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STK984-190-E

MOSFET Power Module 40 V, 30 A, Compact DIP

The STK984-190-E is a MOSFET power module containing 6 MOSFETs in a three-phase bridge (B6) configuration and a seventh MOSFET used as a reverse battery protection switch. The compact module is 29.6 mm × 18.2 mm and is 4.3 mm high (see package drawing for specification details). The MOSFET module uses a DBC substrate for excellent thermal performance. The module is suitable for 12 V automotive and industrial applications with motors rated up to 300 W.

Features

- Three-phase MOSFET bridge with reverse battery protection switch
- Device is PPAP capable.
- Compact 29.6 mm × 18.2 mm dual in-line package
- Motor power up to 300 W for 12 V systems
- 40 V MOSFETs with 30 A continuous and 85 A pulse current ratings
 - $R_{DS(ON)} = 9.5 \text{ m}\Omega$ max
 - $Q_{GD} = 9.8 \text{ nC}$ typical

Typical Applications

- Automotive Pumps
- Automotive Fans
- 12 V Industrial Motors

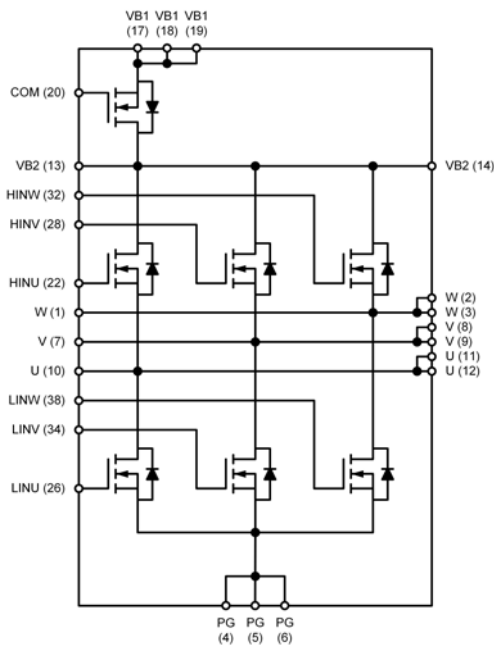


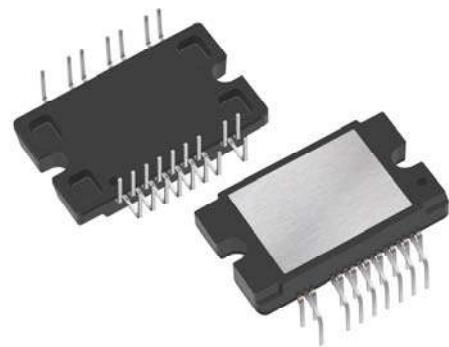
Figure 1: Functional Diagram



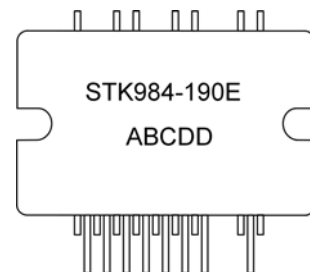
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PACKAGE PICTURE



MARKING DIAGRAM



STK984-190-E = Specific Device Code
 A = Year
 B = Month
 C = Production Site
 DD = Factory Lot Code
 Device marking is on package underside

ORDERING INFORMATION

| Device | Package | Shipping (Qty / Packing) |
|--------------|--|--------------------------|
| STK984-190-E | MODULE SPCM24 29.6x18.2 DIP S3 (Pb-Free) | 16 / Tube |

STK984-190-E

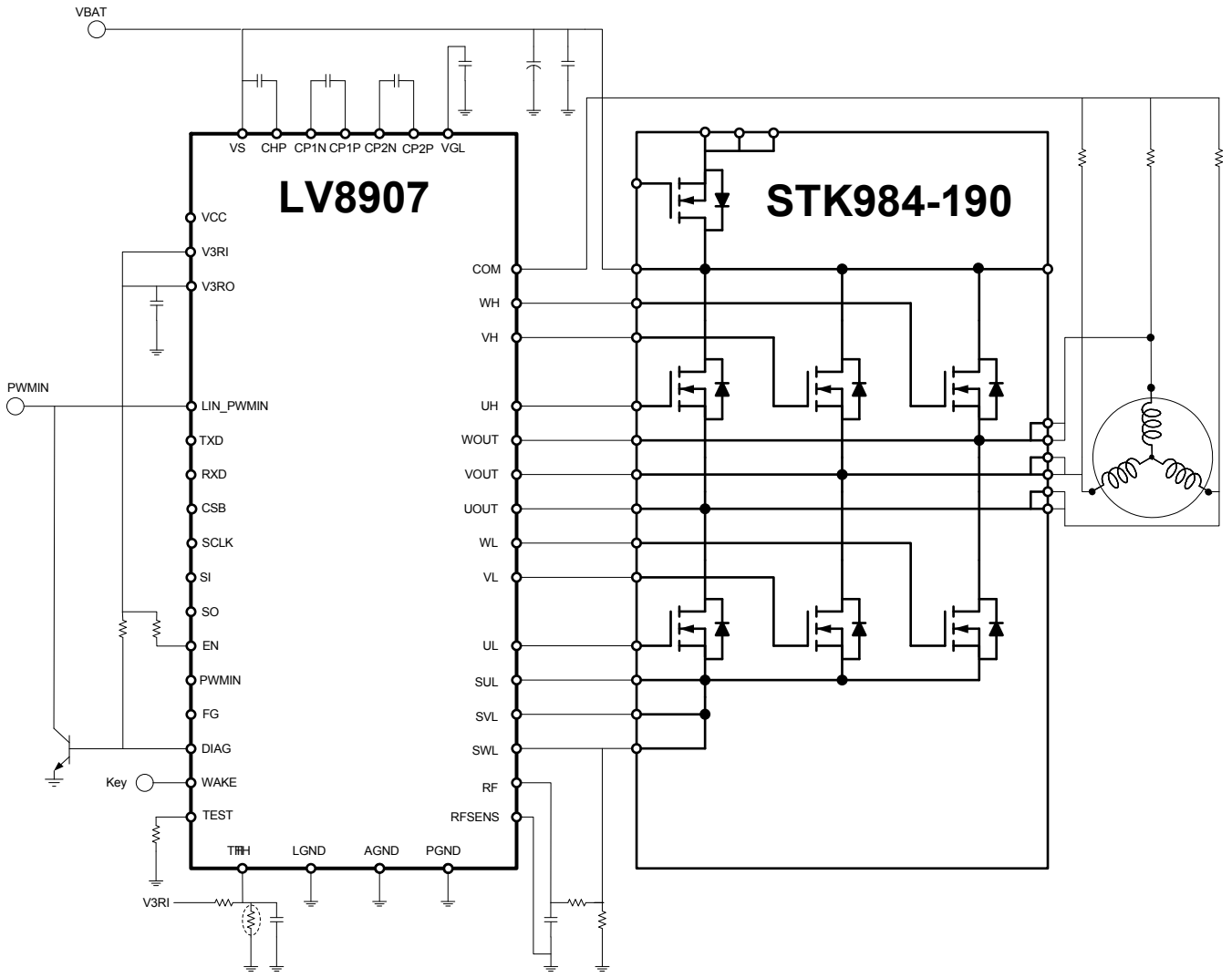


Figure 2: Application Schematic Example

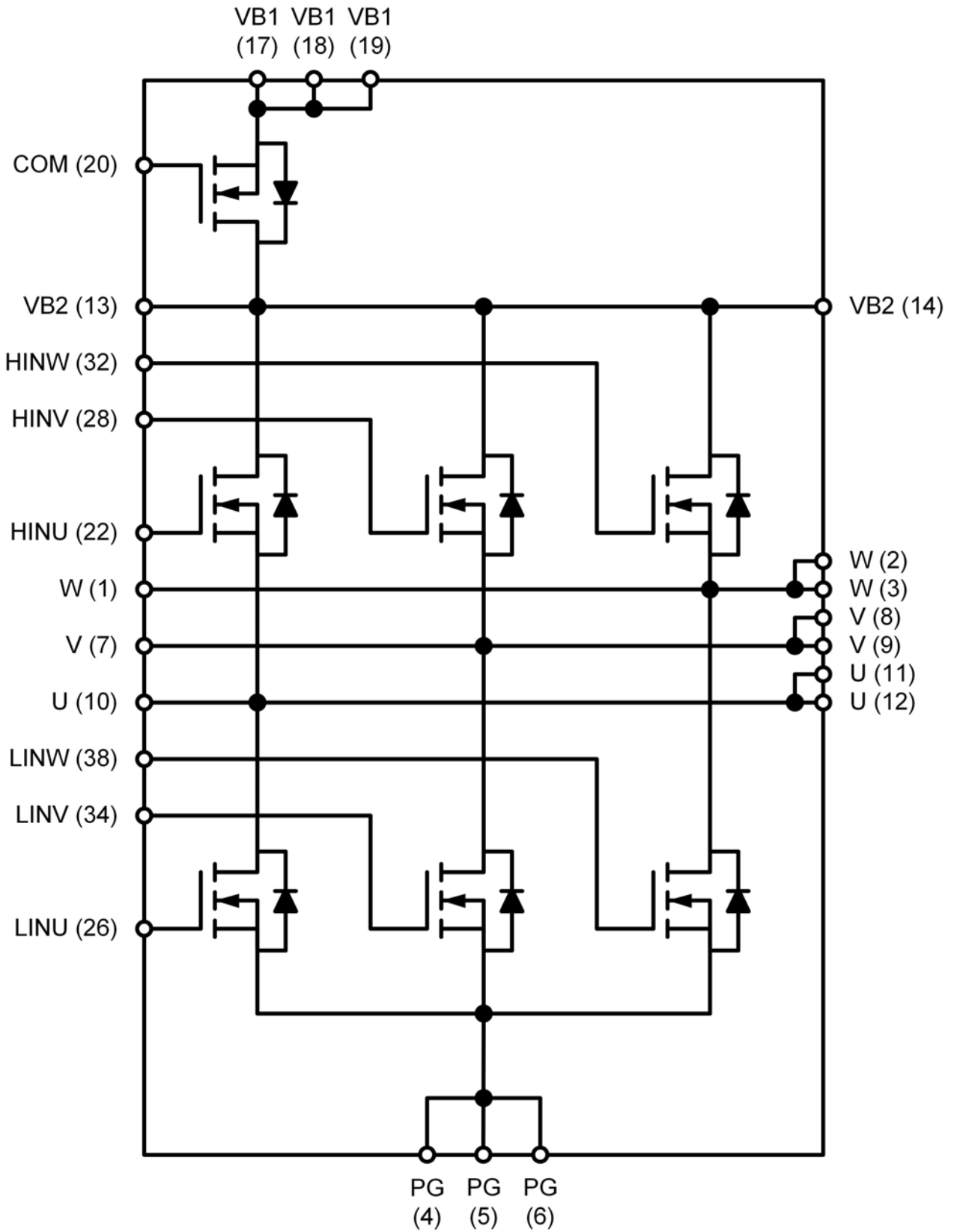


Figure 3: Block Diagram

STK984-190-E

PIN FUNCTION DESCRIPTION

| Pin | Name | Description |
|-----|------|---|
| 1 | W | W Phase Output |
| 2 | W | W Phase Output |
| 3 | W | W Phase Output |
| 4 | PG | Power Ground |
| 5 | PG | Power Ground |
| 6 | PG | Power Ground |
| 7 | V | V Phase Output |
| 8 | V | V Phase Output |
| 9 | V | V Phase Output |
| 10 | U | U Phase Output |
| 11 | U | U Phase Output |
| 12 | U | U Phase Output |
| 13 | VB2 | Positive Supply for 3-phase bridge |
| 14 | VB2 | Positive Supply for 3-phase bridge |
| 17 | VB1 | Positive Supply to reverse battery protect switch |
| 18 | VB1 | Positive Supply to reverse battery protect switch |
| 19 | VB1 | Positive Supply to reverse battery protect switch |
| 20 | COM | Gate of reverse battery protect switch |
| 22 | HINU | High side gate phase U |
| 26 | LINU | Low side gate phase U |
| 28 | HINV | High side gate phase V |
| 32 | HINW | High side gate phase W |
| 34 | LINV | Low side gate phase V |
| 38 | LINW | Low side gate phase W |

Note: Pins 15, 16, 21, 23, 24, 25, 27, 29, 30, 31, 33, 35, 36, 37 are not present

