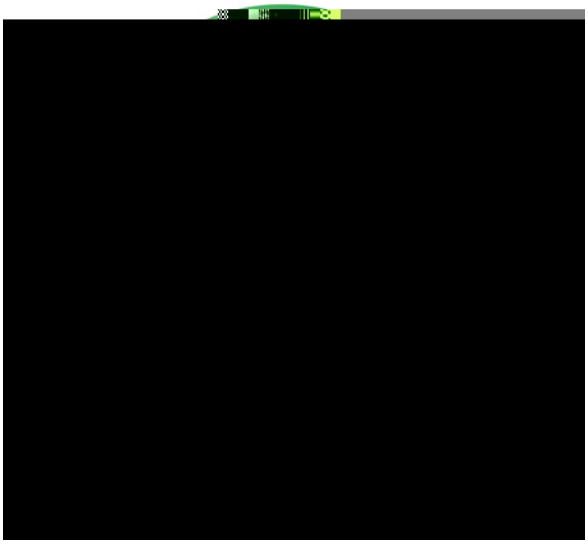
Is Now Part of



To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

January 2014

FNA40860

Motion SPM® 45 Series

Features

- UL Certified No. E209204 (UL1557)
- 600 V - 8 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*

Integrated Power Functions

- 600 V - 8 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

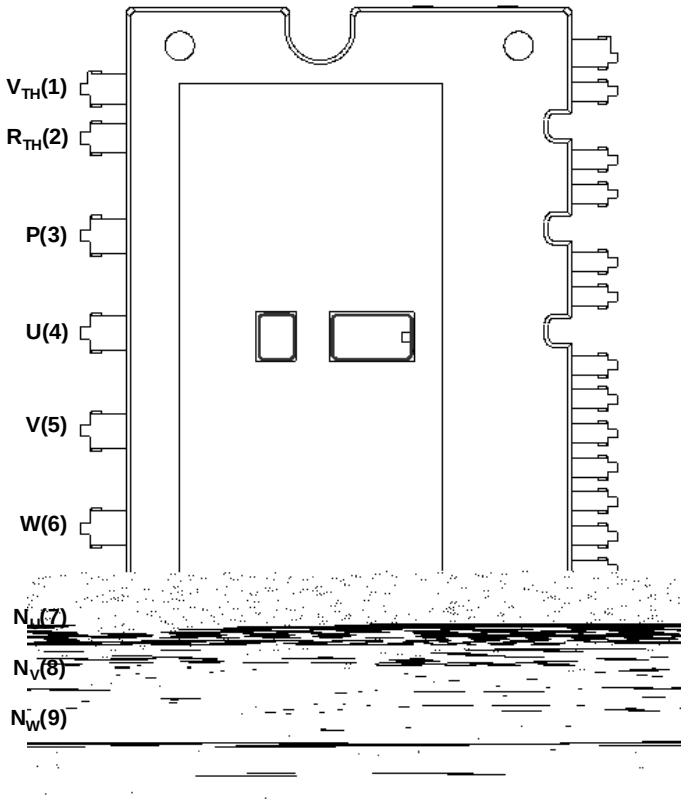


Figure 2. Top View

Pin Descriptions

Pin Number	Pin Name	Pin Description
1	V_{TH}	Thermistor Bias Voltage
2	R_{TH}	Series Resistor for the Use of Thermistor (Temperature Detection)
3	P	Positive DC-Link Input
4	U	Output for U-Phase
5	V	Output for V-Phase
6	W	Output for W-Phase
7	N_U	Negative DC-Link Input for U-Phase
8	N_V	Negative DC-Link Input for V-Phase
9	N_W	Negative DC-Link Input for W-Phase
10	C_{SC}	Capacitor (Low-Pass Filter) for Short-circuit Current Detection Input
11	V_{FO}	Fault Output
12	$IN_{(WL)}$	Signal Input for Low-Side W-Phase
13	$IN_{(VL)}$	Signal Input for Low-Side V-Phase
14	$IN_{(UL)}$	Signal Input for Low-Side U-Phase

Internal Equivalent Circuit and Input/Output Pins

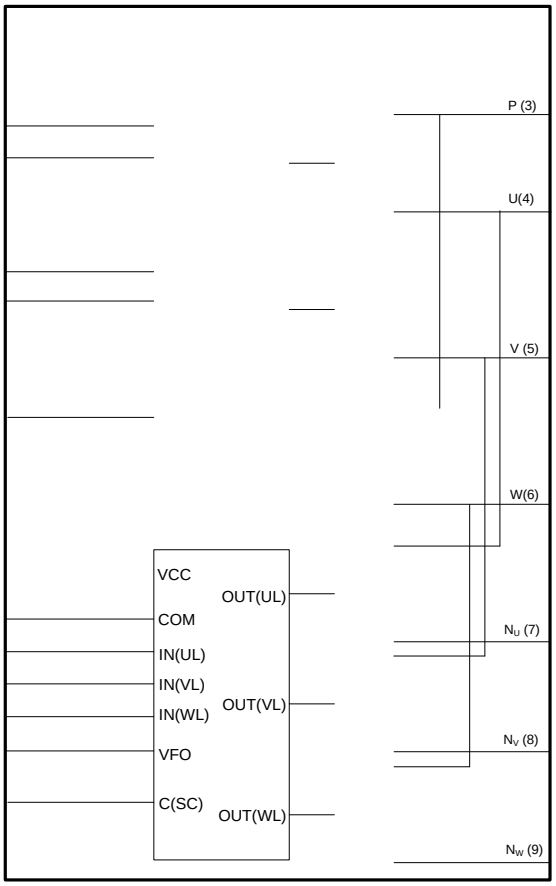


Figure 3. Internal Block Diagram

1st Notes:

1. Inverter high-side is composed of three IGBTs, freewheeling diodes, and one control IC for each IGBT.
2. Inverter low-side is composed of three IGBTs, freewheeling diodes, and one control IC for each IGBT. It has gate drive and protection functions.
3. Inverter power side is composed of four inverter DC-link input terminals and three inverter output terminals.

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

Inverter Part

2nd Notes:

1. The maximum junction temperature rating of the power chips integrated w2C3

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

Inverter Part

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{CE(SAT)}$	Collector - Emitter Saturation Voltage	$V_{CC} = V_{BS}$ = 15 V, I_C = 8 A, T_J = 25°C, V_{IN} = 5 V	-	1.7	2.2	V
V_F	FWDi Forward Voltage	V_{IN} = 0 V, I_F = 8 A, T_J = 25°C	-	1.7	2.2	V
HS t_{ON}	Switching Times	V_{PN} = 300 V, $V_{CC} = V_{BS}$ = 15 V, I_C = 8 A, T_J = 25°C, V_{IN} = 0 V 5 V, Inductive Load (2nd Note 3)	0.45	0.75	1.25	s
$t_{C(ON)}$			-	0.20	0.45	s
t_{OFF}			-	0.80	1.30	s
t						

2nd Notes:

3. t_{ON} and t_{OFF} include the propagation delay of the internal drive IC. $t_{C(ON)}$ and $t_{C(OFF)}$ are the switching time of IGBT itself under the given gate driving condition internally. For the detailed information, please see Figure 4.

Figure 4. Switching Time Definition

Figure 5. Switching Loss Characteristics (Typical)

Control Part

2nd Notes:

4. Short-circuit protection is functioning only at the low-sides.

5. T_{TH} is the temperature of thermister itselt. To know case temperature (T_C

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

Bootstrap Diode Part

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_F	Forward Voltage	I_F = 0.1 A, T_C = 25°C	-	2.5	-	V
t_{rr}	Reverse-Recovery Time	I_F = 0.1 A, T_C = 25°C	-	80	-	ns

Figure 7. Built-In Bootstrap Diode Characteristic

2nd Notes:

6. Built-in bootstrap diode includes around 15 Ω resistance characteristic.

Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{PN}	Supply Voltage	Applied between P - N_U, N_V, N_W	-	300	400	V
V_{CC}	Control Supply Voltage	Applied between $V_{CC(H)}$, $V_{CC(L)}$ - COM	13.5	15.0	16.5	V
V_{BS}	High-Side Bias Voltage	Applied between $V_{B(U)}$ - $V_{S(U)}$, $V_{B(V)}$ - $V_{S(V)}$, $V_{B(W)}$ - $V_{S(W)}$	13.0	15.0	18.5	V
dV_{CC} / dt, dV_{BS} / dt	Control Supply Variation		- 1	-	1	V / s
t_{dead}	Blanking Time for Preventing Arm-Short	For each input signal	1.5	-	-	s
f_{PWM}	PWM Input Signal	- 40 C T_J 150°C	-	-	20	kHz
V_{SEN}	Voltage for Current Sensing	Applied between N_U, N_V, N_W - COM (Including Surge-Voltage)	- 4		4	V
$P_{WIN(ON)}$	Minimun Input Pulse Width	(2nd Note 7)	0.5	-	-	s
$P_{WIN(OFF)}$			0.5	-	-	

2nd Notes:

7. This product might not make response if input pulse width is less than the recommanded value.

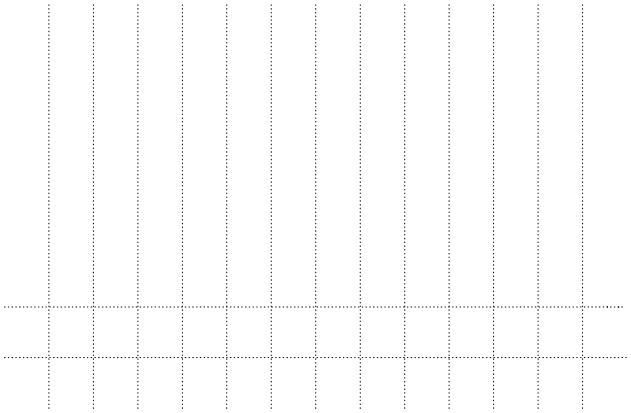


Figure 8. Allowable Maximum Output Current

2nd Notes:

8. This allowable output current value is the reference data for the safe operation of this product. This may be different from the actual application and operating condition.

Mechanical Characteristics and Ratings

Figure 9. Flatness Measurement Position

Figure 10. Mounting Screws Torque Order

2nd Notes:

9. Do not make over torque when mounting screws. Much mounting torque may cause ceramic cracks, as well as bolts and Al heat-sink destruction.

10. Avoid one side tightening stress. Figure 10 shows the recommended torque order for mounting screws. Uneven mounting can cause the ceramic substrate of the SPM®

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.

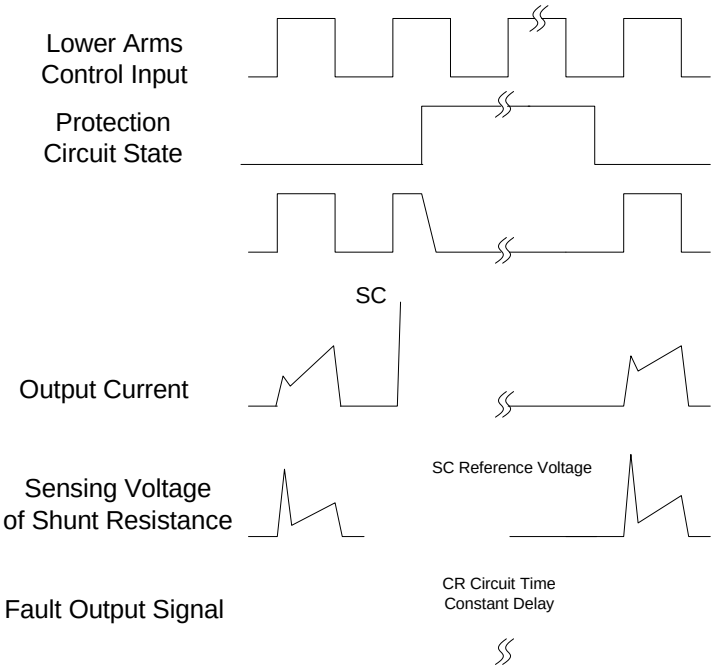
a2 : Normal operation: IGBT ON and carrying current.

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



(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 (typ.) pull-down resistor. Therefore, when using an external filtering resistor, pay attention to the signal voltage drop at input terminal.

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}

Detailed Package Outline Drawings

Package drawings are provided as a servic