



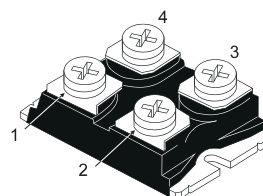
# ESM4045DV

## NPN DARLINGTON POWER MODULE

- HIGH CURRENT POWER BIPOLAR MODULE
- VERY LOW  $R_{th}$  JUNCTION CASE
- SPECIFIED ACCIDENTAL OVERLOAD AREAS
- ULTRAFAST FREEWHEELING DIODE
- INSULATED PACKAGE (UL COMPLIANT)
- EASY TO MOUNT
- LOW INTERNAL PARASITIC INDUCTANCE

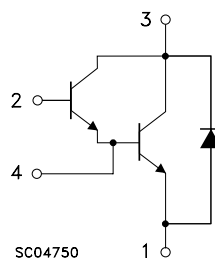
### APPLICATIONS:

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



ISOTOP

### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CEV}$	Collector-Emitter Voltage ( $V_{BE} = -5$ 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 ( $t_p = 10$ ms)	63	A
$I_B$	Base Current	4	A
$I_{BM}$	Base Peak Current ( $t_p = 10$ ms)	8	A
$P_{tot}$	Total Dissipation at $T_c = 25$ °C	150	W
$T_{stg}$	Storage Temperature	-55 to 150	°C
$T_j$	Max. Operating Junction Temperature	150	°C

**THERMAL DATA**

$R_{thj-case}$	Thermal Resistance Junction-case (transistor)	Max	0.83	$^{\circ}\text{C/W}$
$R_{thj-case}$	Thermal Resistance Junction-case (diode)	Max	1.5	$^{\circ}\text{C/W}$
$R_{thc-h}$	Thermal Resistance Case-heatsink With Conductive Grease Applied	Max	0.05	$^{\circ}\text{C/W}$

**ELECTRICAL CHARACTERISTICS** ( $T_{case} = 25^{\circ}\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{CER}$ #	Collector Cut-off Current ( $R_{BE} = 5\ \Omega$ )	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ $T_j = 100^{\circ}\text{C}$			1.5 20	mA mA
$I_{CEV}$ #	Collector Cut-off Current ( $V_{BE} = -5$ )	$V_{CE} = V_{CEV}$ $V_{CE} = V_{CEV}$ $T_j = 100^{\circ}\text{C}$			1 13	mA mA
$I_{EBO}$ #	Emitter Cut-off Current ( $I_C = 0$ )	$V_{EB} = 5\text{ V}$			1	mA
$V_{CEO(SUS)}^*$	Collector-Emitter Sustaining Voltage ( $I_B = 0$ )	$I_C = 0.2\text{ A}$ $L = 25\text{ mH}$ $V_{clamp} = 450\text{ V}$	450			V
$h_{FE}^*$	DC Current Gain	$I_C = 35\text{ A}$ $V_{CE} = 5\text{ V}$		220		
$V_{CE(sat)}^*$	Collector-Emitter Saturation Voltage	$I_C = 25\text{ A}$ $I_B = 0.5\text{ A}$ $I_C = 25\text{ A}$ $I_B = 0.5\text{ A}$ $T_j = 100^{\circ}\text{C}$ $I_C = 35\text{ A}$ $I_B = 2\text{ A}$ $I_C = 35\text{ A}$ $I_B = 2\text{ A}$ $T_j = 100^{\circ}\text{C}$		1.15 1.3 1.4 1.5	2 2	V V V V
$V_{BE(sat)}^*$	Base-Emitter Saturation Voltage	$I_C = 35\text{ A}$ $I_B = 2\text{ A}$ $I_C = 35\text{ A}$ $I_B = 2\text{ A}$ $T_j = 100^{\circ}\text{C}$		2.3 2.3	3	V V
$di/dt$	Rate of Rise of On-state Collector	$V_{CC} = 300\text{ V}$ $R_C = 0$ $t_p = 3\ \mu\text{s}$ $I_{B1} = 0.75\text{ A}$ $T_j = 100^{\circ}\text{C}$	200	250		A/ $\mu\text{s}$
$V_{CE(3\ \mu\text{s})}$	Collector-Emitter Dynamic Voltage	$V_{CC} = 300\text{ V}$ $R_C = 12\ \Omega$ $I_{B1} = 0.75\text{ A}$ $T_j = 100^{\circ}\text{C}$		4.5	8	V
$V_{CE(5\ \mu\text{s})}$	Collector-Emitter Dynamic Voltage	$V_{CC} = 300\text{ V}$ $R_C = 12\ \Omega$ $I_{B1} = 0.75\text{ A}$ $T_j = 100^{\circ}\text{C}$		2.5	4.5	V
$t_s$ $t_f$ $t_c$	Storage Time Fall Time Cross-over Time	$I_C = 25\text{ A}$ $V_{CC} = 50\text{ V}$ $V_{BB} = -5\text{ V}$ $R_{BB} = 0.6\ \Omega$ $V_{clamp} = 450\text{ V}$ $I_{B1} = 0.5\text{ A}$ $L = 0.1\text{ mH}$ $T_j = 100^{\circ}\text{C}$		3.2 0.25 0.75	5 0.5 1.5	$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
$V_{CEW}$	Maximum Collector Emitter Voltage Without Snubber	$I_{CWoff} = 42\text{ A}$ $I_{B1} = 2\text{ A}$ $V_{BB} = -5\text{ V}$ $V_{CC} = 50\text{ V}$ $L = 0.06\text{ mH}$ $R_{BB} = 0.6\ \Omega$ $T_j = 125^{\circ}\text{C}$	450			V
$V_F^*$	Diode Forward Voltage	$I_F = 35\text{ A}$ $T_j = 100^{\circ}\text{C}$		1.5	1.85	V
$I_{RM}$	Reverse Recovery Current	$V_{CC} = 200\text{ V}$ $I_F = 35\text{ A}$ $di_F/dt = -200\text{ A}/\mu\text{s}$ $L < 0.05\ \mu\text{H}$ $T_j = 100^{\circ}\text{C}$		20	24	A

