V_{DS} = 500 V, I_D = 2.5 A
3-phase Motor Drive Inverter
SMA5146

Data Sheet

Description

The SMA5146 is a MOSFET array for 3-phase brushless DC motor driver ICs.

The product incorporates six low on-resistance N-channel power MOSFETs for 3-phase inverter circuits. The SMA5146 is supplied in a compact SIP12 package of through-hole, achieving a smaller mounting area on a PCB.

Features

- $V_{(BR)DSS}$ ----------------------------500 V (I_D = 100 µA)
- I_D -- 2.5 A
- $R_{DS(ON)}$ --2.4 Ω max.

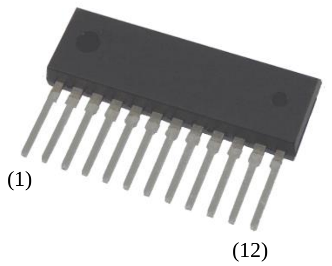
- Bare Lead Frame: Pb-free (RoHS Compliant)
- Built-in Three Half-bridge Circuit Configured by N-channel MOSFET
- Low On-resistance

Applications

- 3-phase DC Motor Driver

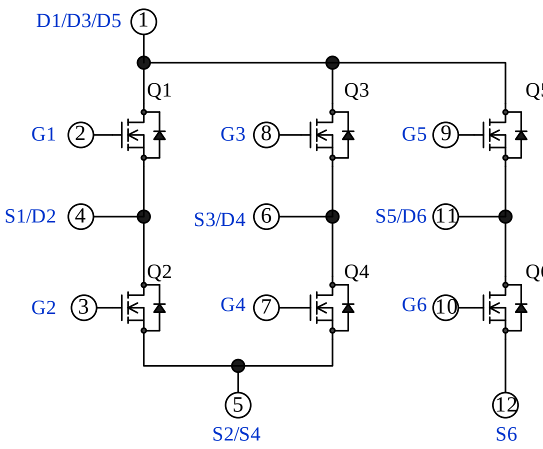
Package

SIP12



Not to scale

Internal Schematic Diagram



Absolute Maximum Ratings

Unless otherwise specified, T_A = 25 °C.

Characteristic	Symbol	Test Conditions	Rating	Unit
Drain-to-Source Voltage	V_{DS}		500	V
Gate- to-Source Voltage	V_{GS}		±30	V
Continuous Drain Current	I_D		2.5	A
Pulsed Drain Current	I_{DM}	Pulse width ≤ 1 ms, duty cycle ≤ 25%	5	A
Avalanche Energy	E_{AS}	V_{DD} = 30 V, L = 10 mH, I_D = 2.5A, unclampd, R_G = 50 Ω	30	mJ
Avalanche Current	I_{AS}		2.5	A
Maximum Allowable Power Dissipation	P_D	Without heatsink, T_A = 25 °C, all element operation	4	W
		T_C = 25 °C, all element operation	28	
Junction Temperature	T_J		150	°C
Storage Temperature	T_{STG}		−40 to 150	°C

Electrical Characteristics

Unless otherwise specified, T_A = 25 °C.

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	I_D = 100 µA, V_{GS} = 0 V	500	—	—	V
Drain-to-Source Leakage Current	I_{DSS}	V_{DS} = 500 V, V_{GS} = 0 V	—	—	100	µA
Gate-to-Source Leakage Current	I_{GSS}	V_{GS} = ±30 V	—	—	± 100	nA
Gate Threshold Voltage	$V_{GS(TH)}$	V_{DS} = 10 V, I_D = 1 mA	2.0	—	4.0	V
Static Drain-to-Source On-resistance	$R_{DS(ON)}$	I_D = 1.5 A, V_{GS} = 10 V	—	2.0	2.4	Ω
Input Capacitance	C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	340	—	pF
Output Capacitance	C_{oss}		—	150	—	
Reverse Transfer Capacitance	C_{rss}		—	25	—	
Turn-on Delay Time	$t_{d(ON)}$	V_{DD} = 280 V, I_D = 1.5 A, V_{GS} = 10 V, R_L = 187 Ω, R_G =50 Ω	—	24	—	ns
Turn-on Rise Time	t_r		—	29	—	
Turn-off Delay Time	$t_{d(OFF)}$		—	67	—	
Turn-off Fall Time	t_f		—	36	—	
Total Gate Charge	Q_G	V_{DD} = 280 V, I_D = 1.5 A, V_{GS} = 10 V	—	8.5	—	nC
Gate-to-Source Charge	Q_{GS}		—	1.5	—	nC
Gate-to-Drain Charge	Q_{GD}		—	3.5	—	nC
Source-to-Drain Diode Forward Voltage	V_{SD}	I_{SD} = 1.5 A, V_{GS} = 0 V	—	1.1	1.5	V
Source-to-Drain Diode Reverse Recovery Time	t_{rr}	I_{SD} = 1.5 A, V_{GS} = 0 V, di/dt = 100 A/µs	—	75	—	ns

