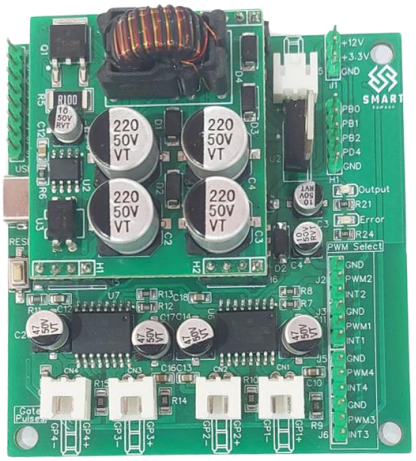
High CMR Isolated Programmable Gate Driver Board for SiC FETs



Applications

- 4 switch isolated SiC/IGBT/MOSFET programmable gate driver
- DC-DC converters
- Switch mode power supplies
- PFC rectifiers

Features:

- Programmable PWM output with PWM types: Square PWM, Quasi-Square PWM, ANDed PWM, Unipolar Sine PWM, Bipolar Sine PWM & Independent PWM
- An onboard 8-bit 24MHz MCU (32KB Flash, 6KB RAM, 1KB DATA EEPROM) for PWM generation
- High Cost to Performance ratio
- Suitable for high voltage/current IGBTs & MOSFETs
- 4A peak gate drive current
- 3000 V_{RMS} input to output isolation
- Output UVLO protection
- 45KV/us typical common mode transient immunity
- 5 MHz maximum frequency operation
- Ultra-Low propagation delay of 45ns maximum
- Output and error indication LED for visual feedback
- Built-in 3.3V regulator for powering up external circuitry
- Built-in 12V regulator for powering up external circuitry

Description:

The SGD-ISP4S is a state-of-the-art, fully isolated gate driver module designed for controlling SiC, IGBT, and MOSFET switches, ideal for high-speed inverter prototyping in research and educational settings. The module integrates an onboard MCU capable of generating various PWM signals, including Square, Quasi-Square, ANDed, Unipolar Sine PWM, Bipolar Sine PWM, and Independent PWM, providing flexibility for a wide range of applications.

This board features an onboard USB Type-C port, enabling easy connectivity to a PC. Through the Smart Gate Driver (SGD) software, users can program PWM types and parameters for precise control. Additionally, the board provides output voltages of 3.3V and 12V, enabling the powering of external circuitry. The four fully isolated channels ensure reliable operation in high-power applications, while a 4-pin general-purpose IO header generates 3.3V logic-level PWM signals at frequencies of 1Hz, 5Hz, 10Hz, and 50Hz.

With ultra-low propagation delay, high common-mode immunity, and a broad range of PWM configurations, the SGD-ISP4S is optimized for high-frequency applications such as ZVS and ZCS topologies, ensuring minimal signal distortion and robust performance.

Revision History

Version	Release Date	Changes
3.0	07/09/2024	First time launched in the market

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*All ratings are given as Vin = 24 V and 25 °C ambient temperature unless otherwise specified.

Table 1

Absolute Maximum Ratings	Test Condition/Note	Value	Unit
Supply Voltage (Vin)		30	V
Input Signal Voltage High		5.0	V
Input Signal Voltage Low		0.0	V
Output Peak Current ($I_{O(PEAK)}$)	Using Rg < 10Ω	4	A
Output Power (P_{out})	Per channel	0.5	W
Input to Output Isolation	AC RMS	3000	V
J1 3.3V Output Current (I_{O3V3})	Supply for external circuit	100	mA
J1 12V Output Current (I_{O12V})	Supply for external circuit	100	mA
Operating Temperature	I_{O3V3} = 0, I_{O12V} = 0	-25 to 70	°C
Storage Temperature		-25 to 85	°C

Table 2

Recommended Operating Condition	Test Condition/Note	Minimum	Typical	Max	Unit
Supply Voltage (Vin)		20	24	28	V
Supply Current		-	120	-	mA
Operating Temperature	I_{O3V3} = 0, I_{O12V} = 0	-10	-	70	°C
Input Signal Voltage ON/OFF			3.3V/0		V

Table 3

Characteristics	Test Condition/Note	Minimum	Typical	Max	Unit
Logic High Input Threshold		2.0	-	-	V
Logic High Input Threshold		-	-	0.8	V
Output UVLO Threshold	UVLO+	5.7		6.3	V
Output UVLO Threshold	UVLO-	5.4		6	V
Minimum Pulse Width		-	20	-	ns
Propagation Delay		14	19	30	ns
Output Rise and Fall Time	Cg = 1.8nF	-	7	16	ns
Maximum Frequency		-	-	5	MHz
Common Mode Rejection	At V_{CM} = 1500 V	45	-	-	kV/us
Dimensions	Width x Length x Height		70 x 74.3 x 35		mm

Block Diagram

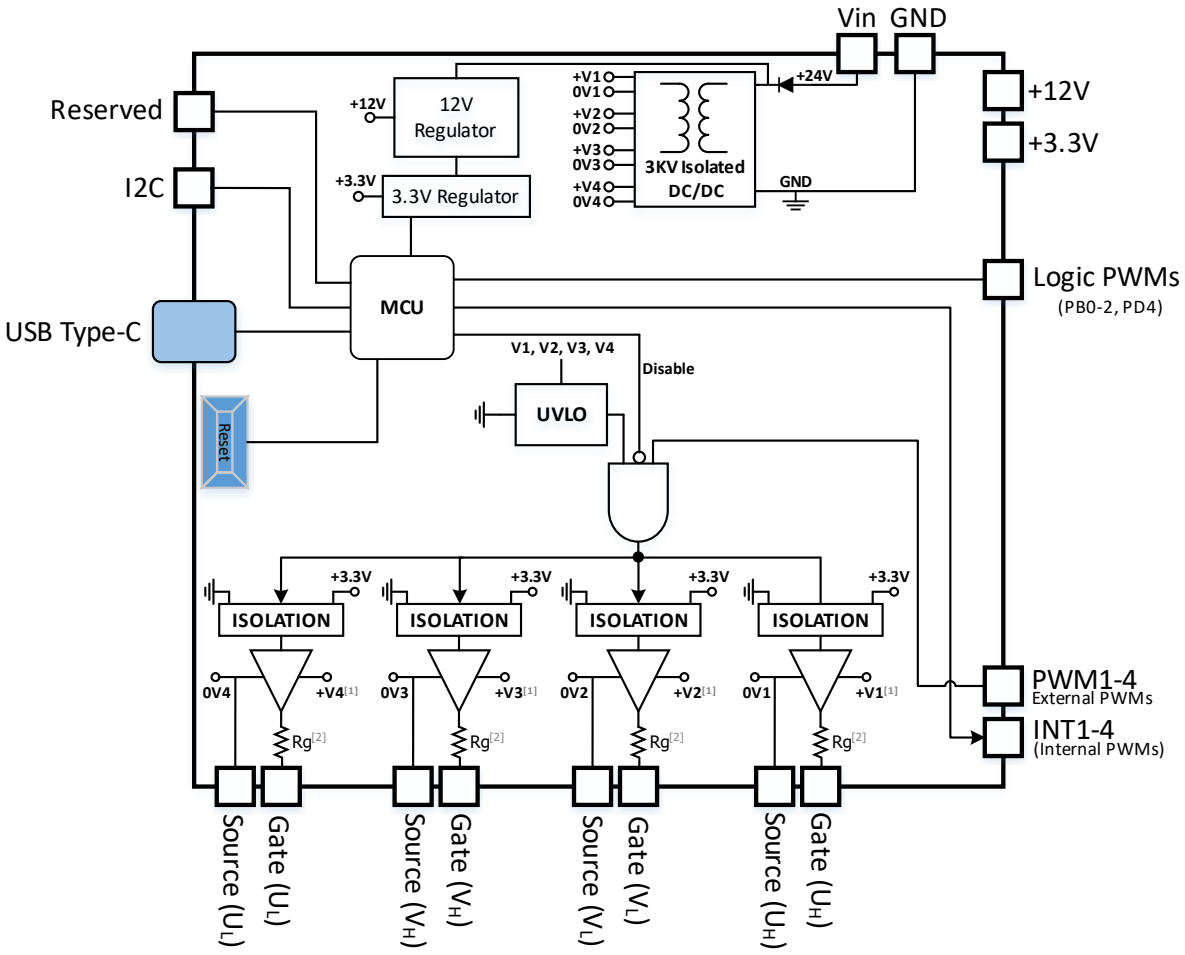

Figure 1: Block Diagram

Notes:

1) All gate drivers are powered by isolated (floating) voltage sources.
2) The default gate resistor is 10Ω and user can control the gate turn on and off by changing Rg to lower value for faster switching, or higher value to minimize ringing. However, the minimum value to be used should be greater than or equal to SiC/IGBT/MOSFET datasheet recommended value for reliable operation.

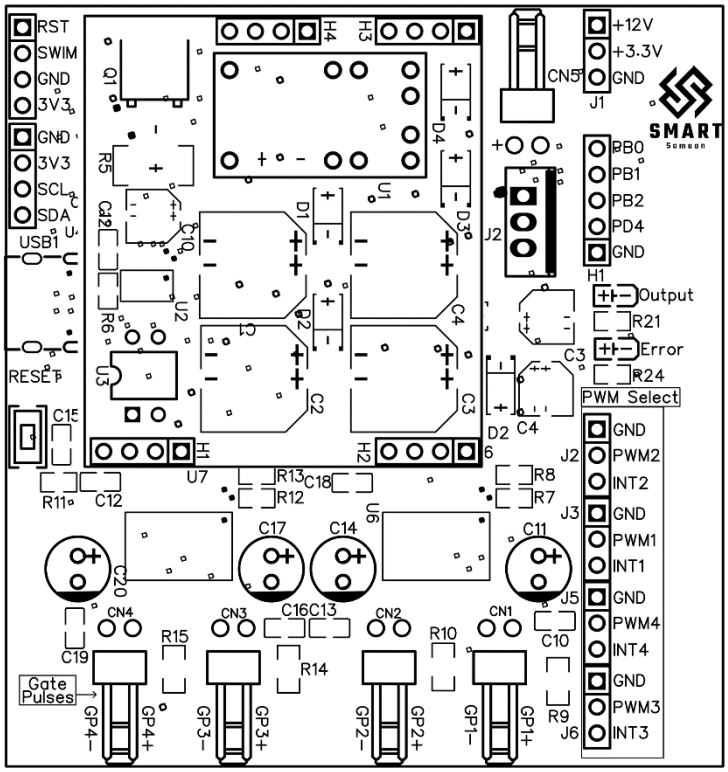

Figure 2: PCB components layout image of Smart Gate Driver Board

Table 4

Name	Connector (Pin No.)	Description
Reserved	RST, SWIM, GND, 3V3	Reserved (Not available to use for the customers)
I2C	GND, 3V3, SCL, SDA	I2C port of the onboard MCU
USB Type-C	USB1	USB port to be used for the programming of required PWM type using Smart Gate Driver PC-based Software
Reset Button	RESET	Resets the onboard MCU
Gate Pulses	CN1-CN4	Output of the 4 isolated gate drivers
PWM Select	J2, J3, J5, J6	PWM select header is used to select the PWM input for the gate driver ICs for which the output is available on CN1-CN4. • Short "INT1-PWM1, INT2-PWM2, INT3-PWM3, INT4-PWM4" for the selection of PWM input from the onboard MCU. • Apply PWM input to the gate driver ICs on the PWM1, PWM2, PWM3, PWM4 pins from any external MCU (Keep INT1-4 floating)
Output LED	Output	ON state: Indicates the gate driver ICs are enabled

		OFF state: Indicates the gate driver ICs are disabled
Fault LED	Error	Indicates the fault condition for the onboard MCU generated PWMs. Blinking at 5 Hz indicates the programming operation using the PC and USB cable.
Logic PWMs	H1	Logic PWMs (3.3V High state) are available as follows: • PB0: 1Hz PWM with 50% duty cycle • PB1: 5Hz PWM with 50% duty cycle • PB2: 10Hz PWM with 50% duty cycle • PD4: 50Hz PWM with 50% duty cycle
DC Voltages	J1	3.3V and 12V DC voltage is available for the biasing of external circuitry (for current limits, see Table 1 for current ratings)
Input	CN5	Input DC voltage of 24V for the operation of the board.
GND	J1 (3), H1 (5), J2 (1), J3 (1), J5 (1), J6 (1)	Ground for the input DC voltage and logic PWMs.

Application Information

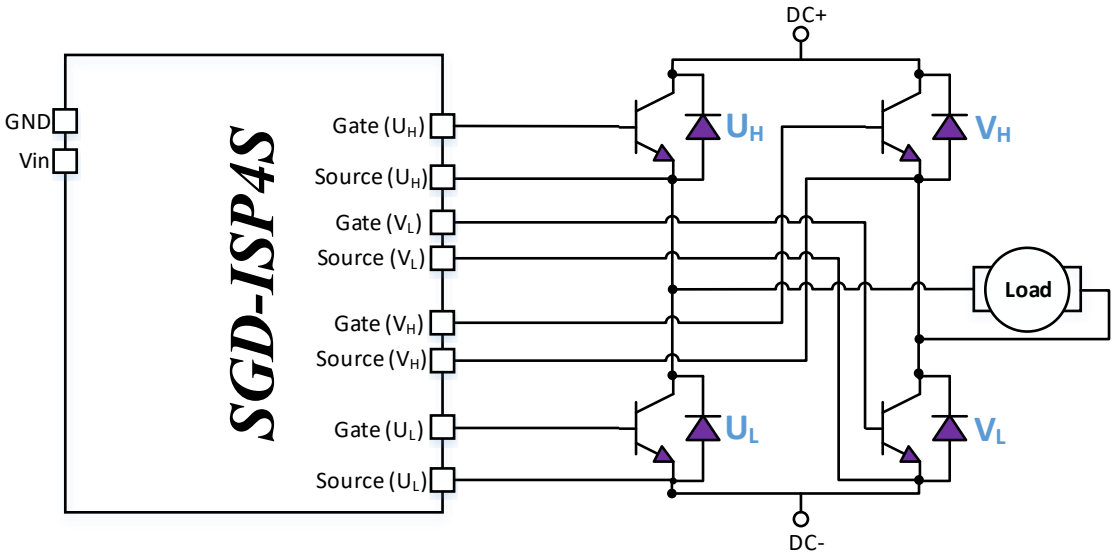

Figure 3: Application of Smart Gate Driver for a single-phase inverter

Operation Requirements:

For proper operation of the programmable gate driver board, certain requirements need to be fulfilled. First, the board needs to be supplied with +24V voltage source through CN5 on the top right side. For the PWM inputs from the onboard MCU, a shorting jumper should be placed on INT1-PWM1, INT2-PWM2, INT3-PWM3 and INT4-PWM4. For the PWM inputs from any external MCU, INT1, INT2, INT3, and INT4 pins should be kept floating while the PWM inputs should be applied to PWM1, PWM2, PWM3, and PWM4.

Single-Phase Inverter Application:

To operate a single-phase inverter with the smart gate driver board, the wiring connections should be performed as shown in Figure 3. To observe the output voltage waveform of the single-phase inverter, a load must be connected to the output of the inverter.

Input & Output LEDs:

The “Power” LED is a red coloured LED use to indicate that the board has been powered up by a DC source. The “Output” LED indicates that the gate driver ICs are enabled. The “Error” LED indicates any error occurred in the operation of the board. Blinking of “Error” LED during PWM programming using the PC indicates that the programming is in progress.

Safety Instructions:

As the output side may involve hazardous high voltages, it is unsafe to touch the circuit during operation. Users must ensure adequate clearance for heat sinks, metal enclosures, and any stray metallic objects near the output. The module and inverter should be enclosed in a properly

insulated casing. Special care should also be taken during mounting, as the mounting holes are located near the output terminals.

Mechanical Drawing

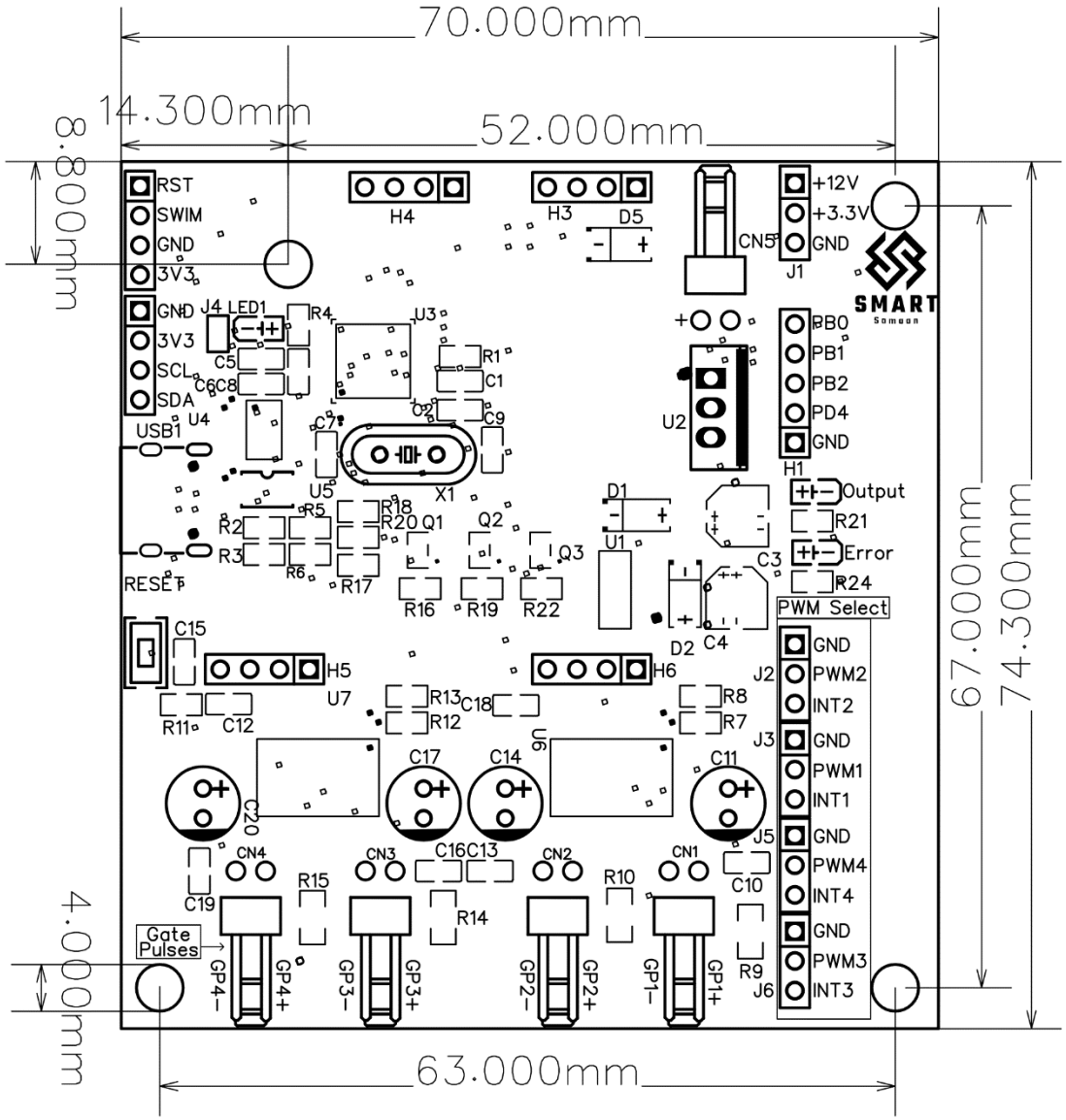

Figure 4: Top View

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