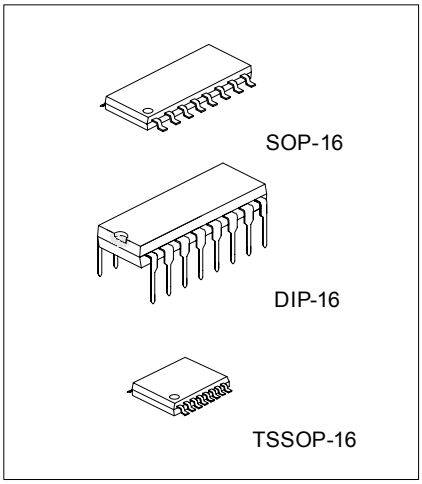
TL594

LINEAR INTEGRATED CIRCUIT

PULSE-WIDTH-MODULATION CONTROL CIRCUIT



*Pb-free plating product number: TL594L

■ 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.

■ 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 Deliuer 5V within 1% tolerance
* Undervoltage Lockout for Low-V_{CC} Conditions

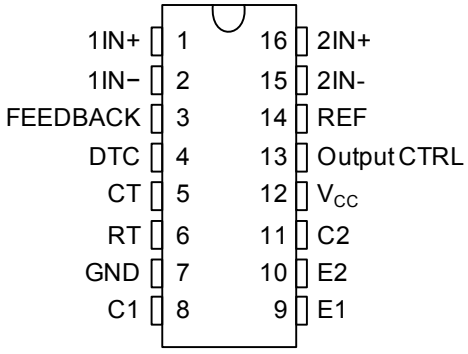
■ ORDERING INFORMATION

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

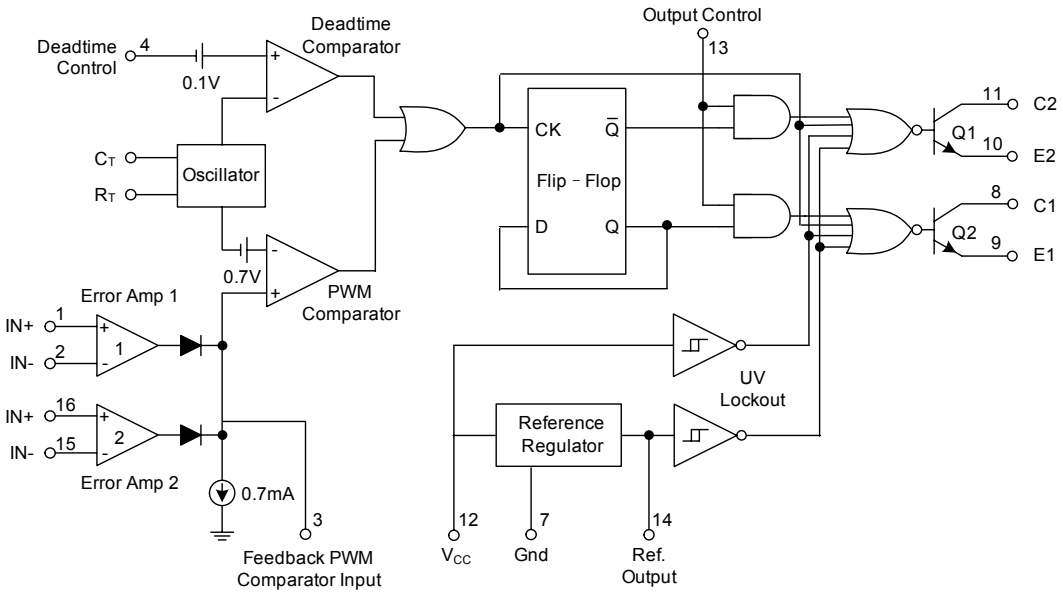
TL594L-D16-T (1)Packing Type (2)Package Type (3)Lead Plating	(1) R: Tape Reel, T: Tube (2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16 (3) L: Lead Free Plating, Blank: Pb/Sn

■ 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	θ_{JA}	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 Operating free-air temperature	T_A	-40	85	°C

■ FUNCTION TABLE

INPUT Output CTRL	OUTPUT FUNCTION
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℃ unless otherwise specified)

reference section

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage (REF)	V_{REF}	I_{OUT} = 1mA, Ta = 25°C	4.95	5	5.05	V
Input regulation	V_{IN}	V_{CC} = 7V ~ 40V, Ta = 25°C		2	25	mV
Output regulation	V_{OUT}	I_{OUT} = 1 ~ 10mA, Ta = 25°C		14	35	mV
Output-voltage change with temperature		ΔT_A = MIN ~ 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 ~ 40V	0.3 to V_{CC}−2			V
Open-loop voltage amplification, error amplifier		ΔV_{OUT}=3V, R_L =2 kΩ, V_{OUT} = 0.5V ~ 3.5V	70	95		dB
Unity-gain bandwidth	B_W	V_{OUT} = 0.5V ~ 3.5V, R_L = 2kΩ		800		kHz
Common-mode rejection ratio, error amplifier		V_{CC} = 40V, T_A = 25°C	65	80		dB
Output sink current, FEEDBACK	$I_{O(SINK)}$	V_{ID} =-15mV ~ -5V, FEEDBACK = 0.5V	0.3	0.7		mA
Output source current, FEEDBACK	$I_{O(SOURCE)}$	V_{ID} = 15mV ~ 5V, FEEDBACK = 3.5V	-2			mA

oscillator section, C_T = 0.01μF, R_T = 12kΩ (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 ~ 40V, T_A = 25°C		1		Hz/kHz
Frequency change with temperature		ΔT_A = MIN ~ 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 ~ 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 ~ 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_{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

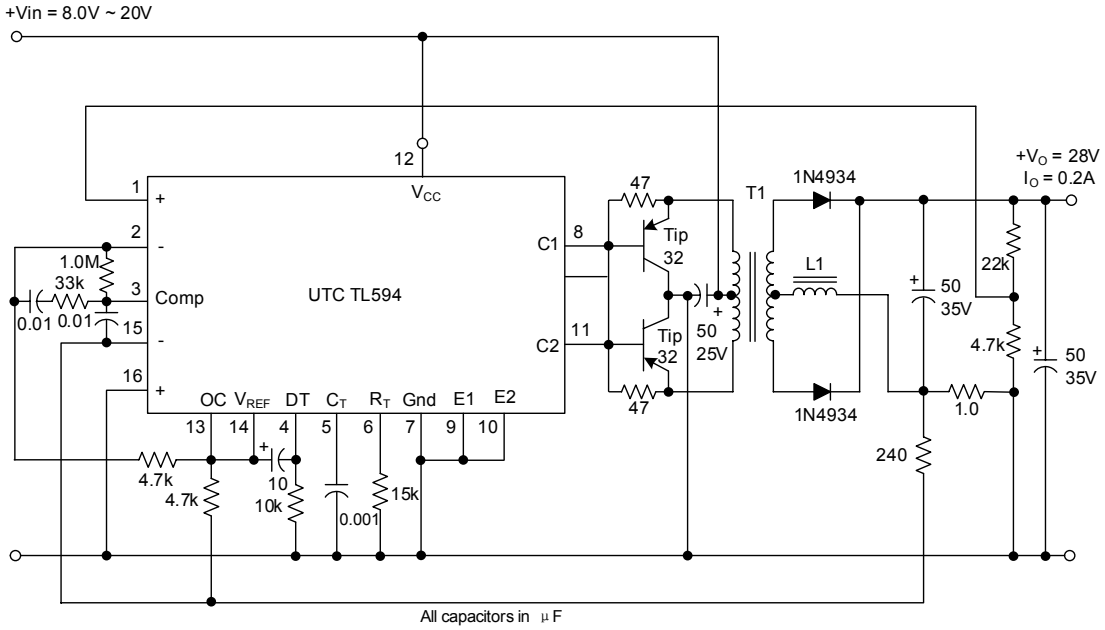
undervoltage lockout section (see Figure 2)

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

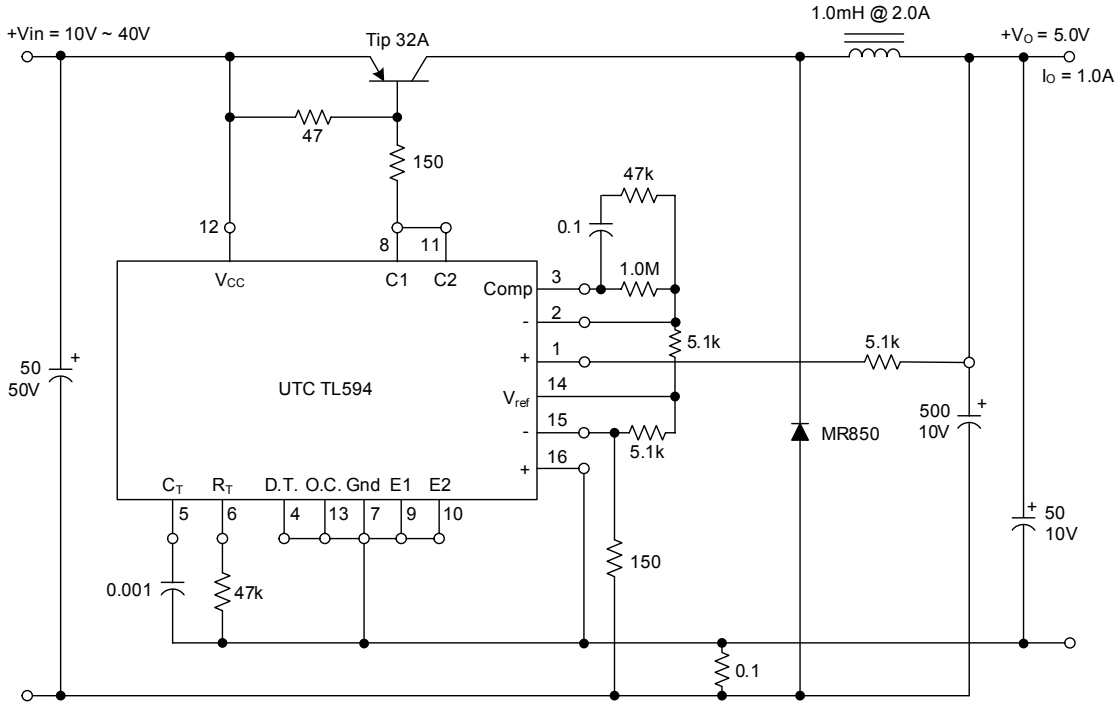
switching characteristics, T_A = 25°C

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

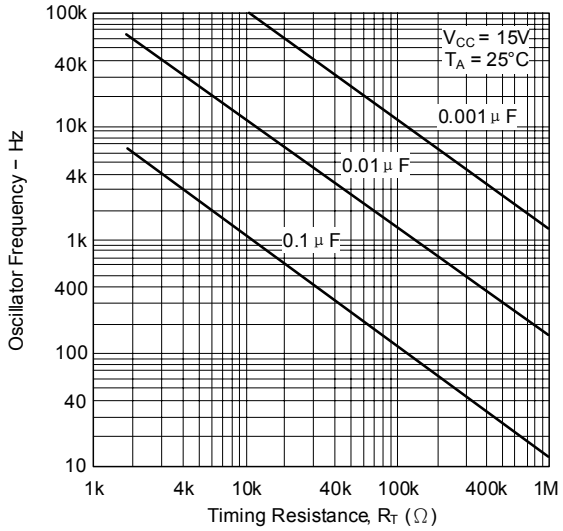


Single-Ended Operation

■ TYPICAL CHARACTERISTICS

Figure 5.

Oscillator Frequency and Frequency Variation(Note1) vs Timing Resistance



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

Figure 6.

Amplifier Voltage Amplification vs Frequency