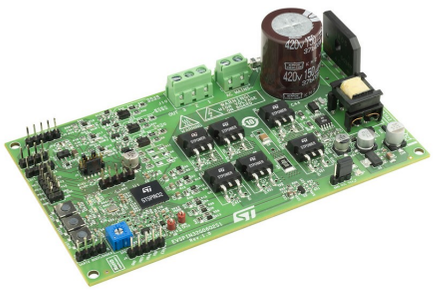
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EVSPIN32G06Q2S1

Data brief

3-phase inverter based on STSPIN32G0602Q



STSPIN

Product status link
EVSPIN32G06Q2S1

Features

- Input voltage from 35 V_{AC} (50 V_{DC}) to 280 V_{AC} (400 V_{DC})
- Suitable for ~300 W applications, 1.2 A_{RMS} phase current
- STGB20M65DF2 IGBTs power stage featuring:
  - $V_{(BR)CES}$ = 650 V
  - $V_{CE(sat)}$ = 1.55 V @ I_C = 20 A
- Overcurrent threshold set to 8.3 A_{peak}
- Dual footprint for IGBT/MOSFET package: D^2PAK 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
- 15 V VCC and 3.3 V VDD supplies
- External connection through STLINK-V3SET
- Easy user interface with buttons and trimmer
- RoHS compliant

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 EVSPIN32G06Q2S1 board is a 3-phase complete inverter based on the STSPIN32G0602 controller, which embeds a 3-phase 600 V gate driver and a Cortex®-M0+ STM32 MCU. The power stage features STGB20M65DF2 IGBTs, but can be populated with any IGBT or Power MOSFET in D^2PAK 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 35 V_{AC} (50 V_{DC}) to 280 V_{AC} (400 V_{DC}), and includes a power supply stage with the VIPER06XS in flyback configuration to generate +15 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. **EVSPIN32G06Q2S1 schematic - driver output stages**

