

PWM Control 3A Step-Down Converter

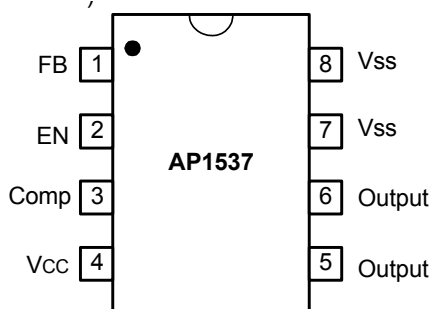
■ Features

- Input voltage: 3.6V to 18V.
- Output voltage: 0.8V to V_{CC} .
- Duty ratio: 0% to 100% PWM control
- Oscillation frequency: 500KHz typ.
- Soft-start, Current Limit, Enable function
- Thermal Shutdown function
- Built-in internal SW P-channel MOS
- Low ESR output capacitor (Multi-layer chip capacitor (MLCC)) application
- SOP-8L **Pb-Free** Package.

■ Applications

- PC Motherboard
- LCD Monitor
- Graphic Card
- DVD-Video Player
- Telecom Equipment
- ADSL Modem
- Printer and other Peripheral Equipment
- Microprocessor core supply
- Networking power supply

■ Pin Assignments



■ General Description

AP1537 consists of step-down switching regulator with PWM control. These devices include a reference voltage source, oscillation circuit, error amplifier, internal PMOS and etc.

AP1537 provides low-ripple power, high efficiency, and excellent transient characteristics. The PWM control circuit is able to vary the duty ratio linearly from 0 up to 100%. This converter also contains an error amplifier circuit as well as a soft-start circuit that prevents overshoot at startup. An enable function, an over current protect function and a short circuit protect function are built inside, and when OCP or SCP happens, the operation frequency will be reduced from 500KHz to 50KHz. Also, an internal compensation block is built in to minimum external component count.

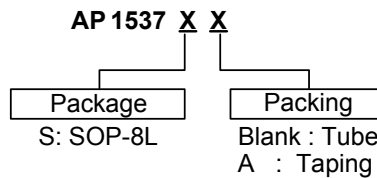
With the addition of an internal P-channel Power MOS, a coil, capacitors, and a diode connected externally, these ICs can function as step-down switching regulators. They serve as ideal power supply units for portable devices when coupled with the SOP-8L mini-package, providing such outstanding features as low current consumption. Since this converter can accommodate an input voltage up to 18V, it is also suitable for the operation via an AC adapter.

■ Pin Descriptions

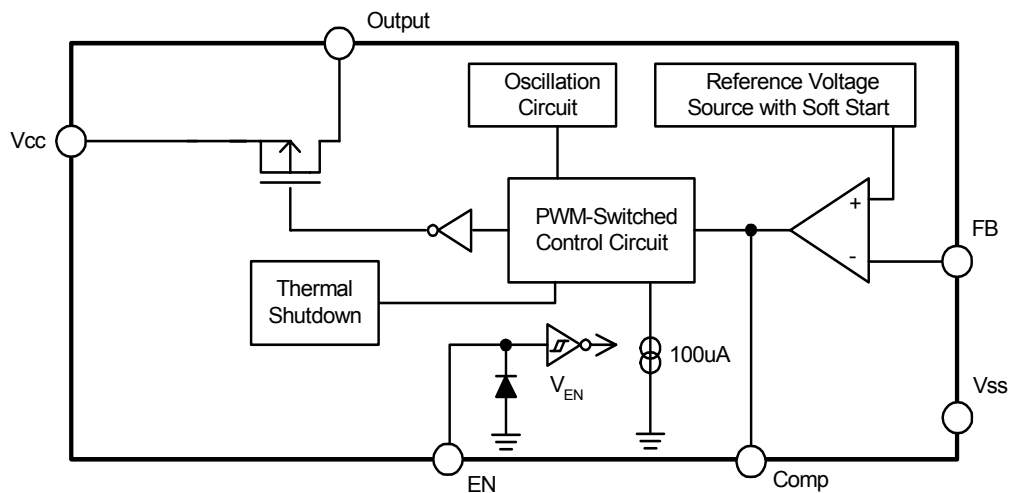
| Name | Pin | Description |
|--------|-------|---|
| FB | 1 | Feedback pin |
| EN | 2 | Power-off pin H: Normal operation (Step-down operation) L: Step-down operation stopped (All circuits deactivated) |
| Comp | 3 | Compensation pin |
| Vcc | 4 | IC power supply pin |
| Output | 5 · 6 | Switch Pin. Connect external inductor/diode here. Minimize trace area at this pin to reduce EMI. |
| Vss | 7 · 8 | GND Pin |

