RTCU DX4i pro

Technical Manual

Version 1.00

logic IO
The M2M Enabler

Introduction

This manual contains technical documentation which allows for easy installation and use of the **RTCU DX4i pro** product. For information on the programming and software configuration of the product please refer to the RTCU IDE documentation.

The RTCU DX4i pro has been designed from the ground up for professional wireless industrial applications with its strong on-board I/O capabilities and multiple communication interfaces such as: dual RS232, dual RS485, 1-Wire, CAN and USB.

Housed in a standard DIN-rail encapsulation, it is a perfect component for automation and control applications.

The on-board I/O system can be expanded almost indefinitely and completely transparently by adding external MODBUS compatible I/O modules! This unique I/O expansion capability, combined with the ability to operate as a MODBUS master and slave simultaneously, positions the RTCU DX4i pro as the perfect product for SCADA-like applications.

The RTCU DX4i pro is based on the X32 Execution Architecture offering high performance along with a large memory capacity for both program and data - meeting the requirements of today's most demanding and sophisticated M2M/IoT applications.

The RTCU DX4i pro rests on the **RTCU M2M Platform** which brings all the necessary tools together to develop, implement and maintain today's sophisticated M2M/IoT applications.

The development task is supported by the **free RTCU IDE development environment**, complimented by a large and comprehensive documentation and application example library.

The **RTCU Gateway 2** is the corner stone of the communication infrastructure and ensures reliable two-way device communication in any network environment.
Deploying and maintaining new application and firmware versions for devices in the field is handled by the powerful **RTCU Deployment Server**.

For detailed information on the powerful RTCU M2M Platform, please refer to the ***RTCU M2M Platform datasheet***.

The technical highlights of the RTCU DX4i pro:

- Based on the **RTCU M2M Platform**[1]**.**
- **X32 execution architecture**.
  - RTCU IDE development tool with full a featured device simulator.
  - Huge standard API with more than 800+ functions.
  - Comprehensive protocol support, including:
    TCP-UDP/IP, FTP, SMTP, RACP, MQTT, MODBUS.
- World-wide **Quad-band GSM engine**.
- Internal and external SIM-card readers.
- **Digitized audio** can be played over GSM or to an external device.
- **DTMF** support for implementation of Interactive Voice Response applications.
- **Graphical 144x32 pixels display** with white-on-blue back-lit text/graphics.
- **Keypad** with 8 keys for sophisticated user interaction and control.
- Large data-flash/logger memory with a capacity **of 4.5 MB**.
- Internal **4 MB FAT32 flash drive**.
- Standard FAT32 **SD-CARD** reader with up to 32 GB capacity.
- **2 x RS232** channels and **2 x RS485** channels.
- **4 x analog inputs** with 0..10 volt / 0..20 mA with **12 bit precision**.
- **4 x analog outputs** with 0..10 volt / 0..20 mA.
- **8 x digital inputs** and **8 x high-power** solid-state **digital outputs**.
- Up to 4 digital inputs can be configured as **IEC62053-31 Class A** compliant.
- **Expandable I/O** with standard MODBUS modules.
- **Full CAN 2.0B** controller with hardware filtering and multi-speed support.
- **1-Wire bus** for accessories such as ID-button reader, temperature sensors, etc.
- Wide operating range from **8..36 VDC**.
- On-board **high-capacity Li-Ion battery**.
- Advanced **power-management** with wake-up on a wide range of events.
- High-speed **Mini-USB programming** connector.
- Housed in an industry standard **M36 DIN** compliant encapsulation.
- Two-part pluggable connectors for easy installation and maintenance.
- Fully supported by the **RTCU Gateway 2** and the **RTCU Deployment Server**.
- **Accessories**: MODBUS modules, Wi-Fi, Ethernet, Bluetooth and 2 MP camera.

1 Please see "The **RTCU M2M Platform**" data sheet for more information.

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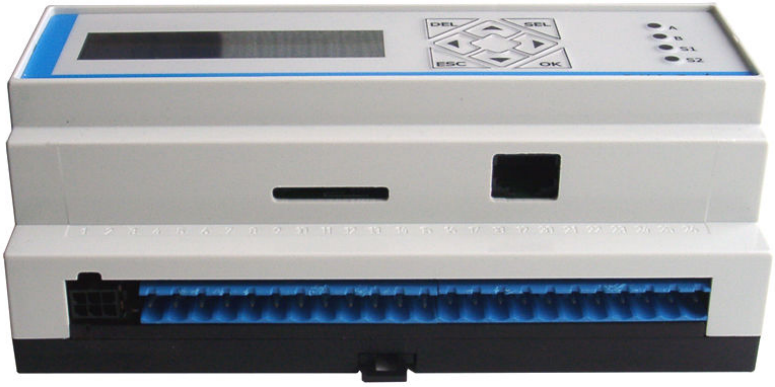
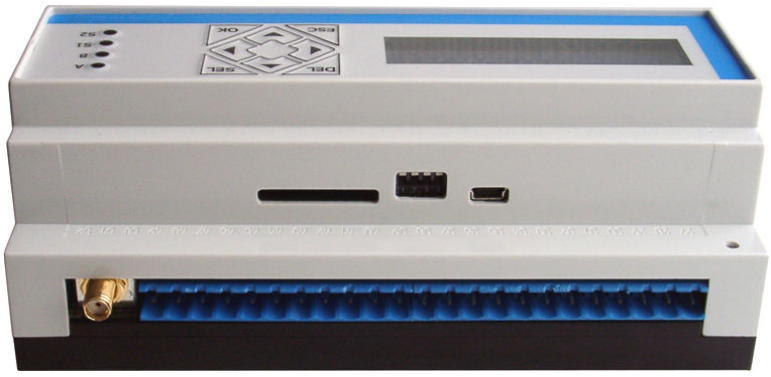
Graphical view





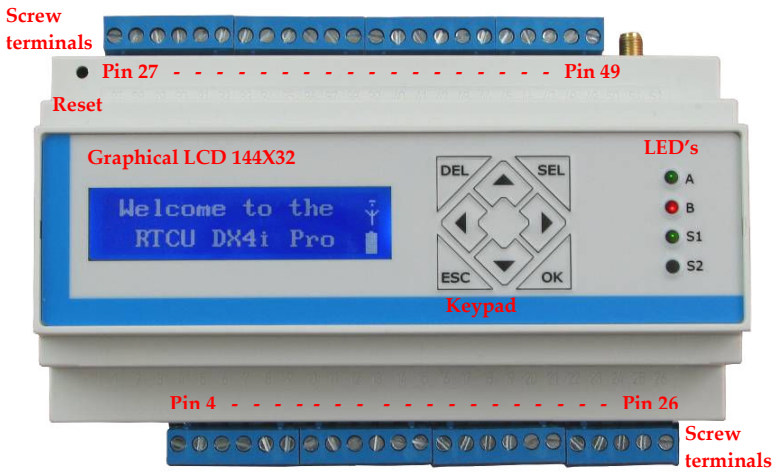
External connections

Overview

Connections to external equipment are done via pluggable screw terminals that are located on the top and bottom sides of the product. All connections are available externally for easy access and maintenance.

On the front a user interface is found. This includes a 144x32 easy-to-read graphical LCD for showing information to the user with both text and graphics fully supported. The LCD also has icons for battery level/charging-in-progress and GSM network status.

