TIP110, TIP111, TIP112 (NPN); TIP115, TIP116, TIP117 (PNP)

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
  = 1.0 Adc
- Collector−Emitter Sustaining Voltage − @ 30 mAdc
  $V_{CEO(sus)}$ = 60 Vdc (Min) − TIP110, TIP115
  = 80 Vdc (Min) − TIP111, TIP116
  = 100 Vdc (Min) − TIP112, TIP117
- Low Collector−Emitter Saturation Voltage −
  $V_{CE(sat)}$ = 2.5 Vdc (Max) @ I_C
  = 2.0 Adc
- Monolithic Construction with Built−in Base−Emitter Shunt Resistors
- Pb−Free Packages are Available*

ON Semiconductor®

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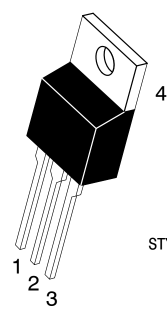
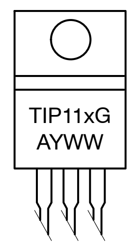
DARLINGTON
2 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60−80−100 VOLTS, 50 WATTS



TO−220AB
CASE 221A
STYLE 1

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

MARKING DIAGRAM



TIP11x	= 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 on page 3 of this data sheet.

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

MAXIMUM RATINGS

Rating	Symbol	TIP110, TIP115	TIP111, TIP116	TIP112, TIP117	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	2.0 4.0			Adc
Base Current	I_B	50			mAdc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	50 0.4			W W/°C
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	2.0 0.016			W W/°C
Unclamped Inductive Load Energy – Figure 13	E	25			mJ
Operating and Storage Junction	T_J, T_{stg}	–65 to +150			°C

THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	2.5	°C/W
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	62.5	°C/W

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (Note 1) (I_C = 30 mAdc, I_B = 0)	 TIP110, TIP115 TIP111, TIP116 TIP112, TIP117	$V_{CEO(sus)}$	 60 80 100	 – – –	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0) (V_{CE} = 40 Vdc, I_B = 0) (V_{CE} = 50 Vdc, I_B = 0)	 TIP110, TIP115 TIP111, TIP116 TIP112 ,TIP117	I_{CEO}	 – – –	 2.0 2.0 2.0	mAdc
Collector Cutoff Current (V_{CB} = 60 Vdc, I_E = 0) (V_{CB} = 80 Vdc, I_E = 0) (V_{CB} = 100 Vdc, I_E = 0)	 TIP110, TIP115 TIP111, TIP116 TIP112, TIP117	I_{CBO}	 – – –	 1.0 1.0 1.0	mAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		I_{EBO}	–	2.0	mAdc
ON CHARACTERISTICS (Note 1)					
DC Current Gain (I_C = 1.0 Adc, V_{CE} = 4.0 Vdc) (I_C = 2.0 Adc, V_{CE} = 4.0 Vdc)		h_{FE}	 1000 500	 – –	–
Collector–Emitter Saturation Voltage (I_C = 2.0 Adc, I_B = 8.0 mAdc)		$V_{CE(sat)}$	–	2.5	Vdc
Base–Emitter On Voltage (I_C = 2.0 Adc, V_{CE} = 4.0 Vdc)		$V_{BE(on)}$	–	2.8	Vdc
DYNAMIC CHARACTERISTICS					
Small–Signal Current Gain (I_C = 0.75 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)		h_{fe}	25	–	–
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz)	 TIP115, TIP116, TIP117 TIP110, TIP111, TIP112	C_{ob}	 – –	 200 100	pF

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

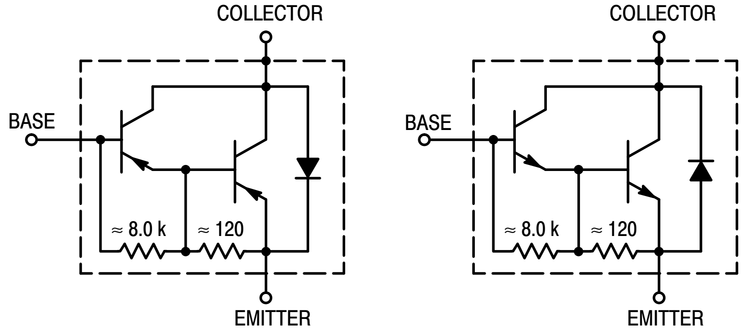


Figure 1. Darlington Circuit Schematic

ORDERING INFORMATION

Device	Package	Shipping
TIP110	TO−220	50 Units / Rail
TIP110G	TO−220 (Pb−Free)	50 Units / Rail
TIP111	TO−220	50 Units / Rail
TIP111G	TO−220 (Pb−Free)	50 Units / Rail
TIP112	TO−220	50 Units / Rail
TIP112G	TO−220 (Pb−Free)	50 Units / Rail
TIP115	TO−220	50 Units / Rail
TIP115G	TO−220 (Pb−Free)	50 Units / Rail
TIP116	TO−220	50 Units / Rail
TIP116G	TO−220 (Pb−Free)	50 Units / Rail
TIP117	TO−220	50 Units / Rail
TIP117G	TO−220 (Pb−Free)	50 Units / Rail

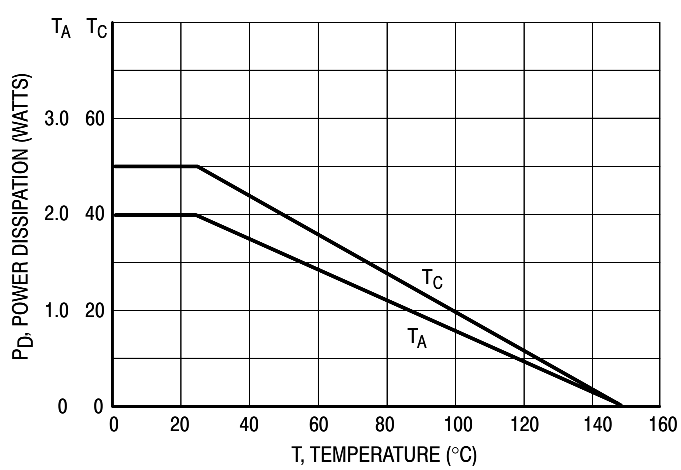


Figure 2. Power Derating

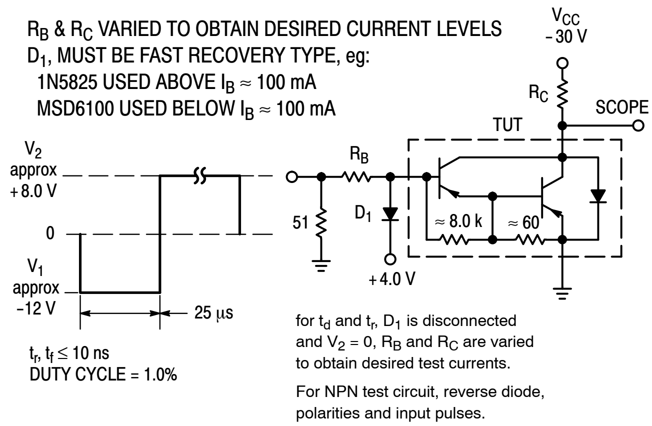


Figure 3. Switching Times Test Circuit

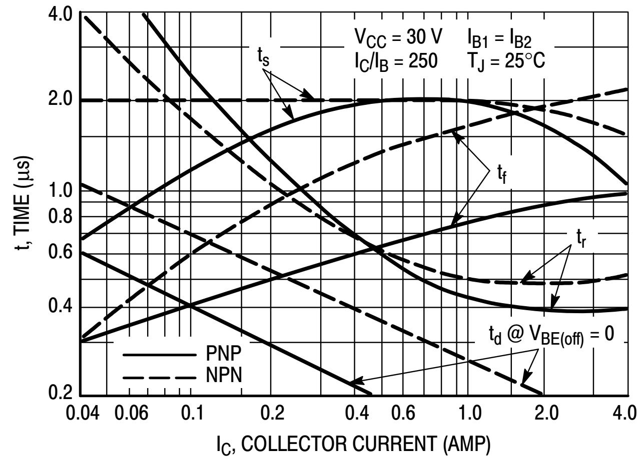


Figure 4. Switching Times

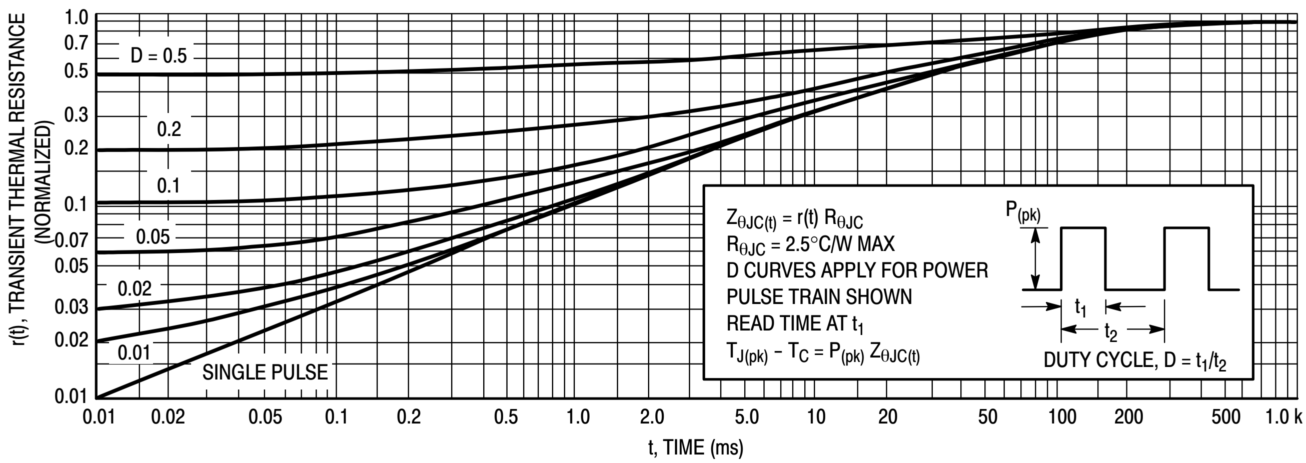


Figure 5. Thermal Response

ACTIVE−REGION SAFE−OPERATING AREA

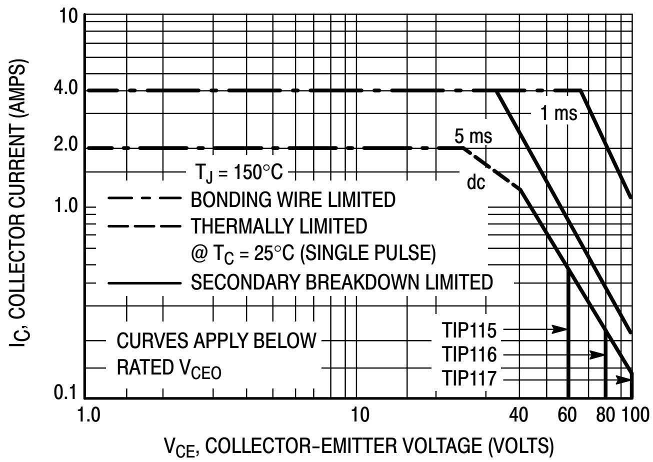


Figure 6. TIP115, 116, 117

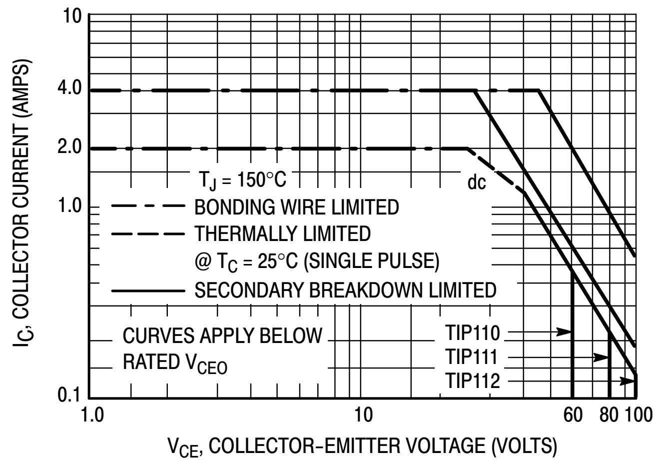


Figure 7. TIP110, 111, 112

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 Figures 6 and 7 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 $T_{J(pk)} < 150°C$. $T_{J(pk)}$ may be calculated from the data in Figure 5. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

