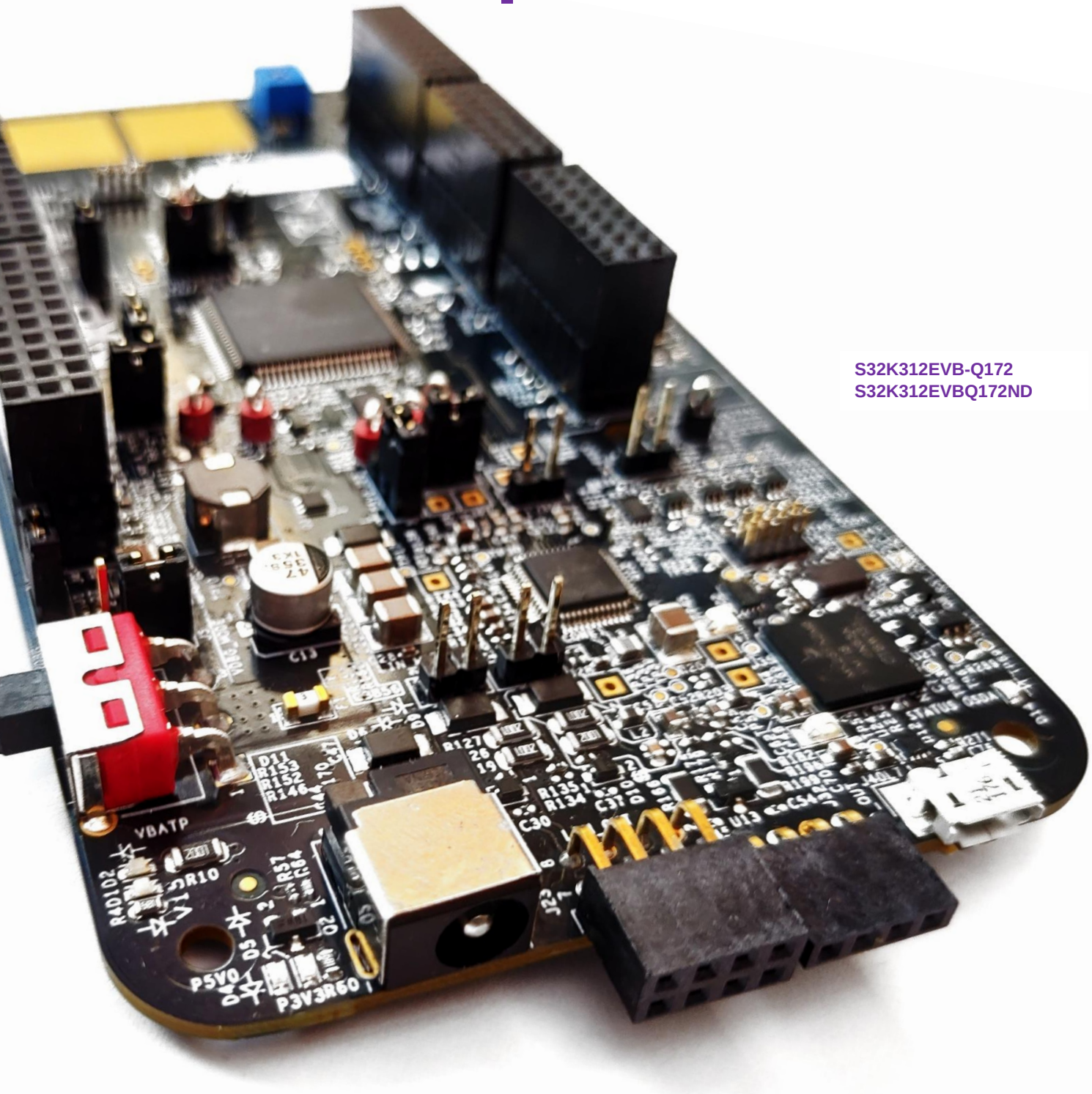
S32K312EVB-Q172

Customer Evaluation Board for S32K312 MCUs
Hardware User Manual



S32K312EVB-Q172
S32K312EVBQ172ND

1 Table of contents

2 Definitions, Acronyms, and Abbreviations

The following list defines the abbreviations used in this document.

CD	Compact Disk
CMOS	Complementary Metal Oxide Semiconductor
CPLD	Custom Programmed Logic Devices
CPU	Central Processing Unit
CSI	Camera Sensor Imaging
CSPI	Serial Peripheral Interface
DDR	Double Data Rate
DIP	Dual In-line Package
EEPROM	Electrically Erasable Programmable Read Only Memory
EPROM	Erasable Programmable Read Only Memory
GPIO	General Purpose Input/output
GPO	General Purpose Output
I2C	Inter-Integrated Circuit
ICE	In-Circuit Emulator
I/O	Input/output
JTAG	Joint Test Access Group
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MB	Megabyte
MCU	Microcontroller Unit
MMC	Multi-Media Card
MCP	Multi-chip product
MS	Memory Stick
NVRAM	Non-volatile Random-Access Memory
PC	Personal Computer
PCB	Printed Circuit Board
PHY	Physical interface
POR	Power on Reset
PSRAM	Pseudo Random Access Memory
PWR	Power
PWM	Pulse Width Modulation
QVGA	Graphics Adapter
RAM	Random Access Memory
SD	SanDisk (Smart Media)
SDRAM	Synchronous Dynamic Random-Access Memory
SI	System International (international system of units and measures)
SIMM	Single In-Line Memory Module
SPST	Single Pole Single Throw
TFT	Thin Film Transistor
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus.
HW	Hardware.
POP	Populate – Component placed
DNP	Do not populate – Component removed

3 S32K312EVB-Q172 - Block Diagram

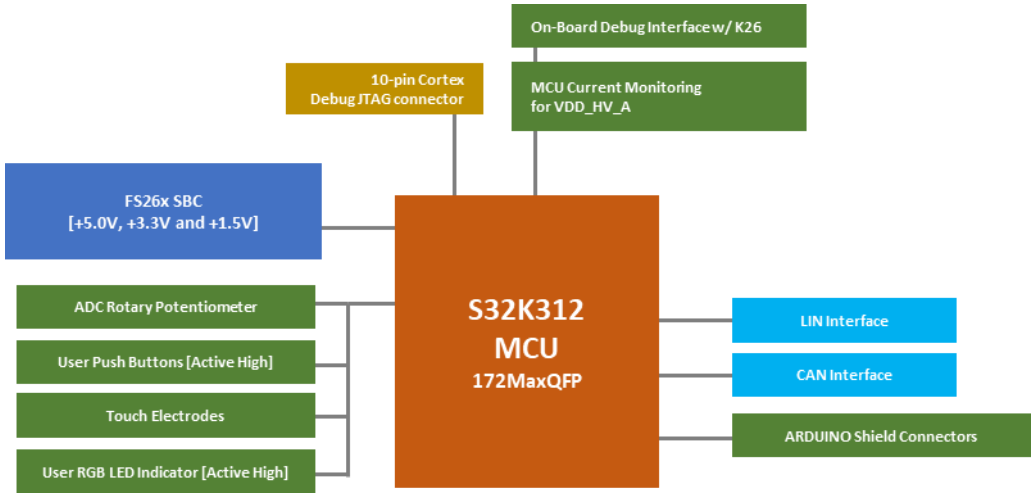


Figure 1. S32K312EVB-Q172 – Block diagram

4 S32K312EVB-Q172 - Features

IMPORTANT

- Verify and download the last version of this document in http://www.nxp.com
- Before the S32K312 Customer Evaluation board is used or power is applied, please fully read this user manual. An incorrect configuration in the board may cause a damage irreparable 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

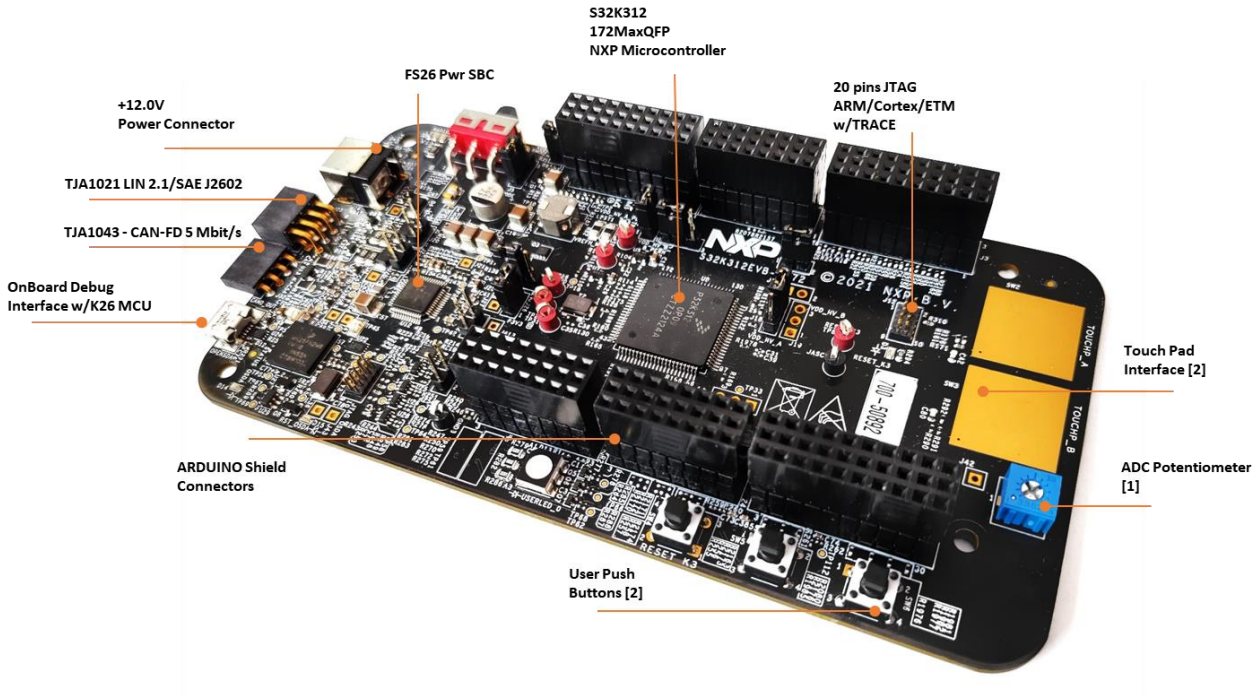


Figure 2. S32K312EVB-Q172 – Features

5 S32K312EVB-Q172 - Default Configuration

Table 1. S32K312EVB-x172 - Default Configuration

Interface	S32K312 EVB-Q172	S32K312 EVBS172 ND	Reference / Signal	Default Configuration	Description/Comment
S32K312 MCU	●	●	U9	V1.01	P32K344EHT1VPBST
MCU Power Supply	●	●	VDD_HV_A_MCU	+5.0V	The VDDA_HV_A domain is connected to +5.0V– Switching Power Supply
	●	●	VDD_HV_B_MCU	+3.3V	The VDDA_HV_B domain is connected to +3.3V– Switching Power Supply
	●	●	VDD_REFH_MCU	[VDD_HV_A]	The VDD_REFH domain is connected to VDD_HV_A_MCU
OnBoard Debugg	●	-		PTA15	PTA15/LPUART6_RX is routed to OpenSDA for serial interface
				PTA16	PTA16/LPUART6_TX is routed to OpenSDA for serial interface
CAN Interface	●	●	TJA1043/CAN0	PTA6	PTA26 is routed to the CAN0_RX signal
				PTA7	PTA27 is routed to the CAN0_TX
				PTC23	PTC23 is routed to the CAN0_ERRN

Interface	S32K312 EVB-Q172	S32K312 EVBS172 ND	Reference / Signal	Default Configuration	Description/Comment
				PTC21	PTCCAN0_EN
				PTC20	CAN0_STB
LIN Interface	●	●	LIN1 TJA1022T	PTB9	LPUART9_RX is routed to LIN Phy0
				PTB10	LPUART9_TX is routed to LIN Phy0
			LIN2 TJA1022T	PTB28	LPUART5_RX is routed to LIN Phy1
				PTB27	LPUART5_TX is routed to LIN Phy1
User Push Buttons	●	●	SW4	Disabled	Active Low,
			SW5	PTB19	Active Low, before PTA1
User LED	●	●	D13	PTA29	Red
				PTA30	Green
				PTA31	Blue
ADC Potentiometer	●	●	ADCPOT0	PTA11	ADCPOT0 [R293] is routed to PTA11 - ADC1_S10
ARDUINO	●	●	-	-	

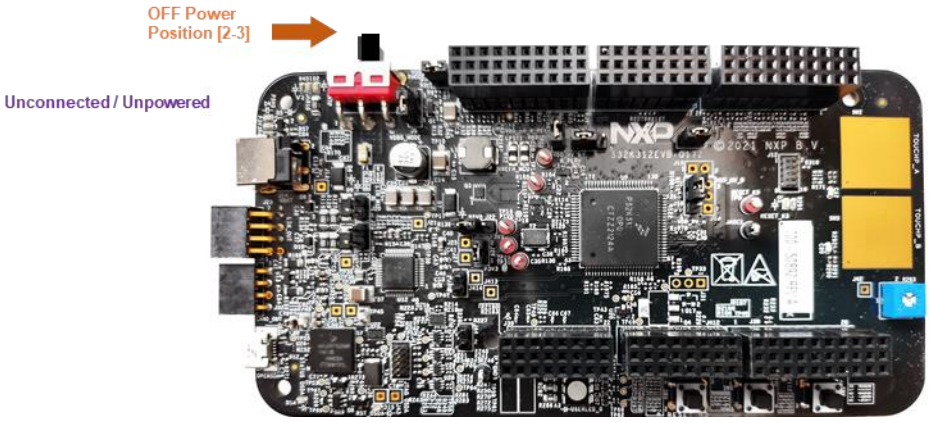
6 S32K312EVB-Q172 - Startup

Follow these steps to connect and power on the board

1. Carefully unpack the S32K312EVB-Q172 and observe ESD preventive measures while handling the K3 development board.
2. Connect necessary cables between host PC and EVB board prior to applying power to the EVB.
3. The power-ON sequence for the EVB must be as follows:

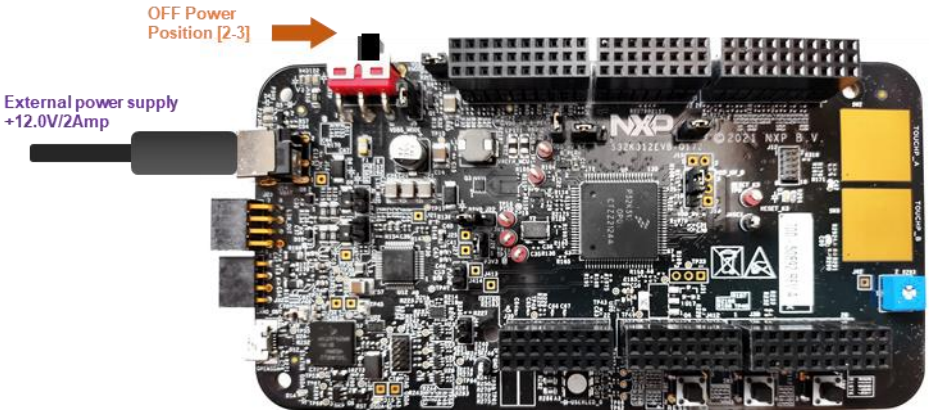
a)

- The power switch -SW1 must be in OFF position before to the EVB be connected to an external power supply.



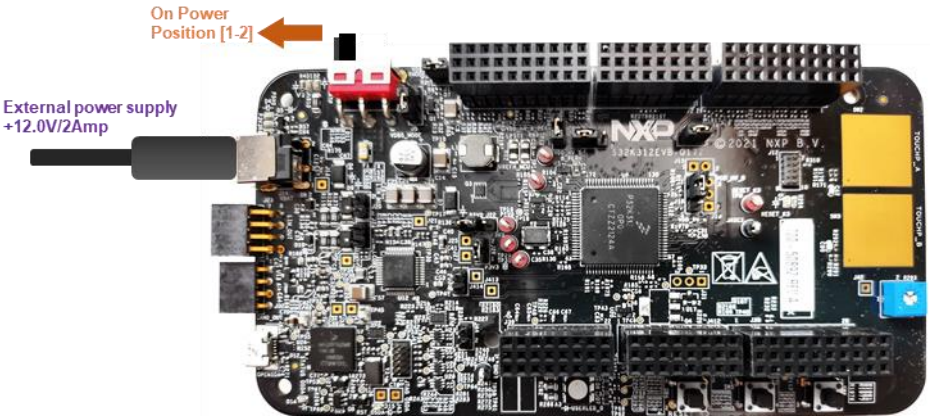
b)

- Once the power switch -SW1 is in OFF position, then the EVB can be connected to an external power supply.



c)

- Now the power switch -SW11 can be changed to ON- position.



4. When power is applied to the EVB, three orange LED's adjacent to the voltage regulators show the presence of the supply voltages as follows:
   - LED D2 Indicates that the 12.0V is connected to the EVB correctly.
   - LED D4 Indicates that the 5.0V linear regulator is enabled and working correctly.
   - LED D5 Indicates that the +3.3Vlinear regulator is enabled and working correctly.

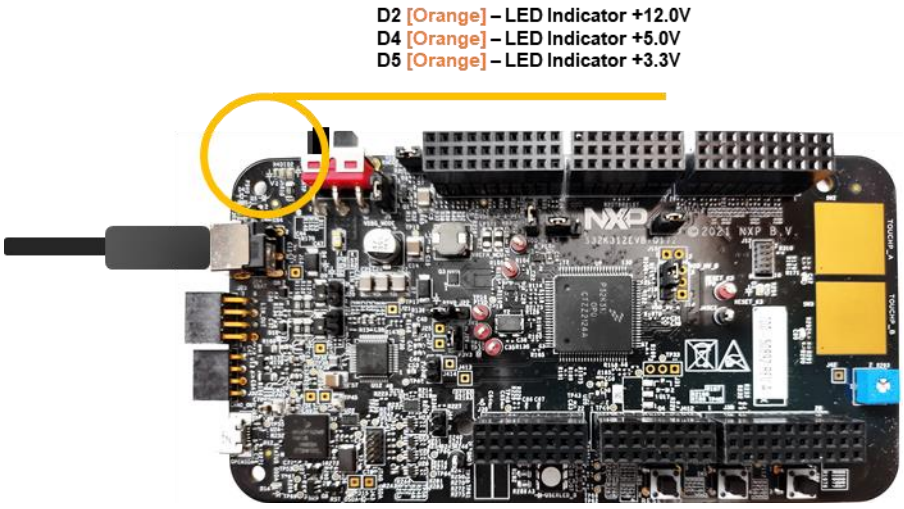


Figure 3. S32K312EVB-Q172 – Power supply Input and LED power indicators

If no LED's are illuminated when power is applied to the EVB and the regulators are correctly enabled using the appropriate jumpers, it is possible that either power supply is not connected properly, or the voltage level is lower that the specified [+12.0V to ≥2Amps].
Note that the fuse will not protect against one of the EVB regulators being shorted. If this happens, damage is likely to occur to the EVB and / or components.

5. The board is ready to use now.

7 S32K312EVB-Q172 - Power supply

The EVB requires an external power supply voltage of between to +12V/≥2A. This allows the EVB to be easily used in a vehicle if required. The 12v input is on the EVB is used to supply a FS26/SBC – U1, the power management IC controller provides +5.0V, +3.3V and +1.5V, for the different power configurations of VDD_HV_A, VDD_HV_B, V15 and other interfaces

7.1 S32K312EVB-Q172 - Main Power Supply

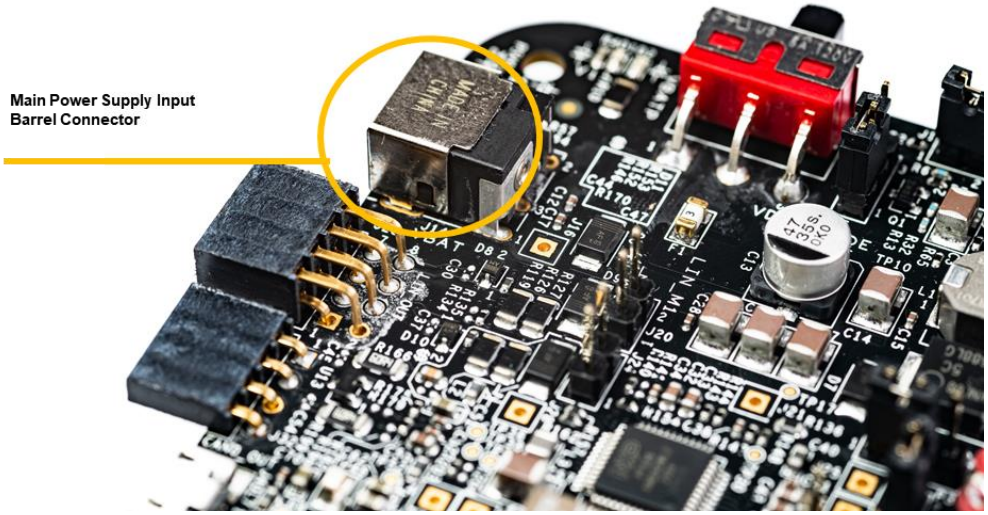
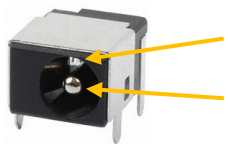


Figure 4. S32K312EVB-Q172 – Main power supply input

Table 2. Main power supply connector

Connector	Description
 Ground V+ (+12Volts).	**2.1mm Barrel Connector – J14** This connector should be used to connect the supplied wall-plug mains 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

7.1.1 S32K312EVB-Q172 – FS26/Modes Operation

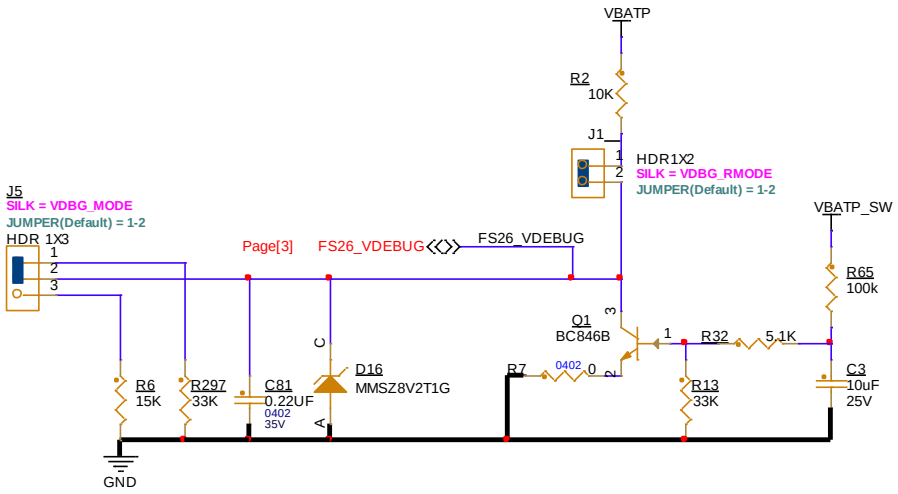


Figure 5. S32K312EVB-Q172 – FS26/Modes Operation

Table 3. S32K312EVB-Q172 – FS26/Modes Operation

Reference	Jumper Position			Description	Comments
Flash Mode [Default configuration]	J1	1-2		The R2 resistor to VBATP (VBAT protected +12.0V) is routed as pull-up to the VDEBUG Pin. This is a common pull-up resistor for the 2 voltage divider configurations, with R6 or R297.	
	J5	1-2		The R297 is selected for the divider voltage, +8.0V is applied on VDEBUG pin to set the FS26-SBC on MCU Flash Mode. In this mode device power up sequence starts with debug mode enabled and can be used during customer production process to flash MCU without need of WD refresh. After ~80ms once the SW1 is in ON-position the VDEBUG pin will be switching to a low voltage (GND) due to the RC delay circuitry and Q18	
Debug Mode	J1	1-2		The R2 resistor to VBATP (VBAT protected +12.0V) is routed as pull-up to the VDEBUG Pin. This is a common pull-up resistor for the 2 voltage divider configurations, with R6 or R297.	
	J5	2-3		The R297 is selected for the divider voltage, +5.0V is applied on VDEBUG pin to set the FS26-SBC on Debug Mode, voltage must be removed from debug pin in order to start power up sequence. In this mode Watchdog refresh is not needed. After ~80ms once the SW1 is in ON-position the VDEBUG pin will be switching to a low voltage (GND) due to the RC delay circuitry and Q18.	

Reference	Jumper Position			Description	Comments
Normal Mode	J1	OPEN		In this mode the FS26 can enter Normal mode by configuring the init_fs window and sending properly serviced watchdog refresh by SPI. Please review the FS26 documentation.	
	J5	OPEN			
All change of jumpers must be done once the EVB is unpowered from J3 and J5 as MANDATORY					

7.2 S32K312EVB-Q172 – +5.0 Volts Power Supply

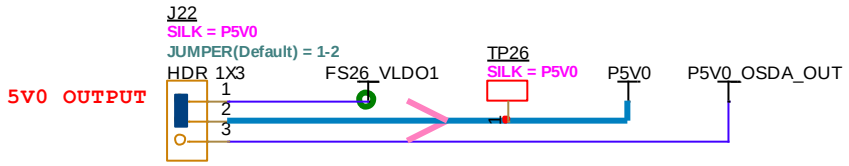


Figure 6. S32K312EVB-Q172 – General jumper for the P5V0 (+5.0V) reference

Table 4. S32K312EVB-Q172 – +5.0 Volts Power Supply

Reference	Jumper Position		Description	Comments
J22	1-2		The +5.0V output of the FS26x SBC [FS26_VLDO1] is routed to the main P5V0 domain (+5.0V for all board).	Default closed
	OPEN		P5V0 domain (+5.0V for all board) is isolated/disconnected from the FS26x	

7.3 S32K312EVB-Q172 – +3.3 Volts Power Supply

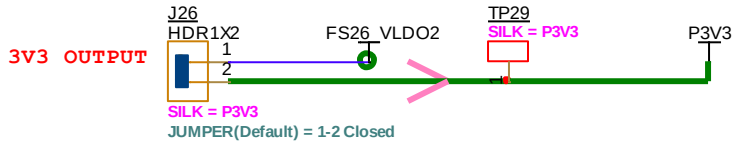
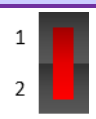


Figure 7. S32K312EVB-Q172 – General jumper for the P3V3 (+3.3V) reference

Table 5. S32K312EVB-Q172 – +.3.3 Volts Power Supply

Reference	Jumper Position		Description	Comments
J26		1-2	The +3.3V Switching power supply is routed to the main P3V3 domain (+3.3V for all board).	Default closed
		OPEN	The +3.3V output of the FS26x SBC is isolated to the main P3V3 domain (+3.3V for all board).	

7.4 S32K312EVB-Q172 – VDD_HV_A

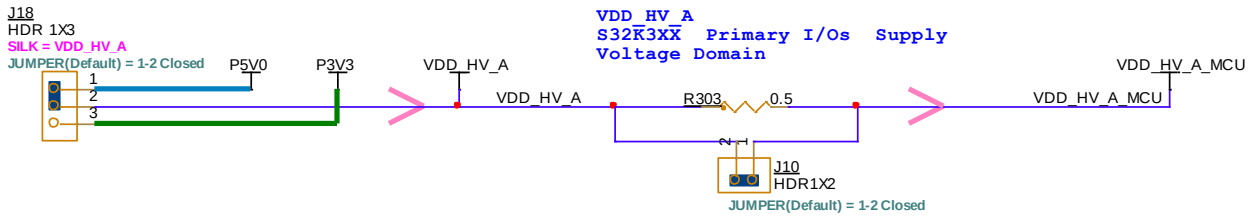
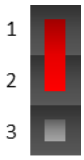
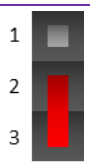
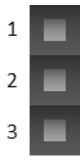
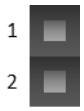


Figure 8. S32K312EVB-Q172 – VDD_HV_A power supply

Table 6. S32K312EVB-Q172 – VDD_HV_A

Reference	Jumper Position		Description	Comments
J18		1-2	P5V0 (+5.0V from the FS26) is selected for the VDD_HV_A_MCU reference	Default closed
		2-3	P3V3 (+3.3V from the FS26) is selected for the VDD_HV_A_MCU reference	
		OPEN	VDD_HV_A domain is isolated and unpowered	
J10		1-2	VDD_HV_A is routed to VDD_HV_A_MCU reference. This jumper can be used to current measurements in the VDD_HV_A domain	Default closed
		OPEN	Without this jumper the VDD_HV_A domain will not be powered. The S32K312 MCU will be turned-OFF	

7.5 S32K312EVB-Q172 – VREFH

The VREFH reference of the S32K312 MCU is directly routed to the VDD_HV_A_MCU domain.

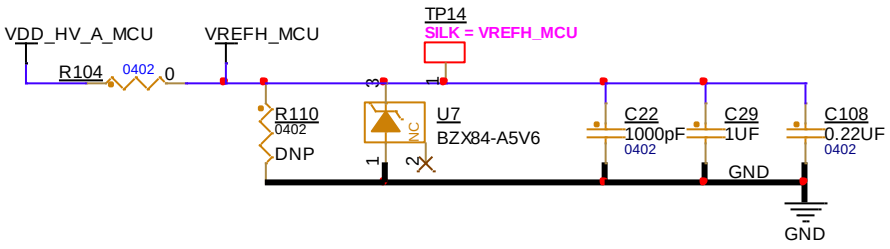


Figure 9. S32K312EVB-Q172 – VREFH power supply

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8 S32K312EVB-Q172 - Programming and Debug Interface

8.1 RESET Switch and LED indicator

The RESET switch [SW2] provides for manual application of the RESET input signal. The S32K3 MCU will drive the RESET signal to reset the EVB board peripherals. The RESET LED indicator [D22] will be ON for the duration of the RESET signal. This operation indicates the S32K312 MCU is in the Reset state.

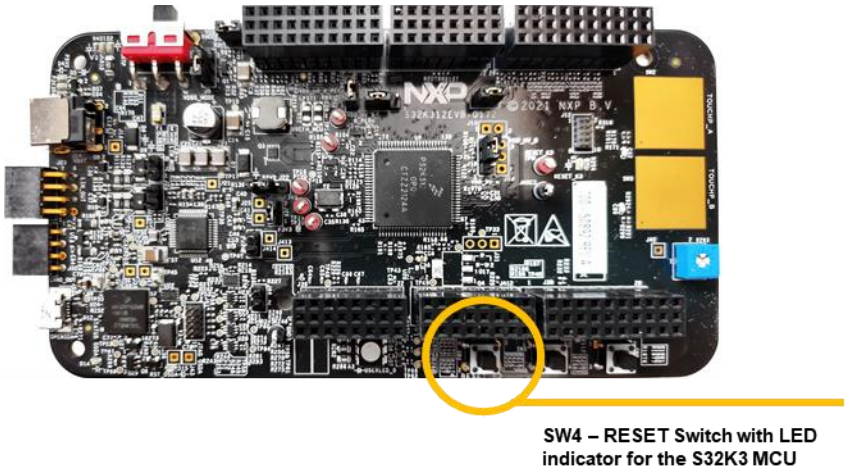


Figure 10. S32K312EVB-Q172 – RESET Switch

8.2 On-board Debugger

The EVB incorporates an On-Board Debugger embedded well as JTAG connectors. It bridges serial and debug communications between a USB host and an embedded target processor.

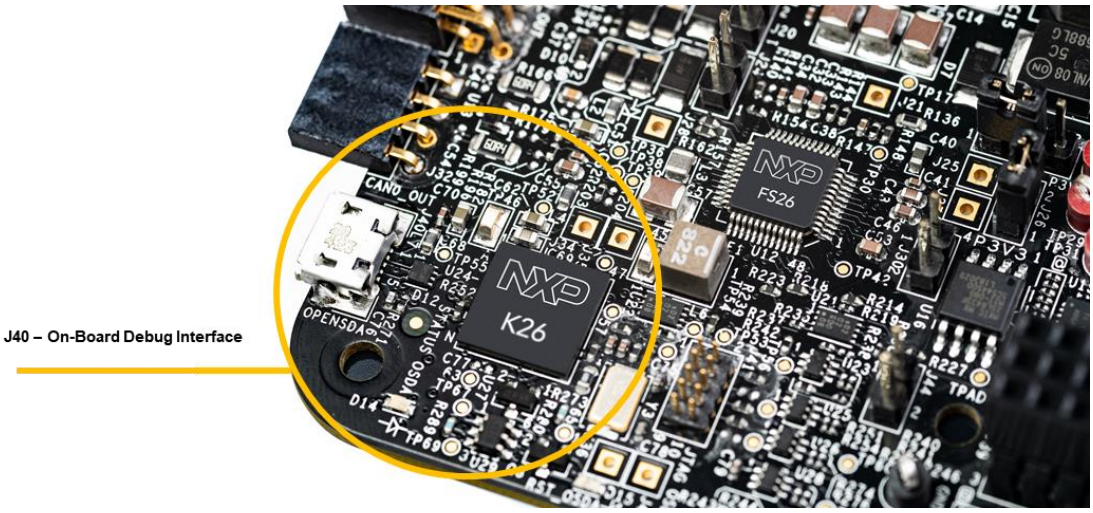


Figure 11. S32K312EVB-Q172 – On-board S32K3 Debugger

Table 7. Programming and Debug Connectors

Connector		Reference/ Component	Description
20-Pin Cortex Debug + ETM Connector		**J50**	This small 20-pin (0.05") connector provides access to SWD, SWV, JTAG, and ETM (4-bit) signals available on a Cortex-M3/M4/M7 device. A 20-pin header (Samtec FTSH-110-01) is specified with dimensions: 0.50" x 0.188" (12.70 mm x 4.78 mm).
			NOTE - JTAG – TRACE Signals Due that the MCU ports used for the trace signals also are shared with other interfaces. It is important to isolate these signals/interfaces for the **J4-Cortex Debug D ETM connector**.

SIGNAL Name	MCU Port Name	Signal Resistor	COMMENT
TRACE_CLK	PTC2	R192	Disabled as DEFAULT
TRACE_D0	PTD7	R452	Disabled as DEFAULT
TRACE_D1	PTD12	R190	Disabled as DEFAULT
TRACE_D2	PTD11	R435	Disabled as DEFAULT
TRACE_D3	PTD10	R511	Disabled as DEFAULT

All TRACE signals are DISABLED as default configuration. In order to enable the TRACE interface, the MCU signals routed to the QSPIA interface must be disabled and isolated.

9 S32K312EVB-Q172 - LIN Interface

The EVB incorporates two LIN interfaces connected the S32K312 MCU. Using an NXP LIN transceivers the TJA1021T/20/C, supporting both master and slave mode (jumper selectable). The output from the LIN transceivers is connected to J23.

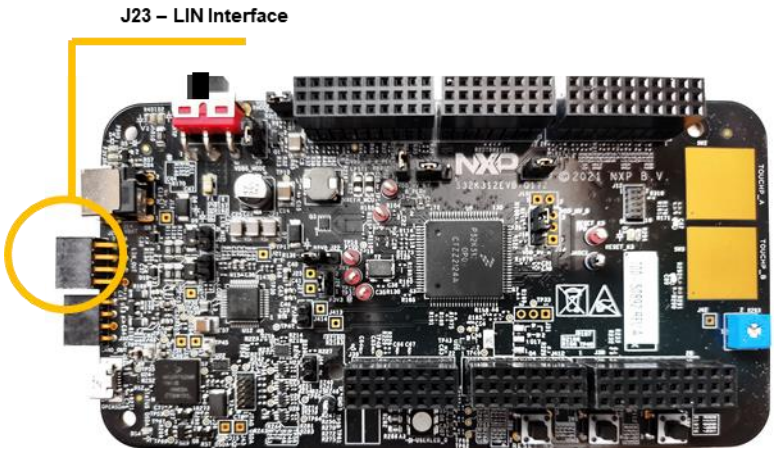
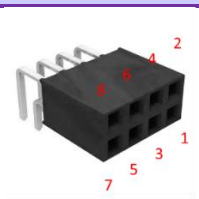


Figure 12. S32K312EVB-Q172 – LIN Interface

The pinout of these headers is shown below and is also detailed on the PCB silkscreen.

Table 8. LIN Connector

Connector	Reference	Pin Number	Signal/Connection
	J23	1	GND
		2	GND
		3	NC
		4	NC
		5	VBAT
		6	VBAT
		7	LIN2_OUT
		8	LIN1_OUT

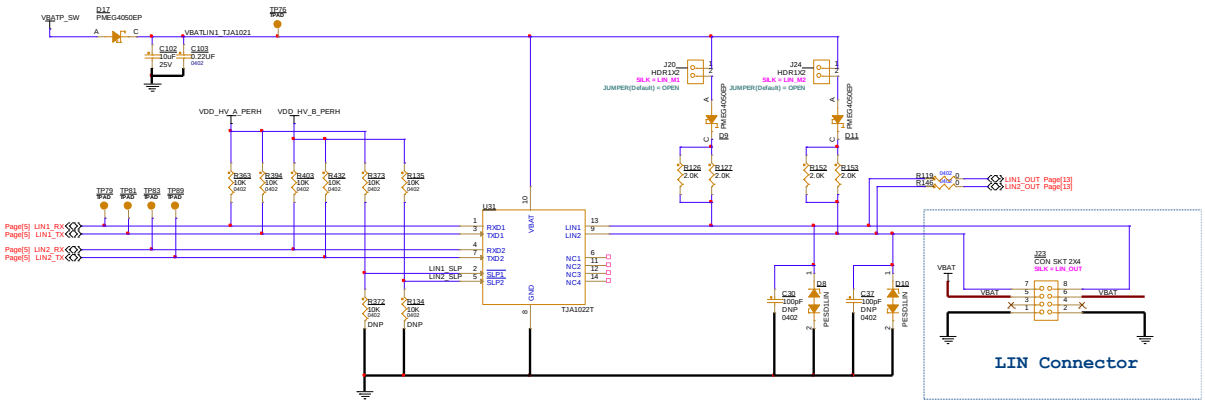


Figure 13. S32K312EVB-Q172 – LIN Physical Layer1 TJA1021HG: Quad LIN 2.2A/SAE J2602 transceiver

Table 9. LIN Interface – MCU Connections

LIN Interface	Signal Name	MCU Port	Comment/Description
TJA1021 /LIN1	LIN1_RX	PTB9	LPUART9_RX is routed to LIN Phy1
	LIN1_TX	PTB10	LPUART9 is routed to LIN Phy1
	LIN2_RX	PTB28	LPUART5_RX is routed to LIN Phy1
	LIN2_TX	PTB27	LPUART5_TX is routed to LIN Phy1

10 S32K312EVB-Q172 - CAN Interface

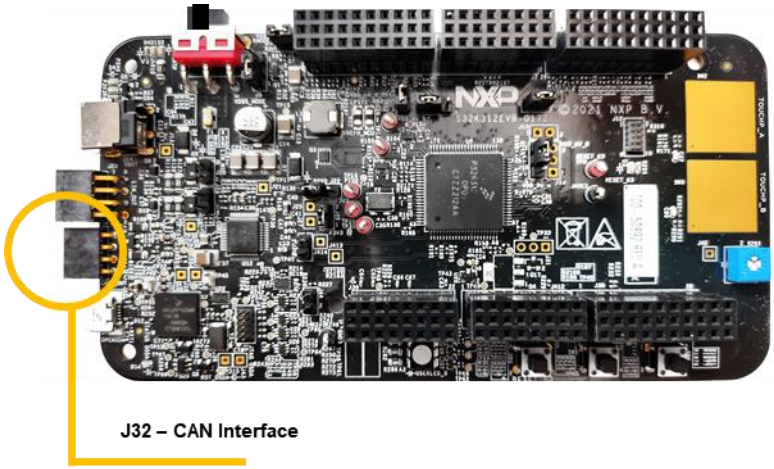


Figure 14. S32K312EVB-Q172 – CAN Interface

Table 10. CAN Interface - Connectors

Connector	Reference	Circuit/ Interface	Pin Number	Signal/Connection
	J32	CAN0	1	CANH0
			2	CANL0
			3	GND
			4	NC

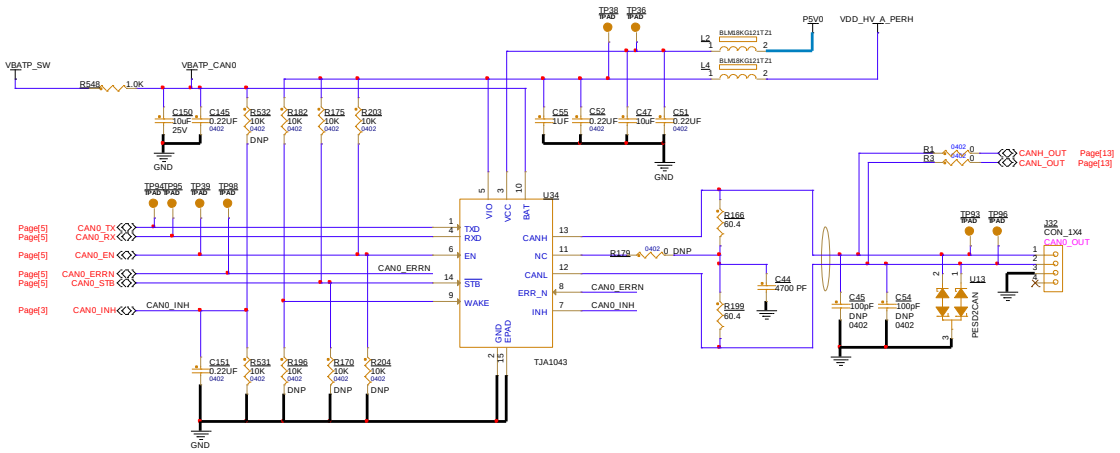


Figure 15. S32K312EVB-Q172 – CAN Physical Layer0 - TJA1043 Secure HS-CAN Transceiver

Table 11. CAN Interface – MCU Connections

CAN Interface	Signal Name	MCU Port	Comment/Description
TJA1153 /CAN0	CAN0_RX	PTA6	[CAN0_RX Module] is routed to CAN Phy0
	CAN0_TX	PTA7	[CAN0_TX Module] is routed to CAN Phy0
	CAN0_ERRN	PTC23	PTC23 is routed to CAN Phy0 as CAN0_ERRN
	CAN0_EN	PTC21	PTC21 is routed to CAN Phy0 as CAN0_EN
	CAN0_STB	PTC20	PTC20 is routed to CAN Phy0 as CAN0_STB

11 S32K312EVB-Q172 - User Peripherals

11.1 User RGB LED Indicator

There is 1 active high user RGB LEDs are connected by NPN transistors to the MCU ports. The USERLEDs are connected as follows:

Table 12. User LED Indicators

Reference	Signal Name	MCU Port Default	Color	Comment
D13	RGBLED0_RED	PTA29	Red	Active High
	RGBLED0_GREEN	PTA30	Green	Active High
	RGBLED0_BLUE	PTA31	Blue	Active High

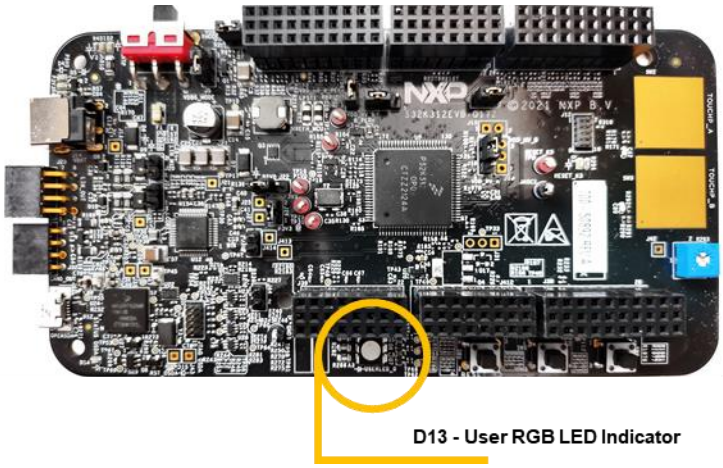


Figure 16. S32K312EVB – User RGB LED Indicator

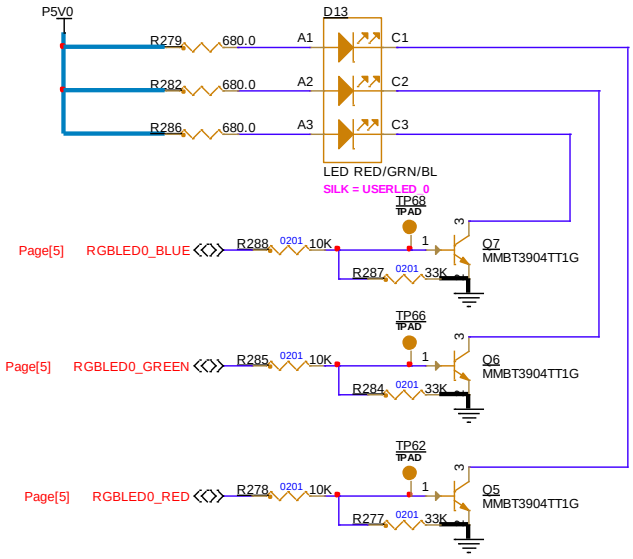


Figure 17. S32K312EVB-Q172 – User LED indicators

11.2 User Pushbuttons

There are 2 push-buttons active to high (pulled low, driven to VDD_HV_A and VDD_HV_B), the push button switches (SW6 and SW5) connected to MCU ports. The switches are connected as follows:

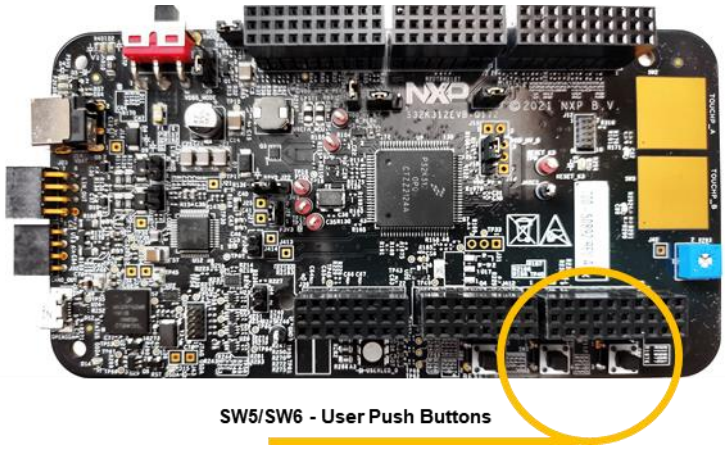


Figure 18. S32K312EVB-Q172 – User Pushbuttons

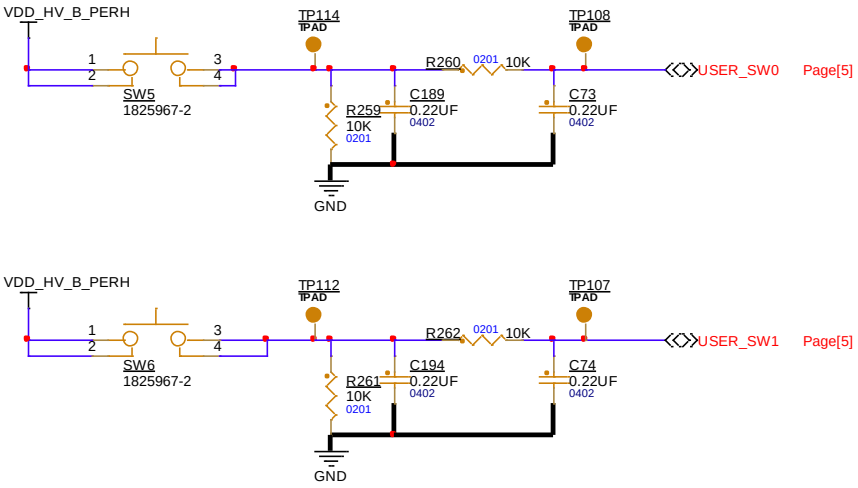


Figure 19. S32K312EVB-Q172 – User Pushbuttons

Table 13. User Pushbuttons

Reference	Function	MCU Port	Comments
SW5	USER_SW0	PTB26	Disabled
SW6	USER_SW1	PTB19	Enabled as DEFAULT
		PTF31	Disabled
		PTC18	Disabled

1. There are zero-ohm resistors 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.

11.3 ADC Rotary Potentiometers

The EVB incorporates a couple of ADC Rotary Potentiometer [which routes a voltage between 0v to VD_HV_A] directly connected to ADC Precise Input Chanel of the S32K312 Microcontroller.

Table 14. ADC Potentiometers

Reference	Function	MCU Port	Comments
R393	ADC_POT0	PTA11	Enabled as DEFAULT
		PTA9	Disabled

NOTE

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

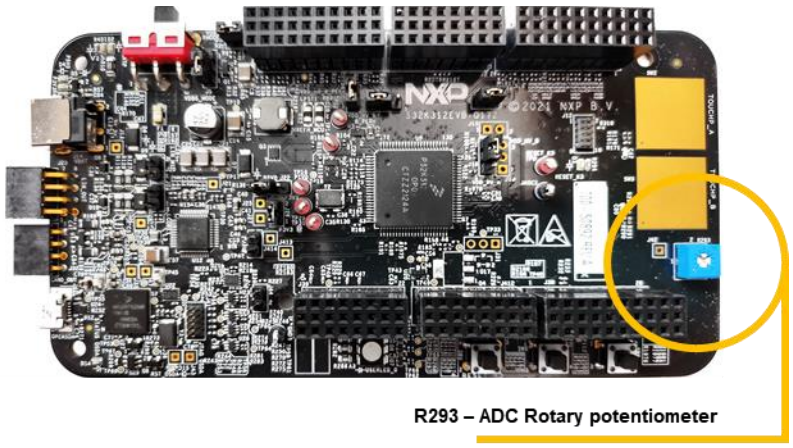


Figure 20. S32K312EVB-Q172 – ADC Rotary Potentiometers

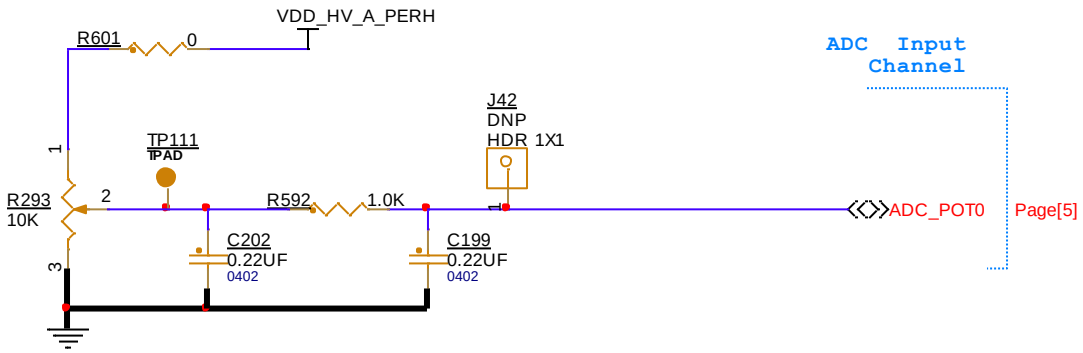


Figure 21. S32K312EVB-Q172 – ADC Rotary Potentiometers

12 S32K312EVB-Q172 - Default Jumpers

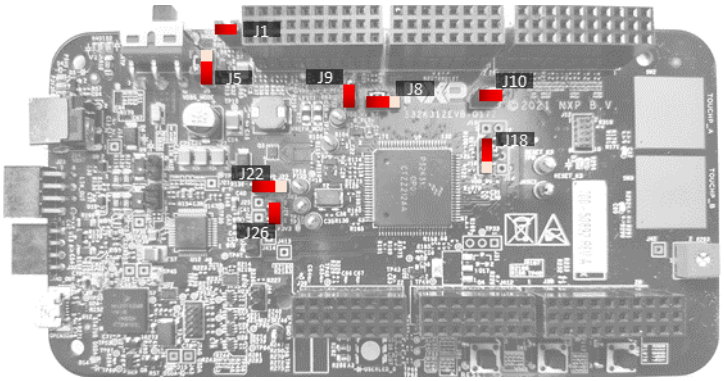


Figure 22. S32K312EVB-Q172 – Default jumpers' configuration

Table 15. Default Jumper Configuration

Interface	Reference	Position	Description / Comments
FS26x SBC Power Supply	**J22**	1-2	FS26_VLDO1 [+5.0V] is routed to P5V0 domain
	J26	1-2	FS26_VLDO2 [+3.3V] is routed to P3V3 domain
	J1	1-2	Flash Mode – configuration in the FS26
	J5	1-2	
S32K312 MCU Power Supply	**J18**	1-2	P5V0 (+5.0V from the FS26) is selected for the VDD_HV_A_MCU reference.
	J10	1-2	VDD_HV_A is routed to VDD_HV_A_MCU reference. A jumper on this position disables the shunt resistors R57 and R58 are disabled for current measurement proposals.
	J9	1-2	VDD_HV_B is routed to VDD_HV_B_PERH
	J8	1-2	VDD_HV_A is routed to VDD_HV_A_PERH

13 S32K312EVB-Q172 - Revision history

Table 16. Revision history

Document Revision	Date	Schematic / Board Number	Schematic / Board Revision	Changes	Author
A1	01/2021	51972	A	Internal version	Jesús Sánchez

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