



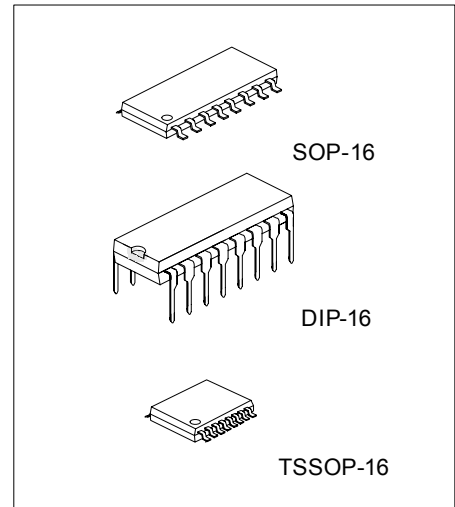
## TL594

## 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

[www.DataSheet4U.com](http://www.DataSheet4U.com)

#### 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<sub>CC</sub> Conditions

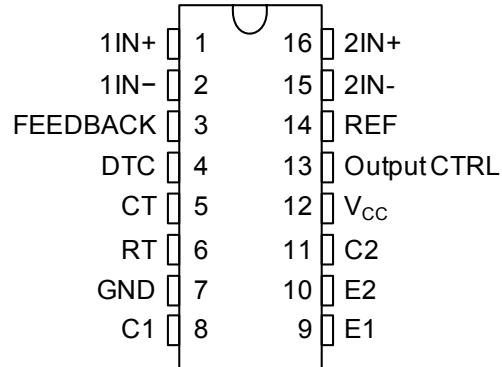
#### ORDERING INFORMATION

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

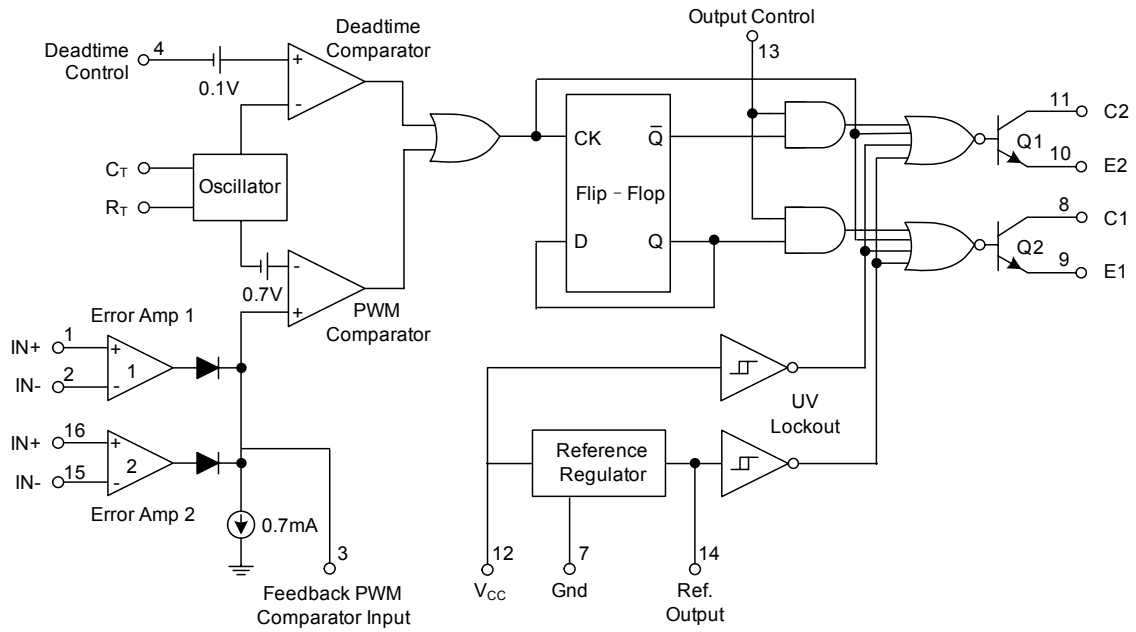
<p>TL594L-D16-T</p> <p>(1)Packing Type (2)Package Type (3)Lead Plating</p>	<p>(1) R: Tape Reel, T: Tube (2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16 (3) L: Lead Free Plating, Blank: Pb/Sn</p>
--	---

