

# MMUN2211LT1G Series, SMMUN2211LT1G Series, NSVMMUN2232LT1G



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

### Features

- Simplifies Circuit Design
- Reduces Board Space and Component Count
- AEC-Q101 Qualified and PPAP Capable
- S, NSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

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

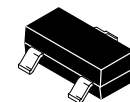
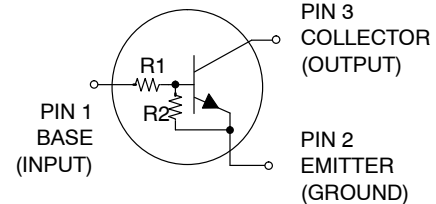
Rating	Symbol	Value	Unit
Collector-Base Voltage	V <sub>CBO</sub>	50	Vdc
Collector-Emitter Voltage	V <sub>CEO</sub>	50	Vdc
Collector Current	I <sub>C</sub>	100	mAdc

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	246 (Note 1) 400 (Note 2) 1.5 (Note 1) 2.0 (Note 2)	mW °C/W
Thermal Resistance, Junction-to-Ambient	R <sub>θJA</sub>	508 (Note 1) 311 (Note 2)	°C/W
Thermal Resistance, Junction-to-Lead	R <sub>θJL</sub>	174 (Note 1) 208 (Note 2)	°C/W
Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C

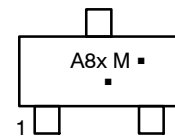
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. FR-4 @ minimum pad
2. FR-4 @ 1.0 x 1.0 inch pad



SOT-23  
CASE 318  
STYLE 6

### MARKING DIAGRAM



A8x = Specific Device

Code

M = Date Code\*

(Note: Microdot may be used for marking)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 17 of this data sheet.

# MMUN2211LT1G Series, SMMUN2211LT1G Series, NSVMMUN2232LT1G

## 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
MMUN2211LT1G, SMMUN2211LT1G		–	–	0.2	
MMUN2212LT1G		–	–	0.1	
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		–	–	0.2	
MMUN2214LT1G, SMMUN2214LT1G		–	–	0.9	
MMUN2215LT1G, SMMUN2215LT1G		–	–	1.9	
MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		–	–	4.3	
MMUN2230LT1G		–	–	2.3	
MMUN2231LT1G		–	–	1.5	
MMUN2232LT1G, NSVMMUN2232LT1G		–	–	0.18	
MMUN2233LT1G, SMMUN2233LT1G		–	–	0.13	
MMUN2234LT1G, SMMUN2234LT1G		–	–	4.0	
MMUN2238LT1G		–	–	0.1	
MMUN2241LT1G		–	–		
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 3), (I <sub>C</sub> = 2.0 mA, I <sub>B</sub> = 0)	V <sub>(BR)CEO</sub>	50	–	–	Vdc

## ON CHARACTERISTICS (Note 3)

DC Current Gain (V <sub>CE</sub> = 10 V, I <sub>C</sub> = 5.0 mA)	h <sub>FE</sub>	35	60	–	
MMUN2211LT1G, SMMUN2211LT1G		60	100	–	
MMUN2212LT1G		80	140	–	
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		80	140	–	
MMUN2214LT1G, SMMUN2214LT1G		160	350	–	
MMUN2215LT1G, SMMUN2215LT1G		160	350	–	
MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		3.0	5.0	–	
MMUN2230LT1G		8.0	15	–	
MMUN2231LT1G		15	30	–	
MMUN2232LT1G, NSVMMUN2232LT1G		80	200	–	
MMUN2233LT1G, SMMUN2233LT1G		80	150	–	
MMUN2234LT1G, SMMUN2234LT1G		160	350	–	
MMUN2238LT1G		160	350	–	
MMUN2241LT1G				–	
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
MMUN2211LT1G, SMMUN2211LT1G		–	–	0.25	
MMUN2212LT1G		–	–	0.25	
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		–	–	0.25	
MMUN2214LT1G, SMMUN2214LT1G		–	–	0.25	
MMUN2233LT1G, SMMUN2233LT1G		–	–	0.25	
MMUN2234LT1G, SMMUN2234LT1G		–	–	0.25	
(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA)		–	–	0.25	
MMUN2215LT1G, SMMUN2215LT1G		–	–	0.25	
MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		–	–	0.25	
MMUN2232LT1G, NSVMMUN2232LT1G		–	–	0.25	
MMUN2238LT1G		–	–	0.25	
(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 5 mA)		–	–	0.25	
MMUN2230LT1G		–	–	0.25	
MMUN2231LT1G		–	–	0.25	
MMUN2241LT1G		–	–	0.25	

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

# MMUN2211LT1G Series, SMMUN2211LT1G Series, NSVMMUN2232LT1G

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>ON CHARACTERISTICS</b> (Note 4)					
Output Voltage (on) (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 2.5 V, R <sub>L</sub> = 1.0 kΩ)	V <sub>OL</sub>				Vdc
MMUN2211LT1G, SMMUN2211LT1G		-	-	0.2	
MMUN2212LT1G		-	-	0.2	
MMUN2214LT1G, SMMUN2214LT1G		-	-	0.2	
MMUN2215LT1G, SMMUN2215LT1G		-	-	0.2	
MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		-	-	0.2	
MMUN2230LT1G		-	-	0.2	
MMUN2231LT1G		-	-	0.2	
MMUN2232LT1G, NSVMMUN2232LT1G		-	-	0.2	
MMUN2233LT1G, SMMUN2233LT1G		-	-	0.2	
MMUN2234LT1G, SMMUN2234LT1G		-	-	0.2	
MMUN2238LT1G		-	-	0.2	
(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 3.5 V, R <sub>L</sub> = 1.0 kΩ)					
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		-	-	0.2	
(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 5.0 V, R <sub>L</sub> = 1.0 kΩ)		-	-	0.2	
MMUN2241LT1G		-	-	0.2	
Output Voltage (off) (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.5 V, R <sub>L</sub> = 1.0 kΩ)	V <sub>OH</sub>				Vdc
MMUN2211LT1G, SMMUN2211LT1G		4.9	-	-	
MMUN2212LT1G		4.9	-	-	
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		4.9	-	-	
MMUN2214LT1G, SMMUN2214LT1G		4.9	-	-	
MMUN2233LT1G, SMMUN2233LT1G		4.9	-	-	
(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.05 V, R <sub>L</sub> = 1.0 kΩ)		4.9	-	-	
MMUN2230LT1G		4.9	-	-	
MMUN2234LT1G, SMMUN2234LT1G		4.9	-	-	
(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.25 V, R <sub>L</sub> = 1.0 kΩ)					
MMUN2215LT1G, SMMUN2215LT1G		4.9	-	-	
MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		4.9	-	-	
MMUN2231LT1G		4.9	-	-	
MMUN2232LT1G, NSVMMUN2232LT1G		4.9	-	-	
MMUN2238LT1G		4.9	-	-	
MMUN2241LT1G		4.9	-	-	
Input Resistor	R1				kΩ
MMUN2211LT1G, SMMUN2211LT1G		7.0	10	13	
MMUN2212LT1G		15.4	22	28.6	
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		32.9	47	61.1	
MMUN2214LT1G, SMMUN2214LT1G		7.0	10	13	
MMUN2215LT1G, SMMUN2215LT1G		7.0	10	13	
MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		3.3	4.7	6.1	
MMUN2230LT1G		0.7	1.0	1.3	
MMUN2231LT1G		1.5	2.2	2.9	
MMUN2232LT1G, NSVMMUN2232LT1G		3.3	4.7	6.1	
MMUN2233LT1G, SMMUN2233LT1G		3.3	4.7	6.1	
MMUN2234LT1G, SMMUN2234LT1G		15.4	22	28.6	
MMUN2238LT1G		1.54	2.2	2.88	
MMUN2241LT1G		70	100	130	
Resistor Ratio	R1/R2				
MMUN2211LT1G, SMMUN2211LT1G		0.8	1.0	1.2	
MMUN2212LT1G		0.8	1.0	1.2	
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		0.8	1.0	1.2	
MMUN2214LT1G, SMMUN2214LT1G		0.17	0.21	0.25	
MMUN2215LT1G, SMMUN2215LT1G		-	-	-	
MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		-	-	-	
MMUN2230LT1G		0.8	1.0	1.2	
MMUN2231LT1G		0.8	1.0	1.2	
MMUN2232LT1G, NSVMMUN2232LT1G		0.8	1.0	1.2	
MMUN2233LT1G, SMMUN2233LT1G		0.055	0.1	0.185	
MMUN2234LT1G, SMMUN2234LT1G		0.38	0.47	0.56	
MMUN2238LT1G		-	-	-	
MMUN2241LT1G		-	-	-	

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

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2211LT1G, SMMUN2211LT1G

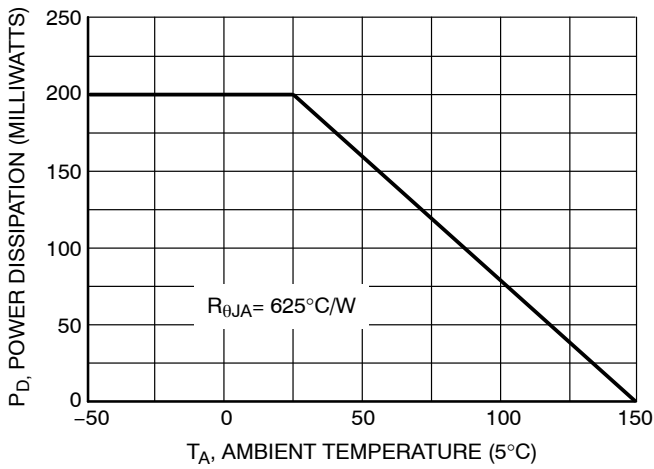


Figure 1. Derating Curve

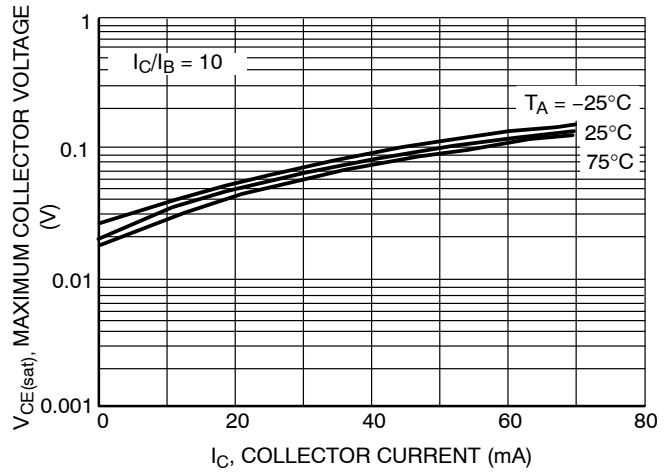


Figure 2. V<sub>CE(sat)</sub> vs. I<sub>C</sub>

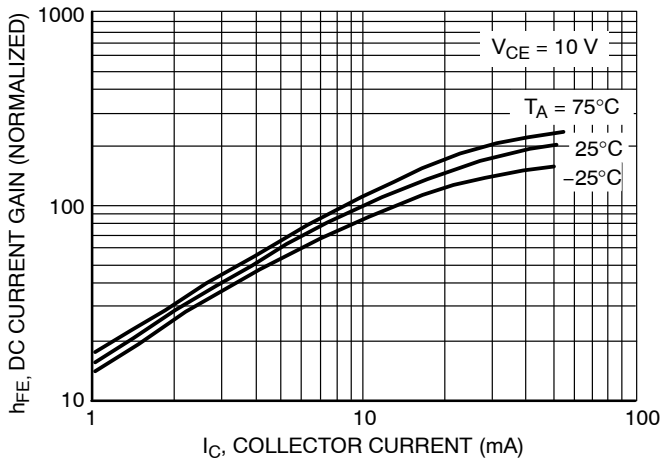


Figure 3. DC Current Gain

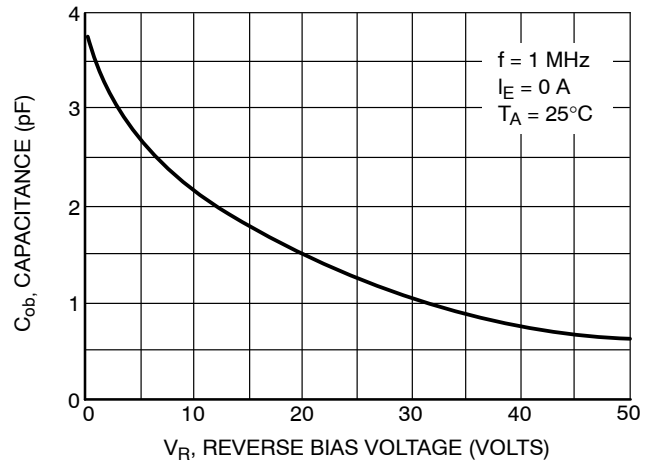


Figure 4. Output Capacitance

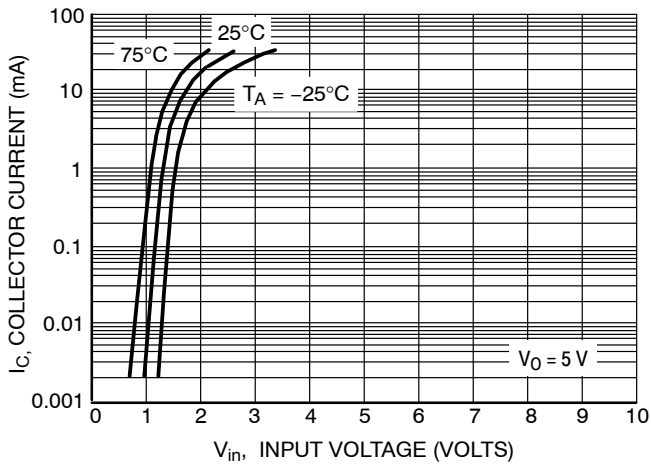


Figure 5. Output Current vs. Input Voltage

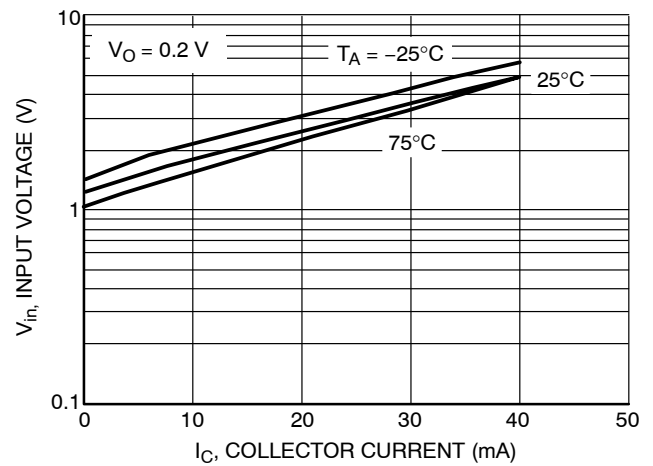


Figure 6. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2212LT1G

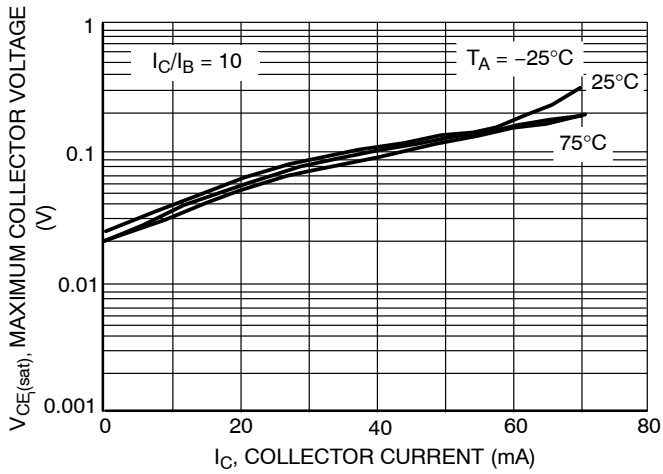


Figure 7.  $V_{CE(sat)}$  vs.  $I_C$

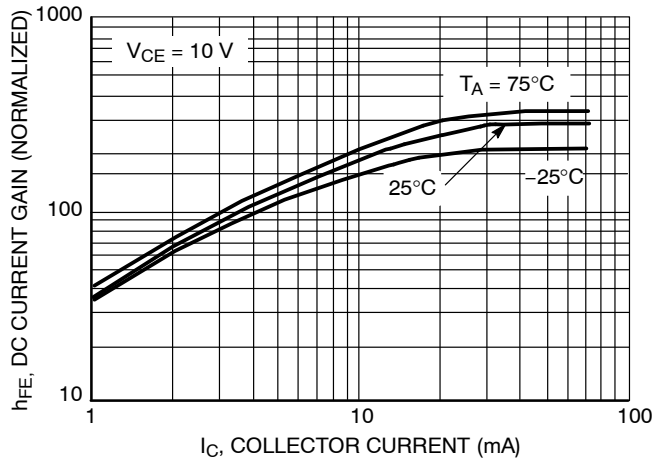


Figure 8. DC Current Gain

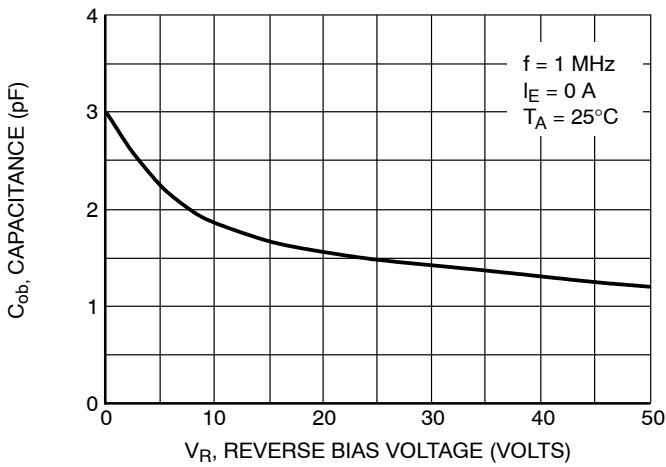


Figure 9. Output Capacitance

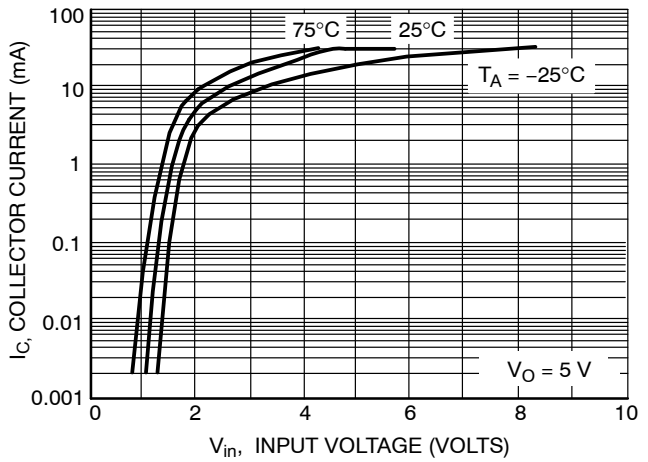


Figure 10. Output Current vs. Input Voltage

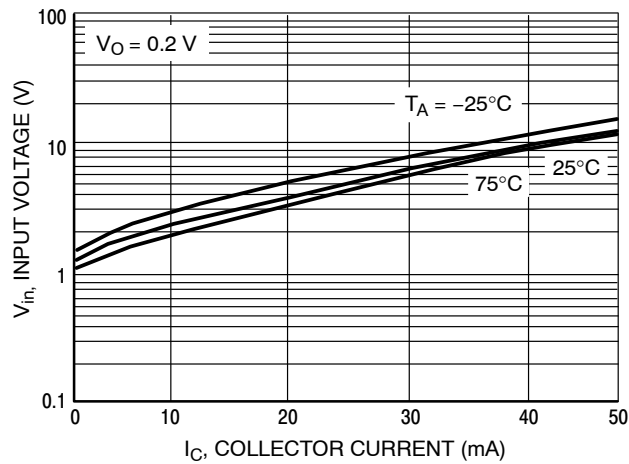


Figure 11. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2213LT1G, SMMUN2213LT1G Series

