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NXP UM12004 TEA2376DK1011 Programming Board

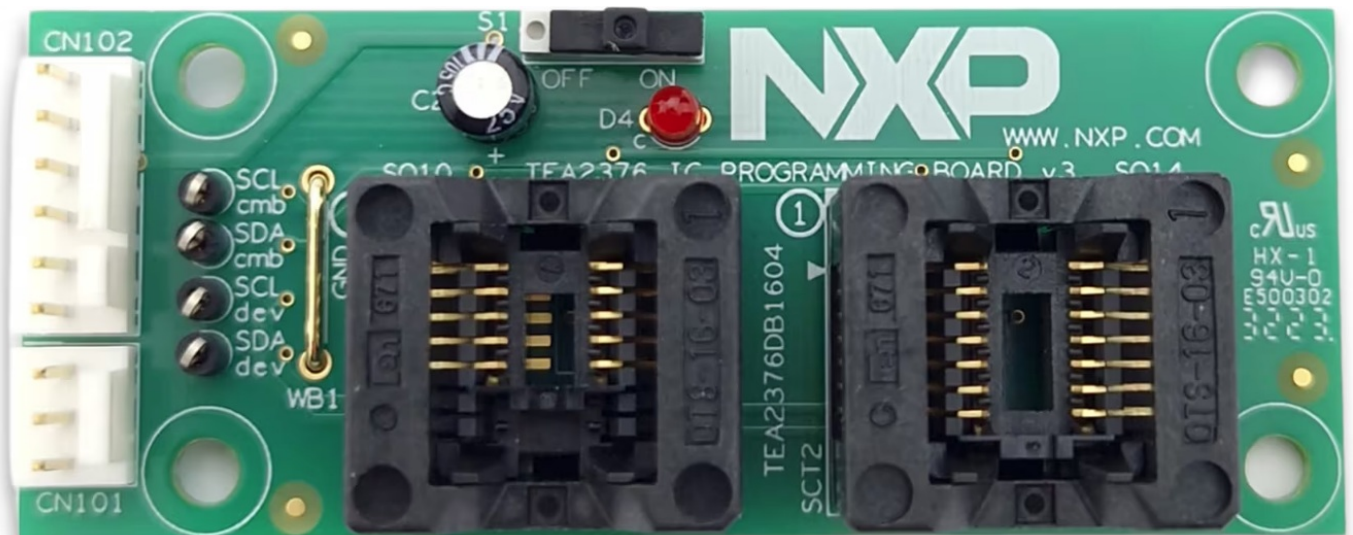# NXP UM12004 TEA2376DK1011 Programming Board User Manual

Contents

NXP UM12004 TEA2376DK1011 Programming Board

Product Information

- **Specifications**
  - **Model:** TEA2376DK1011 programming board and IC samples
  - **Controller:** TEA2376DT interleaved PFC
  - **Communication:** I2C interface
  - **Includes:** 20 TEA2376DT IC samples, 1 TEA2376DB1604v3 programming board

Product Usage Instructions

- **Safety Warnings**
  - When operating the TEA2376DK1011 programming kit, be aware of the following safety warnings:
  - High voltages present pose a risk of electric shock, personal injury, and fire ignition.
  - Operate the product in a designated test area by qualified personnel only.
  - Never leave the product unattended.
- **Kit Content**
  - The TEA2376DK1011 programming kit includes the following:
  - 20 TEA2376DT IC samples
  - 1 TEA2376DB1604v3 programming board
- **Programming Kit Quick Start Guide**
  - **The quick start guide for the programming kit includes the following steps:**
    - Connect the TEA2376DT samples and TEA2376DB1604 programming board as per the provided pin configuration.
    - Refer to the IC pinning diagrams for proper connections.
    - Visit the NXP TEA2376 webpage for additional resources like user manuals, data sheets, and application notes.

FAQs

- **Q: Can the TEA2376DK1011 programming kit be used for commercial purposes?**
  - **A:** No, the kit is intended for engineering development or evaluation purposes only.
- **Q: What is included in the kit?**
  - **A:** The kit includes 20 TEA2376DT IC samples and 1 TEA2376DB1604v3 programming board.

Document Information

Information	Content
Keywords	TEA2376, PFC, interleaved, controller, converter, programmable settings, I^{2}C, TEA2376DB1514, RDK01DB1563, programming kit, quick start guide
Abstract	This user manual describes how to get started with the TEA2376DK1011 programming kit.

Important notice

- **IMPORTANT NOTICE:** For engineering development or evaluation purposes only.

NXP provides the product under the following conditions:

- This evaluation kit or reference design is for use in ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY.
- It is provided as a sample IC pre-soldered to a printed circuit board to make it easier to access inputs, outputs, and supply terminals.
- This evaluation kit or reference design may be used with any development system or other source of I/O signals by connecting it to the host MCU or computer board via off-the-shelf cables.
- The final device in an application will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.
- The product provided may not be complete in terms of required design, marketing, and or manufacturing-related protective considerations, including product safety measures typically found in the end device incorporating the product.
- Due to the open construction of the product, it is the responsibility of the user to take all appropriate precautions for electric discharge.
- To minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.
- For any safety concerns, contact NXP sales and technical support services.

Safety warnings

Open-framed, unenclosed PCB

- This user manual describes the operation of the TEA2376DB1604. The TEA2376DB1604 is provided as an open-framed, unenclosed printed-circuit board (PCB) assembly.
- Use of the TEA2376DB1604 is only intended for development laboratory environments. Only qualified professionals with training, expertise, and knowledge of electrical safety risks in the development and application of high-voltage electrical circuits must use the TEA2376DB1604.
- While the TEA2376DB1604 has been designed with user safety in mind, no agency has formally tested the demo board.
- The TEA2376DB1604 is not intended for and must not be used in a production unit.
- Any use beyond development and testing is strictly prohibited.

Introduction

WARNING: Lethal voltage and fire ignition hazard

- The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire.
- This product is intended for evaluation purposes only.
- It shall be operated in a designated test area by personnel qualified according to local requirements and labour laws to work with non-insulated main voltages and high-voltage circuits.

- This product shall never be operated unattended.
- The TEA2376DK1011 programming kit includes the TEA2376DT interleaved PFC controller ICs and a TEA2376DB1604v3 programming board.
- The TEA2376 is a digitally configurable two-phase interleaved PFC controller for high-efficiency power supplies.
- The PFC operates in discontinuous conduction mode (DCM) or quasi-resonant mode (QRM) with valley switching to optimize efficiency. The TEA2376 is suitable for TV, computing, servers, and industrial power supplies.
- For a low-load operation with good efficiency, phase shedding and burst mode operation are included.
- The TEA2376 supports a high power factor and a low THD.
- It contains many protections, which a GUI can configure independently. The TEA2376 allows an easy-to-design, highly efficient, reliable interleaved PFC with a low external component count for power levels of up to typically 1000 W.
- Included in the box are 20 TEA2376DT IC samples and 1 TEA2376DB1604v3 programming board.
- This user manual and the information on our website get you up and running in no time. For user manuals, data sheets, application notes, software, videos, and brochures, visit the NXP TEA2376 webpage.

Kit content
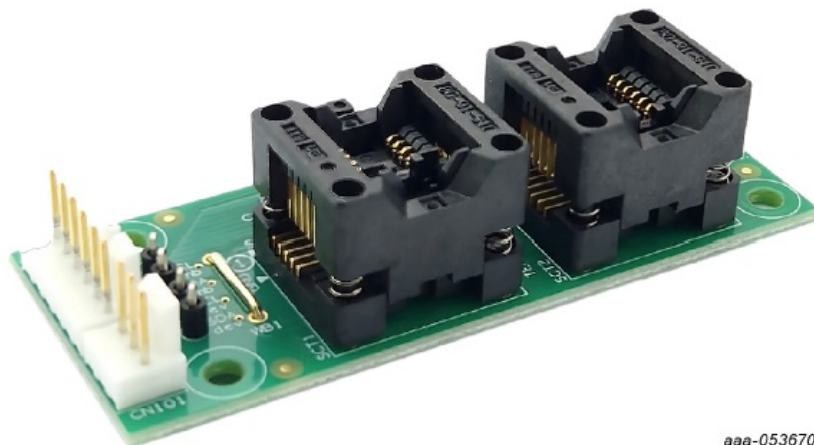
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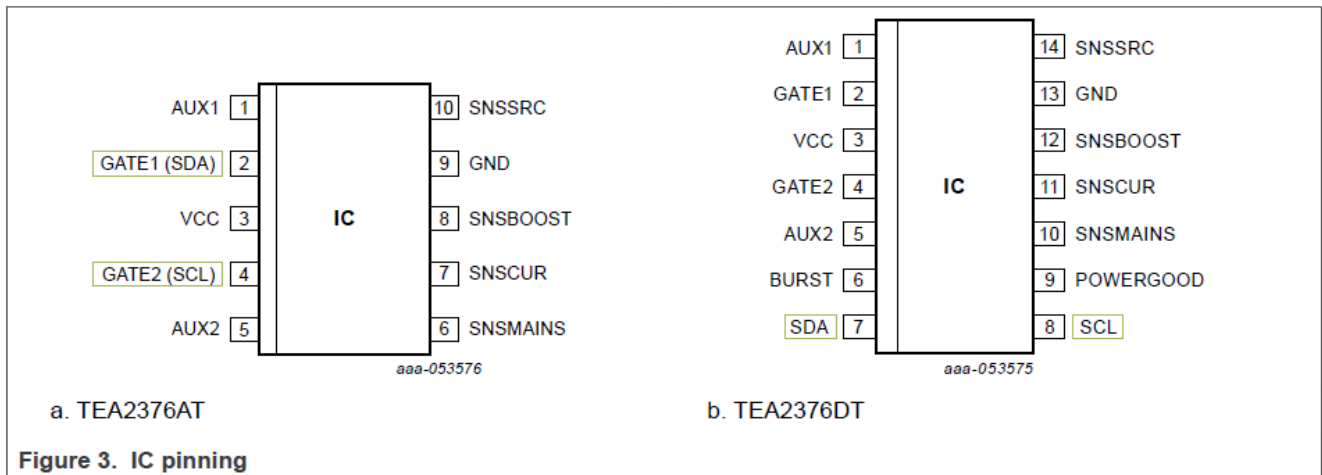**Figure 1. TEA2376DB1604v3 programming board (with SO10 and SO14 socket)**

aaa-053671

Figure 2. 20 TEA2376DT samples and a TEA2376DB1604v3 programming board

Programming kit quick start guide

- **Type:** TEA2376DK1011 GreenChip TEA2376DT samples and TEA2376DB1604 programming board.
- **12nc:** 935504681598

Figure 3. IC pinning

I2C communication pins

- In the SO14 TEA2376DT version, the SDA and SCL connections are available on separate pins for I2C communication during operation.
- This type is very suitable for development work because the settings can be modified "on the fly" in a power supply application (see the TEA2376DK1011 programming board and IC samples (Ref. 1)).
- In the SO10 TEA2376AT version, the SDA and SCL functions are shared on the GATE pins.
- For changing the settings, the IC must be set to the correct state to make the I2C function available on the GATE pins by pulling down SNSMAINS at start-up.
- The PFC operation must be interrupted and an SDA and SCL connection must be created.
- After the modifications have been done, the connection must be removed again. This procedure is automatically arranged in the setup shown in Figure 4 and Figure 5.
- To select the combined GATE-I2C pins, the channel selector on the interface must be set on the "6-pin" connector (see Figure 5).

Additional hardware

- The programming setup requires a computer with a Windows operating system, the TEA2376 Ringo software, an I2C-USB interface with cables (RDK01DB1563) and the TEA2376DB1604v3 programming board.
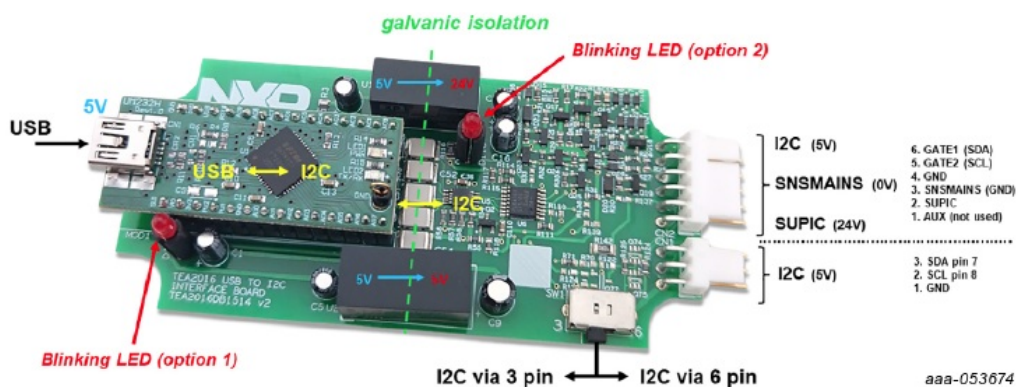
Working with the Ringo software is described in UM12042 TEA2376 Ringo user manual (Ref. 2).

Figure 4. Setup for programming with the Ringo software on a PC

- The I2C-USB interface with cables (the RDK01DB1563 kit) can be used for several other recent NXP power conversion controller ICs, which have settings in MTP.

Figure 5. USB I²C interface board TEA2376DB1514 connections and setup

TEA2376DB1604 board functions

- The TEA2376DB1604 is an IC connection board. It connects the I2C signals to the correct pins and supplies 9 V to the IC VCC via series regulator U4..
- The SO10 IC socket can be used for the TEA2376AT version and the SO14 IC socket can be used for the TEA2376DT version.
- When exchanging IC samples, the VCC voltage can be connected or disconnected using switch S1. A red light from LED D4 indicates that the VCC voltage is applied on the pins.
- Protection diodes D1 and D2 can help to limit overvoltage on the I2C connection, for example, when connecting or disconnecting the cables.
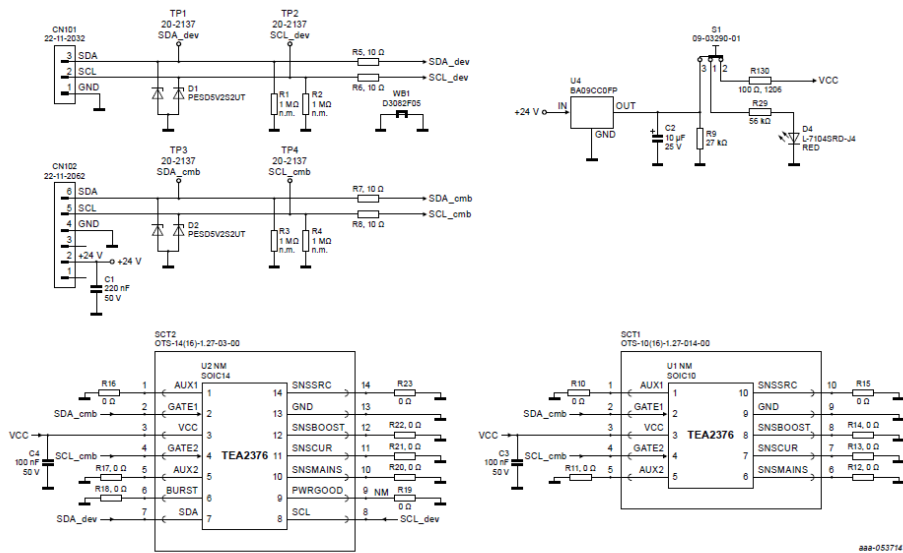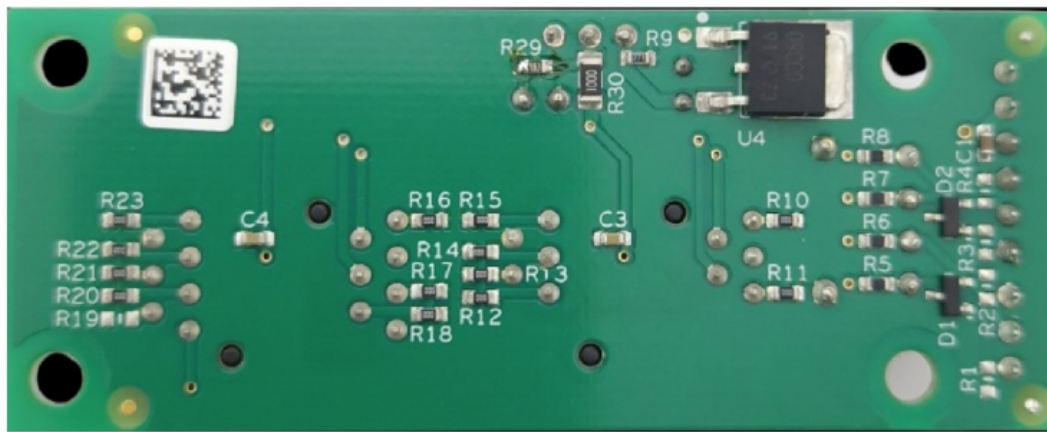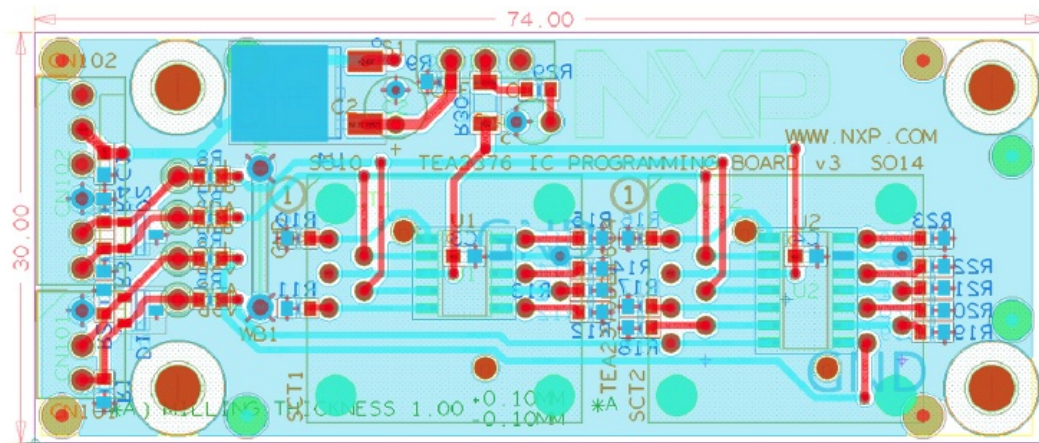- To measure the I2C communication signals, test points TP1 to TP4 can be used.

Schematic

Figure 6. Schematic diagram TEA2376DB1604v3 board

Layout

Figure 7. TEA2376DB1604v3 board picture and PCB design

Frequently asked questions Ringo software

- **Q: Ringo.exe does not start.**
  - **A1:** To enable Ringo software to work, the USB-I2C interface driver (FT232) must be installed on the computer.
  - **A2:** Ensure that you are using a compatible version: 32-bit or 64-bit.

- **A3:** Ringo is made for the Windows operating system. On other operating systems, use a Windows emulator to run Ringo.
- **Q: Can I work with Ringo without the interface connected?**
    - **A1:** Yes, when the USB-I2C interface driver (FT232) is already installed.
    - **A2:** To get started, install the USB-I2C interface driver (FT232) on the computer to enable the Ringo software to work. For the Ringo software to work, the interface must be connected (once) to install the driver.
- **Q: When I connect the USB-I2C interface, it does not work.**
    - **A1:** To make the FT323 module operational, a driver is required. The driver is often automatically installed (plug and play). However, sometimes, a manual installation is required. Watch the video "Installing USB driver manually" on the NXP website. Consult the FTDI website for the latest driver updates.
    - **A2:** When you installed the driver and it still does not work: Completely remove the driver ('delete the driver software for this device') and visit the FTDI chip website for more information on the latest driver version.

USB-I2C interface

- **Q: There is no communication with the IC.**
    - **A1:** Check if the switch on the interface is in the correct position: 3-pin or 6-pin.
    - **A2:** Check if the correct cable is connected (or both cables when using the programming board).
    - **A3:** Check if the signal disturbance is blocking communication.
- **Q: I want to modify or repair the board. Is there a circuit diagram?**
    - **A1:** The circuit diagram is included in the "TEA2016DB1514 USB to I2C hardware interface" user manual (UM11235). This document is available in the help tab of the Ringo software.
- **Q: What is the function of the LEDs on the board?**
    - **A1:** The Ringo software can use them to indicate that the I2C connection is OK. The indication differs between Ringo versions. In general, slow blinking indicates no communication with the IC. And fast blinking indicates correct communication with the IC.
- **Q: Must I buy the RDK01DB1563 kit or can I also build an interface myself?**
    - **A1:** The RDK01DB1563 provides an easy connection with galvanic isolation. It can be used for other NXP products as well. The working of the Ringo software is based on drivers for the UM232H module. It is also possible to use a separate UM232H module from FTDI and apply it in a comparable way as it is used on the TEA2376DB1514v2 board (circuit diagram included in the "TEA2016DB1514 USB to I2C hardware interface" user manual (UM11235)).

Programming Board

- **Q: Which cable do I connect when I want to work with the programming board?**
    - **A1:** Connect the 3-pin and the 6-pin cables and select the correct I2C channel for communication.
    - **A2:** For a TEA2376AT, only the 6-pin cable connection is required.
    - **A3:** For a TEA2376DT, the 3-pin and the 6-pin cables are required.
- **Q: I want to measure signals or modify the board. Is there a circuit diagram?**
    - **A1:** The circuit diagram is included in this document.
- **Q: What is the function of the switch SW1?**

- **A1:** When exchanging IC samples, the VCC voltage can be connected or disconnected using switch S1. A red light from LED D4 indicates that the VCC voltage is applied on the pins.
- **Q: How can I know that the IC is placed correctly in the socket? It fits in two ways.**
  - **A1:** To ensure that the IC is placed correctly, there is a mark for pin 1 on the PCB printing.

Abbreviations

Table 1. Abbreviations

Acronym	Description
DCM	discontinuous conduction mode
GUI	graphical user interface
MTP	multi-time programmable
PFC	power factor correction
QRM	quasi-resonant mode
THE	total harmonic distortion

- **[1] UM12002 user manual —** TEA2376DK1011 programming board and IC samples; 2024, NXP Semiconductors
- **[2] UM12042 user manual —** TEA2376 Ringo GUI; 2024, NXP Semiconductors

Revision history

Table 2. Revision history

Document ID	Release date	Description
UM12004 v.1.0	06 February 2024	• Initial version

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Documents / Resources

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UM12004 TEA2376DK1011 Programming Board, UM12004, TEA2376DK1011 Programming Board, Programming Board, Board

References

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