

2N5190, 2N5191, 2N5192

Silicon NPN Power Transistors

... for use in power amplifier and switching circuits, — excellent safe area limits. Complement to PNP 2N5194, 2N5195.

- ESD Ratings: Machine Model, C; > 400 V
Human Body Model, 3B; > 8000 V
- Epoxy Meets UL 94, V-0 @ 1/8"
- Pb-Free Package is Available*

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	2N5190 2N5191 2N5192	V_{CEO} 40 60 80	Vdc
Collector-Base Voltage	2N5190 2N5191 2N5192	V_{CBO} 40 60 80	Vdc
Emitter-Base Voltage		V_{EBO} 5.0	Vdc
Collector Current		I_C 4.0	Adc
Base Current		I_B 1.0	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C		P_D 40 320	Watts mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150	$^\circ\text{C}$

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.

THERMAL CHARACTERISTICS

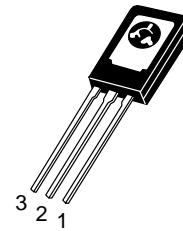
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	3.12	$^\circ\text{C}/\text{W}$



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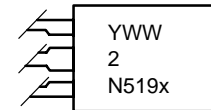
<http://onsemi.com>

4.0 A NPN SILICON POWER TRANSISTORS 40, 60, 80 V, 40 W



TO-225AA
CASE 77
STYLE 1

MARKING DIAGRAM



x = 0, 1, 2
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping†
2N5190	TO-225AA	500 Units/Box
2N5191	TO-225AA	500 Units/Box
2N5191G	TO-225AA (Pb-Free)	500 Units/Box
2N5192	TO-225AA	500 Units/Box

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (Note 1) ($I_C = 0.1\text{ Adc}$, $I_B = 0$)	$V_{CEO(sus)}$	40	–	Vdc
2N5190		60	–	
2N5191		80	–	
2N5192				
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$)	I_{CEO}	–	1.0	mAdc
2N5190		–	1.0	
2N5191		–	1.0	
2N5192		–	1.0	
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$)	I_{CEX}	–	0.1	mAdc
2N5190		–	0.1	
2N5191		–	0.1	
2N5192		–	0.1	
2N5190		–	2.0	
2N5191		–	2.0	
2N5192		–	2.0	
Collector Cutoff Current ($V_{CB} = 40\text{ Vdc}$, $I_E = 0$)	I_{CBO}	–	0.1	mAdc
2N5190		–	0.1	
2N5191		–	0.1	
2N5192		–	0.1	
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	–	1.0	mAdc

ON CHARACTERISTICS (Note 1)

DC Current Gain ($I_C = 1.5\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$)	h_{FE}	25	100	–
2N5190/2N5191		20	80	
2N5192		10	–	
($I_C = 4.0\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$)		7.0	–	
2N5190/2N5191				
2N5192				
Collector–Emitter Saturation Voltage ($I_C = 1.5\text{ Adc}$, $I_B = 0.15\text{ Adc}$)	$V_{CE(sat)}$	–	0.6	Vdc
2N5190		–	1.4	
2N5191		–	1.4	
2N5192		–	1.4	
Base–Emitter On Voltage ($I_C = 1.5\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$)	$V_{BE(on)}$	–	1.2	Vdc

DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product ($I_C = 1.0\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ MHz}$)	f_T	2.0	–	MHz
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*Indicates JEDEC Registered Data.

1. Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

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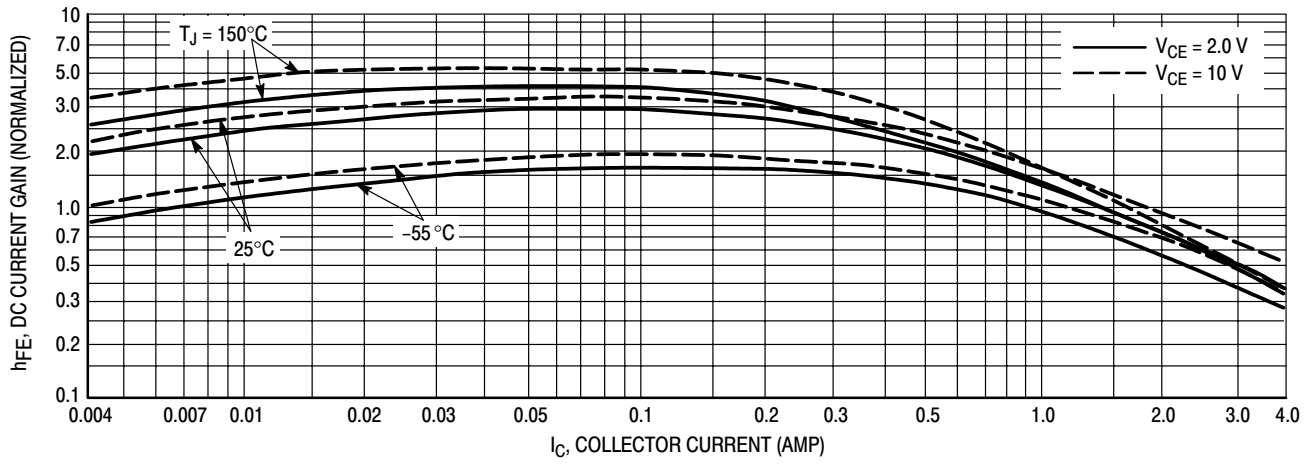


Figure 1. DC Current Gain

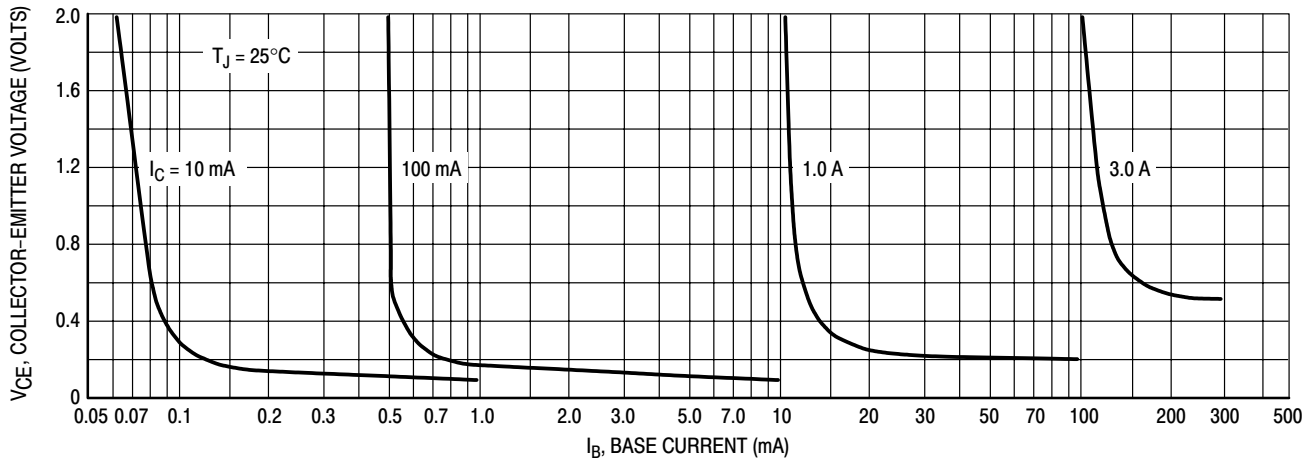


Figure 2. Collector Saturation Region

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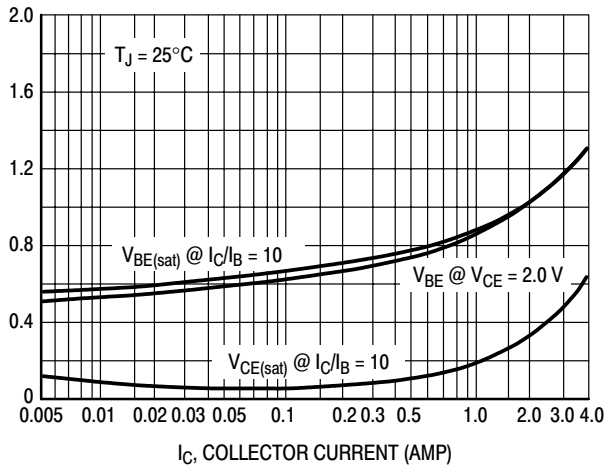