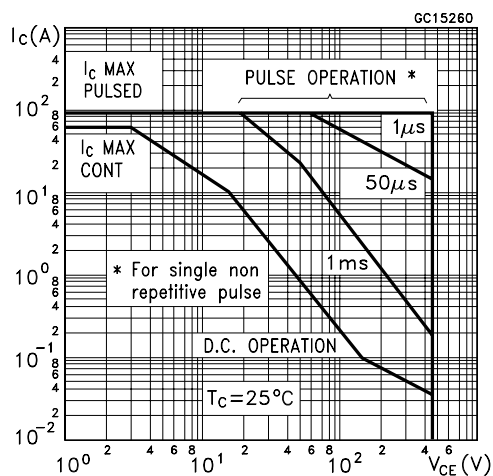
\* Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

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

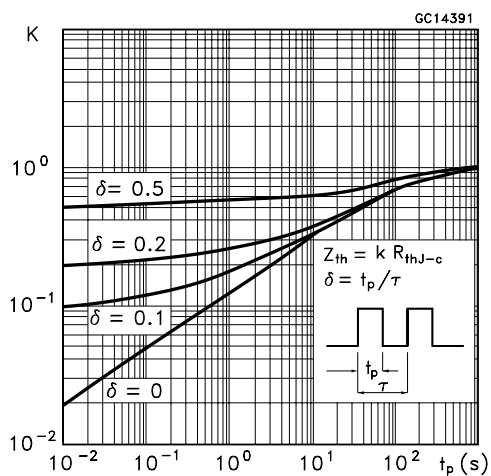
$$V_F = 1.5 + 0.001 I_F \quad P = 1.5 I_{F(AV)} + 0.001 I_{F(RMS)}^2$$

