



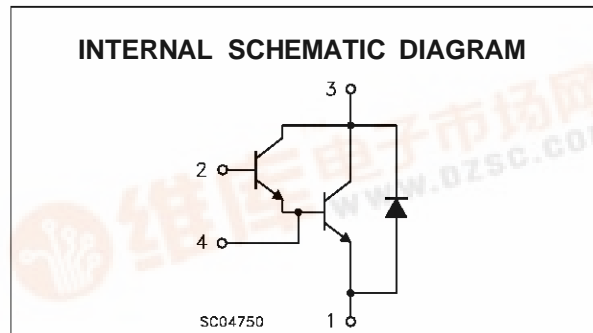
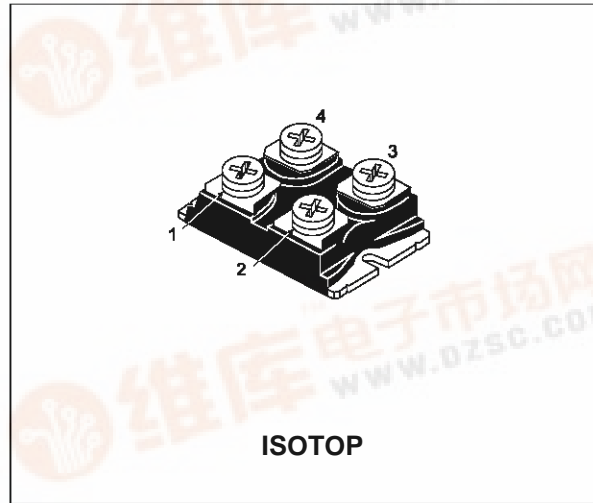
# ESM4045DV

## NPN DARLINGTON POWER MODULE

- HIGH CURRENT POWER BIPOLAR MODULE
- VERY LOW  $R_{th}$  JUNCTION CASE
- SPECIFIED ACCIDENTAL OVERLOAD AREAS
- ULTRAFAST FREEWHEELING DIODE
- ISOLATED CASE (2500V RMS)
- EASY TO MOUNT
- LOW INTERNAL PARASITIC INDUCTANCE

### APPLICATIONS:

- MOTOR CONTROL
- SMPS & UPS
- DC/DC & DC/AC CONVERTERS
- WELDING EQUIPMENT



### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CEV}$	Collector-Emitter Voltage ( $V_{BE} = -5\text{ V}$ )	600	V
$V_{CEO(sus)}$	Collector-Emitter Voltage ( $I_B = 0$ )	450	V
$V_{EBO}$	Emitter-Base Voltage ( $I_C = 0$ )	7	V
$I_C$	Collector Current	42	A
$I_{CM}$	Collector Peak Current ( $t_p = 10\text{ ms}$ )	63	A
$I_B$	Base Current	4	A
$I_{BM}$	Base Peak Current ( $t_p = 10\text{ ms}$ )	8	A
$P_{tot}$	Total Dissipation at $T_c = 25\text{ }^\circ\text{C}$	150	W
$T_{stg}$	Storage Temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Max. Operating Junction Temperature	150	$^\circ\text{C}$
$V_{iso}$	Insulation Withstand Voltage (AC-RMS)	2500	$^\circ\text{C}$

# ESM4045DV

## THERMAL DATA

R <sub>thj-case</sub>	Thermal Resistance Junction-case (transistor)	Max	0.83	°C/W
R <sub>thj-case</sub>	Thermal Resistance Junction-case (diode)	Max	1.5	°C/W
R <sub>thc-h</sub>	Thermal Resistance Case-heatsink With Conductive Grease Applied	Max	0.05	°C/W

## ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I <sub>CER</sub> #	Collector Cut-off Current (R <sub>BE</sub> = 5 Ω)	V <sub>CE</sub> = V <sub>CEV</sub> V <sub>CE</sub> = V <sub>CEV</sub> T <sub>j</sub> = 100 °C			1.5 20	mA mA
I <sub>CEV</sub> #	Collector Cut-off Current (V <sub>BE</sub> = -5)	V <sub>CE</sub> = V <sub>CEV</sub> V <sub>CE</sub> = V <sub>CEV</sub> T <sub>j</sub> = 100 °C			1 13	mA mA
I <sub>EBO</sub> #	Emitter Cut-off Current (I <sub>C</sub> = 0)	V <sub>EB</sub> = 5 V			1	mA
V <sub>CEO(SUS)</sub> *	Collector-Emitter Sustaining Voltage	I <sub>C</sub> = 0.2 A L = 25 mH V <sub>clamp</sub> = 450 V	450			V
h <sub>FE</sub> *	DC Current Gain	I <sub>C</sub> = 35 A V <sub>CE</sub> = 5 V		220		
V <sub>CE(sat)</sub> *	Collector-Emitter Saturation Voltage	I <sub>C</sub> = 25 A I <sub>B</sub> = 0.5 A I <sub>C</sub> = 25 A I <sub>B</sub> = 0.5 A T <sub>j</sub> = 100 °C I <sub>C</sub> = 35 A I <sub>B</sub> = 2 A I <sub>C</sub> = 35 A I <sub>B</sub> = 2 A T <sub>j</sub> = 100 °C		1.15 1.3 1.4 1.5	2 2	V V V V
V <sub>BE(sat)</sub> *	Base-Emitter Saturation Voltage	I <sub>C</sub> = 35 A I <sub>B</sub> = 2 A I <sub>C</sub> = 35 A I <sub>B</sub> = 2 A T <sub>j</sub> = 100 °C		2.3 2.3	3	V V
di <sub>C</sub> /dt	Rate of Rise of On-state Collector	V <sub>CC</sub> = 300 V R <sub>C</sub> = 0 t <sub>p</sub> = 3 μs I <sub>B1</sub> = 0.75 A T <sub>j</sub> = 100 °C	200	250		A/μs
V <sub>CE(3 μs)</sub>	Collector-Emitter Dynamic Voltage	V <sub>CC</sub> = 300 V R <sub>C</sub> = 12 Ω I <sub>B1</sub> = 0.75 A T <sub>j</sub> = 100 °C		4.5	8	V
V <sub>CE(5 μs)</sub>	Collector-Emitter Dynamic Voltage	V <sub>CC</sub> = 300 V R <sub>C</sub> = 12 Ω I <sub>B1</sub> = 0.75 A T <sub>j</sub> = 100 °C		2.5	4.5	V
t <sub>s</sub>	Storage Time	I <sub>C</sub> = 25A V <sub>CC</sub> = 50 V		3.2	5	μs
t <sub>f</sub>	Fall Time	V <sub>BB</sub> = -5 V R <sub>BB</sub> = 0.6 Ω		0.25	0.5	μs
t <sub>c</sub>	Cross-over Time	V <sub>clamp</sub> = 450 V I <sub>B1</sub> = 0.5 A L = 0.1 mH T <sub>j</sub> = 100 °C		0.75	1.5	μs
V <sub>CEW</sub>	Maximum Collector Emitter Voltage Without Snubber	I <sub>CWoff</sub> = 42 A I <sub>B1</sub> = 2 A V <sub>BB</sub> = -5 V V <sub>CC</sub> = 50 V L = 0.06 mH R <sub>BB</sub> = 0.6 Ω T <sub>j</sub> = 125 °C	450			V
V <sub>F</sub> *	Diode Forward Voltage	I <sub>F</sub> = 35 A T <sub>j</sub> = 100 °C		1.5	1.85	V
I <sub>RM</sub>	Reverse Recovery Current	V <sub>CC</sub> = 200 V I <sub>F</sub> = 35 A di <sub>F</sub> /dt = -200 A/μs L < 0.05 μH T <sub>j</sub> = 100 °C		20	24	A

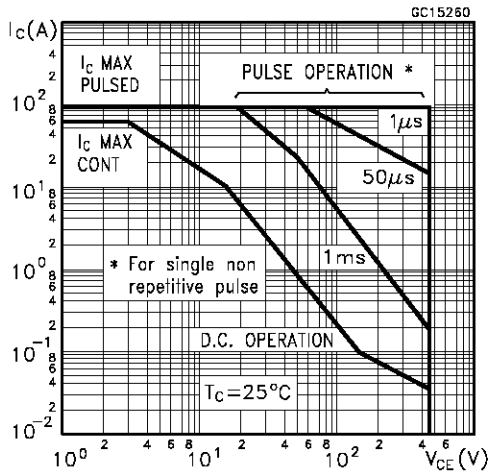
\* Pulsed: Pulse duration = 300 μs, duty cycle 1.5 %

To evaluate the conduction losses of the diode use the following equations:

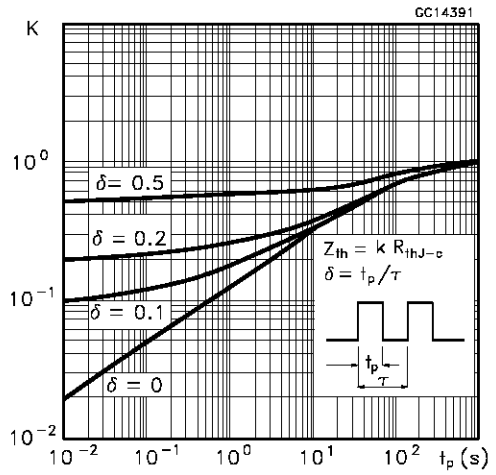
$$V_F = 1.5 + 0.001 I_F \quad P = 1.5 I_{F(AV)} + 0.001 I_{F(RMS)}^2$$

# See test circuits in databook introduction

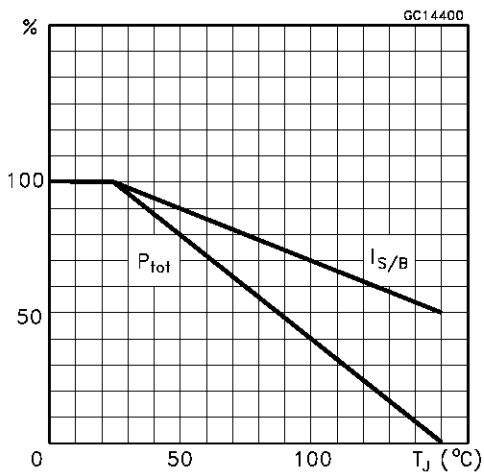
Safe Operating Areas



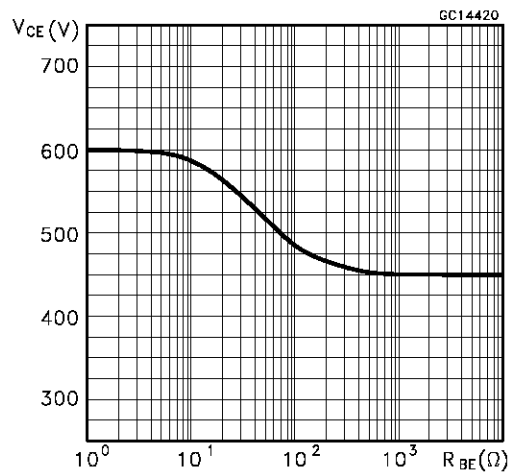
Thermal Impedance



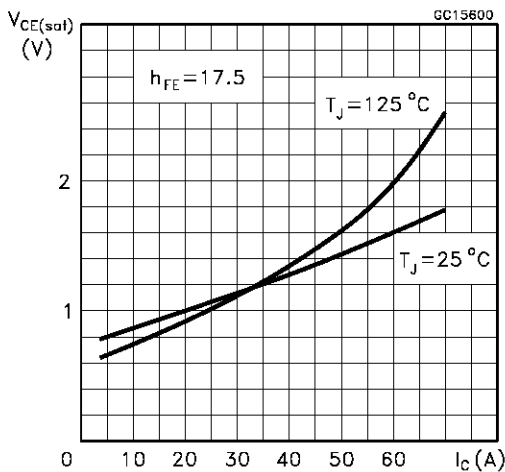
Derating Curve



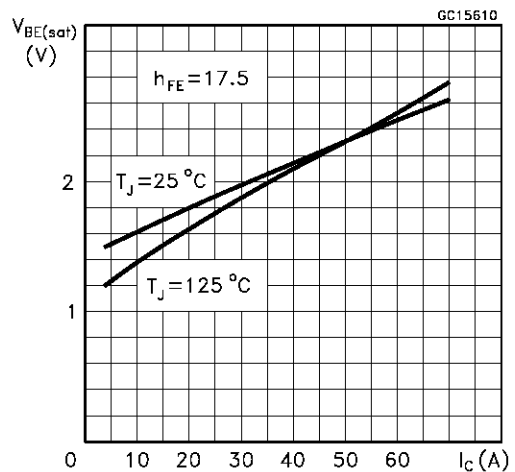
Collector-emitter Voltage Versus base-emitter Resistance



Collector Emitter Saturation Voltage

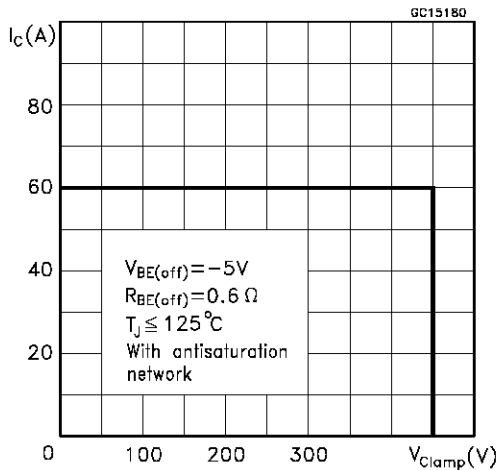


Base-Emitter Saturation Voltage

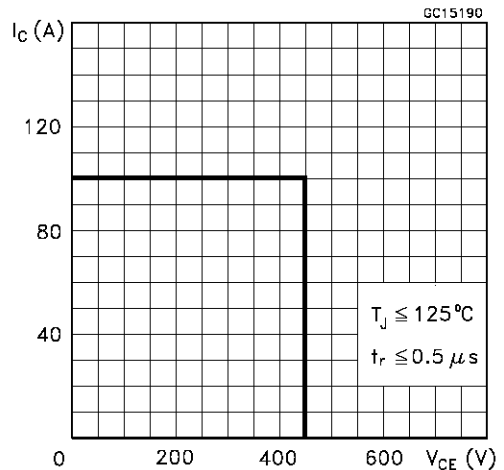


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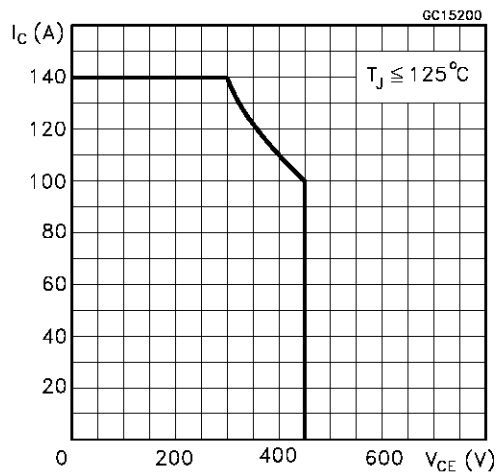
Reverse Biased SOA



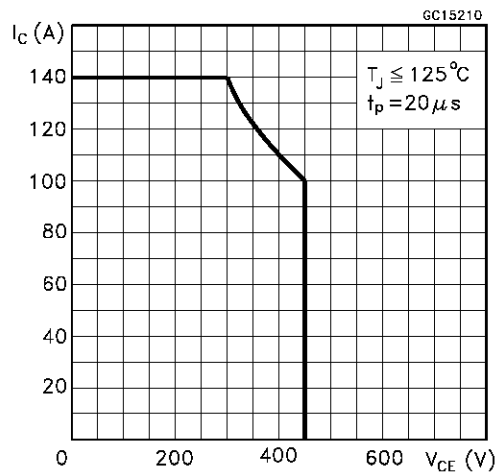
Foward Biased SOA



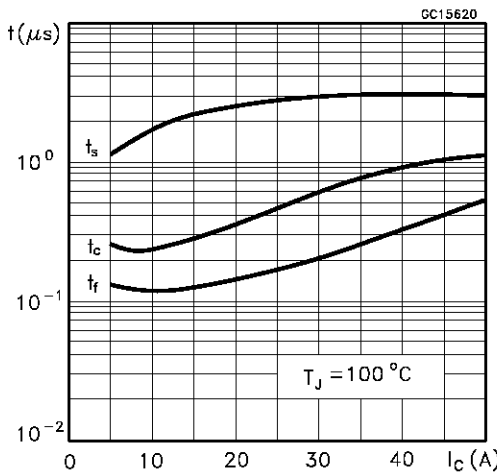
Reverse Biased AOA



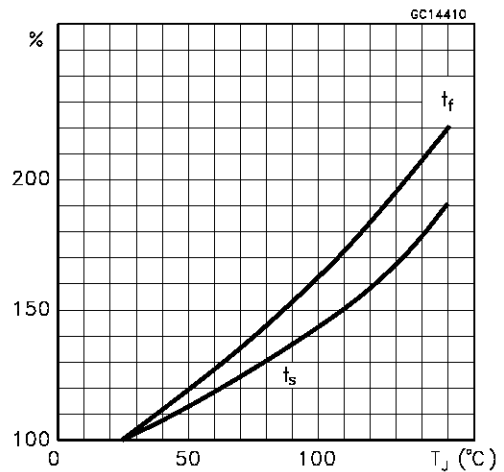
Forward Biased AOA



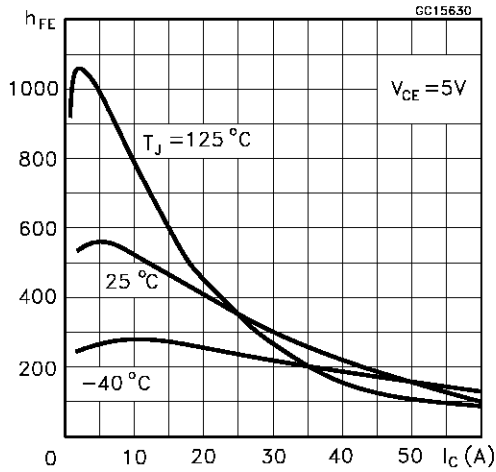
Switching Times Inductive Load



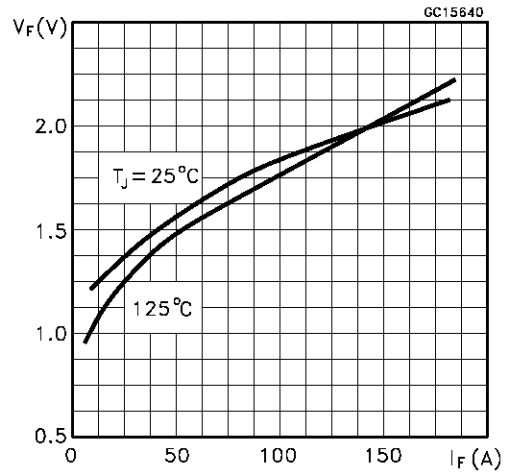
Switching Times Inductive Load Versus Temperature



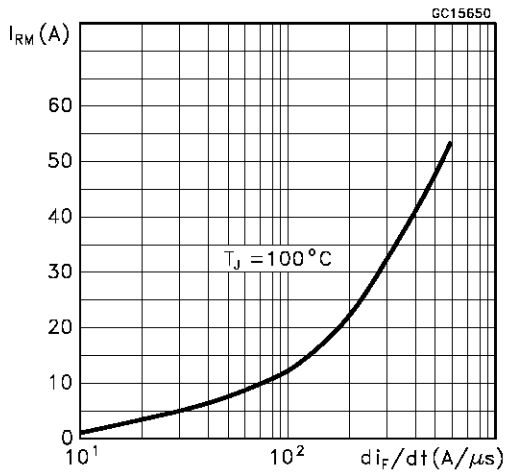
Dc Current Gain



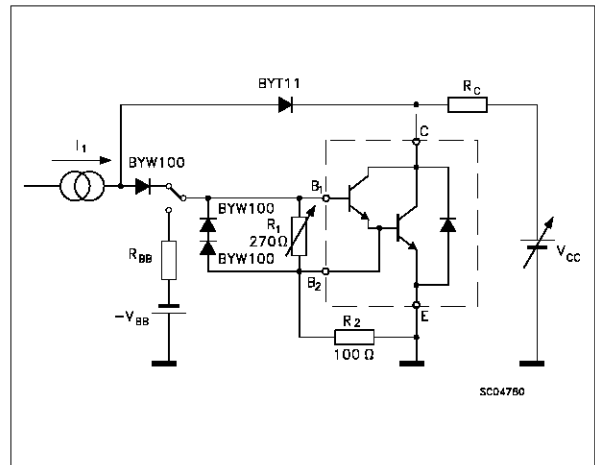
Typical  $V_F$  Versus  $I_F$



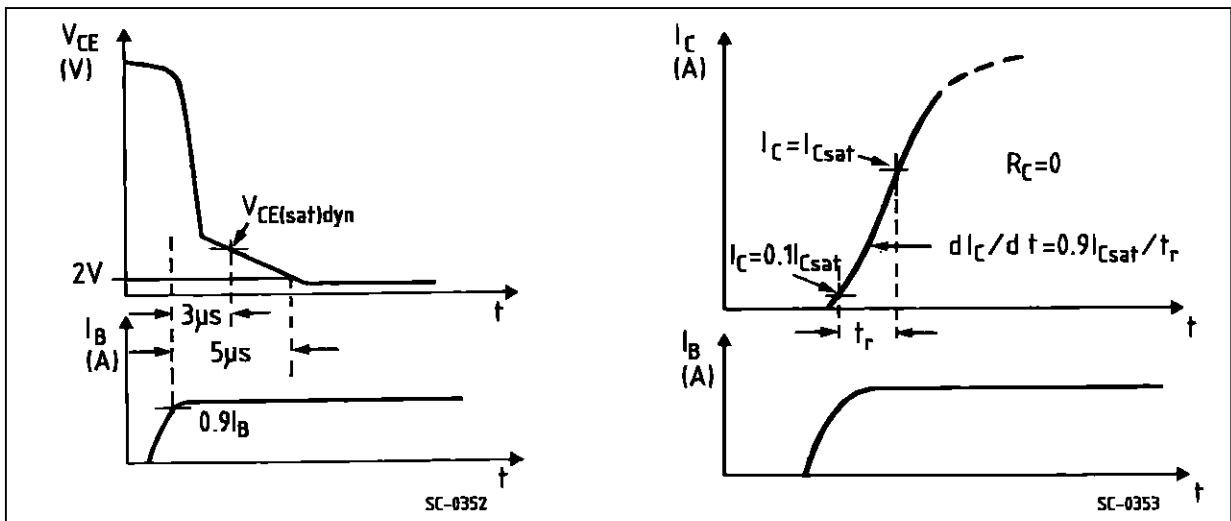
Peak Reverse Current Versus  $di_F/dt$



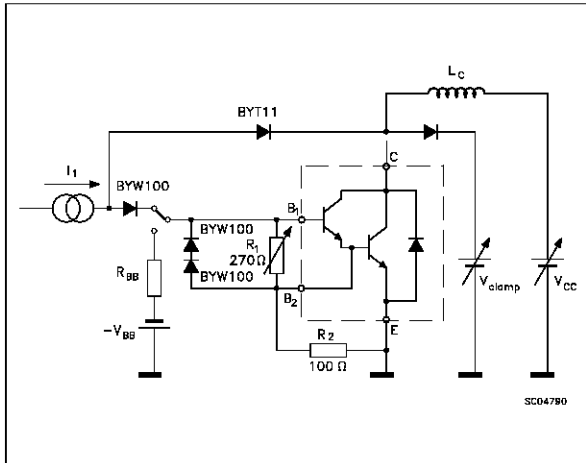
Turn-on Switching Test Circuit



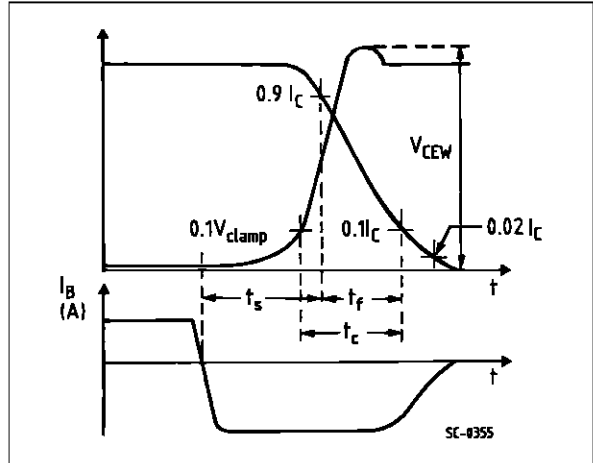
Turn-on Switching Waveforms



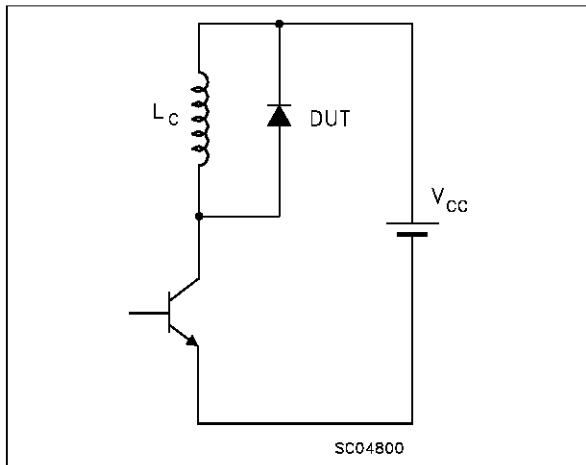
Turn-on Switching Test Circuit



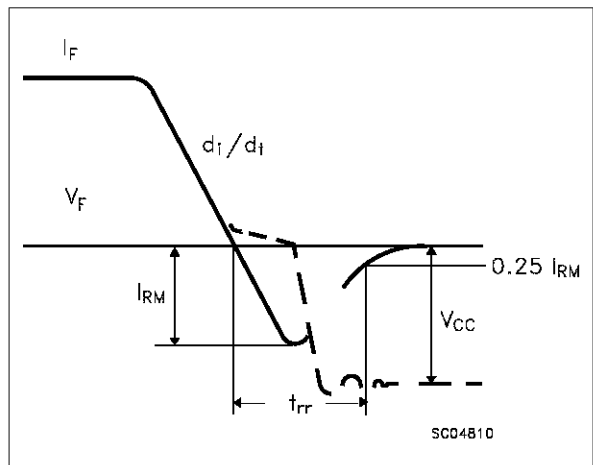
Turn-off Switching Waveforms



Turn-off Switching Test Circuit of Diode

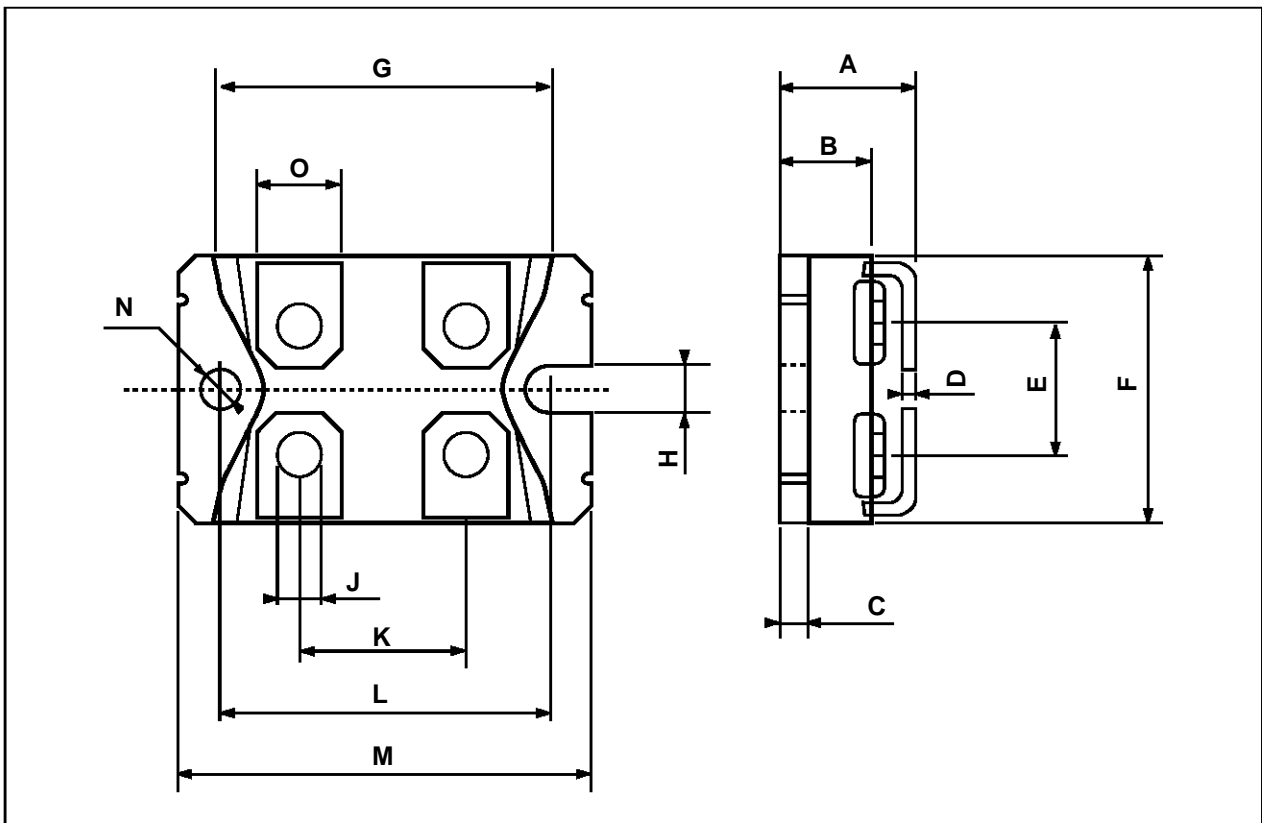


Turn-off Switching Waveform of Diode



## ISOTOP MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	11.8		12.2	0.466		0.480
B	8.9		9.1	0.350		0.358
C	1.95		2.05	0.076		0.080
D	0.75		0.85	0.029		0.033
E	12.6		12.8	0.496		0.503
F	25.15		25.5	0.990		1.003
G	31.5		31.7	1.240		1.248
H	4			0.157		
J	4.1		4.3	0.161		0.169
K	14.9		15.1	0.586		0.594
L	30.1		30.3	1.185		1.193
M	37.8		38.2	1.488		1.503
N	4			0.157		
O	7.8		8.2	0.307		0.322



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