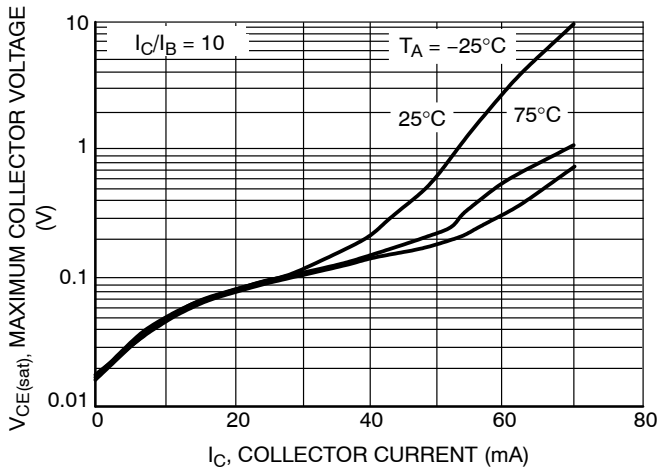


Figure 12.  $V_{CE(sat)}$  vs.  $I_C$

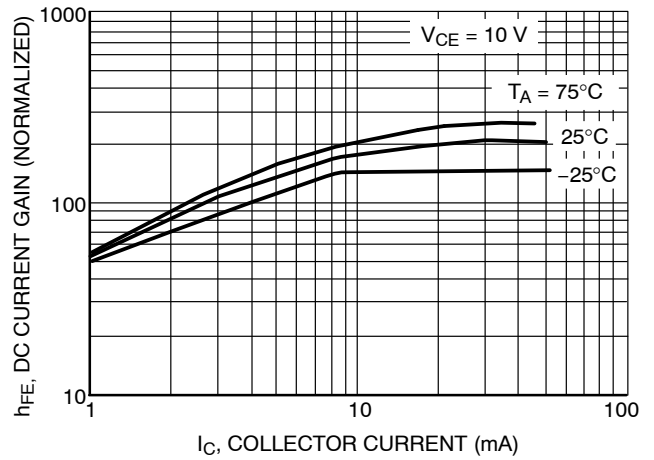


Figure 13. DC Current Gain

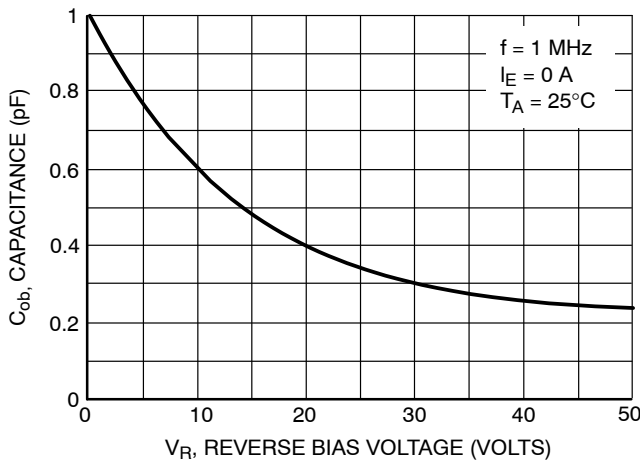


Figure 14. Output Capacitance

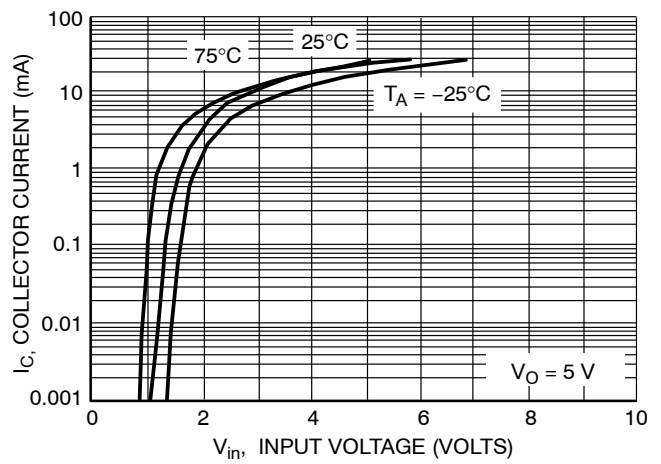


Figure 15. Output Current vs. Input Voltage

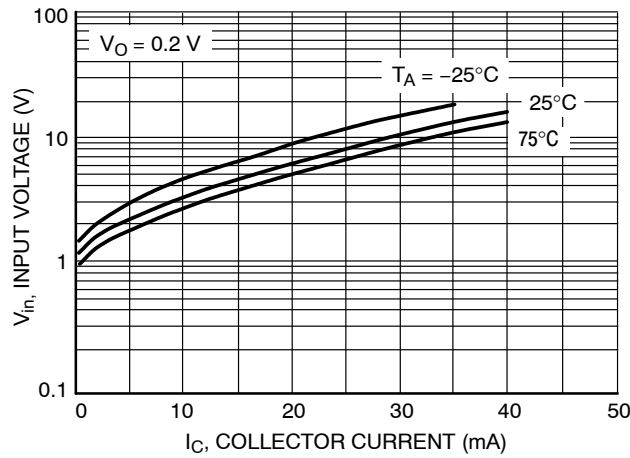


Figure 16. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2214LT1G, SMMUN2214LT1G

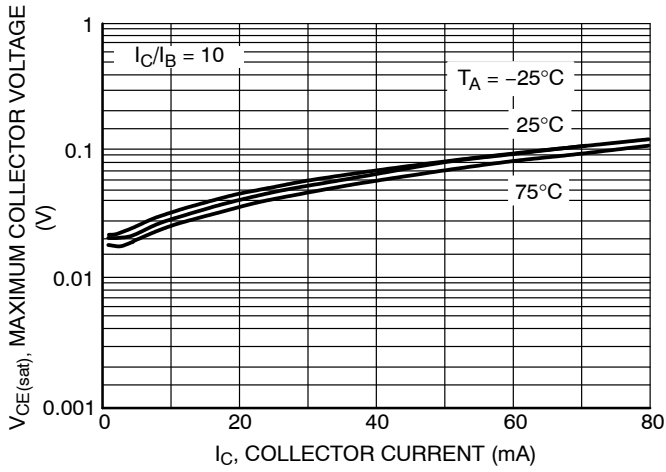


Figure 17.  $V_{CE(sat)}$  vs.  $I_C$

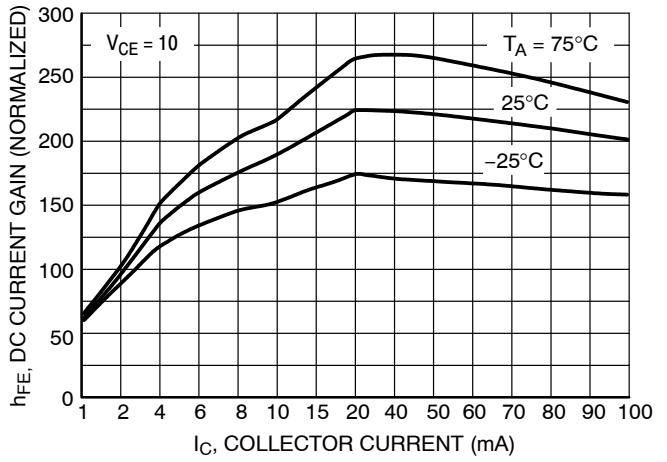


Figure 18. DC Current Gain

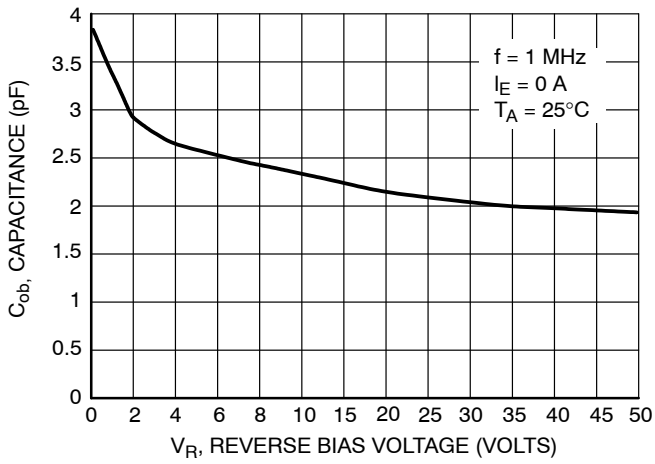


Figure 19. Output Capacitance

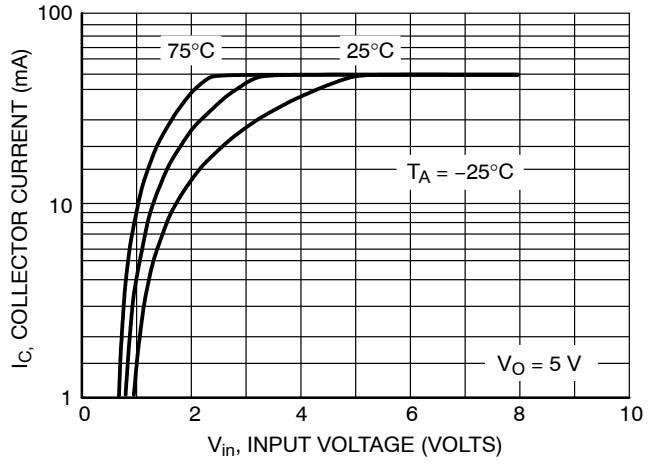


Figure 20. Output Current vs. Input Voltage

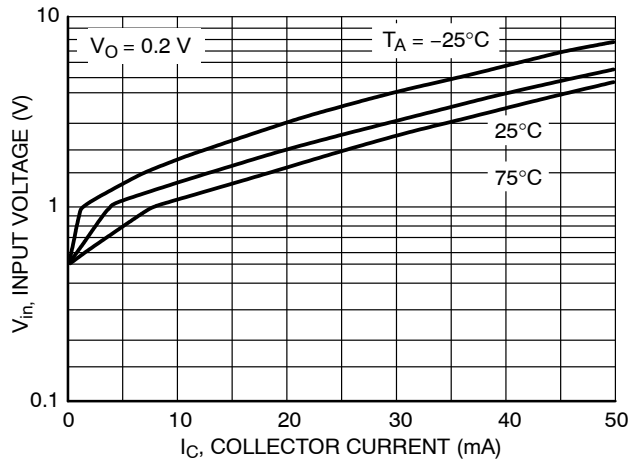


Figure 21. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2215LT1G, SMMUN2215LT1G

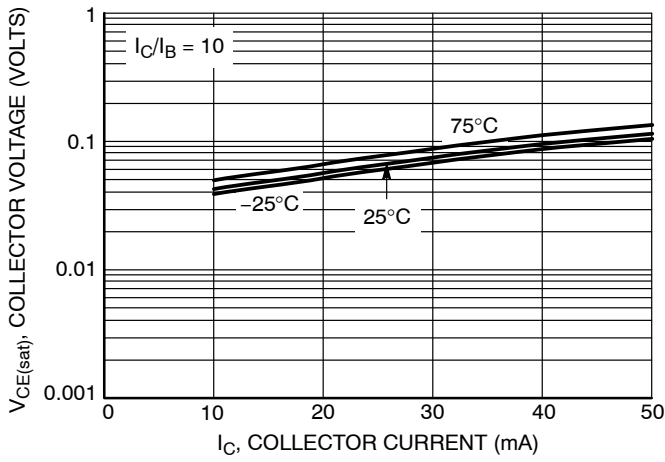


Figure 22.  $V_{CE(sat)}$  versus  $I_C$

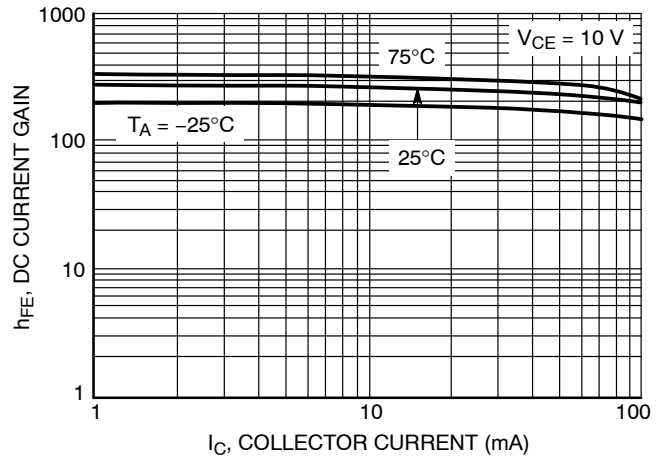


Figure 23. DC Current Gain

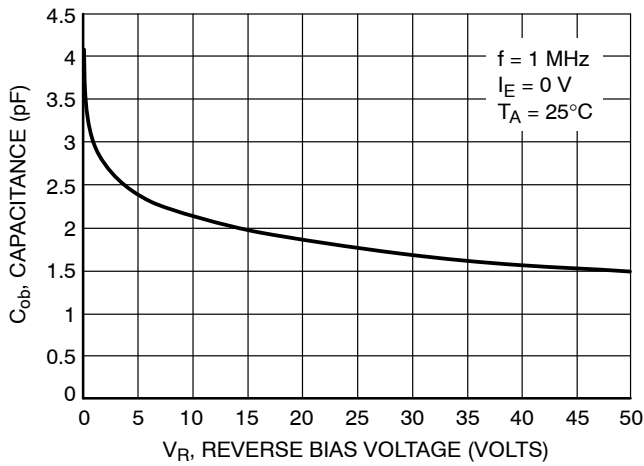


Figure 24. Output Capacitance

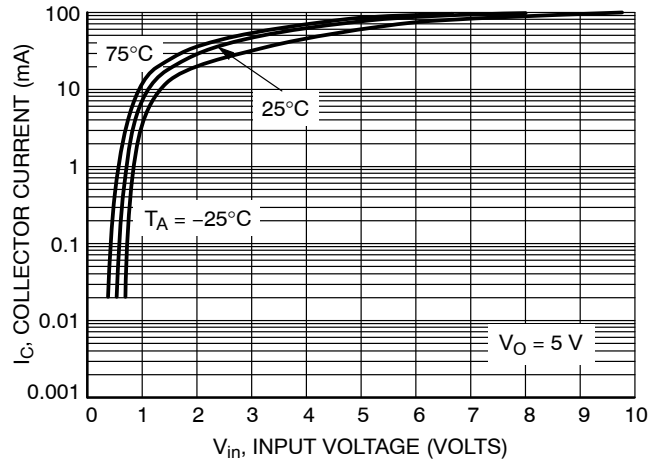


Figure 25. Output Current versus Input Voltage

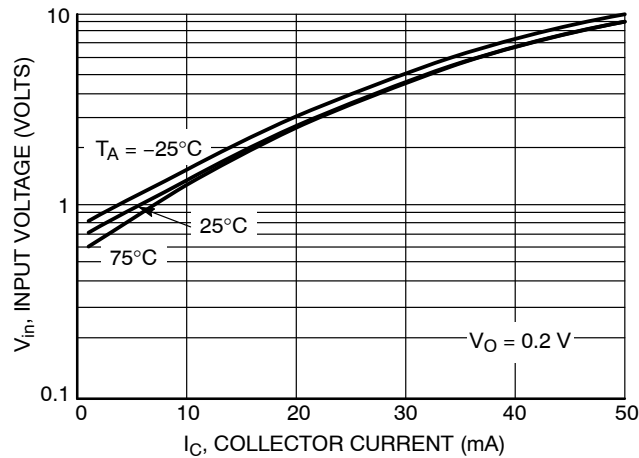


Figure 26. Input Voltage versus Output Current



TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2216LT1G, SMMUN2216LT1G Series

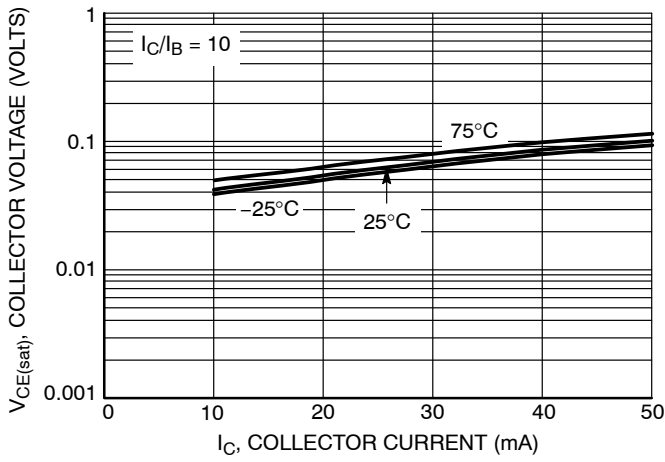


Figure 27.  $V_{CE(sat)}$  versus  $I_C$

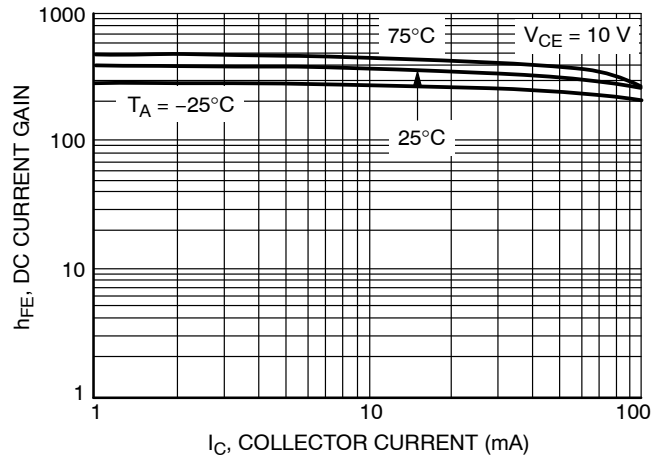


Figure 28. DC Current Gain

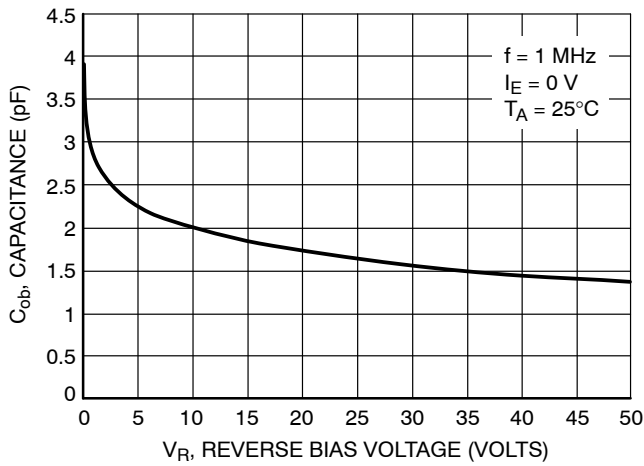


Figure 29. Output Capacitance

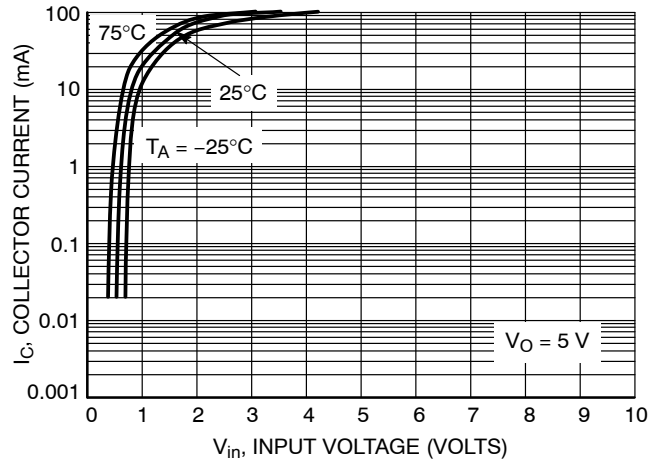


Figure 30. Output Current versus Input Voltage

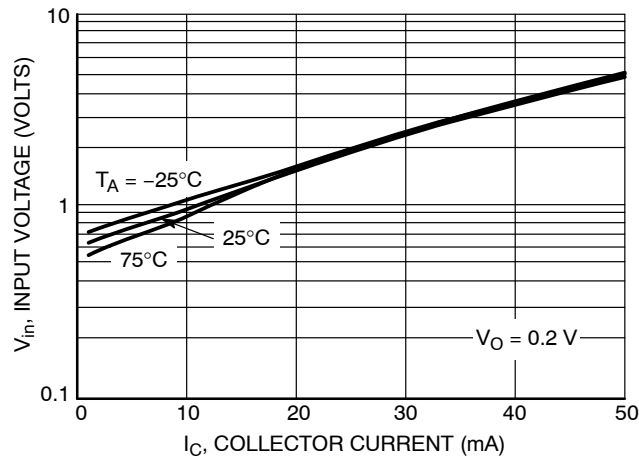


Figure 31. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2230LT1G

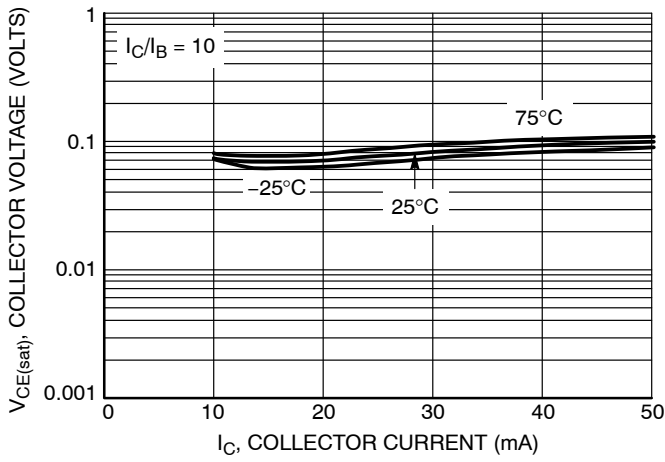


Figure 32.  $V_{CE(sat)}$  versus  $I_C$

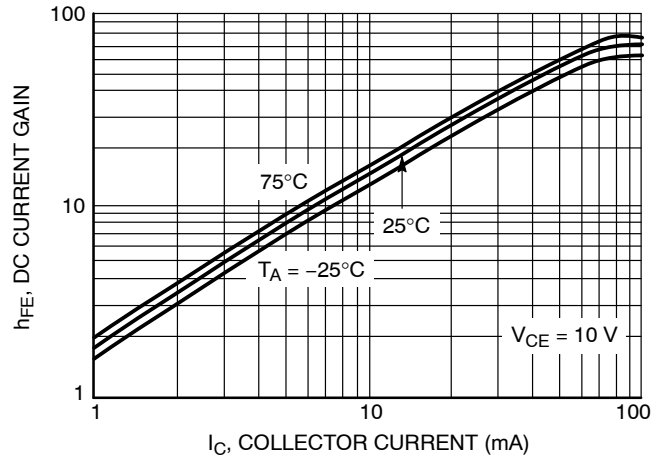


Figure 33. DC Current Gain

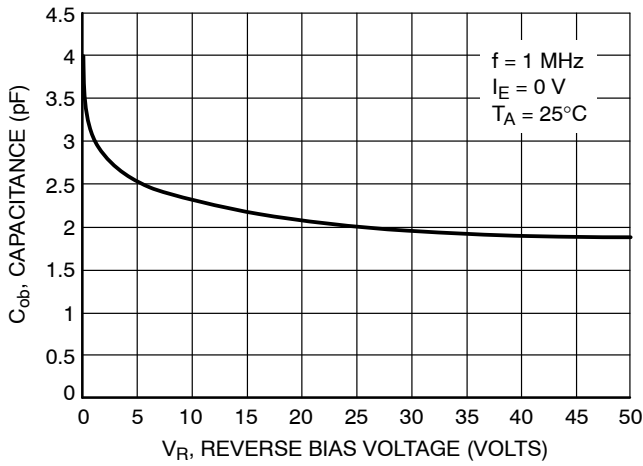


Figure 34. Output Capacitance

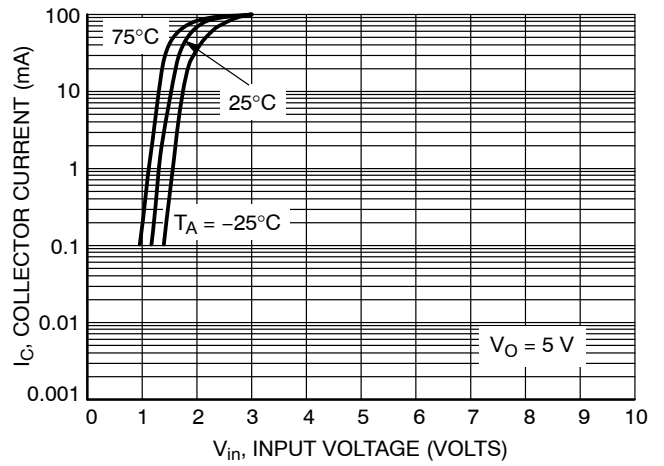


Figure 35. Output Current versus Input Voltage

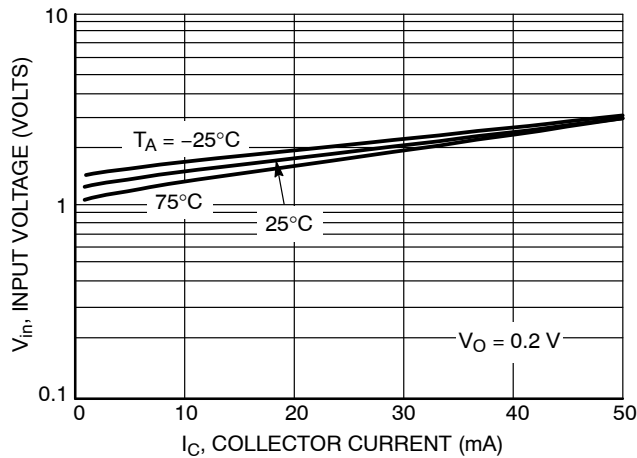


Figure 36. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2231LT1G

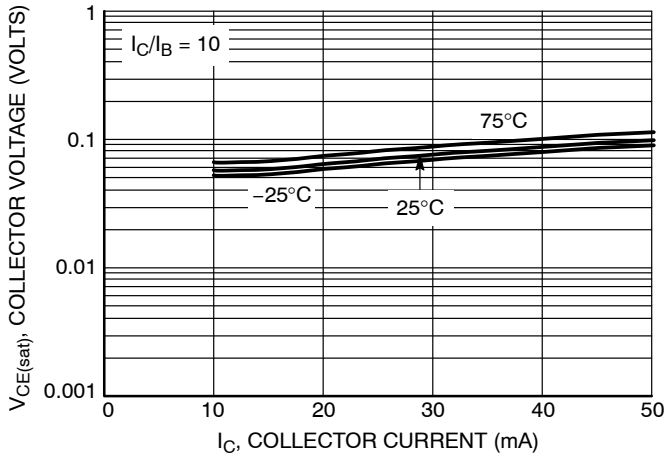


Figure 37.  $V_{CE(sat)}$  versus  $I_C$

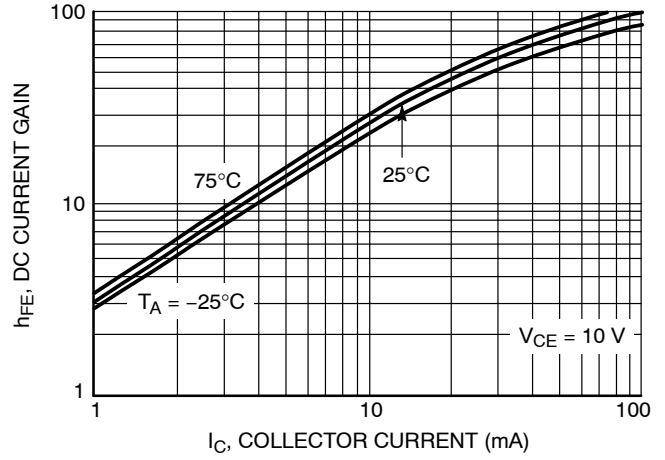


Figure 38. DC Current Gain

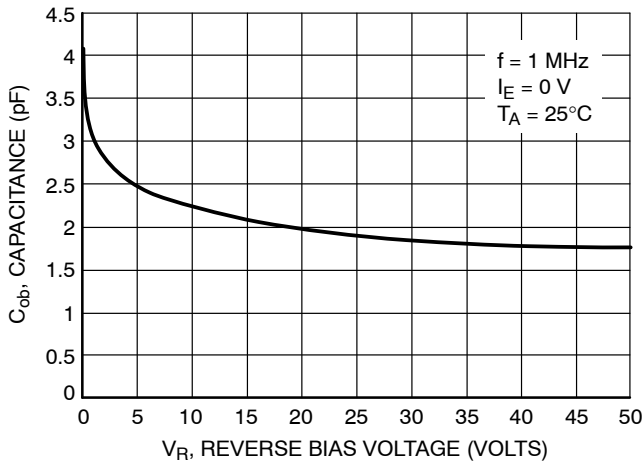


Figure 39. Output Capacitance

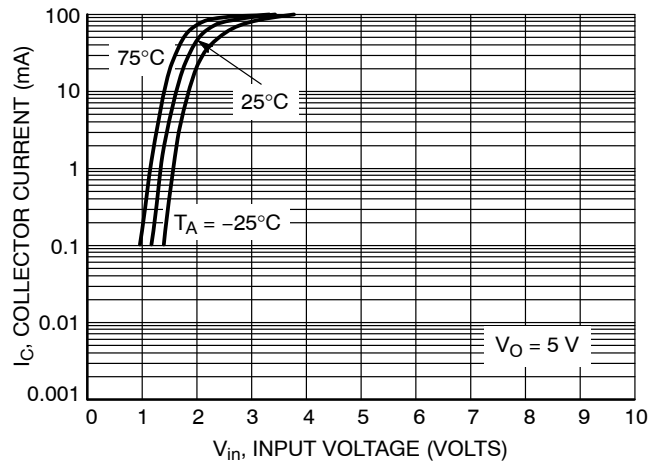


Figure 40. Output Current versus Input Voltage

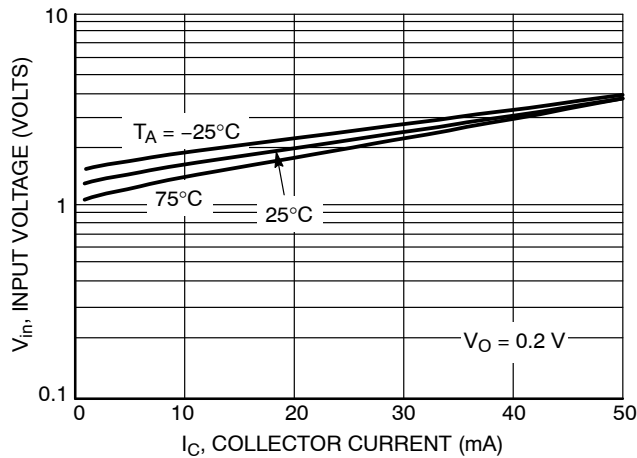


Figure 41. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2232LT1G, NSVMMUN2232LT1G

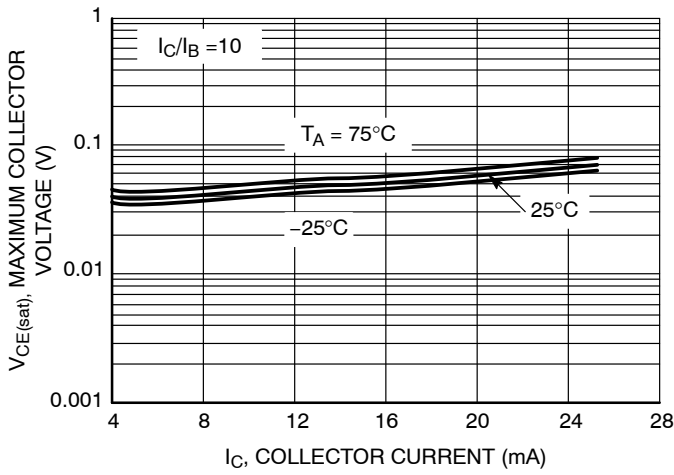


Figure 42.  $V_{CE(sat)}$  vs.  $I_C$

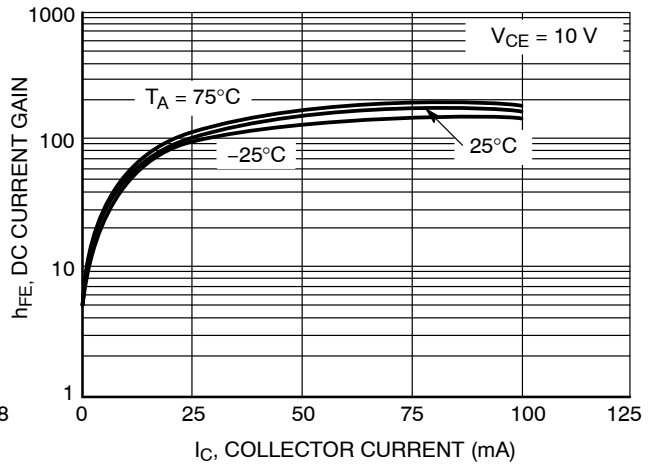


Figure 43. DC Current Gain

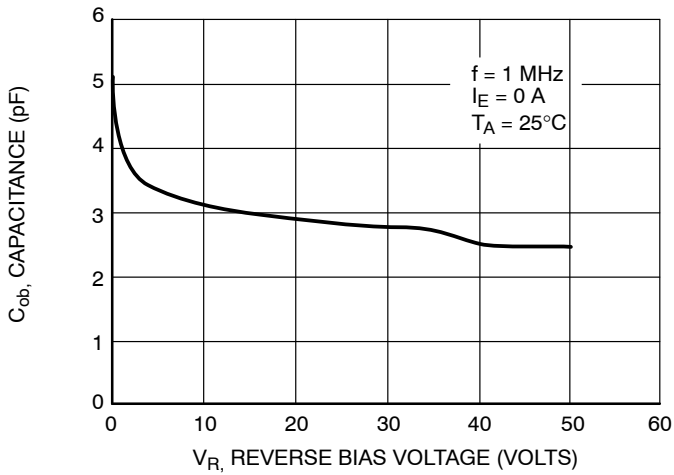


Figure 44. Output Capacitance

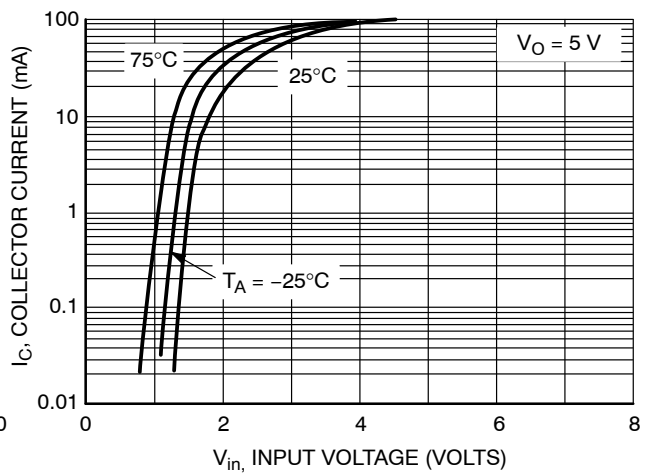


Figure 45. Output Current vs. Input Voltage

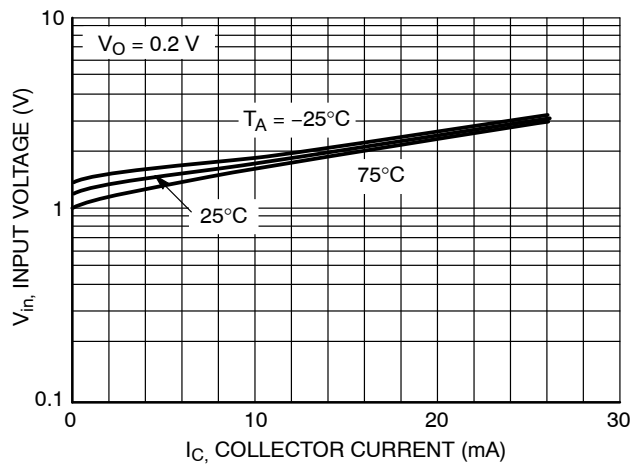


Figure 46. Output Voltage vs. Input Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2233LT1G, SMMUN2233LT1G

