SERIAL LINK CONVERTER SLC-31/32

The SLC-31 (EI6011.xx) and SLC-32 (EI 6012.xx) convert RS-232C and USB to industry interface (RS-232, RS-422, RS-485, 20 mA current loop or M-Bus). They are built in a compact DIN rail mount package. Selection between RS-232C and USB is based upon USB cable insertion.

Converter utilizes exchangeable 'piggyback' modules for external industry interface selection and galvanic isolation. These 'piggybacks' are available as separate products too. Supply and interface signals are wired to plug-in screw clamps except A-type connector for USB. For SLC-31 the USB and RS232C interfaces are galvanic coupled with external supply. For SLC-32 external supply galvanic isolation is added.

Supply number	Interface type	Piggyback type	Piggyback module supply number	Available RS-232 signals	Note
EI6011.90 **EI6012.90**	RS232C	P232GPS	EI5055.21 (EI5055.20)	RxD, TxD, RTS, CTS	
EI6011.50 **EI6012.50**	RS232C	P232GPE	EI5055.01 (EI5055.00)	RxD, TxD, RTS, CTS, DTR, DCD	DTR a DCD USB only
EI6011.30 **EI6012.30**	RS422	P422GPS	EI5052.21 (EI5052.00)	RxD, TxD, RTS, CTS	
EI6011.20 **EI6012.20**	RS422	P422GPE	EI5052.01 (EI5052.00)	RxD, TxD, RTS, CTS, DTR, DCD	DTR a DCD USB only
EI6011.40 **EI6012.40**	RS485	P485GPE (P485GPS)	EI5054.01 (EI5054.00)	RxD, TxD, RTS	
EI6011.70 **EI6012.70**	20 mA loop	PL20GPS	EI5056.01 (EI5056.00)	RxD, TxD	DCD/Err [1)]
EI6011.80 **EI6012.80**	M-Bus master	PMBMGPS	EI5058.00	RxD, TxD	DCD/Err [1)]

obsolete piggyback types in brackets,

[1)] error line condition indication

General description

The main board contains USB to asynchronous serial link interface, RS-232C interface with over voltage protection and power supply. The piggyback module contains selected external industry interface with galvanic isolation. There are modules with DC/DC isolated supply allowed only.

The RS485 or RS422 transceiver can be driven by external RTS or by internal derived transmit detect signal. A transmission detect signal is derived from TXD (monostable flip-flop MFF1) while RS232 operation. While USB operation, this signal is derived from USB packet.

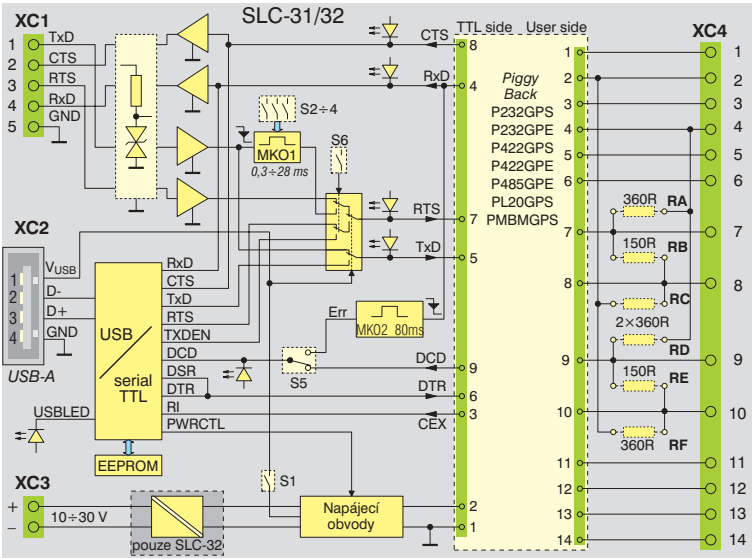


Fig. 1. Converter block schematics

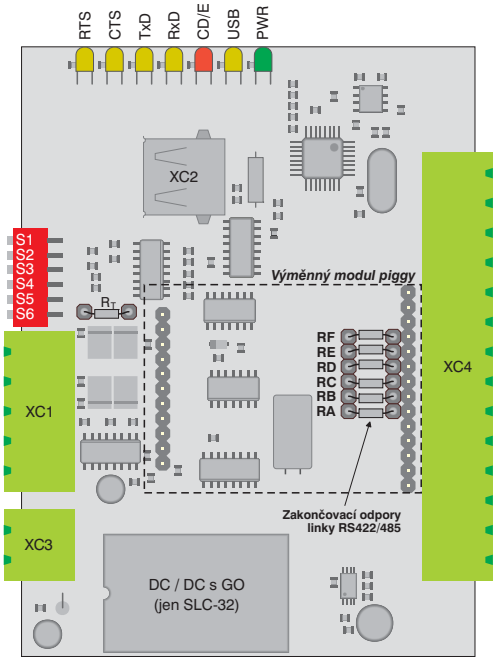


Fig. 2. Main board option's position

While USB operation, you can supply the converter from USB. But the USB host must deliver current required. If this is not the case, use an external supply. The required current depends on piggyback type and external interface load.

