M2M CONTROL C660

Technical Manual

Version 2.0

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Introduction

This manual contains technical documentation which allows for easy installation and use of the M2M Control C660 unit. For information on the programming and software configuration of the M2M Control C660 please refer to the M2M CONTROL IDE documentation.

The M2M Control C660 adds a new chapter to the highly successful era of the C6xx series offering a wide range of new features and performance improvements while still resting on the proven track record and confidence of the M2M Control C600 series.

The M2M Control C660 uses the next generation NX32 execution model, and is fully backward compatible with the X32 execution model of the former C6xx series. Existing software will therefore be able to operate without any changes or costly re-testing. Mechanically and electrically the C660 is fully back-ward compatible with the C600 and constitutes therefore a direct plug-in replacement.

The M2M Control C660 has been designed from the ground up for professional telemetry / telematics applications and has been designed according to the highest technical standards for professional automotive and industrial use. The product has all necessary regulatory approvals – including 2004/104/EC / UN ECE R10 – edition 3 and CE mark.

The advanced power-management features on the M2M Control C660 combined with the on-board high-capacity Li-Ion battery allows the unit to stay in power-saving mode 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.

For demanding applications the M2M Control C660 offers a 4G LTE Cat.1 cellular communication with fallback to 3G and 2G. The positioning is enhanced with a state-of-the-art GNSS receiver with GPS and GLONASS support.

The M2M Control C660 rests on the **M2M CONTROL Professional Series RTCU Platform** which brings all the necessary tools together to develop, implement and maintain today's sophisticated M2M/IoT applications.

The term "**RTCU"** stands for **R**emote **T**erminal **C**ontrol **U**nit and constitutes a unique combination of a programmable control-unit with the possibility of both digital- and analog I/O plus a GSM modem.

The development task is supported by the **M2M CONTROL IDE development environment**, complimented by a large and comprehensive documentation and application example library.

M2M Control GPRS Gateway 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 **M2M Control Upgrade & Deployment Server**.

The technical highlights of the M2M Control C660:

- Based on the **M2M CONTROL RTCU Platform.**
- **NX32 execution architecture.**
  - M2M CONTROL 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, FMS/J1939, NMP/Garmin FMI.
- High-speed **4G LTE Cat. 1 engine.** Backward compatible with 3G/2G
- Internal and external SIM-card reader selectable from the application.
- Digitized audio can be played over GSM or to an external device.
- **DTMF** support for implementation of Interactive Voice Response applications.
- State-of-the art **Multi-GNSS positioning engine** with GPS,GLONASS,QZSS.
- High-performance **3-axis accelerometer** with 16g scale.
- Enhanced memory sub-system with **fast program execution.**
- Huge data-flash/logger memory with a capacity **of 8.5 MB**.
- Internal **8 MB FAT32 flash drive**.
- Standard FAT32 **SD-CARD** reader with up to 32 GB capacity.
- **2 x RS232** channels and **1 x RS485** channel.
- **2 x analog inputs** with 0..10 volt / **12 bit precision**.
- **5 x digital inputs** and **4 high-power** solid-state **digital outputs**.
- **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**.
- External power can be selectable enabled/disabled by the application.
- On-board **high-capacity Li-Ion battery**.
- Advanced **power-management** with wake-up on a wide range of events.
- **Hands-free interface** with microphone and Class-D audio speaker amplifier.
- High-speed **USB programming cable** support.
- Fully supports the Professional Navigation and Messaging device **PNM-220**.
- Support the **Garmin Fleet Management Interface**.
- Fully supported by the **M2M Control GPRS Gateway** and
  the **M2M Upgrade and Deployment Server**.
- Accessories: Wi-Fi, Ethernet, Bluetooth, Camera and PNM-220 Navigation Device.
- Exclusive and durable **GOLD aluminum** encapsulation.

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Graphical view

External connections

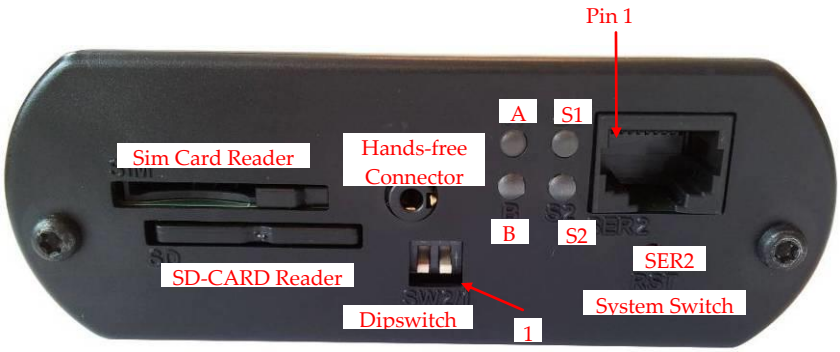
Overview

Connections to external equipment are done via the connectors located on the back and front of the M2M Control C660.

