

## Features

- Integrated 6 low-loss IGBTs(600V/6A)
- Integrated high voltage gate drive circuit
- Compatible with 3.3V&5V input signal,effective at high level
- Insulation class 1500Vrms / min
- Integrated bootstrap functionality
- High reliability and thermal stability,good parameter consistency



DIP-23H



SOP-23H

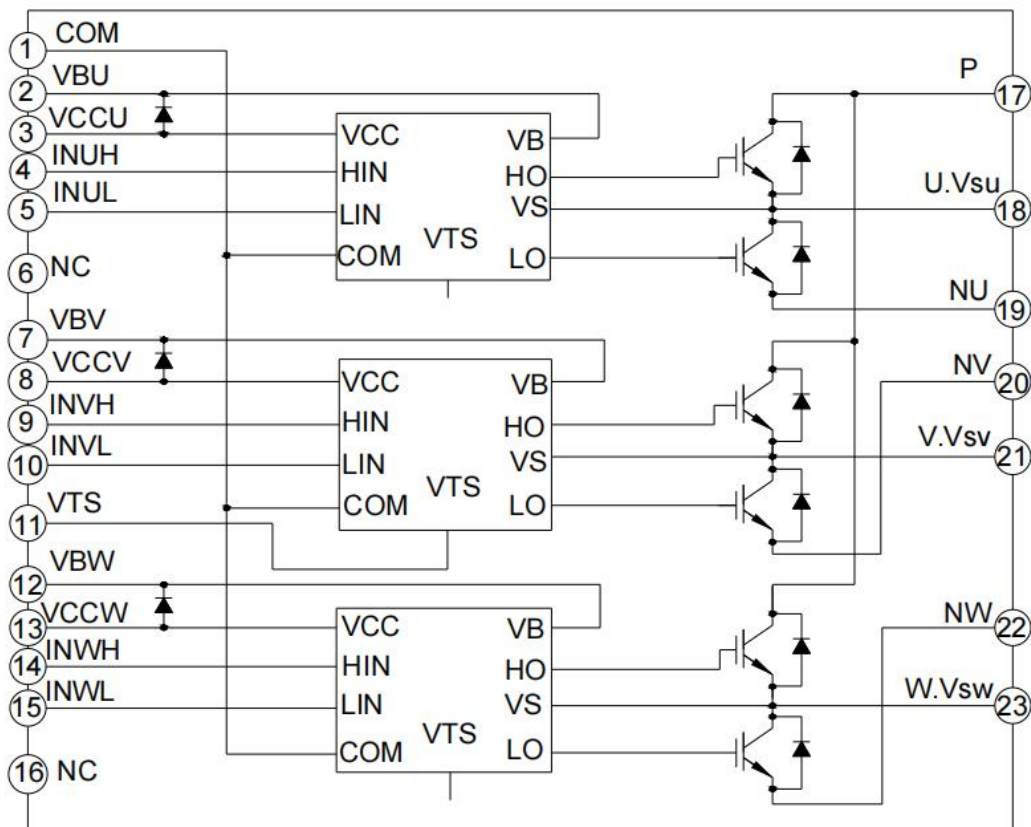
## Ordering Information

| Product Name | Marking      | Package Type |
|--------------|--------------|--------------|
| SYIM06G60BTD | SYIM06G60BTD | SOP-23H      |
| SYIM06G60BTA | SYIM06G60BTA | DIP-23H      |

## Applications

- Frequency converter
- Air Conditioning compressor
- Refrigerator compressor
- Air cleaner

