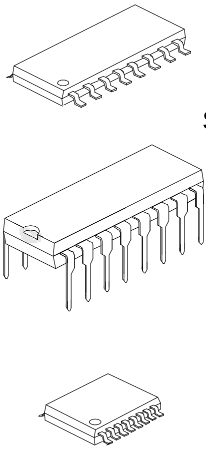
DUAL PULSE-WIDTH-MODULATION CONTROL CIRCUITS



SOP-16

DIP-16

TSSOP-16

Lead-free: TL1451L
Halogen-free: TL1451G

■ 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

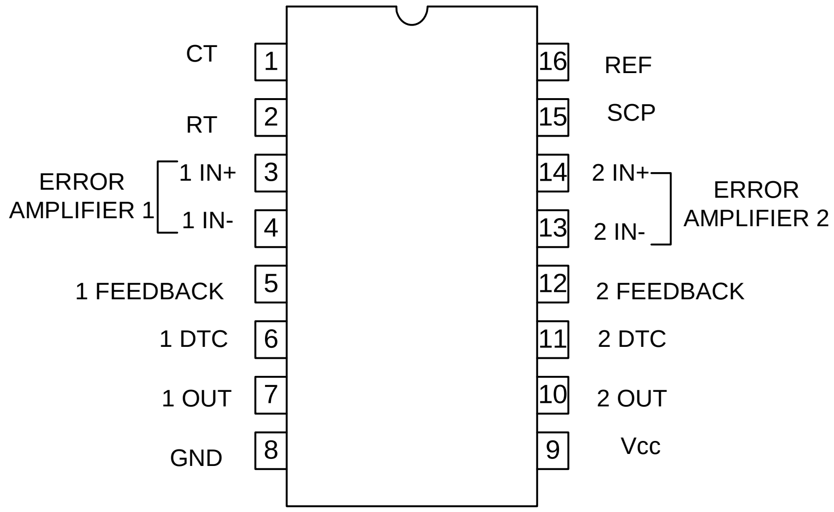
*Complete PWM power control circuitry
*Completely synchronized operation
*Internal undervoltage lockout protection
*Wide supply voltage range
*Internal Short-Circuit protection
*Oscillator frequency 500kHz max
*Variable dead time provides control over total range
*Internal regulator provides a stable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

■ ORDERING INFORMATION

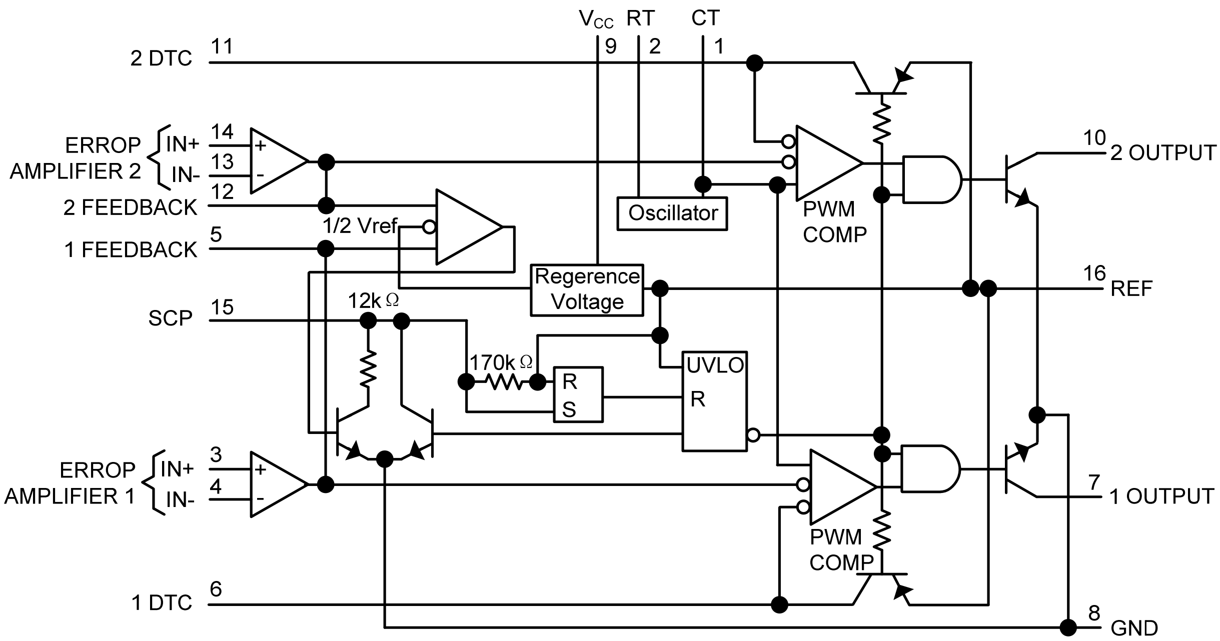
Ordering Number			Package	Packing
Normal	Lead Free	Halogen Free		
TL1451-S16-R	TL1451L-S16-R	TL1451G-S16-R	SOP-16	Tape Reel
TL1451-S16-T	TL1451L-S16-T	TL1451G-S16-T	SOP-16	Tube
TL1451-P16-R	TL1451L-P16-R	TL1451G-P16-R	TSSOP-16	Tape Reel
TL1451-P16-T	TL1451L-P16-T	TL1451G-P16-T	TSSOP-16	Tube
TL1451-D16-T	TL1451L-D16-T	TL1451G-D16-T	DIP-16	Tube

TL1451L-S16-R	
(1)Packing Type	(1) R: Tape Reel, T: Tube
(2)Package Type	(2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16
(3)Lead Plating	(3) G: Halogen Free, L: Lead Free, Blank: Pb/Sn

■ PIN CONFIGURATION



■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (T_a=25°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	°C
Operating Temperature		T_{OPR}	-20 ~ +85	°C
Storage Temperature		T_{STG}	-40 ~ +150	°C

Note: 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.

