

LOW POWER PWM SWITCH FOR OFF-LINE SMPS**AP3902****General Description**

The AP3902 PWM power switch consists of a fixed-frequency current-mode PWM controller and a high voltage transistor. It is specifically designed for high performance off-line switching power supplies or non-isolated small household applications. Compared to discrete MOSFET and PWM controller power supply solutions, AP3902 solution offers advantages such as fewer component numbers, smaller size, and lower total cost.

In normal operation, the AP3902 features with a fixed switching frequency. When the output power falls below a given level, the circuits automatically switches to a burst mode by skipping some switching cycles. In case of failure modes like open loop, over voltage or overload due to short circuit, the device switches into auto restart mode which is controlled by the internal protection unit.

This IC adopts frequency dithering technique to reduce EMI.

The AP3902 is available in DIP-8 package.

Features

- Built-in NPN Transistor with $700V_{CBO}$
- Current Mode Control with Skip Cycle Capability
- Low Operating Current: 0.45mA
- Fixed Switching Frequency: 60kHz
- Frequency Dithering for Low EMI
- Short Circuit Protection
- Open and Short Circuit Protection for Opto-Coupler
- Maximal Input Power less than 0.2W under no Load
- Output Power Range:
 - 5W to 10W for Adapter with Outer Enclosure
 - 5W to 13W for Open Frame Application

Applications

- Induction Cooker
- Set-Top Boxes/DVB
- Adapters
- Auxiliary Power Supplies
- DVD

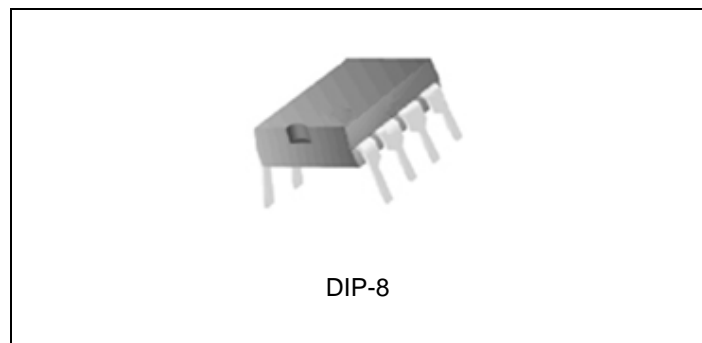


Figure 1. Package Type of AP3902

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Pin Configuration

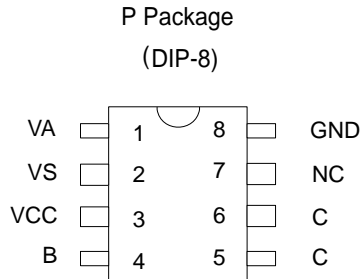


Figure 2. Pin Configuration of AP3902 (Top View)

Pin Description

| Pin Number | Pin Name | Function |
|------------|----------|---|
| 1 | VA | This pin is used for short circuit protection, and it will be pulled to low level when short circuit happens at the load terminal |
| 2, | VS | It is used for line voltage compensation, and PWM uses this pin to terminate the output switch conduction |
| 3 | VCC | The power supply of the IC and it is also used for the feedback control |
| 4 | B | It is internally connected with the base terminal of internal NPN transistor |
| 5, 6 | C | It is internally connected with the collector terminal of internal NPN transistor |
| 7 | NC | No connection to IC |
| 8 | GND | Supply ground |

