

Features

- PWM Buck Control Circuitry
- Operating voltage can be up to 27V
- Under voltage Lockout (UVLO) Protection
- Short Circuit Protection (SCP)
- Soft-start circuit
- Variable Oscillator Frequency -- 300Khz Max
- 1.25V voltage reference Output
- 8-pin SOP package
- Lead Free Finish/ RoHS Compliant for Lead Free and "Green" products (Note 1)
- SOP-8L: Available in "Green" Molding Compound (No Br, Sb)

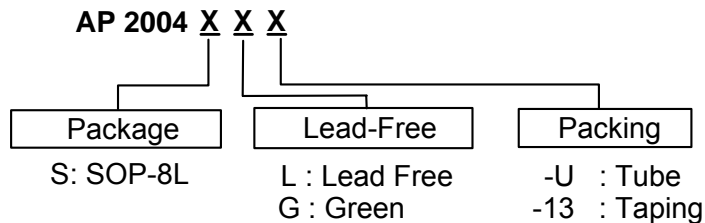
General Description

The AP2004 integrates Pulse-Width-Modulation (PWM) control circuit into a single chip, mainly designs for power-supply regulator. All the functions include an on-chip 1.25V reference output, an error amplifier, an adjustable oscillator, a soft-start, UVLO, SCP circuitry, and a push-pull output circuit. Switching frequency is adjustable by trimming CT. During low VCC situation, the UVLO makes sure that the outputs are off until the internal circuit operates normally.

Applications

- Backlight inverter
- LCD Monitor
- CDROM, XDSL Product
- DC/DC converters in computers, etc.

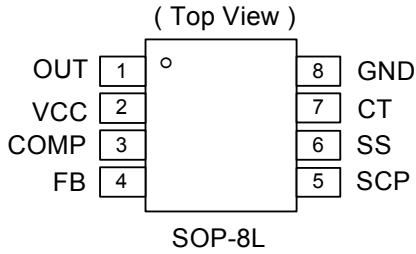
Ordering Information



| Device (Note 2) | Package Code | Packaging | Tube | | 13" Tape and Reel | |
|--------------------|-----------------|-----------|----------|-----------------------|-------------------|-----------------------|
| | | | Quantity | Part Number Suffix | Quantity | Part Number Suffix |
| AP2004S | S | SOP-8L | 100 | - U | 2500/Tape & Reel | -13 |

Note: 1. RoHS revision 13.2.2003. Glass and High Temperature Solder Exemptions Applied, see *EU Directive Annex Notes 5 and 7*.
 2. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

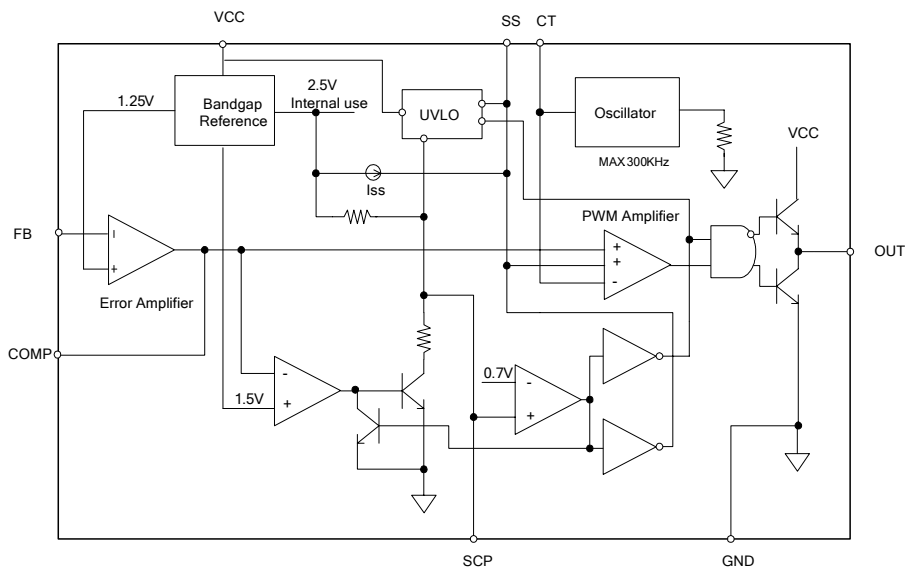
Pin Assignments



Pin Descriptions

| Name | Description |
|------|----------------------------|
| CT | Timing Capacitor |
| FB | Voltage Feedback |
| SS | Soft-Start. |
| COMP | Feedback Loop Compensation |
| OUT | PWM Output |
| GND | Ground |
| VCC | Supply Voltage |
| SCP | Short Circuit Protection |

