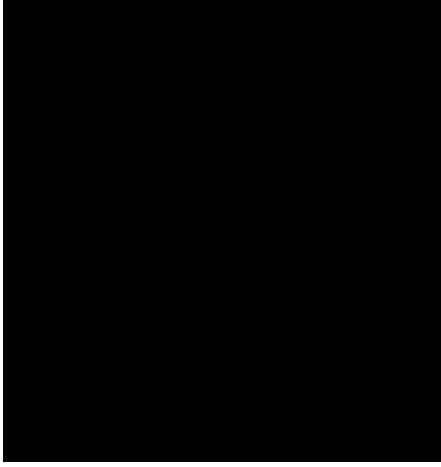


January 2014

FNA40560

Motion SPM® 45 Series

Features

- UL Certified No. E209204 (UL1557)
- 600 V - 5 A 3-Phase IGBT Inverter with Integral Gate Drivers and Protection
- Low Thermal Resistance Using Ceramic Substrate
- Low-Loss, Short-Circuit Rated IGBTs
- Built-In Bootstrap Diodes and Dedicated Vs Pins Simplify PCB Layout
- Built-In NTC Thermistor for Temperature Monitoring
- Separate Open-Emitter Pins from Low-Side IGBTs for Three-Phase Current Sensing
- Single-Grounded Power Supply
- Optimized for 5 kHz Switching Frequency
- Isolation Rating: 2000 V_{rms} / min.

Applications

- Motion Control - Home Appliance / Industrial Motor

Related Resources

- *AN-9070 - Motion SPM® 45 Series Users Guide*
- *AN-9071 - Motion SPM® 45 Series Thermal Performance Information*
- *AN-9072 - Motion SPM® 45 Series Mounting Guidance*
- *RD-344 - Reference Design (Three Shunt Solution)*
- *RD-345 - Reference Design (One Shunt Solution)*

General Description

FNA40560 is a Motion SPM® 45 module providing a fully-featured, high-performance inverter output stage for AC Induction, BLDC, and PMSM motors. These modules integrate optimized gate drive of the built-in IGBTs to minimize EMI and losses, while also providing multiple on-module protection features including under-voltage lockouts, over-current shutdown, thermal monitoring, and fault reporting. The built-in, high-speed HVIC requires only a single supply voltage and translates the incoming logic-level gate inputs to the high-voltage, high-current drive signals required to properly drive the module's robust short-circuit-rated IGBTs. Separate negative IGBT terminals are available for each phase to support the widest variety of control algorithms.

Figure 1. Package Overview

Package Marking and Ordering Information

Device	Device Marking	Package	Packing Type	Quantity
FNA40560	FNA40560	SPMAA-A26	Rail	12

Integrated Power Functions

- 600 V - 5 A IGBT inverter for three-phase DC / AC power conversion (please refer to Figure 3)

Integrated Drive, Protection, and System Control Functions

- For inverter high-side IGBTs: gate drive circuit, high-voltage isolated high-speed level shifting
  control circuit Under-Voltage Lock-Out (UVLO) protection
- For inverter low-side IGBTs: gate drive circuit, Short-Circuit Protection (SCP)
  control supply circuit Under-Voltage Lock-Out (UVLO) protection
- Fault signaling: corresponding to UVLO (low-side supply) and SC faults
- Input interface: active-HIGH interface, works with 3.3 / 5 V logic, Schmitt trigger input

Pin Configuration

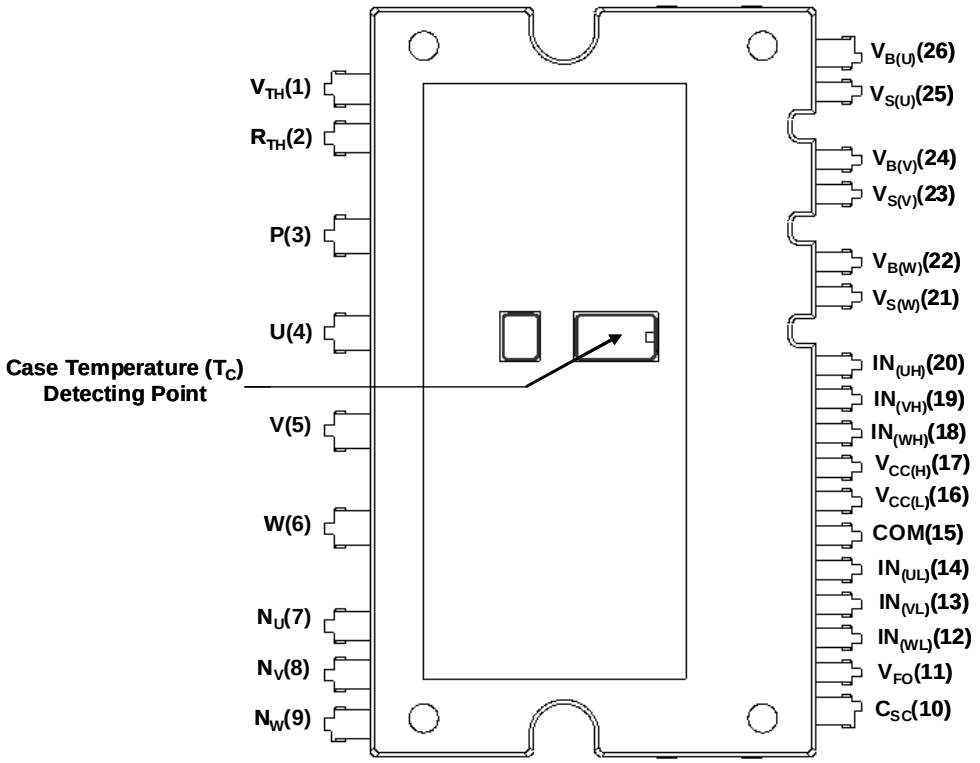


Figure 2. Top View

Internal Equivalent Circuit and Input/Output Pins

Figure 3. Internal Block Diagram

1st Notes:

1. Inverter high-side is composed of three IGBTs, freewheeling diodes, and one control IC for each IGBT.

Absolute Maximum Ratings (T_J = 25°C, unless otherwise specified.)

Inverter Part

2nd Notes:

Electrical Characteristics (T_J = 25°C, unless otherwise specified.)

Inverter Part

Figure 5. Switching Loss Ch

Figure. 6. R-T Curve of The Built-In Thermistor

Bootstrap Diode Part

Time Charts of Protective Function

a1 : Control supply voltage rises: after the voltage rises UV_{CCR}, the circuits start to operate when next input is applied.

a2 : Normal operation: IGBT ON and carrying current.

a3 : Under-voltage detection (UV_{CCD}).

a4 : IGBT OFF in spite of control input condition.

a5 : Fault output operation starts.

a6 : Under-voltage reset (UV_{CCR}).

a7 : Normal operation: IGBT ON and carrying current.

Figure 11. Under-Voltage Protection (Low-Side)

b1 : Control supply voltage rises: after the voltage reaches UV

(with the external shunt resistance and CR connection)

c1 : Normal operation: IGBT ON and carrying current.

c2 : Short-circuit current detection (SC trigger).

c3 : Hard IGBT gate interrupt.

c4 : IGBT turns OFF.

c5 : Input “LOW”: IGBT OFF state.

c6 : Input “HIGH”: IGBT ON state, but during the active period of fault output, the IGBT doesn’t turn ON.

c7 : IGBT OFF state.

Figure 13. Short-Circuit Protection (Low-Side Operation Only)

Input/Output Interface Circuit

Figure 14. Recommended MCU I/O Interface Circuit

2nd Notes:

11. RC coupling at each input (parts shown dotted) might change depending on the PWM control scheme in the application and the wiring impedance of the application’s printed circuit board. The input signal section of the Motion SPM® 45 product integrates a 5 k (

Figure 15. Typical Application Circuit

3rd Notes:

1) To avoid malfunction, the wiring of each input should be as short as possible (less than 2 - 3 cm).

2) By virtue of integrating an application-specific type of HVIC inside the Motion SPM® 45 product, direct coupling to MCU terminals without any optocoupler or transformer isolation is possible.

3) V_{FO} output is open-drain type. This signal line should be pulled up to the positive side of the MCU or control power supply with a resistor that makes I_{FO} up to 1 mA (please refer to Figure 14).

4) C_{SP15} of around seven times larger than bootstrap capacitor C_{BS} is recommended.

5) Input signal is active-HIGH type. There is a 5 k resistor inside the IC to pull down each input signal line to GND. RC coupling circuits is recommanded for the prevention of input signal oscillation. $R_S C_{PS}$ time constant should be selected in the range 50 ~ 150 ns (recommended R_S = 100 , , C_{PS} = 1 nF).

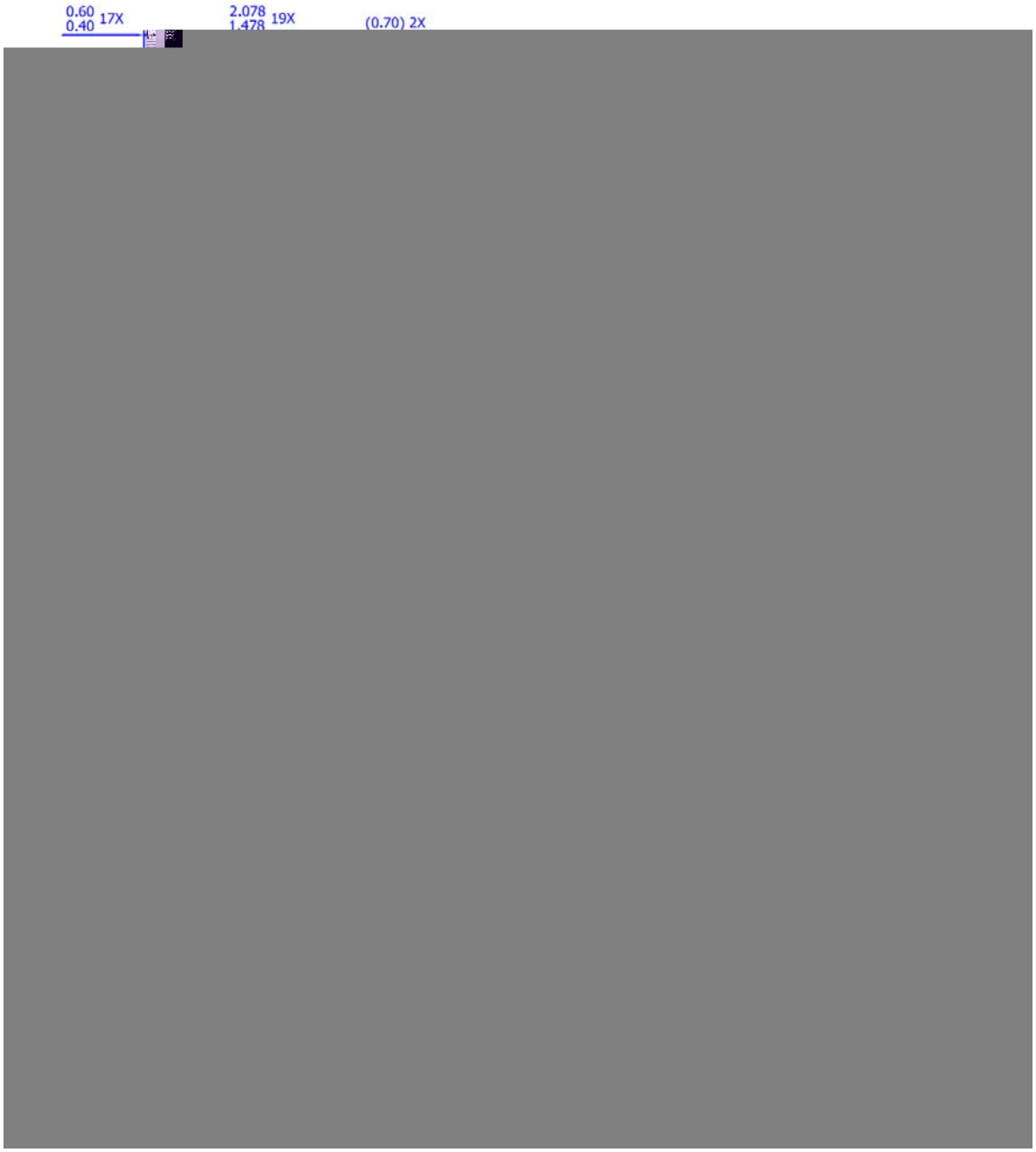
6) To prevent errors of the protection function, the wiring around R_F and C_{SC} should be as short as possible.

7) In the short-circuit protection circuit, please select the $R_F C_{SC}$ time constant in the range 1.5 ~ 2 s.

8) The connection between control GND line and power GND line which includes the N_U, N_V, N_W must be connected to only one point. Please do not connect the control GND to the power GND by the broad pattern. Also, the wiring distance between control GND and power GND should be as short as possible.

9) Each capacitor should be mounted as close to th

Detailed Package Outline Drawings



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