Pulse-Width-Modulation Control Circuits CL494

■ Description

The CL494 incorporate on a single monolithic chip all the functions required in the construction of a pulse-width-modulation control circuit. Designed primarily for power supply control, these devices offer the systems engineer the flexibility to tailor the power supply control circuitry to his application.

The CL494 contains an error amplifier, an on-chip adjustable oscillator, a dead-time control comparator, pulse steering control flip-flop, a 5V, 1% precision regulator and output control circuits. The error amplifier exhibits a common-mode voltage range from -0.3V to Vcc-2V. The dead-time control comparator has a fixed offset that provides approximately 5% dead time when externally altered. The on-chip oscillator may be bypassed by terminating RT (pin 6) to the reference output and providing a saw-tooth input to CT (pin 5), or it may be used to drive the common circuits in synchronous multiple-rail power supply. The uncommitted output transistors provide either common emitter or emitter-follower output capability. Each device provides for push-pull or single-ended output operation, which may be selected through the output-control function. The architecture of these devices prohibits the possibility of either output being pulsed twice during push-pull operation.

The CL494 is available in standard packages of DIP-16 and SOP-16.

■ Features

- Complete PWM power Control Circuitry
- Uncommitted Outputs for 200mA Sink or Source Current
- Output Control Selects Single-Ended or Push-Pull Operation
- Internal Circuitry Prohibits Double Pulse at Either Output
- Variable Dead-Time Provides Control over Total Range
- Internal Regulator Provides a Stable 5V 1% Reference Supply
- Circuit Architecture Allows Easy Synchronization

