



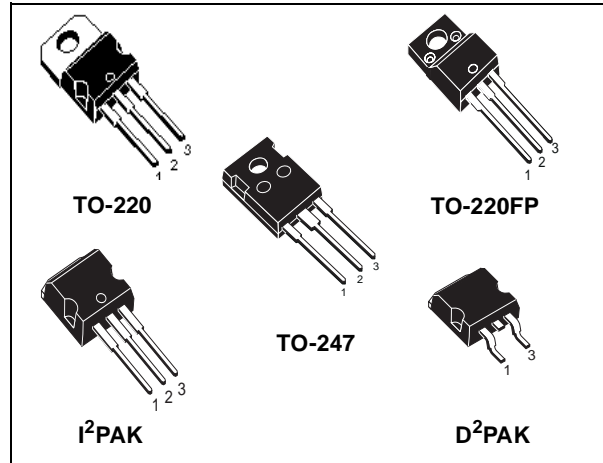
STP14NK50Z, STP14NK50ZFP STB14NK50Z, STB14NK50Z-1, STW14NK50Z

N-CHANNEL 500V-0.34Ω-14A TO-220/FP/D²PAK/I²PAK/TO-247

Zener-Protected SuperMESH™ Power MOSFET

| TYPE | V _{DSS} | R _{DS(on)} | I _D | P _w |
|--------------|------------------|---------------------|----------------|----------------|
| STP14NK50Z | 500 V | < 0.38 Ω | 14 A | 150 W |
| STP14NK50ZFP | 500 V | < 0.38 Ω | 14 A | 35 W |
| STB14NK50Z | 500 V | < 0.38 Ω | 14 A | 150 W |
| STB14NK50Z-1 | 500 V | < 0.38 Ω | 14 A | 150 W |
| STW14NK50Z | 500 V | < 0.38 Ω | 14 A | 150 W |

- TYPICAL R_{DS(on)} = 0.34 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY



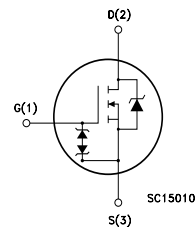
DESCRIPTION

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- IDEAL FOR OFF-LINE POWER SUPPLIES, ADAPTORS AND PFC
- LIGHTING

INTERNAL SCHEMATIC DIAGRAM



ORDERING INFORMATION

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|--------------|------------|--------------------|-------------|
| STP14NK50Z | P14NK50Z | TO-220 | TUBE |
| STP14NK50ZFP | P14NK50ZFP | TO-220FP | TUBE |
| STB14NK50ZT4 | B14NK50Z | D ² PAK | TAPE & REEL |
| STB14NK50Z-1 | B14NK50Z | I ² PAK | TUBE |
| STW14NK50Z | W14NK50Z | TO-247 | TUBE |

STP14NK50Z, STP14NK50ZFP, STB14NK50Z, STB14NK50Z-1, STW14NK50Z

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | | Unit |
|------------------------------------|---|-----------------------------|--------------|------------|------|
| | | STP14NK50Z STB14NK50Z/-1 | STP14NK50ZFP | STW14NK50Z | |
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 500 | | | V |
| V _{DGR} | Drain-gate Voltage (R _{GS} = 20 kΩ) | 500 | | | V |
| V _{GS} | Gate- source Voltage | ± 30 | | | V |
| I _D | Drain Current (continuous) at T _C = 25°C | 14 | 14 (*) | 14 | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 7.6 | 7.6 (*) | 7.6 | A |
| I _{DM} (•) | Drain Current (pulsed) | 48 | 48 (*) | 48 | A |
| P _{TOT} | Total Dissipation at T _C = 25°C | 150 | 35 | 150 | W |
| | Derating Factor | 1.20 | 0.28 | 1.20 | W/°C |
| V _{ESD(G-S)} | Gate source ESD(HBM-C=100pF, R=1.5KΩ) | 4000 | | | V |
| dv/dt (1) | Peak Diode Recovery voltage slope | 4.5 | | | V/ns |
| V _{ISO} | Insulation Withstand Voltage (DC) | - | 2500 | - | V |
| T _j T _{stg} | Operating Junction Temperature Storage Temperature | -55 to 150 | | | °C |

(•) Pulse width limited by safe operating area

(1) I_{SD} ≤ 14A, di/dt ≤ 200A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}.

(*) Limited only by maximum temperature allowed

THERMAL DATA

| | | TO-220 I ² PAK | D ² PAK | TO-220FP | TO-247 | |
|-----------------------|--|------------------------------|--------------------|----------|--------|------|
| R _{thj-case} | Thermal Resistance Junction-case Max | 0.83 | | 3.6 | 0.83 | °C/W |
| R _{thj-pcb} | Thermal Resistance Junction-pcb Max (#) | | 60 | | | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient Max | 62.5 | | | 50 | °C/W |
| T _l | Maximum Lead Temperature For Soldering Purpose | 300 | | | | °C |

AVALANCHE CHARACTERISTICS

| Symbol | Parameter | Max Value | Unit |
|-----------------|---|-----------|------|
| I _{AR} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _j max) | 12 | A |
| E _{AS} | Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V) | 400 | mJ |

