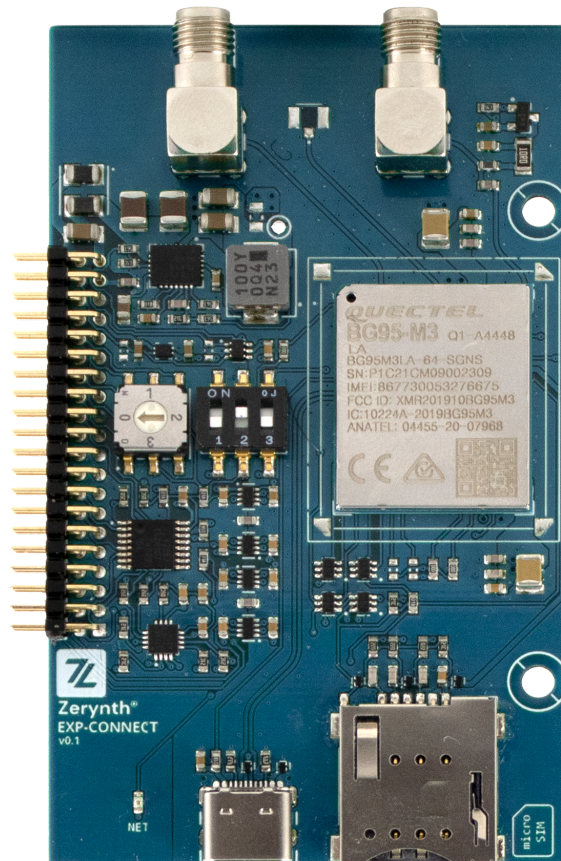


# EXP-CONNECT User Manual



For more details, visit: [www.zerynth.com](http://www.zerynth.com)

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Contents of the present documentation refers to products and technologies described within. All technical data contained in this document may be modified without prior notice The content of this documentation is subject to periodic revision.

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## Overview

The **EXP-CONNECT expansion board** Adds GPS and GSM/NB-IoT capabilities to your application. It enables you to monitor and locate your assets, ensuring visibility of their position and allowing you to receive real time notifications on critical events over cellular connectivity.

Zerynth expansion boards work seamlessly with all of the Zerynth Development boards. Combined, they can act as a Development Boards for prototyping a Product, and a core for industrial applications.

The zBUS allows connection in a cascade of different add-on modules to create specific industrial applications that fit into a DIN-RAIL case.

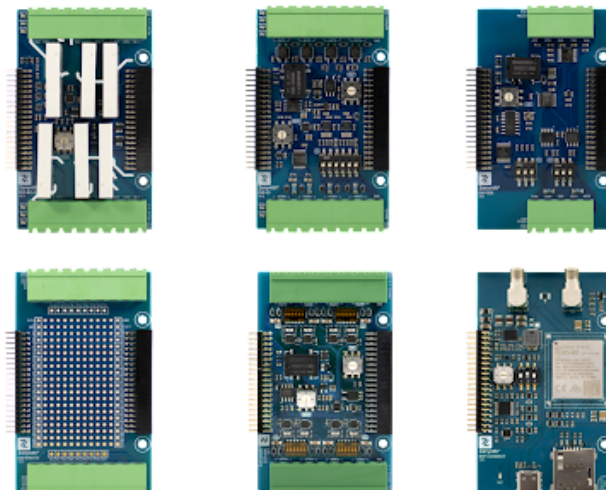
## Modular Expansion System

Zerynth Development boards offer a game-changing way of connecting and adding functionalities to your application in a simple and easy way.

The development board offers a modular expansion system that adds expansion boards through the connectors on the board (zBUS).

**Expansion boards vary in features and functionality. Currently, Zerynth offers :**

- **EXP-AIN:** Expansion board with 8 Industrial analog input channels
- **EXP-CONNECT:** GSM-NB-IoT and GPS enabled expansion module.
- **EXP-IO:** Industrial input/output board with 4 solid-state relays, 2 analog channels (4-20mA/0-10V/NTC/current clamp) channels, 2 opto-isolated digital inputs
- **EXP-RELAY:** Expansion board with 6 Electromechanical power relays.
- **EXP-SER:** Serial Communication board with : CAN, RS232 and RS485 interfaces.
- **EXP-PROTO:** Prototyping board for connecting and testing different types of sensors and devices.



