MR-CANHUBK344 Software User Manual

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User Manual
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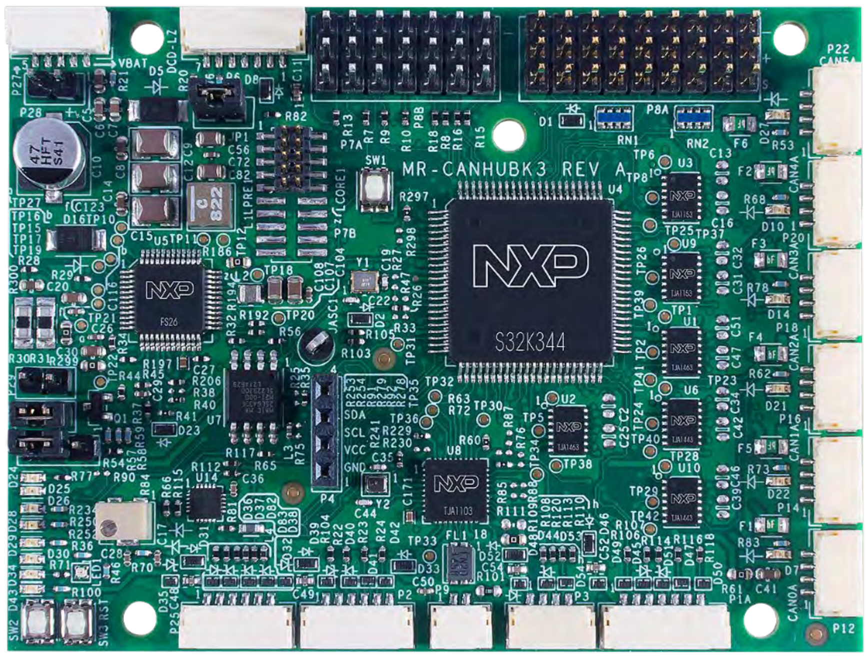

Document information

Info	Content
Keywords	MR-CANHUBK344, MR-CANHUBK344, S32K344, FS26, SE050, TJA1103, TJA1443, TJA1463, TJA1153
Abstract	Software Release notes for IEEE 1722 CAN over Ethernet example. package contents, instructions, open issues, fixes and limitations.

Revision history

Rev	Date	Description
0.1	05/30/2023	SW User Manual for MR-CANHUBK344

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1. 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 release notes also describe the contents of the kit, open issues, changes, fixes and limitations of the released version.

This release of the switch code supports all 6 CAN ports and 100BASE-T1 Ethernet port. The 100BASE-T1 port have automatic mode detection enabled so no further adjustments are needed.

Note that 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

IEEE 1722	Layer 2 transport protocol working group for time-sensitive streams
100BASE-T1	Full-duplex single twisted pair ethernet
CAN	Controller Area Network 1Mbps “classical CAN”,
	although may sometimes be inclusive of CAN FD
CAN FD	CAN Flexible Data rate (up to 8Mbps)
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.
Mbps	Million bits per second (10^6 bits/s)
NFC	Near Field Communication
PCB	Printed Circuit Board
SDK	Software Development Kit

2. Contents

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 SW User Manual
    - `MR_CANHUBK3_IEEE 1722.zip` S32 Design Studio project file

3. Changes

Table 1. Changes

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

4. Limitations

Table 1 Limitations

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

5. Known issues

Table 2 Known issues

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

6. Board connections

The MR-CANHUBK344 board includes several interfaces. The board has been designed for testing within the application space of small mobile robotics. This has defined the use of Linux foundation DroneCode connectors. These cable 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 otherwise modified for your specific needs.