### ■ 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)<sup>Note1</sup>)

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  $T_J(\max)$ ,  $\theta_{JA}$ , 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	$\mu A$
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 <sup>(Note1)</sup>		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	$\mu A$
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	$\mu A$	
		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	$\mu A$	
Collector-emitter saturation voltage	Common emitter	$V_{CE}$		$V_E = 0, I_C = 200mA$	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

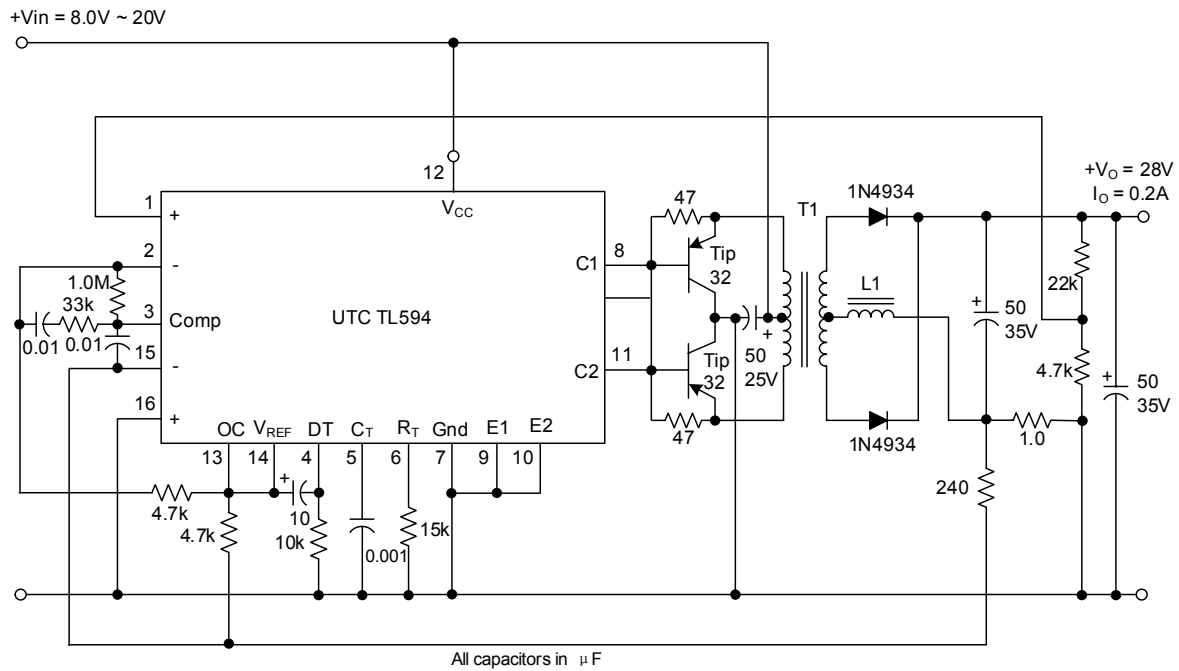
#### undervoltage lockout section (see Figure 2)

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	

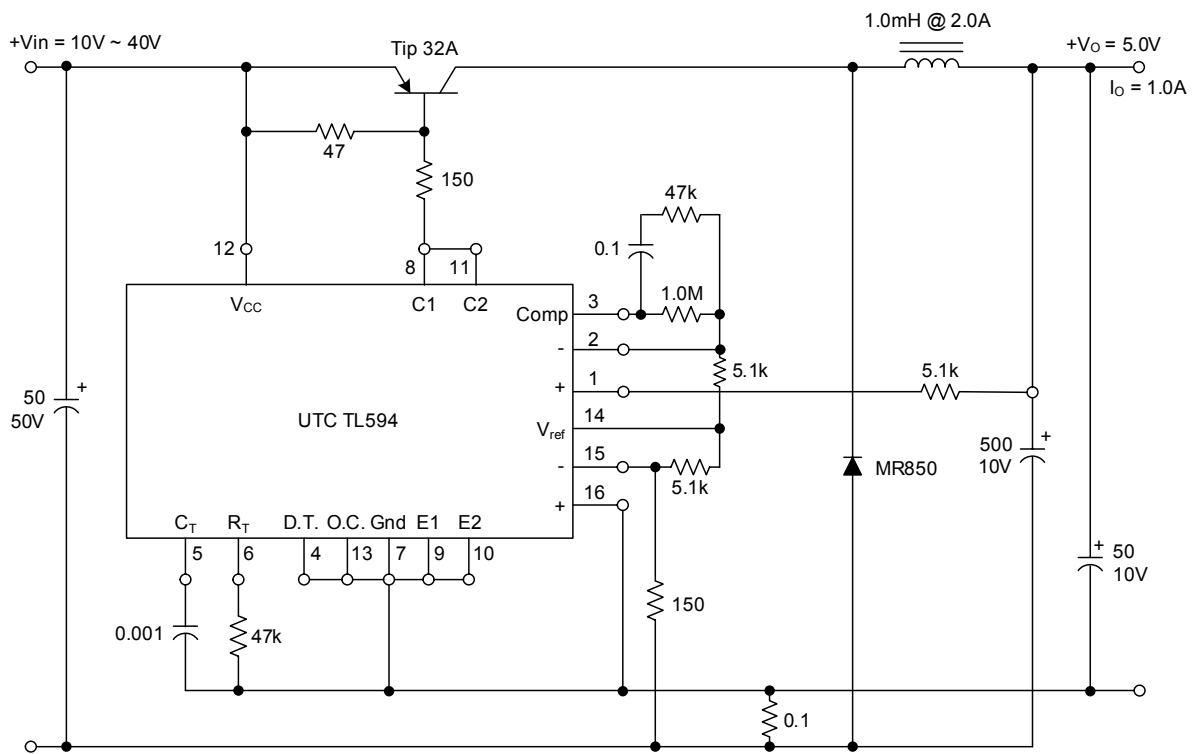
#### switching characteristics, $T_A = 25^\circ C$

