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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 mΩ max
  - Q_{GD} = 9.8 nC typical

Typical Applications

- Automotive Pumps
- Automotive Fans
- 12 V Industrial Motors

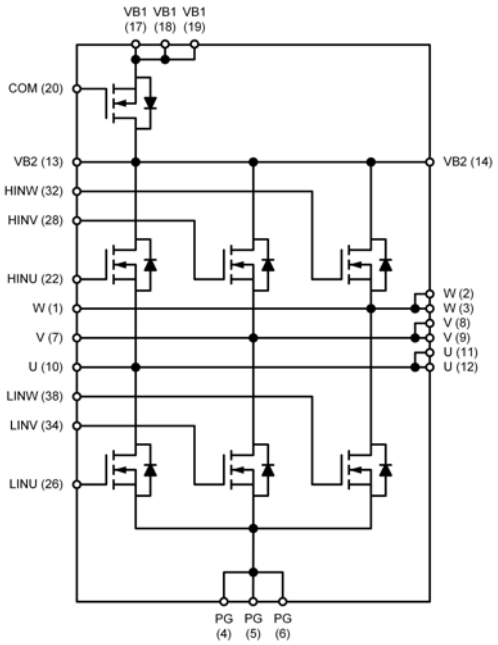

Figure 1: Functional Diagram

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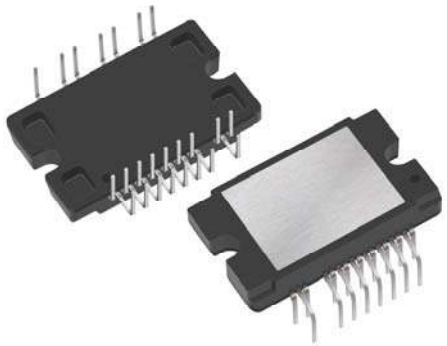
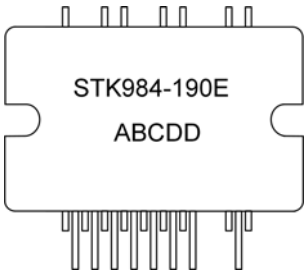
PACKAGE PICTURE



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

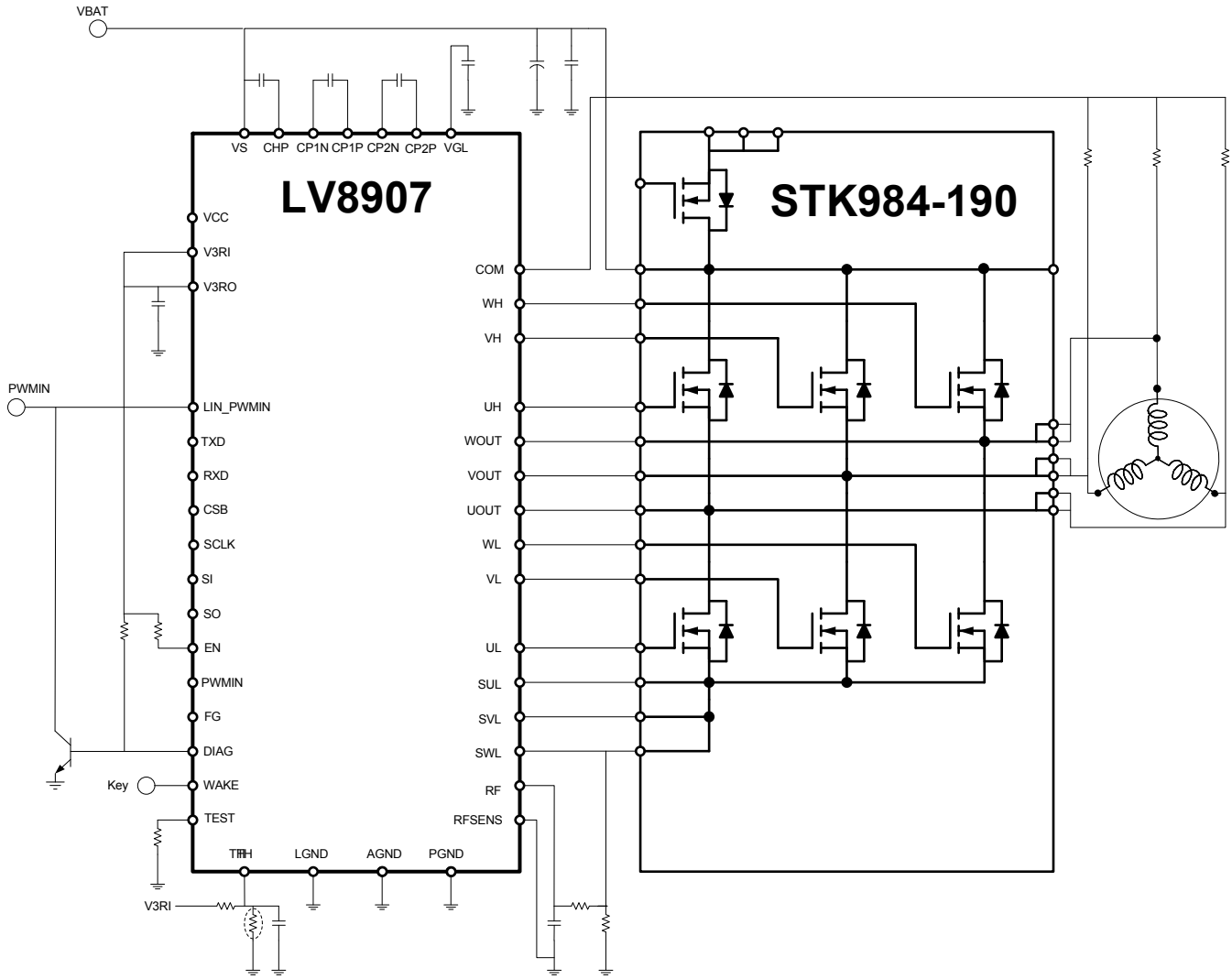


Figure 2: Application Schematic Example

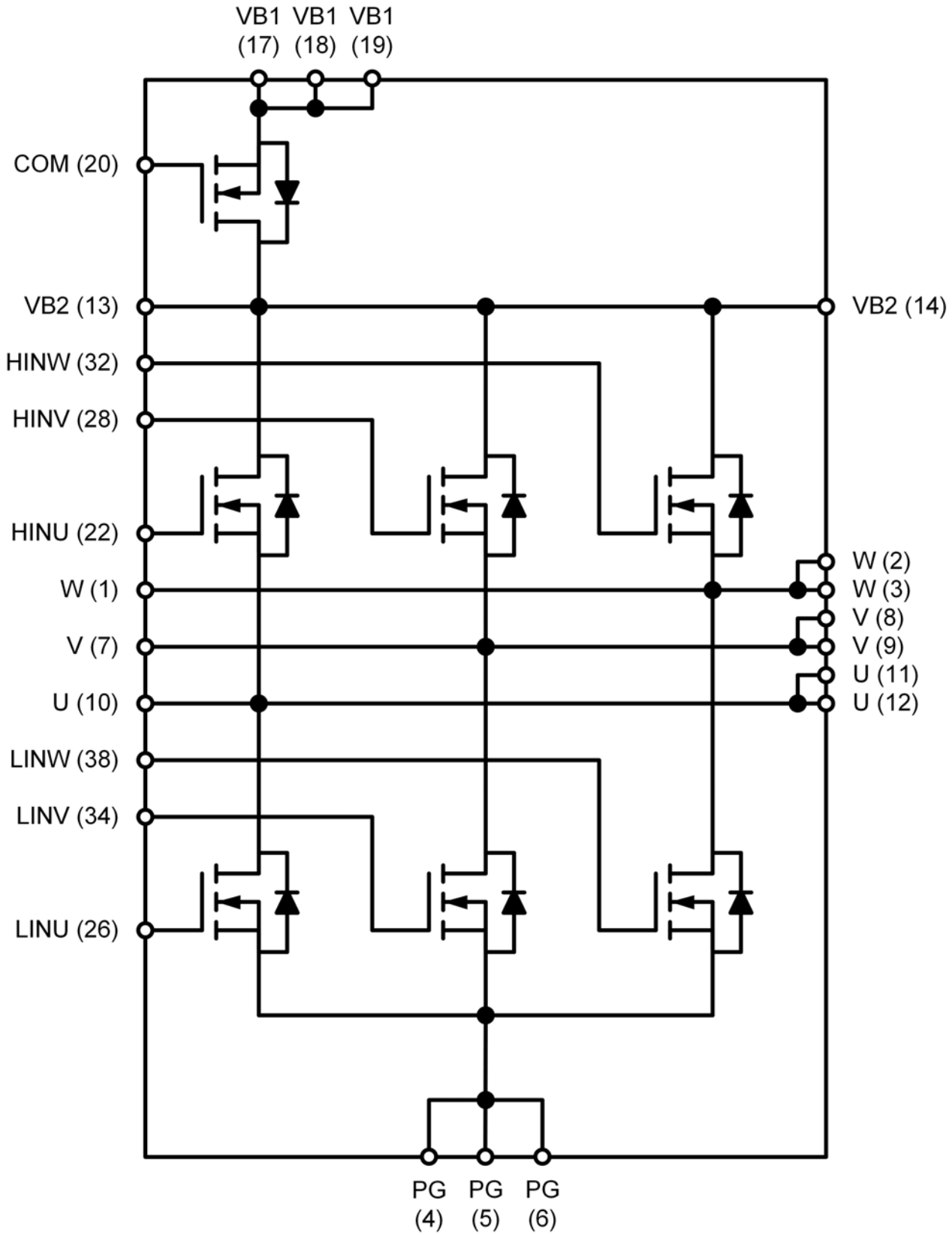


Figure 3: Block Diagram

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

ABSOLUTE MAXIMUM RATINGS (Notes 1,2)

Rating	Symbol	Conditions	Value	Unit
Drain−to−Source Voltage	VDSS		40	V
Control Input Voltage	Vin 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 Tc = 25°C	36	W
Junction Temperature	Tj max		175	°C
Operating Temperature	Tc		−40 to 150	°C
ESD Capability, Human Body Model	ESD_{HBM}		1000	V
ESD Capability, Machine Model	ESD_{MM}		200	V
Storage Temperature	Tstg		−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	Vin	COM to VB1; HINx to x; LINx to PG (x = U,V,W)	-	10	18	V
Drain Current	ID	Tc = 125°C , V_{GS} = 10 V	-	-	27	A
Operating Substrate Temperature	Tc	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.

ELECTRICAL CHARACTERISTICS (Note 4)
at Tc=25°C

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Chip-Case Resistance	Θj-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 (incudes 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

4. 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.
5. Typical data taken from packaged discrete device characteristics

TYPICAL CHARACTERISTICS

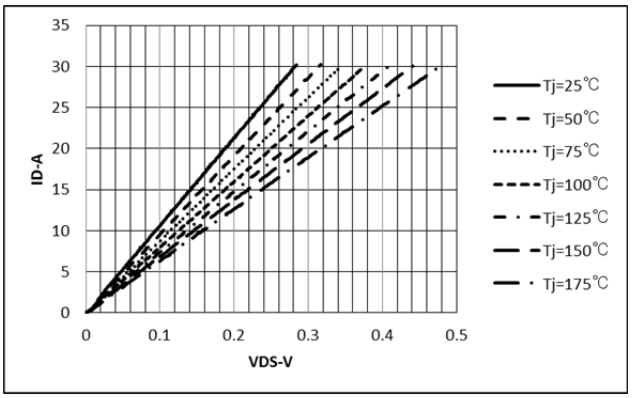


Figure 5 ID versus VDS for different temperatures (VGS = 10 V)

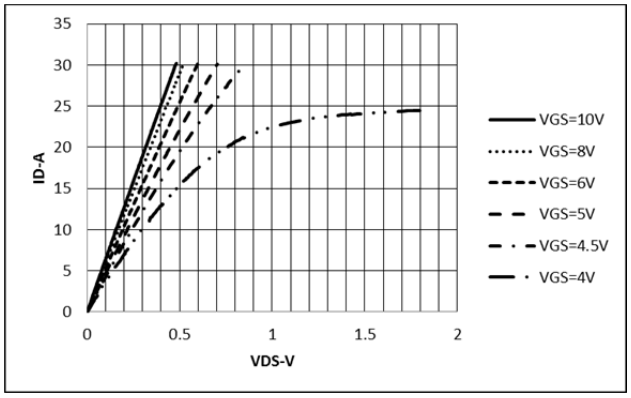


Figure 4 ID versus VDS for different VGS values (Tj = 175°C)

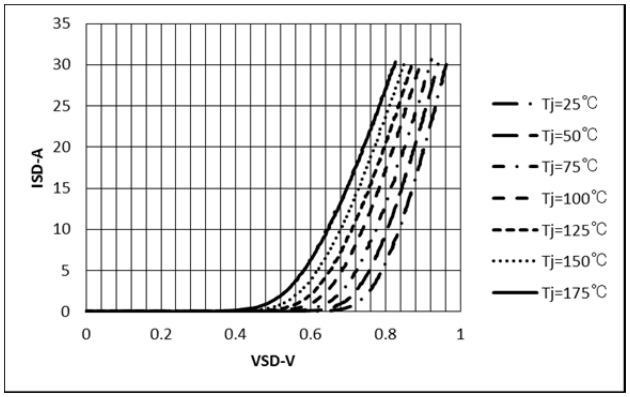


Figure 9 ISD versus VSD for different temperatures

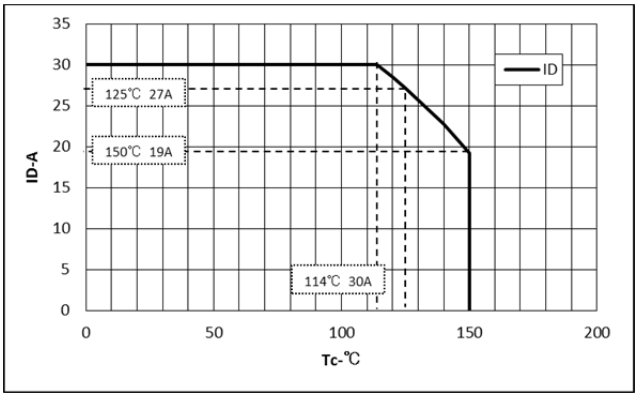


Figure 8 Current Rating

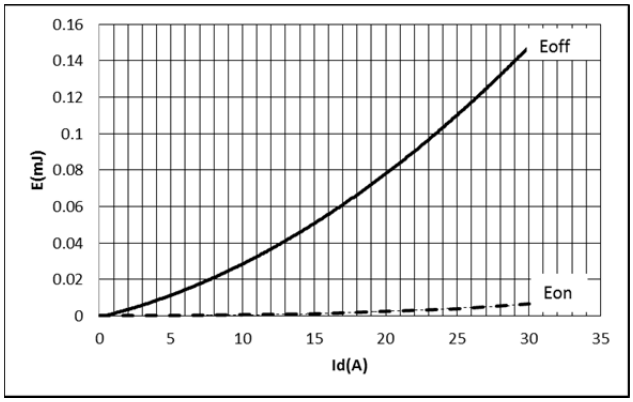


Figure 7 Switching losses versus drain current Tj = 175°C, Id = 30 A, Rg = 51 Ω, L = 40 μH

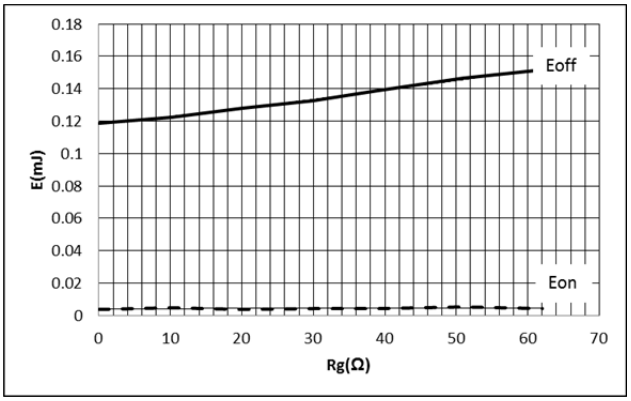


Figure 6 Switching losses versus gate resistance Tj = 175°C, Id = 30 A, L = 40 μH

