MUN2213, MMUN2213L, MUN5213, DTC144EE, DTC144EM3, NSBC144EF3

Digital Transistors (BRT) R1 = 47 kΩ, R2 = 47 kΩ

NPN Transistors with Monolithic Bias Resistor Network

This series of digital transistors is designed to replace a single device and its external resistor bias network. The Bias Resistor Transistor (BRT) 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.

Features

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

MAXIMUM RATINGS (T_A = 25°C)

Rating	Symbol	Max	Unit
Collector−Base Voltage	V_{CBO}	50	Vdc
Collector−Emitter Voltage	V_{CEO}	50	Vdc
Collector Current − Continuous	I_C	100	mAdc
Input Forward Voltage	$V_{IN(fwd)}$	40	Vdc
Input Reverse Voltage	$V_{IN(rev)}$	10	Vdc

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.

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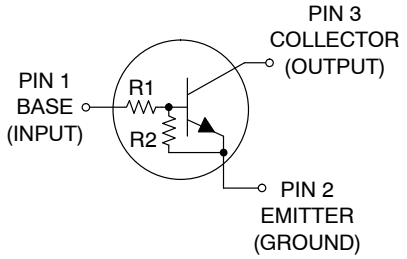
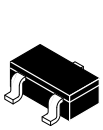
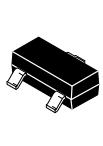
PIN CONNECTIONS



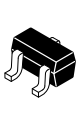
MARKING DIAGRAMS



SC−59
CASE 318D
STYLE 1



SOT−23
CASE 318
STYLE 6



SC−70/SOT−323
CASE 419
STYLE 3

SC−75
CASE 463
STYLE 1

SOT−723
CASE 631AA
STYLE 1

SOT−1123
CASE 524AA
STYLE 1

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

(Note: Microdot may be in either location)

*Date Code orientation may vary depending upon manufacturing location.

ORDERING INFORMATION

See detailed ordering, marking, and shipping information in the package dimensions section on page 2 of this data sheet.

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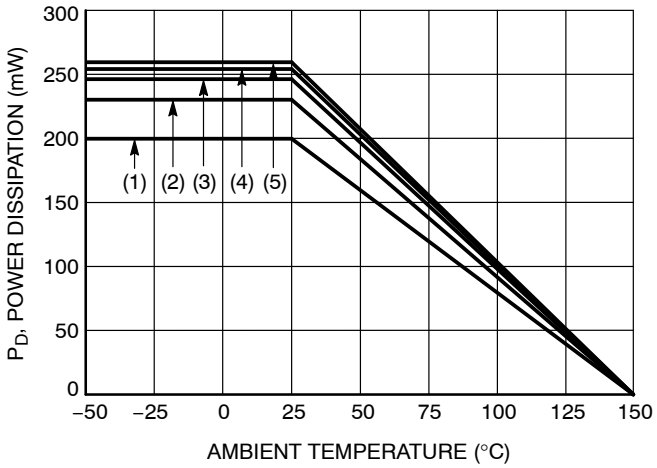
Table 1. ORDERING INFORMATION

Device	Part Marking	Package	Shipping†
MUN2213T1G, SMUN2213T1G	8C	SC−59 (Pb−Free)	3000 / Tape & Reel
MMUN2213LT1G, SMMUN2213LT1G	A8C	SOT−23 (Pb−Free)	3000 / Tape & Reel
SMMUN2213LT3G	A8C	SOT−23 (Pb−Free)	10000 / Tape & Reel
MUN5213T1G, SMUN5213T1G	8C	SC−70/SOT−323 (Pb−Free)	3000 / Tape & Reel
DTC144EET1G, SDTC144EET1G	8C	SC−75 (Pb−Free)	3000 / Tape & Reel
DTC144EM3T5G	8C	SOT−723 (Pb−Free)	8000 / Tape & Reel
NSBC144EF3T5G	D	SOT−1123 (Pb−Free)	8000 / 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.



