

PNP - 2N6040, 2N6042, NPN - 2N6043, 2N6045



ON Semiconductor®

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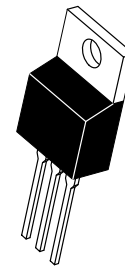
Plastic Medium-Power Complementary Silicon Transistors

Plastic medium-power complementary silicon transistors are 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) – 2N6040, 2N6043
 $= 100$ Vdc (Min) – 2N6042, 2N6045
- Low Collector–Emitter Saturation Voltage –
 $V_{CE(sat)} = 2.0$ Vdc (Max) @ $I_C = 4.0$ Adc – 2N6043,44
 $= 2.0$ Vdc (Max) @ $I_C = 3.0$ Adc – 2N6042, 2N6045
- Monolithic Construction with Built–In Base–Emitter Shunt Resistors
- Epoxy Meets UL 94 V–0 @ 0.125 in
- ESD Ratings: Human Body Model, 3B > 8000 V
Machine Model, C > 400 V
- Pb–Free Packages are Available*

**DARLINGTON, 8 AMPERES
COMPLEMENTARY SILICON
POWER TRANSISTORS
60 – 100 VOLTS, 75 WATTS**



TO–220AB
CASE 221A–09
STYLE 1

MAXIMUM RATINGS (Note 1)

| Rating | Symbol | Value | Unit |
|---|--------------------------------------|------------------------|--------------------------|
| Collector–Emitter Voltage | 2N6040 2N6043 2N6042 2N6045 | V_{CEO} 60 100 | Vdc |
| Collector–Base Voltage | 2N6040 2N6043 2N6042 2N6045 | V_{CB} 60 100 | Vdc |
| Emitter–Base Voltage | | V_{EB} 5.0 | Vdc |
| Collector Current | Continuous Peak | I_C 8.0 16 | A dc |
| Base Current | | I_B 120 | mAdc |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | | P_D 75 0.60 | W W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | –65 to +150 | $^\circ\text{C}$ |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Indicates JEDEC Registered Data.

MARKING DIAGRAM



2N604x = Device Code
x = 0, 2, 3, or 5
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 6 of this data sheet.

*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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THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---------------|------|------|
| Thermal Resistance, Junction-to-Case | θ_{JC} | 1.67 | °C/W |
| Thermal Resistance, Junction-to-Ambient | θ_{JA} | 57 | °C/W |

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

| Characteristic | Symbol | Min | Max | Unit |
|---|---------------|-----------------------|-------------------------------|---------------|
| OFF CHARACTERISTICS | | | | |
| Collector-Emitter Sustaining Voltage ($I_C = 100\text{ mA dc}$, $I_B = 0$) | $V_{CE(sus)}$ | 60 100 | – – | Vdc |
| Collector Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 100\text{ Vdc}$, $I_B = 0$) | I_{CEO} | – – | 20 20 | μA |
| Collector Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 100\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 60\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 80\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 100\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$) | I_{CEX} | – – – – – | 20 20 200 200 200 | μA |
| Collector Cutoff Current ($V_{CB} = 60\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100\text{ Vdc}$, $I_E = 0$) | I_{CBO} | – – | 20 20 | μA |
| Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$) | I_{EBO} | – | 2.0 | mAdc |

ON CHARACTERISTICS

| | | | | |
|--|---------------|---------------------|-----------------------|-----|
| DC Current Gain ($I_C = 4.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 8.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) | h_{FE} | 1000 1000 100 | 20,000 20,000 – | – |
| Collector-Emitter Saturation Voltage ($I_C = 4.0\text{ Adc}$, $I_B = 16\text{ mAdc}$) ($I_C = 3.0\text{ Adc}$, $I_B = 12\text{ mAdc}$) ($I_C = 8.0\text{ Adc}$, $I_B = 80\text{ Adc}$) | $V_{CE(sat)}$ | – – – | 2.0 2.0 4.0 | Vdc |
| Base-Emitter Saturation Voltage ($I_C = 8.0\text{ Adc}$, $I_B = 80\text{ mAdc}$) | $V_{BE(sat)}$ | – | 4.5 | Vdc |
| Base-Emitter On Voltage ($I_C = 4.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) | $V_{BE(on)}$ | – | 2.8 | 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 |
| Small-Signal Current Gain ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$, $f = 1.0\text{ kHz}$) | h_{fe} | 300 | – | – |

*Indicates JEDEC Registered Data.