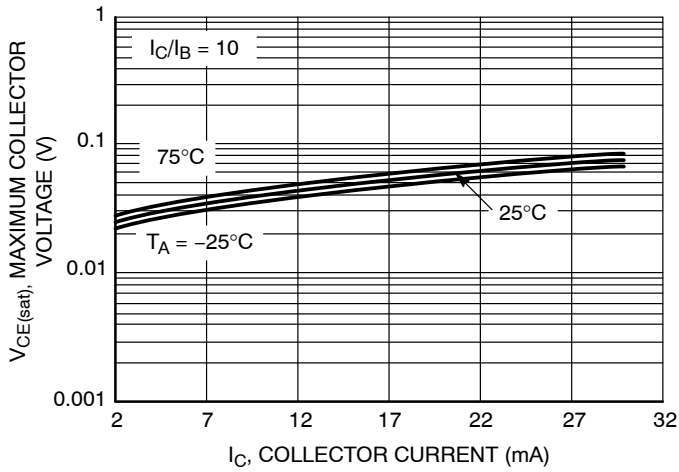


Figure 47.  $V_{CE(sat)}$  vs.  $I_C$

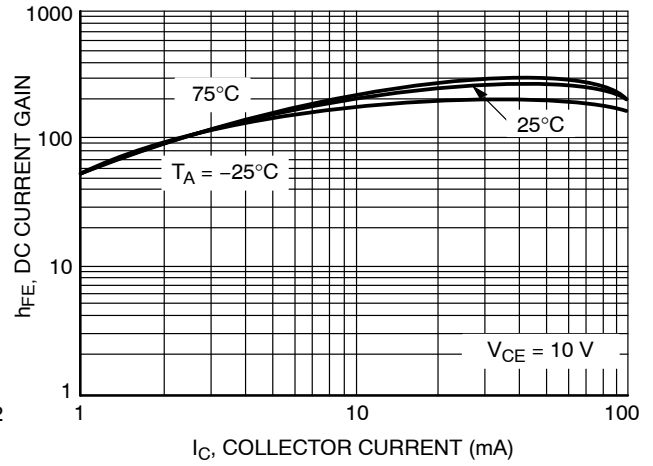


Figure 48. DC Current Gain

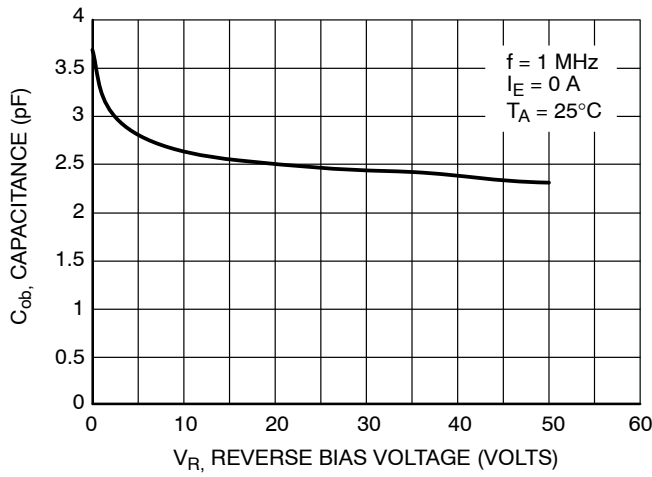


Figure 49. Output Capacitance

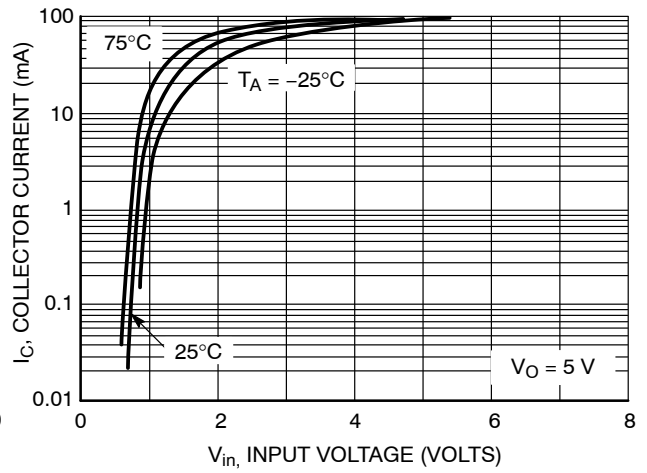


Figure 50. Output Current vs. Input Voltage

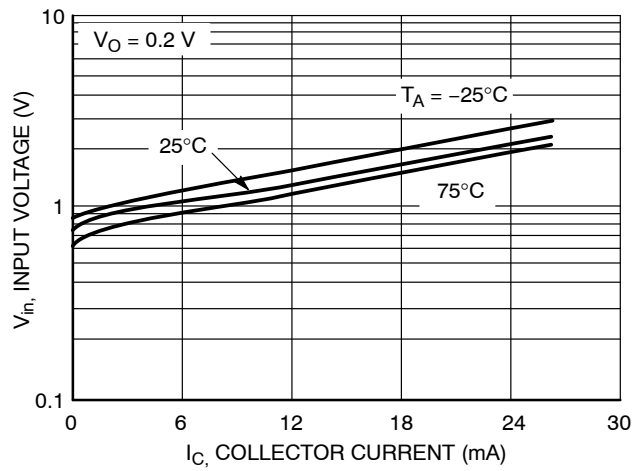


Figure 51. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2234LT1G, SMMUN2234LT1G