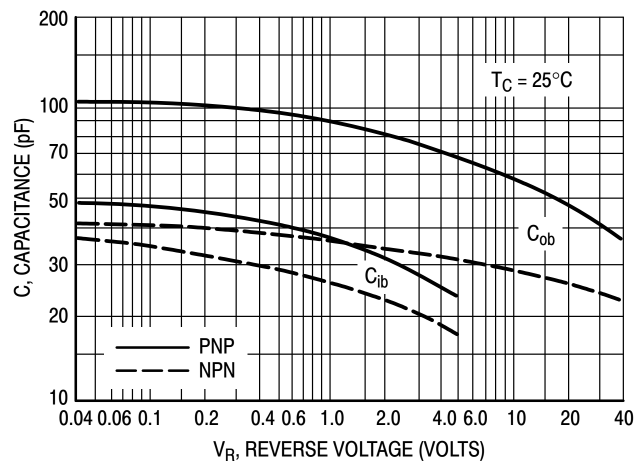


Figure 8. Capacitance

NPN
TIP110, 111, 112

PNP
TIP115, 116, 117

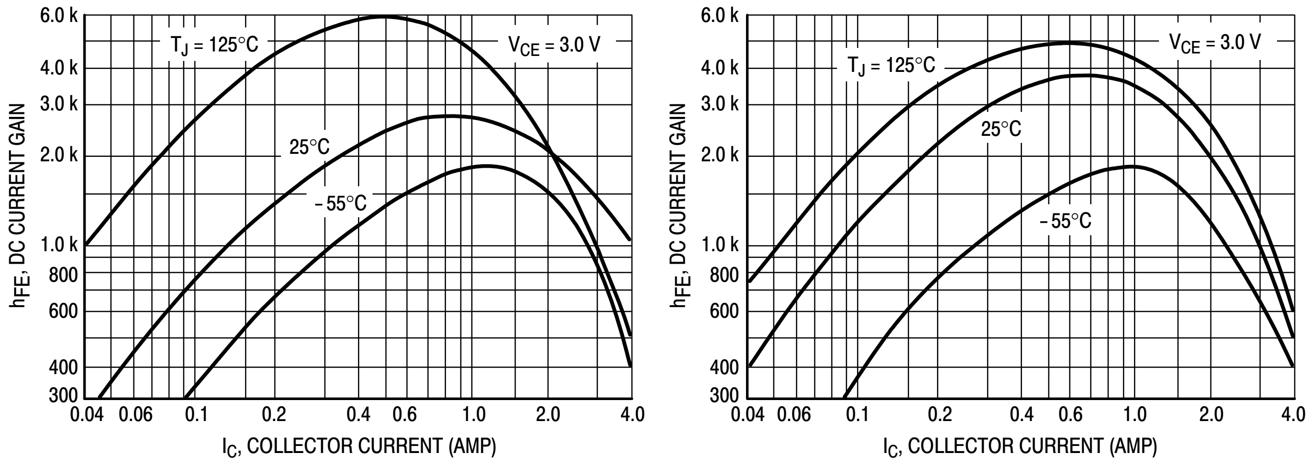


Figure 9. DC Current Gain

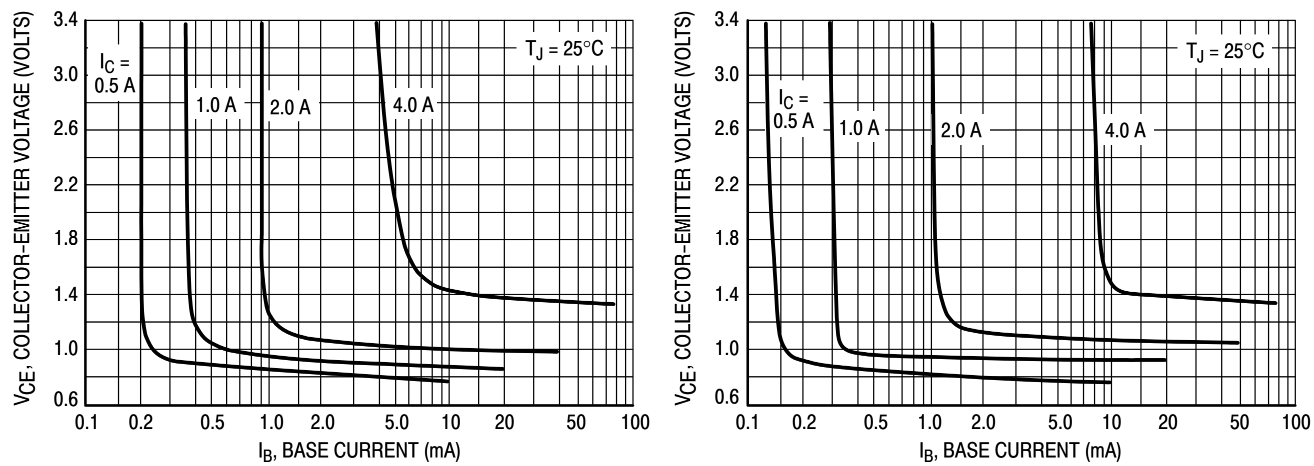


Figure 10. Collector Saturation Region

