Pulse-Width-Modulation Control Circuits

Description

The PD494 is a voltage mode pulse-width-modulation switching regulator control circuit designed primarily for power supply control.

The PD494 consists of a reference voltage circuit, two error amplifies, an on-chip adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, and an output control circuit. The precision of voltage reference (V_{REF}) is improved up to ±1% through trimming and this provides a better output voltage regulation. The PD494 provides for push pull or single-ended output operation, which can be selected through the output control.

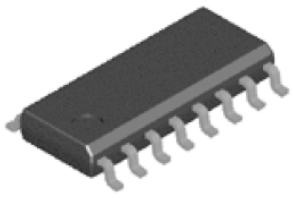
The PD494 is available in standard packages of DIP-16 and SOIC-16.

Feature

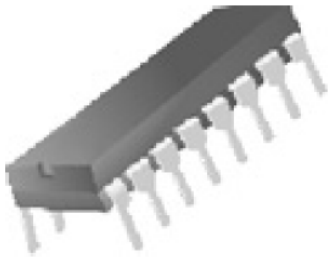
- Stable 5V Reference Voltage Trimmed to ±1% Accuracy
- Uncommitted output TR for 200mA sink or Source current
- Single-End or push-Pull Operation Selected by Output Control
- Internal Circuitry Prohibits Double Pulse at Either Output
- Complete PWM Control Circuit with Variable Duty Cycle
- On-Chip Oscillator with Master or Slave Operation

Application

- SMPS
- Back Light Inverter
- Charger



SOIC-16



DIP-16

Figure 1. Package Types of PD494

Pin Configuration

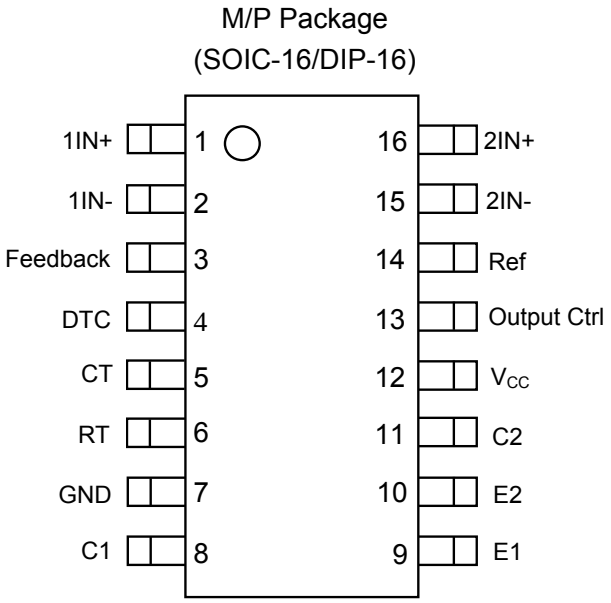


Figure 2. Pin Configuration of PD494 (Top View)

Output Function Control Table

Signal for Output Control	Output Function
V_I=GND	Single-ended or parallel output
V_I=V_{REF}	Normal push-pull operation

