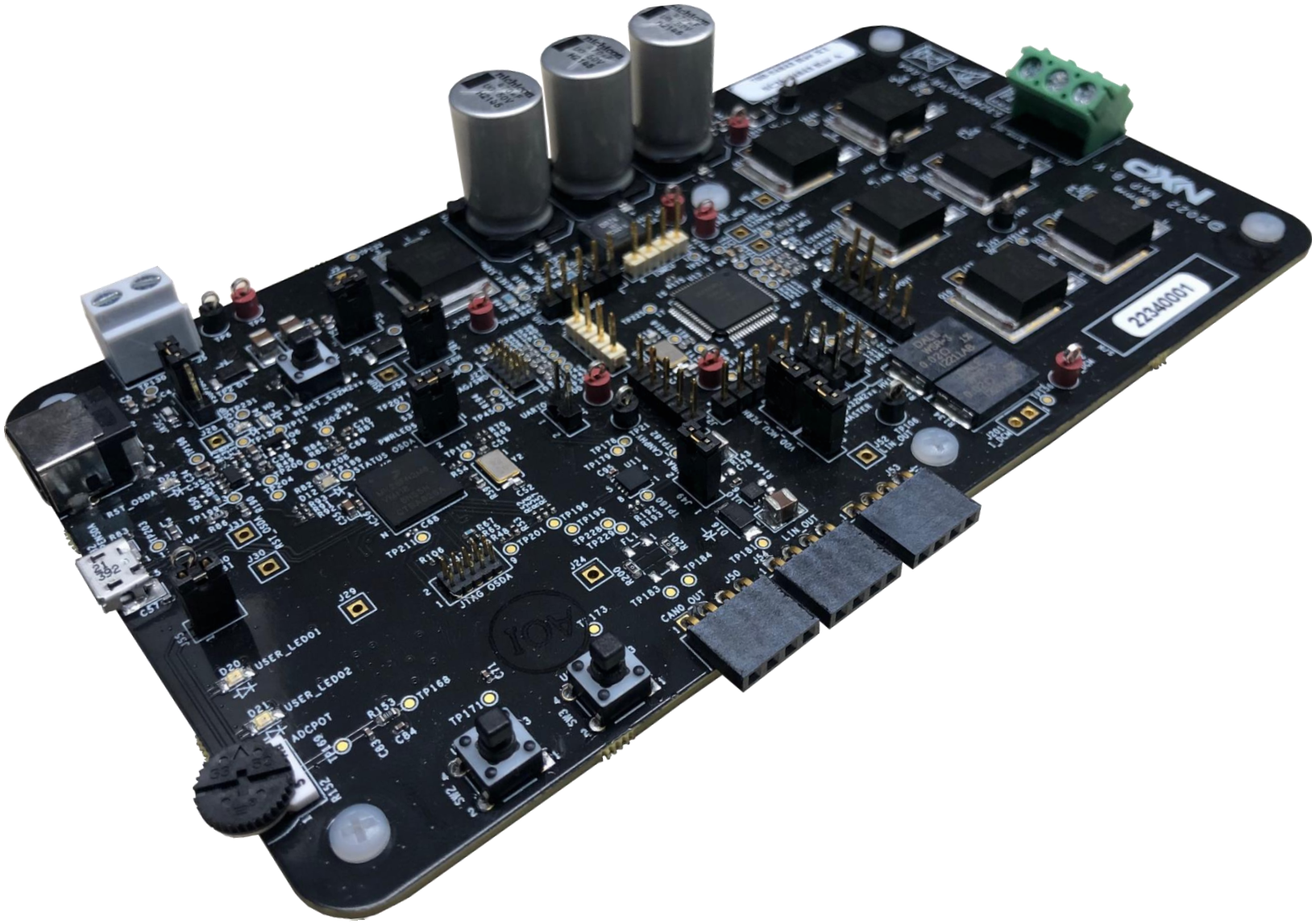
S32M24xEVB-L064

Evaluation Board for **S32M24x LIN MCUs**
Hardware User Manual



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1. Table of contents

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2. Definitions, Acronyms, and Abbreviations

The following list defines the abbreviations used in this document.

BST	Boost
CCM	Counter with CBC MAC (Cipher block chaining message authentication code)
CMOS	Complementary Metal Oxide Semiconductor.
CP	Charge Pump
CPU	Central Processing Unit.
CSPI	Configurable Serial Peripheral Interface.
DDR	Double Data Rate.
DIP	Dual In-line Package.
DPGA	Differential Programmable Gain Amplifier
EEPROM	Electrically Erasable Programmable Read Only Memory.
EPROM	Erasable Programmable Read Only Memory.
FET	Field-Effect Transistor
GCTL	Gate Control
GDU	Gate Driver Unit
GPIO	General Purpose Input/output.
GPO	General Purpose Output.
HG	High-side Gate
HS	High-side Source
HW	Hardware.
HVI	High Voltage Input
HVM	High Voltage Module
I2C	Inter-Integrated Circuit.
I/O	Input/output.
JTAG	Joint Test Access Group.
LED	Light Emitting Diode.
LG	Low-side Gate
LPM	Low-Power Mode
LS	Low-side Source
MB	Megabyte.
MCU	Microcontroller Unit.
MOSFET	Metal-Oxide-Semiconductor Field-Effect Transistor
MS	Memory Stick.
NVRAM	Non-volatile Random-Access Memory.
PCB	Printed Circuit Board.
PHY	Physical interface.
PMC	Power Management Controller
POR	Power-on Reset.
PSRAM	Pseudo Random Access Memory.
PWR	Power.
PWM	Pulse Width Modulation.
RAM	Random Access Memory.
SDRAM	Synchronous Dynamic Random-Access Memory.
TFT	Thin Film Transistor.
UART	Universal Asynchronous Receiver/Transmitter.
USB	Universal Serial Bus.

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3. S32M24xEVB-L064 – Block Diagram

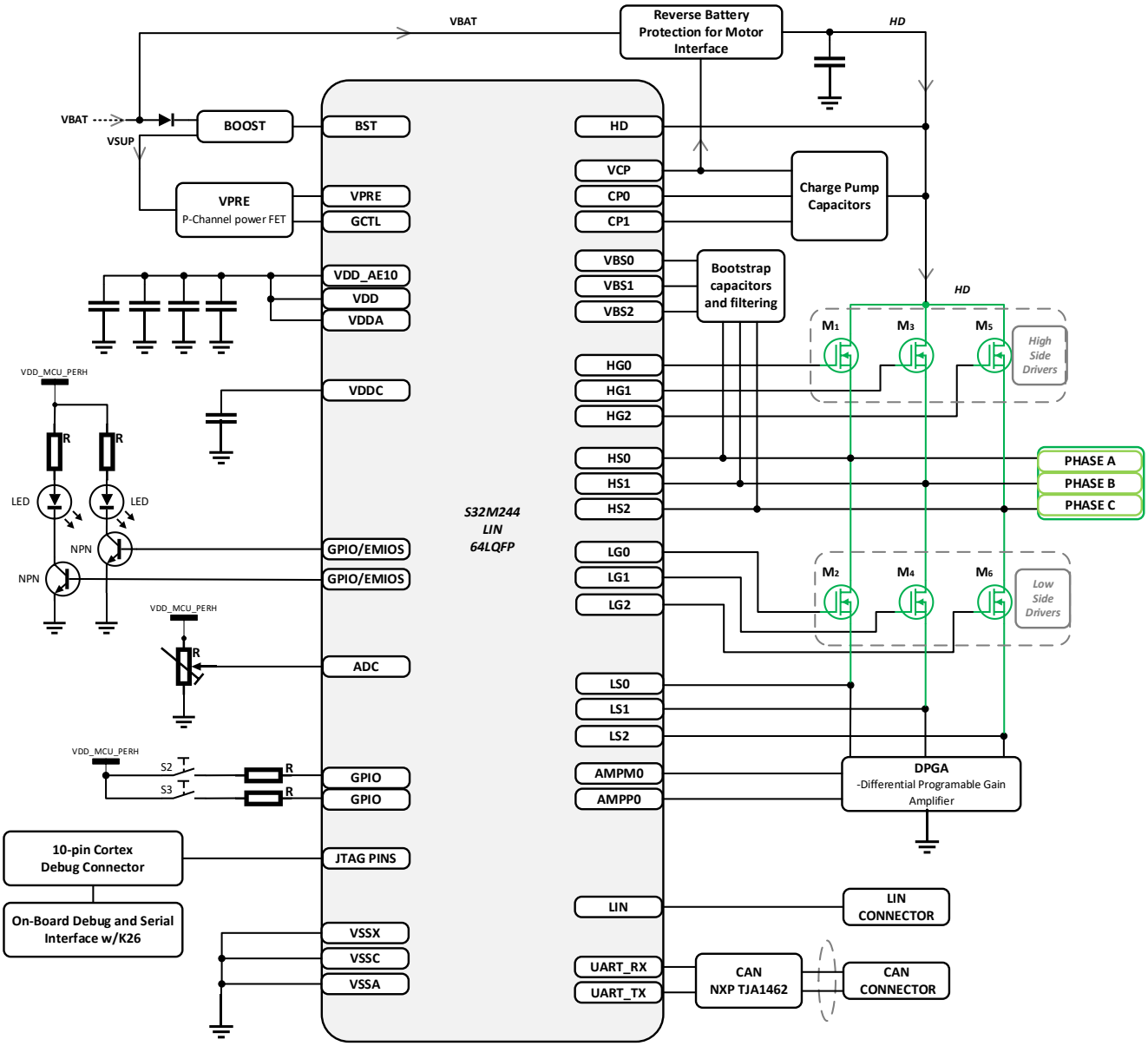

Figure 1. S32M24xEVB-L064 – Block diagram

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4. S32M24xEVB-L064 - Features

IMPORTANT

- Verify and download the last version of this document in http://www.nxp.com
- Before the S32M24xEVB-L064 Evaluation board is used or power is applied, please fully read this user manual. An incorrect configuration in the board may cause a irreparable damage on the component, MCU or EVB. Power must be removed from the EVB prior to:
  - Removing or placing some component or measurement
  - Re-configuring the board jumpers

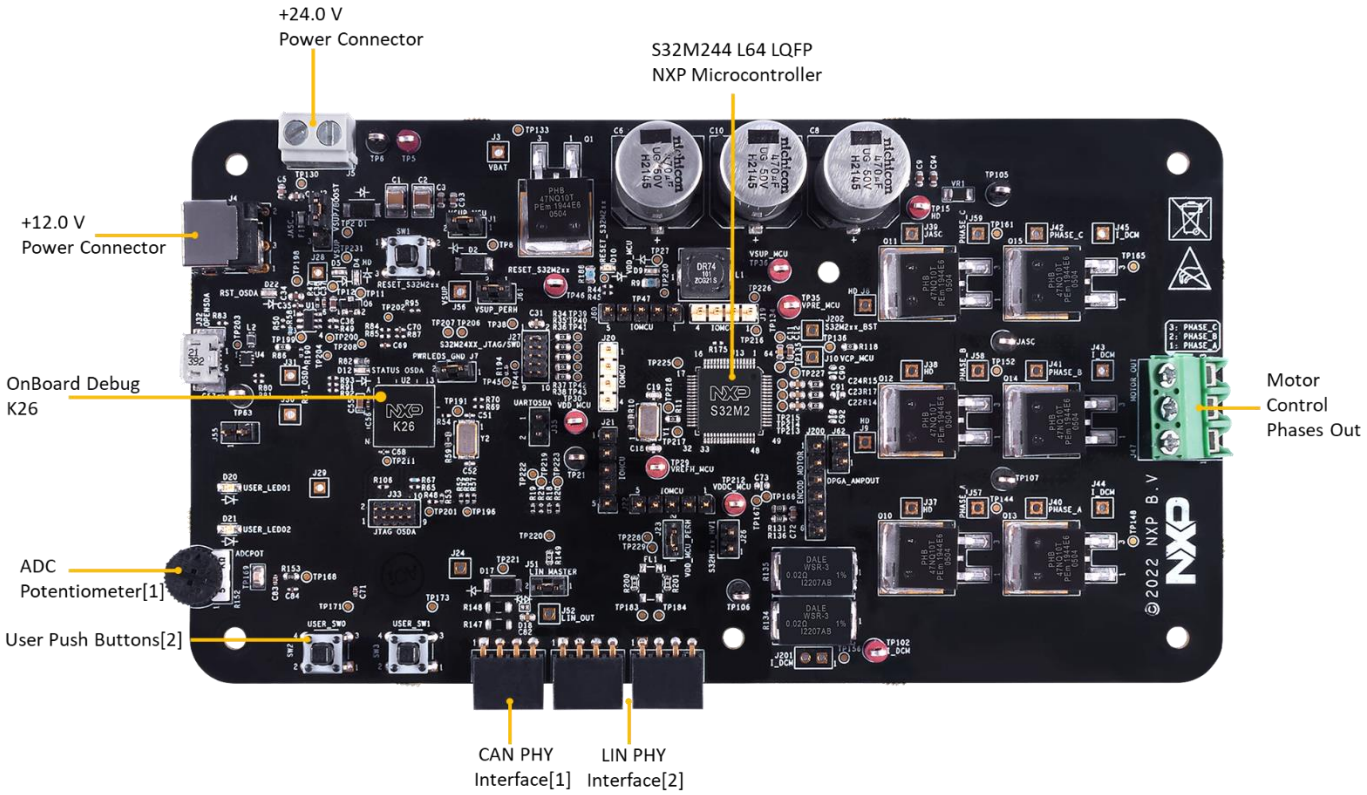

Figure 2. S32M24xEVB-L064– Features

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5. S32M24xEVB-L064 – Default Configuration

Table 1. S32M24xEVB-L064 - Default Configuration

Interface	Reference / Signal	Default Configuration	Description/Comment
S32M246 MCU	U13	N/A	S32M244L_64LQFP
OnBoard Debugger K26	U9	PTC2	PTC2/LPUART0_RX is routed to NTS0102GD terminal B1 for serial interface to K26FN2M0VMI18
		PTC3	PTC3/LPUART0_TX is routed to NTS0102GD terminal B2 for serial interface to K26FN2M0VMI18
LIN Interface	Internal LIN	LIN	LIN pin is routed to J53 and J54 pin 2
CAN Interface TJA1462	U11	CAN0_RX_MCU	PTE4/FXIO_D7 is routed to TJA1462 RX
		CAN0_TX_MCU	PTE5/ FXIO_D6 is routed to TJA1462 TX
		CAN0_STB_MCU	PTE2 is routed to TJA1462SLP
		CANH	CANH is routed to J50 terminal 2
		CANL	CANL is routed to J50 terminal 1
User Push Buttons	SW2	PTA15	Active Low
	SW3	PTD0	Active Low
User LEDs	D20	PTE15	User Led 1
	D21	PTE16	User Led 2
ADC Potentiometers	ADCPOT	PTE6	ADCPOT0 is routed to PTE6 – USER_ADC, to use this feature place J55

6. S32M24xEVB-L064 – Default Jumpers

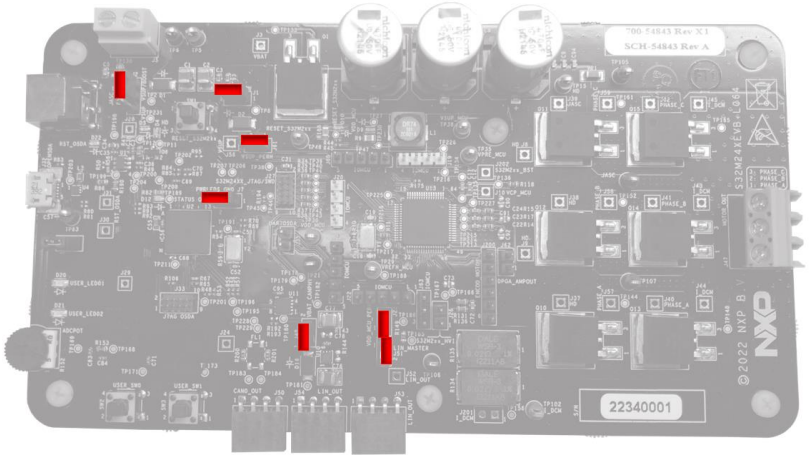

Figure 3. S32M24xEVB-C064– Default jumpers configuration

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Table 2. S32M24xEVB-C064 - Default jumpers position.

Interface	Reference	Position	Description / Comments
Power Supply	**J2**	1-2	VBAT is routed to VSUP
	J61	1-2	VSUP is routed to VSUP_PERH
	J1	1-2	VSUP_MCU is routed to VSUP input of MCU
	J7	1-2	Power LEDs to ground connection
Peripherals	**J23**	1-2	VDD_MCU is connected to the VDD_MCU_PERH to supply SW peripherals (leds, buttons, user_adc) and CAN interface
LIN	**J51**	1-2	VSUP_PERH connected to give robustness to the signal in master mode
CANPHY	**J49**	1-2	VBAT connected to MPQ2013 which is a low power linear regulator to supply CAN PHY U11

7. Power Supplies Options – Overview

The EVB requires an external power supply voltage of +12V/⩾2A that can be connected in the connector J4 or J5. This allows the EVB to be easily used in a vehicle if required. The 12V input on the EVB is used to supply the microcontroller directly (VSUP) and the microcontroller generate an internally supply voltage (VDD_AE10, VDD_HV_A) with the input voltage from VPRE.

One of the outstanding features of this microcontroller is its capability to supply voltage without the need for an SBC, this is of great convenience in order to reduce the BOM of materials. However, In order to reduce MCU power consumption and minimize potential thermal issues, VPRE is generated using the Gate Control pin to reduce the VSUP voltage to 6 volts and thus supply VPRE.

7.1 S32M24xEVB-L064 – Main Power Supply

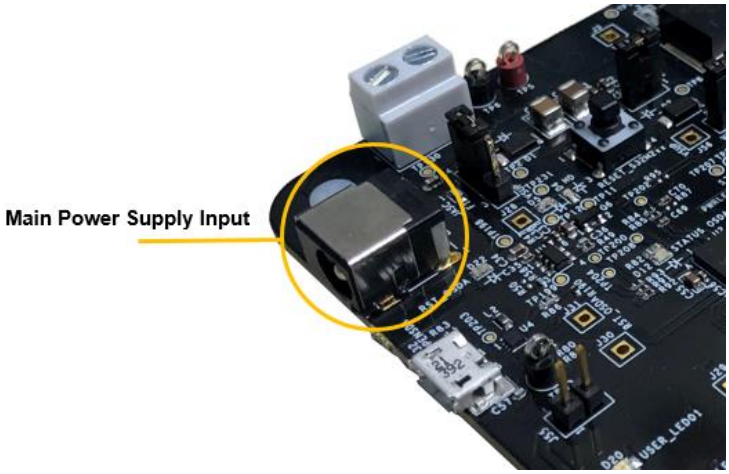

Figure 4.S32M24xEVB-L064– Main power supply input

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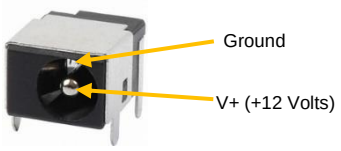
Table 3. S32M24xEVB-C064 - Main power supply connector

Connector	Description
	**2.1mm Barrel Connector – J4** This connector should be used to connect the supplied wall-plug main adapter. Note if a replacement or alternative adapter is used, care must be taken to ensure the 2.1mm plug uses the correct polarization as shown.
	**2-Way Screw Type Connector – J5** This can be used to connect a bare wire lead to the EVB, typically from a laboratory power supply. Care must be taken to ensure correct connection. For more details consult the schematic

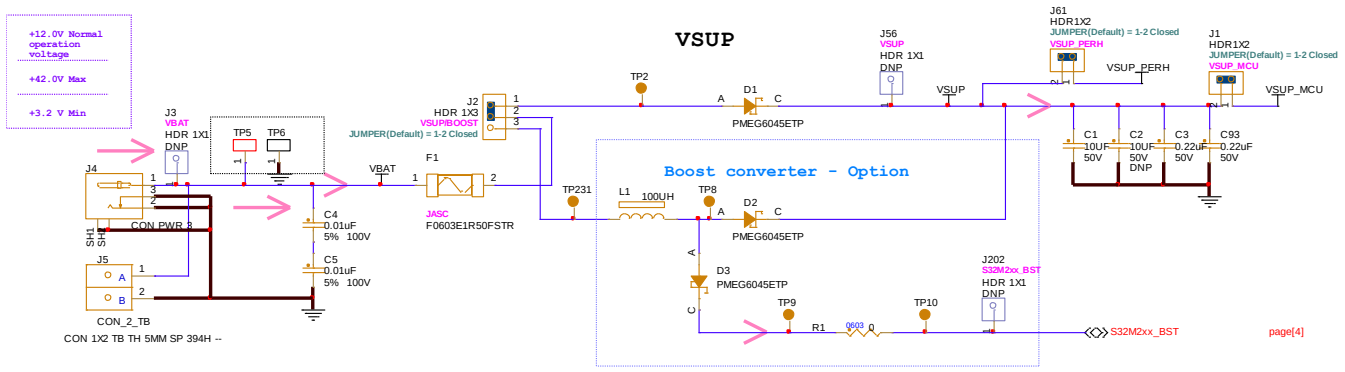


Figure 5. S32M24xEVB-L064– Main power supply input

Table 4. S32M24xEVB-L064 – VSUP jumpers description.

Interface	Reference	Position	Description / Comments
VSUP	**J2**	1-2 (Default)	(Option A) This jumper configuration routes the output from the fuse (VBAT) to a protection diode and then the supply for peripherals and MCU after bulk and decoupling capacitors for the voltage input .
		2-3	(Option B) This jumper configuration routes the output from the fuse (VBAT) to a power boost converter circuit. For more details related to the boost converter circuit consult the S32M2 Hardware Design Guidelines
	J61	1-2 (Default closed)	This header is used to supply the peripherals like RESET LED, LINPHY and USER LEDS.
	J1	1-2	This header is used to supply the VSUP input from the MCU.

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7.2 S32M24xEVB-L064 – VPRE

VPRE_MCU is typical 6V and generated from the VSUP_MCU. It can be either generated with an external power FET (gate controlled via GCTL pin) or generated by a PMC internal regulator. VPRE is always powered (FPM and LPM). An external bypass capacitor in the range from 2.2uF to 4.7uF is required.

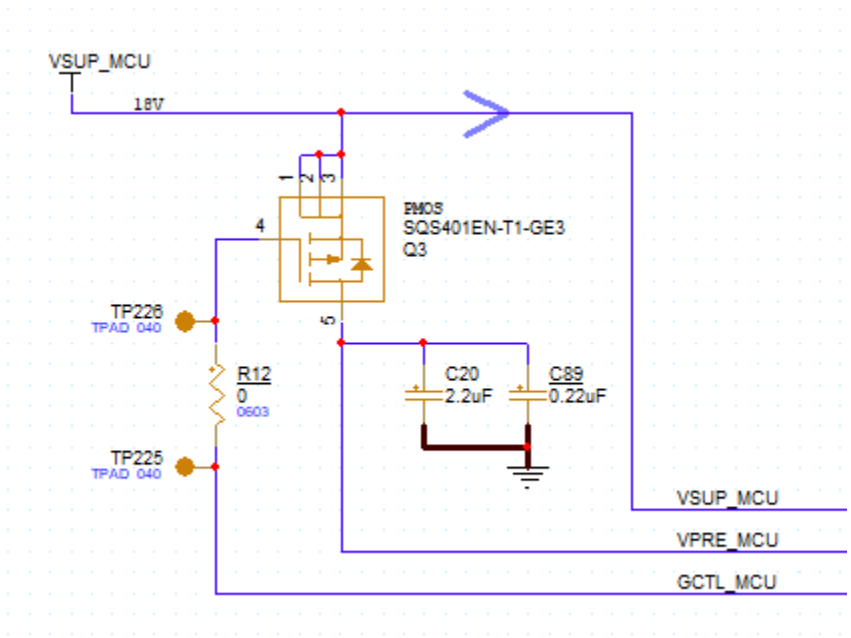

Figure 6. S32M24xEVB-L064– VPRE generated with FET

7.3 S32M24xEVB-L064 VDD_AE10, VDD, VDDA

The VDD_AE10 pin belongs to the analog die side and provides energy to the microcontroller over the VDD pin.

VDD is the supply output that powers the MCU die. It can be configured to be either 3.3V or 5V. It is internally generated from VPRE.

Meanwhile the VDDA pin power the analog modules of the MCU, I,g. AD converter. That pins are connected together with in a common source plane on PCB. Appropriate decoupling capacitors are needed in order to filter noise on the supplies. The value of the decoupling and bulk capacitors are shown in the Table 5.

7.4 S32M24xEVB-L064 – VREFH

The VREFH represents an input pin of the ADC reference voltage. VREFH should always supply by voltage, which is equal to or less than the supply rail + 0.1 V (VDDA + 0.1V and VDD + 0.1 V, or VDD_HV_A + 0.1V). Is mandatory add a decoupling capacitor as shown in the Figure 7.

7.5 S32M24xEVB-L064 – VDDC_MCU

VDDC is CAN supply pin whose voltage is generated by internal voltage regulator from VPRE which can be enabled or disabled to decrease power consumption, this voltage is typically 5V. If configured on, VDDC is automatically turned off in LPM (Low Power Mode) and after wake-up from LPM, VDDC is automatically turned on again. An external bulk capacitor is mandatory as shown in the Figure 7.

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7.6 S32M24xEVB-L064 – VDDE

VDDE is a configurable source which can be used in two modes: digital mode, and analog mode. When used in analog mode, the VDDE pin can drive a strong VDD voltage or a weak GND. In the digital mode, can be set for CANPHY_TX, LINPHY_TX, or not used and not driven. However, for mode selecting, refer to reference manual".

Table 5. Decoupling and bulk capacitors value for VDD_HV_A pins

Capacitor	Characteristic	Value
Decoupling Capacitor	X7R / X8R Ceramic	100nf - 220nF
Bulk Capacitor	X7R / X8R Ceramic	4.7uF - 2.2uF

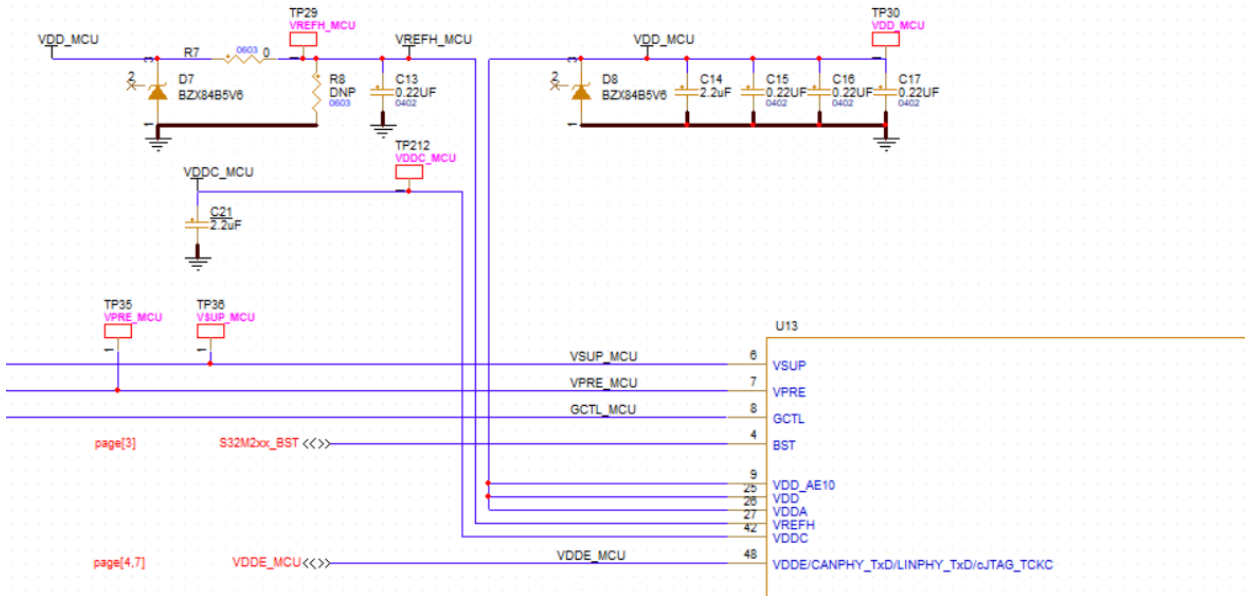

Figure 7. S32M24xEVB-L064– VDD_HV_A

8. Motor Control Interface

The S32M24x integrates automotive qualified and application-focused capabilities like MOSFET Gate pre-drivers for motor control with 6 external power MOSFETs for BLDC or PMSM motor drive applications. The above due the S32M2XX MCU integrates a GDU which provides pre-drivers to control three-phase DC motor via external FETs. In order to support this control, it includes a charge pump and boost converter. The above replace a bootstrap circuit for gate driving.

The GDU contains three gate driver instances. Each instance drives 1 high-side FET (HG) and 1 low-side FET (LG). These high-side and low-side drivers support driving the three phases of a brushless DC motor. The primary function of a driver is to switch a MOSFET from off-state to on-state and vice versa. The pre-driver amplifies the control signals to the required

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levels to drive the power MOSFET. To guarantee reliable operation, the low-side drivers are supplied by the VLS regulator, while the high-side drivers are supplied directly by the bootstrap circuit over the VBS pins internally.

The outputs from the MOSFETs to the motor are connected to J47.

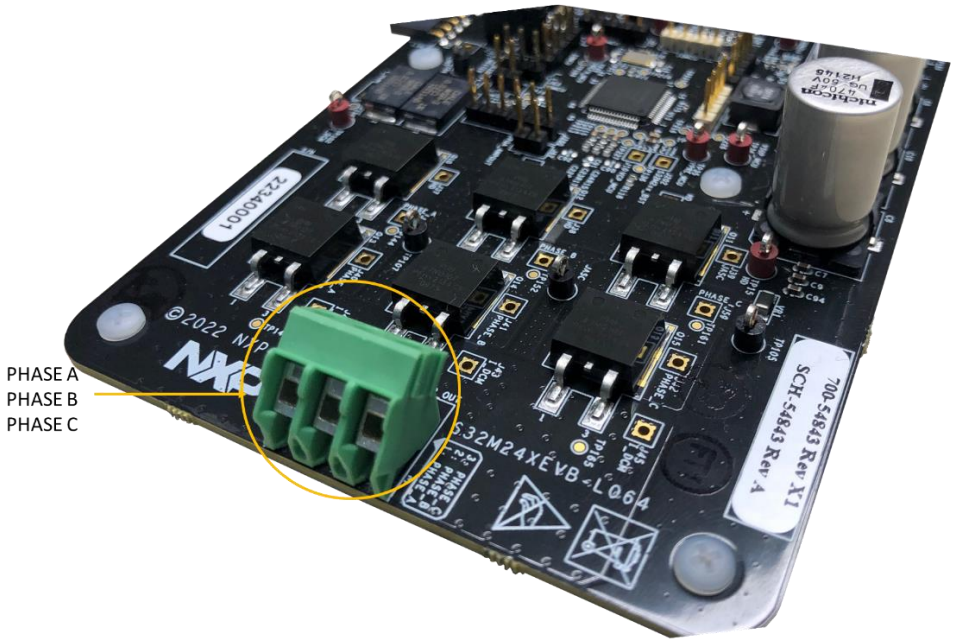
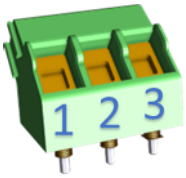


Figure 8.S32M24xEVB-L064– Motor Control Interface

Table 6.- S32M24xEVB-L064 Motor control out

Connector	Reference	Pin Number	Signal/Connection
	J47	1	PHASE A
		2	PHASE B
		3	PHASE C

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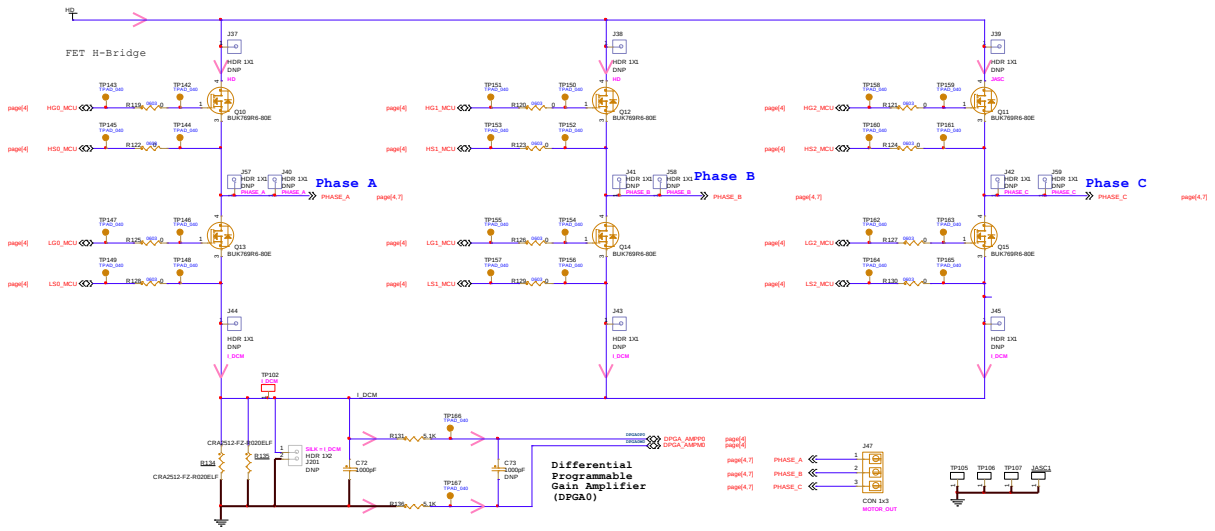

Figure 9. S32M24xEVB-L064– Motor Control Interface

9. S32M24xEVB-L064 – Programming and Debug Interface

9.1 S32M24xEVB-L064 – RESET switch and led indicator

The RESET switch [SW1] provides an input signal for manual application RESET. The S32M2 MCU will drive the RESET signal to the reset pins in the EVB [PTA5 and RESET]. The RESET LED indicator [D10] will be ON for the duration of the RESET signal. This operation indicates the S32M24 MCU is in the RESET state.

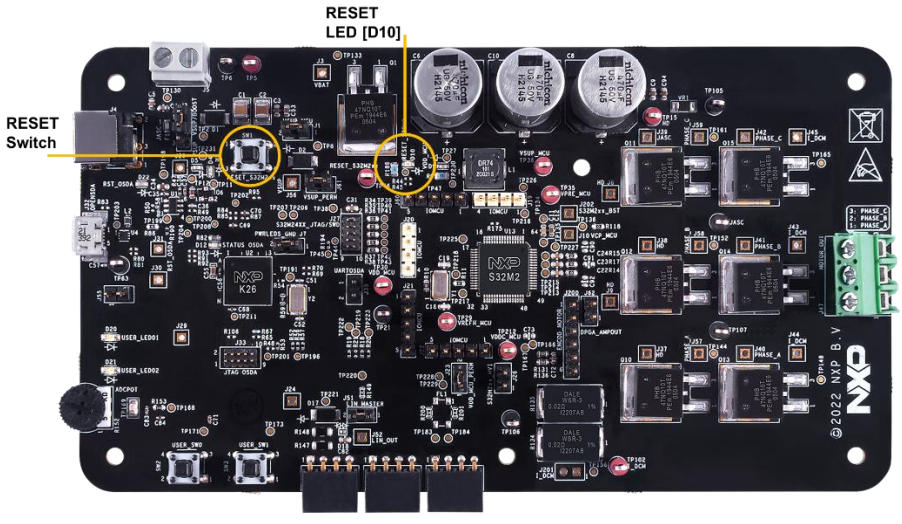

Figure 10. S32M24xEVB-L064– RESET Switch

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9.2 S32M24xEVB-L064 – On-board Debugger

The S32M24xEVB-L064 incorporates an On-Board Debugger (the MK26FN2M0VMI18) as well as embedded JTAG connector [J27]. It bridges serial and debug communications between an USB host and an embedded target processor.

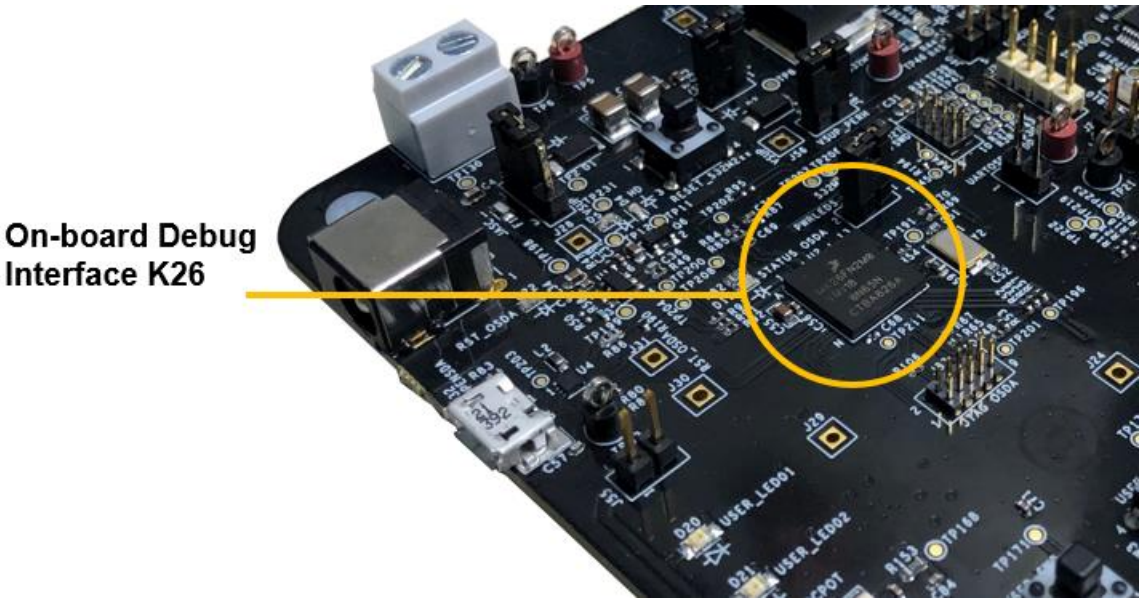

Figure 11. S32M24xEVB-L064– On-board Debugger

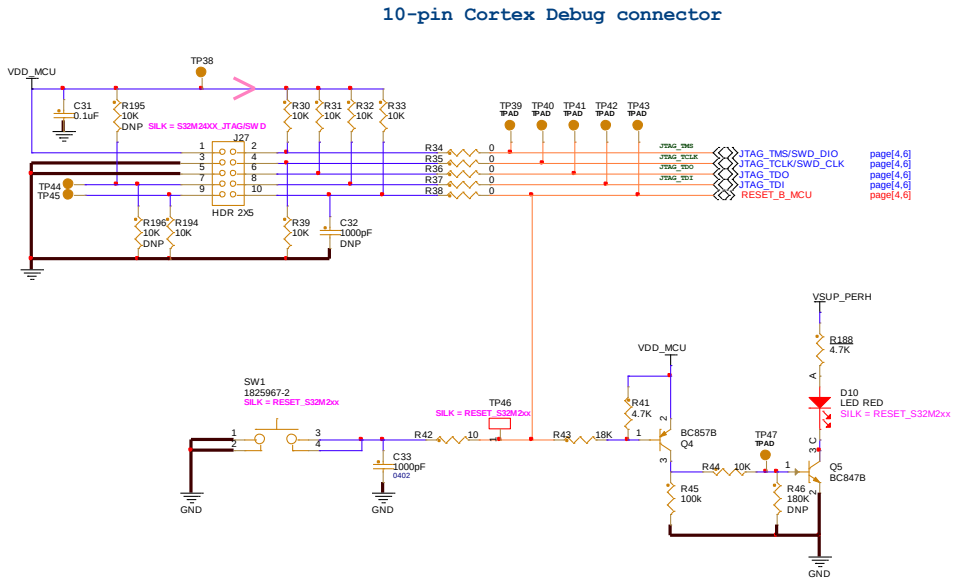

Figure 12. S32M24xEVB-L064– Cortex Debug

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Table 7.- S32M24xEVB-L064 Cortex connector

Connector	Reference	Pin Number	Signal/Connection
	J27	1	VDD_MCU
		2	JTAG_TMS/SWD_DIO
		3	GND
		4	JTAG_TCLK/SWD_CLK
		5	GND
		6	JTAG_TDO
		7	DNP
		8	JTAG_TDI
		9	GND
		10	RESET_B_MCU

10. S32M24xEVB-L064 – CAN PHY

The EVB incorporates a CAN interface connected to the S32M24 MCU. Using an NXP CAN transceiver the TJA1462 enables both interfaces in this EVB, the output of this transceiver is connected to J50.

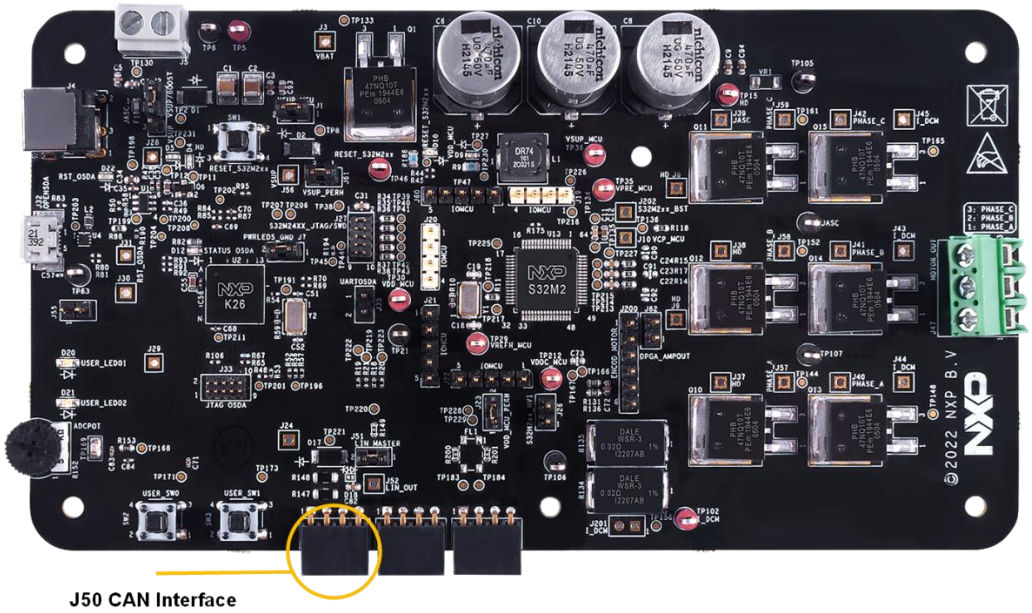

Figure 13. S32M24xEVB-L064 – CAN Interface

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Table 8.- S32M24xEVB-L064 CAN Connector

Connector	Reference	Pin Number	Signal/Connection
	J50	1	CANH
		2	CANL
		3	GND
		4	NC

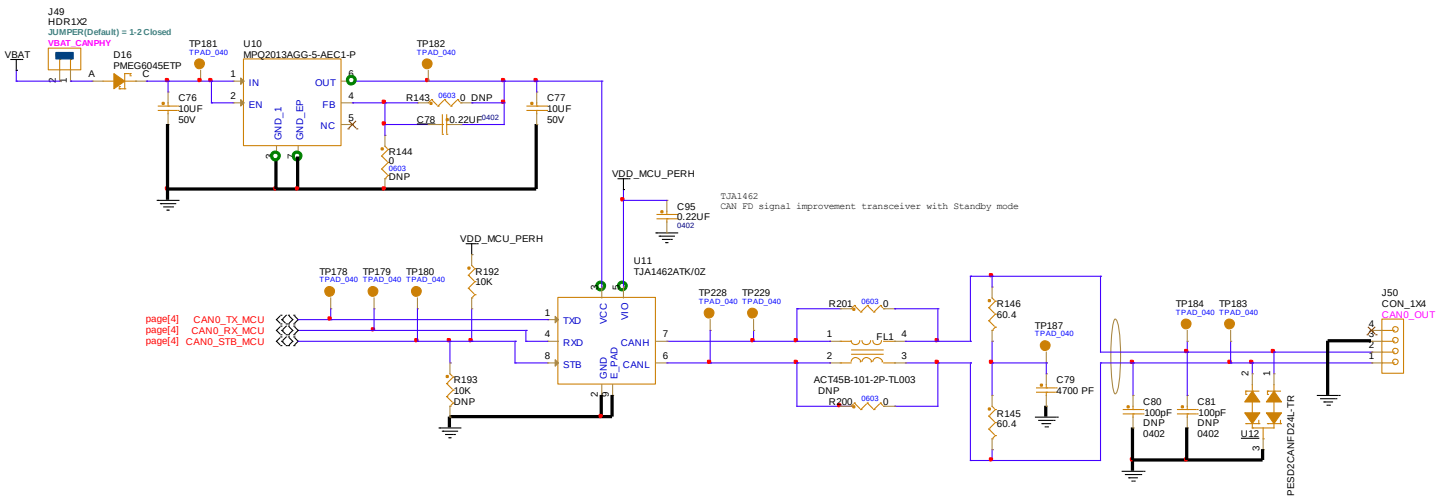

Figure 14. S32M24xEVB-L064– CAN PHY

11. S32M24xEVB-L064 – LIN PHY

The S32M24xEVB-L064 incorporates internally a LIN interface but is necessary connect the passive components at the output pin LIN. The connection in the EVB supports both master and slave mode (jumper selectable).That signals are connected to J53 and J54 respectively.

The pinout of these headers is shown

Table 9.

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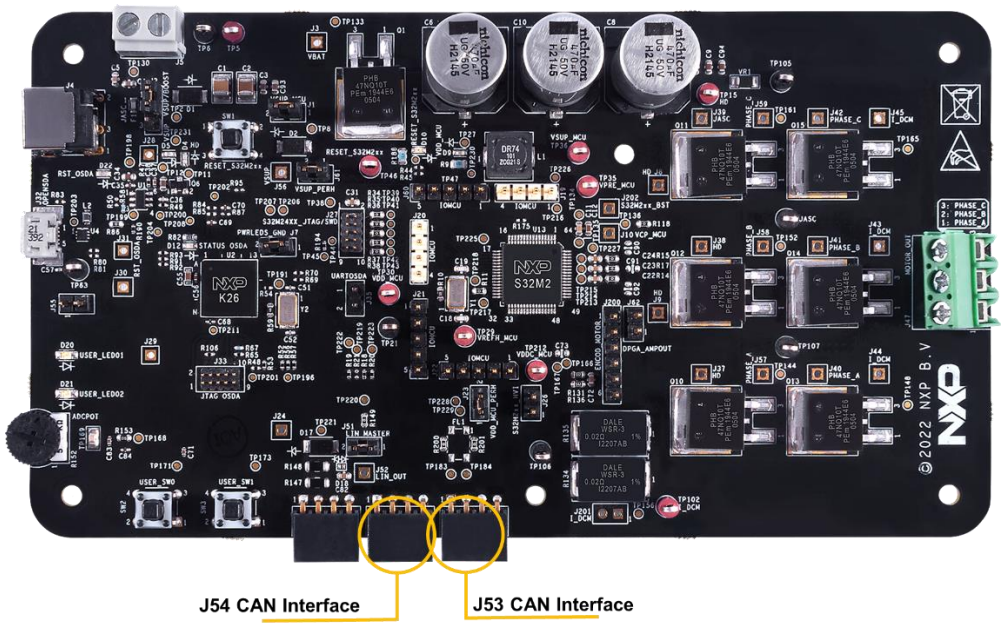

Figure 15. S32M24xEVB-L064– LIN Interface

Table 9.- S32M24xEVB-L064 LIN Connector

Connector	Reference	Pin Number	Signal/Connection
	J53	1	VBAT
		2	LIN
		3	NC
		4	GND
	J54	1	VBAT
		2	LIN
		3	NC
		4	GND

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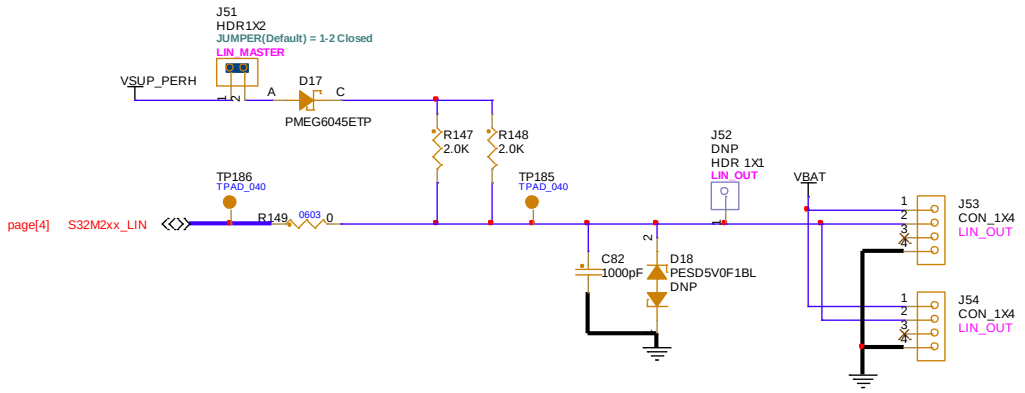

Figure 16. S32M24xEVB-L064– LIN PHY

12. S32M24xEVB-L064 – User Peripherals

12.1 S32M24xEVB-L064 – User Led

The EVB incorporates two red LED connected through NPN transistors to the MCU ports. These are connected as shown in the Figure 18

Table 10.- S32M24xEVB-L064 LED connections

Reference	Signal Name	MCU Port Default	Color
D20	USER_LED0	PTD15	Red
D21	USER_LED1	PTD16	

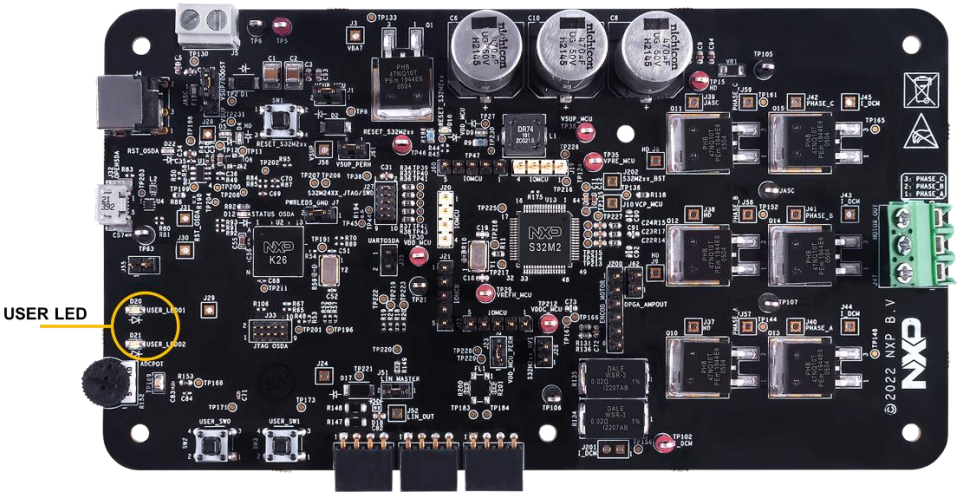

Figure 17. S32M24xEVB-L064– User LED indicators

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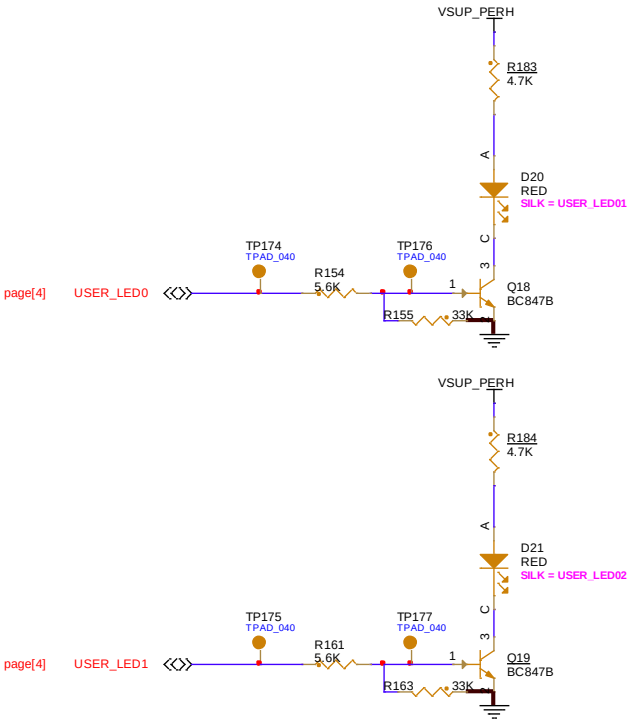

Figure 18. S32M24xEVB-L064– User LED indicators

12.2 S32M24xEVB-L064 – User Push buttons

There are 2 push-buttons active high (pulled low, driven to VDD_MCU_PERH), the push button switches (SW2 and SW3) are connected to MCU ports. The switches are connected as follows:

Table 11. User Pushbuttons

Reference	Function	MCU Port	Comments
SW2	USER_SW0	PTA15	Enabled
SW3	USER_SW1	PTD0	Enabled

1. There are zero-ohm resistors (R181,R182) on the direct connections between each **USER_SWx** and the MCU pins. These can be removed if required to isolate or change the User Switch from the default MCU pin.

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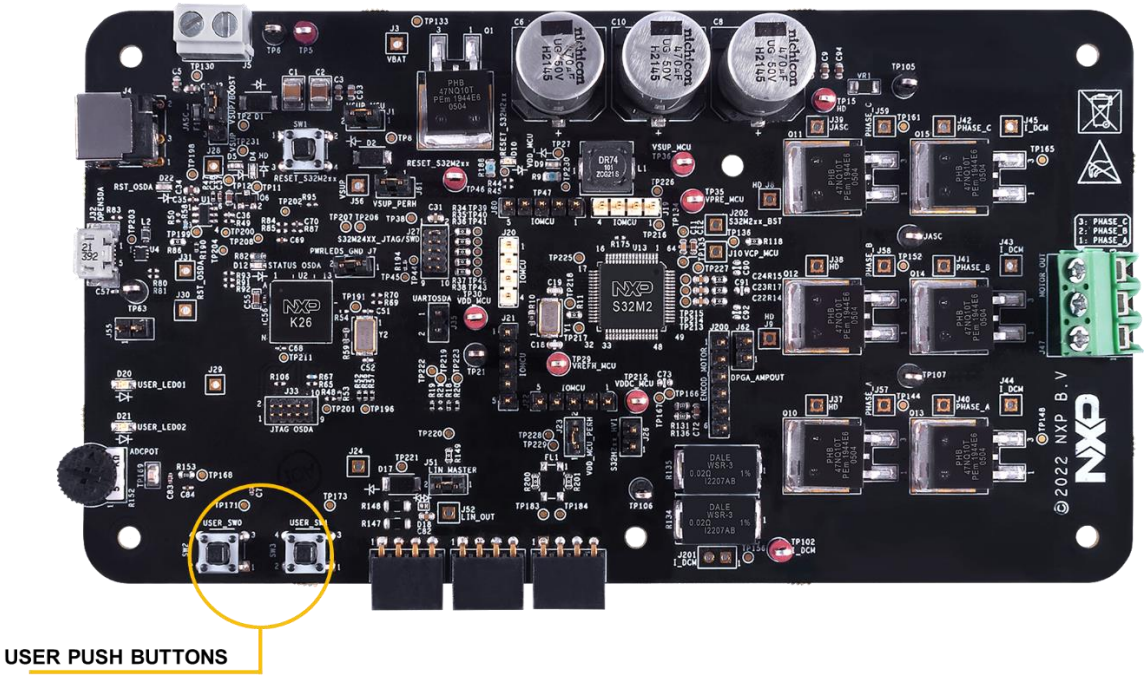

Figure 19. S32M24xEVB-L064– User Push buttons

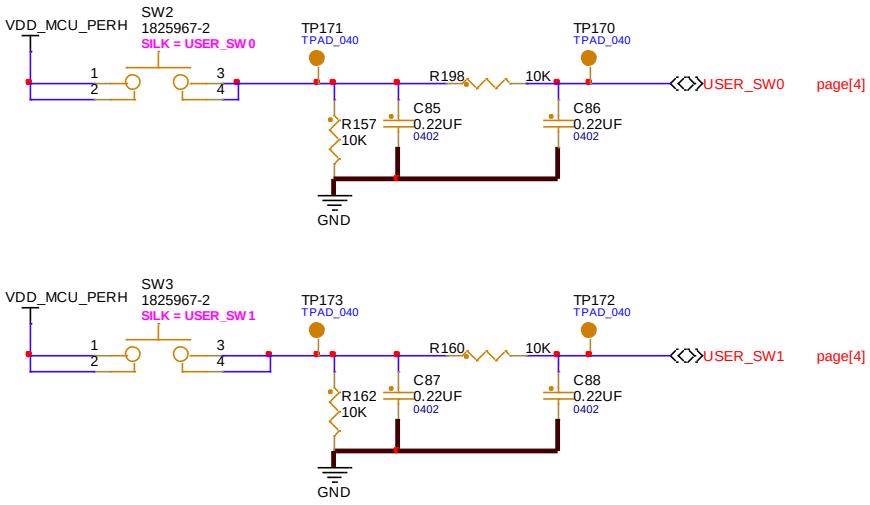

Figure 20. S32M24xEVB-L064– User Push buttons

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12.3 S32M24xEVB-L064 – ADC Rotary Potentiometer

The EVB incorporates an ADC Rotary Potentiometer (which routes a voltage between 0v to VDD_MCU_PERH) connected to an ADC Input Channel of the S32M24 Microcontroller after a low band filter in order to avoid noise in the signal, specifically ADC1_SE11.

Table 12. User ADC Potentiometer

Reference	Function	MCU Port	Comments
R152	ADCPOT	PTE6	Enabled

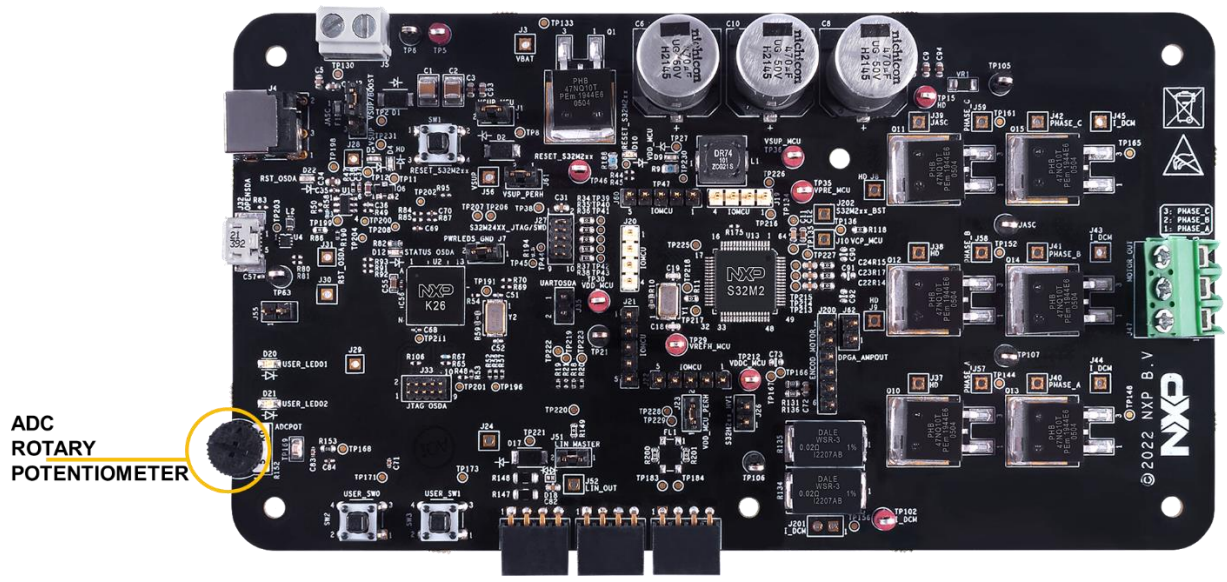

Figure 21. S32M24xEVB-L064– ADC Rotary Potentiometer

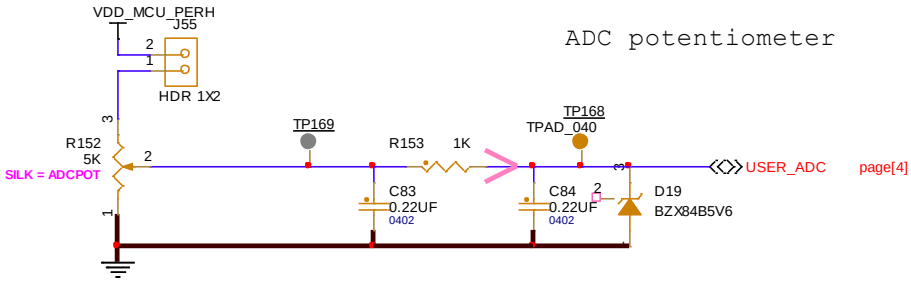

Figure 22. S32M24xEVB-L064– ADC Rotary Potentiometer

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13. S32M24xEVB-L064 – Revision history

Table 13. Revision history

Document Revision	Date	Schematic/ Board Number	Schematic/ Board Revision	Changes	Author
X	02/2023	54842	A	Internal version	Luis Rico
A	01/2024	54842	A	Release	Luis Rico
A1	02/2024	54842	A	Document format and block diagram in the Figure 1 updated	Luis Rico

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