

# MUN2211T1 Series

Preferred Devices

## Bias Resistor Transistors

### NPN Silicon Surface Mount Transistors 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-59 package which is designed for low power surface mount applications.

#### Features

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Moisture Sensitivity Level: 1
- ESD Rating - Human Body Model: Class 1  
- Machine Model: Class B
- The SC-59 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
- Pb-Free Packages are Available

#### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Base Voltage	$V_{CB0}$	50	Vdc
Collector-Emitter Voltage	$V_{CE0}$	50	Vdc
Collector Current	$I_C$	100	mAdc

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	230 (Note 1) 338 (Note 2) 1.8 (Note 1) 2.7 (Note 2)	mW $^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	540 (Note 1) 370 (Note 2)	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Lead	$R_{\theta JL}$	264 (Note 1) 287 (Note 2)	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

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.

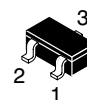
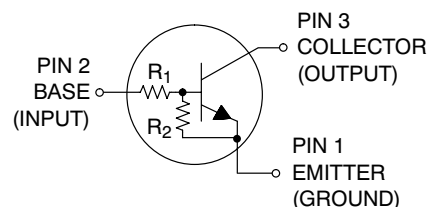
1. FR-4 @ Minimum Pad.
2. FR-4 @ 1.0 x 1.0 inch Pad.



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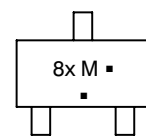
<http://onsemi.com>

### NPN SILICON BIAS RESISTOR TRANSISTORS



SC-59  
CASE 318D  
STYLE 1

#### MARKING DIAGRAM



- 8x = Device Code (Refer to page 2)
- M = Date Code\*
- = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation may vary depending upon manufacturing location.

#### ORDERING INFORMATION

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

#### DEVICE MARKING INFORMATION

See specific marking information in the Device Marking and Resistor Values table on page 2 of this data sheet.

Preferred devices are recommended choices for future use and best overall value.

## MUN2211T1 Series

### DEVICE MARKING AND RESISTOR VALUES

Device	Package	Marking	R1 (K)	R2 (K)	Shipping <sup>†</sup>
MUN2211T1	SC-59	8A	10	10	3000/Tape & Reel
MUN2211T1G	SC-59 (Pb-Free)	8A	10	10	3000/Tape & Reel
MUN2211T3	SC-59	8A	10	10	10,000/Tape & Reel
MUN2211T3G	SC-59 (Pb-Free)	8A	10	10	10,000/Tape & Reel
MUN2212T1	SC-59	8B	22	22	3000/Tape & Reel
MUN2212T1G	SC-59 (Pb-Free)	8B	22	22	3000/Tape & Reel
MUN2213T1	SC-59	8C	47	47	3000/Tape & Reel
MUN2213T1G	SC-59 (Pb-Free)	8C	47	47	3000/Tape & Reel
MUN2214T1	SC-59	8D	10	47	3000/Tape & Reel
MUN2214T1G	SC-59 (Pb-Free)	8D	10	47	3000/Tape & Reel
MUN2214T3	SC-59	8D	10	47	10,000/Tape & Reel
MUN2214T3G	SC-59 (Pb-Free)	8D	10	47	10,000/Tape & Reel
MUN2215T1	SC-59	8E	10	∞	3000/Tape & Reel
MUN2215T1G	SC-59 (Pb-Free)	8E	10	∞	3000/Tape & Reel
MUN2216T1	SC-59	8F	4.7	∞	3000/Tape & Reel
MUN2216T1G	SC-59 (Pb-Free)	8F	4.7	∞	3000/Tape & Reel
MUN2230T1	SC-59	8G	1.0	1.0	3000/Tape & Reel
MUN2230T1G	SC-59 (Pb-Free)	8G	1.0	1.0	3000/Tape & Reel
MUN2231T1 (Note 3)	SC-59	8H	2.2	2.2	3000/Tape & Reel
MUN2231T1G (Note 3)	SC-59 (Pb-Free)	8H	2.2	2.2	3000/Tape & Reel
MUN2232T1	SC-59	8J	4.7	4.7	3000/Tape & Reel
MUN2232T1G	SC-59 (Pb-Free)	8J	4.7	4.7	3000/Tape & Reel
MUN2233T1	SC-59	8K	4.7	47	3000/Tape & Reel
MUN2233T1G	SC-59 (Pb-Free)	8K	4.7	47	3000/Tape & Reel
MUN2234T1 (Note 3)	SC-59	8L	22	47	3000/Tape & Reel
MUN2234T1G (Note 3)	SC-59 (Pb-Free)	8L	22	47	3000/Tape & Reel
MUN2236T1	SC-59	8N	100	100	3000/Tape & Reel
MUN2236T1G	SC-59 (Pb-Free)	8N	100	100	3000/Tape & Reel
MUN2237T1	SC-59	8P	47	22	3000/Tape & Reel
MUN2237T1G	SC-59 (Pb-Free)	8P	47	22	3000/Tape & Reel
MUN2240T1 (Note 3)	SC-59	8T	47	∞	3000/Tape & Reel
MUN2240T1G (Note 3)	SC-59 (Pb-Free)	8T	47	∞	3000/Tape & Reel
MUN2241T1 (Note 3)	SC-59	8U	100	∞	3000/Tape & Reel
MUN2241T1G (Note 3)	SC-59 (Pb-Free)	8U	100	∞	3000/Tape & Reel

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

# MUN2211T1 Series

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-Base Cutoff Current (V <sub>CB</sub> = 50 V, I <sub>E</sub> = 0)	I <sub>CBO</sub>	-	-	100	nAdc
Collector-Emitter Cutoff Current (V <sub>CE</sub> = 50 V, I <sub>B</sub> = 0)	I <sub>CEO</sub>	-	-	500	nAdc
Emitter-Base Cutoff Current (V <sub>EB</sub> = 6.0 V, I <sub>C</sub> = 0)	I <sub>EBO</sub>	-	-	0.5	mAdc
MUN2211T1, G		-	-	0.2	
MUN2212T1, G		-	-	0.1	
MUN2213T1, G		-	-	0.2	
MUN2214T1, G		-	-	0.9	
MUN2215T1, G		-	-	1.9	
MUN2216T1, G		-	-	4.3	
MUN2230T1, G		-	-	2.3	
MUN2231T1, G		-	-	1.5	
MUN2232T1, G		-	-	0.18	
MUN2233T1, G		-	-	0.13	
MUN2234T1, G		-	-	0.05	
MUN2236T1, G		-	-	0.13	
MUN2237T1, G		-	-	0.2	
MUN2240T1, G		-	-	0.1	
MUN2241T1, G		-	-		
Collector-Base Breakdown Voltage (I <sub>C</sub> = 10 μA, I <sub>E</sub> = 0)	V <sub>(BR)CBO</sub>	50	-	-	Vdc
Collector-Emitter Breakdown Voltage (Note 4) (I <sub>C</sub> = 2.0 mA, I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	50	-	-	Vdc

## ON CHARACTERISTICS (Note 4)

DC Current Gain (V <sub>CE</sub> = 10 V, I <sub>C</sub> = 5.0 mA)	h <sub>FE</sub>	35	60	-	
MUN2211T1, G		60	100	-	
MUN2212T1, G		80	140	-	
MUN2213T1, G		80	140	-	
MUN2214T1, G		160	350	-	
MUN2215T1, G		160	350	-	
MUN2216T1, G		3.0	5.0	-	
MUN2230T1, G		8.0	15	-	
MUN2231T1, G		15	30	-	
MUN2232T1, G		80	200	-	
MUN2233T1, G		80	150	-	
MUN2234T1, G		80	150	-	
MUN2236T1, G		80	140	-	
MUN2237T1, G		160	350	-	
MUN2240T1, G		160	350	-	
MUN2241T1, G					
Collector-Emitter Saturation Voltage (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0.3 mA)	V <sub>CE(sat)</sub>	-	-	0.25	Vdc
MUN2211T1, G		-	-	0.25	
MUN2212T1, G		-	-	0.25	
MUN2213T1, G		-	-	0.25	
MUN2214T1, G		-	-	0.25	
MUN2233T1, G		-	-	0.25	
MUN2236T1, G		-	-	0.25	
(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 5 mA)		-	-	0.25	
MUN2230T1, G		-	-	0.25	
MUN2231T1, G		-	-	0.25	
MUN2237T1, G		-	-	0.25	
MUN2241T1, G		-	-	0.25	
(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA)		-	-	0.25	
MUN2215T1, G		-	-	0.25	
MUN2216T1, G		-	-	0.25	
MUN2232T1, G		-	-	0.25	
MUN2234T1, G		-	-	0.25	
MUN2240T1, G		-	-	0.25	