■ 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			kΩ
Timing Capacitor	C_T	150		15000	pF
Timing Resistor	R_T	8		100	kΩ
Oscillator frequency	F_{OSC}	1		350	kHz
Operating Temperature	T_{OPR}	-20		85	°C

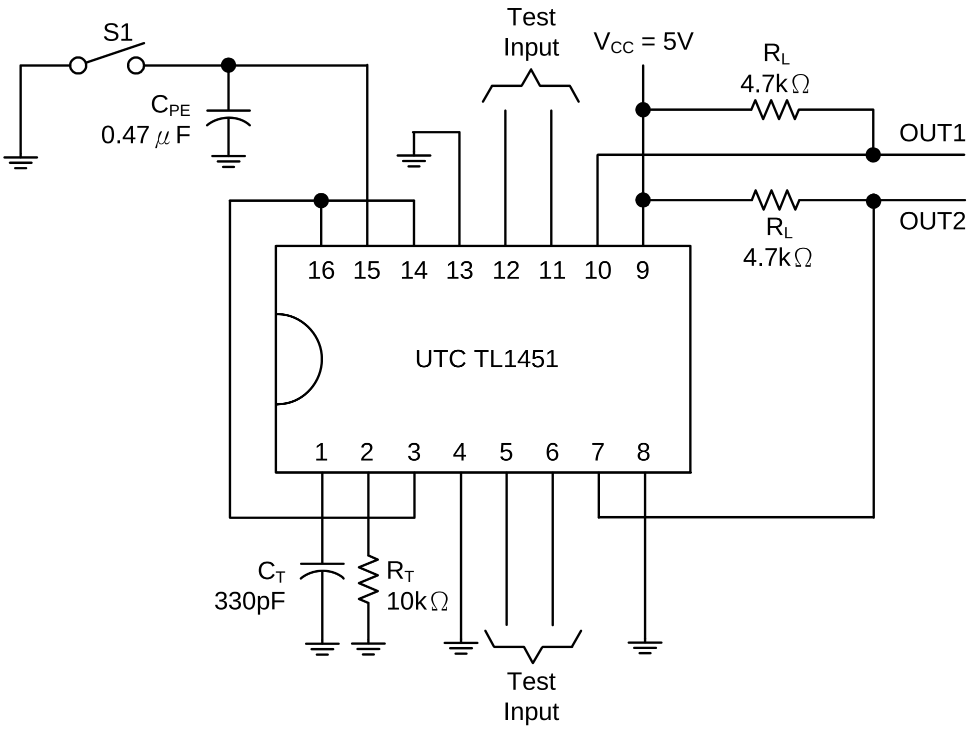
■ ELECTRICAL CHARACTERISTICS(V_{CC}=6V, f=200kHz, T_a=25°C, unless otherwise specified.)

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		$\triangle V_{IN}$	Vcc=3.6V ~ 40V		2	12.5	mV
Output Voltage Regulation		$\triangle V_{OUT}$	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 (Vcc)	Upper	V_{THR}	$I_{OUT(REF)}$=0.1mA		2.72		V
	Lower				2.6		V
Hysteresis (Vcc)		V_{HYS}		80	120		mV
Reset Threshold voltage (Vcc)				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

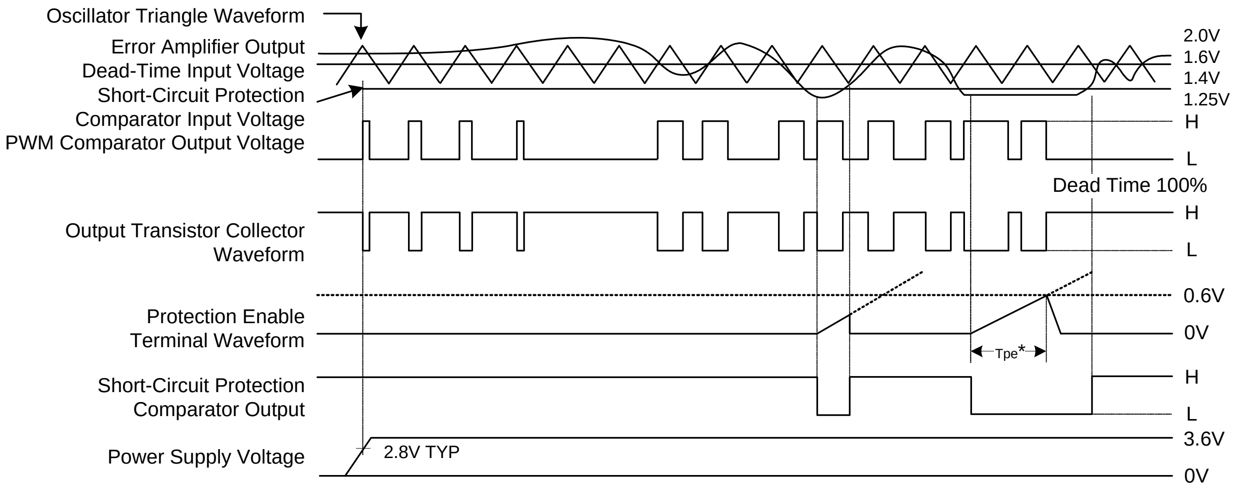
■ ELECTRICAL CHARACTERISTICS(Cont.)

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		Vcc=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	$V_{IN(CM)}$	Vcc=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}		Vref-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



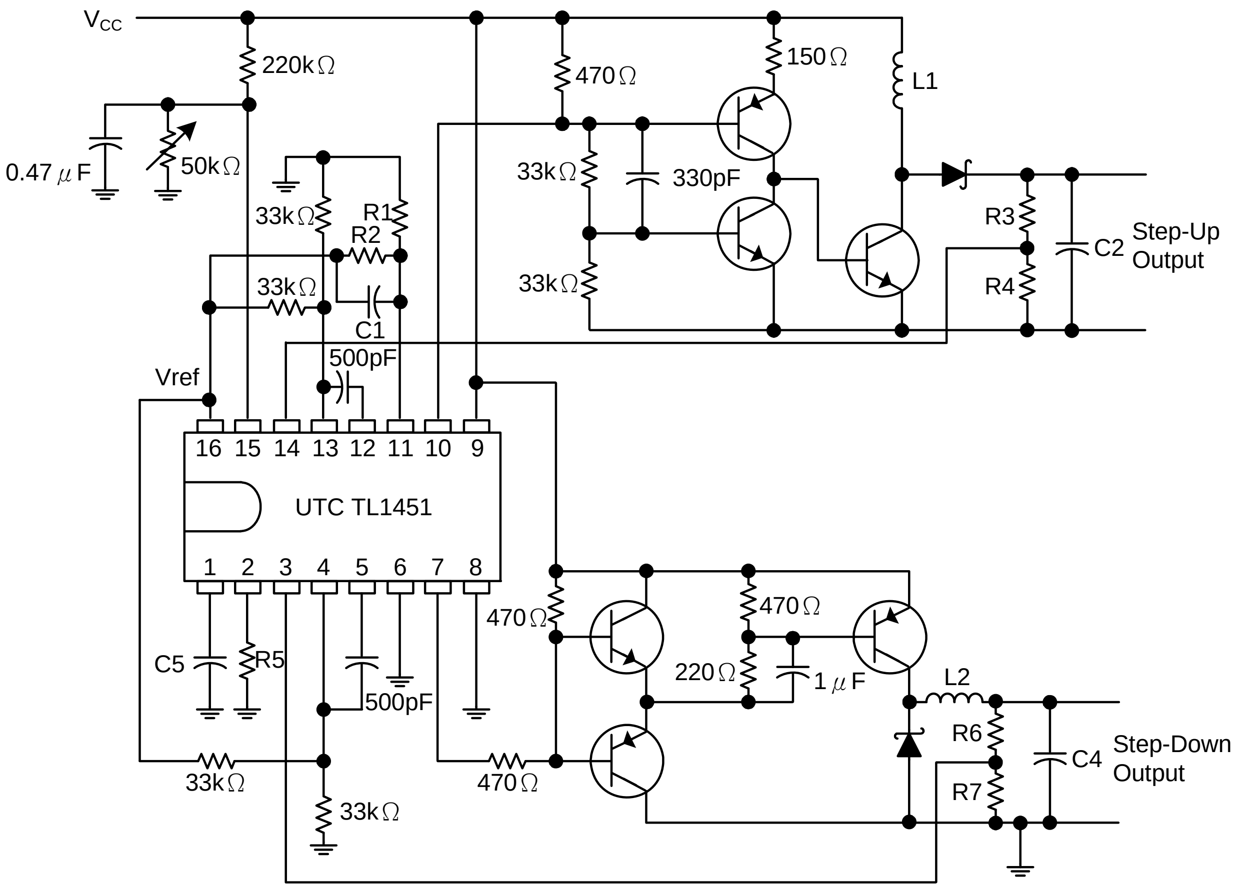
■ TIMING DIAGRAM



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

■ APPLICATION INFORMATION

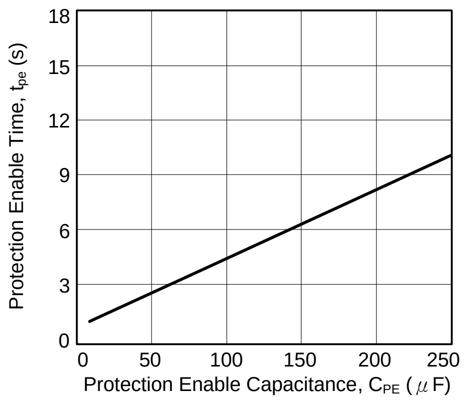
HIGH-SPEED DUAL SWITCHING REGULATOR

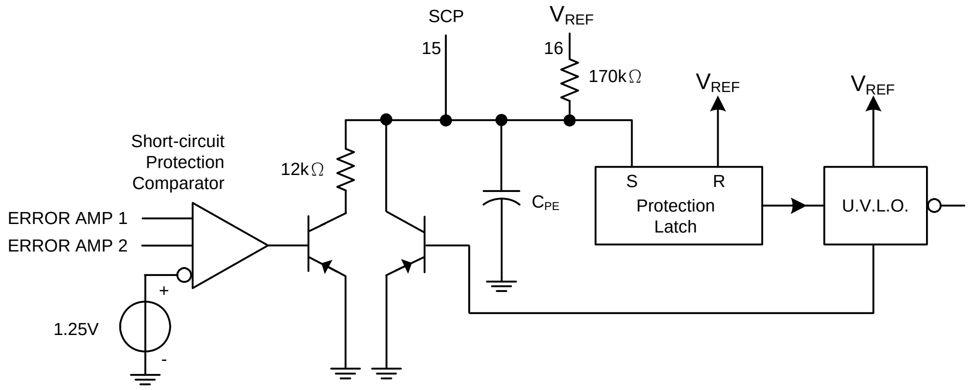


NOTE A: Values for R1 through R7, C1 through C4, and L1 and L2 depend upon individual application.

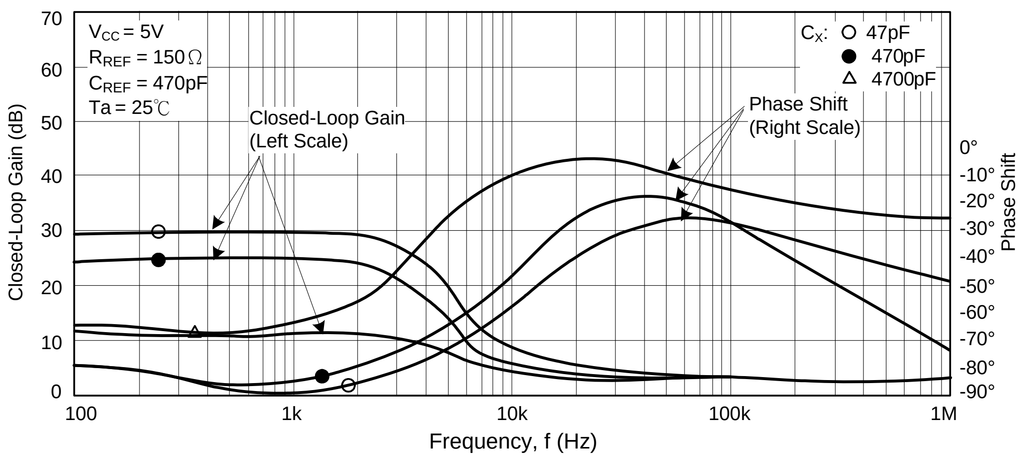
■ TYPICAL CHARACTERISTICS

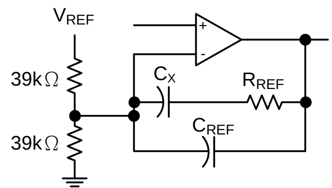
Protection Enable Time vs Protection Enable Capacitance





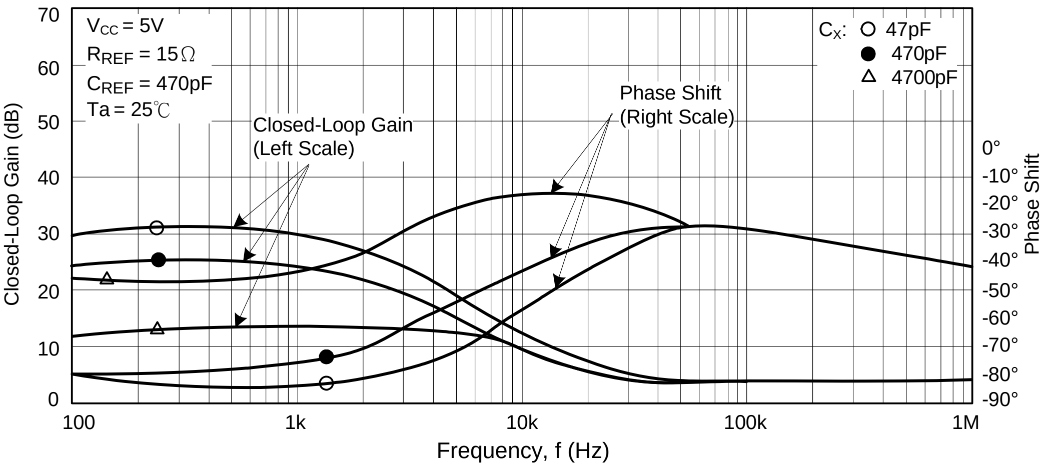
Closed-Loop Gain and Phase Shift vs Frequency

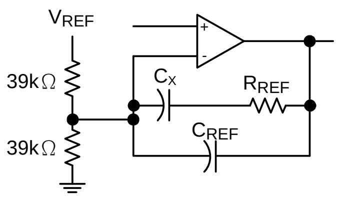




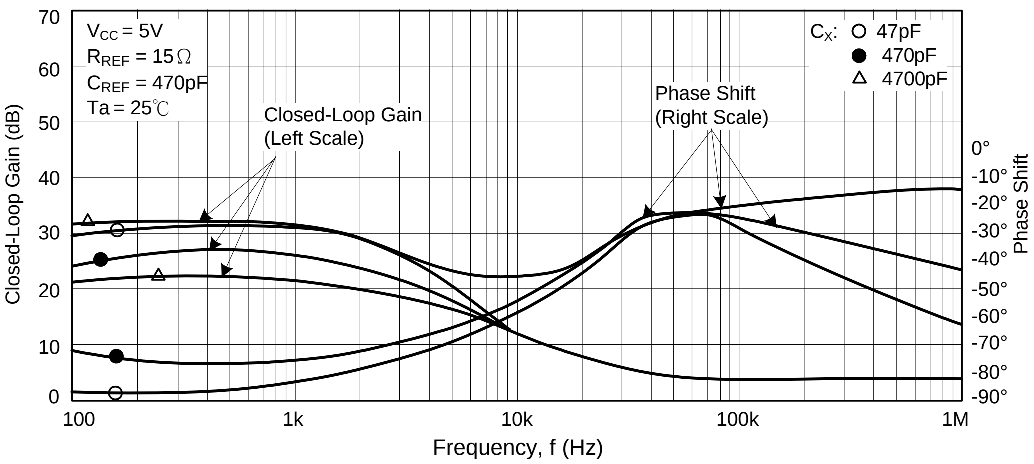
■ TYPICAL CHARACTERISTICS(cont.)

