

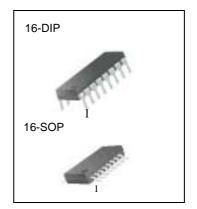
TL494 SMPS Controller

Features

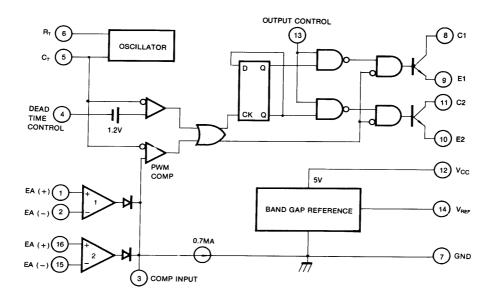
- Internal regulator provides a stable 5V reference supply trimmed to 5%
- Uncommitted output TR for 200mA sink or source current
- Output control for push-pull or single-ended operation
- Variable duty cycle by dead time control (pin 4) Complete PWM control circuit
- On-chip oscillator with master or slave operation
- Internal circuit prohibits double pulse at either output

Description

The TL494 is used for the control circuit of the PWM switching regulator. The TL494 consists of 5V reference voltage circuit, two error amplifiers, flip flop, an output control circuit, a PWM comparator, a dead time comparator and an oscillator. This device can be operated in the switching frequency of 1 KHz to 300 KHz.



Internal Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage	Vcc	42	V
Collector Supply Voltage	Vc	42	V
Output Current	lo	250	mA
Amplifier Input Voltage	VIN	VCC + 0.3	V
Power Dissipation (T _A = 25°C)	PD	1 (TL494CN) 0.9 (TL494CD)	W
Operating Temperature Range	Topr	0 ~ +70	°C
Storage Temperature Range	TSTG	-65 ~ + 150	°C

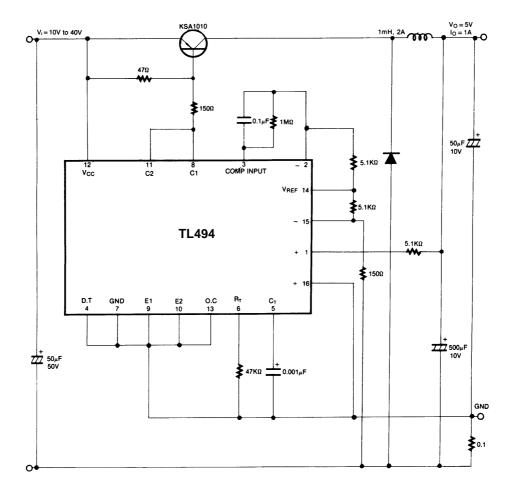
Electrical Characteristics

 $(V_{CC} = 20V, f = 10KHz, T_A = 0^{\circ}C \text{ to} + 70^{\circ}C, \text{ unless otherwise specified})$

