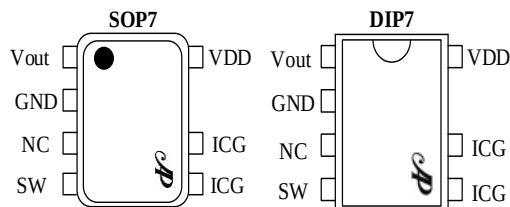


Non-isolated AC / DC converter with fixed 5V output based on high voltage synchronous rectifier architecture

General description

AP8505 is based on high-voltage synchronous rectifier architecture, integrated with PFM controller and 700V high-reliability MOSFET, specifically designed for small power non-isolated switching power supply. AP8505 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.

Package/Order Information



Order Code	Package
AP8505SS-D1	SOP7
AP8505NS-D1	DIP7

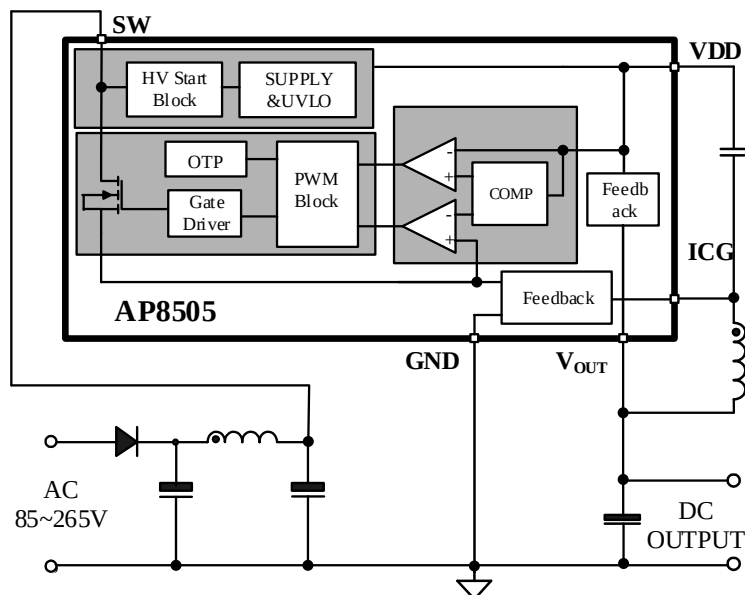
Features

- Internal 700V 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 200mA @230VAC
- 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)

Application

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

Typical Circuit



Pin Definitions

Pin Name	Pin Number	Pin Function Description
Vout	1	System output
GND	2	Ground
NC	3	No connection
SW	4	Drain of the internal MOSFET
ICG	5,6	Ground of AP8505
VDD	7	VDD supply of AP8505

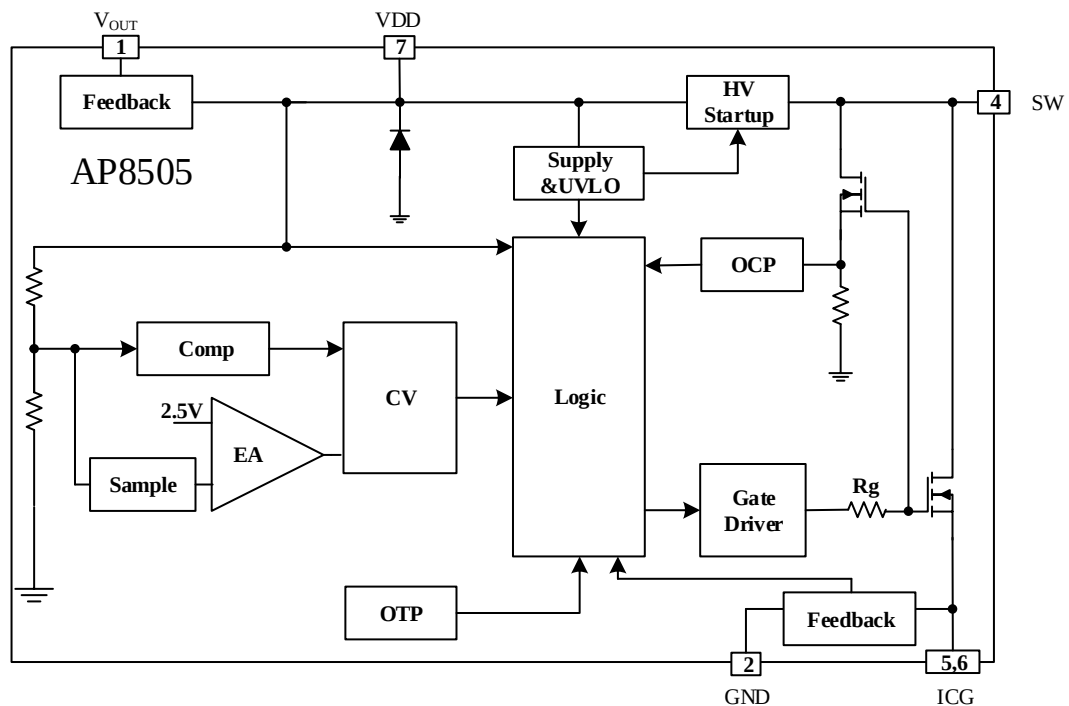
Typical Power

Part number	Input Voltage	Steady output power ⁽¹⁾	Peak Power ⁽²⁾
AP8505	85-265V _{AC}	1W(5V200mA)	1.25W(5V250mA)

Note:

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

Block Diagram



Absolute Maximum Ratings

Supply voltage Pin VDD.....-0.3~10V
 High-Voltage Pin, SW..... -0.3~700V
 Operating Junction Temperature.....-40~150 ℃
 Storage Temperature Range.....-55~150 ℃
 Lead Temperature (Soldering, 10Secs).....260 ℃

Package Thermal Resistance θ_{JC} (SOP7).....40 ℃ /W
 Package Thermal Resistance θ_{JC} (DIP7).....20 ℃ /W
 HBM ESD Protection ⁽¹⁾..... ±2kV
 Pulse Drain Current ($T_{pulse}=100\mu s$).....1A

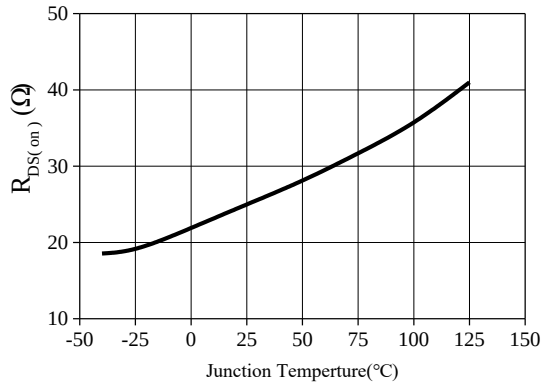
Note: 1. ANSI/ESDA/JEDEC JS-001-2017.

