Part Numbers:

KITRA GTI BLACK 4G/GPS E
KITRA GTI BLACK 4G/GPS A
KITRA GTI BLACK 4G/GPS V

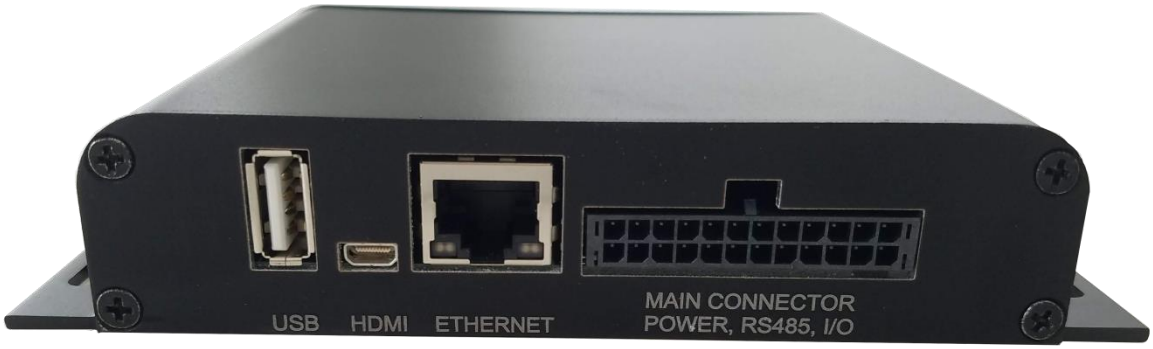
Summary

.1 REVISION HISTORY

Date	Revision	Description
30/03/2018	0.1	Draft version
12/04/2018	0.2	Added connection indications and examples
13/04/2018	0.3	Boot sequence clarification
24/04/2018	0.4	New images
15/06/2018	0.5	Antennas assembly, ADC conversion description on 5V input and pictures modified

.2 KITRA GTI BLACK 4G/GPS IMAGES

Connectors side view



Antennas side view

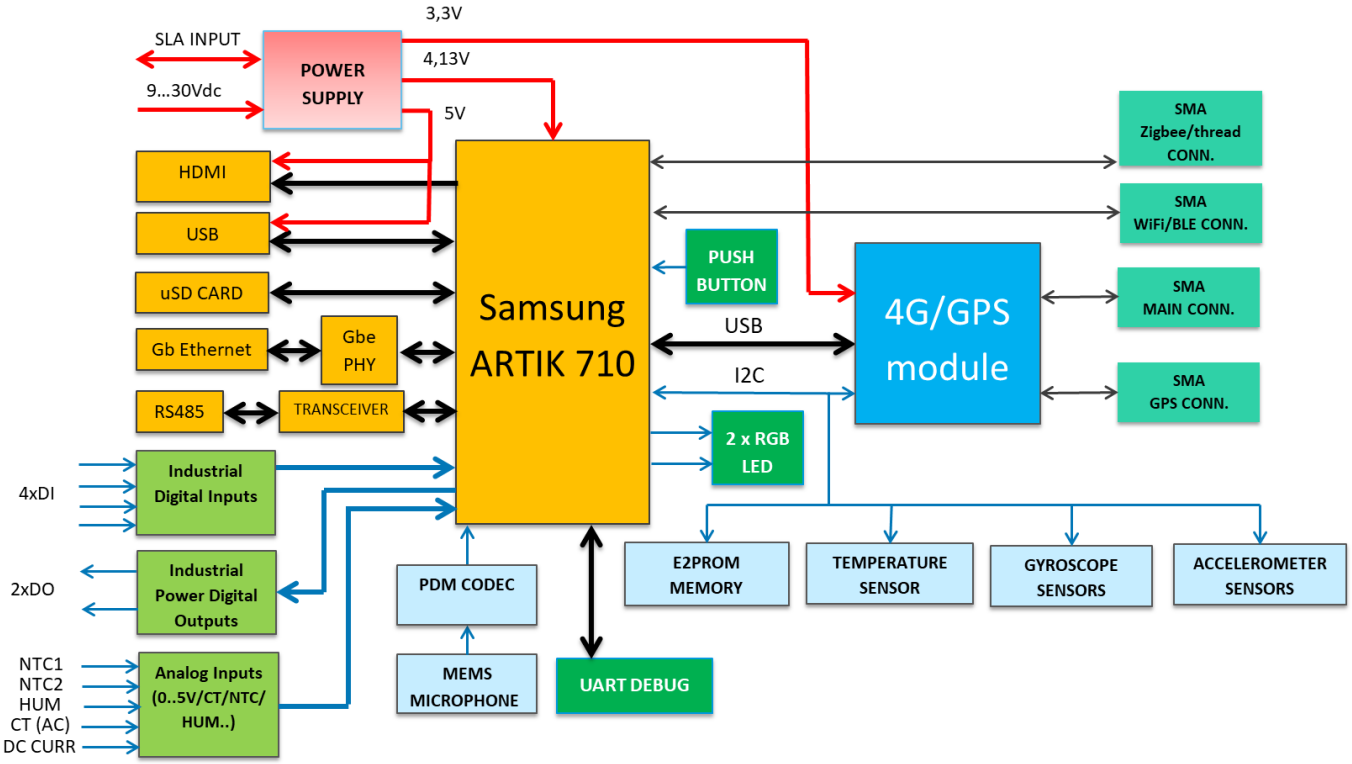
.3 INTRODUCTION

This data sheet provides the description of the KITRA GTI BLACK 4G/GPS.
KITRA is a family of boards and includes a set of carrier boards for Samsung ARTIK modules, KITRA GTI BLACK 4G/GPS is a complete system (electronics board + enclosure + antenna cables) based on powerful Samsung ARTIK 710 module plus 4G/LTE connectivity.
As RushUp electronics platform, KITRA GTI BLACK 4G/GPS is a product accelerator and can be used from makers, developers, high mix low volume products and from all who want the benefit of an off the shelf industrialized system and doesn't have time and/or money to invest in a custom solution.

For details about RushUp and ARTIK, please visit:
www.rushup.tech
www.artik.io

.4 DESCRIPTION AND BLOCK DIAGRAM

Maximum performance in computing, complete solution in wireless, Industrial IoT enabler and connection to industrial legacy products, predictive maintenance sensors, analog and digital industrial IO and rugged architecture for harsh working environment.
Below is the block diagram of the KITRA GTI BLACK 4G/GPS.



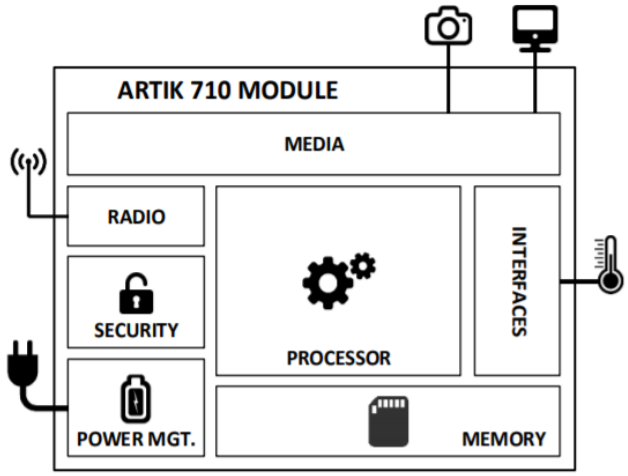
.5 HARDWARE & COMPONENTS DETAIL

.5.1 Samsung ARTIK 710 module

Samsung ARTIK 710 is the module of the KITRA GTI BLACK 4G/GPS board and it embeds four specific functions:

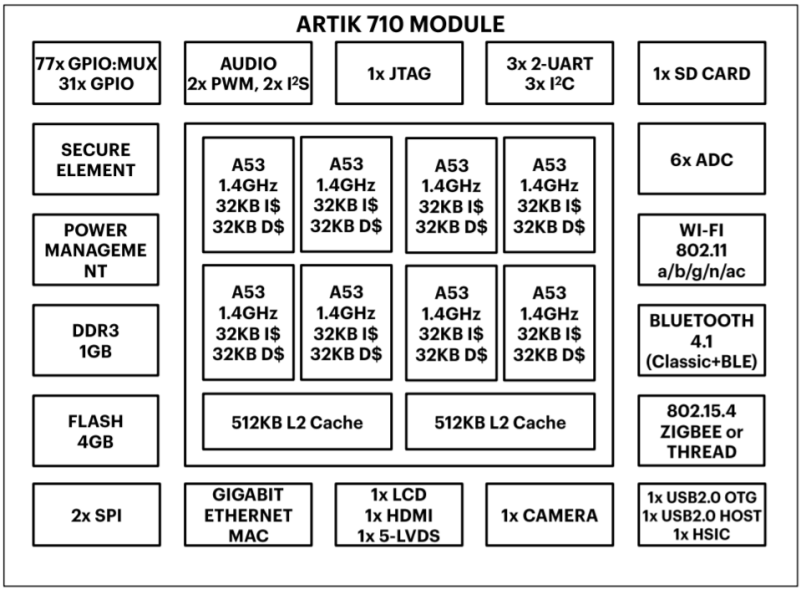
- Processing;
- Memory;
- Wireless;
- Data security.

