

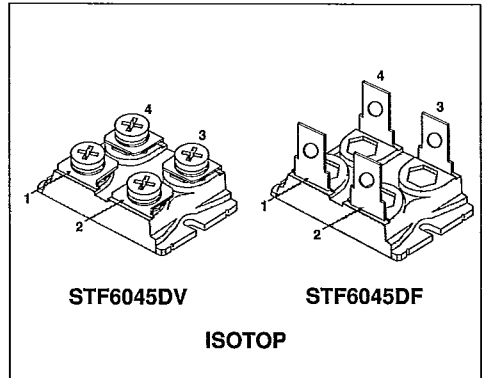
T-3335

## NPN DARLINGTON POWER MODULE

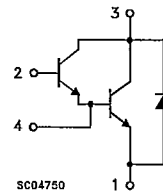
- EASY TO DRIVE TECHNOLOGY (ETD)
- HIGH CURRENT POWER BIPOLAR
- MODULE VERY LOW  $R_{th}$  JUNCTION CASE
- SPECIFIED ACCIDENTAL OVERLOAD AREAS
- ULTRAFAST FREEWHEELING DIODE
- ISOLATED CASE (2500V RMS)
- EASY TO MOUNT
- LOW INTERNAL PARASITIC INDUCTANCE

### INDUSTRIAL APPLICATIONS:

- MOTOR CONTROL
- SMPS & UPS
- WELDING EQUIPMENT



### 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                            | 84         | A    |
| $I_{CM}$       | Collector Peak Current ( $t_p = 10$ ms)      | 120        | A    |
| $I_B$          | Base Current                                 | 8          | A    |
| $I_{BM}$       | Base Peak Current ( $t_p = 10$ ms)           | 16         | A    |
| $P_{tot}$      | Total Dissipation at $T_c = 25$ °C           | 250        | W    |
| $T_{stg}$      | Storage Temperature                          | -55 to 150 | °C   |
| $T_J$          | Max. Operating Junction Temperature          | 150        | °C   |
| $V_{iso}$      | Insulation Withstand Voltage (AC-RMS)        | 2500       | V    |

## THERMAL DATA

T-33-35

|                |                                                                 |     |      |      |
|----------------|-----------------------------------------------------------------|-----|------|------|
| $R_{thj-case}$ | Thermal Resistance Junction-case (transistor)                   | Max | 0.5  | °C/W |
| $R_{thj-case}$ | Thermal Resistance Junction-case (diode)                        | Max | 1.5  | °C/W |
| $R_{thc-h}$    | Thermal Resistance Case-heatsink With Conductive Grease Applied | Max | 0.05 | °C/W |

