



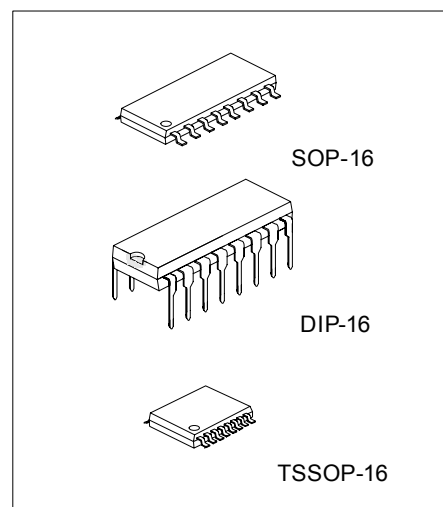
TL594

LINEAR INTEGRATED CIRCUIT

PULSE-WIDTH-MODULATION CONTROL CIRCUIT

■ DESCRIPTION

The UTC **TL594** incorporates all the functions required for a pulse-width-modulation (PWM) control circuit. It is pin compatible with TL494 with upgrade performance.



*Pb-free plating product number: TL594L

■ FEATURES

- * Outputs for 200-mA Sink or Source Current
- * Output is Single-Ended or Push-Pull Operation Selectable suppression circuit
- * Internal Circuitry Prohibits Double Pulse at Either Output
- * Variable Dead Time
- * Internal Reference Supply Deliever 5V within 1% tolerance
- * Undervoltage Lockout for Low- V_{CC} Conditions

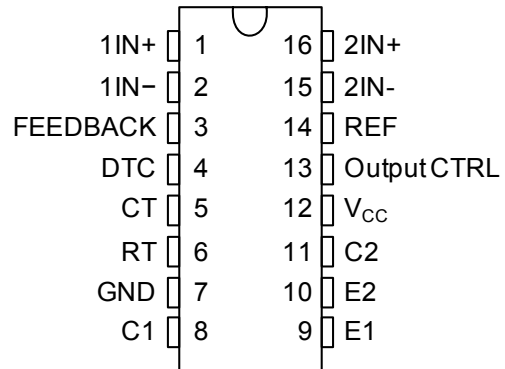
■ ORDERING INFORMATION

Order Number		Package	Packing
Normal	Lead Free Plating		
TL594-D16-T	TL594L-D16-T	DIP-16	Tube
TL594-P16-R	TL594L-P16-R	TSSOP-16	Tape Reel
TL594-P16-T	TL594L-P16-T	TSSOP-16	Tube
TL594-S16-R	TL594L-S16-R	SOP-16	Tape Reel
TL594-S16-T	TL594L-S16-T	SOP-16	Tube

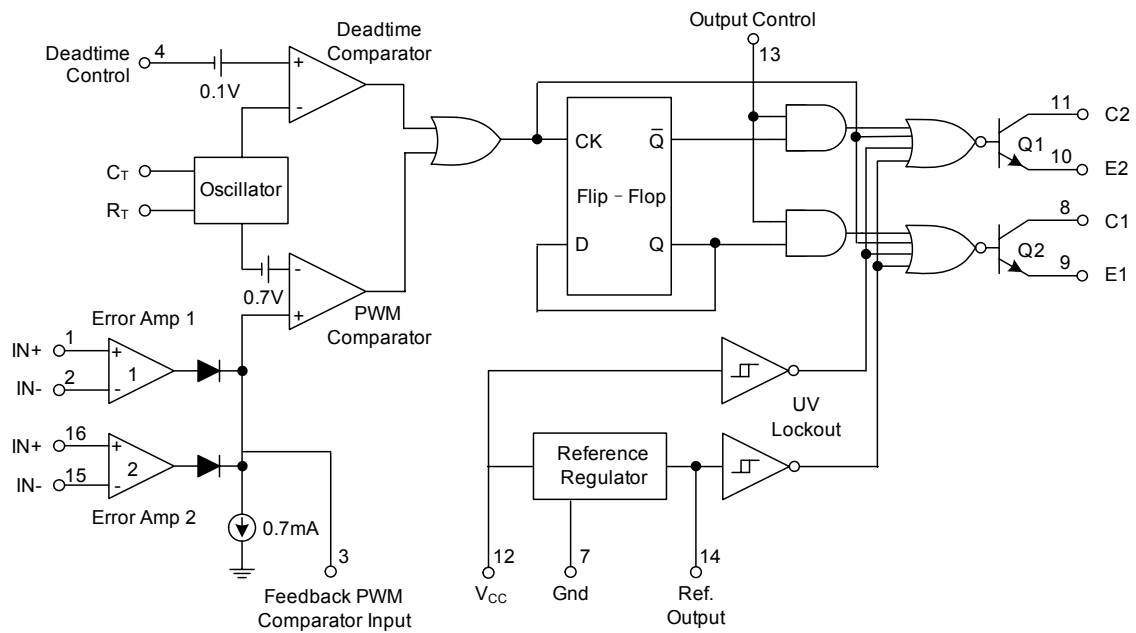
TL594L-D16-T (1)Packing Type (2)Package Type (3)Lead Plating	(1) R: Tape Reel, T: Tube (2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16 (3) L: Lead Free Plating, Blank: Pb/Sn
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■ PIN CONFIGURATION

