SEMICONDUCTOR

DATA SHEET

MUN221 Series

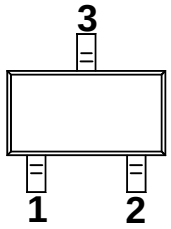
Bias Resistor Transistor

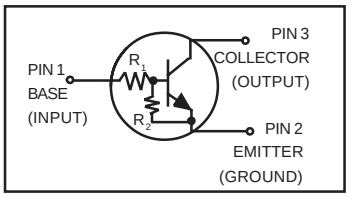
NPN Silicon Surface Mount Transistor with Monolithic Bias Resistor Network

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 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 SOT-23 package which is designed for low power surface mount applications.

- Simplifies Circuit Design
- Reduces Board Space and Component Count
- The SOT-23 package can be soldered using wave or reflow. The modified gull-winged leads absorb thermal stress during soldering eliminating the possibility of damage to the die.

SOT–23 (TO–236AB)





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
Total Power Dissipation @ T_A = 25°C (Note 1.) Derate above 25°C	P_D	246 1.5	mW °C/W

DEVICE MARKING AND RESISTOR VALUES

Device	Marking	R1(K)	R2(K)	Packing	Packing
MUN2211	A8A	10	10	**SOT-23**	**3000/Reel**
MUN2212	A8B	22	22	**SOT-23**	**3000/Reel**
MUN2213	A8C	47	47	**SOT-23**	**3000/Reel**
MUN2214	A8D	10	47	**SOT-23**	**3000/Reel**
MUN2215	A8E	10	∞	**SOT-23**	**3000/Reel**
MUN2216	A8F	4.7	∞	**SOT-23**	**3000/Reel**
MUN2230	A8G	1.0	1.0	**SOT-23**	**3000/Reel**
MUN2231	A8H	2.2	2.2	**SOT-23**	**3000/Reel**
MUN2232	A8J	4.7	4.7	**SOT-23**	**3000/Reel**
MUN2233	A8K	4.7	47	**SOT-23**	**3000/Reel**
MUN2234	A8L	22	47	**SOT-23**	**3000/Reel**
MUN2235	A8M	2.2	47	**SOT-23**	**3000/Reel**
MUN2238	A8R	2.2	∞	**SOT-23**	**3000/Reel**
MUN2241	A8U	100	∞	**SOT-23**	**3000/Reel**

1. Device mounted on a FR-4 glass epoxy printed circuit board using the minimum recommended footprint.

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Resistance – Junction-to-Ambient (Note 1.)	$R_{\theta JA}$	508	°C/W
Operating and Storage Temperature Range	T_J, T_{stg}	–55 to +150	°C
Maximum Temperature for Soldering Purposes, Time in Solder Bath	T_L	260 10	°C Sec

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	MUN2211	I_{EBO}	–	–	0.5	mAdc
(V_{EB} = 6.0 V, I_C = 0)	MUN2212		–	–	0.2	
	MUN2213		–	–	0.1	
	MUN2214		–	–	0.2	
	MUN2215		–	–	0.9	
	MUN2216		–	–	1.9	
	MUN2230		–	–	4.3	
	MUN2231		–	–	2.3	
	MUN2232		–	–	1.5	
	MUN2233		–	–	0.18	
	MUN2234		–	–	0.13	
	MUN2235		–	–	0.2	
	MUN2238		–	–	4.0	
	MUN2241		–	–	0.1	
Collector-Base Breakdown Voltage (I_C = 10 μA, I_E = 0)		$V_{(BR)CBO}$	50	–	–	Vdc
Collector-Emitter Breakdown Voltage (Note 2.), (I_C = 2.0 mA, I_B = 0)		$V_{(BR)CEO}$	50	–	–	Vdc
ON CHARACTERISTICS (Note 2.)						
DC Current Gain	MUN2211	h_{FE}	35	60	–	
(V_{CE} = 10 V, I_C = 5.0 mA)	MUN2212		60	100	–	
	MUN2213		80	140	–	
	MUN2214		80	140	–	
	MUN2215		160	350	–	
	MUN2216		160	350	–	
	MUN2230		3.0	5.0	–	
	MUN2231		8.0	15	–	
	MUN2232		15	30	–	
	MUN2233		80	200	–	
	MUN2234		80	150	–	
	MUN2235		80	140	–	
	MUN2238		160	350	–	
	MUN2241		160	350	–	
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)	MUN2230/MUN2231					
(I_C = 10 mA, I_B = 1 mA)	MUN2215/MUN2216					
	MUN2232/MUN2233/MUN2234					
	MUN2235/MUN2238					

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

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

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS (Note 3.)						
Output Voltage (on)		V_{OL}				Vdc
(V_{CC} = 5.0 V, V_B = 2.5 V, R_L = 1.0 k Ω	MUN2211		–	–	0.2	
	MUN2212		–	–	0.2	
	MUN2214		–	–	0.2	
	MUN2215		–	–	0.2	
	MUN2216		–	–	0.2	
	MUN2230		–	–	0.2	
	MUN2231		–	–	0.2	
	MUN2232		–	–	0.2	
	MUN2233		–	–	0.2	
	MUN2234		–	–	0.2	
	MUN2235		–	–	0.2	
	MUN2238		–	–	0.2	
(V_{CC} = 5.0 V, V_B = 3.5 V, R_L = 1.0 k Ω)	MUN2213		–	–	0.2	
(V_{CC} = 5.0 V, V_B = 5.0 V, R_L = 1.0 k Ω)	MUN2241		–	–	0.2	
Output Voltage (off) (V_{CC} = 5.0 V, V_B = 0.5 V, R_L = 1.0 k Ω)		V_{OH}	4.9	–	–	Vdc
(V_{CC} = 5.0 V, V_B = 0.050 V, R_L = 1.0 k Ω)	MUN2230					
(V_{CC} = 5.0 V, V_B = 0.25 V, R_L = 1.0 k Ω)	MUN2215					
	MUN2216					
	MUN2233					
	MUN2238					
Input Resistor	MUN2211	R_1	7.0	10	13	kΩ
	MUN2212		15.4	22	28.6	
	MUN2213		32.9	47	61.1	
	MUN2214		7.0	10	13	
	MUN2215		7.0	10	13	
	MUN2216		3.3	4.7	6.1	
	MUN2230		0.7	1.0	1.3	
	MUN2231		1.5	2.2	2.9	
	MUN2232		3.3	4.7	6.1	
	MUN2233		3.3	4.7	6.1	
	MUN2234		15.4	22	28.6	
	MUN2235		1.54	2.2	2.86	
	MUN2238		1.54	2.2	2.88	
	MUN2241		70	100	130	
Resistor Ratio	MUN2211/MUN2212/MUN2213	R_1/R_2	0.8	1.0	1.2	
	MUN2214		0.17	0.21	0.25	
	MUN2215/MUN2216/MUN2238		–	–	–	
	MUN2241		–	–	–	
	MUN2230/MUN2231/MUN2232		0.8	1.0	1.2	
	MUN2233		0.055	0.1	0.185	
	MUN2234		0.38	0.47	0.56	
	MUN2235		0.038	0.047	0.056	

