LED Lighting Output Current Ripple Suppressor

REV. 00

General Description

The LD6801 is an output current ripple suppressor for LED lighting. It supports easy use at output terminal with isolation or non-isolation active PFC architecture with constant current.

The LD6801 is easy to achieve current ripple limitation with minimum output capacitance and built-in adjustable over voltage protection/ multi-level over current protection and internal clamp Zener diode could be used at wide range LED voltage application. The device is the SOT-26 package to minimize the PCB size well as component counts.
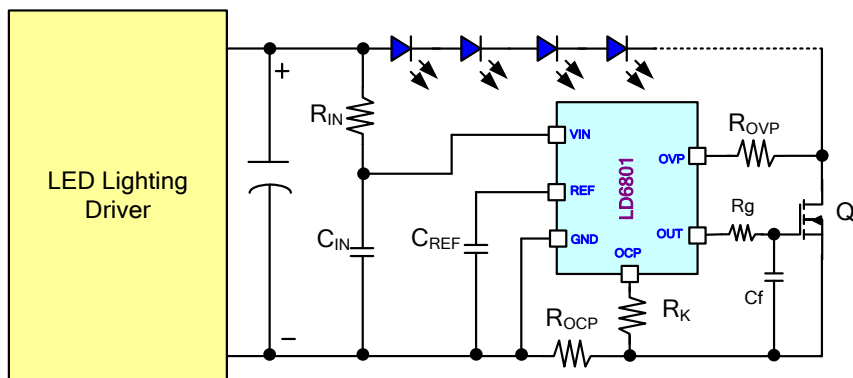
Features

- Controller for adaptive 100Hz/120Hz current ripple remover
- Built-in Zener diode for input voltage clamping
- 10V Output Voltage for MOSFET control
- Programmable amplitude of LED current ripple
- Programmable maximum cathode voltage of LED
- Programmable maximum LED current
- Output Short protection
- Over temperature protection
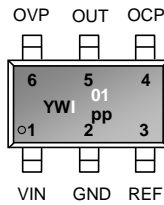- SOT23-6L Package

Applications

- LED Driver Application for Non-Ripple Current
- LED lighting

Typical Application

Pin Configuration

SOT-26 (TOP VIEW)

```
        OVP   OUT   OCP

         6     5     4
              01
        YW    pp
        ○1     2     3

        VIN   GND   REF
```

YY, Y   : Year code (D: 2004, E: 2005…..)
WW, W : Week code
PP   : Production code
I01   : LD6801

Ordering Information

Part number	Package	Top Mark	Shipping
LD6801 GL	SOT-26	LD6801 GL	3000 /tape & reel

The LD6801 is ROHS compliant/Green packaged.

Protection Mode

LED Short Protection	LED Open Protection	Internal OTP
Auto recovery	Auto recovery	Auto recovery

Pin Descriptions

Pin	NAME	FUNCTION
1	VIN	Power Supply for the device. Internal Zener Clamp for wide range LED light bar voltage. Connecting a RIN to LED anode for current limit and a capacitor to GND for filter out noise
2	GND	Ground
3	REF	LED Reference Voltage, It's essential to connect REF pin with a SMD ceramic capacitor to filter the 100/120Hz ripple.
4	OCP	LED current feedback and maximum LED current limit.
5	OUT	This pin connects the MOSFET gate to regulate LED current ripple.
6	OVP	Over voltage Protection for Short LED protection

