DESCRIPTION

AP8025 is based on high-voltage synchronous rectifier architecture, integrated with PFM controller and 650V high-reliability MOSFET , specifically designed for small power non-isolated switching power supply. AP8025 has internal high voltage start-up and self-supply circuit, and complete intelligent protections including Over Current Protection (OCP), Under Voltage Lockout (UVLO) and Over Temperature Protection (OTP). Excellent EMI performance could be achieved with Pulse Frequency Modulation.

The AP8025 is available in SOP7 and DIP7 packages.

ORDERING INFORMATION

Package Type	Part Number	
SOP7 SPQ: 4,000pcs/Reel	M7	AP8025M7R
		AP8025M7VR
DIP7 SPQ: 50psc/Tube	P7	AP8025P7U
		AP8025P7VU
Note	V: Halogen free Package R: Tape & Reel U: Tube	
AiT provides all RoHS products		

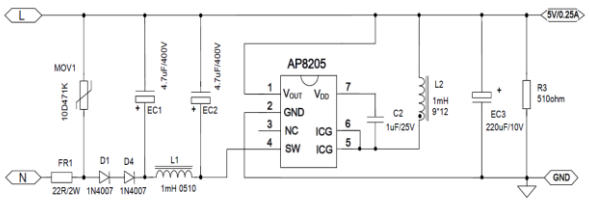
FEATURES

- Internal 650V avalanche-rugged smart power MOSFET
- Internal HV Start-up Circuit
- Advanced HV synchronous rectifier architecture
- Only Supporting Buck, Buck-Boost topologies
- The output voltage is fixed to 5V
- Semi enclosed steady output current 250mA @230V_{AC}
- Frequency modulation for low EMI
- Excellent constant voltage regulation and High efficiency
- Excellent Protection Coverage:
  Over Current Protection (OCP)
  Under Voltage Lockout (UVLO)
  Over Temperature Protection (OTP)
- Available in SOP7 and DIP7 packages

APPLICATION

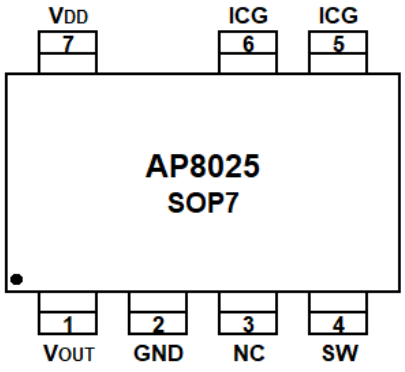
- non-isolated assistant power supply
- Household appliance
- Smart Home

TYPICAL APPLICATION

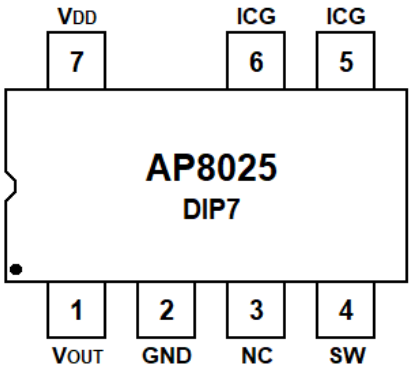


Buck-boost

PIN DESCRIPTION



Top View



Top View

Pin #		Symbol	Function
SOP7	DIP7		
1	1	V_{OUT}	System output
2	2	GND	System ground
3	3	NC	No connection
4	4	SW	Drain of the internal MOSFET
5,6	5,6	ICG	Ground of AP8025
7	7	V_{DD}	V_{DD} supply of AP8025

TYPICAL POWER

Part number	Input Voltage	Steady output power[NOTE1]	Peak Power[NOTE2]
AP8025	85-265V_{AC}	1.25W(5V250mA)	1.5W(5V300mA)

NOTE1: Maximum output power in a semi enclosed design measured at 75°C ambient temperature, Duration: 2hours
NOTE2: Peak power in a semi enclosed design measured at 75°C ambient temperature, Duration: 1min

ABSOLUTE MAXIMUM RATINGS

Supply Voltage Pin V_{DD}		-0.3V ~ 10V
SW, GND, V_{OUT} Pin		-0.3V ~ 600V
Operating Junction Temperature		-40℃ ~ 150℃
Storage Temperature Range		-55℃ ~ 150℃
Lead Temperature (Soldering, 10Secs)		260℃
θ_{JC}, Package Thermal Resistance	SOP7	40°C/W
	DIP7	20°C/W
HBM ESD Protection[NOTE13]		±4kV
Pulse Drain Current (T_{pulse}=100us)		1.5A

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

NOTE3: Test standard: JEDEC JS-001-2014.

