RS232 0-Modem without galvanic coupling

Somtimes a RS232 interface without any galvanic connection is needed to interface electronic systems connected to different supply domains. Opto couples are an appropriate mean to create such link.

The complete RS232 link needs the signals RXD (receive data), TXD (transmit data), DTR (data terminal ready), RTS (request to send), CTS (clear to send), and DSR (data set ready) plus a ground line.

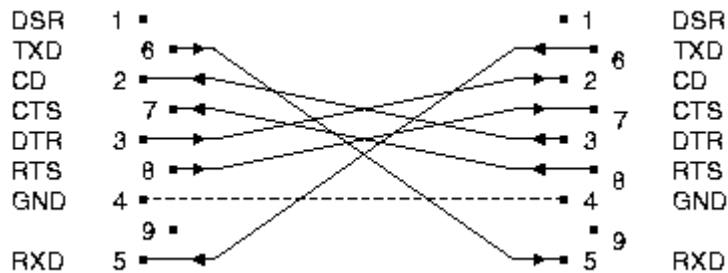The pinout of a 9 pin RS232 0-modem looks like this:

Fig. 1: RS232 0-modem pinout

We have 3 data lines per direction (so the total is 6). Every arrow of figure 1 must be replaced by a optocoupler driver or an optocoupler receiver accordingly. The resulting circuit looks as follows:
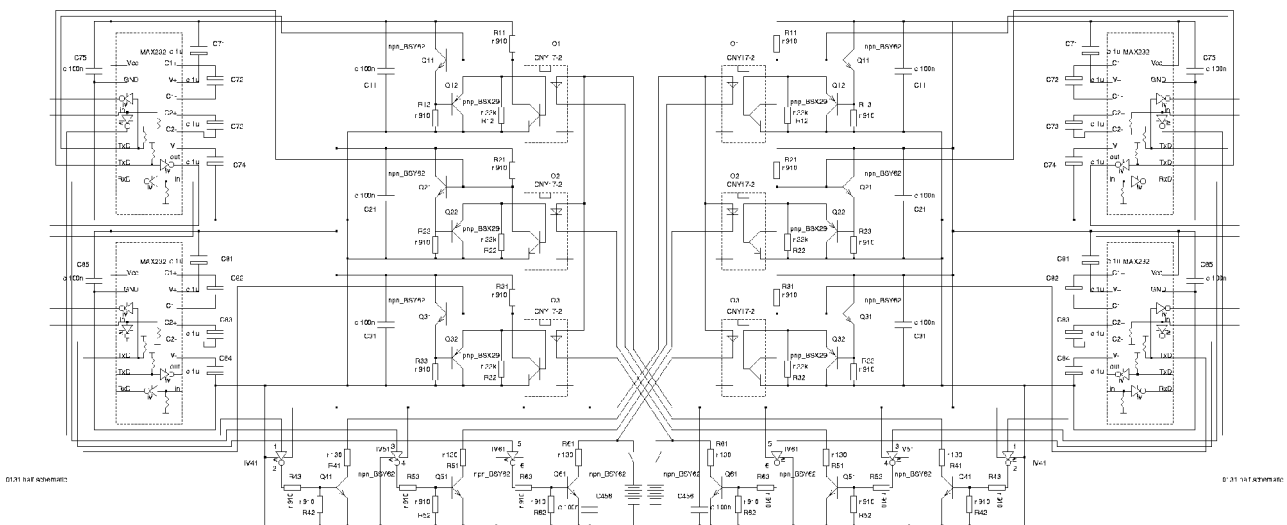

Fig. 2: Complete optical link with 3 data channels per direction.

The circuit consists of two halfs that are each supplied from an individual battery. To make it better readable only one half is considered in the following circuit.
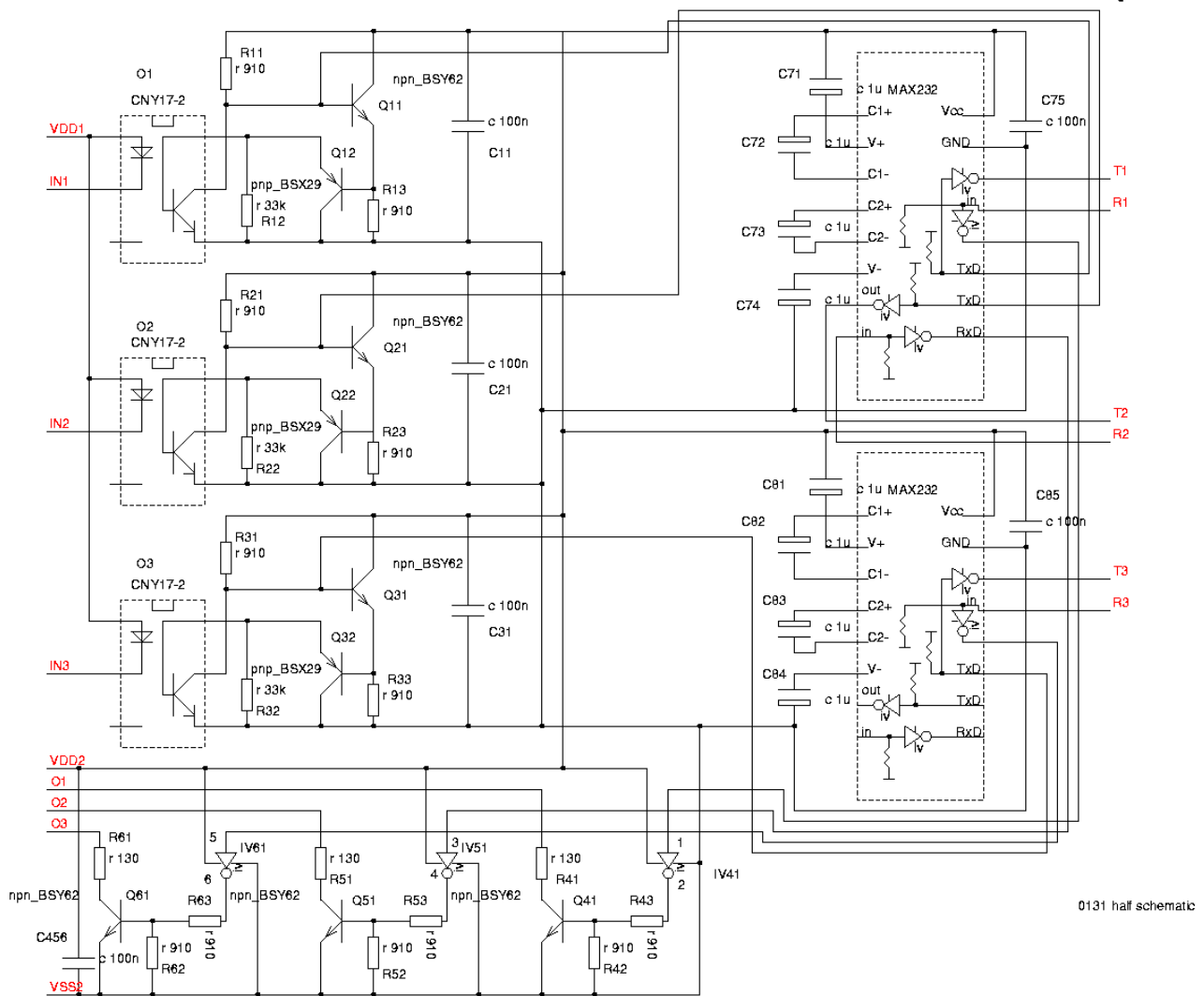
Fig. 3: One half of the 0-modem

The MAX232 circuits act as the electrical interface to the computer or the periphery to be connected.

Data to be sent (TxD, DTR, RTS) is to be connected to signals R1 to R3 (receive pins of the MAX232). The MAX232 drives the transistors Q61, Q51, Q41 via inverters IV61, IV51 and IV41. Q61, Q51 and Q41 operate as saturated switches. Therefore fast switching transistors (BSY62) with a turn off time of about 40ns are chosen. (If this old fashioned device is not available anymore a MOS switching transistor is a good choice too.)

Outputs O1 to O3 drive the optocouplers of the other side.

Data to be received (O1 to O3 of the other half circuit) is connected to inputs IN1 to IN3. Current flow through the optocoupler diod turns on the photo transistor inside the coupler. The photo transistor inside the coupler must be kept in non saturating operation. Therefore Q11, Q21 and Q31 act as level shifts driving Q12, Q22 and Q32. When the optocoupler transistor's operating point approaches $V_{CE}=2*V_{BE}$ transistor Qx2 pulls down the base of he opto coupler transistor to prevent saturation.

The interface circuits (MAX232) read the signals of the opto coupler outputs and drive the inputs of the device connected to the circuit (T1, T2, T3 used for RS232 signals CD, CTS, RXD).