

2N6351, 2N6353



NPN Darlington Power Silicon Transistors

Rev. V2

Features

- Available in JAN, JANTX, JANTXV per MIL-PRF-19500/472
- TO-33 (2N6351) and 3 Pin TO-66 (2N6353) Packages
- Designed for Use in High Gain Amplifier and Switching Applications



Electrical Characteristics ($T_A = +25^\circ\text{C}$ unless otherwise noted)

Parameter	Test Conditions	Symbol	Units	Min.	Max.
Collector - Emitter Breakdown Voltage	$I_C = 25 \text{ mA dc}$; $R_{B1E} = 2.2 \text{ k}\Omega$; $R_{B2E} = 100 \Omega$ 2N6351, 2N6353	$V_{(BR)CER}$	V dc	150	—
Emitter to Base 1 Breakdown Voltage	$I_E = 12 \text{ mA dc}$; base 2 open	$V_{(BR)EBO1}$	V dc	12	—
Emitter to Base 2 Breakdown Voltage	$I_E = 12 \text{ mA dc}$; base 1 open	$V_{(BR)EBO2}$	V dc	6	—
Collector - Emitter Cutoff Current	$V_{EB1} = 2 \text{ V}$; $R_{B2E} = 100 \Omega$ $V_{CE} = 150 \text{ V}$ 2N6351, 2N6353	I_{CEX1}	$\mu\text{A dc}$	—	1.0
Saturation Voltage and Resistance	$I_C = 5.0 \text{ A dc}$; $R_{B2E} = 100 \Omega$ $I_B = 10 \text{ mA dc}$ 2N6351, 2N6353	$V_{CE(sat)1}$	Vdc	—	2.5
Base - Emitter Voltage (nonsaturated)	$V_{CE} = 5 \text{ Vdc}$; $I_C = 5.0 \text{ A dc}$; $R_{B2E} = 100 \Omega$	$V_{BE(on)1}$	Vdc	—	2.5
Forward-Current Transfer Ratio	$V_{CE} = 5 \text{ V dc}$; $I_C = 1.0 \text{ A dc}$; $R_{B2E} = 1 \text{ k}\Omega$ 2N6351, 2N6353	h_{FE1}	-	1000	
Forward-Current Transfer Ratio	$V_{CE} = 5 \text{ V dc}$; $I_C = 5.0 \text{ A dc}$; $R_{B2E} = 100 \Omega$ 2N6351, 2N6353	h_{FE2}	-	1000	10,000
Forward-Current Transfer Ratio	$V_{CE} = 5 \text{ V dc}$; $I_C = 10 \text{ A dc}$; $R_{B2E} = 100 \Omega$ 2N6351, 2N6353	h_{FE3}	-	200	
Collector - Emitter Cutoff Current	$T_A = +150^\circ\text{C}$ $V_{EB1} = 2 \text{ V dc}$; $R_{B2E} = 100 \Omega$ $V_{CE} = 150 \text{ V}$ 2N6351, 2N6353	I_{CEX2}	mA dc	—	1.0
Forward-Current Transfer Ratio	$T_A = -65^\circ\text{C}$ $V_{CE} = 5 \text{ V dc}$; $I_C = 5.0 \text{ A dc}$; $R_{B2E} = 100 \Omega$ 2N6351, 2N6353	h_{FE4}	-	200	

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Electrical Characteristics ($T_A = +25^\circ\text{C}$ unless otherwise noted)

Small-Signal Short-Circuit Forward Current Transfer Ratio	$V_{CE} = 10 \text{ Vdc}; I_C = 1.0 \text{ A dc}; f = 10 \text{ MHz}$ $R_{B2E} = 100 \Omega$	$ h_{fe} $	-	5	25
Open-Circuit Output Capacitance	$V_{CB1} = 10 \text{ V dc}; I_E = 0; 100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ base 2 open	C_{obo}	pF	—	120

Switching Characteristics

Turn-On Time	$V_{CC} = 30 \text{ Vdc}; I_C = 5 \text{ A dc}$ 2N6351, 2N6353 (see figure 5)	t_{on}	μs	—	0.5
Turn-Off Time	$V_{CC} = 30 \text{ Vdc}; I_C = 5 \text{ A dc}$ 2N6351, 2N6353 (see figure 5)	t_{off}	μs	—	1.2

Safe Operating Area

DC Tests: $T_C = +100^\circ\text{C}; t \geq 1.0 \text{ s}; 1 \text{ cycle}; t_r = t_f = 10 \mu\text{s}$ (see figure 6); $R_{B2E} = 100 \Omega$

(2N6351 type only)

Test 1: 2N6351 $V_{CE} = 1.5 \text{ Vdc}; I_C = 3.3 \text{ A dc}$
 Test 2: 2N6351 $V_{CE} = 30 \text{ Vdc}, I_C = 167 \text{ mA dc}$
 Test 4: 2N6351 $V_{CE} = 150 \text{ Vdc}, I_C = 13 \text{ mA dc}$

DC Tests: $T_C = +100^\circ\text{C}; t \geq 1.0 \text{ s}; 1 \text{ cycle}; t_r = t_f = 10 \mu\text{s}$ (see figure 6); $R_{B2E} = 100 \Omega$

(2N6353 type only)

Test 1: 2N6353 $V_{CE} = 5.0 \text{ Vdc}; I_C = 5 \text{ A dc}$
 Test 2: 2N6353 $V_{CE} = 10 \text{ Vdc}, I_C = 2.5 \text{ A dc}$
 Test 4: 2N6353 $V_{CE} = 150 \text{ Vdc}, I_C = 35 \text{ mA dc}$

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Absolute Maximum Ratings ($T_A = +25^\circ\text{C}$ unless otherwise noted)

Ratings	Symbol	Value
Collector - Base Voltage 2N6351, 2N6353	V_{CBO1} V_{CER}	150 V dc
Emitter - Base Voltage	V_{EB1}	12 V dc
Emitter - Base Voltage	V_{EB2}	6 V dc
Collector Current	I_C	5 A dc
Collector Current	$I_C^{(1)}$	10 A dc
Base Current	I_{B1}	0.5 A dc
Total Power Dissipation @ $T_A = +25^\circ\text{C}$ 2N6351 2N6353	P_T	1.0 W ⁽²⁾ 2.0 W ⁽⁴⁾
Total Power Dissipation @ $T_C = +100^\circ\text{C}$ 2N6351 2N6353	P_T	5 W ⁽³⁾ 25 W ⁽⁵⁾
Operating & Storage Temperature Range	T_J, T_{STG}	-65°C to $+200^\circ\text{C}$

Thermal Characteristics

Characteristics	Symbol	Max. Value
Thermal Resistance, Junction to Case 2N6351 2N6353	$R_{\theta JC}$	20°C/W 4.0°C/W

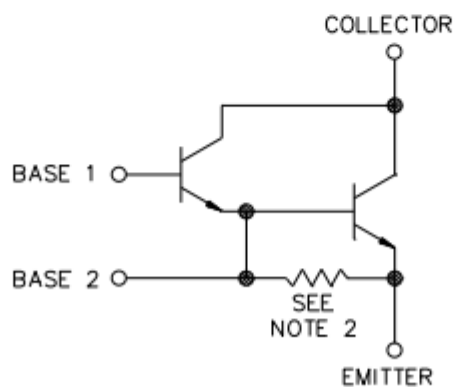
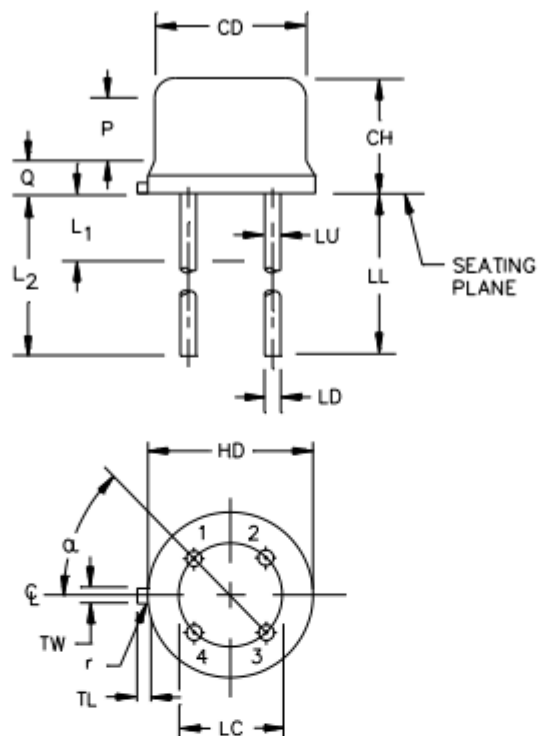
- (1) Applies for $t_p \leq 10$ ms, duty cycle ≤ 50 percent.
- (2) Derate linearly 5.72 mW/ $^\circ\text{C}$ for $T_A > +25^\circ\text{C}$.
- (3) Derate linearly 50 mW/ $^\circ\text{C}$ for $T_C > +100^\circ\text{C}$.
- (4) Derate linearly 11.4 mW/ $^\circ\text{C}$ for $T_A > +25^\circ\text{C}$.
- (5) Derate linearly 250 mW/ $^\circ\text{C}$ for $T_C > +100^\circ\text{C}$.

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Outline Drawing 2N6351 (TO-33)



SCHEMATIC CIRCUIT

2N6351, 2N6353



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Outline Dimensions 2N6351 (TO-33)

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	3
CH	.184	.260	4.67	6.60	
HD	.335	.370	8.51	9.40	
LC	0.200 TP		5.080 TP		4
LD	.016	.021	0.407	0.533	5, 6
LL	1.500	1.750	38.10	44.45	5, 6
L ₁		.050		1.27	5, 6
L ₂	.250		6.35		5, 6
LU	.016	.019	0.407	0.482	5, 6
TL	.029	.045	0.74	1.14	7
TW	.028	.034	0.712	0.863	8
P	.100		2.54		3
Q		.050		1.27	9
r		.010		0.254	10
α	45° TP		45° TP		4

NOTES:

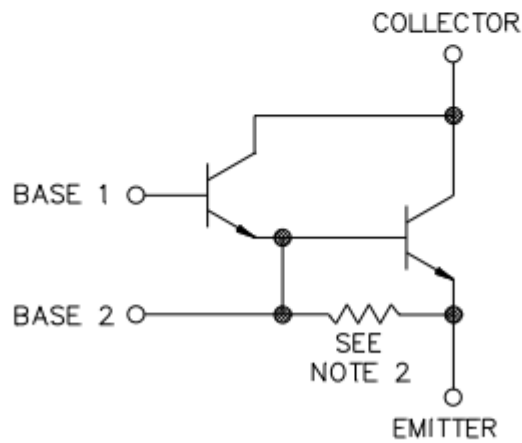
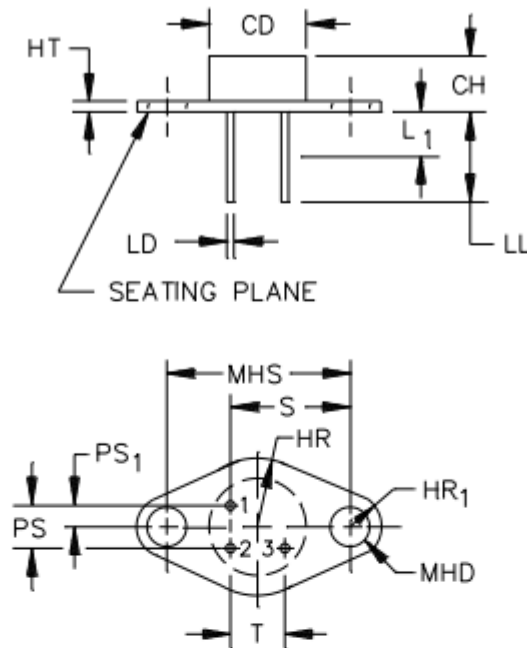
1. Dimensions are in inches. Millimeters are given for general information only.
2. Internal resistance (typically 750 ohms). This resistor is optional.
3. Dimension CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
4. Leads at gauge plane .054 +.001 –.000 inch (1.37 +0.03 –0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
5. Dimension LU applies between dimension L₁ and dimension L₂. Dimension LD applies between L₂ and LL minimum. Diameter is uncontrolled in dimension L₁ and beyond dimension LL minimum.
6. All terminals.
7. Dimension TL measured from maximum HD.
8. Beyond r (radius) maximum, dimension TW shall be held for a minimum length of .011 inch (0.28 mm).
9. Outline in this zone is not controlled.
10. The-radius (dimension r) applies to both inside corners of the tab.
11. Terminal designation is as follows: 1 – emitter, 2 – base 2 (B2), 3 – base 1 (B1), 4 – collector. The collector shall be connected to the case.
12. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

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Outline Drawing 2N6353 (3 pin TO-66)



SCHEMATIC CIRCUIT

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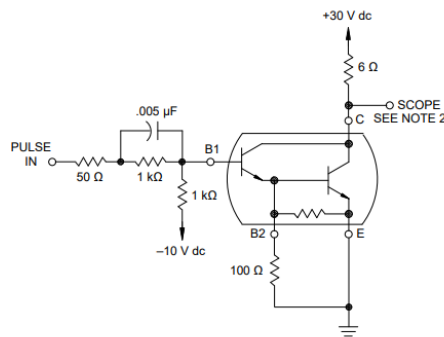
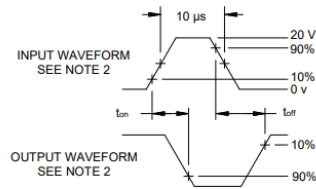
Dimensions 2N6353 (3 pin TO-66)

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	3
CH	.184	.260	4.67	6.60	
HD	.335	.370	8.51	9.40	
LC	0.200 TP		5.080 TP		4
LD	.016	.021	0.407	0.533	5, 6
LL	1.500	1.750	38.10	44.45	5, 6
L ₁		.050		1.27	5, 6
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LU	.016	.019	0.407	0.482	5, 6
TL	.029	.045	0.74	1.14	7
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P	.100		2.54		3
Q		.050		1.27	9
r		.010		0.254	10
α	45° TP		45° TP		4

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Internal resistance (typically 750 ohms). This resistor is optional.
3. Dimension CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
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6. All terminals.
7. Dimension TL measured from maximum HD.
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9. Outline in this zone is not controlled.
10. The-radius (dimension r) applies to both inside corners of the tab.
11. Terminal designation is as follows: 1 – emitter, 2 – base 2 (B2), 3 – base 1 (B1), 4 – collector. The collector shall be connected to the case.
12. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

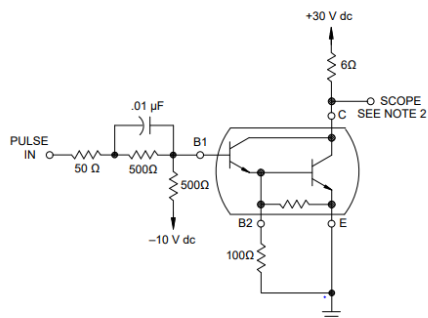
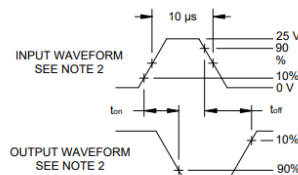
Graphs



NOTES:

1. The input waveform is supplied by a pulse generator with the following characteristics:
 $t_r \leq 15$ ns, $t_f \leq 15$ ns, $Z_{OUT} = 50 \Omega$, $PW = 10 \mu s$, duty cycle ≤ 2 percent.
2. Output waveforms are monitored on an oscilloscope with the following characteristics:
 $t_r \leq 15$ ns, $Z_{IN} \geq 10$ M Ω , $C_{IN} \leq 11.5$ pF.
3. Resistors shall be non-inductive types.
4. The dc power supplies may require additional by-passing in order to minimize ringing.

FIGURE 4. Pulse response test circuit for device types 2N6350 and 2N6352.



