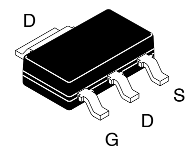
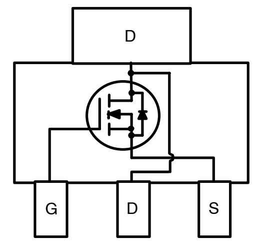
N-Channel Logic Level Enhancement Mode Field Effect Transistor

NDT014L



SOT−223
CASE 318H



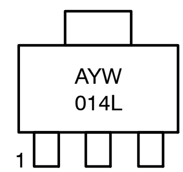
General Description

These N−Channel logic level enhancement mode power field effect transistors are produced using **onsemi’s** proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on−state resistance, provide superior switching performance, and withstand high energy pulses in the avalanche and commutation modes. These devices are particularly suited for low voltage applications such as DC motor control and DC−DC conversion where fast switching, low in−line power loss, and resistance to transients are needed.

Features

- 2.8 A, 60 V. $R_{DS(ON)}$ = 0.2 Ω @ V_{GS} = 4.5 V
  $R_{DS(ON)}$ = 0.16 Ω @ V_{GS} = 10 V
- High Density Cell Design For Extremely Low $R_{DS(ON)}$
- High Power and Current Handling Capability in a Widely Used Surface Mount Package
- This Device is Pb−Free

MARKING DIAGRAM



A = Assembly Location
Y = Year
W = Work Week
014L = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping†
NDT014L	SOT−223	4000 / 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.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

Symbol	Parameter	Value	Unit
V_{DSS}	Drain−Source Voltage	60	V
V_{GSS}	Gate−Source Voltage	±20	V
I_D	Drain Current − Continuous (Note 1a)	±2.8	A
	− Pulsed	±10	
P_D	Maximum Power Dissipation (Note 1a)	3	W
	(Note 1b)	1.3	
	(Note 1c)	1.1	
T_J, T_{STG}	Operating and Storage Temperature Range	−65 to 150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL CHARACTERISTICS Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Ratings	Unit
$R_{\theta JA}$	Thermal Resistance, Junction−to−Ambient (Note 1a)	42	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction−to−Case (Note 1)	12	°C/W

ELECTRICAL CHARACTERISTICS Values are at T_A = 25°C unless otherwise noted.

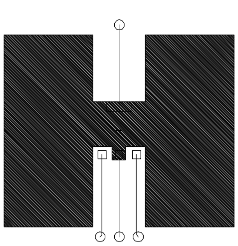
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
BV_{DSS}	Drain–Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 μA	60	–	–	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 60 V, V_{GS} = 0 V T_J = 55°C	–	–	25 250	μA
I_{GSSF}	Gate–Body Leakage, Forward	V_{GS} = 20 V, V_{DS} = 0 V	–	–	100	nA
I_{GSSR}	Gate–Body Leakage, Reverse	V_{GS} = –20 V, V_{DS} = 0 V	–	–	–100	nA
ON CHARACTERISTICS (Note 2)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 μA T_J = 125°C	1 0.8	1.5 1.1	3 2	V
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = 4.5 V, I_D = 2.8 A T_J = 125°C	–	0.17 0.22	0.2 0.36	Ω
		V_{GS} = 10 V, I_D = 3.4 A	–	0.12	0.16	
$I_{D(on)}$	On–State Drain Current	V_{GS} = 4.5 V, V_{DS} = 5 V	5	–	–	A
		V_{DS} = 10 V, V_{DS} = 5 V	10	–	–	
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 2.8 A	–	4.2	–	S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 30 V, V_{GS} = 0 V, f = 1.0 MHz	–	214	–	pF
C_{oss}	Output Capacitance		–	70	–	pF
C_{rss}	Reverse Transfer Capacitance		–	27	–	pF
SWITCHING CHARACTERISTICS (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	V_{DD} = 30 V, I_D = 3 A, V_{GEN} = 10 V, R_{GEN} = 12 Ω	–	6	12	ns
t_r	Turn–On Rise Time		–	14	25	ns
$t_{d(off)}$	Turn–Off Delay Time		–	15	28	ns
t_f	Turn–Off Fall Time		–	10	18	ns
Q_g	Total Gate Charge	V_{DS} = 10 V, I_D = 2.8 A, V_{GS} = 4.5 V	–	36	5	nC
Q_{gs}	Gate–Source Charge		–	0.8	–	nC
Q_{gd}	Gate–Drain Charge		–	1.4	–	nC
DRAIN–SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
I_S	Maximum Continuous Drain–Source Diode Forward Current		–	–	2.3	A
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 2.3 A (Note 2)	–	0.85	1.3	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_F = 2.3 A, d_{iF}/d_t = 100 A/μs	–	–	140	ns

