

# Darlington Silicon Power Transistors

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

- High DC Current Gain —  
 $h_{FE} = 3500$  (Typ) @  $I_C = 4$  Adc
- Collector-Emitter Sustaining Voltage — @ 200 mAdc  
 $V_{CEO(sus)} = 60$  Vdc (Min) — 2N6667  
 $= 80$  Vdc (Min) — 2N6668
- Low Collector-Emitter Saturation Voltage —  
 $V_{CE(sat)} = 2$  Vdc (Max) @  $I_C = 5$  Adc
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- TO-220AB Compact Package
- Complementary to 2N6387, 2N6388

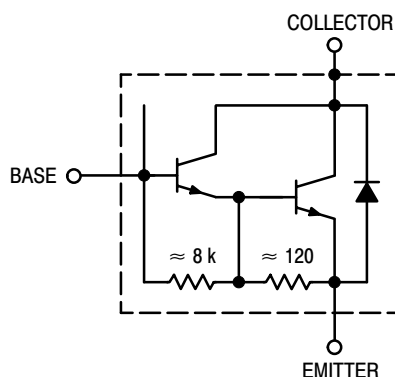
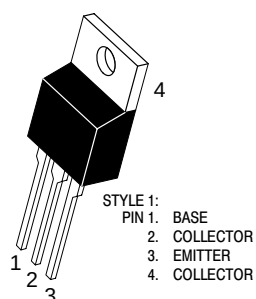


Figure 1. Darlington Schematic

## 2N6667 2N6668

**PNP SILICON  
DARLINGTON  
POWER TRANSISTORS  
10 AMPERES  
60–80 VOLTS  
65 WATTS**



**CASE 221A-09  
TO-220AB**

### MAXIMUM RATINGS (1)

| Rating                                                                                 | Symbol         | 2N6667      | 2N6668 | Unit                               |
|----------------------------------------------------------------------------------------|----------------|-------------|--------|------------------------------------|
| Collector-Emitter Voltage                                                              | $V_{CEO}$      | 60          | 80     | Vdc                                |
| Collector-Base Voltage                                                                 | $V_{CB}$       | 60          | 80     | Vdc                                |
| Emitter-Base Voltage                                                                   | $V_{EB}$       | 5           |        | Vdc                                |
| Collector Current — Continuous<br>— Peak                                               | $I_C$          | 10<br>15    |        | Adc                                |
| Base Current                                                                           | $I_B$          | 250         |        | mAdc                               |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 65<br>0.52  |        | watts<br>$\text{W}/^\circ\text{C}$ |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 2<br>0.016  |        | Watts<br>$\text{W}/^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range                                       | $T_J, T_{stg}$ | -65 to +150 |        | $^\circ\text{C}$                   |

(1) Indicates JEDEC Registered Data.

## 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 | $^{\circ}\text{C/W}$ |

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

| Characteristic                                                                                                                                                                                                                                                                                                                                           | Symbol         | Min              | Max                  | Unit                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|----------------------|-----------------------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                               |                |                  |                      |                             |
| Collector–Emitter Sustaining Voltage (2)<br>( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )                                                                                                                                                                                                                                                                      | $V_{CEO(sus)}$ | 60<br>80         | —<br>—               | Vdc                         |
| Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ )                                                                                                                                                                                                                                            | $I_{CEO}$      | —<br>—           | 1<br>1               | mAdc                        |
| Collector Cutoff Current<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 125^{\circ}\text{C}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 125^{\circ}\text{C}$ ) | $I_{CEX}$      | —<br>—<br>—<br>— | 300<br>300<br>3<br>3 | $\mu\text{Adc}$<br><br>mAdc |
| Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )                                                                                                                                                                                                                                                                                           | $I_{EBO}$      | —                | 5                    | mAdc                        |