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

DEVICE CHARACTERISTICS

MUN221 Series

TYPICAL ELECTRICAL CHARACTERISTICS
MUN2211

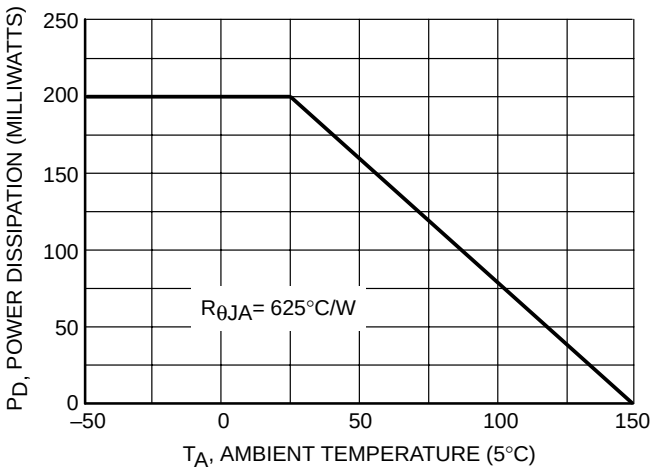


Figure 1. Derating Curve

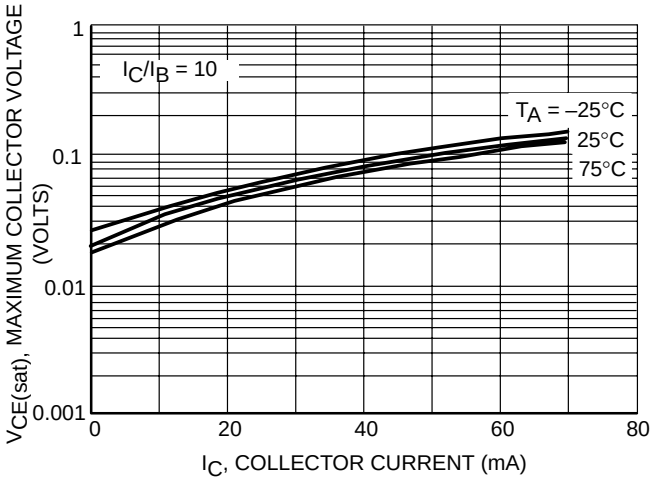


Figure 2. $V_{CE(sat)}$ vs. I_C

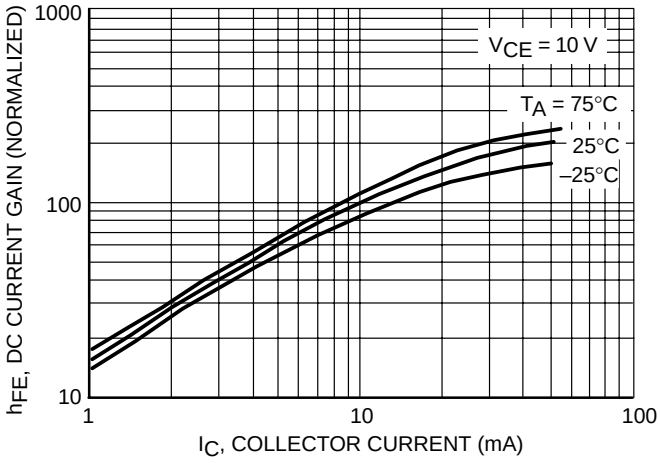


Figure 3. DC Current Gain

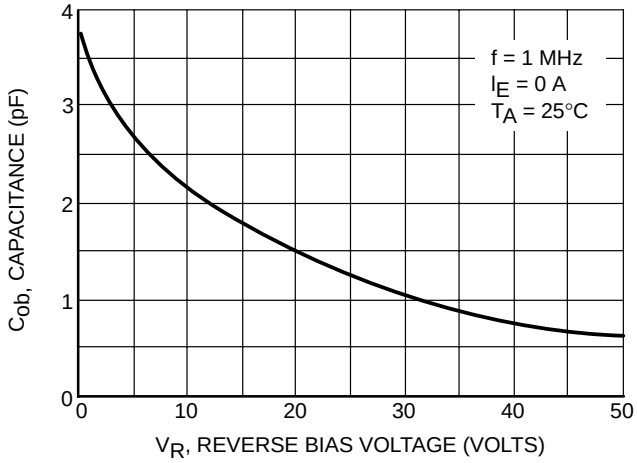


Figure 4. Output Capcitance

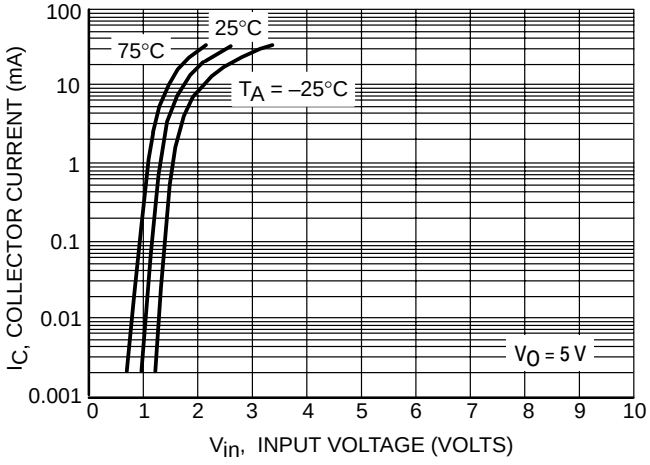


Figure 5. Output Current vs. Input Voltage

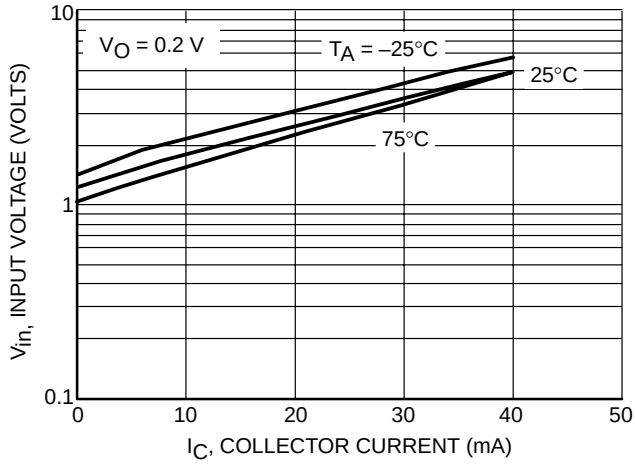


Figure 6. Input Voltage vs. Output Current

