APFC Buck LED Power Switch

FEATURES

- Active Power Factor Correction
- High PF Value >0.9
- Integrated 650V high voltage power supply circuit

- High Output Current Accuracy<±3%
- Built-in 500V MOSFET and Startup Circuit
- No VDD, COMP Capacitor Design
- Programmable OVP
- QR Operation Mode for High Efficiency
- Ultra-low Operation Current
- Good Line and Load Regulation
- Built-in Protections:
  - Output Over Voltage Protection(OVP)
  - Input Over Voltage Protection
  - Cycle by Cycle Current Limit (OCP)
  - Leading Edge Blanking(LEB)
  - LED Open and Short Protection
  - Thermal Fold-back (OTP)
- Package Available with SOP-7 and DIP7

APPLICATIONS

- LED Driver

GENERAL DESCRIPTION

DP9026X is a family of highly integrated Constant Current LED power switch. The IC utilizes Quasi-Resonant (QR) Buck topology with active PFC control for high PF, low THD, and high efficiency.

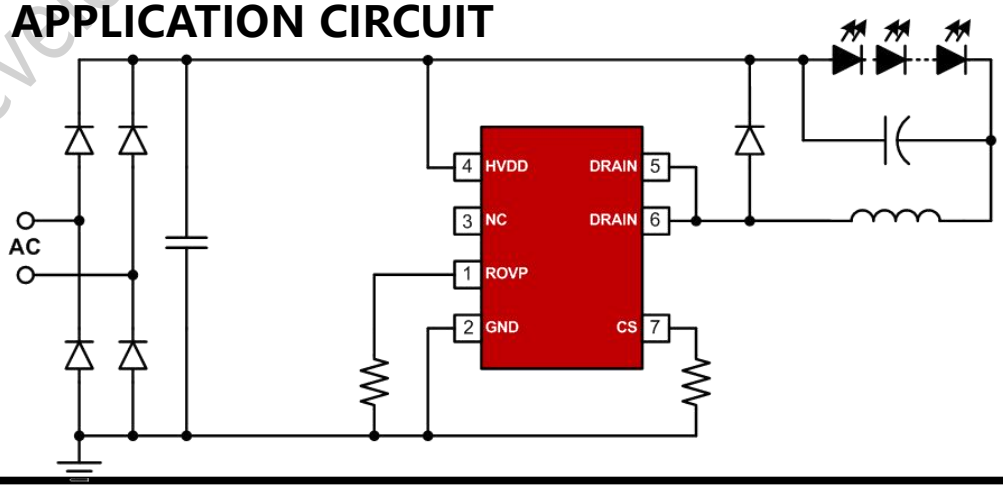
DP9026X integrates internal demagnetization detection circuit and 500V power MOSFET with high voltage startup, which eliminates auxiliary winding for power supply and demagnetization and simplifies the design and production cost of the system. The IC adopts accurate current sensing, close loop constant current control to achieve high precision CC control with excellent line and load regulation.

DP9026X integrates functions and protections of Input Over Voltage Protection, Cycle-by-cycle Current Limiting (OCP), Thermal Fold-back (OTP), Output Over Voltage Protection (OVP), LED Open/Short Protection, etc.

ORDERING INFORMATION

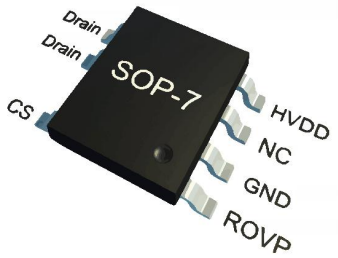
Part Number	Description
DP9026X	SOP-7,Pb free in T&R, 4000Pcs/Reel
	DIP7, Pb free,50 Pcs/Tube

TYPICAL APPLICATION CIRCUIT



PRODUCT DESCRIPTION

➢ PIN CONFIGURATION



➢ PIN DESCRIPTION

Pin Number	Pin Name	I/O	Description
1	ROVP	I	Output OVP adjustment pin. Connecting a resistor to GND can continuously adjust the OVP point. When Rovp<50kΩ, the system is closed.。Rovp typical value150-250K
3	NC		Left floating in use
2	GND	P	IC Ground Reference Pin
4	HVDD	P	IC HV Supply Pin
5, 6	Drain	O	Internal power MOSFET Drain pin
7	CS	I	Internal power MOSFET Source and current sampling pin

➢ MARKING INFORMATION

DP 9026X for product name;

DP9026X fixed print,The X represents the version; The first X reresents the last year,2018 is 8; The second X represents the month, in A-L 12 letters;The third and fourth X on behalf of the date, 01-31 said; The last two X represents the wafer batch code.

➢ ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Value	Unit
HVDD Voltage	-0.3 to 650	V
Drain Voltage	-0.3 to 500	V
CS, ROVP Voltage	-0.3 to 7	V
P_{Dmax}, Power dissipation @T_A=50°C (SOP-7) (Note2)	0.6	W
θ_{JA}, Thermal Resistance---Junction to Ambient (SOP-7) (Note2)	165	°C/W
Maximum Junction Temperature	150	°C
Storage Temperature Range	-65 to 150	°C
Lead Temperature (Soldering, 10sec.)	260	°C
ESD Capability, HBM (Human Body Model)	3	kV

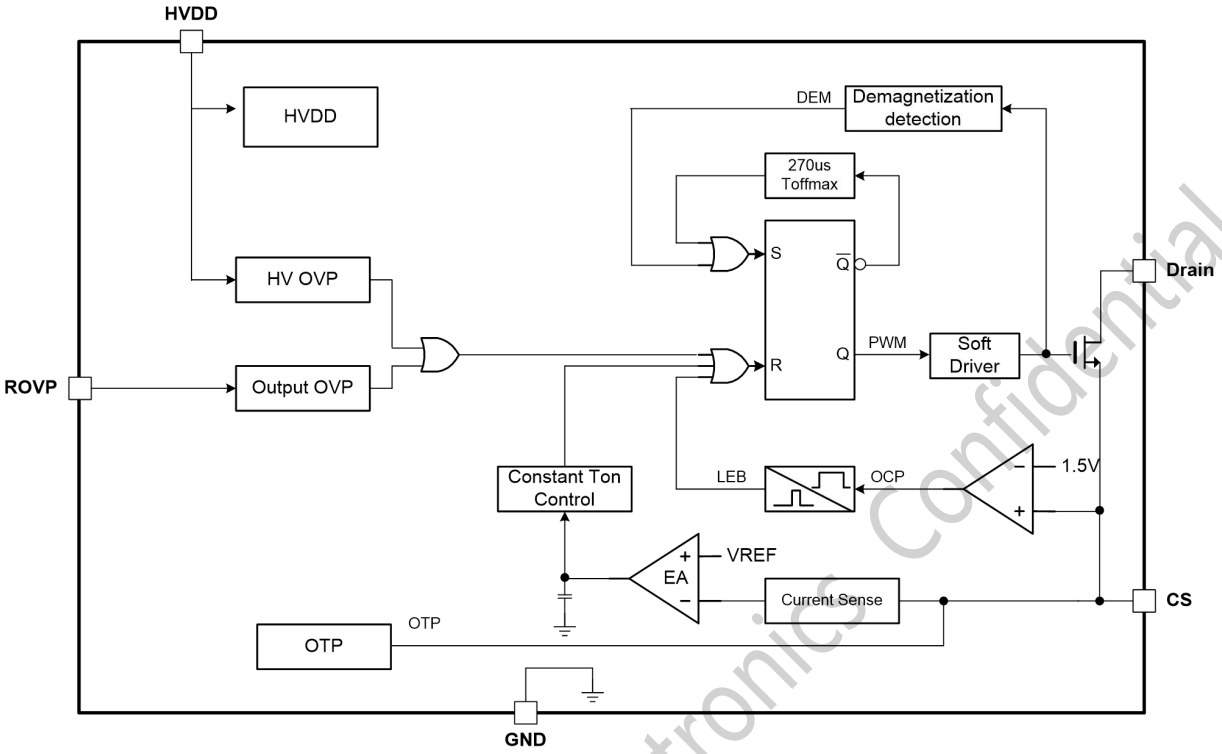
Note1. Stresses listed as the above "Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to maximum rating conditions for extended periods may remain possibility to affect device reliability.

