

P2N2222A

Amplifier Transistors

NPN Silicon

Features

- These are Pb-Free Devices*

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Value	Unit
Collector – Emitter Voltage	V_{CEO}	40	Vdc
Collector – Base Voltage	V_{CBO}	75	Vdc
Emitter – Base Voltage	V_{EBO}	6.0	Vdc
Collector Current – Continuous	I_C	600	mA dc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.5 12	W mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

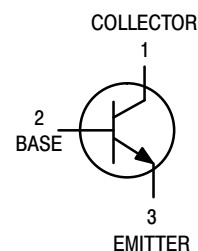
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	$^\circ\text{C/W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	$^\circ\text{C/W}$

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.

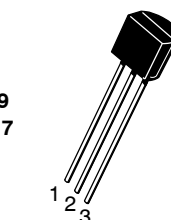


ON Semiconductor®

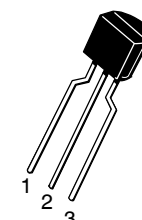
<http://onsemi.com>



TO-92
CASE 29
STYLE 17

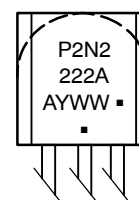


STRAIGHT LEAD
BULK PACK



BENT LEAD
TAPE & REEL
AMMO PACK

MARKING DIAGRAM



A = Assembly Location

Y = Year

WW = Work Week

▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
P2N2222AG	TO-92 (Pb-Free)	5000 Units/Bulk
P2N2222ARL1G	TO-92 (Pb-Free)	2000/Tape & Ammo

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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

P2N2222A

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector – Emitter Breakdown Voltage (I _C = 10 mA _{dc} , I _B = 0)	V _{(BR)CEO}	40	–	V _{dc}
Collector – Base Breakdown Voltage (I _C = 10 μA _{dc} , I _E = 0)	V _{(BR)CBO}	75	–	V _{dc}
Emitter – Base Breakdown Voltage (I _E = 10 μA _{dc} , I _C = 0)	V _{(BR)EBO}	6.0	–	V _{dc}
Collector Cutoff Current (V _{CE} = 60 V _{dc} , V _{EB(off)} = 3.0 V _{dc})	I _{CEX}	–	10	nA _{dc}
Collector Cutoff Current (V _{CB} = 60 V _{dc} , I _E = 0) (V _{CB} = 60 V _{dc} , I _E = 0, T _A = 150°C)	I _{CBO}	– –	0.01 10	μA _{dc}
Emitter Cutoff Current (V _{EB} = 3.0 V _{dc} , I _C = 0)	I _{EBO}	–	10	nA _{dc}
Collector Cutoff Current (V _{CE} = 10 V)	I _{CEO}	–	10	nA _{dc}
Base Cutoff Current (V _{CE} = 60 V _{dc} , V _{EB(off)} = 3.0 V _{dc})	I _{BEX}	–	20	nA _{dc}

ON CHARACTERISTICS

DC Current Gain (I _C = 0.1 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , T _A = –55°C) (I _C = 150 mA _{dc} , V _{CE} = 10 V _{dc}) (Note 1) (I _C = 150 mA _{dc} , V _{CE} = 1.0 V _{dc}) (Note 1) (I _C = 500 mA _{dc} , V _{CE} = 10 V _{dc}) (Note 1)	h _{FE}	35 50 75 35 100 50 40	– – – – 300 – –	–
Collector – Emitter Saturation Voltage (Note 1) (I _C = 150 mA _{dc} , I _B = 15 mA _{dc}) (I _C = 500 mA _{dc} , I _B = 50 mA _{dc})	V _{CE(sat)}	– –	0.3 1.0	V _{dc}
Base – Emitter Saturation Voltage (Note 1) (I _C = 150 mA _{dc} , I _B = 15 mA _{dc}) (I _C = 500 mA _{dc} , I _B = 50 mA _{dc})	V _{BE(sat)}	0.6 –	1.2 2.0	V _{dc}

SMALL-SIGNAL CHARACTERISTICS

Current – Gain – Bandwidth Product (Note 2) (I _C = 20 mA _{dc} , V _{CE} = 20 V _{dc} , f = 100 MHz) _C	f _T	300	–	MHz
Output Capacitance (V _{CB} = 10 V _{dc} , I _E = 0, f = 1.0 MHz)	C _{obo}	–	8.0	pF
Input Capacitance (V _{EB} = 0.5 V _{dc} , I _C = 0, f = 1.0 MHz)	C _{ibo}	–	25	pF
Input Impedance (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz)	h _{ie}	2.0 0.25	8.0 1.25	kΩ
Voltage Feedback Ratio (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz)	h _{re}	– –	8.0 4.0	X 10 ^{–4}
Small-Signal Current Gain (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz)	h _{fe}	50 75	300 375	–
Output Admittance (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , f = 1.0 kHz)	h _{oe}	5.0 25	35 200	μMhos
Collector Base Time Constant (I _E = 20 mA _{dc} , V _{CB} = 20 V _{dc} , f = 31.8 MHz)	rb'C _c	–	150	ps
Noise Figure (I _C = 100 μA _{dc} , V _{CE} = 10 V _{dc} , R _S = 1.0 kΩ, f = 1.0 kHz)	N _F	–	4.0	dB

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
2. f_T is defined as the frequency at which |h_{fe}| extrapolates to unity.

P2N2222A

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS				
Delay Time	t_d	—	10	ns
Rise Time	t_r	—	25	ns
Storage Time	t_s	—	225	ns
Fall Time	t_f	—	60	ns

