

# TIP140, TIP141, TIP142, (NPN); TIP145, TIP146, TIP147, (PNP)



ON Semiconductor®

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## Darlington Complementary Silicon Power Transistors

Designed for general-purpose amplifier and low frequency switching applications.

### Features

- High DC Current Gain –  
 $\text{Min } h_{FE} = 1000 @ I_C$   
 $= 5.0 \text{ A, } V_{CE} = 4 \text{ V}$
- Collector–Emitter Sustaining Voltage – @ 30 mA  
 $V_{CEO(sus)} = 60 \text{ Vdc (Min) – TIP140, TIP145}$   
 $= 80 \text{ Vdc (Min) – TIP141, TIP146}$   
 $= 100 \text{ Vdc (Min) – TIP142, TIP147}$
- Monolithic Construction with Built–In Base–Emitter Shunt Resistor
- These are Pb–Free Devices\*

### MAXIMUM RATINGS

Rating	Symbol	TIP140 TIP145	TIP141 TIP146	TIP142 TIP147	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	$I_C$				Adc
– Continuous		10			
– Peak (Note 1)		15			
Base Current – Continuous	$I_B$	0.5			Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	125			W
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	–65 to +150			$^\circ\text{C}$

### THERMAL CHARACTERISTICS

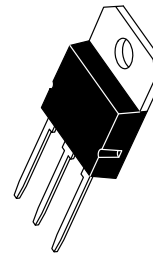
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	1.0	$^\circ\text{C/W}$
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	35.7	$^\circ\text{C/W}$

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.

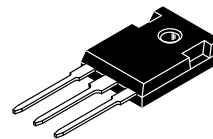
1. 5 ms,  $\leq 10\%$  Duty Cycle.

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

## 10 AMPERE DARLINGTON COMPLEMENTARY SILICON POWER TRANSISTORS 60–100 VOLTS, 125 WATTS



SOT-93 (TO-218)  
CASE 340D  
STYLE 1



TO-247  
CASE 340L  
STYLE 3

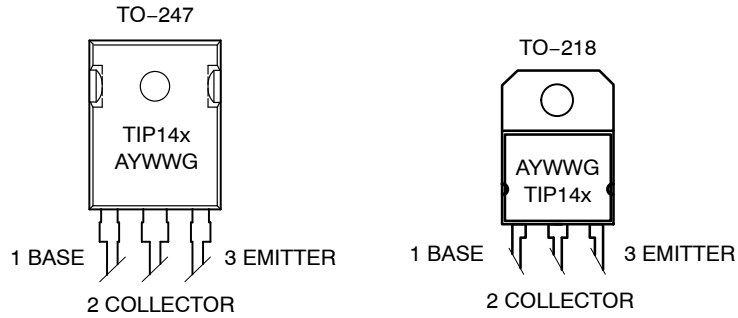
**NOTE:** Effective June 2012 this device will be available only in the TO-247 package. Reference FPCN# 16827.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# TIP140, TIP141, TIP142, (NPN); TIP145, TIP146, TIP147, (PNP)

## MARKING DIAGRAMS



TIP14x = Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

## DARLINGTON SCHEMATICS



## ORDERING INFORMATION

Device	Package	Shipping
TIP140G	SOT-93 (TO-218) (Pb-Free)	30 Units / Rail
TIP141G	SOT-93 (TO-218) (Pb-Free)	30 Units / Rail
TIP142G	SOT-93 (TO-218) (Pb-Free)	30 Units / Rail
TIP145G	SOT-93 (TO-218) (Pb-Free)	30 Units / Rail
TIP146G	SOT-93 (TO-218) (Pb-Free)	30 Units / Rail
TIP147G	SOT-93 (TO-218) (Pb-Free)	30 Units / Rail
TIP140G	TO-247 (Pb-Free)	30 Units / Rail
TIP141G	TO-247 (Pb-Free)	30 Units / Rail
TIP142G	TO-247 (Pb-Free)	30 Units / Rail
TIP145G	TO-247 (Pb-Free)	30 Units / Rail
TIP146G	TO-247 (Pb-Free)	30 Units / Rail
TIP147G	TO-247 (Pb-Free)	30 Units / Rail

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-Emitter Sustaining Voltage (Note 2) ( $I_C = 30\text{ mA}$ , $I_B = 0$ )	$V_{CEO(sus)}$	60 80 100	- - -	- - -	Vdc
Collector Cutoff Current ( $V_{CE} = 30\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 50\text{ Vdc}$ , $I_B = 0$ )	$I_{CEO}$	- - -	- - -	2.0 2.0 2.0	mA
Collector Cutoff Current ( $V_{CB} = 60\text{ V}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ V}$ , $I_E = 0$ ) ( $V_{CB} = 100\text{ V}$ , $I_E = 0$ )	$I_{CBO}$	- - -	- - -	1.0 1.0 1.0	mA
Emitter Cutoff Current ( $V_{BE} = 5.0\text{ V}$ )	$I_{EBO}$	-	-	2.0	mA

## ON CHARACTERISTICS (Note 2)

DC Current Gain ( $I_C = 5.0\text{ A}$ , $V_{CE} = 4.0\text{ V}$ ) ( $I_C = 10\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )	$h_{FE}$	1000 500	- -	- -	-
Collector-Emitter Saturation Voltage ( $I_C = 5.0\text{ A}$ , $I_B = 10\text{ mA}$ ) ( $I_C = 10\text{ A}$ , $I_B = 40\text{ mA}$ )	$V_{CE(sat)}$	- -	- -	2.0 3.0	Vdc
Base-Emitter Saturation Voltage ( $I_C = 10\text{ A}$ , $I_B = 40\text{ mA}$ )	$V_{BE(sat)}$	-	-	3.5	Vdc
Base-Emitter On Voltage ( $I_C = 10\text{ A}$ , $V_{CE} = 4.0\text{ Vdc}$ )	$V_{BE(on)}$	-	-	3.0	Vdc

## SWITCHING CHARACTERISTICS

Resistive Load (See Figure 1)						
Delay Time	$(V_{CC} = 30\text{ V}$ , $I_C = 5.0\text{ A}$ , $I_B = 20\text{ mA}$ , Duty Cycle $\leq 2.0\%$ , $I_{B1} = I_{B2}$ , $R_C$ & $R_B$ Varied, $T_J = 25^\circ\text{C}$ )	$t_d$	-	0.15	-	$\mu\text{s}$
Rise Time		$t_r$	-	0.55	-	$\mu\text{s}$
Storage Time		$t_s$	-	2.5	-	$\mu\text{s}$
Fall Time		$t_f$	-	2.5	-	$\mu\text{s}$

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

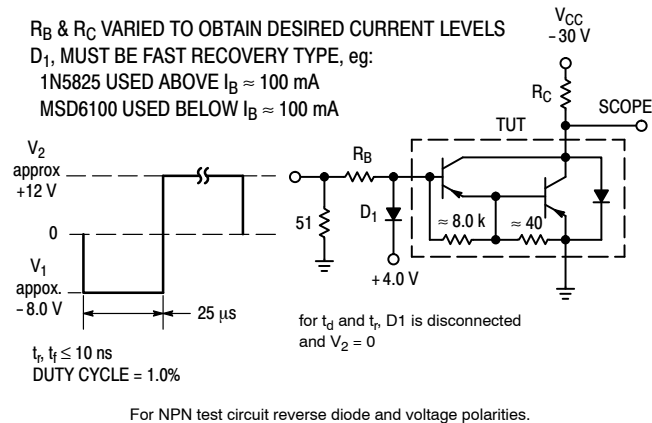


Figure 1. Switching Times Test Circuit

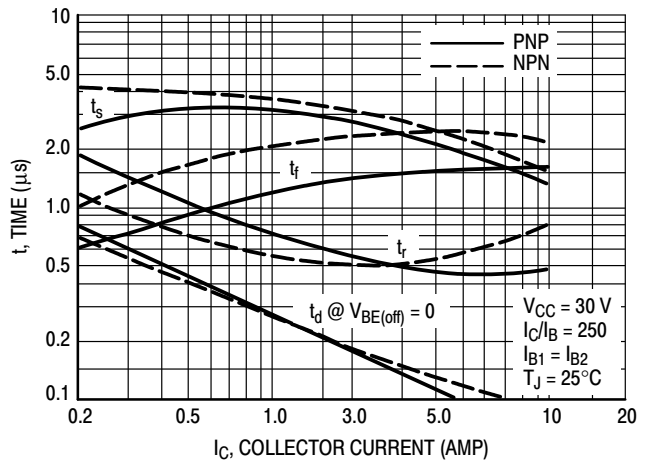


Figure 2. Switching Times

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## TYPICAL CHARACTERISTICS

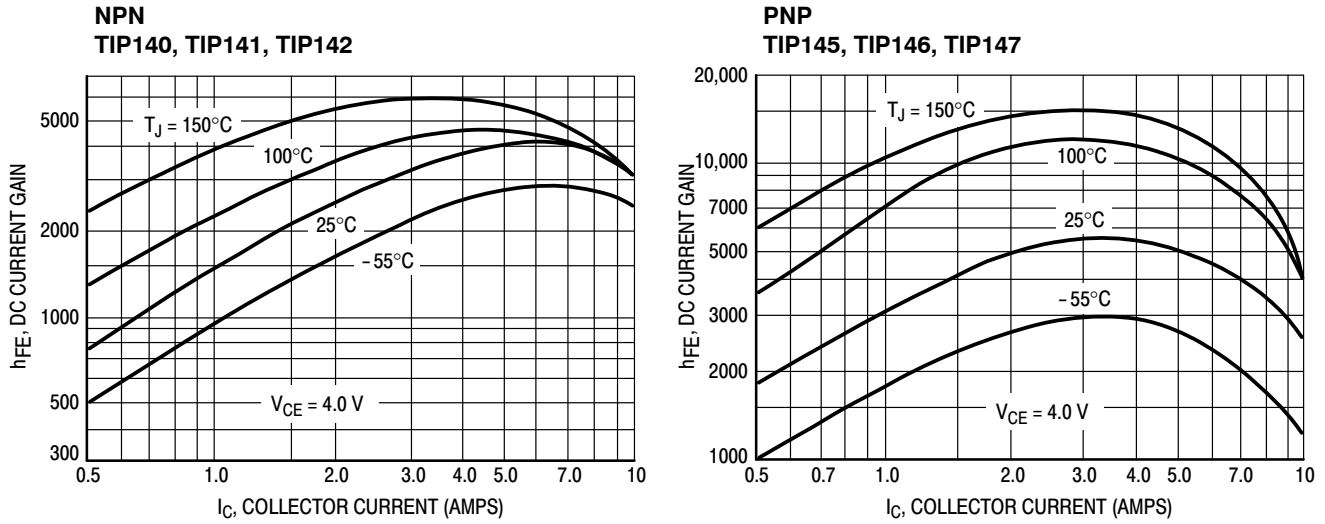


Figure 3. DC Current Gain versus Collector Current

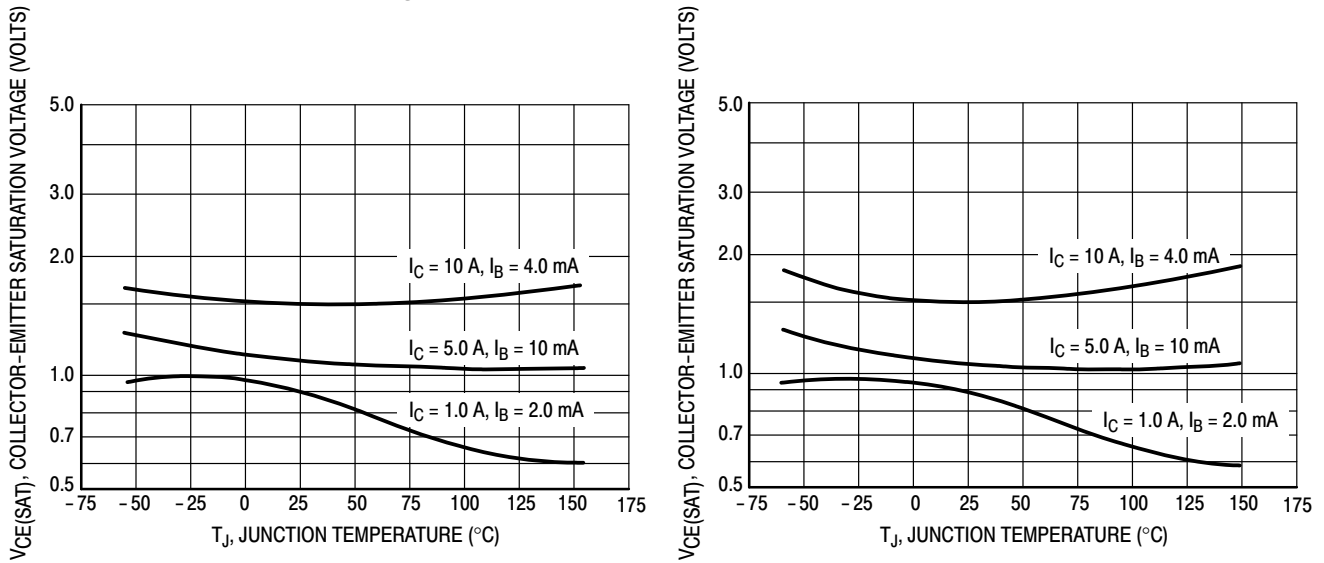


Figure 4. Collector-Emitter Saturation Voltage

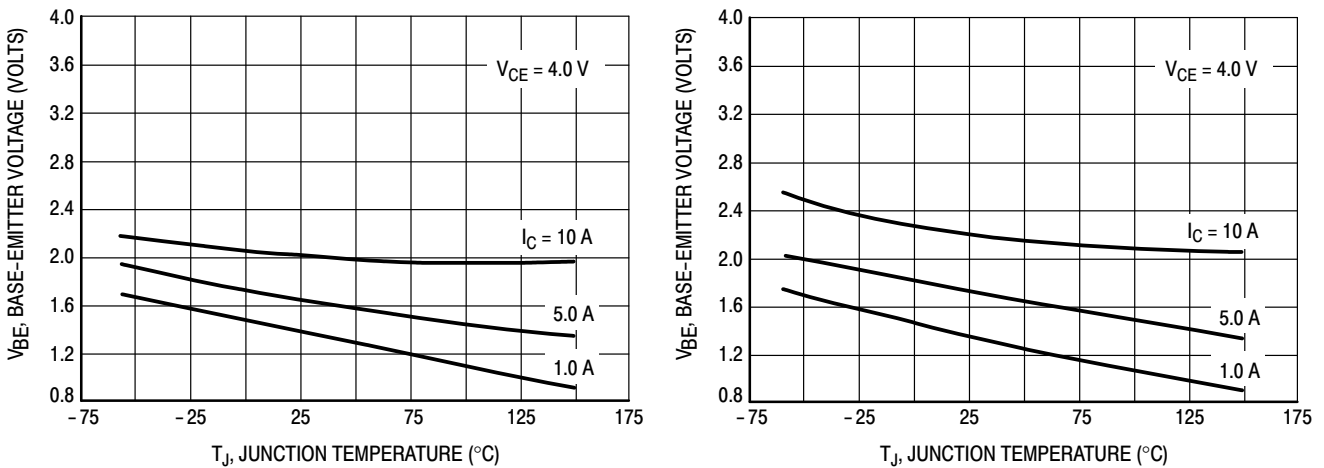


Figure 5. Base-Emitter Voltage

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## 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 6 is based on  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

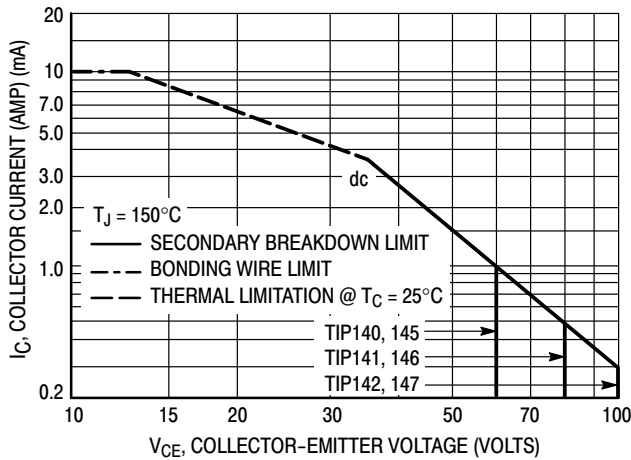


Figure 6. Active-Region Safe Operating Area

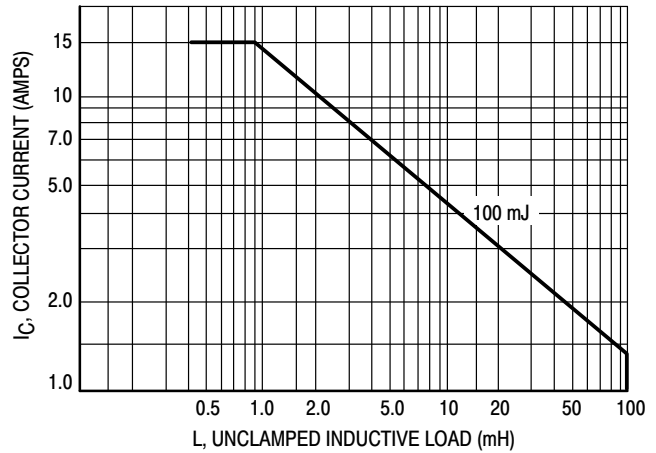
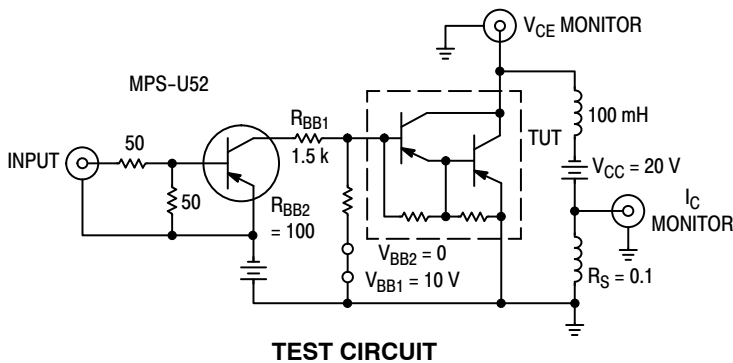
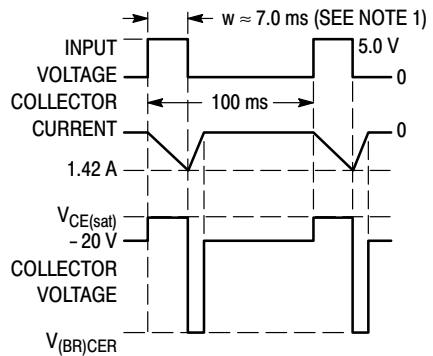


Figure 7. Unclamped Inductive Load



TEST CIRCUIT

NOTE 1: Input pulse width is increased until  $I_{CM} = 1.42\text{ A}$ .  
NOTE 2: For NPN test circuit reverse polarities.



VOLTAGE AND CURRENT WAVEFORMS

Figure 8. Inductive Load

TIP140, TIP141, TIP142, (NPN); TIP145, TIP146, TIP147, (PNP)

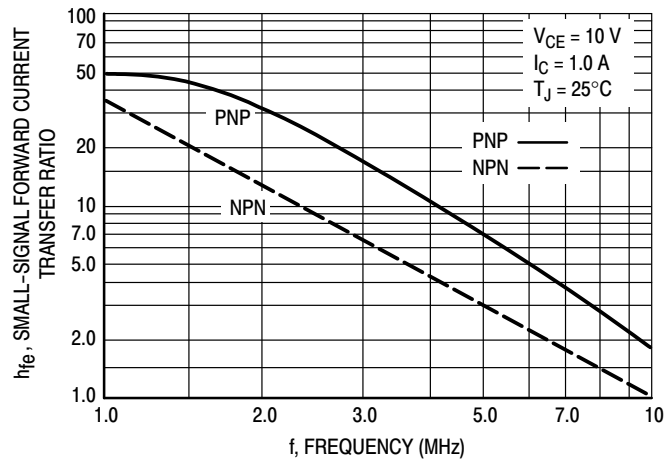


Figure 9. Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio

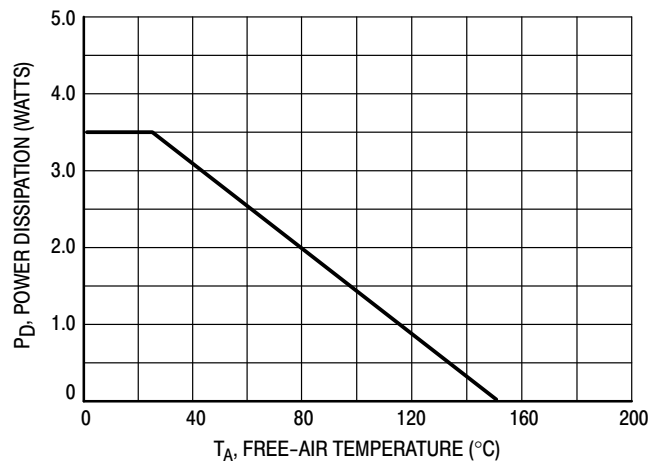


Figure 10. Free-Air Temperature Power Derating

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## PACKAGE DIMENSIONS

**SOT-93 (TO-218)**  
CASE 340D-02  
ISSUE E



NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	20.35	---	0.801
B	14.70	15.20	0.579	0.598
C	4.70	4.90	0.185	0.193
D	1.10	1.30	0.043	0.051
E	1.17	1.37	0.046	0.054
G	5.40	5.55	0.213	0.219
H	2.00	3.00	0.079	0.118
J	0.50	0.78	0.020	0.031
K	31.00 REF		1.220 REF	
L	---	16.20	---	0.638
Q	4.00	4.10	0.158	0.161
S	17.80	18.20	0.701	0.717
U	4.00 REF		0.157 REF	
V	1.75 REF		0.069	

STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

**TO-247**  
CASE 340L-02  
ISSUE F



NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	20.32	21.08	0.800	0.830
B	15.75	16.26	0.620	0.640
C	4.70	5.30	0.185	0.209
D	1.00	1.40	0.040	0.055
E	1.90	2.60	0.075	0.102
F	1.65	2.13	0.065	0.084
G	5.45 BSC		0.215 BSC	
H	1.50	2.49	0.059	0.098
J	0.40	0.80	0.016	0.031
K	19.81	20.83	0.780	0.820
L	5.40	6.20	0.212	0.244
N	4.32	5.49	0.170	0.216
P	---	4.50	---	0.177
Q	3.55	3.65	0.140	0.144
U	6.15 BSC		0.242 BSC	
W	2.87	3.12	0.113	0.123

STYLE 3:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

## TIP140, TIP141, TIP142, (NPN); TIP145, TIP146, TIP147, (PNP)

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