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
- 16-pin PDIP and SOP packages

■ Applications

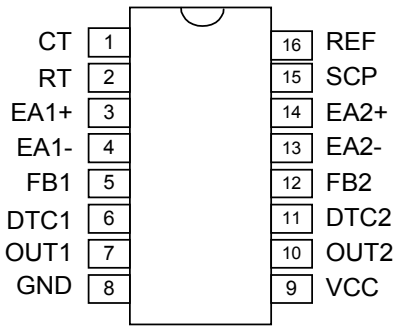
- Backlight inverter
- DC/DC converts in computers, etc.

■ General Description

The AP2001 integrates Pulse-width-Modulation (PWM) control circuit into a single chip, mainly designs for power-supply regulator. All the functions included 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 VCC situation, the UVLO makes sure that the outputs are off until the internal circuit is operational normally.

■ Pin Assignments

(Top View)



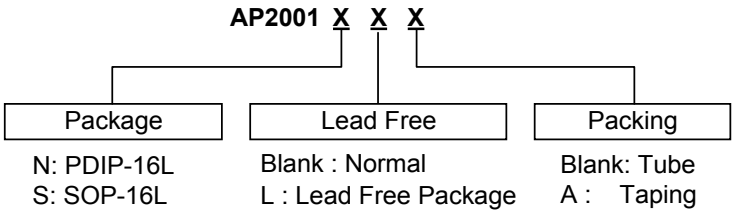
PDIP/SOP

■ Pin Descriptions

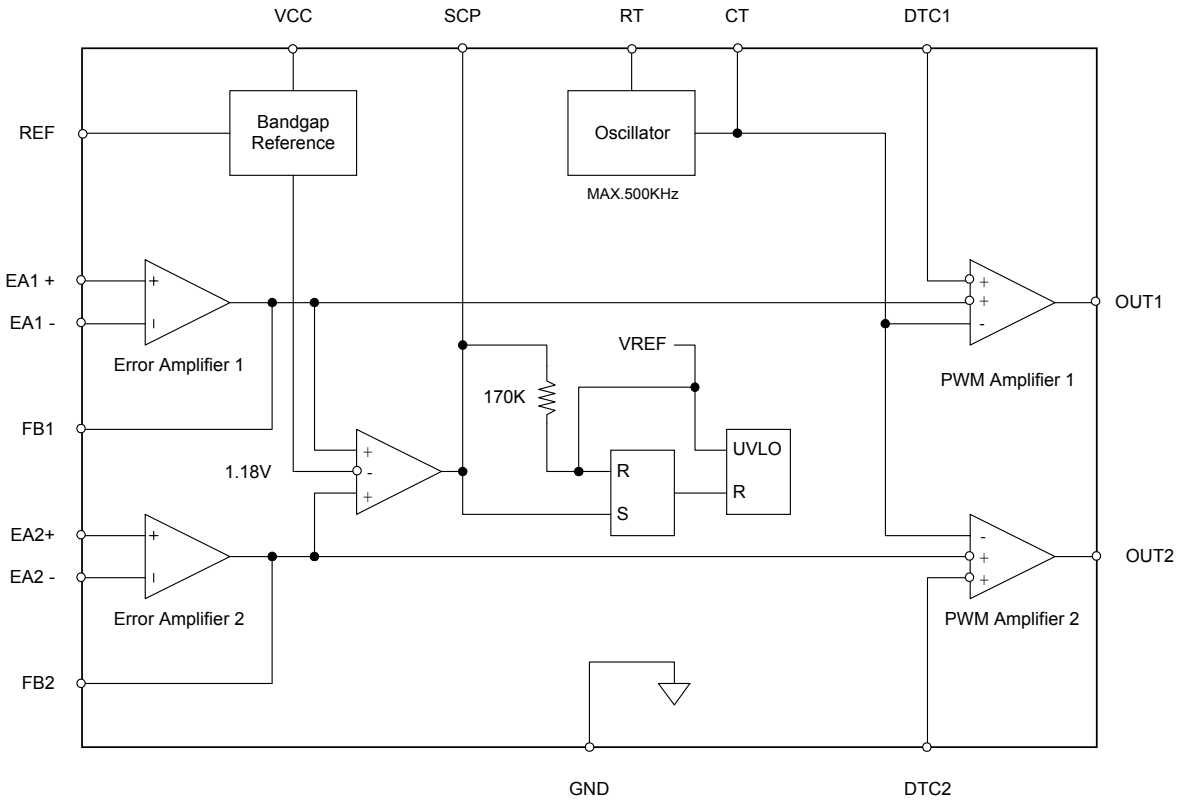
Name	Description
CT	Timing Capacitor
RT	Timing Resistor
EA+	Error Amplifier Input(+)
EA -	Error Amplifier Input(-)
FB	Feedback Loop Compensation
DTC	Dead Time Control
OUT	Pre-driver Output
GND	Ground
VCC	Supply Voltage
SCP	Short Circuit Protection
REF	Voltage Reference

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■ Ordering Information



■ 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 10 seconds	260	°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

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		

■ Electrical Characteristics (Continued)

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

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

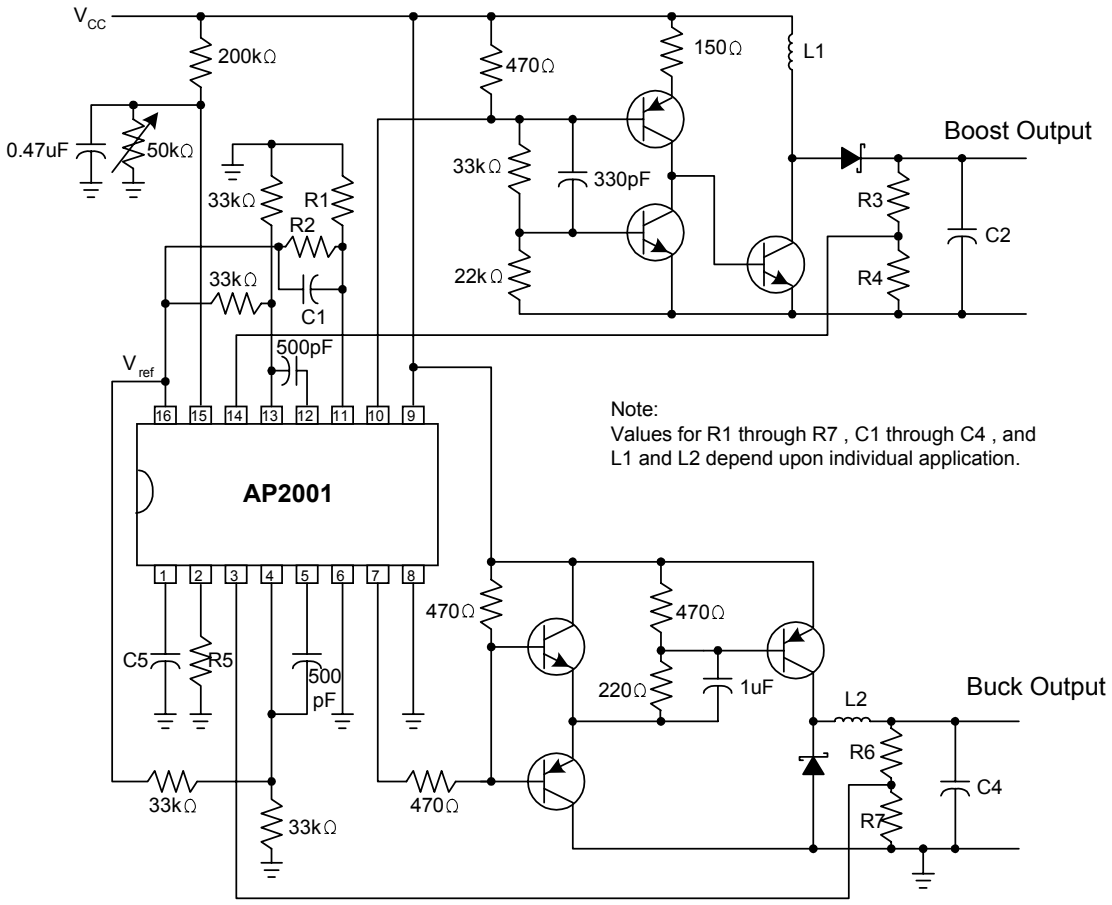
PWM comparator

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

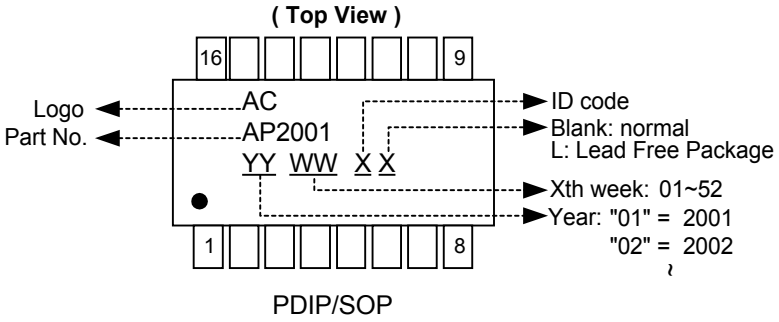
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{CCS}	Standby supply current	Off-state		2.5	3.0	mA
I_{CCA}	Average supply current	R_T = 10 kΩ		2.8	3.5	mA

■ Typical Application Circuit



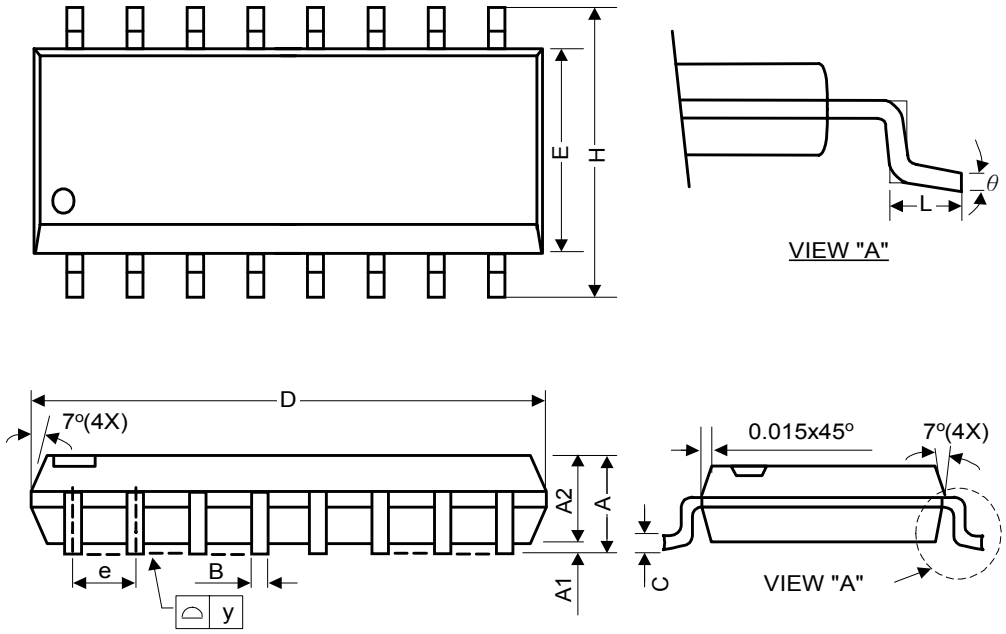
Dual output DC/DC converter

■ Marking Information



■ Package Information

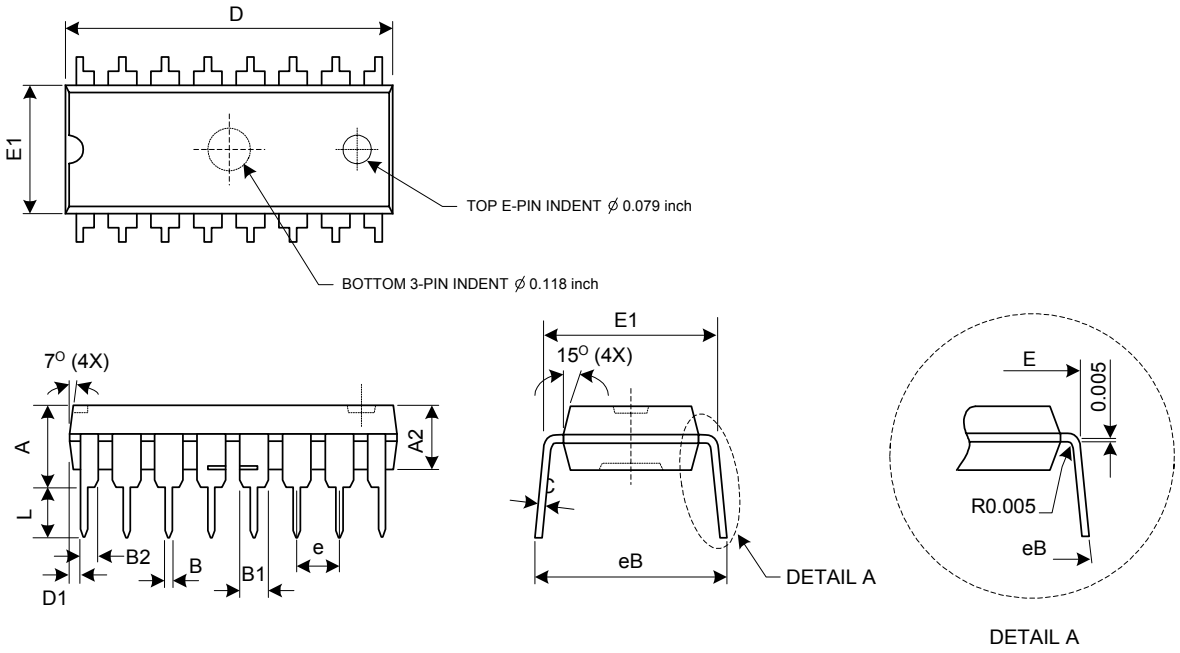
(1) Package Type: SOP-16L



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	-	0.010
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	0.0098
D	9.80	9.90	10.00	0.386	0.390	0.394
E	3.80	3.90	4.00	0.150	0.154	0.157
e	-	1.27	-	-	0.050	-
H	5.80	6.00	6.20	0.228	0.236	0.244
L	0.38	0.71	1.27	0.015	0.028	0.050
Θ	0	-	8	0	-	8

■ Package Information (Continued)

(2) Package Type: PDIP-16L



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	4.57	-	-	0.180
A1	0.38	-	-	0.015	-	-
A2	3.15	3.33	3.50	0.124	0.131	0.138
B	0.36	0.46	0.56	0.014	0.018	0.022
B1	1.14	1.27	1.52	0.045	0.050	0.060
B2	0.81	0.99	1.17	0.032	0.039	0.046
C	0.20	0.25	0.33	0.008	0.010	0.013
D	18.90	19.10	19.30	0.744	0.752	0.760
D1	0.56	0.69	0.76	0.022	0.027	0.030
E	7.62	-	8.26	0.3000	-	0.325
E1	6.15	6.35	6.55	0.242	0.250	0.258
e	-	2.54	-	-	0.100	-
L	2.92	-	3.81	0.115	-	0.150
eB	8.38	-	9.40	0.330	-	0.370