Specifications

External power supply:	
EI6011.xx	10÷30 V / max. 4 W
EI6012.xx	10÷30 V / max. 5 W
USB supply:	
without external supply	
with P..GPS piggyback	5 V / max. 0,4 A
with PMBMGPS piggyback	5 V / max. 0,6 A
with other supplier's piggyback	5V/1A max.
with external supply	5V/1mA
Interface isolation voltage:	
for all types	1000 VDC
External supply isolation voltage (EI6012.xx only)	1000VDC
Insulate protection:	IP20
Dimensions:	22.5×101×114 mm
Ambient temperature:	-10 +50 °C

RS232 interface

Max. baud rate	120 kBd
Receiver input resistance	min. 7 kΩ
Transmitter output voltage	±8V typ.
Cable length max.	15 m

RS422 interface

Baud rate max.	2 Mbd
Receiver input resistance	12 kΩ
Receiver input sensitivity	±200 mV
Transmitter diff. output voltage	3.7V typ. 1.5V min.
Cable length max.	1200 m

RS485 interface

Baud rate max.	2 Mbd
Receiver input resistance	12 kΩ
Receiver input sensitivity	±200 mV
Transmitter diff. output voltage	typ. 3.7V min. 1.5V
Cable length max.	1200m
Maximum signal to SG voltage	
continuously	6 V
peak	11 V
Maximum SG to PE voltage	
continuously	24V
peak	36 V

20mA current loop interface

Baud rate max.	38.4 kBd
L (low) level input current	<3 mA
H (high) level input current	>15 mA
Cable length max.	1500 m

M-Bus master interface

Baud rate max.	9.6 kBd
Slave modules count:	max. 3
	max. 20 with external supply

SLC-31/32			PC			
signal name–clamp			signal name			
			connector - pins			
	type		type	9	25	
RxD	output	→	input	2	3	RxD
TxD	input	←	output	3	2	TxD
GND	signal ground			5	7	SG
RTS	input	←	output	7	4	RTS
CTS	output	→	input	8	5	CTS

Tab. 1. XC1 (RS232 side) clamp names and PC COM port connection

Signal wiring, connectors

Main board RS232 interface is drawn to a 5-clamp XC1 connector. Signal names correspond to a PC COM port ones - it is just like an extension. Thus RXD is a converter output wired to same name COM port input of PC (or similar DTE). Tab. 1 shows an RS232 to PC connection example.

USB is drawn to an XC2 A-type USB connector. When inserting preferred USB plug, the RS232 on XC1 is disconnected.

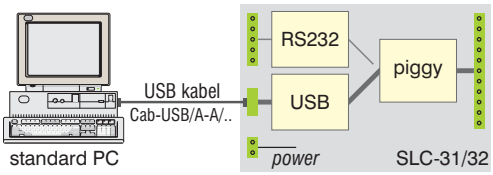
Piggyback's galvanic isolated industry interface is drawn to a 14-clamp XC4 connector. Tab. 2 shows signal and clamp names for all interface types. Fig. 1 shows main board and piggyback connection.

External power supply is drawn to an XC3 connector. External supply is always preferred when connected. USB supply can be enabled depending on S1 switch position as shown in Fig. 3.

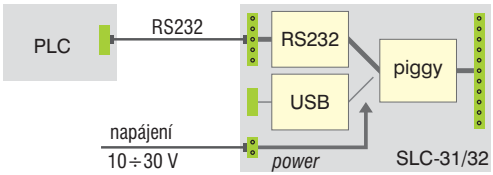
pin	Interface signal				
	RS232	RS422	RS485	20 mA	M-Bus
1	DCD[1)]	–DCD[2)]	PE	I_{20UT}	—
2	+5 V	+5 V	+5 V	I_{10UT}	—
3	SG	+DCD[2)]	—	$+U_{IN2}$	U_{CC2}
4	SG	SG	SG	$+U_{IN1}$	U_{CC2}
5	—	–DTR[2)]	—	$+U_N$	U_{CC2}
6	—	+DTR[2)]	Term.	$–U_N$	–MBus
7	RTS	–CTS	360R–	RxD+	–MBus
8	—	+CTS	360R+	—	U_{CC3}
9	CTS	–RxD	–RxTxD	RxD–	–MBus
10	—	+RxD	+RxTxD	TxD–	+MBus
11	RxD	–RTS	—	—	+MBus
12	DTR[1)]	+RTS	—	TxD+	—
13	TxD	–TxD	–RxTxD	—	–MBus
14	—	+TxD	+RxTxD	—	+MBus

[1)] for EI6011/6012.50 type only
[2)] for EI6011/6012.20 type only

Tab. 2. Interface signal XC4 and connector clamp names



USB to PC wiring and supply (via USB - S1 in ON position).



USB to PLC converter wiring and supply (external power needed = S1 in any position)

Fig. 3. SLC-31/32 system configurations

Configure switch settings

There are six configure switches S1÷S6 between RS232 and USB connectors.

S1 switch blocks supply from USB when it is switched "ON". USB supply is enabled when there is no external supply provided and S1 is switched "OFF". Next table shows possible supplies for selected PC (master) interface.

S1	master interface	Supply
ON	any	external via XC3
OFF	USB	USB or external via XC3
	RS232	external via XC3

S2÷S4 switches set MFF1 transmit detect extending times. Fig. 4 shows these times for different S2÷S4 settings.

The exchangeable RT resistor sets first extending time TMFF1 (default 300us) following the equation:

$$R_T\ [k\Omega] \sim 35 \times \tau_{MKO1}\ [ms]$$

Values between 57us÷28ms can be obtained with RT = 2 kΩ ÷ 1 MΩ. Transmit detection (for RS422/485) is required when there is no external transceiver driving by RTS provided. There are two possible methods for t_{MKO1} evaluation.

Fig. 5a) shows first method when t_{MKO1} is longer than one byte period. The transmitter is active all the time while byte transmission. Both

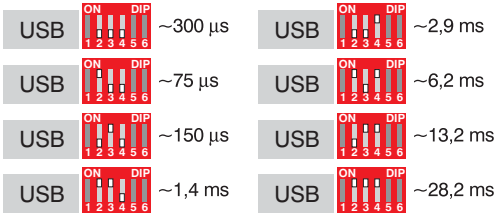
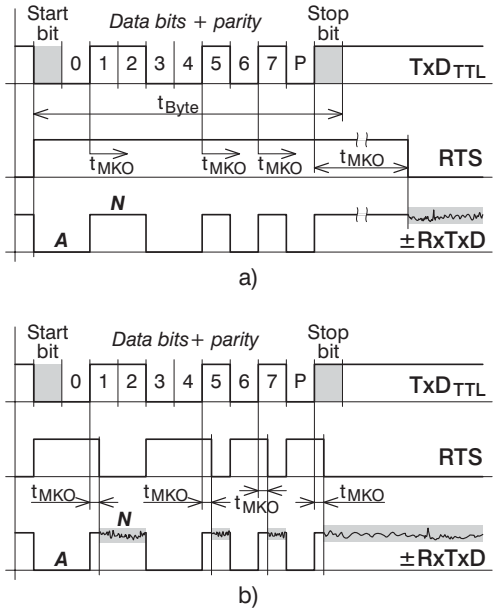


Fig. 4. MKO1 time constant according to S2, S3, S4 settings

bus levels driven by transmitter. A t_{MKO1} must pass since the last active to passive level change before leaving transmission to reception. As a disadvantage t_{MKO1} depends on baud rate.

Fig. 5b) shows second method when t_{MKO1} is considerably shorter. RD÷RF pull up resistors MUST drive a passive bus level. The transmitter drives an active level and its transition to passive one. t_{MKO1} can be set even shorter than one bit period. As an advantage, t_{MKO1} no more depends on baud rate and almost immediate reception is possible.

S5 switch selects DCD signal function.



nonactive state is defined by RD and RF resistors

A *. . . active state* ***N*** *. . . nonactive state*

Fig. 5. RTS driven by MKO1

When switched off an external DCD is connected. When switched on an MKO2 is connected instead of DCD. This MKO2 reception error detect output is derived from RXD. A t_{MKO2} = 80 ms permanent active level period must pass before an error is detected. This can occur, if there is a 20 mA current loop interrupted.

S6 switch selects piggyback's RTS input source. When switched off, an external RTS from RS232 or USB is connected. When switched on, an MFF1 transmit detect output is connected for RS232 operation. For USB operation a TXDEN signal derived from USB packet is used.

RS232/USB ↔ RS232 – EI6011/6012.50 and .90

P232GPS or P232GPE piggyback module inserted into converter utilizes RS232 interface. GPS version converts two inputs (RXD, CTS) and two outputs (TXD, RTS). GPE version converts three inputs (RXD, CTS, DCD) and three outputs (TXD, RTS, DTR). DTR and DCD are available when USB operation only. Different signal count for link, radio, GSM modems (with hardware transmit control) can be converted. No configuration jumpers are contained on RS232 piggybacks. Fig. 6 and Fig. 7 show RS232 converter wiring.

Recommended cables for RS232 and interconnection

RS232 is a voltage interface realizable for short distances to 15 m. Any cable (SYKFY, RO, SRO etc.) is applicable. A shielded cable is recommended for noisy environment. Twisted pair cable should be wired in signal/ground pairs, thus replace shielding.

RS232 receivers have high input impedance. They can produce an error noise when not driven. We recommend connecting unused inputs to defined (unused) outputs or to +5 V through 1 kΩ resistor. XC4 connector is applicable.

