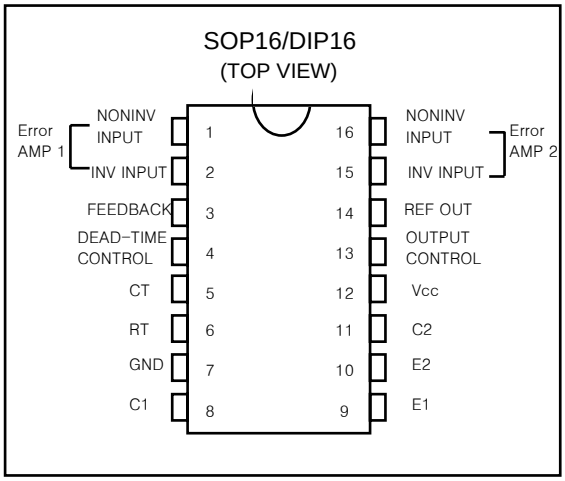
Pulse-Width-Modulation Control Circuits TL494

FEATURES

- Complete PWM Power Control Circuitry
- Uncommitted Outputs for 200 Ma 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 5-V Reference Supply,5%
- Circuit Architecture Allows Easy Synchronization



DESCRIPTION

The TL494 incorporate on a single monolithic chip all the functions required in the construction of a pulse-width-modulation control, these devices offer the systems engineer the flexibility to tailor the power supply control circuitry to his application.

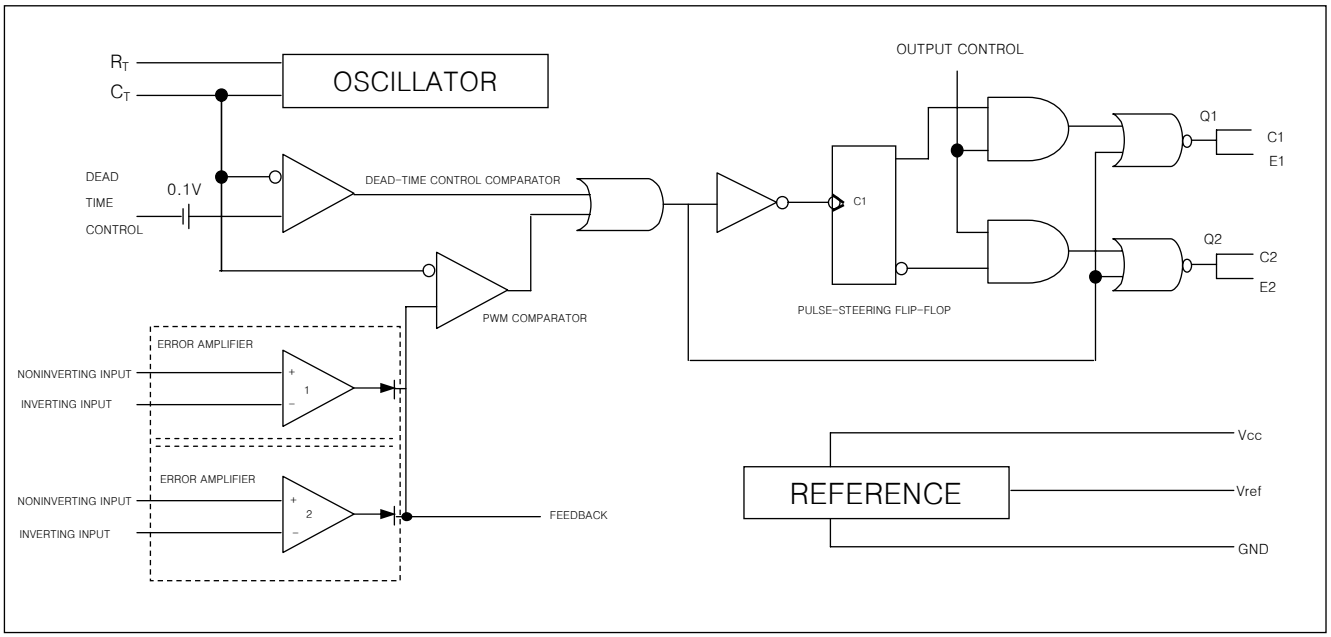
The TL494 contains an error amplifier, an on-chip adjustable oscillator, a dead-time control comparator, pulse-steering control flip-flop, a 5-volt, 5% precision regulator, and output-control circuit.

