DESCRIPTION

The AP8204 consists of an integrated Pulse Frequency Modulator (PFM) controller and power MOSFET , specifically designed for small power non-isolated switching power supply.

AP8204 has internal high voltage start-up circuit and complete intelligent protections including adjustable Over Load Protection (OLP), Under Voltage Lockout (UVLO) and Over Temperature Protection (OTP). Excellent EMI performance could be achieved with Pulse Frequency Modulation.

The AP8204 is available in SOP7 package.

ORDERING INFORMATION

Package Type	Part Number	
SOP7 SPQ: 4,000pcs/Reel	M7	AP8204M7R
		AP8204M7VR
Note	R: Tape & Reel V: Halogen free Package	
AiT provides all RoHS products		

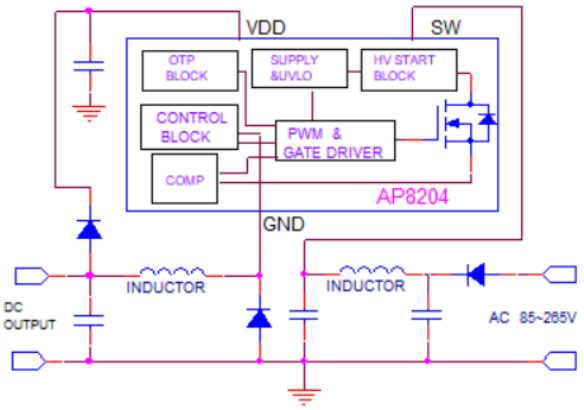
FEATURES

- Internal 650V avalanche-rugged smart power VDMOSFET
- Internal HV Start-up Circuit
- Be optimized with 12V output non-isolated application
- 60°C open frame steady output power 4.8W@230V_{AC}
- Frequency modulation for low EMI
- Excellent constant voltage regulation and High efficiency
- Excellent Protection Coverage:
  Over Load Protection (OLP)
  Over Temperature Protection (OTP)
  Under Voltage Lockout (UVLO)

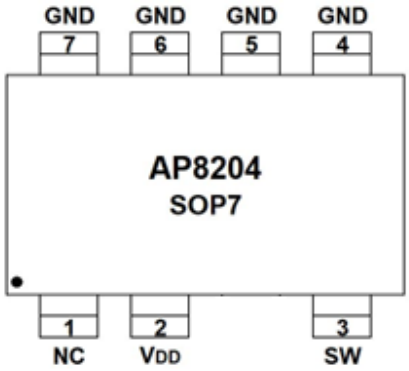
APPLICATION

- Appliances
- Metering
- Smart LED Drivers and industrial controls
- IOT, Home and building automation
- Non-Isolated Assistant Power Supply

TYPICAL APPLICATION



PIN DESCIPTION



SOP7, M7

Top View

#Pin SOP7	Symbol	Function
1	NC	No Connection
2	V_{DD}	Positive Supply Voltage Input.
3	SW	HV MOSFET Drain Pin.
4	GND	Ground
5	GND	Ground
6	GND	Ground
7	GND	Ground

ABSOLUTE MAXIMUM RATINGS

V_{DD}, Supply Voltage Pin		-0.3V ~ +40V
SW, High-Voltage Pin		-0.3V ~ +650V
Operating Junction Temperature		-40℃ ~ +150℃
Storage Temperature Range		-55℃ ~ +150℃
Lead Temperature (Soldering, 10Secs)		260℃
Package Thermal Resistance	SOP7	80℃/W
HBM ESD Protection (1)		±6kV
ESD Voltage Protection (2)		8kV
Pulse Drain Current (T_{pulse}=100us)		3A
TYPICAL POWER		
Input Voltage :150~265V_{AC}	Steady Output Power (3)	4.8W (12V400mA)
	Peak Power (4)	5.4W (12V450mA)

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

(1)Test standard: ESDA/JEDEC JDS-001-2014.

(2)Air discharge to pins of AP8204 with ESD Generator, Enterprise internal standards, for reference only.

(3)Maximum output power in an open frame design measured at 60°C ambient temperature, Duration:2 hours

(4)Peak power in a semi enclosed design measured at 60°C ambient temperature, Duration: 1 min

ELECTRICAL CHARACTERISTICS

T_A = 25°C, unless otherwise specified.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Section						
Drain Break-Down Voltage	BV_{DSS}	I_{SW}=250μA	650	690	-	V
Off-State Drain Current	I_{OFF}	V_{SW}=500V	-	-	100	μA
Drain-Source on State Resistance	$R_{DS(ON)}$	I_{SW}=400mA,T_J=25℃	-	8.0	-	Ω
Start-Up Threshold	V_{SW_START}	V_{DD}= V_{DDon}-1V	-	30	-	V
Supply Voltage Section						
V_{DD} Start Up Threshold	V_{DDon}	-	10.5	11.5	12.5	V
V_{DD} Under Voltage Shutdown Threshold	V_{DDoff}	-	8	9	10	
V_{DD} Voltage Hysteresis	V_{DDhys}	-	-	2.5	-	
V_{DD} Clamp Voltage	$V_{DDclamp}$	-	18	20	22	
V_{DD} Feedback Reference	I_{DD-REF}	-	-	12.3	-	
Supply Current Section						
V_{DD} Charge Current	I_{DDch}	V_{DD}=10V	-	-2	-	mA
Off-State Current	I_{DD0}	V_{DD}=6V	0.3	0.6	0.9	
Operating Supply Current	I_{DD1}	V_{DD}=13V	0.8	1.2	1.6	
Current Sense Section						
Drain Current Limit	I_{limit}	-	600	670	750	mA
Leading Edge Blacking Time	T_{LEB}	-	-	300	-	ns
Feedback Input Section						
Minimum Turn OFF Time	T_{offmin}	-	15	18	21	μs
Minimum Turn ON Time	T_{onmax}	-	-	13	-	
Thermal Shutdown Section						
OTP Threshold	T_{SD}	-	135	150	-	°C
OTP Protect Hysteresis	T_{HYST}	-	-	30	-	°C
Restart Protection Section						
Restart Time	$T_{RESTART}$	C_{VDD}=4.7μF	-	3	-	S

TYPICAL PERFORMANCE CHARACTERISTICS

Fig1. $R_{DS\,(on)}$ vs. T_J

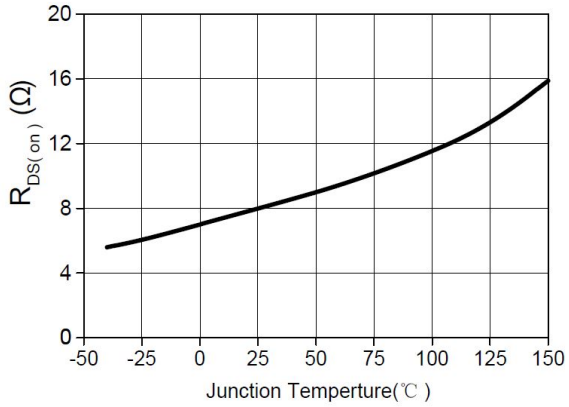


Fig2. BV_{DSS} vs. T_J

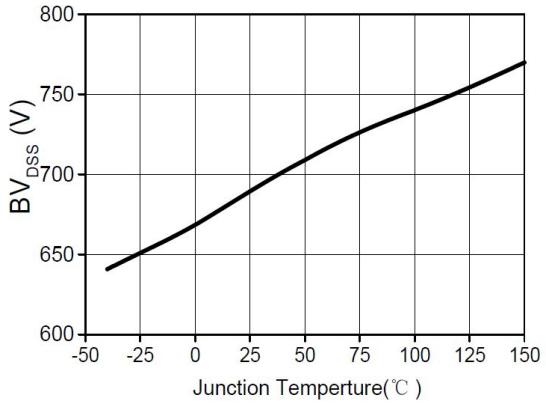


Fig3. V_{REF} vs. T_J

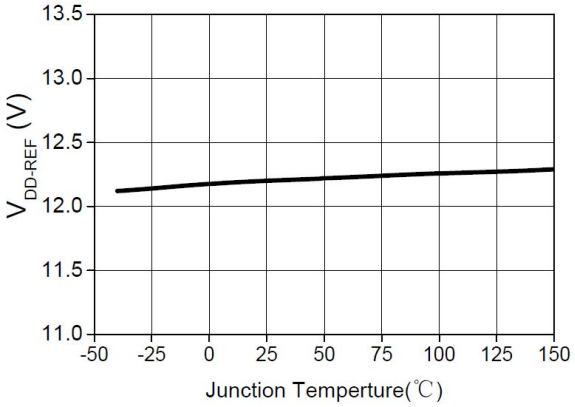


Fig4. T_{offmin} vs. T_J

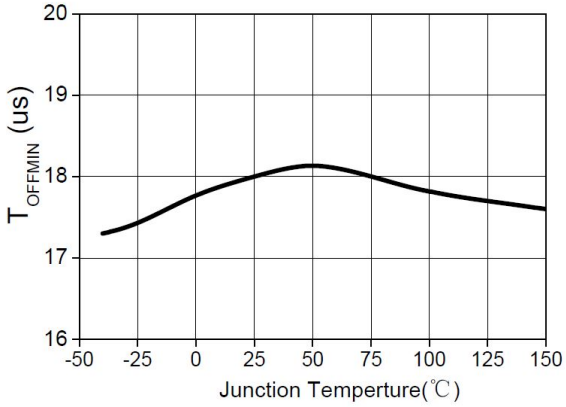


Fig5. V_{DDon} vs. T_J

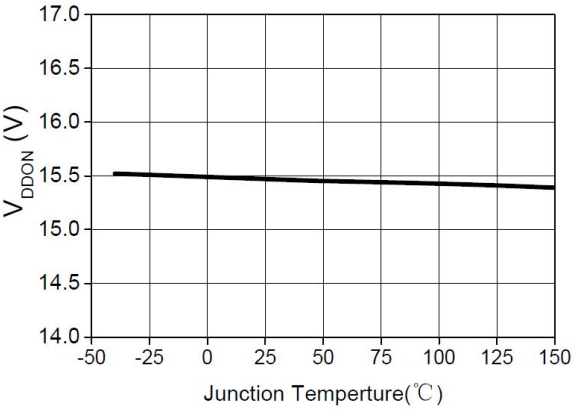
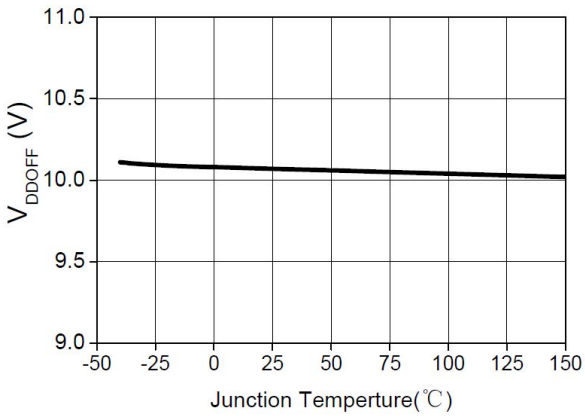
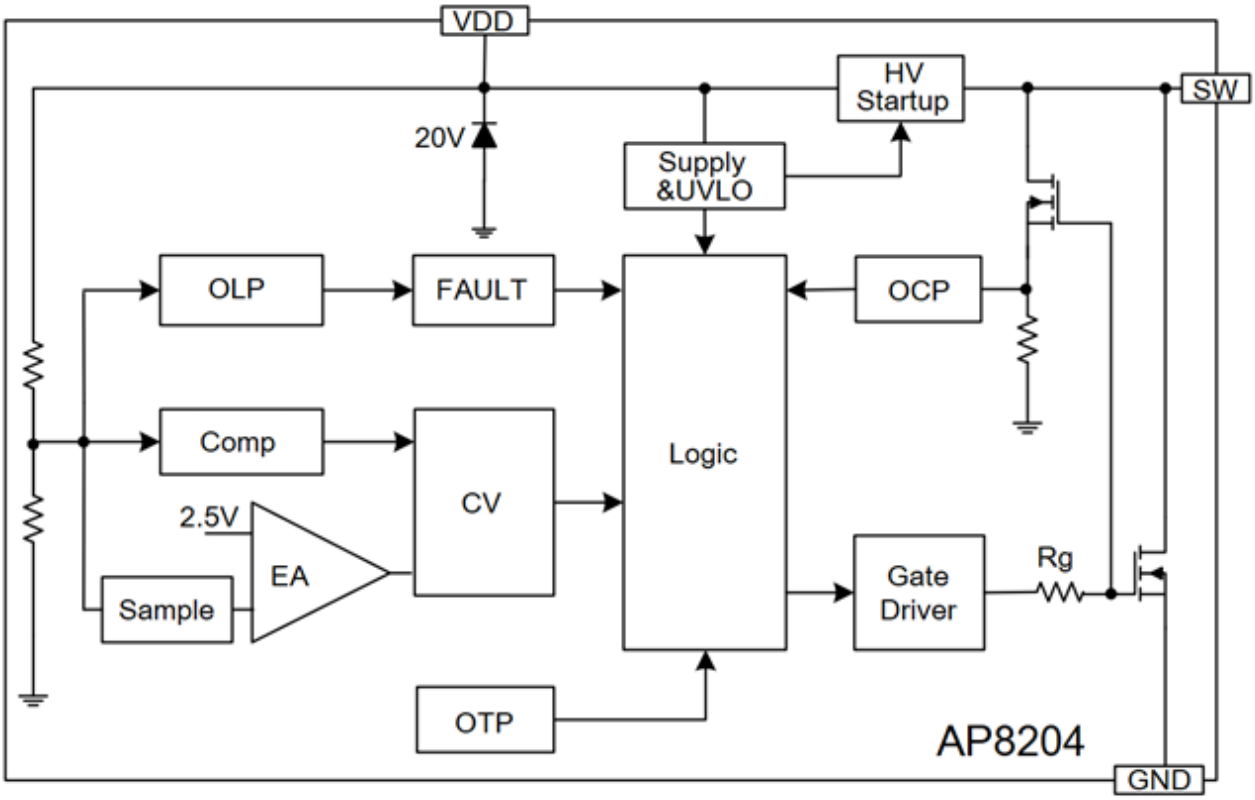


Fig6. V_{DDoff} vs. T_J



BLOCK DIAGRAM



DETAILED INFORMATION

Functional Description

The AP8204 consists of an integrated Pulse Frequency Modulator (PFM) controller and power MOSFET, specifically designed for small power non-isolated switching power supply. AP8204 has internal high voltage start-up circuit and complete intelligent protections including adjustable Over Load Protection (OLP), Under Voltage Lockout (UVLO) and Over Temperature Protection (OTP). Excellent EMI performance could be achieved with Pulse Frequency Modulation.

Start up

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}, AP8204 starts switching and the internal high-voltage current source stops charging the capacitor. After start up, the V_{DD} voltage is supplied from output.

CV Operation Mode

In CV operation, AP8204 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 (I_{peak}), the integrated MOSFET is turned off. Fig7. and Fig8. 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.

In actual applications, V_{DD} sampling voltage is affected by the forward drop of D2 in addition.

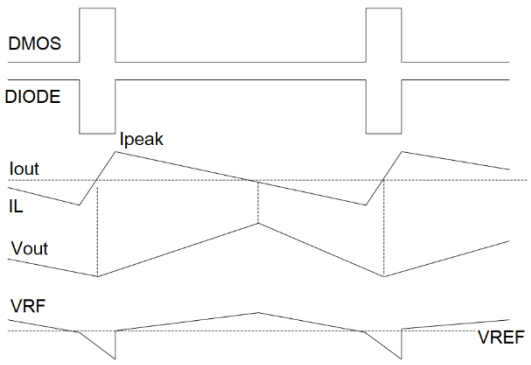


Fig7. Waveform if CCM Mode

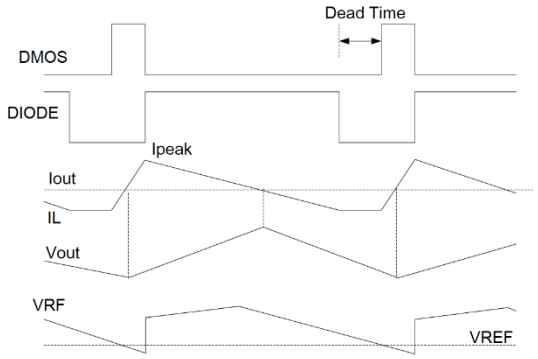


Fig8. Waveform of DCM Mode

PFM Modulation

The IC operates in PFM mode, and I_{PEAK} is set to decrease with the decrease of the IC operating frequency (F_{SW}).when the IC switching cycle increase 1us，I_{PEAK} will decrease 13.3mA.As a result of the internal current sampling and the maximum current limit (I_{limit}), inductance is the only parameter of the frequency modulation when output voltage and output current are fixed.

Soft-Start Up

In order to regulate peak current in deep CCM mode, AP8204 build in soft-start function, at the first 10ms of start up, the switching frequency decrease to 25% of the maximum frequency, while 10ms to 15ms of start up, the switching frequency decrease to 50% of the maximum frequency. Meanwhile, the leading edge blanking (LEB) is 300ns (Typ.), in order to regulate peak current.

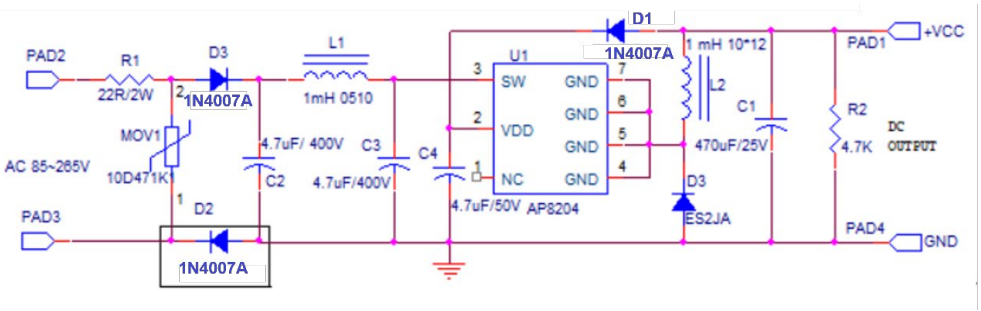
Smart Protection Control

AP8204 has several smart self-protection functions, such as Over Temperature Protection (OTP), V_{DD} Under-Voltage Lockout (UVLO). And all these protections have self-recovery mode.

OTP----If the inner junction temperature exceeds 150℃,the IC will shut down switching, until the junction temperature falls to 120℃.

UVLO----If V_{DD} pin Voltage drops below V_{DDoff}, the IC will restart. Otherwise, self-restart time can be changed by V_{DD} capacitor. The larger the capacitor, the longer the self-restart time is.

Layout Guide



AiT Solution

IC : AP8204

D1 : 1N4007A

D2: 1N4007A

D3 : 1N4007A

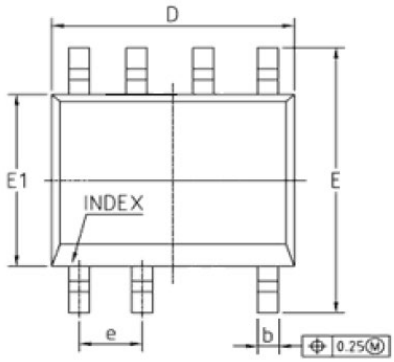
D2 : ES2JA

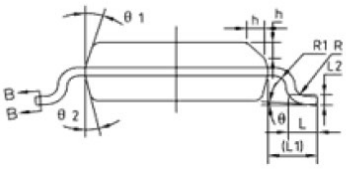
(1) For 2KV differential mode surge, a diode D2* 1N4007A is recommended.

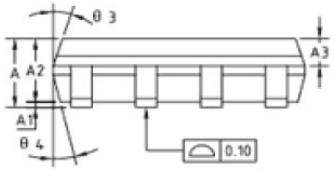
(2) V_{DD} capacitor C2 should be placed at the nearest place from the V_{DD} pin and the GND pin.

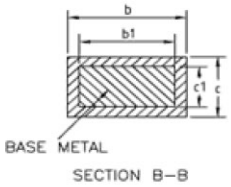
PACKAGE INFORMATION

Dimension in SOP7 (Unit: mm)









Symbol	Min	Max	Symbol	Min	Max
A	1.350	1.750	L	0.450	0.800
A1	0.100	0.250	L1	1.040 (REF)	
A2	1.250	1.650	L2	0.250 (BSC)	
A3	0.500	0.700	R	0.070	-
b	0.380	0.510	R1	0.070	-
b1	0.370	0.470	h	0.300	0.500
c	0.170	0.250	θ	0°	8°
c1	0.170	0.230	θ1	15°	19°
D	4.800	5.000	θ2	11°	15°
E	5.800	6.200	θ3	15°	19°
E1	3.800	4.000	θ4	11°	15°
e	1.270 (BSC)				

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