

Demonstration board for STDRIVEG600 600V high-speed half-bridge gate driver with MDmesh DM2 Power MOSFET



Features

- Half-Bridge topology featuring 600V STDRIVEG600 gate driver
- Equipped with 115 mΩ 600V MDmesh DM2 Power MOSFET STL33N60DM2 with fast recovery diode.
- MOSFET in PowerFLAT 8x8 HV package with Kelvin source or alternative DPAK footprint.
- HV bus up to 450V (capacitor rating limited)
- 4.75 to 20 V VCC gate driver supply voltage
- On-board adjustable deadtime generator to convert single PWM signal into independent high-side and low-side deadtimes.
- Separated inputs with external deadtime can also be used
- On-board 3.3V regulator for external circuitry supply
- 20°C/W junction-to-ambient thermal resistance to evaluate large power topologies
- Optional low-side shunt
- RoHS compliant.

Description

The STDRIVEG600 is a high-speed half-bridge gate driver optimized to drive high-voltage N-channel power MOSFETs or enhanced mode GaN HEMTs. It features an integrated bootstrap diode and allows supplying external switches up to 20 V.

| Product status link |
|---------------------------------|
| EVSTDRIVEG600DM |

The [EVSTDRIVEG600DM](#) board is easy to use and quick and adapt for evaluating the characteristics of STDRIVEG600 driving 600V MDmesh DM2 Power MOSFET with fast recovery diode.

It provides an on-board programmable dead time generator and a 3.3 V linear voltage regulator to supply external logic controllers like microcontrollers.

Spare footprints are also included to allow customizing the board for the final application, such as separate input signal or single PWM signal, use of optional external bootstrap diode, separate supply for VCC, PVCC or BOOT and the use of low-side shunt resistor for peak current mode topologies.

The [EVSTDRIVEG600DM](#) is 54 x 88 mm wide, FR-4 PCB resulting in 20 °C/W $R_{th(J-A)}$ in still air.

1 Safety and operating instructions



DANGER



HOT SURFACE



HIGH VOLTAGE

1.1 General terms

Warning:

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

Danger:

There is 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.

The kit is not electrically isolated from the high-voltage supply DC input. No insulation is ensured between the accessible parts and the high voltage. All measuring equipment must use adequately insulated probes, clamps and connecting wires. Never touch the evaluation board while it is energized as it is capable of causing electrical shock hazard.

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 demonstration board

The 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 demonstration board

- The installation and cooling of the demonstration board must be in accordance with the specifications and target application.
- The board 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 demonstration 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 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 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 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, included PCB, may still be very hot.

The kit is not electrically isolated from the DC input.

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.

2 Schematic diagrams

Figure 1. EVSTDRIVEG600DM schematic - STDRIVEG600 driver, power stage and connectors

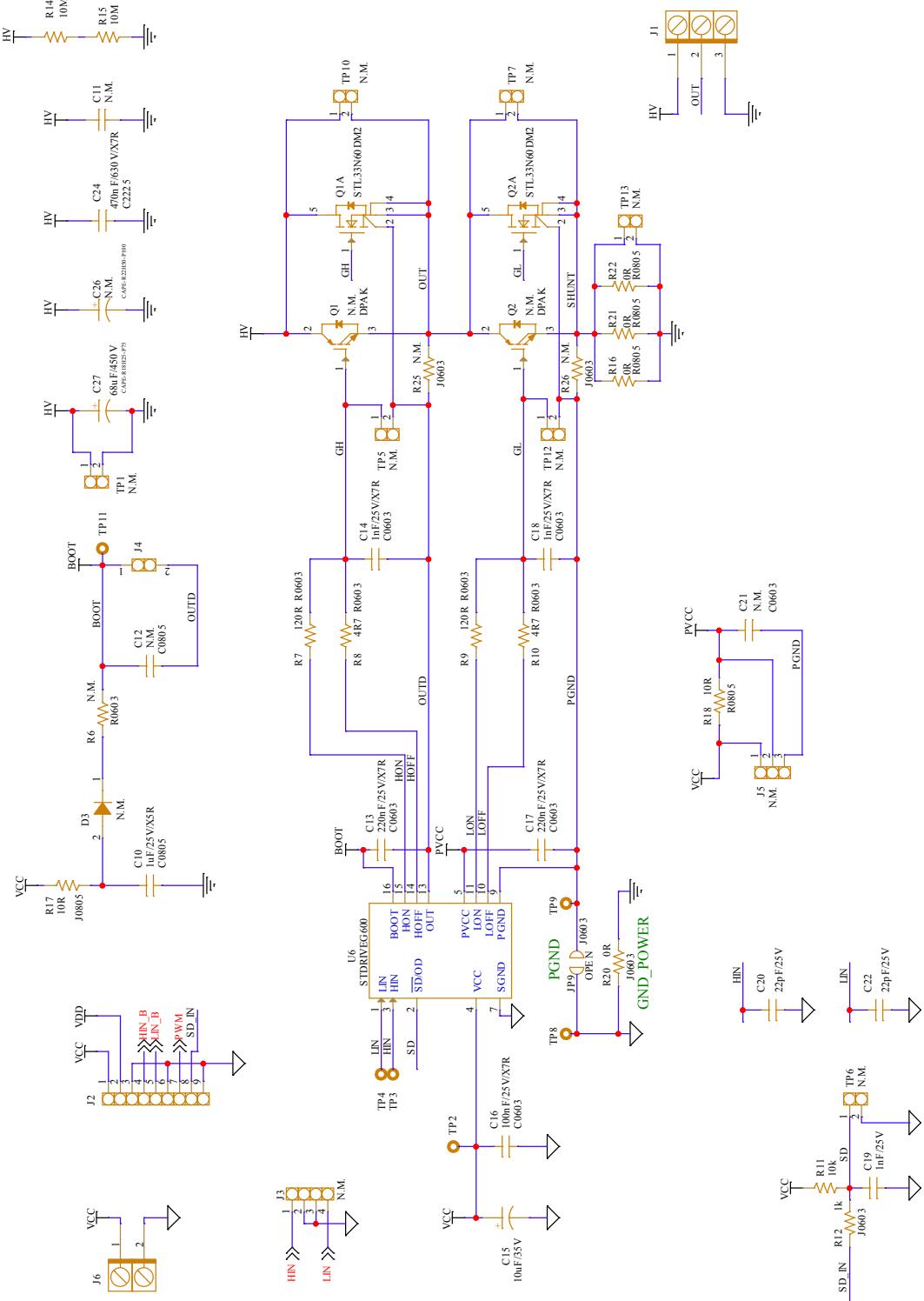
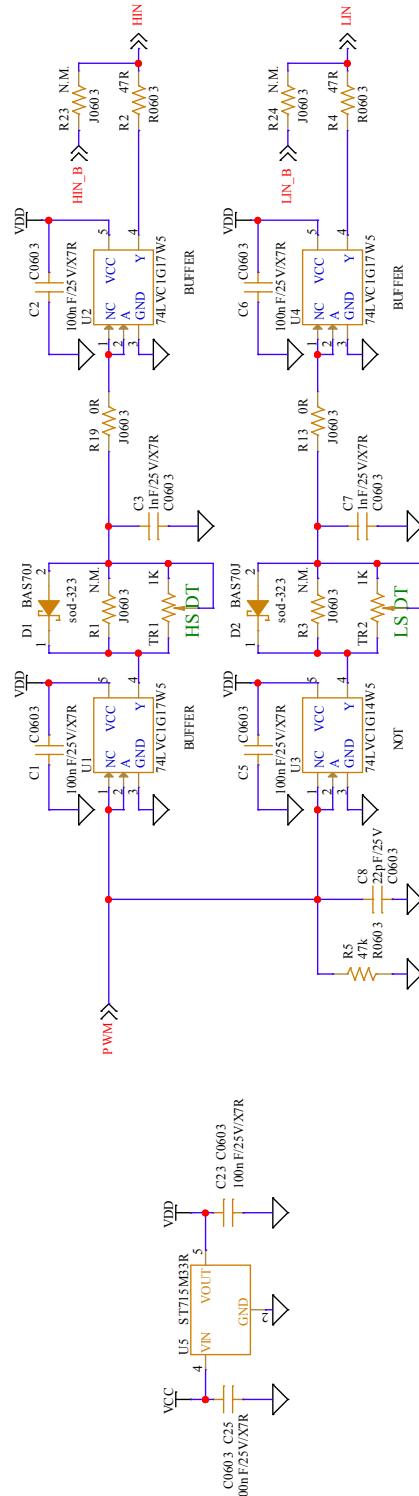
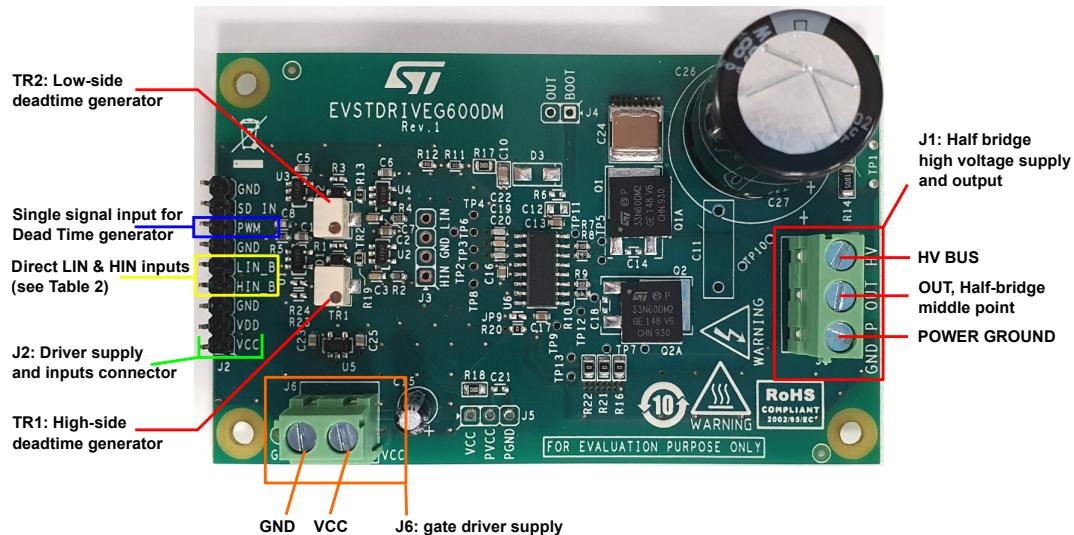


Figure 2. EVSTDRIVEG600DM schematic - Deadtime generator


3 Board power-up and input connection

The following picture shows how to supply the EVSTDRIVEG600DM, how to provide LIN and HIN inputs and set the programmable deadtime generator.

Figure 3. EVSTDRIVEG600DM - Supply and signal connection



The LIN, HIN inputs can be provided from the on-board deadtime generator or directly from an external generator or control device (such as DSP/MCU).

The deadtime value set by the on-board deadtime generator, fed by PWM input signal on J2, can be tuned by setting TR1 and TR2. The typical deadtime value with the trimmer in the default manufacturing middle position is about 400 ns. It is possible to change deadtime generator range by changing C3 and C7.

TR2 sets the deadtime before low side turn-on.

TR1 sets the deadtime before high side turn-on.

Table 1. Connector Map

| Ref | Pin # | Name | Function | Description |
|-----|-------|-----------|---------------|---|
| J1 | 1 | HV | INPUT Power | High voltage (HV) of power stage. Connect the half bridge high voltage positive supply. |
| | 2 | OUT | OUTPUT Power | OUT of half bridge power stage: connect the load to this terminal. |
| | 3 | GND_P | PWR | Power ground of power stage. Connect the half bridge high voltage negative supply. |
| J2 | 1 | VCC | INPUT Power | Board Supply voltage (recommended value 15 V) |
| | 2 | VDD (3V3) | OUT power | Output voltage of on-board 3.3 V regulator: it can be used to supply external circuitry (up to about 20 mA) |
| | 3 | GND | PWR | Board reference potential |
| | 4 | HIN_B | OUT digital | HIN direct input signal (0 to 3.3 V or up to 20 V): mount R23 and remove R2 - see Table 2 and Table 3 |
| | 5 | LIN_B | OUT digital | LIN direct input signal (0 to 3.3 V or up to 20 V): mount R24 and remove R4 - see Table 2 and Table 3 |
| | 6 | GND | PWR | Board reference potential |
| | 7 | PWM | INPUT digital | PWM input signal (0 to 3.3 V or 5 V) – see Table 3 |

| Ref | Pin # | Name | Function | Description |
|-----|-------|-------|---------------------|---|
| J2 | 8 | SD_IN | INPUT / OUT digital | Disable input signal (0 to 3.3 V or up to 20 V) – see Table 3 Open-drain output signal over-temperature protection |
| | 9 | GND | PWR | Board reference potential |
| J6 | 1 | VCC | INPUT Power | Board Supply voltage (recommended value 15 V) |
| | 2 | GND | POWER | Board reference potential |

Table 2. Device input selection

| R2, R4 | R23, R24 | Input source | Function and description |
|-----------------|-----------------|-------------------|---|
| 0-47 Ω (closed) | Open | J2: PWM pin | LIN & HIN are generated by the on-board deadtime generator from a single PWM signal on J2, pin 7. |
| Open | 0-47 Ω (closed) | J2: LIN & HIN pin | Direct connection to LIN and HIN STDRIVEG600 pins. LIN, HIN input range: up to 20 V. |

Table 3. Input signal truth table

| SD/OD | PWM | LIN | HIN |
|-------|-----|-----|-----|
| L | X | L | L |
| H | L | H | L |
| H | H | L | H |

The recommended power-on sequence is to turn VCC on first, then apply the HV bus voltage. The recommended power-off sequence is to turn-off the HV bus supply first, then VCC.

4 Bill of materials

Table 4. EVSTDRIVEG600DM bill of materials

| Reference | Description | Value or Generic Part Number Package |
|--------------------------------|---|--------------------------------------|
| C1, C2, C5, C6, C23, C25 | SMT ceramic capacitor | 100 nF / 25 V / X7R, 0603 |
| C3, C7, C14, C18 | SMT ceramic capacitor | 1 nF / X7R, 0603 |
| C8, C20, C22 | SMT ceramic capacitor | 22 pF / 25 V, 0603 |
| C10 | SMT ceramic capacitor | 1 μ F / 25 V / X5R, 0805 |
| C11 | Film capacitor or Metallized polypropylene | N.M., pitch 10 mm |
| C12 | SMT ceramic capacitor | N.M., 0805 |
| C13, C17 | SMT ceramic capacitor | 220 nF / 25 V / X7R, 00603 |
| C15 | THT Electrolytic Capacitor | 10 μ F / 35V, D5 P2.5 mm |
| C19 | SMT ceramic capacitor | 1 nF / 25 V, 0603 |
| C21 | SMT ceramic capacitor | N.M., 0603 |
| C24 | SMT ceramic capacitor | 470 nF / 630 V /X7R, 2225 |
| C26 | THT Electrolytic Capacitor | N.M, D22 P10 mm |
| C27 | THT Electrolytic Capacitor | 68 μ F / 450 V, D18 P7.5 mm |
| D1, D2 | Low capacitance, low series inductance and resistance Schottky diodes | BAS70JFILM, SOD-323 |
| D3 | Fast Rectifiers | N.M., SMA |
| JP9 | SMT jumper | OPEN, Soldering pads |
| J1 | Terminal block T.H. 3 pos, 5.08 mm | 3 Poles, Pitch 5.08 mm |
| J2 | Strip connector 9 pos, 2.54 mm | STRIP 1x9 |
| J3 | Strip connector 4 pos, 2.54 mm | N.M. |
| J4 | Strip connector 2 pos, 2.54 mm | STRIP 1x2 |
| J5 | Strip connector 3 pos, 2.54 mm | N.M. |
| J6 | Terminal block T.H. 2 pos, 5.08 mm | 2 Poles, Pitch 5.08 mm |
| Q1A, Q2A | N-channel 600 V, 0.115 Ω typ., 21 A MDmesh DM2 Power MOSFET | STL33N60DM2, PowerFLAT 8x8 HV |
| Q1, Q2 | DPAK power switch | DPAK |
| R1, R3, R6, R23, R24, R25, R26 | SMT resistor | N.M., 0603 |
| R2, R4 | SMT resistor | 47 Ω , 0603 |
| R5 | SMT resistor | 47 k Ω , 0603 |
| R7, R9 | SMT resistor | 120 Ω , 0603 |
| R8, R10 | SMT resistor | 4,7 Ω , 0402 |
| R11 | SMT resistor | 10 k Ω , 0603 |
| R12 | SMT resistor | 1 k Ω , 0603 |
| R13, R19, R20 | SMT resistor | 0 Ω , 0603 |
| R14, R15 | SMT resistor | 10 M Ω , 1206 |
| R16, R21, R22 | SMT resistor | 0 Ω , 0805 |
| R17, R18 | SMT resistor | 10 Ω , 0805 |

| Reference | Description | Value or Generic Part Number Package |
|-------------------------------|--|--------------------------------------|
| TP1, TP7, TP10 | Test point for probe | Pitch 5.08 mm |
| TP2, TP3, TP4, TP8, TP9, TP11 | Test point for probe | Metallized Hole 0.8 mm |
| TP5, TP6, TP12, TP13 | Test point for probe | Pitch 2.54 mm |
| TR1, TR2 | 5 mm Square Surface Mount Miniature Trimmers Multi-Turn Cermet Sealed | 1 kΩ, TSM4YJ |
| U1, U2, U4 | Single Schmitt-Trigger buffer | 74LVC1G17W5, SOT23-5L |
| U3 | Single Schmitt-Trigger inverter | 74LVC1G14W5, SOT23-5L |
| U5 | High input voltage, 85 mA LDO linear regulator | ST715M33R, SOT23-5L |
| U6 | High voltage and high-speed half-bridge gate driver | STDRIVEG600, SO16 |

5 Layout and component placements

Figure 4. EVSTDRIVEG600DM - Layout (component placement top view)

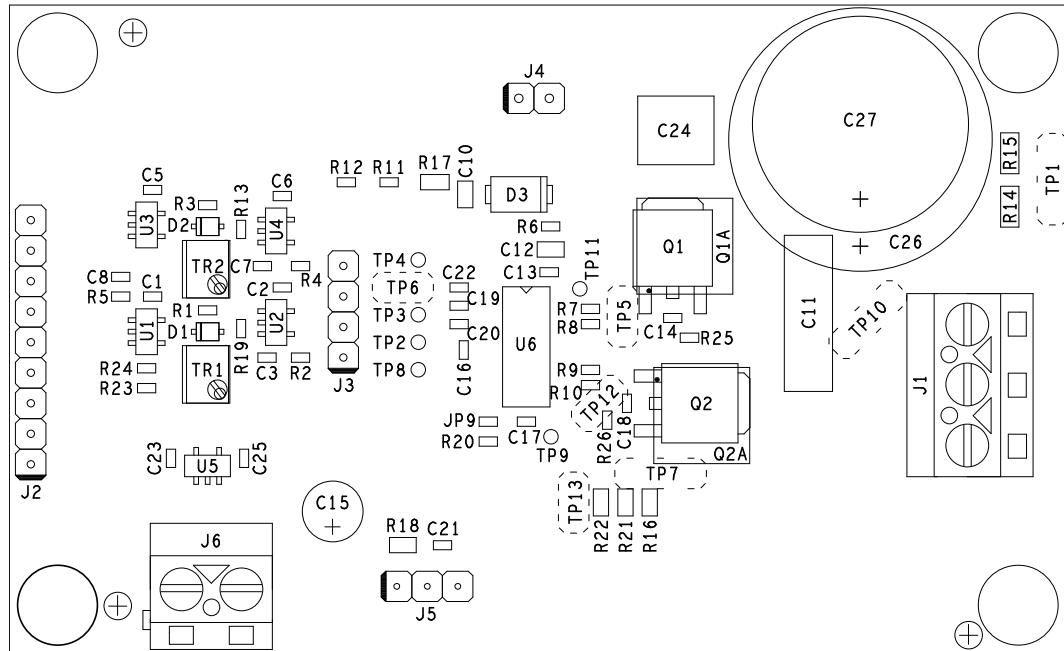


Figure 5. EVSTDRIVEG600DM - Layout (top layer)

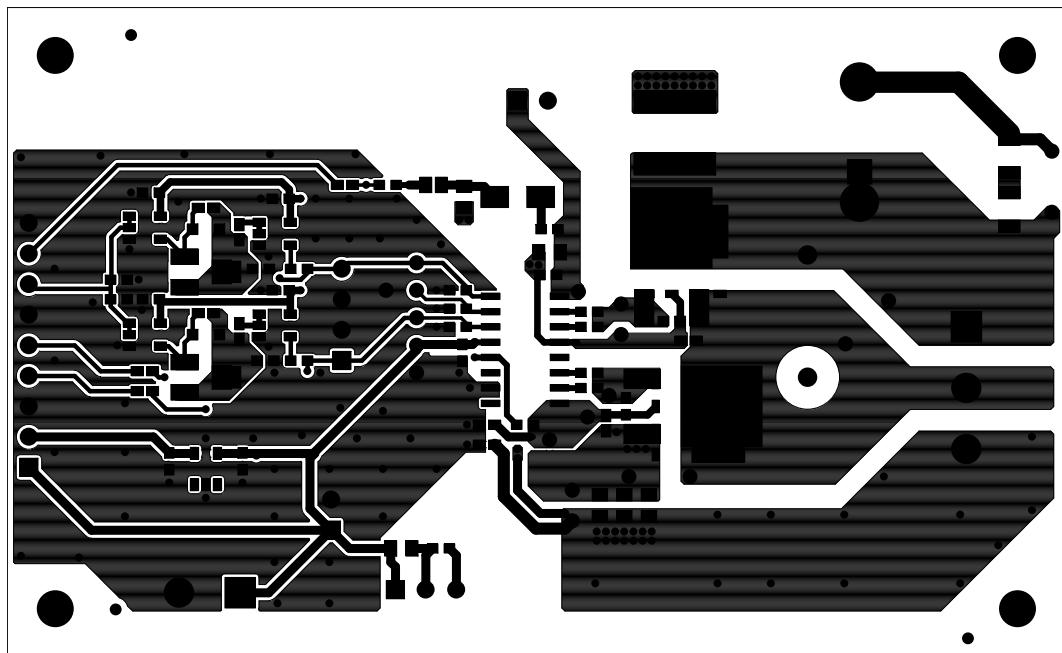
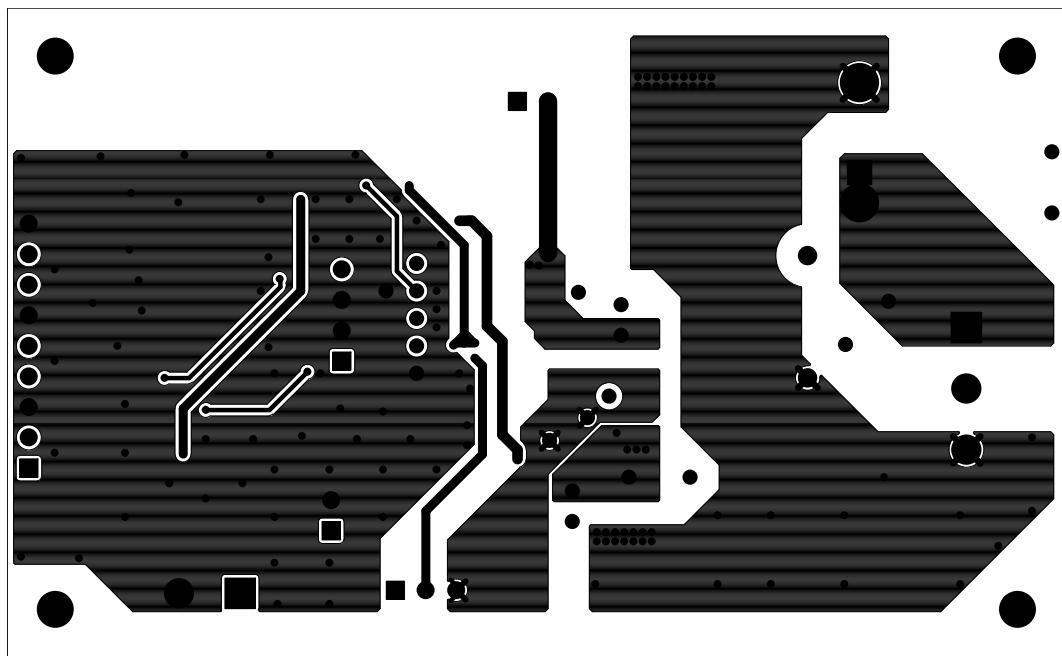


Figure 6. EVSTDRIVEG600DM - Layout (bottom layer)



Revision history

Table 5. Document revision history

| Date | Version | Changes |
|-------------|---------|------------------|
| 21-Jun-2021 | 1 | Initial release. |

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