ORDERING INFORMATION

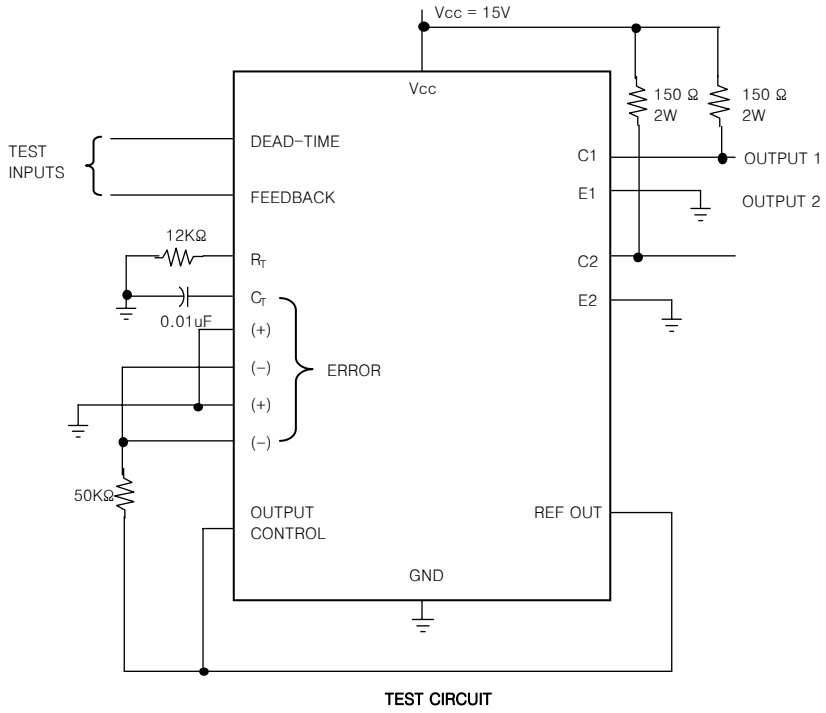
Device	Package
TL494D	16 SOP
TL494N	18 DIP

The error amplifier exhibits a common-mode voltage range from -0.3 volts to Vcc -2 volts. 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 R_T (pin 6) to the reference output and providing a sawtooth in put to CT (pin 5), or it may be used to drive the common circuits in synchronous multiple-rail power supplies. The uncommited 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 funct -ion. The architecture of these devices prohibits the possibility of either output being pulsed twice during push -pull operation.

Functional Block Diagram



Parameter measurement information



TEST CIRCUIT

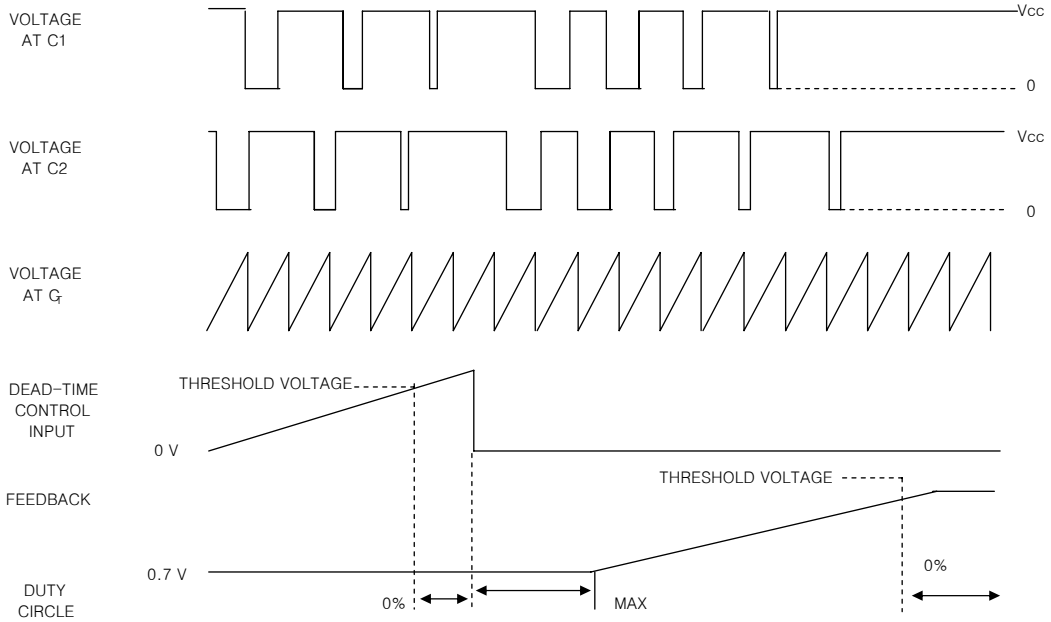


Figure 1. OPERATIONAL TEST CIRCUIT AND WAVEFORMS

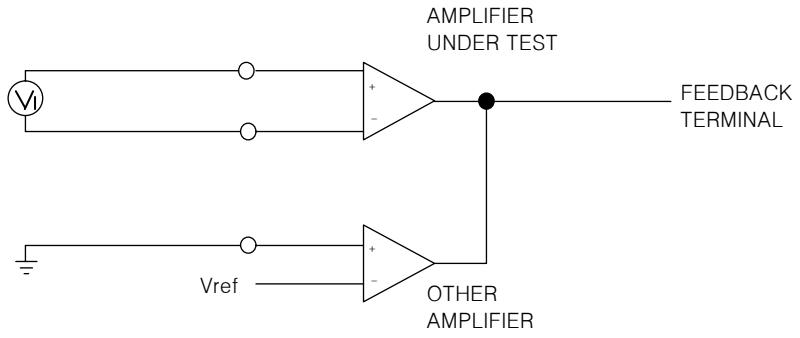
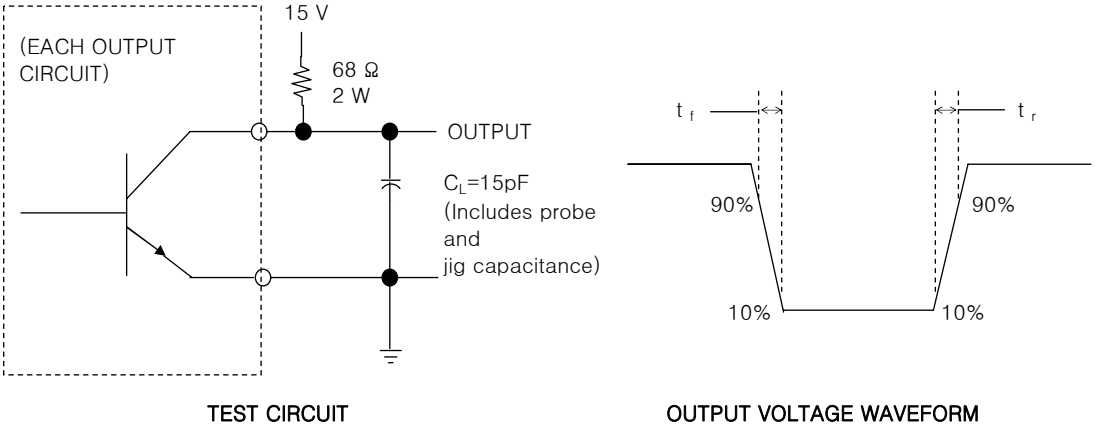
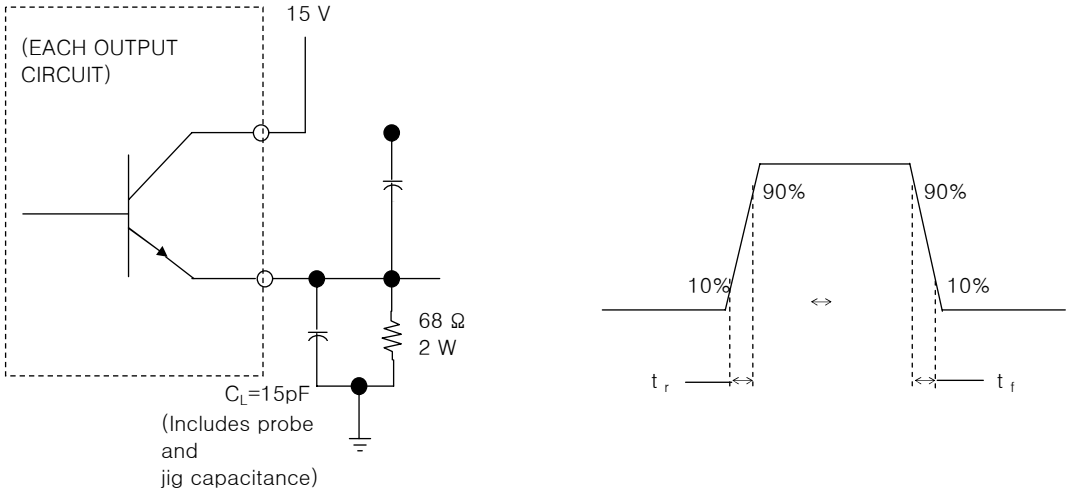