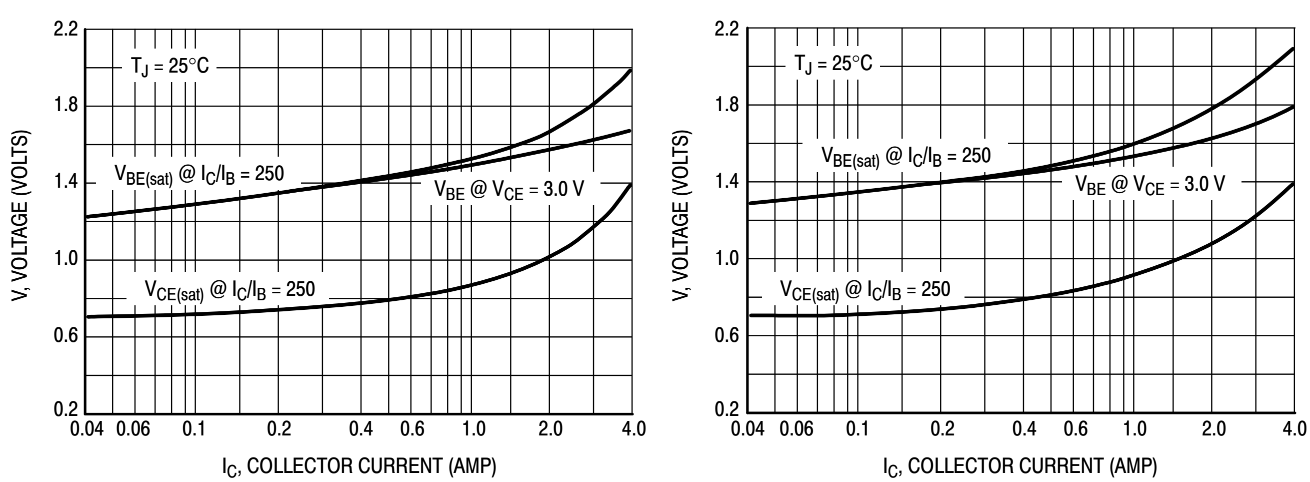


Figure 11. “On” Voltages

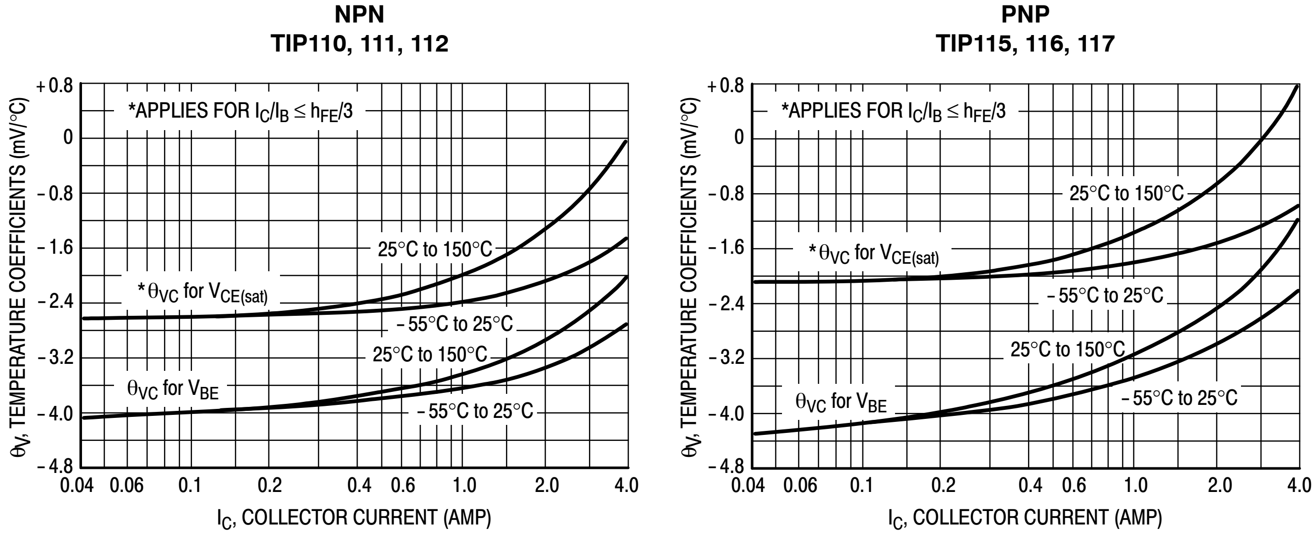


Figure 12. Temperature Coefficients

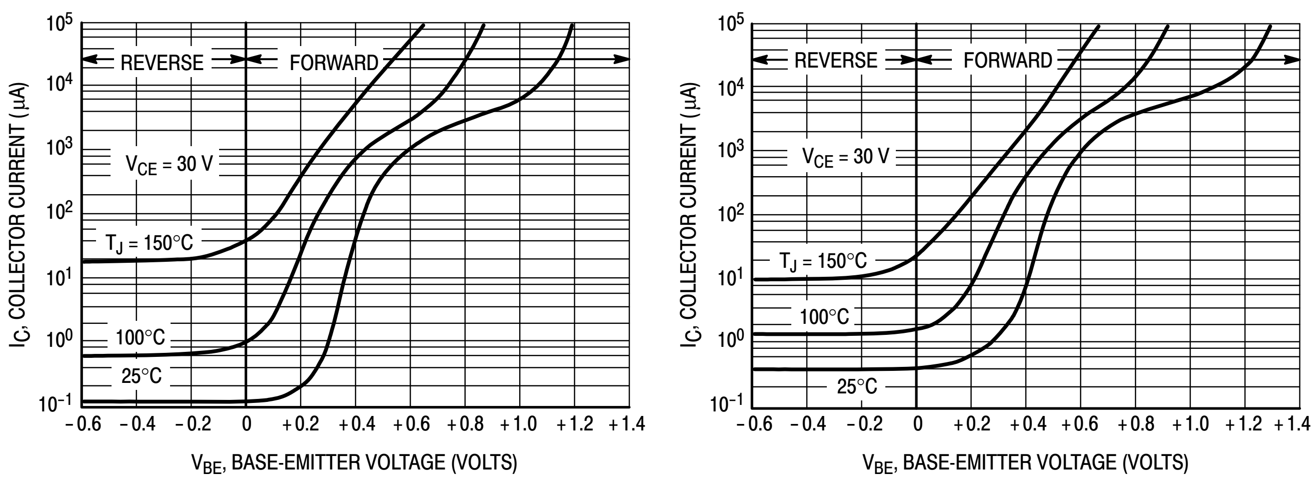
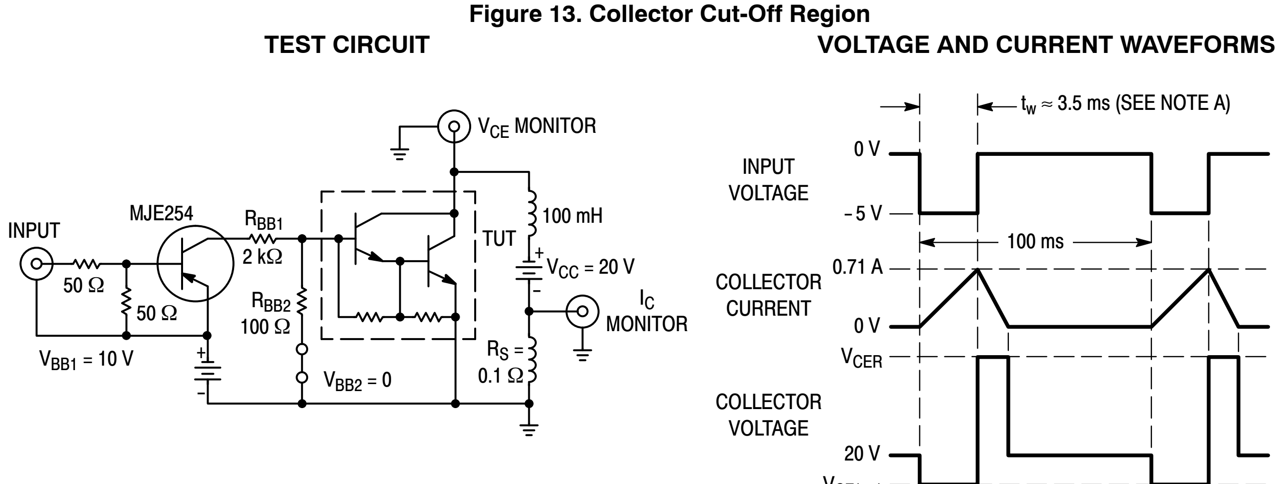


Figure 13. Collector Cut-Off Region



Note A: Input pulse width is increased until I_{CM} = 0.71 A,
NPN test shown; for PNP test
reverse all polarity and use MJE224 driver.

Figure 14. Inductive Load Switching

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
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