智能功率模块：500V /5A 三相全桥驱动 NSMB05S50M1

1 特点

- 内置 6 个 500V/5A 的快恢复功率 MOS（Typ. Rds,on= 1.8Ω @25°C）
- 内置高压栅极驱动电路（HVIC）
- 内置欠压保护
- 内置自举二极管
- 内置温度检测功能
- 内置栅驱动电路的电压范围从 10V 到 20V
- 3 个独立的负电流端用于需要电流检测的应用
- 兼容 3.3V 和 5V 的 MCU 接口，高电平有效
- 优化并采用了低电磁干扰设计
- 绝缘等级 1500Vrms/min

2 典型应用

- 室内/户外空调
- 冰箱压缩机
- 排风扇
- 风扇
- 空气净化器
- 洗碗机水泵

3 芯片概述

3.1 特点

NSMB05S50M1 是高度集成、高可靠性的三相无刷直流电机驱动电路，主要应用于风扇类的小功率电机驱动。该模块内置了 6 个快恢复功率 MOS 管和 3 个半桥高压栅极驱动电路。

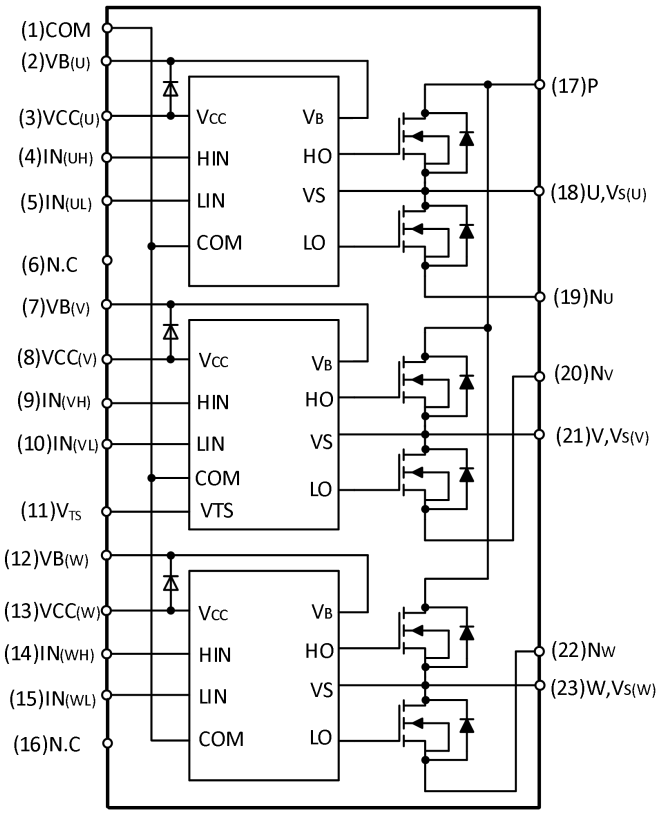
NSMB05S50M1 内部集成了欠压保护功能，提供了优异的保护和失效保护操作。由于每一相都有一个独立的负直流端，其电流可以分别单独检测。

NSMB05S50M1 采用了高绝缘、易导热和低电磁干扰的设计，提供了非常紧凑的封装体，使用非常方便，尤其适合内置于电机的应用和要求紧凑安装的场合。

3.2 芯片信息

Part Number	Package	Body size
NSMB05S50M1	SOP23	29mm x 12mm

Functional Block Diagram



4 Ordering Guide

Part Number	LOGO	Package	Package	SPQ
NSMB05S50M1	NSMB05S50M1 XXXXX	SOP23	Tape & Reel	500