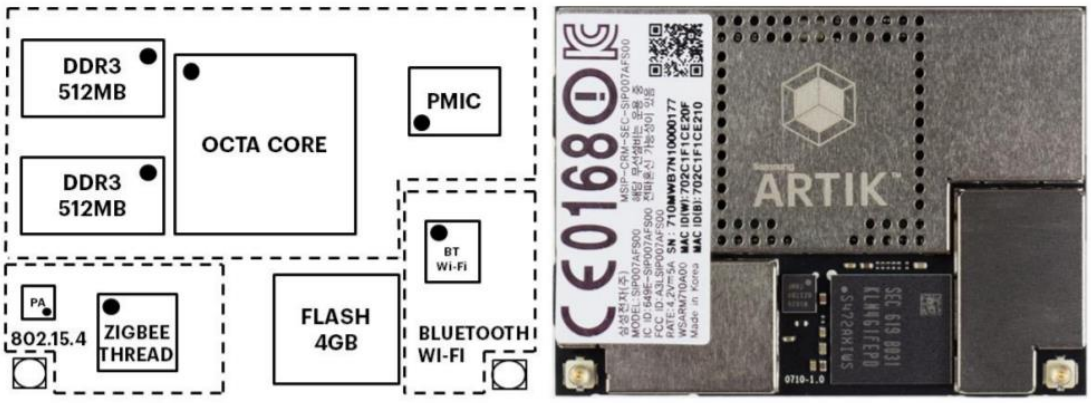
Samsung's ARTIK™ 710 Module is a highly-integrated System in-Module that utilizes an octa-core ARM® Cortex®-A53 processor packaged DRAM and Flash memory, a hardware Secure Element and a wide range of wireless communication options such as 802.11a/b/g/n/ac, Bluetooth® 4.1 (Classic+BLE), and 802.15.4 (ZigBee® or Thread) communications all into an extremely compact footprint. The many standard digital control interfaces support external sensors and higher performance peripherals to expand the module's capabilities. With the combination of Wi-Fi, Bluetooth, ZigBee/Thread, the ARTIK 710 Module is the perfect choice for home automation and home hub devices, while also supporting a rich UI/UX capability with the camera and display support options. The hardware based Secure Element works with the ARM® TrustZone® and Trustonic's Trusted Execution Environment (TEE) to provide enhanced end-to-end security.



ARTIK 710 Module Block Diagram

Processor	
CPU	8x ARM® Cortex®-A53@1.4GHz
GPU	3D graphics accelerator
Media	
Camera I/F	4-Lane MIPI CSI
Display	4-Lane MIPI DSI up to FHD@24bpp
Audio	I²S audio interface
Memory	
DRAM	1GB DDR3 @ 800MHz
FLASH	4GB eMMC
Security	
Secure Element	Secure point to point authentication and data transfer
Trusted Execution Environment	Trustware
Radio	
WLAN	IEEE 802.11a/b/g/n/ac
Bluetooth	4.1 (Classic+BLE)
802.15.4	ZigBee/Thread
Power Management	
PMIC	Provides all power of the ARTIK 710 Module using on board bucks and LDOs
Interfaces	
Analog and Digital I/O	GPIO, I²C, SPI, UART, SDIO, USB 2.0, JTAG, Analog Input





Please refer to www.artik.io website for more details on Samsung ARTIK 710 module.

.5.2 4G/GPS MODULE

4G/GPS connectivity is done through an LTE category 1 module adopting standard PCI Express® MiniCard form factor (Mini PCIe). Especially optimized for M2M and IoT applications, it features cost-saving, low power

LTE connectivity, and delivers M2M-optimized speeds of 10Mbit/s downlink and 5Mbit/s uplink. These make it ideal for numerous IoT applications that are not reliant on high speed connectivity but still require the longevity and reliability of LTE networks.
Module contains some variants depending on the geographic area on which it operates (see ordering information paragraph). This makes it backward-compatible with existing EDGE and GSM/GPRS networks, ensuring that it can easily migrate from LTE to 2G or 3G networks.

The module supports Qualcomm® IZat™ location technology Gen8C Lite (GPS, GLONASS, BeiDou, Galileo and QZSS). The integrated GNSS greatly simplifies product design, and provides quicker, more accurate and more dependable positioning.

A rich set of Internet protocols, industry-standard interfaces and abundant functionalities (USB drivers for Windows XP, Windows Vista, Windows 7/8/8.1/10, Linux, Android/eCall) extend the applicability of the module to a wide range of M2M applications such as smart metering, tracking and tracing, fleet management, wearable devices, smart home gateways, digital signs, and even drones.

Key Benefits

- Lower-power LTE connectivity optimized for broadband IoT applications.
- Worldwide LTE, UMTS/HSPA+ and GSM/GPRS/EDGE coverage.
- MIMO technology meets demands for data rate and link reliability in modem wireless communication systems.
- Multi-constellation GNSS receiver available for applications requiring fast and accurate fixes in any environment

Frequency		KITRA_GTI_BLACK_4G/GPS_E	KITRA_GTI_BLACK_4G/GPS_A	KITRA_GTI_BLACK_4G/GPS_V
LTE	FDD-LTE	B1/ B3/ B5/ B7/ B8/ B20	B2/ B4/ B12	B4/ B13
	TDD-LTE			
3G	WCDMA	B1/ B5/ B8	B2/ B4/ B5	
GSM/EDGE		B3/ B8		
Region		EMEA, Korea, Thailand, India	America	America
Certification		CE/ GCF/ Vodafone*/ FAC	FCC/ PTCRB/ AT&T*/ IC/ ROGERS	FCC/ GCF/ Verizon

* Under development

KITRA GTI BLACK 4G/GPS embeds a nano SIM connector on the bottom side of the electronics board and the 4G/GPS SMA connectors for external antennas are located on side 2 of the enclosure (see connectors paragraph for details).

Electrical Characteristics

Output Power:

- Class 3 (23dBm±2dB) for LTE
- Class 3 (24dBm+1/-3dB) for UMTS
- Class E2 (27dBm±3dB) for EDGE 850/900MHz
- Class E2 (26dBm±3dB) for EDGE1800/1900MHz
- Class 4 (33dBm±2dB) for GSM 850/900MHz
- Class 1 (30dBm±2dB) for GSM 1800/1900MHz

Sensitivity:

- LTE B1: -101.5dBm (10M)
- LTE B2: -101dBm (10M)
- LTE B3: -101.5dBm (10M)

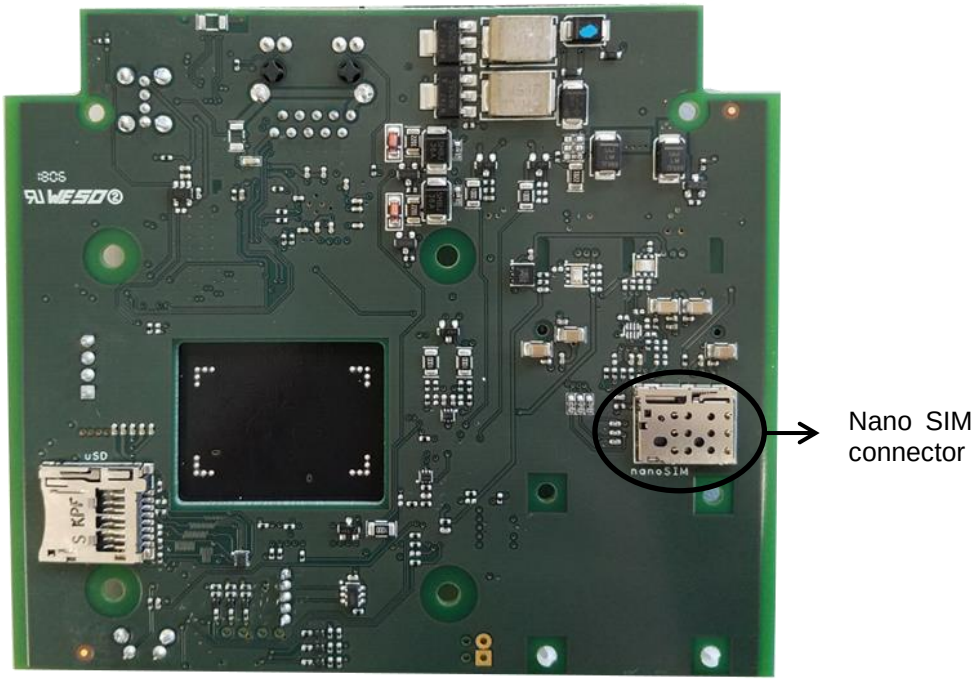
- LTE B4: -101dBm (10M)
- LTE B5: -101dBm (10M)
- LTE B7: -99.5dBm (10M)
- LTE B8: -101dBm (10M)
- LTE B12: -101dBm (10M)
- LTE B13: -100dBm (10M)
- LTE B20: -102.5dBm (10M)
- LTE B28: -102dBm (10M)
- UMTS B1: -110dBm
- UMTS B2: -110dBm
- UMTS B4: -110dBm
- UMTS B5: -110.5dBm
- UMTS B8: -110.5dBm
- GSM: -109dBm
- DCS: -109dBm

Protocols:
- TCP/UDP/PPP/FTP/HTTP/NTP/PING/QMI/
- CMUX*/HTTPS*/SMTP*/MMS*/FTPS*/SMTPS*/
- SSL*/FILE*

General Features
- 3GPP E-UTRA Release 11
- Bandwidth: 1.4/3/5/10/15/20MHz

Nano SIM connector is located in the bottom side of the internal electronics board.

INTERNAL KITRA GTI BLACK PCBA (electronics board) BOTTOM VIEW



.5.3 Accelerometers - Gyroscopes Sensors

The LSM6DSL is a system-in-package featuring a 3D digital accelerometer and a 3D digital gyroscope performing at 0.65 mA in high-performance mode and enabling always-on low-power features for an optimal motion experience for the consumer.
The LSM6DSL supports main OS requirements, offering real, virtual and batch sensors with 4 kbyte for dynamic data batching.
ST's family of MEMS sensor modules leverages the robust and mature manufacturing processes already used for the production of micromachined accelerometers and gyroscopes.
The various sensing elements are manufactured using specialized micromachining processes, while the IC interfaces are developed using CMOS technology that allows the design of a dedicated circuit which is trimmed to better match the characteristics of the sensing element.
The LSM6DSL has a full-scale acceleration range of ±2/±4/±8/±16 g and an angular rate range of ±125/±245/±500/±1000/±2000 dps.
High robustness to mechanical shock makes the LSM6DSL the preferred choice of system designers for the creation and manufacturing of reliable products.
The LSM6DSL is available in a plastic land grid array (LGA) package.

