

### 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
- SOP-8L: Available in "Green" Molding Compound (No Br, Sb)
- Lead Free Finish/ RoHS Compliant (Note 1)

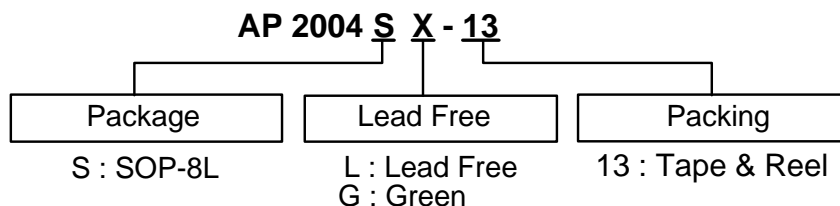
### General Description

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

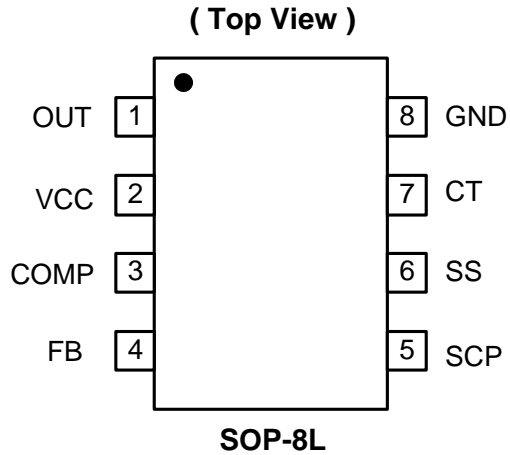


Device	Package Code	Packaging (Note 2)	13" Tape and Reel	
			Quantity	Part Number Suffix
AP2004SL-13	S	SOP-8L	2500/Tape & Reel	-13
AP2004SG-13	S	SOP-8L	2500/Tape & Reel	-13



- Notes:
1. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied. Please visit our website at [http://www.diodes.com/products/lead\\_free.html](http://www.diodes.com/products/lead_free.html).
  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>.

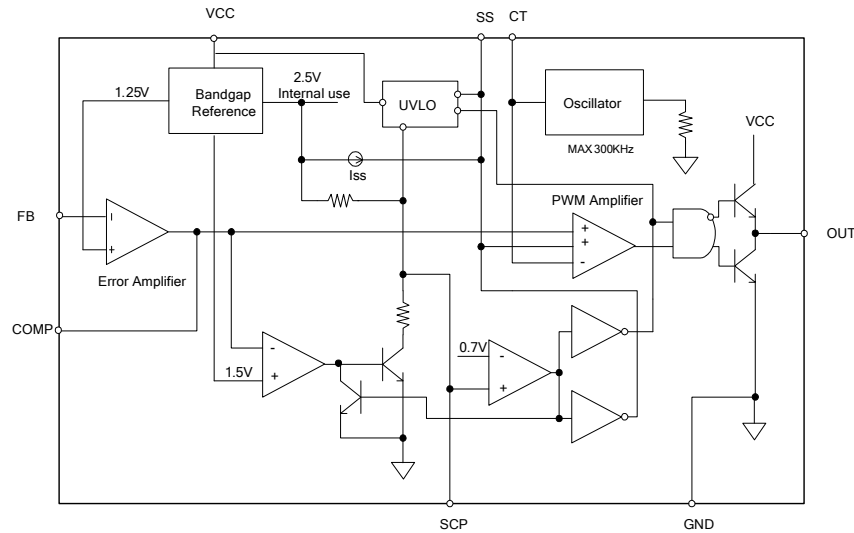
## Pin Assignments



## Pin Descriptions

Pin 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 +125	°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	$\pm 1$	%
		$T_A = 25^\circ\text{C} \sim 85^\circ\text{C}$			-0.2	$\pm 1$

**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	$\mu\text{A}$
$V_{CT}$	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
$\Delta F_{OSC}$	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	$V_O (\text{FB}) = 1.25\text{V}$			$\pm 6$	mV
$I_{IO}$	Input offset current	$V_O (\text{FB}) = 1.25\text{V}$			$\pm 100$	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		$\mu\text{A}$

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

**Output section**

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
$I_{LEAK}$	Leakage current	$V_O = 25\text{V}$			10	$\mu\text{A}$
$I_{DRV}$	Sink current	$V_{IN} = 20\text{V}$		200		$\text{mA}$
	Source current	$V_{IN} = 20\text{V}$		200		$\text{mA}$
$V_{SAT}$	Output saturation voltage	$I_O = 10\text{ mA}$		1.0	1.5	$\text{V}$
$I_{SC}$	Short-circuit output current	$V_O = 6\text{V}$		120		$\text{mA}$

