DESCRIPTION

The AP8024 consists of an integrated Pulse Width Modulator (PWM) controller and power MOSFET , specifically designed for small power non-isolated switching power supply. AP8024 offers fully intelligentized protection including Cycle-by-Cycle current limiting (OCP); Over Voltage Protection (OVP), Over Load Protection (OLP), Under Voltage Lockout and Over Temperature Protection (OTP). Excellent EMI performance is achieved with Pulse Frequency Modulation. AP8024 also consists of the high voltage start-up circuit to ensure that start quickly. The application need less component device.

AP8024 is available in a DIP7 package.

ORDERING INFORMATION

Package Type	Part Number	
DIP7	P7	AP8024P7U
		AP8024P7VU
Note	V: Halogen free Package U: Tube	
AiT provides all RoHS products Suffix " V " means Halogen free Package		

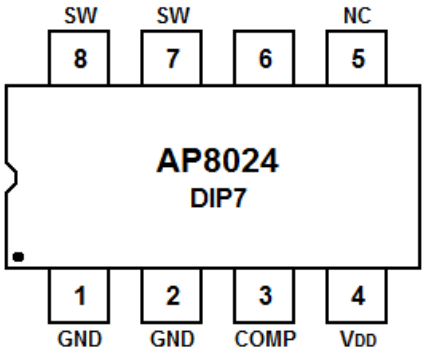
FEATURES

- Be optimized with 12V output non-isolated application
- 85~265VAC wide input voltage scope
- Frequency modulation for low EMI
- Internal HV Start-up Circuit
- Open frame output power >4.5W @230VAC
- Excellent constant voltage regulation and High efficiency
- Excellent Protection Coverage:
  Adjustable Over Current Protection (OCP)
  Over Temperature Protection (OTP)
  Over Load Protection (OLP)
  Over voltage protection (OVP)
- Available in a DIP7 package.

APPLICATION

- Battery protection
- Load switch
- Power management

PIN DESCRIPTION



Top View

Pin #	Symbol	Function
1, 2	GND	Ground
3	COMP	Voltage feedback.
4	V_{DD}	Positive Supply voltage Input.
5, 6	NC	No connection
7, 8	SW	HV MOSFET Drain pin.

NOTE: NC Pin could not be connected

TYPICAL POWER

Part Number	Input Voltage	Adapter	Open Frame
AP8024	150-265 VAC	4W	4.5W

NOTE 1: Typical continuous power in a non-ventilated enclosed adapter measured at 55°C & 25°C ambient temperature.
NOTE2: Maximum practical continuous power in an open-frame design measured at 75°C ambient temperature

ABSOLUTE MAXIMUM RATINGS

T_A = 25℃, unless otherwise noted

V_{DD}, Supply Voltage Pin	-0.3V~32V
SW, High-Voltage Pin	650V
COMP Supply Voltage	-0.3V~5.5V
Junction Operating Temperature	-40℃~140℃
Storage Temperature Range	-55℃~150℃
Lead Temperature (Soldering, 10secs)	260℃
Package Thermal Resistance (DIP7)	100℃/W
Loss power (DIP7 , Temp.= 85℃)	1W
ESD Voltage Protection	2.5kV
The Biggest Drain Pulse Current	2.5A

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.

ELECTRICAL CHARACTERISTICS

Power Supply Section

T_A =25°C, V_{DD} = 14V, unless otherwise specified

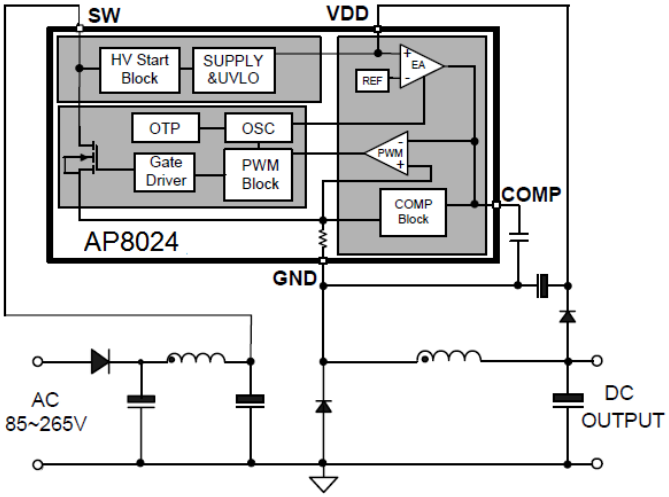
Parameter	Symbol	Conditions	Min	Typ.	Max	Units
Break-Down Voltage	BV_{DSS}	I_{SW} =1mA, V_{COMP} = GND	650	690	-	V
Off-State Drain Current	I_{OFF}	V_{SW} =600V, V_{COMP} = GND	-	-	100	μA
Drain-Source On State Resistance	$R_{DS(ON)}$	I_{SW} = 0.5A, V_{COMP} = 3V	-	13.5	-	Ω

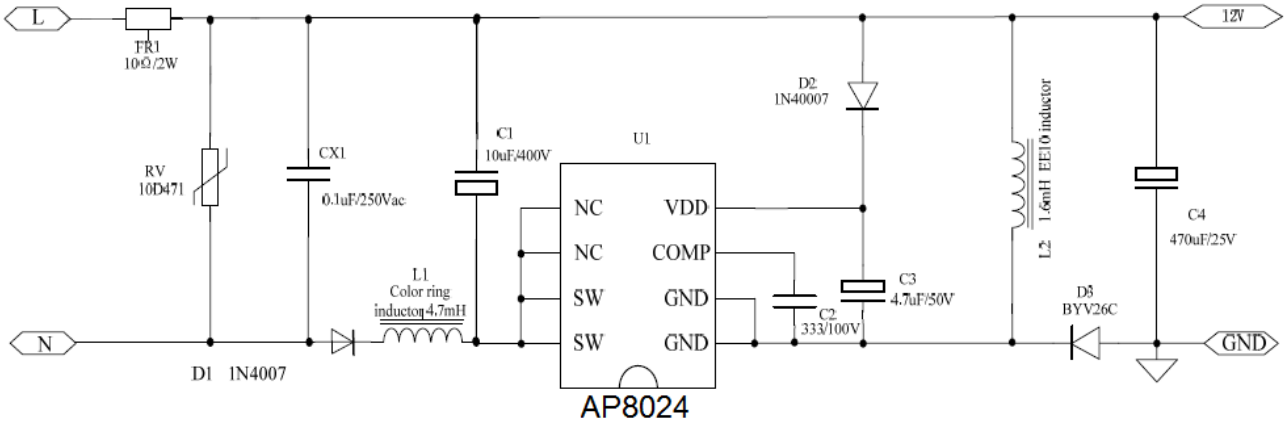
Supply Section

Parameter	Symbol	Conditions	Min	Typ.	Max	Units
Voltage Parameter						
Drain-Source Start Voltage	V_{SW_START}		-	-	105	V
Start Up Charging Current	I_{DD_CH}	V_{SW} = 120V, V_{COMP} = GND, V_{DD} = 4 V	-	-1.2	-	mA
Operating Voltage Range	V_{DD}	After turn-on	9	-	24	V
V_{DD} Clamp Voltage	$V_{DDclamp}$		28	30	32	V
V_{DD} OVP Voltage	V_{DDovp}		24	-	29	V
V_{DD} Start Up Threshold	V_{DDon}	V_{SW} = 120V, V_{COMP} = 3V	11.5	12.5	13.5	V
V_{DD} Under Voltage Shutdown Threshold	V_{DDoff}		7	8	9	V
V_{DD} Restart Threshold	$V_{DDrestart}$	V_{SW} = 120V, V_{COMP} = 3V	5	-	6.5	V
Current Parameter						
Operating Supply Current, Switching	I_{DD1}	V_{SW} = 120V, F_{SW} =work frequency	-	-	2	mA
Operating Supply Current, With Protection Tripping	I_{DD_FAULT}		-	-	550	μA
Operating Supply Current With V_{DD} < V_{DD_OFF}	I_{DD_OFF}	V_{DD} = 7 V	-	-	500	μA
Comp Pin Parameter						
Over Load Shut Down Threshold	V_{COMP_olp}		-	3.7	-	V
OLP Propagation Delay	T_{d_olp}		-	64	-	ms

Parameter	Symbol	Conditions	Min	Typ.	Max	Units
Current Sense Parameter						
Max Drain Current Limitation	I_{dlim}		0.52	0.58	0.64	A
Minimum Turn ON Time	T_{ON_MIN}		-	500	-	ns
Propagation Delay	t_d		-	100	-	ns
Leading Edge Blanking	t_{LEB}		-	400	-	ns
Oscillator Parameter						
Maximum Switching Frequency	F_{OSC_MAX}	V_{DD} =10V, V_{COMP} = 2.5V	70	78	86	kHz
Frequency Variation	FD		-	±8	-	%
Modulation Frequency	FM		-	250	-	Hz
Maximum Duty Cycle	D_{MAX}		55	-	75	%
Error Amplifier Parameter						
DC Current Gain	Gain		-	65	-	dB
Maximum Compensating Current	$I_{\_COMP\_MAX}$	V_{DD} = operating voltage range, V_{COMP} = 0 V	-	3.5	-	µA
Thermal Parameter						
Thermal Shutdown Temperature	T_{SD}		140	160	-	°C
Thermal Shutdown Hysteresis	T_{HYST}		-	30	-	°C

TYPICAL CIRCUIT





DETAILED INFORMATION

Operation Description

Start up

At start up, the internal high-voltage current source supplies the internal bias 1.2mA and charges the external V_{DD} capacitor. When V_{DD} reaches 12.5V, the device starts switching and the internal high-voltage current source stops charging the capacitor. The device is in normal operation provided V_{DD} does not drop below 8V. After start up, the bias is supplied from the auxiliary transformer winding.

Gate driver

The internal power MOSFET in AP8024 is driven by a dedicated gate driver for power switch control. Too weak the gate driver strength results in higher conduction and switch loss of MOSFET while too strong gate drive results in worse EMI.

A good tradeoff is achieved through the built-in totem pole gate design with proper output strength and dead time. The good EMI system design and low idle loss is easier to achieve with this dedicated control scheme.

Oscillator

The switching frequency of AP8024 is internally fixed at 78 kHz. No external frequency setting components are required for PCB design.

The frequency modulation is implemented in AP8024, So that, it minimizes the conduction band EMI and therefore eases the system design because the tone energy could be spread out.

Internal error amplifier

The output voltage modulation could be realized by the error amplifier built –in AP8024. Through the internal resistor voltage divider, output voltage could be modulated via using the error amplifier detection V_{DD} potential.

Over load protection (OLP)

Overload is defined as the load current exceeding a pre-set level due to an accident event as a fault. If V_{COMP} exceeds 3.7V for more than 50ms (power limit debounce time), in this case, the protection circuit should be activated to protect the SMPS.

PFM -mode operation

AP8024 work in the PFM-mode to decrease the light load power consumption. When load mitigated，and frequency reduced. Lower switching frequency is helpful to reduce the switching loss.

Output constant voltage modulation

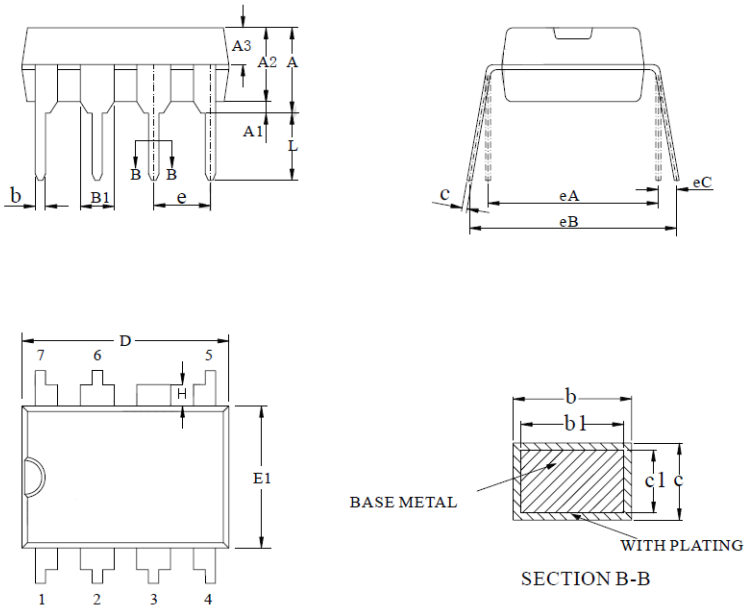
AP8024 provide the load compensation function，that can make good load modulation.

Over temperature protection (OTP)

The power MOSFET and control chip are integrated, making it easier for control chip to detect the temperature of MOSFET. If the temperature exceeds about 160℃，OTP fault is activated.

PACKAGE INFORMATION

Dimension in DIP7 (Unit: mm)



Symbol	Min	Max
A	3.600	4.000
A1	0.510	-
A2	3.000	3.400
A3	1.550	1.650
b	0.440	0.530
b1	0.430	0.480
B1	1.520(BSC)	
c	0.250	0.310
c1	0.240	0.260
D	9.050	9.450
E1	6.150	6.550
e	2.540(BSC)	
eA	7.620(BSC)	
eB	7.620	9.300
eC	0.000	0.840
L	3.000	-
H	0.900 (REF)	

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