Features

- Power consumption: 0.4 mA in combo normal mode and 0.65 mA in combo high-performance mode
- "Always-on" experience with low power consumption for both accelerometer and gyroscope
- Smart FIFO up to 4 kbyte based on features set
- Android M compliant
- Hard, soft ironing for external magnetic sensor corrections
- ±2/±4/±8/±16 g full scale
- ±125/±245/±500/±1000/±2000 dps full scale
- Analog supply voltage: 1.71 V to 3.6 V
- Independent IOs supply (1.62 V)
- Compact footprint, 2.5 mm x 3 mm x 0.83 mm
- SPI & I^2C serial interface with main processor data synchronization feature
- Pedometer, step detector and step counter
- Significant motion and tilt function
- Standard interrupts: free-fall, wakeup, 6D/4D orientation, click and double-click
- Embedded temperature sensor
- ECOPACK® , RoHS and "Green" compliant

For any specific information and for the firmware commands and procedures, please refer to the data sheet of the components.

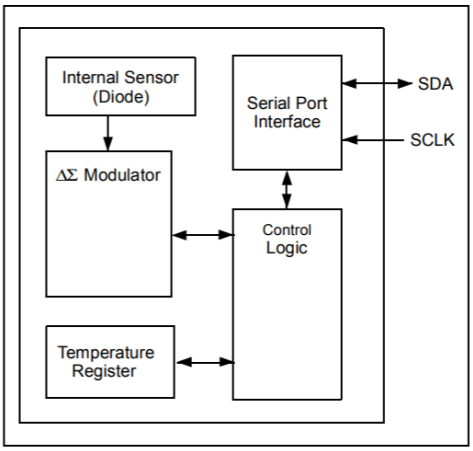
.5.4 Temperature sensor

KITRA GTI embeds TC74A0-3.3VAT temperature sensor.
The TC74 is a serially accessible, digital temperature sensor particularly suited for small form factor applications. Temperature data is converted from the onboard thermal sensing element and made available as an 8-bit digital word. Communication with the TC74 is accomplished via a 2- wire SMBus/I2C compatible serial port. This bus also can be used to implement multi-drop/multi-zone monitoring. The SHDN bit in the CONFIG register can be used to activate the low power Standby mode. Temperature resolution is 1°C. Conversion rate is a nominal 8 samples/sec. During normal operation, the quiescent current is 200 µA (typ). During standby operation, the quiescent current is 5 µA (typ). Small size, low installed cost and ease of use make the TC74 an ideal choice for implementing thermal management in a variety of systems.

Features

- Outputs Temperature as an 8-Bit Digital Word.
- Simple SMBus/I2C™ Serial Port Interface.
- Solid-State Temperature Sensing:
    - ±2°C (max.) Accuracy from +25°C to +85°C
    - ±3°C (max.) Accuracy from 0°C to +125°C
- Supply Voltage of 2.7V to 5.5V
- Low Power:
    - 200 µA (typ.) Operating Current
    - 5 µA (typ.) Standby Mode Current

Functional Block Diagram



.5.5 Audio input and PDM converter

.5.6 MEMS microphone

The MP34DT04 is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.
The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to produce audio sensors.
The IC interface is manufactured using a CMOS process that allows designing a dedicated circuit able to provide a digital signal externally in PDM format.
The MP34DT04 has an acoustic overload point of 120 dBSPL with a 64 dB signal-to-noise ratio and –26 dBFS sensitivity.
The MP34DT04 is available in a top-port, SMDcompliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL acoustic overload point
- 64 dB signal-to-noise ratio
- Omnidirectional sensitivity
- 26 dBFS sensitivity
- PDM output
- HCLGA package
    - Top-port design
    - SMD-compliant
    - EMI-shielded
    - ECOPACK®, RoHS, and “Green” compliant

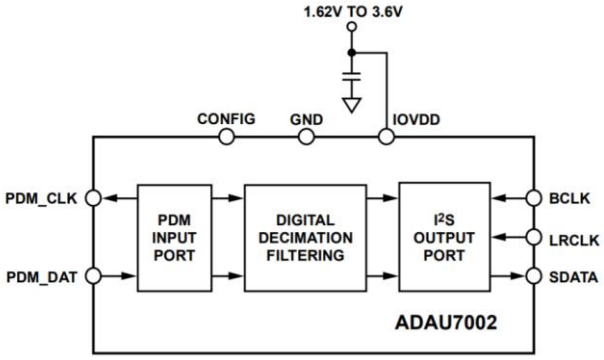
Output of the MEMS microphone is connected to a Stereo PDM-to-I2S converter (ADAU7002ACBZ).
The ADAU7002 converts a stereo PDM bit stream into a PCM output. The PCM audio data is output on a serial audio interface port in either I2 S or TDM format.

Features

- 64× decimation of a stereo pulse density modulation (PDM) bit stream to pulse code modulation (PCM) audio data
- Slave I2S or time division multiplexed (TDM) output interface
- Configurable TDM slots
- I/O supply operation: 1.62 V to 3.6 V
- 64× output sample rate PDM clock
- 64×/128×/192×/256×/384×/512× output sample rate BCLK
- Automatic BCLK ratio detection
- Output sample rate: 4 kHz to 96 kHz

- Automatic PDM CLK drive at 64× the sample rate
- Automatic power down with BCLK removal
- 0.67 mA operating current at 48 kHz and 1.8 V IOVDD supply
- Shutdown current: <1uA

Functional Block Diagram



For any specific information and for the firmware commands and procedures, please refer to the data sheet of the components.

.5.7 GIGABIT ETHERNET

The KSZ9031RNX is a completely integrated triple speed (10Base-T/100Base-TX/1000Base-T) Ethernet Physical Layer Transceiver for transmission and reception of data over standard CAT-5 unshielded twisted pair (UTP) cable. The KSZ9031RNX reduces board cost and simplifies board layout by using on-chip termination resistors for the four differential pairs and by integrating a LDO controller to drive a low cost MOSFET to supply the 1.2V core. On the copper media interface, the KSZ9031RNX can automatically detect and correct for differential pair misplacements and polarity reversals, and correct propagation delays and re-sync timing between the four differential pairs, as specified in the IEEE 802.3 standard for 1000Base-T operation. The KSZ9031RNX provides the Reduced Gigabit Media Independent Interface (RGMII) for direct connection to RGMII MACs in Gigabit Ethernet Processors and Switches for data transfer at 10/100/1000 Mbps speed. The KSZ9031RNX Evaluation Board (KSZ9031RNX-EVAL) provides a comprehensive platform to evaluate the KSZ9031RNX features. All KSZ9031RNX configuration pins are accessible either by jumpers, test points or interface connectors.
For any specific information and for the firmware commands and procedures, please refer to the data sheet of the components.

.5.8 HDMI

The board has one HDMI 1.4a connector (Micro D-Type).
The following video formats are supported:

- 480p/480i @59.94Hz/60Hz, 576p/576i@50Hz
- 720p/720i @50Hz/59.94Hz/60Hz
- 1080p/1080i @50Hz/59.94Hz/60Hz

.5.9 USB HOST 2.0

The board has one USB HOST 2.0.

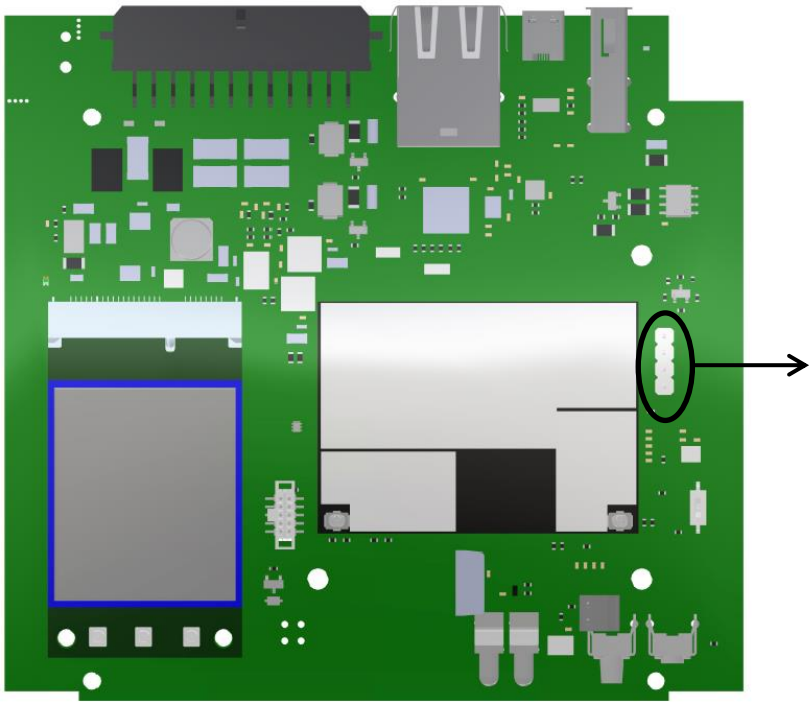
.5.10 SD CARD

The Platform board has one SD-CARD interface supporting SD3.0.
The SD card can be used for flashing a new image to internal MMC or as a mass storage device.

.5.11 Debug UART

The platform has an internal connector that can be used for debug during the development.
It can be used with an external UART to USB converter simply connecting the cable to the pins following the next indications.

