient clearance (keep out area) to prevent the product from overheating! To ensure proper operation, observe the specified minimum keep out area of 150 mm/ 5.9 inch at the front and rear, 50 mm/1.97 inch at the sides, and 100 mm/3.94 inch at the cover.

On the front panel, the required cable clearance depends on the installed connector types and is typically up to 100 mm/3.94 inch that lies within the specified minimum front panel clearance distance of 150 mm/5.9 inch.

5.5. Third Party Components

When configured with third party components, operators must considered that an approximate internal temperature rise occurs.

The maximum system ambient temperature depends predominately on the power consumption of the internal processor and M.2 modules.

6/ Preparing for Installation

The KBox R-101 series is factory configured. Opening the cover invalidates the warranty (see Chapter 16.2: Warranty) and may cause damage to internal components and corrupt the product's internal seal. Operators are only permitted to open the service cover to gain access to the interfaces on the service panel. The operator must always observe Chapter 2/General Safety Instructions within this user guide.

6.1. Accessing the Service Panel

⚠CAUTION

Service Cover Seal Loop

The inside of the service cover includes a seal loop. Failure to install the seal loop properly may result is a broken seal and invalidate the product's IP54 protection or damage the product.

When reinstalling the service cover, operators must check that the seal loop:

- **Remains properly inserted within the service cover groove**
- **Has no visible damaged**
- **Has not suffered degradation such as cracking, hardness and reduced flexibility**

Hot Surface

Heatsinks can get very hot. To avoid burns and personal injury:

- **Do not touch the heatsink when the product is in operation**
- **Allow the product to cool before handling**
- **Wear protective gloves**

Surface chaude

Les dissipateurs thermiques peuvent devenir très chauds. Pour éviter les brûlures et les blessures :

- **Ne touchez pas le dissipateur thermique lorsque le produit est en fonctionnement**
- **Laisser refroidir le produit avant de le manipuler**
- **Portez des gants de protection**

To access the service panel remove the service cover. When removing the service cover while the product is in operation, operators must take precautions not to touch the heatsink, and to wear protective gloves. Alternatively, switch off the product properly and allow the product to cool, before removing the service cover.

To open the service cover, performing the following:

1. Remove the eight screws on the service cover (Figure 4. pos. 1) and retain the screws for later use.
2. Lift the service cover away from the service panel while ensuring that the seal loop (Figure 4. pos. 3) remains in the internal service cover groove (Figure 4. pos. 2) and store the service cover with the eight screws removed in step 1.
3. Before closing the service cover check the seal loop for visable damaged and degradation and ensure that the seal loop is positioned correctly in the designated groove. If damaged or degradation has occurred, the seal loop must be replaced with a new seal loop. The seal loop is available as a spare part, see Table 2: Accessories and Spare Parts.
4. Fasten the service cover with the eight screws removed in step 1 and visually check that the service cover is correctly sealed.

6.1.1. Inserting or Extracting a micro SIM Card(s)

The product must be switched off properly before inserting or extracting a micro SIM card. The micro SIM card's push push insertion and extraction enables quick and easy installation or removal. The product supports two micro SIM slots enabling a maximum of up to two micro SIM cards to be inserted at the same time.

NOTICE **Only insert or remove the micro SIM card(s) if the product is switched off properly.**

To Install or remove a micro SIM, perform the following:

1. Remove the service cover as described in Chapter 6.1: Accessing the Service Panel, steps 1 to 2.
2. To insert, push the micro SIM card with the terminal contacts facing towards the service panel carefully into the slot until the micro SIM card clicks into place at the back of the slot.

   To extract, push the inserted micro SIM card lightly to release the micro SIM and pull the micro SIM card out of the slot.
3. Close the service cover as described in Chapter 6.1: Accessing the Service Panel, step 3 and 4.

The micro SIM slots are used in combination with 5G/LTE and are not available for storage.

6.1.2. Inserting or Extracting a CFexpress Card

The product must be switched off properly before inserting or extracting a CFexpress card. The CFexpress card's push push insertion and extraction enables quick and easy installation or removal.

NOTICE **Only insert or remove the CFexpress card if the product is switched off properly.**

To Install or remove a CFexpress card, perform the following:

1. Remove the service cover as described in Chapter 6.1: Accessing the Service Panel, steps 1 to 2.
2. To insert, push the CFexpress card with the terminal contacts facing towards the service panel on the bottom carefully into the slot until the CFexpress card clicks into place at the back of the slot

   To extract, push the inserted CFexpress card lightly to release the CFexpress card and pull the CFexpress card out of the slot.
3. Close the service cover as describe in Chapter 6.1: Accessing the Service Panel, step 3 and 4.

NOTICE **After changing a storage device, the partitioning of the memory may differ and require repartitioning.**

Kontron reference CFexpress card is:

- **Transcend: TS128GCFE820I**
- **Density: 128 GB**
- **Type B**
- **Interfaces: PCIe Gen 3, NVMe**

7/ Installation

7.1. Before Installing

Before installing the KBox R-101 series in the field, ensure that the operating environment meets the specification as stated within this user guide. There must be sufficient space at the front of the product to access the Power IN connector, interface connectors and antennas. Additionally, sufficient space is required on the rear side to access to the service panel by removing the service cover. Leave the minimum clearance distance specified within this user guide to prevent the product from overheating, see Chapter 5.4: Minimum Clearance.

⚠CAUTION

Installation Orientation

Installing the product with the cover (u-form) facing downward is not permitted!

The permitted install orientations are:

- Horizontally (cover (u-form) facing upwards)
- Vertically (all installation orientations)

⚠CAUTION

Weight of the product

When installing the product consider the product's weight:

- When installing the product, if the product falls there is risk of injury and product damage. A second installer may be required depending on the installation location.
- Always use both wall mount brackets or 19" rack mount brackets
- Fasten using all the provided screws and all the required operator provided screws.

⚠CAUTION

Airflow and Clearance

Operate only in a well-ventilated environment that does not obstruct the product from dissipating heat on the cover (u-form). Ensure that the product' cooling fins do not prevent airflow over the product. Leave the specified clearance (keep out area) to prevent the product from overheating, 150 mm/5.9 inch at the front and rear, 50 mm/1.97 inch at the sides and 100 mm/3.94 inch at the top.

⚠CAUTION

Installation Mount-surface

When installing the product consider the mount-surface:

- Install the product on a flat installation surface.
- Ensure that the mount-surface can bear the product's weight.

⚠CAUTION

Avoid Heat and Damp

Do not place the product close to heat sources or damp places.

7.2. Installation Orientation.

When installing the KBox R-101 series in the field, install only horizontally (cover facing upward) or vertically (all directions). Operation of the product with the cover facing downwards is not permitted.

Ensure that the product's cooling fins are in-line with the airflow (Figure 11 and Figure 12) and do not prevent air from flowing over the product to remove heat effectively. Leave the minimum clearance distance specified within this user guide to prevent, see Chapter 5.4: Minimum Clearance.

⚠CAUTION

Installation Orientation

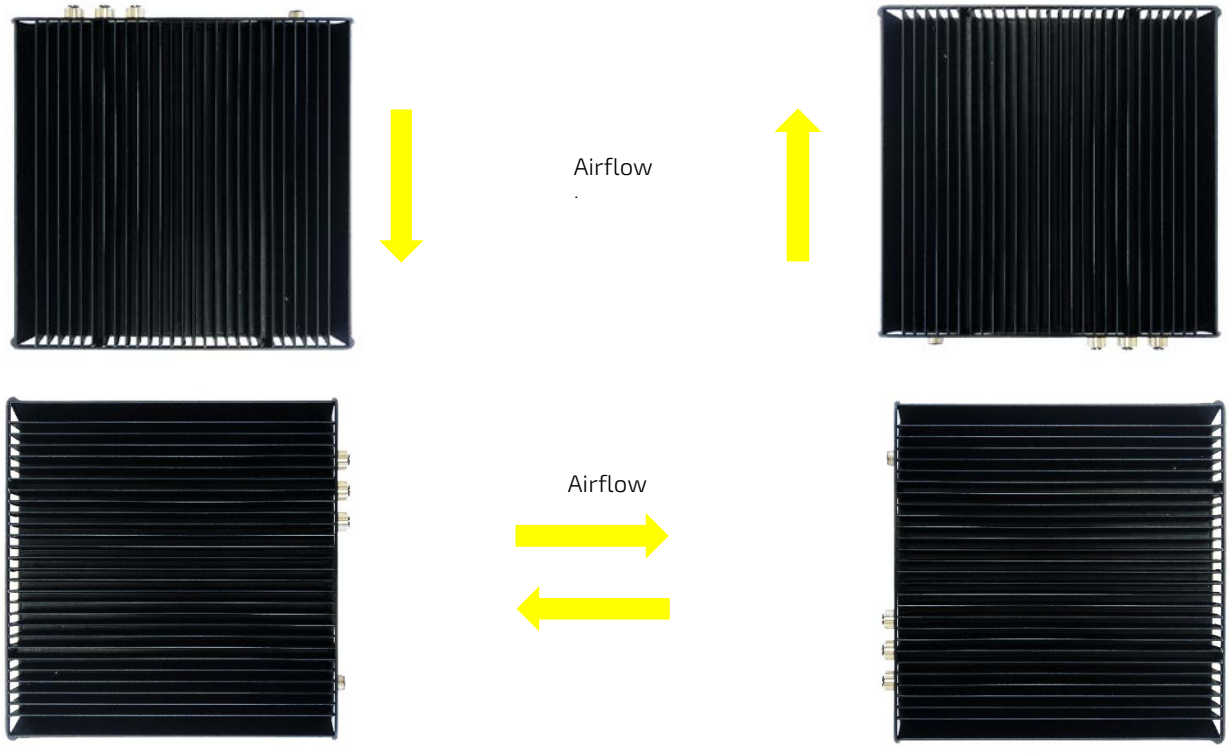
Installing the product with the cover (u-form) facing downward is not permitted!

The permitted install orientations are:

- **Horizontally (cover (u-form) facing upwards)**
- **Vertically (all installation orientations)**

Figure 11: Installation Horizontal

Figure 12: Installation Vertical



7.3. Installing with Wall Mount Brackets

To install the KBox R-101 series in the field using the wall mount brackets provided in the delivery, perform the following:

1. Attach the wall mounting brackets firmly to the left and right sides of the product using the two M3x6 screws provided (Figure 13, pos. 2). Secure with a thread locking compound to prevent loosening.
2. Attach the product to a mount-surface capable of bearing the product's weight see Table 18: Mechanical Specification, using the four keyhole slot openings (Figure 13, pos. 3). The four screws to attach the product to the mount-surface are not included in the product's delivery. The operator is responsible for using screws that ensure the safe installation of the product and take the mount-surface thickness, head size, length and thread locking into consideration.

NOTICE

Kontron recommends installing the product on a clean, smooth and flat mount-surface, capable of bearing the weight of the product.

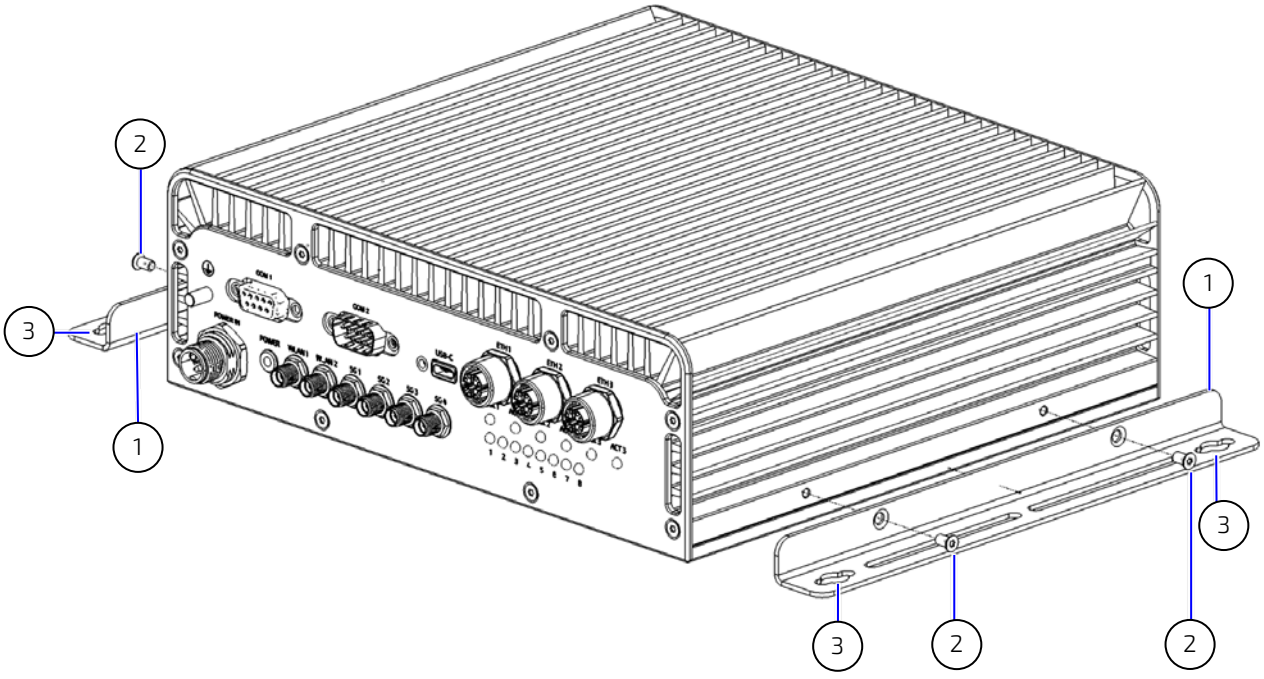
NOTICE

The four screws to attach the product to the mount-surface are not included in the product's delivery. Kontron recommends installing the product on a clean, smooth and flat mount-surface, capable of bearing the weight of the product.

The operator is responsible for providing screws with the required:

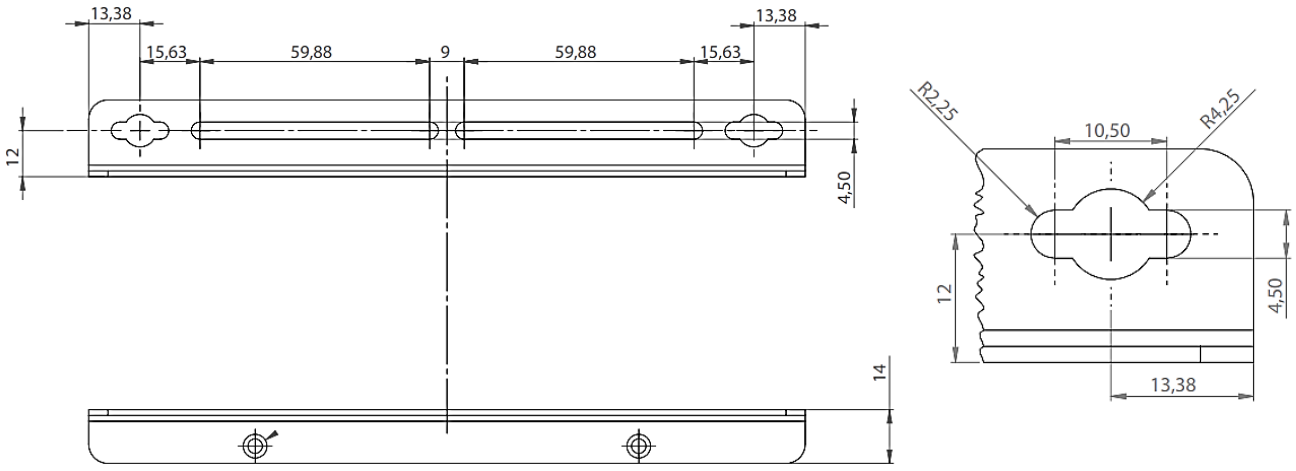
- **Head size**
- **Length for the thickness of the mount-surface**
- **Thread lock compound to prevent loosening (if required)**

Figure 13: Attaching the Two Mounting Brackets



1 Mounting bracket (L-shape)
2 4x M3x6 Screws (product to bracket)
3 Key holes slots for screws (bracket to mount-surface) provided by the operator

Figure 14: Mounting Bracket (L-shape) Dimensions



7.4. Installing with 19" Rack Mount Brackets

The 19" rack mount bracket set contains two identical L-shape brackets that attach to the left and right sides of the product with two M3x6 screws. Use four additional screws and cage nuts (to be provided by the operator) to installation the product within a 19" industrial rack cabinet

Use a well-ventilated 19" industrial rack cabinet that does not prevent the product from dissipating heat from the cover. Leave the minimum clearance distance specified within this user guide to prevent overheating, see Chapter 5.4: Minimum Clearance. There are no clearance requirements for the product's base, enabling the product to be mounted directly on top of other systems in the 19" industrial rack cabinet.

