UM11235

TEA2016DB1514 USB to I^2C hardware interface

Rev. 1 — 27 June 2019 User manual

Document information

Information	Content
Keywords	TEA2016, TEA2016DB1514, I2C, USB, programming, MTP, GUI, Ringo, software, interface
Abstract	The TEA2016DB1514 USB-I2C interface board is a development tool to enable working with theTEA2016 setting by use of a computer. The Ringo TEA2016 development software provides a graphical user interface (GUI) that can be installed on the computer. The interface and software are intended for engineering work in lab environment as part of power supply development.

Revision history

Revision history

Rev	Date	Description
v.1	<Tbd>	Initial version

1 Introduction

1.1 USB I²C interface board TEA2016DB1514

The TEA2016DB1514 interface board is a development tool that enables working with the TEA2016 settings from a computer. The available Ringo TEA2016 development software provides a graphical user interface (GUI) that can be installed on a computer.

The interface and software are intended for engineering work in lab environment as part of power supply development. It is not suitable for use by consumer or industrial purpose.

The TEA2016DB1514 is still being developed.

Note: *Some screenshots of the Ringo GUI may deviate from the version that you are currently using. The reason is that the tool is regularly updated during its development.*

1.2 FT232H module driver

The FT232H module is part of the TEA2016DB1514 interface. It provides the USB-to-I²C communication. The Ringo TEA2016 development software drives the USB-to-I²C communication.

The FT232H module is a USB device from FTDI. It must be installed on the computer with a correct driver. When the device is connected to a USB port (plug and play), the installation of the FT232H module usually happens automatically. Sometimes, the driver must be installed manually.

Install FT232H driver on the computer:

- Automatically (plug and play)
- Manually by running the available dpinst_x64.exe program
- Manually, using the device manager, selecting the location of the driver files when updating the drive for the unknown device

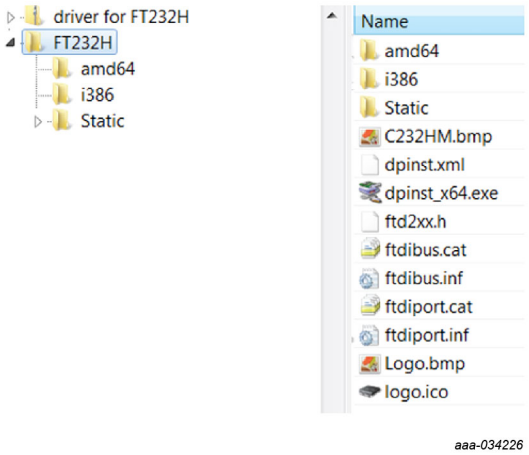


Figure 1. FTDI FT232H driver package content

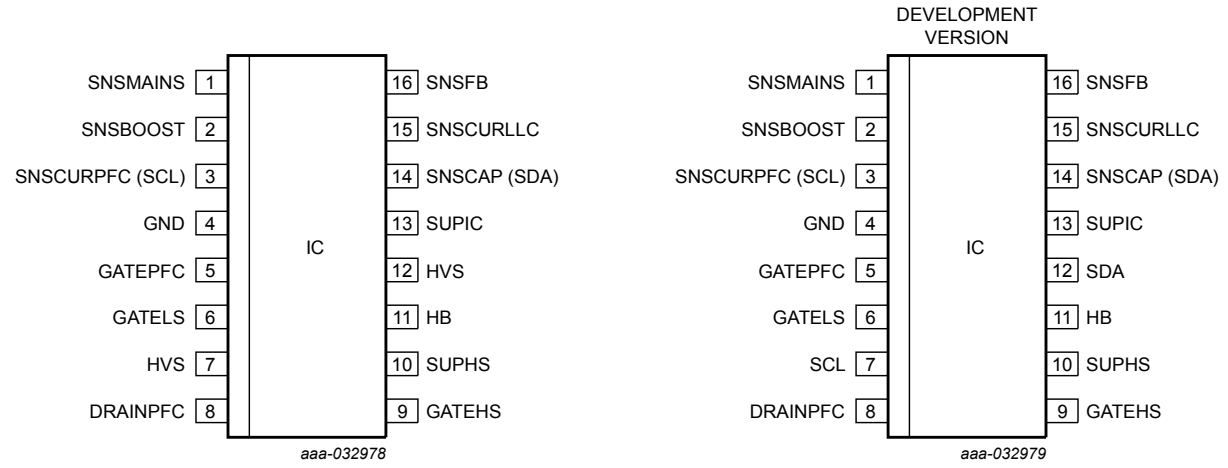
2 USB and I2C communication setup

I2C communication can modify and store parameters and settings inside the TEA2016 IC. The TEA2016DB1514 provides an interface between the TEA2016 IC and a computer USB connection. The TEA2016 parameters and settings can be modified using the graphical user interface (GUI) of the dedicated NXP Semiconductors Ringo development software.

Figure 2. Ringo graphical user interface

2.1 TEA2016 I2C communication

In addition to the production TEA2016 ICs, NXP provides special IC versions for product development. The difference is that the development IC samples provide a second I2C interface for easy modification of settings while the IC is operating. So, parameter settings and operation can be changed “on the fly”.



a. Normal version

b. Development version

Figure 3. IC pinning: normal version and development version

2.1.1 Normal production IC: SDA and SCL on combined pins

The basic I2C interface in the IC is available on the combined pins SNSCURPFC (SCL) and SNSCAP (SDA). To program the IC, it must be put in the disabled condition pulling SNSBOOST to GND. During programming, SUPIC must supply the IC.

The TEA2016DB1514 supports the programming on the combined pins with an IC socket board (6-pin connection). It does not support 6-pin communication on the TEA2016DB1519 v.1 240 W demo board (while the IC is in the power supply).

2.1.2 Development IC samples: SDA and SCL on spacer pins

Connections to the IC second I2C interface are provided on the high-voltage spacer pins 7 and 12, which are normally not connected.

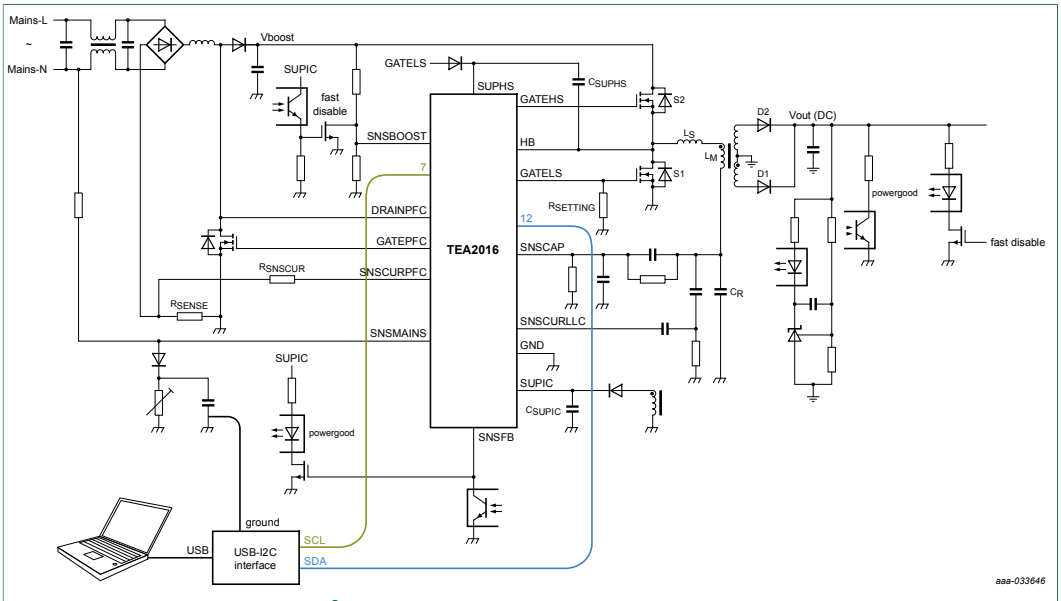


Figure 4. Development IC: I2C connections with spacer pins

The basic I2C interface functions on the combined function pins of the IC are also included in the development samples. However, an internal configuration setting has disabled this function.

The TEA2016DB1514 supports the programming and communication with the development IC version via the spacer pins (3-pin connection). When the IC is working in the (TEA2016DB1519v1 240 W demo board) power supply or on the IC socket board.

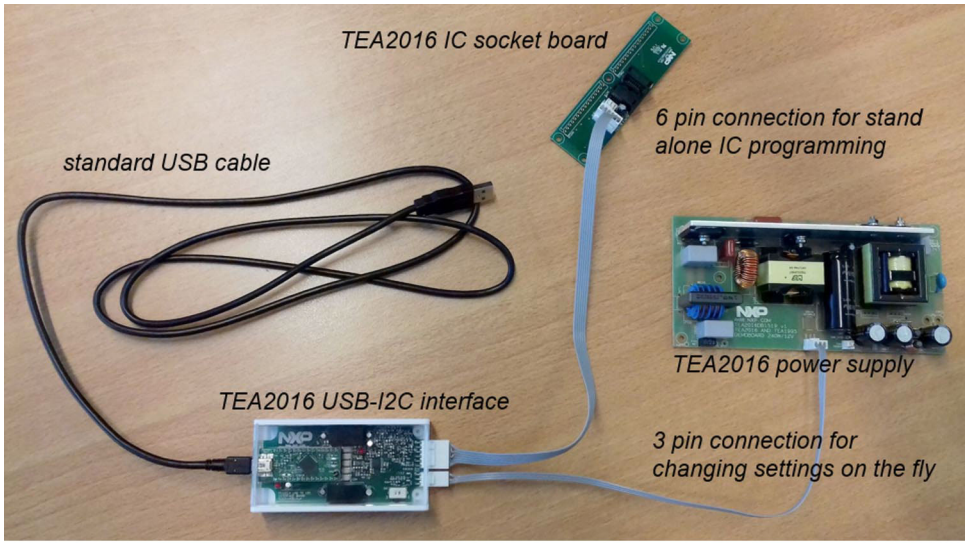


Figure 5. Two TEA2016DB1514 interface setups: on the fly (3-pin) and standalone (6-pin)

2.2 Switch for 3-pin or 6-pin connection to the TEA2016

To change the communication type, the interface incorporates a switch.

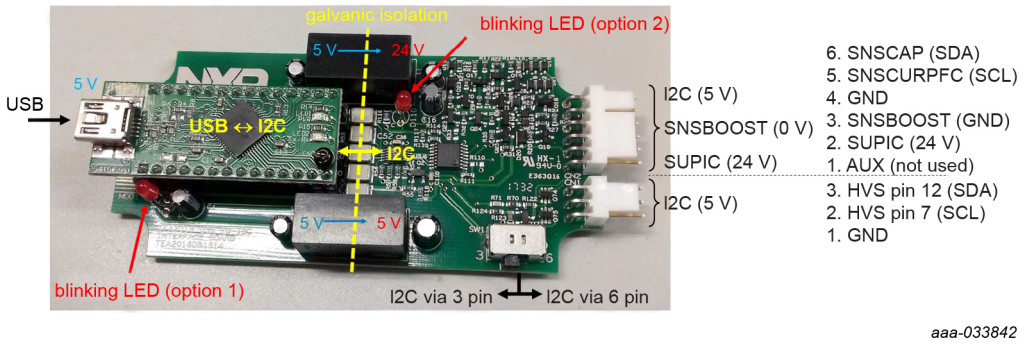


Figure 6. USB I²C interface board TEA2016DB1514 connections and setup

2.3 Blinking LED

When the interface is operational an LED is blinking (2 options depending on Ringo version).

