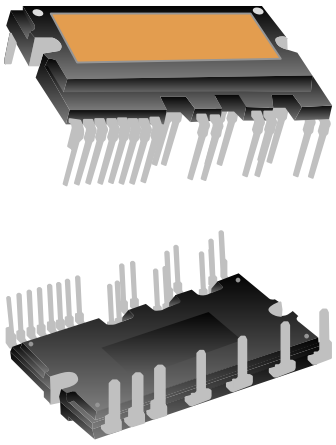
600V/15A 3-PHASE FULL-BRIDGE DRIVER (INTELLIGENT POWER MODULE)

DESCRIPTION

SD15M60AC is a 3-phase brushless DC motor driver with high integration and high reliability for low power inverter driving such as air condition, dishwasher, and industrial sewing machine. It has embedded six low-loss IGBT and three high-speed half-bridge gate drivers with high voltage.

The under voltage, short circuit and over temperature protections integrated make the circuit work safely in a wide range. The current of each phase can be detected separately because there is one independent negative DC terminal for each phase.

SD15M60AC uses high-insulation design, compact package and carries heat easily, which makes it easy to use especially for compact installation applications.



DIP-27H

FEATURES

- Built-in low-loss 600V/15A IGBT;
- Built-in high-voltage gate driver;
- Built-in under voltage, over temperature and over current protections;
- Built-in bootstrap diode;
- Compatible with 3.3V, 5V MCU interface, active high;
- Three independent negative DC terminal for inverter current detection;
- Alarm signal: for low-side under voltage and short circuit protections;
- Package in DBC design with low thermal resistance;
- Insulation level: 2500Vrms/min

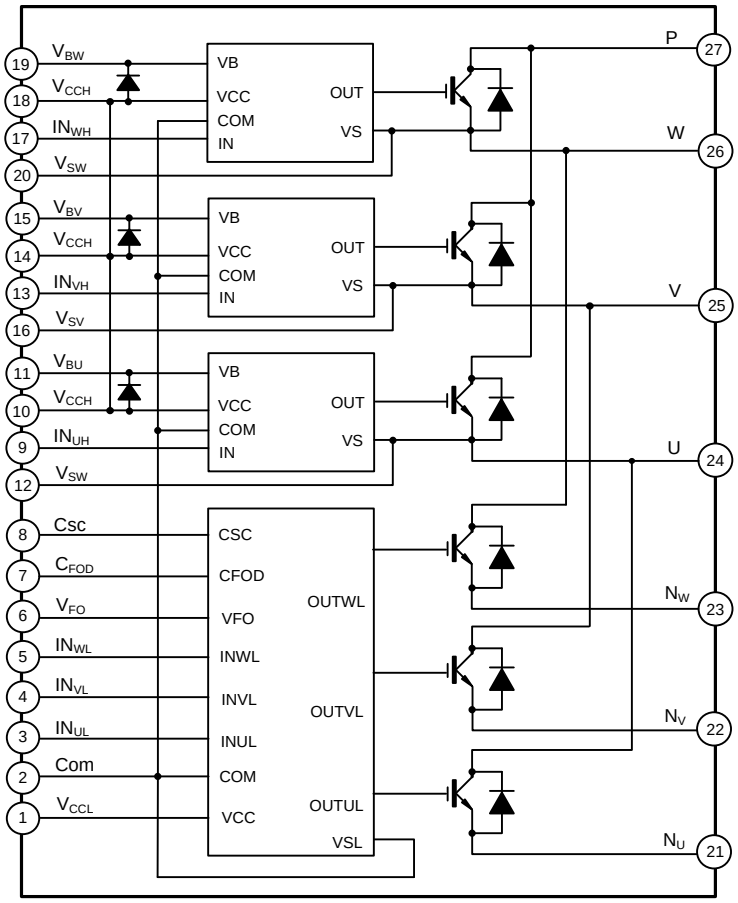
APPLICATIONS

- Air condition compressor
- Refrigerator compressor
- Low power inverter
- Industrial sewing machine

ORDERING INFORMATION

Part No.	Package	Marking	Hazardous Substance Control	Packing Type
SD15M60AC	DIP-27H	SD15M60AC	Halogen free	Tube

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

Characteristics	Symbol	Rating	Unit
Inverter section			
Voltage on the DC bus between PN	V_{PN}	450	V
Surge voltage on the DC bus between PN	$V_{PN(Surge)}$	500	V
Voltage between collector and emitter	V_{CES}	600	V
Continuous current of the single IGBT collector, T_C=25°C	I_C	15	A
Peak current of the single IGBT collector, T_C=25°C, Pulse width less than 1ms	I_{CP}	30	A
Max. power dissipation of the collector of each module, T_C=25°C	P_C	55	W
Control section			
Control supply voltage	V_{CC}	20	V
High-side control voltage	V_{BS}	20	V
Input signal voltage	V_{IN}	-0.3~17	V
Fault output supply voltage	V_{FO}	-0.3~V_{CC}+0.3	V

Characteristics	Symbol	Rating	Unit
Fault output current Sink current at V_{FO} pin	I_{FO}	5	mA
Input voltage at current detect pin	V_{SC}	-0.3~V_{CC}+0.3	V
Whole system			
Voltage limit of short circuit protection V_{CC}=V_{BS}=13.5~16.5V, T_J=150°C, single and less than 2μs	$V_{PN(PROT)}$	400	V
Operating temperature of module case Limit condition: -40°C≤T_J≤150°C	T_C	-40~125	°C
Storage temperature range	T_{STG}	-40~150	°C
Junction-to-case thermal resistance of each IGBT	$R_{\theta JCQ}$	2.27	°C/W
Junction-to-case thermal resistance of each FRD	$R_{\theta JCF}$	3.0	°C/W
Insulation voltage 60Hz, Sine, 1 minute Connect the pin to heatsink	V_{ISO}	2500	V_{rms}
Mounting torque Mounting screws: -M3, 0.62N.m recommended	T	0.5~0.8	N.m
Bootstrap Diode Forward Current，T_C=25°C	I_F	0.5	A
Bootstrap Diode Forward Current(Peak)，T_C=25°C， Under 1ms Pulse Width	I_{FP}	2.0	A

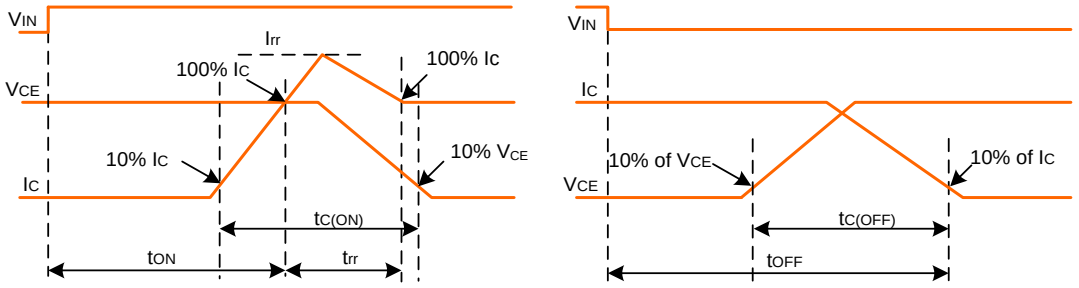
RECOMMENDED OPERATING CONDITIONS

Characteristics	Symbol	Ratings			Unit
		Min.	Typ.	Max.	
Voltage on the bus between PN	V_{PN}	--	300	400	V
Control supply voltage	V_{CC}	13.5	15	16.5	V
High-side control voltage	V_{BS}	13.5	15	16.5	V
Control voltage variation	dVcc/dt dV_{BS}/dt	-1	--	1	V/μs
On threshold voltage	$V_{IN(ON)}$	3.0	--	V_{CC}	V
Off threshold voltage	$V_{IN(OFF)}$	0	--	0.6	V
Blanking time for preventing arm- short V_{CC} =V_{BS}=13.5~16.5V, T_J⩽25°C	T_{dead}	2.0	--	--	μs
PWM input signal	f_{PWM}	--	--	20	KHz
Voltage on current detecting pin	V_{SEN}	-4	--	4	V

ELECTRICAL CHARACTERISTICS(UNLESS OTHERWISE SPECIFIED,Tamb=25°C,VCC=VBS=15V)

Inverter

Characteristics		Symbol	Conditions	Min.	Typ.	Max.	Unit
Saturation voltage between collector and emitter		$V_{CE(SAT)}$	V_{CC}=V_{BS}=15V, V_{IN}=5V I_C=15A, T_J = 25°C	--	--	2.3	V
FRD forward voltage		V_F	V_{IN}=0V, I_F=15A, T_J = 25°C	--	--	2.3	V
Switching times	High side	t_{ON}	V_{PN} = 300V, V_{CC} = V_{BS} = 15V, I_C = 15A, V_{IN} = 0V←→ 5V, Inductive load Refer to fig. 1	--	0.85	--	μs
		$t_{C(ON)}$		--	0.20	--	μs
		t_{OFF}		--	0.63	--	μs
		$t_{C(OFF)}$		--	0.15	--	μs
		t_{rr}		--	0.06	--	μs
	Low side	t_{ON}		--	0.50	--	μs
		$t_{C(ON)}$		--	0.20	--	μs
		t_{OFF}		--	0.25	--	μs
		$t_{C(OFF)}$		--	0.15	--	μs
		t_{rr}		--	0.06	--	μs
Leakage current between collector and emitter		I_{CES}	V_{CE}=V_{CES}	--	--	1	mA



