

# MMUN2211LT1G 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 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
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ 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 $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	246 (Note 1) 400 (Note 2) 1.5 (Note 1) 2.0 (Note 2)	mW  $^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	508 (Note 1) 311 (Note 2)	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Lead	$R_{\theta JL}$	174 (Note 1) 208 (Note 2)	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

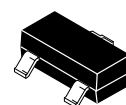
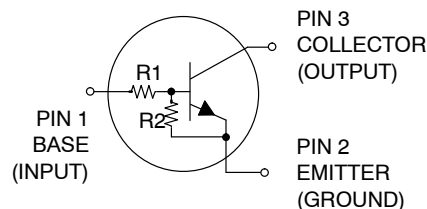
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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



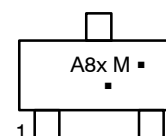
ON Semiconductor®

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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.

# MMUN2211LT1G 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)	MMUN2211LT1G	-	-	0.5	mAdc
	MMUN2212LT1G	-	-	0.2	
	MMUN2213LT1G	-	-	0.1	
	MMUN2214LT1G	-	-	0.2	
	MMUN2215LT1G	-	-	0.9	
	MMUN2216LT1G	-	-	1.9	
	MMUN2230LT1G	-	-	4.3	
	MMUN2231LT1G	-	-	2.3	
	MMUN2232LT1G	-	-	1.5	
	MMUN2233LT1G	-	-	0.18	
	MMUN2234LT1G	-	-	0.13	
	MMUN2238LT1G	-	-	4.0	
MMUN2241LT1G	-	-	0.1		
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)	MMUN2211LT1G	h <sub>FE</sub>	35	60	-		
	MMUN2212LT1G		60	100	-		
	MMUN2213LT1G		80	140	-		
	MMUN2214LT1G		80	140	-		
	MMUN2215LT1G		160	350	-		
	MMUN2216LT1G		160	350	-		
	MMUN2230LT1G		3.0	5.0	-		
	MMUN2231LT1G		8.0	15	-		
	MMUN2232LT1G		15	30	-		
	MMUN2233LT1G		80	200	-		
	MMUN2234LT1G		80	150	-		
	MMUN2238LT1G		160	350	-		
	MMUN2241LT1G		160	350	-		
Collector-Emitter Saturation Voltage (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0.3 mA)	MMUN2211LT1G	V <sub>CE(sat)</sub>	-	-	0.25	Vdc	
	MMUN2212LT1G		-	-	0.25		
	MMUN2213LT1G		-	-	0.25		
	MMUN2214LT1G		-	-	0.25		
	MMUN2233LT1G		-	-	0.25		
	MMUN2234LT1G		-	-	0.25		
	(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA)		MMUN2215LT1G	-	-		0.25
			MMUN2216LT1G	-	-		0.25
			MMUN2232LT1G	-	-		0.25
	(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 5 mA)		MMUN2238LT1G	-	-		0.25
			MMUN2230LT1G	-	-		0.25
			MMUN2231LT1G	-	-		0.25
			MMUN2241LT1G	-	-		0.25

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

## MMUN2211LT1G Series

### 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)	MMUN2211LT1G	V <sub>OL</sub>	-	-	0.2	Vdc		
	MMUN2212LT1G		-	-	0.2			
	MMUN2214LT1G		-	-	0.2			
	MMUN2215LT1G		-	-	0.2			
	MMUN2216LT1G		-	-	0.2			
	MMUN2230LT1G		-	-	0.2			
	MMUN2231LT1G		-	-	0.2			
	MMUN2232LT1G		-	-	0.2			
	MMUN2233LT1G		-	-	0.2			
	MMUN2234LT1G		-	-	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		-	-	0.2			
(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 5.0 V, R <sub>L</sub> = 1.0 kΩ)	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)	MMUN2211LT1G		V <sub>OH</sub>	4.9	-		-	Vdc
	MMUN2212LT1G	4.9		-	-			
	MMUN2213LT1G	4.9		-	-			
	MMUN2214LT1G	4.9		-	-			
	MMUN2233LT1G	4.9		-	-			
(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.05 V, R <sub>L</sub> = 1.0 kΩ)	MMUN2230LT1G	4.9		-	-			
	MMUN2234LT1G	4.9		-	-			
(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.25 V, R <sub>L</sub> = 1.0 kΩ)	MMUN2215LT1G	4.9		-	-			
	MMUN2216LT1G	4.9		-	-			
	MMUN2231LT1G	4.9		-	-			
	MMUN2232LT1G	4.9		-	-			
	MMUN2238LT1G	4.9		-	-			
	MMUN2241LT1G	4.9		-	-			
Input Resistor	MMUN2211LT1G	R1		7.0	10	13	kΩ	
	MMUN2212LT1G			15.4	22	28.6		
	MMUN2213LT1G			32.9	47	61.1		
	MMUN2214LT1G			7.0	10	13		
	MMUN2215LT1G		7.0	10	13			
	MMUN2216LT1G		3.3	4.7	6.1			
	MMUN2230LT1G		0.7	1.0	1.3			
	MMUN2231LT1G		1.5	2.2	2.9			
	MMUN2232LT1G		3.3	4.7	6.1			
	MMUN2233LT1G		3.3	4.7	6.1			
	MMUN2234LT1G		15.4	22	28.6			
	MMUN2238LT1G		1.54	2.2	2.88			
	MMUN2241LT1G		70	100	130			
Resistor Ratio	MMUN2211LT1G		R1/R2	0.8	1.0	1.2		
	MMUN2212LT1G	0.8		1.0	1.2			
	MMUN2213LT1G	0.8		1.0	1.2			
	MMUN2214LT1G	0.17		0.21	0.25			
	MMUN2215LT1G	-		-	-			
	MMUN2216LT1G	-		-	-			
	MMUN2230LT1G	0.8		1.0	1.2			
	MMUN2231LT1G	0.8		1.0	1.2			
	MMUN2232LT1G	0.8		1.0	1.2			
	MMUN2233LT1G	0.055		0.1	0.185			
	MMUN2234LT1G	0.38		0.47	0.56			
	MMUN2238LT1G	-		-	-			
	MMUN2241LT1G	-		-	-			

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

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2211LT1G

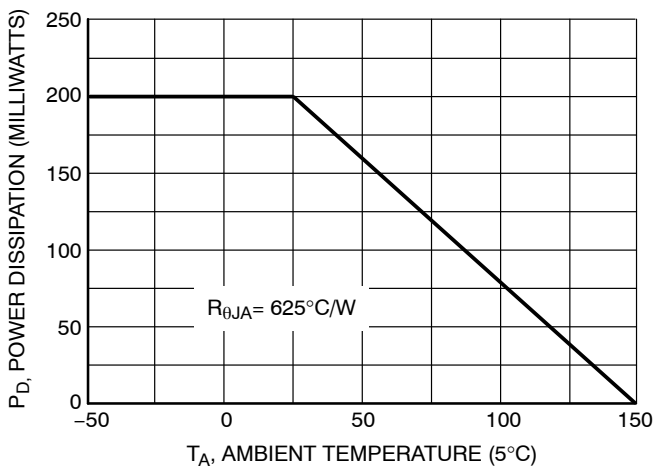


Figure 1. Derating Curve

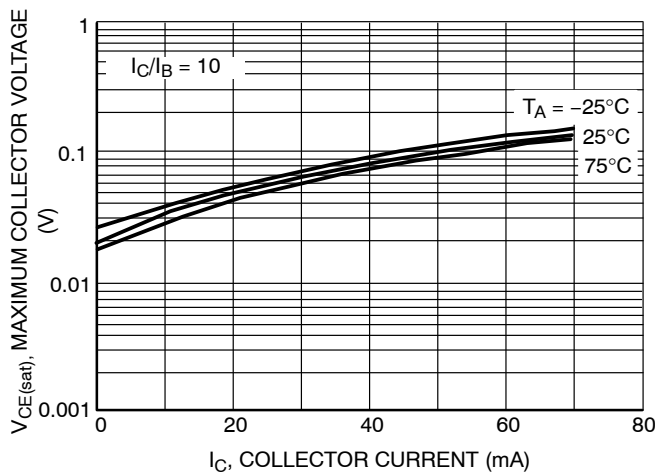


Figure 2. V<sub>CE(sat)</sub> vs. I<sub>C</sub>

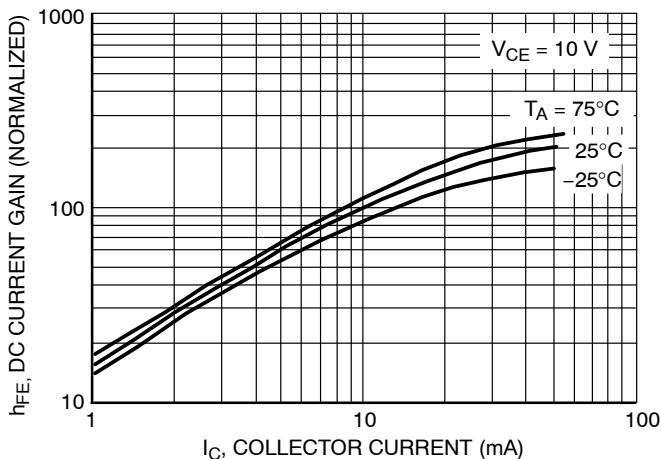


Figure 3. DC Current Gain

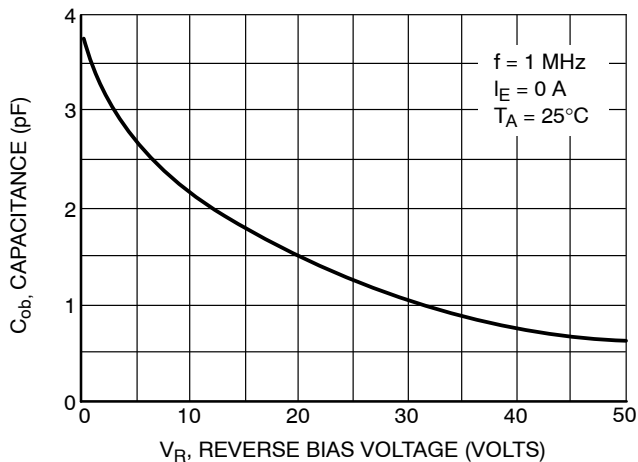


Figure 4. Output Capacitance

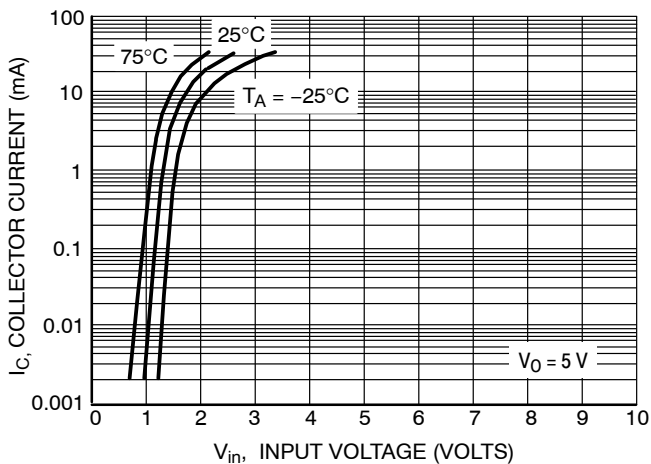


Figure 5. Output Current vs. Input Voltage

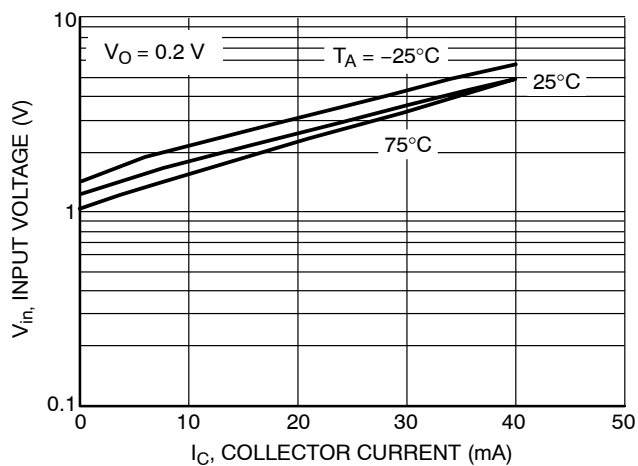


Figure 6. Input Voltage vs. Output Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2212LT1G

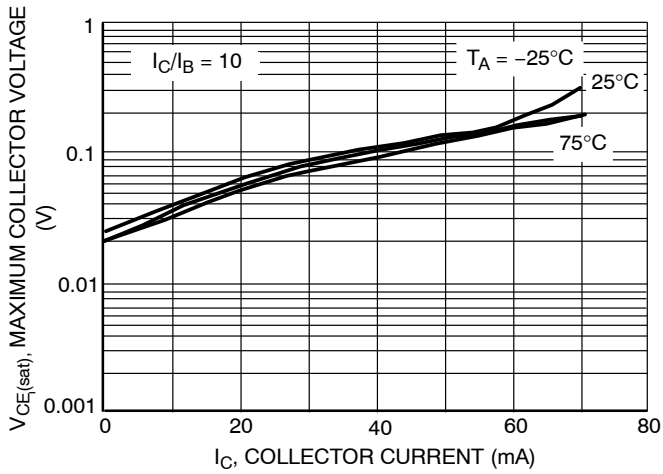


Figure 7.  $V_{CE(sat)}$  vs.  $I_C$

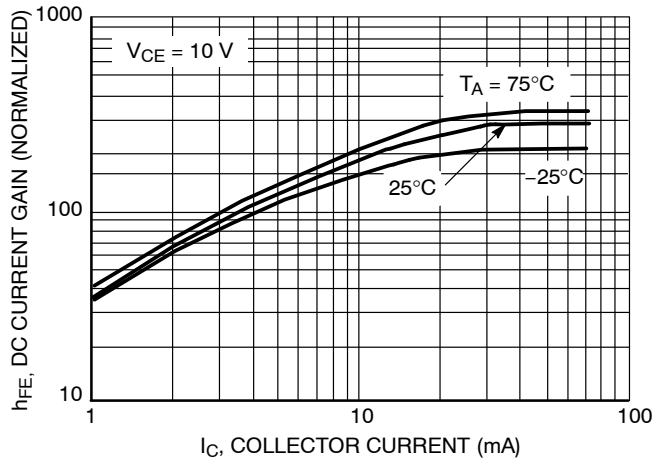


Figure 8. DC Current Gain

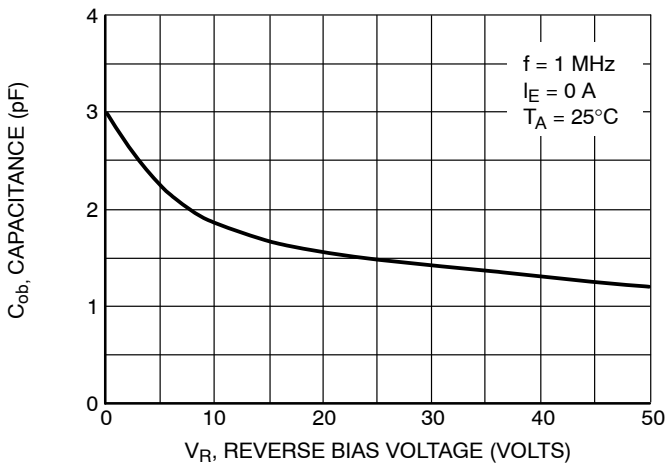


Figure 9. Output Capacitance

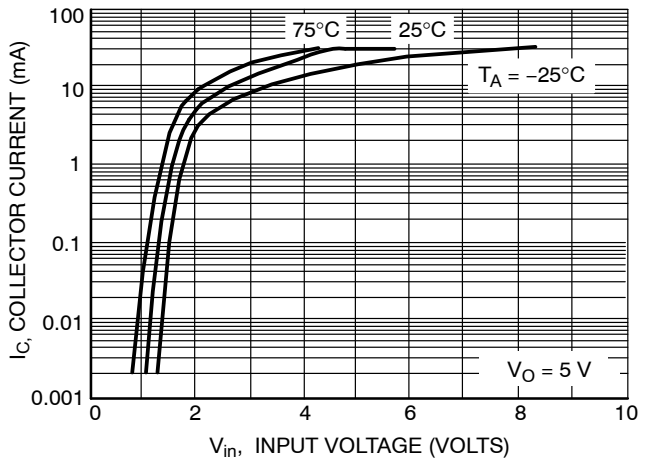


Figure 10. Output Current vs. Input Voltage

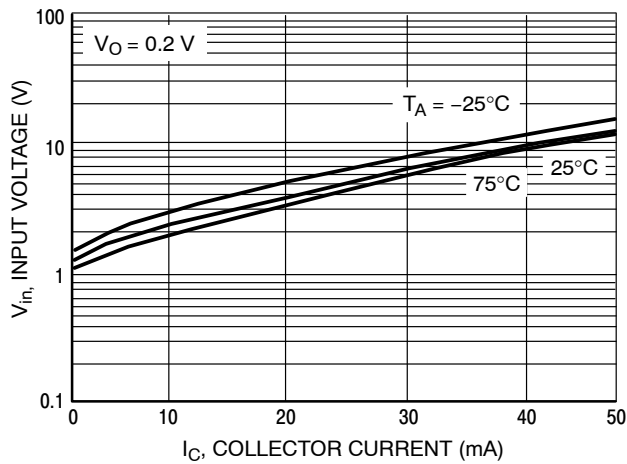


Figure 11. Input Voltage vs. Output Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2213LT1G

