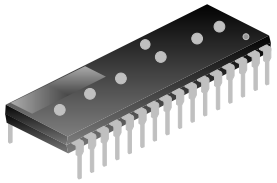
INTELLIGENT POWER MODULE(IPM), 3 PHASE FULL-BRIDGE 500V/2A

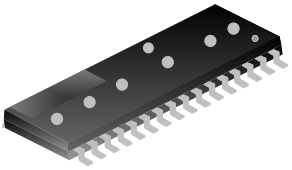
DESCRIPTION

SDM02M50DBE/DBS is a 3-phase brushless DC motor driver IC with highly-integrated and high reliability, using for small power motor drive applications such as fan motor, consisting of built-in 6 fast recovery MOSFET and 3 half-bridge HVIC for gate driving.

SDM02M50DBE/DBS integrates under-voltage protection circuit, providing perfect protection and fail-safe operation. Each phase current of inverter can be monitored separately due to divided negative dc terminals. SDM02M50DBE/DBS is designed with good insulation, perfect thermal properties and low EMI. It is compact and suitable for built-in motors or any other applications requiring the compact installation.



DIP-23E



SOP-23H

FEATURES

- Built-in 500V/2A fast recovery MOSFET
- Built-in high-voltage Gate driver circuit（HVIC）
- Built-in under-voltage protection
- Built-in bootstrap diode
- Compliant with 3.3V and 5V MCU interface, active high
- 3 independent negative DC-link terminals for inverter current sensing
- Optimal adapted for low EMI
- Insulation class: 1500V_{rms}/min

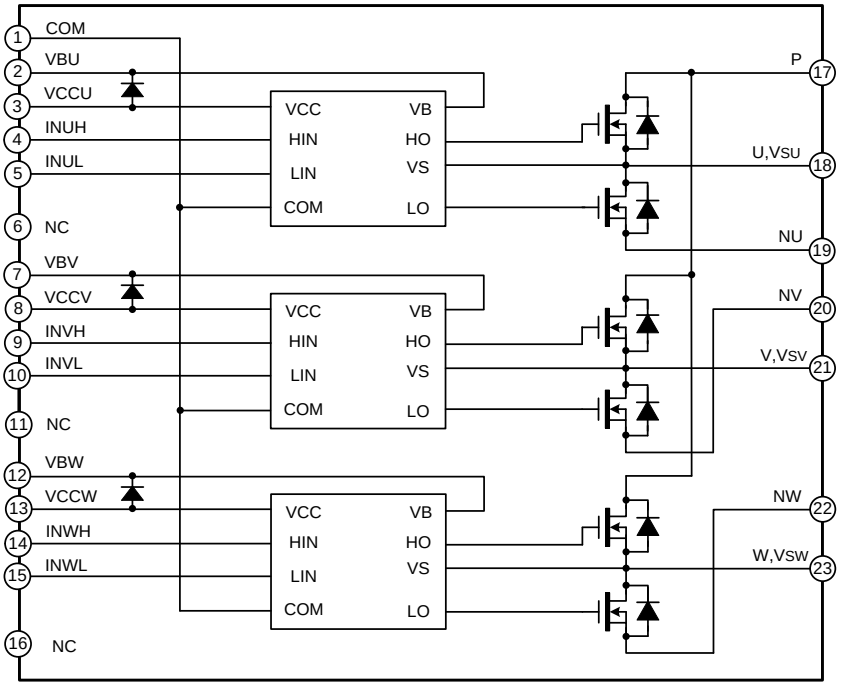
APPLICATIONS

- Indoor/outdoor air conditioner
- Refrigerator compressor
- Smoke exhauster
- Fan
- Air purifiers
- Dishwasher pump

ORDERING INFORMATION

Part No	Package	Marking	Hazardous Substance Control	Packing Type
SDM02M50DBE	DIP-23E	SDM02M50DBE	Pb free	Tube
SDM02M50DBS	SOP-23H	SDM02M50DBS	Pb free	Tube
SDM02M50DBSTR	SOP-23H	SDM02M50DBS	Pb free	Tape&Reel

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Ratings	Unit
P-N Input voltage	V_{PN}	500	V
Each MOSFET Continuous Drain Current T_C=25°C	I_{D25}	2.0	A
Each MOSFET Continuous Drain Current T_C=80°C	I_{D80}	1.5	A
Each MOSFET Peak Drain Current (Peak value) T_C=25°C, pulse width<100μs	I_{DP}	3.0	A
Maximum Power Dissipation, T_C=25°C	P_D	13.4	W
Control Supply Voltage	V_{CC}	20	V
High-side Bias Voltage	V_{BS}	20	V
Input Signal Voltage	V_{IN}	-0.3~V_{CC}+0.3	V
Operating Junction Temperature Range	T_J	-40~150	°C
Operating Case Temperature Range, T_J≤150°C (Note 1)	T_C	-40~125	°C
Storage Temperature Range	T_{STG}	-40~125	°C
Junction to Case Thermal Resistance	$R_{\theta JC}$	9.3	°C/W
Insulation Voltage 60Hz, Sinusoidal, AC 1 minute, Connection Pins to Heatsink	V_{ISO}	1500	V_{rms}
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}	1.5	A

Note 1: Test point for Case Temperature, please see figure 3.

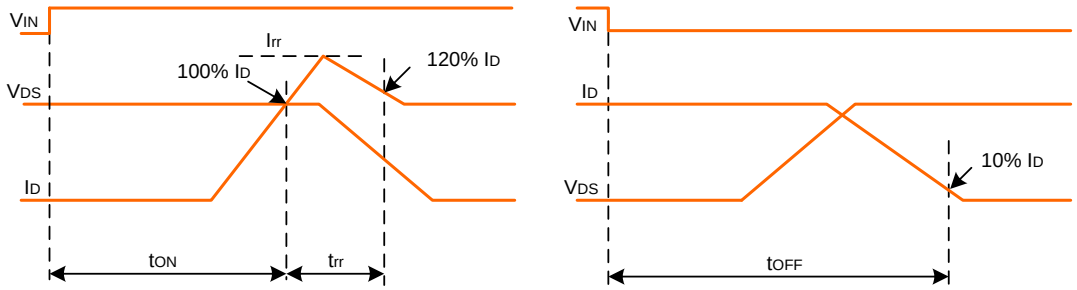
RECOMMENDED OPRATING CONDITIONS

Characteristics	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{PN}	--	300	400	V
Control Supply Voltage	V_{CC}	13.5	15	16.5	V
High-side Bias Voltage	V_{BS}	13.5	15	16.5	V
Input ON Threshold Voltage	$V_{IN(ON)}$	3.0	--	VCC	V
Input OFF Threshold Voltage	$V_{IN(OFF)}$	0	--	0.8	V
Dead Time for Preventing Arm-short V_{CC}=V_{BS}=13.5~16.5V, T_J≤150°C	T_{dead}	1.0	--	--	μs
PWM Switching Frequency, T_J≤150°C	f_{PWM}	--	15	--	kHz

ELECTRICAL CHARACTERISTICS (Unless specified particularly T_{amb}=25°C, V_{CC}=V_{BS}=15V)

Inverter Part (Each fast recovery MOSFET Unless Otherwise Specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	V_{IN}=0V,I_D=250μA (Note 2)	500	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{IN}=0V,V_{DS}=500V	--	--	250	μA
Static Drain-Source On-Resistance	$R_{DS(on)}$	V_{CC}=V_{BS}=15V,V_{IN}=5V,I_D=1.0A	--	3.0	4.0	Ω
Drain-Source Diode Forward Voltage	V_{SD}	V_{CC}=V_{BS}=15V,V_{IN}=0V,I_D=-1.0A	--	--	1.2	V
Switching Time	t_{ON}	V_{PN} = 300V, V_{CC} = V_{BS} = 15V, I_D = 0.5A, V_{IN} = 0V ~ 5V, Inductive load (Note 3)	--	700	--	ns
	t_{OFF}		--	500	--	ns
	t_{rr}		--	80	--	ns
	E_{ON}		--	70	--	uJ
	E_{OFF}		--	10	--	uJ



(a)Turn ON (b) Turn OFF

Figure 1. Switching Time Definition

Control Part (Each HVIC Unless Otherwise Specified)

Characteristics	Symbol	Test Conditions		Min	Typ	Max	Unit
Quiescent VCC Current	I_{QCC}	V_{CC}=15V, V_{IN}=0V	Between V_{CC} and COM	--	--	160	μA
Quiescent VBS Current	I_{QBS}	V_{BS}=15V, V_{IN}=0V	Between $V_{B(U)}$-U, $V_{B(V)}$-V,$V_{B(W)}$-W	--	--	100	μA
Low-side Undervoltage Protection (Figure 5)	UV_{CCD}	Detection Level		7.6	8.6	9.6	V
	UV_{CCR}	Reset Level		8.3	9.3	10.3	V
High-side Undervoltage Protection (Figure 6)	UV_{BSD}	Detection Level		7.6	8.6	9.6	V
	UV_{BSR}	Reset Level		8.3	9.3	10.3	V
ON Threshold Voltage	V_{IH}	Logic High Level	Applied between IN and COM	3.0	--	--	V
OFF Threshold Voltage	V_{IL}	Logic Low Level		--	--	0.8	V
Input Bias Current	I_{IH}	V_{IN}=5V	Applied between IN and COM	--	10	20	μA
	I_{IL}	V_{IN}=0V		--	--	2	μA

Note 2: BV_{DSS} is the maximum voltage applied to source-drain of each MOSFET. V_{PN} should be less than this value considering the effect of the stray inductance so that VDS should not exceed BV_{DSS} in any case.

Note 3: t_{ON} and t_{OFF} consist of IC driving transmission delay. The value listed is tested under laboratory condition, and this value will change due to different PCB and wire. Please refer to switching time definition in figure 1 and switch test circuit in figure 4.

Note 4: Spike current and voltage of each MOSFET should be contained in SOA during switch operation, RBSOA test current is shown in figure 4.

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

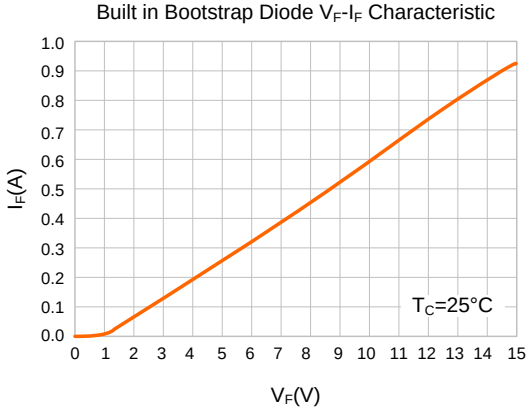
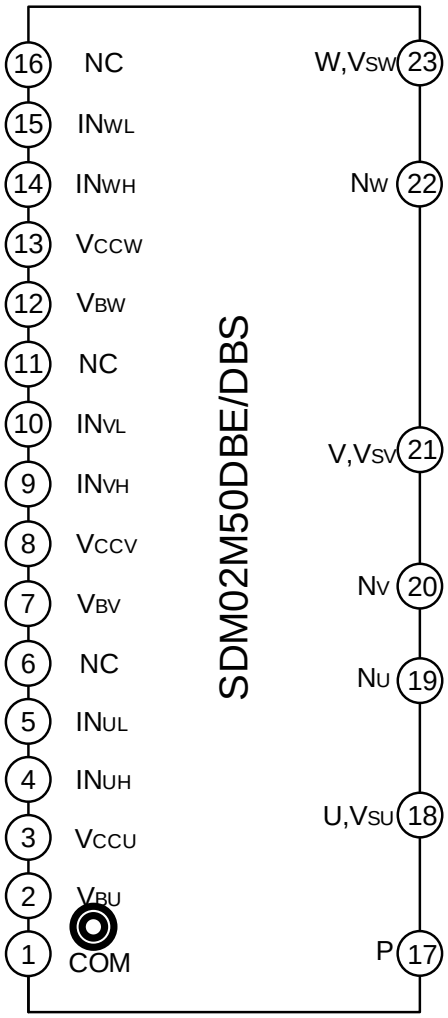


Figure 2. Bootstrap Diode resistor characteristic

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

PIN CONFIGURATIONS



PIN DESCRIPTIONS

Pin No	Pin Name	Description
1	COM	Common Supply Ground
2	V_{BU}	Bias Voltage for U Phase High Side Driving
3	V_{CCU}	Bias Voltage for U Phase Low Side Driving
4	IN_{UH}	Signal Input for U Phase High-side
5	IN_{UL}	Signal Input for U Phase Low-side
6	NC	No connection
7	V_{BV}	Bias Voltage for V Phase High Side Driving
8	V_{CCV}	Bias Voltage for V Phase Low Side Driving
9	IN_{VH}	Signal Input for V Phase High-side
10	IN_{VL}	Signal Input for V Phase Low-side
11	NC	No connection
12	V_{BW}	Bias Voltage for W Phase High Side Driving

Pin No	Pin Name	Description
13	V_{CCW}	Bias Voltage for W Phase Low Side Driving
14	IN_{WH}	Signal Input for W Phase High-side
15	IN_{WL}	Signal Input for W Phase Low-side
16	NC	No connection
17	P	Positive DC–Link Input
18	U,V_{SU}	Output for U Phase and Bias Voltage Ground for U Phase High Side Driving
19	NU	Negative DC–Link Input for U Phase
20	NV	Negative DC–Link Input for V Phase
21	V,V_{SV}	Output for V Phase and Bias Voltage Ground for V Phase High Side Driving
22	NW	Negative DC–Link Input for W Phase
23	W,V_{SW}	Output for W Phase and Bias Voltage Ground for W Phase High Side Driving

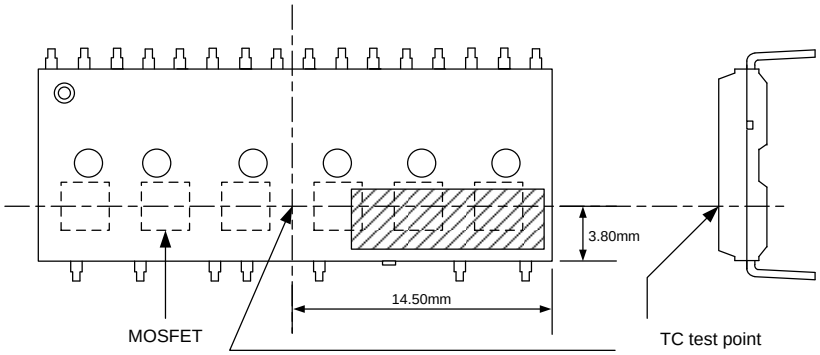


Figure 3. Case temperature TC test point

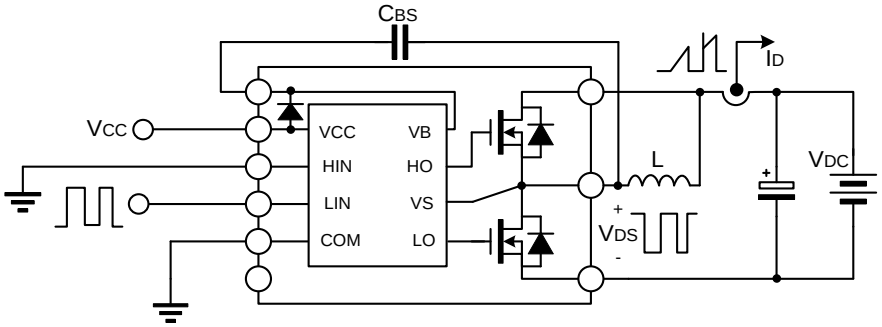


Figure 4. Switching and RBSOA Test Circuit(Low-side)

CONTROL TIME SEQUENCE

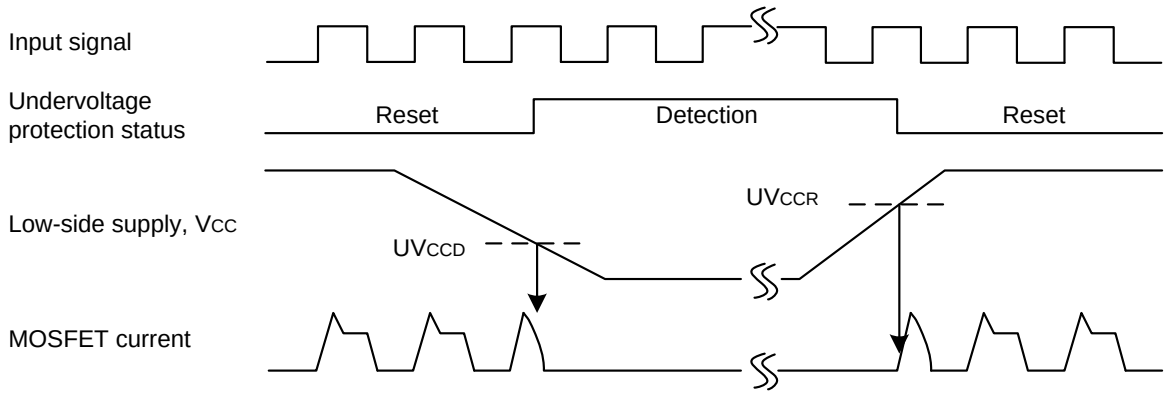


Figure 5. Under-Voltage Protection(Low side)

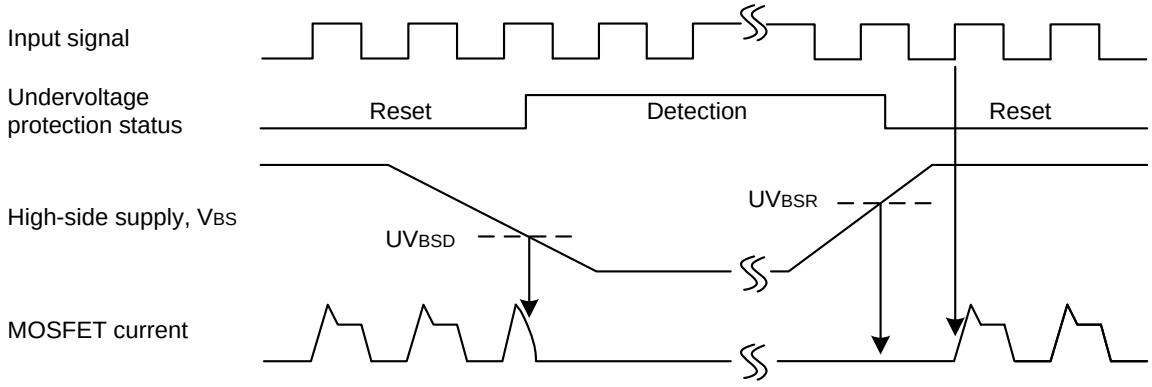
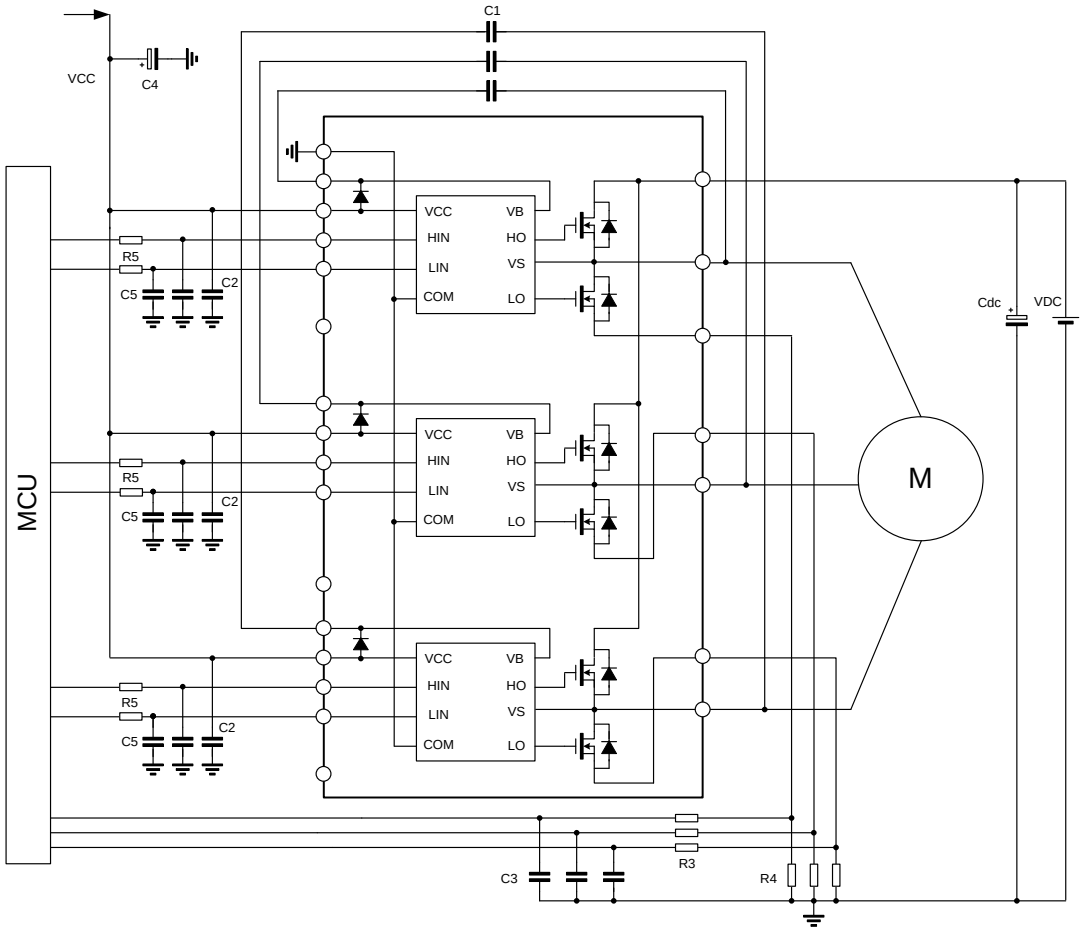


Figure 6. Under-Voltage Protection(High side)

TYPICAL APPLICATION CIRCUIT



Note:

(1) The wire of each pins should be as short as possible to avoid malfunction; RC filtering capacitor maybe connected to inputs to prevent surge noise caused by wrong input signal.

(2) Each external capacitor should be placed as close as to IPM pin.

(3) It is recommended to connect high frequency non-inductive capacitor besides filtering capacitor between PN with short wire to avoid surge destruction.

(4) Better to connect a filtering capacitor which is 7 times larger than bootstrap capacitor C1 to VCC input.

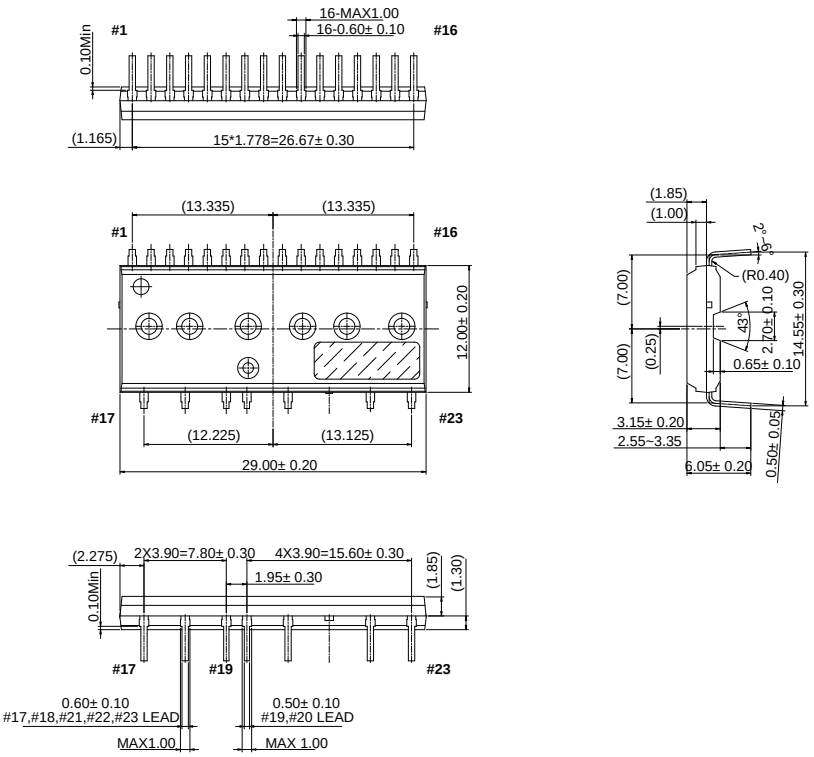
(5) It is recommended to adopt high frequency capacitor C1, whose value is larger than 2.2uF, as bootstrap capacitor to adsorb high frequency ripple.

(6) The wire between current limit resistor R4 and IPM should be as short as possible to avoid IPM damage caused by surge voltage due to wire inductance.

PACKAGE OUTLINE

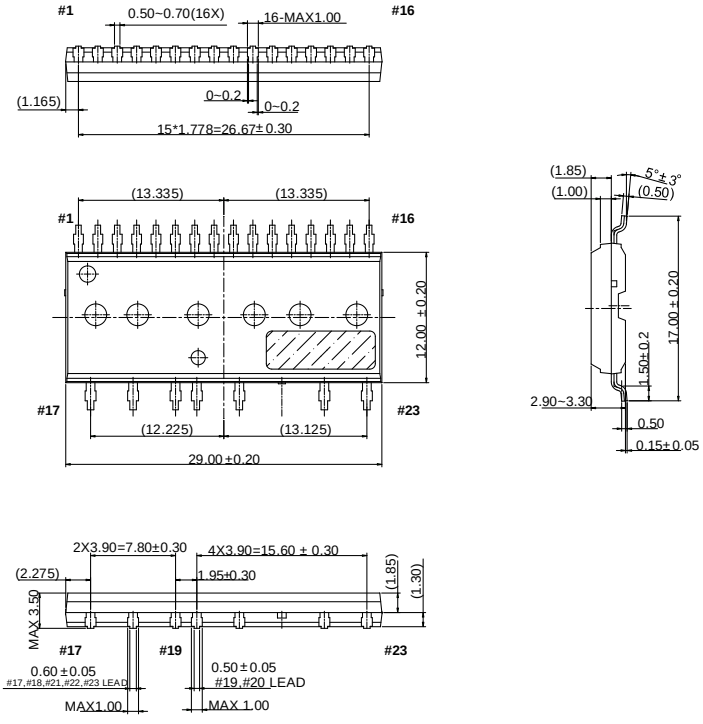
DIP-23E

UNIT: mm



SOP-23H

UNIT: mm



MOS DEVICES OPERATE NOTES:

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

Important notice :

1. Silan reserves the right to make changes of this instruction without notice.
2. Customers should obtain the latest relevant information when purchasing and should verify whether such information is latest and complete. Please read this instruction and application manual and related materials carefully before using products, including the circuit operation precautions, etc.
3. It is neither tested nor verified in accordance with AEC-Q series standards testing or application requirements. Silan does not give any warranties as to the suitability of the Silan's product for any specific use. The design intent, design definition and design of the product are not intended for application (the application stated in this instruction includes use, etc.) in transportation equipment, medical equipment, life-saving equipment, aerospace equipment, non-civil equipment or non-civil use, etc. (the equipment stated in this instruction includes systems, devices, etc., all referred to as equipment).The product should not be used in any equipment or system whose manufacture, use or sale is prohibited under any applicable laws or regulations("unintended use"). If the product is used for unintended use, therefore the full risks of such products application are borne by the customer and Silan assumes no liability for the product used for the unintended use. If the customer intends to use the Silan's product in a application where malfunction or failure can be reasonably be expected to result in personal injury, or serious property, or environment damage, the customer shall make adequate assessment, testing and verification, and Silan shall not be liable for such applications.
4. The application of the product described in this instruction, the application manual of the product and related materials is for illustrative purposes only, and Silan makes no warranty that such application can be used directly without further testing, verification or modification. Silan is not responsible for any assistance in product application or customers' product design. Customer shall be responsible for the application of Silan's products and the design, manufacture and use of customers' products using Silan's products (in this document, "use products", "apply Silan's products", "product application" and "customers' products using Silan's products" are synonymous). It is the sole responsibility of the customer to take the following actions: 1) Verify and determine whether Silan's products are suitable for the customers' applications and customers' products; 2) All applicable standards of the customers' industry shall be complied with and fully tested and verified when applying Silan's product or using Silan's product to develop and design customers' products; 3) Although Silan is constantly committed to improve product's quality and reliability, semiconductor products have possibility to malfunction or fail in various application environments. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for customers' products using Silan's product to minimize risks and avoid situations in which a malfunction or failure could cause bodily injury or damage to property; 4) When using the products, please do not exceed the maximum rating of the products, Stress above one or more limiting values will cause damage to the product and the equipment or affect the reliability to the equipment (customers' product); 5) Ensure customers' product using Silan's product are designed, manufactured and used in full compliance with all applicable standards, safety standards and other requirements of the customers' industry. The parameters stated in this instruction may and do vary in different applications, actual performance may vary over time, and customers must use the products within their effective static storage period (within one year from the delivery date of Silan). Customer should confirm the effective static storage period of the product if purchasing from a third party. Silan does not assume any responsibility if the product has exceeded the static storage period when it is used.
5. Do not disassemble, reverse-engineer, alter, modify, decompile or copy product, without Silan's prior written consent.
6. Please identify Silan's trademark when purchasing our product. Please contact us if there is any question. Our products are not sold through TAOBAO or any other third-party e-commerce platforms. If customers purchase from such platforms, please contact us in writing before purchasing to confirm whether the product is authentic and original from Silan.
7. Please use and apply product in compliance with all applicable laws and regulations, including but not limited to trade control regulations etc. The product is civil electronic product, please do not use it in non-civil fields.
8. Product promotion is endless, our company will wholeheartedly provide customers with better products!
9. Website: http: //www.silan.com.cn

Part No.:	SDM02M50DBE/DBS	Document Type:	Datasheet
Copyright:	HANGZHOU SILAN MICROELECTRONICS CO.,LTD	Website:	http: //www.silan.com.cn

Rev.: 1.1

Revision History:

1. Modify pin configurations name annotation direction
2. Update important notice

Rev.: 1.0

Revision History:

1. First release