DEVICE CHARACTERISTICS

MUN221 Series

TYPICAL ELECTRICAL CHARACTERISTICS
MUN2212

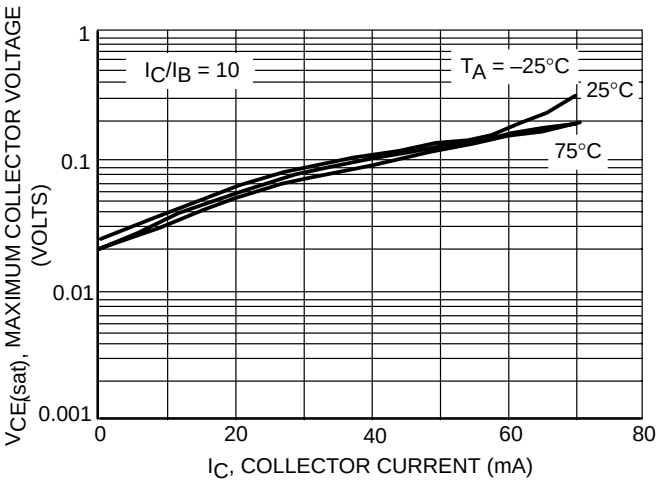


Figure 7. $V_{CE(sat)}$ vs. I_C

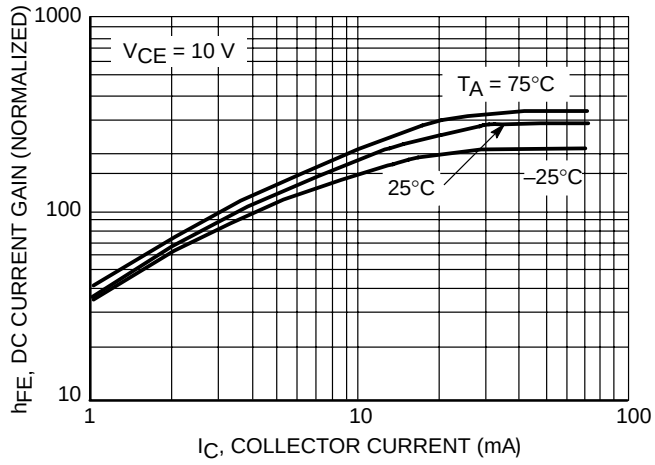


Figure 8. DC Current Gain

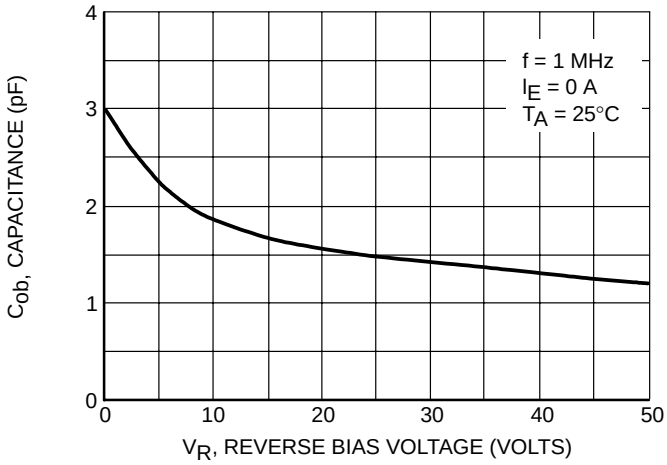


Figure 9. Output Capacitance

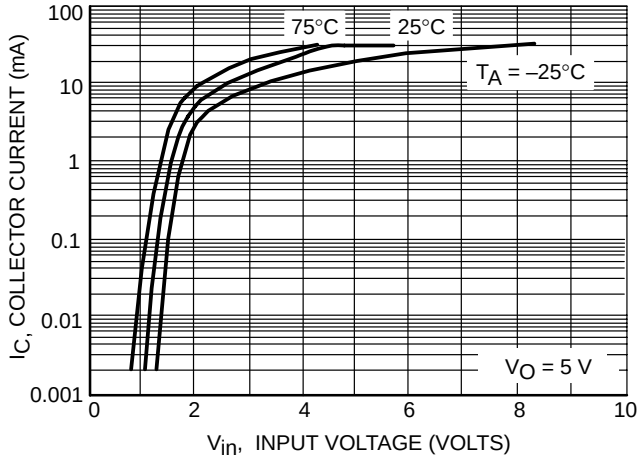


Figure 10. Output Current vs. Input Voltage

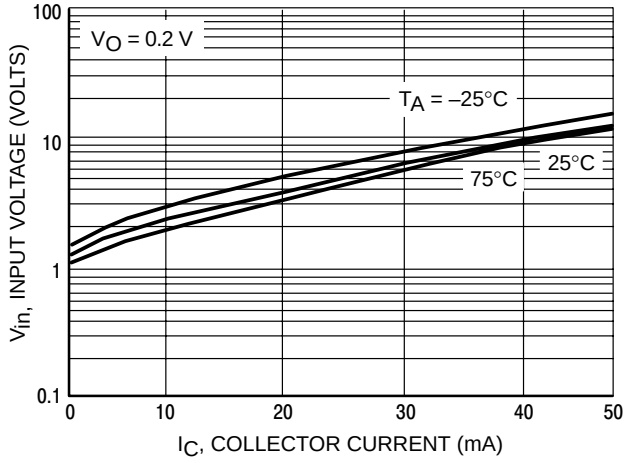


Figure 11. Input Voltage vs. Output Current

DEVICE CHARACTERISTICS

MUN221 Series

TYPICAL ELECTRICAL CHARACTERISTICS

MUN2213

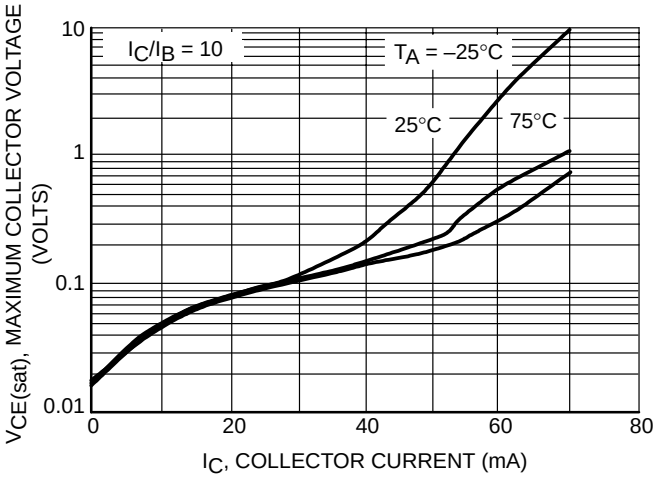


Figure 12. $V_{CE(sat)}$ vs. I_C

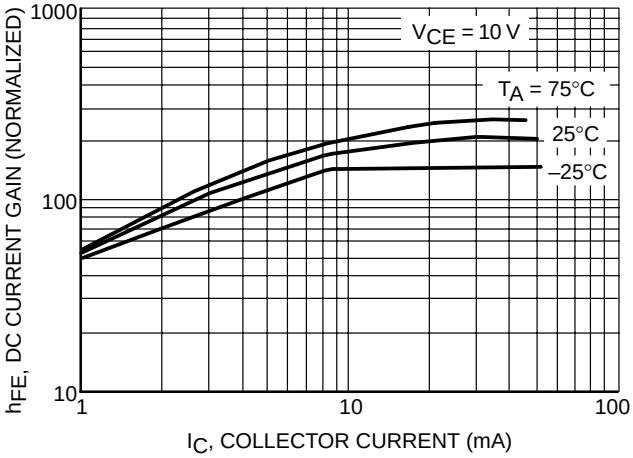


Figure 13. DC Current Gain

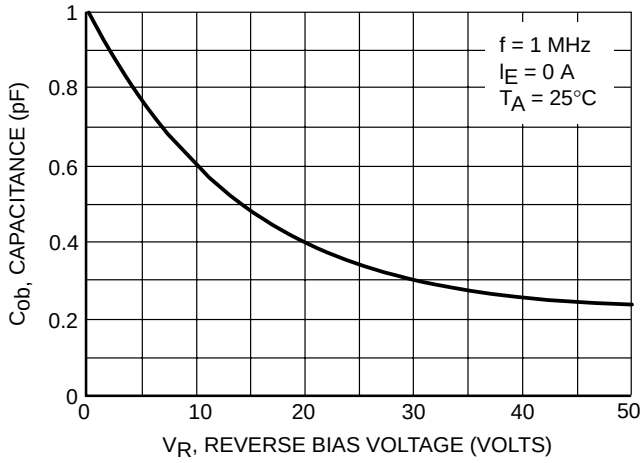


Figure 14. Output Capacitance

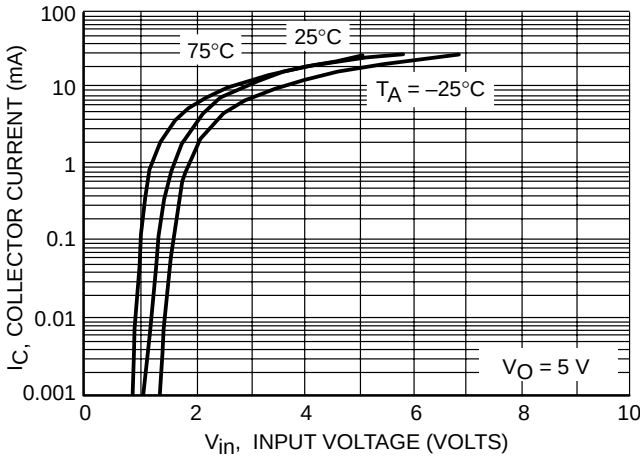


Figure 15. Output Current vs. Input Voltage

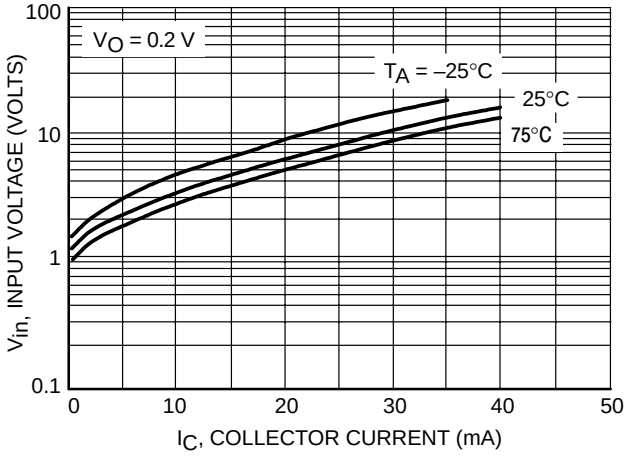


Figure 16. Input Voltage vs. Output Current

DEVICE CHARACTERISTICS

MUN221 Series

TYPICAL ELECTRICAL CHARACTERISTICS
MUN2214

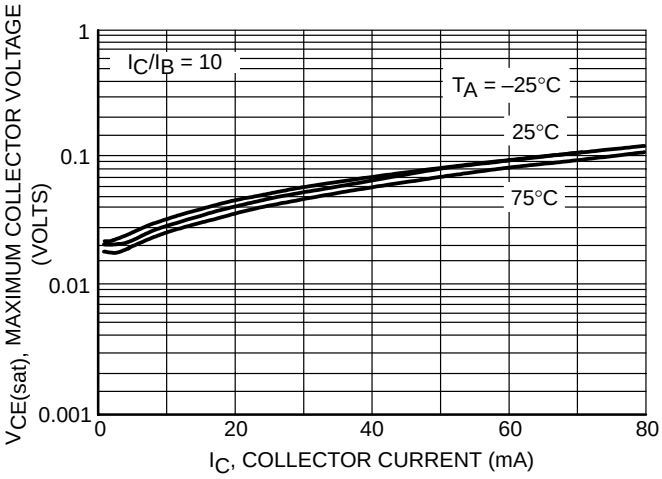


Figure 17. $V_{CE(sat)}$ vs. I_C

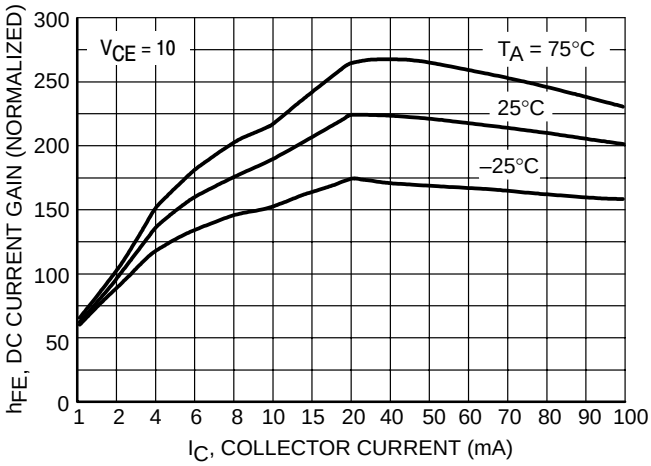


Figure 18. DC Current Gain

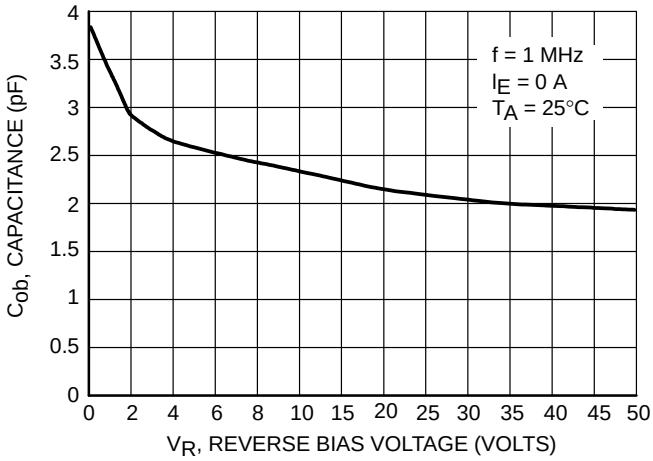


Figure 19. Output Capacitance

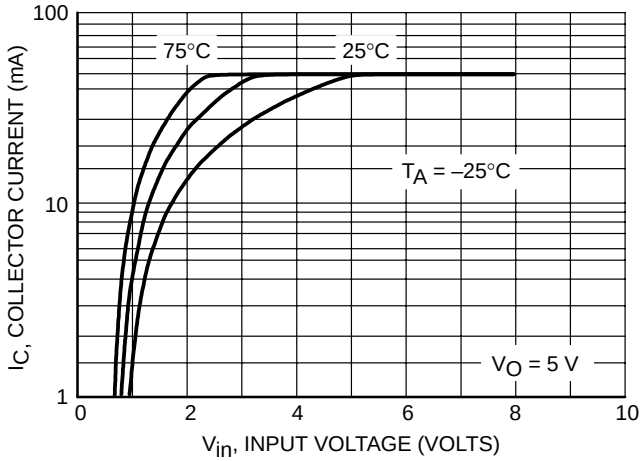


Figure 20. Output Current vs. Input Voltage

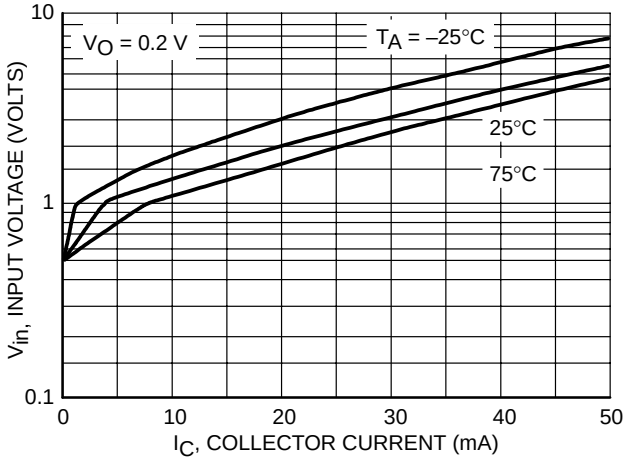


Figure 21. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS
MUN2232

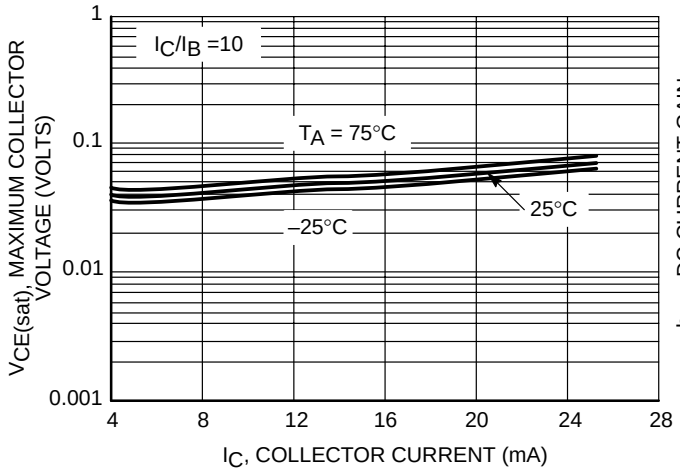


Figure 22. $V_{CE(sat)}$ vs. I_C

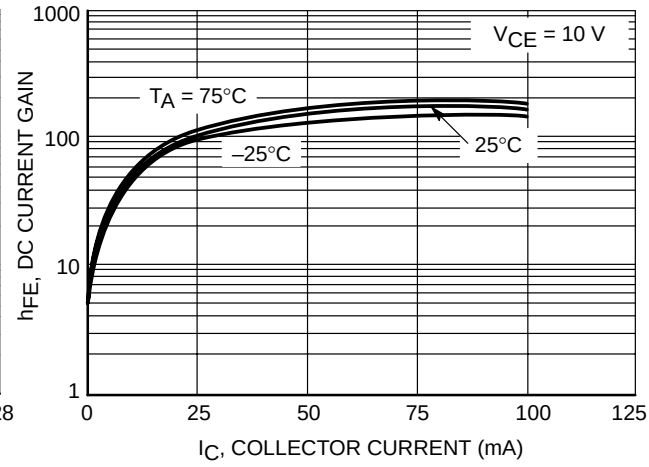


Figure 23. DC Current Gain

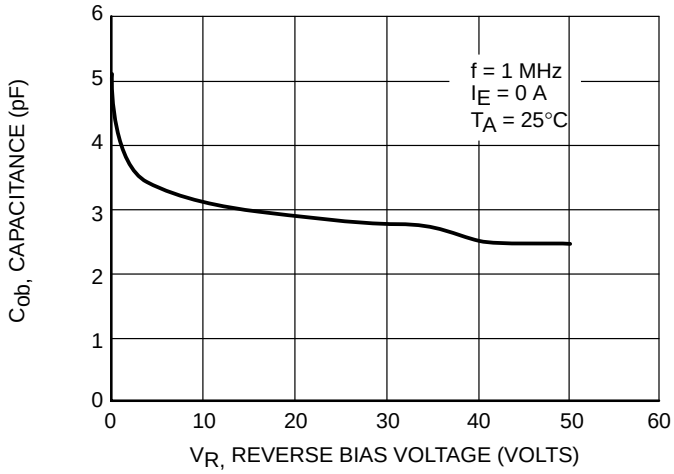


Figure 24. Output Capacitance

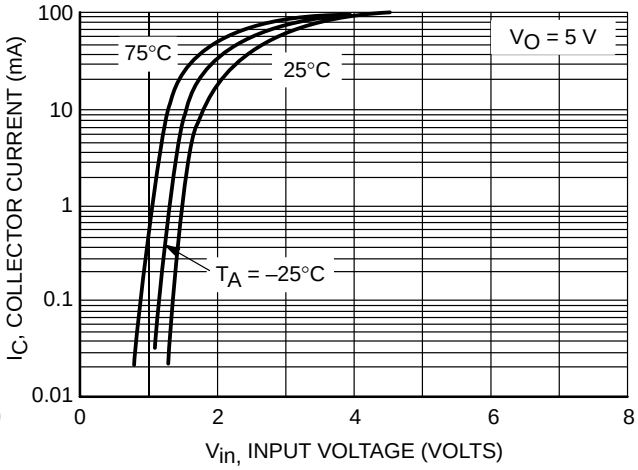


