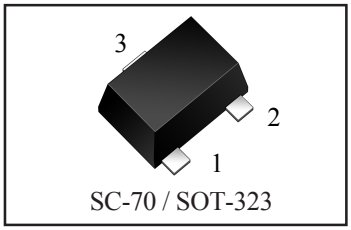
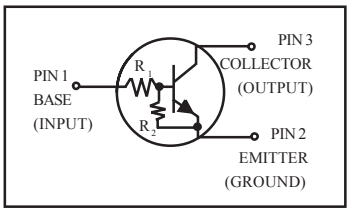
Bias Resistor Transistors

NPN Silicon Surface Mount Transistor with Monolithic Bias Resistor Network





This new series of digital transistors is designed to replace a single device and its external resistor bias network. The BRT (Bias Resistor Transistor) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT eliminates these individual components by integrating them into a single device. The use of a BRT can reduce both system cost and board space. The device is housed in the SC-70 / SOT-323 package which is designed for low power surface mount applications.

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count

DEVICE MARKING INFORMATION

See specific marking information in the device marking table on page 2 of this data sheet.

MAXIMUM RATINGS (T_A = 25 C unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	50	Vdc
Collector-Emitter Voltage	V_{CEO}	50	Vdc
Collector Current	I_C	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation T_A = 25 C Derate above 25 C	P_D	202 (Note 1.) 310 (Note 2.) 1.6 (Note 1.) 2.5 (Note 2.)	mW mW/ C
Thermal Resistance – Junction-to-Ambient	$R_{\theta JA}$	618 (Note 1.) 403 (Note 2.)	C/W
Thermal Resistance – Junction-to-Lead	$R_{\theta JL}$	280 (Note 1.) 332 (Note 2.)	C/W
Junction and Storage Temperature Range	T_J, T_{stg}	–55 to +150	C

1. FR–4 @ Minimum Pad
2. FR–4 @ 1.0 x 1.0 inch Pad

DEVICE MARKING RESISTOR VALUES AND ORDERING INFORMATION

Device	Package	Marking	R1 (K)	R2 (K)	Shipping
DTC301T1G (Note 3) DTC301T3G	SC-70 / SOT-323	8J	4.7	4.7	3000/Tape & Reel 10,000/Tape & Reel
DTC302T1G DTC302T3G	SC-70 / SOT-323	8A	10	10	3000/Tape & Reel 10,000/Tape & Reel
DTC303T1G DTC303T3G	SC-70 / SOT-323	8B	22	22	3000/Tape & Reel 10,000/Tape & Reel
DTC304T1G DTC304T3G	SC-70 / SOT-323	8C	47	47	3000/Tape & Reel 10,000/Tape & Reel
DTC305T1G (Note 3) DTC305T3G	SC-70 / SOT-323	8M	2.2	47	3000/Tape & Reel 10,000/Tape & Reel
DTC306T1G (Note 3) DTC306T3G	SC-70 / SOT-323	8K	4.7	47	3000/Tape & Reel 10,000/Tape & Reel
DTC307T1G DTC307T3G	SC-70 / SOT-323	8D	10	47	3000/Tape & Reel 10,000/Tape & Reel
DTC308T1G (Note 3) DTC308T3G	SC-70 / SOT-323	8L	22	47	3000/Tape & Reel 10,000/Tape & Reel
DTC309T1G (Note 3) DTC309T3G	SC-70 / SOT-323	8P	47	22	3000/Tape & Reel 10,000/Tape & Reel
DTC310T1G (Note 3) DTC310T3G	SC-70 / SOT-323	8F	4.7	∞	3000/Tape & Reel 10,000/Tape & Reel
DTC311T1G (Note 3) DTC311T3G	SC-70 / SOT-323	8E	10	∞	3000/Tape & Reel 10,000/Tape & Reel
DTC317T1G (Note 3) DTC317T3G	SC-70 / SOT-323	8H	2.2	2.2	3000/Tape & Reel 10,000/Tape & Reel
DTC322T1G (Note 3) DTC322T3G	SC-70 / SOT-323	8N	100	100	3000/Tape & Reel 10,000/Tape & Reel
DTC323T1G (Note 3) DTC323T3G	SC-70 / SOT-323	8G	1	1	3000/Tape & Reel 10,000/Tape & Reel