➢ OUTPUT POWER TABLE

Part Number	Package	Maximum Output Current (90-265Vac)	
		36V output	72V output
DP9026A	SOP-7	160 mA	130 mA
DP9026B	SOP-7	220 mA	180 mA
DP9026C	SOP-7	280 mA	240 mA
DP9026D	SOP-7	320mA	280 mA
DP9026C	DIP7	350mA	300 mA
DP9026D	DIP7	380mA	320 mA

Note: Maximum output power is constrained by IC maximum Junction Temperature and determined by ambient temperature and PCB. The system actual maximum output power is determined by the test.

BLOCK DIAGRAM



RECOMMENDED OPERATION CONDITIONS

Parameter	Value	Unit
Operating Junction Temperature	-40 to 125	°C

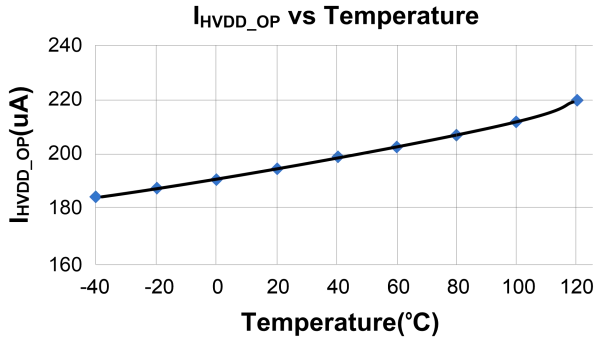
ELECTRICAL CHARACTERISTICS (Ta = 25℃, if not otherwise noted)

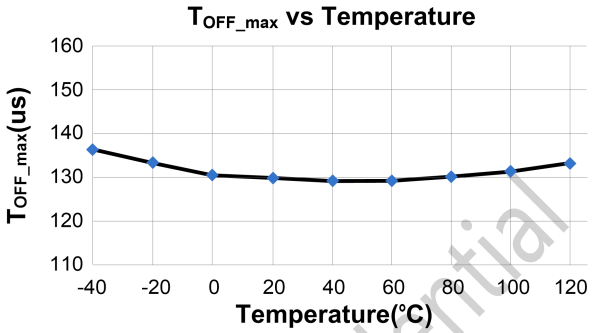
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage Section (HVDD Pin)						
I_{HVDD_ST}	Start-up current into VDD pin	HVDD< $HVDD_{\_ON}$	0.8	1.4	2.0	mA
I_{HVDD_OP}	Operation Current		120	200	250	uA
$HVDD_{\_ON}$	HVDD Startup Voltage		13	15.5	17	V
$HVDD_{\_OFF}$	HVDD Under Voltage Lockout Enter		4.8	6.0	6.8	V
Timing Section						
T_{DEM_BLANK}	Demagnetization Detection blanking Time	(Note 3)	0.4	0.7	1	us
T_{ON_MAX}	Maximum ON Time	(Note 3)	22	23	24	us
T_{OFF_MAX}	Maximum OFF Time		100	140	180	us
F_{SW_MAX}	Maximum Switching Frequency			125		kHz
Current Sense Input Section (CS Pin)						
V_{CC_REF}	Internal Reference for CC Loop Regulation		196	200	204	mV
T_{LEB}	OCP Leading Edge Blanking Time			500		ns
V_{CS_MAX}	Current Limiting Threshold		1.4	1.5	1.6	V
T_{D_OC}	Over Current Detection and Control Delay			150		ns
Over Temperature Protection						
T_{SD}	Thermal Foldback Trigger Point	(Note 3)		145		°C
Power MOSFET Section (Drain Pin)						
V_{BR}	Power MOSFET Drain Source Breakdown Voltage		500			V
R_{dson}	Static Drain-Source On Resistance	DP9026A		8.8		Ω
		DP9026B		4.8		Ω
		DP9026C		2.5		Ω
		DP9026D		1.8		Ω