Thermal Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Thermal Resistance (Junction-to-Ambient)	$R_{\theta JA}$	All Element Operation	—	—	31.25	°C/W
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	All Element Operation	—	—	4.46	°C/W

Mechanical Characteristics

Parameter	Conditions	Min.	Typ.	Max.	Unit
Package Weight		—	4.0	—	g

Derating Curves

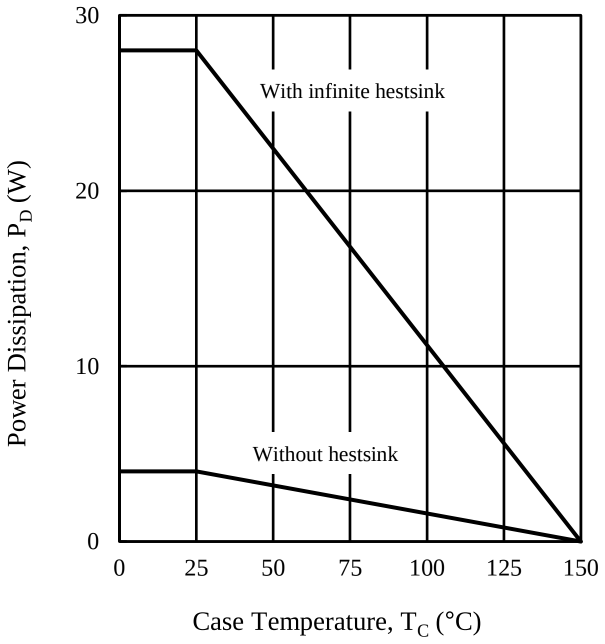


Figure 1. P_D vs. T_C

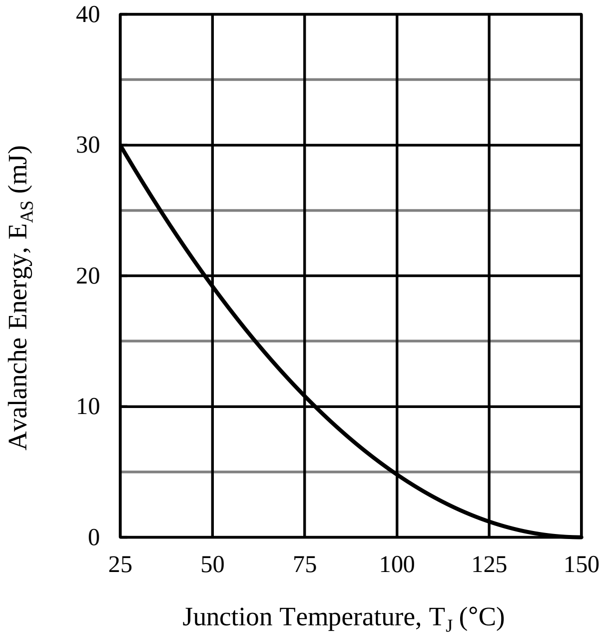


Figure 2. E_{AS} vs. T_J (Single Pulse)

Characteristic Curves

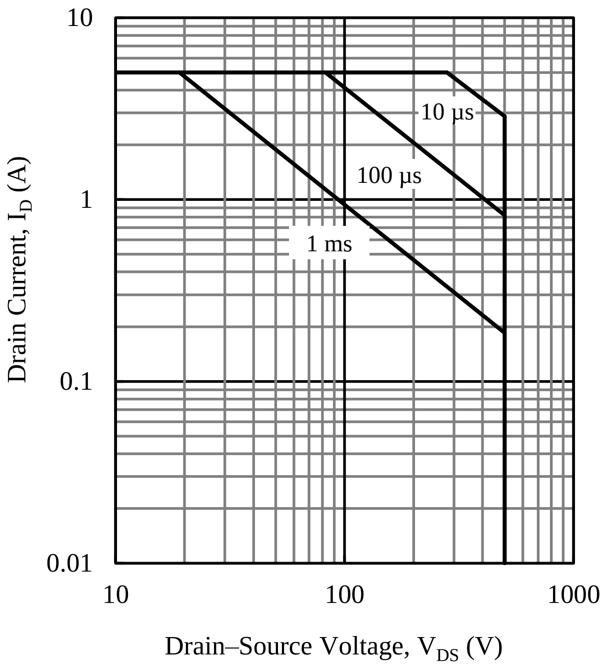


Figure 3. Safe Operating Area
(Single pulse, T_J = 25 °C)