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

# MUN2211T1 Series

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Typ	Max	Unit	
<b>ON CHARACTERISTICS</b> (Note 5) (Continued)						
Output Voltage (on) (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 2.5 V, R <sub>L</sub> = 1.0 kΩ)	MUN2211T1, G MUN2212T1, G MUN2214T1, G MUN2215T1, G MUN2216T1, G MUN2230T1, G MUN2231T1, G MUN2232T1, G MUN2233T1, G MUN2234T1, G (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 3.5 V, R <sub>L</sub> = 1.0 kΩ) MUN2213T1, G MUN2240T1, G (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 5.5 V, R <sub>L</sub> = 1.0 kΩ) MUN2236T1, G (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 4.0 V, R <sub>L</sub> = 1.0 kΩ) MUN2237T1, G (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 5.0 V, R <sub>L</sub> = 1.0 kΩ) MUN2241T1, G	V <sub>OL</sub>	-	-	0.2	Vdc
Output Voltage (off) (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.5 V, R <sub>L</sub> = 1.0 kΩ)	MUN2211T1, G MUN2212T1, G MUN2213T1, G MUN2214T1, G MUN2233T1, G MUN2234T1, G (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.050 V, R <sub>L</sub> = 1.0 kΩ) MUN2230T1, G (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.25 V, R <sub>L</sub> = 1.0 kΩ) MUN2215T1, G MUN2216T1, G MUN2231T1, G MUN2232T1, G MUN2236T1, G MUN2237T1, G MUN2240T1, G MUN2241T1, G	V <sub>OH</sub>	4.9	-	-	Vdc
Input Resistor	MUN2211T1, G MUN2212T1, G MUN2213T1, G MUN2214T1, G MUN2215T1, G MUN2216T1, G MUN2230T1, G MUN2231T1, G MUN2232T1, G MUN2233T1, G MUN2234T1, G MUN2236T1, G MUN2237T1, G MUN2240T1, G MUN2241T1, G	R <sub>1</sub>	7.0 15.4 32.9 7.0 7.0 3.3 0.7 1.5 3.3 3.3 15.4 70 32.9 32.9 70	10 22 47 10 10 4.7 1.0 2.2 4.7 4.7 22 100 47 47 100	13 28.6 61.1 13 13 6.1 1.3 2.9 6.1 6.1 28.6 130 61.1 61.1 130	kΩ
Resistor Ratio	MUN2211T1, G MUN2212T1, G MUN2213T1, G MUN2214T1, G MUN2215T1, G MUN2216T1, G MUN2230T1, G MUN2231T1, G MUN2232T1, G MUN2233T1, G MUN2234T1, G MUN2236T1, G MUN2237T1, G MUN2240T1, G MUN2241T1, G	R <sub>1</sub> /R <sub>2</sub>	0.8 0.8 0.8 0.17 - - 0.8 0.8 0.8 0.8 0.055 0.38 0.8 1.7 - -	1.0 1.0 1.0 0.21 - - 1.0 1.0 1.0 1.0 0.12 0.47 1.0 2.15 - -	1.2 1.2 1.2 0.25 - - 1.2 1.2 1.2 1.2 0.185 0.56 1.2 2.6 - -	

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

# MUN2211T1 Series

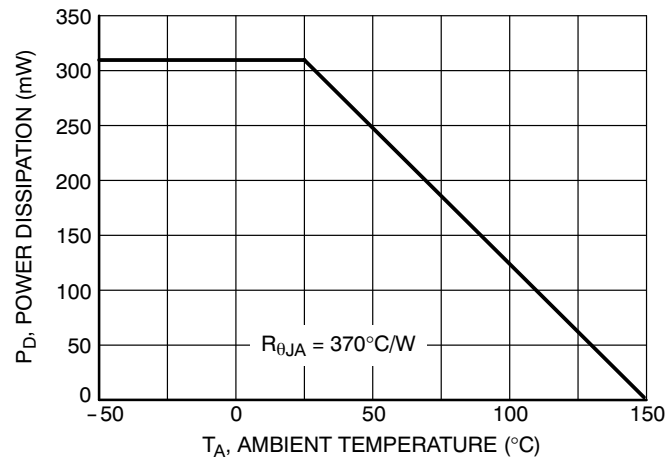


Figure 1. Derating Curve

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS - MUN2211T1

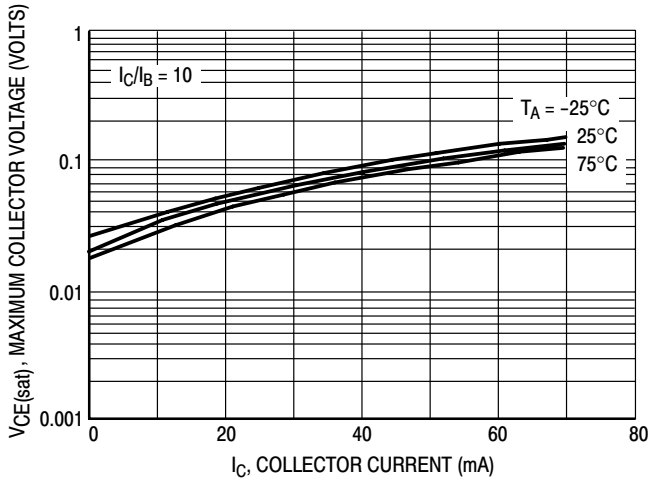


Figure 2.  $V_{CE(sat)}$  versus  $I_C$

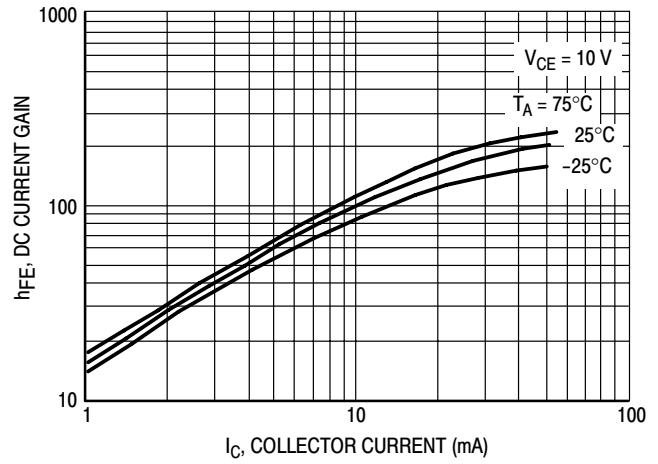


Figure 3. DC Current Gain

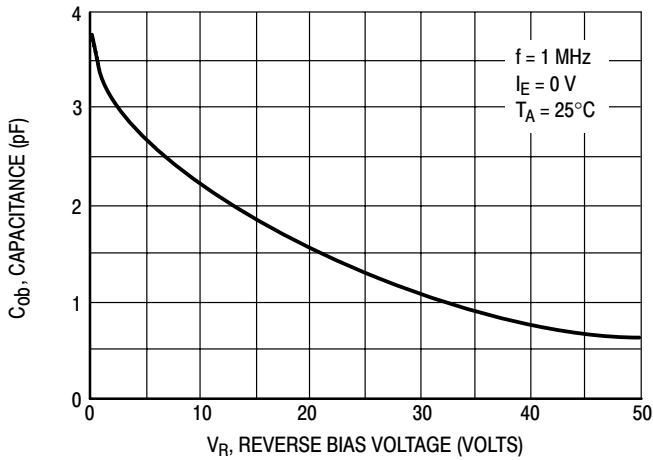


Figure 4. Output Capacitance

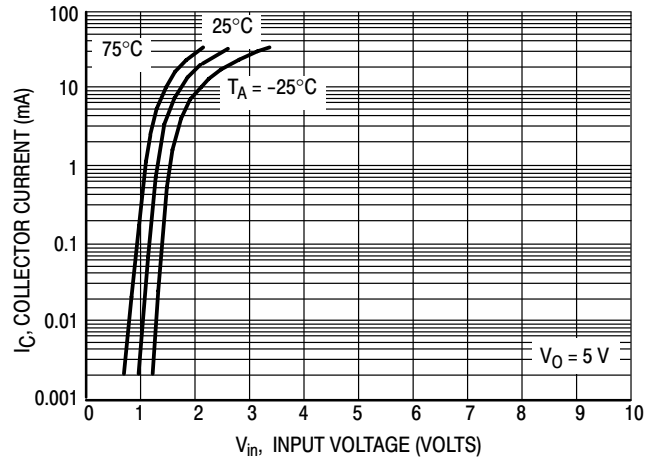


Figure 5. Output Current versus Input Voltage

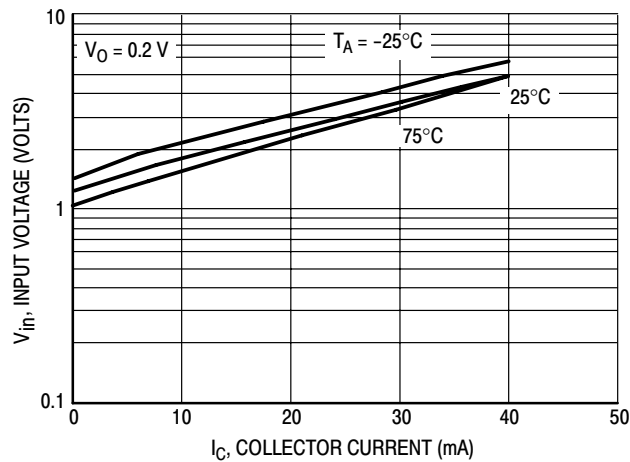


Figure 6. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS - MUN2212T1

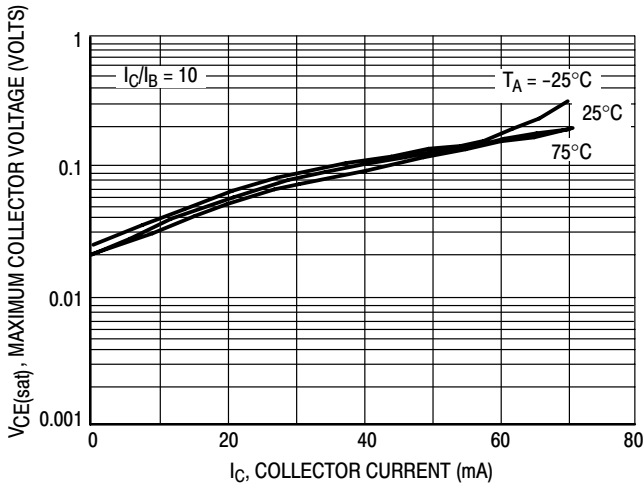


Figure 7.  $V_{CE(sat)}$  versus  $I_C$

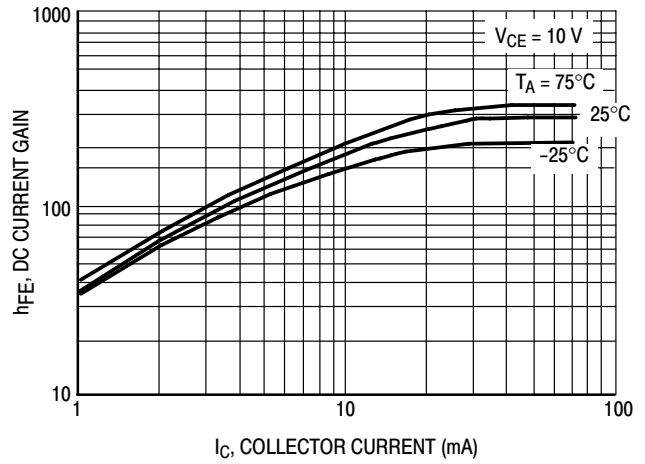


Figure 8. DC Current Gain

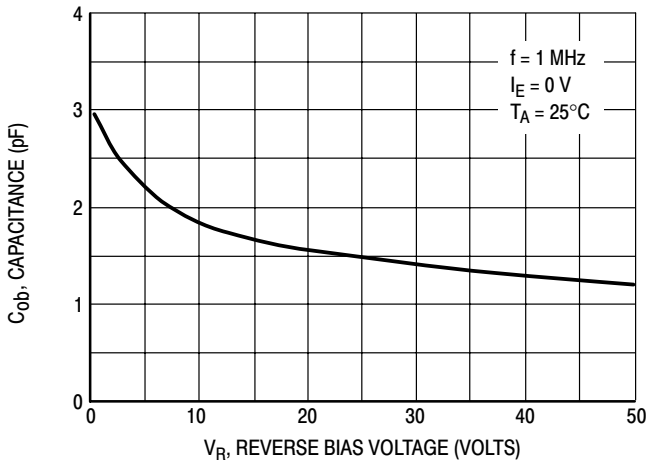


Figure 9. Output Capacitance

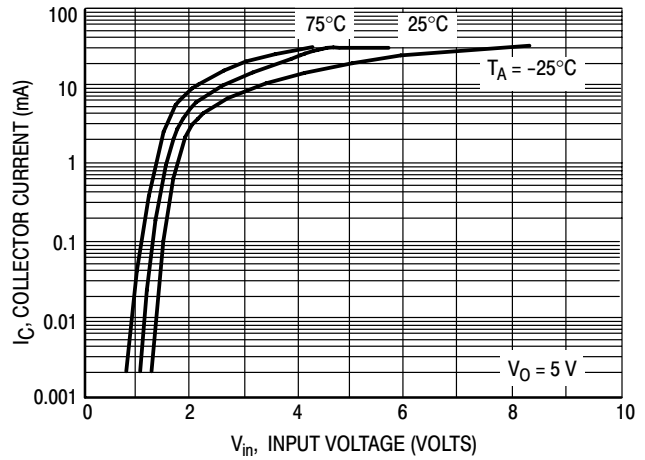


Figure 10. Output Current versus Input Voltage

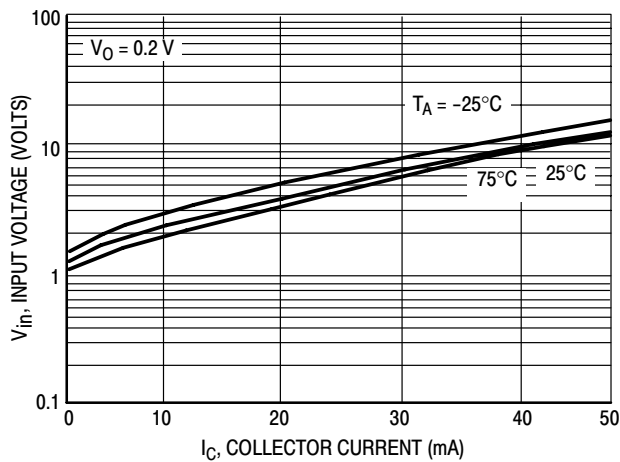


Figure 11. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS - MUN2213T1

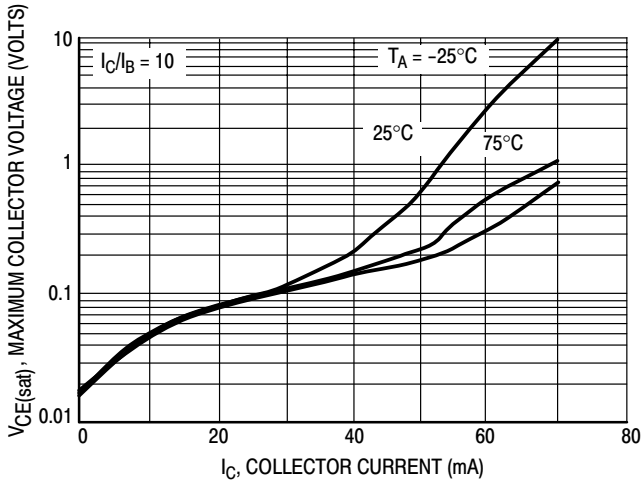


Figure 12.  $V_{CE(sat)}$  versus  $I_C$

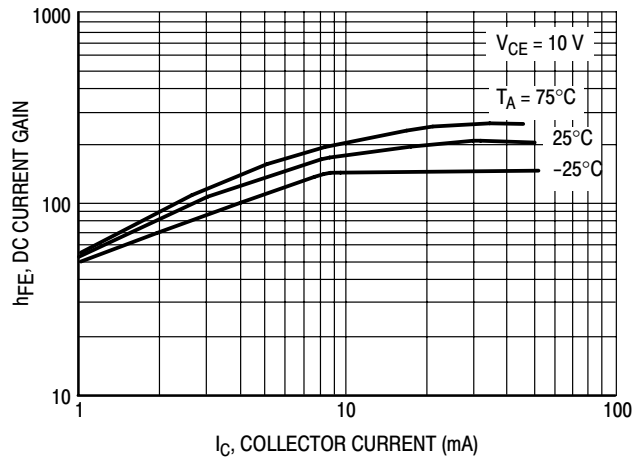


Figure 13. DC Current Gain

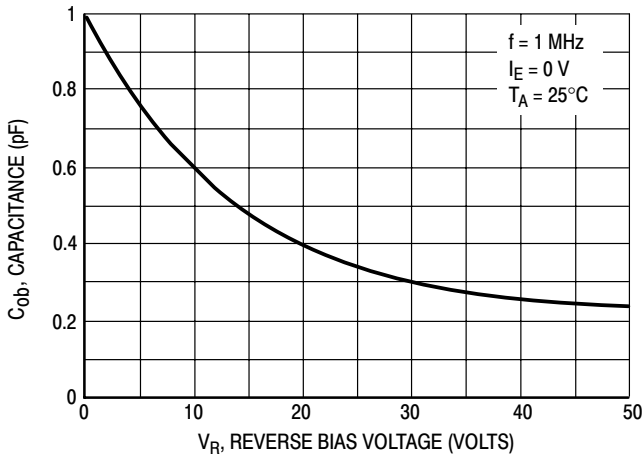


Figure 14. Output Capacitance

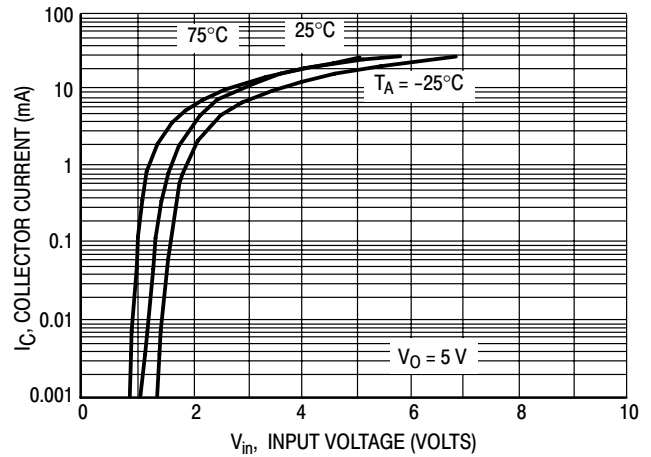


Figure 15. Output Current versus Input Voltage

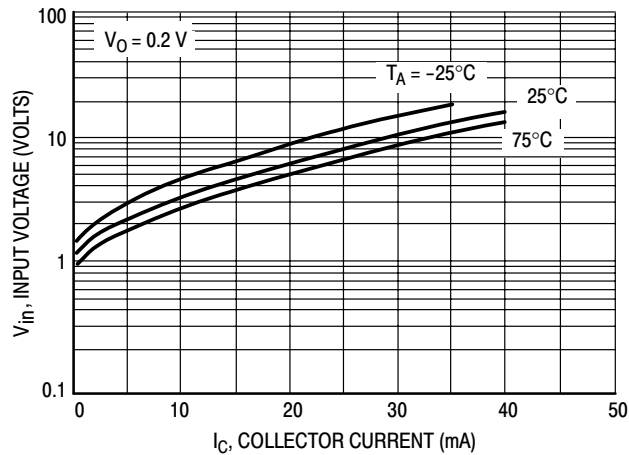


Figure 16. Input Voltage versus Output Current



# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS - MUN2214T1

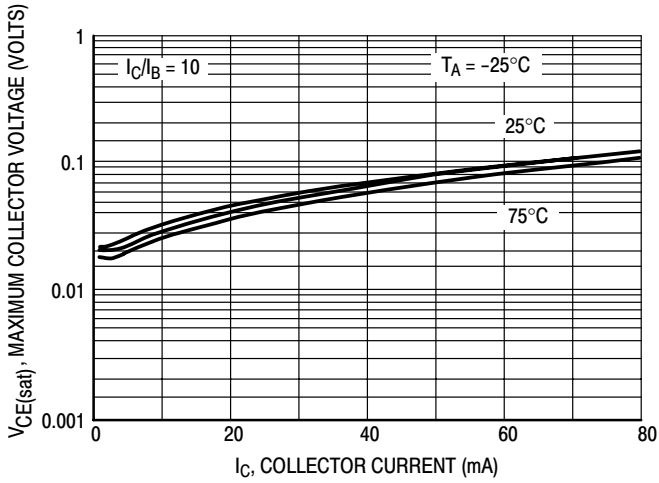


Figure 17.  $V_{CE(sat)}$  versus  $I_C$

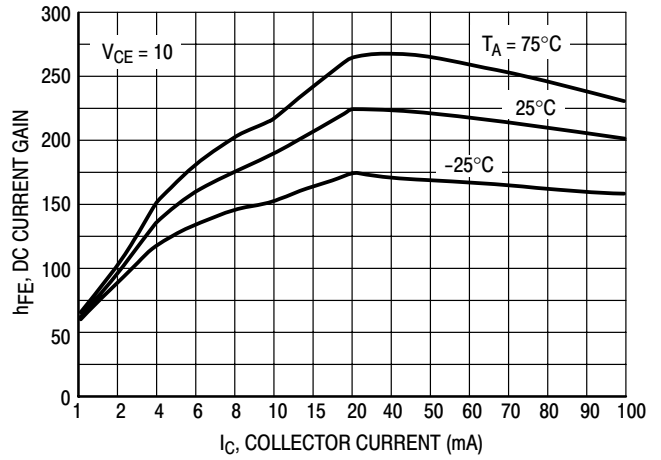


Figure 18. DC Current Gain

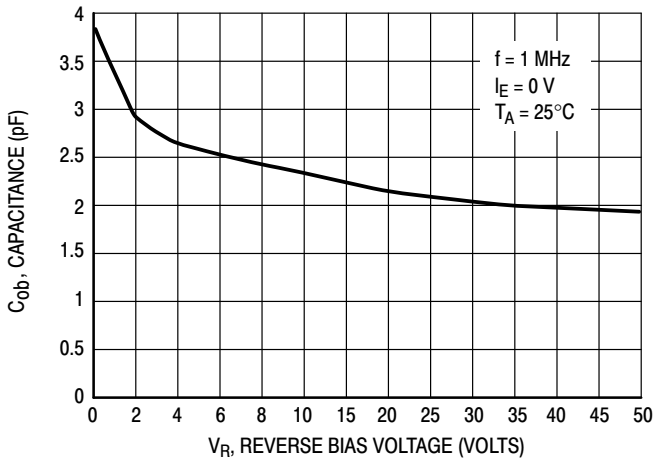


Figure 19. Output Capacitance

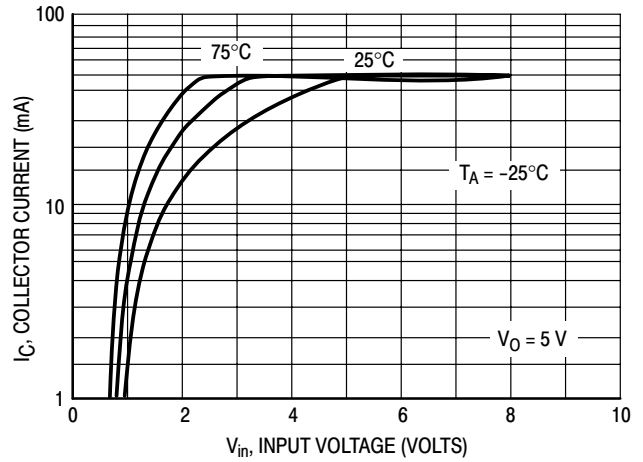


Figure 20. Output Current versus Input Voltage

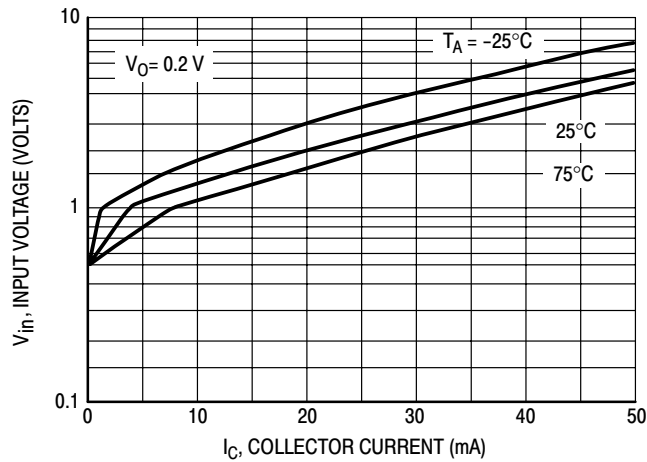


Figure 21. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MUN2215T1

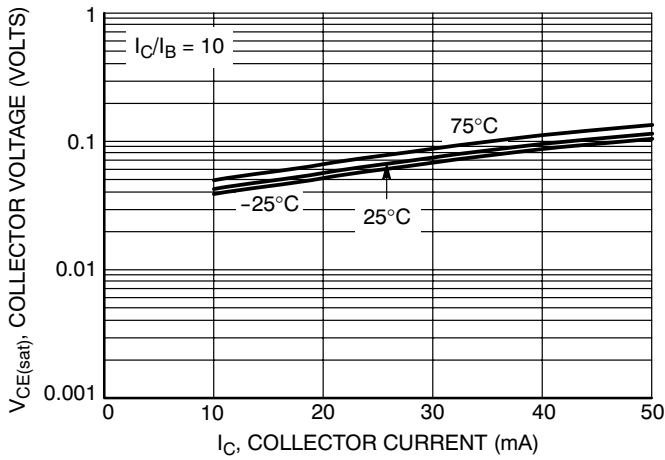


