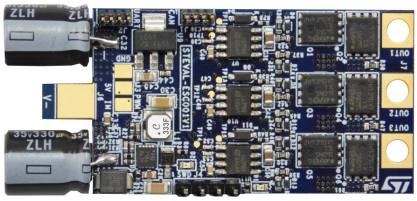
STEVAL-ESC001V1

Data brief

Electronic speed controller reference design for drones



Features

- Complete reference design for electronic speed controller implementing a sensorless FOC algorithm
- Designed for drones with 6S pack of LiPo batteries or systems with an equivalent suitable DC supply
- ESC ready for communication with any standard flight control unit (FCU): PWM or CAN
- Temperature overheating protection
- Nominal operating voltage range: 3S-6S Li-Po battery DC voltage level (11.1 to 22.2 V)
- Maximum RMS output current: 20 Arms
- Output peak current: 30 A
- Battery eliminator circuit (BEC): 5 V/0.5 A for external receiver or FCU
- Example project available on STM32 motor control software development kit (X-CUBE-MCSDK)
- Supported by ST motor control software SDK and ST motor profiler
- Compact PCB design: 29.1 x 58 mm
- Further target applications:
  - motor driving for RC vehicles: electric cars, helicopter, trucks, etc.
  - any three-phase BLDC or PMSM motor application
- RoHS and WEEE compliant

Product summary	
Electronic speed controller reference design for drones	STEVAL-ESC001V1
STM32 motor control software development kit	X-CUBE-MCSDK
ARM Cortex-M4 core mainstream mixed signals MCUs with DSP and FPU	STM32F303CBT7
N-channel 40 V, 2.1 mOhm typ., 120 A STripFET F7 Power MOSFET	STL160N4F7
Applications	PMSM/BLDC Motor Control Drones

Description

The STEVAL-ESC001V1 reference design for electronic speed controllers (ESC) for drones fits entry-level commercial drone designs and drives any three-phase brushless (or PMSM) motor running off 6S LiPo battery packs, or any equivalent DC supply, up to 30 A peak current.

The STEVAL-ESC001V1 lets you spin a motor and its propeller in minutes thanks to STM32 Motor Control Software Development Kit (MCSDK) with ST Motor profiler (X-CUBE-MCSDK). It implements a sensorless field oriented controlled (FOC) algorithm with 3-shunt current reading, speed control and full active braking.

The reference design board can accept commands from a flight control unit through PWM signals; other communication bus interfaces like UART, CAN, and I²C are also available. The reference embeds a battery eliminator circuit working at 5 V, an NTC sensor for temperature measurement and circuitry for overcurrent/overvoltage protection (OCP/OVP). The compact form factor and current capability render this reference design suitable for electronic speed controllers on small and light unmanned aerial vehicles like professional drones.

The X-CUBE-MCSDK software package lets you refine your electronic speed controller design. They act on the FOC parameters embedded in the STM32 and experiment with the ST motor profiler to retrieve rapidly the motor parameters. The ST sensorless FOC algorithm ensures longer flight times and optimal dynamic performance.

The STEVAL-ESC001V1 is designed around the highly efficient, low R_{dson} STripFET F7 power MOSFETs, the high-performance STM32F303CBT7 microcontroller with Arm® Cortex®-M4 core and the L6398 drivers.

1 Schematic diagrams

Figure 1. **STEVAL-ESC001V1 circuit schematic (1 of 4)**

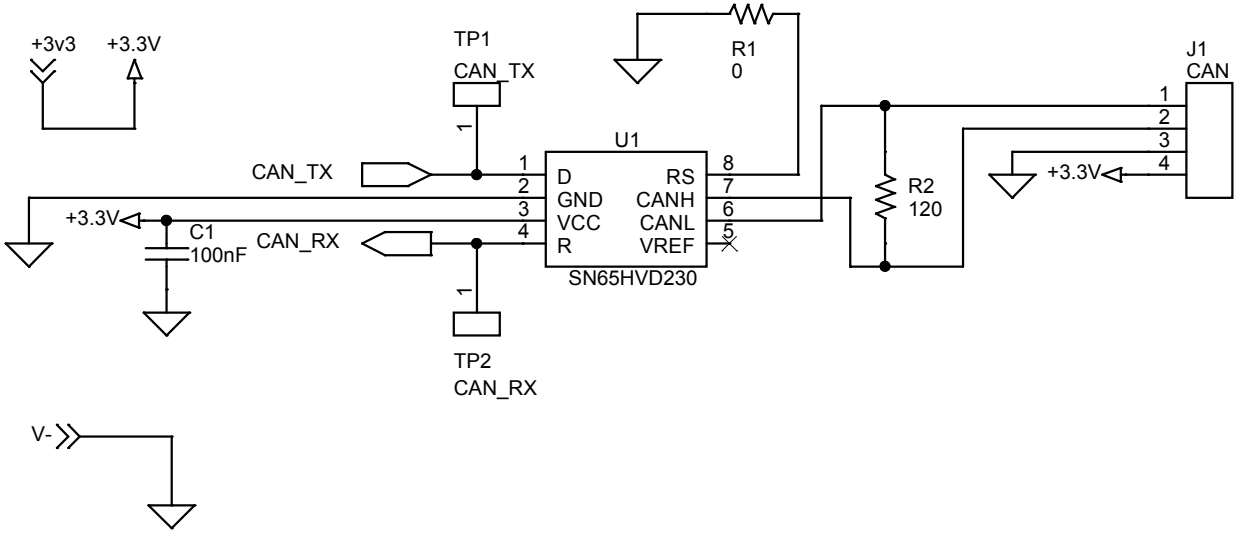


Figure 2. STEVAL-ESC001V1 circuit schematic (2 of 4)

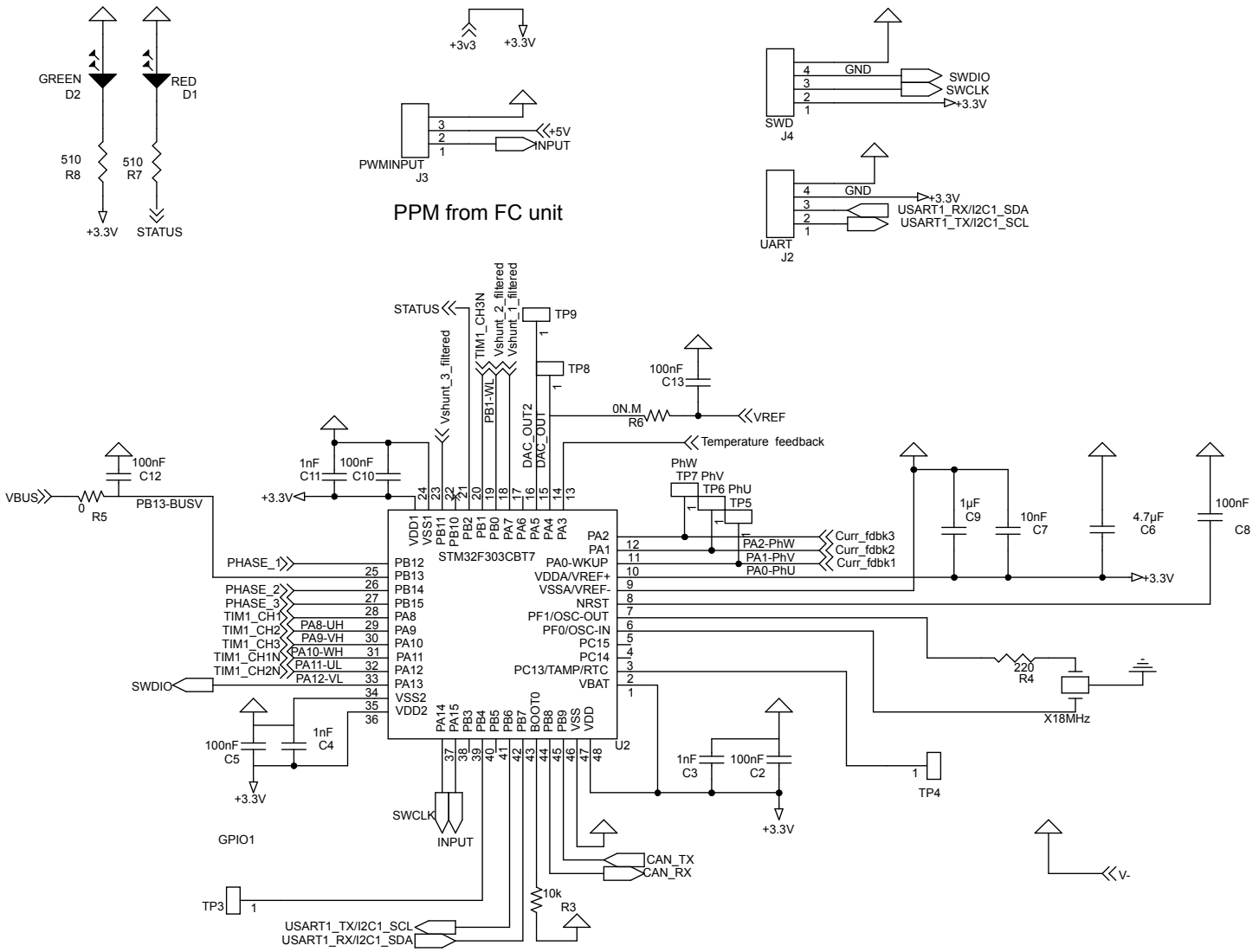
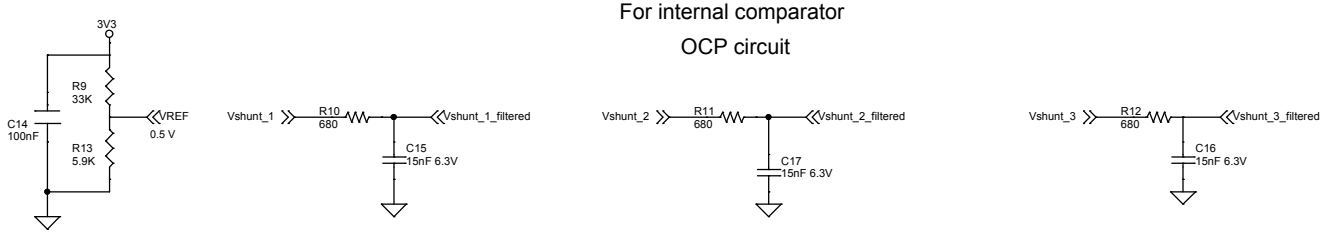
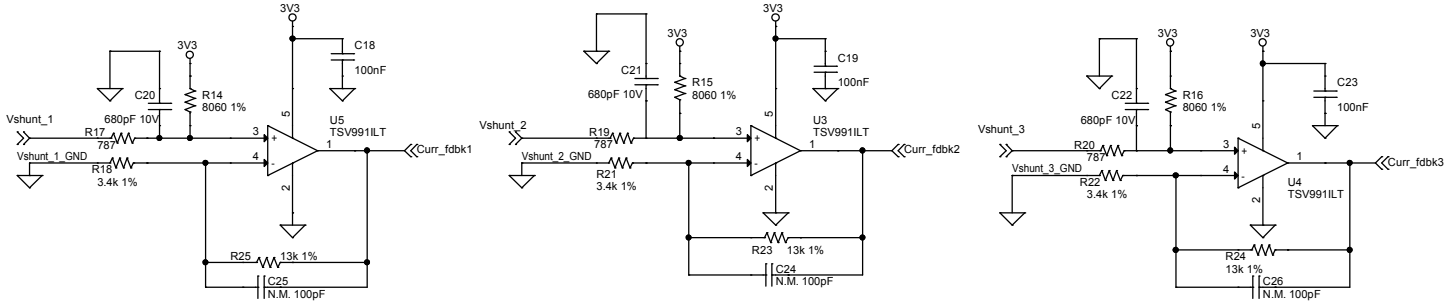


Figure 3. STEVAL-ESC001V1 circuit schematic (3 of 4)

For internal comparator

OCP circuit





External op-amp

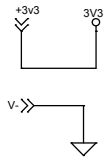
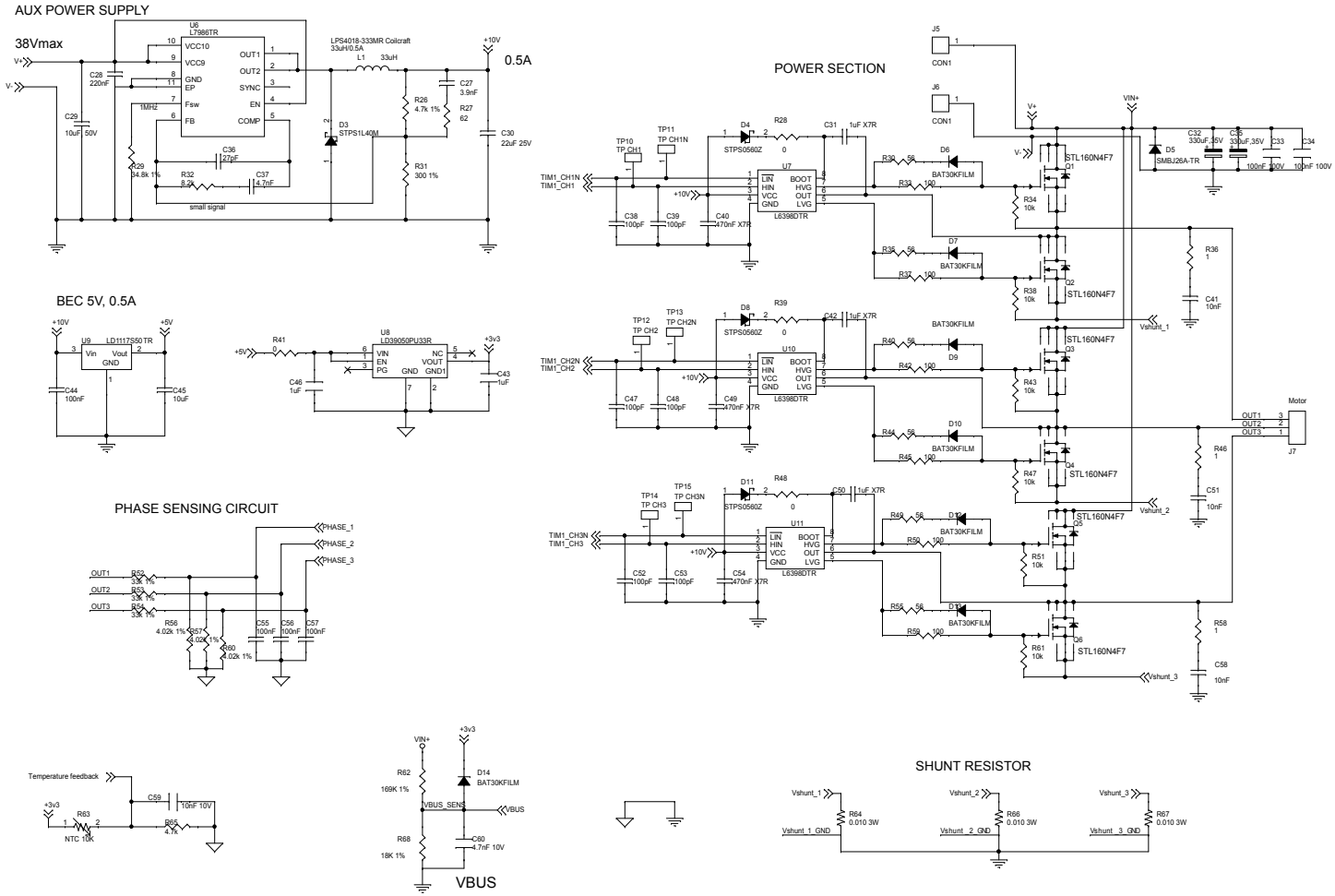


Figure 4. STEVAL-ESC001V1 circuit schematic (4 of 4)



Revision history

Table 1. **Document revision history**

Date	Version	Changes
05-Apr-2017	1	Initial release.
09-Aug-2017	2	Updated cover page title, features and description.
13-Nov-2018	3	Updated Figure 4. STEVAL-ESC001V1 circuit schematic (4 of 4). Added references to STL160N4F7.
10-Nov-2021	4	Replaced references to STSW-ESC001V1 with X-CUBE-MCSDK.