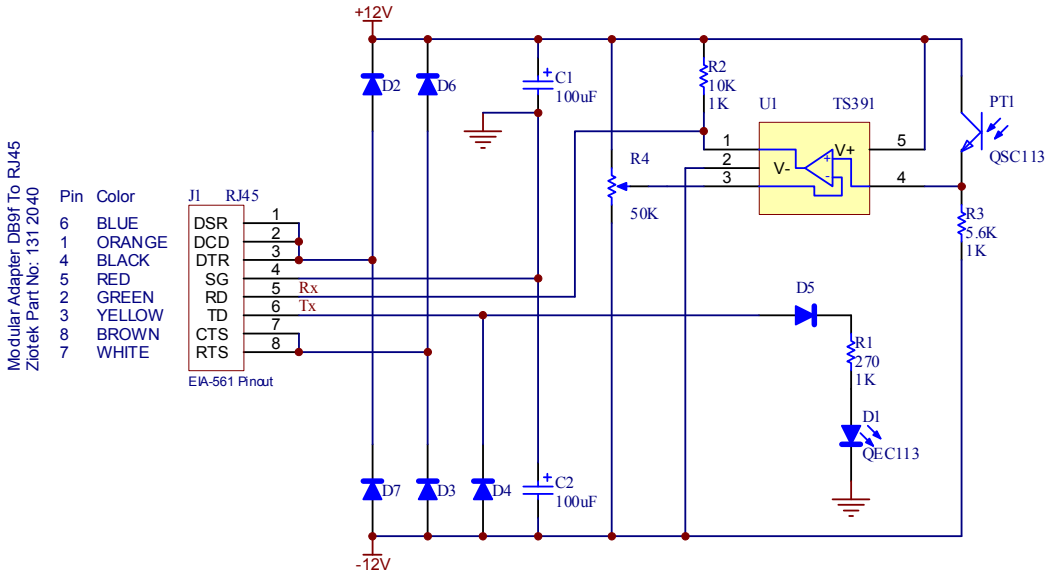
RS232 to ANSI Type 2 Optical Probe

Revision: 2.1

BILL OF MATERIALS

Part	Qty	Description	Footprint	Manufacturer	Part Number	Mouser Part Number
U1	1	SMD Low Power Single Voltage Comparator	SOT-23-5	ST Electronics	TS391ILT	511-TS391IL
PT1	1	IR Photo-Transistor	T-1 3mm (0.1")	Fairchild	QSC113C6R0	512-QSC113C6R0
D1	1	IR Light Emmitting Diode	T-1 3mm (0.1")	Fairchild	QEC113	512-QEC113
D2..7	6	SMD Small Signal Diode, common cathode	SOT-23	Micro Commercial Components	MMBD1504-TP	833-MMBD1504-TP
R1	1	SMD 1/4W 270 Ohm Thick Film Resistor	1206	Vishay	CRCW1206270RJNEA	71-CRCW1206J-270-E3
R2	1	SMD 1/4W 10K Ohm Thick Film Resistor	1206	Vishay	CRCW120610K0FKEA	71-CRCW1206-10K-E3
R3	1	SMD 1/4W 5.6K Ohm Thick Film Resistor	1206	Vishay	CRCW12065K60FKTA	71-CRCW1206-5.6K
R4	1	SMD 50K Ohm Single Turn Trimmer	Custom	BI Technologies	23AR50KLFTR	858-23AR50KLFTR
C1,2	2	SMD 100uF 16V Tantalum Capacitors	7343-31	AVX Technologies	TAJD107M016RNJ	581-TAJD107M016R
J1	1	SMD Modular Jack RA 8/8 RJ45 low profile	Custom	Molex	44144-0003	538-44144-0003



NOTES ON THE CONNECTOR

The circuit is designed to be operated remotely at the end of a long cable. As an 8-conductor cable was required, the cheapest highest quality cable readily available is CAT5 or CAT6 network cable. Therefore, the circuit is designed to have a standard 8-pin RJ45 socket (like a typical Ethernet socket). There is a standard called EIA-561 that defines the pin-out to use for RS232 on RJ45 connectors. This is the pin-out used in this schematic. Typically the PC will have a 9-pin D-Type connector. Therefore you will need a 9-pin D-Type Female “Modular to Sub-D” adapter kit to make the connection to the PC. The required connections to the 9-pin D-Type connector are shown above. The color code is for the Ziotek adapter kit used in the prototype and will likely be different for other adapters.

NOTES ON OPERATION

This circuit converts RS232 signals from electrical to IR optical pulses. It is designed specifically to connect to the ANSI 12.18 optical port found on many American electrical utility meters. However, it is a completely generic circuit and can be used for almost any RS232 over IR application.

The data polarity is as follows:
LED on, start bit, space, logical 0
LED off, stop bit, mark, logical 1, quiescent state

The circuit is powered from the PC serial port outputs; DTR, RTS & TD. DTR and RTS are handshake signals, typically they are both at +12V, but this can vary depending on how the software configures the PC serial port. When DTR or RTS are at +12V they charge C1 through D2 and D6 respectively. When they are at -12V they charge C2 through D7 and D3 respectively. The TD line is mostly at -12V, so it is used to also charge C2 through D4. This guarantees a negative supply, because in many applications DTR and RTS won’t go negative. The actual voltage generated on the supplies will depend on the levels to which the particular PC or USB dongle drives the signal lines.

Connecting the signals DSR (Data Set Ready) and DCD (Data Carrier Detect) to the DTR (Data Terminal Ready) and the CTS (Clear To Send) to the RTS (Ready To Send) takes care of any hand shaking the PC software may want to do.

Diode D5 protects the LED (D1) when TD is lower than -5V, because its maximum permitted reverse voltage is only 5V. R1 limits the current through D1 when TD is high.

The non-inverting input (pin-4) to the comparator U1 is pulled to the negative supply by R3 when the photo-transistor PT1 is off. When PT1 detects infra red light and switches on, it pulls the input to the positive supply. The potentiometer R4 is used to set the threshold at which the comparator switches. Typically it will be adjusted so that the inverting input (pin-3) is around 0V. Use an oscilloscope to set this voltage at the midpoint of whatever swing is observed at pin-4 when PT1 detects IR. Resistor R2 is just a pull-up resistor for the open-collector output of the comparator.