

## HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTORS

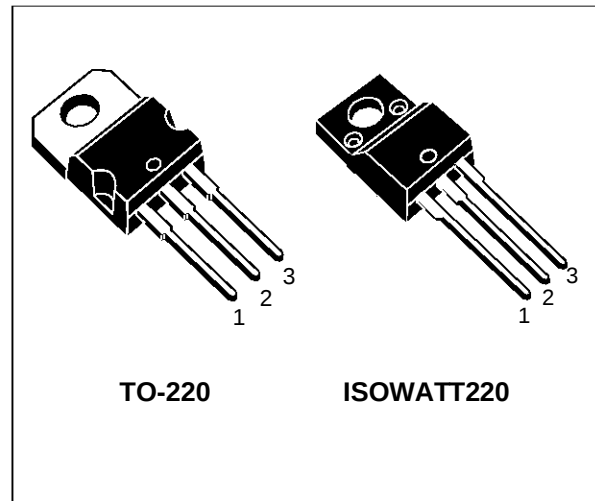
- HIGH VOLTAGE CAPABILITY (450V  $V_{CE0}$ )
- VERY HIGH SWITCHING SPEED:  $t_f = 35\text{ns}$   
TYPICAL AT  $I_C = 2.5\text{A}$ ,  $I_{B1} = 0.5\text{A}$ ,  $V_{BE\text{off}} = -5\text{V}$
- LOW SATURATION VOLTAGE
- COMPLETE CHARACTERIZATION AT  $100^\circ\text{C}$
- U.L. RECOGNISED ISOWATT220 PACKAGE (U.L. FILE # E81734 (N)).

### APPLICATION

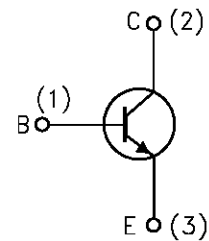
- SWITCH MODE POWER SUPPLIES
- FLYBACK AND FORWARD SINGLE TRANSISTOR LOW POWER CONVERTERS

### DESCRIPTION

The SGSF313 and SGSF313PI are high voltage NPN FASTSWITCHING transistors designed to be used as switch in high efficiency OFF-LINE (220V mains) switching power supplies for consumer applications like sets VCR's and monitors.



### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                                             | Value      |           | Unit             |
|-----------|-------------------------------------------------------|------------|-----------|------------------|
|           |                                                       | SGSF313    | SGSF313PI |                  |
| $V_{CEX}$ | Collector-Emitter Voltage ( $V_{BE} = -2.5\text{V}$ ) | 1000       |           | V                |
| $V_{CES}$ | Collector-Emitter Voltage ( $V_{BE} = 0$ )            | 1000       |           | V                |
| $V_{CEO}$ | Collector-Emitter Voltage ( $I_B = 0$ )               | 450        |           | V                |
| $V_{EBO}$ | Emitter-Base Voltage ( $I_C = 0$ )                    | 10         |           | V                |
| $I_C$     | Collector Current                                     | 7          |           | A                |
| $I_{CM}$  | Collector Peak Current ( $t_p < 5\text{ ms}$ )        | 10         |           | A                |
| $I_B$     | Base Current                                          | 3          |           | A                |
| $I_{BM}$  | Base Peak Current ( $t_p < 5\text{ ms}$ )             | 6          |           | A                |
| $P_{tot}$ | Total Dissipation at $T_c = 25^\circ\text{C}$         | 70         | 35        | W                |
| $T_{stg}$ | Storage Temperature                                   | -65 to 150 |           | $^\circ\text{C}$ |
| $T_j$     | Max. Operating Junction Temperature                   | 150        |           | $^\circ\text{C}$ |

## THERMAL DATA

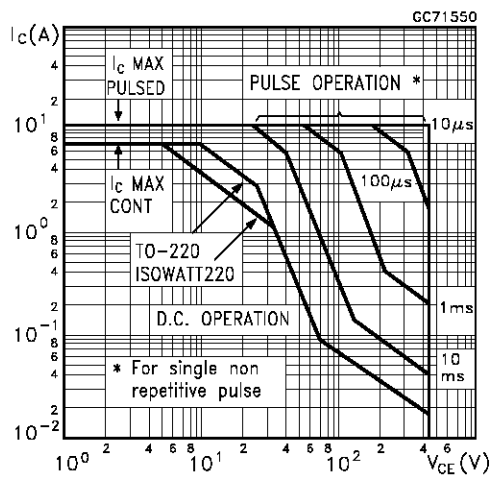
|                |                                  | TO-220 | ISOWATT221 |                             |
|----------------|----------------------------------|--------|------------|-----------------------------|
| $R_{thj-case}$ | Thermal Resistance Junction-Case | Max    | 1.78       | 3.57                        |
|                |                                  |        |            | $^{\circ}\text{C}/\text{W}$ |

