普誠科技股份有限公司
Princeton Technology Corp.
Tel: 886-2-66296288
Fax: 886-2-29174598
URL:http://www.princeton.com.tw

DESCRIPTION

PT6901 is a PWM high brightness LED driver control IC. The output current can be programmed between a few milliamps and up to more than 1.0A. It allows efficient operation of driver current up to more than 1A output, and the input range is from 8V to 18V. PT6901 controls the external MOS at fixed switch frequency up to 300KHz. PT6901 drive a single or multiple series LEDs at a constant-current control method; thus, providing constant current light output and enhanced reliability.

The functions of linear and PWM dimming are included. Output current to LED string can be programmed to any value between 0 to its maximum value at the linear dimming control input of PT6901. PT6901 provides a low-frequency PWM dimming input that can accept an external control signal with a duty cycle of 0~100% and a frequency between 100Hz and a few KHz.

FEATURES

- >85% Efficiency
- 8V to 18V input range
- Constant –Current Driver
- Applications from a few mA to more than 1A LED driver
- LED string from one to hundreds diodes
- PWM low-frequency dimming and linear Dimming

APPLICATIONS

- DC/DC or AC/DC LED Driver
- Backlighting LED driver
- Constant –Current Driver
- Charger

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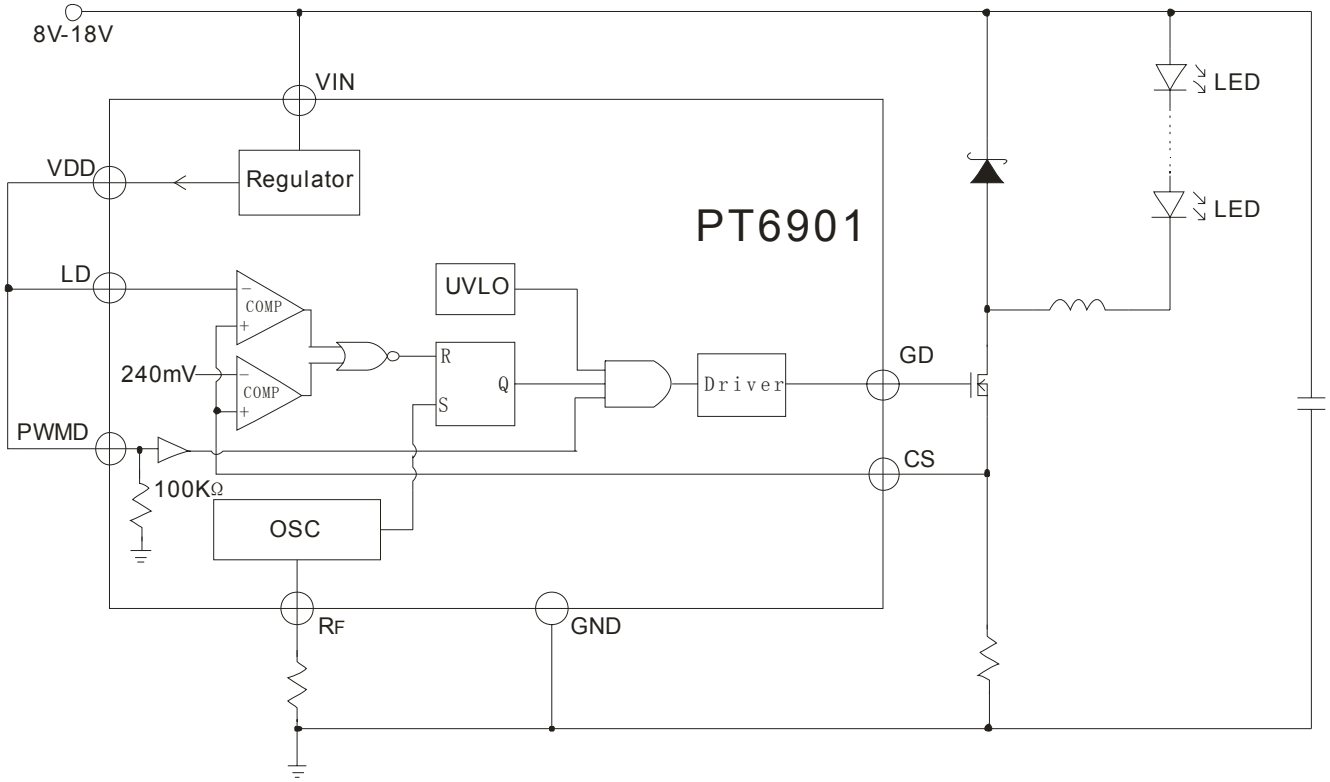
BLOCK DIAGRAM



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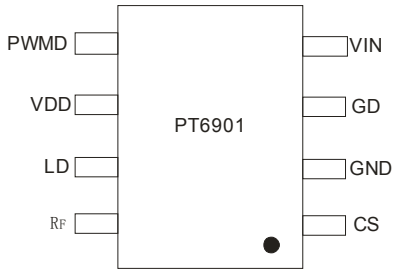
PIN CONFIGURATION

8 PINS, SOP



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PIN DESCRIPTION

Pin Name	Description	Pin No.
CS	Senses LED string current	1
GND	Ground	2
GD	Drives the gate of external MOSFET	3
VIN	Input voltage 8V-18V DC	4
PWMD	Low frequency PWM dimming pin, also enable pin	5
VDD	Internal regulated voltage	6
LD	Linear dimming	7
RF	Oscillator frequency control	8

FUNCTION DESCRIPTION

LED DRIVER OPERATION

PT6901 can control all basic types of converters. When the GD via the external power MOSFET, the LED driver stores the input energy in an inductor or delivers the energy directly to LEDs (depending on the application circuit). The sampling resistor that connects to CS pin controls the maximum value of LED current. When the voltage at CS pin exceeds the internally set, 240mV threshold, the power MOSFET turns off. It can be programmed externally by applying voltage to the LD pin that will be limited the LED maximum current. When soft start is required, a capacitor can be connected to the LD pin to allow the voltage to ramp at a desired rate.

SETTING LIGHT OUTPUT

The peak CS voltage is a good representation of the average current in the LED. There is a certain error when the peak-to-peak current is exceeded to the average current. In order to get the accurate average current, the resistor of CS pin has to figure as the following:
If the peak-to-peak ripple current in the inductor is 100mA, to get a 300mA LED current, the sense resistor should be:
R_{CS}=240mV/(300mA+100mA/2)=0.68Ω

DIMMING

PT6901 can be controlled in two methods: Linear or PWM. The linear dimming can be implemented by applying a control voltage from 0 to 240mV to the LD pin. When the LD voltage underrides the internal set 240mV threshold, the internal clamp voltage, 240mV, is terminated. And when it overrides the internally set 240mV threshold, the LD control voltage is dead.
The PWM dimming scheme can be implemented by external low frequency PWM signal to the PWMD pin. By using the duty cycle of the PWM control method that can change the working and the closing time, and the light output can be adjusted between zero and the internal set. In addition, the PWM dimming method is limited because the output current cannot be exceeded the internal set.

PROGRAMMABLE OPERATING FREQUENCY

The operating frequency of the oscillator is programmed between 30KHz to 300KHz.

$$\text{fosc} = \frac{2.5 \text{ x } 10^{10}}{\text{R}_\text{F}}$$

ENABLE

PT6901 can be turned off by pulling the PWMD to GROUND. When disabled, PT6901 draws quiescent current of less than 0.5mA.

AC/DC OFF-LINE APPLICATIONS

PT6901 is a low-cost buck converter control IC that designs for driving multi-LED strings or arrays. It can operate from either universal AC line or DC voltage via the change of application current. PT6901 can drive up to hundreds of HB LEDs.