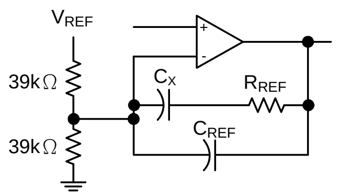
Closed-Loop Gain and Phase Shift vs Frequency





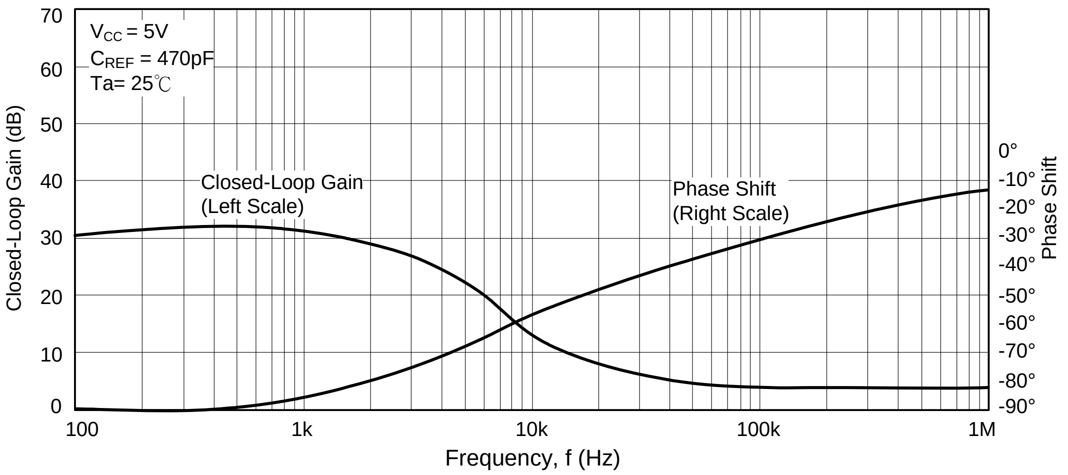
Closed-Loop Gain and Phase Shift vs Frequency

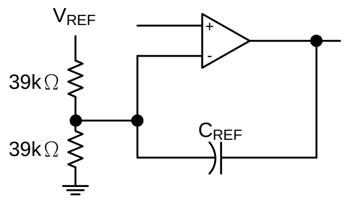




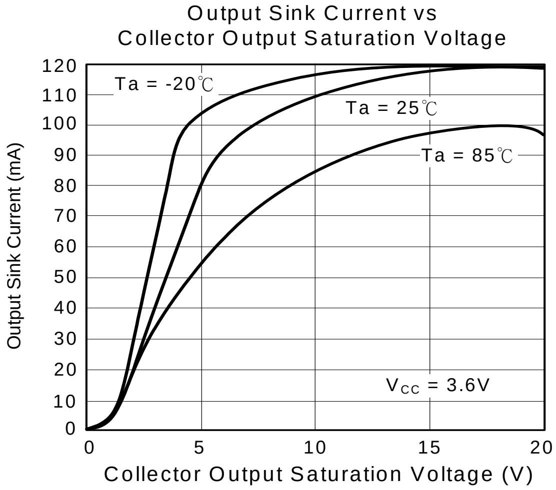
■ TYPICAL CHARACTERISTICS(Cont.)

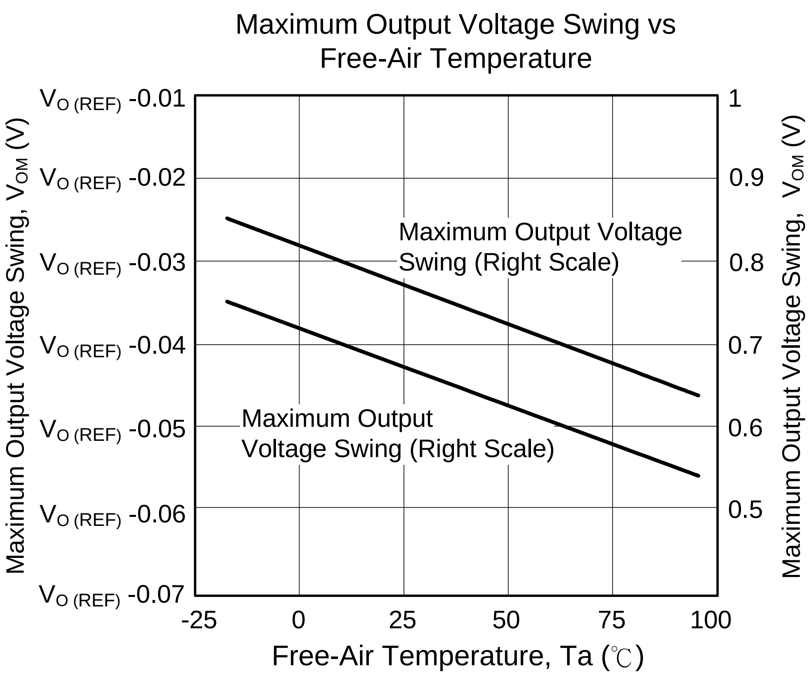
Closed-Loop Gain and Phase Shift vs Frequency

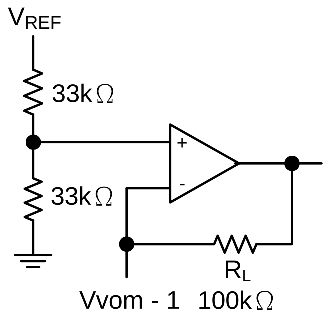




■ TYPICAL CHARACTERISTICS(Cont.)



