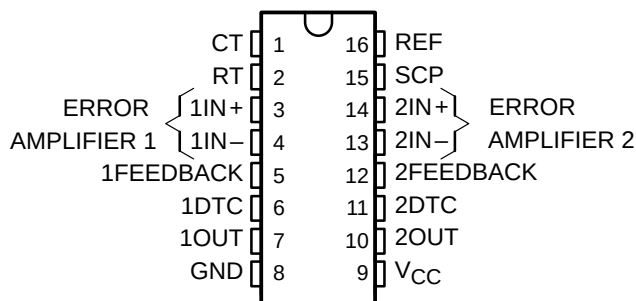


TL1451AC, TL1451AY DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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- Complete PWM Power Control Circuitry
- Completely Synchronized Operation
- Internal Undervoltage Lockout Protection
- Wide Supply Voltage Range
- Internal Short-Circuit Protection
- Oscillator Frequency . . . 500 kHz Max
- Variable Dead Time Provides Control Over Total Range
- Internal Regulator Provides a Stable 2.5-V Reference Supply

DB, N, NS, OR PW PACKAGE
(TOP VIEW)



description

The TL1451AC incorporates on a single monolithic chip all the functions required in the construction of two pulse-width-modulation (PWM) control circuits. Designed primarily for power supply control, the TL1451AC contains an on-chip 2.5-V regulator, two error amplifiers, an adjustable oscillator, two dead-time comparators, undervoltage lockout circuitry, and dual common-emitter output transistor circuits.

The uncommitted output transistors provide common-emitter output capability for each controller. The internal amplifiers exhibit a common-mode voltage range from 1.04 V to 1.45 V. The dead-time control (DTC) comparator has no offset unless externally altered and can provide 0% to 100% dead time. The on-chip oscillator can be operated by terminating RT and CT. During low V_{CC} conditions, the undervoltage lockout control circuit feature locks the outputs off until the internal circuitry is operational.

The TL1451AC is characterized for operation from -20°C to 85°C .

AVAILABLE OPTIONS

T_A	PACKAGED DEVICES				CHIP FORM (Y)
	SMALL OUTLINE (DB) [†]	PLASTIC DIP (N)	SMALL OUTLINE (NS)	TSSOP (PW) [†]	
-20°C to 85°C	TL1451ACDB	TL1451ACN	TL1451ACNS	TL1451ACPW	TL1451AY

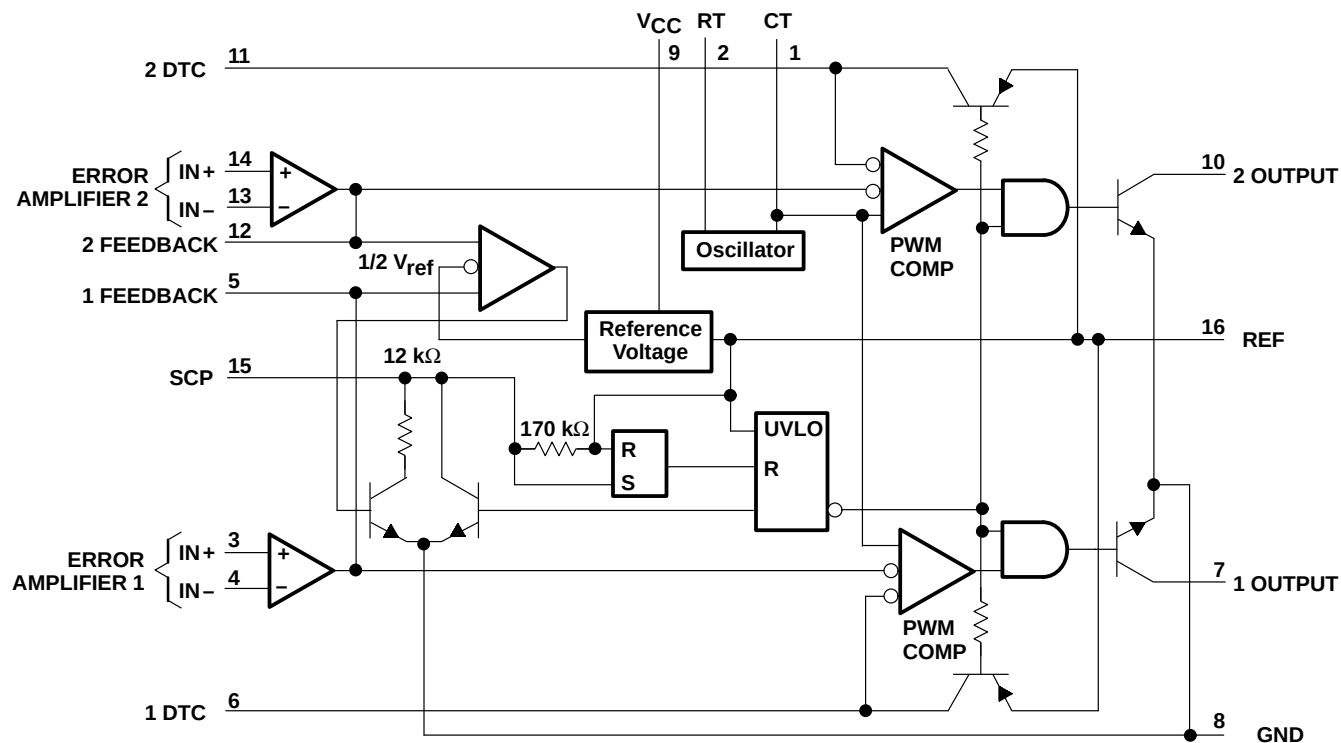
[†] The DB and PW packages are only available left-end taped and reeled (add LE suffix, i.e., TL1451ACPWLE).

TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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functional block diagram



COMPONENT COUNT

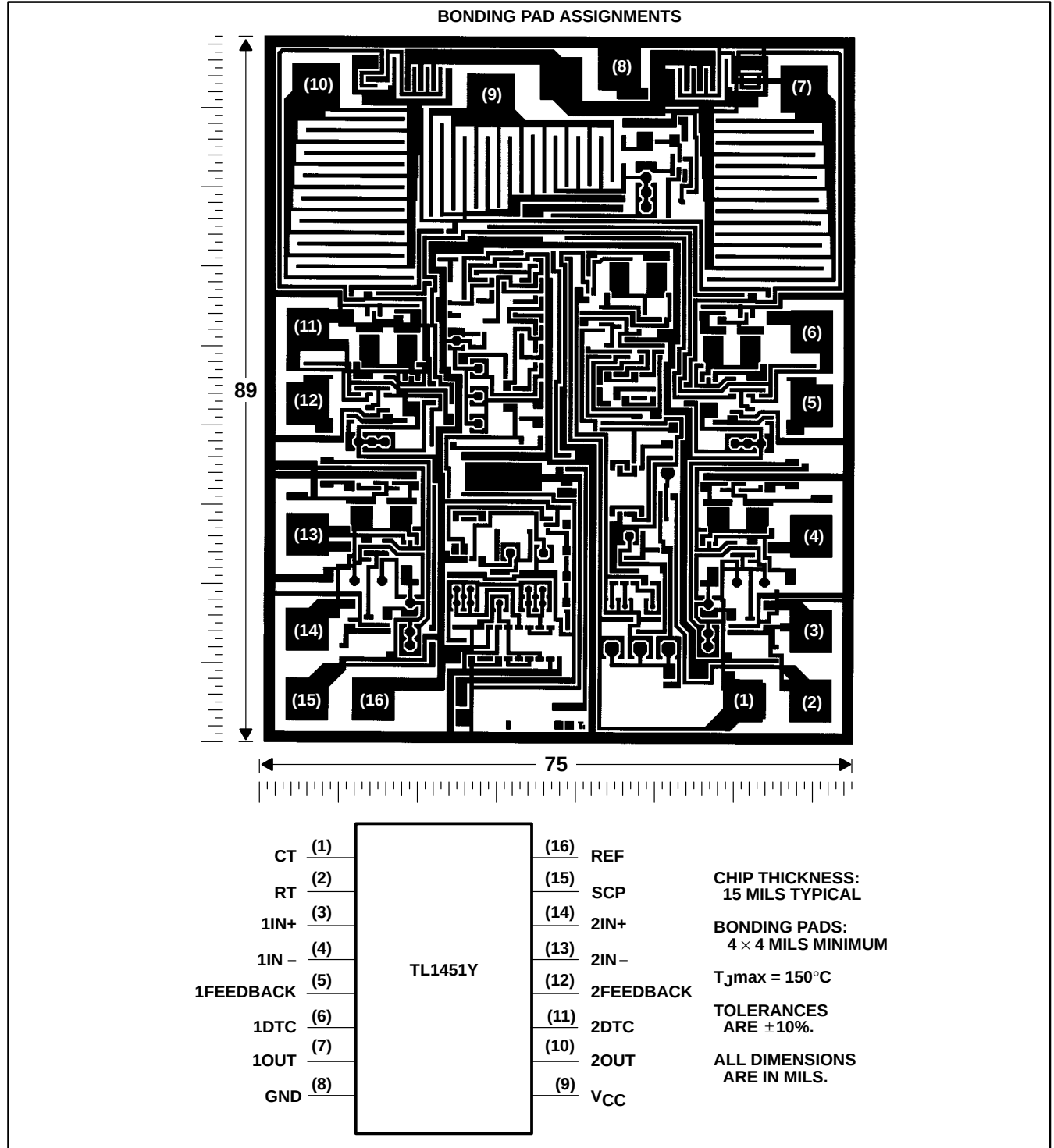
Resistors	65
Capacitors	8
Transistors	105
JFETs	18

TL1451AC, TL1451AY DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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TL1451AY chip information

This chip, when properly assembled, displays characteristics similar to the TL1451AC. Thermal compression or ultrasonic bonding may be used on the doped aluminum bonding pads. The chip may be mounted with conductive epoxy or a gold-silicon preform.



TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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absolute maximum ratings over operating free-air temperature range†

Supply voltage, V_{CC}	51 V
Amplifier input voltage, V_I	20 V
Collector output voltage, V_O	51 V
Collector output current, I_O	21 mA
Continuous power total dissipation	See Dissipation Rating Table
Operating free-air temperature range, T_A	–20°C to 85°C
Storage temperature range, T_{stg}	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
DB	775 mW	6.2 mW/°C	496 mW	403 mW
N	1000 mW	8.0 mW/°C	640 mW	520 mW
NS	500 mW	4.0 mW/°C	320 mW	260 mW
PW	700 mW	5.6 mW/°C	448 mW	364 mW

recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC}	3.6	50	V
Amplifier input voltage, V_I	1.05	1.45	V
Collector output voltage, V_O		50	V
Collector output current, I_O		20	mA
Current into feedback terminal		45	μA
Feedback resistor, R_F	100		kΩ
Timing capacitor, C_T	150	15000	pF
Timing resistor, R_T	5.1	100	kΩ
Oscillator frequency	1	500	kHz
Operating free-air temperature, T_A	–20	85	°C

electrical characteristics over recommended operating free-air temperature range, $V_{CC} = 6\text{ V}$, $f = 200\text{ kHz}$ (unless otherwise noted)

reference section

PARAMETER	TEST CONDITIONS	TL1451AC			TL1451Y			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Output voltage (pin 16)	$I_O = 1\text{ mA}$	2.4	2.5	2.6		2.5		V
Output voltage change with temperature	$T_A = -20^\circ\text{C}$ to 25°C		–0.1%	±1%		–0.1%		
	$T_A = 25^\circ\text{C}$ to 85°C		–0.2%	±1%		–0.2%		
Input voltage regulation	$V_{CC} = 3.6\text{ V}$ to 40 V		2	12.5		2		mV
Output voltage regulation	$I_O = 0.1\text{ mA}$ to 1 mA		1	7.5		1		mV
Short-circuit output current	$V_O = 0$	3	10	30		10		mA

† All typical values are at $T_A = 25^\circ\text{C}$.



TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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undervoltage lockout section

PARAMETER	TEST CONDITIONS	TL1451AC, TL1451AY			UNIT
		MIN	TYP [†]	MAX	
Upper threshold voltage (V_{CC})	$I_{O(ref)} = 0.1 \text{ mA}$, $T_A = 25^\circ\text{C}$	2.72			V
Lower threshold voltage (V_{CC})		2.6			V
Hysteresis (V_{CC})		80	120		mV
Reset threshold voltage (V_{CC})		1.5	1.9		V

[†] All typical values are at $T_A = 25^\circ\text{C}$.

short-circuit protection control section

PARAMETER	TEST CONDITIONS	TL1451AC			TL1451AY			UNIT
		MIN	TYP [†]	MAX	MIN	TYP [†]	MAX	
Input threshold voltage (SCP)	$T_A = 25^\circ\text{C}$	0.65	0.7	0.75	0.65	0.7	0.75	V
Standby voltage (SCP)	No pullup	140	185	230	185			mV
Latched input voltage (SCP)	No pullup	60			60			mV
Input (source) current	$V_I = 0.7 \text{ V}$, $T_A = 25^\circ\text{C}$	-10	-15	-20	-10	-15	-20	μA
Comparator threshold voltage (FEEDBACK)		1.18			1.18			V

[†] All typical values are at $T_A = 25^\circ\text{C}$.

oscillator section

PARAMETER	TEST CONDITIONS	TL1451C			TL1451AY			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Frequency	C _T = 330 pF, R _T = 10 kΩ	200			200			kHz
Standard deviation of frequency	C _T = 330 pF, R _T = 10 kΩ	10%			10%			
Frequency change with voltage	V _{CC} = 3.6 V to 40 V	1%			1%			
Frequency change with temperature	T _A = -20°C to 25°C	-0.4% ±2%			-0.4%			
	T _A = 25°C to 85°C	-0.2% ±2%			-0.2%			

[†] All typical values are at $T_A = 25^\circ\text{C}$.

dead-time control section

PARAMETER	TEST CONDITIONS	TL1451AC			TL1451AY			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Input bias current (DTC)		1						μA
Latch mode (source) current (DTC)	T _A = 25°C	−80	−145		−80	−145		μA
Latched input voltage (DTC)	I _O = 40 μA	2.3						V
Input threshold voltage at f = 10 kHz (DTC)	Zero duty cycle	2.05		2.25	2.05			V
	Maximum duty cycle	1.2	1.45		1.45			

[†] All typical values are at $T_A = 25^\circ\text{C}$.

TL1451AC, TL1451AY

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error-amplifier section

PARAMETER	TEST CONDITIONS	TL1451AC			TL1451AY			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Input offset voltage	V_O (FEEDBACK) = 1.25 V			±6				mV
Input offset current	V_O (FEEDBACK) = 1.25 V			±100				nA
Input bias current	V_O (FEEDBACK) = 1.25 V		160	500		160		nA
Common-mode input voltage range	V_{CC} = 3.6 V to 40 V	1.05 to 1.45						V
Open-loop voltage amplification	R_F = 200 k Ω	70	80			80		dB
Unity-gain bandwidth			1.5			1.5		MHz
Common-mode rejection ratio		60	80			80		dB
Positive output voltage swing		$V_{ref}-0.1$						V
Negative output voltage swing		1						V
Output (sink) current (FEEDBACK)	$V_{ID} = -0.1$ V, $V_O = 1.25$ V	0.5	1.6			1.6		mA
Output (source) current (FEEDBACK)	$V_{ID} = 0.1$ V, $V_O = 1.25$ V	-45	-70			-70		μ A

† All typical values are at $T_A = 25^\circ\text{C}$.

output section

PARAMETER	TEST CONDITIONS	TL1451AC			TL1451AY			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Collector off-state current	$V_O = 50$ V			10				μ A
Output saturation voltage	$I_O = 10$ mA		1.2	2		1.2		V
Short-circuit output current	$V_O = 6$ V		90			90		mA

† All typical values are at $T_A = 25^\circ\text{C}$.

pwm comparator section

PARAMETER	TEST CONDITIONS	TL1451AC			TL1451AY			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Input threshold voltage at $f = 10$ kHz (FEEDBACK)	Zero duty cycle		2.05	2.25		2.05		V
	Maximum duty cycle	1.2	1.45			1.45		

† All typical values are at $T_A = 25^\circ\text{C}$.

total device

PARAMETER	TEST CONDITIONS	TL1451AC			TL1451AY			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
Standby supply current	Off-state		1.3	1.8		1.3		mA
Average supply current	$R_T = 10$ k Ω		1.7	2.4		1.7		mA

† All typical values are at $T_A = 25^\circ\text{C}$.



PARAMETER MEASUREMENT INFORMATION

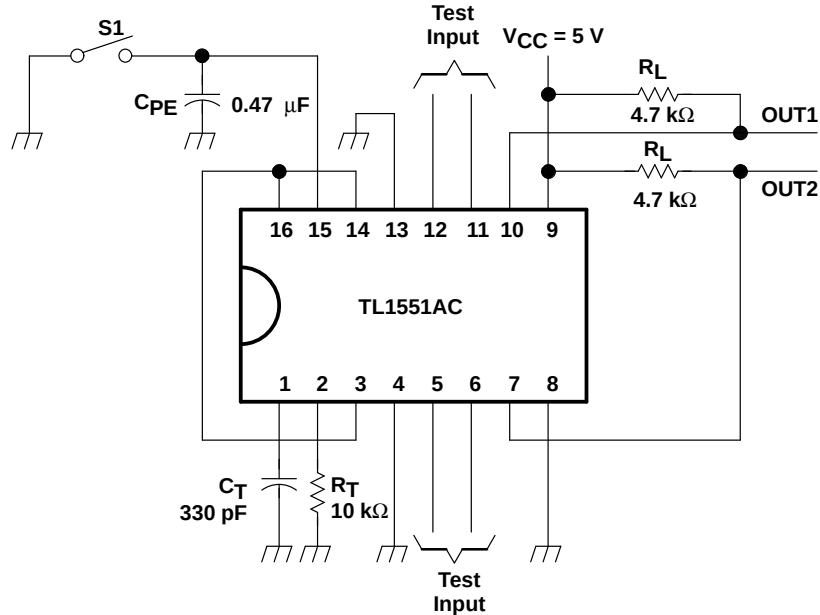
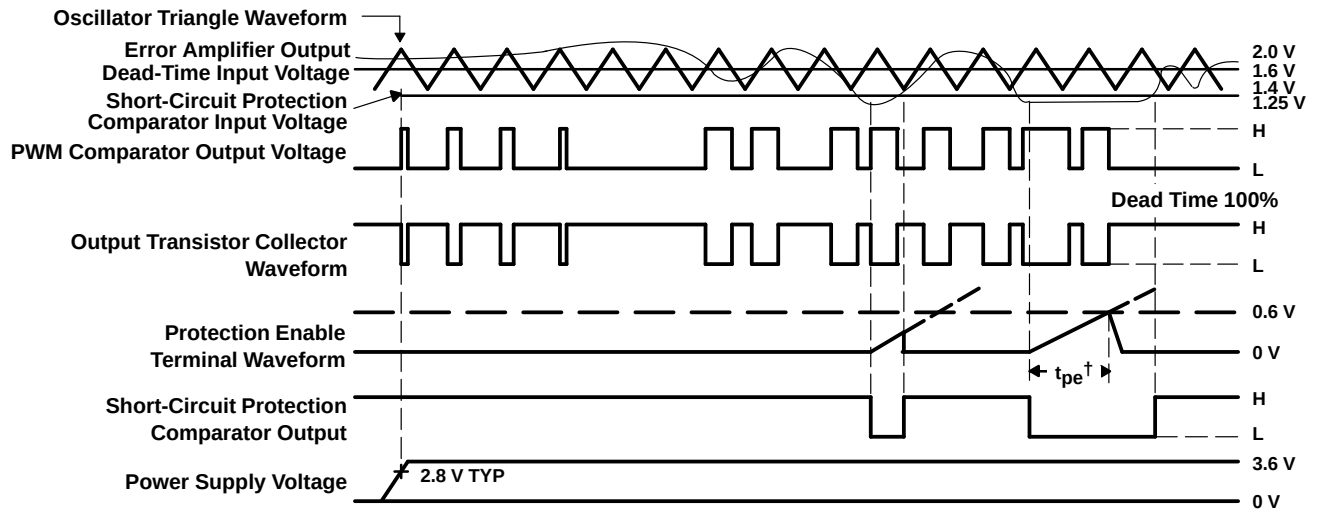


Figure 1. Test Circuit



† Protection Enable Time, $t_{pe} = (0.051 \times 10^6 \times C_{pe})$ in seconds

Figure 2. TL1451AC Timing Diagram

TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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TYPICAL CHARACTERISTICS

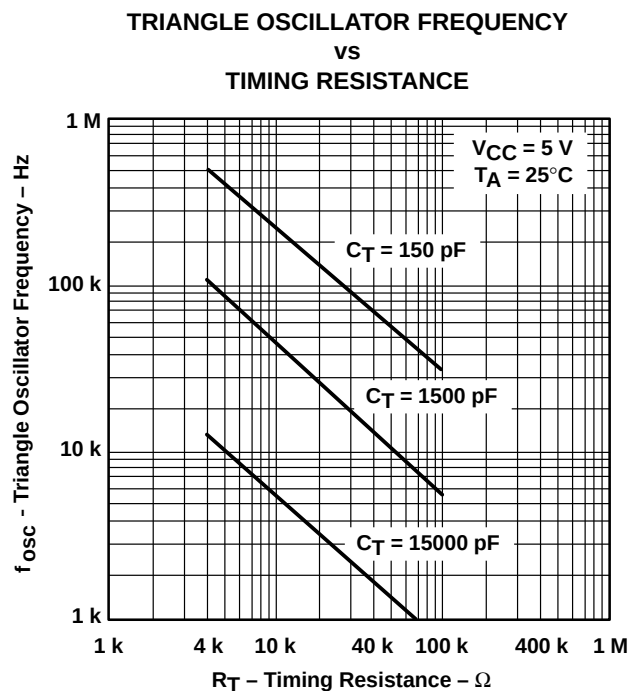


Figure 3

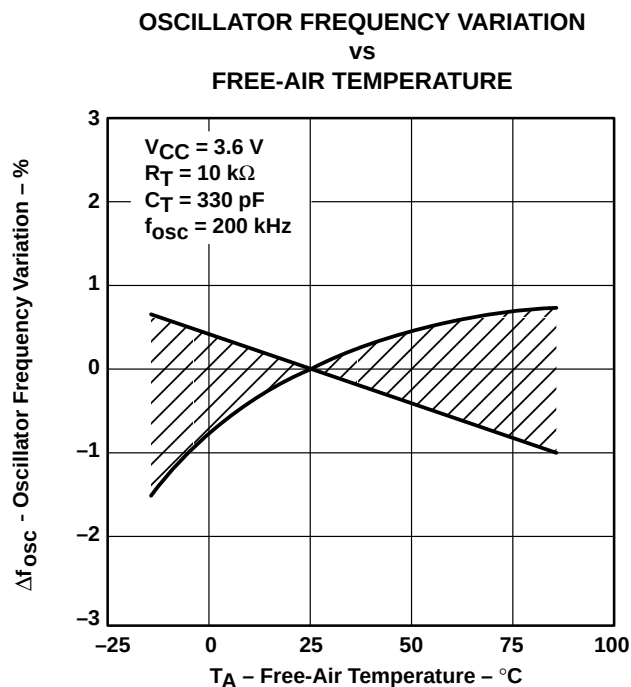


Figure 4

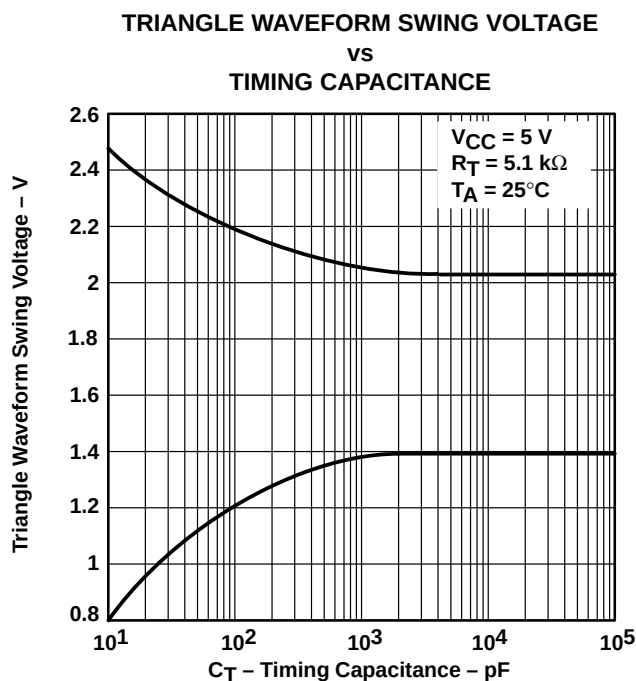


Figure 5

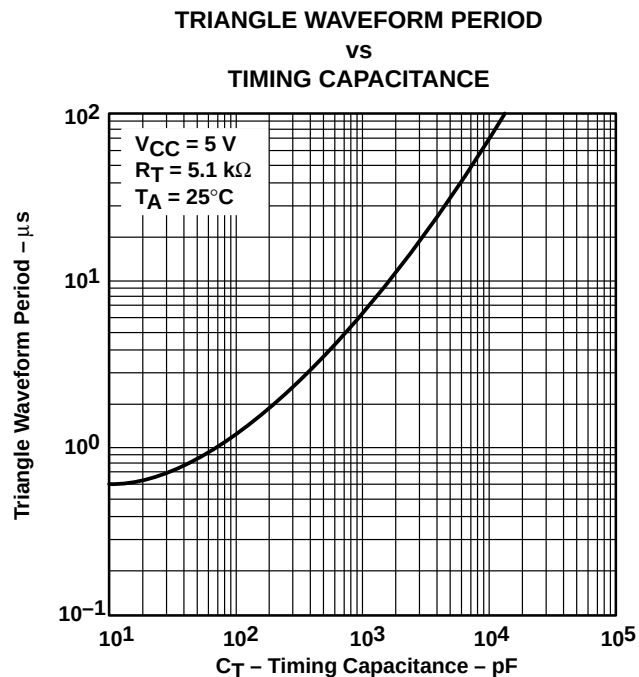


Figure 6

TYPICAL CHARACTERISTICS

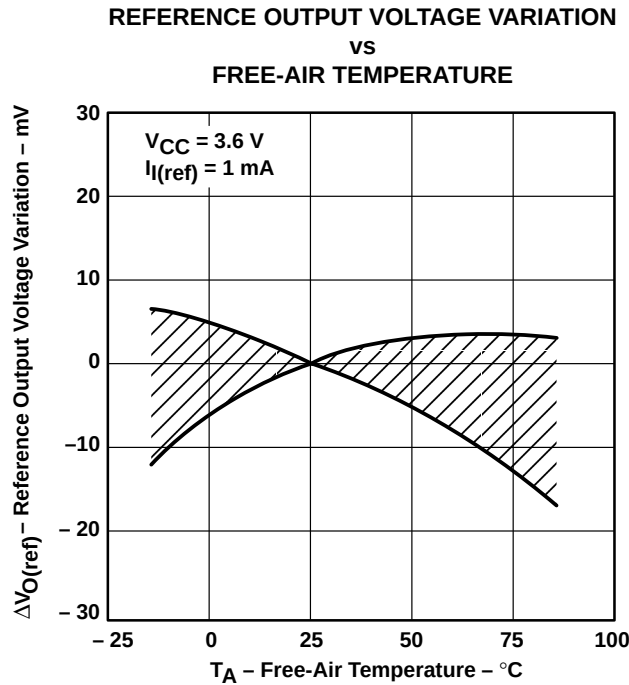


Figure 7

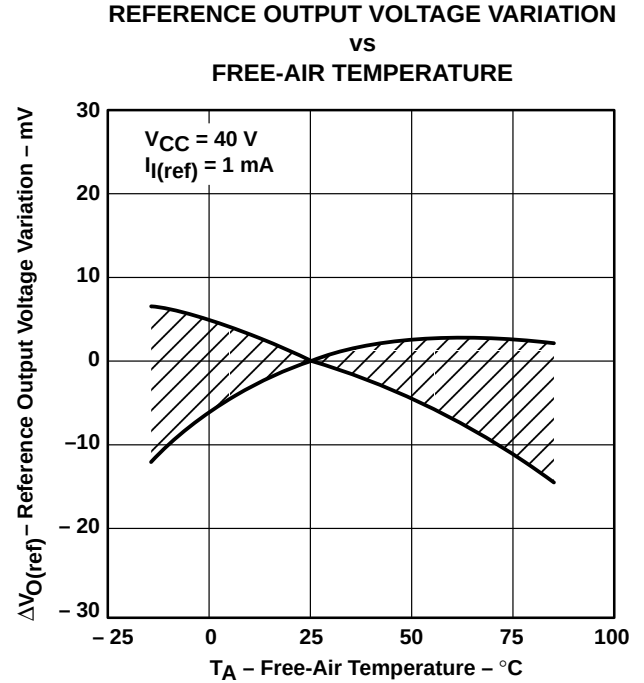


Figure 8

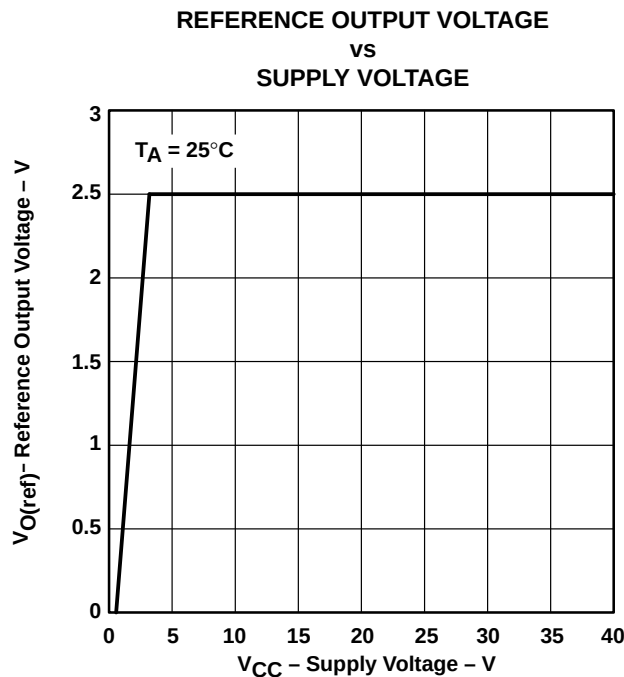


Figure 9

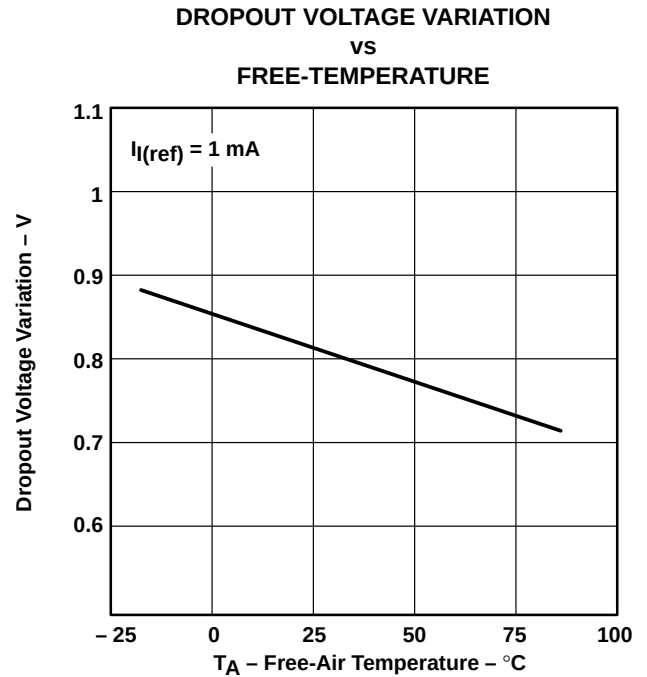


Figure 10

TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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TYPICAL CHARACTERISTICS

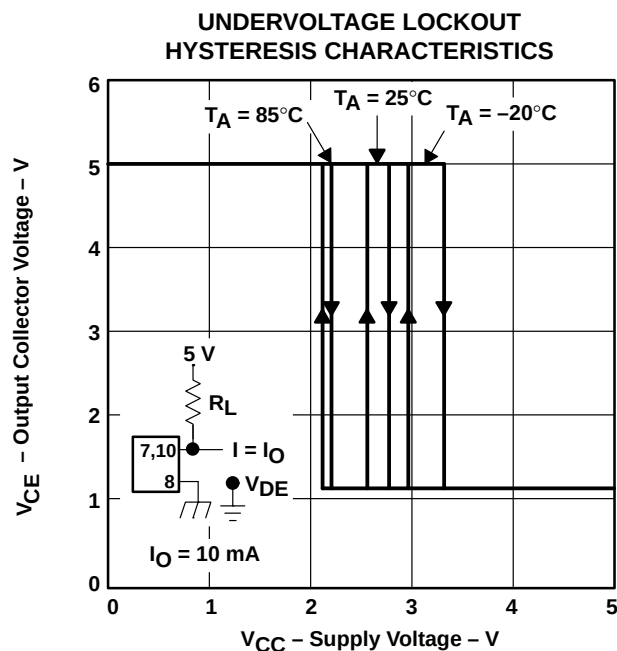


Figure 11

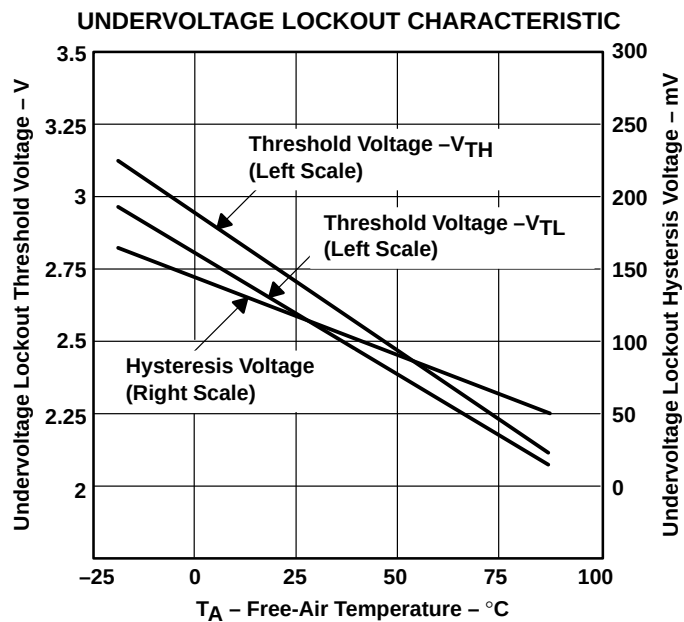


Figure 12

SHORT-CIRCUIT PROTECTION CHARACTERISTICS

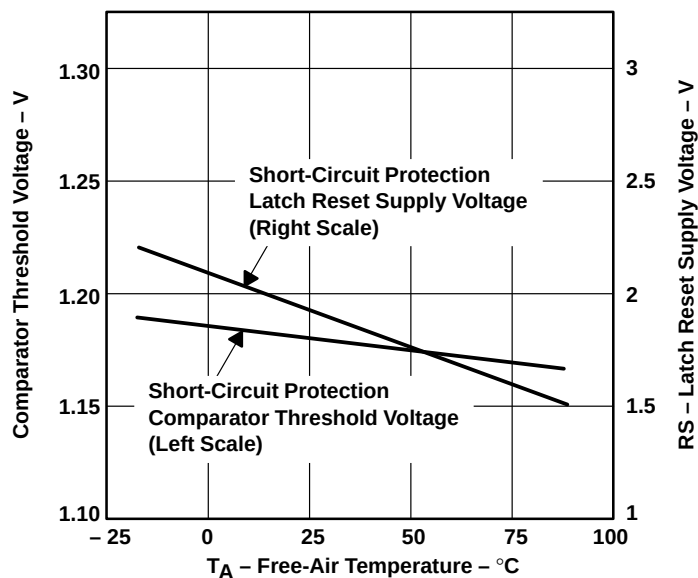


Figure 13

TYPICAL CHARACTERISTICS

PROTECTION ENABLE TIME
VS
PROTECTION ENABLE CAPACITANCE

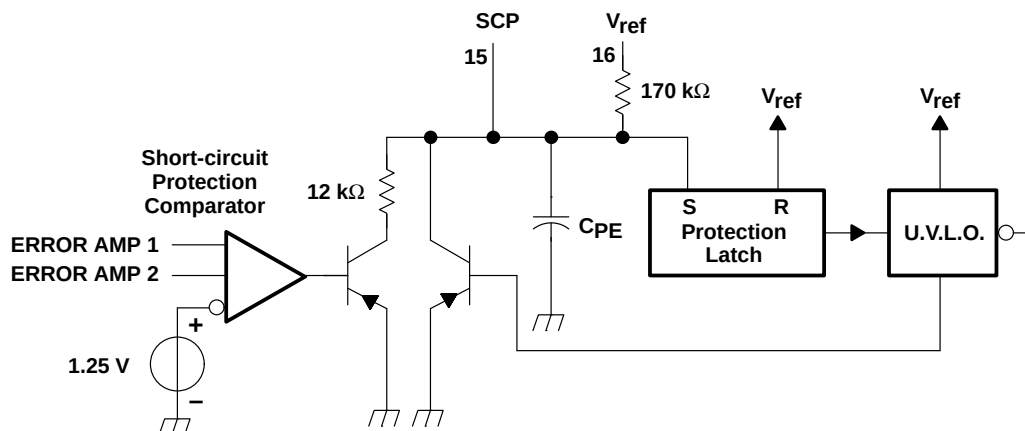
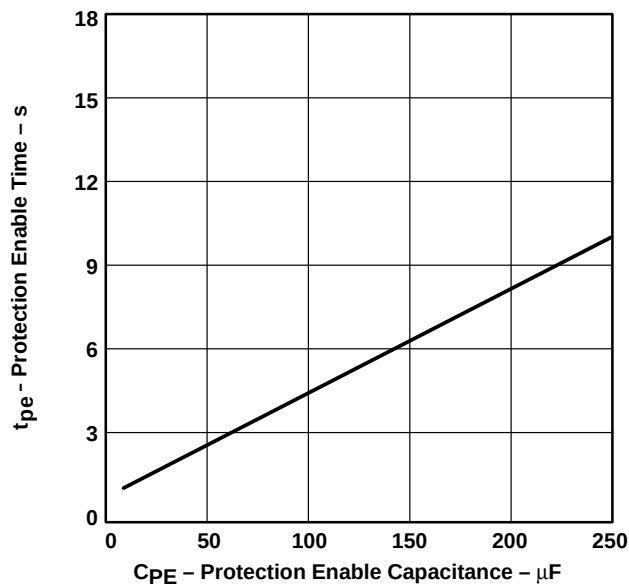


Figure 14

TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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TYPICAL CHARACTERISTICS

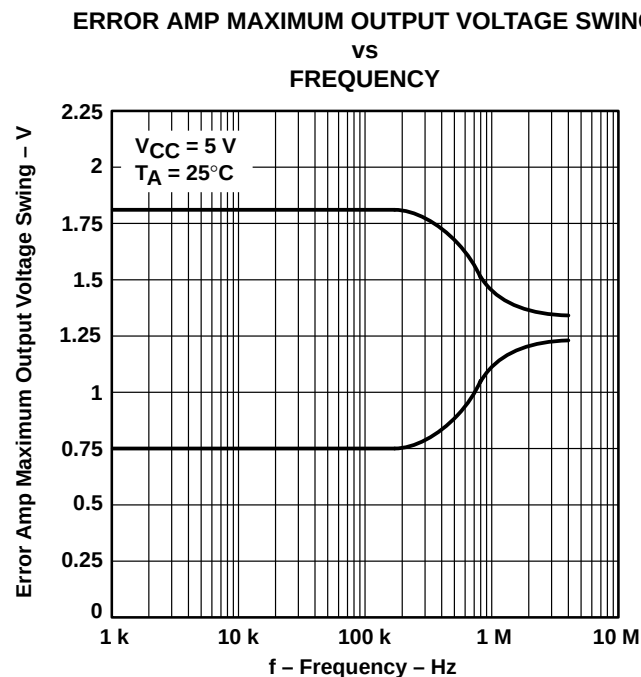


Figure 15

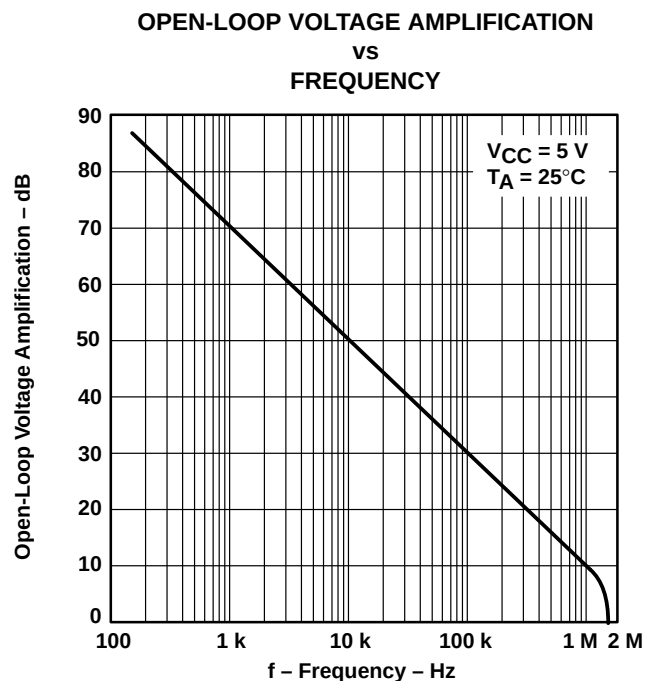


Figure 16

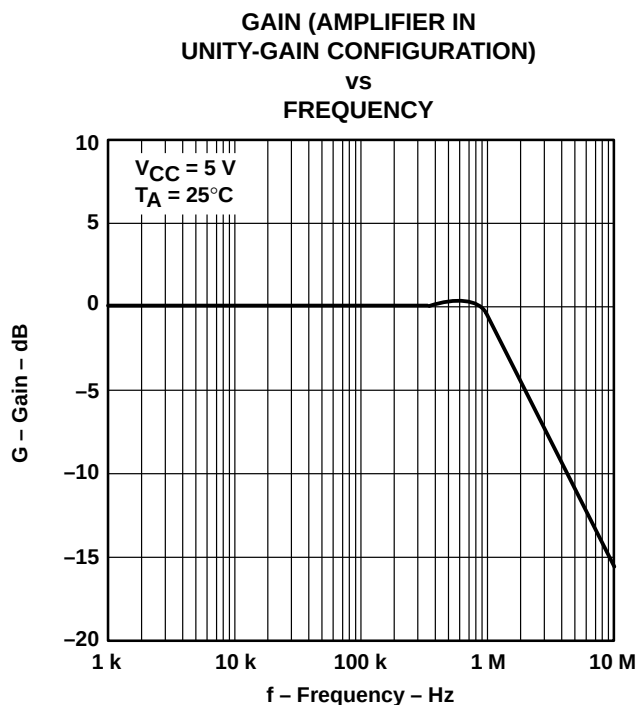
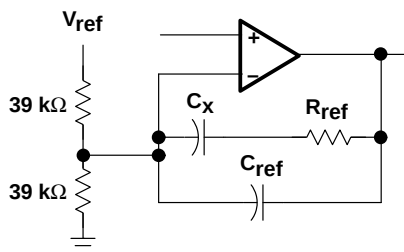
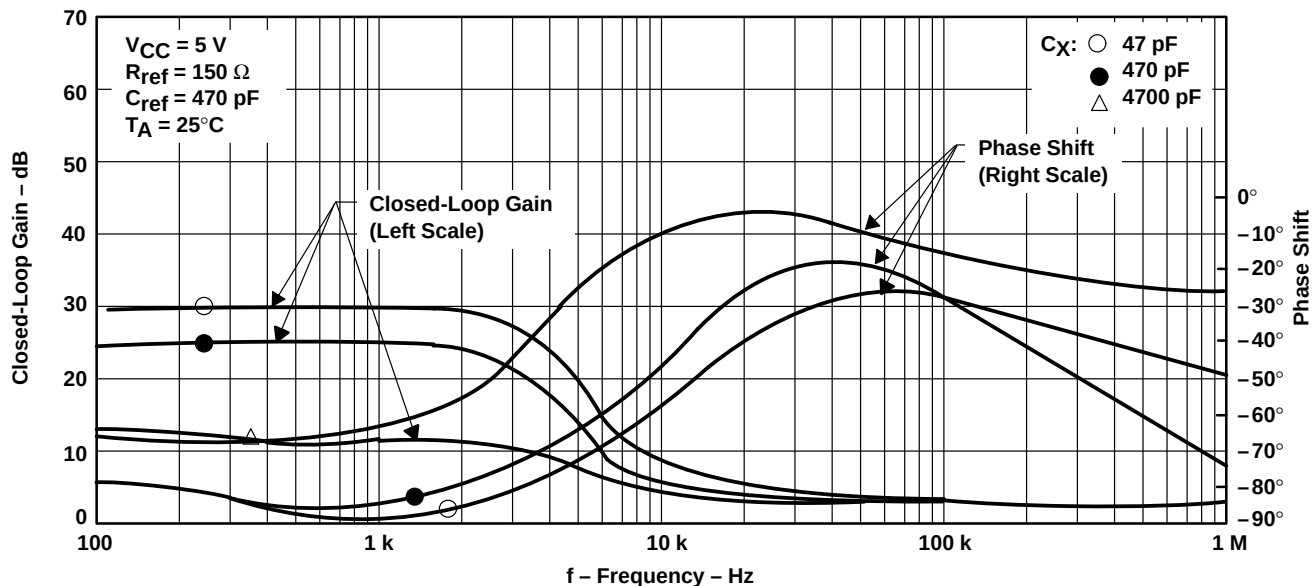


Figure 17

TYPICAL CHARACTERISTICS

CLOSED-LOOP GAIN AND PHASE SHIFT VS FREQUENCY



Test Circuit

Figure 18

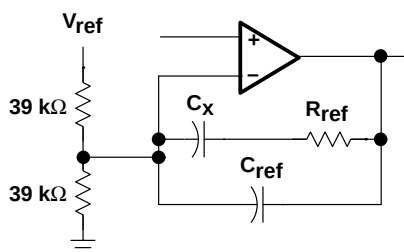
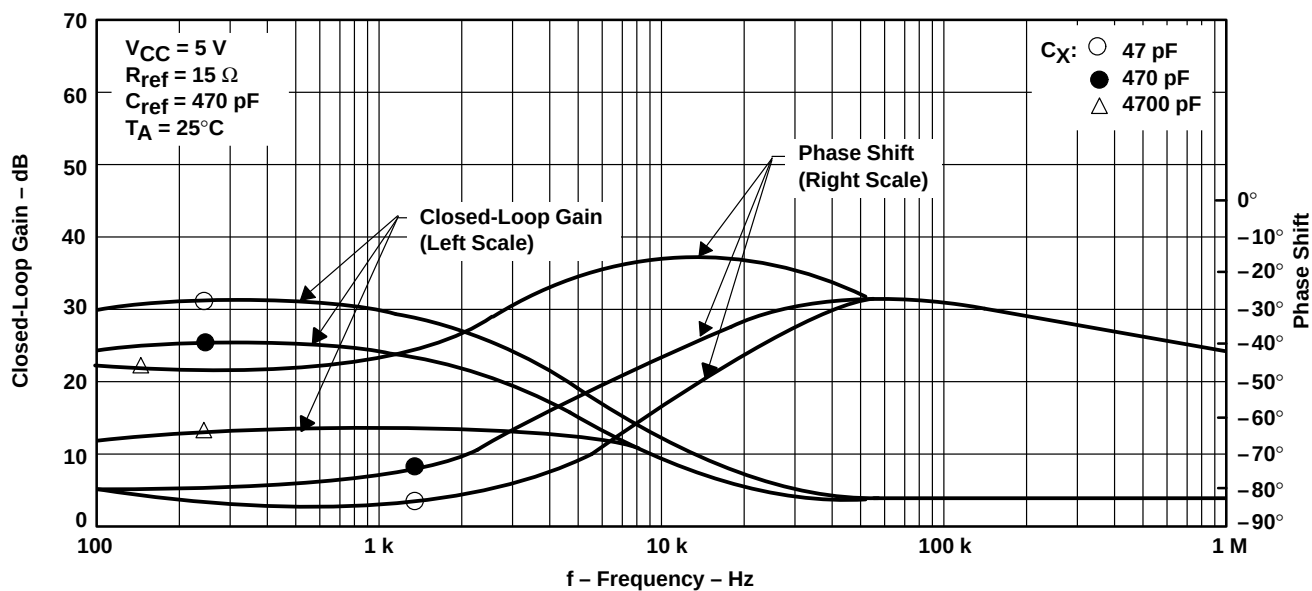
TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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TYPICAL CHARACTERISTICS

CLOSED-LOOP GAIN AND PHASE SHIFT VS FREQUENCY

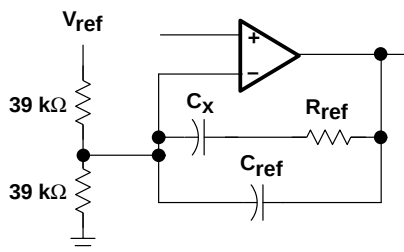
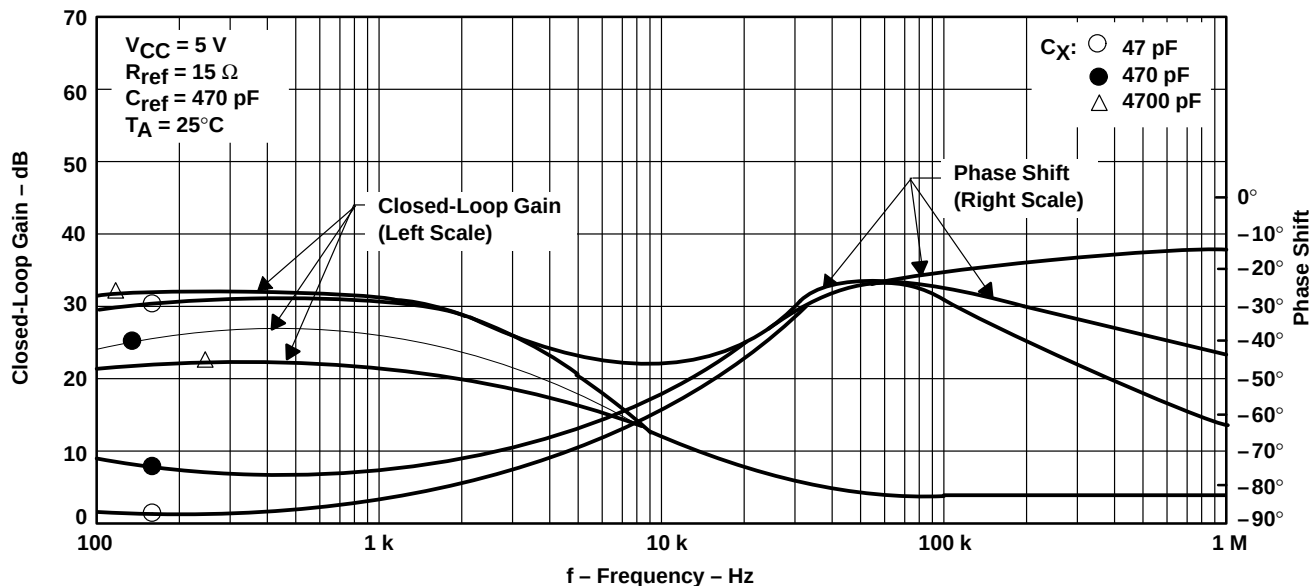


Test Circuit

Figure 19

TYPICAL CHARACTERISTICS

CLOSED-LOOP GAIN AND PHASE SHIFT VS FREQUENCY



Test Circuit

Figure 20

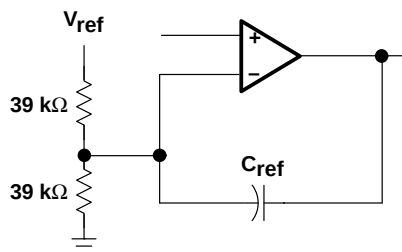
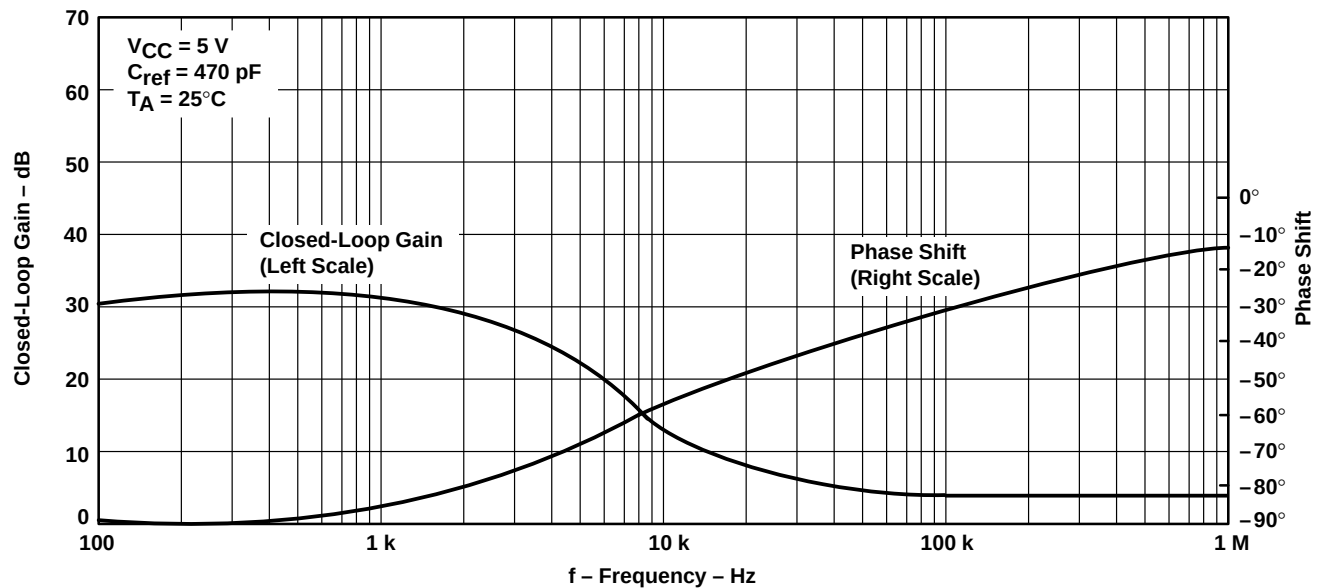
TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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TYPICAL CHARACTERISTICS

CLOSED-LOOP GAIN AND PHASE SHIFT VS FREQUENCY



Test Circuit

Figure 21

TYPICAL CHARACTERISTICS

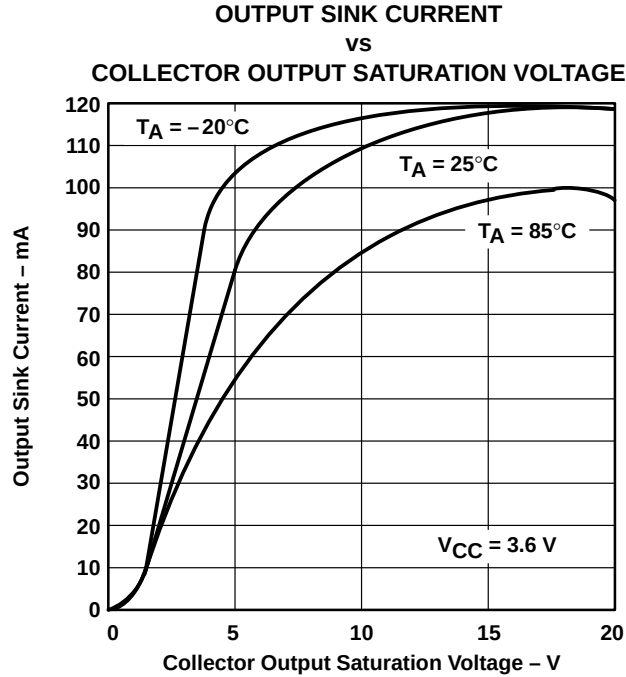


Figure 22

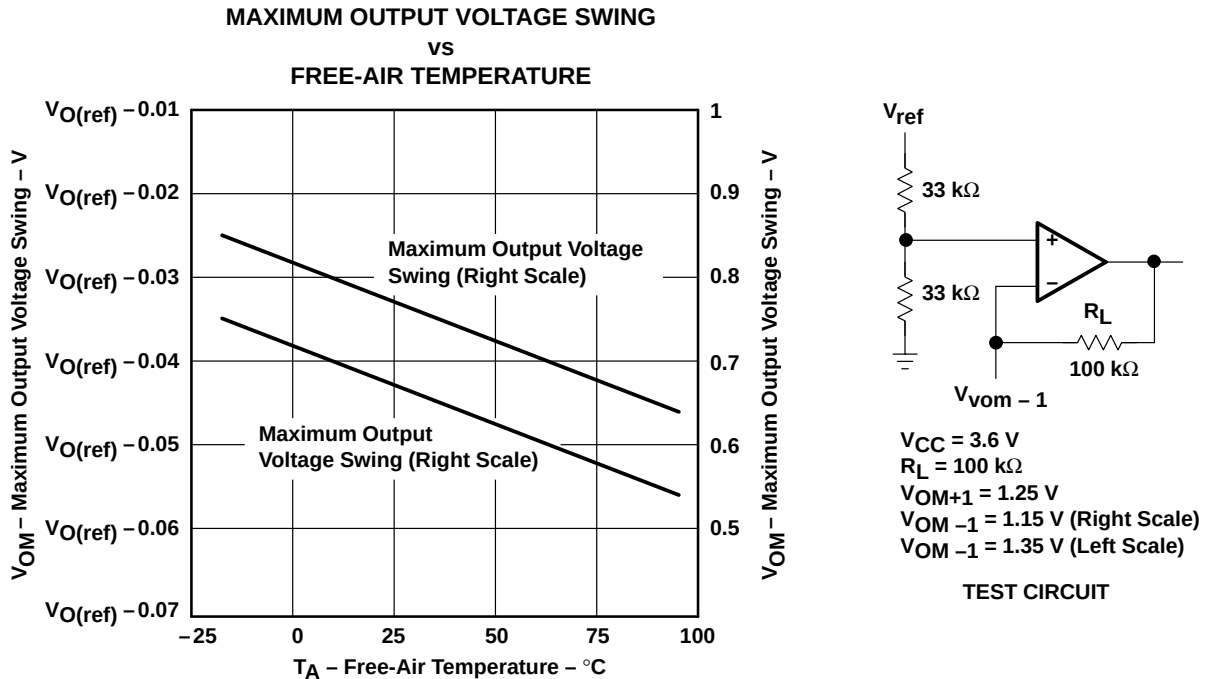


Figure 23

TL1451AC, TL1451AY

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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TYPICAL CHARACTERISTICS

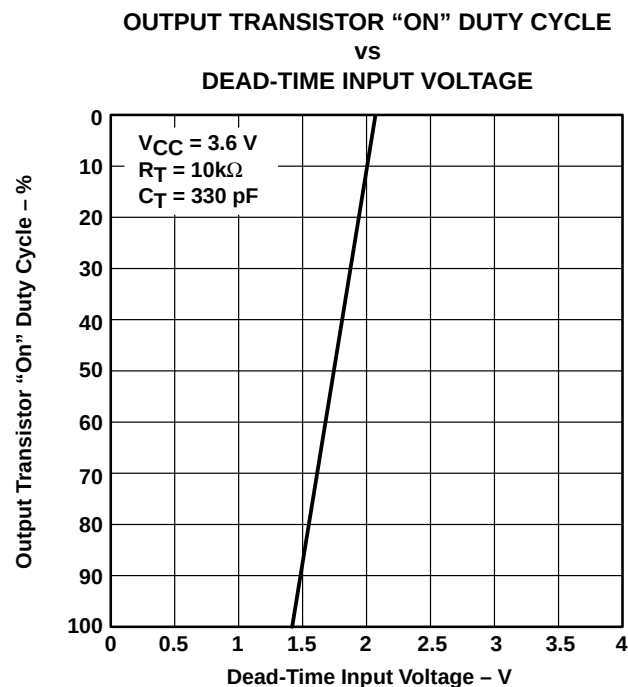


Figure 24

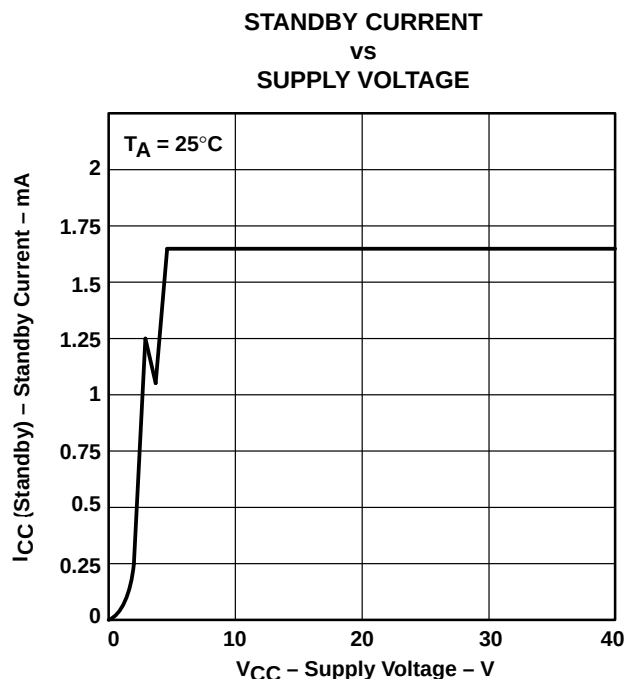


Figure 25

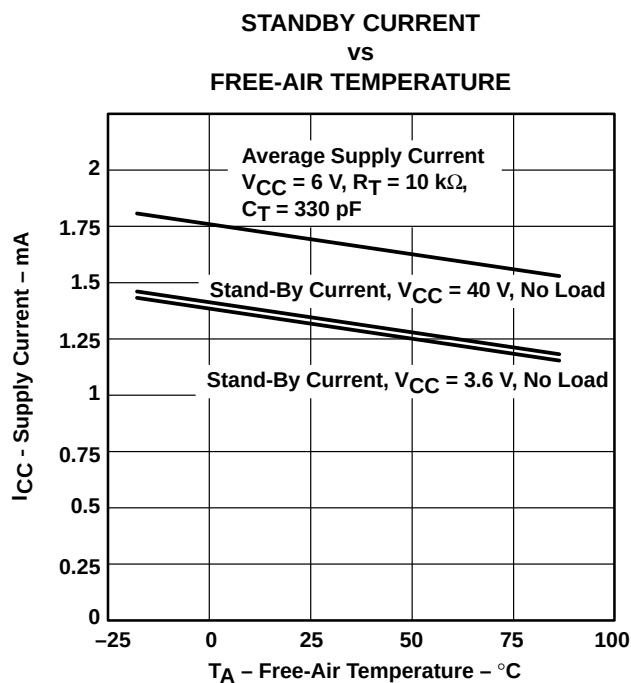


Figure 26

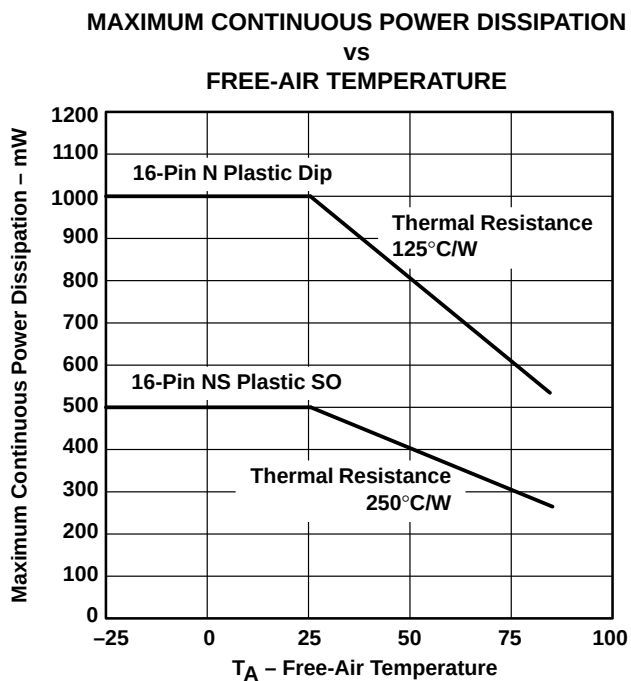
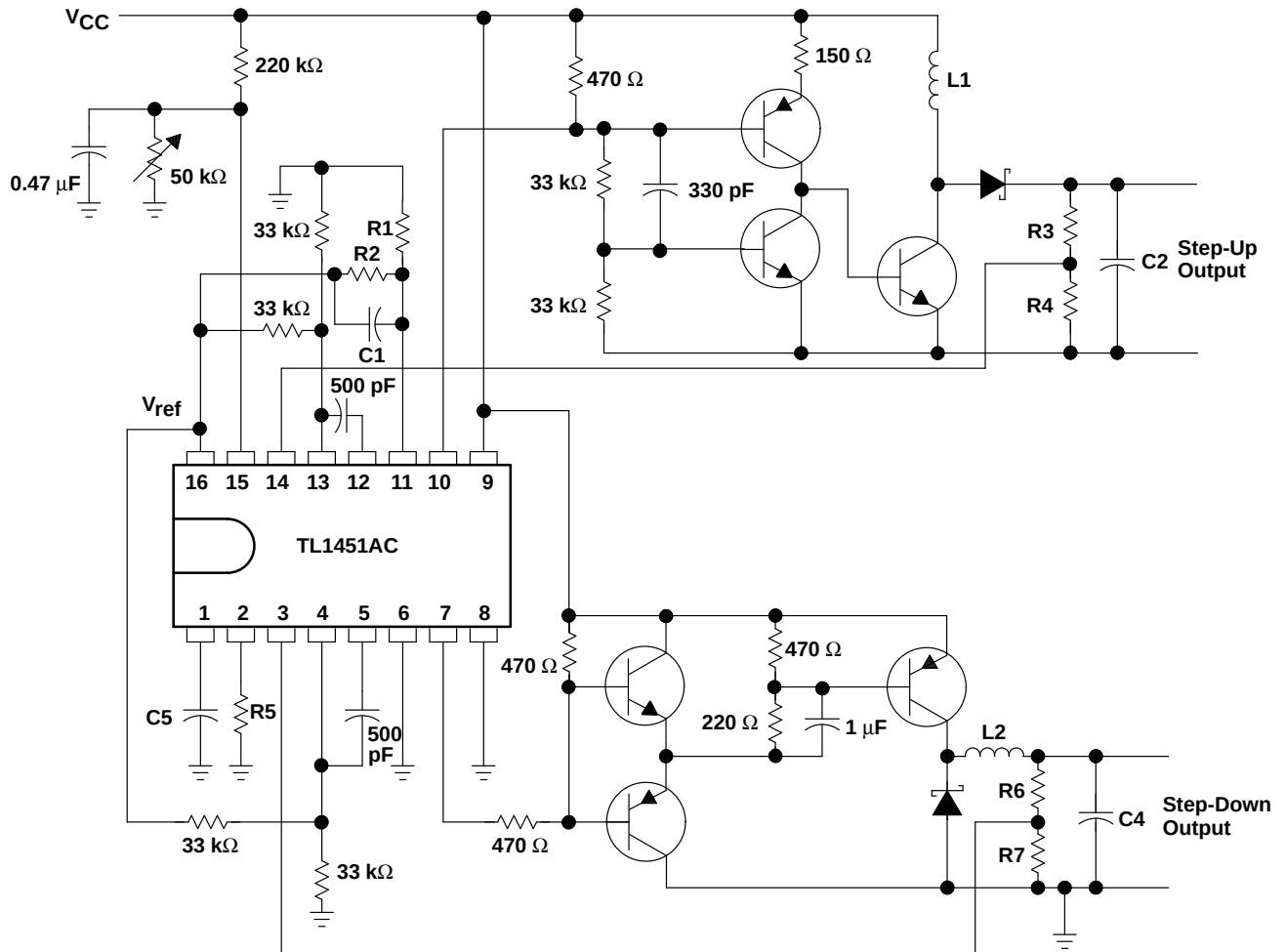


Figure 27

APPLICATION INFORMATION



NOTE A. Values for R1 through R7, C1 through C4, and L1 and L2 depend upon individual application.

Figure 28. High-Speed Dual Switching Regulator

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