Lead-free Green

DML1006LDS

SINGLE CHANNEL SMART LOAD SWITCH

Description and Applications

The DML1006LDS 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 10A current channel with 3.2V to 5.5V bias supply. The load switch is controlled by a low voltage control signal through ON pin.

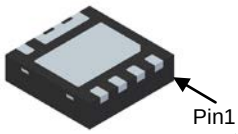
- Portable Computers
- Ultrabooks
- Tablet PCs
- Set Top Boxes
- LCD TV
- Telecom/Networking/Datacom Equipment
- SSD
- Consumer Electronics

Features and Benefits

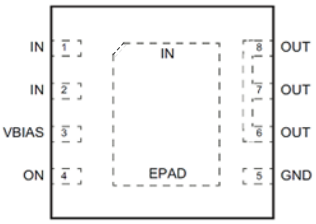
- Low $R_{DS(ON)}$ – Ensures On-State Losses are Minimized
- 0.8V to V_{BIAS}-1.5V Input Voltage Range
- 10A Continuous Current
- Low $R_{DS(ON)}$ Internal NFETs
  5mΩ at V_{BIAS} = 5V, V_{IN} = 1.05V, T_A = +85°C
- 35µA Low Quiescent Current
- 200µs Turn On Rise Time
- 3.2V to 5.5V Bias Voltage
- Integrated Quick Output Discharge Resistor
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen- and Antimony-Free. "Green" Device (Note 3)**

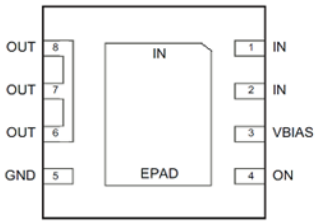
V-DFN3030-8 (Type R)

Top View



Bottom View





Ordering Information (Note 4)

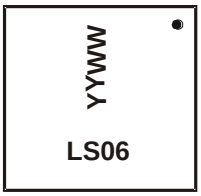
Part Number	Case	Packaging
DML1006LDS-7	V-DFN3030-8 (Type R)	3000/Tape & Reel
DML1006LDS-13	V-DFN3030-8 (Type R)	3000/Tape & Reel

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 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

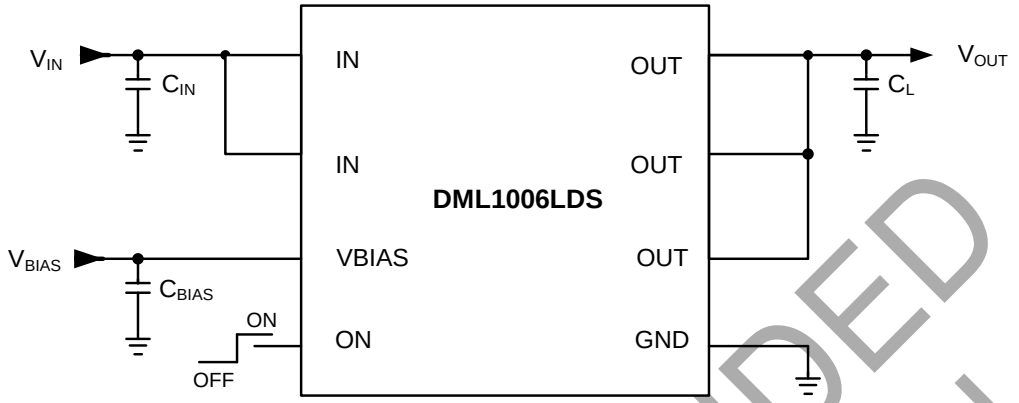
Pin Number	Pin Name	Pin Function
1, 2, EPAD	IN	Load Switch Input. Bypass capacitor is recommended to minimize input voltage dip. Recommended voltage range of this pin is 0.8V to V_{BIAS}-1.5V to obtain optimal R_{ON}.
3	VBIAS	Bias Voltage. Power supply input for the device. Recommended voltage range 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

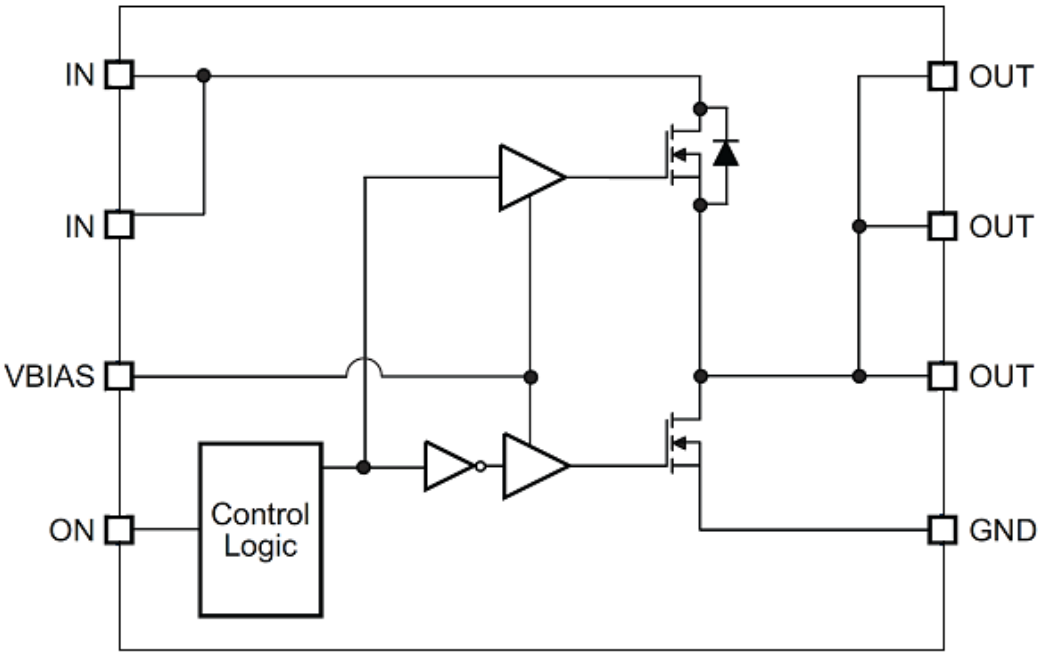


LS06 = Product Type Marking Code
YYWW = Date Code Marking
YY = Last Two Digits of Year (ex: 17 = 2017)
WW = Week Code (01 to 53)

Typical Application



Functional Block Diagram



Absolute Maximum Ratings

Parameter	Rating
IN, ON, VBIAS, 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

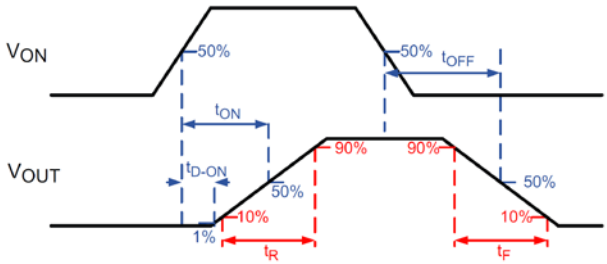
Maximum Operating Ratings

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

Electrical Characteristics (T_A = +25°C, V_{BIAS} = 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_{BIAS}-1.5	V
V_{BIAS}	VBIAS 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 Pulse < 300µs, 2% Duty Cycle	—	12	—	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_{BIAS} = 5V	—	3.8	5	mΩ
		I_{OUT} = -200mA, V_{ON} = 5V, V_{BIAS} = 3.3V	—	4.8	6	mΩ
R_{PD}	Output Pull-Down Resistance	I_{OUT} = 15mA, V_{ON} = 0V	—	—	200	Ω

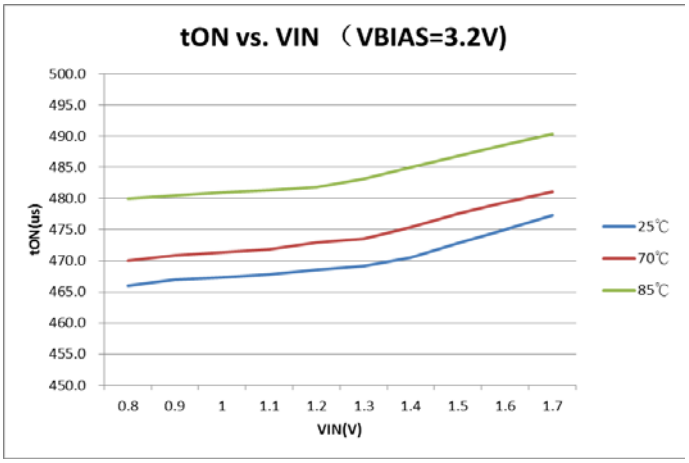
Switching Characteristics

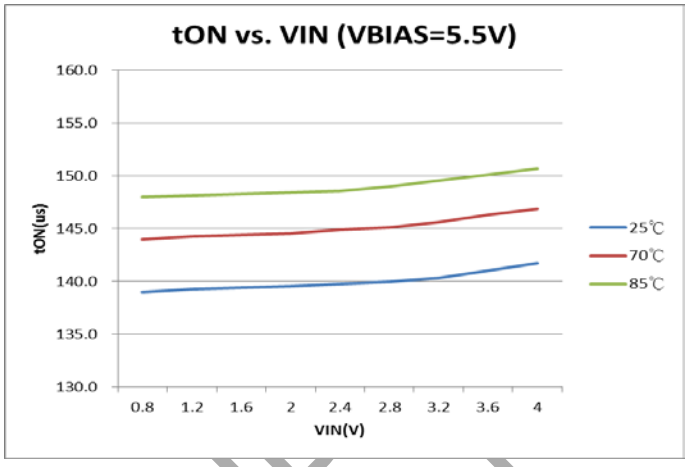


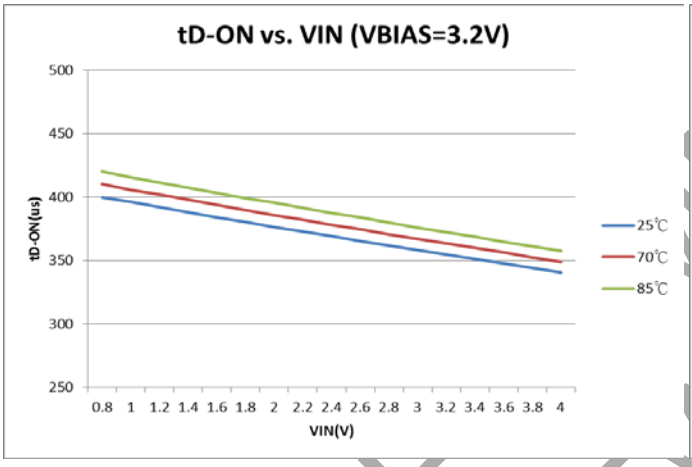
(Test conditions: T_A = +25°C, C_{IN} = 1µF, C_L = 0.1µF, R_L = 10Ω, unless otherwise specified.)

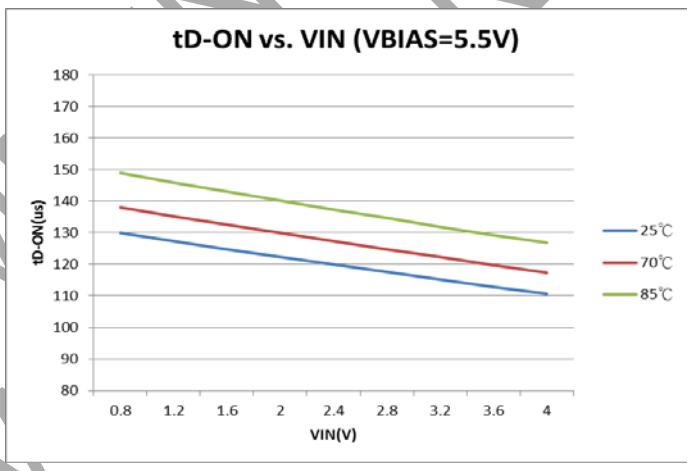
Symbol	Parameter	Min	Typ	Max	Unit
V_{IN} = 1.5V, V_{BIAS} = V_{ON} = 5V					
t_{ON}	Turn-ON Time	—	200	—	µs
t_{D-ON}	Turn-ON Delay Time	—	100	—	
t_R	Turn-ON Rise Time	—	150	—	
t_{OFF}	Turn-OFF Time	—	1	—	
t_F	Turn-OFF Fall Time	—	1	—	
V_{IN} = 1.05V, V_{BIAS} = V_{ON} = 5V					
t_{ON}	Turn-ON Time	—	200	—	µs
t_{D-ON}	Turn-ON Delay Time	—	100	—	
t_R	Turn-ON Rise Time	—	150	—	
t_{OFF}	Turn-OFF Time	—	0.7	—	
t_F	Turn-OFF Fall Time	—	0.7	—	

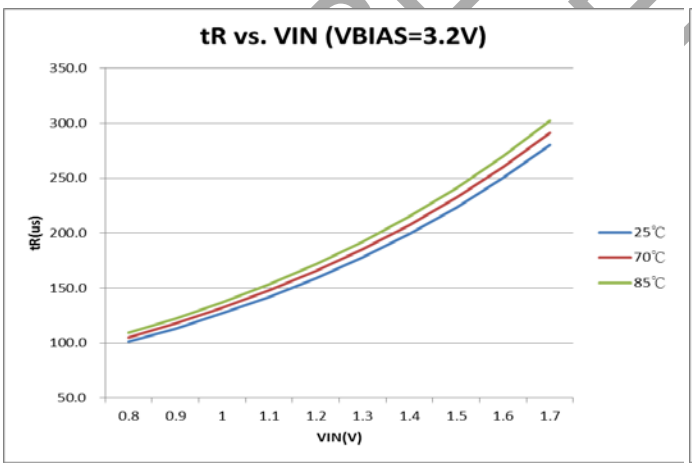
Typical Characteristics

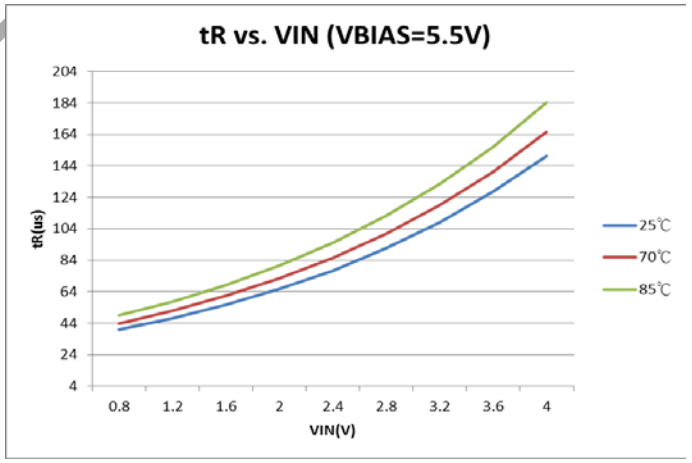




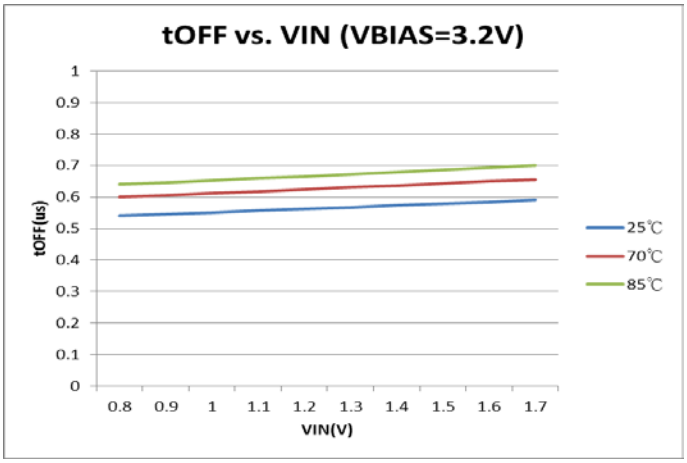


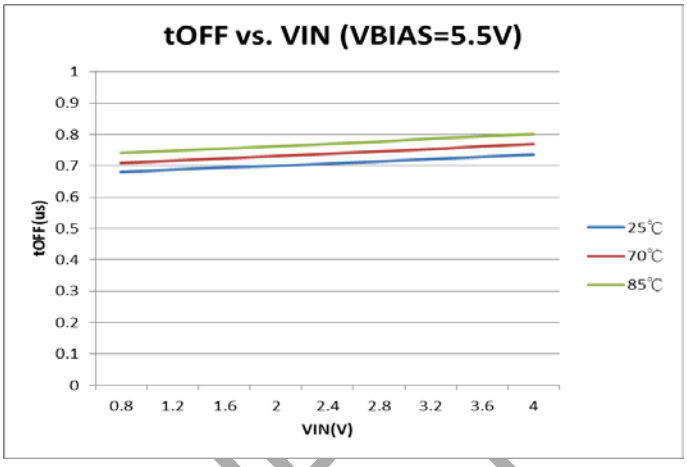


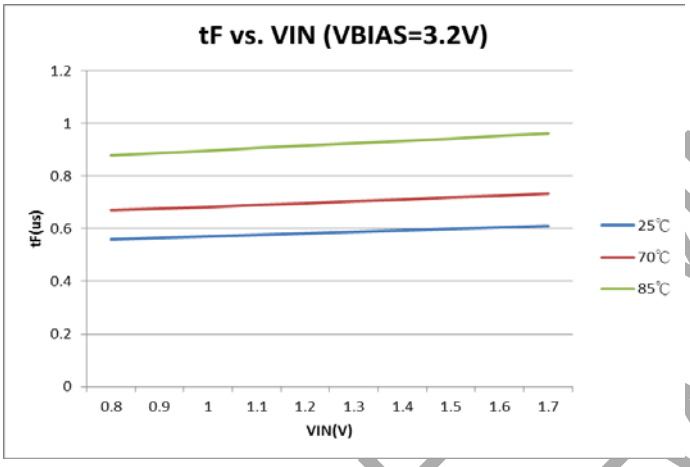


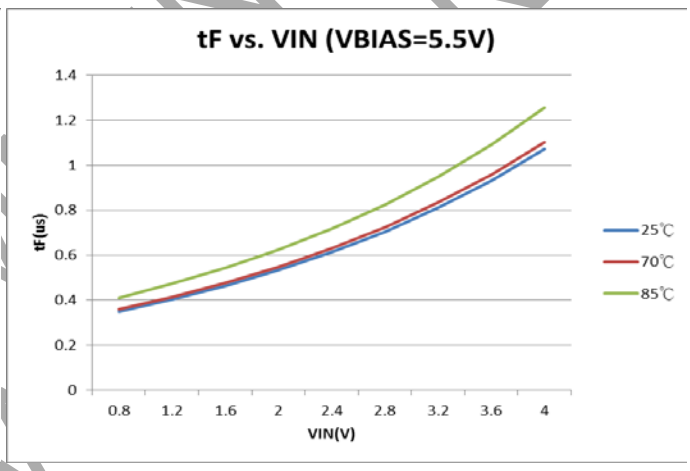


Typical Characteristics (Continued)



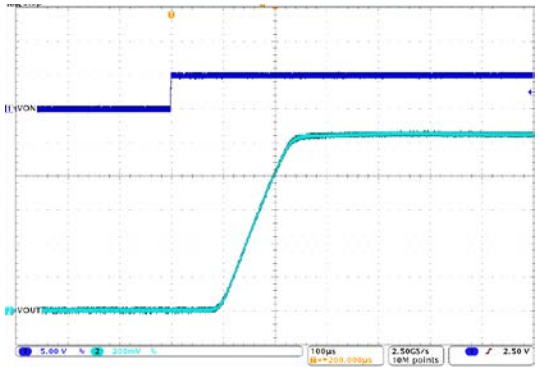






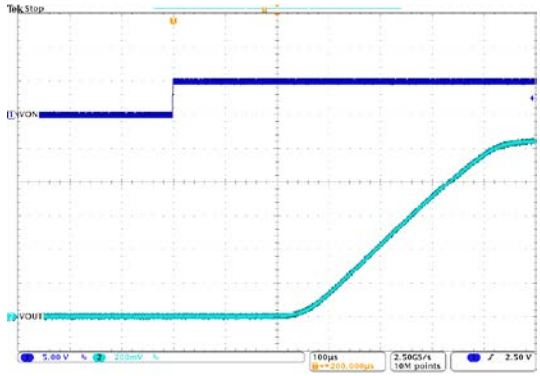
Functional Characteristics

Turn-ON & Turn-ON Rise Times
V_{INX}=1.05V, V_{BIAS}=5V, C_{IN}=1µF, C_L=0.1µF, R_L=10Ω



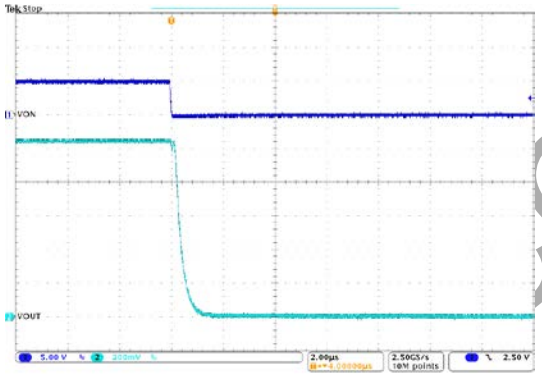
V_{ON} (5V/div)
V_{OUT} (200mV/div)

Turn-ON & Turn-ON Rise Times
V_{INX}=1.05V, V_{BIAS}=3.2V, C_{IN}=1µF, C_L=0.1µF, R_L=10Ω



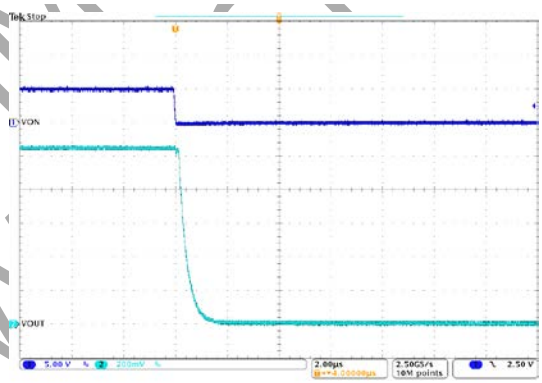
V_{ON} (5V/div)
V_{OUT} (200mV/div)

Turn-OFF & Turn-OFF FALL Times
V_{INX}=1.05V, V_{BIAS}=5V, C_{IN}=1µF, C_L=0.1µF, R_L=10Ω



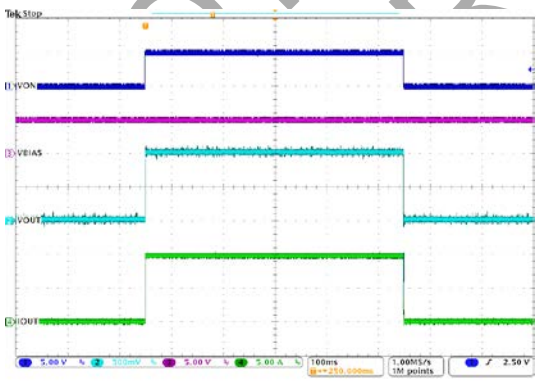
V_{ON} (5V/div)
V_{OUT} (200mV/div)

Turn-OFF & Turn-OFF FALL Times
V_{INX}=1.05V, V_{BIAS}=3.2V, C_{IN}=1µF, C_L=0.1µF, R_L=10Ω



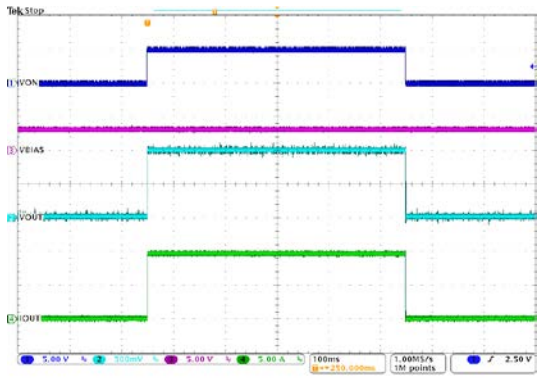
V_{ON} (5V/div)
V_{OUT} (200mV/div)

Turn-ON & Turn-OFF at I_{OUT}= -10A
V_{INX}=1.05V, V_{BIAS}=5V, C_{IN}=1µF, C_L=0.1µF, R_L=0.1Ω



V_{ON} (5V/div)
V_{BIAS} (5V/div)
V_{OUT} (500mV/div)
I_{OUT} (5A/div)

Turn-ON & Turn-OFF at I_{OUT}= -10A
V_{INX}=1.05V, V_{BIAS}=3.2V, C_{IN}=1µF, C_L=0.1µF, R_L=0.1Ω



V_{ON} (5V/div)
V_{BIAS} (5V/div)
V_{OUT} (500mV/div)
I_{OUT} (5A/div)

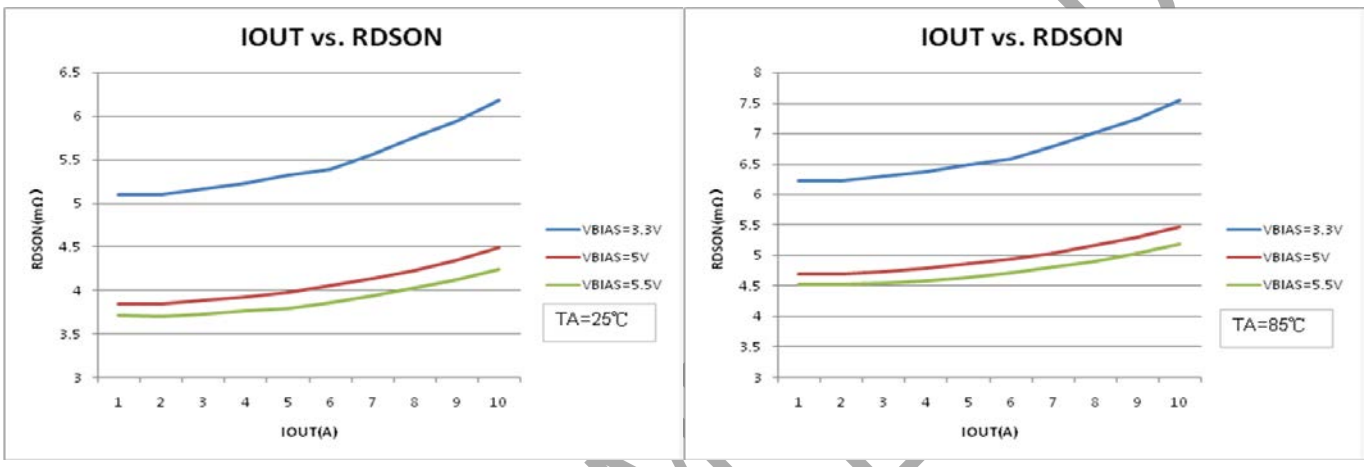
Detailed Description

ON/OFF Control

The DML1006LDS is enabled when the ON pin is on active high with 1.2V or above voltage. 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.

VBIAS Voltage Range

For optimal on-resistance of 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 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 DML1006LDS 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 DML1006LDS. 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 DML1006LDS 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:

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

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

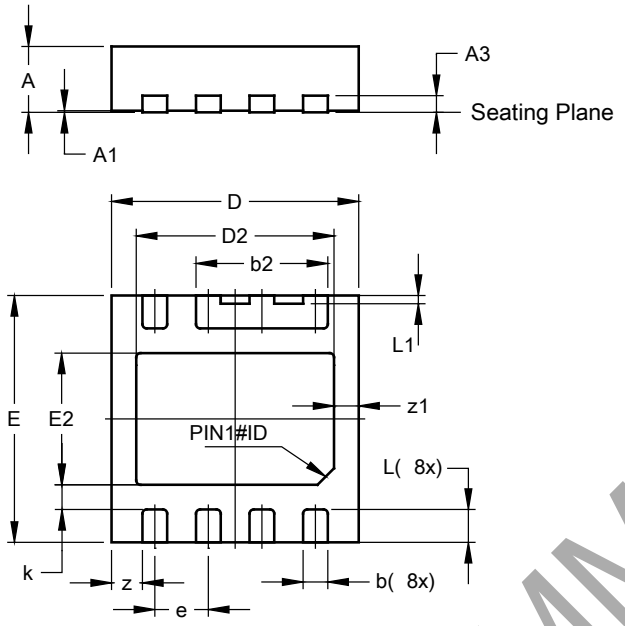
Layout Guidelines

Good PCB is important for improving the thermal performance of DML1006LDS. 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)

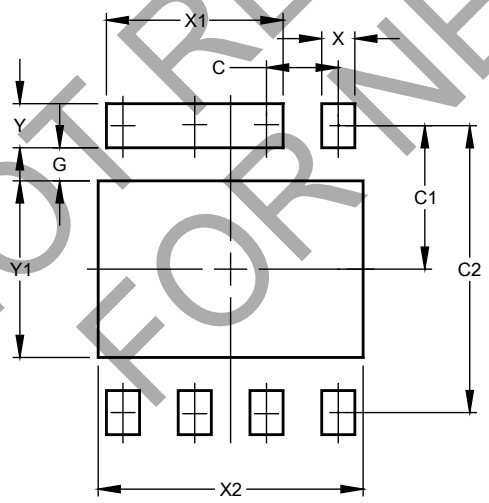


V-DFN3030-8 (Type R)			
Dim	**Min**	**Max**	**Typ**
A	0.77	0.83	0.80
A1	0.00	0.05	0.03
A3	--	--	0.203
b	0.25	0.35	0.30
b2	1.55	1.65	1.60
D	2.95	3.05	3.00
D2	2.30	2.50	2.40
E	2.95	3.05	3.00
E2	1.50	1.70	1.60
e	0.65 BSC		
k	--	--	0.30
L	0.35	0.45	0.40
L1	0.05	0.15	0.10
z	--	--	0.375
z1	--	--	0.30
All Dimensions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

Suggested Pad Layout

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

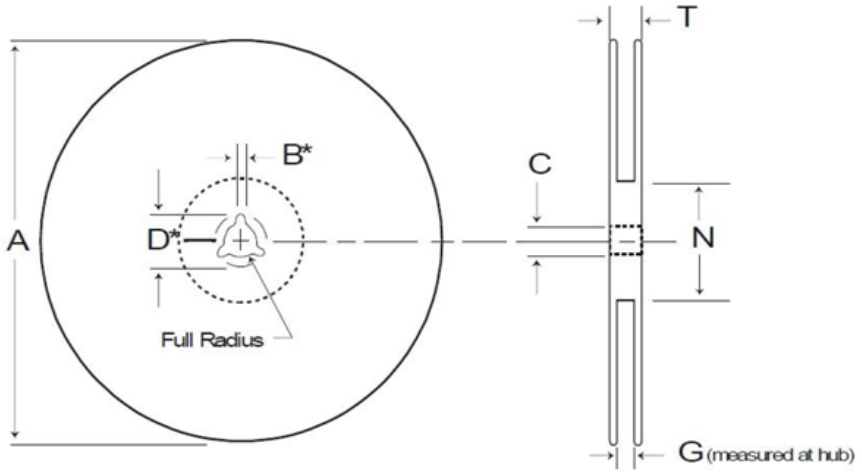
V-DFN3030-8 (Type R)



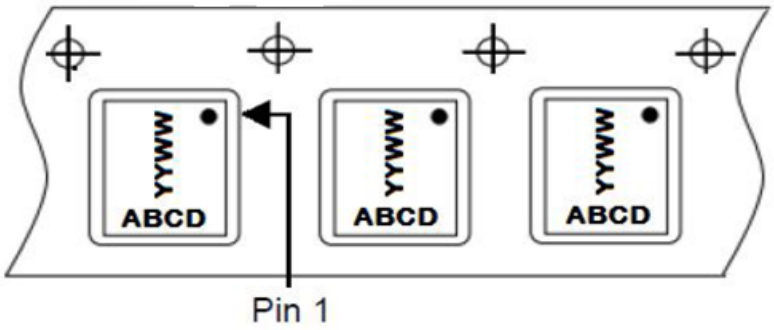
Dimensions	Value (in mm)
C	0.65
C1	1.30
C2	2.60
G	0.30
X	0.30
X1	1.60
X2	2.40
Y	0.40
Y1	1.60

Surface Mount Reel Specifications (All dimensions in mm.)

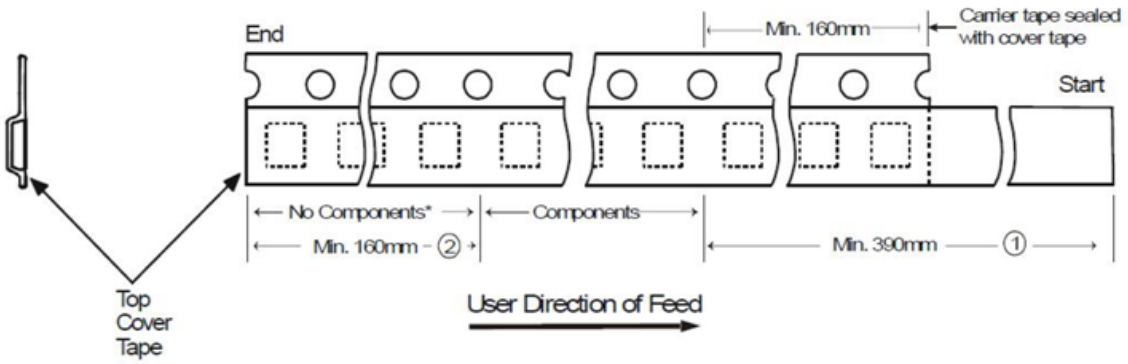
DML1006LDS-7



Tape Size	A Max	B* Max	C	D* Max	N Min	G	T Max
8mm	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



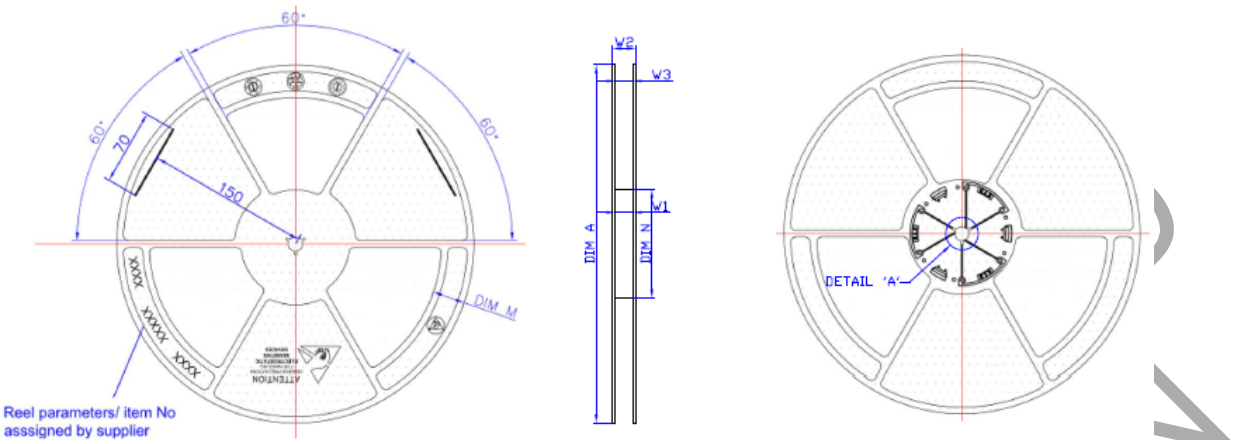
Tape Leader and Trailer



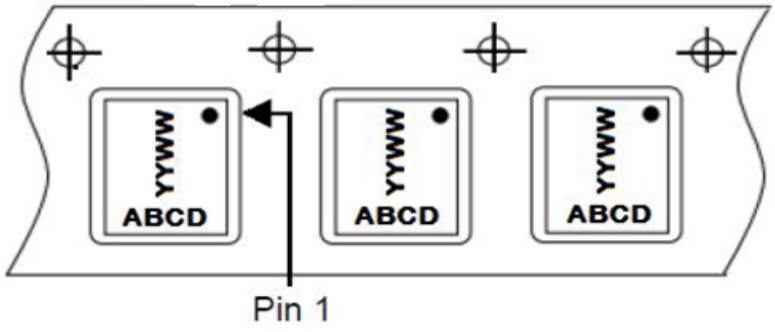
Notes:
1. There shall be a leader of 230mm [9.05 inches] minimum which may consist of carrier and/or cover tape or a start tape followed by a minimum of 160mm [6.30 inches] of empty carrier tape sealed with cover tape.
2. There shall be a trailer of 160mm [6.30 inches] minimum of empty carrier tape sealed 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 (All dimensions in mm.) (Continued)

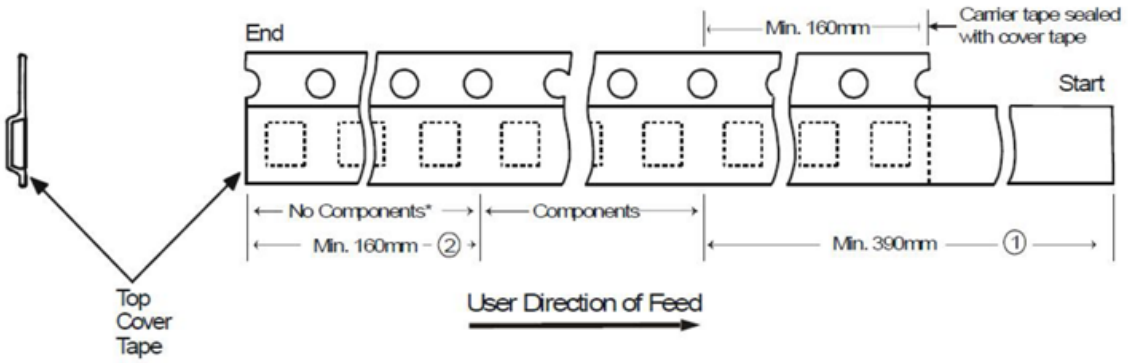
DML1006LDS-13



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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