



## TL494

## LINEAR INTEGRATED CIRCUIT

### VOLTAGE MODE PWM CONTROL CIRCUIT

#### DESCRIPTION

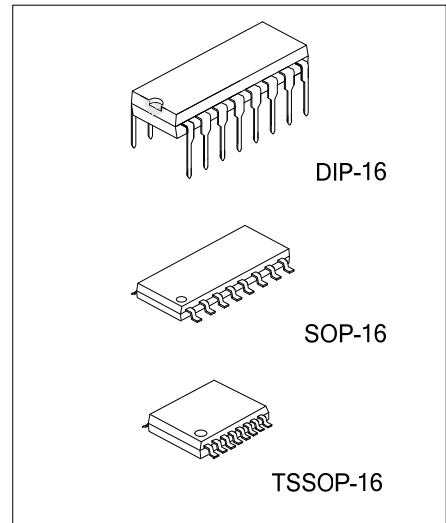
The UTC **TL494** incorporates all the functions required in the construction of a pulse-width modulation switching circuit. Designed primarily for switching power supply control or DC-DC converters, it offers the systems engineer the flexibility to tailor control circuitry to its own application.

#### 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 pulses over total range
- \* Easy synchronization

#### ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
TL494L-D16-T	TL494G-D16-T	DIP-16	Tube
-	TL494G-S16-R	SOP-16	Tape Reel
-	TL494G-P16-R	TSSOP-16	Tape Reel

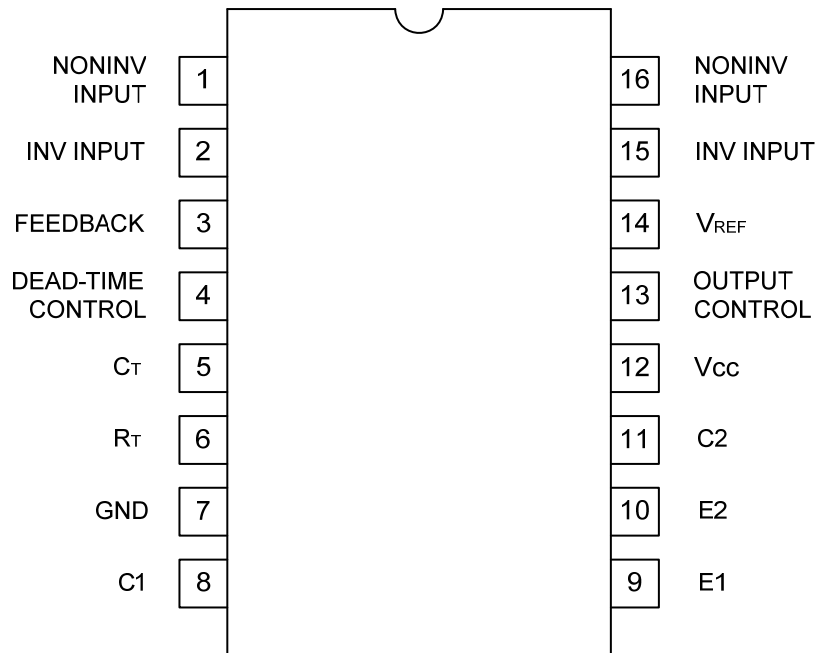


<p>TL494L-D16-T</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16 (3) L: Lead Free, G: Halogen Free and Lead Free</p>
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#### MARKING

DIP-16	SOP-16 / TSSOP-16
<p>UTC □□□□ → Date Code L: Lead Free TL494 □ → G: Halogen Free □□ → Lot Code</p>	<p>UTC □□□□ → Date Code TL494G □□ → Lot Code</p>