- Slow blinking: no communication with TEA2016
- Fast blinking: communication with TEA2016 active (protection register polling)

2.4 Isolated I²C bus

If (overvoltage) problems in the connected TEA2016 power supply occur, the TEA2016DB1514 USB I²C interface board provides galvanic isolation to help prevent grounding disturbances and provide extra protection for the computer USB port.

When the USB is connected to a battery powered computer (laptop) that is not connected to the mains by a power supply adapter, a completely isolated setup is obtained. An adapter connected to the mains can make a connection of the grounds on both sides of the isolation. It is no problem for operation and a suitable way of working in normal operating conditions not to have (complete) isolation.

2.5 Graphical user interface (GUI) and USB-I²C interface

During power supply development, the Ringo development software on a computer with the USB-I²C interface communicates with the IC. Ringo provides the correct protocol and offers several options and tools in a GUI to work with the IC settings.

The TEA2016 GUI (Ref. 1) and the USB-I²C interface user manuals show how to work with it .

2.6 Disturbances on the I²C communication bus

The TEA2016DB1514 interface is often used in combination with a development version of the controller IC. While the power supply is operational, the I²C communication is running via pin 7 and pin 12 (see Figure 4).

This situation can cause disturbances on the I²C bus because converter switching dV/dT signals (like HB and DRAINPFC) cause spikes on the SDA and SCL connections.

The spikes can disturb communication. Worst case, the ICs connected to the I2C bus can be damaged.

2.6.1 Communication disturbance

2.6.1.1 Connection quality indicator in the Ringo GUI

The connection quality indicator at the bottom of the Ringo GUI screen helps to detect when something is going wrong.

Normally, the indicator provides four green bars. At this level, there may be an occasional error that the system can correct.

When the indicator shows three yellow bars, communication is often showing errors. Moving the I2C connection cable to a better position may provide good quality again.

When the indicator shows two orange bars or one red bar, the situation is critical. Changes are necessary. The info button pop-up provides similar information on this subject to what this user manual provides.

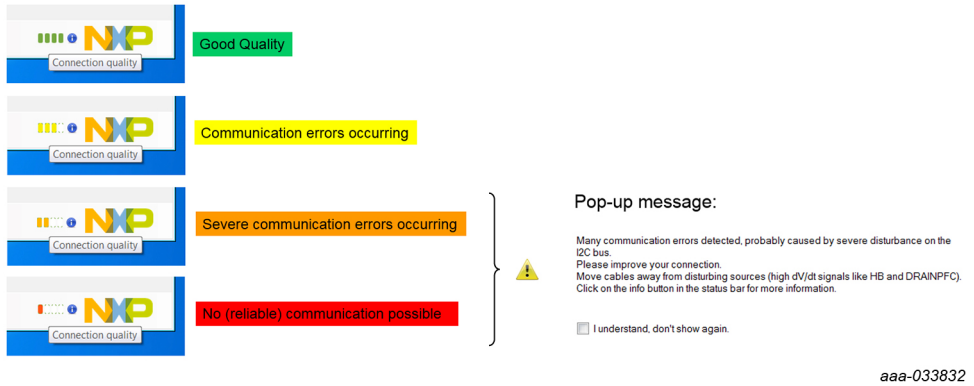


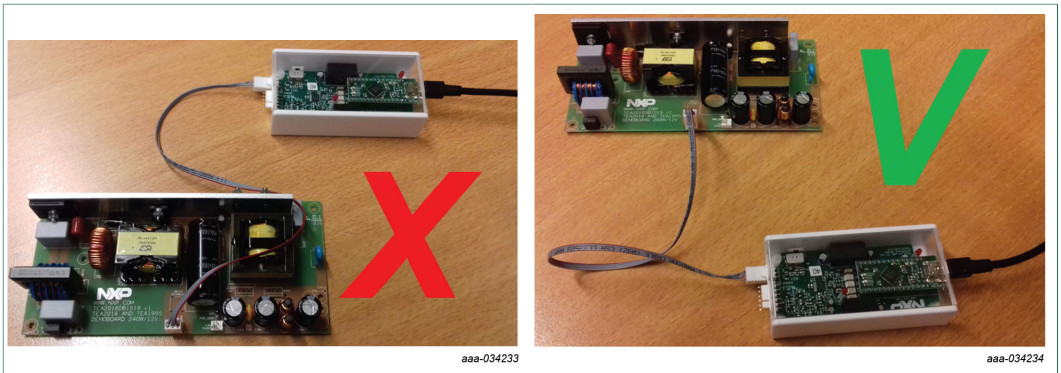
Figure 7. Connection quality indicator in Ringo GUI

2.6.2 Minimizing disturbances on the I2C connection

For minimizing disturbance on the bus communication, the positions of the connecting PCB tracks and the cable for I2C are very important. Keep them removed from steep dV/dt signals, like HB and DRAINPFC, as much as possible.

When disturbance problems occur, a few levels of improvement may be considered

Level 1: Check the position of the connecting cable.



a. Bad b. Good

Figure 8. Position of the cable

Level 2: For further disturbance reduction in the connecting cables, consider to solder wires directly on the IC pins (not using PCB tracks) and/or using coaxial cable instead of the standard flat cable.

Level 3: To avoid converter switching disturbances on I^2C, consider to change settings only when the power supply is not switching (to make the IC operational for I^2C communication apply V_{mains} = 40 V (AC)). And consider to disconnect the cable after the modification. This way of working does not provide the convenient “on the fly” changing.

2.6.3 I^2C component defects

Severe disturbance on the I^2C bus can result in defect components (for example U5 and U6). There is an extra risk for damage during power supply testing that is stressful on board grounding and currents flowing to the mains connection. Like mains surge testing, ESD testing, mains on/off testing, and load step testing. To prevent damage, disconnect the I^2C cable during testing. Disconnecting the I^2C cable is also better for avoiding impact on the performance because of the connected board and the constant I^2C communication.

2.6.4 Disconnecting the I^2C cable during testing

The interface and software are intended for engineering work in lab environment as part of power supply development. Using the interface and software with a development version of the IC, enables on the fly modifying of the settings while the power supply is running. In this way, improvements can be observed immediately.

Because there is a risk of disturbances on the I^2C communication bus, the connection must be removed during performance testing and stress testing.

Stress testing

During stressful tests, like mains on/off testing and surge tests, the (isolated) I^2C bus connection is severely stressed. Although protective devices are included, there is a serious risk that components connected to the I^2C bus can become defect.

Performance testing

When I^2C communication is running, it can influence the performance, especially in burst mode operation, when communication activities continuously interrupt the power-saving state of the IC. The result is a higher IC current consumption.

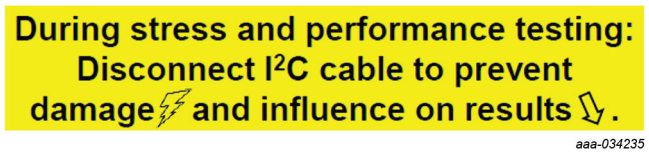


Figure 9. Warning sticker on the TEA2016DB1514 encasing

3 Circuit diagrams

The TEA2016DB1514 USB-I²C interface board is not intended for modification by the user. The circuit diagrams are provided for information only.

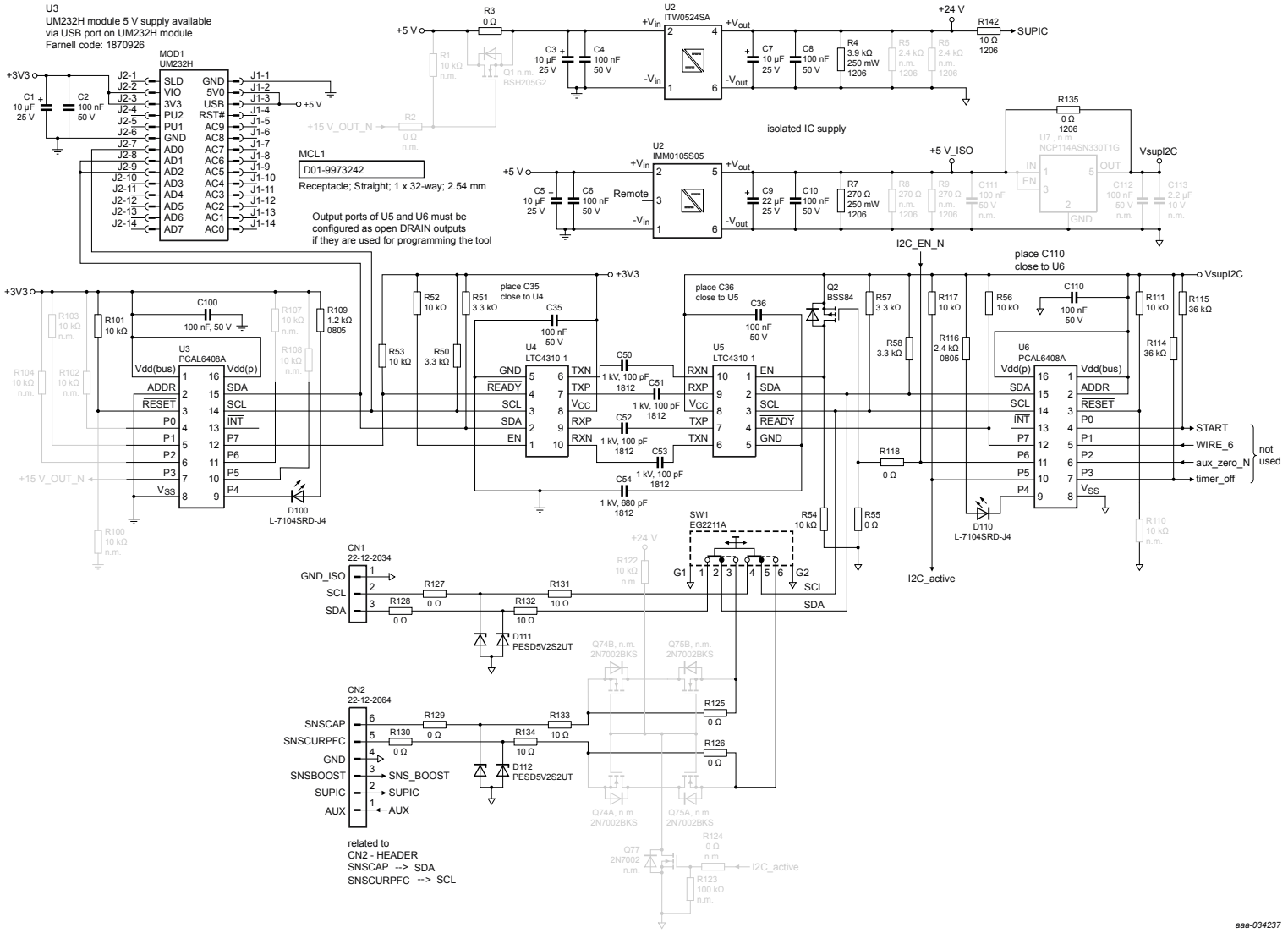


Figure 10. USB-I²C interface board TEA2016DB1514 v.2: main functions

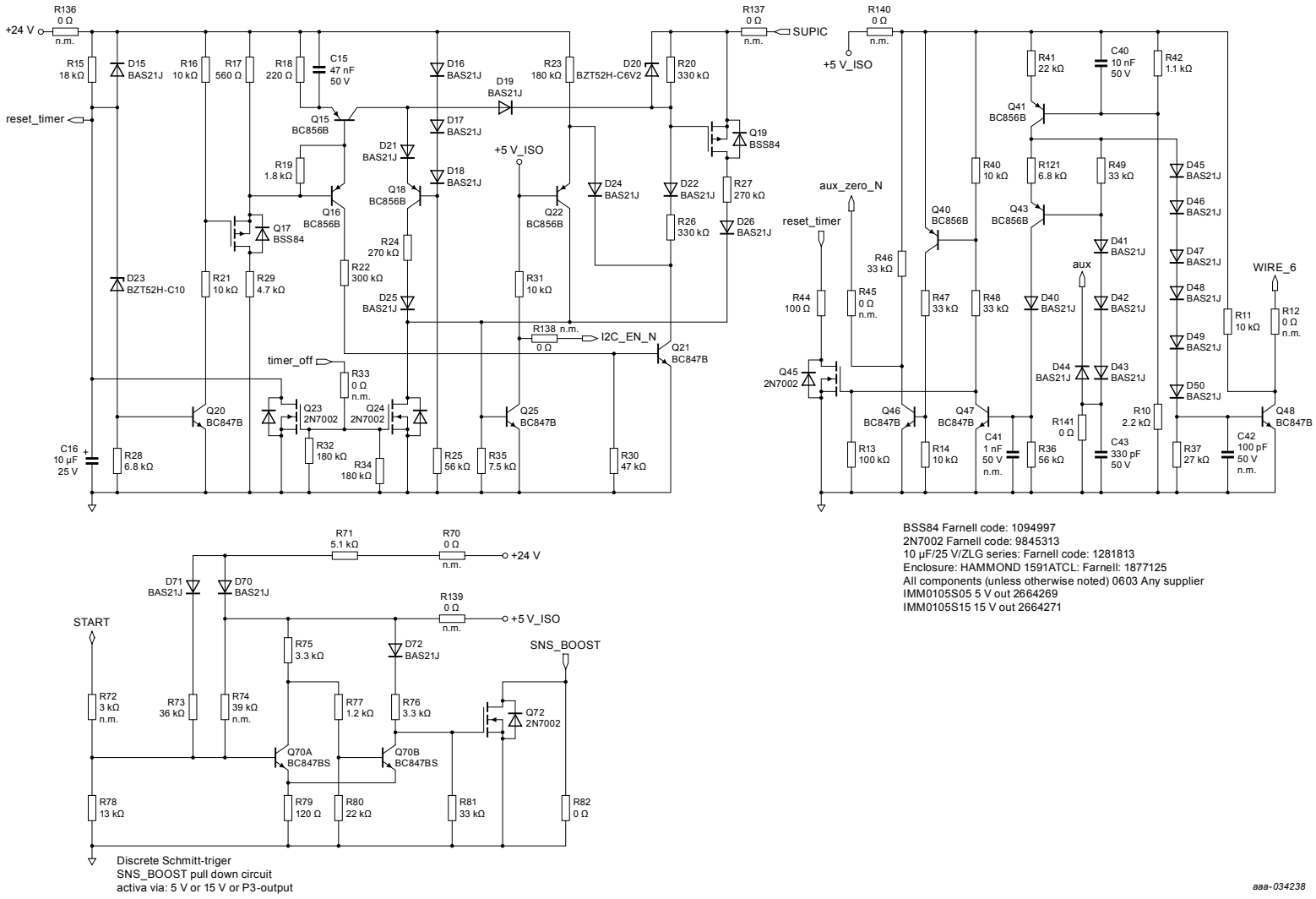


Figure 11. TEA2016DB1514 v.2 