(a)On period (b)Off period

Fig.1Switching definition

Control section

Characteristics	Symbol	Conditions		Min.	Typ.	Max.	Unit
V_{CC} Quiescent current	I_{QCCL}	V_{CC}=15V, V_{INL}=0V	Between V_{CCL} and COM	--	--	28	mA
	I_{QCCH}	V_{CC}=15V, V_{INH}=0V	Between V_{CCH} and COM	--	--	600	μA
V_{BS} Quiescent current	I_{QBS}	V_{BS}=15V, V_{INH}=0V	V_{BU}-V_{SU},V_{BV}-V_{SV}, V_{BW}- V_{SW}	--	--	500	μA
Fault output voltage	V_{FOH}	V_{SC}=0V,V_{FO} pull up 4.7KΩ resistor to 5V		4.5	--	--	V
	V_{FOL}	V_{SC}=1V,V_{FO} pull up 4.7KΩ resistor to 5V		--	--	0.8	V
Fault output pulse width	t_{FO}	C_{FO}=33nF	(note1)	1.0	1.8	--	ms

Characteristics	Symbol	Conditions		Min.	Typ.	Max.	Unit
Trip voltage of short circuit	$V_{SC(ref)}$	V_{CC}=15V (note2)		0.45	0.5	0.55	V
Over-temperature protection	TSD	LVIC temperature		--	160	--	°C
Over-temperature protection hysteresis	ΔTSD	LVIC temperature		--	10	--	°C
Low-side under voltage protection (fig.4)	UV_{CCD}	V_{CC} detect voltage		10.4	11.4	12.4	V
	UV_{CCR}	V_{CC} reset voltage		10.9	11.9	12.9	V
High-side under voltage protection (fig.5)	UV_{BSD}	V_{BS} detect voltage		10.0	11.0	12.0	V
	UV_{BSR}	V_{BS} reset voltage		10.5	11.5	12.5	V
On threshold voltage	V_{IH}	Logic High	Between input and COM	2.8	--	--	V
Off threshold voltage	V_{IL}	Logic Low		--	--	0.9	V

Note1: Fault output pulse width t_{FO} is decided by C_{FOD} and C_{FO}=18.3×10^{-6}×t_{FO}[F]

Note2: Short circuit protection is functioning only at the low-sides.

Bootstrap Diode Part(Each Bootstrap diode, Unless Otherwise Specified)

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

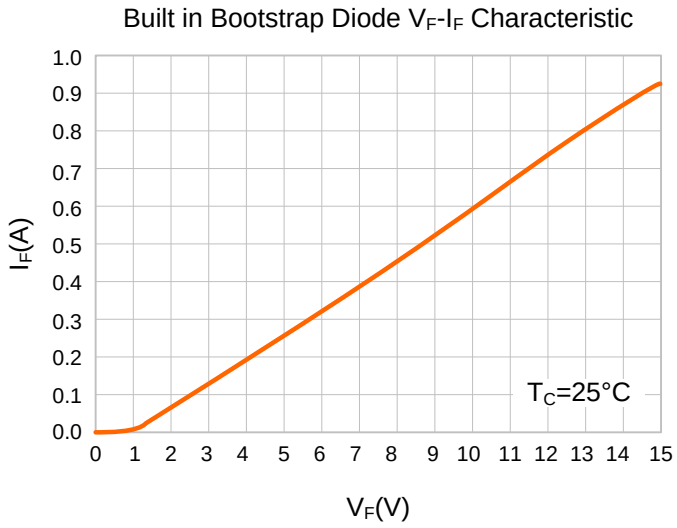
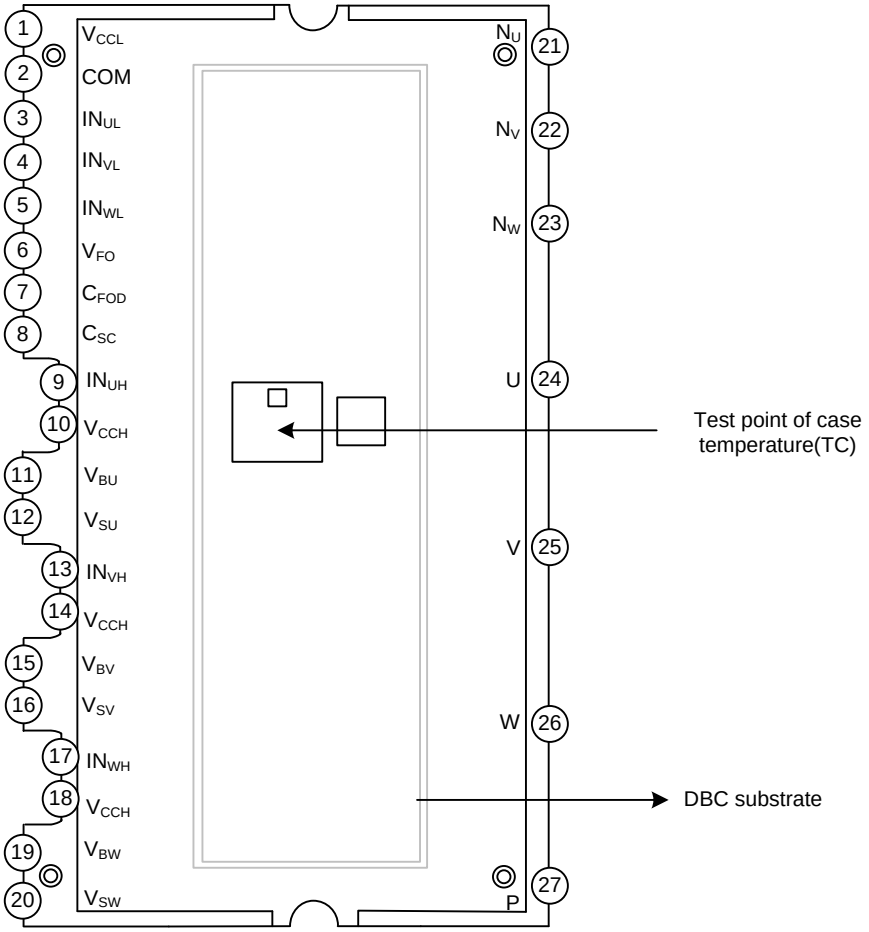


