



# STGB20NB32LZ STGB20NB32LZ-1

N-CHANNEL CLAMPED 20A - D<sup>2</sup>PAK/I<sup>2</sup>PAK  
INTERNALLY CLAMPED PowerMESH™ IGBT

| TYPE           | V <sub>CES</sub> | V <sub>CE(sat)</sub> | I <sub>C</sub> |
|----------------|------------------|----------------------|----------------|
| STGB20NB32LZ   | CLAMPED          | < 2.0 V              | 20 A           |
| STGB20NB32LZ-1 | CLAMPED          | < 2.0 V              | 20 A           |

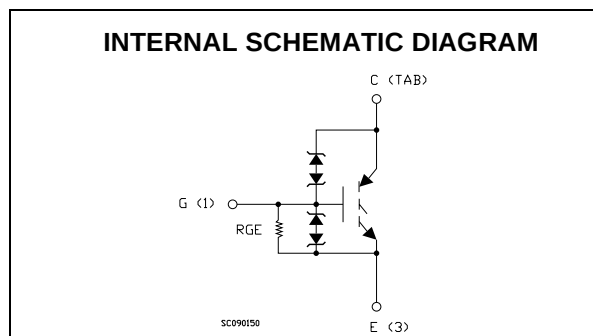
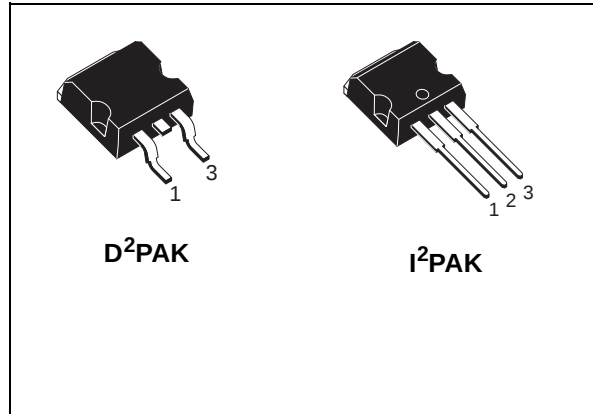
- POLYSILICON GATE VOLTAGE DRIVEN
- LOW THRESHOLD VOLTAGE
- LOW ON-VOLTAGE DROP
- HIGH CURRENT CAPABILITY
- HIGH VOLTAGE CLAMPING FEATURE
- SURFACE-MOUNTING D<sup>2</sup>PAK (TO-263)  
POWER PACKAGE IN TUBE (NO SUFFIX) OR  
IN TAPE & REEL (SUFFIX "T4")

## DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The built in collector-gate zener exhibits a very precise active clamping while the gate-emitter zener supplies an ESD protection.

## APPLICATIONS

- AUTOMOTIVE IGNITION



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                                | Value      | Unit |
|---------------------|----------------------------------------------------------|------------|------|
| V <sub>CES</sub>    | Collector-Emitter Voltage (V <sub>GS</sub> = 0)          | CLAMPED    | V    |
| V <sub>ECR</sub>    | Reverse Battery Protection                               | 20         | V    |
| V <sub>GE</sub>     | Gate-Emitter Voltage                                     | CLAMPED    | V    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 25°C  | 40         | A    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>c</sub> = 100°C | 30         | A    |
| I <sub>CM</sub> (•) | Collector Current (pulsed)                               | 80         | A    |
| E <sub>as</sub>     | Single Pulse Energy T <sub>c</sub> = 25°C                | 700        | mJ   |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25°C               | 150        | W    |
|                     | Derating Factor                                          | 1          | W/°C |
| E <sub>SD</sub>     | ESD (Human Body Model)                                   | 4          | KV   |
| T <sub>stg</sub>    | Storage Temperature                                      | -65 to 175 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                      | 175        | °C   |

(•)Pulse width limited by safe operating area

**STGB20NB32LZ - STGB20NB32LZ-1****THERMAL DATA**

|           |                                         |      |      |
|-----------|-----------------------------------------|------|------|
| Rthj-case | Thermal Resistance Junction-case Max    | 1    | °C/W |
| Rthj-amb  | Thermal Resistance Junction-ambient Max | 62.5 | °C/W |
| Rthc-sink | Thermal Resistance Case-sink Typ        | 0.2  | °C/W |

**ELECTRICAL CHARACTERISTICS** (T<sub>CASE</sub> = 25 °C UNLESS OTHERWISE SPECIFIED)

OFF

| Symbol              | Parameter                                          | Test Conditions                                                      | Min.  | Typ.  | Max.   | Unit |
|---------------------|----------------------------------------------------|----------------------------------------------------------------------|-------|-------|--------|------|
| BV <sub>(CES)</sub> | Clamped Voltage                                    | I <sub>C</sub> = 2 mA, V <sub>GE</sub> = 0, T <sub>C</sub> = -40°C   | 330   | 355   | 380    | V    |
|                     |                                                    | I <sub>C</sub> = 2 mA, V <sub>GE</sub> = 0, T <sub>C</sub> = 25°C    | 325   | 350   | 375    | V    |
|                     |                                                    | I <sub>C</sub> = 2 mA, V <sub>GE</sub> = 0, T <sub>C</sub> = 150°C   | 320   | 345   | 370    | V    |
| BV <sub>(ECR)</sub> | Emitter Collector Break-down Voltage               | I <sub>C</sub> = 75 mA, T <sub>C</sub> = 25°C                        | 20    | 28    |        | V    |
| BV <sub>GE</sub>    | Gate Emitter Break-down Voltage                    | I <sub>G</sub> = ± 2 mA                                              | 12    | 14    | 16     | V    |
| I <sub>CES</sub>    | Collector cut-off Current (V <sub>GE</sub> = 0)    | V <sub>CE</sub> = 15 V, V <sub>GE</sub> = 0, T <sub>C</sub> = 150 °C |       |       | 10     | μA   |
|                     |                                                    | V <sub>CE</sub> = 200 V, V <sub>GE</sub> = 0, T <sub>C</sub> = 150°C |       |       | 100    | μA   |
| I <sub>GES</sub>    | Gate-Emitter Leakage Current (V <sub>CE</sub> = 0) | V <sub>GE</sub> = ± 10V, V <sub>CE</sub> = 0                         | ± 400 | ± 660 | ± 1000 | μA   |
| R <sub>GE</sub>     | Gate Emitter Resistance                            |                                                                      | 10    | 15    | 25     | KΩ   |

ON (1)

| Symbol               | Parameter                            | Test Conditions                                                                    | Min. | Typ. | Max. | Unit |
|----------------------|--------------------------------------|------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>GE(th)</sub>  | Gate Threshold Voltage               | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA, T <sub>C</sub> = -40°C | 1.2  |      |      | V    |
|                      |                                      | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA, T <sub>C</sub> = 25°C  | 1    | 1.4  | 2    | V    |
|                      |                                      | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA, T <sub>C</sub> = 150°C | 0.6  |      |      | V    |
| V <sub>CE(SAT)</sub> | Collector-Emitter Saturation Voltage | V <sub>GE</sub> = 4.5V, I <sub>C</sub> = 10 A, T <sub>C</sub> = 25°C               |      | 1.1  | 1.8  | V    |
|                      |                                      | V <sub>GE</sub> = 4.5V, I <sub>C</sub> = 10 A, T <sub>C</sub> = 150°C              |      | 1    | 1.7  | V    |
|                      |                                      | V <sub>GE</sub> = 4.5V, I <sub>C</sub> = 20 A, T <sub>C</sub> = 25°C               |      | 1.35 | 2    | V    |
|                      |                                      | V <sub>GE</sub> = 4.5V, I <sub>C</sub> = 20 A, T <sub>C</sub> = 150°C              |      | 1.25 | 2    | V    |

**DYNAMIC**

| Symbol           | Parameter                    | Test Conditions                                                       | Min. | Typ. | Max. | Unit |
|------------------|------------------------------|-----------------------------------------------------------------------|------|------|------|------|
| g <sub>fs</sub>  | Forward Transconductance     | V <sub>CE</sub> = 25 V, I <sub>C</sub> = 20 A                         |      | 35   |      | S    |
| C <sub>ies</sub> | Input Capacitance            | V <sub>CE</sub> = 25 V, f = 1 MHz, V <sub>GE</sub> = 0                |      | 2300 |      | pF   |
| C <sub>oes</sub> | Output Capacitance           |                                                                       |      | 165  |      | pF   |
| C <sub>res</sub> | Reverse Transfer Capacitance |                                                                       |      | 28   |      | pF   |
| Q <sub>g</sub>   | Gate Charge                  | V <sub>CE</sub> = 280 V, I <sub>C</sub> = 20 A, V <sub>GE</sub> = 5 V |      | 51   |      | nC   |

## FUNCTIONAL CHARACTERISTICS

| Symbol | Parameter                           | Test Conditions                                                                                                                                                                 | Min.       | Typ.     | Max. | Unit   |
|--------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|------|--------|
| II     | Latching Current                    | $V_{Clamp} = 250\text{ V}$ , $T_C = 150\text{ }^{\circ}\text{C}$<br>$R_{G\text{OFF}} = 1\text{ K}\Omega$ , $V_{GE} = 4.5\text{ V}$                                              | 80         |          |      | A      |
| U.I.S. | Functional Test Open Secondary Coil | $R_{G\text{OFF}} = 1\text{ K}\Omega$ , $L = 3\text{ mH}$ , $T_C = 25^{\circ}\text{C}$<br>$R_{G\text{OFF}} = 1\text{ K}\Omega$ , $L = 3\text{ mH}$ , $T_C = 150^{\circ}\text{C}$ | 21.6<br>15 | 26<br>18 |      | A<br>A |