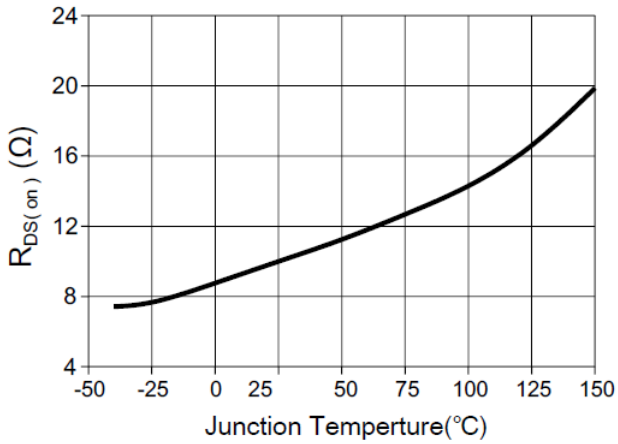
ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_{DD} = 5V, unless otherwise specified

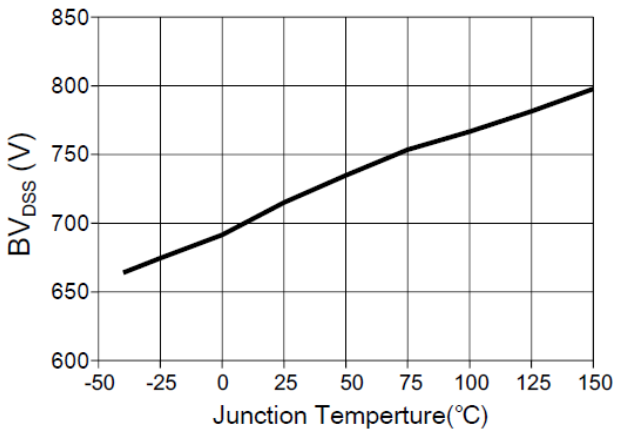
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power section						
Drain Break-Down Voltage	BV_{DSS}	I_{SW}=250μA,T_J=25℃	650	730	-	V
Off-State Drain Current	I_{OFF}	V_{SW}=500V,T_J=25℃	1	5	10	μA
Drain-Source on State Resistance	$R_{DS(ON)}$	I_{SW}=300mA,T_J=25℃	-	10	-	Ω
Supply Voltage Section						
V_{DD} start Up Threshold	V_{DDon}		4.5	4.9	5.5	V
V_{DD} Under Voltage Shutdown Threshold	V_{DDoff}		3.8	4.0	4.5	V
V_{DD} Voltage Hysteresis	V_{DDhys}	-	-	1	-	V
V_{DD} Clamp Voltage	$V_{DDclamp}$		6.1	6.5	7.5	V
V_{OUT} Feedback Reference	V_{OUTPUT}		4.9	5.0	5.2	V
Supply Current Section						
V_{DD} Charge Current	I_{DD_CH}	V_{DD}=4V	-	-2	-	mA
Off-State Current	I_{DD0}	V_{DD}=4V	-	400	-	μA
Operating Supply Current,	I_{DD1}	f_s=40kHz	-	1.0	2.0	mA
Current Sense Section						
Current Sense Threshold	I_{limit}		410	450	490	mA
Leading Edge Blanking Time	t_{LEB}		-	300	-	ns
Feedback Input Section						
Minimum Turn OFF Time	t_{offmin}		18	20	25	μs
Minimum Turn ON Time	t_{onmax}		6	11	14	μs
Thermal Shutdown Section						
OTP Threshold	T_{SD}		135	150	-	°C
OTP Protect Hysteresis	T_{HYST}		-	35	-	°C

TYPICAL PERFORMANCE CHARACTERISTICS

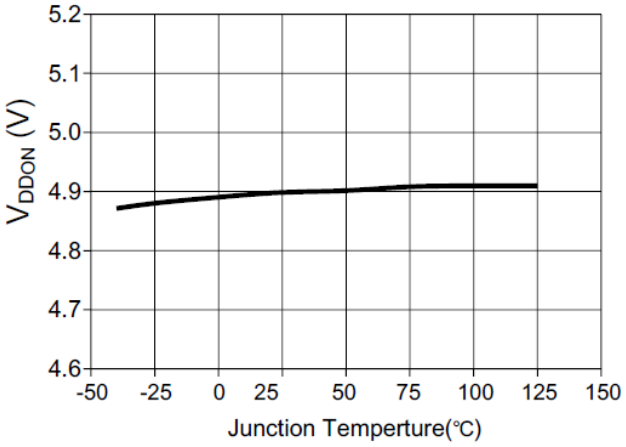
1. $R_{DS(ON)}$ vs T_J



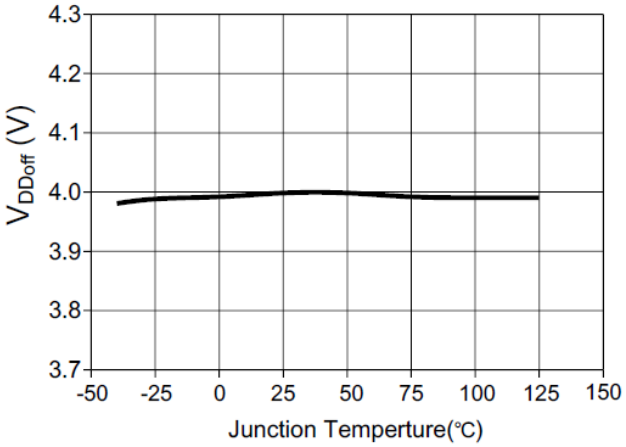
2. BV_{DSS} vs. T_J



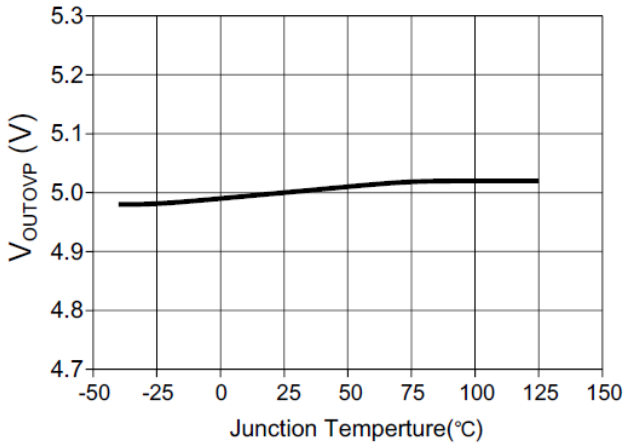
3. V_{DDon} vs. T_J



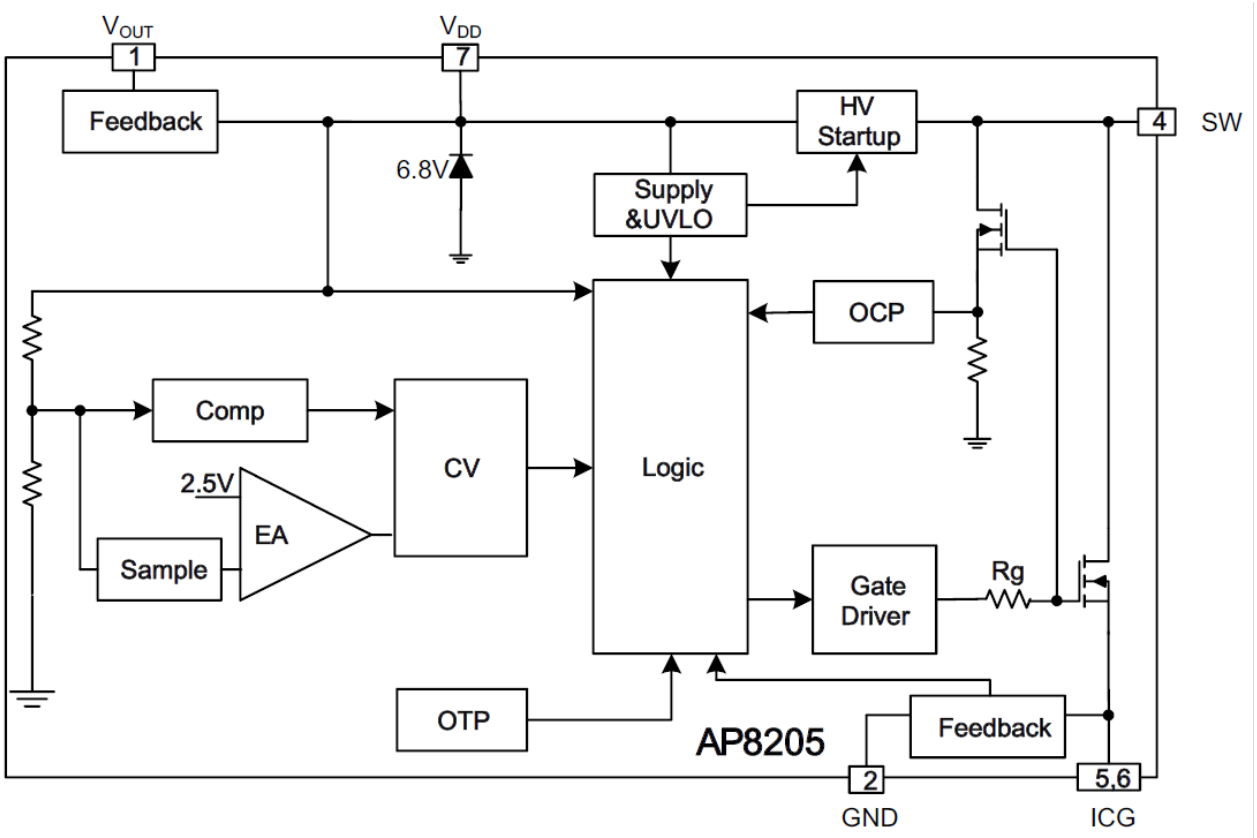
4. V_{DDoff} vs. T_J



5. V_{OUTPUT} vs. T_J



BLOCK DIAGRAM



DETAILED INFORMATION

Functional Description

The AP8025 consists of an integrated Pulse width Modulator (PWM) controller and 650V high reliability MOSFET, specifically designed for small power non-isolated switching power supply, the output voltage is 5V.The AP8025 integrates high voltage startup and self-supply module, which can achieve quick start and ultra-low standby power loss. The AP8025 offers fully intelligent protections including Over Current protection (OCP), Under Voltage Lockout (UVLO) and Over Temperature Protection (OTP). Excellent EMI performance is achieved with Pulse Frequency Modulation.

Startup

At start up, the internal high-voltage current source supplies 2mA current to charges the external V_{DD} capacitor. When V_{DD} rises to V_{DDon}, AP8025 starts switching and the internal high-voltage current source stops charging the capacitor. When V_{DD} drops to V_{DDoff} , AP8025 continues switching while the internal high-voltage current source returns to supplies 2mA current to charge the external V_{DD} capacitor. The internal high-voltage regulator self-supplies the IC, so extra component is not needed for power supply.

CV Operation Mode

In CV operation, AP8025 samples the feedback signal through V_{DD} pin. While the feedback voltage remains below V_{REF}, the IC turns on the integrated MOSFET. When the current of the inductor reaches the peak current limit (Ipeak), the integrated MOSFET is turned off. Figure 1 and Figure 2 shows the operating waveform of key nodes in continuous conduction mode (CCM) and discontinuous conduction mode (DCM). Meanwhile, the IC integrates load compensation function to improve load regulation and CV accuracy.

