MMUN2211LT1G Series, SMMUN2211LT1G Series, NSVMMUN2232LT1G

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_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	246 (Note 1) 400 (Note 2) 1.5 (Note 1) 2.0 (Note 2)	mW °C/W
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	508 (Note 1) 311 (Note 2)	°C/W
Thermal Resistance, Junction−to−Lead	$R_{\theta JL}$	174 (Note 1) 208 (Note 2)	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	−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

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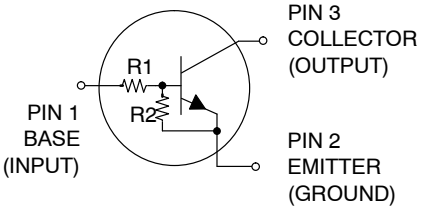
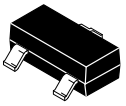
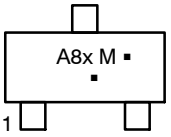




SOT−23
CASE 318
STYLE 6

MARKING DIAGRAM



A8x = Specific Device Code
M = Date Code*
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*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.

January, 2012 − Rev. 13

Publication Order Number:
MMUN2211LT1/D

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	MMUN2211LT1G, SMMUN2211LT1G	I_{EBO}	–	–	0.5	mAdc
(V_{EB} = 6.0 V, I_C = 0)	MMUN2212LT1G		–	–	0.2	
	MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		–	–	0.1	
	MMUN2214LT1G, SMMUN2214LT1G		–	–	0.2	
	MMUN2215LT1G, SMMUN2215LT1G		–	–	0.9	
	MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		–	–	1.9	
	MMUN2230LT1G		–	–	4.3	
	MMUN2231LT1G		–	–	2.3	
	MMUN2232LT1G, NSVMMUN2232LT1G		–	–	1.5	
	MMUN2233LT1G, SMMUN2233LT1G		–	–	0.18	
	MMUN2234LT1G, SMMUN2234LT1G		–	–	0.13	
	MMUN2238LT1G		–	–	4.0	
	MMUN2241LT1G		–	–	0.1	
Collector−Base Breakdown Voltage (I_C = 10 μA, I_E = 0)		$V_{(BR)CBO}$	50	–	–	Vdc
Collector−Emitter Breakdown Voltage (Note 3), (I_C = 2.0 mA, I_B = 0)		$V_{(BR)CEO}$	50	–	–	Vdc
ON CHARACTERISTICS (Note 3)						
DC Current Gain	MMUN2211LT1G, SMMUN2211LT1G	h_{FE}	35	60	–	
(V_{CE} = 10 V, I_C = 5.0 mA)	MMUN2212LT1G		60	100	–	
	MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		80	140	–	
	MMUN2214LT1G, SMMUN2214LT1G		80	140	–	
	MMUN2215LT1G, SMMUN2215LT1G		160	350	–	
	MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		160	350	–	
	MMUN2230LT1G		3.0	5.0	–	
	MMUN2231LT1G		8.0	15	–	
	MMUN2232LT1G, NSVMMUN2232LT1G		15	30	–	
	MMUN2233LT1G, SMMUN2233LT1G		80	200	–	
	MMUN2234LT1G, SMMUN2234LT1G		80	150	–	
	MMUN2238LT1G		160	350	–	
	MMUN2241LT1G		160	350	–	
Collector−Emitter Saturation Voltage		$V_{CE(sat)}$				Vdc
(I_C = 10 mA, I_B = 0.3 mA)	MMUN2211LT1G, SMMUN2211LT1G		–	–	0.25	
	MMUN2212LT1G		–	–	0.25	
	MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		–	–	0.25	
	MMUN2214LT1G, SMMUN2214LT1G		–	–	0.25	
	MMUN2234LT1G, SMMUN2234LT1G		–	–	0.25	
(I_C = 10 mA, I_B = 1 mA)	MMUN2215LT1G, SMMUN2215LT1G		–	–	0.25	
	MMUN2216LT1G, SMMUN2216LT1G, SMMUN2216LT3G		–	–	0.25	
	MMUN2232LT1G, NSVMMUN2232LT1G		–	–	0.25	
	MMUN2233LT1G, SMMUN2233LT1G		–	–	0.25	
	MMUN2238LT1G		–	–	0.25	
(I_C = 10 mA, I_B = 5 mA)	MMUN2230LT1G		–	–	0.25	
	MMUN2231LT1G		–	–	0.25	
	MMUN2241LT1G		–	–	0.25	

3. 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 4)					
Output Voltage (on)	V_{OL}				Vdc
(V_{CC} = 5.0 V, V_B = 2.5 V, R_L = 1.0 kΩ)					
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_{CC} = 5.0 V, V_B = 3.5 V, R_L = 1.0 kΩ)					
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		–	–	0.2	
(V_{CC} = 5.0 V, V_B = 5.0 V, R_L = 1.0 kΩ) MMUN2241LT1G		–	–	0.2	
Output Voltage (off)	V_{OH}				Vdc
(V_{CC} = 5.0 V, V_B = 0.5 V, R_L = 1.0 kΩ)					
MMUN2211LT1G, SMMUN2211LT1G		4.9	–	–	
MMUN2212LT1G		4.9	–	–	
MMUN2213LT1G, SMMUN2213LT1G, SMMUN2213LT3G		4.9	–	–	
MMUN2214LT1G, SMMUN2214LT1G		4.9	–	–	
MMUN2233LT1G, SMMUN2233LT1G		4.9	–	–	
(V_{CC} = 5.0 V, V_B = 0.05 V, R_L = 1.0 kΩ) MMUN2230LT1G		4.9	–	–	
MMUN2234LT1G, SMMUN2234LT1G		4.9	–	–	
(V_{CC} = 5.0 V, V_B = 0.25 V, R_L = 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 MMUN2211LT1G, SMMUN2211LT1G	R1	7.0	10	13	kΩ
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 MMUN2211LT1G, SMMUN2211LT1G	R1/R2	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

