UM11380

TJA1145A evaluation board (compatible with Arduino UNO)

Rev. 1 — 4 November 2020 User guide

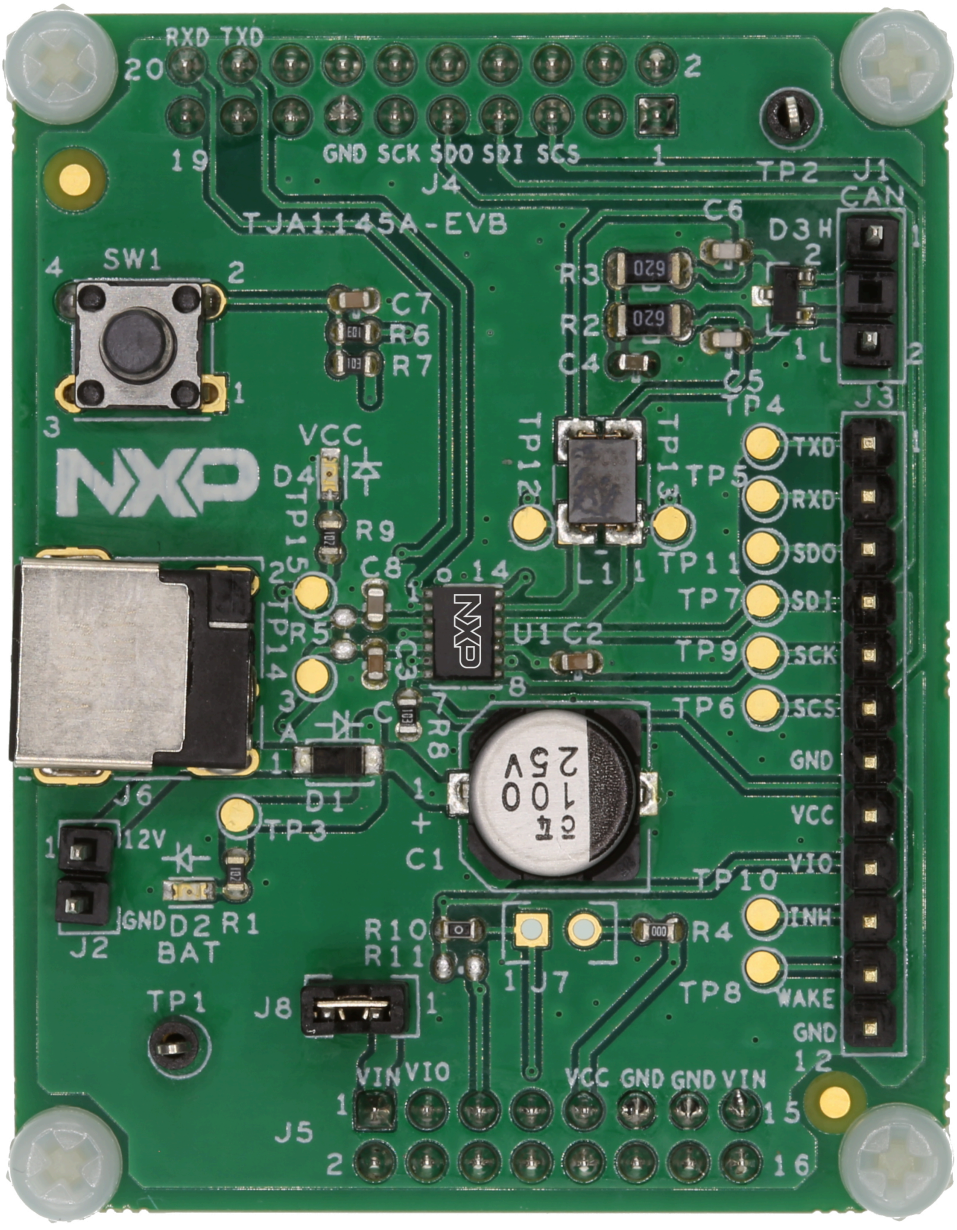

Figure 1. TJA1145A-EVB evaluation board

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1 Introduction

This document is the user guide for the TJA1145A-EVB evaluation board. It is intended for engineers involved in the evaluation, design, implementation, and validation of the TJA1145A High-speed CAN transceiver for partial networking. This guide discusses power supply requirements and the MCU and CAN bus interfaces, and describes how to connect the board into an ECU/CAN network.

The TJA1145A-EVB evaluation board is designed to facilitate the testing and evaluation of TJA1145A product features in a variety of microcontroller IO interface environments. All MCU interface signals can be accessed in two ways: they are available at a header row on the top side and also at header rows on the bottom side that can be plugged directly into many NXP MCU evaluation boards. The TJA1145A-EVB board is designed to be compatible with the S32K1xx evaluation board series from NXP and to support the use of standard software development tools and drivers.

2 Board overview

Top and bottom views of the TJA1145A-EVB evaluation board are illustrated in Figure 2.

Board dimensions are 45.1 mm × 58.4 mm. Only components needed to support basic TJA1145A functionality are included. The board contains CAN communication, power supply and wake-up circuitry and LEDs indicating when pins BAT and VCC are supplied. It provides several header rows (2.56 mm pitch) for connecting MCU interface and application signals.

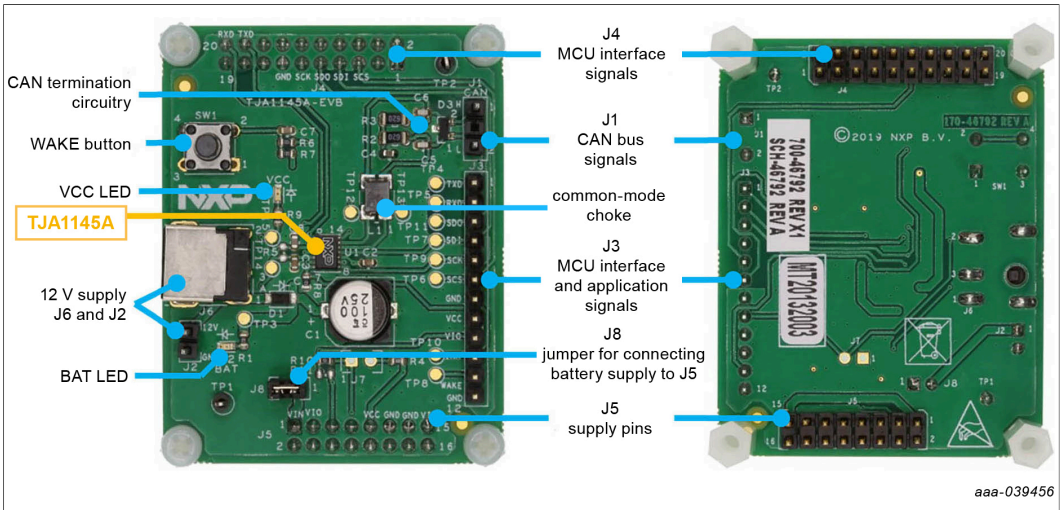


Figure 2. TJA1145A-EVB top (left) and bottom (right) views.

2.1 Ground connections

All ground pins are connected to the ground plane.

Table 1. Ground connections

Ground connections
J2-02
J3-07/12
J4-13
J5-11/13
J6-02/03

2.2 Power supply connections

2.2.1 Battery connections

An external power supply must be connected to either power jack J6 or 2-pin connector J2, as illustrated in Figure 3.

Table 2. TJA1145A/TJA1145A-EVB pins

TJA1145A	TJA1145A-EVB
BAT (pin 10)	J2-01 or J6-01: connect to battery supply

Both supply circuits are routed via polarity protection Schottky diode D1 in order to block reverse currents. Decoupling capacitors C1 and C2 are provided to stabilize the input voltage and remove noise on the battery connection.

Green LED D2 lights up once the 12 V power supply has been connected.

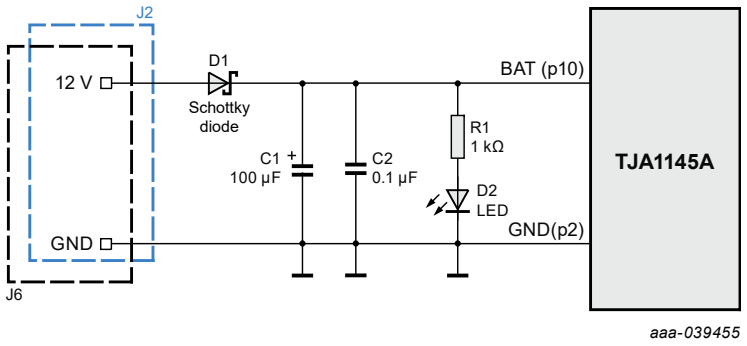


Figure 3. 12 V power supply connection options

2.2.2 VCC/VIO connections

A 5 V VCC supply is needed to operate the CAN transmitter and receiver in Normal and Standby modes. A VIO supply is needed to supply the digital IOs and MCU interface (e.g. SPI pins). The VIO voltage must be aligned with the MCU interface supply voltage. The VCC and VIO voltages are not needed for Sleep mode. Detailed information on the functionality and operation of the TJA1145A can be found in the data sheet and application hints (see Section 6).

Table 3. TJA1145A/TJA1145A-EVB pins

TJA1145A	TJA1145A-EVB
VCC (pin 3)	J3-08 or J5-09: connect 5 V supply voltage
VIO (pin 5)	J3-09 or J5-03: connect MCU-compatible supply voltage
-	J5-01 or J5-15: pin VIN on TJA1145A-EVB board; connected to battery supply by default via jumper J8; remove jumper J8 to disconnect VIN on J5 from the battery supply

The VCC and VIO supplies can be connected to either J3 or J5. J3 is located on the top of the TJA1145A-EVB evaluation board and J5 is mounted on the bottom of the board. The J5 connector pin arrangement follows the Arduino Uno pinout order, allowing the TJA1145A-EVB to be connected directly to a variety of NXP MCU evaluation boards. Decoupling capacitors C3 and C8 are provided to stabilize the input voltages and remove noise on the VCC and VIO inputs. Red LED D4 lights up when the VCC voltage is present.

By default, the TJA1145A-EVB evaluation board battery supply is routed to the MCU board via pin VIN on the Arduino connector, allowing the supply to the entire module to be managed via the TJA1145A-EVB board. This feature can be disabled by removing jumper J8, disconnecting the battery supply from pin VIN.

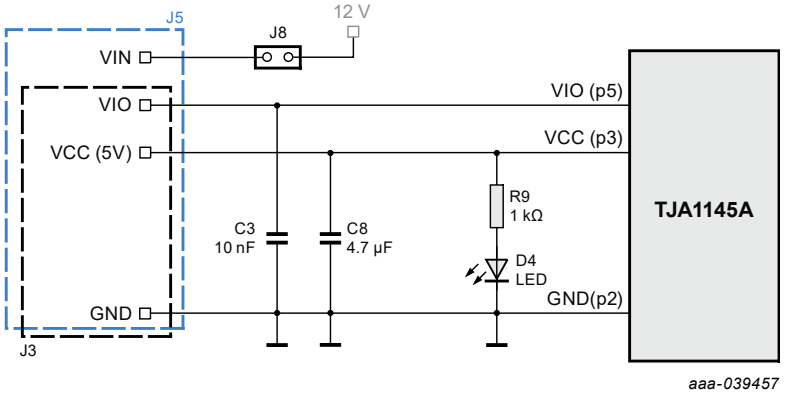


Figure 4. VCC/VIO supply connection options

2.3 CAN communication circuitry

The TJA1145A-EVB evaluation board contains typical CAN communication circuitry. The CANH and CANL bus signals are output on connector J1.

Table 4. TJA1145A/TJA1145A-EVB pins

TJA1145A	TJA1145A-EVB
CANH (pin 13)	J1-01: connect to HIGH-level CAN bus line
CANL (pin 12)	J1-02: connect to LOW-level CAN bus line

Equipped with termination resistors R2 and R3, the TJA1145A-EVB evaluation board is pre-prepared to be used as a termination node in a CAN network. If the CAN network is already terminated at both ends, it is recommended to remove R2 and R3 or replace them with higher value resistors to ensure that the impedance on the bus meets the CAN bus load specification, typically 60 Ω.

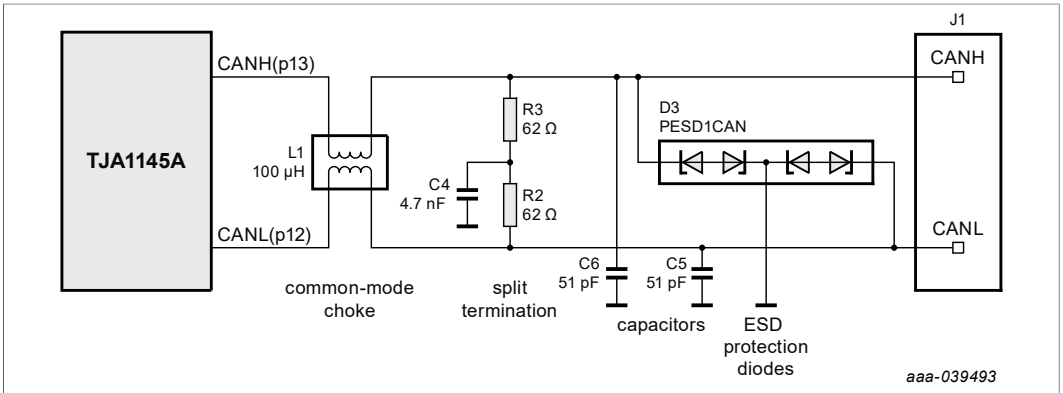


Figure 5. CAN bus interface circuitry

2.4 Wake-up and INH functionality

The TJA1145A supports a Sleep mode for use in energy-sensitive applications. Once in Sleep mode, the device will remain in this low-power mode until a wake-up request is received. A wake-up event can be triggered remotely via a standard pattern or dedicated wake-up frame on the CAN bus, or locally via the WAKE pin (details of wake-up functionality can be found in the TJA1145A data sheet and application hints; see Section 6).

Table 5. TJA1145A/TJA1145A-EVB pins

TJA1145A	TJA1145A-EVB
WAKE (pin 9)	J3-11: connect to wake-up signal
INH (pin 7)	J3-10: connect to control input signal from external regulator(s)

The TJA1145A-EVB evaluation board features local wake-up test circuitry. The WAKE pin is pulled HIGH by default via 10 kΩ resistors R6 and R7. When switch SW1 is pressed, the WAKE pin is pulled LOW. To make use of this feature, falling-edge detection on the WAKE pin must be enabled in the TJA1145A register map (as described in the TJA1145A data sheet).

Pin INH is typically used to control the supply to the MCU and peripherals. In Normal and Standby modes, the level on this pin is equivalent to the voltage on pin BAT. Pin INH is pulled LOW via resistor R8 when the TJA1145A switches to Sleep mode. The MCU can detect when the device is in Sleep mode by monitoring the voltage on this pin.

The WAKE and INH pins are accessible via connector J3 on the top of the board.

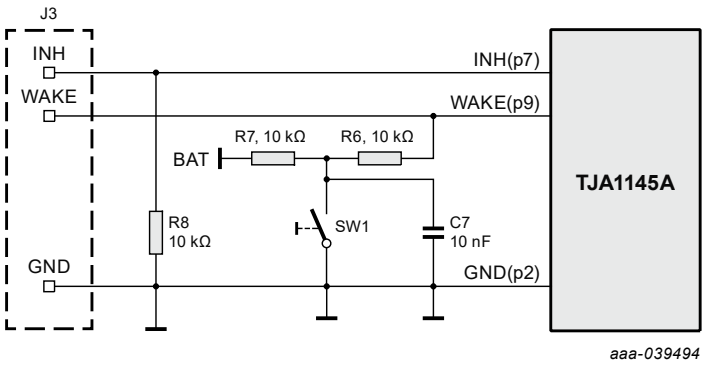


Figure 6. Local wake and INH circuitry

2.5 MCU interface

The digital interface pins are located on the top side connector J3 (J3-01 to J3-06), as well as on the bottom side connector J4. Two of these pins, TXD and RXD, are used for CAN data communication with the MCU. The remaining four pins are used for SPI communication with the MCU.

