普誠科技股份有限公司
Princeton Technology Corp.
Tel: 886-2-66296288
Fax: 886-2-29174598
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DESCRIPTION

PT6903 is a PFM high brightness LED driver control IC. It allows efficient operation of driver current up to 1.0A output, and the input range is from 7V to 36V. Moreover, PT6903 controls the internal MOS at a modulated switch frequency up to 1MHz. PT6903 drives a single or multiple series LEDs at a constant-current control method; thus, providing constant current light output and enhanced reliability.

PT6903 has linear and PWM dimming functions. Output current to an LED string can be programmed to any value between its minimum value to its maximum value at the linear dimming control input of PT6903. PT6903 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

- >90% Efficiency
- 7V to 36V input range
- Constant Current Driver
- Applications up to 1.0A
- Linear & PWM Dimming
- Thermal Shutdown Protection

APPLICATIONS

- DC/DC LED Driver
- Industrial LED Lighting
- Replacement of halogen lamp
- Decorative Lighting

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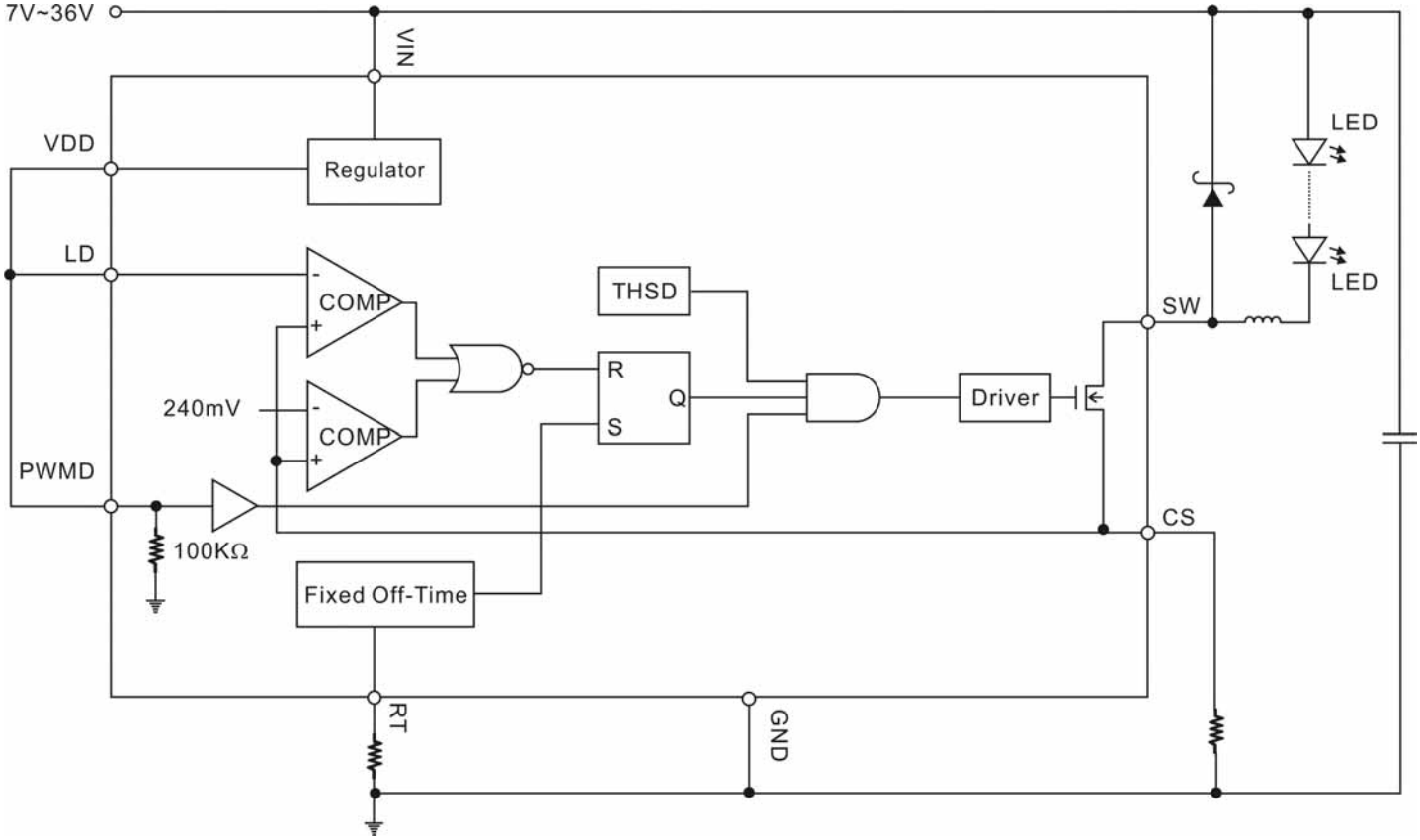
BLOCK DIAGRAM



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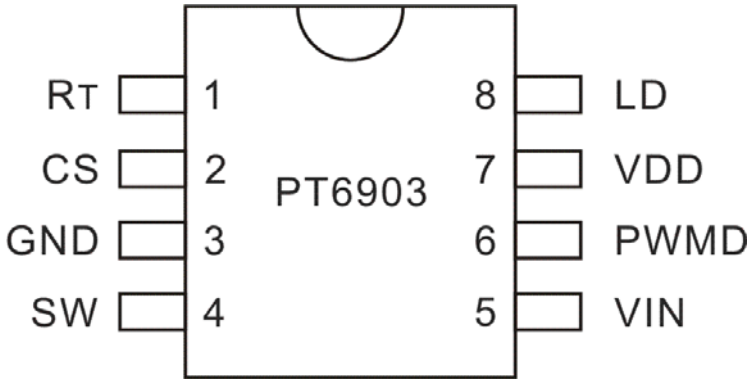
PIN CONFIGURATION

8 PINS, SOP



PIN DESCRIPTION

Pin Name	Description	Pin No.
RT	Fixed Off-Time Control Resistor	1
CS	Senses LED string current	2
GND	Ground	3
SW	Switch PIN	4
VIN	Supply Voltage	5
PWMD	PWMD Dimming & Shutdown	6
VDD	Internal Regulated Voltage	7
LD	Linear Dimming	8

FUNCTION DESCRIPTION

LED DRIVER OPERATION

When the internal power MOSFET switching, the LED driver stores the energy into the inductor or may deliver 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, the internal power MOSFET turns off. The power MOSFET is forced to turn-off at a fixed Off-Time. The Off-Time can be changed by external resistor RT. PT6903 can work in high frequency, but we recommend the operation frequency is between 30kHz and 1MHz.

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

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 internal 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 FIXED OFF-TIME

The fixed off-time can be changed by external resistor RT.

$$T_{OFF} = 12.5 \times 10^{-12} \times R_T$$

So, the operation frequency can be calculated by following relation:

$$f = \frac{V_{IN} - V_{LED} - V_{DS}}{12.5 \times 10^{-12} \times R_T \left(V_{IN} + V_D - V_{DS}\right)}$$

VIN	VLED	VDS	VD
Input Voltage	LED(s) Voltage	SW Voltage when NMOS Turned-On	Schottky Diode Forward Voltage

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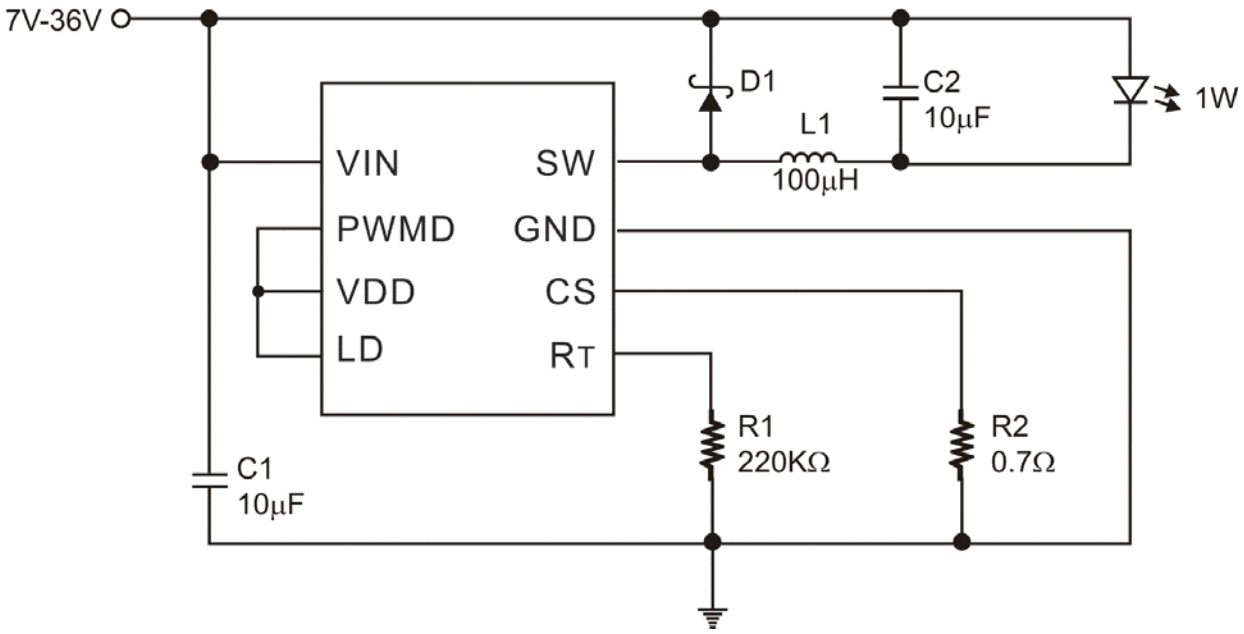
DC/DC LOW VOLTAGE APPLICATIONS

BUCK CONVERTER OPERATING

When PT6903 works in buck-mode, the total forward-voltage of LED(s) should be lower than input voltage about 2V at least.



Typical buck driver for a 1W HB LED (VIN=7V-36V)

Inductor Design

Referring to the figure of typical buck driver for a 1W HB LED at above, the forward voltage of 1W LED is about 3.3V and the average current is about 300mA. We assume that the peak-to-peak current is about 100mA. When input voltage is 12V, we can calculate that:

the fixed off-time is

$$T_{OFF} = 12.5\times10^{-12}\times R_T = 12.5\times10^{-12}\times 220k = 2.75uS$$

$$L = \frac{(V_{LED}+V_D)\times T_{OFF}}{di} = \frac{(3.3+0.4)\times 2.75u}{100m} = 104uH$$

The nominal application is100μH.

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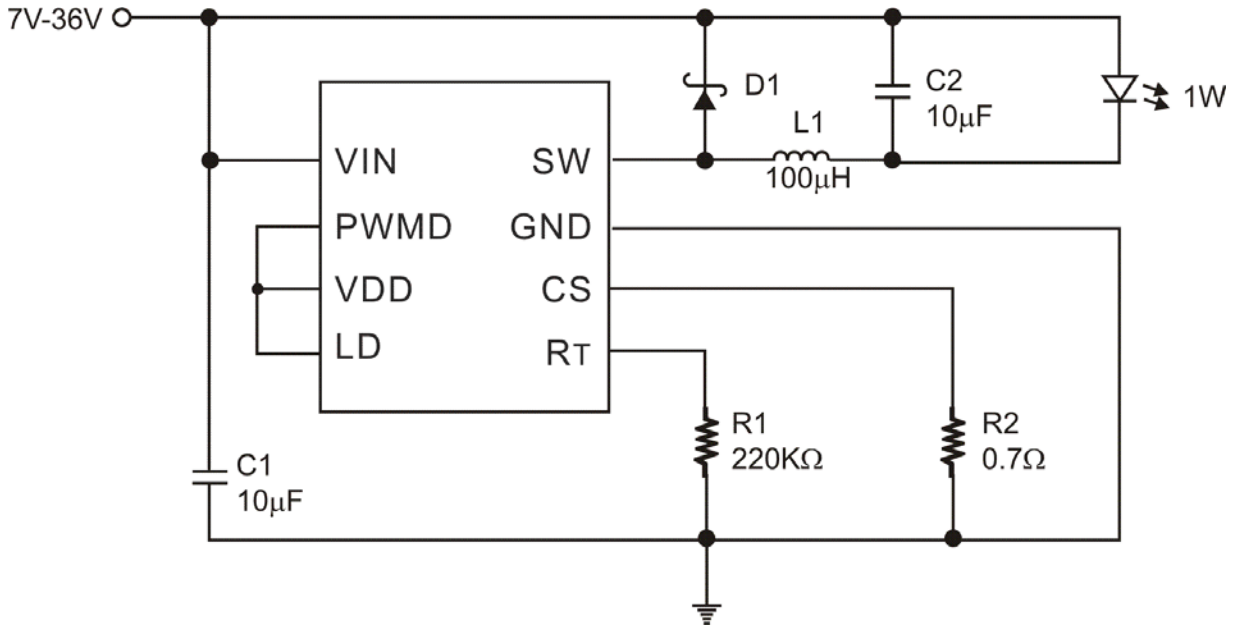
TYPICAL APPLICATION



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ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
R_T to GND	R_T	-0.3 ~ +6	V
CS to GND	CS	-0.3 ~ +0.6	V
SW to GND	SW	-0.3~+40	V
VIN to GND	VIN	-0.3 ~ +40	V
PWMD to GND	PWMD	-0.3 ~ +6	V
VDD to GND	VDD	-0.3 ~ +6	V
LD to GND	LD	-0.3 ~ +6	V
Operating temperature	Topr	-40 ~ +85	℃
Storage temperature	Tstg	-65 ~ +150	℃

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=25℃)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input DC supply voltage	VIN	DC input voltage	7	24	36	V
Active supply current	I_{IN}	VIN=7~36V		0.8	1.5	mA
SW sink current	I_{SW}	VIN=24V			1	A
Current sense threshold voltage	V_{CS}	Ta=-40~+85℃	220	240	260	mV
PWMD pull-down resistor	R_{PWMD}		70	100	130	kΩ
Thermal shutdown temperature	T_{SD}			140		℃
Hysteresis temperature	T_{HYS}			25		℃
R_T voltage	V_{RT}	VIN=24V, R_T=56KΩ	1.16	1.18	1.20	V
VDD voltage	VDD	VIN=12V	4.5	4.8	5.1	V
Fixed Off-Time	T_{OFF}	VIN=24V, R_T=220KΩ	2.4	2.8	3.2	uS
Internal NMOS Turn-On resistor	R_{ON}	VIN=24V		1		Ω
SW leakage current	I_{SW_LC}	VIN=24V, VSW=36V			0.1	uA

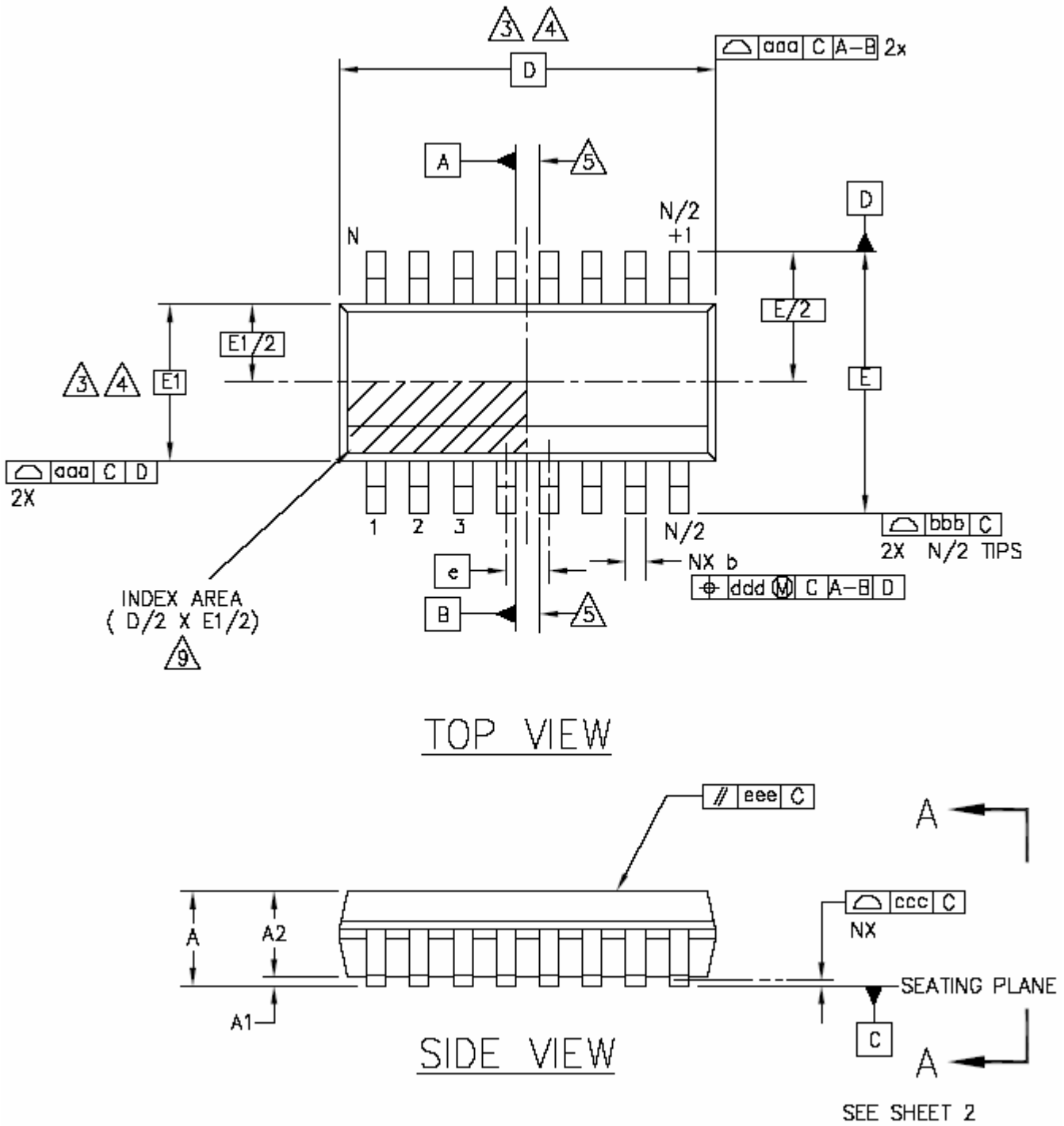
ORDER INFORMATION

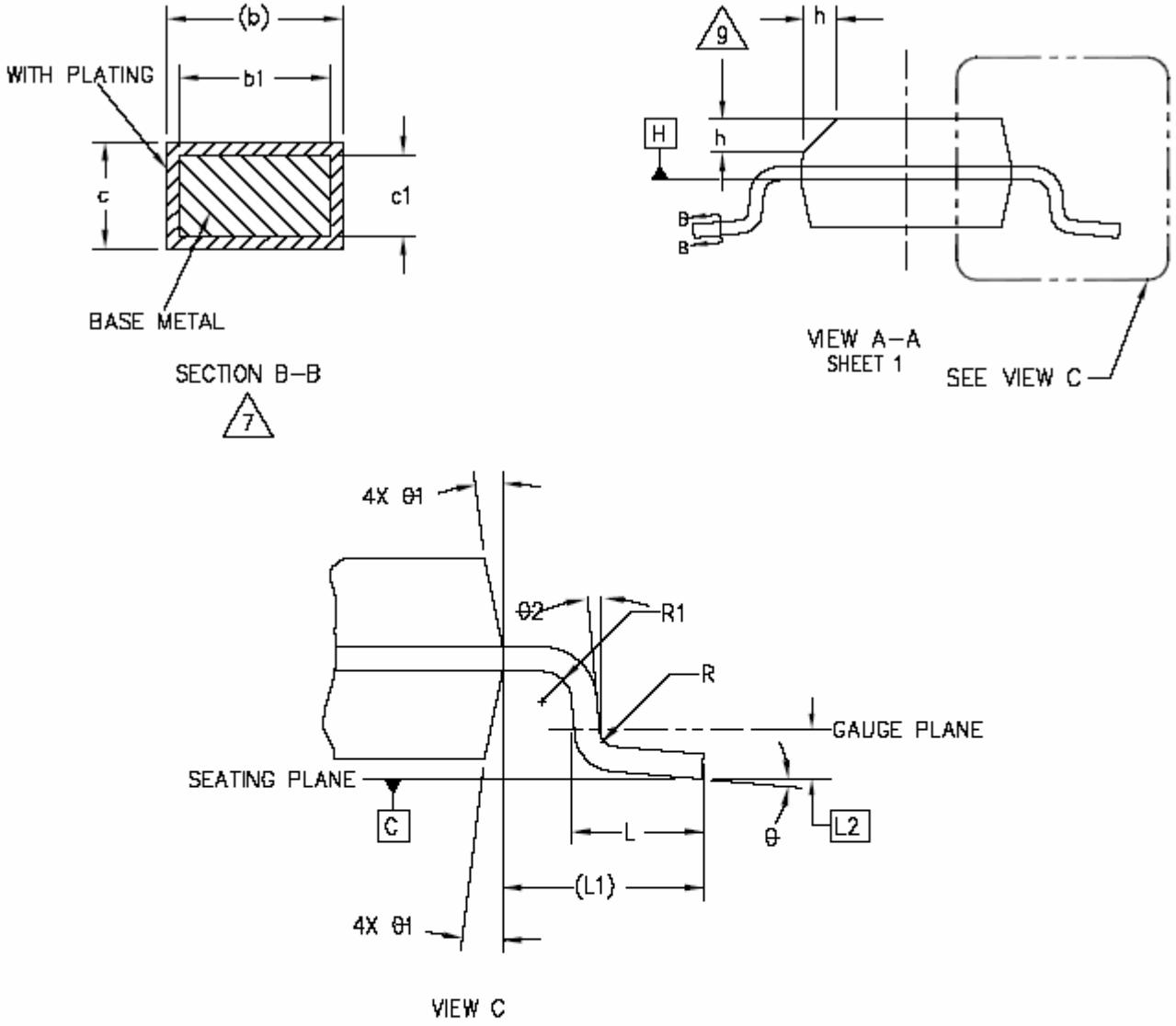
Valid Part Number	Package Type	Top Code
PT6903-S (L)	8 Pins, SOP, 150MIL	PT6903-S

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

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.
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