Figure 22.  $V_{CE(sat)}$  versus  $I_C$

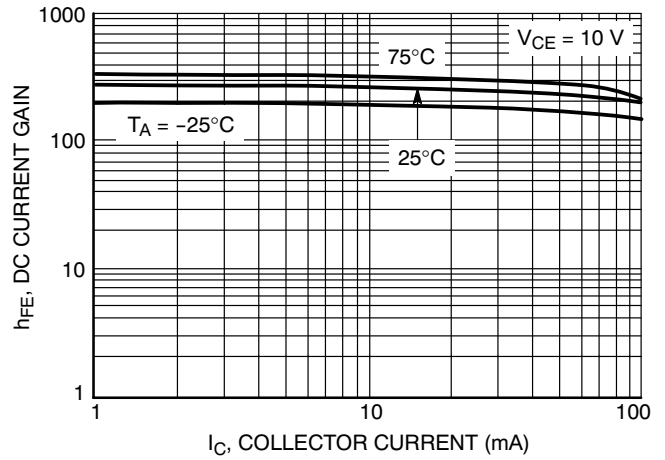


Figure 23. DC Current Gain

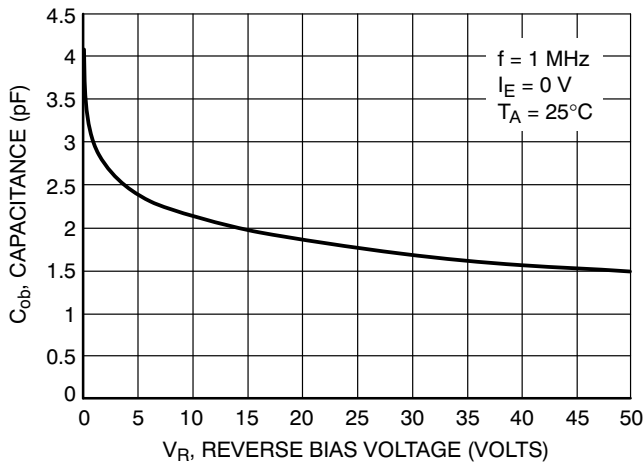


Figure 24. Output Capacitance

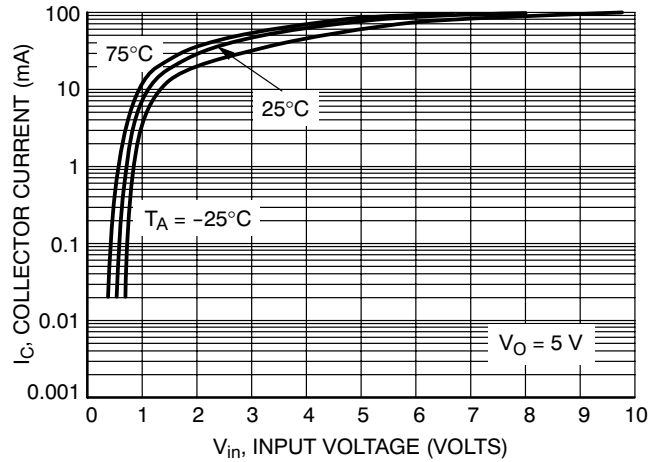


Figure 25. Output Current versus Input Voltage

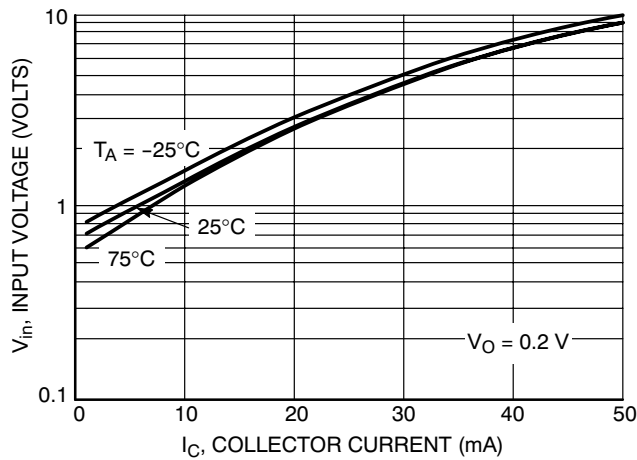


Figure 26. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MUN2216T1

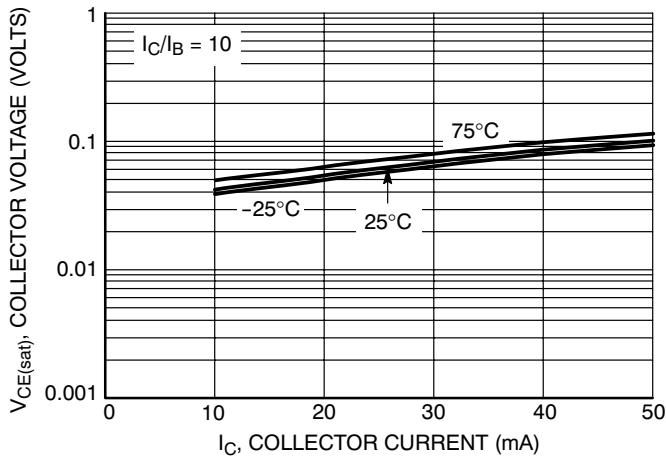


Figure 27.  $V_{CE(sat)}$  versus  $I_C$

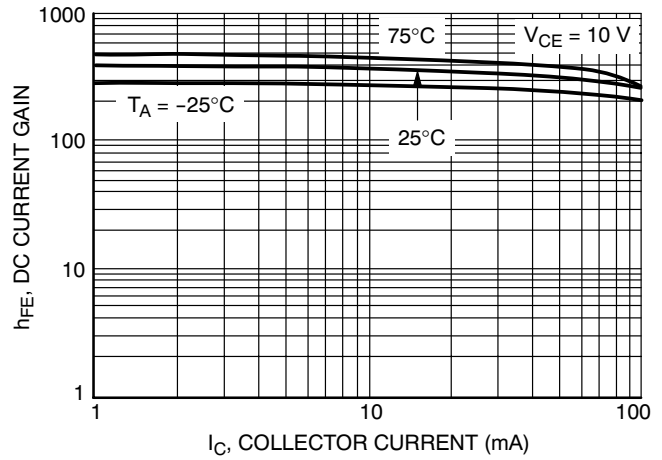


Figure 28. DC Current Gain

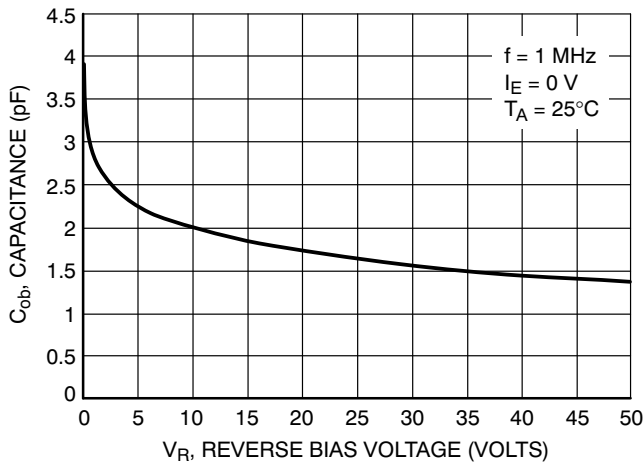


Figure 29. Output Capacitance

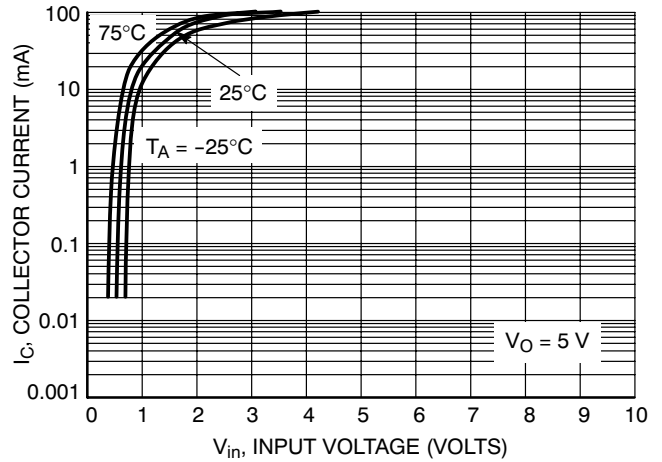


Figure 30. Output Current versus Input Voltage

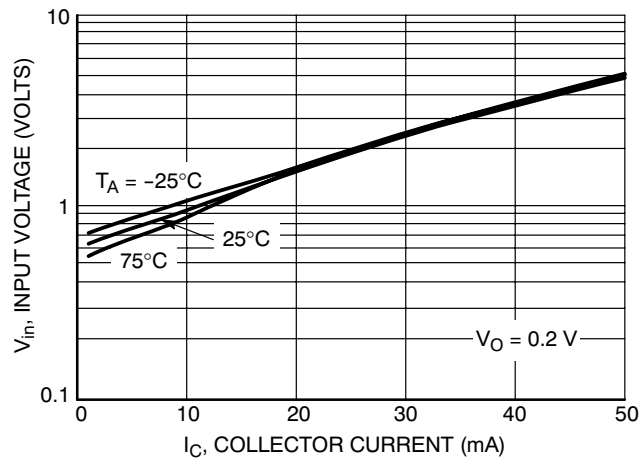


Figure 31. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MUN2230T1

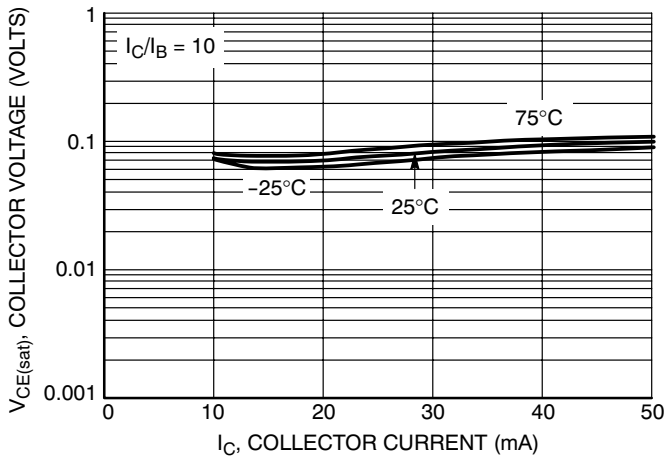


Figure 32.  $V_{CE(sat)}$  versus  $I_C$

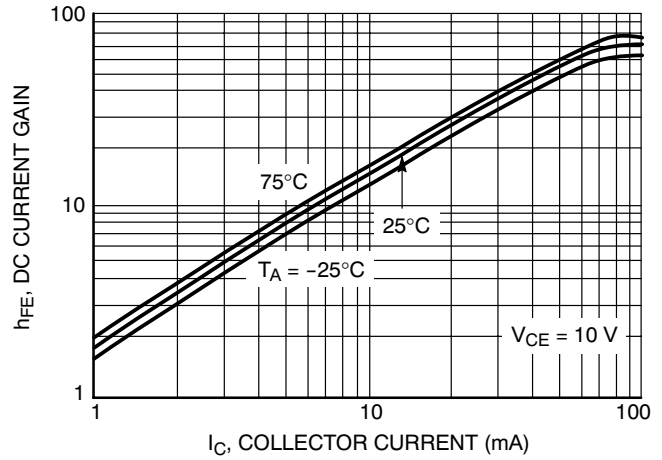


Figure 33. DC Current Gain

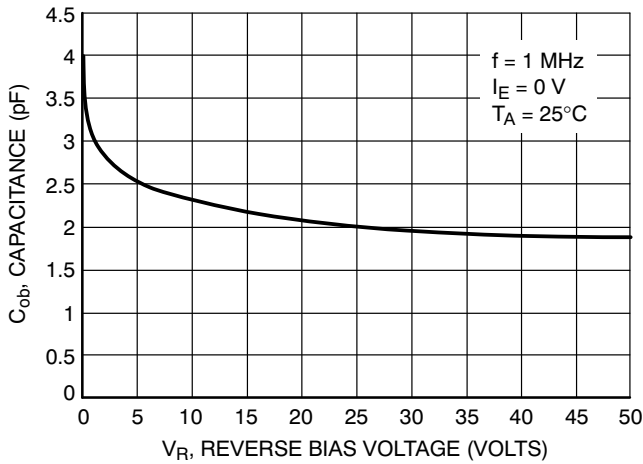


Figure 34. Output Capacitance

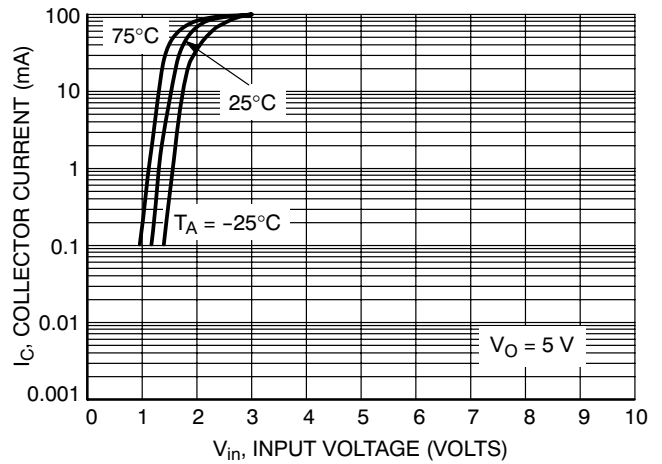


Figure 35. Output Current versus Input Voltage

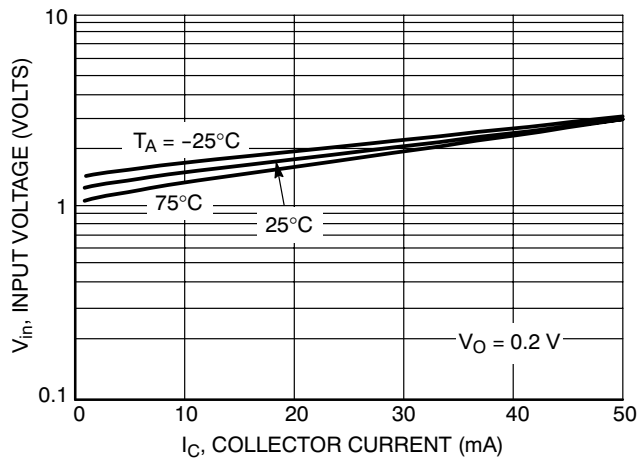


Figure 36. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MUN2232T1

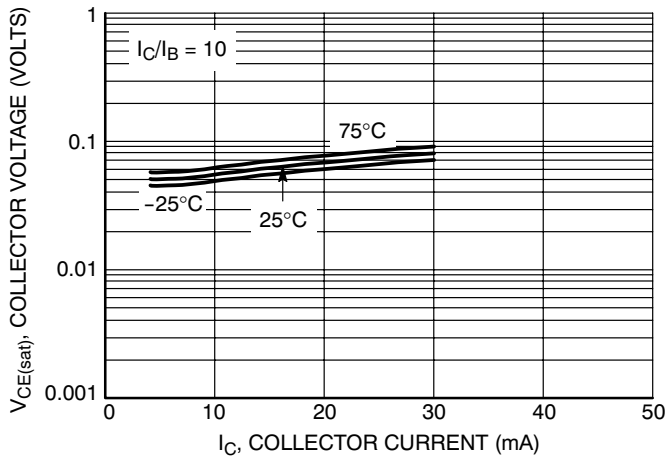


Figure 37.  $V_{CE(sat)}$  versus  $I_C$

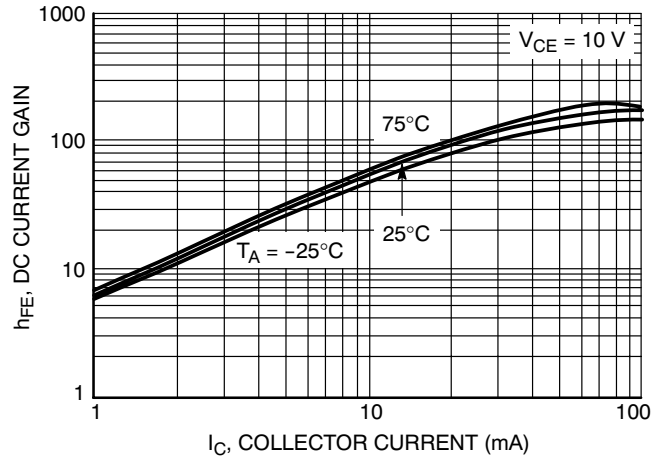


Figure 38. DC Current Gain

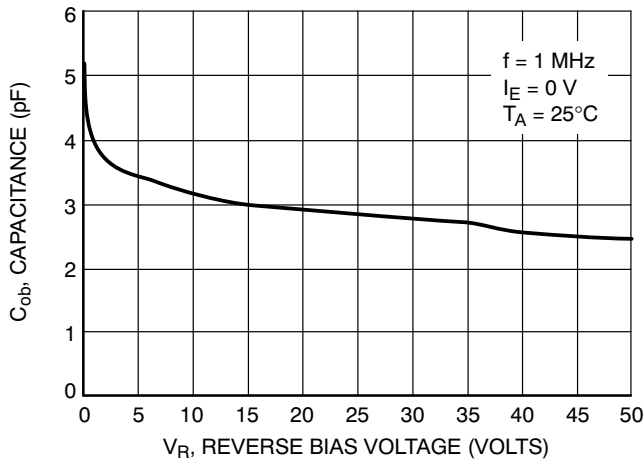


Figure 39. Output Capacitance

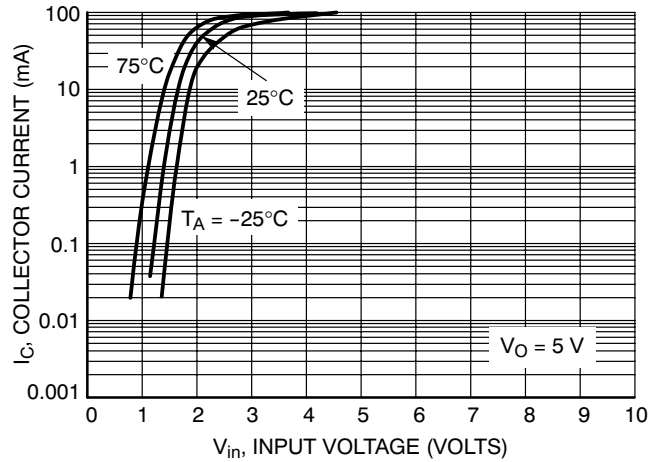


Figure 40. Output Current versus Input Voltage

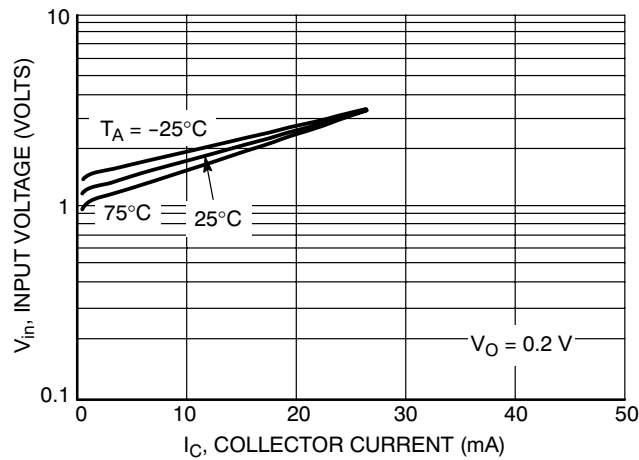


Figure 41. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MUN2233T1

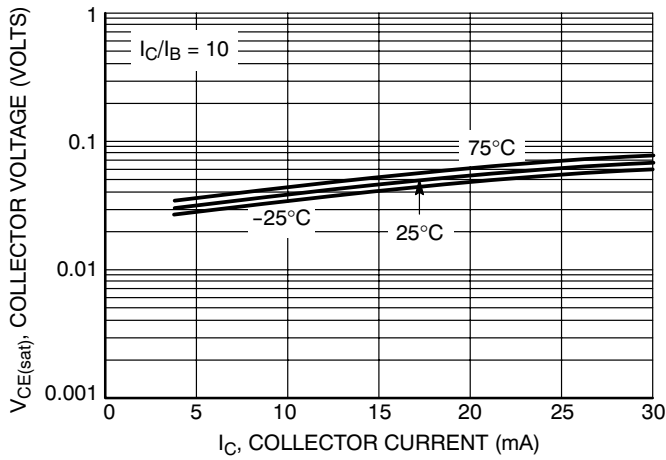


Figure 42.  $V_{CE(sat)}$  versus  $I_C$

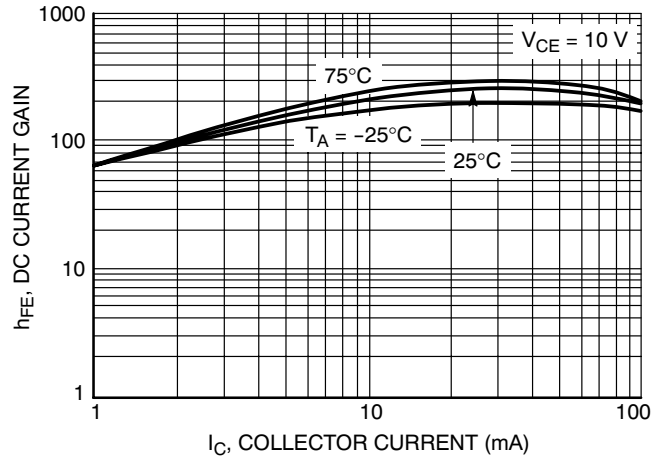


Figure 43. DC Current Gain

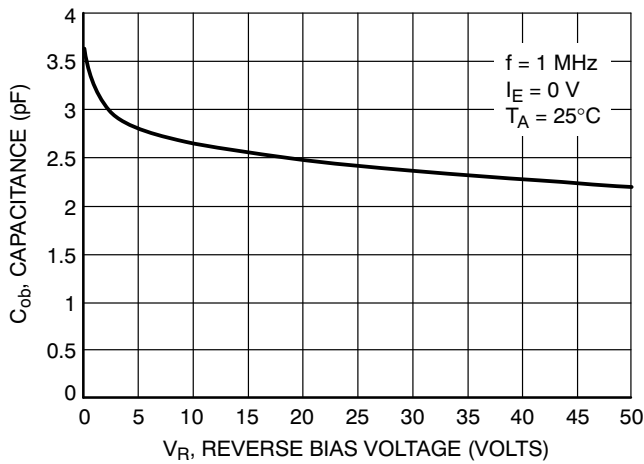


Figure 44. Output Capacitance

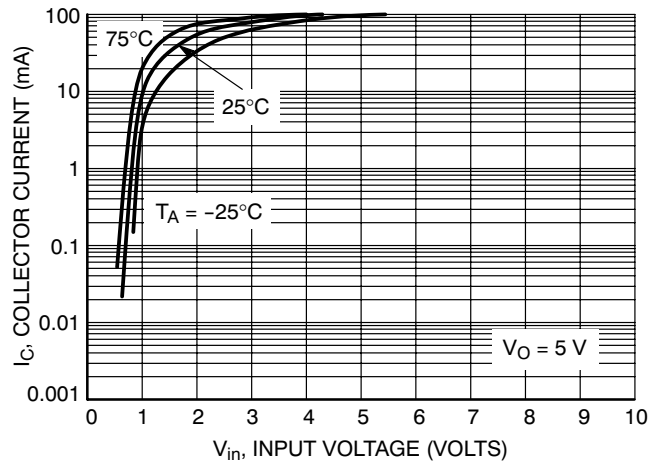


Figure 45. Output Current versus Input Voltage

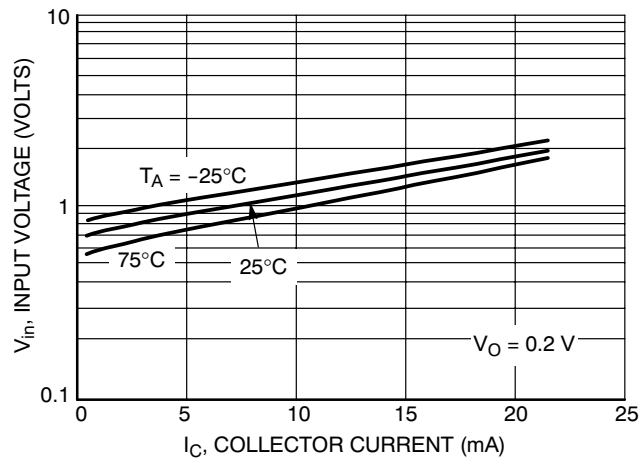


Figure 46. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS - MUN2236T1

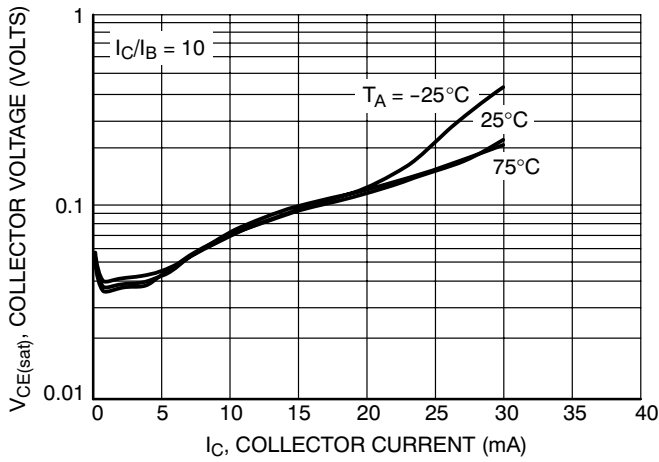


Figure 47.  $V_{CE(sat)}$  versus  $I_C$

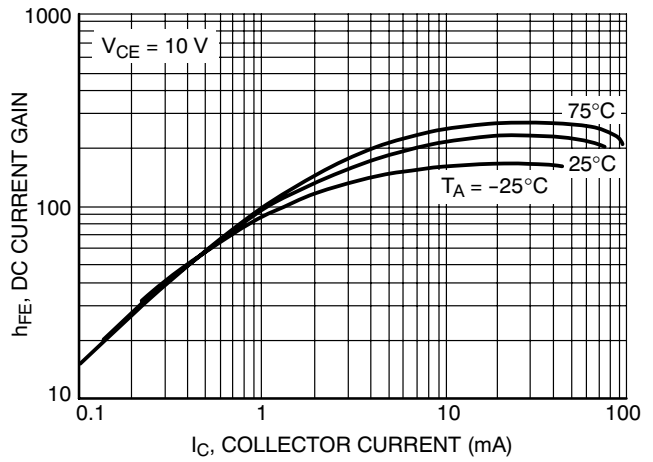


Figure 48. DC Current Gain

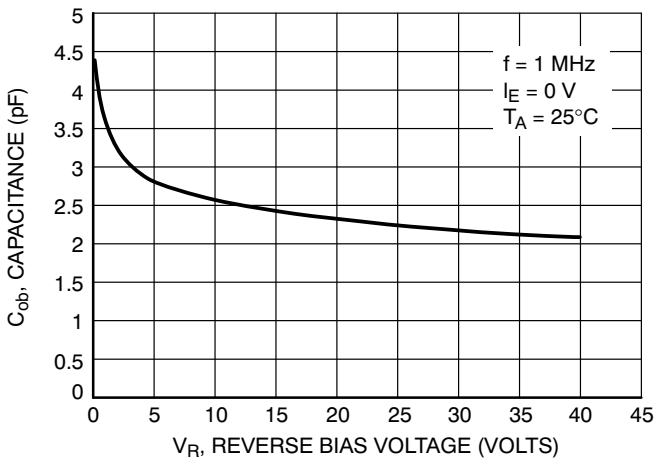


Figure 49. Output Capacitance

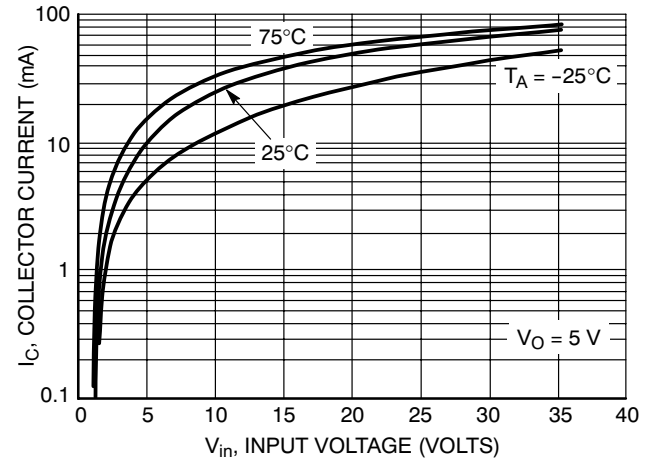


Figure 50. Output Current versus Input Voltage

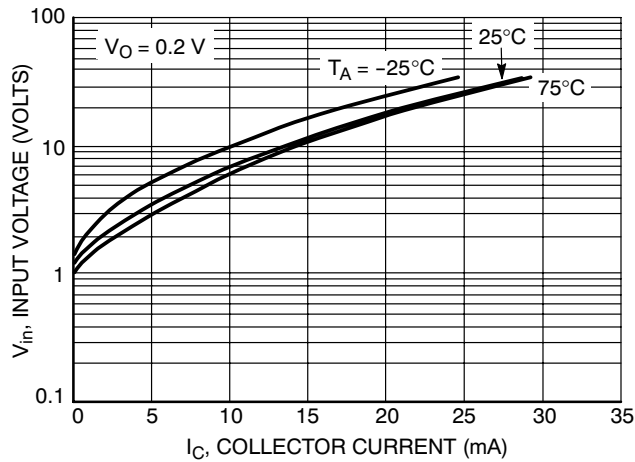


Figure 51. Input Voltage versus Output Current

# MUN2211T1 Series

## TYPICAL ELECTRICAL CHARACTERISTICS - MUN2237T1

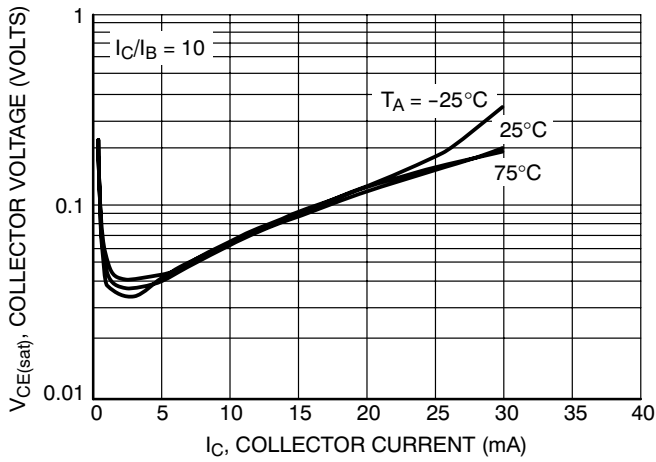


Figure 52.  $V_{CE(sat)}$  versus  $I_C$

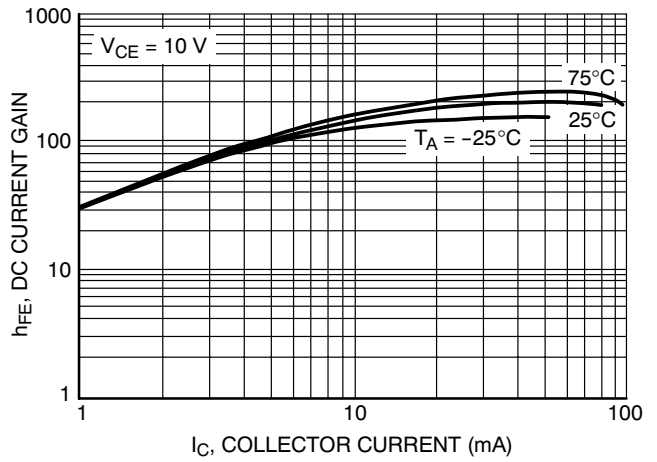


Figure 53. DC Current Gain

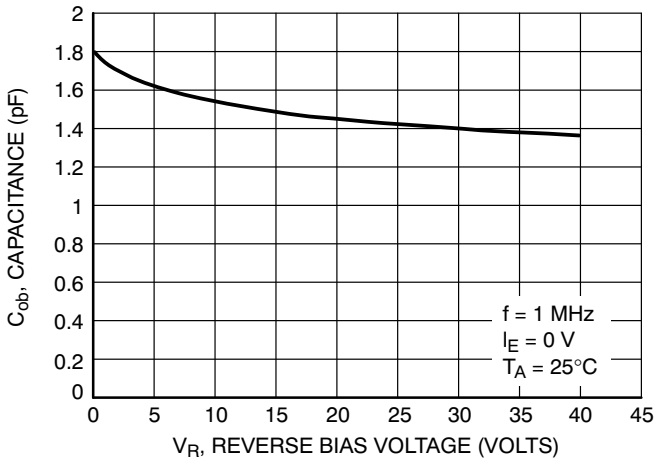


Figure 54. Output Capacitance

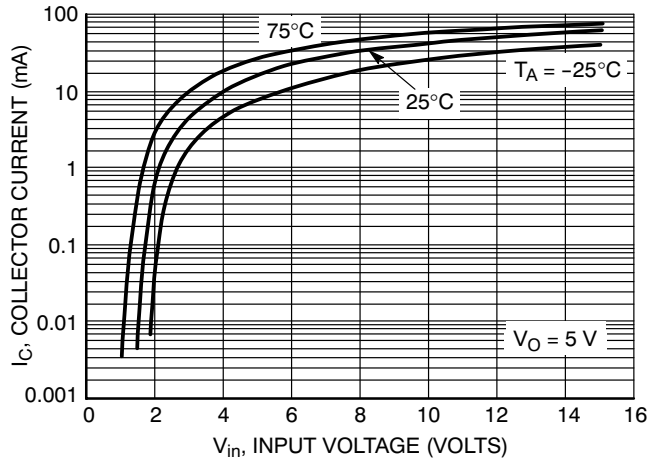


Figure 55. Output Current versus Input Voltage

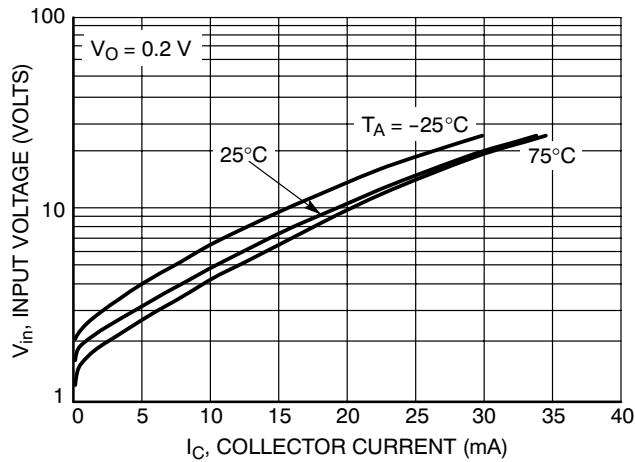


Figure 56. Input Voltage versus Output Current



# MUN2211T1 Series

## TYPICAL APPLICATIONS FOR NPN BRTs

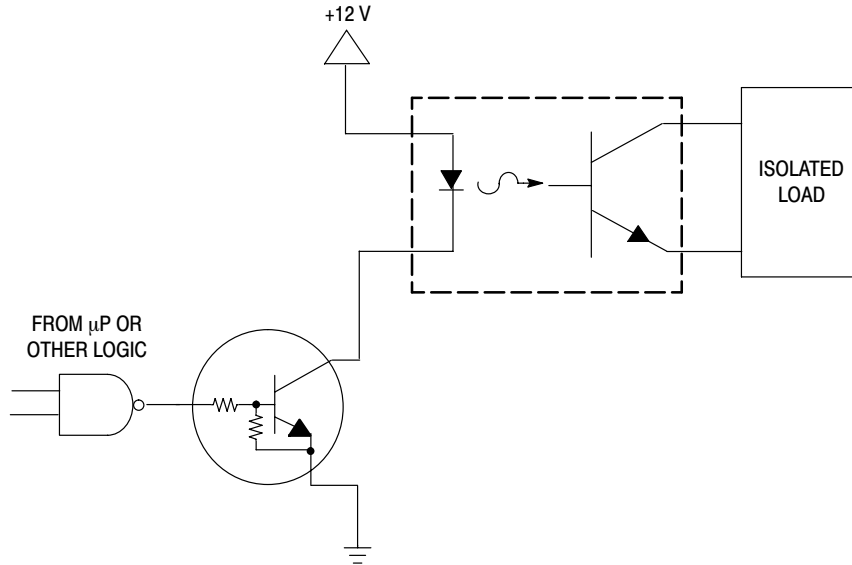