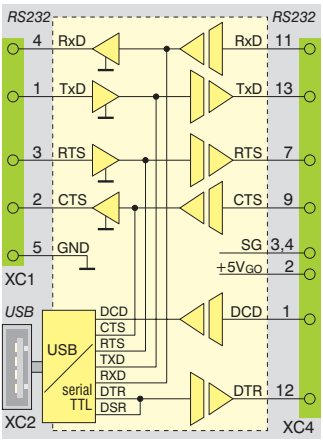


Fig. 6. Converter with P232GPE module (EI6011/6012.50)

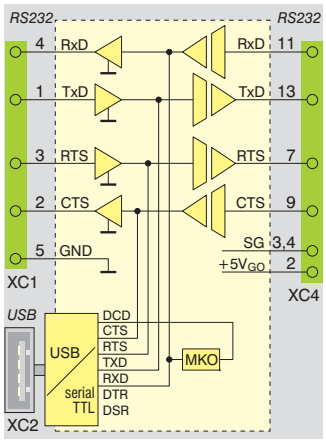


Fig. 7. Converter with P232GPS module (EI6011/6012.90)

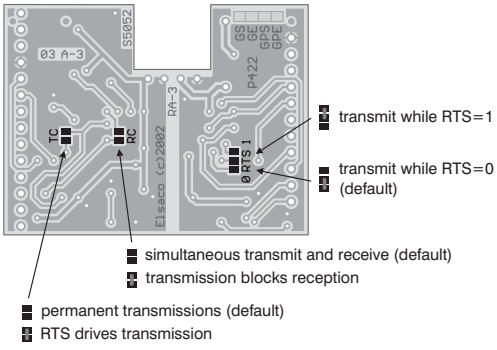


Fig. 8. P422GPS/GPE module jumpers

P422GPS or P422GPE piggyback module inserted into converter utilizes an RS422 interface. GPS version converts two inputs (RXD, CTS) and two outputs (TXD, RTS). GPE version converts three inputs (RXD, CTS, DCD) and three outputs (TXD, RTS, DTR). DTR and DCD are available when USB operation only.

Two converters can establish full duplex connection. This is applicable for RS232 or USB extension. There are enough signals for synchronous communication. Fig. 8 shows P422GPE or P422GPS jumper settings.

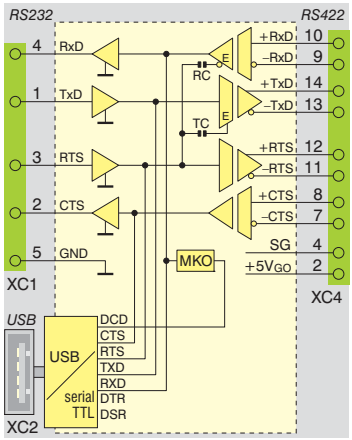


Fig. 9. Converter with P422GPS module for duplex operation (EI6011/EI6012.30)

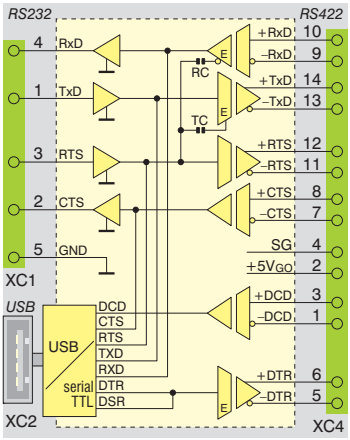


Fig. 10. Converter with P422GPE module for duplex operation (EI6011/EI6012.20)

TC jumper selects transmit control. It is open as default. Then a transmitter is always connected – duplex mode selected. When TC closed, RTS signal drives transmission with optional polarity. Piggyback's RTS source (transmit detection or external RTS) is selected on a main board (switch S6 – Fig. 2). Transmit control enables two-wire (RS485) or four-wire multipoint connection. RC jumper can disable reception while transmission.

Duplex operation

S6 main board switch is off, TC and RC jumpers open (permanent transmission, RTS free). Fig. 9 and Fig. 10 shows RS422 converter wiring. Fig. 13 shows an example of duplex operation.

Half duplex operation

TC jumper on P422GPS/GPE piggyback, when closed, set transmitter control. Afterwards RTS piggyback input drives transmitter active state. Converter is applicable as a slave in a four-wire multipoint networks (see fig.11 – RS422). With external receiver and transmitter wiring (see fig. 12) it is applicable in two-wire networks. In addition to GPS version, DTR and DCD signals are converted with GPE version and USB operation.

External RTS signal as transmit control

S6 main board switch is off. RTS (from RS232 or USB) drives transmitter active state.

Transmit (TxD) detection as transmitter control

S6 main board switch is on. Transmit detect monostable flip-flop MKO1 drives transmitter active state. MKO1 drives from transmission to reception after its extending time t_{MKO1} pass. t_{MKO1} is always restarted after TXD active to passive transition.

