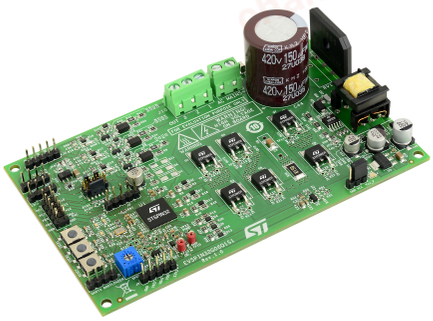
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EVSPIN32G02Q1S1

Data brief

3-phase inverter based on STSPIN32G0251Q



Features

- Input voltage from 15 V_{AC} (20 V_{DC}) to 120 V_{AC} (170 V_{DC})
- Suitable for application up to 300 W
- STD17NF25 MOSFETs power stage featuring:
  - V_{DS} = 250 V
  - $R_{DS(on)}$ max =0.165 Ω
- Overcurrent threshold set to 4 A_{peak}
- Dual footprint for IGBT/MOSFET package:
  - DPAK or PowerFlat 8x8 HV
- Single-shunt current sensing, suitable for:
  - Sensored or sensorless 6-step algorithm
  - Sensored or sensorless single-shunt vector (FOC) algorithm
- Smart shutdown overcurrent protection
- Digital Hall sensors and encoder input
- Bus voltage sensing
- 12 V VCC and 3.3 V VDD supplies
- External connection through STLINK-V3SET
- Easy user interface with buttons and trimmer
- RoHS compliant

Product status link
EVSPIN32G02Q1S1

Applications

- Residential and industrial refrigerator compressors
- Industrial drives, pumps, and fans
- Air conditioning compressors and fans
- Corded power tools, garden tools
- Home appliances
- Industrial automation

Description

The EVSPIN32G02Q1S1 board is a 3-phase complete inverter based on the STSPIN32G0251 controller, which embeds a 3-phase 250 V gate driver and a Cortex®-M0+ STM32 MCU. The power stage features STD17NF25 MOSFETs, but can be populated with any IGBT or Power MOSFET in DPAK or powerFLAT 8x8 HV package. The board has a single-shunt sensing topology, and both FOC and 6-step control algorithms in either sensored or sensorless mode can be implemented. This allows driving permanent magnet synchronous motors (PMSMs) and brushless DC (BLDC) motors.

The evaluation board is compatible with a wide range input voltage from 15 V_{AC} (20 V_{DC}) to 120 V_{AC} (170 V_{DC}), and includes a power supply stage with the VIPER013BLS in buck configuration to generate +12 V and +3.3 V supply voltage required by the application.

Debug and configuration of firmware can be performed with standard STM32 tools through the STLINK debugger. SWD and UART TX-RX connectors are also available.

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1 Safety and operating instructions



1.1 General terms

Warning: *During assembly, testing, and operation, the evaluation board poses several inherent hazards, including bare wires, moving or rotating parts, and hot surfaces.*

Danger: *There is a danger of serious personal injury, property damage, or death due to electrical shock and burn hazards if the kit or components are improperly used or installed incorrectly.*

Attention: *The kit is not electrically isolated from the high-voltage supply AC/DC input. The evaluation board is directly linked to the mains voltage. No insulation is ensured between the accessible parts and the high voltage. All measuring equipment must be isolated from the mains before powering the board. When using an oscilloscope with the demo, it must be isolated from the AC line. This prevents shock from occurring as a result of touching any single point in the circuit, but does NOT prevent shock when touching two or more points in the circuit.*

Important: All operations involving transportation, installation and use, and maintenance must be performed by skilled technical personnel able to understand and implement national accident prevention regulations. For the purposes of these basic safety instructions, “skilled technical personnel” are suitably qualified people who are familiar with the installation, use, and maintenance of power electronic systems.

1.2 Intended use of evaluation board

The evaluation board is designed for demonstration purposes only, and must not be used for electrical installations or machinery. Technical data and information concerning the power supply conditions are detailed in the documentation and should be strictly observed.

1.3 Installing the evaluation board

- The installation and cooling of the evaluation board must be in accordance with the specifications and target application.
- The motor drive converters must be protected against excessive strain. In particular, components should not be bent nor should isolating distances be altered during transportation or handling.
- No contact must be made with other electronic components and contacts.
- The board contains electrostatically sensitive components that are prone to damage if used incorrectly. Do not mechanically damage or destroy the electrical components (potential health risks).