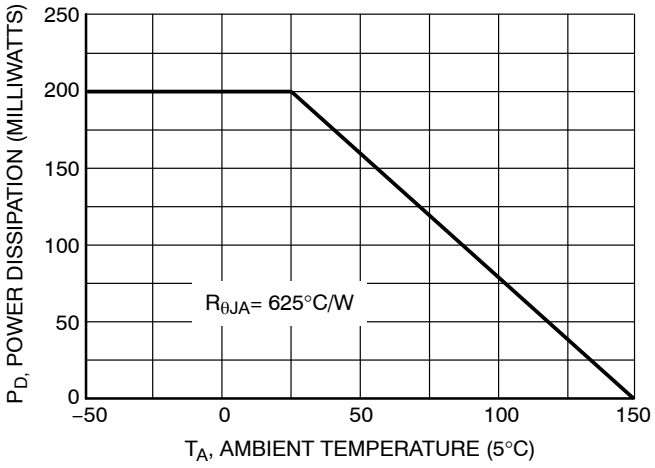


Figure 1. Derating Curve

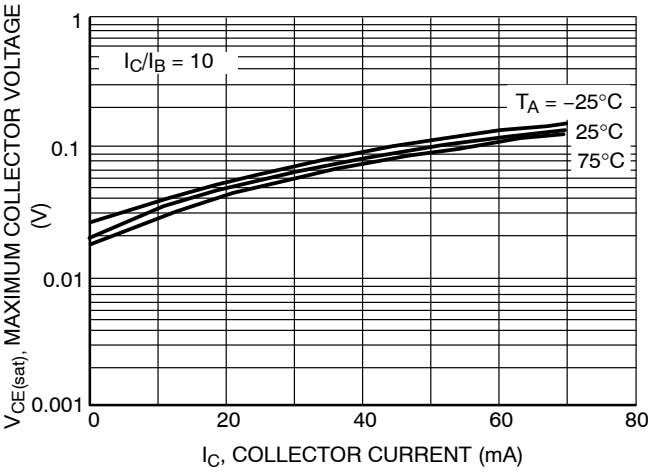


Figure 2. $V_{CE(sat)}$ vs. I_C

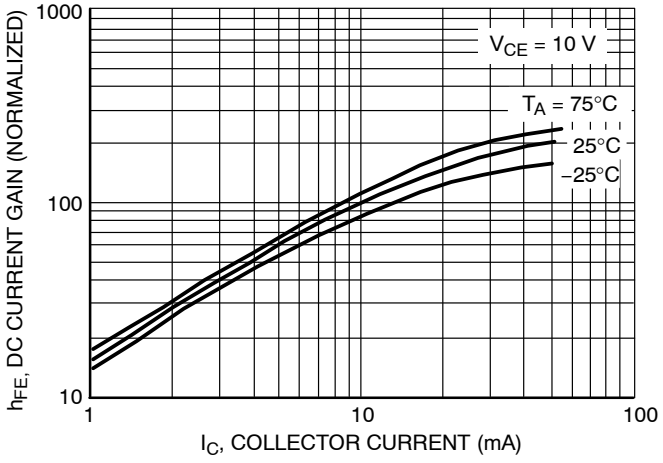


Figure 3. DC Current Gain

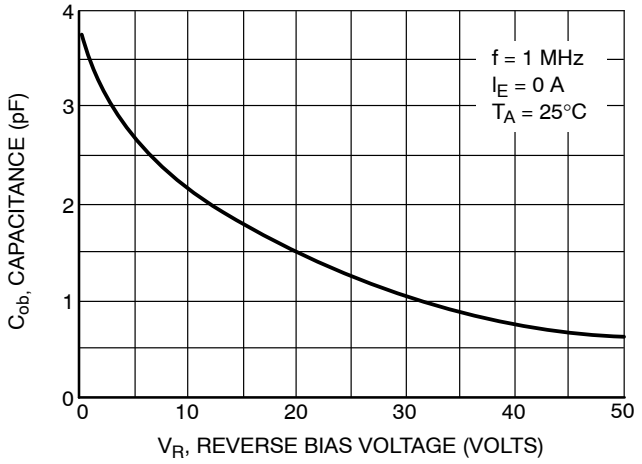


Figure 4. Output Capcitance

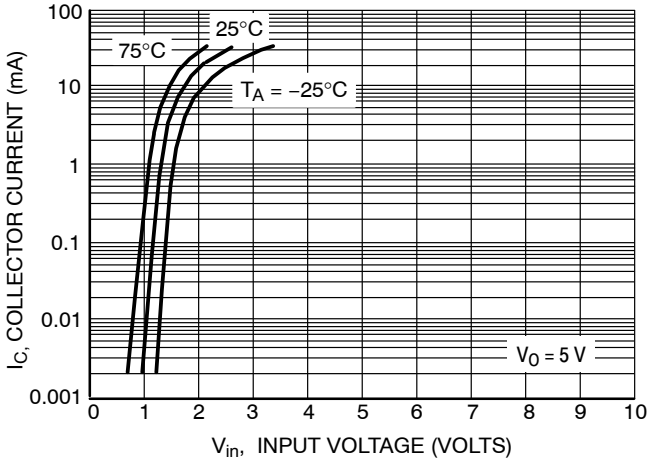


Figure 5. Output Current vs. Input Voltage

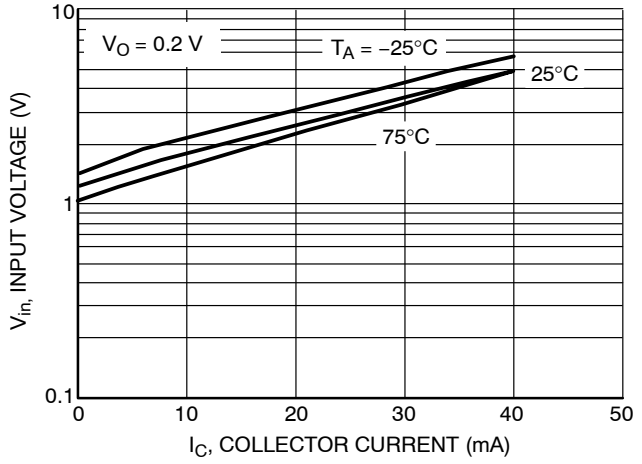


Figure 6. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2212LT1G

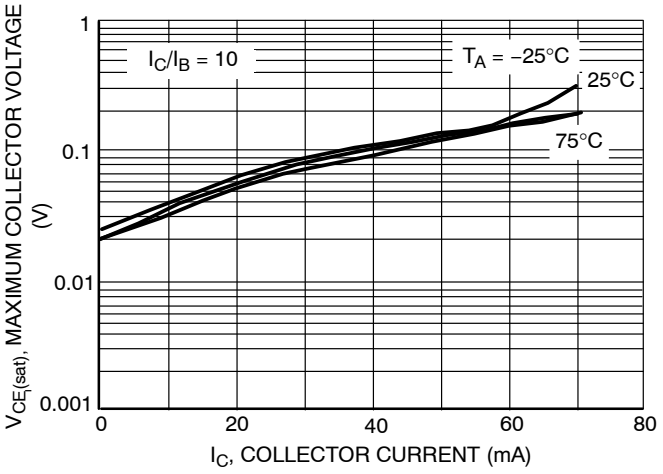


Figure 7. $V_{CE(sat)}$ vs. I_C

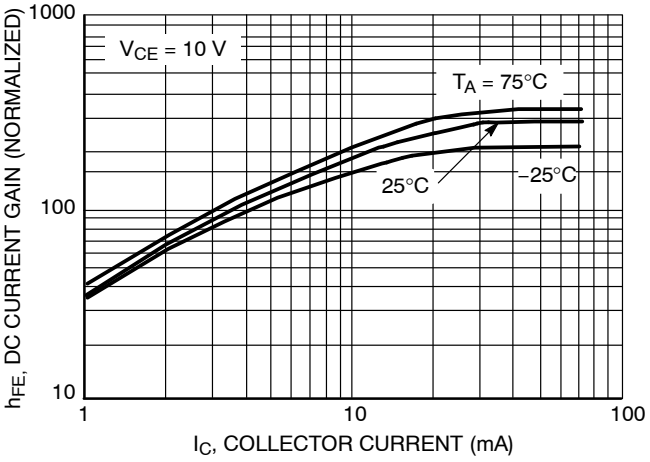


Figure 8. DC Current Gain

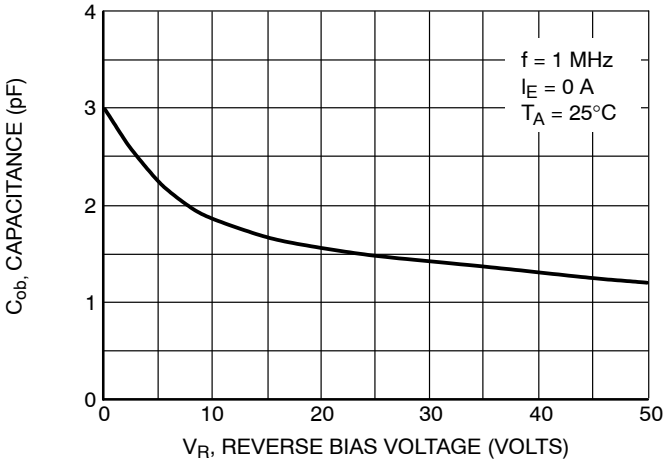


Figure 9. Output Capacitance

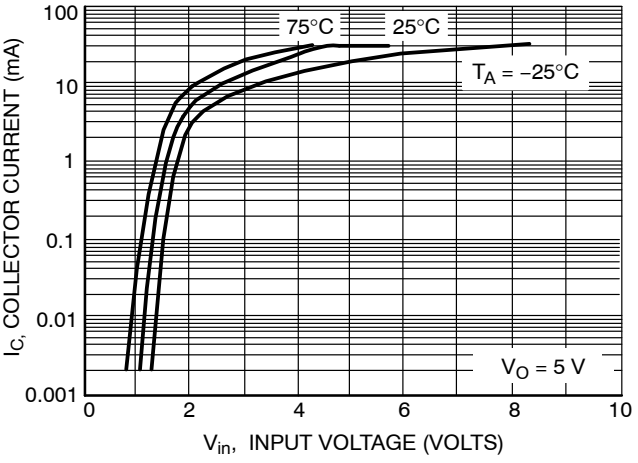


Figure 10. Output Current vs. Input Voltage

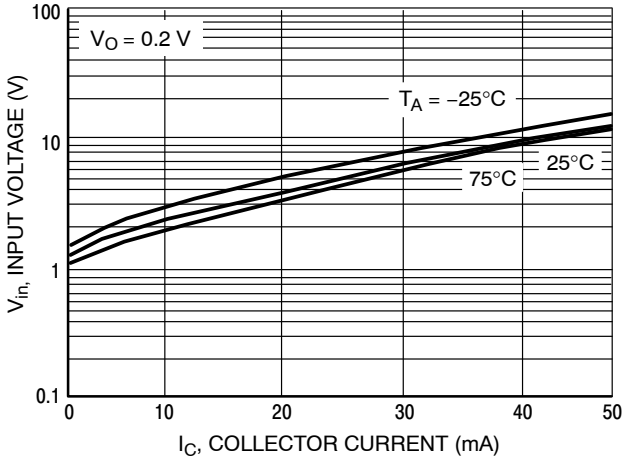


Figure 11. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2213LT1G, SMMUN2213LT1G Series