**PWM comparator**

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

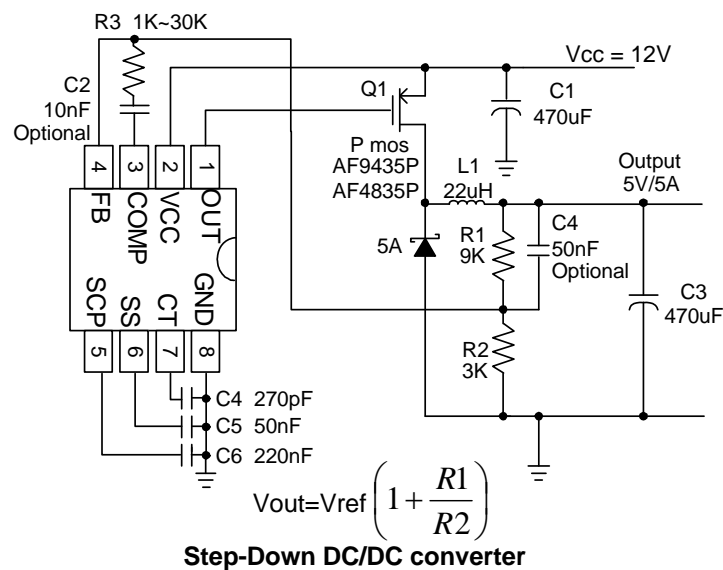
**Total device**

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
$I_{CCA}$	Average supply current	$C_T = 270\text{pF}$		6	10	$\text{mA}$

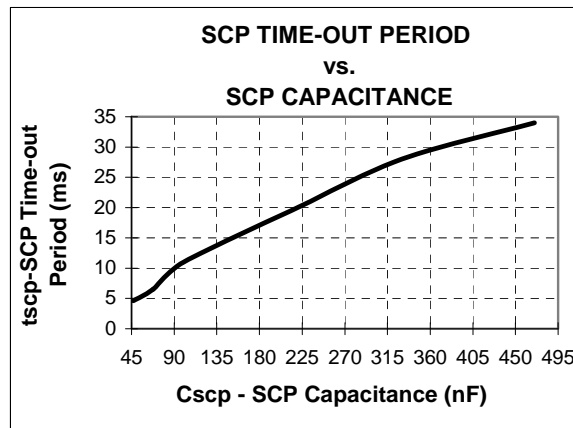
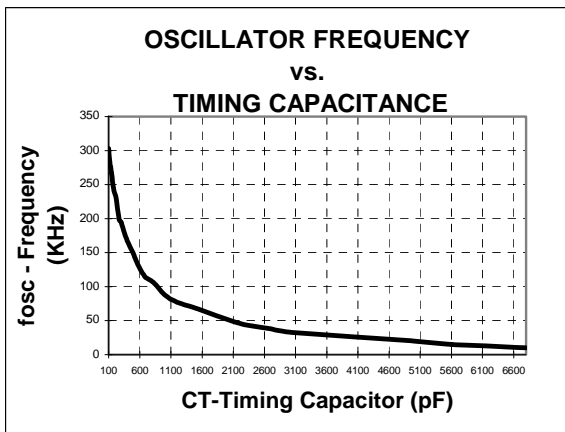
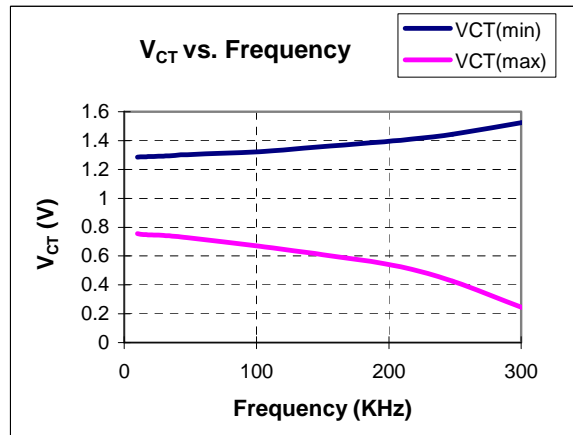
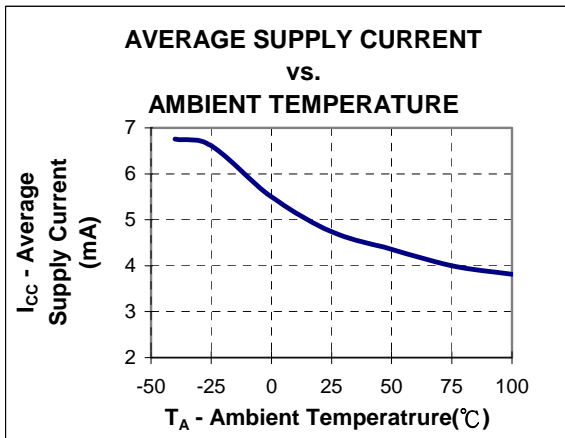
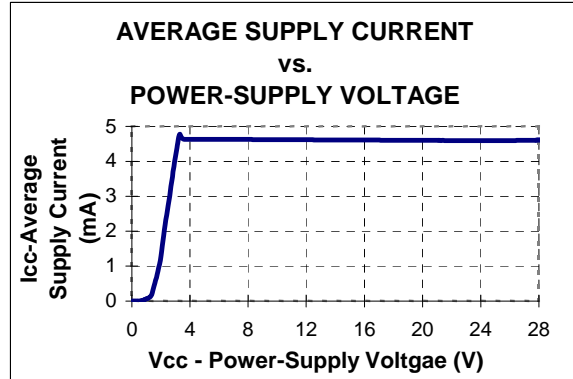
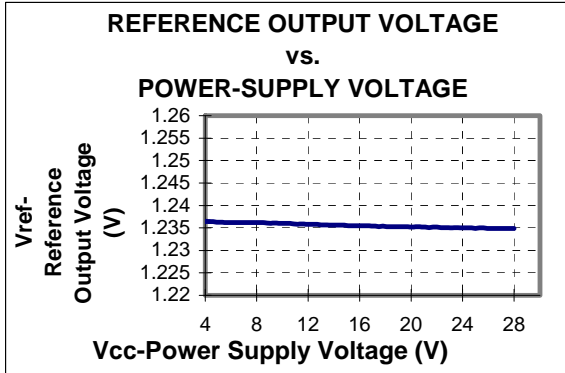
**Soft Start**

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
$V_{SS}$	Soft-start Voltage			2.3		$\text{V}$
$I_{SS}$	Constant Charge Current			20		$\mu\text{A}$

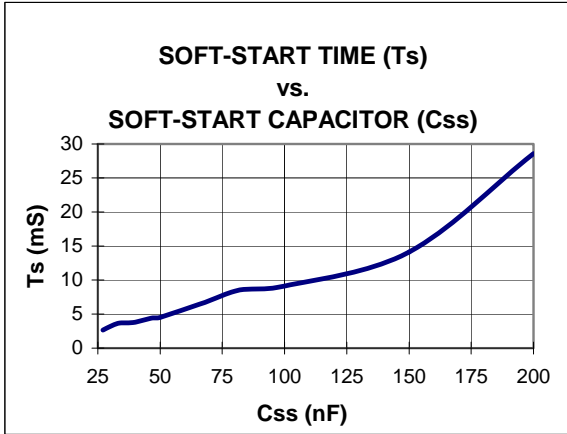
**Typical Application Circuit**



**Typical Characteristics**

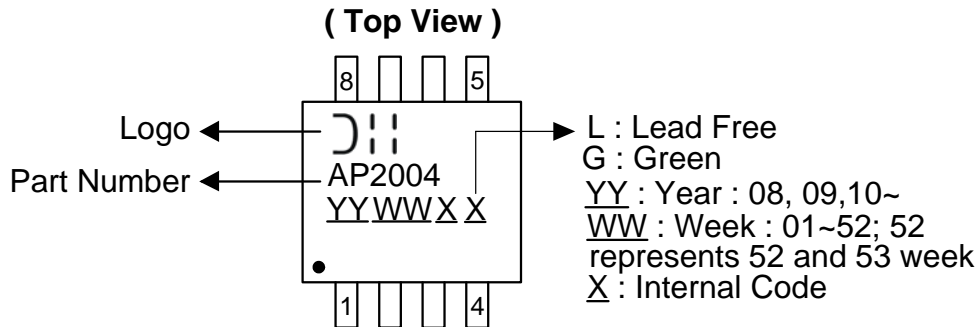


**Typical Characteristics (Continued)**



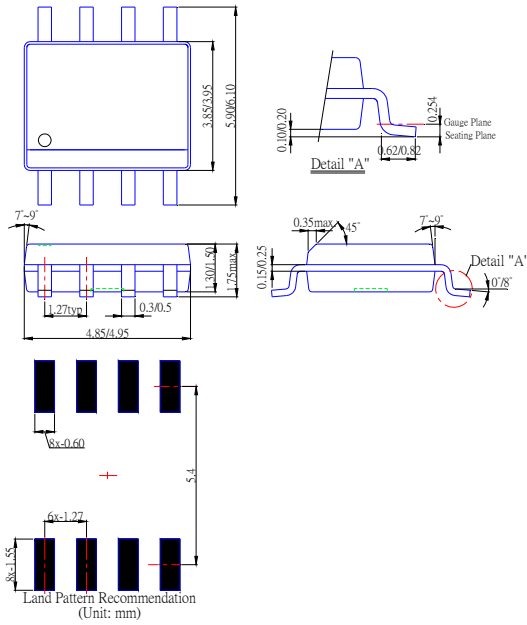
**Marking Information**

(1) SOP-8L



**Package Information (All Dimensions in mm)**

**(1) Package Type: SOP- 8L**



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