logic IO
The M2M Enabler

Technical Manual for the RTCU MX2i eco

Version 1.03

Introduction

This manual contains technical documentation allowing easy installation and use of the RTCU MX2i eco unit. For information on the programming and software configuration of the RTCU MX2i eco please refer to the RTCU IDE documentation.

The RTCU MX2i eco is the second member belonging to the new MX generation of powerful RTCU units. The unit is a low cost version of the popular RTCU-MX2i PRO. With a reduced feature set compared to the RTCU-MX2i PRO the product has a perfect balance between price and performance. The price-level of the RTCU MX2i eco belongs to the entry-level segment, but the advanced features are in a league of its own!

The unit has an impressive list of features including full support for GPRS, SMS and Data calls. The unit is especially suited for mobile tracking applications with its onboard GPS-receiver and advanced power management features. The unit is fully supported by the RTCU IDE development tool and is fully backward compatible with previous generation of RTCU units.

The advanced power-management features on the RTCU MX2i eco allows the unit to stay in power-saving modes for a longer period of time still being connected to the GSM network and capable of waking up on for example GSM activity, change of digital inputs or a vibration sensor!

These features open up for the use of the RTCU MX2i eco in exciting new application areas where extremely low power consumption and flexible wake-up conditions are a crucial parameter for successful product integration.

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Graphical view

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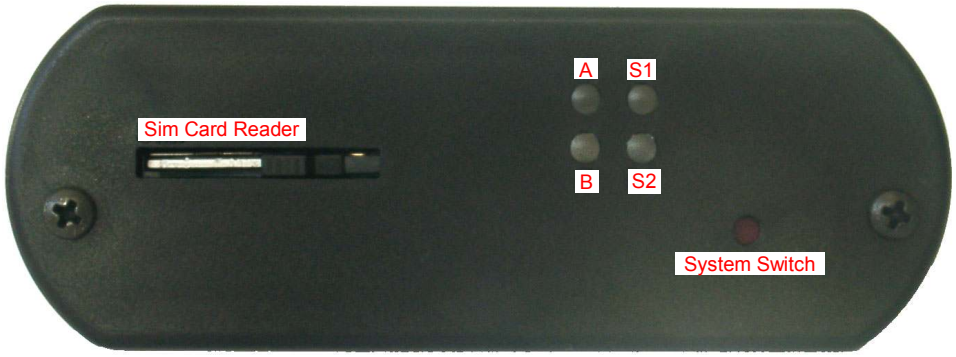
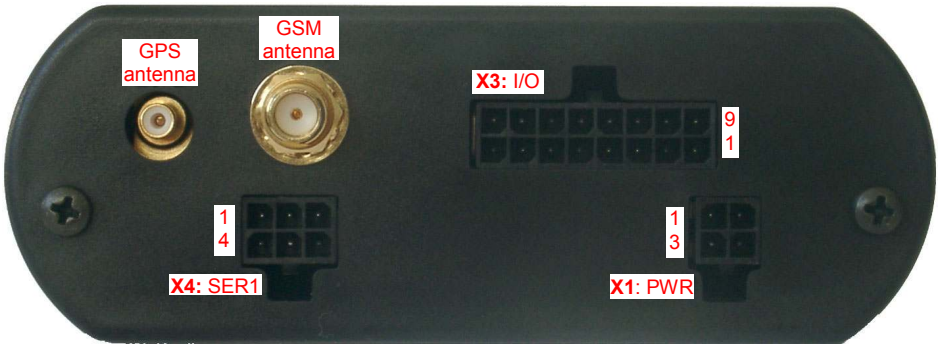
External connections

Overview

Connections to external equipment are done via the connectors located back and forth on the product. All connections are available externally for easy access; this also includes SIM-Card. There are no user-serviceable parts inside and the warranty is void if the unit is disassembled.
The front plate is equipped with SIM-Card reader, LED's and the System Switch. The back plate holds all connectors necessary for installation; 4-pin for Power and ignition, 6-pin for RS232/Programming and a 16-pin for digital I/O and analog inputs. Connection to Quad-band GSM antenna is via a SMA Female and connection to a 3V active GPS antenna is done via the SMB Male connector. Both antenna connectors are located on the back plate.
A graphical overview of the front- and back plate is shown below:



Front-side view



Back-side view

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Connector X1: 4 pin PWR connector overview.

Pin	Name	Description
1	SUPP	Power Supply, positive (+) connection
2	DI5/IGN	Digital Input 5 / Ignition Input (Shared with 16 pin connector)
3	SUPP	Power Supply, positive (+) connection
4	PGND	Power Ground

Connector X3: 16 pin I/O connector overview.

Pin	Name	Description
1	DOUT 1	Digital Output 1
2	DOUT 3	Digital Output 3
3	DIN 1	Digital Input 1
4	SGND	Signal Ground
5	DIN 3	Digital Input 3
6	DIN 5/IGN	Digital Input 5 / Ignition Input (Shared with 4 pin connector)
7	N.C	Not Connected
8	N.C	Not Connected
9	DOUT 2	Digital Output 2
10	DOUT 4	Digital Output 4
11	DIN 2	Digital Input 2
12	SGND	Signal Ground
13	DIN 4	Digital Input 4
14	SGND	Signal Ground
15	AGND	Analog Ground
16	AGND	Analog Ground

Connector X4: 6 pin SER1 connector overview.

Pin	Name	Description
1	TD	Transmit Data from serial port 1, RS232 compatible
2	RS-DET	Programming cable detect, normally unconnected (if programming cable, connect to GND)
3	DC-Out	+3.3V/150mA DC-Out for external equipment.
4	RD	Receive Data for serial port 1, RS232 compatible
5	SGND	Signal Ground
6	SGND	Signal Ground

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Accessories available from Logic IO for cable assembly.

Order-code	Name
RT-O-TYCO-H4 TYCO p/n: 794617-4	TYCO, Connector house 4 pins. Bag with 10 pcs
RT-O-TYCO-H6 TYCO p/n: 794617-6	TYCO, Connector house 6 pins. Bag with 10 pcs
RT-O-TYCO-H16 TYCO p/n: 1-794617-6	TYCO, Connector house 16 pins. Bag with 10 pcs
RT-O-TYCO-CR TYCO p/n: 794606-1	TYCO, Crimp Contacts for connector house. Wire size 0.2 to 0.5 mm^2. Bag with 100 pcs.
RT-O-TYCO-TOOL TYCO p/n: 91501-1	TYCO, Crimp hand tool for easy assembly of TYCO crimp contacts. Wire size 0.2 to 0.5 mm^2
Recommended tool:	Tyco 91501-1 (0.20 to 0.50mm^2) RS 495-9675, Farnell 1111475
Alternative tools:	Tyco 91502-1 (0.05 to 0.15mm^2) RS 495-9675, Farnell 1111476 Molex 69008-0982 (0.20 to 0.50mm^2) RS 233-3059, Farnell 673122 Molex 69008-0983 (0.05 to 0.05mm^2) RS 233-3065, Farnell 673134
Extraction tool:	Tyco 843996-6 extraction tool. RS 495-9704, Farnell 1111477

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Power supply

The RTCU MX2i eco unit is to be supplied with 8...36 VDC from an external DC power source connected to the 4 pin power connector. Positive power is applied to the SUPP pin and ground is connected to the PGND pin.
The connector has two “SUPP” supply pins as these also supplies power for the Digital Outputs. If the total current consumption on the digital outputs exceeds 1.5A then power must be applied to both pins. Otherwise one pin would be sufficient.

There are three different labels for the ground connections: Power Ground (PGND), Signal Ground (SGND) and Analog Ground (AGND). The signal and analog grounds are filtered from the power ground. Power ground must only be used as power supply return path. The signal ground is used as ground reference for digital I/O’s and serial interfaces. And the analog ground is used as a low noise analog ground reference for the analog inputs.

The RTCU MX2i eco is protected against wrong polarity. If a chassis or system grounds are connected to either SGND or AGND a wrong polarity on the supply lines will destroy the internal GND connection. For avoidance of such a scenario a fuse can be installed on the positive supply.

When the ignition input is activated with a logical high, the RTCU unit will wake-up if it was in power down mode. The ignition input (digital input 5) is available on the power connector to minimize the need for connectors in minimal connector installations, but it is also available on the 16 pin connector (Digital I/O) - only one should be used at a time.

Please note: When external power is removed from the unit the Real Time Clock (RTC) looses the time.

X1: 4 pin PWR connector overview.

Pin	Name	Description
1	SUPP	Power Supply, positive (+) connection
2	DI5/IGN	Digital Input 5 / Ignition input (Shared with 16 pin connector)
3	SUPP	Power Supply, positive (+) connection
4	PGND	Power Ground

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Digital outputs

The digital outputs control four “high-side” switches. They function like a contact, where one side is connected to the positive supply of the RTCU unit, and the other is the output. The switches are protected against short circuit, ESD and electronic kickback from inductive loads such as relays etc. The maximum switch-able inductance is 20mH and must not be exceeded.

The digital outputs are supplied through the 4 pin power connector, which also supplies the rest of the RTCU unit. As the power is also the RTCU MX2i eco main power, a power-fail would also affect the digital outputs.

The RTCU unit offers a very advanced power management, which makes it possible to have one or more outputs enabled while the RTCU is in low power mode. Please consult the RTCU-IDE online help for more information.

Please note: Special attention to wiring must be taken; if the total current consumption of the digital outputs exceeds 1.5A then PGND must be used as return path for the output(s). If the total current consumption of the digital outputs exceeds 5A the two SUPP pins and PGND must be used for supply.

X3: 16 pin I/O connector overview.

Pin	Name	Description
1	DOUT 1	Digital Output 1
9	DOUT 2	Digital Output 2
2	DOUT 3	Digital Output 3
10	DOUT 4	Digital Output 4

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Digital Inputs / Ignition Input

The digital inputs are all low-pass filtered and transient protected. To activate the inputs, connect a positive voltage between the input and the GND connector.

Please note: The DIN 5/IGN input is a special input as it also functions as the ignition input. If the ignition input is activated with a logical high or low (Wait For Event mode only) when the RTCU is in low power mode, it will wake-up the unit. A power apply will also wake-up the unit if it is in power-down mode or WaitForEvent mode with power Apply and/or ignition selected for wake-up. The ignition is de-bounced with a period between 1-2 ms when used as a digital input. So any logical level applied to this input must be greater than 2 ms to be valid. The DIN 5/IGN input is available on both the 4 pin power connector and the16 pin connector together with the other digital inputs – only one should be used at a time.

The power management allows the possibility to configure a wake-up on one or more digital inputs with individually configured falling- or rising edge detection. Please consult the RTCU-IDE online help for more information.

X3: 16 pin I/O connector overview.

Pin	Name	Description
3	DIN 1	Digital Input 1
11	DIN 2	Digital Input 2
5	DIN 3	Digital Input 3
13	DIN 4	Digital Input 4
6	DIN 5/IGN	Digital Input 5 / Ignition Input. (Shared with 4 pin connector)
4	SGND	Signal Ground
10	SGND	Signal Ground
14	SGND	Signal Ground

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Serial port 1 / Programming port.

This port can be used as general-purpose RS232 serial port or as a programming port. In order to use the port for programming, the RS-DET pin must be connected to GND. When using the port as general-purpose RS232, the RS-DET pin must be left unconnected. Further details on the programming cable are available in the RTCU-IDE online help.

X4: 6 pin SER1 connector overview.

Pin	Name	Description
1	TD	Transmit Data from serial port 1, RS232 compatible
4	RD	Receive Data for serial port 1, RS232 compatible
2	RS-DET	Programming cable detect, normally unconnected (if programming cable, connect to GND)
5	SGND	Signal Ground

DC-Out

A 3.3VDC output is available on the 6 pin serial port 1 connector. It is possible to control the output in order to save power. The output is short circuit- (to ground), ESD- and transient protected.

Make sure not exceed the current specification of the output and be aware of inrush currents of the external equipment may exceed the specifications. It is recommended to install a fuse to protect the output.
This output must be enabled from the application. Please consult the RTCU-IDE online manual for more information.

X4: 6 pin SER1 connector overview.

Pin	Name	Description
3	DC-Out	+3.3V/150mA DC-Out for external equipment.
5	SGND	Signal Ground

Vibration Sensor

The RTCU MX2i eco unit contains a vibration sensor. It makes it possible through the power management to detect vibrations when for example the vehicle is moved. The sensitivity can be altered from within the VPL program - making it suitable for various applications. Please consult the RTCU-IDE online manual for more information.

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Indicators (LED's)

Three bi-colored (red and green) and a single yellow LED indicators are present on the front of the unit (see the graphical view). Two bi-colored LED's (A and B) are available to the user and the remaining two LED's (S1 and S2) are signaling the status and possible errors of the RTCU unit.

The user control LED one through four for application specific signaling purposes.

- LED named A on the front-plate, consists of LED 1 (green) and LED 2 (red)
- LED named B on the front-plate, consists of LED 3 (green) and LED 4 (red)

They are easily accessed from within the VPL program, and it is possible to mix the LED's to obtain a third color, yellow. Please consult the RTCU-IDE online manual for more information.

The remaining two LED's a used by the RTCU to signal the status of the unit. The different patterns are listed in the table below. If the color of the S1 is yellow, the unit is actively communicating with for example the RTCU-IDE program (or another program, supporting the RTCU protocol, RACP).

S1: System LED1 pattern overview.

Pattern	Description
Fastest blinking, green	The unit is initializing, preparing to start the VPL program
Fast blinking, green (or yellow)	The VPL program is not executing, but stopped by the reset/diagnostic switch.
500ms On / 500ms Off green (or yellow)	The unit is executing the VPL program
1.5s On / 0.5s Off. green (or yellow)	The unit is executing the VPL program and charging the internal back-up battery.
Fast blinking, red (or yellow)	A runtime error has been detected in the program. Use the RTCU IDE to obtain the fault log.
Alternating Fast/Slow, red (or yellow)	The unit has lost its Firmware! This can only happen if, during a firmware upgrade, the RTCU Unit looses power, or the communication is lost completely. In this case, simply upload the firmware to the unit again.
75ms On / 925ms Off	Execution speed is different from full-speed.

The single yellow LED is signaling either the GSM module activity or if all other LED's are off it will signal that the RTCU is in the "wait for event" low power state. Please see the table below:

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S2: System LED2 pattern overview (GSM activity and "Wait For Event").

Pattern	Operating Status
Off	The GSM module is turned off
600 ms On / 600 ms Off	No SIM card inserted or no PIN code entered, or network search in progress, or ongoing user authentication, or network logon in progress.
75 ms On / 3 s Off	Logged to the network. No call in progress.
75 ms On / 75 ms Off / 75 ms On / 3 s OFF	A GPRS session is active
Flashing	Indicates GPRS data transfer.
On	Depending on type of call: *Voice call*: Connected to remote party. *Data call:* Connected to remote party or exchange of parameters while setting up or disconnecting a call.
8 s OFF / 10 ms ON	The RTCU unit is in "Wait For Event" low power state.

System Switch (RST)

The RTCU MX2i eco unit contains a combined reset/diagnostic switch. This switch is located on the front-plate of the RTCU unit (see the graphical view).

By activating the switch shortly the RTCU unit will do a complete reset, as if the power was removed and reapplied. If the reset switch is held down for approx. 3 seconds[1] the VPL program present in the unit will not be started and the unit will turn on the GSM module and establish connection to the GSM network and to GPRS / Gateway (if configured). This method will also activate the unit if it is powered down due to a power fail. The feature is very helpful when maintenance without power is needed. To "exit" (power down the unit again) from this mode simply activate the reset switch shortly.
The status indicator indicates the state by fast blinking green or yellow as stated above.

[1] System LED S2 will flash three times when this state is entered.

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Installing the SIM-card

The RTCU MX2i eco unit contains a standard SIM card reader. It is located on the front plate (see the graphical view) and is easily accessed. The SIM card reader has a push/push eject system and a mechanical lock for secure installation of the SIM card. Orientate the card as showed below, and insert it into the card reader. Push the card into the reader until a click sound occurs – the card will now stay in its position. It might be necessary to use a small tool or pencil as the card, for protection purposes, is placed underneath the front-plate surface. Furthermore a mechanical lock can be slide in front of the card to prevent it from being removed accidentally.
To remove the card slide the lock to its unlocked position, and push the card into the reader until a small click sound occurs. The reader will now eject the card. It might be necessary to use a small tool or pencil to push the card into the reader.

It is possible to detect the state of both the SIM Insert and SIM lock status from the VPL program. Please consult the RTCU-IDE online manual for more information.

SIM card Orientation.

If the SIM-card is removed during GSM operation the unit will shortly after be rejected from the GSM network. When a SIM-card is inserted again the unit will automatically reset approx. 10 seconds after insertion and then commence normal operation.

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Antennas

GSM

The RTCU MX2i eco unit contains an SMA Female connector for connection of a suitable GSM quad band antenna (850/900/1800/1900 MHz). When installing the antenna, please make sure that the antenna is not in close proximity of metallic parts or anything else that can influence the efficiency of the GSM antenna. Please consult the installation guide that follows the GSM antenna.

GPS

The RTCU MX2i eco unit contains an SMB Male connector for connection of a suitable GPS antenna. The GPS antenna must be a 3V active GPS antenna mounted with a SMB Female connector.
When installing the antenna, please make sure that the antenna has a reasonable view of the sky so that it can receive the weak signals from the satellites. Please also consult the installation guide that follows the GPS antenna.

Barcode

The barcode found on the MX2i unit contains the serial number.
The first eight digits in the barcode is Logic IO specific.

The barcode format is:

- 2/5 Interleaved with Check Digit

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Power consumption

Detailed information on the maximum power consumption of the MX2i unit in different states and at different supply voltages is listed below.

Maximum power consumption: Unit running on external supply.

	8V	12V	36V		
Unit Active	60	45	20	mA	
Unit Active with GSM On	90	50	25	mA	GSM idle @ -63dBm
Unit active with GPS On	90	65	25	mA	
Unit Active with GSM/GPS On	115	75	30	mA	GSM idle @ -63dBm
Unit in power-down	0.4	0.3	0.2	mA	Resume on DI5, RTC
Unit in “wait for event”	0.6	0.4	0.2	mA	Resume on DI, Vibration, RTC
Unit in “wait for event”	10	7	3	mA	Resume on RS232
Unit in “wait for event”	20	15	6	mA	Resume on GSM activity

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Specifications for the RTCU MX2i eco

Power supply	Min	Typ	Max		
Operating Voltage	8	-	36	VDC	Protected against wrong polarity.
Unit Active		45		mA	
Unit Active with GSM On		50		mA	GSM idle @ -63 dBm
Unit Active with GPS On		65		mA	
Unit Active with GSM/GPS On		75		mA	GSM idle @ -63 dBm
Unit in Power-down		0.3		mA	Restart on: DI 5 and RTC
Unit in "Wait for Event"		0.4		mA	Resume on: DI, Vibration, RTC
Unit in "Wait for Event"		7		mA	Resume on: RS232
Unit in "Wait for Event", GSM On		15		mA	Resume on: GSM
					Typical measurements @ 12 VDC Supply.

		Min	Typ	Max		
Digital inputs	Logic "High"	8	12	40	VDC	All inputs are protected against transients and low-pass filtered.
	Logic "Low"	-5	-	3	VDC	

	Min		Max		
Digital outputs (Solid state)	-	-	36	VDC	Protected against: Short circuit, ESD and inductive (Relay) kickback up to 20mH
	-	-	1.5	A	

Storage temperature	-40	-	+85	℃	External interfaces: • TYCO "Mate'n'Lock' connector for: ▪ RS232 port 1 (service port) ▪ Power, Digital I/O • Three bi-color LED and one yellow status LED • SMA-Female connector for GSM antenna • SMB-Male for active 3 Volt GPS antenna • Standard 3 Volt SIM-Card reader (external access) All interfaces are externally accessible
Operating temperature (According to GSM 11.10 specification)	-25	-	+55	℃	
Restricted operation (deviations from the GSM specification may occur)	-30	-	+65	℃	
Humidity (non condensing)	5	-	90	%	
Weight	0.2			Kg	
External dimensions	W 97 x H 35 x D 132 mm				without SMA and SMB connectors
Ingress Protection (IP)	IP40 (SIM / Connectors in use)				Aluminum enclosure
Approvals	EN-61000-6-3;2001 Emission EN-61000-6-2;2001 Immunity				E1 10R-024899 e1 034899 CE

Technical data subject to change

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Specifications for the 16-channel GPS receiver

	u-blox LEA-4A
General:	16 Channels simultaneous operation DGPS and A-GPS capable L1 frequency (1575.42MHz) C/A code (Standard Positioning Service) Continuous tracking receiver
Update Rate:	NMEA @ 1 Hz
Accuracy:	Position 2.5m CEP DGPS/SBAS 2.5m CEP[2]
Acquisition:	Autonomous Operation in Standard Sensitivity Mode Reacquisition <1 sec. Hot Start < 3.5 sec. Warm start 33 sec. Cold start 34 sec.
Interface protocol:	NMEA 0183 v3.0 with GGA, VTG, GLL, GSA, GSV and RMC

Definitions:

Cold Start:
The GPS has no valid navigation data.

Warm Start:
The GPS has been powered down for more than one hour, but has stored information about its current position and time

Hot Start:
The GPS has been powered down for less than 2 hours and the stored position and time are valid

Reacquisition:
Time to get a fix if the signal has been blocked for a short period of time.

[2] Depends on accuracy of correction data provided by the DGPS or SBAS service

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