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
Output-voltage rise time	$T_R$	Emitter-follower configuration (see Figure 4)		200	400	ns
Output-voltage fall time	$T_F$				45	100

## TYPICAL APPLICATIONS INFORMATION



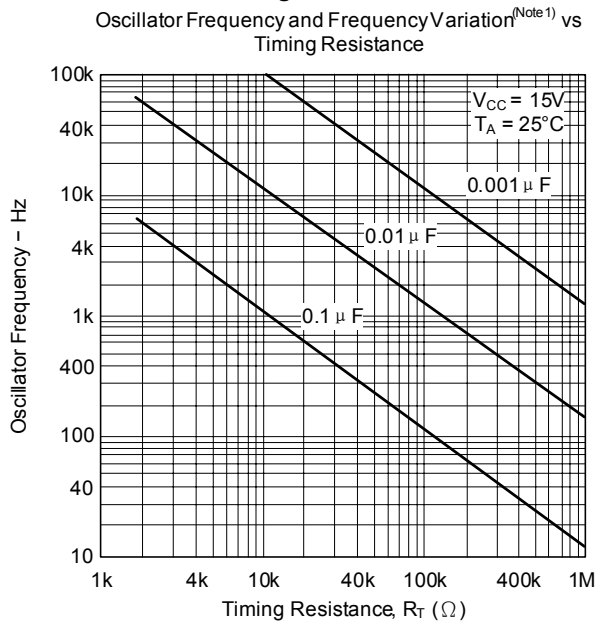
Push-Pull Operation



Single-Ended Operation

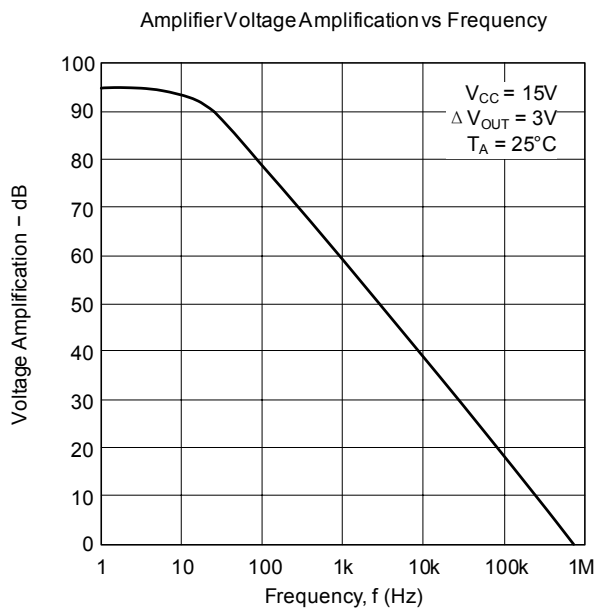
■ TYPICAL CHARACTERISTICS

Figure 5.



Note 1. Frequency variation ( $\Delta f$ ) is the change in oscillator frequency that occurs over the full temperature range.

Figure 6.



UTC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all UTC products described or contained herein. UTC products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice.