



TL1451

LINEAR INTEGRATED CIRCUIT

DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS

■ DESCRIPTION

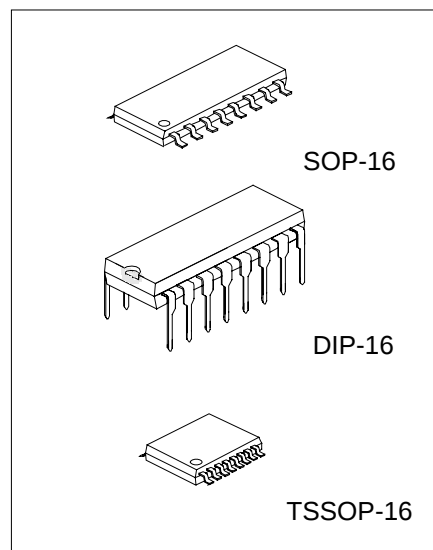
The UTC **TL1451** incorporates on a single monolithic chip all the functions required in the construction of two pulse-width-modulation (PWM) control circuits. Designed primarily for power supply control, the UTC **TL1451** contains an on-chip 2.5V regulator, two error amplifiers, an adjustable oscillator, two dead-time comparators, undervoltage lockout circuitry, and dual common –emitter output transistor circuits.

■ FEATURES

- *Complete PWM power control circuitry
- *Completely synchronized operation
- *Internal undervoltage lockout protection
- *Wide supply voltage range
- *Internal Short-Circuit protection
- *Oscillator frequency 500kHz max
- *Variable dead time provides control over total range
- *Internal regulator provides a stable 2.5V reference supply

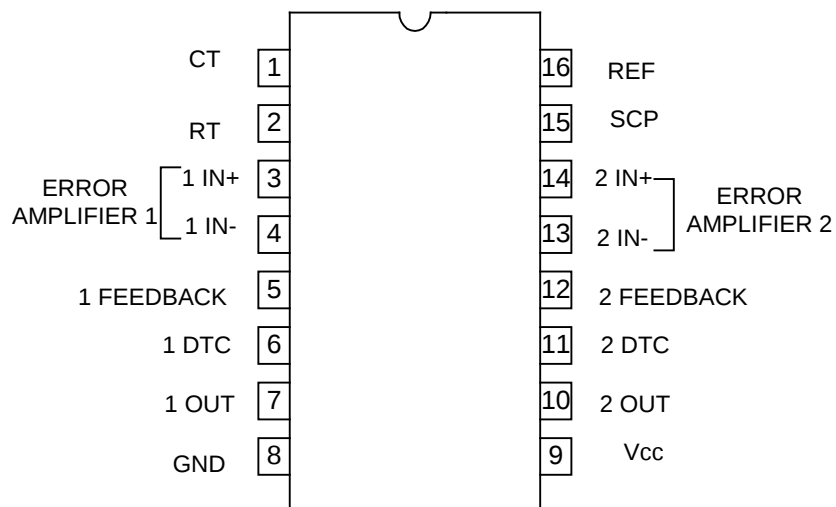
■ ORDERING INFORMATION

Order Number		Package	Packing
Normal	Lead free plating		
TL1451-S16-R	TL1451L-S16-R	SOP-16	Tape Reel
TL1451-S16-T	TL1451L-S16-T	SOP-16	Tube
TL1451-P16-R	TL1451L-P16-R	TSSOP-16	Tape Reel
TL1451-P16-T	TL1451L-P16-T	TSSOP-16	Tube
TL1451-D16-T	TL1451L-D16-T	DIP-16	Tube

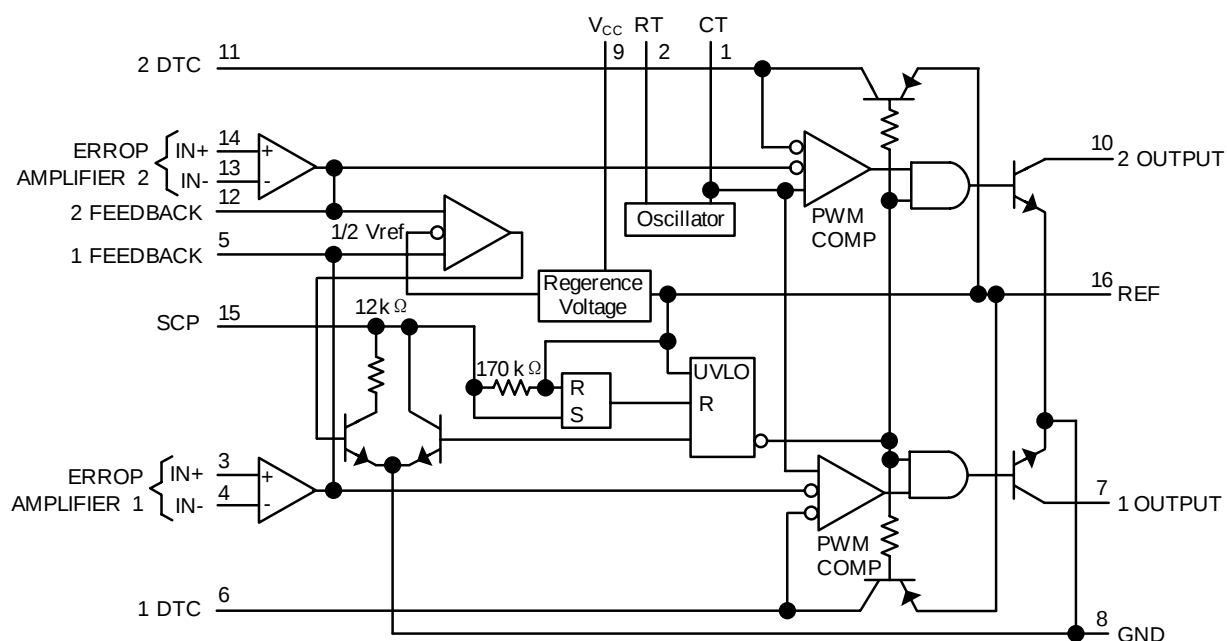


*Pb-free plating product number: TL1451L

PIN CONFIGURATION



BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS ($T_a=25^{\circ}\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	VALUE	UNIT
Supply Voltage		V_{CC}	51	V
Amplifier Input Voltage		V_{IN}	20	V
Collector Output Voltage		V_{OUT}	51	V
Collector Output Current		I_{OUT}	21	mA
Power Dissipation	DIP-16	P_D	1000	mW
	SOP-16		500	
	TSSOP-16		700	
Junction Temperature		T_J	+125	$^{\circ}\text{C}$
Operating Temperature		T_{OPR}	-20 ~ +85	$^{\circ}\text{C}$
Storage Temperature		T_{STG}	-40 ~ +150	$^{\circ}\text{C}$

Note 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. The device is guaranteed to meet performance specification within 0 ~ +70 operating temperature range and assured by design from -20 ~ +85 .