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

| Symbol                         | Parameter                                          | Test Conditions                                                                                                                                                                                                  | Min. | Typ.                     | Max.    | Unit             |
|--------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------|---------|------------------|
| $I_{CER}\#$                    | Collector Cut-off Current ( $R_{BE} = 5\ \Omega$ ) | $V_{CE} = V_{CEV}$<br>$V_{CE} = V_{CEV}$ $T_j = 100\text{ °C}$                                                                                                                                                   |      |                          | 1<br>15 | mA<br>mA         |
| $I_{CEV}\#$                    | Collector Cut-off Current ( $V_{BE} = -5$ )        | $V_{CE} = V_{CEV}$<br>$V_{CE} = V_{CEV}$ $T_j = 100\text{ °C}$                                                                                                                                                   |      |                          | 1<br>15 | mA<br>mA         |
| $I_{EBO}\#$                    | Emitter Cut-off Current ( $I_C = 0$ )              | $V_{EB} = 5\text{ V}$                                                                                                                                                                                            |      |                          | 1       | mA               |
| $V_{CEO(sus)}^*$               | Collector-Emitter Sustaining Voltage               | $I_C = 0.2\text{ A}$ $L = 25\text{ mH}$<br>$V_{clamp} = 450\text{ V}$                                                                                                                                            | 450  |                          |         | V                |
| $h_{FE}^*$                     | DC Current Gain                                    | $I_C = 70\text{ A}$ $V_{CE} = 5\text{ V}$                                                                                                                                                                        |      | 160                      |         |                  |
| $V_{CE(sat)}^*$                | Collector-Emitter Saturation Voltage               | $I_C = 50\text{ A}$ $I_B = 1\text{ A}$<br>$I_C = 50\text{ A}$ $I_B = 1\text{ A}$ $T_j = 100\text{ °C}$<br>$I_C = 70\text{ A}$ $I_B = 4\text{ A}$<br>$I_C = 70\text{ A}$ $I_B = 4\text{ A}$ $T_j = 100\text{ °C}$ |      | 1.2<br>1.3<br>1.4<br>1.5 | 2       | V<br>V<br>V<br>V |
| $V_{BE(sat)}^*$                | Base-Emitter Saturation Voltage                    | $I_C = 70\text{ A}$ $I_B = 4\text{ A}$<br>$I_C = 70\text{ A}$ $I_B = 4\text{ A}$ $T_j = 100\text{ °C}$                                                                                                           |      | 2.3<br>2.3               | 3       | V<br>V           |
| $di_C/dt$                      | Rate of Rise of On-state Collector                 | $V_{CC} = 300\text{ V}$ $R_C = 0$ $t_p = 3\text{ }\mu\text{s}$<br>$I_{B1} = 1.5\text{ A}$ $T_j = 100\text{ °C}$                                                                                                  | 375  |                          |         | A/ $\mu\text{s}$ |
| $V_{CE(3\text{ }\mu\text{s})}$ | Collector-Emitter Dynamic Voltage                  | $V_{CC} = 300\text{ V}$ $R_C = 6\ \Omega$<br>$I_{B1} = 1.5\text{ A}$ $T_j = 100\text{ °C}$                                                                                                                       |      | 4                        | 7       | V                |
| $V_{CE(5\text{ }\mu\text{s})}$ | Collector-Emitter Dynamic Voltage                  | $V_{CC} = 300\text{ V}$ $R_C = 6\ \Omega$<br>$I_{B1} = 1.5\text{ A}$ $T_j = 100\text{ °C}$                                                                                                                       |      | 2                        | 3       | V                |
| $t_s$                          | Storage Time                                       | $I_C = 50\text{ A}$ $V_{CC} = 50\text{ V}$                                                                                                                                                                       |      | 3.2                      | 5       | $\mu\text{s}$    |
| $t_f$                          | Fall Time                                          | $V_{BB} = -5\text{ V}$ $R_{BB} = 0.6\ \Omega$                                                                                                                                                                    |      | 0.15                     | 0.4     | $\mu\text{s}$    |
| $t_c$                          | Cross-over Time                                    | $V_{clamp} = 400\text{ V}$ $I_{B1} = 1\text{ A}$<br>$L = 50\text{ }\mu\text{H}$ $T_j = 100\text{ °C}$                                                                                                            |      | 0.5                      | 1.2     | $\mu\text{s}$    |
| $t_s$                          | Storage Time                                       | $I_C = 50\text{ A}$ $V_{CC} = 50\text{ V}$                                                                                                                                                                       |      | 4.8                      |         | $\mu\text{s}$    |
| $t_f$                          | Fall Time                                          | $V_{BB} = 0\text{ V}$ $R_{BB} = 0.6\ \Omega$                                                                                                                                                                     |      | 0.35                     |         | $\mu\text{s}$    |
| $t_c$                          | Cross-over Time                                    | $V_{clamp} = 400\text{ V}$ $I_{B1} = 1\text{ A}$<br>$L = 50\text{ }\mu\text{H}$ $T_j = 100\text{ °C}$                                                                                                            |      | 1.1                      |         | $\mu\text{s}$    |
| $V_{CEW}$                      | Maximum Collector Emitter Voltage Without Snubber  | $I_{Cwoff} = 80\text{ A}$ $I_{B1} = 4\text{ A}$<br>$V_{BB} = -5\text{ V}$ $V_{CC} = 50\text{ V}$<br>$L = 30\text{ }\mu\text{H}$ $R_{BB} = 0.3\ \Omega$<br>$T_j = 125\text{ °C}$                                  | 400  |                          |         | V                |
| $V_F^*$                        | Diode Forward Voltage                              | $I_F = 70\text{ A}$ $T_j = 100\text{ °C}$                                                                                                                                                                        |      |                          | 1.9     | V                |
| $I_{RM}$                       | Reverse Recovery Current                           | $V_{CC} = 200\text{ V}$ $I_F = 70\text{ A}$<br>$di_F/dt = -375\text{ A}/\mu\text{s}$ $L < 0.05\text{ nH}$<br>$T_j = 100\text{ °C}$                                                                               |      |                          | 45      | A                |

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

# See test circuits in databook introduction

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

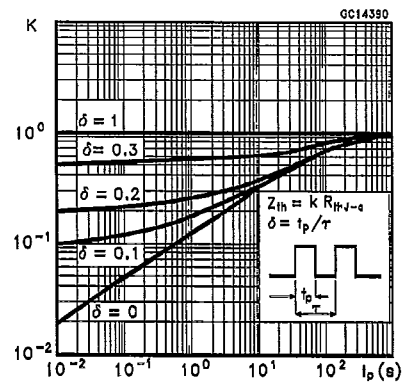
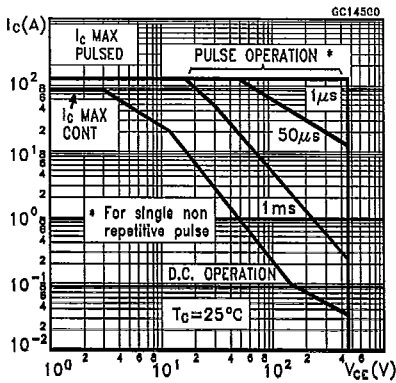
$$V_F = 1.1 + 0.007 I_F \quad P = 1.1 I_F(AV) + 0.007 I_F^2(RMS)$$

S G S-THOMSON

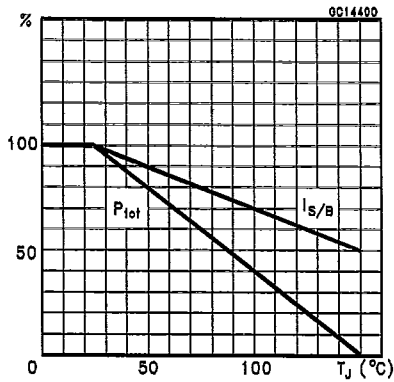
T-33-35

## Safe Operating Areas

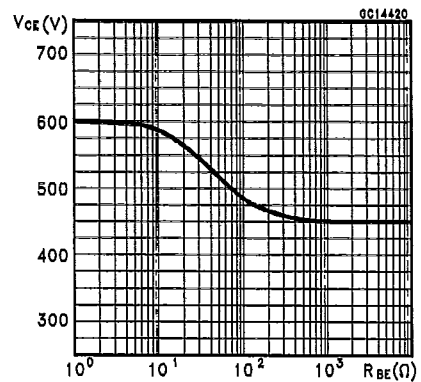
## Thermal Impedance



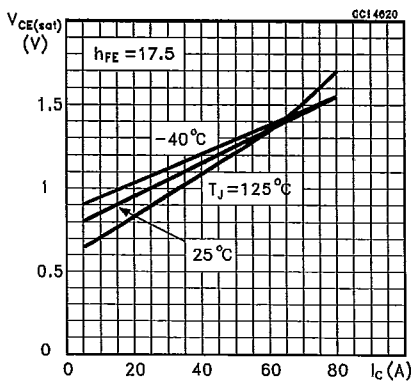
## Derating Curve



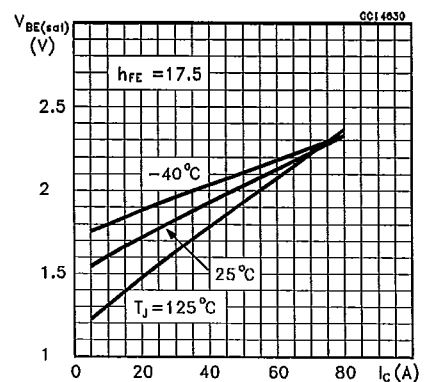
## Collector-Emitter Voltage Versus Base-Emitter Resistance