Figure 3. "On" Voltages

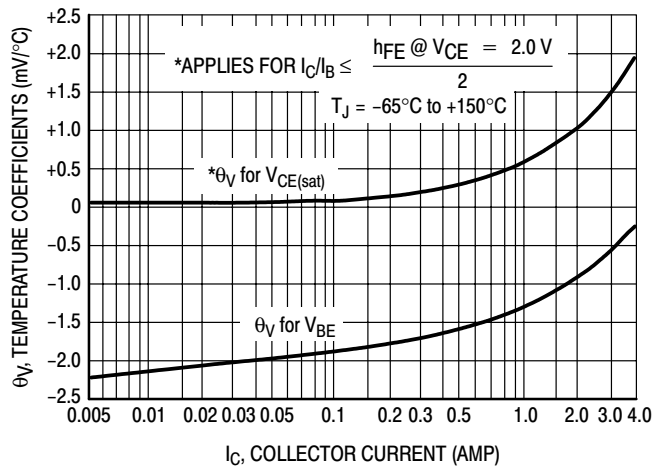


Figure 4. Temperature Coefficients

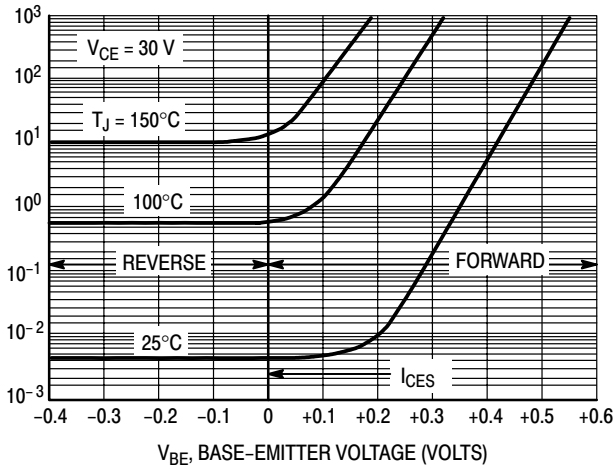


Figure 5. Collector Cut-Off Region

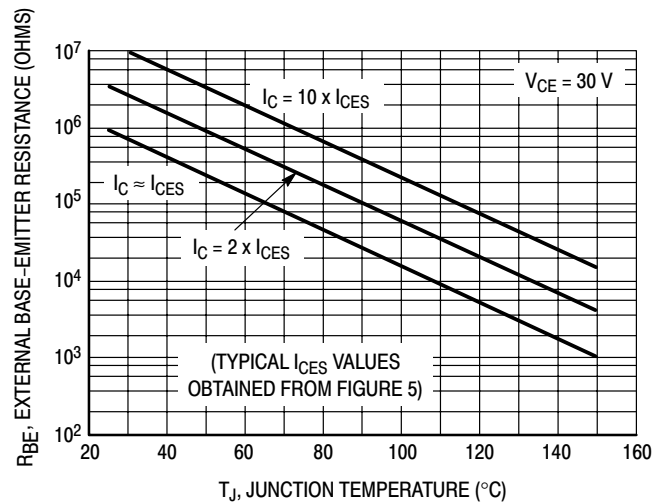


Figure 6. Effects of Base-Emitter Resistance

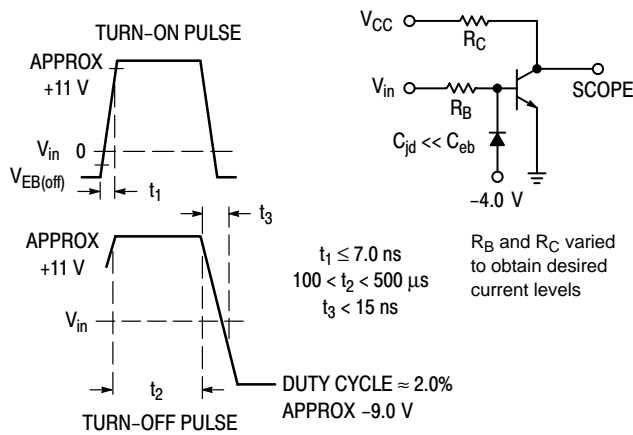


Figure 7. Switching Time Equivalent Test Circuit

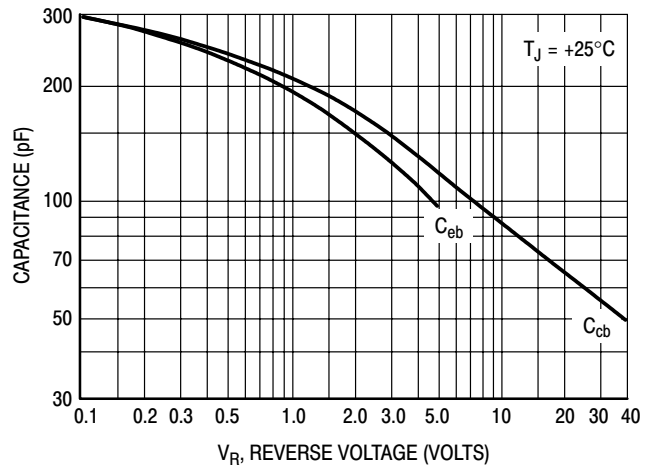


Figure 8. Capacitance

