USRobotics®
A Division of UNICOM® Global

Courier M2M 3G Cellular Modem

USR3500

Reference Guide

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices are used in a normal manner with a well-constructed network, the modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Neither Sierra Wireless nor USRobotics accepts any responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the modem, or for failure of the modem to transmit or receive such data.

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Contact Information

Web:	http://www.usr.com/support

Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, and troubleshooting tips: http://www.usr.com/support/3500

Document History

Version	Date	Updates
1.0		Initial release

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1. Functional Specifications

This section discusses the functional specifications of the USR3500.

1.1. Functional Architecture

The global architecture of the USR3500 is shown in the figure below.

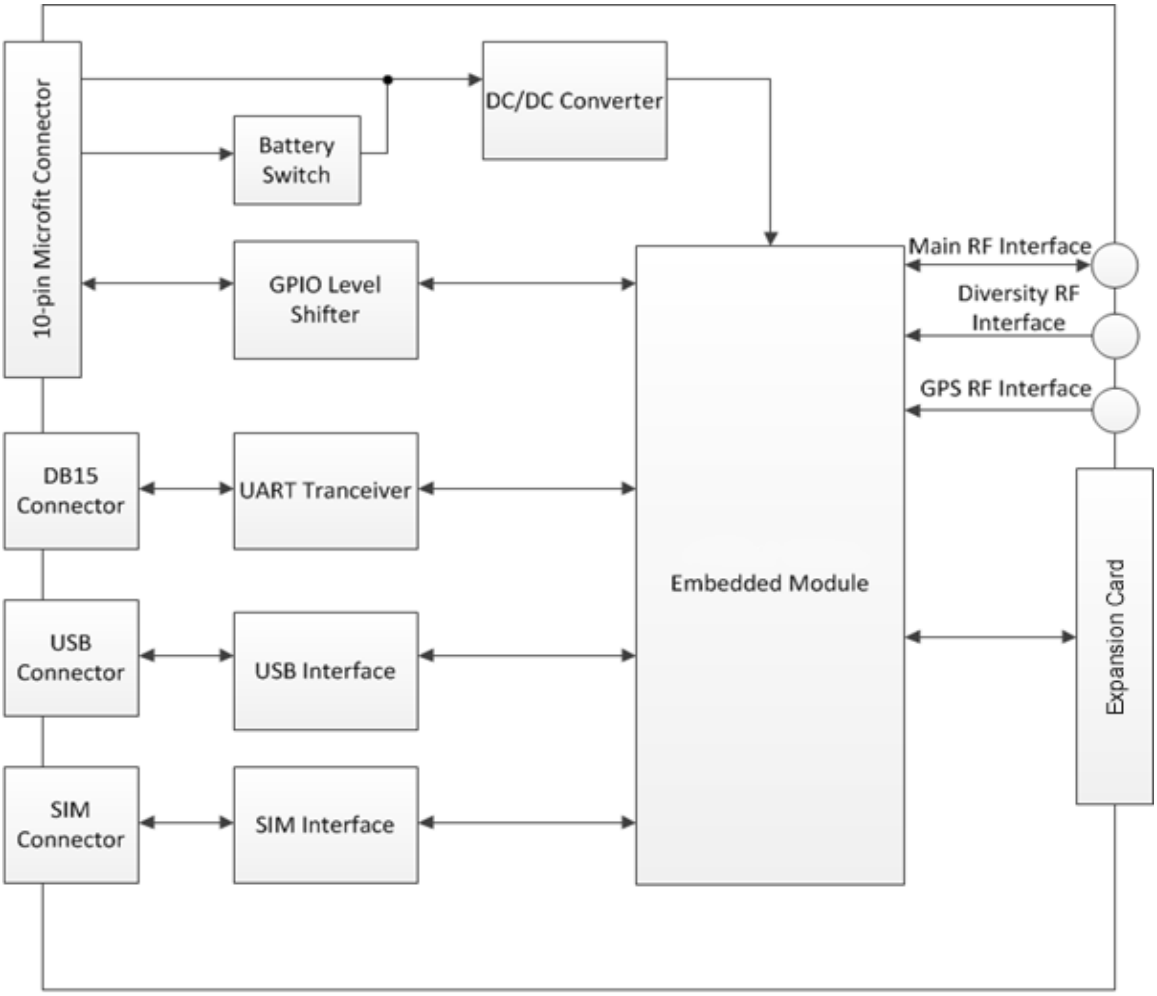


Figure 1. Functional Architecture

1.2. RF Functionalities

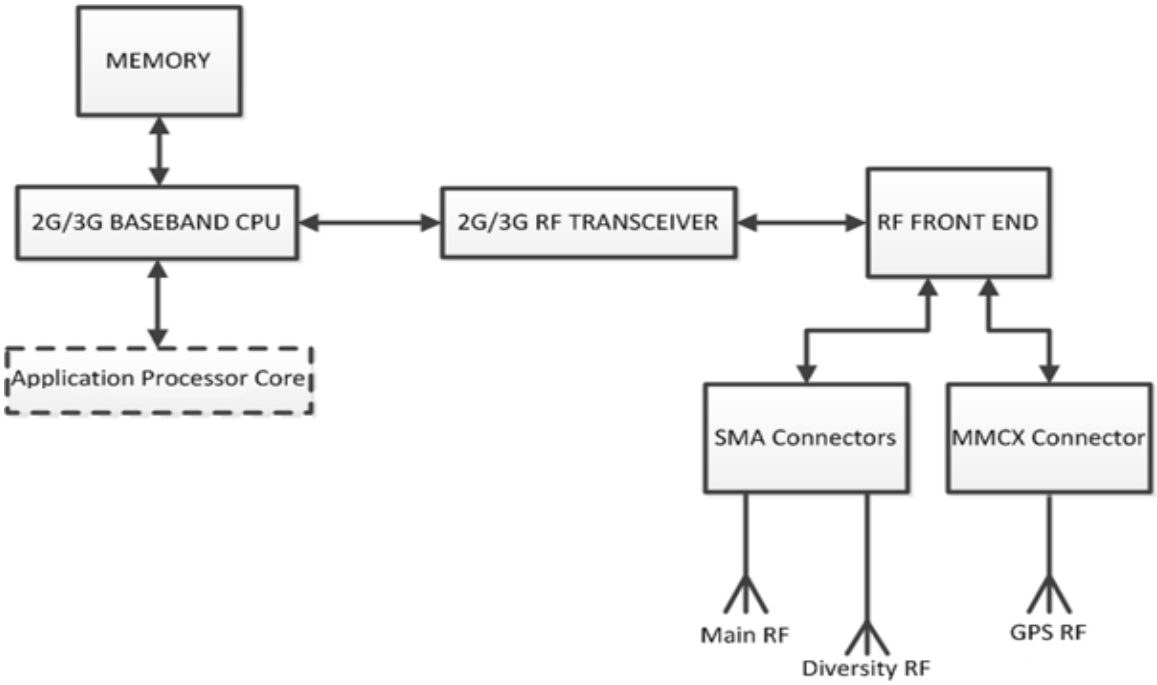


Figure 2. RF Architecture

1.3. Operating System

The modem is Open AT Application Framework compliant. With the Courier M2M Open AT application loaded, the modem becomes a solution for many specific market needs. The operating system of the modem is responsible for the following functions:

- AT Command processing
- Real Time Clock (RTC) with calendar

2. Technical Specifications

2.1. Power Supply

The modem is supplied by an external DC voltage, DC-IN, with a voltage range of +4.75V to +32V.

The main regulation is made with an internal DC/DC converter in order to supply all the internal functions with a DC voltage. The correct operation of the modem in Communication mode is not guaranteed if the input voltage falls below 4.75V.

Refer to the following table for the modem's operating voltage range and maximum current.

Table 1. Power Supply Electrical Characteristics

Operating Voltage Range	• 4.75V to 32V DC, nominal at 13.2V
Maximum Current (Typical)	• 850mA, average at 4.75V; 3.7A Peak at 4.75V

The modem is permanently powered once the power supply is connected. In the case of Alarm mode (Low Power mode), the user can set the modem "Turn-on" time. Refer to section 4.1 Alarm Mode for more information.

Caution: *The minimum input voltage specified here is the modem input. Be mindful of the input voltage decrease caused by the power cable. When using the optional 6-wire cable accessory, this input drop is at around 800mV at 4.75V and 220mV at 32V (EDGE 4TX).*

*The modem is designed for use with the original power cable, and the fuse that came with the original cable is a 2A/250V Slow Break fuse 5.2mm*20mm.*

2.2. Mechanical Specifications

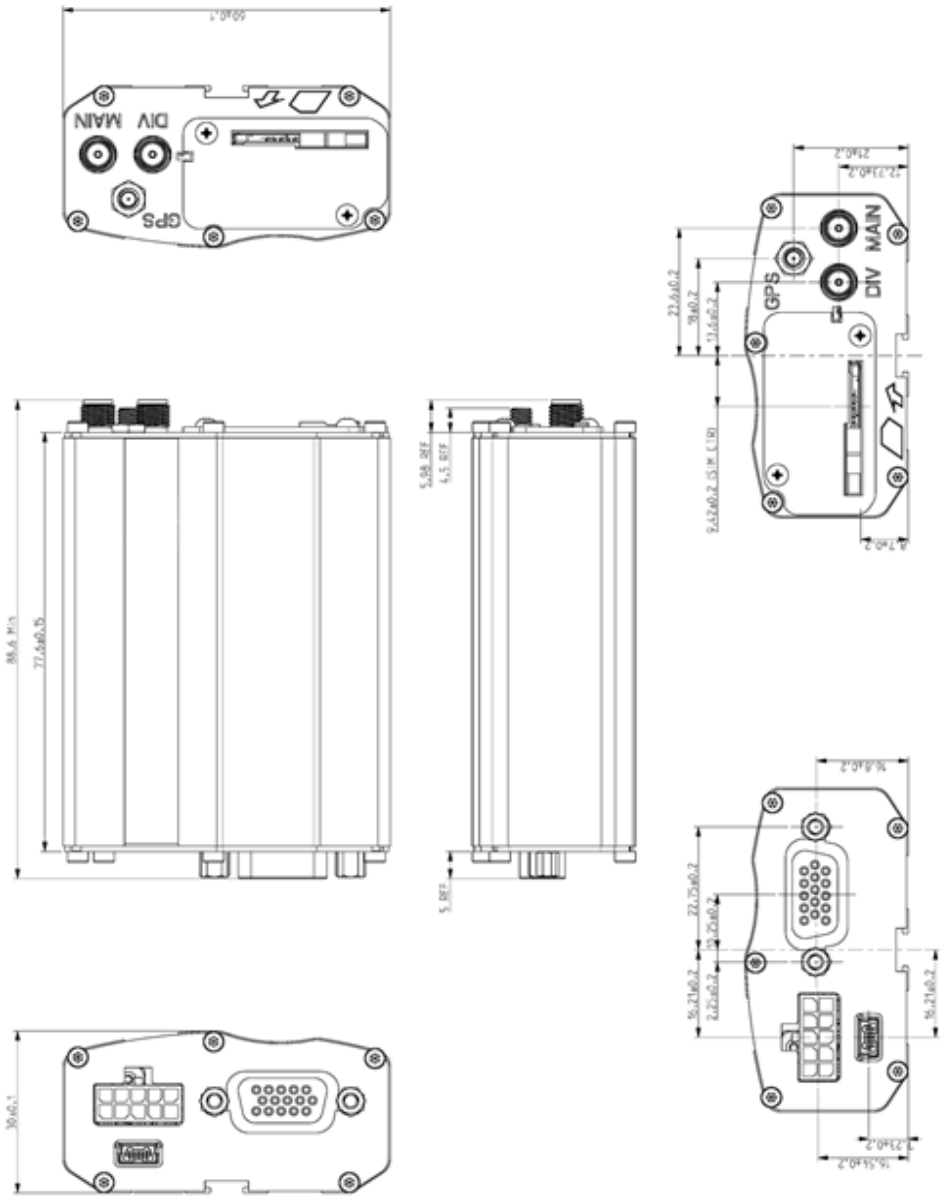


Figure 3. USR3500 Mechanical Drawing

3. Interfaces

This section describes the different interfaces that connect with the USR3500. The modem comes with the following interfaces:

- 10-pin Micro-Fit Connector
- USB Interface (mini-B connector)
- 15-pin Sub-D Serial Interface
- Main RF Interface
- Secondary RF Interface
- GPS RF Interface
- SIM Interface
- LED Status Indicator

3.1. Front Interface

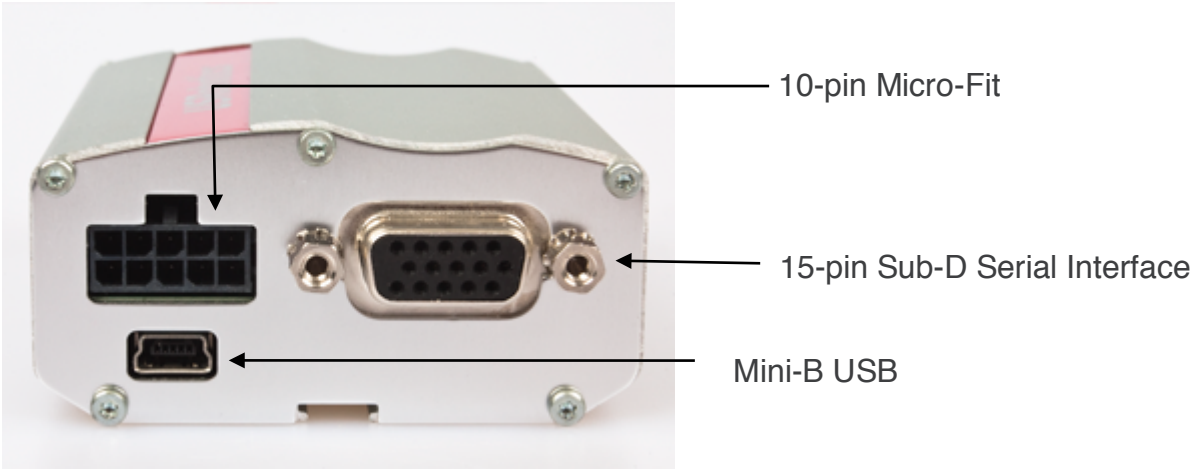


Figure 4. Front Interface

3.1.1. Power Supply Connector

The power supply connector is a 10-pin Micro-Fit connector that is used for:

- External DC Power Supply connection with voltage from +4.75V to +32V, at 3.7A
- GPIO connections and GPIO voltage reference
- ON/OFF pin to power OFF the modem
- Interrupt pin

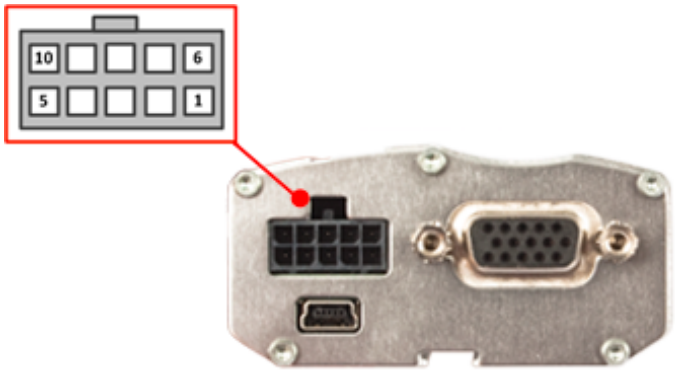


Figure 5. Power Supply Connector

Refer to the following table for the pin description of the power supply connector.

Table 2. Power Supply Connector Pin Description

Pin #	Signal	Description
1	GPIO25/INT1	General purpose input/output or Interrupt
2	GPIO35	General purpose input/output
3	Vref	Voltage reference for the GPIOs
4	Reserved	Reserved
5	Reserved	Reserved
6	GND	Ground
7	DC-IN	Input Supply for the modem (4.75V to 32V)
8	ON/OFF	Control pin to power OFF the modem
9	Reserved	Reserved
10	Reserved	Reserved

The input voltage range (DC-IN) is from 4.75V to 32V, with a typical operating voltage of 13.2V.

Caution: *Pins 1, 2, 3, 4, 5, 8, 9 and 10 are low voltage interfaces. It is strictly prohibited to connect these pins to any power supply as there is a risk of damaging the modem.*

3.1.1.1. General Purpose Input/Output

The modem has two external GPIO ports:

- GPIO35

  and

- GPIO25;

as well as a voltage reference line, **Vref**.

Vref sets the reference voltage of the input or output of the two GPIOs. Leaving it unconnected sets the GPIO level at 2.3V – 2.6V by default. It is **strongly** recommended to connect to the required GPIOs' output voltage (2.8V ~ 15V).

Refer to the following table for the pin description of the GPIOs.

Table 3. GPIO Pin Description

Pin #	Signal	I/O	I/O Voltage	Description
1	GPIO25/INT 1	I/O	Vref	General purpose input/output or Interrupt
2	GPIO35	I/O	Vref	General purpose input/output
3	Vref	I	2.8V ~ 15V	Voltage reference for the GPIOs

*Note: It is recommended to use a **6-wire cable accessory** for easy access to these three lines. Please refer to the Getting Started Guide at http://www.usr.com/support/3500 for more information about the 6-wire cable accessory.*

*When the voltage reference, **Vref**, is not connected, if one of the GPIO output is in High state while the other is in Low state, the GPIO in high level voltage will be at 2.3V.To avoid this voltage drop, it is recommended to use **Vref** to the desired output voltage.*

With **Vref** connected to 2.8V, both GPIO35 and GPIO25 may be interfaced with a component that complies with the following levels.

Table 4. GPIO Pin Operating Conditions when Vref is at 2.8V

Parameter	Mininum	Typical	Maximum	Condition
V_{IL}			0.84V	Please refer to Figure 6.
V_{IH}	1.96V			Please refer to Figure 7.
V_{OL}			0.4*	Please refer to Figure 8.
V_{OH}	2.8*			modem Zout = 100K Pull-up to **Vref**, please refer to Figure 9.

* Value without external load.

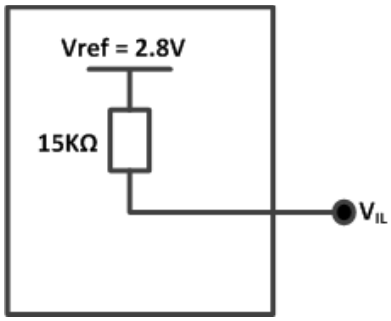


*Figure 6. Equivalent Circuit of V_{IL}, **Vref** = 2.8V*

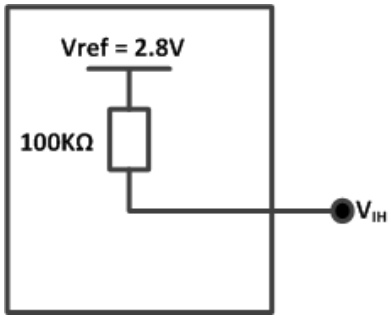


*Figure 7. Equivalent Circuit of V_{IH}, **Vref** = 2.8V*

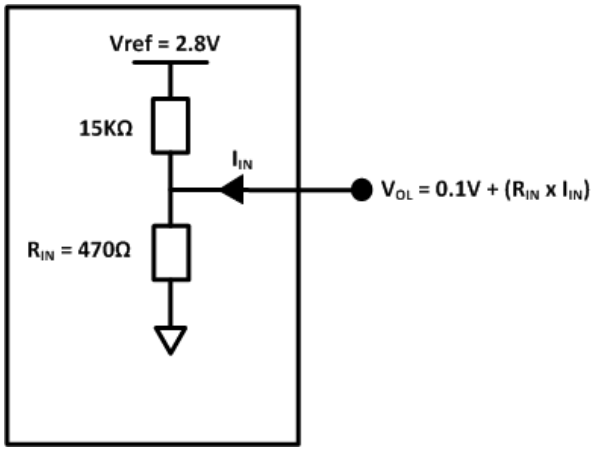


*Figure 8. Equivalent Circuit of V_{OL}, **Vref** = 2.8V*

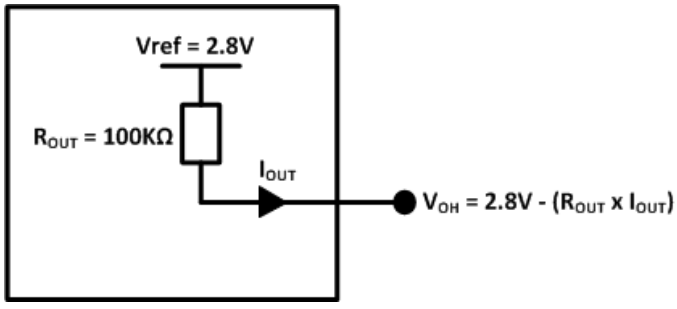


*Figure 9. Equivalent Circuit of V_{OH}, **Vref** = 2.8V*

With **Vref** > 2.8V, both GPIO35 and GPIO25 may be interfaced with a component that complies with the following levels.

Table 5. GPIO Pin Operating Conditions when Vref > 2.8V

Parameter	Min	Typ	Max	Condition
V_{IL}			0.84V	Please refer to Figure 10.
V_{IH}	1.96V			Please refer to Figure 11.
V_{OL}			$\frac{Vref}{110} + 0.058^{*}$	Please refer to Figure 12.
V_{OH}	**Vref***			modem Zout = 100K Pull-up to **Vref**, please refer to Figure 13.

* Value without external load.

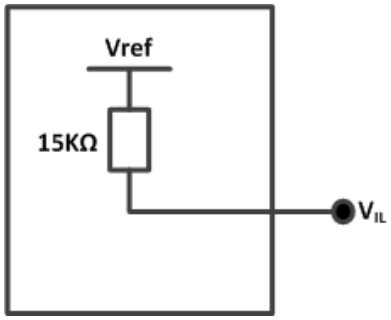


*Figure 10. Equivalent Circuit of V_{IL}, **Vref** > 2.8V*

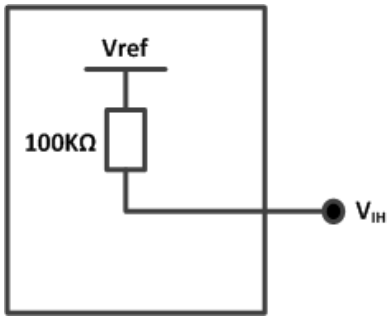


*Figure 11. Equivalent circuit of V_{IH}, **Vref** > 2.8V*

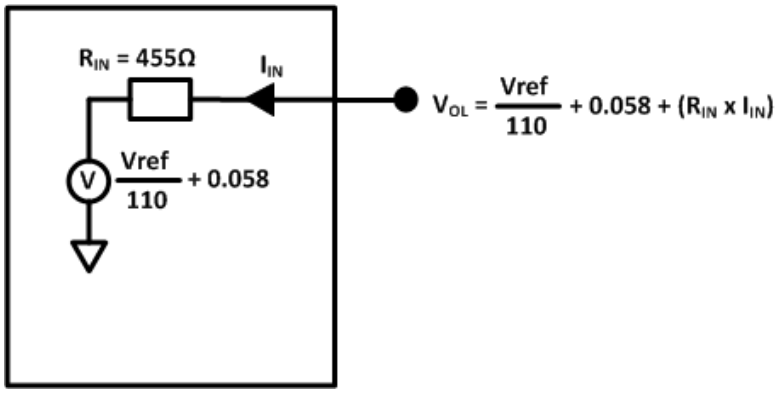


*Figure 12. Equivalent circuit of V_{OL}, **Vref** > 2.8V*

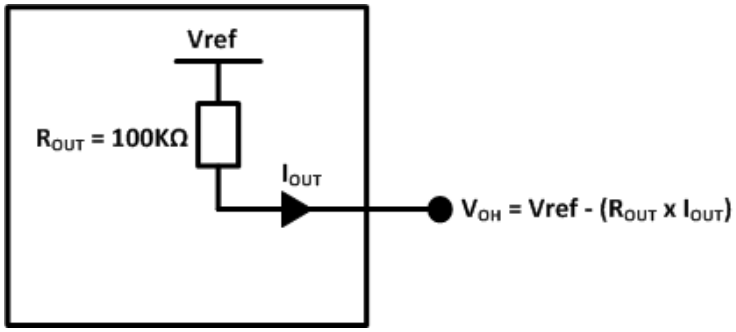


*Figure 13. Equivalent circuit of V_{OH}, **Vref** > 2.8V*

The GPIO pin is mainly used to:

- Act as a switch for a transistor when the GPIO is configured as output.

- Act as a status reading when the GPIO is configured as input.

The GPIOs may be controlled with the following AT commands:

- **AT+WIOW** for write access to the GPIO value, when the GPIO is used as an output
- **AT+WIOR** for read access to the GPIO value, when the GPIO is used as an input

[1] By default, and when the modem has been reset, both GPIOs are configured as inputs. The AT command **AT+WIOM** must be used to change this configuration. Refer to documents [3] AT Commands Interface Guide

[2] Customer Release Notes for Firmware 7.52 A1

for more information regarding this AT command.

3.1.1.1.1. Setting the GPIO as an Output

Refer to the following example for how to configure the GPIO as an output.

- Enter the following commands:
  - **AT+WIOM=1,"GPIO21",1,0** → this command activates GPIO21 as an output and sets it at a low level.
  - **AT+WIOW="GPIO21",1** → this command sets the output level of GPIO21 to HIGH.

3.1.1.1.2. Setting the GPIO as an Input

Refer to the following example for how to configure the GPIO as an input.

- Enter the following commands:
  - **AT+WIOM=1,"GPIO21",0** → this command activates GPIO21 as an input.
  - **AT+WIOR="GPIO21"** → this command reads the GPIO21 level and returns the value "1" which represents a HIGH level.
- Pull the GPIO21 pin to GND, and read again. The return value should now be "0" which represents a LOW level.

Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information regarding AT commands.

*Note: The **AT+WIOW** and **AT+WIOR** commands will automatically set the GPIO to the desired mode. For example, **AT+WIOW=42,1** will set GPIO42 to output mode and in High state.*

3.1.1.2. ON/OFF Pin

The modem has an external ON/OFF pin which is used to turn the device ON or OFF. The following table describes the operation of this pin.

Table 6. ON/OFF Pin Operation

Condition	State	Power Supply	Operation
1	Open	When 4.75V to 32V supply is applied.	The modem is turned ON.
2	Pulled to GND	When 4.75V to 32V supply is applied.	The modem remains OFF.
3	Left open when turning ON the modem, then pulled to GND	4.75V to 32V supply is initially applied.	The modem remains ON and will remain ON until **AT+CPOF** is sent to turn the device OFF.

To enable the low power mode, the user may simply pull the ON/OFF pin to GND and send **AT+CPOF** to the modem using a communication software such as a HyperTerminal.

Table 7. ON/OFF Pin Description

Pin #	Signal	I/O	I/O Voltage	Description
8	ON/OFF	I	4V	Pin to turn the modem ON/OFF.

Refer to the power consumption tables in section 6 Power Consumption for the power consumption values when the modem is in Alarm mode (Low Power mode).

3.1.2. Serial Interface

A SUB-D 15-pin connector is available as a serial interface to directly communicate with the modem. This serial interface is used for:

- RS232 serial link connection
- Audio lines connection (microphone and speaker)
- RESET signal connection

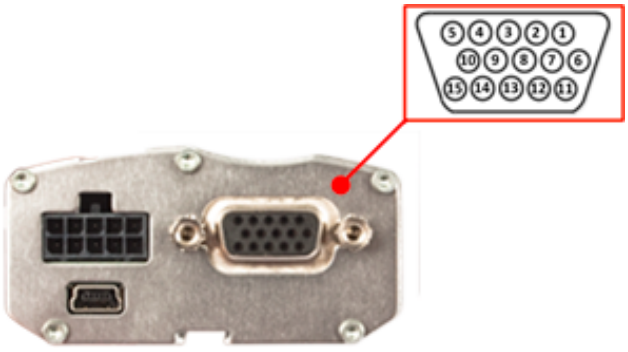


Figure 14. 15-Pin Serial Connector

Refer to the following table for the pin description of the 15-pin serial connector.

Table 8. Serial Connector Pin Description

Pin #	Signal	I/O	I/O Type	Reset State	Description
1	CT109/DCD	O	+/- 5.5V	Undefined	Data Carrier Detect
2	CT103/TXD	I	+/- 5.5V	Z	Transmit Serial Data
3	Reserved				Do not connect
4	CMIC2P	I	Analog		Microphone positive input
5	CMIC2N	I	Analog		Microphone negative input
6	CT104/RXD	O	+/- 5.5V	1	Receive Serial Data
7	CT107/DSR	O	+/- 5.5V	Z	Data Set Ready
8	CT108-2/DTR	I	+/- 5.5V	Z	Data Terminal Ready
9	GND		GND		Ground
10	CSPK2P	O	Analog		Speaker positive input
11	CT106/CTS	O	+/- 5.5V	Z	Clear To Send
12	CT105/RTS	I	+/- 5.5V	Z	Request To Send
13	CT125/RI	O	+/- 5.5V	Undefined	Ring Indicator
14	RESET	I/O	1V8		Modem Reset
15	CSPK2N	O	Analog		Speaker negative input

3.1.2.1. RS232 Serial Link Connection

Also known as the main serial link, the RS232 interface performs the voltage level adaptation (V24/CMOS ⇔ V24/V28) between the internal modem (DCE) and external applications (DTE).

The signals available on the RS232 serial link are as follows:

- TX data (CT103/TXD)
- RX data (CT104/RXD)
- Request To Send (CT105/RTS)
- Clear To Send (CT106/CTS)
- Data Terminal Ready (CT108-2/DTR)
- Data Set Ready (CT107/DSR)
- Data Carrier Detect (CT109/DCD)
- Ring Indicator (CT125/RI)

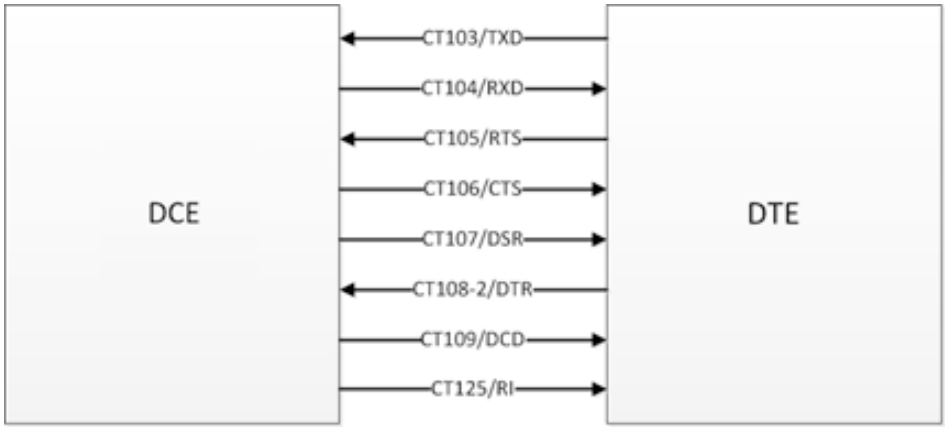


Figure 15. RS232 Serial Link Signals

The RS232 interface has been designed to allow flexibility in the use of the serial interface signals. However, the use of TXD, RXD, CTS and RTS signals are mandatory; while the use of DTR, DSR, DCD and RI signals are optional.

Tip: *The modem is designed to operate using all serial interface signals and it is recommended to use CT105/RTS and CT106/CTS for hardware flow control in order to avoid data corruption during transmission.*

The USR3500 also implements the Serial Port Auto Shut Down feature with the DTR signal. It is recommended to use the CT108-2/DTR signal to benefit from the current consumption improvement performed by this feature.

3.1.2.2. RS232 Implementation

The following subsections describe how the RS232 serial link can be implemented to suit different designs.

3.1.2.2.1. 5-wire Serial Interface RS232 Implementation

The signals used in this interface are as follows:

- CT103/TXD
- CT104/RXD
- CT105/RTS
- CT106/CTS
- CT108-2/DTR

Note: The CT108-2/DTR signal must be managed following the V24 protocol signaling if the Sleep Idle Mode and Serial Port Auto Shut Down feature are to be used.

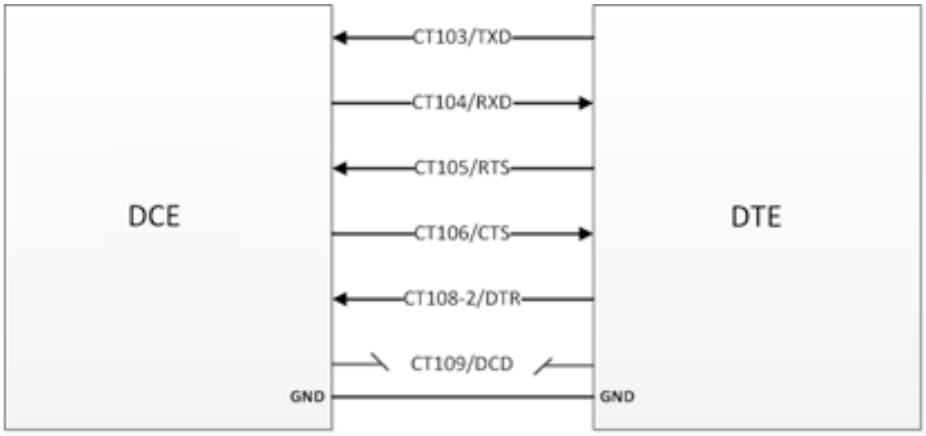


Figure 16. V24 Serial Link Implementation for a 5-wire UART

3.1.2.2.2. 4-wire Serial Interface RS232 Implementation

The signals used in this interface are as follows:

- CT103/TXD
- CT104/RXD
- CT105/RTS
- CT106/CTS

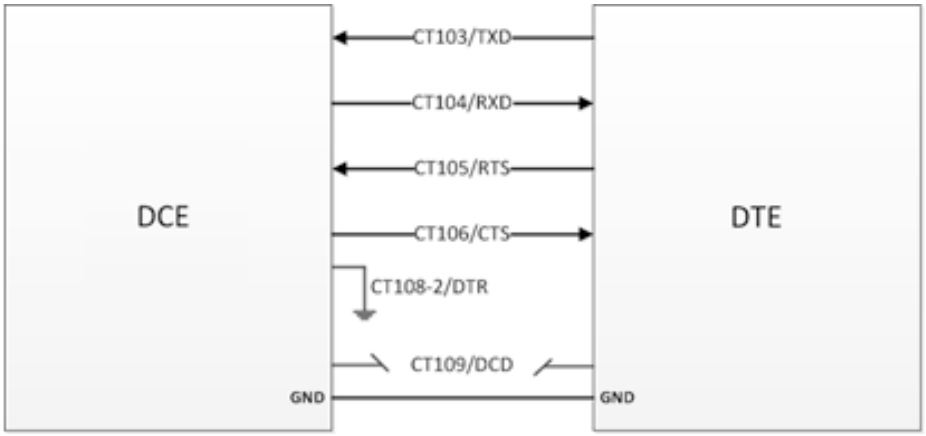


Figure 17. V24 Serial Link Implementation for a 4-wire UART

3.1.2.2.3. 2-wire Serial Interface RS232 Implementation

The signals used in this interface are as follows:

- CT103/TXD
- CT104/RXD

Note: Although this case is possible, it is not recommended.

The flow control mechanism must be managed from the customer end.

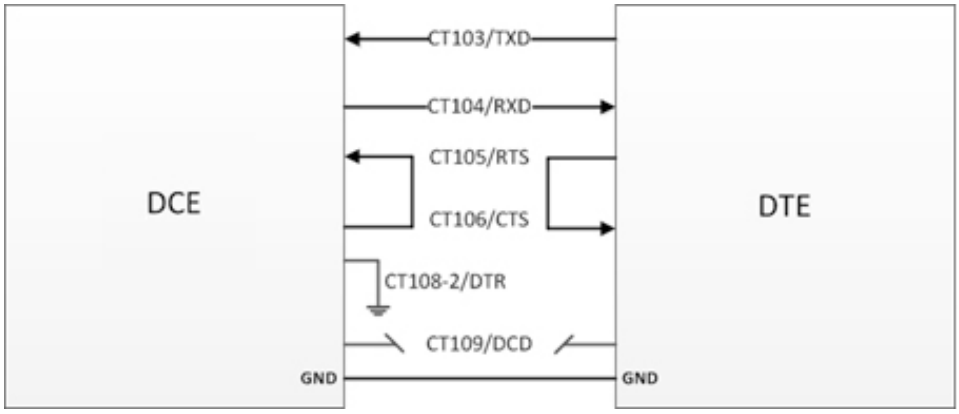


Figure 18. V24 Serial Link Implementation for a 2-wire UART

The CT105/RTS and the CT106/CTS signals are not used in this configuration. Configure the AT command **AT+IFC=0,0** to disable the flow control function. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information regarding AT Commands.

For more information on how to use the RS232 serial link to communicate with the modem, refer to section 3.1.2.1 RS232 Serial Link Connection.

3.1.2.3. Autobauding Mode

The autobauding mode allows the modem to detect the baud rate used by the DTE connected to the RS232 serial link. The autobauding mode is controlled by AT commands. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information.

3.1.2.4. Serial Port Auto Shut Down Feature

The RS232 serial link can be shut down when there is no activity between the DTE and the modem. This can help improve the power consumption performance.

The Serial Port Auto Shut Down feature is controlled by the AT command **AT+WASR**. Enter:

- **AT+WASR=1** to enter the serial port auto shut down mode
- **AT+WASR=0** to exit the serial port auto shut down mode

Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information on AT commands.

Caution: *GPIO24 is reserved for serial port auto shut down feature. It is prohibited for customer use. Improper access to GPIO24 by customers may lead to unexpected behavior on serial port performance.*

It is prohibited to use the serial port auto shut down feature when the CT108-2/DTR is not used in the application. Otherwise, there will be data lost from the DTE side to the modem.

3.1.2.5. Audio Lines Connection

The modem supports one microphone input and one speaker output.

3.1.2.5.1. Microphone

The microphone inputs are connected in differential mode to reject common mode noise and TDMA noise. The microphone inputs have already included biasing for an electret microphone (0.5mA and 2V) and are ESD protected. An electret microphone may be directly connected to these inputs allowing an easy connection to a headset.

The microphone gain can be adjusted by **AT+VGT** and the transmit digital gain can be adjusted by **AT+WDGT**. Refer to documents the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information about these AT commands.

The following table shows the pin assignments of the microphone input.

Table 9. Microphone Pin Description for USR3500

(Sub D 15-pin) Pin #	Signal	I/O	I/O Type	Description
4	CMIC1P	I	Analog	Microphone positive input
5	CMIC1N	I	Analog	Microphone negative input

Table 10. Equivalent Circuits of CMIC

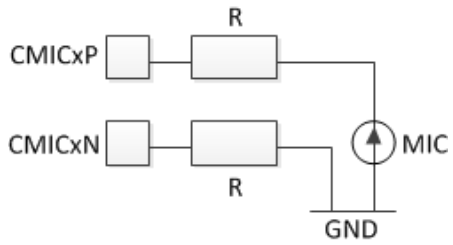
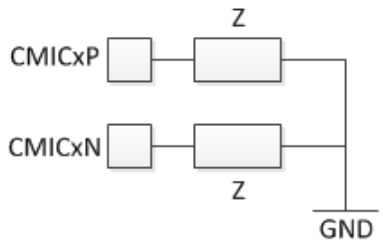
DC Equivalent Circuit	AC Equivalent Circuit
	

Table 11. Electrical Characteristics of CMIC for USR3500

Parameters		Min	Typ	Max	Unit
DC Characteristics			N/A		V
AC Characteristics 200 Hz<F<4 kHz	Z	70	120	160	kΩ
Working voltage (CMICxP-CMICxN)	AT+VGT*=3500dB		13.8		mVrms
	AT+VGT*=2000dB		77.5		
	AT+VGT*=700dB		346		
Maximum rating voltage (CMICxP or CMICxN)	Positive			+7.35**	V
	Negative	-0.9			

* The input voltage depends of the input micro gain set by AT command. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500.

** Because CMICxP is internally biased, it is necessary to use a coupling capacitor to connect an audio signal provided by an active generator. Only a passive microphone can be directly connected to the CMICxP and CMICxN inputs.

Refer to the following table for the list of recommended microphone characteristics.

Table 12. Recommended Microphone Characteristics

Feature	Values
Type	Electret 2V/0.5 mA
Impedance	Z = 2kΩ
Sensitivity	-40dB to -50dB
SNR	> 50dB
Frequency response	Compatible with GSM specifications

3.1.2.5.2. Speaker

The speaker outputs are connected in differential mode to reject common mode noise and TDMA noise.

Speaker outputs are connected to internal push-pull amplifiers and may be loaded down with components between 32 – 150Ω and up to 1nF. These outputs may be directly connected to a speaker.

The output power may be adjusted by 2dB steps. The gain of the speaker outputs is internally adjusted and may be tuned using the **AT+VGR** command. Furthermore, the digital gain can be adjusted using **AT+WDGR**. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information about these AT commands.

The following table shows the pin assignments of the speaker output.

Table 13. Speaker Outputs Pin Description for USR3500

(Sub D 15-pin) Pin #	Signal	I/O	I/O Type	Description
10	CSPK1P	O	Analog	Speaker positive output
15	CSPK1N	O	Analog	Speaker negative output

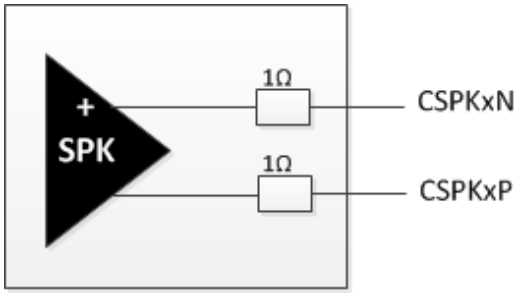


Figure 19. Equivalent Circuit of CSPK

Table 14. Electrical Characteristics of CSPK for USR3500

Parameters		Min	Typ	Max	Unit
Biasing voltage	CSPKxP and CSPKxN	-1.5		1.5	mV
Output swing voltage	RL=16Ω: AT+VGR=-1600*; single-ended	-	1.7		Vpp
	RL=32Ω: AT+VGR=-1600*; single-ended	-	1.9	2.75	Vpp
RL	Load resistance	14.5	32	-	Ω
IOUT	Output current; peak value; RL=16Ω	-	40	85	mA
	Output current; peak value; RL=32Ω	-	22	-	mA
POUT	RL=16Ω; AT+VGR=-1600*	-	25	-	mW
	RL=32Ω; AT+VGR=-1600*	-	16	27	mW
RPD	Output pull-down resistance at power-down	28	40	52	kΩ

* The output voltage depends of the output speaker gain set by AT command. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500. This value is given in dB, but it's possible to toggle this to index value.

Refer to the following table for the list of recommended speaker characteristics.

Table 15. Recommended Speaker Characteristics

Feature	Values
Type	10mW, electro-magnetic
Impedance	Z = 30 to 50Ω
Sensitivity	110dB SPL min. (0dB = 20μPa)
Frequency response	Compatible with GSM specifications

3.1.3. USB Interface

Aside from the serial interface, the Mini-B USB interface (USB slave) may also be used to directly communicate with the modem.

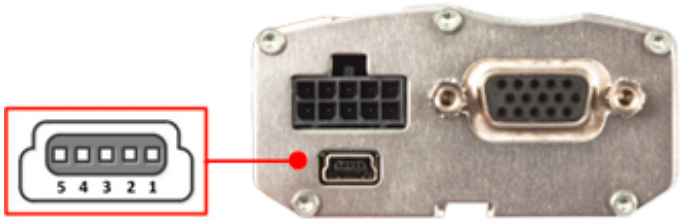


Figure 20. Mini-B USB Connector

Refer to the following table for the pin description of the mini-B USB connector.

Table 16. Mini-B USB Pin Description

Pin #	Signal	Description
1	VBUS	+5V Power supply
2	D-	Differential data interface negative
3	D+	Differential data interface positive
4	ID	Not connected
5	GND	Ground

The USR3500 USB slave interface complies with USB 2.0 protocol signaling and with USB 2.0 electrical interface.

The USB interface features:

- 480Mbit/s high-speed transfer rate
- 3.3V type compatible
- USB Soft-connect feature
- USB Download feature
- CDC 1.1 – ACM compliant

Table 17. USB Electrical Characteristics for USR3500

Parameter	I/O	Min	Typ	Max	Unit
VBUS	Input	4.75	5		V
D-, D+ (Low / Full speed)	Input High	2.00	3.30	3.60	V
	Input Low	0		0.80	V
	Output High	2.80	3.30	3.60	V
	Output Low			0.30	V
D-, D+ (High speed)	Input High	0.30		0.44	V

Parameter	I/O	Min	Typ	Max	Unit
	Input Low	0		0.01	V
	Output High	0.36	0.38	0.44	V
	Output Low	0		0.01	V

The USB feature can be activated by using the **AT+WMFM=0,1,3** AT command. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information regarding this AT command.

3.2. Back Interface

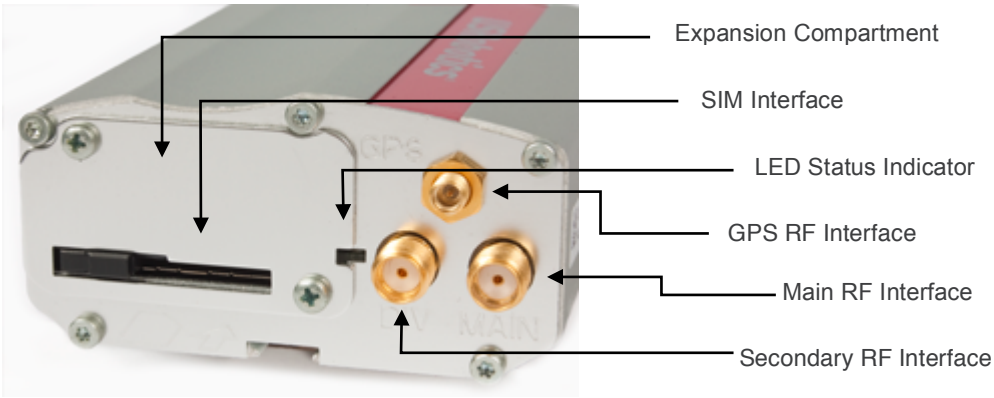


Figure 21. USR3500 Back Interface

3.2.1. SIM Interface

A SIM card can be directly connected to the USR3500 through the embedded SIM socket. This interface controls 3V / 1V8 SIM cards and it is fully compliant with GSM 11.11 recommendations concerning SIM functions.

The SIM interface of the USR3500 is ESD protected. Transient overvoltage protections in ESD are internally added on the signals connected to the SIM interface in order to prevent any damage from electrostatic discharge.

The SIM interface uses 5 SIM signals, namely:

- SIM-VCC: SIM Power supply
- ~SIM-RST: Reset
- SIM-CLK: Clock
- SIM-IO: I/O Port
- SIMPRES: SIM card detection

3.2.1.1. SIM Socket Pin Description

Refer to the following table for the pin description of the SIM socket.

Table 18. SIM Socket Pin Description

Pin #	Signal	I/O	I/O Type	Reset State	Description
1	SIMVCC	O	2V9 / 1V8		SIM Power Supply
2	SIMRST	O	2V9 / 1V8	O	SIM RESET
3	SIMCLK	O	2V9 / 1V8	O	SIM Clock
7	SIMDATA	I/O	2V9 / 1V8	Pull up*	SIM DATA
8	SIMPRES	I	1V8	Pull low**	SIM Card Detect

* SIM-IO pull up is about 10KΩ.

** SIMPRES pull low is about 100KΩ.

3.2.2. RF Interface

The USR3500 has three RF interfaces. Refer to the following table for the list of available RF interfaces.