3. New devices. Updated curves to follow in subsequent data sheets.

ELECTRICAL CHARACTERISTICS (T_A = 25 C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Base Cutoff Current (V_{CB} = 50 V, I_E = 0)		I_{CBO}	–	–	100	nAdc
Collector-Emitter Cutoff Current (V_{CE} = 50 V, I_B = 0)		I_{CEO}	–	–	500	nAdc
Emitter-Base Cutoff Current (V_{EB} = 6.0 V, I_C = 0)	DTC301	I_{EBO}	–	–	1.5	mAdc
	DTC302		–	–	0.5	
	DTC303		–	–	0.2	
	DTC304		–	–	0.1	
	DTC305		–	–	0.2	
	DTC306		–	–	0.18	
	DTC307		–	–	0.2	
	DTC308		–	–	0.13	
	DTC309		–	–	0.13	
	DTC310		–	–	1.9	
	DTC311		–	–	0.9	
	DTC317		–	–	2.3	
	DTC322		–	–	0.05	
	DTC323		–	–	4.3	
Collector-Base Breakdown Voltage (I_C = 10μA, I_E = 0)		$V_{(BR)CBO}$	50	–	–	Vdc
Collector-Emitter Breakdown Voltage (Note 4.) (I_C = 2.0 mA, I = 0)		$V_{(BR)CEO}$	50	–	–	Vdc
ON CHARACTERISTICS (Note 4.)						
DC Current Gain (V_{CE}= 10 V, I_C = 5.0 mA)	DTC301	h_{FE}	15	30	–	
	DTC302		35	60	–	
	DTC303		60	100	–	
	DTC304		80	140	–	
	DTC305		80	140	–	
	DTC306		80	200	–	
	DTC307		80	140	–	
	DTC308		80	150	–	
	DTC309		80	140	–	
	DTC310		160	350	–	
	DTC311		160	350	–	
	DTC317		8.0	15	–	
	DTC322		80	150	–	
	DTC323		3.0	5.0	–	
Collector-Emitter Saturation Voltage (I_C = 10 mA, I_B = 0.3 mA)		$V_{CE(sat)}$	–	–	0.25	Vdc
(I_C = 10 mA, I_B = 5 mA)	DTC317 / DTC323					
(I_C = 10 mA, I_B = 1 mA)	DTC301 / DTC306 / DTC308 / DTC310 / DTC311					
Output Voltage (on) (V_{CC} = 5.0 V, V_B =2.5 V, R_L = 1.0 kΩ)	DTC301	V_{OL}	–	–	0.2	Vdc
	DTC302		–	–	0.2	
	DTC303		–	–	0.2	
	DTC305		–	–	0.2	
	DTC306		–	–	0.2	
	DTC307		–	–	0.2	
	DTC308		–	–	0.2	
	DTC310		–	–	0.2	
	DTC311		–	–	0.2	
	DTC317		–	–	0.2	
	DTC323		–	–	0.2	
(V_{CC} = 5.0 V, V_B =3.5 V, R_L = 1.0 kΩ)	DTC304		–	–	0.2	
(V_{CC} = 5.0 V, V_B =4.0 V, R_L = 1.0 kΩ)	DTC309		–	–	0.2	
(V_{CC} = 5.0 V, V_B =5.5 V, R_L = 1.0 kΩ)	DTC322		–	–	0.2	

4. Pulse Test: Pulse Width < 300μs, Duty Cycle < 2.0%

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS (Note 5.) (Continued)						
Output Voltage (off) (V_{CC} = 5.0 V, V_B =0.5 V, R_L = 1.0 kΩ) (V_{CC} = 5.0 V, V_B =0.25 V, R_L = 1.0 kΩ) (V_{CC} = 5.0 V, V_B =0.050 V, R_L = 1.0 kΩ)	DTC306 DTC310 DTC311 DTC323	V_{OH}	4.9	–	–	Vdc
Input Resistor	DTC301	R_1	3.3	4.7	6.1	kΩ
	DTC302		7.0	10	13	
	DTC303		15.4	22	28.6	
	DTC304		32.9	47	61.1	
	DTC305		1.54	2.2	2.86	
	DTC306		3.3	4.7	6.1	
	DTC307		7.0	10	13	
	DTC308		15.4	22	28.6	
	DTC309		32.9	47	61.1	
	DTC310		3.3	4.7	6.1	
	DTC311		7.0	10	13	
	DTC317		1.5	2.2	2.9	
	DTC322		70	100	130	
	DTC323		0.7	1.0	1.3	
Resistor Ratio	DTC301 / DTC317 / DTC323	R_1/R_2	0.8	1.0	1.2	
	DTC302 / DTC303 / DTC304 / DTC322		0.8	1.0	1.2	
	DTC305		0.038	0.047	0.056	
	DTC306		0.055	0.1	0.185	
	DTC307		0.17	0.21	0.25	
	DTC308		0.38	0.47	0.56	
	DTC309		1.7	2.1	2.6	
	DTC310 / DTC311		–	–	–	