DIP-16/SOP-16/TSSOP-16 PACKAGE
(TOP VIEW)



FUNCTIONAL BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

(over operating free-air temperature range (unless otherwise noted)^{Note1})

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{CC}	41	V
Amplifier input voltage		$V_{CC} + 0.3$	V
Collector output voltage		41	V
Collector output current		250	mA
Operating Junction Temperature	T_J	+150	°C
Operating Free-Air Temperature	T_A	-40 ~ +85	°C
Storage Temperature	T_{STG}	-40 ~ 150	°C

Note 1. Stresses beyond “absolute maximum ratings” may cause permanent damage to the device. For reliability, considerations use 80% or below for application is recommended.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Package thermal impedance (see Notes 2 and 3)	DIP package	67	°C/W
	SOP package	64	
	TSSOP package	108	

Note 1. Maximum power dissipation is a function of $T_J(\max)$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

2. The package thermal impedance is calculated in accordance with JESD 51-7.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply voltage	V_{CC}	7	40	V
Amplifier input voltage	V_I	-0.3	$V_{CC}-2$	V
Collector output voltage	V_O		40	V
Collector output current (each transistor)			200	mA
Current into feedback terminal			0.3	mA
Timing capacitor	C_T	0.47	10000	nF
Timing resistor	R_T	1.8	500	kΩ
Oscillator frequency	f_{OSC}	1	300	kHz
Operating free-air temperature	T_A	-40	85	°C

■ FUNCTION TABLE

INPUT	OUTPUT FUNCTION
Output CTRL	
$V_I = 0$	Single-ended or parallel output
$V_I = V_{REF}$	Normal push-pull operation

ELECTRICAL CHARACTERISTICS

(Testing conditions is set at $V_{CC}=15V$, $25^{\circ}C$ unless otherwise specified)

reference section

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage (REF)	V_{REF}	$I_{OUT} = 1mA$, $T_a = 25^{\circ}C$	4.95	5	5.05	V
Input regulation	V_{IN}	$V_{CC} = 7V \sim 40V$, $T_a = 25^{\circ}C$		2	25	mV
Output regulation	V_{OUT}	$I_{OUT} = 1 \sim 10mA$, $T_a = 25^{\circ}C$		14	35	mV
Output-voltage change with temperature		$\Delta T_a = MIN \sim MAX$		2	10	mV/V
Short-circuit output current (Note1)		$V_{REF} = 0$	10	35	50	mA

amplifier section (see Figure 1)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input offset voltage, error amplifier	$V_{I(OFF)}$	FEEDBACK = 2.5V		2	10	mV
Input offset current	$I_{I(OFF)}$	FEEDBACK = 2.5V		25	250	nA
Input bias current	$I_{I(BIAS)}$	FEEDBACK = 2.5V		0.2	1	μA
Common-mode input voltage range, error amplifier		$V_{CC}=7V \sim 40V$	0.3 to $V_{CC}-2$			V
Open-loop voltage amplification, error amplifier		$\Delta V_{OUT}=3V$, $R_L = 2k\Omega$, $V_{OUT} = 0.5V \sim 3.5V$	70	95		dB
Unity-gain bandwidth	B_W	$V_{OUT} = 0.5V \sim 3.5V$, $R_L = 2k\Omega$		800		kHz
Common-mode rejection ratio, error amplifier		$V_{CC} = 40V$, $T_a = 25^{\circ}C$	65	80		dB
Output sink current, FEEDBACK	$I_{O(SINK)}$	$V_{ID} = -15mV \sim -5V$, FEEDBACK = 0.5V	0.3	0.7		mA
Output source current, FEEDBACK	$I_{O(SOURCE)}$	$V_{ID} = 15mV \sim 5V$, FEEDBACK = 3.5V	-2			mA

oscillator section, $C_T = 0.01\mu F$, $R_T = 12k\Omega$ (see Figure 2)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Frequency	F			10		kHz
Standard deviation of frequency ^(Note1)		All values of V_{CC} , C_T , R_T , and T_a constant		100		Hz/kHz
Frequency change with voltage		$V_{CC} = 7V \sim 40V$, $T_a = 25^{\circ}C$		1		Hz/kHz
Frequency change with temperature		$\Delta T_a = MIN \sim MAX$			50	Hz/kHz

Note 1. Standard deviation is a measure of the statistical distribution about the mean, as derived from the formula:

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

dead-time control section (see Figure 2)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input bias current	$I_{I(BIAS)}$	$V_I = 0 \sim 5.25V$		-2	-10	μA
Maximum duty cycle, each output		DTC = 0V	0.45			
Input threshold voltage	$V_{I(THD)}$	Zero duty cycle		3	3.3	V
		Maximum duty cycle	0			

■ ELECTRICAL CHARACTERISTICS(Cont.)

output section

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Collector off-state current	$I_{C(OFF)}$	$V_C = 40V, V_E = 0V, V_{CC} = 40V$		2	100	μA
		DTC and Output CTRL = 0V, $V_C = 15V, V_E = 0V, V_{CC} = 1 \sim 3V$		4	200	
Emitter off-state current	$I_{E(OFF)}$	$V_{CC} = V_C = 40V, V_E = 0$			-100	μA
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		$V_I = V_{REF}$			3.5	mA

pwm comparator section (see Figure 2)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input threshold voltage, FEEDBACK	$V_{I(THD)}$	Zero duty cycle		4	4.5	V
Input sink current, FEEDBACK	$I_{I(SINK)}$	FEEDBACK = 0.5V	0.3	0.7		mA

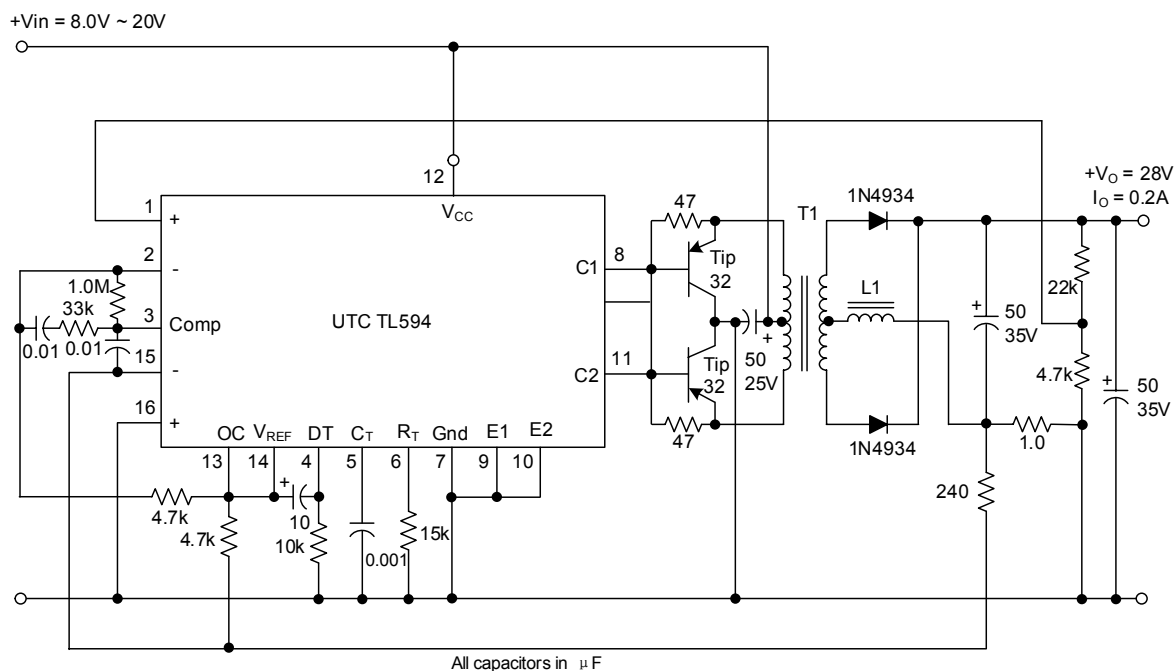
undervoltage lockout section (see Figure 2)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Threshold voltage	V_{THD}	$T_A = 25^\circ C$			6	V
		$\Delta T_A = MIN \sim MAX$	3.5		6.9	
Hysteresis	V_{HYS}		100			mV
Standby supply current	I_{ST-BY}	R_T at V_{REF} All other inputs and outputs open	$V_{CC} = 15V$	9	15	mA
			$V_{CC} = 40V$	11	18	
Average supply current		DTC = 2V, See Figure 2		12.4		mA

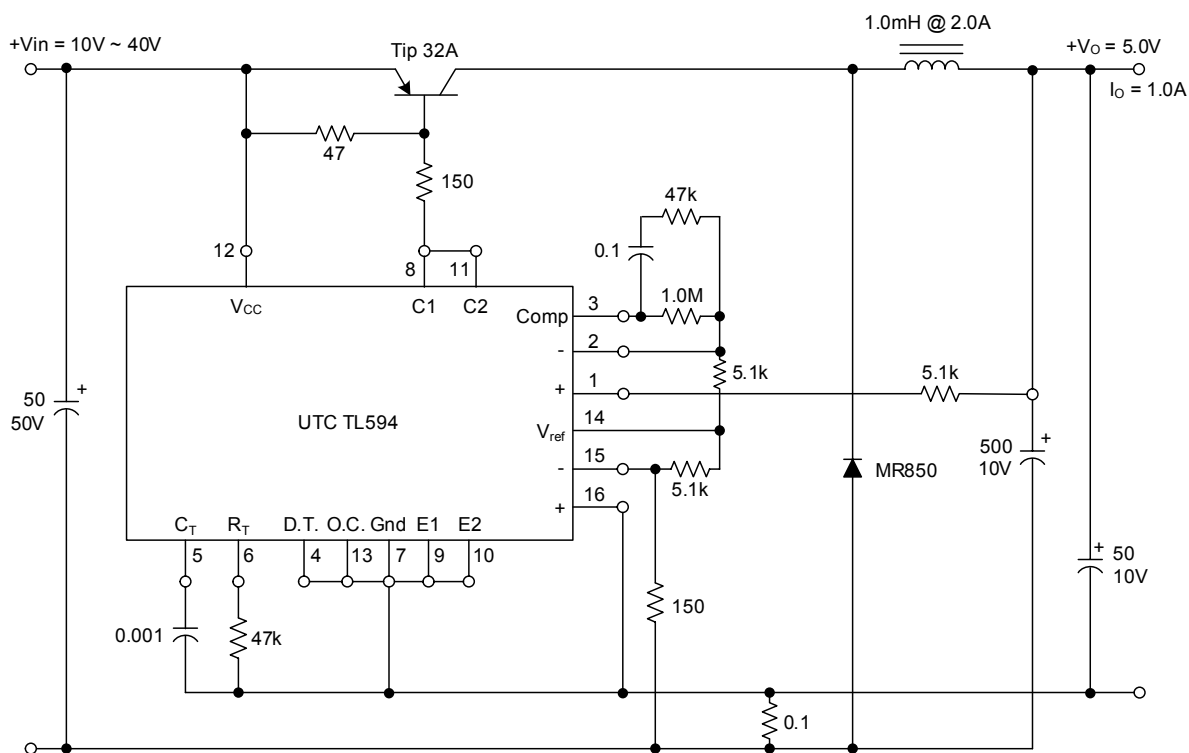
switching characteristics, $T_A = 25^\circ C$

