

## Description and Applications

The DML1009LDS is a single channel load switch with very low on-resistance in a small package. It contains an N-Channel MOSFET for up to  $V_{BIAS}$ -1.5V input voltage operation and 6A current channel with 3.2V to 5.5V bias supply. The load switch is controlled by a low voltage control signal through the ON Pin.

- Portable Computers
- Ultrabooks
- Tablet PCs
- Set Top Boxes
- LCD TVs
- Telecom/Networking/Datacom Equipment
- SSDs
- Consumer Electronics

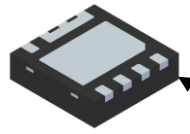
## Features and Benefits

- Low  $R_{DS(ON)}$  – Ensures On-State Losses are Minimized
- 0.8V to  $V_{BIAS}$ -1.5V Input Voltage Range
- 10A Continuous Current
- Low  $R_{DS(ON)}$  Internal NFETs  
5m $\Omega$  at  $V_{BIAS} = 5V$ ,  $V_{IN} = 1.05V$
- 35 $\mu$ A Low Quiescent Current
- 10 $\mu$ s Turn On Rise Time
- 3.2V to 5.5V Bias Voltage
- Integrated Quick Output Discharge Resistor
- Moisture Sensitivity: Level 1 per J-STD-020
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

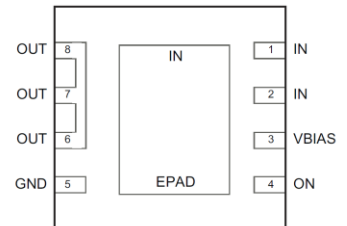
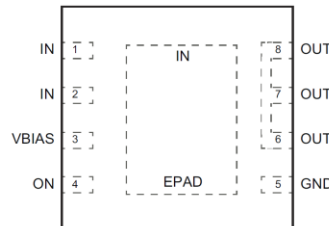
V-DFN3030-8 (Type R)



Top View



Bottom View



## Ordering Information (Note 4)

| Part Number   | Case                 | Packaging         |
|---------------|----------------------|-------------------|
| DML1009LDS-7  | V-DFN3030-8 (Type R) | 3,000/Tape & Reel |
| DML1009LDS-13 | V-DFN3030-8 (Type R) | 3,000/Tape & Reel |

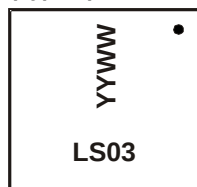
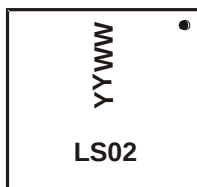
- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Pin Description

| Pin Number | Pin Name | Pin Function                                                                                                                                                                     |
|------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 2, EPAD | IN       | Load Switch Input. Bypass capacitor is recommended to minimize input voltage dip. Recommended voltage range of this pin is 0.8V to $V_{BIAS}$ -1.5V to obtain optimal $R_{ON}$ . |
| 3          | VBIAS    | Bias Voltage. Power supply input for the device. Recommended voltage range is 3.2V to 5.5V.                                                                                      |
| 4          | ON       | Enable Input. Load switch is on when ON is pulled high. Load switch is off when ON is pulled low. Do not leave floating.                                                         |
| 5          | GND      | Ground.                                                                                                                                                                          |
| 6, 7, 8    | OUT      | Load switch output.                                                                                                                                                              |

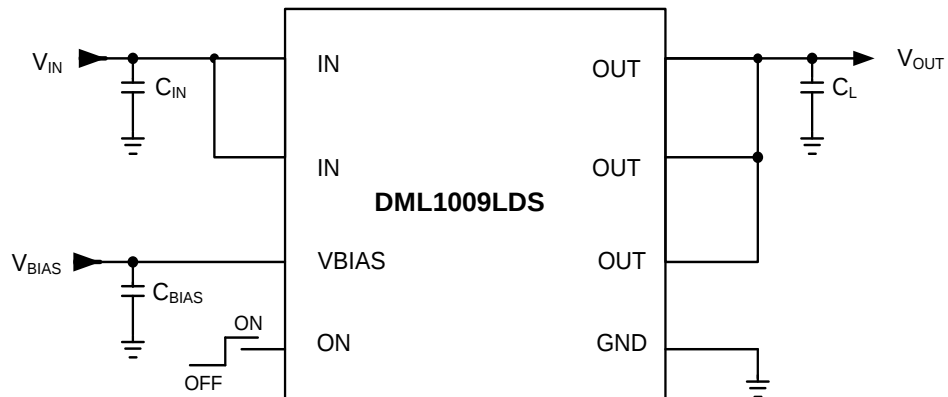
## Marking Information

V-DFN3030-8 (Type R)

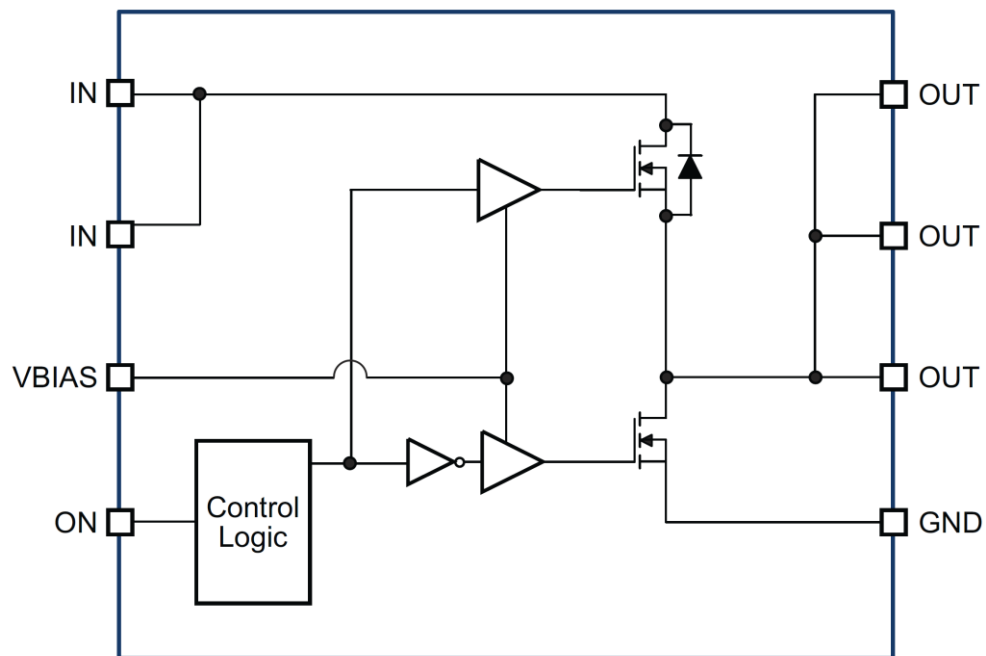


LS02/LS03 = Product Type Marking Code  
 YYWW = Date Code Marking  
 YY = Last Two Digits of Year (ex: 16 = 2016)  
 WW = Week Code (01 to 53)

## Typical Application



## Functional Block Diagram



## Absolute Maximum Ratings

| Parameter                       | Rating          |
|---------------------------------|-----------------|
| IN, ON, $V_{BIAS}$ , OUT to GND | -0.3V to 6V     |
| Junction Temperature ( $T_J$ )  | +150°C          |
| Storage Temperature ( $T_S$ )   | -65°C to +150°C |
| ESD Rating HBM/CDM              | 2kV/1kV         |

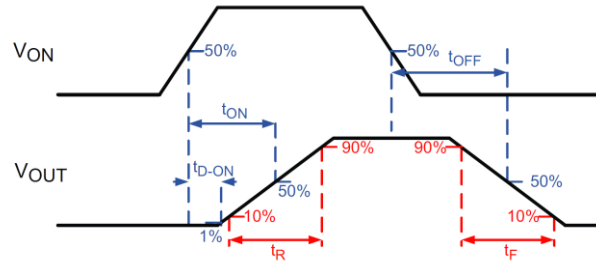
## Maximum Operating Ratings

| Parameter                                    | Rating          |
|----------------------------------------------|-----------------|
| Supply Voltage ( $V_{IN}$ )                  | $V_{BIAS}-1.5V$ |
| Ambient Temperature ( $T_A$ )                | -40°C to +85°C  |
| Package Thermal Resistance ( $\theta_{JC}$ ) | 8°C/W           |
| Package Thermal Resistance ( $\theta_{JA}$ ) | 60°C/W          |

## Electrical Characteristics (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Symbol                         | Parameter                              | Condition                                                    | Min | Typ  | Max            | Unit       |
|--------------------------------|----------------------------------------|--------------------------------------------------------------|-----|------|----------------|------------|
| $V_{IN}$                       | IN Supply Voltage                      | $V_{ON} = 5V$                                                | 0.8 | 1.05 | $V_{BIAS}-1.5$ | V          |
| $V_{BIAS}$                     | $V_{BIAS}$ Supply Voltage              | —                                                            | 3.2 | 5    | 5.5            | V          |
| $I_D$                          | Maximum Continuous Current             | $V_{ON} = 5V$                                                | —   | 10   | —              | A          |
| $I_{PLS}$                      | Maximum Pulsed Switch Current          | $V_{IN} = V_{ON} = 5V$<br>Pulse < 300 $\mu$ s, 2% Duty Cycle | —   | 9    | —              | A          |
| $I_Q$                          | Quiescent Supply Current of $V_{BIAS}$ | $I_{OUT} = 0V$ , $V_{ON} = 5V$                               | —   | 35   | —              | $\mu$ A    |
| $I_{OFF}$                      | $V_{BIAS}$ Shutdown Supply Current     | $V_{ON} = 0V$ , $V_{OUT} = 0V$                               | —   | —    | 2              | $\mu$ A    |
| $I_{INOFF}$                    | IN Shutdown Supply Current             | $V_{ON} = 0V$ , $V_{OUT} = 0V$                               | —   | —    | 2              | $\mu$ A    |
| $I_{ON}$                       | ON Leakage Current                     | $V_{ON} = 5V$                                                | —   | —    | 1              | $\mu$ A    |
| $V_{ONH}$                      | ON High Level Voltage                  | —                                                            | 1.2 | —    | —              | V          |
| $V_{ONL}$                      | ON Low Level Voltage                   | —                                                            | —   | —    | 0.5            | V          |
| <b>Switching ON-Resistance</b> |                                        |                                                              |     |      |                |            |
| $R_{ON}$                       | Switch ON-State Resistance             | $I_{OUT} = -200mA$ , $V_{ON} = 5V$ , $V_{BIAS} = 5V$         | —   | —    | 5              | m $\Omega$ |
|                                |                                        | $I_{OUT} = -200mA$ , $V_{ON} = 5V$ , $V_{BIAS} = 3.3V$       | —   | —    | 6              | m $\Omega$ |
| $R_{PD}$                       | Output Pull-Down Resistance            | $I_{OUT} = 15mA$ , $V_{ON} = 0V$                             | —   | —    | 200            | $\Omega$   |

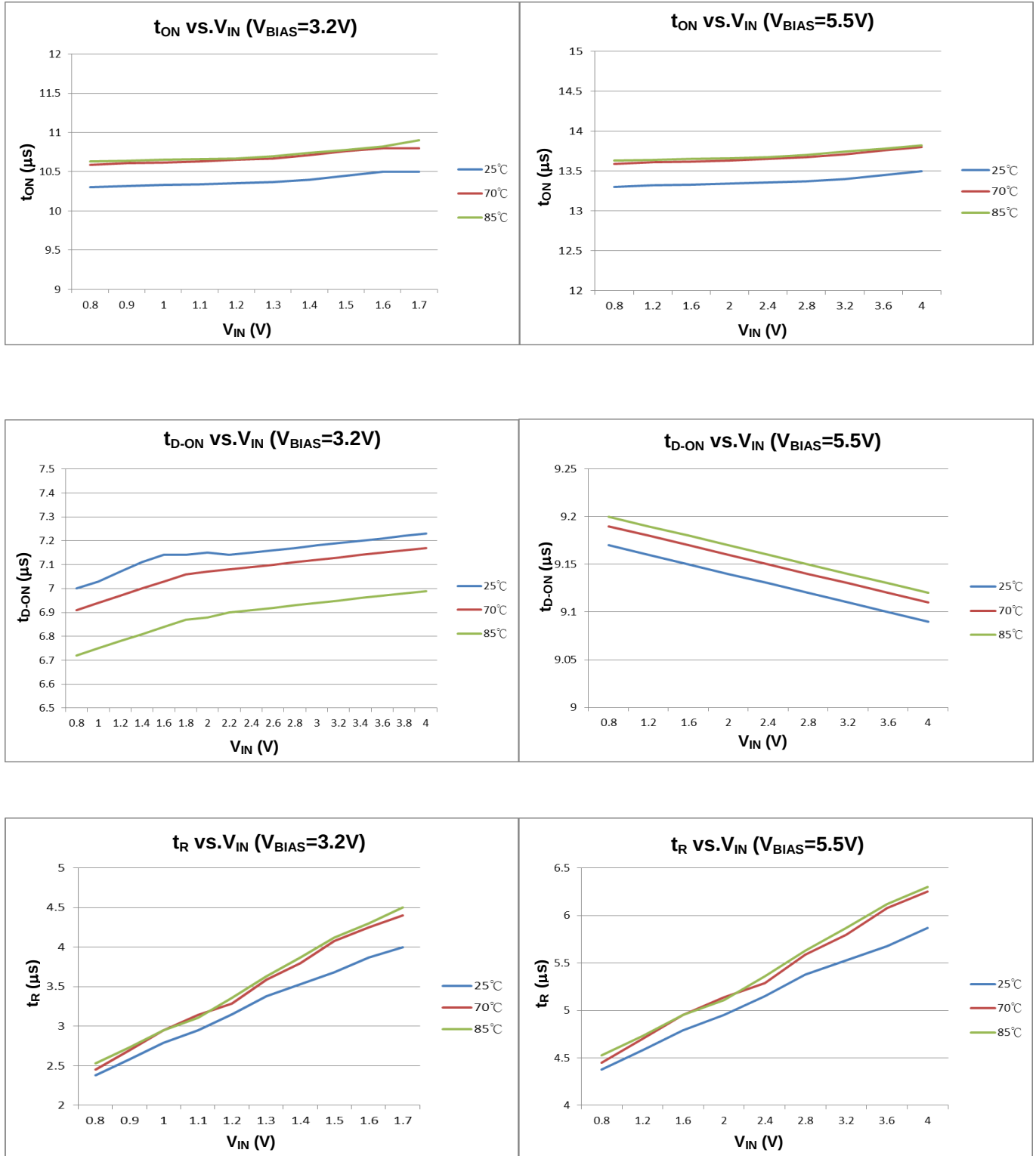
## Switching Characteristics



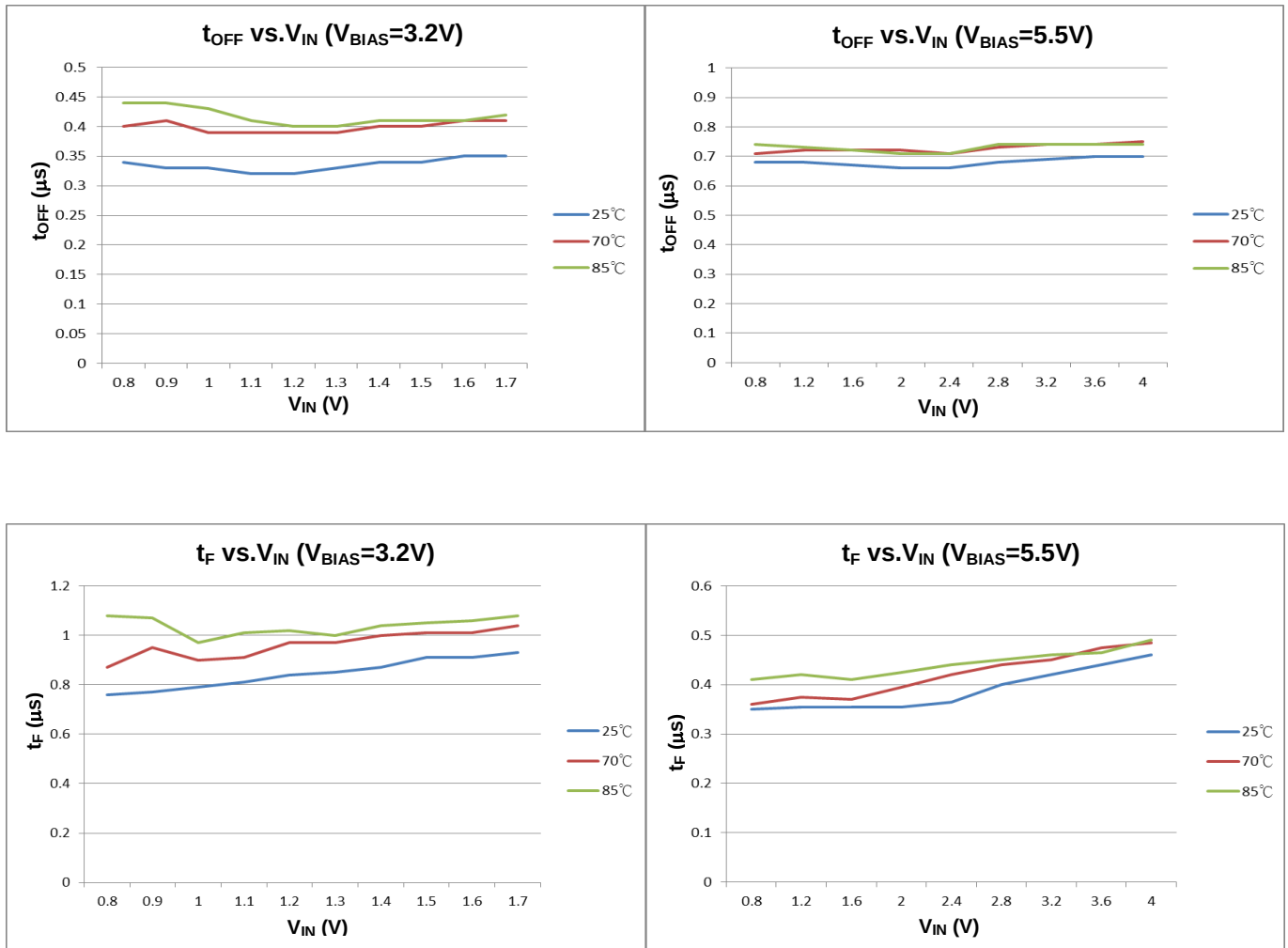
(Test Conditions:  $T_A = +25^\circ\text{C}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 0.1\mu\text{F}$ ,  $R_L = 10\Omega$  unless otherwise specified.)

| Symbol                                                            | Parameter          | Min | Typ | Max | Unit |
|-------------------------------------------------------------------|--------------------|-----|-----|-----|------|
| V <sub>IN</sub> = 1.5V, V <sub>BIAS</sub> = V <sub>ON</sub> = 5V  |                    |     |     |     |      |
| t <sub>ON</sub>                                                   | Turn-On Time       | —   | 10  | —   | μs   |
| t <sub>D-ON</sub>                                                 | Turn-ON Delay Time | —   | 5   | —   |      |
| t <sub>R</sub>                                                    | Turn-On Rise Time  | —   | 5   | —   |      |
| t <sub>OFF</sub>                                                  | Turn-Off Time      | —   | 2   | —   |      |
| t <sub>F</sub>                                                    | Turn-Off Fall Time | —   | 3   | —   |      |
| V <sub>IN</sub> = 1.05V, V <sub>BIAS</sub> = V <sub>ON</sub> = 5V |                    |     |     |     |      |
| t <sub>ON</sub>                                                   | Turn-On Time       | —   | 10  | —   | μs   |
| t <sub>D-ON</sub>                                                 | Turn-ON Delay Time | —   | 5   | —   |      |
| t <sub>R</sub>                                                    | Turn-On Rise Time  | —   | 5   | —   |      |
| t <sub>OFF</sub>                                                  | Turn-Off Time      | —   | 2   | —   |      |
| t <sub>F</sub>                                                    | Turn-Off Fall Time | —   | 3   | —   |      |

## Typical Characteristics



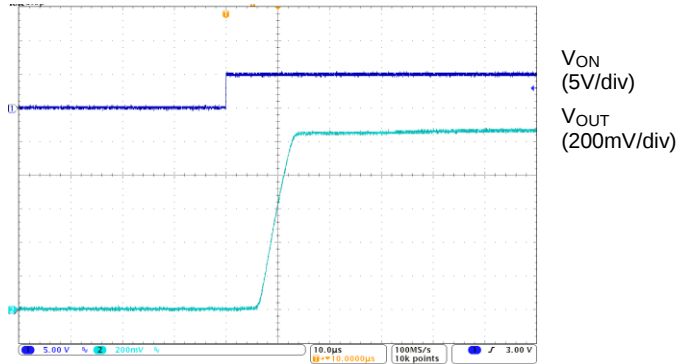
**Typical Characteristics (Cont.)**



## Functional Characteristics

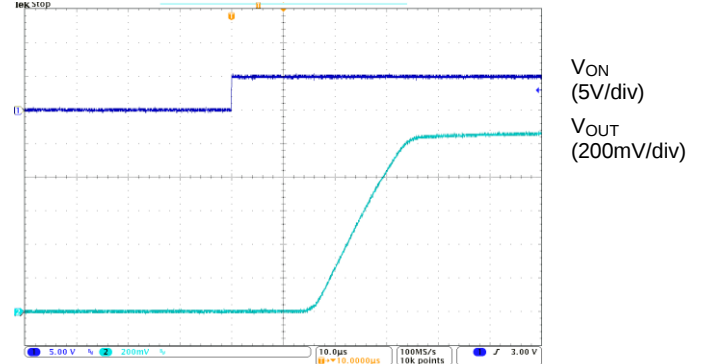
### Turn-ON & Turn-ON Rise Times

$V_{INX}=1.05V$ ,  $V_{BIAS}=5V$ ,  $C_{IN}=1\mu F$ ,  $C_L=0.1\mu F$ ,  $R_L=10\Omega$



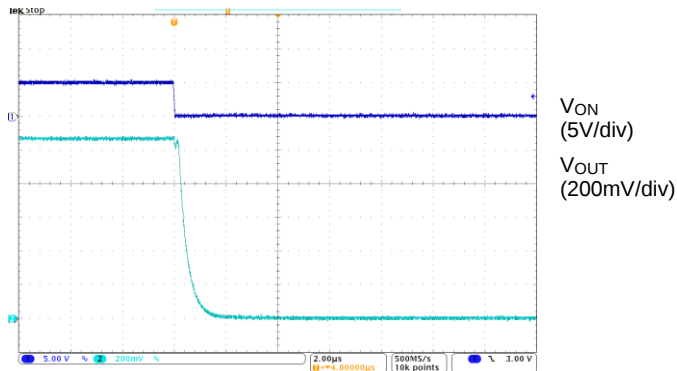
### Turn-ON & Turn-ON Rise Times

$V_{INX}=1.05V$ ,  $V_{BIAS}=3.2V$ ,  $C_{IN}=1\mu F$ ,  $C_L=0.1\mu F$ ,  $R_L=10\Omega$



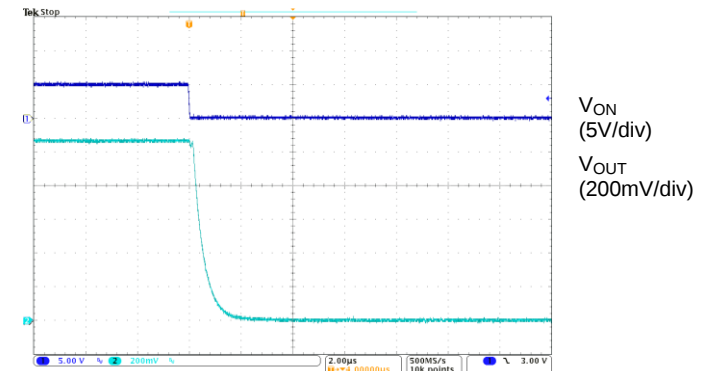
### Turn-OFF & Turn-OFF FALL Times

$V_{INX}=1.05V$ ,  $V_{BIAS}=5V$ ,  $C_{IN}=1\mu F$ ,  $C_L=0.1\mu F$ ,  $R_L=10\Omega$



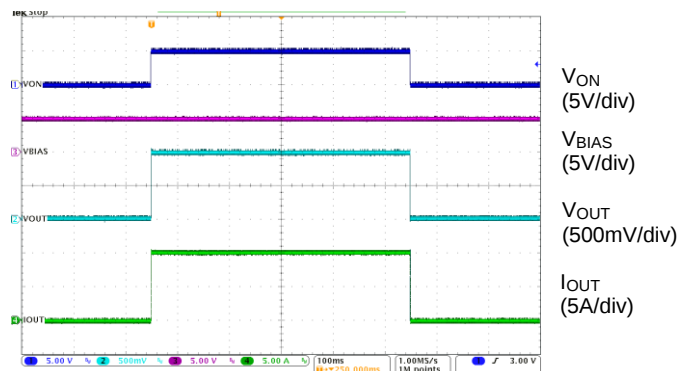
### Turn-OFF & Turn-OFF FALL Times

$V_{INX}=1.05V$ ,  $V_{BIAS}=3.2V$ ,  $C_{IN}=1\mu F$ ,  $C_L=0.1\mu F$ ,  $R_L=10\Omega$



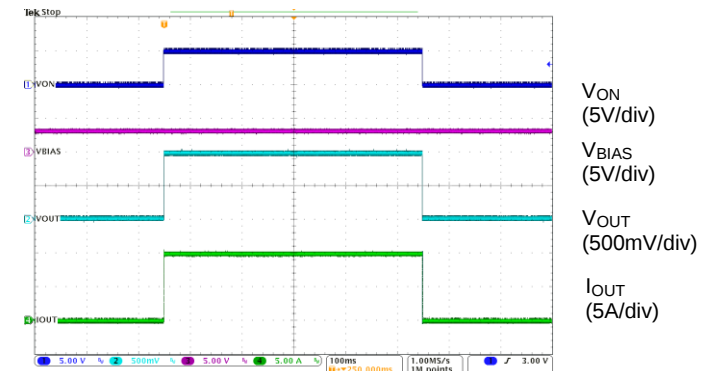
### Turn-ON & Turn-OFF at $I_{OUT} = -10A$

$V_{INX}=1.05V$ ,  $V_{BIAS}=5V$ ,  $C_{IN}=1\mu F$ ,  $C_L=0.1\mu F$ ,  $R_L=0.1\Omega$



### Turn-ON & Turn-OFF at $I_{OUT} = -10A$

$V_{INX}=1.05V$ ,  $V_{BIAS}=3.2V$ ,  $C_{IN}=1\mu F$ ,  $C_L=0.1\mu F$ ,  $R_L=0.1\Omega$



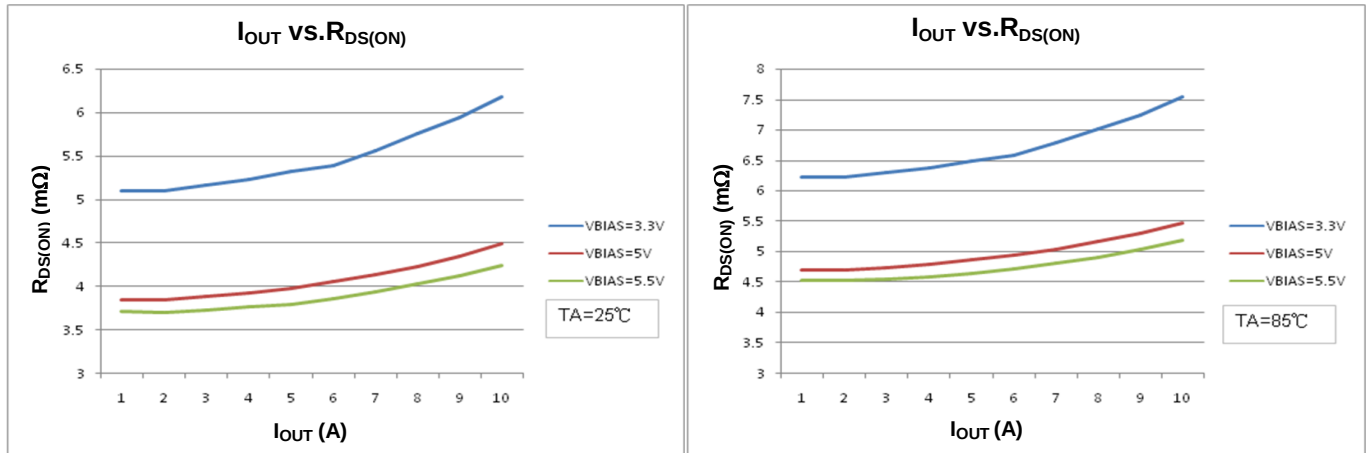
## Detailed Description

### ON/OFF Control

The DML1009LDS is enabled when the ON Pin is on active high with voltage of 1.2V or above. The device is disabled when the ON Pin voltage is 0.5V or lower. The EN input is compatible with both TTL and CMOS logic.

### V<sub>BIAS</sub> Voltage Range

For optimal on-resistance of the load switch, make sure  $V_{IN} \leq 1.5V + V_{BIAS}$  and  $V_{BIAS}$  is within the voltage range from 3.2V to 5.5V. On-resistance of the load switch will be higher if  $V_{IN} + 1.5V > V_{BIAS}$ . Resistance curves of a typical sample device at different  $V_{BIAS} = V_{IN}$  at  $I_{OUT} = -200mA$  are shown as below.



## Applications Information

The basic DML1009LDS application circuit is shown in the second page. Component selection is explained below.

### Input Capacitor

A capacitor of 10μF or higher value is recommended to be placed close to the IN pins of DML1009LDS. This capacitor can reduce the voltage drop caused by the in-rush current during the turn-on transient of the load switch. A higher value capacitor can be used to further reduce the voltage drop during high-current application.

### Output Capacitor

A capacitor of 0.1μF or higher value is recommended to be placed between the OUT pins and GND. The switching times are affected by the capacitance. A larger capacitor makes the initial turn-on transient smoother. This capacitor must be large enough to supply a fast transient load in order to prevent the output from dropping.

### Thermal Considerations

To ensure proper operation, the maximum junction temperature of the DML1009LDS should not exceed +150°C. Several factors attribute to the junction temperature rise: load current, MOSFET on-resistance, junction-to-ambient thermal resistance, and ambient temperature. The maximum load current can be determined by:

$$I_{LOAD(MAX)} = \sqrt{\frac{T_{J(MAX)} - T_C}{\Theta_{JC} \times R_{DS(ON)}}}$$

It is noted that the maximum continuous load current is 10A.

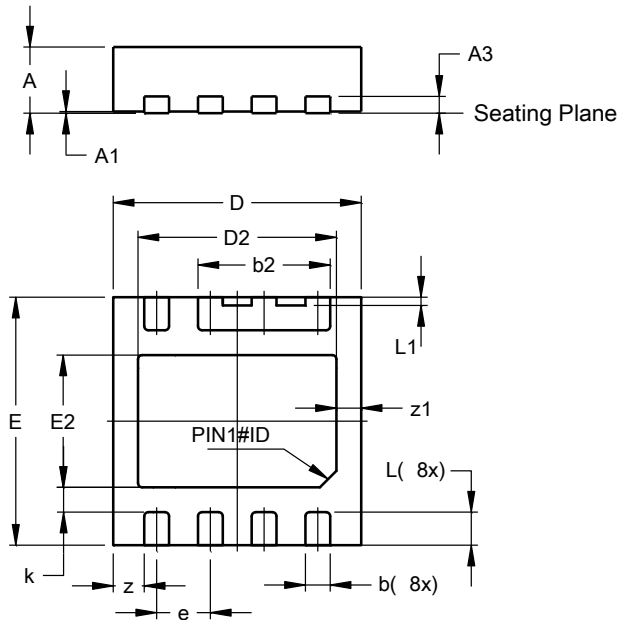
### Layout Guidelines

Good PCB is important for improving the thermal performance of DML1009LDS. Place the input and output bypass capacitors close to the IN and OUT pins. The input and output PCB traces should be as wide as possible for the given PCB space. Use a ground plane to enhance the power dissipation capability of the device.

## Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**V-DFN3030-8 (Type R)**

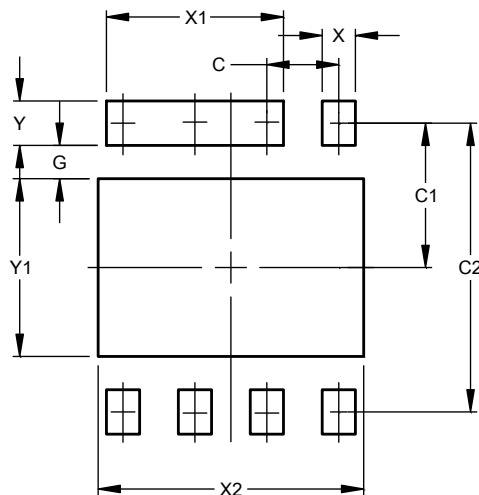


| V-DFN3030-8<br>(Type R) |          |      |       |
|-------------------------|----------|------|-------|
| Dim                     | Min      | Max  | Typ   |
| A                       | 0.77     | 0.83 | 0.80  |
| A1                      | 0.00     | 0.05 | 0.03  |
| A3                      | —        | —    | 0.203 |
| b                       | 0.25     | 0.35 | 0.30  |
| b2                      | 1.55     | 1.65 | 1.60  |
| D                       | 2.95     | 3.05 | 3.00  |
| D2                      | 2.30     | 2.50 | 2.40  |
| E                       | 2.95     | 3.05 | 3.00  |
| E2                      | 1.50     | 1.70 | 1.60  |
| e                       | 0.65 BSC |      |       |
| k                       | —        | —    | 0.30  |
| L                       | 0.35     | 0.45 | 0.40  |
| L1                      | 0.05     | 0.15 | 0.10  |
| z                       | —        | —    | 0.375 |
| z1                      | —        | —    | 0.30  |
| All Dimensions in mm    |          |      |       |

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

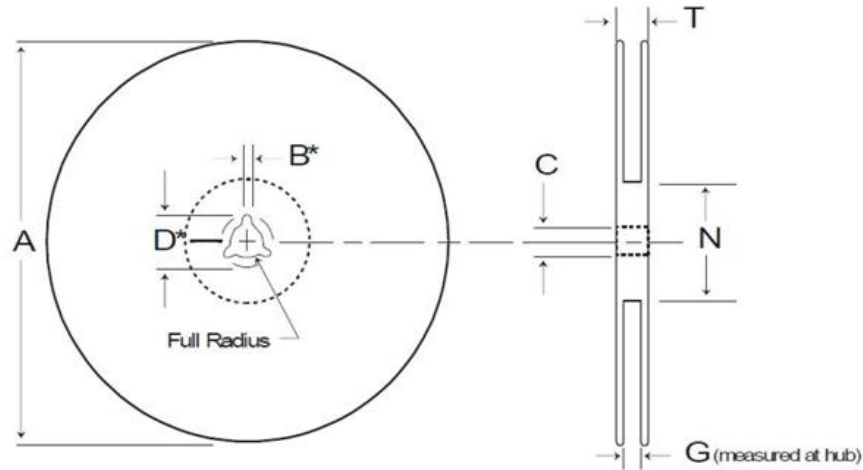
**V-DFN3030-8 (Type R)**



| Dimensions | Value<br>(in mm) |
|------------|------------------|
| C          | 0.65             |
| C1         | 1.30             |
| C2         | 2.60             |
| G          | 0.30             |
| X          | 0.30             |
| X1         | 1.60             |
| X2         | 2.40             |
| Y          | 0.40             |
| Y1         | 1.60             |

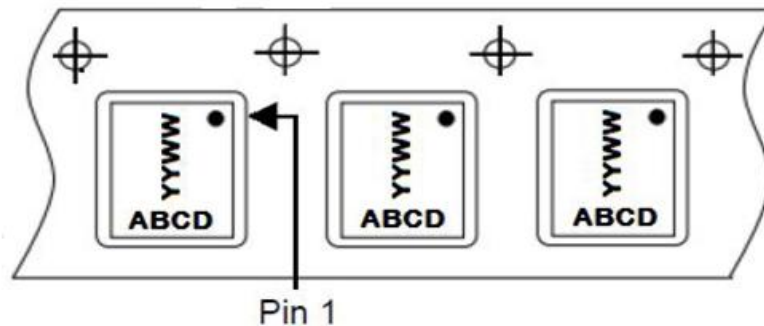
**Surface Mount Reel Specifications** (All dimensions in mm.)

DML1009LDS-7

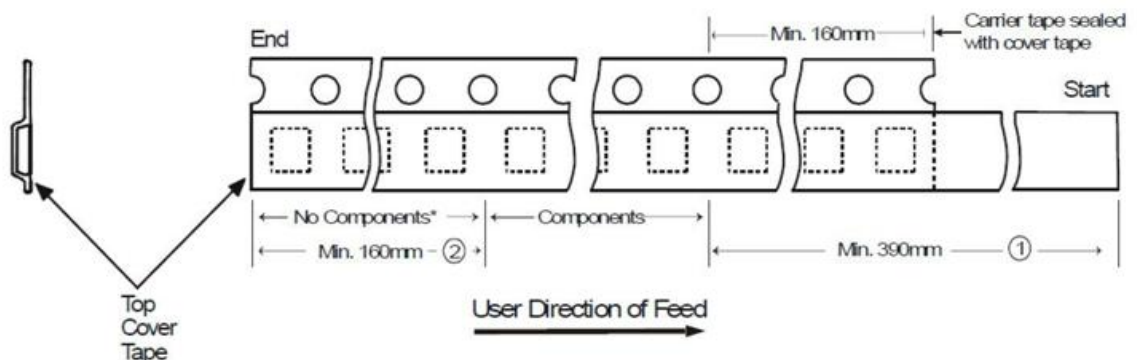


\* Drive spokes optional. If used, dimensions with asterisks apply.

| Tape Size | A<br>Max | B*<br>Max      | C               | D*<br>Max | N<br>Min | G                | T<br>Max |
|-----------|----------|----------------|-----------------|-----------|----------|------------------|----------|
| 8mm       | 178 ±2   | 2.0 +0.5<br>-0 | 13 +0.5<br>-0.2 | 20.5 ±0.2 | 55 ±5    | 8.4 +1.5<br>-0.0 | 14.4     |



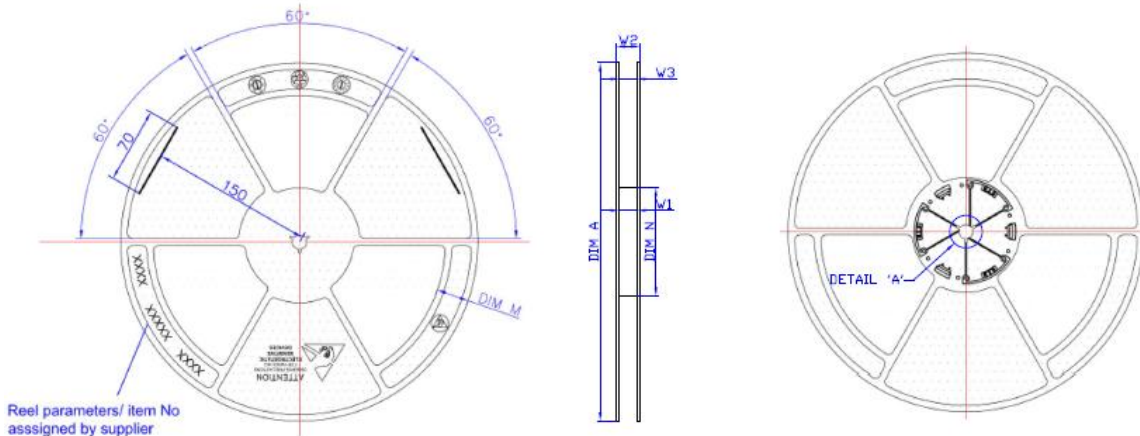
**Tape Leader and Trailer**



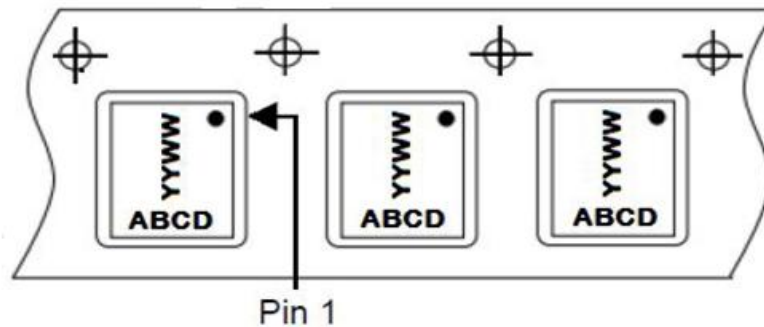
- Notes:
1. There shall be a leader of 230mm [9.05 inches] minimum which may consist of carrier and/or cover tape or a start tape followed by a minimum of 160mm [6.30 inches] of empty carrier tape sealed with cover tape.
  2. There shall be a trailer of 160mm [6.30 inches] minimum of empty carrier tape sealed with cover tape. The entire carrier tape must release from the reel hub as the last portion of the tape unwinds from the reel without damage to the carrier tape and the remaining components in the cavities.

**Surface Mount Reel Specifications** (Cont.) (All dimensions in mm.)

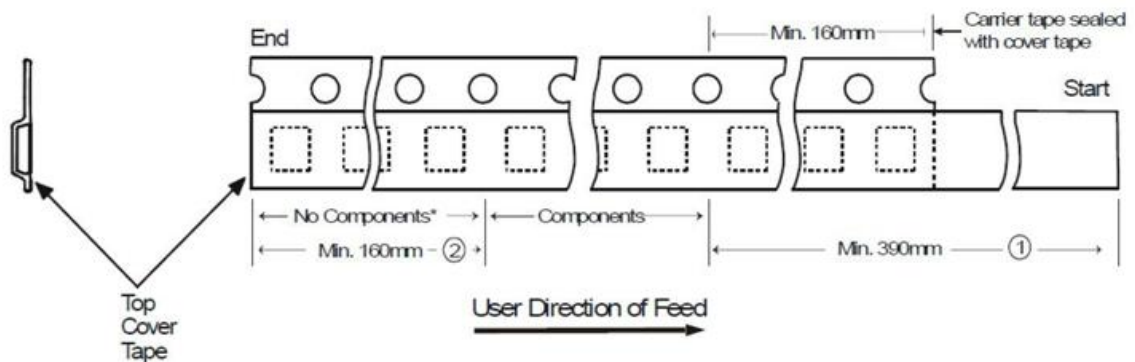
**DML1009LDS-13**



| PRODUCT SPECIFICATIONS |      |           |           |          |           |           |           |
|------------------------|------|-----------|-----------|----------|-----------|-----------|-----------|
| P.N.                   | Tape | DIM A(mm) | W1(mm)    | W2(mm)   | W3(mm)    | DIM N(mm) | DIM M(mm) |
| KRL00002               | 12   | 330 ±2    | 12.4+2/-0 | 18.4MAX. | 11.9~15.4 | 100 ±2    | 65        |



**Tape Leader and Trailer**



- Notes:
1. There shall be a leader of 230mm [9.05 inches] minimum which may consist of carrier and/or cover tape or a start tape followed by a minimum of 160mm [6.30 inches] of empty carrier tape sealed with cover tape.
  2. There shall be a trailer of 160mm [6.30 inches] minimum of empty carrier tape sealed with cover tape. The entire carrier tape must release from the reel hub as the last portion of the tape unwinds from the reel without damage to the carrier tape and the remaining components in the cavities.

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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

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