

Demonstration board for MASTERGAN1 high power density half-bridge high voltage driver with two 650 V enhanced mode GaN HEMT



Features

- Half-bridge demonstration board equipped with MASTERGAN1 and able to withstand 600 V
- VCC input on screw connector or pin strip configured for MASTERGAN1 supply voltages
- Complete set of features to drive MASTERGAN1 with single or complementary driving signal
- Embedded deadtime generator to convert single PWM signal into dual complementary LIN and HIN signals with independently adjustable deadtimes
- On board 3.3 V regulator for external circuitry supply (up to 50 mA)
- 35°C/W junction to ambient thermal resistance to evaluate large power topologies
- High frequency connector for MASTERGAN1 GL and GH pin monitoring
- Spare footprint for low side shunt, external bootstrap capacitors and high voltage high capacitance bulk capacitor
- RoHS compliant

Description

The EVALMASTERGAN1 board is an easy to use and quick to adapt tool to evaluate the characteristics of MASTERGAN1 and to quickly create new topologies without the need of complete PCB design.

The EVALMASTERGAN1 provides an on-board programmable inputs deadtime generator with a single VCC supply (typ. 6 V). An embedded linear voltage regulator offers 3.3 V rail to supply low voltage logic circuit like microcontrollers or FPGA.

Some spare footprints are also included to customize the board to operate with final application. These customizations include: use of separate input signal or single PWM signal, use of external bootstrap diode, separate supply for VCC, PVCC or Vbo and also the use of low side shunt resistor for peak current mode topologies.

All pins of MASTERGAN1 are accessible.

The EVALMASTERGAN1 is 56 x 70 mm wide, FR-4 PCB resulting in an $R_{th(J-A)}$ of 35 °C/W, without forced airflow.

Product status link

[EVALMASTERGAN1](#)

1 Architecture and components placement

Figure 1. EVALMASTERGAN1 – top component placement

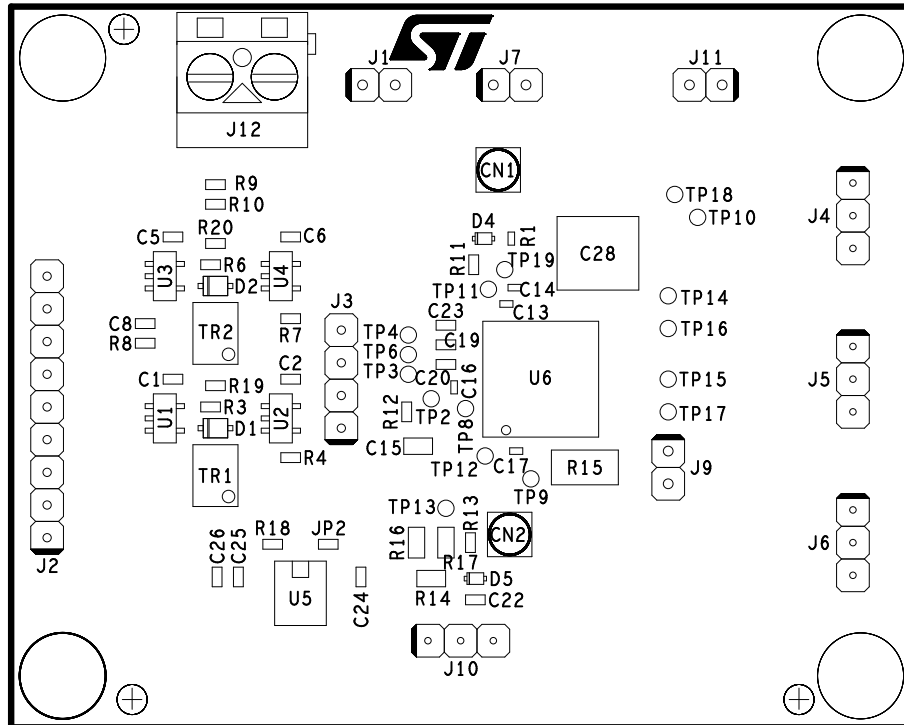
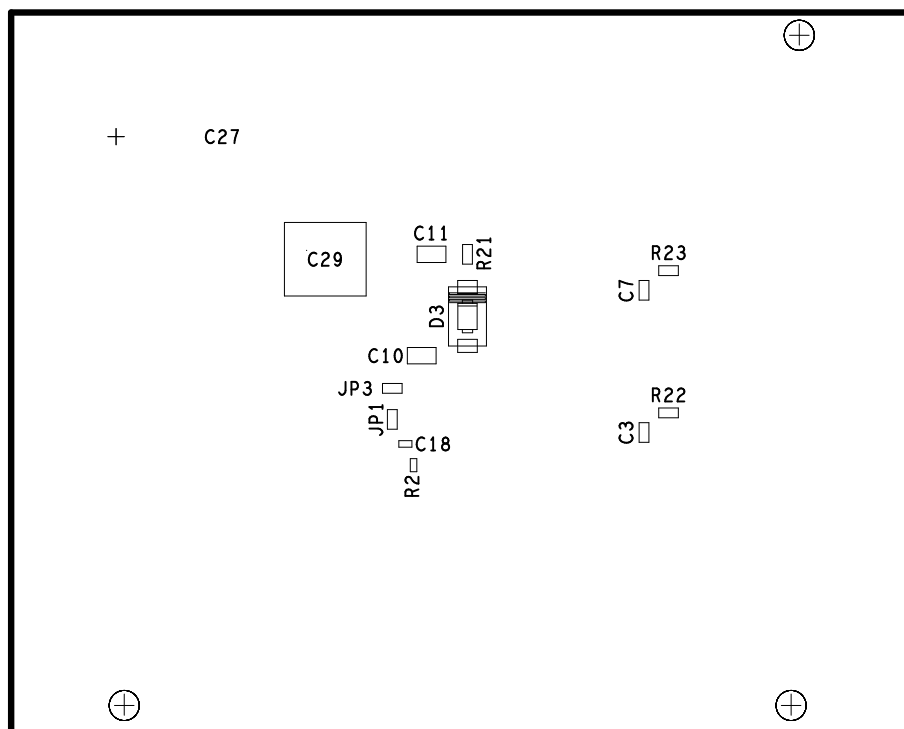


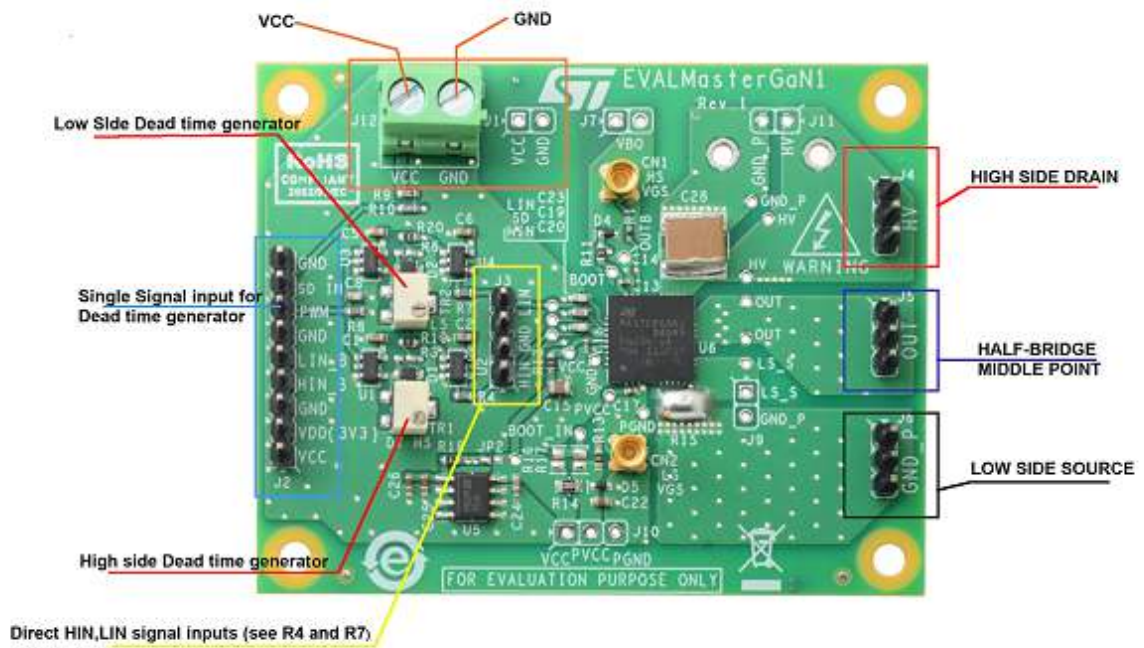
Figure 2. EVALMASTERGAN1 – bottom component placement



2 Board power-up and input connection

The following image shows how to supply MASTERGAN1, how to provide LIN and HIN inputs and set the programmable deadtime generator.

Figure 3. EVALMASTERGAN1 – Supply and signal connection



The LIN, HIN inputs can be supplied from the on-board deadtime generator or directly from an external generator (as DSP/MCU) with the following settings:

Table 1. Connector map

| Ref. | Pin # | Name | Function | Description |
|------|-------|-----------|---------------|--|
| J2 | 1 | VCC | INPUT power | Board supply voltage: set to a value between 4.5 V and 6 V |
| | 2 | VDD (3V3) | OUT power | Output voltage of on-board 3.3 V regulator: it can be used to supply external circuitry (50 mA max.) |
| | 3 | GND | PWR | Board reference potential |
| | 4 | HIN_B | OUT digital | Buffered HIN signal (0-3.3 V level output) |
| | 5 | LIN_B | OUT digital | Buffered LIN signal (0-3.3 V level output) |
| | 6 | GND | PWR | Board reference potential |
| | 7 | PWM | INPUT digital | PWM input signal (0 to 3.3 V or 5 V) – see Table 3 |
| | 8 | SD_IN | INPUT digital | Disable input signal (0 to 3.3 V or 5 V) – see Table 3 |
| | 9 | GND | PWR | Board reference potential |

| Ref. | Pin # | Name | Function | Description |
|------|-------|------|---------------------|---|
| J3 | 1 | HIN | OUT (INPUT) digital | The pin is connected to HIN pin of MASTERGAN1: the pin can be used either to monitor the output of the deadtime generator or to force the input to MASTERGAN1 according to the status of R4 (see Table 2) |
| | 2 | GND | PWR | Board reference potential |
| | 3 | GND | PWR | Board reference potential |
| | 4 | LIN | OUT (INPUT) digital | The pin is connected to LIN pin of MASTERGAN1: the pin can be used either to monitor the output of the deadtime generator or to force the input to MASTERGAN1 according to the status of R7 (see Table 2) |
| J4 | 1,2,3 | HV | INPUT power | These three pins are connected to VS pins of MASTERGAN1: connect high voltage potential to this pin according to MASTERGAN1 recommended values (520 V) |
| J5 | 1,2,3 | OUT | OUTPUT power | These three pins are connected to OUT pins of MASTERGAN1: connect the load to this terminal (resonant tanks, transformers,...) |
| J6 | 1,2,3 | LS_S | POWER | These three pins are connected to SENSE pins of MASTERGAN1: the board is configured with shorted sense resistor (R15), therefore this pin can be connected to the reference voltage of high voltage potential (GND_P) |
| J12 | 1 | VCC | INPUT power | Board Supply voltage: set to a value between 4.5 V and 6 V |
| | 2 | GND | POWER | Board reference potential |
| CN1 | | GH | OUTPUT | To be used with proper MMCX male connector to monitor the GH pin of MASTERGAN1 with high bandwidth, high voltage differential probes (optically isolated probes are recommended) |
| CN2 | | GL | OUTPUT | To be used with proper MMCX male connector to monitor the GL pin of MASTERGAN1 with high bandwidth differential probes (optically isolated probes are recommended) |

Table 2. Device input selection

| R4, R7 | Input source | Function and description |
|-----------------|-------------------|---|
| 0-47 Ω (closed) | J2: PWM pin | LIN & HIN are generated by the on-board deadtime generator from a single PWM signal on J2, PIN 7. |
| Open | J3: LIN & HIN pin | Direct connection to LIN & HIN MASTERGAN1 pins. LIN, HIN input range: up to 20 V |

Table 3. Input signal truth table

| SD_IN | 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.

3 Schematic diagram

Figure 4. EVALMASTERGAN1 schematic – high density power driver

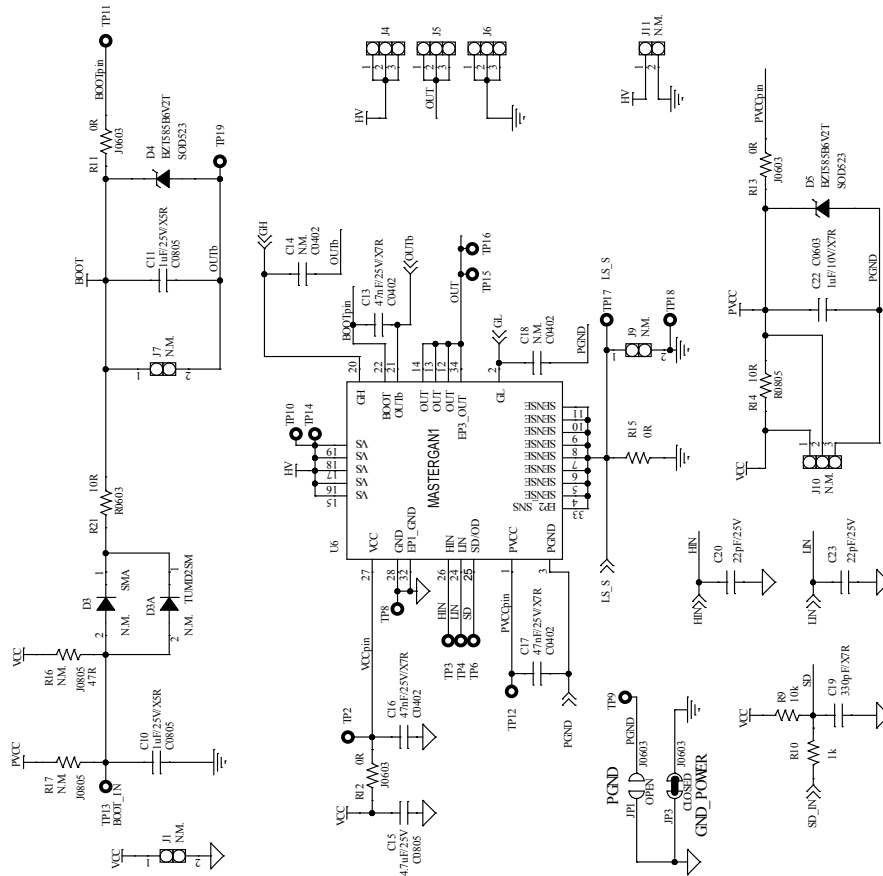
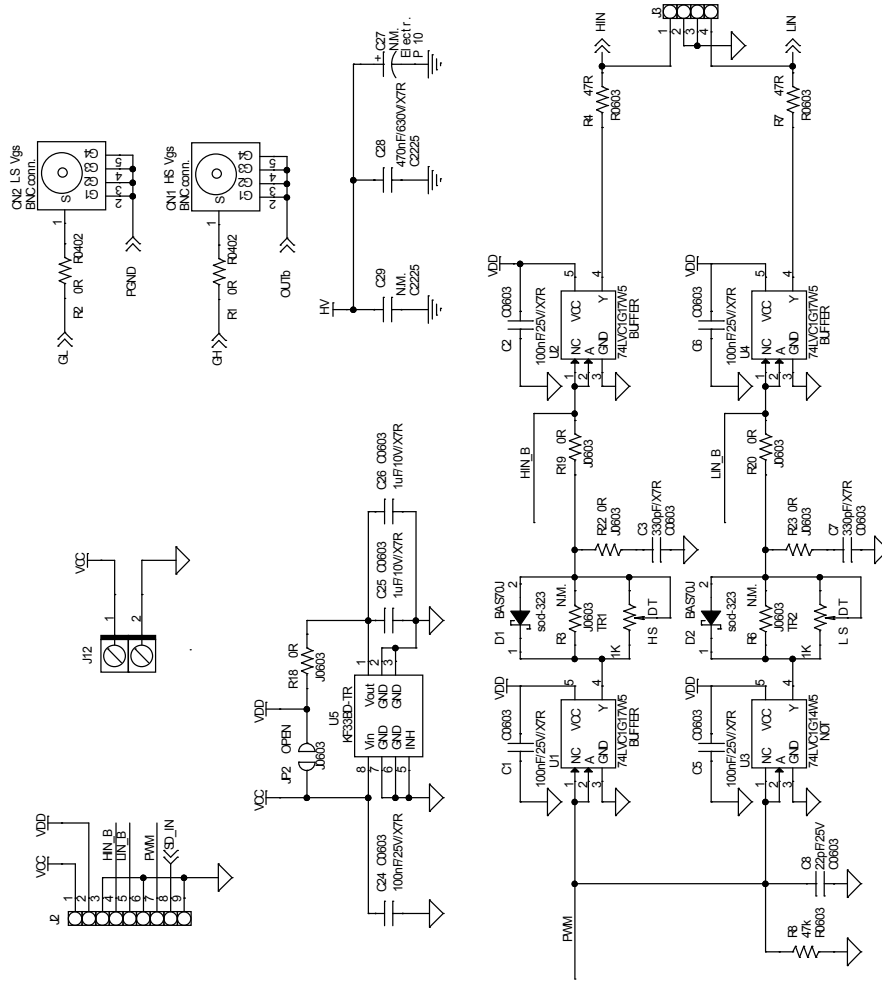


Figure 5. EVALMASTERGAN1 schematic – deadtime generator and connectors



4 Bill of material

Table 4. Bill of material

| Item | Q.ty | Ref. | Value | Description | Manufacturer | Part Number |
|------|------|---------------------|-------------------------------|---|---------------------|--------------|
| 1 | 2 | CN1, CN2 | BNC connector | MMCX straight receptacle | Cinch | 135-3701-201 |
| 2 | 5 | C1, C2, C5, C6, C24 | 100 nF/X7R, Size 0603, 25 V, | SMT ceramic capacitor | | |
| 5 | 2 | C10, C11 | 1 uF/X5R, Size 0805, 25 V, | SMT ceramic capacitor | | |
| 6 | 3 | C13, C16, C17 | 47 nF/X7R, Size 0402, 25 V, | SMT ceramic capacitor | | |
| 7 | 2 | C14, C18 | N.A., Size 0402, | SMT ceramic capacitor | | |
| 8 | 1 | C15 | 4.7 uF/X7R, Size 0805, 25 V, | SMT ceramic capacitor | | |
| 9 | 3 | C22, C25, C26 | 1 uF/X7R, Size 0603, 10 V, | SMT ceramic capacitor | | |
| 10 | 1 | C27 | N.A. | Electrolytic Cap, Diam. 22 p. 10, | | |
| 11 | 1 | C28 | 470 nF/X7R, Size 2225, 630 V, | SMT ceramic capacitor | | |
| 12 | 1 | C29 | N.A., Size 2225, 630 V, | SMT ceramic capacitor | | |
| 13 | 2 | D1, D2 | BAS70J | Schottky diodes | STMicroelectronics | BAS70JFILM |
| 14 | 1 | D3 | N.A. | 600 V, 1A, turbo 2 ultrafast high voltage rectifier | STMicroelectronics | STTH1R06A |
| 15 | 1 | D3A | N.A. | 600 V, 0.2 A super-fast recovery diodes | ROHM Semiconductor | RFU02VSM6S |
| 16 | 2 | D4, D5 | BZT585B6V2T | ZENER 6.2 V 300 mW | Diodes Incorporated | BZT585B6V2T |
| 17 | 2 | JP1, JP2 | Open, Soldering pads, | SMT jumper | | |
| 18 | 3 | J1, J7, J9 | N.A. | Strip connector 2 pos, 2.54 mm | | |
| 19 | 1 | J2 | STRIP 1x9 | Strip connector 9 pos, 2.54 mm | | |

| Item | Q.ty | Ref. | Value | Description | Manufacturer | Part Number |
|------|------|---|-----------------------------|--|---------------------|------------------|
| 20 | 1 | J3 | STRIP 1x4 | Strip connector 4 pos, 2.54 mm | | |
| 21 | 3 | J4, J5, J6 | STRIP 1x3 | Strip connector 3 pos, 2.54 mm | | |
| 22 | 1 | J10 | N.A. | Strip connector 3 pos, 2.54 mm | | |
| 23 | 1 | J11 | N.A. | Strip connector 2 pos, 2.54 mm | | |
| 24 | 1 | J12 | 2P_screw, pitch 5.08 mm, | Terminal block T.H. 2 pos, 5.08 mm | Wurth Elektronik | 691213510002 |
| 25 | 2 | R1, R2 | 0R, Size 0402 | SMT resistor | | |
| 26 | 2 | R3, R6 | N.A., Size 0603 | SMT resistor | | |
| 27 | 2 | R4, R7 | 47R, Size 0603 | SMT resistor | | |
| 28 | 1 | R8 | 47k, Size 0603 | SMT resistor | | |
| 29 | 1 | R9 | 10k, Size 0603, | SMT resistor | | |
| 30 | 1 | R10 | 1k, Size 0603, | SMT resistor | | |
| 31 | 9 | R11, R12, R13, R18, R19, R20, R22, R23, JP3 | 0R, Size 0603, | SMT resistor | | |
| 32 | 1 | R14 | 10R, Size 0805, | SMT resistor | | |
| 33 | 1 | R15 | Closed, Soldering pads, | SMT jumper | | |
| 34 | 2 | R16, R17 | N.A., Size 0603, | SMT resistor | | |
| 35 | 1 | R21 | 10R, Size 0603, | SMT resistor | | |
| 37 | 2 | TR1, TR2 | 1K, 12 turns | 5 mm 12 turns surface mount miniature trimmers | BOURNS | 3224W-1-102E |
| 38 | 3 | U1, U2, U4 | 74LVC1G17W5 | Single Schmitt- Trigger buffer | Diodes Incorporated | 74LVC1G17W5 / -7 |
| 39 | 1 | U3 | 74LVC1G14W5 | Single Schmitt- Trigger inverter | Diodes Incorporated | 74LVC1G14W5 / -7 |
| 40 | 1 | U5 | KF33BD-TR | Very low drop voltage regulators with inhibit | STMicroelectronics | KF33BD-TR |
| 41 | 1 | U6 | MASTERGAN1 | High power density half-bridge high voltage driver with two 650 V enhanced mode GaN HEMT | STMicroelectronics | MASTERGAN1 |

Revision history

Table 5. Document revision history

| Date | Version | Changes |
|-------------|---------|---------------------------|
| 06-Aug-2020 | 1 | Initial release. |
| 05-Nov-2021 | 2 | Changed Figure 3, 4 and 5 |

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