NOTES:

1. The input waveform is supplied by a pulse generator with the following characteristics:
 $t_r \leq 15$ ns, $t_f \leq 15$ ns, $Z_{OUT} = 50 \Omega$, $PW = 10 \mu s$, duty cycle ≤ 2 percent.
2. Output waveforms are monitored on an oscilloscope with the following characteristics:
 $t_r \leq 15$ ns, $Z_{IN} \geq 10$ M Ω , $C_{IN} \leq 11.5$ pF.
3. Resistors shall be non-inductive types.
4. The dc power supplies may require additional by-passing in order to minimize ringing.

FIGURE 5. Pulse response test circuit for device types 2N6351 and 2N6353.

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Graphs

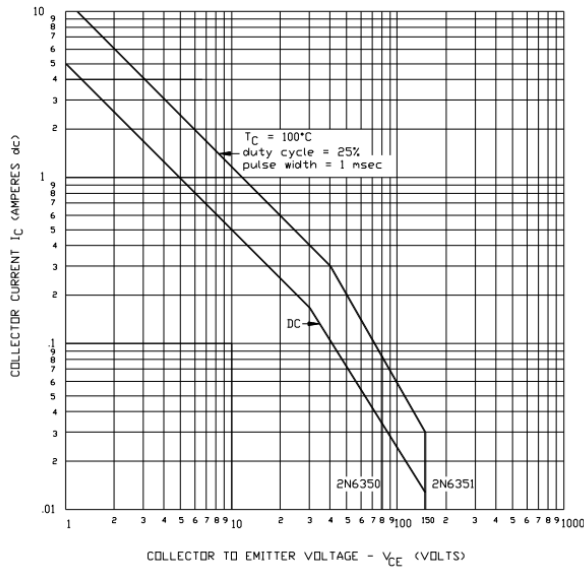


FIGURE 6. Maximum safe operating area graph for device types 2N6350 and 2N6351.

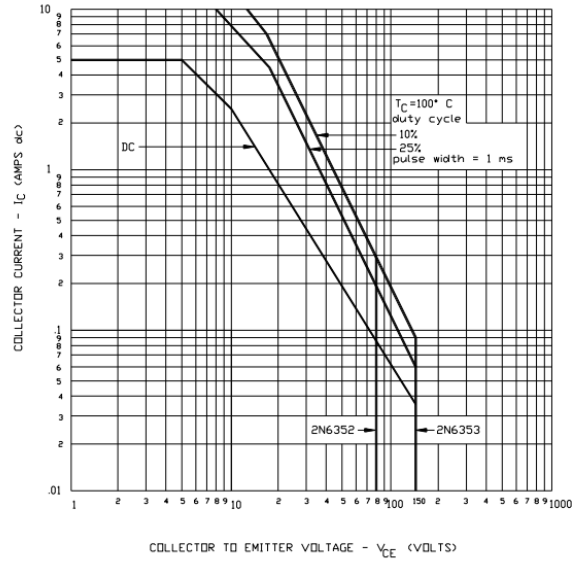


FIGURE 7. Maximum safe operating area graph for device types 2N6352 and 2N6353.

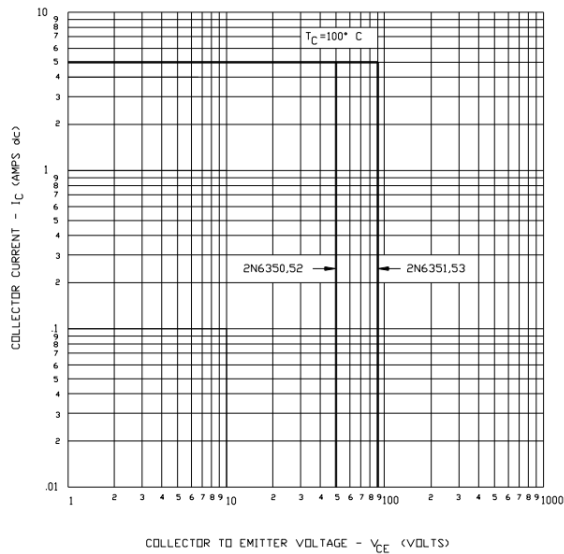


FIGURE 8. Safe operating area for switching between saturation and cutoff - (clamped inductive load).

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