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°C Derate above 25°C		P_D	40 320	Watts mW/°C
Operating and Storage Junction Temperature Range		T_J, T_{stg}	−65 to +150	°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	°C/W

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

ON Semiconductor®

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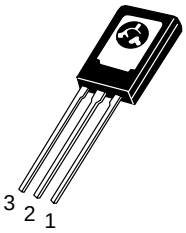
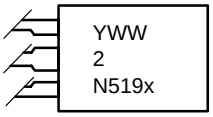
4.0 A
NPN SILICON
POWER TRANSISTORS
40, 60, 80 V, 40 W



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.

***ELECTRICAL CHARACTERISTICS** (T_C = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector−Emitter Sustaining Voltage (Note 1)		$V_{CEO(sus)}$			Vdc
(I_C = 0.1 Adc, I_B = 0)	2N5190		40	−	
	2N5191		60	−	
	2N5192		80	−	
Collector Cutoff Current		I_{CEO}			mAdc
(V_{CE} = 40 Vdc, I_B = 0)	2N5190		−	1.0	
(V_{CE} = 60 Vdc, I_B = 0)	2N5191		−	1.0	
(V_{CE} = 80 Vdc, I_B = 0)	2N5192		−	1.0	
Collector Cutoff Current		I_{CEX}			mAdc
(V_{CE} = 40 Vdc, $V_{EB(off)}$ = 1.5 Vdc)	2N5190		−	0.1	
(V_{CE} = 60 Vdc, $V_{EB(off)}$ = 1.5 Vdc)	2N5191		−	0.1	
(V_{CE} = 80 Vdc, $V_{EB(off)}$ = 1.5 Vdc)	2N5192		−	0.1	
(V_{CE} = 40 Vdc, $V_{EB(off)}$ = 1.5 Vdc, T_C = 125°C)	2N5190		−	2.0	
(V_{CE} = 60 Vdc, $V_{EB(off)}$ = 1.5 Vdc, T_C = 125°C)	2N5191		−	2.0	
(V_{CE} = 80 Vdc, $V_{EB(off)}$ = 1.5 Vdc, T_C = 125°C)	2N5192		−	2.0	
Collector Cutoff Current		I_{CBO}			mAdc
(V_{CB} = 40 Vdc, I_E = 0)	2N5190		−	0.1	
(V_{CB} = 60 Vdc, I_E = 0)	2N5191		−	0.1	
(V_{CB} = 80 Vdc, I_E = 0)	2N5192		−	0.1	
Emitter Cutoff Current		I_{EBO}	−	1.0	mAdc
(V_{BE} = 5.0 Vdc, I_C = 0)					
ON CHARACTERISTICS (Note 1)					
DC Current Gain		h_{FE}			−
(I_C = 1.5 Adc, V_{CE} = 2.0 Vdc)	2N5190/2N5191		25	100	
	2N5192		20	80	
(I_C = 4.0 Adc, V_{CE} = 2.0 Vdc)	2N5190/2N5191		10	−	
	2N5192		7.0	−	
Collector−Emitter Saturation Voltage		$V_{CE(sat)}$			Vdc
(I_C = 1.5 Adc, I_B = 0.15 Adc)			−	0.6	
(I_C = 4.0 Adc, I_B = 1.0 Adc)			−	1.4	
Base−Emitter On Voltage		$V_{BE(on)}$	−	1.2	Vdc
(I_C = 1.5 Adc, V_{CE} = 2.0 Vdc)					
DYNAMIC CHARACTERISTICS					
Current−Gain — Bandwidth Product		f_T	2.0	−	MHz
(I_C = 1.0 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)					

*Indicates JEDEC Registered Data.