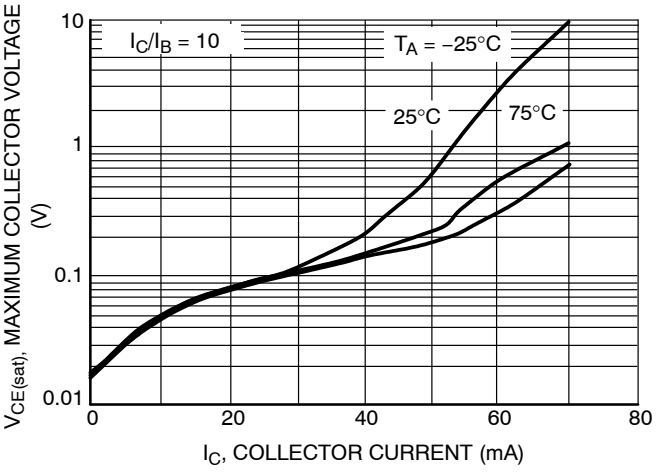


Figure 12. $V_{CE(sat)}$ vs. I_C

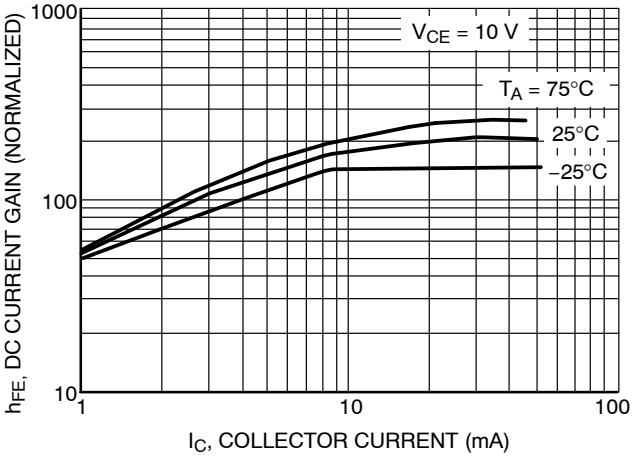


Figure 13. DC Current Gain

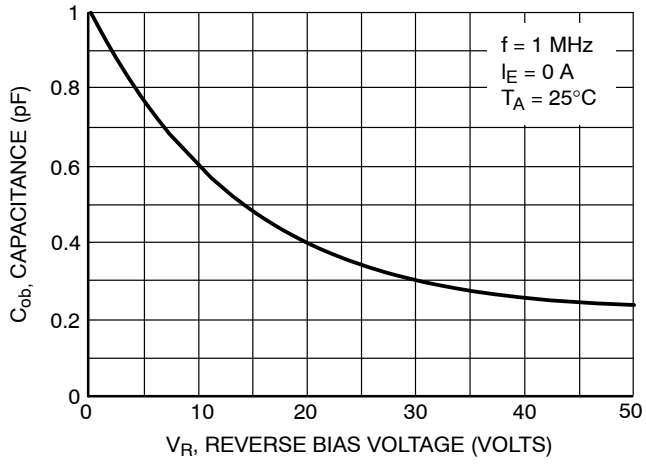


Figure 14. Output Capacitance

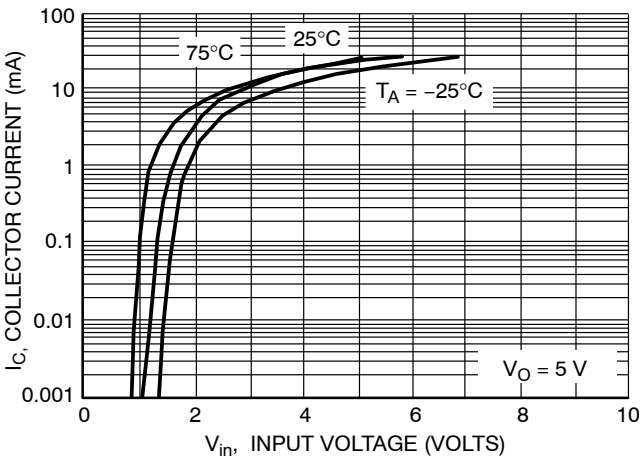


Figure 15. Output Current vs. Input Voltage

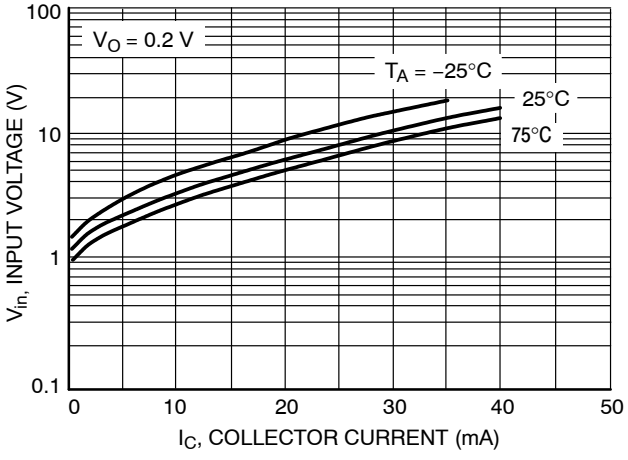


Figure 16. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2214LT1G, SMMUN2214LT1G

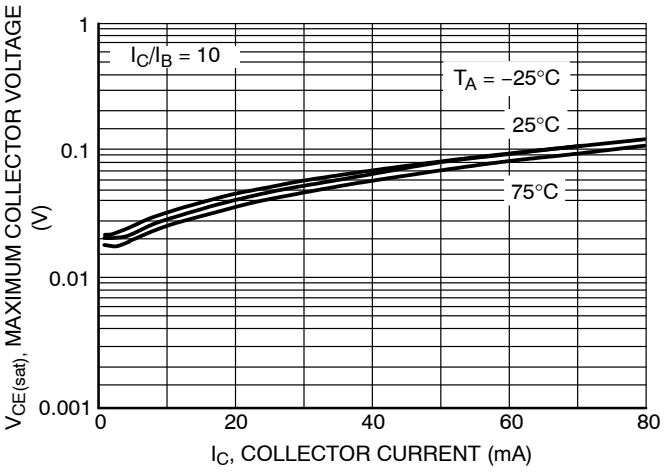


Figure 17. $V_{CE(sat)}$ vs. I_C

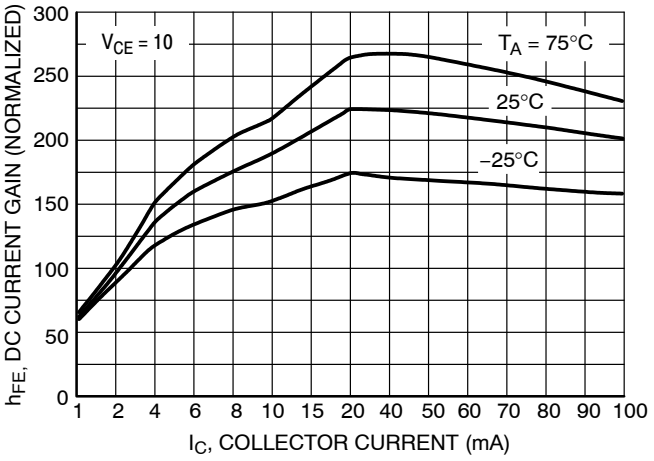


Figure 18. DC Current Gain

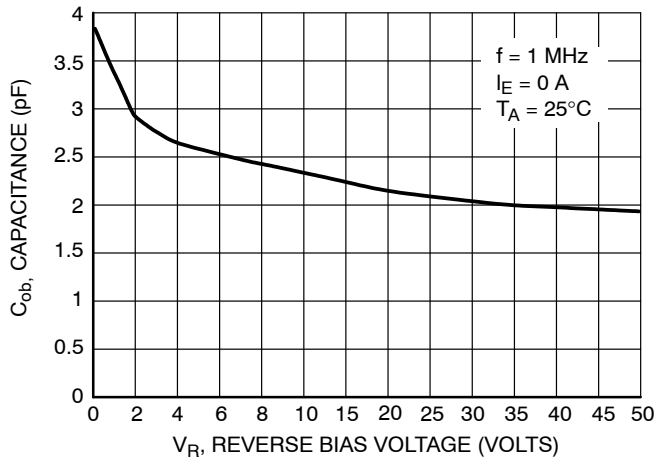


Figure 19. Output Capacitance

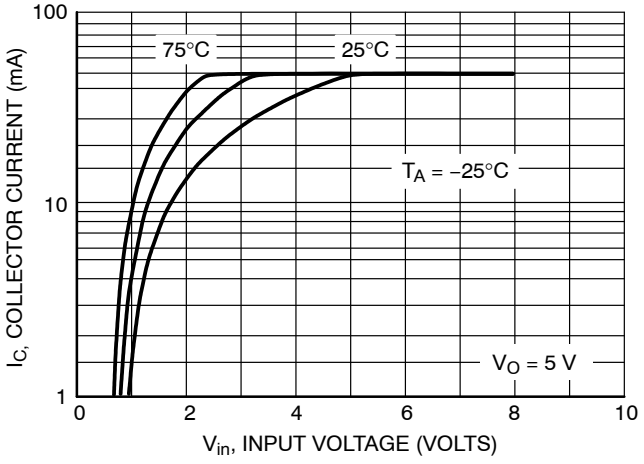


Figure 20. Output Current vs. Input Voltage

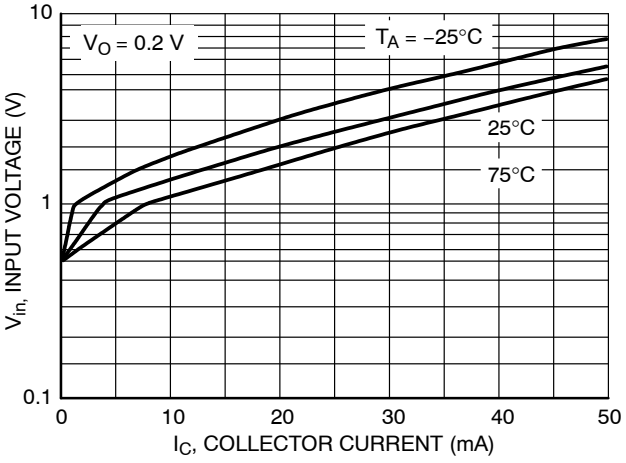


Figure 21. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2215LT1G, SMMUN2215LT1G

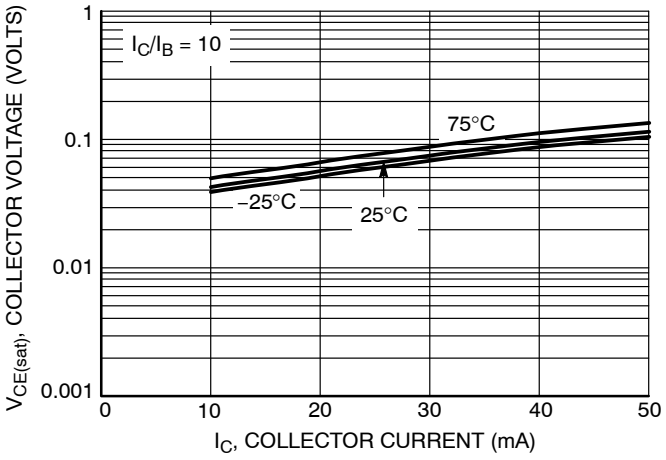


Figure 22. $V_{CE(sat)}$ versus I_C

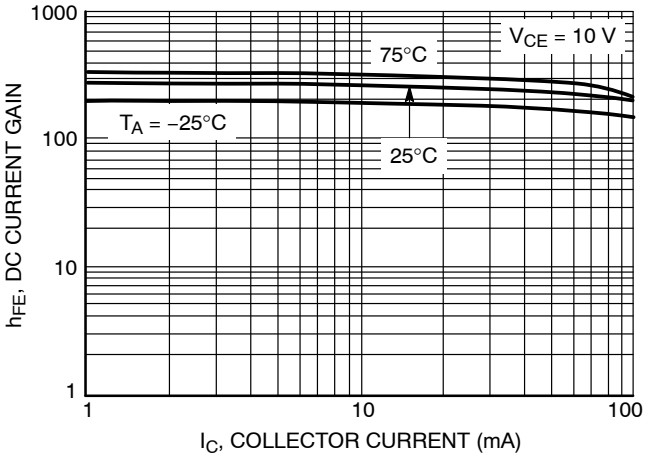


Figure 23. DC Current Gain

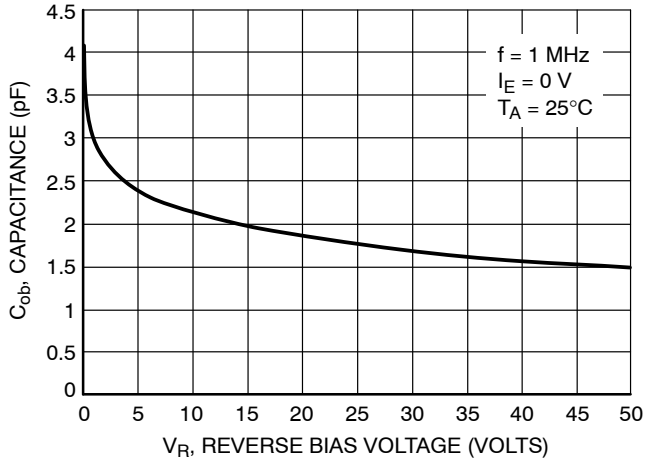


Figure 24. Output Capacitance

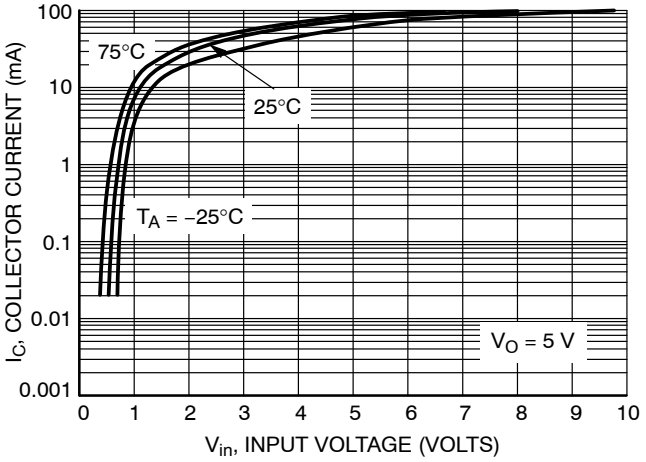


Figure 25. Output Current versus Input Voltage

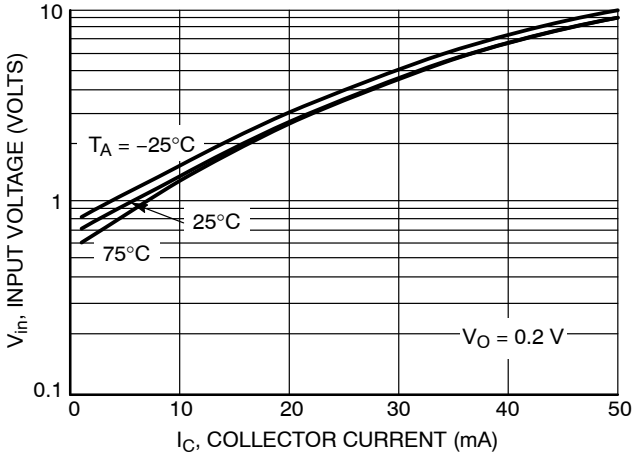


Figure 26. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2216LT1G, SMMUN2216LT1G Series

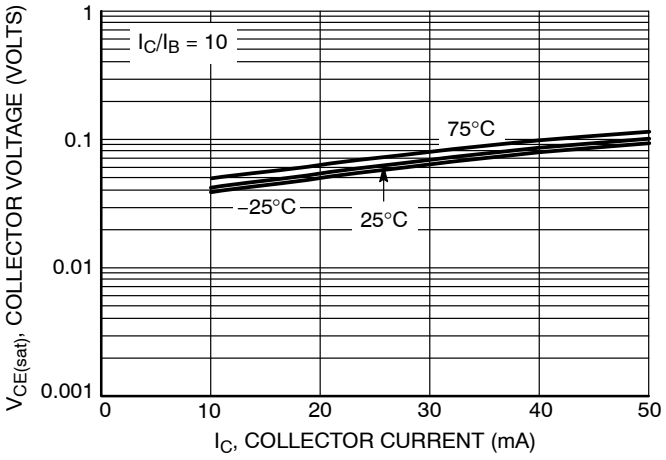


Figure 27. $V_{CE(sat)}$ versus I_C

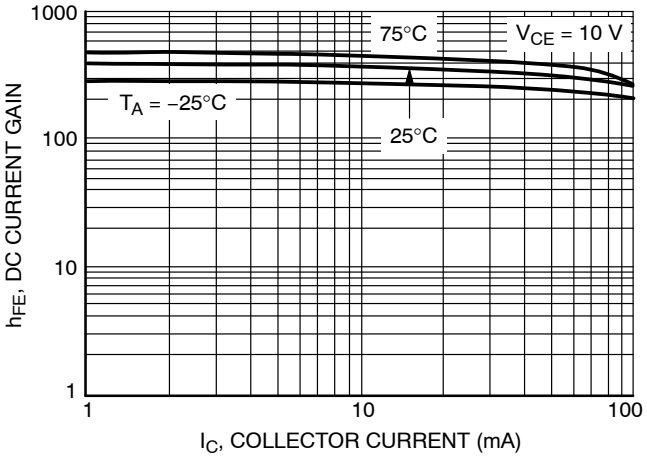


Figure 28. DC Current Gain

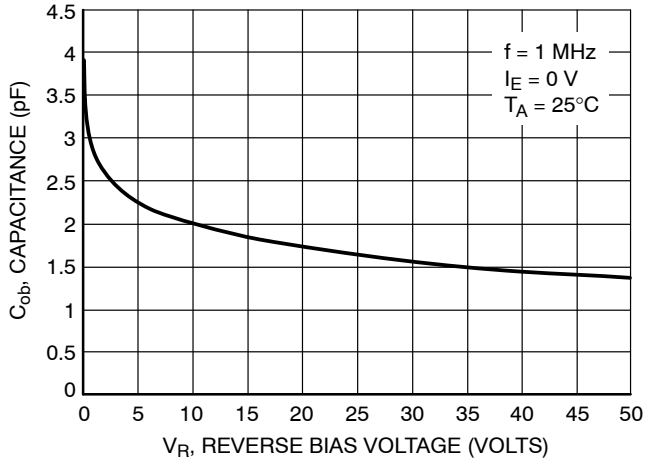


Figure 29. Output Capacitance

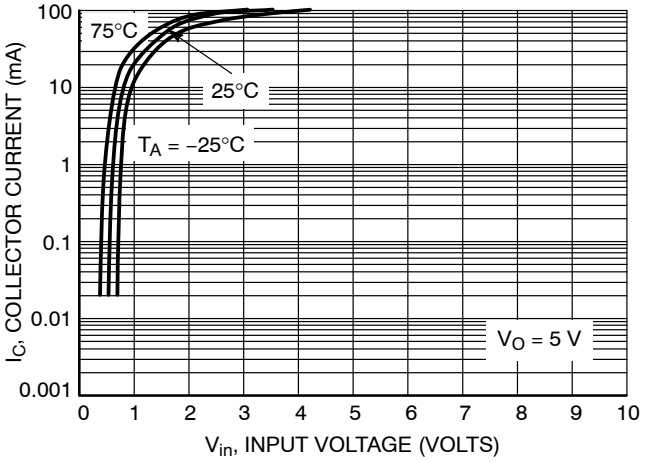


Figure 30. Output Current versus Input Voltage

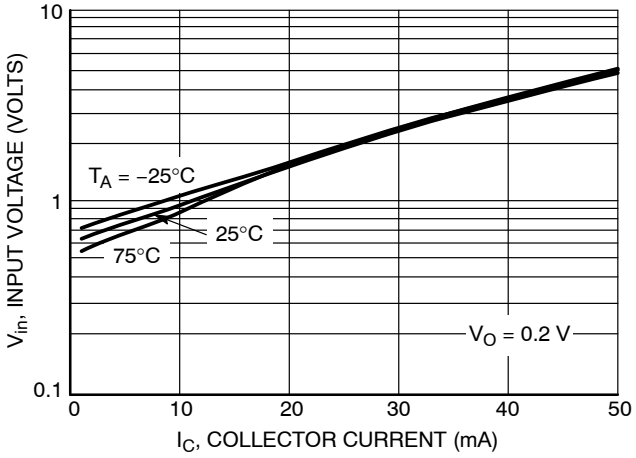


Figure 31. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2230LT1G

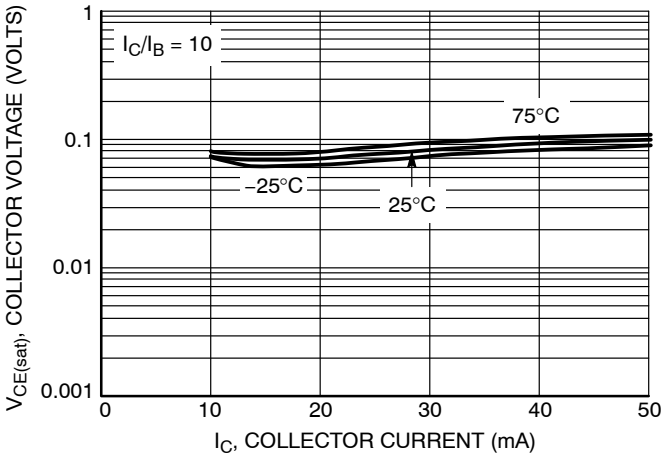


Figure 32. $V_{CE(sat)}$ versus I_C

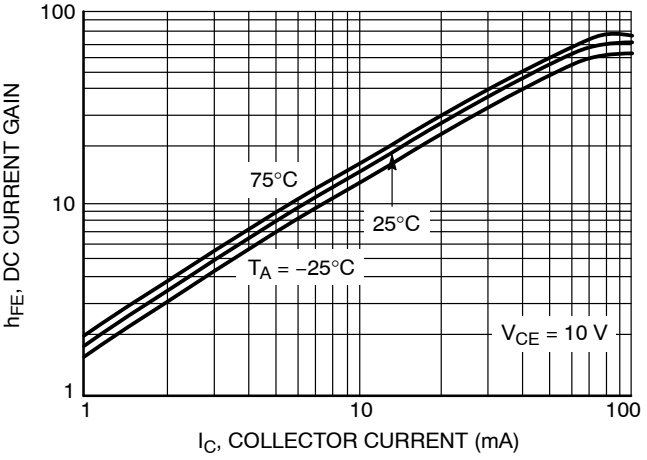


Figure 33. DC Current Gain

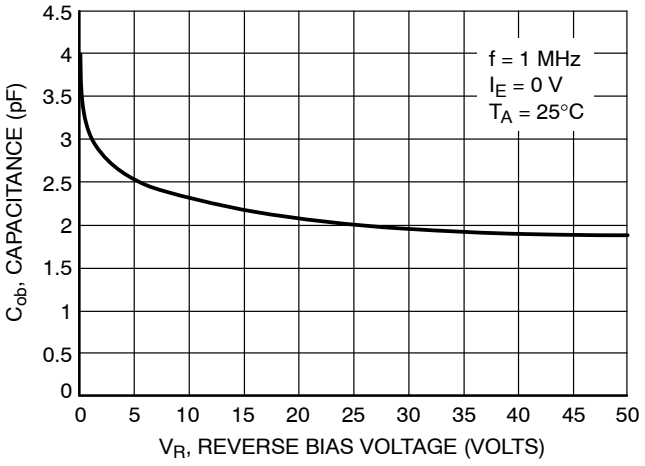


Figure 34. Output Capacitance

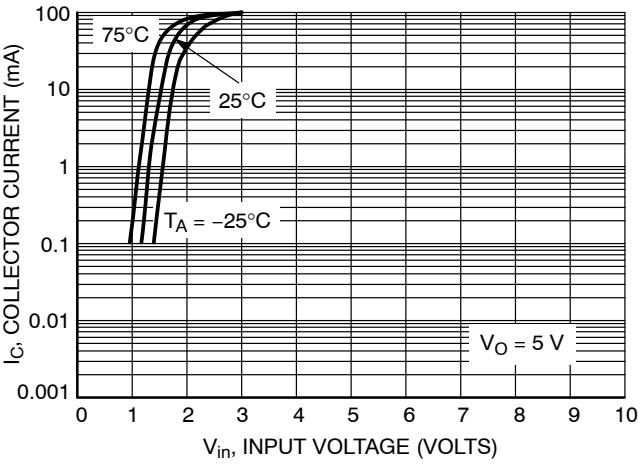


Figure 35. Output Current versus Input Voltage

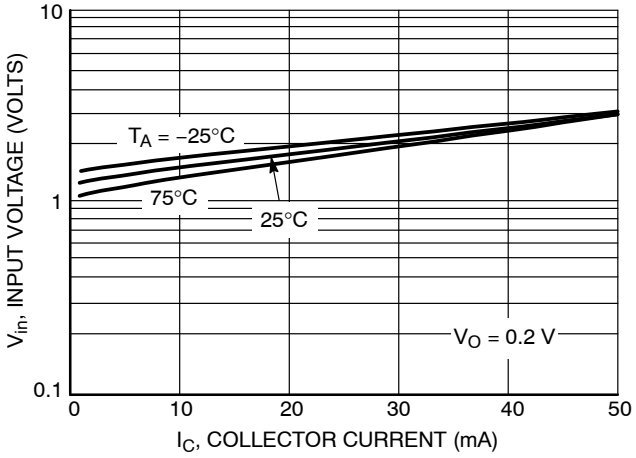


Figure 36. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2231LT1G

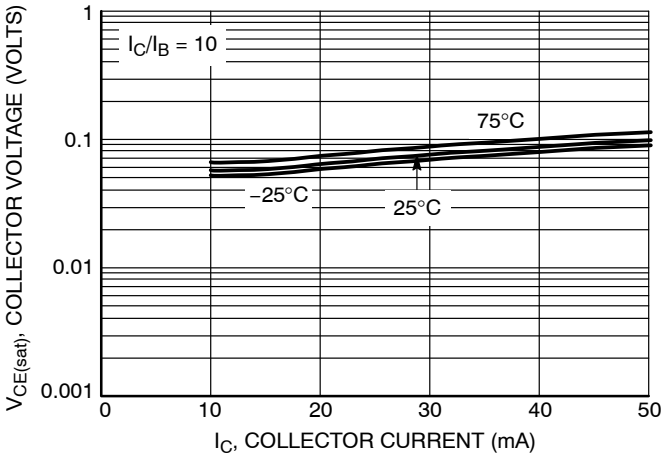