The extending time t_{MKO1} has to be derived from baud rate and response time. Response time is a period after transmission ends until reception from replying device starts. The default t_{MKO1} is 6,2 ms. This is applicable for 2400 Bd and faster baud rates and responses longer than 10 ms. The slower the baud rate the longer t_{MKO1}. If t_{MKO1} is too short, transmission of

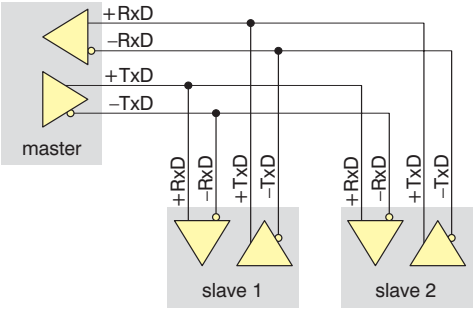


Fig. 11. Multi-point RS422 network.

log. "1" bit series can be cut. If T_{MKO1} is too long, fast reply in two-wired networks (RS485) can be blocked.

t_{MKO1} evaluation example:
baud rate is 19200 Bd; format: 1 start bit + 8 data bits + 1 parity bit + 1 stop bit.
TMFF1 > 11 bits / 19200 Bd = 0.573 ms
TMFF1 is selected by S2-S4 switches (see fig. 4) or exchangeable RT (see fig. 2).

Line termination and pull-up

Both line ends should be terminated and pulled up. See fig. 14. Pull-up resistors (RA, RC, RD, RF = 360 Ω) set passive line state. Termination resistors (RB, RE = 150 Ω) matches line impedance.

Passive state never occurs while duplex operation, all lines are always driven. While half-duplex operation, there are more transmitters on one line. They are active while transmission only. Passive line state during pauses should

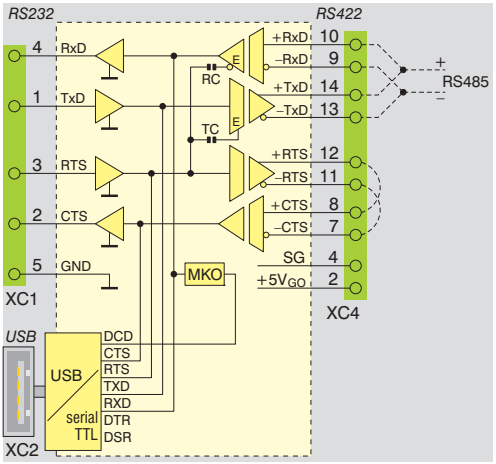


Fig. 12. Converter with P422GPS module for half-duplex operation (RS485 replacement)

be set by pull-up resistors. They prevent error noise reception.

Impedance matching is important on high baud rates (>100 kBd) to prevent reflection from line ends. Unused CTS should be wired to RTS. RD, RE, RF pulls up and terminates RXD signal. RA, RB, RC pull up and terminate CTS signals. These resistors are supplied in an extra pack. They are to be mounted into socket's holes on a main board (see fig. 2).

Recommended cables for RS422

Any twisted pair cable (SYKFY, SRO, DATAX, YCY and etc.) is applicable for short distances (tens of meters) and slow baud rates (19200Bd max.). UTP cables or special cables (BELDEN, UTP/FTP, LAM TWIN, FLEXO and etc.) are suitable for higher baud rates and longer dis-

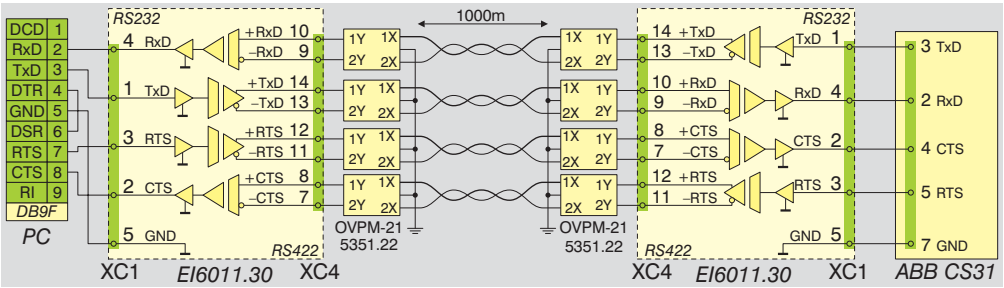


Fig. 13. Example. Remote PLC connected to PC with the use of two RS422 (EI6011.30) converters. RS422 line utilizes OVPM-21/6/24/4 protections

tances. Shielded cables are more electromagnetic noise resistant. Data transfer through non twisted multicore cables can't be guaranteed, especially at noisy environment.

RS422 device interconnection

Related pair signals must be cross connected (±RXD - ±TXD). Floating signal grounds (SG) voltage levels on both ends should be matched. Pull-up resistors can provide voltage matching, but a direct SG wiring is better. Cable shielding for SG wiring is applicable too. Multilevel protection is important for outdoor networks. It protects against atmospheric flash over voltage. Suitable Elsaco OVPM-21/6/24 protections are supplied (more pair option possible).

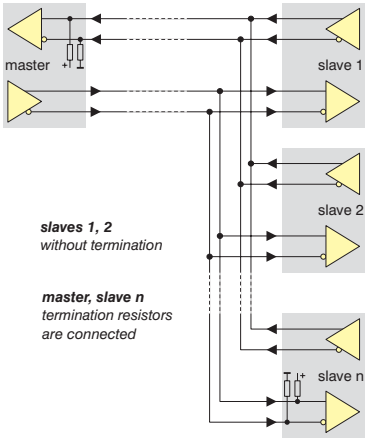


Fig. 14. Multi-point RS422 network termination.

RS232 ↔ RS485 Converter – EI6011/6012.40

P485GPE piggyback module inserted into converter utilizes RS485 interface. Fig. 17 shows P485GPE jumpers. Devices that control its transmission need an open RCD jumper. This is not typical and can be even troublesome for devices, that don't want to listen own transmission.

External RTS signal as transmit control

S6 main board switch is off. RTS (from RS232 or USB) drives transmitter active state. Active state must be maintained until last message byte. This could be especially verified for a RS232 channel from PC. Not all programs (especially Windows based) drive transmission correctly. Received message after transmission can be corrupted, if RTS doesn't leave active state in time. Correct transmit control is guaranteed when using USB TXDEN signal.

Transmit (TxD) detection as transmitter control

S6 main board switch is on. Autodetect monostable flip-flop MKO1 drives transmitter active state. MKO1 drives from transmission to reception after its extending time T_{MKO1} pass. T_{MKO1} is always restarted after TXD active to passive transition.

The extending time T_{MKO1} has to be derived from baud rate and response time. Response time is a period after transmission ends until reception from replying device starts. The default t_{MKO1} is 6,2ms. This is applicable for 2400Bd and faster baud rates and responses longer than 10ms. The slower the baud rate the longer t_{MKO1} is. If t_{MKO1} is too short, transmission of log. "1" bit series can be cut. If t_{MKO1} is too long, fast reply in two-wired networks (RS485) can be blocked.

t_{MKO1} evaluation example:
baud rate is 19200 Bd; format is 1 start bit + 8 data bits + 1 parity+ 1 stop bit.
t_{MKO1}>11 bits/19200Bd=0.573ms.
t_{MKO1} is selected by S2-S4 switches (see fig. 4) or exchangeable RT (see fig.2).

Line termination and pull-up

Both line ends should be terminated and pulled up. See fig. 18. Pull-up resistors (RD, RF = 360 Ω) set passive line state. Termination resistors (RE = 150 Ω) matches line impedance.

Passive state never occurs while duplex operation, all lines are always driven. While half-duplex operation, there are more transmitters on one line. They are active while transmission only. Passive line state during pauses should be set by pull-up resistors. They prevent error noise reception.

Impedance matching is important on high baud rates (>100 kBd) to prevent reflection

from line ends. RD, RE, RF pull up and terminate RXD signals. These resistors are supplied in an extra pack. They are to be mounted into socket's holes on a main board (see fig. 2).

Recommended cables for RS485

Any twisted pair cable (SYKFY, SRO, DATAX and YCY) is applicable for short distances (tens of meters) and slow baud rates (19200Bd max.). UTP cables or special cables (BELDEN, UTP/FTP, LAM TWIN, FLEXO and etc.) are suitable for higher baud rates and longer distances. Shielded cables are more electromagnetic noise resistant. Data transfer through non twisted two-line (bell) cables can't be guaranteed, especially at noisy environment. Then an experimental verification is required.

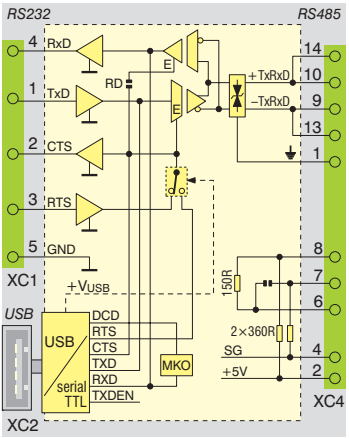


Fig. 15. Converter with P485GPS module, RTS drives transmitter (EI6011/6012.40)

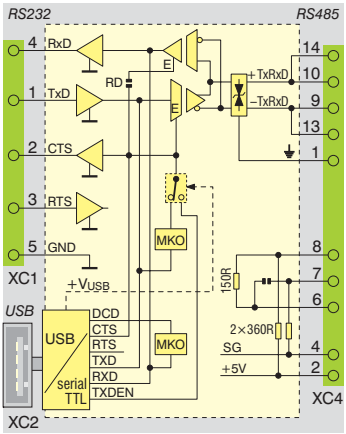


Fig. 16. Converter with P485GPS module, transmit (TxD) detection drives transmitter (EI6011/6012.40)

RS485 equipment interconnection

One signals pair must be connected (±RxTxD-±RxTxD). Floating signal ground (SG) voltage levels on both ends should be matched. Pull-up resistors can provide voltage matching, but a direct SG wiring is better. Cable shielding for SG wiring is applicable too. P485GPE contains transil protection devices to limit differential and ground related voltage potentials. Ground must be connected to protected earth.

Multilevel protection is important for outdoor networks. It protects against atmospheric flash over voltage. Suitable Elsaco OVPM-21/6/24 protections are supplied.

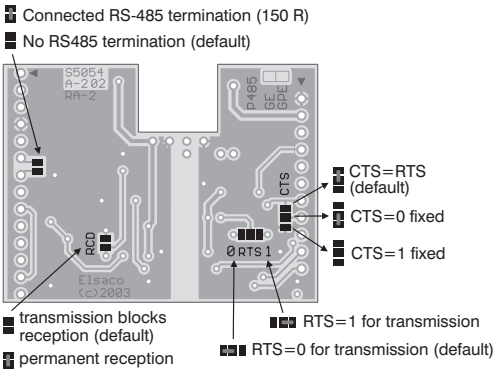


Fig. 17. P485GPE module jumpers.

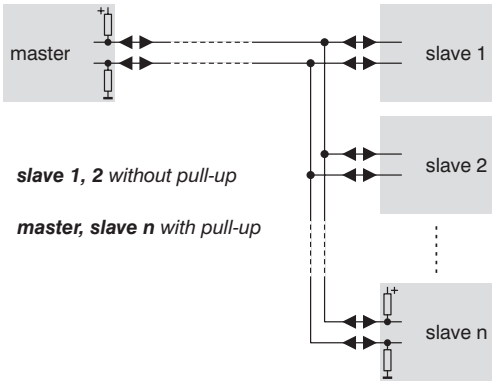


Fig. 18. RS485 pull-up.

PL20GPS piggyback module inserted into converter utilizes 20mA current loop interface. RxD and TxD are converted only. Fig. 19 shows PL20GPS jumpers. CTS jumper can connect RTS to CTS. T/T* and R/R* jumpers can invert transmit or receive signals. Some devices need these special signals (e.g. PLC NS905). As default, CTS is wired to RTS, and transmitter and receiver are wired without inversion.

Monostable flip-flop 2 (MKO2) detects RxD active line state (current flowing to receiver). A continuous RxD active state is considered to be an error when longer than 80ms. Then a DCD is set and DCD/Err lits. A cable interrupt is detected this way.

Two current sources are provided at separate outputs. Thus a lot of optional connections with active or passive transmitter or receiver are applicable.

20mA current loop connection

A current path must be closed by current source, transmitter (switching transistor) and receiver (optocoupler's LED) to common ground signal. SLC-31/32 doesn't care about its order in loop, but an opposite device can require common ground for its grounded transmitter or receiver.

Active or passive status depends on current source position. SLC-31/32 creates an active transmitter respective receiver, if it has its current source wired with its switching transistor respective optocoupler's LED. Then its current source supplies current to its transmitter respective receiver, opposite receiver respective

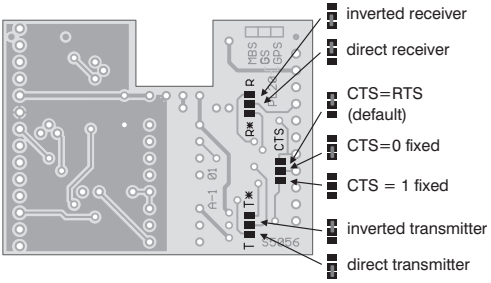


Fig. 19. PL20GPS module jumpers.

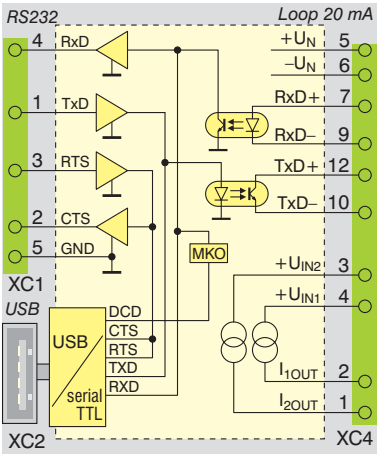


Fig. 20. Converter with PL20GPS module (EI6011/6012.70)

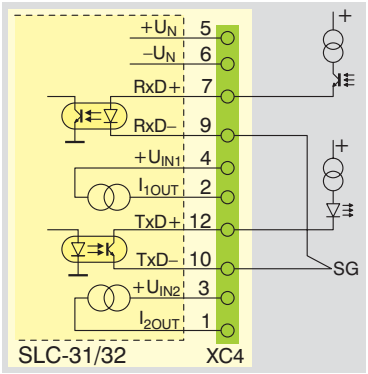


Fig. 21. Passive transmitter and receiver configuration

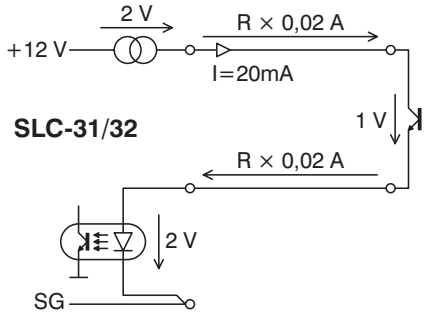


Fig. 23. Loop voltage loss

transmitter and common ground. Fig. 22 shows more active options.

For passive configuration no current sources are used. See fig. 21.

The configure selection depends on opposite device. Quiet current measurement enables unknown device identification. Active transmitter/receiver supplies current to a milliammeter connected, while the passive one doesn't.