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

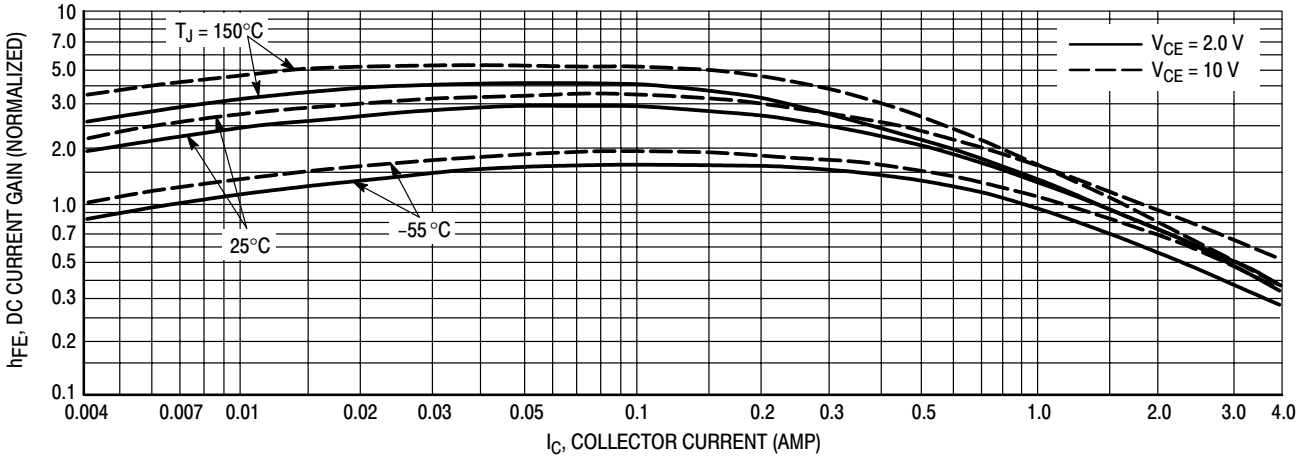


Figure 1. DC Current Gain

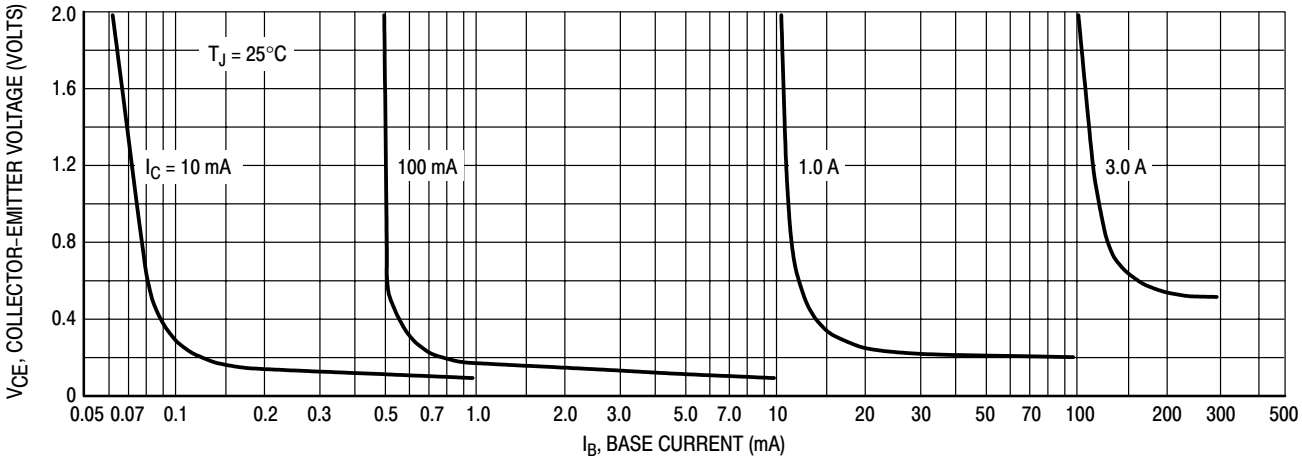


Figure 2. Collector Saturation Region

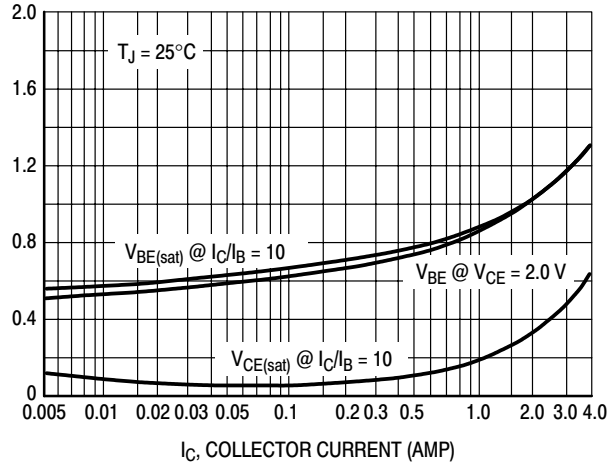


Figure 3. “On” Voltages

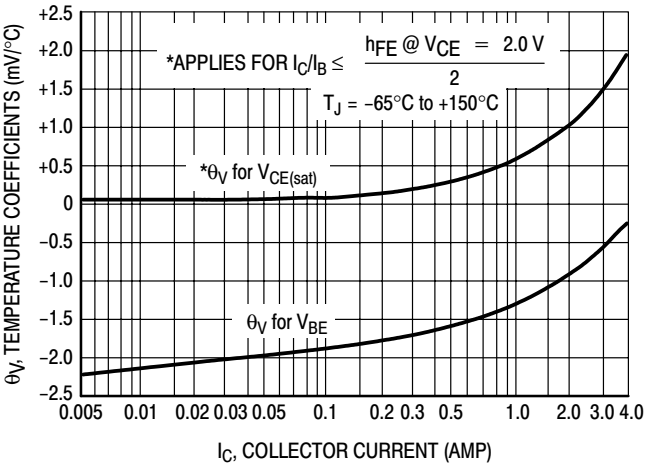


Figure 4. Temperature Coefficients

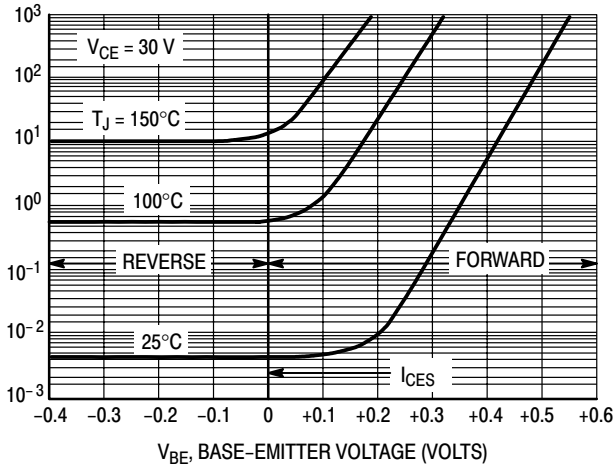


Figure 5. Collector Cut−Off Region

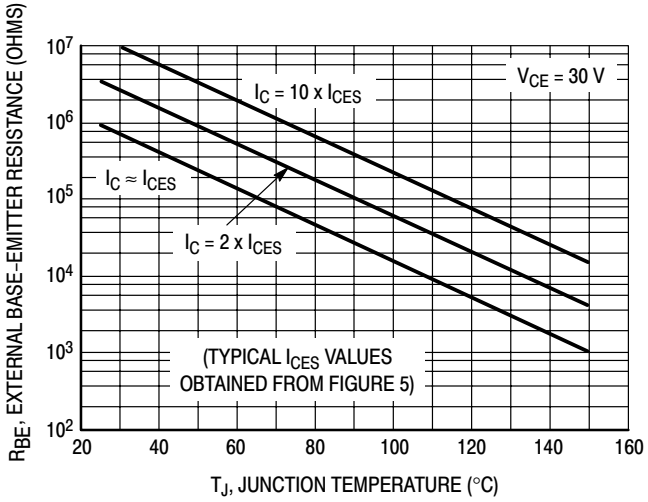


Figure 6. Effects of Base−Emitter Resistance

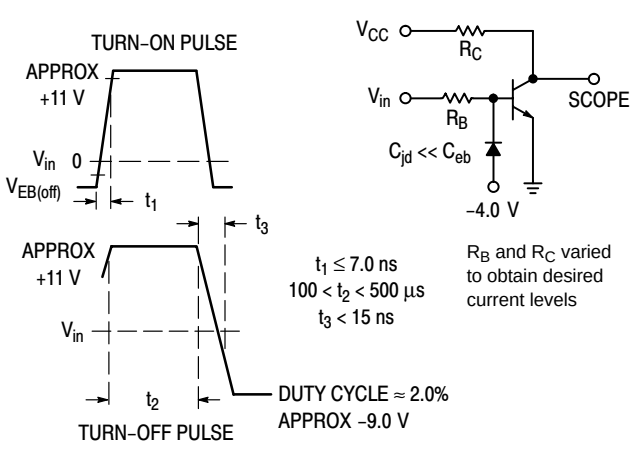


Figure 7. Switching Time Equivalent Test Circuit

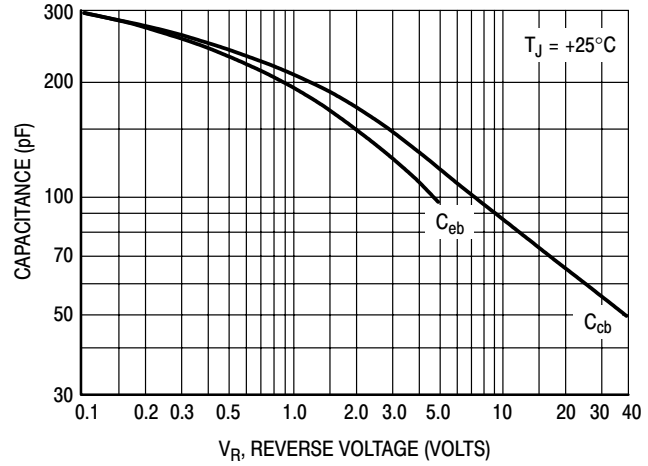


Figure 8. Capacitance

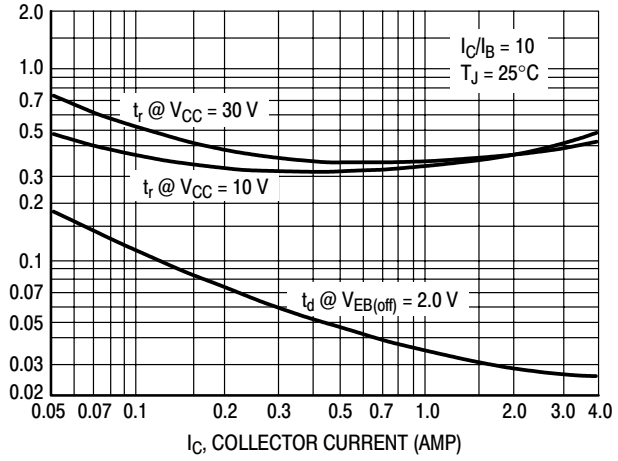


Figure 9. Turn−On Time

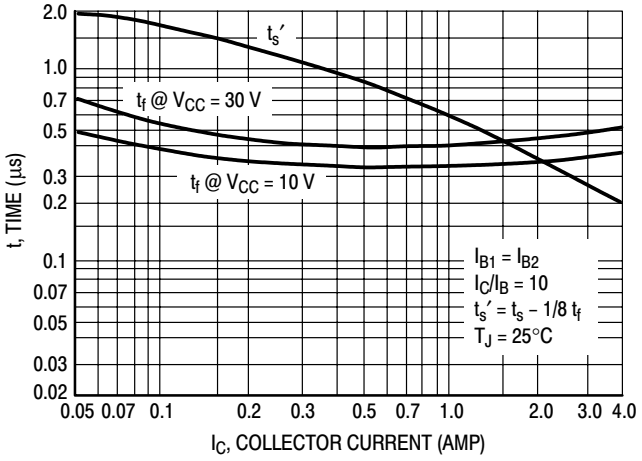


Figure 10. Turn−Off Time

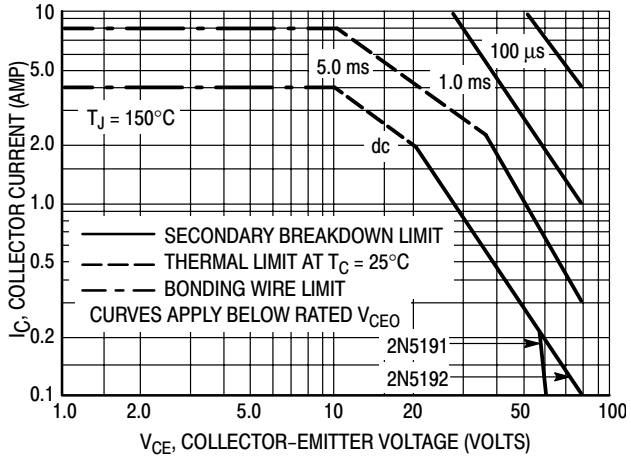


Figure 11. Rating and Thermal Data
Active−Region Safe Operating Area

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 $T_{J(pk)} = 150°C$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 150°C$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

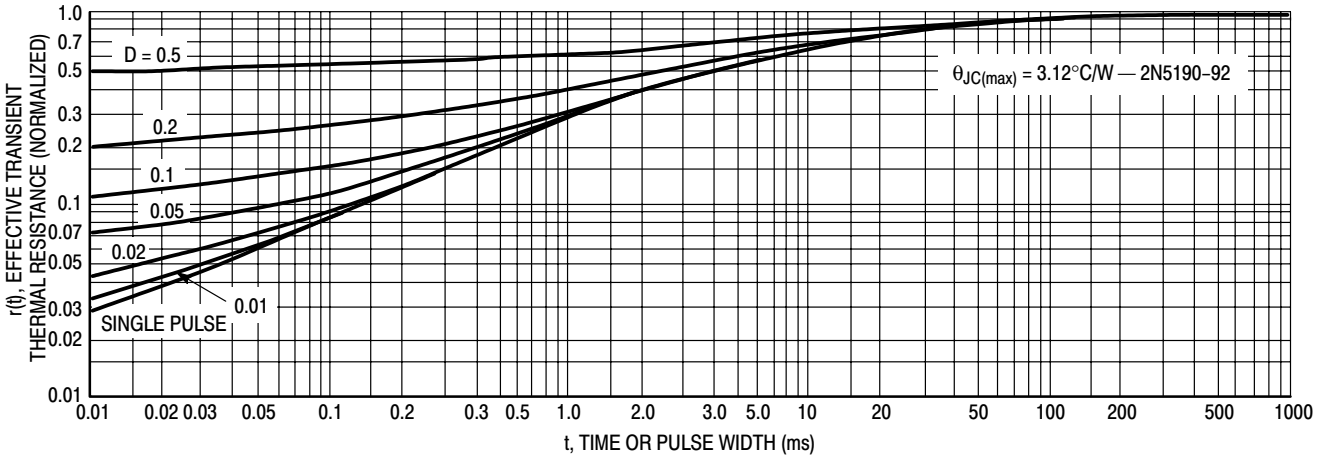


Figure 12. Thermal Response

DESIGN NOTE: USE OF TRANSIENT THERMAL RESISTANCE DATA

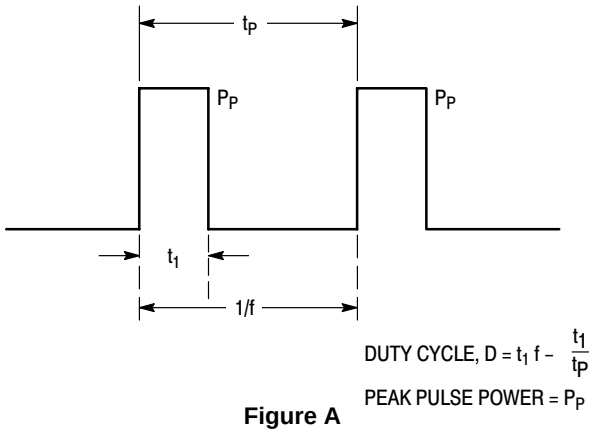


Figure A

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).

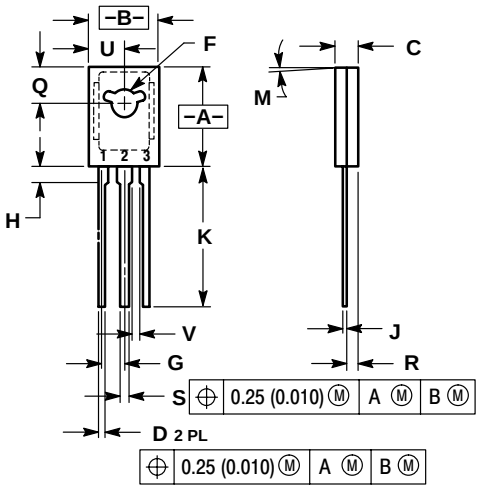
Using Figure 12, at a pulse width of 0.1 ms and D = 0.2, the reading of $r(t_1, D)$ is 0.27.

The peak rise in function temperature is therefore:

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

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.

	INCHES		MILLIMETERS	
DIM	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:
PIN 1. EMITTER
2. COLLECTOR
3. BASE

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
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