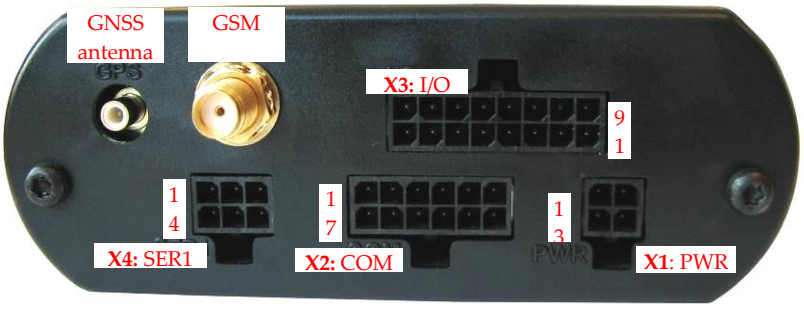
The front panel is equipped with connectors commonly accessed by the user: SIM-Card, SD-CARD, DIP-Switch, Headset, LED's and RS232.

The back panel holds all connectors necessary for installation: 4-pin (X1) power and ignition, 6-pin (X4) for RS232/Programming, 12-pin (X2) for different communication interfaces and a 16-pin (X3) for analog and digital I/O. Connection to the GSM antenna is via a SMA female, and connection to a 3V active GNSS antenna is done via the SMB male connector. Both antenna connectors are located on the back panel.

A graphical overview of the front- and back are shown below:



Front-side view



Back-side view

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 X3)
3	SUPP	Power supply, positive (+) connection
4	PGND	Power Ground

Connector X2: 12 pin COM connector overview

Pin	Name	Description
1	1Wire	1-Wire bus
2	SGND	Signal Ground
3	CAN-H	CAN-bus H-signal
4	Voice	External voice
5	RS485+	RS485 non-inverting signal
6	RS485-	RS485 inverting signal
7	1W-LED	1-Wire ID-Button LED
8	SGND	Signal Ground
9	CAN-L	CAN-bus L-signal
10	SGND	Signal Ground
11	SGND	Signal Ground
12	DC-Out	+3.3V/150mA DC-Out for external equipment. (Shared with X4)

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 X1)
7	AIN 1	Analog input 1
8	AIN 2	Analog input 2
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. (Shared with X2)
4	RD	Receive Data for serial port 1, RS232 compatible
5	SGND	Signal Ground
6	SGND	Signal Ground

Connector 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	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

Accessories 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-H12 TYCO p/n: 1-794617-2	Tyco, Connector house 12 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
Extraction tool:	Tyco 843996-6 extraction tool. RS 495-9704, Farnell 1111477
2.5mm MicroJack	Plug for headset connector. Farnell 5096339 (black plastic house) or Farnell 8045453 (metal house).

Power supply

The M2M Control C660 device must be supplied with 8..36 VDC from an external DC power source connected to the X1 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 to the digital outputs. If the total current consumption on the digital outputs exceeds 5A, then power must be applied to both pins. Otherwise one pin is sufficient.
There are three different labels for the ground connections:

- Power Ground (PGND)
- Signal Ground (SGND)
- 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 C660 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. For avoidance of such a scenario, a fuse can be installed on the positive supply.

The C660 also contains an internal high capacity backup battery which will supply the C660 if the external power supply fails or is disconnected. By default the C660 is powered down when a power fail occurs. This setting, however, can be changed. Please consult the M2M CONTROL IDE on-line help for more information. The display will automatically turn off when external power is removed.

Disabling the external DC power from the application interface and forcing the device to operate on the internal backup battery is supported. Please consult the M2M CONTROL IDE documentation for additional information.

When the ignition input is activated with a logical high, the C660 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 installations, but it is also available on the X3 connector (digital I/O and analog Inputs) - only one should be used at a 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 X3)
3	SUPP	Power supply, positive (+) connection
4	PGND	Power Ground

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 C660 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 through the X1 power connector that also supplies the rest of the C660 unit. As the power is also the M2M Control C660 main power, a power-fail would also affect the digital outputs.

The C660 unit offers very advanced power management which makes it possible to have one or more outputs enabled while the C660 is in low-power mode. Please consult the M2M CONTROL IDE on-line help for more information.