Figure 25. Output Current vs. Input Voltage

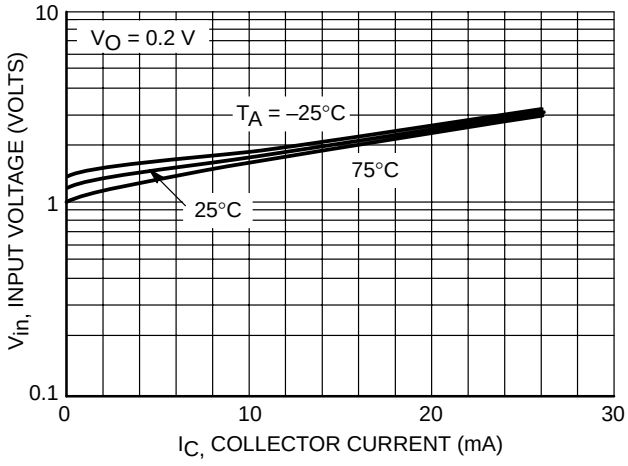


Figure 26. Output Voltage vs. Input Current

DEVICE CHARACTERISTICS

MUN221 Series

TYPICAL ELECTRICAL CHARACTERISTICS
MUN2233

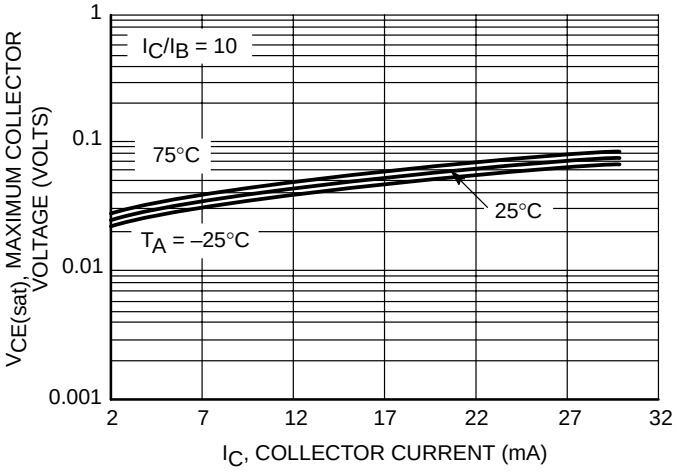


Figure 27. $V_{CE(sat)}$ vs. I_C

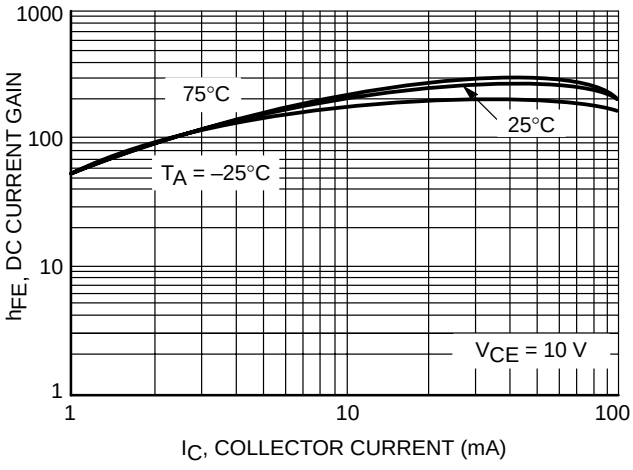


Figure 28. DC Current Gain

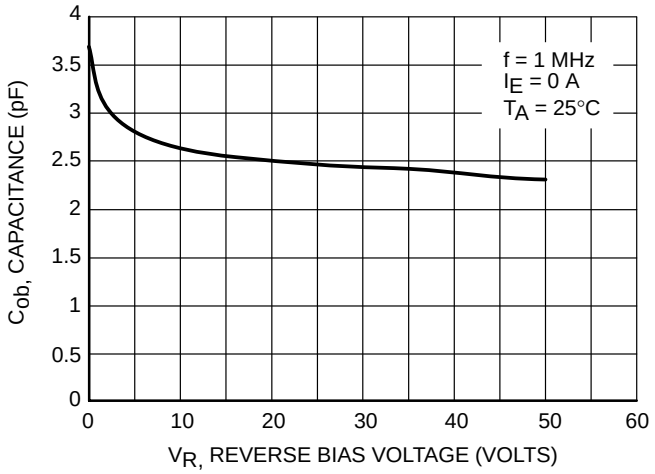


Figure 29. Output Capacitance

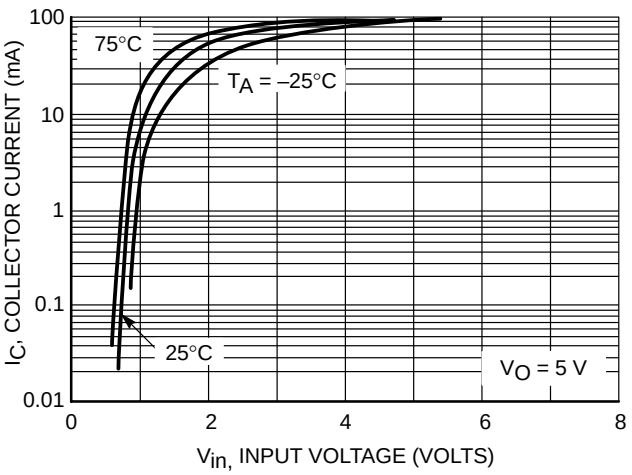


Figure 30. Output Current vs. Input Voltage

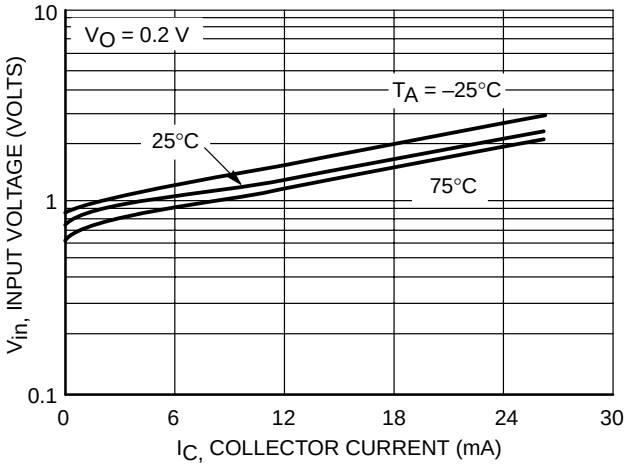


