MMUN2211LT1 Series

Preferred Devices

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
- Pb−Free Packages are Available

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

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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

ON Semiconductor®

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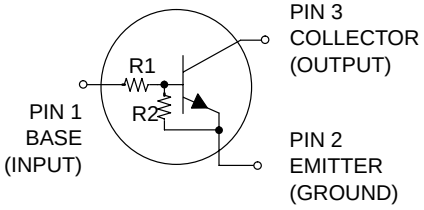
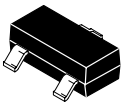
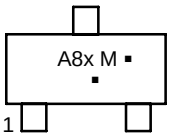




SOT−23
CASE 318
STYLE 6

MARKING DIAGRAM



A8x = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

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

August, 2005 − Rev. 7

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 (V_{EB} = 6.0 V, I_C = 0)	MMUN2211LT1	I_{EBO}	−	−	0.5	mAdc
	MMUN2212LT1		−	−	0.2	
	MMUN2213LT1		−	−	0.1	
	MMUN2214LT1		−	−	0.2	
	MMUN2215LT1		−	−	0.9	
	MMUN2216LT1		−	−	1.9	
	MMUN2230LT1		−	−	4.3	
	MMUN2231LT1		−	−	2.3	
	MMUN2232LT1		−	−	1.5	
	MMUN2233LT1		−	−	0.18	
	MMUN2234LT1		−	−	0.13	
	MMUN2238LT1		−	−	4.0	
	MMUN2241LT1		−	−	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 (V_{CE} = 10 V, I_C = 5.0 mA)	MMUN2211LT1	h_{FE}	35	60	−	
	MMUN2212LT1		60	100	−	
	MMUN2213LT1		80	140	−	
	MMUN2214LT1		80	140	−	
	MMUN2215LT1		160	350	−	
	MMUN2216LT1		160	350	−	
	MMUN2230LT1		3.0	5.0	−	
	MMUN2231LT1		8.0	15	−	
	MMUN2232LT1		15	30	−	
	MMUN2233LT1		80	200	−	
	MMUN2234LT1		80	150	−	
	MMUN2238LT1		160	350	−	
	MMUN2241LT1		160	350	−	
Collector-Emitter Saturation Voltage (I_C = 10 mA, I_B = 0.3 mA) (I_C = 10 mA, I_B = 5 mA) MMUN2230LT1/MMUN2231LT1 (I_C = 10 mA, I_B = 1 mA) MMUN2215LT1/MMUN2216LT1 MMUN2232LT1/MMUN2233LT1/MMUN2234LT1/ MMUN2238LT1		$V_{CE(sat)}$	−	−	0.25	Vdc

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 k Ω)	MMUN2211LT1		–	–	0.2	
	MMUN2212LT1		–	–	0.2	
	MMUN2214LT1		–	–	0.2	
	MMUN2215LT1		–	–	0.2	
	MMUN2216LT1		–	–	0.2	
	MMUN2230LT1		–	–	0.2	
	MMUN2231LT1		–	–	0.2	
	MMUN2232LT1		–	–	0.2	
	MMUN2233LT1		–	–	0.2	
	MMUN2234LT1		–	–	0.2	
	MMUN2238LT1		–	–	0.2	
(V_{CC} = 5.0 V, V_B = 3.5 V, R_L = 1.0 k Ω)	MMUN2213LT1		–	–	0.2	
(V_{CC} = 5.0 V, V_B = 5.0 V, R_L = 1.0 k Ω)	MMUN2241LT1		–	–	0.2	
Output Voltage (off) (V_{CC} = 5.0 V, V_B = 0.5 V, R_L = 1.0 k Ω)		V_{OH}	4.9	–	–	Vdc
(V_{CC} = 5.0 V, V_B = 0.050 V, R_L = 1.0 k Ω)	MMUN2230LT1					
(V_{CC} = 5.0 V, V_B = 0.25 V, R_L = 1.0 k Ω)	MMUN2215LT1					
	MMUN2216LT1					
	MMUN2233LT1					
	MMUN2238LT1					
Input Resistor	MMUN2211LT1	R1	7.0	10	13	kΩ
	MMUN2212LT1		15.4	22	28.6	
	MMUN2213LT1		32.9	47	61.1	
	MMUN2214LT1		7.0	10	13	
	MMUN2215LT1		7.0	10	13	
	MMUN2216LT1		3.3	4.7	6.1	
	MMUN2230LT1		0.7	1.0	1.3	
	MMUN2231LT1		1.5	2.2	2.9	
	MMUN2232LT1		3.3	4.7	6.1	
	MMUN2233LT1		3.3	4.7	6.1	
	MMUN2234LT1		15.4	22	28.6	
	MMUN2238LT1		1.54	2.2	2.88	
	MMUN2241LT1		70	100	130	
Resistor Ratio	MMUN2211LT1/MMUN2212LT1/MMUN2213LT1	R1/R2	0.8	1.0	1.2	
	MMUN2214LT1		0.17	0.21	0.25	
	MMUN2215LT1/MMUN2216LT1/MMUN2238LT1		–	–	–	
	MMUN2241LT1		–	–	–	
	MMUN2230LT1/MMUN2231LT1/MMUN2232LT1		0.8	1.0	1.2	
	MMUN2233LT1		0.055	0.1	0.185	
	MMUN2234LT1		0.38	0.47	0.56	

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

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2211LT1

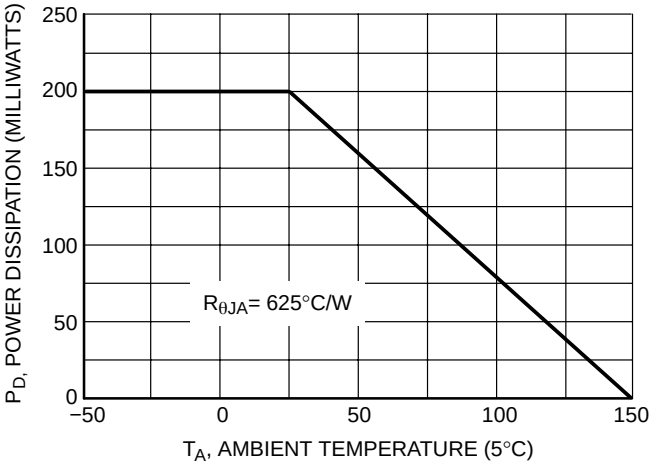


Figure 1. Derating Curve

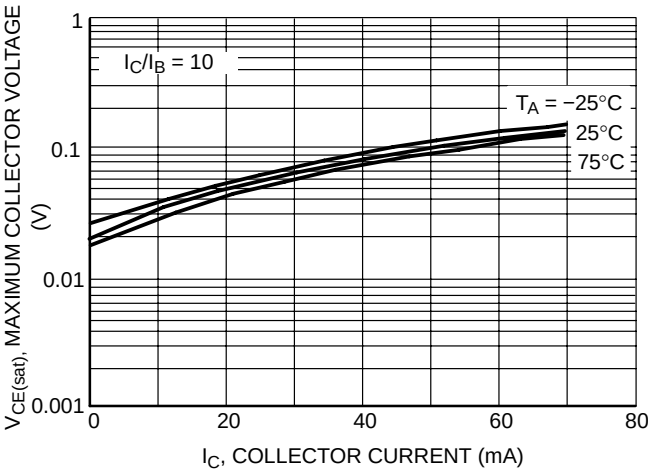


Figure 2. $V_{CE(sat)}$ vs. I_C

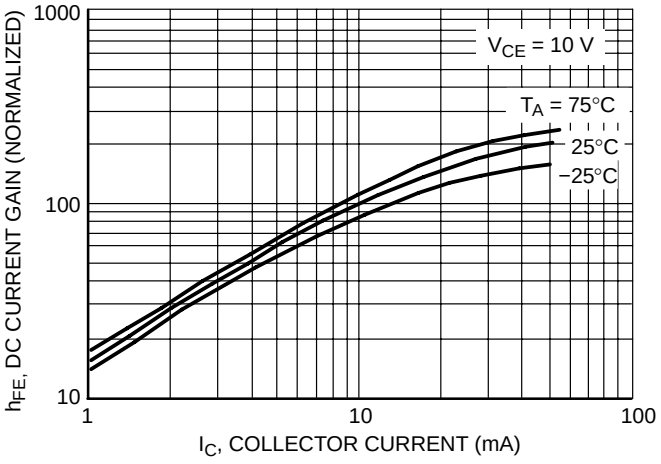


Figure 3. DC Current Gain

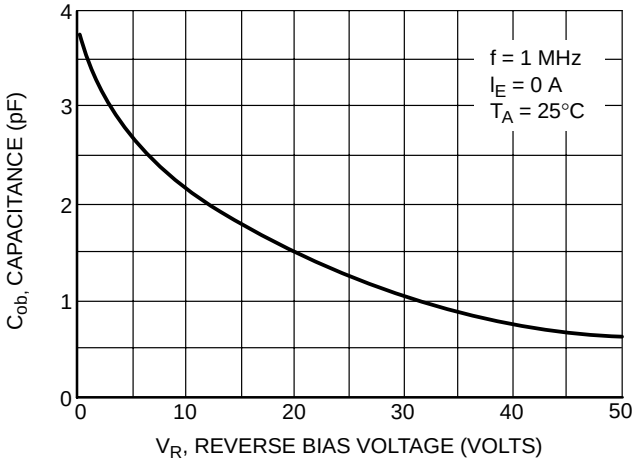


Figure 4. Output Capcitance

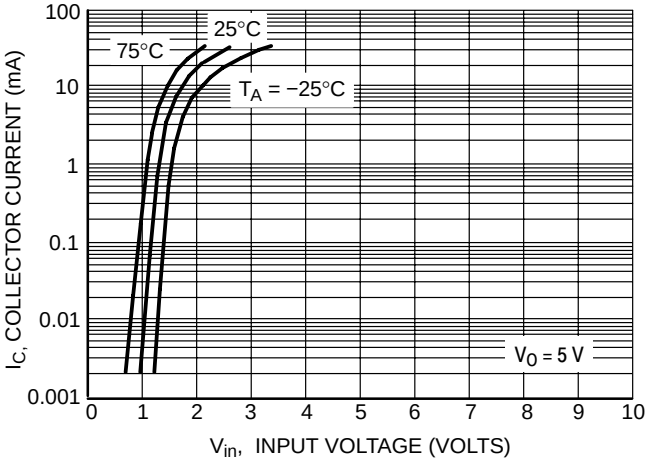


Figure 5. Output Current vs. Input Voltage

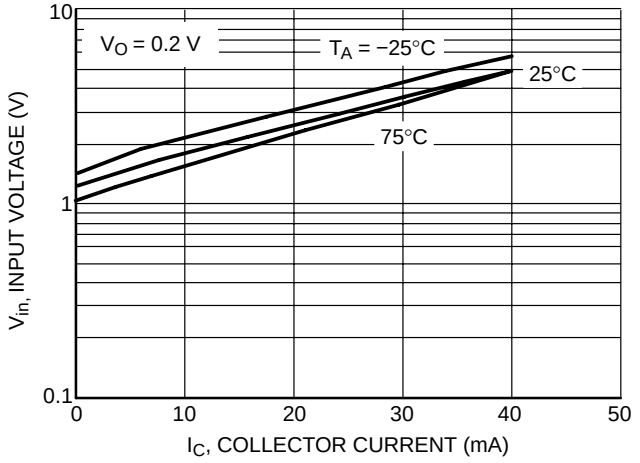


Figure 6. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2212LT1

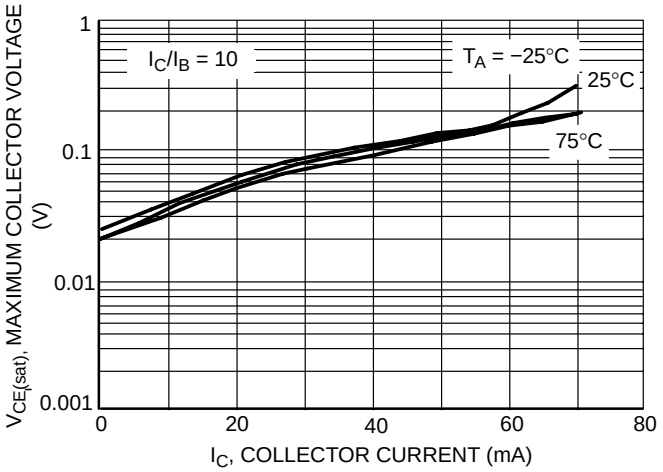


Figure 7. $V_{CE(sat)}$ vs. I_C

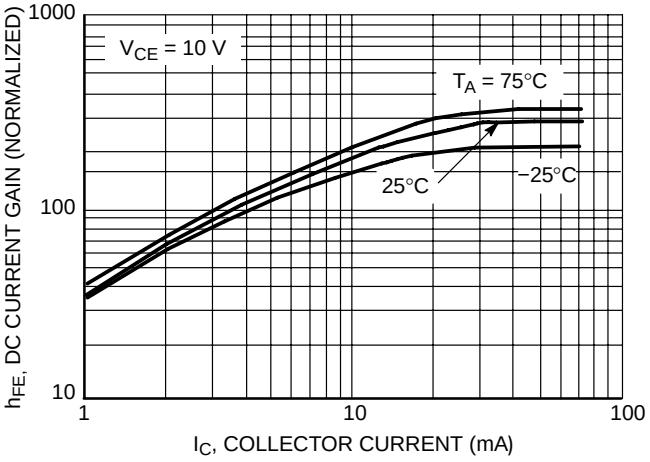


Figure 8. DC Current Gain

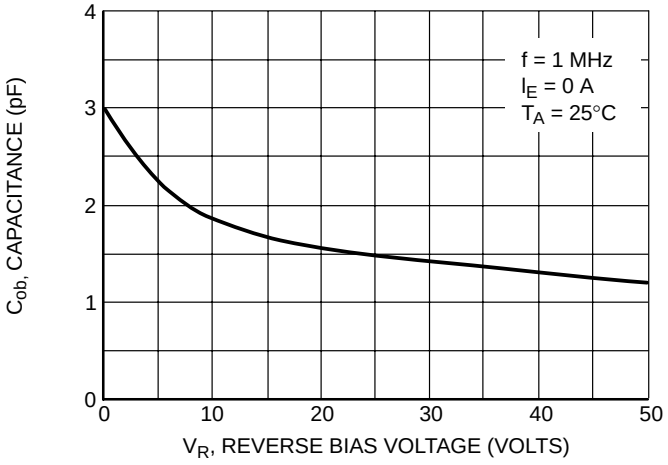


Figure 9. Output Capacitance

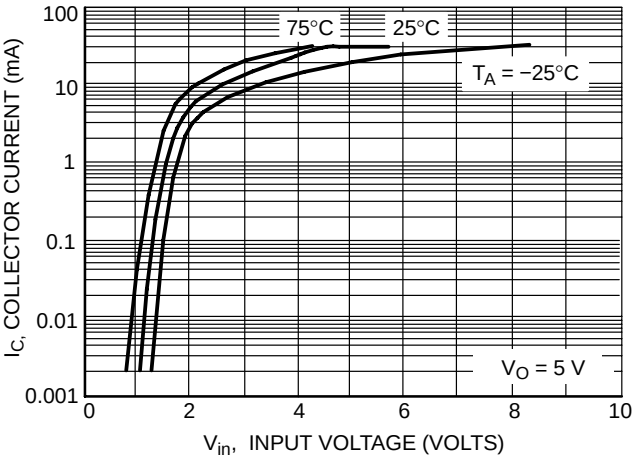


Figure 10. Output Current vs. Input Voltage

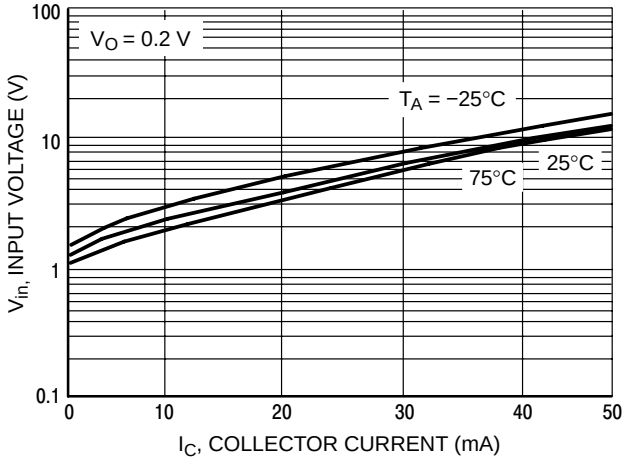


Figure 11. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2213LT1

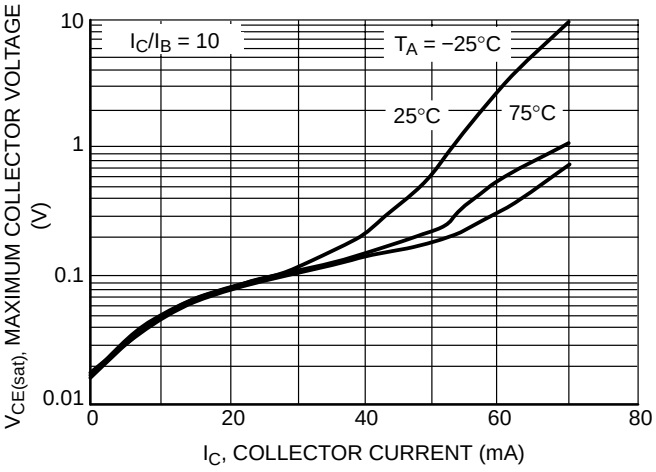


Figure 12. $V_{CE(sat)}$ vs. I_C

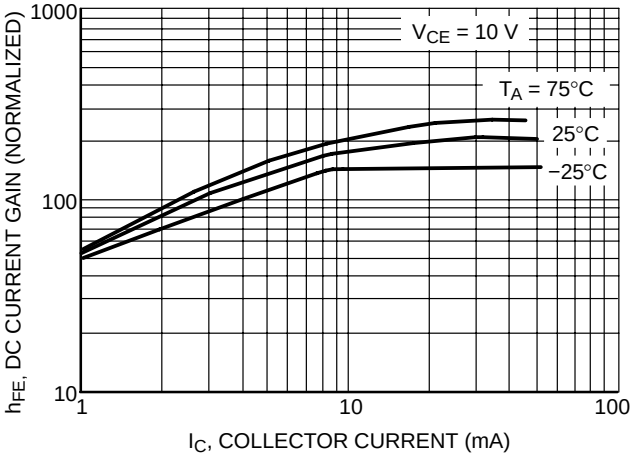


Figure 13. DC Current Gain

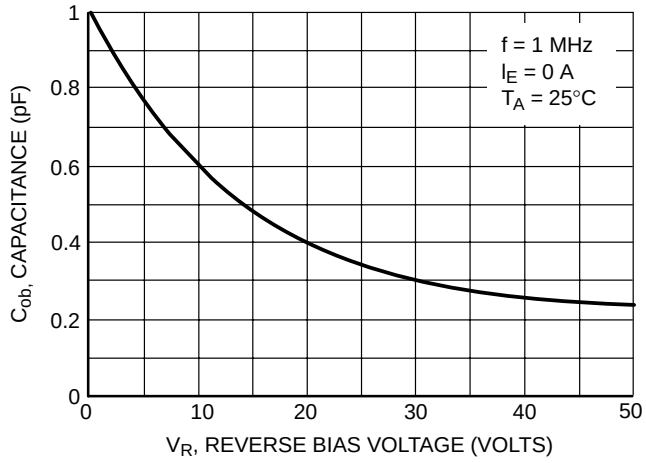


Figure 14. Output Capacitance

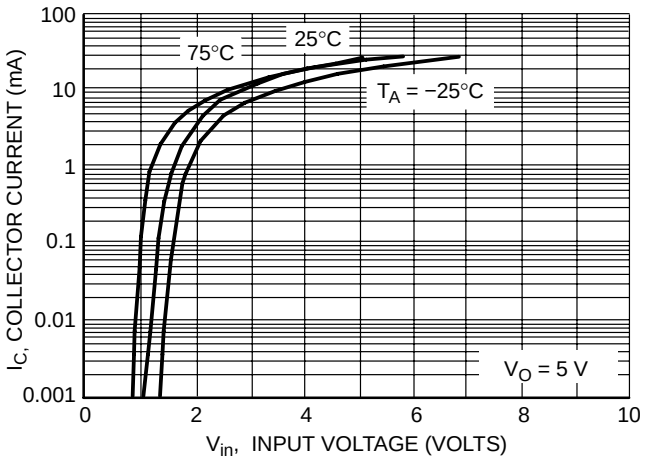


Figure 15. Output Current vs. Input Voltage

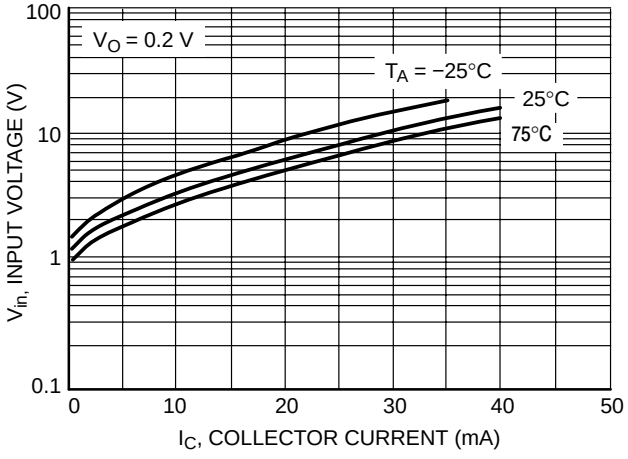


Figure 16. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2214LT1

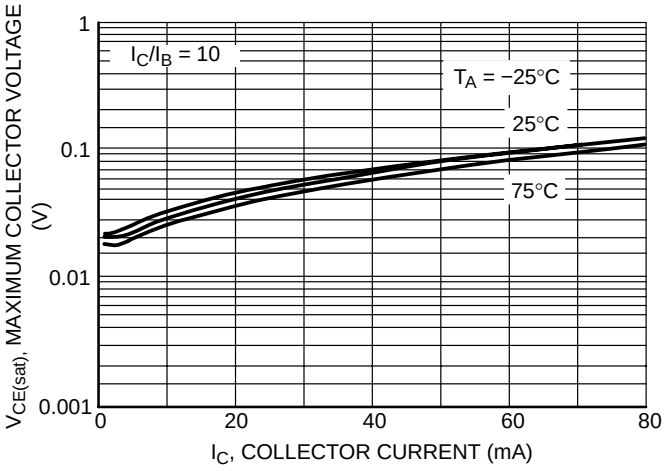


Figure 17. $V_{CE(sat)}$ vs. I_C

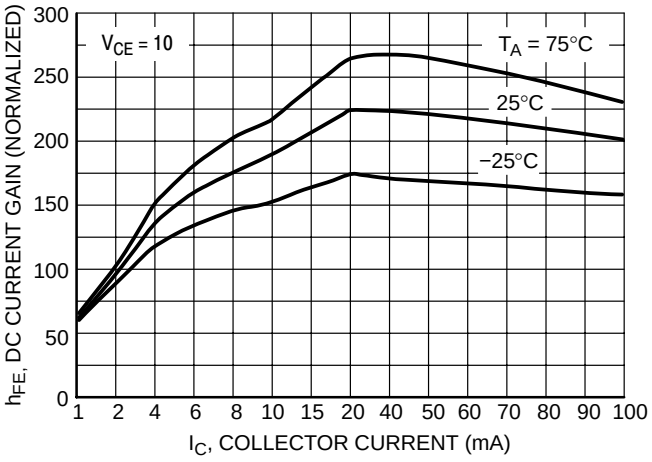


Figure 18. DC Current Gain

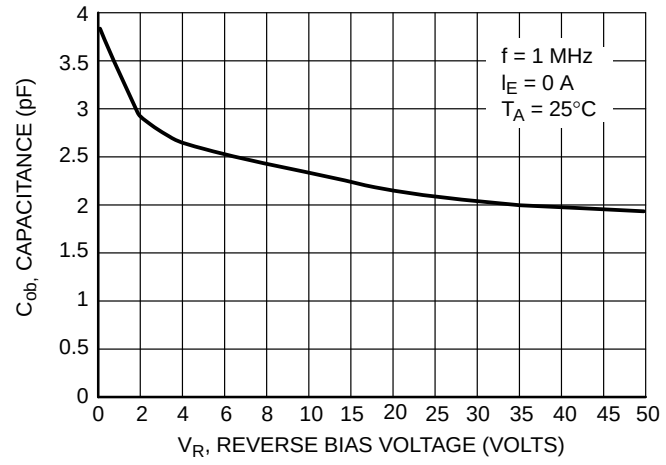


Figure 19. Output Capacitance

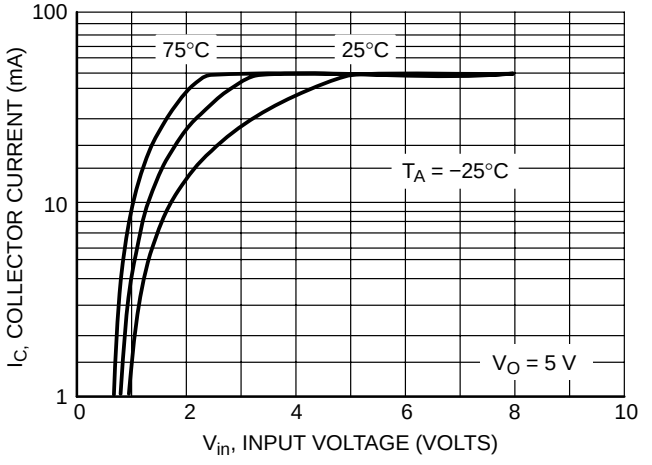


Figure 20. Output Current vs. Input Voltage

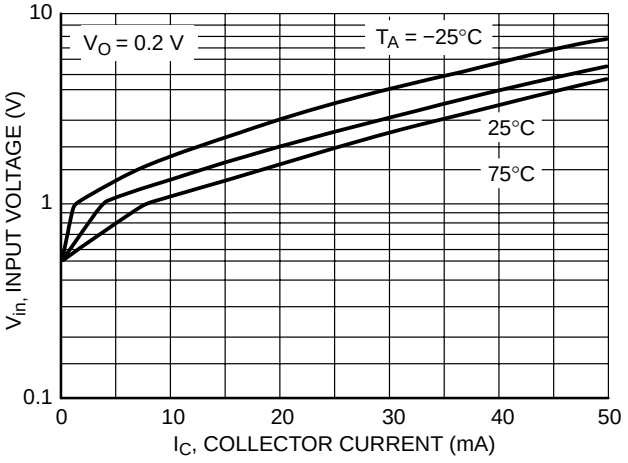


Figure 21. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2232LT1

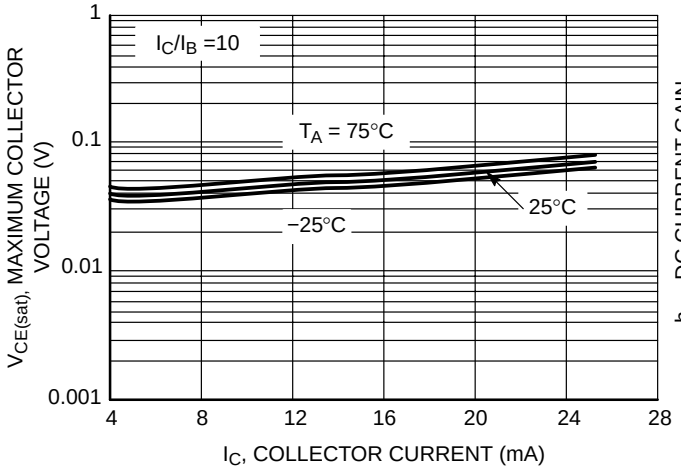


Figure 22. $V_{CE(sat)}$ vs. I_C

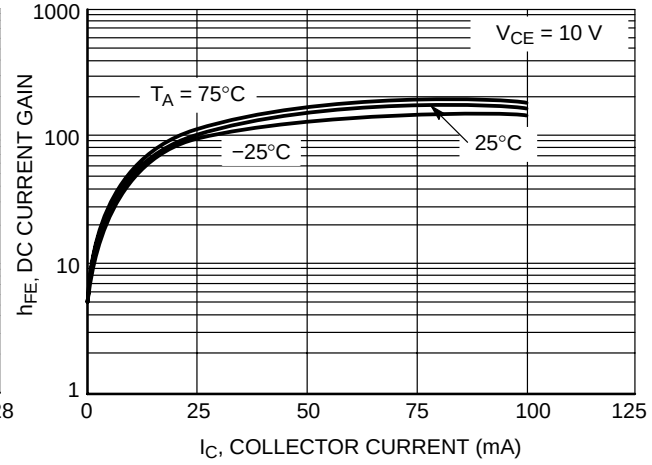


Figure 23. DC Current Gain

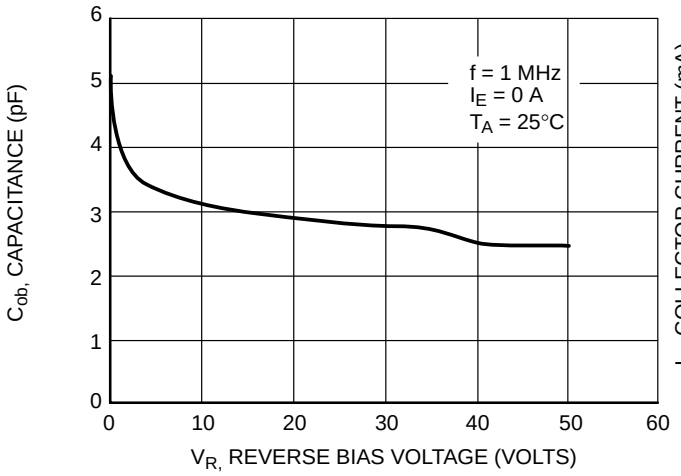


Figure 24. Output Capacitance

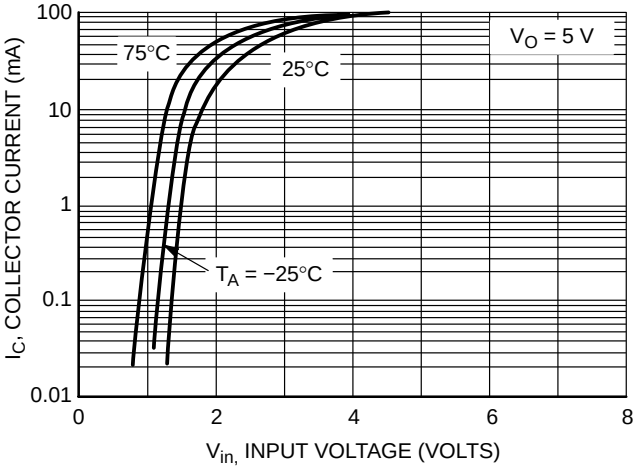


Figure 25. Output Current vs. Input Voltage

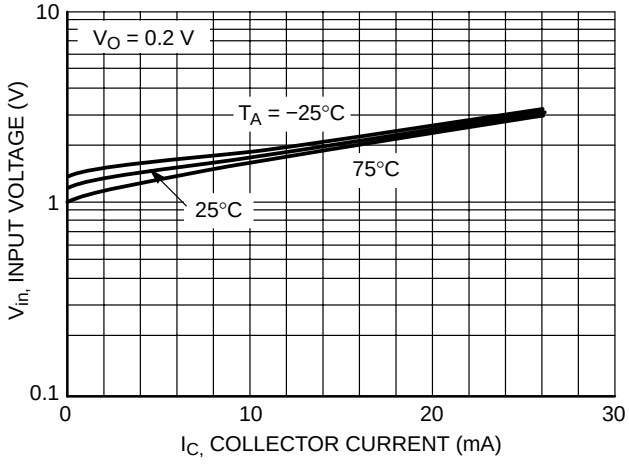


Figure 26. Output Voltage vs. Input Current

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2233LT1

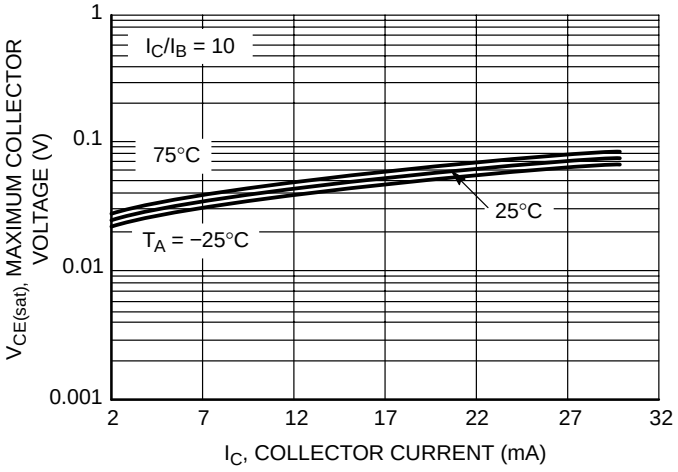


Figure 27. $V_{CE(sat)}$ vs. I_C

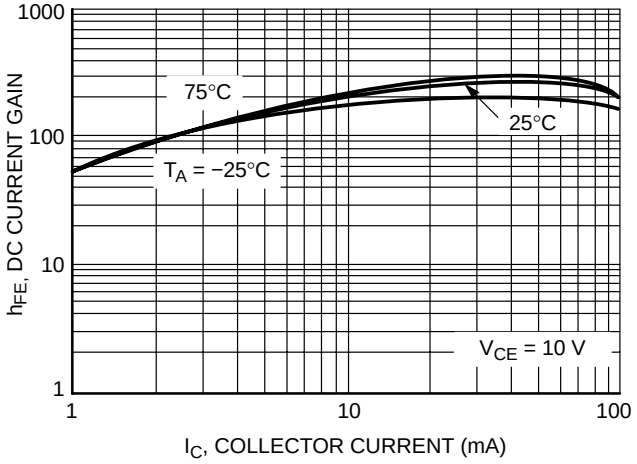


Figure 28. DC Current Gain

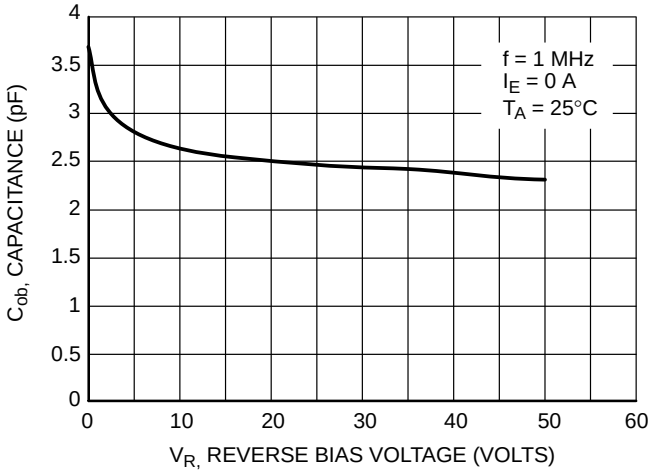


Figure 29. Output Capacitance

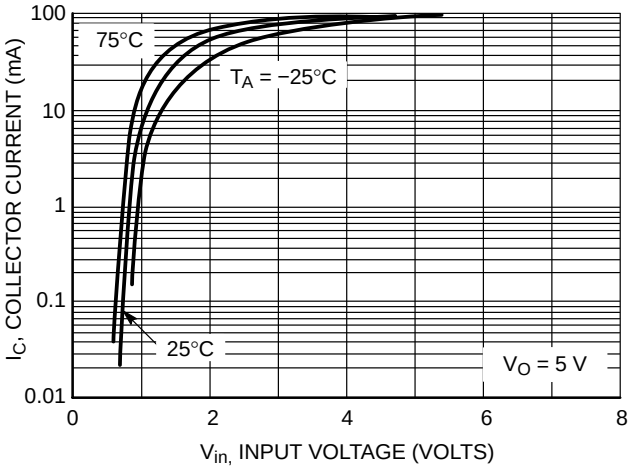


Figure 30. Output Current vs. Input Voltage

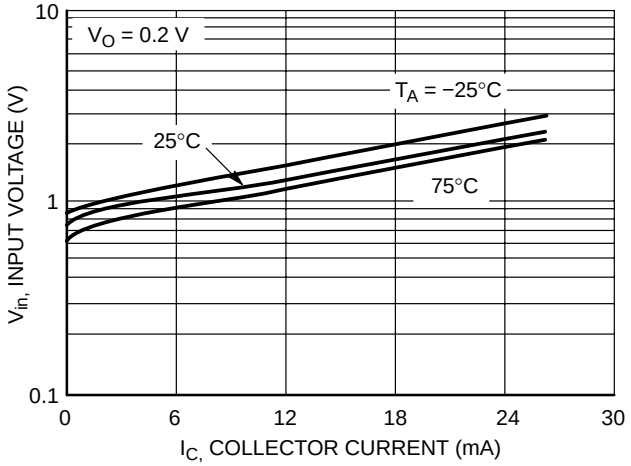


Figure 31. Input Voltage vs. Output Current

TYPICAL APPLICATIONS FOR NPN BRTs

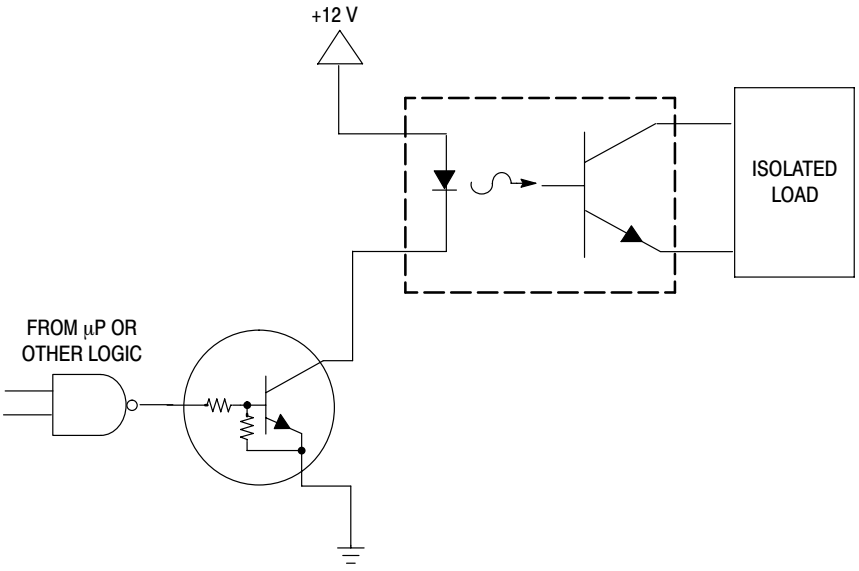


Figure 32. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

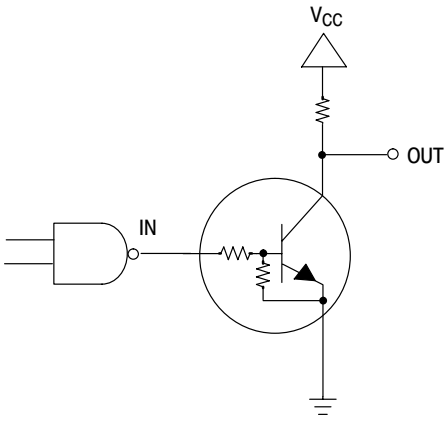


Figure 33. Open Collector Inverter: Inverts the Input Signal

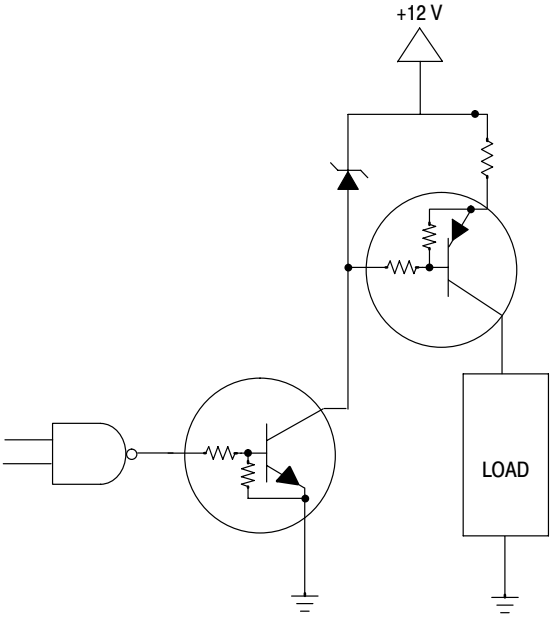


Figure 34. Inexpensive, Unregulated Current Source

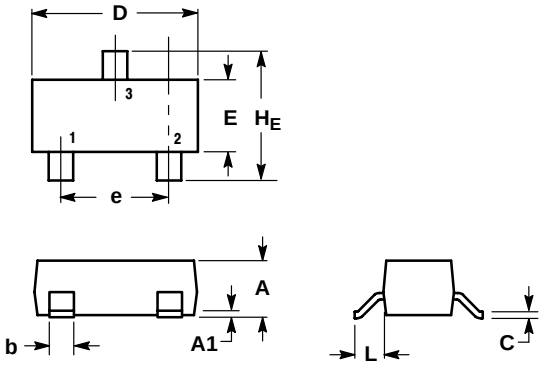
ORDERING INFORMATION

Device	Marking	R1(k)	R2(k)	Package	Shipping†
MMUN2211LT1	A8A	10	10	SOT−23	3000 / Tape & Reel
MMUN2211LT1G		10	10	SOT−23 (Pb−Free)	
MMUN2211LT3		10	10	SOT−23	10,000 / Tape & Reel
MMUN2211LT3G		10	10	SOT−23 (Pb−Free)	
MMUN2112LT1	A8B	22	22	SOT−23	3000 / Tape & Reel
MMUN2212LT1G		22	22	SOT−23 (Pb−Free)	
MMUN2213LT1	A8C	47	47	SOT−23	
MMUN2213LT1G		47	47	SOT−23 (Pb−Free)	
MMUN2214LT1	A8D	10	47	SOT−23	
MMUN2214LT1G		10	47	SOT−23 (Pb−Free)	
MMUN2215LT1	A8E	10	∞	SOT−23	
MMUN2215LT1G		10	∞	SOT−23 (Pb−Free)	
MMUN2216LT1	A8F	4.7	∞	SOT−23	
MMUN2216LT1G		4.7	∞	SOT−23 (Pb−Free)	
MMUN2230LT1	A8G	1.0	1.0	SOT−23	
MMUN2230LT1G		1.0	1.0	SOT−23 (Pb−Free)	
MMUN2231LT1	A8H	2.2	2.2	SOT−23	
MMUN2231LT1G		2.2	2.2	SOT−23 (Pb−Free)	
MMUN2232LT1	A8J	4.7	4.7	SOT−23	
MMUN2232LT1G		4.7	4.7	SOT−23 (Pb−Free)	
MMUN2233LT1	A8K	4.7	47	SOT−23	
MMUN2233LT1G		4.7	47	SOT−23 (Pb−Free)	
MMUN2234LT1	A8L	22	47	SOT−23	
MMUN2234LT1G		22	47	SOT−23 (Pb−Free)	
MMUN2234LT3		22	47	SOT−23	10,000 / Tape & Reel
MMUN2234LT3G		22	47	SOT−23 (Pb−Free)	
MMUN2238LT1	A8R	2.2	∞	SOT−23	3000 / Tape & Reel
MMUN2238LT1G		2.2	∞	SOT−23 (Pb−Free)	
MMUN2241LT1	A8U	100	∞	SOT−23	
MMUN2241LT1G		100	∞	SOT−23 (Pb−Free)	

†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 AL

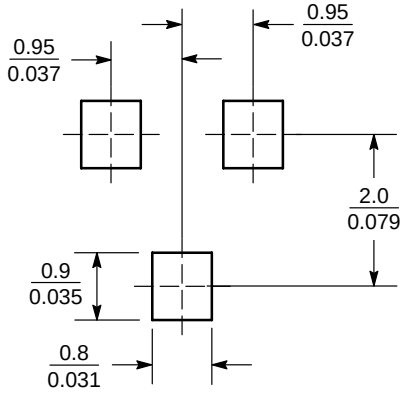


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318−01 THRU −07 AND −09 OBSOLETE, NEW STANDARD 318−08.

	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	0.35	0.54	0.69	0.014	0.021	0.029
H_E	2.10	2.40	2.64	0.083	0.094	0.104

STYLE 6:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

SOLDERING FOOTPRINT*



SCALE 10:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

*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

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MMUN2211LT1/D