SWITCHING TIME EQUIVALENT TEST CIRCUITS

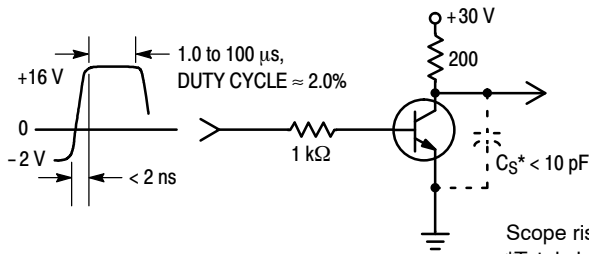


Figure 1. Turn-On Time

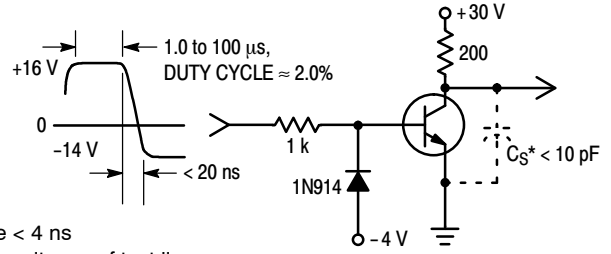


Figure 2. Turn-Off Time

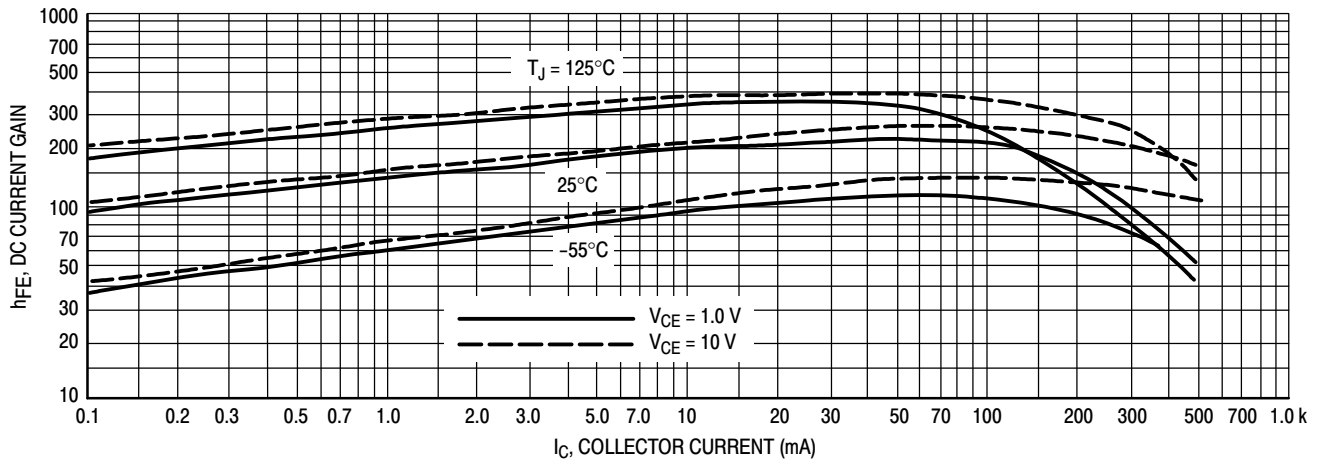