Figure 57. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

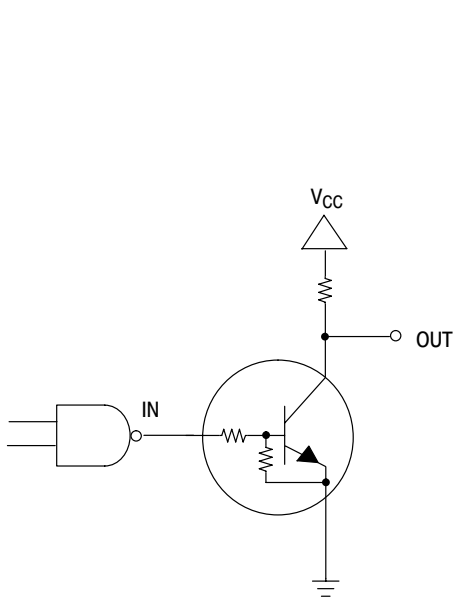


Figure 58. Open Collector Inverter:  
Inverts the Input Signal

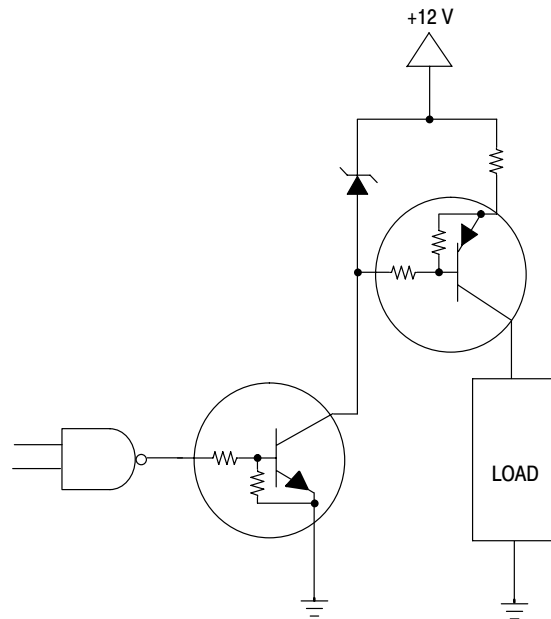
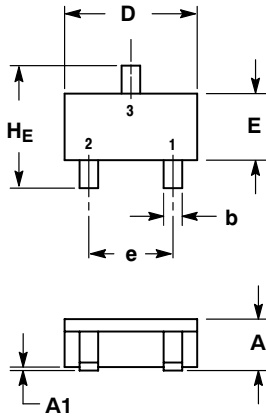


Figure 59. Inexpensive, Unregulated Current Source

# MUN2211T1 Series

## PACKAGE DIMENSIONS

SC-59  
CASE 318D-04  
ISSUE G



NOTES:

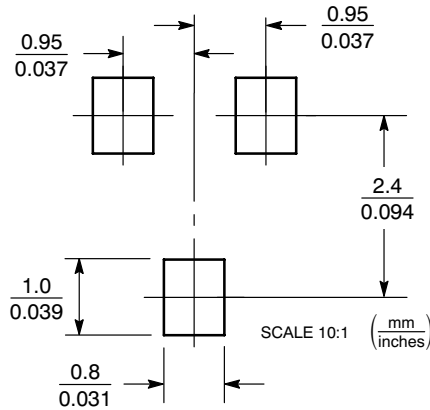
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.15	1.30	0.039	0.045	0.051
A1	0.01	0.06	0.10	0.001	0.002	0.004
b	0.35	0.43	0.50	0.014	0.017	0.020
c	0.09	0.14	0.18	0.003	0.005	0.007
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.30	1.50	1.70	0.051	0.059	0.067
e	1.70	1.90	2.10	0.067	0.075	0.083
L	0.20	0.40	0.60	0.008	0.016	0.024
HE	2.50	2.80	3.00	0.099	0.110	0.118


STYLE 1:

1. EMITTER
2. BASE
3. COLLECTOR

### SOLDERING FOOTPRINT\*



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

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