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

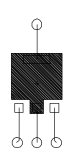
1. $R_{\theta JA}$ is the sum of the junction–to–case and case–to–ambient resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.

$$P_D(t) = \frac{T_J - T_A}{R_{\theta JA}(t)} = \frac{T_J - T_A}{R_{\theta JC} + R_{\theta CA}(t)} = I_D^2(t) \times R_{DS(on)@T_J}$$

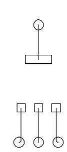
Applications on 4.5"x5" FR–4 PCB under still air environment, typical $R_{\theta JA}$ is found to be:



a. 42°C/W with 1 in^2 of 2 oz copper mounting pad.



b. 95°C/W with 0.066 in^2 of 2 oz copper mounting pad.



c. 110°C/W with 0.0123 in^2 of 2 oz copper mounting pad.

Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤2.0%.

TYPICAL CHARACTERISTICS

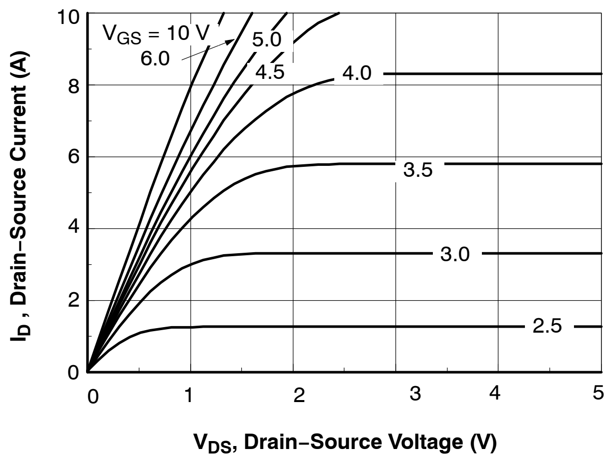


Figure 1. On−Region Characteristics

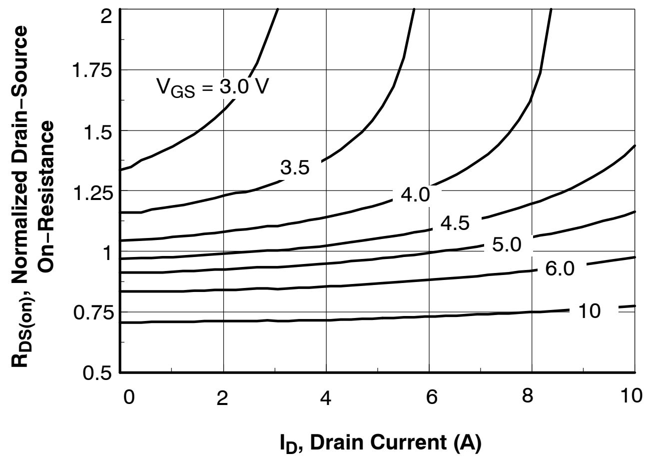


Figure 2. On−Resistance Variation with Gate Voltage and Drain Current

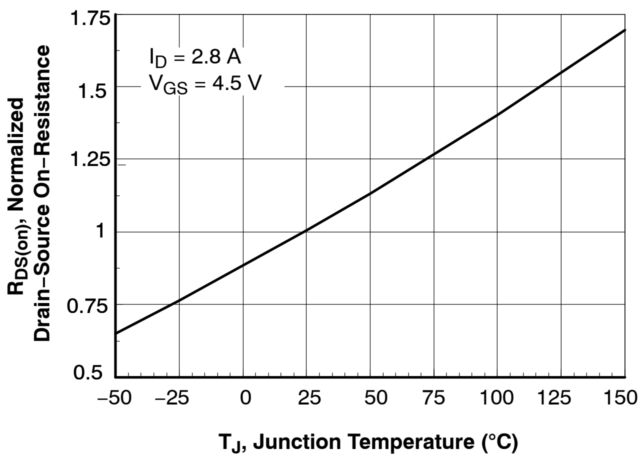


Figure 3. On−Resistance Variation with Temperature

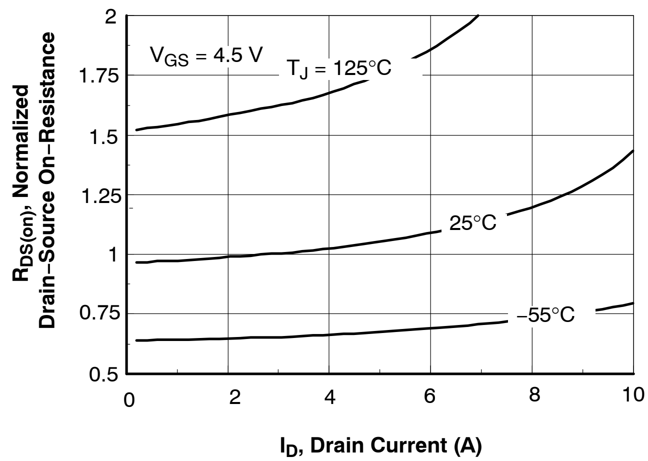


Figure 4. On−Resistance Variation with Drain Current and Temperature

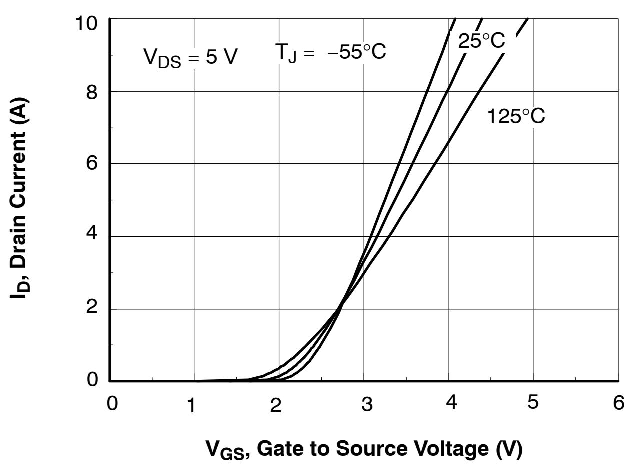


Figure 5. Transfer Characteristics

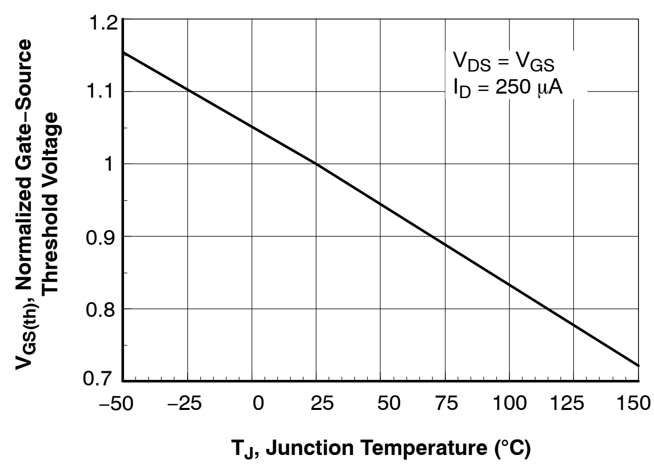


Figure 6. Gate Threshold Variation with Temperature

TYPICAL CHARACTERISTICS (continued)

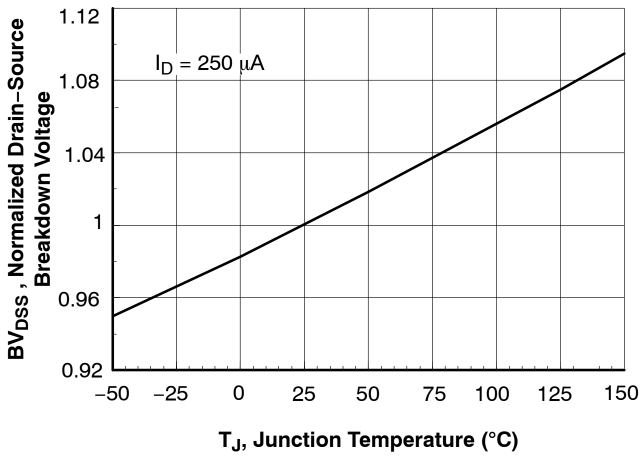


Figure 7. Breakdown Voltage Variation with Temperature

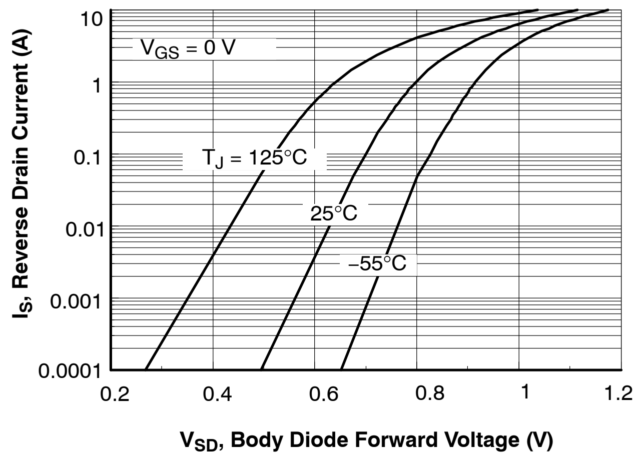


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature

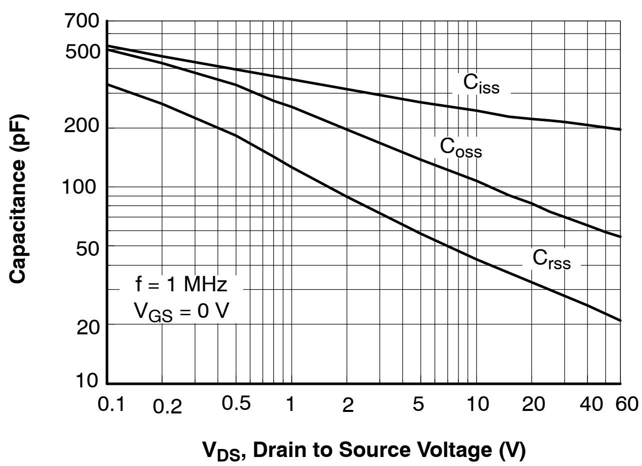


Figure 9. Capacitance Characteristics

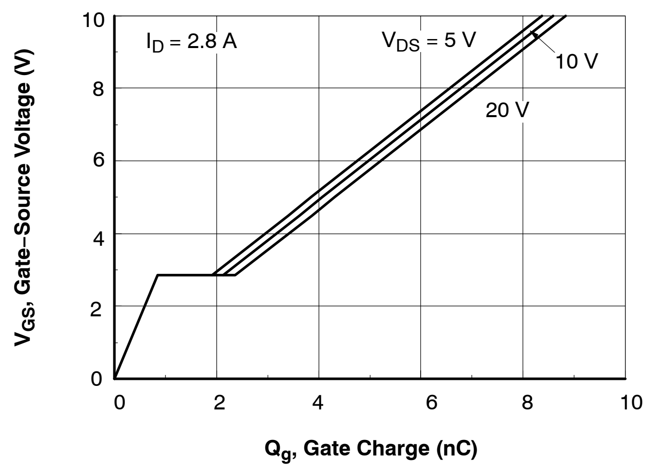


Figure 10. Gate Charge Characteristics

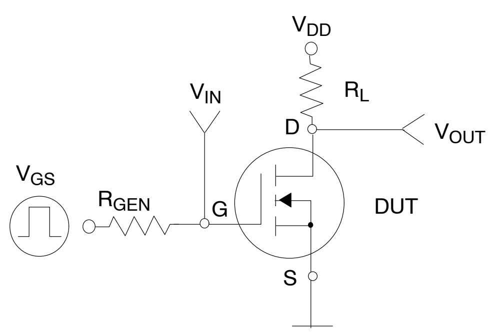


