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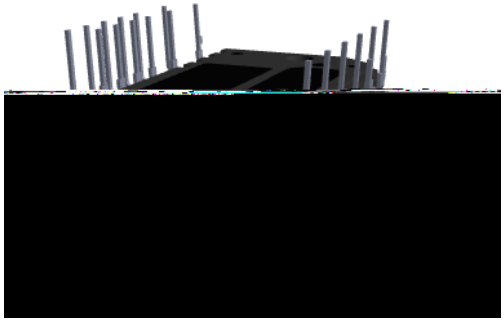
FNB51060TD1 Motion SPM® 55 Series

April 2017



Integrated Power Functions

- 600 V - 10 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: High-active interface, works with 3.3 / 5 V logic, Schmitt trigger input
- Built in Bootstrap circuitry in HVIC

Pin Configuration

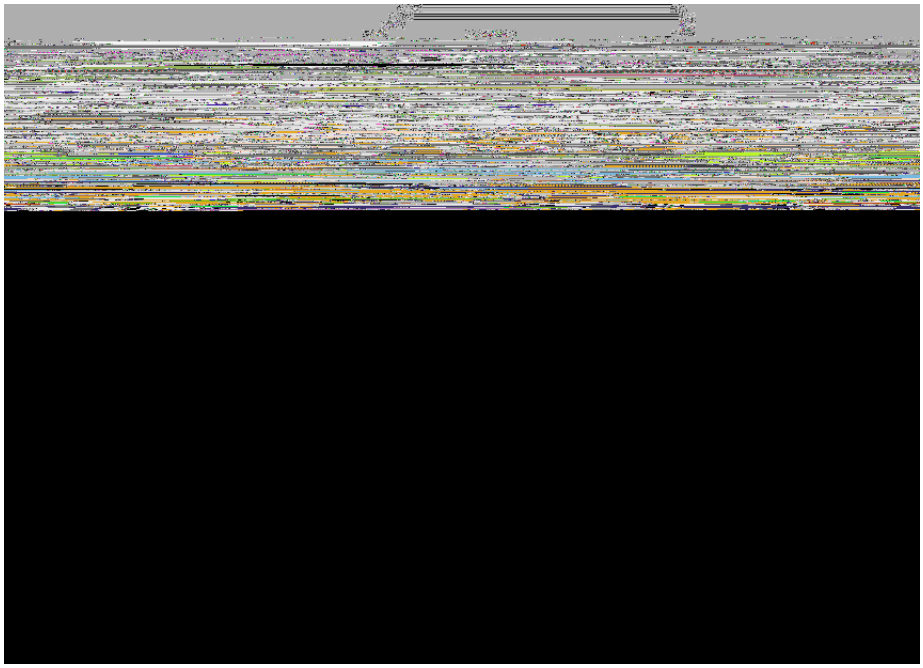


Figure 2. Top View

Pin Descriptions

Pin Number	Pin Name	Pin Description
1	P	Positive DC-Link Input
2	U, V_S(U)	Output for U Phase
3	V, V_S(V)	Output for V Phase
4	W, V_S(W)	Output for W Phase
5	N_U	Negative DC-Link Input for U Phase
6	N_V	Negative DC-Link Input for V Phase
7	N_W	Negative DC-Link Input for W Phase
8	$IN_{(UL)}$	Signal Input for Low-Side U Phase
9	$IN_{(UH)}$	Signal Input for High- ide U Phase
10	$IN_{(VL)}$	Signal Input for Low-Side V Phase
11	$IN_{(VH)}$	Signal Input for High-Side V Phase
12	$IN_{(WL)}$	Signal Input for Low-Side W Phase
13	$IN_{(WH)}$	Signal Input for High-Side W Phase
14	V_{DD}	Common Bias Voltage for IC and IGBTs Driving
15	COM	Common Supply Ground
16	C_{SC}	Capacitor (Low-Pass Filter) for Short-circuit Current Detection Input
17	V_F	Fault Output, Shut-Down Input, Temperature Output of Drive IC
18	$V_{B(W)}$	High-Side Bias Voltage for W-Phase IGBT Driving
19	$V_{B(V)}$	High-Side Bias Voltage for V-Phase IGBT Driving
20	$V_{B(U)}$	High-Side Bias Voltage for U-Phase IGBT Driving

Internal Equivalent Circuit and Input/Output Pins

Figure 3. Internal Block Diagram

Note:

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

Note:

5. The maximum junction temperature rating of the power chips integrated within the Motion SPM® 55 product is 150 C.

Control Part

Total System

Thermal Resistance

Note:

6. For Marking " * ", These Value had been made an acquisition by the calculation considered to design factor.

7. For the measurement point of case temperature (T_C

Control Part

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
I_{QDD}	Quiescent V_{DD} Supply Current	V_{DD} = 15 V, $IN_{(UH,VH,WH,UL,VL,WL)}$ = 0 V	V_{DD} - COM	-	1.5	2.0	mA
I_{PDD}	Operating V_{DD} Supply Current	V_{DD} = 15 V, f_{PWM} = 20 kHz, duty = 50%, applied to one PWM signal input	V_{DD} - COM	-	1.8	2.5	mA
I_{QBS}	Quiescent V_{BS} Supply Current	V_{BS} = 15 V, $IN_{(UH, VH, WH)}$ = 0 V	$V_{B(U)}$ - $V_{S(U)}$, $V_{B(V)}$ - $V_{S(V)}$, $V_{B(W)}$ - $V_{S(W)}$	-	30	60	A
I_{PBS}	Operating V_{BS} Supply Current	V_{DD} = V_{BS} = 15 V, f_{PWM} = 20 kHz, duty = 50%, applied to one PWM signal input for high - side	$V_{B(U)}$ - $V_{S(U)}$, $V_{B(V)}$ - $V_{S(V)}$, $V_{B(W)}$ - $V_{S(W)}$	-	330	450	A
V_{FH}	Fault Output Voltage	V_{SC} = 0 V, V_F Circuit: 10 k to 5 V Pull-up		4.5	-	-	V
V_{FL}		V_{SC} = 1 V, V_F Circuit: 10 k to 5 V Pull-up		-	-	0.5	V
$V_{SC(ref)}$	Short-Circuit Trip Level	V_{DD}					

Note:

9. Short-circuit protection is functioning for all six IGBTs.

Figure. 5. V-T Curve of Temperature Output of IC (5V pull-up with 10kohm)

Bootstrap Diode Part

Figure 6. Built-In Bootstrap Diode Charaterstics

Recommended Operating Conditions

Note:

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

Note:

11. RC coupling at each input (parts shown dotted) might change depending on the PWM control scheme used in the application and

Mechanical Characteristics and Ratings

Parameter	Conditions		Min.	Typ.	Max.	Unit
Device Flatness	See Figure 8		-50	-	100	m
Mounting Torque	Mounting Screw: - M3	Recommended 0.7 N • m	0.6	0.7	0.8	N • m
	Note Figure 9	Recommended 7.1 kg • cm	5.9	6.9	7.9	kg • cm
Weight			-	6.0	-	g

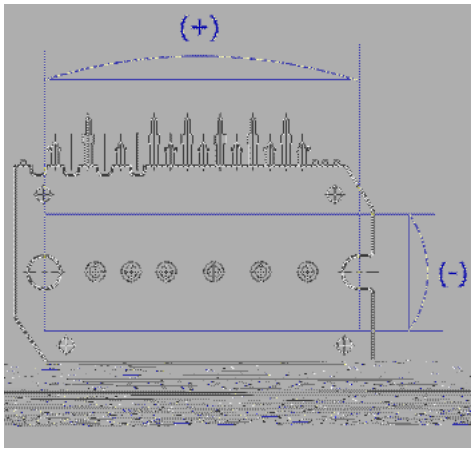


Figure 8. Flatness Measurement Position

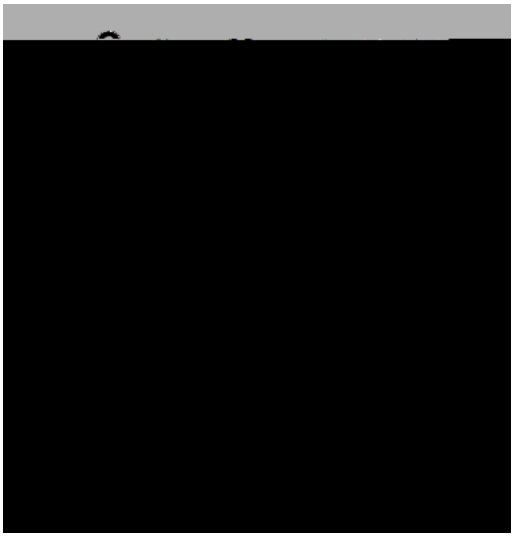


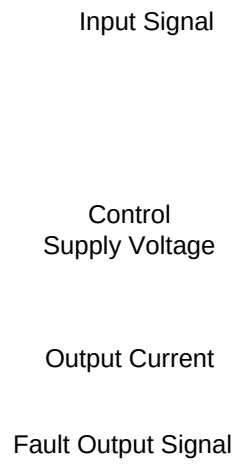
Figure 9. Mounting Screws Torque Order

Note:

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

13. Avoid one side tightening stress. Figure 10 shows the recommended torque order for mounting screws. Uneven mounting can cause the ceramic substrate of the Motion SPM 55 product to be damaged. The Pre-screwing torque is set to 20 ~ 30 % of maximum torque rating.

Time Charts of Protective Function



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

a2 : Normal operation: IGBT ON and carrying current.

a3 : Under voltage detection (UV_{DDD}).

a4 : IGBT OFF in spite of control input condition.

a5 : Fault output operation starts.

a6 : Under voltage reset (UV_{DDR}).

a7 : Normal operation: IGBT ON and carrying current.

Figure 10. Under-Voltage Protection (Low-Side)

b1 : Control supply voltage rises: After the voltage reaches UV_{BSR}, the circuits start to operate when next input is applied.

b2 : Normal operation: IGBT ON and carrying current.

b3 : Under voltage detection (UV_{BSD}).

b4 : IGBT OFF in spite of control input condition, but there is no fault output signal.

b5 : Under voltage reset (UV_{BSR})

b6 : Normal operation: IGBT ON and carrying current

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

(with the external shunt resistance and CR connection)

d1 : High Side First - Input - First - Output Mode

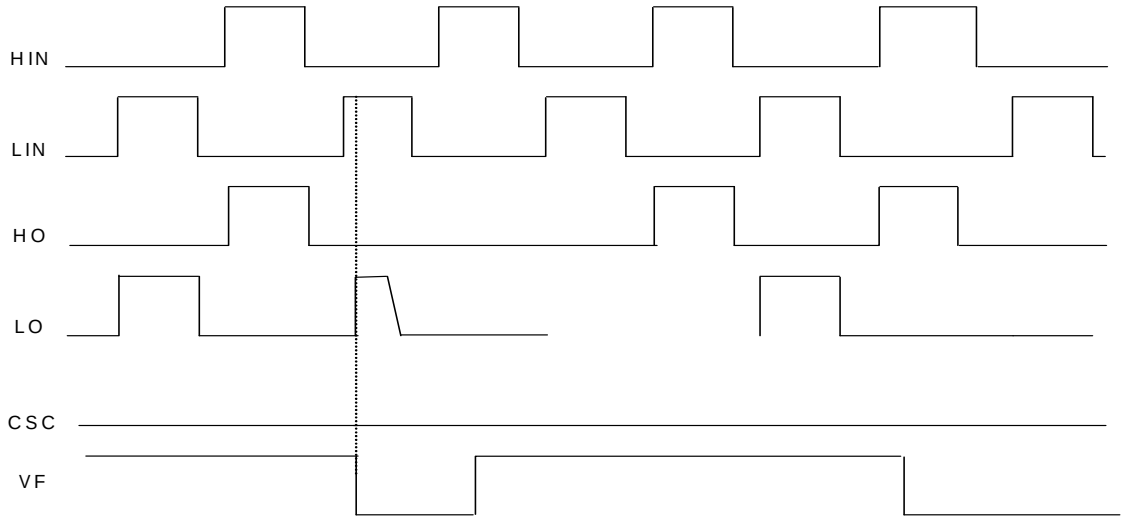
d2 : Low Side Noise Mode : No Lo

d3 : High Side Noise Mode : No Ho

d4 : Low Side First - Input - First - Output Mode

d5 : In - Phase Mode : No Ho

Figure 12. Inter-Lock Function



HIN : High-side Input Signal
LIN : Low-side Input Signal
HO : High-Side Output Signal
LO : Low-Side Output Signal
CSC : Over Current Detection Input
VF : Shutdown Input Function

Figure 14. Shutdown Input Function By External Command

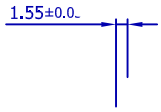
Note:

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 SPM® 55 product, direct coupling to MCU terminals without any opto-coupler or transformer isolation is possible.

3) V_F 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 5 mA. Please refer to Figure 15.

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


1.55±0.0