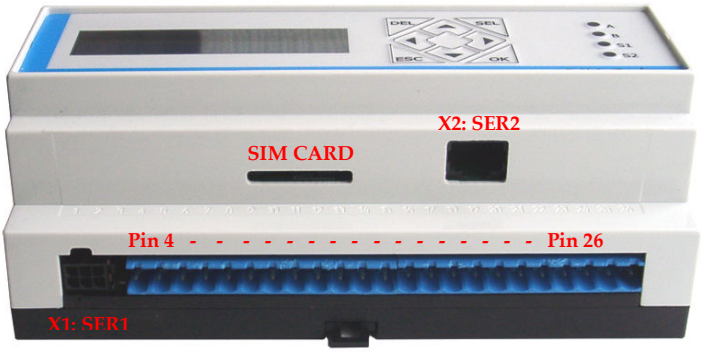
Eight push-buttons are available for the user to interact with on the RTCU DX4i pro. Also present are four user-controlled and three system LED's for system information and status.



Front view with pluggable screw terminals.

The bottom side of the RTCU DX4i pro has all the communication interfaces: CAN, 1-Wire, RS232 Port 1, RS232 Port 2, RS485 Port 1, RS485 Port 2 and external voice output. The analog inputs/outputs are also found on this side.

The external SIM card reader with lock mechanism is also located on the bottom side.



Bottom-side view

On the top side of the RTCU DX4i pro, the following interfaces are found: power, digital inputs, digital outputs and an SMA female connector for an external GSM antenna.
The SD-CARD reader and three DIP switches are also found on this side. Finally the mini USB-B connector used as programming/service interface is located on the top side.

Top-side view

The RTCU DX4i pro uses two-way pluggable screw terminals for maximum flexibility and easy installation and maintenance.

Signal Overview

Connector X1: 6-pin SER1 connector overview.

Pin	Name	Description
1	TXD	Transmit data from serial port 1, RS232 compatible
2	RS-DET	Accessory connection detect, normally unconnected
3	DC-OUT	+3.3V / 400mA DC-OUT for external equipment.
4	RXD	Receive data for serial port 1, RS232 compatible
5	SGND	Signal ground
6	SGND	Signal ground

Connector X2: SER2 - RJ45 connector overview, fully RS232 compatible.

Pin	Name	Description
1	DSR	Data set ready
2	DCD	Data carrier detect
3	DTR	Data terminal ready
4	SGND	Signal ground
5	RXD	Receive data for serial port 2
6	TXD	Transmit data from serial port 2
7	CTS	Clear to send
8	RTS	Request to send

Connector X3: Mini USB-B connector

The USB port is for programming and communicating with the RTCU IDE (RACP compliant application). A standard USB cable can be used between the unit and the PC.

Pin 4 - 26 overview

Pin	Name	Description
4	CAN-H	CAN-bus H-signal
5	CAN-L	CAN-bus L-signal
6	SGND	Signal ground
7	1Wire	1-Wire bus for accessories such as ID-Button / temperature sensors
8	1Wire-LED	1-Wire ID-Button LED
9	SGND	Signal ground
10	RS485_1+	RS485 non-inverting signal for RS485 port 1
11	RS485_1-	RS485 inverting signal for RS485 port 1
12	SGND	Signal ground
13	RS485_2+	RS485 non-inverting signal for RS485 port 2
14	RS485_2-	RS485 inverting signal for RS485 port 2
15	SGND	Signal ground
16	Voice	External voice
17	AIN1	Analog input 1
18	AIN2	Analog input 2
19	AIN3	Analog input 3
20	AIN4	Analog input 4
21	AGND	Analog ground
22	AOUT1	Analog output 1
23	AOUT2	Analog output 2
24	AOUT3	Analog output 3
25	AOUT4	Analog output 4
26	AGND	Analog ground

Pin 27 - 49 overview

Pin	Name	Description
27	PGND	Power ground, negative (-) connection
28	SUPP	Power supply, positive (+) connection
29	SUPP	Power supply, positive (+) connection
30	DOUT1	Digital output 1
31	DOUT2	Digital output 2
32	DOUT3	Digital output 3
33	DOUT4	Digital output 4
34	DOUT5	Digital output 5
35	DOUT6	Digital output 6
36	DOUT7	Digital output 7
37	DOUT8	Digital output 8
38	SGND	Signal ground
39	SGND	Signal ground
40	DIN1 / S0IN1	Digital input 1 / S0 input 1
41	DIN2 / S0IN2	Digital input 2 / S0 input 2
42	DIN3 / S0IN3	Digital input 3 / S0 input 3
43	DIN4 / S0IN4	Digital input 4 / S0 input 4
44	DIN5 / WAKEUP	Digital input 5 / Wakeup (*ignition*) input
45	DIN6	Digital input 6
46	DIN7	Digital input 7
47	DIN8	Digital input 8
48	SGND	Signal ground
49	SGND	Signal ground

Accessories available for cable assembly

Order-code	Name
RT-O-TYCO-H6 TYCO p/n: 794617-6	Tyco, Connector house 6 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: Alternative tools: Extraction tool:	Tyco 91501-1 (0.20 to 0.50mm^2) RS 495-9675, Farnell 1111475 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 Tyco 843996-6 extraction tool. RS 495-9704, Farnell 1111477

Power supply

The RTCU DX4i pro unit can be supplied with 8..36VDC from an external DC power source. Positive power is applied to the SUPP pin and ground is connected to the PGND pin. There are two SUPP pins, as these also supply the digital outputs. If the total current consumption of the digital outputs exceeds 1A, please refer to the digital output section for more information on the wiring. Otherwise one pin is sufficient.

There are three different ground labels: 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 a power supply return path. The signal ground is used as ground reference for digital I/O's and serial interfaces. The analog ground is used as a low noise analog ground reference for the analog inputs.

The RTCU DX4i pro is protected against wrong polarity. If a chassis or system ground is connected to either SGND or AGND, a wrong polarity on the supply lines will destroy the internal GND connection.

The RTCU DX4i pro also contains an internal high capacity backup battery which will supply the RTCU if the external power supply fails or is disconnected. By default the RTCU is powered down when a power fail occurs. This setting, however, can be changed. Please consult the RTCU IDE on-line help for more information. The display will automatically turn off when external power is removed.

When the wakeup/ignition input is activated with a logical high, the RTCU DX4i pro unit will wake-up if it was in power-down mode.

Please Note:

- Minimum 12VDC supply is necessary for 0-10V analog output configuration.
- Minimum 16VDC supply is necessary for digital inputs 1-4 to work as S0 compliant inputs.
- In-rush currents up to 2A can occur on initial power apply.

Power supply pins

Pin	Name	Description
27	PGND	Power ground, negative (-) connection
28	SUPP	Power supply, positive (+) connection
29	SUPP	Power supply, positive (+) connection

Digital outputs

The digital outputs control eight "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 switchable inductance is 20mH and must not be exceeded.

The digital outputs are supplied directly from the SUPP power pins which also supply the rest of the RTCU unit. As the power is also the main power of the unit, a power-fail would also affect the digital outputs.

The RTCU DX4i pro unit offers 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 on-line help for more information.

Please note: Special attention to wiring must be taken; if the total current consumption of the digital outputs exceeds 1A then PGND must be used as return path for the output(s).