## Internal Electrical Schematic



# Absolute Maximum Ratings: $T_J = 25^{\circ}\text{C}$ , unless otherwise noted

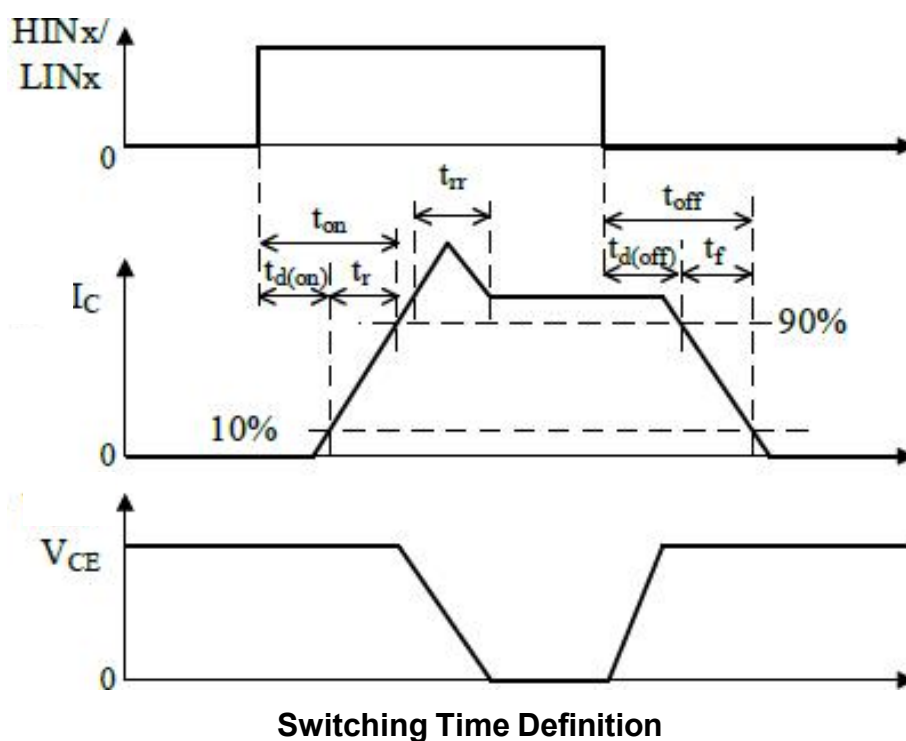
| Parameter                                                                                            | Symbol          | Value              | Unit               |
|------------------------------------------------------------------------------------------------------|-----------------|--------------------|--------------------|
| <b>Inverter section</b>                                                                              |                 |                    |                    |
| Supply Voltage                                                                                       | $V_{PN}$        | 450                | V                  |
| Supply Voltage (surge)                                                                               | $V_{PN(surge)}$ | 500                | V                  |
| Collector – Emitter Voltage                                                                          | $V_{ce}$        | 600                | V                  |
| Each IGBT Collector Current, $T_C = 25^{\circ}\text{C}, T_J \leq 150^{\circ}\text{C}$                | $I_C$           | 6                  | A                  |
| Each IGBT Collector Current (Peak), $T_C = 25^{\circ}\text{C}, T_J \leq 150^{\circ}\text{C}$         | $I_{CP}$        | 12                 |                    |
| Maximum power dissipation per module collector, $T_C = 25^{\circ}\text{C}, T_C = 25^{\circ}\text{C}$ | $P_C$           | -                  | W                  |
| <b>Control section</b>                                                                               |                 |                    |                    |
| Control Supply Voltage                                                                               | $V_{CC}$        | 20                 | V                  |
| High–Side Control Bias Voltage                                                                       | $V_{BS}$        | 20                 | V                  |
| Input Signal Voltage                                                                                 | $V_{IN}$        | -0.3~ $V_{CC}+0.3$ | V                  |
| Operating junction temperature                                                                       | $T_J$           | -40 to 150         | $^{\circ}\text{C}$ |
| Storage temperature range                                                                            | $T_{STG}$       | -40 to 125         | $^{\circ}\text{C}$ |
| Isolation test voltage (1min, RMS, $f = 60\text{Hz}$ )                                               | $V_{ISO}$       | 1500               | Vrms               |

Note: The maximum junction temperature of the power chips is  $150^{\circ}\text{C}$ . To ensure the safe operation of IPM, it is recommended that the average junction temperature should be limited to  $T_J \leq 125^{\circ}\text{C}$  (@ $T_C \leq 100^{\circ}\text{C}$ )

# Electrical Characteristics: $T_J=25^{\circ}\text{C}$ , unless otherwise noted

## Inverter section

| Parameter                              | Symbol        | Condition                                                                                                                                    | Value |      |      | Unit          |
|----------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|---------------|
|                                        |               |                                                                                                                                              | Min.  | Typ. | Max. |               |
| Collector – Emitter Saturation Voltage | $V_{CE(SAT)}$ | $V_{CC}=V_{BS}=15\text{V}$ ,<br>$V_{IN}=5\text{V}$ $I_C=6\text{A}$                                                                           | -     | 1.2  | -    | V             |
| FRD Forward Voltage                    | $V_F$         | $V_{IN}=0\text{V}$ , $I_F=6\text{A}$                                                                                                         | -     | 1.3  | -    | V             |
| High Side                              | $t_{on}$      | $V_{PN}=300\text{V}$ ,<br>$V_{CC}=V_{BS}=15\text{V}$ ,<br>$I_C=6\text{A}$ , $V_{IN}=0\text{V} \leftrightarrow 5\text{V}$ ,<br>Inductive load | -     | 749  | -    | ns            |
|                                        | $t_r$         |                                                                                                                                              | -     | 77   | -    | ns            |
|                                        | $t_{off}$     |                                                                                                                                              | -     | 719  | -    | ns            |
|                                        | $t_f$         |                                                                                                                                              | -     | 150  | -    | ns            |
|                                        | $t_{rr}$      |                                                                                                                                              | -     | 205  | -    | ns            |
| Low Side                               | $t_{on}$      |                                                                                                                                              | -     | 745  | -    | ns            |
|                                        | $t_r$         |                                                                                                                                              | -     | 89   | -    | ns            |
|                                        | $t_{off}$     |                                                                                                                                              | -     | 714  | -    | ns            |
|                                        | $t_f$         |                                                                                                                                              | -     | 136  | -    | ns            |
|                                        | $t_{rr}$      |                                                                                                                                              | -     | 196  | -    | ns            |
| Collector – Emitter Leakage Current    | $I_{CES}$     | $V_{CE}=600\text{V}$                                                                                                                         | -     | -    | 250  | $\mu\text{A}$ |



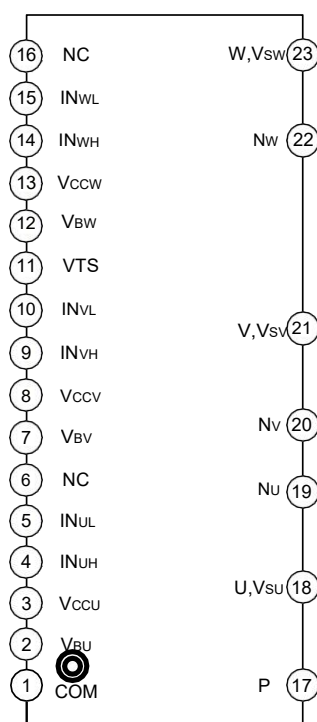
## Control section

| Parameter                          | Symbol     | Condition                                                        |                       | Value |      |      | Unit          |
|------------------------------------|------------|------------------------------------------------------------------|-----------------------|-------|------|------|---------------|
|                                    |            |                                                                  |                       | Min.  | Typ. | Max. |               |
| Quiescent $V_{CC}$ supply current  | $I_{QCC}$  | VBIAS ( $V_{CC}$ , $V_{BS}$ ) =15V<br>$T_A = 25^{\circ}\text{C}$ |                       | -     | 150  | -    | $\mu\text{A}$ |
| Quiescent $V_{BS}$ supply current  | $I_{QBS}$  |                                                                  |                       | -     | 70   | -    | $\mu\text{A}$ |
| Temperature Output                 | VTS        | V phase HVIC temperature @25 $^{\circ}\text{C}$                  |                       | 0.78  | 0.89 | 1.0  | V             |
|                                    |            | V phase HVIC temperature @100 $^{\circ}\text{C}$                 |                       | 2.0   | 2.25 | 2.5  | V             |
| Low side undervoltage protection   | $UV_{CCR}$ | Reset level                                                      |                       | 9     | 10   | 11   | V             |
| High side undervoltage protection  | $UV_{BSR}$ | Reset level                                                      |                       | 9.2   | 10   | 11.1 | V             |
| Logic "1" input voltage (LIN, HIN) | $V_{IH}$   | Logic high level                                                 | Between input and COM | -     | -    | 2.3  | V             |
| Logic "0" input voltage (LIN, HIN) | $V_{IL}$   | Logic Low level                                                  |                       | 1.1   | -    | -    | V             |
| Input bias current for LIN, HIN    | $I_{IH}$   | $V_{IN}=5\text{V}$                                               | Between input and COM | -     | 13   | -    | $\mu\text{A}$ |
|                                    | $I_{IL}$   | $V_{IN}=0\text{V}$                                               |                       | -     | -    | 1    |               |

## Bootstrap diode section

| Parameter             | Symbol   | Condition                                   |  | Value |      |      | Unit |
|-----------------------|----------|---------------------------------------------|--|-------|------|------|------|
|                       |          |                                             |  | Min.  | Typ. | Max. |      |
| Forward voltage       | $V_F$    | $I_F=10\text{mA}$ $T_C= 25^{\circ}\text{C}$ |  | -     | 3.3  | -    | V    |
| Reverse recovery time | $t_{rr}$ | $I_F=10\text{mA}$ $T_C= 25^{\circ}\text{C}$ |  | -     | -    | 50   | ns   |

## Pin Assignment



## Pin Description

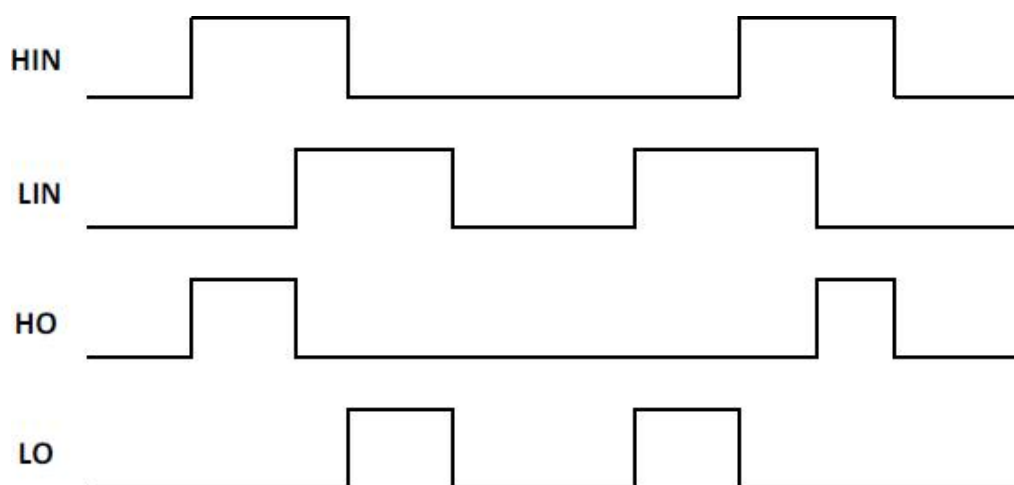
| Pin Number | Pin Name          | I/O | Pin Description                                                      |
|------------|-------------------|-----|----------------------------------------------------------------------|
| 1          | COM               | I/O | Module common ground                                                 |
| 2          | V <sub>BU</sub>   | I/O | U-phase high side floating IC supply voltage                         |
| 3          | V <sub>CCU</sub>  | I/O | U-phase low side driver supply voltage                               |
| 4          | IN <sub>UH</sub>  | I   | U-phase high side gate driver input                                  |
| 5          | IN <sub>UL</sub>  | I   | U-phase low side gate driver input                                   |
| 6          | NC                | I/O | No Connection                                                        |
| 7          | V <sub>BV</sub>   | I/O | V-phase high side floating IC supply voltage                         |
| 8          | V <sub>CCV</sub>  | I/O | V-phase low side driver supply voltage                               |
| 9          | IN <sub>VH</sub>  | I   | V-phase high side gate driver input                                  |
| 10         | IN <sub>VL</sub>  | I   | V-phase low side gate driver input                                   |
| 11         | VTS               | O   | Temperature sensing output signal                                    |
| 12         | V <sub>BW</sub>   | I/O | W-phase high side floating IC supply voltage                         |
| 13         | V <sub>CCW</sub>  | I/O | W-phase low side driver supply voltage                               |
| 14         | IN <sub>WH</sub>  | I   | W-phase high side gate driver input                                  |
| 15         | IN <sub>WL</sub>  | I   | W-phase low side gate driver input                                   |
| 16         | NC                | I/O | No Connection                                                        |
| 17         | P                 | I/O | Positive bus input voltage                                           |
| 18         | U,V <sub>SU</sub> | O   | Motor U-phase output and U-phase high side drive bias voltage ground |
| 19         | NU                | I/O | U-phase low side source                                              |
| 20         | NV                | I/O | V-phase low side source                                              |
| 21         | V,V <sub>SV</sub> | O   | Motor V-phase output and V-phase high side drive bias voltage ground |

| Pin Number | Pin Name          | I/O | Pin Description                                                      |
|------------|-------------------|-----|----------------------------------------------------------------------|
| 22         | NW                | I/O | W-phase low side source                                              |
| 23         | W,V <sub>SW</sub> | O   | Motor W-phase output and W-phase high side drive bias voltage ground |

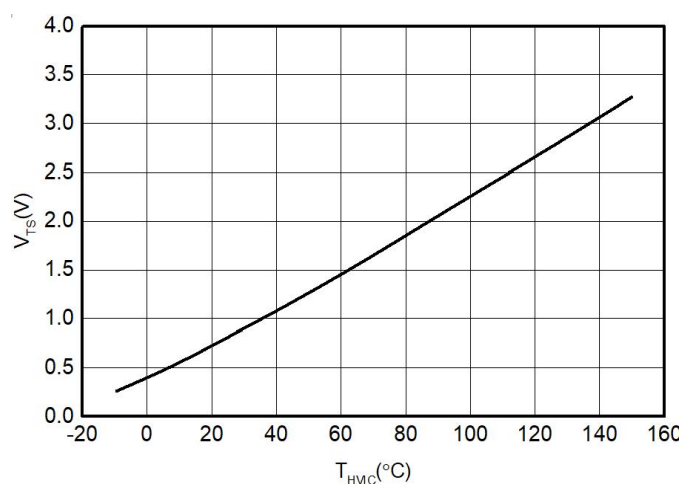
## Function description

### Input-output table

| IN <sub>H</sub> | IN <sub>L</sub> | O <sub>OUTPUT</sub> | Remark                                              |
|-----------------|-----------------|---------------------|-----------------------------------------------------|
| 0               | 0               | Z                   | The high and low sides of the bridge arm are closed |
| 0               | 1               | 0                   | The low side of the bridge arm is opened            |
| 1               | 0               | VDC                 | The high side of the bridge arm is opened           |
| 1               | 1               | Forbid              | Bridge arm punch through                            |
| Open            | Open            | Z                   | The high and low sides of the bridge arm are closed |

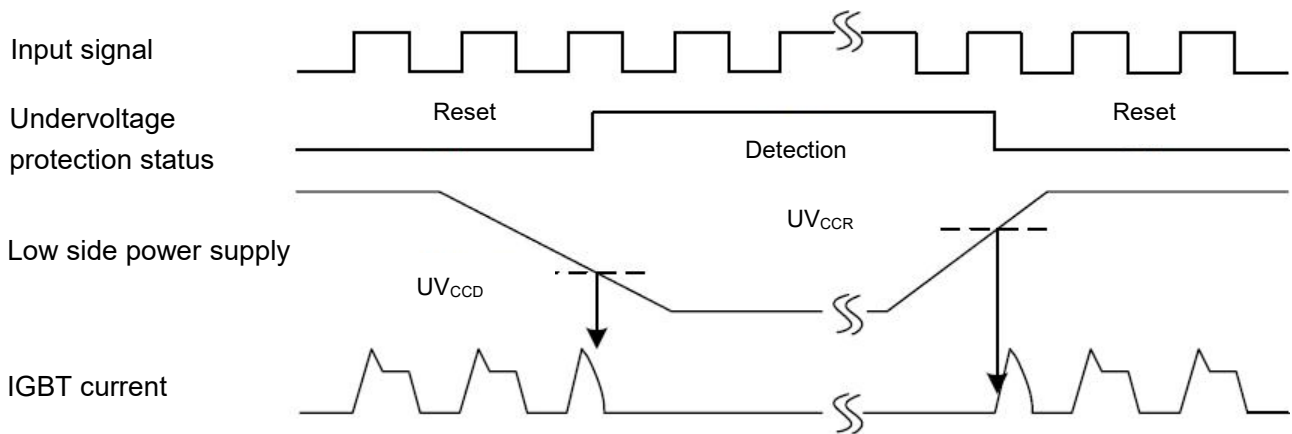
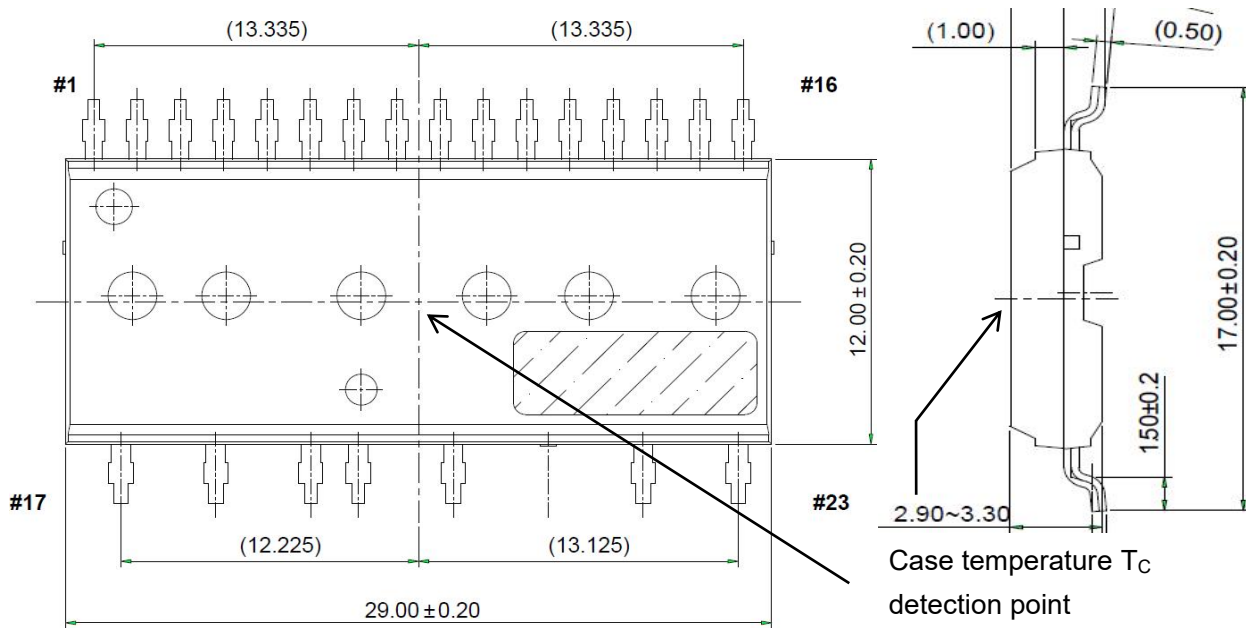


Control sequence diagram

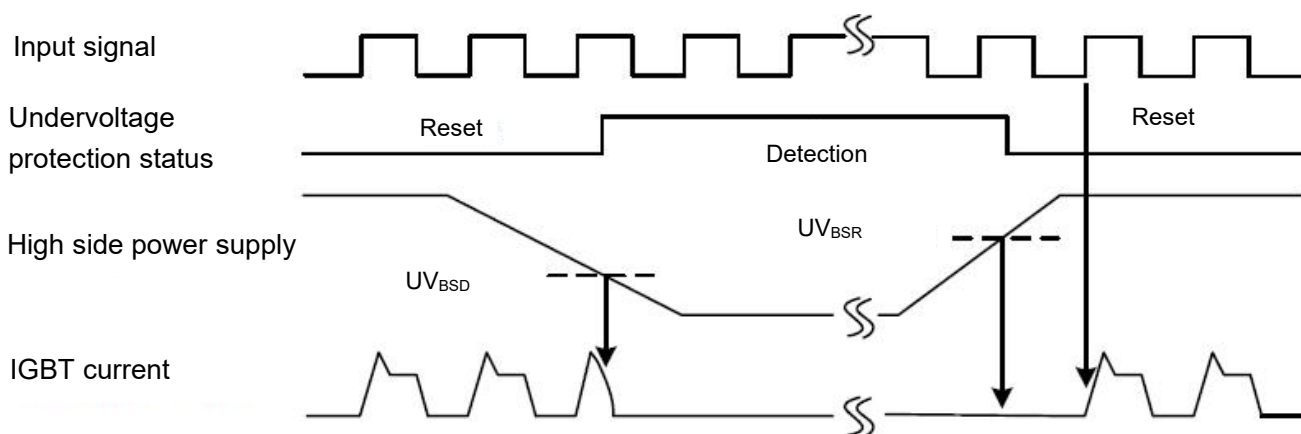


Temperature Profile of V<sub>TS</sub>(Typical)

## Case temperature $T_c$ detection

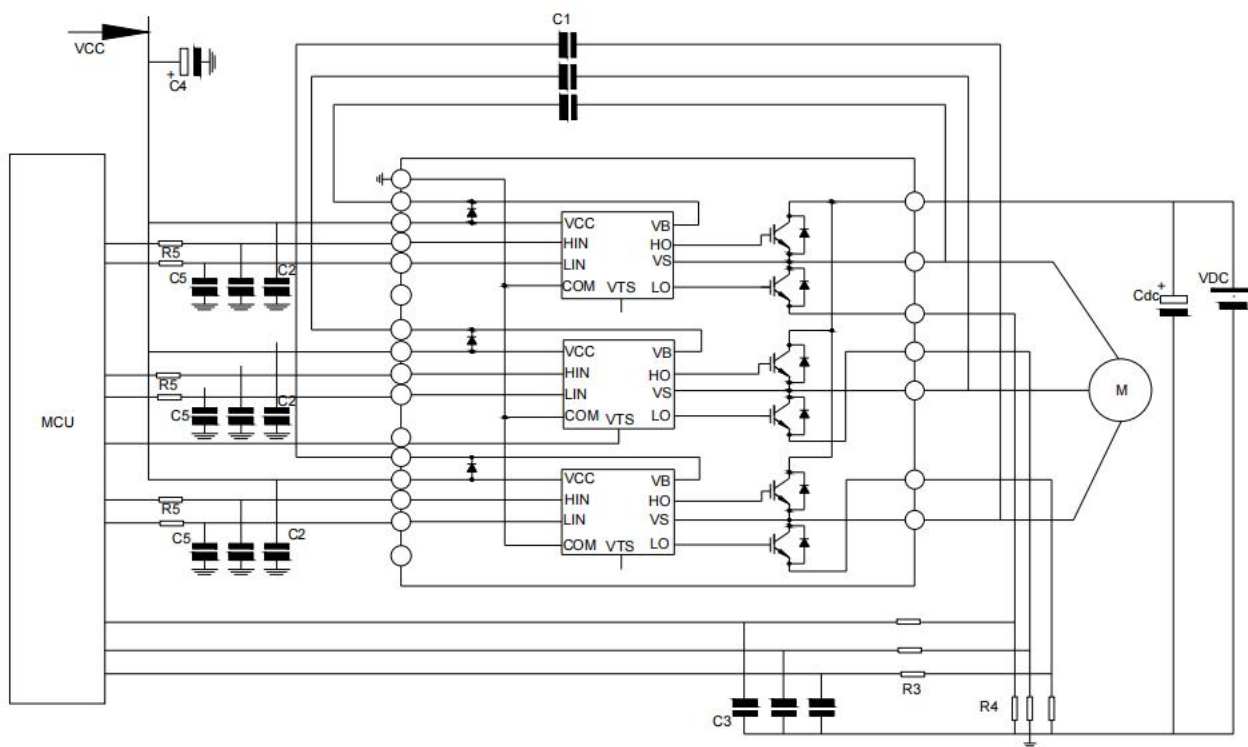


Undervoltage protection(Low side)



Undervoltage protection(High side)

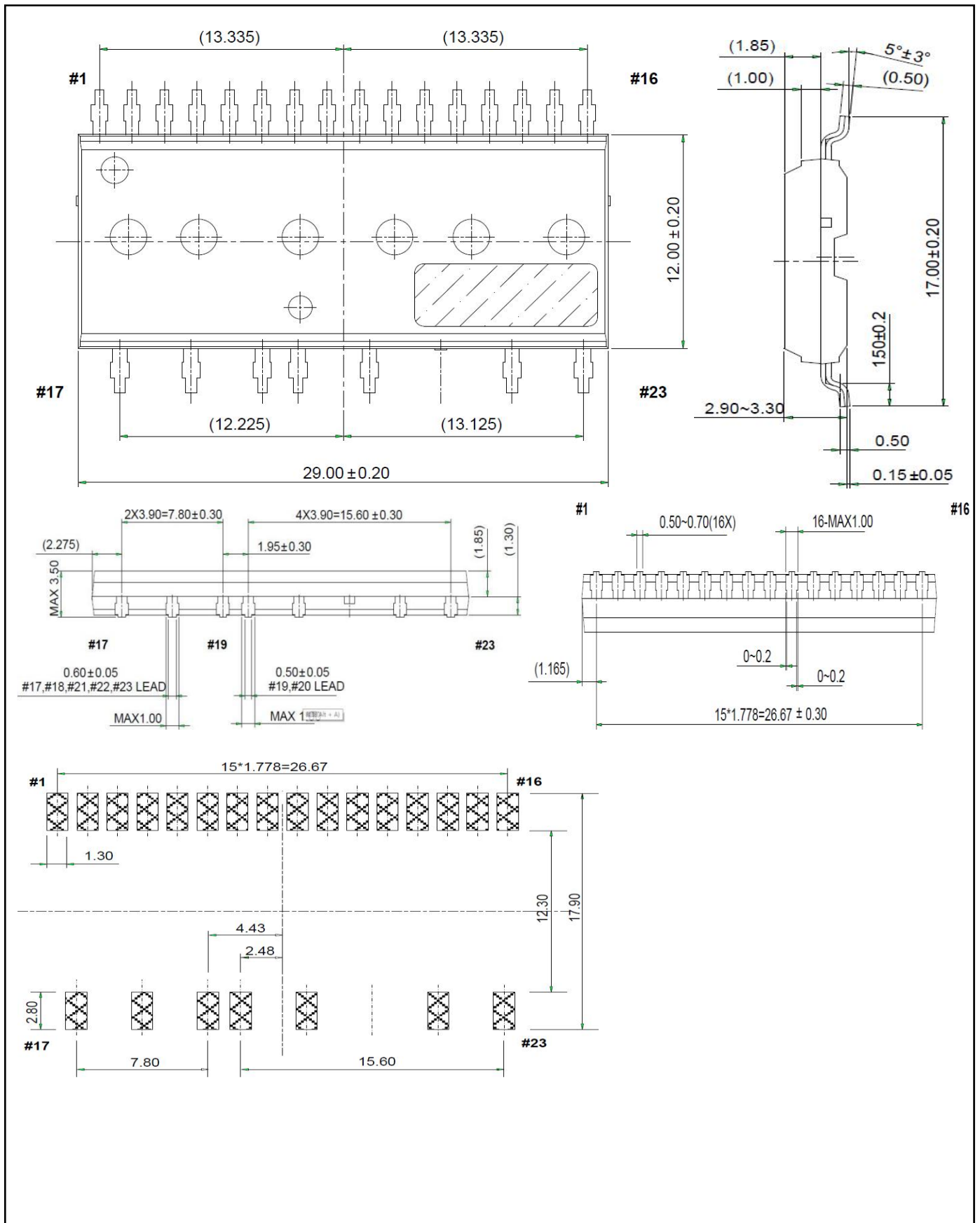
## Typical Application Schematic:



### Remark:

- (1) The wiring of each input pin shall be as short as possible, otherwise it may cause mis operation; in addition, RC filter can be used to reduce input signal noise.
- (2) All external capacitors should be located close to IPM.
- (3) In order to prevent surge damage, in addition to filter capacitance between PN, it is recommended to add a high-frequency non inductive smoothing capacitance, and the connection of capacitance should be as short as possible.
- (4) The filter capacitance at the input of VCC power supply is recommended to be at least 7 times of bootstrap capacitance C1.
- (5) The bootstrap capacitor C1 is suggested to adopt a capacitor with high frequency characteristics to absorb high frequency ripple current, and its capacitance value is suggested to be greater than 2.2uf.
- (6) The connection between current limiting resistor R4 and IPM shall be as short as possible to prevent the large surge voltage generated by the connection inductance from damaging IPM.

# Package Outline SOP-23H



# Package Outline DIP-23H

