

# NPN THREE STAGE DARLINGTON POWER MODULE

S G S-THOMSON

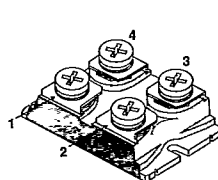
T.33-35

ADVANCE DATA

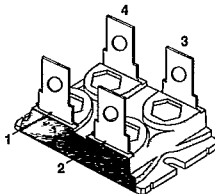
- HIGH CURRENT POWER BIPOLAR MODULE
- VERY LOW  $R_{th}$  JUNCTION CASE
- SPECIFIED ACCIDENTAL OVERLOAD AREAS
- ULTRAFAST FREEWHEELING DIODE
- ISOLATED CASE (2500V RMS)
- EASY TO MOUNT
- LOW INTERNAL PARASITIC INDUCTANCE

**INDUSTRIAL APPLICATIONS:**

- MOTOR CONTROL
- SMPS & UPS
- WELDING EQUIPMENT

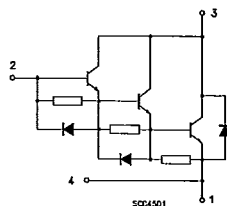


ESMT5070DV



ESMT5070DF

ISOTOP

**INTERNAL SCHEMATIC DIAGRAM**

**ABSOLUTE MAXIMUM RATINGS**

| Symbol         | Parameter                                             | Value      | Unit             |
|----------------|-------------------------------------------------------|------------|------------------|
| $V_{CEV}$      | Collector-Emitter Voltage ( $V_{BE} = -5\text{ V}$ )  | 1000       | V                |
| $V_{CEO(sus)}$ | Collector-Emitter Voltage ( $I_B = 0$ )               | 700        | V                |
| $V_{EBO}$      | Emitter-Base Voltage ( $I_C = 0$ )                    | 7          | V                |
| $I_C$          | Collector Current                                     | 50         | A                |
| $I_{CM}$       | Collector Peak Current ( $t_p = 10\text{ ms}$ )       | 75         | A                |
| $I_B$          | Base Current                                          | 5          | A                |
| $I_{BM}$       | Base Peak Current ( $t_p = 10\text{ ms}$ )            | 7          | A                |
| $P_{tot}$      | Total Dissipation at $T_c = 25\text{ }^\circ\text{C}$ | 300        | 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       | V                |

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## THERMAL DATA

T-33-35

|                |                                                                 |     |      |      |
|----------------|-----------------------------------------------------------------|-----|------|------|
| $R_{thj-case}$ | Thermal Resistance Junction-case (transistor)                   | Max | 0.41 | °C/W |
| $R_{thj-case}$ | Thermal Resistance Junction-case (diode)                        | Max | 1.1  | °C/W |
| $R_{thc-h}$    | Thermal Resistance Case-heatsink With Conductive Grease Applied | Max | 0.05 | °C/W |

ELECTRICAL CHARACTERISTICS ( $T_{case} = 25^{\circ}C$  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>$V_{CE} = V_{CEV}$ $T_J = 100^{\circ}C$                                                                                                  |      |                          | 2<br>25  | mA<br>mA                      |
| $I_{CEV}$               | Collector Cut-off Current ( $V_{BE} = -5$ )       | $V_{CE} = V_{CEV}$<br>$V_{CE} = V_{CEV}$ $T_J = 100^{\circ}C$                                                                                                  |      |                          | 2<br>25  | mA<br>mA                      |
| $I_{EBO}$               | Emitter Cut-off Current ( $I_C = 0$ )             | $V_{EB} = 5 V$                                                                                                                                                 |      |                          | 200      | mA                            |
| $V_{CE(SUS)}^*$         | Collector-Emitter Sustaining Voltage              | $I_C = 0.2 A$ $L = 25 mH$<br>$V_{olamp} = 700 V$                                                                                                               | 700  |                          |          | V                             |
| $h_{FE}^*$              | DC Current Gain                                   | $I_C = 50 A$ $V_{CE} = 4 V$                                                                                                                                    |      | 200                      |          |                               |
| $V_{CE(sat)}^*$         | Collector-Emitter Saturation Voltage              | $I_C = 30 A$ $I_B = 0.3 A$<br>$I_C = 30 A$ $I_B = 0.3 A$ $T_J = 100^{\circ}C$<br>$I_C = 50 A$ $I_B = 0.5 A$<br>$I_C = 50 A$ $I_B = 0.5 A$ $T_J = 100^{\circ}C$ |      | 2.6<br>2.8<br>3<br>10    | 3.5      | V<br>V<br>V<br>V              |
| $V_{BE(sat)}^*$         | Base-Emitter Saturation Voltage                   | $I_C = 30 A$ $I_B = 0.3 A$<br>$I_C = 30 A$ $I_B = 0.3 A$ $T_J = 100^{\circ}C$<br>$I_C = 50 A$ $I_B = 0.5 A$<br>$I_C = 50 A$ $I_B = 0.5 A$ $T_J = 100^{\circ}C$ |      | 2.6<br>2.8<br>2.9<br>3.1 | 3.2<br>4 | V<br>V<br>V<br>V              |
| $di_C/dt$               | Rate of Rise of On-state Collector                | $V_{CC} = 300 V$ $R_C = 0$ $t_p = 3 \mu s$<br>$I_{B1} = 0.5 A$ $T_J = 100^{\circ}C$                                                                            | 300  |                          |          | A/ $\mu s$                    |
| $V_{CE(3 \mu s)}$       | Collector-Emitter Dynamic Voltage                 | $V_{CC} = 300 V$ $R_C = 6 \Omega$<br>$I_{B1} = 0.75 A$ $T_J = 100^{\circ}C$                                                                                    |      |                          | 10       | V                             |
| $V_{CE(5 \mu s)}$       | Collector-Emitter Dynamic Voltage                 | $V_{CC} = 300 V$ $R_C = 6 \Omega$<br>$I_{B1} = 0.75 A$ $T_J = 100^{\circ}C$                                                                                    |      |                          | 5        | V                             |
| $t_s$<br>$t_f$<br>$t_c$ | Storage Time<br>Fall Time<br>Cross-over Time      | $I_C = 50 A$ $V_{CC} = 50 V$<br>$I_{B1} = 0.5 A$ $I_{B2} = -0.5 A$<br>$R_{BB} = 10 \Omega$ $V_{clamp} = 400 V$<br>$L = 40 \mu H$ $T_J = 100^{\circ}C$          |      | 14<br>1.5<br>5.5         |          | $\mu s$<br>$\mu s$<br>$\mu s$ |
| $V_{CEW}$               | Maximum Collector Emitter Voltage Without Snubber | $I_{Coff} = 50 A$ $V_{CC} = 50 V$<br>$I_{B1} = 0.5 A$ $I_{B2} = -0.5 A$<br>$L = 40 \mu H$ $R_{BB} = 10 \Omega$<br>$T_J = 125^{\circ}C$                         | 600  |                          |          | V                             |
| $V_F^*$                 | Diode Forward Voltage                             | $I_F = 50 A$ $T_J = 100^{\circ}C$                                                                                                                              |      |                          | 2        | V                             |
| $I_{RM}$                | Reverse Recovery Current                          | $V_{CC} = 200 V$ $I_F = 35 A$<br>$di_F/dt = 200 A/\mu s$ $L < 50 nH$<br>$T_J = 100^{\circ}C$                                                                   |      |                          | 24       | A                             |

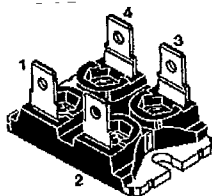
\* Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %

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

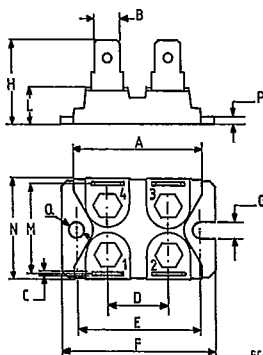
$$V_F = 1.1 + 0.006 I_F \quad P = 1.1 I_F (V_F) + 0.006 I_F^2 (R_{FS})$$

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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

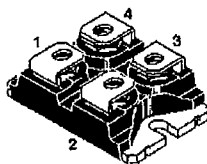
Torque: Mounting  $1.3 \pm 0.2 \text{ N} \cdot \text{m}$  (max)

Weight: Package 25.5 g

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

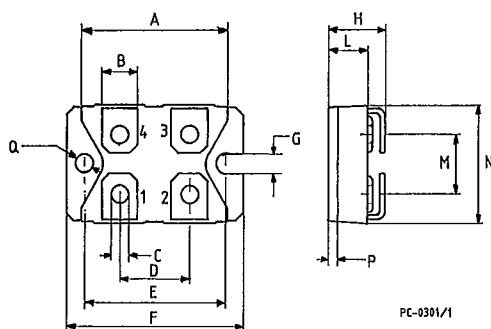
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T-91-20



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

## MECHANICAL DATA



PC-0301/1

## 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

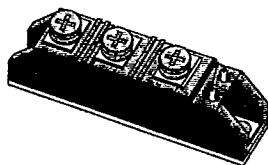
Note: The mechanical data are the same for the 3 pin version  
(4th pin missing)

|   | 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  | —     |

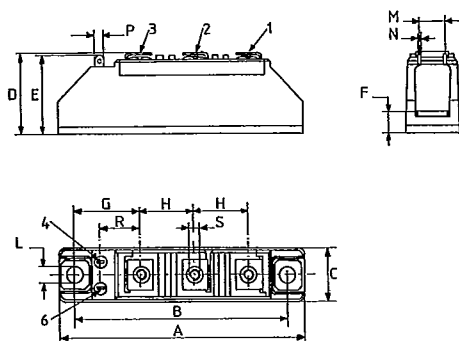
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TRANSPACK (TO-240)



## MECHANICAL DATA



|   | 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)