Figure 31. Input Voltage vs. Output Current

TYPICAL APPLICATIONS FOR NPN BRTs

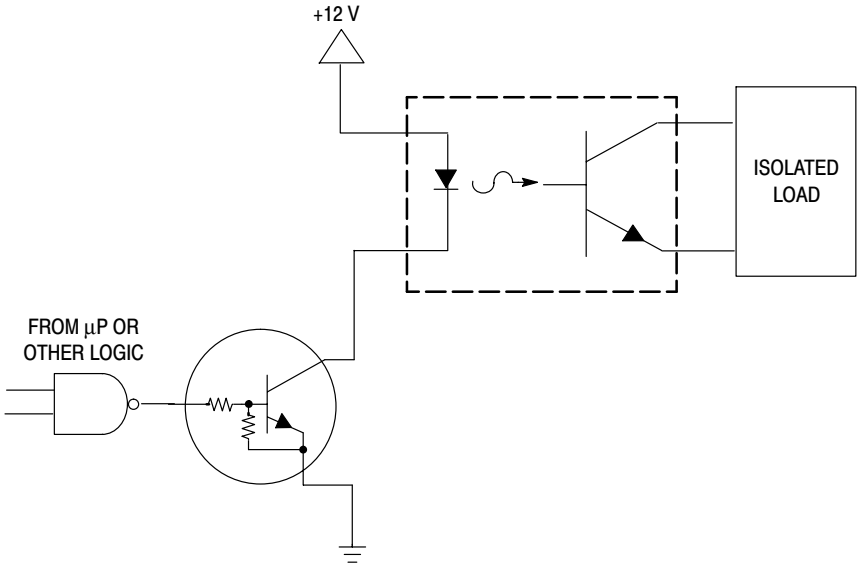


Figure 32. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

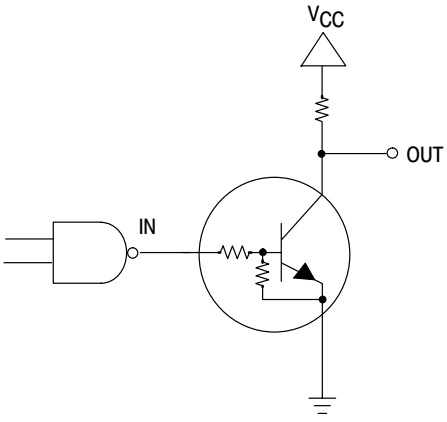


Figure 33. Open Collector Inverter: Inverts the Input Signal

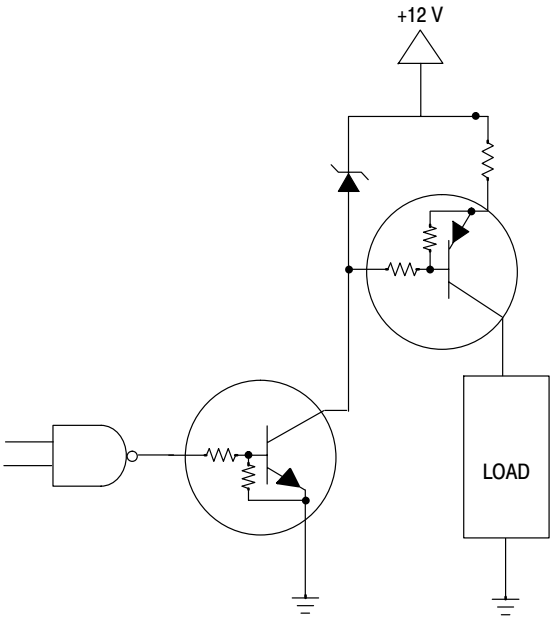
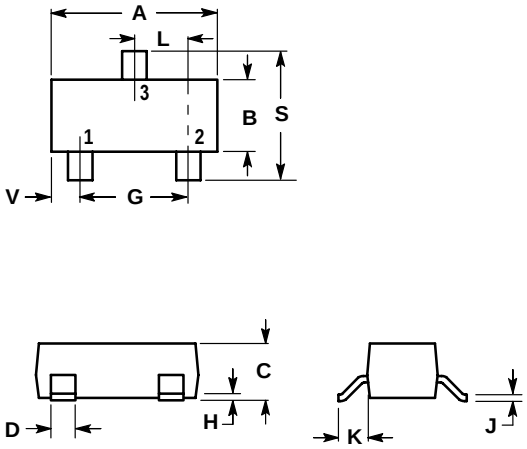


Figure 34. Inexpensive, Unregulated Current Source

PACKAGE OUTLINE & DIMENSIONS

MUN221 Series

SOT-23



NOTES:

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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60