

# Designer's™ Data Sheet

## Insulated Gate Bipolar Transistor

### N-Channel Enhancement-Mode Silicon Gate

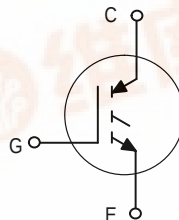
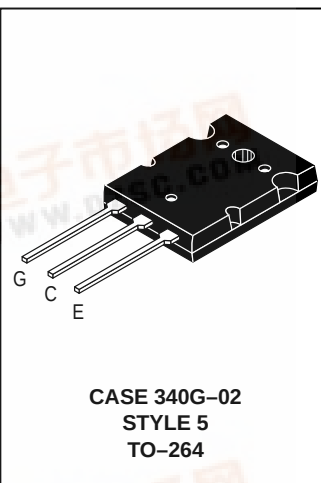
**MGY25N120**

Motorola Preferred Device

This Insulated Gate Bipolar Transistor (IGBT) uses an advanced termination scheme to provide an enhanced and reliable high voltage blocking capability. Short circuit rated IGBT's are specifically suited for applications requiring a guaranteed short circuit withstand time. Fast switching characteristics result in efficient operation at high frequencies.

- Industry Standard High Power TO-264 Package (TO-3PBL)
- High Speed  $E_{off}$ : 216  $\mu$ J/A typical at 125°C
- High Short Circuit Capability – 10  $\mu$ s minimum
- Robust High Voltage Termination

**IGBT IN TO-264**  
25 A @ 90°C  
38 A @ 25°C  
1200 VOLTS  
SHORT CIRCUIT RATED



#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating                                                                                                                                     | Symbol                             | Value          | Unit          |
|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------|---------------|
| Collector-Emitter Voltage                                                                                                                  | $V_{CES}$                          | 1200           | Vdc           |
| Collector-Gate Voltage ( $R_{GE} = 1.0 \text{ M}\Omega$ )                                                                                  | $V_{CGR}$                          | 1200           | Vdc           |
| Gate-Emitter Voltage — Continuous                                                                                                          | $V_{GE}$                           | $\pm 20$       | Vdc           |
| Collector Current — Continuous @ $T_C = 25^\circ\text{C}$<br>— Continuous @ $T_C = 90^\circ\text{C}$<br>— Repetitive Pulsed Current (1)    | $I_{C25}$<br>$I_{C90}$<br>$I_{CM}$ | 38<br>25<br>76 | Adc<br>Apk    |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$                                                      | $P_D$                              | 212<br>1.69    | Watts<br>W/°C |
| Operating and Storage Junction Temperature Range                                                                                           | $T_J, T_{stg}$                     | -55 to 150     | °C            |
| Short Circuit Withstand Time<br>( $V_{CC} = 720 \text{ Vdc}$ , $V_{GE} = 15 \text{ Vdc}$ , $T_J = 125^\circ\text{C}$ , $R_G = 20 \Omega$ ) | $t_{sc}$                           | 10             | $\mu$ s       |
| Thermal Resistance — Junction to Case – IGBT<br>— Junction to Ambient                                                                      | $R_{\theta JC}$<br>$R_{\theta JA}$ | 0.6<br>35      | °C/W          |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds                                                              | $T_L$                              | 260            | °C            |
| Mounting Torque, 6-32 or M3 screw                                                                                                          | 10 lbf•in (1.13 N•m)               |                |               |

(1) Pulse width is limited by maximum junction temperature. Repetitive rating.

**Designer's Data for "Worst Case" Conditions** — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

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## MGY25N120

### ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

#### OFF CHARACTERISTICS

|                                                                                                                                                                                         |               |           |          |             |                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------|----------|-------------|-----------------------------|
| Collector-to-Emitter Breakdown Voltage<br>( $V_{GE} = 0\text{ Vdc}$ , $I_C = 25\text{ }\mu\text{Adc}$ )<br>Temperature Coefficient (Positive)                                           | $V_{(BR)CES}$ | 1200<br>— | —<br>960 | —<br>—      | Vdc<br>mV/ $^\circ\text{C}$ |
| Emitter-to-Collector Breakdown Voltage ( $V_{GE} = 0\text{ Vdc}$ , $I_{EC} = 100\text{ mAdc}$ )                                                                                         | $V_{(BR)ECS}$ | 25        | —        | —           | Vdc                         |
| Zero Gate Voltage Collector Current<br>( $V_{CE} = 1200\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ )<br>( $V_{CE} = 1200\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ , $T_J = 125^\circ\text{C}$ ) | $I_{CES}$     | —<br>—    | —<br>—   | 100<br>2500 | $\mu\text{Adc}$             |
| Gate-Body Leakage Current ( $V_{GE} = \pm 20\text{ Vdc}$ , $V_{CE} = 0\text{ Vdc}$ )                                                                                                    | $I_{GES}$     | —         | —        | 250         | nAdc                        |

#### ON CHARACTERISTICS (1)

|                                                                                                                                                                                                                                               |              |             |                      |                   |                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|----------------------|-------------------|-----------------------------|
| Collector-to-Emitter On-State Voltage<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 12.5\text{ Adc}$ )<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 12.5\text{ Adc}$ , $T_J = 125^\circ\text{C}$ )<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 25\text{ Adc}$ ) | $V_{CE(on)}$ | —<br>—<br>— | 2.37<br>2.15<br>2.98 | 3.24<br>—<br>4.19 | Vdc                         |
| Gate Threshold Voltage<br>( $V_{CE} = V_{GE}$ , $I_C = 1.0\text{ mAdc}$ )<br>Threshold Temperature Coefficient (Negative)                                                                                                                     | $V_{GE(th)}$ | 4.0<br>—    | 6.0<br>10            | 8.0<br>—          | Vdc<br>mV/ $^\circ\text{C}$ |
| Forward Transconductance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 25\text{ Adc}$ )                                                                                                                                                                 | $g_{fe}$     | —           | 12                   | —                 | Mhos                        |

#### DYNAMIC CHARACTERISTICS

|                      |                                                                                 |           |   |      |   |    |
|----------------------|---------------------------------------------------------------------------------|-----------|---|------|---|----|
| Input Capacitance    | $(V_{CE} = 25\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ ,<br>$f = 1.0\text{ MHz}$ ) | $C_{ies}$ | — | 2795 | — | pF |
| Output Capacitance   |                                                                                 | $C_{oes}$ | — | 181  | — |    |
| Transfer Capacitance |                                                                                 | $C_{res}$ | — | 45   | — |    |

#### SWITCHING CHARACTERISTICS (1)

|                         |                                                                                                                                                                                                           |              |   |      |      |    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|------|------|----|
| Turn-On Delay Time      | $(V_{CC} = 720\text{ Vdc}$ , $I_C = 25\text{ Adc}$ ,<br>$V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$<br>$R_G = 20\text{ }\Omega$ )<br>Energy losses include "tail"                             | $t_{d(on)}$  | — | 91   | —    | ns |
| Rise Time               |                                                                                                                                                                                                           | $t_r$        | — | 124  | —    |    |
| Turn-Off Delay Time     |                                                                                                                                                                                                           | $t_{d(off)}$ | — | 196  | —    |    |
| Fall Time               |                                                                                                                                                                                                           | $t_f$        | — | 310  | —    |    |
| Turn-Off Switching Loss |                                                                                                                                                                                                           | $E_{off}$    | — | 2.44 | 4.69 | mJ |
| Turn-On Delay Time      | $(V_{CC} = 720\text{ Vdc}$ , $I_C = 25\text{ Adc}$ ,<br>$V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$<br>$R_G = 20\text{ }\Omega$ , $T_J = 125^\circ\text{C}$ )<br>Energy losses include "tail" | $t_{d(on)}$  | — | 88   | —    | ns |
| Rise Time               |                                                                                                                                                                                                           | $t_r$        | — | 126  | —    |    |
| Turn-Off Delay Time     |                                                                                                                                                                                                           | $t_{d(off)}$ | — | 236  | —    |    |
| Fall Time               |                                                                                                                                                                                                           | $t_f$        | — | 640  | —    |    |
| Turn-Off Switching Loss |                                                                                                                                                                                                           | $E_{off}$    | — | 5.40 | —    | mJ |
| Gate Charge             | $(V_{CC} = 720\text{ Vdc}$ , $I_C = 25\text{ Adc}$ ,<br>$V_{GE} = 15\text{ Vdc}$ )                                                                                                                        | $Q_T$        | — | 97   | —    | nC |
|                         |                                                                                                                                                                                                           | $Q_1$        | — | 31   | —    |    |
|                         |                                                                                                                                                                                                           | $Q_2$        | — | 40   | —    |    |

#### INTERNAL PACKAGE INDUCTANCE

|                                                                                                        |       |   |    |   |    |
|--------------------------------------------------------------------------------------------------------|-------|---|----|---|----|
| Internal Emitter Inductance<br>(Measured from the emitter lead 0.25" from package to emitter bond pad) | $L_E$ | — | 13 | — | nH |
|--------------------------------------------------------------------------------------------------------|-------|---|----|---|----|

(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

# TYPICAL ELECTRICAL CHARACTERISTICS

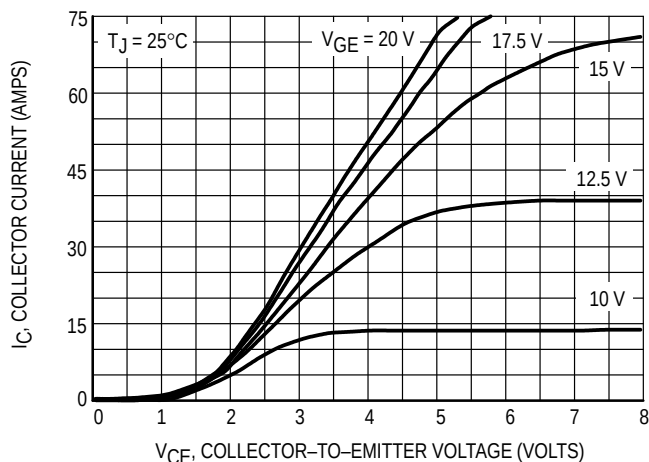


Figure 1. Output Characteristics

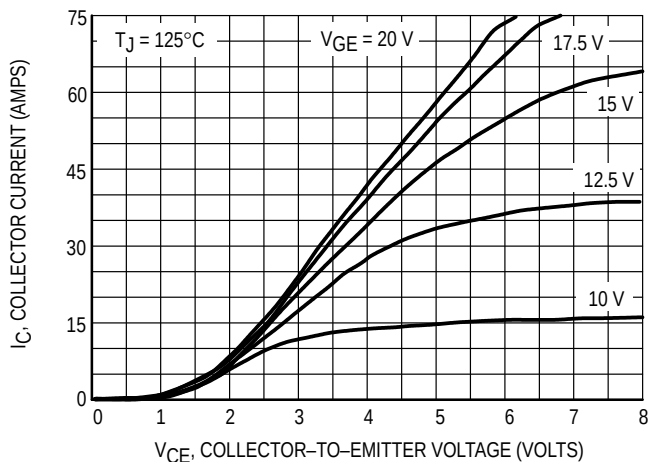


Figure 2. Output Characteristics

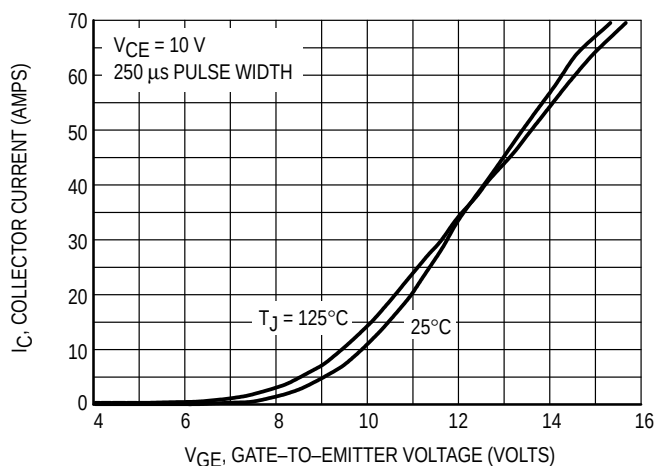


Figure 3. Transfer Characteristics

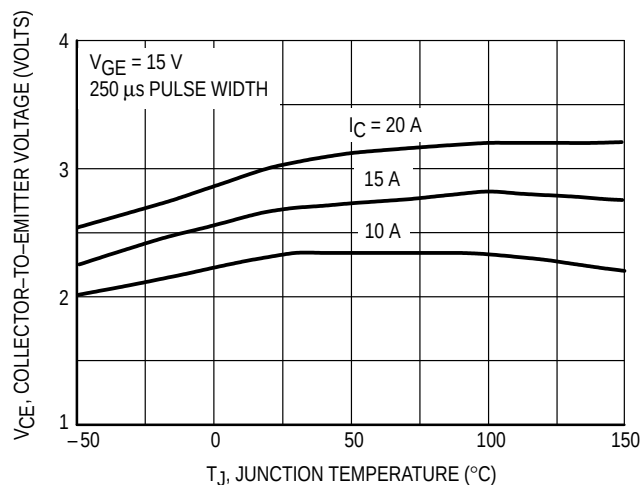


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

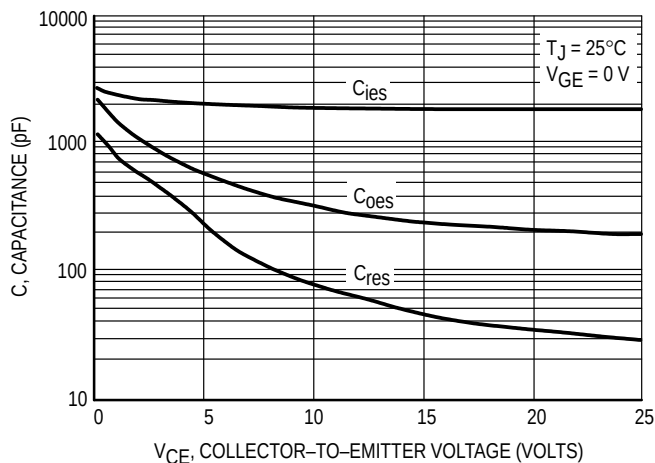


Figure 5. Capacitance Variation

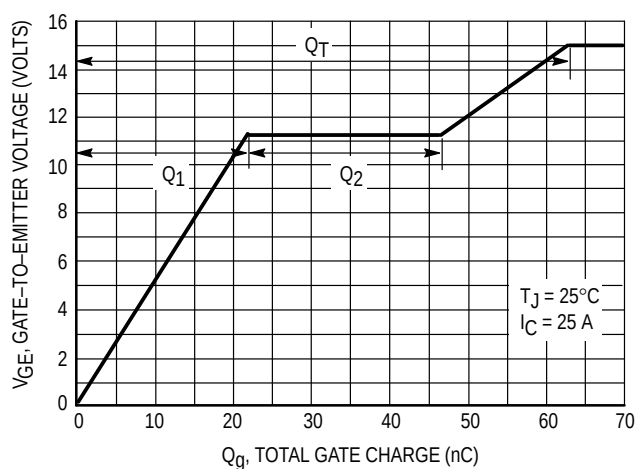


Figure 6. Gate-to-Emitter Voltage versus Total Charge

## MGY25N120

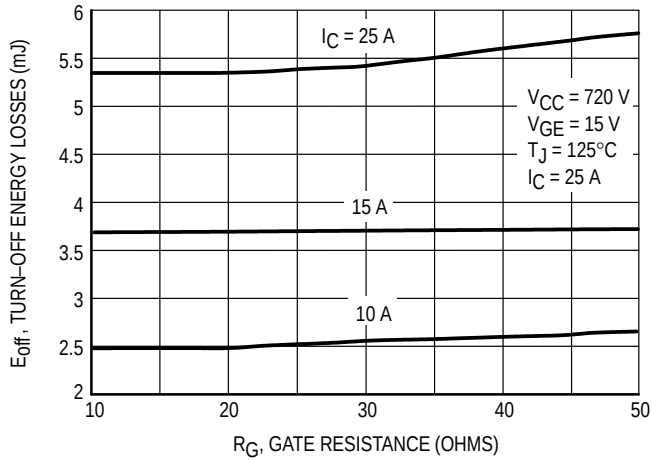


Figure 7. Turn-Off Losses versus Gate Resistance

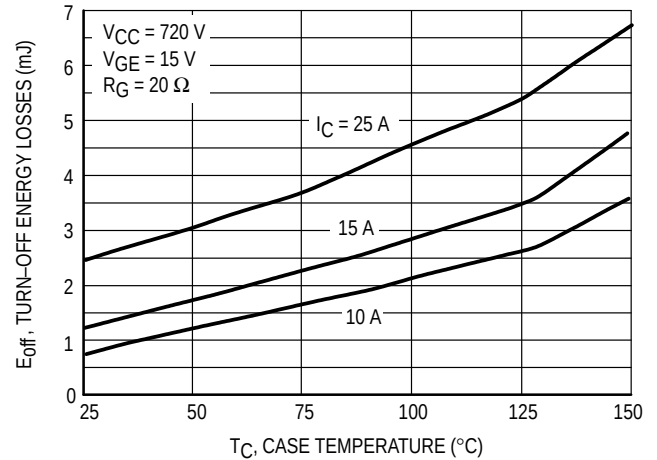


Figure 8. Turn-Off Losses versus Case Temperature

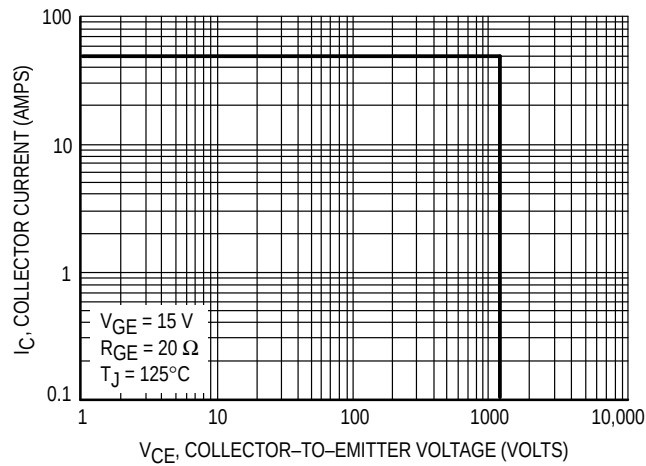


Figure 9. Reverse Biased Safe Operating Area

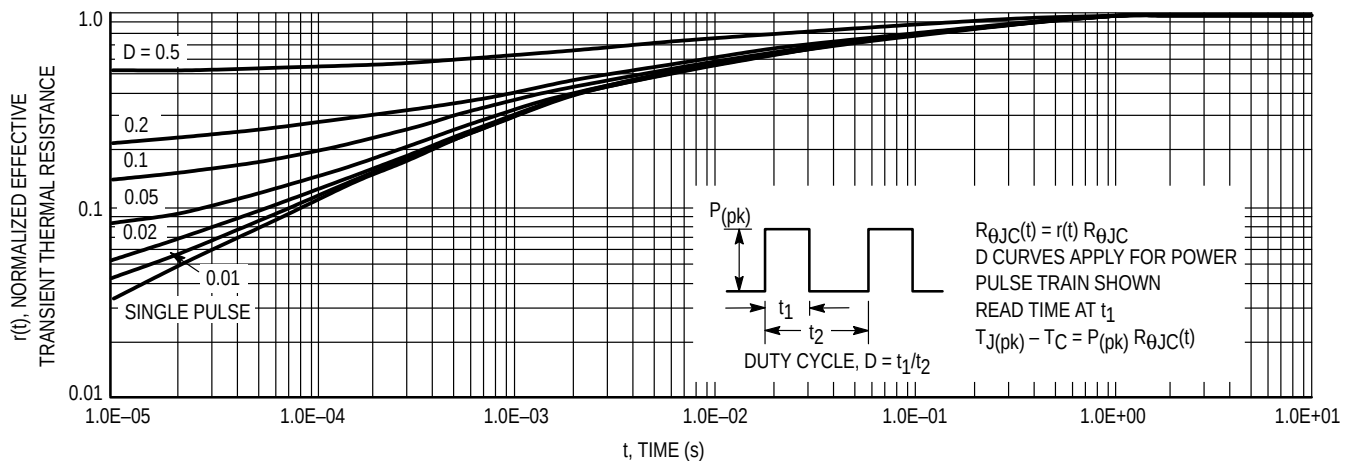
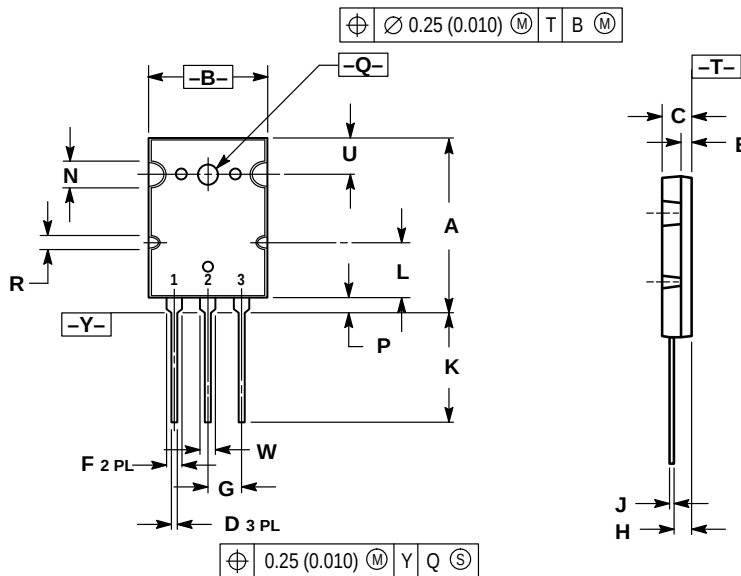


Figure 10. Thermal Response

PACKAGE DIMENSIONS



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 2.8         | 2.9  | 1.102     | 1.142 |
| B   | 19.3        | 20.3 | 0.760     | 0.800 |
| C   | 4.7         | 5.3  | 0.185     | 0.209 |
| D   | 0.93        | 1.48 | 0.037     | 0.058 |
| E   | 1.9         | 2.1  | 0.075     | 0.083 |
| F   | 2.2         | 2.4  | 0.087     | 0.102 |
| G   | 5.45 BSC    |      | 0.215 BSC |       |
| H   | 2.6         | 3.0  | 0.102     | 0.118 |
| J   | 0.43        | 0.78 | 0.017     | 0.031 |
| K   | 17.6        | 18.8 | 0.693     | 0.740 |
| L   | 11.0        | 11.4 | 0.433     | 0.449 |
| N   | 3.95        | 4.75 | 0.156     | 0.187 |
| P   | 2.2         | 2.6  | 0.087     | 0.102 |
| Q   | 3.1         | 3.5  | 0.122     | 0.137 |
| R   | 2.15        | 2.35 | 0.085     | 0.093 |
| U   | 6.1         | 6.5  | 0.240     | 0.256 |
| W   | 2.8         | 3.2  | 0.110     | 0.125 |

- STYLE 5:
- PIN 1. GATE
  - COLLECTOR
  - EMITTER

CASE 340G-02  
TO-264  
ISSUE F

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