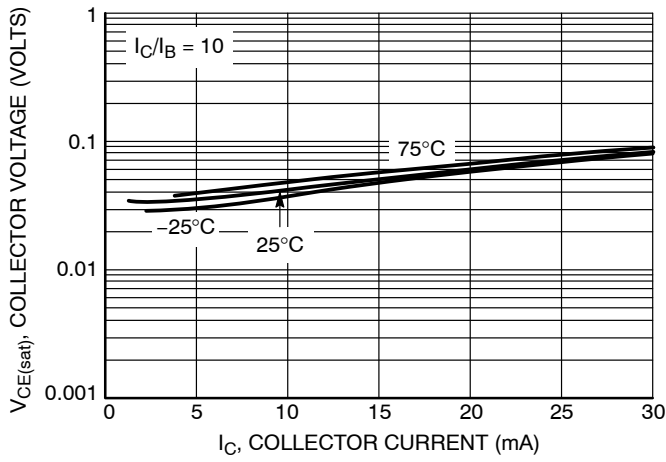


Figure 52.  $V_{CE(sat)}$  versus  $I_C$

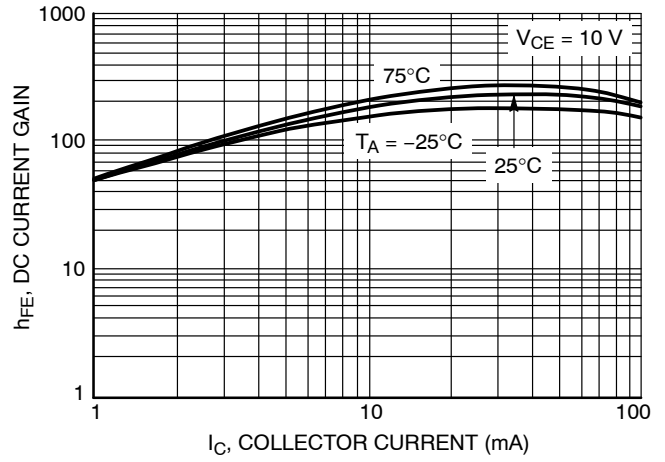


Figure 53. DC Current Gain

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2238LT1G

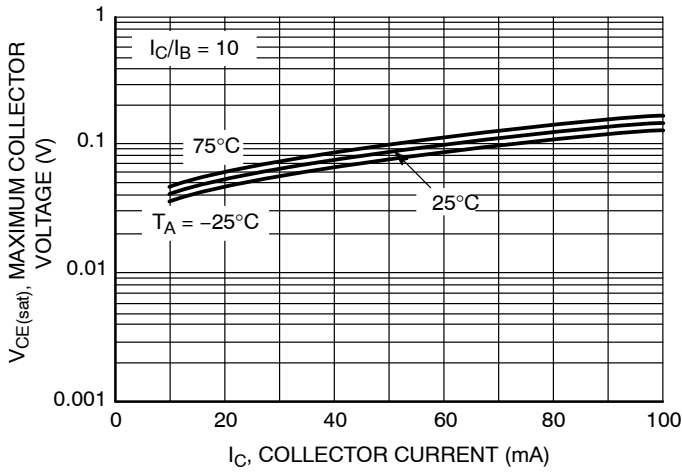


Figure 54.  $V_{CE(sat)}$  vs.  $I_C$

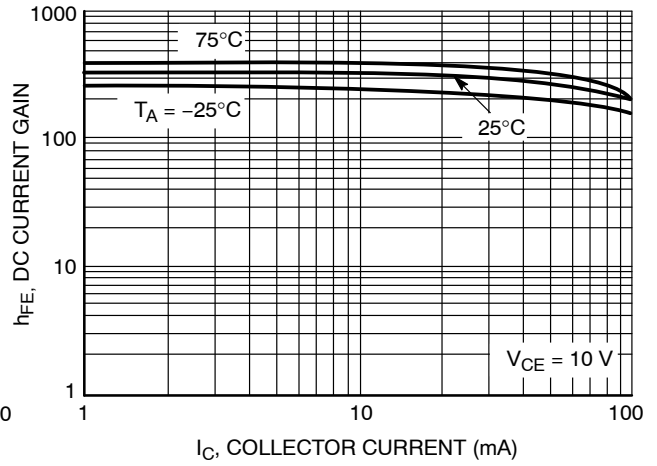


Figure 55. DC Current Gain

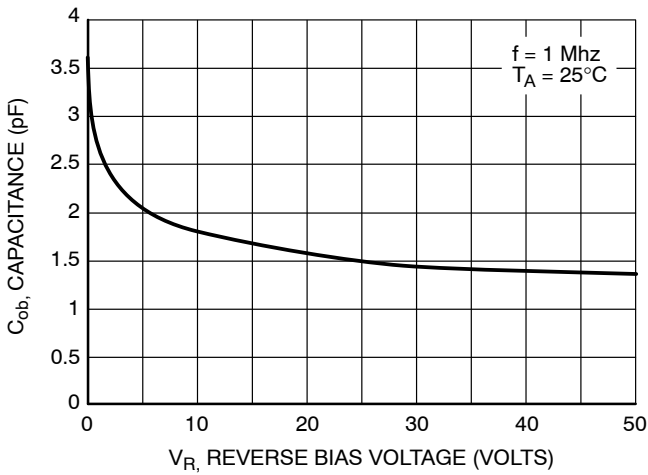


Figure 56. Output Capacitance

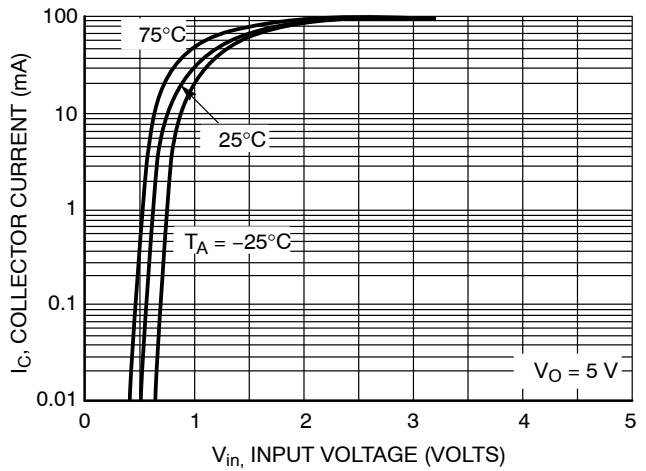


Figure 57. Output Current vs. Input Voltage

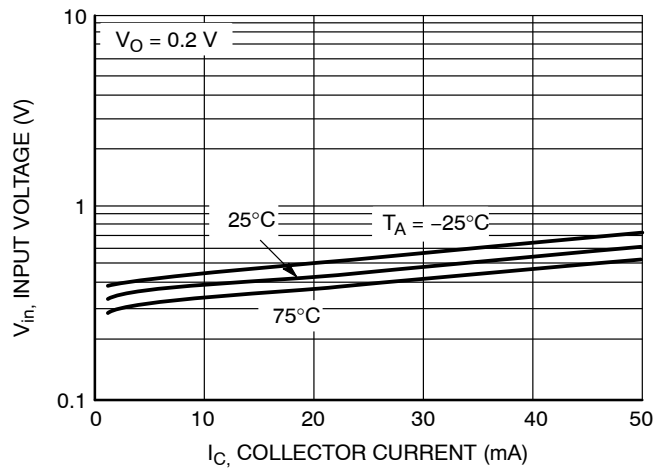


Figure 58. Input Voltage vs. Output Current

TYPICAL APPLICATIONS FOR NPN BRTs

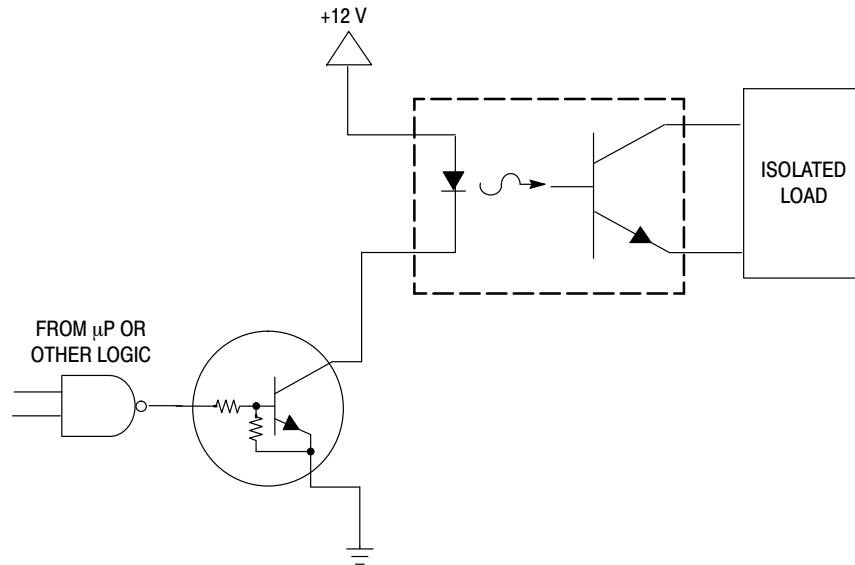


Figure 59. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

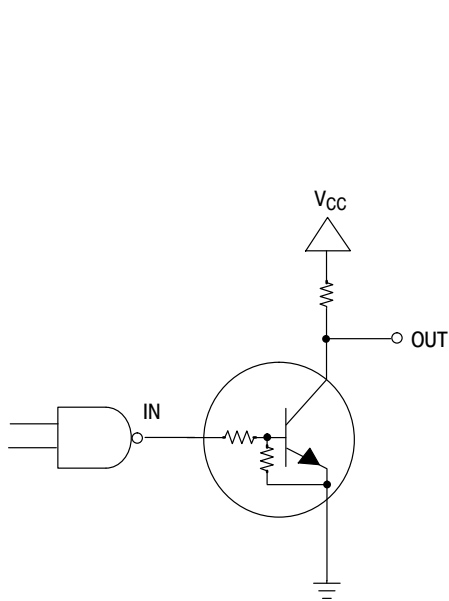


Figure 60. Open Collector Inverter: Inverts the Input Signal

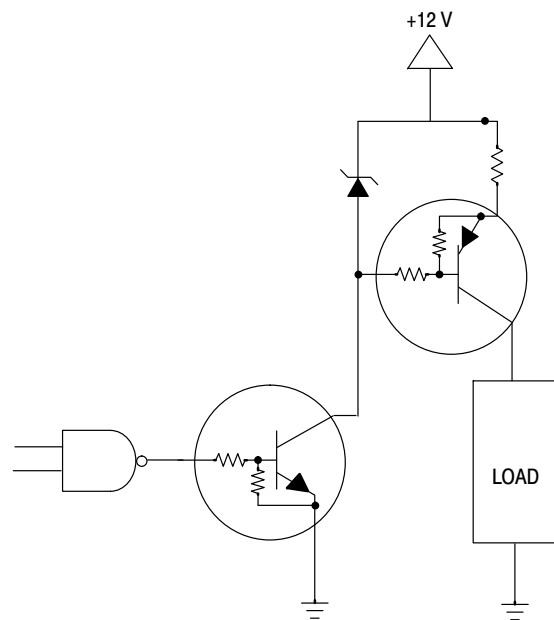


Figure 61. Inexpensive, Unregulated Current Source



# MMUN2211LT1G Series, SMMUN2211LT1G Series, NSVMMUN2232LT1G

## ORDERING INFORMATION

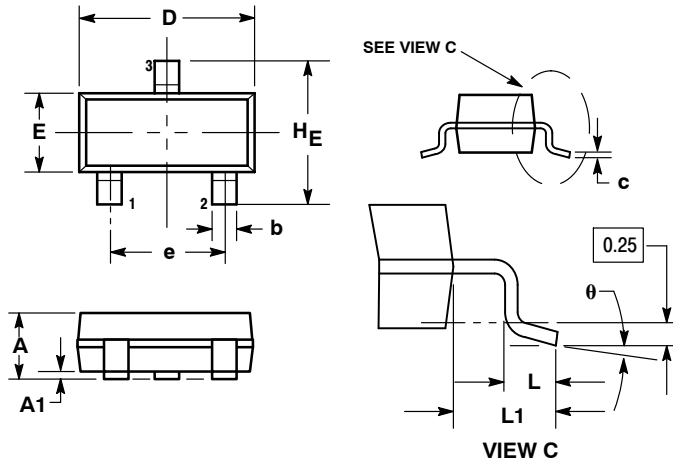
Device	Marking	R1(k)	R2(k)	Package	Shipping <sup>†</sup>
MMUN2211LT1G	A8A	10	10	SOT-23 (Pb-Free)	3000 / Tape & Reel
MMUN2211LT3G		10	10		10,000 / Tape & Reel
MMUN2212LT1G	A8B	22	22	SOT-23 (Pb-Free)	3000 / Tape & Reel
MMUN2213LT1G	A8C	47	47	SOT-23 (Pb-Free)	
MMUN2214LT1G	A8D	10	47	SOT-23 (Pb-Free)	
MMUN2215LT1G	A8E	10	∞	SOT-23 (Pb-Free)	
MMUN2216LT1G	A8F	4.7	∞	SOT-23 (Pb-Free)	
MMUN2230LT1G	A8G	1.0	1.0	SOT-23 (Pb-Free)	
MMUN2231LT1G	A8H	2.2	2.2	SOT-23 (Pb-Free)	
MMUN2232LT1G	A8J	4.7	4.7	SOT-23 (Pb-Free)	
MMUN2233LT1G	A8K	4.7	47	SOT-23 (Pb-Free)	
MMUN2234LT1G	A8L	22	47	SOT-23 (Pb-Free)	
MMUN2234LT3G		22	47	SOT-23 (Pb-Free)	
MMUN2238LT1G	A8R	2.2	∞	SOT-23 (Pb-Free)	
MMUN2241LT1G	A8U	100	∞	SOT-23 (Pb-Free)	
SMMUN2211LT1G	A8A	10	10	SOT-23 (Pb-Free)	3000 / Tape & Reel
SMMUN2211LT3G		10	10		10,000 / Tape & Reel
SMMUN2213LT1G	A8C	47	47	SOT-23 (Pb-Free)	3000 / Tape & Reel
SMMUN2213LT3G	A8C	47	47		10,000 / Tape & Reel
SMMUN2214LT1G	A8D	10	47	SOT-23 (Pb-Free)	3000 / Tape & Reel
SMMUN2215LT1G	A8E	10	∞	SOT-23 (Pb-Free)	3000 / Tape & Reel
SMMUN2216LT1G	A8F	4.7	∞	SOT-23 (Pb-Free)	3000 / Tape & Reel
SMMUN2216LT3G		4.7	∞		10,000 / Tape & Reel
SMMUN2233LT1G	A8K	4.7	4.7	SOT-23 (Pb-Free)	3000 / Tape & Reel
SMMUN2234LT1G	A8L	22	47	SOT-23 (Pb-Free)	3000 / Tape & Reel
NSVMMUN2232LT1G	A8J	4.7	4.7	SOT-23 (Pb-Free)	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.

# MMUN2211LT1G Series, SMMUN2211LT1G Series, NSVMMUN2232LT1G

## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AP



NOTES:

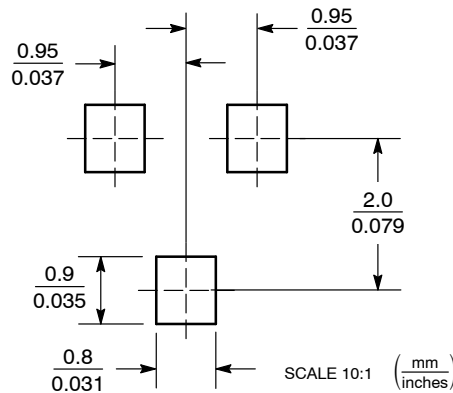
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.040	0.044
A1	0.01	0.06	0.10	0.001	0.002	0.004
b	0.37	0.44	0.50	0.015	0.018	0.020
c	0.09	0.13	0.18	0.003	0.005	0.007
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.081
L	0.10	0.20	0.30	0.004	0.008	0.012
L1	0.35	0.54	0.69	0.014	0.021	0.029
HE	2.10	2.40	2.64	0.083	0.094	0.104
θ	0°	---	10°	0°	---	10°

STYLE 6:

- PIN 1. BASE
- EMITTER
- 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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