Functional Block Diagram

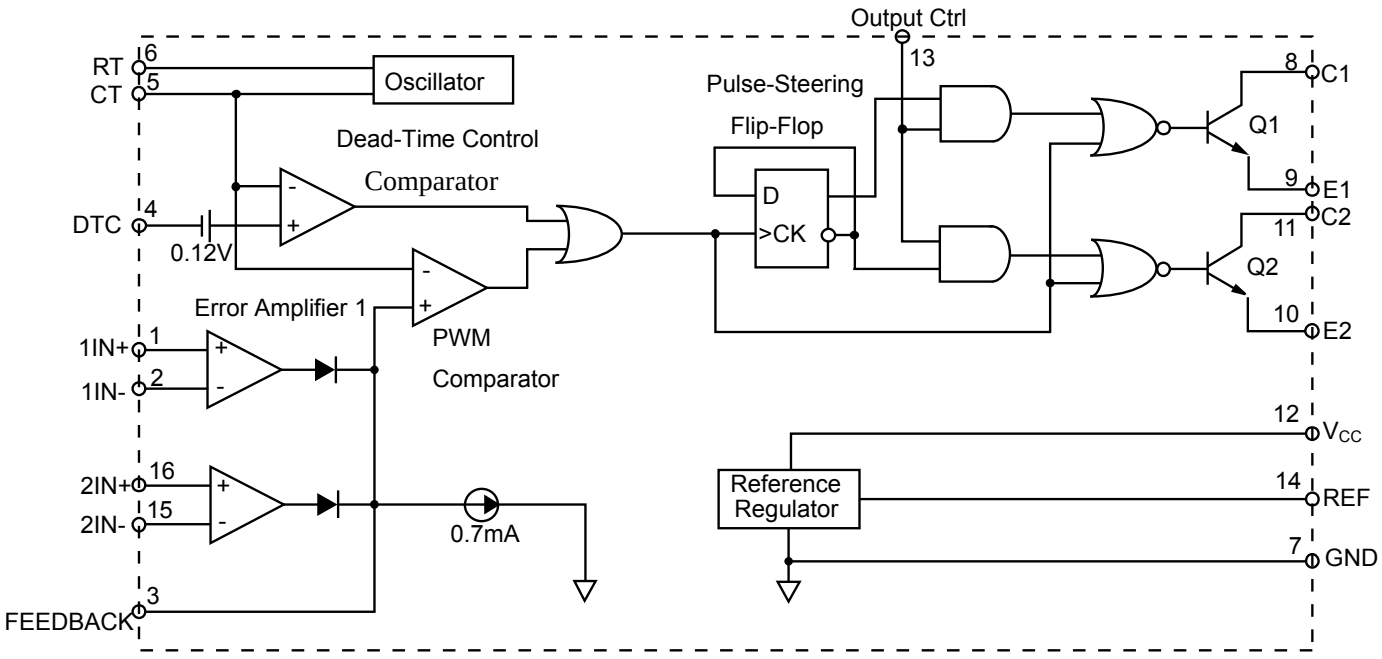


Figure 3. Functional Block Diagram of PD494

Absolute maximum rating(Note 1)

Parameter	Symbol	Value		Unit
Supply Voltage(Note 2)	V_{CC}	40		V
Amplifier Input Voltage	V_I	-0.3 to V_{CC}+0.3		V
Collector Output Voltage	V_O	40		V
Collector Output Current	I_O	250		mA
Package Thermal Impedance (Note 3)	$R_{\theta JA}$	M Package	73	℃/W
		P Package	67	
Lead Temperature 1.6mm from case for 10 seconds		260		℃
Storage Temperature Range	T_{STG}	-65 to 150		℃
ESD rating (Machine Model)		200		V

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	7	15	36	V
Collector Output Voltage	V_{C1},V_{C2}		30	36	V
Collector Output Current (Each Transistor)	I_{C1},I_{C2}			200	mA
Amplifier Input Voltage	V_I	0.3		V_{CC}-2	V
Current Into Feedback Terminal	I_{FB}			0.3	mA
Reference Output Current	I_{REF}			10	mA
Timing Capacitor	C_T	0.00047	0.001	10	μF
Timing Resistor	R_T	1.8	30	500	KΩ
Oscillator Frequency	f_{osc}	1.0	40	200	KHz
PWM Input Voltage(Pin3,4,14)		0.3		5.3	V
Operating Free-Air Temperature	T_A	-40		85	℃

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings"for extended periods may affect device reliability.

Note 2: All voltage values are with respect to the network ground terminal.

Note 3: Maximum power dissipation is a function of T_J(max), $R_{\theta JA}$ and T_A. The maximum allowable power dissipation at any allowable ambient temperature is P_D = (T_J(max) - T_A)/$R_{\theta JA}$. Operating at the absolute maximum T_J of 150℃ can affect reliability.