Figure 37. $V_{CE(sat)}$ versus I_C

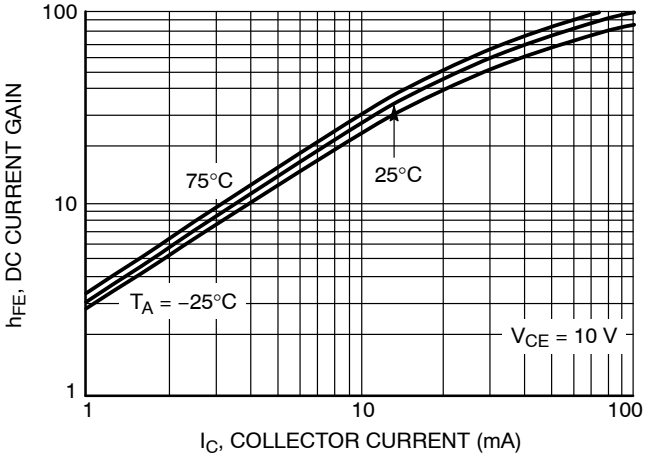


Figure 38. DC Current Gain

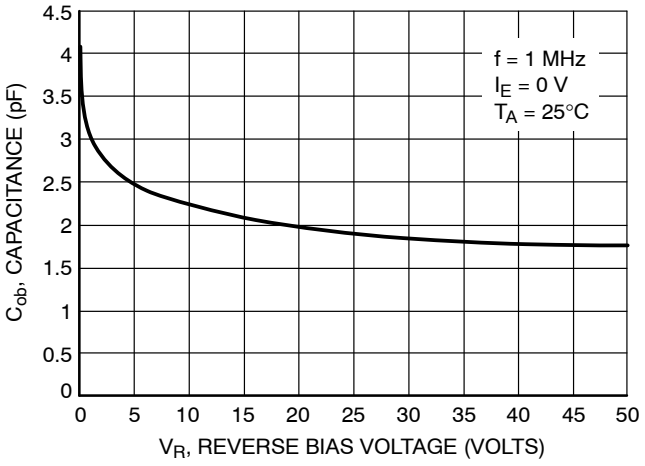


Figure 39. Output Capacitance

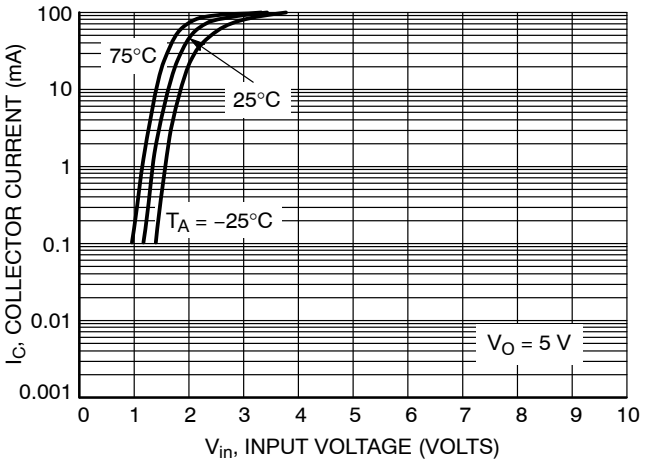


Figure 40. Output Current versus Input Voltage

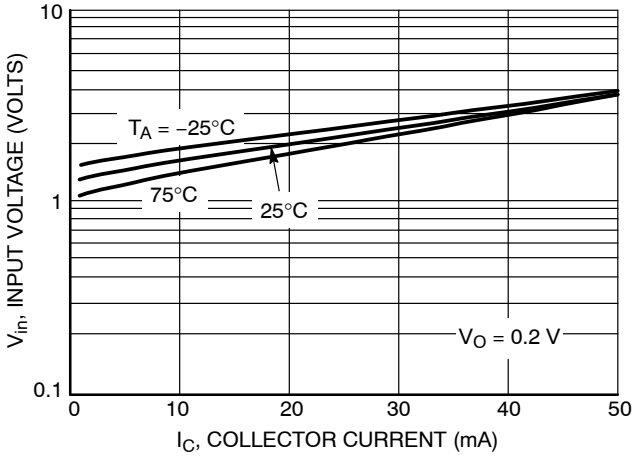


Figure 41. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2232LT1G, NSVMMUN2232LT1G

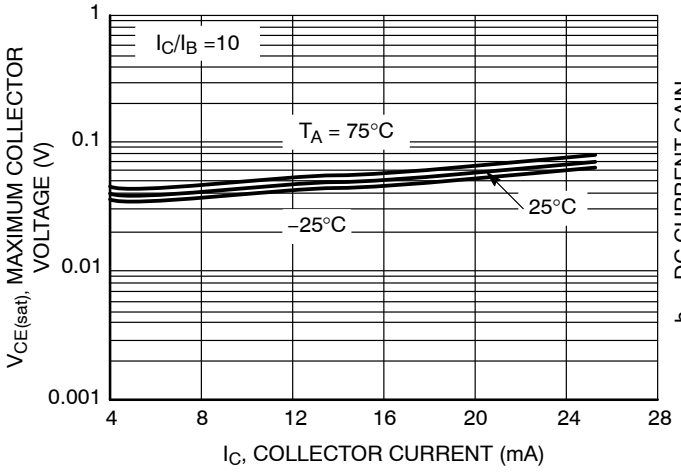


Figure 42. $V_{CE(sat)}$ vs. I_C

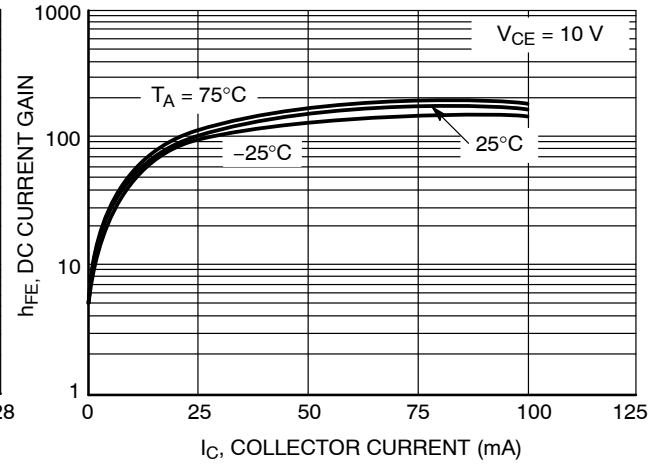


Figure 43. DC Current Gain

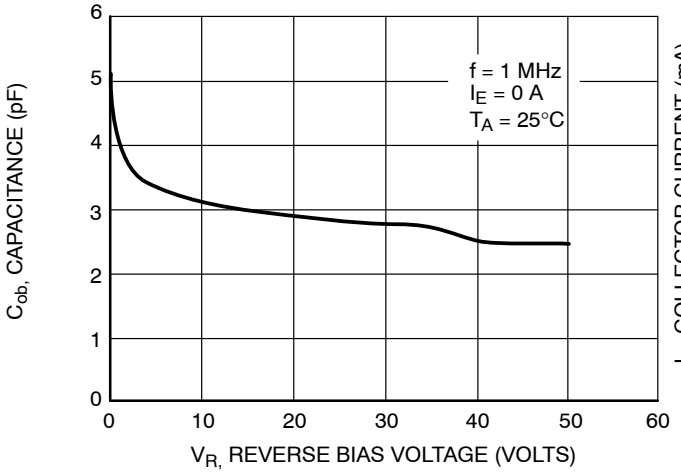


Figure 44. Output Capacitance

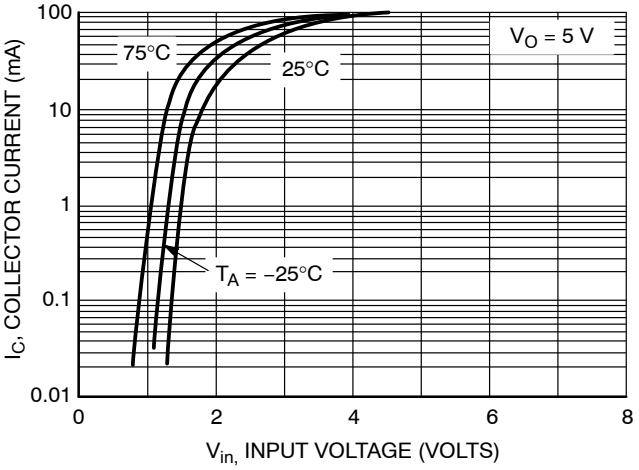


Figure 45. Output Current vs. Input Voltage

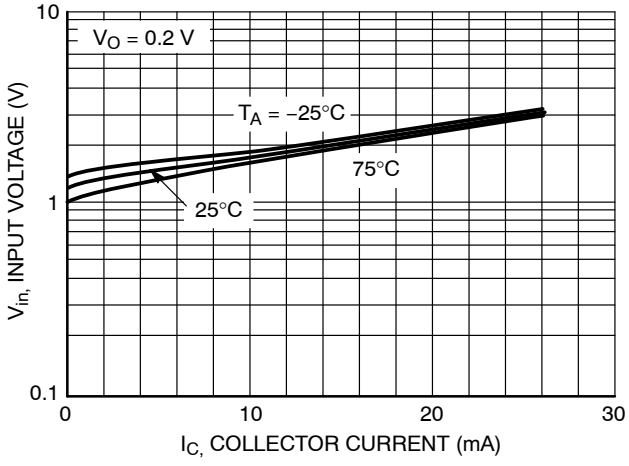


Figure 46. Output Voltage vs. Input Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2233LT1G, SMMUN2233LT1G

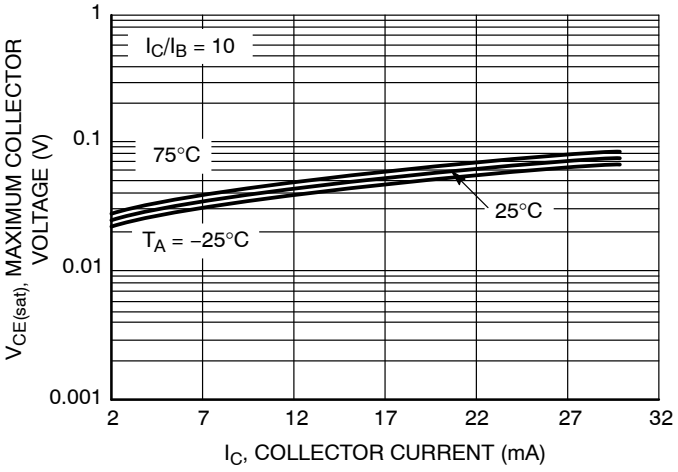


Figure 47. $V_{CE(sat)}$ vs. I_C

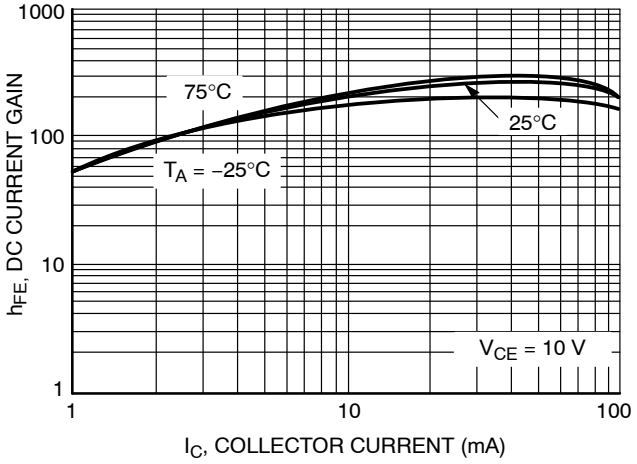


Figure 48. DC Current Gain

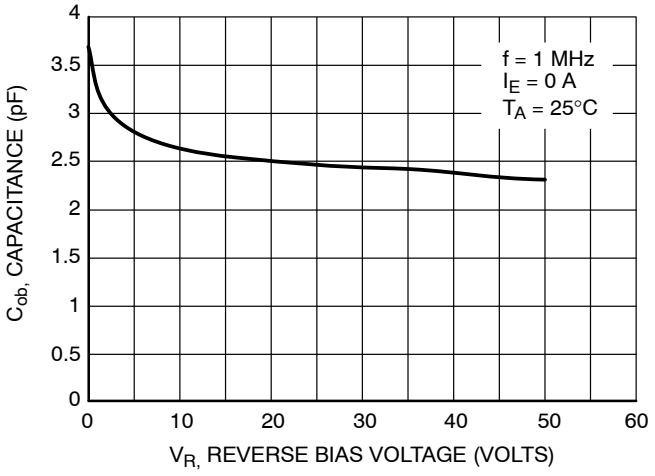


Figure 49. Output Capacitance

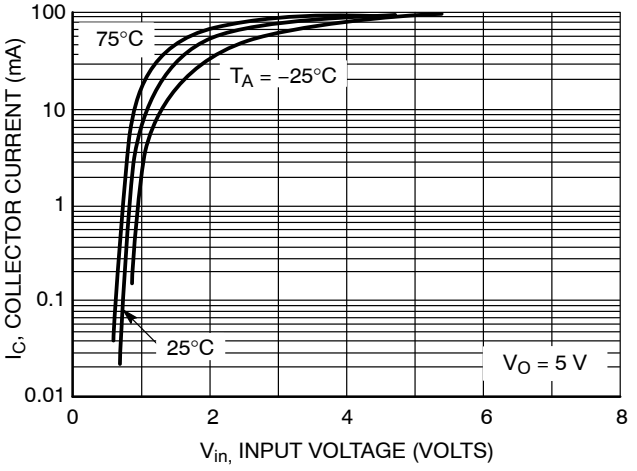


Figure 50. Output Current vs. Input Voltage

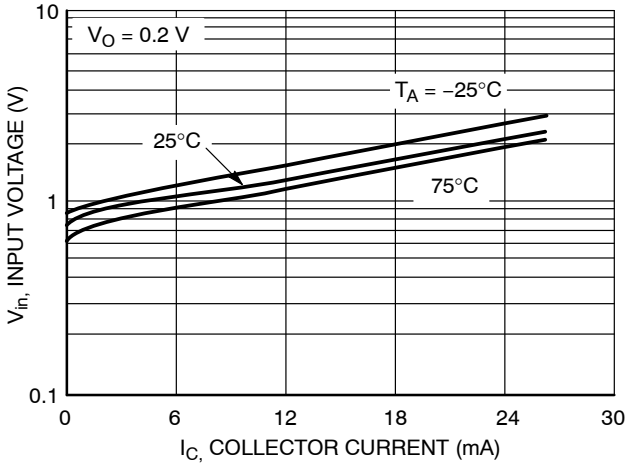


Figure 51. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2234LT1G, SMMUN2234LT1G