■ Applications

- SMPS
- Charger
- Back Light Inverter

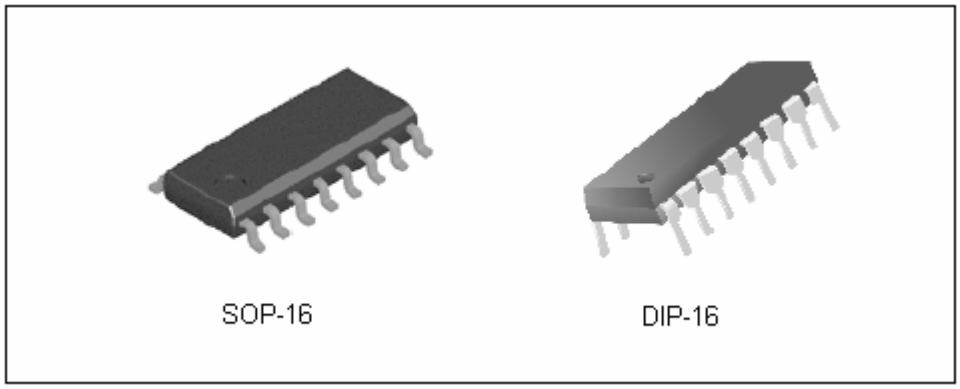


Figure 1. Package Types of CL494

Pulse-Width-Modulation Control Circuits CL494

■ Functional Block Diagram

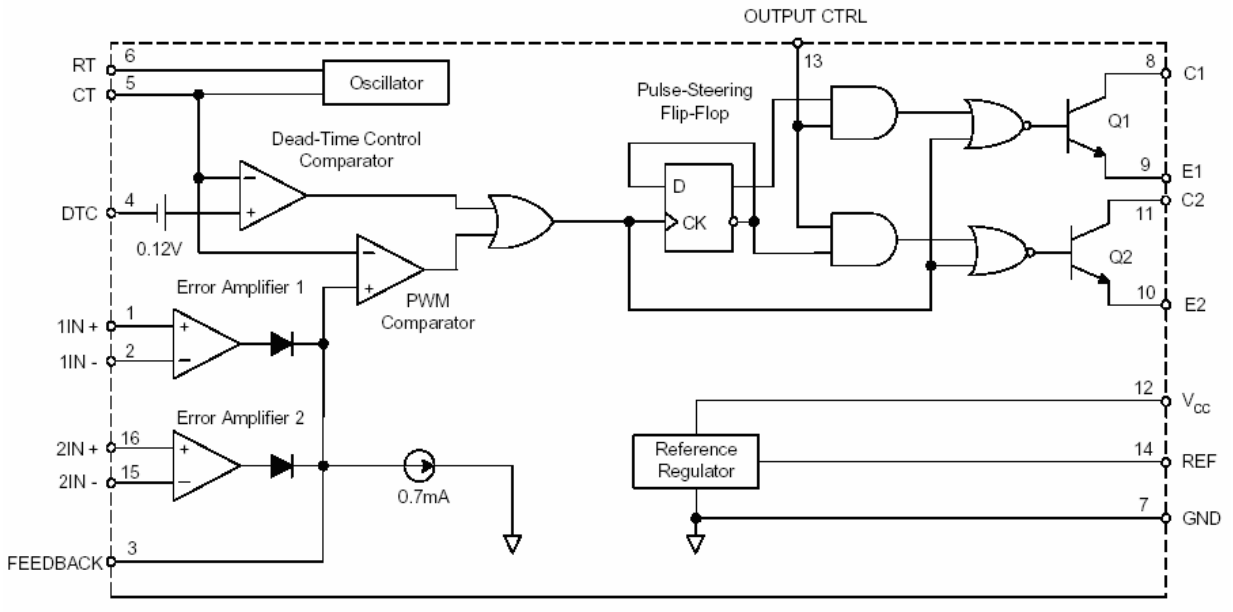


Figure 2. Functional Block Diagram of CL494

■ Pin Configuration

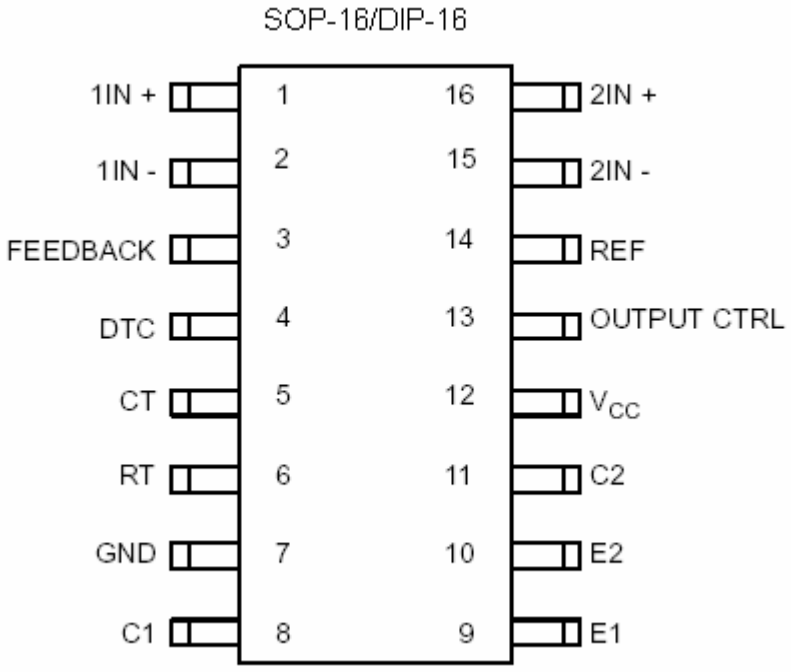
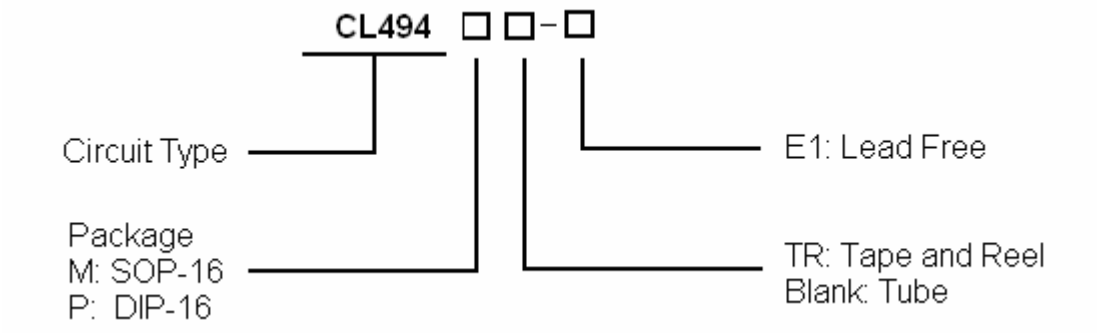


Figure 3. Pin Configuration of CL494 (Top View)

Pulse-Width-Modulation Control Circuits CL494

■ Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
DIP-16	-40℃~ +85℃	CL494P-E1	CL494	Tube
SOP-16	-40℃~ +85℃	CL494M-E1	CL494	Tube
	-40℃~ +85℃	CL494MTR-E1	CL494	Tape & Reel

