N-Channel Power MOSFET 600 V, 15 Ω

Features

- 100% Avalanche Tested
- Gate Charge Minimized
- Zener-protected
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

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

Parameter	Symbol	NDD	NDT	Unit
Drain-to-Source Voltage	V_{DSS}	60	00	V
Gate-to-Source Voltage	V_{GS}	±3	30	V
Continuous Drain Current Steady State, T _C = 25°C (Note 1)	Ι _D	0.8	0.25	Α
Continuous Drain Current Steady State, T _C = 100°C (Note 1)	Ι _D	0.5	0.15	Α
Power Dissipation Steady State, T _C = 25°C	P _D	26	2	W
Pulsed Drain Current, $t_p = 10 \mu s$	I _{DM}	3.4		Α
Source Current (Body Diode)	IS	2.5	1.7	Α
Single Pulse Drain-to-Source Avalanche Energy (I _D = 0.8 A)	EAS	12		mJ
Peak Diode Recovery (Note 2)	dv/dt	4.5		V/ns
Lead Temperature for Soldering Leads	TL	260		°C
Operating Junction and Storage Temperature	T _J , T _{STG}	–55 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.

- 1. Limited by maximum junction temperature
- 2. $I_S = 1.5 \text{ A}, \text{ di/dt} \le 100 \text{ A/}\mu\text{s}, V_{DD} \le BV_{DSS}$

THERMAL RESISTANCE

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain) NDDL1N60Z	$R_{\theta JC}$	4.8	°C/W
Junction-to-Ambient (Note 4) NDDL1N60Z (Note 3) NDDL1N60Z-1 (Note 4) NDTL1N60Z (Note 5) NDTL1N60Z	$R_{ hetaJA}$	42 96 62 151	°C/W

- 3. Insertion mounted.
- 4. Surface-mounted on FR4 board using 1" sq. pad size (Cu area = 1.127" sq. [2 oz] including traces).
- Surface-mounted on FR4 board using minimum recommended pad size (Cu area = 0.026" sq. [2 oz]).

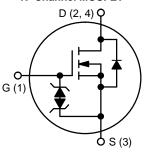


ON Semiconductor®

http://onsemi.com

V _{(BR)DSS}	R _{DS(ON)} MAX
600 V	15 Ω @ 10 V

N-Channel MOSFET







CASE 369C STYLE 2



IPAK CASE 369D STYLE 2

MARKING & ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 3 of this data sheet.

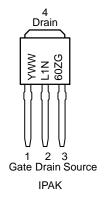
ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

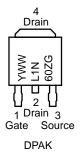
Characteristic	Symbol	Test Condition	s	Min	Тур	Max	Unit
OFF CHARACTERISTICS							
Drain-to-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0 V, I _D = 1	mA	600			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V _{(BR)DSS} /T _J	Reference to 25°C, I _D = 1 mA			610		mV/°C
Drain-to-Source Leakage Current	I _{DSS}	V _{DS} = 600 V, V _{GS} = 0 V	$T_J = 25^{\circ}C$			1	μΑ
			T _J = 125°C			50	1
Gate-to-Source Leakage Current	I _{GSS}	V _{GS} = ±20 V				±100	nA
ON CHARACTERISTICS (Note 6)							
Gate Threshold Voltage	V _{GS(TH)}	$V_{DS} = V_{GS}$, $I_D = 5$	0 μΑ	3	4.0	4.5	V
Negative Threshold Temperature Coefficient	V _{GS(TH)} /T _J				9.6		mV/°C
Static Drain-to-Source On Resistance	R _{DS(on)}	$V_{GS} = 10 \text{ V}, I_D = 0$.4 A		12.2	15	Ω
Forward Transconductance	9FS	$V_{DS} = 15 \text{ V}, I_{D} = 0$.4 A		0.7		S
CHARGES, CAPACITANCES & GATE R	ESISTANCES						
Input Capacitance (Note 7)	C _{iss}				92		pF
Output Capacitance (Note 7)	C _{oss}	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$	f = 1 MHz		13		7
Reverse Transfer Capacitance (Note 7)	C _{rss}		•		3		1
Effective output capacitance, energy related (Note 9)	C _{o(er)}	V _{GS} = 0 V, V _{DS} = 0 to 480 V			5.5		pF
Effective output capacitance, time related (Note 10)	C _{o(tr)}	I_D = constant, V_{GS} = 0 V, V_{DS} = 0 to 480 V			8.1		
Total Gate Charge (Note 7)	Q_g	-			4.9		nC
Gate-to-Source Charge (Note 7)	Q_{gs}				1.2		1
Gate-to-Drain Charge (Note 7)	Q_{gd}	$V_{DS} = 300 \text{ V}, I_D = 0.4 \text{ A}, Y_D = 0.4 \text{ A}$	$V_{GS} = 10 \text{ V}$		2.4		1
Plateau Voltage	V_{GP}		•		5.8		V
Gate Resistance	R_{g}				6.6		Ω
SWITCHING CHARACTERISTICS (Note	8)						
Turn-on Delay Time	t _{d(on)}				10		ns
Rise Time	t _r	V _{DD} = 300 V. I _D = 0	.4 A.		5		
Turn-off Delay Time	t _{d(off)}	$V_{DD} = 300 \text{ V}, I_{D} = 0$ $V_{GS} = 10 \text{ V}, R_{G} = 0$	0 Ω΄		13		1
Fall Time	t _f	1			18		
DRAIN-SOURCE DIODE CHARACTERI					•		•
Diode Forward Voltage	V_{SD}		$T_J = 25^{\circ}C$		0.8	1.2	V
		$I_S = 0.4 \text{ A}, V_{GS} = 0 \text{ V}$	T _J = 100°C		0.7		1
Reverse Recovery Time	t _{rr}		•		183		ns
Charge Time	t _a	Von = 0 V Von = 30 V			33		1
Discharge Time	t _b	$V_{GS} = 0 \text{ V, } V_{DD} = 0 \text{ I}_{S} = 1 \text{ A, } d_{t}/d_{t} = 100 \text{ C}$	A/μs		150		1
Reverse Recovery Charge	Q _{rr}		•		255		nC

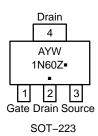
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

- 6. Pulse Width $\leq 300 \,\mu\text{s}$, Duty Cycle $\leq 2\%$.
- 7. Guaranteed by design.
- 8. Switching characteristics are independent of operating junction temperatures.
 9. C_{o(er)} is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{(BR)DSS} 10.C_{o(tr)} is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{(BR)DSS}

MARKING DIAGRAMS







A = Assembly Location

= Year

W, WW = Work Week

L1N60Z, 1N60Z = Specific Device Codes

G or ■ = Pb-Free Package

(*Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping [†]
NDDL01N60Z-1G	IPAK (Pb-Free, Halogen-Free)	75 Units / Rail
NDDL01N60ZT4G	DPAK (Pb-Free, Halogen-Free)	2500 / Tape & Reel
NDTL01N60ZT1G	SOT-223 (Pb-Free, Halogen-Free)	1000 / Tape & Reel
NDTL01N60ZT3G	SOT-223 (Pb-Free, Halogen-Free)	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.

TYPICAL CHARACTERISTICS

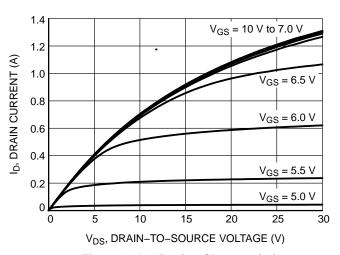


Figure 1. On-Region Characteristics

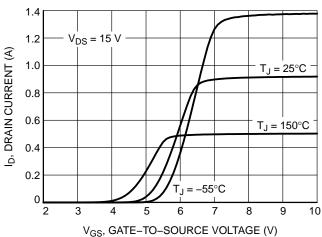


Figure 2. Transfer Characteristics

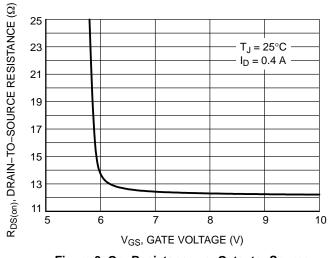


Figure 3. On-Resistance vs. Gate-to-Source Voltage

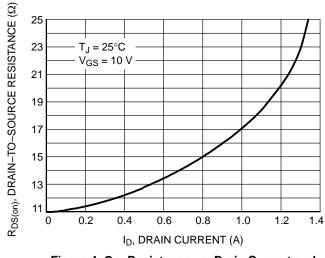


Figure 4. On–Resistance vs. Drain Current and Gate Voltage

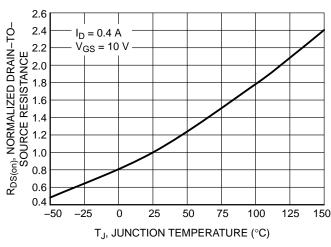


Figure 5. On–Resistance Variation with Temperature

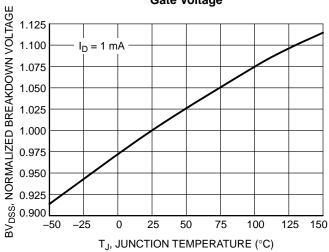


Figure 6. Breakdown Voltage Variation with Temperature

TYPICAL CHARACTERISTICS

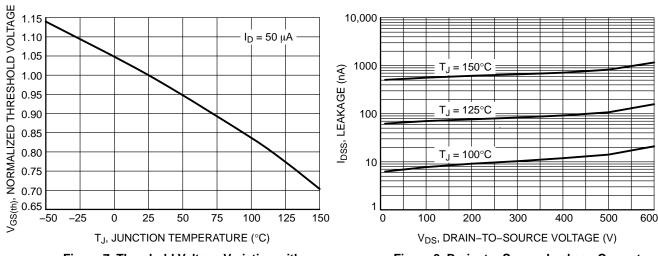


Figure 7. Threshold Voltage Variation with Temperature

Figure 8. Drain-to-Source Leakage Current vs. Voltage

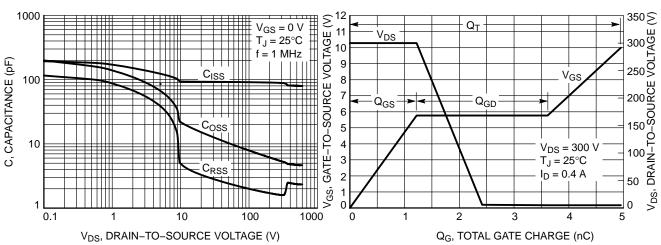


Figure 9. Capacitance Variation

Figure 10. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

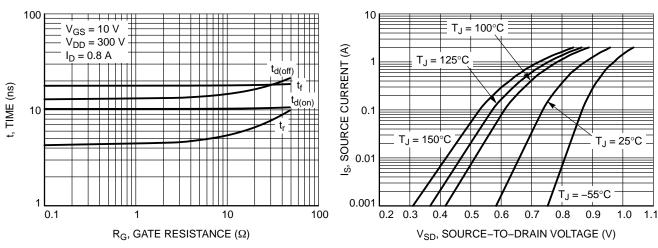


Figure 11. Resistive Switching Time Variation vs. Gate Resistance

Figure 12. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS

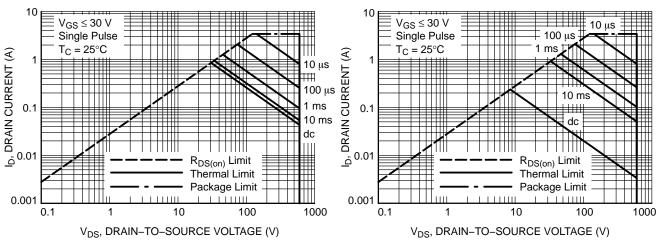


Figure 13. Maximum Rated Forward Biased Safe Operating Area for NDDL01N60Z

Figure 14. Maximum Rated Forward Biased Safe Operating Area for NDTL01N60Z

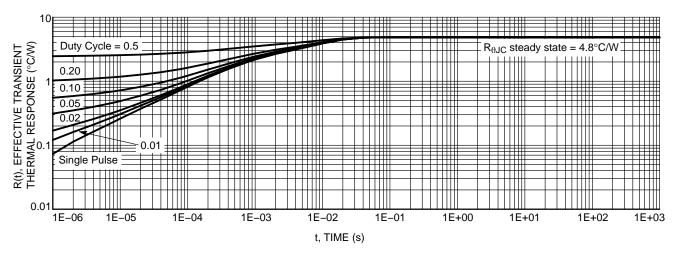


Figure 15. Thermal Impedance (Junction-to-Case) for NDDL01N60Z

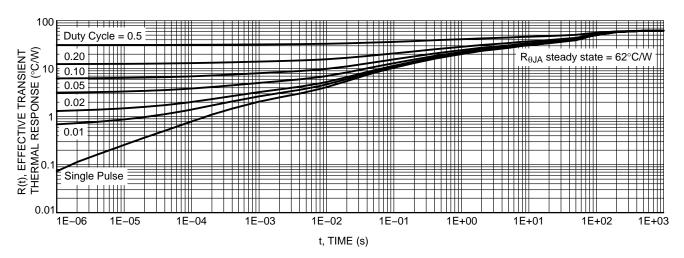
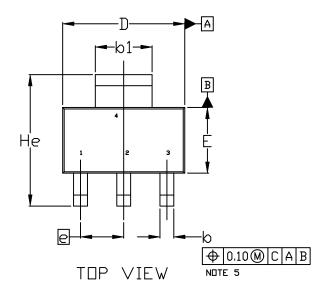


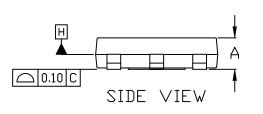
Figure 16. Thermal Impedance (Junction-to-Ambient) for NDTL01N60Z

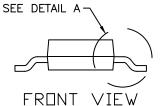


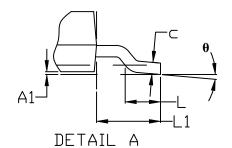
SOT-223 (TO-261) CASE 318E-04 ISSUE R

DATE 02 OCT 2018





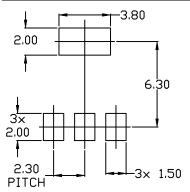




NOTES:

- 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- 2. CONTROLLING DIMENSION: MILLIMETERS
- 3. DIMENSIONS D & E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
 MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.200MM PER SIDE.
- 4. DATUMS A AND B ARE DETERMINED AT DATUM H.
- 5. ALLIS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
- 6. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS 6 AND 61.

	MILLIMETERS				
DIM	MIN.	N□M.	MAX.		
Α	1.50	1.63	1.75		
A1	0.02	0.06	0.10		
b	0.60	0.75	0.89		
b1	2.90	3.06	3.20		
c	0.24	0.29	0.35		
D	6.30	6.50	6.70		
E	3.30	3.50	3.70		
е		5'30 B2C	,		
L	0.20				
L1	1.50	1.75	2.00		
He	6.70	7.00	7.30		
θ	0°		10°		



RECOMMENDED MOUNTING FOOTPRINT

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DESCRIPTION:	SOT-223 (TO-261)		PAGE 1 OF 2

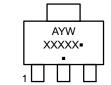
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SOT-223 (TO-261) CASE 318E-04 ISSUE R

DATE 02 OCT 2018

STYLE 1: PIN 1. BASE 2. COLLECTOR 3. EMITTER 4. COLLECTOR	STYLE 2: PIN 1. ANODE 2. CATHODE 3. NC 4. CATHODE	STYLE 3: PIN 1. GATE 2. DRAIN 3. SOURCE 4. DRAIN	STYLE 4: PIN 1. SOURCE 2. DRAIN 3. GATE 4. DRAIN	STYLE 5: PIN 1. DRAIN 2. GATE 3. SOURCE 4. GATE
STYLE 6: PIN 1. RETURN 2. INPUT 3. OUTPUT 4. INPUT	STYLE 7: PIN 1. ANODE 1 2. CATHODE 3. ANODE 2 4. CATHODE	STYLE 8: CANCELLED	STYLE 9: PIN 1. INPUT 2. GROUND 3. LOGIC 4. GROUND	STYLE 10: PIN 1. CATHODE 2. ANODE 3. GATE 4. ANODE
STYLE 11: PIN 1. MT 1 2. MT 2 3. GATE 4. MT 2	STYLE 12: PIN 1. INPUT 2. OUTPUT 3. NC 4. OUTPUT	STYLE 13: PIN 1. GATE 2. COLLECTOR 3. EMITTER 4. COLLECTOR		

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 (TO-261)		PAGE 2 OF 2

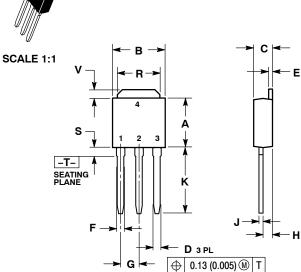
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MECHANICAL CASE OUTLINE





DATE 15 DEC 2010



STYLE 2:

PIN 1. GATE

3

STYLE 6: PIN 1. MT1 2. MT2 3. GATE

2. DRAIN

4. DRAIN

MT2

SOURCE

STYLE 3: PIN 1. ANODE

2. CATHODE

4. CATHODE

3 ANODE

STYLE 7: PIN 1. GATE 2. COLLECTOR

3. EMITTER

COLLECTOR

STYLE 1: PIN 1. BASE

3

STYLE 5: PIN 1. GATE

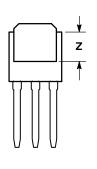
2. ANODE 3. CATHODE

ANODE

2. COLLECTOR

FMITTER

COLLECTOR



NOTES:

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

	INCHES		MILLIN	ETERS
DIM	MIN	MAX	MIN	MAX
Α	0.235	0.245	5.97	6.35
В	0.250	0.265	6.35	6.73
С	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.090	BSC	2.29	BSC
Н	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.350	0.380	8.89	9.65
R	0.180	0.215	4.45	5.45
S	0.025	0.040	0.63	1.01
٧	0.035	0.050	0.89	1.27
Z	0.155		3.93	

MARKING

STYLE 4: PIN 1. CATHODE Integrated Circuits ANODE
 GATE **Discrete** 4. ANODE YWW XXXXX ALYWW XXXXXXXX

WW

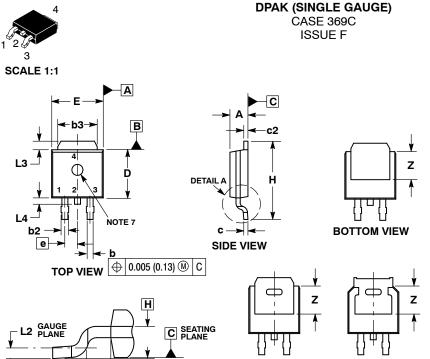
DIAGRAMS

xxxxxxxxx = Device Code Α = Assembly Location IL = Wafer Lot Υ = Year

= Work Week

DESCRIPTION	IPAK (DPAK INSERTION MOUNT)		PAGE 1 OF 1
DOCUMENT NUMBER:	98AON10528D	Electronic versions are uncontrolled except when accessed directly from Printed versions are uncontrolled except when stamped "CONTROLLED O	

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DATE 21 JUL 2015

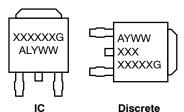
NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 CONTROLLING DIMENSION: INCHES.
- 3. THERMAL PAD CONTOUR OPTIONAL WITHIN DI-
- MENSIONS b3, L3 and Z.
 4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
 5. DIMENSIONS D AND E ARE DETERMINED AT THE
- OUTERMOST EXTREMES OF THE PLASTIC BODY.

 6. DATUMS A AND B ARE DETERMINED AT DATUM
- 7. OPTIONAL MOLD FEATURE.

	INCHES		MILLIM	IETERS
DIM	MIN	MAX	MIN	MAX
Α	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.028	0.045	0.72	1.14
b3	0.180	0.215	4.57	5.46
С	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
е	0.090	BSC	2.29 BSC	
Н	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.114	0.114 REF		REF
L2	0.020 BSC		0.51	BSC
L3	0.035	0.050	0.89	1.27
L4		0.040		1.01
Z	0.155		3.93	

GENERIC MARKING DIAGRAM*



XXXXXX = Device Code

= Assembly Location Α L = Wafer Lot

Υ = Year WW = Work Week G = Pb-Free Package

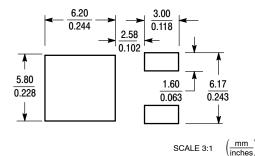
*This information is generic. Please refer to device data sheet for actual part marking.

STYLE 1: STYLE 2: STYLE 3: STYLE 4: STYLE 5: PIN 1. GATE 2. ANODE 3. CATHODE PIN 1. BASE 2. COLLECTOR 3. EMITTER PIN 1. GATE 2. DRAIN PIN 1. ANODE 2. CATHODE PIN 1. CATHODE 2. ANODE 3. GATE SOURCE 3. ANODE 4. CATHODE 4. COLLECTOR 4. DRAIN 4. ANODE 4. ANODE STYLE 6: STYLE 7: STYLE 8: STYLE 9: STYLE 10: PIN 1. MT1 2. MT2 PIN 1. GATE 2. COLLECTOR PIN 1. N/C 2. CATHODE PIN 1. ANODE 2. CATHODE PIN 1. CATHODE 2. ANODE 3. GATE 4. MT2 3. EMITTER 4. COLLECTOR 3. ANODE 4. CATHODE 3. RESISTOR ADJUST 4. CATHODE 3. CATHODE 4. ANODE

SOLDERING FOOTPRINT*

Α1

DETAIL A ROTATED 90° CW



*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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BOTTOM VIEW

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