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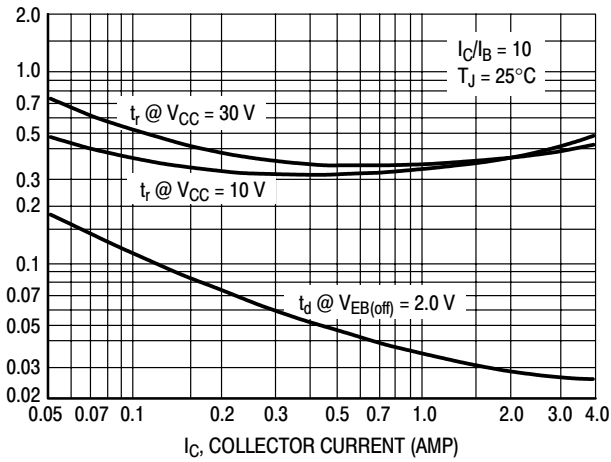


Figure 9. Turn-On Time

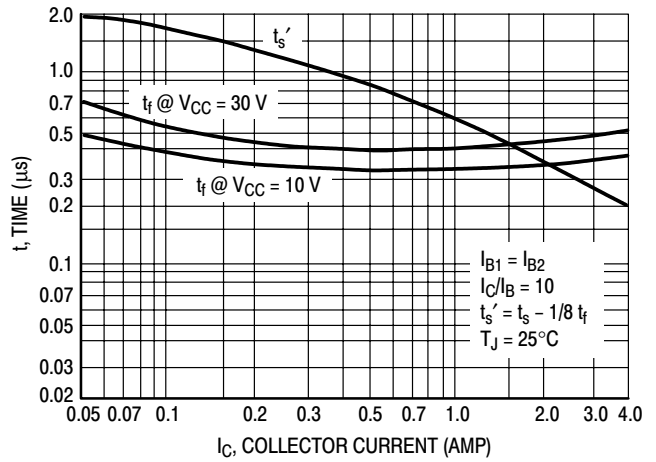
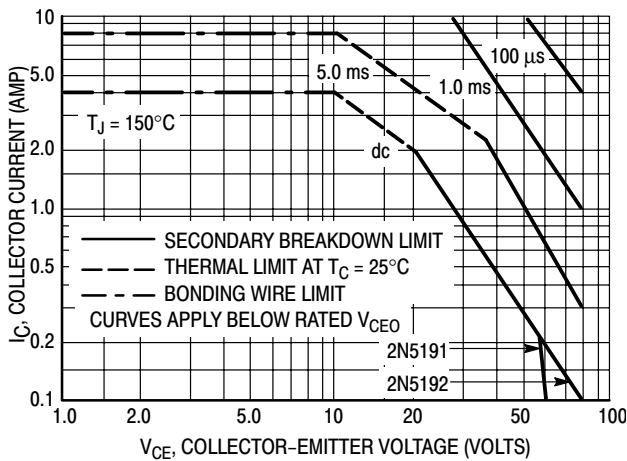


Figure 10. Turn-Off Time



**Figure 11. Rating and Thermal Data
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 11 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 $T_{J(pk)} \leq 150^\circ\text{C}$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