# See test circuits in databook introduction

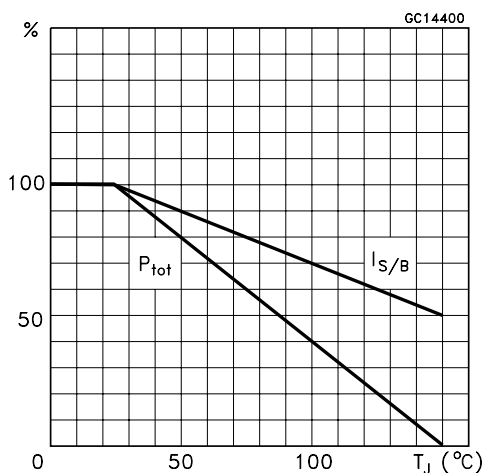
## Safe Operating Areas



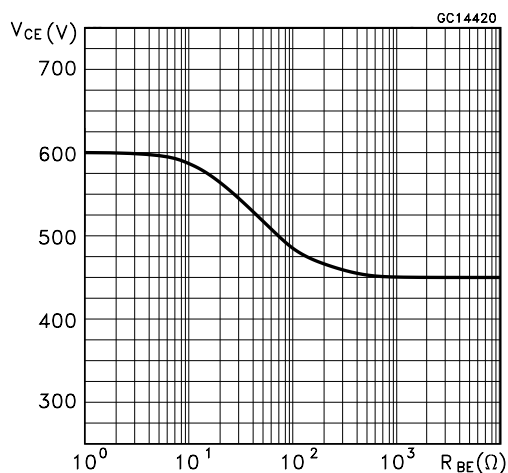
## Thermal Impedance



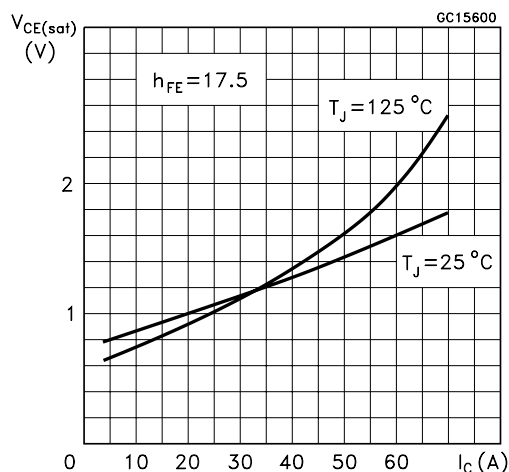
## Derating Curve



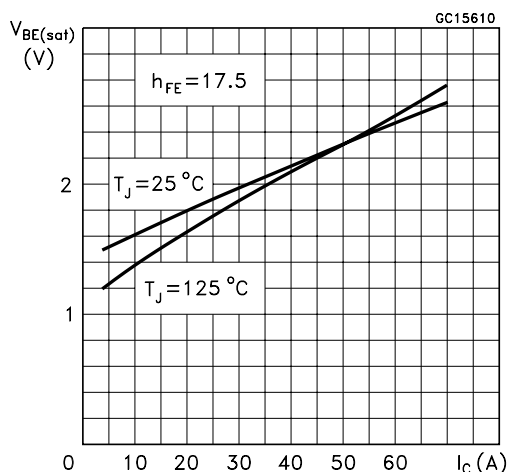
## Collector-emitter Voltage Versus base-emitter Resistance



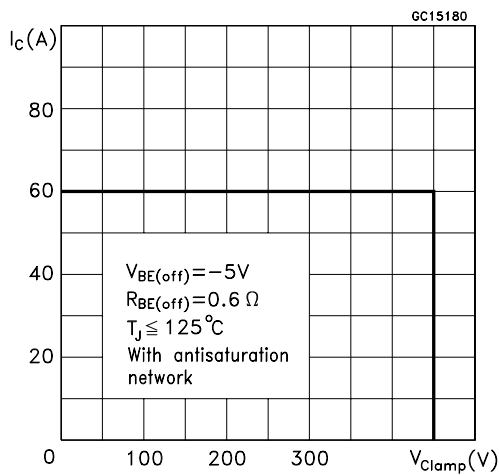
## Collector Emitter Saturation Voltage



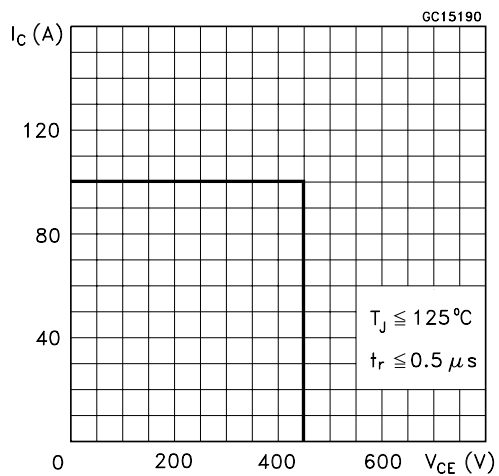
## Base-Emitter Saturation Voltage



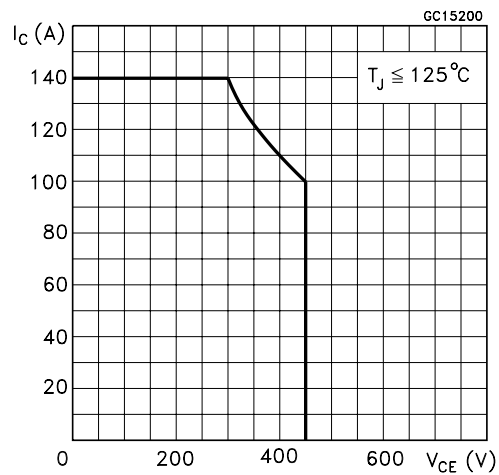
Reverse Biased SOA



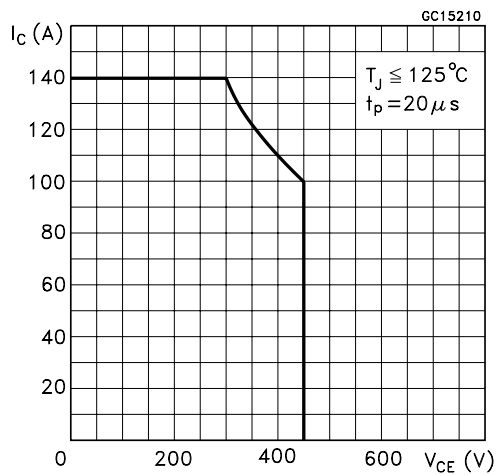
Foward Biased SOA



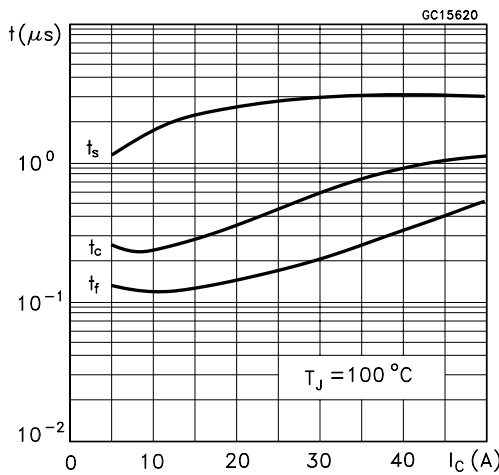
Reverse Biased AOA



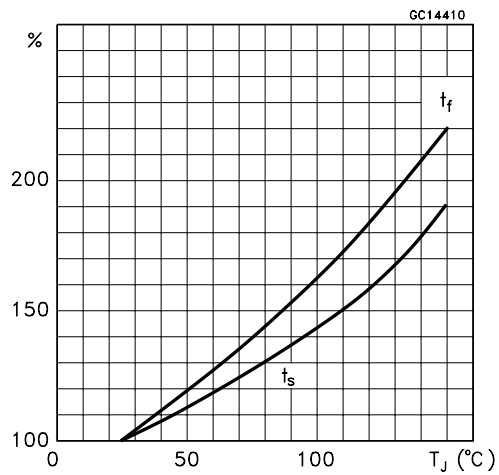
Forward Biased AOA



Switching Times Inductive Load

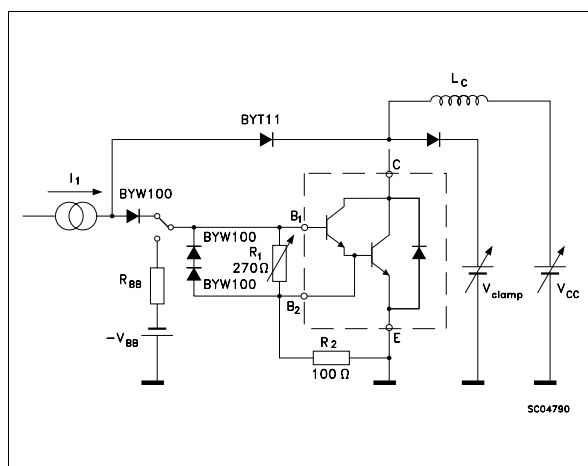


Switching Times Inductive Load Versus Temperature

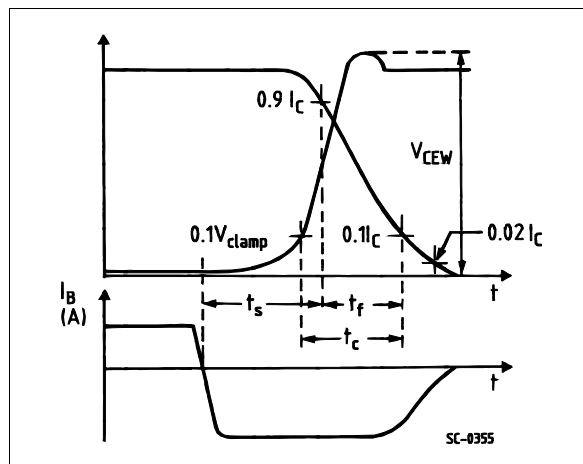




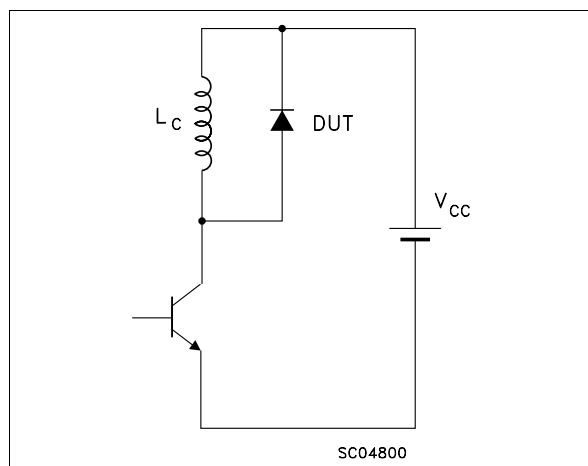
### Turn-on Switching Test Circuit



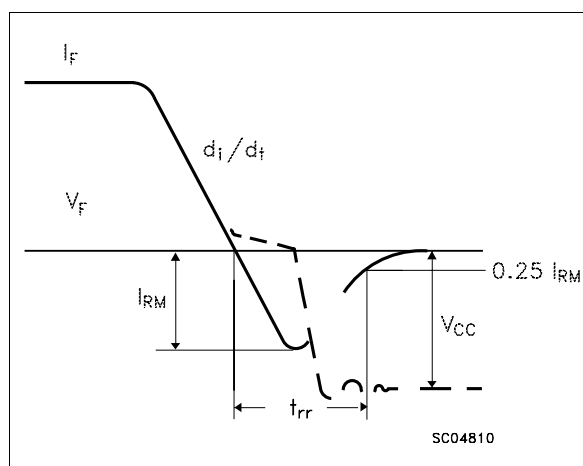