5. Pulse Test: Pulse Width < 300μs, Duty Cycle < 2.0%

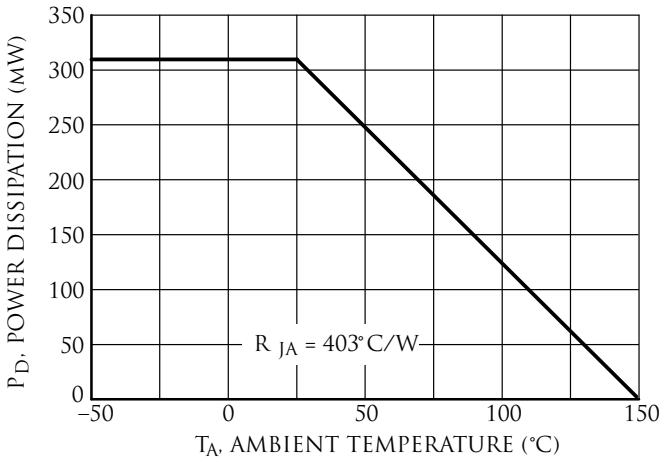


FIGURE 1. DERATING CURVE

TYPICAL ELECTRICAL CHARACTERISTICS – DTC302

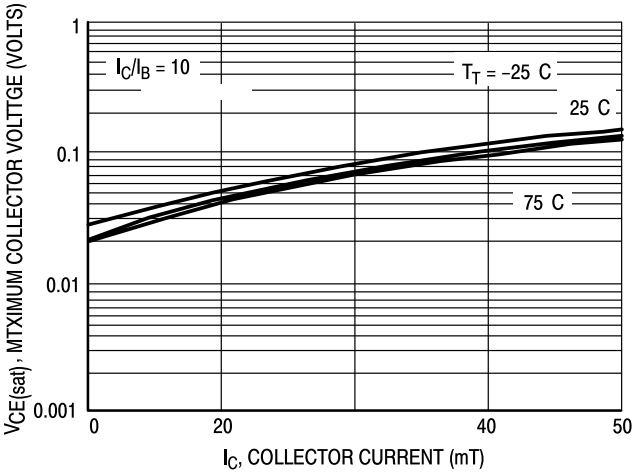


Figure 2. $V_{CE(sat)}$ versus I_C

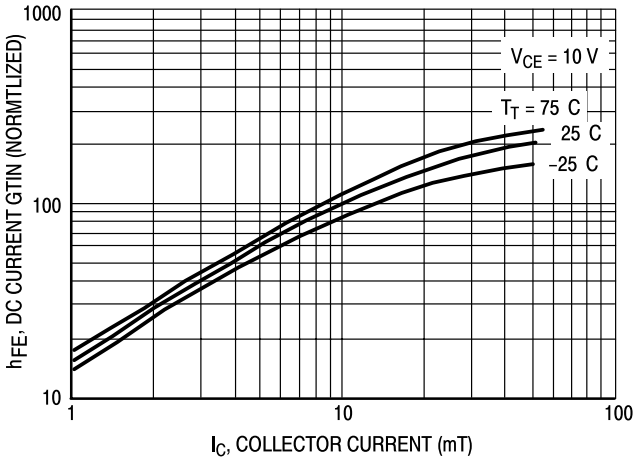


Figure 3. DC Current Gain

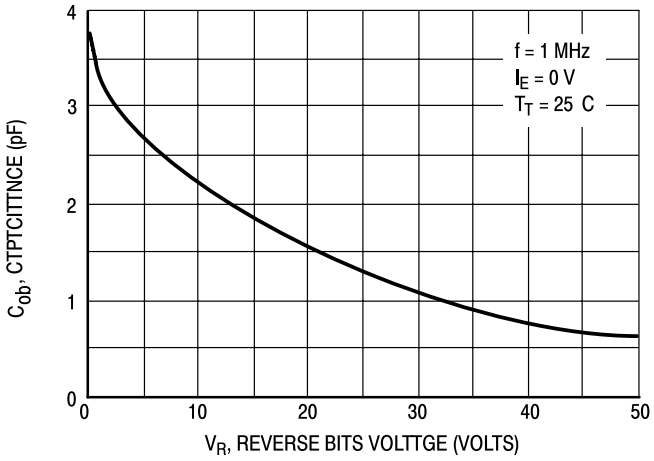


Figure 4. Output Capacitance

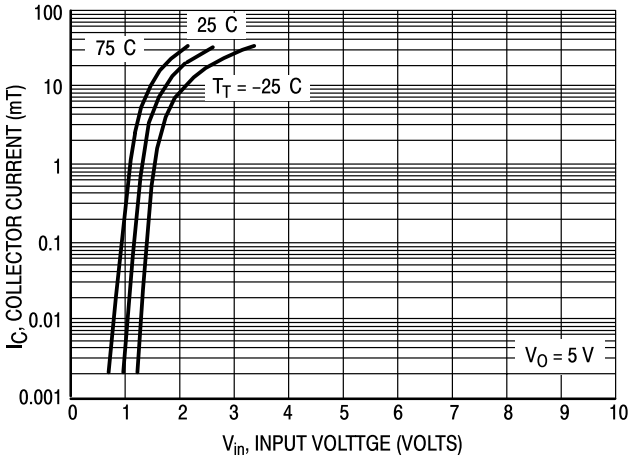


Figure 5. Output Current versus Input Voltage

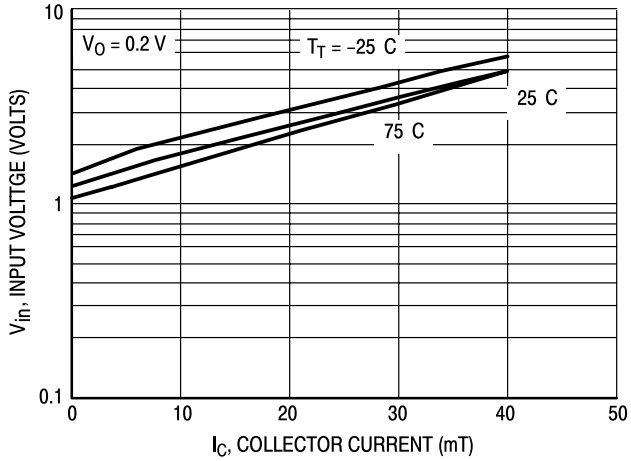


Figure 6. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – DTC303

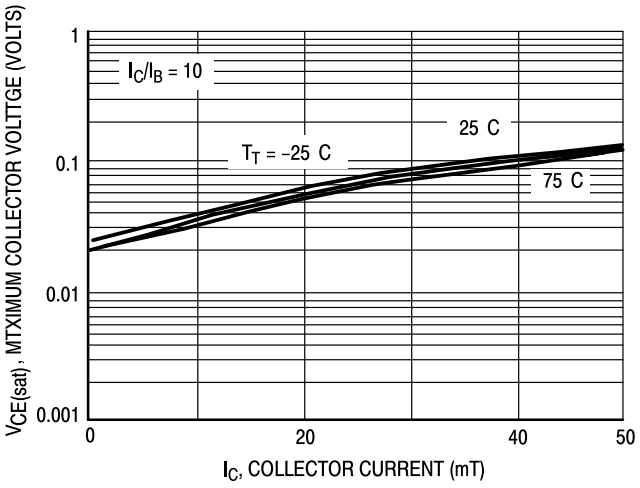


Figure 7. $V_{CE(sat)}$ versus I_C

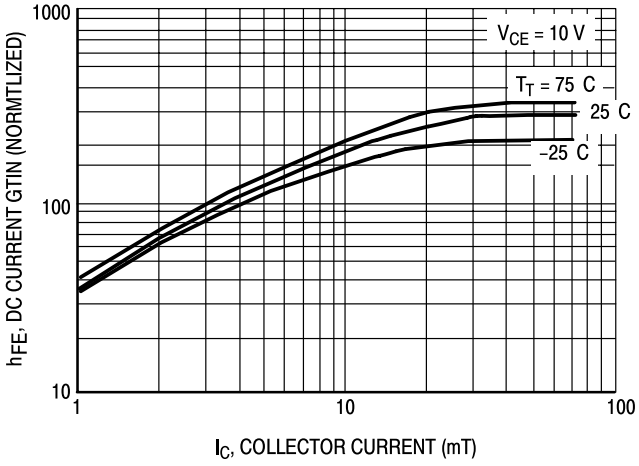


Figure 8. DC Current Gain

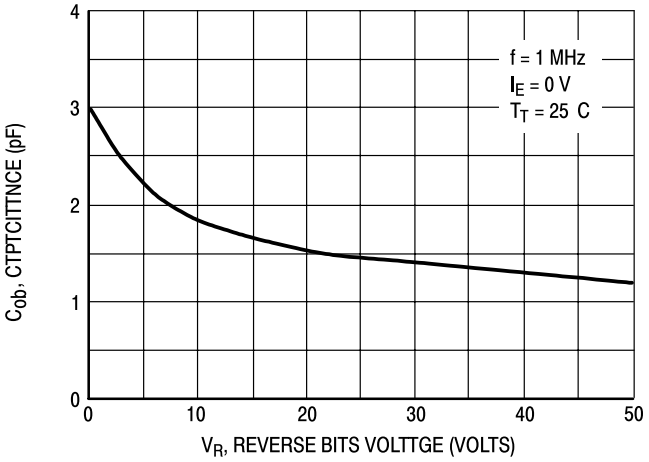


Figure 9. Output Capacitance

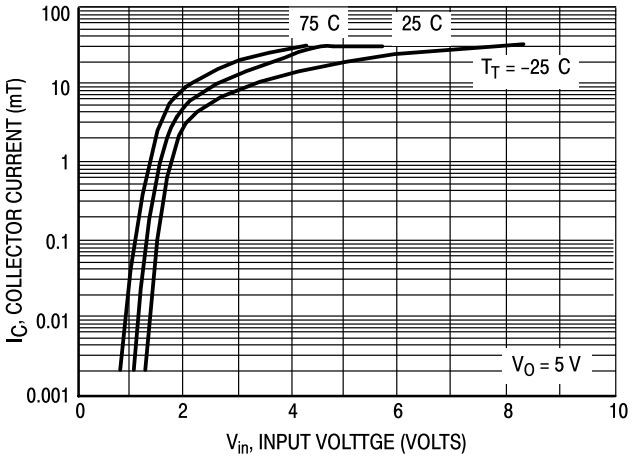


