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SiAM Conversor · Version 2.0

EXTERNAL RS232-RS485 AUTO-SPEED AUTO-RTS CONVERTER

User manual

CHARACTERISTICS

- External RS232/RS485 microcontroller-based converter with **automatic transmission detection** (Auto-RTS) and **automatic speed detection** (Auto-Speed).
- Works at 7 different speeds (2400, 4800, 9600, 19200, 38400, 57600 y 115200 bps) with byte sizes of 9, 10, 11 and 12 bits.
- Three selectable working modes: automatic transmission and reception, only transmission, only reception.
- Echo option switch.
- Fully compatible with Siemens PC/PPI Cable for connection with Siemens S7-200 PLCs.
- End-of-bus resistances to avoid reflexions, and pull-up and pull-down to stabilize the RS-485 bus.
- Up to 64 converters in the RS-485 bus (without repeaters).
- Switches for configuration of byte size and pull-up, pull-down and end-of-bus resistances.
- Internal jumpers for configuration of loopback connections for **hardware flow control**.
- LED indication for external power supply, reception state, transmission state and working speed.
- **Port-powered operation** with connector for external 7-30VDC power supply (optional).
- DB9F connection for RS-232 port (DB9M-DB9F 1.8m serial cable optional).
- Pluggable 3-way terminal block connector for RS-485 port. Other connectors available under special request: DB9M, DB9F, RJ-45, RJ-11, RJ-12, RCA, jack, etc.
- Optional DIN-rail mounting clip.
- Dimensions: 100 x 50 x 25 mm