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1.4 Operating the evaluation board

To properly operate the board, follow these safety rules:

1. Work area safety:
   - The work area must be clean and tidy.
   - Do not work alone when boards are energized.
   - Protect against inadvertent access to the area where the board is energized using suitable barriers and signs.
   - A system architecture that supplies power to the evaluation board must be equipped with additional control and protective devices in accordance with the applicable safety requirements (i.e., compliance with technical equipment and accident prevention rules).
   - Use a non-conductive and stable work surface.
   - Use adequately insulated clamps and wires to attach measurement probes and instruments.
2. Electrical safety:
   - Remove the power supply from the board and electrical loads before taking any electrical measurements.
   - Proceed with the arrangement of measurement setup, wiring, or configuration paying attention to high voltage sections.
   - Once the setup is complete, energize the board.

Danger: *Do not touch the evaluation board when it is energized or immediately after it has been disconnected from the voltage supply as several parts and power terminals containing potentially energized capacitors need time to discharge.*
Do not touch the boards after disconnection from the voltage supply as several parts, like heat sinks and transformers, may still be very hot.
The kit is not electrically isolated from the AC/DC input. The USB interface of the board does not insulate the host computer from high voltage. When the board is supplied at a voltage outside the ELV range, a proper insulation method such as a USB isolator must be used to operate the board.

3. Personal safety:
   - Always wear suitable personal protective equipment such as, for example, insulating gloves and safety glasses.
   - Take adequate precautions and install the board in such a way to prevent accidental touch. Use protective shields such as, for example, an insulating box with interlocks, if necessary.

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2 Schematic diagrams

Figure 1. **EVSPIN32G02Q1S1 schematic - driver output stages**

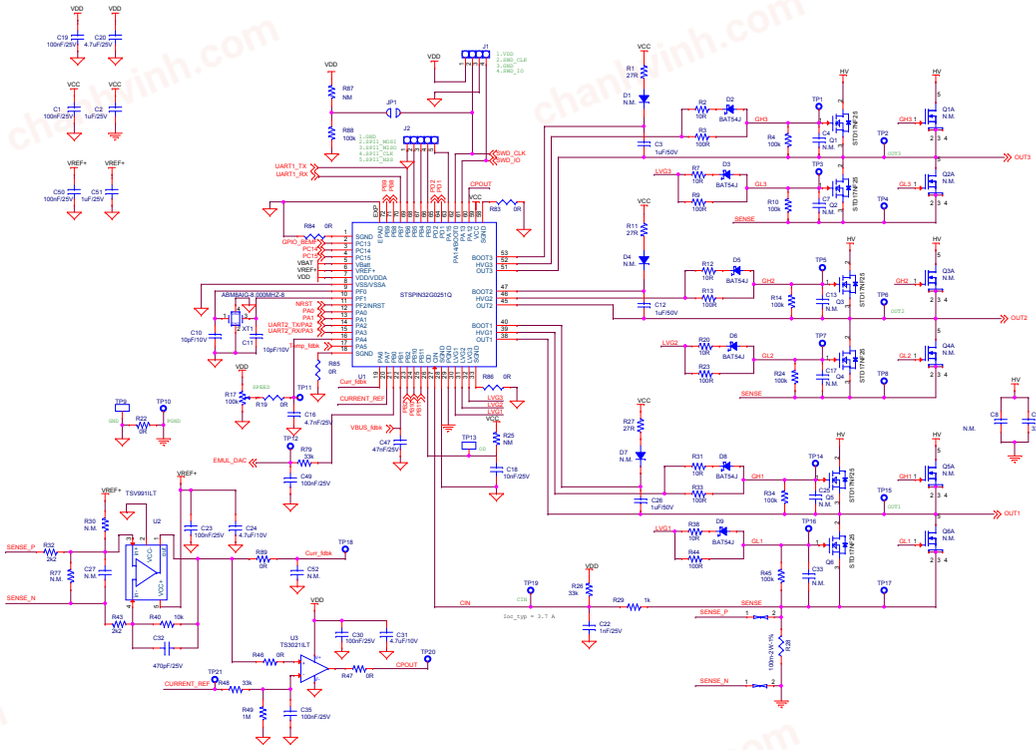
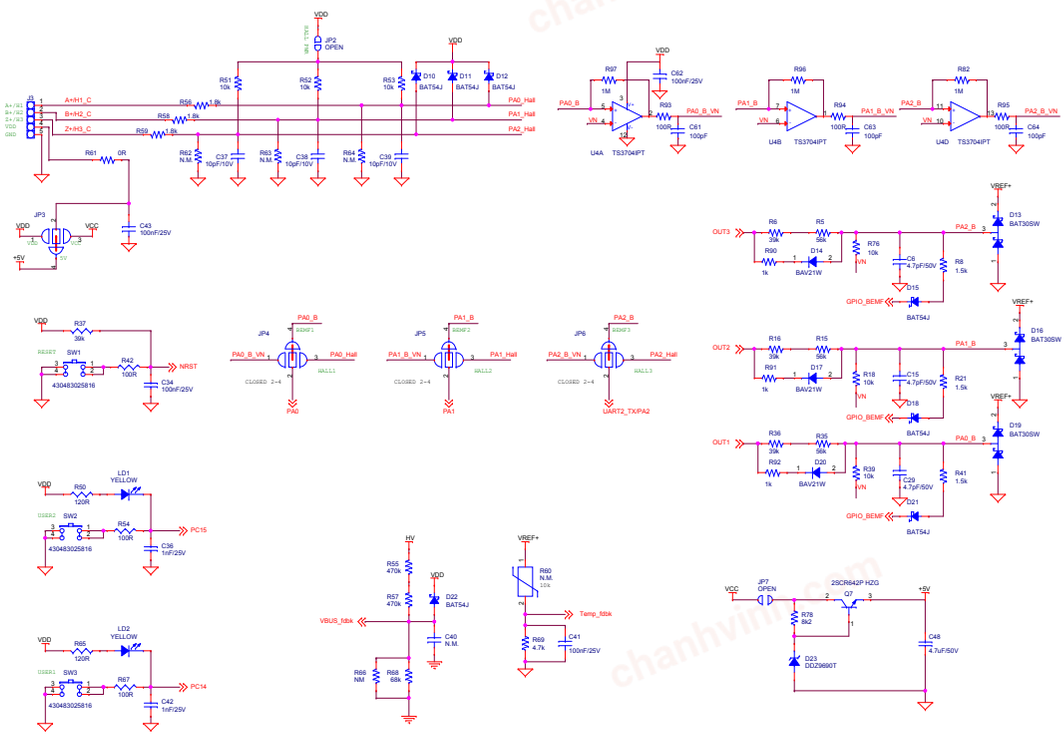


Figure 2. **EVSPIN32G02Q1S1 schematic - feedback network**



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Figure 3. **EVSPIN32G02Q1S1 schematic - power supply**

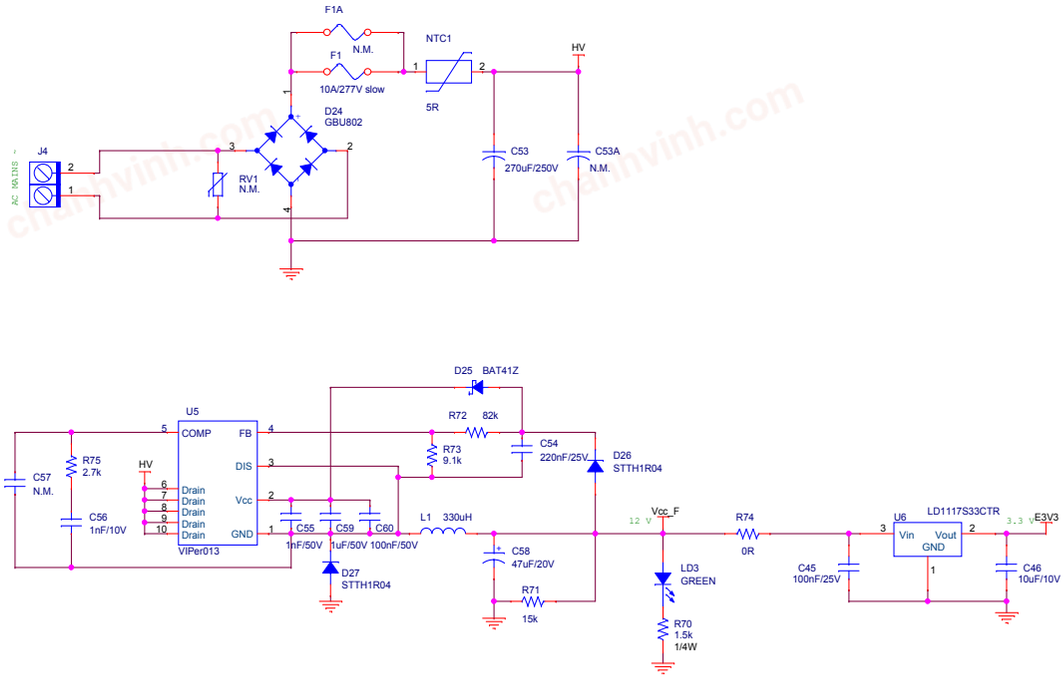
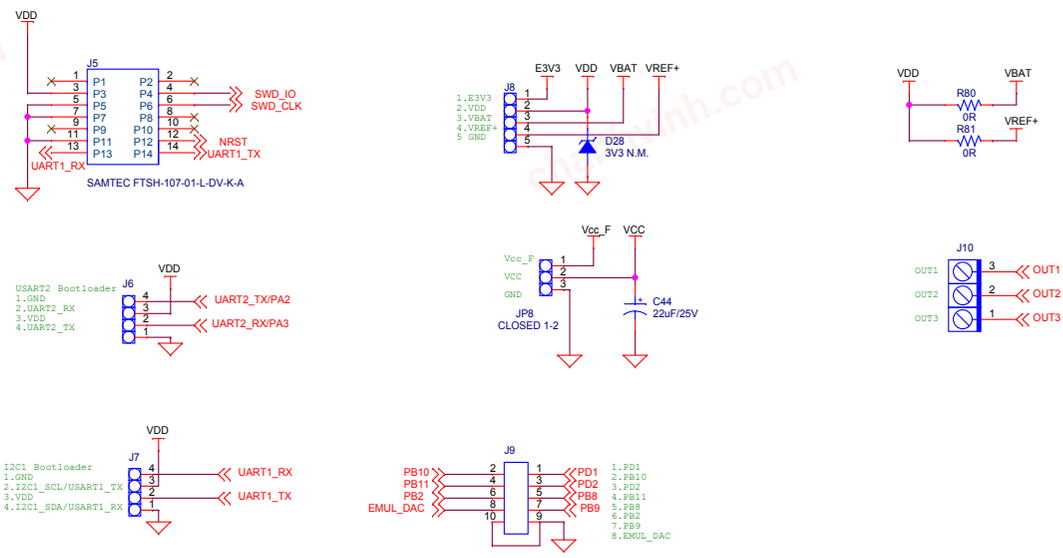


Figure 4. **EVSPIN32G02Q1S1 schematic - connectors**



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3 Bill of materials

Table 1. **EVSPIN32G02Q1S1 bill of materials**

Part reference	Part description	Part Value	Package / Manufacturer' code
C1, C19, C23, C30, C34, C35, C41, C43, C45, C49, C50, C62	SMT ceramic capacitor	100 nF / 25 V	Size 0603
C2, C51	SMT ceramic capacitor	1 µF / 25 V	Size 0603
C3, C12, C26, C59	SMT ceramic capacitor	1 µF / 50 V	Size 0805
C4, C7, C13, C17, C25, C27, C33, C40, C52, C57	SMT ceramic capacitor	N.M.	Size 0603
C6, C15, C29	SMT ceramic capacitor	4.7 pF / 50 V	Size 0603
C8	Film metallized polypropylene	N.M.	4x13 mm, pitch 10 mm Kemet R71MF31004030K or equivalent
C9	SMT ceramic capacitor	33 nF / 630 V	Size 1206
C10, C11, C37, C38, C39	SMT ceramic capacitor	10 pF / 10 V	Size 0603
C16	SMT ceramic capacitor	4.7 nF / 25 V	Size 0603
C18	SMT ceramic capacitor	10 nF / 25 V	Size 0603
C20	SMT ceramic capacitor	4.7 µF / 25 V	Size 0603
C22, C36, C42	SMT ceramic capacitor	1 nF / 25 V	Size 0603
C24, C31	SMT ceramic capacitor	4.7 µF / 10 V	Size 0805
C32	SMT ceramic capacitor	470 pF / 25 V	Size 0603
C44	SMD Aluminum electrolytic capacitor	22 µF / 25 V	5x5.4 mm Panasonic EEE1EA220WR or equivalent
C46	SMT ceramic capacitor	10 µF / 10 V	Size 1206
C47	SMT ceramic capacitor	47 nF / 25 V	Size 0603
C48	SMT ceramic capacitor	4.7 µF / 50 V	Size 1206
C53	THT electrolytic capacitor	270 µF / 250 V	Radial p10 d22h27 mm Nichicon LGN2E271MELZ25 or equivalent
C53A	THT electrolytic capacitor	N.M.	Radial p7.5 d18h25 mm Rubycon 450BXW68MEFC18X25 or equivalent
C54	SMT ceramic capacitor	220 nF / 25 V	Size 0603
C55	SMT ceramic capacitor	1 nF / 50 V	Size 0603
C56	SMT ceramic capacitor	1 nF / 10 V	Size 0603
C58	Low ESR series of robust MnO_2 solid electrolyte capacitor	47 µF / 20 V	Size 7343 AVX, TPS series or equivalent
C60	SMT ceramic capacitor	100 nF / 50 V	Size 0805
C61, C63, C64	SMT ceramic capacitor	100 pF	Size 0603
D1, D4, D7	Turbo 2 ultrafast high voltage rectifier	N.M.	SMA

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Part reference	Part description	Part Value	Package / Manufacturer' code
			STMicroelectronics STTH1L06A
D2, D3, D5, D6, D8, D9, D10, D11, D12, D15, D18, D21, D22	40 V, 300 mA small signal Schottky SMT diode	BAT54J	SOD-323 STMicroelectronics BAT54JFILM
D13, D16, D19	Small signal Schottky diode	BAT30SW	SOT323 STMicroelectronics BAT 30SWFILM or equivalent
D14, D17, D20	Surface mount switching diode	BAV21W	SOD123 Diodes Incorporated BAV21W-7-F / Q-7-F or equivalent
D23	Surface mount Zener diode	DDZ9690T	SOD523 Diodes Incorporated DDZ9690T-7 or equivalent
D24	8 A glass passivated bridge rectifier	GBU802 or equivalent	Diodes Incorporated
D25	100 V, 200 mA low capacitance small signal Schottky diode	BAT41Z	SOD-123 BAT41ZFILM STMicroelectronics
D26, D27	Ultrafast recovery diode, 1 A 400 V	STTH1R04	SMA STMicroelectronics STTH1R04A
D28	3.3 V Zener diode	N.M.	SOD-123
F1	Surface mount fuse, Time-Lag T	10 A / 277 V slow	UMT250 Schurter 3403.0176.24 or equivalent
F1A	Time Lag radial lead micro fuse	N.M.	Belfuse 0697-xx or equivalent
JP1, JP2, JP7	SMT jumper	Open	Soldering pad
JP3	SMT jumper	Closed 2-4	Soldering pad
JP8	Strip connector	1x3 pins, 2.54 mm Closed 1-2	Amphenol FCI 68000-403HLF or equivalent
J1, J6, J7	Strip connector	1x4 pins, 2.54 mm	Amphenol FCI 68000-404HLF or equivalent
J2, J8	Strip connector	1x5 pins, 2.54 mm	Würth Elektronik 61300511121 or equivalent
J3	Strip connector	1x5 pins, 2.54 mm	Amphenol FCI 68000-405HLF or equivalent
J4	Connector terminal block T.H.	MORSV-508-2P_screw	2 poles, pitch 5.08 Phoenix Contact 1715721 or equivalent
J5	SMT Micro Header	FTSH-107-01-L-DV-K-A	Pitch 1.27 mm Samtec
J9	Strip connector	2x5 pins, 2.54 mm	Würth Elektronik 61301021121 or equivalent

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Part reference	Part description	Part Value	Package / Manufacturer' code
J9	Connector terminal block T.H. 3 positions 5.08 mm	MORSV-508-3P_screw	3 poles, pitch 5.08 Phoenix Contact 1715857 or equivalent
LD1, LD2	Yellow LED	YELLOW	Size 0603 Würth Elektronik 150060YS75000 or equivalent
LD3	Green LED	GREEN	Size 0805
L1	SMD Power inductors for automotive/ industrial applications	330 µH	Taiyo Yuden EST1060T331MDGA or equivalent
NTC1	NTC thermistor for inrush current limiting	5 Ω	TDK B57235S0509M000 or equivalent
Q1, Q2, Q3, Q4, Q5, Q6	N-channel 250 V, 0.140 O typ., 17 A STripFET™ II Power MOSFETs	STD17NF25	DPAK STMicroelectronics
Q1A, Q2A, Q3A, Q4A, Q5A, Q6A	N-channel 600 V, 0.195 Ω typ., 15 A MDmesh DM2 power MOSFET	N.M.	PowerFLAT 8x8 HV STMicroelectronics STL24N60DM2
Q7	BJT 30 V 10 A	2SCR642P HZG	SOT-89 ROHM 2SCR642PHZGT100 or equivalent
RV1	Varistor	N.M.	Pitch 2.3x7.5 mm
R1, R11, R27	SMT resistor	27 Ω	Size 0805
R2, R7, R12, R20, R31, R38	SMT resistor	10 Ω	Size 0805
R3, R9, R13, R23, R33, R44	SMT resistor	100 Ω	Size 0805
R4, R10, R14, R24, R34, R45, R88	SMT resistor	100 kΩ	Size 0603
R5, R15, R35	SMT resistor	56 kΩ	Size 1206
R6, R16, R36	SMT resistor	39 kΩ	Size 1206
R8, R21, R41	SMT resistor	1.5 kΩ	Size 0603
R17	Trimming potentiometer	100 kΩ	Bourns 3362P-1-104 LF or equivalent
R18, R39, R40, R51, R52, R53, R76	SMT resistor	10 kΩ	Size 0603
R19, R22, R46, R47, R61, R80, R81, R83, R84, R85, R86, R89	SMT resistor	0 Ω	Size 0603
R25, R30, R62, R63, R64, R77, R87	SMT resistor	N.M.	Size 0603
R26, R48, R79	SMT resistor	33 kΩ	Size 0603
R28	SMT resistor	100 mΩ / 2 W / 1%	Size 2512
R29, R90, R91, R92	SMT resistor	1 kΩ	Size 0603
R32, R43	SMT resistor	2.2 kΩ	Size 0603
R37	SMT resistor	39 kΩ	Size 0603

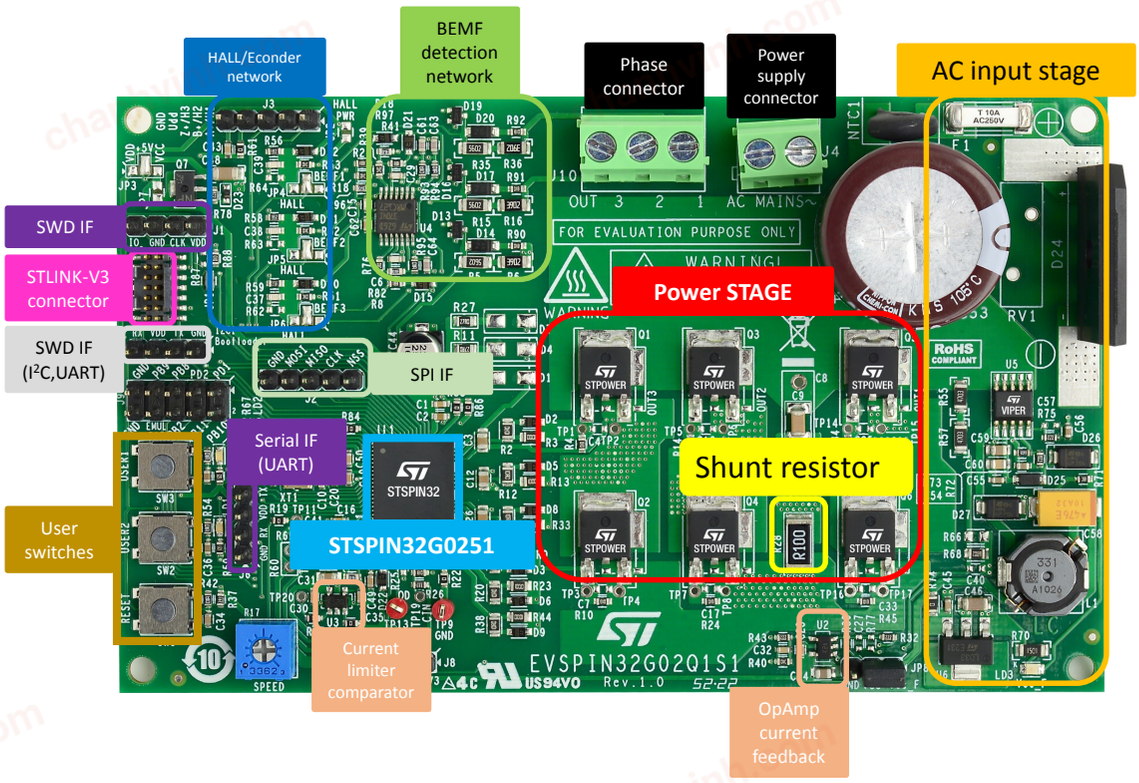
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Part reference	Part description	Part Value	Package / Manufacturer' code
R42, R54, R67, R93, R94, R95	SMT resistor	100 Ω	Size 0603
R49, R82, R96, R97	SMT resistor	1 MΩ	Size 0603
R50, R65	SMT resistor	120 Ω	Size 0603
R55, R57	SMT resistor	470 kΩ	Size 1206
R56, R58, R59	SMT resistor	1.8 kΩ	Size 0603
R60	NTC Resistor	N.M.	Hole 0.8 mm
R66	SMT resistor	N.M.	Size 0805
R68	SMT resistor	68 kΩ	Size 0805
R69	SMT resistor	4.7 kΩ	Size 0603
R70	SMT resistor	1.5 kΩ	Size 1206
R71	SMT resistor	15 kΩ	Size 0603
R72	SMT resistor	82 kΩ	Size 0603
R73	SMT resistor	9.1 kΩ	Size 0603
R74	SMT resistor	0 Ω	Size 0805
R75	SMT resistor	2.7 kΩ	Size 0603
R78	SMT resistor	8.2 kΩ	Size 0603
SW1, SW2, SW3	CMS tactile switches - 6x6 J-bend		Würth Elektronik 430483025816
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP10, TP11, TP12, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21	Test point for probe	-	Metallized hole, 0.8 mm
TP9, TP13	Ring test point	Red test point 1mm	Keystone 5003 or equivalent
U1	250 V three-phase controller with MCU	STSPIN32G0251Q	QFN 10x10 72L pitch 0.5 STMicroelectronics
U2	Rail-to-rail input/output 20 MHz GBP op amp	TSV991ILT	SOT23-5 STMicroelectronics
U3	Rail-to-rail 1.8 V high-speed comparator	TS3021ILT	SOT23-5 STMicroelectronics
U4	Micropower quad CMOS voltage comparators	TS3704IPT	TSSOP14 STMicroelectronics
U5	Energy saving off-line high voltage converter	VIPer013	SSO10 STMicroelectronics VIPer013BLS/TR
U6	800 mA, 3.3 V adjustable and fixed low drop positive voltage regulator	LD1117S33CTR	SOT-223 STMicroelectronics
XT1	Automotive & industrial grade ceramic base SMD crystal	ABM8AIG-8.000MHZ-8 or equivalent	Abracon

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4 Layout and component placements

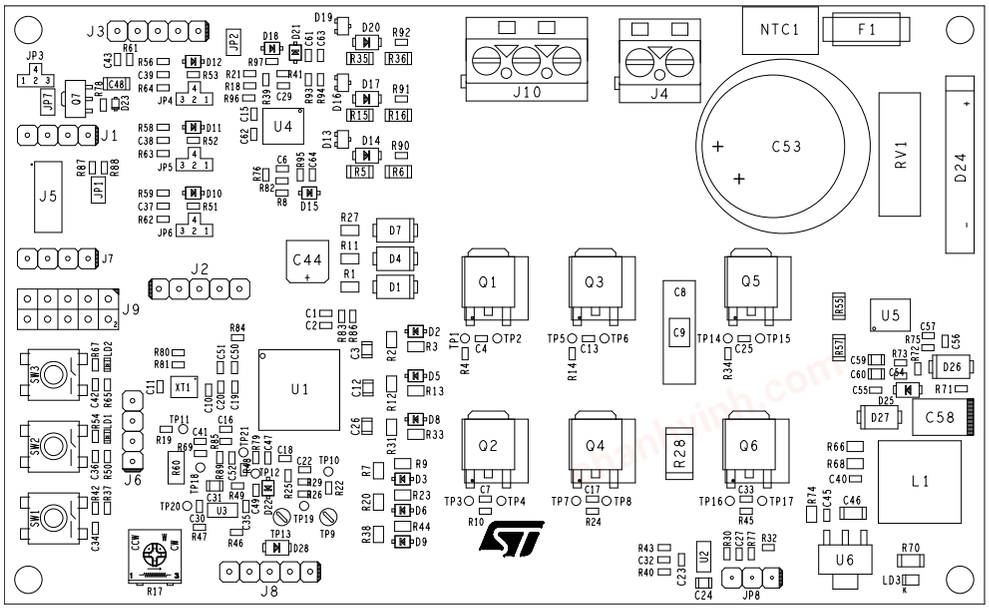
Figure 5. **EVSPIN32G02Q1S1 - functional blocks**



Warning

The kit is not electrically isolated from the AC/DC input. The USB interface of the board does not insulate host computer from high voltage. When the board is supplied at a voltage outside the ELV range, a proper insulation method such as a USB isolator must be used to operate the board.

Figure 6. **EVSPIN32G02Q1S1 layout - component placement top view**



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Figure 7. **EVSPIN32G02Q1S1 layout - top layer**

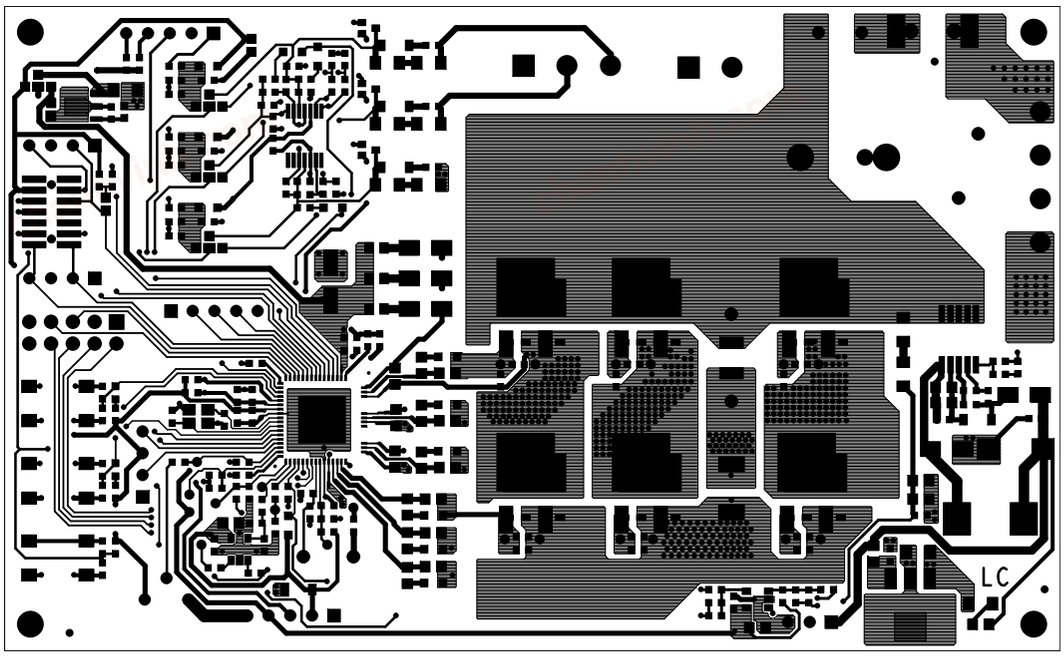
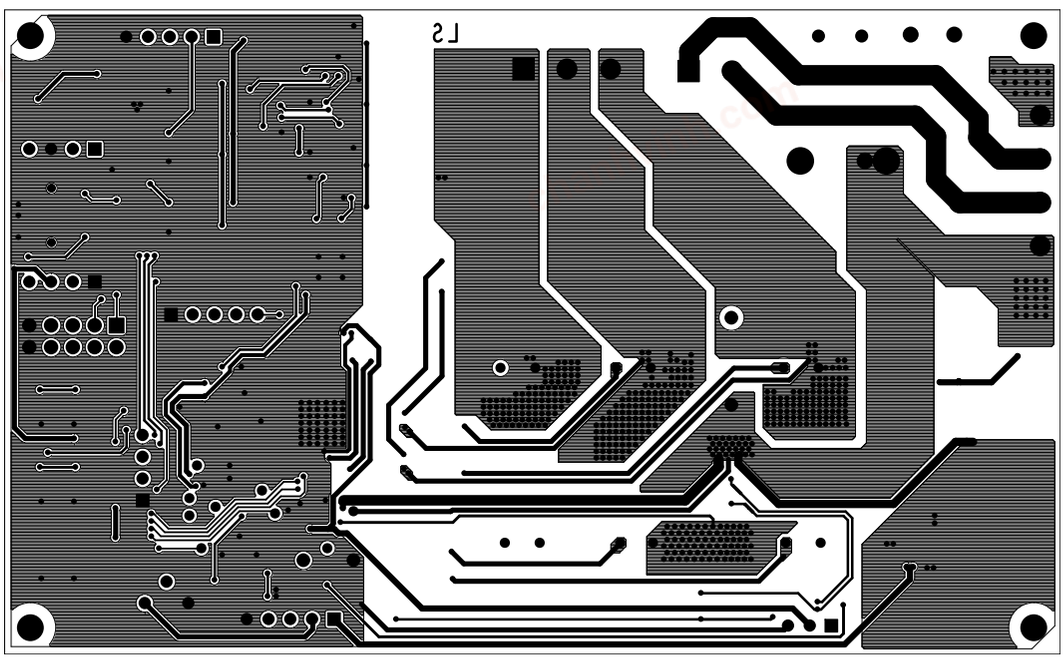


Figure 8. **EVSPIN32G02Q1S1 layout - bottom layer**



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Revision history

Table 2. **Document revision history**

Date	Version	Changes
14-Mar-2024	1	Initial release.

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Contents

1 Safety and operating instructions 2
1.1 General terms 2
1.2 Intended use of evaluation board 2
1.3 Installing the evaluation board 2
1.4 Operating the evaluation board 3
2 Schematic diagrams 4
3 Bill of materials 6
4 Layout and component placements 10
Revision history 12
List of tables 14
List of figures 15

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List of tables

Table 1. EVSPIN32G02Q1S1 bill of materials 6
Table 2. Document revision history 12

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List of figures

Figure 1. EVSPIN32G02Q1S1 schematic - driver output stages 4
Figure 2. EVSPIN32G02Q1S1 schematic - feedback network 4
Figure 3. EVSPIN32G02Q1S1 schematic - power supply 5
Figure 4. EVSPIN32G02Q1S1 schematic - connectors 5
Figure 5. EVSPIN32G02Q1S1 - functional blocks 10
Figure 6. EVSPIN32G02Q1S1 layout - component placement top view 10
Figure 7. EVSPIN32G02Q1S1 layout - top layer 11
Figure 8. EVSPIN32G02Q1S1 layout - bottom layer 11

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