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Operating Instructions – Evaluation Board for dBC Operation with RS232 or SPI Interface

Module type	Interface	Vb / Vout (max)
dBC-120-3R	RS232[1]	[3.1 ...12.5] V / 120 V
dBC-220-3R	RS232[1]	[3.1 ...12.5] V / 220 V
dBC-380-5R	RS232[1]	[4.8 ...12.5]V / 380 V
dBC-120-3S	SPI[2]	[3.1 ...12.5] V / 120 V
dBC-220-3S	SPI[2]	[3.1 ...12.5] V / 220 V
dBC-380-5S	SPI[2]	[4.8 ...12.5] V / 380 V

1: 9k6, 8-bit, no parity, 1 stop-bit, no flow control
2: SPI-slave, 4-wire serial bus operation

Functions: RS232 version:

Analog mode: Setting of Vout and TK using potentiometers.
Remote mode: Setting of Vout and TK via the RS232 interface.

The evaluation board (EVA board) allows the dBC module to be connected to a computer via the RS232 interface and controlled as described in the table of functions.

Functions: SPI version:

Analog mode: Setting of Vout and TK using potentiometers.
Remote mode: Setting of Vout and TK via the SPI interface.

The evaluation board allows the dBC module to be connected to a computer via the SPI interface.

The EVA board is equipped with an RS232 <- > SPI converter, so that the SPI version of the dBC can communicate with a computer.

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EVA-Board

Pot: Vout	HV setting at 25°C	
Pot: TK	Temperature compensation setting TK = [0……3] V	
Vin	EVA-board operating voltage Vin = [6..12] V	Reverse voltage protected Regulated +5 V operating voltage for the HV supply Regulated +3.3 V supply for the Vout and TK pots
R112	0 Ohm	Connects the temperature sensor to the ADC of the HV module
Temperature sensor	Silicon diode	Type BAV 102
RS232	Terminal interface	RS232 driver for connection to a computer is included on the EVA board
uC interface (C2 mode)	Programming interface for the dBC and EVA board	Firmware upload and debugging

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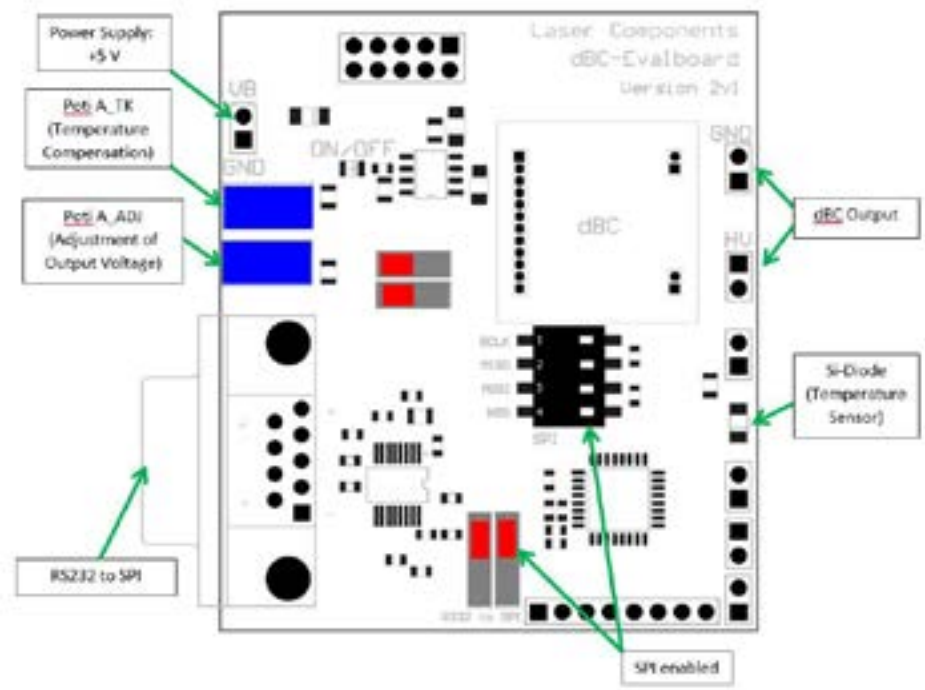
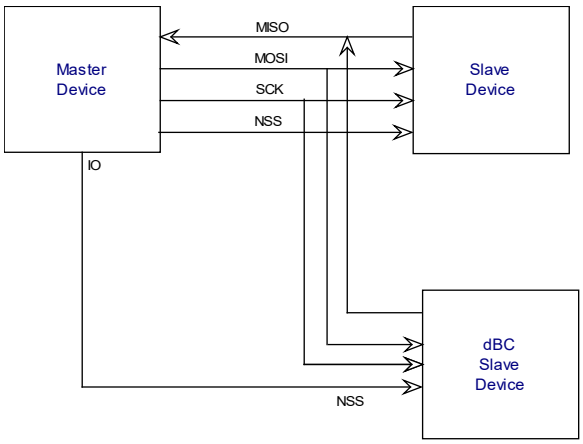
SPI-Version

EVA-board: RS232 to SPI



4-wire master and slave



Pin configuration for Master Device:

MISO (Master In, Slave Out)	Open Drain (Master Input)
MOSI (Master Out, Slave In)	Push Pull
SCK (Clock)	Push Pull
NSS	Push Pull

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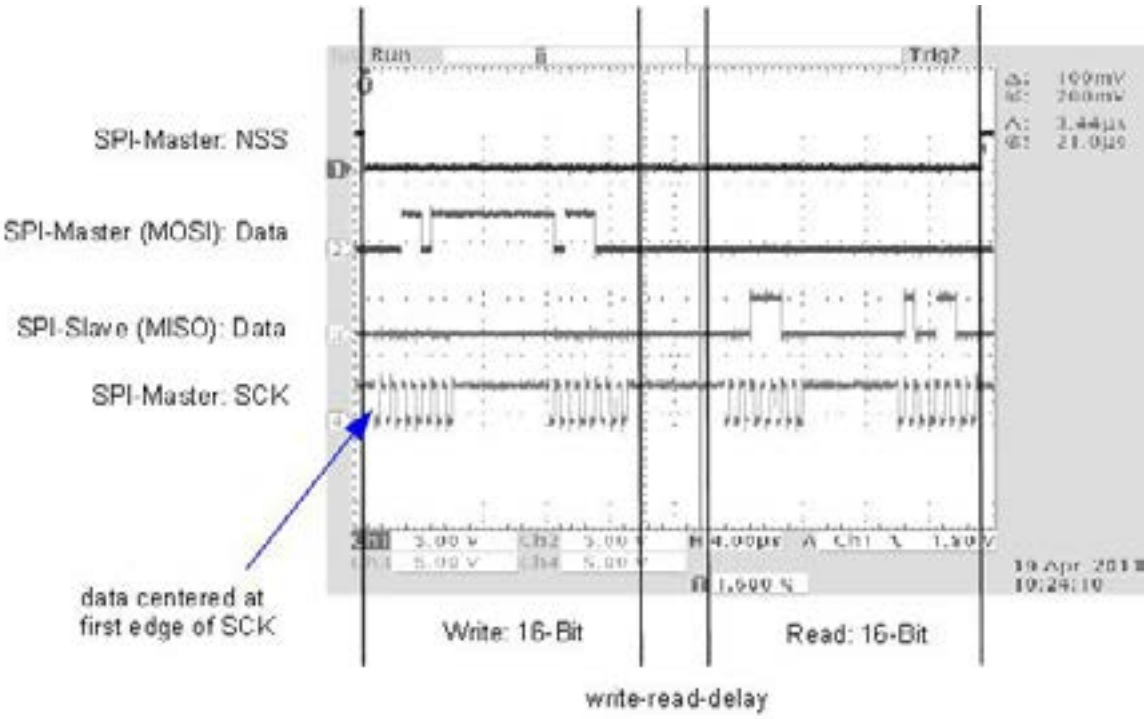
SPI Timing: Write Read



It is necessary to always write and read 16 bits.

The dBC module analyses 4 signals from the master.
Data are read from the first two 8-bit blocks, then the dBC answers with 16-bit data.

Write: SPI_Cmnd 4-Bit SPI-Data 12-Bit
Read: Highbyte und Lowbyte

A minimum delay of 3.3 µs is required between the write and read phases, to allow the write data to be evaluated by the µC.

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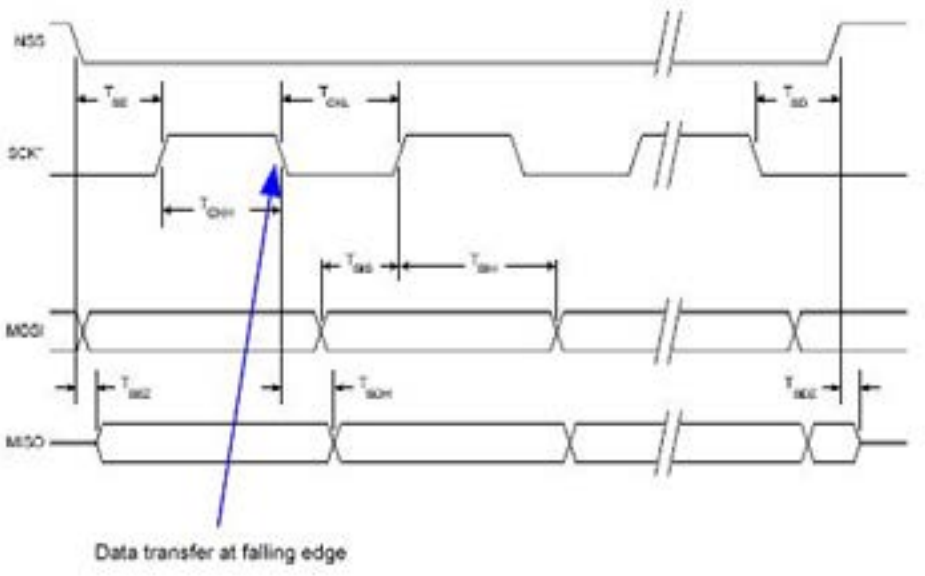
Timing Diagram:



Write-read-delay	> 3.3 µs
TCKH / TCKL	> 80 ns
TSE / TSD	> 380 ns

*max. SCK 7

Write-read-delay:

A minimum delay of 3.3 µs is required between the write and read phases, to allow the write data to be evaluated by the µC.

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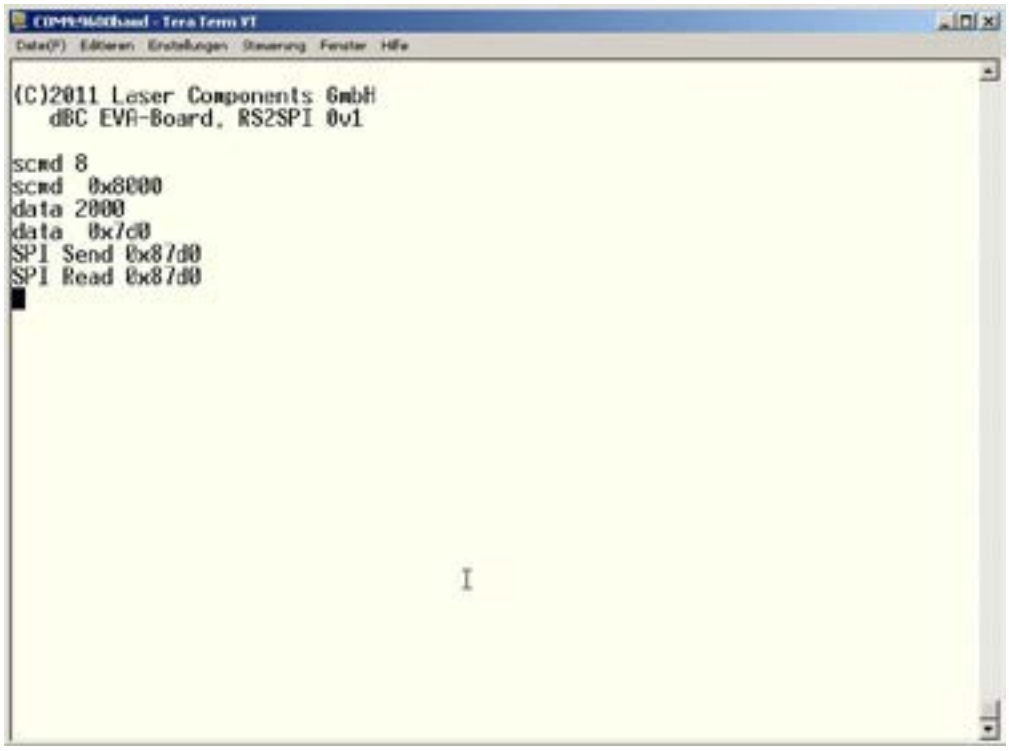
EVA Board commands: SPI

Terminal command	Parameter	Function
spio		Transfers SPI data
scmd Y (see table of functions)	Y = [0..127] (4-Bit)	SPI commando
data Z	Z = [0..4095] (12-Bit)	SPI data
Port X	X = [0..255] (8-Bit)	Set port pins
sckl X	X = [0..223] (8-Bit)	Set SPI CLK Ca. 200 kHz ...1.5 MHz

Example: set HV (see table of functions)

16 bit write: scmd -> 4 bit / data -> 12 bit data
16 bit read: answer from dBC



The following commands are must be entered to switch to remote mode:

scmd 11 [Return or Enter]
spio [Return or Enter]

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Table of Functions:

Function	SPI – command (2x 8 bit)	Response	Description
U_{out} @25°C **scmd 8**	High byte = 1000 yyyy Low byte = yyyy yyyy	High byte = 1000 yyyy Low byte = yyyy yyyy	Output voltage at 25 °C and TK = 0 mV (e.g. APD data sheet Vop value)
TK Wert **scmd 4**	High byte = 0100 yyyy Low byte = yyyy yyyy	High byte = 0100 yyyy Low byte = yyyy yyyy	TK value [mV] (V_{out} @25 °C + Temp * TK)
TEMP ? **scmd 2**	High byte = 0010 yyyy Low byte = yyyy yyyy	High byte = 0010 yyyy Low byte = yyyy yyyy	Temp. Sensor readout (12 bit ADC value)
HV ? **scmd 1**	High byte = 0001 yyyy Low byte = yyyy yyyy	High byte = 0001 yyyy Low byte = yyyy yyyy	HV readout (12 bit ADC-value)
Modul ON/OFF **scmd 9 / 10**	High byte = 1001 yyyy Low byte = yyyy yyyy High byte = 1010 yyyy Low byte = yyyy yyyy	High byte = 1001 0000 (0x90) Low byte = 1001 0000 (0x90) High byte = 1100 0000 (0xA0) Low byte = 1100 0000 (0xA0)	Switch V_{out} on or off
Remote-Mode ON/OFF **scmd 11 / 12**	High byte = 1011 yyyy Low byte = yyyy yyyy High byte = 1100 yyyy Low byte = yyyy yyyy	High byte = 1011 0000 (0xB0) Low byte = 1011 0000 (0xB0) High byte = 1100 0000 (0xC0) Low byte = 1100 0000 (0xC0)	Switch between analog mode and remote mode
ERROR		High byte = 1111 0000 (0xF0) Low byte = 1111 0000 (0xF0)	BUS collision or buffer overrun

Evaluation of Returned Values

Function	Range	Evaluation
TEMP ? / scmd 2 (all dBC versions)	x = [0…0xffff] x = [0 ….4095]	Vtemp = x * 0.537 mV / digit Vtemp = [0…..2.2] V
HV ? / scmd 1 dBC-380…..	x = [0…0xffff] or x = [0 ….4095]	HV = x * 110 mV / digit*
HV ? / scmd 1 dBC-220….	x = [0…0xffff] or x = [0 ….4095]	HV = x * 60 mV / digit*
HV ? / scmd 1 dBC-120….	x = [0…0xffff] or x = [0 ….4095]	HV = x * 30 mV / digit*

*resolution ±5%

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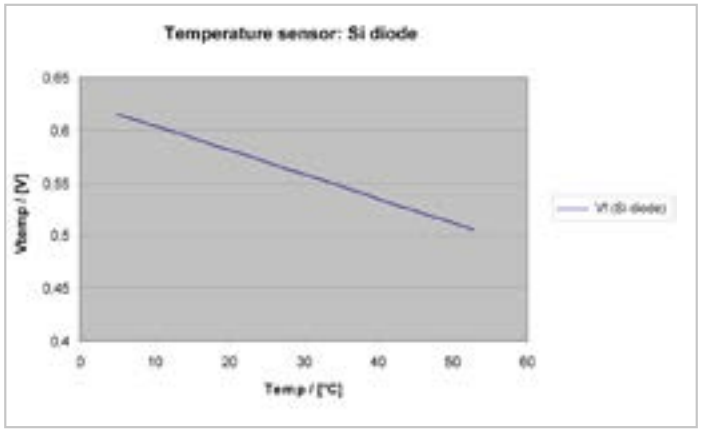
Temperature Measurement (Iref/Vtemp): TEMP ?