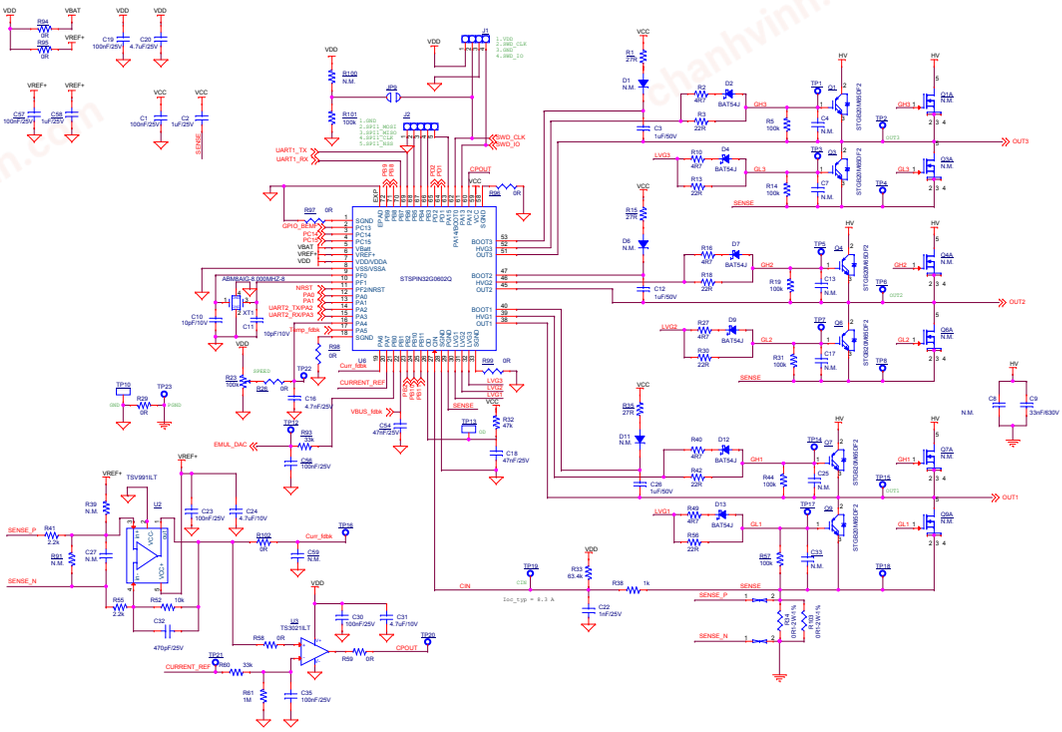
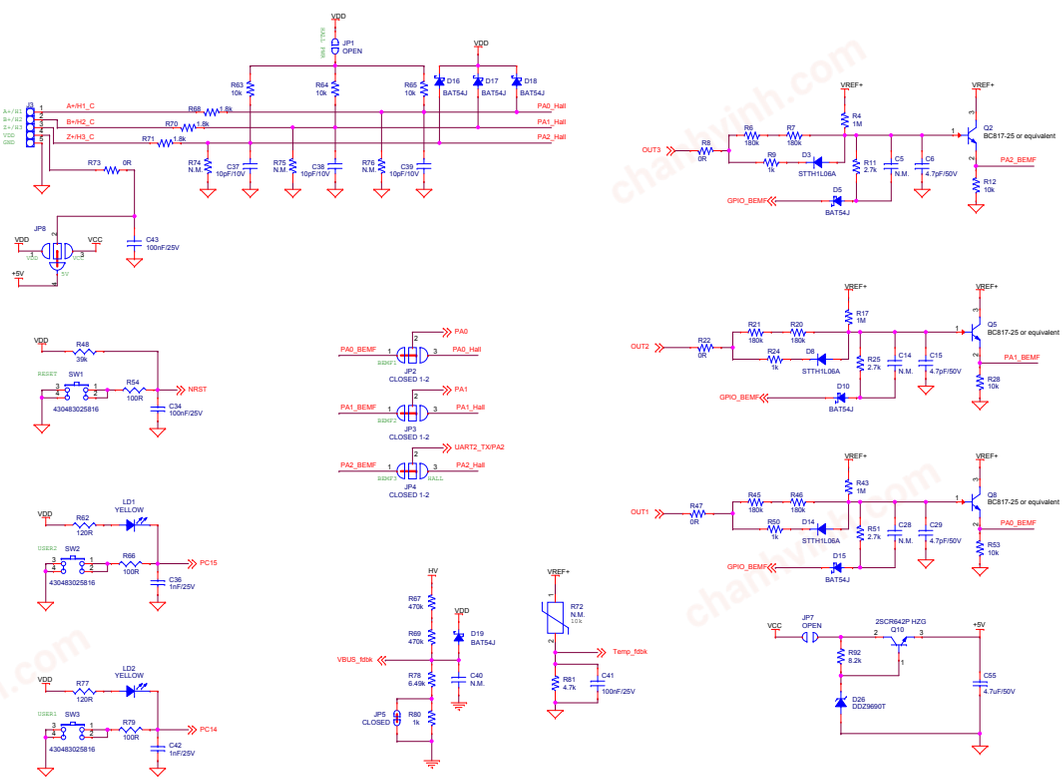


Figure 2. **EVSPIN32G06Q2S1 schematic - feedback network**



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Figure 3. **EVSPIN32G06Q2S1 schematic - power supply**

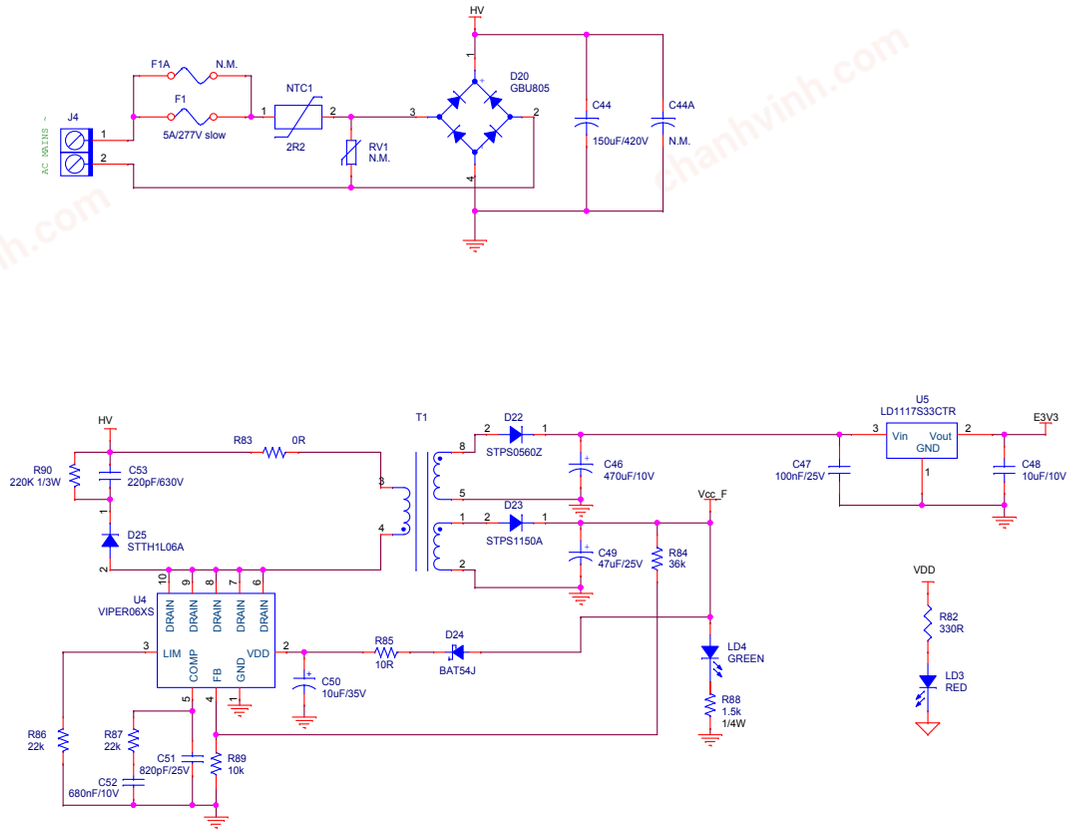
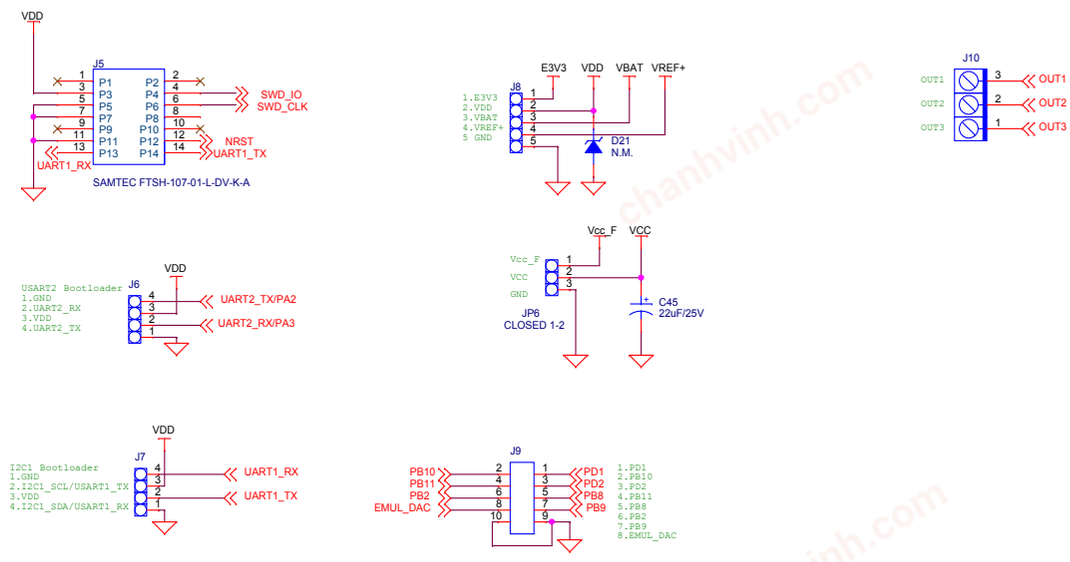


Figure 4. **EVSPIN32G06Q2S1 schematic - connectors**



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3 Bill of materials

Table 1. **EVSPIN32G06Q1S1 Bill of Materials**

Part reference	Part description	Part Value	Package / Manufacturer' code
C1, C19, C23, C30, C34, C35, C41, C43, C47, C56, C57	SMT ceramic capacitor	100 nF / 25 V	Size 0603
C2, C58	SMT ceramic capacitor	1 µF / 25 V	Size 0603
C3, C12, C26	SMT ceramic capacitor	1 µF / 50 V	Size 0805
C4, C5, C7, C13, C14, C17, C25, C27, C28, C33, C40, C59	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 1210
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, C54	SMT ceramic capacitor	47 nF / 25 V	Size 0603
C20	SMT ceramic capacitor	4.7 µF / 25 V / X5R	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	THT electrolytic capacitor	150 µF / 420 V	Radial p10 d22h27.5 mm United Chemi-Con EKMZ421VSN151MP25S or equivalent
C44A	THT electrolytic capacitor	N.M.	Radial p7.5 d18h25 mm Rubycon 450BXW68MEFC18X25 or equivalent
C45	SMD Aluminum electrolytic capacitor	22 µF / 25 V	5x5.4 mm Panasonic EEE1EA220WR or equivalent
C46	SMD Aluminum electrolytic capacitor	470 µF / 10 V	6.3x7.7 mm Panasonic EEEFTA471XAP or equivalent
C48	SMT ceramic capacitor	10 µF / 10 V	Size 1206
C49	SMD Aluminum electrolytic capacitor	47 µF / 25 V	6.3x5.8 mm Nichicon UCD1E470MCL1GS or equivalent
C50	SMD Aluminum electrolytic capacitor	10 µF / 35 V	5x5.4 mm Panasonic EEE1VA100SR or equivalent
C51	SMT ceramic capacitor	820 pF / 25 V	Size 0603
C52	SMT ceramic capacitor	680 nF / 10 V	Size 0603
C53	SMT ceramic capacitor	220 pF / 630 V	Size 1206

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Part reference	Part description	Part Value	Package / Manufacturer' code
			Multicomp MC1206N221J631CT or equivalent
C55	SMT ceramic capacitor	4.7 µF / 50 V	Size 1206
D1, D6, D11	Turbo 2 ultrafast high voltage rectifier	N.M.	SMA STMicroelectronics STTH1L06A or equivalent
D2, D4, D5, D7, D9, D10, D12, D13, D15, D16, D17, D18, D19, D24	40 V, 300 mA small signal Schottky SMT diode	BAT54J	SOD-323 STMicroelectronics BAT54JFILM or equivalent
D3, D8, D14, D25	Turbo 2 Ultrafast high-voltage rectifier	STTH1L06A	SMA STMicroelectronics STTH1L06A or equivalent
D20	8 A glass passivated single-phase bridge rectifier	GBU805	Taiwan Semiconductor GBU805 or equivalent
D21	3.3 V Zener diode	N.M.	SOD-123
D22	60 V, 0.5 A Schottky rectifier	STPS0560Z	SOD-123 STMicroelectronics STPS0560Z or equivalent
D23	150 V, 1 A power Schottky rectifier	STPS1150A	SMA STMicroelectronics STPS1150A or equivalent
D26	Surface mount Zener diode	DDZ9690T	SOD523 DIODES Incorporated DDZ9690T-7 or equivalent
F1	Surface mount fuse, Time-Lag T	5 A / 277 V slow	UMT250 Schurter 3403.0173.24
F1A	Time Lag radial lead micro fuse	N.M.	Belfuse 0697-xx or equivalent
JP1, JP7	SMT jumper	Open	Soldering pad
JP2, JP3, JP4	SMT jumper	Closed 1-2	Soldering pad
JP5	SMT jumper	Closed	Soldering pad
JP6	Strip connector	1x3 pins, Closed 1-2	Pitch 2.54 mm Amphenol FCI 68000-403HLF or equivalent
JP8	SMT Jumper	Closed 2-4	Soldering pad
JP9	SMT jumper	Open	Soldering pad
J1, J6, J7	Strip connector	1x4 pins	Pitch 2.54 mm Amphenol FCI 68000-404HLF or equivalent
J2, J8	Strip connector	1x5 pins	Pitch 2.54 mm Würth Elektronik 61300511121 or equivalent

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Part reference	Part description	Part Value	Package / Manufacturer' code
J3	Strip connector	1x5 pins	Pitch 2.54 mm Amphenol FCI 68000-405HLF or equivalent
J4	Connector terminal block T.H.	-	2 poles, pitch 5.08 mm Phoenix Contact 1715721 or equivalent
J5	SMT Micro Header	-	Pitch 1.27 mm Samtec FTSH-107-01-L-DV-K-A
J9	Strip connector	2x5 pins	Pitch 2.54 mm Würth Elektronik 61301021121 or equivalent
J10	Connector terminal block T.H.	-	3 poles, pitch 5.08 mm Phoenix Contact 1715857 or equivalent
LD1, LD2	Yellow LED	YELLOW	Size 0603 Würth Elektronik 150060YS75000 or equivalent
LD3	Red LED	RED	Size 0603 Würth Elektronik 150060RS75000 or equivalent
LD4	Green LED	GREEN	Size 0805
NTC1	NTC thermistor for inrush current limiting	2.2 Ω	TDK B57236S0229M000 or equivalent
Q1, Q3, Q4, Q6, Q7, Q9	Trench gate field-stop, 650 V, 20 A, M series low-loss IGBT	STGB20M65DF2	D^2PAK STMicroelectronics STGB20M65DF2 or equivalent
Q1A, Q3A, Q4A, Q6A, Q7A, Q9A	N-channel 600 V, 0.195 Ω typ., 15 A MDmesh DM2 power MOSFET	N.M.	PowerFLAT 8x8 STMicroelectronics STL24N60DM2
Q2, Q5, Q8	45 V NPN small signal transistor	BC817-25	SOT23
Q10	BJT 30 V 10 A	2SCR642P HZG	SOT-89 ROHM 2SCR642PHZGT100 or equivalent
RV1	Varistor	N.M.	Pitch 2.3x7.5 mm
R1, R15, R35	SMT resistor	27 Ω	Size 0805
R2, R10, R16, R27, R40, R49	SMT Resistor	4.7 Ω	Size 0805
R3, R13, R18, R30, R42, R56	SMT Resistor	22 Ω	Size 0805
R4, R17, R43, R61	SMT Resistor	1 MΩ	Size 0603
R5, R14, R19, R31, R44, R57, R101	SMT Resistor	100 kΩ	Size 0603
R6, R7, R20, R21, R45, R46	SMT Resistor	180 kΩ	Size 1206
R8, R22, R47	SMT Resistor	0 Ω	Size 0805

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Part reference	Part description	Part Value	Package / Manufacturer' code
R9, R24, R50, R80	SMT Resistor	1 kΩ	Size 0805
R11, R25, R51	SMT Resistor	2.7 kΩ	Size 0603
R12, R28, R52, R53, R63, R64, R65, R89	SMT Resistor	10 kΩ	Size 0603
R23	Trimming Potentiometer	100 kΩ	Bourns 3362P-1-104 LF or equivalent
R26, R29, R58, R59, R73, R94, R95, R102	SMT Resistor	0 Ω	Size 0603
R32	SMT Resistor	47 kΩ	Size 0603
R33	SMT Resistor	63.4 kΩ	Size 0603
R34	Power metal plate current sense resistor	50 mΩ / 3W / 1%	Size 2512 Vishay WFMB2512R0500FEA or equivalent
R38	SMT Resistor	1 kΩ	Size 0603
R39, R74, R75, R76, R91, R100	SMT Resistor	N.M.	Size 0603
R41, R55	SMT Resistor	2.2 kΩ	Size 0603
R48	SMT Resistor	39 kΩ	Size 0603
R54, R66, R79	SMT Resistor	100 Ω	Size 0603
R60, R93	SMT Resistor	33 kΩ	Size 0603
R62, R77	SMT Resistor	120 Ω	Size 0603
R67, R69	SMT Resistor	470 kΩ	Size 1206
R68, R70, R71	SMT Resistor	1.8 kΩ	Size 0603
R72	NTC Resistor	N.M.	Hole 0.8 mm
R78	SMT Resistor	6.49 kΩ	Size 0805
R81	SMT Resistor	4.7 kΩ	Size 0603
R82	SMT Resistor	330 Ω	Size 0603
R83	SMT Resistor	0 Ω	Size 1206
R84	SMT Resistor	36 kΩ	Size 0603
R85	SMT Resistor	10 Ω	Size 0603
R86, R87	SMT Resistor	22 kΩ	Size 0603
R88	SMT Resistor	1.5 kΩ	Size 1206
R90	SMT Resistor	220 kΩ / 1/3 W	Size 0805 TE Connectivity CRGH0805J220K or equivalent
R92	SMT Resistor	8.2 kΩ	Size 0603
R96, R97, R98, R99	SMT Resistor	0 Ω	Size 0603
SW1, SW2, SW3	CMS tactile switches - 6x6 J-bend		Würth Elektronik 430483025816 or equivalent
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP12, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23	Test point for probe	-	Metallized hole, 0.8 mm
TP10, TP13	Ring test point	Red test point 1 mm	Keystone 5003 or equivalent

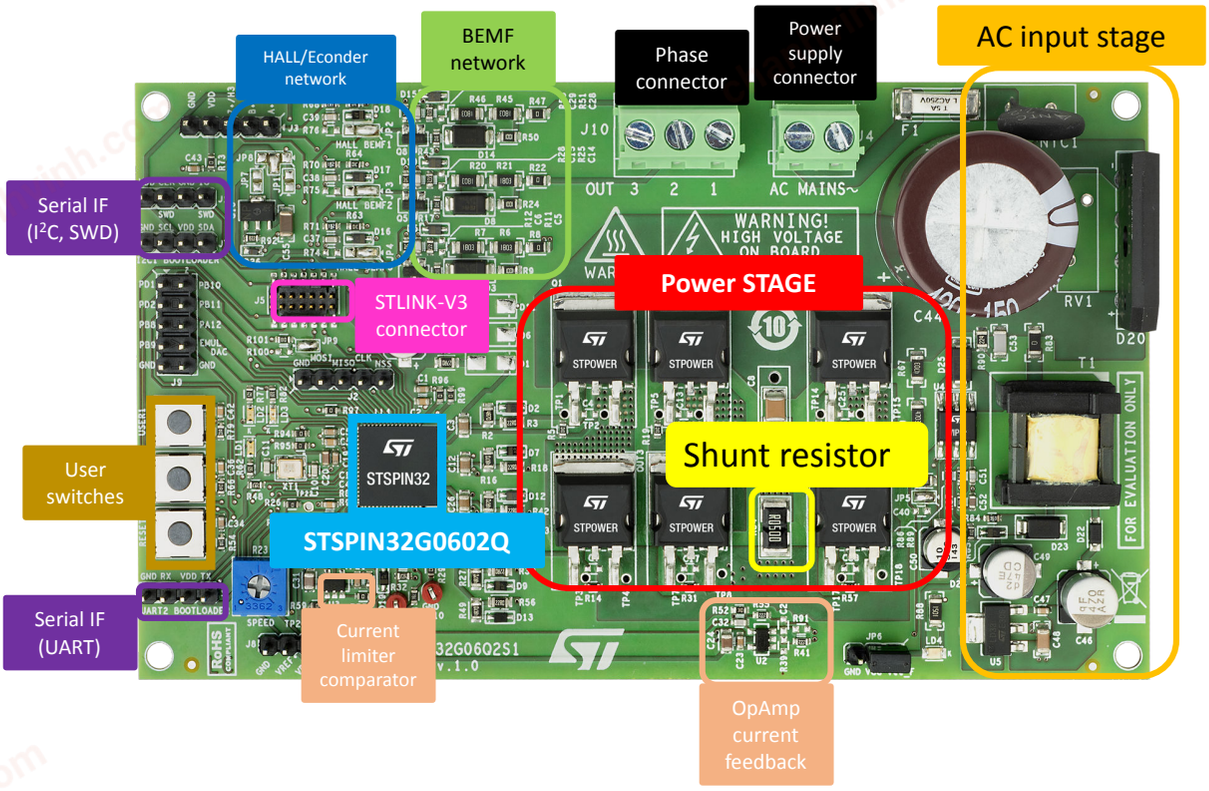
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Part reference	Part description	Part Value	Package / Manufacturer' code
T1	Switch mode transformer 2.3 W 60 kHz 3.15 mH 7-15 V	-	Würth Elektronik 750318434 or Magnetica 1921.0059
U1	600 V three-phase controller with MCU	STSPIN32G0602Q	QFN 10x10 72L pitch 0.5 STMicroelectronics STSPIN32G0602Q/TR
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	Fixed-frequency VIPer plus family	VIPER06XS	SSO10 STMicroelectronics
U5	800 mA, 3.3 V adjustable and fixed low drop positive voltage regulator	LD1117	SOT-223 STMicroelectronics LD1117S33CTR or equivalent
XT1	Automotive & industrial grade ceramic base SMD crystal	8 MHz	Abracon ABM8AIG-8.000MHZ-8-V1R-T or equivalent

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4 Layout and component placements

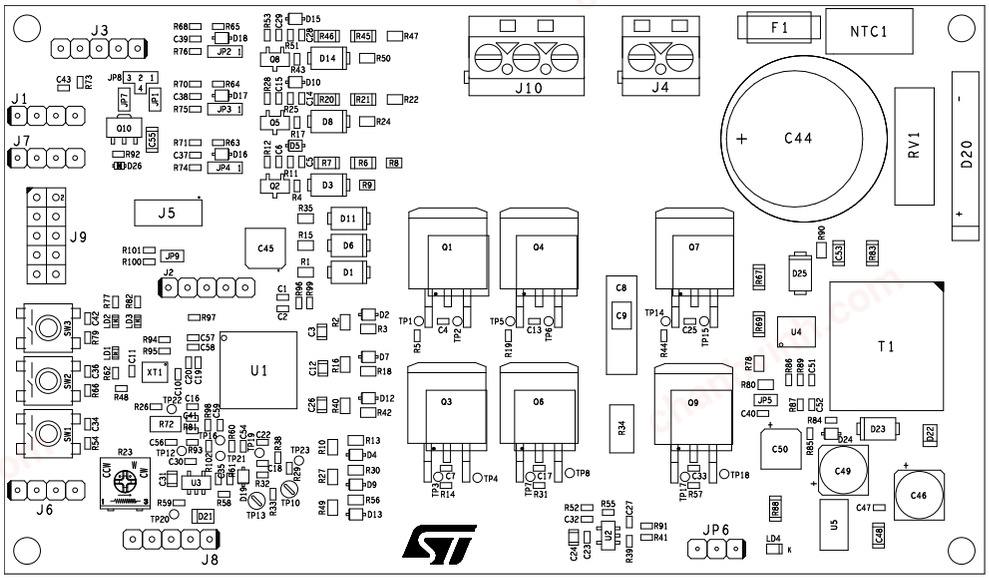
Figure 5. **EVSPIN32G06Q2S1 - functional blocks**



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. **EVSPIN32G06Q2S1 layout - component placement top view**



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Figure 7. **EVSPIN32G06Q2S1 layout - top layer**

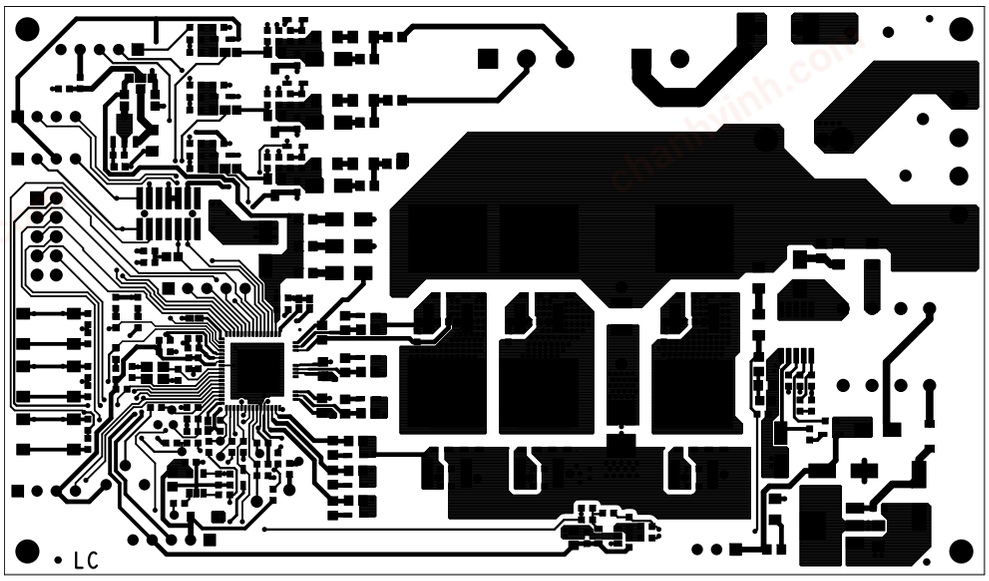
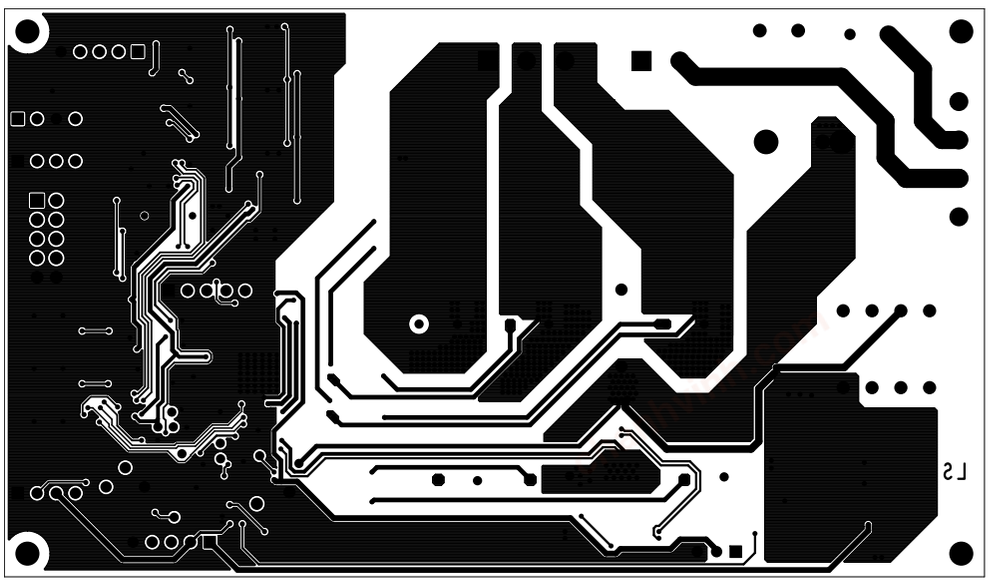


Figure 8. **EVSPIN32G06Q2S1 layout - bottom layer**



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Revision history

Table 2. **Document revision history**

Date	Version	Changes
05-Aug-2024	1	Initial release.

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