

# 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

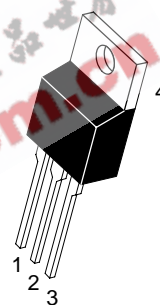
- High DC Current Gain –  
 $h_{FE} = 2500$  (Typ) @  $I_C = 4.0$  Adc
- Collector–Emitter Sustaining Voltage – @ 100 mAdc  
 $V_{CEO(sus)} = 60$  Vdc (Min) – TIP120, TIP125  
 $= 80$  Vdc (Min) – TIP121, TIP126  
 $= 100$  Vdc (Min) – TIP122, TIP127
- Low Collector–Emitter Saturation Voltage –  
 $V_{CE(sat)} = 2.0$  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\*



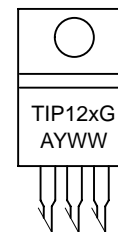
ON Semiconductor®

<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.

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

### 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 $25^\circ\text{C}$	$P_D$	65 0.52			W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	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

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

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
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  $\leq 2\%$

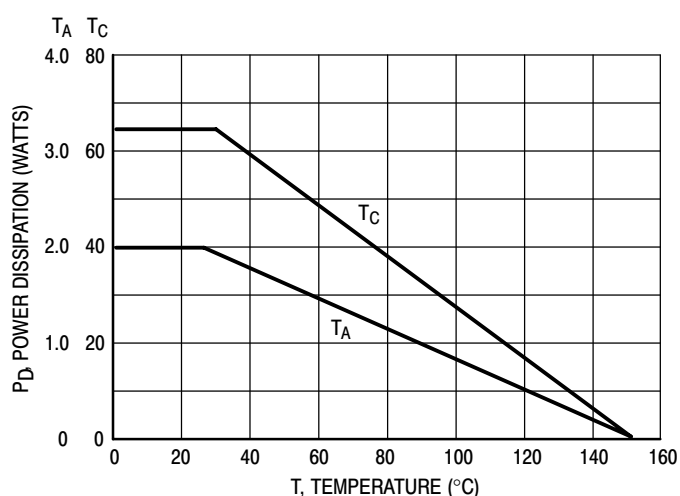


Figure 1. Power Derating

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

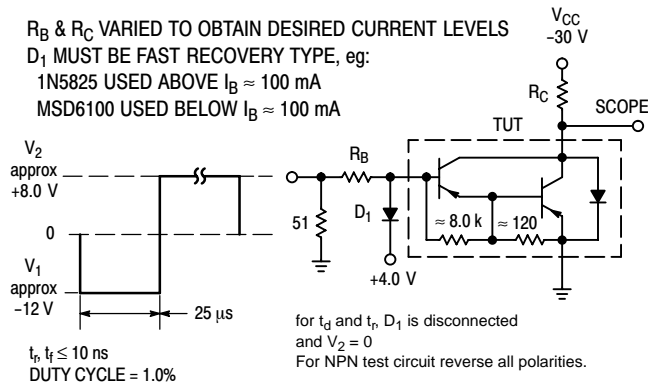


Figure 2. Switching Times Test Circuit

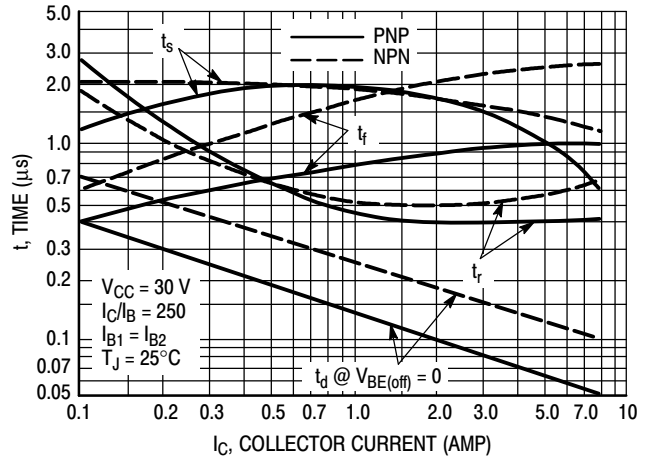


Figure 3. Switching Times

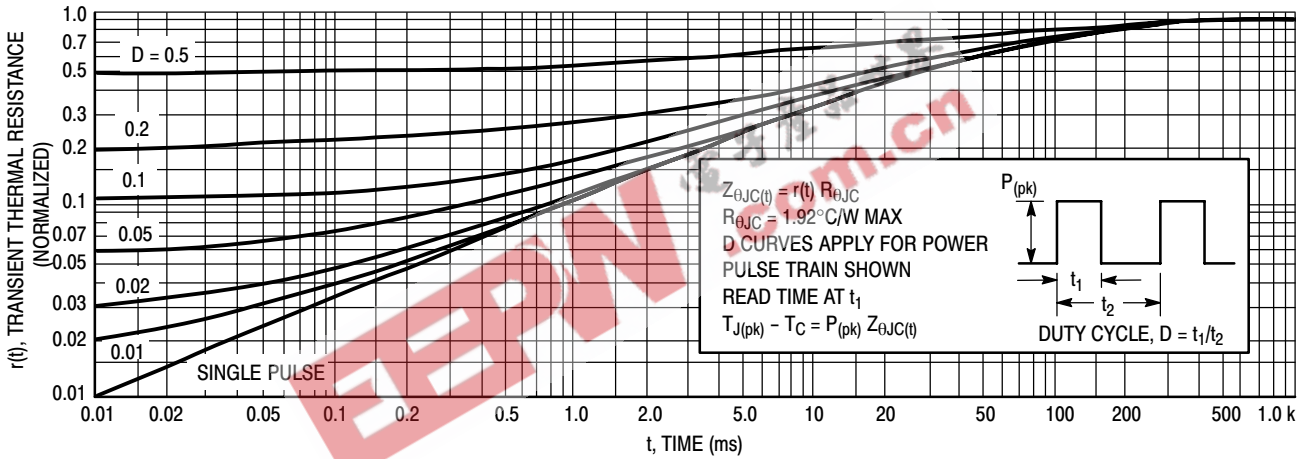


Figure 4. Thermal Response

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

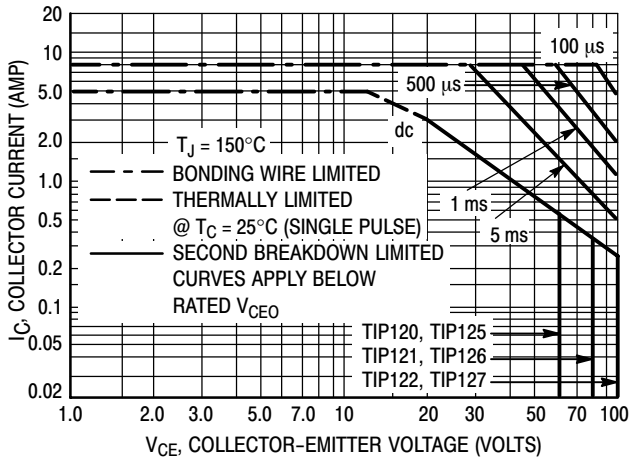


Figure 5. Active-Region Safe Operating Area

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

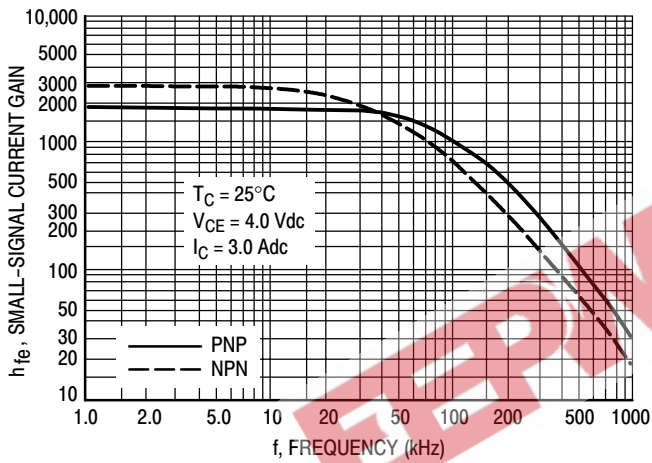


Figure 6. Small-Signal Current Gain

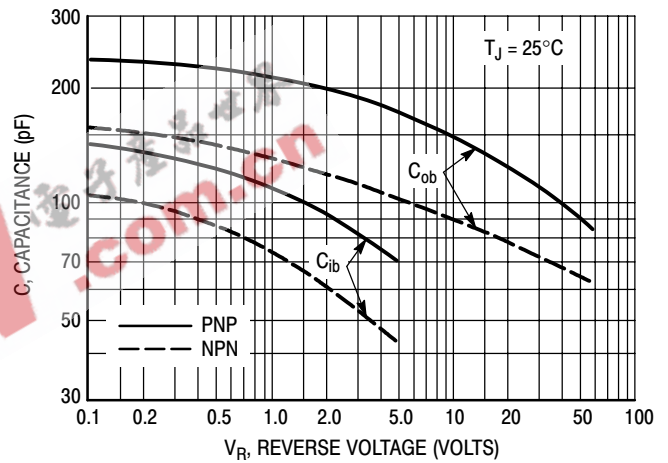


Figure 7. Capacitance

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

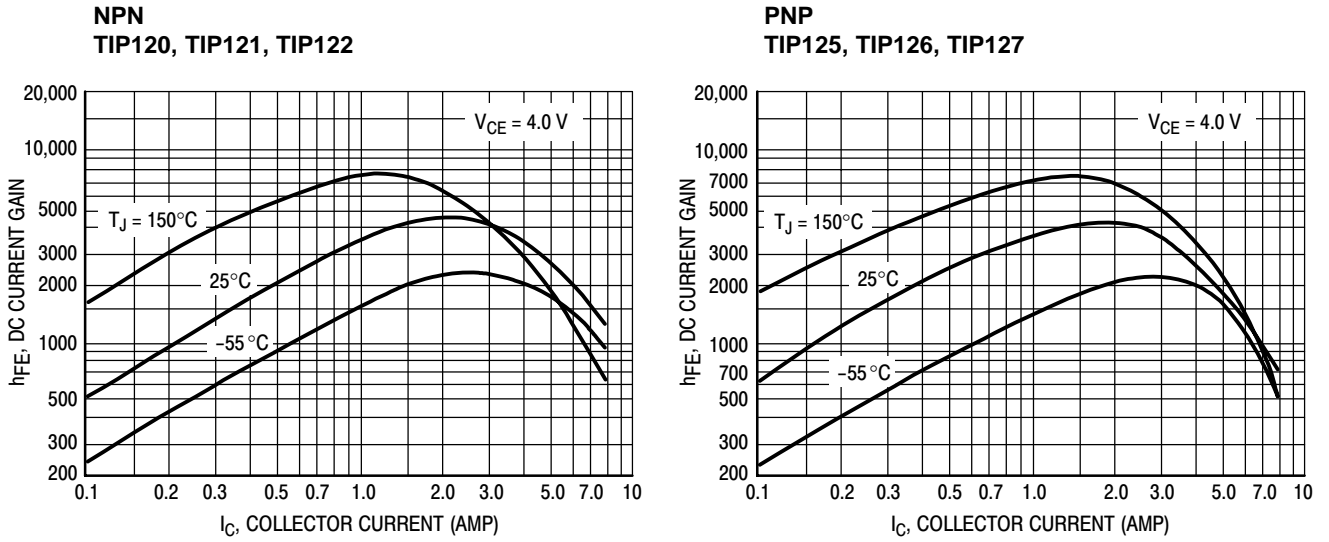


Figure 8. DC Current Gain

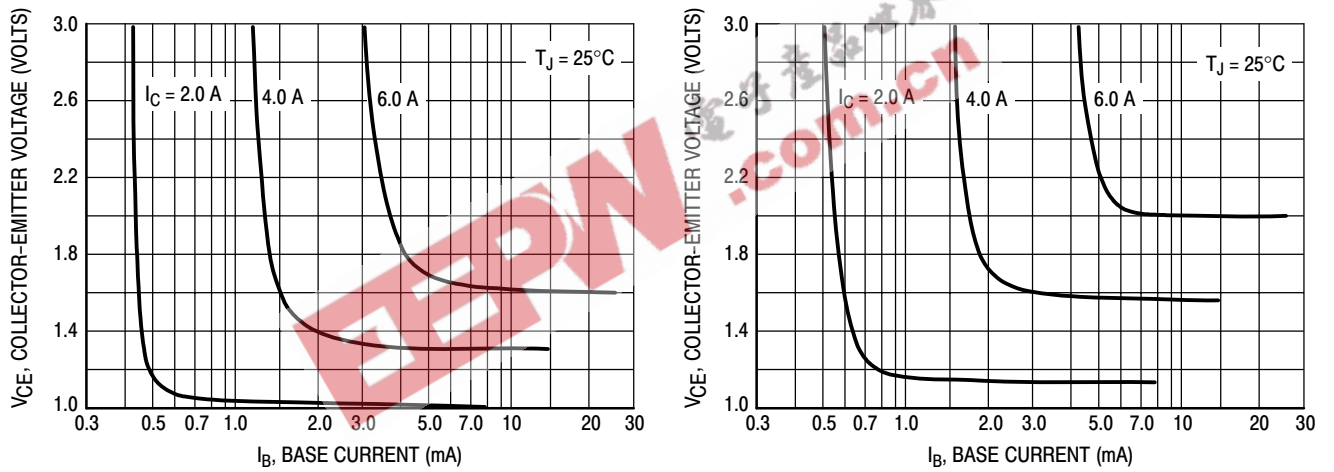


Figure 9. Collector Saturation Region

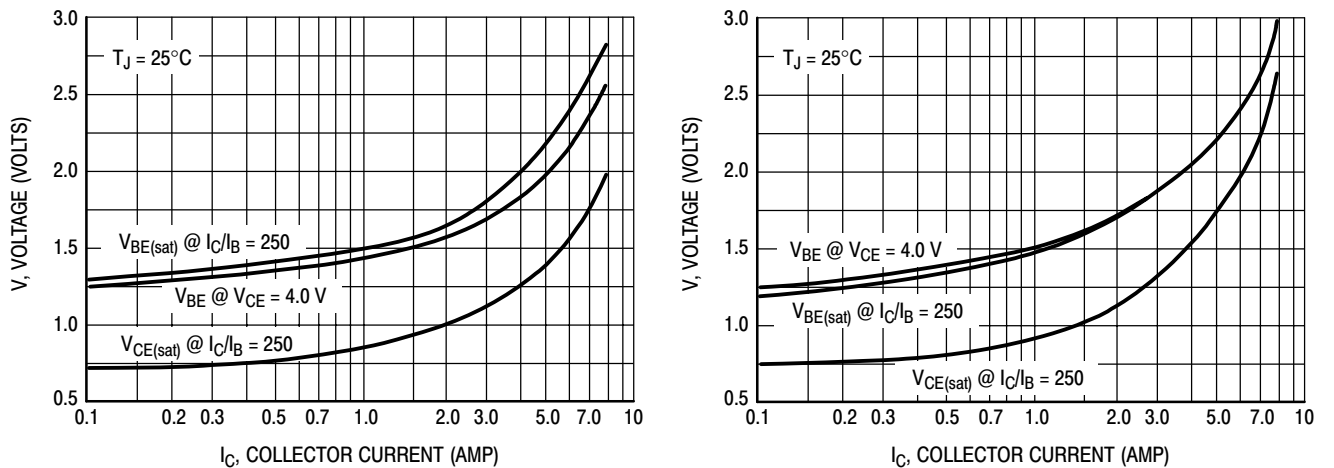
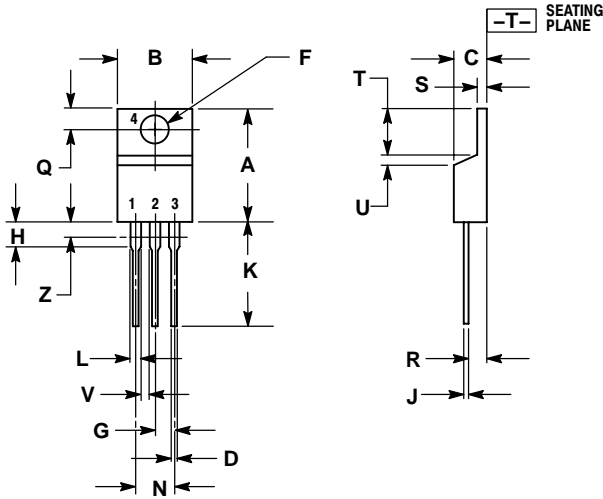


Figure 10. "On" Voltages

# 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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