Example: BAV102

I_{ref} : Constant current source (default 1mA)
V_{temp} : Si diode or temperature sensor

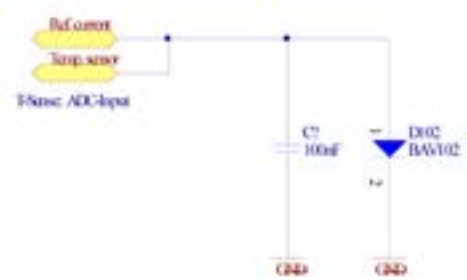


Deviations from the absolute value may occur depending on the temperature sensor used. With an uncalibrated Si diode, a resolution of approx ± 1°C can be achieved. A calibrated diode in the range 1.8 mV/K – 2.1 mV/K will allow a resolution of approx. 0.25°C.

Reference current: constant current source ca. 1 mA
Maximum voltage at the sensor: ca. 2.2 V

Resolution 12 bit (0.537 mV/digit)

Die sensor voltage may be read out using the TEMP? command.



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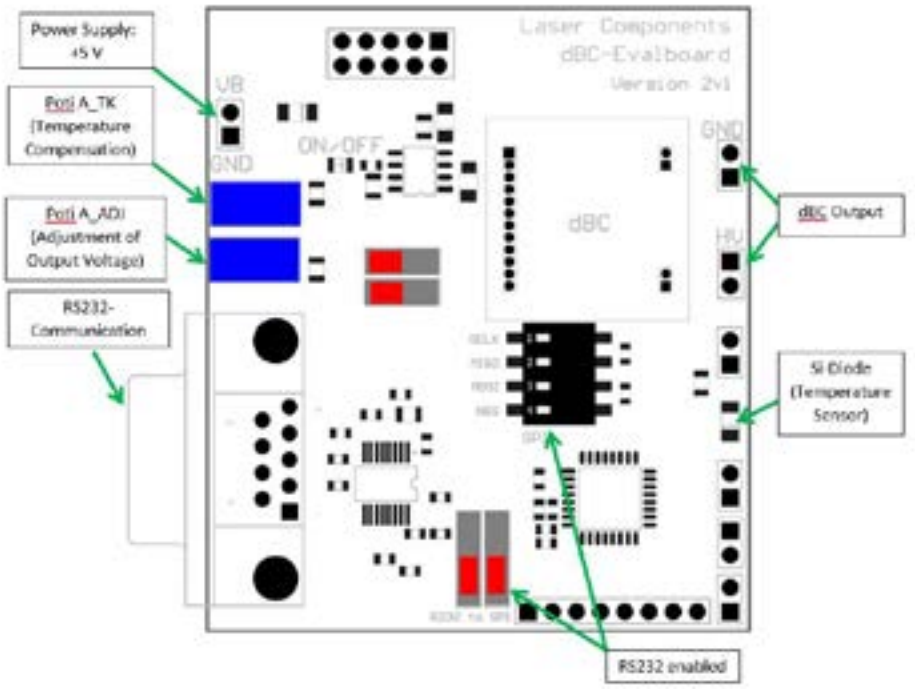
RS232 Version



dBC commands: RS232 version

Function	RS232 Command	Description
V_{out} @ 25 °C	u_xxxx	Output voltage at 25 °C and TK = 0 mV (e.g. APD data sheet V_{op} value)
TK value	t_xxxx	Temperature compensation value [mV] (V_{out} @ 25 °C + Temp * TK)
TEMP ?	t_?	Temperature sensor readout (12 bit ADC value)
HV ?	v_?	HV readout (12 bit ADC value)
Module ON/OFF	m_1 m_0	Switch output voltage on/off
Remote mode ON/OFF	r_1 r_0	Switch between analog and remote mode
Data out ON OFF	d_1 „ESC"	Continuous readout:TK [mV] HV [0.1 * V] Temperature [0.1 * °C]
Help	h ?	

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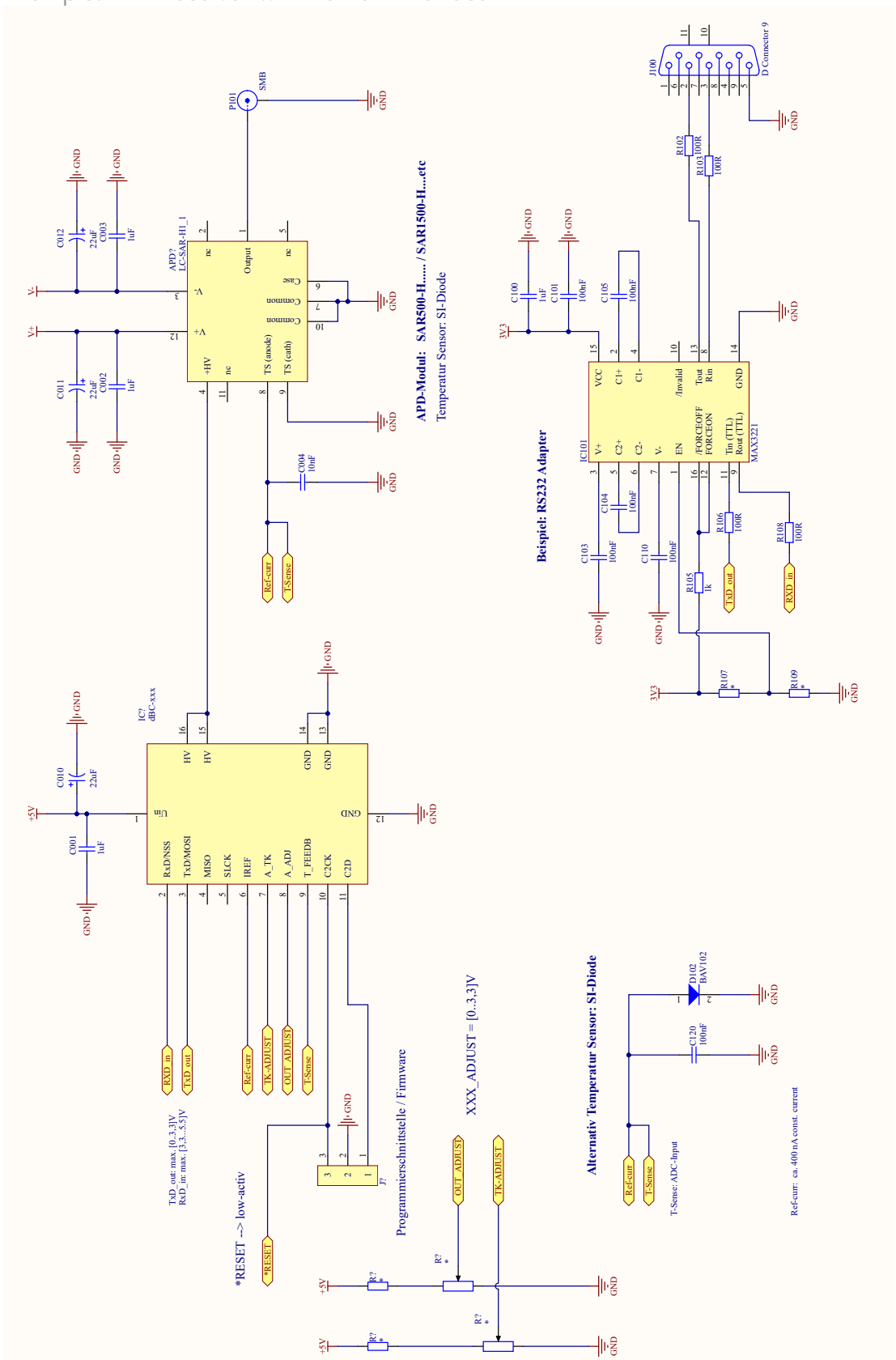
Example: APD receiver with RS-232 interface



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