INTERNAL KITRA GTI BLACK PCBA (electronics board) TOP VIEW



As a simple example of UART to USB converter you can use one of these:

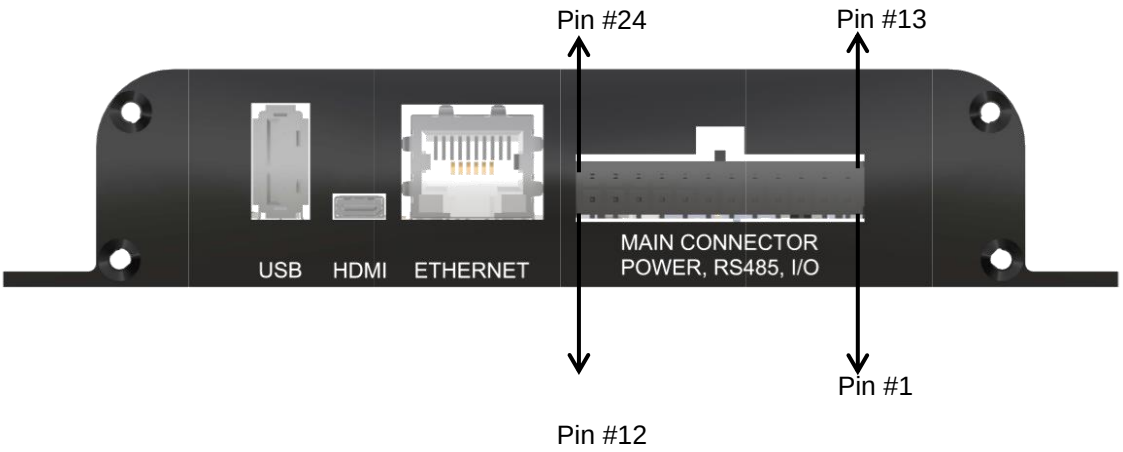
- https://www.digikey.com/product-detail/en/adafruit-industries-llc/954/1528-2128-ND/7064488
- https://www.mouser.it/ProductDetail/Adafruit/954?qs=sGAEpiMZZMsMyYRRhGMFNg7907eNh002i%2fEnSsNEsb4%3d

Simply connect

- BLACK to pin #4 (GND).
- WHITE to pin #3 (TX of ARTIK and RX of USB converter).
- GREEN to pin #2 (RX of ARTIK and TX of USB converter).

See the chapter 10 for the development details and how this serial port can be used.

.6 KITRA GTI BLACK CONNECTORS



USB: USB host type A (female)

HDMI: Micro D-Type

ETHERNET: Standard RJ45

MAIN CONNECTOR: Mounted on KITRA GTI PCBA Wurth Elekronik WR-MPC3 P/N 662024231722

The external cable needs to be equipped with the matching connector and terminals as follow indicated:

- 3.00mm Female Dual Row Receptacle WR-MPC3 24 pins P/N 662024113322

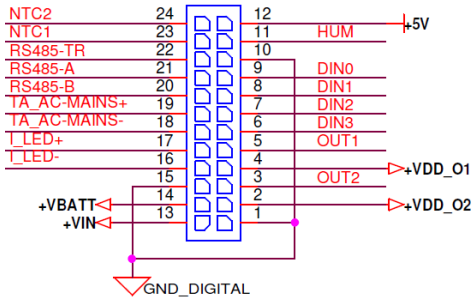
- 3.00mm Female Crimp Terminal 20 to 24 AWG WR-MPC3 P/N 66200113722

Second source option from Molex:

- Micro-Fit 3.0 43025 Series Molex Connector Free Hanging - Pitch 3,0mm - 24 positions P/N 43025-2400.
- Crimp Contact P/N 43030-0038.

.6.1 MAIN CONNECTOR PINOUT AND DESCRIPTION

Here in after the electrical diagram of the main connector and in the table below the pinout indication with detailed indications.



PIN #	FUNCTION	ELECTRICAL RANGE AND DESCRIPTION
1	-Vpower (GND)	Negative reference for power supply
2	+Vdd Output 2	Positive power supply for OUTPUT 2. Range 9…30V
3	Output 2	Open collector NPN transistor. Maximum sink current of 1A. Protected by a resettable fuse (Hold at 1,5A, trip to 3A).
4	+Vdd Output 1	Positive power supply for OUTPUT 1. Range 9…30V
5	Output 1	Open collector NPN transistor. Maximum sink current of 1A. Protected by a resettable fuse (Hold at 1,5A, trip to 3A).
6	Digital Input 4	Push pull voltage input up to 30Vdc.
7	Digital Input 3	Push pull voltage input up to 30Vdc.
8	Digital Input 2	Push pull voltage input up to 30Vdc.
9	Digital Input 1	Push pull voltage input up to 30Vdc.
10	GND	Negative reference for external active sensor.
11	ADC 1 (0…5Vdc input)	Analog input 0…5V range. Internal ADC channel of ARTIK module is 1,8V range with 12 bit resolution and the internal voltage divider is set to 1000/3100 so when 5V is applied at this input the digital value is 3669. The formula for ADC conversion is then: DIV(digital value)=Vin/5*3669 Vin=DIV/3669*5V
12	+5Vdc (power output)	5Vdc power supply for external active sensor. Max 250mA
13	+Vpower (9..30Vdc)	Main power supply. 9…30Vdc range, typical 12Vdc or 24Vdc.
14	+Vbatt (SLA 12V or 24V)*	SLA backup external battery. 12Vdc or 24Vdc. The SLA battery nominal voltage must be compatible with the main power supply used. If +Vpower is 12V, SLA must be 12V If +Vpower is 24V, SLA must be 24V
15	GND	Negative reference of the power supply
16	SHUNT DC-	External continuous current negative wire Internal shunt resistor between CT- and CT+ of 68mΩ. Current input range: 0 - 3A DC ADC input range of 1,8V referred to GND

		ANALOG TO DIGITAL CONVERSION FORMULA Vadc=Iinput*0.068 Vadcmax=3*0.068=200mV
17	SHUNT DC+	External continuous current positive wire Internal shunt resistor between CT- and CT+ of 68mΩ. Current input range: 0 - 3A DC ADC input range of 1,8V referred to GND ANALOG TO DIGITAL CONVERSION FORMULA Vadc=Iinput*0.068 Vadcmax=3*0.068=200mV
18	CT-	External CT sensor negative wire Internal burden resistor between CT+ and CT- of 43,2ohm. ADC input range of 1,8V with virtual ground of 0,9V. ANALOG TO DIGITAL CONVERSION FORMULA Vadc=43.2*Iin/CTratio+0.9 With CTratio 1:3000 IinMAX=55A Vadcmax=1.692V
19	CT+	External CT sensor positive wire Internal burden resistor between CT+ and CT- of 43,2ohm. ADC input range of 1,8V with virtual ground of 0,9V. ANALOG TO DIGITAL CONVERSION FORMULA Vadc=43.2*Iin/CTratio+0.9 With CTratio 1:3000 IinMAX=55A Vadcmax=1.692V
20	RS485-B	Non isolated B terminal of RS485 electrical interface
21	RS485-A	Non isolated A terminal of RS485 electrical interface
22	RS485-TR	RS485 termination resistor of 120Ω that can be inserted if connecting this terminal with RS485-A
23	ADC 2 (NTC1)	Analog input 0…1,8V range Internal 10kΩ pull up resistor to 1,8V with 100Ω series resistor between ADC input and internal pull up. Can be connected and external NTC temperature sensor of 10kohm@25°C model B=3380K NTC formula Vadc=1.8*Rntc/(Rntc+10k) Conversion points: -40 -> Vadc= 1.71V 0 -> Vadc=1.32V 25° -> Vadc=900mV 50° -> Vadc=540mV 120° -> Vadc=107mV
24	ADC 3 (NTC2)	Analog input 0…1,8V range Internal 10kΩ pull up resistor to 1,8V with 100Ω series resistor between ADC input and internal pull up. Can be connected and external NTC temperature sensor of 10kohm@25°C model B=3380K NTC formula

		Vadc=1.8*Rntc/(Rntc+10k) Conversion points: -40 -> Vadc= 1,71V 0 -> Vadc=1,32V 25° -> Vadc=900mV 50° -> Vadc=540mV 120° -> Vadc=107mV

MAIN: SMA female connector for 4G antenna that have to be screwed on it
GNSS: SMA female connector for GPS active antenna that have to be screwed on it
WIFI/BLE: SMA female connector for Wi-Fi and Bluetooth antenna that have to be screwed on it
ZIGBEE/THREAD: SMA female connector for GPS active antenna that have to be screwed on it
LD1: General purpose RGB LED 1 (available for the user, driven by software)
LD2: General purpose RGB LED 2 (available for the user, driven by software)
MIC: Openings for internal microphone
USR: General purpose push button (available for the user, read by software)
RST: Opening for internal reset push button (if pressed ARTIK 710 will be reset and the system will reboot).

.6.1.1 ASSEMBLEY OF THE ANTENNAS

4G quad band antenna must be connected to MAIN SMA connector and is the only one with golden internal screw as indicated in the picture blow.

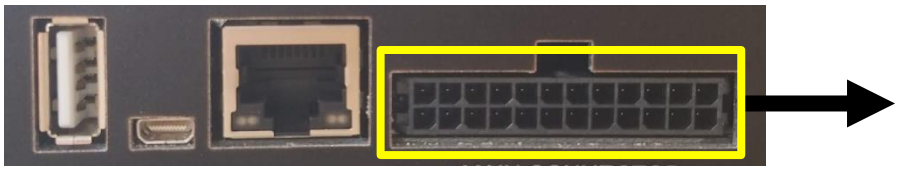
The plastic package of this antenna has a green round label.

2.4GHz antennas used for WiFi/BLE and for Zigbee/Thread as exactly the same and are similar to the 4G antenna except that the inner screw is not golden.

GPS active antenna is the square one with a cable connected.
For every antenna simply screw it into the related SMA male connector present in the KITRA GTI BLACK.

.7 CONNECTION EXAMPLES

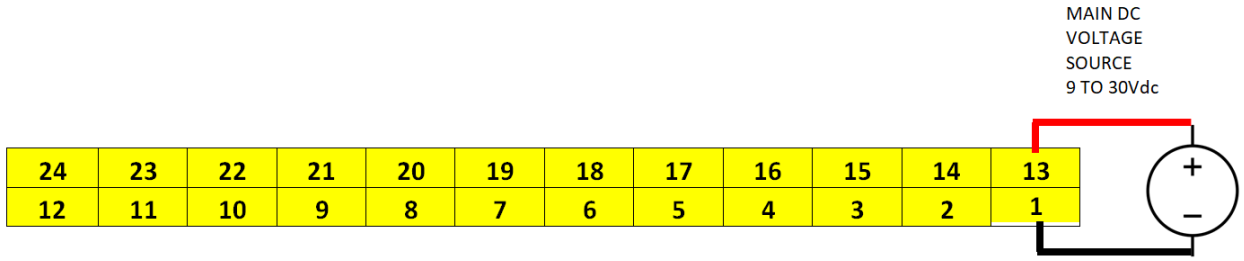
Here in after you can find wiring indications and some example on how you can connect external sensors or devices to the main connector of the KITRA GTI BLACK 4G/GPS.