(1) SC−75 and SC−70/SOT323; Minimum Pad
(2) SC−59; Minimum Pad
(3) SOT−23; Minimum Pad
(4) SOT−1123; 100 mm^2, 1 oz. copper trace
(5) SOT−723; Minimum Pad

Figure 1. Derating Curve

Table 2. THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
THERMAL CHARACTERISTICS (SC−59) (MUN2213)			
Total Device Dissipation	P_D		
T_A = 25°C (Note 1)		230	mW
(Note 2)		338	
Derate above 25°C (Note 1)		1.8	mW/°C
(Note 2)		2.7	
Thermal Resistance, (Note 1)	$R_{\theta JA}$	540	°C/W
Junction to Ambient (Note 2)		370	
Thermal Resistance, (Note 1)	$R_{\theta JL}$	264	°C/W
Junction to Lead (Note 2)		287	
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°C
THERMAL CHARACTERISTICS (SOT−23) (MMUN2213L)			
Total Device Dissipation	P_D		
T_A = 25°C (Note 1)		246	mW
(Note 2)		400	
Derate above 25°C (Note 1)		2.0	mW/°C
(Note 2)		3.2	
Thermal Resistance, (Note 1)	$R_{\theta JA}$	508	°C/W
Junction to Ambient (Note 2)		311	
Thermal Resistance, (Note 1)	$R_{\theta JL}$	174	°C/W
Junction to Lead (Note 2)		208	
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°C
THERMAL CHARACTERISTICS (SC−70/SOT−323) (MUN5213)			
Total Device Dissipation	P_D		
T_A = 25°C (Note 1)		202	mW
(Note 2)		310	
Derate above 25°C (Note 1)		1.6	mW/°C
(Note 2)		2.5	
Thermal Resistance, (Note 1)	$R_{\theta JA}$	618	°C/W
Junction to Ambient (Note 2)		403	
Thermal Resistance, (Note 1)	$R_{\theta JL}$	280	°C/W
Junction to Lead (Note 2)		332	
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°C
THERMAL CHARACTERISTICS (SC−75) (DTC144EE, SDTC144EE)			
Total Device Dissipation	P_D		
T_A = 25°C (Note 1)		200	mW
(Note 2)		300	
Derate above 25°C (Note 1)		1.6	mW/°C
(Note 2)		2.4	
Thermal Resistance, (Note 1)	$R_{\theta JA}$	600	°C/W
Junction to Ambient (Note 2)		400	
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°C
THERMAL CHARACTERISTICS (SOT−723) (DTC144EM3)			
Total Device Dissipation	P_D		
T_A = 25°C (Note 1)		260	mW
(Note 2)		600	
Derate above 25°C (Note 1)		2.0	mW/°C
(Note 2)		4.8	
Thermal Resistance, (Note 1)	$R_{\theta JA}$	480	°C/W
Junction to Ambient (Note 2)		205	
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°C

1. FR−4 @ Minimum Pad.
2. FR−4 @ 1.0 x 1.0 Inch Pad.
3. FR−4 @ 100 mm^2, 1 oz. copper traces, still air.
4. FR−4 @ 500 mm^2, 1 oz. copper traces, still air.

Table 2. THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
THERMAL CHARACTERISTICS (SOT−1123) (NSBC144EF3)			
Total Device Dissipation T_A = 25°C (Note 3) (Note 4) Derate above 25°C (Note 3) (Note 4)	P_D	 254 297 2.0 2.4	 mW mW/°C
Thermal Resistance, (Note 3) Junction to Ambient (Note 4)	$R_{\theta JA}$	493 421	°C/W
Thermal Resistance, Junction to Lead (Note 3)	$R_{\theta JL}$	193	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°C

1. FR−4 @ Minimum Pad.
2. FR−4 @ 1.0 x 1.0 Inch Pad.
3. FR−4 @ 100 mm^2, 1 oz. copper traces, still air.
4. FR−4 @ 500 mm^2, 1 oz. copper traces, still air.

Table 3. 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)	I_{EBO}	–	–	0.1	mAdc
Collector−Base Breakdown Voltage (I_C = 10 μA, I_E = 0)	$V_{(BR)CBO}$	50	–	–	Vdc
Collector−Emitter Breakdown Voltage (Note 5) (I_C = 2.0 mA, I_B = 0)	$V_{(BR)CEO}$	50	–	–	Vdc
ON CHARACTERISTICS					
DC Current Gain (Note 5) (I_C = 5.0 mA, V_{CE} = 10 V)	h_{FE}	80	140	–	
Collector−Emitter Saturation Voltage (Note 5) (I_C = 10 mA, I_B = 0.3 mA)	$V_{CE(sat)}$	–	–	0.25	Vdc
Input Voltage (off) (V_{CE} = 5.0 V, I_C = 100 μA)	$V_{i(off)}$	–	1.2	0.8	Vdc
Input Voltage (on) (V_{CE} = 0.3 V, I_C = 2.0 mA)	$V_{i(on)}$	3.0	1.6	–	Vdc
Output Voltage (on) (V_{CC} = 5.0 V, V_B = 3.5 V, R_L = 1.0 kΩ)	V_{OL}	–	–	0.2	Vdc
Output Voltage (off) (V_{CC} = 5.0 V, V_B = 0.5 V, R_L = 1.0 kΩ)	V_{OH}	4.9	–	–	Vdc
Input Resistor	R1	32.9	47	61.1	kΩ
Resistor Ratio	R_1/R_2	0.8	1.0	1.2	

5. Pulsed Condition: Pulse Width = 300 msec, Duty Cycle ≤ 2%.

TYPICAL CHARACTERISTICS
MUN2213, MMUN2213L, MUN5213, DTC144EE, SDTC144EE, DTC144EM3

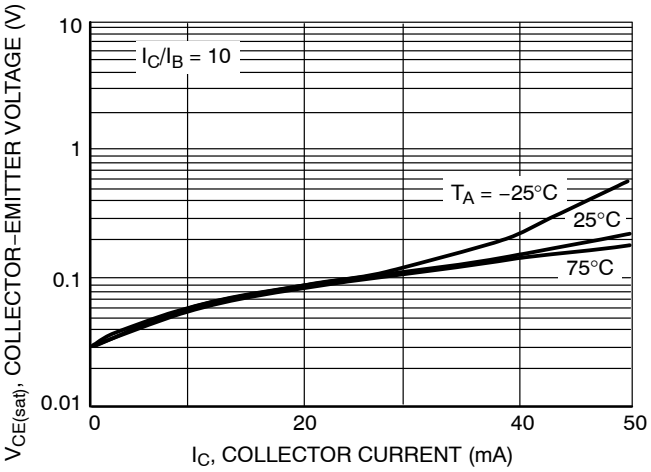


Figure 2. $V_{CE(sat)}$ vs. I_C

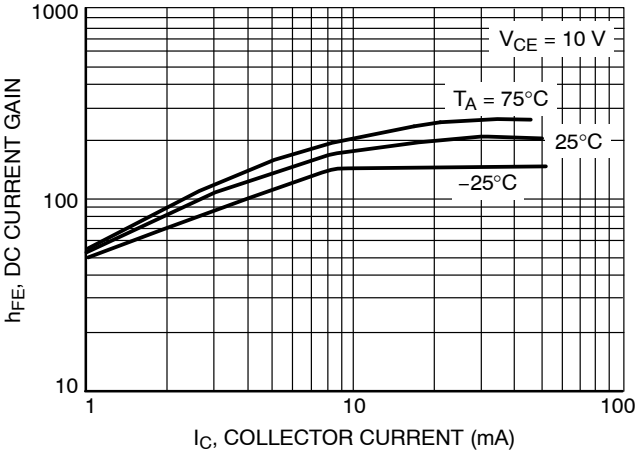


Figure 3. DC Current Gain

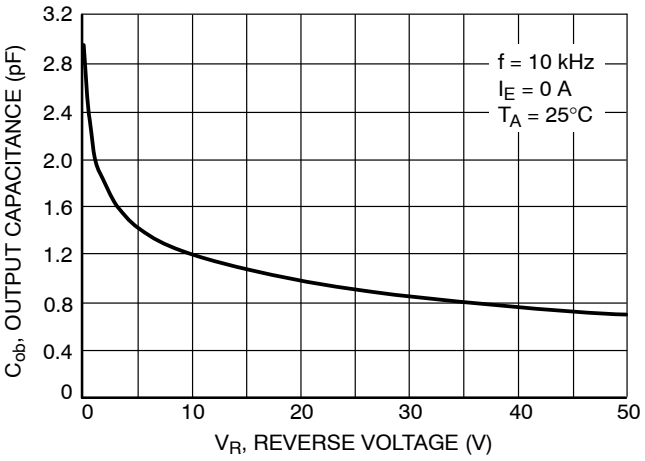


Figure 4. Output Capacitance

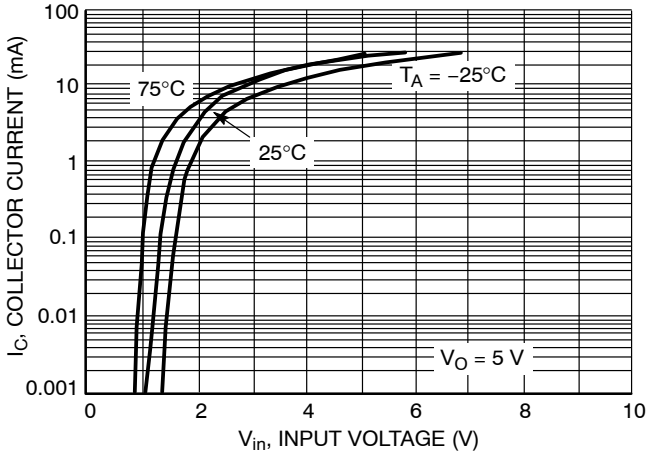


Figure 5. Output Current vs. Input Voltage

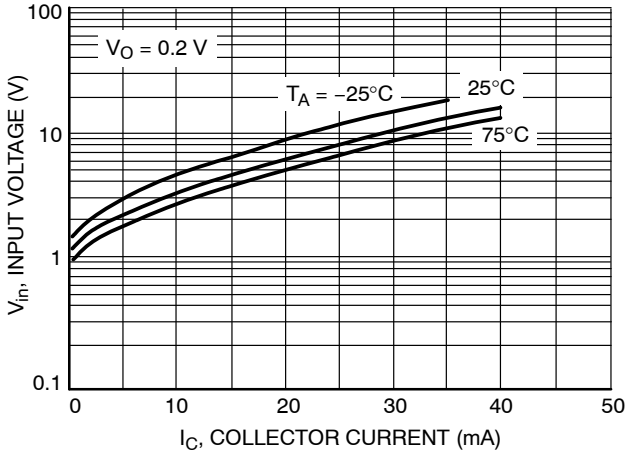


Figure 6. Input Voltage vs. Output Current

TYPICAL CHARACTERISTICS – NSBC144EF3

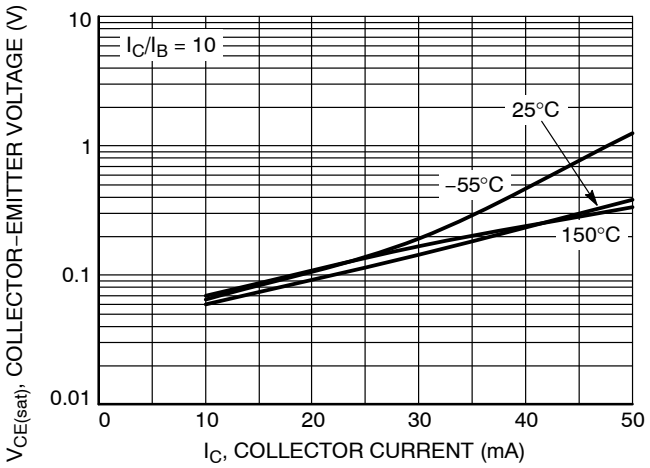


Figure 7. $V_{CE(sat)}$ vs. I_C

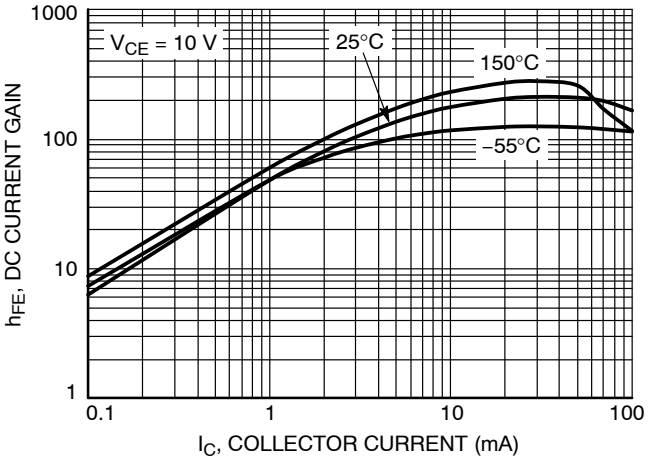


Figure 8. DC Current Gain

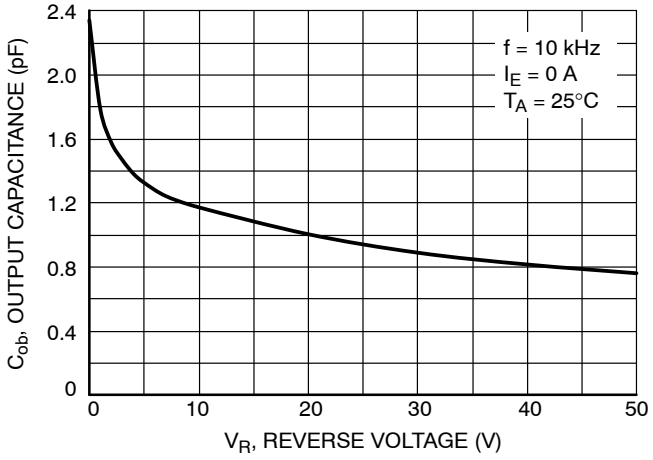


Figure 9. Output Capacitance

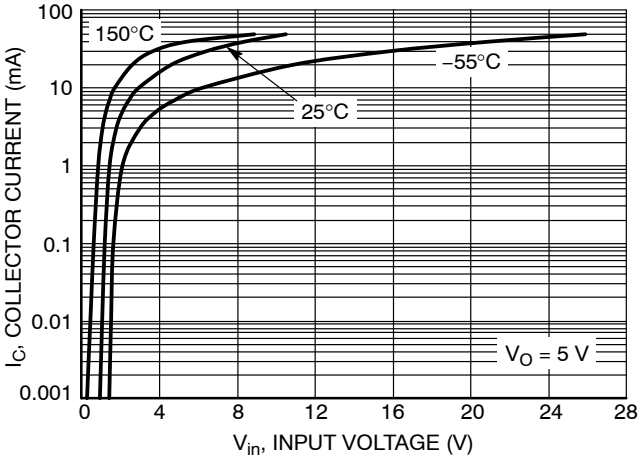


Figure 10. Output Current vs. Input Voltage

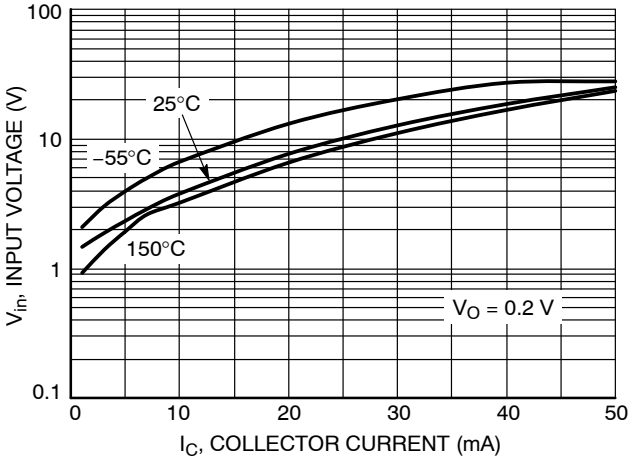
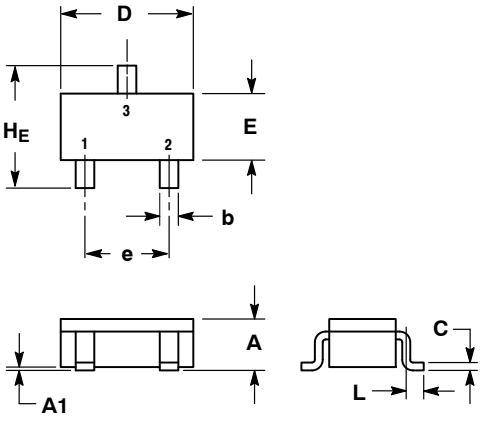


Figure 11. Input Voltage vs. Output Current

PACKAGE DIMENSIONS

SC−59
CASE 318D−04
ISSUE H

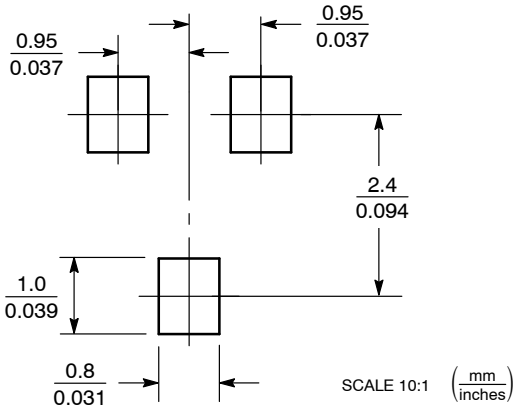


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

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

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

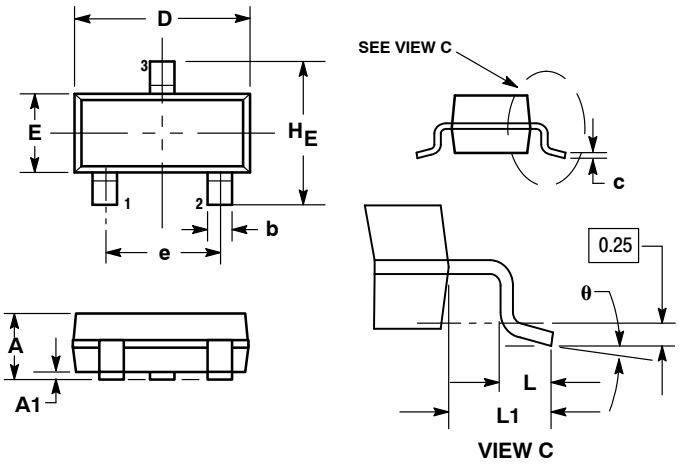
SOLDERING FOOTPRINT*



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

PACKAGE DIMENSIONS

SOT−23 (TO−236)
CASE 318−08
ISSUE AP

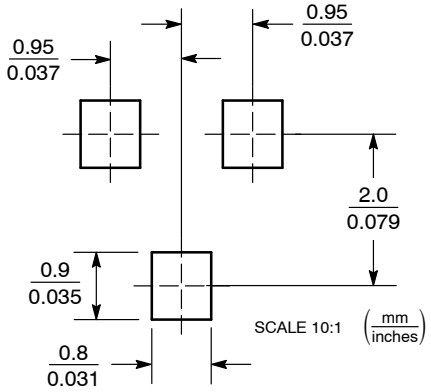


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	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°

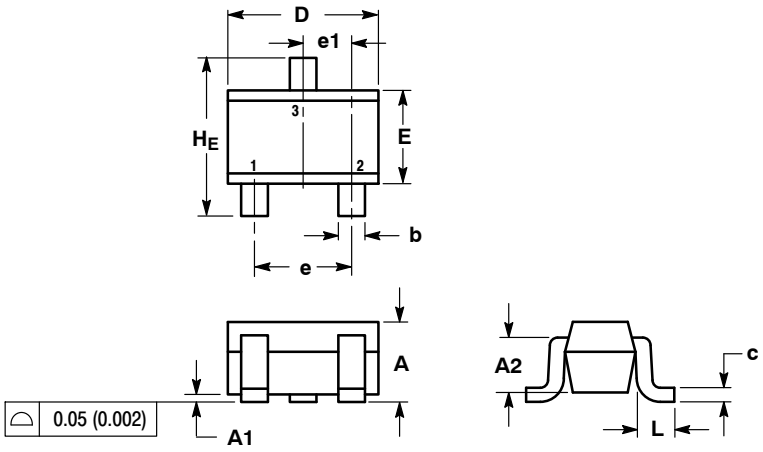
STYLE 6:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

SOLDERING FOOTPRINT



PACKAGE DIMENSIONS

SC−70 (SOT−323)
CASE 419−04
ISSUE N

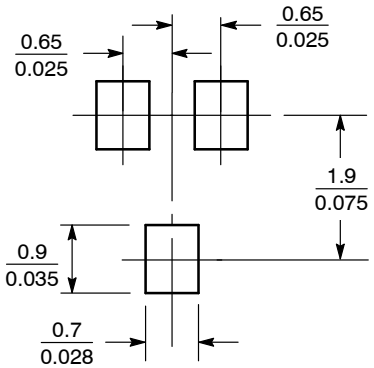


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.90	1.00	0.032	0.035	0.040
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2		0.70 REF			0.028 REF	
b	0.30	0.35	0.40	0.012	0.014	0.016
c	0.10	0.18	0.25	0.004	0.007	0.010
D	1.80	2.10	2.20	0.071	0.083	0.087
E	1.15	1.24	1.35	0.045	0.049	0.053
e	1.20	1.30	1.40	0.047	0.051	0.055
e1		0.65 BSC			0.026 BSC	
L	0.20	0.38	0.56	0.008	0.015	0.022
H_E	2.00	2.10	2.40	0.079	0.083	0.095

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

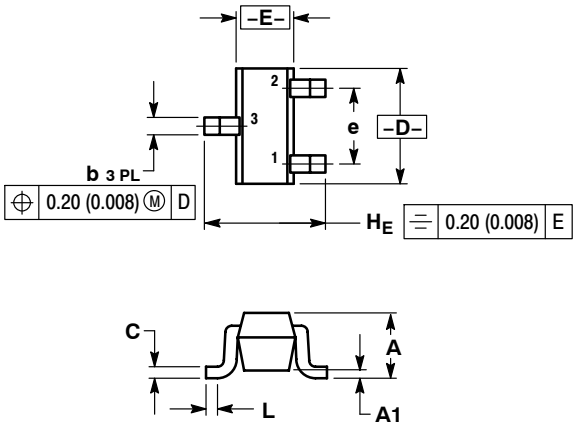
SOLDERING FOOTPRINT*



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

PACKAGE DIMENSIONS

SC−75/SOT−416
CASE 463
ISSUE F

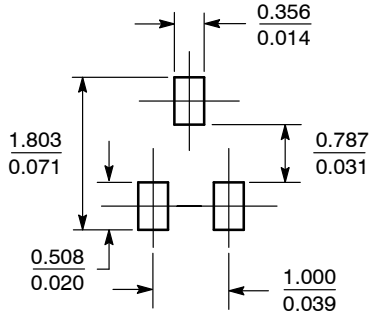


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	0.70	0.80	0.90	0.027	0.031	0.035
A1	0.00	0.05	0.10	0.000	0.002	0.004
b	0.15	0.20	0.30	0.006	0.008	0.012
C	0.10	0.15	0.25	0.004	0.006	0.010
D	1.55	1.60	1.65	0.059	0.063	0.067
E	0.70	0.80	0.90	0.027	0.031	0.035
e	1.00 BSC			0.04 BSC		
L	0.10	0.15	0.20	0.004	0.006	0.008
H_E	1.50	1.60	1.70	0.061	0.063	0.065

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

SOLDERING FOOTPRINT*

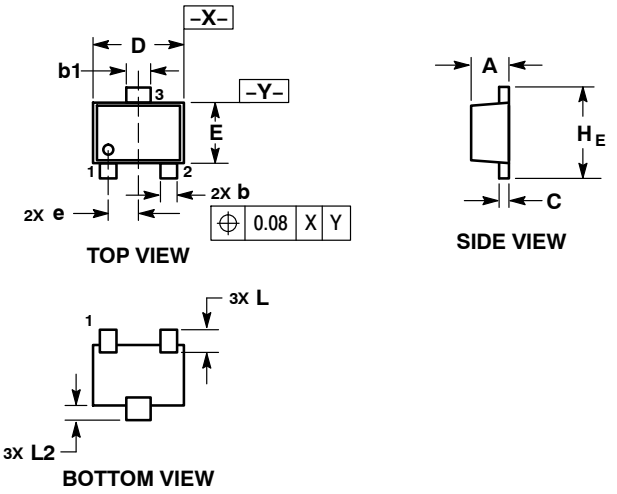


SCALE 10:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

PACKAGE DIMENSIONS

SOT−723
CASE 631AA
ISSUE D

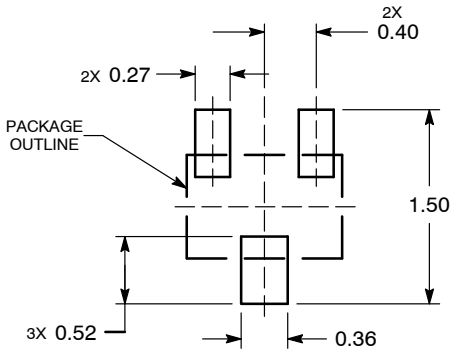


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

	MILLIMETERS		
DIM	MIN	NOM	MAX
A	0.45	0.50	0.55
b	0.15	0.21	0.27
b1	0.25	0.31	0.37
C	0.07	0.12	0.17
D	1.15	1.20	1.25
E	0.75	0.80	0.85
e		0.40 BSC	
H E	1.15	1.20	1.25
L		0.29 REF	
L2	0.15	0.20	0.25

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

RECOMMENDED SOLDERING FOOTPRINT*

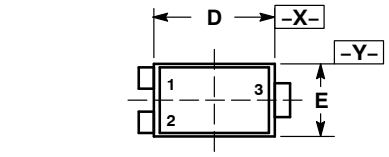


DIMENSIONS: MILLIMETERS

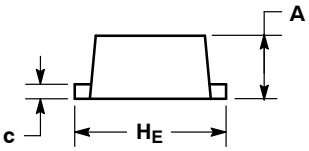
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

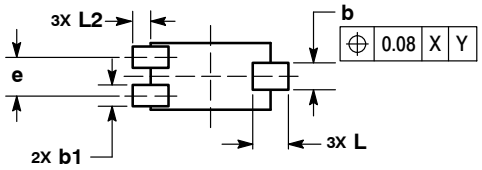
SOT−1123
CASE 524AA
ISSUE C



TOP VIEW



SIDE VIEW



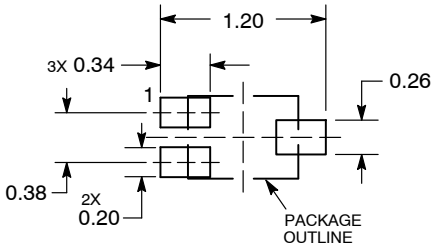
BOTTOM VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. 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	
DIM	MIN	MAX
A	0.34	0.40
b	0.15	0.28
b1	0.10	0.20
c	0.07	0.17
D	0.75	0.85
E	0.55	0.65
e	0.35	0.40
H_E	0.95	1.05
L	0.185 REF	
L2	0.05	0.15

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

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

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