6.1.1 Power input

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

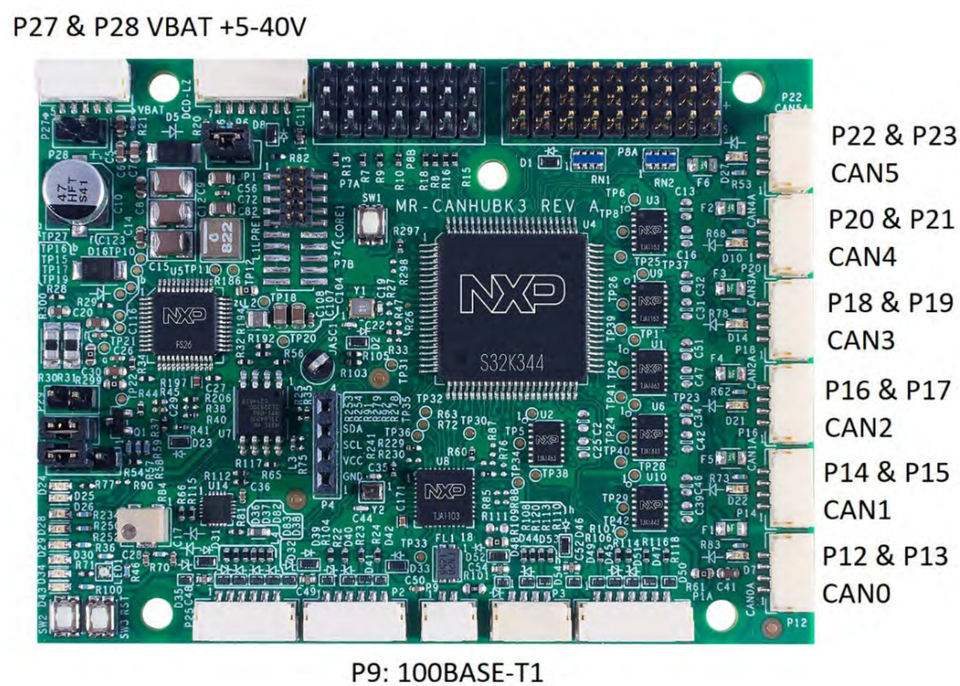


Figure 1 Connector locations MR-CANHUBK3 for the demo software

The power is to be supplied at the 5 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). The board draws roughly 100mA @ 12V.

6.1.2 CAN bus connections

P12-P23 are CAN connectors with following pinout.

pin #	signal	specification
1	5V4	5.4V
2	CANx_H	5.0V
3	CANx_L	5.0V
4	GND	0V

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 will accomplish termination for this end.

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

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

6.1.3 100Base-T1 Ethernet Connection

The T1 connector (P9) is an 2 pin JST-GH connector for 2 wire 100Mbps ethernet. The signals are capacitively coupled and are polarized P and N. On this board the TJA1103 T1 interface chip will auto-negotiate the polarity if it is reversed.

This cable will connect directly to other Mobile Robotics boards such as the UCANS32K1SIC, the UCANS32K1SCT, the RDDRONE-T1ETH8 and NavQPlus. RDDRONE-T1ADAPT may be used to translate to an RJ45 connection type.

Alternatively you may adapted this cable to other connector types as needed, by cutting the cable and soldering to the wires.

The Amber LED (D88) at the backside of the PCB indicates the link status. When flashing it indicates there is a link.

6.2 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 on-line.