If the total current consumption of the digital outputs exceeds 5A, then both SUPP and the PGND must be used for supply.

Digital output pins

Pin	Name	Description
27	PGND	Power ground, negative (-) connection
28	SUPP	Power supply, positive (+) connection
29	SUPP	Power supply, positive (+) connection
30	DOUT1	Digital output 1
31	DOUT2	Digital output 2
32	DOUT3	Digital output 3
33	DOUT4	Digital output 4
34	DOUT5	Digital output 5
35	DOUT6	Digital output 6
36	DOUT7	Digital output 7
37	DOUT8	Digital output 8

Digital inputs / S0 inputs / Ignition input

The eight digital inputs are all low-pass filtered (*450kHz*) and transient-protected. To activate the inputs, connect a positive voltage between the corresponding input (DINx) and SGND.

Digital input 1-4 can be configured individually as S0 input (*IEC62053-31, Class A*) and DIN5 can work as a wakeup (*ignition*) input.

As default the digital inputs are configured as normal inputs. For placement and configuration of the hardware jumpers inside the unit, please refer to the configuration guide in Appendix A.

S0 compliant inputs (*IEC62053-31, Class A* compatible)

In S0 configuration the relevant RTCU DX4i pro input will act as a 'pulse input device', and a current is supplied into the input connector so that a simple switch between SGND and the appropriate input will activate it. This is used in most electricity metering equipment.

Please note: The RTCU DX4i pro unit must be supplied with a minimum of 16 VDC for the S0 mode to work correctly.
S0 must also be enabled from the application in order to work as an S0 compliant input.

Wakeup (*ignition*) input

The DIN5 / wakeup (*ignition*) input is a special input in that it also functions as the wakeup input. If the input is activated with a logical high or low (Wait For Event mode only) when the RTCU DX4i pro is in low-power mode it will wake-up the unit. A power apply will also wake the unit up if it is in power-down mode or in Wait For Event mode with power Apply and/or ignition selected for wakeup. The input 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 power management allows for the possibility of configuring a wakeup on one or more digital inputs with individually configured falling- or rising edge detection. Please consult the RTCU IDE on-line help for more information.

Digital input pins

Pin	Name	Description	Jumper Setting
40	DIN1 / S0IN1	S0 input 1	JP8 position 1-2
		Digital input 1	JP8 position 2-3 (*default*)
41	DIN2 / S0IN2	S0 input 2	JP9 position 1-2
		Digital input 2	JP9 position 2-3 (*default*)
42	DIN3 / S0IN3	S0 input 3	JP10 position 1-2
		Digital input 3	JP10 position 2-3 (*default*)
43	DIN4 / S0IN4	S0 input 4	JP11 position 1-2
		Digital input 4	JP11 position 2-3 (*default*)
44	DIN5 / WAKEUP	Digital input 5	
		Wakeup (*ignition*) input	
45	DIN6	Digital input 6	
46	DIN7	Digital input 7	
47	DIN8	Digital input 8	
48	SGND	Signal ground	
49	SGND	Signal ground	

For placement and configuration of the hardware jumpers inside the unit, please refer to the unit configuration guide in Appendix A.

Analog inputs

The RTCU DX4i pro unit has four analog inputs which can be configured individually to work either as voltage or current measurement inputs by using the configuration jumper. The range in voltage mode is 0-10VDC and in current mode it is 0-20mA.
The conversion resolution is 12 bit.

By default the analog inputs are configured as voltage inputs, and are converted to a digital value with a resolution of 10-bit before being presented to the application (0..1023). The application can change the resolution to the full 12 bit (0..4095). Please consult the RTCU IDE for further details.

The input signal is connected between AINx and AGND. AGND must be connected to the reference of the connected equipment. Please be aware that deviations may occur, as the system is very noise sensitive. Avoid long, unshielded wires and high current, fast changing signals routed parallel to the analog signals.

Analog input pins

Pin	Name	Description	Jumper Setting
17	AIN1	Analog input 1 – Voltage	JP1 not installed (*default*)
		Analog input 1 – Current	JP1 installed
18	AIN2	Analog input 2 – Voltage	JP14 not installed (*default*)
		Analog input 2 – Current	JP14 installed
19	AIN3	Analog input 3 – Voltage	JP16 not installed (*default*)
		Analog input 3 – Current	JP16 installed
20	AIN4	Analog input 4 – Voltage	JP17 not installed (*default*)
		Analog input 4 – Current	JP17 installed
21	AGND	Analog ground	
26	AGND	Analog ground	

Specification for each analog input (voltage mode)

	Min.	Typ.	Max.	Unit	
	0	-	10	VDC	Protected against transients and
Resolution	-	-	12	Bit	low-pass filtered
Precision	-1.5	-	1.5	%FSR	Precision is based on
Cut-off frequency	-	4.5	-	kHz	measurements @ 25 ˚C
Input impedance	-	40	-	kΩ	

Specification for each analog input (current mode)

	Min.	Typ.	Max.	Unit	
	0	-	20	mA	Protected against transients and
Resolution	-	-	12	Bit	low-pass filtered
Precision	-1.5	-	1.5	%FSR	Precision is based on
Cut-off frequency	-	4.5	-	kHz	measurements @ 25 ˚C
Input impedance	-	504	-	Ω	

Analog outputs

The analog outputs can individually be configured to work either as voltage or current outputs. The range in voltage mode is 0-10VDC and in current mode it is 0-20mA. The resolution of the digital-to-analog converter is 10bit or 1024 in decimal scale.

The decimal value for 10V/20mA output are 1023 and 512 for 5V/10mA.

As default the outputs are configured as voltage outputs. For placement and configuration of the hardware jumpers inside the unit, please refer to the unit configuration guide in Appendix A.

The output signal is connected to external equipment between AOUTx and AGND. AGND must be connected to the reference of the connected equipment. Please be aware that deviations may occur, as the system is very noise sensitive. Avoid long unshielded wires and large fast-changing signals routed parallel to the analog signals. In current mode the specifications for the analog output only valid if the load is maximal 250Ω.

Each output is ESD and transient protected.

Please note: The RTCU DX4i pro unit must be supplied with minimum 12VDC in order for the analog outputs to work according to specifications.

Analog output pins

Pin	Name	Description	Jumper Setting
22	AOUT1	Analog output 1 – Voltage	JP2 position 2-3 (*default*)
		Analog output 1 – Current	JP2 position 1-2
23	AOUT2	Analog output 2 – Voltage	JP3 position 2-3 (*default*)
		Analog output 2 – Current	JP3 position 1-2
24	AOUT3	Analog output 3 – Voltage	JP4 position 2-3 (*default*)
		Analog output 3 – Current	JP4 position 1-2
25	AOUT4	Analog output 4 – Voltage	JP6 position 2-3 (*default*)
		Analog output 4 – Current	JP6 position 1-2
21	AGND	Analog ground	
26	AGND	Analog ground	

RS232 port 1

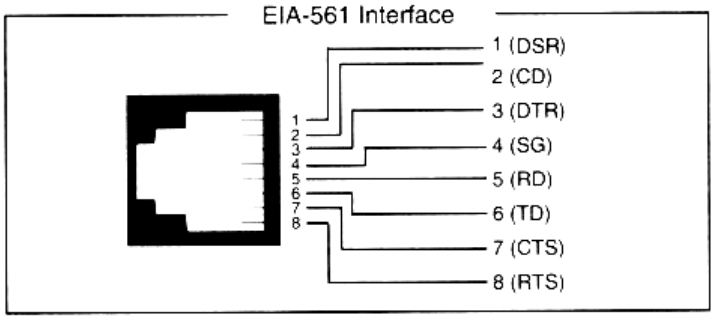
This port can be used as a general-purpose RS232 serial port and does not support handshaking. This port can also be used for communication with the RTCU accessories. This serial port shares its resources with the RS485 port 2 and only one of them can be active at a given time.