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

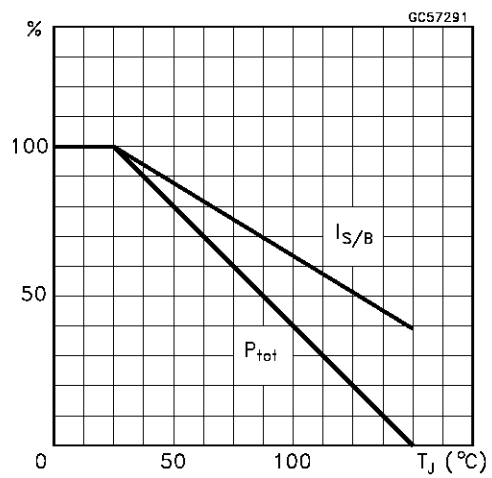
| Symbol                     | Parameter                                                   | Test Conditions                                                                                                                                                                                                                                                                                                                                                                                           | Min.                | Typ.               | Max.                              | Unit                                            |
|----------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------|-----------------------------------|-------------------------------------------------|
| $I_{CES}$                  | Collector Cut-off Current ( $V_{BE} = 0$ )                  | $V_{CE} = 1000\text{ V}$<br>$V_{CE} = 1000\text{ V}$ $T_j = 125^{\circ}\text{C}$                                                                                                                                                                                                                                                                                                                          |                     |                    | 10<br>100                         | $\mu\text{A}$<br>$\mu\text{A}$                  |
| $I_{CEO}$                  | Collector Cut-off Current ( $I_B = 0$ )                     | $V_{EC} = 450\text{ V}$                                                                                                                                                                                                                                                                                                                                                                                   |                     |                    | 100                               | $\mu\text{A}$                                   |
| $V_{CEO(sus)}$             | Collector-Emitter Sustaining Voltage                        | $I_C = 100\text{ mA}$ $L = 25\text{ mH}$                                                                                                                                                                                                                                                                                                                                                                  | 450                 |                    |                                   | V                                               |
| $V_{CE(sat)*}$             | Collector-Emitter Saturation Voltage                        | $I_C = 1\text{ A}$ $I_B = 0.1\text{ A}$<br>$I_C = 2\text{ A}$ $I_B = 0.4\text{ A}$<br>$I_C = 2.5\text{ A}$ $I_B = 0.5\text{ A}$<br>$I_C = 1\text{ A}$ $I_B = 0.1\text{ A}$ $T_j = 125^{\circ}\text{C}$<br>$I_C = 2\text{ A}$ $I_B = 0.4\text{ A}$ $T_j = 125^{\circ}\text{C}$                                                                                                                             |                     |                    | 0.5<br>0.45<br>0.75<br>0.6<br>0.8 | V<br>V<br>V<br>V<br>V                           |
| $V_{BE(sat)*}$             | Base-Emitter Saturation Voltage                             | $I_C = 1\text{ A}$ $I_B = 0.1\text{ A}$<br>$I_C = 2\text{ A}$ $I_B = 0.4\text{ A}$<br>$I_C = 2.5\text{ A}$ $I_B = 0.5\text{ A}$                                                                                                                                                                                                                                                                           |                     |                    | 1.1<br>1.25<br>1.3                | V<br>V<br>V                                     |
| $h_{FE*}$                  | DC Current Gain                                             | $I_C = 1\text{ A}$ $V_{CE} = 2.5\text{ V}$<br>$I_C = 1\text{ A}$ $V_{CE} = 5\text{ V}$<br>$I_C = 2\text{ A}$ $V_{CE} = 1\text{ V}$<br>$I_C = 5\text{ mA}$ $V_{CE} = 5\text{ V}$<br>$I_C = 1\text{ A}$ $V_{CE} = 2.5\text{ V}$ $T_j = 125^{\circ}\text{C}$<br>$I_C = 1\text{ A}$ $V_{CE} = 5\text{ V}$ $T_j = 125^{\circ}\text{C}$<br>$I_C = 2\text{ A}$ $V_{CE} = 1\text{ V}$ $T_j = 125^{\circ}\text{C}$ | 12<br>15<br>6<br>10 | 30                 | 45                                |                                                 |
| $t_{ON}$<br>$t_s$<br>$t_f$ | RESISTIVE LOAD<br>Turn-on Time<br>Storage Time<br>Fall Time | $V_{CC} = 250\text{ V}$ $I_C = 2.5\text{ A}$<br>$I_{B1} = 0.5\text{ A}$ $I_{B2} = -1\text{ A}$                                                                                                                                                                                                                                                                                                            |                     | 0.5<br>1.5<br>0.18 | 1<br>2.5<br>0.3                   | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $t_{ON}$<br>$t_s$<br>$t_f$ | RESISTIVE LOAD<br>Turn-on Time<br>Storage Time<br>Fall Time | $V_{CC} = 250\text{ V}$ $I_C = 2.5\text{ A}$<br>$I_{B1} = 0.5\text{ A}$ $I_{B2} = -1\text{ A}$<br>With Antisaturation Network                                                                                                                                                                                                                                                                             |                     | 0.5<br>1.1<br>0.13 |                                   | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $t_{ON}$<br>$t_s$<br>$t_f$ | RESISTIVE LOAD<br>Turn-on Time<br>Storage Time<br>Fall Time | $V_{CC} = 250\text{ V}$ $I_C = 2.5\text{ A}$<br>$I_{B1} = 0.5\text{ A}$ $V_{BE(off)} = -5\text{ V}$                                                                                                                                                                                                                                                                                                       |                     | 0.5<br>1.1<br>0.13 |                                   | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $t_s$<br>$t_f$             | INDUCTIVE LOAD<br>Storage Time<br>Fall Time                 | $I_C = 2.5\text{ A}$ $h_{FE} = 5\text{ A}$<br>$V_{BE(off)} = -5\text{ V}$ $R_{BB} = 2\ \Omega$<br>$V_{CL} = 300\text{ V}$ $L = 300\ \mu\text{H}$                                                                                                                                                                                                                                                          |                     | 1<br>0.1           | 2<br>0.2                          | $\mu\text{s}$<br>$\mu\text{s}$                  |
| $t_s$<br>$t_f$             | INDUCTIVE LOAD<br>Storage Time<br>Fall Time                 | $I_C = 2.5\text{ A}$ $h_{FE} = 5\text{ A}$<br>$V_{BE(off)} = -5\text{ V}$ $R_{BB} = 2\ \Omega$<br>$V_{CL} = 300\text{ V}$ $L = 300\ \mu\text{H}$<br>$T_j = 100^{\circ}\text{C}$                                                                                                                                                                                                                           |                     |                    | 3<br>0.3                          | $\mu\text{s}$<br>$\mu\text{s}$                  |

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

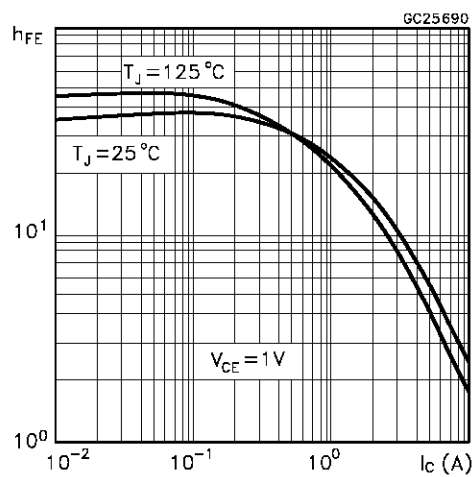
Safe Operating Area Thermal Impedance



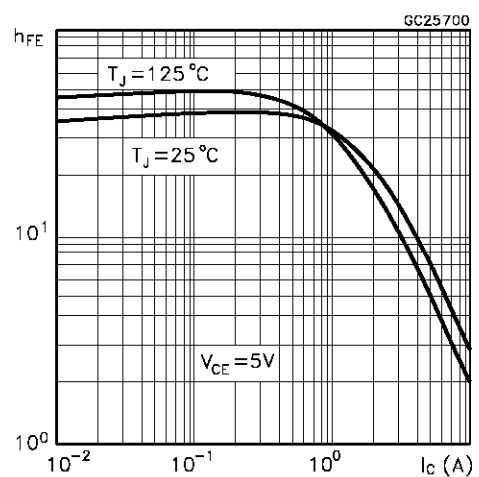
Derating Curve



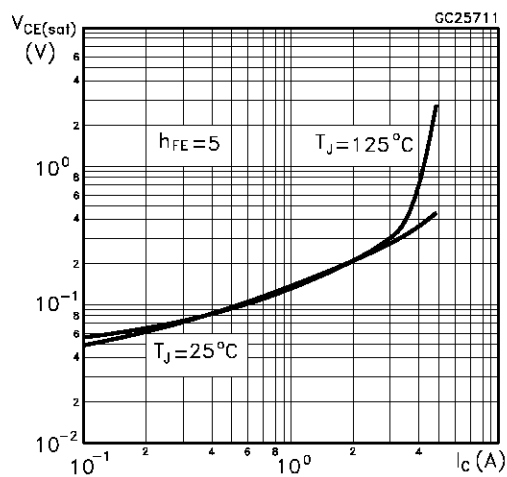
DC Current Gain



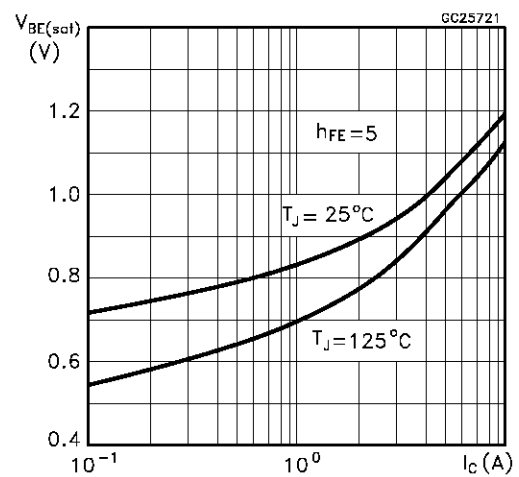
DC Current Gain



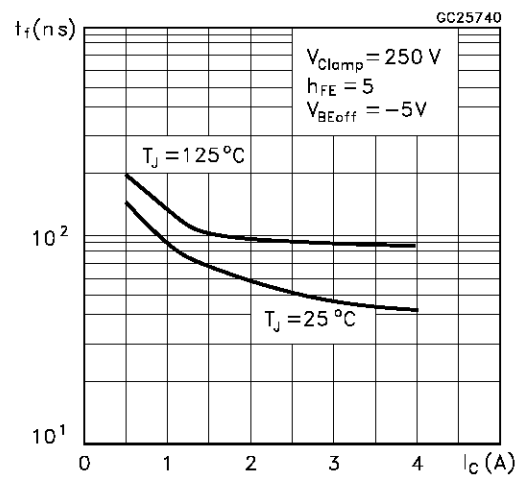
Collector Emitter Saturation Voltage



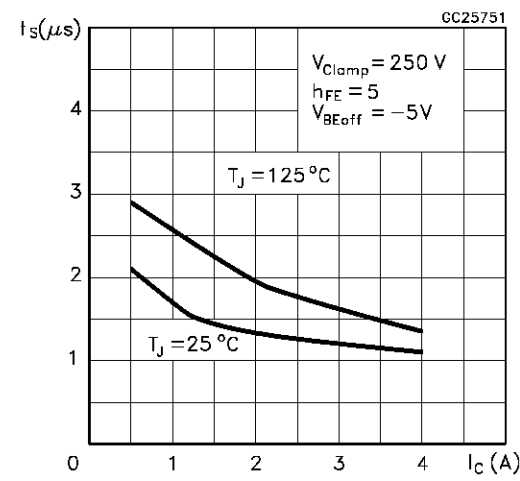
Base Emitter Saturation Voltage



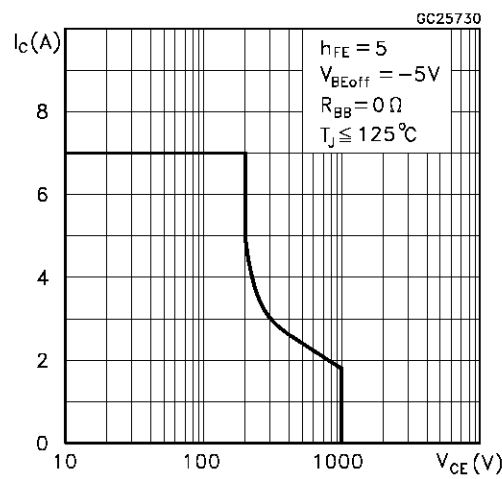
Inductive Fall Time



Inductive Storage Time

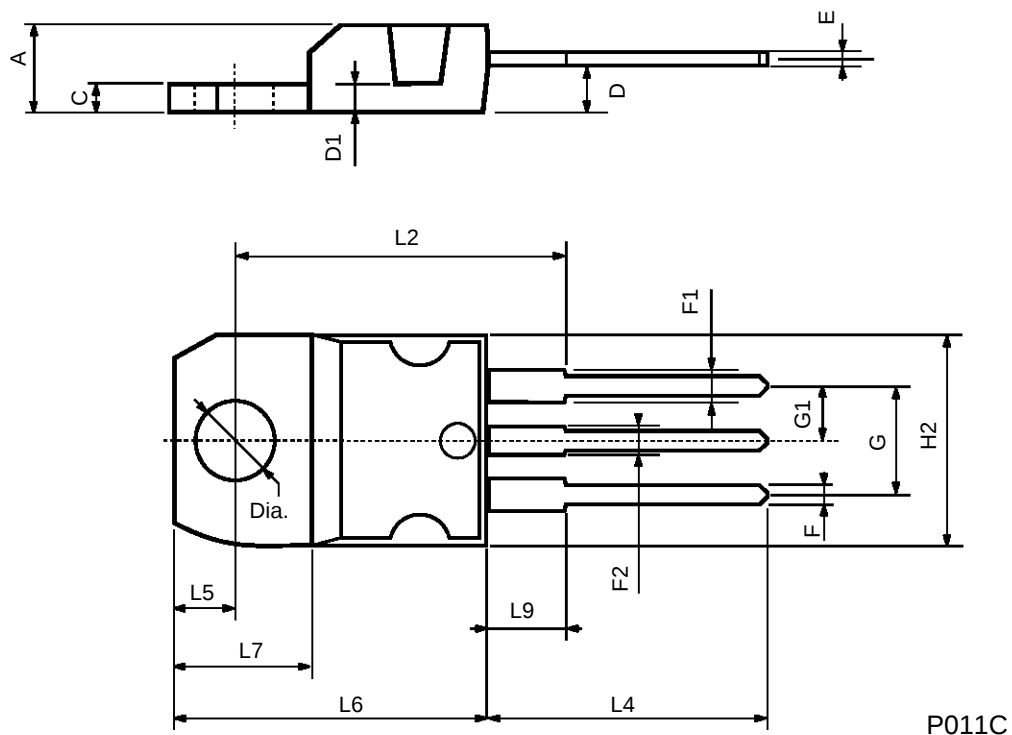


Reverse Biased SOA



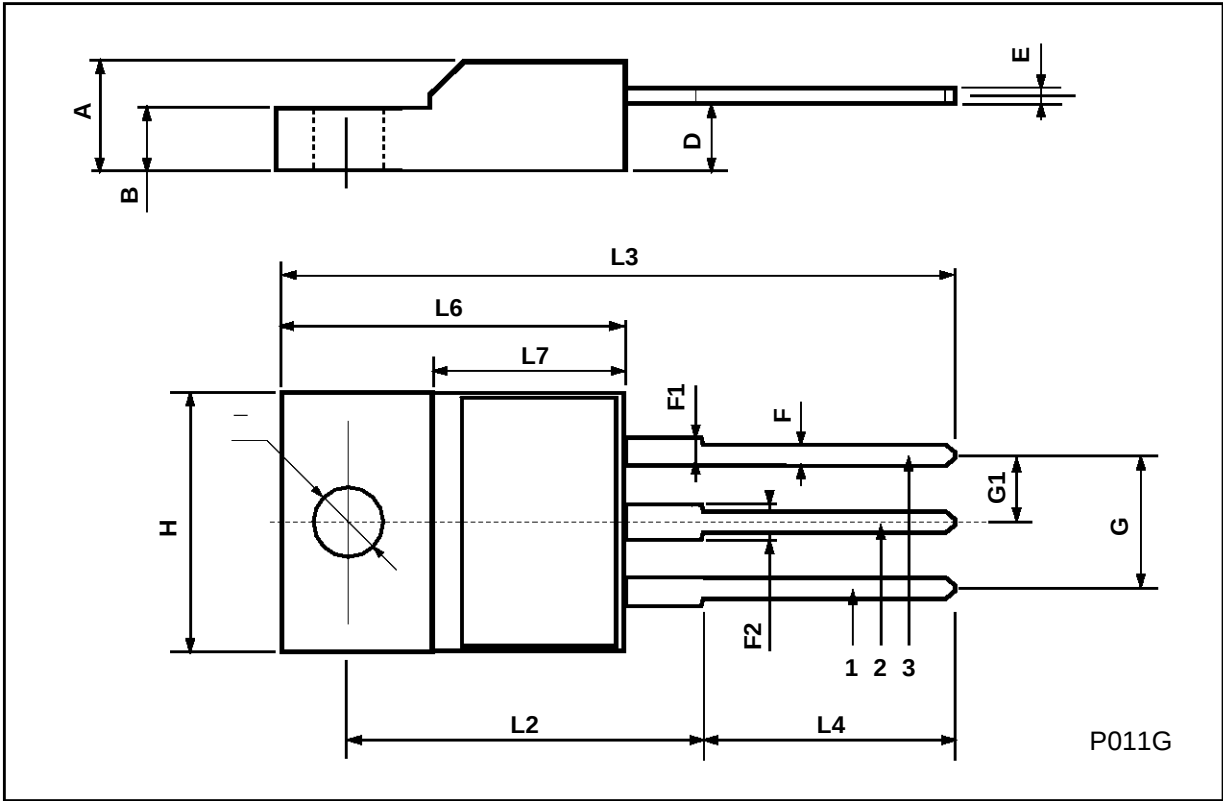
## TO-220 MECHANICAL DATA

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |      | 4.60  | 0.173 |       | 0.181 |
| C    | 1.23  |      | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |      | 2.72  | 0.094 |       | 0.107 |
| D1   |       | 1.27 |       |       | 0.050 |       |
| E    | 0.49  |      | 0.70  | 0.019 |       | 0.027 |
| F    | 0.61  |      | 0.88  | 0.024 |       | 0.034 |
| F1   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| F2   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| G    | 4.95  |      | 5.15  | 0.194 |       | 0.203 |
| G1   | 2.4   |      | 2.7   | 0.094 |       | 0.106 |
| H2   | 10.0  |      | 10.40 | 0.393 |       | 0.409 |
| L2   |       | 16.4 |       |       | 0.645 |       |
| L4   | 13.0  |      | 14.0  | 0.511 |       | 0.551 |
| L5   | 2.65  |      | 2.95  | 0.104 |       | 0.116 |
| L6   | 15.25 |      | 15.75 | 0.600 |       | 0.620 |
| L7   | 6.2   |      | 6.6   | 0.244 |       | 0.260 |
| L9   | 3.5   |      | 3.93  | 0.137 |       | 0.154 |
| DIA. | 3.75  |      | 3.85  | 0.147 |       | 0.151 |



ISOWATT220 MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| B    | 2.5  |      | 2.7  | 0.098 |       | 0.106 |
| D    | 2.5  |      | 2.75 | 0.098 |       | 0.108 |
| E    | 0.4  |      | 0.7  | 0.015 |       | 0.027 |
| F    | 0.75 |      | 1    | 0.030 |       | 0.039 |
| F1   | 1.15 |      | 1.7  | 0.045 |       | 0.067 |
| F2   | 1.15 |      | 1.7  | 0.045 |       | 0.067 |
| G    | 4.95 |      | 5.2  | 0.195 |       | 0.204 |
| G1   | 2.4  |      | 2.7  | 0.094 |       | 0.106 |
| H    | 10   |      | 10.4 | 0.393 |       | 0.409 |
| L2   |      | 16   |      |       | 0.630 |       |
| L3   | 28.6 |      | 30.6 | 1.126 |       | 1.204 |
| L4   | 9.8  |      | 10.6 | 0.385 |       | 0.417 |
| L6   | 15.9 |      | 16.4 | 0.626 |       | 0.645 |
| L7   | 9    |      | 9.3  | 0.354 |       | 0.366 |
| Ø    | 3    |      | 3.2  | 0.118 |       | 0.126 |



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