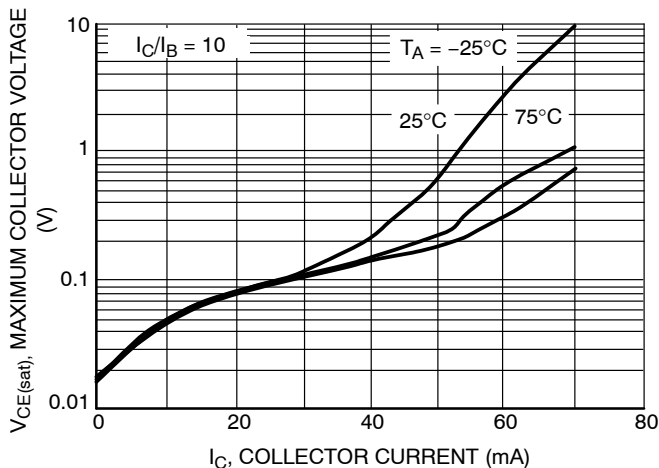


Figure 12.  $V_{CE(sat)}$  vs.  $I_C$

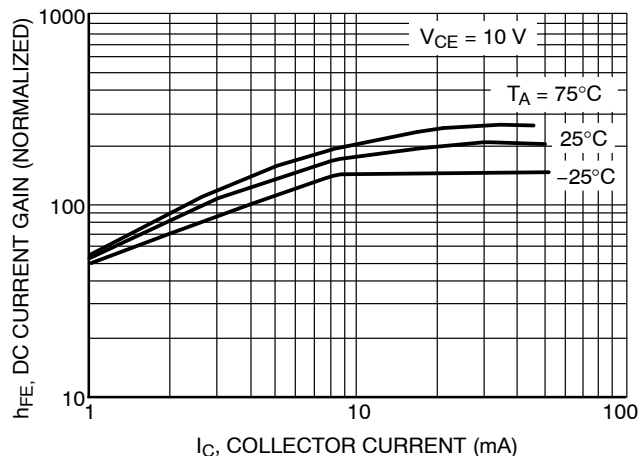


Figure 13. DC Current Gain

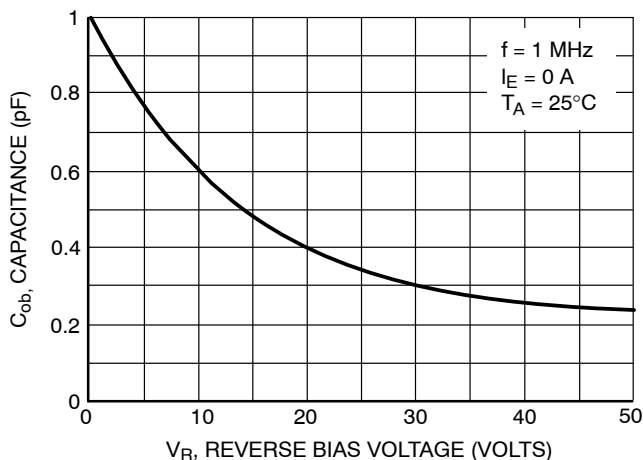


Figure 14. Output Capacitance

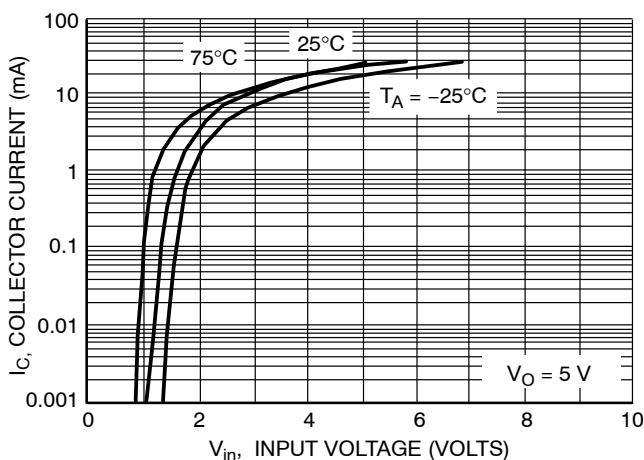


Figure 15. Output Current vs. Input Voltage

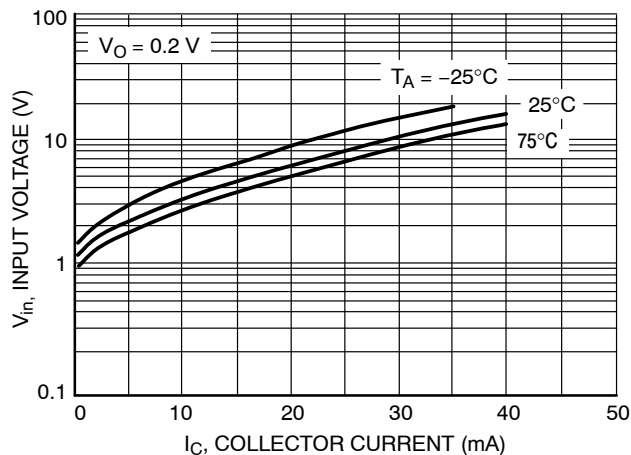


Figure 16. Input Voltage vs. Output Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2214LT1G

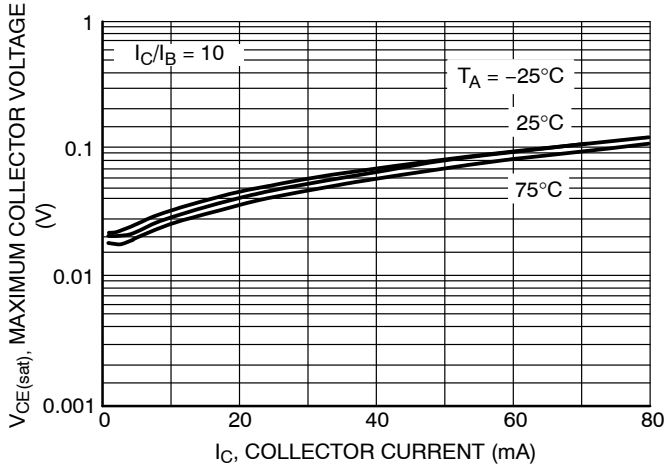


Figure 17.  $V_{CE(sat)}$  vs.  $I_C$

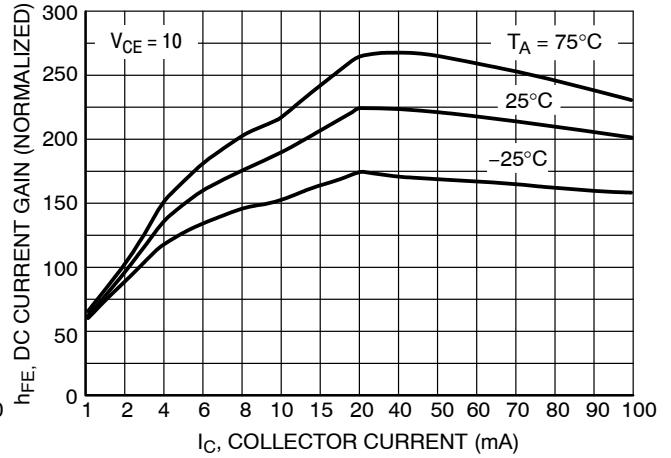


Figure 18. DC Current Gain

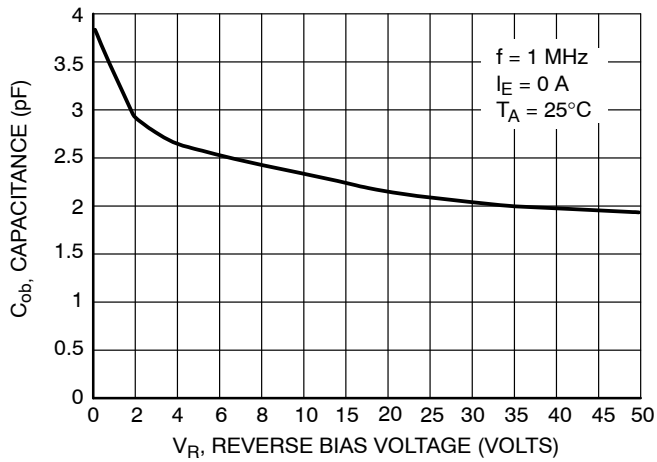


Figure 19. Output Capacitance

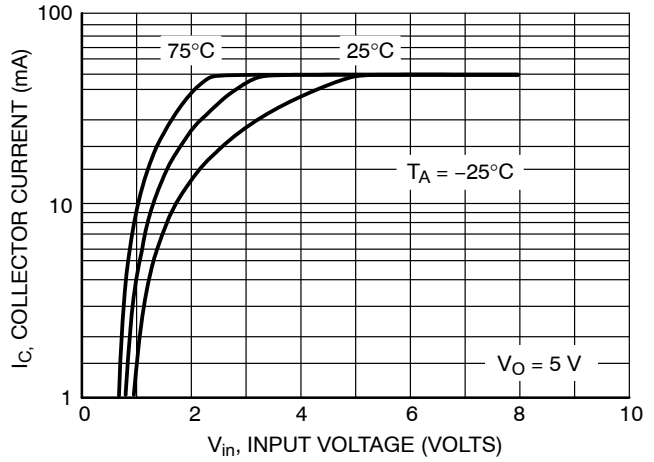


Figure 20. Output Current vs. Input Voltage

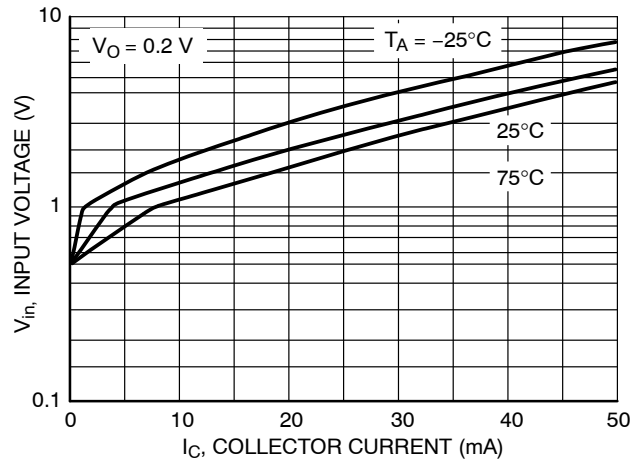


Figure 21. Input Voltage vs. Output Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2215LT1G

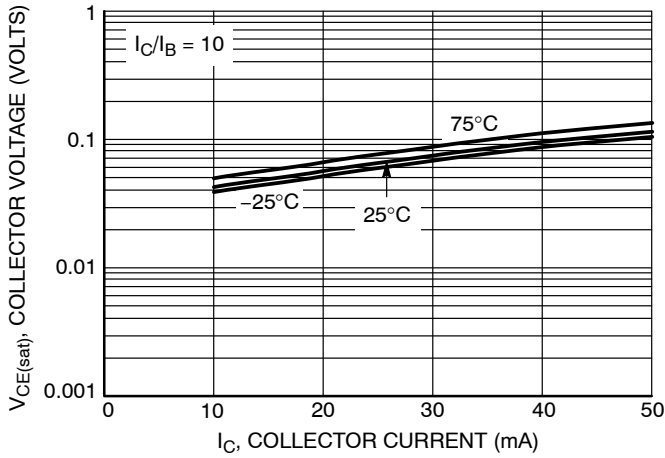


Figure 22.  $V_{CE(sat)}$  versus  $I_C$

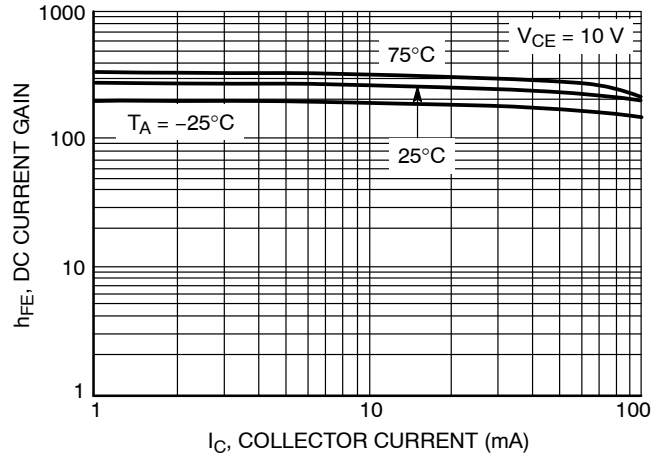


Figure 23. DC Current Gain

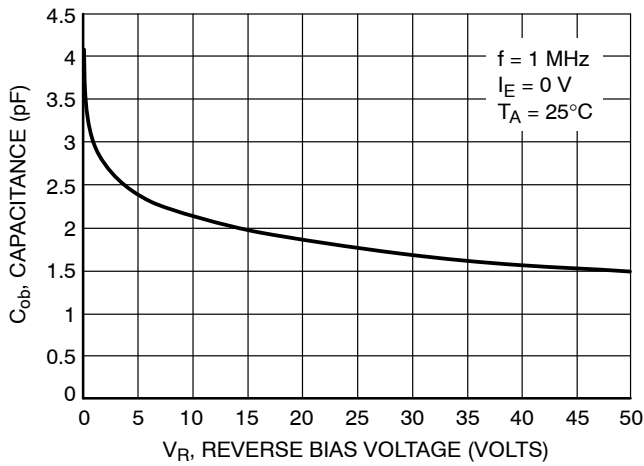


Figure 24. Output Capacitance

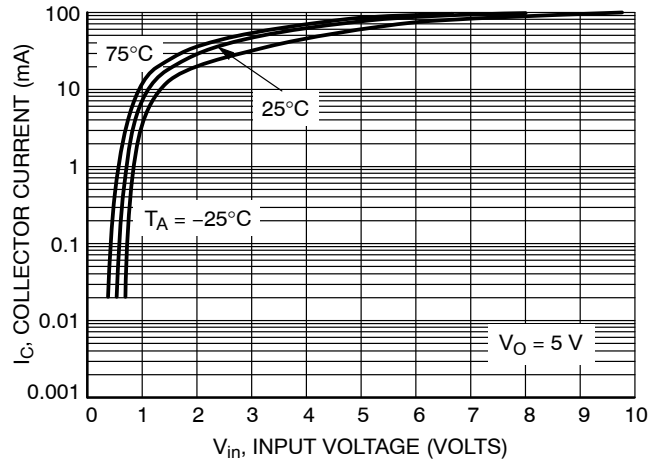


Figure 25. Output Current versus Input Voltage

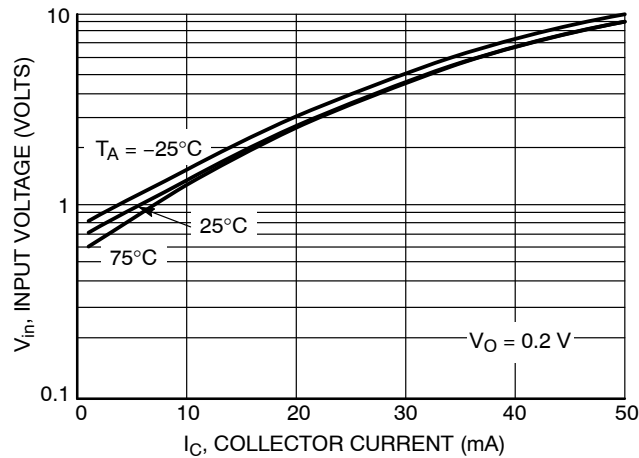


Figure 26. Input Voltage versus Output Current



# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2216LT1G

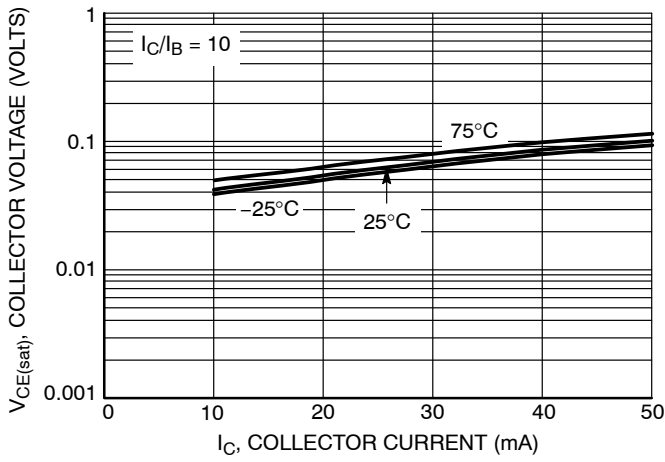


Figure 27.  $V_{CE(sat)}$  versus  $I_C$

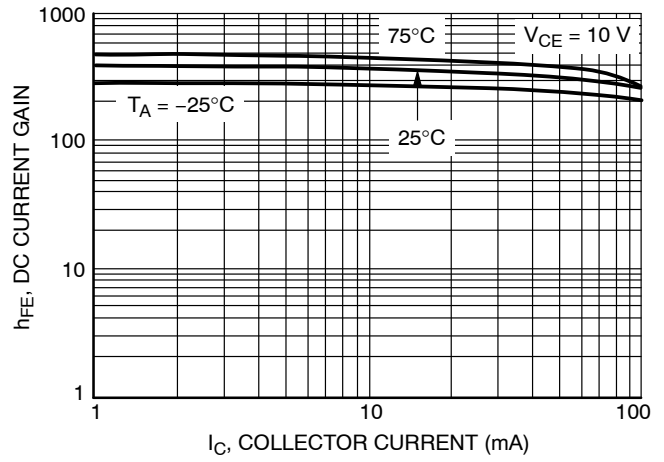


Figure 28. DC Current Gain

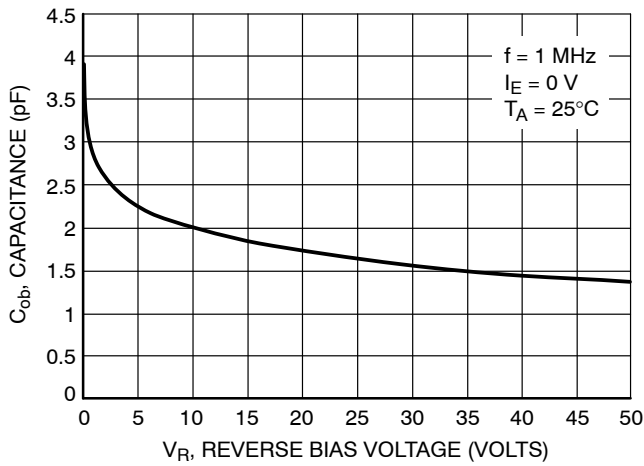


Figure 29. Output Capacitance

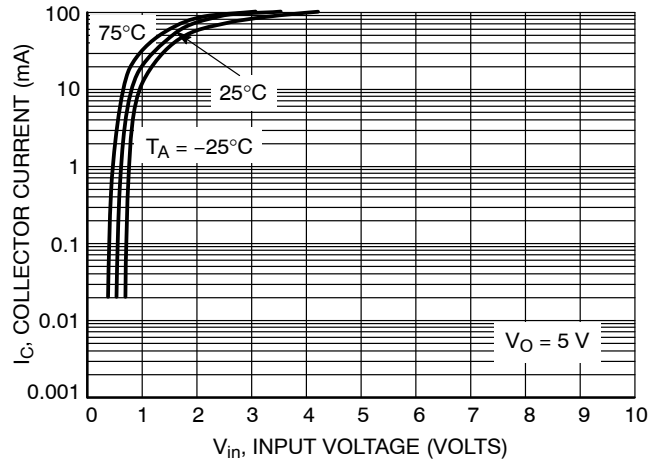


Figure 30. Output Current versus Input Voltage

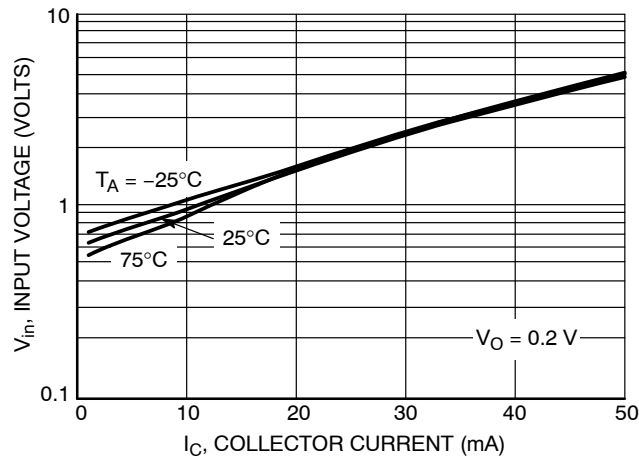
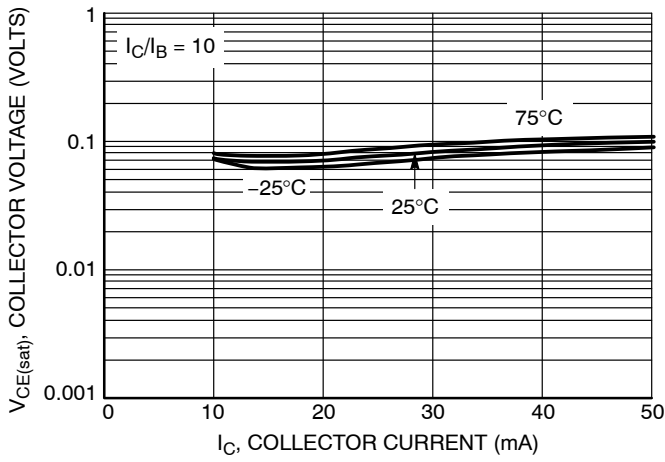


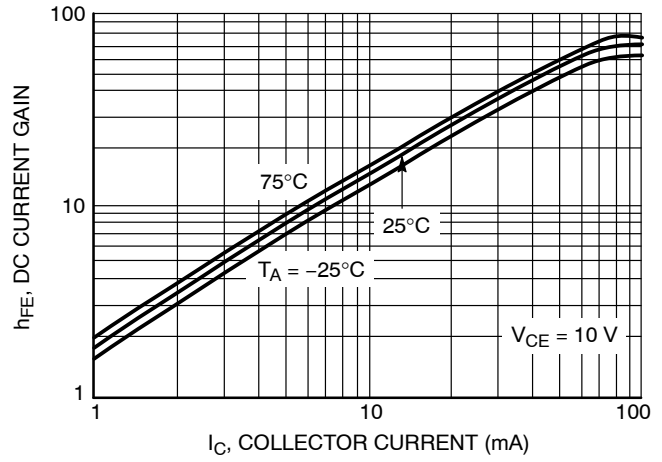
Figure 31. Input Voltage versus Output Current

# MMUN2211LT1G Series

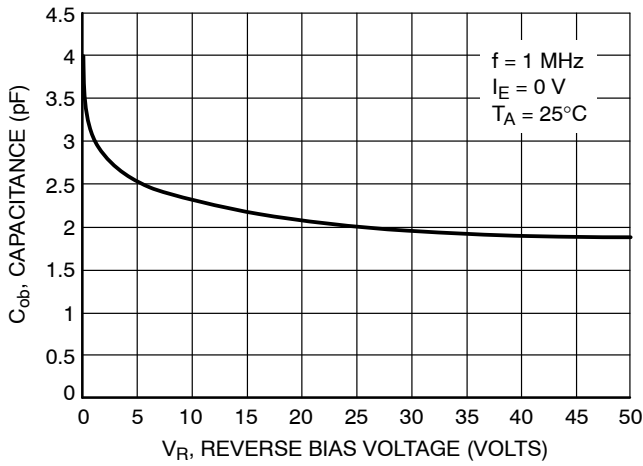
## TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2230LT1G



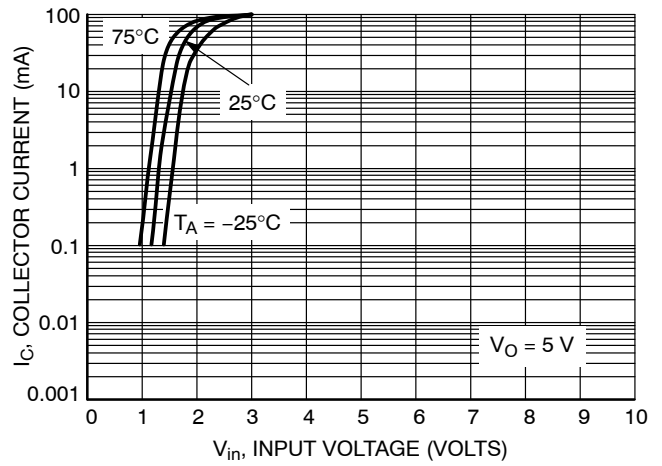
**Figure 32.  $V_{CE(sat)}$  versus  $I_C$**



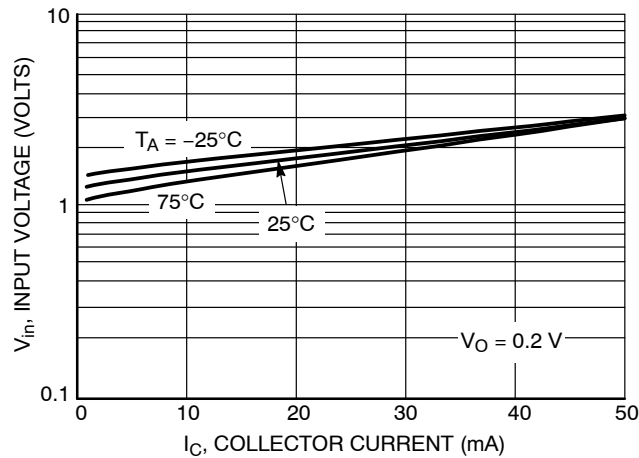
**Figure 33. DC Current Gain**



**Figure 34. Output Capacitance**



**Figure 35. Output Current versus Input Voltage**



**Figure 36. Input Voltage versus Output Current**

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2231LT1G

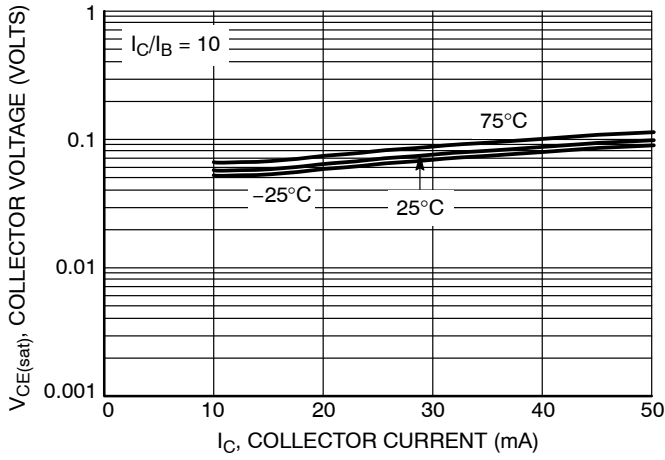


Figure 37.  $V_{CE(sat)}$  versus  $I_C$

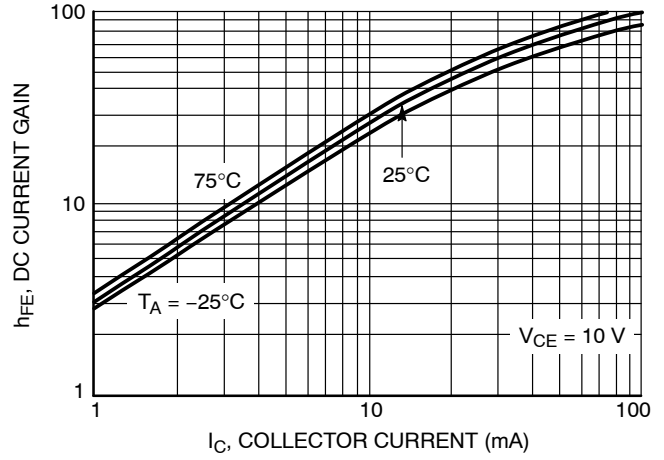


Figure 38. DC Current Gain

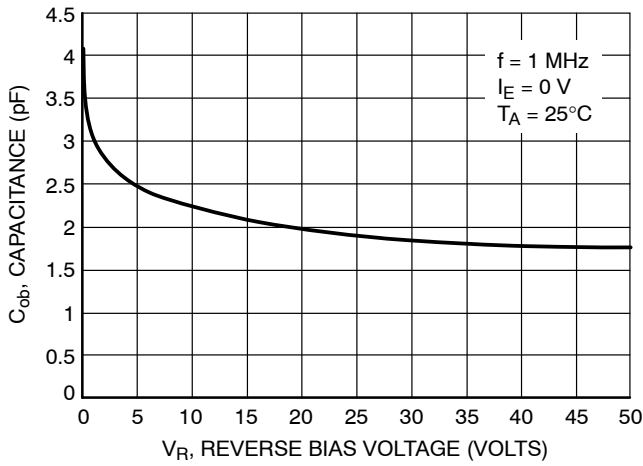


Figure 39. Output Capacitance

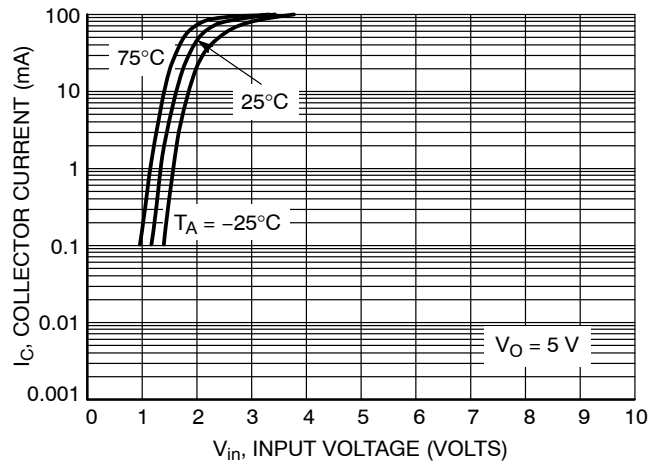


Figure 40. Output Current versus Input Voltage

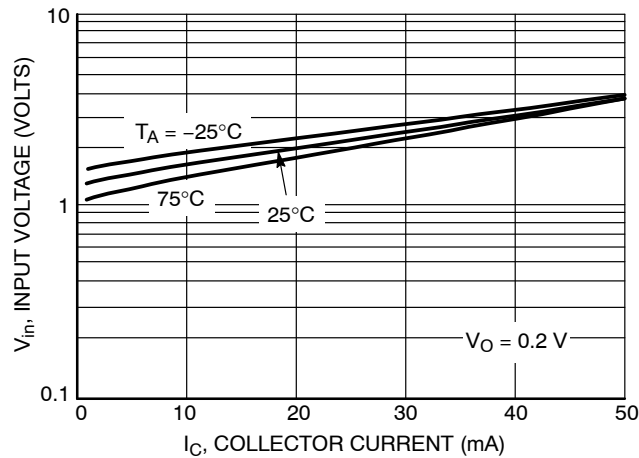


Figure 41. Input Voltage versus Output Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2232LT1G

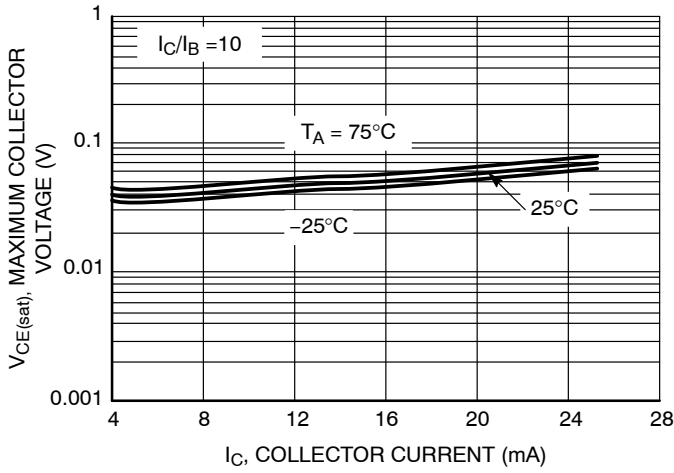


Figure 42.  $V_{CE(sat)}$  vs.  $I_C$

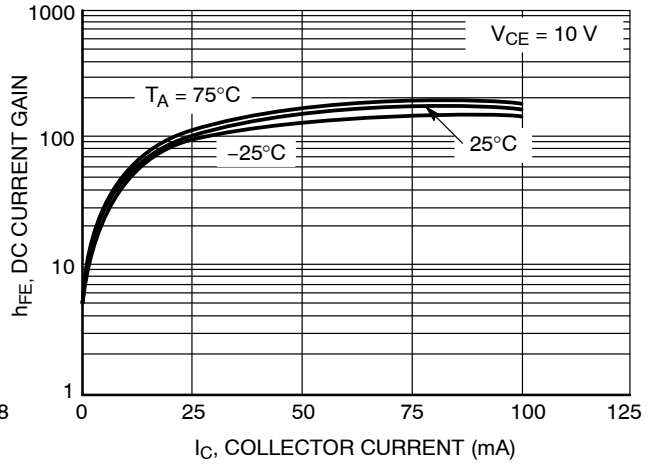


Figure 43. DC Current Gain

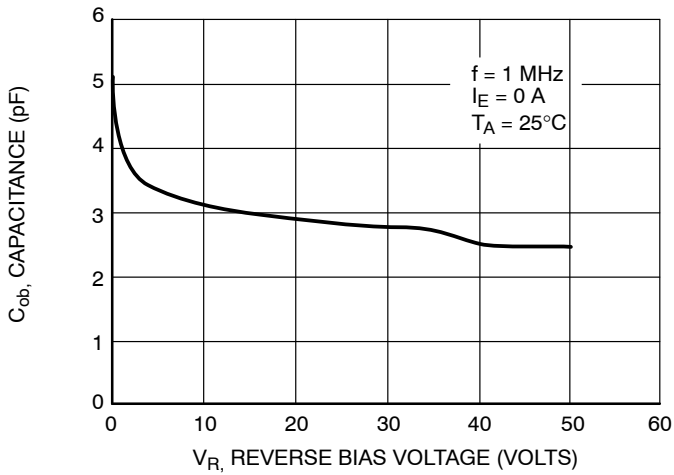


Figure 44. Output Capacitance

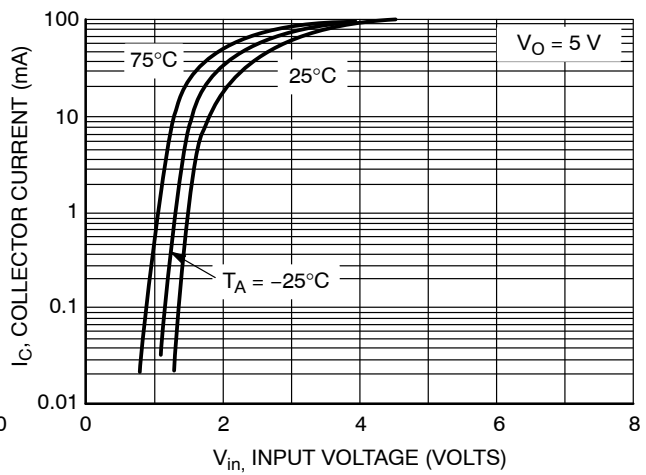


Figure 45. Output Current vs. Input Voltage

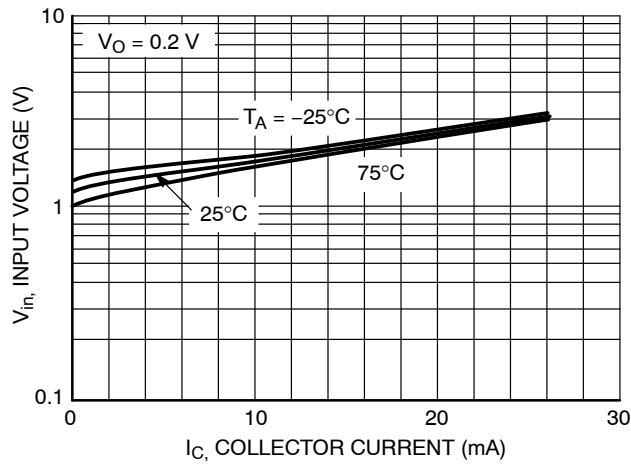


Figure 46. Output Voltage vs. Input Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2233LT1G

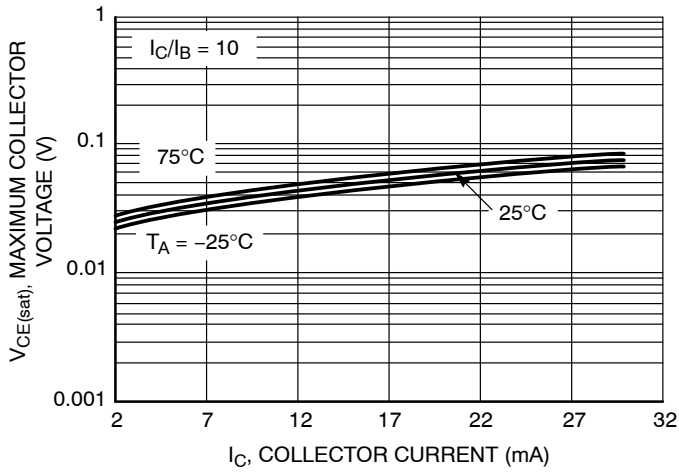


Figure 47.  $V_{CE(sat)}$  vs.  $I_C$

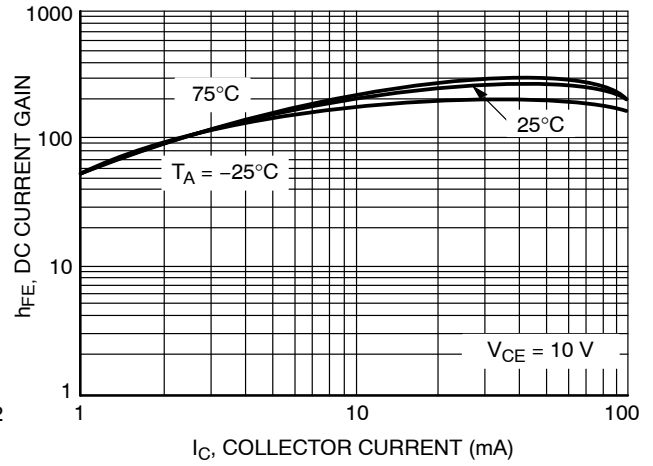


Figure 48. DC Current Gain

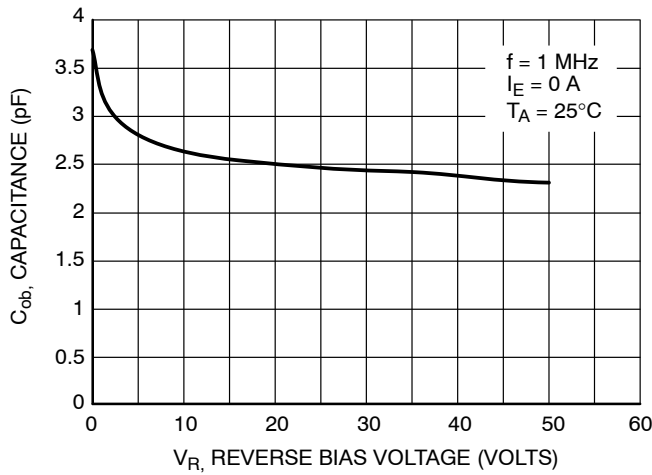


Figure 49. Output Capacitance

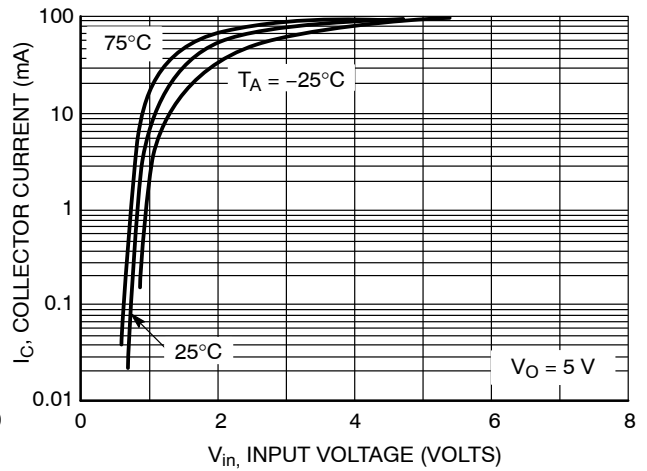


Figure 50. Output Current vs. Input Voltage

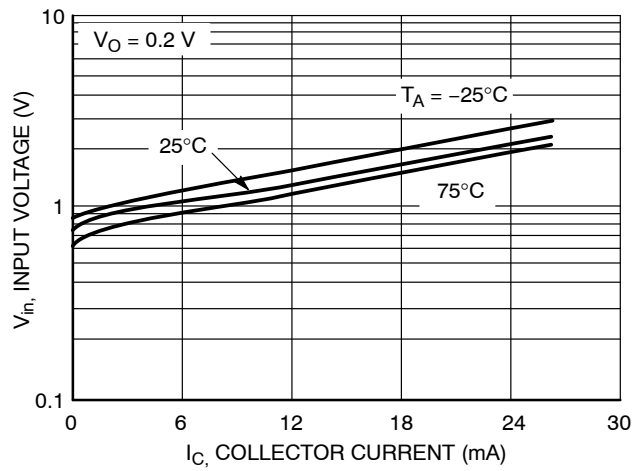


Figure 51. Input Voltage vs. Output Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2234LT1G

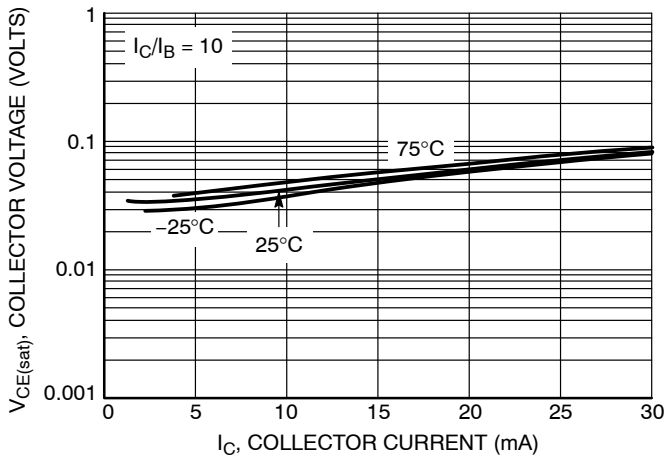


Figure 52.  $V_{CE(sat)}$  versus  $I_C$

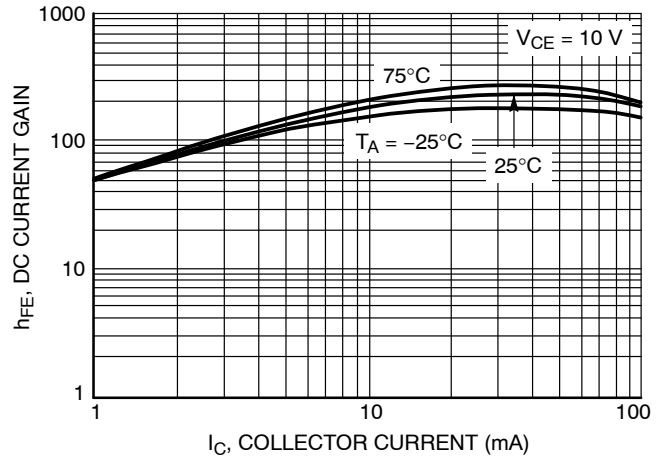


Figure 53. DC Current Gain

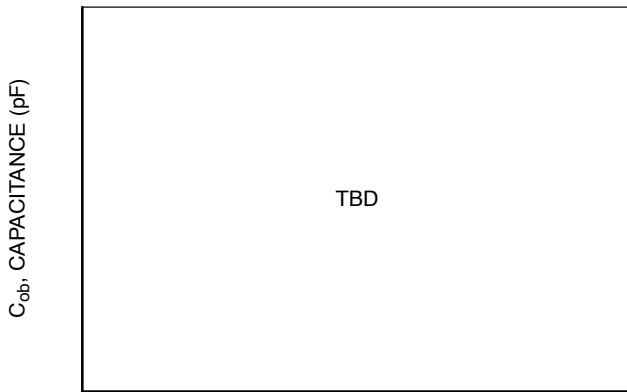


Figure 54. Output Capacitance

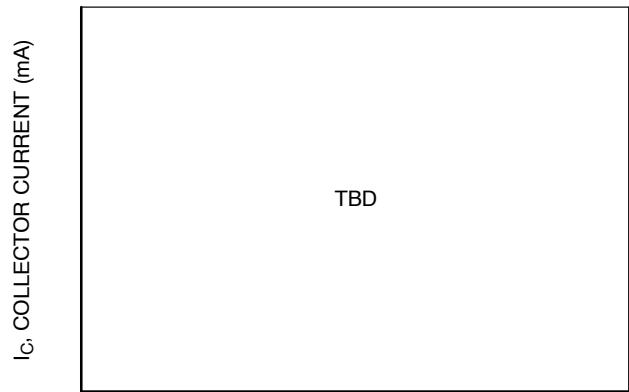


Figure 55. Output Current versus Input Voltage

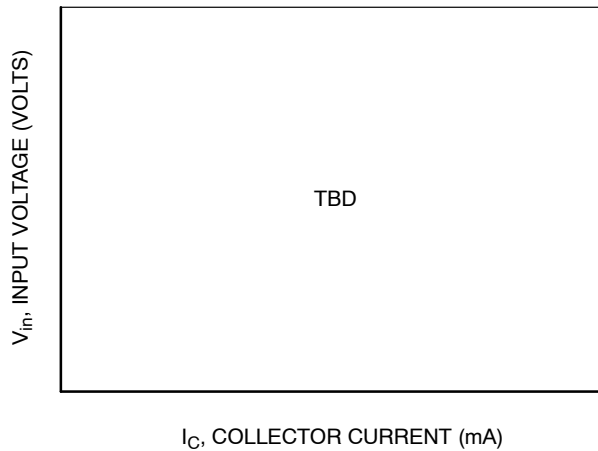


Figure 56. Input Voltage versus Output Current

# MMUN2211LT1G Series

## TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2238LT1G

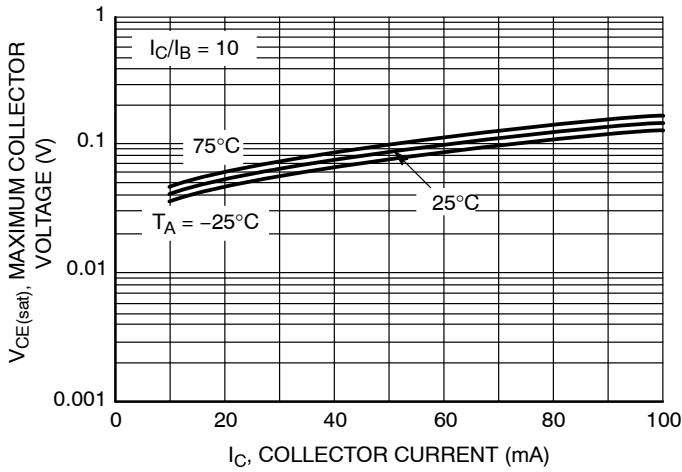


Figure 57.  $V_{CE(sat)}$  vs.  $I_C$

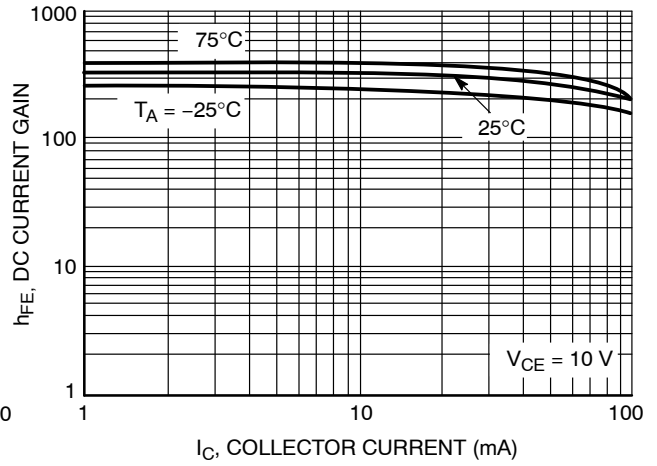


Figure 58. DC Current Gain

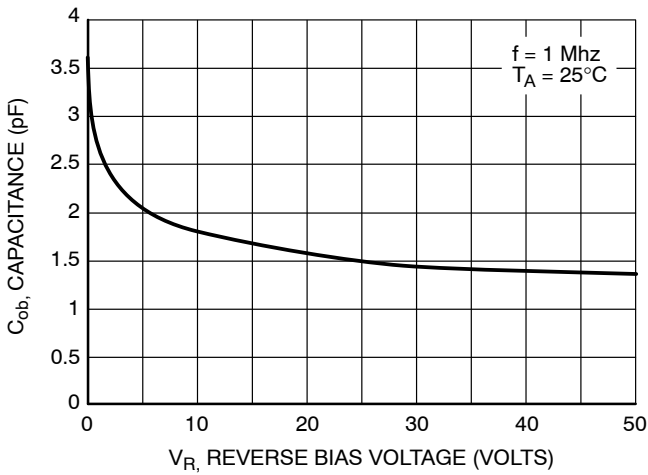


Figure 59. Output Capacitance

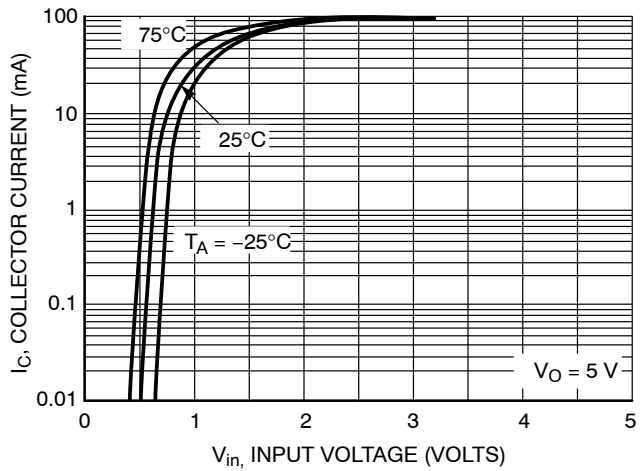


Figure 60. Output Current vs. Input Voltage

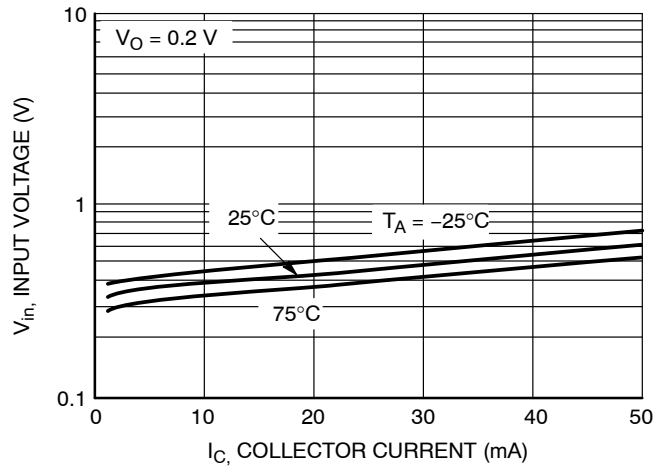


Figure 61. Input Voltage vs. Output Current

# MMUN2211LT1G Series

## TYPICAL APPLICATIONS FOR NPN BRTs

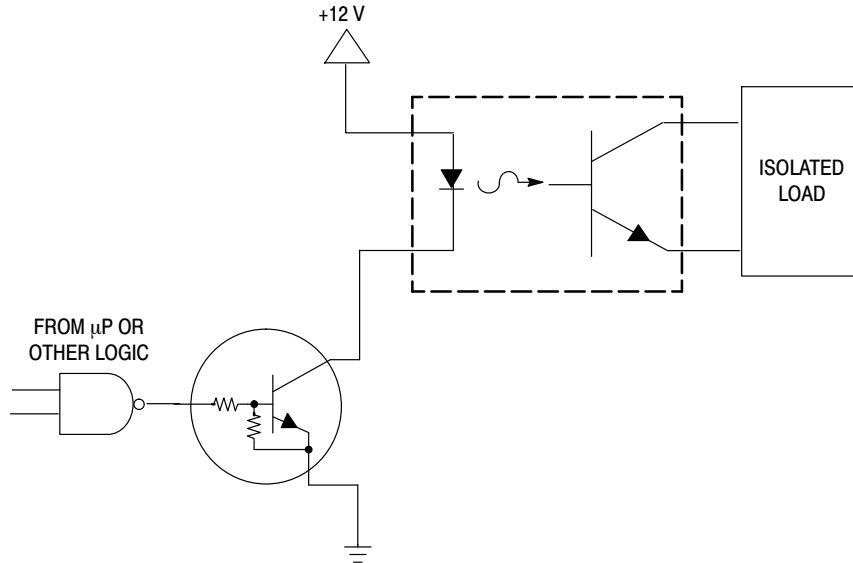


Figure 62. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

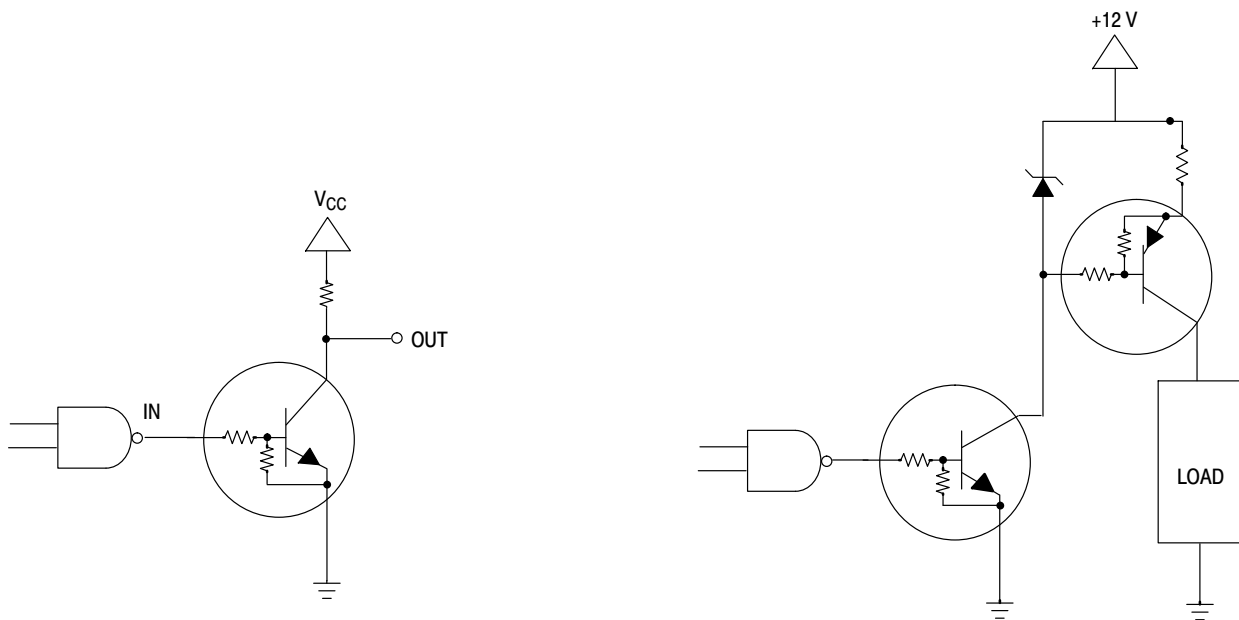


Figure 63. Open Collector Inverter: Inverts the Input Signal

Figure 64. Inexpensive, Unregulated Current Source



## MMUN2211LT1G Series

### ORDERING INFORMATION

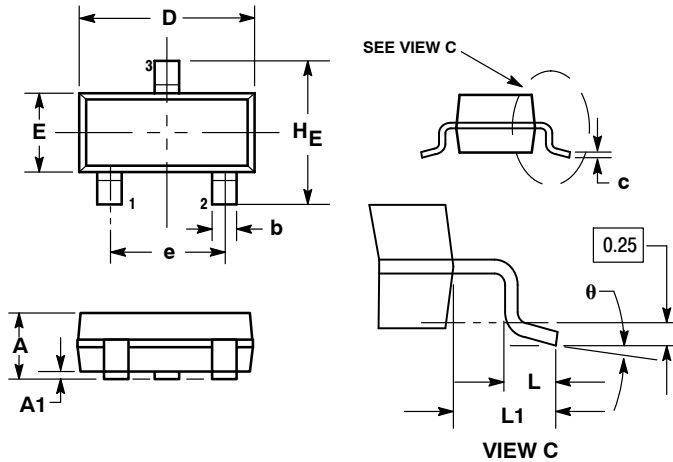
Device	Marking	R1(k)	R2(k)	Package	Shipping <sup>†</sup>
MMUN2211LT1G	A8A	10	10	SOT-23 (Pb-Free)	3000 / Tape & Reel
MMUN2211LT3G		10	10	SOT-23 (Pb-Free)	10,000 / Tape & Reel
MMUN2212LT1G	A8B	22	22	SOT-23 (Pb-Free)	3000 / Tape & Reel
MMUN2213LT1G	A8C	47	47	SOT-23 (Pb-Free)	
MMUN2214LT1G	A8D	10	47	SOT-23 (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)	

<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

## PACKAGE DIMENSIONS

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



NOTES:

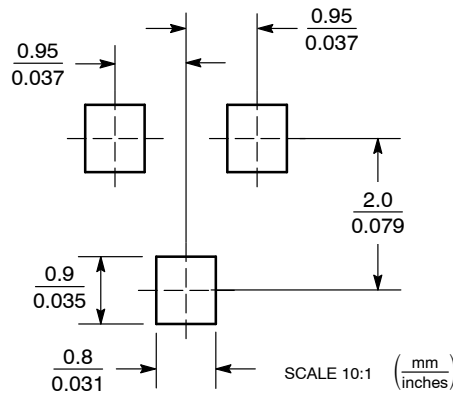
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

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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