X1: SER1 connector overview (6-pin TYCO Mate-n-Lock)

Pin	Name	Description
1	TXD	Transmit data from serial port 1, RS232 compatible
4	RXD	Receive data for serial port 1, RS232 compatible
2	RS-DET	RTCU accessories detection
5	SGND	Signal ground
6	SGND	Signal ground

RS232 port 2

The port is a general-purpose RS232 port with all control signals according to EIA-561 which defines RS232 on a modular connector.



The signals are available on the RJ-45 connector located on the bottom side of the RTCU DX4i pro unit.

X2: SER2 connector overview, fully RS232-compatible (RJ-45)

Pin	Name	Description
1	DSR	Data Set Ready
2	DCD	Data Carrier Detect
3	DTR	Data Terminal Ready
4	SGND	Signal Ground
5	RD	Receive Data for serial port 2
6	TD	Transmit Data from serial port 2
7	CTS	Clear To Send
8	RTS	Request To Send

RS485 communication ports (EIA/TIA-485-A compatible)

RS485 is a multi-drop network with a maximum of 32 units connected simultaneously to the bus. The RS485 bus contains an RS485+ (*non-inverting*) and an RS485- (*inverting*) signal as well as a signal ground which must always be connected to the common signal ground for all units connected to the RS485 bus!

The maximum cable length for the RS485 bus is according to the EIA/TIA-485-A standard (max. 1200m @ <100kbit); this limit is highly influenced by the quality of the cable, signaling rate, noise etc.

At longer cable lengths, noisy environments, or high communication speeds, it might be necessary to terminate the transmission line with a 120[1] ohm resistor at each end of the transmission line to terminate it and avoid signal reflections. If the RTCU DX4i pro is used as an endpoint unit, the hardware jumper JP7 (*port 1*) / JP12 (*port 2*) can be installed to terminate the RS485 communication lines with 120 ohm.

By default the RS485 communication lines are not terminated with 120 ohm. For placement and configuration of the hardware jumpers inside the unit, please refer to the configuration guide in Appendix A.

RS485 port 1

This port is available on the pluggable screw terminals and is not shared with other resources.

RS485 port 1 pins

Pin	Name	Description
9	SGND	Signal ground
10	RS485_1+	RS485 non-inverting signal for RS485 port 1
11	RS485_1-	RS485 inverting signal for RS485 port 1
12	SGND	Signal ground

RS485 port 2

The RS485 port 2 is available on the pluggable screw terminals. Internally this RS485 port and the RS232 port 1 share the same signals, and only one of them can be used at any time.

RS485 port 2 pins

Pin	Name	Description
12	SGND	Signal ground
13	RS485_2+	RS485 non-inverting signal for RS485 port 2
14	RS485_2-	RS485 inverting signal for RS485 port 2
15	SGND	Signal ground

1 Assuming use of a CAT5 twisted pair cable

CAN communication port

The RTCU provides the physical layer for the CAN (Controller Area Network) serial communication interface in accordance with the ISO 11898 standard. The CAN bus is designed for high-speed (up to 1Mbit) robust communication in especially harsh environments like those found in the automotive industry.

The CAN interface can be connected to an existing CAN network with a common protocol like the J1939 standard, to retrieve information for surveillance or information purposes. The interface can also be used as a robust serial data link with a non-standard protocol. Please consult the RTCU IDE documentation for more information.

The physical layer consists of a two wire (CAN-H and CAN-L) differential bus and a signal ground for reference.

If the RTCU is connected to a "non-existing" network, a 120[1] ohm resistor must be connected between CAN-H and CAN-L on each end of the transmission line in order to terminate it and avoid signal reflections. This resistor can be connected by installing the hardware jumper JP15[2] inside the unit.

Be aware that connecting the RTCU to a CAN network can be dangerous. If the RTCU is not configured with the correct network parameters, it will lead to network corruption and may interfere with other connected equipment on the bus. Especially in vehicles great precautions must be observed to prevent communication interruptions.

By default unit writing capability on the CAN bus is enabled. This can be disabled by installing the hardware jumper JP5[2] inside the unit.

A wide range of software functions is available for easy access to the network. Please consult the RTCU IDE documentation for further information.

CAN pins.

Pin	Name	Description
4	CAN-H	CAN-bus H-signal
5	CAN-L	CAN-bus L-signal
6	SGND	Signal ground

Logic IO cannot be held responsible for any problems or damage due to corruption and interference in an existing CAN network.

1 Assuming use of a CAT5 twisted pair cable

2 Please refer to "Appendix A – Unit configuration guide" regarding location.

1-Wire bus

The 1-Wire bus is available on the pluggable screw terminals. All 1-Wire communication goes through a single connection, and all 1-Wire devices connected to this connection retrieves its power directly from the bus (called parasitic power). For this only two wires are needed – the 1-wire signal and the ground reference – allowing minimal cable installations.

For 1-Wire ID-Button readers, which include a built-in LED, a dedicated output is available for this purpose. Please consult the RTCU IDE documentation for further information.

For further information regarding modular 1-wire concept, please refer to the document "Modular 1-Wire Concept Technical Manual" on the Logic IO webpage.

1-Wire pins

Pin	Name	Description
7	1Wire	1-Wire bus for communication
8	1Wire-LED	1-Wire ID-Button LED
9	SGND	Signal ground

DC-Out

A 3.3VDC output is available in the TYCO 6-pin connector (X1). 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 to exceed the current specification of the output and be aware that 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 on-line manual for more information.

Connector X1: 6-pin SER1 connector overview

Pin	Name	Description
3	DC-OUT	+3.3V / 400mA DC-OUT for external equipment.
5	SGND	Signal ground
6	SGND	Signal ground

User interface

On the front of the RTCU DX4i pro unit the user interface is found. This includes a 144x32 easy-to-read graphical LCD, a small incorporated keypad, and three bi-colored LED's and one single color LED.

Graphical LCD display

The display mounted on the RTCU DX4i pro is a 144x32 pixels white-on-blue graphical display. A range of display functions is available for making graphical and alpha numerical presentations of the data, user interaction with menus etc. The display is fully backward compatible with previous applications using the on-board LCD Display.

By default the display is powered on at startup and shows I/O status, battery and GSM status as shown in the following picture:

The top half of the display is showing the status of the 4 analog and the 8 digital outputs (in groups of 4), the bottom half is showing the status of the 4 analog and the 8 digital inputs (in groups of 4).

Right-most 8x32 pixels are reserved for battery and GSM network status indication while the rest of the display is available to the user application.

States of the GSM network and battery are indicated with different icons and level indicators. The following tables describe the states and their indications:

Status	Icon
GSM off	
GSM on	
GSM on and connected	
GPRS connected	

GSM signal levels are indicated with 4 bars – also known from many mobile phones. One bar means low signal strength and four bars mean high signal strength. No signal strength bars mean that the GSM module is powered up, but is not connected to a network service provider.