**ON CHARACTERISTICS (1)**

|                                                                                                                                               |               |             |            |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------|------------|-----|
| DC Current Gain ( $I_C = 5\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ )<br>( $I_C = 10\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ )                     | $h_{FE}$      | 1000<br>100 | 20000<br>— | —   |
| Collector–Emitter Saturation Voltage ( $I_C = 5\text{ Adc}$ , $I_B = 0.01\text{ Adc}$ )<br>( $I_C = 10\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ ) | $V_{CE(sat)}$ | —<br>—      | 2<br>3     | Vdc |
| Base–Emitter Saturation Voltage ( $I_C = 5\text{ Adc}$ , $I_B = 0.01\text{ Adc}$ )<br>( $I_C = 10\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ )      | $V_{BE(sat)}$ | —<br>—      | 2.8<br>4.5 | Vdc |

**DYNAMIC CHARACTERISTICS**

|                                                                                                                 |            |      |     |    |
|-----------------------------------------------------------------------------------------------------------------|------------|------|-----|----|
| Current Gain — Bandwidth Product ( $I_C = 1\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ , $f_{test} = 1\text{ MHz}$ ) | $ h_{fe} $ | 20   | —   | —  |
| Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1\text{ MHz}$ )                                | $C_{ob}$   | —    | 200 | pF |
| Small–Signal Current Gain ( $I_C = 1\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ , $f = 1\text{ kHz}$ )               | $h_{fe}$   | 1000 | —   | —  |

\*Indicates JEDEC Registered Data

(2) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ . $R_B$  &  $R_C$  VARIED TO OBTAIN DESIRED CURRENT LEVELS $D_1$ , MUST BE FAST RECOVERY TYPES e.g.,1N5825 USED ABOVE  $I_B \approx 100\text{ mA}$ MSD6100 USED BELOW  $I_B \approx 100\text{ mA}$ FOR  $t_d$  AND  $t_r$ ,  $D_1$  IS DISCONNECTED AND  $V_2 = 0$  $t_r, t_f \leq 10\text{ ns}$ 