■ Output Function Control Table

Signal for Output Control	Output Function
VI = GND	Single-ended or parallel output
VI = VREF	push-pull operation

■ Absolute Maximum Ratings (Note1)

Rating	Symbol	Value		Unit
Supply Voltage (Note 2)	VCC	40		V
Amplifier Input Voltage	VI	-0.3 to VCC+0.3		V
Collector Output Voltage	VO	40		V
Collector Output Current	IO	250		mA
Package Thermal Impedance (Note 3)	$R_{\theta JA}$	SOP-16	73	℃/W
		DIP-16	67	
Lead Temperature 1.6mm from case for 10 seconds		260		℃
Storage Temperature Range	TSTG	-65 to 150		℃

Note1: 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 TJ (max), $R_{\theta JA}$ and TA. The maximum allowable power dissipation at any allowable ambient temperature is PD = (TJ (max) - TA)/$R_{\theta JA}$. Operating at the absolute maximum TJ of 150℃ can affect reliability.

■ Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	VCC	7	36	V
Collector Output Voltage	VC1, VC2		36	V
Collector Output Current (Each Transistor)	IC1, IC2		200	mA
Amplifier Input Voltage	VI	0.3	VCC-2	V
Current Into Feedback Terminal	IFB		0.3	mA
Reference Output Current	IREF		10	mA
Timing Capacitor	CT	0.0047	10	uF
Timing Resistor	RT	1.8	500	kΩ
Oscillator Frequency	FOSC	1.0	200	kHz
PWM Input Voltage (Pin 3, 4, 14)		0.3	5.3	V
Ambient Operating Temperature	TA	-40	+85	℃

■ Electrical Characteristics

V_{CC} = 15V, GND = 0V, f=10kHz, T_A = 25℃ unless otherwise specified.

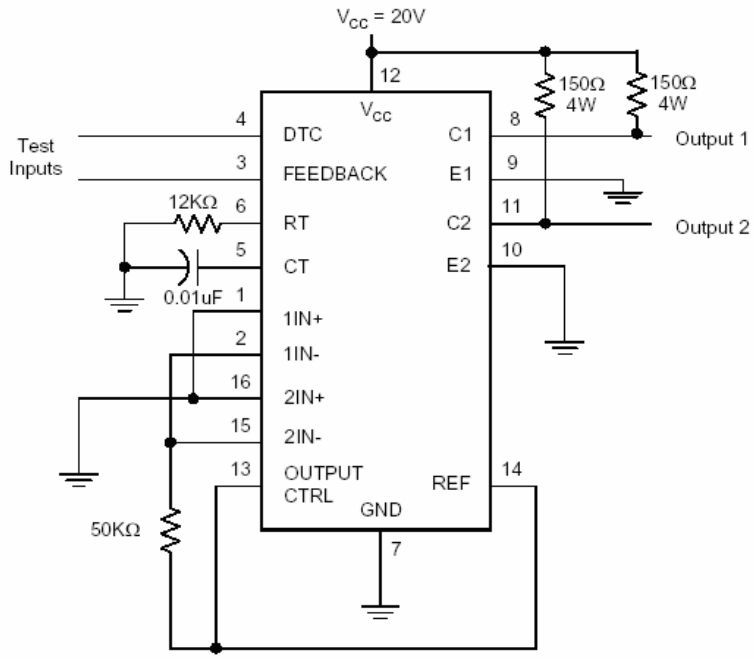
Parameter	Symbol	Condition	Min	Type	Max	Unit
Reference Section						
Output Reference Voltage	VREF	IREF=1mA	4.95	5.0	5.05	V
		IREF=1mA TA=-40 to 85℃	4.9	5.0	5.1	
Line Regulation	RLINE	VCC=7 to 36V		2	25	mV
Load Regulation	RLOAD	IREF=1 to 10mA		1	15	mV
Short-Circuit Output Current (Note4)	ISC	VREF=0V	10	35	50	mA
Oscillator Section						
Oscillator Frequency	FOSC	CT=0.01 F, RT=12KΩ	9.2	10	10.8	kHz
		CT=0.01 F, RT=12KΩ TA=-40 to 85℃	9.0		12.0	
Frequency Change with Temperature	Δf/ΔT	CT=0.01 F, RT=12KΩ TA=-40 to 85℃			1.0	%
Dead-Time Control Section						
Input Bias Current	IBIAS	VCC=15V, V4=0 to 5.25V		-2	-10	uA
Maximum Duty Cycle	D(MAX)	VCC=15V, V4= 0V Pin 13= VREF	45			%
Input Threshold Voltage	VITH	Zero Duty Cycle		3.0	3.3	V
		Maximum Duty Cycle	0			
Error-Amplifier Section						
Input Offset Voltage	VIO	V3 = 2.5V		2	10	mV
Input Offset Current	IIO	V3 = 2.5V		25	250	nA
Input Bias Current	IBIAS	V3 = 2.5V		0.2	1.0	uA
Common-Mode Input Voltage Range	VCM	VCC= 7 to 36V	-0.3		V_{CC}-2	V
Open-Loop Voltage Gain	GVO	VO =0.5 to 3.5V	70	95		dB
Unity-Gain Bandwidth	BW			650		kHz
Common-Mode Rejection Ratio	CMRR		65	80		dB
Output Sink Current (Feedback)	ISINK	VID = -15mV to -5V V3 = 0.7V	0.3	0.7		mA
Output Source Current (Feedback)	ISOURCE	VID = 15mV to 5V V3 = 3.5V	2.0			mA

■ Electrical Characteristics (Continued)

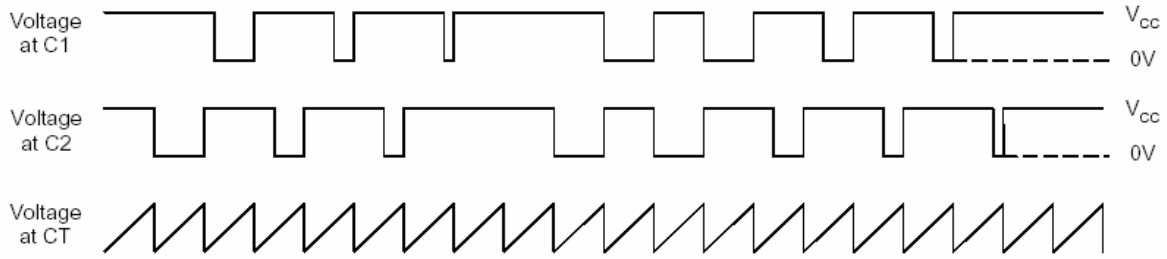
Parameter	Symbol	Condition	Min	Type	Max	Unit
PWM Comparator Section						
Input Threshold Voltage		Zero Duty Cycle		4.0	4.5	V
Input Sink Current		V3 = 0.7V	0.3	0.7		mA
Output Section						
Collector Off-State Current	IC (OFF)	VCE = 36V, VCC=36V		2	100	uA
Emitter Off-State Current	IE (OFF)	VCC =VC =36V, VE = 0			-100	uA
Output Saturation Voltage	$V_{CE\ (SAT)}$	Common-Emitter VE = 0V, IC =200mA		1.1	1.3	V
	$V_{CC\ (SAT)}$	Emitter-follower VCC=15V,IE= -200mA		1.5	2.5	V
Output control input current	ICTRL	VI=VREF			3.5	mA
Total Device						
Supply Current	ICC	Pin 6=VREF, VCC=15V		6	10	mA
Output Switching Characteristics						
Output Voltage Rise time	TR	Common-Emitter		100	200	ns
		Emitter-follower		100	200	ns
Output Voltage Fall time	TF	Common-Emitter		25	100	ns
		Emitter-follower		25	100	ns

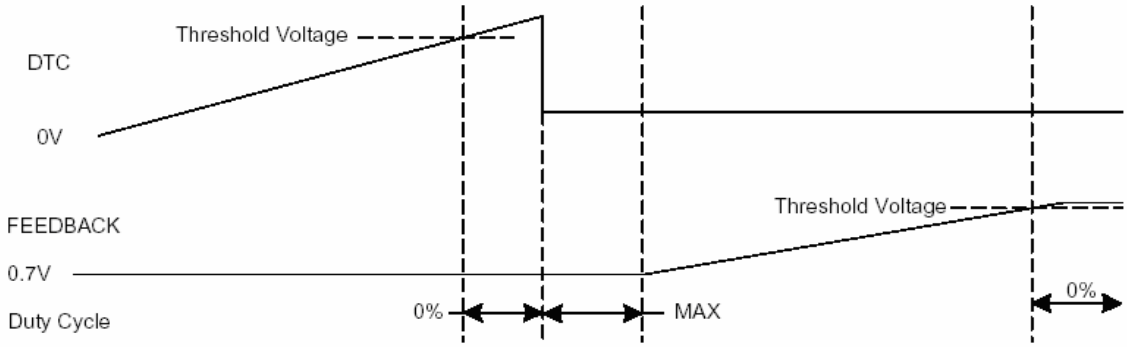
Note 4: Duration of short-circuit should not exceed one second