Electrical Characteristics

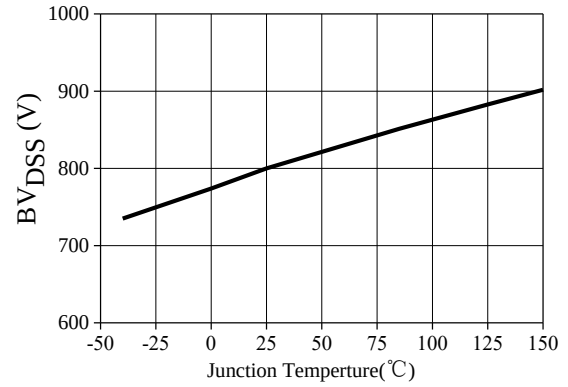
($T_A = 25\text{ }^\circ\text{C}$, VDD = 5 V, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Power Section						
Drain Break-down voltage	BV_{DSS}	$I_{SW} = 250\mu A$, $T_J = 25\text{ }^\circ\text{C}$	700	800		V
Off-state drain current	I_{OFF}	$V_{SW} = 700V$, $T_J = 25\text{ }^\circ\text{C}$	0	4	10	μA
Drain-source on state resistance	$R_{DS(on)}$	$I_{SW} = 300mA$, $T_J = 25\text{ }^\circ\text{C}$		25		Ω
Supply Voltage Section						
VDD startup threshold	V_{DDon}		4.35	4.53	4.65	V
VDD under voltage shutdown threshold	V_{DDoff}		4.3	4.48	4.6	V
VDD voltage Hysteresis	V_{DDhys}			0.05		V
VDD clamp voltage	$V_{DDclamp}$		5.55	6.0	6.5	V
V_{OUT} feedback reference	V_{OUTPUT}		4.75	4.9	5.2	V
Supply Current Section						
VDD charge current	I_{DDch}	VDD=4V		-2		mA
Off-state current	I_{DD0}	VDD=4V		300		μA
Operating supply current,	I_{DD1}	$f_s = 40kHz$	0.5	0.8	1.2	mA
Current Sense Section						
Drain current limit	I_{limit}		260	290	330	mA
Leading edge blanking time	T_{LEB}			300		ns
Feedback Input Section						
Minimum turn OFF time	T_{offmin}		15	18	21	μs
Minimum turn ON time	T_{onmax}		5.5	7.5	9.5	μs
Thermal Shutdown Section						
OTP threshold	T_{SD}		135	150		$^\circ\text{C}$
OTP Protect Hysteresis	T_{HYST}			35		$^\circ\text{C}$

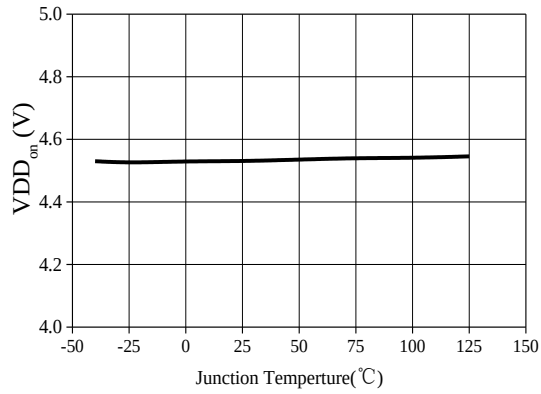
Typical Characteristics Plots



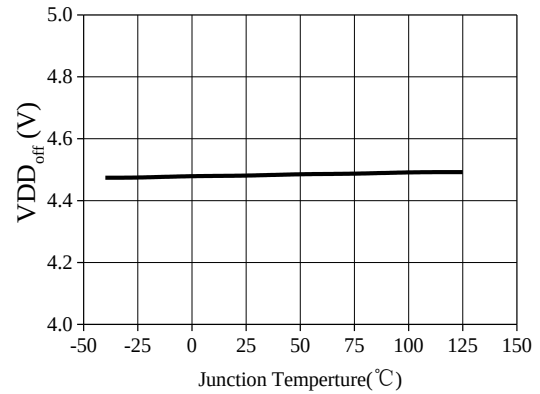
(a) $R_{DS(on)}$ vs T_j



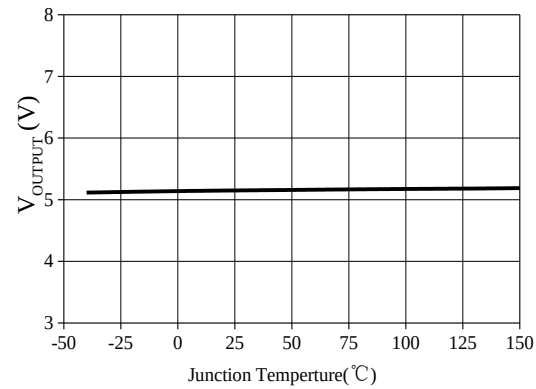
(b) BV_{DSs} vs T_j



(c) $V_{DD(on)}$ vs T_j



(d) $V_{DD(off)}$ vs T_j



(e) V_{OUTPUT} vs T_j

Functional Description

The AP8505 consists of an integrated Pulse width Modulator (PWM) controller and 700V high reliability MOSFET, specifically designed for small power non-isolated switching power supply, the output voltage is 5V. The AP8505 integrates high voltage startup and self-supply module, which can achieve quick start and ultra-low standby power loss. The AP8505 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.

1. Startup

At start up, the internal high-voltage current source supplies 2mA current to charges the external VDD capacitor. When VDD rises to V_{DDon} , AP8505 starts switching and the internal high-voltage current source stops charging the capacitor. When VDD drops to V_{DDoff} , AP8505 continues switching while the internal high-voltage current source returns to supplies I_{DDch} current to charge the external VDD capacitor. The internal high-voltage regulator self-supplies the IC, so extra component is not needed for power supply.

2. CV Operation Mode

In CV operation, AP8505 samples the feedback signal through VDD 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 (I_{peak}), the integrated MOSFET is turned off. Fig.1-1 and Fig.1-2 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.

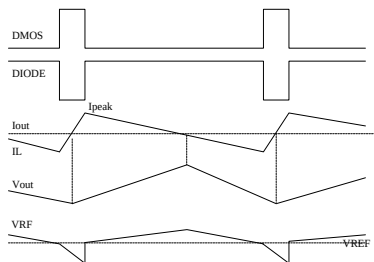


Fig.1-1 Waveform if CCM mode

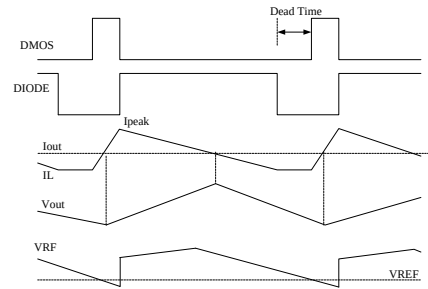


Fig.1-2 Waveform of DCM mode

3. Soft-Start up

In order to regulate peak current in deep CCM mode, AP8505 build in soft-start function, at the first 7ms of start up, the switching frequency decrease to 33% of the maximum frequency, while 7ms to 14ms 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.

4. Smart Protection Control

AP8505 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 VDD pin voltage drops below V_{DDoff} , the internal high-voltage current source returns to supply 2mA current to charge the external VDD capacitor until VDD rises to V_{DDon} . Otherwise, self-restart time can be changed by VDD capacitor. The larger the capacitor, the longer the self-restart time is.

OTP----If the inner junction temperature exceeds T_{SD} , the IC will shut down switching, until the junction temperature falls to $T_{SD}-T_{HYST}$.

Typical Application

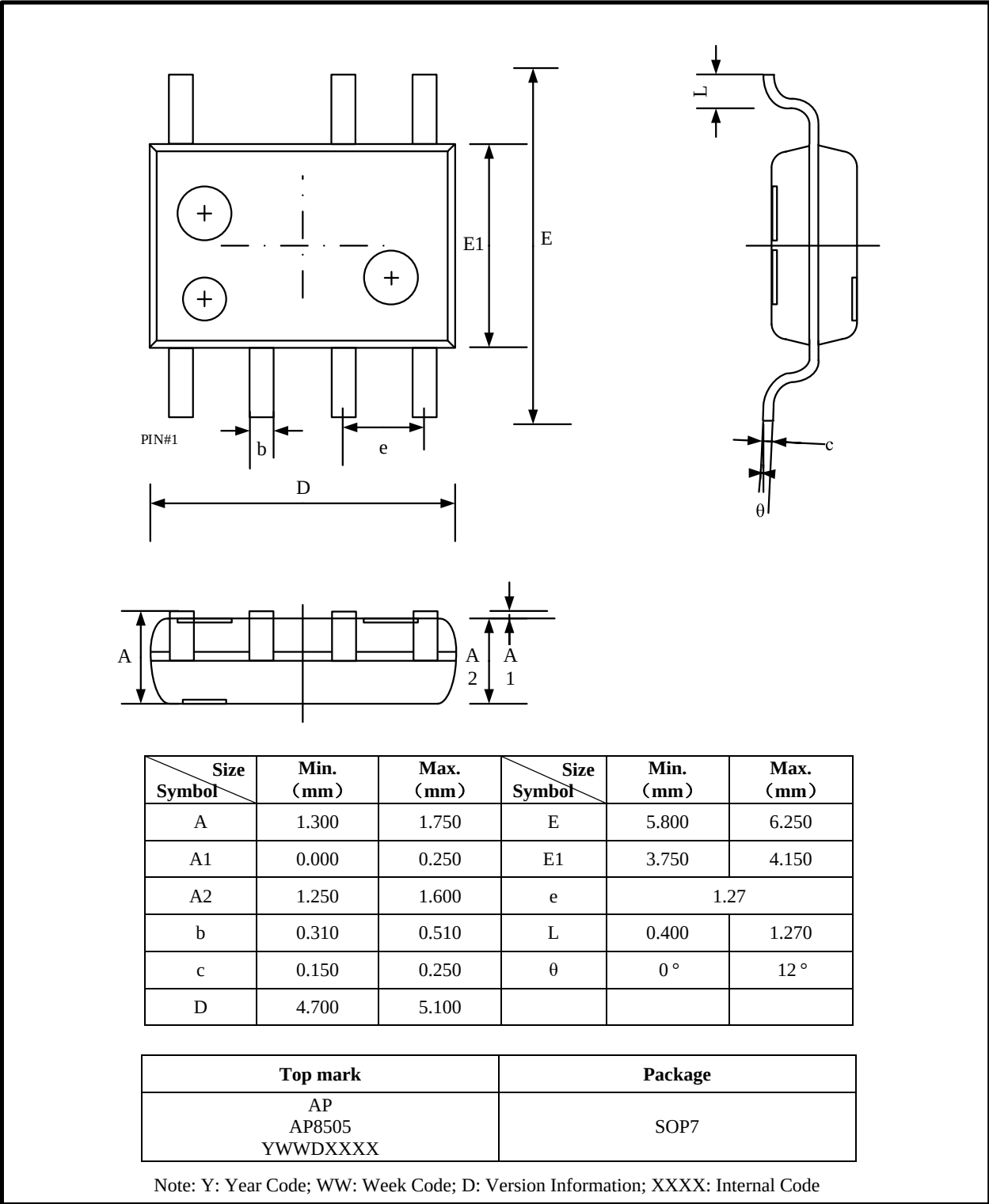


Component Parameter and Layout Considerations:

1. VDD capacitor C2 should be placed at the nearest place from the IC.

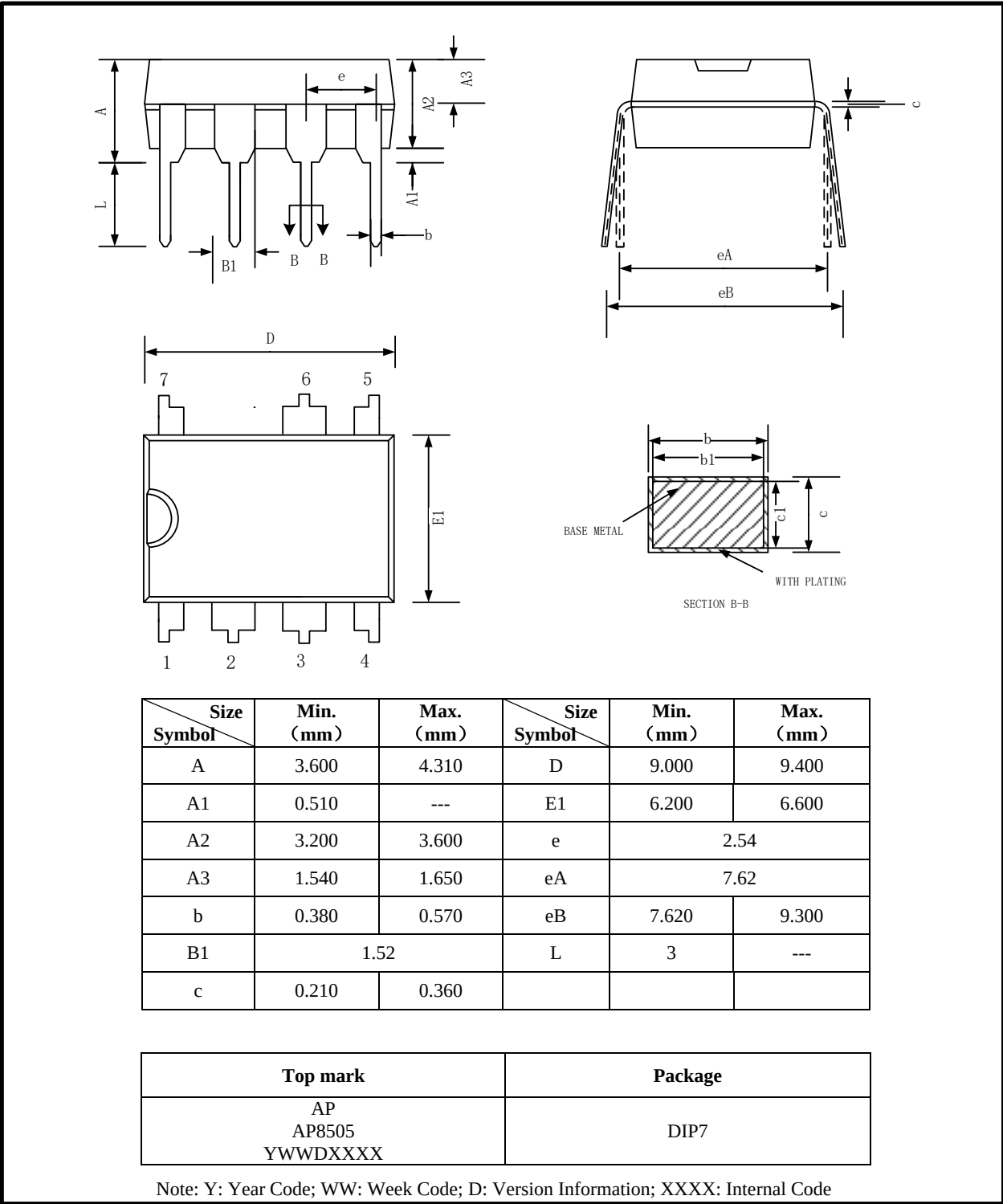
Package Information

SOP7 Package Information



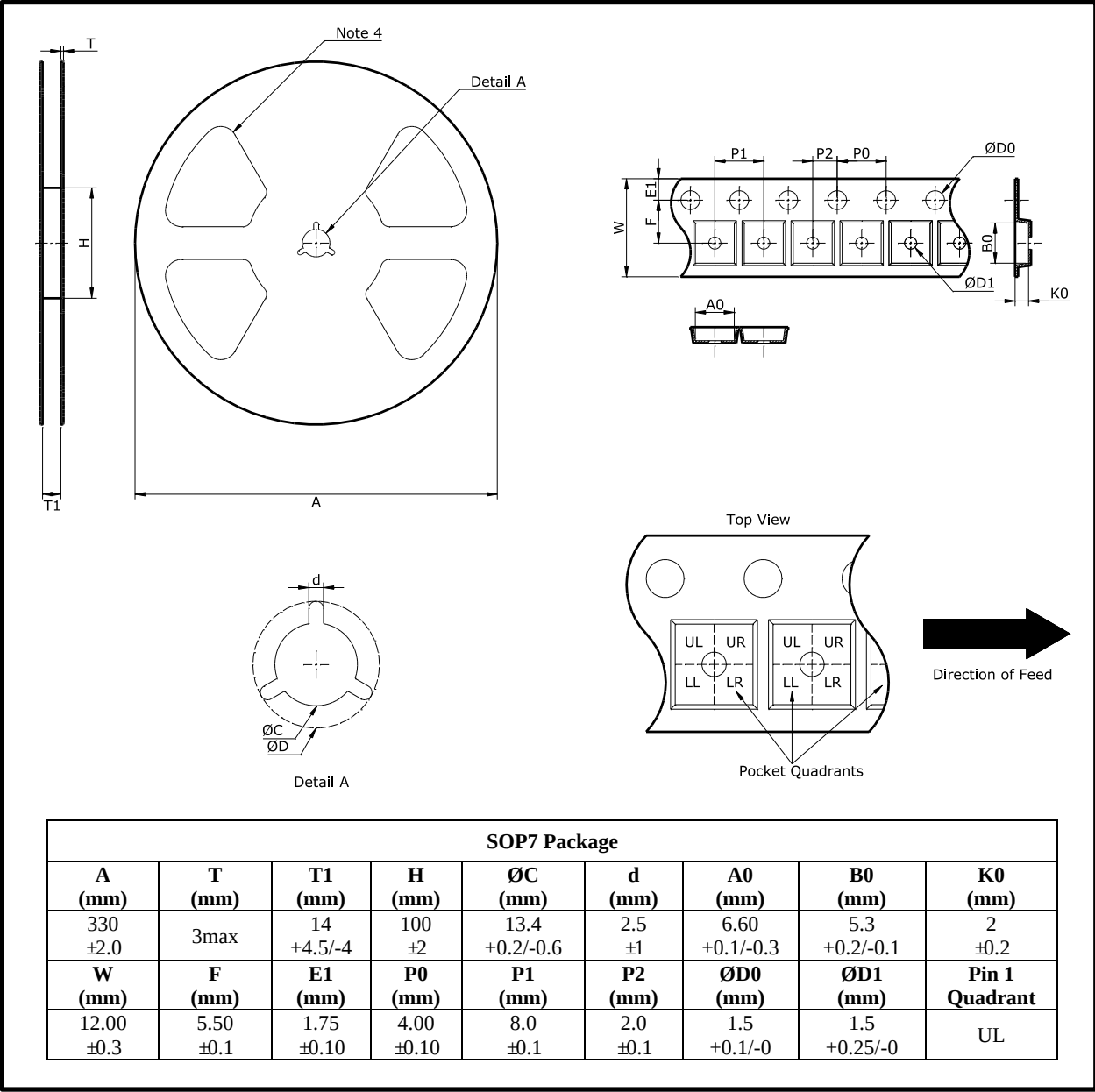
- Notes:
1. This drawing is subjected to change without notice.
 2. Body dimensions do not include mold flash or protrusion.

DIP7 Package Information



- Notes:
- 1. This drawing is subjected to change without notice.
 - 2. Body dimensions do not include mold flash or protrusion.

Tape and Reel Information



Notes:

1. This drawing is subjected to change without notice.
2. All dimensions are nominal and in mm.
3. This drawing is not in scale and for reference only. Customer can contact Chipown sales representative for further details.
4. The number of flange openings depends on the reel size and assembly site. This drawing shows an example only.

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