NXP MR CANHUBK344 Evaluation Board For Mobile Robotics User Manual

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MR CANHUBK344 Software User Manual
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Document Information

Information	Content
Keywords	MR_CANHUBK3, MR_CANHUBK344, Ethernet to CAN, CAN to Ethernet, IEEE 1722, A CF-CAN, S32K344, FS26, SE050, TJA1103, TJA1443, TJA1463, TJA1153.
Abstract	Software User Manual for IEEE1722 CAN over Ethernet example. Package contents, instructions, open issues, fixes and limitations.

Contents

Introduction

This document is the release notes for the MR-CANHUBK344 demonstration software, which converts Ethernet to CAN and CAN to Ethernet using the IEEE 1722 ACF-CAN protocol.

The user manual also describe the kit's contents, open issues, changes, fixes, and limitations of the released version.

This release of the switch code supports all six CAN ports and 100BASE-T1 Ethernet port. The 100BASE-T1 port has automatic mode detection enabled, so no further adjustments are needed.

Note: Other code examples specific to Mobile Robotics team, vehicle software stacks, and associated RTOSs may be found elsewhere on **nxp.com/mr-canhubk344**.

1.1 Abbreviations

Table 1. Abbreviations

Term	Description
IEEE 1722	Layer 2 transport protocol working group for time-sensitive streams.
100BASE-T1	Full-duplex single twisted pair ethernet
CAN	Controller Area Network 1 Mbps "classical CAN", although may sometimes be inclusive of CAN- FD.
CAN FD	CAN Flexible Data rate (up to 8 Mbps)
CAN SIC	CAN FD using Signal Improvement CAN PHY
CAN SCT	CAN FD using Secure CAN Transceiver
JTAG	Joint Test Action Group, interface commonly used for software debugging
KB	1024 bytes
MAC	Media Access Control, a MAC address is a so called physical address
Mbit/s	Million bits per second (10^6 bits/s)
NFC	Near Field Communication
PCB	Printed Circuit Board
SDK	Software Development Kit

MR-CANHUBK344 kit content

The released package consists of:

- Hardware:
  - MR-CANHUBK344 board
  - DCD-LZ Programming Adapter board (giving access to a console UART)
  - USB-UART adapter cable (attaches to DCD-LZ)
  - Power adapter cables, including JST-JH to common red SY connector, barrel connector, XT-60 Lipo battery connector
  - 6x CAN cables
  - 6x CAN Termination boards
  - 1x T1 Ethernet cable (using JST-GH connectors)
  - Generic JST-GH cables for UART/SPI/I2C/customizing to your specific needs.
  - Small OLED display
  - NFC antenna connected to secure element.
- Documentation and software:
  - **MR-CANHUBK344 HW User Manual**
  - **MR-CANHUBK344 HW design package**
  - **MR-CANHUBK344 SW User Manual**
  - **S32 Design Studio project file**

Changes

Table 2. Changes

Item	Description
Release package	MR-CANHUBK344 IEEE1772 ACF-CAN over ethernet demo
Documentation	

Limitations

Table 3. Limitations

Item	Description
Software stack	**Limitation:** (none currently reported) **Impact:**

Known issues

Table 4. Known issues

Item	Description
Hardware bugs PCB version1	**Limitation:** (None currently reported). **Impact:**

Board connections

The MR-CANHUBK344 board includes several interfaces. The board is designed for testing within the application space of small mobile robotics. This has defined the use of Linux foundation DroneCode connectors. These cables are easily assembled and customized using housings and pre-crimped cables. There is the added benefit of many off-the-shelf modules being able to plug in directly. Cables are typically provided in the kit and may need to be cut or modified for your specific needs.

6.1 Power input

The power input connection and PMIC support a wide input voltage range from 5 V to 40 V and are suitable for direct connection to a battery. For example, a 12 V car battery or a 2 S, 3 S, 4 S LiPo battery.

