MC93 (RS-232)

User's guide

4G
LTE-M & NB-IoT

RS-232

USB 2.0

Optional GNSS

Document revision 2.3.2

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1   Introduction

Thank you for choosing an MC Technologies product.

The MC93 is a multi-mode LPWA modem supporting LTE Cat M1/Cat NB2/EGPRS network and optionally GNSS location services (GNSS functionality must be ordered explicitly).

These instructions enable the safe and efficient handling of the product. The instructions are an integral part of the product and must be kept accessible at all times to installation, maintenance, commissioning, and operating persons.

1.1   Warranty provisions

Unauthorized use, non-observance of this documentation, the usage by insufficiently qualified persons, and unauthorized modifications exclude the manufacturer's liability for resulting damages. Any modification to the device will void the manufacturer warranty. The provisions of our General Terms of Sale (AGB) apply. These can be found on our website:

www.mc-technologies.net/en/terms-and-conditions.php

2   Safety instructions

The safety and maintenance instructions must be strictly followed to ensure safe operation of the product. In addition to the safety and maintenance instructions, the individual sections of this document contain descriptions of procedures and operation instructions with safety-critical information.

General safety regulations and local guidelines for the area of application of the device and for the prevention of accidents must be followed strictly.

Only the consideration of all safety guidelines ensures protection of persons and the environment against hazards and the safe and trouble-free operation of the product.

2.1   Technical limits

The product is exclusively intended for use within the technical limitations and maximum ratings specified in this document. The following limitations must be observed in particular:

• 	The surrounding temperature limits must not be exceeded or dropped below.

• 	The supply voltage range must not be violated under or above.

• 	The maximum air humidity must not be exceeded and condensation must be avoided.

• 	The maximum switching voltage and the maximum switching current must not be exceeded.

• 	The maximum input voltage and the maximum input current must not be exceeded.

2.2   Obligations of the operator

The operator must observe the applicable regional regulations regarding the operation, functional testing, repair and maintenance of electronic devices all times.

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2.3 Qualification of installers

Installation and maintenance of the product may only be carried out by trained authorised installers which possess the necessary levels of qualification to ensure safe maintenance and operation. The qualified installer must have read and understood this documentation and follow its guidelines and instructions.

The electrical installation and commissioning of the product may only be carried out by persons who, due to their specialist training, knowledge and experience including knowledge of the relevant standards and regulations, are able to carry out work on electrical systems and independently detect and avoid possible hazards.

2.4 Guidelines for transport and storage

The following guidelines must be observed:

•	Do not expose the product to moisture or other potentially harmful environmental conditions (radiation, gases, etc.) during transport and storage. Pack the product properly.

•	Pack the product so that it is protected from shocks during transport and storage, e.g. by using air-cushioned packaging.

•	Before installing the product, check for possible damage that may have been caused by improper transport or storage. Damage in transit must be noted on the shipping documents. All claims for damages must be made immediately and before installation to the carrier or company responsible for the storage or logistics respectively.

3 Product label

The label of the product is located on one surface of the product. It may contain the following markings, among others, which are explained in more detail below.

3.1 Special waste

This symbol indicates that the device must be disposed of separately from residual waste at suitable collection points. Refer to the disposal section at the end of this manual.

3.2 CE marking

By affixing the CE marking, the manufacturer confirms that the product complies with the product-specific regulations of the European Union.

4 Environmental protection

Dispose the product and its packaging in accordance with the relevant environmental protection regulations. Refer to the disposal section of this manual for instructions on how to dispose the product. Separate the packaging components made of cardboard and paper as well as plastic and recycle them using the dedicated collection systems.

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5   Safety precautions

⚠	**Electrostatic discharges, short circuits and voltage spikes increase the risk of fire, cause damage to the product and may cause bodily harm.** Observe the general precautions for handling electrostatically sensitive components. Turn off the power before performing any work on an electric device. Make sure a suitable surge protection is installed. Do not operate the device with visible or otherwise known damage.
⚠	**Damage due to improper handling, repairs and modifications increase the risk of fire, cause damage to the product and may cause bodily harm.** It is not permitted to open the product for repair work or modifications beyond the removal and insertion of the provided plug-in cards. Make sure power accessory is well-suited for the purpose. Keep the device away from children and animals to prevent hazards like choking of parts and danger due to biting.
⚠	**Dust, debris, moisture and liquids from the surrounding area could get inside the product and increase the risk of fire, cause damage to the product and may cause bodily harm.** The product must not be used in humid environments or in the immediate vicinity of water or other liquids. Install the product in a clean, dry place protected from splashing water, dust and debris that could enter the device.
⚠	**Open flames, harsh chemicals and flammables including aerosols increase the risk of fire, cause damage to the product and may cause bodily harm.** The product must be kept away from direct sunlight, open flames, harsh chemicals, flammables, explosives, aerosols and be operated well within the operating temperature specification.
⚠	**Extreme temperatures, bad heat dissipation or insufficient ventilation increase the risk of fire, cause damage to the product and may cause bodily harm.** Operate the device in a well-ventilated area away from direct sunlight. Do not enclose or cover the device or its ventilation holes to allow heat dissipation.
⚠	**Strong magnetic or electric fields, vibrations and shocks cause malfunctions and may damage the device.** Keep the device away from electronic appliances that generate strong magnetic or electric fields, such as a microwave oven, radar, electrical motor or generator. Make sure the device is fixed properly and avoid high accelerations.
⚠	**A too small distance between antennas and persons might affect their health.** Be aware that wireless devices may affect the performance of e.g. hearing aids or pacemakers. The antennas must be placed at least 20 cm away from persons during operation. If applicable respect the rules and regulations for device operations set forth in hospitals and health care facilities.

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6 Package content

The package includes the accessories listed below. Please check that all accessories listed are included in the box. If a part is missing or damaged, please contact MC Technologies directly.

• MC93

Optional accessories are not included. Among others, the following parts are available at MC Technologies:

• DIN mounting clip-in for DIN rail

• DIN rail

• GSM (LTE) antenna

• GPS antenna

• Power supply

7 Technical specifications

7.1 Physical characteristics and limitations

Physical characteristic / limitation	Value
Power supply	6 V … 30 V DC (min. 12 W)
Dimensions (W x H x D)	74 x 33 x 65 mm
Weight	~ 90 g (~ 3.2 oz)
Operating temperature	-20°C to +70°C
Housing material	ABS

7.2 Mobile network features

Feature	Description
Supported networks	LTE Cat M1: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B26/B27/B28/B66/B85
	LTE Cat NB2: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B28/B66/B71/B85
	GSM/EDGE: 850/900/1800/1900 MHz
Transmission rates LTE-M	Cat M1: Up to 1119 kbps upload and 588 kbps download
Transmission rates NB-IoT	Cat NB2: Up to 158.5 kbps upload and 127 Kbps download Cat NB1: Up to 70 kbps upload and 32 kbps download
Transmission rates EDGE	Up to 236.8 kbps upload and 296 kbps download
Transmission rates GPRS	Up to 85.6 kbps upload and 107 kbps download

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MC93 (RS-232)

LPWA cellular modem

8 Ports, display and operating elements
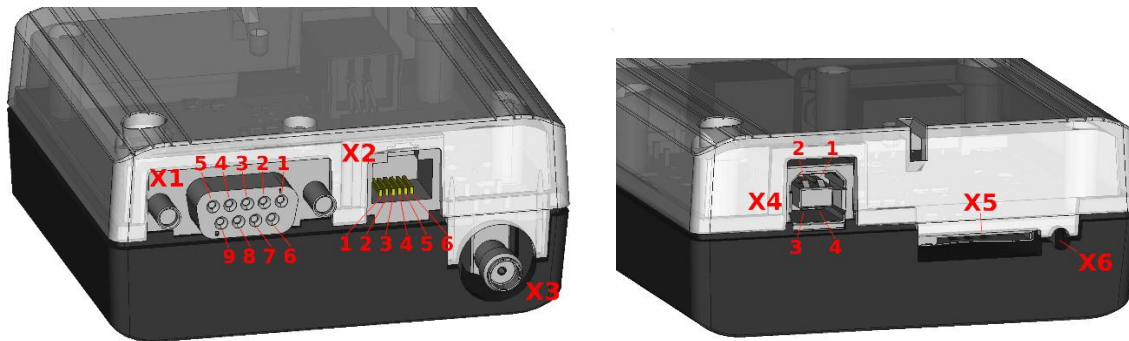
	Port	Description
X1	DE-9 male	Connected to internal RS-232 module
X2	RJ12 (Power / Serial)	For power supply and connected to internal RS-232 module
X3	SMA female	For GSM antenna
X4	USB B	Only for data connection (not suitable for power supply)
X5	SIM card slot	Push-push mechanism
X6	Button	Used for recovery and update purposes

8.1 RJ12 port pinout

The DC voltage must be between 6 and 30V, typical supply voltage is 12V.

Port	Signal	Description
1	GND	Ground
2	GND	Ground
3	N/C	Not connected
4	TXD (OUT)	Transmit line (of the modem)
5	RXD (IN)	Receive line (of the modem)
6	POWER	Positive power supply input (6…30V)

8.2 DE-9 port pinout

Standard DSUB-9 female connector for RS-232 communication (standard DCE).

Port	Signal	Description
1	DCD (OUT)	Data Carrier Detect (Modem wants to send data)
2	TXD (OUT)	Transmit line (of the modem)
3	RXD (IN)	Receive line (of the modem)
4	DTR (IN)	Data Terminal Ready (Terminal is initialized)
5	GND	Ground
6	DSR (OUT)	Data Set Ready (Modem is initialized)
7	RTR / RTS (IN)	Ready To Receive / Request To Send (Terminal is ready to receive)
8	CTS (OUT)	Clear To Send (Modem is ready to receive)
9	RI (OUT)	Ring Indicator (Modem has an incoming call)

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8.3 LED indicators

LED	Color	Description
LED 1	Orange	Connection status indicator
LED 2	Red	Error indication (e.g. under/over voltage situation)
LED 3	Orange	Connection status indicator (same as LED 1)
LED 4	Green	Power

8.3.1 Status LED blink patterns

Blink pattern	Network Status
Short interval (200 ms High/1800 ms Low)	Network searching
Long interval (1800 ms High/200 ms Low)	Idle
Flickering (125 ms High/125 ms Low)	Data transfer in progress
Always on	Voice or data call in progress

9 Installation

Please follow the instructions step by step and configure the settings for the SIM card.

9.1 Antenna

Mount the supplied antenna on the red SMA connector of the MC93. Check whether the local network coverage of the mobile phone provider is sufficient.

Warning: Persons must be at least 20 cm away from the transmitting antenna during device operation.

9.2 Power supply

The MC93 can be operated with a supply voltage of 6 - 30V DC powered using its RJ12 socket.

The description of the pinout of the RJ12 connector can be found in the section above. Make sure the polarity is correct as it might otherwise destroy the device.

10 Serial communication

10.1 Putty

1. In Putty, select "Serial" as the "Connection type"

2. Choose the serial line (COM port) where the device is attached

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3.   Set the speed to "115200"

4.   Click on "Open".

Note: When using the RJ12 connector, the flow control needs to be deactivated:

1. Expand the "Connection" tab on the left side, then under "SSH" click on "Serial".
2. Set "Flow control" to "None"

10.2 STTY

You can use "stty" to configure your "tty" and connect to the modem using "cat" and "echo".

1. Using Command Prompt, give the command:

```
stty -F /dev/ttyUSB0 -crtscts 115200 cs8 -cstopb -parenb -echo –echon1
```

2. Execute cat /dev/ttyUSB0 in one terminal and echo "AT+CSQ" >/dev/ttyUSB0 in another.

10.3 Minicom

You can use the Linux command line tool minicom to connect to the modem.

Enter the following command in the console:

```
minicom --device /dev/ttyUSB0 --baud 115200,8,N,1
```

The modem will now respond to AT-Commands.

Note: When using the RJ12 connector, the flow control needs to be deactivated:
Press CTRL+A followed by O to get into the settings. Then go down to "Serial port setup", press "Enter" and then press "F" to toggle "Hardware Flow Control".

10.4 C/C++

This code snippet should give you an idea how to establish a connection with the modem:

```c
Portname = "/dev/ttyUSB0";

serial_port = open(portname, O_RDWR);

// Check for errors

if (serial_port < 0) {

fprintf(stderr, "Could not open %s: %s\n", portname, strerror(errno));

exit(EXIT_FAILURE);

}

// Create new termios struc, we call it 'tty' for convention

struct termios tty;

memset(&tty, 0, sizeof tty);

// Read in existing settings, and handle any error

if (tcgetattr(serial_port, &tty) != 0) {

fprintf(stderr, "Error %i from tcgetattr: %s\n", errno, strerror(errno));

fprintf(stderr, "Could not get options for modem connection%s\n", portname);

exit(EXIT_FAILURE);

}

tty.c_cflag &= ~PARENB; // Clear parity bit, disabling parity

tty.c_cflag &=

~CSTOPB; // Clear stop field, only one stop bit used in communication

tty.c_cflag |= CS8; // 8 bits per byte

tty.c_cflag &= ~CRTSCTS; // Disable RTS/CTS hardware flow control

tty.c_cflag |=

CREAD | CLOCAL; // Turn on READ & ignore ctrl lines (CLOCAL = 1)

tty.c_lflag &= ~ICANON;

tty.c_lflag &= ~ECHO; // Disable echo
```

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11.2 Sending SMS

11.2.1 Preparing the device

Activate SMS text mode using the following command:

AT+CMGF=1

In text mode there are some additional parameters that can be set.

Using the following command, we can read the current values:

AT+CSMP?

The device will respond with a string like this:

> +CSMP: 1,169,0,0

> OK

The first value is a combination of some option bits:

Bit 7	RP	Reply path, not used in text mode
Bit 6	UDHI	User Data Header Information
Bit 5	SRR	Set this bit to request a delivery report
Bit 3,4	VPF	Validity Period, set b4=1 if a VP value is present
Bit 2	RD	Reject Duplicates, do not return a message ID when a message with the same destination and ID is still pending
Bit 0,1	MTI	Message Type Indicatorb1=0 & b0=0 -> SMS-DELIVERb1=0 & b0=1 -> SMS-SUBMIT

Bit 0 of the message is always set when sending messages (SMS-SUBMIT). So, the first value should be 1 or higher. The second parameter sets the Validity Period of the message. This value is encoded as follows:

0 - 143	(VP + 1) x 5 minutes
144 - 167	12 Hours + ((VP-143) x 30 minutes)
168 - 196	(VP-166) x 1 day
197 - 255	(VP-192) x 1 week

The third parameter contains the PID (Protocol Identifier). This parameter is only used for advanced messaging. The fourth parameter contains the DCS (Data Coding Scheme). This parameter is used to select the character set/message type. When setting the DCS parameter to '0' standard 7-bit text is sent. When setting this parameter to '16' the message is sent as a flash message.

To send a message with a validity period of 1 day, the parameters have to be set like this:

Bit 0 and 4 of the first field has to be set, so the first value will become 1 + 16 = 17.

Send the following command to the modem to set these parameters:

AT+CSMP=17,167,0,16

If the modem responds with "OK", the modem is ready to send (flash) text messages with a validity period of 1 day.

11.2.2 Sending an SMS message
To send the SMS message

AT+CMGS="+4917604069083"

Replace the above phone number with the wanted phone number. The device will respond with:

>

Type the message text and send the message using the <CTRL>-<Z> key combination:

> Test! <CTRL-Z>

<wait until the message has been processed>

> +CMGS: 62   Message was sent correctly

11.2.3 Sending a Unicode SMS message
To check whether your device supports this mode, just type the following command:

AT+CSCS=?

This command displays the code pages supported by the device. The device will respond like this:

+CSCS: ("IRA","GSM","UCS2")

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If this string contains "HEX" or "UCS2", Unicode seems to be supported. To specify that you will use a UCS2 string to send the message, set the codepage to "UCS2" depending on the device response. In our example we will set the device to "UCS2":

AT+CSCS="UCS2"

Next, specify the correct DCS (Data Coding Scheme) for Unicode messages, which is 0x08. Set this value by changing the fourth parameter of the AT+CSMP command to '8':

AT+CSMP=1,167,0,8

The device is now ready to send messages as Unicode.

11.3 GNSS (localization)

11.3.1 Turning GNSS on and off

Turn on GNSS function:

AT+QGPS=1

Turn off GNSS function:

AT+QGPSEND

11.3.2 Activating GNSS automatically

AT+QGPSCFG="autogps",1

11.3.3 Retrieving the location

Enable <nmeasrc> functionality:

AT+QGPSCFG="nmeasrc",1

Obtain positioning information:

AT+QGPSLOC?

11.3.4 Obtaining NMEA sentences

Enable <nmeasrc> functionality:

AT+QGPSCFG="nmeasrc",1

Execute one of the following commands for setting the corresponding NMEA output format:

AT+QGPSGNMEA="GGA"	Query GGA information
AT+QGPSGNMEA="RMC"	Query RMC information
AT+QGPSGNMEA="GSV"	Query GSV information
AT+QGPSGNMEA="GSA"	Query GSA information
AT+QGPSGNMEA="VTG"	Query VTG information
AT+QGPSGNMEA="GNS"	Query GNC information

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11.3.5 Using the dedicated USB NMEA port as output

AT+QGPSCFG="outport","usbnmea"

11.3.6 Disabling <nmeasrc> functionality:

AT+QGPSCFG="nmeasrc",0

11.3.7 GNSS error codes

Error	Meaning
501	Invalid Parameter(s)
502	Operation not support
503	GNSS subsystem busy
504	Session is on Going
505	Session is not active
506	Operation timeout
507	Function not enabled
508	Time information error
512	Validity time is out of range
513	Internal resource error
514	GNSS locked
515	End by E911
516	Not fixed now (No GPS position received)
549	Unknown error

11.4 Setting WWAN Priority Mode

MC93 features ultra-low power consumption by supporting Extended Discontinuous Reception (eDRX), a feature in NB-Iot and LTE M that enables developers to set, and later change how long a device stays in low-power sleep mode before it wakes up to listen for any network indications for pending data, thus reducing the power consumption.

To minimize the power consumption, GNSS and WWAN cannot work simultaneously, either WWAN or GNSS takes priority during implementation. By default, the modules are configured into the GNSS priority mode, which can be switched to the WWAN priority mode.

Enable WWAN Priority Mode:

AT+QGPSCFG="priority",1,1

Enable GNSS Priority Mode:

AT+QGPSCFG="priority",0,1

11.4.1 Paging Time Window Value and eDRX Setting

Depending on the values given by your SIM Card provider, you can set the TPTW and eDRX value to allow the change between WWAN and GNSS modes in WWAN priority mode.

Note that the switch between WWAN and GNSS may not work if the TPTW and eDRX values are not supported by the mobile provider.

To set the values the command AT+QPTWEDRXS is used.

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AT+QPTWEDRXS=<mode>, <AcT-type>,
<Requested_paging_time_window>,<Requested_eDRX_value>

AT+QPTWEDRXS=2,5,"0000","0010"

Parameters	Value	Description
<mode>	0	Disable the use of requested paging time window and eDRX.
	1	Enable the use of requested paging time window and eDRX.
	2	Enable the use of requested paging time window and eDRX, and enable the URC.
	3	Disable the use of eDRX and discard all parameters for eDRX.
<AcT-type>	0	Access technology is not using eDRX.
	2	GSM (not applicable)
	4	eMTC
	5	NB-IoT
<Requested_paging_time_window>	0000	
	0001	
	0010	
	0011	
	0100	
	0101	
	0110	
	0111	
	1000	
	1010	
	1011	
	1100	
	1101	
	1110	
	1111	
<Requested_eDRX_value>		

12 Product care and handling

12.1 Maintenance

The product is maintenance-free and requires no special regular maintenance.

12.2 Troubleshooting

If a fault occurs during operation of the product and you need assistance, please contact MC Technologies support. You can reach our support department by email:

support@mc-technologies.net

12.3 Repair

Only qualified personnel at MC Technologies GmbH is authorised to perform repairs.

Send defective products with a detailed error description to:

MC Technologies

-Repair-

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Before shipping the device make sure to:

- Call our support team and ask for an RMA number (Return to Manufacturer Authorisation)

- Remove any personal belongings like inserted SIM cards

- Back up any relevant data like configurations on the device

12.4 Disposal

In accordance with WEEE regulations, the return and recycling of old MC Technologies equipment for our customers is regulated as follows:

Please send your old devices carriage paid to the following address:

MC Technologies

-Disposal-

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