■ Parameter Measurement information



Test Circuit





Voltage Waveforms

Figure 4. Operational Test Circuit and Waveforms

■ Parameter Measurement information (Continued)

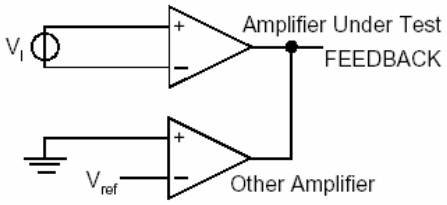
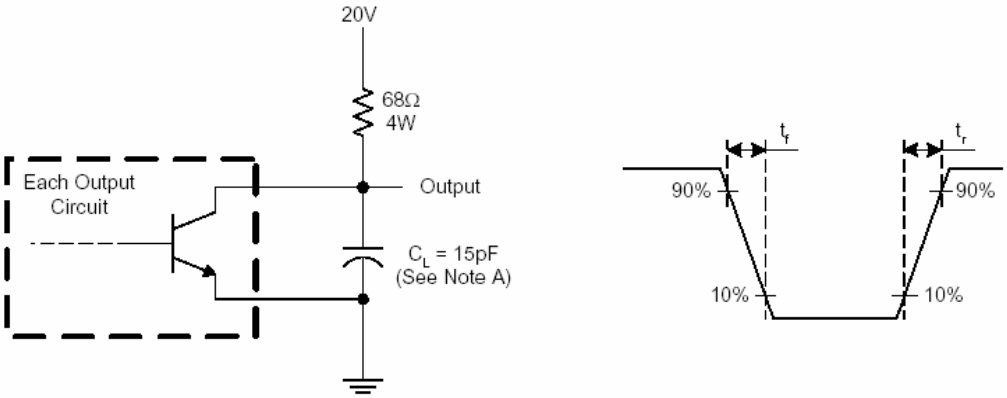
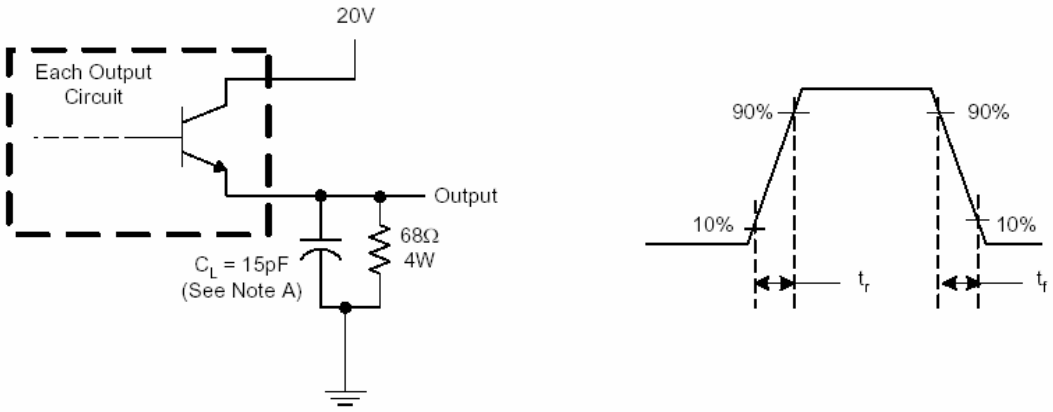


Figure 5. Error Amplifier Characteristics



Note A: C_L includes probe and jig capacitance.

Figure 6. Common-Emitter Configuration



Note A: C_L includes probe and jig capacitance.

Figure 7. Emitter-Follower Configuration

■ Typical Performance Characteristics

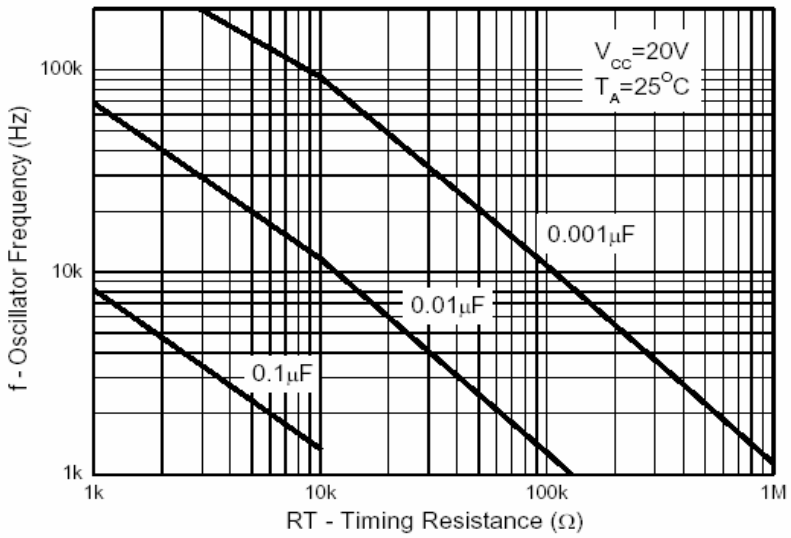


Figure 8. Oscillator Frequency vs. RT and CT

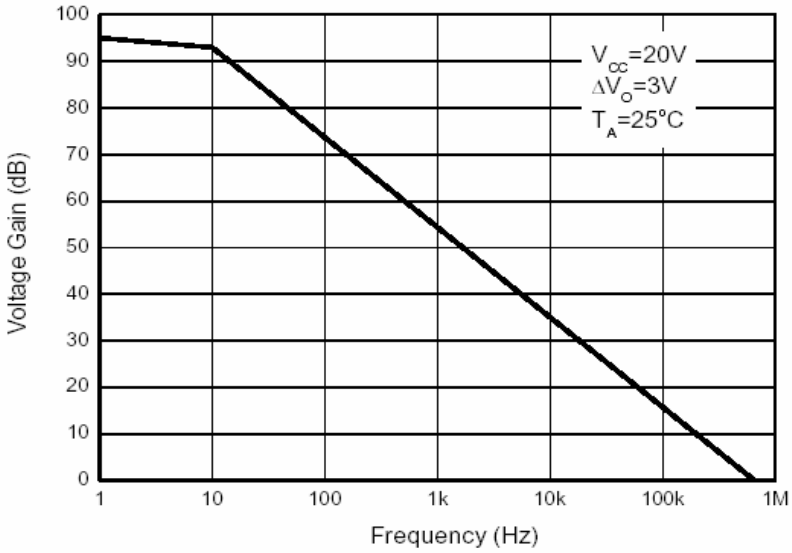


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency

■ Typical Application

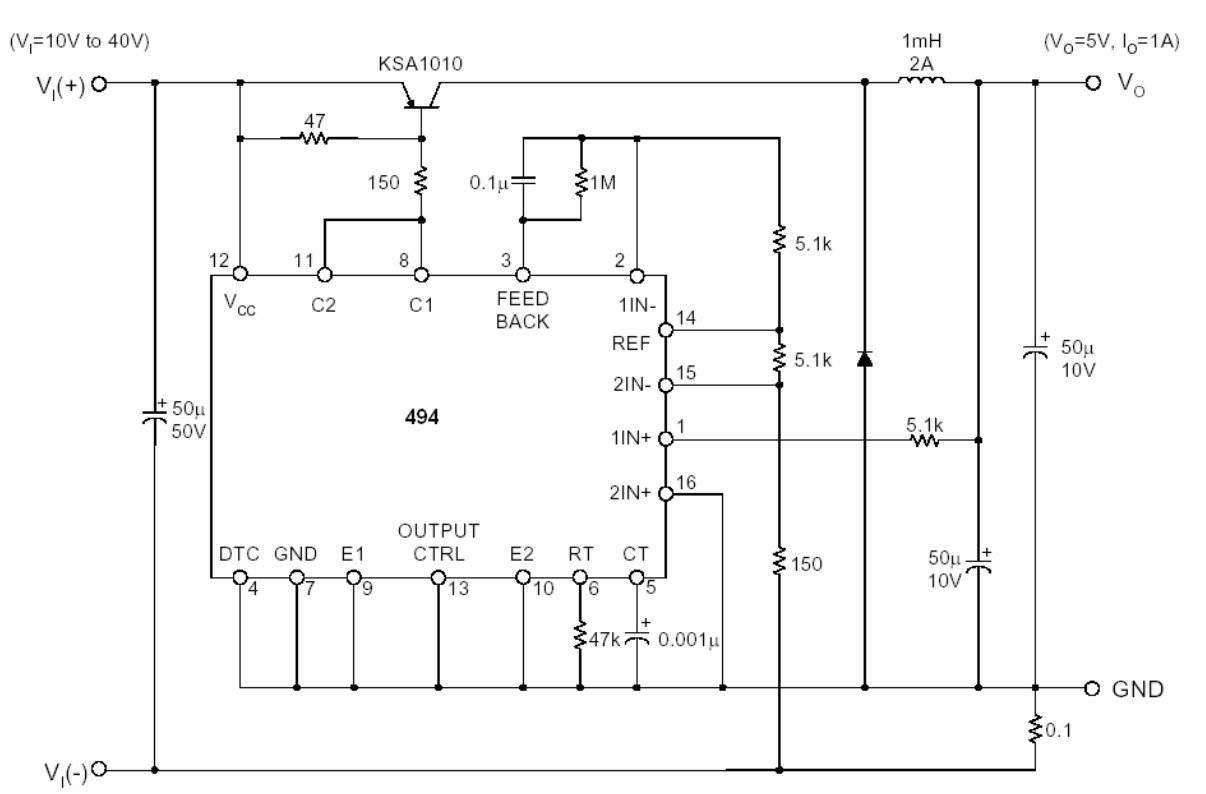
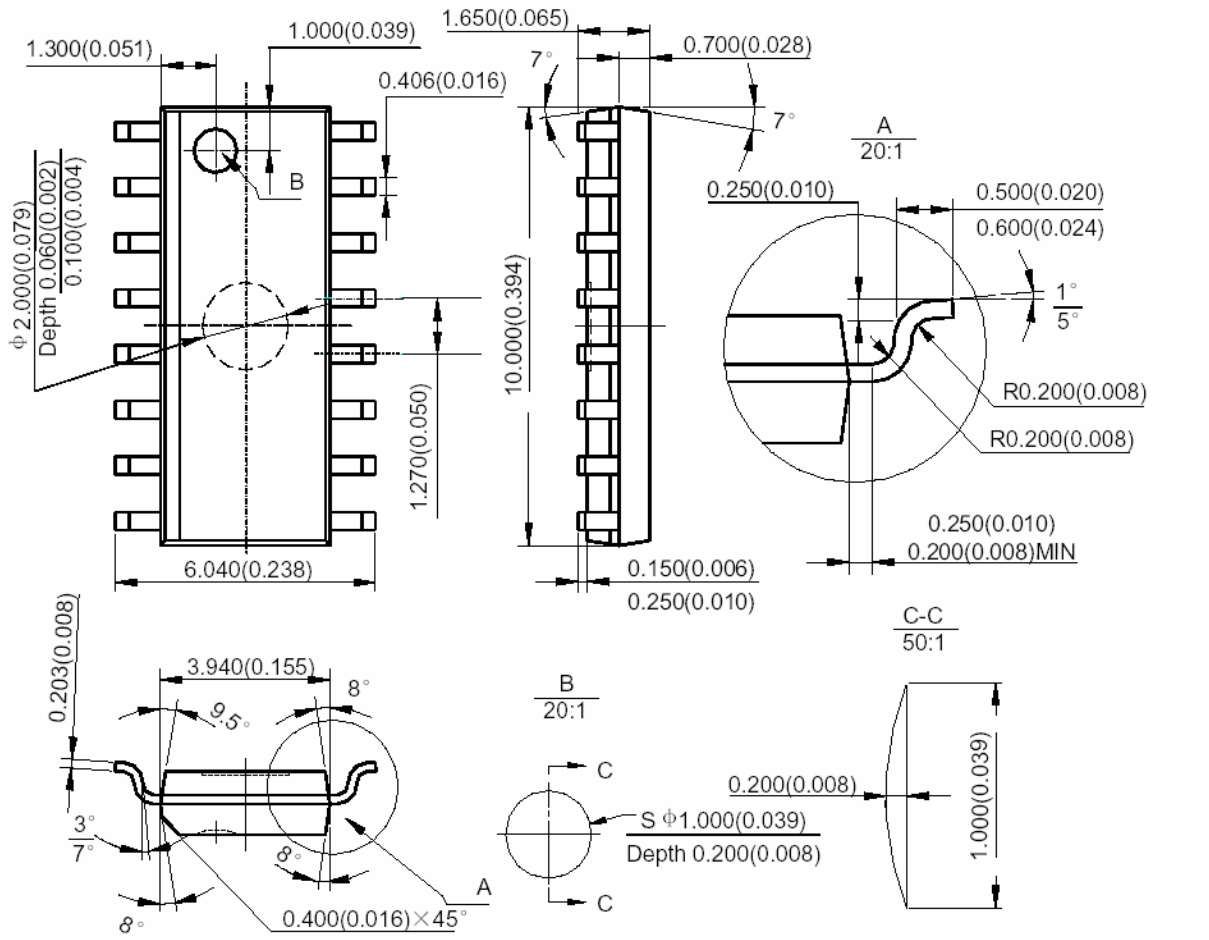


Figure 10. Pulse Width Modulated Step-Down Converter

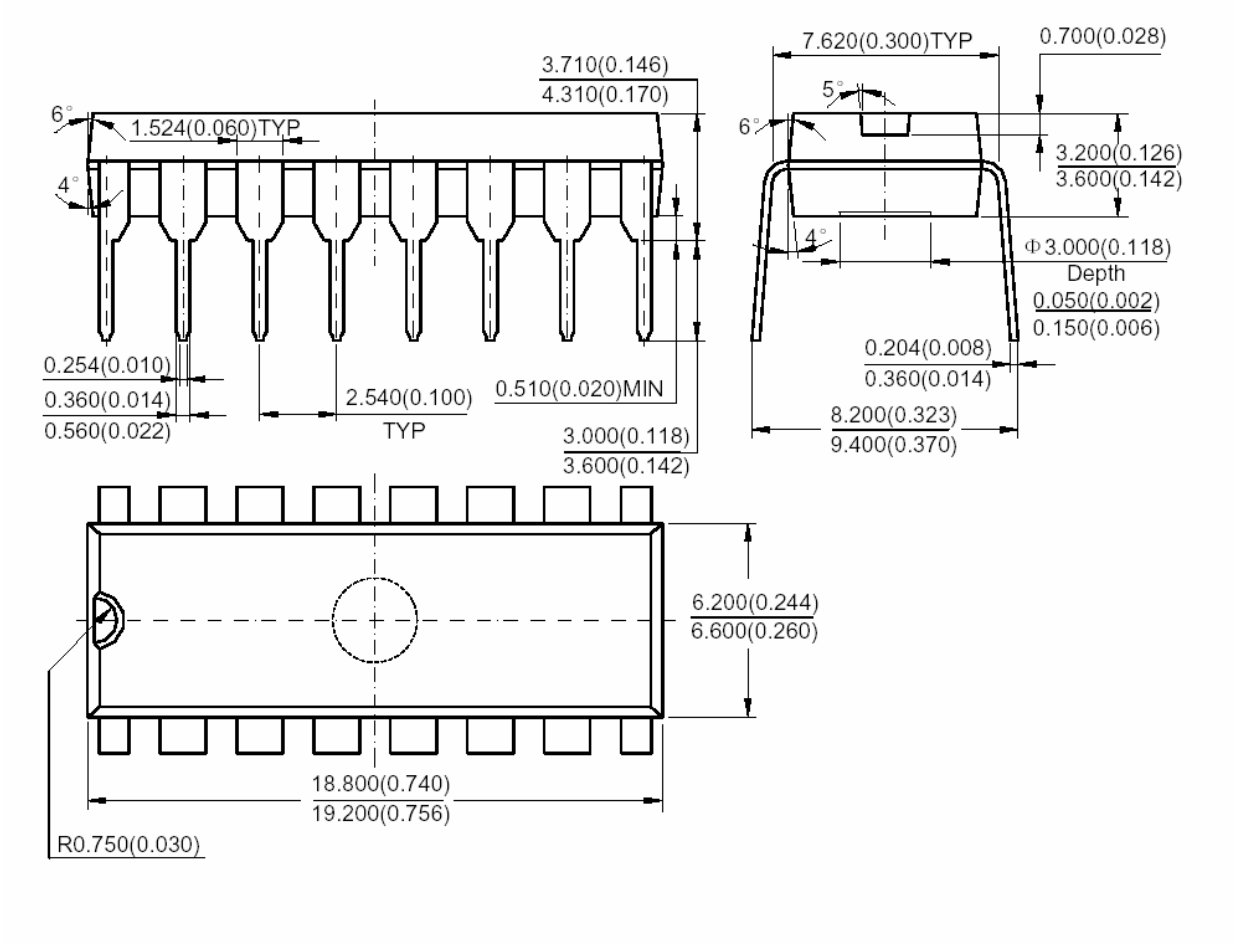
■ Mechanical Dimensions

SOP-16 Unit: mm (inch)



■ Mechanical Dimensions (Continued)

DP- 16 Unit: mm (inch)



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