Figure 11. Switching Test Circuit

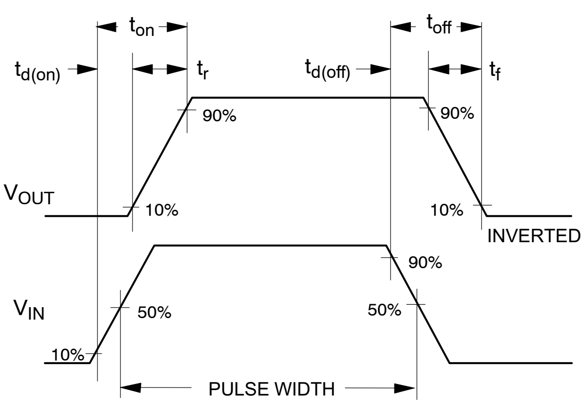


Figure 12. Switching Waveforms

TYPICAL CHARACTERISTICS (continued)

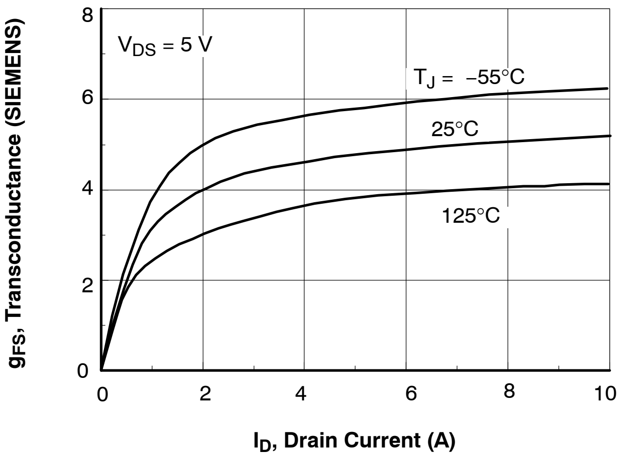


Figure 13. Transconductance Variation with Drain Current and Temperature

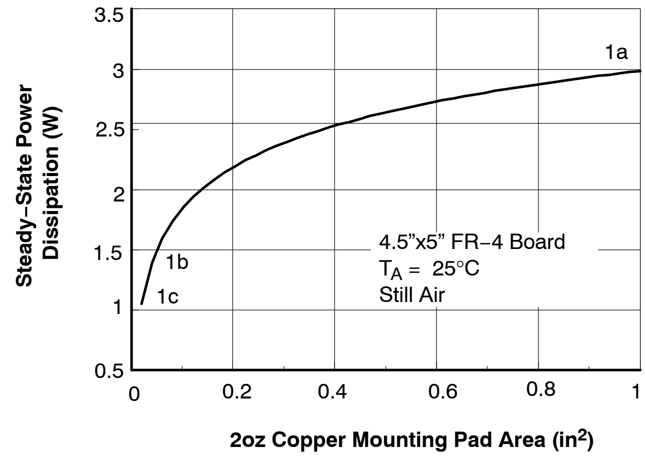


Figure 14. SOT−223 Maximum Steady− State Power Dissipation versus Copper Mounting Pad Area

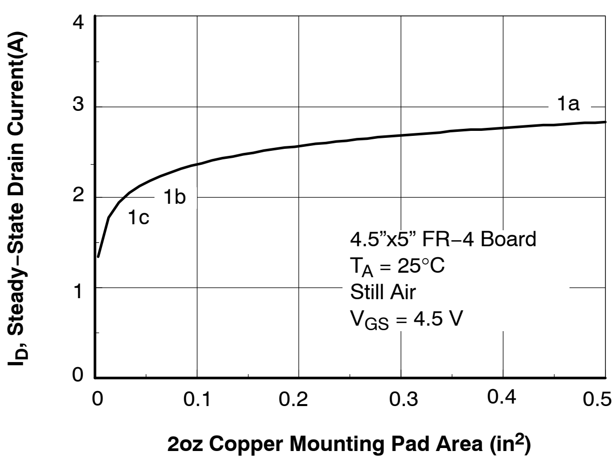


Figure 15. Maximum Steady− State Drain Current versus Copper Mounting Pad Area

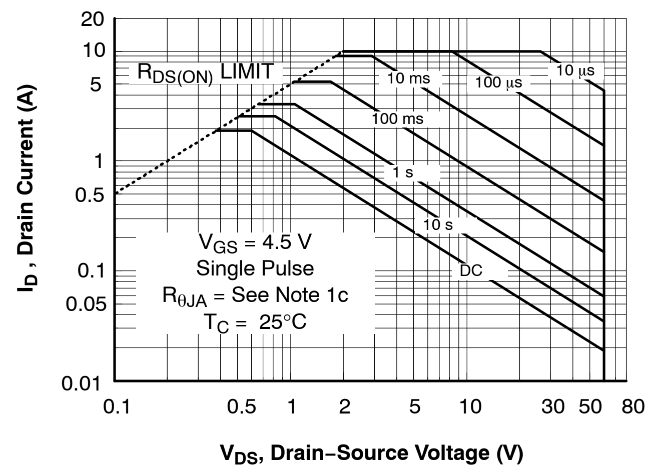


Figure 16. Maximum Safe Operating Area

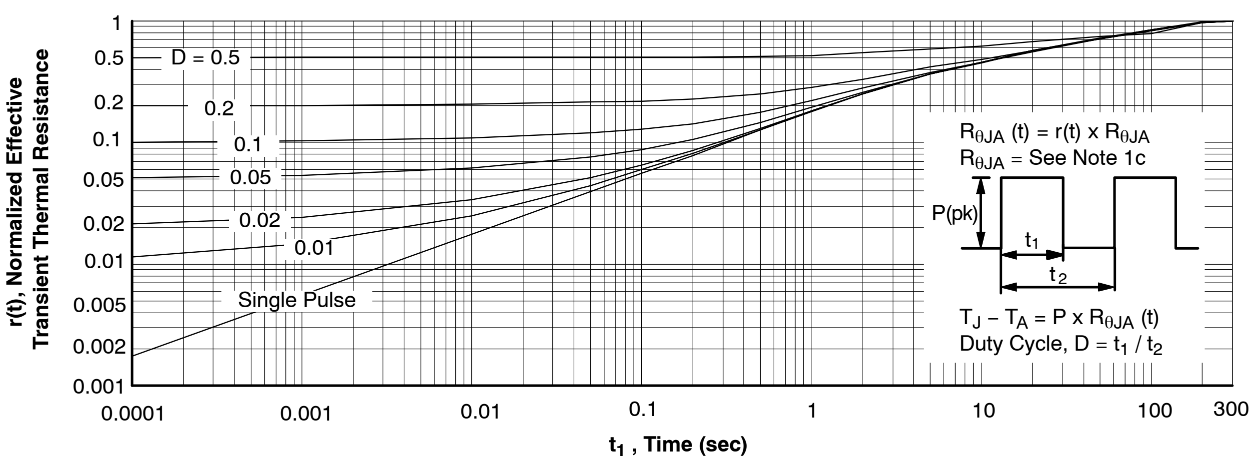
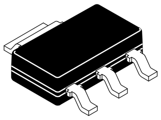


Figure 17. Typical Transient Thermal Impedance Curve

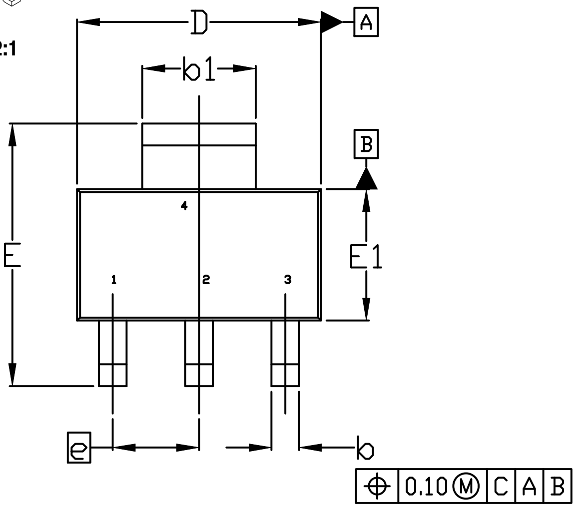
Thermal characterization performed under the conditions of Note 1c. Should better thermal design employs, $R_{\theta JA}$ will be lower and reach thermal equivalent sooner.



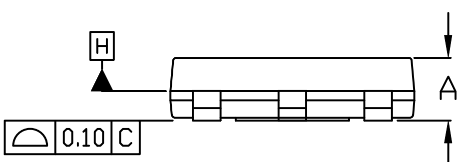
SCALE 2:1

SOT−223
CASE 318H
ISSUE B

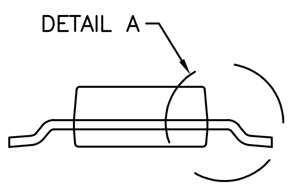
DATE 13 MAY 2020



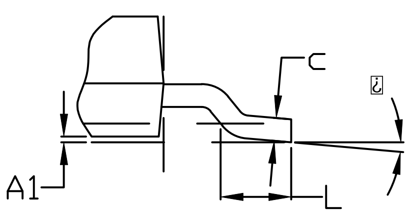
TOP VIEW



SIDE VIEW



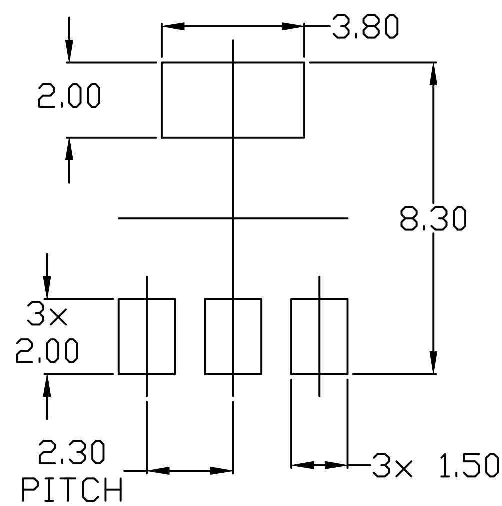
END VIEW



DETAIL A

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D & E1 ARE DETERMINED AT DATUM H. DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. SHALL NOT EXCEED 0.23mm PER SIDE.
4. LEAD DIMENSIONS b AND b1 DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBBAR PROTRUSION IS 0.08mm PER SIDE.
5. DATUMS A AND B ARE DETERMINED AT DATUM H.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
7. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS b AND b1.

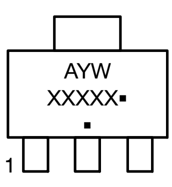
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	1.80
A1	0.02	0.06	0.11
b	0.60	0.74	0.88
b1	2.90	3.00	3.10
c	0.24	---	0.35
D	6.30	6.50	6.70
E	6.70	7.00	7.30
E1	3.30	3.50	3.70
e	2.30 BSC		
L	0.25	---	---
¿	0°	---	10°



RECOMMENDED MOUNTING 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.

GENERIC MARKING DIAGRAM*



A = Assembly Location
Y = Year
W = Work Week
XXXXX = Specific Device Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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DESCRIPTION:	**SOT−223**	**PAGE 1 OF 1**

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