

Simplified Test Method for DRV7308 Fan Driver and Comparative Test Results with Competitor IPM



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Introduction to DRV7308

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The DRV7308 is a 650V enhancement-mode GaN (e-mode GaN) 3-phase intelligent power module (IPM) designed specifically for 150W–250W high-voltage brushless motor drives. Targeting high-efficiency, quiet, and high-power-density applications for BLDC/PMSM motors, it supports up to 450V DC bus voltage and achieves nearly 99% inverter efficiency within a compact package, making it an ideal drive solution for high-voltage small appliances, fans, and pumps. Integrating three 650V/205mΩ GaN FET half-bridges, gate drivers, bootstrap rectification, current-sensing op-amps, and complete protection circuitry in a 12mm×12mm QFN package, it eliminates external Schottky diodes, bootstrap diodes, and high-power heat sinks, significantly simplifying system design.

Its core advantages lie in the zero reverse recovery charge and extremely low switching losses of GaN devices. Combined with optimized driving and slew rate control, it maintains ultra-high efficiency even at a 20kHz switching frequency, with heat generation significantly lower than traditional IGBT and silicon MOS solutions. Other advantages are summarized as follows:

- In terms of driving capability, the DRV7308 features a 5A peak output current capability and supports adjustable gate drive slew rates from 5V/ns to 40V/ns, allowing a flexible balance between EMI performance and switching efficiency. Built-in adaptive dead-time control (<200ns) and ultra-low propagation delay (<135ns) significantly reduce current distortion and torque ripple. Combined with FOC, sinusoidal, or square wave drive, it achieves ultra-quiet motor operation and effectively enhances dynamic response and low-speed smoothness.
- In terms of sensing and control, the DRV7308 routes out three low-side source pins, supports 1/2/3 shunt resistor current sampling, and integrates a 12MHz, 15V/μs high-speed op-amp optimized specifically for single-resistor FOC current reconstruction, simplifying the sampling circuit and improving control precision. Its integrated GaN bootstrap rectification and current-limiting functions provide higher reliability without the need for external fast-recovery diodes, reducing BOM cost and board area.
- Regarding protection functions, the DRV7308 integrates overcurrent, undervoltage lockout (UVLO), overtemperature, and short-circuit protections, outputting fault indications via the nFAULT pin. Combined with an on-chip temperature sensor, it achieves real-time status monitoring and rapid shutdown to prevent damage to power transistors and motors, thereby enhancing long-term system reliability.

Overall, the DRV7308 uses a GaN+IPM convergence solution to resolve the contradictions in efficiency, size, noise, and reliability in high-voltage motor drives. It simplifies the threshold for high-voltage power design and shortens the development cycle. At the same time, with ultimate efficiency and miniaturization, it helps products achieve lower power consumption, quieter operation, and higher power density, making it a benchmark device for next-generation high-efficiency, high-voltage 3-phase motor drives.

Simplified Test Method for DRV7308

To fully evaluate the effectiveness of an IPM solution, evaluations on a dynamometer or a more professional calorimetry test bench are required. However, on the customer side, scheduling a dynamometer is time-consuming and labor-intensive, which is likely to cause project delays and miss the testing window. Therefore, this paper proposes a simpler test method, which has been recognized after communication with

leading domestic home appliance customers, successfully demonstrating the high-efficiency advantages of the DRV7308 through this test method. The specific method and equipment used are as follows.

- Equipment:
 - Outdoor air conditioner unit
 - Power meter, with input connected to 220V mains electricity and output connected to the entire outdoor air conditioner unit
 - Speed control upper computer
- Test Steps:
 - Disable the boost PFC of the outdoor air conditioner unit via the upper computer
 - Power meter output connected to the inverter board
 - Set speeds from 300rpm to 1200rpm with a step size of 100rpm, covering all operating conditions and power segments of the 3P outdoor unit
 - Read and record the power from the power meter
 - Use a current clamp to record the motor phase current

The advantages of this test method are:

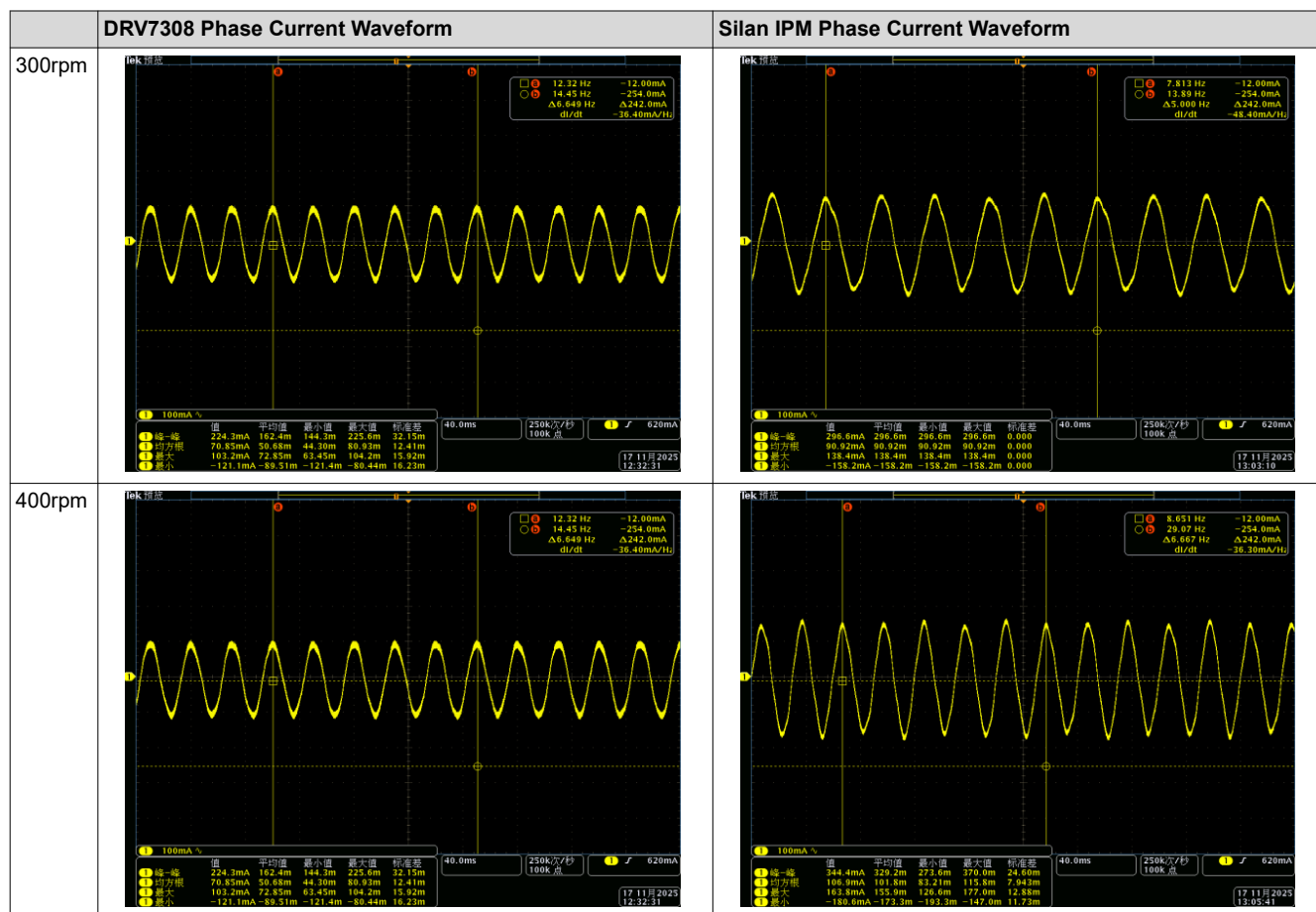
- It is very convenient to fix the speed via the upper computer (e.g., 300rpm), and by comparing the power consumed by the inverter board at the same speed, the power saved by different IPMs can be compared.
- Control variables by simply replacing the customer's original Si-based IPM with the TI DRV7308 GaN IPM
- Only a single power meter is used, making it very easy for home appliance customers to set up their experimental environment and avoiding the scheduling of calorimetry test benches or dynamometers
- Saves time, features low equipment operation thresholds, and requires no additional training

Test Results and Efficiency Improvement

On a mainstream 3P outdoor air conditioner fan drive of a leading home appliance customer, comparative tests were conducted against the original Si-based IPM using the method mentioned in this paper. Ultimately, TI's advantages were demonstrated in both efficiency and current waveforms, with results summarized as follows:

Speed	DRV7308 Input Power (W)	DRV7308 Phase Current (mA rms)	Silan IPM Input Power (W)	Silan IPM Phase Current (mA rms)	Power Saved by TI (W)	Phase Current Saved by TI (mA rms)
300 rpm	4.5	44.4	7.7	90.9	3.2	46.6
400 rpm	7.7	70.9	11.0	106.9	3.3	36.1
500 rpm	12.8	102.8	15.1	106.5	2.3	3.7
600 rpm	20.4	143.8	22.7	145.7	2.3	1.9
700 rpm	30.6	190.0	33.0	192.7	2.4	2.7
800 rpm	44.1	240.7	46.9	242.4	2.8	1.7
900 rpm	61.4	296.7	64.2	300.6	2.8	3.9
1000 rpm	82.6	357.9	85.6	359.7	3.0	1.8
1100 rpm	108.8	425.9	112.4	429.1	3.6	3.2
1200 rpm	140.9	502.9	144.0	505.4	3.1	2.5

At 300rpm and 400rpm, the phase current saved by the DRV7308 is relatively noticeable. The phase current waveforms are as follows:



In actual outdoor air conditioner operating scenarios, the outdoor unit initially runs at a high speed to quickly cool down the room, operating at approximately ~1000rpm. When the room temperature drops close to the set temperature, the outdoor unit runs at a low speed for a longer duration, operating at approximately ~500rpm. Combining the above test results, TI effectively improves efficiency at both high and low speeds, consuming lower power to ensure the same rotational speed, with more pronounced effects at low speeds:

- At a low speed of 300rpm, the DRV7308 saves 3.2W of power. The original solution power is 7.7W, while the TI power is only 4.5W. Therefore, when driving the fan at the same 300rpm speed, TI can save $3.2/7.7 = 48\%$ power.
- At a low speed of 300rpm, the DRV7308 saves 46.6mA of phase current. The original solution phase current is 90.9mA, while the TI phase current is only 44.4mA. Therefore, when driving the fan at the same 300rpm speed, TI can save $46.6/90.9 = 51\%$ phase current.

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