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output-voltage rise time	T_R	Common-emitter configuration (see Figure 3)		100	200	ns
Output-voltage fall time	T_F			30	100	ns
Output-voltage rise time	T_R	Emitter-follower configuration (see Figure 4)		200	400	ns
Output-voltage fall time	T_F			45	100	ns

TYPICAL APPLICATIONS INFORMATION

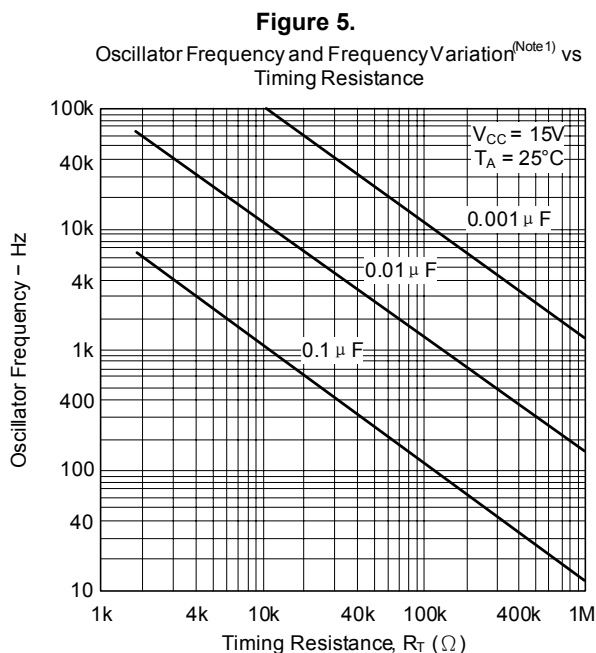


Push-Pull Operation

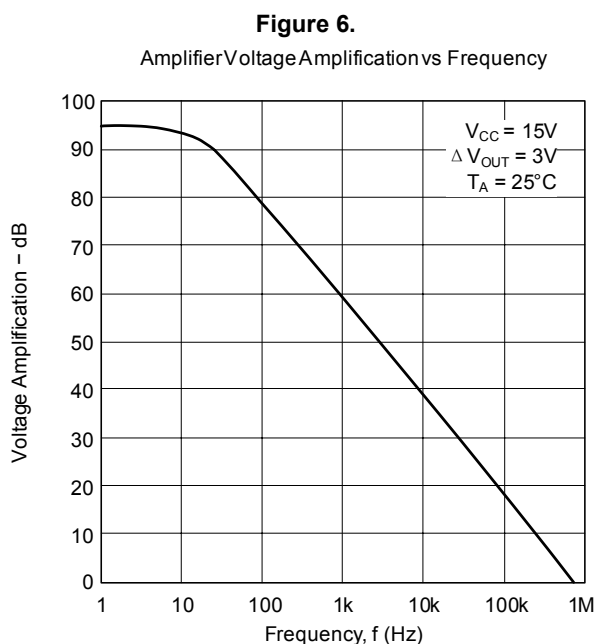


Single-Ended Operation

■ TYPICAL CHARACTERISTICS



Note 1. Frequency variation (Δf) is the change in oscillator frequency that occurs over the full temperature range.



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