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

Specification for each digital output

Type	Max.	Unit	
Solid state	36	VDC	Short-circuit, ESD,
	1.5	A	Inductive kick-back protected up to 20mH.

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 must be used for supply.

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 C660 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 X1 power connector and the X3 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 M2M CONTROL IDE documentation for additional 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	DIN5/IGN	Digital input 5 / Ignition input. (Shared with X1)
4	SGND	Signal Ground
10	SGND	Signal Ground
14	SGND	Signal Ground

Specification for each digital input

	Min.	Typ.	Max.	Unit	
Logic “High”	8	12	40	VDC	Protected against transients and low-pass filtered
Logic “Low”	-5	-	3	VDC	
Cut-off frequency	-	450	-	kHz	
Input impedance	-	14	-	kΩ	

Analog Inputs

There are two analog inputs available on the unit.
The analog inputs are voltage inputs specified with an operating range of 0V to 10V DC. The conversion resolution is 12 bit +/- 1.5% FSR @ 25 degrees ˚C.

By default the analog voltage is 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 M2M CONTROL IDE documentation 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.

The inputs are low-pass filtered, ESD- and transient protected.

X3: 16 pin I/O connector overview

Pin	Name	Description
7	AIN 1	Analog input 1
8	AIN 2	Analog input 2
15	AGND	Analog Ground
16	AGND	Analog Ground

Specification for each analog input

	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 measurements
Cut-off frequency	-	4.5	-	kHz	@ 25 ˚C
Input impedance	-	40	-	kΩ	

RS232 port 1 / programming port

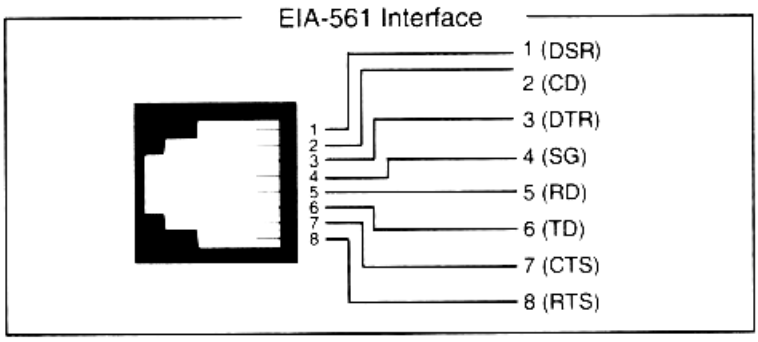
This port can be used as general-purpose RS232 serial port or as a programming port. In order to use the port for programming, the RS-DET pin must be connected to GND. When using the port as general-purpose RS232, the RS-DET pin must be left unconnected.

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

RS232 port 2

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



The signals are available on the RJ-45 connector located on the front panel of the C660.

Connector SER2: RJ-45 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	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

RS485 is available on the X2 connector as serial port 1. The RS485 bus 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 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 speed it might be necessary to terminate the transmission line with a 120[1] ohm resistor between terminal RS485+ and terminal RS485- at each end of the wires to avoid signal reflections etc.

X2: 12 pin COM connector overview

Pin	Name	Description
5	RS485+	RS485 non-inverting signal (A)
6	RS485-	RS485 inverting signal (B)
11	SGND	Signal Ground

[1] Assuming use of a CAT5 twisted pair cable

CAN

The M2M Control C660 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 M2M CONTROL 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 C660 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.

Be aware that connecting the C660 to a CAN network can be dangerous. If the C660 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 *disabled* and may be enabled by installing hardware jumper JP901[2] inside the unit.

A wide range of software functions is available for easy access to the network. Please consult the M2M CONTROL IDE documentation for further information.

X2: 12 pin COM connector overview

Pin	Name	Description
3	CAN-H	CAN-bus H-signal
9	CAN-L	CAN-bus L-signal
8	SGND	Signal Ground

[1] Assuming use of a CAT5 twisted pair cable
[2] Please refer to appendix C regarding location.

1-Wire bus

The 1-Wire bus is available on the X2 connector. 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 M2M CONTROL IDE documentation for further information.

X2: 12 pin COM connector overview

Pin	Name	Description
1	1Wire	1-Wire bus
7	1W-LED	1-Wire ID-Button LED
2	SGND	Signal Ground

Specification of the 1-Wire bus:

	Max.	Unit
Total weight1	65	m

DC-Out

A 3.3V DC output is available on the X2 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 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 M2M CONTROL IDE on-line manual for more information.

X2: 12 pin COM connector overview

Pin	Name	Description
12	DC-Out	+3.3V/150mA DC-Out for external equipment. (Shared with 6 pin connector)
11	SGND	Signal Ground

Hands-free connector

The C660 unit has a 4-pole 2.5mm jack connector for connecting a hands-free set to the built-in GSM modem. The speaker output is amplified through the internal Class-D amplifier and is a differential (balanced) signal. A loudspeaker of 4/8 Ω can be connected directly to the speaker output. The microphone input is differential in order to minimize GSM (TDMA) noise. An audio line transformer must be used to convert the signal to a single ended signal, when connected to external equipment that does not have a differential (balanced) input. Otherwise the GSM noise will not be suppressed / cancelled, and will pass through all the way to the loudspeaker.

The microphone signal is biased internal for active microphones.

4 pin headset connector overview

Pin	Name	Description
1	Mic +	Microphone positive Input
2	SPK +	Speaker positive output
3	Mic -	Microphone negative input
4	SPK -	Speaker negative output

Microphone characteristics

Parameter	Min.	Typ.	Max.	Unit
Working voltage	1.65	1.8	1.95	V
Working current	20		1000	µA

Speaker characteristics

Parameter	Min.	Typ.	Max.	Unit
Working voltage	3.5	3.8	4.2	V
Output power (THD+N=10%)	0.83		2.05	W

Please consult the M2M CONTROL IDE documentation for more information on using the Hands-free interface.

External voice output

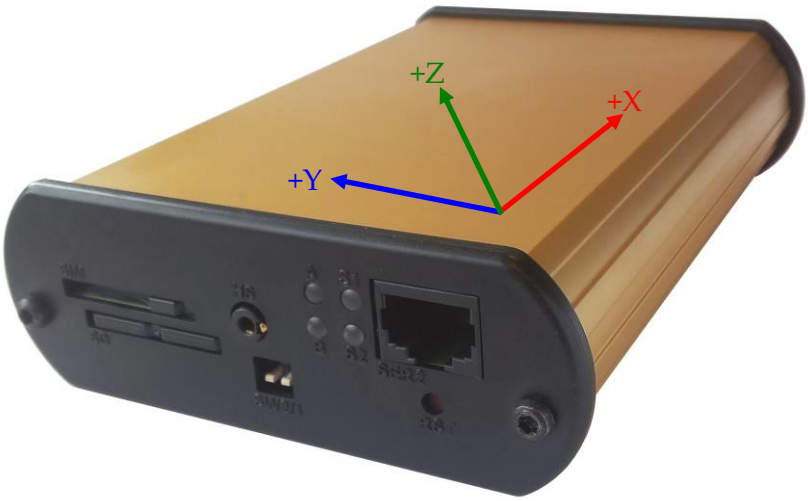
A voice audio output is available on X2 connector. Digitized audio can be played through this output by the application interface. Please consult the M2M CONTROL IDE documentation for more information about enabling the xVoice output, and playing digitized voice messages.

The output is at line-out level (3Vpeak-peak), and internally shared with GSM voice line.

3D movement sensor

The M2M Control C660 unit contains a 3-axis accelerometer in order to detect both vibration and motion. It makes it possible to detect movement and position change in 3 directions, X-Y-Z with a force as high as 16g. The simplest use is with the power management detecting when the vehicle is moved, and the most advanced analytical applications such as driving behavior / eco driving. Please consult the M2M CONTROL IDE documentation for more detailed information.

The positions of the 3-axis is as following:



Specification

		Unit	
Resolution	±16	g	The acceleration can be set as relative to motion,
Precision	12	bit	or relative to earth gravity

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 C660 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 M2M CONTROL IDE documentation for more information.

System LED S1 and S2

The C660 is equipped with two system LED's which shows the status and possible errors of the C660 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 M2M CONTROL 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 C660 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 Fehler! Textmarke nicht definiert.	The unit is executing the application program
1.5s On / 0.5s Off. green Fehler! Textmarke nicht definiert.	The unit is executing the application program, while charging the internal back-up battery.
Fast blinking, red Fehler! Textmarke nicht definiert.	A runtime error has been detected in the program. Use the M2M CONTROL IDE to obtain the fault log.
Alternating Fast/Slow, red Fehler! Textmarke nicht definiert.	The unit has lost its firmware! This can only happen if, during a firmware upgrade, the C660 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 LTE/UMTS/GSM session is active.
Flashing	Indicates LTE/UMTS/GPRS data transfer.
On	A voice or CSD session is active.
8 s OFF / 10 ms ON (and all other LED's OFF)	The C660 unit is in low-power "Wait For Event" state.

[1] Or yellow when communicating with the M2M CONTROL IDE or another program, supporting the RTCU RACP protocol).

Switches

DIP-switch

The M2M Control C660 unit contains a dipswitch with two switches. The dipswitch is located on the front panel for easy user access (see the graphical view).

System switch (RST)

The M2M Control C660 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 C660 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 M2M Control GPRS 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 C660 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 M2M CONTROL IDE documentation.

The digital 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 C660 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 C660 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 C660 unit may cause the built-in battery security circuit to be damaged.

- *Do not place the C660 unit in high temperature locations such as in direct sunlight or near engines. Using the C660 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 M2M Control C660 ” below.

Internal / External SIM-card readers

The M2M Control C660 unit contains both an internal and an external standard SIM card reader.

The external reader is located on the front panel (please see the graphical view) and is easily accessed. The internal reader is located on the top side of the base-board. It is possible to install SIM-card in both readers at the same time and switch programmatically between them from the application. The M2M Control C660 is also prepared for an M2M-chip internally, which shares the SIM-card signals with the internal SIM-reader. Please contact to M2M Control for information on this option.

Installing the external SIM-card

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 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

Installing the internal SIM-card

The internal SIM-card reader is located internally on the top-side of the base-board. The reader does not have a mechanical detection, or lock status pins.

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

Please refer to Appendix B for detailed description of installing the internal SIM-card.

SD-CARD reader

The M2M Control C660 unit has a standard SD-CARD reader with a FAT32 file-system support for standard PC-compatibility, with up to 32 GB capacity support.

The SD-CARD reader features a Push/Push eject system for reliable insertion and operation.

Approved SD-CARDs

To ensure the highest performance and compatibility it is important to use SD-CARDs that has been approved and tested by M2M Control.

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.

M2M Control 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	Industrial 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**

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.

Please consult the M2M CONTROL IDE documentation for more information.

SD-CARD orientation

Antennas

Cellular

The M2M Control C660 contains an SMA female connector for connecting a suitable LTE/UMTS/GSM band antenna. 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.

GNSS

The M2M Control C660 supports GPS, GLONASS and QZSS so a suitable GNSS antenna must therefore be used. The connection is with an SMB Male connector and the GNSS antenna must be a 3V active antenna 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 antenna.

Device identification label

The barcode found on the C660 unit contains the serial number. The first three digits in the serial-number identify the unit type. For the M2M Control C660 this unique code is **288** .

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

Power consumption

Detailed information on the maximum power consumption of the C660 unit in different states and at different supply voltages is listed below.

Maximum power consumption: Unit running on external supply

	8V	12V	30V		
Unit Active	70	45	20	mA	
Unit Active with GSM On	80	55	22	mA	GSM idle @ -63dBm
Unit active with GPS On	100	65	26	mA	
Unit Active with GSM/GPS On	110	75	30	mA	GSM idle @ -63dBm
Unit Active while charging	950	650	300	mA	
Unit in power-down	0.4	0.3	0.2	mA	Restart on DI5, RTC
Unit in "wait for event"	0.4	0.3	0.2	mA	Resume on DI, Vibration, RTC
Unit in "wait for event"	9	6	3	mA	Resume on CAN
Unit in "wait for event"	9	6	3	mA	Resume on RS232 port 1
Unit in "wait for event"	10	7	4	mA	Resume on RS232 port 2
Unit in "wait for event"	25	16	7	mA	Resume on GSM activity

Note: Measured at TA = 25 ˚C

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

	Battery		
Unit Active	100	mA	
Unit Active with GSM On	130	mA	GSM idle @ -63dBm
Unit active with GPS On	140	mA	
Unit Active with GSM/GPS On	180	mA	GSM idle @ -63dBm
Unit in power-down	0.7	mA	Restart on DI5, RTC
Unit in "wait for event"	0.7	mA	Resume on DI, Vibration, RTC
Unit in "wait for event"	12	mA	Resume on CAN
Unit in "wait for event"	12	mA	Resume on RS232 port 1
Unit in "wait for event"	13	mA	Resume on RS232 port 2
Unit in "wait for event"	35	mA	Resume on GSM activity