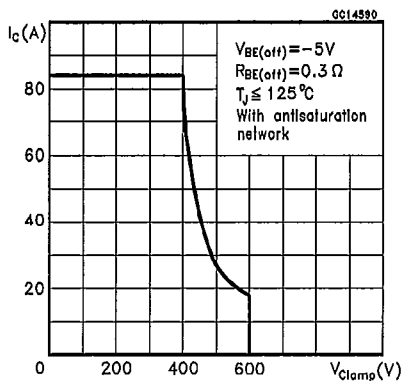
## Collector-Emitter Saturation Voltage



## Base-Emitter Saturation Voltage

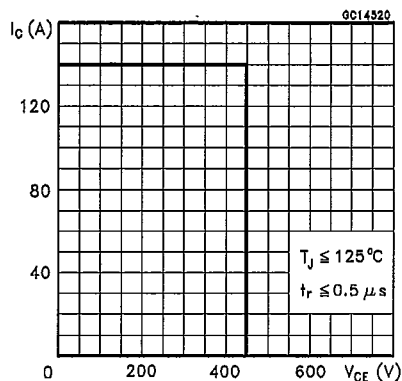


## Reverse Biased SOA

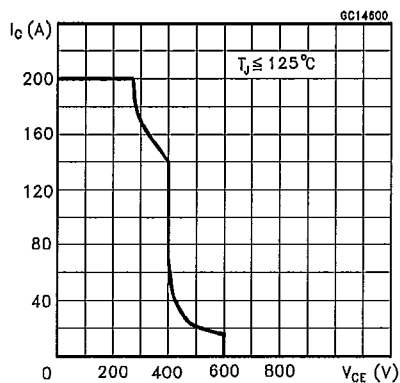


## Forward Biased SOA

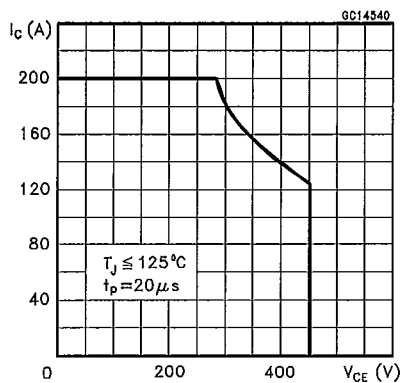
T-33-35



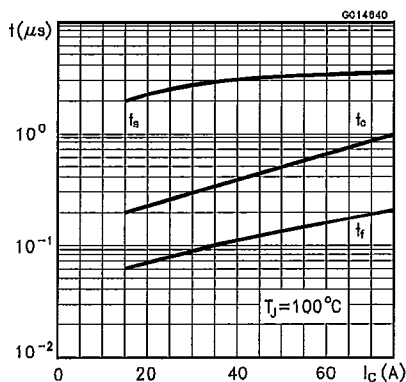
## Reverse Biased AOA



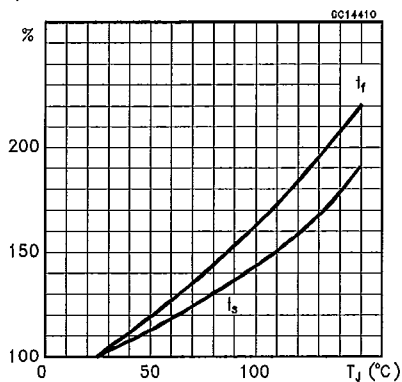
## Forward Biased AOA



## Switching Times Inductive Load



## Switching Times Inductive Load Versus Temperature

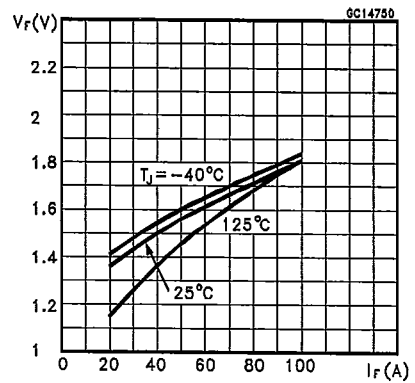
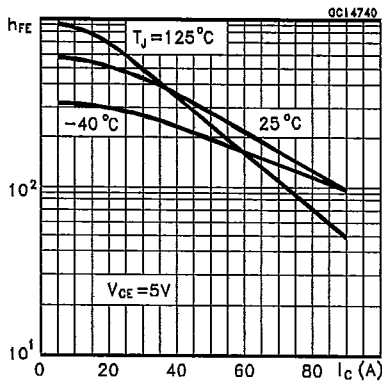


S G S-THOMSON

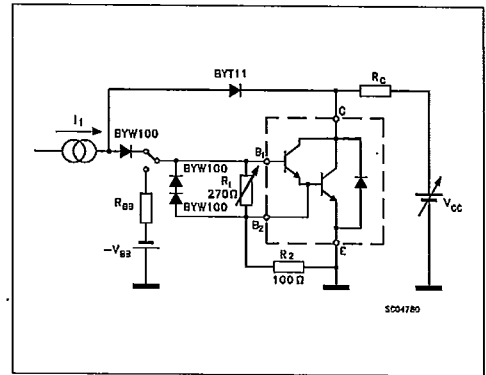
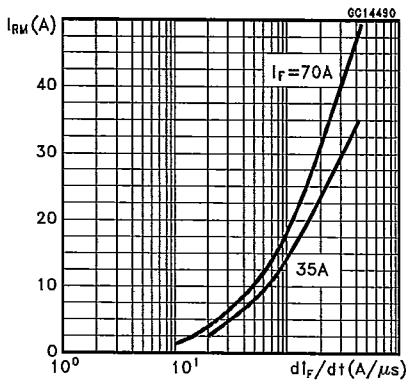
DC Current Gain

Typical  $V_F$  Versus  $I_F$ 

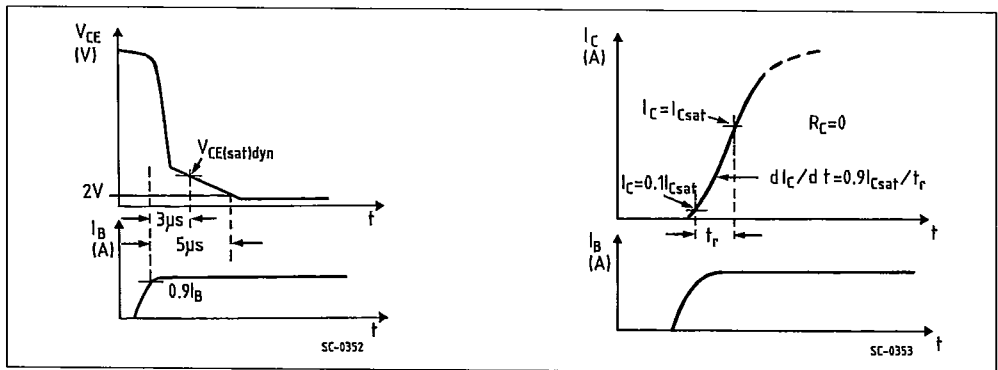
T-33-35

Peak Reverse Current Versus  $di_F/dt$ 

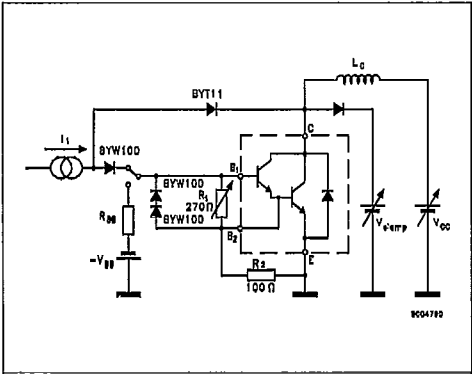
Turn-on Switching Test Circuit



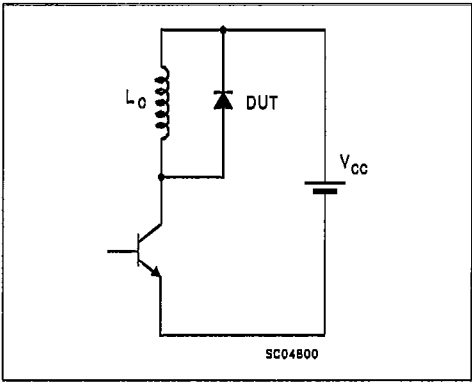
Turn-on Switching Waveforms



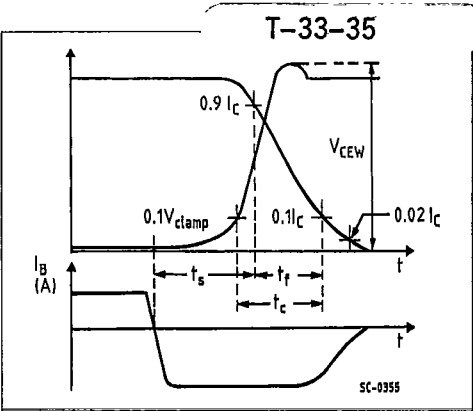
Turn-off Switching Test Circuit



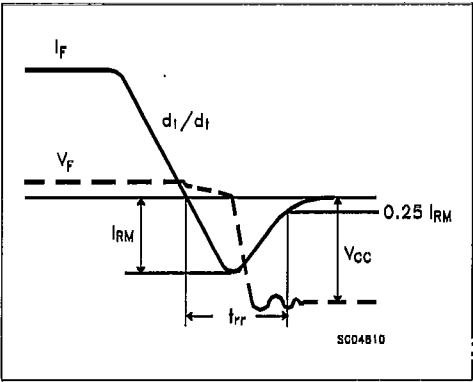
Turn-off Switching Test Circuits of Diode



Turn-off Switching Waveforms

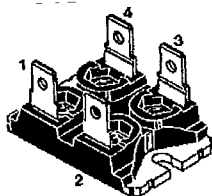


Turn-off Switching Waveform of Diode

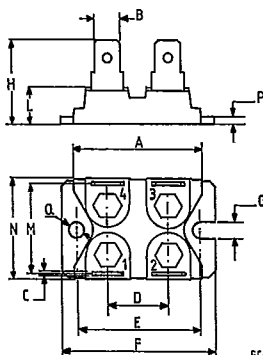


S G S-THOMSON

T-91-20



**ISOTOP**  
**Fast-on version**  
 sales types with the suffix F

**MECHANICAL DATA**

FC-9309

|   | DIMENSIONS |      |        |       |
|---|------------|------|--------|-------|
|   | mm         |      | Inches |       |
|   | min.       | max  | min.   | max   |
| A | 31.5       | 31.7 | 1.240  | 1.248 |
| B | 6.2        | 6.4  | 0.244  | 0.252 |
| C | 0.75       | 0.85 | 0.029  | 0.033 |
| D | 14.9       | 15.1 | 0.586  | 0.590 |
| E | 30.1       | 30.3 | 1.185  | 1.193 |
| F | 38         | 38.2 | 1.496  | 1.503 |
| G | 4          | —    | 0.157  | —     |
| H | 20.3       | 20.7 | 0.799  | 0.815 |
| L | 8.9        | 9.1  | 0.350  | 0.358 |
| M | 22.4       | 23   | 0.881  | 0.905 |
| N | 25.2       | 25.4 | 0.992  | 1.000 |
| P | 1.95       | 2.05 | 0.076  | 0.080 |
| Q | 4          | —    | 0.157  | —     |

**PIN CONNECTIONS****MOSFET**

pin 1: Source      pin 2: Gate  
 pin 3: Drain      pin 4: Source sensings

**DARLINGTON**

pin 1: Emitter      pin 2: Base1  
 pin 3: Collector      pin 4: Base 2

**TRANSISTOR**

pin 1: Emitter      pin 2: Base  
 pin 3: Collector      pin 4: Emitter sensing

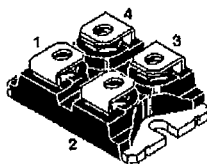
Torque: Mounting  $1.3 \pm 0.2 \text{ N} \cdot \text{m}$  (max)

Weight: Package 25.5 g

Note: The mechanical data are the same for the 3 pin version  
 (4th pin missing)

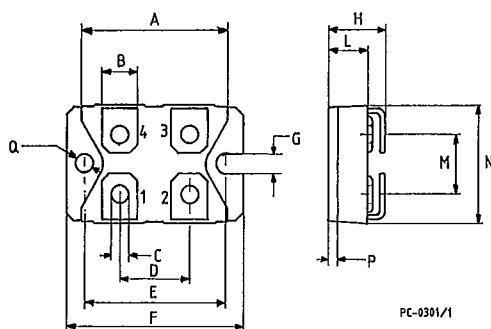
S G S-THOMSON

T-91-20



**ISOTOP**  
Screw version  
sales types with the suffix V

## MECHANICAL DATA



PC-0301/1

|   | DIMENSIONS |      |        |       |
|---|------------|------|--------|-------|
|   | mm         |      | Inches |       |
|   | min.       | max  | min.   | max   |
| A | 31.5       | 31.7 | 1.240  | 1.248 |
| B | 7.8        | 8.2  | 0.307  | 0.322 |
| C | 4.1        | 4.3  | 0.161  | 0.169 |
| D | 14.9       | 15.1 | 0.586  | 0.590 |
| E | 30.1       | 30.3 | 1.185  | 1.193 |
| F | 38         | 38.2 | 1.496  | 1.503 |
| G | 4          | —    | 0.157  | —     |
| H | 11.8       | 12.2 | 0.464  | 0.480 |
| L | 8.9        | 9.1  | 0.350  | 0.358 |
| M | 12.6       | 12.8 | 0.496  | 0.503 |
| N | 25.2       | 25.4 | 0.992  | 1.000 |
| P | 1.95       | 2.05 | 0.076  | 0.080 |
| Q | 4          | —    | 0.157  | —     |

## PIN CONNECTIONS

## MOSFET

pin 1: Source      pin 2: Gate  
pin 3: Drain      pin 4: Source sensings

## DARLINGTON

pin 1: Emitter      pin 2: Base1  
pin 3: Collector      pin 4: Base 2

## TRANSISTOR

pin 1: Emitter      pin 2: Base  
pin 3: Collector      pin 4: Emitter sensing

Torque: Terminal  $1.3 \pm 0.2 \text{ N} \cdot \text{m}$  (max)  
Mounting  $1.3 \pm 0.2 \text{ N} \cdot \text{m}$  (max)

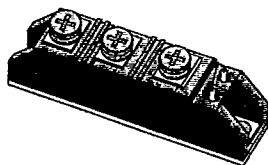
Weight: Package 29 g  
4 Screws: 7.5 g

Note: The mechanical data are the same for the 3 pin version  
(4th pin missing)

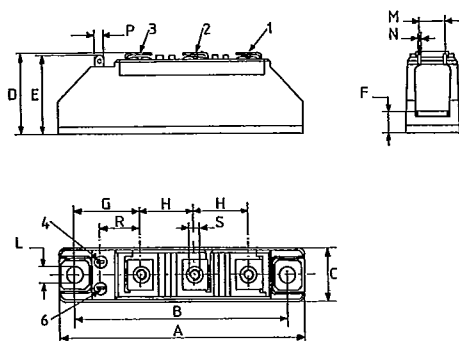
S G S-THOMSON

T-91-20

TRANSPACK (TO-240)



## MECHANICAL DATA



PC-0296

|   | DIMENSIONS |       |            |       |
|---|------------|-------|------------|-------|
|   | mm         |       | Inches     |       |
|   | min.       | max   | min.       | max   |
| A | 91.5       | 92.5  | 3.602      | 3.641 |
| B | 79.75      | 80.25 | 3.140      | 3.160 |
| C | 19.5       | 20.55 | 0.767      | 0.809 |
| D | 29.00      | 31.00 | 1.141      | 1.220 |
| E | 28.8       | 30    | 1.134      | 1.181 |
| F | 8.5 typ.   |       | 0.334 typ. |       |
| G | 24.4 typ.  |       | 0.960 typ. |       |
| H | 19.5       | 20.5  | 0.767      | 0.807 |
| L | 6.2 typ.   |       | 0.244 typ. |       |
| M | 8.95       | 11.05 | 0.352      | 0.435 |
| N | 0.78       | 0.84  | 0.030      | 0.033 |
| P | 2.72       | 2.87  | 0.107      | 0.113 |
| R | 14         | —     | 0.551      | —     |
| S | M5         |       |            |       |

Torque: Terminal  $2.2 \pm 0.5 \text{ N} \cdot \text{m}$  (max)  
 Mounting  $3.5 \pm 0.5 \text{ N} \cdot \text{m}$  (max)

Weight: Package 110 g  
 Accessory 21 g

Note: The mechanical data are the same for the 2 power pin version (either pin 1 or pin 2 missing)