Figure 10. Output Current versus Input Voltage

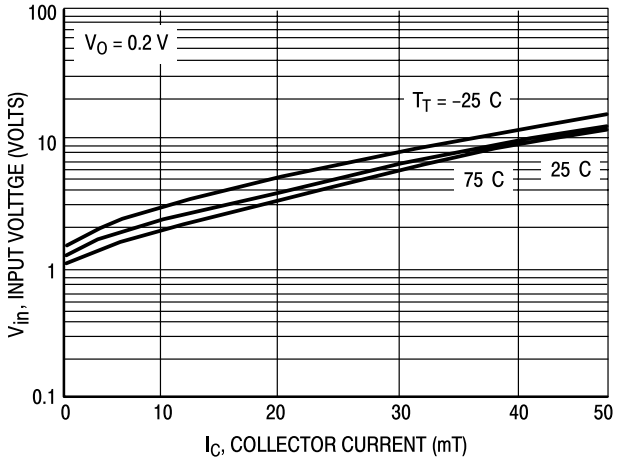


Figure 11. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – DTC304

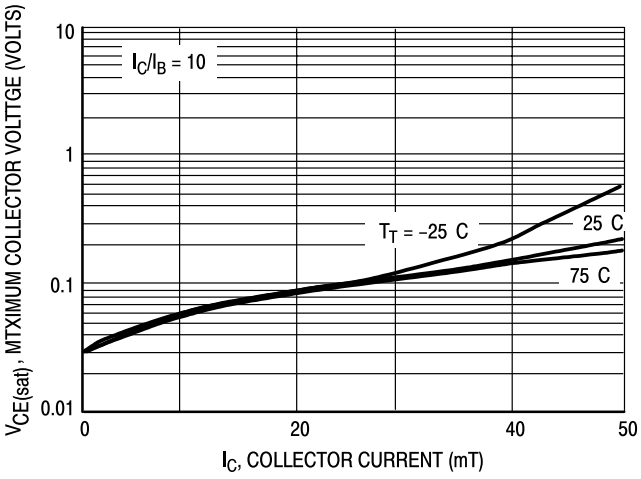


Figure 12. $V_{CE(sat)}$ versus I_C

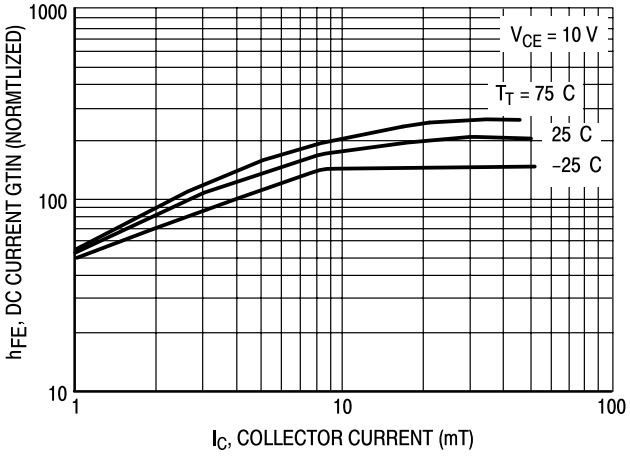


Figure 13. DC Current Gain

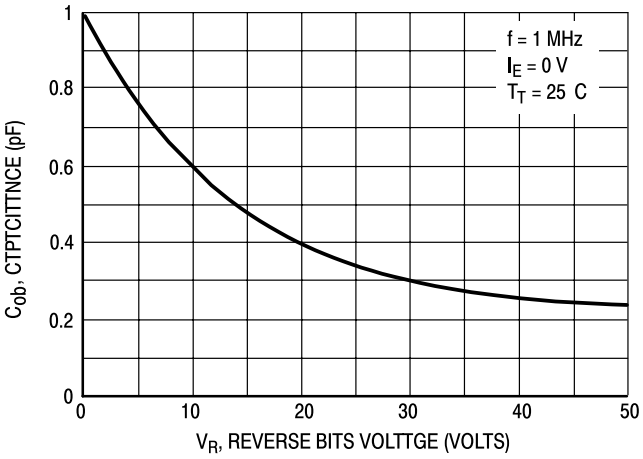


Figure 14. Output Capacitance

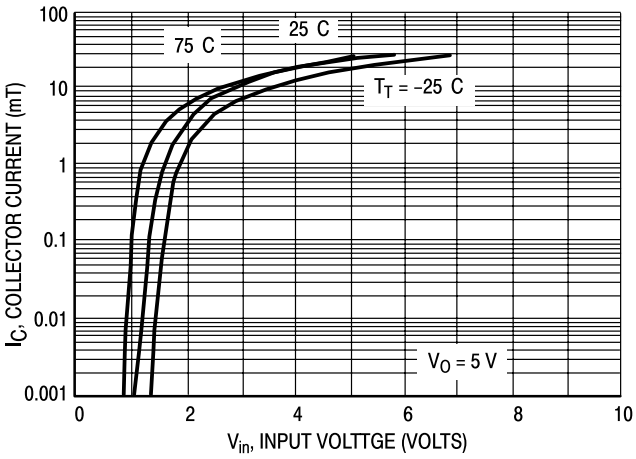