Note: Power consumption from a 80% charged battery at TA = 25 ˚C

Specification for the 99-channels multi-GNSS receiver

	MediaTek MT3333 Single Chip Super Sensitivity	
General:	99 acquisition / 33 tracking / up to 210 PRN channels. Multi GNSS engine for GPS, GLONASS and QZSS Support DGPS, SBAS(WAAS,EGNOS,MSAS,GAGAN). A-GPS capable. Anti-jamming, Multi-tone Active Interface Canceller.	
Update Rate:	NMEA @ up-to 4 Hz	
Accuracy:	Position	<2.5m CEP
	Velocity	<0.1m/s
	DGPS/SBAS	<2.5m CEP[1]
Sensitivity:	Tracking/navigation	-165 dBm
	Reacquisition	-160 dBm
	Cold Start (Autonomous)	-148 dBm
	(GPS chipset reference parameters)	
Time-To-First-Fix[2]:	Autonomous Operation in Standard Sensitivity Mode	
	Reacquisition[3]	< 1 sec.
	Hot Start[4]	< 1 sec.
	Aided start[5]	< 3 sec.
	Warm start[6]	< 30 sec.
	Cold start[7]	< 35 sec.
Interface protocol:	NMEA 0183 v3.01 with GGA, VTG, GLL, GSA, GSV and RMC.	

[1] Depends on accuracy of correction data provided by the SBAS service.
[2] All satellites at -130 dBm.
3 Time to get a fix when signal has been blocked for a short period of time.
4 The GPS has been powered down for less than 2 hours and the stored position and time are valid.
[5] The GPS has valid A-GPS information. A-GPS is currently unsupported in the standard firmware.
[6] The GPS has been powered down for more than one hour, but has stored information about its current position and time.
[7] The GPS has no valid navigation data.

Appendix A – Assembling/disassembling of the unit

The CAN write enable jumper and a SIM-card reader are located inside of the unit. In order to gain access to these interfaces, it is necessary to remove the internal board from the aluminum encapsulation. The following steps describe the process.

ATTENTION: The device internal electronics are sensitive to Electro Static Discharge (ESD), and must be handled only in an ESD safe environment.
Avoid touching the electronics components and parts.

1. Remove the back-panel. Use a Torx TX10 screwdriver to remove the two screws.

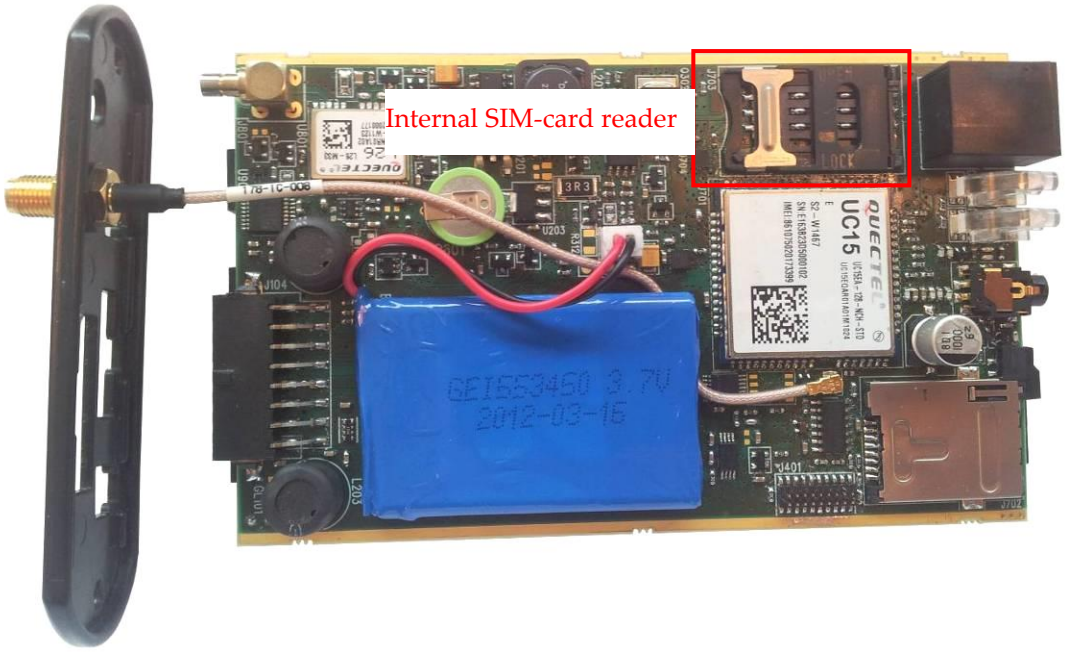
2. Gently pull out (not all the way) the electronic board so it is exposed.
   Hint: Use a finger to push on the RJ45 connector on the opposite end.

For assembling please follow the above steps backwards. In any case DO NOT USE FORCE.
If difficulty is experienced, it is because the light-pipes on the opposite end has moved a bit, when the electronic board was removed, and it may be necessary to loosen the front end-panel a bit to make them fit in the holes again.