⚠CAUTION

Ensure Sufficient Airflow.

Ensure that the 19" industrial rack cabinet is well ventilated and supports heat dissipation and transfer away from the product without obstructions.

⚠CAUTION

Mount only in a stable 19" industrial rack cabinet and use proper installation procedures:

- **Mount systems from the bottom up**
- **Place heavy systems lower down**
- **Bolt the cabinet to the floor or anchor the cabinet to the wall**

⚠CAUTION

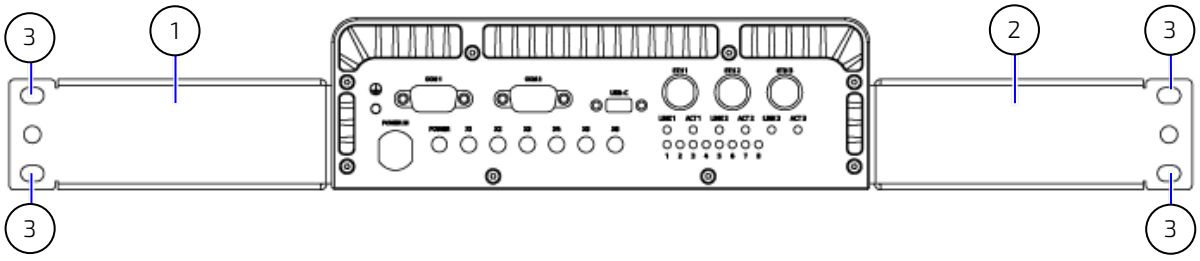
Verify Secure Mounting

Fasten both 19" rack mount brackets to the front side posts of the 19" industrial rack cabinet using all four screws and cage nuts (to be provided by the operator) to provide full support for the product's weight.

Figure 15: Attaching the 19" Rack Mount Brackets

1 Rack mount bracket (L-shape) left
2 Rack mount bracket (L-shape) right
3 4x M3x6 Screws

Figure 16: Installing in a 19" Industrial Rack Cabinet



1 Rack mount bracket (L-shape) left
2 Rack mount bracket (L-shape) right
3 4x openings for screws and cage nuts (to be provided by operator)

To install the KBox R-101 series in the field using the 19" rack mount bracket set, perform the following:

1. Attach the 19" rack mount brackets firmly to the left and right sides of the product using the two M3x6 screws provided (Figure 15 pos. 3). Secure with a thread locking compound.
2. Mount the product to both front side posts of the 19" industrial rack cabinet (Figure 16, pos. 3) with four cage nuts and screws (to be provided by operator). Due to the product's weight, always use four screws to provide full support for the product's weight.

NOTICE

The operator is responsible for providing four screws and cage nuts to attach the rack mount brackets (L-shape) to the 19" rack cabinet's front side posts that meet the requirements of the 19" rack mount bracket and 19" industrial rack cabinet:

- **Head size**
- **Length**
- **Thread lock compound to prevent loosening (if required)**

8/ Starting Up

8.1. Before Starting Up

Before starting up the KBox R-101 series read the instructions in this user guide and observe the safety instructions in Chapter 2/General Safety Instructions. If connected incorrectly the product may malfunction or short circuit leading to product damage or serious injury.

Kontron recommends testing functions in a safe environment before operating the product in the field. Additionally, when attaching cables check the labelling to avoid mixing up electrically compatible ports and interfaces as this may cause unwanted behavior and operation.

The Power IN connector connects to an external DC power supply that meets the requirements specified in this user guide (Table 15: Electrical Specification) using the delivered M12 mating power connector. Before starting up wire the delivered M12 mating power connector with a suitable cable, see Chapter 8.2: Wiring the M12 Mating Power Connector.

A no fuse symbol with warning text on the type label (Figure 2, pos. 6) stipulates the use of an external DC power supply with mandatory 5AT fuse or safety device. When the no fuse symbol with warning text is not present (Figure 2, pos. 7) the use of an external DC power supply with fuse or safety device is not a requirement. Whether either a 5AT fuse or a safety device is implemented must be decided by the operator to meet the requirements in the field.

⚠CAUTION

Safety Device Requirement

It is prohibited to connect the product to an external DC power supply without a 5AT fuse or safety device, if the product is configured with no internal fuse as stipulated on the type label (no-fuse symbol and warning text “External fuse mandatory 5AT”).

⚠CAUTION

Switch Off and Disconnect

The product is only switched off properly when disconnected from the external DC power supply, by removing the power cable from the Power IN connector or the external DC power supply.

⚠CAUTION

The power cable connecting to Power IN must be easily accessible. If the operational environment restricts access to the power cable, disconnection must be guaranteed using a separate cut-off fixture.

⚠CAUTION

When connecting cables, following proper cabling procedures:

1. Connect the ground Cable to the protective earth bolt
2. Connect all interface cables
3. Connecting the Power cable to the Power IN connector

⚠CAUTION

Power Source Requirements

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.

⚠CAUTION

Ensure that the power supply and power cables have no visible damage.

NOTICE

Do not disconnect the power while the product is in operation. This performs a forced shutdown and can lead to loss of data. To avoid loss of data, first perform an orderly system shutdown.

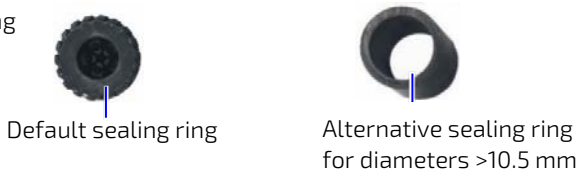
8.2. Wiring the M12 Mating Power Connector

The operator is responsible for wiring the delivered M12 mating power connector. To order a replacement M12 mating power connector, see Table 2: Accessories and Spare Parts. The power cable is not part of the delivery und must be provided by the operator to meet the requirements of the M12 mating power connector (cable outer diameter 8 mm to 13 mm). The power cable wires must be clearly marked (+/-/protective earth) to ensure proper connection to the external DC power supply.

To wire the M12 mating power connector, perform the following:

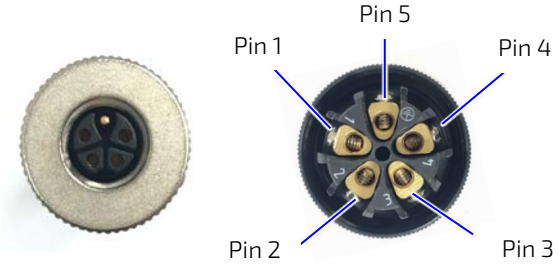
1. Open the M12 mating power connector packaging and locate the four items included in the delivery.

2. If required, change the pre-installed sealing ring to the alternative sealing ring. The alternative sealing ring is only for cables with a diameter greater than 10.5 mm.



3. Before wiring the connector pins, insert the power cable through the end and sleeve of the M12 mating power connector.
4. Prepare the wires by removing approximately 30 mm of the power cable coating.
5. Strip each wire end by approximately 8 mm and twist the striped wire-ends.
6. Loosen the pin-screws far enough to insert the end of the stripped wires.
7. Insert the corresponding stripped wire into the connector pin.

   Pin 1: Ignition (operator implemented)
   Pin 2: VIN+ 24 VDC Input
   Pin 3: Gound
   Pin 4: Not Connected
   Pin 5: Protective Earth



8. Fasten all five pin-screws to secure the wires.

9. Close the M12 mating power connector by screwing the front, sleeve and end securely together.

The product is delivered with the required M12 mating power connector. To order a replacement M12 mating power connector, see Table 2: Accessories and Spare Parts.

For the M12 mating power connector's pin assignment, with a description of the ignition feature, see Chapter 13.1.1: M12 Power IN Connector.

8.3. Starting Up

⚠CAUTION

Mandatory 5AT Fuse or Safety Device Requirement

It is prohibited to connect the product to an external DC power supply without a 5AT fuse or safety device, if the product is configured with no internal fuse as stipulated on the type label (no-fuse symbol and warning text "External fuse mandatory 5AT").

NOTICE

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

NOTICE

Only insert or extract the CFexpress card when the product is switched off properly.

To switch on the KBox R-101 series, perform the following:

1. Check the type label on the product's base that specifies if the external DC power supply requires a 5AT fuse or safety device (Figure 2, pos. 6).
2. Open the service cover to inserting the SIM card(s) Chapter 6.1.1: Inserting or Extracting a micro SIM Card(s) and the CFexpress card Chapter 6.1.2: Inserting or Extracting a CFexpress Card.
3. Connect the ground cable to the protective earth bolt.
4. Connect the required interface cables and antenna cables to the front panel connectors.
5. Connect the power cable with the wired M12 mating power connector to the Power IN connector on the front panel and to an external DC power supply. The product starts automatically and the power LED illuminates green to indicate the powered on state.

NOTICE

Do not disconnect the power while the product is in operation. This performs a forced shutdown and can lead to loss of data. To avoid loss of date, first perform an orderly system shutdown.

Whether either a 5AT fuse or a safety device is implemented, must be decided by the operator to meet the requirements in the field.

8.4. Operating System (OS) and Drivers

The KBox R-101 series comes hardware configured, and on request with a pre-installed operating system and all the necessary drivers (in accordance with the ordered hardware configuration). No further internal configuration is required, enabling full operation when connected to power for the first time.

If ordered without a pre-installed operating system, operators will need to install the operating system and the appropriate drivers for the configuration ordered.

To download relevant drivers for the factory configured hardware components visit Kontron's Customer Section.

Pay attention to the manufacturer operating systems specifications relating to the integrated hardware components.

8.5. Switching Off

⚠CAUTION

Switch Off and Disconnect

The product is only switched off properly when disconnected from the external DC power supply, by removing the power cable from the Power IN connector or the external DC power supply.

Hot Surface

Heatsinks can get very hot. To avoid burns and personal injury:

- Do not touch the heatsink when the product is in operation
- Allow the product to cool before handling
- Wear protective gloves

Surface chaude

Les dissipateurs thermiques peuvent devenir très chauds. Pour éviter les brûlures et les blessures :

- Ne touchez pas le dissipateur thermique lorsque le produit est en fonctionnement
- Laisser refroidir le produit avant de le manipuler
- Portez des gants de protection

⚠CAUTION

When connecting cables, following proper cabling procedures:

1. Connect the ground Cable to the protective earth bolt
2. Connect all interface cables
3. Connecting the Power cable to the Power IN connector

Always switch off the product properly as described in this user guide. When initially switched off the product may still be hot and operators must allow the product to cool before handling.

To switch off by performing an orderly shutdown, perform the following:

1. Perform an orderly system shutdown.
2. Disconnect the power cable from the Power IN connector on the front panel or the external DC power supply.
3. Once switched off properly the interface connectors and antenna cable may be disconnected.
4. Remove the ground cable from the protective earth bolt.

9/ Setting Up

9.1. Before Setting Up

All software installed by the operator is at the operator'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 operator. Kontron is not responsible for the loss of stored, transmitted, received and used data. It is the operator's responsibility to consider access control and the protection measures required to prevent unwanted access.

9.2. Setting up the Mobile Network

Set up the mobile network software correctly using Kontron's Board Support Package (BSP). The Board Support Package includes an installer with the required drivers for the supported mobile networks (Wi-Fi, Bluetooth®, LTE and 5G).

Kontron is not responsible for the installation of the Board Support Package drivers. The operator must consider that an incorrect installation and setup of the mobile network software can lead to the product becoming inaccessible. Kontron recommends testing the mobile network software in a safe test environment before installation in the field.

NOTICE Only insert or remove the micro SIM card(s) if the product is switched off properly.

For the product's Board Support Package, visit Kontron's Customer Section and click on KBox R-Series > Board Support Package (BSP).

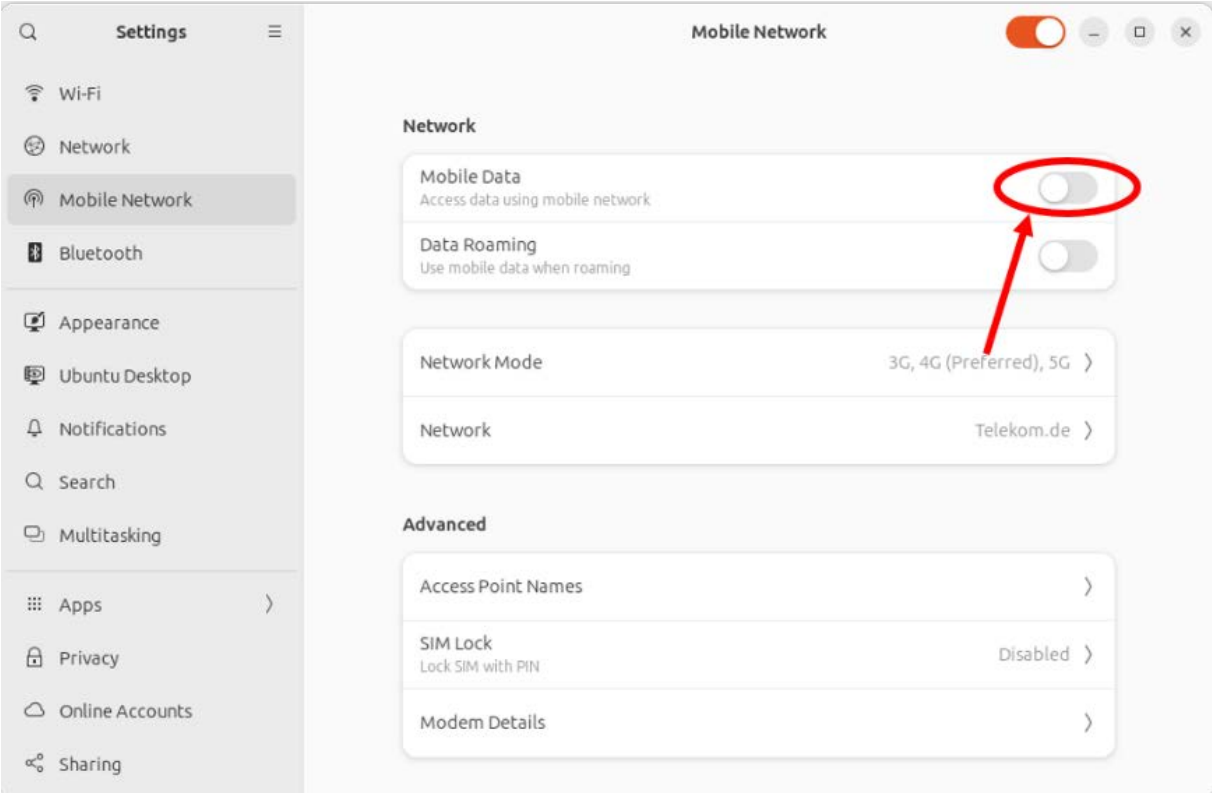
To use the AT Command interface to set up the mobile network (5G/LTE) connection, perform the following:

1. After booting up Linux the product recognizes the installed module (5G -EM9191 or LTE-AirPrime EM7565) and informs the operator of the requirement to install a micro SIM card.

Figure 17: No SIM Installed

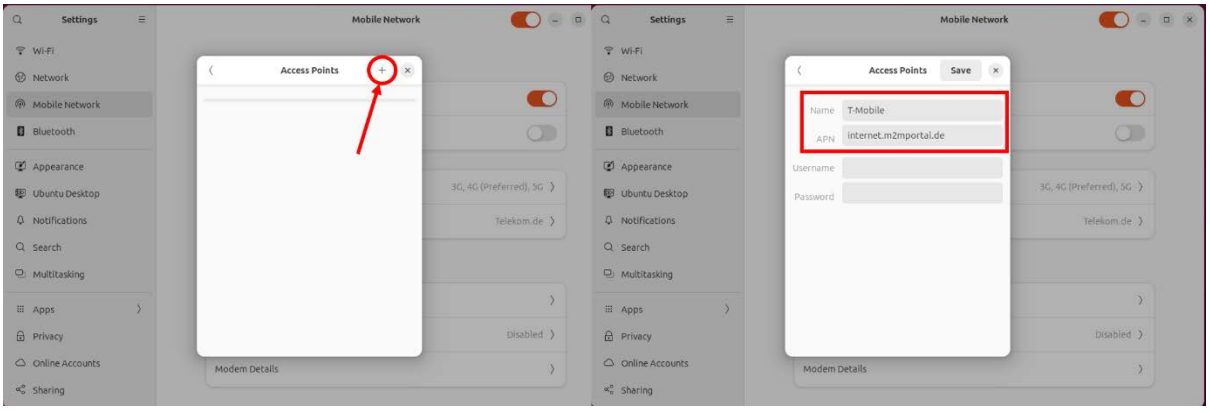
2. When inserting the SIM (PIN may be required) the connection is disabled by default. After activating the button "**Mobile Data**", a new APN (Access Point Name) has to be set up.

Figure 18: Network Manager



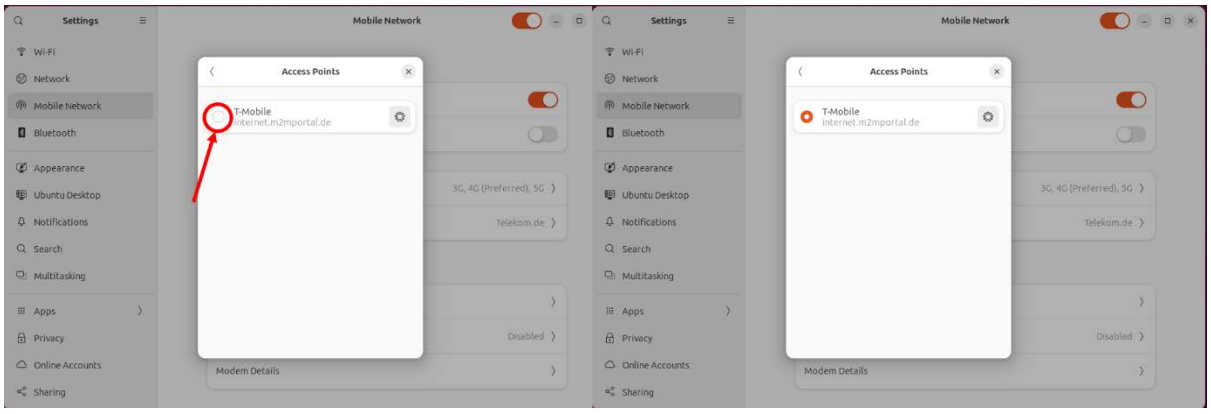
3. During set up of the new APN, the correct APN of the used provider must be filled in. Depending on the provider, a username and password may be required.

Figure 19: Add an APN (Access Point Name)



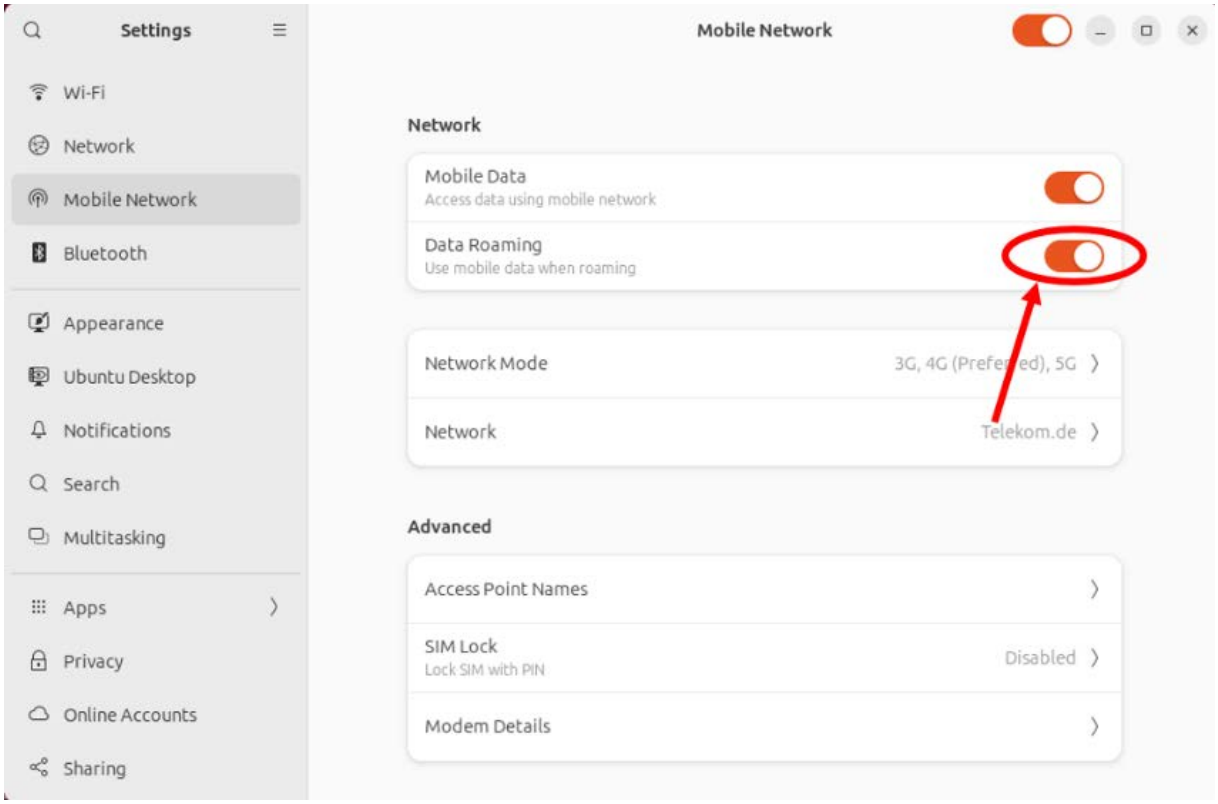
4. Select the new configured APN.

Figure 20: Activate APN



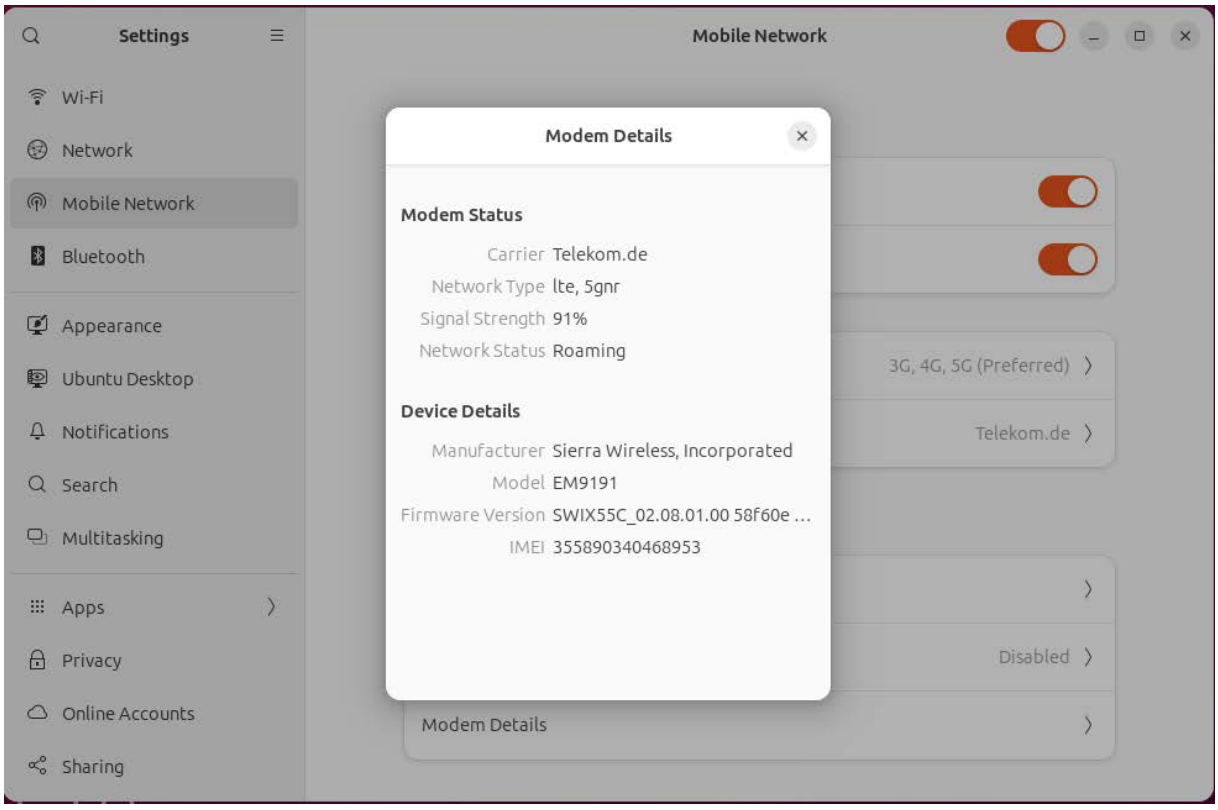
5. Enable "**Data Roaming**", for devices with contracts requiring "**Data Roaming**", even if the device is in the device's home country.

Figure 21: Roaming



6. Check the connection under "**Modem Details**".

Figure 22: Modem Details



9.2.1. Testing the Mobile Network Connection under Linux

To test the 5G or LTE connection further, investigation and debugging is required using the terminal.

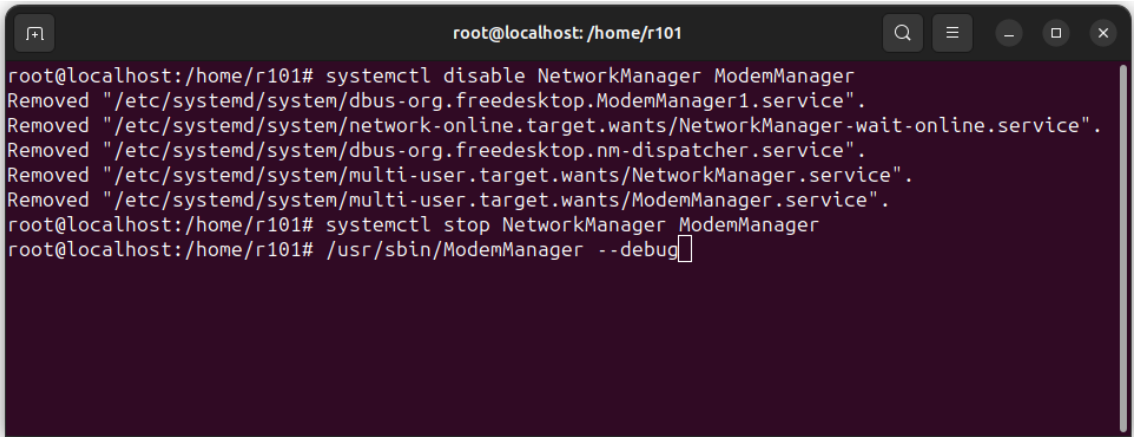
To debug using the terminal, perform the following:

1. Enter debug mode using the required commands:

```
"systemctl disable NetworkManager ModemManager"
"systemctl stop NetworkManager ModemManager"
"/usr/sbin/ModemManager --debug"
```

Use of the terminal requires root permission. When using the terminal the normal connection is disabled, as the Network Manager has to be stopped and disabled.

Figure 23: Enter Debug Mode



2. Open a new terminal and check the number of the 5G or LTE modems using the command:

```
"mmcli -L"
```

For a 5G or LTE network Figure 24: Debug LTE Information, shows the number of modems is "**Modem 0**".

AT-Commands can be sent via:

```
"mmcli -m 0 --command='AT!xxx'"
```

For example:

```
AT!GSTATUS?
AT!LTEINFO?
AT!GPSSTATUS?
AT!GPSSATINFO?
AT!GPSLOC?
AT!RESET
```

The AT Command Reference Guide contains more commands:

For more AT commands, download the AT Command Reference Guide for the EM9191 5G module or the AirPrime EM7565 LTE module.

Figure 24: Debug LTE Information

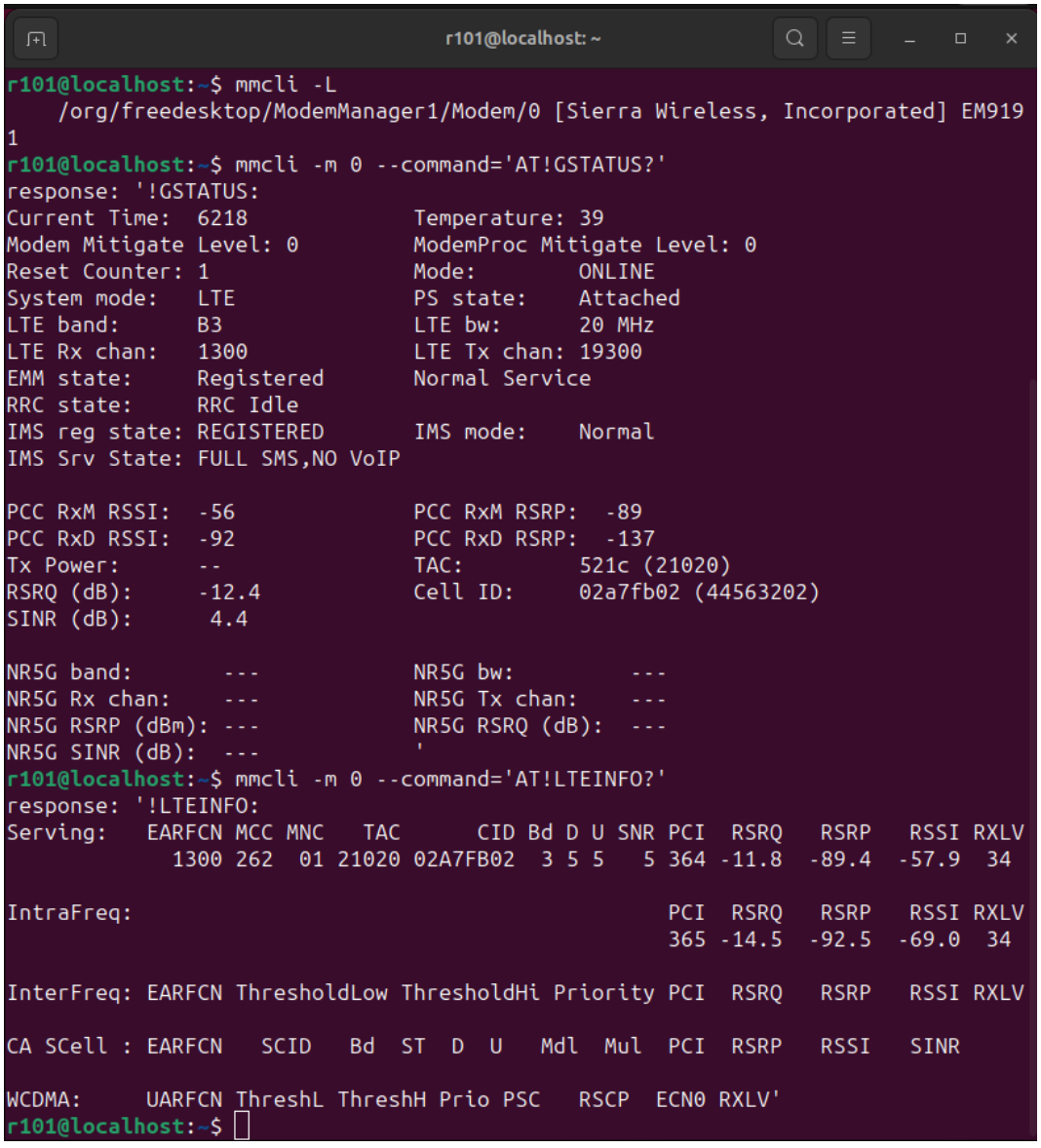


Figure 25: Debug GPS Information

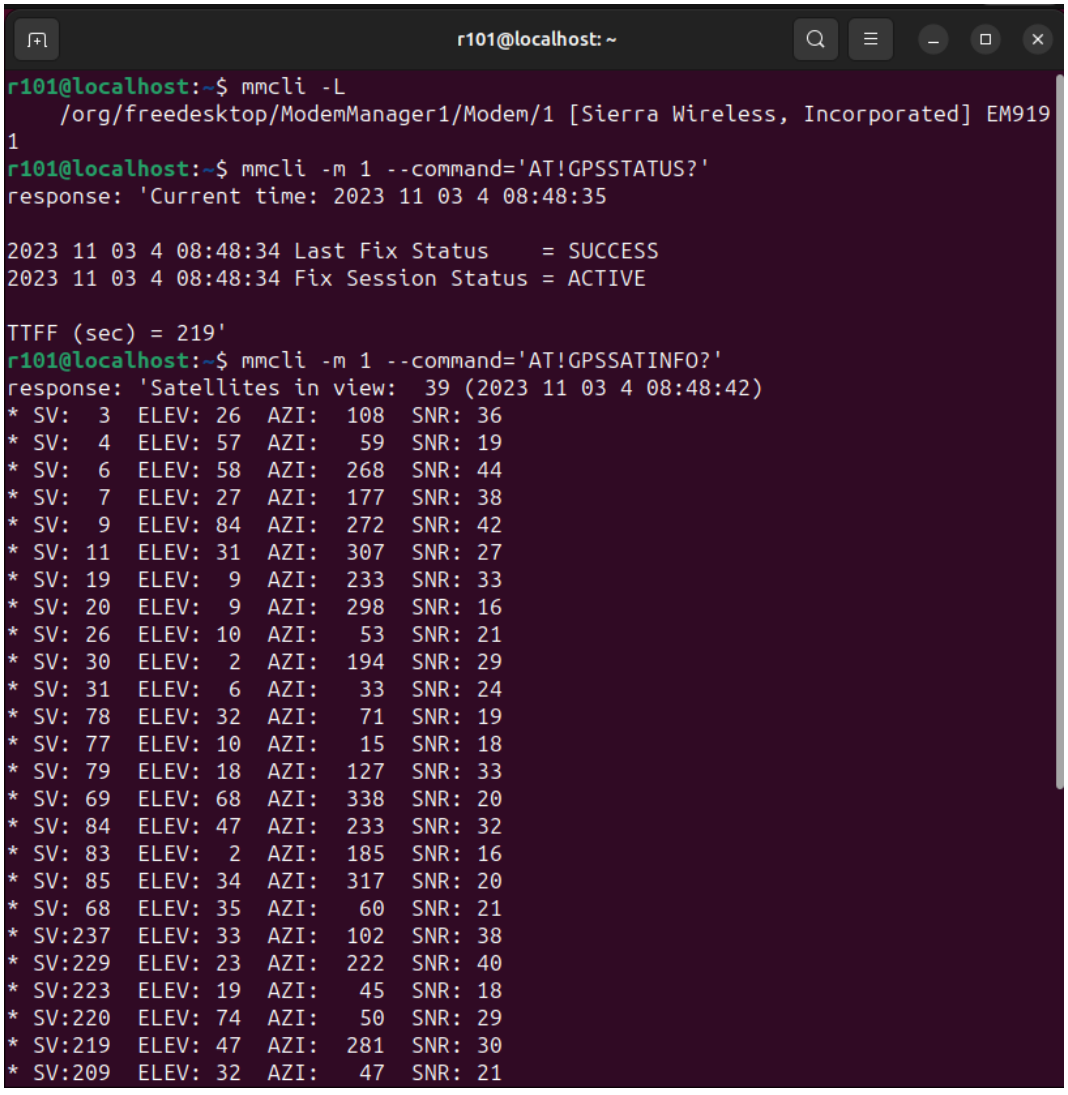
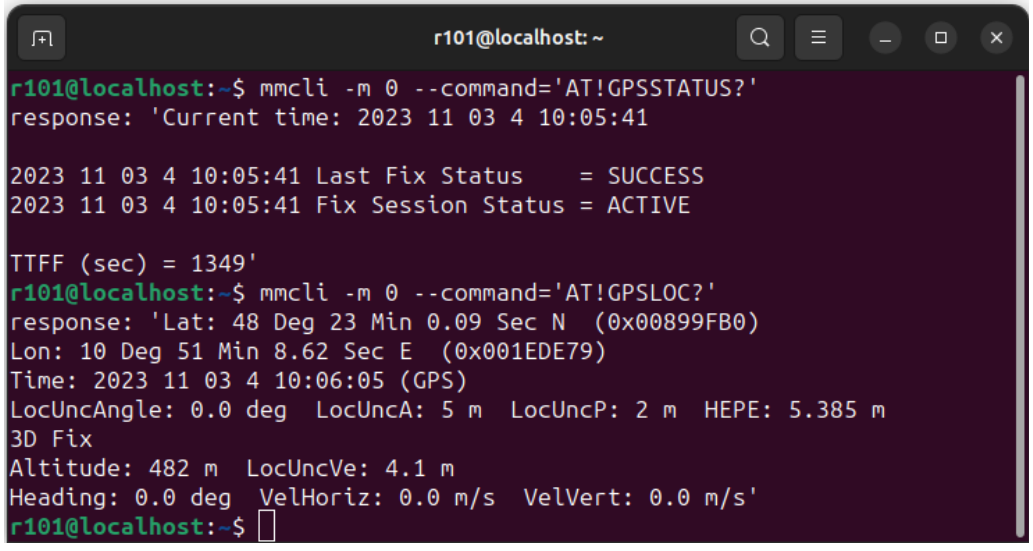


Figure 26: Debug GPS Information 2



3. When finished, enable the Network Manger and Modem Manager to allow the 5G or LTE modem to operate again.

   Close the Debug-Mode with:

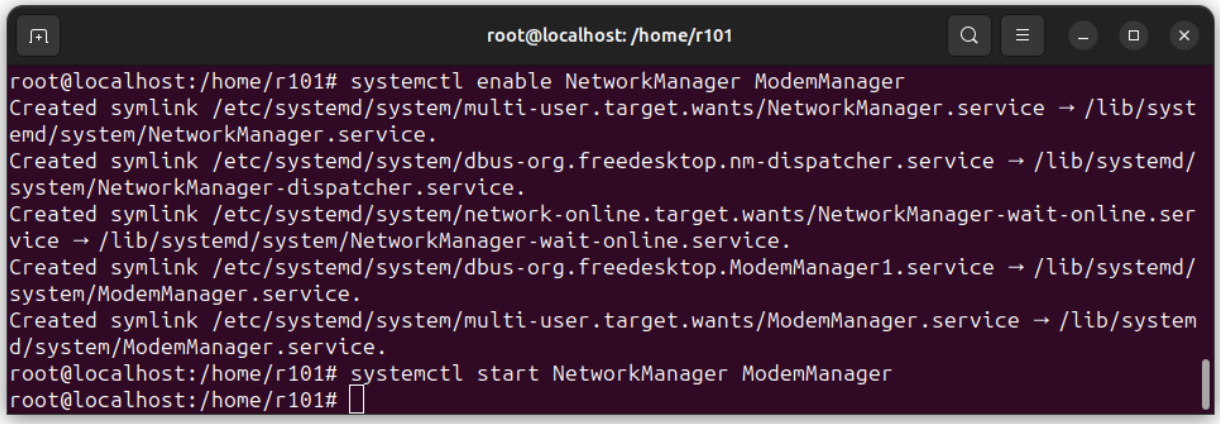
   "CTRL+C"

   Enter:

   ```
   "systemctl enable NetworkManager ModemManager"
   "systemctl start NetworkManager ModemManager"
   ```

For the 5G or LTE modem to operate again in normal operation mode, a system restart may be necessary.

Figure 27: Exit Debug Mode



9.3. Setting Up the Indicator LEDs

The eight indicator LEDs are operator definable configurable GPIO LEDs, used to display the status of specific activities on the front panel by illuminating the LED (yellow) in a set state.

To configure the eight indicator LEDs, operators must access the GPIO programmable logic ICs specific drivers. These drivers are available within Kontron's Customer Section.

1. Access Kontron's Customer Section website.
2. Select <COM Express® Compact>.
3. Select <COMe-cTL6 Driver & Board Support Packages> for the KBox R-101-TGL or

   Select <COMe-cEL6 Driver & Board Support Packages> for the KBox R-101-EKL.
4. Click on <Linux PLD Driver> to download the Linux PLD board driver.
5. Follow the GPIO. Readme Instructions for driver usage and supported features

The Kontron PLD driver is part of the stable Linux Kernel compatible with Rev. 3.11 or later. Supported hardware and features depend on the Kernel revision and may differ from the driver available here. For more information, contact Kontron Support.

10/ BIOS

This chapter informs operators how to start the BIOS, use the BIOS setup to configure, and perform a BIOS update. BIOS features are open to change and may not be available in the latest version of the BIOS.

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

Only use the Kontron provided tools!

The KBox R-101 series uses the AMI Aptio V uEFI BIOS based on the Unified Extensible Firmware Interface (uEFI) specification.

10.1. Starting the uEFI BIOS

The uEFI BIOS's Setup program provides quick and easy access to the individual function settings for control or modification of the uEFI BIOS configuration. The Setup program allows for access to various functions that include sub-menus with further functions and sub-menus.

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

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

If the <DEL> key is not pressed, the POST continues with the test routines.

10.2. Setup Menus

The uEFI BIOS comes with a setup program that provides quick and easy access to control or modify individual BIOS settings. The Setup menu selection bar is located at the top of the screen and features the following menus:

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

Each Setup menu consists of two main frames. The left frame displays all available functions. Functions displayed in blue are configurable and functions displayed in grey provide information about the status or the operational configuration. The right frame displays an explanation of the respective BIOS function in a help window.

NOTICE

Advanced and Chipset Setup Menus

Setting items to incorrect values within the Advanced and Chipset Setup menus may cause system malfunctions.

Security Setup Menu – Password Control

Administrator password set: password is only requested when entering the Setup.

User password set: password is a power on password and must be entered to boot or enter Setup. In the Setup the operator has administrator rights.

The required password length in characters is max. 20 and min. 3.

10.3. BIOS Navigation

The current active Setup menu and active BIOS function are highlighted in white. Using the hot key navigation system operators can navigate through the BIOS. The hot key legend bar is located at the bottom of the Setup screens.

The following table provides a list of navigation hot keys available in the legend bar.

Table 10: Navigation Hot Keys in Legend Bar

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

10.4. Getting Help

The Setup menu's right frame displays a help window. The help window provides an explanation of the respective BIOS function.

Register for Kontron's Customer Section to access further BIOS Information.

10.5. BIOS Updates

Kontron recommends regular BIOS updates, to ensure compatibility with a new operating system, hardware, software or to integrate new BIOS functions. Additionally, if a problem cannot be solved using a new driver, Kontron recommends updating the BIOS. Before updating the BIOS, Kontron's recommends making a backup of the current BIOS setting.

⚠CAUTION

Only update the BIOS with the new BIOS version provided in Kontron's Customer Section Website, adapted to meet the special requirements of the KBox R-101 series.

10.5.1. Updating the BIOS

Only update the BIOS with the new BIOS version provided in Kontron's Customer Section Website. The BIOS has been adapted to meet the special requirements of the KBox R-101 series variants (KBox R-101-TGL and KBox R-101-EKL).

⚠CAUTION

Only update the BIOS with the new BIOS version provided in Kontron's Customer Section Website, adapted to meet the special requirements of the KBox R-101 series.

The latest KBox R-101 series BIOS updates are available by visiting Kontron's Customer Section Website by selecting:

- KBox R Series > KBox R-101-TGL> KBox R-101-TGL BIOS or
- KBox R Series > KBox R-101-EKL> KBox R-101-EKL BIOS

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

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

After a BIOS update If the product fails to boot, the updated BIOS maybe damaged, contact Kontron Support.

11/ Board Management Controller (BMC)

11.1. BMC Task and Features

The Board Management Controller (BMC) is responsible for the following tasks and features:

- Measuring the board voltages
- Measuring the board temperature
- Control of the Power LED
- Providing an Operating Time Counter (OTC)
- Last-Reset-Cause
- Access to a non-volatile memory (EEPROM) with 7936 Bytes for general purpose
- Download and flashing new firmware versions

11.2. BMC Bootloader

The BMC consists of two parts that work in conjunction:

- BMC Bootloader
- BMC Firmware Application

When booting the KBox R-101 series, the controller starts the BMC bootloader. The BMC bootloader is responsible for verifying, whether a firmware application is available at a certain memory location in the controller. If a firmware application is available, the BMC bootloader hands over to the firmware application that performs a startup and controls the board. If no firmware application is available, the BMC bootloader remains active and handles further actions, for example, waiting for a firmware application download.

11.2.1. Power LED with BMC Bootloader

The Power LED indicates the various bootloader states and the firmware application states.

Table 11: Power LED States with BMC Bootloader

Power LED State	Description
Off	Switched off
Blinking 1 s/1 s	Bootloader active, in Suspend Mode
Blinking 0.5 s/0.5 s	Bootloader active, in Power-On Mode

11.2.2. Download a Firmware Application

The two methods of downloading a new firmware application are using the bootloader or using the current running firmware application. A detailed and latest description for the download is available in the README text file of the provided firmware package.

To download a new firmware application using the bootloader or the current running firmware application, perform the following:

1. Extract the ZIP file and copy Bootloader_Console.exe and the KBox-R101-FW-App_<version>.hex into a <folder>.
2. Find the valid device file in the kernel udev folder "/dev".

Normally the device file for the firmware download is “ttyACM0”.
Where ttyACMx: x stands for the enumeration of the device file, e.g. ttyACM0

If an additional USB-to-Serial adapter is connected to the product, other ttyACMx files are visible. It is then necessary to distinguish between the device files, either by disconnecting the USB-to-Serial device or by evaluating the device file in the kernel system folder:

```
cat /sys/class/tty/ttyACMx/device/driver/<bus-topology>/modalias
```

<bus-topology>: refers to USB-topology and references the connected USB ports e.g. "3-5.1:1.0"

Example of the output string of modalias e.g. usb:v208Bp0035d0100dc02dsc00dp00ic02isc02ip01in00

The Vendor-ID of the virtual COM-Port is 0x208B ("v208B), the Product-ID is 0x0033 ("p0033"), which is exactly the device file for the FW download

3. Start a Linux console
4. Enter the command line:

```
sudo ./Bootloader_Console_linux -c=/dev/ttyACM0 -f=<path>/KBox-R101-FW-App_<version>.hex
```

<path> is the folder path to the file.

Root permission is necessary to run the tool.

5. The new firmware application is downloaded to the controller flash. After the download and verification, the KBox R-101 series must be switched off and switch on again, to be able to run the new downloaded version of the firmware application.

11.3. BMC Firmware Application

The firmware application performs various duties when started automatically by the bootloader. Most duties are performed automatically and others duties can be controlled by the KEAPI (Kontron's embedded API). For KEAPI information, see Chapter 11.3.2: Access to the Firmware Application.

11.3.1. Power LED with BMC Firmware Application

The Power LED indicates the various bootloader states and the firmware application states.

Table 12: Power LED States with an active Firmware Application

Power LED Status	Description
Off	Switched off
Blinking 0.5 s/2 s	Firmware application active, in Suspend Mode
Permanently On	Firmware application active, Power-On Mode

11.3.2. Access to the Firmware Application

The Board Support Package (BSP) includes the KEAPI (**K**ontron **E**mbedded **A**pplication **P**rogramming **I**nterface). The KEAPI enables operators to interact with the BMC's firmware application. It is possible, to obtain the current KBox R-101 information such as temperature values, the applied voltages or other information.

Additionally, operators can read and write data to the internal EEPROM connected to the BMC.

The KEAPI comes with a tool named "ktool", that demonstrates the usage of the KEAPI. The source code is provided and documentation is available in the KEAPI package.

For the KBox R-Series BSP visit Kontron's Customer Section Website and select:

- KBox R Series >KBox R-101-TGL>KBox R-101-TGL Board Support Packages/Drivers/Tools or
- KBox R Series >KBox R-101-EKL>KBox R-101-EKL Board Support Packages/Drivers/Tools

11.4. Special Considerations with the Firmware Application

11.4.1. The Operating Time Counter (OTC)

The firmware application sets a counter every 10 minutes and saves the information in the internal EEPROM that is not accessible to the operator. This value can be read (but not written) via the KEAPI.

For example, a counter value of 360 means, the KBox R-101 series is running for 3600 minutes.

11.4.2. Last-Reset-Cause

The firmware application provides information about the last-reset-cause via the KEAPI. The return value shows what happened on the last reset or power-off.

```
Bit 7   EXTR: External Reset (MCLR) Pin bit
1 = A Master Clear (pin) Reset has occurred
0 = A Master Clear (pin) Reset has not occurred
Bit 6   SWR: Software Reset (Instruction) Flag bit
1 = A RESET instruction has been executed
0 = A RESET instruction has not been executed
Bit 5   SWDTEN: Software Enable/Disable of WDT bit(2)
1 = WDT is enabled
0 = WDT is disabled
Bit 4   WDTO: Watchdog Timer Time-out Flag bit
1 = WDT time-out has occurred
0 = WDT time-out has not occurred
Bit 3   SLEEP: Wake From Sleep Flag bit
1 = Device has been in Sleep mode
0 = Device has not been in Sleep mode
bit 2   IDLE: Wake-up From Idle Flag bit
1 = Device has been in Idle mode
0 = Device has not been in Idle mode
bit 1   BOR: Brown-out Reset Flag bit
1 = A Brown-out Reset has occurred
Note that BOR is also set after a Power-on Reset.
0 = A Brown-out Reset has not occurred
bit 0   POR: Power-on Reset Flag bit
1 = A Power-on Reset has occurred
0 = A Power-on Reset has not occurred
```

11.4.3. Get Sensor Status

The BMC cannot send status data to the operating system. The status information can only be accessed by sending a status request to the BMC via the KEAPI. In other words, the information must be polled by the operating system application.

The return value gives the following information:

```
bit 7 - 2 reserved
bit 1   PWRFAIL: Power Failure
                        1 = A Power Failure of Input Power has been detected
                        0 = Power Voltage is ok
bit 0   TEMPALERT: Temperature Alert
                        1 = A Temperature Alert in system has been detected
                        0 = Temperature in system is ok
```

The status flags can be reset by sending the RESET command (0xFE).

If the flags are set again afterwards, the KBox R-101 series and operational environment should be verified to avoid any further damages.

11.4.4. Access to the USER Partition of the EEPROM

The BMC controller provides an area of 7936 Bytes for any user data to be stored in a non-volatile memory. Data can be sent and retrieved using the KEAPI.

A read or write cycle is limited to a maximum of 32 Bytes due to the page size of the EEPROM. To read or write more data, the API call must be split into several calls. In this case page aligning, is handled by the firmware.

11.4.5. Reset Firmware

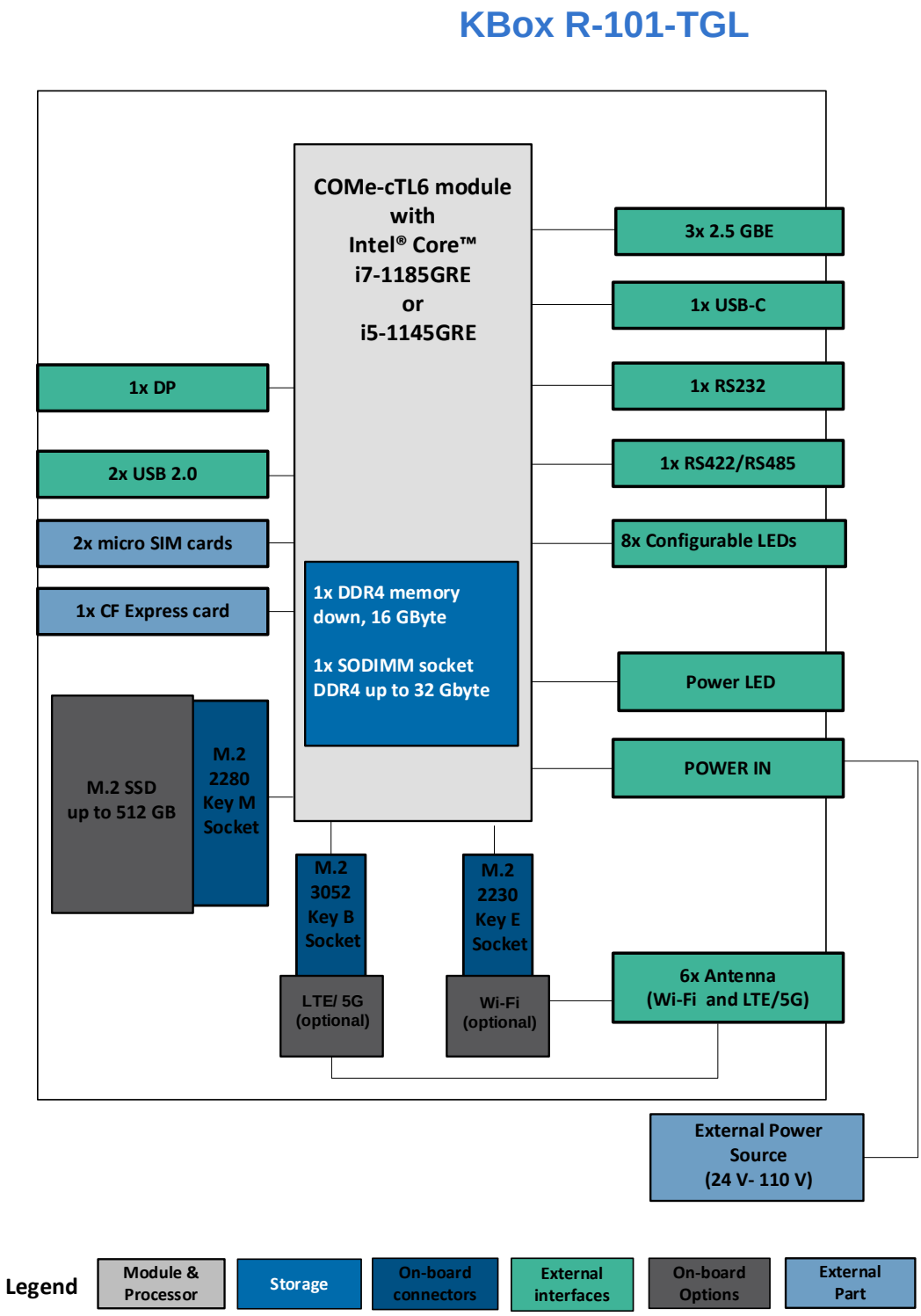
The firmware application can be reset via KEAPI. This command only resets the firmware, but not the operating system. When sending this command, a loss of the interface to the BMC might occur on the operating system side.

12/ Product Specification

12.1. Block Diagram

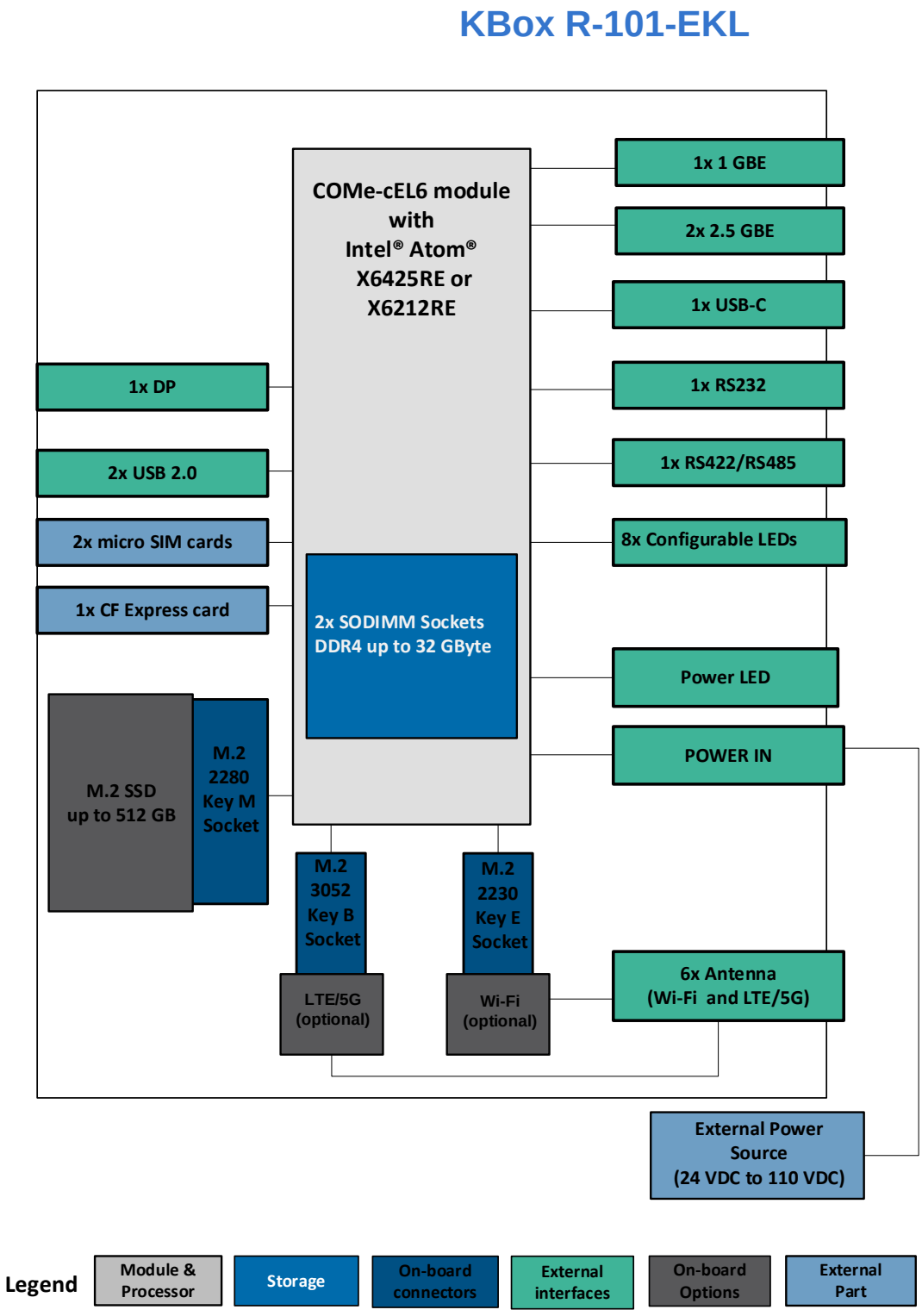
The KBox R-101-TGL implements a COM Express (COMe) module (COMe-cTL6) on a baseboard with standardized open platform interface connectors and optional network connectivity (Wi-Fi and LTE/5G).

Figure 28: Block Diagram KBox R-101-TGL



The KBox R-101-EKL implements a COM Express (COMe) module (COMe-cEL6) on a baseboard with standardized open platform interface connectors and optional network connectivity (Wi-Fi and LTE/5G).

Figure 29: Block Diagram KBox R-101-EKL



12.2. Hardware Specification

Table 13: Hardware Specification

		KBox R-101-TGL		KBox R-101-EKL	
Processor (integrated Chipset)		**Core™ i7-1185GRE** 1.8 GHz Base freq. 4.4 GHz Turbo freq. 15 W TDP 12 MB Intel® Smart Cache	**Core™ i5-1145GRE** 1.9 GHz Base freq. 4.1 GHz Turbo freq. 15 W TDP 8 MB Intel® Smart Cache	**Atom® X6425RE** 1.9 GHz Base freq. 12 W TDP 1.5 MB L2 Cache	**Atom® X6212RE** 1.2 GHz Base freq. 6 W TDP 1.5 MB L2 Cache
System Memory		DDR4 3200, 260-Pin Density: 48 GByte (max.) 1x soldered memory (16 GByte) 1x SODIMM		DDR4 3200, 260-Pin Density: 32 GByte (max.) 2x SODIMM	
Storage		1x M.2 key M 2230 SSD module Up to 512 GByte Interface: PCIe, NVMe		1x M.2 key M 2280 SSD module Up to 512 GByte Interface: SATA	
Storage Expansion		1x CFexpress slot (for reference card) • Transcend: TS128GCFE820I, 128 GB • Type B • Interfaces: PCIe Gen 3, NVMe		1x CFexpress slot (for reference card) • Transcend: TS128GCFE820I, 128 GB • Type B • Interfaces: PCIe Gen 3, NVMe	
I/O Connectors (front panel)		1x Serial port RS232 (isolated) 1x Serial port RS422/RS485 (isolated) 1x USB-C 3x 2.5 GbE (M12 X-coded) 4x Antenna (SMA) 2x Antenna (RP-SMA)		1x Serial port RS232 (isolated) 1x Serial port RS422/RS485 (isolated) 1x USB-C 2x 2.5 GbE (M12 X-coded) 1x 1 GbE (M12 X-coded) 4x Antenna (SMA) 2x Antenna (RP-SMA)	
Indicator LEDs		3x Link and Activity Ethernet LEDs 8x Configurable GPIO LEDs (yellow) 1x Power status LED (green)		3x Link and Activity Ethernet LEDs 8x Configurable GPIO LEDs (yellow) 1x Power status LED (green)	
I/O Connectors (service panel)		1x Display Port (DP++) 2x USB 2.0		1x Display Port (DP++) 2x USB 2.0	
Security		TPM 2.0		TPM 2.0	
RTC Supercap		72 hour buffer time (when fully charged)		72 hour buffer time (when fully charged)	
Power		24 VDC to 110 VDC Imax 3 A		24 VDC to 110 VDC Imax3 A	
Options	**Wi-Fi**	1x M.2 2230 Wi-Fi module Interface: Wi-Fi – PCIe / BT - USB Category: Wi-Fi (IEEE 802.11ax)/Bluetooth® 5.3			
	5G **or** **LTE**	1x M.2 3052 5G module Category: 5G with automatic 4G and 3G fallback Downlink: 4.5 Gbps and Uplink 660 Mbps			
		1x M.2 3042 LTE Module Category: 4G with 3G fallback Downlink up to 600 Mbps and Uplink 150 Mbps			

12.3. Software Specification

Table 14: Software Specification

	KBox R-101-TGL	KBox R-101-EKL
Operating System (OS)	Linux	
BIOS	AMI Aptio V5	

12.4. Power Specification

Before connecting the KBox R-101 series to an external DC power supply, ensure that the external DC power supply meets the product's electrical specification (Table 15) and that protection and supply limitations have been taken into consideration. A no fuse symbol with warning text on the type label (Figure 2, pos. 6) stipulates the use of an external DC power supply with mandatory 5AT fuse or safety device. When the no fuse symbol with warning text is not present (Figure 2, pos. 7) the use of a external DC power supply with fuse or safety device is not a requirement. Whether either a 5AT fuse or a safety device is implemented must be decided by the operator to meet the requirements in the field.

The external DC power supply used must automatically recover from AC power loss and start up under peak loading and be designed to achieve NEC Class-2 and Limited Power Source (LPS).

Table 15: Electrical Specification

Electrical Specification	KBox R-101-TGL	KBox R-101-EKL
Input Voltage (nominal)	24 VDC to 110 VDC	
Input Voltage (operating)	16.8 VDC to 137.5 VDC	
Input Current	Imax 3 A	
Power	60 W	
Hold-up Time	>10 ms at 60 W load (class S2)	
Recovery Time	2 s (minimum time between switching off and switching on the product)	

⚠CAUTION

Mandatory 5AT Fuse or Safety Device Requirement

It is prohibited to connect the product to an external DC power supply without a 5AT fuse or safety device, if the product is configured with no internal fuse as stipulated on the type label (no-fuse symbol and warning text "External fuse mandatory 5AT").

⚠CAUTION

Only connect the product to an external DC power supply delivering the specified input rating and complying with the requirements of Safety Extra Low Voltage (SELV) and LPS and PS2 (UL/IEC 62368-1).

⚠CAUTION

Observed that wiring and short-circuit/overcurrent protection is performed according to the applicable standards, regulations and in respect to the product's electrical specification. The disconnecting device fuse/circuit breaker rating (when not specified on the type label) must be in accordance with the product's wire cross-section.

NOTICE

Operate the external DC power supply according to the manufacturer's instructions.

NOTICE

Ensure the power supply has been fully tested to meet the minimum immunity of AC inputs requirements, as stipulated in IEC 55024. Including power supplies marketed with a separate AC/DC power converter.

NOTICE

Do not disconnect the power while the product is in operation. This performs a forced shutdown and can lead to loss of data. To avoid loss of date, first perform an orderly system shutdown.

NOTICE

If the product is switched off or a power off state (brownout) occurs for longer that the supported hold up time of 10 ms, a recovery time of 2 s must be maintained to allow internal voltages to discharge sufficiently.

Failure to observe the specified recovery time of 2 s between switching off and switching on the product, may lead to malfunction. For recovery time information, contact Kontron Support.

12.4.1. Power Supply Protection Requirements

The external DC power supply must incorporates protection such as over current protection, inrush current protection, over voltage protection, and under voltage (brownout) protection against fluctuations and interruptions in the delivered DC power supply.

12.4.2. Power Consumption

The total power consumption depends on factors such as the COM Express (COMe) module, external interfaces and expansion devices.

Table 16: Power Consumption

State	Max. Power Consumption
Switched Off	7 W
Idel Mode	16 W
Maximum Load	35 W

The external DC power supply must supply the power required by all configured components.

The maximum system ambient temperature depends mostly on the power consumption of the processor, chipset and third party components.

12.4.3. Protective Earth Bolt

The protective earth bolts connects to an external conductor to in the case of a fault protection against electric shock, or the terminal of a protective earth (ground electrode).

When installing cables, ensure that the first cable connects the protective earth bolt to a suitable to ground. When disconnecting ensure that, the protective earth bolt is the last disconnected cable.

⚠CAUTION

When connecting cables, following proper cabling procedures:

1. Connect the ground cable to the protective earth bolt
2. Connect all interface cables
3. Connecting the power cable to the Power IN connector

12.5. Environmental Specification

Table 17: Environmental Specification

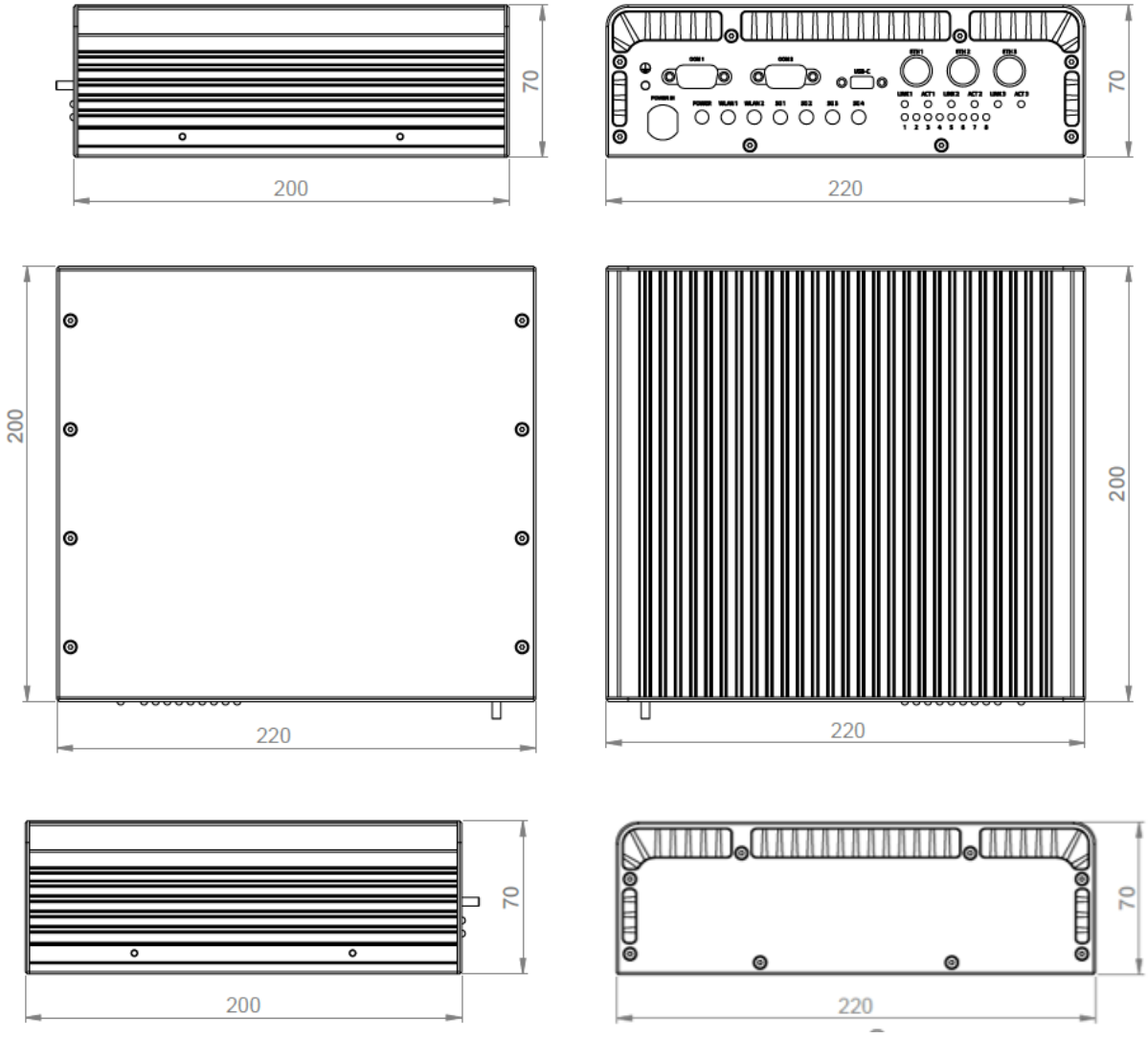
Environmental Specification	Description
Temperature (operating) According to: EN 50155 - EN 60068-2-1 – Cold and EN 60068-2-2 - Dry heat)	OT4: -40°C to +70°C (-40°F to 158°F) ST1: OT4 +15°C (duration: 10 min)
Humidity (operating) According to: EN 50155 - EN 60068-2-30- Damp heat cyclic	+25°C to +55°C (77°F to 131°F), 95%
Shock (non-operating) According to: EN 50155 - EN 60068-2-27- Single shock and EN 61373- Shock testing conditions	Category: 1, Class B Severity: 50 m/s2 Duration: 30 ms No. Shocks: 3 per axis and direction
Vibration (operating) According to: EN 50155- EN 60068-2-64- Random vibration and EN 61373 – Functional random vibration test conditions	Functional Category: 1, Class B Severity: 1.01 m/s2 RMS Duration per axis: 10 min.
Vibration (operating) According to: EN 50155 - EN 60068-2-64- Random vibration and EN 61373 – Simulated long-life testing at increased random vibration levels	Long-life Category: 1, Class B Severity: 5.72 m/s2 RMS Duration per axis: 5 hours
Salt Mist (non-operating) According to: EN 50155 - EN 60068-2-11 – Test Ka: Salt Mist	Duration: 48 hours
Altitude (operating)	3,000 m (9,840 feet) maximum
Altitude (non-operating)	10,000 m (32,800 feet)
IP Protection Class	IP54
MTBF	187,747.94 hours KBox R-101-TLE-i5i-0-256-0-0-0-1-0-000

12.6. Mechanical Specification

Table 18: Mechanical Specification

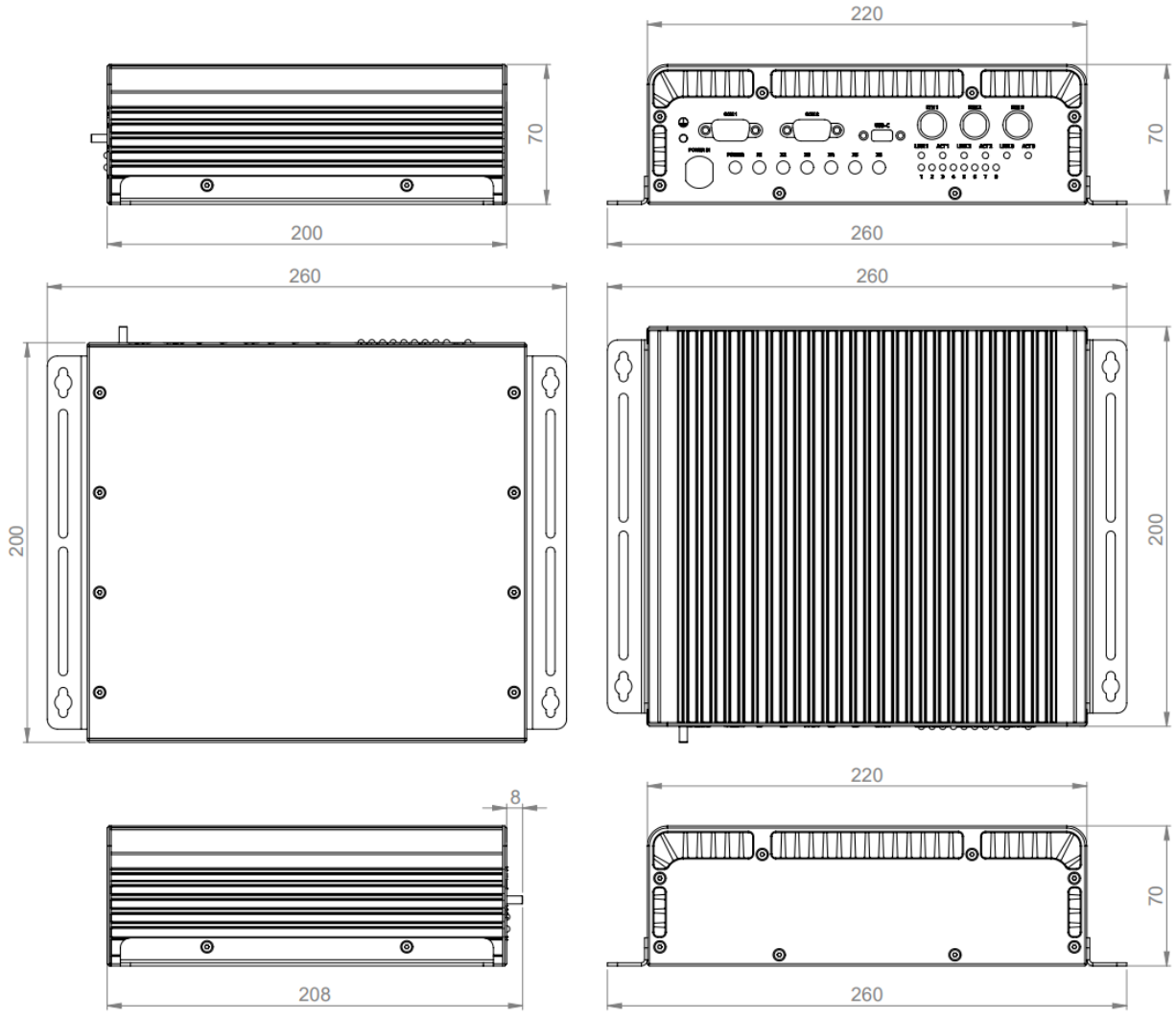
Mechanical Specification	Description
Dimension (WxHxD)	220 mm x 70 mm x 200 mm (8.66" x 2.76" x 7.87")
Chassis	Aluminum black anodized
Front Panel	Aluminum
Cooling Solution	Fanless operation, natural convection
Weight	3.1 kg/6.8 lbs. (approx.)

Figure 30: Mechanical Dimensions (mm)



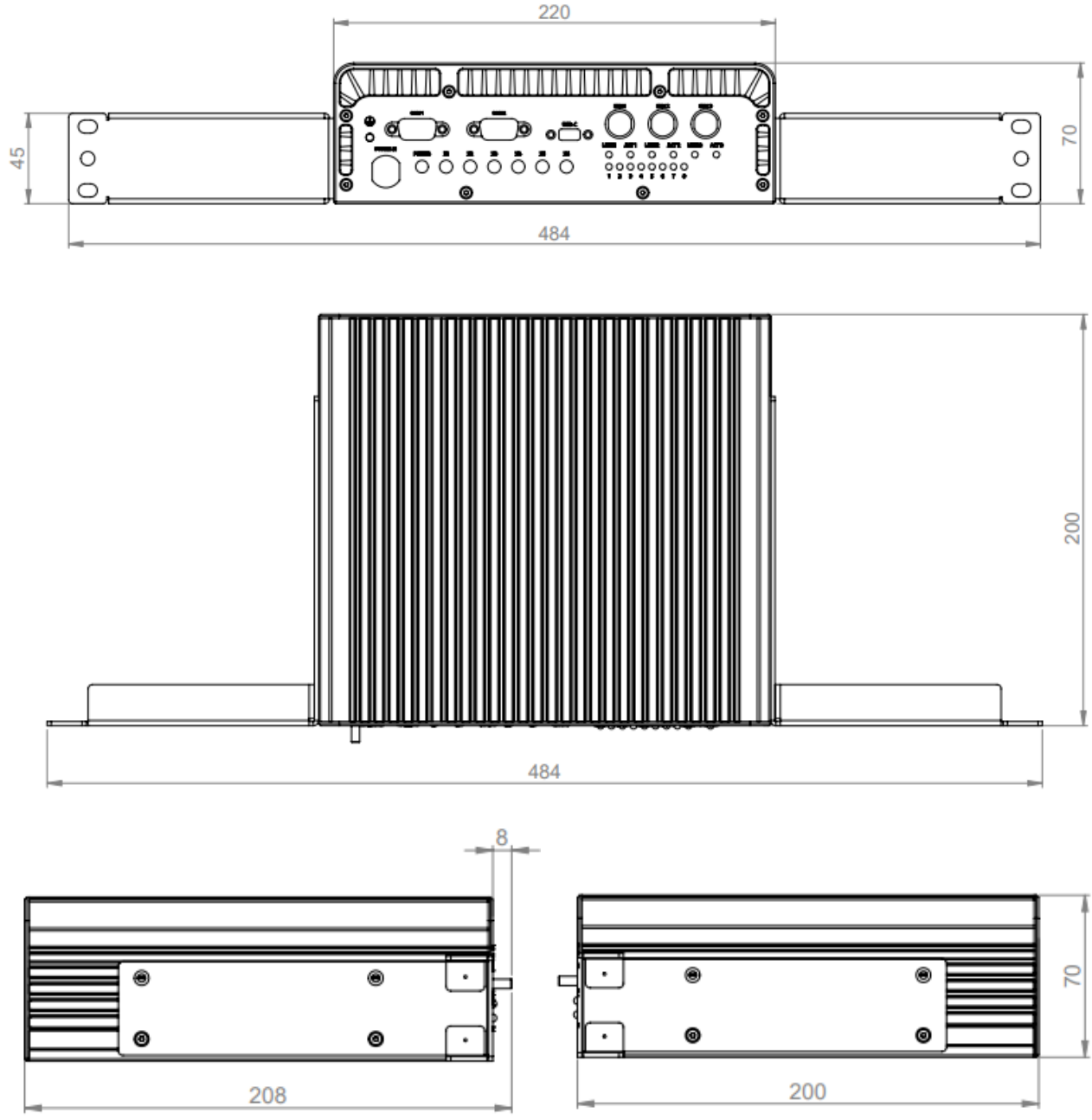
To download the product's Step files, visit Kontron's Customer Section.

Figure 31: Mechanical Dimensions with Wall Mount Brackets (mm)



To download the product's Step files, visit Kontron's Customer Section.

Figure 32: Mechanical Dimensions with 19" Rack Mount Brackets (mm)



To download the product's Step files, visit Kontron's Customer Section.

12.7. Compliance

The KBox R-101 series complies with the requirements and the approximation of the laws relating to compliance for 'Railway', 'CE' or 'RED', and the standards (or later thereof) that are constitutional parts of the declaration.

Table 19: Compliance Railway

Railway	
General	**EN 50155** Railway Applications- Rolling stock- electronic equipment
EMC	**EN 50121-3-2** Railway applications - Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus **EN 61000-4-29** Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques; Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests **EMV 06** Technical rules on electromagnetic compatibility; verification of the radio compatibility of rail vehicles with rail radio services
Safety	**EN 50153** Railway applications - Rolling stock - Protective provisions relating to electrical hazards **EN50124-1** Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment **EN ISO 13732-1** Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces (ISO 13732-1:2006) **EN 45545-1** Railway applications - Fire protection on railway vehicles - Part 1: General **EN 45545-2** Railway applications - Fire protection on railway vehicles - Part 2: Requirements for fire behavior of materials and components **EN 45545-5** Railway applications - Fire protection on railway vehicles - Part 5: Fire safety requirements for electrical equipment including that of trolley buses, track guided buses and magnetic levitation vehicles **EN 61373** Railway applications - Rolling stock equipment - Shock and vibration tests
Environment	**EN 50125-1** Railway applications - Environmental conditions for equipment - Part 1: Rolling stock and on-board equipment **EN 61373** Railway applications - Rolling stock equipment - Shock and vibration tests **EN 45545-2** Railway applications - Fire protection on railway vehicles - Part 2: Requirements for fire behavior of materials and components; **EN 60529** Degrees of protection provided by enclosures (IP Code) **EN 60068-2-1** Environmental testing - Part 2-1: Tests - Test A: Cold **EN 60068-2-2** Environmental testing - Part 2-2: Tests - Test B: Dry heat **EN 60068-2-11** Environmental testing - Part 2-11: Tests - Test Ka: Salt mist **EN 60068-2-30** Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle) **EN 60068-2-27** Environmental testing - Part 2-27 : Single shock **EN 60068-2-64** Environmental testing - Part 2-64: Randon Vibration

Table 20: Compliance CE

CE Mark	
Directives	2014/30/EU Electromagnetic Compatibility 2014/35/EU Low Voltage 2011/65/EU RoHS II
EMC	EN 55032 Electromagnetic compatibility of multimedia equipment- Emission Requirements EN 55035 Electromagnetic compatibility of multimedia equipment - Immunity requirements EN 61000-6-2 Electromagnetic Compatibility (EMC) – Part 6-2: Generic standards - Immunity standard for industrial environments
Safety	EN 62368-1 Audio/video, information and communication technology equipment - Part 1: Safety requirements.
Environment	EN 60068-2-1 Environmental testing - Part 2-1: Tests - Test A: Cold EN 60068-2-2 Environmental testing - Part 2-2: Tests - Test B: Dry heat EN 60068-2-11 Environmental testing - Part 2-11: Tests - Test Ka: Salt mist EN 60068-2-30 Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle) EN 60068-2-27 Environmental testing - Part 2-27 : Single shock EN 60068-2-64 Environmental testing - Part 2-64: Random Vibration

Table 21: Compliance RED mark

CE RED Mark	
Directives	2014/53/EU Radio equipment 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment
EMC	EN 55032 Electromagnetic Compatibility of multimedia equipment- Emission Requirements EN 55035 Electromagnetic compatibility of multimedia equipment - Immunity requirements EN 61000-6-2 Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments EN 301 489-1 V2.2.3 Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements EN 300 328 V2.2.2 Wideband transmission systems - Data transmission equipment operating in the 2.4 GHz ISM band and using wide band modulation techniques EN 301 893 V2.1.1 5 GHz RLAN EN 301 908-1 V15.1.1 IMT cellular networks; Harmonized standard for access to radio spectrum; Part 1: Introduction and common requirement Release 15

CE RED Mark	
Safety Health & Safety	EN 62368-1 Audio/video, information and communication technology equipment - Part 1: Safety requirements EN 62311 Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
Environment	EN 60068-2-1 Environmental testing - Part 2-1: Tests - Test A: Cold EN 60068-2-2 Environmental testing - Part 2-2: Tests - Test B: Dry heat EN 60068-2-11 Environmental testing - Part 2-11: Tests - Test Ka: Salt mist EN 60068-2-30 Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle) EN 60068-2-27 Environmental testing - Part 2-27 : Single shock EN 60068-2-64 Environmental testing - Part 2-64: Random Vibration

The KBox-R-101-TGL and KBox R-101-EKL plan to comply with the following country specific certifications (or later thereof). If the product is modified, the prerequisites for specific approvals may no longer apply.

Table 22: Country Compliance

USA/CANADA	
EMC	FCC 47 CFR Part 15 (Class B) and ICES-003 Complies with part 15 FCC rules and regulations of title 47 of the CFR rules for class B products; under which an unintentional radiator may be operated, administrated and other conditions relating to the marketing of part 15 devices.

International Certifications	
EMC	IEC 61000-6-2 Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments.
Safety	IEC 62368-1 Audio/video, information and communication technology equipment - Part 1: Safety 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 operator's responsibility.

The transmission and reception of data cannot be guaranteed when using wireless networks. Corruption may occur or data may be lost. The product should not be used in environments where the failure to send data could result in personal injury or damage. Kontron is not responsible for personal injuries or damages caused by delays, errors or failures to transmitted or received data using the product.

Do not operate the product near equipment that may be susceptible to any form of radio interference. Switch the product off in such environments, to avoid interference with this equipment.

13/ Standard Interfaces – Pin Assignments

This chapter describes the KBox R-101 series available power, interface connectors, status LEDs, antenna and slots.

13.1. Front Panel

NOTICE

All front panel connectors are IP54 compliant.

13.1.1. M12 Power IN Connector

The Power IN connector is a 5-pin K code M12 connector with locking thread suitable for industrial applications and environments. The Power IN connector is IP54 compatible. To connect the Power IN connector to an external DC power supply only use the M12 mating power connector included in the delivery and available as a spare part, see Table 2: Accessories and Spare Parts.

For information on how to wire the M12 mating Power IN connector, see Chapter 8.2: Wiring the M12 Mating Power Connector.

For information on which DC power supply to connect to the Power IN connector, see Chapter 4.1.1: Power IN and Chapter 12.4: Power Specification.

⚠CAUTION

Mandatory 5AT Fuse or Safety Device Requirement

It is prohibited to connect the product to an external DC power supply without a 5AT fuse or safety device, if the product is configured with no internal fuse as stipulated on the type label (no-fuse symbol and warning text "External fuse mandatory 5AT").

Whether either a 5AT fuse or a safety device is implemented must be decided by the operator to meet the requirements in the field.

The product is delivered with the required M12 mating power connector. To order a replacement M12 mating power connector, see Table 2: Accessories and Spare Parts.

Table 23: Power IN Pin Assignment

5-position K code M12 (male)	Pin	Signal	Description
	1	Ignition	Ignition control states: • Ignition NC - ignition function not in use • Ignition disabled – Ignition control voltage 0 V to 0.8 V product switches off • Ignition enabled - Ignition control voltage 2 V to 138 V product switches on
	2	VIN+	24 VDC Input
	3	GND	Ground
	4	NC	Not Connected
	PE	PE	Protective Earth

The mating M12 power connector specification is:

- Type M12, female, round, 5-pins, Coding K-power
- Cable outer diameter 8 mm to 13 mm

- Screw terminal wire connection
  - Wire cross section of 1.5 mm^2 (max.) with ferrules or 2.5 mm^2 (max.) without ferrules
  - AWG 16 with ferrules or AWG 14 without ferrules

13.1.2. Power LED (Green)

The power LED illuminated green when the product is switched on. The power LED is IP54 compliant.

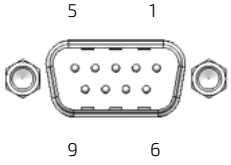
13.1.3. Serial Port Connectors (COM1, COM2)

The two isolated COM serial ports. COM2 is a 9-pin D-SUB (male) connector and supports the RS232 protocol. COM1 is a 9-pin D-SUB (female) connector and RS422/RS485 configurable with the RS422 protocol as default. The serial port connectors are both IP54 compatible. Lock the cables securely to the serial ports connectors using UNC bolts.

Table 24: RS232 (COM2) 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	NC

Table 25: RS422/RS485 (COM1) Pin Assignment

9-pin D-SUB (female)	Pin	RS422	RS485
	1	Rx+	
	2		
	3		
	4	TX+	TX+/RX+
	5	GND	GND
	6	RX-	
	7		
	8		
	9	TX-	TX-/RX-

Signal	Description
TX+/-	Transmitted Data differential pair sends data to the communications link.
RX+/-	Received Data differential pair receives data from the communications link.
GND	Power supply GND signal

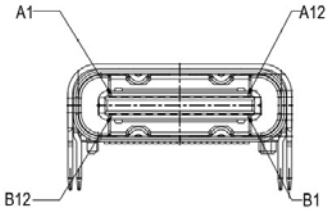
The two serial ports (COM1 and COM2) use different connector types,

- COM1 is a 9-pin D-SUB (female) connector
- COM2 is a 9-pin D-SUB (male) connector

13.1.4. USB-C Port Connector (USB-C)

The USB-C connector with seal is suitable for industrial applications and environments. The USB-C connector is IP54 compatible.

Table 26: USB 3.1 Type C Port (USB-C) Pin Assignment

USB Type C	Pin	Signal Name	Pin	Signal Name
	A1	GND	B12	GND
	A2	SSTX1+	B11	SSRX1+
	A3	SSTX1-	B10	SSRX1-
	A4	VBus	B9	VBus
	A5	CC1	B8	SBU2
	A6	D1+	B7	D2-
	A7	D1-	B6	D2+
	A8	SBU1	B5	CC2
	A9	VBus	B4	VBus
	A10	SSRX2-	B3	SSTX2-
	A11	SSRX2+	B2	SSTX2+
	A12	GND	B1	GND

Signal	Description
SSTX1+/ SSTX1-	Super Speed differential pair Transmit (+/-) Signal direction is to USB device.
SSRX1+/SSRX1-	Super Speed differential pair, Receive (+/-) Signal direction is from USB device
D1+/D1-	USB 2.0 differential pair (+/-)
CC1	Configuration channel
SBU	Side Band Use
VBus / GND	Bus power/Ground

To achieve the specified performance for USB 3.1 use cabling that complies with the USB 3.1 standard.

13.1.5. Antenna Connectors for Wi-Fi Connection (X1, X2)

The two RP-SMA (female) antenna connectors are suitable for industrial applications and environments and require a mating antenna cable with connector type, RP-SMA (male). The antenna connectors are IP54 compliant.

13.1.6. Antenna Connectors for Cellular Connection (LTE or 5G) (X3, X4, X5, X6)

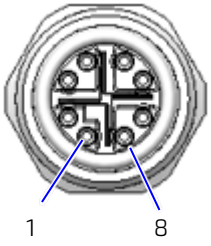
The four SMA (female) antenna connectors are suitable for industrial applications and environments and require a mating antenna cable with connector type SMA (male). The antenna connectors are IP54 compliant.

13.1.7. M12 Ethernet Port Connectors (ETH1, ETH2, ETH3)

The three M12 Ethernet ports with locking thread are suitable for industrial applications and environments. The Ethernet connectors are IP54 compliant.

For the KBox R-101-TGL, ETH1, ETH2 & ETH3 are 2.5 GbE and KBox R-101-EKL, ETH1 is 1 GbE & ETH2, ETH3 are 2.5 GbE.

Table 27: 2.5 GbE Ethernet Port Pin Assignment (ETH1, ETH2, ETH3)

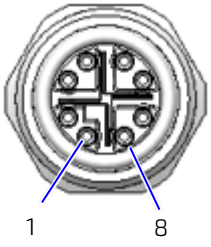
M12 (ETH2, ETH3) (female)	Pin	Signal Name	Description
	1	TX1+	Transmitted Data differential pair 1+/-
	2	TX1-	
	3	TX 2+	Transmitted Data differential pair 1+/-
	4	TX 2-	
	5	TX 4+	Transmitted Data differential pair 4+/-
	6	TX 4-	
	7	TX 3-	Transmitted Data differential pair 3+/-
	8	TX 3+	

Ethernet LINK LEDs		Ethernet ACT LEDs	
Off	10/100 Mbit/s	Off	Link down
Blinking	1 Gbit/s	Blinking	Link up and active
On	2.5 Gbit/s	On	Link up and no activity

Signal	Description
TX1+ / TX1-	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.
TX2+ / TX2-	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.
TX3+ / TX3-	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.
TX4+ / TX4-	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.

For the KBox R-101-EKL - ETH1 is 1 GBE.

Table 28: 1 GbE Ethernet Port Pin Assignment (ETH1)

M12 (ETH1) (female)	Pin	Signal Name	Description
	1	TX1+	Transmitted Data differential pair 1+/-
	2	TX1-	
	3	TX 2+	Transmitted Data differential pair 1+/-
	4	TX 2-	
	5	TX 4+	Transmitted Data differential pair 4+/-
	6	TX 4-	
	7	TX 3-	Transmitted Data differential pair 3+/-
	8	TX 3+	

Ethernet LINK LEDs		Ethernet ACT LEDs	
Off	10Mbit/s	Off	Link down
Blinking	100 Mbit/s	Blinking	Link up and active
On	1 Gbit/s	On	Link up and no activity

The mating (2.5 GbE/1GbE) Ethernet port connector specification is:

- Type M12, male
- Round
- 8-pin
- Coding X

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.

For technical reasons, the LEDs, especially the Activity LEDs, may blink at different rhythms.

13.1.8. Configurable LEDs (1,2,3,4,5,6,7,8)

The eight configurable GPIO LEDs are operator definable, enabling operators to display the status of specific activities on the front panel by activating the LED to illuminate (yellow) in a set state. The configurable LEDs are IP54 compliant.

For information on how to configure the LEDs, see Chapter 9.3: Setting Up the Indicator LEDs.

13.2. Service Panel

The service panel connectors are not IP54 compliant. For IP54 compliance, the service cover must be installed and sealed properly.

⚠CAUTION

Service Cover Seal Loop

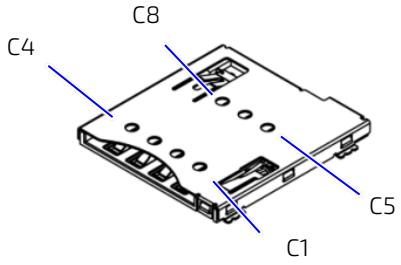
The inside of the service cover includes a seal loop. Failure to install the seal loop properly may result is a broken seal and invalidate the product's IP54 protection or damage the product.

When reinstalling the service cover, operators must check that the seal loop:

- remains properly inserted within the service cover groove
- has no visible damaged
- has not suffered degradation such as cracking, hardness and reduced flexibility

13.2.1. micro SIM Card Slot (SIM1, SIM2)

Table 29: micro SIM Card Slot Pin Assignment

6-pin micro SIM card slot	Pin	Signal Name
	C1	VCC
	C2	RST
	C3	CLK
	C4	NA
	C5	GND
	C6	VPP
	C7	IO
	C8	NA
	CD	Card Detect

NOTICE

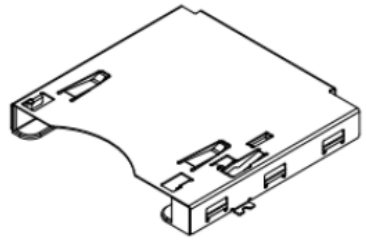
Only insert or remove the SIM cards if the product is switched off properly.

The micro SIM cards are not part of the delivery and must be provided by the operator, to support the require network.

The two SIM slots are only used in combination with 5G/LTE and are not available for storage.

13.2.2. CFexpress Card Slot (CFexpress)

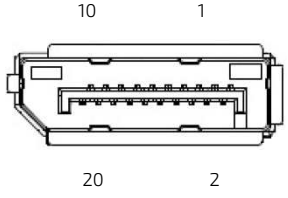
Table 30: CFexpress Slot Pin Assignment

CFexpress slot	Pin	Signal Name	Pin	Signal Name
	1	GND	11	CLKREQ#
	2	NC	12	INS#
	3	NC	13	REFCLK-
	4	NC	14	RECLK+
	5	NC	15	GND
	6	NC	16	PERno
	7	NC	17	PERpo
	8	NC	18	GND
	9	PERST#	19	PETno
	10	+3.3V	20	PETpo
			21	GND

NOTICE Only insert or remove the CFexpress card if the product is switched off properly.

13.2.3. Display Port Connectors (DP)

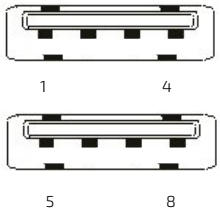
Table 31: Display Port (DP) Pin Assignment

20-pin DP Connector (female)	Pin	Signal Name	Description
	1	TX0+	Display Port Lane 0 transmitter differential pair (+)
	2	GND	Ground
	3	TX0-	Display Port Lane 0 transmitter differential pair (-)
	4	TX1+	Display Port Lane 1 transmitter differential pair (+)
	5	GND	Ground
	6	TX1-	Display Port Lane 1 transmitter differential pair (-)
	7	TX2+	Display Port Lane 2 transmitter differential pair (+)
	8	GND	Ground
	9	TX2-	Display Port Lane 2 transmitter differential pair (-)
	10	TX3+	Display Port Lane 3 transmitter differential pair (+)
	11	GND	Ground
	12	TX3-	Display Port Lane 3 transmitter differential pair (-)
	13	CONFIG1	Cable adapter Detest signal for DP++
	14	CONFIG2	Connected to Ground
	15	AUX+	Display Port Auxiliary channel differential pair (+)
	16	GND	Ground
	17	AUX-	Display Port Auxiliary channel differential pair (-)
	18	Hot Plug Detect	Display Port hot plug detect
	19	Return	
	20	PWR	Power for connector

13.2.4. USB 2.0 Port Connectors (USB 2.0)

The two USB 2.0 ports support Type A connectors and are located on the service panel behind the service cover.

Table 32: USB 2.0 port Type A (USB 2.0) Pin Assignment

USB 2.0 Type A (4-pin)	Pin	Signal Name	Description
	1	VCC_Top	+5 V power supply for USB device
	2	Top_Data-	USB 2.0 differential pair (-)
	3	Top_Data+	USB 2.0 differential pair (+)
	4	GND_Top	Ground
	5	VCC_Bottom	+5 V power supply for USB device
	6	Bottom_Data-	USB 2.0 differential pair (-)
	7	Bottom_Data+	USB 2.0 differential pair (+)
	8	GND_Bottom	Ground

To achieve the specified performance for USB 2.0 use cabling that complies with the USB 2.0 standard.

14/ Maintenance

The KBox R-101 series is factory configured and maintenance free. Opening the cover invalidates the warranty and may cause damage to internal components and corrupt the product's internal seal. Operators are only permitted to open the product's service cover to gain access to the interfaces on the service panel.

⚠CAUTION

Service Cover Seal Loop

The inside of the service cover includes a seal loop. Failure to install the seal loop properly may result is a broken seal and invalidate the product's IP54 protection or damage the product.

When reinstalling the service cover, operators must check that the seal loop:

- Remains properly inserted within the service cover groove
- Has no visible damaged
- Has not suffered degradation such as cracking, hardness and reduced flexibility

⚠CAUTION

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

ESD Sensitive

Follow the safety instructions for components that are sensitive to electrostatic discharge (ESD). Failure to observe this warning notice may result in damage to the product or/and internal components.

NOTICE

Seal label

The product is factory configured to meet customer requirements and closed with an adhesive seal label. Opening the product by removing the base, damages the seal label and invalidates the warranty and may cause damage to internal components, and corrupt the product's protection class IP 54 seal.

NOTICE

The product is factory configured. To replace or install internal components, returning the product to Kontron, see Chapter 16.1: Returning Defective Merchandise.

14.1. Cleaning

Cleaning the KBox R-101 series is not a requirement, however Kontron recommends cleaning the product to remove dust and dirt to maintain the best conditions for cooling the product.

When cleaning take into consideration, that the product is IP54 protected against dust in harmful quantities and water splashes on all sides. The product may become hot during operation and the operator must take precautions when handling the product during operation.

Hot Surface

Heatsinks can get very hot. To avoid burns and personal injury:

- **Do not touch the heatsink when the product is in operation**
- **Allow the product to cool before handling**
- **Wear protective gloves**

Surface chaude

Les dissipateurs thermiques peuvent devenir très chauds. Pour éviter les brûlures et les blessures :

- **Ne touchez pas le dissipateur thermique lorsque le produit est en fonctionnement**
- **Laisser refroidir le produit avant de le manipuler**
- **Portez des gants de protection**

To clean the surface of the KBox R-101 series, perform the following:

1. Take precaution not to touch the product's heatsink during operation or allow the product to cool before handling.
2. Initially remove dust using a clean soft brush and/or a clean soft microfiber cloth only.
3. If lightly soiled, gently wipe the product with a dry microfiber cloth.
4. Remove stubborn dirt using a microfiber cloth, dampened with warm soapy water only! Do not use a chemical substance this may damage the lettering and chassis finish.

Do not use steel wool, metallic threads or solvents like abrasives, alcohol, acetone or benzene to clean the product.

14.2. Accessing the Service Panel

To perform maintenance on the service panel and access the DP port, two USB 2.0 ports, two SIM card slots and one CFexpress card slot, the operator must remove the service cover, see Chapter 6.1: Accessing the Service Panel.

To removing the service cover during operation, the operator must take precautions not to touch the product such as wearing protective gloves. Alternatively, switch off the product properly and allow the product to cool.

Hot Surface

Heatsinks can get very hot. To avoid burns and personal injury:

- Do not touch the heatsink when the product is in operation
- Allow the product to cool before handling
- Wear protective gloves

Surface chaude

Les dissipateurs thermiques peuvent devenir très chauds. Pour éviter les brûlures et les blessures :

- Ne touchez pas le dissipateur thermique lorsque le produit est en fonctionnement
- Laisser refroidir le produit avant de le manipuler
- Portez des gants de protection

⚠CAUTION

Service Cover Seal Loop

The inside of the service cover includes a seal loop. Failure to install the seal loop properly may result is a broken seal and invalidate the product's IP54 protection or damage the product.

When reinstalling the service cover, operators must check that the seal loop:

- Remains properly inserted within the service cover groove
- Has no visible damaged
- Has not suffered degradation such as cracking, hardness and reduced flexibility

15/ Storage and Transportation

15.1. Storage

If it is necessary to store the KBox R-101 series, switch off properly by disconnecting the product from the external DC power supply, by removing the power cable from the Power IN connector or the external DC power supply.

Once disconnected the KBox R-101 series is still hot and the operator must wait until the product cools down before handling.

⚠CAUTION

Hot Surface

Heatsinks can get very hot. To avoid burns and personal injury:

- Do not touch the heatsink when the product is in operation
- Allow the product to cool before handling
- Wear protective gloves

Surface chaude

Les dissipateurs thermiques peuvent devenir très chauds. Pour éviter les brûlures et les blessures :

- Ne touchez pas le dissipateur thermique lorsque le produit est en fonctionnement
- Laisser refroidir le produit avant de le manipuler
- Portez des gants de protection

When cooled the operator should disconnect the KBox R-101 series in the following order, remove the power cable from the front panel (if not already removed), remove the interface and antenna cables and remove the ground cable from the protective earth bolt. If inserted remove the service cover and extract the SIM card(s) and CFexpress card from the service panel.

Repack the KBox R-101 series as originally delivered to avoid damage. The storage facility must meet the products environmental storage requirements as stated within this user guide. Kontron recommends keeping the original packaging material for future storage or warranty shipments.

15.2. Transportation

To ship the KBox R-101 series, 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.

16/ 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, located on the base.

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

16.1. 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.

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 – Augsburg** 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 on the type label (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.
   Send the completed RMA-Request form to the fax or email address given on the RMA Request sheet and Kontron will provide an RMA-Number.
3. The goods for repair must be packed properly for shipping, considering shock and ESD protection.

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

4. 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.

16.2. Warranty

Kontron defines product warranty in accordance with regional warranty definitions. Claims are at Kontron's discretion and limited to the defect being of a material nature. To find out more about the warranty conditions and the defined warranty period for your region, following the steps below:

1. Visit Kontron's Term and Conditions webpage.

   http://www.kontron.com/terms-and-conditions

2. Click on your region's General Terms and Conditions of Sale.

NOTICE

Seal label

The product is factory configured to meet customer requirements and closed with an adhesive seal label. Opening the product by removing the base, damages the seal label and invalidates the warranty and may cause damage to internal components, and corrupt the product's protection class IP 54 seal.

16.2.1. Limitation/Exemption from Warranty Obligation

In general, Kontron shall not be required to honor the warranty, even during the warranty period, and shall be exempted from the statutory accident liability obligations in the event of damage caused to the product due to failure to observe the following:

- General safety instructions within this user guide.
- Type label information and specifications
- Warning labels on the product and warning symbols within this user guide.
- Information and hints within this user guide.

Additionally, alterations or modifications to the product that are not explicitly approved by Kontron, described in this user guide, or received from Kontron Support as a special handling instruction will void your 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.

List of Acronyms

Table 33: List of Acronyms

API	Application Programming Interface
AWG	American Wire Gauge
BIOS	Basic Input Output System
BMC	Board Management Controller
BSP	Board Support Package
BT	BlueTooth
CFR	Code of Federal Regulations
COM	Communication port
DP	Display Port
EN-DC	E-UTRA-NR Dual Connectivity
EEPROM	Electrically Erasable Programmable Read Only Memory
ESD	Electro Static Device
EMC	Electromagnetic Compatibility
FCC	Federal Communications Commission
FDD	Frequency Division Duplex
GbE	Giga bit Ethernet
HSPA	High Speed Packet Access
IOT	Internet of Things
ITE	Information Technology Equipment
KEAPI	Kontron Embedded API
LAN	Local Area Network
LED	Light-Emitting Diode
LTE	Long Term Evolution
MIMO	Multiple -input Multiple-output
MTBF	Mean Time Before Failure
NA	Not Available
NC	Not Connected
NE-DC	NR-only Dual Connectivity
NR	New Radio
NSA	Non Standalone
OS	Operating System
O	Operating Time Counter
PE	Protective Earth
PSU	Power Supply Unit
RAT	Radio Access Technology
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
RED	Radio Equipment Directive
RMA	Return of Material Authorization
ROHS	Restriction Of Hazardous Substances
RTC	Real Time Clock
RSS	Radio Standards Specification
SA	Standalone
SELV	Separate Extra Low Voltage
SN	Serial Number
TBD	To Be Decided
TDD	Time Division Duplex
UEFI	Unified Extensible Firmware Interface
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
VCC	Voltage Common Collector
VDC	Voltage Direct Current
WCDMA	Wideband Code Division Multiple Access
WEEE	Waste Electrical and Electronic Equipment
Wi-Fi	Wireless

About Kontron

Kontron is a global leader in IoT/Embedded Computing Technology (ECT). Kontron 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.

For more information, please visit: **www.kontron.com**

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