## Turn-off Switching Waveforms



### Turn-off Switching Test Circuit of Diode

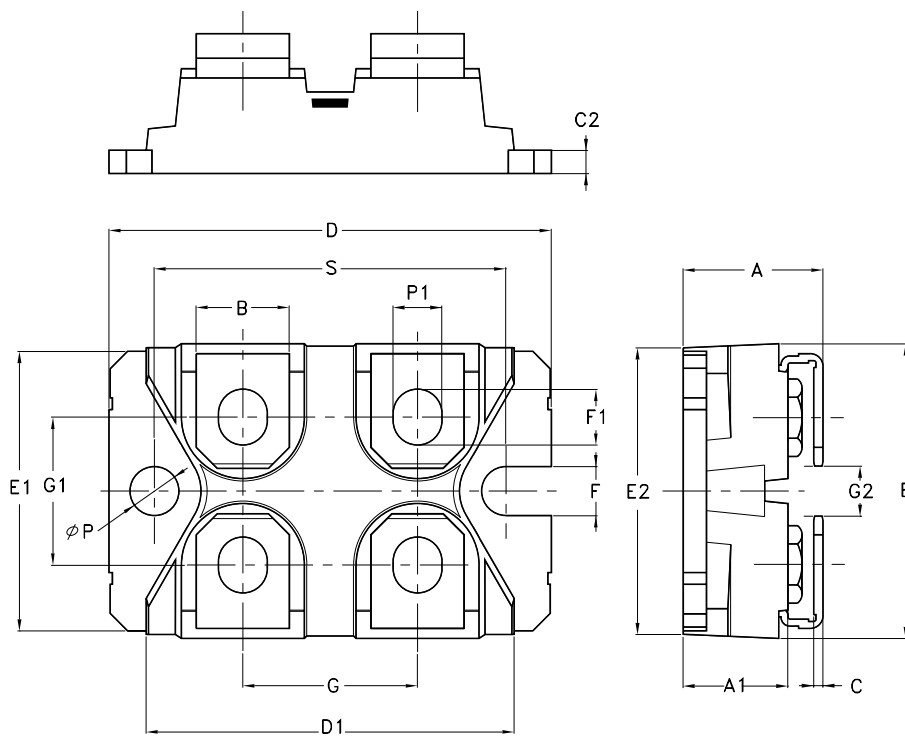


### Turn-off Switching Waveform of Diode



## ISOTOP MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	11.8		12.2	0.465		0.480
A1	8.9		9.1	0.350		0.358
B	7.8		8.2	0.307		0.322
C	0.75		0.85	0.029		0.033
C2	1.95		2.05	0.076		0.080
D	37.8		38.2	1.488		1.503
D1	31.5		31.7	1.240		1.248
E	25.15		25.5	0.990		1.003
E1	23.85		24.15	0.938		0.950
E2		24.8			0.976	
G	14.9		15.1	0.586		0.594
G1	12.6		12.8	0.496		0.503
G2	3.5		4.3	0.137		1.169
F	4.1		4.3	0.161		0.169
F1	4.6		5	0.181		0.196
P	4		4.3	0.157		0.169
P1	4		4.4	0.157		0.173
S	30.1		30.3	1.185		1.193



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