Table 1: Pin Function Description

STK984-190-E

ABSOLUTE MAXIMUM RATINGS (Notes 1,2)

| Rating | Symbol | Conditions | Value | Unit |
|----------------------------------|---------------------|---|------------|------|
| Drain-to-Source Voltage | VDSS | | 40 | V |
| Control Input Voltage | V _{in} max | COM to VB1; HINx to x; LINx to PG (x = U,V,W) | +/-20 | V |
| Continuous Drain Current | ID max | DC | 30 | A |
| Pulsed Drain Current | ID pulse | Pulse (t _p = 10 μs) | 85 | A |
| Power Dissipation | Pd max | Each channel T _c = 25°C | 36 | W |
| Junction Temperature | T _j max | | 175 | °C |
| Operating Temperature | T _c | | -40 to 150 | °C |
| ESD Capability, Human Body Model | ESD _{HBM} | | 1000 | V |
| ESD Capability, Machine Model | ESD _{MM} | | 200 | V |
| Storage Temperature | T _{stg} | | -40 to 150 | °C |
| Package mounting torque | | Case mounting screw. Thermal Grease | 0.6 | Nm |

1. Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
2. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.

RECOMMENDED OPERATING RANGES (Note 3)

| Rating | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---------------------------------|-----------------|---|-----|------|-----|------|
| Supply Voltage | VBmax | VB1 to PG; VB2 to PG | 8 | 13.5 | 18 | V |
| Control Input Voltage | V _{in} | COM to VB1; HINx to x; LINx to PG (x = U,V,W) | - | 10 | 18 | V |
| Drain Current | ID | T _c = 125°C , V _{GS} = 10 V | - | - | 27 | A |
| Operating Substrate Temperature | T _c | Module Substrate Temperature | -40 | - | 125 | °C |
| Package mounting torque | | 'M3' type screw. Thermal Grease. | 0.4 | - | 0.6 | Nm |

3. Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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ELECTRICAL CHARACTERISTICS (Note 4)

at T_C=25°C

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---------------------------------------|---|-----|-------|------|-------|
| Chip-Case Resistance | Θ _{J-C} | Each MOSFET die to outside of case | - | - | 4.1 | °C/W |
| Drain-to-Source Breakdown Voltage | V _{BR(DSS)} | V _{GS} = 0 V, I _D = 250 μA | 40 | - | - | V |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | V _{BR(DSS)} / T _J | Note 5 | - | 40.8 | - | mV/°C |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{GS} = 0 V, V _{DS} = 40 V | - | - | 1.0 | μA |
| Gate-to-Source Leakage Current | I _{GSS} | V _{GS} = 0 V, V _{GS} = ±20 V | - | - | ±100 | nA |
| Gate Threshold Voltage | V _{GS(TH)} | | 1.5 | - | 3.5 | V |
| Negative Gate Threshold Voltage Temperature Coefficient | V _{GS(TH)/} T _J | Note 5 | - | 7 | - | mV/°C |
| Drain-to-source ON resistance | R _{DS(ON)} | V _{GS} = 10 V, I _D = 15 A, Note 5 | - | 7.6 | - | mΩ |
| | | V _{GS} = 5V, I _D = 10 A, Note 5 | - | 10.9 | - | mΩ |
| Output Saturation Voltage / Each FET (includes the wiring resistance) | V _{DS(sat)} | V _{GS} = 10 V, I _D = 30 A VB2 to VB1, VB2 to U/V/W; U/V/W to PG | - | 0.285 | 0.38 | V |
| Forward Transconductance | g _{FS} | Note 5 | - | 8.54 | - | S |
| Input Capacitance | C _{iss} | V _{GS} = 0 V, V _{DS} = 25 V, 10 MHz, Note 5 | - | 1725 | - | pF |
| Output Capacitance | C _{oss} | | - | 220 | - | pF |
| Reverse transfer capacitance | C _{rss} | | - | 160 | - | pF |
| Total Gate Charge | Q _{G(TOT)} | V _{GS} = 10 V, V _{DS} = 32 V, I _D = 30 A, Note 5 | - | 33 | - | nC |
| Threshold Gate Charge | Q _{G(TH)} | | - | 2.0 | - | nC |
| Gate-to-Source Charge | Q _{GS} | | - | 7.2 | - | nC |
| Gate-to-Drain Charge | Q _{GD} | | - | 9.8 | - | nC |
| Turn-on delay time | t _{d(on)} | V _{GS} = 10 V, V _{DS} = 32 V, I _D = 30 A, R _G = 2.5 Ω, Note 5 | - | 10.2 | - | ns |
| Rise time | t _r | | - | 17.9 | - | ns |
| Turn-off delay time | t _{d(off)} | | - | 22.9 | - | ns |
| Fall time | t _f | | - | 4.5 | - | ns |
| Forward Diode Voltage | V _{SD} | V _{GS} = 10 V, I _{SD} = 10 A, Note 5 | - | 0.83 | - | V |
| Reverse Recovery Time | t _{RR} | V _{GS} = 0 V, I _{SD} = 30 A, dI _{SD} /dt = 100 A/μs, Note 5 | - | 24.8 | - | ns |
| Charge Time | t _A | | - | 14.6 | - | ns |
| Discharge Time | t _B | | - | 10.2 | - | ns |
| Reverse Recovery Charge | Q _{RR} | | - | 15.5 | - | nC |

- Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
- Typical data taken from packaged discrete device characteristics

TYPICAL CHARACTERISTICS

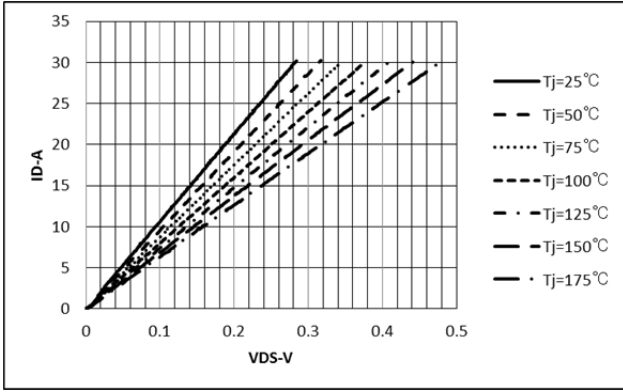


Figure 5 ID versus VDS for different temperatures (VGS = 10 V)

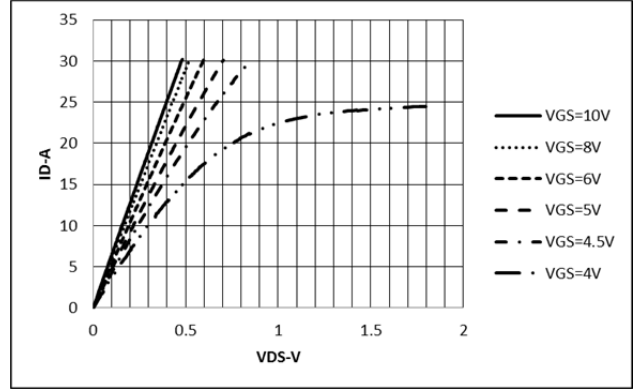


Figure 4 ID versus VDS for different VGS values (Tj = 175°C)

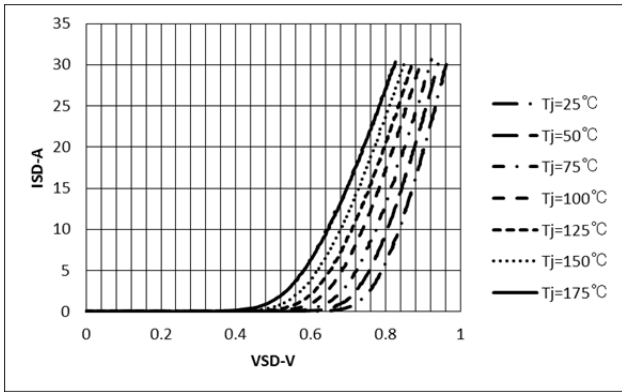


Figure 9 ISD versus VSD for different temperatures

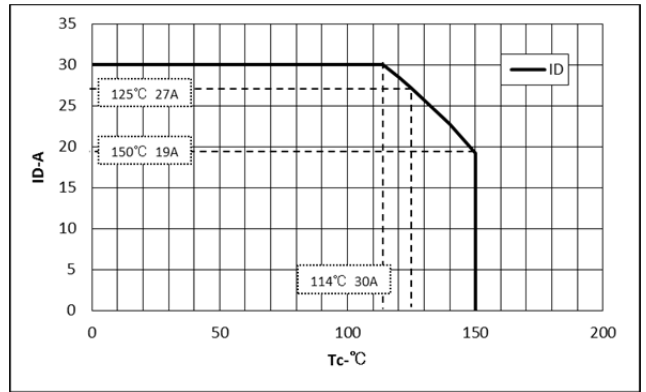


Figure 8 Current Rating

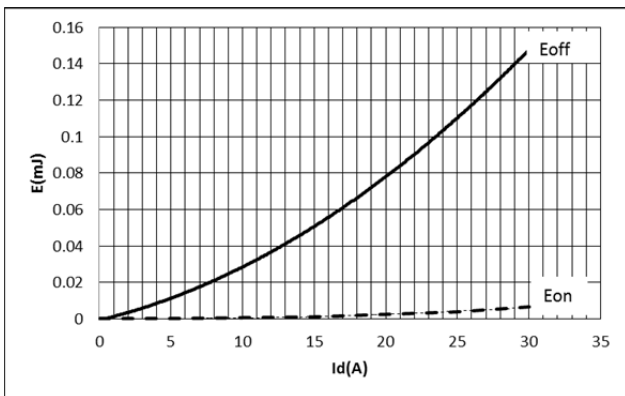


Figure 7 Switching losses versus drain current
Tj = 175°C, Id = 30 A, Rg = 51 Ω, L = 40 μH

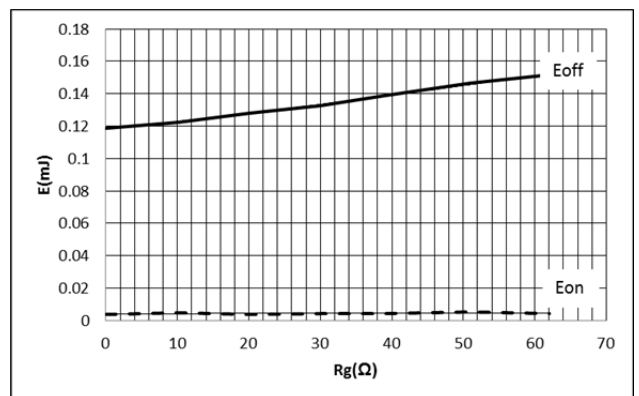


Figure 6 Switching losses versus gate resistance
Tj = 175°C, Id = 30 A, L = 40 μH

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TYPICAL CHARACTERISTICS

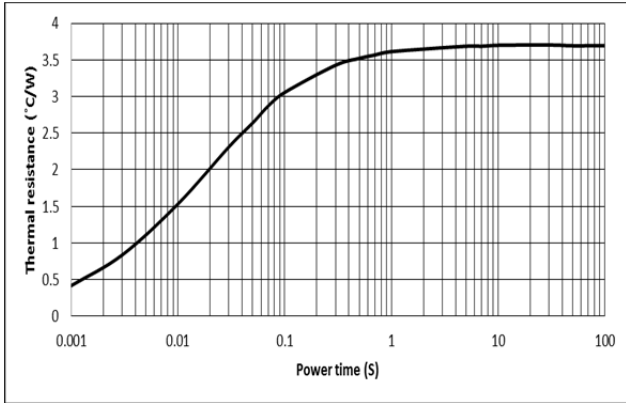


Figure 13 Thermal Impedance

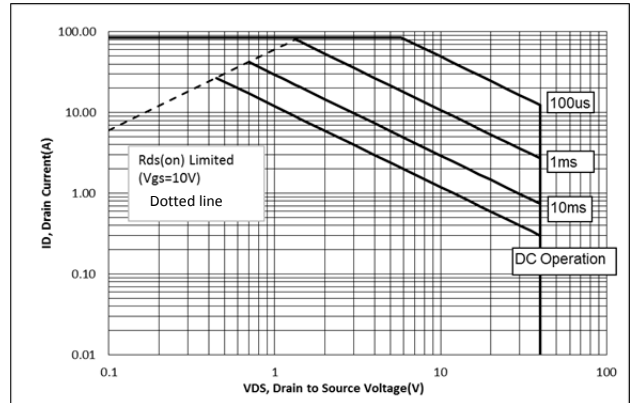


Figure 12 Safe Operating Area

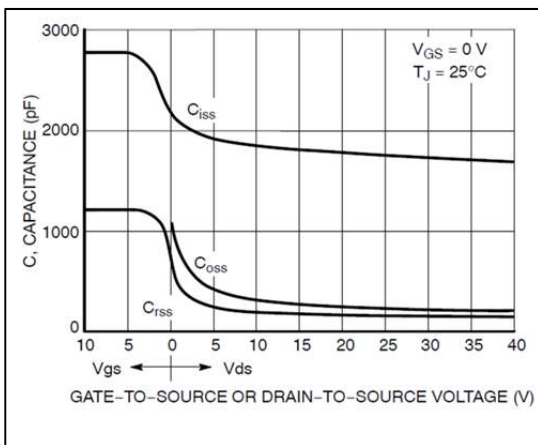


Figure 11 Capacitance Characteristics

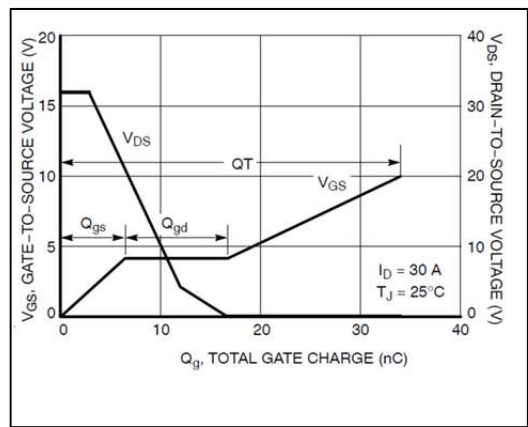


Figure 10 Gate Charge Characteristics

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Mounting Instructions

| Item | Recommended Condition |
|-----------|---|
| Pitch | 26.0±0.1 mm (Please refer to Package Outline Diagram) |
| Screw | Diameter : M3 Screw head types: pan head, truss head, binding head |
| Washer | Plane washer dimensions (Figure 14) D = 7 mm, d = 3.2 mm and t = 0.5 mm JIS B 1256 |
| Heat sink | Material: Aluminum or Copper Warpage (the surface that contacts IPM) : -50 to 50 µm Screw holes must be countersunk. No contamination on the heat sink surface that contacts IPM. |
| Torque | Temporary tightening : 50 to 60 % of final tightening on first screw Temporary tightening : 50 to 60 % of final tightening on second screw Final tightening : 0.4 to 0.6Nm on first screw Final tightening : 0.4 to 0.6Nm on second screw |
| Grease | Silicone grease. Thickness : 50 to 100 µm Uniformly apply silicon grease to whole back. Thermal foils are only recommended after careful evaluation. Thickness, stiffness and compressibility parameters have a strong influence on performance. |

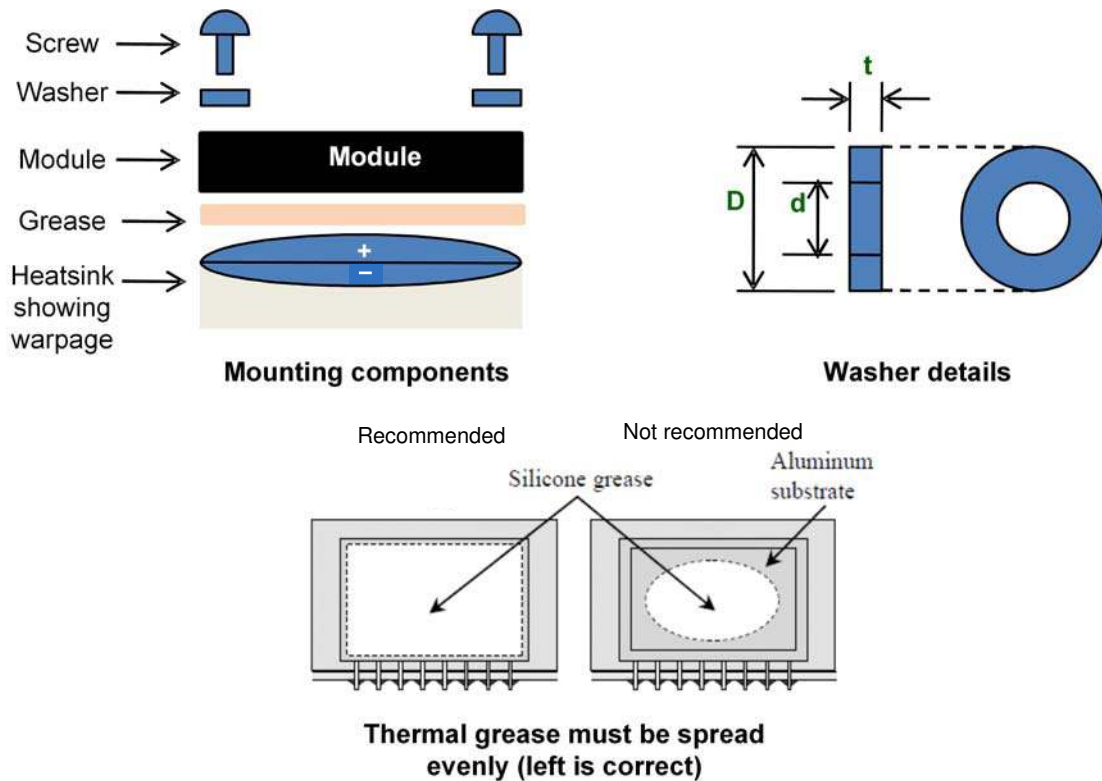


Figure 14: Module Mounting details: components; washer drawing; need for even spreading of thermal grease