Electrical Characteristics

T_A=25℃, V_{CC}=20V,f=10KHz unless otherwise noted

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Reference Section						
Output Reference Voltage for PD494	V_{REF}	I_{REF}=1mA	4.75	5.0	5.25	V
		I_{REF}=1mA,T_A=-40 to 85℃	4.7	5.0	5.2	V
Line Regulation	R_{LINE}	V_{CC}=7V to 36V		2	25	mV
Load Regulation	R_{LOAD}	I_{REF}=1mA to 10mA		1	15	mV
Short-Circuit Output Current (Note 4)	I_{SC}	V_{REF}=0V	10	35	50	mA
Oscillator Section						
Oscillator Frequency	fosc	C_T=0.001μF,R_T=30 KΩ		40		KHz
		C_T=0.01μF,R_T=12 KΩ	9.2	10	10.8	
		C_T=0.01μF,R_T=12 KΩ, T_A=-40 to 85℃	9.0		12	
Frequency Change with Temperature	△f/△T	C_T=0.01μF,R_T=12 KΩ, T_A=-40 to 85℃			2	%
Dead-Time Control Section						
Input Bias Current	I_{BIAS}	V_{CC}=15V,V_{PIN4}=0 to 5.25V		-2	-10	μA
Maximum Duty Cycle	D(MAX)	V_{CC}=15V,V_{PIN4}=0V, V_{PIN13}=V_{REF}	45			%
Input Threshold Voltage	V_{ITH}	Zero Duty Cycle		3	3.3	V
		Maximum Duty Cycle	0			
Error-Amplifier Section						
Input Offset Voltage	V_{IO}	V_{PIN3}=2.5V		2	10	mV
Input Offset Current	I_{IO}	V_{PIN3}=2.5V		25	250	nA
Input Bias Current	I_{BIAS}	V_{PIN3}=2.5V		0.2	1	μA
Common-Mode Input Voltage Range	V_{CM}	V_{CC}=7V to 36V	-0.3		V_{CC}-2	V
Open-Loop Voltage Gain	G_{VO}	△V_O=3V, R_L=2kΩ, V_O=0.5V to 3.5V	70	95		dB
Unity-Gain Bandwidth	BW	R_L=2kΩ,V_O=0.5V to 3.5V		650		KHz
Common-Mode Rejection Ratio	CMRR	△V_O=40V,T_A=25℃	65	80		dB
Output Sink Current (Feedback)	I_{SINK}	V_{ID}=-15mV to -5V, V(Feedback)=0.7V	0.3	0.7		mA
Output Soure Current(Feedback)	I_{SOURCE}	V_{ID}=15mV to 5V V(Feedback)=3.5V	-2			mA

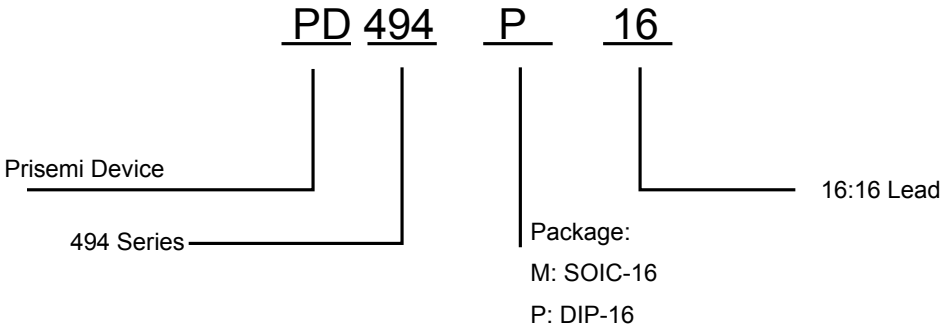
Note 4: Duration of short circuit should not exceed one second.

Electrical Characteristics(Continued)

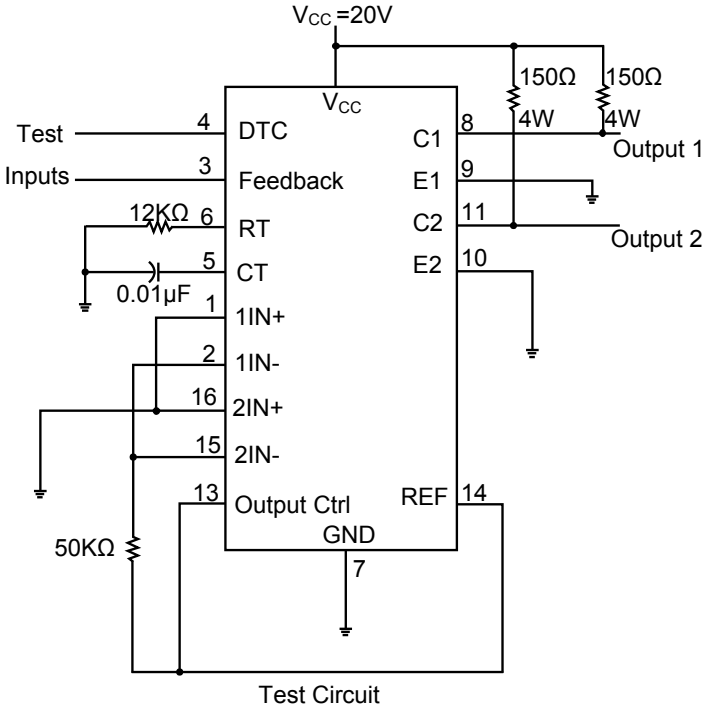
T_A=25℃,V_{CC}=20V,f=10KHz unless otherwise

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Unit
PWM Comparator Section							
Input Threshold Voltage		V_{ITH}	Zero duty Cycle		4	4.5	V
Input Sink Current		I_{SINK}	V(Feedback)=0.7V	0.3	0.7		mA
Output Section							
Output Saturation Voltage	Common Emitter	$V_{CE(SAT)}$	V_E=0V,I_C=200mA		1.1	1.3	V
	Emitter Follower	$V_{CC(SAT)}$	V_{CC}=15V I_E=-200mA		1.5	2.5	
Collector Off-State Current		$I_{C(OFF)}$	V_{CE}=36V,V_{CC}=36V		2	100	μA
Emitter Off-State Current		$I_{E(OFF)}$	V_{CC}=V_C=36V,V_E=0			-100	μA
Total Device							
Supply Current		I_{CC}	V_{PIN6}=V_{REF},V_{CC}=15V		6	10	mA
Output Switching Characteristics							
Rise Time		t_R	Common Emitter Common Collector		100	200	ns
Fall Time		t_F	Common Emitter Common Collector		25	100	ns

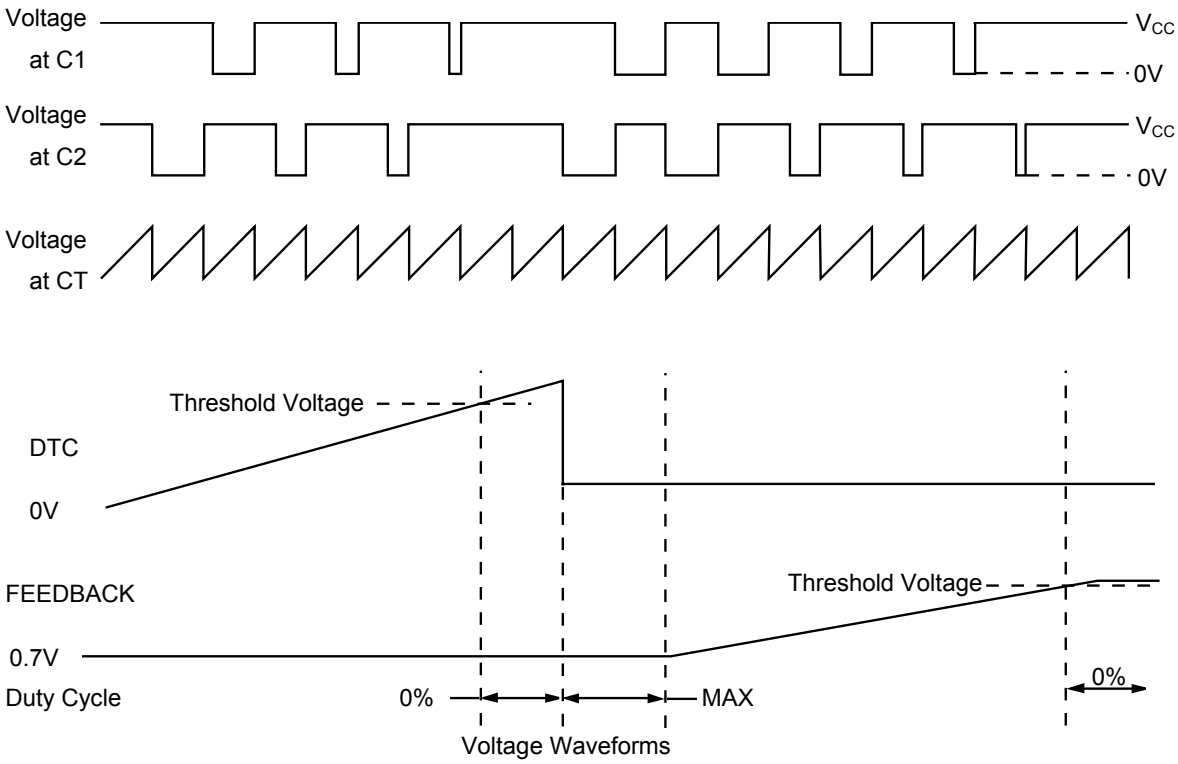
Naming Rule



Parameter Measurement information



Test Circuit



Voltage Waveforms

Figure 4. Operational Test Circuit and Waveforms

Parameter Measurement information(Continued)

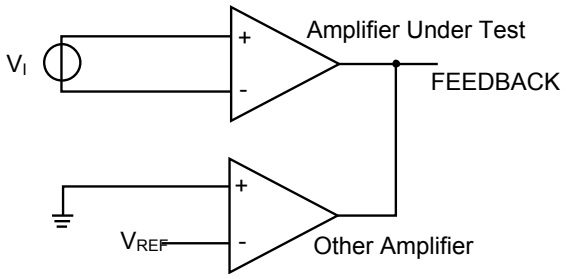
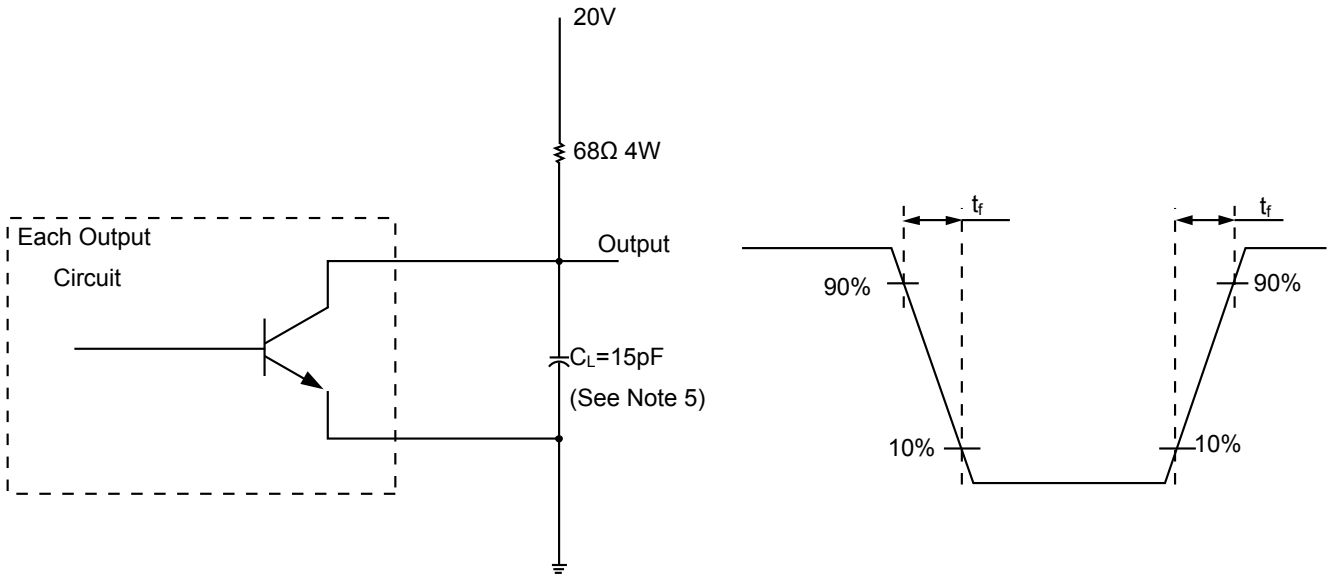
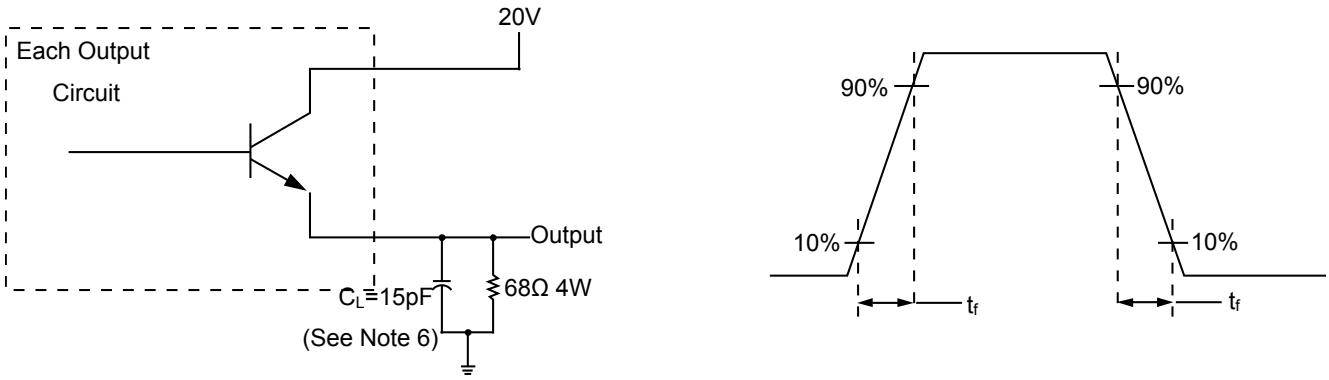


Figure 5. Error Amplifier Characteristics



Note 5: CL includes probe and jig capacitance

Figure 6. Common-Emitter Configuration



Note 6: C_L includes probe and jig capacitance.

Figure 7. Emitter-Follower Configuration

Typical Performance Characteristics

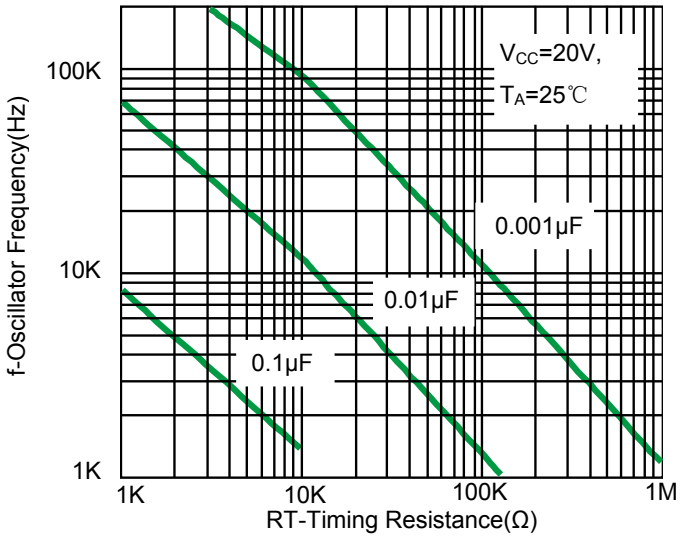


Figure 8. Oscillator Frequency vs. RT and CT

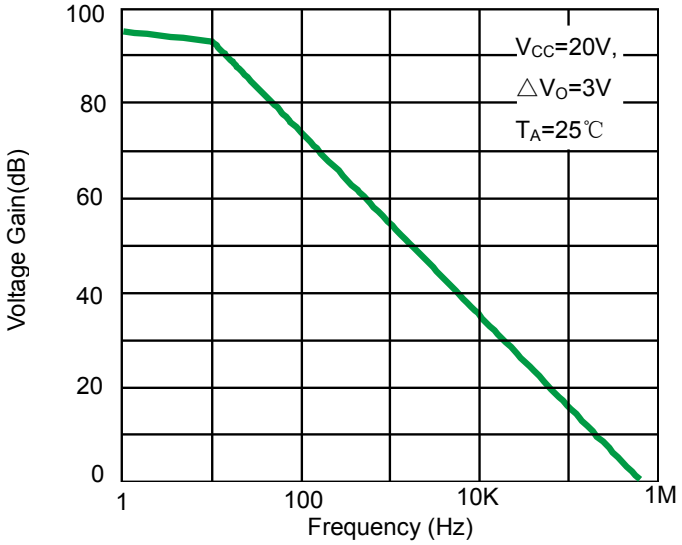


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency

Typical Applications

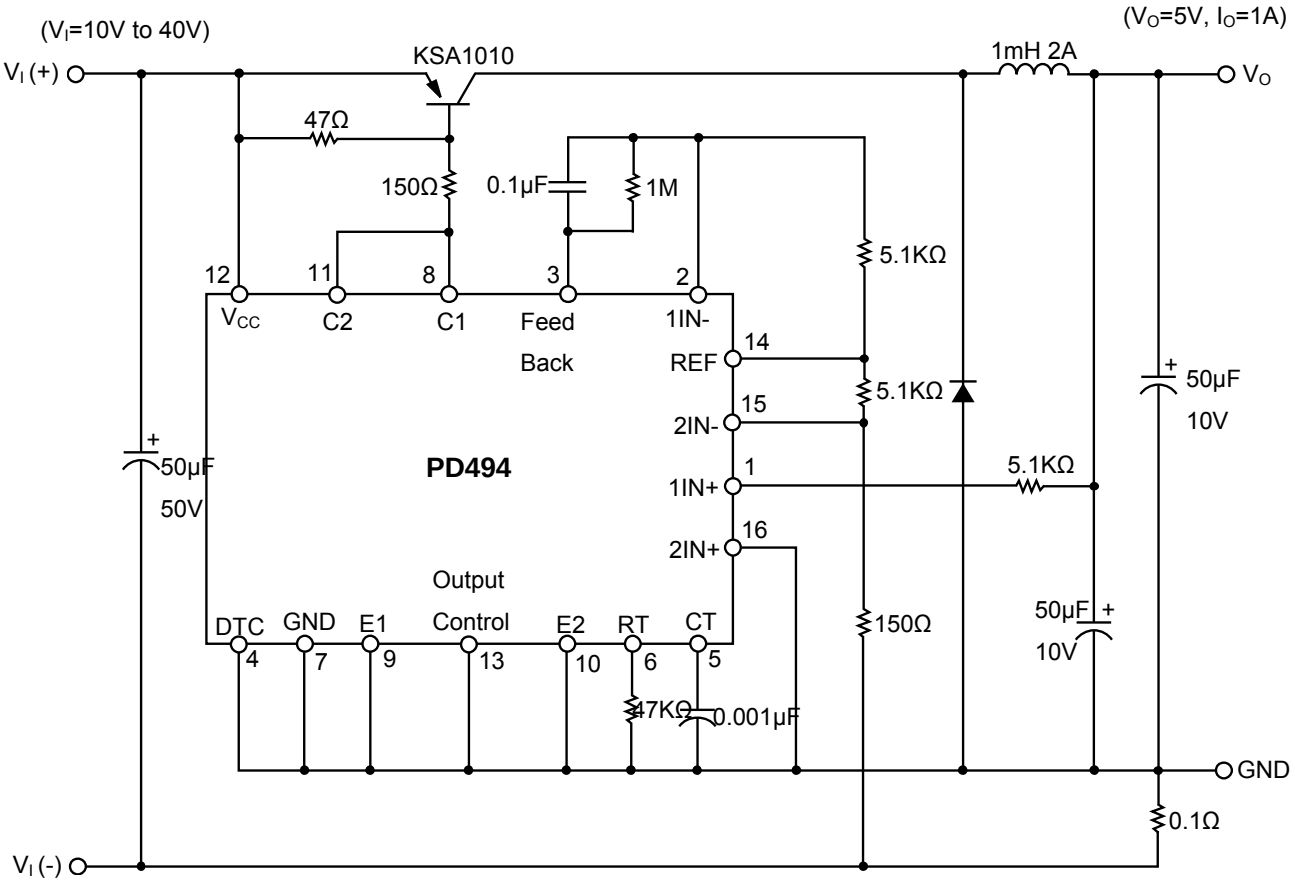
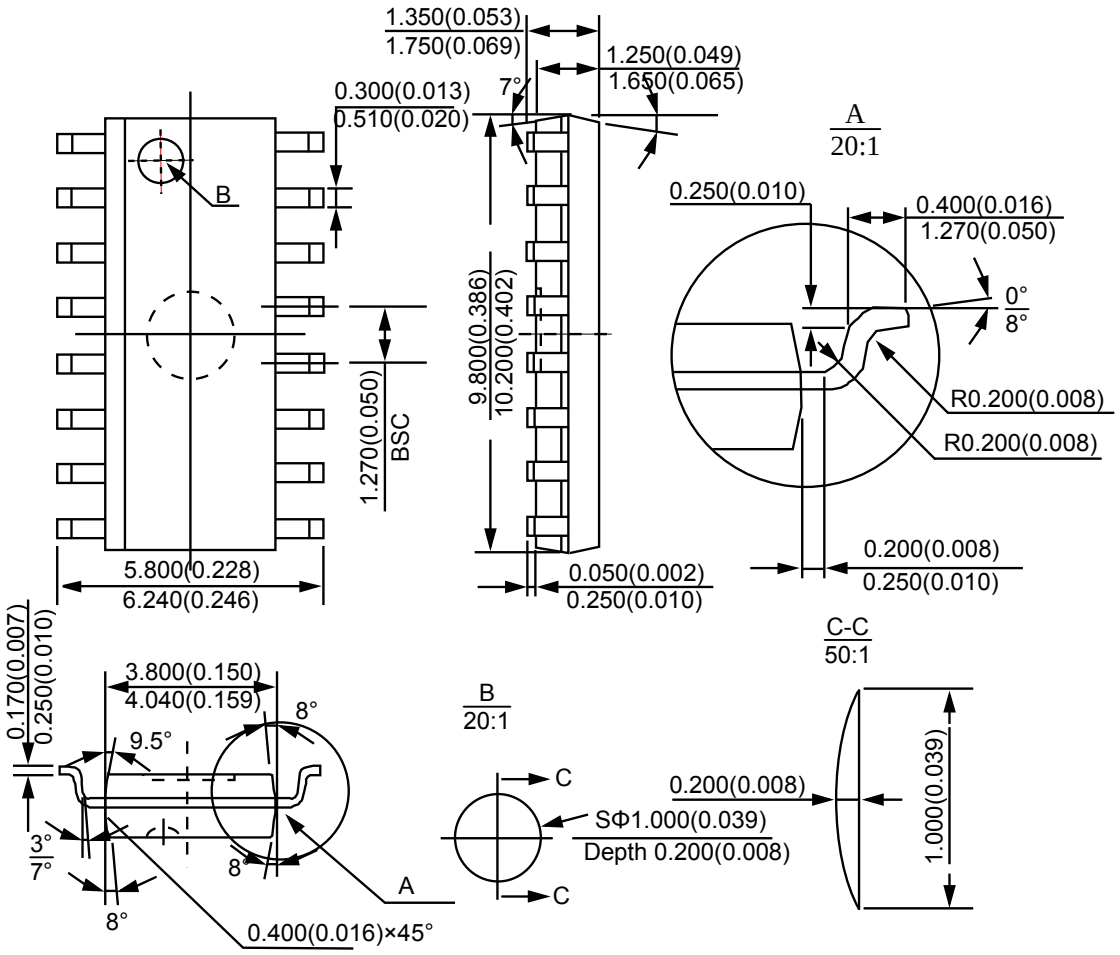


Figure 10.Pulse Width Modulated Step-Down Converter

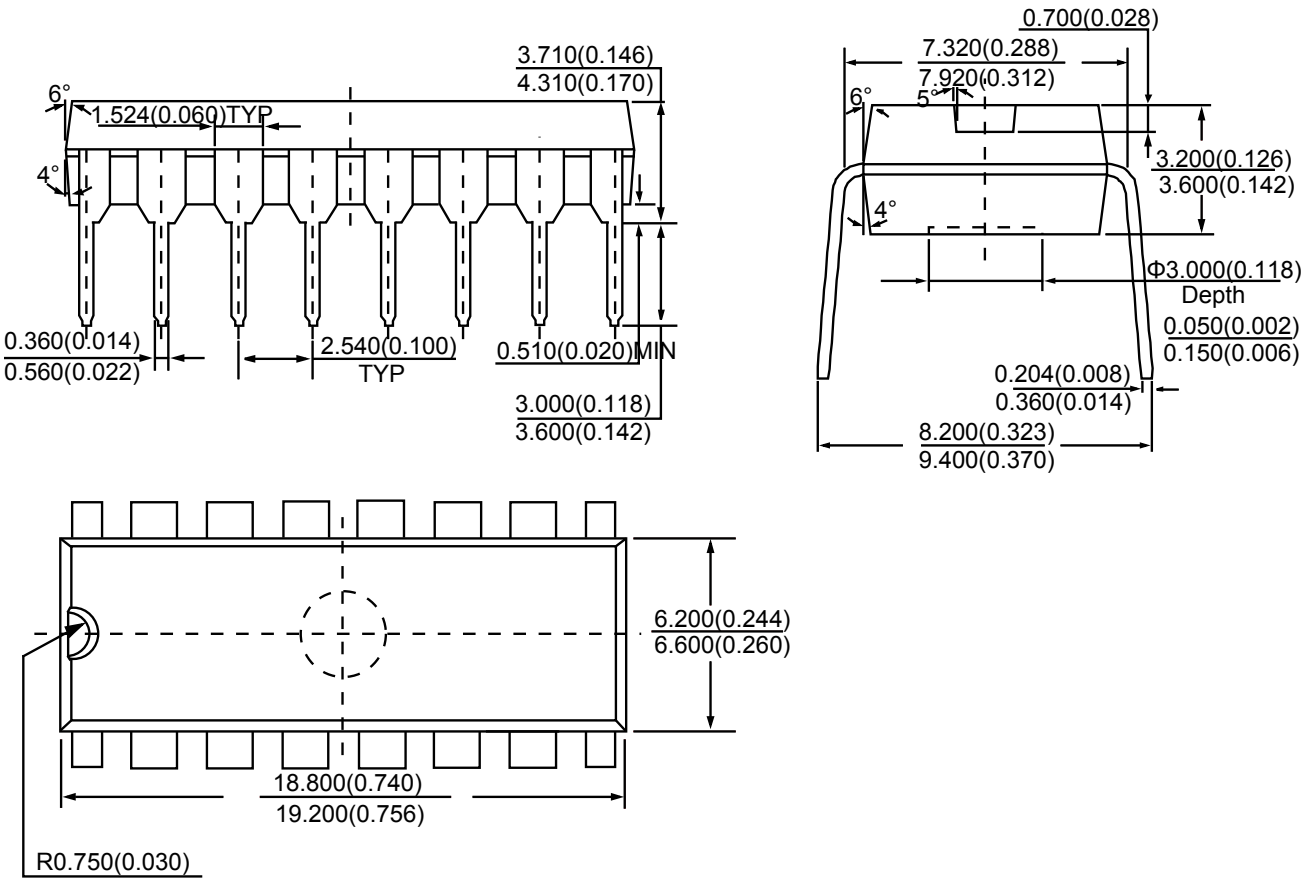
Product dimension (SOIC-16)

Unit:mm(inch)



Product dimension (DIP-16)

Unit:mm(inch)



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