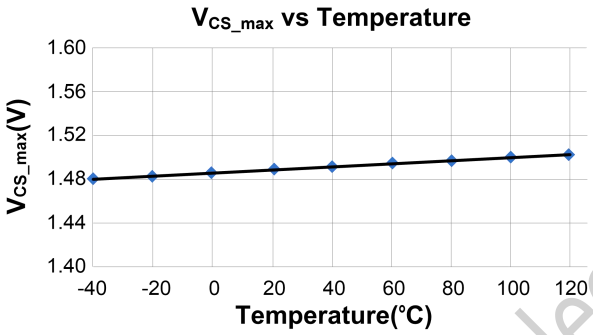
Note2. Maximum Power dissipation P_{Dmax}= (T_{Jmax}-T_A)/ θ_{JA}. As ambient temperature rises, P_{Dmax} will decrease.

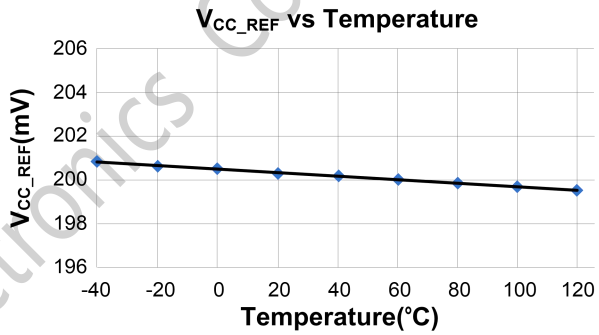
Note3. Guaranteed by the Design.

PARAMETRIC CHARACTERISTIC CURVE









OPERATION DESCRIPTION

DP9026X is a highly integrated power switch with constant current (CC) control for LED lighting applications. The IC utilizes Quasi-Resonant (QR) Buck topology with active PFC control for high PF, low THD, and high efficiency. DP9026X integrates internal loop compensation capacitance (COMP capacitance) and VDD capacitance and supports for non auxiliary winding design. Output OVP voltage is continuously adjustable. The system cost can be minimized.

- **System Start-Up Operation**

After system power up, a digital counter is enabled. When 60ms had been counted, IC starts to switch at the lowest frequency, and then the output current slowly rises to the design value.

- **Constant Current (CC) Control**

DP9026X samples the peak inductor current in each switching cycle to be as the CC loop feedback, and the high accurate output current can be realized with a high accurate current reference. The output current is determined by:

$$I_{CC\_OUT}(mA)=\frac{V_{CC\_REF}}{R_{CS}}=\frac{200mV}{R_{CS}(\Omega)}$$

In the equation above,

Rcs--- the sensing resistor connected between CS and GND.

- **Leading Edge Blanking (LEB)**

Each time the power MOSFET is switched on, a turn-on spike occurs across the sensing resistor. The spike is caused by MOSFET parasitic capacitance and freewheeling rectifier reverse recovery. To avoid premature termination of the switching pulse, an internal leading-edge blanking circuit is built in. During this blanking period (500ns, typical), the PWM comparator is disabled and cannot switch off the gate driver.

- **Demagnetization Detection**

DP9026X integrates internal demagnetization detection circuit which eliminates the auxiliary winding and simplifies the design cost of the system.

- **Timing Control**

In DP9026X, a minimum blanking time (typically 0.7us) is implemented to suppress ringing when the power MOSFET is off. Meanwhile the maximum OFF time in DP9026X is typically 270us. The chip also integrates maximum frequency clamping function (typically 125kHz) to achieve good EMI performance.

- **Output Over Voltage Protection (OVP)**

DP9026X is integrated proprietary OVP control scheme, and the output over voltage can be programmed by the ROVP. The output over voltage is determined by:

$$V_{OVP}(V)\approx\frac{2.28\times10^{10}\times L_P}{R_{OVP}\times R_{CS}}$$

where:

Lp---Inductance

Rcs---current sense resistor

Rovp---the resistor connected between Rovp and GND:

- **Auto-Restart LED Open Protection**

In the event of LED open circuit condition/output

OVP protection, the IC enters auto-restart mode, wherein the power MOSFET is disabled and a digital counter is enabled. When 250ms had been counted, the IC will reset and start up the system again. However, if the fault still exists, the system will experience the above-mentioned process.

- **On Chip Thermal Fold-back (OTP)**

KP26XC integrates thermal fold-back function. When the IC temperature is over 145oC, the system output regulation current is gradually reduced, as shown in Fig.1. Thus, the output power and thermal dissipation are also reduced. In this way, the system temperature is limited and system reliability is also improved。

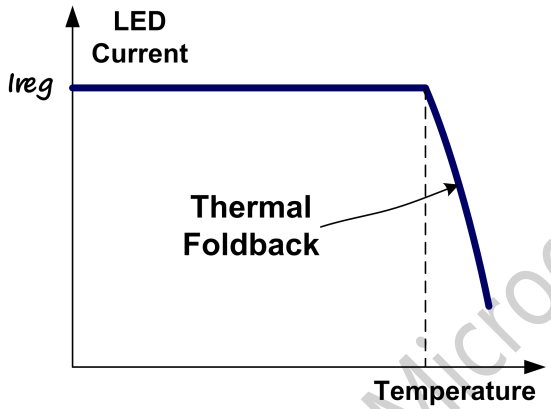


Fig.1

- **Soft Totem-Pole Gate Driver**

DP9026X has a soft totem-pole gate driver with optimized EMI performance.

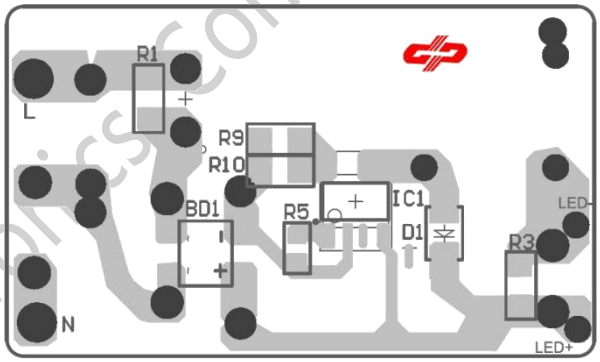
- **PCB Layout Guidelines**

PCB layout is very important for reliable operation. Please follow guideline to optimize performance.

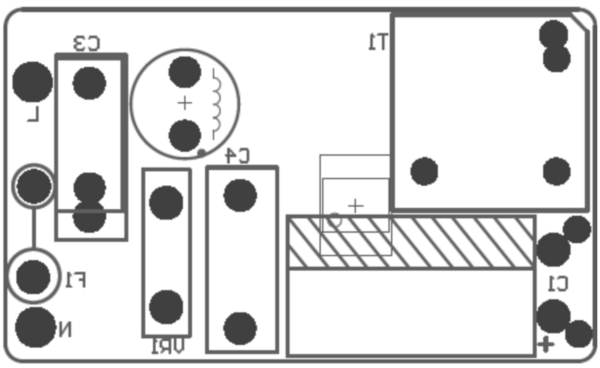
1, The area of main power switching loop should be as small as possible to reduce the EMI radiation, such as the inductor charging loop consisted of the EMI filter capacitor, output capacitor, inductor and IC; the inductor discharging loop consisted of the inductor, freewheeling diode and output capacitor.

2, Use single-point grounding. IC ground and other small signals ground should be connected to terminal ground point-the current sampling resistor ground. And the trace should be as short as possible.

3, Increase the copper area of the Drain pin to improve thermal performance. But too much copper area will worsen EMI performance.



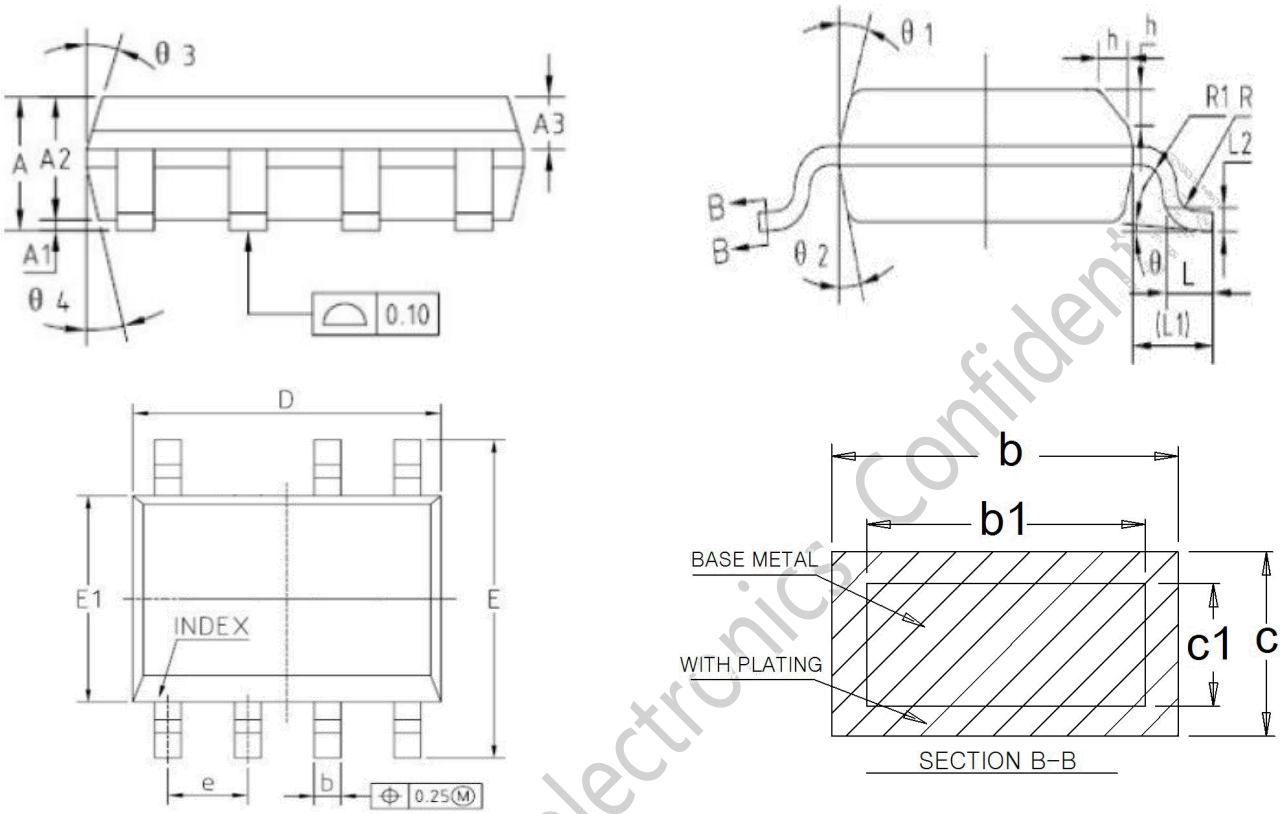
Top layer layout



Bottom layer layout

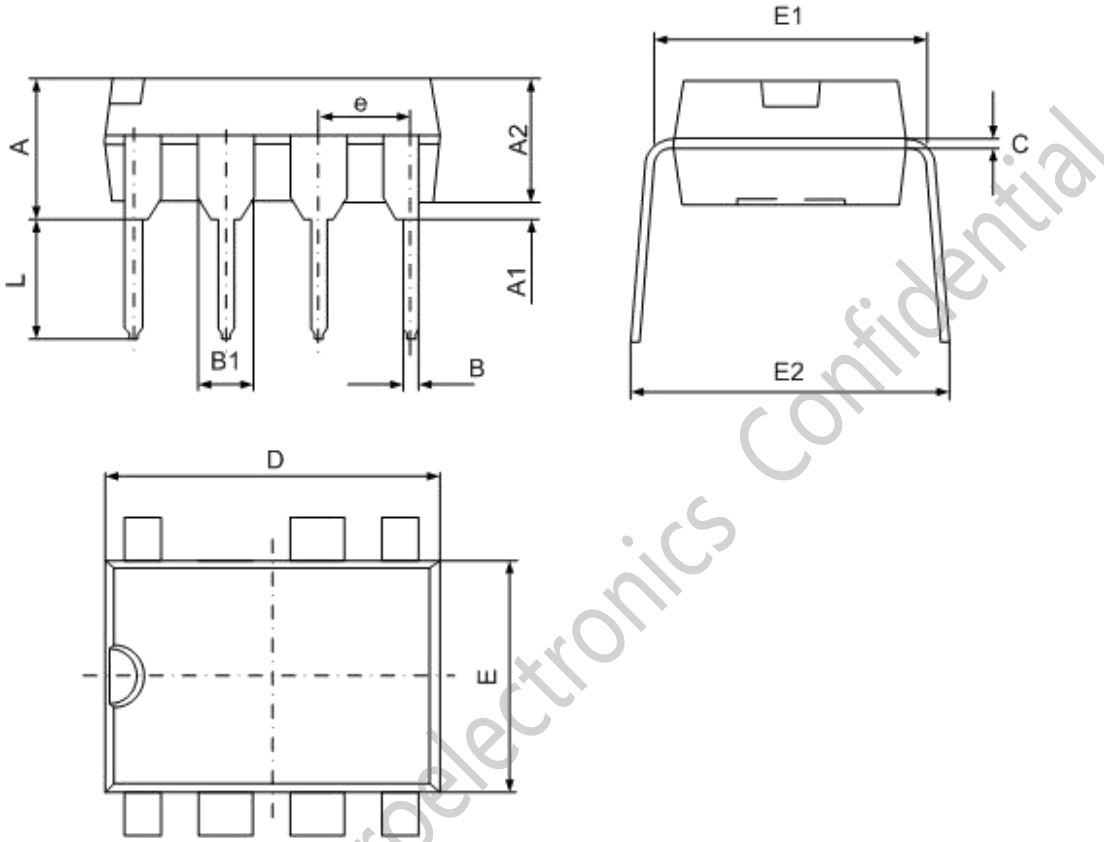
PACKAGE DIMENSION

SOP-7



Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A	1.45	1.55	1.65
A1	0.10	0.15	0.20
A2	1.353	1.40	1.453
A3	0.55	0.60	0.65
b	0.38	-	0.51
b1	0.37	0.42	0.47
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.85	4.90	4.95
E	5.85	6.00	6.15
E1	3.85	3.90	3.95
e	1.245	1.27	1.295
L	0.45	0.60	0.75
L1	-	1.050REF	-
L2	-	0.250BSC	-
Θ1-Θ4	12° REF		
h	0.40REF		
R	0.15° REF		
R1	0.15° REF		

DIP7



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	5.334	0.146	0.210
A1	0.381		0.015	
A2	3.175	3.600	0.125	0.142
B	0.350	0.500	0.014	0.026
B1	1.524 (BSC)		0.06 (BSC)	
C	0.200	0.360	0.008	0.014
D	9.000	10.160	0.354	0.400
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540 (BSC)		0.1 (BSC)	
L	2.921	3.810	0.115	0.150
E2	8.200	9.525	0.323	0.375

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