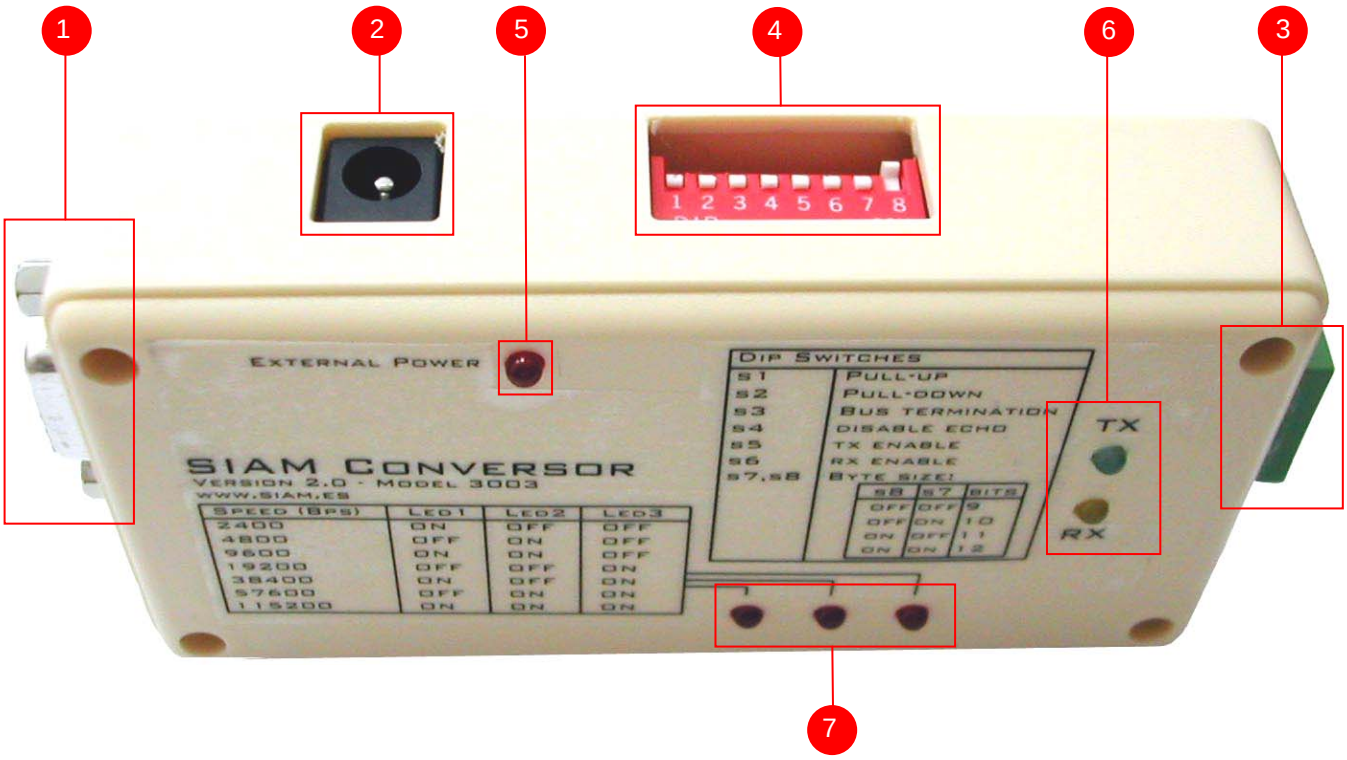
CONTENTS

- 232/485 converter.
- User manual.
- 220 VAC to 12 VDC transformer (optional).
- DB9M-DB9F 1.8m serial cable for RS-232 PC port connection (optional).
- DIN-rail mounting adapter (optional).

INTRODUCTION

SiAM-Conversor is a RS-232 to RS-485 communications converter with automatic detection of transmisión direction (Auto-RTS) and automatic detection of the communications baud rate (Auto-Speed).

In the following figure you can see the layout of the configuration switches, display LEDs and connectors in the converter case.



1. DB9 female connector for RS-232.
2. Power supply connector.
3. RS-485 bus connector.
4. Configuration switches.
5. LED for external power supply.
6. LEDs for communication monitoring.
7. LEDs for baud rate monitoring.

THE RS-485 BUS AND TRANSMISSION CONTROL

The RS-485 bus –conventional term for the TIA/EIA-485 norm- offers several advantages over the RS-232:

- It allows *multipoint* communications up to 32 nodes, while RS-232 only allows *point-to-point* communications between 2 stations.
- The communication distance can be increased to more than 1000 metres (depending on the transmission speed).
- Transmission speed can be much higher than in RS-232, up to 10 Mbits/s.
- Higher noise immunity.

The physical layer consists in a twisted pair (shielded or unshielded) whose wires are named 485+/485- (although they are also named TX+/TX- or A/B). A 1 bit is translated in a positive differential voltage between 485+ and 485- higher than 0.2V (tipically 1.5V), and, while at same time a 0 bit establishes a negative differential voltage between 485+ and 485-.

The RS-485 bus is a *half-duplex* shared medium where stations cannot transmit and receive data at the same time. The bus nodes must enable their transmission drivers only when they have data to transmit, and disable them immediately after transmission to release the bus and allow the rest of nodes to transmit. The signal that controls the transmission enabling is the *Request to Send* or *RTS* signal. The control of this signal in the RS-232 ports in a PC (or any other device with an RS-232 port) is complicated, because the serial port must be low-level programmed to ensure a short delay in disabling RTS after transmission.

SiAM-Conversor incorporates an automatic, microcontroller-based RTS control that guarantees the correct data transmission from the RS-232 side to the RS-485 side without the need of programming the RTS control line in the RS-232 port.

AUTO-RTS AND AUTO-SPEED WORKING MODE

In Auto-RTS mode, knowing the actual transmission speed accurately it's very important, because transmission deactivation delay is calculated depending on this speed. In this mode, the converter calculates the actual transmission speed measuring pulse widths in the RS-232 port. The detected speed will be shown in the speed monitoring leds.

Speed detection is performed dinamically, so that if the transmitting device changes the communication speed, the converter will detect it after a short time and will automatically adjust transmission deactivation delay.

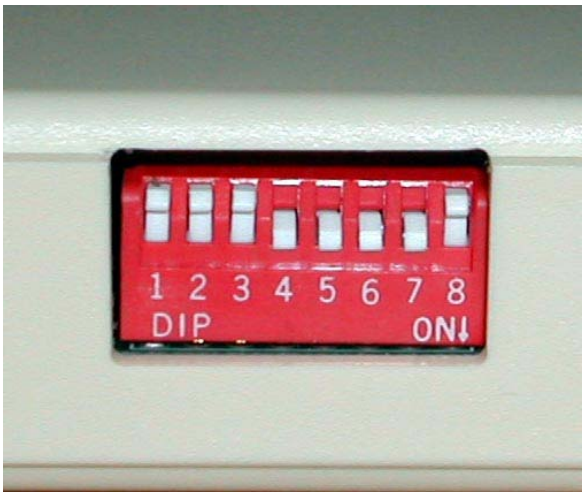
The converter has a security mechanism in automatic speed detection mode that automatically resets the converter and sets the detected speed to its lowest value (2400 bps) after a 5-second (approx.) interval with no activity in the transmission line.

Whenever posible, it's convenient to program the RS-232 devices so that they wait for at least one byte time before beginning the transmission, in order to ensure that the device which transmitted previously has released the bus before the new transmission begins. If this is not taken into account, communication errors can occur. At higher speeds, RTS delay after transmission is lower than the device's processing time and so this problem is less important. In fact, this converter has been used to communicate with many kinds of RS-485 devices with no related to delays.

The following table shows the minimum delay times for every speed with 9, 10, 11 and 12 bit-sized bytes.

Speed	Byte time (9 bits)	Byte time (10 bits)	Byte time (11 bits)	Byte time (12 bits)
2400 bps	3.750 ms	4.167 ms	4.583 ms	5.000 ms
4800 bps	1.875 ms	2.083 ms	2.292 ms	2.500 ms
9600 bps	0.938 ms	1.042 ms	1.146 ms	1.250 ms
19200 bps	0.469 ms	0.521 ms	0.573 ms	0.625 ms
38400 bps	0.234 ms	0.260 ms	0.286 ms	0.313 ms
57600 bps	0.156 ms	0.174 ms	0.191 ms	0.208 ms
115200 bps	0.078 ms	0.087 ms	0.095 ms	0.104 ms

CONFIGURATION SWITCHES



The eight configuration switches placed if one side of the converter case are inactive (OFF) in upper position and active (ON) in the lower position, as indicated by the arrow. The default setting for the configuration switches is shown in the picture on the right: S1-S2-S3-S8 inactive and S4-S5-S6-S7 active.

The purpose of each one of the configuration switches (from left to right) is described in the following table:

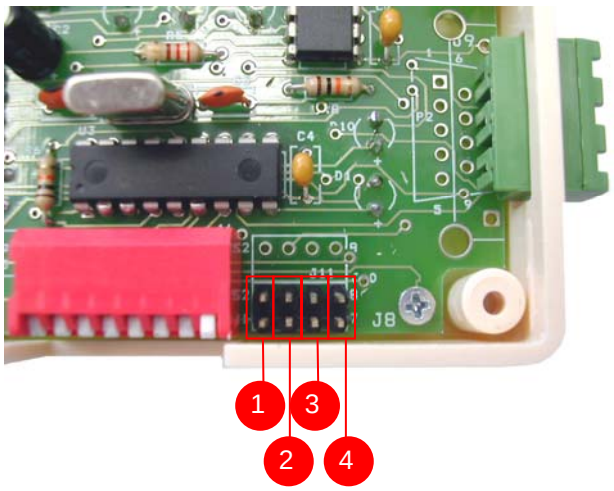
Switch	Function	Description
S1	Pull-up	Activates the 390 Ω pull-up resistor to stabilize the bus. **Must be set in only one node in the RS-485 network.**
S2	Pull-down	Activates the 390 Ω pull-down resistor to stabilize the bus. **Must be set in only one node in the RS-485 network.**
S3	End-of-bus	Activates the 220 Ω end-of-bus resistor to avoid reflections in the bus. **Must be turned on in the end nodes of the bus** and turned off in all the intermediate nodes.
S4	Echo disable	If S4 is OFF, echo in the RS-485 bus is enabled. This means that all the data transmitted by the converter will also be received by itself. If S4 is ON, nothing will be received when transmitting. The echo option can be necessary for some particular software, but **normally this switch should be turned on**.
S5	TX enable	This switch enables transmission to the RS-485 bus. If turned OFF, no data will be sent to the bus and the device would only be able to receive data (if S6 is ON). **It should normally be active**.
S6	RX enable	This switch enables reception from the RS-485 bus. If turned OFF, no data will be received from the bus and the device would only be able to transmit data (if S5 is ON). **It should normally be active**.

<table>
<tr><th>Switch</th><th>Function</th><th>Description</th></tr>
<tr><td>S7,S8</td><td>Byte size</td><td>These two switches select one between the four possible byte sizes (including data, start, stop and parity bits) according to the following table:

<table>
<tr><th>S8</th><th>S7</th><th>Byte size</th><th>Possible configurations
(Data bits -Parity (Yes/No)-Stop bits)</th></tr>
<tr><td>OFF</td><td>OFF</td><td>9 bits</td><td>7-No-1</td></tr>
<tr><td>OFF</td><td>ON</td><td>10 bits</td><td>8-No-1, 7-Si-1, 7-No-2</td></tr>
<tr><td>ON</td><td>OFF</td><td>11 bits</td><td>8-Yes-1, 8-No-2</td></tr>
<tr><td>ON</td><td>ON</td><td>12 bits</td><td>8-Yes-2</td></tr>
</table>

If communications byte size is unknown, try all possibilities to see which one works best.</td></tr>
</table>

CONFIGURATION JUMPERS

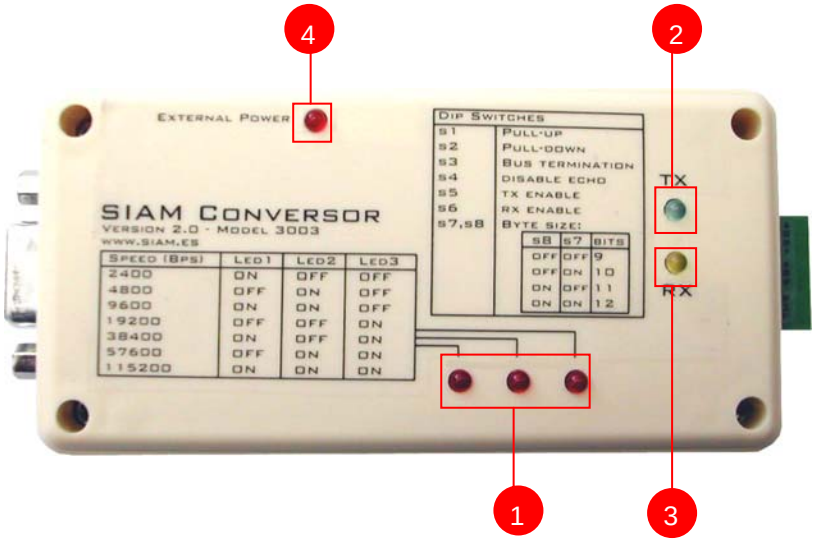


Configuration jumpers are not accesible from outside the converter because their functionality is not required for most applications. If it were necessary to set these jumpers, the converter's plastic case should be open by removing the four screws in the bottom side. They're placed just beside the configuration switches, as shown in the picture on the left. Its purpose is described in the following table:

Jumper	Function	Description
J1	LED activation without external power supply	If this jumper is activated (closed), the converter will turn on the LEDs even when no external power supply is present. This is not advisable because the current consumption with all LEDs active can be higher than the current supplied by typical PC serial ports, and this can cause malfunction and converter resets.
J2	RTS-CTS loopback	Connects the lines RTS and CTS in the RS-232 port.
J3	DTR-DSR loopback	Connects the lines DTR and DSR in the RS-232 port.
J4	DTR-RI loopback	Connects the lines DTR and RI in the RS-232 port.

Loopback connections (RTS-CTS and DTR-DSR-RI) can be necessary if the software that controls the serial port requires hardware flow control. Otherwise, it's recommended to leave the jumpers inactive (open) to minimize current consumption.