Table 6. TJA1145A/TJA1145A-EVB pins

TJA1145A	TJA1145A-EVB
TXD (pin 1)	J3-01 or J4-18
RXD (pin 4)	J3-02 or J4-20
SDO (pin 6)	J3-03 or J4-09
SDI (pin 11)	J3-04 or J4-07
SCK (pin 8)	J3-05 or J4-11
SCSN (pin 14)	J3-06 or J4-05

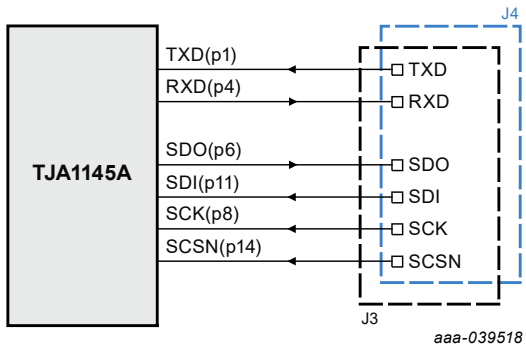


Figure 7. MCU interface

2.6 TJA1145A-EVB to TJA1145A pin summary

Table 7. Overview of TJA1145A-EVB to TJA1145A cross-link

TJA1145A-EVB evaluation board			TJA1145A		
Header name	**EVB pin #: top**	**EVB pin #: bottom**	**Test pad #:**	**Pin #**	**Pin name**
CAN H[1]	J1-01	-	TP12	13	CANH
CAN L[1]	J1-02	-	TP13	12	CANL
TXD	J3-01	J4-18	TP4	1	TXD
RXD	J3-02	J4-20	TP5	4	RXD
SDO	J3-03	J4-09	TP11	6	SDO
SDI	J3-04	J4-07	TP7	11	SDI
SCK	J3-05	J4-11	TP9	8	SCK
SCS	J3-06	J4-05	TP6	14	SCSN
GND	J3-07/12, J2-02, J6-02/03	J4-13, J5-11/13	TP1, TP2	2	GND
VCC	J3-08	J5-09	TP15	3	VCC
VIO	J3-09	J5-03	TP14	5	VIO
INH	J3-10	-	TP10	7	INH
WAKE	J3-11	-	TP8	9	WAKE
-	-	-	TP3	10	BAT
12 V	J2-01, J6-01, J8-02	-	-	-	-
VIN	J8-01	J5-01/15	-	-	-

[1] Common mode choke L1 connects TJA1145A pins CANH/CANL to header pins CAN H/CAN L.

3 Connecting the TJA1145A-EVB to a CAN network

An example of how to connect the TJA1145A-EVB between an MCU and the CAN bus is shown in Figure 8.

The following conditions must be met before powering up the system with a 12 V supply:

- Connect all boards in the ECU to a common GND
- Connect SPI pins to the MCU SPI master:
  - SDI → MOSI
  - SDO → MISO
  - SCK → SCK
  - SCSN → CS
- Connect TXD/RXD pins to the MCU CAN controller TXD/RXD pins
- Connect CANH and CANL to the CAN bus twisted-pair cables
- Connect VCC and VIO to the MCU supply unit; VIO shares the MCU IO supply
- Connect pin INH to the control/enable pin on the ECU supply unit (optional)

Once the above steps have been completed, the ECU/EVB can be powered up using an external battery supply. The TJA1145A starts up in Standby mode, awaiting commands from the MCU via the SPI interface.

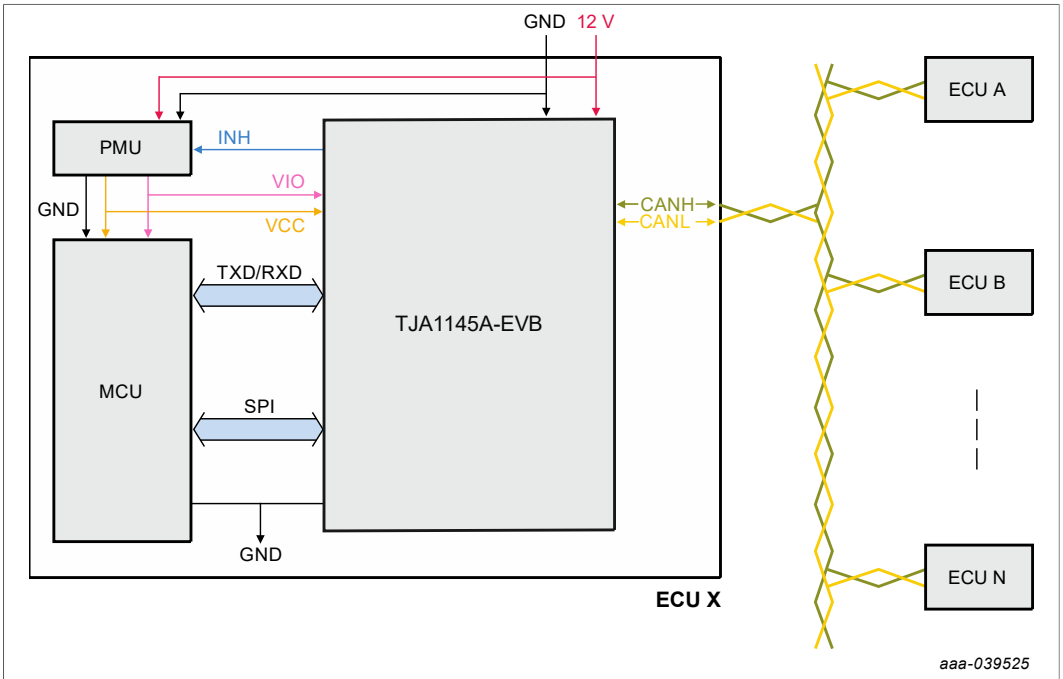
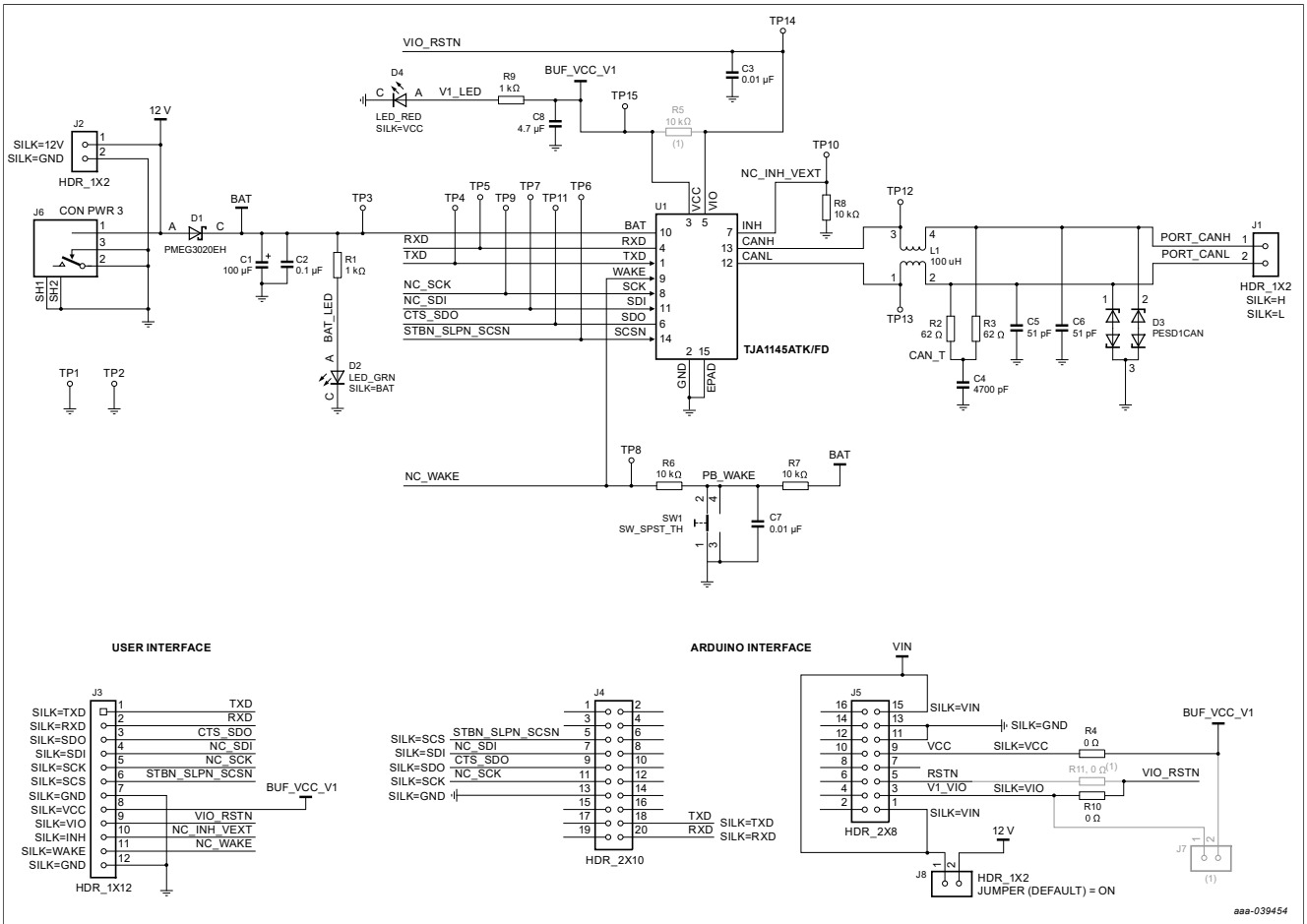


Figure 8. Connecting the TJA1145A-EVB in an ECU/CAN bus network

4 Schematic diagram



(1) Component not populated.

Figure 9. TJA1145A-EVB schematic diagram

5 Bill of Materials

Table 8. Bill of Materials

NXP does not assume liability, endorse, or warrant components from external manufacturers referenced in circuit drawings or tables. While NXP offers component recommendations in this configuration, it is the responsibility of the customer to validate their application.

For critical components, it is vital to use the manufacturer listed.

Item number	Quantity	Schematic label	Value	Description	Part number	Manufacturer name
Active components						
1	1	U1	TJA1145ATK/FD	IC XCVR CAN FD 4.5-5.5 V 5 Mbit/s AEC-Q100 HVSON14	TJA1145ATK/FD	NXP SEMICONDUCTORS
Capacitors						
3	1	C1	100 µF	CAP ALEL 100 µF 25 V 20 % -- SMT	UWX1E101MCL1GB	NICHICON
5	1	C2	0.1 µF	CAP CER 0.1 µF 25 V 10 % X7R AEC-Q200 0603	CGA3E2X7R1E104K080AA	TDK
4	2	C3, C7	0.1 µF	CAP CER 0.01 µF 50 V 10 % X7R AEC-Q200 0603	CGA3E2X7R1H103K080AA	TDK
7	1	C4	4700 pF	CAP CER 4700 pF 50 V 5 % C0G AEC-Q200 0603	CGA3E2C0G1H472J080AA	TDK
2	2	C5, C6	51 pF	CAP CER 51 pF 50 V 5 % C0G 0603	CC0603JRNPO9BN510	YAGEO
6	1	C8	4.7 µF	CAP CER 4.7 µF 16 V 10 % X5R 0603	GRM188R61C475KE11D	MURATA
Diodes						
8	1	D1	SCH/30 V	DIODE SCH PWR RECT 2A 30 V AEC-Q101 SOD123F	PMEG3020EH,115	NEXPERIA
9	1	D2	LED/GRN	LED BRIGHT GRN SGL 30 mA 0603	150060VS75000	WURTH ELEKTRONIK EISOS GMBH & CO. KG
10	1	D3	ESD Prot./24 V	DIODE BIDIR CAN BUS ESD PROTECTION 200 W 24 V AEC-Q 101 SOT23	PESD1CAN,215	NEXPERIA
11	1	D4	LED/RED	LED BRIGHT RED CLEAR SGL 2 V 20 mA SMT 0603	150060RS75000	WURTH ELEKTRONIK EISOS GMBH & CO. KG
Inductors						
12	1	L1	100 µH	IND CHK 100 µH 150 mA -30/+50 % AEC-Q200 1812	B82789C0104N002[1]	EPCOS
Resistors						
13	2	R1, R9	1 kΩ	RES MF 1 kΩ 1/10 W 5 % AEC-Q200 0603	CRCW06031K00JNEA	VISHAY INTERTECHNOLOGY (preferred)
					ERJ-3GEYJ103V	PANASONIC (alternative)
					RK73B1JTTD102J	KOA SPEER (alternative)
14	2	R2, R3	62 Ω	RES MF 62 Ω 1/4W 5 % AEC-Q200 1206	CRCW120662R0JNEA	VISHAY INTERTECHNOLOGY
15	2	R4, R10	0 Ω	RES MF ZERO Ω 1/10 W -- AEC-Q200 0603	ERJ-3GEY0R00V	PANASONIC (preferred)
					CRCW06030000Z0EA	VISHAY INTERTECHNOLOGY (alternative)
16	1	R5	not populated			
17	3	R6, R7, R8	10 kΩ	RES MF 10 kΩ 1/10 W 5 % AEC-Q200 0603	ERJ-3GEYJ103V	PANASONIC (preferred)
					RK73B1JTTD103J	KOA SPEER (alternative)
18	1	R11	not populated			
Switches, Connectors, Jumpers, and Test Points						
19	1	J1	HDR_1X2	HDR 1X2 TH 200 MIL SP 338H SN 100L	TSW-202-07-T-S	SAMTEC
20	2	J2, J8	HDR_1X2	HDR 1X2 TH 100 MIL SP 338H SN 100L	TSW-102-07-T-S	SAMTEC
21	1	J3	HDR_1x12	HDR 1X12 TH 100 MIL SP 344H AU 118L	6130121112	WURTH ELEKTRONIK EISOS GMBH & CO. KG
22	1	J4	HDR_2X10	HDR 2X10 TH 100 MIL CTR 428H AU 110L	TSW-110-14-G-D	SAMTEC
23	1	J5	HDR_2X8	HDR 2X8 TH 100 MIL CTR 433H AU 110L	TSW-108-14-G-D	SAMTEC
24	1	J6	CON 3	CON 3 PWR JACK RA TH 295H -- NI 98L	PJ-051A	CUI INC
25	1	J7	not populated			
26	1	SW1	SPST_SWITCH	SW SPST PB TACT 50MA 12 V TH	430186070716	WURTH ELEKTRONIK EISOS GMBH & CO. KG
27	2	TP1, TP2	TEST_040	TEST POINT BLACK 40 MIL DRILL 180 MIL TH 109L	5001	KEYSTONE ELECTRONICS (preferred)
					TP-105-01-00	COMPONENTS CORPORATION (alternative)
					151-203-RC	KOBICONN (alternative)
28	13	TP3 to TP15	TPAD_059	TEST POINT PAD 59 MIL DIA SMT, NO PART TO ORDER	-	-

[1] NXP used the ACT45B-101-2P from TDK for the latest TJA1145A EMC test report.

6 References

[1] **TJA1145A** data sheet — High-speed CAN transceiver for partial networking
http://www.nxp.com/TJA1145A

[2] **AH1903 Application Hints** — High-speed CAN transceiver for partial networking TJA1145A, available from NXP Semiconductors

7 Revision history

Revision history

Rev	Date	Description
v.1	20201104	Initial version

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