Block Diagram



Absolute Maximum Ratings

| Symbol | Parameter | Rating | Unit |
|--------------|--------------------------------------|---------------|------|
| P_D | Power dissipation at 25°C | 600 | mW |
| V_{CC} | Supply voltage | 28 | V |
| V_I | Amplifier input voltage | 20 | V |
| V_O | Collector output voltage | $V_{CC}-1.0V$ | V |
| I_{SOURCE} | Source current | 200 | mA |
| I_{SINK} | Sink current | 200 | mA |
| T_{OP} | Operating junction temperature range | -20 to +85 | °C |
| T_{ST} | Storage temperature range | -65 to +150 | °C |

Recommended Operating Conditions

| Symbol | Parameter | Min. | Max. | Unit |
|-----------|--------------------------------|------|--------------|------|
| V_{CC} | Supply voltage | 3.6 | 27 | V |
| V_I | Amplifier input voltage | 1.05 | 1.45 | V |
| V_O | Collector output voltage | | $V_{CC}-1.5$ | V |
| I_{FB} | Current into feedback terminal | | 45 | μA |
| R_F | Feedback resistor | 100 | | kΩ |
| C_T | Timing capacitor | 100 | 6800 | pF |
| F_{OSC} | Oscillator frequency | 10 | 300 | KHz |

Electrical Characteristics ($T_A = 25^\circ\text{C}$, $V_{CC} = 6\text{V}$, $f = 200\text{KHz}$)

Reference (REF)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|--|---|-------|------|---------|---------|
| V_{REF} | Comp connect to FB | | 1.225 | 1.25 | 1.275 | V |
| | Output voltage change with temperature | $T_A = -20^\circ\text{C} \sim 25^\circ\text{C}$ | | -0.1 | ± 1 | % |
| | | $T_A = 25^\circ\text{C} \sim 85^\circ\text{C}$ | | | -0.2 | ± 1 |

Under voltage lockout (UVLO)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------------------|---|------|------|------|------|
| V_{UT} | Upper threshold voltage (V_{CC}) | $I_{O(REF)} = 0.1\text{mA}$ $T_A = 25^\circ\text{C}$ | | 2.9 | | V |
| V_{LWT} | Lower threshold voltage (V_{CC}) | | | 2.4 | | V |
| V_{HT} | Hysteresis (V_{CC}) | | | | 500 | mV |

Short-circuit protection (SCP) control

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|-------------------------------------|--|------|------|------|---------------|
| V_{IT} | Input threshold voltage | $T_A = 25^\circ\text{C}$ | 0.60 | 0.67 | 0.75 | V |
| V_{STB} | Standby voltage | No pull up | 100 | 130 | 160 | mV |
| V_{LT} | Latched input voltage | No pull up | | 50 | 100 | mV |
| I_{SCP} | Input (source) current | $V_I = 0.7\text{V}$, $T_A = 25^\circ\text{C}$ | -10 | -15 | -20 | μA |
| V_{CT} | Comparator threshold voltage (COMP) | | | 1.5 | | V |

Oscillator (OSC)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|------------------|---------------------------------|--|------|------|------|------|
| F_{OSC} | Frequency | $C_T = 270\text{pF}$ | | 200 | | KHz |
| ΔF_{OSC} | Standard deviation of frequency | $C_T = 270\text{pF}$ | | 10 | | % |
| | Frequency change with voltage | $V_{CC} = 3.6\text{V} \sim 20\text{V}$ | | 1 | | |

Error-amplifier

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|----------|---------------------------------|--|---------------|------|-----------|---------------|
| V_{IO} | Input offset voltage | $V_O(\text{FB}) = 1.25\text{V}$ | | | ± 6 | mV |
| I_{IO} | Input offset current | $V_O(\text{FB}) = 1.25\text{V}$ | | | ± 100 | nA |
| I_{IB} | Input bias current | $V_O(\text{FB}) = 1.25\text{V}$ | | 160 | 500 | nA |
| V_{CM} | Common-mode input voltage range | $V_{CC} = 3.6\text{V} \sim 20\text{V}$ | 1.05 | | 1.45 | V |
| AV | Open-loop voltage amplification | $R_F = 200\text{k}\Omega$ | 70 | 80 | | dB |
| GBW | Unity-gain bandwidth | | | 1.5 | | MHz |
| CMRR | Common-mode rejection ratio | | 60 | 80 | | dB |
| V_{OH} | Max. output voltage | | $V_{ref}-0.1$ | | | V |
| V_{OL} | Min. output voltage | | | | 1 | V |
| I_{OI} | Output (sink) current (COMP) | $V_{ID} = -0.1\text{V}$, $V_O = 1.25\text{V}$ | 0.5 | 1.6 | | mA |
| I_{OO} | Output (source) current (COMP) | $V_{ID} = 0.1\text{V}$, $V_O = 1.25\text{V}$ | -45 | -70 | | μA |

Electrical Characteristics (Continued) (T_A = 25°C, V_{CC} = 6V, f = 200 KHz)

Output section

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------|------------------------------|------------------------|------|------|------|------|
| I _{LEAK} | Leakage current | V _O = 25V | | | 10 | μA |
| I _{DRV} | Sink current | V _{IN} = 20V | | 200 | | mA |
| | Source current | V _{IN} = 20V | | 200 | | mA |
| V _{SAT} | Output saturation voltage | I _O = 10 mA | | 1.0 | 1.5 | V |
| I _{SC} | Short-circuit output current | V _O = 6V | | 120 | | mA |

PWM comparator

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------|--|--------------------|------|------|------|------|
| V _{T0} | Input threshold voltage at f = 10 KHz (COMP) | CT | | 0.6 | 0.7 | V |
| V _{T100} | | Maximum duty cycle | 1.2 | 1.3 | | V |

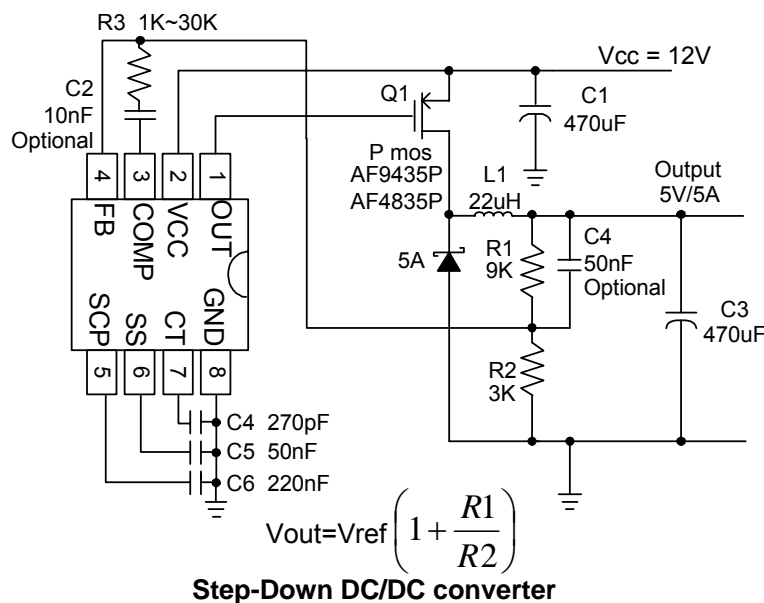
Total device

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|------------------|------------------------|------------------------|------|------|------|------|
| I _{CCA} | Average supply current | C _T = 270pF | | 6 | 10 | mA |

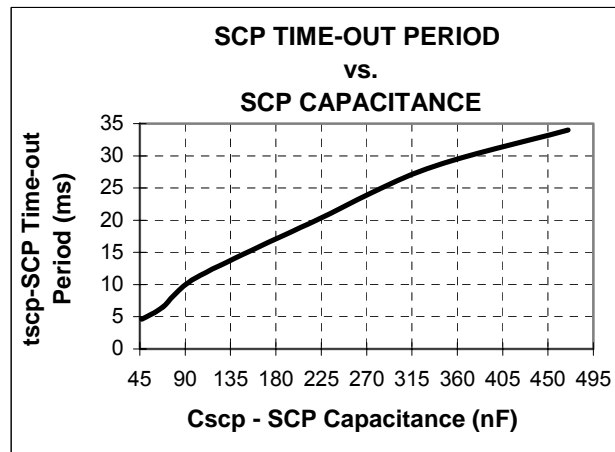
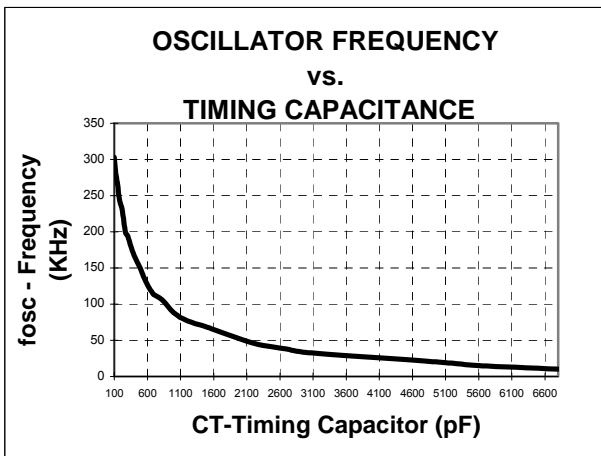
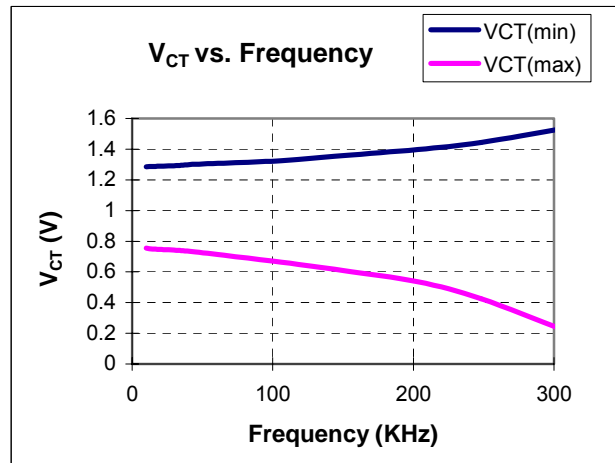
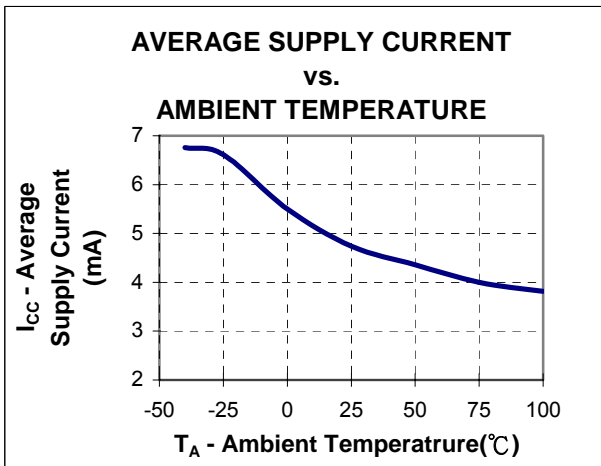
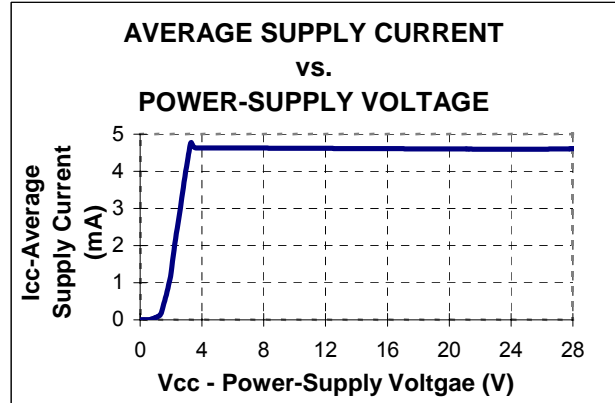
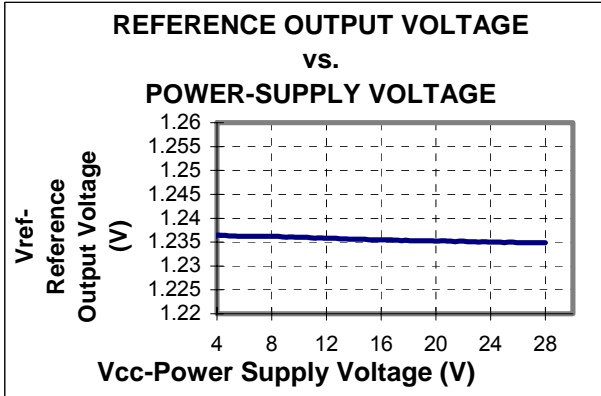
Soft Start

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------|------------|------|------|------|------|
| V _{SS} | Soft-start Voltage | | | 2.3 | | V |
| I _{SS} | Constant Charge Current | | | 20 | | μA |

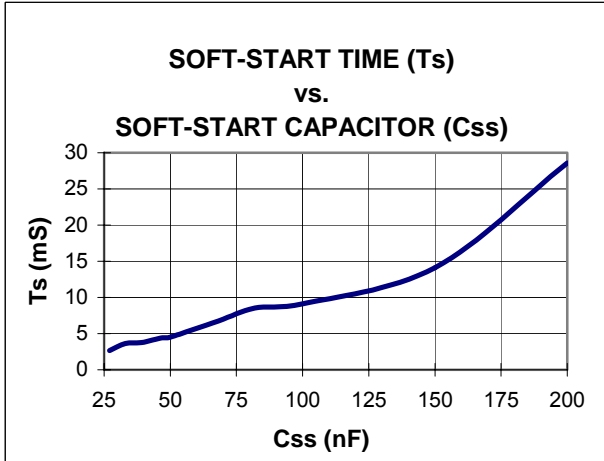
Typical Application Circuit



Typical Characteristics

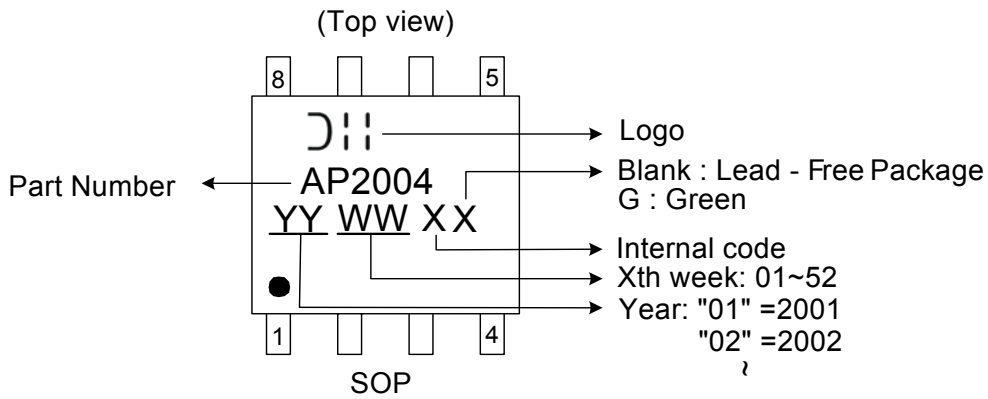


Typical Characteristics (Continued)



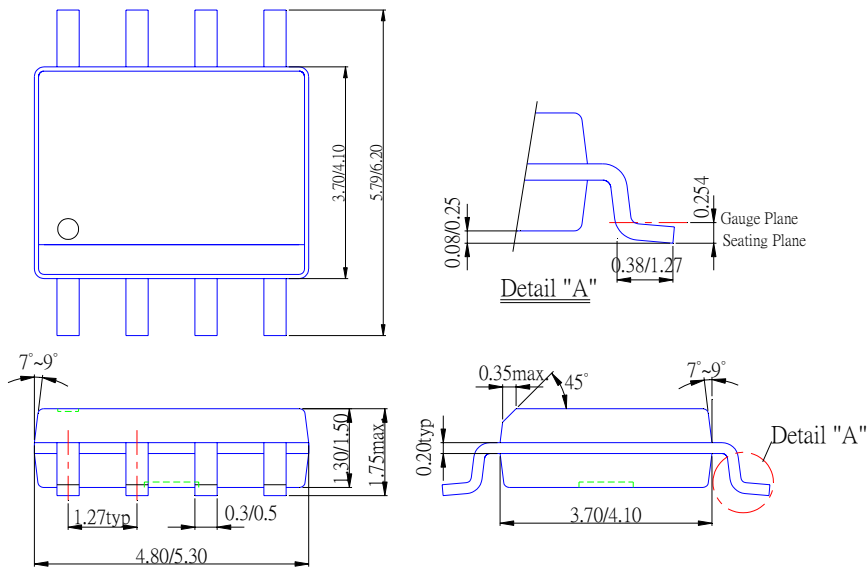
Marking Information

(1) SOP-8L



Package Information (All Dimensions in mm)

(1) Package Type: SOP- 8L (JEDEC Small Outline Package)



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