# SPE04M50T-A

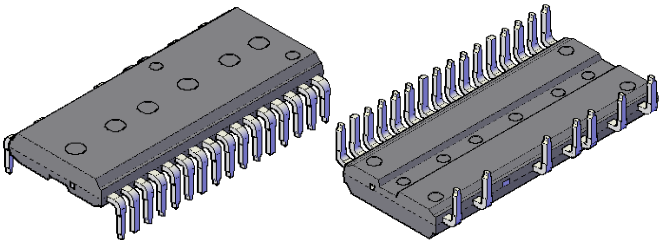


**Figure 1**

## Applications

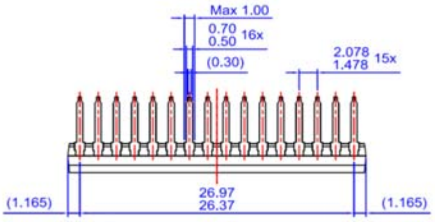
500V/4A low-loss MOSFET inverter driver for Small Power AC Motor Drives

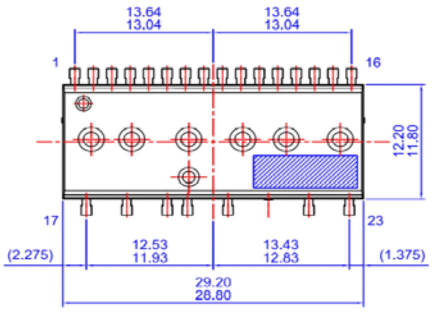
## Features

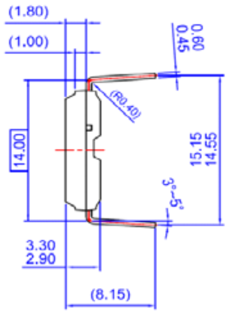
- 500V Rds(on)=3.5ohm（Max）MOSFET 3-Phase inverter with Gate Drivers and protection
- Separate Open-Source Pins from Low-Side MOSFETs for Three-Phase Current-Sensing
- Gate drive supply range from 10v to 20v
- Active-High interface, works with 3.3v/5v logic input, Schmitt-trigger input
- HVIC Temperature-Sensing Built-In for temperature Monitoring
- HVIC for Gate Driving and Under-voltage Protection
- Built-In Bootstrap Diodes simplify PCB layout
- Isolation Rating:1500Vrms/min

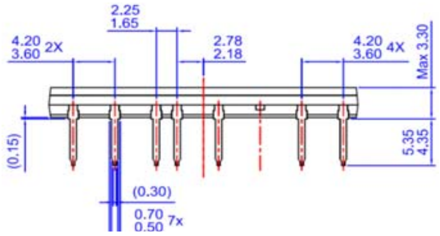
## Detailed Package Outline Drawings

Dimensions in mm









## Pin Configuration and Internal Block Diagram

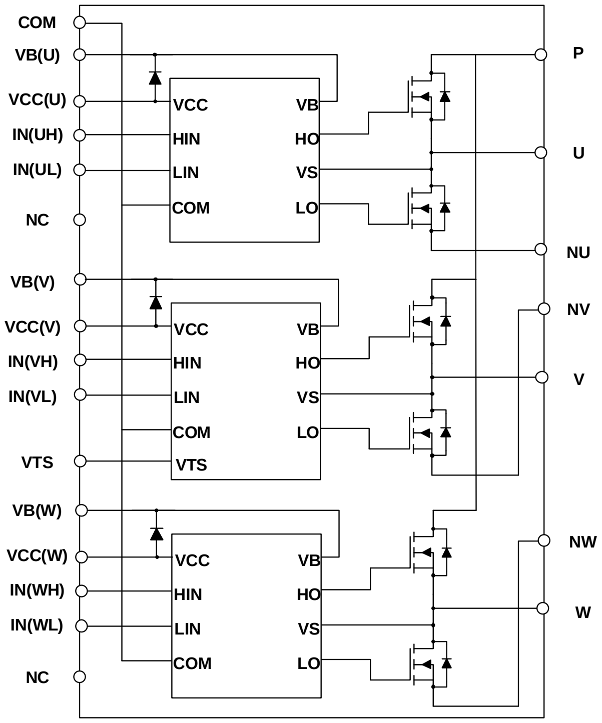


Figure 2. Bottom view

## Pin Descriptions

| Pin number | Pin name | Pin Description |
|---|---|---|
| 1 | COM | IC Common Supply Ground |
| 2 | VB(U) | Bias Voltage for U-Phase High-Side MOSFET Driving |
| 3 | VCC(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 | NC | No Connection |
| 7 | VB(V) | Bias Voltage for V-Phase High Side MOSFET Driving |
| 8 | VCC(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 | VTS | Output for HVIC Temperature Sensing |
| 12 | VB(W) | Bias Voltage for W-Phase High-Side MOSFET Driving |
| 13 | VCC(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 | NC | No Connection |
| 17 | P | Positive DC-Link Input |
| 18 | U | Output for U-Phase & Bias Voltage Ground for High-Side MOSFET Driving |
| 19 | NU | Negative DC-Link Input for U-Phase |
| 20 | NV | Negative DC-Link Input for V-Phase |
| 21 | V | Output for V-Phase & Bias Voltage Ground for High-Side MOSFET Driving |
| 22 | NW | Negative DC-Link Input for W-Phase |
| 23 | W | Output for W Phase & Bias Voltage Ground for High-Side MOSFET Driving |

## Absolute Maximum Ratings (TJ= 25°C, Unless Otherwise Specified)

### Inverter Part

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| VDSS | Drain-Source Voltage of Each MOSFET | | 500 | V |
| ID | Each MOSFET Current, Continuous | TC = 25°C | 4 | A |
| IDM | Each MOSFET Pulse Current, Peak | TC = 25°C, Less than 100us | 12 | A |
| IDrms | Each MOSFET Current, Rms | TC = 25°C, FPWM <20KHz | 4 | Arms |
| PD | Maximun Power Dissipation | TC = 25°C For each MOSFET | 16.6 | W |

### Control Part

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| VCC | Control Supply Voltage | Applied between VCC and COM | 20 | V |
| VBS | High-side Bias Voltage | Applied between VB and VS | 20 | V |
| VIN | Input Signal Voltage | Applied between VIN and COM | -0.3~VCC+0.3 | V |

### Bootstrap Diode Part

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| VRRMB | Maximum Repetitive Reverse Voltage | | 500 | V |
| IFB | Forward Current | TC = 25°C | 1 | A |
| IFPB | Forward Peak Current, Peak | TC = 25°C,Under 1ms Pulse Width | 2.5 | A |

### Total System

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| TJ | Operating Junction Temperature | | -40~150 | ℃ |
| TSTG | Storage Temperature | TC = 25°C | -40~125 | ℃ |
| VISO | Isolation Voltage | 60Hz, Sinusoidal, AC 1 minute, between pins and heat-sink plate | 1500 | V |

**Note:**

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

### Thermal Resistance

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Rth(j-c) | Junction to Case Thermal resistance | For Each MOSFET | 7.5 | °C/W |

## Electrical Characteristics (TJ= 25°C, Unless Otherwise Specified)

### Inverter Part

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| BVDSS | Drain - Source Breakdown Voltage | VIN = 0 V, ID = 1 mA | 500 | - | - | V |
| IDSS | Zero Gate Voltage Drain Current | VIN = 0 V, VDS = 500 V | - | - | 10 | uA |
| VSD | Drain - Source Diode Forward Voltage | VCC = VBS = 15V, VIN = 0 V, ID = -1 A | - | 0.95 | 1.5 | V |
| RDS(on) | Drain-Source Turn-On Resistance | VCC = VBS = 15 V, VIN = 5 V, ID =1A | - | 1.45 | 1.8 | ohm |
| tON | Switching Times | VPN = 300 V, VCC = VBS = 15 V, ID = 1A<br>VIN = 0/5 V, Inductive Load L = 3 mH<br>High- and Low-Side MOSFET Switching | - | 1050 | - | ns |
| tOFF | | | - | 450 | - | ns |
| trr | | | - | 200 | - | ns |
| EON | | | - | 50 | - | uJ |
| EOFF | | | - | 10 | - | uJ |
| RBSOA | Reverse Bias Safe Operating Area | VPN = 400 V, VCC = VBS = 15 V, ID = IDP, VDS = BVDSS,TJ = 150°C High- and Low-Side MOSFET Switching | Full Square | | | |

### Control Part

| Symbol | Parameter | Condition | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| IQCC | Quiescent VCC Supply Current | VCC = 15V<br>VIN = 5V | Applied between VCC and COM | - | - | 500 | uA |
| IQB | Quiescent VBS Supply Current | VDB = 15V<br>VIN = 5V | Applied between VB(U) - U, VB(V) - V, VB(W) - W | - | - | 200 | uA |
| UVCCD | Low-Side Under-Voltage Protection | VCC Under-Voltage Protection Detection Level | | 7.4 | 7.9 | 9 | V |
| UVCCR | | VCC Under-Voltage Protection Reset Level | | 8.0 | 8.6 | 9.8 | V |
| UVBSD | High-Side Under-Voltage Protection | VBS Under-Voltage Protection Detection Level | | 7.4 | 7.9 | 9 | V |
| UVBSR | | VBS Under-Voltage Protection Reset Level | | 8.0 | 8.6 | 9.8 | V |
| VTS | HVIC Temperature Sensing Voltage Output | VCC = 15 V, THVIC = 25°C | | 600 | 790 | 980 | mV |
| VIH | ON Threshold Voltage | Logic HIGH Level, Applied between VIN and COM | | 2.7 | - | - | V |
| VIL | OFF Threshold Voltage | Logic Low Level, Applied between VIN and COM | | - | - | 0.8 | V |
| VF | BSD Forward voltage | IF = 0.1 A, TC = 25°C | | - | 1.35 | 1.8 | V |
| trr | Reverse Recovery Time | IF = 0.1 A, TC = 25°C | | - | 45 | - | ns |

## Recommended Operating Conditions

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| VPN | Supply Voltage | Applied between P and N | - | 300 | 400 | V |
| VCC | Control Supply Voltage | Applied between VCC and COM | 13.5 | 15.0 | 16.5 | V |
| VBS | High-Side Bias Voltage | Applied between VB and VS | 13.5 | 15.0 | 16.5 | V |
| VIN(ON) | Input ON Threshold Voltage | Applied between VIN and COM | 3.0 | - | 10 | V |
| VIN(OFF) | Input OFF Threshold Voltage | | 0 | - | 0.6 | V |
| tdead | Blanking Time for Preventing Arm-Short | VCC = VBS = 13.5 ~ 16.5 V, TJ <150°C | 1.0 | - | - | us |
| fPWM | PWM Switching Frequency | TJ <150°C | - | 15 | - | KHz |