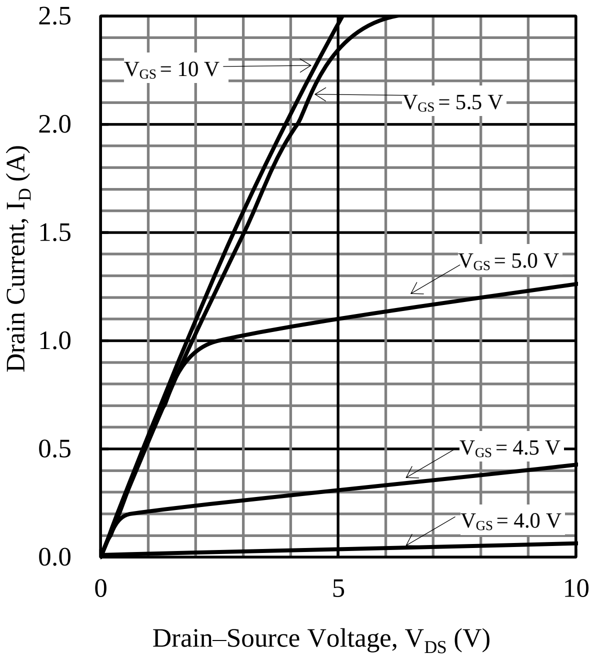


Figure 4. Typical Characteristics:
I_D vs. V_{DS} (T_J = 25 °C)

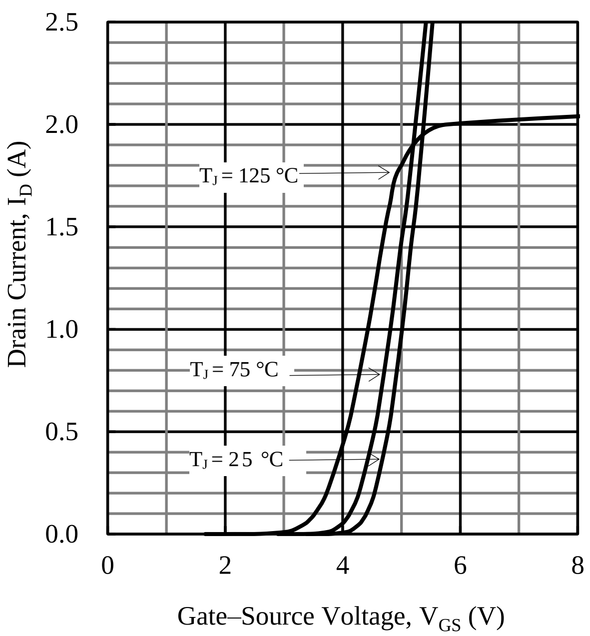


Figure 5. Typical Characteristics:
I_D vs. V_{GS} (V_{DS} = 10 V)

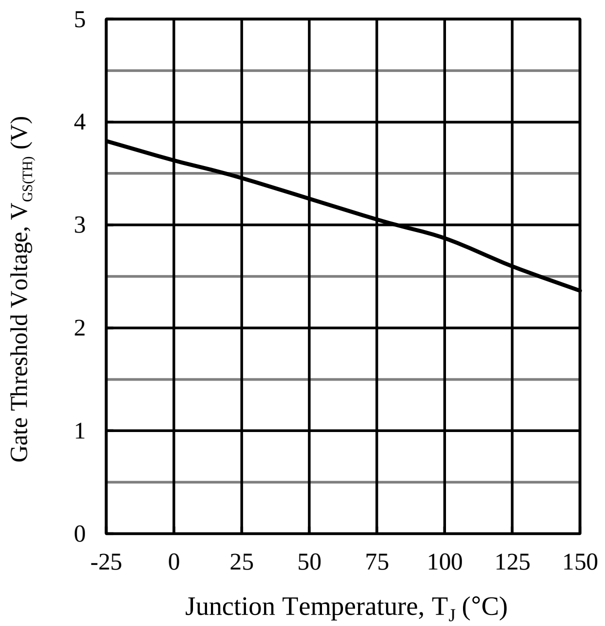


Figure 6. Typical Characteristics:
$V_{GS(TH)}$ vs. T_J (V_{DS} = 10 V, I_D = 1 mA)