MAIN CONNECTOR
The following wiring examples are referred to this connector and it will be represented in yellow

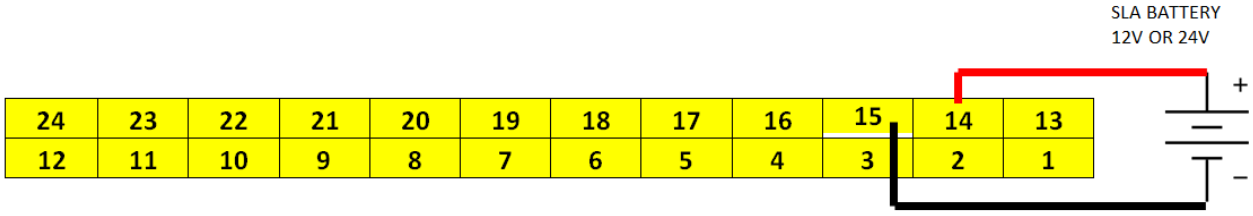
.7.1 MAIN POWER SUPPLY

KITRA GTI BLACK 4G/GPS is powered by an external DC voltage source (typically 12V or 24V) as indicated here in after.



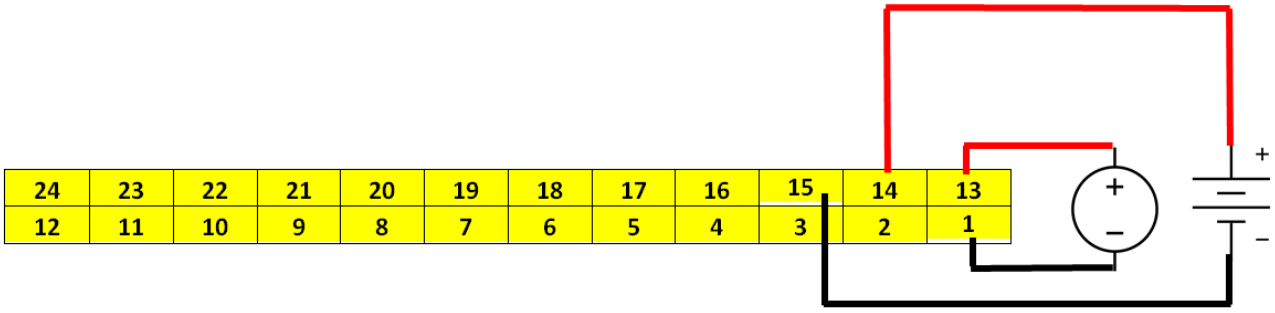
.7.2 SLA BATTERY POWER SUPPLY

KITRA GTI BLACK 4G/GPS can also be powered by an external SLA battery (typically 12V or 24V) using the dedicated pins as indicated here in after.



.7.3 MAIN POWER SUPPLY WITH SLA BATTERY AS BACKUP

KITRA GTI BLACK 4G/GPS can be powered by an external DC voltage source and has an SLA battery as a backup of the main power source.



VERY IMPORTANT NOTE:

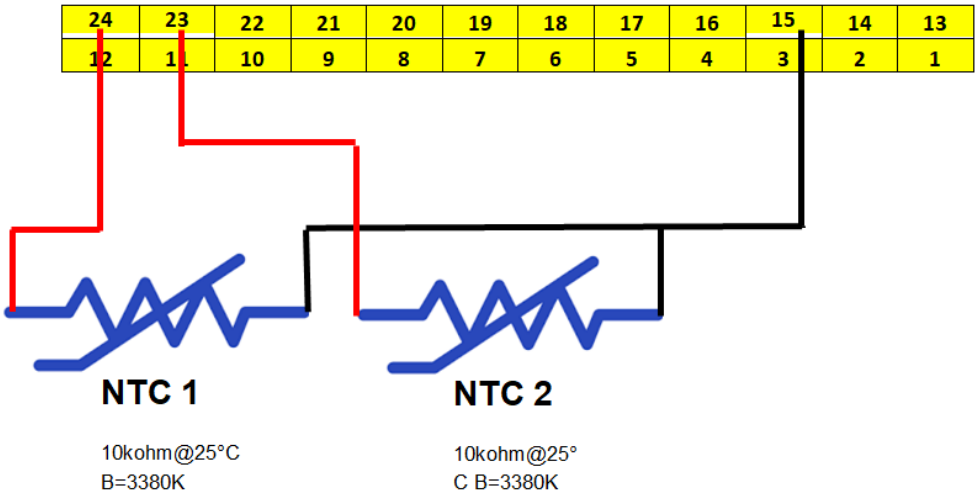
- SLA BATTERY AND VOLTAGE SOURCE MUST BE AT THE SAME VOLTAGE LEVEL AS INDICATED IN THE TABLE BELOW.

CONDITION	SLA NOMINAL VOLTAGE	MAIN VOLTAGE SOURCE
OK	12V	12V
OK	24V	24V
PROHIBITED	12V	24V
PROHIBITED	24V	12V

.7.4 SENSORS

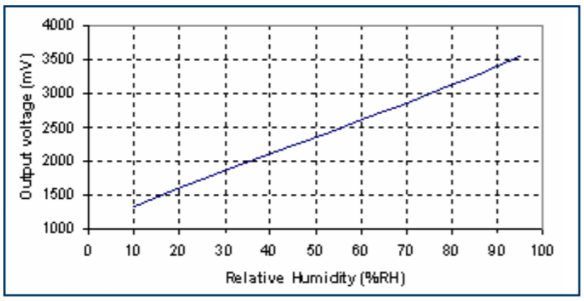
.7.4.1 Connection of NTC temperature sensors.

This example is suitable also for any other resistive passive sensor like potentiometers, force sensors etc. etc.

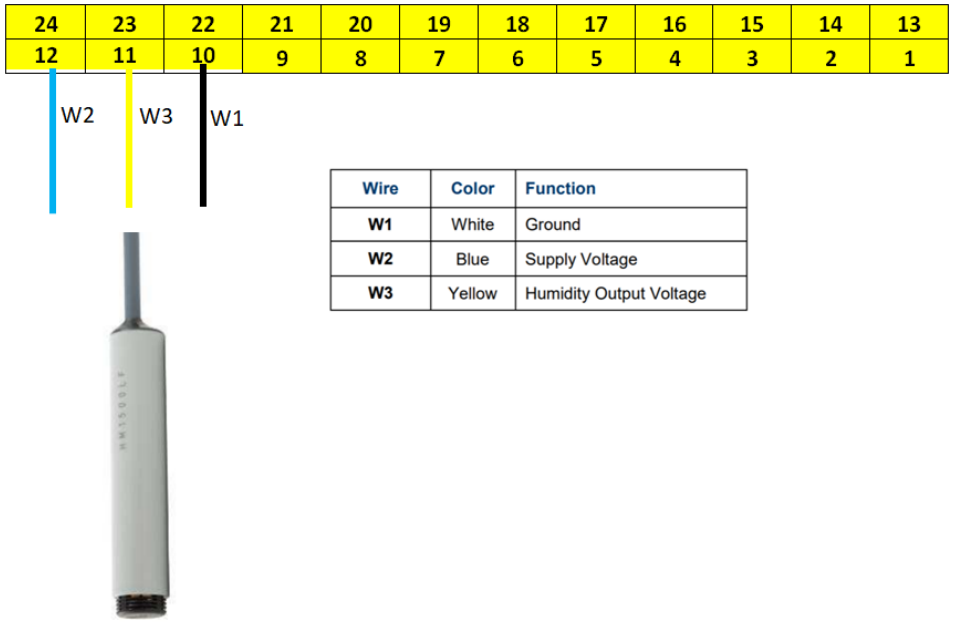


.7.4.2 Connection of an active 5Vdc sensor.

Sensor used: HM1500LF.



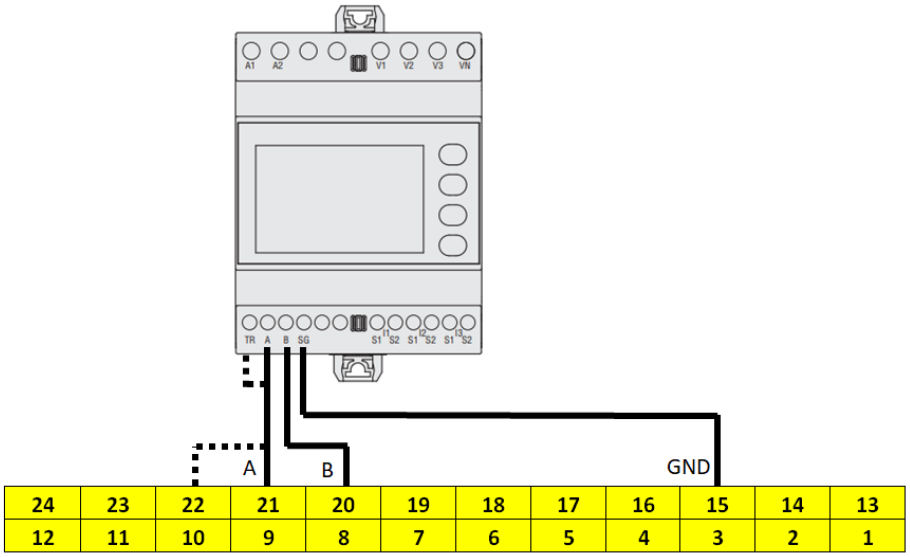
RH (%)	Vout (mV)	RH (%)	Vout (mV)
10	1325	**55**	2480
15	1465	**60**	2605
20	1600	**65**	2730
25	1735	**70**	2860
30	1860	**75**	2990
35	1990	**80**	3125
40	2110	**85**	3260
45	2235	**90**	3405
50	2360	**95**	3555



Wire	Color	Function
W1	White	Ground
W2	Blue	Supply Voltage
W3	Yellow	Humidity Output Voltage

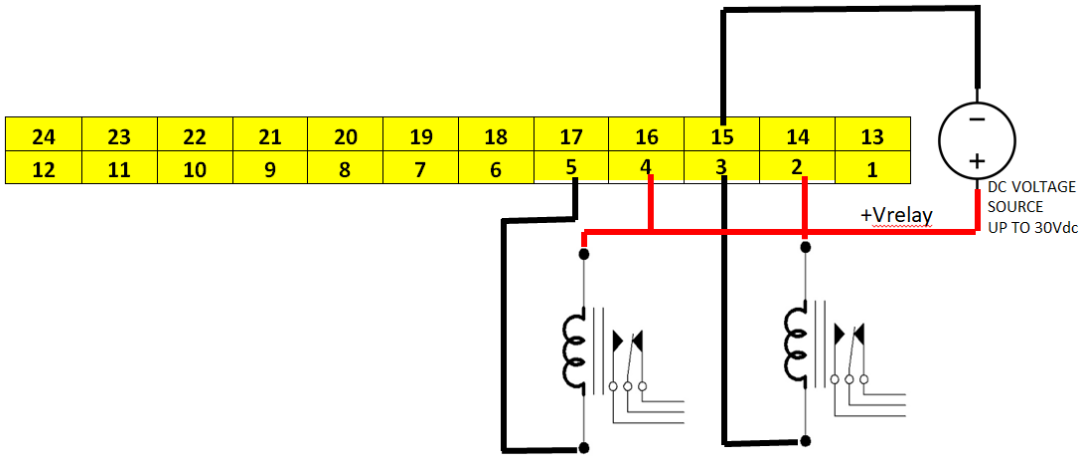
.7.5 MODBUS POWER METER

Power meter used: Lovato Electric DMG210 (http://www.lovatoelectric.com/DMG210/DMG210/snp)

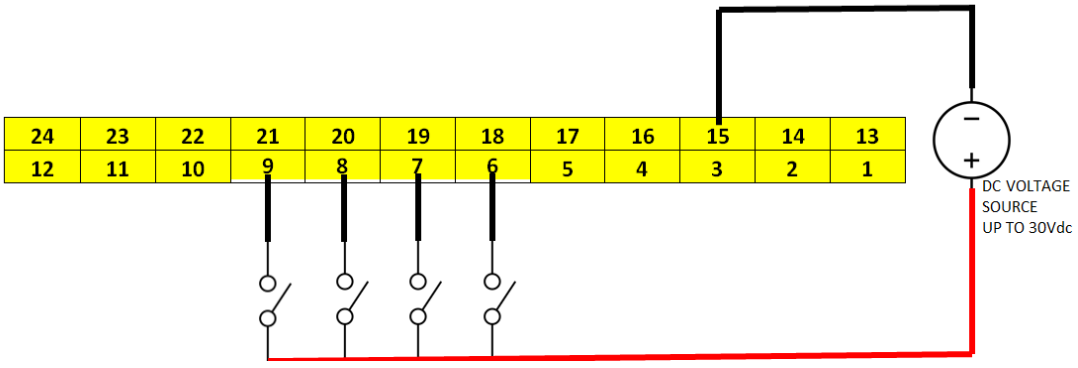


Dotted lines indicate the termination resistor (TR) connection that can be present if needed in the application (normally used in the first and last nodes).

.7.6 RELAYS

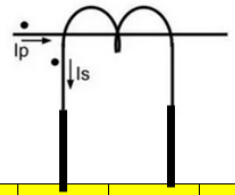


.7.7 CONTACT SWITCHES



.7.8 AC CURRENT MEASUREMENT

Examples of CT that can be used for AC current measurement: CR3110-3000 (sensor measures up to 75A).

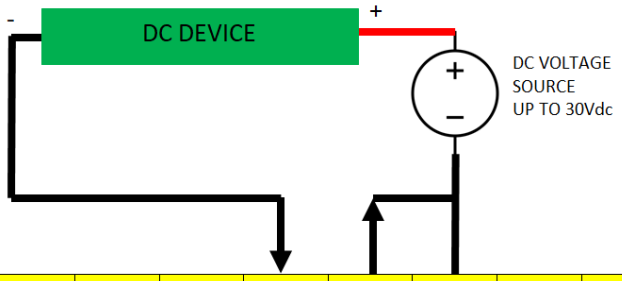


24	23	22	21	20	19	18	17	16	15	14	13
12	11	10	9	8	7	6	5	4	3	2	1

The CR3100 Series Split Core Current Transformer is designed to provide a low cost method to monitoring electrical current. A unique hinge and locking snap allows attachment without interrupting the current-carrying wire. High secondary turn will develop signals up to 10.0 VAC across a burden resistor

.7.9 DC CURRENT MEASUREMENT

Example of DC DEVICE can be a 12V/24V LED strip and the measure can be used to check if the light is ON or OFF.

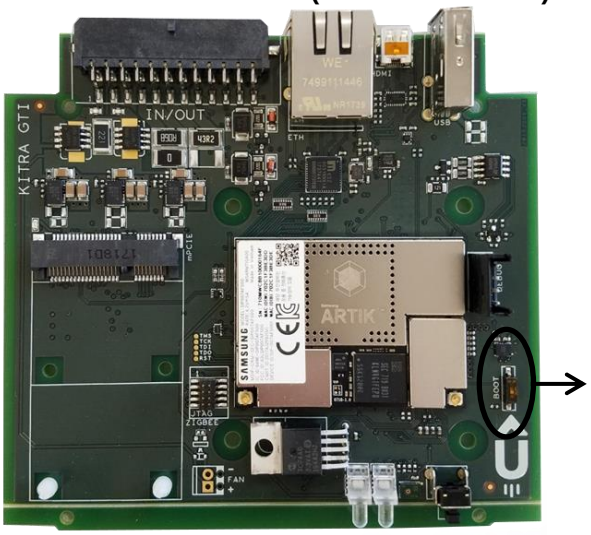


24	23	22	21	20	19	18	17	16	15	14	13
12	11	10	9	8	7	6	5	4	3	2	1

.8 BOOTING SEQUENCE

This section describes the boot mode that is supported on the KITRA GTI BLACK 4G/GPS board.
Here you can see show how to manipulate dipswitch located on the board to set the booting option that is available.

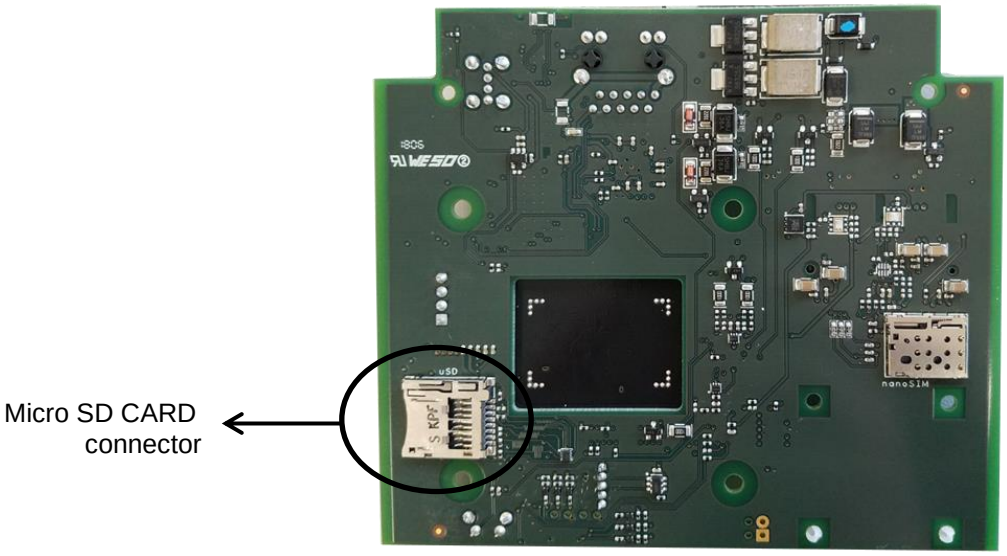
INTERNAL KITRA GTI BLACK PCBA (electronics board) TOP VIEW



DIP SWITCH BOOT

ON: BOOT MODE
OFF: NORMAL MODE

INTERNAL KITRA GTI BLACK PCBA (electronics board) BOTTOM VIEW



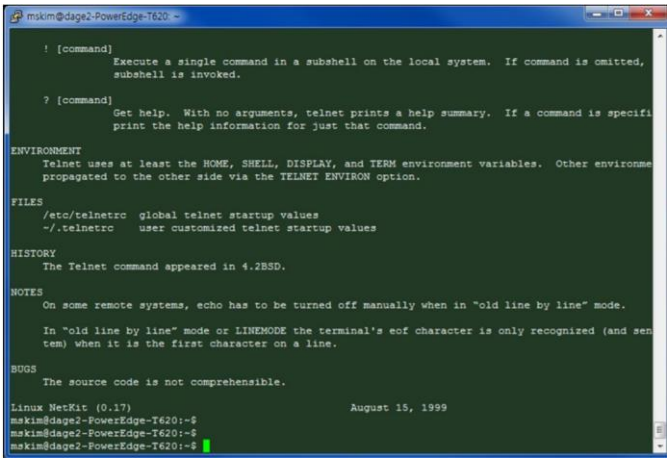
When 'eMMC 1st Boot' is selected as a booting option, the system will first try to boot from eMMC, if ROM bootloader fails launching the MMC bootloader (U-boot), the system will boot from SD-Card.
If the boot fails due to file system corruption, the system can be recovered from the bootloader (U-boot).
When choosing the SD-Card booting option, the system starts booting from SD.

.9 KITRA GTI BLACK 4G/GPS DEVELOPMENT BOARD BOOTING

This section will describe how to start working with your KITRA GTI BLACK 4G/GPS Development Environment by setting up a serial connection on your development PC and booting up the ARTIK 710 Development Environment.