Fig.2 Built in Bootstrap Diode V_F-I_F Characteristic

Note: Resistive characteristic: equivalent resistor: ~ 15Ω.

PIN CONFIGURATION



PIN DESCRIPTION

Pin No.	Pin Name	Pin Descriptions
1	V_{CCL}	Supply voltage for low-side gate driver
2	COM	Common ground for the module
3	IN_{UL}	U-phase low-side signal input
4	IN_{VL}	V-phase low-side signal input
5	IN_{WL}	W-phase low-side signal input
6	V_{FO}	Fault output
7	C_{FOD}	Connect to the capacitor to adjust the duration time of fault output
8	C_{SC}	Connect to the capacitor for short circuit current detection input and low-pass filter
9	IN_{UH}	U-phase high-side signal input
10	V_{CCH}	Supply voltage for high-side gate driver
11	V_{BU}	Floating supply voltage for U-phase high-side IGBT driving
12	V_{SU}	Floating ground for U-phase high-side IGBT driving
13	IN_{VH}	V-phase high-side signal input
14	V_{CCH}	Supply voltage for high-side gate driver
15	V_{BV}	Floating supply voltage for V-phase high-side IGBT driving
16	V_{SV}	Floating ground for V-phase high-side IGBT driving
17	IN_{WH}	W-phase high-side signal input
18	V_{CCH}	Supply voltage for high-side gate driver
19	V_{BW}	Floating supply voltage for W-phase high-side IGBT driving
20	V_{SW}	Floating ground for W-phase high-side IGBT driving
21	N_U	U-phase DC negative terminal
22	N_V	V-phase DC negative terminal
23	N_W	W-phase DC negative terminal
24	U	U-phase output
25	V	V-phase output
26	W	W-phase output
27	P	DC positive terminal

CONTROL TIMING SEQUENCE DESCRIPTION

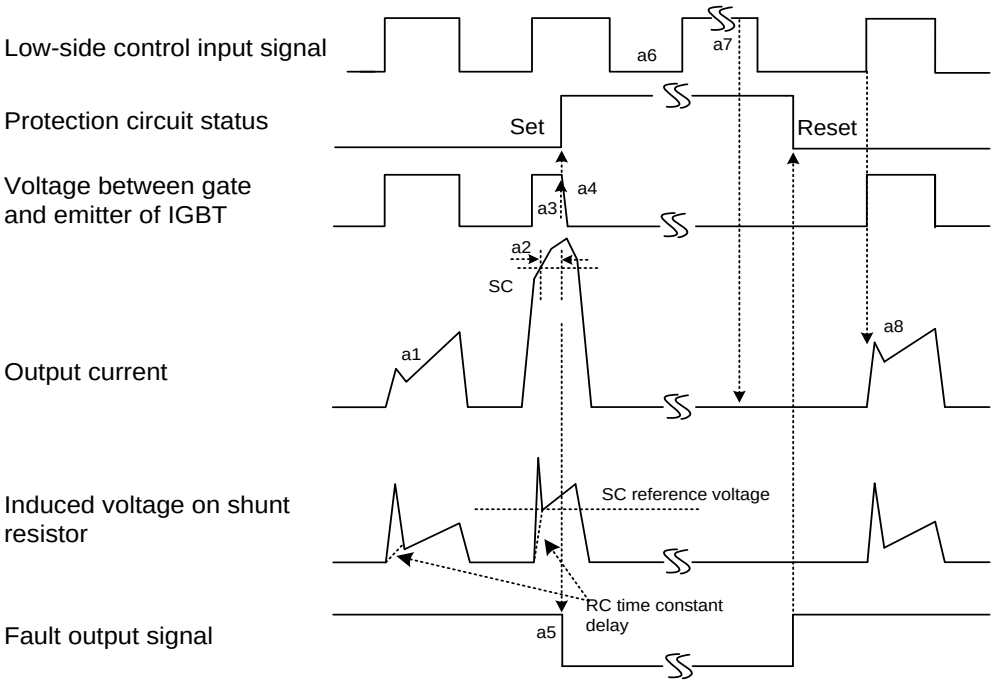


Fig.3 Timing sequence for short circuit current protection (only for low-side)

(Including the external shunt resistor and RC connection)

a1: Normal operation: IGBT turn on and carrying current.

a2: Short circuit current detect (SC trigger).

a3: IGBT gate hard interrupt.

a4: IGBT turns off.

a5: Fault output timer starts working: the pulse width of fault output signal is decided by external capacitor CFO.

a6: Input "L": IGBT off state.

a7: Input "H": IGBT on state, but during the active period of fault output, the IGBT doesn't turn ON.

a8: Normal operation: IGBT turn on and carrying current.

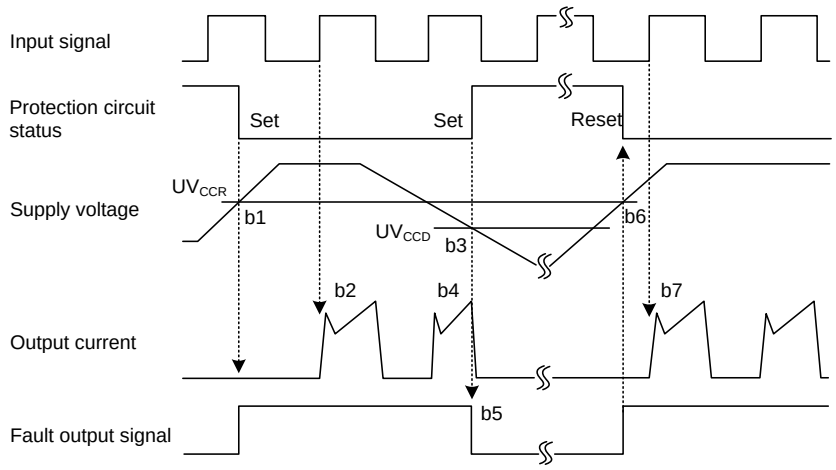


Fig.4 Timing sequence for under voltage protection(low-side)

b1: Supply voltage rises to UV_{CCR}, the circuit start to operate when next input waveform arrives.

b2: Normal operation: IGBT turn on and carrying current.

b3: Under voltage detect point (UV_{CCD}).

b4: IGBT is off no matter what signal is input.

b5: Fault output operation starts.

b6: Under voltage reset (UV_{CCR}).

b7: Normal operation: IGBT turn on and carrying current.

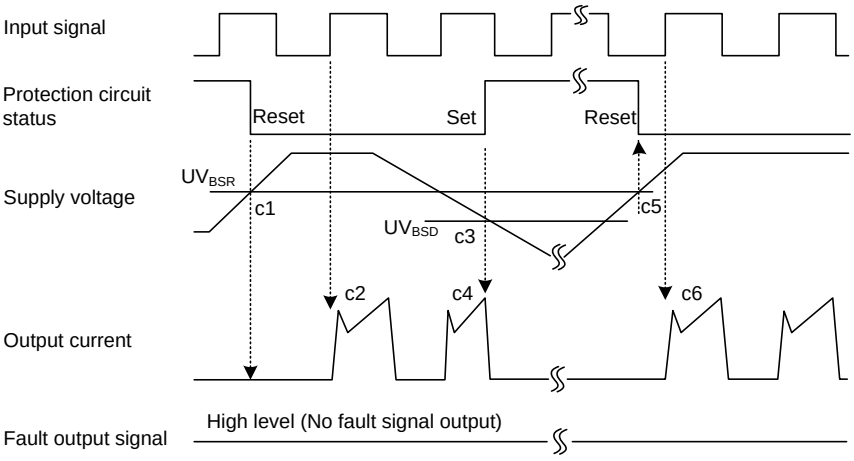


Fig.5 Timing sequence for under voltage protection (high-side)

c1: Supply voltage rises to UV_{BSR}, the circuit start to operate when next input signal arrives.

c2: Normal operation: IGBT turn on and carrying current.

c3: Under voltage detect (UV_{BSD}).

c4: IGBT turn off in spite of control input condition, but there is no fault signal output.

c5: Under voltage reset (UV_{BSR}).

c6: Normal operation: IGBT turn on and carrying current.

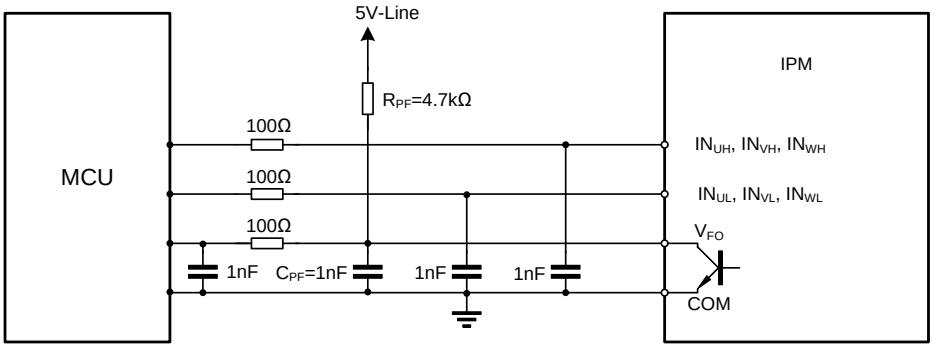


Fig.6 MCU input/output connection circuit recommended

Note:

The RC coupling of each input should change following the PWM control solution and the PCB connection impedance. There is a 5K pull-down resistor connected to IPM input, and attention should be paid to the voltage drop at the input when the external filter resistor is used.

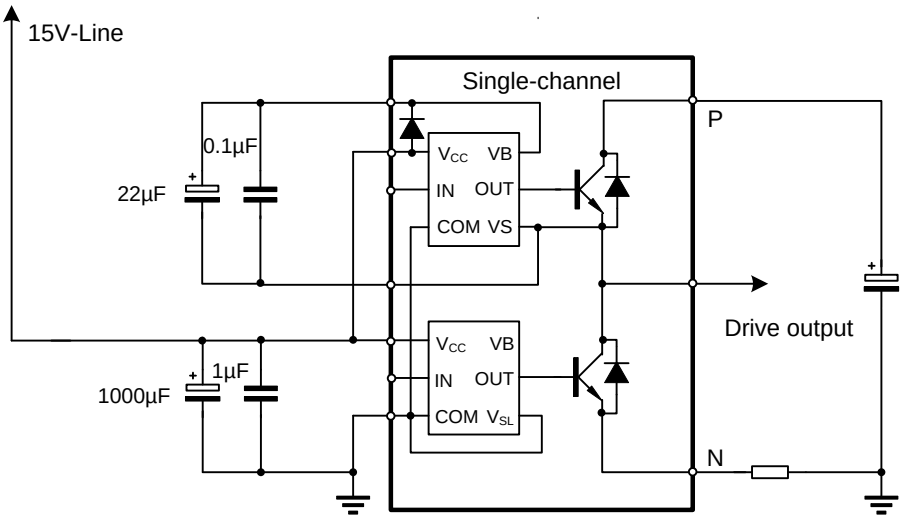
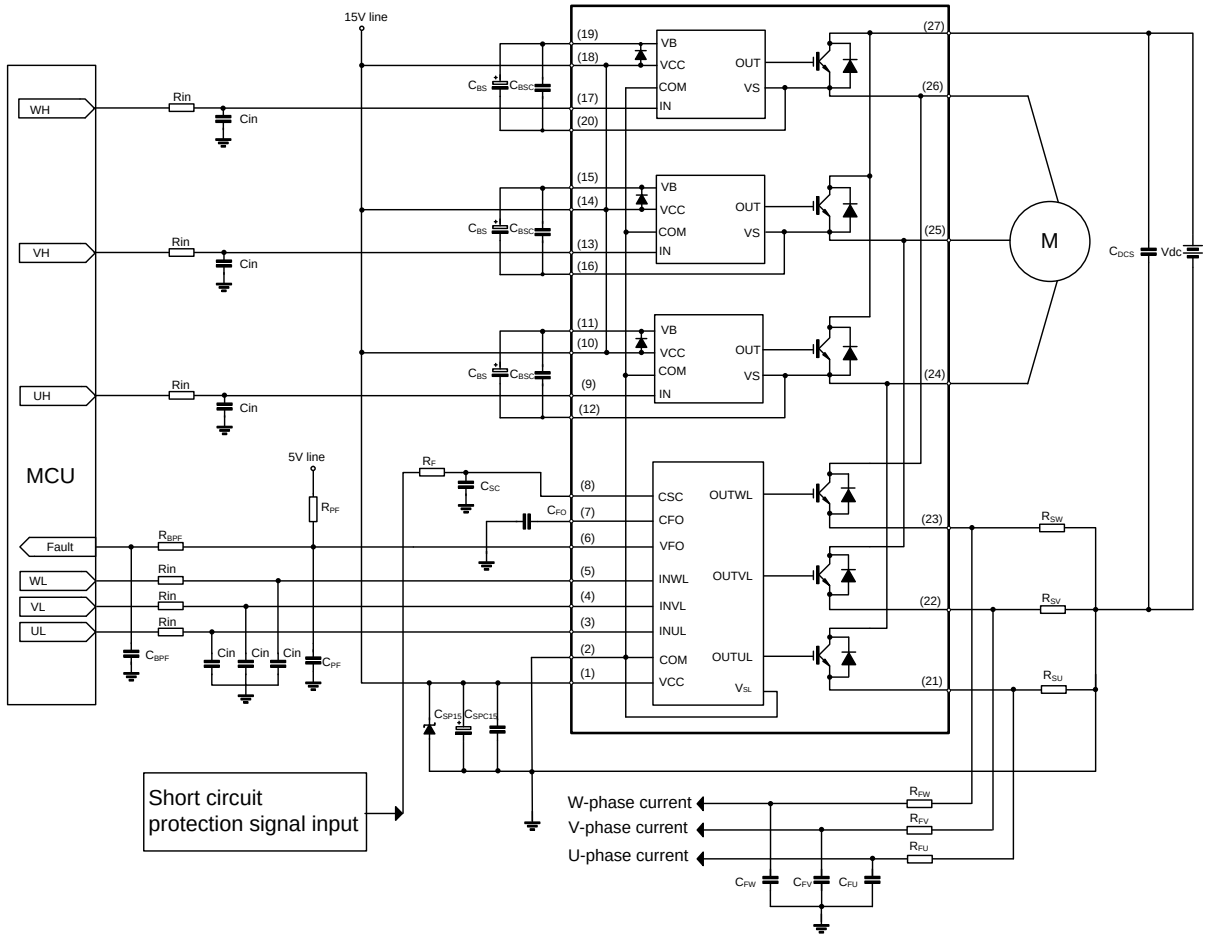


Fig.7 Bootstrap circuit and parameter setting recommended

Note:

1. The bootstrap capacitance should change following the PWM control solution;
2. Ceramic capacitor between V_{CC} and COM must be more than 1μF and should be close to the pin of the power module as near as possible.

TYPICAL APPLICATION CIRCUIT



Note:

(1) The routing of each input pin should be as short as possible to avoid the possible error action;

(2) Input signal is high active and there is a 5KΩ pull-down resistor connected to the ground at input of each channel in the HVIC; In addition, RC filter circuit can be added to the input, which will prevent the surge noise caused by the incorrect input. The time constant of Rin Cin is selected between 50 and 150nS with Cin not less than 1nF(R_{in}=100Ω , C_{in}=1nF are recommended) ;

(3) To avoid the surge damage, a flat high-frequency non-inductive capacitor between 0.1μF and 0.22μF should be connected between PN and the routing must be as short as possible;

(4) The routing between current detect resistor and IPM should be as short as possible to avoid the damage caused by the big surge voltage bringing from the connection inductance.

(5) A filter capacitor at least 7 times by bootstrap capacitor CBS is better to be added at the 15V power supply input;

(6) Each external capacitor must be connected to the pins of IPM as near as possible;

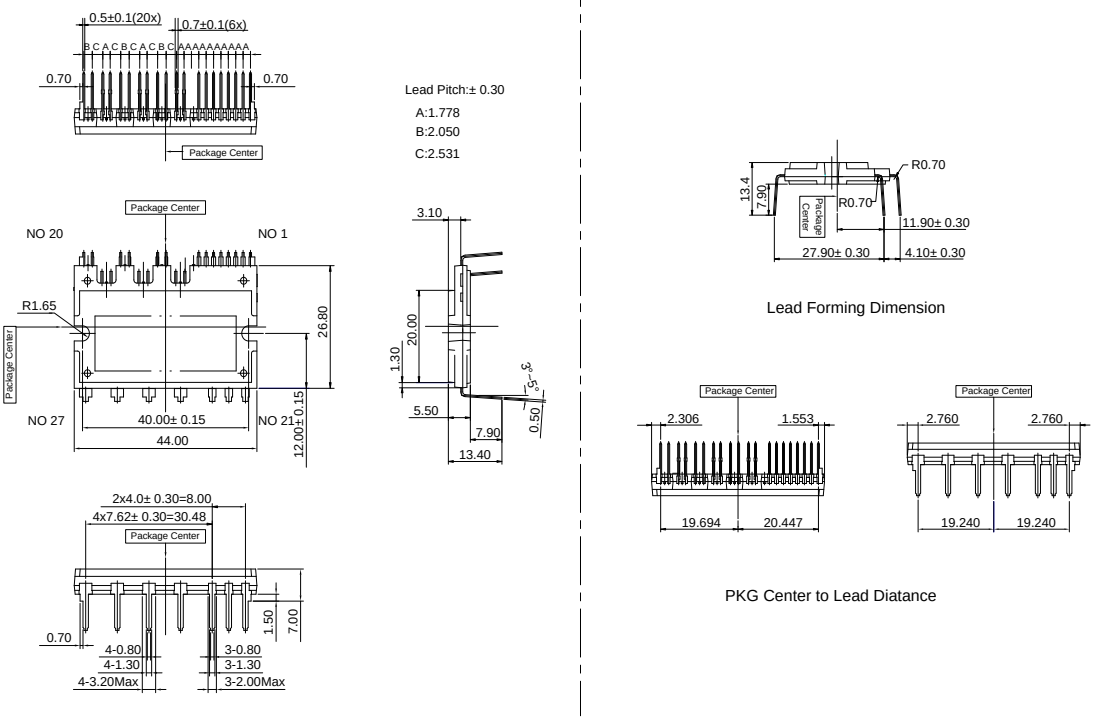
(7) V_{FO} output is open and an external 4.7kΩ resistor pulled up to 5V is needed;

(8) V_{FO} fault output pulse width t_{FO} is decided by C_{FO}, C_{FO}=18.3×10^{-6}×t_{FO}[F], if C_{FOD}=33nF, then t_{FO}=1.8ms (typ);

(9) In short circuit protection circuit, please select the time constant of RF and CSC between 1.5~2 μs, at the same time, the routing around the RF and CSC should be as short as possible.

PACKAGE OUTLINE

DIP-27H **UNIT: mm**



Important notice :

1. **The instructions are subject to change without notice!**
2. **Customers should obtain the latest relevant information before placing orders and should verify that such information is complete and current. Please read the instructions carefully before using our products, including the circuit operation precautions.**
3. **Our products are consumer electronic products or the other civil electronic products.**
4. **When using our products, please do not exceed the maximum rating of the products, otherwise the reliability of the whole machine will be affected. There is a certain possibility of failure or malfunction of any semiconductor product under specific conditions. The buyer is responsible for complying with safety standards and taking safety measures when using our products for system design, sample and whole machine manufacturing, so as to avoid potential failure risk that may cause personal injury or property loss.**
5. **It is strongly recommended to identify the trademark when buying our products. Please contact us if there is any question.**
6. **Product promotion is endless, our company will wholeheartedly provide customers with better products!**
7. **Website: http: //www.silan.com.cn**

Part No.:	SD15M60AC	Document Type:	Datasheet
Copyright:	HANGZHOU SILAN MICROELECTRONICS CO.,LTD	Website:	http: //www.silan.com.cn

Rev.: 1.2

Revision History:

1. Update package outline diagram and important notice

Rev.: 1.1

Revision History:

1. Modify Characteristic

Rev.: 1.0

Revision History:

1. First release

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Silan ***manufacturer:***

Other Similar products are found below :

SVF7N60F SDH8323 SGT15T60QD1F SVD540T SVF4N65M SVS11N65FJD2 SVF14N65CFJ SVF5N65F SGM40HF12A1TFD SGT40N60FD2P7 SGM50PA12A6BTFD SGM50HF12A1TFD SGM100HF12A3TFD SBD30C45T SD6602D SVD3205T SVS7N65FJD2 SGM75HF12A1TLD SDH8302 SBD20C200F SDH7712SFTR SVF1N60BTR SVF12N65F SGM150HF12A3TFD SGM75HF12A1TFDT4 SVF4N65F SBD20C100D SGM35PA12A6BTFD SFR4204PN SBD20C100T SD7602D SDM30G60FC SD6904STR SD30M60AC SGM100HF12A1TFD SVF3878PN SD6804ASTR SD02M50DBS SDH7611STR SBD20C100F SD6604D SVF10N60F SD6603D SVF7N65CF SD6703D SDM20G60FC8 SDH6971S SD6827D SDH8312TR SDH8323B