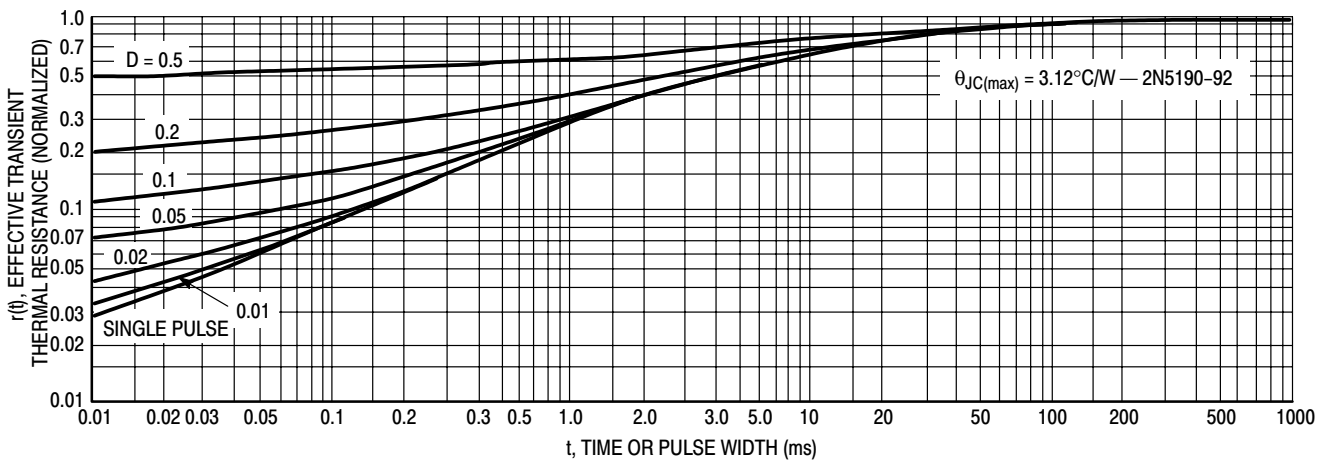


Figure 12. Thermal Response

DESIGN NOTE: USE OF TRANSIENT THERMAL RESISTANCE DATA

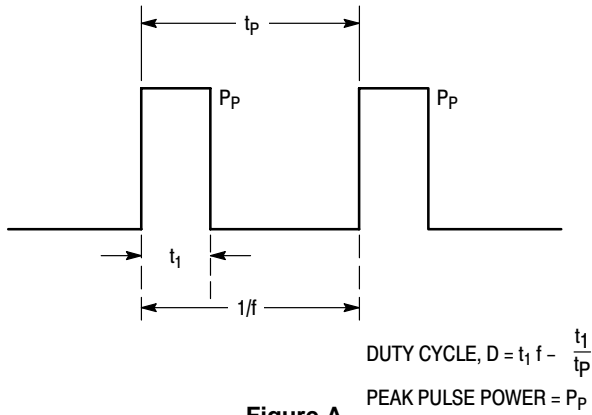


Figure A

A train of periodical power pulses can be represented by the model shown in Figure A. Using the model and the device thermal response, the normalized effective transient thermal resistance of Figure 12 was calculated for various duty cycles.

To find $\theta_{JC}(t)$, multiply the value obtained from Figure 12 by the steady state value θ_{JC} .

Example:

The 2N5190 is dissipating 50 watts under the following conditions: $t_1 = 0.1$ ms, $t_p = 0.5$ ms. ($D = 0.2$).

Using Figure 12, at a pulse width of 0.1 ms and $D = 0.2$, the reading of $r(t_1, D)$ is 0.27.

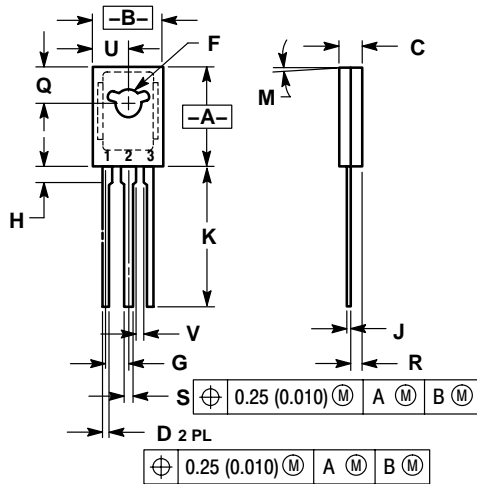
The peak rise in junction temperature is therefore:

$$\Delta T = r(t) \times P_p \times \theta_{JC} = 0.27 \times 50 \times 3.12 = 42.2^\circ\text{C}$$

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PACKAGE DIMENSIONS

TO-225AA
CASE 77-09
ISSUE Z



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 077-01 THRU -08 OBSOLETE, NEW STANDARD 077-09.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.425	0.435	10.80	11.04
B	0.295	0.305	7.50	7.74
C	0.095	0.105	2.42	2.66
D	0.020	0.026	0.51	0.66
F	0.115	0.130	2.93	3.30
G	0.094 BSC		2.39 BSC	
H	0.050	0.095	1.27	2.41
J	0.015	0.025	0.39	0.63
K	0.575	0.655	14.61	16.63
M	5° TYP		5° TYP	
Q	0.148	0.158	3.76	4.01
R	0.045	0.065	1.15	1.65
S	0.025	0.035	0.64	0.88
U	0.145	0.155	3.69	3.93
V	0.040	---	1.02	---

STYLE 1:

1. EMITTER
2. COLLECTOR
3. BASE

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