SERIAL PORT CONNECTION

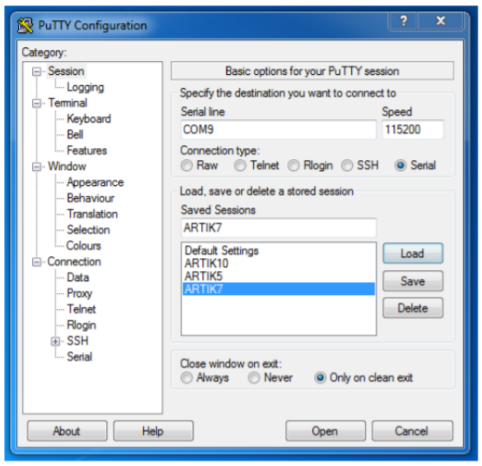
As a first step we will select a serial console to communicate with the ARTIK 710 Module that is located on the ARTIK 710 Development Environment.
You can use a typical Linux® serial console as depicted in the next Figure, using the USB 2.0 DEBUG connector.
To use the serial USB cable you need to install the associated device driver.



Setting up a connection with the ARTIK 710 Module can be done in a wired or wireless manner. Here we choose to install PuTTY a free serial console.
The software can be downloaded from **HTTP://WWW.PUTTY.ORG/.**
Once downloaded go through the following steps:

1) Open the device manager on the control panel.
2) When using a PC install the USB to Serial driver. The driver can be found at the following location: (http://www.ftdichip.com/Drivers/CDM/CDM21218_Setup.zip). For other drivers please visit (http://www.ftdichip.com/Drivers/D2XX.htm).
3) Check the COM port number on your PC when you connect the USB serial cable. In our case the COM port allocated is COM9.

4) Set the PuTTY configuration as follows:
    a) Set the “Serial line” as the COM port number found in step 3.
    b) Set the COM speed to "115200".
    c) Set the connection type to "Serial".
    d) Save the session under ARTIK7.
5) Select your saved session and click the “Open” button.



POWER ON THE KITRA GTI 4G/GPS

Once the connector is applied and the board is powered, KITRA GTI BLACK 4G/GPS will automatically start the booting process and you should see the messages from your console, using the serial connection that you previously established.

.10 RF ELECTRICAL SPECIFICATIONS

All performance numbers related to 802.11, 802.15.1 and 802.15.4 mentioned in this section are preliminary and likely to change once module characterization has taken place. All these data are taken from the Samsung ARTIK 710 data sheet because the RF functions are integrated in the module, for more info visit www.artik.io.

802.11, 2,4GHz Receive RF specifications

Parameter	Conditions	Min	Typ.	Max	Unit
Frequency Range	–	2400	–	2500	MHz
Minimum receiver sensitivity in 802.11b mode					
1Mbps	PER < 8%, Packet size = 1024 bytes	–	–	-92	dBm
2Mbps		–	–	-80	dBm
5.5Mbps		–	–	-76	dBm
11Mbps		–	–	-83	dBm
Minimum receiver sensitivity in 802.11g mode					
6Mbps	PER < 10%, Packet size= 1024 bytes	–	–	-82	dBm
9Mbps		–	–	-81	dBm
12Mbps		–	–	-79	dBm
18Mbps		–	–	-77	dBm
24Mbps		–	–	-74	dBm
36Mbps		–	–	-70	dBm
48Mbps		–	–	-66	dBm
54Mbps		–	–	-65	dBm
Minimum receiver sensitivity in 802.11n mode					
MCS 0	PER<10%, Packet size= 4096 bytes, GF, 800ns GI, Non-STBC	–	–	-82	dBm
MCS 1		–	–	-79	dBm
MCS 2		–	–	-77	dBm
MCS 3		–	–	-74	dBm
MCS 4		–	–	-70	dBm
MCS 5		–	–	-68	dBm
MCS 6		–	–	-65	dBm
MCS 7		–	–	-64	dBm
Maximum input level					
Maximum input signal level in 802.11b mode	PER < 8%	-10	–	–	dBm
Maximum input signal level in 802.11g mode	PER < 10%	-20	–	–	dBm
Maximum input signal level in 802.11n mode	PER < 10%	-20	–	–	dBm

802.11, 2,4GHz Transmit RF specifications

Parameter	Conditions	Min	Typ.	Max	Unit
Linear output power					
Maximum output power in 802.11b mode	As specified in IEEE802.11	–	16	–	dBm
Maximum output power in 802.11g mode		–	12.5	–	dBm
Maximum output power in 802.11n mode		–	13	–	dBm
Transmit spectrum mask					
Margin to 802.11b spectrum mask	Maximum output power	0	–	–	dBr
Margin to 802.11g spectrum mask		0	–	–	dBr
Margin to 802.11n spectrum mask		0	–	–	dBr
Transmit modulation accuracy in 802.11b mode					
1Mbps	As specified in IEEE 802.11b	–	–	35	%
2Mbps		–	–	35	%
5.5Mbps		–	–	35	%
11Mbps		–	–	35	%
Transmit modulation accuracy in 802.11g mode					
6Mbps	Mandatory	–	–	-5	dB
9Mbps	Optional	–	–	-8	dB
12Mbps	Mandatory	–	–	-10	dB
18Mbps	Optional	–	–	-13	dB
24Mbps	Mandatory	–	–	-16	dB
36Mbps	Optional	–	–	-19	dB
48Mbps	Optional	–	–	-22	dB
54Mbps	Optional	–	–	-25	dB
Transmit modulation accuracy in 802.11n mode					
MCS7	As specified in IEEE 802.11n	–	–	-27	dB
Transmit power-on and power-down ramp time in 802.11b mode					
Transmit power-on ramp time from 10% to 90% output power	–	–	–	2	µs
Transmit power-down ramp time from 90% to 10% output power	–	–	–	2	µs

802.11, 5GHz Receive RF specifications

Parameter	Conditions	Min	Typ.	Max	Unit
Frequency Range	–	4900	–	5845	MHz
Minimum receiver sensitivity in 802.11a mode					
6Mbps	PER < 10%	–	–	-82	dBm
12Mbps		–	–	-79	dBm
24Mbps		–	–	-74	dBm
36Mbps		–	–	-70	dBm
48Mbps		–	–	-66	dBm
54Mbps		–	–	-65	dBm
Minimum receiver sensitivity in 802.11n (HT-20) mode					
MCS 0	–	–	–	-82	dBm
MCS 1		–	–	-79	dBm
MCS 2		–	–	-77	dBm
MCS 3		–	–	-74	dBm
MCS 4		–	–	-70	dBm

Parameter	Conditions	Min	Typ.	Max	Unit
Frequency Range	-	4900	-	5845	MHz
MCS 5		-	-	-66	dBm
MCS 6		-	-	-65	dBm
MCS 7		-	-	-64	dBm
Minimum receiver sensitivity in 802.11n (HT-40) mode					
MCS 0		-	-	-79	dBm
MCS 1		-	-	-76	dBm
MCS 2		-	-	-74	dBm
MCS 3	PER<10	-	-	-71	dBm
MCS 4		-	-	-67	dBm
MCS 5		-	-	-63	dBm
MCS 6		-	-	-62	dBm
MCS 7		-	-	-61	dBm
Minimum receiver sensitivity in 802.11ac (VHT-20) mode					
MCS 0		-	-	-82	dBm
MCS 1		-	-	-79	dBm
MCS 2		-	-	-77	dBm
MCS 3		-	-	-74	dBm
MCS 4	PER<10	-	-	-70	dBm
MCS 5		-	-	-66	dBm
MCS 6		-	-	-65	dBm
MCS 7		-	-	-64	dBm
MCS 8		-	-	-59	dBm
Minimum receiver sensitivity in 802.11ac (VHT-40) mode					
MCS 0		-	-	-79	dBm
MCS 1		-	-	-76	dBm
MCS 2		-	-	-74	dBm
MCS 3		-	-	-71	dBm
MCS 4		-	-	-67	dBm
MCS 5	PER<10	-	-	-63	dBm
MCS 6		-	-	-62	dBm
MCS 7		-	-	-61	dBm
MCS 8		-	-	-56	dBm
MCS 9		-	-	-54	dBm
Minimum receiver sensitivity in 802.11ac (VHT-80) mode					
MCS 0		-	-	-76	dBm
MCS 1		-	-	-73	dBm
MCS 2		-	-	-71	dBm
MCS 3		-	-	-68	dBm
MCS 4	PER<10	-	-	-64	dBm
MCS 5	-	-	-	-60	dBm
MCS 6		-	-	-59	dBm
MCS 7		-	-	-58	dBm
MCS 8		-	-	-53	dBm
MCS 9		-	-	-51	dBm
Maximum input level					
Maximum input signal level in 802.11a mode	PER < 10%	-30	-	-	dBm
Maximum input signal level in 802.11n mode	PER < 10%	-30	-	-	dBm
Maximum input signal level in 802.11ac mode	PER < 10%	-30	-	-	dBm

802.11, 5GHz Transmit RF specifications

Parameter	Conditions	Min	Typ.	Max	Unit
Frequency Range	–	4900		5845	MHz
Linear output power					
Maximum output power in 802.11a mode	54M, UNII-2e	–	12.5	–	dBm
Maximum output power in 802.11n mode	HT20, MCS7, UNII-2e	–	12	–	dBm
	HT40, MCS7, UNII-2e	–	11	–	dBm
Maximum output power in 802.11ac mode	VHT20, MCS8, UNII-2e	–	12	–	dBm
	VHT40, MCS9, UNII-2e	–	11	–	dBm
	VHT80, MCS9, UNII-2e	–	8	–	dBm
Transmit spectrum mask					
Margin to 802.11a spectrum mask	Maximum output power	0	–	–	dBr
Margin to 802.11n spectrum mask		0	–	–	dBr
Margin to 802.11ac spectrum mask		0	–	–	dBr
Transmit constellation error in 802.11a mode					
54Mbps	As specified in IEEE 802.11n	–	–	-25	dB
Transmit constellation error in 802.11n (HT-20, HT-40) mode					
MCS 7	As specified in IEEE 802.11n	–	–	-27	dB
Transmit constellation error in 802.11ac (VHT-20) mode					
MCS 8	As specified in IEEE 802.11n	–	–	-30	dB
Transmit constellation error in 802.11ac (VHT-40, VHT-80) mode					
MCS 9	As specified in IEEE 802.11n	–	–	-32	dB

Bluetooth receive RF specifications

Parameter	Conditions	Min	Typ	Max	Unit
Frequency Range	–	2402	–	2480	MHz
Sensitivity (BER)	GPSK, BER ≤0.1%	–	–	-80	dBm
	π/4-DQPSK, BER ≤ 0.01%	–	–	-80	dBm
	BER ≤ 0.01%, 8DPSK	–	–	-80	dBm
Maximum Input Level	GPSK, BER ≤0.1%	-20	–	–	dBm
	π/4-DQPSK, BER ≤ 0.1%	-20	–	–	dBm
	BER ≤ 0.1%, 8 DPSK	-20	–	–	dBm
BDR					
Intermodulation Performance	–	–	–	0.1	%
Rx C/I Performance	1DH1	–	–	0.1	%
	1DH3	–	–	0.1	%
	1DH5	–	–	0.1	%
EDR					
Rx C/I Performance	2DH1	–	–	0.1	%
	2DH3	–	–	0.1	%
	2DH5	–	–	0.1	%
	3DH1	–	–	0.1	%
	3DH3	–	–	0.1	%
	3DH5	–	–	0.1	%
Rx BER Floor Performance	BER ≤ 0.001%	–	–	-70	dBm

Bluetooth transmit RF specifications

Parameter	Conditions	Min	Typ	Max	Unit
Frequency Range	–	2402	–	2480	MHz
Output Power (Average)					
BDR (QPSK)	2440 MHz	–	7	–	dBm
EDR (π/4-DQPSK)	2440 MHz	–	3	–	dBm
EDR (8DPSK)	2440 MHz	–	3	–	dBm

BLE RF specifications

Parameter	Conditions	Min	Typ	Max	Unit
Frequency Range	–	2402	–	2480	MHz
Rx Receiver Sensitivity PER	@ -70dBm	–	–	30.8	%
Rx C/I and Receiver Selectivity Performance PER	–	–	–	30.8	%
Tx Power	–	–	7	–	dBm

802.15.4 receive RF specifications

Receive measurements were collected with the 802.15.4 SoC Ceramic Balun Reference Design (Version A0) at 2440MHz. The typical number indicates one standard deviation above the mean, measured at room temperature (25°C). The Min and Max numbers were measured over process corners at room temperature.

Parameter	Test Condition	Min	Typ	Max	Unit
Frequency range		2400	–	2500	MHz
Sensitivity (boost mode)	1% PER, 20 byte packet defined by IEEE 802.15.4-2003;	–	-102	-96	dBm
Sensitivity	1% PER, 20 byte packet defined by IEEE 802.15.4-2003;	–	-100	-94	dBm
High-side adjacent channel rejection	IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	35	–	dB
Low-side adjacent channel rejection	IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	35	–	dB
2nd high-side adjacent channel rejection	IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	46	–	dB
2nd low-side adjacent channel rejection	IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	46	–	dB
High-side adjacent channel rejection	Filtered IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	39	–	dB
Low-side adjacent channel rejection	Filtered IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	47	–	dB
2nd high-side adjacent channel rejection	Filtered IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	49	–	dB
2nd low-side adjacent channel rejection	Filtered IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	49	–	dB
High-side adjacent channel rejection	CW interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	44	–	dB
Low-side adjacent channel rejection	CW interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	47	–	dB
2nd high-side adjacent channel rejection	CW interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	59	–	dB
2nd low-side adjacent channel rejection	CW interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	59	–	dB
Channel rejection for all other channels	IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	40	–	dB
802.11g rejection centered at +12 MHz or -13 MHz	IEEE 802.15.4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	36	–	dB
Maximum input signal level for correct operation		0	–	–	dBm
Co-channel rejection	IEEE 802.15. 4-2003 interferer signal, wanted IEEE 802.15.4-2003 signal at -82 dBm	–	-6	–	dBc
Relative frequency error (50% greater than the 2x40 ppm required by IEEE 802.15.4-2003)		-120	–	+120	ppm
Relative timing error (50% greater than the 2x40 ppm required by IEEE 802.15.4-2003)		-120	–	+120	ppm
Linear RSSI range	As defined by IEEE 802.15.4-2003	40	–	–	dB
RSSI Range		-90	–	-40	dB

802.15.4 RF transmit specifications

Transmit measurements were collected with the Silicon Labs 802.15.4 SoC ceramic balun reference design (Version A0) at 2440MHz. The typical number indicates one standard deviation below the mean, measured at room temperature of 25°C. The Min and Max numbers were measured over process corners at room temperature. In terms of impedance, this reference design presents a 3n3 inductor in parallel with a 100:50Ω balun to the RF pins.

ZigBee/Thread RF transmit specifications

Parameter	Test Condition	Min	Typ	Max	Unit
Maximum output power	At highest normal mode power setting (+3)	-3	6.5	–	dBm
Minimum output power	At lowest power setting	–	-55	–	dBm
Error vector magnitude (Offset-EVM)	As defined by IEEE 802.15.4-2003, which sets a 35% maximum	–	–	10	%
Carrier frequency error	–	-40	–	+40	ppm
PSD mask relative	3.5 MHz away (Normal)	-20	–	–	dBm
PSD mask absolute	100 KHz BW	-30	–	–	dBm

ZigBee/Thread RF receive specifications

Parameter	Test Condition	Min	Typ	Max	Unit
Operating Frequency Range		2400	–	2483.5	MHz
Receiver Sensitivity PER	@[-95dBm]	–	–	1	%
Receiver Sensitivity Search	@PER 1%	–	–	-95	dBm
Receiver Interference Rejection PER	@[-2 Channel, Alternate Channel, 30dB]	–	–	1	%
Receiver Interference Rejection PER	@[-1 Channel, Adjacent Channel, 0dB]	–	–	1	%
Receiver Interference Rejection PER	@[+1 Channel, Adjacent Channel, 0dB]	–	–	1	%
Receiver Interference Rejection PER	@[+2 Channel, Alternate Channel, 30dB]	–	–	1	%
Error Vector Magnitude - RMS (EVM)	@[Target Power]	–	–	30	%
Error Vector Magnitude - Offset (EVM)	@[Target Power]	–	–	10	%
Receiver Maximum Input Level of Desired Signal	@[-20dBm Input]	–	–	1	%

.11 SPECIFICATIONS

Parameter	Minimum	Typical	Maximum	Conditions
External power supply	9Vdc	12Vdc/24Vdc	28Vdc	Pins #1 and #13
Power rating			30W	
Operation temperature	0	-	50°C	
Storage temperature	-25	-	70°C	

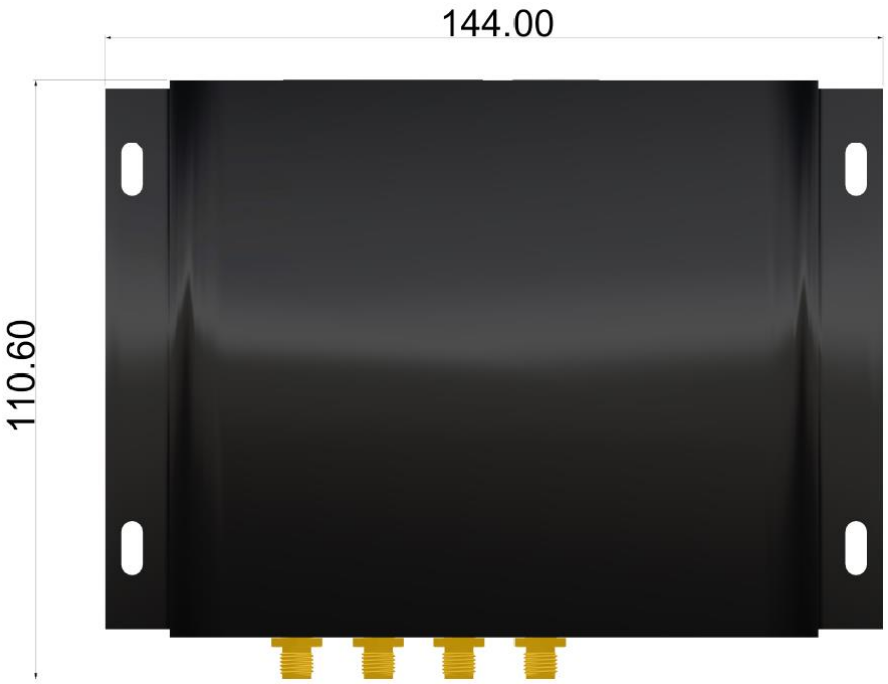
For the electrical characteristics of the I/O refer to chapter 6.1.

Wireless standard	Frequency band low	Frequency band high	Transmitted power
Bluetooth	2402 MHz	2480 MHz	9,8 dBm
Wi-Fi	2412 MHz	2472 MHz	17,6 dBm
Wi-Fi	5150 MHz	5350 MHz	17,1 dBm
Wi-Fi	5470 MHz	5725 MHz	16,1 dBm
Wi-Fi	5725 MHz	5850 MHz	11,6 dBm
Zigbee	2405 MHz	2480 MHz	7,8 dBm

.12 MECHANICAL SPECIFICATIONS

All the measures are in [mm].

TOP VIEW



SIDE VIEW

.13 PACKAGING

Standard package of the KITRA GTI BLACK 4G/GPS bundle kit is made up with these items:

- KITRA GTI BLACK 4G/GPS.
- Two 2.4GHz uFL antennas (WiFi/BLE & Zigbee/Thread).
- Quad band GSM antenna (MAIN).
- GPS active antenna (GNSS).
- One connector (3.00mm Female Dual Row Receptacle WR-MPC3 24 pins P/N 662024113322)
- 24 crimp terminals (Female Crimp Terminal 20 to 24 AWG WR-MPC3 P/N 66200113722)

.14 INDOOR USE ONLY FOR 5GHZ BAND

In the frequency band 5150-5350 MHz, the use of the KITRA GTI BLACK 4G/GPS with Wi-Fi wireless communications is restricted to indoor use only.

.15 OPERATING ENVIRONMENT

The operating environment excludes special environments (extreme temperatures, dust, humidity, vibrations, flammable gases, corrosive or explosive atmosphere, etc.).

.16 DICLAIMERS

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