MONITORING LEDS



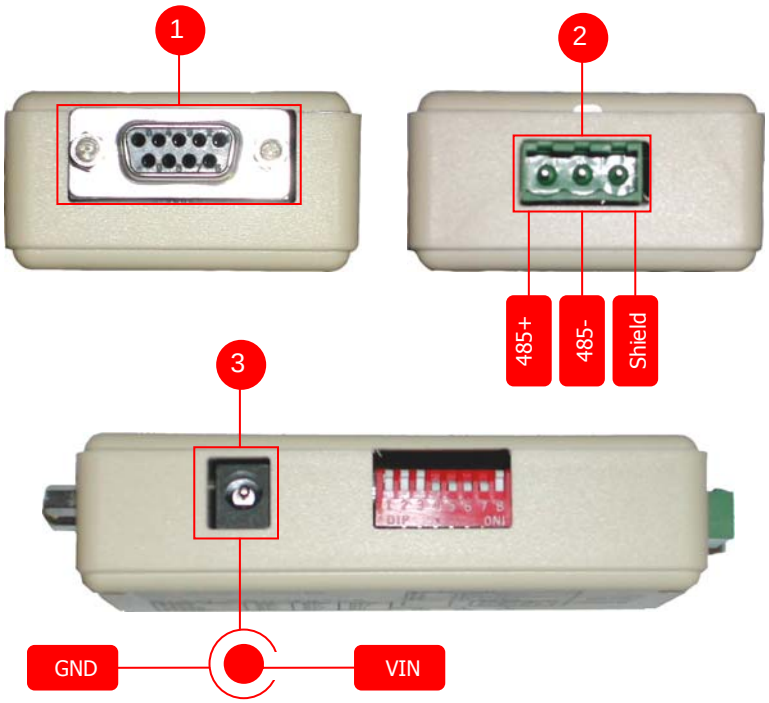
1. **LEDs for baud rate monitoring.** These LEDs indicate the comms baud rate detected by the converter, according to the following table:

L1	L2	L3	Detected baud rate
Off	Off	Off	---
On	Off	Off	2400 bps
Off	On	Off	4800 bps
On	On	Off	9600 bps
Off	Off	On	19200 bps
On	Off	On	38400 bps
Off	On	On	57600 bps
On	On	On	115200 bps

2. **LED for reception state**. Turns on when data is received from the RS-485 bus.
3. **LED for transmission state**. Turns on when the device is transmitting data to the RS-485 bus.
4. **LED for external power supply**. Indicates if an external power supply is present.

If the converter is getting power only from the serial port, it will work but no LED will be active –unless jumper J1 is active as described in the previous page- because normally a serial port can't source enough current to keep all the LEDs active at the same time.

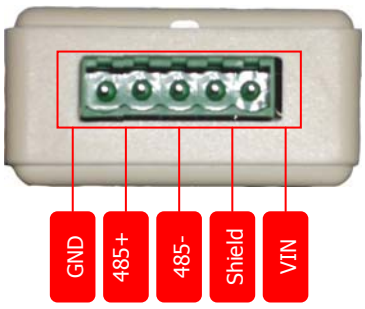
CONNECTORS

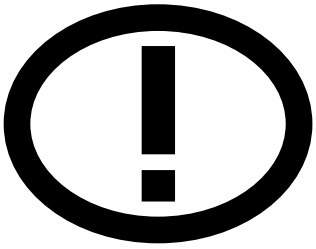


1. **RS-232 port connector.** DB9 female connector where a normal serial extender cable can be connected.
2. **RS-485 bus connector.** Connect here the RS-485 bus cable (to the *485+* and *485-* terminals) and the cable shield (to the *Shield* terminal). Connecting shield will reduce noise in the RS-485 bus.
3. **External power supply connector.** Connect here the external power supply (between 7 and 30 VDC). The positive terminal is in the center pin.

In some custom models of the converter, the RS-485 bus connector can be of another type like DB9 male, DB9 female, RJ-45, RJ-11, RJ-12, etc. In these cases, the connection between lines *485+*, *485-* and *Shield* to the pins in the connector will be specified for each particular case. In those models, the standard connector for external power supply can be removed because power can be supplied through some of the unused pins in the bus connector.

It's possible to change the standard 3-way pluggable terminal block connector for the RS-485 bus by a 5-way connector which allows the connection of the external power supply through the two additional poles. In this case, the connection diagram would be as shown in the picture on the right.

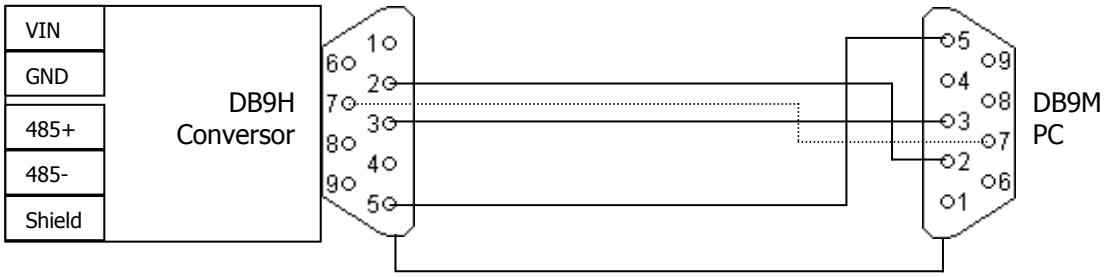




Don't power the converter through the RS-485 bus connector –in the models where it can be done- and through the standard external power supply connector at the same time. Only one power supply connection can be used.

PC CONNECTION

Connection between the converter and the RS-232 PC port is performed by a normal serial port extending cable, as the following diagram shows:



Connecting DB9 shields is optional though recommended to increase noise immunity. Connection to serial ports with DB25M is also possible using standard DB25-DB9 adapters.

SIEMENS S7-200 PLC CONNECTION

This converter can replace Siemens communication adapter (PC/PPI Cable) for S7-200 CPUs. Moreover, no external power supply is required in this case because the CPU supplies 24VDC through its PPI port. The connection is described in the following diagram:

For short distance connection to an S7-200, it's recommended to use an specific version of the converter with a DB9 male connector which allows direct connection to the PLC and powering the converter with only a standard serial port extender cable.

STANDARD RS-485 DEVICE CONNECTION

Standard RS-485 devices with DB9 connectors tipically assign 485+ and 485- signals to pins 8 and 3. So, the connection diagram is just like the one in the previous page for the Siemens S7-200, removing the power supply and ground signals (pins 7 and 2).

Specific versions of the converter can be requested -with any kind of connectors- ready to connect to any RS-485 device, by specifying the type of connector to use and the correspondence between the RS-485 and power signals and the pins in the connector.

FREQUENTLY ASKED QUESTIONS

- **The converter is not receiving anything and the reception LED is always on.**

  Check that the 485+ and 485- cables have been correctly connected and have not been swapped. Check also end-of-bus, pull-up and pull-down configuration switches. End-of-bus resistance must be turned on in the first and the last device in the RS-485 bus. Pull-up and pull-down resistances must be turned on in only one device in the bus.

- **The converter is not functioning properly when powered only from the serial port.**

  The converter gets its power from the RTS and DTR lines in the RS-232 port. The software that's controlling the port must activate these two lines so the converter can work without external power. If the software is not activating these lines or can't be configured to do so, then the converter will need an external power supply.

  Even in the case where RTS and DTR lines are active, there can still be problems. PC serial ports can source a very limited amount current. In some cases –like in notebook PCs- the current is so low that the converter can't work at all. In normal serial ports the converter should work fine but care must be taken to reduce its consumption as much as possible. The converter automatically detects the absence of an external power source and turns off all the LEDs -unless jumper J1 is active- but if this is not enough, the following actions are recommended:

  - Disable pull-up and pull-down resistors in the converter. Those resistors, if necessary, can be activated in any other node in the bus.
  - Disable the end-of-bus resistor. Normally it's not necessary unless the baud rate is 38400 bps or higher.
  - Disable loopback connections for hardware flow control.

ELECTRIC CHARACTERISTICS

Parameter	Units	Minumum	Maximum
Supply voltage	V	7	30
Supply current	mA	10	150
Power consumption	W	0,07	4,5
Operating temperature	ºC	0	50
Operating humidity	%	10	90

COMMUNICATION CHARACTERISTICS

Parameter	Units	Minimum	Maximum
Number of stations in the RS-485 bus	---	---	64
Communication speed	bps	2400	115200[1]

[1] Baud rate of 115200 bps is in the limit of the conversor performance and may present some error rate which can be overcome by retries by the protocol in the data link layer.

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