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage	V_{CC}	3.6		50	V
Amplifier Input Voltage	V_{IN}	1.05		1.45	V
Collector Output Voltage	V_{OUT}			50	V
Collector Output Current(each Transistor)	I_{OUT}			20	mA
Current into Feedback Terminal	I_{FB}			45	μA
Feedback Resistor	R_F	100			$\text{k}\Omega$
Timing Capacitor	C_T	150		15000	pF
Timing Resistor	R_T	5.1		100	$\text{k}\Omega$
Oscillator frequency	F_{OSC}	1		500	kHz
Operating Temperature	T_{OPR}	-20		85	$^{\circ}\text{C}$

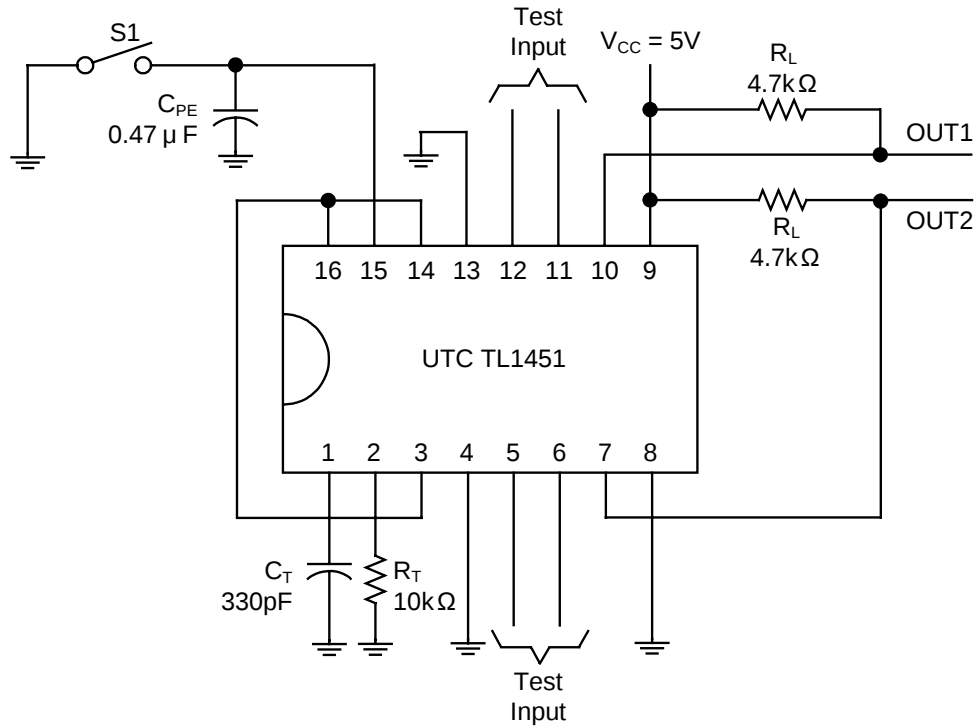
■ ELECTRICAL CHARACTERISTICS($V_{CC}=6\text{V}$, $f=200\text{kHz}$, $T_a=25^{\circ}\text{C}$, unless otherwise specified.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference Section							
Output Voltage		V _{OUT}	I _{OUT} =1mA	2.4	2.5	2.6	V
Output Voltage Change with Temperature			T _a = -20°C ~ 25°C		-0.1	±1	%
			T _a = 25°C ~ 85°C		-0.2	±1	
Input Voltage Regulation		V _{IN}	V _{CC} =3.6V ~ 40V		2	12.5	mV
Output Voltage Regulation		V _{OUT}	I _{OUT} =0.1mA ~ 1mA		1	7.5	mV
Short-Circuit Output Current		I _{OUT}	V _{OUT} =0	3	10	30	mA
Undervoltage Lockout Section							
Threshold Voltage (V _{CC})	Upper	V _{THR}	I _{OUT(REF)} =0.1mA		2.72		V
	Lower				2.6		V
Hysteresis (V _{CC})		V _{HYS}		80	120		mV
Reset Threshold voltage (V _{CC})				1.5	1.9		V
Short-Circuit Protection Control Section							
Input Threshold Voltage(SCP)		V _{IN(THR)}		0.65	0.7	0.75	V
Standby Voltage(SCP)		V _{STN-BY}	No pullup	140	185	230	mV
Latched Input Voltage (SCP)		V _{IN(LAT)}	No pullup		60	120	mV
Input (source) Current		I _{IN(source)}	V _{IN} =0.7V	-10	-15	-20	μA
Comparator Threshold Voltage (FEEDBACK)		V _{THR}			1.18		V

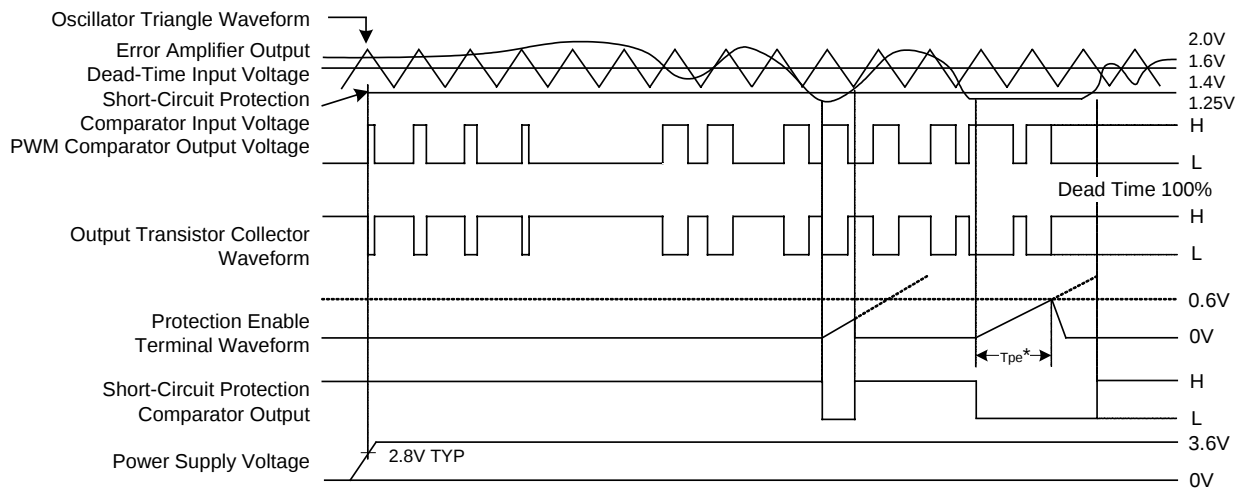
■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Oscillator Section						
Frequency	F	C _T =330pF, R _T =10kΩ		200		kHz
Standard deviation of frequency		C _T =330pF, R _T =10kΩ		10%		
Frequency Change with Voltage		V _{CC} =3.6V ~ 40V		1%		
Frequency Change with Temperature		T _A =-20°C ~ 25°C		-0.4	±2	%
		T _A =25°C ~ 85°C		-0.2	±2	
Dead-Time Control Section						
Input bias Current (DTC)	I _{IN(BIAS)}				1	μA
Latch mode (source) Current (DTC)			-80	-145		μA
Latched Input Voltage (DTC)	V _{IN}	I _{OUT} =40μA	2.3			V
Input threshold Voltage at f=10kHz (DTC)	V _{IN(THR)}	Zero duty cycle		2.05	2.25	V
		Maximum duty cycle	1.2	1.45		
Error-Amplifier Section						
Input Offset Voltage	V _{IN(OFF)}	V _{OUT} (FEEDBACK)=1.25V			±6	mV
Input Offset Current	I _{IN(OFF)}	V _{OUT} (FEEDBACK)=1.25V			±100	nA
Input Bias current	I _{IN(BIAS)}	V _{OUT} (FEEDBACK)=1.25V		160	500	nA
Common-Mode Input Voltage Range	V _{IN(CM)}	V _{CC} =3.6V ~ 40V	1.05~1.45			V
Open-loop Voltage Amplification		R _F =200kΩ	70	80		dB
Unity-gain Bandwidth	B _G			1.5		MHz
Common-mode Rejection Ratio	RR		60	80		dB
Positive Output Voltage Swing	V _{OUT}		V _{ref} -0.1			V
Negative Output Voltage Swing	V _{OUT}				1	V
Output (sink) Current (FEEDBACK)	I _{OUT(SIN)}	V _{ID} =-0.1V, V _{OUT} =1.25V	0.5	1.6		mA
Output (source) Current (FEEDBACK)	I _{OUT(SOU)}	V _{ID} =0.1V, V _{OUT} =1.25V	-45	-70		μA
Output Section						
Collector off-state Current	I _{OFF}	V _{OUT} =50V			10	μA
Output Saturation Voltage	V _{OUT(SAT)}	I _{OUT} =10mA		1.2	2	V
Short-Circuit Output Current	I _{OUT(SHT)}	V _{OUT} =6V		90		mA
PWM Comparator Section						
Input Threshold Voltage at f=10kHz (FEEDBACK)	V _{I(THR)}	Zero duty cycle		2.05	2.25	V
		Maximum duty cycle	1.2	1.45		
TOTAL DEVICE						
Standby Supply Current	I _{STN-BY}	Off-state		1.3	1.8	mA
Average Supply Current		R _T =10kΩ		1.7	2.4	mA