Figure 15. Output Current versus Input Voltage

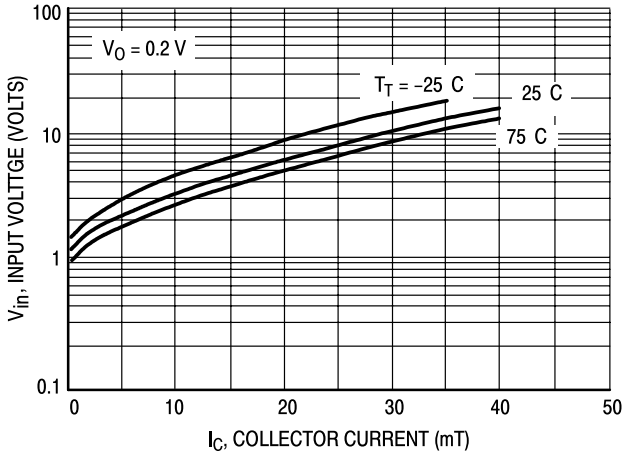


Figure 16. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – DTC307

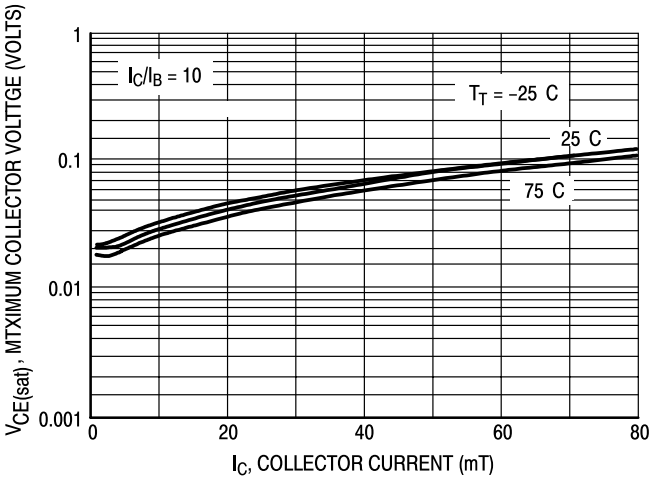


Figure 17. $V_{CE(sat)}$ versus I_C

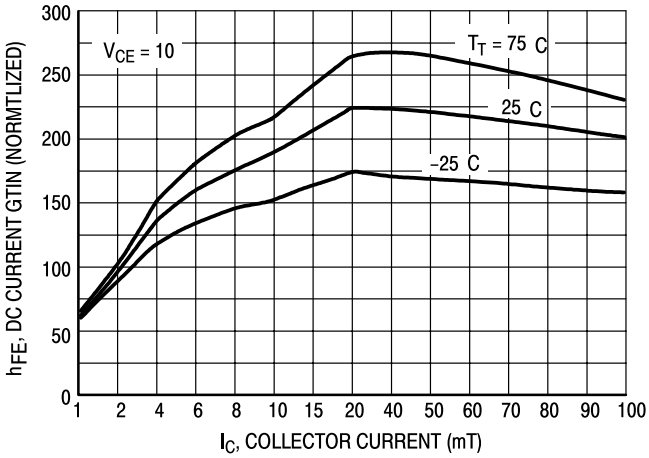


Figure 18. DC Current Gain

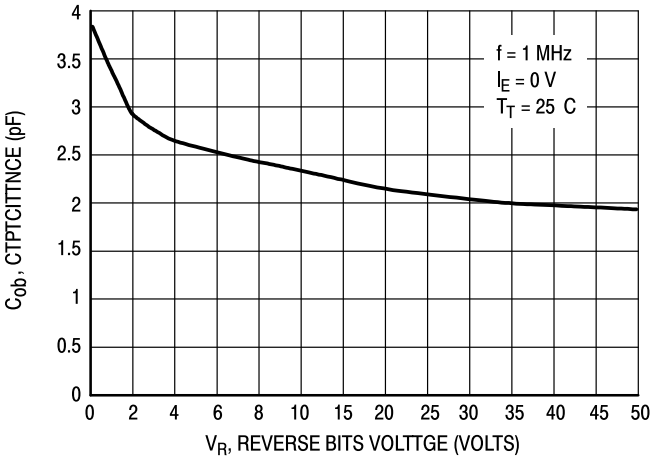


Figure 19. Output Capacitance

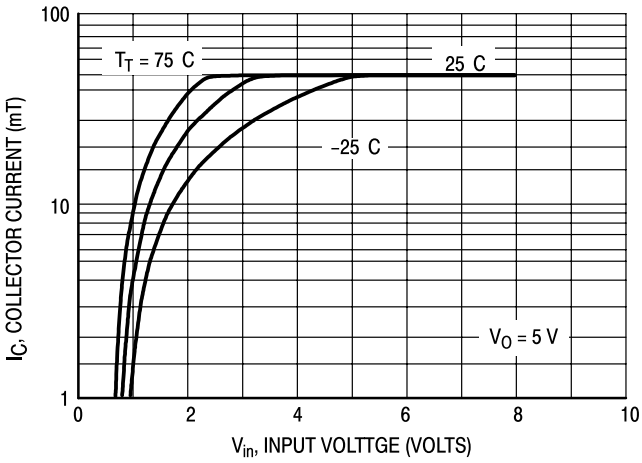


Figure 20. Output Current versus Input Voltage

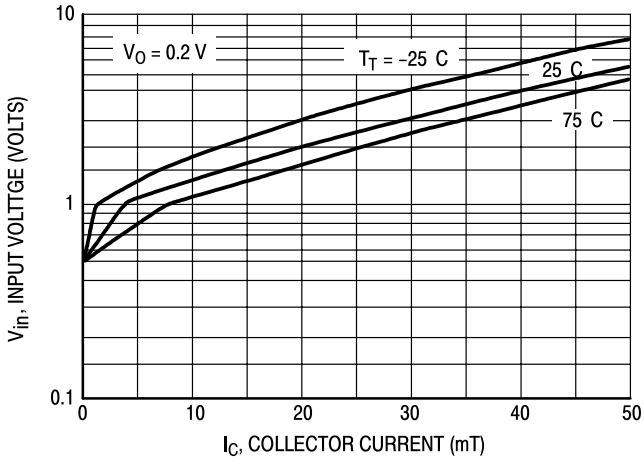


Figure 21. Input Voltage versus Output Current

TYPICAL APPLICATIONS FOR NPN BRTs

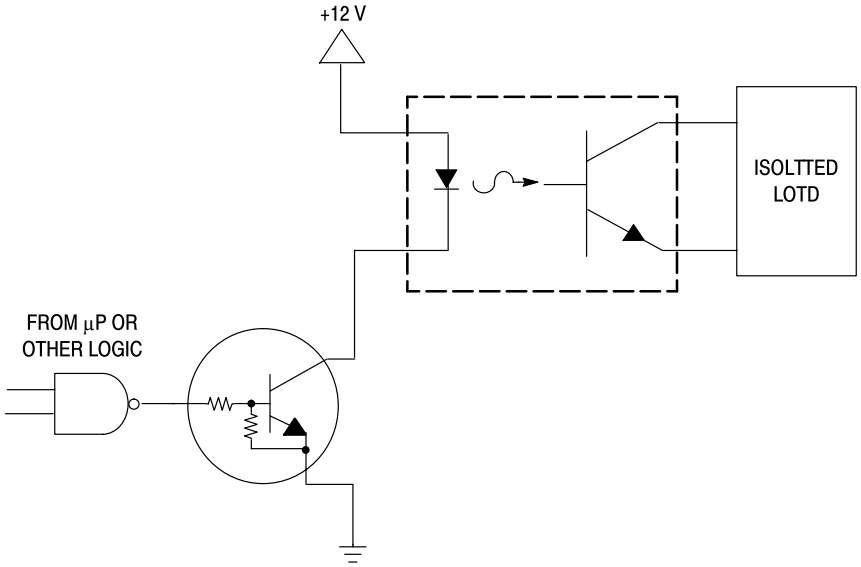


Figure 22. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

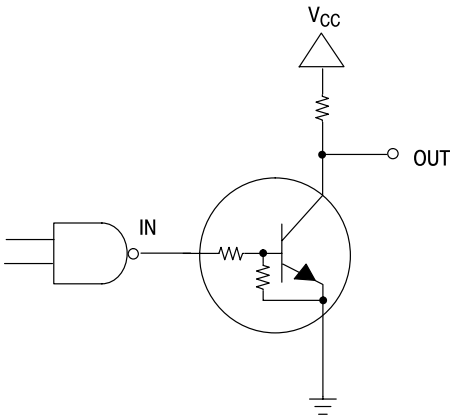


Figure 23. Open Collector Inverter:
Inverts the Input Signal

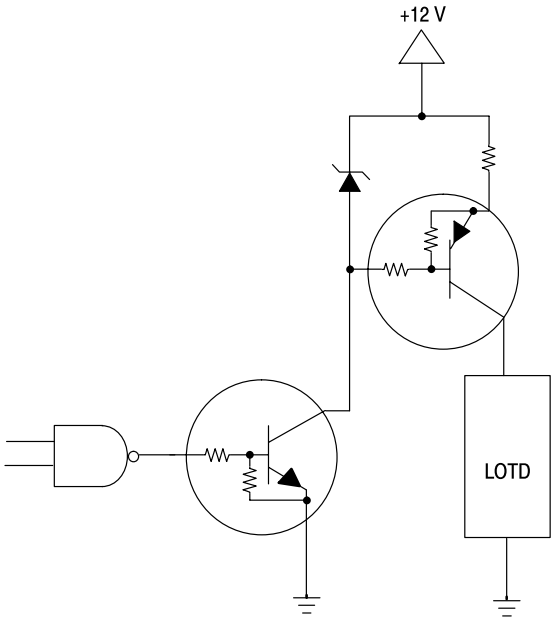
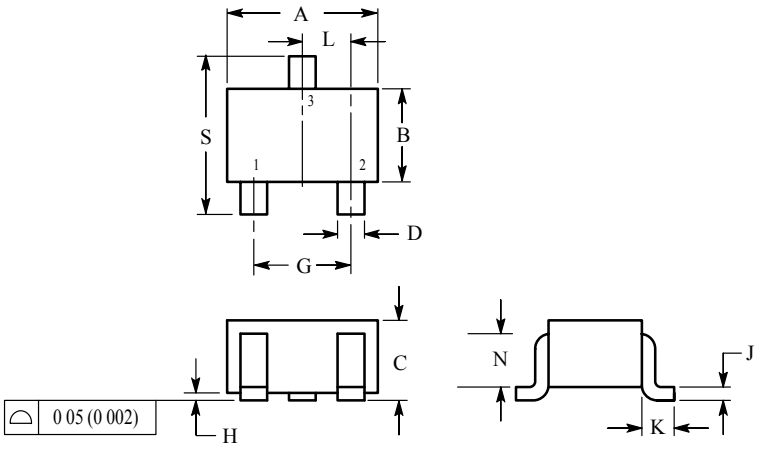


Figure 24. Inexpensive, Unregulated Current Source

SC –70 / SOT –323



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.032	0.040	0.80	1.00
D	0.012	0.016	0.30	0.40
G	0.047	0.055	1.20	1.40
H	0.000	0.004	0.00	0.10
J	0.004	0.010	0.10	0.25
K	0.017 REF		0.425 REF	
L	0.026 BSC		0.650 BSC	
N	0.028 REF		0.700 REF	
S	0.079	0.095	2.00	2.40

PIN 1. BASE
2. EMITTER
3. COLLECTOR