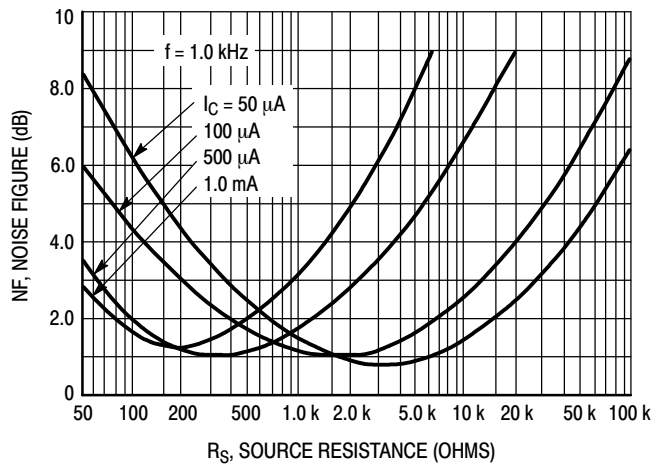
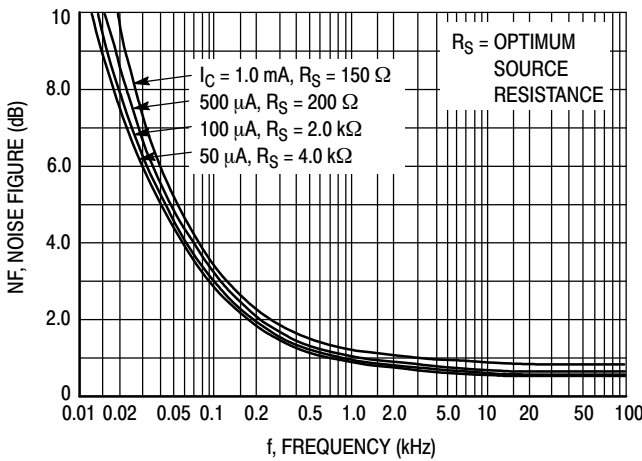
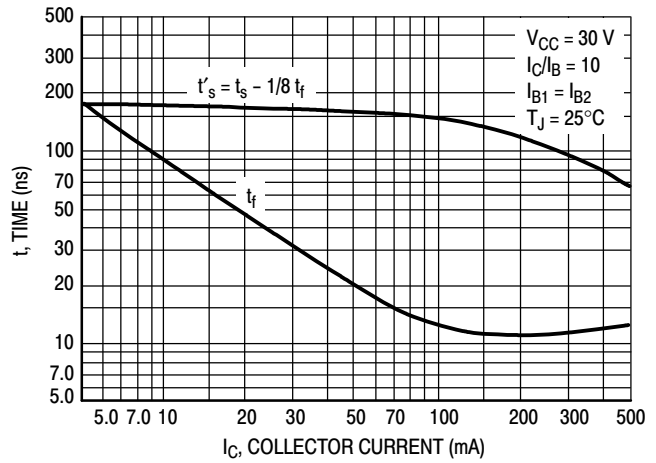
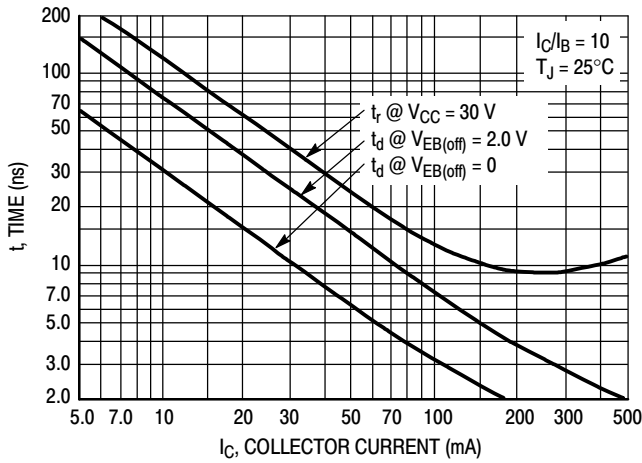
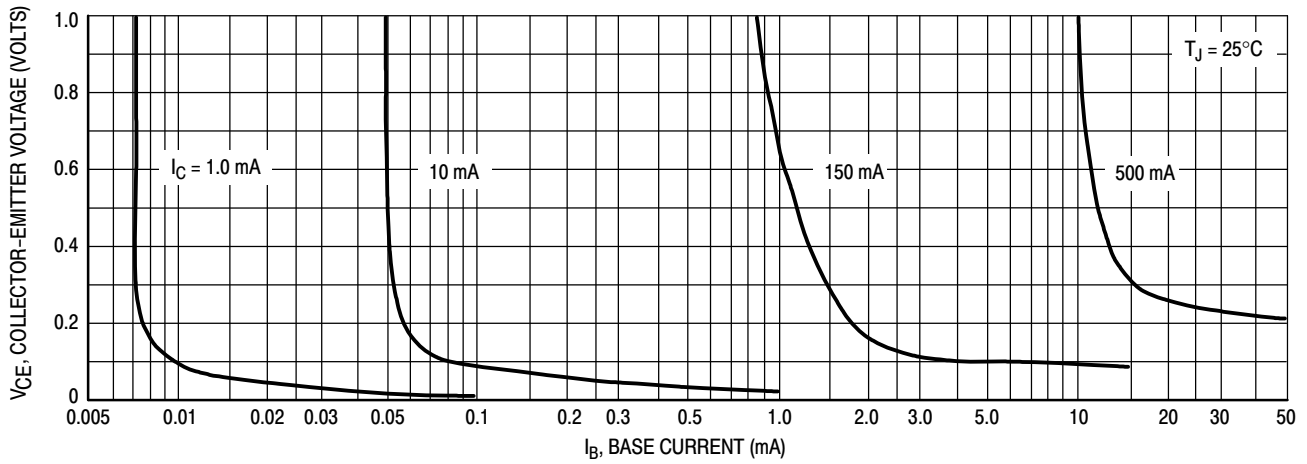


Figure 3. DC Current Gain

P2N2222A



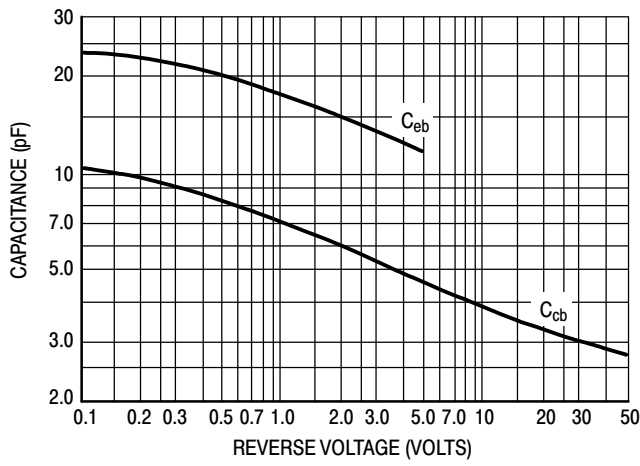


Figure 9. Capacitances

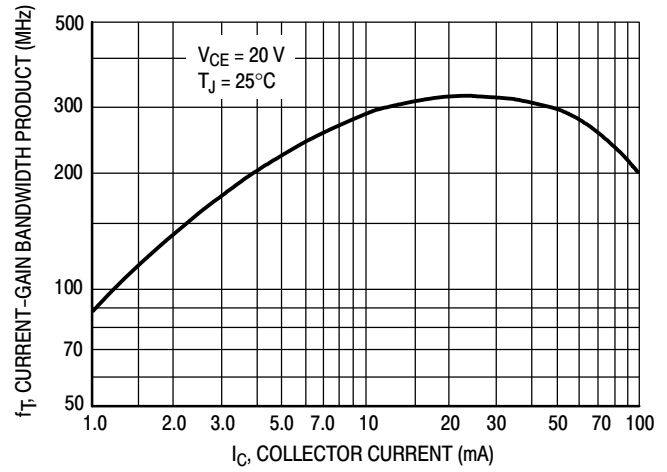


Figure 10. Current-Gain Bandwidth Product

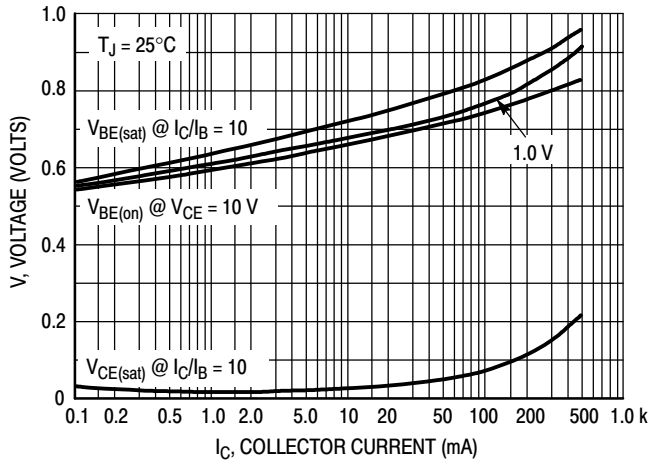


Figure 11. "On" Voltages

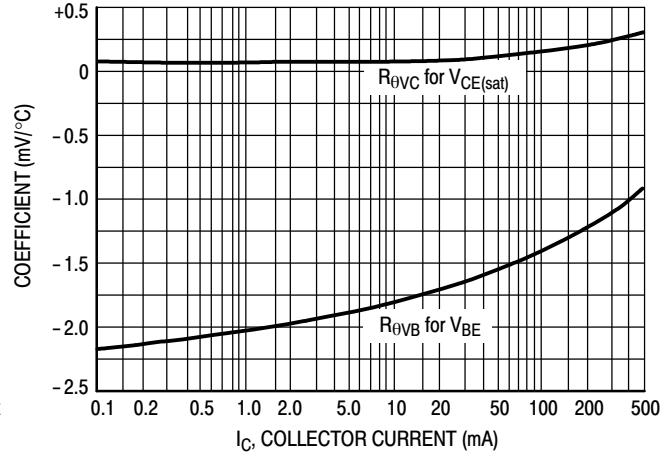


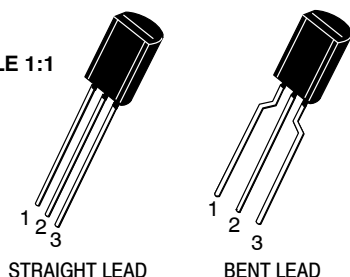
Figure 12. Temperature Coefficients

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1

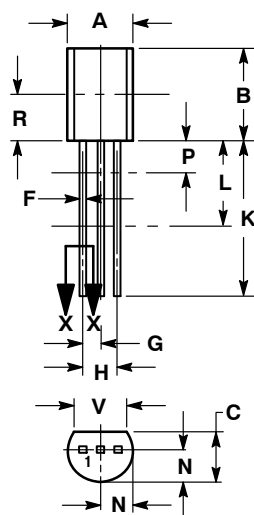


STRAIGHT LEAD

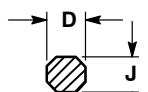
BENT LEAD

TO-92 (TO-226) 1 WATT CASE 29-10 ISSUE A

DATE 08 MAY 2012



STRAIGHT LEAD

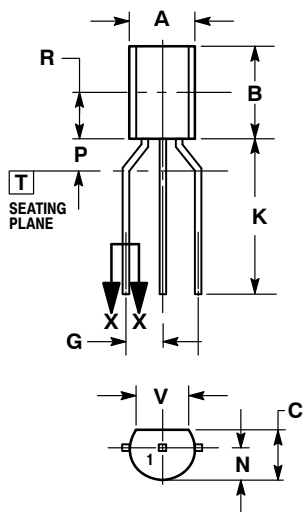


SECTION X-X

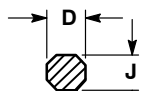
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN DIMENSIONS P AND L. DIMENSIONS D AND J APPLY BETWEEN DIMENSIONS L AND K MINIMUM. THE LEAD DIMENSIONS ARE UNCONTROLLED IN DIMENSION P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.44	5.21
B	0.290	0.310	7.37	7.87
C	0.125	0.165	3.18	4.19
D	0.018	0.021	0.46	0.53
F	0.016	0.019	0.41	0.48
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.018	0.024	0.46	0.61
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.135	---	3.43	---
V	0.135	---	3.43	---



BENT LEAD



SECTION X-X

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN DIMENSIONS P AND L. DIMENSIONS D AND J APPLY BETWEEN DIMENSIONS L AND K MINIMUM. THE LEAD DIMENSIONS ARE UNCONTROLLED IN DIMENSION P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.44	5.21
B	0.290	0.310	7.37	7.87
C	0.125	0.165	3.18	4.19
D	0.018	0.021	0.46	0.53
G	0.094	0.102	2.40	2.80
J	0.018	0.024	0.46	0.61
K	0.500	---	12.70	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.135	---	3.43	---
V	0.135	---	3.43	---

STYLES ON PAGE 2

DOCUMENT NUMBER:	98AON52857E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO-92 (TO-226) 1 WATT	PAGE 1 OF 2


ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

TO-92 (TO-226) 1 WATT
CASE 29-10
ISSUE A

DATE 08 MAY 2012

STYLE 1: PIN 1. EMITTER 2. BASE 3. COLLECTOR	STYLE 2: PIN 1. BASE 2. EMITTER 3. COLLECTOR	STYLE 3: PIN 1. ANODE 2. ANODE 3. CATHODE	STYLE 4: PIN 1. CATHODE 2. CATHODE 3. ANODE	STYLE 5: PIN 1. DRAIN 2. SOURCE 3. GATE
STYLE 6: PIN 1. GATE 2. SOURCE & SUBSTRATE 3. DRAIN	STYLE 7: PIN 1. SOURCE 2. DRAIN 3. GATE	STYLE 8: PIN 1. DRAIN 2. GATE 3. SOURCE & SUBSTRATE	STYLE 9: PIN 1. BASE 1 2. EMITTER 3. BASE 2	STYLE 10: PIN 1. CATHODE 2. GATE 3. ANODE
STYLE 11: PIN 1. ANODE 2. CATHODE & ANODE 3. CATHODE	STYLE 12: PIN 1. MAIN TERMINAL 1 2. GATE 3. MAIN TERMINAL 2	STYLE 13: PIN 1. ANODE 1 2. GATE 3. CATHODE 2	STYLE 14: PIN 1. EMITTER 2. COLLECTOR 3. BASE	STYLE 15: PIN 1. ANODE 1 2. CATHODE 3. ANODE 2
STYLE 16: PIN 1. ANODE 2. GATE 3. CATHODE	STYLE 17: PIN 1. COLLECTOR 2. BASE 3. EMITTER	STYLE 18: PIN 1. ANODE 2. CATHODE 3. NOT CONNECTED	STYLE 19: PIN 1. GATE 2. ANODE 3. CATHODE	STYLE 20: PIN 1. NOT CONNECTED 2. CATHODE 3. ANODE
STYLE 21: PIN 1. COLLECTOR 2. EMITTER 3. BASE	STYLE 22: PIN 1. SOURCE 2. GATE 3. DRAIN	STYLE 23: PIN 1. GATE 2. SOURCE 3. DRAIN	STYLE 24: PIN 1. EMITTER 2. COLLECTOR/ANODE 3. CATHODE	STYLE 25: PIN 1. MT 1 2. GATE 3. MT 2
STYLE 26: PIN 1. V _{CC} 2. GROUND 2 3. OUTPUT	STYLE 27: PIN 1. MT 2. SUBSTRATE 3. MT	STYLE 28: PIN 1. CATHODE 2. ANODE 3. GATE	STYLE 29: PIN 1. NOT CONNECTED 2. ANODE 3. CATHODE	STYLE 30: PIN 1. DRAIN 2. GATE 3. SOURCE
STYLE 31: PIN 1. GATE 2. DRAIN 3. SOURCE	STYLE 32: PIN 1. BASE 2. COLLECTOR 3. EMITTER	STYLE 33: PIN 1. RETURN 2. INPUT 3. OUTPUT	STYLE 34: PIN 1. INPUT 2. GROUND 3. LOGIC	STYLE 35: PIN 1. GATE 2. COLLECTOR 3. EMITTER

DOCUMENT NUMBER:	98AON52857E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO-92 (TO-226) 1 WATT	PAGE 2 OF 2

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Email Requests to: orderlit@onsemi.com

ON Semiconductor Website: www.onsemi.com

TECHNICAL SUPPORT

North American Technical Support:

Voice Mail: 1 800-282-9855 Toll Free USA/Canada

Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative