

Compact reference design for battery-operated brushless power tools based on STSPIN32F0252



Features

- Input voltage from 20 VDC to 72 VDC
- Recommended for power tools supplied from 8S to 15S
- Output current up to 19 Arms
- Overcurrent threshold set to 36 A peak
- STSPIN32F0252 featuring
 - 250 V, 1 A, 3-phase gate driver
 - SmartShutDown OCP
 - Cortex-M0 STM32
- STL130N8F7 MOSFETs power stage featuring:
 - VDS = 80 V
 - RDS(on) max.= 3.6 mΩ
 - PowerFlat 5x6 package
- Compact footprint (80 mm x 58 mm)
- Heatsink for best power dissipation performance
- Single shunt current sensing, suitable for:
 - Sensored or sensorless 6 step algorithm
 - Single-shunt vector (FOC) algorithm
- Digital Hall sensors and encoder input
- Plug-and-play thanks to available six-steps firmware with Hall-effect sensors feedback
- Speed regulation through trimmer
- Fully protected:
 - Thermal shutdown
 - Undervoltage lockout
 - Overcurrent protection
- Bus voltage sensing
- 12 V VCC and 3.3 V VDD supplies
- Serial wire debug (SWD) port for debugging/programming
- UART TX RX interface available
- Easy user interface with buttons and trimmer

Product summary

3-phase inverter based on STSPIN32F0252	STEVAL-PTOOL2V1
Reference firmware for LV 3-ph BLDC motors with STEVAL-PTOOL2V1	STSW-PTOOL2V1
250 V three-phase controller	STSPIN32F0252
N-channel 80 V STripFET F7 Power MOSFET in PowerFLAT 5x6 package	STL130N8F7

Description

The **STEVAL-PTOOL2V1** BLDC driver reference design is tailored for battery-operated power tools using 8S to 15S battery packs. It is based on the **STSPIN32F0252** motor controller with embedded 3-phase, 250 V gate driver and low-power STM32 MCU. The power stage is based on the **STL130N8F7** power MOSFETs or any similarly rated device in a PowerFlat 5x6 package.

The board implements single shunt sensing topology with both field-oriented control (FOC) and sensored or sensorless 6-step control supported for driving permanent magnet synchronous motors (PMSM) and brushless DC (BLDC) motors.

The companion 6-step [STSW-PTOOL2V1](#) firmware is ready to use with position feedback from phase Hall-effect sensors.

This reference design can deliver up to 19 A continuous current with very good thermal dissipation performance thanks to the mounted heatsink. It is compatible with a wide input voltage range from 20 to 72 VDC, and includes an auxiliary power stage with the VIPER013 in buck configuration to generate +12V and +3.3V supply voltage required by the application.

The STEVAL-PTOOL2V1 features a potentiometer for speed variation and protection features include thermal shutdown, undervoltage lockout, and overcurrent protection.

This compact 80 mm x 58 mm design is ideal for power tools and any similar battery-operated applications in terms of architecture, rating and performance.

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

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 demonstration 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 or isolating distances 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)

1.4 Operating the evaluation board

To operate properly 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 the area where the board is energized using suitable barriers and signs
 - A system architecture that supplies power to the demonstration 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 non-conductive and stable work surface
 - Use adequately insulated clamps and wires to attach measurement probes and instruments
2. Electrical safety:
 - Remove power supply from the board and electrical loads before performing any electrical measurement
 - 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 demonstration 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 host computer from high voltage. When the board is supplied at a voltage outside the ELV range, a proper insulation method such as an 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 insulating box with interlocks if necessary

Figure 1. STEVAL-PTOOL2V1 circuit schematic (1 of 2)

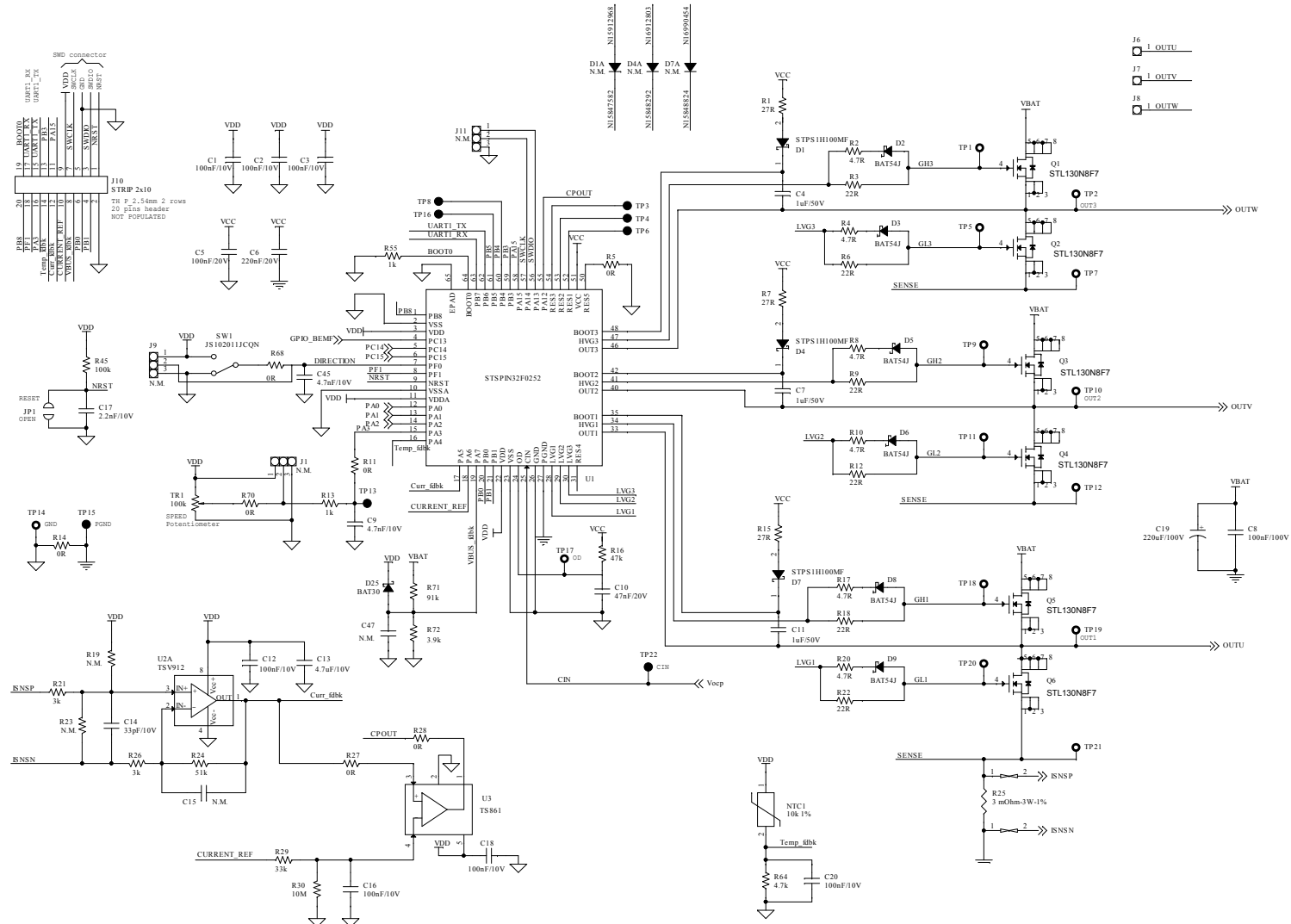
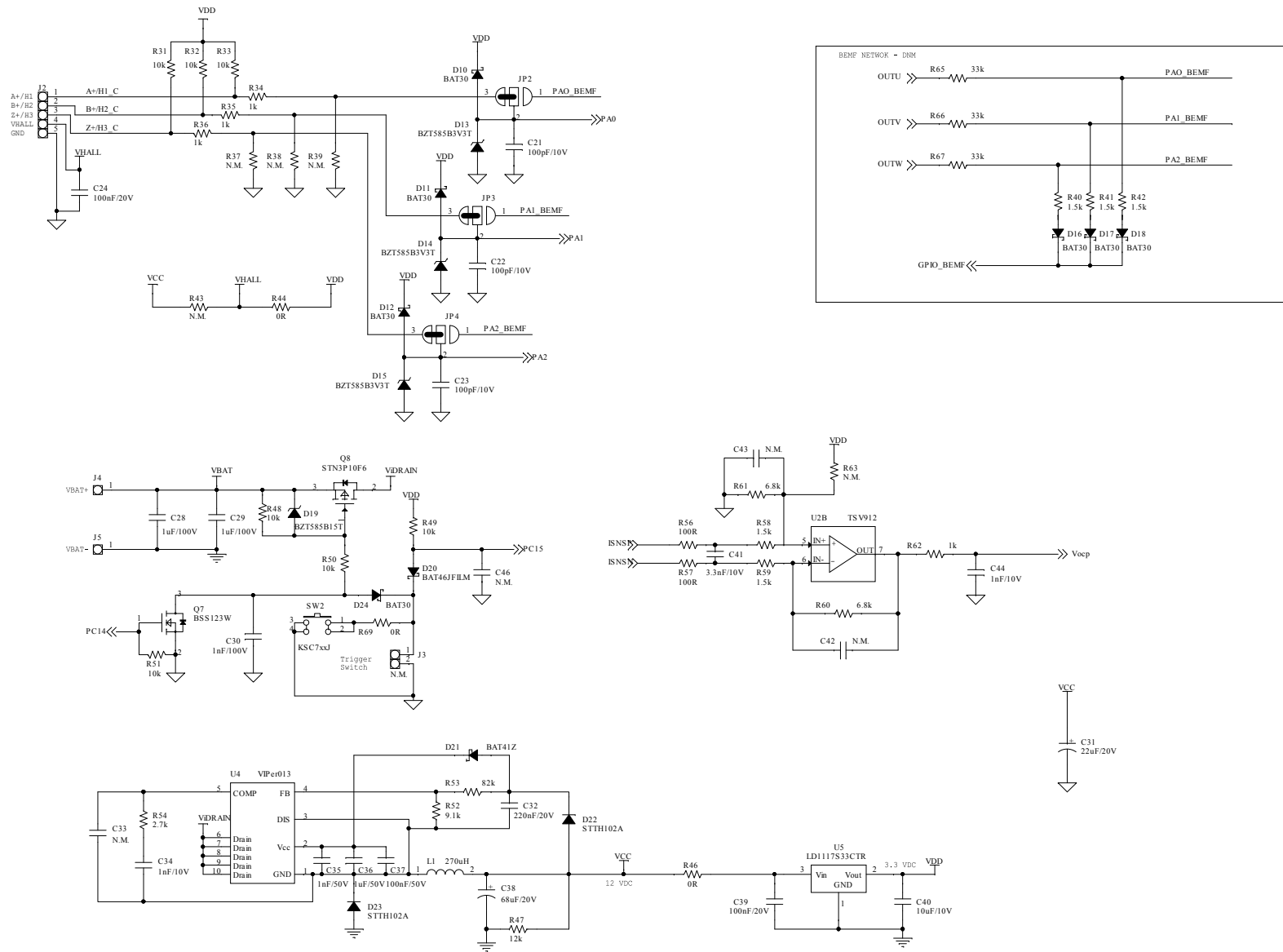


Figure 2. STEVAL-PTOOL2V1 circuit schematic (2 of 2)



Revision history

Table 1. Document revision history

Date	Version	Changes
06-Oct-2020	1	Initial release.

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