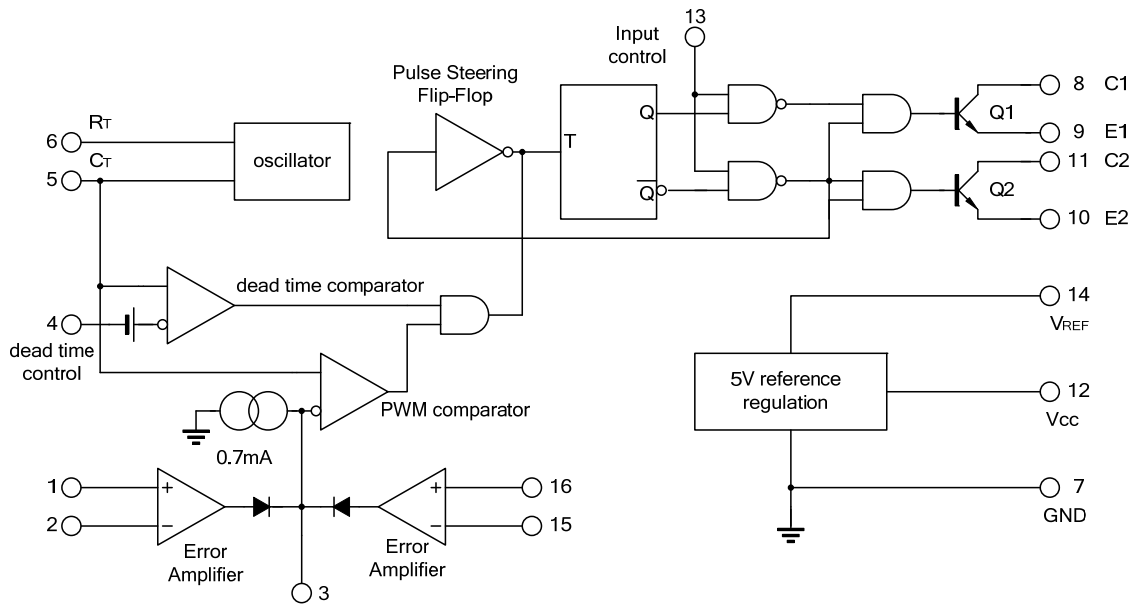
## ■ PIN CONFIGURATION



## ■ PIN DESCRIPTION

PIN No.	SYMBAL	NAME AND FUNCTION
1, 16	NONINV INPUT	Error Amplifier NONINV Input
2, 15	INV INPUT	Error Amplifier INV Input
3	FEEDBACK	Output Feedback Voltage
4	DEAD-TIME CONTROL	Output DEAD-TIME Control
5	CT	Timing Capacitor
6	RT	Timing Resistor
7	GND	Ground
8	C1	Internal Power NPN Collect1
9	E1	Internal Power NPN Emitter1
10	E2	Internal Power NPN Emitter2
11	C2	Internal Power NPN Collect2
12	VCC	Supply Voltage
13	OUTPUT CONTROL	Output mode select
14	VREF	Reference Voltage

## ■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage(Note 3)	$V_{CC}$	41	V
Amplifier Input Voltage	$V_{IN}$	$V_{CC}+0.3$	V
Collector Output Voltage	$V_{OUT}$	41	V
Collector Output Current	$I_{CO}$	250	mA
Power Dissipation ( $T_A=25^{\circ}C$ )	$P_D$	1000	mW
Derate at $T_A > 25^{\circ}C$		9.2	mW/ $^{\circ}C$
Junction Temperature	$T_J$	125	$^{\circ}C$
Operating Temperature	$T_{OPR}$	-25 ~ +85	$^{\circ}C$
Storage Temperature	$T_{STG}$	-40 ~ +150	$^{\circ}C$

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.  
 2. All voltage values, except differential voltages are with respect to the network ground terminal.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage	$V_{CC}$	7		40	V
Amplifier Input Voltage	$V_{IN}$	-0.3		$V_{CC}-2$	V
Collector Output Voltage	$V_{OUT}$			40	V
Collector Output Current (each Transistor)	$I_C$			200	mA
Current into Feedback	$I_f$			0.3	mA
Timing Capacitor	$C_T$	0.47		10000	nF
Timing Resistor	$R_T$	1.8		500	k $\Omega$
Oscillator Frequency	$f_{OSC}$	1		300	kHz
Operating Free-Air Temperature	$T_A$	0		70	$^{\circ}C$

■ ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range,  $V_{CC}=15V$ ,  $f=1kHz$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>REFERENCE SECTION</b>						
Output Voltage	$V_{OUT}$	$I_{OUT}=1mA$	4.75	5	5.25	V
Input Regulation	$V_{IN}$	$V_{CC}=7V \sim 40V$		2	25	mV
Output Regulation	$V_{OUT}$	$I_{OUT}=1 \sim 10mA$		1	15	mV
Output Voltage Change with Temperature		$\Delta T_A=MIN \sim MAX$ (note 2)		0.2	1	%
Short-Circuit Output Current	$I_{O(SC)}$	$V_{REF}=0$		35		mA
<b>OSCILLATOR SECTION</b>						
Frequency	F	$C_T=0.01\mu F$ , $R_T=12k\Omega$		10		kHz
Standard Deviation of Frequency		All Values of $V_{CC}$ , $C_T$ , $R_T$ , $T_A$ constant		10		%
Frequency Change with Voltage		$V_{CC}=7V \sim 40V$ , $T_A=25^{\circ}C$		0.1		%
Frequency Change with Temperature		$C_T=0.01\mu F$ , $R_T=12k\Omega$ , $\Delta T_A=MIN \sim MAX$			12	%

## ■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>AMPLIFIER SECTION</b>							
Input Offset Voltage	Error	$V_{I(OFF)}$	$V_{OUT}(\text{pin } 3)=2.5V$		2	10	mV
Input Offset Current		$I_{I(OFF)}$	$V_{OUT}(\text{pin } 3)=2.5V$		25	250	nA
Input Bias Current		$I_{I(BIAS)}$	$V_{OUT}(\text{pin } 3)=2.5V$		0.2	1	$\mu A$
Common-Mode Input Voltage Range	Error		$V_{CC}=7V \sim 40V$	-0.3 ~ $V_{CC}-2$			V
Open-Loop Voltage Amplification			$\Delta V_{OUT}=3V, V_{OUT}=0.5V \sim 3.5V$	70	95		dB
Unity-Gain Bandwidth		$GB_W$			800		kHz
Common-Mode Rejection Ratio	Error	CMRR	$V_{CC}=40V, T_A=25^\circ C$	65	80		dB
Output Sink Current(pin 3)		$I_{O(SINK)}$	$V_{ID}=-15mV \sim -5V, V(\text{pin } 3)=0.5V$	0.3	0.7		mA
Output source Current(pin 3)		$I_{O(SOURCE)}$	$V_{ID}=15mV \sim -5V, V(\text{pin } 3)=3.5V$	-2			mA
<b>OUTPUT SECTION</b>							
Collector off-state current		$I_{C(OFF)}$	$V_{CE}=40V, V_{CC}=40V$		2	100	$\mu A$
Emitter off-state Current		$I_{E(OFF)}$	$V_{CC}=V_C=40V, V_E=0$			-100	$\mu A$
Collector -emitter Saturation Voltage	Common-emitter		$V_E=0, I_C=200mA$		1.1	1.3	V
	Emitter-Follower		$V_C=15V, I_E=-200mA$		1.5	2.5	
Output Control Input Current			$V_{IN}=V_{REF}$			3.5	mA
<b>DEAD TIME CONTROL SECTION</b>							
Input bias (pin 4)		$I_{I(BIAS)}$	$V_{IN}=0 \sim 5.25V$		-2	-10	$\mu A$
Maximum duty cycle, each output			$V_{IN}(\text{pin } 4)=0$	45			%
Input threshold Voltage(pin 4)		$V_{THR}$	Zero duty Cycle		3	3.3	V
			Maximum duty cycle	0			
<b>PWM COMPARATOR SECTION</b>							
Input Threshold Voltage(pin 3)		$V_{THR}$	Zero Duty cycle		4	4.5	V
Input Sink Current (pin 3)		$I_{I(SINK)}$	$V(\text{pin } 3)=0.7V$	0.3	0.7		mA
<b>TOTAL DEVICE</b>							
Standby Supply Current	$V_{CC}=15V$	$I_{ST-BY}$	pin 6 at $V_{REF}$ , all other Inputs and outputs open		6	10	mA
	$V_{CC}=40V$				9	15	
Average supply current			$V(\text{pin } 4)=2V$		7.5		mA
<b>SWITCHING CHARACTERISTICS, <math>T_A=25^\circ C</math></b>							
Output Voltage Rise Time		$t_R$	Common-emitter configuration		100	200	ns
Output Voltage Fall Time		$t_F$			25	100	ns
Output Voltage Rise Time		$t_R$	Emitter-follower configuration		100	200	ns
Output Voltage Fall Time		$t_F$			40	100	ns

- Notes: 1. All typical Values except for temperature coefficient are at  $T_A=25^\circ C$ .  
 2. For conditions shown as MIN or MAX, use appropriate value under recommended operating conditions.  
 3. Duration of the short-circuit should not exceed one second.  
 4. Standard deviation is a measure of the statistical distribution the mean as derived from the formula:

$$\sigma = \sqrt{\frac{\sum_{n=1}^N (x_n - \bar{x})^2}{N-1}}$$

## ■ TEST CIRCUIT

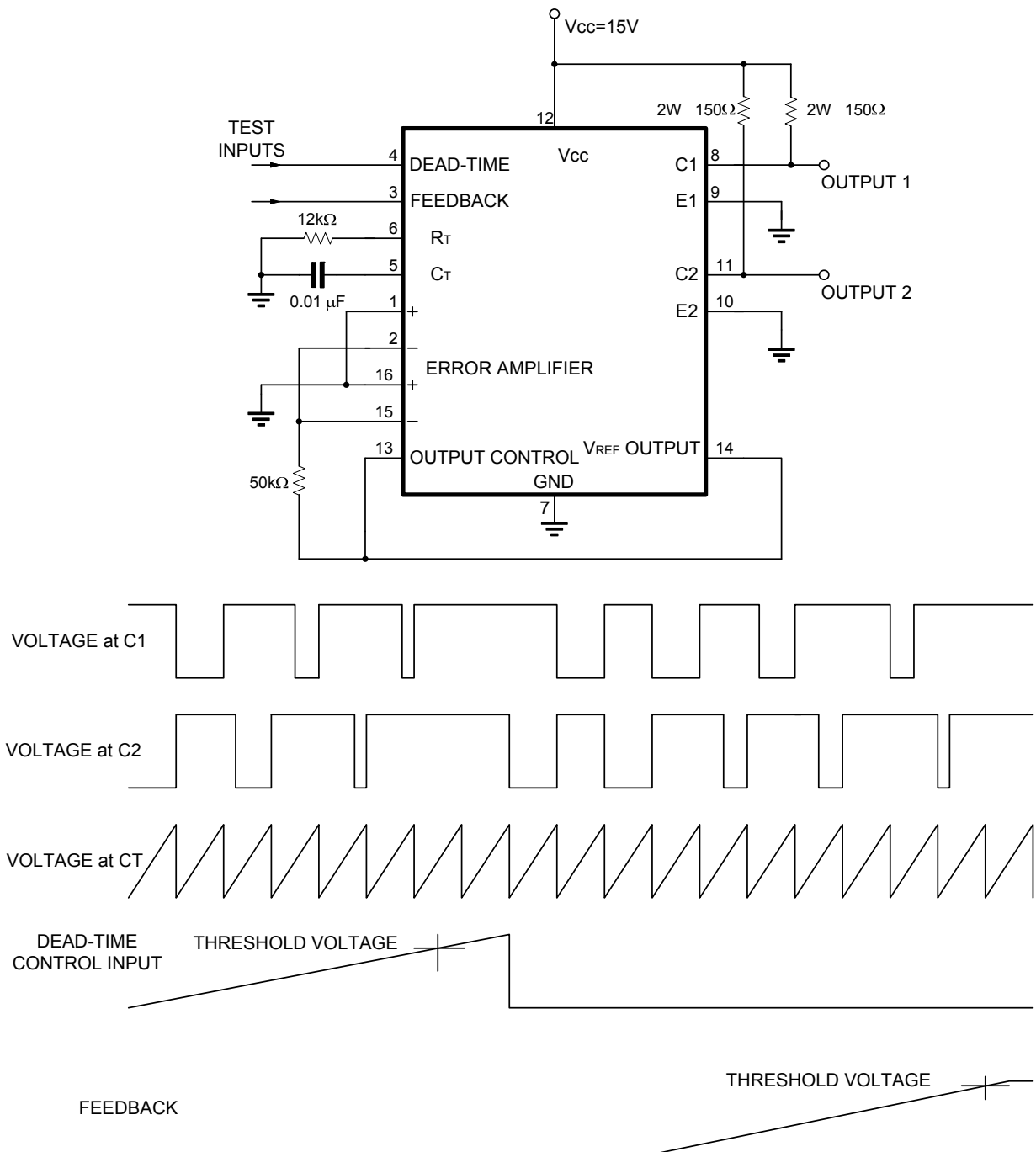


FIG 1. OPERATIONAL TEST CIRCUIT AND WAVEFORMS

■ TEST CIRCUIT(Cont.)