5 Revision history

Version	Content	Time
V1.0	Create	2022.10.10

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6 Function Pin Description

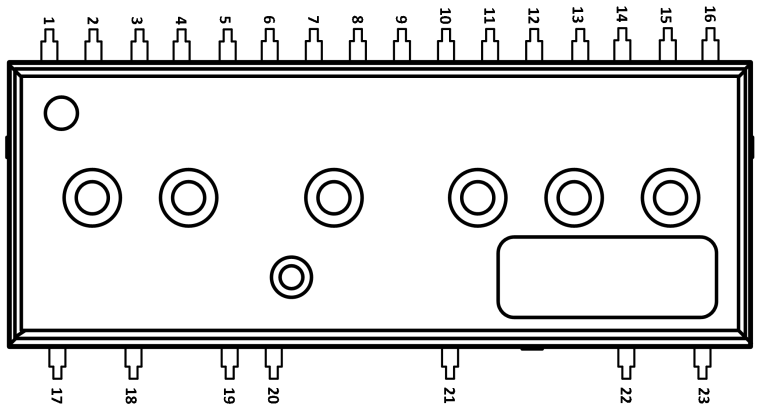


Figure6-1 23-Pin Top view

Table6-1 Lead Definitions

Number	Symbol	Description
1	COM	IC Common Supply Ground
2	$V_{B(U)}$	Bias Voltage for U-Phase High-Side MOSFET Driving
3	$V_{CC(U)}$	Bias Voltage for U-Phase IC and Low-Side MOSFET Driving
4	$IN_{(UH)}$	Signal Input for U-Phase High-Side
5	$IN_{(UL)}$	Signal Input for U-Phase Low-Side
6	N.C	No Connection
7	$V_{B(V)}$	Bias Voltage for V-Phase High Side MOSFET Driving
8	$V_{CC(V)}$	Bias Voltage for V-Phase IC and Low Side MOSFET Driving
9	$IN_{(VH)}$	Signal Input for V-Phase High-Side
10	$IN_{(VL)}$	Signal Input for V-Phase Low-Side
11	V_{TS}	Output for HVIC Temperature Sensing
12	$V_{B(W)}$	Bias Voltage for W-Phase High-Side MOSFET Driving
13	$V_{CC(W)}$	Bias Voltage for W-Phase IC and Low-Side MOSFET Driving
14	$IN_{(WH)}$	Signal Input for W-Phase High-Side
15	$IN_{(WL)}$	Signal Input for W-Phase Low-Side
16	N.C	No Connection
17	P	Positive DC-Link Input
18	$U,V_{S(U)}$	Output for U-Phase & Bias Voltage Ground for High-Side MOSFET Driving
19	N_U	Negative DC-Link Input for U-Phase
20	N_V	Negative DC-Link Input for V-Phase
21	$V,V_{S(V)}$	Output for V-Phase & Bias Voltage Ground for High-Side MOSFET Driving
22	N_W	Negative DC-Link Input for W-Phase
23	$W,V_{S(W)}$	Output for W Phase & Bias Voltage Ground for High-Side MOSFET Driving

7 Product specifications

7.1 Absolute Maximum Ratings

Exceeding the limit maximum rating may cause permanent damage to the device. All voltage parameters are rated with reference to COM and an ambient temperature of 25°C.

Inverter Part (each MOSFET unless otherwise specified)

Symbol	Definition	Conditions	Rating	Units
V_{DSS}	Drain-Source Voltage of Each MOSFET		500	V
I_D	Each MOSFET Drain Current, Continuous	T_C = 25°C	5.0	A
I_{DP}	Each MOSFET Pulse Current, Peak	T_C = 25°C, Less than 100us	10.0	A
I_{DRMS}	Each MOSFET Current, Rms	T_C = 80°C, F_{PWM} <20KHz	2.5	A_{rms}
P_D	Maximum Power Dissipation	T_C = 25°C For each MOSFET	14	W

Control Part (each HVIC unless otherwise specified)

Symbol	Definition	Conditions	Rating	Units
V_{CC}	Control Supply Voltage	Applied between V_{CC} and COM	20	V
V_{BS}	High-side Bias Voltage	Applied between V_B and V_S	20	V
V_{IN}	Input Signal Voltage	Applied between V_{IN} and COM	-0.3~V_{CC}+0.3	V

Bootstrap Diode Part (each bootstrap diode unless otherwise specified)

Symbol	Definition	Conditions	Rating	Units
V_{RRMB}	Maximum Repetitive Reverse Voltage		500	V
I_{FB}	Forward Current	T_C = 25°C	0.25	A
I_{FPB}	Forward Peak Current, Peak	T_C = 25°C,Under 1ms Pulse Width	0.5	A

Total System

Symbol	Definition	Conditions	Rating	Units
T_J	Operating Junction Temperature		-40~150	°C
T_{STG}	Storage Temperature		-40~150	°C
V_{ISO}	Isolation Voltage	60Hz, Sinusoidal, 1 minute, Connect Pins to Heat-Sink Plate	1500	Vrms

Thermal Resistance

Symbol	Definition	Conditions	Rating	Units
$R_{\theta JC}$	Junction to Case Thermal resistance	Each MOSFET under Inverter Operating Condition	7.1	°C/W

Note1:To insure safe operation of the IPM, the average junction temperature should be limited to TJ ≤ 150°C (@Tc ≤ 100°C).

7.2 Recommended Operating Conditions

Symbol	Parameter	Condition	MIN.	TYP.	MAX.	Units
V_{PN}	Supply Voltage	Applied between P and N	-	300	400	V
V_{CC}	Control Supply Voltage	Applied between V_{CC} and COM	10		18.5	V
V_{BS}	High-Side Bias Voltage	Applied between V_B and V_S	10		18.5	V
$V_{IN(ON)}$	Input ON Threshold Voltage	Applied between V_{IN} and COM	3.0	-	VCC	V
$V_{IN(OFF)}$	Input OFF Threshold Voltage		0	-	0.6	V
t_{dead}	Blanking Time for Preventing Arm-Short	V_{CC} = V_{BS} = 13.5 ~ 16.5 V, T_J <150°C	-	1.0	-	us
f_{PWM}	PWM Switching Frequency	T_J <150°C	-	15	-	KHz

7.3 Electrical Characteristics

Valid for temperature range at T_A= 25°C, unless otherwise specified

Inverter Part(each MOSFET unless otherwise specified)

Symbol	Parameter	Condition	MIN.	TYP.	MAX.	Units
BV_{DSS}	Drain - Source Breakdown Voltage	V_{GS}= 0 V, I_D = 250 uA	500	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{GS} = 0 V, V_{DS} = 500 V	-	-	1	uA
$R_{DS(on)}$	Static Drain-Source Turn-On Resistance	V_{CC} = V_{BS} = 15V, V_{IN} = 5V, I_D =2.5A	-	1.8	2.4	Ω
V_{SD}	Drain - Source Diode Forward Voltage	V_{CC} = V_{BS} = 15V,I_D = - 5.0A	-	0.9	1.4	V
t_{ON}	Switching Times	V_{PN} = 300 V, V_{CC} = V_{BS} = 15 V, I_D = 0.5A IN = 0V↔5V, Inductive Load L = 3 mH High- and Low-Side MOSFET Switching	-	960	-	ns
t_{OFF}			-	560	-	ns
t_{rr}			-	230	-	ns
E_{ON}			-	46	-	uJ
E_{OFF}			-	16	-	uJ
RBSOA	Reverse Bias Safe Operating Area	V_{PN} = 400 V, V_{CC} = V_{BS} = 15 V, I_D = I_{DP}, V_{DS} = B_{VDSS},T_J = 150°C High- and Low-Side MOSFET Switching	Full Square			

Control Part(each HVIC unless otherwise specified)

Symbol	Parameter	Condition		MIN.	TYP.	MAX.	Units
I_{QCC}	Quiescent VCC Supply Current	V_{CC} = 15V V_{IN}= 0V	Applied between VCC and COM	-	100	220	uA
I_{QBS}	Quiescent VB Supply Current	V_{BS} = 15V V_{IN} = 0V	Applied between $V_{B(U)}$ - U, $V_{B(V)}$ - V, $V_{B(W)}$ - W	-	50	100	uA
V_{CCD}	Low-side UVLO threshold	VCC Under-Voltage Protection Detection Level		-	7.7	-	V
V_{CCR}		VCC Under-Voltage Protection Reset Level		-	8.7	-	V
V_{BSD}	High-side UVLO threshold	VBS Under-Voltage Protection Detection Level		-	7.7	-	V
V_{BSR}		VBS Under-Voltage Protection Reset Level		-	8.7	-	V
V_{TS}	HVIC Temperature Sensing Voltage Output	V_{CC} = 15V, T_{HVIC}=25°C		320	650	900	mV
V_{IH}	ON Threshold Voltage	Logic HIGH Level	Applied between V_{IN} and COM	-	-	2.6	V
V_{IL}	OFF Threshold Voltage	Logic LOW Level		0.8	-	-	V

Control Part(each bootstrap diode unless otherwise specified)

Symbol	Parameter	Condition	MIN.	TYP.	MAX.	Units
VF	BSD Forward voltage	I_F = 0.1 A, T_C = 25°C	-	2.8	-	V
t_{rrB}	Reverse Recovery Time	I_F = 0.1 A, T_C = 25°C	-	80	-	ns
R	BSD Current Limiting Resistor		-	18	-	ohm

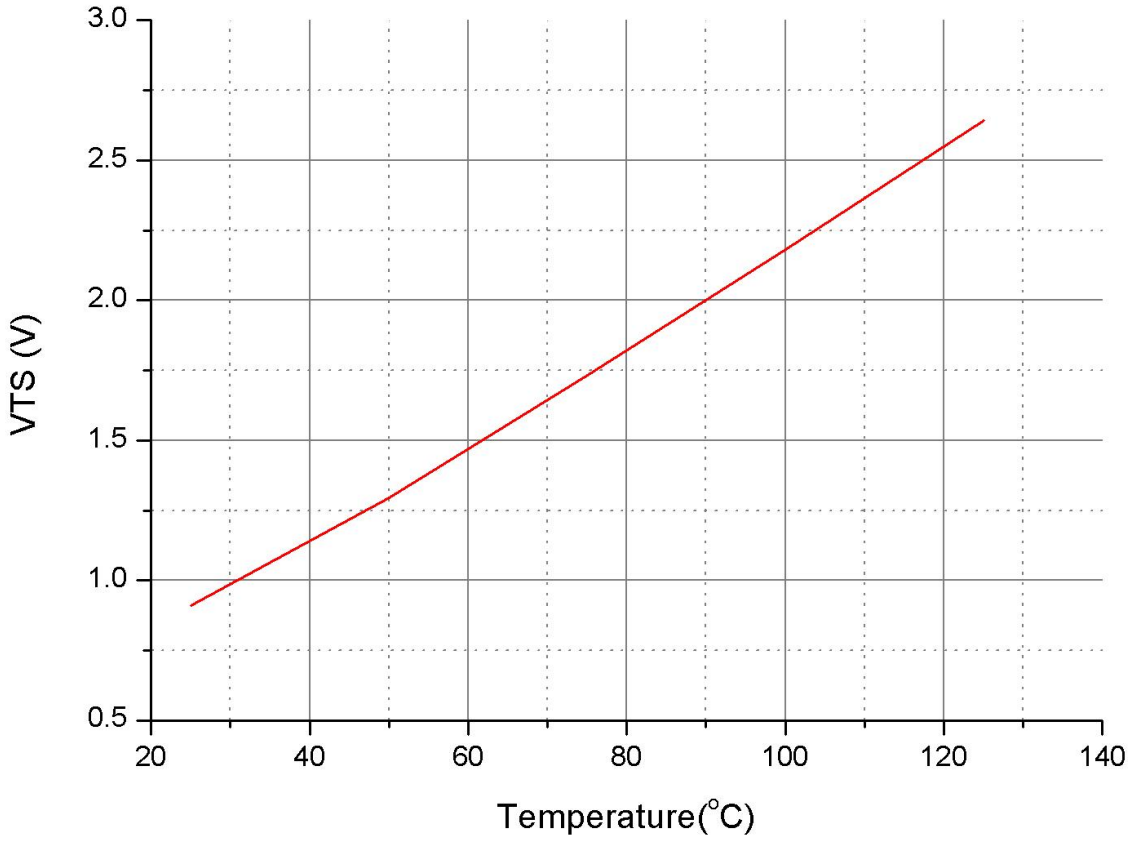


Figure7-1 Temperature Profile of V_{TS}(Typical)

8 NSMB05S50M1 Description

Typical application circuit

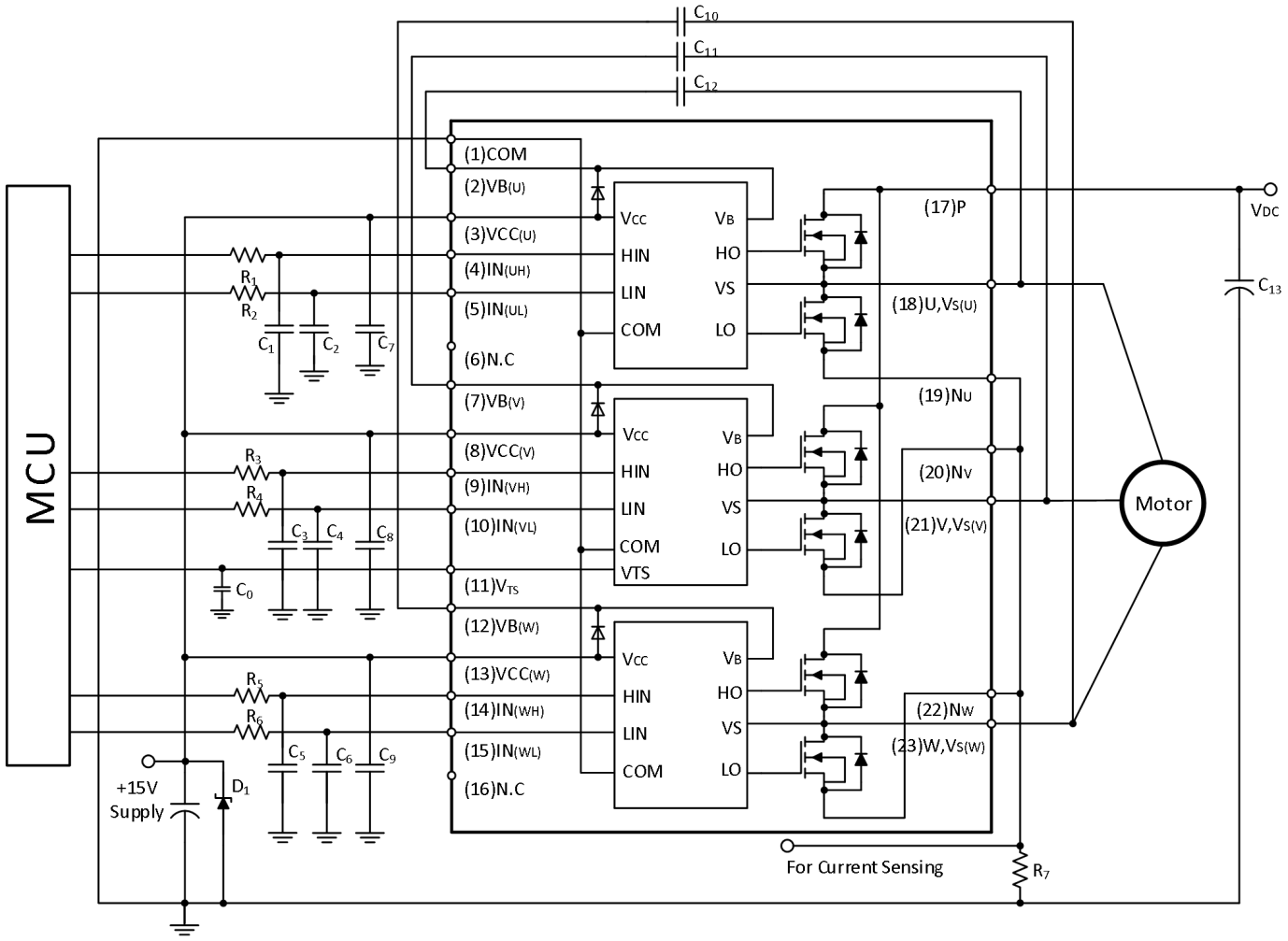


Figure8-1 Example of RC-coupling parameter 390 ohm and 1nF

Recommended Application Circuit and MCU Interface with parameter

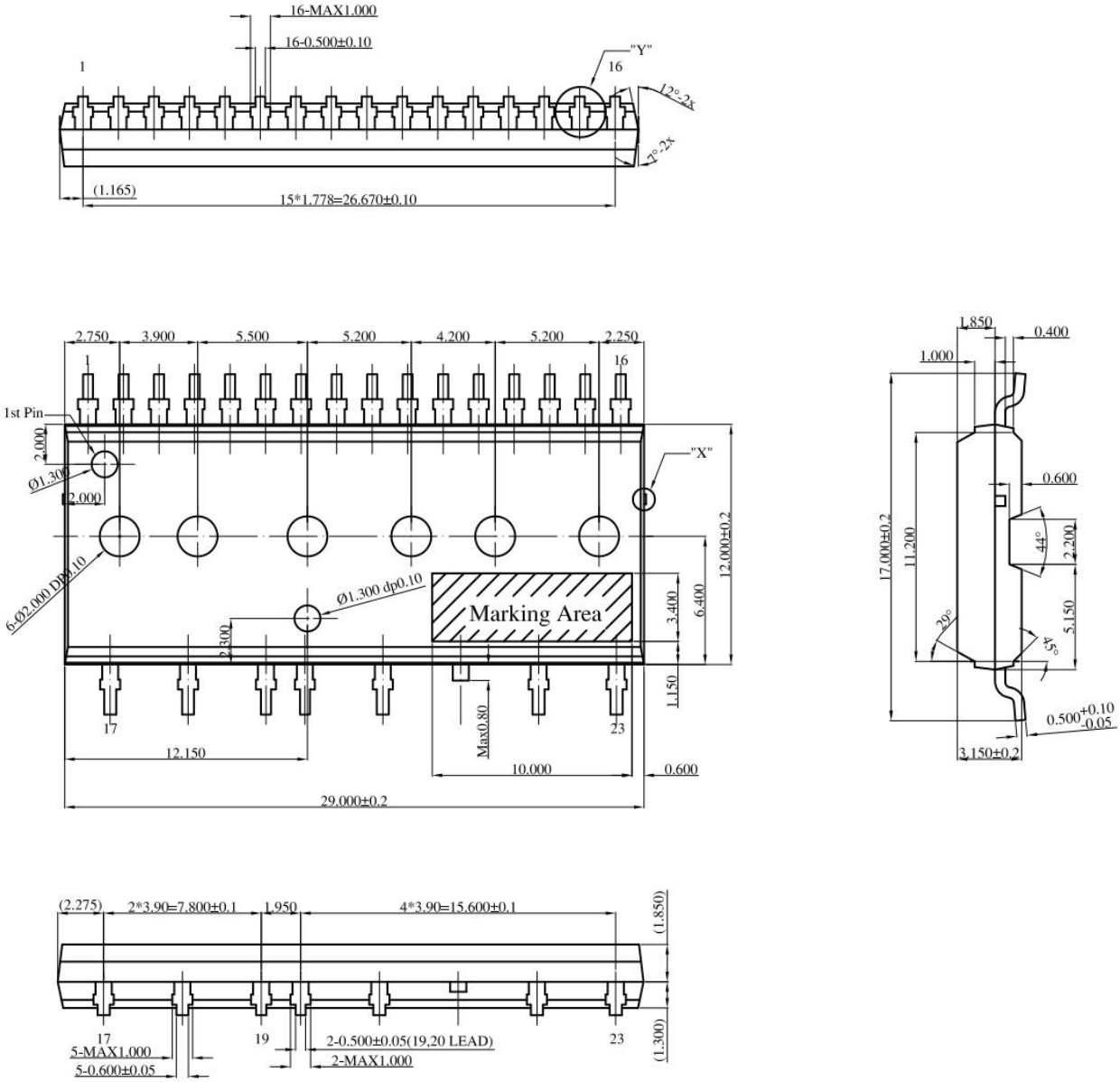
Notes:

1. RC-coupling (R_1 – R_6 and C_0 – C_6) at each input of IPM product and MCU are useful to prevent improper input signal caused by controller scheme and /or surge-noise.

2. All the filter capacitors should be connected close to IPM product, and they should have good characteristics for rejecting high-frequency ripple current.

9 Package Information

SOP23 Package Outlines



2024.12.31

1.VTS 温度曲线修改

2.VBS 欠压修改

3.原理图调整

4.目录字体格式调整