

Designer's™ Data Sheet

Insulated Gate Bipolar Transistor with Anti-Parallel Diode

N-Channel Enhancement-Mode Silicon Gate

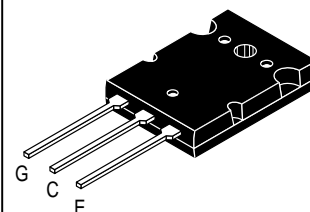
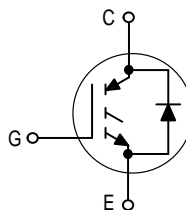
MGY20N120D

Motorola Preferred Device

IGBT & DIODE IN TO-264
20 A @ 90°C
28 A @ 25°C
1200 VOLTS
SHORT CIRCUIT RATED

This Insulated Gate Bipolar Transistor (IGBT) is co-packaged with a soft recovery ultra-fast rectifier and 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 such as Motor Control Drives. Fast switching characteristics result in efficient operation at high frequencies. Co-packaged IGBT's save space, reduce assembly time and cost.

- Industry Standard High Power TO-264 Package (TO-3PBL)
- High Speed E_{off} : 160 μ s per Amp typical at 125°C
- High Short Circuit Capability – 10 μ s minimum
- Soft Recovery Free Wheeling Diode is included in the package
- Robust High Voltage Termination
- Robust RBSOA



CASE 340G-02
STYLE 5
TO-264

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} | ± 20 | Vdc |
| Collector Current — Continuous @ $T_C = 25^\circ\text{C}$ — Continuous @ $T_C = 90^\circ\text{C}$ — Repetitive Pulsed Current (1) | I_{C25} I_{C90} I_{CM} | 28 20 56 | Adc Apc |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 174 1.39 | Watts W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | -55 to 150 | $^\circ\text{C}$ |
| Short Circuit Withstand Time ($V_{CC} = 720 \text{ Vdc}$, $V_{GE} = 15 \text{ Vdc}$, $T_J = 125^\circ\text{C}$, $R_G = 20 \Omega$) | t_{sc} | 10 | μs |
| Thermal Resistance — Junction to Case – IGBT — Junction to Case – Diode — Junction to Ambient | $R_{\theta JC}$ $R_{\theta JD}$ $R_{\theta JA}$ | 0.7 1.1 35 | $^\circ\text{C/W}$ |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds | T_L | 260 | $^\circ\text{C}$ |
| 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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Preferred devices are Motorola recommended choices for future use and best overall value.

REV 1



MGY20N120D

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|--|---------------------|----------------------|-------------------|--------------|
| OFF CHARACTERISTICS | | | | | |
| Collector-to-Emitter Breakdown Voltage (V _{GE} = 0 Vdc, I _C = 25 μAdc) Temperature Coefficient (Positive) | V _{(BR)CES} | 1200 — | — 870 | — — | Vdc mV/°C |
| Zero Gate Voltage Collector Current (V _{CE} = 1200 Vdc, V _{GE} = 0 Vdc) (V _{CE} = 1200 Vdc, V _{GE} = 0 Vdc, T _J = 125°C) | I _{CES} | — — | — — | 100 2500 | μAdc |
| Gate-Body Leakage Current (V _{GE} = ± 20 Vdc, V _{CE} = 0 Vdc) | I _{GES} | — | — | 250 | nAdc |
| ON CHARACTERISTICS (1) | | | | | |
| Collector-to-Emitter On-State Voltage (V _{GE} = 15 Vdc, I _C = 10 Adc) (V _{GE} = 15 Vdc, I _C = 10 Adc, T _J = 125°C) (V _{GE} = 15 Vdc, I _C = 20 Adc) | V _{CE(on)} | — — — | 2.42 2.36 2.90 | 3.54 — 4.99 | Vdc |
| Gate Threshold Voltage (V _{CE} = V _{GE} , I _C = 1.0 mAdc) Threshold Temperature Coefficient (Negative) | V _{GE(th)} | 4.0 — | 6.0 10 | 8.0 — | Vdc mV/°C |
| Forward Transconductance (V _{CE} = 10 Vdc, I _C = 20 Adc) | g _{fe} | — | 12 | — | Mhos |
| DYNAMIC CHARACTERISTICS | | | | | |
| Input Capacitance | (V _{CE} = 25 Vdc, V _{GE} = 0 Vdc, f = 1.0 MHz) | C _{ies} | — | 1876 | pF |
| Output Capacitance | | C _{oes} | — | 208 | |
| Transfer Capacitance | | C _{res} | — | 31 | |
| SWITCHING CHARACTERISTICS (1) | | | | | |
| Turn-On Delay Time | (V _{CC} = 720 Vdc, I _C = 20 Adc, V _{GE} = 15 Vdc, L = 300 μH R _G = 20 Ω) Energy losses include “tail” | t _{d(on)} | — | 88 | ns |
| Rise Time | | t _r | — | 103 | |
| Turn-Off Delay Time | | t _{d(off)} | — | 190 | |
| Fall Time | | t _f | — | 284 | |
| Turn-Off Switching Loss | | E _{off} | — | 1.65 | mJ |
| Turn-On Switching Loss | | E _{on} | — | 2.42 | |
| Total Switching Loss | | E _{ts} | — | 4.07 | |
| Turn-On Delay Time | (V _{CC} = 720 Vdc, I _C = 20 Adc, V _{GE} = 15 Vdc, L = 300 μH R _G = 20 Ω, T _J = 125°C) Energy losses include “tail” | t _{d(on)} | — | 83 | ns |
| Rise Time | | t _r | — | 107 | |
| Turn-Off Delay Time | | t _{d(off)} | — | 216 | |
| Fall Time | | t _f | — | 494 | |
| Turn-Off Switching Loss | | E _{off} | — | 3.19 | mJ |
| Turn-On Switching Loss | | E _{on} | — | 4.26 | |
| Total Switching Loss | | E _{ts} | — | 7.45 | |
| Gate Charge | (V _{CC} = 720 Vdc, I _C = 20 Adc, V _{GE} = 15 Vdc) | Q _T | — | 63 | nC |
| | | Q ₁ | — | 20 | |
| | | Q ₂ | — | 27 | |
| DIODE CHARACTERISTICS | | | | | |
| Diode Forward Voltage Drop (I _{EC} = 10 Adc) (I _{EC} = 10 Adc, T _J = 125°C) (I _{EC} = 20 Adc) | V _{FEC} | — — — | 2.92 1.73 3.67 | 3.59 — 4.57 | Vdc |

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

(continued)

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|----------|-----|------|-----|---------------|
| DIODE CHARACTERISTICS — continued | | | | | |
| Reverse Recovery Time | t_{rr} | — | 114 | — | ns |
| | t_a | — | 74 | — | |
| | t_b | — | 40 | — | |
| Reverse Recovery Stored Charge | Q_{RR} | — | 0.68 | — | μC |
| Reverse Recovery Time | t_{rr} | — | 224 | — | ns |
| | t_a | — | 149 | — | |
| | t_b | — | 75 | — | |
| Reverse Recovery Stored Charge | Q_{RR} | — | 2.40 | — | μC |
| INTERNAL PACKAGE INDUCTANCE | | | | | |
| Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad) | L_E | — | 13 | — | nH |

TYPICAL ELECTRICAL CHARACTERISTICS

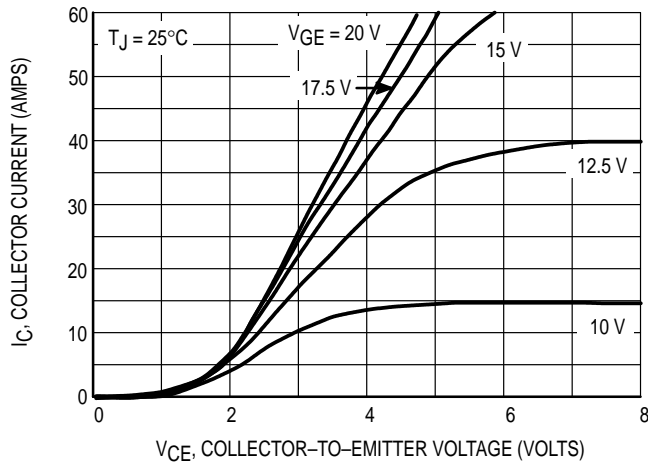


Figure 1. Output Characteristics

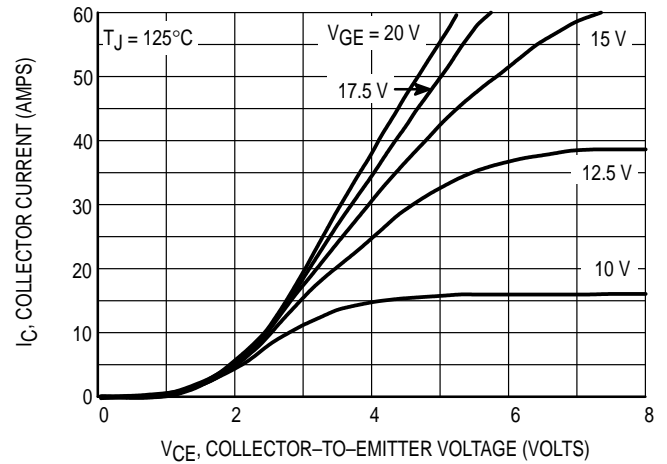


Figure 2. Output Characteristics

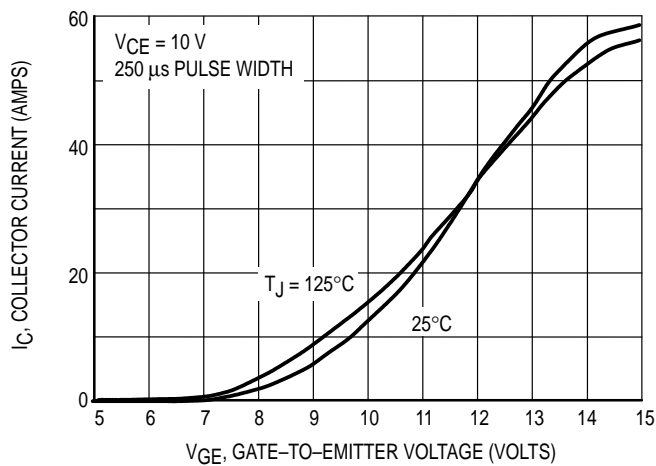


Figure 3. Transfer Characteristics

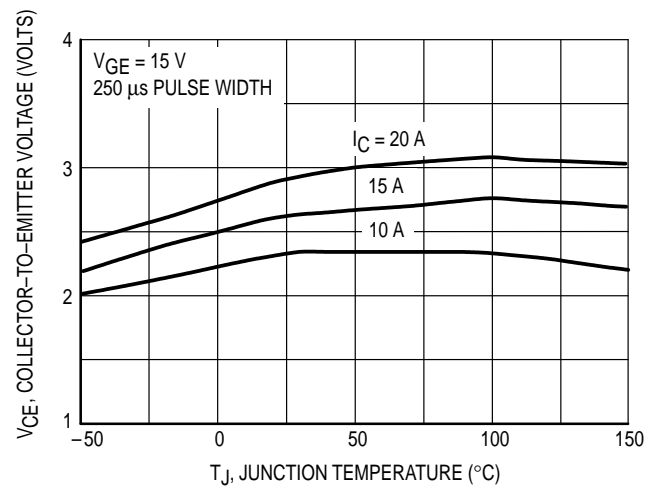


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

MGY20N120D

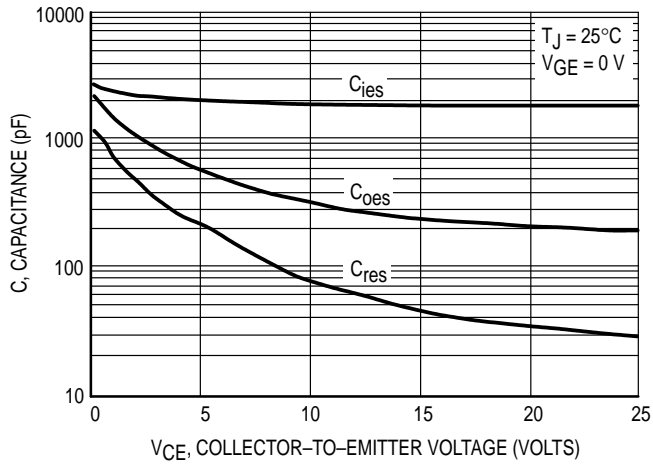


Figure 5. Capacitance Variation

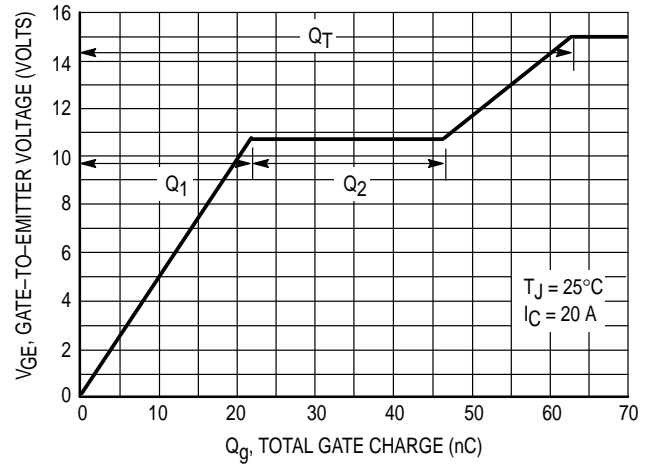


Figure 6. Gate-to-Emitter Voltage versus Total Charge

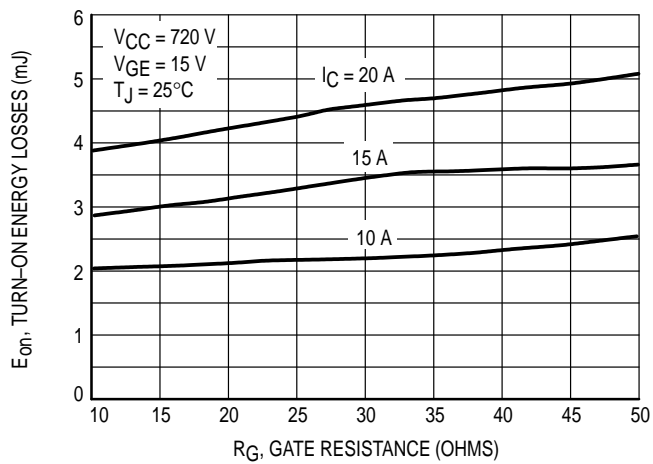


Figure 7. Turn-On Losses versus Gate Resistance

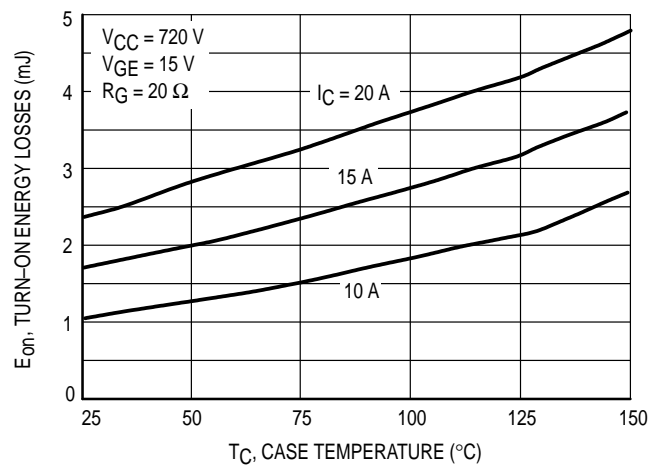


Figure 8. Turn-On Losses versus Case Temperature

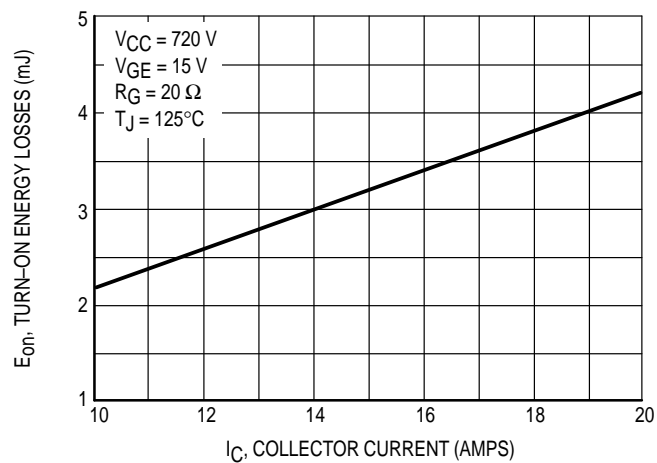


Figure 9. Turn-On Losses versus Collector Current

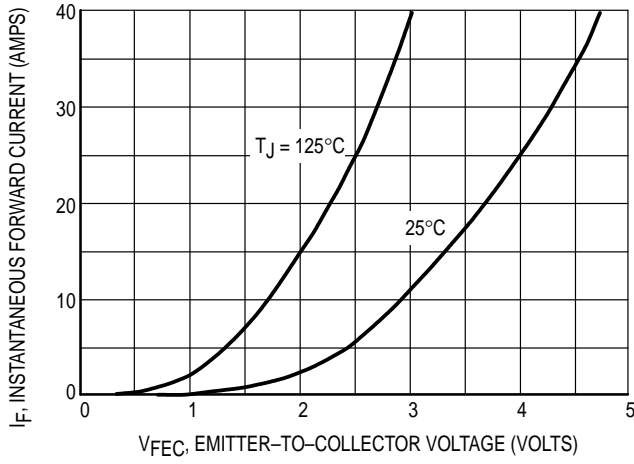


Figure 10. Diode Forward Voltage Drop

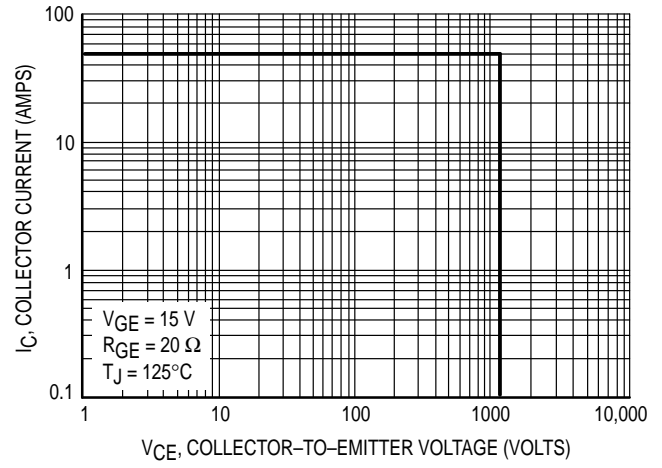


Figure 11. Reverse Biased Safe Operating Area

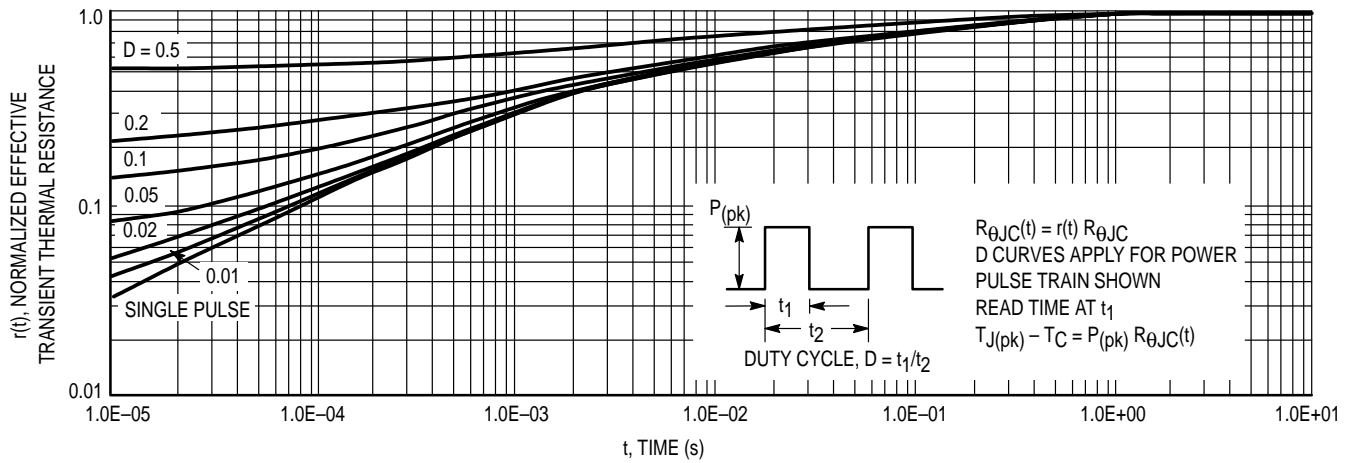
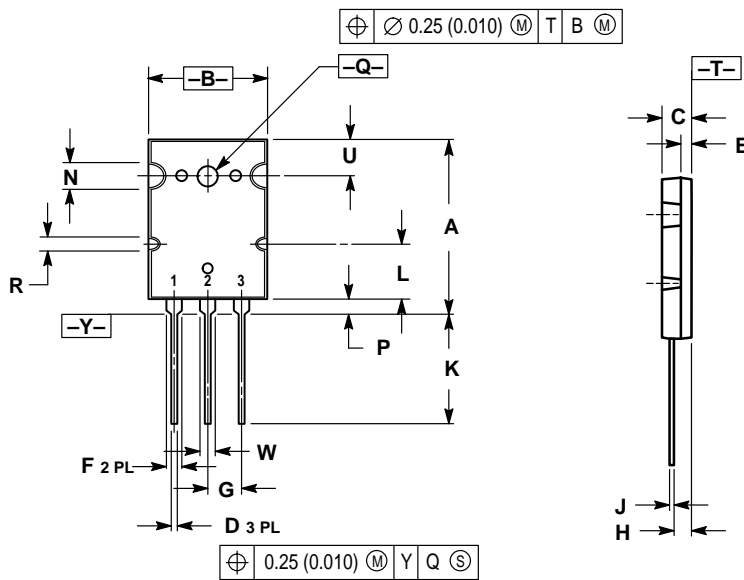


Figure 12. Thermal Response

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:
1. GATE
 2. COLLECTOR
 3. EMITTER

**CASE 340G-02
TO-264
ISSUE E**

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JAPAN: Nippon Motorola Ltd.: SPD, Strategic Planning Office, 141,
4-32-1 Nishi-Gotanda, Shagawa-ku, Tokyo, Japan. 03-5487-8488

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