DUTY CYCLE = 1.0%

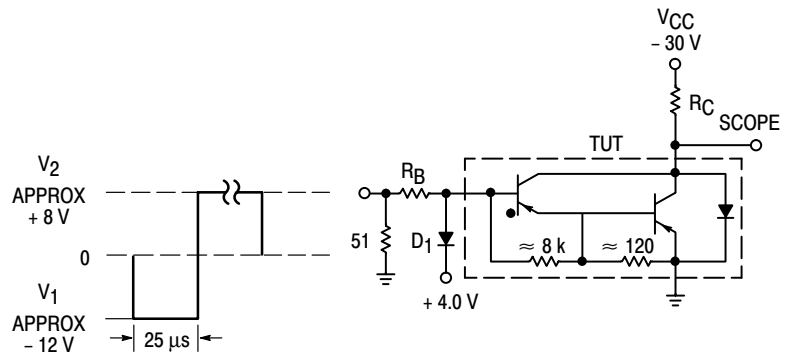


Figure 2. Switching Times Test Circuit

## 2N6667 2N6668

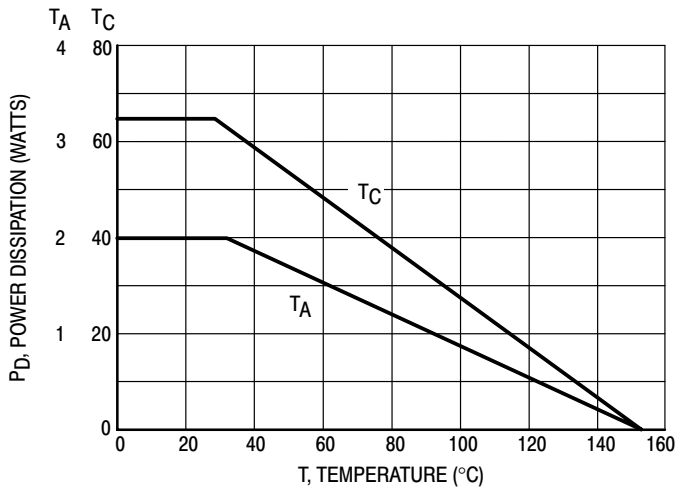


Figure 3. Power Derating

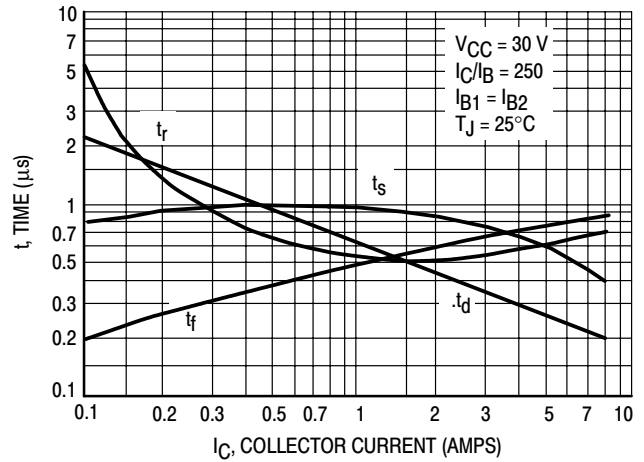


Figure 4. Typical Switching Times

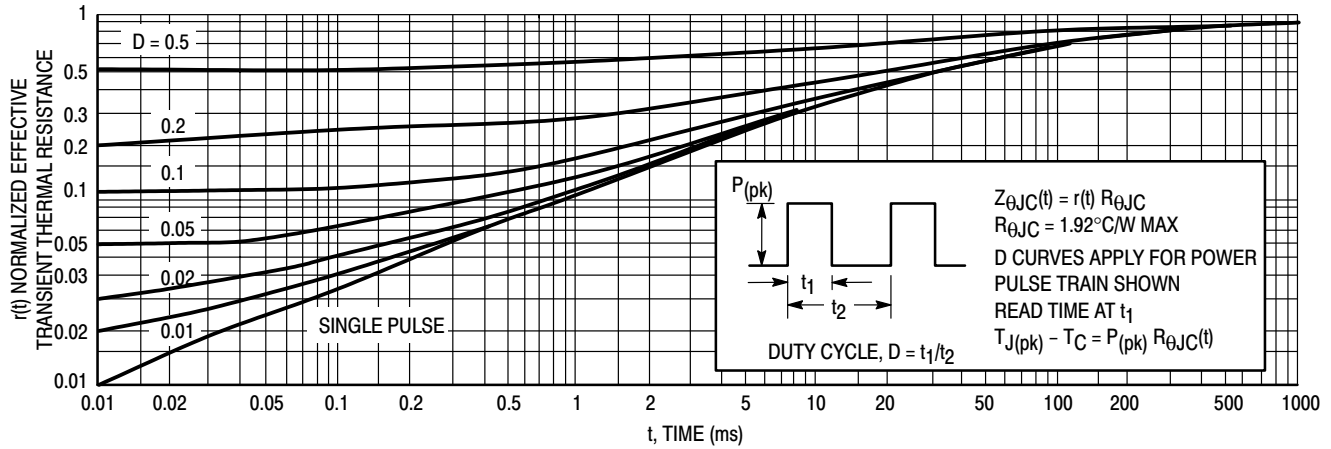


Figure 5. Thermal Response

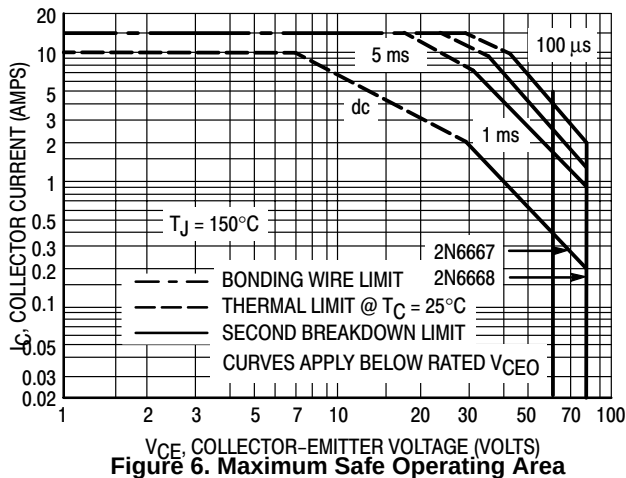


Figure 6. Maximum Safe Operating Area

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 6 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 5. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

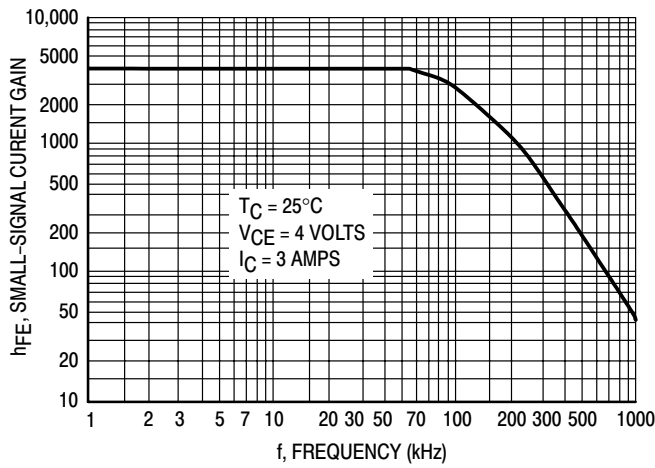


Figure 7. Typical Small-Signal Current Gain

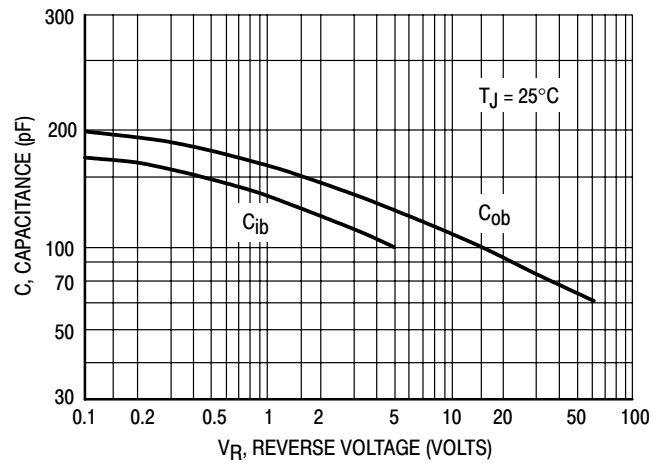


Figure 8. Typical Capacitance

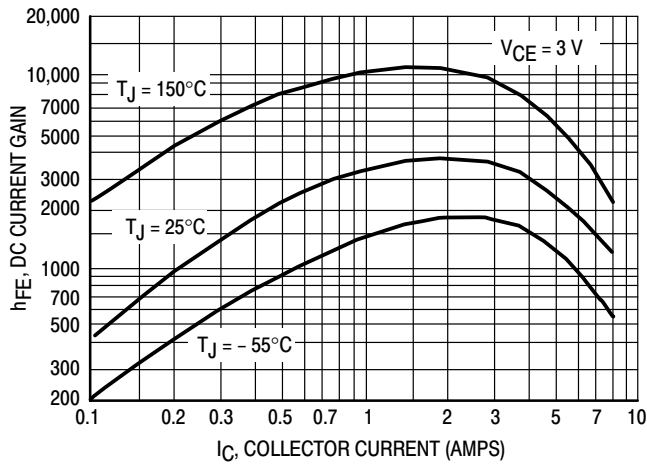


Figure 9. Typical DC Current Gain

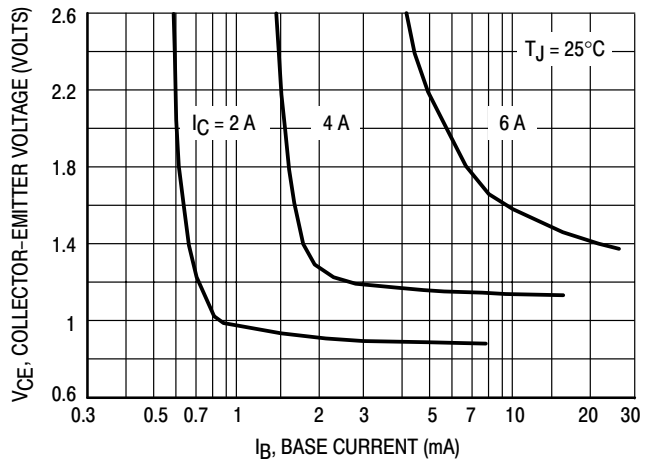


Figure 10. Typical Collector Saturation Region

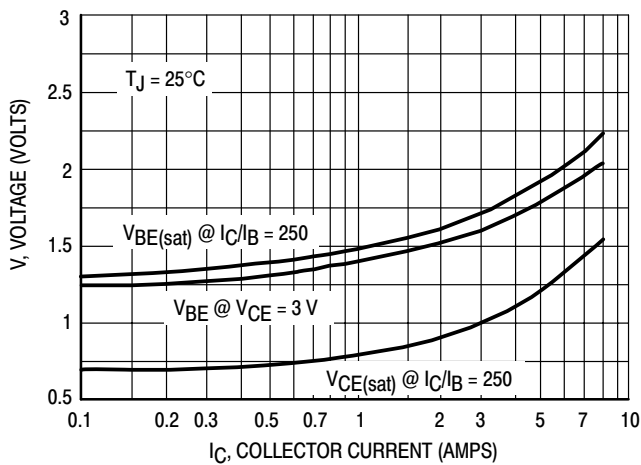


Figure 11. Typical "On" Voltages

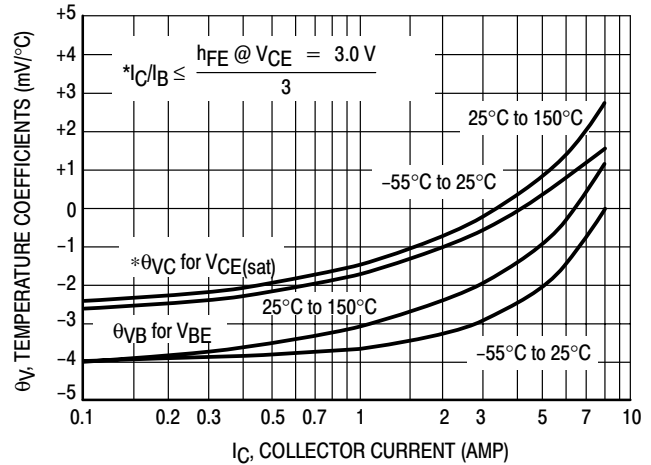


Figure 12. Typical Temperature Coefficients

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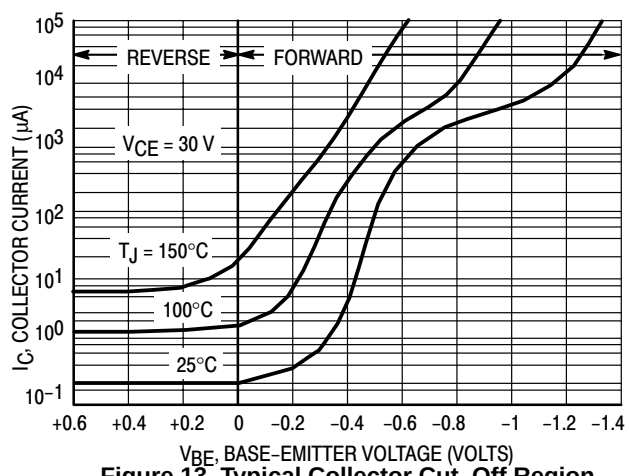
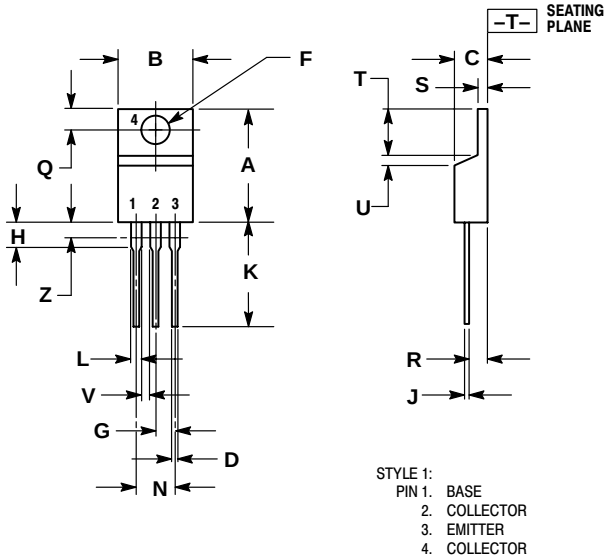


Figure 13. Typical Collector Cut-Off Region

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## 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  |

## **Notes**

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