Reference Output Voltage	Parameter	Symbol	Conditions	Min.	Тур.	Max.	Unit	
Line Regulation	REFERENCE SECTION			•	•	•		
Temperature Coefficient of VREF ΔVREF/ΔT TA = 0°C to 70°C - 0.01 0.03 %°C Load Regulation ΔVREF IREF = 1mA to 10mA - 1.0 15 mV	Reference Output Voltage	VREF	IREF = 1mA	4.75	5.0	5.25	V	
Load Regulation ΔVREF IREF = 1mA to 10mA - 1.0 15 mV Short-Circuit Output Curmet ISC VREF = 0V 10 35 50 mA OSCILATOR SECTION	Line Regulation	ΔVREF	Vcc = 7V to 40V	-	2.0	25	mV	
Short-Circuit Output Curmet ISC VREF = 0V 10 35 50 mA	Temperature Coefficient of VREF	ΔVREF/ΔT	$T_A = 0$ °C to 70 °C	-	0.01	0.03	%/°C	
OSCILLATOR SECTION Oscillation Frequency f CT = 0.01μF, RT = 12KΩ - 10 - KHz Frequency Change with Temperature $\Delta f/\Delta T$ CT = 0.01μF, RT = 12KΩ - - 2 % DEAD TIME CONTROL SECTION Input Bias Current IBIAS VCC = 15V, 0V≤V4≤5.25V - -2.0 -10 μA Maximum Duty Cycle D(MAX) VCC = 15V, V4 = 0V O.C Pin = VREF 45 -	Load Regulation	ΔVREF	IREF = 1mA to 10mA	-	1.0	15	mV	
Oscillation Frequency f CT = 0.01μF, RT = 12KΩ - 10 - KHz Frequency Change with Temperature Δf/ΔT CT = 0.01μF, RT = 12KΩ - - 2 % DEAD TIME CONTROL SECTION Input Bias Current IBJAS VCC = 15V, V9≤0.525V - -2.0 -10 μA Maximum Duty Cycle D(MAX) VCC = 15V, V9 = 0V O.C. Pin = VREF 45 - - - % Input Threshold Voltage VITH Zero Duty Cycle - 3.0 3.3 V ERROR AMP SECTION VITH Zero Duty Cycle - 3.0 3.3 V Input Offset Current Ilio V3 = 2.5V - 2.0 10 mV Input Offset Current Ilio V3 = 2.5V - 2.0 10 mV Input Offset Current Ilio V3 = 2.5V - 0.2 1.0 μA Common Mode Input Voltage VCM 7V ≤ VC ≤ 40V -0.3 - VCC V </td <td>Short-Circuit Output Currnet</td> <td>Isc</td> <td>VREF = 0V</td> <td>10</td> <td>35</td> <td>50</td> <td>mA</td>	Short-Circuit Output Currnet	Isc	VREF = 0V	10	35	50	mA	
Prequency Change with Temperature Δ //Δ	·							
DEAD TIME CONTROL SECTION Input Bias Current IBIAS VCC = 15V, 0V≤V4≤5.25V - -2.0 -10 μA Maximum Duty Cycle D(MAX) VCC = 15V, V4 = 0V O.C Pin = VREF - 3.0 3.3 V D(MAX) VCC = 15V, V4 = 0V O.C Pin = VREF - 3.0 3.3 V D(MAX) VCC = 15V, V4 = 0V O.C Pin = VREF - 3.0 3.3 V D(MAX) D(V) Cycle - 3.0 3.3 V D(MAX) D(MAX)	Oscillation Frequency	f	$C_T = 0.01 \mu F, R_T = 12 K\Omega$	-	10	-	KHz	
Input Bias Current	Frequency Change with Temperature	Δf/ΔΤ	$C_T = 0.01 \mu F, R_T = 12 K\Omega$	-	-	2	%	
Maximum Duty Cycle D(MAX) VCC = 15V, V4 = 0V O.C Pin = VREF 45 - - % Input Threshold Voltage VITH Zero Duty Cycle - 3.0 3.3 √ ERROR AMP SECTION Input Offset Voltage VIO V3 = 2.5V - 2.0 10 mV Input Offset Current IIO V3 = 2.5V - 2.5 250 mA Input Bias Current IBIAS V3 = 2.5V - 0.2 1.0 μA Common Mode Input Voltage VCM 7V ≤ VCC ≤ 40V - 0.3 - VCC V Open-Loop Voltage Gain GVO 0.5V ≤ V3 ≤ 3.5V 70 95 - dB Unit-Gain Bandwidth BW - - 650 - KHz PWM COMPARATOR SECTION Input Threshold Voltage VITH Zero Duty Cycle - 4 4.5 V Input Sink Currnet Issue Type Type Type Type Type Type Type Typ	DEAD TIME CONTROL SECTION		l	· I			I	