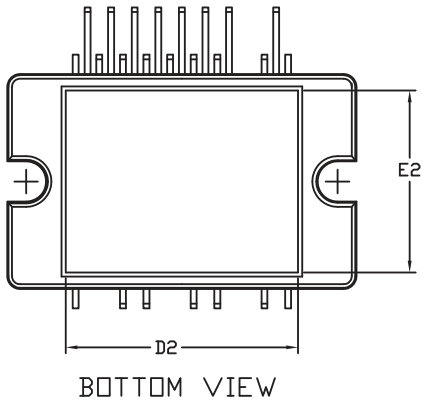
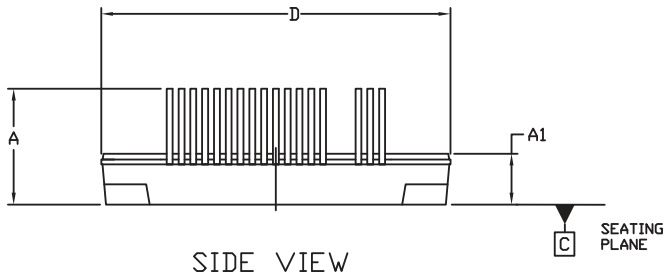
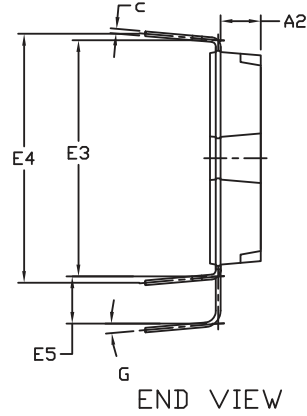
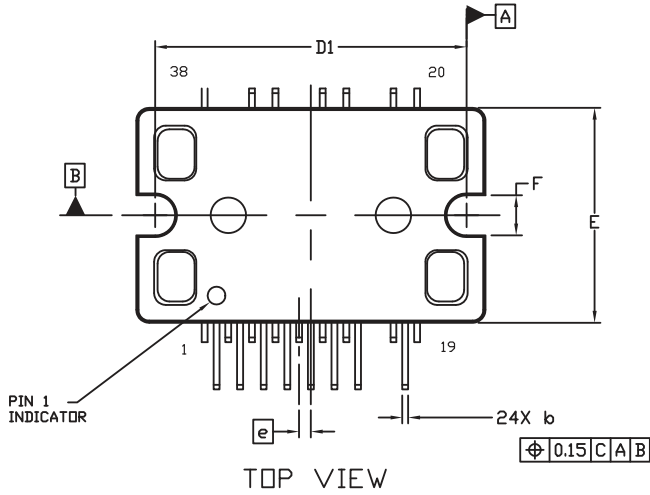
STK984-190-E

PACKAGE DIMENSIONS

unit : mm

MODULE SPCM24 29.6x18.2 DIP S3

CASE MODBL
ISSUE A



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION *b* APPLIES TO THE PLATED LEAD AND IS MEASURED BETWEEN 0.10 AND 0.25 FROM THE LEAD TIP.
4. PACKAGE IS MISSING PINS: 15, 16, 21, 23, 24, 25, 27, 29, 30, 31, 33, 35, 36, AND 37.

| DIM | MILLIMETERS | |
|----------|-------------|-------|
| | MIN. | MAX. |
| A | 9.30 | 10.30 |
| A1 | 3.80 | 4.80 |
| A2 | 2.90 | 3.90 |
| <i>b</i> | 0.45 | 0.70 |
| <i>c</i> | 0.35 | 0.60 |
| D | 29.10 | 30.10 |
| D1 | 26.30 | 26.50 |
| D2 | 19.20 | 20.20 |
| E | 17.70 | 18.70 |
| E2 | 14.90 | 15.90 |
| E3 | 19.50 | 20.50 |
| E4 | 21.10 | REF |
| E5 | 3.50 | 4.50 |
| <i>e</i> | 1.00 | BSC |
| F | 2.90 | 3.90 |
| G | 4° | 6° |

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