■ TEST CIRCUIT



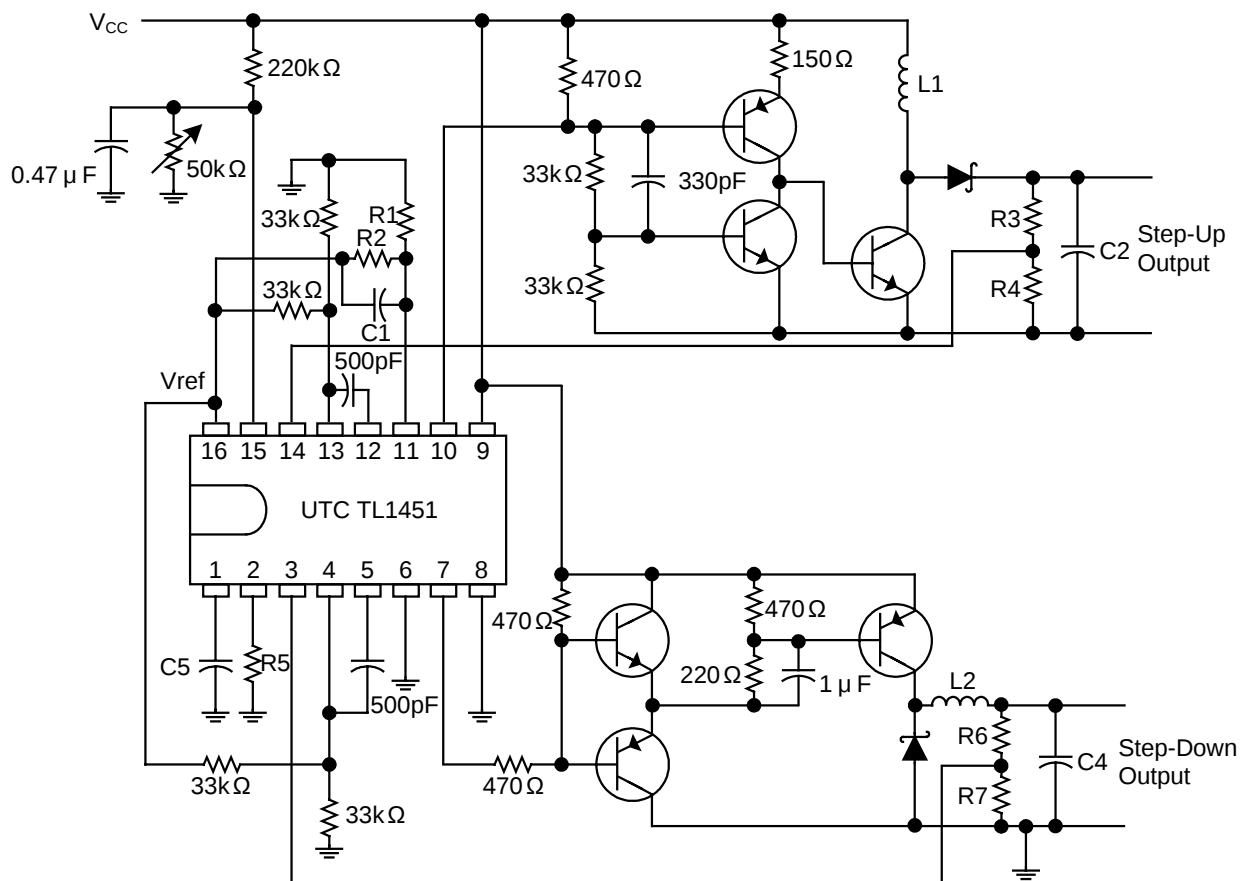
■ TIMING DIAGRAM



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

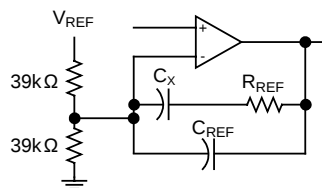
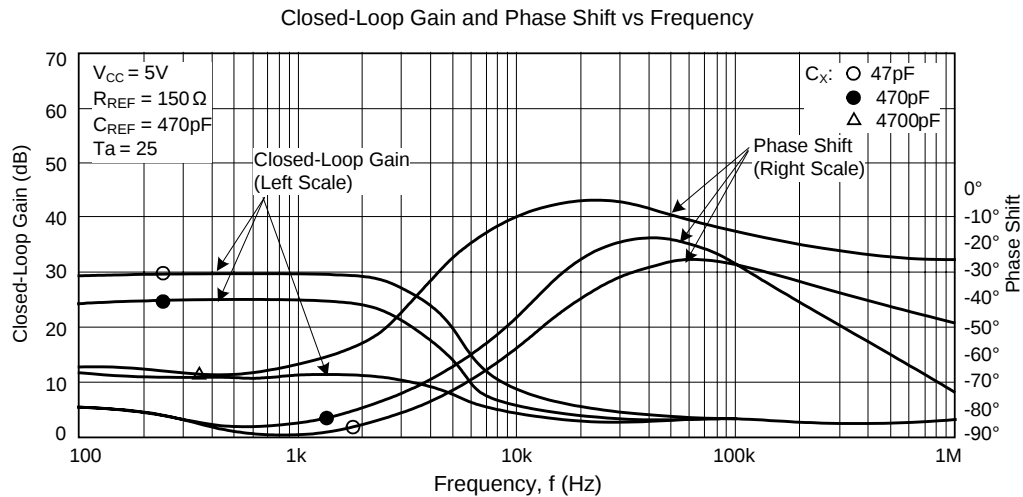
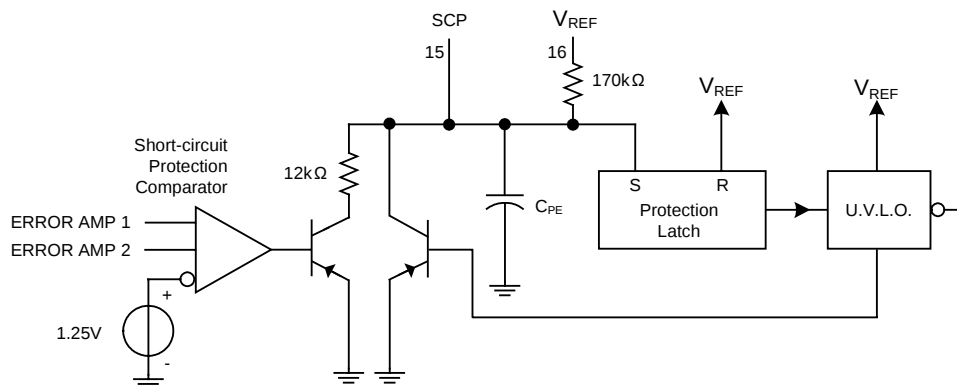
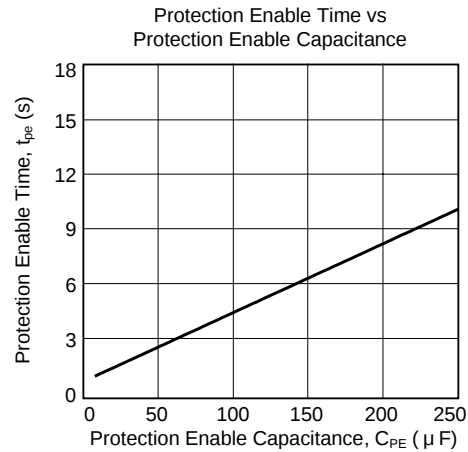
■ APPLICATION INFORMATION

HIGH-SPEED DUAL SWITCHING REGULATOR



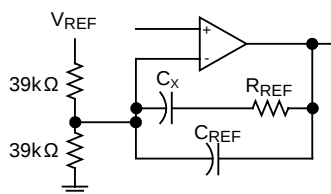
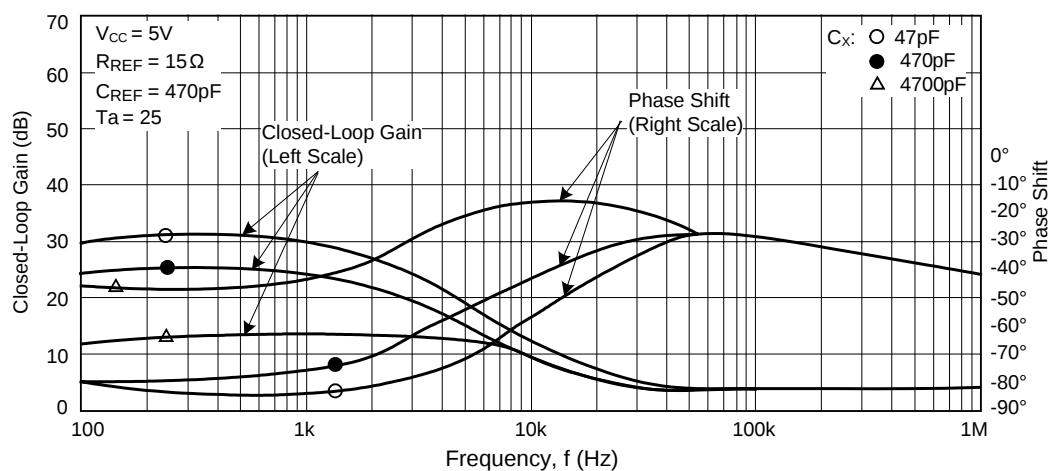
NOTE A: Values for R1 through R7, C1 through C4, and L1 and L2 depend upon individual application.

TYPICAL CHARACTERISTICS

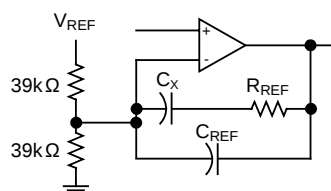
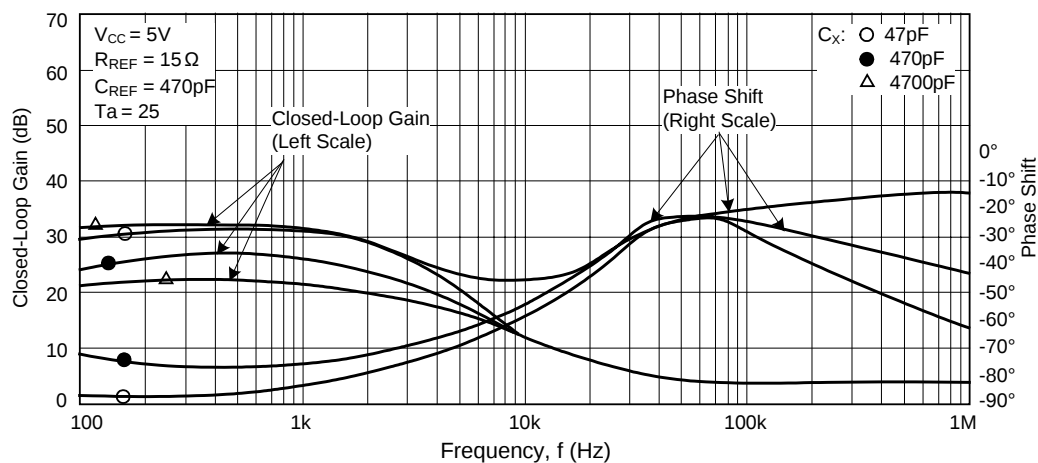


■ TYPICAL CHARACTERISTICS(cont.)

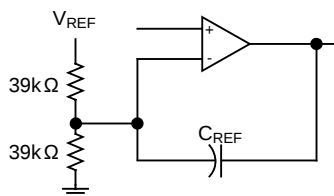
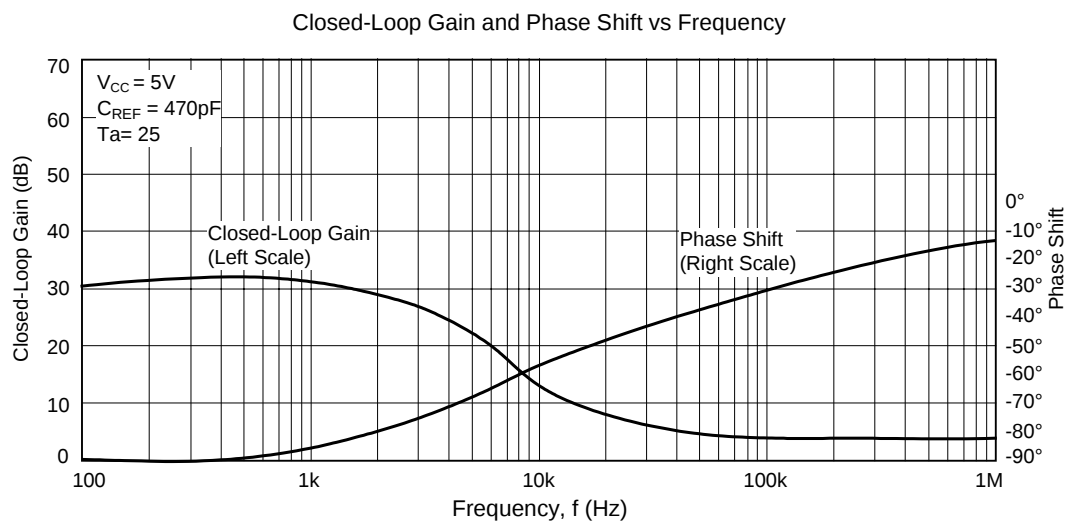
Closed-Loop Gain and Phase Shift vs Frequency



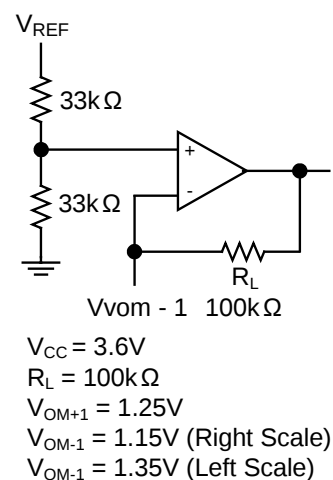
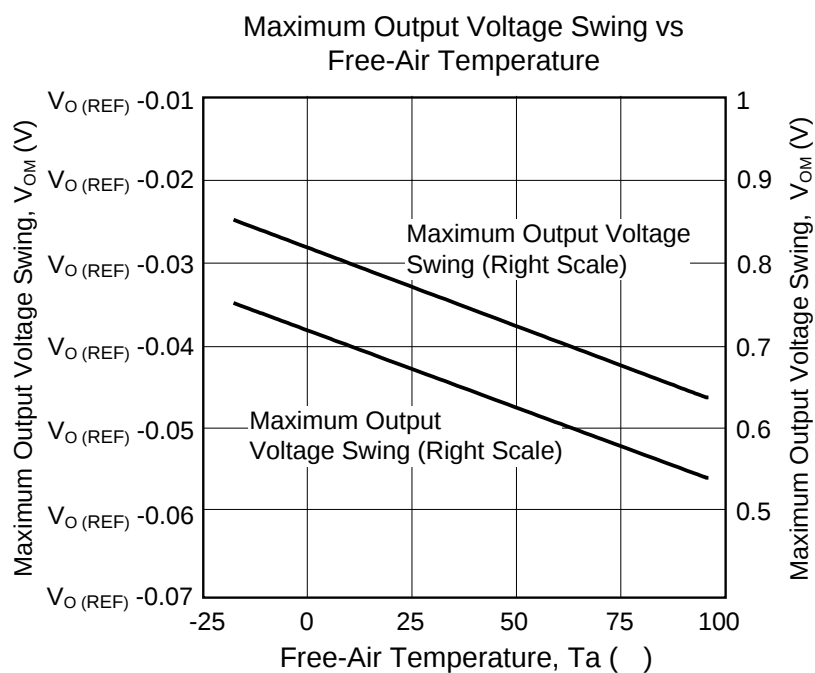
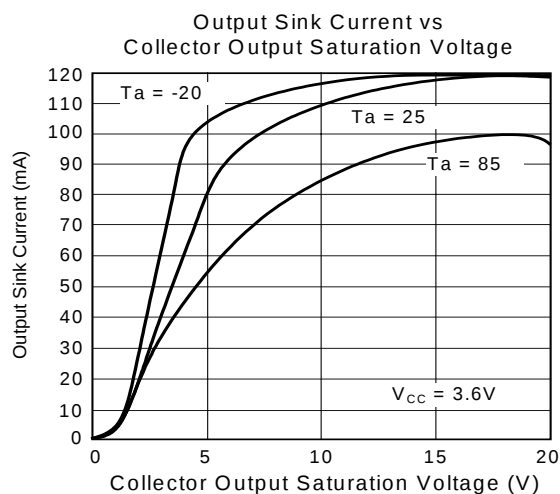
Closed-Loop Gain and Phase Shift vs Frequency



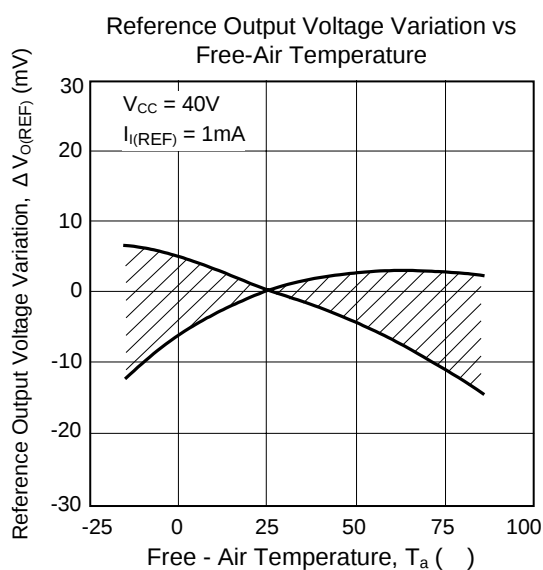
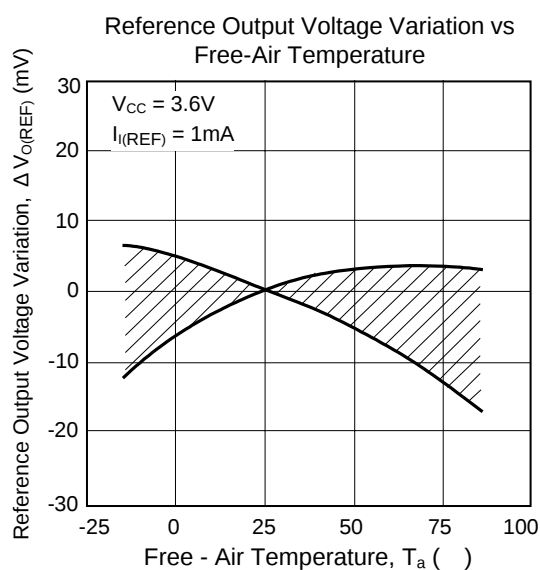
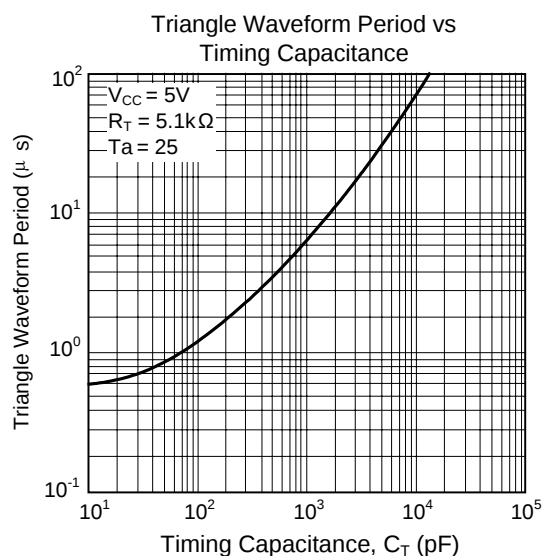
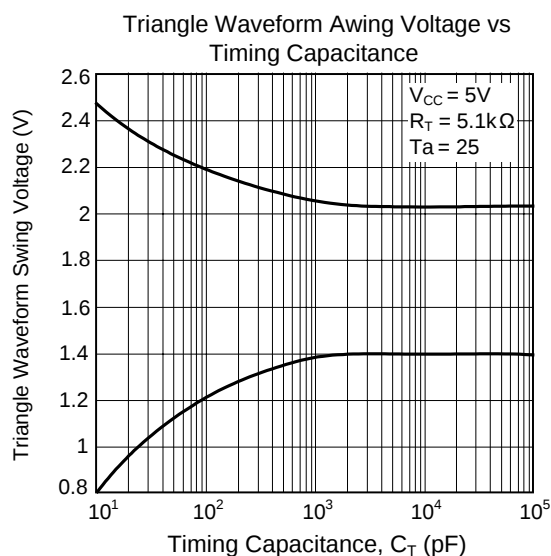
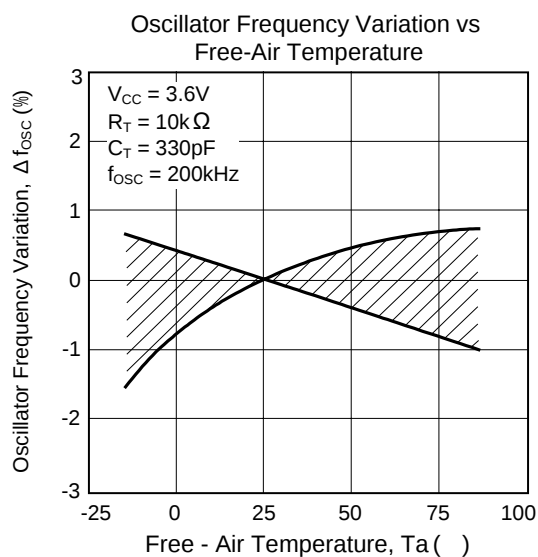
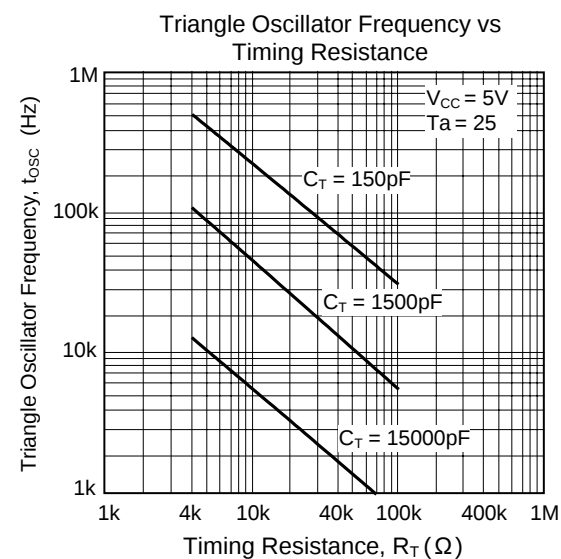
■ TYPICAL CHARACTERISTICS(Cont.)



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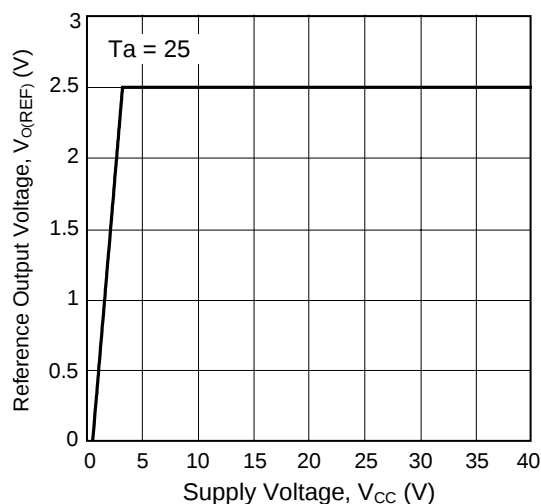


TYPICAL CHARACTERISTICS

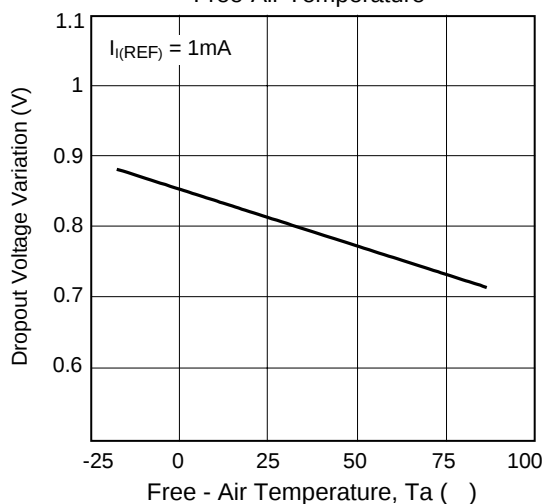


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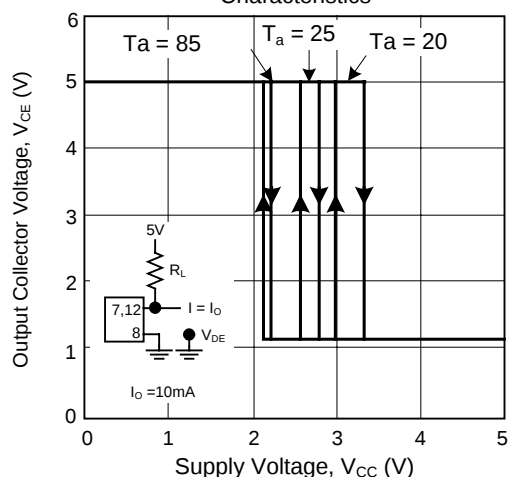
Reference Output Voltage vs Supply Voltage



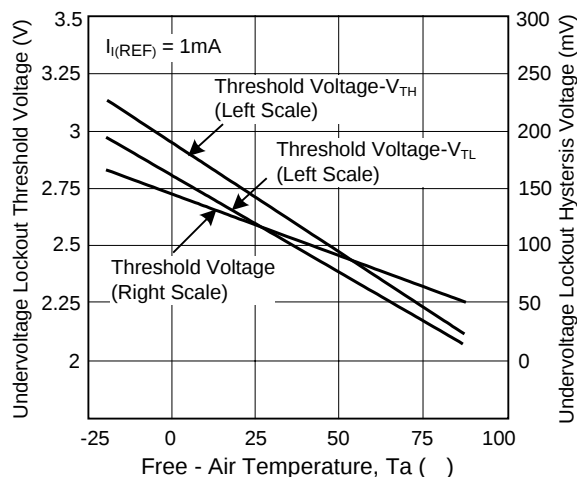
Dropout Voltage Variation vs Free-Air Temperature



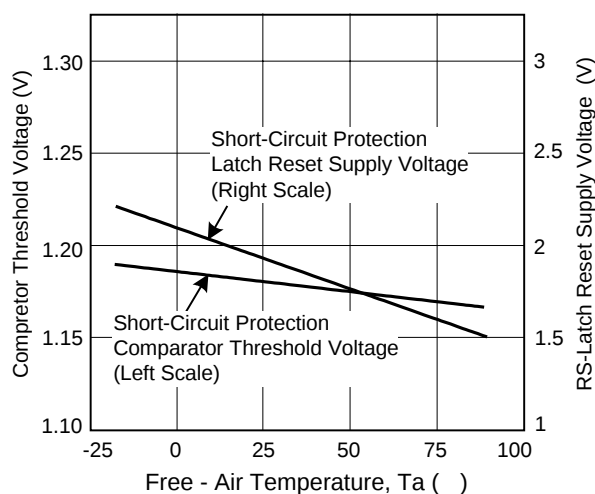
Undervoltage Lockout Hysteresis Characteristics



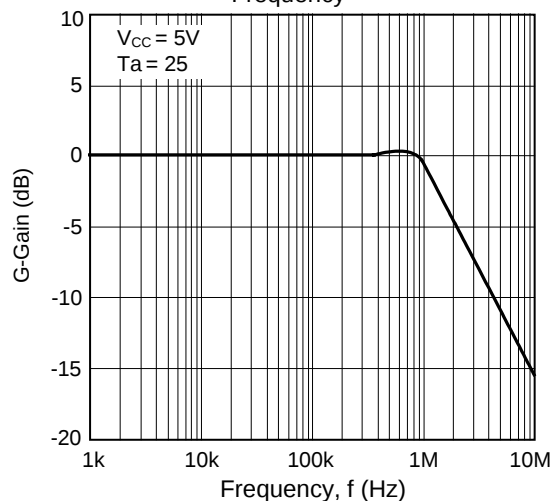
Undervoltage Lockout Characteristics



Short-Circuit Protection Characteristics

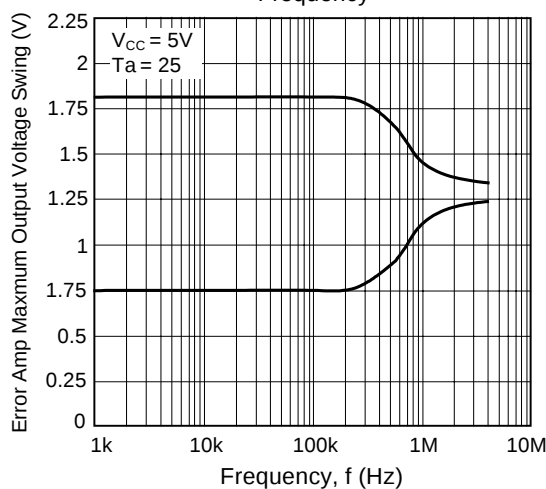


Gain (Amplifier In Unity-Gain Configuration) vs Frequency

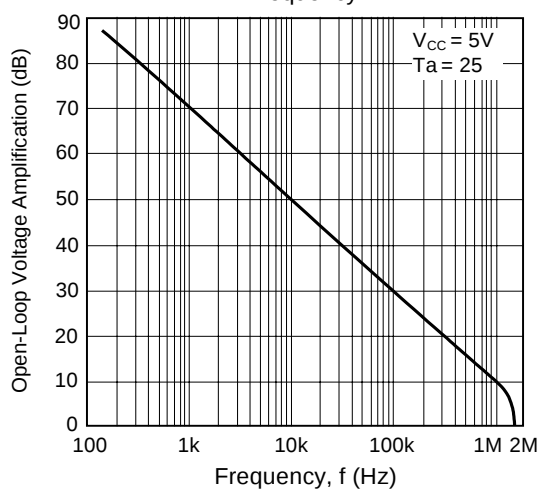


■ TYPICAL CHARACTERISTICS(Cont.)

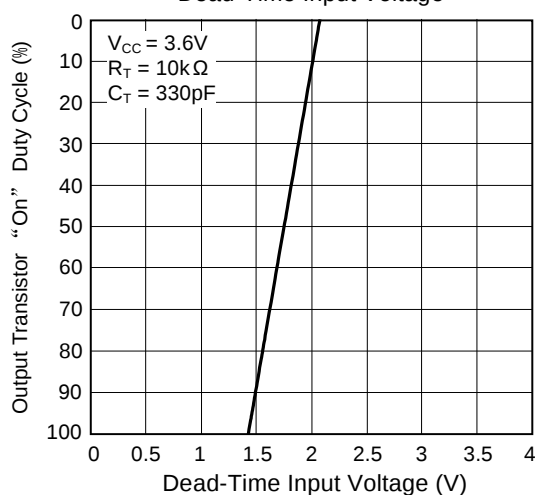
Error Amp Maximum Output Voltage Swing vs Frequency



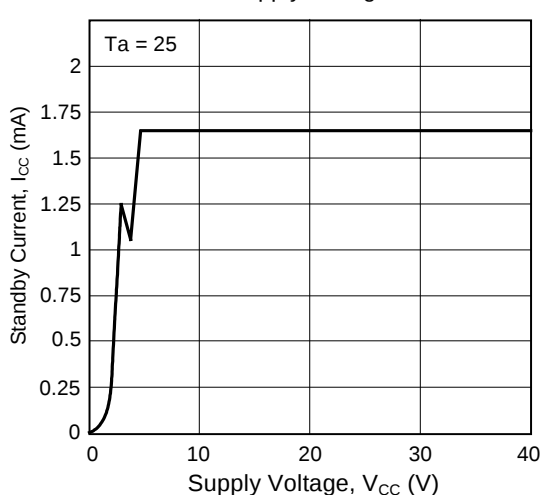
Open-Loop Voltage Amplification vs Frequency



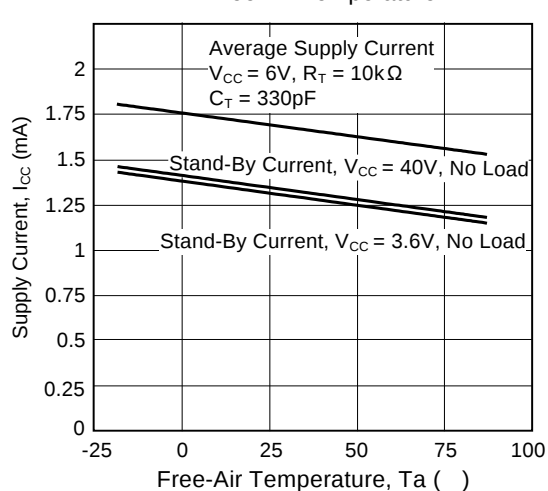
Output Transistor on Duty Cycle vs Dead-Time Input Voltage



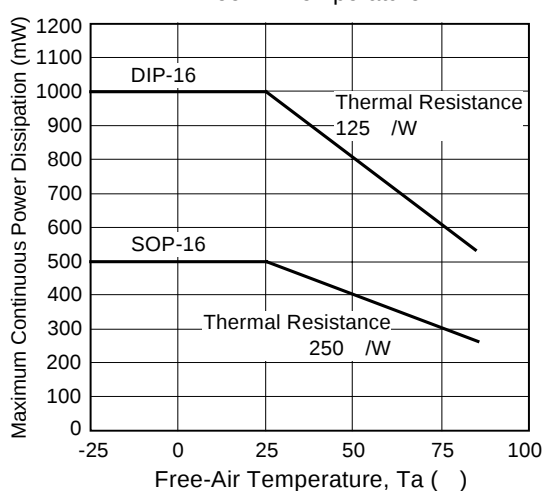
Standby Current vs Supply Voltage



Standby Current vs Free-Air Temperature



Maximum Continuous Power Dissipation vs Free-Air Temperature



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