Functional Block Diagram

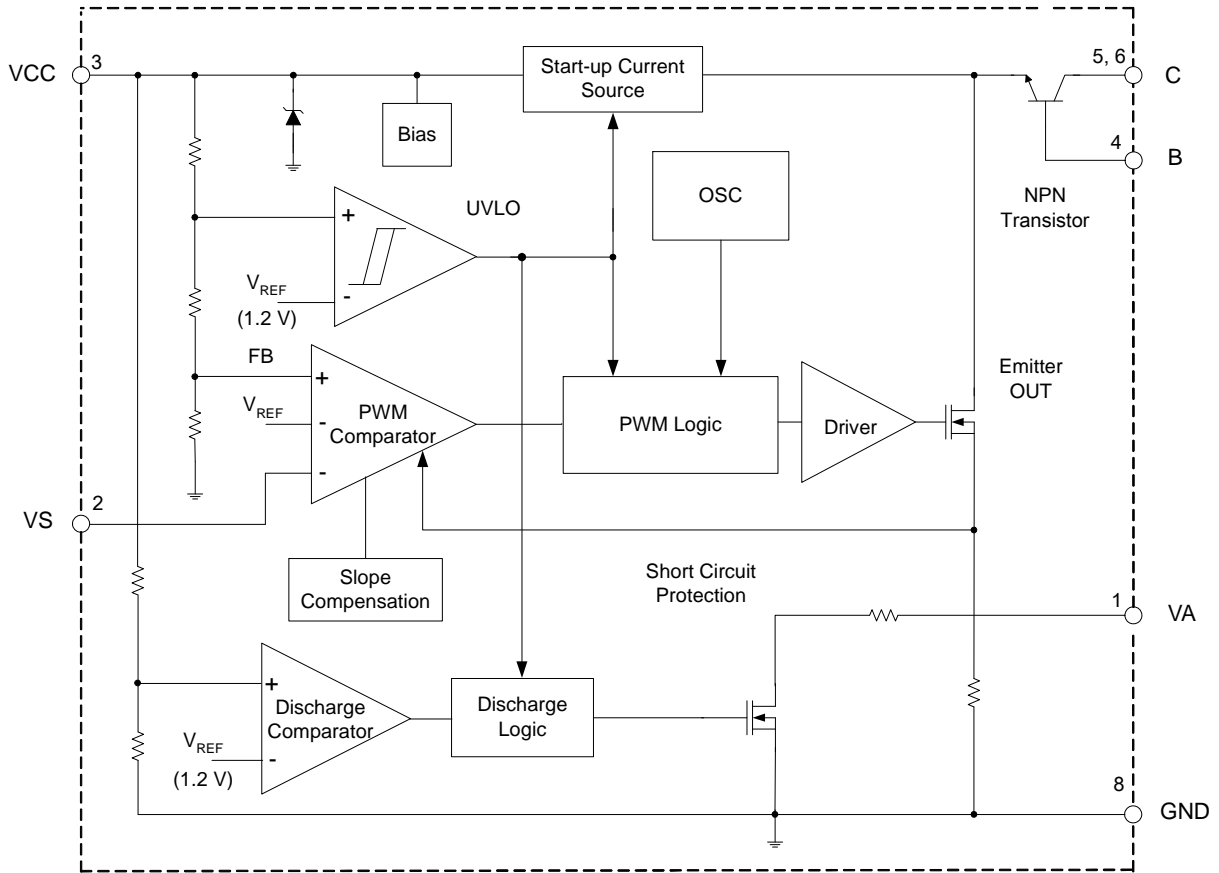
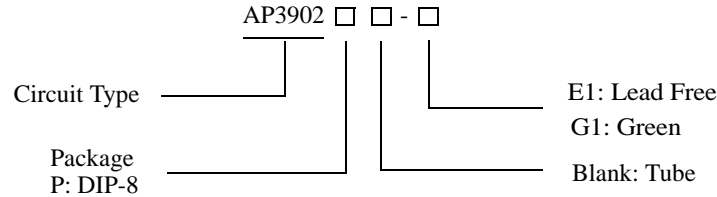


Figure 3. Functional Block Diagram of AP3902

**LOW POWER PWM SWITCH FOR OFF-LINE SMPS****AP3902****Ordering Information**

| Package | Temperature Range | Part Number | | Marking ID | | Packing Type |
|---------|-------------------|-------------|------------|------------|------------|--------------|
| | | Lead Free | Green | Lead Free | Green | |
| DIP-8 | -40 to 85°C | AP3902P-E1 | AP3902P-G1 | AP3902P-E1 | AP3902P-G1 | Tube |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

Absolute Maximum Ratings (Note 1)

| Parameter | Symbol | Value | Unit |
|---|-----------|-------------|------|
| Collector Pin Voltage | V_{CES} | 700 | V |
| Voltage at the Emitter of Internal NPN Transistor | V_E | -0.3 to 40 | V |
| Supply Voltage | V_{CC} | -0.3 to 6.3 | V |
| Analog Input at VS | V_S | -0.3 to 6.3 | V |
| VA Pin Voltage | V_A | -0.3 to 40 | V |
| Continuous Collector Current | | 1 | A |
| Power Dissipation | | 1.3 | W |
| Operating Junction Temperature | | 150 | °C |
| Storage Temperature | | -65 to 150 | °C |
| Lead Temperature (Soldering, 10s) | | 300 | °C |
| ESD (Human Body Model) | | 3000 | V |

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" 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 under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.



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Electrical Characteristics

($V_{CC}=4V$, $T_J=25^{\circ}C$, unless otherwise specified.)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|--------------------------------------|----------------|-----------------------------|---------|-----------|---------|------------|
| Power Transistor Section | | | | | | |
| Collector-Emitter Breakdown Voltage | V_{CES} | $V_{BE}=0, I_{CE}=100\mu A$ | 700 | | | V |
| Collector-Emitter Saturation Voltage | $V_{CE, SAT}$ | $I_C=0.5A, I_B=0.1A$ | | | 0.3 | V |
| DC Current Gain | h_{FE} | $I_C=0.5A, V_{CE}=2V$ | 13 | 18 | 30 | |
| UVLO Section | | | | | | |
| Turn on Threshold Voltage | $V_{CC(on)}$ | | 5.00 | 5.25 | 5.50 | V |
| Turn off Threshold Voltage | $V_{CC(off)}$ | | 3.37 | 3.55 | 3.73 | V |
| Discharge Voltage | V_{DIS} | | 2.7 | 2.9 | 3.1 | V |
| Standby Current Section | | | | | | |
| Start-up Current | I_{ST} | $V_{CC} = 4V$ | | 0.22 | 0.4 | mA |
| Operating Current | $I_{CC(op)}$ | | | 0.45 | 0.7 | |
| VCC Zener Voltage | V_Z | $I_{CC}=5mA$ | 6.5 | | | V |
| Dynamic Impedance | R_{VCC} | $V_{CC} = 3.8V$ to $4.8V$ | | 18 | 26 | k Ω |
| Internal Oscillator Section | | | | | | |
| Switching Frequency | f_{SW} | | 55 | 60 | 70 | kHz |
| Frequency Dithering | | | ± 2 | ± 3.5 | ± 5 | |
| Temperature Stability | | -40 to $85^{\circ}C$ | | 5 | 10 | % |
| Driver and Output Section | | | | | | |
| OUT Turn on Voltage | $V_{OUT(on)}$ | | | 8.5 | 11 | V |
| OUT Turn off Voltage | $V_{OUT(off)}$ | | 4.8 | 6 | 7.2 | V |
| Rise Time | t_R | $C_L=1nF, 15\Omega$ pull-up | | 60 | | ns |
| Fall Time | t_F | $C_L=1nF, 15\Omega$ pull-up | | 30 | | |
| Maximum Duty Cycle | D_{MAX} | $V_{CC(off)} + 0.2V$ | 68 | 75 | 82 | % |
| Minimum Duty Cycle | | $V_{CC}=V_{CC(on)} - 0.2V$ | | 3 | | |
| Driver OUT On-Resistance | R_{OUT} | $I_{OUT}=0.7A$ | | 2.5 | 4 | Ω |
| Switch Off Current | | Driver off, $V_{OUT}=10V$ | | 20 | 40 | μA |
| Effective Current Limit | I_{LIM} | $V_{CC}=V_{CC(off)} + 0.5V$ | 680 | 800 | 920 | mA |



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Thermal Impedance

| Parameter | Symbol | Value | Unit |
|---------------------|-----------------|-------|------|
| Junction to Ambient | $R_{\theta JA}$ | 60 | °C/W |
| Junction to Case | $R_{\theta JC}$ | 30 | |

Typical Performance Characteristics

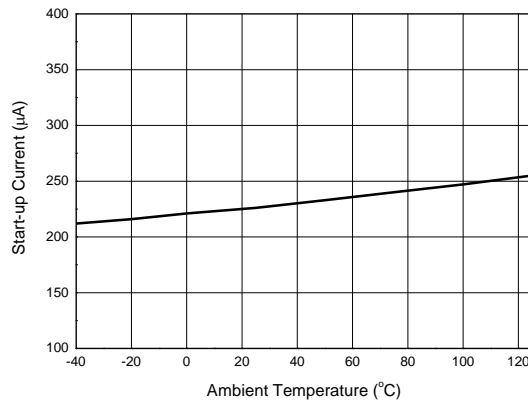


Figure 4. Start-up Current vs. Ambient Temperature

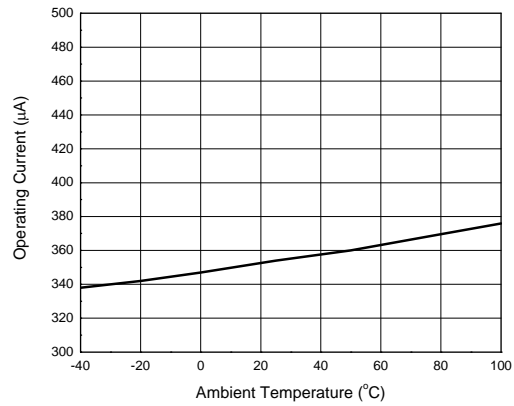


Figure 5. Operating Current vs. Ambient Temperature

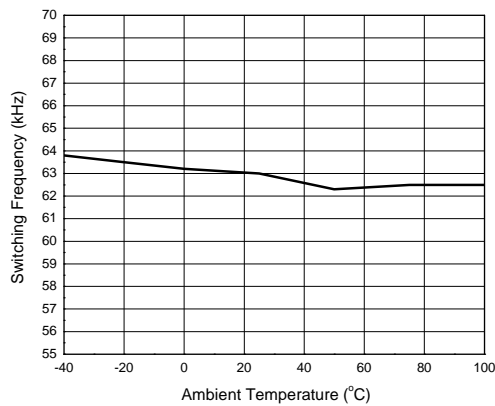


Figure 6. Switching Frequency vs. Ambient Temperature



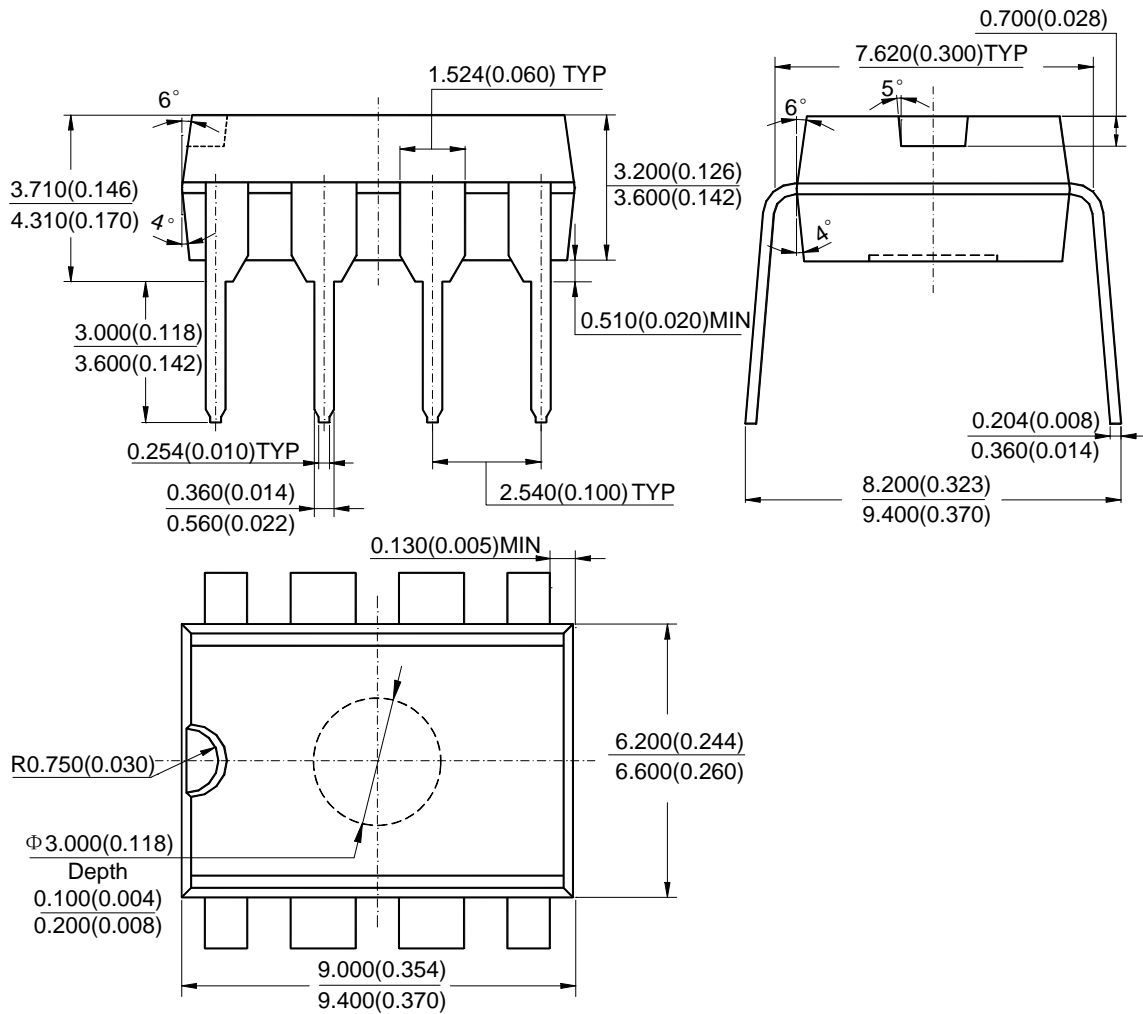
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Mechanical Dimensions

DIP-8

Unit: mm(inch)





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