

High Voltage PWM Controller

General Description

AT6002H is a highly integrated current mode PWM control for flyback converter, optimized for high performance, low standby power consumption and cost effective offline flyback converter applications.

The AT6002H built-in multiple protection with VCC under voltage lockout (UVLO), VCC over voltage protection (OVP), VCC clamp, GATE clamp, cycle-by-cycle current limiting (OCP), over load protection (OLP), RT Low Level Protection(RTLP), RT High Level Protection(RTHP), and leading-edge blanking (LEB) of the current sensing to prevent circuit damage occurred under abnormal conditions.

The AT6002H also has an X-cap discharge function to discharge the X-cap when the input is unplugged and Brown-out protection function.

The AT6002H is available in an SOP-8L package and require very few external devices for operation.

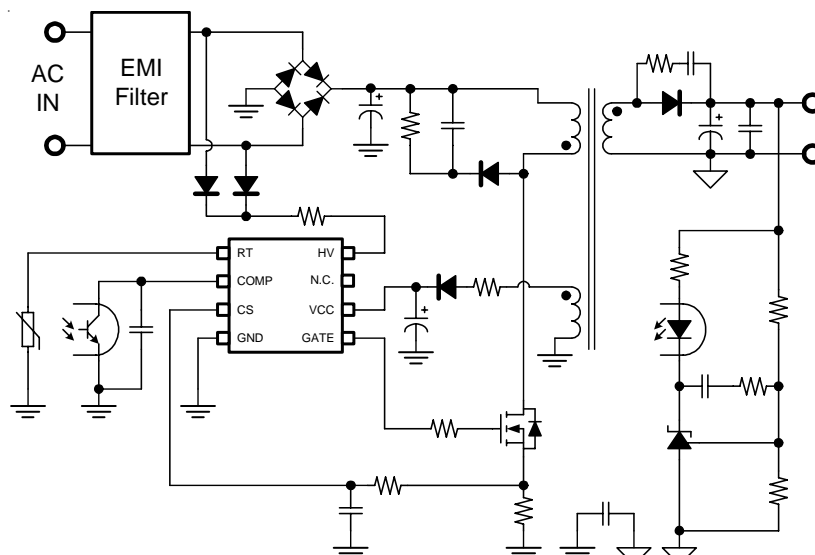
Features

- High Voltage Startup Circuit
- VCC Under Voltage Lockout (UVLO)
- VCC Over voltage Protection (OVP)
- Cycle-by-Cycle Current Limiting (OCP)
- Over Load Protection (OLP)
- Connection of an NTC for Over Temperature Protection (OTP)
- Leading Edge Blanking (LEB)
- X-CAP Discharge Function
- Brown-out Protection
- VCC & Gate Voltage Clamp
- 500mA Source/500mA Sink Gate Driver
- 100kHz Switching Frequency with Frequency Hopping for Reducing EMI
- SOP-8 Package

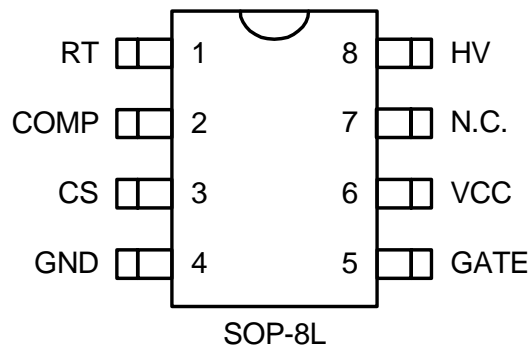
Applications

- AC/DC Switching Power Adaptor
- Battery Charger
- Open Frame Switching Power Supply

Typical Application Circuit



Pin Configuration



Function Pin Description

| Pin No. | Pin Name | Description |
|---------|----------|--|
| 1 | RT | Temperature Detection. An internal current source allows the direct connection of an NTC for over temperature detection. |
| 2 | COMP | Voltage Feedback. This pin connecting an opto-coupler to monitor output for regulation control loop. |
| 3 | CS | Current Sense. This pin sense primary MOSFET current. |
| 4 | GND | Ground. |
| 5 | GATE | PWM Signal Output. This pin output to drive the external power MOSFET. |
| 6 | VCC | Power Supply. |
| 7 | N.C. | No Connection. |
| 8 | HV | High Voltage. This pin connecting to X-cap capacitor via resistors to be a high voltage start-up current source, and to implement X-cap discharge and Brown in/out detection. |

Protection Mode

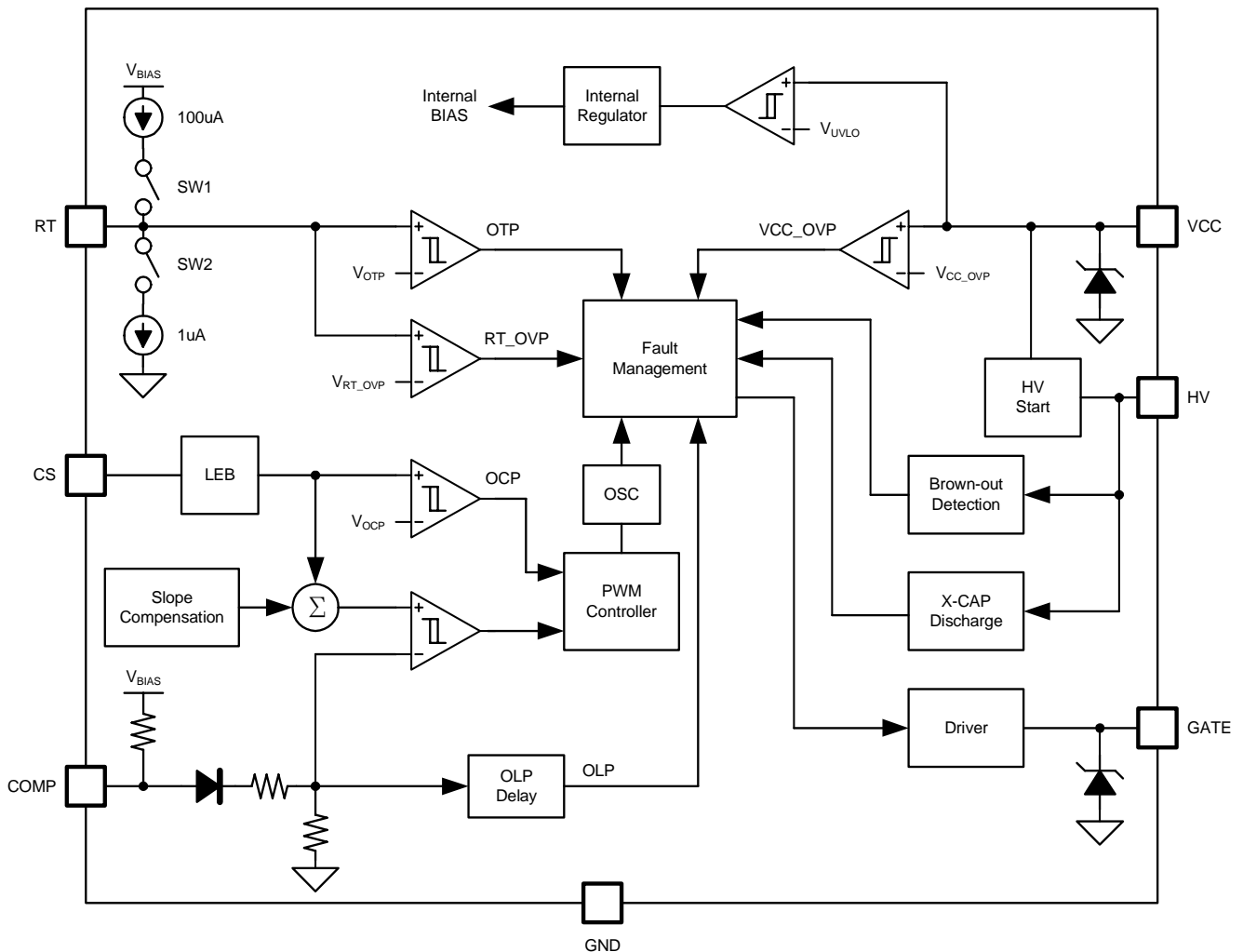
| Part Number | Switching Frequency | OLP | VCC OVP | RTL P | RTH P | Int. TSD |
|-------------|---------------------|------|---------|-------|-------|----------|
| AT6002H | 100kHz | Auto | Latch | Auto | Latch | Auto |

Ordering and Marking Information

| Order Number | Package | Top Marking |
|--------------|---------|-------------|
| AT6002HSP8 | SOP-8L | AT6002H |

Note: Aplustek products are compatible with the current IPC/JEDEC J-STD-020 requirement. They are halogen-free, RoHS compliant and 100% matte tin (Sn) plating that are suitable for use in SnPb or Pb-free soldering processes.

Function Blocks





Absolute Maximum Ratings

(Note1)

| | | |
|---|-------|-----------------|
| Supply Input Voltage, VCC | ----- | -0.3V to +32V |
| High-Voltage Pin, HV | ----- | - 0.3V to +600V |
| RT, COMP, CS | ----- | -0.3V to +7V |
| GATE | ----- | -0.3V to +20V |
| Storage Temperature Range | ----- | -65°C to +150°C |
| Junction Temperature | ----- | -40°C to +150°C |
| Lead Temperature Range(Soldering 10sec) | ----- | 260°C |

ESD Rating (Note2)

| | | |
|-------------------------------------|-------|-------|
| HBM(Human Body Mode, Except HV Pin) | ----- | 4KV |
| HBM(Human Body Mode, HV Pin) | ----- | 1.5KV |
| MM(Mechine Mode) | ----- | 400V |

Thermal Characteristics

Package Thermal Resistance (Note3)

| | | |
|----------------------|-------|---------|
| SOP-7L θ_{JA} | ----- | 250°C/W |
| SOP-7L θ_{JC} | ----- | 140°C/W |

Power Dissipation, PD @ TA = 25°C

| | | |
|--------|-------|-------|
| SOP-7L | ----- | 400mW |
|--------|-------|-------|

Electrical Characteristics

(V_{CC} = 12V, T_A = +25°C unless otherwise specified.)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|------------------------------------|-----------------------|---|------|------|------|-------|
| Supply Input Section | | | | | | |
| Operating Voltage | | | 8 | -- | 27 | V |
| Power On Voltage | VCC_on | | 13.5 | 14 | 14.5 | V |
| Holdup Voltage | VCC_hold | I _{HV} >1mA | 8 | 8.5 | 9 | V |
| Power Off Voltage | VCC_off | | 7 | 7.5 | 8 | V |
| Reset Voltage | VCC_rst | | 6 | 6.5 | 7 | V |
| Over Voltage Protection Voltage | VCC_ovp | | 27 | 28.5 | 30 | V |
| Internal Zener Clamp | VCC_clamp | I _{CC} >2*I _{CC_op} | -- | 31 | -- | V |
| Startup Current | I _{CC_start} | | 200 | 270 | 350 | uA |
| Normal Operating Current | I _{CC_op} | C _L =1nF | -- | 1.3 | -- | mA |
| Burst Mode Operating Current | I _{CC_bs} | V _{CMOP} <V _{CMOP_bs} | -- | 0.35 | -- | mA |
| COMP Pin Section | | | | | | |
| COMP Pull High Impedance | ZCOMP | | -- | 20 | -- | kΩ |
| Open Loop Voltage | V _{COMP_o} | COMP Open | -- | 5 | -- | V |
| Over Load Protection Voltage | V _{COMP_olp} | | -- | 4.4 | -- | V |
| Over Load Protection Debounce Time | T _{deb_olp} | | -- | 65 | -- | ms |



| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|--|-------------|--|-------|------|-------|-------|
| High Voltage Section | | | | | | |
| High-Voltage Current | IHV_on | VCC>1V | 2.5 | 3 | 3.5 | mA |
| Initial High-Voltage Current | IHV0_on | VCC=0V | -- | 0.67 | -- | mA |
| High-Voltage Off Current | IHV_off | VHV=600V,VCC>VCC_on | -- | -- | 20 | uA |
| Brown In Threshold | | | 101 | 106 | 111 | V |
| Brown In Delay Time | | | -- | 200 | -- | us |
| Brown Out Threshold | | | 94 | 99 | 104 | V |
| Brown Out Delay Time | | | -- | 90 | -- | ms |
| Xcap Discharge Current | | | -- | 2 | -- | mA |
| Xcap Debounce Time | | | -- | 90 | -- | ms |
| Xcap Discharge Time | | | -- | 500 | -- | ms |
| HV Resister Range | | | -- | 20 | 40 | kΩ |
| Oscillation Section | | | | | | |
| Nominal Frequency | Fosc_n | VCOMP>VCOMP_f | 94 | 100 | 106 | kHz |
| Green Frequency | Fosc_gr | VCOMP_bs<VCOMP<VCOMP_gr | -- | 24 | -- | kHz |
| COMP Threshold for Frequency Reduction | VCOMP_f | Fosc<Fosc_n | -- | 2.2 | -- | V |
| COMP Voltage for Green Frequency | VCOMP_gr | Fosc=Fosc_gr | -- | 2 | -- | V |
| COMP Threshold for Zero Duty | VCOMP_bs | | -- | 1.6 | -- | V |
| Frequency Hopping Range | | Fosc=Fosc_n | -- | +5 | -- | % |
| Current Sense Section | | | | | | |
| Delay to Output | | | -- | -- | 100 | ns |
| Leading Edge Blanking Time | t_leb | VCS>1.1V | -- | 350 | -- | ns |
| Minimum On Time | ton_min | | -- | 710 | -- | ns |
| CS Threshold at Max Duty | VCS_max | Fosc=Fosc_n | 0.885 | 0.9 | 0.915 | V |
| Input Impedance | ZCS | | 1 | -- | -- | MΩ |
| Soft Start Time | tss | | -- | 0.5 | -- | ms |
| GATE Section | | | | | | |
| Maximum Duty Cycle | Dmax | Max Frequency | 71 | 80 | 89 | % |
| Output Voltage Low | Vol | VCC=15V, I _o =20mA Sinking | -- | 0.12 | 0.25 | V |
| Output Voltage High | Voh | VCC=15V, I _o =20mA Sourcing | 9 | 11 | -- | V |
| Rising Time | tr | CL=1nF,Vgate from 2V to 6V | -- | 88 | -- | ns |
| Falling Time | tf | CL=1nF,Vgate from 6V to 2V | -- | 10 | -- | ns |
| Gate Voltage Clamping | Vgate_clamp | VCC=27V | 12 | 14 | 16 | V |



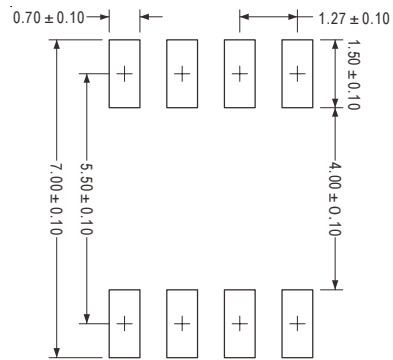
| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|--|------------|-----------------|-------|------|-------|-------|
| RT Pin Section | | | | | | |
| Floating Voltage of RT | VRT_o | RT Open | 2.1 | 2.3 | 2.5 | V |
| RT Sourcing Current | IRT | RT < 1.5V | 95 | 100 | 105 | uA |
| RT High Level Protection | VRTTHP | | 3.325 | 3.5 | 3.675 | V |
| RT Low Level Protection | VRTTLP | | 0.95 | 1 | 1.05 | V |
| RT Low Protection Blanking Time after Brown In | tbk_rtlp | | -- | 5.12 | -- | ms |
| TSD Section | | | | | | |
| Internal Thermal Protection | | | -- | 140 | -- | °C |
| Fault Section | | | | | | |
| Fault Recycle Time | tcyc_fault | | -- | 1 | -- | s |
| Fault Debounce Time (Exclude OLP) | tdeb_fault | | -- | 75 | -- | us |

Note 1. Exceeding these limits may impair the life of the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.

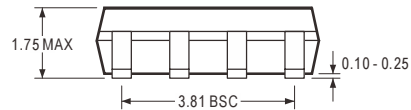
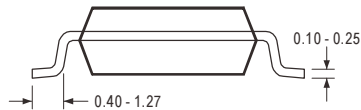
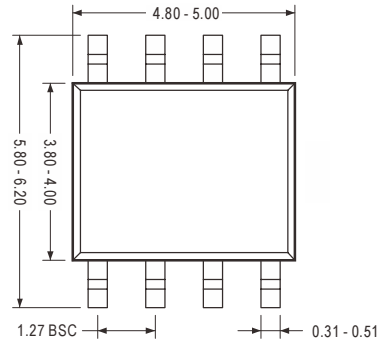
Note 2. θ_{JA} is measured with the component mounted on a high effective thermal conductivity test board in free air. The exposed pad of the package is soldered directly on the PCB.

Package Information

SOP-8L



Recommended Solder Pad Layout



Note

1. Package Outline Unit Description:

BSC: Basic. Represents theoretical exact dimension .

MAX: Maximum dimension specified.

MIN: Minimum dimension specified.

REF: Represents dimension for reference use only. The value is not the device specification.

TYP: Represents as a typical value. The value is not the device specification.

2. All linear dimensions are in Millimeters.