PWM Control 3A Step-Down Converter

■ Ordering Information



■ Block Diagram



■ Absolute Maximum Ratings

| Symbol | Parameter | Rating | Unit |
|---------------|--|----------------------------------|------|
| V_{CC}^{*1} | V _{CC} Pin Voltage | $V_{SS} - 0.3$ to $V_{SS} + 20$ | V |
| V_{FB} | Feedback Pin Voltage | $V_{SS} - 0.3$ to V_{CC} | V |
| V_{EN} | EN Pin Voltage | $V_{SS} - 0.3$ to $V_{IN} + 0.3$ | V |
| V_{OUTPUT} | Switch Pin Voltage | $V_{SS} - 0.3$ to $V_{IN} + 0.3$ | V |
| P_D | Power Dissipation | 1000 | mW |
| T_{OPR} | Junction Operating Temperature Range | -20 to +125 | °C |
| T_{STG} | Storage Temperature Range | -40 to +150 | °C |
| θ_{JC} | Thermal Resistance Junction-to-Case 3 inch ² Copper as a heat-sink | 15 | °C/W |
| θ_{JA} | Thermal Resistance Junction-to-Case 3 inch ² Copper as a heat-sink | 65 | °C/W |

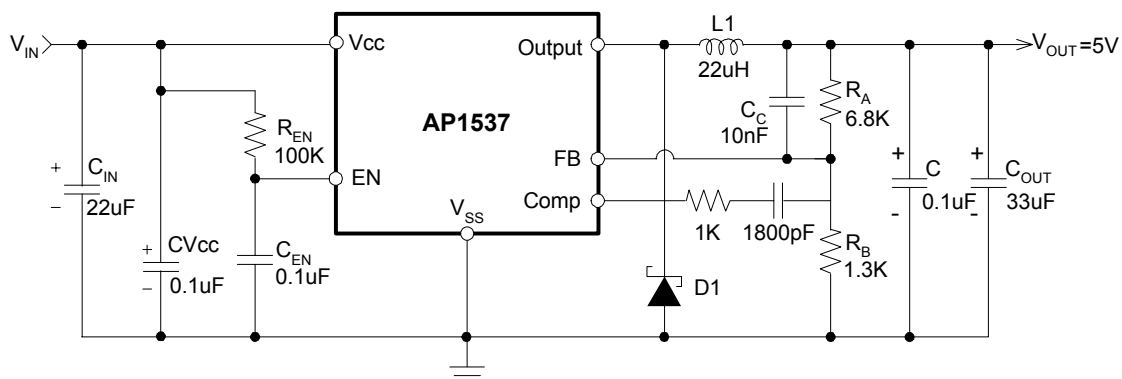
Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

PWM Control 3A Step-Down Converter

■ Electrical Characteristics ($V_{IN} = 12V$, $T_a=25^\circ C$, unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|----------------------------------|---|---|-------|------|-------|------------|
| V_{IN} | Input Voltage | -- | 3.6 | - | 18 | V |
| V_{FB} | Feedback Voltage | $I_{OUT}=0.1A$ | 0.784 | 0.8 | 0.816 | V |
| I_{FB} | Feedback Bias Current | $I_{OUT}=0.1A$ | - | 0.1 | 0.5 | μA |
| I_{SW} | Switch Current | -- | 3.5 | - | - | A |
| I_{SSS} | Current Consumption During Power Off | $V_{EN}=0V$ | - | 10 | - | μA |
| $\frac{\Delta V_{OUT}}{V_{OUT}}$ | Line Regulation | $V_{IN} = 5V\sim 18V$, $I_{OUT}=0.2A$ | - | 1 | 2 | % |
| $\frac{\Delta V_{OUT}}{I_{OUT}}$ | Load Regulation | $I_{OUT} = 0.1$ to 3A | - | 0.2 | 0.5 | % |
| f_{OSC} | Oscillation Frequency | Measure waveform at SW pin | 400 | 500 | 600 | KHz |
| f_{OSC1} | Frequency of Current Limit or Short Circuit Protect | Measure waveform at SW pin | 40 | - | - | KHz |
| V_{SH} | EN Pin Input Voltage | Evaluate oscillation at SW pin | 2.0 | - | - | V |
| V_{SL} | | Evaluate oscillation stop at SW pin | - | - | 0.8 | |
| I_{SH} | EN Pin Input Leakage Current | $V_{IN} = 12V$ | -10 | - | 10 | μA |
| I_{SL} | | -- | -10 | - | 10 | |
| T_{SS} | Soft-Start Time | -- | 0.3 | 2 | 5 | ms |
| R_{DSON} | Internal MOSFET Rdson | $V_{IN}=5V$, $V_{FB}=0V$ | - | 110 | 150 | m Ω |
| | | $V_{IN}=12V$, $V_{FB}=0V$ | - | 70 | 100 | |
| EFFI | Efficiency | $V_{IN} = 12V$, $V_{OUT} = 5V$ $I_{OUT} = 3A$ | - | 91 | - | % |

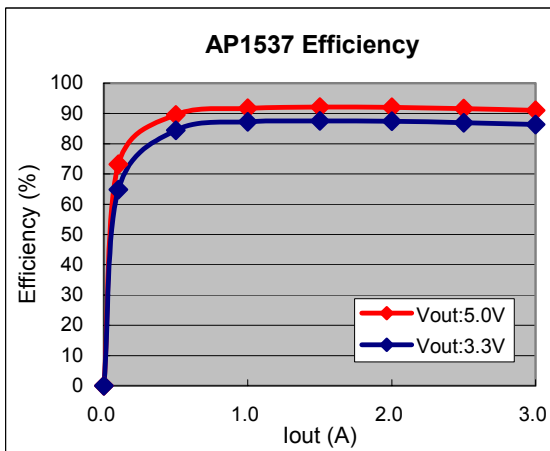
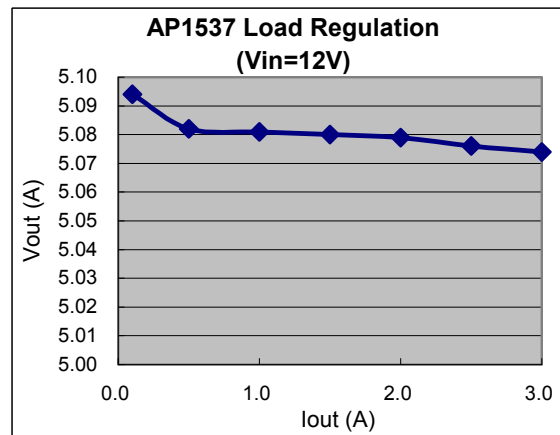
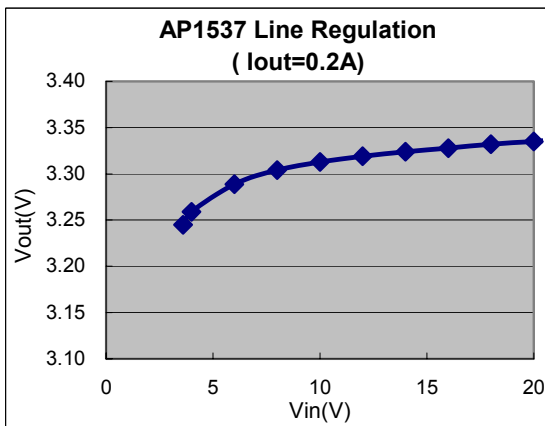
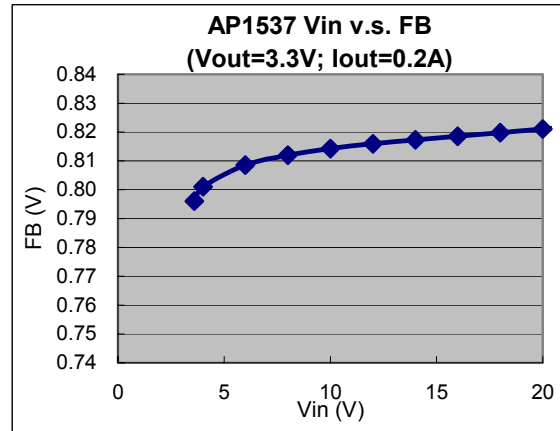
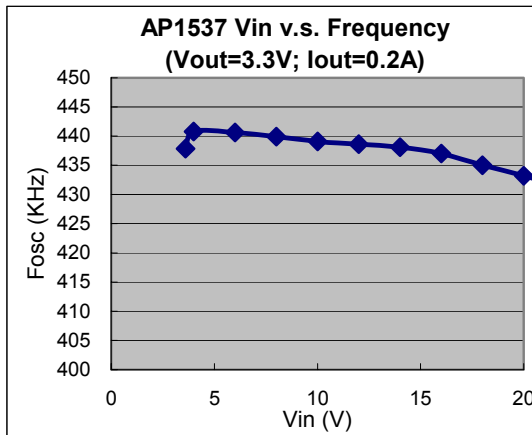
■ Typical Application Circuit



Note: $V_{OUT} = V_{FB} \times (1 + R_A/R_B)$
 $R_B = 0.7K \sim 5K$ ohm

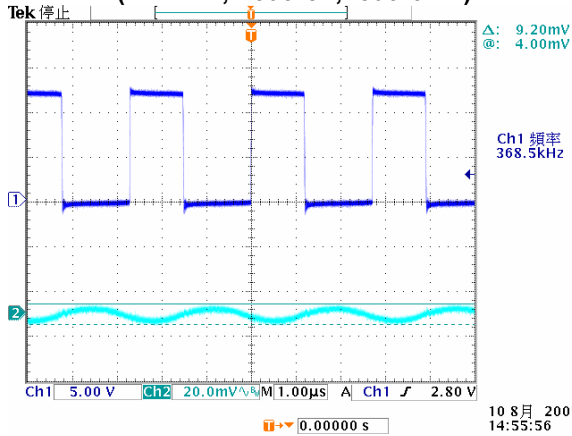
| $V_{IN}=12V$, $I_{MAX}=3A$ | | | |
|-----------------------------|------|------|------|
| V_{OUT} | 2.5V | 3.3V | 5V |
| L1 Value | 18uH | 22uH | 22uH |

■ Typical Performance Characteristics

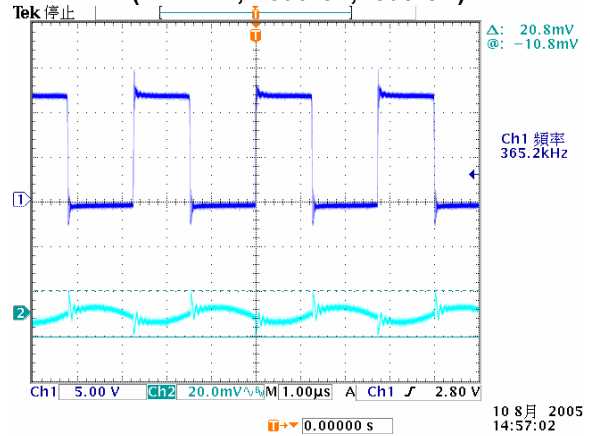


Typical Performance Characteristics (Continued)

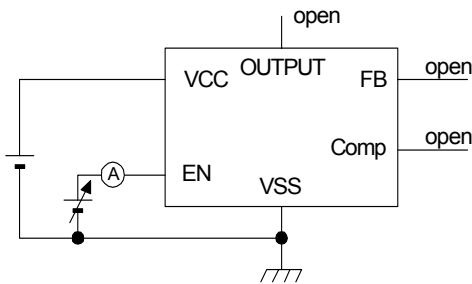
AP1537 Vout Ripple
(Vin=12V; Vout=5V; Iout=0.2A)



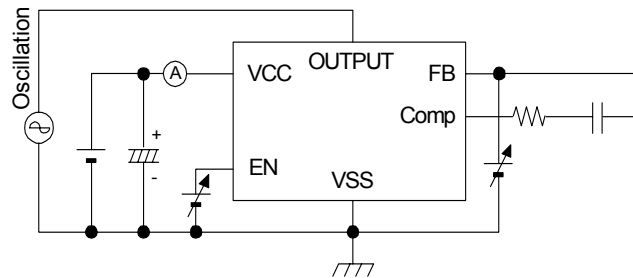
AP1537 Vout Ripple
(Vin=12V; Vout=5V; Iout=3A)



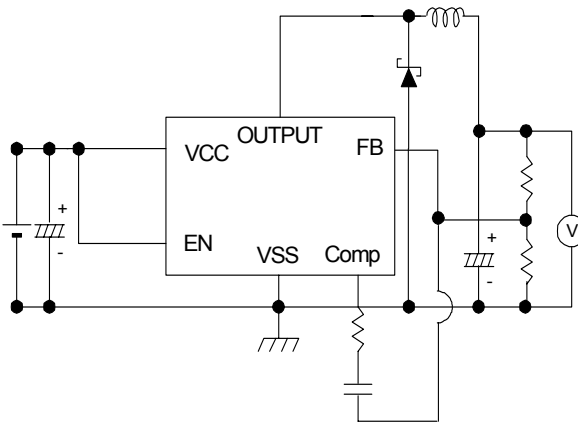
Test Circuit



Enable function test



Feedback function test



Operation function test

■ Function Description

PWM Control

The AP1537 consists of DC/DC converters that employ a pulse-width modulation (PWM) system. In converters of the AP1537, the pulse width varies in a range from 0 to 100%, according to the load current. The ripple voltage produced by the switching can easily be removed through a filter because the switching frequency remains constant. Therefore, these converters provide a low-ripple power over broad ranges of input voltage and load current.

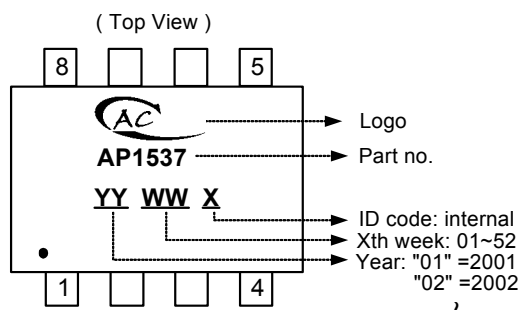
Under Voltage Lockout

The under voltage lockout circuit of the AP1537 assures that the high-side MOSFET driver outputs remain in the off state whenever the supply voltage drops below 3.3V. Normal operation resumes once V_{CC} rises above 3.5V.

$R_{DS(ON)}$ Current Limiting

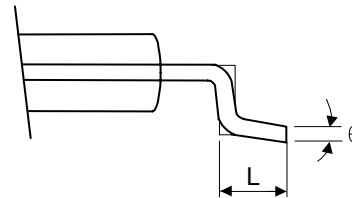
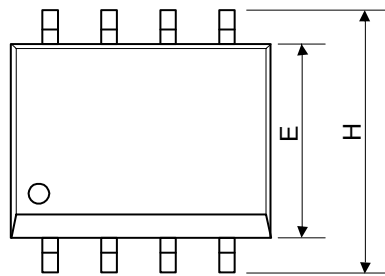
The current limit threshold is setting by the internal circuit.

■ Marking Information

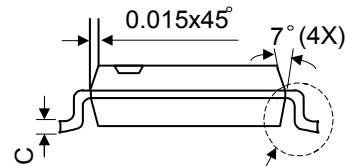
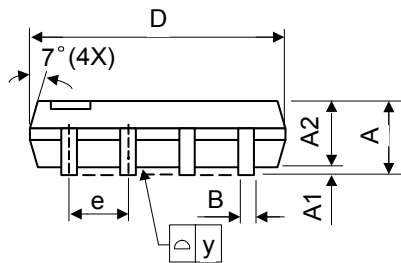


■ Package Information

Package Type: SOP-8L



VIEW "A"



VIEW "A"

| Symbol | Dimensions In Millimeters | | | Dimensions In Inches | | |
|----------|---------------------------|------|------|----------------------|-------|-------|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | 1.40 | 1.60 | 1.75 | 0.055 | 0.063 | 0.069 |
| A1 | 0.10 | - | 0.25 | 0.040 | - | 0.100 |
| A2 | 1.30 | 1.45 | 1.50 | 0.051 | 0.057 | 0.059 |
| B | 0.33 | 0.41 | 0.51 | 0.013 | 0.016 | 0.020 |
| C | 0.19 | 0.20 | 0.25 | 0.0075 | 0.008 | 0.010 |
| D | 4.80 | 5.05 | 5.30 | 0.189 | 0.199 | 0.209 |
| E | 3.70 | 3.90 | 4.10 | 0.146 | 0.154 | 0.161 |
| e | - | 1.27 | - | - | 0.050 | - |
| H | 5.79 | 5.99 | 6.20 | 0.228 | 0.236 | 0.244 |
| L | 0.38 | 0.71 | 1.27 | 0.015 | 0.028 | 0.050 |
| y | - | - | 0.10 | - | - | 0.004 |
| θ | 0° | - | 8° | 0° | - | 8° |