AP2001

MONOLITHIC DUAL CHANNEL PWM CONTROLLER

Features

- Dual PWM control circuitry
- Operating voltage can be up to 50V
- Adjustable Dead Time Control (DTC)
- Under Voltage Lockout (UVLO) protection
- Short Circuit Protection (SCP)
- Variable oscillator frequency: 500KHz Max
- 2.5V voltage reference output
- SOP-16L package
- Lead Free Finish/RoHS Compliant for Lead Free products (Note 1)

General Description

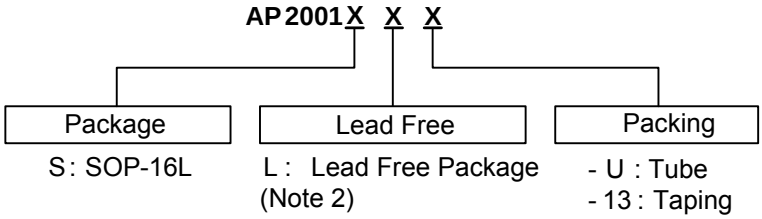
The AP2001 integrates Pulse-width-Modulation (PWM) control circuit into a single chip, mainly designed for power-supply regulator. All the functions included are an on-chip 2.5V reference output, two error amplifiers, an adjustable oscillator, two dead-time comparators, UVLO, SCP, DTC circuitry, and dual common-emitter (CE) output transistor circuit.

Recommend the output CE transistors as pre-driver for Driving externally. The DTC can provide from 0% to 100%. Switching frequency can be adjustable by trimming RT and CT. During low V_{CC} situation, the UVLO makes sure that the outputs are off until the internal circuit is operating normally.

Applications

- Backlight inverter
- DC/DC converts in computers, etc.

Ordering Information

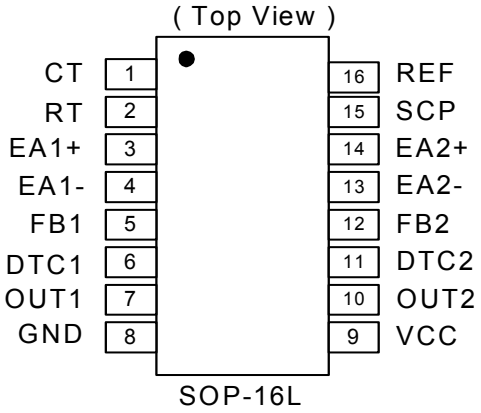


Note: 1. RoHS revision 13.2.2003. Glass and High Temperature Solder Exemptions Applied, see *EU Directive Annex Notes 5 and 7*.

Device	Package Code	Packaging (Note 2)	Tube		13" Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AP2001S	S	SOP-16L	50	-U	2500/Tape & Reel	-13

Note: 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.

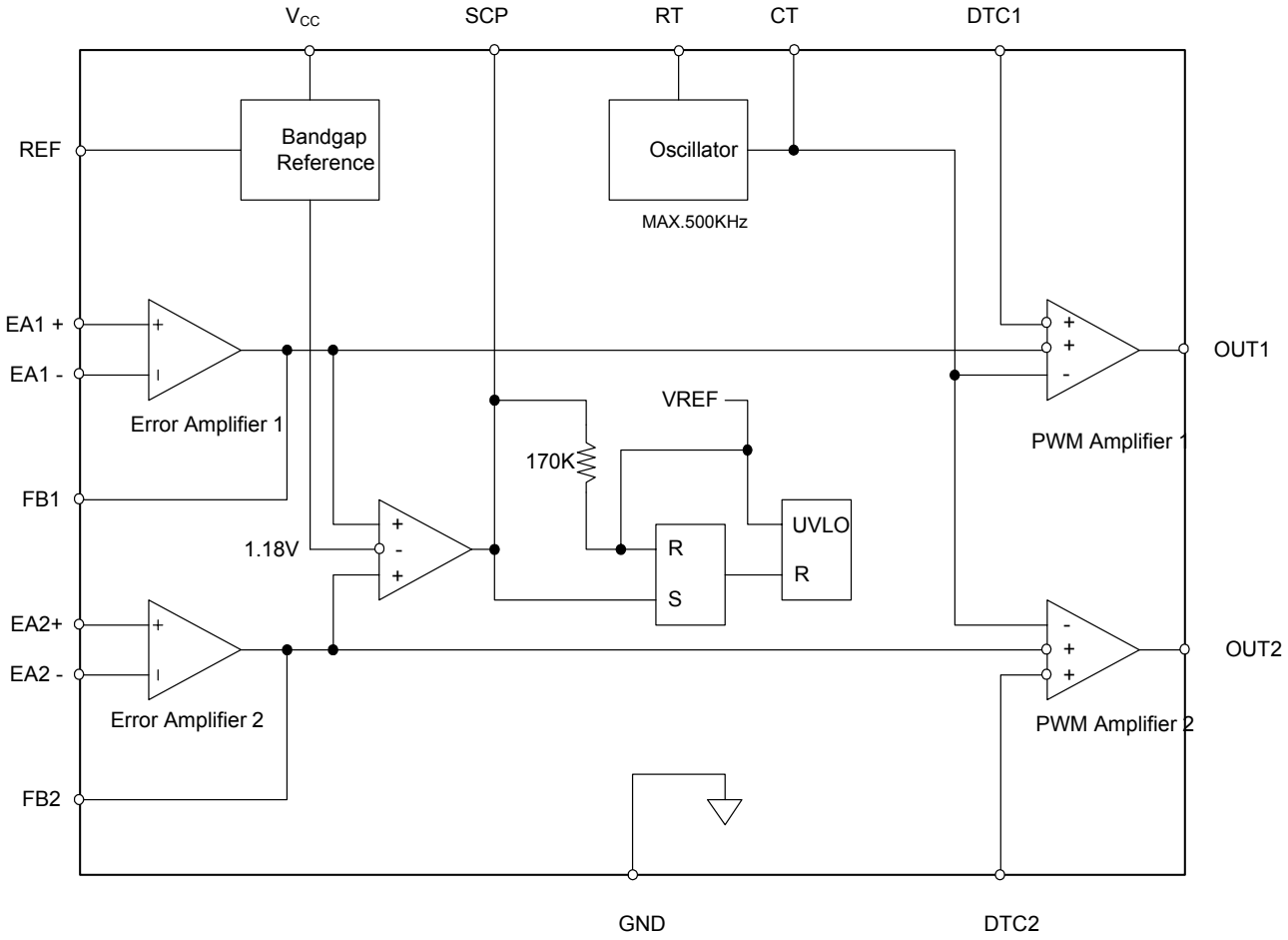
Pin Assignments



Pin Descriptions

Name	Description
CT	Timing Capacitor
RT	Timing Resistor
EA+	Error Amplifier Input(+)
EA -	Error Amplifier Input(-)
FB	Feedback Loop Compensation
DTC	Dead Time Control
OUT	Pre-driver Output
GND	Ground
VCC	Supply Voltage
SCP	Short Circuit Protection
REF	Voltage Reference

Block Diagram



Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{CC}	Supply Voltage	40	V
V_I	Amplifier Input Voltage	20	V
V_O	Collector Output Voltage	40	V
Io	Collector Output Current	21	mA
T_{OP}	Operating Temperature Range	-20 to +85	°C
T_{ST}	Storage Temperature Range	-65 to +150	°C
T_{LEAD}	Lead Temperature 1.6 mm (1/16 inch) from Case for 5 Seconds	245	°C

Recommended Operating Conditions

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply Voltage	3.6	40	V
V_I	Amplifier Input Voltage	1.05	1.45	V
V_O	Collector Output Voltage		40	V
I_O	Collector Output Current		20	mA
I_{FB}	Current into Feedback Terminal		45	μA
R_F	Feedback Resistor	100		kΩ
C_T	Timing Capacitor	150	15000	pF
R_T	Timing Resistor	5.1	100	kΩ
F_{OSC}	Oscillator Frequency	1	500	KHz
T_{OP}	Operating Free-air Temperature	-20	85	ºC

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

Reference (REF)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage (pin 16)	I_O = 1mA	2.4	2.5	2.6	V
	Output Voltage Change with Temperature	T_A = -20ºC ~ 25ºC		-0.1	±1	%
		T_A = 25ºC ~ 85ºC		-0.2	±1	%
V_{DLI}	Input Stability	V_{CC} = 3.6V ~ 40V		2	12.5	mV
V_{DLO}	Output Stability	I_O = 0.1 mA ~ 1mA		1	7.5	mV
I_O	Short-circuit Output Current	V_O = 0	3	10	30	mA

Under voltage lockout (UVLO)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{UT}	Upper Threshold Voltage (V_{CC})	$I_{O(REF)}$ = 0.1mA T_A = 25ºC		2.65		V
V_{LWT}	Lower Threshold Voltage (V_{CC})			2.45		V
V_{HT}	Hysteresis (V_{CC})		80	200		mV

Electrical Characteristics (Continued)

Short-circuit protection (SCP) control

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IT}	Input Threshold Voltage	T_A = 25ºC	0.65	0.7	0.75	V
V_{STB}	Standby Voltage	No pull up	140	185	230	mV
V_{LT}	Latched Input Voltage	No pull up		60	120	mV
I_{SCP}	Input (Source) Current	V_I = 0.7V, T_A = 25ºC	-10	-15	-20	µA
V_{CT}	Comparator Threshold Voltage (FB)			1.18		V

Oscillator (OSC)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
F_{OSC}	Frequency	C_T = 330 pF, R_T = 10 KΩ		200		KHz
ΔF_{OSC}	Standard Deviation of Frequency	C_T = 330 pF, R_T = 10 KΩ		10		%
	Frequency Change with Voltage	V_{CC} = 3.6V ~ 40V		1		
	Frequency Change with Temperature	T_A = -20ºC ~ 25ºC		-0.4	± 2	
		T_A = 25ºC ~ 85ºC		-0.2	± 2	

Dead-time control (DTC)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{BDT}	Input Bias Current				1	µA
I_{DT}	Latch Mode (Source) Current	T_A = 25ºC	-80	-145		
V_{DT}	Latched Input Voltage	I_O = 40µA	2.3			V
V_{T0}	Input Threshold Voltage at f= 10 KHz	Zero duty cycle		2.05	2.25	
V_{T100}		Maximum duty cycle	1.2	1.45		

Error-amplifier

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IO}	Input Offset Voltage	V_O (FB) = 1.25V			±6	mV
I_{IO}	Input Offset Current	V_O (FB) = 1.25V			±100	nA
I_{IB}	Input Bias Current	V_O (FB) = 1.25V		160	500	nA
V_{CM}	Common-mode Input Voltage Range	V_{CC} = 3.6V ~ 40V	1.05 to 1.45			V
AV	Open-loop Voltage Amplification	R_F = 200 KΩ	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 (FB)	V_{ID} = -0.1V, V_O = 1.25V	0.5	1.6		mA
I_{OO}	Output (Source) Current (FB)	V_{ID} = 0.1V, V_O = 1.25V	-45	-70		µA

Electrical Characteristics (Continued)

Output section

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{LEAK}	Leakage Current	V_O = 40V			10	μA
V_{SAT}	Output Saturation Voltage	I_O = 10 mA		1.2	2	V
I_{SC}	Short-circuit Output Current	V_O = 6V		90		mA

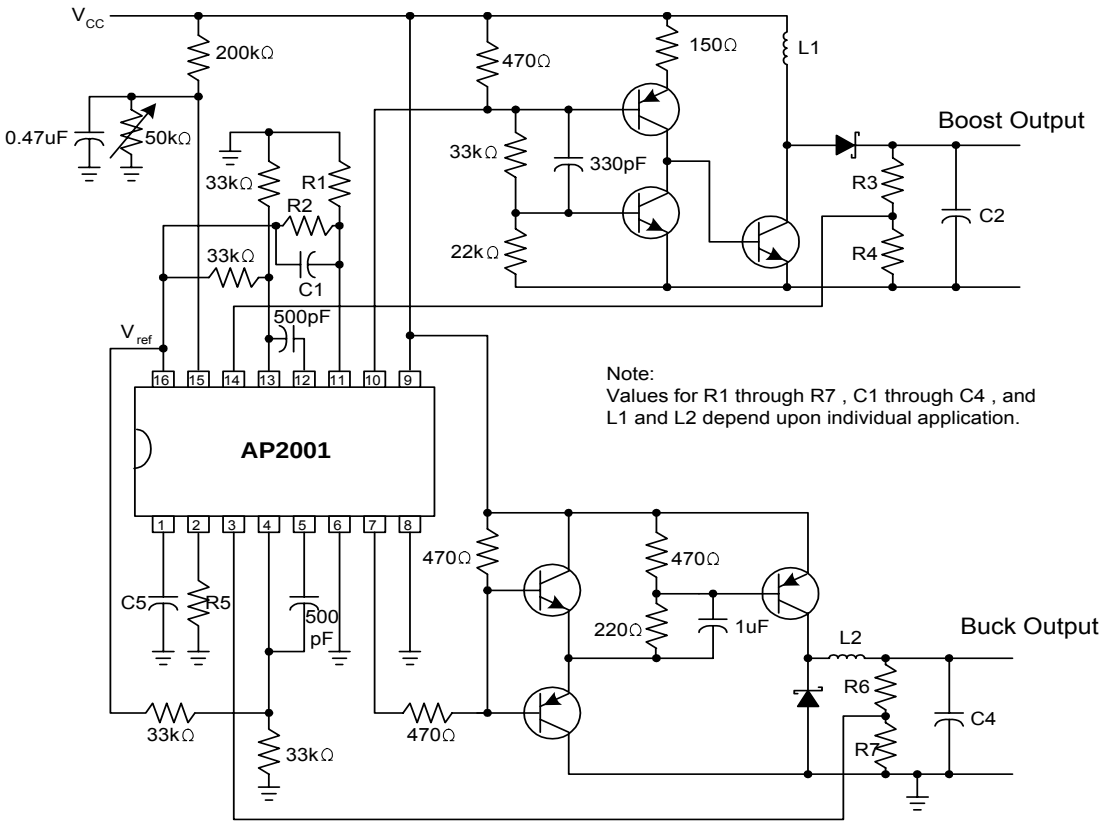
PWM comparator

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{T0}	Input Threshold Voltage at f = 10 KHz (FB)	Zero duty cycle		2.05	2.25	V
V_{T100}		Maximum duty cycle	1.2	1.45		V

Total device

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{CCS}	Standby Supply Current	Off-state		2.5	3.0	mA
I_{CCA}	Average Supply Current	R_T = 10 KΩ		2.8	3.5	mA

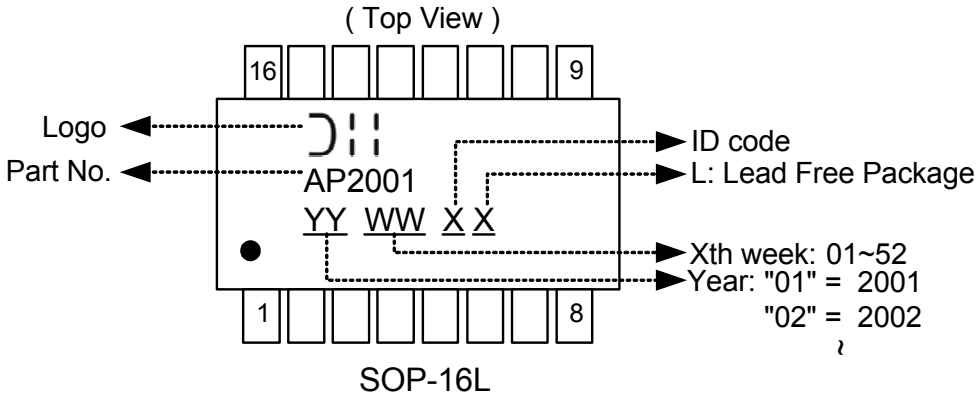
Typical Application Circuit



Dual output DC/DC converter

Marking Information

(1) SOP-16L



Package Information

(1) Package Type: SOP-16L