Block Diagram
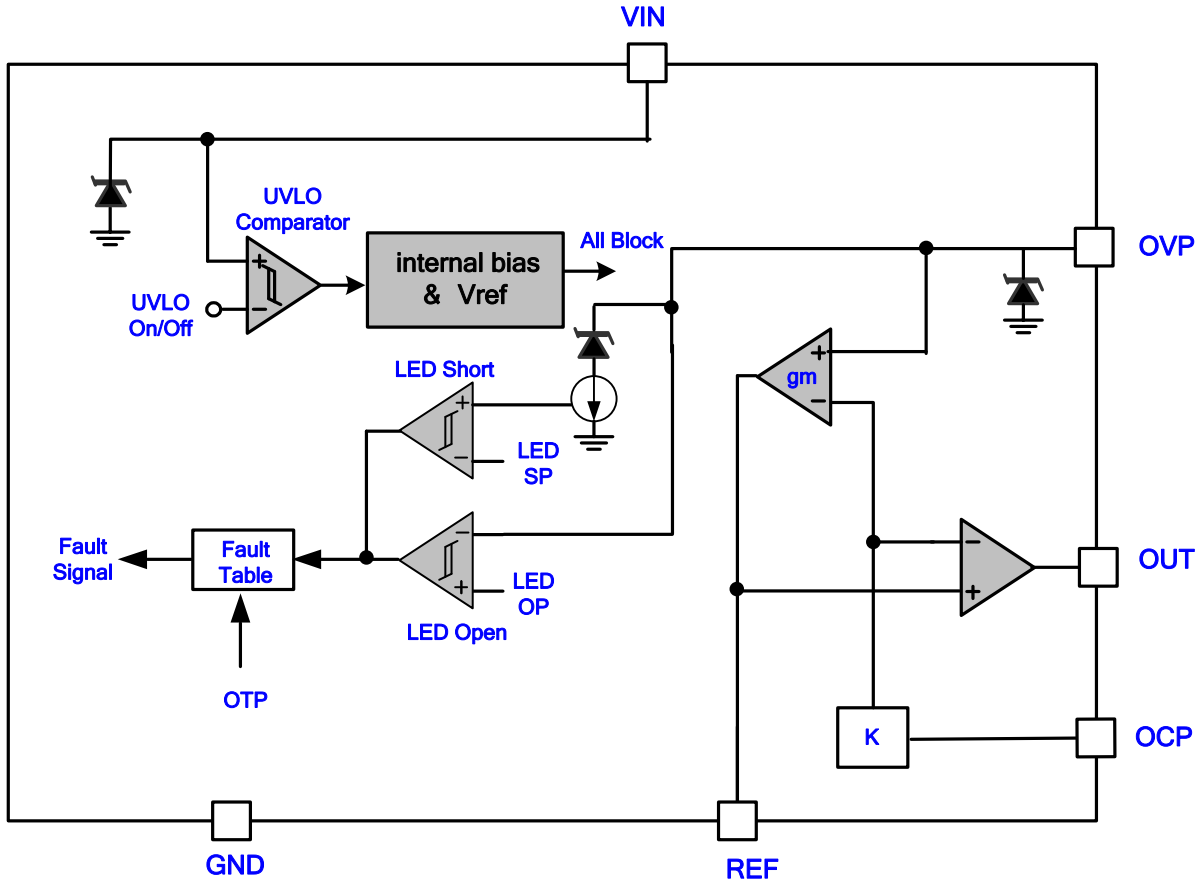
Absolute Maximum Ratings

VIN, OVP .... -0.3V ~ 30V

OCP, OUT .... -0.3V ~ 18V

REF .... -0.3V ~ 6V

Maximum Junction Temperature .... 150°C

Storage Temperature Range .... -65°C ~ 150°C

VIN Clamp Zener maximum current 2.4mA

Package Thermal Resistance (SOT-26, θ_{JA}) .... 200°C/W

Power Dissipation (SOT-26, Tj=125°C, Ta=85°C) 200mW

Lead temperature (Soldering, 10sec) .... 260°C

ESD Voltage Protection, Human Body Model 2.5KV

ESD Voltage Protection, Machine Model .... 250 V

Caution:

Stress exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stress above Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions

Item	Min.	Max.	Unit
Operating Junction Temperature	-40	125	°C
VIN Operation Range	10	30	V
VIN Sink Current	0.5	2	mA
VIN pin Filter Capacitor	22	220	nF
REF pin Capacitor to GND	0.1	1	μF

Note:

1. It's essential to connect VCC pin with a SMD ceramic capacitor (22nF~220nF) to filter out the undesired switching noise for stable operation. This capacitor should be placed close to IC pin as possible

2. The input resistor is limit VIN sink current under 2mA.

3. The REF pin capacitor should be placed close to IC pin as possible.

Electrical Characteristics

(V_{IN}=18V, T_A = 25°C unless otherwise specified.)

PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNITS
Supply Voltage (VIN Pin)						
VIN Clamp Voltage *	I_{IN_CLAMP}=2mA;	V_{IN_CLAMP}	29		33	V
Operating Current		I_{VIN}			500	μA
UVLO(OFF)		V_{UV_OFF}	7	8	9	V
UVLO(ON)		V_{UV_ON}	15.5	16.5	17.5	V
Gate Drive Output (OUT Pin)						
Maximum Output voltage		V_{OUT}	10	11	13	V
LED REFERENCE FILTER (REF Pin)						
VREF Clamp Voltage	Start Up and Protection mode	V_{REF_CLAMP}	3.2	3.6	3.9	V
VREF Maximum operation Voltage	Normal operation mode	V_{REF_MAX}	2.8	3	3.2	V
LED Reference Voltage to LED Current rate	R_K≤1K(+/-5%)	K_{10}	9.5	10	10.5	-
	R_K =51K(+/-5%)	K_{13}		13		-
	R_K = 100K(+/-5%)	K_{16}		16		-
Over Voltage Protection (OVP pin)						
OVP Pin Clamp Voltage		V_{OVP_CLAMP}		4		V
Short LED Protection Sink Current		I_{OVP}	35	40	45	μA
Short LED Protection Delay Time *		T_{ON_SHORT}		150		μS
Short LED Protection Reset Time *		T_{OFF_SHORT}		40		mS
LED Open Protection Threshold Voltage		V_{OVP_LOW}			100	mV
Internal OTP						
OTP Trip level *			110	130	150	$^\circ$C
OTP Hysteresis *				30		$^\circ$C

*: Guaranteed by Design.

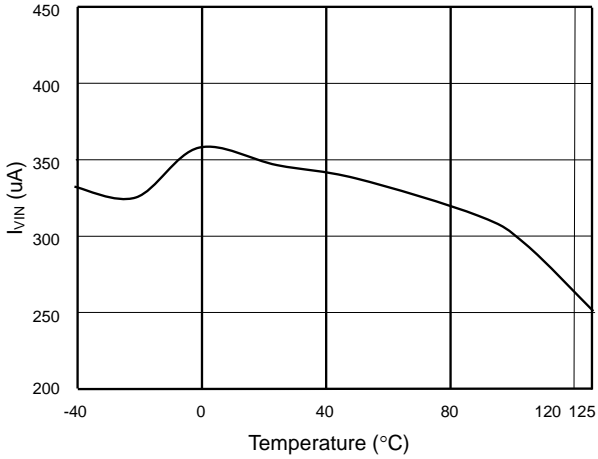# Typical Performance Characteristics

Fig. 1   I$_{VIN}$ vs. Temperature
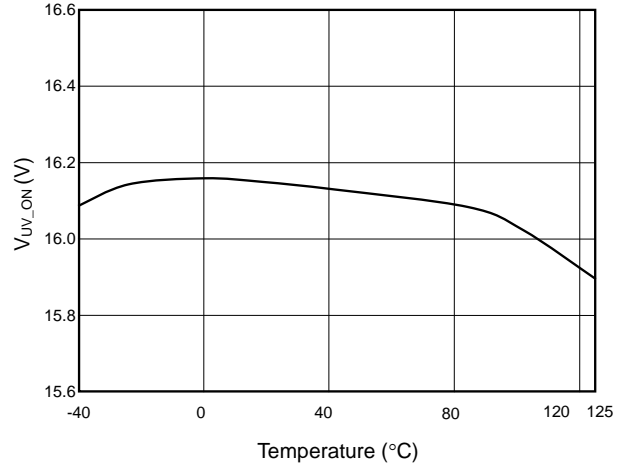
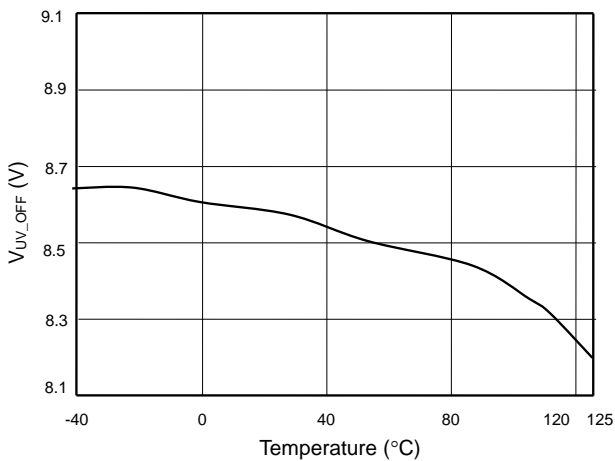
Fig. 2   V$_{UV\_ON}$ vs. Temperature

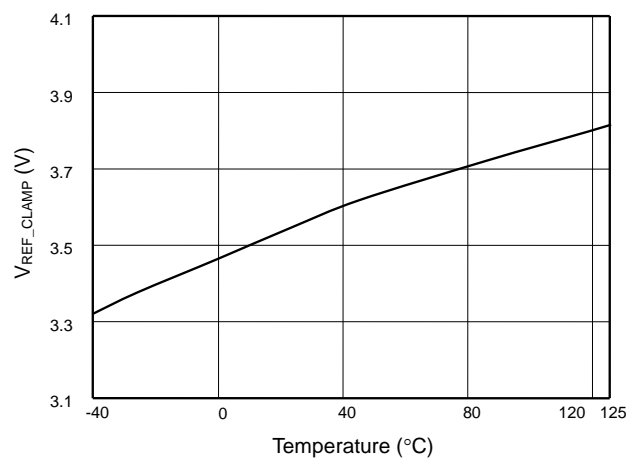Fig. 3   V$_{UV\_OFF}$ vs. Temperature
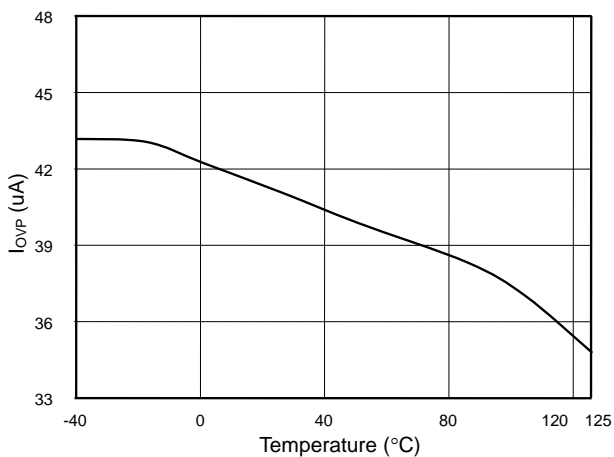

Fig. 4   V$_{REF\_CLAMP}$ vs. Temperature

Fig. 5   I$_{OVP}$ vs. Temperature

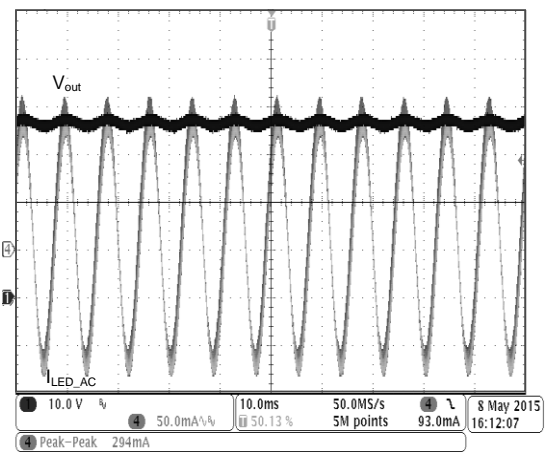Fig. 6   V$_{LED}$=36V,I$_{LED}$=1000mA,W/O LD6801

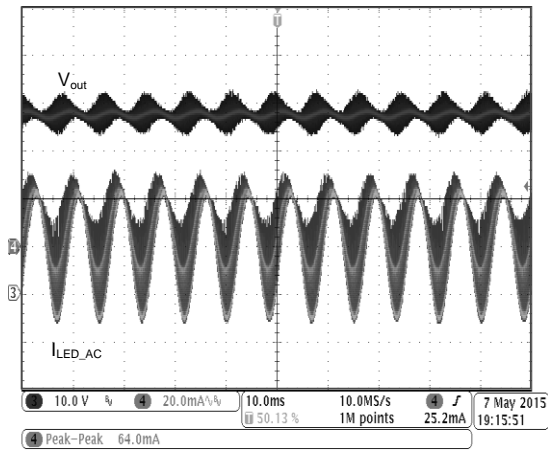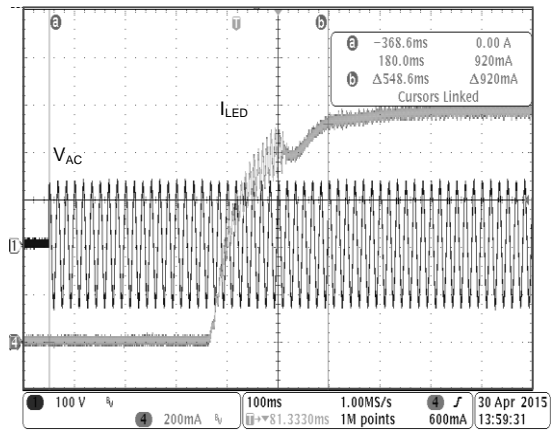Fig. 7   V_LED=36V,I_LED=1000mA,With LD6801