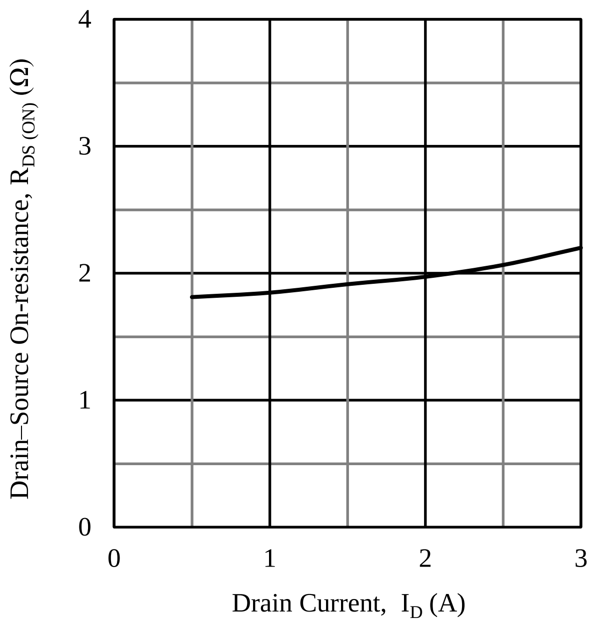


Figure 7. Typical Characteristics:
$R_{DS(ON)}$ vs. I_D (V_{GS} = 10 V, T_J = 25 °C)

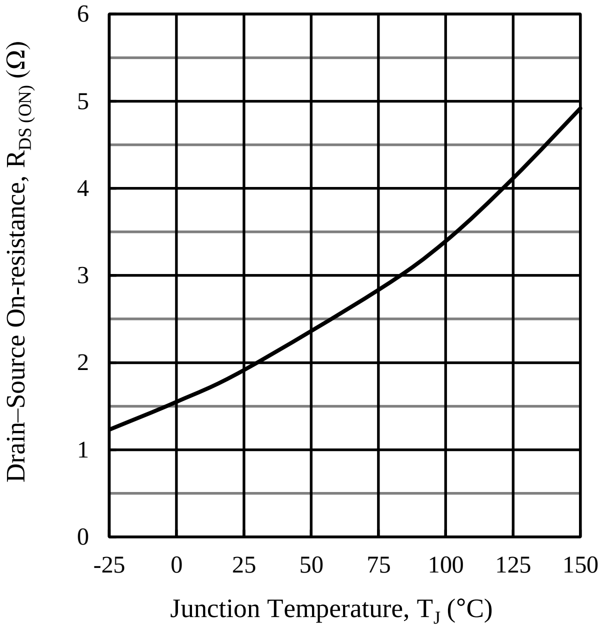


Figure 8. Typical Characteristics:
$R_{DS(ON)}$ vs. T_J (V_{GS} = 10 V, I_D = 1.5 A)

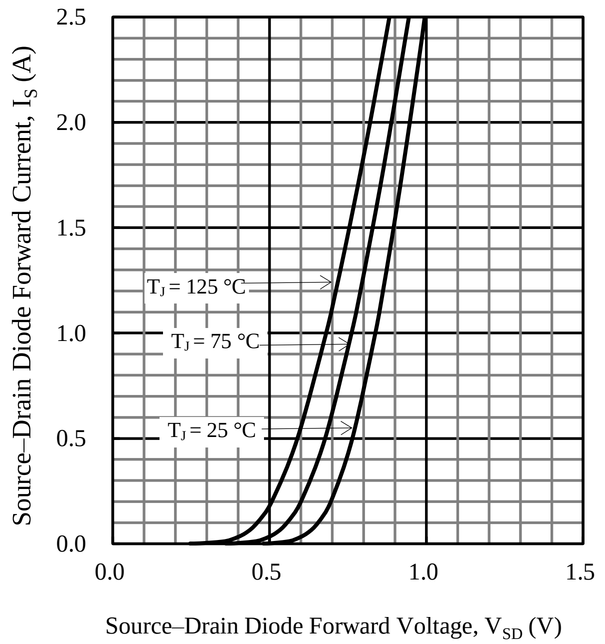


Figure 9. Typical Characteristics:
I_S vs. V_{SD} (V_{GS} = 0 V)

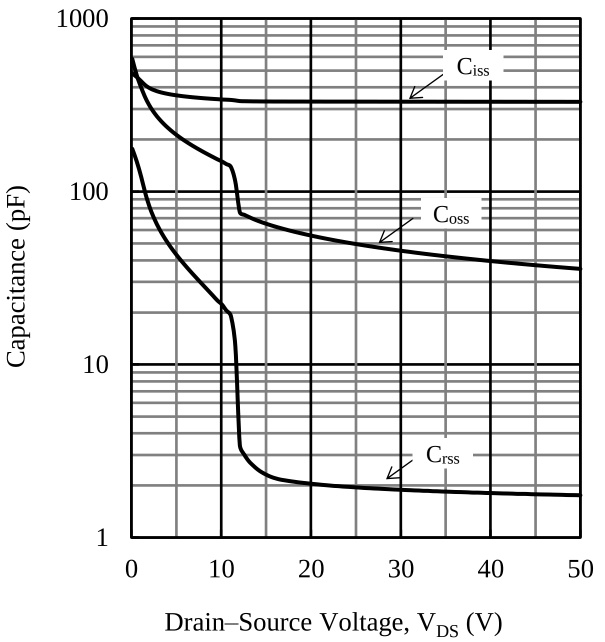


Figure 10. Typical Characteristics:
Capacitance vs. V_{DS}
(f = 1 MHz, V_{GS} = 0 V)

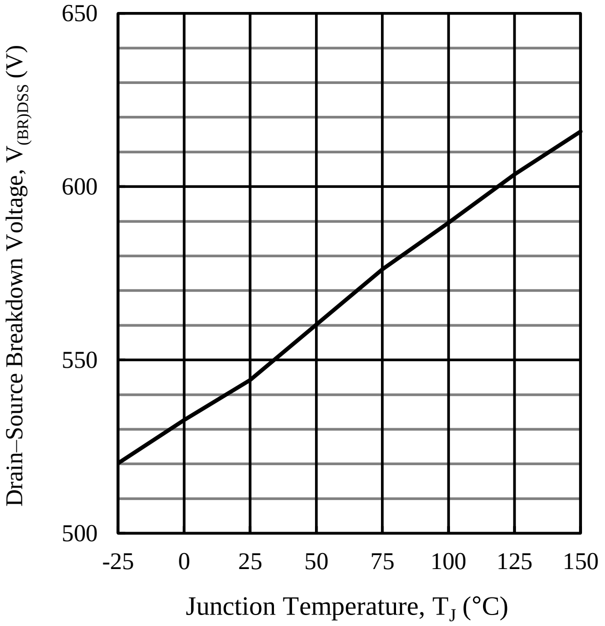


Figure 11. Typical Characteristics:
$V_{(BR)DSS}$ vs. T_J (I_D = 100 µA, V_{GS} = 0 V)

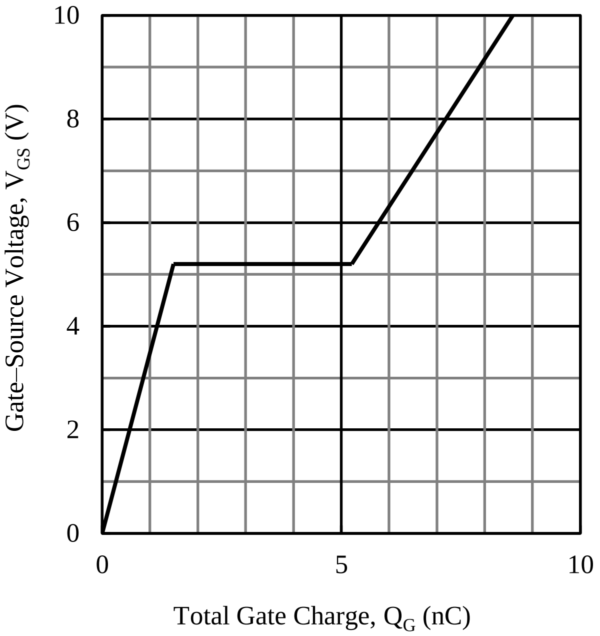


Figure 12. Typical Characteristics:
V_{GS} vs. Q_G (I_D = 1.5 A, V_{DD} = 10 V)

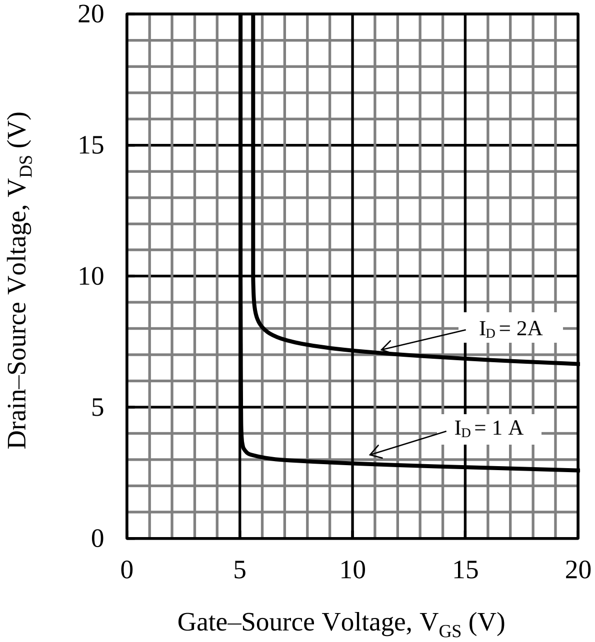


Figure 13. Typical Characteristics:
V_{DS} vs. V_{GS} (T_A = 25 °C)

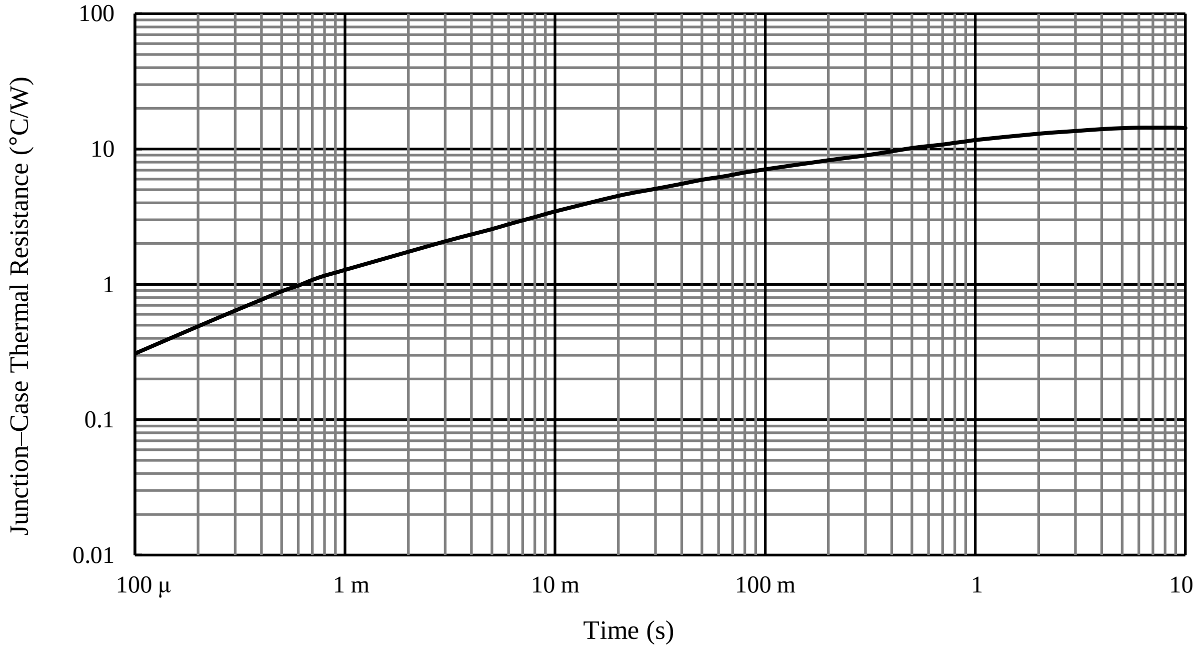
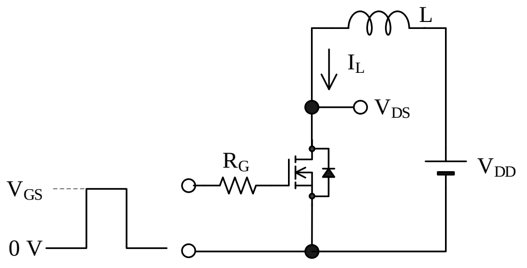
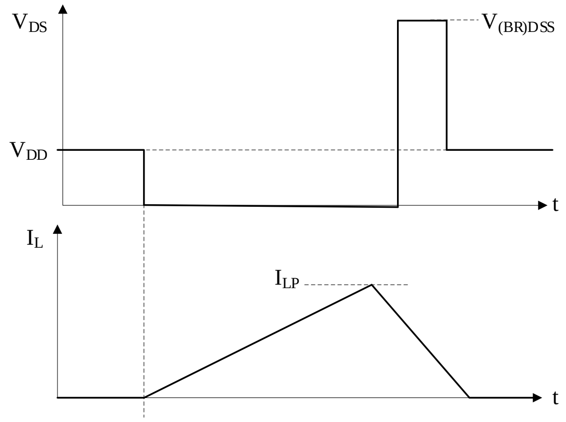


Figure 14. Transient Thermal Resistance Characteristics
(V_{DS} < 10 V, T_C=25°C, Single Pulse, 1 Element Operation)

$$E_{AS} = \frac{1}{2} \times L \times I_{LP}{}^{2} \times \frac{V_{(BR)DSS}}{V_{(BR)DSS} - V_{DD}}$$

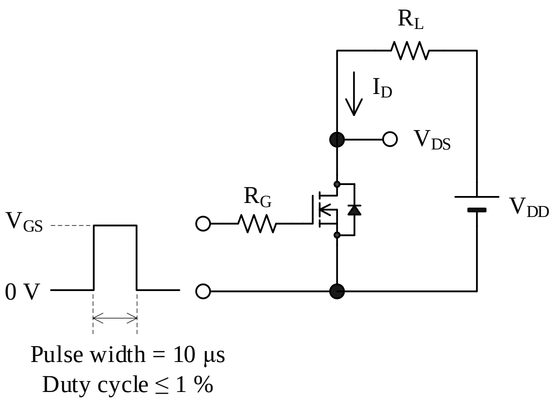


(a) Test Circuit

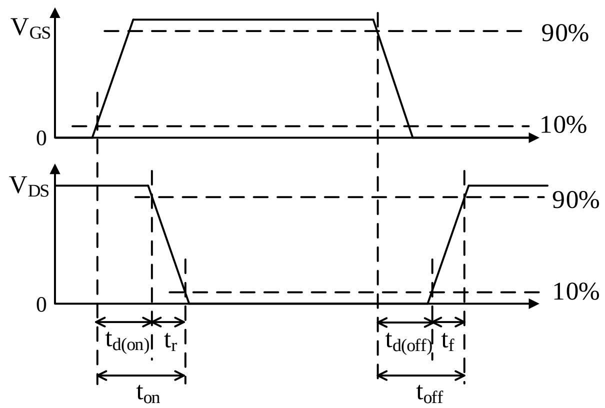


(b) Waveforms

Figure 15. Avalanche Energy Test



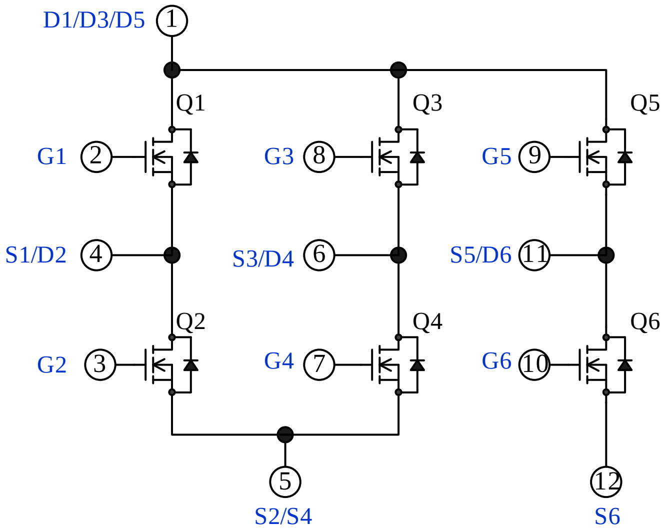
(a) Test Circuit



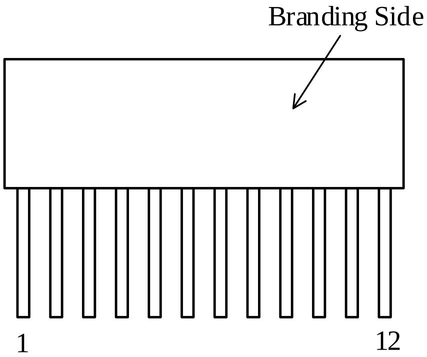
(b) Waveforms

Figure 16. Switching Time Test

Internal Schematic Diagram



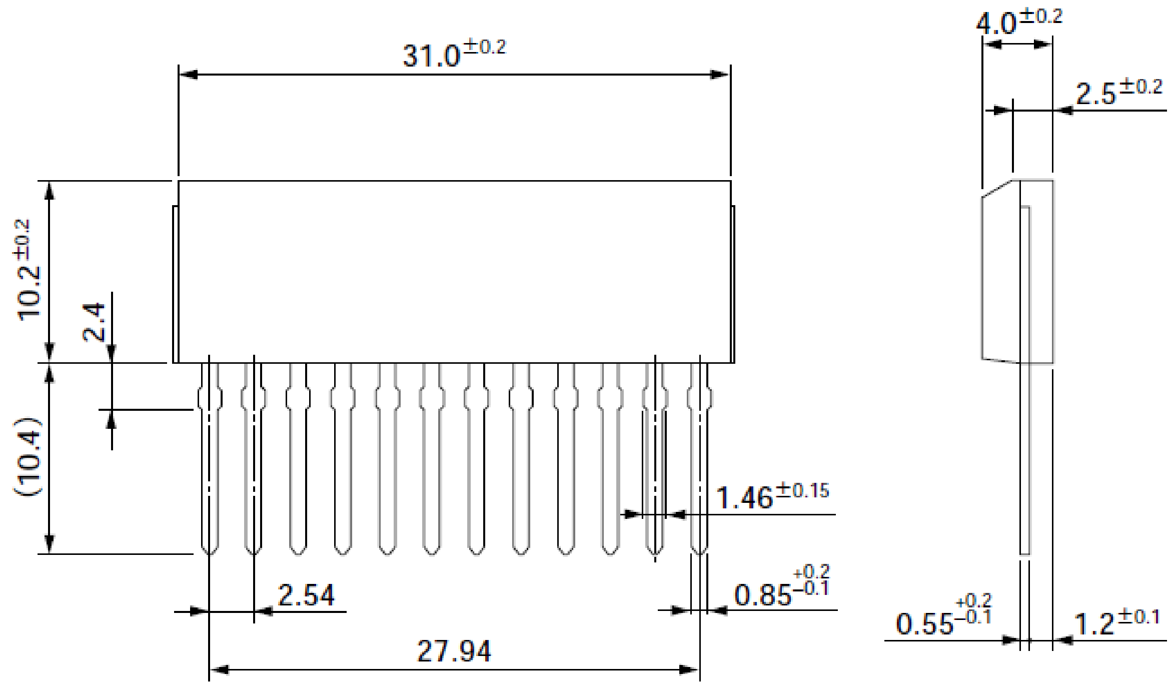
Pin Configuration Definitions



Pin Number	Name	Description	Pin Number	Name	Description
1	D1/D3/D5	Q1, Q3, Q5 drain	7	G4	Q4 gate
2	G1	Q1 gate	8	G3	Q3 gate
3	G2	Q2 gate	9	G5	Q5 gate
4	S1/D2	Q1 source, Q2 drain	10	G6	Q6 gate
5	S2/S4	Q2, Q4 source	11	S5/D6	Q5 source, Q6 drain
6	S3/D4	Q3 source, Q4 drain	12	S6	Q6 source

Physical Dimensions

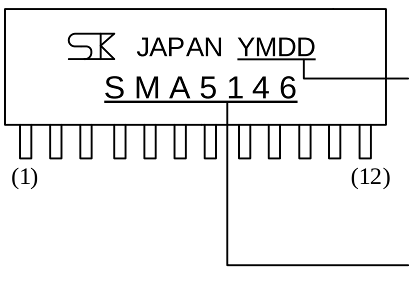
- **SIP12**



NOTES:

- Dimensions in millimeters
- Bare lead frame: Pb-free (RoHS compliant)
- When soldering the products, it is required to minimize the working time within the following limits:
  Flow: 260 °C / 10 s, 1 time
  Soldering Iron: 350 °C / 3.5 s, 1 time (Soldering should be at a distance of at least 1.5 mm from the body of the product.)
  Soldering should be at a distance of at least 1.5 mm from the body of the product

Marking Diagram



Lot Number:
Y is the last digit of the year of manufacture (0 to 9)
M is the month of the year (1 to 9, O, N or D)
DD is the day of the month (01 to 31)

Part Number

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