## SWITCHING ON

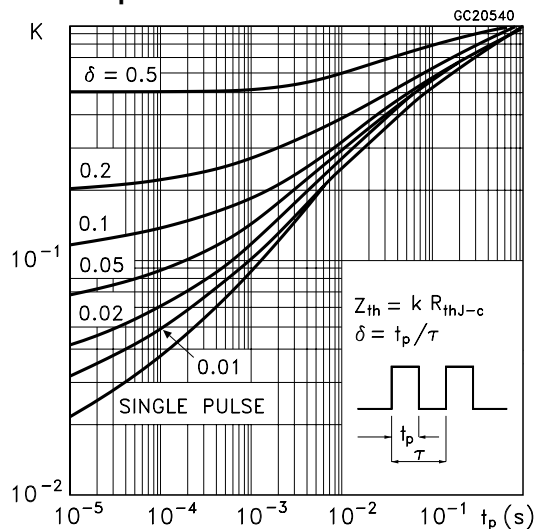
| Symbol                      | Parameter                | Test Conditions                                                                                                                                                | Min. | Typ.       | Max. | Unit                           |
|-----------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------|------|--------------------------------|
| $t_{d(\text{on})}$<br>$t_r$ | Delay Time<br>Rise Time  | $V_{CC} = 250\text{ V}$ , $I_C = 20\text{ A}$<br>$R_G = 1\text{ K}\Omega$ , $V_{GE} = 4.5\text{ V}$                                                            |      | 2.3<br>0.6 |      | $\mu\text{s}$<br>$\mu\text{s}$ |
| $(di/dt)_{\text{on}}$       | Turn-on Current Slope    | $V_{CC} = 250\text{ V}$ , $I_C = 20\text{ A}$<br>$R_G = 1\text{ K}\Omega$ , $V_{GE} = 4.5\text{ V}$                                                            |      | 550        |      | A/ $\mu\text{s}$               |
| $E_{\text{on}}$             | Turn-on Switching Losses | $V_{CC} = 250\text{ V}$ , $I_C = 20\text{ A}$ , $T_C = 25^{\circ}\text{C}$<br>$R_G = 1\text{ K}\Omega$ , $V_{GE} = 4.5\text{ V}$ , $T_C = 150^{\circ}\text{C}$ |      | 8.8<br>9.2 |      | mJ<br>mJ                       |

## SWITCHING OFF

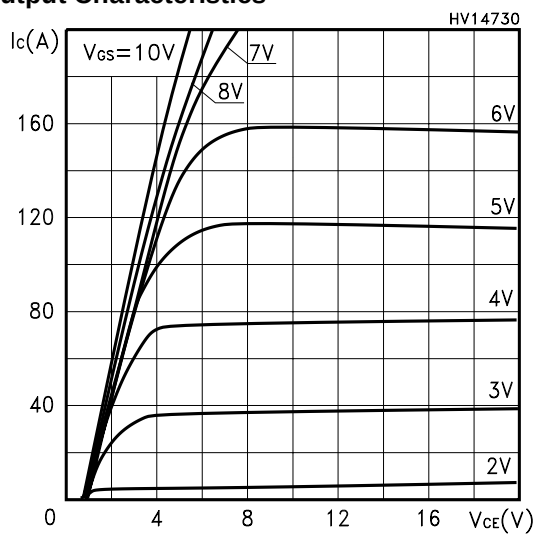
| Symbol                                                                                 | Parameter                                                                                                  | Test Conditions                                                                                                                                 | Min. | Typ.                            | Max. | Unit                                                                   |
|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------|------|------------------------------------------------------------------------|
| $t_c$<br>$t_r(V_{\text{off}})$<br>$t_f$<br>$t_{d(\text{off})}$<br>$E_{\text{off}}(**)$ | Cross-Over Time<br>Off Voltage Rise Time<br>Fall Time<br>Off Voltage Delay Time<br>Turn-off Switching Loss | $V_{CC} = 250\text{ V}$ , $I_C = 20\text{ A}$ ,<br>$R_{GE} = 1\text{ K}\Omega$ , $V_{GE} = 4.5\text{ V}$                                        |      | 4.8<br>2.6<br>2<br>11.5<br>11.8 |      | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$<br>mJ |
| $t_c$<br>$t_r(V_{\text{off}})$<br>$t_f$<br>$t_{d(\text{off})}$<br>$E_{\text{off}}(**)$ | Cross-Over Time<br>Off Voltage Rise Time<br>Fall Time<br>Off Voltage Delay Time<br>Turn-off Switching Loss | $V_{CC} = 250\text{ V}$ , $I_C = 20\text{ A}$ ,<br>$R_{GE} = 1\text{ K}\Omega$ , $V_{GE} = 4.5\text{ V}$<br>$T_C = 150\text{ }^{\circ}\text{C}$ |      | 7.8<br>3.5<br>3.9<br>12<br>17.8 |      | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$<br>mJ |

(\*\*) Losses Include Also the Tail (jedec Standardization)

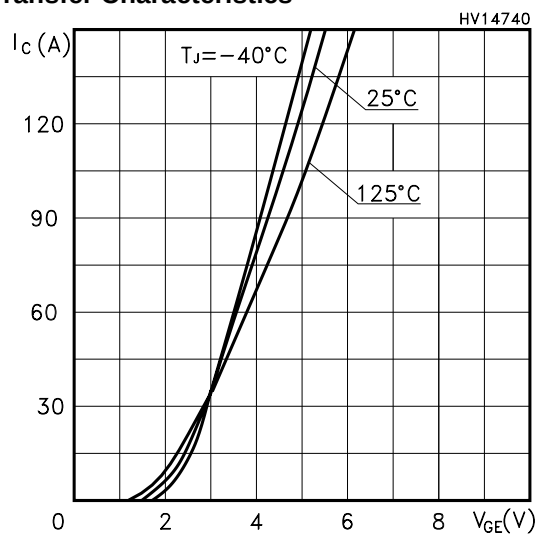
## Thermal Impedance



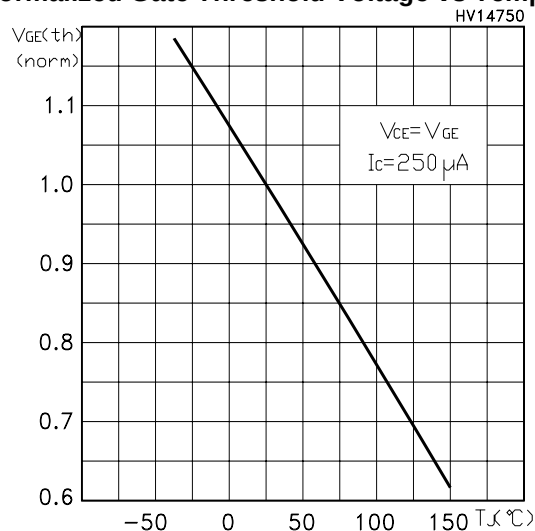
## Output Characteristics



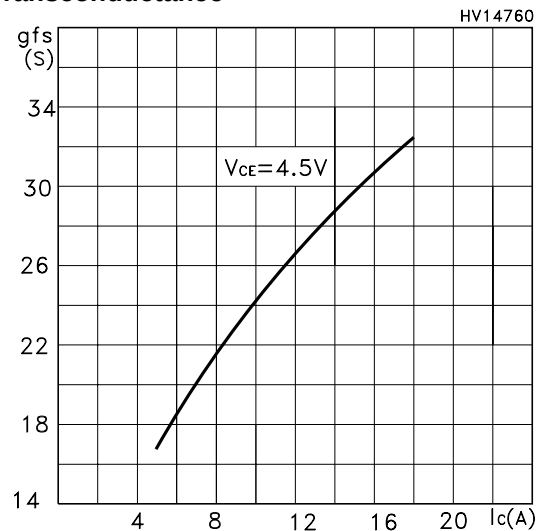
## Transfer Characteristics



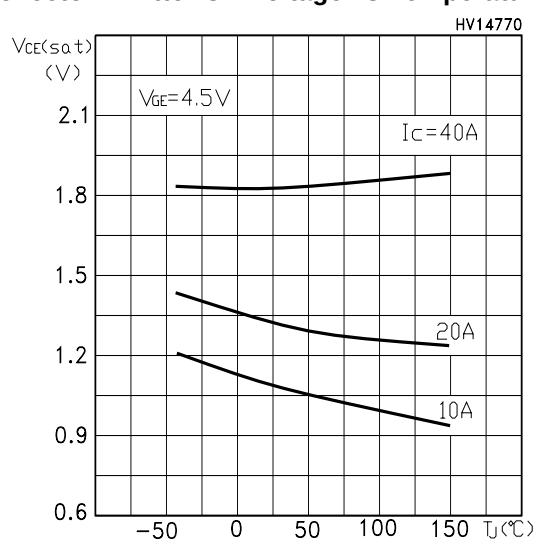
## Normalized Gate Threshold Voltage vs Temp.



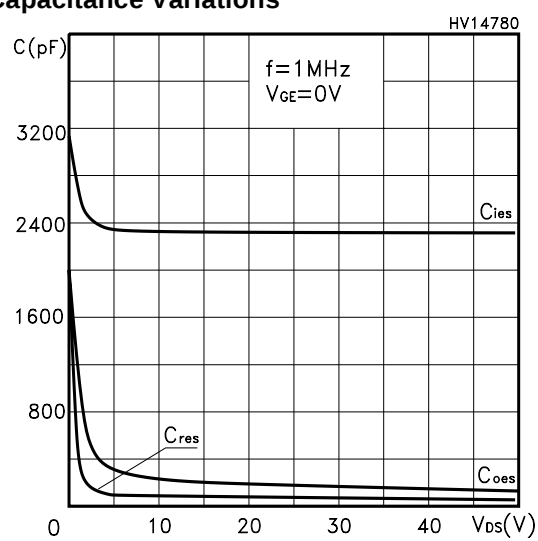
## Transconductance



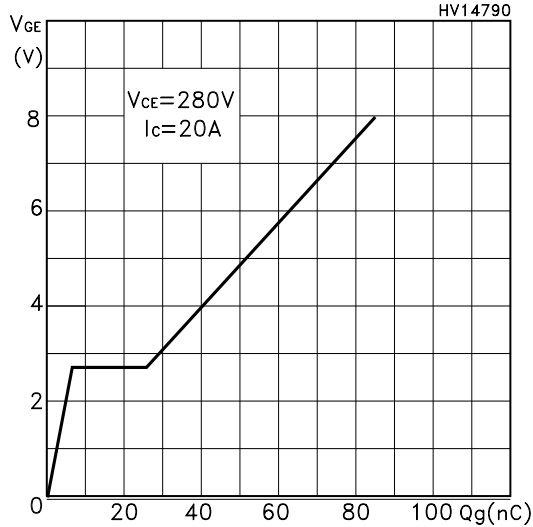
## Collector-Emitter On Voltage vs Temperature



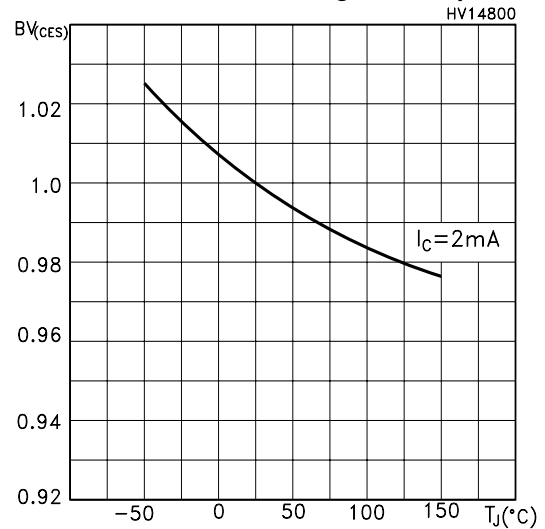
## Capacitance Variations



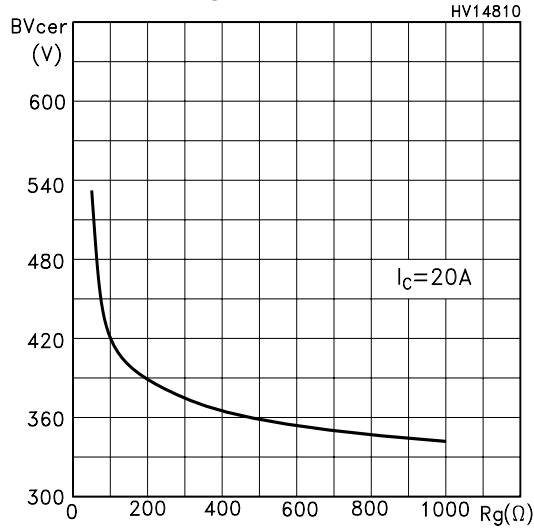
Gate Charge vs Gate-Emitter Voltage



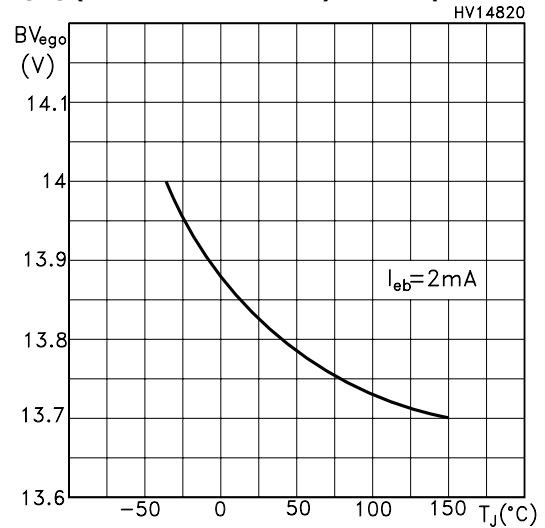
Normalized BreakDown Voltage vs Temperature



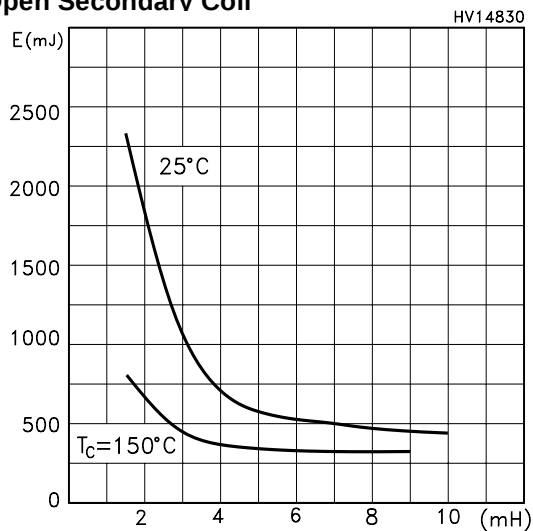
Break-Down Voltage vs Emitter Resistance



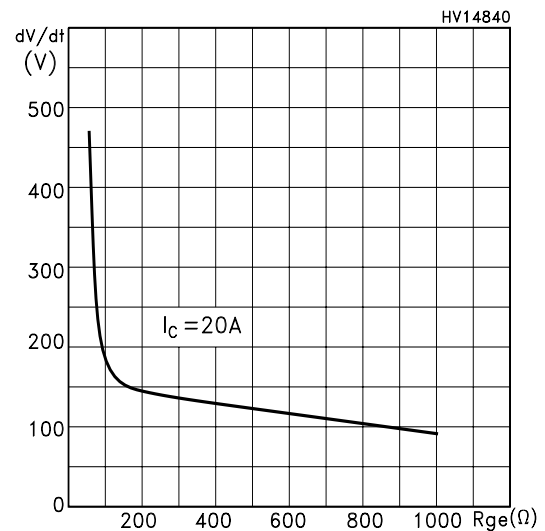
$BV_{GEO}$  (Zener Gate-Emitter) vs Temperature



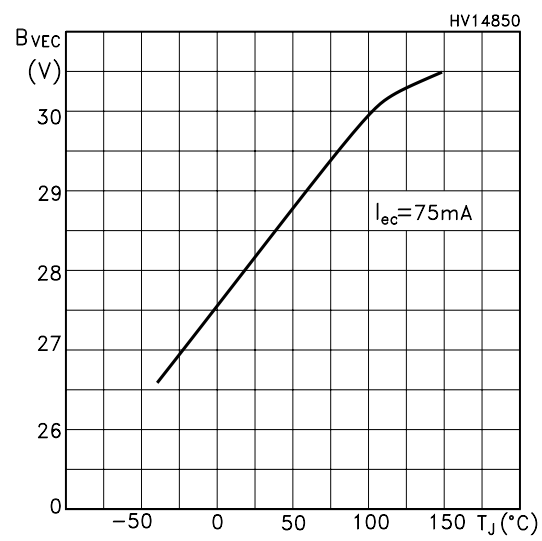
Self Clamped Inductive Switching Energy vs Open Secondary Coil



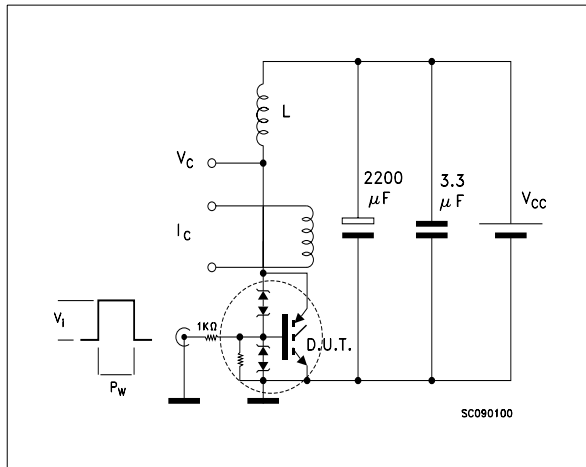
dV/dt Gate-Emitter Resistance



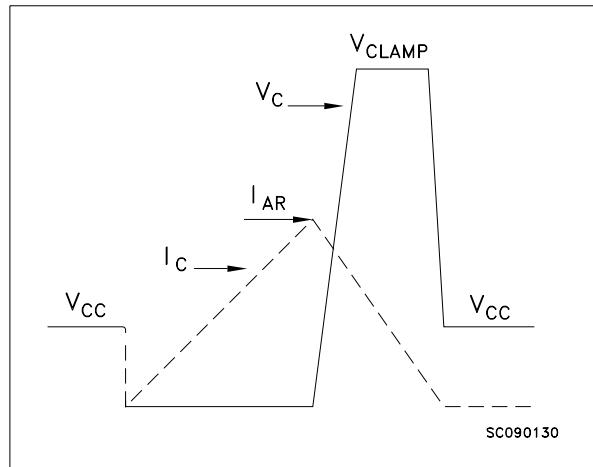
### $B_{VEC}$ Reverse Battery Voltage



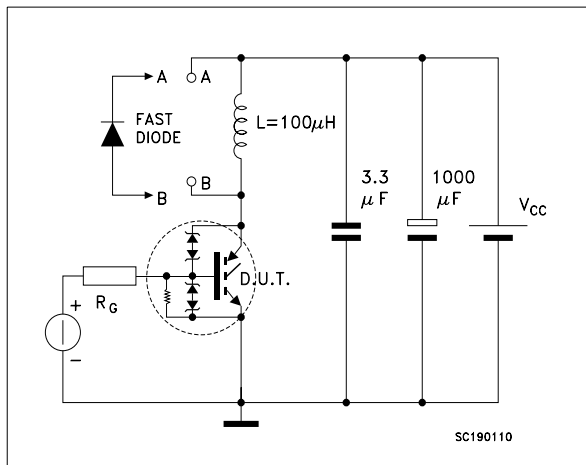
**Fig. 1: Unclamped Inductive Load Test Circuit**



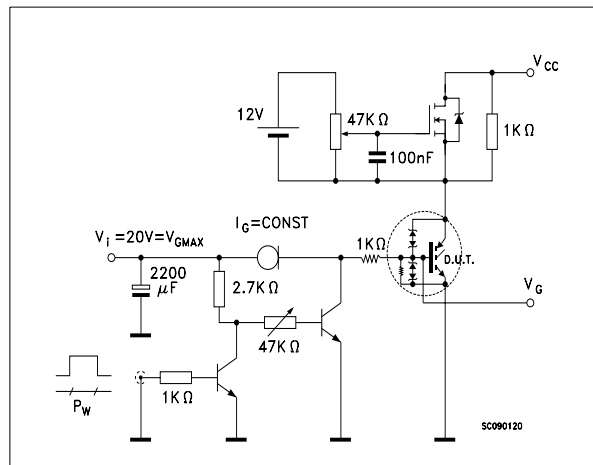
**Fig. 2: Unclamped Inductive Waveform**



**Fig. 3: Test Circuit For Inductive Load Switching And Diode Recovery Times**

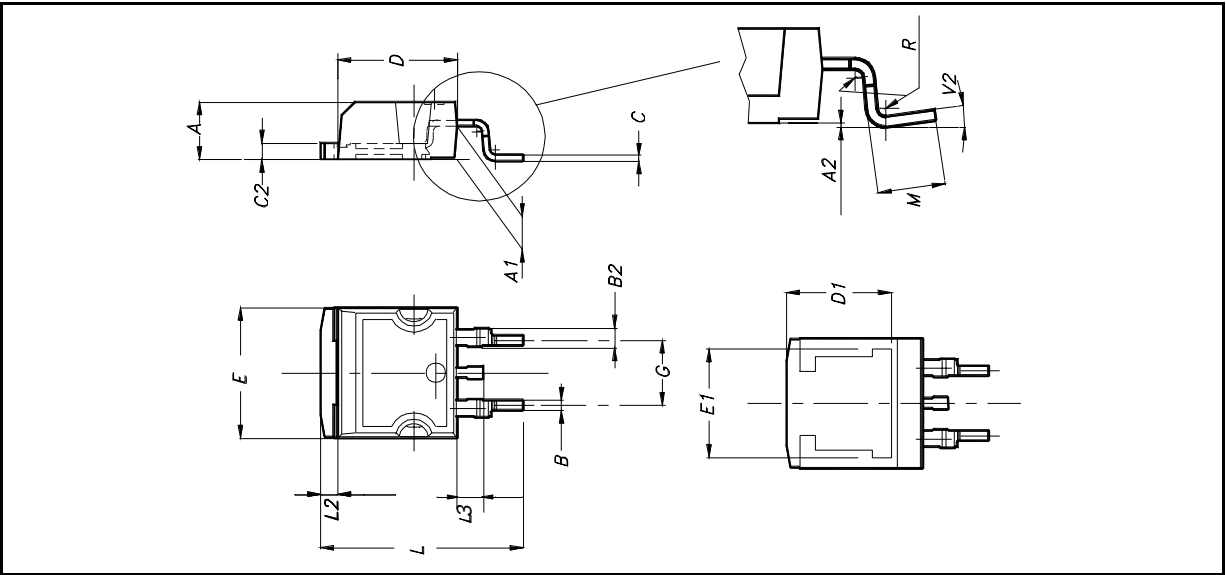


**Fig. 4: Gate Charge test Circuit**



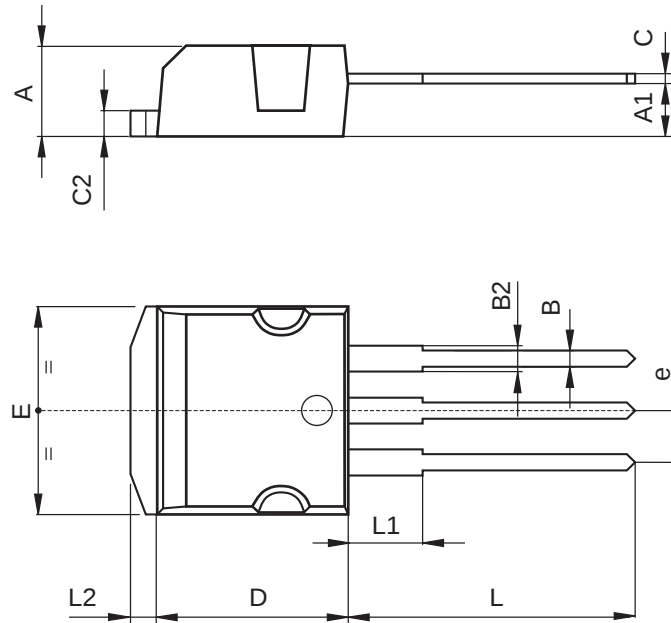
D<sup>2</sup>PAK MECHANICAL DATA

| 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°    |       |       |       |



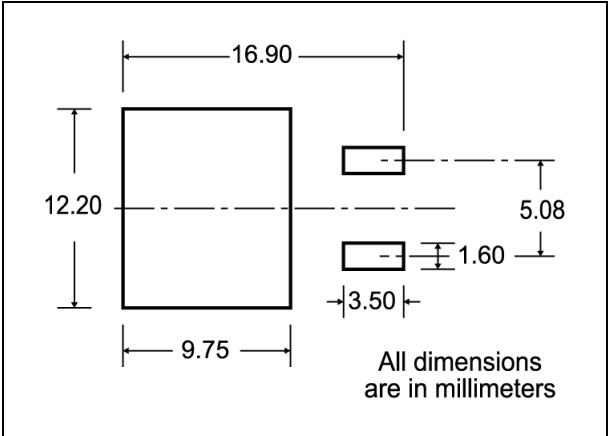
TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA

| 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 |

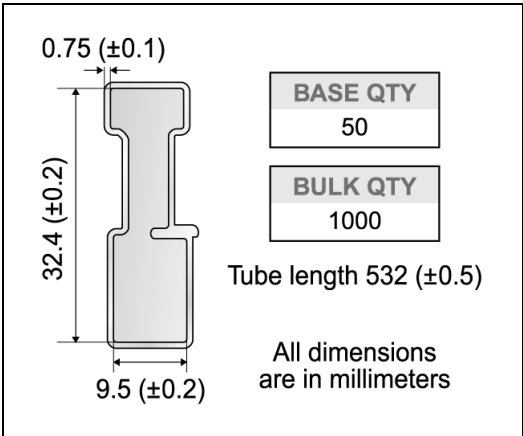


P011P5/E

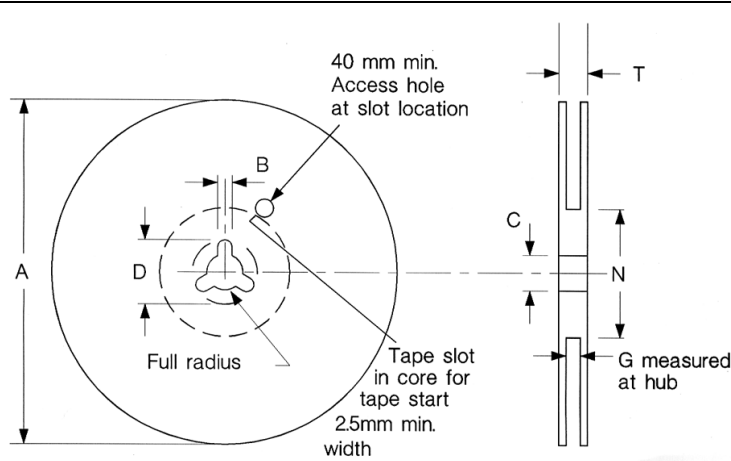
D<sup>2</sup>PAK FOOTPRINT



TUBE SHIPMENT (no suffix)\*



TAPE AND REEL SHIPMENT (suffix "T4")\*



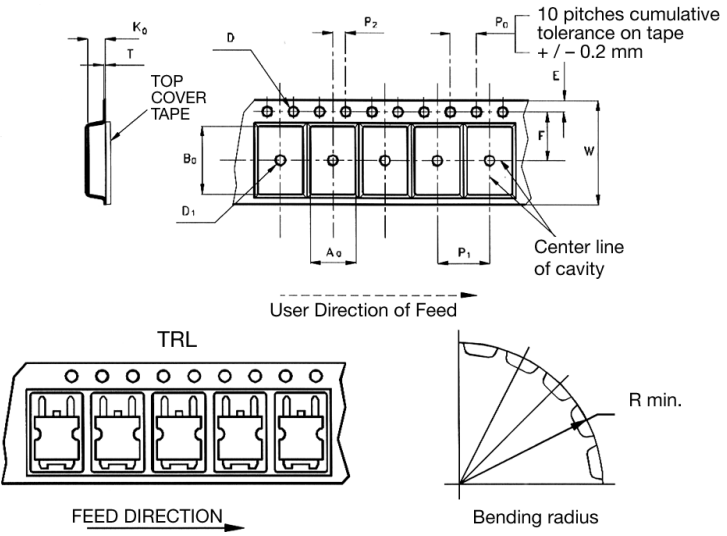
TAPE MECHANICAL DATA

| 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 | BULK QTY |
|----------|----------|
| 1000     | 1000     |



\* on sales type  
10/11

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