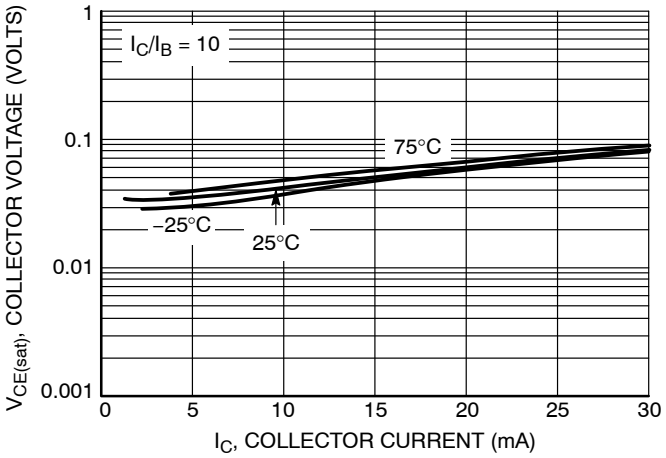


Figure 52. $V_{CE(sat)}$ versus I_C

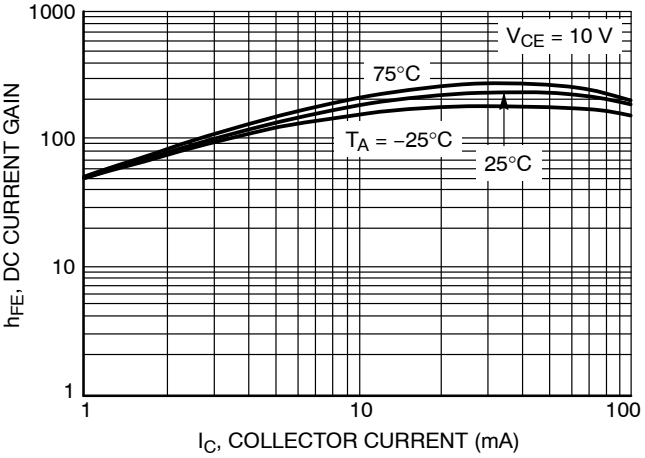


Figure 53. DC Current Gain

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2238LT1G

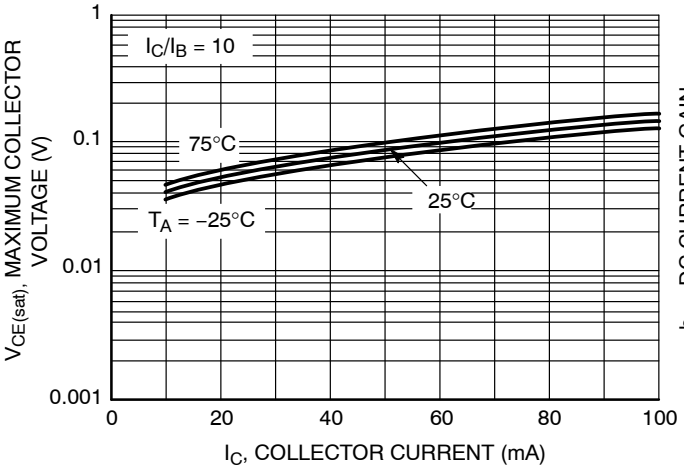


Figure 54. $V_{CE(sat)}$ vs. I_C

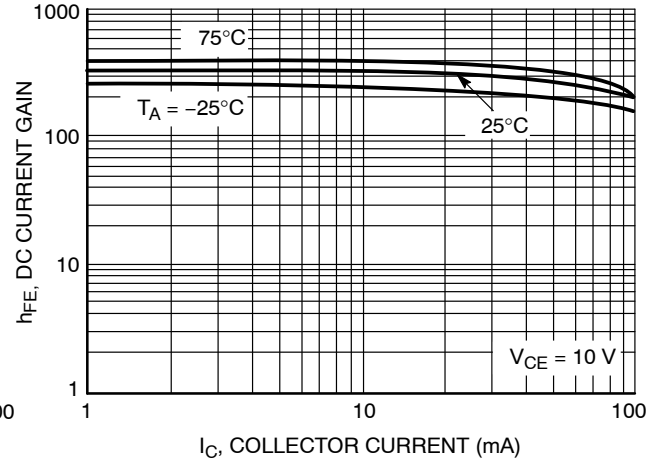


Figure 55. DC Current Gain

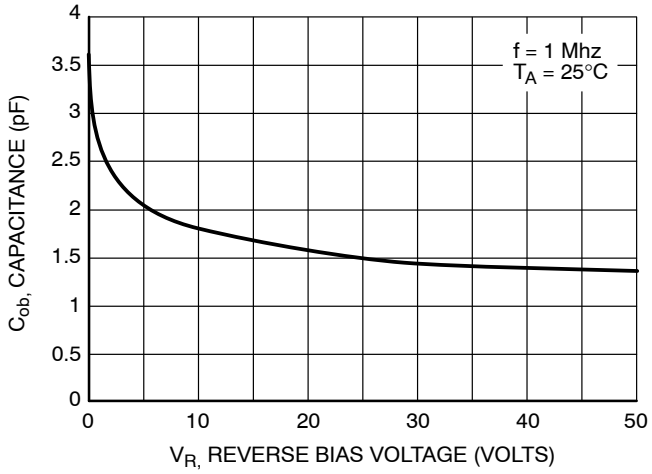


Figure 56. Output Capacitance

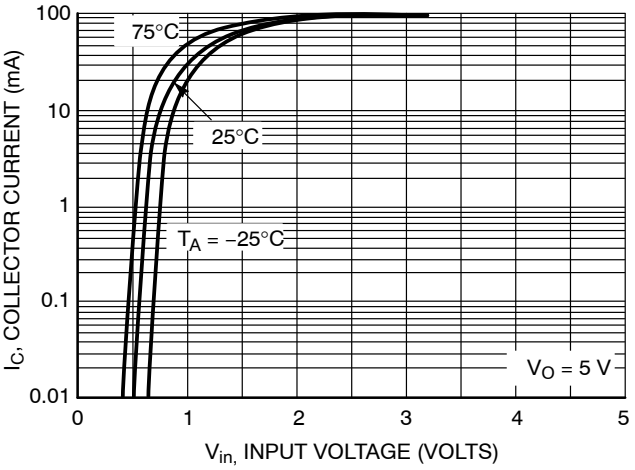


Figure 57. Output Current vs. Input Voltage

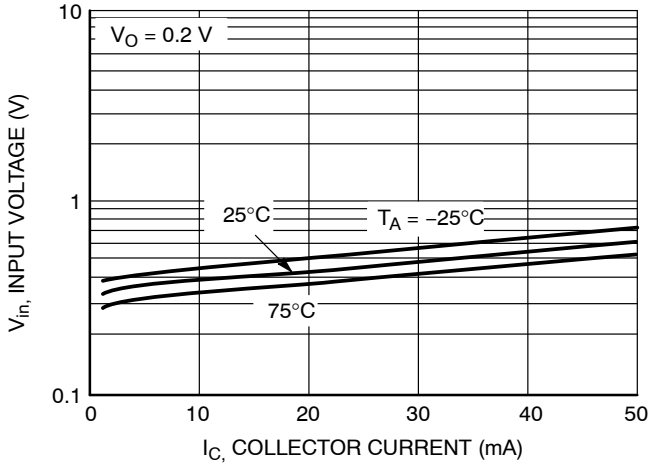


Figure 58. Input Voltage vs. Output Current

TYPICAL APPLICATIONS FOR NPN BRTs

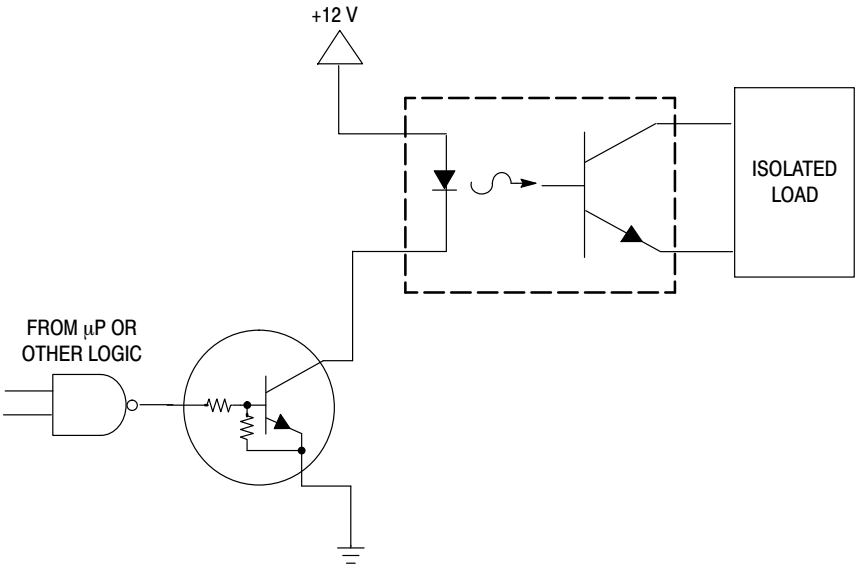


Figure 59. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

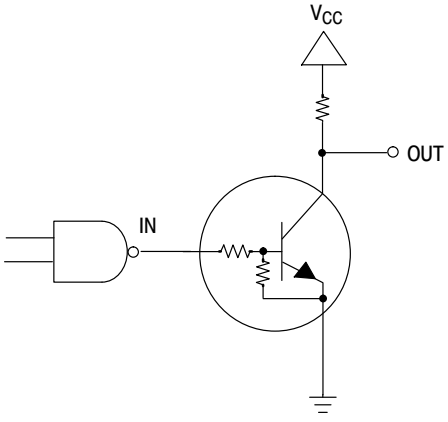


Figure 60. Open Collector Inverter: Inverts the Input Signal

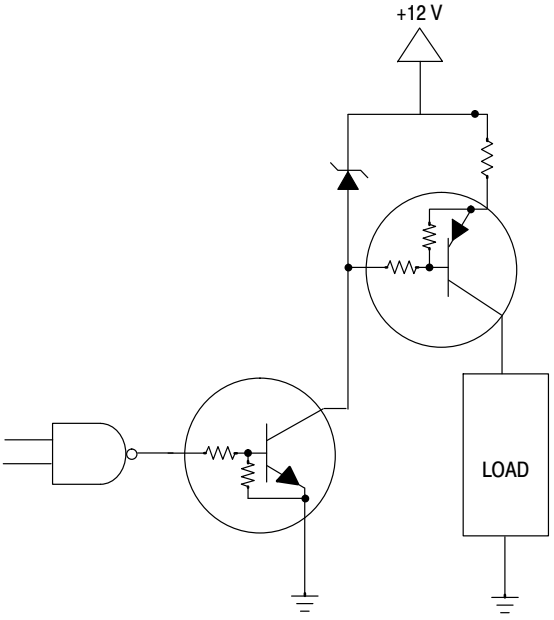


Figure 61. Inexpensive, Unregulated Current Source

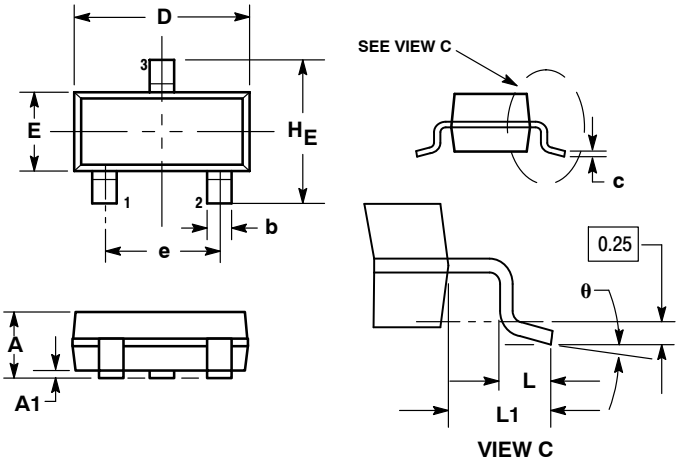
ORDERING INFORMATION

Device	Marking	R1(k)	R2(k)	Package	Shipping†
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)	10,000 / Tape & Reel
MMUN2238LT1G	A8R	2.2	∞	SOT−23 (Pb−Free)	3000 / Tape & Reel
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

†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.

PACKAGE DIMENSIONS

SOT−23 (TO−236)
CASE 318−08
ISSUE AP

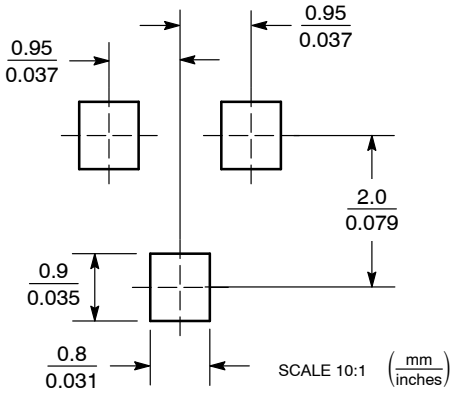


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	MILLIMETERS			INCHES		
DIM	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
H_E	2.10	2.40	2.64	0.083	0.094	0.104
θ	0°	−−−	10°	0°	−−−	10°

STYLE 6:
PIN 1. BASE
2. EMITTER
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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative

MMUN2211LT1/D