GATE-SOURCE ZENER DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------|-------------------------------|--------------------------------------|------|------|------|------|
| BV _{GSO} | Gate-Source Breakdown Voltage | I _{GS} = ± 1mA (Open Drain) | 30 | | | V |

(#) When mounted on minimum Footprint

PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the 30V Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

STP14NK50Z, STP14NK50ZFP, STB14NK50Z, STB14NK50Z-1, STW14NK50Z

ELECTRICAL CHARACTERISTICS (T_{CASE} = 25°C UNLESS OTHERWISE SPECIFIED) ON/OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|---|------|------|---------|----------|
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 1mA, V _{GS} = 0 | 500 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current (V _{GS} = 0) | V _{DS} = Max Rating V _{DS} = Max Rating, T _C = 125 °C | | | 1 50 | μA μA |
| I _{GSS} | Gate-body Leakage Current (V _{DS} = 0) | V _{GS} = ± 20V | | | ±10 | μA |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 100 μA | 3 | 3.75 | 4.5 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10V, I _D = 6 A | | 0.34 | 0.38 | Ω |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--|---|---|------|-------------------|------|----------------|
| g _{fs} (1) | Forward Transconductance | V _{DS} = 8 V, I _D = 6 A | | 12 | | S |
| C _{iss} C _{oss} C _{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | V _{DS} = 25V, f = 1 MHz, V _{GS} = 0 | | 2000 238 55 | | pF pF pF |
| C _{oss eq.} (3) | Equivalent Output Capacitance | V _{GS} = 0V, V _{DS} = 0V to 400V | | 150 | | pF |

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--|--|---|------|----------------|------|----------------|
| t _{d(on)} t _r | Turn-on Delay Time Rise Time | V _{DD} = 250 V, I _D = 6 A R _G = 4.7Ω V _{GS} = 10 V (Resistive Load see, Figure 3) | | 24 16 | | ns ns |
| Q _g Q _{gs} Q _{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | V _{DD} = 400V, I _D = 12 A, V _{GS} = 10V | | 69 12 31 | 92 | nC nC nC |

SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--|---|--|------|----------------|------|----------------|
| t _{d(off)} t _f | Turn-off Delay Time Fall Time | V _{DD} = 250 V, I _D = 6 A R _G = 4.7Ω V _{GS} = 10 V (Resistive Load see, Figure 3) | | 54 12 | | ns ns |
| t _{r(Voff)} t _f t _c | Off-voltage Rise Time Fall Time Cross-over Time | V _{DD} = 400V, I _D = 12 A, R _G = 4.7Ω, V _{GS} = 10V (Inductive Load see, Figure 5) | | 9.5 9 20 | | ns ns ns |

SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|--|--|------|--------------------|----------|---------------|
| I _{SD} I _{SDM} (2) | Source-drain Current Source-drain Current (pulsed) | | | | 12 48 | A A |
| V _{SD} (1) | Forward On Voltage | I _{SD} = 12 A, V _{GS} = 0 | | | 1.6 | V |
| t _{rr} Q _{rr} I _R RM | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | I _{SD} = 12 A, di/dt = 100A/μs V _{DD} = 35V, T _j = 150°C (see test circuit, Figure 5) | | 470 3.1 13.2 | | ns μC A |

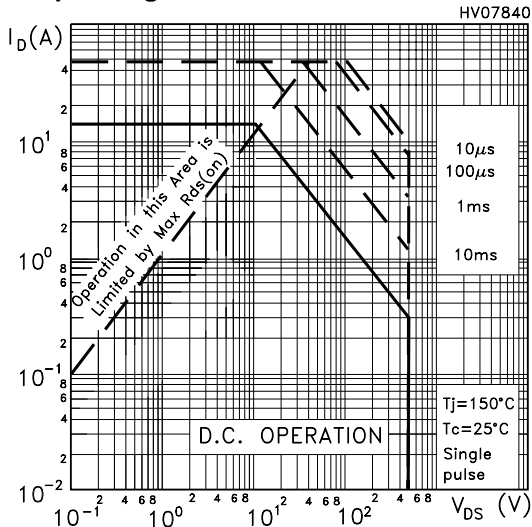
Note: 1. Pulsed: Pulse duration = 300 μs, duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

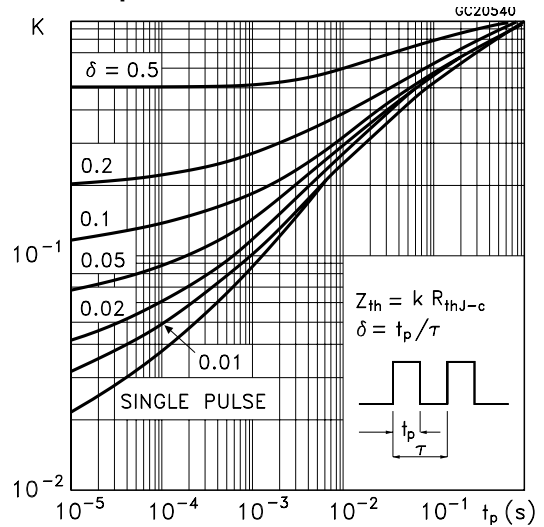
3. C_{oss eq.} is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.

STP14NK50Z, STP14NK50ZFP, STB14NK50Z, STB14NK50Z-1, STW14NK50Z

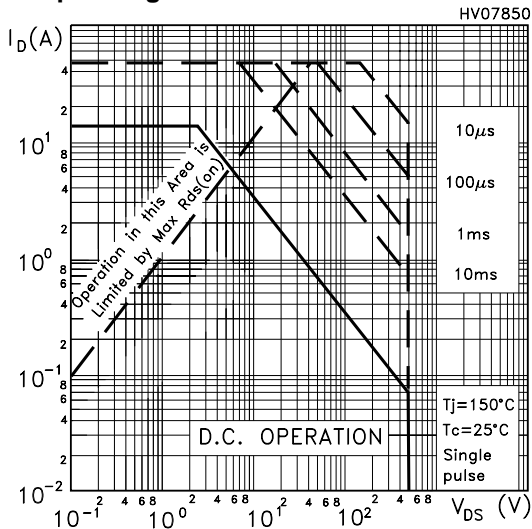
Safe Operating Area For TO-220/D2PAK/I2PAK



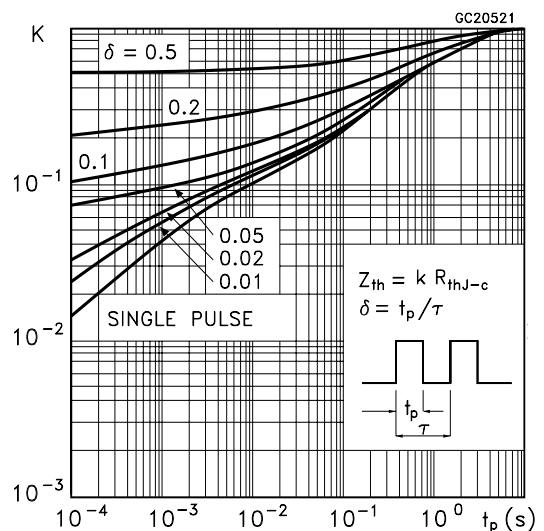
Thermal Impedance For TO-220/D2PAK/I2PAK



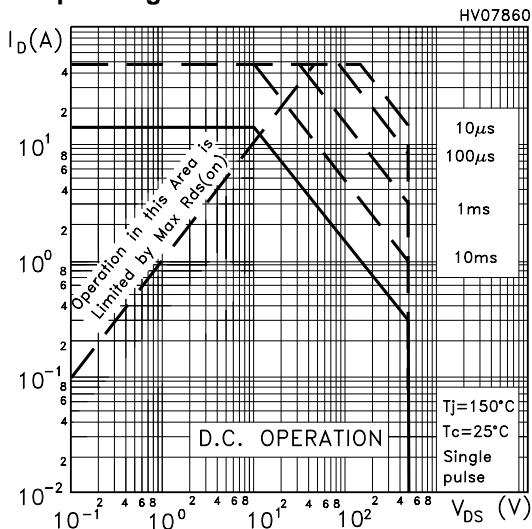
Safe Operating Area For TO-220FP



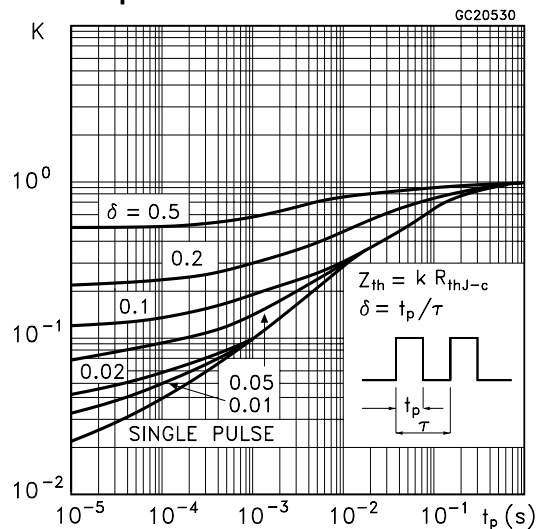
Thermal Impedance For TO-220FP



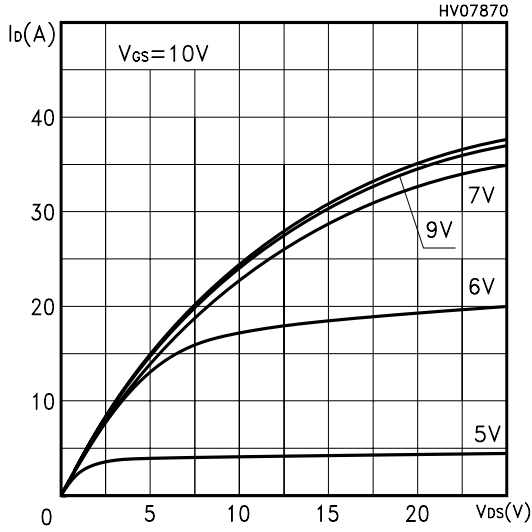
Safe Operating Area For TO-247



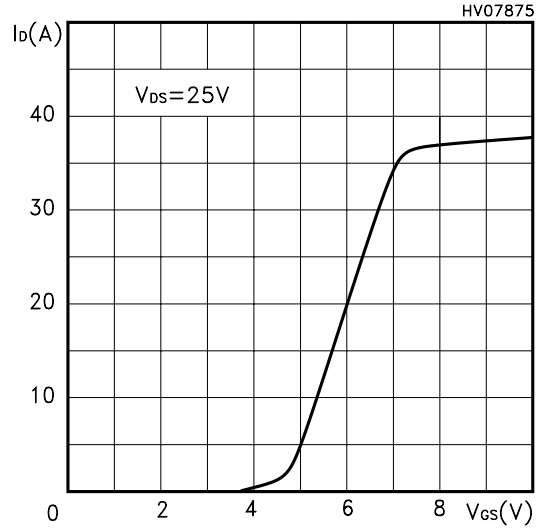
Thermal Impedance For TO-247



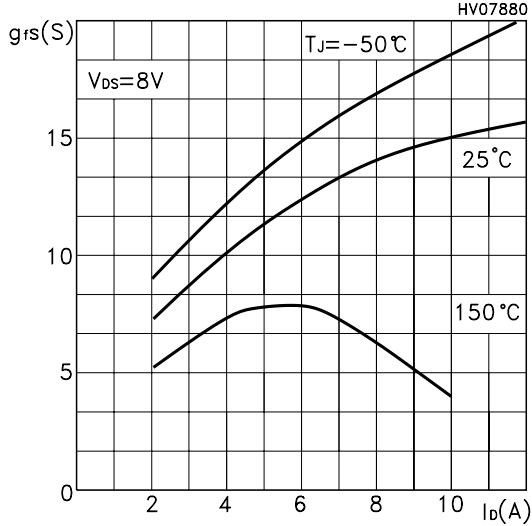
Output Characteristics



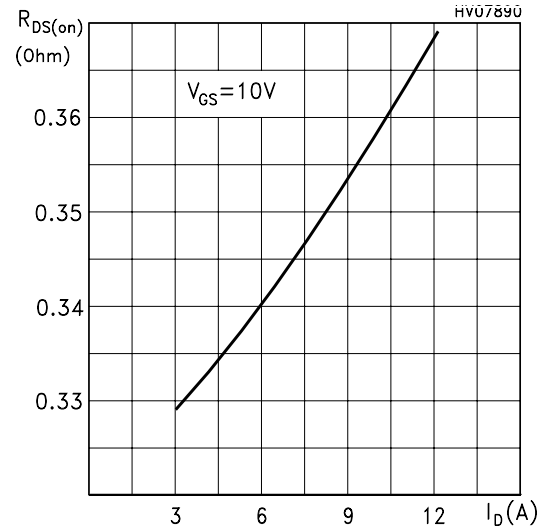
Transfer Characteristics



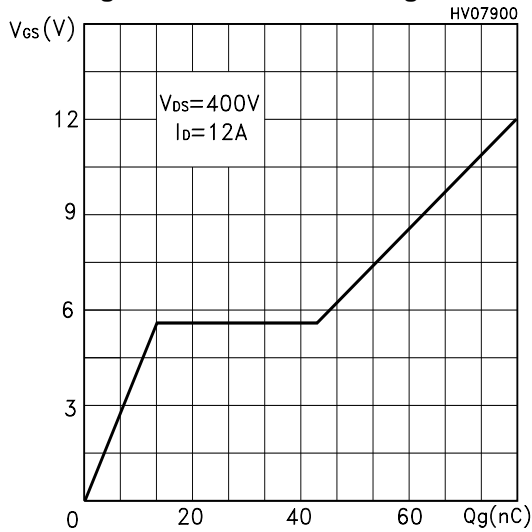
Transconductance



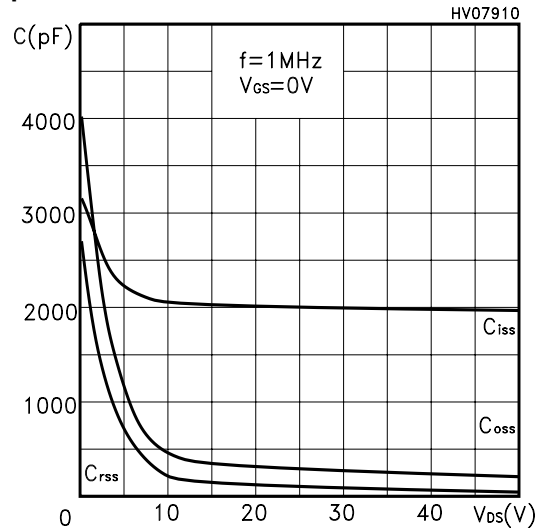
Static Drain-source On Resistance



Gate Charge vs Gate-source Voltage

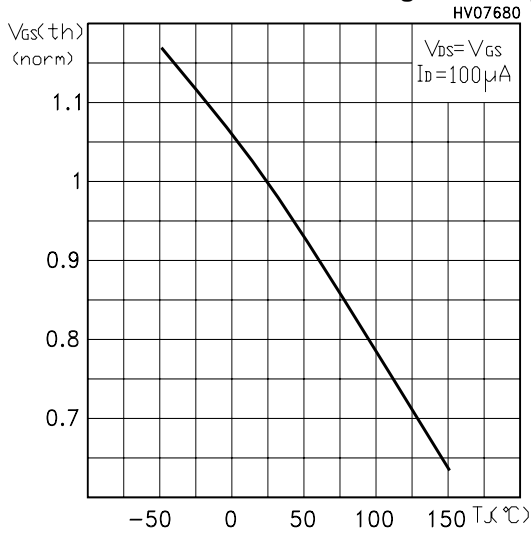


Capacitance Variations

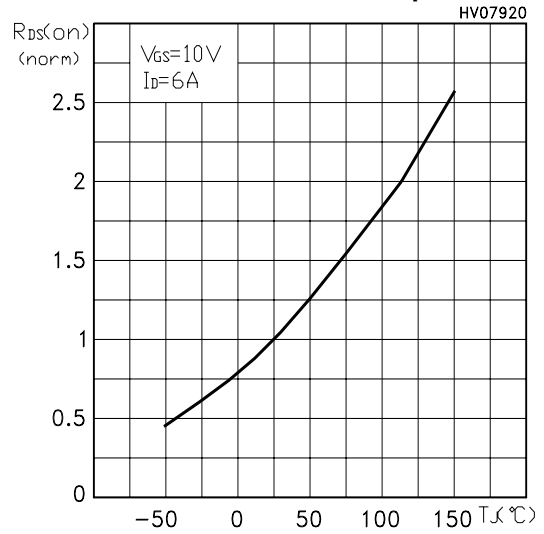


STP14NK50Z, STP14NK50ZFP, STB14NK50Z, STB14NK50Z-1, STW14NK50Z

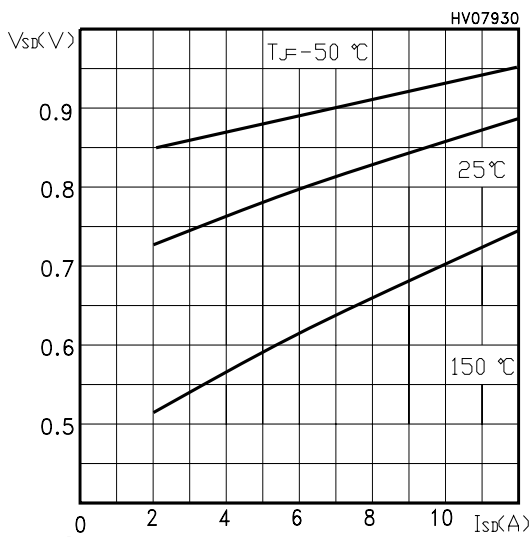
Normalized Gate Threshold Voltage vs Temp.



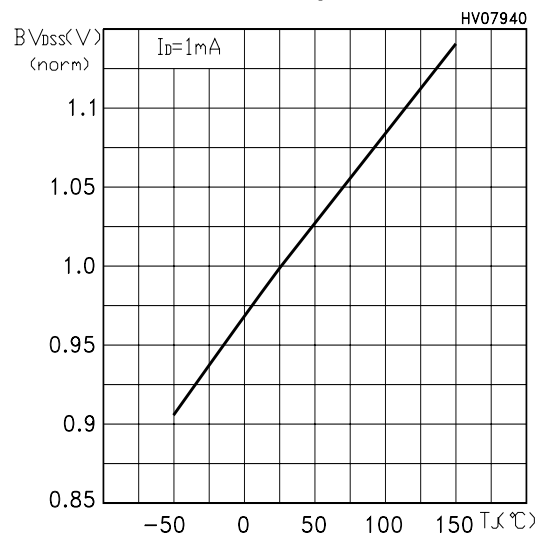
Normalized On Resistance vs Temperature



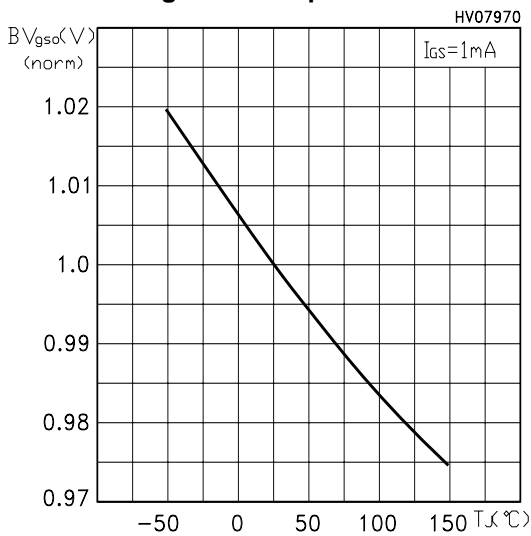
Source-drain Diode Forward Characteristics



Normalized BVDSS vs Temperature



Normalized BVgso vs Temperature



Maximum Avalanche Energy vs Temperature

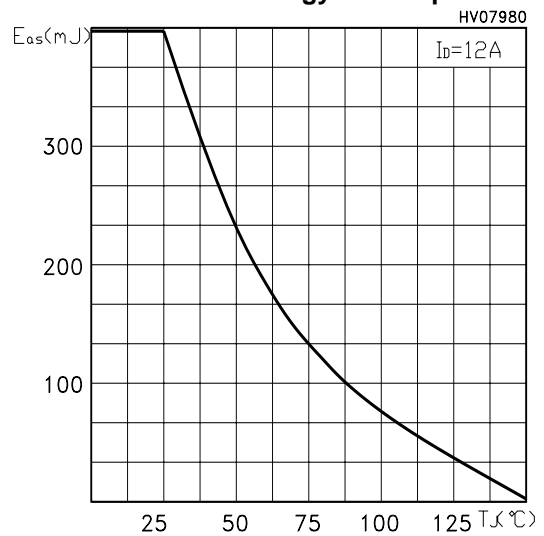


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuit For Resistive Load



Fig. 4: Gate Charge test Circuit



Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



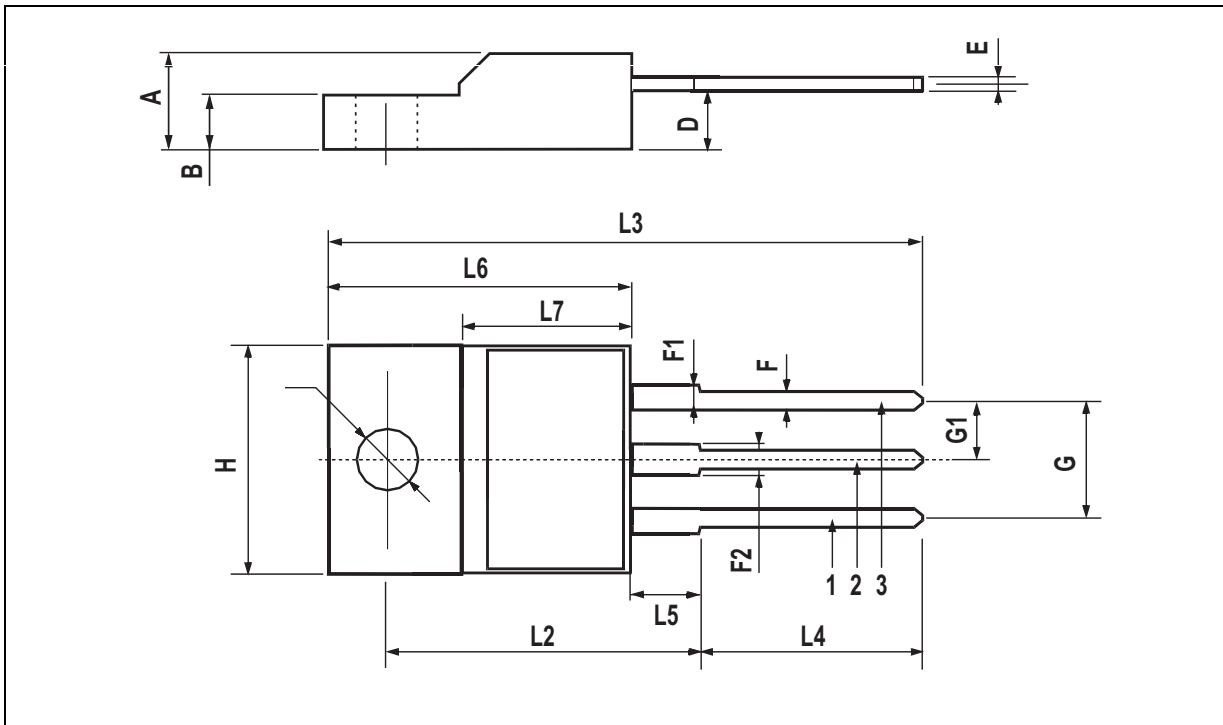
TO-220 MECHANICAL DATA

| 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 |



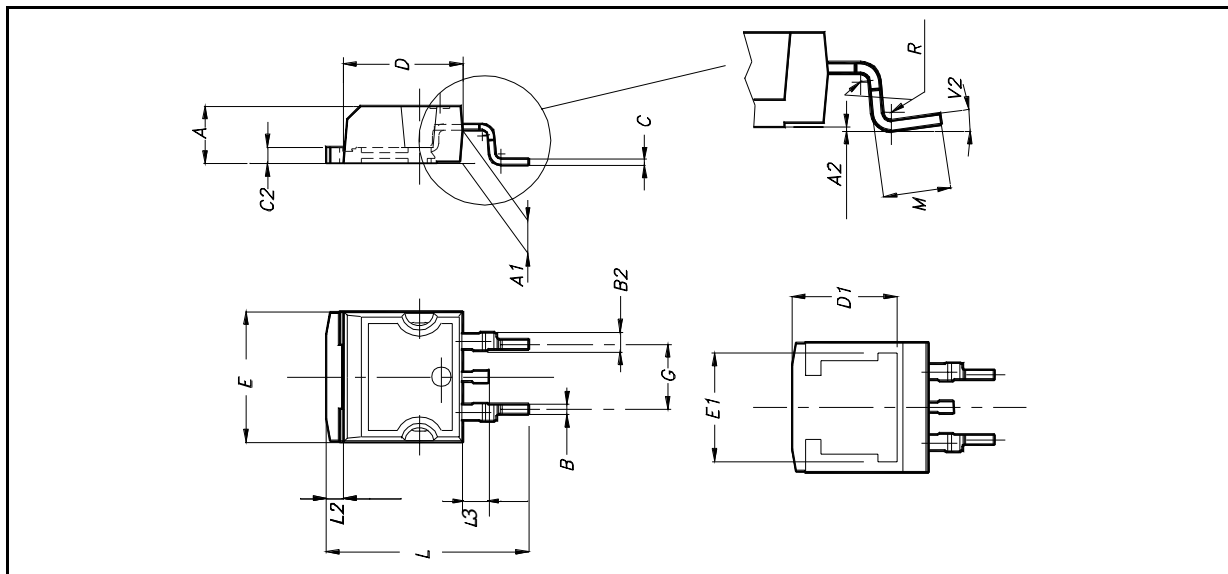
TO-220FP MECHANICAL DATA

| 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 | 0.45 | | 0.7 | 0.017 | | 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 | .0385 | | 0.417 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| 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 |



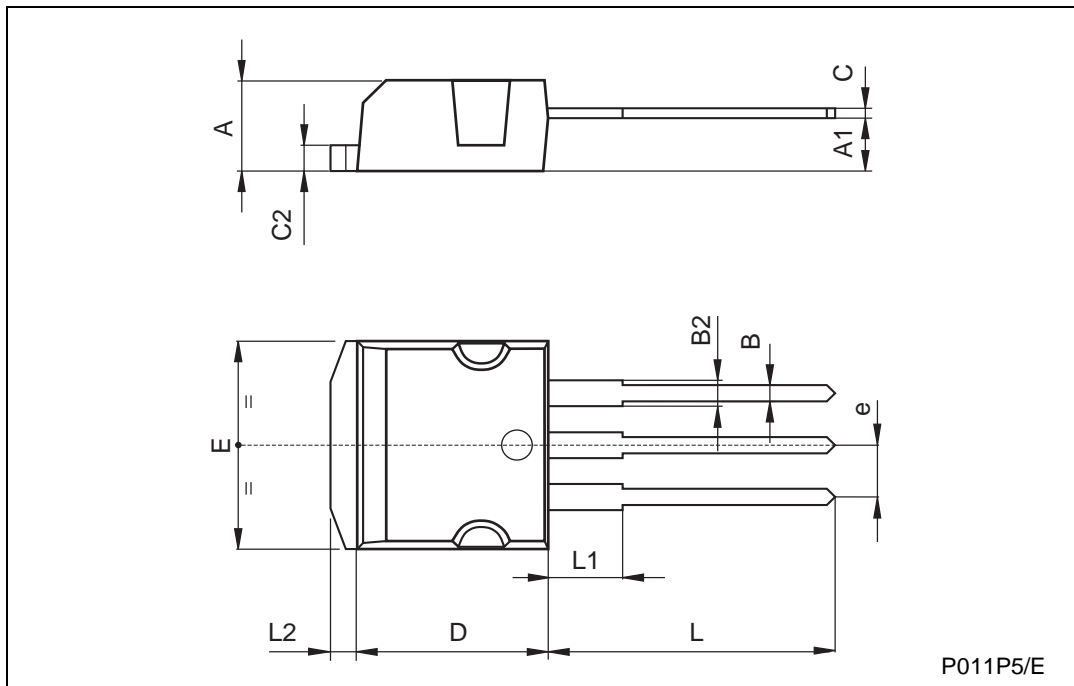
D²PAK MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|-----|-------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | | 8 | | | 0.315 | |
| E | 10 | | 10.4 | 0.393 | | |
| E1 | | 8.5 | | | 0.334 | |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15 | | 15.85 | 0.590 | | 0.625 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |
| L3 | 1.4 | | 1.75 | 0.055 | | 0.068 |
| M | 2.4 | | 3.2 | 0.094 | | 0.126 |
| R | | 0.4 | | | 0.015 | |
| V2 | 0° | | 8° | | | |



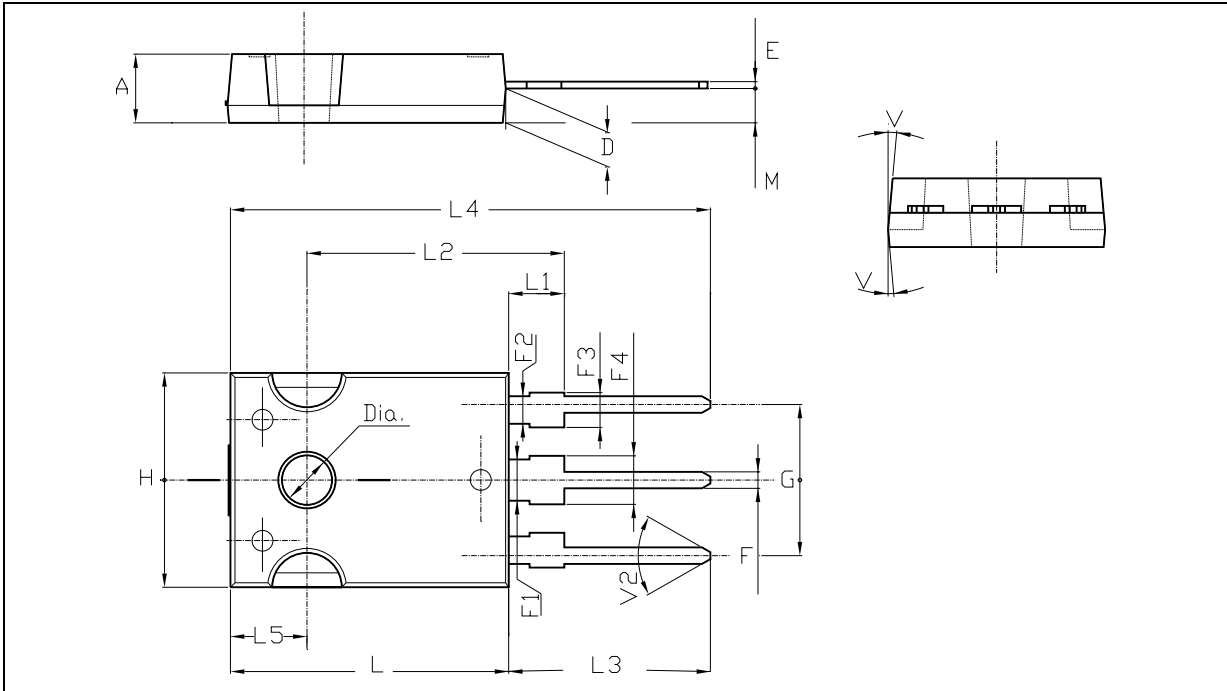
TO-262 (I²PAK) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 1.7 | 0.044 | | 0.067 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.4 | | 2.7 | 0.094 | | 0.106 |
| E | 10 | | 10.4 | 0.393 | | 0.409 |
| L | 13.1 | | 13.6 | 0.515 | | 0.531 |
| L1 | 3.48 | | 3.78 | 0.137 | | 0.149 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |

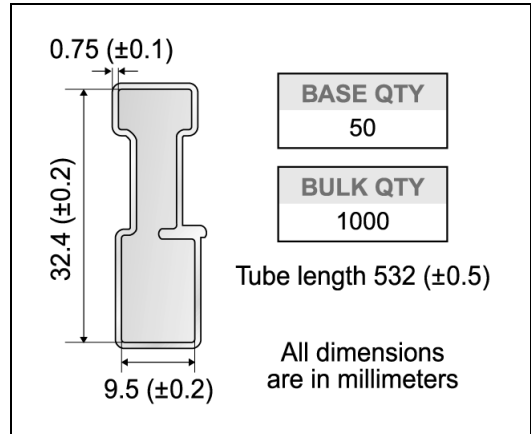
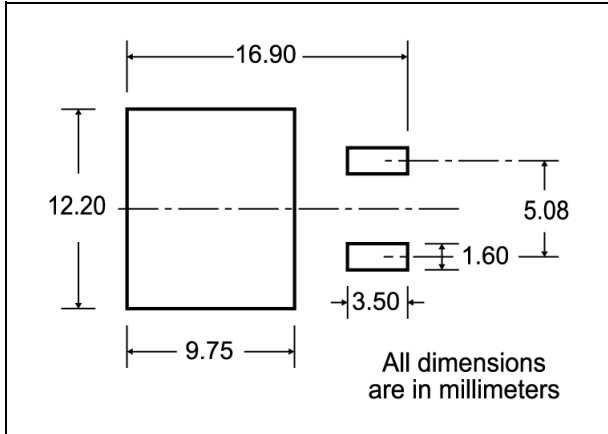


TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|-------|-------|------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| D | 2.20 | | 2.60 | 0.08 | | 0.10 |
| E | 0.40 | | 0.80 | 0.015 | | 0.03 |
| F | 1 | | 1.40 | 0.04 | | 0.05 |
| F1 | | 3 | | | 0.11 | |
| F2 | | 2 | | | 0.07 | |
| F3 | 2 | | 2.40 | 0.07 | | 0.09 |
| F4 | 3 | | 3.40 | 0.11 | | 0.13 |
| G | | 10.90 | | | 0.43 | |
| H | 15.45 | | 15.75 | 0.60 | | 0.62 |
| L | 19.85 | | 20.15 | 0.78 | | 0.79 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.72 | |
| L3 | 14.20 | | 14.80 | 0.56 | | 0.58 |
| L4 | | 34.60 | | | 1.36 | |
| L5 | | 5.50 | | | 0.21 | |
| M | 2 | | 3 | 0.07 | | 0.11 |
| V | | 5° | | | 5° | |
| V2 | | 60° | | | 60° | |
| Dia | 3.55 | | 3.65 | 0.14 | | 0.143 |



STP14NK50Z, STP14NK50ZFP, STB14NK50Z, STB14NK50Z-1, STW14NK50Z
D²PAK FOOTPRINT **TUBE SHIPMENT (no suffix)***



TAPE AND REEL SHIPMENT (suffix "T4")*

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|--------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |

REEL MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

BASE QTY: 1000 BULK QTY: 1000

10 pitches cumulative tolerance on tape +/- 0.2 mm

User Direction of Feed

Center line of cavity

R min.

Bending radius

FEED DIRECTION

* on sales type



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