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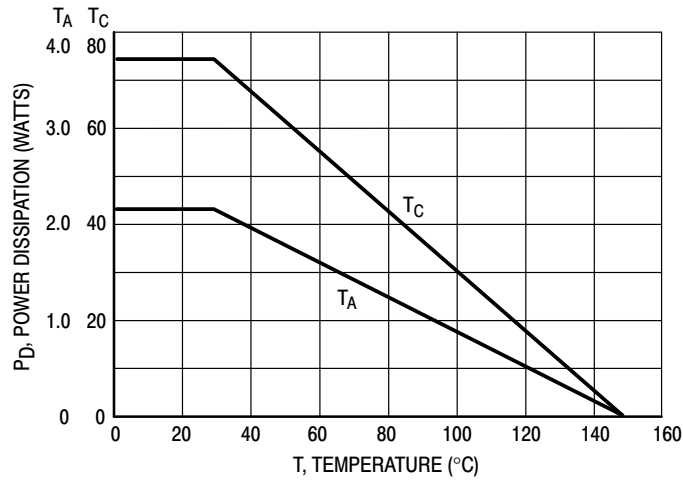


Figure 1. Power Derating

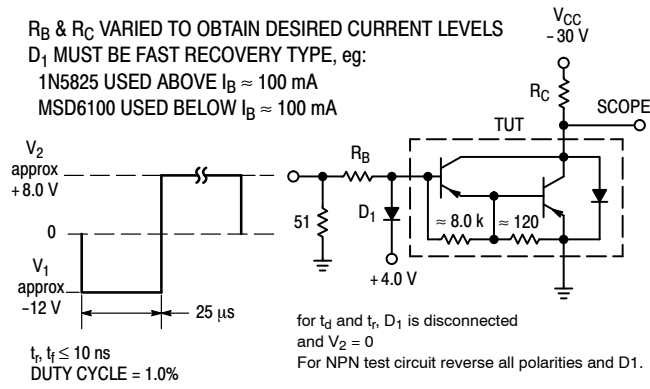


Figure 2. Switching Times Equivalent Circuit

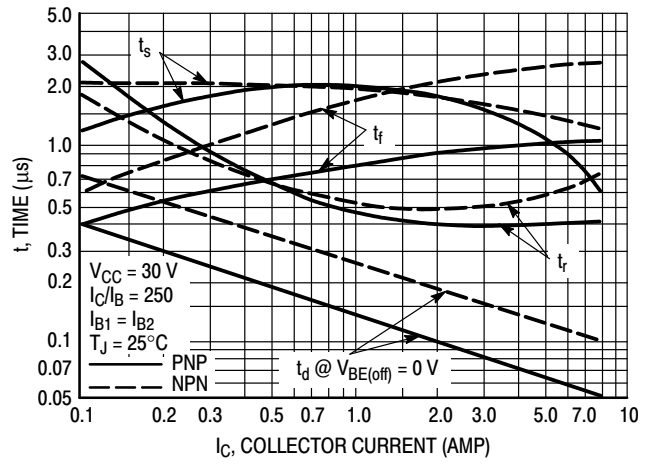


Figure 3. Switching Times

