

TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

Preferred Devices

Plastic Medium-Power Complementary Silicon Transistors

Designed for general-purpose amplifier and low-speed switching applications.

Features

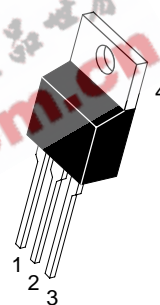
- High DC Current Gain –
 $h_{FE} = 2500$ (Typ) @ $I_C = 4.0$ Adc
- Collector–Emitter Sustaining Voltage – @ 100 mAdc
 $V_{CEO(sus)} = 60$ Vdc (Min) – TIP120, TIP125
 $= 80$ Vdc (Min) – TIP121, TIP126
 $= 100$ Vdc (Min) – TIP122, TIP127
- Low Collector–Emitter Saturation Voltage –
 $V_{CE(sat)} = 2.0$ Vdc (Max) @ $I_C = 3.0$ Adc
 $= 4.0$ Vdc (Max) @ $I_C = 5.0$ Adc
- Monolithic Construction with Built–In Base–Emitter Shunt Resistors
- Pb–Free Packages are Available*



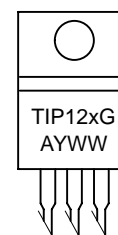
ON Semiconductor®

<http://onsemi.com>

**DARLINGTON
5 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60–80–100 VOLTS, 65 WATTS**



MARKING
DIAGRAM



TO–220AB
CASE 221A
STYLE 1

TIP12x = Device Code
x = 0, 1, 2, 5, 6, or 7
A = Assembly Location
Y = Year
WW = Work Week
G = Pb–Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

Preferred devices are recommended choices for future use and best overall value.

*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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MAXIMUM RATINGS

| Rating | Symbol | TIP120, TIP125 | TIP121, TIP126 | TIP122, TIP127 | Unit |
|---|----------------|-------------------|-------------------|-------------------|--------------------------|
| Collector–Emitter Voltage | V_{CEO} | 60 | 80 | 100 | Vdc |
| Collector–Base Voltage | V_{CB} | 60 | 80 | 100 | Vdc |
| Emitter–Base Voltage | V_{EB} | 5.0 | | | Vdc |
| Collector Current – Continuous – Peak | I_C | 5.0 8.0 | | | Adc |
| Base Current | I_B | 120 | | | mAdc |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 65 0.52 | | | W W/ $^\circ\text{C}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 2.0 0.016 | | | W W/ $^\circ\text{C}$ |
| Unclamped Inductive Load Energy (Note 1) | E | 50 | | | mJ |
| Operating and Storage Junction, Temperature Range | T_J, T_{stg} | –65 to +150 | | | $^\circ\text{C}$ |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|------|--------------------|
| Thermal Resistance, Junction–to–Case | $R_{\theta JC}$ | 1.92 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction–to–Ambient | $R_{\theta JA}$ | 62.5 | $^\circ\text{C/W}$ |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. $I_C = 1\text{ A}$, $L = 100\text{ mH}$, P.R.F. = 10 Hz, $V_{CC} = 20\text{ V}$, $R_{BE} = 100\ \Omega$

ORDERING INFORMATION

| Device | Package | Shipping |
|---------|---------------------|-----------------|
| TIP120 | TO–220 | 50 Units / Rail |
| TIP120G | TO–220 (Pb–Free) | 50 Units / Rail |
| TIP121 | TO–220 | 50 Units / Rail |
| TIP121G | TO–220 (Pb–Free) | 50 Units / Rail |
| TIP122 | TO–220 | 50 Units / Rail |
| TIP122G | TO–220 (Pb–Free) | 50 Units / Rail |
| TIP125 | TO–220 | 50 Units / Rail |
| TIP125G | TO–220 (Pb–Free) | 50 Units / Rail |
| TIP126 | TO–220 | 50 Units / Rail |
| TIP126G | TO–220 (Pb–Free) | 50 Units / Rail |
| TIP127 | TO–220 | 50 Units / Rail |
| TIP127G | TO–220 (Pb–Free) | 50 Units / Rail |

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

| Characteristic | Symbol | Min | Max | Unit |
|---|---------------|-----------------|-------------------|------|
| OFF CHARACTERISTICS | | | | |
| Collector–Emitter Sustaining Voltage (Note 2) ($I_C = 100\text{ mAdc}$, $I_B = 0$) | $V_{CE(sus)}$ | 60 80 100 | – – – | Vdc |
| Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 50\text{ Vdc}$, $I_B = 0$) | I_{CEO} | – – – | 0.5 0.5 0.5 | mAdc |
| Collector Cutoff Current ($V_{CB} = 60\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100\text{ Vdc}$, $I_E = 0$) | I_{CBO} | – – – | 0.2 0.2 0.2 | mAdc |
| Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$) | I_{EBO} | – | 2.0 | mAdc |

ON CHARACTERISTICS (Note 2)

| | | | | |
|--|---------------|--------------|------------|-----|
| DC Current Gain ($I_C = 0.5\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) | h_{FE} | 1000 1000 | – – | – |
| Collector–Emitter Saturation Voltage ($I_C = 3.0\text{ Adc}$, $I_B = 12\text{ mAdc}$) ($I_C = 5.0\text{ Adc}$, $I_B = 20\text{ mAdc}$) | $V_{CE(sat)}$ | – – | 2.0 4.0 | Vdc |
| Base–Emitter On Voltage ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) | $V_{BE(on)}$ | – | 2.5 | Vdc |

DYNAMIC CHARACTERISTICS

| | | | | |
|--|----------|--------|------------|----|
| Small–Signal Current Gain ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$, $f = 1.0\text{ MHz}$) | h_{fe} | 4.0 | – | – |
| Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 0.1\text{ MHz}$) | C_{ob} | – – | 300 200 | pF |

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

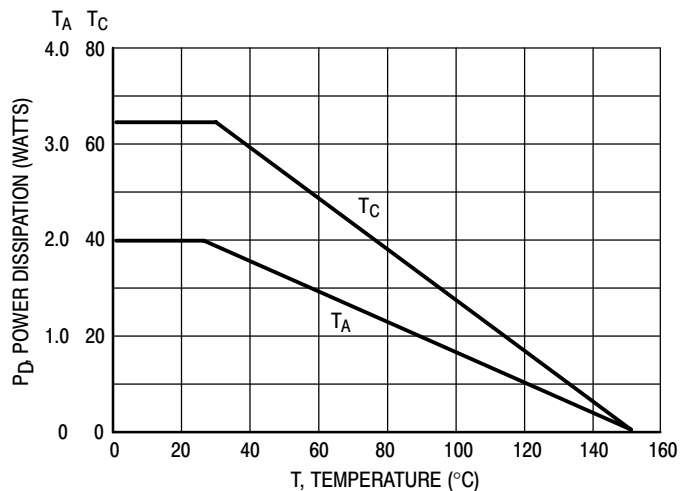


Figure 1. Power Derating

TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

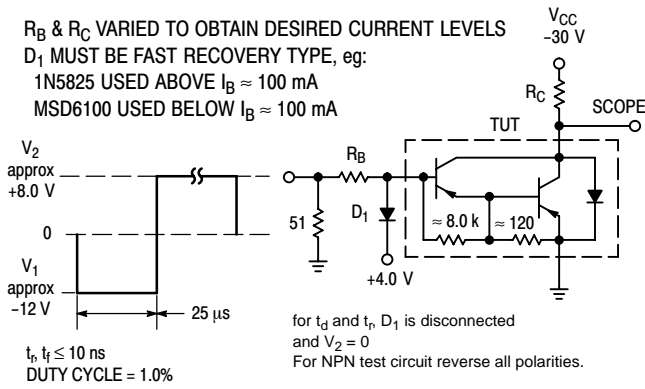


Figure 2. Switching Times Test Circuit

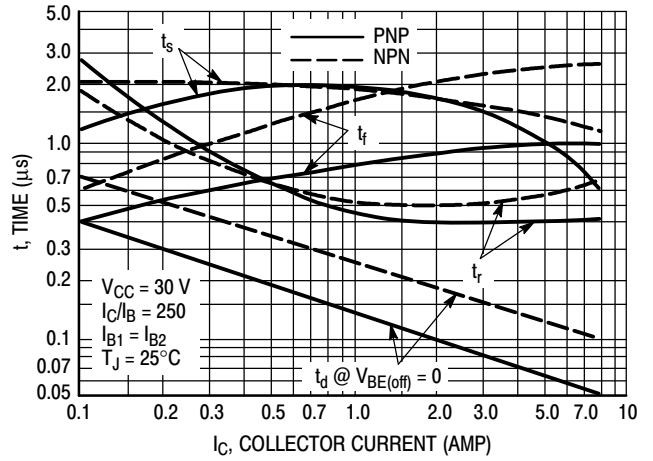


Figure 3. Switching Times

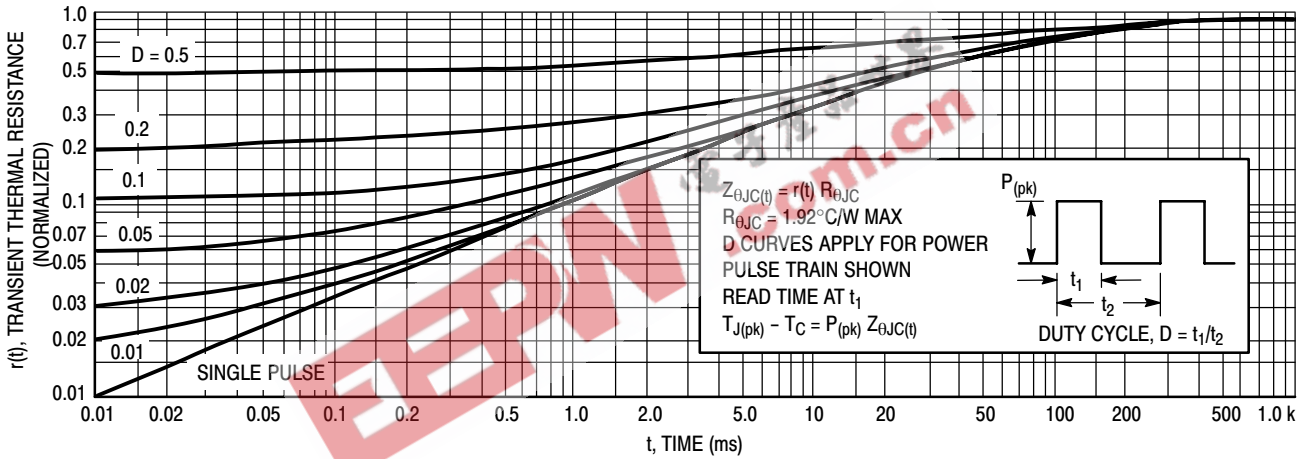


Figure 4. Thermal Response

TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

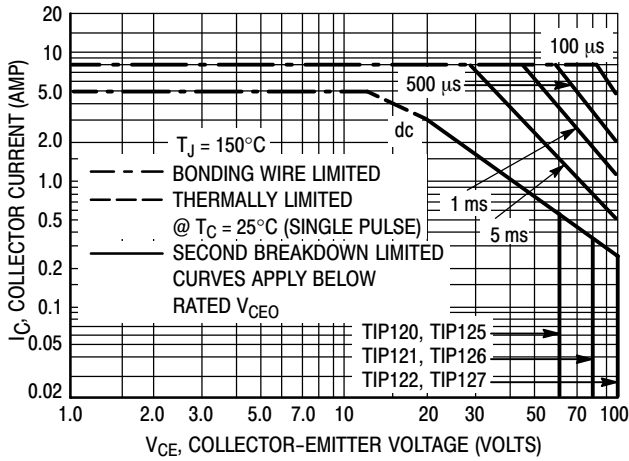


Figure 5. Active-Region Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)} = 150^\circ\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150^\circ\text{C}$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown

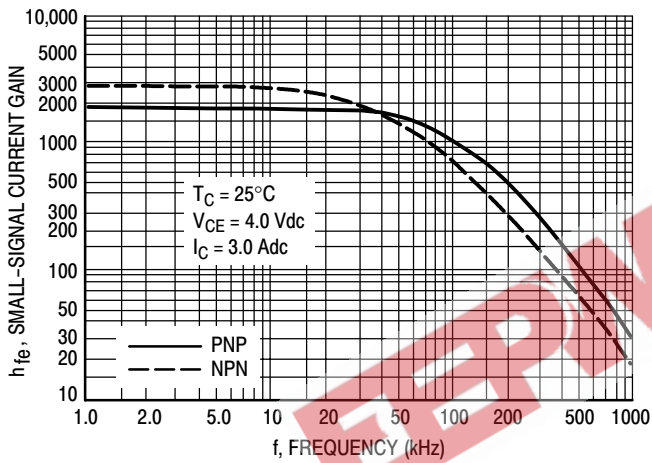


Figure 6. Small-Signal Current Gain

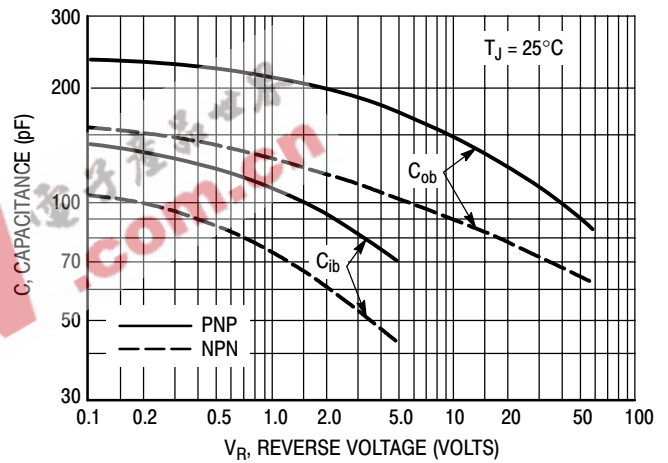


Figure 7. Capacitance

TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

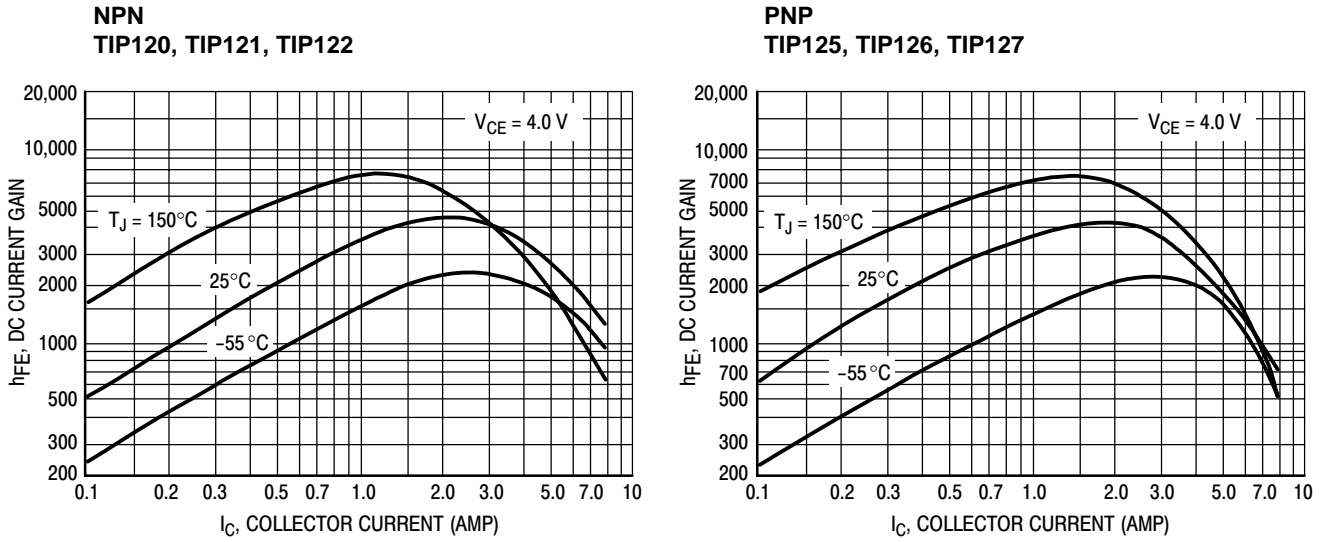


Figure 8. DC Current Gain

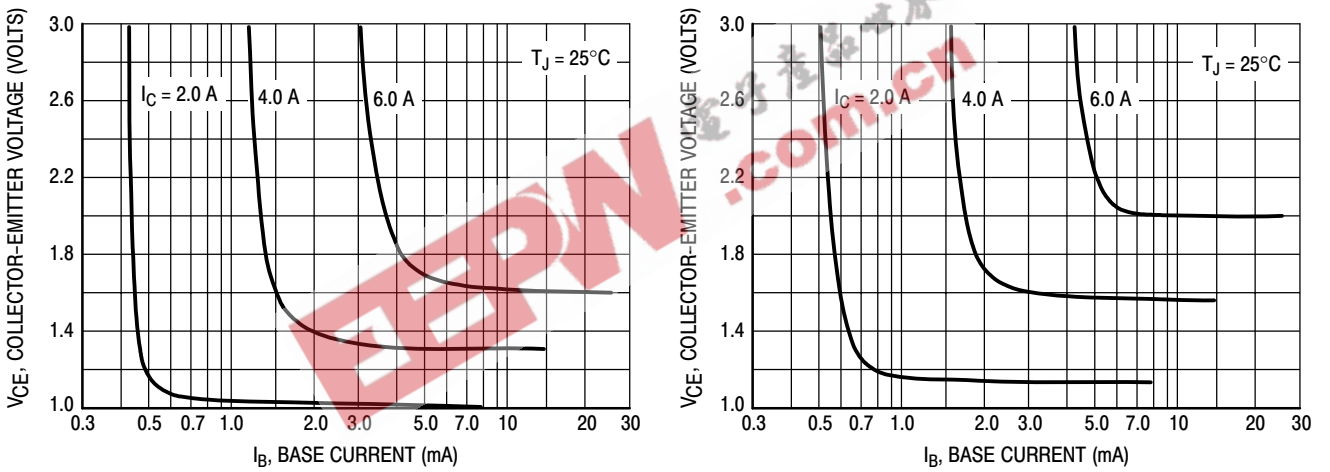


Figure 9. Collector Saturation Region

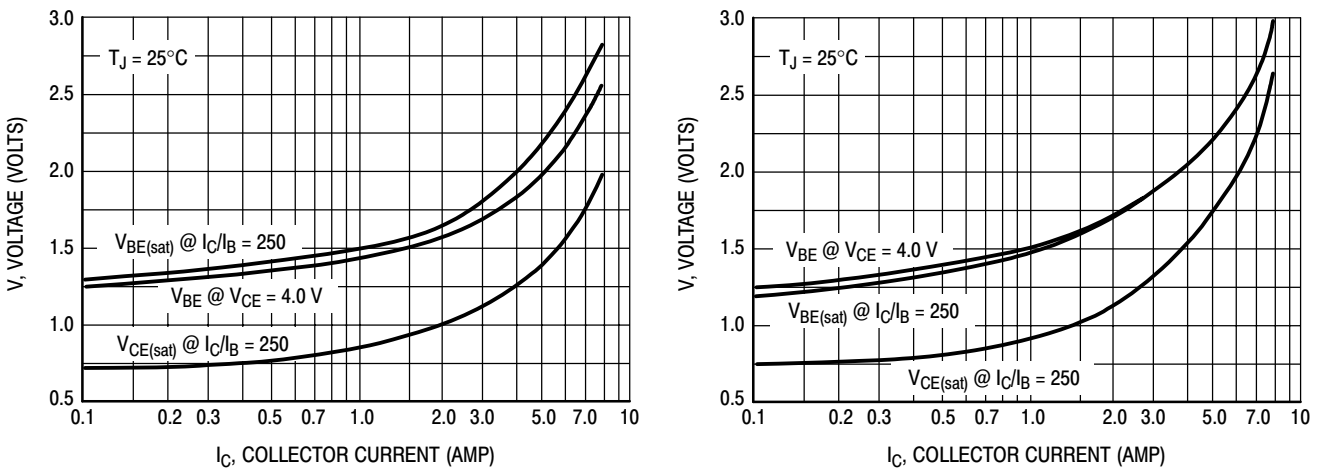
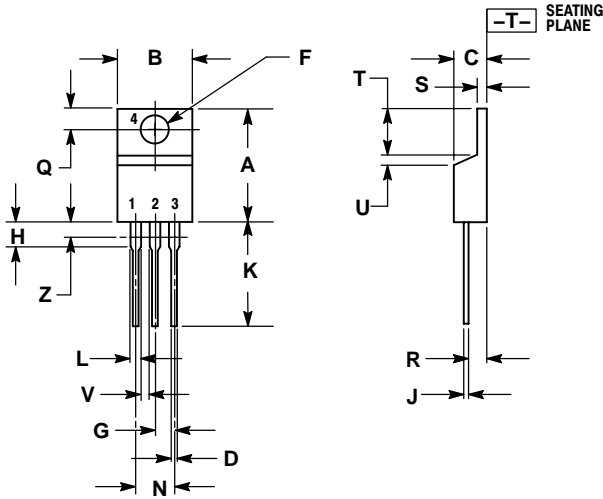


Figure 10. "On" Voltages

TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

PACKAGE DIMENSIONS

TO-220
CASE 221A-09
ISSUE AA



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.570 | 0.620 | 14.48 | 15.75 |
| B | 0.380 | 0.405 | 9.66 | 10.28 |
| C | 0.160 | 0.190 | 4.07 | 4.82 |
| D | 0.025 | 0.035 | 0.64 | 0.88 |
| F | 0.142 | 0.147 | 3.61 | 3.73 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.155 | 2.80 | 3.93 |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.500 | 0.562 | 12.70 | 14.27 |
| L | 0.045 | 0.060 | 1.15 | 1.52 |
| N | 0.190 | 0.210 | 4.83 | 5.33 |
| Q | 0.100 | 0.120 | 2.54 | 3.04 |
| R | 0.080 | 0.110 | 2.04 | 2.79 |
| S | 0.045 | 0.055 | 1.15 | 1.39 |
| T | 0.235 | 0.255 | 5.97 | 6.47 |
| U | 0.000 | 0.050 | 0.00 | 1.27 |
| V | 0.045 | --- | 1.15 | --- |
| Z | --- | 0.080 | --- | 2.04 |

STYLE 1:

1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

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