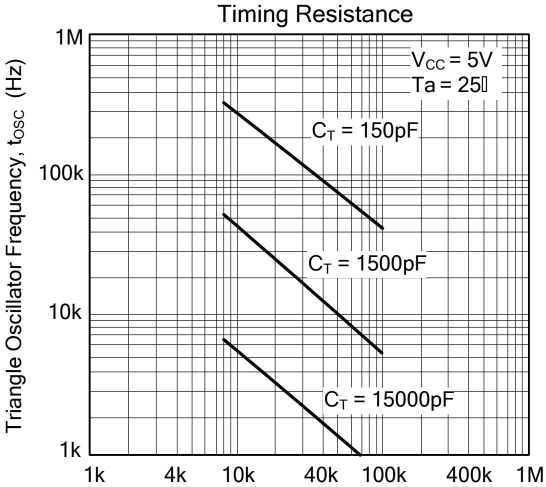




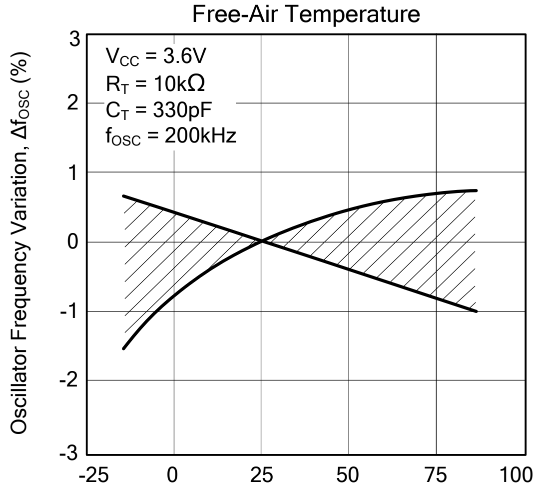
V_{CC} = 3.6V
R_L = 100kΩ
V_{OM+1} = 1.25V
V_{OM-1} = 1.15V (Right Scale)
V_{OM-1} = 1.35V (Left Scale)

■ TYPICAL CHARACTERISTICS

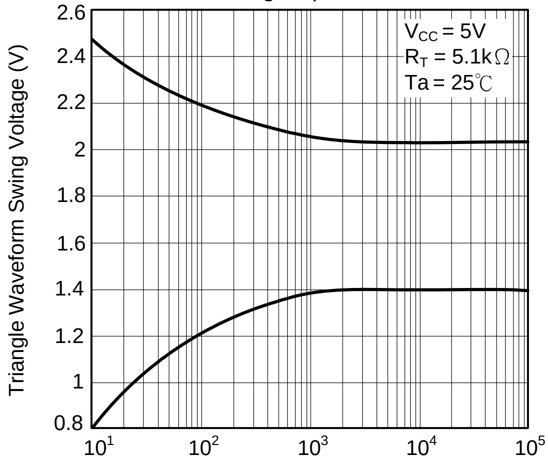
Triangle Oscillator Frequency vs Timing Resistance



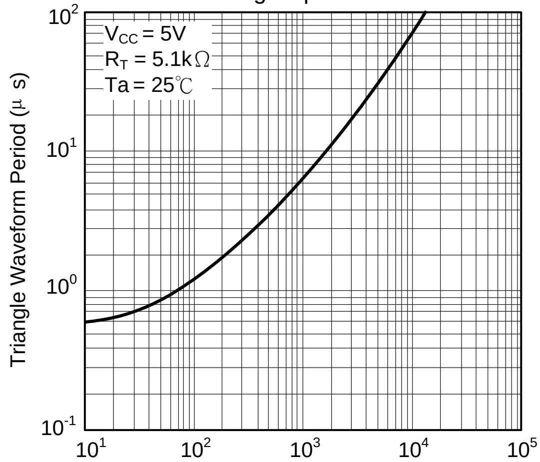
Oscillator Frequency Variation vs Free-Air Temperature



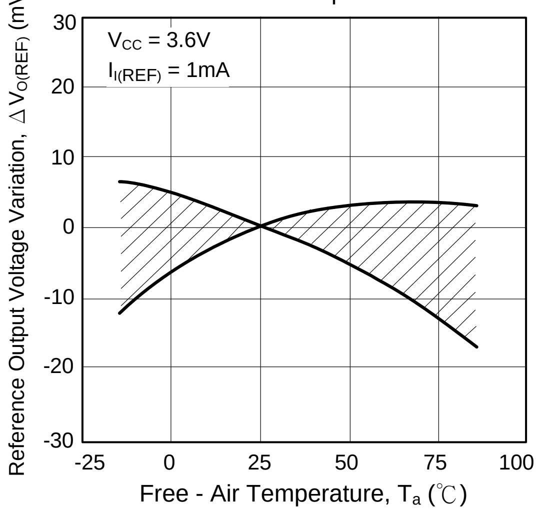
Triangle Waveform Awing Voltage vs Timing Capacitance



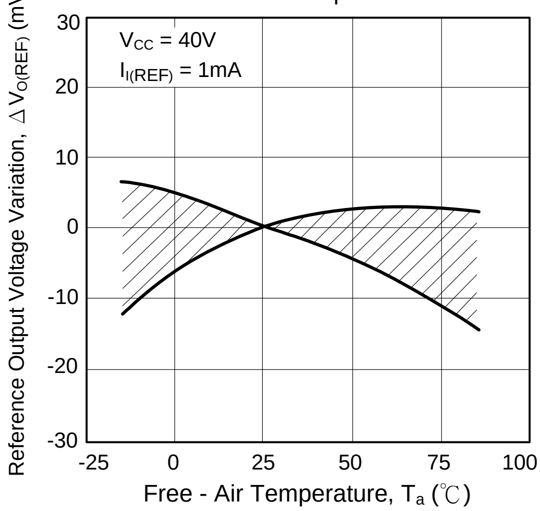
Triangle Waveform Period vs Timing Capacitance



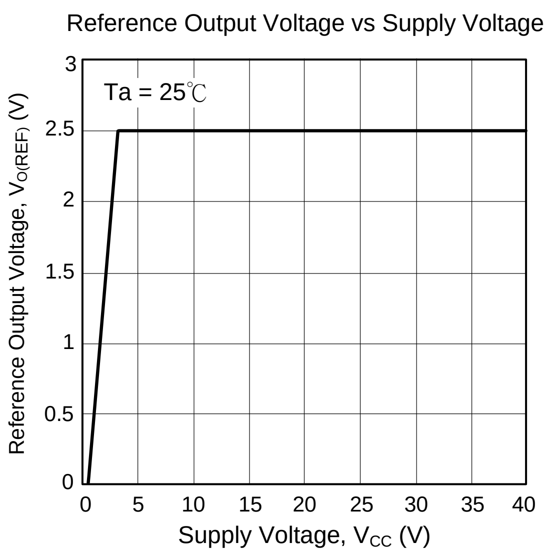
Reference Output Voltage Variation vs Free-Air Temperature

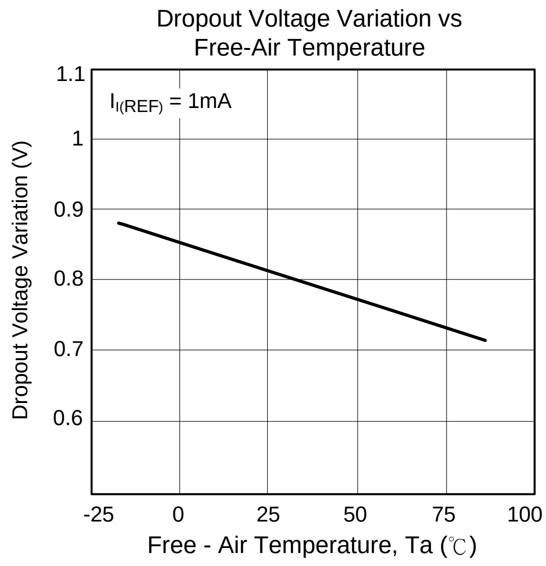


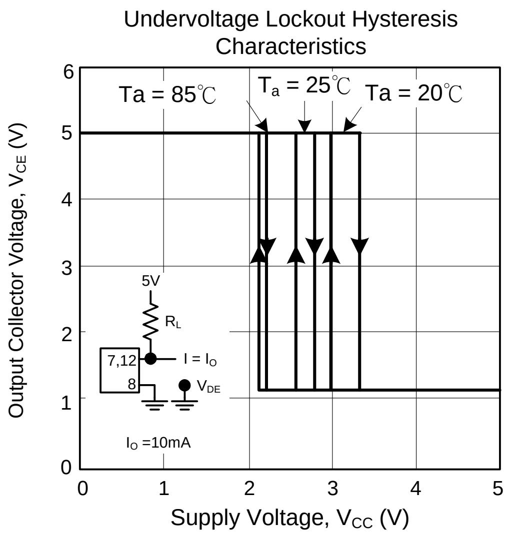
Reference Output Voltage Variation vs Free-Air Temperature

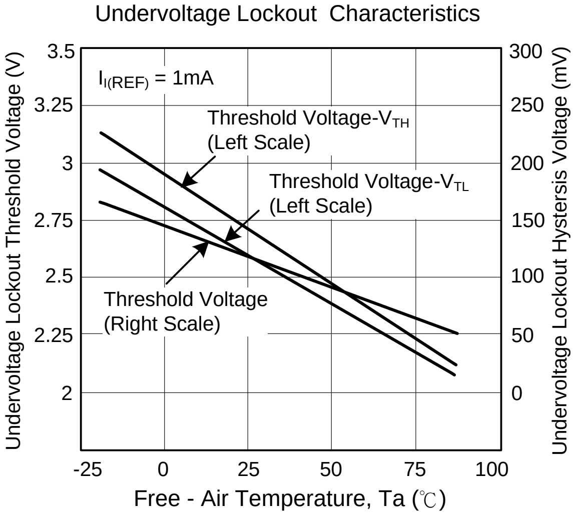


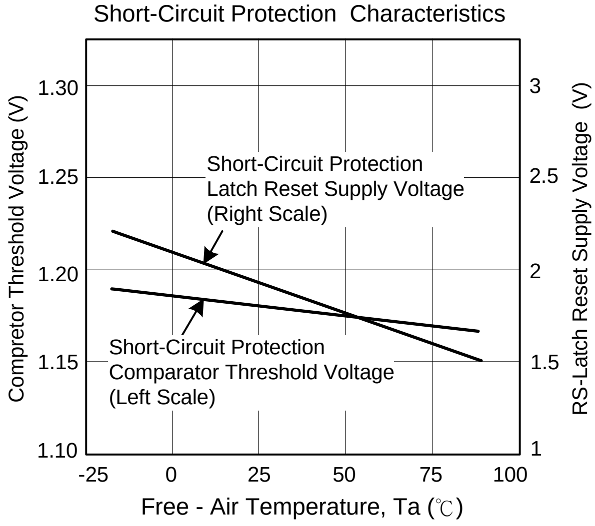
■ TYPICAL CHARACTERISTICS(Cont.)

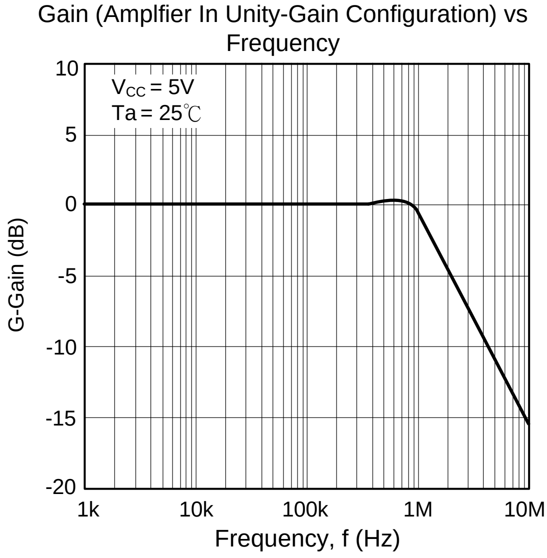






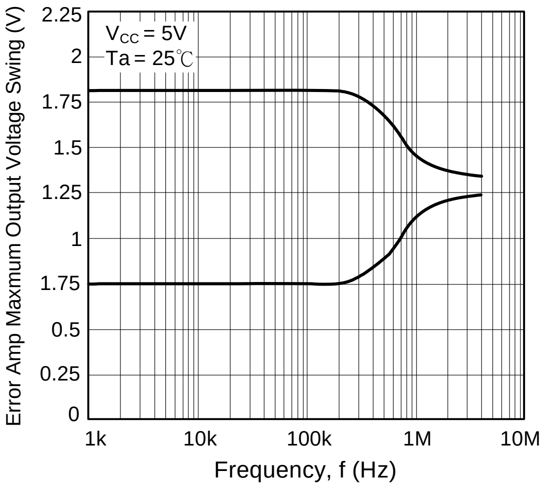




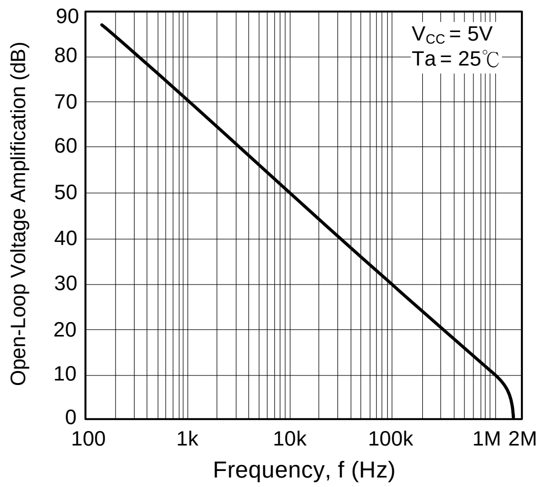


■ TYPICAL CHARACTERISTICS(Cont.)

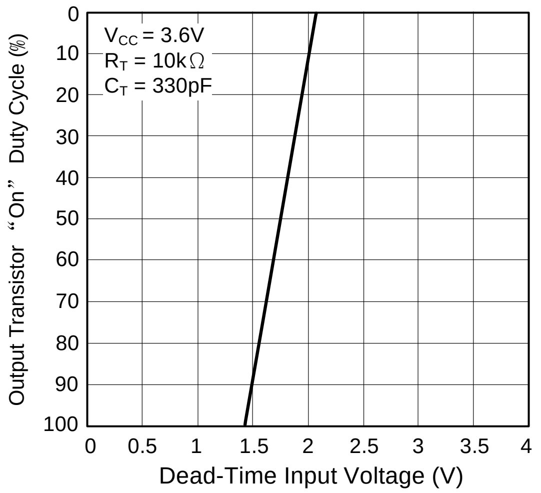
Error Amp Maximum Output Voltage Swing vs Frequency



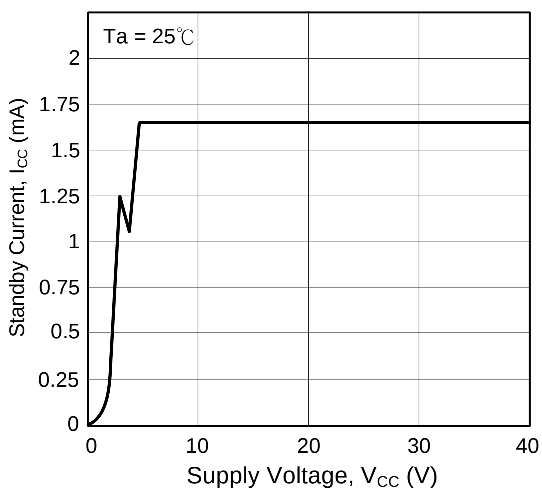
Open-Loop Voltage Amplification vs Frequency



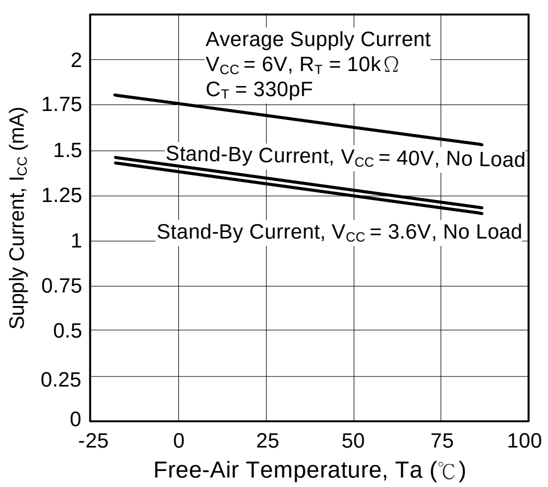
Output Transistor on Duty Cycle vs Dead-Time Input Voltage



Standby Current vs Supply Voltage



Standby Current vs Free-Air Temperature



Maximum Continuous Power Disspation vs Free-Air Temperature