CCD-bus Transceiver Development Board

V1.03
Part number: BC-002103
Last update: 2020.08.05

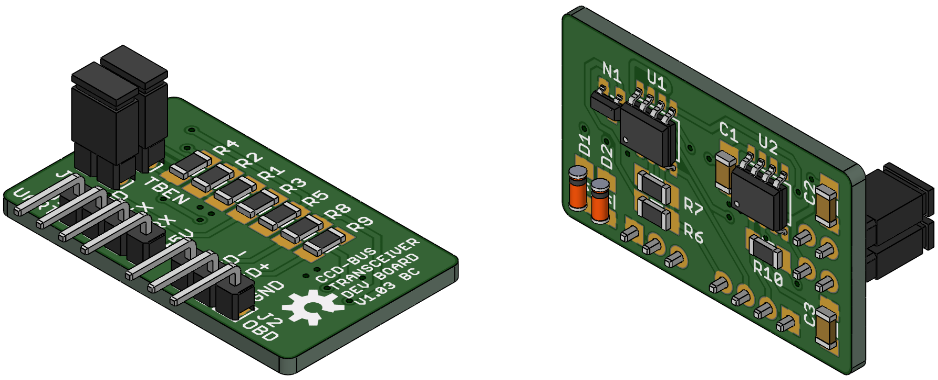


Figure 1. CAD drawing of the development board.

1. Features

- CCD-bus transmitter and receiver for passenger vehicle diagnostics
- Jumper selectable bus-termination and bus-bias

2. Applications

- Chrysler/Dodge/Jeep CCD-bus diagnostics
- Standalone CCD-bus testing

3. Description

This development board is designed to copy the functionality of CDP68HC68S1 transceiver chips commonly used in CCD-modules and diagnostic tools. It converts regular single ended UART signal to a differential signal and vice versa. A 5V logic microcontroller with at least 2 UART-channels is required as the host.

4. Specifications

Device type:	differential bus transceiver
Rated communication speed:	7812.5 baud
UART RX/TX logic voltage:	5V
Input voltage:	V_{IN} = +5VDC
Bus termination:	R_L = 120Ω
Common mode output voltage:	V_{OC} = 2.5V
Differential output voltage:	V_{OD} = 0.72V @ R_L = 120Ω
	V_{OD} = 0.26V @ R_L = 40Ω
Output current:	I_O = 5.95mA @ R_L = 120Ω
	I_O = 6.58mA @ R_L = 40Ω
Recessive (1-bit) BUS+ voltage:	V_{R+} = 2.488V
Recessive (1-bit) BUS- voltage:	V_{R-} = 2.512V
Dominant (0-bit) BUS+ voltage:	V_{D+} = 2.86V @ R_L = 120Ω
Dominant (0-bit) BUS+ voltage:	V_{D+} = 2.63V @ R_L = 40Ω
Dominant (0-bit) BUS- voltage:	V_{D-} = 2.14V @ R_L = 120Ω
Dominant (0-bit) BUS- voltage:	V_{D-} = 2.37V @ R_L = 40Ω
Operation temperature:	-40-85°C | -40-185°F
Size (L×W×H):	33×25×12.4 mm | 1.3×1.0×0.5 inch
Weight:	4 g | 0.14 oz

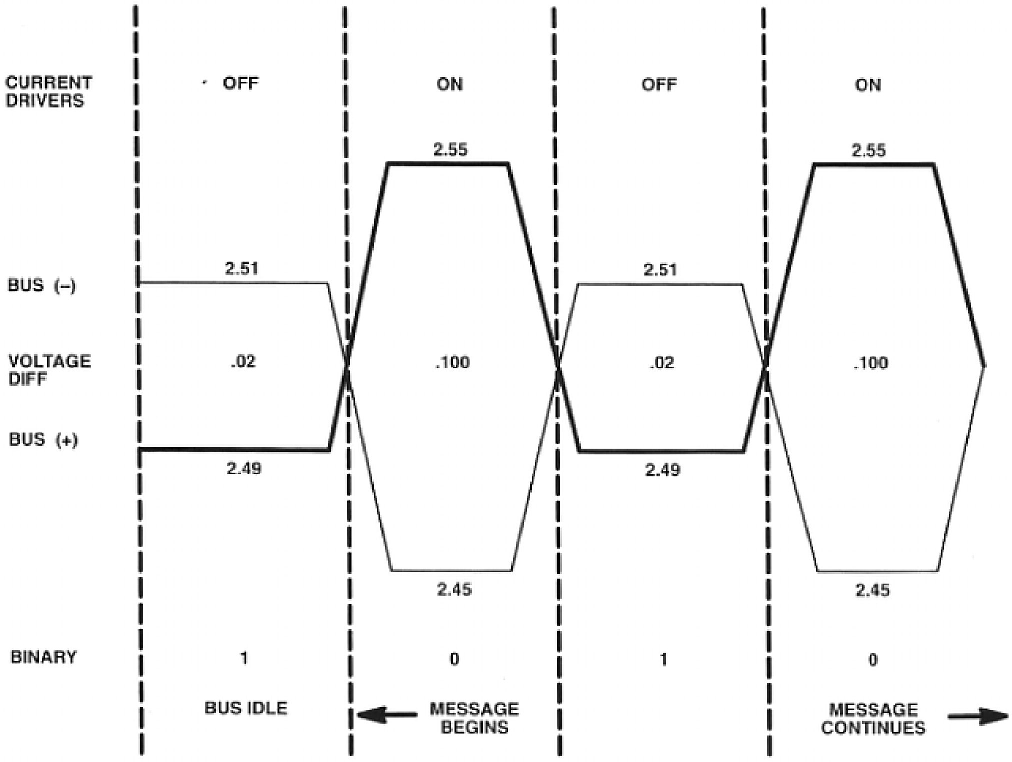


Figure 2. Recessive (1) and dominant (0) voltage levels of the bus-pins.

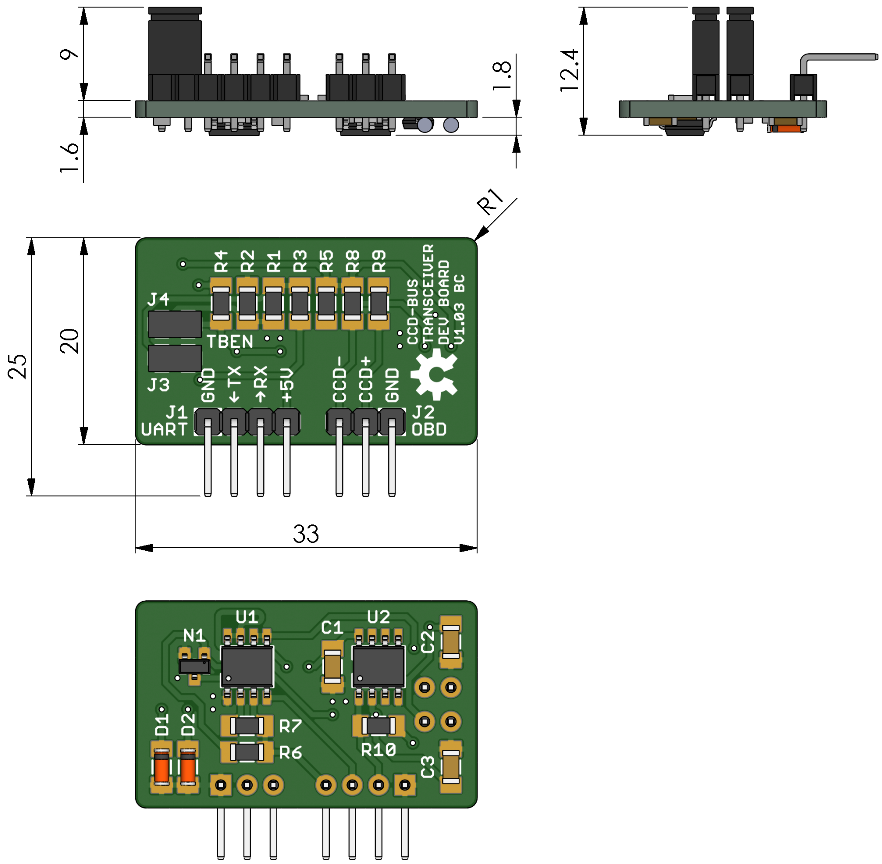


Figure 3. Dimensions of the board (mm).

5. Operation

5.1 Wiring

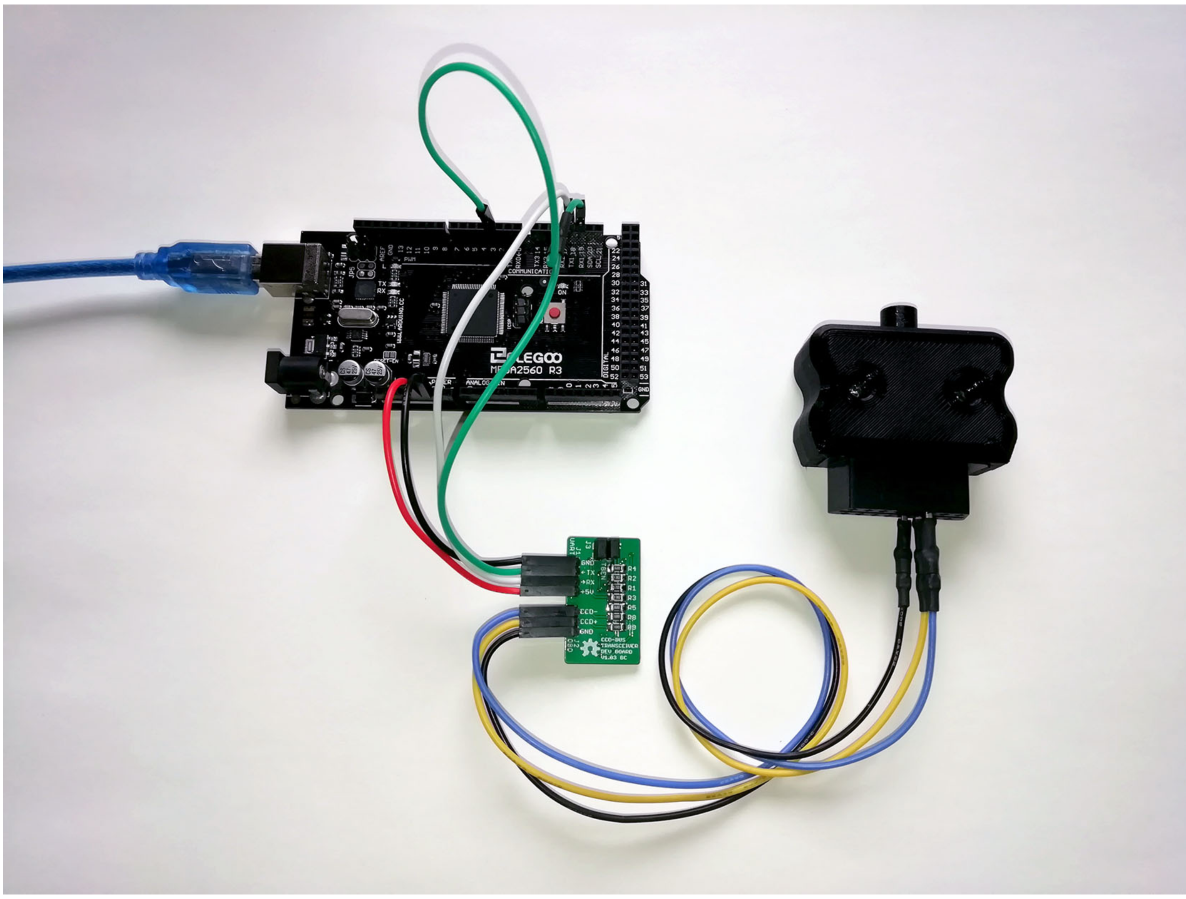


Figure 4. Wiring example (OBD2).

Development board:	Arduino Mega / OBD:
J1:	
- GND	- GND
- TX	- RX1 and D3
- RX	- TX1
- +5V	- 5V
J2:	
- CCD-	- OBD1 pin 3 | OBD2 pin 11
- CCD+	- OBD1 pin 4 | OBD2 pin 3
- GND	- OBD1 pin 6 | OBD2 pin 4

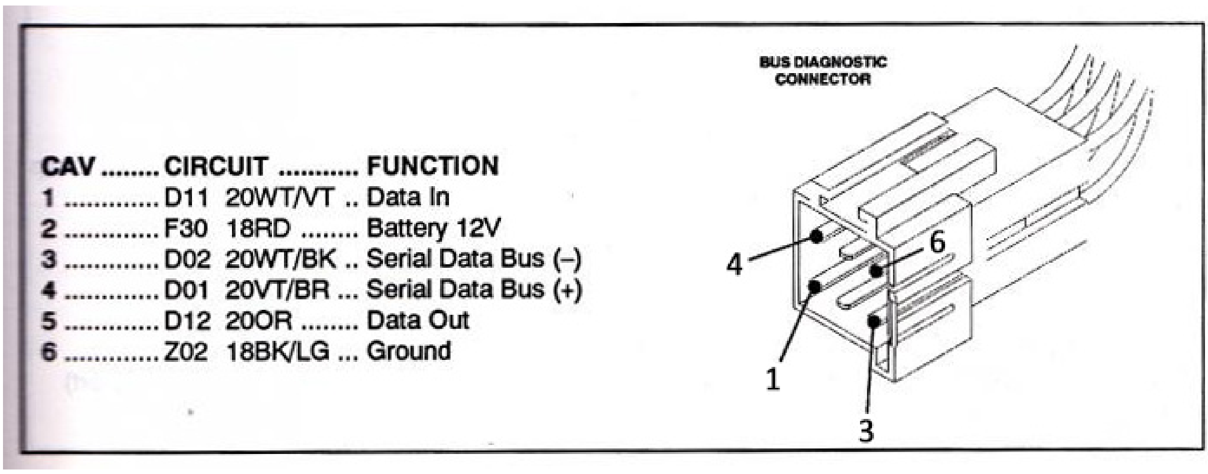


Figure 5. OBD1 body connector pinout.

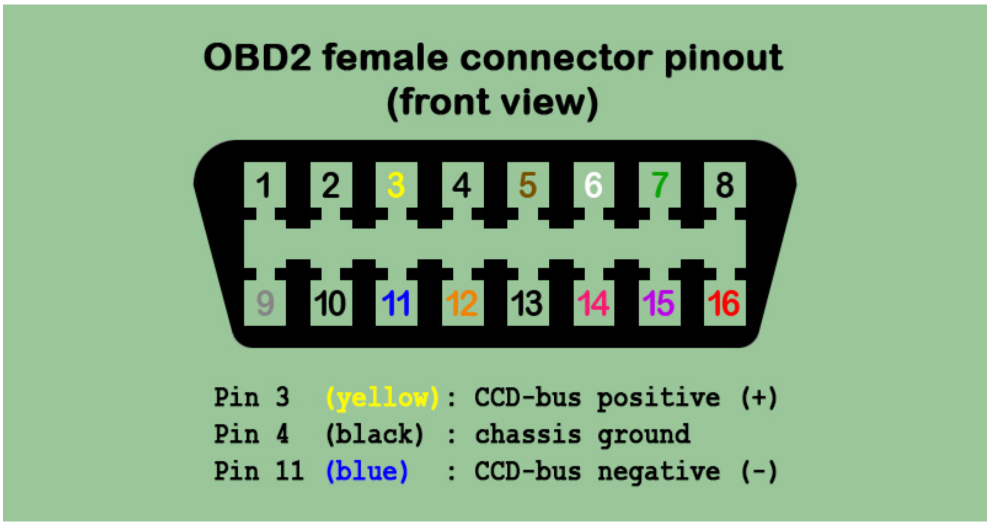


Figure 6. OBD2 diagnostic connector pinout.

For proper communication both J1 and J2 ground pins should be connected individually to the micro-controller and to the vehicle, respectively.

Microcontroller power pins may not be precise (4.8V instead of 5.0V), therefore an external 12V/5V-regulator is recommended to maintain rated common mode voltage and avoid shifting of the dominant voltage levels. However, tests show that slight common mode voltage shifting does not adversely affect signal reliability.

5.2 CCD-bus termination and bias (TBEN)

The voltage drop across the termination resistor(s) is responsible for the dominant (0-bit) voltage levels and the bias resistor network establishes the recessive/idle (1-bit) voltage levels of the bus-pins. These resistors are present on this board (R1, R2, R3) and they are selectable with a double jumper (J3, J4) in case they are needed.

Normally the CCD-bus network in a vehicle already has two 120Ω termination resistors (one for backup). They are connected in parallel in separate modules. This means that the effective bus termination becomes 60Ω. The current drivers found in CCD-chips are designed to handle this lower resistance. In case of a third termination resistor enters the network the effective bus termination reduces to 40Ω, which is an absolute minimum value and should be avoided. It is recommended to remove J3 and J4 jumpers when the board is connected to a live CCD-bus network.

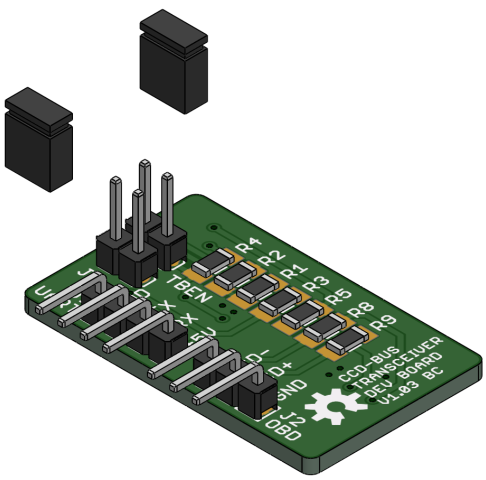


Figure 7. CCD-bus termination and bias jumpers removed from the board.

5.3 Standalone test

Connect the board's J1 pins to a suitable 5V logic microcontroller (preferably Arduino Mega) and attach J3 and J4 jumpers to enable CCD-bus termination and bias. Without termination and biasing common mode voltage (2.5V) is not generated and bus-pins are floating. Keep in mind that the 5V supplied by Arduino boards may be lower than usual (4.8V).

Make sure that the development board's TX-pin is splitted and routed to RX1 and D3 too (an interrupt pin of the Arduino Mega board). This enables a timer in the Arduino board to count bit-times precisely for bus-idle detection in the background.

Load the CCDWrite example of the CCDLibrary and make sure to select the correct CCD.begin() function. By default the appropriate custom transceiver option is commented out. Only one CCD.begin() function can be active at a time.

Upload the modified example to the Arduino Mega and open the Serial Monitor. Set serial speed to 250.000 baud and observe two 4-byte messages being sent and received, one after another, repeatedly in 200 ms intervals.

Data written on the CCD-bus is immediately received by the receiver circuit. This is how one module can talk to itself.

5.4 Live CCD-bus test

The same CCDLibrary with different examples can be tested in a vehicle too. In this environment the J3 and J4 jumpers need to be removed.

Load the CCDMonitor example and select the correct CCD.begin() function again. After uploading to modified example to the Arduino Mega and opening Serial Monitor, the development board passively observes CCD-bus communication and prints every received message in a new line. Message reception frequency may be too high to observe when the ignition is on. This is normal.

Load and upload another example called CCDRequest to test CCD-bus writing. This example writes 1 request message starting with a B2 ID byte repeatedly every 500 ms and waits for a response starting with an F2 ID byte. The received messages are filtered in this example so that only these two ID bytes appear in the Serial Monitor.

Arbitrary data can be written on a live CCD-bus but be mindful not to confuse modules with unexpected messages.

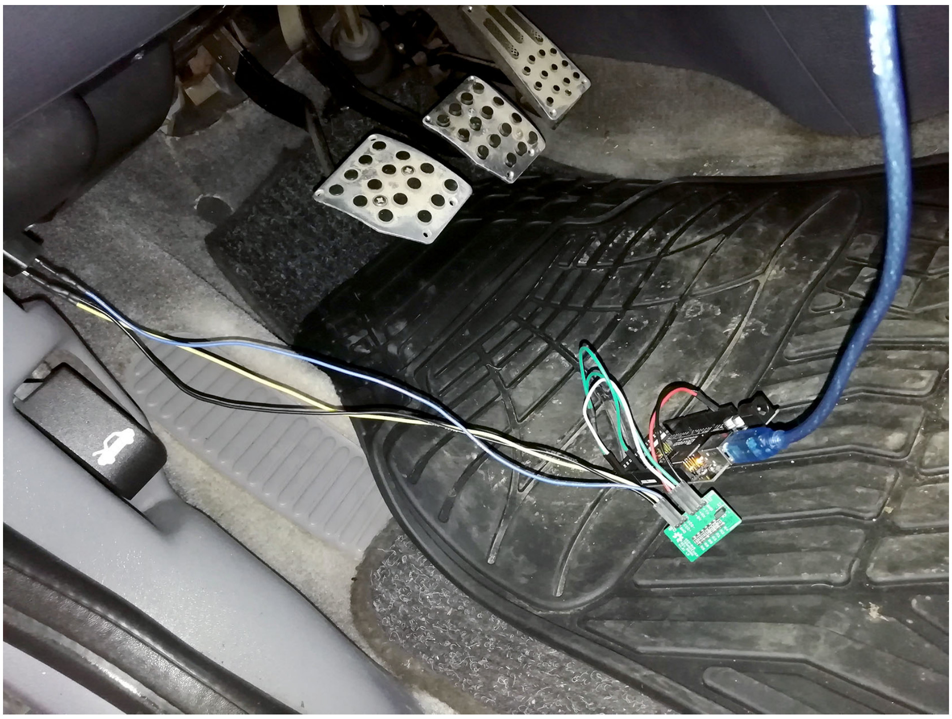


Figure 8. Old devboard (V1.01) connected to an OBD2 diagnostic connector.

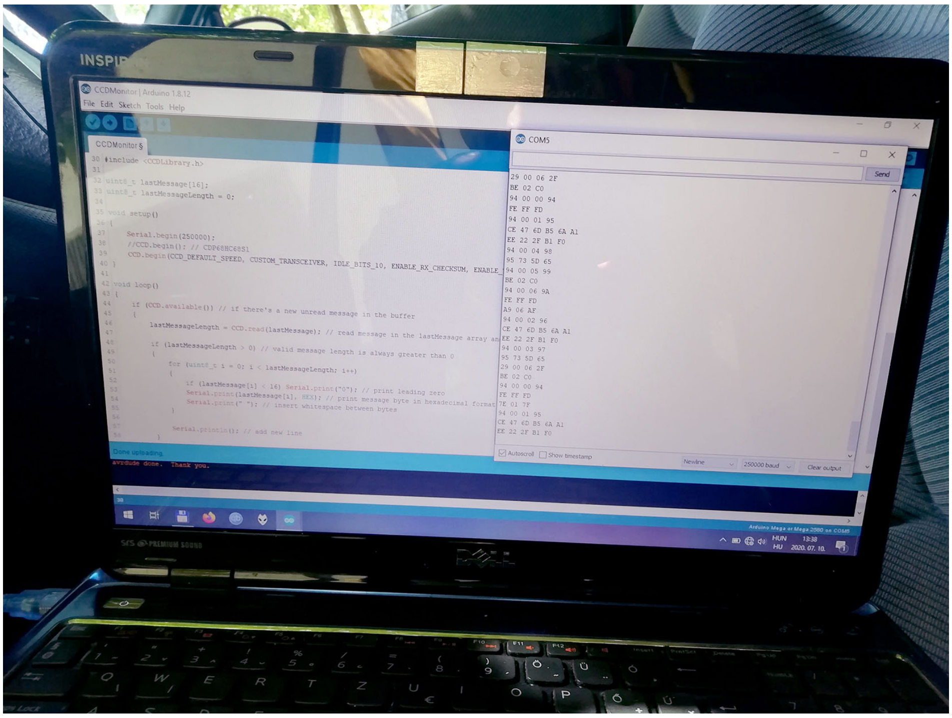


Figure 9. The CCDMonitor example code captures CCD-bus messages.

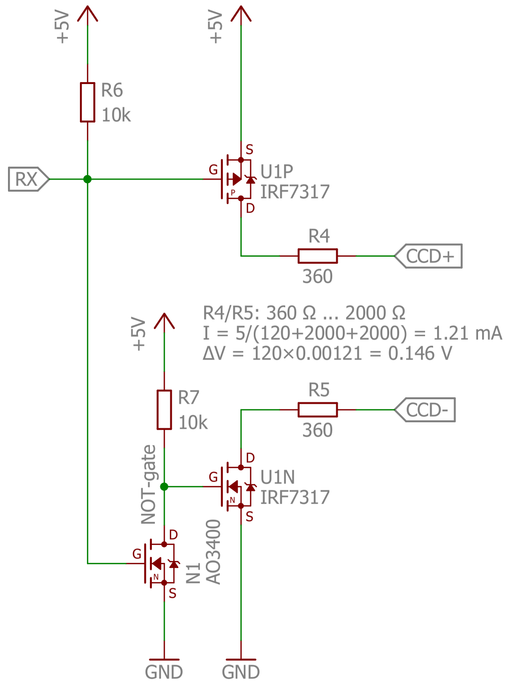
6. Downloads

Project repository:
https://github.com/laszlodaniel/CCDBusTransceiver

Recommended Arduino library for testing:
https://github.com/laszlodaniel/CCDLibrary

Extensive description of the CCD-bus:
https://chryslerccdsci.files.wordpress.com/2020/05/880586-ccdbususersmanual.pdf

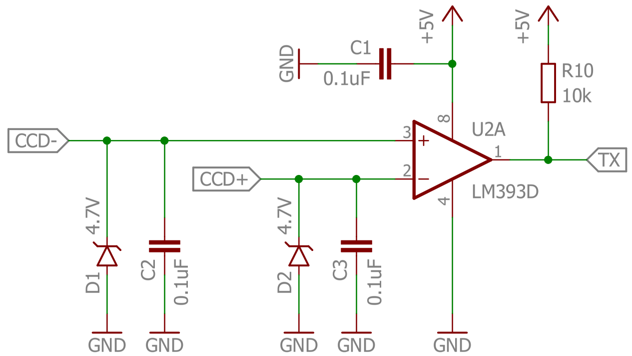
CCD-bus transmitter



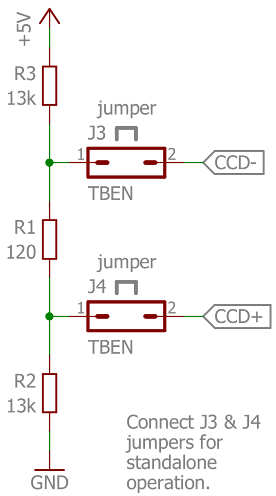
RX	CCD+	CCD-	ΔV	
Z/1	2.488V	2.512V	-0.024V	
0	2.860V	2.140V	+0.720V	R4/R5=360
0	2.573V	2.427V	+0.146V	R4/R5=2000

RX:
Z=INPUT/HIGH-Z
1=5V
0=GND

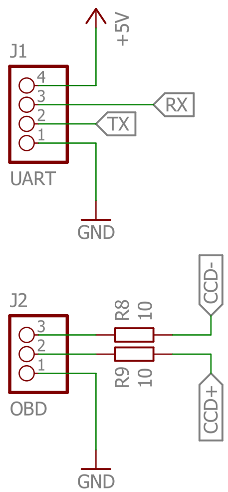
CCD-bus receiver



CCD-bus termination and bias



Connectors



Changelog:

V1.00: original

V1.01:
- mounting holes removed,
- board size reduced.

V1.02:
- copper trace width reduced to 0.6 mm,
- D1 and D2 Zener-diode values increased to 4.7V;
previous lower value (3.3V) may interfere with the CCD-bus wake-up signal (3.5V minimum).

V1.03:
- copper trace width reduced to 0.5 mm,
- CCD-bus termination and bias separated completely with 2 jumpers.

open hardware

CCD-bus Transceiver Development Board	
CCDBusTransceiver_V103	
2020. 08. 05. 11:15	László Dániel
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