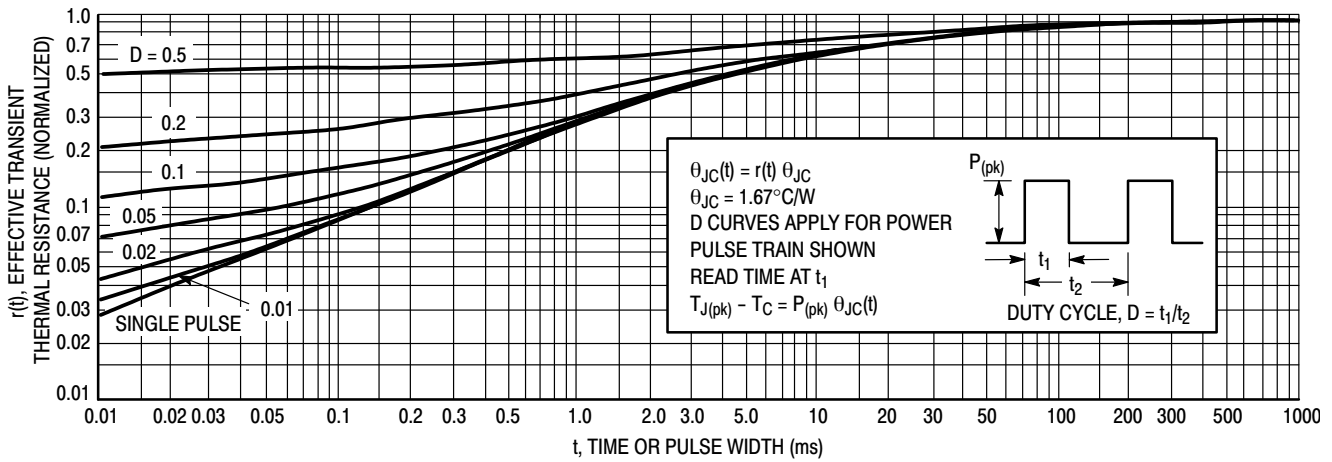


Figure 4. Thermal Response

PNP – 2N6040, 2N6042, NPN – 2N6043, 2N6045

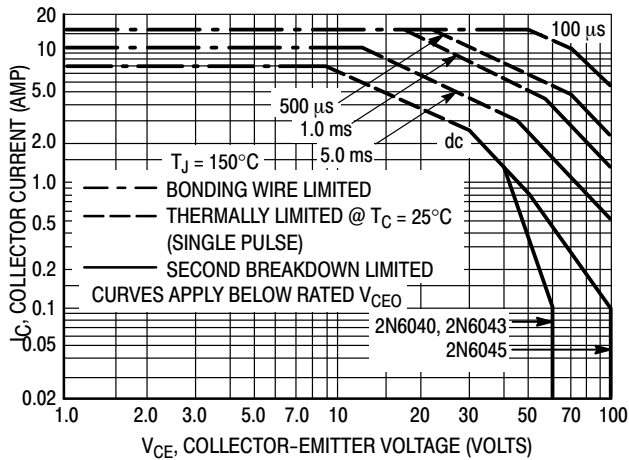


Figure 5. Active-Region Safe Operating Area

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.

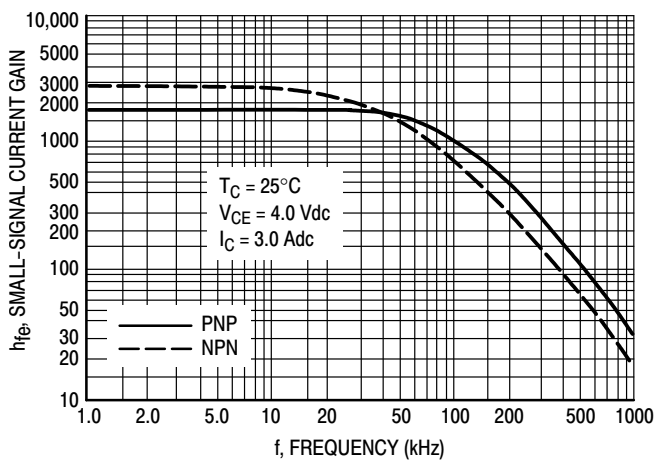


Figure 6. Small-Signal Current Gain

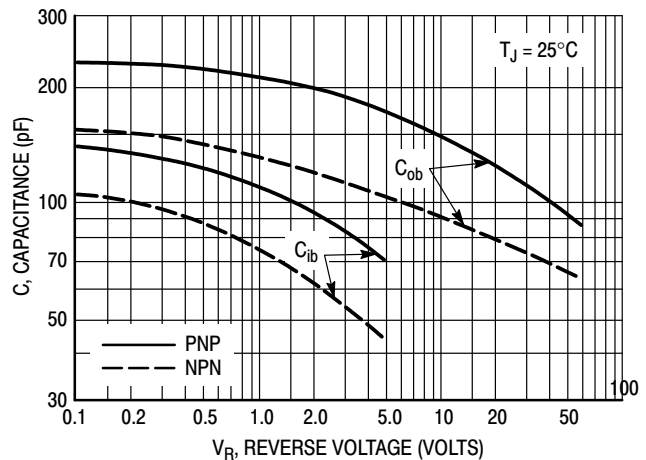
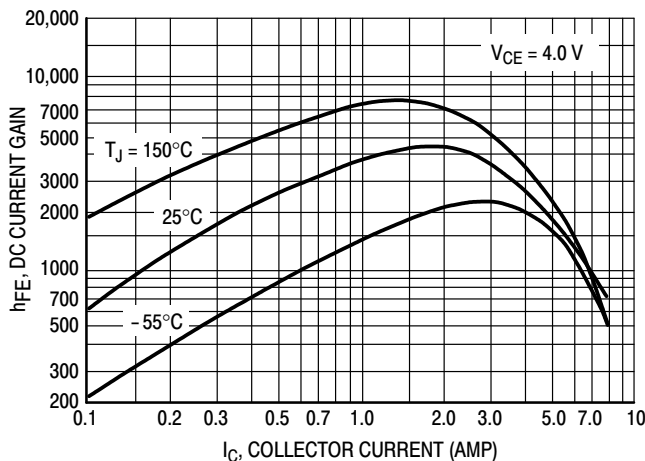


Figure 7. Capacitance

PNP
2N6040, 2N6042



NPN
2N6043, 2N6045

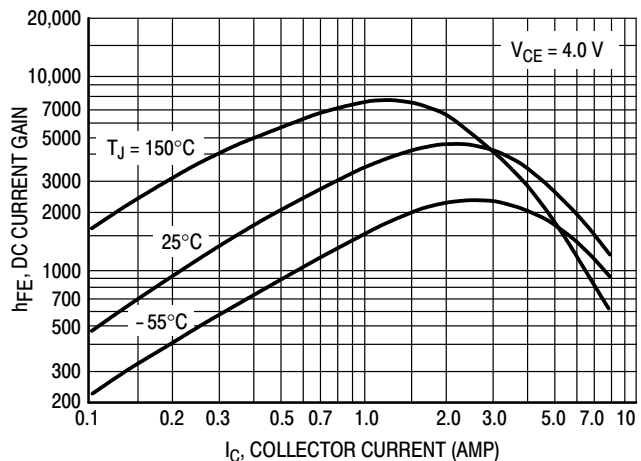


Figure 8. DC Current Gain

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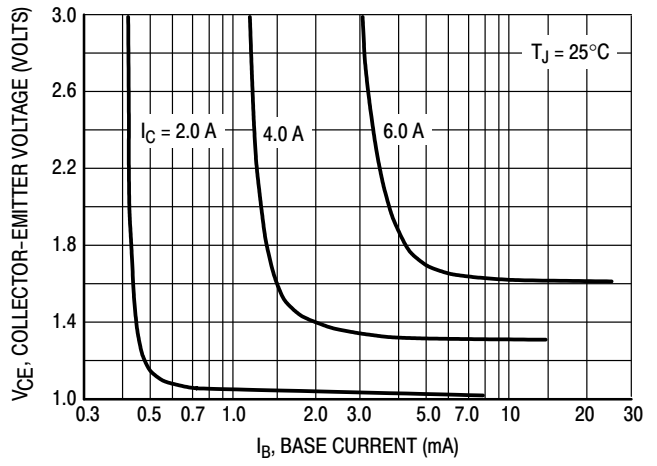
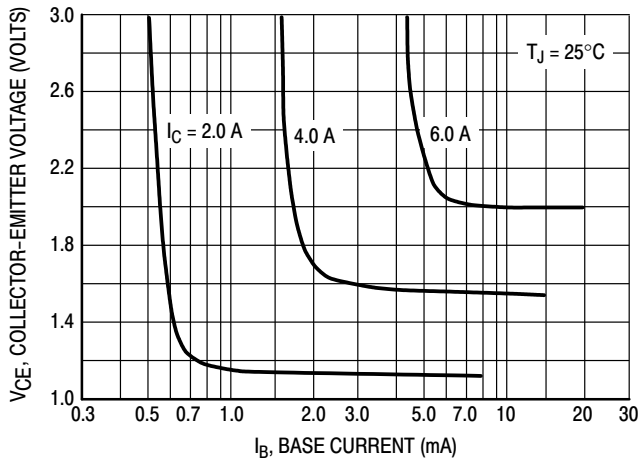


Figure 9. Collector Saturation Region

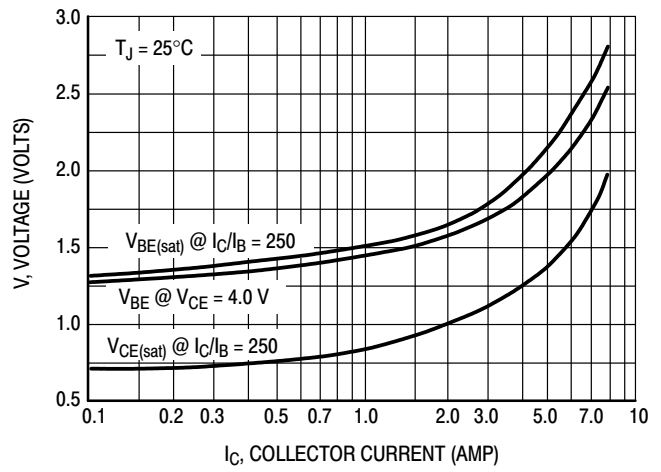
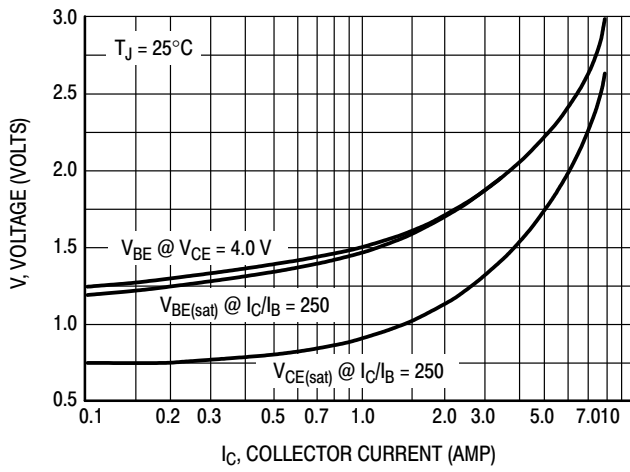


Figure 10. "On" Voltages

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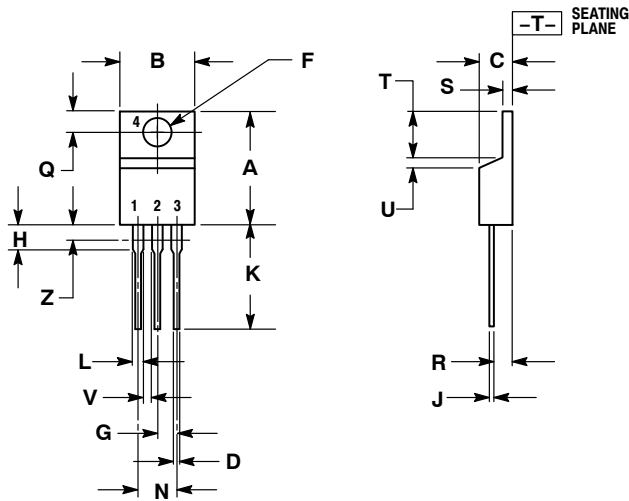
ORDERING INFORMATION

| Device | Package | Shipping |
|---------------|-----------------------|-----------------|
| 2N6040 | TO-220AB | 50 Units / Rail |
| 2N6040G | TO-220AB (Pb-Free) | |
| 2N6042 | TO-220AB | |
| 2N6042G | TO-220AB (Pb-Free) | |
| 2N6043 | TO-220AB | |
| 2N6043G | TO-220AB (Pb-Free) | |
| 2N6045 | TO-220AB | |
| 2N6045G | TO-220AB (Pb-Free) | |

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PACKAGE DIMENSIONS

TO-220 CASE 221A-09 ISSUE AG



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 | 0.036 | 0.64 | 0.91 |
| F | 0.142 | 0.161 | 3.61 | 4.09 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.161 | 2.80 | 4.10 |
| J | 0.014 | 0.025 | 0.36 | 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:

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

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