Figure 1. Power input
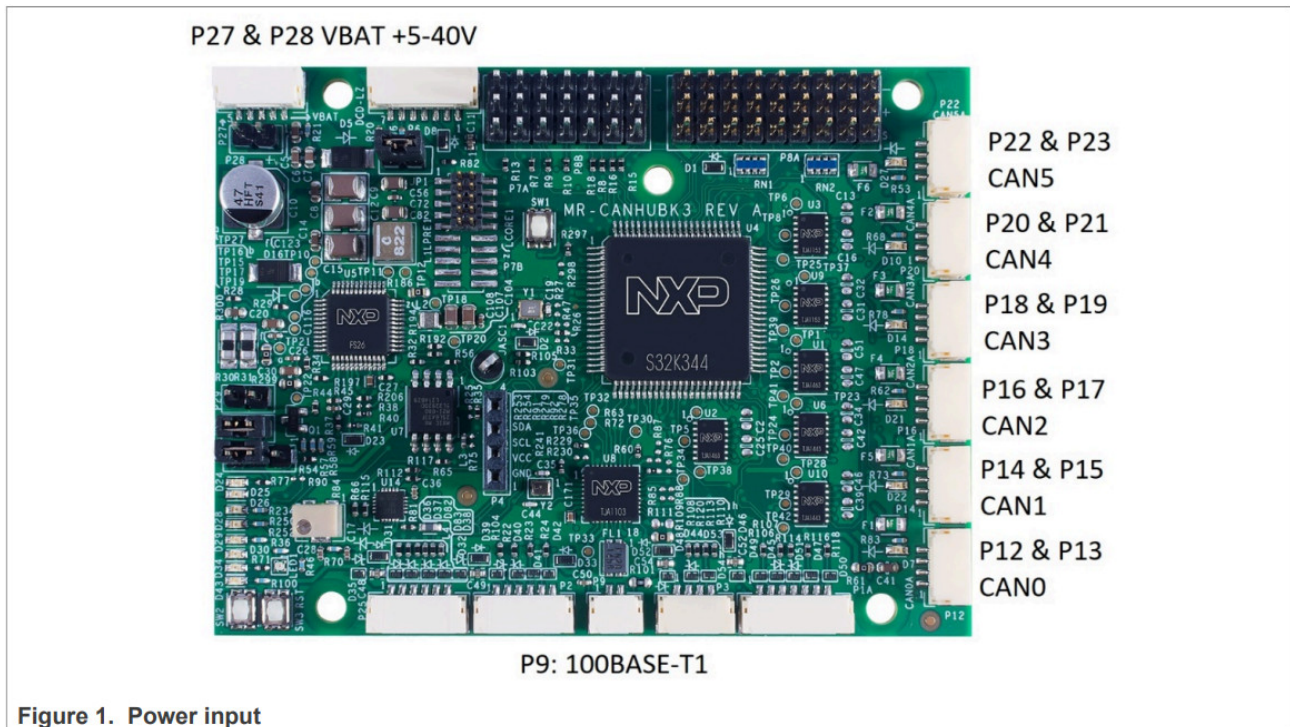
The power is to be supplied at the five-pin P27 (Pin 1-2 power, Pin 3 NC, Pin 4-5 ground) connector at the top left corner of the board (see Figure 1) or at the two-pin P28 connector (Pin 1 power, Pin 2 ground). The board draws roughly 100 mA @ 12 V.

6.2 CAN bus connections

P12-P23 are CAN connectors with following pinout.

Table 5. CAN connectors pinout

Pin #	Signal	Specification
1	5V4	5.4 V
2	CANx_H	5.0 V
3	CANx_L	5.0 V
4	GND	0 V

A CAN bus generally requires termination at both ends; assuming this CANHUBK344 is at one end of the bus, connecting one of the included CAN-TERM termination boards on the corresponding CAN connector accomplishes termination for this end.

The CAN ports on MR-CANHUBK344 sources 5 V power on pin 1 to connected devices. You may gently remove the Pin1 wire on the connector if this is not required.

Note that while these CAN-TERM boards may be able to inject 5 V through the USB connector interface, you should take extra care and consideration to validate that this is what you intend for your system.

6.3 100Base-T1 Ethernet connection

The T1 connector (P9) is a 2-pin JST-GH connector for two wire 100 Mbps ethernet. The signals are capacitively coupled and are polarized P and N. On this board, the TJA1103 T1 interface chip autonegotiates the polarity if it is reversed. This cable connects directly to other Mobile Robotics boards such as **UCANS32K1SIC**, **UCANS32K1SCT**, **RDDRONET1ETH8**, and **NavQPlus**.

RDDRONE-T1ADAPT may translate to an RJ45 connection type. Alternatively, you can adapt this cable to other connector types as required, by cutting the cable and soldering to the wires.

On the back of the PCB, there is a yellow LED (D88) that shows the link status. If it is flashing, it means there is a link.

6.4 Main semiconductor components

This compact board holds some key components, which are briefly described in this section. More detailed documentation on these components can be found online.
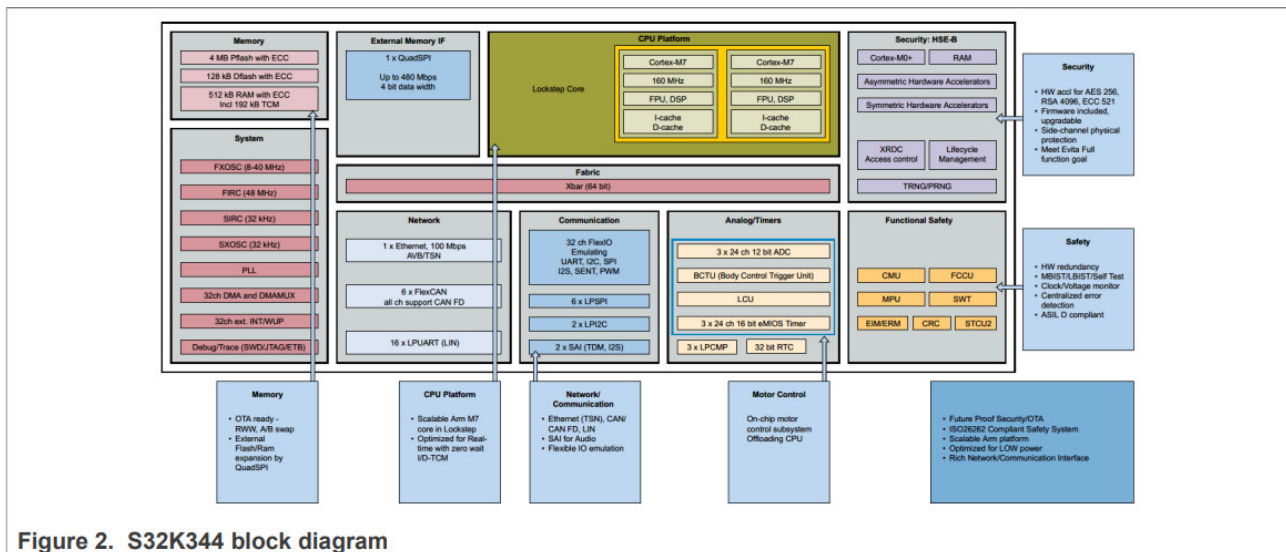
6.4.1 S32K344 MCU

Figure 2. S32K344 block diagram

S32K344 is an automotive general purpose MCU of NXP Semiconductors. Figure 2 shows the block diagram of this chip. The software discussed in this document runs on the Lockstep Arm Cortex M7 embedded in this chip.

Note: There are equivalent versions of this chip where the two cores can run independently (S32K324).

6.4.2 FS26 Functional safety SBC

F26 is the 'Safety System Basis Chip with Low Power Fit for ASIL D' of NXP Semiconductors. Figure 3 shows the block diagram of this power supply chip. Although capable of much more, in this design it allows for a compact power supply design and high input voltage.

The FS26 is connected through SPI to the S32K344 and implements a challenger window watchdog. Sending challenges to the through SPI S32K344 as the window watchdog when the response is invalid or not during the timing window the FS26 will reset the S32K344 MCU. In this included sample code, the challenge watchdog functionality has not been implemented. Instead during startup of the S32K344 the sample application sends a request to the FS26 to disable the watchdog functionality thus avoiding the S32K344 will go into reset.
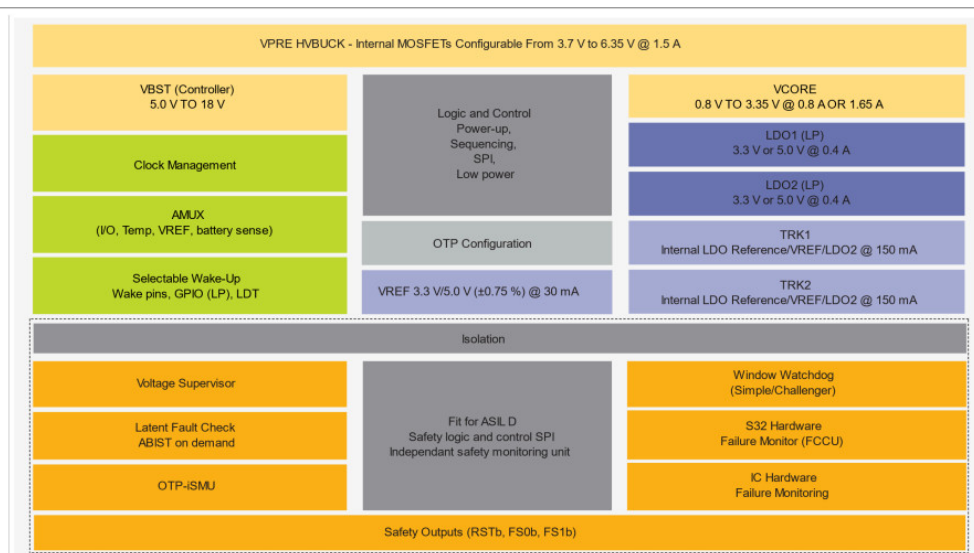
Figure 3. FS26 block diagram

Board power up sequence

As described in Section 6.4.2, the FS26, by default, implements a challenger window watchdog that resets the S32K344 MCU continuously if the challenge is not managed.

To circumvent this, the FS26 must enter into debug mode. This is done by removing JP1, supplying 12.0 V on P27 or P28, and inserting the JP1 jumper.

Once completed, the reset LED D24 stops blinking, indicating that the S32K344 does not reset continuously by the FS26.
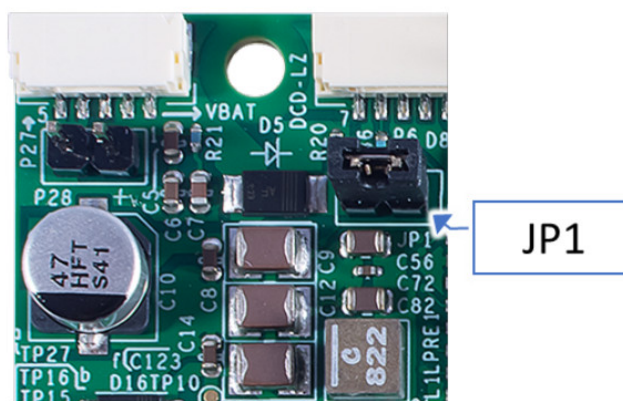

Figure 4. Power connectors and debug mode jumper

S32 design example project

The included MR_CANHUBK3_IEEE1722.zip **project file** is compatible with **S32 Design Studio for S32 Platform version 3.4**.

Note: The S32DS version 3.4 is located under previous tab.

Figure 5. Automotive SW - S32K3 - S32 Design Studio (previous tab)

The following extensions are required to build the project:

- **FreeRTOS for S32K3 2.0.0**
- **S32K3 RTD AUTOSAR 4.4 Version 2.0.0**
- **S32K3xx development package Version 3.4.3**

Figure 6 gives an overview what the S32 Design Studio extension manager should show. Click on Add Update Sites link to add manually downloaded update site files.
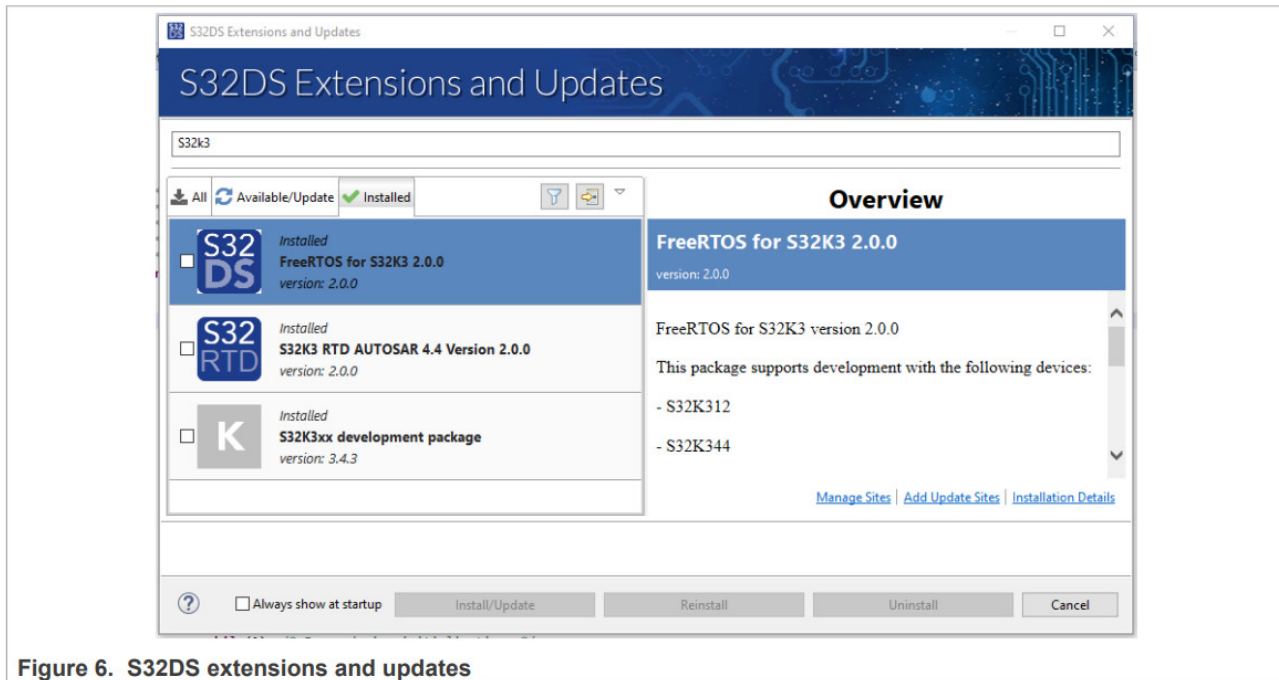

Figure 6. S32DS extensions and updates

To import the included MR_CANHUBK3_IEEE1722.zip , open File -> Import -> General -> Project from folder or archive and then select the Project.zip archive.

After the project has imported, right click on "MR_CANHUBK3_IEEE1722" in the projects explorer and select S32 Configuration Tools -> Open Pins.

The S32 Pin tool perspective view appears and in the menu there is a button "Update Code" and select "OK" now the driver configuration files are generated.

Go back to the Project Explorer right click on "MR_CANHUBK3_IEEE1722" and select "Build Project". Now you can flash the "MR_CANHUBK3_IEEE1722.elf" using your programmer.

See **Getting started with S32K3 & S32DS** guide, for more information regarding S32 Design Studio, S32 configuration tools, and debugging.

8.1 Application

After MR_CANHUBK3_IEEE1722 is successfully flashed on the MR-CANHUBK344 board, it acts as an ETH <> CAN IEEE1722 protocol converter.

CAN messages received on CAN0 through CAN5 are converted to an IEEE1722 ACF-CAN fame and are broadcasted to the ethernet. To view incoming CAN frames, you can install WireShark on a Windows/Linux machine (**https://www.wireshark.org/**).

Note: The 100BaseTx to 100BASE-T1 media converter tool (not included with the board) is necessary for debugging Ethernet frames. You may use for example **NXP RDDRONE-T1ADAPT**.

You can also simulate CAN messages by pressing SW1 or SW2.

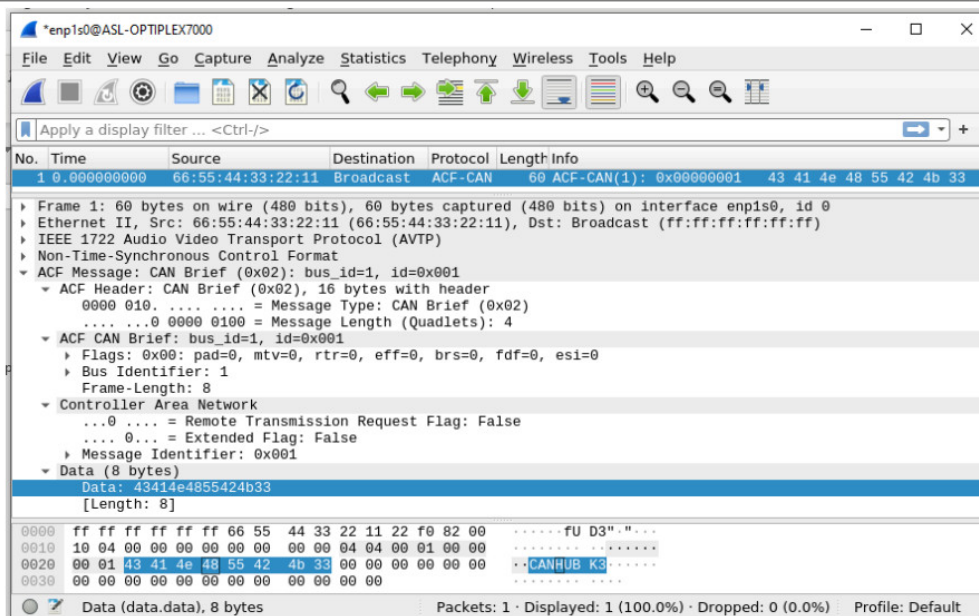SW1 sends a CAN message to CAN0 and SW2 sends a CAN message to CAN1.

Figure 7. WireShark tool

You can connect CAN0 (P12) back to CAN1 (P14) to create a bus using included cable for a setup without CAN peripherals. Also, connect the CAN-Term board to P13 to terminate the bus. When pressing either SW1 or SW2, both LEDs D7 and D22 turn on indicating there's CAN packet. When connected to a PC running WireShark, it shows there's a CAN packet send using IEEE1722 as shown in Figure 6.

8.2 Board Status LEDs

The MR-CANHUBK344 has various LEDs to indicate status as shown in Table 6. Under normal circumstances, the state of the LEDs is shown in the following table:

Table 6. Board Status LEDs

| Dxx	LED name	Normal state	Description
D24	RESET_K3	Off	Indicates if the S32K344 is in reset
D25	P1V8_TRK2	On	Indicates FS26 SBC 1V8_TRK2 status
D26	P3V3_TRK1	On	Indicates FS26 SBC 3V3_TRK1 status
D28	P3V3_LDO2	On	Indicates FS26 SBC 3V3_LDO2 status
D29	P3V3_LDO1	On	Indicates FS26 SBC 3V3_LDO1 status
D30	VBATP_SW	On	Indicates VBAT status
D34	V15_MCU	On	Indicates FS26 SBC V15 status
D43	P5V4	On	Indicates FS26 SBC P5V4 status
LED1	RGB Status LED	Green	Controlled by the software, green indicates normal operation, blue indicates initialization, red indicates that an error has occurred.
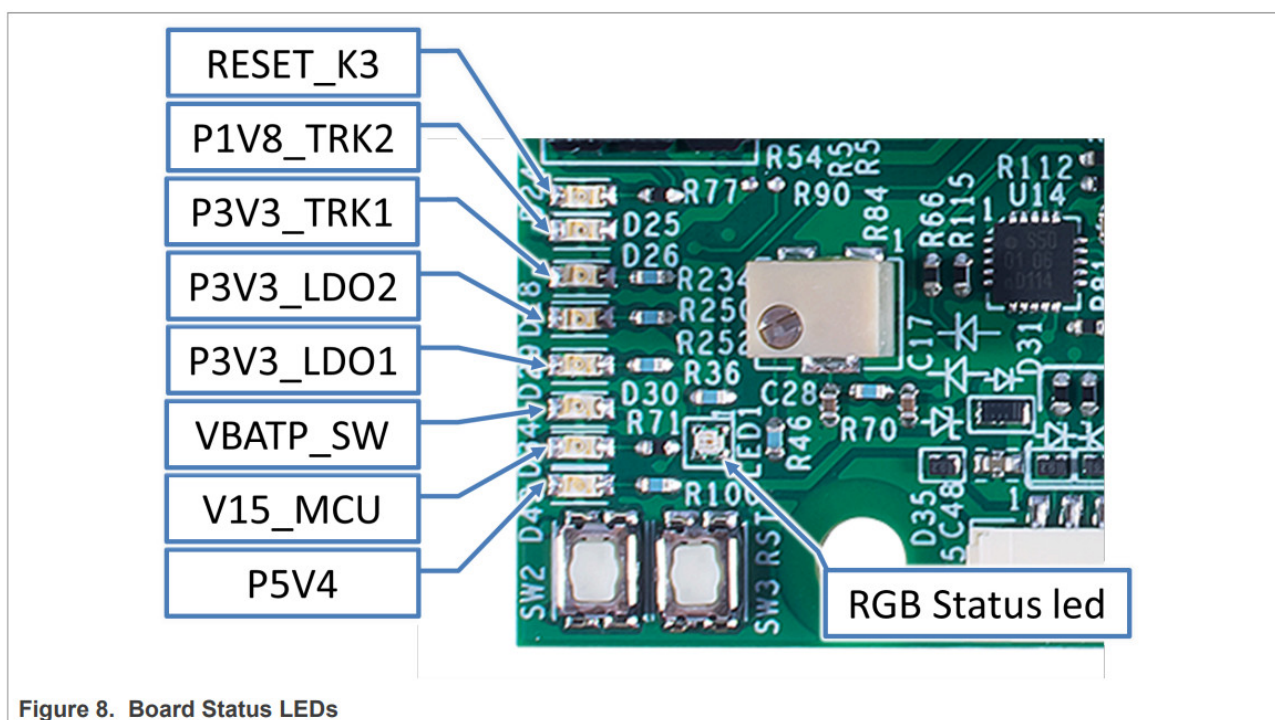
Figure 8. Board Status LEDs

Revision history

Table 7. Revision history

Rev. No.	Date	Substancial changes
0	August 2023	Initial version

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