USB-I²C interface board: unused functions

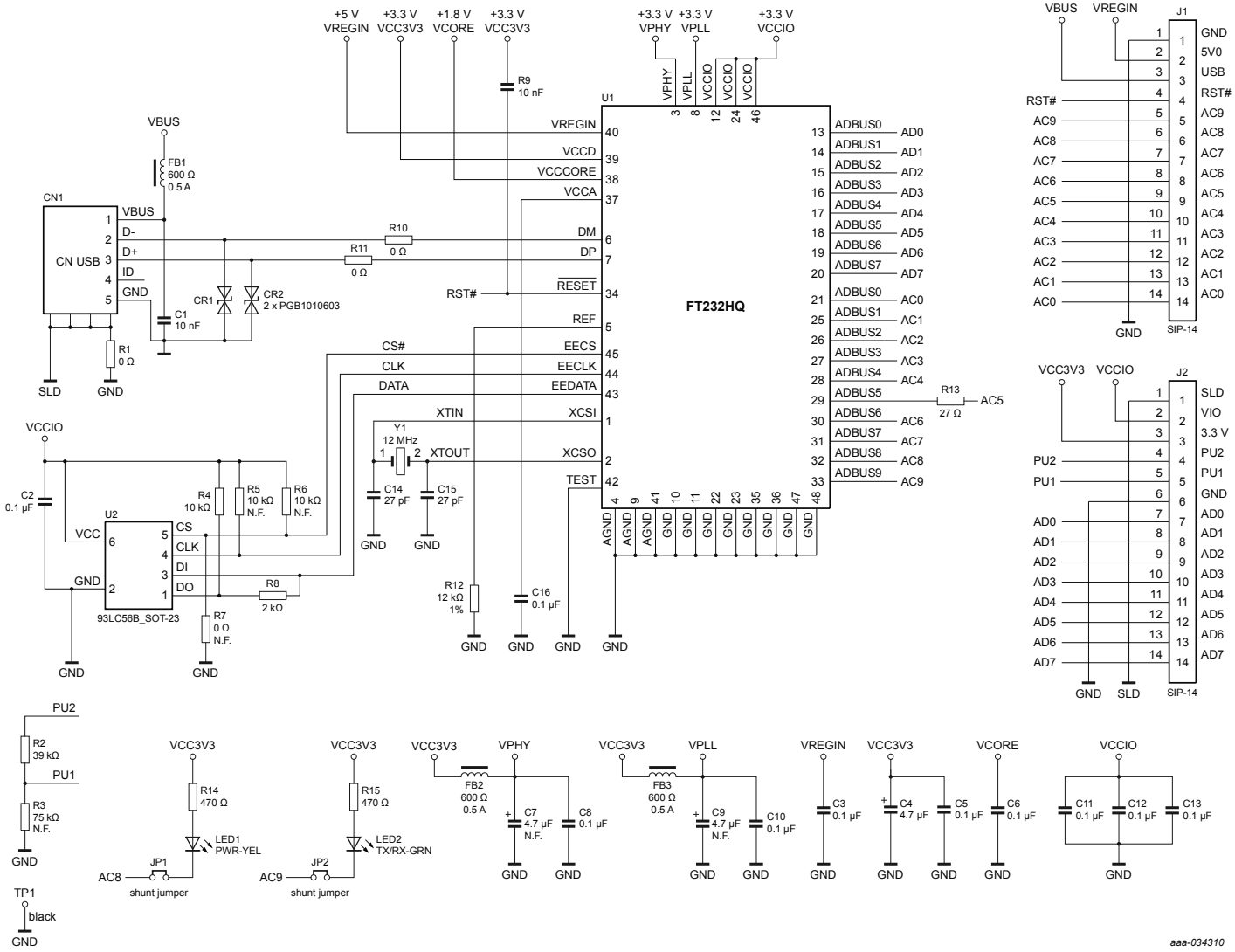


Figure 12. FTDI FT232H development module (mounted as MOD1)

4 References

[1] **UM11219 user manual** — Ringo TEA2016 development software with GUI; 2019, NXP Semiconductors

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Date of release: 27 June 2019
Document identifier: UM11235