Input Threshold Voltage	Input Bias Current	IBIAS	VCC = 15V, 0V≤V4≤5.25V	-	-2.0	-10	μΑ	
Max. Duty Cycle 0 - - V	Maximum Duty Cycle	D(MAX)		45	-	-	%	
Max. Duty Cycle 0	Input Threshold Voltage	VITH	Zero Duty Cycle	-	3.0	3.3		
Input Offset Voltage			Max. Duty Cycle	0	-	-	─	
Input Offset Current								
Input Bias Current	Input Offset Voltage	Vio	V ₃ = 2.5V	-	2.0	10	mV	
Common Mode Input Voltage VCM 7V ≤ VCC ≤ 40V -0.3 - VCC V Open-Loop Voltage Gain GVO 0.5V ≤ V3 ≤ 3.5V 70 95 - dB Unit-Gain Bandwidth BW - - 650 - KHz PWM COMPARATOR SECTION Input Threshold Voltage VITH Zero Duty Cycle - 4 4.5 V Input Sink Currnet ISINK V3=0.7V -0.3 -0.7 - mV OUTPUT SECTION VCE(SAT) VE = 0, IC = 200mA - - 1.1 1.3 V Common Emitter VCE(SAT) VE = 0, IC = 200mA - 1.5 2.5 V Collector Off-State Currnet IC(OFF) VCC = 40V, VE = -200mA - 1.5 2.5 Collector Off-State Currnet IE(OFF) VCC = 40V, VE = 40V - 2 100 µA TOTAL DEVICE Supply Current IC Pin 6 = VREF, VCC = 15V - 6 10	Input Offset Current	lio	V ₃ = 2.5V	-	25	250	mA	
Open-Loop Voltage Gain GVO 0.5V ≤ V3 ≤3.5V 70 95 - dB Unit-Gain Bandwidth BW - - 650 - KHz PWM COMPARATOR SECTION Input Threshold Voltage VITH Zero Duty Cycle - 4 4.5 V Input Sink Currnet Isink V3=0.7V -0.3 -0.7 - mV OUTPUT SECTION Output Saturation Voltage Common Emitter VCE(SAT) VE = 0, IC = 200mA - 1.1 1.3 V Common Collector VCC(SAT) VC = 15V, IE = -200mA - 1.5 2.5 1.00 V Collector Off-State Currnet IC(OFF) VCC = 40V, VCE = 40V - 2 100 µA Emitter Off-State Current IE(OFF) VCC = VC = 40V, VE = 0 - - - - -100 µA TOTAL DEVICE Supply Current IC Pin 6 = VREF, VCC = 15V - 6 10 mA <td< td=""><td>Input Bias Current</td><td>IBIAS</td><td>V3 = 2.5V</td><td>-</td><td>0.2</td><td>1.0</td><td>μΑ</td></td<>	Input Bias Current	IBIAS	V3 = 2.5V	-	0.2	1.0	μΑ	
Duit-Gain Bandwidth BW - - 650 - KHz	Common Mode Input Voltage	Vсм	7V ≤ V _{CC} ≤ 40V	-0.3	-	Vcc	V	
PWM COMPARATOR SECTION Input Threshold Voltage VITH Zero Duty Cycle - 4 4.5 V Input Sink Currnet ISINK V3=0.7V -0.3 -0.7 - mV OUTPUT SECTION Output Saturation Voltage Common Emitter VCE(SAT) VE = 0, IC = 200mA - 1.1 1.3 V Common Collector VCC(SAT) VC = 15V, IE = -200mA - 1.5 2.5 Collector Off-State Currnet IC(OFF) VCC = 40V, VCE = 40V - 2 100	Open-Loop Voltage Gain	Gvo	0.5V ≤ V ₃ ≤3 .5V	70	95	-	dB	
Input Threshold Voltage	Unit-Gain Bandwidth	BW	-	-	650	-	KHz	
Input Sink Currnet ISINK V3=0.7V -0.3 -0.7 - mV	PWM COMPARATOR SECTION	l			1	1	I	
OUTPUT SECTION Output Saturation Voltage Common Emitter VCE(SAT) VE = 0, IC = 200mA - 1.1 1.3 V Common Collector VCC(SAT) VC = 15V, IE = -200mA - 1.5 2.5 V Collector Off-State Currnet IC(OFF) VCC = 40V, VCE = 40V - 2 100 μA Emitter Off-State Current IE(OFF) VCC = VC = 40V, VE = 0 - - - -100 PIA TOTAL DEVICE Supply Current ICC Pin 6 = VREF, VCC = 15V - 6 10 mA OUTPUT SWITCHING CHARACTERISTIC Rise Time tR -	Input Threshold Voltage	VITH	Zero Duty Cycle	-	4	4.5	V	