In the same manner the battery level is indicated with five levels; the fully filled battery icon means fully charged and the empty battery icon means low battery level. While charging the battery the battery icon is animated to show all the levels with a one second delay.

Power state of the display is saved in persistent memory,and the state will be restored when power recycling or restarting the unit.

Please consult the RTCU-IDE on-line manual for more information about the use of the display.

Please note: The display will automatically turn off when the external power is removed.
The application can still access the display, and when the external power is restored, the display content will automatically be visible again.

Keypad

The keypad consists of eight pushbuttons which are available on the front of the unit for the user to interact with. These buttons are arranged in a logical way for easy use and each button is marked with generally used symbols/text to fit almost every possible use. The firmware button poll frequency is approximately 10 Hz.

Please consult the RTCU IDE on-line manual for more information about the use of the buttons.

LED Indicators

Three bi-colored (red and green) and a single yellow LED indicator are present on the front of the unit (see 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.

User LED A and B

LED A and B are composed of four individually controllable LEDs:

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

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

System LED S1 and S2

The RTCU is equipped with two system LED's which shows the status and possible errors of the RTCU unit.

The different patterns are listed in the table below. If the color of the system LED S1 is yellow, the unit is actively communicating with the RTCU IDE (or another program, supporting the RTCU RACP protocol).

The single yellow LED is signaling either the GSM module activity, or if all other LED's are off, that the RTCU is in the "wait for event" low power state.

S1: System LED1 pattern overview

Pattern	Description
Fastest blinking, green	The unit is initializing, preparing to start the application.
Fast blinking, green[1]	The unit has been forced into recovery mode with the use of the system switch. The application is not executing.
500ms On / 500ms Off green[1]	The unit is executing the application program
1.5s On / 0.5s Off. green[1]	The unit is executing the application program, while charging the internal back-up battery.
Fast blinking, red[1]	A runtime error has been detected in the program. Use the RTCU IDE to obtain the fault log.
Alternating Fast/Slow, red[1]	The unit has lost its firmware! This can only happen if, during a firmware upgrade, the RTCU unit loses power or the communication is lost completely. In this case, simply upload the firmware to the unit again.
75ms On / 925ms Off, green	Execution speed is different from full-speed.

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	Missing SIM card or PIN code. Network search and logon in progress.
75 ms On / 3 s Off	Logged on to the network.
75 ms On / 75 ms Off / 75 ms On / 3 s OFF	A GPRS session is active.
Flashing	Indicates GPRS data transfer.
On	A voice or CSD session is active.
8 s OFF / 10 ms ON (and all other LED's OFF)	The RTCU unit is in low-power "Wait For Event" state.

1 Or yellow when communicating with the RTCU IDE or another program, supporting the RTCU RACP protocol).

Switches

DIP-switch

The RTCU DX4i pro unit contains four dipswitches and three of them are available for the application to use (*fourth dipswitch is reserved for future use*).

The dip switches are located on the top side of the unit for easy user access (see graphical view).

System switch (RST)

The RTCU DX4i pro unit contains a combined reset/diagnostic switch. This switch is accessible from the front of the unit (see graphical view) It is necessary to use a small thin object with a diameter of approx. 2 mm, for example a straightened-out paper clip for this purpose.

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 unit will enter recovery mode[2] where the application will not be started. In recovery mode the system will automatically turn on the GSM module to establish a connection to the GSM network and RTCU Gateway (if configured). This method will also activate the unit when the unit is in power-down mode.

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

2 System LED S1 will indicates this state by fast blinking green or yellow.

Internal Li-Ion battery

The RTCU contains an internal Li-Ion battery for operation even when the external power is absent making it possible to report power loss etc. Please note that when external power is removed, the unit will be powered down by default. This setting can be changed as documented in the RTCU IDE documentation.

The graphical LCD display, digital and analog outputs will be disabled when a power fail occurs as the internal battery cannot provide the supply voltage needed.

The battery charging is completely automated and handled internally by the RTCU unit – leaving no need for user interaction. Different kinds of functions (Battery low, Charger enable, Charging status, etc.) are available to the user application.

The charge current is relatively high, for a shorter charge time, as specified in the technical specification. Make sure both power supply and cables can handle the high current.

The battery will be charged whenever a power fail has occurred to establish the capacity thus making the battery ready for the next power fail. A maintenance charge will start every 20 days after the last charge. This is to compensate for the battery self-discharge etc.

By default the battery cannot be charged above 45°C or below 0°C. The RTCU offers charging down to -10 °C using a specialized algorithm to protect the battery.

If the temperature is above 45°C the charging will not start and will be postponed until it is below this threshold.

The temperature has a very high influence on the battery capacity. At 0°C the capacity has dropped to 60% of the initial capacity and it falls dramatically at lower temperatures.

The battery cycle (numbers of charges and discharges) also influences the capacity. After 300 cycles the capacity has dropped to approximately 80% of the initial capacity.

Warning

Misusing the RTCU unit may cause the built-in battery security circuit to be damaged.

- *Do not place the RTCU unit in high temperature locations such as in direct sunlight or near engines. Using the RTCU unit in this environment may result in loss of battery performance and a shortened life expectancy.*
- *Do not expose the unit to water, salt water or allow the battery to get wet.*
- *Avoid strong impacts and shocks.*

For more information regarding the environmental limitations, see "Specifications for RTCU DX4i pro" below or consult the RTCU DX4i pro datasheet.

GSM

For GSM and GPRS communication an industry-leading QUAD band (850/900/1800/ 1900MHz) GSM module is used.

The RTCU DX4i pro supports:

- Digitized voice (182 seconds.)
- SMS (Text and PDU.)
- GPRS. Multislot class 10. Support for simultaneous Voice and GPRS (suspended.)
- CSD (Datacall)

SIM-Card

The RTCU DX4i pro unit contains a standard SIM card reader which is located on the bottom side of the unit (see graphical view) for easy of access, and an internal SIM card reader which is located inside the unit on top of the GSM module. The externally accessible SIM card reader has a push/push eject system and a mechanical lock for secure installation of the SIM card.
Please refer to Appendix B for a SIM card installation guide.

NOTE: ***Only one SIM card may be inserted at any given time.***
Do NOT insert a SIM card in both SIM-card readers at the same time.

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

If the SIM-card is removed during GSM operation, the unit will be rejected from the GSM network shortly after.

GSM Antenna

The RTCU DX4i pro unit contains an SMA female connector for connecting 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 to metallic parts or anything else that can influence the efficiency of the GSM antenna. Please consult the installation guide that follows the GSM antenna.

SD-CARD reader

The RTCU DX4i pro unit has a standard SD-CARD reader which is located on the top side of the unit (see graphical view) The RTCU DX4i pro supports a FAT file-system for standard PC-compatibility with up to 32 GB capacity support.

The SD-CARD features a push/push eject system for reliable insertion and operation. Please refer to Appendix C for an SD-Card installation guide.

Approved SD-CARDs

To ensure the highest performance and compatibility it is important to use SD-CARDs that has been approved and tested by Logic IO.

The following **Commercial Grade** SD-CARDs from Sandisk have been approved for use:

Capacity	Sandisk SKU
4GB	SDSDB-004G-B35
8GB	SDSDB-008G-B35
16GB	SDSDB-016G-B35
32GB	SDSDB-032G-B35

Commercial grade SD-CARDs can be used in applications where the limited write endurance is acceptable - for example if the SD-CARD is often replaced. Commercial grade SD-CARDs should ***not*** be used in applications where a potential failure on the media is considered mission critical.

For applications that uses the SD-CARD media extensively and where a failure is critical, it is recommended to use approved **Industrial Grade** SD-CARDs.

Logic IO has approved and recommends industrial grade SD-CARDs from **ATP** that is available in capacities from 512 MB to 32 GB.

ATP Industrial Grade SD/SDHC Cards are optimized for demanding industrial applications with consistent performance in all conditions. ATP uses reliable SLC flash technology with a flash endurance more than 20 times higher than commercial grade products with MLC flash.

The differences in write endurance between commercial grade MLC flash and ATP Industrial grade SLC flash is quite remarkable for write-intensive applications:

Product Line	Details	Total Writeable Data Prediction @ 1GB	Time Prediction @ 500 writes a day (1GB)
ATP Industrial Grade	SLC Flash + Advanced Wear Leveling	80,000GB or 2,800,000 writes	**5,740 days** or **15.7 years**
Commercial Grade	Grade A MLC (2 bits per cell) + Advanced Wear Leveling	4,000GB or 140,000 writes	**280 days**

Barcode

The barcode found on the DX4i pro unit contains the serial number.

The first three digits in the serial-number identify the unit type, and for the RTCU DX4i pro this unique code is **272**.

The barcode format used: 2/5 Interleaved with Check Digit

Power consumption

Detailed information on the maximum power consumption of the RTCU DX4i pro unit in different states and different supply voltages is listed below.

Maximum power consumption: unit running on external supply

	8V	12V	36V		
Unit active	85	55	20	mA	
Unit active with GSM on*	120	65	30	mA	GSM idle @ -63dBm*
Unit active with GPRS session* *(102kB file transfer over GPRS)*	200	140	50	mA	GSM @ -65dBm, LCD off, Battery not charging*
Unit active with LCD on	95	70	50	mA	
Unit active while charging	900	580	300	mA	
Unit in power-down	0.8	0.6	0.3	mA	Restart on DIN5, RTC
Unit in "wait for event"	0.8	0.6	0.3	mA	Resume on DIN, RTC
Unit in "wait for event"	17	13	4	mA	Resume on CAN
Unit in "wait for event"	11	8	3	mA	Resume on RS232
Unit in "wait for event"	30	17	6	mA	Resume on GSM activity

Note: Values marked with (*) is average and should be considered as guidelines as they may vary depending on the GSM signal strength.

If the external power source is removed and the internal battery is enabled the power consumption from the battery will be as listed below.

Maximum power consumption: unit running on internal battery

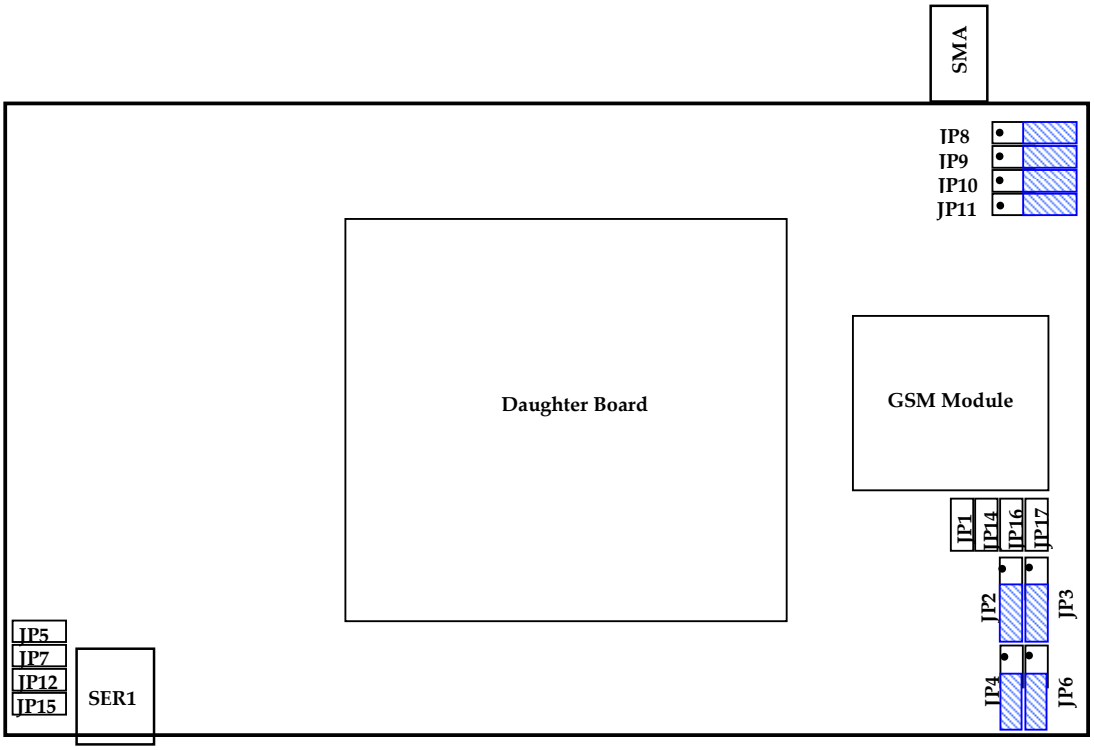
	BAT		
Unit active	90	mA	
Unit active with GSM on	110	mA	GSM idle @ -63dBm
Unit in power-down	0.8	mA	Restart on DIN5, RTC
Unit in "wait for event"	0.8	mA	Resume on DIN, RTC
Unit in "wait for event"	21	mA	Resume on CAN
Unit in "wait for event"	13	mA	Resume on RS232
Unit in "wait for event"	27	mA	Resume on GSM activity

Note: Power consumption from a fully charged battery.

Appendix A – Unit configuration guide

The RTCU DX4i pro has many features and some of them require configuration by using hardware jumpers inside the unit.

The following figure shows the location of the jumpers when the lid is removed. Blue lined boxes show the default state of the jumpers. A dot on the corner of the 2-state jumpers indicates the pin number 1.



A number of jumpers enable/disable a feature while the others are used to select between two features. A brief overview can be found in the following table.

Feature	Jumper	State	Default state
Communication	JP5	Installed	CAN bus write disabled
		Not installed	CAN bus write enabled (*default*)
	JP7 (***RS485_1***)	Installed	120 ohm resistor enabled
		Not installed	120 ohm resistor disabled (*default*)
	JP12 (***RS485_2***)	Installed	120 ohm resistor enabled
		Not installed	120 ohm resistor disabled (*default*)
	JP15 (***CAN***)	Installed	120 ohm resistor enabled
		Not installed	120 ohm resistor disabled (*default*)
Analog input	JP1	Installed	AIN1 current measurement
		Not installed	AIN1 voltage measurement (*default*)
	JP14	Installed	AIN2 current measurement
		Not installed	AIN2 voltage measurement (*default*)
	JP16	Installed	AIN3 current measurement
		Not installed	AIN3 voltage measurement (*default*)
	JP17	Installed	AIN4 current measurement
		Not installed	AIN4 voltage measurement (*default*)
Analog output	JP2	Position 1-2	AOUT1 current
		Position 2-3	AOUT1 voltage (*default*)
	JP3	Position 1-2	AOUT2 current
		Position 2-3	AOUT2 voltage (*default*)
	JP4	Position 1-2	AOUT3 current
		Position 2-3	AOUT3 voltage (*default*)
	JP6	Position 1-2	AOUT4 current
		Position 2-3	AOUT4 voltage (*default*)
Digital input	JP8	Position 1-2	DIN1 S0
		Position 2-3	DIN1 normal (*default*)
	JP9	Position 1-2	DIN2 S0
		Position 2-3	DIN2 normal (*default*)
	JP10	Position 1-2	DIN3 S0
		Position 2-3	DIN3 normal (*default*)
	JP11	Position 1-2	DIN4 S0
		Position 2-3	DIN4 normal (*default*)

JP5

Enable/disable write capability to the CAN bus. When the jumper is installed writing to the CAN bus is disabled.

JP7, **JP12** and **JP15**

Enables/disables the on-board 120 ohm line termination resistors.
CAN and RS485 communication requires as proper line termination value (*assuming a CAT5 twisted pair cable is used*) and resistors in both ends of the bus. If the RTCU DX4i pro unit is used as endpoint the relevant jumper can be installed.

By default the 120 ohm termination resistor is disabled.

JP1, **JP14**, **JP16** and **JP17**

These jumpers are used to select between current and voltage input. With a jumper installed on the relevant analog input it will measure current between 0-20mA.

By default the inputs measure voltage.

JP2, **JP3**, **JP4** and **JP6**

These jumpers are used to select either current or voltage output. With the relevant jumper installed on pin 1+2, the output is a current between 0-20mA. When installed on pin 2+3, the output is a voltage.

By default the jumper is installed on pin 2+3 which means a voltage output.

JP8, **JP9**, **JP10** and **JP11**

These select either normal or S0 input for DIN1-4. With the relevant jumper installed on pin 1+2, the input is configured to S0. When installed on pin 2+3 the input is a normal digital input.

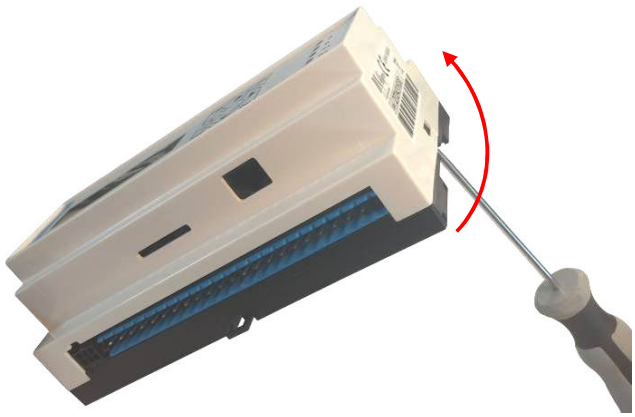
By default the jumper is installed on pin 2+3 and acts as normal digital input.

Follow the instructions on the next page on how to open the lid and change the jumper settings.

Opening the lid

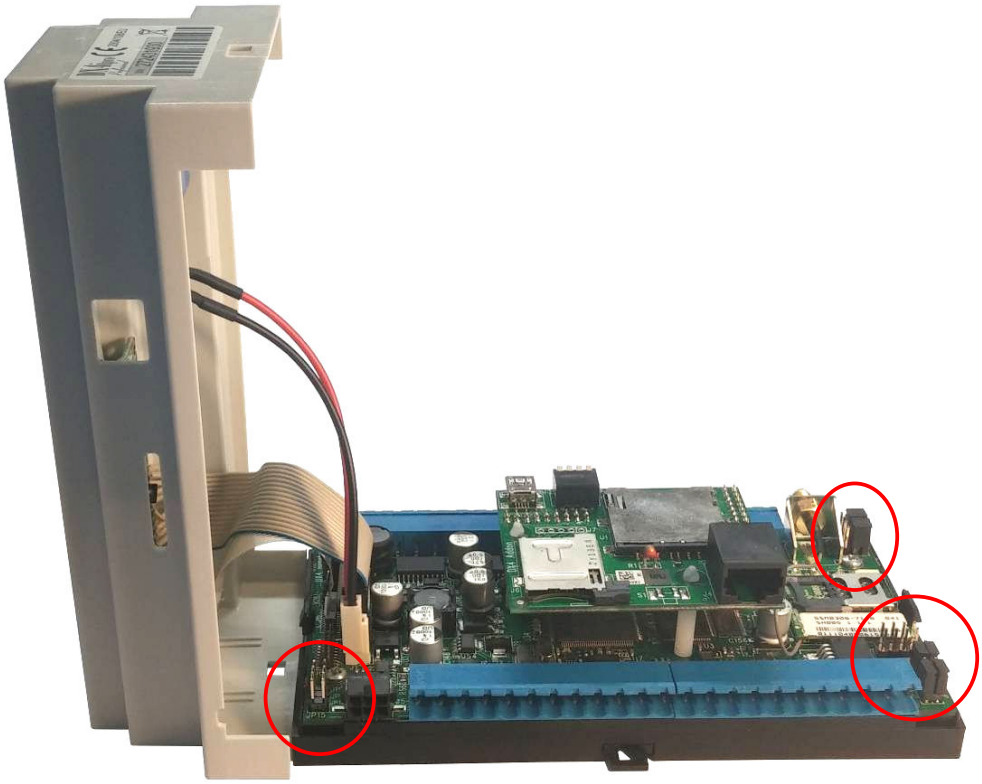
1. Make sure no SD-CARD is inserted. Damage can be caused to the reader if forced open with an SD-CARD inserted.

2. Place a screwdriver or a flat-tipped tool as shown in the picture and lift the screwdriver handle upwards gently to unlock the lid.



3. Lift the lid carefully to the right. Be aware of the cables at the left end do not use force.

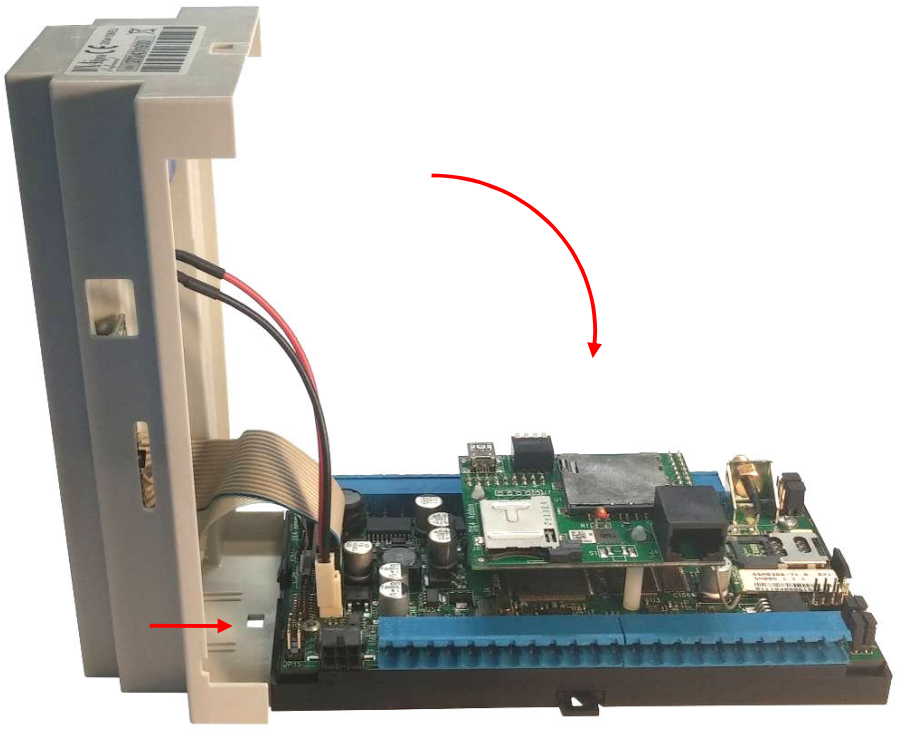
4. Rest the lid as in the following picture. The jumper locations are marked with red circles.



Closing the lid:

1. Begin by placing the left side of the lid onto the tap on the bottom part then close the lid gently.

2. Make sure that the cables, especially the battery cable are placed correctly and not stuck to the add-on board.



3. Push gently on the right side of the lid until you hear a click.

Appendix B – Installing the SIM-Card

The external accessible SIM card reader has a push/push eject system and a mechanical lock for secure installation of the SIM card.

Orientate the card as shown 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 it is placed underneath the enclosure surface. Furthermore, a mechanical slide lock can be used 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.

SIM card orientation.

The internal SIM card reader is located inside the unit on top of the GSM module. The form factor and mechanical design of the reader is securing the SIM card when inserted.

Orientate the card as shown below, and push it into the reader – the card will now stay in position. Please make sure that the power to the GSM module is off during this operation.

NOTE: ***Only one SIM card may be inserted at any given time.***
Do NOT insert a SIM card in both SIM-card readers at the same time.

SIM card orientation

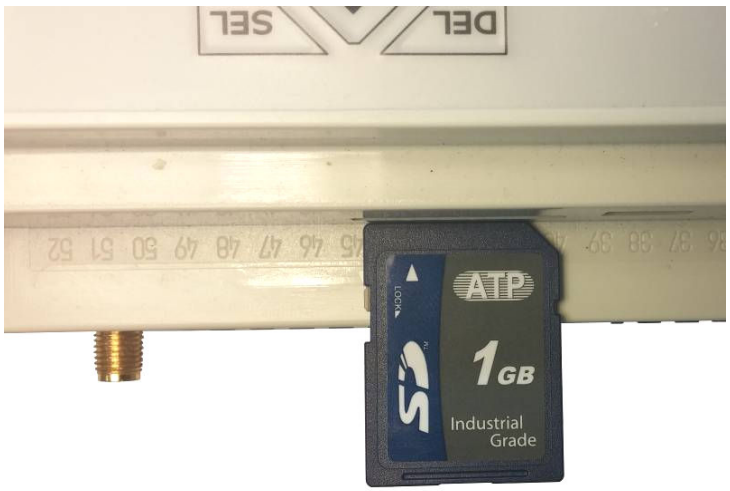
SIM card inserted.

To remove the SIM card, gently lift the left side of the card and push from the right side. The SIM should now be able to slide out of the reader.

SIM card removal

Appendix C – Installing the SD-CARD

To insert a card into the reader, orientate it as shown below and push the card into the reader until a click sound occurs. Remove the card by pushing it into the reader until it clicks and the reader will eject the card. Avoid removing the SD-CARD during access to the card.



SD-Card orientation

RTCU DX4i pro Specifications

Processor and Main-memory
- Powerful 32-bit ST ARM7 processor.
- 1088 KB fast execution RAM.
- 2304 KB Flash for firmware/application.

Storage
- 3.5 MB persistent data flash.
- 4 MB internal FAT32 flash drive.
- 1 MB circular automatic datalogger.
- 8 KB FRAM with fast access / unlimited write endurance.
- SD-CARD reader with up to 32 GB.

GSM
- Quad-band GSM engine. 850/900/1800/1900 MHz.
- GPRS Class B, Multislot 10.
- CSD with up to 19 Kbps.
- SMS / PDU.
- DTMF decoding / transmission.
- Digitized voice playback / IVR.
- Micro-SIM 1.8/3 volt.
- External and internal SIM card-reader.
- Optional Gemalto SIM-on-chip.

User Interaction
- 144x32 pixels graphical/text display. White-on-blue back-lit.
- Keypad with 8 user defined keys.
- Piezo Buzzer for user attention.
- 3 x bi-colour LED.
- Yellow status LED.
- DIP-switches.
- Reset / recovery switch.

Electrical Specification.
- Operating voltage is 8 to 36 VDC.
- Short and reverse power protected.

Battery and Charger
- On-board 2Ah (nominal) Li-Ion battery.
- Intelligent charger with temperature throttle and sub-zero degrees support.
- On-board temperature sensor.

Digital/Analog Interface
- 8 x digital solid-state digital output. Max. 36 volt / 1.5 A per. channel. Short-circuit, ESD, Inductive kick-back protected up to 20 mH.
- 8 x digital inputs. Logic high: 6 to 40 VDC. Logic low: -5 to 3 VDC.
- 4 x IEC62053-31 Class A input.
- Digital input #5 can be used as ignition.
- 4 x analog inputs. Range is 0..10VDC or 0..20 mA Resolution: 12 bit Precision: ±1.5% FSR @ 25°C
- 4 x analog outputs. Range is 0..10VDC or 0..20 mA Resolution: 10 bit Precision: ±1.5% FSR @ 25°C
- Protected against transients and low-pass filtered.
- Expandable I/O with MODBUS.

Communication
- Full CAN2.0B with hardware filtering and multi-speed support.
- 1 x RS232 with control signals.
- 1 x RS485
- 1 x shared RS232 / RS485.
- 1-Wire bus.

Power Management
- 5 execution speeds.
- Wait for Event: Timer, Digital input, RS232, CAN, GSM, power change state.
- Wait for event, from: 600 uA@12V.
- Supervision of supply voltage / type.

External Interfaces.
- SIM-card slot for micro-SIM with lock and presence detection.
- SD-CARD slot with presence and write protect detection.
- Audio out for digitized voice playback.
- LED indicators and DIP switches.
- Reset/recovery switch,
- Two-part pluggable connector for: Power, I/O, RS485, 1Wire. CAN.
- TE-Connectivity "Mate'n'Lock' for: RS232 / DCOUT.
- RJ45 for RS232 (EIA-561)
- SMA Female connector for GSM.
- Mini USB-B as service port.

Physical Characteristics
- Encapsulation: 9 Module M36 DIN-rail.
- Approx. 430 gram without accessories.
- W 157 x H 86 x D 58 mm. (wihout SMA and screw-terminals).

Environmental Specification
- Operating temperature: -30 to 60°C.
- Battery charge temperature: -10 to 45 °C
- Recommended storage temperature: 0 to 45°C.
- Humidity: 5..90% (non condensing).
- Ingress Protection: IP20 .

Approvals
- CE. EU EMC directive 2004/108/EU.
- Applied R&TTE directive.
- GSM engine: CE/GCF/FCC/PTCRB.

Warranty
- Two-years return to factory parts and labor.
- Optional warranty up to 5 years. (restrictions apply).

Technical data are subject to changes.

* * * * END OF DOCUMENT * * * *

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