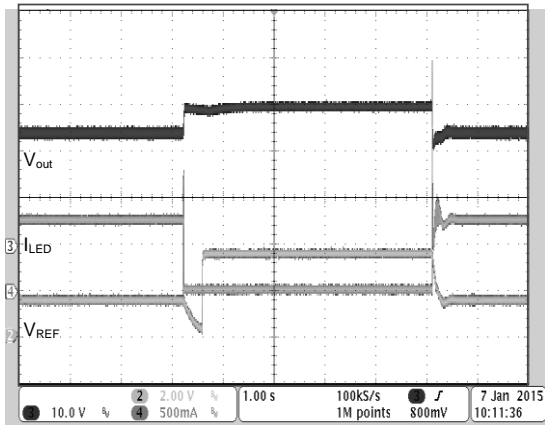Fig. 8   Power On @ 90VAC,With LD6801
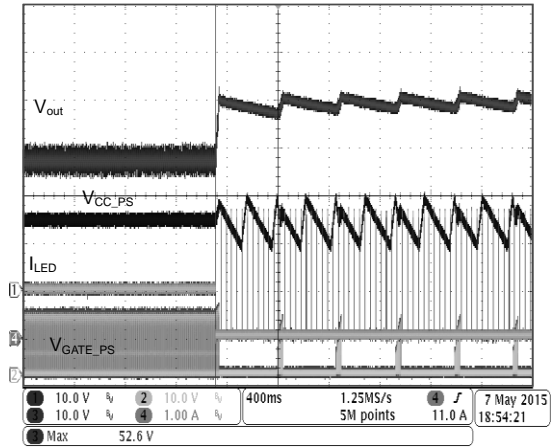

Fig. 9   LED Open Protection

Fig. 10   LED Short Protection

Application Information
Basic Description

LD6801 is an external MOSFET controller for LED lighting current ripple eliminated. The REF pin connection a filter capacitor to GND to suppressor the 100/120Hz LED current ripple. In the start-up process, the LD6801 charges the REF capacitor quickly to avoid LED voltage overshoot this time. And the device provide adjustable short LED string protection, LED string open protection and programmable over current limiting.

Theory of Operation

The LED light bar and LD6801 are both supplied by an AC/DC current source. The drain of external MOSFET is connected to the cathode of LED light bar. A sensing resistor R_{OCP} is connected between the source of MOSFET and GND. The gate is connected to the OUT pin of LD6801.

The LD6801 detects the OVP pin and OCP pin voltage to adjust C_{REF} Voltage and control the external MOSFET operate in saturation region. When external MOSFET working in the saturation region, the LED current ripple transfer to LED voltage on MOSFET. If the drain Voltage of external MOSFET break away saturation region, the LED current ripple suppressor will invalid naturally.

Reference Voltage to LED Current Ratio and LED Current Limit

There is K value ratio of the LED current and V_{REF} voltage. It provides stable voltage to let MOSFET be working in saturation Region and suppress LED current 100~120Hz ripple. The following table is the K value ratio setting.

R_K parameter (Ω)	K value ratio (V_{REF}/V_{OCP})
< 1k	10
45~58k	13
> 75k	16

The over current protection is regulation the LED current to limit threshold. The V_{REF} operation voltage is limited to 3V on REF pin. So that the LED limit current threshold is

$$V_{OCP} = I_{LED} * R_{OCP} = V_{REF} / K$$

The suggestion for normal LED operation current is 0.4~0.8 times LED limit current threshold. It avoids the larger LED current ripple to trigger over current limit protection or produce MOSFET thermal issue.

LED String Open Protection

When OVP pin voltage and REF Voltage is under 0.2V. The LD6801 would be go to LED open stage and OUT pin and V_{REF} voltage pull high until the LED string reply connection.

LED string Short Protection

Fig. 11 is the function block of LED short protection. If OVP pin voltage larger than 4V and in condition of $I_{OVP} >$ 40uA and continuous 150uS around, the LD6801 would be turn off MOSFET until 40mS around. Then, the Over voltage protection state is reset.

The programed over voltage protection calculated as below:

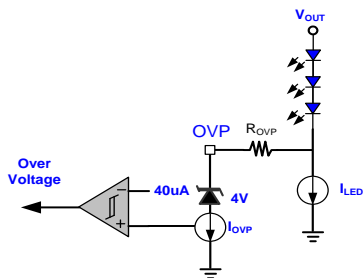$$V_{OVP\_TH} = 4V + (R_{OVP} * 40\mu A)$$

Fig. 11

VIN Zener Clamp and RIN Selection

The LD6801 support wide range LED light bar application that integrated Zener diode which is about 2mA sink current and V_{UV_ON} is to 16V. So the value of R_{IN} that is connected between V_{LED} and V_{IN} of LD6801, we can be calculated as below:

$$(V_{LED\_MIN} - V_{UV\_ON}) / 0.5mA > R_{IN}$$

And $\quad R_{IN} > (V_{LED\_MAX} - V_{IN\_CLAMP}) / 2mA$

Where V_{LED} is a terminal voltage of LED light bar

Internal Thermal protection

Thermal protection limits total power dissipation in this device. When the junction temperature reaches 130°C approximately, The LD6801 would be turn off the MOSFET until the IC's junction temperature cools down approximately 30°C.

PCB Design Guideline

1. The bypass capacitor of V_{IN} should be placed as close as possible to the V_{IN} and GND pin of IC.

2. LD6801 should be placed near to the external MOSFET

3. To consider temperature requirement, we need add PCB pad or heat sink be to fit system spec.

4. The area of LED current loop should be as small as possible

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Package Information

SOT-26
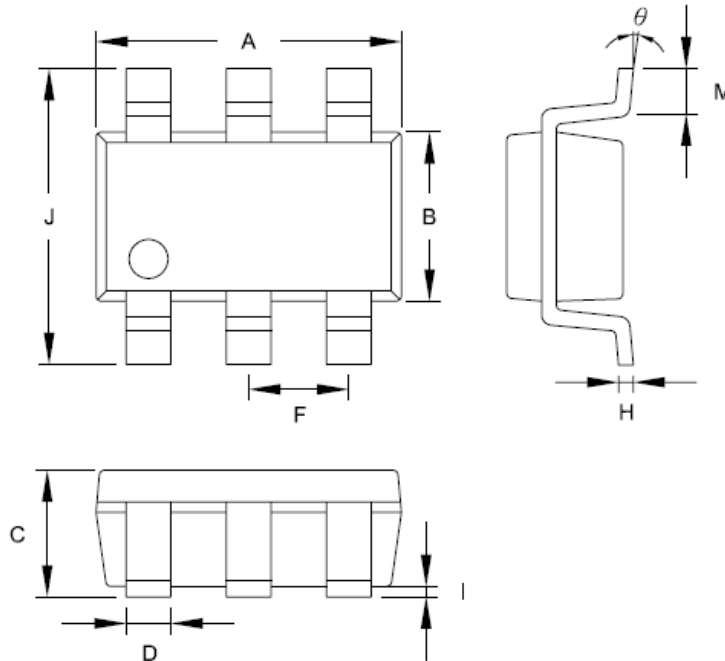
Symbol	Dimension in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	2.692	3.099	0.106	0.122
B	1.397	1.803	0.055	0.071
C	-------	1.450	-------	0.057
D	0.300	0.500	0.012	0.020
F	0.95 TYP		0.037 TYP	
H	0.080	0.254	0.003	0.010
I	0.050	0.150	0.002	0.006
J	2.600	3.000	0.102	0.118
M	0.300	0.600	0.012	0.024
Θ	0°	10°	0°	10°

Important Notice

Leadtrend Technology Corp. reserves the right to make changes or corrections to its products at any time without notice. Customers should verify the datasheets are current and complete before placing order

Revision History

REV.	Date	Change Notice
00	07/28/2016	Original Specification.

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