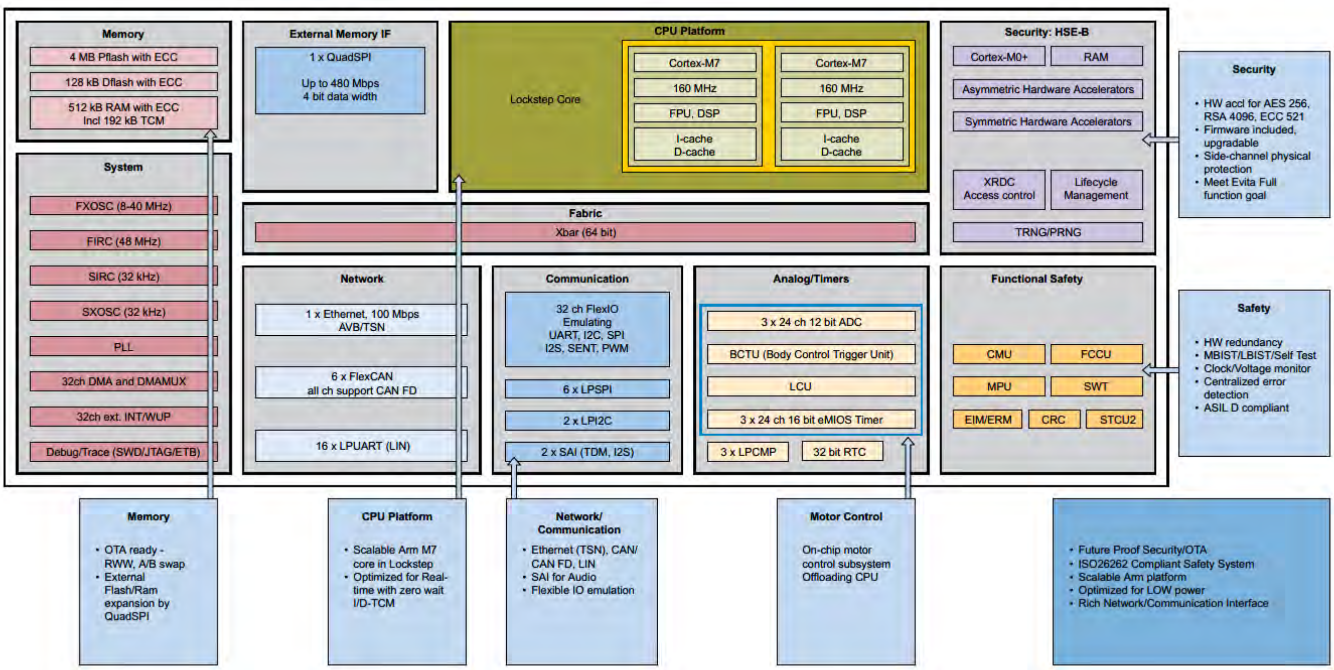


Figure 2 S32K344 Block diagram

6.2.1 S32K344 MCU

The S32K344 is an Automotive General Purpose MCU of NXP Semiconductors. Figure 2 gives the block diagram of this chip. The software discussed in this document is running on the Lockstep Arm Cortex M7 embedded in this chip. Note there are equivalent versions of this chip where the two cores are able to run independently (S32K324)

6.2.2 FS26 Functional Safety SBC

The FS26 is the '*Safety System Basis Chip with Low Power Fit for ASIL D*' of NXP Semiconductors. Figure 3 gives 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.

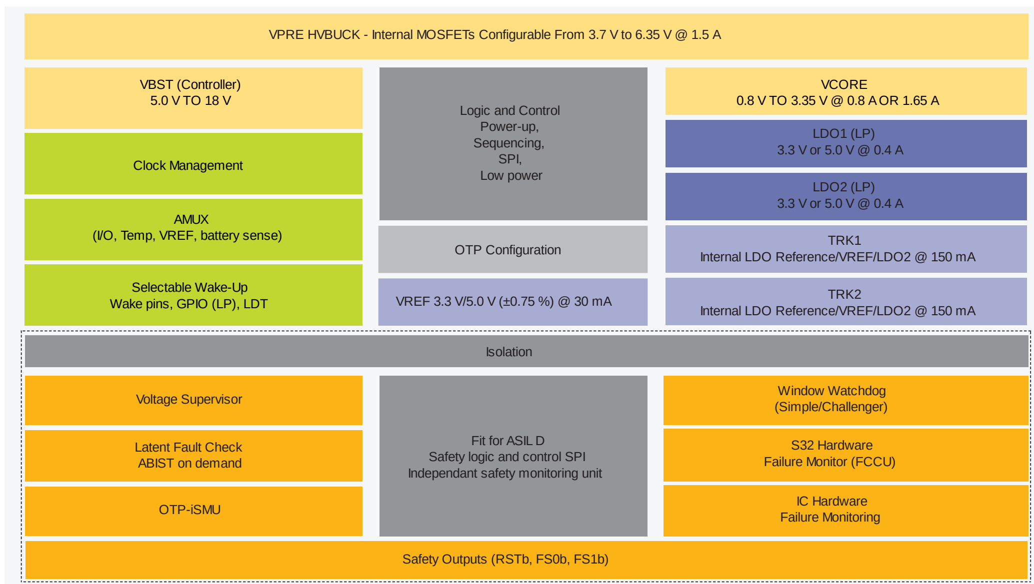


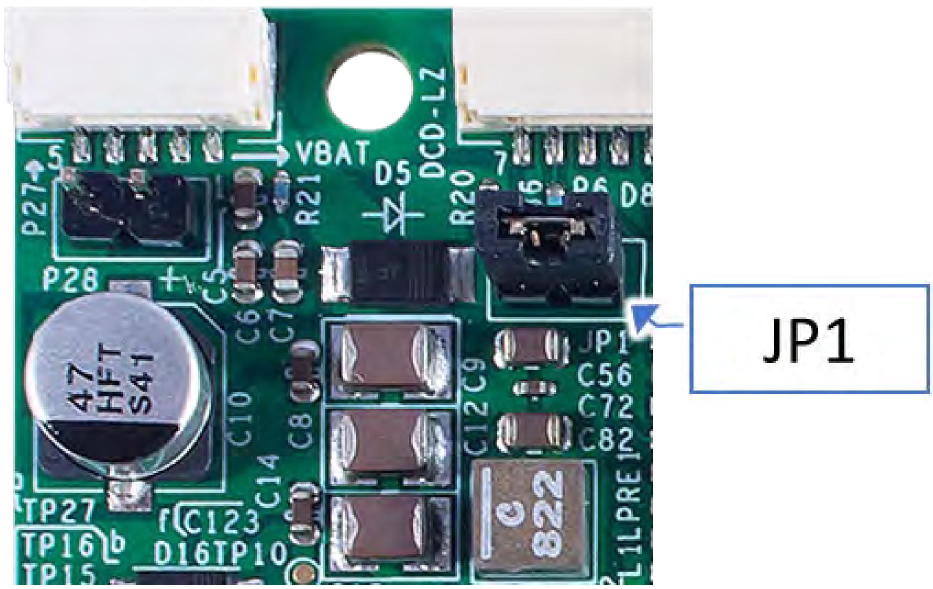
Figure 3 FS26 Block diagram

7. Board bring up

As described in 6.1.2, the FS26 by default implements a challenger window watchdog that will reset the S32K344 MCU continuously if the challenge is not handled.

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

Once this is done, the reset LED D24 should no longer blink, indicating the S32K344 will not be reset continuously by the FS26.



8. S32 Design Example project

The included `MR_CANHUBK3_IEEE 1722.zip` project file is compatible with S32 Design Studio for S32 Platform version 3.4

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

FreeRTOS needs to be downloaded from S32K3 Reference Software package

Figure 4 gives an overview what the S32 Design Studio extension manager should show.

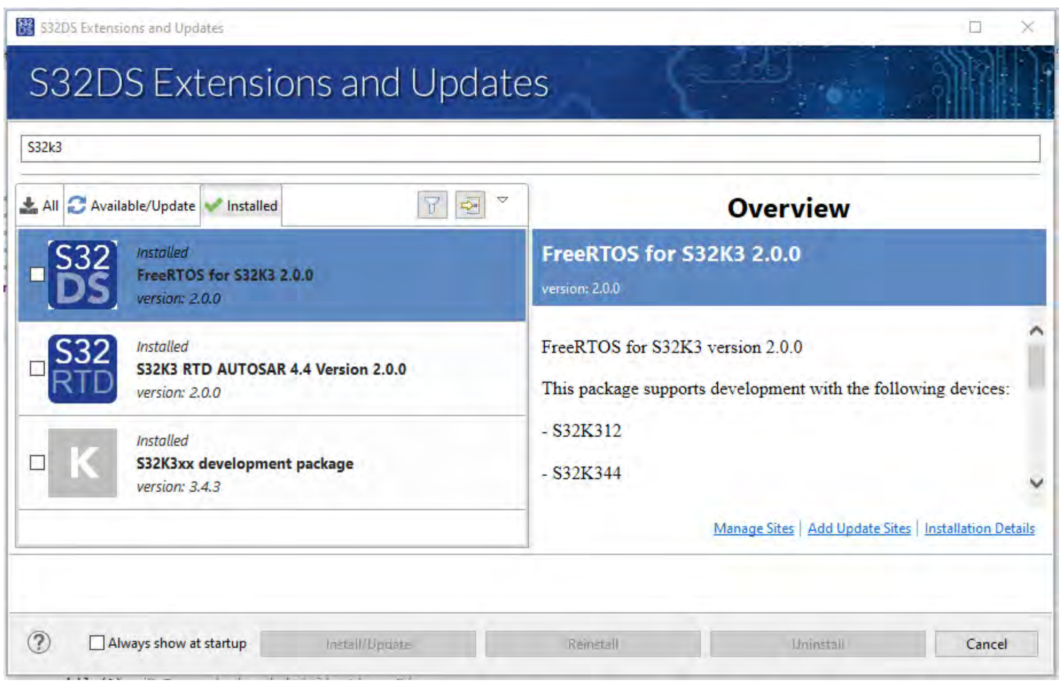


Figure 4 Required S32 Design Studio 3.4 extensions

To import the included `MR_CANHUBK3_IEEE 1722.zip`, open *File -> Import -> General -> Project* from Folder or Archive and then select the `Project.zip` archive.

Once the project has been imported, right click on “MR_CANHUBK3_IEEE 1722” in the projects explorer and select *S32 Configuration Tools -> Open Pins*.

The S32 Pin tool perspective view will appear and in the menu there’s a button “Update Code” and select “OK” now the driver configuration files will be generated.

Go back to the Project Explorer right click on “MR_CANHUBK3_IEEE 1722” and select “Build Project”. Now you can flash the “MR_CANHUBK3_IEEE 1722.elf” using your programmer.

For more information regarding S32 Design Studio, S32 Configuration Tools and debugging please refer to the to the “Getting started with S32K3 & S32DS” guide

8.1.1 Application

Once “MR_CANHUBK3_IEEE 1722” has been successfully flashed on the MR-CANHUBK344 board, it will act as an ETH <-> CAN IEEE 1722 protocol converter.

CAN messages received on CAN0 through CAN5 will be converted to an IEEE 1722 ACF-CAN fame and will be broadcasted to the ethernet. To view incoming the CAN frames you can install Wireshark on a Windows / Linux machine.

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

SW1 will send a CAN message to CAN0 and SW2 will send a CAN message to CAN1.

For a setup without CAN peripherals, you can connect CAN0 (P12) back to CAN1 (P14) to create a bus using included cable. 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 briefly indicating there’s CAN packet.
When connected to a PC running Wireshark it will show there’s a CAN packet send using IEEE 1722 as shown in Figure 5.

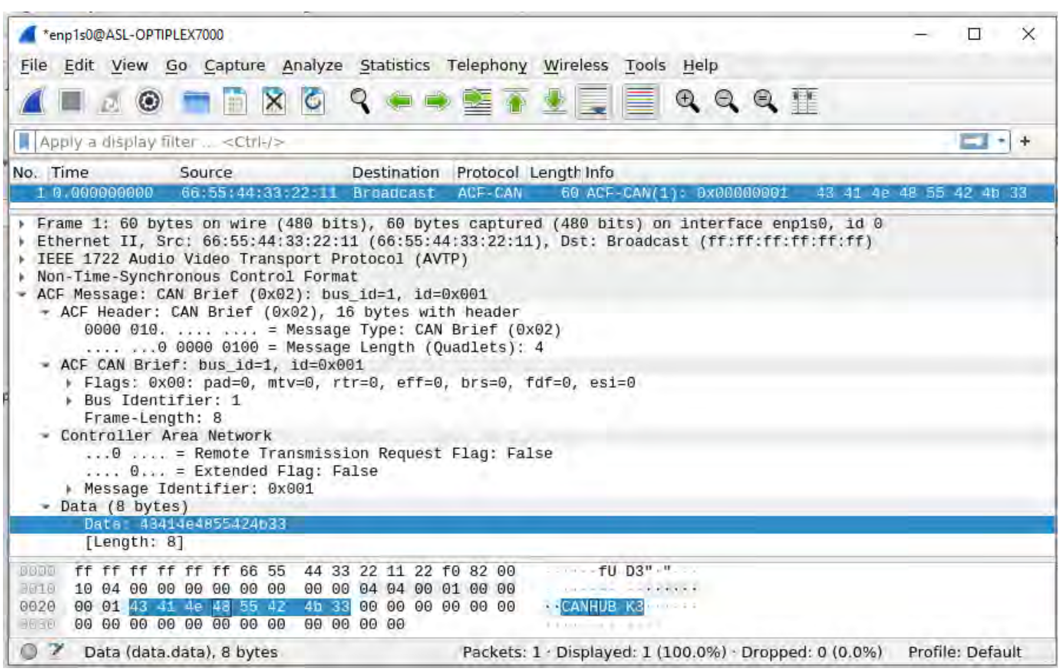


Figure 5 Wireshark output of an IEEE 1722 ACF-CAN Frame

8.1.2 Board status LEDs

The MR-CANHUBK344 has various LEDs to indicate status as shown in Figure 6. Under normal circumstances the state of the LEDs should as indicate in the table below.

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.

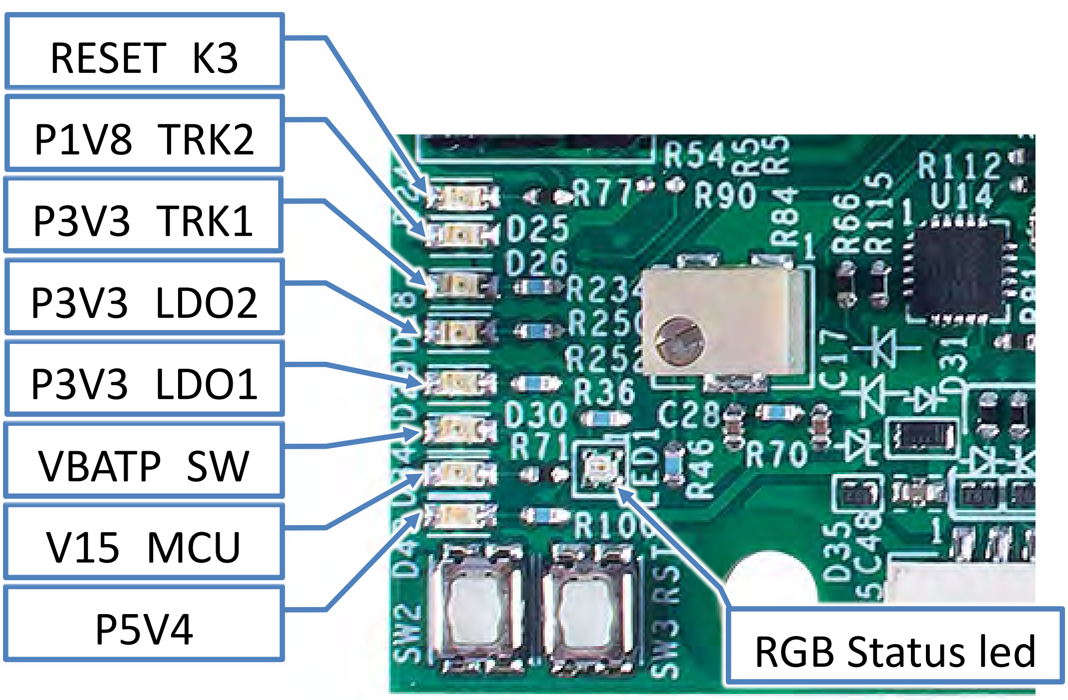


Figure 6 Led overview

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