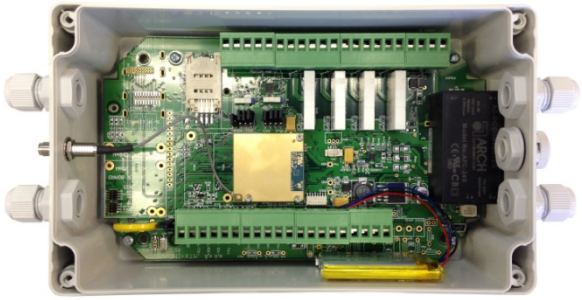
MTX-IND Family

User Manual



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Important information

This technical description contains important information for the start up and use of the MTX-IND modems.

Read it carefully before you start working with the MTX-IND modems.

The warranty will be void should damage occur due to non-compliance with these instructions for use.

We cannot accept any responsibility for consequential loss.

Service and Support

To contact customer support please use the contact details below:

Matrix Electrónica
Alejandro Sánchez, 109
28019 Madrid (SPAIN)
gsmsupport@matrix.es

Information about MTX-IND-2G product and accessories is available on the following web site:

www.mtxm2m.com

Or contact your local distributor / sales agent.

Revision information

Revision	Date	Author	Changes

1.0	2012/03	JS	First edition
1.1	2012/07	JS	Fixed errata
2.0	2014/11	AEM/TP	New document format and general revision. Language revision
2.1	2015/05	AEM	Minor revision
2.2	2015/10	AEM	Minor revision
2.3	2016/08	JLA	Fixed errata
2.4	2017/12	JALL	Relays works now on completed DC input voltage range. Label with HR: 2.0417 or higher

Index

1. Introduction

1.1 Description

The MTX-IND modems family is an innovative and powerful all-in-one solution enabling GSM, SMS, fax and 2G/3G (GPRS&UMTS/HSPA) data transmission. It has an intrinsic TCP/IP communication stack with Internet Services such as TCP, UDP, HTTP, FTP, SMTP, and POP3.

The MTX-IND is the perfect choice for applications that are installed outdoors and need a mains AC power supply to control high loads and communicate with RS232/RS485/RS422 serial buses.

The MTX-IND is Java J2ME programmable and can host and control your wireless applications. This allows you to develop and embed your code directly inside the modem, minimizing the need for extra hardware components, shortening time to market and reducing costs. Alternatively, it can be used as a powerful standalone GPRS modem with its intrinsic TCP/IP stack.

The MTX-IND also has a complete set of interfaces (2xRS232/RS485/RS422, USB, I2C, SPI, optoisolated IOs, 4x 1P1C Relays, Analog-to-Digital converters, etc). It also has a wide range of options (depending on the model) which allow it to be used in infinite M2M applications:

- **GNSS module inside**: GPS and GLONASS receiver modules allow track & location applications. The GLONASS feature must be ordered as an option
- **RF card**: allows for the easy development of RF gateways (Wavenis, WiFi, Bluetooth, ZigBee, ISM 868/915)
- Internal **Li-Po battery**

The MTX-IND family contains industrial features: the modem can be used in industrial environments due to its extended operating temperature range and its waterproof IP65 enclosure. It also features an automatic restart after shutdown in case of power glitches or faulty conditions.

The MTX-IND is a self contained modem with its own SIM card holder, USB 2.0 High Speed and RS232/485/422 interfaces (among others), minimizing the need for further hardware development. This modem can be used as a powerful and flexible device that can be integrated in a wide range of telemetry applications that rely on the remote exchange of data, SMS or faxes via the GSM cellular network.

With quad-band 900/1800MHz and 850/1900MHz, your applications can be deployed all over the world.

The MTX-IND modems can also be controlled via AT commands and standard interfaces such us USB 2.0 High Speed or RS232 with Linux and Windows® drivers.

The MTX-IND family is RoHS & WEEE compliant and it is manufactured following the ISO 9001 & IS0 14001 Quality certifications.

A full list of antennas, cables and accessory supplies are available.

The MTX-IND-2G modems are powered by an internal Cinterion® TC65i module
The MTX-IND-3G modems are powered by an internal Cinterion® EHS6 module

1.2 Ordering information

199801329: MTX-IND-2G
GSM/GPRS, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801355: MTX-IND-2G-BT-WT12
GSM/GPRS, Bluetooth 2.1, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801356: MTX-IND-2G-BLE
GSM/GPRS, Bluetooth Low Energy (4.0), Li-Po battery, 1xRS232, USB, I2C, 2xADC, 1xGPIO, 6xOptoIO, Accelerometer, Sleep mode, Hardware Watchdog

199801321: MTX-IND-2G-GPS
GSM/GPRS, GPS, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801117: MTX-IND-2G-WC25
GSM/GPRS, Wavecard 25mW, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801121: MTX-IND-2G-WC500
GSM/GPRS, Wavecard 500mW, Li-Po battery, USB, I2C, SPI, 4xRelays 2xRS232/RS485/RS422, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

TBD: MTX-IND-2G-WC25
GSM/GPRS, Wavecard 25mW, 1xRS232/RS485/RS422

TBD: MTX-IND-2G-WC500
GSM/GPRS, Wavecard 500mW, 1xRS232/RS485/RS422

199801358: MTX-IND-3G
UMTS/HSPA, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801361: MTX-IND-3G-BT-WT12
UMTS/HSPA, Bluetooth 2.1, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801362: MTX-IND-3G-BLE
UMTS/HSPA, Bluetooth Low Energy (4.0), Li-Po battery, 1xRS232, USB, I2C, 2xADC, 1xGPIO, 6xOptoIO, Accelerometer, Sleep mode, Hardware Watchdog

199801363: MTX-IND-3G-GPS
UMTS/HSPA, GPS, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801359: MTX-IND-3G-WC25
UMTS/HSPA, Wavecard 25mW, Li-Po battery, 2xRS232/RS485/RS422, USB, I2C, SPI, 4xRelays, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

199801360: MTX-IND-3G-WC500
UMTS/HSPA, Wavecard 500mW, Li-Po battery, USB, I2C, SPI, 4xRelays 2xRS232/RS485/RS422, 4xOptoisolated inputs, 2xOptoisolated outputs/GPIO 2xADC

TBD: MTX-IND-3G-WC25
UMTS/HSPA, Wavecard 25mW, 1xRS232/RS485/RS422

TBD: MTX-IND-3G-WC500
UMTS/HSPA, Wavecard 500mW, 1xRS232/RS485/RS422

1.3 Features by model

	MTX-IND-2G	MTX-IND-2G-WC25	MTX-IND-2G-WC500	MTX-IND-2G-WC25-LC	MTX-IND-2G-WC500-LC	MTX-IND-2G-BT-WT12	MTX-IND-2G-BLE	MTX-IND-2G-GPS	MTX-IND-3G	MTX-IND-3G-WC25	MTX-IND-3G-WC500	MTX-IND-3G-WC25-LC	MTX-IND-3G-WC500-LC	MTX-IND-3G-BT-WT12	MTX-IND-3G-BLE	MTX-IND-3G-GPS
RS232/485/422	x2	x2	x2	x1	x1	x2	x2	x2	x2	x2	x2	x2	x1	x1	x2	x2	x2
USB	X	X	X			X	X	X	X	X	X			X	X	X
I2C/SPI	*1	*1	*1			*1	*1	*1	*1	*1	*1			*1	*1	*1
ADC	x2	x2	x2			x2	x2	x2	x2	x2	x2			x2	x2	x2
DAC	x1	x1	x1			x1	x1	x1	x1	x1	x1			x1	x1	x1
Optoisolated IO	x6	x6	x6			x6	x6	x6	x6	x6	x6			x6	x6	x6
Relay	x4	x4	x4			x4	x4	x4	x4	x4	x4			x4	x4	x4
Coronis/Wavenis Wavecard		X	X	X	X					X	X	X	X			
Bluetooth 2.1						X								X		
Bluetooth 4.0 Low Energy							X								X	
GPS								X								X
Internal RF socket expansion	X								X							
Li-Po Battery	X	X	X			X	X	X	X	X	X			X	X	X

1.4 Highlights

Interfaces

- GSM SMA F antenna connector
- Optional internal 5 band 2.5dBi antenna upon request
- GPS SMA F antenna connector (*)
- USB 2.0 High Speed port up to 480Mbps (*)
- SIM card interface 1.8V and 3V
- Plug-in 52-way (45 usable) 5mm pitch modem block:
    - 2x optoisolated inputs/outputs
    - 4x optoisolated inputs
    - 2x analog inputs
    - 1x analog output (PWM)
    - 1x I2C/SPI bus (*)
    - 2x RS232/RS422/RS485 configurable ports (*)
    - 4x form C switching contact relays (*)
    - Speaker and microphone signals available (not amplified)
- Operating status LEDs
- 4x IP68 cable glands
- Internal RF module (*)

General features (2G models)

- Quad band GSM/GPRS/EDGE 850/900/1800/1900MHz
- GPRS multislot class 12
- GSM release 99
- Output power:
    - Class 4 (2W) for EGSM850 & EGSM900
    - Class 1 (1W) for GSM1800 & GSM1900
- SIM Application Toolkit, 3GPP release 99
- Control via AT commands (Hayes, 3GPP TS 27.007, TS 27.005)
- TCP/IP stack access via AT commands
- Internet services: TCP, UDP, HTTP, FTP, SMTP, POP3
- Supply voltage range:
    - DC: 9 to 30VDC (typ. 24VDC)
    - AC: 90-264VAC/120-370VDC (typ. 230 VAC)
- Power consumption at 12V (average)
    - Idle mode (registered DRX=2): 17mA
    - Sleep mode: 7mA
    - GPRS class 12: 570mA
- Operating temperature range: -30ºC to +85ºC
- Dimensions, excluding connectors: 200 x 120 x 77mm
- Weight: < 500 g
- Powered by Cinterion TC65i module
- Internal 1650mAh Li-Po battery (*)

General features (3G models)

- World Wide Version (default)
  - UMTS/HSPA+: Five-Band 800/850/900/1900/2100MHz
  - GSM/GPRS/EDGE: Quad band 850/900/1800/1900MHz
- European Version
  - UMTS/HSPA+: Dual-Band 900/2100MHz
  - GSM/GPRS/EDGE: Dual band 900/1800MHz
- American Version
  - UMTS/HSPA+: Dual-Band 850/1900MHz
  - GSM/GPRS/EDGE: Dual band 850/1900MHz
- 3GPP Release 6, 7
- SIM Application Toolkit, 3GPP release 99
- Control via AT commands (Hayes, TS 27.007, TS 27.005)
- TCP/IP stack access via AT commands
- Internet services: TCP, UDP, HTTP, FTP, SMTP, POP3
- Power consumption at 12V (average)
  - Idle: 12mA
  - Sleep mode: 7mA
  - HSPA data transfer: 152mA
- Temperature range
  - Operating: -30ºC to +85ºC
- Dimensions, excluding connectors: 200 x 120 x 77mm
- Weight: < 500 g
- Powered by Cinterion EHS6 module
- Internal 1650mAh Li-Po battery (*)

Drivers

- USB, MUX driver for Microsoft® Windows XP™, Vista™, Windows 7™
- RIL, USB driver for Microsoft® Windows Embedded Handheld™ >= 6.x
- USB, MUX driver for Microsoft® Windows Embedded Compact™ >= 5.x
- USB serial/CDC-ACM driver for Linux

Specifications (2G models)

- GPRS data transmission
  - GPRS class 12
  - Mobile station class B
  - PBCCH support
  - Coding schemes CS 1-4
- CSD data transmission
  - Up to 14.4kbps
  - V.110
  - Non-transparent mode
  - USSD support

- Voice features
  - Triple-rate codec for HR, FR and EFR
  - Adaptive multirate AMR
  - Basic hands-free operation
  - Echo cancellation
  - Noise reduction
- SMS
  - Point-to-point MO and MT
  - SMS cell broadcast
  - Text and PDU mode

Specifications (3G models)

- HSPA (3GPP Release 6,7)
  - DL 7.2Mbps, UL 5.7Mbps
  - HSDPA Cat.8 / HSUPA Cat.6 data rates
  - Compressed mode (CM) according to 3GPP TS25.212
- UMTS (3GPP Release 4)
  - PS data rate – 384 kbps DL, UL 384kbps
  - CS data rate – 64 kbps DL, UL 64kbps
- HSPA (3GPP Release 6,7)
  - DL 7.2Mbps, UL 5.7Mbps
  - HSDPA Cat.8 / HSUPA Cat.6 data rates
- GPRS
  - GPRS class 12
  - Mobile station class B
  - PBCCH support
  - Coding schemes CS 1-4
- EGPRS
  - Multislot class 12
  - EDGE E2 power class for 8PSK
- CSD data transmission
  - Up to 9.6kbps
  - V.110
  - Non-transparent mode
  - USSD support
- SMS
  - Point-to-point MO and MT
  - SMS cell broadcast
  - Text and PDU mode
- Fax
- Group 3, class 1,2

Java™ features (2G models)

- JavaTM profile IMP-NG & CLDC 1.1 HI, GPS support
- Multi-threading programming and program execution
- Memory space for Java applications: 1.7MB RAM & 8MB Flash

Java™ features (3G models)

- Oracle Java ME Embedded 3.2
- Compliant to CLDC 1.1 HI and IMP-NG standards
- Capable of running multiple MIDlets in parallel with inter-MIDlet communication
- Additional Java standards APIs:
  - JSR75 (FileConnection)
  - JSR177 (CRYPTO)
  - JSR280 (XML)
- Additional accessible periphery for Java applications
  - I/O pins, I2C, ADC/DAC
  - Serial interfaces (API): ASC0, ASC1, USB
- Memory space for Java applications
  - Flash File System: 8MB
  - RAM: 6MB
  - Just-in-Time (JIT) Compiler execution optimization

Special features (2G models)

- Secure data transmission with HTTPS, SSL and PKI
- Serial interface modem for Microsoft® 7™/XP™/Vista™
- RLS Monitoring (Jamming detection)
- Firmware update via USB/RS232
- Integrated Firmware Update Over The Air (FOTA), configurable and royalty free
- TLS for IP over AT
- Tunneling mode for external serial devices
- Real time clock with alarm functionality
- Informal Network Scan

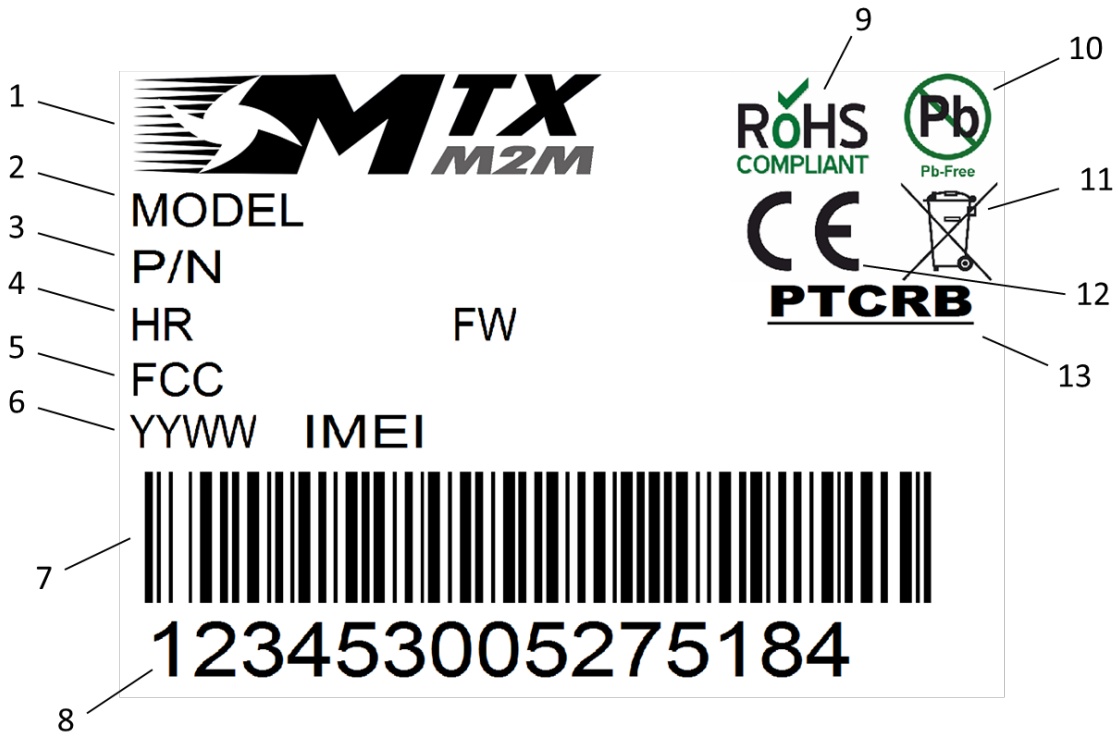
Special features (3G models)

- USB interfaces support multiple composite modes and a Linux -/Mac- compliant mode
- Firmware update via USB/RS232
- Real time clock with alarm functionality
- Multiplexer according 3GPP TS 27.010
- RLS Monitoring (Jamming detection)
- Informal Network Scan
- Customer IMEI/SIM-Lock as variant
- Integrated FOTA, configurable and royalty free

*: depending on model, see Section 1.3

1.5 Product label

The label fixed to the bottom of a MTX Terminal comprises the following information:



No.	Information
1	MTX Terminals logo
2	Product name (model)
3	Product ordering number
4	Hardware and Firmware Revisions
5	FCC ID
6	Year/Week of fabrication
7	Barcode (Code 128) (IMEI)
8	Product IMEI
9	RoHS symbol
10	Pb-Free symbol
11	WEEE symbol
12	CE logo
13	PTCRB Certification logo

1.6 Main features and services

The MTX-IND-2G performs a set of telecom services (TS) according to GSM standard phase 2+, ETSI and ITU-T. The services and functions of the MTX-IND-2G are implemented by issuing customized applications embedded on the device, by AT commands issued internally or over the USB, RS232, RS422 or RS485 interface.

1.6.1 Key features at a glance (2G models)

The MTX-IND-2G is a GSM/GPRS bands mobile station with the characteristics shown in the table below.

Feature	Implementation
General	
Frequency bands	GSM/GPRS: Quad band, 850/900/1800/1900MHz
GSM class	Small MS
Output power	Class 4 (+33dBm ±2dB) for EGSM850 Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class 1 (+30dBm ±2dB) for GSM1900 The values stated above are maximum limits. According to Release 99, the maximum output power in a multislot configuration may be lower. The nominal reduction of maximum output power varies with the number of uplink timeslots used and amounts to 2.0dB for 2Tx, 4.0dB for 3Tx and 6.0dB for 4Tx.
Power supply	Single supply voltage DC: 9 to 30V AC: 90-264VAC/120-370VDC
Physical	Dimensions: 200 x 120 x 77 mm Weight: approx. <500g
RoHS	All hardware components fully compliant with EU RoHS Directive
GSM / GPRS features	
Data transfer	GPRS • Multislot Class 12 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 CSD • V.110, RLP, non-transparent • 9.6kbps • USSD PPP-stack for GPRS data transfer
SMS	Point-to-point MT and MO Cell broadcast Text and PDU mode Storage: SIM card plus 25 SMS locations in mobile equipment Transmission of SMS alternatively over CSD or GPRS. Preferred mode can be user defined
Fax	Group 3; Class 1
Audio	Speech codecs: • Half rate HR (ETS 06.20) • Full rate FR (ETS 06.10) • Enhanced full rate EFR (ETS 06.50/06.60/06.80) • Adaptive Multirate AMR Line echo cancellation, noise reduction, DTMF, 7 ringing tones

Software	
AT commands	Hayes, 3GPP TS 27.007, 27.005, Gemalto M2M
Java™ Open Platform	Java™ Virtual Machine with APIs for amongst others AT Parser, Serial Interface, FlashFile System and TCP/IP Stack. Major benefits: seamless integration into Java applications, ease of programming, no need for application microcontroller, extremely cost-efficient hardware and software design – ideal platform for industrial GSM applications. The memory space available for Java programs is around 1.7MB in the flash file system and around 6MB RAM. Application code and data share the space in the flash file system and in RAM.
SIM Application Toolkit	SAT Release 99
TCP/IP stack	Access by AT commands
Remote SIM Access	MTX-IND-2G supports Remote SIM Access. RSA enables MTX-IND-2G to use a remote SIM card via its serial interface and an external application, in addition to the SIM card locally attached to the modem. The connection between the external application and the remote SIM card can be a Bluetooth wireless link or a serial link. The necessary protocols and procedures are implemented according to the "SIM Access Profile Interoperability Specification of the Bluetooth Special Interest Group"
Firmware update	Firmware update from host application over RS232/USB. Over-the-air (OTA) firmware is also possible.
Interfaces (depending on models)	
USB	Supports a USB 2.0 High Speed (480Mbit/s) device interface, Full Speed (12Mbit/s) compliant
RS232 (4-wires)	Adjustable baud rates: 1200bps to 921600bps Autobauding: 1200 to 230400bps Supports RTS/CTS hardware flow control Multiplex ability according to GSM 07.10 Multiplexer Protocol
RS422	Adjustable baud rates: 1200bps to 921600bps Autobauding: 1200 to 230400bps Multiplex ability according to GSM 07.10 Multiplexer Protocol
RS485	Adjustable baud rates: 1200bps to 921600bps Autobauding: 1200 to 230400bps Half-duplex
I2C interface	Supports I2C serial interface up to 400kbps
Audio	Not amplified balanced analogs input and output signals available
GPIO	2x digital input/outputs and 4 Optoisolated inputs
ADC	2x analog-to-digital converters
DAC	1x digital-to-analog converter
Relays	4x form C switching contacts relays
Status	4x status LEDs (GSM status and user programmable
UICC interface	Supported chip cards: UICC/SIM/USIM 3V, 1.8V
Antenna	50 Ohms. GSM/UMTS main antenna
Power on/off, Reset	
Power on/off	Automatic switch-on at power supply Switch off by AT command Switch off by hardware signal TURN_OFF Automatic switch-off in case of critical temperature or voltage conditions
Software Reset	Orderly shutdown and reset by AT command
Special features	
Antenna	SAIC (Single Antenna Interference Cancellation) / DARP (Downlink Advanced Receiver Performance) Rx Diversity (receiver type 3i – 64-QAM) / MIMO

1.6.2 Key features at a glance (3G models)

The MTX-IND-3G is a UMTS/HSPA bands mobile station with the characteristics shown in the table below.

Feature	Implementation
General	
Frequency bands	UMTS/HSPA+: Five band, 800/850/900/1900/2100MHz GSM/GPRS/EDGE: Quad band, 850/900/1800/1900MHz
GSM class	Small MS
Output power	Class 4 (+33dBm ±2dB) for EGSM850 Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class 1 (+30dBm ±2dB) for GSM1900 Class E2 (+27dBm ± 3dB) for GSM 850 8-PSK Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+27dBm +3dB/-4dB) for GSM 1800 8-PSK Class E2 (+27dBm +3/-4dB) for GSM 1900 8-PSK Class E2 (+26dBm +3/-4dB) for GSM 1800 8-PSK Class 3 (+24dBm +1/-3dB) for UMTS 2100, WCDMA FDD BdI Class 3 (+24dBm +1/-3dB) for UMTS 1900, WCDMA FDD BdII Class 3 (+24dBm +1/-3dB) for UMTS 900, WCDMA FDD BdVIII Class 3 (+24dBm +1/-3dB) for UMTS 850, WCDMA FDD BdV Class 3 (+24dBm +1/-3dB) for UMTS 800, WCDMA FDD BdVI
Power supply	Single supply voltage DC: 9 to 30V AC: 90-264VAC/120-370VDC
Physical	Dimensions: 200 x 120 x 77 mm Weight: approx. <500g
RoHS	All hardware components are fully compliant with the EU RoHS Directive
HSPA features	
3GPP Release 6,7	DL 7.2Mbps, UL 5.7Mbps HSDPA Cat.8 / HSUPA Cat.6 data rates Compressed mode (CM) supported according to 3GPP TS25.212
UMTS features	
3GPP Release 8	PS data rate – 384 kbps DL / 384 kbps UL CS data rate – 64kbps DL / 64 kbps UL
GSM / GPRS / EGPRS features	

Data transfer	GPRS • Multislot Class 12 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 EGPRS • Multislot Class 12 • EDGE E2 power class for 8 PSK • Downlink coding schemes – CS 1-4, MCS 1-9 • Uplink coding schemes – CS 1-4, MCS 1-9 • SRB loopback and test mode B • 8-bit, 11-bit RACH • PBCCH support • 1 phase/2 phase access procedures • Link adaptation and IR • NACC, extended UL TBF • Mobile Station Class B CSD • V.110, RLP, non-transparent • 9.6kbps • USSD
SMS	Point-to-point MT and MO Cell broadcast Text and PDU mode Storage: SIM card plus SMS locations in mobile equipment
Software	
AT commands	Hayes, 3GPP TS 27.007, 27.005, Gemalto M2M AT commands for RIL compatibility
Java™ Open Platform	Java™ Open Platform with • Java™ profile IMP-NG & CLDC 1.1 HI • Secure data transmission via HTTPS/SSL • Multi-threading programming and multi-application execution Major benefits: seamless integration into Java applications, ease of programming, no need for application microcontrollers, extremely cost-efficient hardware and software design – an ideal platform for industrial GSM applications. The memory space available for Java programs is around 8MB in the flash file system and around 6MB of RAM. Application code and data share the space in the flash file system and in the RAM.
Microsoft™ compatibility	RIL for Pocket PC and Smartphone
SIM Application Toolkit	SAT Release 99
Firmware update	Firmware update from host application over USB.
Interfaces (depending on models)	
USB	Supports a USB 2.0 High Speed (480Mbit/s) device interface, Full Speed (12Mbit/s) compliant
RS232 (4-wires)	Adjustable baud rates: 1200bps to 921600bps Autobauding: 1200 to 230400bps Supports RTS/CTS hardware flow control Multiplex ability according to GSM 07.10 Multiplexer Protocol
RS422	Adjustable baud rates: 1200bps to 921600bps

	Autobauding: 1200 to 230400bps Multiplex ability according to GSM 07.10 Multiplexer Protocol
RS485	Adjustable baud rates: 1200bps to 921600bps Autobauding: 1200 to 230400bps Half-duplex
I2C interface	Supports I2C serial interface up to 400kbps
Audio	Not amplified balanced analog input and output signals available
GPIO	2x digital input/outputs and 4 Optoisolated inputs
ADC	2x analog-to-digital converters
DAC	1x digital-to-analog converter
Relays	4x form C switching contacts relays
Status	4x status LEDs (GSM status and user programmable
Power on/off, Reset	
Power on/off	Automatic switch-on at power supply Switch off by AT command Switch off by hardware signal TURN_OFF Automatic switch-off in case of critical temperature or voltage conditions
Software Reset	Orderly shutdown and reset by AT command
Special features	
Antenna	SAIC (Single Antenna Interference Cancellation) / DARP (Downlink Advanced Receiver Performance) Rx Diversity (receiver type 3i – 64-QAM) / MIMO

1.6.3 Operating modes (2G models)

The table below briefly summarizes the various operating modes referred to in the following chapters.

Limits	Function	
Normal operation	GSM / GPRS SLEEP	Various power saving modes set with AT+CFUN command. Software is active to the minimum extent. If the modem was registered to the GSM network in IDLE mode, it is registered and paging with the BTS in SLEEP mode too. Power saving can be chosen at different levels: the NON-CYCLIC SLEEP mode (AT+CFUN=0) disables the AT interface. The CYCLIC SLEEP modes AT+CFUN=7 and 9 alternately activate and deactivate the AT interfaces to allow permanent access to all AT commands.
	GSM IDLE	Software is active. Once registered to the GSM network, paging with BTS is carried out. The modem is ready to send and receive.
	GSM TALK	Connection between two subscribers is in progress. Power consumption depends on the network coverage individual settings, such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	GPRS IDLE	Terminal is ready for GPRS data transfer, but no data is currently sent or received. Power consumption depends on network settings and GPRS configuration (e.g. used multislot settings).
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and GPRS configuration (e.g. used multislot settings).
Sleep mode	Normal shutdown after sending the AT^SMSO command. The internal GSM engine enters in a power down mode where only a voltage regulator is active for powering the internal RTC. Software is not active. Interfaces are not accessible.	
Airplane mode	Airplane mode shuts down the radio part of the modem, causes the modem to log off from the GSM/GPRS network and disables all AT commands whose execution requires a radio connection. Airplane mode can be controlled by using AT commands AT^SCFG and AT+CALA: • With AT^SCFG=MEopMode/Airplane/OnStart the modem can be configured to enter the Airplane mode each time when switched or reset • The parameter AT^SCFG=MEopMode/Airplane can be used to switch back and forth between Normal mode and Airplane mode any time during operation. • Setting an alarm with AT+CALA followed by AT^SMSO wakes the modem up into Airplane mode at the scheduled time.	

1.6.4 Operating modes (3G models)

The table below briefly summarizes the various operating modes referred to in the following chapters.

Limits	Function	
Normal operation	GSM / GPRS / UMTS / HSPA SLEEP	Power saving automatically activated when no calls are in progress, the USB connection is suspended by the host or not present, and there is no active communication via ASC0
	GSM / GPRS / UMTS / HSPA IDLE	Power saving is disabled if a USB connection is not suspended, but no call is in progress.
	GSM TALK / GSM DATA	Connection between two subscribers is in progress. Power consumption depends on the GSM network coverage and several connection settings (e.g. DTX off/on, FR/EFR/HR, hopping sequences and antenna connection). The following applies when power is to be measured in TALK_GSM mode: DTX off, FR and no frequency hopping.
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and GPRS configuration (e.g. used multislot settings).
	EGPRS DATA	EGPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and EGPRS configuration (e.g. used multislot settings).
	UMTS TALK / UMTS DATA	UMTS data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
	HSPA DATA	HSPA data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
Sleep mode	Normal shutdown after sending the power down command. The internal GSM engine enters in a power down mode where only a voltage regulator is active for powering the internal RTC. Software is not active. Interfaces are not accessible.	
Airplane mode	Airplane mode shuts down the radio part of the modem, causes the modem to log off from the GSM/GPRS network, and disables all AT commands whose execution requires a radio connection. Airplane mode can be controlled by AT commands.	

1.6.5 Power Consumption (2G models)

	Description	Conditions		Typical	Unit
IIN[1]	Sleep mode supply current	Internal GSM module powered down		7	mA
	GSM/GPRS supply current	IDLE (UART activated but no communication)	USB disconnected	13	mA
			USB active	17	mA
		GSM call (GSM850/900; P_{RFOUT}=2W; 1Tx/1Rx; ROPR=1..3)	Average	98.3	mA
			Burst	553	mA
		GPRS Class 8 (GSM850/900; P_{RFOUT}=2W; 1Tx/4Rx; ROPR=1..3)	Average	95	mA
			Burst	553	mA
		GPRS Class 10 (GSM850/900; P_{RFOUT}=2W; 2Tx/3Rx; ROPR=1)	Average	170	mA
			Burst	553	mA
		GPRS Class 10 (GSM850/900; P_{RFOUT}=1W; 2Tx/3Rx; ROPR=2/3)	Average	143	mA
			Burst	451	mA
		GPRS Class 12 (GSM850/900; P_{RFOUT}=1W; 4Tx/1Rx; ROPR=1)	Average	201	mA
			Burst	382	mA
		GPRS Class 12 (GSM850/900; P_{RFOUT}=0.5W; 4Tx/1Rx; ROPR=2/3)	Average	170	mA
			Burst	307	mA
		GSM call (GSM1800/1900; P_{RFOUT}=1W; 1Tx/1Rx; ROPR=1..3)	Average	75	mA
			Burst	348	mA
		GPRS Class 8 (GSM1800/1900; P_{RFOUT}=1W; 1Tx/4Rx; ROPR=1..3)	Average	75	mA
			Burst	348	mA
		GPRS Class 10 (GSM1800/1900; P_{RFOUT}=1W; 2Tx/3Rx; ROPR=1)	Average	116	mA
			Burst	348	mA
		GPRS Class 10 (GSM1800/1900; P_{RFOUT}=0.5W; 2Tx/3Rx; ROPR=2/3)	Average	102	mA
			Burst	297	mA
		GPRS Class 12 (GSM1800/1900; P_{RFOUT}=0.5W; 4Tx/1Rx; ROPR=1)	Average	143	mA
			Burst	245	mA
		GPRS Class 12 (GSM1800/1900; P_{RFOUT}=0.25W; 4Tx/1Rx;ROPR=2/3)	Average	133	mA
			Burst	218	mA

1. With an impedance of Z_{LOAD}=50Ohm at the antenna port.
2. Measurements start 6 minutes after switching ON the modules
   Averaging times: SLEEP mode – 3 minutes, transfer modes – 1.5 minutes
   Communication tester settings: no neighbor cells, no cell reselection etc., RMC (reference measurement channel)

1.6.6 Power Consumption (3G models)

	Description	Conditions		Typical	Unit
IIN[1]	Sleep mode supply current	Internal GSM module powered down		7	mA
	Average GSM/GPRS supply current	IDLE (UART activated but no communication) @ DRX=2	USB disconnected	11	mA
			USB active	12	mA
		GPRS Data transfer GSM850/900; PCL=5; 1Tx/4Rx	ROPR=4 (max. reduction)	67	mA
			ROPR=0 (no reduction)		
		GPRS Data transfer GSM850/900; PCL=5; 2Tx/3Rx	ROPR=4 (max. reduction)	84.5	mA
			ROPR=0 (no reduction)	115	mA
		GPRS Data transfer GSM850/900; PCL=5; 4Tx/1Rx	ROPR=4 (max. reduction)	90	mA
			ROPR=0 (no reduction)	205	mA
		EDGE Data transfer GSM850/900; PCL=5; 1Tx/4Rx	ROPR=4 (max. reduction)	50	mA
			ROPR=0 (no reduction)		
		EDGE Data transfer GSM850/900; PCL=5; 2Tx/3Rx	ROPR=4 (max. reduction)	64.5	mA
			ROPR=0 (no reduction)	81	mA
		EDGE Data transfer GSM850/900; PCL=5; 4Tx/1Rx	ROPR=4 (max. reduction)	97	mA
			ROPR=0 (no reduction)	136	mA
		GPRS Data transfer GSM1800/1900; PCL=0; 1Tx/4Rx	ROPR=4 (max. reduction)	52	mA
			ROPR=0 (no reduction)		
		GPRS Data transfer GSM1800/1900; PCL=0; 2Tx/3Rx	ROPR=4 (max. reduction)	57	mA
			ROPR=0 (no reduction)	85	mA
		GPRS Data transfer GSM1800/1900; PCL=0; 4Tx/1Rx	ROPR=4 (max. reduction)	67	mA
			ROPR=0 (no reduction)	145	mA
		EDGE Data transfer GSM1800/1900; PCL=0; 1Tx/4Rx	ROPR=4 (max. reduction)	45	mA
			ROPR=0 (no reduction)		
		EDGE Data transfer GSM1800/1900; PCL=0; 2Tx/3Rx	ROPR=4 (max. reduction)	62	mA
			ROPR=0 (no reduction)	70	mA
		EDGE Data transfer GSM1800/1900; PCL=0; 4Tx/1Rx	ROPR=4 (max. reduction)	95	mA
			ROPR=0 (no reduction)	115	mA
	Average WCDMA supply current supply current	IDLE (UART activated but no communication) @ DRX=6	USB disconnected	10	mA
			USB active	16	mA
		UMTS Data transfer Band I @ 23dBm		132	mA
		UMTS Data transfer Band II @ 23dBm		150	mA
		UMTS Data transfer Band V/VI @ 23dBm		150	mA
		UMTS Data transfer Band VIII @ 23dBm		152	mA
		HSPA Data transfer Band I @ 23dBm		132	mA
		HSPA Data transfer Band II @ 23dBm		150	mA
		HSPA Data transfer Band V/VI @ 23dBm		150	mA
		HSPA Data transfer Band VIII @ 23dBm		152	mA

3. With an impedance of Z_{LOAD}=50Ohm at the antenna port.
4. Measurements start 6 minutes after switching ON the modules
   Average times: SLEEP mode – 3 minutes, transfer modes – 1.5 minutes
   Communication tester settings: no neighbor cells, no cell reselection etc., RMC (reference measurement channel)

1.6.7 RF antenna interface description (2G models)

The table below briefly summarizes the RF Antenna interface GSM/UMTS

Parameter	Conditions	Min.	Typical	Max.	Unit
Frequency range Uplink (MS → BTS)	GSM 850	824		849	MHz
	EGSM 900	880		915	MHz
	GSM 1800	1710		1785	MHz
	GSM 1900	1850		1910	MHz
Frequency range Uplink (BTS → MS)	GSM 850	869		894	MHz
	EGSM 900	925		960	MHz
	GSM 1800	1805		1880	MHz
	GSM 1900	1930		1990	MHz
RF Power @ ARP with 50Ohm Load	GSM 850	31	33	35	dBm
	EGSM 900[1]	31	33	35	dBm
	GSM 1800[2]	28	30	32	dBm
	GSM 1900	28	30	32	dBm
Number of carriers	GSM 850		124		
	EGSM 900		174		
	GSM 1800		374		
	GSM 1900		299		
Duplex spacing	GSM 850		45		MHz
	EGSM 900		45		MHz
	GSM 1800		95		MHz
	GSM 1900		80		MHz
Carrier spacing			200		kHz
Multiplex, Duplex		TDMA/FDMA, FDD			
Time slots per TDMA frame			8		
Frame duration			4.615		ms
Time slot duration			577		µs
Modulation		GMSK			
Static Receiver Input Sensitivity @ ARP	GSM 850	-102	-108		dBm
	EGSM 900	-102	-108		dBm
	GSM 1800	-102	-107		dBm
	GSM 1900	-102	-107		dBm

1. Power control level PCL 5
2. Power control level PCL 0

1.6.8 RF antenna interface description (3G models)

The table below briefly summarizes the RF Antenna interface GSM/UMTS

Parameter		Conditions	Min.	Typical	Max.	Unit
UMTS/HSPA connectivity		Band I, II, V, VI, VIII				
Receiver Input Sensitivity @ ARP		UMTS 800/850 Band VI/V	-104.7/-106.7	-110		dBm
		UMTS 900 Band VIII	-103.7	-110		dBm
		UMTS 1900 Band II	-104.7	-109		dBm
		UMTS 2100 Band I	-106.7	-110		dBm
RF Power @ ARP with 50Ohm Load		UMTS 800/850 Band VI/V	21	24	25	dBm
		UMTS 900 Band VIII	21	24	25	dBm
		UMTS 1800 Band III	21	24	25	dBm
		UMTS 2100 Band I	21	24	25	dBm
GPRS coding schemes		Class 12, CS1 to CS4				
EGPRS		Class 12, MCS1 to MCS9				
GSM Class		Small MS				
Static Receiver Input Sensitivity @ ARP		GSM 850 / E-GSM 900	-102	-109		dBm
		GSM 1800 / GSM 1900	-102	-108		dBm
RF Power @ ARP with 50Ohm Load	GSM	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
RF Power @ ARP with 50Ohm Load, (ROPR = 0, i.e. no reduction)	GPRS, 1 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 1 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 2 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 2 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 3 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 3 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 4 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 4 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
RF Power @ ARP with 50Ohm Load, (ROPR = 1)	GPRS, 1 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 1 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 2 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 2 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm

	GPRS, 3 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 3 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 4 TX	GSM 850 / E-GSM 900		31		dBm
		GSM 1800 / GSM 1900		28		dBm
	EDGE, 4 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
RF Power @ ARP with 50Ohm Load, (ROPR = 2)	GPRS, 1 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 1 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 2 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 2 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 3 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 3 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 4 TX	GSM 850 / E-GSM 900		29		dBm
		GSM 1800 / GSM 1900		26		dBm
	EDGE, 4 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
RF Power @ ARP with 50Ohm Load, (ROPR = 3)	GPRS, 1 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 1 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 2 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 2 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 3 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 3 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 4 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		24		dBm
	EDGE, 4 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		24		dBm
RF Power @ ARP with 50Ohm Load, (ROPR = 4, i.e. maximum reduction)	GPRS, 1 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 1 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 2 TX	GSM 850 / E-GSM 900		30		dBm

		GSM 1800 / GSM 1900		27		dBm
	EDGE, 2 TX	GSM 850 / E-GSM 900		24		dBm
		GSM 1800 / GSM 1900		23		dBm
	GPRS, 3 TX	GSM 850 / E-GSM 900		28.2		dBm
		GSM 1800 / GSM 1900		25.2		dBm
	EDGE, 3 TX	GSM 850 / E-GSM 900		22.2		dBm
		GSM 1800 / GSM 1900		21.2		dBm
	GPRS, 4 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		24		dBm
	EDGE, 4 TX	GSM 850 / E-GSM 900		21		dBm
		GSM 1800 / GSM 1900		20		dBm

1.6.9 SIM Card

The MTX-IND family supports an external SIM card through the integrated SIM holder. Both 3V and 1.8V SIM technology is supported. Older, 5V SIM technology is not supported.

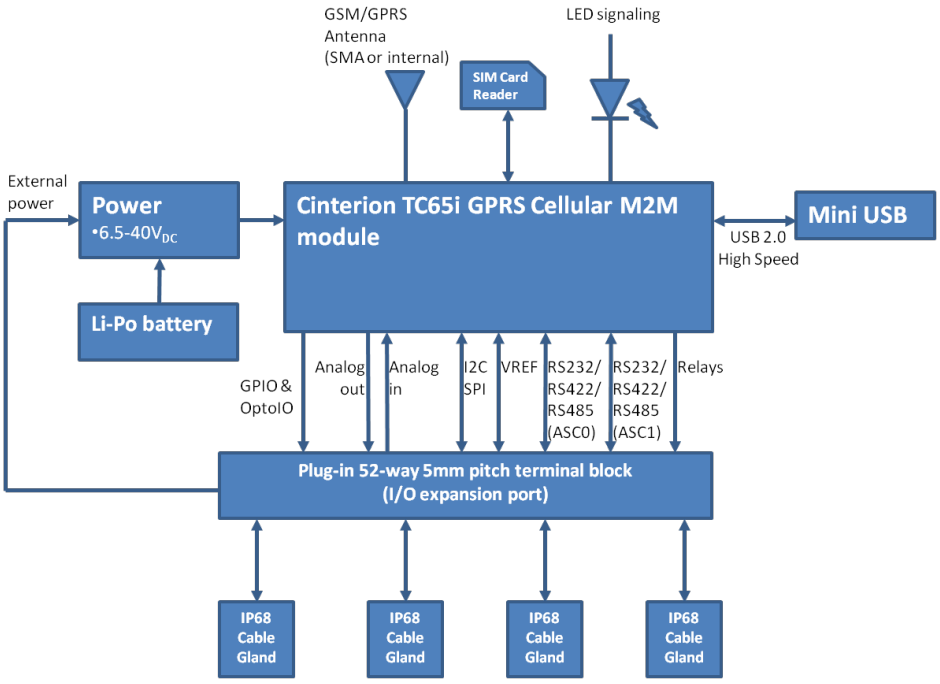
1.7 Precautions

MTX-IND as a standalone item is designed for both indoor and outdoor use, because of its IP65 enclosure. Do not exceed the environmental and electrical limits as specified in Technical Data

1.8 Block diagram

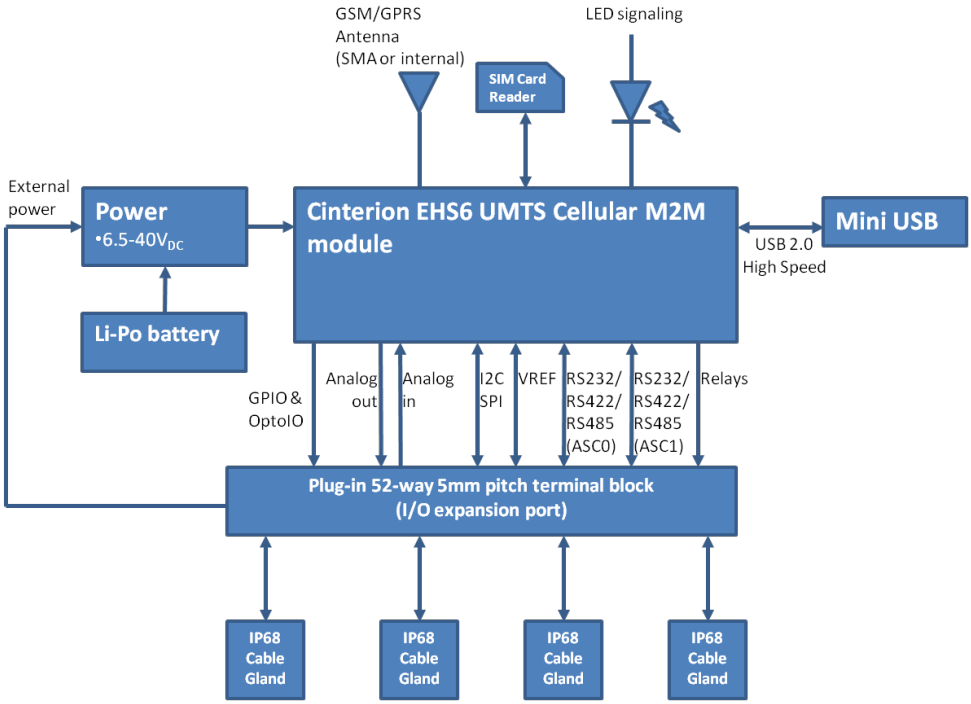
1.8.1 2G models

The MTX-IND-2G modem's block diagram is shown in the following figure:



1.8.2 3G models

The MTX-IND-3G modem's block diagram is shown in the following figure:



1.9 Hardware revisions

2G models:

Hardware Revision	Starting production date	Changes
2.04	01/2014	Initial version

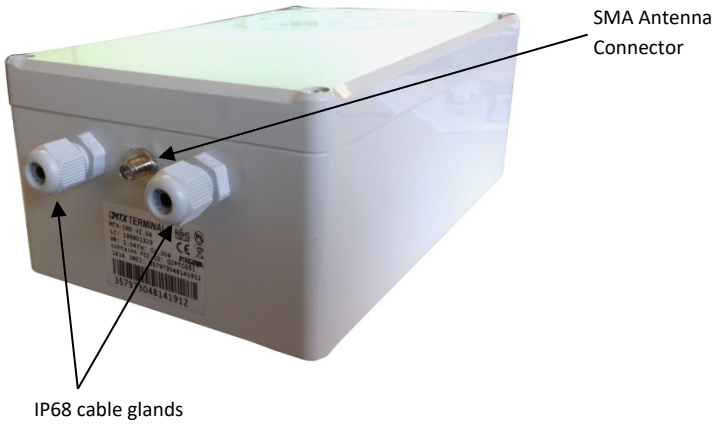
3G models:

Hardware Revision	Starting production date	Changes
2.04	11/2014	Initial version

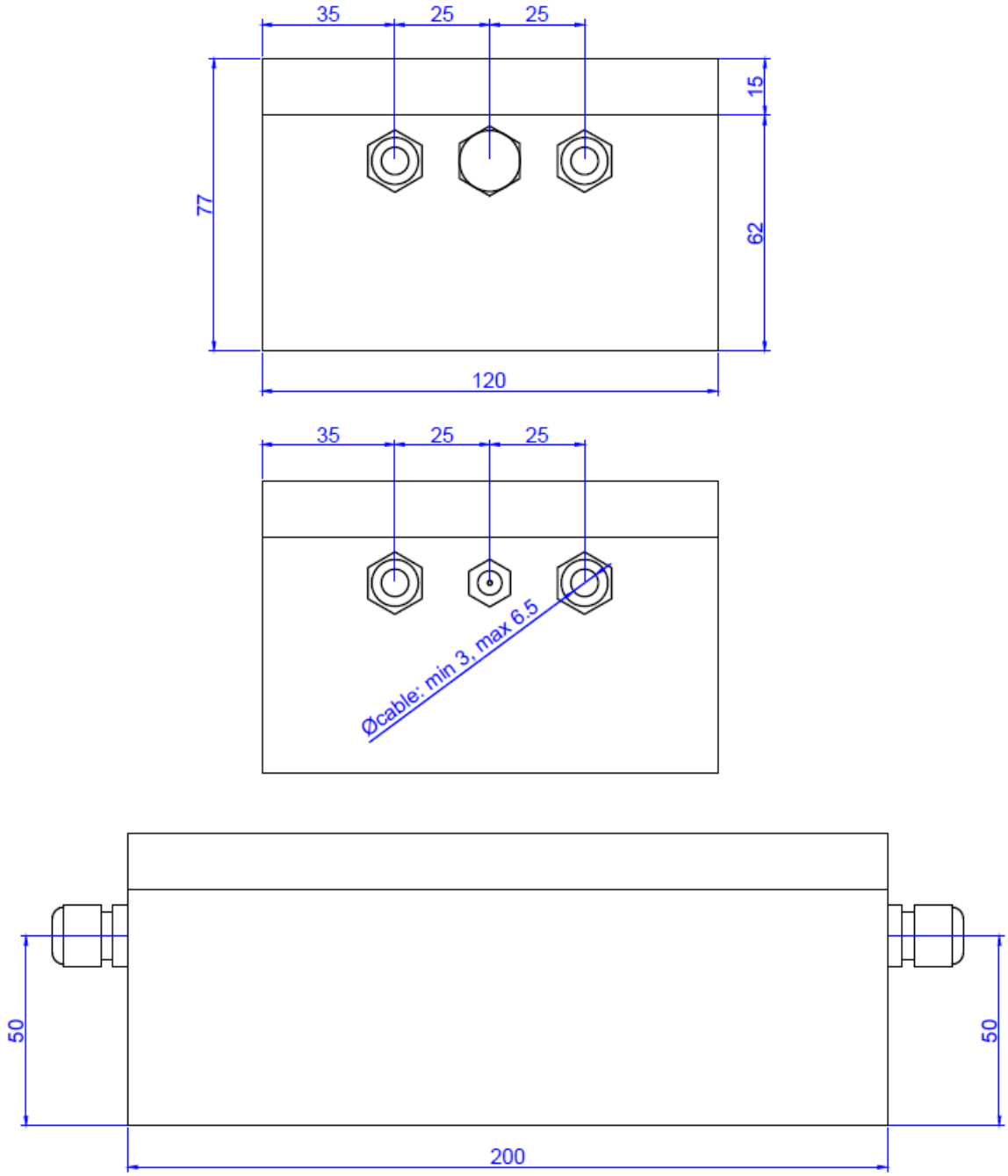
2. Mechanical description

2.1 Overview

The pictures below show the mechanical design of the modem along with the positions of the different connectors and mounting holes. The modem case is made of durable PC/ABS plastic.



2.2 Dimensions



All dimensions are in millimeters

3. Electrical and environmental characteristics

3.1 Electrical specifications

3.1.1 Power supply

CHARACTERISTICS						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
VIN	Supply voltage	DC	120		370	V
		AC	90		264	V
IIN	Supply current		-	*	-	A

* See section 1.6.5 and 1.6.6

3.1.2 RS232 interface

ABSOLUTE MAXIMUM RATINGS					
Symbol	**Parameter**	**Conditions**	**Min.**	**Max.**	**Unit**
V_I	Input voltage range	Drivers	-0.3	6	V
		Receivers	-25	25	V
V_O	Output voltage range	Drivers	-13.2	13.2	V
		Receivers	-0.3	5	V
	Electrostatic discharge	Human body model		2	kV

CHARACTERISTICS						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
V_{OH}	Driver high-level output voltage	R_L=3kΩ to GND	5	5.4		V
V_{OL}	Driver low-level output voltage	R_L=3kΩ to GND	-5	-5.4		V
r_o	Driver output resistance	VIN = 0V	300	10M		Ω
V_{IT+}	Receiver positive-going input threshold voltage				2.4	V
V_{IT-}	Receiver negative-going input threshold voltage		0.6			V
V_{hys}	Receiver input hysteresis			053		V
r_i	Receiver input resistance		3	5	7	kΩ

3.1.3 RS485/422 interface

ABSOLUTE MAXIMUM RATINGS					
Symbol	**Parameter**	**Conditions**	**Min.**	**Max.**	**Unit**
V_I	Input voltage range	Drivers	-0.3	6	V
		Receivers	-25	25	V
V_O	Output voltage range	Drivers	-13.2	13.2	V
		Receivers	-0.3	5	V
	Electrostatic discharge	Human body model		2	kV

CHARACTERISTICS						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
V_{OD}	Driver differential output voltage		1.5			V
V_{OC}	Common mode output voltage				3	V
I_{SC}	Output short-circuit current				250mA	mA
V_{TH}	Receiver input differential threshold voltage		-200		-50	mV
V_{TH}	Receiver input differential threshold voltage		-200		-50	mV
V_{hys}	Receiver input hysteresis			30		mV
r_i	Receiver input resistance	$-7V < V_{CM} < +12V$	48			kΩ

3.1.4 I2C/SPI interface

ABSOLUTE MAXIMUM RATINGS					
Symbol	**Parameter**	**Conditions**	**Min.**	**Max.**	**Unit**
V_I	Input voltage range		-0.3	+3.5	V
SCLK frequency	Clock frequency	2G models		400	kHz
		3G model		100	kHz

CHARACTERISTICS						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
V_{IH}	High-level input voltage		2.15		3.05	V
V_{IL}	Low-level input voltage				0.8	V
V_{OH}	High-level output voltage	I=-0.5mA	2.55		3	V
V_{OL}	Low-level output voltage	I=2mA			0.2	V

3.1.5 Optoisolated Input/Output

ABSOLUTE MAXIMUM RATINGS (TCMD4000 OPTOCOUPLER)					
Symbol	**Parameter**	**Conditions**	**Min.**	**Max.**	**Unit**
Input					
V_R	Reverse voltage			6	V
I_F	Forward current			60	mA
I_{FSM}	Forward surge current			1.5	A
P_{diss}	Power dissipation			100	mW
Output					
V_{CEO}	Collector-emitter voltage			35	V
V_{ECO}	Emitter-collector voltage			7	V
I_C	Collector current			80	mA
I_{CM}	Collector peak current	$t_P/T=0.5$, $t_P \leq 10ms$		100	mA
P_{diss}	Power dissipation			150	mW
Coupler					
V_{ISO}	AC isolation test voltage (RMS)			3750	V_{RMS}
P_{tot}	Total power dissipation			250	mW

CHARACTERISTICS (TCMD4000 OPTOCOUPLER)						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Input						
V_F	Forward voltage	I_F =50mA		1.25	1.6	V
C_j	Junction capacitance	V_R =0V, f=1MHz		50		pF
Output						
V_{CEO}	Collector-emitter voltage	I_C =100µA	35			V
V_{ECO}	Emitter-collector voltage	I_E =100µA	7			V
I_{CEO}	Collector dark current	V_{CE}=10V, I_F =0			100	nA
Coupler						
V_{CEsat}	Collector-emitter saturation voltage	I_F =20mA, I_C =5mA			1	V
f_c	Cut-off frequency	I_F =10mA, V_{CE}=5V, R_L=100Ω		10		kHz
C_k	Coupling capacitance	f=1MHz		0.3		pF
I_C /I_F	Current transfer ratio	V_{CE} =2V, I_F=1mA	600	800		%
t_r	Rise time	V_{CE} =2V, I_F=1mA, R_L=100Ω		300		µs
t_{off}	Turn-off time	V_{CE} =2V, I_F=1mA, R_L=100Ω		250		µs

Please see equivalent circuits in Section 4.2.9 to view voltage input/output ranges and determine operating conditions in each case.

3.1.6 Analog Input/Output (2G models)

ABSOLUTE MAXIMUM RATINGS					
Symbol	**Parameter**	**Conditions**	**Min.**	**Max.**	**Unit**
V_I	Input voltage		-0.3	3.5	V

CHARACTERISTICS						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
$V_{OH(PWM)}$	PWM/DAC High-level output voltage	I=-0.5mA	2.55		3	V
$V_{OL(PWM)}$	PWM/DAC Low-level output voltage	I=2mA			0.2	V
$DC_{(PWM)}$	PWM/DAC Duty cycle in percentage steps		0		100	%
$f_{(PWM)}$	PWM frequency		320, 970, 8125, 16250, 32500, 65000			Hz
V_{ia}	ADC input voltage range		0		2.4	V
R_i	ADC input resistance			750		kΩ
T_m	Measurement interval		0.1		30	s
	Resolution	1 step = 1mv		2400		steps
	Total accuracy				±2	mV
f_c	Cut-off frequency			30		Hz
	Accuracy				±0.5	mV
E_L	ADC Linearity error				±0.5	mV
E_T	ADC Temperature error				±0.5	mV
E_B	ADC Burst error				±0.5	mV

3.1.7 Analog Input/Output (3G models)

ABSOLUTE MAXIMUM RATINGS					
Symbol	**Parameter**	**Conditions**	**Min.**	**Max.**	**Unit**
V_I	Input voltage		-0.5	3.5	V
I_I	Input current			±10	mA
I_O	Output current			±20	mA
	Electrostatic discharge	Human body model		±3000	V
		Machine model		±300	V
P_{OUT}	DAC output power dissipation			100	mW

CHARACTERISTICS						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
V_{oa}	Analog output voltage range	No resistive load	0		3	V
		R_L=10kΩ	0		2.7	V
E_O	DAC Offset error	T_A=25ºC			50	mV
E_L	DAC Linearity error				±1.5	LSB
E_G	DAC Gain error	No resistive load			1	%
$t_{s(DAC)}$	DAC settling time	To ½ LSB full scale			90	µs
$f_{c(DAC)}$	DAC conversion frequency				11.1	kHz
V_{ia}	Analog input voltage range		0		3	V
I_{LIA}	Analog input leakage current				100	nA
$C_{I(a)}$	Analog input capacitance			10		pF
E_O	ADC Offset error	T_A=25ºC			20	mV
E_L	ADC Linearity error				±1.5	LSB
E_G	ADC Gain error				1	%
		Small signal; ΔV_i=16LSB			5	%
CMRR	ADC Common Mode Rejection Ratio			60		dB
$f_{c(ADC)}$	ADC conversion frequency				50	kHz
NBITS	ADC & DAC converter bits number		8	8	8	bits

3.2 Operating temperatures

3.2.1 2G models

Please note that the modem's lifetime, i.e., the MTTF (mean time to failure) may be reduced if operated outside the extended temperature range.

Parameter	Min	Typ	Max	Unit
Normal operation	-30	+25	+70	ºC
Restricted operation[1]	-40 to -30		+70 to +75	ºC
Automatic shutdown[2]	<-40		>+80	ºC

1. Extended operation allows normal mode speech calls or data transmissions for a limited time until automatic thermal shutdown takes effect. Within the extended temperature range (outside the operating temperature range) the specified electrical characteristics may be increased or decreased.
2. Due to temperature measurement uncertainty, a tolerance of ±5ºC on the stated shutdown thresholds may occur.

Note that within the specified operating temperature ranges the modem temperature may vary to a great extent depending on the operating mode, frequency band used, radio output power and current supply voltage.

3.2.2 3G models

Please note that the modem's lifetime, i.e., the MTTF (mean time to failure) may be reduced if operated outside the extended temperature range.

Parameter	Min	Typ	Max	Unit
Normal operation	-30	+25	+85	ºC
Extended operation[1]	-40		+90	ºC
Automatic shutdown[2]	<-40		>+90	ºC

1. Extended operation allows normal mode speech calls or data transmissions for a limited time until the automatic thermal shutdown mode takes effect. Within the extended temperature range (outside the operating temperature range) the specified electrical characteristics may be increased or decreased.
2. Due to uncertainty in temperature measurement, a tolerance of ±3ºC on the stated shutdown thresholds may occur.

Note that within the specified operating temperature ranges the modem temperature may vary to a great extent depending on the operating mode, frequency band used, radio output power and current supply voltage.

3.3 Storage conditions

The conditions stated below are only valid for modems in their original packed state in weather protected, non-temperature-controlled storage locations. Normal storage time under these conditions is 12 months maximum. The modems will be delivered in a packaging that meets the requirements according “IPD/JEDEC J-STD-033B.1” for Low Temperature Carriers.

Type	Condition	Unit	Reference
Air temperatura: Low High	-30 +75	ºC	ETS 300 019-2-1: T1.2, IEC 60068-2-1 Ab ETS 300 019-2-1: T1.2, IEC 60068-2-2 Db
Humidity relative: Low High Condensation	10 90 at 30ºC 90-100 at 30ºC	%	--- ETS 300 019-2-1: T1.2, IEC 60068-2-56 Cb ETS 300 019-2-1: T1.2, IEC 60068-2-30 Db
Air pressure: Low High	70 106	kPa	IEC TR 60271-3-1:1K4 IEC TR 60271-3-1:1K4
Movement of surrounding air	1.0	m/s	IEC TR 60271-3-1:1K4
Water: rain, dripping, icing and frosting	Not allowed	-	-
Radiation: Solar Heat	1120 600	W/m2	ETS 300 019-2-1: T1.2, IEC 60068-2-2Bb ETS 300 019-2-1: T1.2, IEC 60068-2-2Bb
Chemically active substances	Not recommended		IEC TR 60271-3-1:1C1L
Mechanically active substances	Not recommended		IEC TR 60271-3-1:1S1
Vibration sinusoidal: Displacement Acceleration Frequency range	 1.5 5 2-9 9-200	 mm m/s2 Hz	IEC TR 60271-3-1:1M2
Shocks: Shock spectrum Duration Acceleration	 semi-sinusoidal 1 50	 ms m/s2	IEC 60068-2-27 Ea

4. Interface description

All electrical connections to the modem are protected in compliance with the standard air and contact Electrostatic Discharge (ESD).

The modem family uses the following industry standard connectors:

- USB mini connector
- Plug-in 52-way 5mm pitch modem block
- SIM card reader
- SMA female coaxial jack (GSM antenna connector)
- SMA female coaxial jack (GPS/GNSS antenna connector) or other RF options

4.1 Mini USB connector

The MTX-IND modems support a USB 2.0 High Speed (480Mbit/s) device interface. The USB interface is primarily intended for use as a command and data interface and for downloading firmware. The USB I/O pins are capable of driving the signal at a minimum of 3.0V. They are 5V I/O compliant.

The USB port has different functions depending on whether or not Java is running. Under Java, the lines may be used for debugging purposes. If Java is not used, the USB interface is available as a command and data interface and for downloading firmware.

To properly connect the module's USB interface to the host, a USB 2.0 compatible connector is required. Furthermore, the USB modem driver delivered with MTX-IND must be installed as described below.

The USB host is responsible for supplying power, across the VUSB_IN line, to the module's USB interface. This is because MTX-IND is designed as a self powered device compliant with the *"Universal Serial Bus Specification Revision 2.0".*

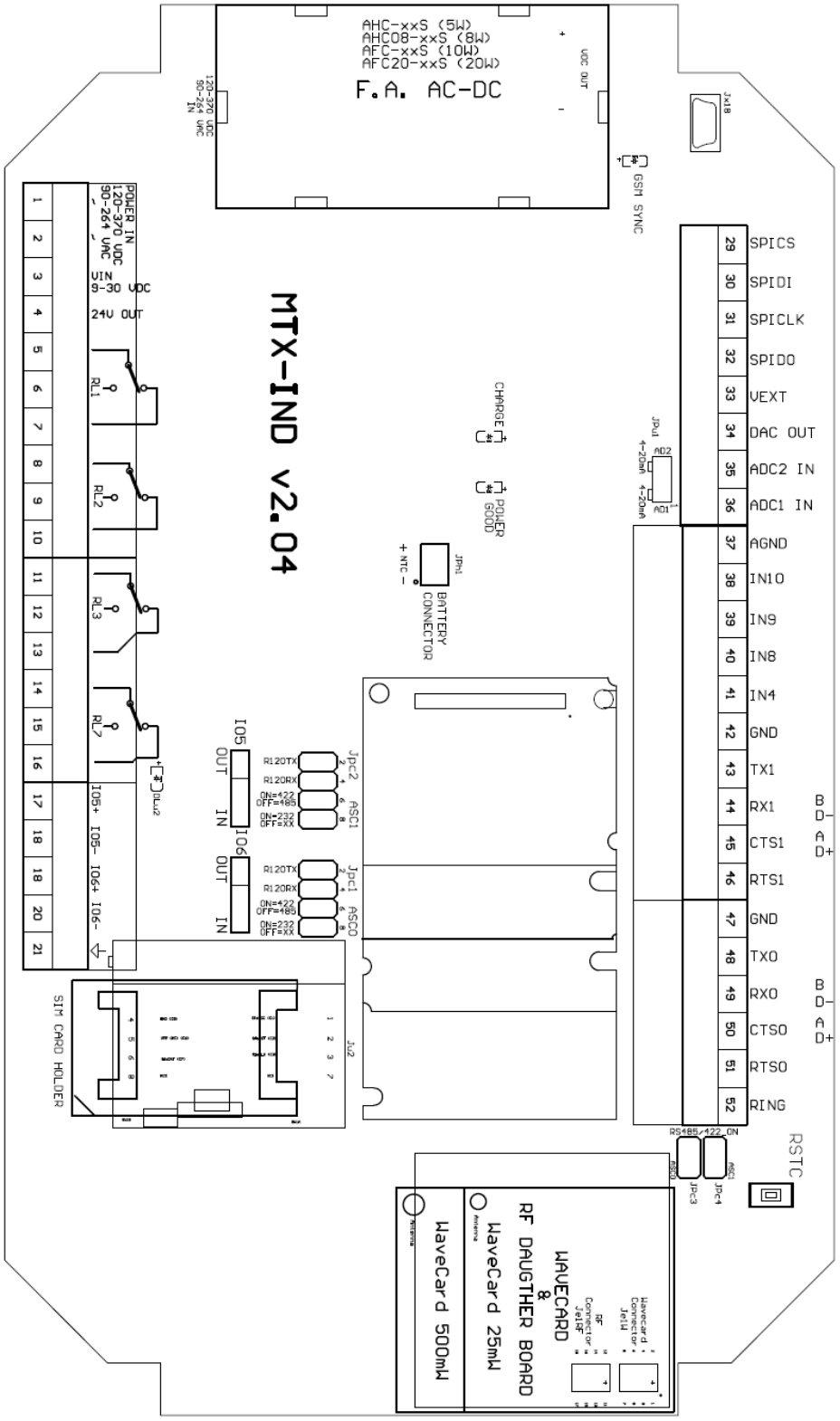
The MTX-IND can be powered by USB port: you must assure the internal Li-Po battery included by default is connected to the PCB.

There are drivers available for Windows and Linux environment applications. Visit the MTX-IND web page at www.mtxm2m.com or ftp.matrix.es/MTX-Terminals

4.2 Plug-in 52-way 5mm pitch terminal block

4.2.1 Connector pinout

Every MTX-IND modem has a 52-way terminal block where all the interface signals are available for use by the user. Below you can find the board overlay and a terminal assignments table. Use it as a reference for the following sections



Pin	Signal	Direction	Description
1	VAC IN	Input	Power In 90-264VAC
2	VAC IN	Input	Power In 90-264VAC
3	VDC IN	Input	Power In 9-30VDC
4	VDC OUT	Output	24V
5	RL1COM		Relay 1 common contact
6	RL1NO		Relay 1 normally open contact
7	RL1NC		Relay 1 normally closed contact
8	RL2COM		Relay 2 common contact
9	RL2NO		Relay 2 normally open contact
10	RL2NC		Relay 2 normally closed contact
11	RL3COM		Relay 3 common contact
12	RL3NO		Relay 3 normally open contact
13	RL3NC		Relay 3 normally closed contact
14	RL7COM		Relay 7 common contact
15	RL7NO		Relay 7 normally open contact
16	RL7NC		Relay 7 normally closed contact
17	IN5/OUT5+	I/O	Optocoupled IO positive signal (HW selectable)
18	IN5/OUT5 -	I/O	Optocoupled IO negative signal (HW selectable)
19	IN6/OUT6+	I/O	Optocoupled IO positive signal (HW selectable)
20	IN6/OUT6-	I/O	Optocoupled IO negative signal (HW selectable)
21	GND		Ground connection
29	SPICS	Output	SPI chip select line
30	SPIDI	Input	SPI data in line
31	I2CCLK/SPICLK	Output	I2C clock signal / SPI clock signal
32	I2CDAT/SPIDO	Output	I2C data line / SPI data out line
33	Vext	Output	Voltage reference (3V, 50mA max.)
34	DAC_OUT	Output	
35	ADC2_IN	Input	
36	ADC1_IN	Input	
37	AGND		Analog Ground connection
38	IN10	Input	
39	IN9	Input	
40	IN8	Input	
41	IN4	Input	
42	GND		Ground connection
43	TX1/TX+1	Input	Secondary RS232/RS422/RS485 UART signal: - RS232: transmitted data signal - RS422: transmitted data positive signal - RS485: no function
44	RX1/RX-1/B1	Output	Secondary RS232/RS422/RS485 UART signal: - RS232: received data signal - RS422: received data negative signal - RS485: B signal
45	CTS1/RX+1/A1	Output	Secondary RS232/RS422/RS485 UART signal: - RS232: clear to send signal - RS422: received data positive signal - RS485: A signal
46	RTS1/TX-1	Input	Secondary RS232/RS422/RS485 UART signal: - RS232: request to send signal - RS422: transmitted data negative signal - RS485: no function
47	GND		Ground connection

48	TX0/TX+0	Input	Primary RS232/RS422/RS485 UART signal: - RS232: transmitted data signal - RS422: transmitted data positive signal - RS485: no function
49	RX0/RX-0/B0	Output	Primary RS232/RS422/RS485 UART signal: - RS232: received data signal - RS422: received data negative signal - RS485: B signal
50	CTS0/RX+0/A0	Output	Primary RS232/RS422/RS485 UART signal: - RS232: clear to send signal - RS422: received data positive signal - RS485: A signal
51	RTS0/TX-0	Input	Primary RS232/RS422/RS485 UART signal: - RS232: request to send signal - RS422: transmitted data negative signal - RS485: no function
52	RING0		Primary RS232 ring indicator signal

4.2.2 Power supply

The MTX-IND modems are powered through pins 1 and 2. The power supply must be in the range of 120 to 370VDC or 90 to 264VAC to ensure the correct operation of the modem. If you prefer to use a lower DC voltage in the range of 9 to 30VDC, you can either use pin 3 instead of pins 1 and 2 (which must be left disconnected).

If you use pins 1 and 2 to power the modem, there will be a 24VDC voltage output available at connector pin 4.

The power supply has to be a single voltage source capable of providing a current peak during an active transmission. The uplink burst causes strong ripples (drop) on the power lines.

The modem module is switched on at the same time the modem is powered. It also has an Automatic Restart after Shutdown feature that allows an application to always be switched on and to restart itself.

The internal LED called *POWER GOOD* will light when power is present.

The MTX-IND modems also have an internal 1650mAh Li-Po battery which allows the device to operate for a few hours (autonomy will vary depending the application) without external power. When external power is applied again, the battery is being charged. Please refer to section 4.5 for further details. The internal LED called *CHARGE* will light when the battery is being charged. If the battery is completely charged or disconnected from board the LED will remain switched off.

Both POWER GOOD and CHARGE status information is available at the internal IO expander.

4.2.3 Internal IO expander

The MTX-IND modems have attached an internal IO expander chip in order to control several functions of the devices such as ASC0 & ASC1 bus configuration, power management, RF card control and IO support.

The IO expander chip is an NXP PCA9535 connected to the GSM module's I2C bus at a 7-bit address 0x27 hexadecimal. Please refer to the device datasheet or the Java code examples available at www.mtxm2m.com in the *Downloads* section, in order to learn how to use I/Os.

The PCA9535 has 16 IO lines which can be configured independently as inputs or outputs by issuing I2C related AT commands or via the I2C Java class.

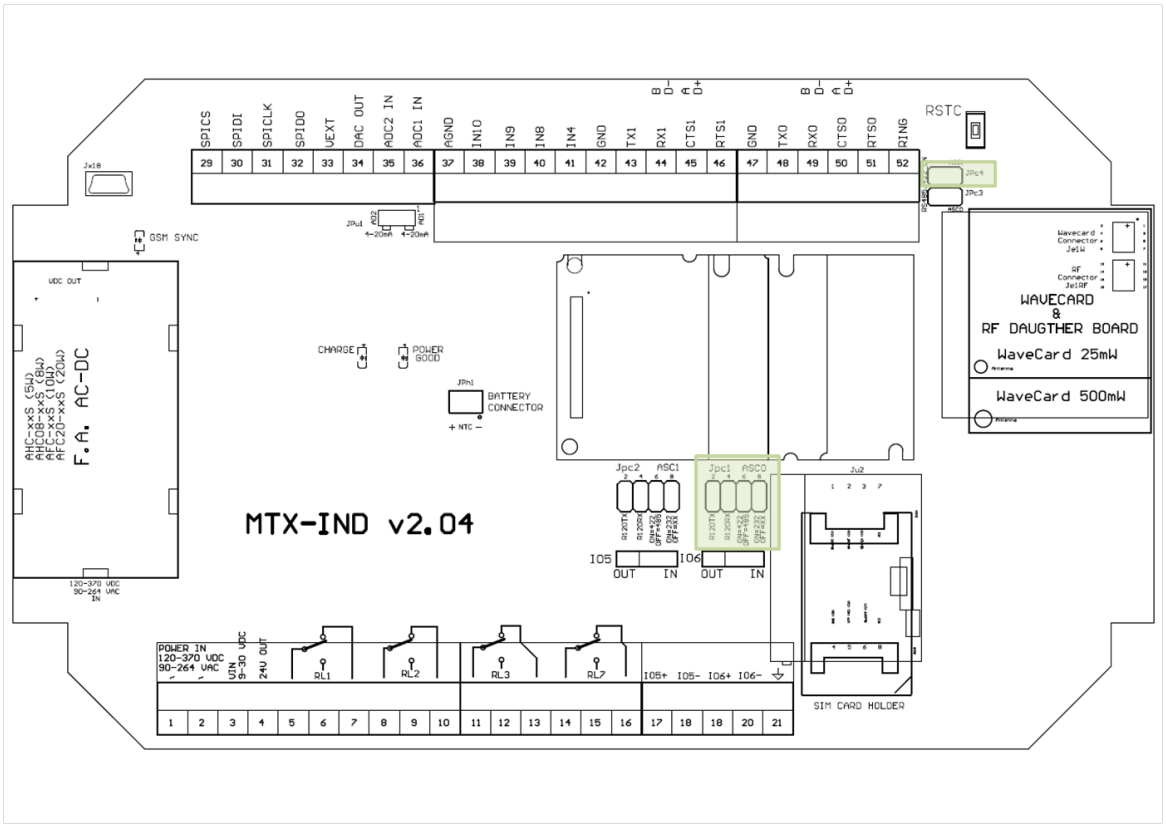
In the following table you can find which signals are assigned to each IO:

TCA9535 chip port	Line function	"Shared" GSM module GPIO
IO0_0	Relay 1 control	GPIO1
IO0_1	Relay 2 control	GPIO2
IO0_2	Relay 3 control	GPIO3
IO0_3	Relay 7 control	GPIO7
IO0_4	ASC0 RS485/RS422 selection	
IO0_5	Enable RF module	
IO0_6	POWER GOOD signal	
IO0_7	CHARGE signal	
IO1_0	ASC0 RS232/RS485 selection	
IO1_1	ASC0 half duplex selection	
IO1_2	ASC1 RS232/RS485 selection	
IO1_3	ASC1 half duplex selection	
IO1_4	User LED control	
IO1_5	ASC1 RS485/RS422 selection	
IO1_6	IO5 line	GPIO5
IO1_7	IO6 line	GPIO6

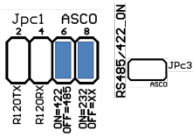
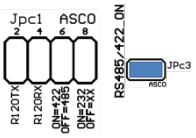
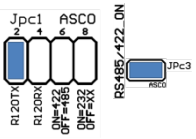
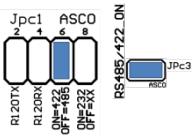
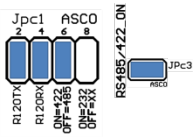
The functionality of each IO will be explained deeper in the next sections.

4.2.4 Main RS232/RS485/RS422 interface (ASC0)

The MTX-IND modems have a standard RS232/RS422/RS485 main serial interface connected to the ASC0 module's UART. The operating mode of this port can be configured by hardware through the internal jumpers JPc1 and JPc3, which are located at the PCB as shown below:



The following table shows the jumpers' positions to choose between different port modes:

Mode	JPc1	JPc3	
RS232 (4 wire)	JP 1-2: Open JP 3-4: Open JP 5-6: Closed JP 7-8: Closed	JP 1-2: Open	
RS485 (no termination)	JP 1-2: Open JP 3-4: Open JP 5-6: Open JP 7-8: Open	JP 1-2: Closed	
RS485 (120Ω termination)	JP 1-2: Closed JP 3-4: Open JP 5-6: Open JP 7-8: Open	JP 1-2: Closed	
RS422 (no termination)	JP 1-2: Open JP 3-4: Open JP 5-6: Closed JP 7-8: Open	JP 1-2: Closed	
RS422 (120Ω termination)	JP 1-2: Close JP 3-4: Close JP 5-6: Closed JP 7-8: Open	JP 1-2: Closed	

You can also do this configuration via software by using the internal IO expander. To do this, the Jpc3 jumper as well as the Jpc1 jumpers 5-6 and 7-8 must remain open. The termination resistor is configured in any case by the Jpc1 jumpers 1-2 and 3-4. The following table shows the possible configurations in this case:

Mode	JPc1	Signals
RS232 (4 wire)	JP 1-2: Open JP 3-4: Open	ASC0 RS232/RS485 selection: logic '0' ASC0 RS485/RS422 selection: logic '0' ASC0 half duplex selection: logic '0'
RS485 (no termination)	JP 1-2: Open JP 3-4: Open	ASC0 RS232/RS485 selection: logic '1' ASC0 RS485/RS422 selection: logic '1' ASC0 half duplex selection: logic '1'
RS485 (120Ω termination)	JP 1-2: Closed JP 3-4: Open	ASC0 RS232/RS485 selection: logic '1' ASC0 RS485/RS422 selection: logic '1' ASC0 half duplex selection: logic '1'
RS422 (no termination)	JP 1-2: Open JP 3-4: Open	ASC0 RS232/RS485 selection: logic '1' ASC0 RS485/RS422 selection: logic '1' ASC0 half duplex selection: logic '0'
RS422 (120Ω termination)	JP 1-2: Closed JP 3-4: Closed	ASC0 RS232/RS485 selection: logic '1' ASC0 RS485/RS422 selection: logic '1' ASC0 half duplex selection: logic '0'

All the interface signals are located at pin 47 to 52 of the terminal block. See section 4.2.1 for signals description.

The RS232 interface of the MTX-IND modems is designed to be used as a DCE (data circuit-terminating equipment). Based on the conventions for DCE-DTE connections, it communicates with the customer application (DTE- data terminating equipment) using the following signals:

- Port TxD @ application sends data to TXD of MTX-IND Terminal
- Port RxD @ application receives data from RXD of MTX-IND Terminal

The RS232 interface is implemented as a serial asynchronous transmitter and receiver conforming to ITU-T V.24 Interchange Circuits DCE. It is configured by default for 8 data bits, no parity and 1 stop bit and can be operated at fixed bit rates from 1200bps to 921600bps.

Autobauding supports bit rates from 1200bps to 230400bps. Autobauding is not compatible with multiplex mode. Hardware handshake using the /RTS and /CTS signals and XON/XOFF software flow control are supported.

In addition the modem control signal RING is available. The MODEM control RING signal (Ring Indication) can be used to indicate to the cellular device application that an incoming call or Unsolicited Result Code (URC) is received. It can also be used to send pulses to the host application; for example, to wake up the application from power saving state.

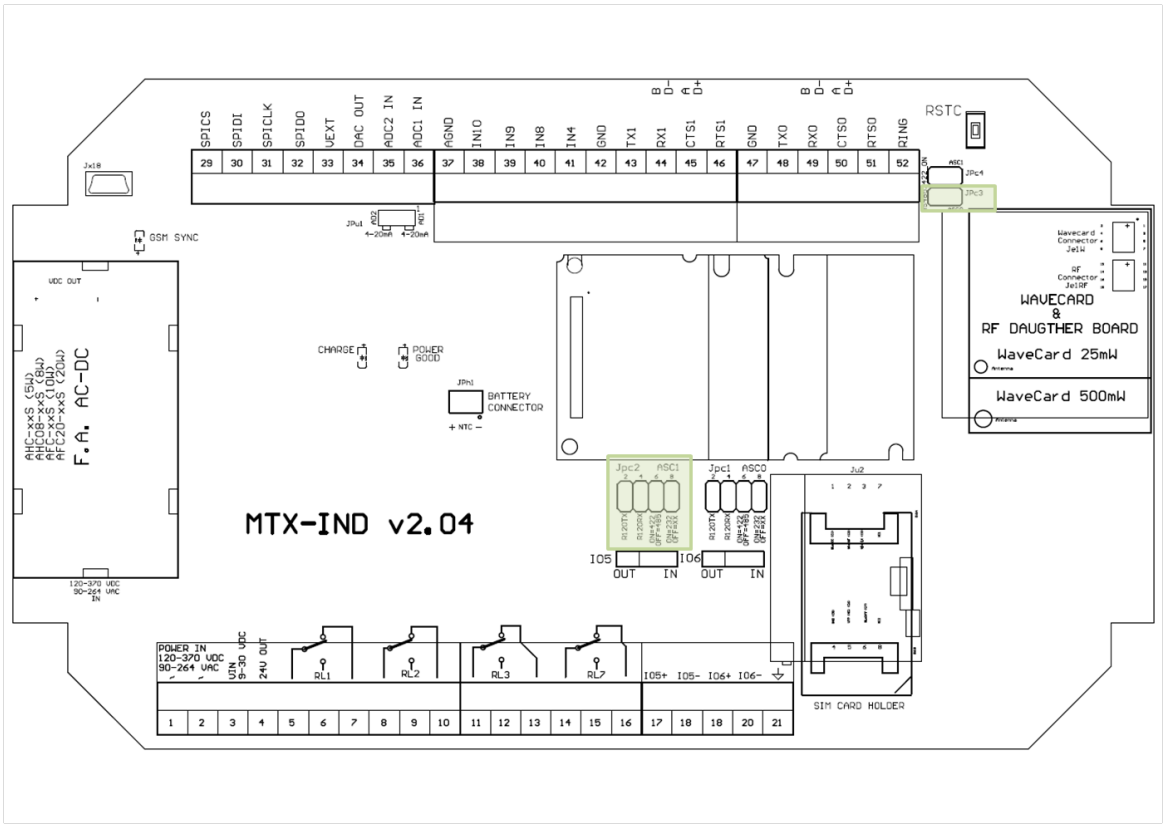
Features

- Includes the data lines TXD0 and RXD0, the status lines RTS0 and CTS0 and also the modem control line RING0.
- ASC0 is primarily designed for controlling voice calls, transferring CSD, fax and GPRS data and for controlling the GSM engine with AT commands.
- Full Multiplex capability allows the interface to be partitioned into three virtual channels, but with CSD and fax services only available on the first logical channel. Please note that when the ASC0 interface runs in Multiplex mode, ASC1 cannot be used.
- The RING0 signal serves to indicate incoming calls and other types of URCs (Unsolicited Result Code). It can also be used to send pulses to the host application; for example, to wake up the application from power saving state. To configure the RING0 line use following AT Command: AT^SCFG.
- By default it is configured for 8 data bits, no parity and 1 stop bit. The setting can be changed using the AT command AT+ICF and, if required, AT^STPB.
- ASC0 can be operated at fixed bit rates from 1200bps to 921600bps.

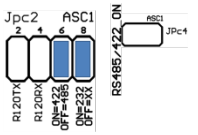
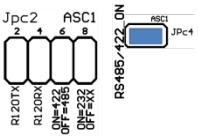
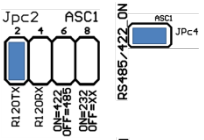
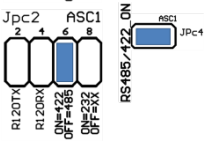
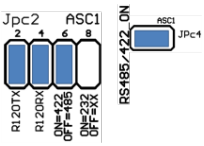
By default, the serial speed for MTX-IND is 115200bps.

4.2.5 Secondary RS232/RS485/RS422 interface (ASC1)

The MTX-IND modems have a standard RS232/RS422/RS485 secondary serial interface connected to the ASC1 module's UART. The operating mode of this port can be configured by hardware through the internal jumpers JPc2 and JPc4, which are located at the PCB as shown below:



The following table shows the jumpers' positions to choose between different port modes:

Mode	JPc2	JPc4	
RS232 (4 wire)	JP 1-2: Open JP 3-4: Open JP 5-6: Closed JP 7-8: Close	JP 1-2: Open	
RS485 (no termination)	JP 1-2: Open JP 3-4: Open JP 5-6: Open JP 7-8: Open	JP 1-2: Closed	
RS485 (120Ω termination)	JP 1-2: Closed JP 3-4: Open JP 5-6: Open JP 7-8: Open	JP 1-2: Closed	
RS422 (no termination)	JP 1-2: Open JP 3-4: Open JP 5-6: Closed JP 7-8: Open	JP 1-2: Closed	
RS422 (120Ω termination)	JP 1-2: Close JP 3-4: Closed JP 5-6: Closed JP 7-8: Open	JP 1-2: Closed	

You can also do this configuration via software by using the internal IO expander. To do this, the Jpc3 jumper as well as the Jpc1 jumpers 5-6 and 7-8 must remain open. The termination resistor is configured in any case by the Jpc1 jumpers 1-2 and 3-4. The following table shows the possible configurations in this case:

Mode	JPc2	Signals
RS232 (4 wire)	JP 1-2: Open JP 3-4: Open	ASC1 RS232/RS485 selection: logic '0' ASC1 RS485/RS422 selection: logic '0' ASC1 half duplex selection: logic '0'
RS485 (no termination)	JP 1-2: Open JP 3-4: Open	ASC1 RS232/RS485 selection: logic '1' ASC1 RS485/RS422 selection: logic '1' ASC1 half duplex selection: logic '1'
RS485 (120Ω termination)	JP 1-2: Closed JP 3-4: Open	ASC1 RS232/RS485 selection: logic '1' ASC1 RS485/RS422 selection: logic '1' ASC1 half duplex selection: logic '1'
RS422 (no termination)	JP 1-2: Open JP 3-4: Open	ASC1 RS232/RS485 selection: logic '1' ASC1 RS485/RS422 selection: logic '1' ASC1 half duplex selection: logic '0'
RS422 (120Ω termination)	JP 1-2: Closed JP 3-4: Closed	ASC1 RS232/RS485 selection: logic '1' ASC1 RS485/RS422 selection: logic '1' ASC1 half duplex selection: logic '0'

All the interface signals are located at pins 42 to 46 of the terminal block. See section 4.2.1 for the signals' description.

The RS232 interface of the MTX-IND modems is designed to be used as a DCE (data circuit-terminating equipment). Based on the conventions for DCE-DTE connections, it communicates with the customer application (DTE- data terminating equipment) using the following signals:

- Port TxD @ application sends data to TXD of MTX-IND Terminal
- Port RxD @ application receives data from RXD of MTX-IND Terminal

The RS232 interface is implemented as a serial asynchronous transmitter and receiver conforming to ITU-T V.24 Interchange Circuits DCE. It is configured by default for 8 data bits, no parity and 1 stop bit and can be operated at fixed bit rates from 1200bps to 921600bps.

Features

- Includes the data lines TXD1 and RXD1 and the status lines RTS1 and CTS1
- ASC1 is primarily designed for controlling voice calls, transferring CSD, fax and GPRS data and for controlling the GSM engine with AT commands.
- By default it is configured for 8 data bits, no parity and 1 stop bit. The setting can be changed using the AT command AT+ICF and, if required, AT^STPB.
- ASC1 can be operated at fixed bit rates from 1200bps to 921600bps. Autobauding is not supported on ASC1.

By default, the serial speed for MTX-IND is 115200bps.

4.2.6 I2C bus

I2C is a serial, 8-bit oriented data transfer bus for bit rates up to 400kbps in Fast mode. It consists of two lines, the serial data line I2CDAT and the serial clock line I2CCLK.

The MTX-IND modem acts as a single master device, e.g. the clock I2CCLK is driven by the modem. I2CDAT is a bi-directional line.

Each device connected to the bus's software is identified by a unique 7-bit address. Simple master/slave relationships exist at all times: the modem operates as master-transmitter or as master-receiver. The customer application transmits or receives data only at the modem's request.

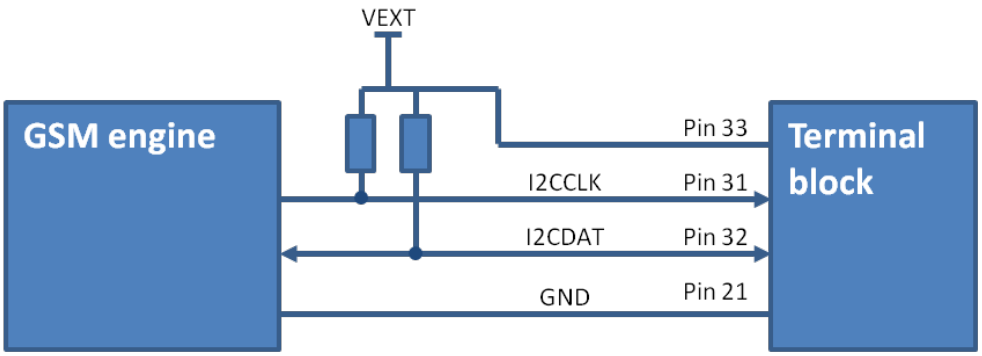
I2C lines are located at pins 31 and 32 of the terminal block

Signal	Direction	Description
I2CCLK	Output	I2C bus clock signal[1234]
I2CDAT	I/O	I2C data bus[1234]

1. I2C lines are Open Drain. Internal 10kOhm pull-up resistors are mounted, so there is no need to fit them by the host application.
2. According to the I2C Bus Specification Version 2.1 for the fast mode a rise time of max. 300ns is permitted.
3. The value of the pull-up depends on the capacitive load of the whole system (I2C Slave + lines). The maximum sink current of I2CDAT and I2CCLK is 4mA.
4. If lines are unused, keep pins open

Use the AT^SSPI command or Java class to configure and activate the I2C bus.

The picture below shows I2C interface is powered from an internal VEXT supply line so the I2C interface will be properly shut down when the modem enters the Power-down mode.

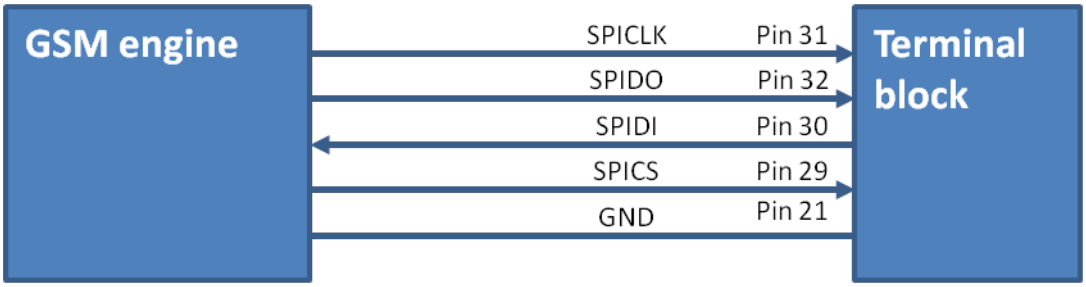


By default, the terminal block pins corresponding to the I2C and SPI interfaces are not mounted on the PCB.

4.2.7 SPI bus

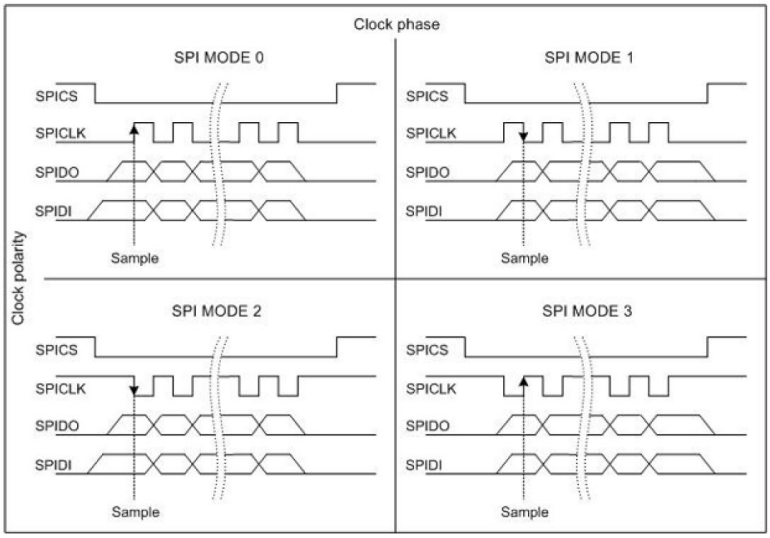
The SPI bus (Serial Peripheral Interface) is a synchronous serial interface for control and data transfer between the MTX-IND modem and the connected application. Only one application can be connected to the module's SPI. The interface supports transmission rates of up to 6.5Mbps. It consists of four lines: the two data lines SPIDI/SPIDO, the clock line SPICLK and chip select line SPICS.

The MTX-IND modem acts as a single master device, e.g. the clock SPICLK is driven by the modem. Whenever the SPICS pin is in a low state, the SPI bus is activated and data can be transferred from the module and vice versa. The SPI interface uses two independent lines for data input (SPIDI) and data output (SPIDO).



To configure and activate the SPI bus use the AT^SSPI command. If the SPI bus is active the two lines I2CCLK and I2CDAT are locked for use as SPI lines.

SPI supports four operation modes. The modes are different in clock phase and clock polarity. The module's SPI mode can be configured by using the AT command AT^SSPI. Make sure the module and the connected slave device works with the same SPI mode. The following picture shows the characteristics of the four SPI modes. The SPI modes 0 and 3 are the most commonly used modes.

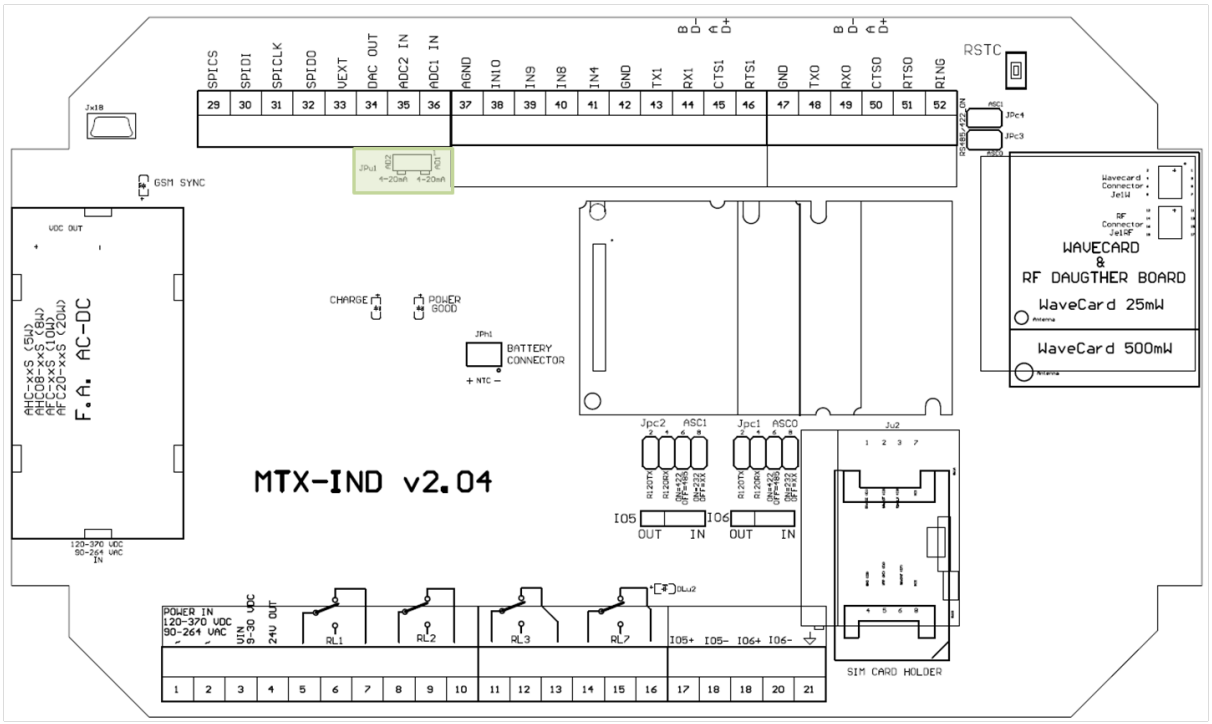


The SPI interface is only available if pins 1 and 6 of the I/O interface connector are not used as an I2C interface. By default, terminal block pins corresponding to I2C and SPI interfaces are not mounted on PCB.

4.2.8 Analog-to-Digital and Digital-to-Analog converters

The MTX-IND modem has 2 independent, unbalanced analog inputs as well as 1 analog output. Depending on the internal GSM module used (2G or 3G) there are several differences between them which will be described in detail in the following sections.

Both analog inputs can be configured for measuring DC voltages in the range of 0 to 2.4V, or DC currents in the range of 0-20mA. This is done with the jumper JPu1. The next figure shows its exact location on the PCB.



The following table shows the configuration of each analog input:

Mode	JPu1
ADC1 voltage, ADC2 voltage	JP 1-2: Open JP 3-4: Open
ADC1 voltage, ADC2 current	JP 1-2: Open JP 3-4: Closed
ADC1 current, ADC2 voltage	JP 1-2: Closed JP 3-4: Open
ADC1 current, ADC2 current	JP 1-2: Closed JP 3-4: Closed

4.2.8.1 2G models

The ADC of the MTX-IND-2G consists of 2 independent, unbalanced, multiplexed analog inputs that can be used for measuring external DC voltages in the range of 0mV…+2400mV. The ADC has a resolution of 12 bits.

Use the command AT^SRADC to select the analog inputs ADC1_IN or ADC2_IN, to set the measurement mode and read out the measurement results. The measured values are indicated in mV.

There is no out of range detection. Voltages beyond these limits cannot be measured:

- Underflow: Values ≤ -25mV
- Overflow: Values > 2425mV

The sample period is adjustable from 30s up to 100ms by AT^SRADC. Only during sample time (ts~400µs) is the S&H switch closed.

The DAC of the MTX-IND-2G consists of one independent and unbalanced PWM digital output that can be used to generate signals in the range of 0mV...3000mV.

Use the command AT^SWDAC to set the PWM frequency and the duty cycle. You can use the following values of frequency: 320, 970, 8125, 16250, 32500 or 65000Hz; it is also possible to set the duty cycle in percentage steps between 0 and 100%.

You can use an external filter (such as a simple RC filter) to smooth the PWM signal and obtain the baseband signal.

4.2.8.2 3G models

The ADC/DAC of the MTX-IND-3G consists of two independent, unbalanced, multiplexed analog inputs as well as one unbalanced analog output, which can be used for measuring external DC voltages in the range of 0mV…+2988.3mV, or generate them in the same range. Both ADC and DAC have a resolution of 8 bits, which means that the voltage resolution in the given range is 11.71875mV.

The MTX-IND-3G has an internal ADC/DAC chip (PCF8591) connected to its I2C bus, at a 7-bit address 0x48 hexadecimal. Maximum bus frequency allowed is 100kHz.

The A/D converter uses the successive approximation conversion technique. The D/A converter and a high-gain comparator are used temporarily during the A/D conversion cycle.

The D/A converter consists of a resistor divider chain connected to the external reference voltage with 256 taps and selection switches. The tap-decoder switches one of these taps to the DAC output line. The analog output voltage is buffered by an auto-zeroed unity gain amplifier.

In order to release the DAC for an A/D conversion cycle the unity gain amplifier is equipped with a track and hold circuit. This circuit holds the output voltage while executing the A/D conversion.

You can configure and use the ADC/DAC converters by issuing I2C related AT commands or via the I2C Java class.

The maximum A/D and D/A conversion rate is given by the actual speed of the I2C bus.

You can find Java code examples in the *Downloads* section at www.mtxm2m.com

- **D/A conversion**

In order to write a new sample to the DAC buffer, you have to send three bytes over the I2C bus before sending the I2C STOP condition

1. Address byte (write mode): 0x90 hexadecimal
2. Control byte: 0x40 hexadecimal
3. Data byte: the 8-bit sample value in straight binary format

You can calculate the sample value you have to write to the D/A converter using the following expression:

$$D = \frac{256}{3} V_{DACOUT}$$

where D is the sample value in decimal format ($0 \leq D \leq 255$) and V_{DACOUT} is the voltage value you want to generate ($0 \leq V_{DACOUT} \leq$ 2988.3mV)

- **A/D conversion**

In order to read samples from the ADC buffer, you have to send three bytes over the I2C bus before sending the I2C STOP condition

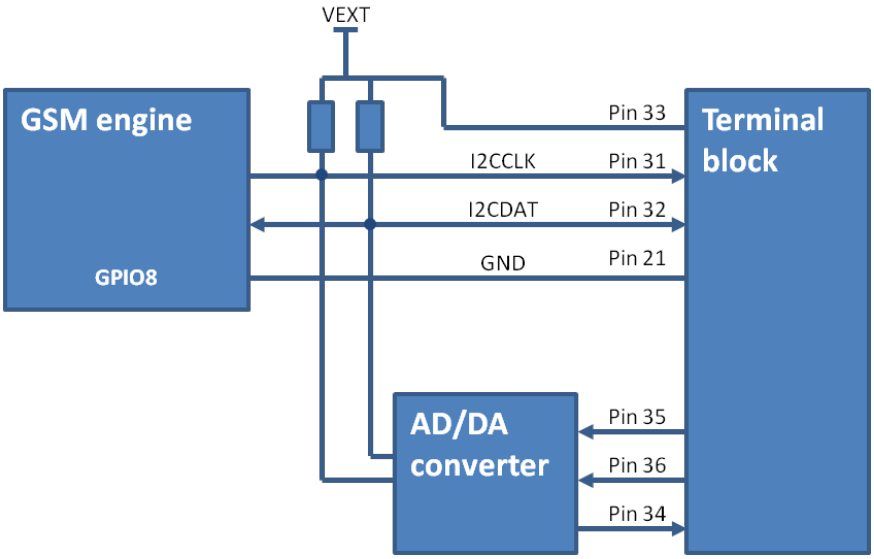
1. Address byte (write mode): 0x90 hexadecimal
2. Control byte:
   a. 0x00 hexadecimal to read from ADC1
   b. 0x01 hexadecimal to read from ADC2
3. Address byte (read mode): 0x91 hexadecimal
4. Dummy byte 1: 0x00 hexadecimal
5. Dummy byte 2: 0x10 hexadecimal

After that you should have three bytes in the I2C read buffer: the second one is the 8-bit sample value retrieved from the AD converter, in straight binary format.

You can calculate the voltage value from the A/D input using the following expression:

$$V_{ADC} = \frac{3}{256} D$$

where V_{ADC} is the voltage value present at the A/D converter input ($0 \leq V_{ADC} \leq 2988.3$mV) and D is the sample value in decimal format ($0 \leq D \leq 255$)

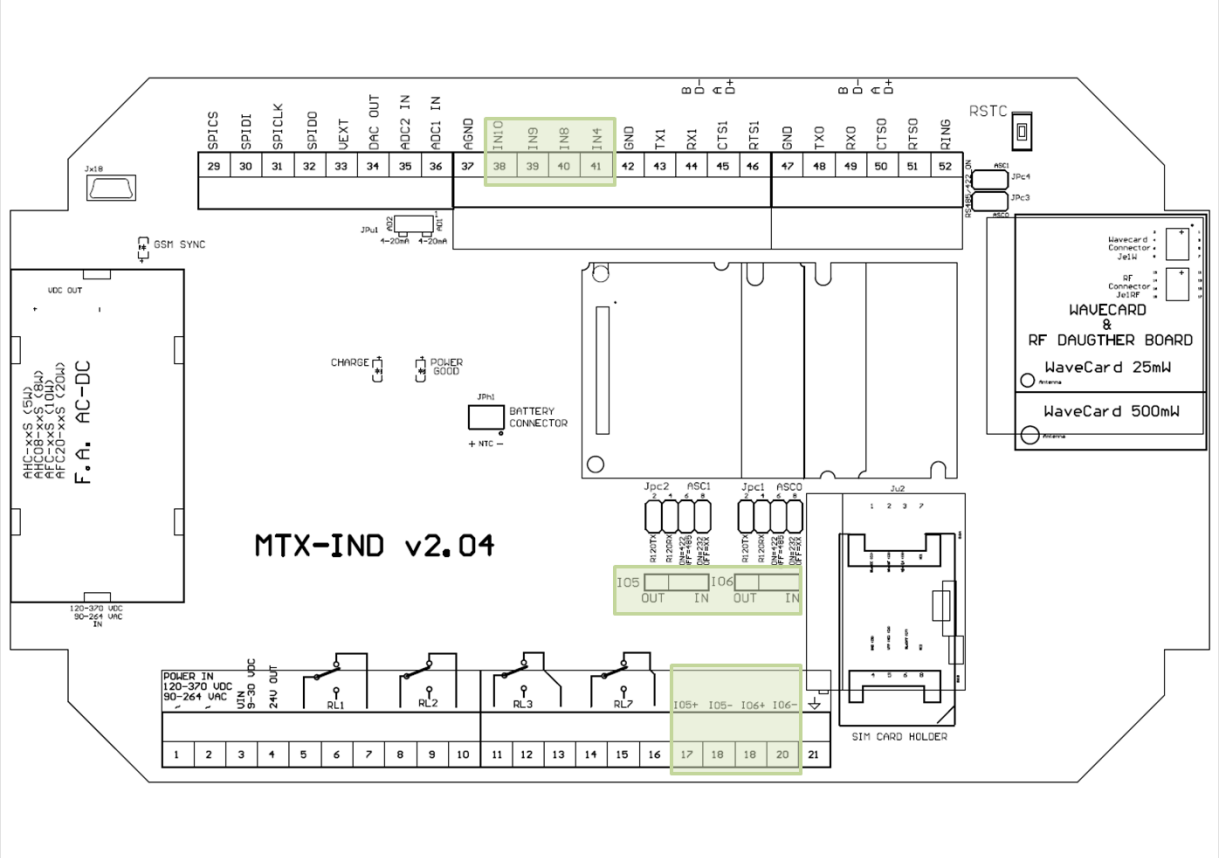


4.2.9 Optoisolated I/O

The MTX-IND modem has 2 bidirectional (hardware configurable) optoisolated input/outputs (IO5 and IO6) as well as 4 optoisolated inputs (IN4, IN8, IN9 and IN10) available for use by the user.

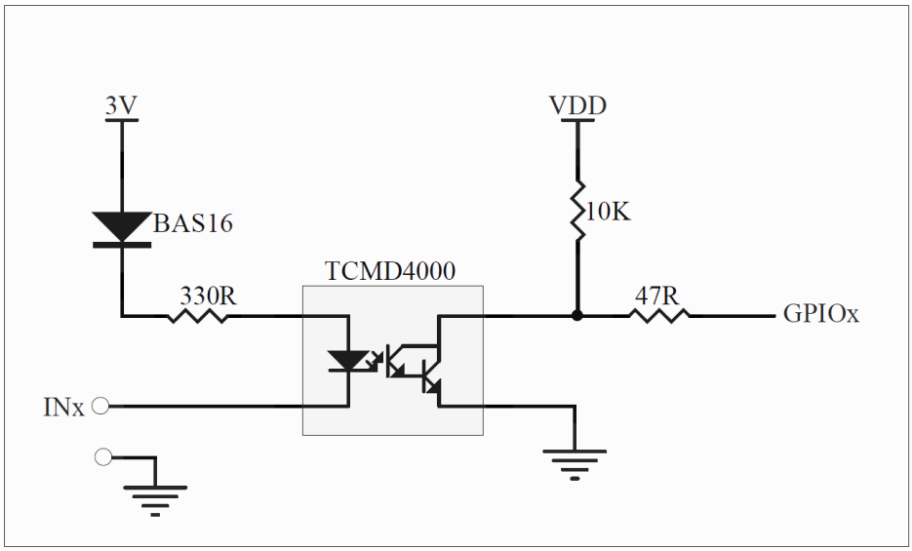
The two optoisolated I/Os are located at pins 17 to 20 of the terminal block connector, and the four optoisolated inputs are located at pins 38 to 41.

To configure the direction of IO5 and IO6 you must use the switches SW1 and SW2 respectively. Please see the following figure for exact board locations of these items



IN4, IN8, IN9 and IN10

The optoisolated inputs IN4, IN8, IN9 and IN10 are connected directly to the GSM module's GPIO4, GPIO8, GPIO9 and GPIO10 respectively. The electrical equivalent circuit of each input is shown in the following figure:



Optoisolated inputs equivalent circuit

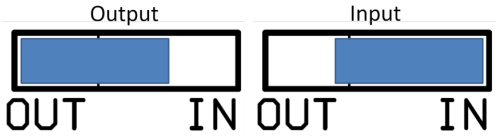
0V ≤ VIN ≤ 2.5V → Logic '0'

2.7V ≤ VIN ≤ 40V → Logic '1'

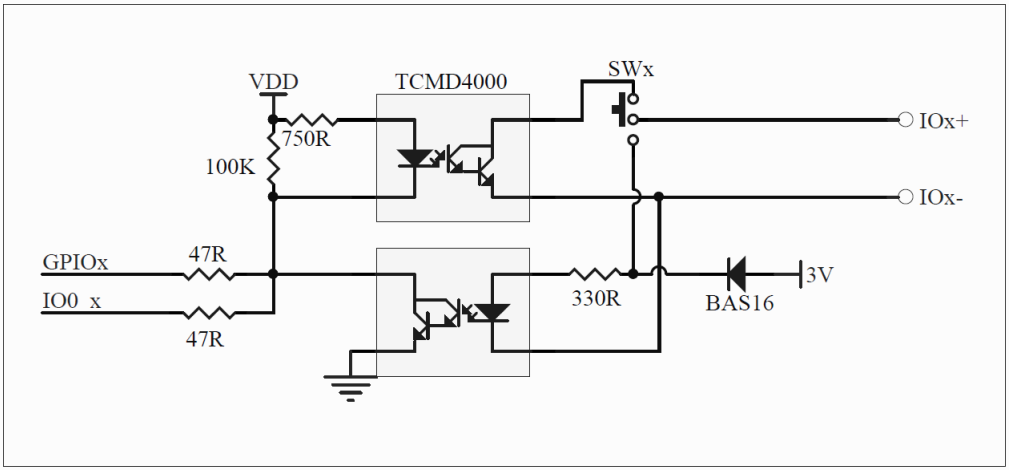
IO5 and IO6

All these optoisolated I/Os are controlled by both the GPIO lines of the internal GSM module (TC65i or EHS6) as well as the internal IO expander. This allows setup the behaviour on reset of each I/O (when configured as outputs): if use the IO expander, the line value will remain stable when GSM modules were switched off.

With SW1 and SW2 you can configure the direction of IO5 and IO6 as shown below:



The electrical equivalent circuit of each input/output is shown in the following figure:



Optoisolated inputs/outputs equivalent circuit

Please note that you must choose between module or IO expander lines to control IO5 and IO6 in output mode: if you set the module's GPIO as outputs, IO expander lines must be set as inputs and vice versa.

In 3G models, the module's GPIO are controlled by another NXP PCA9535 IO expander attached to the I2C bus at a 7-bit address 0x20 hexadecimal. Please refer to the device datasheet or the Java code examples available at www.mtxm2m.com in the *Downloads* section, in order to learn how to use I/Os.

In the following table you can find the module's IO assignments:

TCA9535 chip port	"Shared" GSM module GPIO
IO0_0	GPIO1
IO0_1	GPIO2
IO0_2	GPIO3
IO0_3	GPIO4
IO0_4	GPIO5
IO0_5	GPIO6
IO0_6	GPIO7
IO0_7	GPIO8
IO1_0	GPIO9
IO1_1	GPIO10

4.2.10 Relay outputs

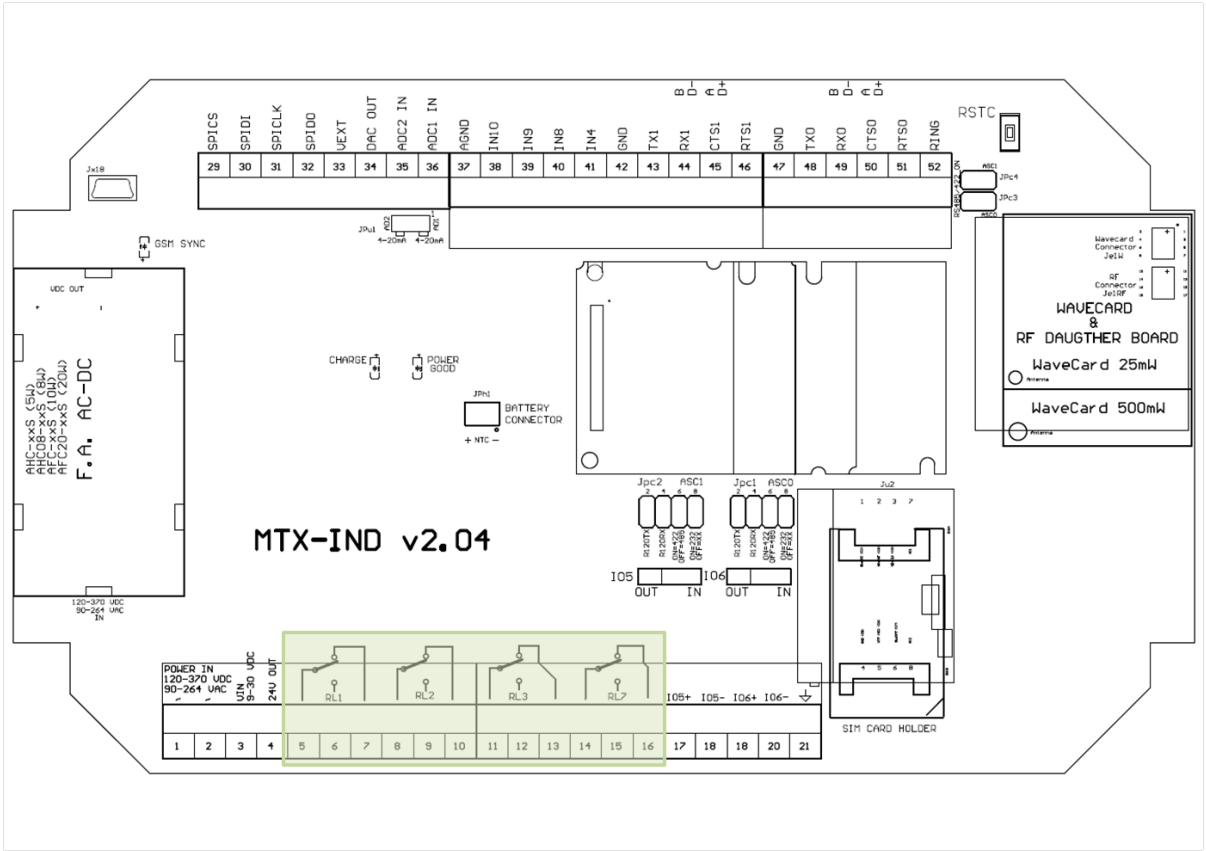
The MTX-IND modem has up to four 1-form-C (SPDT) relays with a contact rating of 6A, 250VAC/24VDC.

The contacts of each relay (Common, Normally Open and Normally Closed) are available on the terminal block connector's pins 5 to 16. All relays are controlled with module's GPIOs and IO expander, as shown in table below:

Relay	GPIO number	IO expander line
RL1	GPIO 1	IO0_0
RL2	GPIO 2	IO0_1
RL3	GPIO 3	IO0_2
RL7	GPIO 7	IO0_3

Please note that you must choose between module or IO expander lines to control the relay: if you set the module's GPIO as outputs, IO expander lines must be set as inputs and vice versa.

To activate the relay, a logic-1 must be set at the corresponding GPIO module.



4.3 GSM/GPRS antenna connector

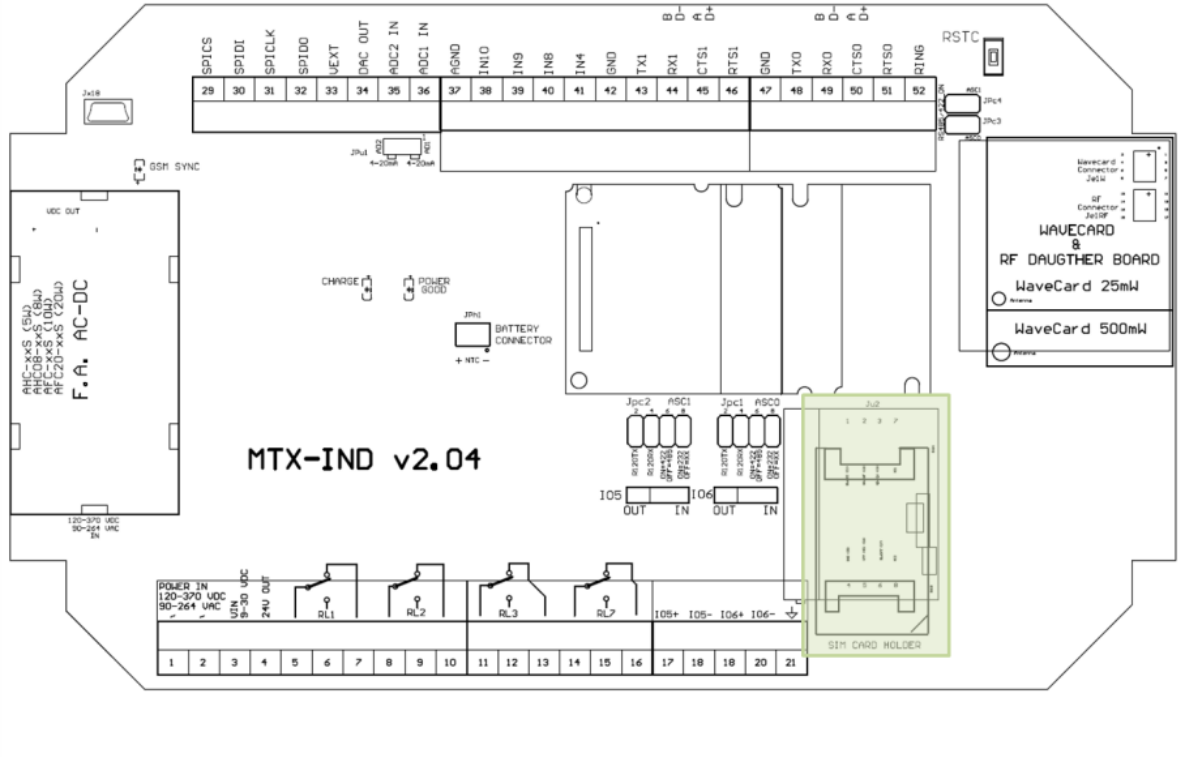
The antenna connector allows radio frequency (RF) transmission signals between the modem and an external customer-supplied antenna. The modem is fitted with a 50Ω, SMA female coaxial jack.

The external antenna must be properly matched to achieve the best performance regarding radiated power, DC-power consumption, modulation accuracy and harmonic suppression.

Optionally, an internal 5 band 2.5dBi patch antenna can be ordered upon request.

4.4 SIM card reader

The MTX-IND modem is fitted with a SIM card reader designed for 1.8V and 3V SIM cards. It is the flip-up type which is lockable in the horizontal position and is accessed through a removable panel as shown below.



The card holder is a six wire interface according to GSM 11.11. It has a SIM card detector switch to detect whether or not the SIM card drawer is inserted.

Removing and inserting the SIM card during operation requires the software to be reinitialized. Therefore, after reinserting the SIM card it is necessary to restart the MTX-IND modem.

The full operation of the MTX-IND relies on a SIM card being inserted. Some MTX-IND functionality may be lost if you try to operate the control modem without a SIM card.

4.5 Internal Li-Po battery

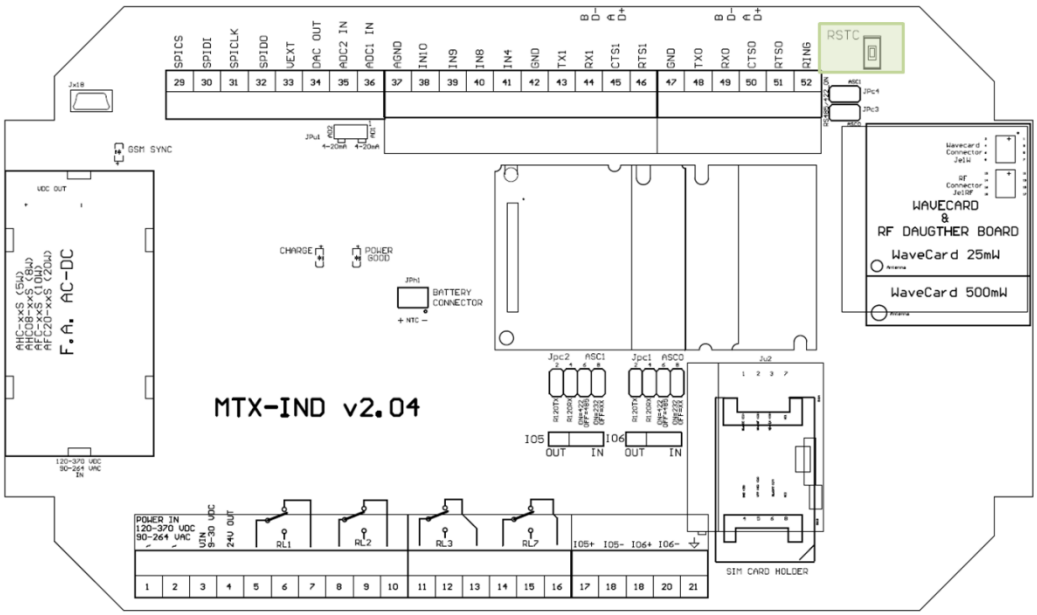
The MTX-IND devices have an internal 3.7V 1650mAh Li-Po battery attached. The unit is shipped with the battery disconnected. Please open the unit and connect the battery connector to the main board and then plug in the power supply to the terminal block supply pins for around 5 hours to fully charge the battery.

You can know the battery level using the AT command AT^SBV. The command result is given in mV. When charging, the previous value is increased in +200mV. It is also possible to know if the charger is plugged in by testing the LED *"Charge"*. The Charge signal information is also present at the internal IO expander: logic '0' denotes battery is charging.

With the battery attached, the VEXT voltage value at the terminal block is approximately 3.86V when charger is plugged in. If not, this values drops to approximately 3.46V.

We do not guarantee full working features with battery voltages below 3.6V. We strongly recommend that you completely switch off the modem when this condition occurs.

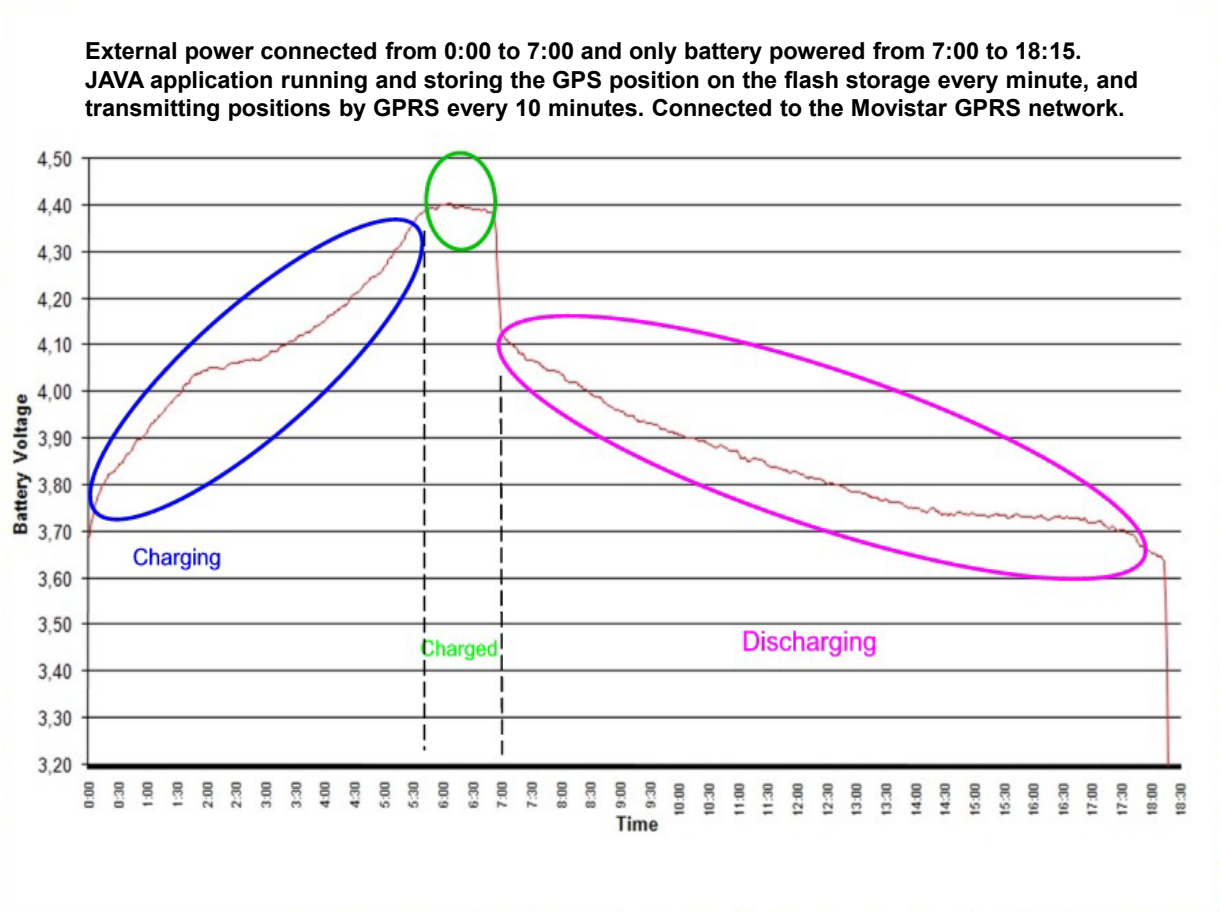
When the battery is attached, the modem will be always powered on and cannot be switched off because "automatic restart" is featured by default. If you need to stop a Java application, when Automatic Restart is enabled you should press the switch button located near the SIM holder as shown in picture below.



The duration of the discharge status depends on the end application. It is very sensitive to transmission (Voice and Data) so we recommend making as few connections as possible and keeping them as short as possible. Please disable GPS, or keep it in a low power mode when possible to extend battery life when longer periods of use (without charging) are required.

Keep in mind that the battery will be 100% operative when a few complete charge and discharge cycles have been performed.

Example 1. Li-Po battery attached, 25ºC ambient temperature



The blue colored circle shows when the battery is being charged. When it reaches 4.40V (to be checked using the AT^SBV command), the battery is fully charged (green colored circle). In the above example, charging time is 6 hours 30 minutes.

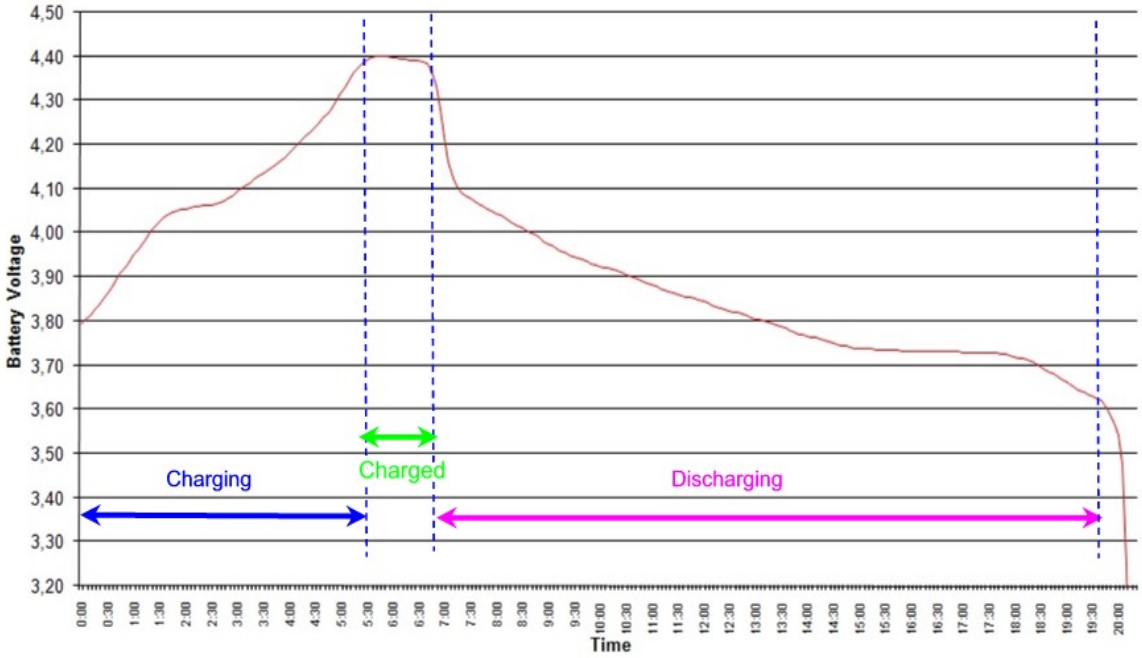
If the charger is disconnected, the battery starts to discharge. The duration of the battery is very dependent upon the applications used; in the example above, the battery lasts approximately 11 hours 30 minutes. Please note that the minimum battery level module switches off automatically, when the battery voltage is around 3.65V (please remember to check using the AT^SBV command).

Example 2. Li-Po battery attached, 25ºC ambient temperature

Example 2 has the same charging time (indicated by the blue arrow) as in example 1 (6 hours 30 minutes); at this time the battery is fully charged; checking using the AT^SBV command, we discover that it is around 4.40V (indicated by the green arrow).

Discharging time in these conditions is around 12 hours, so the more often you connect to GPRS, the shorter the battery will last. Keep GPRS connections short and infrequent where possible to extend battery life if you require longer periods of use without charging.

External power connected from 0:00 to 7:00 and only battery powered from 7:00 to 20:00.
JAVA application running and storing the GPS position on the flash storage every five minutes, and transmitting positions by GPRS every 30 minutes. Connected to the Movistar GPRS network.



Note: there are two internal LEDs that provide information about the battery status:

- The LED named *"CHARGE"* will illuminate when the battery is charging.
- The LED named *"POWER GOOD"* will illuminate when external power is applied.

4.6 Real Time Clock

The GSM module attached to MTX-IND devices contains a real time clock (RTC) to maintain accurate timekeeping and to enable you to “time stamp” messages.

This RTC is supplied by a separate voltage regulator, which is also active when the MTX-IND is in power down mode and a power supply is available. An alarm function is provided that allows the MTX-IND to wake up in Airplane mode without logging onto the GSM network.

The MTX-IND modems can also accommodate an independent battery or super-cap inside to maintain the date and time of the RTC when the power supply is disconnected. Both the battery and the super-cap will be charged when the power supply is present again.

The size of the capacitor determines the duration of buffering when no voltage is applied to MTX-IND; the larger the capacitor, the longer the date and time will be saved by the device. A serial 1kΩ resistor placed on the board next to VDDLP limits the charged current of an empty capacitor or battery.

This capacitor is not fitted by default and must be ordered separately. Please contact gsmsupport@matrix.es for more details.

If you need the internal RTC, please contact gsmsupport@matrix.es

4.7 GPS

The MTX-IND devices can have an internal GPS receiver, which offers the full performance of GPS technology. The GPS receiver continuously tracks all satellites in view, thus providing accurate satellite positioning data.

4.7.1 GPS antenna connector

The antenna connector allows for the transmission of radio frequency (RF) signals between the modem and an external customer-supplied antenna. The modem is fitted with a 50Ω, SMA F coaxial jack.

It is possible to connect active or passive GPS antennas. In either case they must have 50 Ohm impedance.

4.7.2 GPS application interface

The MTX-IND has an internal GPS receiver, which offers the full performance of GPS technology. The GPS receiver continuously tracks all satellites in view, thus providing accurate satellite positioning data.

The GPS receiver supports implemented NMEA protocols. It is able to recognize input messages from any of these protocols (e.g., GGA, RMC GSA, GSV) and respond to them accordingly. Input messages can be arbitrarily mixed.

The NMEA protocol is an industry standard protocol developed for marine electronics. It was originally designed to allow data exchange between various sensors and navigation equipment aboard ships. Nowadays, it is a de-facto standard for GPS receiver data output. For more information on the NMEA Standard, please refer to www.nmea.org.

The GPS receiver can be software controlled using NMEA protocol. We recommend the use of Java code to read NMEA sentences.

The GPS receiver is connected to the TC65i/EHS6 ASC1 port and NMEA data at 9600 bauds is present. JAVA code needs to open the ACS1 port and collect all these protocols and parses to calculate latitude and longitude positions.

To help all customers, Matrix Electronica provides “as is” (without further technical support, warranties, etc.) PARSER source code to improve the time to market in JAVA developing code.

4.7.3 GPS Parser

Matrix Electronica provides MTXParser for developing purposes at no cost.

MTXParser is JAVA source code which basically handles the GPS unit installed on the internal module and translates this into useful information such as positioning, as well as carrying out other useful features like:

- Obtaining GPS positioning in the same format as XT65
- A function to activate/deactivate AutoPowerON feature.
- A function to activate/deactivate/refresh the Hardware Watchdog feature.
- A function to read X,Y,Z acceleration values.
- A function to configure MTX-65i-GPS and power up the alarm: after switching off, the modem will power UP when one axis (X, Y, Z) reaches the trigger acceleration value. Useful to save battery power consumption.
- A function to assist GPS (AGPS). Please ask gsmsupport@matrix.es
- A function to switch ON/OFF secondary red LED for user purposes.

MTXParser can be used as a library/example. We supply this code “as is”: this means that there will be no documentation, no further support will be provided and no warranties will be given regarding functionality. Matrix has tested it and uses it for internal purposes and customer support. It is not commercial software/code.

Please ask gsmsupport@matrix.es to obtain a free copy.

4.7.4 Power saving

Power saving can be enabled on the GSM part (using the AT+CFUN function). On the GPS receiver it is possible to use a special NMEA command. For more information on the AT command AT+CFUN, see the AT command manual.

For more information about the NMEA internal GPS module please ask gsmsupport@matrix.es

4.8 Wireless RF modules

MTX-3G-JAVA can be shipped with an internal RF card installed which allows for use with almost all protocols that exist nowadays, such as Bluetooth, WiFi, ISM, ZigBee, etc.

The RF card is connected to the internal ASC1 port. This means that models mounting an RF card, ASC1 will not be available to be used by the terminal block connector.

RF card modules can have internal or external antennas. In the case of modules mounting external antennas, an SMA Female connector will be available.

The power supply of the internal RF module is controlled by the internal IO expander.

4.8.1 Bluetooth 2.1

It is based on a Bluegiga WT12, which is a next-generation, class 2, Bluetooth 2.1 + EDR module. By default WT12 is shipped with a powerful and easy-to-use iWRAP firmware. This firmware enables users to access Bluetooth functionality with simple ASCII commands delivered to the module over the ASC1 serial interface.

- Bluetooth Class 2 radio
- Integrated chip antenna
- Transmit power: 3dBm
- Receiver sensitivity: -86dBm
- Enhanced Data Rates (EDR) with data throughput up to 2-3Mbps
- Support for Adaptive Frequency Hopping (AFH) and 802.11 co-existence
- UART with bypass mode
- 8Mbits of flash memory
- Supported Bluetooth profiles: SPP, DUN, OBEX OPP, HFP v1.5, DID, and HID + HCI

You can find more information about using the module and how to communicate with it by consulting the module specific user manual available at ftp.matrix.es or by asking our engineers at gsmsupport@matrix.es

4.8.2 Bluetooth Low Energy (4.0)

It is based on Bluegiga WT113, which is a Bluetooth Smart module targeted for small and low-power sensors and accessories. It integrates all the features required for a Smart application, including radio, software stack and GATT-based profiles. The BLE113 can also host end-user applications.

- Bluetooth 4.0 low energy radio
- Transmit power: 0dBm
- Receiver sensitivity: -93dBm

- Integrated antenna
- BGAPI host protocol
- BGScript programming for standalone applications
- Bluetooth Smart (low energy) support
- L2CAP, ATT, GTT, GAP and Security Manager
- Bluetooth Smart profiles
- Client and master mode
- 100kbps+ throughput
- Over-the-air firmware upgrade

You can find more information about using the module and how to communicate with it by consulting the module specific user manual available at ftp.matrix.es or by asking our engineers at gsmsupport@matrix.es

4.8.3 Coronis Wavecard 25/500mW

It is based on Elster Coronis WCA868-OEM-25 (25mW output power) or WCA868-OEM-500 (500mW output power), which allows users to add Wavenis wireless functionality to their products. It can also be used in ad hoc networking for sensor network applications, smart objects, alarms and security, metering and more. The Wavecard is accessed via the ASC1 port of the internal GSM module

- Operates in license-free ISM 868MHz
- Typical data rate 9.6kbps
- Frequency Hopping Spread Spectrum (FHSS)
- GFSK modulation
- Single channel operation for narrowband applications (alarms)
- Point-to-Point and Point-to-Multipoint (broadcast, polling) modes and native repeater (up to 3 hops)
- Tree and star network topologies
- Supports asynchronous and synchronous modes
- EN300-220/FCC15.247 certified & compliant

You can find more information about using the module and how to communicate with it by consulting the module specific user manual available at ftp.matrix.es or by asking our engineers at gsmsupport@matrix.es

4.8.4 ISM (868/900MHz)

This option is only available upon request. Please contact gsmsupport@matrix.es for further information.

4.8.5 WiFi

This option is only available upon request. Please contact gsmsupport@matrix.es for further information.

4.8.6 ZigBee

This option is only available upon request. Please contact gsmsupport@matrix.es for further information.

4.9 Software updates

It is possible and sometimes necessary to update the MTX-IND software.
Updates must be carried out by an approved technician.
Please contact your supplier for details Service/Programming.

5. Operation

5.1 Switching on/off the modem. New *"Automatic restart after shutdown"* feature

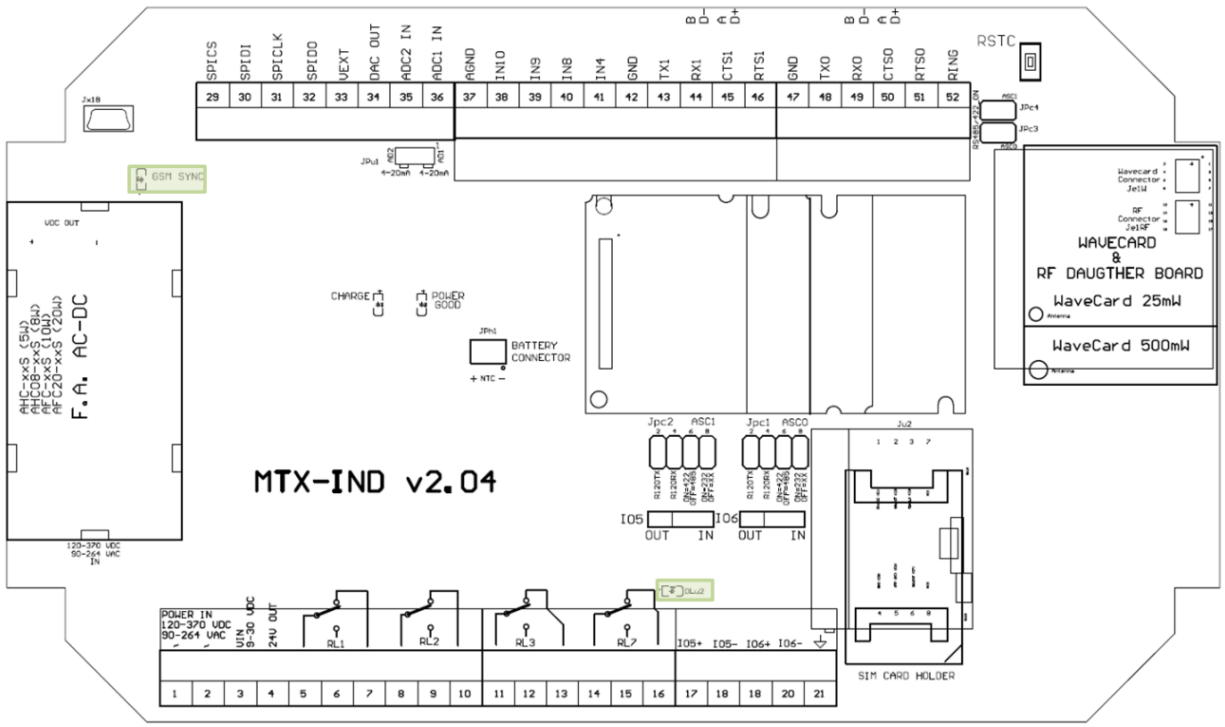
There is no special way to turn the modem on: just apply power to the VIN terminal via a power connector. The modem will be fully operational after 4 to 9 seconds. Logging onto a network may take longer than this and is out of the modem's control.

The *Automatic Restart after Shutdown* feature is enabled as part of the default factory settings, and cannot be disabled. This means that if/when the modem has to be switched off, due to a critical power supply, the modem will restart itself within a few seconds. This feature allows an application to be switched on all the time and also allows it to restart itself.

The only way to switch off the MTX-IND modem is by disconnecting it from the power supply. Furthermore, if you use the AT^SMSO command, the device will log off from the network and then will be restarted.

5.2 Status LEDs (2G models)

The MTX-IND modem has two status LEDs: one called *"GSM SYNC"* which is handled automatically by the modem and indicates its different operating modes, and another one which is user programmable. In the following figure you can see the exact location of these on the PCB board.



The behavior of GSM SYNC LED is configured by AT commands, depending on whether 2G or 3G models are used.

5.2.1 2G models

The LED mode configuration is set by the AT^SSYNC command

LED behavior	ME operating status if AT^SSYNC=1	ME operating status if AT^SSYNC=2
Permanently off	ME is in one of the following modes: - POWER DOWN mode - AIRPLANE mode - CHARGE ONLY mode - NON-CYCLIC SLEEP mode - CYCLIC SLEEP mode with no temporary wake-up event in progress	ME is in one of the following modes: - POWER DOWN mode - AIRPLANE mode - CHARGE ONLY mode
600 ms on / 600ms off	Limited Network Service: No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress.	Same as for AT^SSYNC=1
75 ms on / 3 s off	IDLE mode: The mobile is registered to the GSM network (monitoring control channels and user interactions). No call is in progress.	Same as for AT^SSYNC=1
75 ms on / 75 ms off / 75 ms on / 3 s off	One or more GPRS PDP contexts activated.	Same as for AT^SSYNC=1
500 ms on / 50 ms off	Packet switched data transfer is in progress.	Same as for AT^SSYNC=1
Permanently on	Depending on type of call: Voice call: Connected to remote party. Data call: Connected to remote party or exchange of parameters while setting up or disconnecting a call.	Same as for AT^SSYNC=1
<n> ms on / <n> ms off	Not possible: With AT^SSYNC=1, LED signalization is disabled in SLEEP mode.	SLEEP mode is activated (AT+CFUN parameter <fun> ≠ 1), but the ME is not registered to the GSM network (e.g. SIM not inserted or PIN not entered, and therefore, either no network service or only Limited Network Service is available.
25 ms on / 4 * <n> ms off	Not possible: With AT^SSYNC=1, LED signalization is disabled in SLEEP mode.	SLEEP mode is activated (AT+CFUN parameter <fun> ≠ 1) while the ME is registered to the GSM network and in IDLE mode.
25 ms on / <m> ms off / 25 ms on / 3 * <m> ms off	Not possible: With AT^SSYNC=1, LED signalization is disabled in SLEEP mode.	SLEEP mode is activated (AT+CFUN parameter <fun> ≠ 1) while the ME is registered to the GSM network. Additionally, PDP context is activated.

5.2.2 3G models

The LED mode configuration is set by AT^SLED command.

Terminal status	<mode>=1	<mode>=2 <flash>=default	<mode>=2 <flash>=user defined
• GSM CS data call in progress or established • GSM voice call in progress or established • UMTS voice call in progress or established • UMTS CS data call in progress	Permanently ON	10ms ON 990ms OFF	<flash> ms ON 990 ms OFF
• GSM PS data transfer • UMTS data transfer	Permanently ON	10ms ON 1990ms OFF	<flash> ms ON 1990 ms OFF
• ME registered to a network. No call, no data transfer	Permanently ON	10ms ON 1990ms OFF	<flash> ms ON 3990 ms OFF
• Limited Network Service (e.g. no SIM, no PIN or during network search)	500ms ON 500ms OFF	10ms ON 990ms OFF	<flash> ms ON 990 ms OFF

6. AT command interpreter

After a successful installation of the GSM module driver package (TC65i for 2G models and EHS6 for 3G models), the physical USB interface of the modem is represented in the operating system by two virtual interfaces, each assigned to a virtual COM port of its own:

- **Modem interface:**

This interface is referred to as "Modem" if queried using the AT^SQPORT command. In the quick reference tables it is named USB0-MDM.

The Modem interface is intended particularly for data transmission (UMTS or GPRS).

All URCs are normally issued on the Application interface. URCs related to data calls (RING, NO CARRIER) as well as the "^SYSSTART" URC are issued on the Modem interface.

- **Application interface:**

This interface is referred to as "Application" if queried using the AT^SQPORT command. In the quick reference tables it is named USB0-APP.

The Application interface is designed especially to control the MTX-IND, i.e. for entering AT commands, receiving URCs, or sending and receiving short messages. It cannot be used as a data interface for UMTS, or GPRS.

Please note that URCs are normally indicated only on this interface, no matter whether the Modem interface or the Application interface was used to send the AT commands to activate their presentation. This URC management scheme is the default configuration recommended for a typical MTX-IND application.

Bear in mind that the Modem interface and the Application interface are handled by the same AT command interpreter.

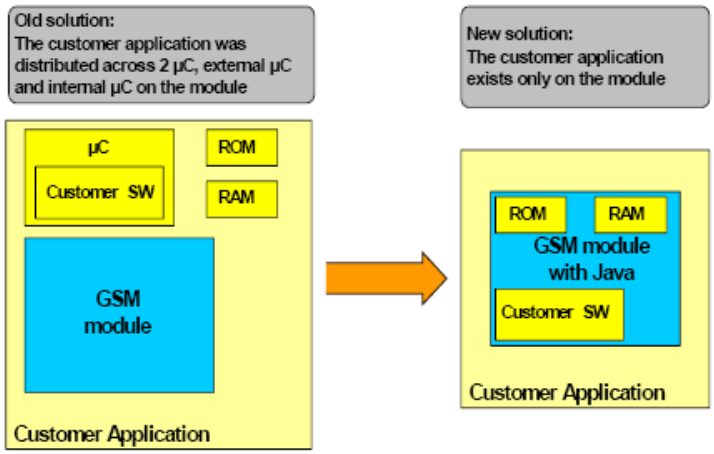
As a result, AT commands entered on both interfaces are not executed in parallel but sequentially, one after the other. So, an AT command issued on one interface will be buffered on this interface to be executed after the other interface has completed processing earlier AT command(s).

When a data connection is established over the Modem interface, the Application interface can be used simultaneously for any control functions. This eliminates the need for the user to enter AT commands, such as +++ and ATO, as well as switching back and forth between command and online mode when working on one interface only.

See the MTX-IND Quick Start guide for a complete step by step installation process.

7. Embedded applications

The MTX-IND can embed an internal application written in popular JAVA language. Java technology and several peripheral interfaces on the modem allow you to easily integrate your application. This way, the customer application can be reduced because all the resources (Microcontroller, Flash & RAM memory and all kind of I/O and bus peripheral) can be used by the customer. This solution saves the external intelligence with all the associate costs and also saves space and power consumption.



Features:

- Oracle Java ME Embedded 3.2 Compliant to CLDC 1.1 HI (JSR139) and IMP-NG (JSR228) Java standards.
- Capable of running multiple midlets in parallel with inter-midlet communication.
- Additional Java standard APIs:
  - JSR75 (FileConnection)
  - JSR177 (CRYPTO)
  - JSR280 (XML)
- Additional Java proprietary APIs:
  - AT Command API
  - Watchdog API
- Additional accessible periphery for Java applications
  - I/O pins- I2C Interface, SPI interface, DAC,ADC
  - Serial interfaces (API): (ASC0, ASC1, USB*) can be used to connect external devices
- Memory space for Java programs:
  - Flash File System: around 8 MB
  - RAM: around 6MB
  - Just-in-Time Compiler execution optimization
- Over-the-air update
  - Application SW: OTAP
  - Firmware: FOTA (OMA compliant)

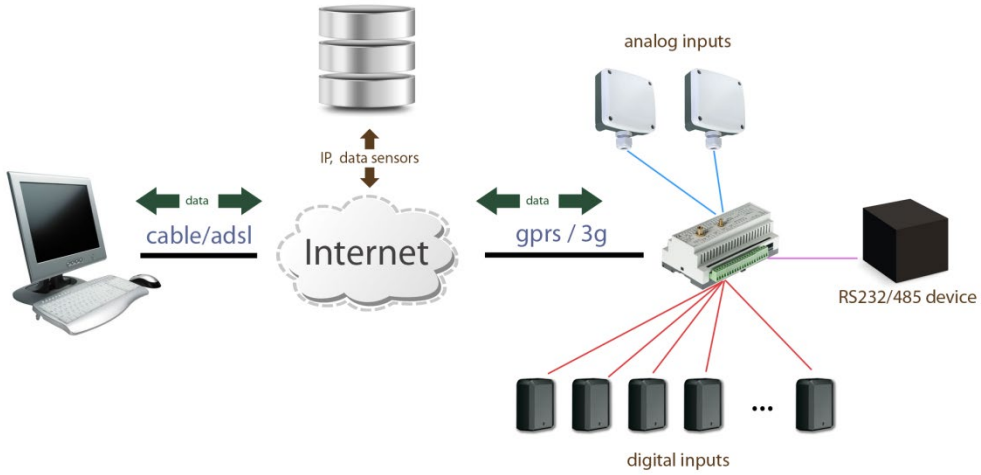
Ask gsmsupport@matrix.es for application notes and a free Cinterion SDK (Software Development Kit), we will provide Matrix FTP server to download it.

7.1 MTX-Tunnel software application

If you are not a JAVA expert and you do not have experts on hand in your company, we have a readily compiled JAVA code which fits into 99% of M2M applications: MTX-TUNNEL. This is optional and must be ordered separately.

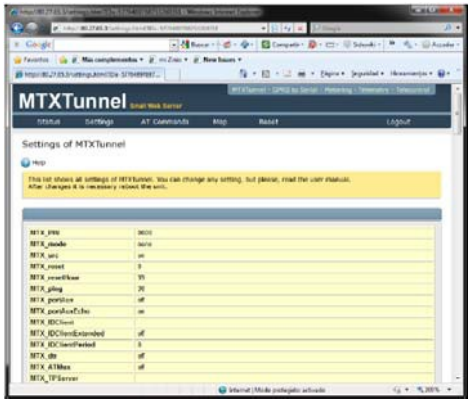
MTX-TUNNEL is an application running in the GSM/GPRS/UMTS modems and is based on the Cinterion TC65i module which is designed for communicating with remote devices that have RS232/I2C ports.

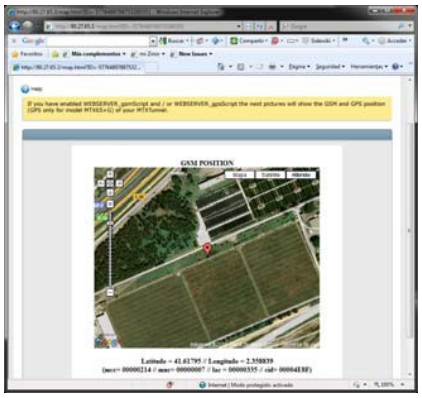
Frequently, remote meters, network switches, routers or other devices need to connect to the network, but they only have an RS232 port and the only possible way to reach them is using the GSM/GPRS Network. MTX-TUNNEL is ready-to-go solution for such cases.

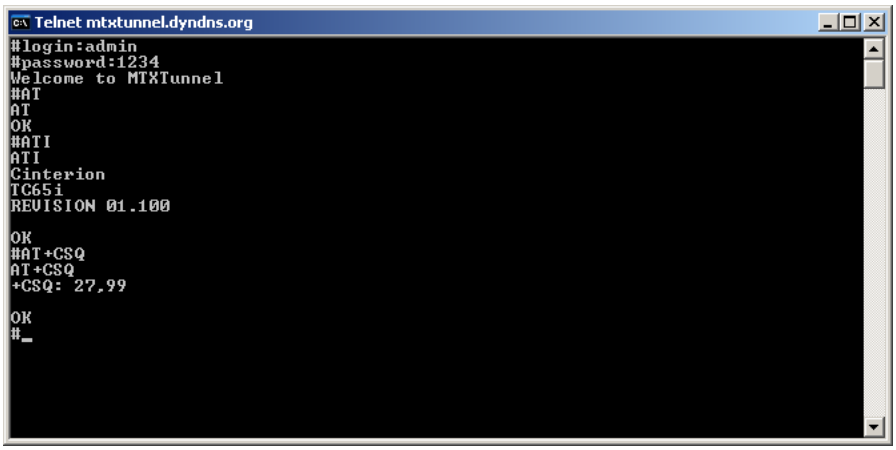


It acts as a transparent RS232 port. You will see your remote devices as if they were directly connected to the computer.

MTX-TUNNEL V8 has extra features like WebServer, SMS telemetry, Telnet, DNS, ModBus and Gateway RF.







Features:

- GPRS-SERIAL TUNNEL
  - TCP Client
  - TCP Server
  - UDP Client / Server
- GPRS connection modes:
  - Permanent mode
  - Upon request (SMS or missed calls, authorized or blocked phone numbers)
  - Change on an input digital level
  - An analog input is out of the selected level window (MIN, MAX)
  - Serial data present on RS232/RS485 port
  - Scheduled date/hour timing
- WebServer
- Telnet
- SMS Alarms and Output control
- IPs dynamic resolution:
  - DynDNS
  - Private DNS
  - SMS
- SSL Security
- Firewall IP
- User API
- Telemetry (GPIOs and GPS)
- Serial RS232/485 – HTTP tunnel
- Serial RS232/485 – SMS tunnel
- Timing synchronization
- ModBus
- RF Gateway

8. Safety and product care

Please read the information in this section and the information in "Installation of the Modem", before starting your integration work!

8.1 Safety instructions

PLEASE READ THESE SAFETY INSTRUCTIONS AND KEEP A COPY OF THEM

- Always ensure that use of the modem is permitted. The modem may present a hazard if used in proximity to personal electronic medical devices. As a rule, the modem must not be used in hospitals, airports or planes.

- Never use the modem at a gas station, refuelling point, blasting area or in any other environment where explosives may be present.

- Operating the modem close to other electronic devices, such as antennas, television sets, and radios may cause electromagnetic interference.

- This product is intended to be used with the antenna or other radiating element at least 20cm away from any part of the human body. In applications where this rule cannot be applied, the application designer is responsible for providing the SAR measurement test report and declaration.

- You are responsible for observing your country's safety standards, and where applicable, the relevant wiring rules.

8.2 General precautions

The MTX-IND modem as a standalone item is designed for indoor use only. For outdoor use it must be integrated into a weatherproof enclosure. Do not exceed the environmental and electrical limits as specified in "Technical Data".

- Avoid exposing the modem to lighted cigarettes, naked flames or to extreme hot or cold temperatures.

- Never try to dismantle the modem yourself. There are no components inside the modem that can be serviced by the user. If you attempt to dismantle the modem, you may invalidate the warranty.

- The MTX-IND modem must not be installed or located in areas where the surface temperature of the plastic case could exceed 85°C.

- In order to provide strain relief and to avoid transmitting excessive vibration to the modem during installation, all cables connected to the MTX-IND modem must be secured or clamped immediately adjacent to the modem's connectors.

- To protect the power supply cables and to comply with fire safety requirements, when the unit is powered from a battery or a high current supply, a fast 1.25A fuse should be connected in line with the positive supply.

- Any incompatible components or products must not be connected to the MTX-IND modem.

Note! MTX-IND distributors and sales offices may refuse warranty claims where evidence of product misuse is found.

8.3 SIM card precautions

Before handling the SIM card in your application, ensure that you are not charged with static electricity. Use proper precautions to avoid electrostatic discharges.

- When the SIM card hatch is opened, the SIM card connectors lie exposed under the SIM card holder.

Caution! Do not touch these connectors! If you do, you may release an electrical discharge that could damage the modem or the SIM card.

- When designing your application, the SIM card's accessibility should be taken into account. We always recommend that you have the SIM card protected by a PIN code. This will ensure that the SIM card cannot be used by an unauthorized person.

8.4 Antenna precautions

If the antenna is to be mounted outside, consider the risk of lightning. Follow the instructions provided by the antenna manufacturer.

- Never connect more than one modem to a single antenna. The modem can be damaged by radio frequency energy from the transmitter of another modem.

- Like any mobile station, the antenna of the modem emits radio frequency energy. To avoid EMI (electromagnetic interference), you must determine whether the application itself, or equipment in the application's proximity, needs further protection against radio emission and the disturbances it might cause. Protection is secured either by shielding the surrounding electronics or by moving the antenna away from the electronics and the external signal cable.

- The modem and antenna may be damaged if either come into contact with ground potentials other than the one in your application. Beware: ground potentials are not always what they appear to be.

8.5 Radio Frequency (RF) exposure and SAR

Your wireless modem device is a low-power radio transmitter and receiver (transceiver). When it is turned on, it emits low levels of radio frequency energy (also known as radio waves or radio frequency fields).

Governments around the world have adopted comprehensive international safety guidelines, developed by scientific organizations such asICNIRP (International Commission on Non-Ionizing Radiation Protection) and IEEE (The Institute of Electrical and Electronics Engineers Inc.), through periodic and thorough evaluation of scientific studies. These guidelines establish permitted levels of radio wave exposure for the general population. The levels include a safety margin designed to assure the safety of all persons, regardless of age and health, and to account for any variations in measurements.

Specific Absorption Rate (SAR) is the unit of measurement for the amount of radio frequency energy absorbed by the body when using a transceiver. The SAR value is determined at the highest certified power level in laboratory conditions, but the actual SAR level of the transceiver while operating can be well below this value. This is because the transceiver is designed to use the minimum power required to reach the network.

The MTX-IND wireless modem device has been approved for applications where the antenna is located more than20cm from the body. In all other configurations **the user** is responsible for meeting the local SAR regulations.

Users of the MTX-IND wireless modem device are responsible for ensuring that they meet the SAR regulatory requirements of the countries in which they intend to operate the device and that their documentation contains the relevant SAR declaration, certification information and user guidance as appropriate.

8.6 Personal medical devices

Wireless modem devices may affect the operation of cardiac pacemakers, hearing aids and certain other implanted equipment. If a minimum distance of 15 cm (6 inches) is maintained between the MTX-IND modem radiating antenna and a pacemaker, the risk of interference is limited. If the user's application is likely to be situated in the vicinity of personnel, a suitable warning should be contained in the equipment manual to this effect.

9. Modem installation

This chapter gives you advice and helpful hints on how to integrate the MTX-IND Terminal into your application from a hardware perspective.

9.1 Where to install the modem

There are several conditions which need to be taken into consideration when designing your application as they might affect the modem and its function. They are:

9.1.1 Environmental conditions

The modem must be installed so that the environmental conditions stated in the Technical Data chapter such as temperature, humidity and vibration are satisfied.
Additionally, the electrical specifications in the Technical Data section must not be exceeded.

9.1.2 Signal strength

The modem has to be placed in a way that ensures sufficient signal strength. To improve signal strength, the antenna can be moved to another position. Signal strength may depend on how close the modem is to a radio base station. You must ensure that where you intend to use the modem is within the network coverage area. Degradation in signal strength can be the result of disturbance from another source; for example, an electronic device in the immediate vicinity. More information about possible communication disturbances can be found in section 9.3.5.

When an application is completed, you can verify the signal strength by issuing the AT command AT+CSQ.

Tip! Before installing the modem, use an ordinary mobile telephone to check a possible location for it. In determining the location for the modem and antenna, you should consider signal strength as well as cable length.

9.1.3 Connections of components to MTX-IND modem

The user is responsible for the final integrated system. If not correctly designed or installed, external components may cause radiation limits to be exceeded. For instance, improperly made connections or improperly installed antennas can disturb the network and lead to malfunctions in the modem or equipment.

9.1.4 Network and subscription

Before your application is used, you must ensure that your chosen network provides the necessary telecommunication services. Contact your service provider to obtain the necessary information.

- If you intend to use SMS in the application, ensure this is included in your (voice) subscription.
- Consider the choice of supplementary services

9.2 How to install the modem

9.2.1 Power supply

Use a high-quality power supply cable with low resistance. This ensures that the voltages at the connector pins are within the allowed range, even during the maximum peak current.
When the unit is powered from a battery or a high current supply, connect a fast 1.25A fuse in line with the positive supply. This protects the power cabling and modem.

9.2.2 Securing the modem

Before securing the modem take into account the amount of additional space required for the mating connectors and cables that will be used in the application.

- Where access is restricted, it may be easier to connect all the cables to the modem prior to securing it in the application.
- Securely attach the MTX-IND modem to the host application using two 3mm diameter pan-head screws

9.3 Antenna

9.3.1 General

The antenna is the component in your system that maintains the radio link between the network and the modem. Since the antenna transmits and receives electromagnetic energy, its efficient function will depend on:

- The type of antenna (for example, circular or directional);
- The placement of the antenna;
- Communication disturbances in the vicinity in which the antenna operates.

In the sections below, issues concerning antenna type, antenna placement, antenna cable, and possible communication disturbances are addressed. In any event, you should contact your local antenna manufacturer for additional information concerning antenna type, cables, connectors, antenna placement, and the surrounding area.

You should also determine whether the antenna needs to be grounded or not. Your local antenna manufacturer might be able to design a special antenna suitable for your application.

9.3.2 Antenna type

Make sure that you choose the right type of antenna for the modem. Consider the following requirements:

- The antenna must be designed for one of the frequency bands in use; please ask your network provider for more information:
  - GSM 850/900/1800/1900 MHz
- The impedance of the antenna and antenna cable must be 50Ω;
- The antenna output-power handling must be a minimum of 2W

9.3.3 Antenna placement

The antenna should be placed away from electronic devices and other antennas. The recommended minimum distance between adjacent antennas, operating in a similar radio frequency band, is at least 50cm. If the signal strength is weak, it is useful to face a directional antenna towards the closest radio base station. This can increase the strength of the signal received by the modem. The modem's peak output power can reach 2W.

RF field strength varies with antenna type and distance. At 10cm from the antenna the field strength may be up to 70V/m and at 1m it will have reduced to 7V/m. In general, CE-marked products for residential /commercial areas and the light industry can withstand a minimum of 3V/m.

9.3.4 The antenna cable

Use 50Ω impedance low-loss cable and high-quality 50Ω impedance connectors (frequency range up to 3GHz) to avoid RF losses. Ensure that the antenna cable is as short as possible. The Voltage Standing-Wave Ratio (VSWR) may depend on the effectiveness of the antenna, cable and connectors. In addition, if you use an adaptor between the antenna cable and the antenna connector, it is crucial that the antenna cable is a high-quality, low-loss cable. Minimize the use of extension cables, connectors and adapters. Each additional cable, connector or adapter causes a loss of signal power.

9.3.5 Possible communications disturbances

Possible communication disturbances include the following:

- **Noise** can be caused by electronic devices and radio transmitters.
- **Path-loss** occurs as the strength of the received signal steadily decreases in proportion to the distance from the transmitter.
- **Shadowing** is a form of environmental attenuation of radio signals caused by hills, buildings, trees or even vehicles. This can be a particular problem inside buildings, especially if the walls are thick and reinforced.
- **Multi-path fading** is a sudden decrease or increase in the signal strength. This is the result of interference which is caused when direct and reflected signals reach the antenna simultaneously. Surfaces such as buildings, streets, vehicles, etc., can reflect signals.
- **Hand-over** occurs as you move from one cell to another in the GSM network. Your mobile application call is transferred from one cell to the next. Hand-over can briefly interfere with communication and may cause a delay, or at worst, a disruption.

10. Conformity assessment

MATRIX ELECTRONICA S.L.U.
C/ Alejandro Sanchez 109
28019 Madrid
Spain

10.1 Standards of European Type Approval (2G models)

We declare under our sole responsibility that the products, MTX-IND-2G modem containing Cellular Engine Cinterion engine TC65i (Type L30960-N1150-A200), to which this declaration relates, are labeled with the CE conformity mark.

DIRECTIVE 2006/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

ETSI EN 301 511 V9.0.2: Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC) (GSM 13.11 version 7.0.1 Release 1998).

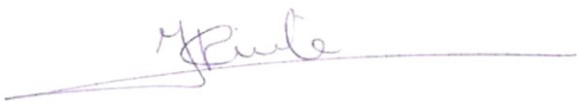
ETSI EN 301 489-1 V1.8.1: Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements

ETSI EN 301 489-7 V1.3.1: Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS).

IEC/EN 60950-1:2005 / EN 60950-1:2006+A11:2009: Health and Safety

The technical documentation relevant to the above equipment will be held at
MATRIX ELECTRONICA S.L.U.
Alejandro Sanchez 109
28019 Madrid
Spain

Madrid, 20/05/2013.
Mr. J. Vicente
Managing Board



10.2 Standards of European Type Approval (3G models)

We declare under our sole responsibility that the products MTX-IND-3G modem containing Cellular Engine Cinterion engine EHS6 (Type L30960-N2950-A100), to which this declaration relates, are labeled with the CE conformity mark.

DIRECTIVE 2004/108/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.

DIRECTIVE 2006/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

ETSI EN 301 511 V9.0.2: Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC) (GSM 13.11 version 7.0.1 Release 1998).

ETSI EN 301 489-1 V1.9.2: Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements

ETSI EN 301 489-7 V1.3.1: Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS).

ETSI EN 301 489-24 V1.5.1: Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment.

ETSI EN 301 908-01 V5.2.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 1: Harmonized EN for IMT-2000, introduction and common requirements of article 3.2 of the R&TTE Directive.

ETSI EN 301 908-02 V5.2.1: Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive

IEC/EN 60950-1:2005 / EN 60950-1:2006+A11:2009: Health and Safety

The technical documentation relevant to the above equipment will be held at

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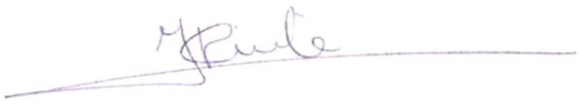


10.3 FCC Compliant and SAR information (2G models)

MTX-IND-2G and any variants contain FCC ID: QIPTC65i. The FCC Equipment Authorization Certification for the TC65i Module is listed under the FCC identifier QIPTC65i
Industry Canada Certification Number: 7830A-TC65i granted to Gemalto M2M GmbH.

The Gemalto reference application of the TC65i module registered under the above identifier is certified to be in accordance with the following Rules and Regulations of the Federal Communications Commission (FCC). Power listed is ERP for Part 22 and EIRP for Part 24. It is compliant with FCC regulations.

Equipment class: PCS Licensed Transmitter
Notes: Quad band GSM/GPRS Modem

SAR INFORMATION

Cinterion Wireless Modules models: TC65i is marketed without a defined antenna.

The Maximum Antenna Gain when using indoor antennas depends on the distance from the antenna to any nearby persons when in normal operation. It should not exceed the values shown in the table below.

According to the limit in 47 CFR 1.1310, we get the value of the maximum antenna gain as follows:

The maximum measured power output in the 850 MHz band is 1866.38 mW (32.71 dBm, see 7layers test report MDE_Siem_0714_FCCb).
The maximum permissible exposure is defined as 47 CFR 1.1310 with 0.55773 mW/cm².
The maximum measured power output in the 1900 MHz band is 974.99 mW (29.89 dBm, see 7layers test report MDE_Siem_0714_FCCc).
The maximum permissible exposure is defined as 47 CFR 1.1310 with 1 mW/cm².

According to the limit in 47 CFR 1.1310, we get the value of the maximum antenna gain as follows:

$S = P*G/4\pi R^2$
$S = 0.55773$ mW/cm² or 1 mW/cm²
P = 1866.38 mW or 974.99 mW
R = 20 cm or 100cm
$\pi = 3.1416$
G(dBi)=10*log10(G)

Solving for G; the maximum antenna gain is

Band	Distance	Maximum Gain in dBi
850MHz	20cm	1.7669
850MHz	50cm	9.7257
1900MHz	20cm	7.1227

1900MHz	50cm	15.0815

10.4 FCC Compliant and SAR information (3G models)

MTX-IND-3G and any variants contain FCC ID: QIPEHS6. The FCC Equipment Authorization Certification for the EHS6 Module is listed under the FCC identifier QIPEHS6
Industry Canada Certification Number: 7830A-EHS6 granted to Gemalto M2M GmbH.

The Cinterion reference application of the EHS6 Module registered under the above identifier is certified to be in accordance with the following Rules and Regulations of the Federal Communications Commission (FCC). Power listed is ERP for Part 22 and EIRP for Part 24. It is compliant with FCC regulations.

Equipment class: PCS Licensed Transmitter
Notes: Quad band GSM/GPRS Modem

SAR INFORMATION

Cinterion Wireless Modules models: EHS6 is marketed without a defined antenna.

The Maximum Antenna Gain when using indoor antennas depends on the distance from the antenna to any nearby persons when in normal operation. It should not exceed the values shown on the table below.

According to the limit in 47 CFR 1.1310, we get the value of the maximum antenna gain as follows:

The maximum measured power output in the 850 MHz band is 1866.38 mW (32.71 dBm, see 7layers test report MDE_Siem_0714_FCCb).
The maximum permissible exposure is defined as 47 CFR 1.1310 with 0.55773 mW/cm².
The maximum measured power output in the 1900 MHz band is 974.99 mW (29.89 dBm, see 7layers test report MDE_Siem_0714_FCCc).
The maximum permissible exposure is defined as 47 CFR 1.1310 with 1 mW/cm².

According to the limit in 47 CFR 1.1310, we get the value of the maximum antenna gain as follows:
$S = P*G/4\pi R^2$
$S = 0.55773$ mW/cm² or 1 mW/cm²
P = 1866.38 mW or 974.99 mW
R = 20 cm or 100cm
$\pi = 3.1416$
G(dBi)=10*log10(G)

Solving for G; the maximum antenna gain is

Band	Distance	Maximum Gain in dBi
850MHz	20cm	1.7669
850MHz	50cm	9.7257

1900MHz	20cm	7.1227
1900MHz	50cm	15.0815

11. Declaración de conformidad (Spanish)

MATRIX ELECTRONICA S.L.U.
C/ Alejandro Sanchez 109
28019 Madrid
Spain

11.1 Estándares de homologación europea (modelos 2G)

Declaramos bajo nuestra responsabilidad que los productos MTX-IND-2G que contienen un modulo celular Cinterion TC65i (tipo L30960-N1150-A200), al cual se refiere esta declaración, están etiquetados con el marcado CE de conformidad.

DIRECTIVA 2006/95/EC DEL PARLAMENTO EUROPE Y DEL CONSEJO del 12 de Diciembre de 2006 sobre la armonización de las leyes de los estados miembros relacionadas con los equipos eléctricos diseñados para su uso bajo ciertos límites de voltaje.

ETSI EN 301 511 V9.0.2: Sistema Global de Comunicaciones Móviles (GSM); estándar unificado para estaciones móviles en las bandas GSM 900 y DCS 1800, que cubren los requisitos esenciales del artículos 3.2 de la directiva R&TTE (1999/5/EC) (GSM 13.11 versión 7.0.1 Release 1998).

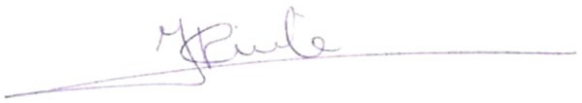
ETSI EN 301 489-1 V1.8.1: Cuestiones sobre Compatibilidad Electromagnética y espectro Radioeléctricos (ERM); estándar de compatibilidad electromagnética (EMC) para equipos y sistema de radio; Parte 1: Requisitos Técnicos Comunes

ETSI EN 301 489-7 V1.3.1: Cuestiones sobre Compatibilidad Electromagnética y espectro Radioeléctricos (ERM); estándar de compatibilidad electromagnética (EMC) para equipos y sistema de radio; Parte 7: Condiciones específicas para equipos de radio móviles y portátiles y equipos auxiliares de sistemas de radiocomunicaciones móviles digitales (GSM y DCS).

IEC/EN 60950-1:2005 / EN 60950-1:2006+A11:2009: Salud y Seguridad

La documentación técnica referente al equipo anterior está disponible en:
MATRIX ELECTRONICA S.L.U.
Alejandro Sanchez 109
28019 Madrid
España

Madrid, 20/05/2013.
Mr. J. Vicente
Managing Board



11.2 Estándares de homologación europea (modelos 3G)

Declaramos bajo nuestra responsabilidad que los productos MTX-IND-3G que contienen un modulo celular Cinterion EHS6 (tipo L30960-N2950-A100), al cual se refiere esta declaración, están etiquetados con el marcado CE de conformidad.

DIRECTIVA 2004/108/EC DEL PARLAMENTO EUROPE Y DEL CONSEJO del 15 de Diciembre de 2004 sobre la aproximación de las leyes de los Estados Miembros correspondientes a la compatibilidad electromagnética y que deroga la Directiva 89/336/EEC.

DIRECTIVA 2006/95/EC DEL PARLAMENTO EUROPE Y DEL CONSEJO del 12 de Diciembre de 2006 sobre la armonización de las leyes de los estados miembros relacionadas con los equipos eléctricos diseñados para su uso bajo ciertos límites de voltaje.

ETSI EN 301 511 V9.0.2: Sistema Global de Comunicaciones Móviles (GSM); estándar unificado para estaciones móviles en las bandas GSM 900 y DCS 1800, que cubren los requisitos esenciales del artículos 3.2 de la directiva R&TTE (1999/5/EC) (GSM 13.11 versión 7.0.1 Release 1998).

ETSI EN 301 489-1 V1.9.2: Cuestiones sobre Compatibilidad Electromagnética y espectro Radioeléctricos (ERM); estándar de compatibilidad electromagnética (EMC) para equipos y sistema de radio; Parte 1: Requisitos Técnicos Comunes

ETSI EN 301 489-7 V1.3.1: Cuestiones sobre Compatibilidad Electromagnética y espectro Radioeléctricos (ERM); estándar de compatibilidad electromagnética (EMC) para equipos y sistema de radio; Parte 7: Condiciones específicas para equipos de radio móviles y portátiles y equipos auxiliares de sistemas de radiocomunicaciones móviles digitales (GSM y DCS).

ETSI EN 301 489-24 V1.5.1: Cuestiones sobre Compatibilidad Electromagnética y espectro Radioeléctricos (ERM); estándar de compatibilidad electromagnética (EMC) para equipos y sistema de radio; Parte 24: Condiciones específicas para IMT-2000 CDMA Direct Spread (UTRA) para radios móviles y portátiles (UE) y equipamiento auxiliar.

ETSI EN 301 908-01 V5.2.1: Cuestiones sobre Compatibilidad Electromagnética y espectro Radioeléctricos (ERM); estaciones base (BS) y equipamiento de usuario (UE) para redes celulares IMT-2000 de tercera generación; Parte 1: Normativa europea armonizada para IMT-2000, introducción y requisitos comunes del artículo 3.2 de la directiva R&TTE.

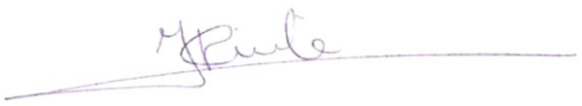
ETSI EN 301 908-02 V5.2.1: Cuestiones sobre Compatibilidad Electromagnética y espectro Radioeléctricos (ERM); estaciones base (BS) y equipamiento de usuario (UE) para redes celulares IMT-

2000 de tercera generación; Parte 2: Normativa europea armonizada para IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) que cubre los requisitos esenciales del artículo 3.2 de la directiva R&TTE

IEC/EN 60950-1:2005 / EN 60950-1:2006+A11:2009: Salud y Seguridad

La documentación técnica referente al equipo anterior está disponible en:
MATRIX ELECTRONICA S.L.U.
Alejandro Sanchez 109
28019 Madrid
España

Madrid, 20/05/2013.
Sr. J. Vicente
Managing Board



11.3 Conformidad FCC e información de SAR

MTX-IND-2G y todas sus variantes contienen el FCC ID: QIPTC65i. El Certificado de Autorización de Equipo de la FCC para el módulo EHS6 está listado con el identificador FCC QIPTC65i
Número de Certificación de Industria en Canadá: 7830A-TC65i asignado a Gemalto M2M GmbH.

El formulario de referencia del módulo TC65i registrado bajo el anterior identificador está conforme con las siguientes Reglas y Regulaciones de la Comisión Federal de Comunicaciones (FCC). La potencia listada como ERP para la parte 22 y como EIRP para la parte 24 cumple con las regulaciones de la FCC.

Clase de equipo: Transmisor PCS Licenciado
Notas: Quad band GSM/GPRS Modem

INFORMACION SOBRE SAR

El modulo Cinterion TC65i es comercializado sin una antena definida. La ganancia máxima de antena usando antenas de interior depende de la distancia de esta a las personas cercanas y en condiciones normales no debe sobrepasar los límites mostrados en la tabla siguiente.

La máxima potencia de salida medida en la banda de 850MHz es 1866.38 mW (32.71 dBm, ver el reporte de test de 7layers MDE_Siem_0714_FCCb).
La máxima exposición permisible se define en 47 CFR 1.1310 con un valor de 0.55773 mW/cm².
La máxima potencia de salida medida en la banda de 1900 MHz es 974.99 mW (29.89 dBm, ver el reporte de test de 7layers MDE_Siem_0714_FCCc).
La máxima exposición permisible se define en 47 CFR 1.1310 con un valor de 1 mW/cm².

De acuerdo al límite en 47 CFR 1.1310, obtenemos el valor de la máxima ganancia de antena como sigue:

$S = P*G/4\pi R^2$
$S = 0.55773\ mW/cm^2$ o $1\ mW/cm^2$
$P = 1866.38\ mW$ o $974.99\ mW$
$R = 20\ cm$ o $100cm$
$\pi = 3.1416$
$G(dBi)=10*\log10(G)$

Despejando G; la máxima ganancia de antena es:

Banda	Distancia	Ganancia Máxima en dBi
850MHz	20cm	1.7669
850MHz	50cm	9.7257
1900MHz	20cm	7.1227
1900MHz	50cm	15.0815

11.4 Conformidad FCC (modelos 3G)

MTX-IND-3G y todas sus variantes contienen el FCC ID: QIPEHS6. El Certificado de Autorización de Equipo de la FCC para el módulo EHS6 está listado con el identificador FCC QIPEHS6
Número de Certificación de Industria en Canadá: 7830A-EHS6 asignado a Gemalto M2M GmbH.

El formulario de referencia del módulo EHS6 registrado bajo el anterior identificador está conforme con las siguientes Reglas y Regulaciones de la Comisión Federal de Comunicaciones (FCC). La potencia listada como ERP para la parte 22 y como EIRP para la parte 24 cumple con las regulaciones de la FCC.

Clase de equipo: Transmisor PCS Licenciado
Notas: Quad band GSM/GPRS Modem

INFORMACION SOBRE SAR

El modulo Cinterion EHS6 es comercializado sin una antena definida. La ganancia máxima de antena usando antenas de interior depende de la distancia de esta a las personas cercanas y en condiciones normales no debe sobrepasar los límites mostrados en la tabla siguiente.

La máxima potencia de salida medida en la banda de 850MHz es 1866.38 mW (32.71 dBm, ver el reporte de test de 7layers MDE_Siem_0714_FCCb).
La máxima exposición permisible se define en 47 CFR 1.1310 con un valor de 0.55773 mW/cm².
La máxima potencia de salida medida en la banda de 1900 MHz es 974.99 mW (29.89 dBm, ver el reporte de test de 7layers MDE_Siem_0714_FCCc).
La máxima exposición permisible se define en 47 CFR 1.1310 con un valor de 1 mW/cm².

De acuerdo al límite en 47 CFR 1.1310, obtenemos el valor de la máxima ganancia de antena como sigue:

$S = P*G/4\pi R^2$
$S = 0.55773\ mW/cm^2$ o $1\ mW/cm^2$
P = 1866.38 mW o 974.99 mW
R = 20 cm o 100cm
$\pi = 3.1416$
G(dBi)=10*log10(G)

Despejando G; la máxima ganancia de antena es:

Banda	Distancia	Ganancia Máxima en dBi
850MHz	20cm	1.7669
850MHz	50cm	9.7257
1900MHz	20cm	7.1227
1900MHz	50cm	15.0815

12. Regulatory and type approval information

12.1 Directives and standards (2G models)

The MTX-IND-2G family modems have been designed to comply with the directives and standards listed below.

It is the responsibility of the application manufacturer to ensure compliance of the final product with all provisions of the applicable directives and standards as well as with the technical specifications provided in this document.

Directives	
1999/05/EC	Directive of the European Parliament and of the council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (in short referred to as R&TTE Directive 1999/5/EC). The product is labeled with the CE conformity mark
2002/95/EC (RoHS 1)	Directive of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

Standards of North American type approval	
CFR Title 47	Code of Federal Regulations, Part 22 and Part 24 (Telecommunications, PCS); US Equipment Authorization FCC
UL 60 950-1	Product Safety Certification (Safety requirements)
NAPRD.03 V5.15	Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control PCS Type Certification Review board (PTCRB)
RSS132 (Issue2)	Canadian Standard

Standards of European type approval	
3GPP TS 51.010-1	Digital cellular telecommunications system (Release 7); Mobile Station (MS) conformance specification;
ETSI EN 301 511 V9.0.2	Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC)
GCF-CC V3.43	Global Certification Forum - Certification Criteria
ETSI EN 301 489-01 V1.8.1	Candidate Harmonized European Standard (Telecommunications series) Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements
ETSI EN 301 489-07 V1.3.1	Candidate Harmonized European Standard (Telecommunications series) Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
IEC/EN 60950-1:2006	Safety of information technology equipment

Requirements of quality	
IEC 60068	Environmental testing
DIN EN 60529	IP codes

Standards of the Ministry of Information Industry of the People's Republic of China	
SJ/T 11363-2006	"Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products" (2006-06).
SJ/T 11364-2006	"Marking for Control of Pollution Caused by Electronic Information Products" (2006-06). According to the "Chinese Administration on the Control of Pollution caused by Electronic Information Products" (ACPEIP) the EPUP, i.e., Environmental Protection Use Period, of this product is 20 years as per the symbol shown here, unless otherwise marked. The EPUP is valid only as long as the product is operated within the operating limits described in the Gemalto M2M Hardware Interface Description. Please see next table for an overview of toxic or hazardous substances or elements that might be contained in product parts in concentrations above the limits defined by SJ/T 11363-2006.

部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	O	O	O	O	O	O
电路模块 (Circuit Modules)	X	O	O	O	O	O
电缆及电缆组件 (Cables and Cable Assemblies)	O	O	O	O	O	O
塑料和聚合物部件 (Plastic and Polymeric parts)	O	O	O	O	O	O

O:
表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。
Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X:
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。
Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part *might exceed* the limit requirement in SJ/T11363-2006.

12.2 Directives and standards (3G models)

The MTX-IND-3G modem has been designed to comply with the directives and standards listed below.

It is the responsibility of the application manufacturer to ensure compliance of the final product with all provisions of the applicable directives and standards, as well as with the technical specifications provided in this document.

Directives	
1999/05/EC	Directive of the European Parliament and of the council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (in short referred to as R&TTE Directive 1999/5/EC). The product is labeled with the CE conformity mark
ECE-R 10	Economic Commission for Europe (ECE) Regulation No. 10: Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility
2002/95/EC (RoHS 1) 2011/65/EC (RoHS 2)	Directive of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

Standards of North American type approval	
CFR Title 47	Code of Federal Regulations, Part 22 and Part 24 (Telecommunications, PCS); US Equipment Authorization FCC
OET Bulletin 65 (Edition 97-01)	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
UL 60 950-1	Product Safety Certification (Safety requirements)
NAPRD.03 V5.15	Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control PCS Type Certification Review board (PTCRB)
RSS132 (Issue2) RSS133 (Issue5)	Canadian Standard

Standards of European type approval	
3GPP TS 51.010-1	Digital cellular telecommunications system (Release 7); Mobile Station (MS) conformance specification;
ETSI EN 301 511 V9.0.2	Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC)
GCF-CC V3.49	Global Certification Forum - Certification Criteria
ETSI EN 301 489-01 V1.9.2	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements
ETSI EN 301 489-07 V1.3.1	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
ETSI EN 301 489-24 V1.5.1	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
EN 301 908-01 V5.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 1: Harmonized EN for IMT-2000, introduction and common requirements of article 3.2 of the R&TTE Directive

EN 301 908-02 V5.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
EN 62311:2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
IEC/EN 60950-1:2006+ A11:2009+A1:2010+ A12:2011	Safety of information technology equipment

Requirements of quality	
IEC 60068	Environmental testing
DIN EN 60529	IP codes

Standards of the Ministry of Information Industry of the People's Republic of China	
SJ/T 11363-2006	"Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products" (2006-06).
SJ/T 11364-2006	"Marking for Control of Pollution Caused by Electronic Information Products" (2006-06). According to the "Chinese Administration on the Control of Pollution caused by Electronic Information Products" (ACPEIP) the EPUP, i.e., Environmental Protection Use Period, of this product is 20 years as per the symbol shown here, unless otherwise marked. The EPUP is valid only as long as the product is operated within the operating limits described in the Gemalto M2M Hardware Interface Description. Please see next table for an overview of toxic or hazardous substances or elements that might be contained in product parts in concentrations above the limits defined by SJ/T 11363-2006.

部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	O	O	O	O	O	O
电路模块 (Circuit Modules)	X	O	O	O	O	O
电缆及电缆组件 (Cables and Cable Assemblies)	O	O	O	O	O	O
塑料和聚合物部件 (Plastic and Polymeric parts)	O	O	O	O	O	O

O:
表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。
Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X:
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。
Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part *might exceed* the limit requirement in SJ/T11363-2006.

12.3 SAR requirements specific to portable mobiles

Mobile phones, PDAs or other portable transmitters and receivers incorporating a GSM module must be in accordance with the guidelines for human exposure to radio frequency energy. This requires the Specific Absorption Rate (SAR) of portable TC65i/EHS6 based applications to be evaluated and approved for compliance with national and/or international regulations.

Since the SAR value varies significantly with the individual product design manufacturers are advised to submit their product for approval if designed for portable use. For European markets the relevant directives are mentioned below. It is the responsibility of the manufacturer of the final product to verify whether or not further standards, recommendations or directives are in force outside these areas.

Products intended for sale in US markets

EN 59005/ANSI C95.1: Considerations for evaluation of human exposure to Electromagnetic Fields (EMFs) from Mobile Telecommunication Equipment (MTE) in the frequency range 30MHz – 6GHz

Products intended for sale in European markets

EN 50360: Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz - 3GHz)

Please note that SAR requirements are specific only for portable devices and not for mobile devices as defined below:

- Portable device:
  A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the user's body.
- Mobile device:
  A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitters's radiating structure(s) and the user's body or that of nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and cannot be easily moved to another location.

12.4 SELV requirements

The power supply connected to the MTX-IND device shall be in compliance with the SELV requirements defined in EN 60950-1.

13. RoHS Statement

The MTX-IND modem is compliant with the 2002/95/EC Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

14. Disposal of old electrical & electronic equipment

This symbol, applied on our products and/or on its packaging, indicates that this product should not be treated as household waste when you wish to dispose of it. Instead, it should be handed over to an applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences to the environment and human health, which could otherwise be caused by inappropriate disposal of this product. The recycling of materials will help to conserve natural resources. For more detailed information about the recycling of this product, please contact your local city office, household waste disposal service or the retail store where you purchased this product.

15. Abbreviations

Abbreviation	Description
ADC	Analog-to-digital converter
AGC	Automatic Gain Control
ANSI	American National Standards Institute
ARFCN	Absolute Radio Frequency Channel Number
ARP	Antenna Reference Point
ASC0/ASC1	Asynchronous Controller. Abbreviations used for first and second serial interface of TC65i
B	Thermistor Constant
BER	Bit Error Rate
BTS	Base Transceiver Station
CB or CBM	Cell Broadcast Message
CE	Conformité Européene (European Conformity)
CHAP	Challenge Handshake Authentication Protocol
CPU	Central Processing Unit
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DAI	Digital Audio Interface
dBm0	Digital level, 3.14dBm0 corresponds to full scale, see ITU G.711, A-law
DCE	Data Communication Equipment (typically modems, e.g. Gemalto M2M module)
DCS 1800	Digital Cellular System, also referred to as PCN
DL	Download
dnu	Do not use
DRX	Discontinuous Reception
DSB	Development Support Box
DSP	Digital Signal Processor
DSR	Data Set Ready
DTE	Data Terminal Equipment (typically a computer, terminal, printer or, for example, a GSM application)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EDGE	Enhanced Data rates for GSM Evolution
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EIRP	Equivalent Isotropic Radiated Power
EMC	Electromagnetic Compatibility
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission (U.S.)
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access

FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GPIO	General Purpose Input/Output
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HiZ	High Impedance
HR	Half Rate
HSDPA	High Speed Downlink Packet Access
I/O	Input/Output
IC	Integrated Circuit
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LED	Light Emitting Diode
Li-Ion/Li+	Lithium-Ion
Li battery	Rechargeable Lithium Ion or Lithium Polymer battery
LPM	Link Power Management
MBB	Moisture barrier bag
Mbps	Mbits per second
MCS	Modulation and Coding Scheme
MMI	Man Machine Interface
MO	Mobile Originated
MS	Mobile Station (GSM module), also referred to as TE
MSISDN	Mobile Station International ISDN number
MSL	Moisture Sensitivity Level
MT	Mobile Terminated
nc	Not connected
NTC	Negative Temperature Coefficient
OEM	Original Equipment Manufacturer
PA	Power Amplifier
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCM	Pulse Code Modulation
PCN	Personal Communications Network, also referred to as DCS 1800
PCS	Personal Communication System, also referred to as GSM 1900
PD	Pull Down resistor (appr. 100k)
PDU	Protocol Data Unit
PLL	Phase Locked Loop
PPP	Point-to-point protocol
PS	Packet Switched
PSK	Phase Shift Keying
PSU	Power Supply Unit

PU	Pull Up resistor (appr. 100k)
PWM	Pulse Width Modulation
QAM	Quadrature Amplitude Modulation
R&TTE	Radio and Telecommunication Terminal Equipment
RAM	Random Access Memory
RF	Radio Frequency
RLS	Radio Link Stability
RMS	Root Mean Square (value)
RoHS	Restriction of the use of certain hazardous substances in electrical and electronic equipment.
ROM	Read-only Memory
RTC	Real Time Clock
RTS	Request to Send
Rx	Receive Direction
SAR	Specific Absorption Rate
SAW	Surface Acoustic Wave
SELV	Safety Extra Low Voltage
SIM	Subscriber Identification Module
SMD	Surface Mount Device
SMS	Short Message Service
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
SRAM	Static Random Access Memory
SRB	Signalling Radio Bearer
TA	Terminal adapter (e.g. GSM module)
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TLS	Transport Layer Security
TPC	Transmit Power Control
TS	Technical Specification
Tx	Transmit Direction
UART	Universal asynchronous receiver-transmitter
UICC	USIM Integrated Circuit Card
UL	Upload
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
USB	Universal Serial Bus
USIM	UMTS Subscriber Identification Module
USSD	Unstructured Supplementary Service Data
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access

16. AT command summary

16.1 2G models

The AT standard is a line-oriented command language. AT is an abbreviation of ATtention and it is always used to send a command line from the terminal equipment (TE) to the terminal adaptor (TA). The command line consists of a string of alphanumeric characters. It is sent to the MTX-IND-2G to instruct it to perform the commands specified by the characters.
The AT commands listed below are supported from within the MTX-IND-2G. The AT Command Set manual can be downloaded from the MTX-IND-2G web page at www.mtx-modems.com.

AT Command	Description
+++	Switch from data mode or PPP online mode to command mode
A/	Repeat Previous Command Line
AT&C	Set Data Carrier Detect (DCD) Line Mode
AT&D	Set Data Terminal Ready (DTR) Line Mode
AT&F	Reset AT Command Settings to Factory Default Values
AT&S	Set Data Set Ready (DSR) Line Mode
AT&V	Display current configuration
AT&W	Store AT Command Settings to User Defined Profile
AT+CACM	Accumulated call meter (ACM) reset or query
AT+CALA	Alarm Configuration
AT+CAMM	Accumulated call meter maximum (ACMmax) set or query
AT+CAOC	Advice of Charge Information
AT+CBST	Select Bearer Service Type
AT+CCFC	Call forwarding number and conditions control
AT+CCLK	Real Time Clock
AT+CCUG	Closed User Group
AT+CCWA	Call Waiting
AT+CEER	Extended Error Report
AT+CFUN	Functionality Level
AT+CGACT	PDP context activate or deactivate
AT+CGANS	Manual response to a network request for PDP context activation
AT+CGATT	GPRS attach or detach
AT+CGAUTO	Automatic response to a network request for PDP context activation
AT+CGDATA	Enter data state
AT+CGDCONT	Define PDP Context
AT+CGEQMIN	Rel. 99 Quality of Service Profile (Minimum acceptable)
AT+CGEQREQ	Rel. 99 Quality of Service Profile (Requested)
AT+CGMI	Request manufacturer identification
AT+CGMM	Request model identification
AT+CGMR	Request revision identification of software status
AT+CGPADDR	Show PDP address
AT+CGQMIN	Quality of Service Profile (Minimum acceptable)
AT+CGQREQ	Quality of Service Profile (Requested)
AT+CGREG	GPRS Network Registration Status
AT+CGSMS	Select service for MO SMS messages
AT+CGSN	Request International Mobile Equipment Identity (IMEI)
AT+CHLD	Call Hold and Multiparty
AT+CHUP	Hang up call
AT+CIMI	Request International Mobile Subscriber Identity (IMSI)
AT+CIND	Indicator control
AT+CLCC	List of current calls

AT+CLCK	Facility lock
AT+CLIP	Calling Line Identification Presentation
AT+CLIR	Calling Line Identification Restriction
AT+CLVL	Loudspeaker volume level
AT+CMEE	Error Message Format
AT+CMER	Common Event Reporting Configuration
AT+CMGC	Send SMS Command
AT+CMGD	Delete short message
AT+CMGF	Select SMS message format
AT+CMGL	List SMS messages from preferred store
AT+CMGR	Read SMS messages
AT+CMGS	Send SMS
AT+CMGW	Write Short Messages to Memory
AT+CMSS	Send short messages from storage
AT+CMUT	Mute control
AT+CMUX	Multiplex mode
AT+CNMA	New Message Acknowledgement to ME/TE
AT+CNMI	SMS Event Reporting Configuration
AT+CNUM	Read own numbers
AT+COLP	Connected Line Identification Presentation
AT+COPN	Read operator names
AT+COPS	Operator Selection
AT+CPAS	Activity Status
AT+CPBR	Read from Phonebook
AT+CPBS	Select phonebook memory storage
AT+CPBW	Write into Phonebook
AT+CPIN	PIN Authentication
AT+CPIN2	PIN2 Authentication
AT+CPMS	Preferred SMS message storage
AT+CPOL	Preferred Operator List
AT+CPUC	Price per unit and currency table
AT+CPWD	Change Password
AT+CR	Service reporting control
AT+CRC	Incoming Call Indication Format
AT+CREG	Network Registration Status
AT+CRLP	Configure RLP Parameters for Outgoing Non-Transparent Data Calls
AT+CRSM	Restricted SIM Access
AT+CSCA	SMS Service Center Address
AT+CSCB	Select Cell Broadcast Message Indication
AT+CSCS	Character Set
AT+CSDH	Show SMS text mode parameters
AT+CSIM	Generic SIM Access
AT+CSMP	Set SMS Text Mode Parameters
AT+CSMS	Select Message Service
AT+CSNS	Single Numbering Scheme
AT+CSQ	Signal quality
AT+CSSN	Supplementary service notifications
AT+CUSD	Unstructured Supplementary Service Data
AT+CXXCID	Display card ID
AT+FCLASS	Fax: Select, read or test service class
AT+FRH	Receive Data Using HDLC Framing
AT+FRM	Receive Data
AT+FRS	Receive Silence
AT+FTH	Transmit Data Using HDLC Framing
AT+FTM	Transmit Data

AT+FTS	Stop Transmission and Wait
AT+GCAP	Capabilities List
AT+GMI	Request manufacturer identification
AT+GMM	Request model identification
AT+GMR	Request revision identification of software status
AT+GSN	Request International Mobile Equipment Identity (IMEI)
AT+ICF	Character Framing
AT+IFC	Flow Control
AT+ILRR	Bit Rate Reporting
AT+IPR	Bit Rate
AT+VTD	Tone duration
AT+VTS	DTMF and tone generation
AT+WS46	Select wireless network
AT\Q	Flow Control
AT\V	Set CONNECT result code format
AT^MONI	Monitor idle mode and dedicated mode
AT^MONP	Monitor neighbor cells
AT^SACM	Advice of charge and query of ACM and ACMmax
AT^SAIC	Audio Interface Configuration
AT^SALS	Alternate Line Service
AT^SATR	Query SIM's Answer to Reset Data
AT^SBC	Battery Charge Control
AT^SBNR	Binary Read
AT^SBNW	Binary Write
AT^SBV	Battery/Supply Voltage
AT^SCCNT	Configure Pulse Counter
AT^SCFG	Extended Configuration Settings
AT^SCID	SIM Identification Number
AT^SCKS	Query SIM and Chip Card Holder Status
AT^SCML	List Concatenated Short Messages from preferred store
AT^SCMR	Read Concatenated Short Messages
AT^SCMS	Send Concatenated Short Messages
AT^SCMW	Write Concatenated Short Messages to Memory
AT^SCNI	List Call Number Information
AT^SCPIN	Pin Configuration
AT^SCPOL	Polling Configuration
AT^SCPORT	Port Configuration
AT^SCSL	Customer SIM Lock
AT^SCTM	Critical Operating Temperature Monitoring
AT^SDLD	Delete the 'last number redial' memory
AT^SDPORT	Delete a Port Configuration
AT^SFDL	Firmware Download
AT^SFNUR	Select the fixed network user rate
AT^SGACT	Query all PDP context activations
AT^SGAUTH	Set type of authentication for PPP connection
AT^SGCONF	Configuration of GPRS related Parameters
AT^SGIO	Get IO state of a specified pin or port
AT^SHOM	Display Homezone
AT^SHUP	Hang up call(s) indicating a specific 3GPP TS 24.008 release cause
AT^SICC	Internet Connection Close
AT^SICI	Internet Connection Information
AT^SICO	Internet Connection Open
AT^SICS	Internet Connection Setup Profile
AT^SIND	Extended Indicator Control
AT^SISC	Internet Service Close

AT^SISE	Internet Service Error Report
AT^SISI	Internet Service Information
AT^SISO	Internet Service Open
AT^SISR	Internet Service Read Data
AT^SISS	Internet Service Setup Profile
AT^SIST	Enter Transparent Access Mode
AT^SISW	Internet Service Write Data
AT^SISX	Internet Service Execution
AT^SJNET	Set Dialup Network Access Parameters
AT^SJOTAP	Over The Air Application Provisioning
AT^SJRA	Run Java Application
AT^SJSEC	Write Binary Java Security Data
AT^SLCC	Extended list of current calls
AT^SLCD	Display Last Call Duration
AT^SLCK	Facility lock
AT^SLMS	List SMS Memory Storage
AT^SM20	Set M20 compatibility mode
AT^SMGL	List Short Messages from preferred store without setting status to REC READ
AT^SMGO	Set or query SMS overflow presentation mode or query SMS overflow
AT^SMGR	Read short message without setting status to REC READ
AT^SMONC	Cell Monitoring
AT^SMOND	Cell Monitoring
AT^SMONG	Packet Data Monitor
AT^SMSO	Switch Off TC65i
AT^SNFA	Set or query of microphone attenuation
AT^SNFD	Set audio parameters to manufacturer default values
AT^SNFG	Generate Tone
AT^SNFI	Set microphone path parameters
AT^SNFM	Set microphone audio path and power supply
AT^SNFO	Set audio output (= loudspeaker path) parameter
AT^SNFPT	Set progress tones
AT^SNFS	Select audio hardware set
AT^SNFTTY	Signal TTY/CTM audio mode capability
AT^SNFV	Set loudspeaker volume
AT^SNFW	Write audio setting in non-volatile store
AT^SNMON	Network monitoring
AT^SOPS	Extended Operator Selection
AT^SPBC	Find first matching entry in sorted phonebook
AT^SPBD	Purge phonebook memory storage
AT^SPBG	Display phonebook entries in alphabetical order
AT^SPBS	Step through the selected phonebook alphabetically
AT^SPBW	Write into Phonebook with location report
AT^SPCL	Set Preferred Cell List
AT^SPIC	Display PIN counter
AT^SPIO	GPIO Driver Open/Close
AT^SPLM	Read the PLMN list
AT^SPWD	Change Password
AT^SRADC	Configure and Read ADC Measurement
AT^SRPN	Replace Operator Names
AT^SRSA	Remote SIM Access (RSA) Activation
AT^SRSM	Remote SIM Access Message
AT^SRTC	Ringtone configuration
AT^SSCNT	Start and Stop Pulse Counter
AT^SSCONF	SMS Command Configuration
AT^SSDA	Set SMS Display Availability

AT^SSET	SIM Data Ready Indication
AT^SSIO	Set IO state of a specified pin or port
AT^SSMSS	Set Short Message Storage Sequence
AT^SSPI	Serial Protocol Interface
AT^SSTA	Remote-SAT Interface Activation
AT^SSTGI	SAT Get Information
AT^SSTGI	SAT Get Information - Refresh (1)
AT^SSTGI	SAT Get Information - Set Up Event List (5)
AT^SSTGI	SAT Get Information - Set Up Call (16)
AT^SSTGI	SAT Get Information - Send SS (17)
AT^SSTGI	SAT Get Information - Send USSD (18)
AT^SSTGI	SAT Get Information - Send Short Message (19)
AT^SSTGI	SAT Get Information - Send DTMF (20)
AT^SSTGI	SAT Get Information - Launch Browser (21)
AT^SSTGI	SAT Get Information - Play Tone (32)
AT^SSTGI	SAT Get Information - Display Text (33)
AT^SSTGI	SAT Get Information - Get Inkey (34)
AT^SSTGI	SAT Get Information - Get Input (35)
AT^SSTGI	SAT Get Information - Select Item (36)
AT^SSTGI	SAT Get Information - Set up Menu (37)
AT^SSTGI	SAT Get Information - Set up Idle Mode Text (40)
AT^SSTGI	SAT Get Information - Language Notification (53)
AT^SSTGI	SAT Get Information - Open Channel (64)
AT^SSTGI	SAT Get Information - Close Channel (65)
AT^SSTGI	SAT Get Information - Receive Data (66)
AT^SSTGI	SAT Get Information - Send Data (67)
AT^SSTR	SAT Response
AT^SSTR	SAT Response - Refresh (1)
AT^SSTR	SAT Response - Set Up Event List (5)
AT^SSTR	SAT Response - Set Up Call (16)
AT^SSTR	SAT Response - Send SS (17)
AT^SSTR	SAT Response - Send USSD (18)
AT^SSTR	SAT Response - Send Short Message (19)
AT^SSTR	SAT Response - Send DTMF (20)
AT^SSTR	SAT Response - Launch Browser (21)
AT^SSTR	SAT Response - Play Tone (32)
AT^SSTR	SAT Response - Display Text (33)
AT^SSTR	SAT Response - Get Inkey (34)
AT^SSTR	SAT Response - Get Input (35)
AT^SSTR	SAT Response - Select Item (36)
AT^SSTR	SAT Response - Setup Menu (37)
AT^SSTR	SAT Response - Set Up Idle Mode Text (40)
AT^SSTR	SAT Response - Language Notification (53)
AT^SSTR	SAT Response - Open Channel (64)
AT^SSTR	SAT Response - Close Channel (65)
AT^SSTR	SAT Response - Receive Data (66)
AT^SSTR	SAT Response - Send Data (67)
AT^SSTR	SAT Event - Menu Selection (211)
AT^SSTR	SAT Event - User Activity (232)
AT^SSTR	SAT Event - Idle Screen Available (233)
AT^SSTR	SAT Event - Language Selection (235)
AT^SSTR	SAT Event - Browser Termination (236)
AT^SSTR	SAT Event - Terminate Command (254)
AT^SSYNC	Configure SYNC Pin
AT^STCD	Display Total Call Duration

AT^STPB	Transmit Parity Bit (for 7E1 and 7O1 only)
AT^SWDAC	PWM Signal Configuration for DAC
AT^SXSM	Extended SIM Access
ATA	Connect to Incoming Call
ATA	Manual acceptance of a network request for PDP context activation
ATD	Mobile originated call to specified number
ATD*98#	Request GPRS IP service
ATD*99#	Request GPRS service
ATD><mem><n>	Mobile originated call using specific memory and index number
ATD><n>	Mobile originated call from active memory using index number
ATD><str>	Mobile originated call from active memory using corresponding field
ATDI	Mobile originated data call to ISDN number
ATDL	Redial last number used
ATE	AT Command Echo
ATH	Disconnect existing connection
ATH	Manual rejection of a network request for PDP context activation
ATI	Display product identification information
ATL	Set monitor speaker loudness
ATM	Set monitor speaker mode
ATO	Switch from command mode to data mode / PPP online mode
ATP	Select pulse dialing
ATQ	Result Code Presentation Mode
ATS0	Set number of rings before automatically answering a call
ATS0	Automatic Response to Network Request for PDP Context Activation
ATS10	Set disconnect delay after indicating the absence of data carrier
ATS18	Extended call release report
ATS2	Set escape sequence character
ATS3	Command Line Termination
ATS4	Response Formatting
ATS5	Command Line Editing
ATS6	Set pause before blind dialing
ATS7	Set number of seconds to wait for connection completion
ATS8	Comma Dial Pause Time
ATT	Select tone dialing
ATV	Result code format mode
ATX	CONNECT Result Code Format
ATZ	Restore AT Command Settings from User Defined Profile

16.2 3G models

The AT standard is a line-oriented command language. AT is an abbreviation of ATtention and it is always used to send a command line from the terminal equipment (TE) to the terminal adaptor (TA). The command line consists of a string of alphanumeric characters. It is sent to the MTX-IND-3G to instruct it to perform the commands specified by the characters.
The AT commands listed below are supported from within the MTX-IND-3G. The AT Command Set manual can be downloaded from the MTX-IND-3G web page at www.mtx-modems.com.

AT Command	Description
+++	Switch from data mode or PPP online mode to command mode
A/	Repeat Previous Command Line
AT&C	Set Data Carrier Detect (DCD) Line Mode
AT&D	Set Data Terminal Ready (DTR) Line Mode
AT&F	Reset AT Command Settings to Factory Default Values
AT&S	Set Data Set Ready (DSR) Line Mode
AT&V	Display current configuration
AT&W	Store AT Command Settings to User Defined Profile
AT+CACM	Accumulated call meter (ACM) reset or query
AT+CALA	Alarm Configuration
AT+CAMM	Accumulated call meter maximum (ACMmax) set or query
AT+CAOC	Advise of Charge Information
AT+CBST	Select Bearer Service Type
AT+CCFC	Call forwarding number and conditions control
AT+CCID	USIM Card Identification Number
AT+CCLK	Real Time Clock
AT+CCUG	Closed User Group
AT+CCWA	Call Waiting
AT+CEER	Extended Error Report
AT+CFUN	Functionality Level
AT+CGACT	PDP context activate or deactivate
AT+CGANS	Manual response to a network request for PDP context activation
AT+CGATT	GPRS attach or detach
AT+CGAUTO	Automatic response to a network request for PDP context activation
AT+CGCMOD	PDP Context Modify
AT+CGDATA	Enter data state
AT+CGDCONT	Define PDP Context
AT+CGEQMIN	Rel. 99 Quality of Service Profile (Minimum acceptable)
AT+CGEQREQ	Rel. 99 Quality of Service Profile (Requested)
AT+CGEREP	GPRS event reporting
AT+CGMI	Request manufacturer identification
AT+CGMM	Request model identification
AT+CGMR	Request revision identification of software status
AT+CGPADDR	Show PDP address

AT+CGQMIN	Quality of Service Profile (Minimum acceptable)
AT+CGQREQ	Quality of Service Profile (Requested)
AT+CGREG	Packet Domain Network Registration Status
AT+CGSMS	Select service for MO SMS messages
AT+CGSN	Request International Mobile Equipment Identity (IMEI)
AT+CHLD	Call Hold and Multiparty
AT+CHUP	Hang up call
AT+CIMI	Request International Mobile Subscriber Identity (IMSI)
AT+CLCC	List of current calls
AT+CLCK	Facility lock
AT+CLIP	Calling Line Identification Presentation
AT+CLIR	Calling Line Identification Restriction
AT+CMEE	Error Message Format
AT+CMGC	Send SMS Command
AT+CMGD	Delete short message
AT+CMGF	Select SMS message format
AT+CMGL	List SMS messages from preferred store
AT+CMGR	Read SMS messages
AT+CMGS	Send SMS
AT+CMGW	Write Short Messages to Memory
AT+CMMS	More Messages to Send
AT+CMSS	Send short messages from storage
AT+CMUT	Mute control
AT+CMUX	Multiplex mode
AT+CNAP	Calling Name Presentation
AT+CNMA	New Message Acknowledgement to ME/TE
AT+CNMI	SMS Event Reporting Configuration
AT+CNUM	Read own numbers
AT+COLP	Connected Line Identification Presentation
AT+COPN	Read operator names
AT+COPS	Operator Selection
AT+CPAS	Activity Status
AT+CPBF	Find phonebook entries
AT+CPBR	Read from Phonebook
AT+CPBS	Select phonebook memory storage
AT+CPBW	Write into Phonebook
AT+CPIN	PIN Authentication
AT+CPIN2	PIN2 Authentication
AT+CPLS	Select Preferred Operator List
AT+CPMS	Preferred SMS message storage
AT+CPOL	Preferred Operator List
AT+CPUC	Price per unit and currency table
AT+CPWD	Change Password
AT+CR	Service reporting control
AT+CRC	Incoming Call Indication Format

AT+CREG	Network Registration Status
AT+CRLP	Configure RLP Parameters for Outgoing Non-Transparent Data Calls
AT+CRSM	Restricted SIM Access
AT+CSCA	SMS Service Center Address
AT+CSCB	Select Cell Broadcast Message Indication
AT+CSCS	Character Set
AT+CSDH	Show SMS text mode parameters
AT+CSIM	Generic USIM Access
AT+CSMP	Set SMS Text Mode Parameters
AT+CSMS	Select Message Service
AT+CSQ	Signal quality
AT+CSSN	Supplementary service notifications
AT+CSTA	Select type of address
AT+CSVM	Set voice mail number
AT+CTZR	Time Zone Reporting
AT+CTZU	Automatic Time Zone Update
AT+CUSD	Unstructured Supplementary Service Data
AT+GSN	Request International Mobile Equipment Identity (IMEI)
AT+IPR	Bit Rate
AT+STKCC	USAT Call Control Notification
AT+STKCNF	USAT Proactive Session Status
AT+STKENV	USAT Envelope Command
AT+STKPRO	USAT Proactive Command URCs
AT+STKTR	USAT Terminal Response Commands
AT+VTD	Tone duration
AT+VTS	DTMF and tone generation
AT\Q	Flow Control
AT^SBV	Battery/Supply Voltage
AT^SCCNT	Configure Pulse Counter
AT^SCFG	Extended Configuration Settings
AT^SCPIN	Pin Configuration
AT^SCPOL	Polling Configuration
AT^SCTM	Critical Operating Temperature Monitoring
AT^SFDL	Firmware Download
AT^SFSA	Flash File System Access
AT^SGAUTH	Set Type of Authentication for PDP-IP Connections
AT^SGIO	Get IO state of a specified pin or port
AT^SHUP	Hang up call(s) indicating a specific 3GPP TS 24.008 release cause
AT^SICI	Internet Connection Information
AT^SICS	Internet Connection Setup Profile
AT^SIND	Extended Indicator Control
AT^SIPS	Internet Profile Storage
AT^SISC	Internet Service Close
AT^SISE	Internet Service Error Report
AT^SISH	Internet Listener Service Disconnect

AT^SISI	Internet Service Information
AT^SISO	Internet Service Open
AT^SISR	Internet Service Read Data
AT^SISS	Internet Service Setup Profile
AT^SIST	Enter Transparent Access Mode
AT^SISW	Internet Service Write Data
AT^SISX	Internet Service Execution
AT^SJAM	Manage Java Application
AT^SJDL	Java Download
AT^SJMSEC	Java Midlet Security
AT^SJNET	Set Dialup Network Access Parameters
AT^SJOTAP	Over The Air Application Provisioning
AT^SJRA	Run Java Application
AT^SLED	LED Feature
AT^SMGL	List Short Messages from preferred store without setting status to REC READ
AT^SMGR	Read short message without setting status to REC READ
AT^SMONI	Monitoring Serving Cell
AT^SMONP	Monitoring Neighbour Cells
AT^SMSO	Switch Off EHS6
AT^SNFI	Set microphone path parameters
AT^SNFM	Set microphone audio path and power supply
AT^SNFO	Set audio output (= loudspeaker path) parameter
AT^SNFS	Select audio hardware set
AT^SNFTTY	Signal TTY/CTM audio mode capability
AT^SNMON	Network monitoring
AT^SPIO	GPIO Driver Open/Close
AT^SPOW	Set UART Mode and SLEEP Mode on UART
AT^SRADC	Configure and Read ADC Measurement
AT^SRTC	Ringtone configuration
AT^SSCNT	Start and Stop Pulse Counter
AT^SSIO	Set IO state of a specified pin or port
AT^SSPI	Serial Protocol Interface
AT^SSTA	Remote-SAT Interface Activation
AT^SWDAC	PWM Signal Configuration for DAC
AT^SXCALLSTAT	Set Reporting Call Status
AT^SXEONS	Display Eons names
AT^SXRAT	Selection of Radio Access Technology
ATA	Connect to Incoming Call
ATA	Manual acceptance of a network request for PDP context activation
ATD	Mobile originated call to specified number
ATD*99#	Request Packet Domain Service
ATD><mem><n>	Mobile originated call using specific memory and index number
ATD><n>	Mobile originated call from active memory using index number
ATD><str>	Mobile originated call from active memory using corresponding field
ATDL	Redial last number used

ATE	AT Command Echo
ATH	Disconnect existing connection
ATI	Display product identification information
ATL	Set monitor speaker loudness
ATO	Switch from command mode to data mode / PPP online mode
ATQ	Result Code Presentation Mode
ATS0	Set number of rings before automatically answering a call
ATS10	Set disconnect delay after indicating the absence of data carrier
ATS3	Command Line Termination
ATS4	Response Formatting
ATS5	Command Line Editing
ATS6	Set pause before blind dialing
ATS7	Set number of seconds to wait for connection completion
ATS8	Comma Dial Pause Time
ATV	Result code format mode
ATX	CONNECT Result Code Format
ATZ	Restore AT Command Settings from User Defined Profile

17. Accessories

The MTX-IND family has a wide range of available accessories, including:

- Power supplies
- All types of antennas (indoor, outdoor, high gain, etc…)
- Cables and DIN adapters

The MTX-IND is shipped without any accessories.

Please visit the following web sites to see the full-range of accessories:

- www.mtxm2m.com

18. Sales contact

www.mtxm2m.com

Matrix Madrid	Matrix Barcelona	Matrix Bilbao	Matrix Valencia
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