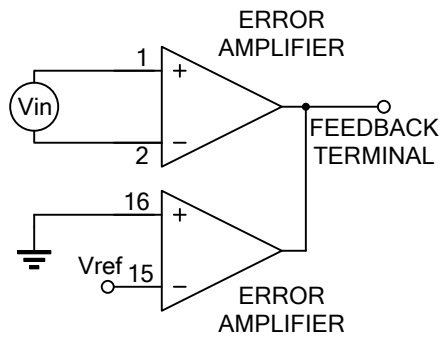


Fig. 2 AMPLIFIER CHARACTERISTICS

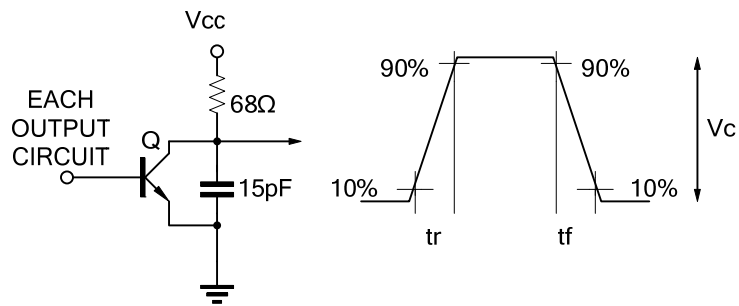


Fig. 3 COMMON-EMITTER CONFIGURATION

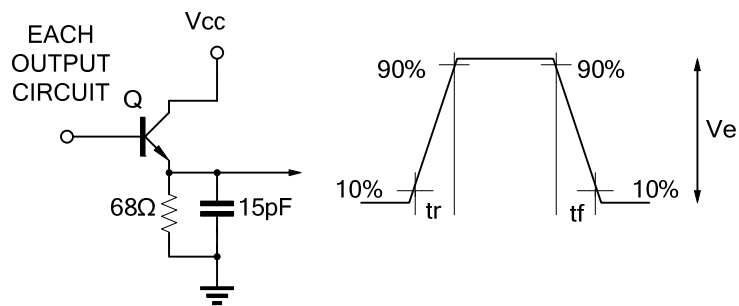
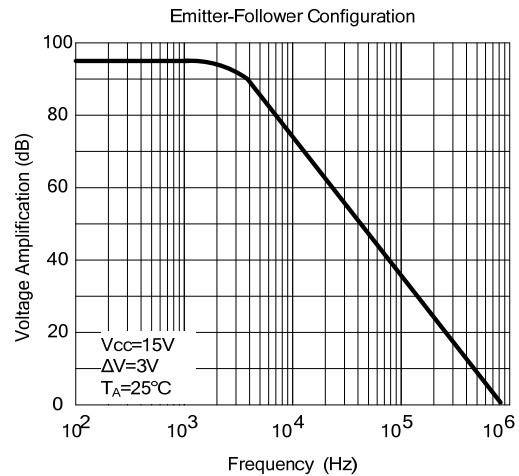
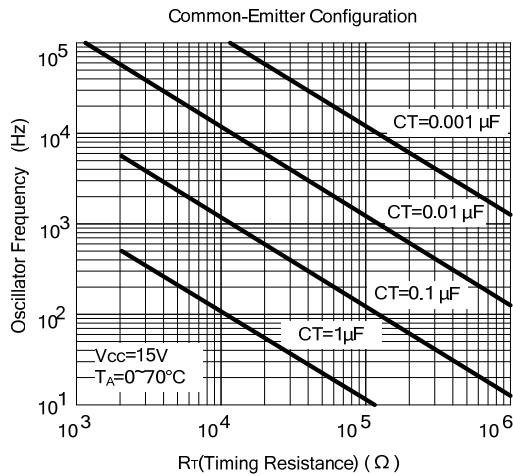


Fig. 4 EMITTER -FOLLOWER CONFIGURATION

■ TYPICAL PERFORMANCE CHARACTERISTICS



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