Toradex
Swiss. Embedded. Computing.

Zinnia Gateway

Datasheet

Preliminary – Subject to Change

Revision History

Document Revisions

Date	Doc. Revision	Product Version	Changes
09-Jul-2026	Rev. 0.1	V1.0	Initial documentation

Contents

1 Introduction **8**
1.1 Purpose of This Document . . . 8
1.2 Product Overview . . . 8
1.3 Performance, Interfaces and Mechanical . . . 9
1.4 Environmental and Installation Conditions . . . 10
1.5 Reference Documents . . . 11
1.5.1 Toradex Developer Center . . . 11
1.5.2 Zinnia Gateway Product Page . . . 11
1.5.3 Verdin iMX8M Plus and Zinnia Carrier Board . . . 11
1.5.4 NXP i.MX 8M Plus . . . 11
1.5.5 Ethernet Transceiver . . . 11
1.5.6 Wi-Fi and Bluetooth Module . . . 11
1.6 Security . . . 12
1.6.1 Security Features . . . 12
1.6.2 High Assurance Boot (HAB) . . . 12
1.6.3 Cryptographic Acceleration . . . 12
1.6.4 Arm TrustZone . . . 13
1.6.5 Secure Key Storage . . . 13
1.6.6 Hardware Random Number Generator . . . 13

2 Architecture Overview **14**
2.1 Block Diagram . . . 15
2.2 Mechanical Drawings . . . 16

3 Power Input **19**
3.1 Overview . . . 19
3.2 Power Requirements and Recommendations on Power Adapter . . . 19
3.3 Connector Specification . . . 20
3.3.1 Compatible Mating Connectors . . . 20
3.4 Pin Assignment . . . 20
3.5 Protection Features . . . 21
3.5.1 Grounding and Shielding . . . 21
3.6 Absolute Maximum Ratings . . . 21

4 Interfaces Description **23**
4.1 Control Buttons . . . 23
4.1.1 Recovery Button . . . 23
4.1.2 Reset Button . . . 23
4.2 Ethernet . . . 23
4.2.1 Overview . . . 23
4.2.2 Mating Connector . . . 25
4.2.3 Time Synchronization and TSN Capabilities . . . 25
4.3 PCI Express (Mini Card) Expansion Slot . . . 25
4.3.1 Overview . . . 25
4.3.2 Nano SIM and Cellular Connectivity . . . 27
4.4 RTC Battery Holder . . . 28
4.5 SD Card . . . 29
4.5.1 Overview . . . 29
4.5.2 Functional Description . . . 29
4.5.3 Electrical Characteristics . . . 30
4.5.4 Protection Features . . . 30
4.5.5 Design Considerations . . . 30
4.6 Status LEDs . . . 30
4.7 Temperature Sensor . . . 31
4.7.1 Overview . . . 31
4.7.2 Features . . . 32

4.7.3 I²C Interface . . . 32
4.7.4 Design Considerations . . . 32
4.8 Terminal Block – GPIO and Serial Communications . . . 32
4.8.1 Overview . . . 32
4.8.2 CAN – Controlled Area Network . . . 34
4.8.3 Industrial Digital I/O (Isolated) . . . 35
4.8.4 RS-232 . . . 39
4.8.5 RS-485 . . . 39
4.9 USB – Universal Serial Bus . . . 41
4.9.1 USB Port Electrical Characteristics . . . 41
4.9.2 USB Type A (Host) . . . 42
4.9.3 USB Type C (OTG) . . . 43
4.9.4 USB Type C (Debug) . . . 45
4.10 Wi-Fi and Bluetooth Module . . . 46

5 Recovery Mode 49

6 Known Issues 50

7 Product Compliance 51

8 Device and Documentation Support 52
8.1 Trademarks . . . 52

List of Tables

1 Zinnia Gateway hardware summary . . . 9
2 Power input requirements . . . 19
3 On-Module Peripheral Power Control . . . 19
4 Power input connector specification . . . 20
5 Power input compatible mating connectors . . . 20
6 Power input pin assignment . . . 20
7 Recommended operating and absolute maximum conditions . . . 21
8 Ethernet overview . . . 24
9 Ethernet connector characteristics . . . 24
10 Ethernet LED indicators . . . 25
11 MiniPCIe signals . . . 25
12 MiniPCIe characteristics . . . 27
13 RTC battery characteristics . . . 28
14 MicroSD characteristics . . . 29
15 RGB status LED GPIO mapping . . . 31
16 Temperature sensor characteristics . . . 32
17 Terminal block . . . 33
18 CAN characteristics . . . 34
19 CAN pin assignment . . . 35
20 Digital I/O control signals . . . 35
21 Terminal block digital I/O . . . 36
22 Terminal block digital I/O input . . . 37
23 Terminal block digital I/O output . . . 37
24 RS-232 features . . . 39
25 RS-232 pinout . . . 39
26 RS-485 features . . . 40
27 RS-485 pinout . . . 40
28 USB electrical characteristics . . . 42
29 USB-A characteristics . . . 42
30 USB OTG features . . . 44
31 USB OTG connector . . . 44
32 USB debug characteristics . . . 45
33 USB-UART mapping . . . 46
34 USB-C debug characteristics . . . 46
35 Signal pins between AW-CM276NF and i.MX 8M Plus . . . 47

List of Figures

1 Zinnia Gateway features 9
2 Block diagram 15
3 Mechanical drawing front view 16
4 Mechanical drawing side view 17
5 Mechanical drawing top and section views 17
6 Mechanical drawing back view 18
7 Zinnia Gateway power input polarity diagram 20
8 Terminal block pin assignment diagram 33
9 Terminal block (20 pin connector) 34
10 Zinnia Gateway to Verdin iMX8M Plus USB mapping 41

Abbreviations

Abbreviations

Abbreviation	Explanation
ADC	Analog to Digital Converter
BTB	Board To Board
CAN	Controller Area Network, a bus that is mainly used in the automotive and industrial environment
CAN FD	Controller Area Network Flexible Data-Rate, an extension to the original CAN bus protocol which allows higher data rates and larger message sizes.
CEC	Consumer Electronic Control, HDMI feature that allows controlling CEC compatible devices
CPU	Central Processor Unit
CSI	Camera Serial Interface
DAC	Digital to Analog Converter
DDC	Display Data Channel, interface for reading out the capability of a monitor. In this document DDC2B (based on I2C) is always meant.
DFP	Downstream Facing Port, USB Type-C port that acts as a host
DRP	Dual-Role Port, USB Type-C port that can operate as power sink and source
DSI	Display Serial Interface
DVI	Digital Visual Interface, digital signals are electrically compatible with HDMI
EDID	Extended Display Identification Data, timing setting information provided by the display in a PROM
EMI	Electromagnetic Interference, high-frequency disturbances
ESD	Electrostatic Discharge, high voltage spike or spark that can damage electrostatic-sensitive devices
FPD-Link	Flat Panel Display Link, high-speed serial interface for liquid crystal displays. In this document is also called the LVDS interface.
GBE	Gigabit Ethernet, Ethernet interface with a maximum data rate of 1000Mbit/s
GND	Ground
GND_CHASSIS	Chassis Ground
GPIO	General Purpose Input/Output, pin that can be configured as an input or output
GSM	Global System for Mobile Communications
HDA	High-Definition Audio (HD Audio), the digital audio interface between CPU and audio codec
I2C	Inter-Integrated Circuit, the two-wire interface for connecting low-speed peripherals
I2S	Integrated Interchip Sound, serial bus for connecting PCM audio data between two devices
I/O	Input-Output
JTAG	Joint Test Action Group, widely used debug interface
LCD	Liquid Crystal Display
LSB	Least Significant Bit
LVDS	Low-Voltage Differential Signaling, electrical interface standard that can transport high-speed signals over twisted-pair cables. Many interfaces like PCIe or SATA use this interface. Since the first successful application was the Flat Panel Display Link, LVDS became a synonymous for this interface. In this document, the term LVDS is used for the FPD-Link interface.
MAC	Medium Access Control is part of the second layer (data link layer) in the Ethernet stack
MIPI	Mobile Industry Processor Interface Alliance
MDI	Medium Dependent Interface, the physical interface between Ethernet PHY and cable connector
MDIO	Management Data Input/Output, an interface that is used for controlling the Ethernet PHY. The bus consists of the MDC clock and the MDIO bidirectional data signal.

Continued on next page

Abbreviations (Continued)

Abbreviation	Explanation
mini PCIe	PCI Express Mini Card, the card form factor for internal peripherals. The interface features PCIe and USB 2.0 connectivity
MMC	MultiMediaCard, flash memory card
MSB	Most Significant Bit
NC	Not Connected
OD	Open-Drain
OTG	USB On-The-Go, a USB host interface that can also act as USB client when connected to another host interface
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect, parallel computer expansion bus for connecting peripherals
PCIe	PCI Express, a high-speed serial computer expansion bus, replaces the PCI bus
PCM	Pulse-Code Modulation, digitally representation of analog signals, standard interface for digital audio
PD	Pull-Down Resistor
PHY	The physical layer of the OSI model
PU	Pull-up Resistor
PWM	Pulse-Width Modulation
PWR	Power
QSPI	Quad SPI, SPI interface with four bidirectional data signals
RGMII	Reduced Gigabit Media-Independent Interface, the interface between Ethernet MAC and PHY for up to 1Gb/s
RJ45	Registered Jack, common name for the 8P8C modular connector that is used for Ethernet wiring
RS232	The single-ended serial port interface
RS485	Differential signaling serial port interface, half-duplex, multi-drop configuration possible
R-UIM	Removable User Identity Module, identifications card for CDMA phones and networks, an extension of the GSM SIM card
SD	Secure Digital, flash memory card
SDIO	Secure Digital Input Output, an external bus for peripherals that uses the SD interface
SIM	Subscriber Identification Module, an identification card for GSM phones
SMBus	System Management Bus (SMB), a two-wire bus based on the I^2C specifications, is used in x86 designs for system management.
SoC	System on a Chip, IC which integrates the main component of a computer on a single chip
SoM	System on a Module, PCB which integrates the main component of a computer on a single board
SPI	Serial Peripheral Interface Bus, synchronous four-wire full-duplex bus for peripherals
TIM	Thermal Interface Material, thermally conductive material between CPU and heat spreader or heat sink
TMDS	Transition-Minimized Differential Signaling, serial high-speed transmitting technology that is used by DVI and HDMI
TVS Diode	Transient-Voltage-Suppression Diode, a diode that is used to protect interfaces against voltage spikes
UFP	Upstream Facing Port, USB Type-C port that acts as a client
UART	Universal Asynchronous Receiver/Transmitter, serial interface, in combination with a transceiver an RS232, RS422, RS485, IrDA or similar interface can be achieved
USB	Universal Serial Bus, serial interface for internal and external peripherals

1 Introduction

1.1 Purpose of This Document

This document provides the hardware reference information required to integrate, install, configure, and maintain the Zinnia Gateway platform based on the Toradex Verdin iMX8M Plus System-on-Module (SoM) and the Zinnia Carrier Board.

The document is intended for:

- Hardware engineers integrating the gateway into embedded systems
- Software and embedded Linux developers developing applications and BSPs
- System integrators deploying complete gateway solutions
- Manufacturing and production engineers responsible for assembly and testing
- Validation and quality assurance engineers performing hardware verification
- Field service and maintenance personnel responsible for installation, configuration, troubleshooting, and repair

It describes the available hardware interfaces, including the Ethernet ports, USB Type-A and USB Type-C (Dual-Role Port and console) connectors, antenna connectors, console interface, power input, digital I/O connector, user LEDs, reset, and recovery controls, as well as their electrical characteristics, connector information, and integration guidelines required for system deployment, configuration, and maintenance.

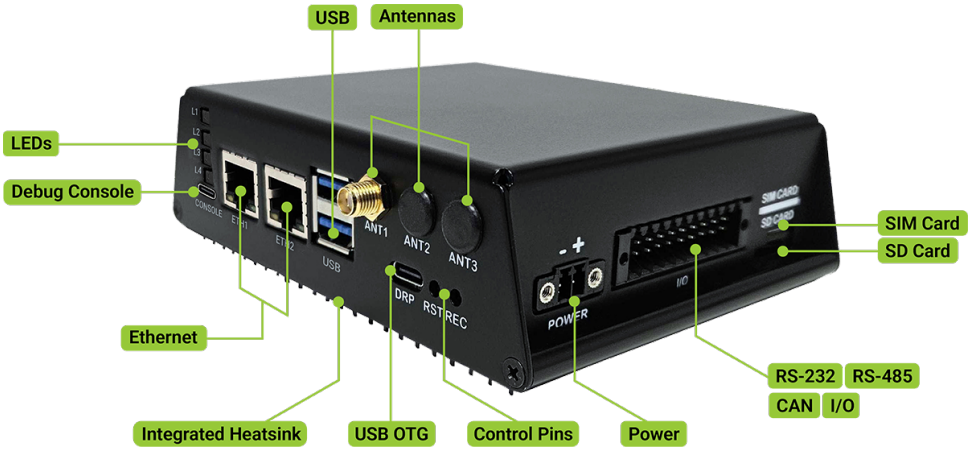
1.2 Product Overview

The Zinnia Gateway is a certified industrial gateway designed for reliable operation in demanding environments. It combines the processing capabilities of the Toradex Verdin iMX8M Plus System-on-Module (SoM) with the industrial connectivity and interface features provided by the Zinnia Carrier Board. Housed in a rugged, compact, fanless enclosure with DIN-rail mounting compatibility, the gateway is intended for direct deployment in machines, control cabinets, and industrial infrastructure. Built on Toradex's embedded hardware platform, the Zinnia Gateway integrates high-performance processing, industrial communication interfaces, optional cellular connectivity, and hardware security into a compliant, ready-to-deploy solution suitable for equipment monitoring, protocol integration, edge processing, and industrial connectivity applications.

The platform supports:

- Dual Gigabit Ethernet connectivity
- USB 2.0 and USB 3.0 interfaces
- CAN communication
- RS-232 and RS-485 serial communication
- Digital I/O
- LTE connectivity through M.2 expansion
- Industrial power input (9-32 VDC)

Figure 1: Zinnia Gateway features



The gateway is designed for industrial automation, edge computing, machine monitoring, protocol conversion, remote connectivity, and IoT applications.

1.3 Performance, Interfaces and Mechanical

Table 1 summarizes the main hardware characteristics of the Zinnia Gateway, including processing, memory, operating system, connectivity, multimedia, and mechanical specifications.

Table 1: Zinnia Gateway hardware summary

Parameter	Value/Remark
CPU details	
CPU Name	NXP i.MX 8M Plus
CPU Type	4x Arm Cortex-A53
Microcontroller	1x Arm Cortex-M7
CPU Clock	1600 MHz (A53) 800 MHz (M7)
NEON	Yes
L1 Instruction Cache	32 KB (A53) 32 KB (M7)
L1 Data Cache	32 KB (A53) 32 KB (M7)
L2 Cache	512 KB
Memory	
RAM	4 GB LPDDR4 (32 Bit)
Flash	32 GB eMMC

Continued on next page

Table 1: Zinnia Gateway hardware summary (Continued)

Parameter	Value/Remark
Connectivity	
USB 3.0	2x Host
USB 2.0	1x OTG 1x Debug
Ethernet	2x Gigabit
Wi-Fi	2.4 / 5 GHz Dual Band 2x2 Wi-Fi 5, 802.11ac
Bluetooth	Bluetooth 5.3
PCIe	1x Mini PCIe
SIM Card	1x Nano SIM card slot
UART	1x RS232 1x RS485
GPIO	3x isolated I/Os
SDIO / SD / MMC	1x 4 Bit microSD
CAN	1x CAN
Multimedia	
Neural Processing Unit (NPU)	Yes (2.3 TOPS)
Operating System	
Pre-flashed OS	
Physical	
LEDs	
Weight	0.439 kg
Size	98.4 x 133.5 x 36.2 mm
Thermal Solution	Built-in Heatsink
Temperature	-40°C to 85°C
Shock / Vibration	TBD
Supply Voltage	9-32 V
Power Dissipation	TBD[1]
Intended Use	For End Products
Product Availability	2036+

[1] Next revisions of the Zinnia Gateway will have the accurate power dissipation of the product.

1.4 Environmental and Installation Conditions

In addition to the following restrictions, the environmental and installation conditions should comply with the absolute maximum ratings in Table 7.

The maximum permissible ambient temperature depends on system workload, peripheral loading, installation orientation, and available airflow, and should be validated against the final product to ensure absolute maximum rating compliance. The operating temperature specified in Table 7 applies to the complete Zinnia Gateway and is subject to the installed Verdin iMX8M Plus variant and the applicable thermal conditions.

Storage temperature applies to the gateway while unpowered. Environmental parameters for which

no qualified product-level limit is specified, including humidity, altitude, shock, vibration, and ingress protection, are marked as `TBD` and shall not be inferred from individual component ratings.

1.5 Reference Documents

The following documents provide additional technical information required to develop and maintain the Zinnia Gateway.

1.5.1 Toradex Developer Center

The Toradex Developer Center is the primary source for module documentation, software enablement, and integration guidelines. Verify the selected content that applies specifically to the Zinnia Gateway.

https://developer.toradex.com/

1.5.2 Zinnia Gateway Product Page

The product page provides a consolidated entry point for hardware and software collateral, ordering information, and ecosystem resources for the Zinnia Gateway.

https://www.toradex.com/gateway/zinnia

1.5.3 Verdin iMX8M Plus and Zinnia Carrier Board

The Zinnia Gateway is built around the Toradex Verdin iMX8M Plus SoM and the Zinnia Carrier Board; for detailed module- and carrier board-specific information, refer to the following websites:

https://developer.toradex.com/hardware/verdin-som-family/modules/verdin-imx8m-plus

https://developer.toradex.com/hardware/verdin-som-family/carrier-boards/zinnia-carrier-board

1.5.4 NXP i.MX 8M Plus

Additional details about the i.MX 8M Plus SoC are available in the Datasheet and Reference Manual provided by NXP.

https://www.nxp.com/products/i.MX8MPLUS

1.5.5 Ethernet Transceiver

There are 2 Ethernet Transceivers in the Zinnia Gateway:

- The Verdin iMX8M Plus utilizes a Microchip KSZ9131RNX Gigabit Ethernet Transceiver (PHY):

  https://www.microchip.com/wwwproducts/en/KSZ9131

- The Zinnia Carrier Board adds a second Ethernet port through the DP83867IRRGZR robust gigabit Ethernet PHY transceiver :

  https://www.ti.com/product/DP83867IR/part-details/DP83867IRRGZR

1.5.6 Wi-Fi and Bluetooth Module

Some Verdin iMX8M Plus models utilize an AzureWave AW-CM276NF wireless module. The AW-CM276NF datasheet is available from AzureWave.

https://www.azurewave.com/wireless-modules-nxp.html

Information on pre-certified antennas and cables can be found here:

https://developer.toradex.com/knowledge-base/wi-fi-accessories-recommended-for-toradex-products

Certification documents are available on the Toradex website:

https://developer.toradex.com/knowledge-base/certification-documents-for-azurewave-aw-cm276nf-wi-fi-bluetooth-module

1.6 Security

The gateway leverages the hardware security capabilities of the Toradex Verdin iMX8M Plus SoM, based on the NXP i.MX 8M Plus System-on-Chip. The security architecture provides a hardware Root of Trust, secure boot, hardware cryptographic acceleration, secure key storage, and trusted execution environments to protect the integrity, authenticity, and confidentiality of software and data.

These security features enable the implementation of secure device provisioning, authenticated firmware updates, encrypted communications, secure storage, and device authentication for industrial and edge computing applications.

1.6.1 Security Features

The i.MX 8M Plus integrates a comprehensive hardware security subsystem that includes Arm TrustZone technology, the Cryptographic Acceleration and Assurance Module (CAAM), hardware random number generation (TRNG), High Assurance Boot (HAB), secure eFuse programming, secure JTAG control, and secure key storage.

Together, these features establish a trusted execution environment and provide hardware-assisted protection against unauthorized software execution and unauthorized access to sensitive information.

1.6.2 High Assurance Boot (HAB)

The i.MX 8M Plus implements NXP's High Assurance Boot (HAB) architecture, providing a hardware Root of Trust that authenticates software before execution.

During the boot sequence, cryptographic signatures are verified to ensure that only authenticated boot images are executed. If authentication fails, the boot process is halted according to the configured security policy.

Secure Boot enables the creation of a trusted software chain extending from the on-chip Boot ROM through the bootloader, operating system, and application software.

1.6.3 Cryptographic Acceleration

The Cryptographic Acceleration and Assurance Module (CAAM) provides hardware acceleration for cryptographic operations and hardware-backed mechanisms for protecting cryptographic keys.

Supported functions include:

- AES encryption and decryption
- DES and Triple-DES
- SHA hashing
- RSA public-key cryptography
- Elliptic Curve Cryptography (ECC)
- Secure random number generation

- Hardware key management

Offloading cryptographic operations to dedicated hardware improves both performance and system security.

1.6.4 Arm TrustZone

The Arm Cortex-A53 processors implement Arm TrustZone technology, allowing software to be partitioned into secure and non-secure execution environments.

TrustZone enables trusted operating systems and secure applications to execute independently from normal application software, helping protect sensitive assets such as cryptographic keys, authentication services, and secure applications.

1.6.5 Secure Key Storage

The security subsystem supports secure storage of cryptographic keys using on-chip One-Time Programmable (OTP) eFuse memory.

Device-specific keys and security values can be provisioned during manufacturing to support:

- Secure Boot
- Device authentication
- Secure communications
- Secure provisioning

Once programmed, security-critical eFuse fields can be permanently locked to prevent unauthorized modification.

1.6.6 Hardware Random Number Generator

The integrated True Random Number Generator (TRNG) provides high-quality entropy for cryptographic applications, including:

- Cryptographic key generation
- Secure communications
- Authentication protocols
- Random number generation

The TRNG is integrated with the CAAM security subsystem to provide hardware-generated entropy for security-sensitive operations.

2 Architecture Overview

The **Zinnia Gateway** combines the processing capabilities of the Toradex Verdin iMX8M Plus SoM with the industrial connectivity, power management, and interface circuitry provided by the Zinnia Carrier Board. The gateway integrates processing, storage, networking, industrial communication interfaces, and optional cellular connectivity into a rugged, ready-to-deploy platform for industrial and edge computing applications.

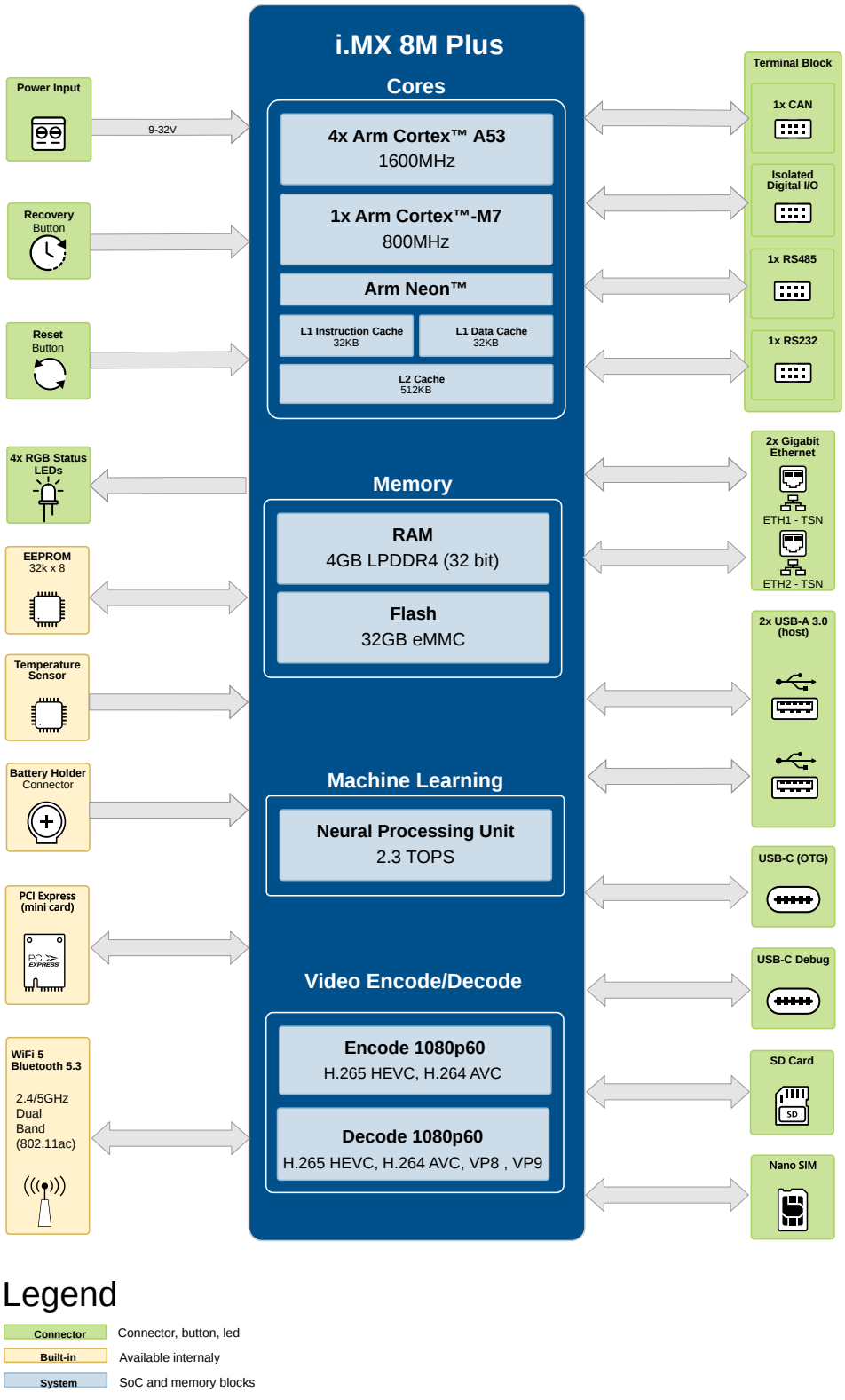
The overall architecture combines:

- **Application Processing:** Quad-core Arm® Cortex®-A53 processor for embedded Linux applications and general-purpose computing
- **Real-Time Processing:** Integrated Arm® Cortex®-M7 core for deterministic control and real-time processing
- **Graphics & Multimedia:** Integrated GPU, video processing engine, and multimedia accelerators supporting DisplayPort output, hardware video encoding/decoding, and graphics acceleration
- **AI Acceleration:** Integrated 2.3 TOPS Neural Processing Unit (NPU) enabling efficient machine learning inference at the edge
- **Memory & Storage:** LPDDR4 memory, eMMC flash storage, and removable MicroSD storage expansion
- **Connectivity:** Dual Gigabit Ethernet, USB OTG, DisplayPort, CAN, RS-232, RS-485, Digital I/O, and MiniPCIe expansion with optional LTE cellular connectivity
- **Security:** Hardware Root of Trust, High Assurance Boot (HAB), Arm® TrustZone®, Cryptographic Acceleration and Assurance Module (CAAM), secure key storage, and secure JTAG
- **System Infrastructure:** Power management, real-time clock (RTC), system monitoring, user LEDs, recovery mode, and industrial power input circuitry

The functional block diagram of the Zinnia Gateway is shown in Figure 2.

2.1 Block Diagram

Figure 2: Block diagram



Legend

Connector	Connector, button, led
Built-in	Available internaly
System	SoC and memory blocks

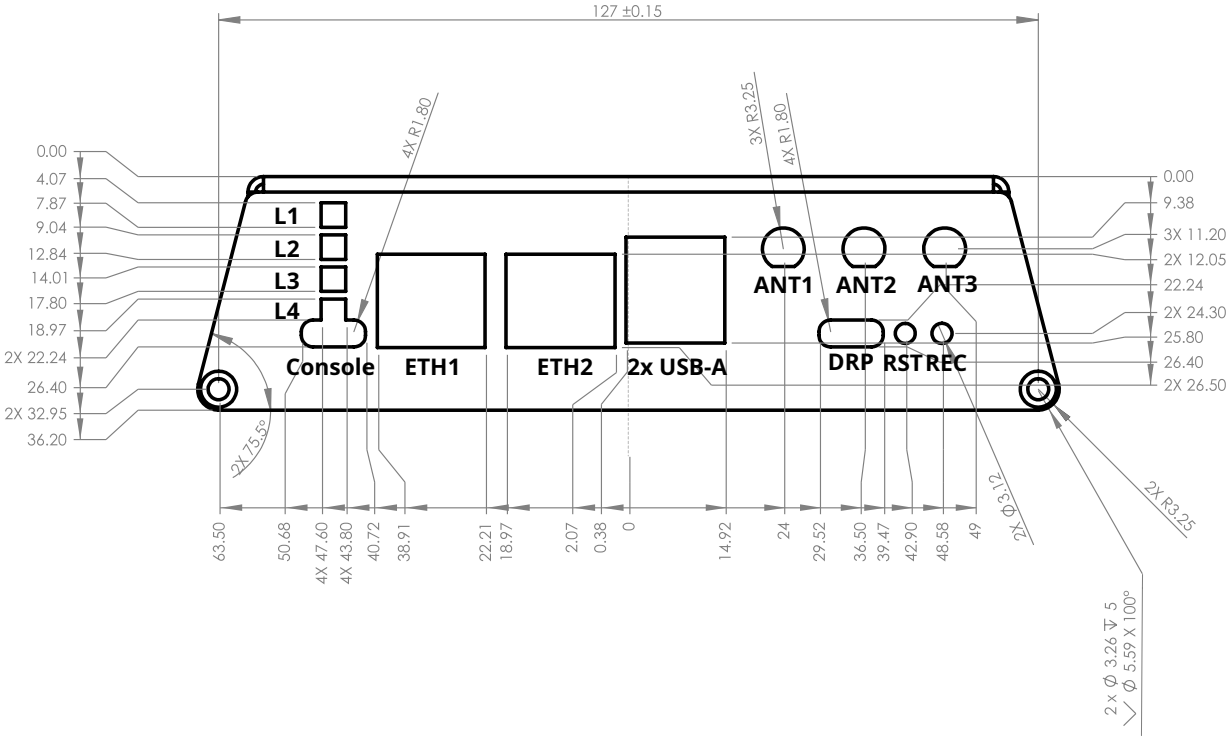
2.2 Mechanical Drawings

This subsection provides the **mechanical drawings of the Zinnia Gateway**, including the overall enclosure dimensions, mounting features, connector locations, and external mechanical interfaces. The information presented is intended to assist system integrators in designing the mechanical installation, verifying enclosure clearances, planning cable routing, and ensuring compatibility with the intended installation environment.

Dimension Units
Refer to the corresponding mechanical drawing for dimensional tolerances. Explicit tolerances shown on the drawings take precedence over general tolerances.

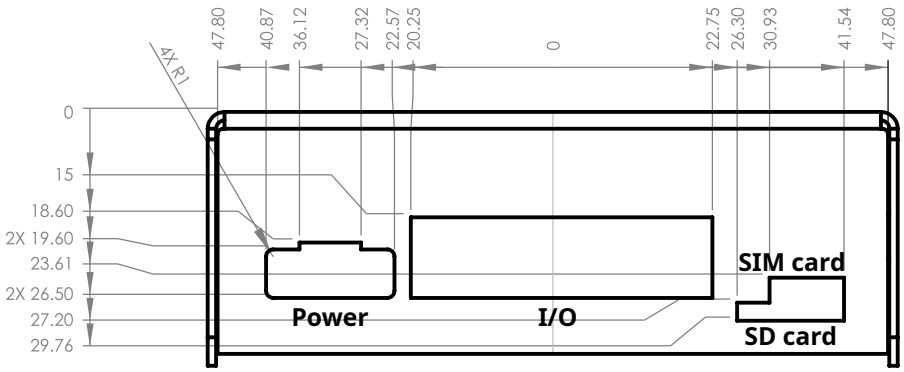
The overall dimensions and the front mechanical features of the enclosure are shown in Figure 3. This view provides the primary reference for the gateway dimensions and the location of the front-facing connectors and indicators.

Figure 3: Mechanical drawing front view



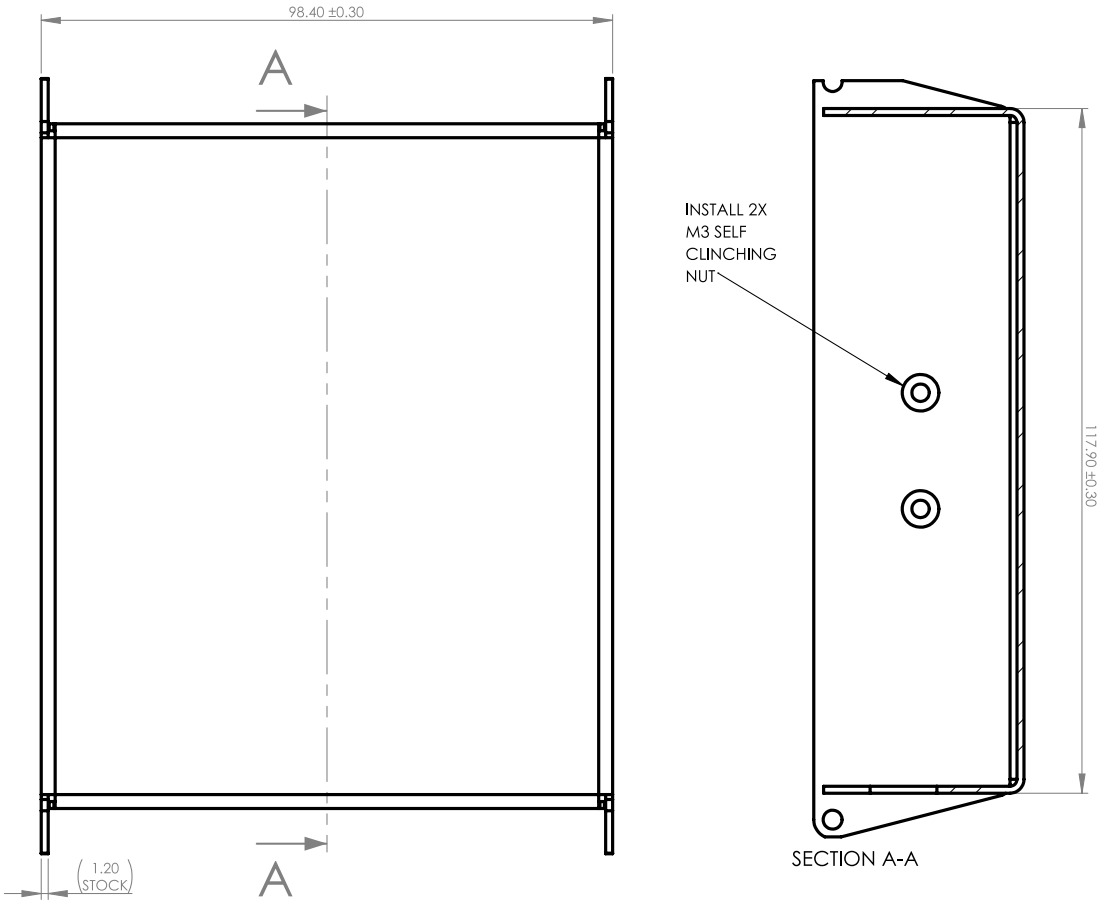
The side view of the enclosure is shown in Figure 4, illustrating the enclosure profile, height, and the relative position of the mounting features.

Figure 4: Mechanical drawing side view



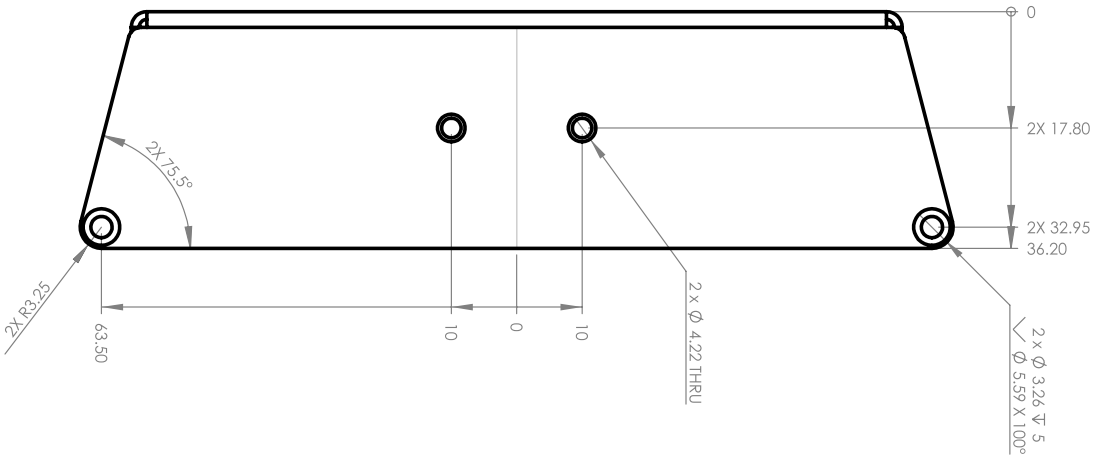
The top view and cross-sectional view are presented in Figure 5. These drawings provide additional dimensional information, including connector placement, enclosure width, and cross-sectional details required for mechanical integration.

Figure 5: Mechanical drawing top and section views



The rear view of the enclosure is shown in Figure 6, providing the dimensions and location of the rear mechanical features and external interfaces.

Figure 6: Mechanical drawing back view



3 Power Input

3.1 Overview

The gateway is powered through a **two-position Molex Eurostyle terminal block** designed for industrial DC power distribution. The connector supports the required **9-32 VDC input voltage range** and provides a secure field-wiring interface suitable for industrial and embedded applications.

3.2 Power Requirements and Recommendations on Power Adapter

The recommended external power adapter shall comply with the electrical requirements summarized in Table 2. In addition, it shall be equipped with a compatible mating connector conforming to the mechanical characteristics specified by the power connector manufacturer.

Table 2: Power input requirements

Parameter	Value
Nominal Input Voltage	24 VDC
Supported Input Range	9-32 VDC
Input Current Rating	5 A
Power Source Type	SELV / Limited Energy Source (LES) recommended
Connector Type	Field-wired removable terminal block

Power Supply Compliance
The power supply shall also comply with the applicable safety and regulatory requirements for the target installation environment.

Power Saving

The on-module Ethernet PHY power rails can be switched off to reduce power consumption. The `GPIO2_IO20` signal controls the Ethernet PHY power rails and is active-high: driving the signal **high** enables the power rails, while driving it **low** disables them.

The Wi-Fi and Bluetooth module power rails are not individually switchable through a GPIO. Power-management of the wireless subsystem is instead handled through the control and wake mechanisms provided by the `AW-CM276NF` module.

Table 3: On-Module Peripheral Power Control

GPIO	i.MX 8MP ball name	Peripheral power rail
GPIO2_IO11	SD1_STROBE	Wi-Fi and Bluetooth wake signaling
GPIO2_IO20	SD2_WP	Ethernet PHY enable signaling

Wake Signals

The `AW-CM276NF` provides dedicated wake signals that allow the wireless module and the i.MX 8M Plus SoC to coordinate low-power operation. These signals allow the host processor to wake the wireless subsystem when required.

3.3 Connector Specification

The power input connector specification is summarized in Table 4.

Table 4: Power input connector specification

Parameter	Value
Connector Current Rating	Up to 8 A per contact
Connector Type	Plug-in Connector, Shrouded Male Header
Mating Interface/Connector	Removable 3.50 mm-pitch, 2-position Female Plug
Number of Positions	2
Part Information	Molex Eurostyle Terminal Block, 0395061002
Pitch	3.50 mm
Reference Designator	Power
Retention	Threaded Retention

3.3.1 Compatible Mating Connectors

Compatible Molex mating connectors for the power input connector are listed in Table 5.

Table 5: Power input compatible mating connectors

Molex Part Number	Description
39530-0002	2-position pluggable terminal block (recommended)
39531-0002	2-position locking pluggable terminal block
39532-0002	2-position interlocking pluggable terminal block

3.4 Pin Assignment

The power input pin assignment is shown in Table 6 and the diagram of the connector is shown in Figure 7.

Figure 7: Zinnia Gateway power input polarity diagram

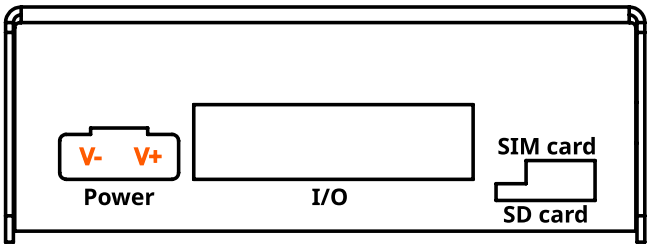


Table 6: Power input pin assignment

Pin	Signal	Description
1	V-	Power Return / Ground
2	V+	9-32 VDC Power Input

3.5 Protection Features

The power input circuit incorporates protection and conditioning circuitry before distributing power to the internal voltage rails. The input stage includes:

- Resettable fuse protection
- Surge suppression circuitry
- Reverse polarity protection
- DC/DC power conversion for internal supply rails

These features help protect the gateway against common industrial power disturbances and wiring errors.

3.5.1 Grounding and Shielding

Proper grounding and shield termination are essential for reliable operation and EMC performance of the Zinnia Gateway, particularly when the gateway is connected to external equipment through power, communication, or shielded cable interfaces.

The negative terminal of the DC power input provides the primary power return and system ground reference for the gateway. Unless otherwise specified for an individual interface, external signal interfaces shall be considered with respect to this system ground. Any galvanic isolation provided by a specific interface is described in the corresponding interface section.

Cable shields and connector shields shall be terminated according to the recommendations for the corresponding interface and the installation environment. Shield connections are intended to provide a low-impedance path for high-frequency interference and shall not be used as a substitute for the DC power return or protective-earth connection.

When the gateway is installed together with other equipment, differences in ground potential between interconnected devices shall be considered. Excessive ground-potential differences can cause unwanted currents through signal grounds or cable shields and may result in communication errors, EMC degradation, or damage to the interface circuitry. The allowable ground-potential difference is therefore limited by the electrical ratings of the respective interface and shall not exceed the limits specified for the connected equipment.

3.6 Absolute Maximum Ratings

The absolute maximum ratings are listed in Table 7.

Table 7: Recommended operating and absolute maximum conditions

Parameter Description	Symbol / Net	Min	Max	Unit
DC Input Voltage				
Input voltage (absolute maximum)[1]	V_IN	-0.3	36.7	V
Input TVS Protection				
TVS breakdown voltage[2]	V_BR	36.7	40.6	V
TVS clamping voltage[3]	V_CLAMP	–	53.3	V
TVS peak pulse current[3]	I_PP	–	7.5	A

Continued on next page

Table 7: Recommended operating and absolute maximum conditions (Continued)

Parameter Description	Symbol / Net	Min	Max	Unit
Temperature				
Operating ambient temperature[4]	T_A	-40	85	°C
Storage temperature[5]	T_STG	-40	85	°C

[1] DC absolute maximum rating. This value defines a component-level voltage limit and must not be interpreted as a qualified transient or surge withstand rating. Normal operation shall remain within the specified recommended input-voltage range.
[2] The TVS breakdown voltage is a characteristic of the input protection device and does not define the maximum permissible DC input voltage.
[3] TVS clamping voltage and peak pulse current are device characteristics specified under the pulse waveform and test conditions defined in the TVS diode datasheet. These values do not constitute a system-level transient immunity or survival rating for the gateway.
[4] Depending on the variant of the System-on-Module and the applicable thermal conditions.
[5] The storage temperature range is limited by the Verdin module, in particular by the eMMC specification.

Stress limits only
Operation beyond these limits may cause permanent damage to the Zinnia Gateway.

Input Transient Immunity

The DC input absolute maximum rating in Table 7 is separate from transient immunity. The breakdown and clamping voltages specified for the input TVS diode are component characteristics and must not be interpreted as the maximum transient voltage that may be applied to the gateway.

4 Interfaces Description

4.1 Control Buttons

4.1.1 Recovery Button

The Recovery button is used to **place the Zinnia Gateway (more precisely the Verdin iMX8M Plus SoM) into recovery mode**. Pressing and holding the button during power-up or reset asserts the recovery control signal, allowing the processor to enter USB recovery mode.

To enter recovery mode, press and hold the Recovery button for **more than 5 seconds** while powering up or resetting the gateway. In recovery mode, the SoM does not boot the installed operating system. Instead, it waits for recovery or provisioning commands from a host computer through the supported recovery interface.

Recovery mode is intended for:

- Initial software installation
- Firmware recovery
- Factory provisioning
- System recovery when the installed image is not bootable

Release the Recovery button after the required hold time. To return to normal operation, power-cycle or reset the The Recovery button is used to **place the Zinnia Gateway processor into recovery mode**. Pressing and holding the button during power-up or reset prompts the processor to enter USB recovery mode.

For more information about the Recovery Mode, refer to the Section 5.

4.1.2 Reset Button

The Reset button provides a **manual hardware reset input** for the Verdin iMX8M Plus SoM. Pressing the button pulls the reset control signal low, forcing the SoM and the associated system circuitry into reset.

When the Reset button is pressed, the gateway performs a hardware reset. This is equivalent to restarting the system without removing the main power supply.

The Reset button should be used for system recovery, troubleshooting, or restarting the device when software-controlled reboot is not possible.

4.2 Ethernet

4.2.1 Overview

The gateway provides **two independent Gigabit Ethernet interfaces** for industrial networking, cloud connectivity, protocol conversion, and edge computing applications.

Both Ethernet ports support standard **IEEE 802.3 Ethernet** operation at **speeds up to 1 Gbps** and incorporate Gigabit Ethernet PHYs designed for industrial networking applications. The underlying hardware platform supports **IEEE 1588 Precision Time Protocol (PTP)**, enabling accurate network time synchronization for industrial and distributed control systems.

Features

Table 8: Ethernet overview

Parameter	Value
Number of Ports	2
Ethernet Standard	IEEE 802.3
Supported Speeds	10 / 100 / 1000 Mbps
Connector Type	RJ45
Auto-Negotiation	Supported
Auto MDI-X	Supported
Full Duplex Operation	Supported
Integrated Magnetics	Yes
Link / Activity LEDs	Yes
IEEE 1588 PTP	Supported
TSN-Capable PHY	Yes[1]

[1] Availability of specific Time-Sensitive Networking (TSN) features depends on the operating system, software stack, and application implementation.

Both Ethernet interfaces support simultaneous operation and automatically negotiate the highest common communication speed supported by the connected network device. The interfaces support **10BASE-T (10 Mbps)**, **100BASE-TX (100 Mbps)**, and **1000BASE-T (1 Gbps)** Ethernet operation, allowing interoperability with standard Ethernet infrastructure without requiring manual configuration.

The Ethernet interfaces use standard RJ45 connectors with integrated magnetics. The connector characteristics common to both Ethernet ports are summarized in Table 9.

Table 9: Ethernet connector characteristics

Parameter	Value
Connector Type	RJ45 Receptacle
Connector Style	Shielded Ethernet Receptacle
Mating Connector	Standard RJ45 Plug
Integrated Magnetics	Yes
Link Indicators	Integrated LEDs
Recommended Cable	CAT5e, CAT6, or CAT6A
User Accessible	Yes

Ethernet Power and Isolation
The Ethernet connectors provide standard data connectivity only. **Power over Ethernet (PoE) is not a supported gateway function.** Do not apply or expect PoE.
The connectors incorporate Ethernet magnetics. Product-level isolation withstand voltage, shield-to-chassis termination, and qualified ESD/EMC levels are `TBD` as of this release of this datasheet.

LED Indicators

Each Ethernet connector includes integrated status indicators to assist with installation and diagnostics,

as listed in Table 10.

Table 10: Ethernet LED indicators

Indicator	Color	Function
Link LED	Green	Indicates network link status
Activity LED	Yellow	Indicates network traffic activity

4.2.2 Mating Connector

The Ethernet interfaces use standard **RJ45 (8P8C)** receptacles designed to mate with commercially available **RJ45 modular plugs** compliant with the IEEE 802.3 Ethernet standards. To ensure reliable Gigabit Ethernet performance, the use of **CAT5e**, **CAT6**, or **CAT6A** twisted-pair Ethernet cables is recommended.

4.2.3 Time Synchronization and TSN Capabilities

Both Ethernet interfaces support standard 10/100/1000BASE-T Ethernet operation. Support for individual TSN mechanisms and profiles, including IEEE 802.1AS, IEEE 802.1Qbv, IEEE 802.1Qbu, or related standards, is not guaranteed solely by the presence of a TSN-capable PHY. The required feature shall be verified against the selected operating system, BSP, driver, and application configuration.

4.3 PCI Express (Mini Card) Expansion Slot

4.3.1 Overview

The Zinnia Gateway provides a **Mini PCIe expansion slot** inside the enclosure that enables the integration of compatible Mini PCI Express modules, allowing the expansion with cellular modem, extra storage, and other mini PCIe compatible cards supported by USB signals. The interface supports up to USB 3.0 with retro-compatibility for USB 2.0, and is connected to the on-board USB Hub. Refer to Figure 10 for more details. The expansion modules shall remain within the available electrical and thermal power budget of the gateway.

The Mini PCIe expansion slot is implemented using a **TE Connectivity** `1717832-2` surface-mount Mini Card connector and supports full-size Mini PCIe cards measuring **30.00 mm × 50.95 mm**. The installed card is mechanically retained using the gateway's **single retention latch**.

Table 11 summarizes the PCIe-related routing implemented in the design.

Table 11: MiniPCIe signals

MiniPCIe pin	MiniPCIe signal	Signal destination / mapping	I/O	Description / Remarks
Control Signals				
1	WAKE#	CTRL_WAKE1_MICO#	I	Wake signal 27 kΩ pull-up to 1.8V
20	W_DISABLE#	3.3V	I	Wireless disable via 27 kΩ pull-up (interface always on)
Power Signals				
2, 24, 39, 41, 52	3.3V	MPCI1_3V3	PWR	Main supply
Multiple pins[1]	GND	GND	GND	Ground reference

Continued on next page

Table 11: MiniPCIe signals (Continued)

MiniPCIe pin	MiniPCIe signal	Signal destination / mapping	I/O	Description / Remarks
SIM Signals				
8	UIM_PWR	VCC of Nano SIM (J9) pin C1	O	SIM power
10	UIM_DATA	IO of Nano SIM (J9) pin C7	I/O	SIM data
12	UIM_CLK	CLK of Nano SIM (J9) pin C3	O	SIM clock
14	UIM_RESET	RST of Nano SIM (J9) pin C2	O	SIM reset
16	UIM_VPP	VPP of Nano SIM (J9) pin C6		
High-speed Signals				
22	PERST#	PCIE_1_RESET#	O	Reset
23	PERn0	USB Hub DS3_RXM, pin 36	I	USB SS RX negative
25	PERp0	USB Hub DS3_RXP, pin 35	I	USB SS RX positive
31	PETn0	USB Hub DS3_TXM, pin 39	O	USB SS TX negative via 100 nF AC-coupling capacitor
33	PETp0	USB Hub DS3_TXP, pin 38	O	USB SS TX positive via 100 nF AC-coupling capacitor
36	USB_D-	USB Hub DS3_DP, pin 65	I/O	USB 2.0 data -
38	USB_D+	USB Hub DS3_DM, pin 64	I/O	USB 2.0 data +
LED Indicators				
42	LED_WWAN#	LED not connected	O	WWAN LED
44	LED_WLAN#	LED not connected	O	WLAN LED
46	LED_WPAN#	LED not connected	O	WPAN LED

[1] Ground pins: 4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50.

MiniPCIe Power Requirements
The MiniPCIe slot provides the required power and interface signals for compatible full-size MiniPCIe expansion modules. The total system power consumption depends on the installed module. When selecting an external power adapter, ensure that it is rated to supply sufficient power for both the gateway and the maximum power requirements of the installed MiniPCIe module.

Features

The electrical, mechanical, and functional characteristics of the MiniPCIe expansion slot are summarized in Table 12.

Table 12: MiniPCIe characteristics

Parameter	Value / Remark
Antenna Support	The enclosure provides provisions for optional external antennas RF connectors are not mounted or supplied and depend on the installed Mini PCIe module and its antenna requirements
Card Retention	Single retention latch
Expansion Standard	Mini PCI Express
Insertion Method	Edge connector
Installation / Service	The gateway shall be powered off and disconnected from all external power sources before installing, removing, or servicing a Mini PCIe module[1]
Maximum Current	TBD[2]
Maximum Module Power	TBD[2]
Operating Voltage	3.3 V
PCI Express Interface	Available[3]
Qualified Card Constraints	The installed module shall comply with the electrical, mechanical, power, and thermal limits specified in this table[4]
SIM Card Support	Nano SIM; availability and compatibility depend on the installed Mini PCIe module
Supported Card Type	Full-Size Mini PCIe (30.00 mm × 50.95 mm)
Thermal Allowance	The installed module shall operate within its specified temperature limits under the thermal conditions inside the enclosure[5]
Typical Applications	Communication and peripheral expansion modules
USB 3.0/2.0 Interface	Available[3]
User Accessible	Yes[6]

[1] Mini PCIe modules shall not be installed or removed while the gateway is powered. Follow the installation and service procedure before accessing the internal Mini PCIe slot.
[2] The maximum current and power values shall be defined according to the available 3.3 V power budget of the gateway.
[3] Interface availability depends on the Zinnia Gateway hardware configuration and the installed Mini PCIe module.
[4] Use of a Mini PCIe module does not imply compatibility solely from mechanical fit. Module interface requirements, supply current, power dissipation, thermal characteristics, and antenna requirements shall be verified before installation.
[5] The Mini PCIe module does not have a dedicated active cooling solution. The thermal requirements of the selected module shall be evaluated for the intended operating conditions.
[6] Mini PCIe modules shall not be installed or removed while the gateway is powered. Follow the installation and service procedure before accessing the internal Mini PCIe slot.

Mini PCIe Power and Thermal Budget
The Mini PCIe slot operates from the gateway's 3.3 V rail. The maximum continuous current, peak current, and module power available from this rail are currently TBD. Until these values are qualified, mechanical and electrical fit alone shall not be interpreted as confirmation that a Mini PCIe module is supported.
The installed module must also remain within its own temperature limits under the internal enclosure temperature and available natural-convection cooling conditions.

4.3.2 Nano SIM and Cellular Connectivity

The gateway supports **optional cellular connectivity** through a modem connected to the MiniPCIe slot. The modem **operates independently of the Ethernet interfaces** and may be used as either the primary or backup communication path.

Features

- SIM Interface: Nano SIM
- External Antennas: Required
- Data Communication: Supported

Antenna Connections

Cellular modem might require one or more external antennas connected directly to the installed MiniP-CIe modem.

4.4 RTC Battery Holder

The gateway incorporates a **rechargeable lithium coin-cell battery holder** to provide backup power for the Real-Time Clock (RTC). The battery is intended to maintain the RTC during periods when the primary system power is unavailable, preserving the system date and time across power interruptions.

The RTC backup battery should be rechargeable. During normal gateway operation, the gateway automatically maintains the battery charge.

The RTC backup battery is not supplied with the gateway.

Battery Operation
The RTC backup battery **supplies power exclusively to the Real-Time Clock subsystem** when the gateway is not powered by its primary power source. During normal operation, the onboard charging circuit maintains the battery at its nominal charge level.

The battery is **not intended to power the gateway** or maintain application execution during power loss.

Table 13 lists the electrical and mechanical characteristics of the battery for the RTC subsystem.

Table 13: RTC battery characteristics

Parameter	Value / Remark
Electrical Characteristics	
Chemistry	Lithium Rechargeable
Nominal Voltage	3 V[1]
Nominal Capacity	3 mAh
Charging	Automatic (On-board Charging Circuit)
Intended Function	RTC Backup Power
Mechanical Characteristics	
Battery Diameter	6.8 mm
Battery Height	2.1 mm
Type	Coin Cell MS621

[1] An approved 3 V coin cell battery is the Seiko Instruments MS621T-FL11E. This battery is **not installed** by default and must be purchased separately.

RTC Battery
The RTC backup circuit is designed for the **MS621T-FL11E rechargeable 3 V battery only**. The battery slot is **not populated by default**. If an RTC battery is installed or replaced, use only the approved **MS621T-FL11E** and observe the polarity marked on the PCB.

Do not install primary (non-rechargeable) lithium coin cells such as CR-series batteries, 3.6 V lithium cells, or any other unapproved battery chemistry or part number. The RTC battery connection includes a charging path; installing a non-rechargeable or otherwise incompatible battery may result in battery leakage, overheating, rupture, or other damage.

Battery replacement must be performed only with the gateway powered off and disconnected from external power.

4.5 SD Card

4.5.1 Overview

The gateway provides a **MicroSD card interface** for removable mass storage, enabling convenient expansion of non-volatile storage capacity. The interface supports standard MicroSD memory cards for application storage, data logging, software distribution, diagnostics, and system maintenance.

The MicroSD interface supports removable flash memory cards compliant with the Secure Digital (SD) specification. The interface is intended for applications requiring user-accessible storage or removable media.

Features

The MicroSD interface characteristics are summarized in Table 14.

Table 14: MicroSD characteristics

Parameter	Value
Boot Support	Supported when selected by the configured boot sequence; refer to the boot and recovery section
Card Capacity	Depends on the MicroSD card, operating system, and selected file system
Card Current Limit	0.5 A
Card Detection	Dedicated Card Detect (CD) signal
Card Type	MicroSD
ESD Protection	Integrated[1]
Hot-Plug Support	Supported; the card must be safely unmounted before removal
Interface	SDIO/MMC 4-bit
Power Switching	Software-controlled, current-limited load switch
Recommended Media	Industrial-grade MicroSD card for continuous logging, frequent write operations, or extended-temperature applications
Storage Expansion	Supported
Supply Voltage	3.3 V (software-controlled)
Transfer Speed	Depends on the MicroSD card capabilities and software configuration

[1] The MicroSD interface includes dedicated low-capacitance ESD protection arrays on the SD signal lines. The protection devices are connected between the interface signals and ground to provide local protection against electrostatic-discharge events.

4.5.2 Functional Description

The MicroSD socket is connected directly to the SD/MMC controller of the Verdin iMX8M Plus through a dedicated **4-bit SDIO interface**, providing high-speed data transfers while maintaining compatibility

with standard MicroSD cards.

The interface incorporates dedicated power switching, overcurrent protection, and ESD protection devices to improve reliability during card insertion, removal, and operation in industrial environments.

A dedicated **Card Detect (CD)** signal allows the operating system to automatically detect card insertion and removal events.

4.5.3 Electrical Characteristics

The MicroSD socket operates from a regulated **3.3 V, 0.5 A supply** provided through a dedicated current-limited load switch. Power to the card can be enabled or disabled under software control, allowing the operating system to safely initialize or remove power from the card as required.

The interface includes:

- Software-controlled 3.3 V power switching
- Card Detect input
- 4-bit SDIO/MMC (4-lane) data interface

4.5.4 Protection Features

To improve reliability in industrial applications, the MicroSD interface incorporates several hardware protection mechanisms:

- **Current-limited power switch** to protect against excessive current during card insertion or fault conditions.
- **Integrated ESD protection** on all signal lines to reduce susceptibility to electrostatic discharge.
- **Power supply filtering and decoupling** to improve signal integrity and reduce electrical noise.

4.5.5 Design Considerations

The MicroSD interface is designed for field operation while supporting **hot insertion and removal** of compatible memory cards. Although the hardware supports hot-plug operation, applications should ensure that all file system activity has completed before removing the card to prevent data corruption.

For best performance and reliability, **industrial-grade MicroSD cards are recommended** for applications involving frequent write operations, continuous data logging, or extended operating temperature ranges.

4.6 Status LEDs

The Zinnia Gateway provides four front-panel LED indicators (`L1` to `L4`) to provide customer-visible feedback on power state, system operation, and diagnostic conditions.

The LEDs should be interpreted according to their externally visible behavior rather than by the internal SoM GPIO or ball-name assignments used to control them. The programmable status LEDs support multiple colors and can be used by system software to indicate application-specific states. The detailed signal mapping is provided in Table 15.

Table 15: RGB status LED GPIO mapping

LED	Color	Verdin signal name	SoC ball name	Alternate function	GPIO signal (active high)
LED 1					
L1	Blue	I2S_2_D_OUT	SAI3_TXD	ALT5	GPIO5_IO1
	Green	Always on[1]	–	–	–
	Red	I2S_2_D_IN	SAI3_RXD	ALT5	GPIO4_IO30
LED 2					
L2	Blue	Not connected	–	–	–
	Green	Always on[2]	–	–	–
	Red	Not connected	–	–	–
LED 3					
L3	Blue	I2S_1_D_IN	SAI1_RXD0	ALT5	GPIO4_IO2
	Green	QSPI_1_CS#	NAND_CE0_B	ALT5	GPIO3_IO1
	Red	I2S_2_SYNC	SAI3_TXFS	ALT5	GPIO4_IO31
LED 4					
L4	Blue	I2S_1_BCLK	SAI5_MCLK	ALT6	GPIO3_IO25
	Green	I2S_1_SYNC	SAI5_RXD1	ALT7	GPIO3_IO22
	Red	I2S_1_D_OUT	SAI5_RXFS	ALT8	GPIO3_IO19

[1] LED 1 green is always on and indicates the powering of the device.
[2] LED 2 green is always on and indicates that the 3.3V rail is ready.
LED color control: the LED color is controlled using the corresponding alternate function, with each LED driven by an **active-high GPIO signal**, where a logic high turns the LED on.

The customer-visible LED behavior is fully customizable in software. The reference BSP image provides a set of internal GPIO, SoC ball, and software-control mappings used to drive the programmable LEDs according to the categories below. Implementation details and are documented separately in the corresponding platform or software documentation.

- **Power indication**: Indicates that the corresponding gateway power rail is present.
- **Boot indication**: Indicates the default LED state during system initialization and boot.
- **Reset indication**: Defines the LED behavior while the gateway or SoM is held in reset.
- **Normal operation**: Defines the default LED state after the operating system has completed initialization.
- **Diagnostic indication**: Identifies LED states used to indicate faults, recovery mode, or other diagnostic conditions.
- **Software-controlled indication**: Indicates LEDs or color channels that can be reassigned by software for application-specific status reporting.

Green LED Always On
The green elements on `LED1` and `LED2` are always on and cannot be controlled.

4.7 Temperature Sensor

4.7.1 Overview

The gateway integrates an onboard **Texas Instruments TMP1075** digital temperature sensor to monitor the internal board temperature. The sensor communicates with the Verdin iMX8M Plus SoM over an **I²C interface**, providing high-accuracy temperature measurements for system monitoring, thermal

management, and diagnostics.

4.7.2 Features

The temperature sensor characteristics are summarized in Table 16.

Table 16: Temperature sensor characteristics

Parameter	Value
Device	Texas Instruments TMP1075DSGR
Sensor Type	Digital Temperature Sensor
Interface	I^2C
Supply Voltage	1.8 V
I^2C Address (7-bit)	0x4F
Temperature Resolution	12-bit
Temperature Accuracy	±1 °C (typical, refer to device datasheet)
Operating Temperature Range	-55 °C to +125 °C
ALERT Output	Not connected

4.7.3 I^2C Interface

The sensor is connected to the primary I^2C bus of the Verdin iMX8M Plus through dedicated **SCL** and **SDA** signals with external pull-up resistors to the **1.8 V** supply.

The device address is fixed by the hardware configuration:

- **I^2C Bus:** `I2C_1`
- **7-bit Address:** `0x4F`
- **Bus Voltage:** 1.8 V

4.7.4 Design Considerations

The `TMP1075` is permanently installed on the gateway and requires no user configuration. Since the `ALERT` output is not connected, over-temperature events are detected by periodically reading the temperature registers via the I^2C interface rather than through a hardware interrupt.

Temperature Readings
The temperature sensor provides a measurement of the PCB temperature and can be used to monitor system temperature trends and detect changes in the gateway's thermal conditions. The reported temperature should not be interpreted as the temperature of any specific component. Component temperature readings and limits, such as those of the i.MX 8M Plus SoC, must be evaluated independently.

4.8 Terminal Block – GPIO and Serial Communications

4.8.1 Overview

The Zinnia Gateway provides a multi-position industrial **terminal block** (Weidmuller `1728700000`) that consolidates the **primary I/O interfaces** into a single, easily accessible connection point. The terminal block enables direct connection to industrial control systems, field devices, sensors, actuators, and communication networks without requiring additional interface adapters.

The terminal block is designed for field wiring in industrial environments and provides secure screw-clamp connections suitable for permanent installation. By grouping the industrial communication and control interfaces into a single connector, the gateway simplifies system integration, commissioning, and maintenance while reducing wiring complexity.

Connector Information

Table 17: Terminal block

Parameter	Value
Connector Current Rating	Up to 10 A per contact
Connector Type	Plug-in Connector, Shrouded Male Header
Mating Interface/Connector	Removable 3.50 mm-pitch, 20-position Female Plug
Number of Positions	20
Part Information	Weidmüller OMNIMATE Signal S2L 3.50/20/90F, 1728700000
Pitch	3.50 mm
Reference Designator	I/O
Retention	Threaded Retention

The terminal block provides access to the following industrial interfaces:

- CAN bus
- Industrial Digital Inputs and Outputs (Digital I/O)
- RS-232 serial communication
- RS-485 serial communication

Figure 8 and Figure 9 show the pin location and functions of the I/O terminal block.

Figure 8: Terminal block pin assignment diagram

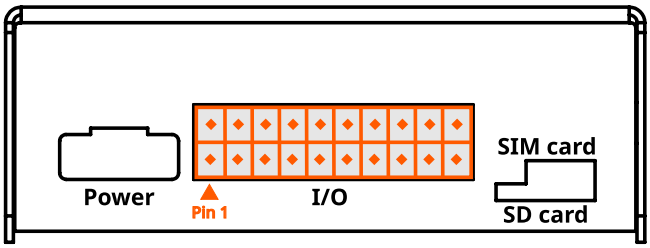
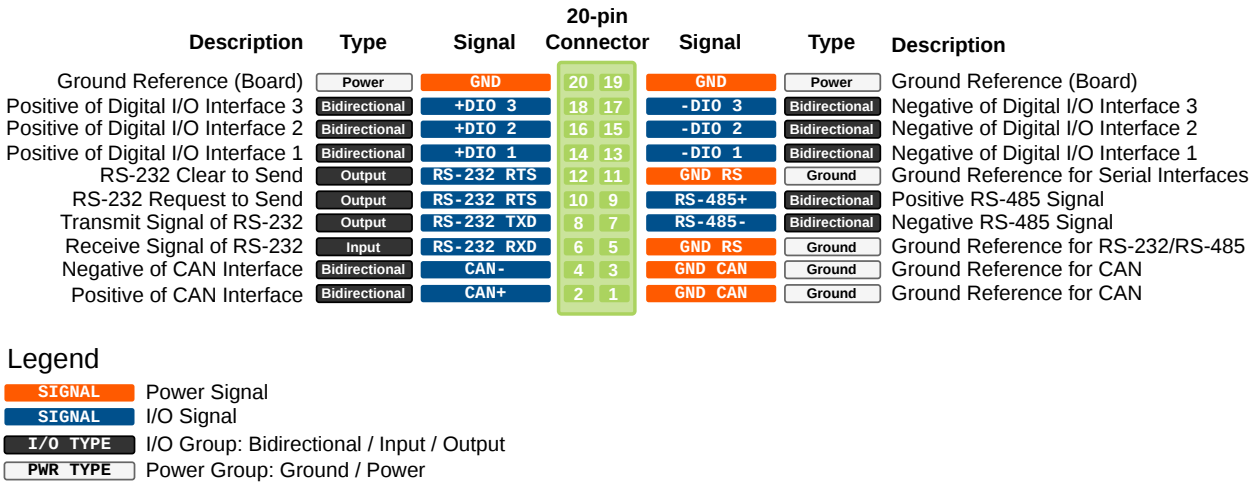


Figure 9: Terminal block (20 pin connector)



Common Ground Reference
The ground connections shown for the CAN, digital I/O, and RS-232/RS-485, interfaces share a common electrical ground reference. The different ground signal names are used to identify their associated interfaces and do not indicate galvanic isolation between these ground connections.

4.8.2 CAN – Controlled Area Network

The gateway provides one **CAN bus interface** through the industrial terminal block, enabling communication with industrial controllers, distributed I/O modules, sensors, actuators, and other CAN-enabled equipment. The interface is implemented using the **Texas Instruments TCAN1044VDRQ1** high-speed CAN transceiver, supporting both **Classical CAN** and **CAN FD** communication.

Features

The CAN interface characteristics are summarized in Table 18.

Table 18: CAN characteristics

Parameter	Value
CAN Standard	ISO 11898-2 High-Speed CAN
CAN FD	Supported
Transceiver	Texas Instruments TCAN1044VDRQ1
Bus Interface	Differential (CAN_H / CAN_L)
Termination	Split termination
ESD Protection	Integrated TVS protection[1]
Connector	Industrial Terminal Block

[1] Refer to Table 7 for ESD protection ratings.

CAN Bus Termination

The CAN interface includes a **fixed split termination network** consisting of two **60.4** Ω resistors, providing a nominal differential termination resistance of **120.8** Ω between `CAN_H` and `CAN_L`. The midpoint of

the split termination is coupled to `GND_CAN1` through a **4.7 nF capacitor** to improve common-mode noise performance.

The termination is permanently implemented in hardware and cannot be disabled by software, jumper, or user-accessible switch.

CAN Bus Placement
Because the Zinnia Gateway includes a fixed CAN termination, it shall be installed at one end of the CAN bus segment. Installing the gateway at an intermediate position can result in incorrect bus termination and degraded communication reliability.

Connector Pin Assignment

The CAN interface is accessible through the industrial terminal block. The CAN-related pins are summarized in Table 19.

Table 19: CAN pin assignment

Pin	Gateway Signal	SoM Signal	SoC Pin	Description
1	GND_CAN	Ground	–	CAN interface ground reference
2	CAN_H	CAN_1_TX	SPDIF_TX	CAN High differential bus signal
3	GND_CAN	Ground	–	CAN interface ground reference
4	CAN_L	CAN_1_RX	SPDIF_RX	CAN Low differential bus signal

Protection Devices
The CAN interface is protected against electrostatic discharge (ESD) by dedicated TVS protection devices on the `CAN_H` and `CAN_L` bus lines.

4.8.3 Industrial Digital I/O (Isolated)

The Zinnia Gateway provides **three isolated digital I/O channels** on the field I/O terminal connector. Each channel is exposed as a differential terminal pair (`DIOx+` and `DIOx-`), where `x` represents the channel number (`1` to `3`), and can be configured for either digital input or digital output operation.

Each channel is controlled by GPIO signals from the Verdin iMX8M Plus SoM. The `DIx_EN` signal enables the digital input path, while `DOx_EN` enables the digital output path. When operating as an input, the corresponding `DIx_RB` signal provides the detected input state to the SoM. These control and read-back signals are internal to the gateway and are not exposed on the field I/O terminal connector. The mapping of the isolated digital I/O channels to the SoM signals are shown in Table 20.

Table 20: Digital I/O control signals

Signal	SoM Signal	SoC Pin	Function
Digital I/O 1			
DI1_EN	GPIO_2	GPIO_IO01	Digital input 1 enable
DI1_RB	GPIO_3	GPIO_IO05	Digital input 1 read-back
DO1_EN	GPIO_1	GPIO_IO00	Digital output 1 enable

Continued on next page

Table 20: Digital I/O control signals (Continued)

Signal	SoM Signal	SoC Pin	Function
Digital I/O 2			
DI2_EN	GPIO_6	GPIO_IO08	Digital input 2 enable
DI2_RB	GPIO_5	GPIO_IO07	Digital input 2 read-back
DO2_EN	GPIO_4	GPIO_IO06	Digital output 2 enable
Digital I/O 3			
DI3_EN	GPIO_8	SAI1_RXC	Digital input 3 enable
DI3_RB	QSPI_1_IO0	NAND_DATA00	Digital input 3 read-back
DO3_EN	GPIO_7	SAI1_RXD1	Digital output 3 enable

Digital I/O Pin Assignment

Table 21: Terminal block digital I/O

Pin	Signal	Description
Digital I/O 1		
13	-DIO_1	Digital I/O Channel 1 Negative
14	+DIO_1	Digital I/O Channel 1 Positive
Digital I/O 2		
15	-DIO_2	Digital I/O Channel 2 Negative
16	+DIO_2	Digital I/O Channel 2 Positive
Digital I/O 3		
17	-DIO_3	Digital I/O Channel 3 Negative
18	+DIO_3	Digital I/O Channel 3 Positive

Isolation and Wiring

Each DIO channel is galvanically isolated from the Verdin iMX8M Plus system through the digital I/O circuitry. The field-side terminals can therefore interface directly with industrial equipment while maintaining isolation from the processor domain.

For best EMC performance:

- Route digital I/O wiring separately from power cables.
- Keep field wiring as short as practical.
- Install suppression devices when driving inductive loads.
- The output can be used anywhere a low-current isolated contact closure is required.

Digital Input Operating Mode

When configured as a digital input, the interface monitors an externally applied DC voltage connected to the field-side terminals.

The input circuitry is implemented using a current-limited optocoupler input stage, allowing the gateway to detect external industrial signals while maintaining isolation from the Verdin module.

Table 22: Terminal block digital I/O input

Parameter	Value
Input Type	Isolated digital input
Input Turn-On Voltage	Approximately 5.3 V
Input Current	Approximately 2.2 mA
Recommended Input Voltage Range	0-32 VDC
Field-Side Protection	33 V TVS diode
Isolation Method	Optocoupler
Logic-Level Output to Verdin Module	1.8 V
Verdin Exposure to Field Voltage	None

When used as a digital input, the field-side terminals accept an external DC signal. The input turns on at approximately **5.3 V** and draws approximately **2.2 mA**. The field input is protected by a **33 V TVS diode** and is galvanically isolated from the Verdin module.

The input circuitry is designed as a current-limited industrial input rather than a direct GPIO interface, allowing the gateway to monitor external field signals while protecting the internal electronics from electrical disturbances.

The Verdin iMX8M Plus does not receive the external field voltage directly. Instead, the field signal is transferred through an optocoupler and presented to the module as a **1.8 V logic-level readback signal**. As a result, the Verdin module remains electrically isolated from the field wiring and is not exposed to the external input voltage.

Digital Output Operating Mode

When configured as a digital output, **the interface behaves as an isolated solid-state relay** that electrically connects the two field terminals when activated.

The output is implemented using a PhotoMOS relay and functions as an electronic contact closure rather than a voltage source.

Table 23: Terminal block digital I/O output

Parameter	Value
Output Type	Isolated solid-state relay (PhotoMOS)
Output Function	Electronic contact closure
Recommended Switching Voltage	0–32 VDC[1]
Maximum Continuous Current	100 mA[2]
PTC Trip Current	300 mA nominal[2]
PhotoMOS ON-State Current	500 mA maximum[3]
PhotoMOS ON Resistance	2 Ω maximum[3]
Additional Series Resistance	10 Ω nominal
Turn-On Time	3 ms maximum[3]
Turn-Off Time	1 ms maximum[3]
Isolation	Galvanically isolated

Continued on next page

Table 23: Terminal block digital I/O output (Continued)

Parameter	Value
Control Signal	DOx_EN[4]
Enable Polarity	High = output closed
Output Reference	Floating with respect to the processor domain
Field-Side Polarity	Polarity-sensitive; observe `+DIOx` and `-DIOx`
Protection	PTC fuse, TVS diode, series resistor, series diode

[1] Recommended field operating range. The output protection network includes a 33 V TVS diode; the PhotoMOS 60 V off-state rating shall not be interpreted as the permissible gateway switching voltage.
[2] The output path includes a `0ZCG0010FF2C` resettable PTC with a 100 mA hold current and a nominal 300 mA trip current. The hold current is temperature-dependent and shall be derated at elevated ambient temperature.
[3] Component characteristic of the `TLP240A` PhotoMOS relay. These values do not override the lower limits imposed by the complete gateway output circuit.
[4] `x` represents the output channel number (`1` to `3`).

When the digital output is enabled, the internal PhotoMOS relay closes and electrically connects the two field terminals:

- `DIOx+`
- `DIOx-`

where `x`, from `1` to `3`, represents the digital I/O being used. The output behaves similarly to a dry contact or solid-state relay contact.

The gateway **does not** source voltage onto the output terminals and does not require a common ground connection to the external system. Instead, an external voltage source must be provided by the user application. When enabled, the gateway simply completes the circuit between the two terminals.

Advantages of Contact-Closure Outputs
- Galvanic isolation between gateway and field wiring
- No shared ground required
- Reduced susceptibility to ground loops
- Compatible with PLC digital inputs
- Compatible with alarm and monitoring systems
- Bidirectional operation

Usage Notes

- The external circuit must provide the operating voltage.
- The output should be treated as an isolated switch rather than a powered output.
- Observe the maximum switching voltage and current ratings of the PhotoMOS output stage.
- For inductive loads, use appropriate external suppression devices.

Simultaneous Digital Input and Output Operation
Each of the three digital I/O channels can be configured with both `DIx_EN` and `DOx_EN` asserted simultaneously, where `x` represents the channel number (`1` to `3`). In this configuration, the output function provides an electronic contact closure between `DIOx+` and `DIOx-`, while the input sensing circuit remains active.
Care must be taken to enable the input while switching the isolated output to avoid inadvertly switching the connected load through the read-back circuitry. A safer approach is to enable the input mode only during the activation of the load, in this case the input should accuse low logic level.

4.8.4 RS-232

The gateway provides a single **RS-232 serial communication interface** for connection to industrial controllers, PLCs, instrumentation devices, service terminals, and other equipment supporting the RS-232 standard.

Features

Table 24: RS-232 features

Parameter	Value
Interface Standard	TIA/EIA-232-F (RS-232)
Communication Mode	Full Duplex
Flow Control	RTS / CTS
Connector Type	Field I/O Connector
Configuration	Software Configurable

The RS-232 interface is non-isolated, therefore it is intended for applications where the gateway and connected equipment share a common electrical reference.

Pinout

The pin assignment for the RS-232 interface is summarized in Table 25.

Table 25: RS-232 pinout

Pin	Gateway Signal	SoM Signal	SoC Pin	Description
6	RS232_RXD	UART_1_RXD	UART1_RXD	RS232 receive data[1]
8	RS232_TXD	UART_1_TXD	UART1_TXD	RS232 transmit data[1]
10	RS232_RTS	UART_1_RTS	SAI2_TXFS	RS232 request to send[1]
12	RS232_CTS	UART_1_CTS	SAI2_RXF0	RS232 clear to send[1]
5/11	GND	Ground	–	Ground Reference

[1] Signal direction is from the perspective of the Zinnia Gateway and shifted to 3.3V. The RS-232 interface incorporates bidirectional TVS diodes rated for a **28 V working standoff voltage (VRWM)** and a **59 V maximum clamping voltage (VC)** on all signal lines, providing protection against ESD and transient surge events commonly encountered in industrial environments.
Pin Numbers: The pin numbers correspond to the Terminal Block on the Zinnia Gateway.

4.8.5 RS-485

The gateway provides a single **RS-485 serial communication interface** for industrial networking applications. RS-485 differential signaling enables reliable communication over long cable distances and in electrically noisy environments.

Features

Table 26: RS-485 features

Parameter	Value
Interface Standard	TIA/EIA-485-A (RS-485)
Communication Mode	Half Duplex
Signaling Method	Differential
Network Topology	Multi-Drop
Connector Type	Field I/O Connector
Isolation Options	Isolated or Non-Isolated
Configuration	Software Configurable

The RS-485 interface is non-isolated and is therefore intended for applications where all devices share a common ground reference. This implementation provides a cost-effective solution with lower power consumption and a reduced component count, making it suitable for local networks within a common electrical system.

Pinout

The pin assignment for the RS-485 interface is summarized in Table 27.

Table 27: RS-485 pinout

Pin	Signal	Description
7	A (RS-485_P)	Positive Differential Signal[1]
9	B (RS-485_N)	Negative Differential Signal[1]
5/11[2]	GND	Ground Reference (when applicable)

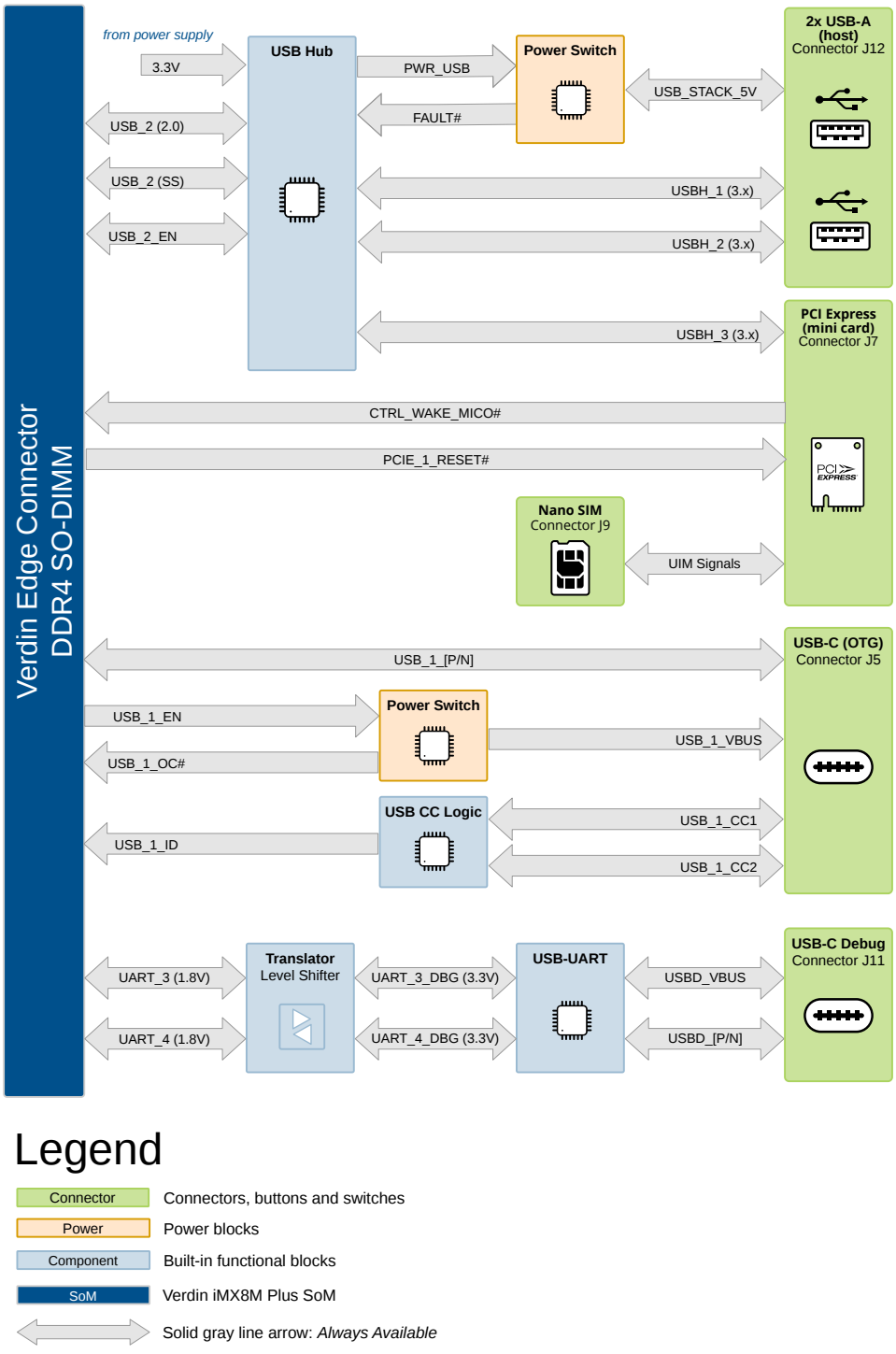
[1] Signal direction is from the perspective of the Zinnia Gateway. The RS-485 interface incorporates 28 V bidirectional TVS diodes (`SMAJ28CA-TR`) on all signal lines to provide protection against ESD and transient surge events commonly encountered in industrial environments.
[2] Ground connection shared between RS-232 and RS-485 interfaces.
Pin Numbers: The pin numbers correspond to the Terminal Block on the Zinnia Gateway.

Network Termination
RS-485 networks should be terminated according to industry best practices.
- Install a 120 Ω termination resistor at each end of the network segment.
- Keep stub lengths as short as possible.
- Follow the recommendations of connected devices regarding bias resistors.

4.9 USB – Universal Serial Bus

The USB architecture overview, including the mapping between the Zinnia Gateway USB interfaces and the corresponding signals on the Verdin iMX8M Plus, is shown in Figure 10.

Figure 10: Zinnia Gateway to Verdin iMX8M Plus USB mapping



4.9.1 USB Port Electrical Characteristics

The Zinnia Gateway provides multiple USB interfaces with different data, power, and system roles. The electrical characteristics and intended use of each physical USB connector are summarized in Table 28.

Table 28: USB electrical characteristics

Connector	Data interface	Data rate[1]	VBUS behavior	Current limit / budget	Power Delivery	Recovery support
USB-A 1	USB 3.2 Gen 1 + USB 2.0	5 Gbps	5 V source	2 A source current limit shared with both USB-A ports	N/A	Yes
USB-A 2	USB 3.2 Gen 1 + USB 2.0	5 Gbps	5 V source		N/A	No
USB-C OTG	USB 3.2 Gen 1 + USB 2.0 Dual-Role (DRP)	5 Gbps	5 V source in Host Mode source is switchable	0.5 A source current limit in Host Mode active-low overcurrent indication (USB_1_OC#)	CC1/CC2 role detection with USB Power Delivery (PD)	No
USB-C Debug	USB 2.0	480 Mbps	VBUS sink	Powered from external USB host	No USB PD	No

[1] Data rate is the maximum supported by the USB controller. Actual data rate may be lower depending on the connected device.

USB Power Budget
The maximum current available from USB host ports is limited by the gateway power-distribution circuitry. When multiple bus-powered USB devices are connected simultaneously, the combined load shall remain within the specified aggregate USB power budget. Refer to Table 28 for the applicable per-port and aggregate limits.

4.9.2 USB Type A (Host)

The gateway provides **two USB Type-A host connectors** for the connection of USB peripheral devices such as mass storage devices, Human Interface Devices (HID), wireless adapters, industrial communication adapters, cameras, and other USB-compatible equipment.

The USB host interfaces are implemented through the **USB 3.0 hub integrated on the Zinnia Gateway board**, allowing both connectors to operate simultaneously while sharing the upstream USB interface of the Verdin iMX8M Plus. The interfaces support **USB 3.2 Gen 1 (5 Gbps) SuperSpeed** operation as well as backward compatibility with USB 2.0 and USB 1.1 devices.

Features

The USB host interface characteristics are summarized in Table 29.

Table 29: USB-A characteristics

Parameter	Value
Connector Type	USB Type-A Receptacle
Number of Ports	2
USB Role	Host
Upstream Interface	USB 3.2 Gen 1
Maximum Data Rate	5 Gbps
USB 2.0 Support	Yes
USB 1.1 Compatibility	Yes
Hub Controller	Genesys Logic GL3523 (HX3 USB 3.0 Hub)
Supply Voltage	5 V
Port Protection	Current limiting, overcurrent protection and ESD protection
Recovery Mode	Supported on one USB host port

Functional Description

The Verdin iMX8M Plus connects to the onboard USB hub through a single SuperSpeed USB interface. The hub distributes this connection to the two external USB Type-A host ports while maintaining full USB

compliance and supporting simultaneous operation of multiple downstream devices.

The USB ports provide:

- 5 V bus power for connected peripherals
- Automatic device enumeration
- Hot-plug operation
- USB 2.0 High-Speed (480 Mbps) compatibility
- USB Full-Speed and Low-Speed compatibility
- USB SuperSpeed (5 Gbps) operation

Protection Features

To improve robustness in industrial environments, the USB host interfaces incorporate multiple hardware protection mechanisms, including ESD protection on all USB 2.0 and SuperSpeed signal pairs, an integrated current-limited power switch, overcurrent detection and reporting, power rail filtering and local decoupling, and shield grounding through an RC network for improved EMC performance.

These protection features improve immunity against electrostatic discharge, cable insertion transients, and fault conditions while maintaining reliable USB communication.

Power Distribution

Both USB Type-A host ports provide a nominal **5 V VBUS** output. The two ports share the USB-A power-distribution circuit, which has a **2 A aggregate source-current limit** as specified in Table 28.

The `2 A` value is the shared current limit for the two USB Type-A connectors and shall not be interpreted as `2 A` available independently from each port. The combined current drawn by devices connected to both USB-A ports shall remain within the specified aggregate USB power budget.

The power-distribution circuitry provides:

- Current-limited VBUS distribution
- Overcurrent and short-circuit protection
- Overcurrent fault indication
- Controlled VBUS switching
- Local power filtering and decoupling

4.9.3 USB Type C (OTG)

The gateway provides a **USB On-The-Go (USB OTG) interface** that supports both **USB Host** and **USB Device** operation. This flexibility enables the gateway to connect directly to external peripherals, computers, and service tools without requiring additional hardware.

In addition to normal USB host functionality, the USB Type-C DRP connector is used to access the **Recovery Mode** of the Verdin iMX8M Plus. When Recovery Mode is activated using the dedicated Recovery button, the SoM enters the NXP Serial Download Protocol (SDP) instead of booting the installed operating system. The SoM then identifies itself to the host computer as a USB device, enabling a host computer to perform firmware installation, storage programming, software recovery, and factory provisioning.

Operating Mode
The operating mode is determined by software configuration and the connected device.

Features

The main features of the USB Type-C OTG interface is listed in Table 30.

Table 30: USB OTG features

Parameter	Value
Interface Type	USB On-The-Go (OTG)
USB Standard	USB 2.0
Operating Modes	Host or Device
Connector Type	USB Type-C
Hot-Plug Support	Supported
Power Switching	Integrated
ESD Protection	Integrated

USB Type-C Power Capability
The USB Type-C OTG connector does not support USB Power Delivery (USB PD). In Host/DFP mode, the gateway supplies nominal 5 V VBUS through a current-limited power switch configured for approximately 0.5 A. In Device/UFP mode, VBUS is received from the connected USB host. The USB-C connector shall not be used as a general-purpose power input for the Zinnia Gateway.

Connector Characteristics

The USB-C connector characteristics for the USB OTG interface are listed in Table 31.

Table 31: USB OTG connector

Parameter	Value
Connector Type	USB Type-C Receptacle
USB Standard	USB 2.0
Connector Orientation	Reversible
Hot-Plug Support	Yes

USB Type-C Power and Role Behavior

The USB Type-C OTG interface supports **Host (DFP)**, **Device (UFP)**, and **Dual-Role (DRP)** operation. When operating as a host, VBUS is supplied from the gateway's 5 V system rail through a **current-limited high-side power switch**. The VBUS supply can be enabled or disabled by the system and is configured for a current limit of approximately **0.5 A**. The power switch also provides an active-low overcurrent indication, allowing overload and short-circuit conditions to be detected.

The supported USB-C roles, VBUS characteristics, current limits, and power capabilities are summarized in Table 28.

Recovery Mode

Recovery Mode is available exclusively through the designated USB Type-C OTG recovery port. During normal operation, this connector functions as a USB host port through the onboard USB PHY.

When Recovery Mode is selected, the USB routing is reconfigured so that the Verdin iMX8M Plus recovery USB interface is presented directly on this connector. The SoM then operates as a USB device and can communicate with an external host using the NXP **Serial Download Protocol (SDP)**.

The second USB Type-C connector does not provide this recovery function.

4.9.4 USB Type C (Debug)

The gateway provides a dedicated **USB Type-C Debug interface** that enables access to the serial debug consoles of the Zinnia Gateway, that has in its core the Verdin iMX8M Plus. The interface is implemented using a **Silicon Labs CP2105 USB-to-Dual-UART Bridge Controller**, allowing a host computer to communicate with two independent UART interfaces over a single USB connection.

The USB Debug interface is intended for software development, system bring-up, debugging, diagnostics, bootloader interaction, and console access. When connected to a host computer, the interface enumerates as two independent virtual COM ports, providing simultaneous access to multiple serial interfaces of the SoM.

Features

The USB Debug interface characteristics are summarized in Table 32.

Table 32: USB debug characteristics

Parameter	Value
Connector Type	USB Type-C Receptacle
USB Pins Used	D+, D-, VBUS, GND, CC1, CC2
USB Version	USB 2.0
Orientation	Reversible
User Accessible	Yes
ESD Protection	Integrated[1,2]
Common-Mode Choke	Yes
Shield Connection	RC network to GND

[1] Refer to Table 7 for ESD protection ratings for the USB power output.
[2] The CC and data channels feature 4-channel TVS diode protection (5.5 V working voltage, 11 V clamping voltage at 5.5 A).

Functional Description

The USB Type-C connector is connected to the **Silicon Labs CP2105 dual USB-to-UART bridge**. The CP2105 converts the USB 2.0 device interface into two independent UART channels:

- `UART3`
- `UART4`

When connected to a host computer, the CP2105 enumerates as two independent virtual serial ports. The actual availability and intended use of each UART depend on the installed Verdin iMX8M Plus configuration and the software configuration of shared SoC resources.

USB Debug Power

The USB-to-UART circuitry is powered from the USB Type-C connector. The USB `VBUS` signal supplies the debug circuitry only and does **not** power the Zinnia Gateway. The USB-to-UART debug circuitry is bus-

powered from the USB-C Debug connector. This ensures the interface works continously across power cycles.

UART Mapping

The connector operates exclusively as a USB device interface and does not source VBUS. The `CP2105` exposes two independent virtual serial ports. Their assignments are summarized in Table 33.

Table 33: USB-UART mapping

Virtual COM port	Verdin interface	Typical use
UART Channel 1	UART3	Debug console
UART Channel 2	UART4 shared with Wi-Fi/Bluetooth/Core M7	Application/debug interface

UART4 Debug Availability
The second USB debug channel uses `UART4`, which is a shared system resource. Availability of this channel depends on the installed Verdin configuration and the active use of Bluetooth and Cortex-M7 debug functionality. `UART4` shall not be assumed to be available concurrently with another function that uses the same interface.

USB Connector

The USB Debug interface uses a USB Type-C receptacle operating as a **USB 2.0 device**. The connector is intended exclusively for debug and service access and is not used for general-purpose USB peripheral connectivity.

The connector characteristics are summarized in Table 34.

Table 34: USB-C debug characteristics

Parameter	Value
Connector Type	USB Type-C Receptacle
USB Role	USB Device
USB Standard	USB 2.0
Bridge Controller	Silicon Labs CP2105
Number of UART Channels	2
Host Interface	USB 2.0 Full-Speed
Power Source	USB VBUS
Operating System Support	Linux, Windows, macOS

4.10 Wi-Fi and Bluetooth Module

The Verdin iMX8M Plus inside the Zinnia Gateway is available with optional on-module Wi-Fi and Bluetooth interfaces. The addition of “WB” in the product name indicates that a version features Wi-Fi and Bluetooth. These Verdin module versions make use of the `AW-CM276NF` Dual-Band Wi-Fi and Bluetooth module from AzureWave.

Features

The main features of the `AW-CM276NF` module are:

- Wi-Fi 802.11a/b/g/n/ac
- Dual-Band 5 GHz and 2.4 GHz
- Up to 866.7 Mbps
- 20/40/80 MHz channel bandwidth
- Station/Client Mode, Access Point Mode, Wi-Fi- Direct Mode, and Simultaneous Station and Access point mode
- Bluetooth 5.3 (BR/EDR), BLE
- Murata HSC (MXHP32) connector for the dual external antenna in 2x2 configuration, compatible to IPX/IPEX connector MHF4 series
- Pre-certified for CE (Europe), FCC (United States), IC (Canada), TELEC (Japan), and WPC (India). Refer to https://developer.toradex.com/knowledge-base/wi-fi-accessories-recommended-for-toradex-products.

The Wi-Fi module is connected over a 4-bit SDIO interface with the i.MX 8M Plus SoC and it uses the `USDHC1` instance of the SoC. For Bluetooth Audio, an additional I^2S interface is available between the SoC and the Wi-Fi module, which uses the `SAI5` instance of the SoC. The Bluetooth UART signals (`RX`, `TX`, `RTS`, `CTS`) are connected to an alternate location of the UART4 of the SoC. This interface can only be used if the Verdin standard `UART_4` (M7 debug port) is not in use.

UART4 Usage
It is only possible to use the `UART4` as M7 debug if either the Bluetooth is not used (explicitly turned off in software) or the module is not Wi-Fi-enabled.

Table 35: Signal pins between AW-CM276NF and i.MX 8M Plus

AW-CM276NF pin name	i.MX 8M Plus ball name	i.MX 8M Plus function	I/O	Description
SDIO Interface for Wi-Fi				
SD_CLK	SD1_CLK	USDHC1_CLK	I/O	4-bit SDIO interface for Wi-Fi
SD_DAT[0]	SD1_DATA0	USDHC1_DATA0	I/O	
SD_DAT[1]	SD1_DATA1	USDHC1_DATA1	I/O	
SD_DAT[2]	SD1_DATA2	USDHC1_DATA2	I/O	
SD_DAT[3]	SD1_DATA3	USDHC1_DATA3	I/O	
SD_CMD	SD1_CMD	USDHC1_CMD	I	
I^2S Interface for Bluetooth Audio				
GPIO[6]/PCM_CLK	SAI5_RXD2	SAI5_TX_BCLK	I	I^2S interface for Bluetooth audio
GPIO[7]/PCM_SYNC	SAI2_RXFS	SAI5_TX_SYNC	I	
GPIO[4]/PCM_DIN	SAI5_RXD3	SAI5_TX_DATA0	I	
GPIO[5]/PCM_DOUT	SAI5_RXD0	SAI5_RX_DATA0	O	
UART Interface for Bluetooth				
GPIO[9]/UART_SIN	ECSPI2_MOSI	UART4_TX	I	UART interface for Bluetooth. The UART4 interface is shared with the Verdin UART_4 port (M7 UART debug port)
GPIO[8]/UART_SOUT	ECSPI2_SCLK	UART4_RX	O	
GPIO[11]/UART_RTS	ECSPI2_SS0	UART4_RTS_B	O	
GPIO[10]/UART_CTS	ECSPI2_MISO	UART4_CTS_B	I	

Continued on next page

Table 35: Signal pins between AW-CM276NF and i.MX 8M Plus (Continued)

AW-CM276NF pin name	i.MX 8M Plus ball name	i.MX 8M Plus function	I/O	Description
Power-Down and Wake-Up Signals				
GPIO[15]/TMS/Host Wake WLAN	SD1_DATA7	GPIO2_IO9	I	SoC to AW-CM276NF Wi-Fi PHY wakeup signal
GPIO[12]/ UART Host Wake BT	SD1_DATA6	GPIO2_IO8	I	SoC to AW-CM276NF Bluetooth PHY wakeup signal
PDn	SD1_STROBE	GPIO2_IO11	I	Power Down of complete Wi-Fi/BT module (active low). Firmware needs to be re-downloaded after powering on again

The `AW-CM276NF` features **four wake signals** of which **two are connected to the SoC**. Two are input signals (one for the Wi-Fi and one for Bluetooth), allowing for waking up the radio. The other two signals are wake output signals (one for the Wi-Fi and one for Bluetooth) for waking up the host. The actually available sleep functions and wake signals depend on the firmware loaded into the AzureWave module.

The usage of Wi-Fi and Bluetooth is regulated depending on the region and needs certification. For more information, refer to: https://developer.toradex.com/hardware/hardware-resources/peripherals/wireless/wi-fi-cables-and-antennas-for-toradex-modules.

Antenna Openings
The Zinnia Gateway enclosure provides antenna openings identified on the enclosure drawing as ANT1, ANT2, and ANT3. Unused openings shall be sealed with plastic caps.
External antennas, RF cables, pigtails, and panel-mount RF connectors are **not supplied as standard gateway components**. Additional RF hardware depends on the customer-selected wireless on the Mini PCIe module.

Recommended Antennas and Cables

External antennas, antenna cables, and pigtails are **not included** with the standard gateway and must be selected and provided by the customer.

For recommendations on antennas and cables for the AzureWave `AW-CM276NF`, refer to Wi-Fi Cables and Antennas for Toradex Modules[1].

[1] https://developer.toradex.com/hardware/hardware-resources/peripherals/wireless/wi-fi-cables-and-antennas-for-toradex-modules

5 Recovery Mode

The recovery mode (USB serial loader) can be used to download new software to the Zinnia Gateway (and the Verdin iMX8M Plus within) even when the bootloader is no longer capable of booting the module. In the standard development process, this mode is not needed. When the module is in recovery mode, the `USB_1` interface connects it to a host computer.

The dedicated recovery button needs to be pushed during the initial power on (cold boot) of the module to enter the recovery mode.

Refer to the Toradex Developer Center https://developer.toradex.com/hardware/hardware-resources/recovery-mode/imx-recovery-mode for more information about the Recovery Mode procedure.

6 Known Issues

The Zinnia Carrier Board and the integrated Verdin iMX8M Plus module may be subject to known hardware and software issues depending on the product revision and software version in use. Before deployment, review the **Errata/Known Issues** sections for both the **Zinnia Carrier Board** and **Verdin iMX8M Plus**. These sections provide links to the applicable board errata, hardware issue trackers, and software issue trackers. The product version purchased should therefore be considered together with the known issues documented for the corresponding Zinnia Carrier Board revision, Verdin iMX8M Plus revision, and software release.

https://developer.toradex.com/hardware/verdin-som-family/modules/verdin-imx8m-plus/#errataknown-issues

https://developer.toradex.com/hardware/verdin-som-family/carrier-boards/zinnia-carrier-board#erataknown-issues

7 Product Compliance

Up-to-date information about product compliance such as RoHS, CE, UL-94, Conflict Mineral, REACH, etc. can be found on the Toradex website[2].

[2] https://www.toradex.com/support/product-compliance

8 Device and Documentation Support

8.1 Trademarks

NXP is a trademark of NXP B.V. All other product or service names are the property of their respective owners. © 2023 NXP B.V.

Arm, Cortex, Neon, and TrustZone are registered trademarks or trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

MIPI® is a registered trademark of MIPI Alliance.

The Bluetooth® word mark is a registered trademark owned by Bluetooth SIG, Inc.

Secure Digital® and SD® are registered trademarks of SD Card Association.

DISCLAIMER

Copyright © Toradex AG. All rights are reserved. The information and content in this document are provided "as-is" with no warranties of any kind and are for informational purposes only. Data and information have been carefully checked and are believed to be accurate; however, no liability or responsibility for any errors, omissions or inaccuracies is assumed.

Brand and product names are trademarks or registered trademarks of their respective owners. Specifications are subject to change without notice.