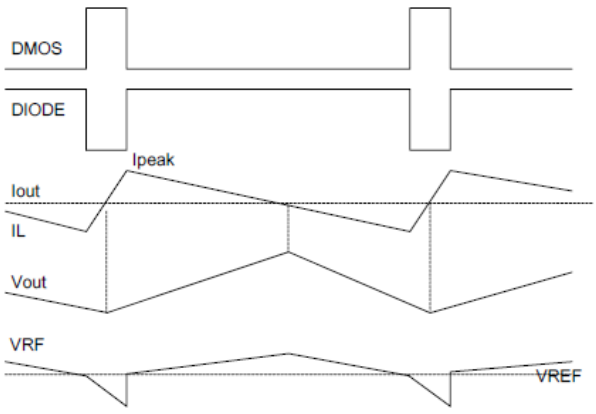


Figure 1 Waveform if CCM mode

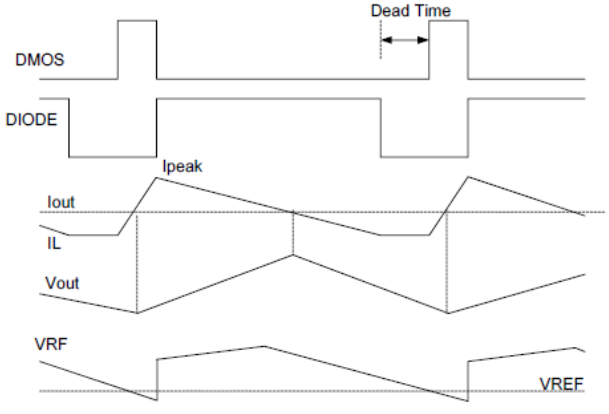


Figure 2 Waveform of DCM mode

Soft-Start up

In order to regulate peak current in deep CCM mode, AP8025 build in soft-start function, at the first 8ms of start up, the switching frequency decrease to 33% of the maximum frequency, while 8ms to 12ms of startup, the switching frequency decrease to 66% of the maximum frequency. Meanwhile, the leading edge blanking (LEB) is 300ns (Typ.), in order to regulate peak current.

Intelligent up and down frequency function

The chip works in PFM mode, i.e. fixed IPEAK adapts to load change by adjusting switch frequency. In order to avoid the audio noise generated by the chip during light load, when the switch frequency is detected to be lower than 18kHz in the chip, the IPEAK can be reduced by 25% immediately to improve the switch frequency, and the IPEAK can be reduced by up to four times; on the other hand, to avoid the chip working in the depth CCM, when the chip working frequency is detected to be higher than 40kHz in the chip, the IPEAK will be restored to the limit immediately.

Smart Protection Control

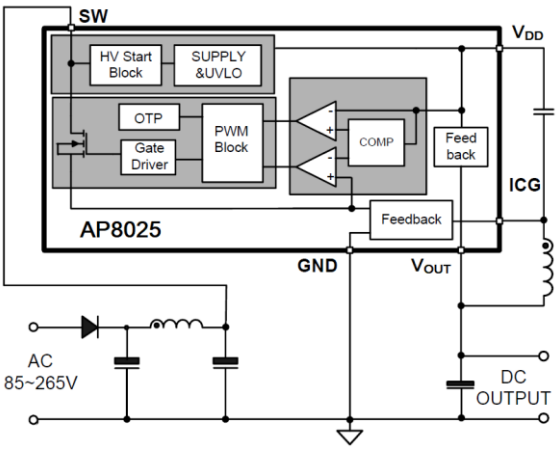
AP8025 has several smart protection functions, such as Over Current protection (OCP), Under Voltage Lockout (UVLO) and Over Temperature Protection (OTP).And all these protections have self-recovery mode.

OCP---If the peak current exceeds I_{limit}, the IC shutdown the power MOSFET immediately and keep on at least T_{offmin} until feedback voltage is lower than V_{REF}.

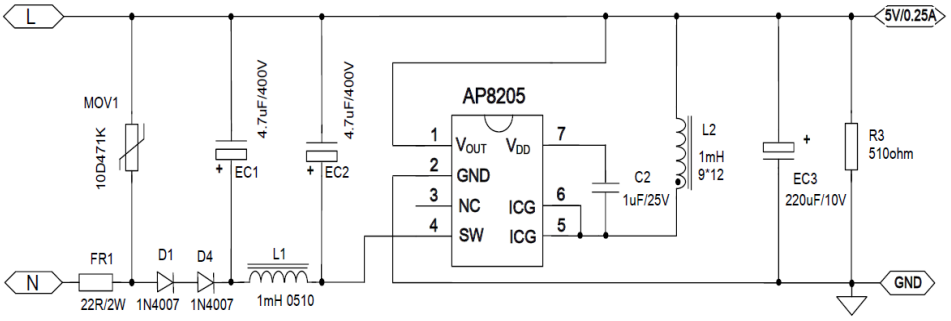
UVLO----If V_{DD} pin voltage drops below V_{DDoff}, the internal high-voltage current source returns to supply 2mA current to charge the external V_{DD} capacitor until V_{DD} rises to V_{DDon}. Otherwise, self-restart time can be changed by V_{DD} capacitor. The larger the capacitor, the longer the self-restart time is.

OTP----If the inner junction temperature exceeds 150℃,the IC will shut down switching, until the junction temperature falls to 115℃.

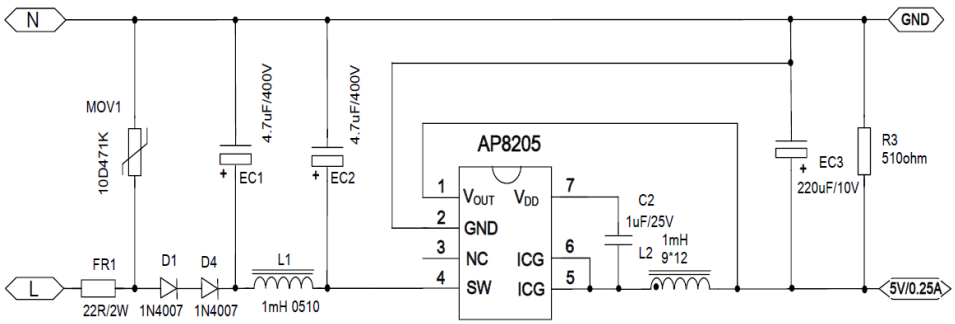
Typical Circuit



Typical Application



Buck-boost



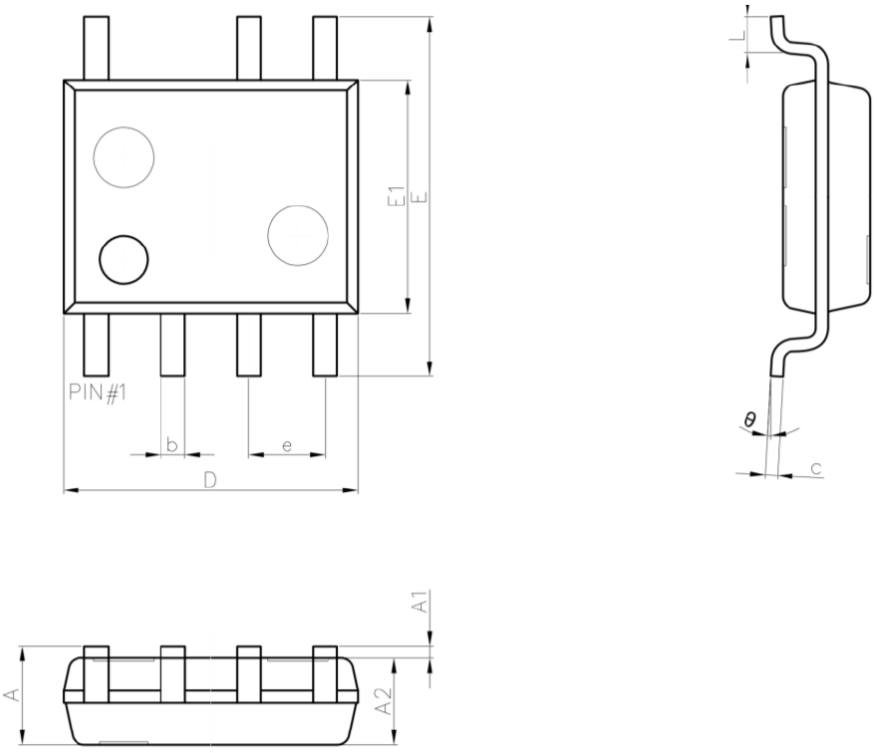
Buck

Component Parameter and Layout Considerations:

V_{DD} capacitor C2should be placed at the nearest place from the IC.

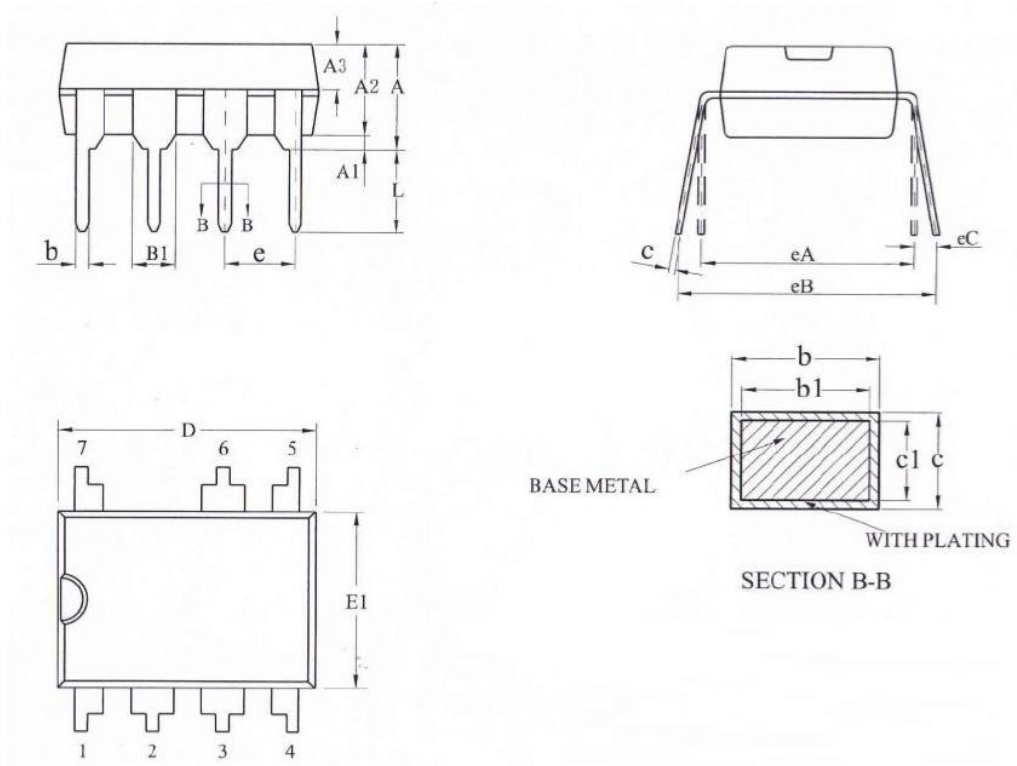
PACKAGE INFORMATION

Dimension in SOP7 (Unit: mm)



Symbol	Min	Max
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
E	5.800	6.200
E1	3.800	4.000
e	1.27 BSC	
L	0.400	0.800
θ	0°	8°

Dimension in DIP7 (Unit: mm)



Symbol	Min	Max
A	3.60	4.00
A1	0.51	-
A2	3.20	3.40
A3	1.55	1.65
b	0.44	0.52
b1	0.43	0.49
B1	1.52 REF	
c	0.25	0.29
c1	0.24	0.26
D	9.15	9.35
E1	6.25	6.45
e	2.54 BSC	
eA	7.62 REF	
eB	7.62	9.30
eC	0	0.84
L	3.00	-

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