

# Product Overview and Technical User Guide

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**Product Model: ZK-200**

**Description: IoT Gateway**

Version: 1.0

Date: 05 March, 2024

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Revision History

Date	Version	Details of change	Author	Reviewer
05/Mar/2024	1.0	First release; amended with Flanged Enclosure,Updated Block Diagram for ZK200	ND	JP

Table 1: Revision History

## **1 INTRODUCTION**

### **1.1 Purpose**

This document describes Zome Power's ZK-200 IoT Gateway. It can be targeted for multiple use cases in various IoT segments such as Smart Home, Buildings and Industries. Master SKU of this Gateway has scalable Hardware Design to support Multi-RF Connectivity such as Wi-Fi, BLE, ZigBee, Z-wave, Thread and LTE along with all basic wired interfaces such as Ethernet, RS232.438, CAN, and USB. **ZK-200 SKU is equipped with Ethernet, USB, and LTE & Z-wave** (other interface PCB components are not populated). So, this document mainly describes ZK-200 Hardware interfaces & user guidance.

### **1.2 Scope**

The scope of this document is to detail out aspects of ZK-200 Gateway product design, specifications, Features etc.

### **1.3 Acronyms & Abbreviations**

<b>Terms</b>	<b>Definition</b>
SoC	System on Chip
CPU	Central Processing Unit
BLE	Bluetooth Low Energy
IoT	Internet of things
RST	Reset
UART	Universal asynchronous receiver-transmitter
LED	Light Emitting Diode
GPIO	General Purpose Input/output
TBD	To Be Determined
Etc.	et cetera
DNP	Do not populate (for component of PCB)

Table 2: Acronyms & Abbreviations

### 2 PRODUCT OVERVIEW

Zome Power's ZK-200 is all-in-one gateway development kit, which is based on NXP's power efficient i.MX6ULL/ i.MX6UltraLite/ i.MX6ULZ applications processor featuring ARM® Cortex®-A7 core CPUs.

ZK-200 has mainly USB and Ethernet as wired interfaces & wireless connectivity over Z-Wave and LTE. ZK-200 has a standard Mikrobus compatible socket header which enables a user to use any standard Mikrobus add-on modules. ZK-200 is equipped with the ZW700 (ZGM130S based Z-Wave) module on Mikrobus. The figure below shows the complete ZK-200 unit and internal view depicting all its interfaces.

ZK-200 IoT Gateway platform is specifically crafted to satisfy all the needs of the IoT Gateway Solution. Gateway is built on secure, power-efficient, and cost-optimized ARM® Cortex®-A7 based iMX6ULL SoC. This enables a greater amount of flexibility in providing various RF connectivity and peripherals to make a tailor-made solution according to end-user needs. Zome also offers a ZK-200 Software Framework to support their field applications.



Figure 1: ZK-200 Unit

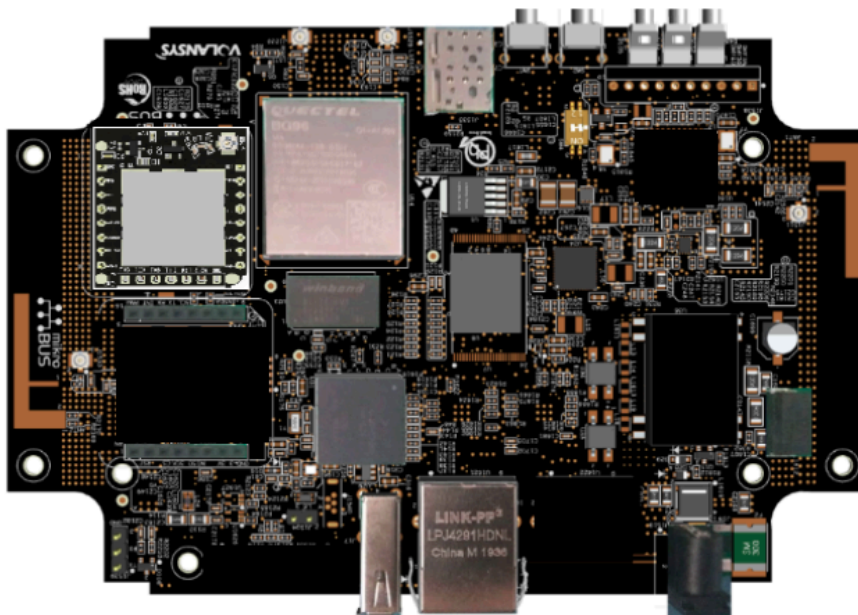


Figure 2: ZK-200 PCBA

## 2.1 System Block Diagram

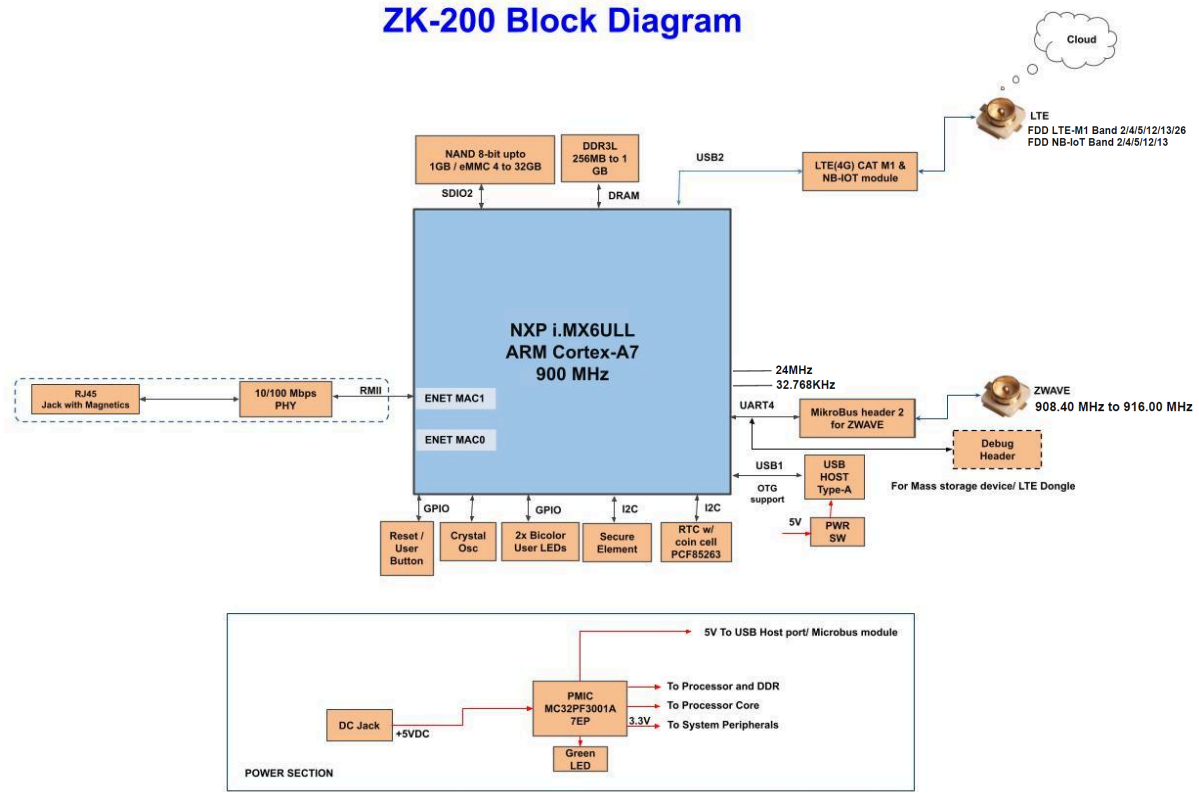


Figure 3: ZK-200 - System Block Diagram

## 2.2 Hardware configuration

The table below lists Hardware configuration supported by ZK-200.

Sr No	Block	Feature Parameter	Specification
1	CPU	Core & Frequency	i.MX 6ULL (792 MHz) ARM Cortex A7
2	Memory	RAM Memory	DDR3L (512MB)
		eMMC Storage	32 GB
3	Interfaces	Ethernet	1x 10/100Mbps
		USB	1x USB2.0 (Host/Device)
		Mikrobus header	1x Z-wave Module (on Mikrobus)
		LTE	Quectel BG96 (Cat M1/NB-IoT module)
		GPS	No
4	User Interface/ IO	Switch	2x user configurable push-buttons
		LEDs	1x power LED
			2x user configurable LEDs
		Debug Port	1x UART port for serial logs

Table 3: Hardware configuration

### 3 MAJOR COMPONENTS ON ZK-200

Below are some of major features and interfaces of ZK-200 base board:

- 2x Mikrobus Compatible Header. (ZGM130S Z-Wave module is mounted on Mikrobus-2)
- 1x 4FF (Nano) SIM card connector for LTE.
- 1x JTAG header.
- 1x USB 2.0 port (host/device configurable).
- 1x 10/100 Ethernet port.
- 3x LEDs (1x power & 2x user configurable).
- 2x user configurable switches.
- DC power supply input jack (5V, 3A)

Note: Mikrobus-1 can be used to add other Mikrobus RF modules (only if nRF52840 BLE is not populated).

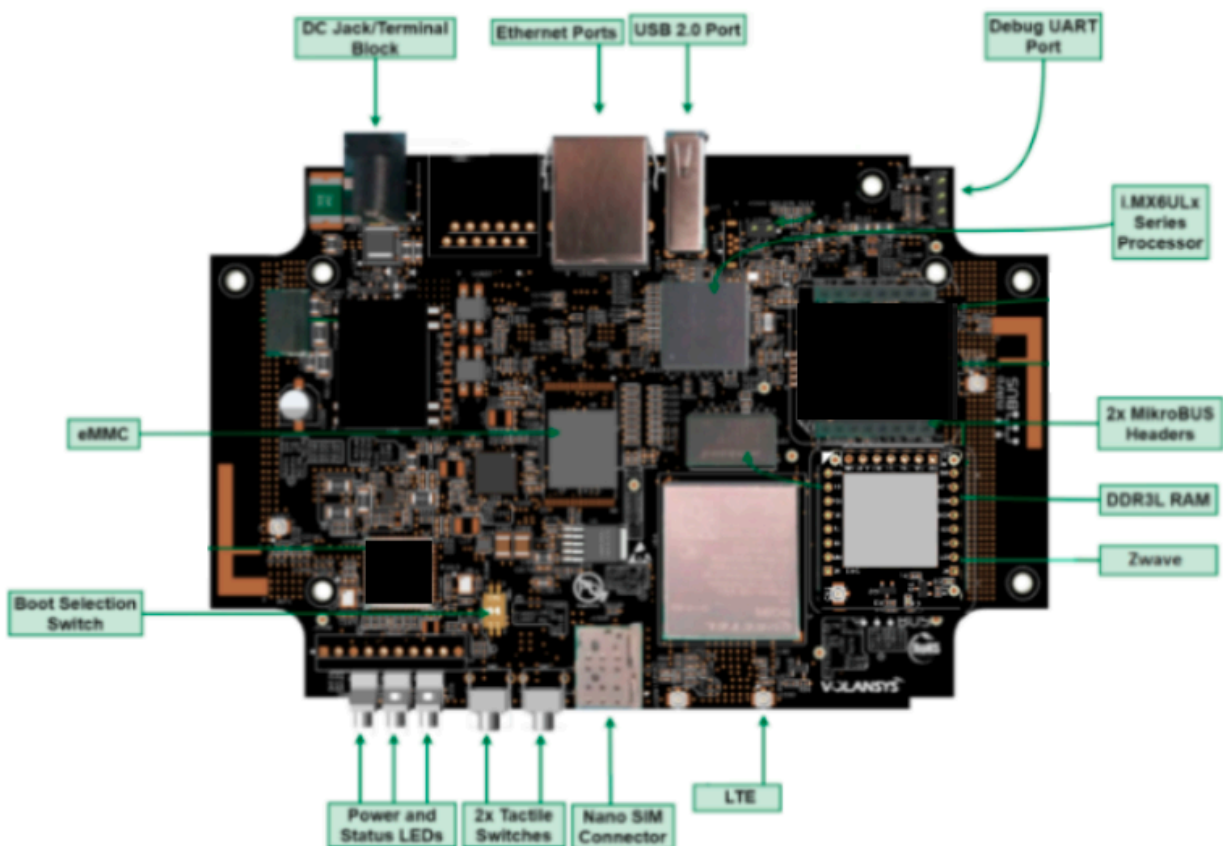


Figure 4: ZK-200 PCBA with Interfaces identity

### 3.1 Secure Element

ZK-200 has a built-in secure element IC providing device to device authentication, key storage and data protection, etc. features based on NXP's A71CH chip.

The A71CH is a ready-to-use solution providing a root of trust at the IC level and proven, chip-to-cloud security right out of the box. It is a platform capable of securely storing and provisioning credentials, securely connecting IoT devices to cloud services and performing cryptographic node authentication.

More information regarding this chip can be found at the link below:

<https://www.nxp.com/docs/en/data-sheet/A71CH-SDS.pdf>

### 3.2 Wireless Connectivity

ZK-200 contains the Z-Wave Mikrobus module (based on Silab ZGM130S chip) and Quectel's BG96 module for LTE CatM1/NB1 northbound connectivity. Below are major features of each wireless peripheral. More information regarding the wireless modules can be obtained from their respective websites and data-sheets.

#### 3.2.1 ZWave (ZW700\_ Module)

ZWave connectivity is possible on ZK-200 using Volansys' ZW700 module. It is developed using SiLabs Z-Wave 700 Zen Gecko SiP chip #ZGM130S. The ZGM130S is a fully integrated Z-Wave module, enabling rapid development of Z-Wave solutions. A baseband controller, Sub-GHz radio transceiver, crystal, decoupling, and matching is included to provide a complete Z-Wave System-in-Package module requiring only an external antenna. An ideal solution for smart home control and sensing applications such as sensors, door locks, light switches, security networks as well as gateways.

#### **Following are the features of the ZGM130S:**

- ITU G.9959 compliant.
- Supports all ZWave bands (865.2 MHz - 926.3 MHz).
- ARM Cortex-M4 Floating Point Unit.
- 39 MHz clock speed.
- 64 Kb application flash.
- 8 Kb application RAM.



**Following are the features of the ZW700:**

- Mikrobus compliant.
- On-board SAW filter on RF path.

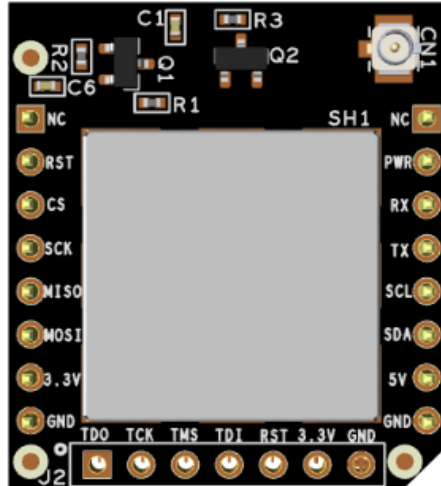


Figure 5: ZW700 Mikrobus Module

Programming of the ZWave 700 module can be done through the JTAG/SWD interface provided on the header “J2”. The pin out of the programming header is shown in the figure below.

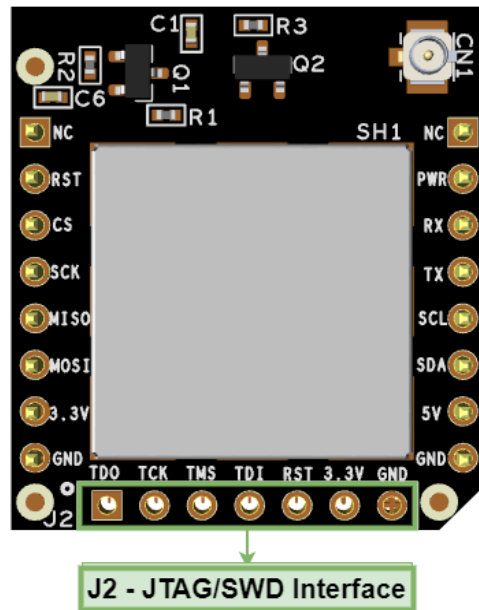


Figure 6: ZWave 700 Module Programming Interface

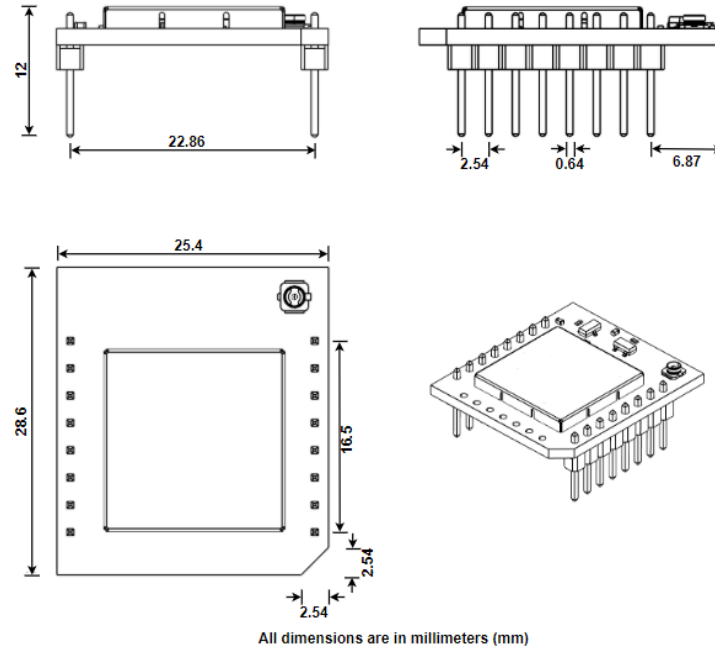


Figure 7: ZWave 700 Mikrobus form-factor

More information on the EVK SLWSTK6050A, please refer to UG381: ZGM130S Zen Gecko Wireless Starter Kit User's Guide available here,

<https://www.silabs.com/documents/login/user-guides/ug381-brd4202a-user-guide.pdf>

### 3.2.2 Long Term Evolution (LTE) Module

ZK-200 supports cellular connectivity via Global LTE CatM1/NB1 supported BG96 module available from Quectel, which provides compatibility world-wide like North America, Europe, etc. ZK-200 needs an external antenna for LTE wireless connectivity.

ZK-200 also has a Nano (4FF) SIM card socket. The socket is user accessible from enclosure cut-out and SIM card can be easily inserted/ejected without opening the Product.

#### **Following are the features of the BG96MAR02A10M1G (R1.1) module:**

- LTE Cat M1/NB-IoT/EGPRS module with ultra-low power consumption with Optional-GPS
- Compact SMT formfactor (Super Slim LGA Package) for size-constrained applications with tight space
- **Interfaces:**
  - USB 2.0 with High Speed up to 480Mbps
  - UART × 3
  - PCM × 1
  - ADC × 2 (15 bits)
  - GPIO × 2 (I2C and UART3 can be re-configured as extra 4 GPIOs)
  - (U)SIM Interface × 1
  - NETLIGHT for Network Status Indication
  - STATUS for Power ON/OFF Indication
  - Main and GNSS Antenna Interfaces
- Firmware Upgrade via USB interface & DFOTA (Delta Firmware Upgrade Over the Air) support
- Processor: ARM A7 Processor, with 3MB Flash and 3MB RAM Available for Users

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- Cat M1/Cat NB1: LTE FDD: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B26/B28 (R1.1 supports B26 cat M1 only)  
Max. 300Kbps (DL), Max. 375 Kbps (UL)
- LTE TDD: B39 (For Cat M1 Only)  
Max. 32Kbps (DL), Max. 70 Kbps (UL)
- EGPRS: 850/900/1800/1900MHz  
EDGE: Max. 296 Kbps (DL), Max. 236.8Kbps (UL)  
GPRS: Max. 107 Kbps (DL), Max. 85.6Kbps (UL)
- Global Regulatory Approvals - CE/GCF (Europe), FCC/PTCRB/Verizon/AT&T (North America), RCM/Telstra (Australia), IFETEL (Mexico), IC (Canada, CCC (China)
- Various Software features - all type of driver support (USB, RIL, NDIS, ECM, Gobinet, QMI\_WWAN)
- Protocols supported are PPP/TCP/UDP/SSL/TLS/FTP(S)/HTTP(S)/NITZ/PING/MQTT
- GNSS (Optional): GPS, GLONASS, BeiDou/Compass, Galileo, QZSS
- Supports VoLTE & SMS

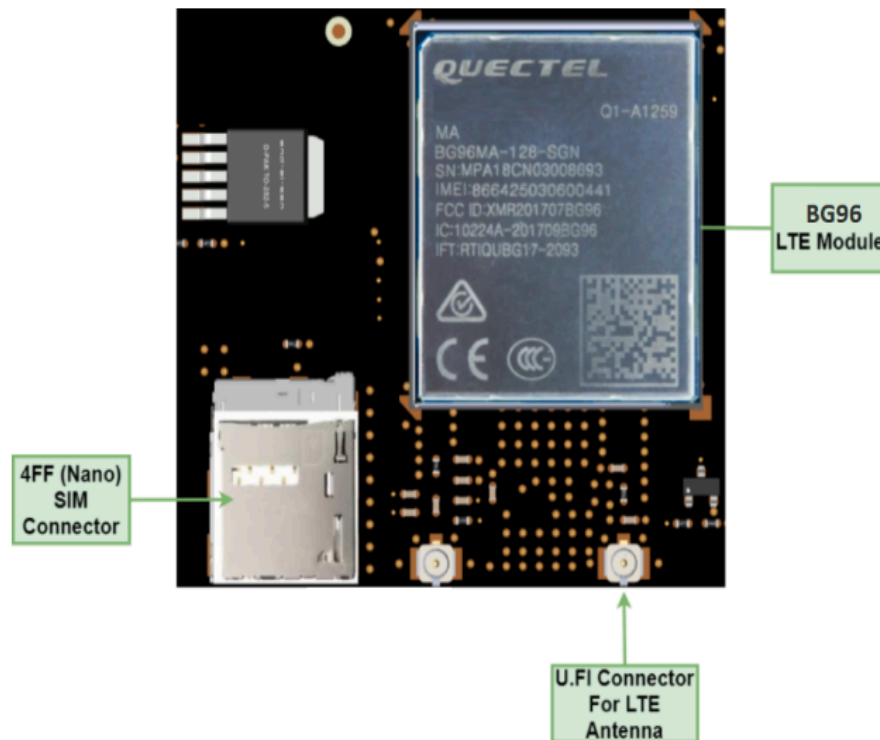


Figure 8: LTE Module

### 3.3 Power Supply

The ZK-200 has a single power supply from 5 mm DC barrel Jack (Center + pin) via 5V, 3A DC power adapter. Users can also use a PoE Splitter to connect RJ45 Data & 5V, 3A DC Jack.

### 3.4 Peripheral Interfaces

This section describes interfaces of ZK-200. Below figure shows the available interfaces of ZK-200.

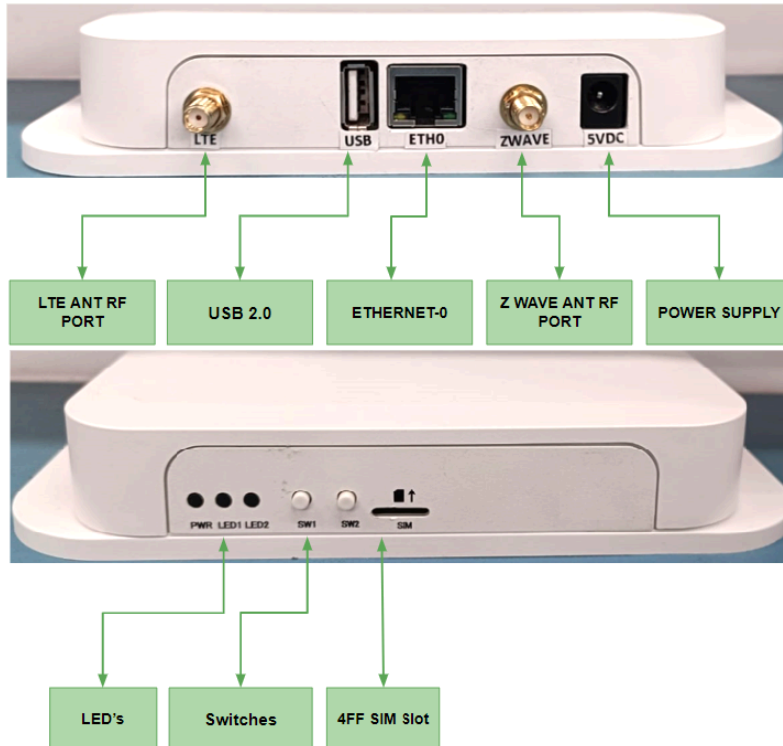


Figure 9: Peripheral Interfaces of ZK-200

### 3.4.1 Ethernet

The ZK-200 has 1x 10/100Mbps Ethernet port (with 2 LEDs indicated in RJ45 connector).

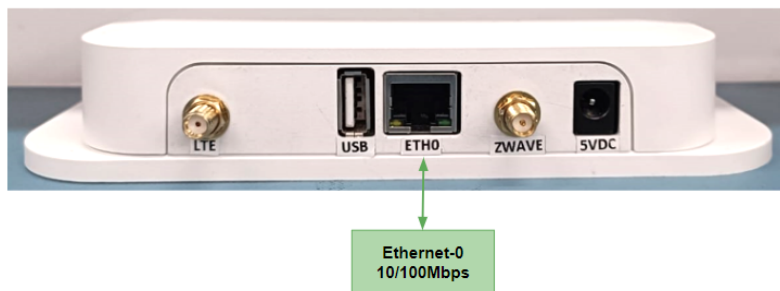


Figure 10: Ethernet Ports

#### **Ethernet PHY features:**

- Implements the full 802.3 specification with preamble/SFD generation, frame padding generation, CRC generation and checking, and supports zero-length preamble.
- Dynamically configurable to support 10/100-Mbit/s operation.
- Supports 10/100 Mbit/s full-duplex and configurable half-duplex operation.
- Compliant with the AMD magic packet detection with interrupt for node remote power management.
- Seamless interface to commercial Ethernet PHY devices via one of the following:

- A 4-bit Media Independent Interface (MII) operating at 2.5/25 MHz.
- A 4-bit non-standard MII-Lite (MII without the CRS and COL signals) operating at 2.5/25 MHz.
- A 2-bit Reduced MII (RMII) operating at 50 MHz.
- Simple 64-Bit FIFO user-application interface.
- CRC-32 checking at full speed with optional forwarding of the frame check sequence (FCS) field to the client.
- CRC-32 generation and append on transmit or forwarding of user application provided FCS selectable on a per-frame basis.
- In full-duplex mode:
  - Implements automated pause frame (802.3 x31A) generation and termination, providing flow control without user application intervention.
  - Pause quanta used to form pause frames — dynamically programmable.
  - Pause frame generation additionally controllable by user application offering flexible traffic flow control.
  - Optional forwarding of received pause frames to the user application.
  - Implements standard flow-control mechanism.
- In half-duplex mode: provides full collision support, including jamming, back-off, and automatic re-transmission.
- Supports VLAN-tagged frames according to IEEE 802.1Q
- Programmable MAC address: Insertion on transmit; discards frames with mismatching destination address on receive. (except broadcast and pause frames)
- Programmable promiscuous mode support to omit MAC destination address checking on receive.
- Multicast and unicast address filtering on receive based on 64-entry hash table, reducing higher layer processing load.
- Programmable frame maximum length providing support for any standard or proprietary frame length.
- Statistics indicators for frame traffic and errors (alignment, CRC, length) and pause frames providing for IEEE 802.3 basic and mandatory management information database (MIB) package and remote network monitoring (RFC 2819).
- Simple handshake user application FIFO interface with fully programmable depth and threshold levels.
- Provides separate status words for each received frame on the user interface providing information such as frame length, frame type, VLAN tag, and error information.
- Multiple internal loopback options.
- MDIO master interface for PHY device configuration and management supports two programmable MDIO base addresses, & standard (IEEE 802.3 Clause 22) & extended (Clause 45) MDIO frames.
- Supports legacy FEC buffer descriptors.
- Interrupt coalescing reduces the number of interrupts generated by the MAC, reducing CPU loading.

### **IP protocol performance optimization features:**

- Operates on TCP/IP and UDP/IP and ICMP/IP protocol data or IP header only, enables wire-speed processing, Supports IPv4 and IPv6.

- Transparent passing of frames of other types and protocols.
- Supports VLAN tagged frames according to IEEE 802.1q with transparent forwarding of VLAN tag and control field.
- Automatic IP-header and payload (protocol specific) checksum calculation and verification on receive.
- Automatic IP-header and payload (protocol specific) checksum generation and automatic insertion on transmitter configurable on a per-frame basis.
- Supports IP and TCP, UDP, ICMP data for checksum generation and checking.
- Supports full header options for IPv4 and TCP protocol headers.
- Provides statistics information for received IP and protocol errors.
- Configurable automatic discard of erroneous frames.
- Configurable automatic host-to-network (RX) and network-to-host (TX) byte order conversion for IP and TCP/UDP/ICMP headers within the frame.
- Configurable padding removes short IP datagrams on receive.
- Configurable Ethernet payload alignment to allow for 32-bit word-aligned header and payload processing.
- Programmable store-and-forward operation with clock and rate decoupling FIFOs.

### **IEEE features:** (Supports all IEEE 1588 frames)

- Allows reference clocks to be chosen independently of network speed.
- Software-programmable precise time stamping of ingress and egress frames.
- Timer monitoring capabilities for system calibration and timing accuracy management.
- Precise time stamping of external events with programmable interrupt generation.
- Programmable event and interrupt generation for external system control.
- Supports hardware- and software-controllable timer synchronization.
- Provides a 4-channel IEEE 1588 timer. Each channel supports input capture and output comparison using the 1588 counter.

### **3.4.2 USB**

ZK-200 has 1x USB 2.0 Type-A port (configured as a host device by default).

#### **Below are major features of USB interface:**

- High-Speed/Full-Speed/Low-Speed support.
- High Speed, and Full Speed operation in Peripheral mode (with UTMI transceiver).
- Hardware support for OTG signalling, session request protocol, and host negotiation protocol.
- Up to 8 bidirectional endpoints.
- Low-power mode with local and remote wake-up capability.
- Serial PHY interfaces configurable for bidirectional/unidirectional and differential/single ended.
- Embedded DMA controller.

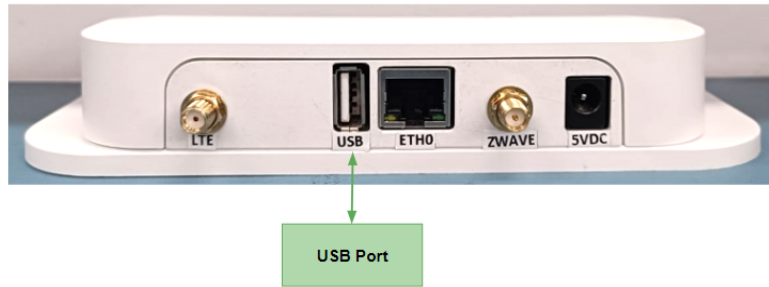


Figure 11: USB Type-A Port

The ZK-200 can also be configured as a USB slave device (by a selection jumper on board). Refer below image for location of the selection jumper on PCB.

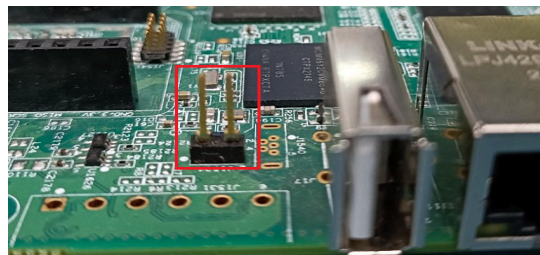


Figure 12 : USB Jumper selection

### 3.4.3 Serial Console UART Port

The ZK-200 has an inbuilt Serial Console UART port (on three Tx/Rx/GND pins). This port is not accessible for Enclosed Product, User must have access to ZK-200 PCBA Top. Please note that UART signals are 3.3V logic levels (not 5V tolerant), so use only 3.3V logic USB to UART converter with any Host-PC.

#### Parameters to establish serial Console UART connection:

- Baud rate: 115200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

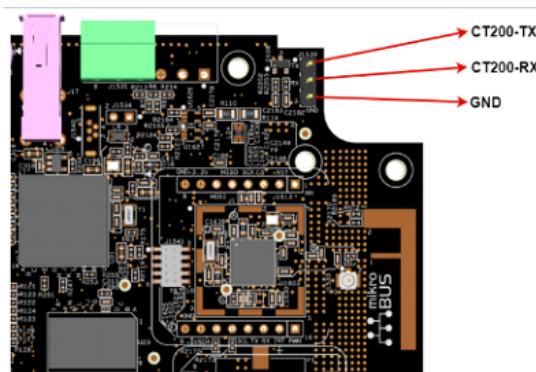


Figure 13: Debug Port (show TX, Rx, GND pins)

### 3.4.4 eMMC

For storage of data, ZK-200 offers on-board eMMC of 32GB size.

### 3.4.5 DDR (Double Data Rate) RAM

The ZK-200 offers DDR3L RAM of 512MB size.

### 3.4.6 Switches

The ZK-200 has two tactile (push-button) switches on the front panel. These switches are completely user configurable for any use-case.

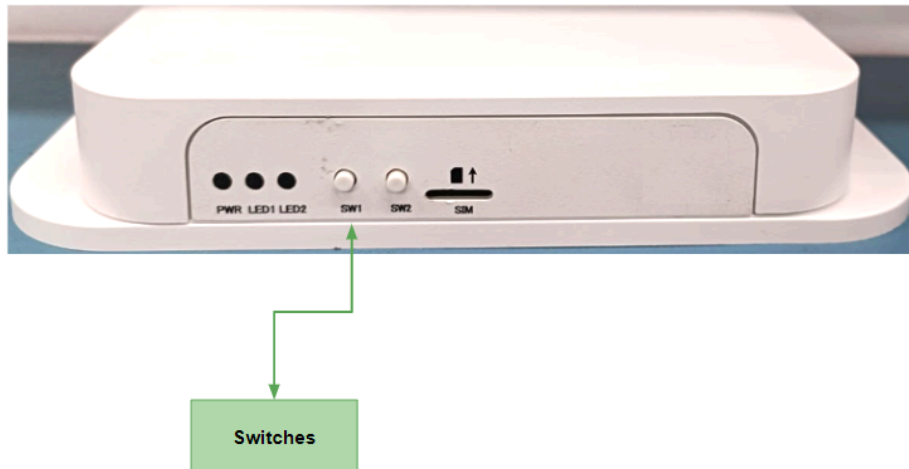


Figure 14: User Configurable Switches

### 3.4.7 LEDs

The ZK-200 has three LEDs to support User Interface requirements. 1x Single color LED to indicate Power-supply & other 2x Bi-Color LEDs are user configurable LEDs to support any use-case.

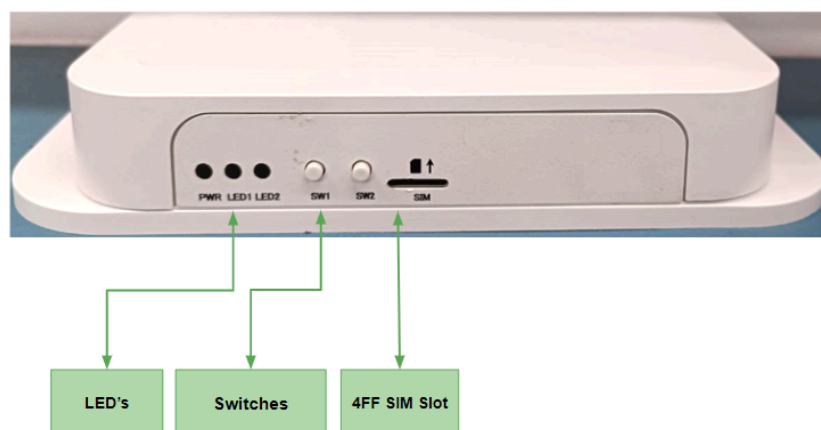


Figure 15: User Interface LEDs



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Sr No	LED	LED Colour	Function
1	PWR	Green	Solid ON: Gateway is powered ON
			Solid OFF: Gateway is powered OFF
2	LED1 & LED2	Bi-colour (Red/Green)	Status: User configurable

Table 4: LED indications

### 3.4.8 IO Table

Below table describes the IO interfacing to all the internal peripherals of the Master SKU to facilitate user addressing as required in Firmware.

Sr.	Peripheral	Section	Microprocessor IO Name	MPU Pin	Linux IO	Use
1	ORing Control	ORing	GPIO5_IO09	R6	IO137	ORing - Used to know which input source is switched when two voltage inputs are available. RTC - Used as an interrupt source from RTC.
2	RTC INTA	ORing + RTC	GPIO1_IO04	M16	IO4	Used to enable/disable power to the USB type A connector.
3	EN_USB	USB	GPIO1_IO01	C15	IO1	Used to put the CT200 in master/slave mode.
4	USB_OTG_ID		GPIO1_IO00	K13	IO0	
5	USB_OTG_N		USB_OTG1_DN	T15	-	
6	USB_OTG_P		USB_OTG1_DP	U15	-	
7	CAN_PD	CAN	GPIO1_IO09	M15	IO9	Used to enable/disable CAN transmissions.
8	CAN_RX		UART3_RTS	G14	-	CAN Receive.
9	CAN_TX		UART3_CTS	H15	-	CAN Transmit.
10	BLE_RST	nRF52840 BLE	GPIO1_IO05	M17	IO5	Used to reset the on board BLE module.
11	BLE_INT		GPIO5_IO01	R9	IO129	
12	UART1_TX	nRF52840 BLE + MikroBUS1	UART1_TX_DATA	K14	-	UART1. Used to communicate with nRF52840 BLE module
13	UART1_RX		UART1_RX_DATA	K16	-	
14	UART1_RTS		UART1_RTS	J14	-	
15	UART1_CTS		UART1_CTS	K15	-	
16	SPI1_CLK	nRF52840 BLE + MikroBUS1 + MikroBUS2	ECSP1_SCLK	D4	-	Serial Peripheral Interface (SPI) Bus.
17	SPI1_MOSI		ECSP1_MOSI	D2	-	
18	SPI1_MISO		ECSP1_MISO	D1	-	
19	SPI1_SS0		GPIO4_IO26	D3	IO122	
20	SPI1_SS1	nRF52840 BLE + MikroBUS2	GPIO4_IO24	E1	IO120	Slave Select (SS) for SPI BUS.
21	SWITCH_1	Switch	GPIO3_IO00	A8	IO64	User configurable switches.
22	SWITCH_2		GPIO5_IO00	R10	IO128	
23	LED_ST_2	LED's	GPIO4_IO17	F5	IO113	User configurable LED's.
24	LED_ST_3		GPIO4_IO18	E5	IO114	
25	LED_ST_4		GPIO5_IO07	N10	IO135	
26	LED_ST_5		GPIO5_IO08	N9	IO136	
27	WLAN_RST	Wi-Fi	GPIO4_IO19	F2	IO115	Used to reset on board Wi-Fi Module.
28	WLAN_DAT0		usdhc1_DAT0	B3	-	Used for communicating with the Wi-Fi section of the on board Wi-Fi combo module.
29	WLAN_DAT1		usdhc1_DAT1	B2	-	
30	WLAN_DAT2		usdhc1_DAT2	B1	-	
31	WLAN_DAT3		usdhc1_DAT3	A2	-	
32	WLAN_CMD		usdhc1_CMD	C2	-	
33	WLAN_CLK		usdhc1_CLK	C1	-	
34	BT_RST	Wi-Fi + BT Combo	GPIO4_IO20	F3	IO116	Used to reset BT/BLE section of the on board combo module.
35	BT_WAKE		GPIO5_IO02	P11	IO130	Used to wake BT/BLE section of the on board combo module.
36	WLAN_TX		UART2_TX_DATA	J17	-	UART2 interface. Used for communicating with the BT/BLE section of the on board Wi-Fi combo module.
37	WLAN_RX		UART2_RX_DATA	J16	-	
38	WLAN_CTS		UART2_CTS	H14	-	
39	WLAN_RTS		UART2_RTS	J15	-	
40	ZWave_RST		GPIO4_IO21	E4	IO117	Reset IO for Mikrobus module.

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41	ZWave_INT	MikroBUS2	GPIO5_IO04	P9	IO132	Interrupt IO for Mikrobus module.
42	BOOT_MODE0	Boot config selector switch	SRC_BOOT_MODE0	T10	-	Used for selecting boot mode configuration.
43	BOOT_MODE1		SRC_BOOT_MODE1	U10	-	
44	RS485_DIR	RS485/RS232	GPIO4_IO14	B5	IO110	Used to enable/disable RS485 receiver.
45	RS485_RX		UART5_RX_DATA	G13	-	UART5 interface for communicating with RS232/485 transceiver.
46	RS485_TX		UART5_TX_DATA	F17	-	
47	LTE_DM	LTE	USB_OTG2_DN	T13	-	USB interface for communicating with the LTE module.
48	LTE_DP		USB_OTG2_DP	U13	-	
49	LTE_NETW		GPIO4_IO23	E2	IO119	Used to get network status.
50	LTE_STATUS		GPIO3_IO03	C9	IO67	Used to get status of the module.
51	LTE_PWR_KEY		GPIO3_IO02	D9	IO68	Used to turn the module ON/OFF.
52	LTE_RST		GPIO4_IO22	E3	IO118	Used to reset the LTE module.
53	EN_LTE_LDO		GPIO5_IO03	P10	IO131	Used to enable/disable power to the LTE module.
54	SCL	PMIC, RTC, EEPROM, Secure element, MikroBUS1 and MikroBUS2	I2C_SCL	L14	-	I2C interface.
55	SDA		I2C_SDA	L17	-	
56	UART3_TX	MikroBUS2	UART3_TX_DATA	H17	-	UART3 Interface.
57	UART3_RX		UART3_RX_DATA	H16	-	
58	UART3_RTS	MikroBUS2/CAN	UART3_RTS	G14	-	
59	UART3_CTS		UART3_CTS	H15	-	
60	UART4_TX	Debug header	UART4_TX_DATA	G17	-	UART4 interface. Used for debug.
61	UART4_RX		UART4_RX_DATA	G16	-	

Table 5: IO Table of Master SKU

## 4 OPERATING, THERMAL & ANTENNA CHARACTERISTICS

### 4.1 Recommended Operating Conditions

Sr No	Description	Minimum	Typical	Maximum	Unit
1	Operating voltage	4.75	5	5.5	V
2	Current consumption	-	-	3	A
3	Operating temperature range (ambient)	-10	25	60	°C

Table 6: Recommended Operating Conditions

### 4.2 Thermal Analysis data

Thermal analysis of ZK-200 was done with 4 different configurations as per below table.

Sr. No.	Objective	Processor Temperature	Ambient Temperature
1	CPU Runs in normal Condition	81 °C	65 °C
2	CPU run at 33%	84 °C	65 °C
3	CPU run at 66%	86 °C	65 °C
4	CPU run at 100%	92 °C	65 °C

Table 7: Thermal Analysis

Note: The CPU threshold limit of the processor is 100 °C. When CPU temperature increases >100 °C, it will auto-shutdown PMIC and apparently all interfaces will shut-down abruptly.

### 4.3 Antenna details

Sr	Radio	Description	Manufacturer	Part No	Gain
1	External LTE ANT	LTE 4G Antenna with black color	Shengda Com	SDD15	+3 dBi
2	External ZW700 ANT	RF ANT 850MHZ/900MHZ WHIP ANT	Pulse Larsen	W1902	+2 dBi

Table 8: Antenna Analysis

### 5 MECHANICAL DIMENSIONS

ZK-200 product's wall mount (with Flanges) Enclosure dimensions are 180 x 100 x 30 mm (L x W x H)

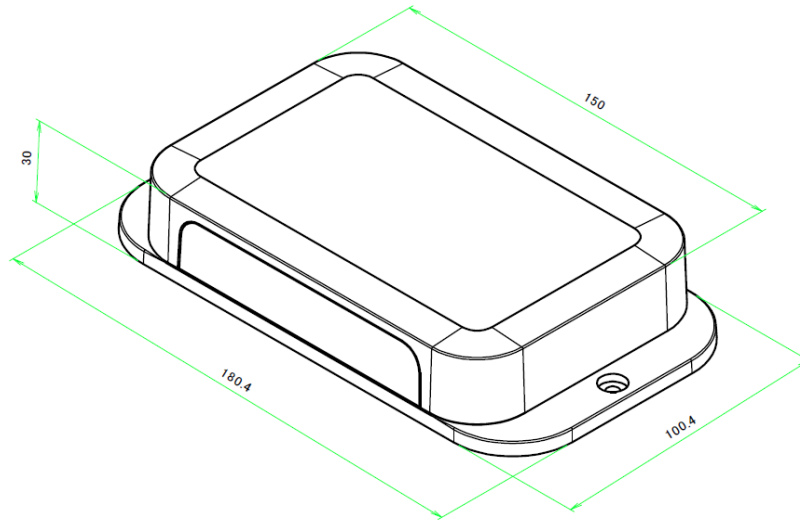


Figure 16: ZK-200 Dimensions of wall mount Enclosure

## **6 CERTIFICATION**

### **6.1 FCC (Federal Communications Commission)**

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with part 15 of the FCC rules and RSS-247 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement..

## **APPLICATION NOTES**

### **Safety Precautions**

These specifications are intended to preserve the quality assurance of products as individual components.

Before use, check and evaluate the module's operation when mounted on your products. Abide by these specifications when using the products. These products may short-circuit. If electrical shocks, smoke, fire, and/or accidents involving human life are anticipated when a short circuit occurs, then provide the following fail safe functions as a minimum:

1. Ensure the safety of the whole system by installing a protection circuit and a protection device.
2. Ensure the safety of the whole system by installing a redundant circuit or another system to prevent a single fault causing an unsafe status.

### **Design Engineering Notes**

1. Heat is the major cause of shortening the life of the modules. Avoid assembly and use of the target equipment in conditions where the product's temperature may exceed the maximum allowable.
2. Failure to do so may result in degrading of the product's functions and damage to the product.
3. If pulses or other transient loads (a large load applied in a short time) are applied to the products, before use, check and evaluate their operation when assembled onto your products.
4. These products are not intended for other uses, other than under the special conditions shown below. Before using these products under such special conditions, check their performance and reliability under the said special conditions carefully, to determine whether or not they can be used in such a manner.
5. In liquid, such as water, salt water, oil, alkali, or organic solvent, or in places where liquid may splash. In direct sunlight, outdoors, or in a dusty environment. In an environment where condensation occurs. In an environment with a high concentration of harmful gas (ex. salty air, HCl,

Cl<sub>2</sub>, SO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, and NO<sub>x</sub>).

6. If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these products with new products because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.
7. Mechanical stress during assembly of the board and operation must be avoided.
8. Pressing on parts of the metal cover or fastening objects to the metal cover is not permitted.

### Storage Conditions

1. The module must not be stressed mechanically during storage.
2. Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance, may well be adversely affected:
  - Storage in salty air or in an environment with a high concentration of corrosive gas, such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub> or NO<sub>x</sub>.
  - Storage (before assembly of the end product) for more than one year after the date of date of delivery even if all the above conditions have been met, should be avoided.