Be careful not to tighten the screws too much thereby damaging the aluminum.

Appendix B – Installing a SIM-card into the internal SIM-card reader

To get access to the internal SIM-card reader it is necessary to disassembly the device as described in Appendix A.

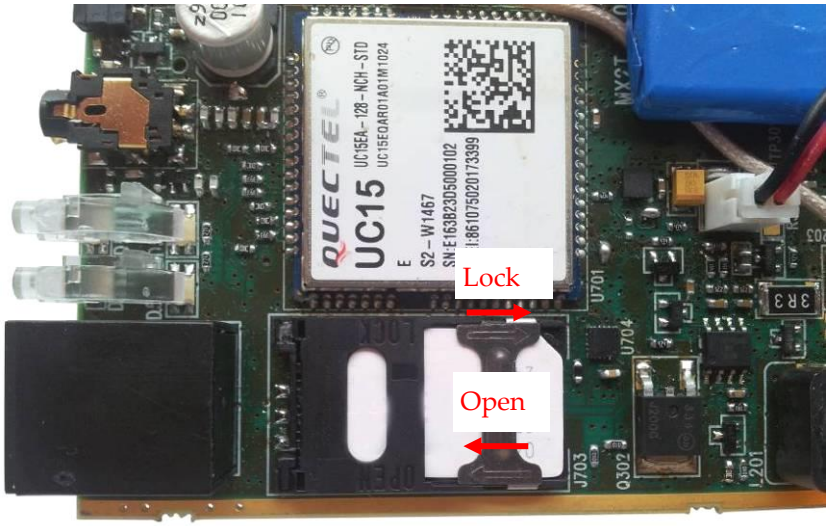


The SIM card reader is a lid based type with a mechanical lock to secure a safe installation.

1. Open the hinged lid of the reader and orientate the SIM- card as shown below.
2. Insert the SIM-card into the lid of the card reader.
3. Close the lid and slide the metal locking mechanism to the locked position.
4. Assemble the unit again.

To remove the card slide the metal locking mechanism to the unlocked position as shown with an arrow and text on the lid, and open the lid. The SIM-card can now be removed.

SIM card orientation



SIM inserted and locked

Appendix C – Enabling the CAN bus Write capability

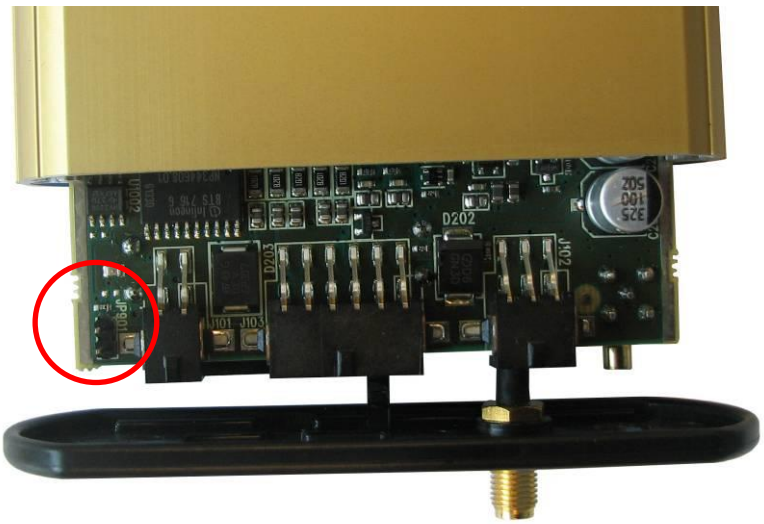
Connecting the C660 to a CAN network can be dangerous. If the C660 is not configured with the correct network parameters, it can lead to network corruption and may interfere with other connected equipment on the bus. Especially in vehicles great precautions must be observed to prevent interruption of the communication.

By default reading from the CAN bus is enabled and writing to the CAN bus is disabled.

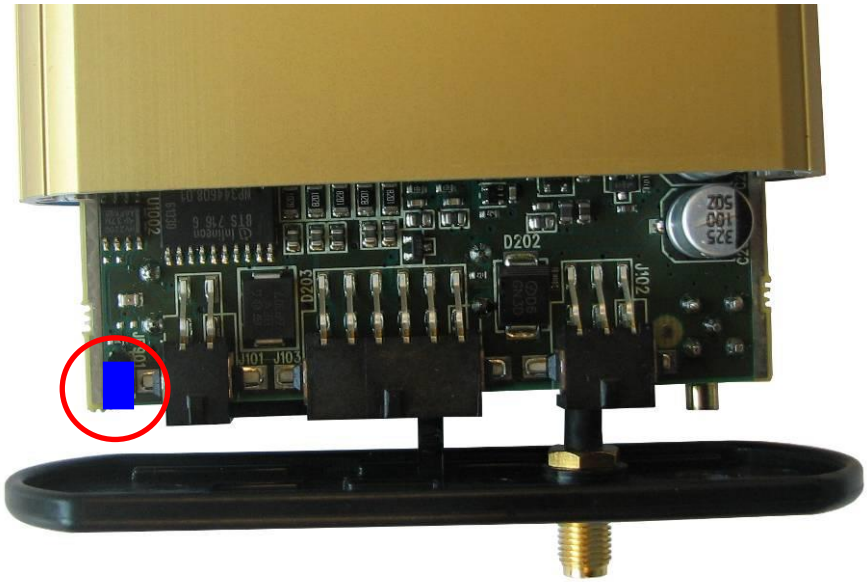
Installing jumper JP901, and thereby enabling the CAN-bus Write capability of the unit, is done on the sole responsibility of the user. M2M Control can not be held responsible for any problems, or damage due to the decision to enable the CAN-bus Write capability.

The following steps must be taken to enable the CAN bus Write capability of the unit:

1. Disassemble the unit as described in the Appendix A



2. The jumper is located near the back panel as shown in the picture above.



3. Install the jumper as shown above
4. Mount the end-panel and secure it with the screws.

M2M Control C660 Specifications

Processor and Main-memory
- Powerful 32-bit ST ARM processor.
- 2112 KB fast execution RAM.
- 4532 KB Flash for firmware/application.
- Real-Time clock with battery backup

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

LTE / UMTS / GSM
- LTE Cat. 1 (EMEA).
- UMTS / /EDGE / GPRS / Quad-band GSM.
- SMS / PDU.
- DTMF decoding / transmission.
- Digitized voice playback / IVR.
- eCall prepared.
- Micro-SIM 1.8/3 volt.
- External and internal SIM card-reader. Switchable from the application.

GNSS / GPS
- Mediatek MT3333 Multi-GNSS chip.
- GPS, GLONASS and QZSS.
- 99 acquisition / 33 tracking channels.
- SBAS (WAAS,EGNOS,MSAS,GAGAN).
- Position update with up to 4 hz.
- A-GPS capable.
- Sensitivity.
  Tracking: -165 dBm
  Reacquisition: -160 dBm
  Cold start: -148 dBm.
- Accuracy: < 2.5m CEP.
- Anti-jamming, Noise cancellation.
- Active 3 volt GNSS antenna.

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
- 4 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.
- 5 x digital inputs.
  Logic high: 8 to 40 VDC.
  Logic low: -5 to 3 VDC.
- Digital input #5 can be used as ignition.
- 2 x analog inputs.
  Range is 0..10V.
  Resolution: 12 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 RS232 with RX/TX.
  Alternatively used as service port.
- 1 x RS485 with MODBUS support.
- 1-Wire bus.

Power Management
- 5 execution speeds.
- Wait for Event: Timer, Digital input, RS232, CAN, GSM, Accelerometer and power change state.
- Wait for event, from: 300 uA@12V.
- Supervision of supply voltage.
- Disable external power.

Accelerometer
- 3-axis digital acceleormeter.
- Resolution: 12 bit @ ±16g.
- Low-power mode.

External Interfaces.
- SIM-card slot for micro-SIM with lock and presence detection.
- SD-CARD slot with presence and write protect detection.
- Micro-jack 2.5" connector for hands-free.
- Audio out for digitized voice playback.
- 4 x LED indicators and 2 x DIP switches.
- Reset/recovery switch,
- TE-Connectivity "Mate'n'Lock':
  RS232, I/O, Power, Communicaton.
- RJ45 for RS232 with full control signals.
- SMA Female connector for GSM.
- SMB Female connector for GNSS/GPS.

Physical Characteristics
- Encapsulation: Aluminum/plastic.
- Optional mounting bracket.
- Approx. 300 gram without accessories.
- W 97 x H 35 x D 132 mm.
  (without antenna connectors).

Environmental Specification
- Operating temperature: -35 to 60°C.
- Battery charge temperature:
  -10 to 45 °C
- Recommended storage temperature:
  0 to 45°C.
- Humidity: 5..90% (non condensing).

Approvals
- E1 type approval:
  2004/104/EC UN ECE R10 - ed 3.
- RE Directive, RED 2014/53/EU.
- Cellular engine: CE/GCF/FCC/PTCRB.

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

Note: Some features are currently under development.

Technical data are subject to changes.

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