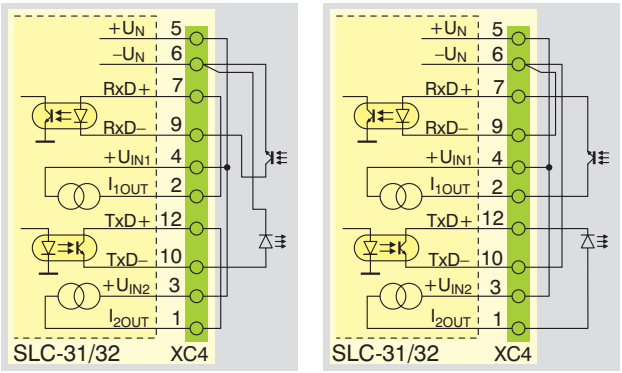


Fig. 22. Different active transmitter and receiver configurations

Recommended cables for 20mA current loop wiring

Current loops are used at slow baud rates. Thus a cable resistance is more important than signal features. Current source is 12V supplied. But 2V are lost in current source, 1V in a switch transistor, 2V in LED. There is a 7V left for cable. Its resistance is limited to 7V/20mA=350Ω, a 175Ω for one wire (SYKFY 2x2x0.5 features 100Ω/km).

There are SYKY, SYKFY, UfaU LAM FLEXO and etc. cables applicable. Twisted cables can be used too. In a very noisy electromagnetic environment a shielding is needed. ELSACO OVPM-21/12/24 or OVPM 21/24/48 protections are suitable for outdoor networks.

RS232 ↔ M-Bus master Converter – EI6011/6012.80

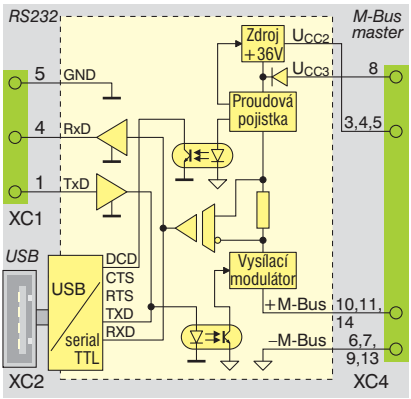


Fig. 25. A converter with PMBMGPS module (EI 6011/6012.80)

PMBMGPS module inserted into a converter utilizes MBus master interface. RxD and TxD signals are converted only. DCD signal detects current overload. Internal 36V step-up converter enables to drive 3 slaves max. This step-up converter can be supplied by built-in DC/DC converter or external supply (U_{cc2}).

More slaves can be driven when using external 36V supply (U_{cc3}). This supply MUST have 50mA current limit. Then max. 20 slaves can be driven and DCD can detect overload during reception.

Max. 0.5V can be lost in a single MBus wire. This limits a bus length. For one slave a 1.5mA has to be considered (total current = module count x 1.5mA).

Current sensing is differential and no configuration is required when adding or removing slaves. An internal supply for step-up converter is wired to clamps 3, 4, 5. Nothing should be connected to.

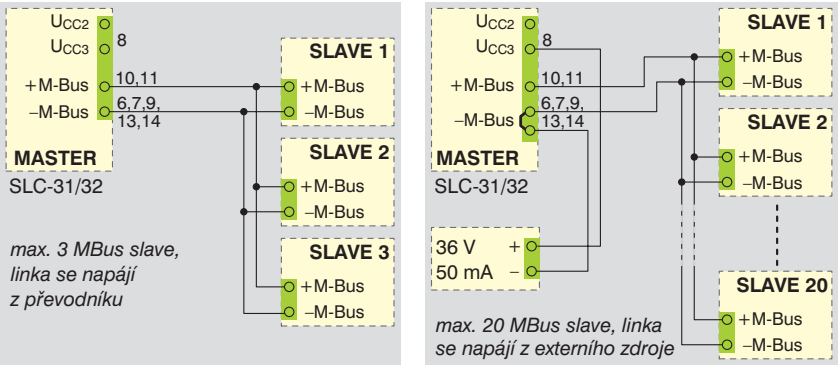


Fig. 24. MBus slaves and external supply wiring

USB driver installation

Computer needs drivers to communicate with SLC-31/32 through USB. These drivers are available in www.elsaco.cz pages in "Download/SW tools/usb.zip" file. Unzip this file (e.g. to C:\FTDI) and switch off the computer. Connect PC and converter with a USB A-A type cable. Switch on the converter and then a computer. Windows OS messages a new hardware found. Enter the directory to search for drivers. According to *.inf file, USB driver is installed as a new COM port (e.g. COM4). Port settings are possible at Settings/System/Device Manager tab – sort by type/Ports (COM and LPT). Remember its name (e.g. COM4).

Producer: ELSACO, Jaselská 177, 28000 Kolín, CZ
tel. +420 321 727753, fax +420 321 727759
e-mail: elsaco@elsaco.cz, www.elsaco.cz

21. 04. 2006