Table 19. Available RF Interfaces

Main RF Interface	Secondary RF Interface	GPS RF Interface
✓	✓	✓

The main antenna connector allows the transmission of radio frequency (RF) signals from the device to an external customer supplied antenna. This interface is an SMA type connector and its nominal impedance is 50Ω.

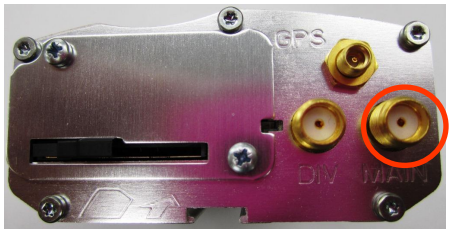


Figure 22. Main RF Connector

The secondary RF interface is used in USR3500 for 3G diversity antenna connection. It is an SMA type connector and its nominal impedance is 50Ω.

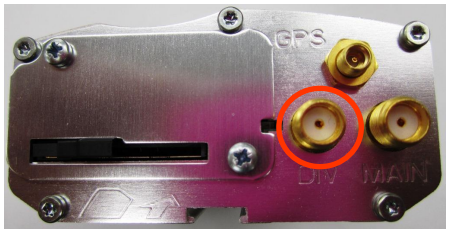


Figure 23. Secondary RF Connector for USR3500

The GPS RF interface is used for GPS antenna connection. It is an MMCX type connector and its nominal impedance is 50Ω. It also provides bias for active antenna. For more details, refer to section 3.2.2.3.6 Active GPS Antenna Bias.

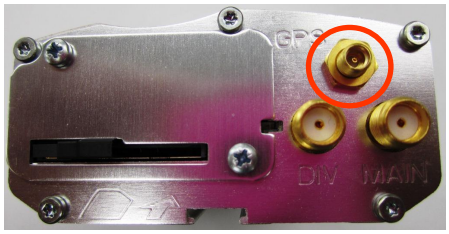


Figure 24. GPS RF Connector for USR3500

3.2.2.1. RF Performances

RF performances are compliant with ETSI recommendation GSM 05.05. Refer to the tables below for the main parameters used for both the Receiver and the Transmitter.

Table 20. Main Receiver Parameters for USR3500

Parameters	Typical Values
GSM850 Reference Sensitivity	-108dBm
E-GSM900 Reference Sensitivity	-109dBm
DCS1800 Reference Sensitivity	-107dBm
PCS1900 Reference Sensitivity	-107dBm
3G Band I 2100 Reference Sensitivity	-108dBm
3G Band II 1900 Reference Sensitivity	-107dBm
3G Band V 850 Reference Sensitivity	-110dBm
3G Band VI 800 Reference Sensitivity	-110dBm
3G Band VIII 900 Reference Sensitivity	-108dBm
Selectivity @ 200 kHz	> +9dBc
Selectivity @ 400 kHz	> +41dBc
Linear dynamic range	63dB
Co-channel rejection	>= 9dBc

Table 21. Main Transmitter Parameters for USR3500

Parameters	Typical Values
Output power at PCL5 (EGSM & GSM850)	32dBm
Output power at PCL0 (GSM1800 & PCS1900)	29dBm

Parameters	Typical Values
Output power at PCL19 (EGSM & GSM850)	5dBm
Output power at PCL15 (GSM1800 & PCS1900)	0dBm
Output power Class 3 (3G all band)	23dBm

3.2.2.2. Antenna Specifications

The main/secondary antenna must meet the requirements specified in the table below.

The optimum operating frequency depends on the application. A dual-band or quad-band antenna should operate in these frequency bands and have the following characteristics.

Antennas used with the USR3500 must have a maximum antenna gain of 1 dBi for Bands 900 and 1800, and 2.5 dBi for Band 2100.

Table 22. Antenna Specifications for USR3500

Characteristics		GSM850 and WCDMA Band V	WCDMA Band VI	EGSM 900 and WCDMA Band VIII	DCS 1800	PCS 1900 and WCDMA Band II	WCDMA Band I
TX Frequency		824 to 849 MHz	830 to 840 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz	1920 to 1980 MHz
RX Frequency		869 to 894 MHz	875 to 885 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz	2110 to 2170 MHz
Impedance		50Ω					
VSWR	Rx max	1.5:1					
	Tx max	1.5:1					
Typical radiated gain		0dBi in one direction at least					

The USR3500 GPS antenna must meet the requirements specified in the table below.

Table 23. GPS Antenna Specifications for USR3500

Characteristic		GPS L1
RX Frequency		1575.42 MHz
RF Impedance		50Ω
VSWR	Rx max	1.5:1
LNA Bias Voltage		5V
LNA Current Consumption		40mA MAX
Polarization		Linear, vertical
Typical radiated gain		0dBi in one direction at least

3.2.2.3. GPS Specifications for USR3500

Note: These specifications are preliminary targets that are subject to change without notice. Actual GPS functionality depends on the firmware version and module configuration.

The USR3500 provides the GPS features listed in the following sub-sections. This GPS feature can be used through AT commands provided by the Extended Open AT application (which is pre-loaded at the factory) or from a custom Open AT application using Location Library.

3.2.2.3.1. Standalone GPS

- Leading standalone/autonomous GPS performance
- -145 dBm cold start sensitivity
- -153 dBm hot start sensitivity
- -155 dBm tracking sensitivity
- < 45 second average cold start TTFF (Time To First Fix) in open air
- < 3 second average super hot TTFF in open sky
- < 10 m accuracy in open sky

Note: For optimum performance, the modem should be registered on the GSM/UMTS network, but does not need to be on an active data or voice call.

3.2.2.3.2. gpsOneXTRA™

- Enables enhanced standalone GPS operation by downloading < 40 kB file from a server on the Internet
- Performance closer to UE-based operation than traditional standalone GPS operation

- Best if downloaded once every 1–2 days, but valid for up to 7 days with some accuracy degradation

3.2.2.3.3. A-GPS Features

- Leading A-GPS performance

  Exceeds 3GPP RAN 4 AGPS performance specification
- -153 dBm cold start sensitivity
- -155 dBm tracking sensitivity
- < 5 second average cold start TTFF in open sky (UE-based)
- < 3 second average super hot TTFF in open sky
- < 2 m accuracy in open sky 1 Hz tracking with CEP-50
- UMTS Control Plane (CP) – UE-assisted and UE-based
- GSM Control Plane (CP) – UE-assisted and UE-based

3.2.2.3.4. Enhanced Navigation 2.0 Feature

- Provides leading performance in car and walking navigation modes as well as accuracy while stationary
- Airline/Game/Offline mode
- GPS capability is available while phone is offline

3.2.2.3.5. NMEA

Supported sentences: GGA, GSA, GSV, RMC, VTG

3.2.2.3.6. Active GPS Antenna Bias

The USR3500 provides bias for active antenna, which can be enabled or disabled using GPIO44. Note that GPIO44 needs to be at high level for antenna bias to be activated.

4. Signals and Indicators

4.1. Alarm Mode

The USR3500 can be turned on using the Alarm mode when power supply is applied. The USR3500 will remain in Low Power mode until the alarm is triggered to start the USR3500 up.

Note: *Refer to section 3.1.1.2 ON/OFF Pin for more information on how to turn the USR3500 ON or OFF using the ON/OFF pin.*

Table 24. Alarm Mode (Low Power Mode)

Steps	State	Power Supply	Operation
1	**AT+CALA="YY/MM/DD,HH:MM"**	4.75V to 32V supply is applied.	The alarm is set. The USR3500 remains ON.
2	Pulled ON/OFF PIN to GND	4.75V to 32V supply is applied.	The USR3500 remains ON.
3	**AT+CPOF**	4.75V to 32V supply is applied. (The ON/OFF signal remains at GND.)	The USR3500 turns OFF and will remain OFF until the Alarm mode is activated to turn the device ON.

Note: *The USR3500' clock must be set before Alarm mode is activated. To set the clock, refer to the **AT+CCLK** command in the AT Commands Interface Guide at http://www.usr.com/support/3500.*

4.2. RESET Signal Connection

This signal is used to force a reset procedure by providing the USR3500 with a LOW level that lasts at least 200μs (when the power supply is already stabilized). It is activated by either an external Reset signal or by an internal signal (from the Reset generator); and is automatically driven by an internal hardware during the power ON sequence.

Note: *The USR3500 remains in Reset mode for as long as the Reset signal is held LOW.*

A software reset is always preferred to a hardware reset. Refer to document documents the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information regarding software resets.

This signal may also be used to provide a reset to an external device when the pin is configured as an output. If no external reset is necessary, this input may be left open.

When used (as an emergency reset), it has to be driven by either an open collector or an open drain output.

Caution: *This signal is for emergency resets only.*

Table 25. USR3500 Reset Status

(Serial Port) Pin #	Signal	I/O	I/O Type	Voltage	Description
14	Reset	I/O	Open drain	1V8	USR3500 Reset

Table 26. Reset Electrical Characteristics for USR3500

Parameter	Minimum	Typical	Maximum	Unit
Input Impedance (R)*		10		kΩ
Input Impedance (C)		20		nF

* Internal pull-up

Table 27. Reset Operating Conditions

Parameter	Minimum	Typical	Maximum	Unit
~Reset time (Rt)[1]	200			µs
~Reset time (Rt)[2] (at power up only)	20	40	100	ms
Cancellation time (Ct)		34		ms
V_H*	0.57			V
V_{IL}	0		0.57	V
V_{IH}	1.33			V

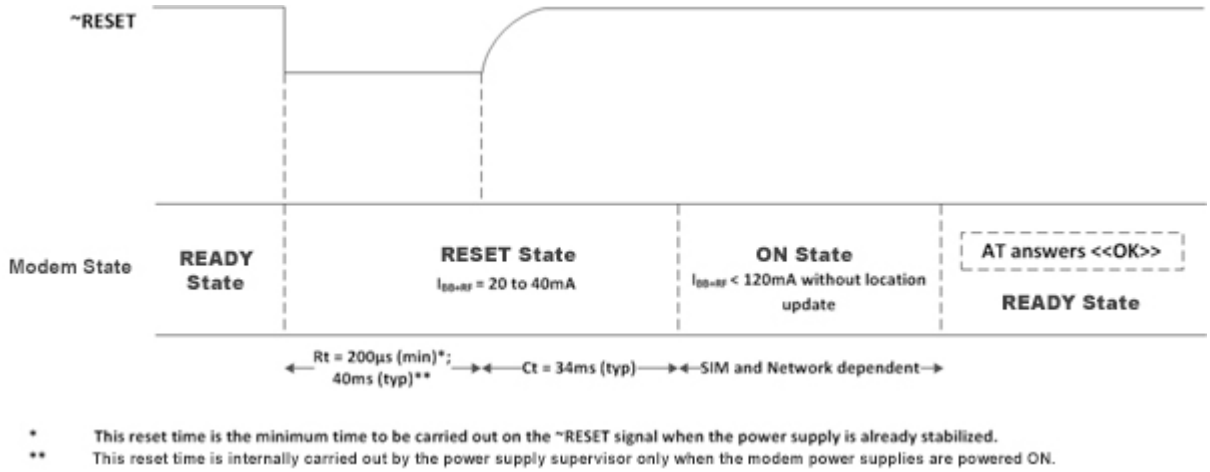
* V_H = Hysterisis Voltage

1: This reset time is the minimum to be carried out on the ~Reset signal when the power supply is stabilized.

2: This reset time is internally carried out by the embedded module power supply supervisor only when the embedded module power supplies are powered ON.

4.2.1. Reset Sequence

To activate the Reset sequence, the Reset signal has to be set to LOW for a minimum of 200µs. As soon as the reset is done, the application can send the command **AT↵** and the AT interface will send an "OK" back to the application. If the application manages hardware flow control, the AT command may be sent during the initialization phase.



* This reset time is the minimum time to be carried out on the ~RESET signal when the power supply is already stabilized.
** This reset time is internally carried out by the power supply supervisor only when the modem power supplies are powered ON.

Figure 25. Reset Sequence Diagram

Another solution is to use the **AT+WIND** command to get an unsolicited status from the USR3500. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information regarding AT commands.

4.3. LED Status Indicator

The USR3500 has a red LED that indicates the current operational status of the device.

Table 28. USR3500 LED Status

USR3500 State	LED Status	USR3500 Status
ON	Permanently lighted	The modem is switched ON, but not registered in the network.
	Flashing slowly LED is ON for 200ms, OFF for 2s	The modem is switched ON and is registered in a network (Idle mode).
	Flashing rapidly LED is ON for 200ms, OFF for 600ms	The modem is switched ON and is registered in a network (Connected mode).
	Very quick flash LED is ON for 100ms, OFF for 200ms	The modem is switched on, and the software downloaded is either corrupted or non-compatible ("BAD SOFTWARE").
OFF	OFF	The modem is either switched OFF, or the Flash LED has been disabled by the user*.

* The Flash LED can be disabled by the user when in Sleep mode in order to save power consumption. Refer to the AT Commands Interface Guide at http://www.usr.com/support/3500 for more information on how to disable the Flash LED using an AT command.

4.4. Real Time Clock (RTC)

The USR3500 has implemented Real Time Clock for saving date and time when the USR3500 is unplugged from the DC power supply through the DC power cable.

Table 29. Real Time Clock Specifications

Item		Minimum	Typical	Maximum
Charging Time start from fully discharged to fully charged			15 Hours	
RTC Time Period*	Guaranteed		30 Hours	
	Not guaranteed		60 Hours	

* This RTC time period is measured when the RTC battery is fully charged before the modem is unplugged from the DC power source.

* This RTC time period is for temperature from -20°C to +60°C. Once the operating/storage temperature is beyond this range, this time period is not guaranteed.

Caution: *When the modem is shipped out, the charging voltage of the RTC battery is not guaranteed. Once the modem is on power, the RTC battery will start charging and the RTC feature can then be resumed.*

4.5. Interrupt

An interrupt pin, INT1, is multiplexed with GPIO25 on pin 1 of the Microfit connector. Additional interrupt pins are also available via the expansion card connector. Refer to the following table for the list of available interrupt pins in the modem.

Table 30. Available Interrupt Pins on the USR3500

Interface Location	Pin Number	Signal Name	Multiplex	Notes
Microfit connector	1	INT1	GPIO25	
Expansion connector	32	INT0	GPIO3	

5. Expansion

5.1. Expansion Compartment

The expansion compartment allows users to easily expand the USR3500's features (Ethernet, for example) for their own applications.

Figure 26. USR3500 expansion compartment

Refer to the Ethernet Expansion Card User Guide at http://www.usr.com/support/3500 for more information regarding this feature.

6. Power Consumption

The following sub-sections details out the power consumption values of the USR3500 for various modes and RF bands. These consumption values were obtained by performing measurements on USR3500 samples at a temperature of 25°C using a 3V SIM card.

Note: For power consumption, the software version used is R7.50 A1.

Refer to the Courier M2M Application guide at http://www.usr.com/support/3500 for details on how to upgrade modem firmware.

The table below gives the average power consumption of the USR3500 for the first 10s when power supply (DC-IN, supplied by Agilent 66321D in this example) is initially applied to it with no serial port, LED ON or SIM card at ambient temperature.

Table 31. Initial Power Consumption (Typical)

Configuration	USR3500 Average Power Consumption with FW R7.50 A1
DC-IN @ 13.2V	18mA

6.1. Various Operating Modes

The power consumption levels of the USR3500 vary depending on the operating mode used. Refer to the table below for the different kinds of operating modes available. Refer to Appendix 3.1 of the AT Commands Interface Guide at http://www.usr.com/support/3500 for the working mode description.

Table 32. USR3500 Operating Modes

Operating Mode	Description
GSM Connected Mode	The modem is connected to a live GSM network, during circuit switch voice or data call.
Transfer Mode	The modem has GPRS data transfer connection with a live network, during packet data transmission.
Active mode with GSM stack in Idle	When the RF function is active and the modem is synchronized with the network, but there is currently no communication.
Sleep mode with GSM stack in Idle	When the RF function is disabled but is regularly activated to remain synchronized with the network. This mode only works when the DTE sends an AT command to shut the serial link down (DTE turns DTR to inactive state).
Active Mode	When the RF function is disabled and there is no synchronization with the network but the UART is available.
Sleep Mode	When the RF function is disabled, and there is no synchronization with the network and the UART is not available.

Operating Mode	Description
Alarm Mode	Low power consumption mode, the only feature which is available in this mode is the alarm wake up. When the alarm clock is set for the modem with **ALL** of the following conditions: • before the alarm time is up • with the ON/OFF signal pulled to GND • with **AT+CPOF** entered from a computer that is connected to the modem
Serial Port Auto Shut Down Feature	The serial link can be shut down when there is no activity between the DTE and the modem. This auto shut down feature can be enabled by AT command. Refer to section 3.1.2.4 Serial Port Auto Shut Down Feature for more information on this feature.
FLASH LED Activated/Deactivated	The modem Flash LED can be enabled or disabled by AT command. Refer to section for more information on this feature.

6.2. Working Mode Features

The table below sums up the feature availability in each mode.

Table 33. USR3500 Operating Modes Feature Availability

Features	Alarm Mode	ACTIVE Mode with GSM Stack in Idle	SLEEP Mode with GSM Stack in Idle	ACTIVE Mode	SLEEP Mode	Connected Mode	Transfer Mode
Alarm	√	√	√	√	√	√	√
Wake-up Open AT Application Framework on timer events	-	√	√	√	√	√	√
GSM/GPRS paging (alert from the network for incoming call, incoming SMS or incoming GPRS data)	-	√	√	-	-	√	√
SIM	-	√	-	-	-	√	√
UARTs	-	√	-	√	-	√	√
USB	-	√	-	√	-	√	√
SPIs	-	√	-	√	-	√	√
I^2C	-	√	-	√	-	√	√
GPIO	-	√	-	√	-	√	√
ADCs	-	√	-	√	-	√	√
Buzzer	-	√	-	√	-	√	√
Keypad	-	√	√	√	√	√	√
External IT	-	√	√	√	√	√	√
Flash LED	-	√	√	√	√	√	√

6.3. Connected Mode Power Consumption

Table 34. Power Consumption of USR3500 in Connected Mode with Serial Port OFF, Flash LED OFF and USB ON (typical values)

Mode	Parameters		$I_{average}$			I_{peak}		Unit
			DC-IN =4.75V	DC-IN =13.2V	DC-IN =32V	DC-IN =4.75V	DC-IN =13.2V	
GSM	850 MHz	PCL5 (TX power 33dBm)	420	107	46	3625	703	mA
		PCL19 (TX power 5dBm)	97	34	15	682	249	mA
	900 MHz	PCL5 (TX power 33dBm)	428	109	47	3782	710	mA
		PCL19 (TX power 5dBm)	99	35	15	698	215	mA
	1800 MHz	PCL0 (TX power 30dBm)	299	91	39	2374	536	mA
		PCL15 (TX power 0dBm)	101	35	16	728	226	mA
	1900 MHz	PCL0 (TX power 30dBm)	269	86	37	2169	497	mA
		PCL15 (TX power 0dBm)	102	36	16	813	255	mA
GPRS class 8 (1TX, 4RX)	850 MHz	PCL5 (gamma 3)	363	102	45	3478	702	mA
	900 MHz	PCL5 (gamma 3)	384	107	42	3600	720	mA
	1800 MHz	PCL0 (gamma 3)	291	84	38	2413	538	mA
	1900 MHz	PCL0 (gamma 3)	253	83	36	2008	486	mA
GPRS class 10 (2TX, 3RX)	850 MHz	PCL5 (gamma 3)	654	174	76	3503	880	mA
	900 MHz	PCL5 (gamma 3)	698	185	78	3489	1001	mA
	1800 MHz	PCL0 (gamma 3)	476	143	61	2348	910	mA
	1900 MHz	PCL0 (gamma 3)	459	129	58	2201	833	mA
GPRS class 12 (4TX, 1 RX)	850 MHz	PCL5 (gamma 3)	467	147	72	1414	749	mA
	900 MHz	PCL5 (gamma 3)	519	180	75	1510	787	mA
	1800 MHz	PCL0 (gamma 3)	553	184	78	1587	794	mA
	1900 MHz	PCL0 (gamma 3)	570	183	76	1598	801	mA
EGPRS class 8 (1TX, 4RX)	850 MHz	PCL8 (gamma 6)	197	67	58	1508	401	mA
	900 MHz	PCL8 (gamma 6)	203	66	29	1464	406	mA
	1800 MHz	PCL2 (gamma 5)	192	68	29	1404	497	mA
	1900 MHz	PCL2 (gamma 5)	193	64	28	1357	387	mA
EGPRS class 10 (2TX, 3RX)	850 MHz	PCL8 (gamma 6)	312	100	42	1453	740	mA
	900 MHz	PCL8 (gamma 6)	301	95	43	1470	772	mA
	1800 MHz	PCL2 (gamma 5)	313	108	49	1521	775	mA
	1900 MHz	PCL2 (gamma 5)	293	97	43	1454	785	mA
EGPRS class 12 (4TX, 1RX)	850 MHz	PCL8 (gamma 6)	437	150	66	1441	718	mA
	900 MHz	PCL8 (gamma 6)	459	164	70	1460	804	mA
	1800 MHz	PCL2 (gamma 5)	567	185	78	1557	811	mA
	1900 MHz	PCL2 (gamma 5)	507	174	72	1494	765	mA

Mode	Parameters		$I_{average}$			I_{peak}		Unit
			DC-IN =4.75V	DC-IN =13.2V	DC-IN =32V	DC-IN =4.75V	DC-IN =13.2V	
UMTS (Voice)	Band I	+22 dBm	637	222	94	1090	767	mA
		+10 dBm	227	81	34	1057	442	mA
	Band II	+22 dBm	616	210	88	1074	830	mA
		+10 dBm	232	80	35	1062	423	mA
	Band V	+22 dBm	606	204	89	1042	898	mA
		+10 dBm	204	70	31	842	417	mA
	Band VI	+22 dBm	609	204	88	1036	858	mA
		+10 dBm	200	71	30	978	404	mA
	Band VIII	+22 dBm	582	200	87	1050	895	mA
		+10 dBm	328	114	51	804	646	mA
UMTS (Data Transfer 2) 384 kbit/s	Band I	+22 dBm	694	225	97	585	781	mA
		+10 dBm	243	85	42	987	457	mA
	Band II	+22 dBm	798	226	107	1306	899	mA
		+10 dBm	250	89	38	1121	481	mA
	Band V	+22 dBm	628	208	90	1095	961	mA
		+10 dBm	206	73	33	1117	430	mA
	Band VI	+22 dBm	669	221	92	1133	827	mA
		+10 dBm	216	76	32	1170	406	mA
	Band VIII	+22 dBm	594	201	87	1045	1003	mA
		+10 dBm	330	118	52	810	708	mA
HSDPA Data Transfer 2 Cat.10 14.4 Mbit/s	Band I	+22 dBm	736	243	103	1155	754	mA
		+10 dBm	314	109	48	747	592	mA
	Band II	+22 dBm	636	213	96	1032	724	mA
		+10 dBm	322	107	46	703	585	mA
	Band V	+22 dBm	664	225	96	1024	863	mA
		+10 dBm	278	98	42	774	509	mA
	Band VI	+22 dBm	705	227	95	885	928	mA
		+10 dBm	269	92	42	668	415	mA
	Band VIII	+22 dBm	668	219	91	988	656	mA
		+10 dBm	386	133	61	820	749	mA
HSUPA Data Transfer 2 Cat.5 2 Mbit/s	Band I	+22 dBm	697	238	91	960	509	mA
		+10 dBm	377	130	58	659	519	mA
	Band II	+22 dBm	635	217	85	899	498	mA
		+10 dBm	483	132	58	786	534	mA
	Band V	+22 dBm	660	226	87	951	499	mA
		+10 dBm	347	120	54	625	514	mA
	Band VI	+22 dBm	657	224	88	922	549	mA
		+10 dBm	335	117	52	618	506	mA
	Band VIII	+22 dBm	638	220	85	946	557	mA
		+10 dBm	401	140	54	715	558	mA

6.4. Non-Connected Mode Power Consumption

Note: The USB port must be deactivated to enter Sleep Mode.

Table 35. Power Consumption of USR3500 in Non-Connected Mode with UART ON, FLASH LED OFF and USB OFF (typical values)

Mode	Serial Port Status	$I_{average}$			Unit
		DC-IN=4.75V	DC-IN=13.2V	DC-IN=32V	
Active Idle Mode, HSPA	ON	45.82	16.56	7.6	mA
	OFF	15.48	5.96	2.81	mA
Sleep Idle Mode, HSPA	ON	32.66	11.89	5.8	mA
	OFF	3.09	1.39	0.78	mA
Active Idle Mode, 2G page 9	ON	46.01	16.47	7.5	mA
	OFF	16.43	6.01	2.96	mA
Sleep Idle Mode, 2G page 9	ON	31.91	11.51	5.65	mA
	OFF	2.7	1.12	0.81	mA
Active Idle Mode, 2G page 2	ON	47.11	16.82	7.75	mA
	OFF	17.54	6.4	3.15	mA
Sleep Idle Mode, 2G page 2	ON	33.51	12.07	5.65	mA
	OFF	4.3	1.64	1.14	mA
Alarm Mode	OFF	2.7	1.23	0.91	mA

7. Recommendations when Using the USR3500 on Trucks

Caution: *The power supply connection of the modem must **never** be directly connected to the truck battery.*

7.1. Recommended Power Supply Connection on Trucks

All trucks have a circuit breaker on the exterior of the cabin. The circuit breaker is used for safety reasons: if a fire blazes in the trucks, (for example, on the wiring trunk) the driver may cut the current source to avoid any damage (explosion). The circuit breaker is connected to the truck ground, most often associated with the fuse box.

Most truck circuit breakers do not cut the Positive Supply line of the battery, but cut the ground line of the latter.

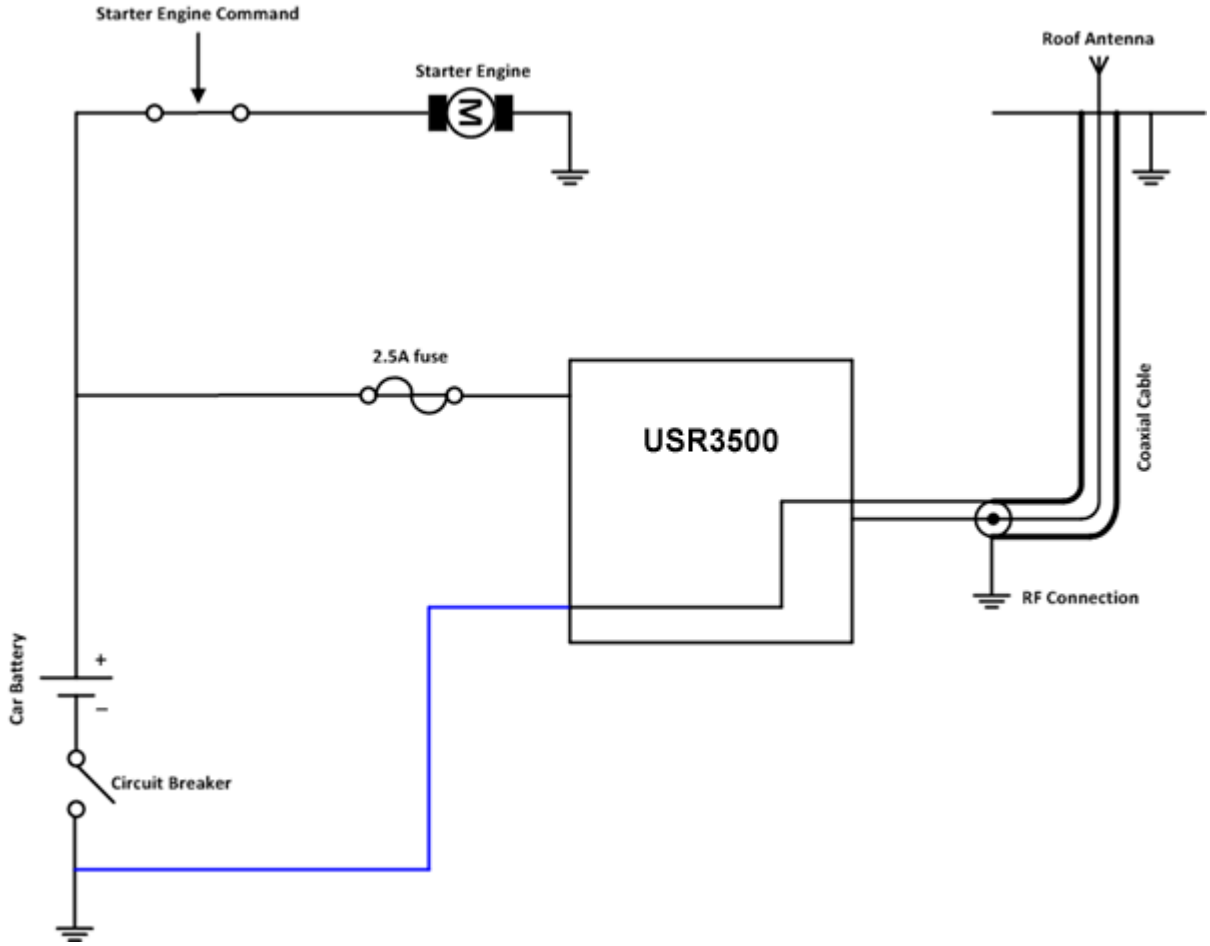


Figure 27. Recommended Power Supply Connection on Trucks

The figure above shows the recommended power supply connection where the ground connection of the modem is not directly connected to the battery but is connected after the Circuit Breaker (on the truck ground or the fuse box).

7.2. Technical Constraints on Trucks

It is highly recommended to directly connect the power supply on the circuit breaker rather than on the battery. The modem may be damaged when starting the truck if the circuit breaker is switched OFF (in this case, the truck ground and the battery ground will be connected through the modem as shown in the following figure).

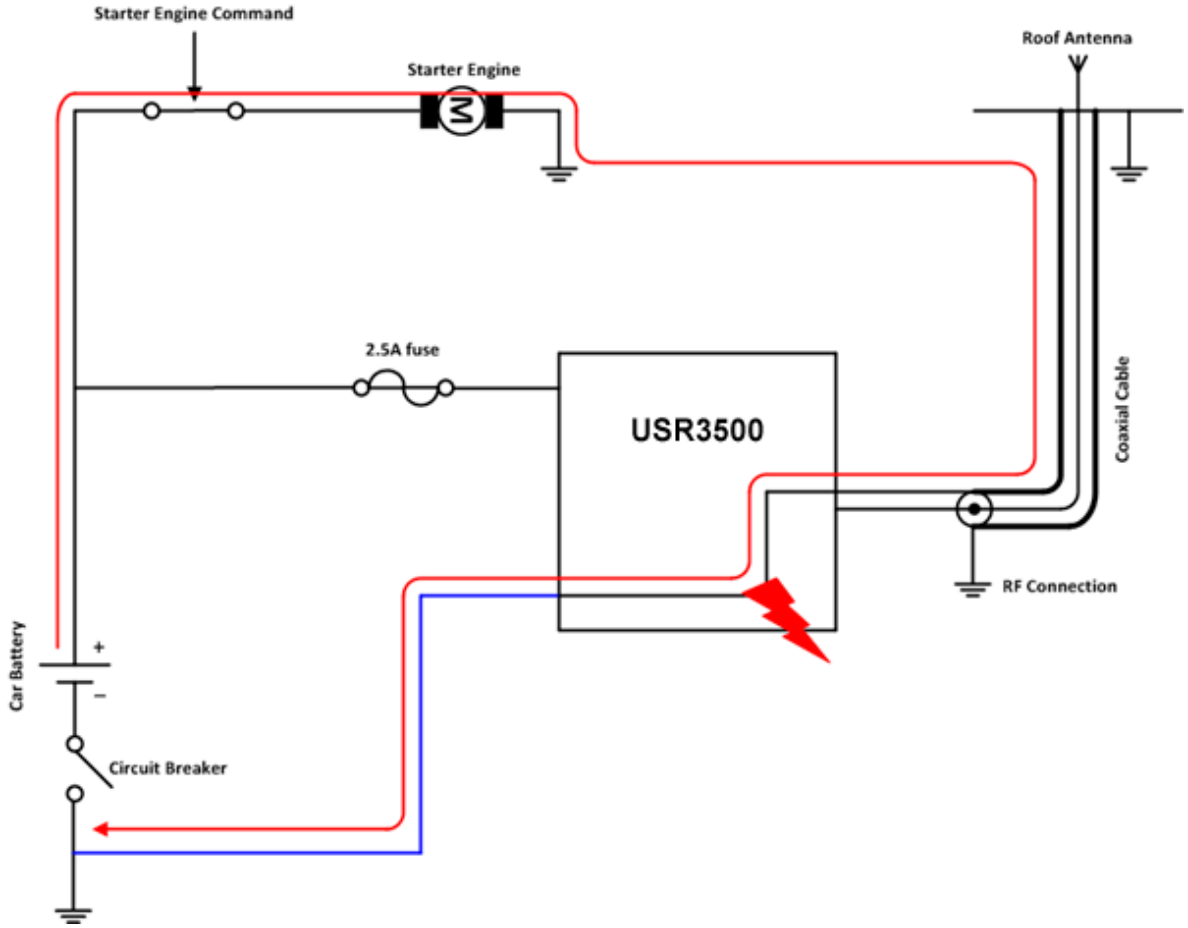


Figure 28. Example of an Electrical Connection That May Damage the modem

The figure above gives an example of an electrical connection which may dramatically damage the modem when its ground connection is directly connected to the battery ground.

In this example, when the circuit breaker is switched OFF, the current flows through the modem and powers the electrical circuit of the truck (for example, the dashboard). Furthermore, when the Starter Engine command is used, it will destroy the cables or the modem.

Since the internal tracks of the modem are not designed to support high currents (up to 60A when starting the truck), they will be destroyed.

8. Reliability Compliance and Recommended Standards

8.1. Reliability Compliance

The USR3500 is compliant with the following requirements.

Table 36. Standards Conformity for the modem

Abbreviation	Definition
IEC	International Electro technical Commission
ISO	International Organization for Standardization

8.2. Applicable Standards Listing

The table hereafter gives the basic list of standards applicable to the USR3500.

Note: References to any features can be found from these standards.

Table 37. Applicable Standards and Requirements for the modem

Document	Current Version	Title
IEC6006826	7.0	Environmental testing - Part 2.6: Test FC: Sinusoidal Vibration.
IEC60068234	73	Basic environmental testing procedures part 2: Test FD: random vibration wide band - general requirements. Cancelled and replaced by IEC60068-2-64. For reference only.
IEC60068264	2.0	Environmental testing - part 2-64: Test FH: vibration, broadband random and guidance.
IEC60068232	2.0	Basic environmental testing procedures - part 2: Test ED: (procedure 1) Withdrawn & replaced by IEC60068-2-31. For reference only.
IEC60068231	2.0	Environmental testing part 2-31: Test EC: rough handling shocks, primarily for equipment-type specimens.
IEC60068229	2.0	Basic environmental testing procedures - part 2: Test EB and guidance: bump. Withdrawn and replaced by IEC60068-2-27. For reference only.
IEC60068227	4.0	Environmental testing - part 2-27: Test EA and guidance: shock.
IEC60068214	6.0	Environmental testing - part 2-14: Test N: change of temperature.
IEC6006822	5.0	Environmental testing - part 2-2: Test B: dry heat.
IEC6006821	6.0	Environmental testing - part 2-1: Test A: cold.
IEC60068230	3.0	Environmental testing - part 2-30: Test DB: damp heat, cyclic (12 h + 12 h cycle).
IEC6006823	69 w/A1	Basic environmental testing procedures part 2: Test CA: damp heat, steady State. Withdrawn and replaced by IEC60068-2-78. For reference only.
IEC60068278	1.0	Environmental testing part 2-78: Test CAB: damp heat, steady state.

Document	Current Version	Title
IEC60068238	2.0	Environmental testing - part 2-38: Test Z/AD: composite temperature/humidity cyclic test.
IEC60068240	1.0 w/A1	Basic environmental testing procedures - part 2: Test Z/AM combined cold/low air pressure tests.
ISO167501	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 1: general.
ISO167502	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 2: electrical loads.
ISO167503	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 3: mechanical loads.
ISO167504	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 4: climatic loads.
IEC60529	2.1 w/COR2	Degrees of protection provided by enclosures (IP code).
IEC60068217	4.0	Basic environmental testing procedures - part 2: Test Q: sealing.
IEC60068218	2.0	Environmental testing - part 2-18: Tests - R and guidance: water.
IEC60068270	1.0	Environmental testing - part 2: tests - test XB: abrasion of markings and letterings caused by rubbing of fingers and hands.
IEC60068268	1.0	Environmental testing - part 2: tests - test l: dust and sand.
IEC60068211	3.0	Basic environmental testing procedures, part 2: test KA: salt mist.
IEC60068260	2.0	Environmental testing - part 2: Test KE: flowing mixed gas corrosion test.
IEC60068252	2.0 w/COR	Environmental testing - part 2: Test KB: salt mist, cyclic (sodium chloride solution).

8.3. Environmental Specifications

The USR3500 is compliant with the operating classes listed below. The ideal temperature range of the environment for each operating class is also specified.

Table 38. Operating Class Temperature Range

Conditions	Temperature Range
Operating / Class A	-20 °C to +55°C
Operating / Class B*	-30 °C to +75°C
Operating / Class C*	-30 °C to +85°C
Storage*	-40 °C to +85°C

* Refer to the Footnotes of Table 29 Real Time Clock Specifications for RTC battery related issues.

8.3.1. Function Status Classification

The classes reported below comply with the Annex "ISO Failure Mode Severity Classification", ISO Standard 7637, and Section 1.

Note: The word "function" used here only concerns the function performed by the modem.

Table 39. ISO Failure Mode Severity Classification

Class	Definition
CLASS A	All equipment/system functions are fulfilled normally (100% functional) during and after the constraint. The modem shall exhibit normal function during and after environmental exposure. The modem performance shall meet the minimum requirements of 3GPP or appropriate wireless standards.
CLASS B	All equipment/system functions are fulfilled normally during application of the constraint; however, one or several of them may be out of the specified tolerances. After application of the constraint, all functions automatically return within standard limits. The memories shall remain in compliance with Class A. The modem shall exhibit the possibility at all times to establish a voice, SMS or DATA call. Unless otherwise stated, full performance should return to normal after the external influence has been removed.
CLASS C	No functional requirement will be fulfilled during the application of the constraint; however, full functionality will automatically be returned after the constraint has been removed.

9. Certification Compliance and Recommended Standards

9.1. Certification Compliance

Refer to the following tables for the requirements compliance of the USR3500.

Table 40. Standards Conformity for USR3500

Domain	Applicable Standard
Safety & Health	IEC 60950:2005+A1:2009 EN 60950:2006+A11:2009+A1:2010+A12:2011 EN 62311: 2008
Efficient use of the radio frequency spectrum	EN 301 440-1, v1.6.1 EN 301 440-2 v1.4.1 EN 301 511, v9.0.2 EN 301 908-1, v4.2.1 EN 301 908-2, v5.2.1
EMC	EN 301 489-1, v1.9.2 EN 301 489-3, v1.4.1 EN 301 489-7, v1.3.1 EN 301 489-24, v1.5.1
FCC	FCC Part 22, 24
IC	RSS-132 Issue 2 RSS-133 Issue 5
International Standard for Battery	IEC 61951-2

9.2. Applicable Standards Listing

The table hereafter gives the basic list of standards applicable for 2G and 3G (HSPA).

Note: References to any features can be found from these standards.

Table 41. Applicable Standards and Requirements for USR3500

Document	Current Version	Title
GCF-CC	3.46.0	GSM Certification Forum-Certification Criteria
NAPRD.03	5.11	Overview of PCS Type certification review board (PTCRB) Mobile Equipment Type Certification and IMEI control
TS 51.010-1	10.1.0	3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 1: Conformance specification
TS 51.010-2	10.1.0	3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Mobile Station (MS) conformance specification; Part 2: Protocol Implementation Conformance Statement (PICS) proforma specification
TS 51.010-4	4.23.0	3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 4: SIM Application Toolkit Conformance specification
EN 301 511	9.0.2	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)
EN 301 908-2	5.2.1	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)

10. Safety Recommendations

10.1. General Safety

For the efficient and safe operation of your programmable modem, please read the following information carefully.

It is important to follow any special regulations regarding the use of radio equipment due in particular to the possibility of radio frequency (RF) interference. Carefully follow the safety advice given.

Switch OFF your programmable modem:

- When in an aircraft. The use of cellular telephones in an aircraft may endanger the operation of the aircraft, disrupt the cellular network and is illegal. Failure to observe this instruction may lead to suspension or denial of cellular telephone services to the offender, or legal action or both,
- When at a refueling point,
- When in any area with a potentially explosive atmosphere which could cause an explosion or fire,
- In hospitals and any other place where medical equipment may be in use.

Respect restrictions on the use of radio equipment in:

- Fuel depots,
- Chemical plants,
- Places where blasting operations are in progress,
- Any area where the use of a cellular telephone is forbidden or dangerous.
- Any other area where you would normally be advised to turn off your vehicle engine.

Turn your modem OFF when in any area with a potentially explosive atmosphere. It is rare, but your modem or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injuries or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include below decks on boats and areas where the air contains chemicals or particles, such as grain, dust, or metal powders.

Do not transport or store flammable gas, liquid, or explosives, in the compartment of your vehicle which contains your modem or accessories.

Before using your modem in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is to be used.

There may be a hazard associated with the operation of your USR3500 close to inadequately protected personal medical devices such as hearing aids and pacemakers. Consult the manufacturers of the medical device to determine if it is adequately protected.

Operation of your USR3500 close to other electronic equipment may also cause interference if the equipment is inadequately protected. Observe any warning signs and manufacturers' recommendations.

The USR3500 is designed for and intended to be used in "***fixed***" and "***mobile***" applications:

"*Fixed*" means that the device is physically secured at one location and is not able to be easily moved to another location.

"*Mobile*" means that the device is designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm (8 inches) is normally maintained between the transmitter's antenna and the body of the user or nearby persons.

The USR3500 is not designed for nor intended to be used in portable applications (within 20 cm or 8 inches of the body of the user) and such uses are strictly prohibited.

10.2. RF Safety

10.2.1. General

Your GSM modem is based on the GSM standard for cellular technology. The GSM standard is spread all over the world. It covers Europe, Asia and some parts of America and Africa. This is the most used telecommunication standard.

Your GSM modem is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When you use your GSM application, the cellular system which handles your calls controls both the radio frequency and the power level of your cellular modem.

10.2.2. Exposure to RF Energy

There has been some public concern about possible health effects of using GSM modems. Although research on health effects from RF energy has focused on the current RF technology for many years, scientists have begun research regarding newer radio technologies, such as GSM. After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product was acceptable for use.

If you are concerned about exposure to RF energy there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular modem efficiently by following the below guidelines.

10.2.3. Efficient Modem Operation

For your GSM modem to operate at the lowest power level, consistent with satisfactory connection quality:

Do not hold the antenna when the modem is « IN USE ». Holding the antenna affects connection quality and may cause the modem to operate at a higher power level than needed.

10.3. Vehicle Safety

Do not use your USR3500 while driving, unless equipped with a correctly installed vehicle kit allowing ‘Hands-Free’ Operation.

Respect national regulations on the use of cellular telephones in vehicles. Road safety always comes first.

If incorrectly installed in a vehicle, the operation of the USR3500 could interfere with the correct functioning of vehicle electronics. To avoid such problems, make sure

that the installation has been performed by qualified personnel. Verification of the protection of vehicle electronics should form part of the installation.

The use of an alert device to operate a vehicle's lights or horn on public roads is not permitted.

10.4. Care and Maintenance

Your USR3500 is the product of advanced engineering, design and craftsmanship and should be treated with care. The suggestion below will help you to enjoy this product for many years.

Do not expose the USR3500 to any extreme environment where the temperature or humidity is high.

Do not use or store the USR3500 in dusty or dirty areas. Its moving parts can be damaged.

Do not attempt to disassemble the modem. There are no user serviceable parts inside.

Do not expose the USR3500 to water, rain or beverages. It is not waterproof.

Do not abuse your USR3500 by dropping, knocking, or violently shaking it. Rough handling can damage it.

Do not place the USR3500 alongside computer discs, credit or travel cards or other magnetic media. The information contained on discs or cards may be affected by the embedded module.

The use of third party equipment or accessories not authorized by USRobotics may invalidate the warranty of the modem.

Contact USRobotics in the unlikely event of a modem failure.

10.5. Your Responsibility

This USR3500 is under your responsibility. Please treat it with care, respecting all local regulations. It is not a toy. Therefore, keep it in a safe place at all times and out of the reach of children.

Remember your Unlock and PIN codes. Become familiar with and use the security features to block unauthorized use and theft.

11. Reference Documents

For more details, several reference documents can be consulted. The documents referenced herein are provided by USRobotics. Visit the USRobotics website at http://www.usr.com/ for the latest documentation available.

11.1. Firmware Documentation

[3] AT Commands Interface Guide

[4] Customer Release Notes for Firmware 7.52 A1

11.2. Expansion Card Documentation

[5] Ethernet Expansion Card User Guide

12. List of Abbreviations

Abbreviation	Definition
AC	Alternating Current
ACM	Accumulated Call Meter
AMR	Adaptive Multi-Rate
AT	ATtention (prefix for Wireless CPU® commands)
CLK	CLocK
CMOS	Complementary Metal Oxide Semiconductor
CS	Coding Scheme
CTS	Clear To Send
dB	Decibel
dBc	Decibel relative to the Carrier power
dBi	Decibel relative to an Isotropic radiator
dBm	Decibel relative to one milliwatt
DC	Direct Current
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DCS	Digital Cellular System
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency
DTR	Data Terminal Ready
EEPROM	Electrically Erasable Programmable Read-Only Memory
EFR	Enhanced Full Rate
E-GSM	Extended GSM
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
ESD	ElectroStatic Discharges
ETSI	European Telecommunications Standards Institute
FIT	Series of connectors (micro-FIT)
FR	Full Rate
FTA	Full Type Approval
GCF	Global Certification Forum
GND	GrouND
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
HR	Half Rate
HSDPA	High Speed Downlink Packet Access
HSPA	High Speed Packet Access
HSUPA	High Speed Uplink Packet Access
I	Input

Abbreviation	Definition
IEC	International Electrotechnical Commission
IES	Internal Expansion Socket
IESM	Internal Expansion Socket Module
IMEI	International Mobile Equipment Identification
I/O	Input / Output
LED	Light Emitting Diode
MAX	MAXimum
ME	Mobile Equipment
MIC	MICrophone
Micro-Fit	Family of connectors from Molex
MIN	MINimum
MNP	Microcom Networking Protocol
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
NOM	NOMinal
O	Output
Pa	Pascal (for speaker sound pressure measurements)
PBCCH	Packet Broadcast Control Channel
PC	Personal Computer
PCL	Power Control Level
PDP	Packet Data Protocol
PIN	Personal Identity Number
PLMN	Public Land Mobile Network
PUK	Personal Unblocking Key
RF	Radio Frequency
RFI	Radio Frequency Interference
RI	Ring Indicator
RMS	Root Mean Square
RTS	Request To Send
RX	Receive
SIM	Subscriber Identification Module
SMA	SubMiniature version A RF connector
SMS	Short Message Service
SNR	Signal-to-Noise Ratio
SPL	Sound Pressure Level
SPK	SpeaKer
SRAM	Static RAM
TCP/IP	Transmission Control Protocol / Internet Protocol
TDMA	Time Division Multiple Access
TU	Typical Urban fading profile
TUHigh	Typical Urban, High speed fading profile
TX	Transmit

Abbreviation	Definition
TYP	TYPical
UMTS	Universal Mobile Telecommunications System
VSWR	Voltage Standing Wave Ratio