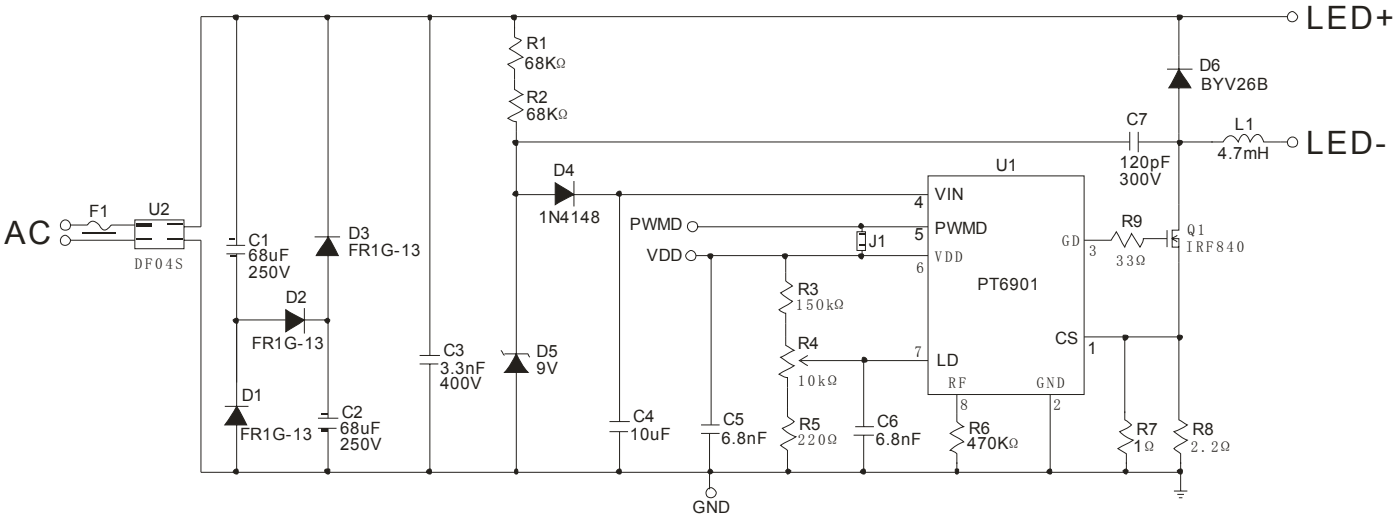

Figure 1. Typical AC application for a string of 16 HB LEDs

POWER FACTOR CORRECTION

When the input power to the LED driver does not exceed 25W, a simple passive power factor correction (PFC) circuit can be added to the application circuit of figure 1. A simple circuit consists of PFC to improve the line current harmonic distortion and to achieve a power factor greater than 0.85.

DC/DC LOW VOLTAGE APPLICATIONS

BUCK CONVERTER OPERATION

When the LED string voltage is needed to be lower than the input supply voltage, the buck power conversion topology can be used. The basic design procedure for a buck LED driver outline in the previous chapter, but the application of the output voltage must be maintain lower than two times of the input voltage. With this limitation, PT6901 buck converter enables to operate at a duty cycle less than 0.5 to avoiding an oscillation of the output current at a sub-harmonic of the switching frequency.

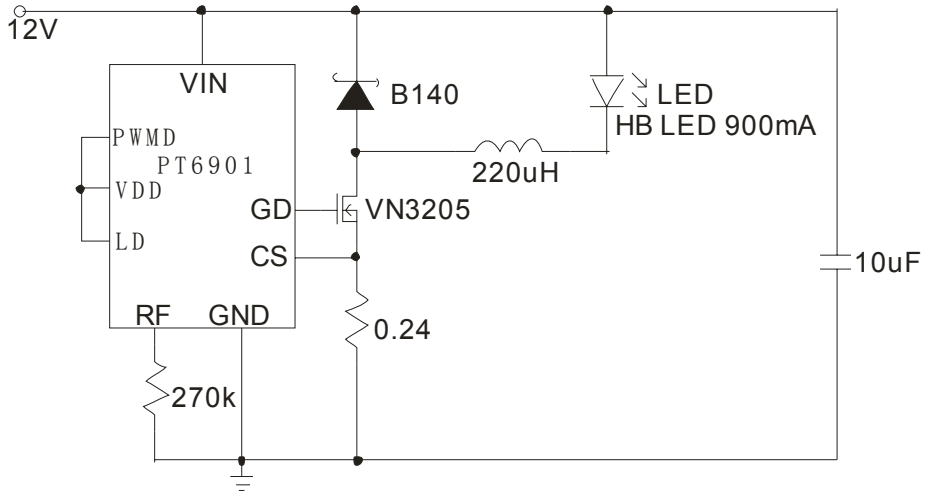

Figure 2. PT6901 Buck Driver for a Single 900mA HB LEDs

Inductor Design

Referring to figure 2, when the nominal current I_{LED} is 900mA with one 5W LED, the peak-to-peak current is 20% of average current**.** So, the sense resistor is:

$$R_{CS} = \frac{240mV}{I_{AVG} + I_{PP}/2} = \frac{240mV}{900mA + 900mA * 0.2/2} \approx 0.24\Omega$$

When the I_{LED} is 900mA, the forward drop voltage of LED is about 4.5V. Knowing the nominal input voltage is 12V, the switching duty cycle is :

$$D = \frac{V_{LED}}{V_{IN}} = \frac{4.5}{12} \approx 0.38$$

If the oscillation frequency is 100KHz, the required off-time of MOSFET transistor can be calculated:

$$T_{OFF} = (1-D)/f_{osc} = (1-0.38)/100k = 6.2uS$$

The required value inductor is given by

$$L = (V_{LED} + V_D) \cdot T_{OFF} / I_{PP} = (4.5 + 0.4) \times 6.2u / (0.2 \times 900m) \approx 170uH$$

The nominal application is 220μH, because the value of inductor is greater than the calculation.

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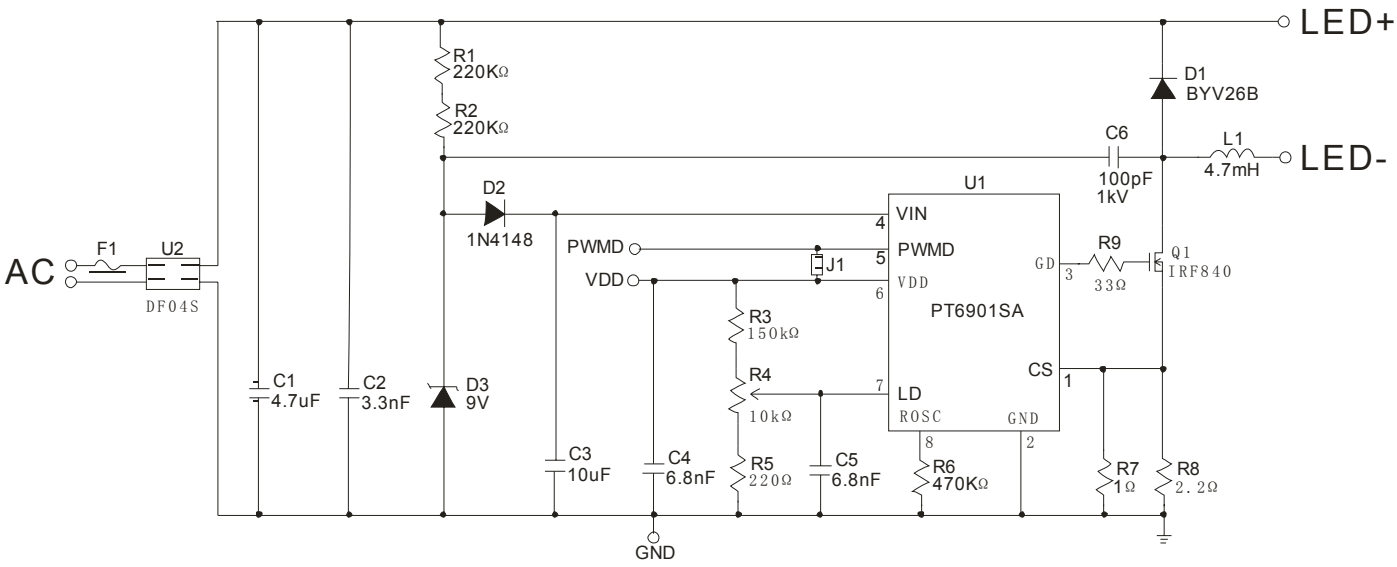
TYPICAL APPLICATION



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ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
VIN to GND		-0.3 ~ +20	V
CS to GND		-0.3 ~ VDD+0.3	V
LD, PWMD to GND		-0.3 ~ VDD+0.3	V
OSC to GND		-0.3 ~ VDD+0.3	V
VDD to GND		-0.3 ~7	V
Operating temperature	Topr	-40 ~ +85	℃
Storage temperature	Tstg	-65 ~ +150	℃

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ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=25℃)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input DC supply voltage	VIN	DC input voltage	8	12	18	V
Internal regulated voltage	VDD	VIN=8~18V, IDD(ext)=0, pin GD open	4.6	5	5.4	V
VDD source current	I_{VDD}	VIN=12V			10	mA
RF voltage	V_{RF}	VIN=8~18V,R_{RF}=270kΩ	1.18	1.21	1.24	V
Active supply current	I_{IN}	VIN=8~18V		0.4	0.6	mA
Shut-down supply current	I_{INsd}	Pin PWMD to GND, VIN=12V		0.3	0.5	mA
VIN start voltage	V_{ST}	VIN rising	6.3	6.9	7.5	V
VIN under voltage lockout hysteresis	V_{HYS}	VIN falling	500	700	900	mV
Pin PWMD input low voltage	V_{ENL}	VIN=8~18V			0.5	V
Pin PWMD input high voltage	V_{ENH}	VIN=8~18V	1.5			V
Pin PWMD pull-down resistance	R_{EN}	VPWMD=5V	70	100	130	KΩ
Current sense threshold voltage	V_{CS}	Ta=-40~+85℃	220	240	260	mV
GD high output voltage	V_{GDH}	IOUT=10mA	VDD-0.2			V
GD low output voltage	V_{GDL}	IOUT=10mA			0.2	V
Oscillator frequency	fosc	RF=270KΩ	80	100	120	KHz
Maximum oscillator PWM duty cycle	D_{MAX}	FPWM=100KHz, at CS to GND			100	%
Linear dimming pin voltage range	V_{LD}	VIN=12V	0		240	mV
Current sense blanking internal	T_{BLANK}	VCS=0.55VLD, VLD=VDD	200	400	600	ns
GD output rise time	T_{RISE}	CGD=560pF		30	50	ns
GD output fall time	T_{FALL}	CGD=560pF		30	50	ns

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ORDER INFORMATION

Valid Part Number	Package Type	Top Code
PT6901-S	8 Pins, SOP	PT6901-S
PT6901-S (L)	8 Pins, SOP	PT6901-S

Notes:
1. (L), (C) or (S) = Lead Free.
2. The Lead Free mark is put in front of the date code.

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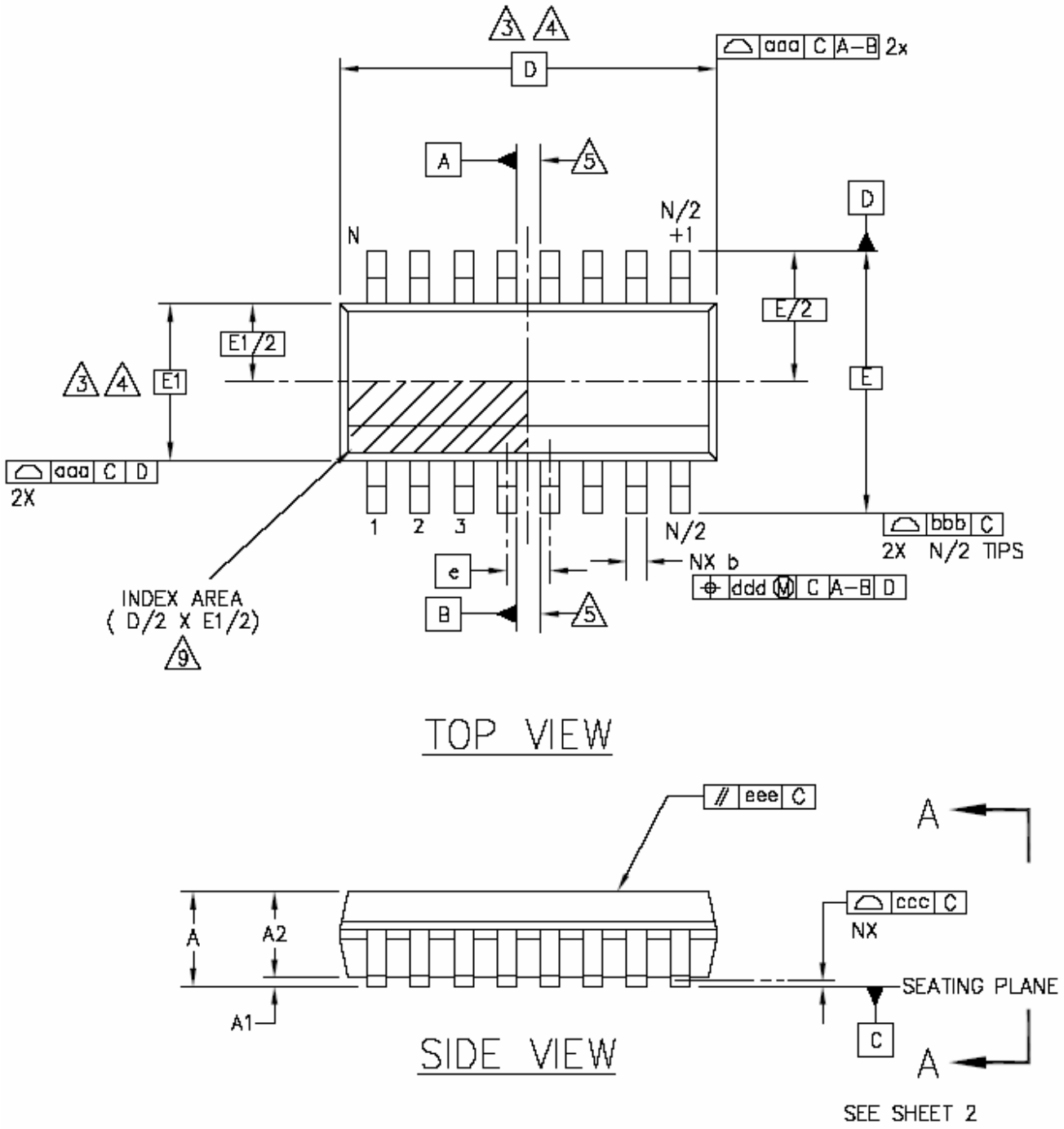
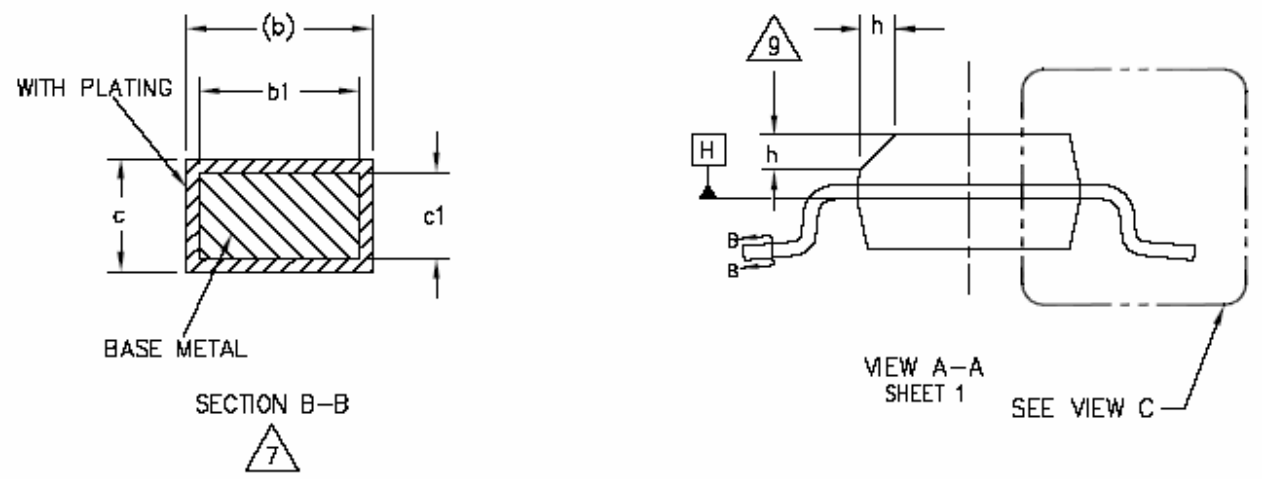
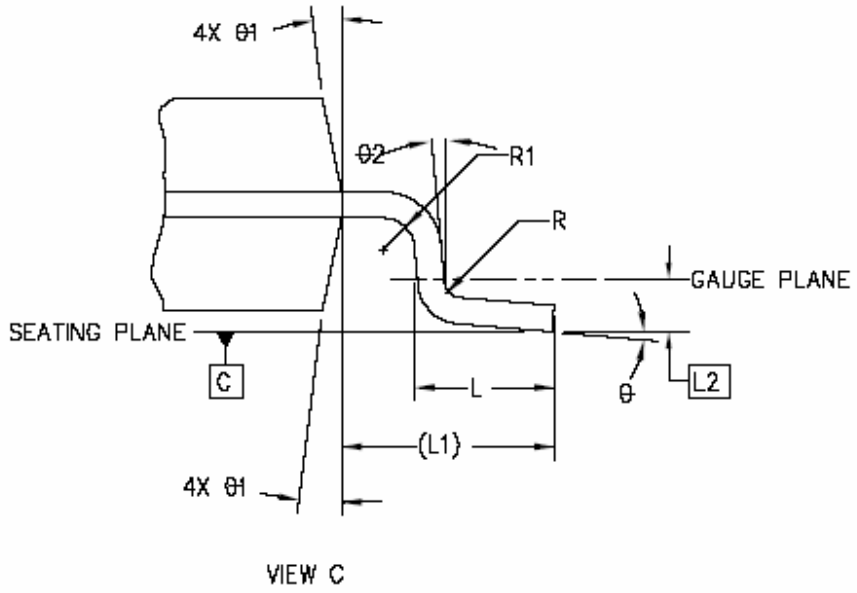
PACKAGE INFORMATION

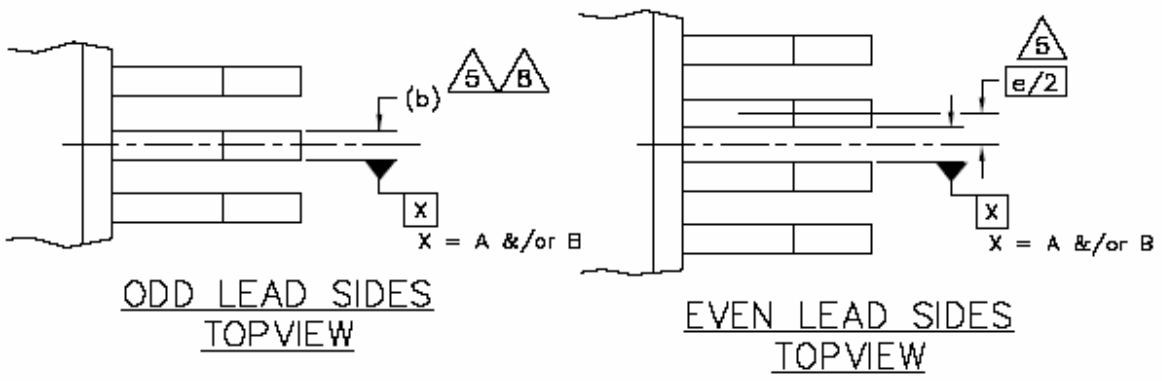
8 PINS, SOP, 150MIL




(b)
WITH PLATING
b1
c
c1
BASE METAL
SECTION B–B
7
g
h
H
h
B
B
VIEW A–A
SHEET 1
SEE VIEW C


4X θ1
θ2
R1
R
GAUGE PLANE
SEATING PLANE
C
L
θ
L2
(L1)
4X θ1

VIEW C


(b)
5
B
X
X = A &/or B
ODD LEAD SIDES
TOPVIEW
5
e/2
X
X = A &/or B
EVEN LEAD SIDES
TOPVIEW

Symbol	Min.	Typ.	Max.
A	1.35	-	1.75
A1	0.10	-	0.25
A2	1.25	-	1.65
b	0.31	-	0.51
b1	0.28	-	0.48
c	0.17	-	0.25
c1	0.17	-	0.23
D	4.90 BSC.		
E	6.00 BSC.		
E1	3.90 BSC.		
e	1.27 BSC.		
L	0.40	-	1.27
L1	1.04 REF.		
L2	0.25 BSC.		
R	0.07	-	-
R1	0.07		-
h	0.25	-	0.50
θ	0°	-	8°
θ1	5°	-	15°
θ2	0°	-	-

Notes
1. Dimensioning and tolerancing per ANSI Y 14.5M-1994
2. Controlling Dimension: MILLIMETERS.
3. Dimension D does not include mold flash protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm (0.006 in) per end. Dimension E1 does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25mm per side. D and E1 dimensions are determined at datum H.
4. The package top may be smaller than the package bottom. Dimensions D and E1 are determined at the outermost extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.
5. Datums A & B to be determined at datum H.
6. N is the number of terminal positions. (N=8)
7. The dimensions apply to the flat section of the lead between 0.10 to 0.25mm from the lead tip.
8. Dimension “b” does not include dambar protrusion. Allowable dambar protrusion shall be 0.10mm total in excess of the “b” dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot.
9. This chamfer feature is optional. If it is not present, then a pin 1 identifier must be located within the index area indicated.
10. Refer to JEDEC MS-012, Variation AA.
    JEDEC is the registered trademark of JEDEC SOLID STATE TECHNOLOGY ASSOCIATION.

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REVISION HISTORY

Date	Revision #	Reference #	Remarks
June, 26, 2006	-	PT6901 REF1.0	Request #: