RB600-NB

USER MANUAL

LTE Cat. NB-IoT

ENGLISH VERSION

TELEORIGIN
UNIQUE TECHNOLOGY FOR TELEMETRY

Elproma Elektronika Sp. z o.o.
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Contents

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1. Overview

The RB600-NB Terminal is the complete modem solution for wireless m2m applications. Based on the high quality module, it offers high level NB-IoT network features in compact plastic housing with all the standardized interfaces. Together with its small size and wide supply voltage range, makes it easy to integrate into all kinds of machines.

The RB600-NB terminal enabling TCP/UDP/LWM2M data transmission, HTTP(S), SNTP and MQTT communication is a universal solution for all low-volume M2M and mobile data applications including metering, traffic systems, transportation and logistics, security, vending machines, and facility management.

Device can be controlled by standard AT commands.

This document contains full RB600-NB modem description and gives information about installation and using it.

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2. References

[1] Quectel_BC66_Series_AT_Commands_Manual_V1.0

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3. Package

3.1 Box

On original box of the product you can find product sticker. It should matches modems sticker that is placed on the device. This proves that your modem is original product. More information about stickers in **Product sticker**.

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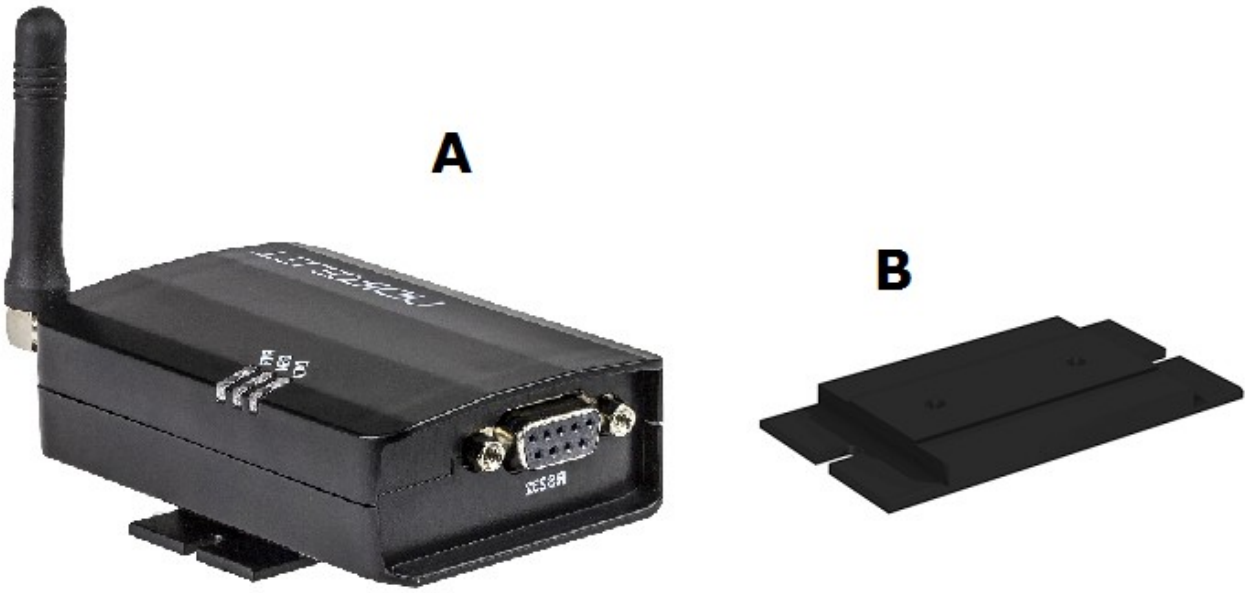
4. Complete package contents



Complete package contains:

- RB600-NB terminal (item A)
- wall handle (item B)

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5. General presentation

5.1 Product pictures

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5.2 External connections

5.2.1 NB-IoT antenna connector

SMA antenna input is used to connect external NB-IoT antenna. To establish connection with NB-IoT network an external antenna must be used. Type of antenna depends on NB-IoT network coverage. In good circumstances (level of received signal is high) use antenna which is attached in the package. If range of NB-IoT network is low or none, an outdoor or indoor (for instance in place where NB-IoT range is sufficient) antenna should be used.

Note: *If there is no antenna connected to SMA connector, the connection with NB-IoT network is impossible.*

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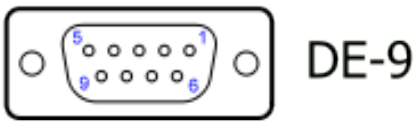
5.2.2 RS-232 Interface (EIA574)

RB600-NB terminal is equipped with RS-232 interface (as shown below). DE9 DSUB socket is connected via voltage level translator circuit to the NB-IoT module.

Table of RS-232 DB9 pins:

Pin No.	Name	Dir	Description
1	DCD	IN	Data Carrier Detect. Raised by DCE when modem synchronized.
2	RD	IN	Receive Data (a.k.a RxD, Rx). Arriving data from DCE.
3	TD	OUT	Transmit Data (a.k.a TxD, Tx). Sending data from DTE.
4	DTR	OUT	Data Terminal Ready. Raised by DTE when powered on. In auto-answer mode raised only when RI arrives from DCE.
5	SGND	-	Ground
6	DSR	IN	Data Set Ready. Raised by DCE to indicate ready (optionally RS485 A)
7	RTS	OUT	Request To Send. Raised by DTE when it wishes to send. Expects CTS from DCE.
8	CTS	IN	Clear To Send. Raised by DCE in response to RTS from DTE.
9	RI	IN	Ring Indicator. Set when incoming ring detected - used for auto-answer application. DTE raised DTR to answer (optionally RS485 B)

DE-9 (EIA/TIA 574)
looking into female connector



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5.2.3 Power supply connector

The power supply connector is a 2-pin connector for external DC power supply connection, which can handle voltage from range 5..30 V DC, 2.5 W max. continuous power.

No.	Singal	I/O	Description
+	V+BATTERY	I	5 V – 30 V DC
-	GND	-	Ground

Attention!
An attempt to power terminal from DC source outside of 5..30 V range may result in physical destruction of the device.

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5.2.4 SIM card holder

SIM card holder is placed in front of RB600-NB terminal (as shown below) and is accessible externally. To insert SIM card into the holder press the **yellow button**, eject the little drawer, place there the SIM card and insert drawer into the modem (you will hear “click”). To operate the module in a NB-IoT network, it is necessary to insert a SIM card obtained from the network operator.

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5.3 Product sticker

Product stickers are on the modem and on the box of the product.
A production sticker includes the following information:

- product serial number (IMEI) and model signature
- manufacturer address
- the CE marking
- the 15-digit bar code (box sticker only)

Device sticker

Box sticker

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6. Basic features and services

Basic features and available services for RB600-NB are contained in table below.

Feature/service	Description
Standard	Supported Bands: LTE NB-IoT B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/B20/B25/B26*/B28/B66 Physical: • 83 x 53,5 x 25 mm • Weight 89 g
Speed	Single-Tone: • 25.5kbps (DL)/16.7kbps (UL) Multi-Tone: • 25.5kbps (DL)/62.5kbps (UL)
Interfaces	Connectors • SMA antenna SIM Card • 3.0V / 1.8V • STK 3.1 Connectivity • UART: BR from 300 bps to 115.2 Kbps • Auto BR
Protocol stacks	UDP/TCP/LwM2M/SNTP/MQTT/CoAP*/PPP*/TLS*/DTLS*/HTTP*/HTTPS*
SMS	MO / MT Text and PDU mode
Power supply	5V – 30V DC

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7. Using the modem

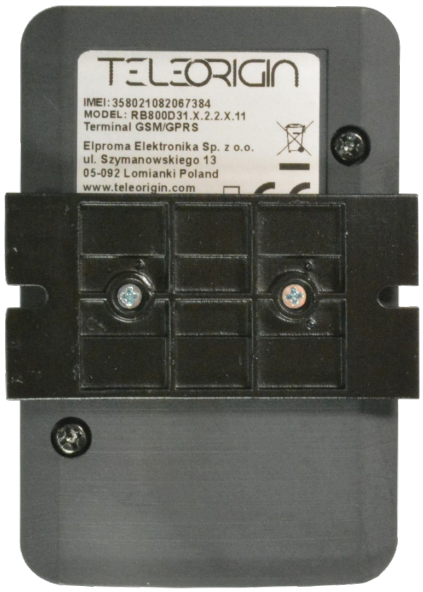
7.1 Setting up the modem

To set up the modem, do the following steps:

- Eject SIM card holder using yellow button and pull out the drawer.
- Insert Your SIM card into drawer.
- Verify if SIM card fits in the drawer properly.
- Insert the drawer into the modem. Connect the antenna to the SMA connector
- Optionally modem can be connected using RS-232 interface
- Plug the power supply cable to the power supply input
- Now the modem is ready to work.

7.2 Mounting the modem on the wall

To mount modem on the wall install wall handles as shown below:



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7.3 Checking the communication with the modem

Once the modem is connected you can check communication between RB600-NB terminal and the PC using terminal e.g. free software Terminal Br@y v20130116 which is available here: https://sites.google.com/site/terminalbpp/
You can use any Terminal program also. Configuration of the DTE (port COM) can be as follows:

- Bits per second: **115200 bps**,
- Data bits: **8**,
- Parity: **None**,
- Stop bits: **1**,
- Flow control: **hardware**.

Using a communication software such as Terminal Br@y, enter the ***AT*** and **push 'enter'** button. The response of the terminal should be '***OK'*** displayed in the Hyperterminal window.

If the connection with the modem cannot be established do the following:

- Check if modem is connected with PC via RS-232 or USB.
- Check the configuration of the COM port.
  Examples of AT commands:
- ***ATE1*** enables modem echo function,
- **AT+CGMI** modem answers “Quectel” when connection is OK.
- **AT+CPIN?** shows current status of SIM card
- **AT+CPIN=xxxx** to enter PIN, where 'xxxx' are digitals
- **AT+CSQ** to verify received signal strength

For further information about AT commands and their usage, refer to [1].

7.4 Status of the modem (LEDs)

The operational status of the RB600-NB Terminal is signalized by external LEDs placed on the front panel of the modem.

The table below shows what is the meaning of LEDs.

LED name	LED colour	Description
DATA	blue	Software controlled using AT
LTE	orange	Off – LTE module is not running 64ms On/800ms Off – module is not synchronized with network 64ms On/2000ms Off – module is synchronized with network 64ms On/600ms Off – GPRS data transmission after dialing the PPP connection
PWR	green	Lights when modem is power on

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7.5 Disabling and enabling echo function

If echo is not displayed when entering AT command, that means:

- The local echo function in software (such as Hyperterminal) is disabled
- The echo function of the modem is disabled

To enable echo function of the modem enter ***ATE1*** command.

In Machine to Machine communication it is recommended to disable echo function (type ***ATE0***) in order to avoid useless CPU processing.

For further information about ***AT*** commands and their usage, refer to [1].

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7.6 Verifying the strength of received signal

RB600-NB terminal can establish connection with network if the received signal strength is sufficiently strong.

To verify the signal strength and bit error rate, do the following:
Using software such as Terminal Br@y enter ***AT+CSQ***. This command displays the received signal strength indication <rssi> and channel bit error rate <ber>. The modem answers as follows:

+CSQ: <rssi>,<ber>
OK

<parameter>	Description
<rssi>	0 through 31 - covers the range of -113 dbm (or less) to -51dbm (or greater)
<ber>	Channel bit error rate (in percent) 0–7 RXQUAL values as defined in 3GPP TS 45.008 99 Unknown or not detectable

For further information about ***AT*** commands and their usage, refer to [1].

7.7 PIN code status

To check PIN code status enter ***AT+CPIN?*** Command.
The table below shows the most interesting responses of the modem:

Answer	Description
+CPIN: SIM PIN	PIN code has not been entered
+CPIN: READY	PIN code has been entered correctly

For further information about ***AT*** commands and their usage, refer to [1].

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7.8 Network registration

7.8.1 NB-IoT network registration

To check *EPS* network registration status enter ***AT+CEREG?*** into software (for instance Hyperterminal) Modem will answer in following format:

+CEREG: <n>,<stat>[,<tac>,<ci>,<AcT>]
OK

The following table shows the *+CEREG* parameters:

<parameter>	Description
<n>	**0** Disables the network registration unsolicited result code. **1** Enables the network registration unsolicited result code +CEREG: <stat>. **2** Enables the network registration and location information in unsolicited reports and Read command +CEREG:<stat>[,<tac>,<ci>,<AcT>]. The default is **0**.
<stat>	**0** Not registered, and the ME is not currently searching for a new operator to which to register. **1** Registered, home network. **2** Not registered, but the ME is currently searching for a new operator to which to register. **3** Registration denied.* **4** Unknown. **5** Registered, roaming.
<tac>	Two bytes tracking area code in hexadecimal format (e.g. “00C3” equals 195 in decimal).
<ci>	Four bytes E-UTRAN cell ID in hexadecimal format.
<AcT>	Access technology of the registered network. **7** E-UTRAN **9** E-UTRAN (NB-S1 mode)

*To manage connecting to network SIM card inserted into the modem must be valid.
For further information about ***AT*** commands and their usage, refer to [1].

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8. Troubleshooting

8.1 No connection/communication with the modem

If there is no communication with the modem do the following steps:

- Check all external connections of the modem (RS-232 or USB, Power supply)
- Verify if power supply is correct (see **Power supply**)
- Check if COM port is correctly parametrized
- Check if program used for communication works properly and if there is none other program interfering. If yes close the interfering program.

8.2 Receiving ERROR message

Modem answers ***ERROR*** on AT command in following cases:

- Syntax of typed AT command is incorrect – check the command syntax in [1]
- Parameters of typed AT command are incorrect – type ***AT+CMEE=1*** for enabling wide description of error which occurred. The response now will be in format:
  ERROR
  +CME ERROR: <err>
  where <err> is a description of error which has occurred
- Refer to [1] for further details about occurred error

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8.3 Receiving NO CARRIER message

There are some common cases when modem answers ***NO CARRIER:***

- If data/voice/fax connection cannot be established
- Right after hanging up the data/voice/fax connection
- If there is no connection with network – check antenna and registration status (see **Network registration**)
- If there is no power supply (see **Power supply)**

If modem answers ***NO CARRIER*** in some cases, you can have extended error code using ***AT+CEER.*** The table below shows some of codes which can appear.

Error code	Description
1	Unassigned or unallocated number
3	No route to destination
6	Channel unacceptable
8	Operator determined barring
16	Normal call clearing
17	User busy
18	No user responding
19	User alerting, no answer
21	Call rejected
22	Number changed
27	Destination out of order
28	Invalid number format (incomplete number)
34	No circuit/channel available
38	Network out of order
41	Temporary failure

For further information about ***AT*** commands and their usage, refer to [1].

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9. Technical characteristics

9.1 Mechanical characteristic

Max. dimensions	72 x 53.5 x 26 mm (w/o connectors) 83 x 53.5 x 26 mm (w/ connectors)
Weight	≈ 89 g
Volume	100 cm^3 (w/o connectors)

9.2 Housing description (dimensioning diagram)

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10. Electrical characteristic

10.1 Power supply

- Nominal voltage range: 5..30 V, 10%
- Maximum continuous (average) supply power: 2.5 W
- Maximum continuous (average) supply current: 200 mA at 12V

10.2 RF characteristics

Frequency Band	Receiving Frequency	Transmitting Frequency
B1	2110MHz~2170MHz	1920MHz~1980MHz
B2	1930MHz~1990MHz	1850MHz~1910MHz
B3	1805MHz~1880MHz	1710MHz~1785MHz
B4	2110MHz~2155MHz	1710MHz~1755MHz
B5	869MHz~894MHz	824MHz~849MHz
B8	925MHz~960MHz	880MHz~915 MHz
B12	729MHz~746MHz	699MHz~716MHz
B13	746MHz~756MHz	777MHz~787MHz
B17	734MHz~746MHz	704MHz~716MHz
B18	860MHz~875MHz	815MHz~830MHz
B19	875MHz~890MHz	830MHz~845MHz
B20	791MHz~821MHz	832MHz~862MHz
B25	1930MHz~1995MHz	1850MHz~1915MHz
B26*	859MHz~894MHz	814MHz~849MHz
B28	758MHz~803MHz	703MHz~748MHz
B66	2110MHz~2200MHz	1710MHz~1780MHz

"*" means under development.

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10.3 External antenna

The external antenna is connected to the modem via SMA connector.
Antenna must have parameters as shown below in table.

Antenna type	LTE NB-IoT network
Impedance	50 Ω
DC impedance	0 Ω
Gain	0 dBi w/o cable; 2dBi w/ cable
VSWR (with cable)	-10 dB

The antenna chosen for working with modem should best fit to circumstances of environment it is used in. When the modem is placed in a room or somewhere where the range of networks signal is too low, the outdoor or specific indoor antenna should be used to increase it.

10.4 Environmental characteristic

Table below gives the environmental operating conditions of RB600-NB terminal.

Attention!
Exceeding the values may result in permanent damage to the module.

Parameter	Conditions	Min	Max	Unit
Ambient Operating Temperature		-20	60	°C
Storage Temperature		-40	85	°C
ESD	At antenna connector Contact Air At interface connector		 ± 6 ± 15 ± 1	KV
Humidity		5	85	%

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11. Safety recommendations

11.1 General Safety

Please follow safety regulations regarding the use of radio equipment due to the possibility of radio frequency interference. Read given advices carefully.

Switch ***off*** NB-IoT terminal when:

- in an aircraft – using cellular telephones in aircraft may endanger the operation of the aircraft; it is illegal
- at a refuelling point
- in any area with potentially explosive atmosphere which could cause an explosion or fire
- in hospitals and any other places where medical equipment is in use

Respect restrictions on the use of radio equipment in any area or place where it is signalized that using cellular telephony is forbidden or dangerous.

Using NB-IoT modem close to other electronic equipment may also cause interference if the equipment is inadequately protected. It may lead to damage or failure of NB-IoT modem or the other equipment.

11.2 Care and Maintenance

The RB600-NB terminal is an electronic product that should be treated with care. Please follow suggestions shown below due to using modem for many years.

- Do not expose RB600-NB to any extreme circumstances like high temperature or high humidity
- Do not keep modem in dirty and dust places
- Do not disassemble the RB600-NB modem
- Do not expose the modem to any water, rain or steam
- Do not drop, shake or knocking your modem
- Do not place your modem close to magnetic devices – credit cards, etc
- Use of third party equipment or accessories, not made or authorized by Elproma Electronics may invalid the warranty of modem and/or cause failure or permanent damage of modem
- Do not expose the modem to children under 3 years

11.3 Responsibility

The modem is under your responsibility. Please treat it with care, and respect local regulations. This is not a toy – keep it out of the reach of children.

Try to use security features (PIN etc.) to block unauthorized use or theft.

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12. Conformity Assessment Issues

The RB600-NB has been assessed in order to satisfy the essential requirements of the RED 2014/53/EU to demonstrate the conformity against the harmonised standards with the final involvement of a Notified Body.

CE

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13. Safety Recommendations

READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc
- Where there is risk of explosion such as gasoline stations, oil refineries, etc

It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity.

We recommend following the instructions of the hardware user guides for a correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conforming to the security and fire prevention regulations.

The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. The same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible of the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as of any project or installation issue, because the risk of disturbing the NB-IoT network or external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force.

Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the people (20 cm). In case of this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

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14. List of Acronyms

ACM	Accumulated Call Meter
ASCII	American Standard Code for Information Interchange
AT	Attention commands
CB	Cell Broadcast
CBS	Cell Broadcasting Service
CCM	Call Control Meter
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CMOS	Complementary Metal-Oxide Semiconductor
CR	Carriage Return
CSD	Circuit Switched Data
CTS	Clear To Send
DAI	Digital Audio Interface
DCD	Data Carrier Detected
DCE	Data Communications Equipment
DRX	Data Receive
DSR	Data Set Ready
DTA	Data Terminal Adaptor
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi Frequency
DTR	Data Terminal Ready
EMC	Electromagnetic Compatibility
ETSI	European Telecommunications Equipment Institute
FTA	Full Type Approval (ETSI)
GPRS	General Radio Packet Service
GSM	Global System for Mobile communication
HF	Hands Free
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IRA	Internationale Reference Alphabet
ITU	International Telecommunications Union
IWF	Inter-Working Function
LCD	Liquid Crystal Display

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LED	Light Emitting Diode
LF	Linefeed
ME	Mobile Equipment
MMI	Man Machine Interface
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
NB-IoT	Narrowband IoT communication
OEM	Other Equipment Manufacturer
PB	Phone Book
PDU	Protocol Data Unit
PH	Packet Handler
PIN	Personal Identity Number
PLMN	Public Land Mobile Network
PUCT	Price per Unit Currency Table
PUK	PIN Unblocking Code
RACH	Random Access Channel
RLP	Radio Link Protocol
RMS	Root Mean Square
RTS	Ready To Send
RI	Ring Indicator
SAR	Specific Absorption Rate (e.g. of the body of a person in an electromagnetic field)
SCA	Service Center Address
SIM	Subscriber Identity Module
SMD	Surface Mounted Device
SMS	Short Message Service
SMSC	Short Message Service Center
SPI	Serial Protocol Interface
SS	Supplementary Service
TIA	Telecommunications Industry Association
UDUB	User Determined User Busy
USSD	Unstructured Supplementary Service Data

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15. On-line support

Elproma provides a range on on-line support which includes:

- the latest version of this document
- the latest drivers for RB600-NB
- technical support

This information can be found on our web sites at **www.teleorigin.com**

For further information you can contact us at:
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