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Lead-free Green

DML10M8LDS

SINGLE CHANNEL SMART LOAD SWITCH

Description and Applications

The DML10M8LDS 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_{VBIAS}-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 ON pin.

Applications

- Portable Electronics and Systems
- Notebook and Tablet Computers
- Telecom, Networking, Medical and Industrial Equipment
- Set−Top Boxes, Servers and Gateways
- SSD

Features and Benefits

- Low $R_{DS(ON)}$ – Ensures On State Losses are Minimized
- 0.8V to V_{VBIAS}-1.5V Input Voltage Range
- 6A Continuous Current
- Low $R_{DS(ON)}$ Internal NFETs
  8mΩ at V_{BIAS} = 5V, V_{IN} = 1.05V, T_A = +85°C
- 35µA Low Quiescent Current
- 10µs 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)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.**
  https://www.diodes.com/quality/product-definitions/

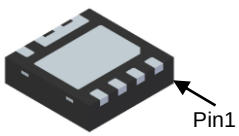
Mechanical Data

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: NiPdAu Finish, Solderable per MIL-STD-202, Method 208e4
- Weight: 0.022 grams (Approximate)

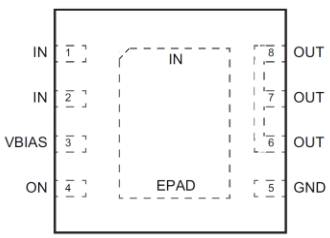
V-DFN3030-8 (Type R)

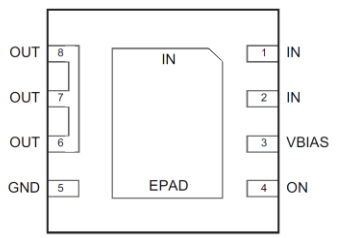


Top View



Bottom View





Ordering Information (Note 4)

Part Number	Case	Tape Width	Tape Pitch	Packaging
DML10M8LDS-7	V-DFN3030-8 (Type R)	8	4	3,000/Tape & Reel
DML10M8LDS-7A	V-DFN3030-8 (Type R)	12	8	1,500/Tape & Reel
DML10M8LDS-13	V-DFN3030-8 (Type R)	12	8	3,000/Tape & Reel

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ 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 https://www.diodes.com/design/support/packaging/diodes-packaging/.

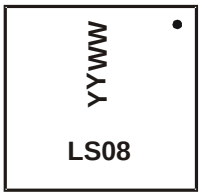
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Marking Information

Site 1

V-DFN3030-8 (Type R)



LS08 = Product Type Marking Code
YYWW = Date Code Marking
YY = Last Two Digits of Year (ex: 21 = 2021)
WW = Week Code (01 to 53)

Site 2

V-DFN3030-8 (Type R)



LS08 = Product Type Marking Code
YWX = Date Code Marking
Y = Year (ex: 1 = 2021)
W = Week (ex: a = Week 27; z Represents Week 52 and 53)
X = Internal Code (ex: U = Monday)

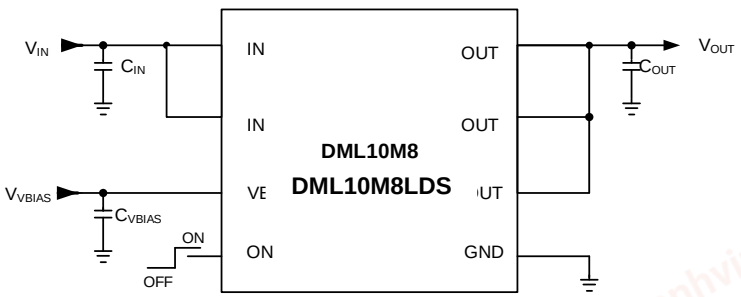
Date Code Key

Year	2017	…	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Code	7	…	1	2	3	4	5	6	7	8	9	0

Week	1-26	27-52	53
Code	A-Z	a-z	z

Internal Code	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Code	T	U	V	W	X	Y	Z

Typical Application Circuit



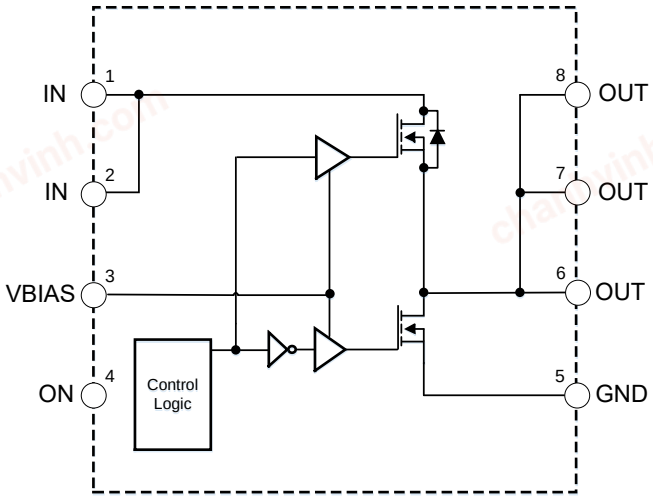
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Pin Description

Pin Number	Pin Name	Pin Function
1, 2, EPAD	IN	Load switch input. Bypass capacitor is recommended to minimize input voltage dip.
3	VBIAS	Bias voltage. Power supply input for the device.
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.

Functional Block Diagram



Absolute Maximum Rating

Parameter	Rating
Voltage from IN, ON, VBIAS, OUT to GND pin	-0.3V to 6V
Junction Temperature (T_J)	+150°C
I_{MAX}	12A
Storage Temperature (T_S)	-65°C to +150°C
ESD Rating HBM/CDM	2kV/1kV

Recommended Operating Ranges

Parameter	Rating
Supply Voltage (V_{VBIAS})	3.2V to 5.5V
Input Voltage (V_{IN})	0.8V to V_{VBIAS}-1.5V
Ambient Temperature (T_A)	-40°C to +85°C
Package Thermal Resistance (θ_{JC})	8°C/W
Package Thermal Resistance (θ_{JA})	60°C/W

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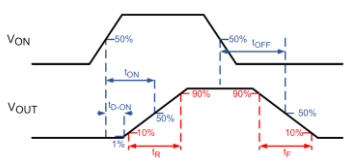
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Electrical Characteristics (T_A = +25°C, V_{VBIAS}=5V, V_{IN}=1.05V, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	In Supply Voltage	V_{ON} = 5V	0.8	1.05	V_{VBIAS} -1.5	V
V_{VBIAS}	VBIAS Supply Voltage	—	3.2	5	5.5	V
I_D	Maximum Continuous Current	V_{ON} = 5V	—	6	—	A
I_{PLS}	Maximum Pulsed Switch Current	V_{IN} = V_{ON} = 5V Pulse < 300µs, 2% Duty Cycle	—	9	—	A
I_Q	Quiescent Supply Current of VBIAS	I_{OUT} = 0V, V_{ON} = 5V	—	35	—	µA
I_{OFF}	VBIAS Shutdown Supply Current	V_{ON} = 0V, V_{OUT} = 0V	—	—	2	µA
I_{INOFF}	IN Shutdown Supply Current	V_{ON} = 0V, V_{OUT} = 0V	—	—	2	µA
I_{ON}	On Leakage Current	V_{ON} = 5V	—	—	1	µA
V_{ONH}	On High Level Voltage	—	1.2	—	—	V
V_{ONL}	On Low Level Voltage	—	—	—	0.5	V
Switching On Resistance						
R_{ON}	Switch On-State Resistance	I_{OUT} = -200mA, V_{ON} = 5V, V_{VBIAS} = 5V	—	—	8	mΩ
		I_{OUT} = -200mA, V_{ON} = 5V, V_{VBIAS} = 3.3V	—	—	10	mΩ
R_{PD}	Output Pull-Down Resistance	I_{OUT} = 15mA, V_{ON} = 0V	—	—	200	Ω

Switching Electrical Characteristics (T_A = +25°C, V_{VBIAS} = V_{ON} =5V, V_{IN} = 1.05V, C_{IN} = 1µF, C_{OUT} = 0.1µF, unless otherwise specified.)

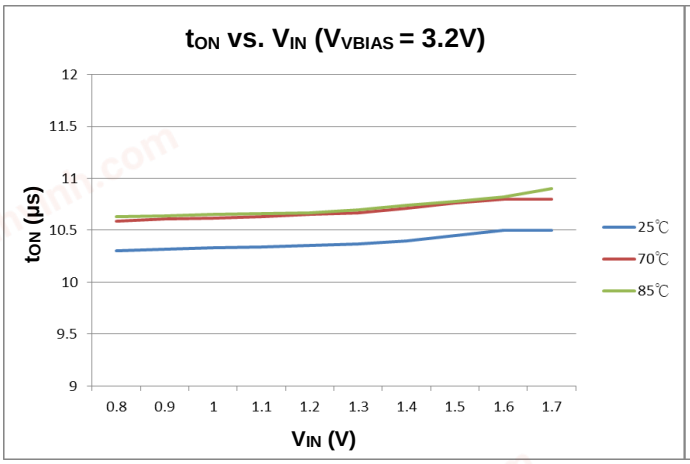
Symbol	Parameter	Min	Typ	Max	Unit
V_{IN} = 1.5V, V_{VBIAS} = V_{ON} = 5V					
t_{ON}	Turn-On Time	10	—	65	µs
t_{D-ON}	Turn-On Delay Time	7.5	—	45	
t_R	Turn-On Rise Time	5	—	33	
t_{OFF}	Turn-Off Time	—	0.2	—	
t_F	Turn-Off Fall Time	—	0.7	—	
V_{IN} = 1.05V, V_{VBIAS} = V_{ON} = 5V					
t_{ON}	Turn-On Time	10	—	65	µs
t_{D-ON}	Turn-On Delay time	7.5	—	45	
t_R	Turn-On Rise Time	5	—	33	
t_{OFF}	Turn-Off Time	—	0.2	—	
t_F	Turn-Off Fall Time	—	0.7	—	

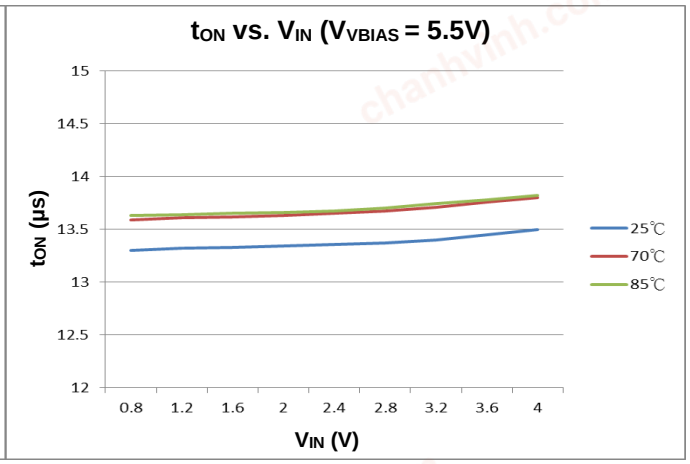


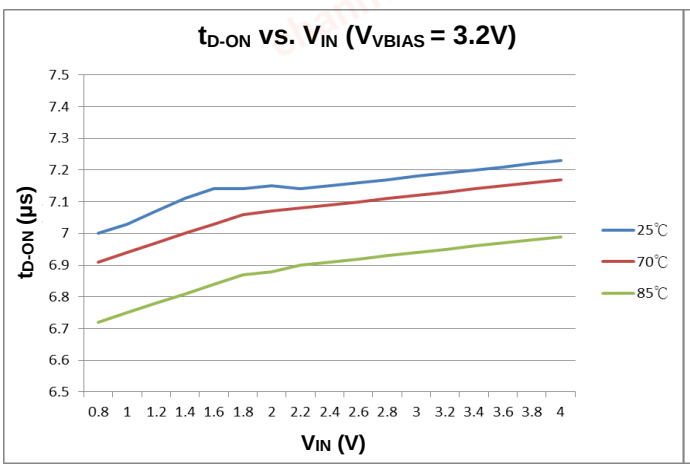
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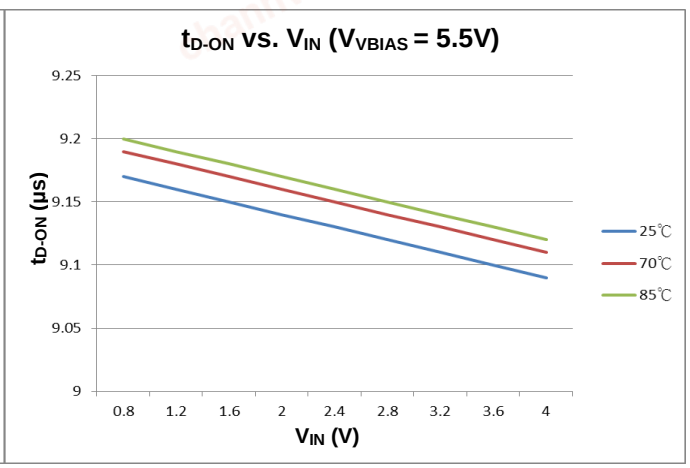
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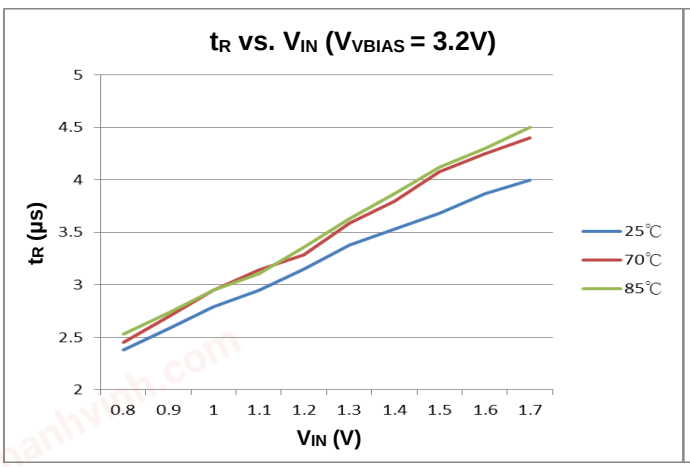
Performance Characteristics (@T_A = +25°C, unless otherwise specified.)

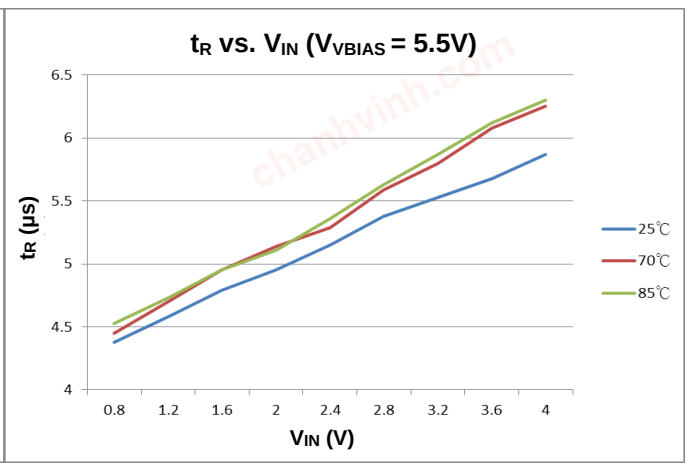








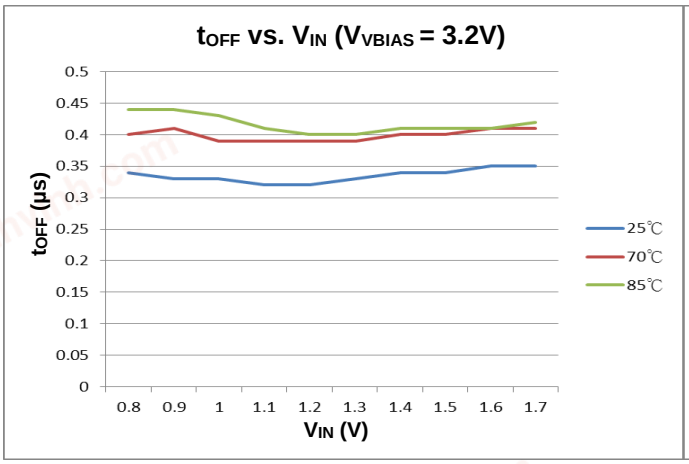


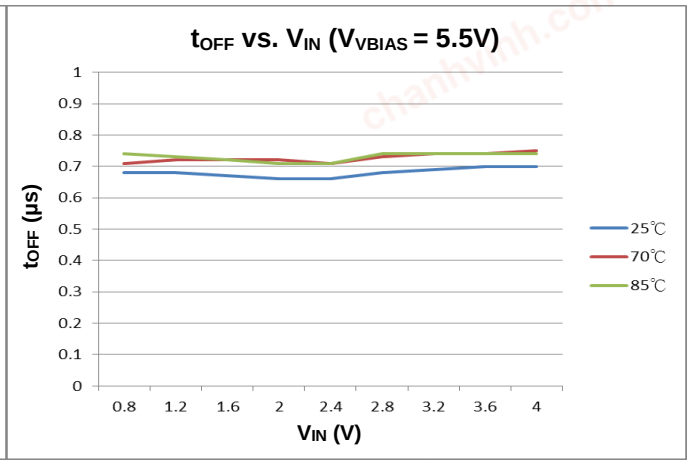


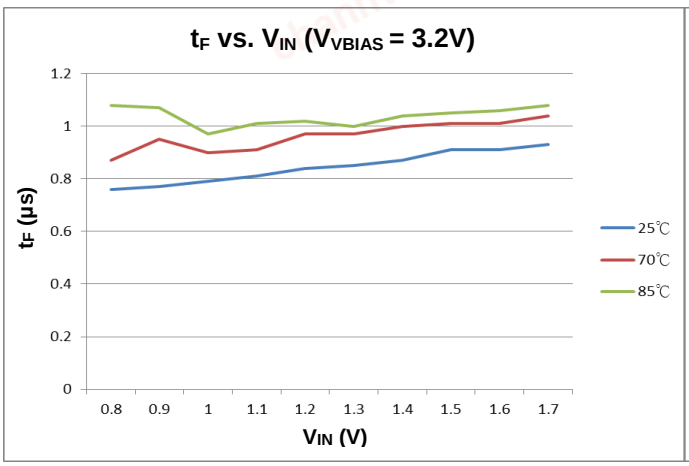
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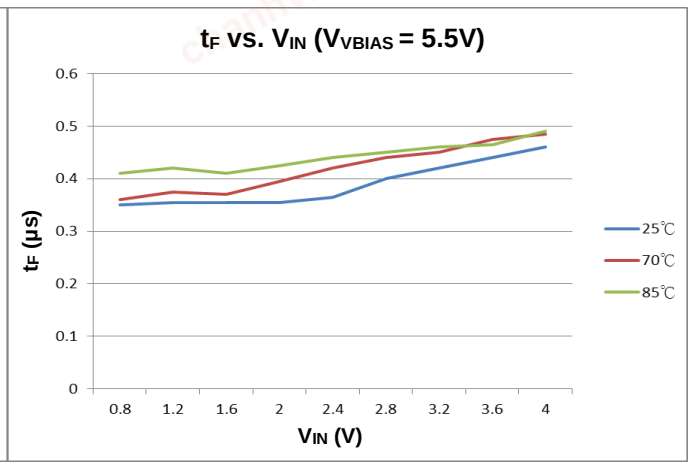
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Performance Characteristics (@T_A = +25°C, unless otherwise specified. continued)









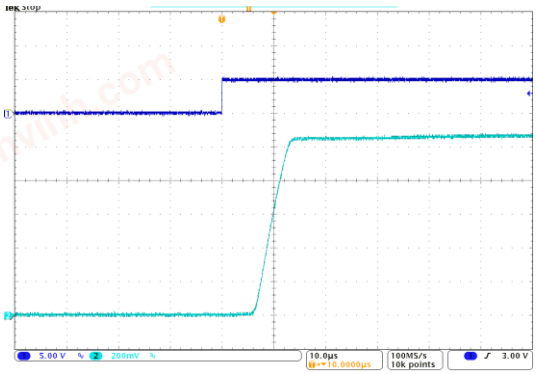
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Performance Characteristics (@T_A = +25°C, unless otherwise specified. continued)

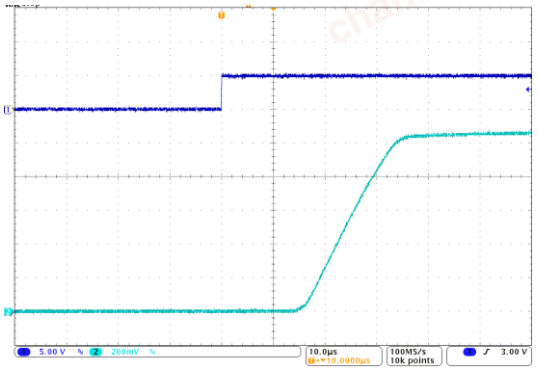
Turn-On & Turn-On Rise Time

V_{IN} = 1.05V, V_{VBIAS} = 5V, C_{IN} = 1µF, C_{OUT} = 0.1µF, R_{OUT} = 10Ω



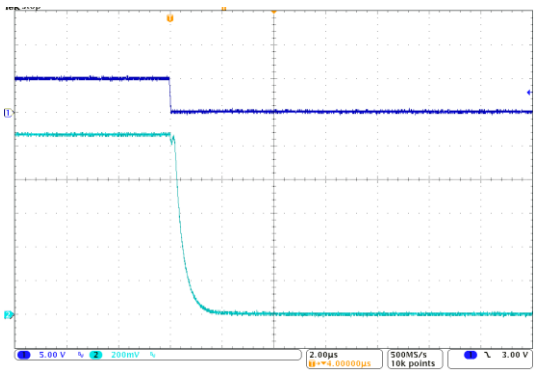
Turn-On & Turn-On Rise Time

V_{IN} = 1.05V, V_{VBIAS} = 3.2V, C_{IN} = 1µF, C_{OUT} = 0.1µF, R_{OUT} = 10Ω



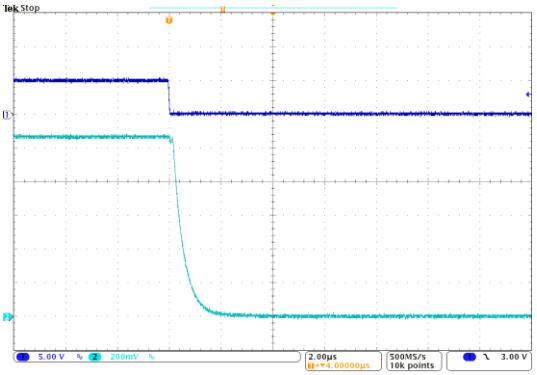
Turn-Off & Turn-Off Fall Time

V_{IN} = 1.05V, V_{VBIAS} = 5V, C_{IN} = 1µF, C_{OUT} = 0.1µF, R_{OUT} = 10Ω



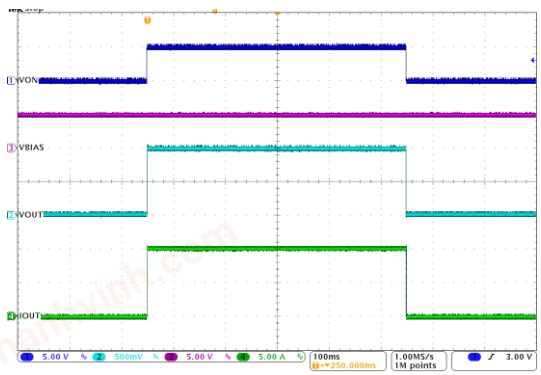
Turn-Off & Turn-Off Fall Time

V_{IN} = 1.05V, V_{VBIAS} = 3.2V, C_{IN} = 1µF, C_{OUT} = 0.1µF, R_{OUT} = 10Ω



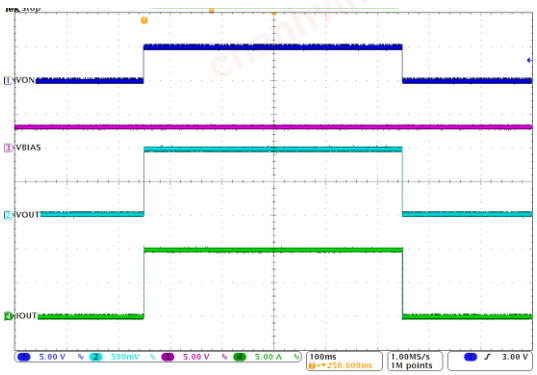
Turn-On & Turn-Off at I_{OUT} = -10A

V_{IN} = 1.05V, V_{VBIAS} = 5V, C_{IN} = 1µF, C_{OUT} = 0.1µF, R_{OUT} = 0.1Ω



Turn-On & Turn-Off at I_{OUT} = -10A

V_{IN} = 1.05V, V_{VBIAS} = 3.2V, C_{IN} = 1µF, C_{OUT} = 0.1µF, R_{OUT} = 0.1Ω



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Application Information

General Description

The DML10M8LDS is a single channel, 6A load switch in an 8-pin V-DFN3030-8 (Type R) package. To reduce the voltage drop in high current rails, the device implements an ultra-low resistance N-channel MOSFET which can be operated input voltage range from 0.8V to 3.5V.

The device has very low leakage current during off state. This prevents downstream circuits from pulling high standby current from the supply. Integrated control logic, driver, power supply and discharge FET eliminates the needs for any external components, which reduce solution size and bill of materials (BOM) count.

Enable Control

The DML10M8LDS device allows for enabling the MOSFET in an active-high configuration. When the VBIAS supply pin has an adequate voltage applied and the ON pin is at logic high level, the MOSFET will be enabled. Similarly, when the ON pin is at logic low level, the MOSFET will be disable.

Power Sequencing

The DML10M8LDS device will function with any power sequence, but the output turn-on delay performance may vary from what is specified. To archives the specified performance, there are two recommended power sequences:

1.) V_{VBIAS} → V_{IN} → V_{ON}

2.) V_{IN} → V_{VBIAS} → V_{ON}

Input Capacitor

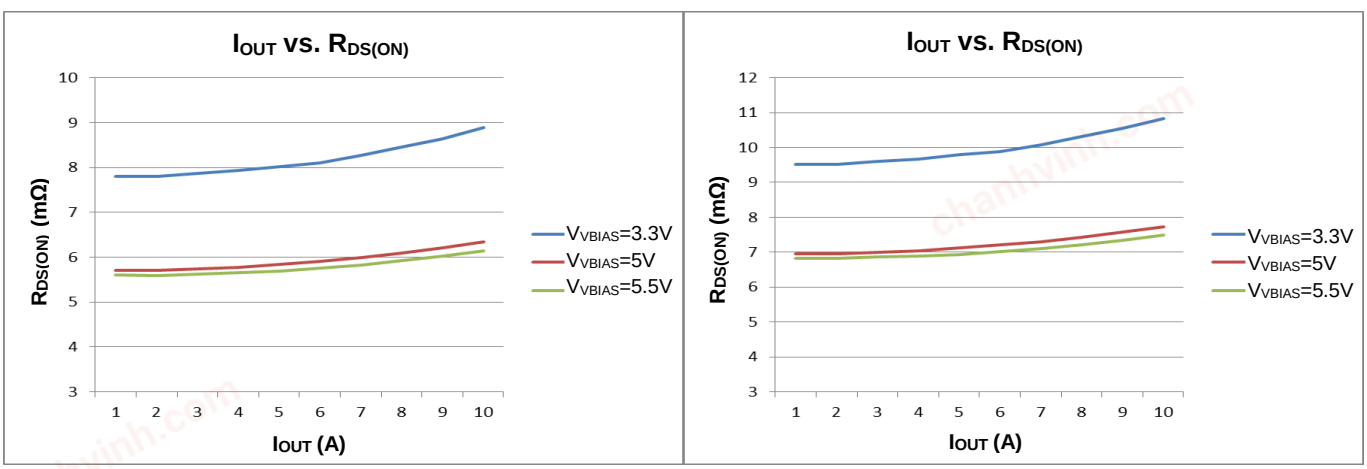
A capacitor of 10µF or higher value is recommended to be placed close to the IN pins of DML10M8LDS. This capacitor can reduce the voltage drop caused by the in-rush current during the turn-on transient of the load switch. A higher value capacitor can be used to further reduce the voltage drop during high-current application.

Output Capacitor

A capacitor of 0.1µF or higher value is recommended to be placed between the OUT pins and GND pin. 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.

V_{IN} and V_{VBIAS} Voltage Range

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



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Application Information (continued)

Thermal Considerations

To ensure proper operation, the maximum junction temperature of the DML10M8LDS should not exceed +150°C. Several factors attribute to the junction temperate rise: load current, MOSFET on-resistance, junction-to-ambient thermal resistance, and ambient temperature. The maximum load current can be determined by:

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

Where

$I_{LOAD(MAX)}$ is the maximum allowable current on load (A). (6A for DML10M8LDS)

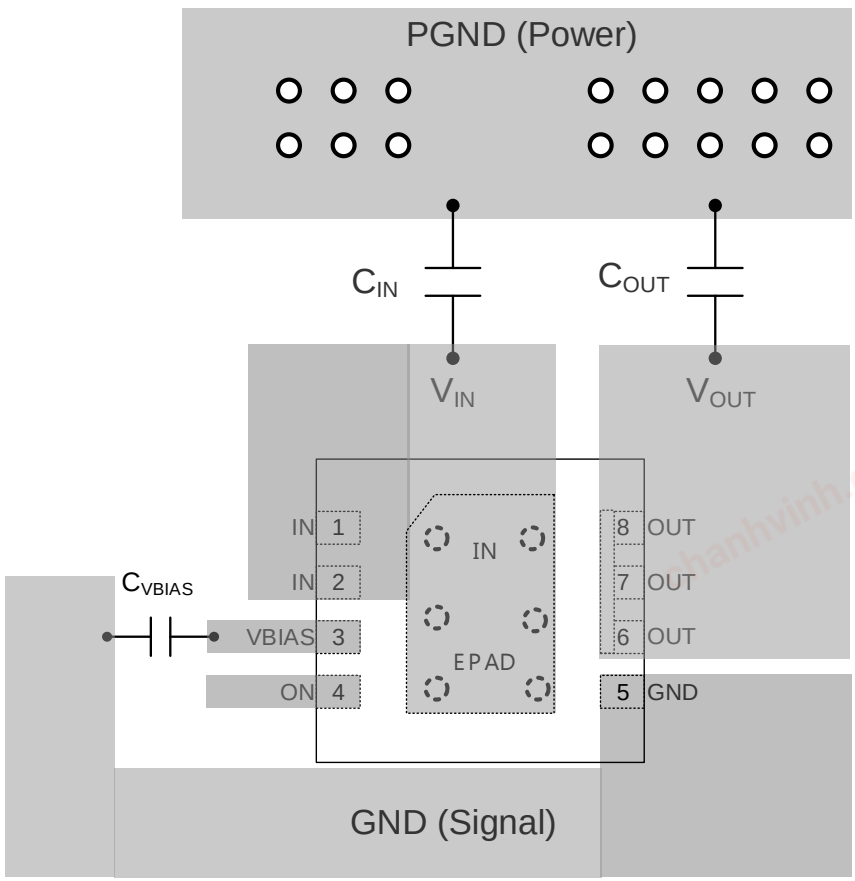
$T_{J(MAX)}$ is the maximum allowable junction temperature.

T_C is the case temperature of the device.

θ_{JC}= junction to case thermal impedance. This parameter is highly dependent upon PCB layout.

PCB Layout Consideration

1. Place the input/output capacitors C_{IN} and C_{OUT} as close as possible to the IN and OUT pins.
2. The power traces which are IN trace, OUT trace and GND trace. They should be short, wide and directly for minimize parasitic inductance.
3. Place C_{VBIAS} capacitor near the device pin.
4. Connect the signal ground to the GND pin, and keep a single connection from GND pin to the power ground behind the input or output capacitors.
5. For better power dissipation, holes are recommended to connect to the exposed pad's landing area with a large copper polygon on the other side of the printed circuit board. The copper polygons and exposed pad shall connect to IN pin on the printed circuit board.



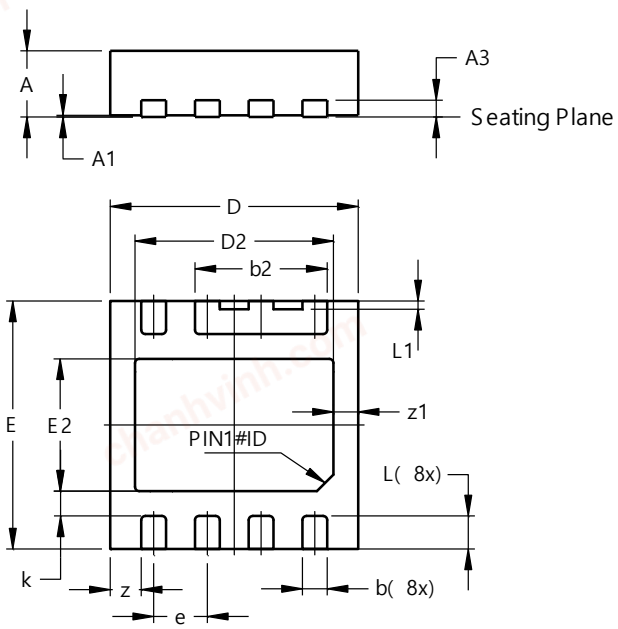
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Package Outline Dimensions

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

V-DFN3030-8 (Type R)

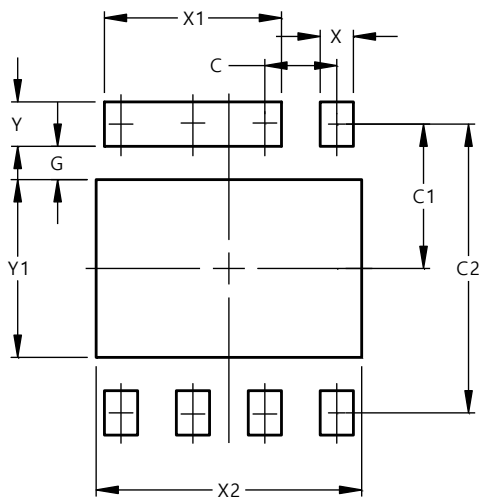


V-DFN3030-8 (Type R)			
Dim	**Min**	**Max**	**Typ**
A	0.77	0.83	0.80
A1	0.00	0.05	0.03
A3	--	--	0.203
b	0.25	0.35	0.30
b2	1.55	1.65	1.60
D	2.95	3.05	3.00
D2	2.30	2.50	2.40
E	2.95	3.05	3.00
E2	1.50	1.70	1.60
e	0.65 BSC		
k	--	--	0.30
L	0.35	0.45	0.40
L1	0.05	0.15	0.10
z	--	--	0.375
z1	--	--	0.30
All Dimensions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

Suggested Pad Layout

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

V-DFN3030-8 (Type R)



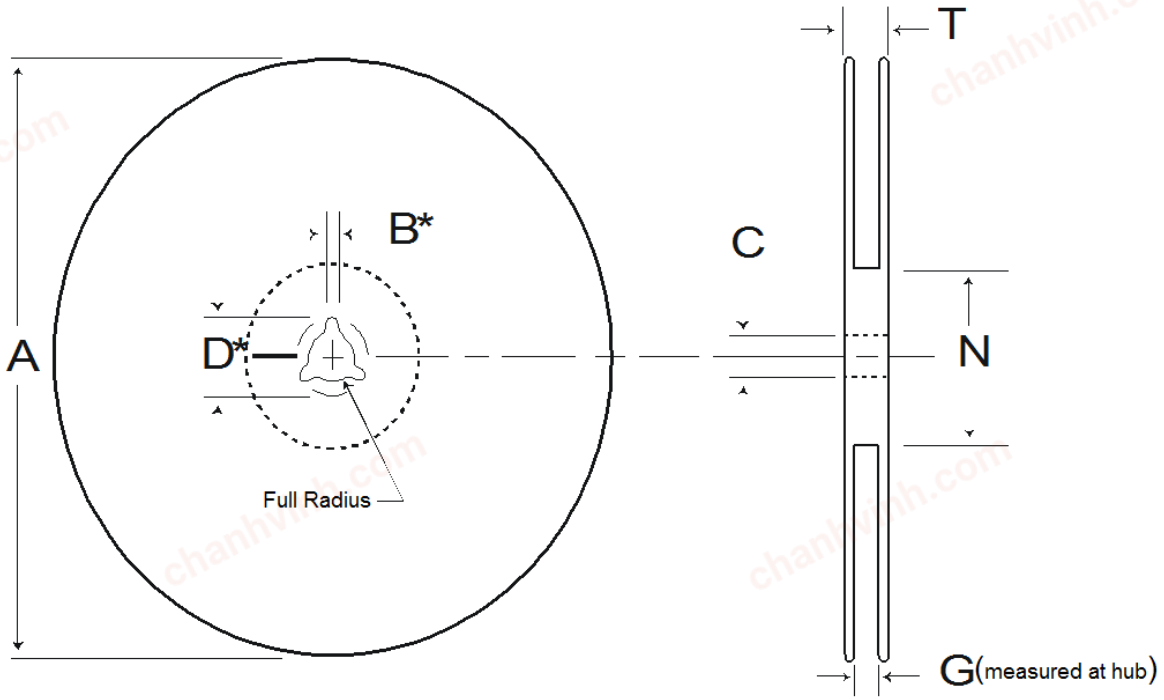
Dimensions	Value (in mm)
C	0.65
C1	1.30
C2	2.60
G	0.30
X	0.30
X1	1.60
X2	2.40
Y	0.40
Y1	1.60

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Surface Mount Reel Specifications

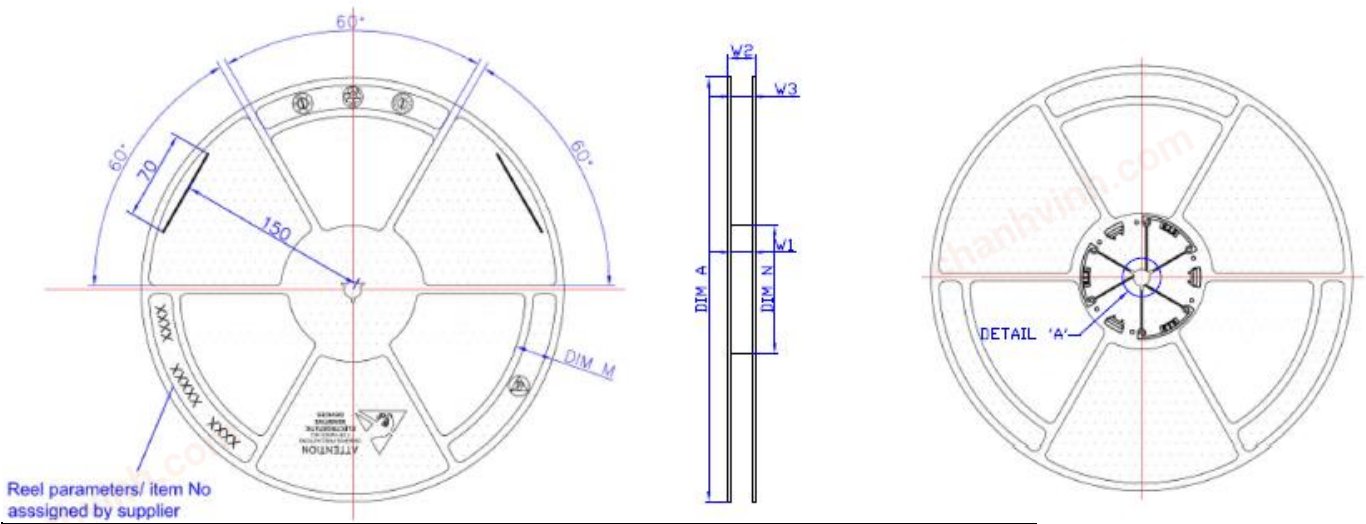
DML10M8LDS-7



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

Tape Width	Reel Size	A (mm)	B Max (mm)	C (mm)	D Max (mm)	N Min (mm)	G (mm)	T Max (mm)
8mm	7”	178 ±2	2.0 +0.5 -0	13 +0.5 -0.2	20.5 ±0.2	55 ±5	8.4 +1.5 -0.0	14.4

DML10M8LDS-13

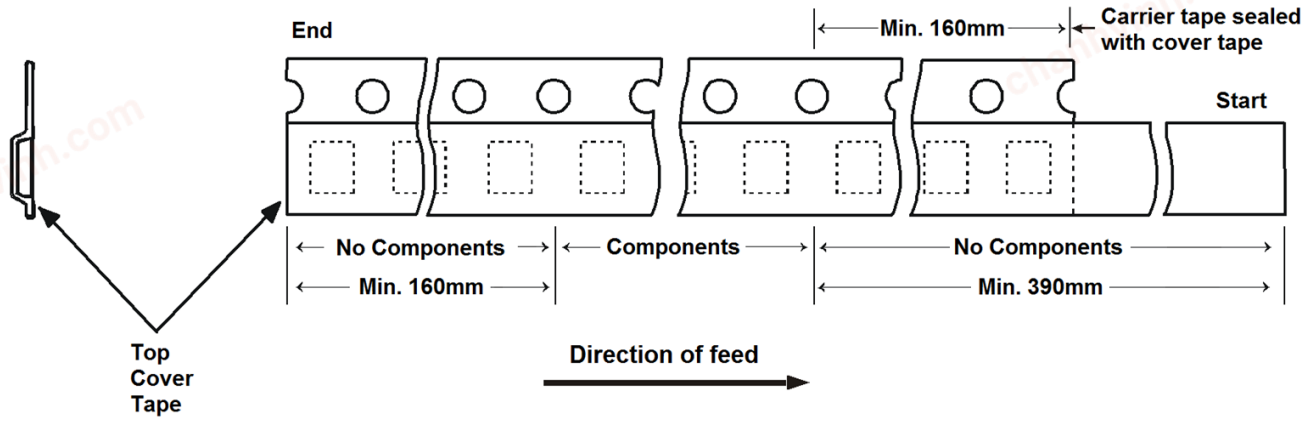


Tape Width	Reel Size	DIM A (mm)	W1 (mm)	W2 (mm)	W3 (mm)	DIM N (mm)	DIM M (mm)
12mm	13”	330 ±2	12.4 +2 -0	18.4MAX.	11.9~15.4	100 ±2	65

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Tape Leader and Trailer Specifications (Notes 5 and 6)



Notes:
5. There shall be a leader of at least 230mm which may consist of carrier tape and/or cover tape or a start tape followed by at least 160mm of empty carrier tape sealed with cover tape.
6. There shall be a trailer of at least 160mm 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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