## General Characteristics

- **Quectel BG95-M3 modem 2G e NB-IoT:** LPWA module which supports LTE Cat M1/Cat NB2/EGPRS and integrated GNSS.
- **MicroSIM Slot**
- **GPS and GSM/NB-IoT Antennas: 2 SMA connectors**

**IMPORTANT:** The EXP-CONNECT works only if the ZM1-DB is powered with 24VDC from the external screws.

## Technical Specifications

Environmental Conditions	
<b>Temperature</b>	-40 to +85 °C
<b>Humidity</b>	Max 80% not condensing
<b>Storage Temperature</b>	-40 to +85 °C
<b>Degree Protection</b>	< IP40

## Components' Guide

**Quectel BG95-M3 modem:** BG95 is a series of embedded IoT (LTE Cat M1, LTE Cat NB2 and EGPRS) wireless communication modules. It provides data connectivity on LTE-FDD and GPRS/EGPRS networks, and supports half-duplex operation in LTE networks. It also provides GNSS functionality to meet your specific application demands.

### Frequency Bands and GNSS Types

Supported Bands LTE Bands	Power Class	GNSS
Cat M1: LTE-FDD: B1/B2/B3/B4/B5/B8/B12/B13/ B18/B19/B20/B25/B26/B27/ B28/B66/B85 Cat NB2: LTE-FDD: B1/B2/B3/B4/B5/B8/B12/B13/ B18/B19/B20/B25/B28/B66/B71/ B85 EGPRS: 850/900/1800/1900 MHz	Power Class 5 (21 dBm)	GPS, GLONASS, BeiDou, Galileo, QZSS.

### Transmitting Power

LTE-FDD bands	GSM bands
Class 5 (21 dBm +1.7/-3 dB) Class 3 (23 dBm ±2 dB) Class 2* (26 dBm ±2 dB)	Class 4 (33 dBm ±2 dB) for GSM850 Class 4 (33 dBm ±2 dB) for EGSM900 Class 1 (30 dBm ±2 dB) for DCS1800 Class 1 (30 dBm ±2 dB) for PCS1900 Class E2 (27 dBm ±3 dB) for GSM850 8-PSK Class E2 (27 dBm ±3 dB) for EGSM900 8-PSK Class E2 (26 dBm ±3 dB) for DCS1800 8-PSK Class E2 (26 dBm ±3 dB) for PCS1900 8-PSK

### Main Antenna Interface: Operating Frequency

3GPP Band	Transmit	Receive	Unit
LTE-FDD B1	1920–1980	2110–2170	Mhz
LTE-FDD B2, PCS1900	1850–1910	1930–1990	MHz
LTE-FDD B3, DCS1800	1710–1785	1805–1880	MHz
LTE-FDD B4	1710–1755	2110–2155	Mhz
LTE-FDD B5	GSM850	824–849	869–894
LTE-FDD B8	EGSM900	880–915	925–960
LTE-FDD	B12	699–716	729–746
LTE-FDD	B13	777–787	746–756
LTE-FDD	B18	815–830	860–875
LTE-FDD	B19	830–845	875–890
LTE-FDD	B20	832–862	791–821
LTE-FDD	B25	1850–1915	1930–1995
LTE-FDD	B26	814–849	859–894
LTE-FDD	B27	807–824	852–869
LTE-FDD	B28	703–748	758–803
LTE-FDD	B31	452.5–457.5	462.5–467.5

LTE-FDD	B66	1710–1780	2110–2180
LTE-FDD	B71	663–698	617–652
LTE-FDD	B71	663–698	617–652
LTE-FDD	B72	451–456	461–466
LTE-FDD	B73	450–455	460–465
LTE-FDD	B85	698–716	728–746

### GNSS Antenna Interface: GNSS Operating Frequency

Type	Frequency	Unit
GPS	1575.42 ±1.023	MHz
GLONASS	1597.5–1605.8	MHz
Galileo	1575.42 ±2.046	MHz
BeiDou	1561.098 ±2.046	MHz
QZSS	1575.42 ±1.023	MHz

### Antenna Requirements

Antenna Type	Requirements
GNSS	Frequency range: 1559–1609 MHz Polarization: RHCP or linear VSWR: < 2 (Typ.) Passive antenna gain: > 0 dBi Active antenna noise figure: < 1.5 dB Active antenna gain: > 0 dBi Active antenna embedded LNA gain: < 17 dB
LTE/GSM	VSWR: ≤ 2 Efficiency: > 30 % Max Input Power: 50 W Input Impedance: 50 Ω Cable Insertion Loss: < 1 dB (LTE B5/B8/B12/B13/B18/B19/B20/B26/B27/B28/B31/B71/B72/B73/B85, GSM850/EGSM900) Cable Insertion Loss: < 1.5 dB (LTE B1/B2/B3/B4/B25/B66, DCS1800/PCS1900)

### Absolute Maximum Ratings

Absolute maximum ratings for power supply and voltage on digital and analog pins of the module are listed in the following table.

Parameter	Min.	Max.	Unit
VBAT_BB	-0.5	6.0	V
VBAT_RF	-0.3	6.0	V
USB_VBUS	-0.3	5.5	V
Voltage at Digital Pins	-0.3	2.09	V

### Power Supply Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
VBAT	VBAT_BB/ VBAT_RF	The actual input voltages must be kept between the minimum and the maximum values.	3.3	3.8	4.3	V
IVBAT	Peak supply current (during transmission slot)	Maximum power control level on EGSM900	-	1.8	2.0	A
USB_VBUS	USB connection detection		-	5.0	-	V

### BG95-M3 Current Consumption (3.8 V Power Supply, Room Temperature)

Description	Conditions	Average	Peak	Unit
Leakage*	Power-off @ USB and UART disconnected	12.99	-	μA
PSM**	Power Saving Mode	3.89	-	μA
Rock Bottom	AT+CFUN=0 @ Sleep mode	0.575	-	mA
Sleep Mode (USB disconnected)	LTE Cat M1 DRX = 1.28 s	1.89	-	mA
	LTE Cat NB1 DRX = 1.28 s	1.49	-	mA
	EGSM900 DRX = 5	1.21	-	mA
	DCS1800 DRX = 5	1.20	-	mA
	LTE Cat M1 e-I-DRX = 81.92 s	0.63	-	mA

	@ PTW = 2.56 s, DRX = 1.28 s			
	LTE Cat NB1 e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	0.67	-	mA
Idle Mode (USB disconnected)	LTE Cat M1 DRX = 1.28 s	18.9	-	mA
	LTE Cat NB1 DRX = 1.28 s	14.8	-	mA
	LTE Cat M1 e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	18.2	-	mA
	LTE Cat NB1 e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	14.3	-	mA
LTE Cat M1 data transfer (GNSS OFF)	B1 @ 21.29 dBm	193.65	491.42	mA
	B2 @ 20.73 dBm	190.76	477.7	mA
	B3 @ 20.67 dBm	185.89	462.63	mA
	B4 @ 20.85 dBm	185.14	456.71	mA
	B5 @ 21.02 dBm	194.99	487.59	mA
	B8 @ 21.02 dBm	197.31	497.83	mA
	B12 @ 20.96 dBm	189.54	467.22	mA
	B13 @ 20.99 dBm	198.75	510.51	mA
	B18 @ 21 dBm	195.07	490.61	mA
	B19 @ 20.95 dBm	197.63	502.55	mA
	B20 @ 20.92 dBm	197.33	498.89	mA
	B25 @ 21.08 dBm	190.67	481.36	mA
	B26 @ 20.98 dBm	195.96	493.02	mA
	B27 @ 20.69 dBm	192.07	486.82	mA
	B28A @ 20.87 dBm	192.04	482.44	mA
	B28B @ 21.03 dBm	197.39	501.64	mA
	B66 @ 21.11 dBm	188.1	471.7	mA
	B85 @ 20.87 dBm	185.3	453.97	mA



LTE Cat NB1 data transfer (GNSS OFF)	B1 @ 20.86 dBm	153.2	477.37	mA
	B2 @ 21.28 dBm	155.14	478.3	mA
	B3 @ 21.07 dBm	149.14	450.59	mA
	B4 @ 20.91 dBm	147.72	449.24	mA
	B5 @ 20.55 dBm	154.68	476.59	mA
	B8 @ 21.01 dBm	158.82	493.93	mA
	B12 @ 20.88 dBm	148.37	452.51	mA
	B13 @ 21.09 dBm	167.03	520.85	mA
	B18 @ 20.79 dBm	157.12	489.47	mA
	B19 @ 20.68 dBm	156.29	489.16	mA
	B20 @ 21.01 dBm	161.75	503.43	mA
	B25 @ 21.02 dBm	154.16	476.58	mA
	B28 @ 20.82 dBm	147.82	458.52	mA
	B66 @ 21 dBm	148.58	459.72	mA
	B71 @ 20.81 dBm	137.53	428.61	mA
	B85 @ 20.64 dBm	146.51	462.26	mA
GPRS data transfer (GNSS OFF)	GPRS GSM850 4UL/1DL @ 30.5 dBm	670.73	1535	mA
	GPRS GSM900 4UL/1DL @ 29.65 dBm	623.34	1442	mA
	GPRS DCS1800 4UL/1DL @ 26.24 dBm	408.25	836.38	mA
	GPRS PCS1900 4UL/1DL @ 26.43 dBm	423.12	885.95	mA
EDGE data transfer (GNSS OFF)	EDGE GSM850 4UL/1DL @ 22.97 dBm	519	1114	mA
	EDGE GSM900 4UL/1DL @ 22.51 dBm	517.59	1101	mA
	EDGE DCS1800 4UL/1DL @ 22.73 dBm	439.73	919.79	mA
	EDGE PCS1900 4UL/1DL @ 22.27 dBm	443.94	922.29	mA

\*The current consumption of BG95 series in PSM is much lower than that in power-off mode, and this is due to the following two designs:

- More internal power supplies are powered off in PSM.
- Also, the internal clock frequency is reduced in PSM.

\*\*The module's USB and UART are disconnected and GSM network (if available) does not support PSM.

### GNSS Current Consumption of BG95-M3 (3.8 V Power Supply, Room Temperature)

Description	Conditions	Typ.	Unit
Searching (AT+CFUN=0)	Cold start @ Instrument	70.00	mA
	Host start @ Instrument	73.66	mA
	Warm start @ Instrument	72.54	mA
	Lost start @ Instrument	69.24	mA
Tracking (AT+CFUN=0)	Instrument Environment @ Passive Antenna	22.31	mA
	Open Sky @ Real network, Passive Antenna	21.792	mA
	Open Sky @ Real network, Active Antenna	22.357	mA

## Switches

**Rotary Switch SW1:** Controls which hardware channel you want to link the ADS7128 interrupt.

Position	Pin on zBUS	Pin ZM1-DB
0	INTR	D35
1	INTB	NC
2	INTE1	D46
3	INTE2	D47

### S1 Switch:

Controls the serial ports connected to the quectel modem

PIN	OFF	ON
1	Connect SERIAL1 to GPS of BG95	Connect PE15/PE16 to GPS of BG95
2	-	GPS Serial Enabled
3	-	Connect USB_BOOT to VDD

**Note:** PIN2 electrically isolates the channels of the dedicated GPS serial so as not to create electrical conflicts with other serial circuits that need the same channels

**Note:** PIN3 is used for updating the BG95 fw from the dedicated usb-c on board

**To dedicate the SERIAL1 for the GPS, Put the following switch settings**

Switch pin	State
1	OFF
2	ON
3	OFF

**Note:** If SERIAL1 is also dedicated to the GPS, no more serial port will be available over the zBUS.

**Note:** By default, the BG95-M3 uses SERIAL2 of the ZM1-DB for communication with the modem, Don't use it with other expansion boards.

**IMPORTANT:** The EXP-CONNECT works only if the ZM1-DB is powered with 24VDC from the external screws

**Note:** EXP-CONNECT Expansion board exposes the following pins to manage the Quectel Modem functionalities:

PIN	Description
DTR	Data terminal ready pin: To exit from PPP mode to AT Commands mode.
RING	Interrupt Pin of Quectel Modem
ANT_ON	Power GPS Antenna
STATUS	Checks modem power status
PWR	PWR of Modem
RESET	Resets the modem.
DCD	Data Carrier Detect pin: Checks NET signal
PSM IND	Power Save Mode Indicator

## Pin Map



PINOUT DIAGRAM

## EXP-CONNECT

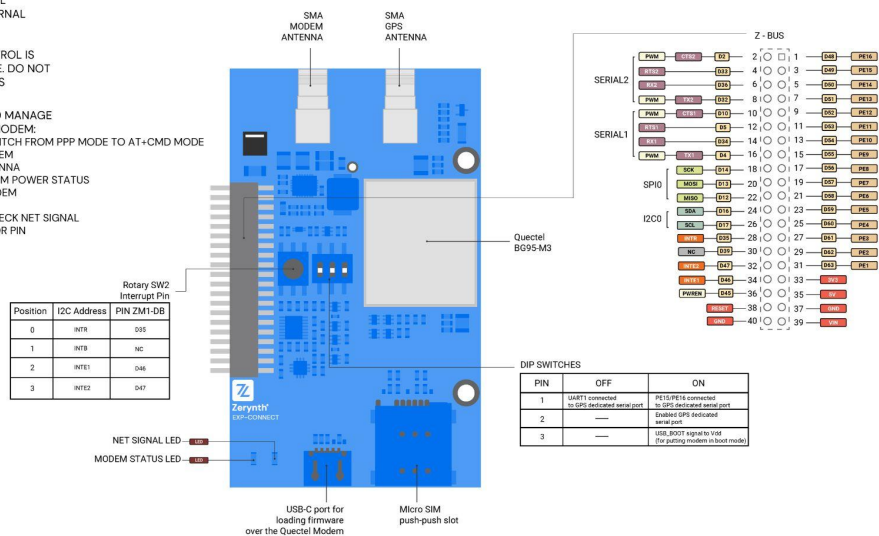
### NOTE:

EXP-CONNECT WORKS ONLY WITH EXTERNAL POWER SUPPLY (24VDC) PROVIDED BY EXTERNAL SCREWS OF A ZMI-DB.

ZBUS SERIAL2 WITH HARDWARE FLOW CONTROL IS USED TO HANDLE MODEM SERIAL INTERFACE. DO NOT USE SERIAL2 FOR OTHER EXPANSION BOARDS.

EXP-CONNECT EXPOSES FOLLOWING PIN TO MANAGE EXTRA FUNCTIONALITIES OF THE QUECTEL MODEM:

- DTR PIN --> DATA TERMINAL READY PIN TO SWITCH FROM PPP MODE TO AT+CMD MODE
- RING PIN --> INTERRUPT PIN OF QUECTEL MODEM
- ANT\_ON PIN --> PIN TO POWER THE GPS ANTENNA
- STATUS PIN --> PIN TO CHECK QUECTEL MODEM POWER STATUS
- PWR KEY PIN --> POWER PIN OF QUECTEL MODEM
- RESET PIN --> RESET OF QUECTEL MODEM
- DCD PIN --> DATA CARRIER DETECT PIN TO CHECK NET SIGNAL
- PSM IND PIN --> POWER SAVE MODE INDICATOR PIN



### LEDs

- Power-on LED.
- Net: Feedback of the modem operation.
- Status: status of the modem

## Software

Zerynth SDK provides software libraries for each board, alongside API documentation and examples. Please check the Hardware section for more information.

<https://docs.zerynth.com/latest/hardware/>

## Zerynth SDK

**Zerynth SDK** is the official development framework for Zerynth hardware. It includes a compiler, device drivers and libraries drivers. In addition to simple tutorials, example codes, and application examples.

Zerynth SDK and all the required libraries can be installed on Windows, Linux and Mac using the Zerynth Installer (<https://www.zerynth.com/zsdk>).

## Declaration of Conformity

IMPORTANT: KEEP THESE INFORMATION FOR FUTURE REFERENCE FOR FULL SET UP AND INSTALLATION INSTRUCTIONS PLEASE VISIT [docs.zerynth.com](https://docs.zerynth.com)

## Warnings

- All external power supplies used with Zerynth boards must comply with the relevant regulations and standards applicable in the country of use and must provide a voltage between 9 and 36 VDC.
- Hereby, Zerynth srl declares that the radio equipment type Zerynth boards are in compliance with Directive 2014/53/EU (RED). The full text of the EU declaration of conformity is available at the following internet address:  
<https://www.zerynth.com/download/26799/>
- The manufacturer cannot guarantee compliance with the RED directive if the end user uses custom circuits other than those supplied by Zerynth (used in conformity tests).
- All expansion boards that require CE marking have been tested and meet the essential requirements set by the Directives: 2014/30/EU (EMC), 2014/35/EU (LVD), 2011/65/EU (RoHS). The declaration of conformity (DoC) can be downloaded from the website  
<https://www.zerynth.com/download/26799/>
- All Zerynth boards have undergone compliance testing for conducted and radiated emissions meeting the requirements of the following standards: FCC Part 15 B and IC ICES-003.
- Any device or component connected to one of the expansion connectors must comply with the electrical characteristics defined in the specifications described in the complete manual to ensure that the performance and safety requirements are met.

- Each cable used to connect other devices or components to the Zerynth boards must be less than 300 cm long and must offer adequate insulation and operation so that the appropriate performance and safety requirements are met.

## Instructions for safe use

- Do not expose this product to water or moisture and do not place it on a conductive surface while it is operating.
- Do not expose this product to excessive heat sources which could cause it to operate outside the permitted temperature range defined in the specifications (-40, +85 ° C).
- Be careful when handling the product to avoid mechanical or electrical damage to the printed circuit board and connectors.
- If a board looks damaged, do not use it.
- Do not touch the printed circuit board when it is powered and never operate on live electrical parts.
- The printed circuit board must not come into contact with conductive objects when it is powered.
- Discharge static electricity from your body and touch only the edges of the board to minimize the risk of damage from electrostatic discharge.



### EN - Waste Electrical and Electronic Equipment (WEEE) Symbol

The use of the WEEE symbol indicates that this product/board may not be treated as household waste. By ensuring this product/board is disposed of correctly, you will help protect the environment. For more detailed information about recycling of this product/board, please contact your local authority, your household waste disposal service provider or the shop where you purchased it.