TYPICAL CHARACTERISTICS

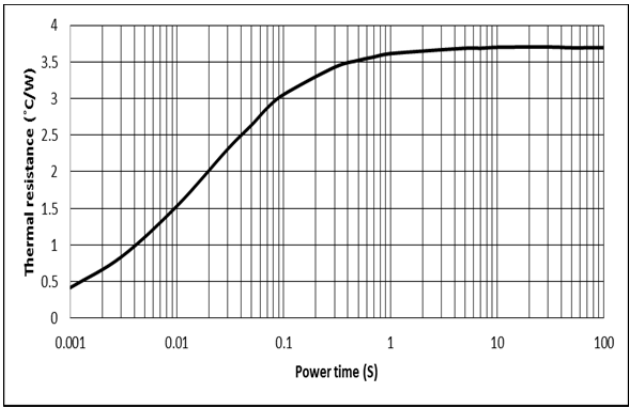


Figure 13 Thermal Impedance

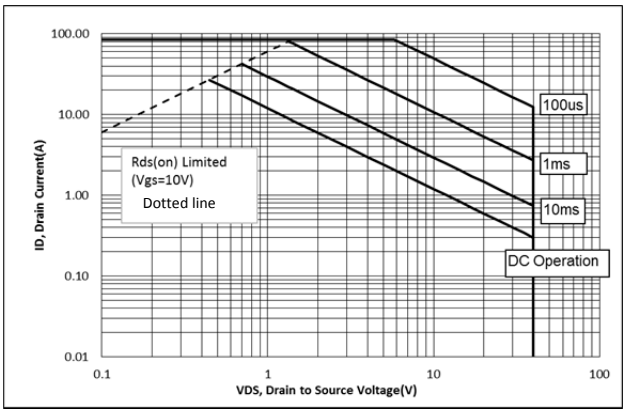


Figure 12 Safe Operating Area

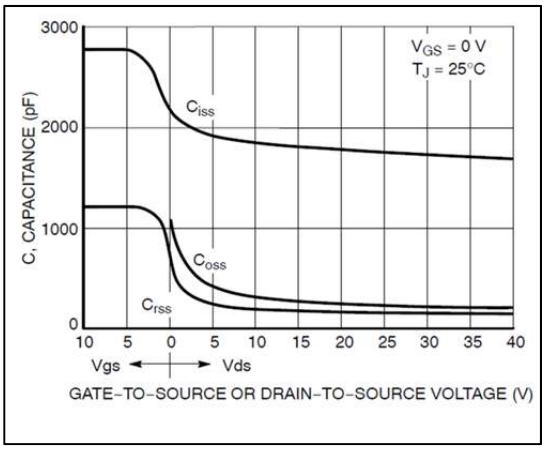


Figure 11 Capacitance Characteristics

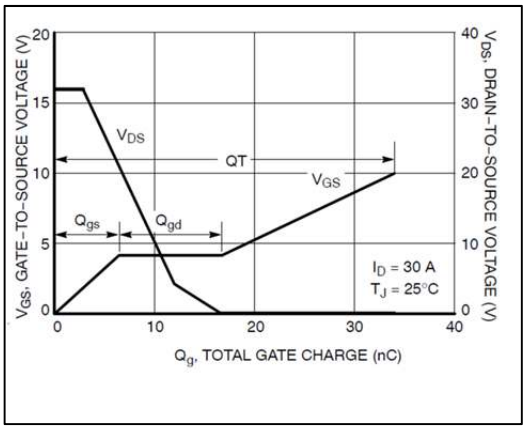


Figure 10 Gate Charge Characteristics

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.

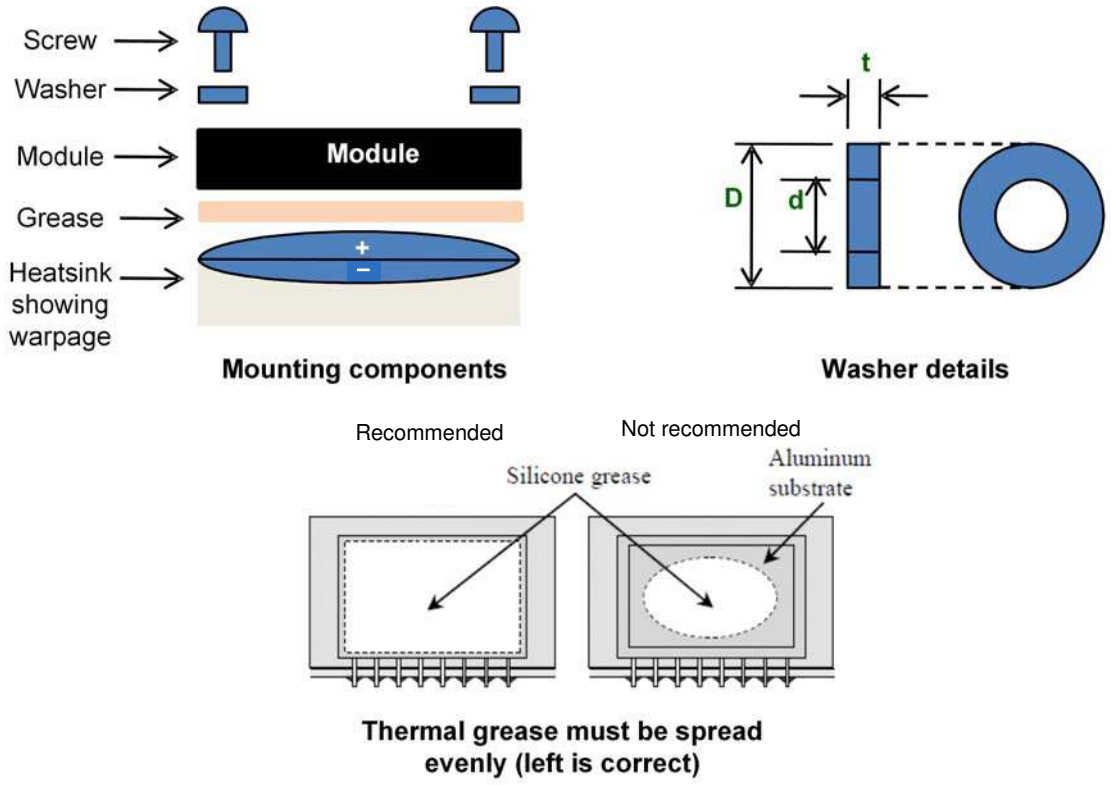


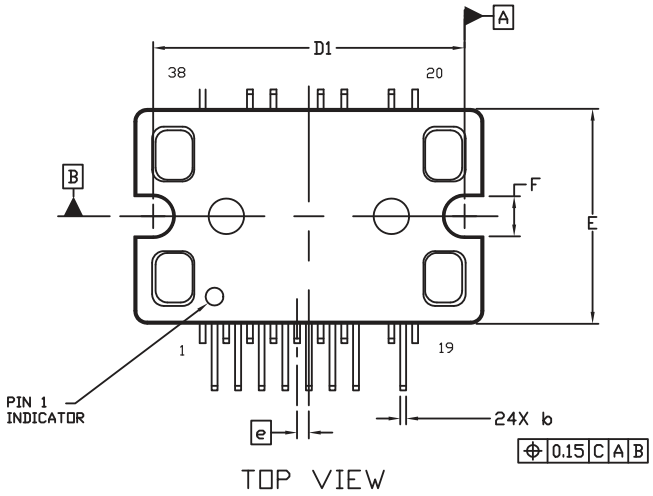
Figure 14: Module Mounting details: components; washer drawing; need for even spreading of thermal grease

PACKAGE DIMENSIONS

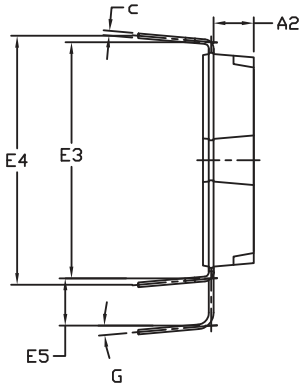
unit : mm

MODULE SPCM24 29.6x18.2 DIP S3

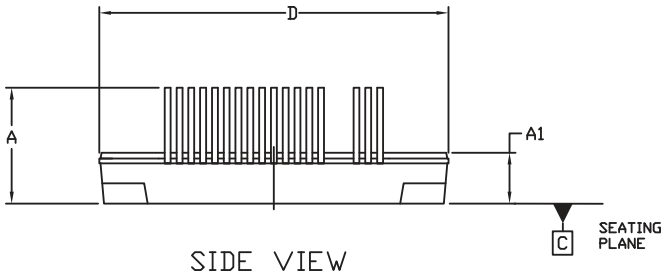
CASE MODBL
ISSUE A



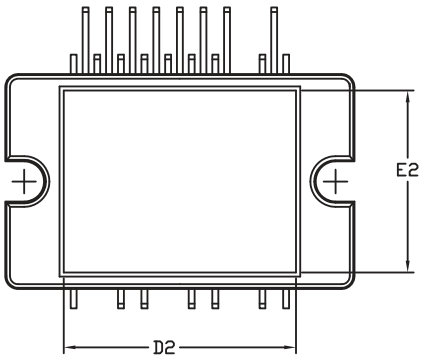
TOP VIEW



END VIEW



SIDE VIEW



BOTTOM VIEW

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.

	MILLIMETERS	
DIM	MIN.	MAX.
A	9.30	10.30
A1	3.80	4.80
A2	2.90	3.90
b	0.45	0.70
c	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
e	1.00 BSC	
F	2.90	3.90
G	4°	6°