Output Saturation Voltage Common Emitter VCE(SAT) VE = 0, IC = 200mA - 1.1 1.3 V Common Collector VCC(SAT) VC = 15V, IE = -200mA - 1.5 2.5 Collector Off-State Currnet IC(OFF) VCC = 40V, VCE = 40V - 2 100 μA Emitter Off-State Current IE(OFF) VCC = VC = 40V, VE = 0 - - - -100 PA TOTAL DEVICE Supply Current ICC Pin 6 = VREF, VCC = 15V - 6 10 mA OUTPUT SWITCHING CHARACTERISTIC Rise Time tR -	Input Sink Currnet	ISINK	V ₃ =0.7V	-0.3	-0.7	-	mV	
Common Emitter VCE(SAT) VE = 0, IC = 200mA - 1.1 1.3 V Common Collector VCC(SAT) VC = 15V, IE = -200mA - 1.5 2.5 Collector Off-State Current IC(OFF) VCC = 40V, VCE = 40V - 2 100 μA Emitter Off-State Current IE(OFF) VCC = VC = 40V, VE = 0 - - - -100 PA TOTAL DEVICE Supply Current ICC Pin 6 = VREF, VCC = 15V - 6 10 mA OUTPUT SWITCHING CHARACTERISTIC Rise Time tR -	OUTPUT SECTION		l	· I			I	
Common Collector VCC(SAT) VC = 15V, IE = -200mA - 1.5 2.5 Collector Off-State Currnet IC(OFF) VCC = 40V, VCE = 40V - 2 100 μA Emitter Off-State Current IE(OFF) VCC = VC = 40V, VE = 0 - - - -100 μA TOTAL DEVICE Supply Current ICC Pin 6 = VREF, VCC = 15V - 6 10 mA OUTPUT SWITCHING CHARACTERISTIC Rise Time tR -	,	VCE(SAT)	VE = 0, IC = 200mA	-	1.1	1.3	.,	
Emitter Off-State Current IE(OFF) VCC = VC = 40V, VE = 0 - - -100 μΑ TOTAL DEVICE Supply Current ICC Pin 6 = VREF, VCC = 15V - 6 10 mA OUTPUT SWITCHING CHARACTERISTIC Rise Time tR -	Common Collector	VCC(SAT)	Vc = 15V, IE = -200mA	-	1.5	2.5	V	
TOTAL DEVICE Supply Current IE(OFF) VCC = VC = 40V, VE = 0 - - -100	Collector Off-State Currnet	IC(OFF)	VCC = 40V, VCE = 40V	-	2	100	^	
Supply Current ICC Pin 6 = VREF, VCC = 15V - 6 10 mA OUTPUT SWITCHING CHARACTERISTIC Rise Time tR -	Emitter Off-State Current	IE(OFF)	VCC = VC = 40V, VE = 0	-	-	-100	μΑ	
OUTPUT SWITCHING CHARACTERISTIC Rise Time tR - - - - - Common Emitter - - - 100 200 ns Common Collector - - - 100 200 - Fall Time tF - - - - - - Common Emitter - - - 25 100 ns								
Rise Time tR -	Supply Current	Icc	Pin 6 = VREF, VCC = 15V	-	6	10	mA	
Common Emitter - - 100 200 ns Common Collector - - - 100 200 ns Fall Time tF - - - - - - Common Emitter - - - 25 100 ns	OUTPUT SWITCHING CHARACTERISTIC							
Common Collector - - 100 200 Fall Time tF - - - - Common Emitter - - 25 100 ns	Rise Time	t _R	-	-	-	-	-	
Common Collector - - 100 200 Fall Time tF - - - - Common Emitter - - - 25 100	Common Emitter	-	-	-	100	200	no	
Common Emitter 25 100	Common Collector	-	-	-	100	200	- ns	
ns ns	Fall Time	tF	-	-	-	-	-	
Common Collector 40 100	Common Emitter	-	-	-	25	100	ns	
	Common Collector	-	-	-	40	100		

Typical Application

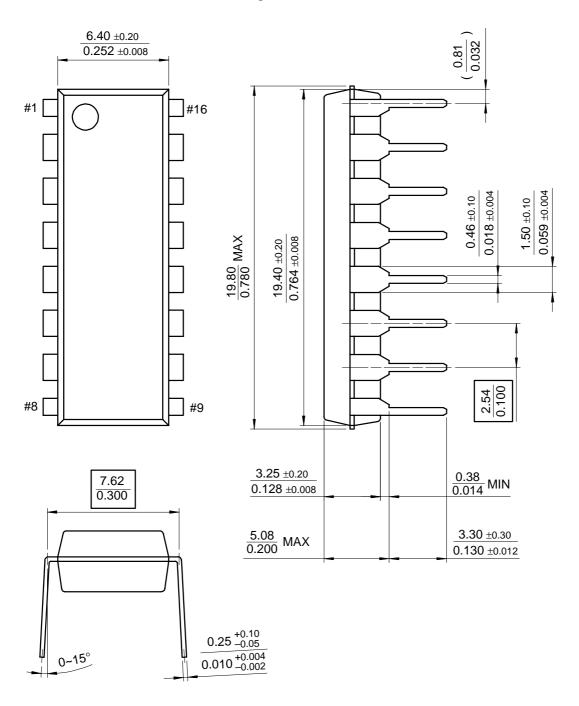
Pulse Width Modulated Step-down Converter



Mechanical Dimensions

Package

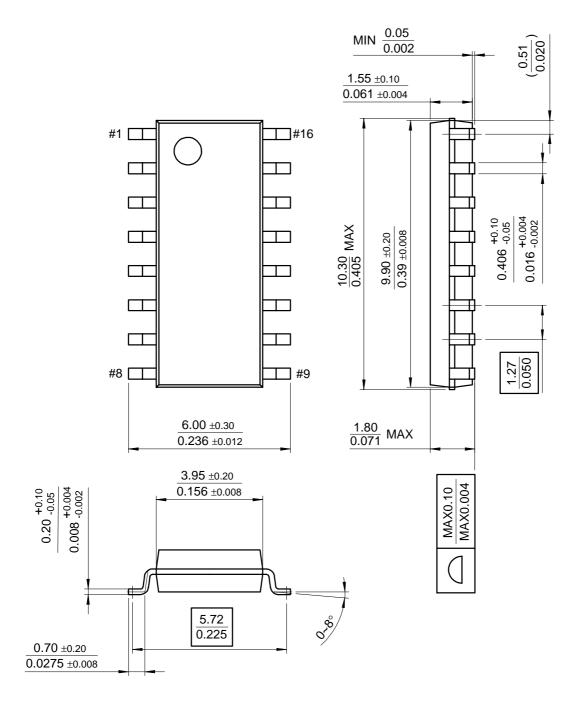
16-DIP



Mechanical Dimensions (Continued)

Package

16-SOP



Ordering Information

Product Number	Package	Operating Temperature
TL494CN	16 DIP	0 ~ + 70°C
TL494CD	16 SOP	0~+700

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