FIGURE 2. AMPLIFIER CHARACTERISTICS



TEST CIRCUIT OUTPUT VOLTAGE WAVEFORM

FIGURE 3. COMMON-EMITTER CONFIGURATION



TEST CIRCUIT OUTPUT VOLTAGE WAVEFORM

FIGURE 4. EMITTER-FOLLOWER CONFIGURATION

ABSOLUTE MAXIMUM RATINGS OVER OPERATING FREE-AIR TEMPERATURE RANGE

Rating	Value	Unit
Supply voltage, Vcc	41	V
Amplifier input voltage	Vcc +0.3	
Collector output voltage	41	
Collector output current	250	mA
Operating free-air temperature range	0 to 70	°C
Storage temperature range	-65 to 150	
Lead temperature 1,6 mm from case for 10 seconds	260	

RECOMMENDED OPERATING CONDITIONS

Parameter	Value		Unit
	MIN	MAX	
Supply voltage, Vcc	7	40	V
Amplifier input voltage, Vi	-0.3	Vcc -2	
Collector output voltage, Vo		40	
Collector output current (each transistor)		200	mA
Current into feedback terminal		0.3	
Timing capacitor, C_T	0.47	10000	nF
Timing resistor, R_T	1.8	500	KΩ
Oscillator frequency	1	300	KHz
Operating free-air temperature, T_A	0	70	°C

Electrical characteristics over recommended operatng free-air temperature range, Vcc=15V, f= 10 kHz(unless otherwise noted).

Parameter	Test Conditions*	Value			Unit
		MIN	TYP**	MAX	
Output voltage (Vref)	Io = 1mA	4.75	5	5.25	V
Input regulation	Vcc = 7V to 40 V		2	25	mV
Output regulation	Io = 1mA to 10mA		1	15	
Output voltage change with temperature	T_A = MIN to MAX		0.2	1	%
Short-circuit output current***	Vref = 0		35		mA

Oscillator section (See Figure 1)

Parameter	Test Conditions*	Value			Unit
		MIN	TYP**	MAX	
Frequency	C_T=0.01μF, R_T=12KΩ		10		KHz
Standard deviation of frequency****	All values of Vcc, C_T,R_T, and T_A constant		10		%
Frequency change with voltage	Vcc=7V to 40V, T_A=25oC		0.1		
Frequency change with temperature****	C_T=0.01μF, R_T=12KΩ, T_A = MIN to MAX			1	

Electrical characteristics over recommended operating free-air temperature range, Vcc=15V, f=10kHz (unless otherwise noted)

Amplifier section (See Figure 2)

SYMBOL	TEST CONDITIONS	MIN.	TYP**.	MAX.	UNIT
Input offset voltage	Vo(pin 3)=2.5V		2	10	mV
Input offset current	Vo(pin 3)=2.5V		25	250	nA
Input bias current	Vo(pin 3)=2.5V		0.2	1	μA
Common-mode input voltage range	Vcc = 7V to 40V	-0.3~-2			V
Open-loop voltage amplification	Vo=3V, R_L=2KΩ, Vo=0.5~3.5V	70	95		dB
Unity-gain bandwidth	Vo=0.5~3.5V, R_L=2KΩ		800		kHz
Common-mode rejection ratio	Vo= 40V, T_A= 25°C	65	80		dB
Output sink current (pin 3)	V_{ID}=-15mV~-5V, V($_{pin3}$)=0.7V	0.3	0.7		mA
Output source current (pin 3)	V_{ID}=15mV~5V, V($_{pin3}$)=3.5V	-2			mA

*For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

** All typical values except for parameter changes with temperature are at TA =25 oC

*** Duration of the short-circuit should not exceed one second.

**** Standard deviation is a measure of the statistical distribution about the mean as derived from the formula.

***** Temperature coefficient of timing capacitor and timing resistor not taken into account.

Output section

PARAMETER		TEST CONDITIONS	MIN.	TYP*	MAX.	UNIT
Collector off-state current		V_{CE}=40V, Vcc=40V		2	100	μA
Emitter off-state current		V_{CC}=V_C=40V,V_E=0			-100	
Collector-emitter saturation voltage	Common-emitter	V_E=0, I_C=200mA		1.1	1.3	V
	Emitter-follower	Vc=15V, I_E=-200mA		1.5	2.5	
Output control input current		V_I=Vref			3.5	mA

Dead-time control-section (See Figure 1)

PARAMETER	TEST CONDITIONS	MIN.	TYP*	MAX.	UNIT
Input bias current(pin4)	V_I=0 to 5.25V		-2	-10	μA
Maximum duty cycle, each output	$V_{I\ (pin\ 4)}$=0, C_T=0.1uF, R_T=12KΩ		45		%
Input threshold voltage(pin 4)	Zero duty cycle		3	3.3	V
	Maximum duty cycle	0			

PMW comparator section (See Figure 1)

PARAMETER	TEST CONDITIONS	MIN.	TYP*	MAX.	UNIT
Input threshold voltage (pin3)	Zero duty cycle		4	4.5	V
Input sink current (pin 3)	V(pin3) = 0.7V	0.3	0.7		mA

Total device

PARAMETER	TEST CONDITIONS		MIN.	TYP*	MAX.	UNIT
Standby supply current	Pin 6 at Vref, all other inputs and outputs open	V_{CC}=15V		6	10	mA
		V_{CC}=40V		9	15	
Average supply current	V_I(pin 4)= 2V			7.5		

Switching characteristics, $T_A = 25°C$

PARAMETER	TEST CONDITIONS	MIN.	TYP*	MAX.	UNIT
Output voltage rise time	Common-emitter configuration		100	200	ns
Output voltage fall time			25	100	
Output voltage rise time	Emitter-follower configuration		100	200	
Output voltage fall time			40	100	

* All typical values except for temperature coefficient are at $T_A = 25°C$