AUK Semiconductor

S494

Pulse Width Modulation

Description

The S494 is a monolithic integrated circuit which includes all the necessary building blocks for the design of pulse width modulate(PWM) switching power supplies, including push-pull, bridge and series configuration. The device can operate at switching frequencies between 1KHz and 300KHz and output voltage up to 40V. The S494 is specified over an operating temperature range of -40℃to85℃.

Features

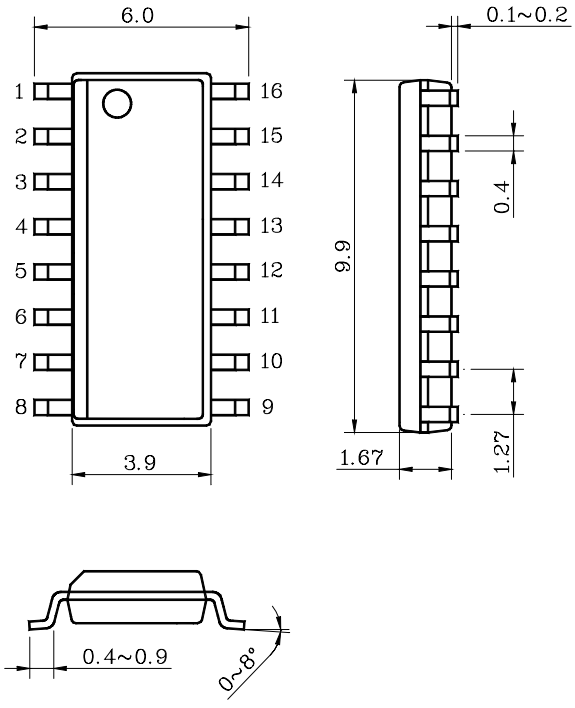
- Uncommitted output transistors capable of 200mA source or sink
- Internal protection from double pulsing of out-puts with narrow pulse widths or with supply voltages bellows specified limits
- Easily synchronized to other circuits
- Dead time control comparator
- Output control selects single-ended or push-pull operation

Ordering Information

Type NO.	Marking	Package Code
S494	S494	SOP-16

Outline Dimensions

unit : mm



PIN Connections

1. Non-INV Input
2. INV Input
3. Feed-Back
4. Dead-Time Control
5. C_T
6. R_T
7. GND
8. C1
9. E1
10. E2
11. C2
12. Vcc
13 Output Control
14. Ref Out
15. INV-Input
16. Non-INV Input

Absolute Maximum Ratings

Ta=25°C

Characteristic	Symbol	Ratings	Unit
supply voltage	V_{CC}	42	V
Voltage From Any Pin to Ground (except pin 8 and pin 11)	V_{IN}	V_{CC}+0.3	V
Output Collector Voltage	V_{C1}, V_{C2}	42	V
Peak Collector Current	I_{C1}, I_{C2}	250	mA
Power Dissipation	P_D	1500	mW
Operating Temperature	T_{opr}	-40 ~ 85	°C
Storage Temperature	T_{stg}	-65 ~ 150	°C

Recommended Operating Condition

Characteristic	Symbol	Min.	Max.	Unit
supply voltage	V_{CC}	7	40	V
Voltage on Any Pin Except Pin 8 and 11(Referenced to Ground)	V_{IN}	-0.3	V_{CC}+0.3	V
Output Voltage	V_{C1}, V_{C2}	-0.3	40	V
Output Collector Current	I_{C1}, I_{C2}	-	200	mA
Timing Capacitor	C_t	470	-	PF
Timing Capacitor	C_t	-	10	μF
Timing Resistor	R_t	1.8	500	kΩ
Oscillator Frequency	f_{OSC}	1	300	KHz

Electrical Characteristics

Reference Section

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Reference Voltage	Vref	Iref = 1.0mA	4.75	5.00	5.25	V
Line Regulation	V_{LINE}	7V < Vcc < 40V	-	2	25	mV
Load Regulation	V_{LOAD}	1mA< I_{REF} <10mA	-	1	15	mV
Temperature Coefficient	-	0°C < Ta <70°C	-	0.01	0.03	%/°C

Oscillator Section

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Oscillator Frequency	f_{OSC}	C_t=0.01 μF, R_t=12 kΩ	-	10	-	kHz
Oscillator Frequency Change Over Operating Temperature Range	Δf_{SOC}	C_t=0.01 μF, R_t=12 kΩ	-	-	2	%

Dead Time Control Section

Characteristic		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input Bias Current (Pin4)		$I_{IB(DT)}$	Vcc = 15V, 0V < V_4 < 5.25V	-	-2	-10	μA
Max. Duty cycle, Each Output		$DC_{(Max)}$	Vcc = 15V, Pin4 = 0V, Output Control Pin = Vref	43	-	45	%
Input Threshold Voltage	Zero Duty	V_{TH}	-	-	3	3.3	V
	Max Duty			0	-	-	

Error Amplifier Section

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input Offset Voltage	V_{IOS}	V_3 = 2.5V	-	2	10	mV
Input Offset Current	I_{IOS}	V_3 = 2.5V	-	25	250	nA
Input Bias Current	I_{IB}	V_3 = 2.5V	-	0.2	1	μA
Input Common Mode voltage Range	V_{ICR}	7V ≤ V_{CC} ≤ 40V	-0.3	-	V_{CC}	V
Large Signal Open Loop Voltage Range	G_{VO}	0.5V ≤ V_3 ≤ 3.5V	60	74	-	dB
Unity Gain Band width	f_C	-	-	650	-	kHz

PWM Comparator Section (Pin3)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Inhibit Threshold Voltage	V_{THI}	Zero duty cycle	-	4	4.5	V
Output Source Current	Io^+	0.5V < V_3 < 3.5V	2	-	-	mA
Output Sink Current	Io^-	0.5V< V_3 < 3.5V	-0.2	-0.6	-	mA

Output Section

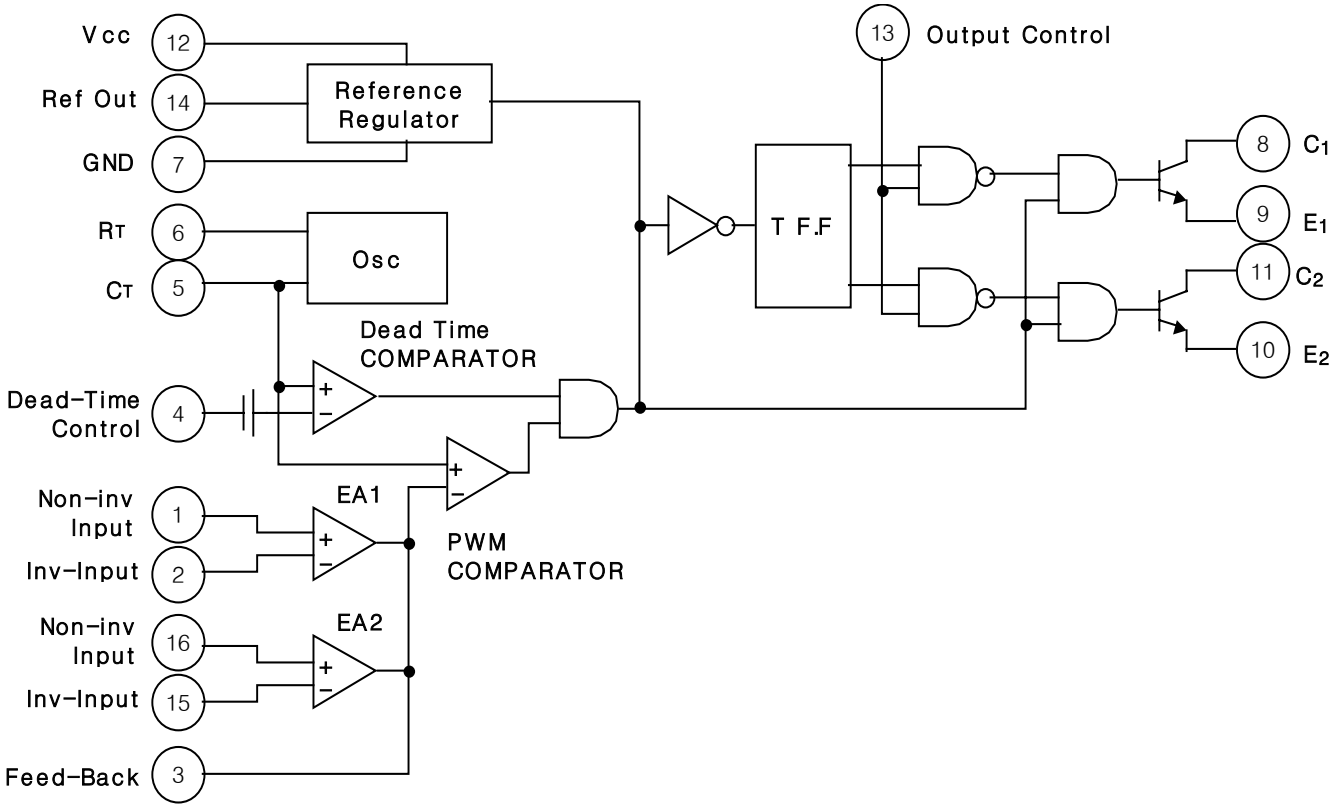
Characteristic		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Output Saturation Voltage	Common-Emitter	$V_{CE(SAT)}$	V_E= 15V, I_C = 200mA	-	1.1	1.3	V
	Emitter-Follower		V_C =15V, I_E = 200mA	-	1.5	2.5	
Collector off-state Current		$I_{C(off)}$	V_{CC} = V_C = 40V, V_E = 0	-	2	100	μA
Emitter off-state Current		$I_{E(off)}$	V_{CC} = V_C = 40V, V_E = 0	-	-	-100	
Output Control(Pin 13)							
Output Control Voltage Required for single-Ended or Parallel Output Operation		V_{OCL}	-	-	-	0.4	V
Output Control Voltage Required for Push-pull operation		V_{OCH}	-	2.4	-	-	V
Total Device							
Standby power Supply Current		I_{CC}	-	-	6	10	mA

: These limits apply when the voltage measured at Pin 3 is with in the range specified.

Output AC Characteristic

Characteristic		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Rise Time	Common Emitter	t_r	-	-	100	200	ns
	Emitter Follower			-	100	200	
Fall Time	Common Emitter	t_f	-	-	25	100	
	Emitter Follower			-	40	100	

Block Diagram



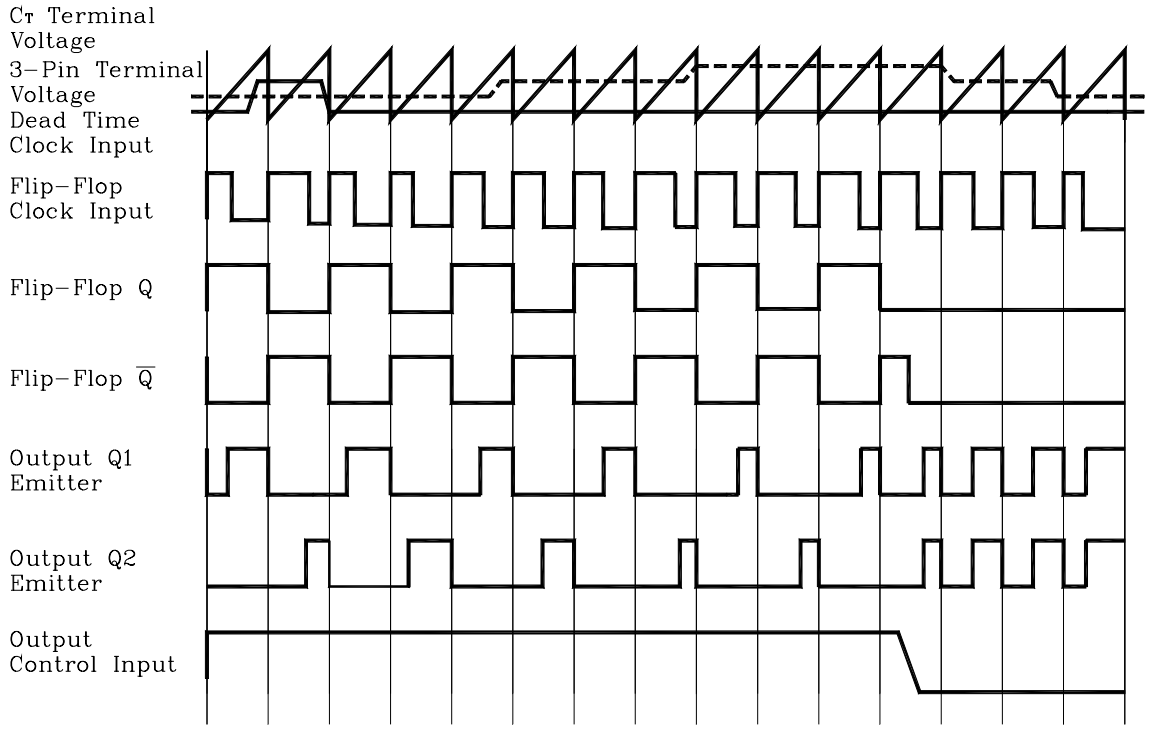
INFORMATION

The basic oscillator(switching)frequency is controlled by an external resistor (Rt) and capacitor(Ct). The relationship between the values of Rt Ct and frequency is shown in.

The level of the sawtooth wave form is compared with an error voltage by the pulse width modulated comparator. The output of the PWM Comparator directs the pulse steering flip flop and the output control logic.

The error voltage is generated by the error amplifier. The error amplifier boosts the voltage difference between the output and the 5V internal reference. See Figure7 for error amp sensing techniques. The second error amp is typically used to implement current limiting. The output control logic (Pin13) selects either push-pull or single-ended operation of the output transistors (see Figure6). The dead time control prevents on-state overlap of the output transistors as can be seen is Figure5. The dead time is approximately 3 to 5% of the total period if the dead time control(pin4) is grounded. This dead time can be increased by connecting the dead time control to a voltage up to 5 V. The frequency response of the error amps can be modified by using external resistors and capacitors. These components are typically connected between the compensation terminal (pin3) and the inverting input of the error amps(pin2 or pin15). The switching frequency of two or more S494 circuits can be synchronized. The timing capacitor, Ct is connected as shown in Figure8. Charging current is provided by the master circuit. Discharging is through all the circuits slaved to the master. Rt is required only for the master circuit.

Operating Waveform



Test Circuit

Fig.1Error Amplifier Test Circuit

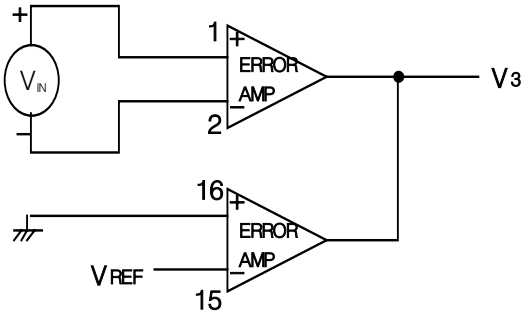


Fig.2 Current Limit sense Amplifier Test Circuit

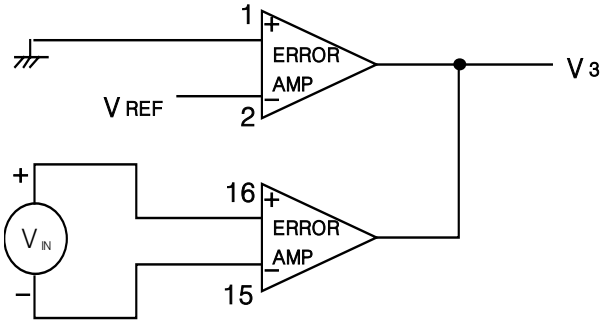


Fig. 3 Common-Emitter Configuration Test circuit and Waveform

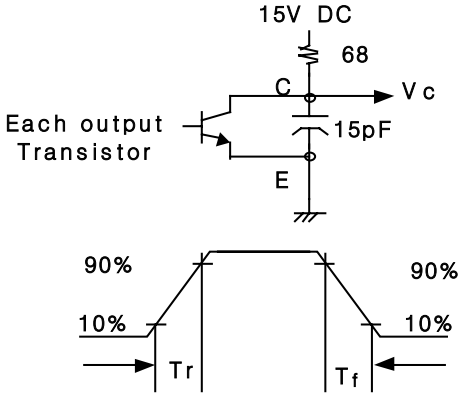


Fig. 5 Dead-Time and Feedback Control Test Circuit

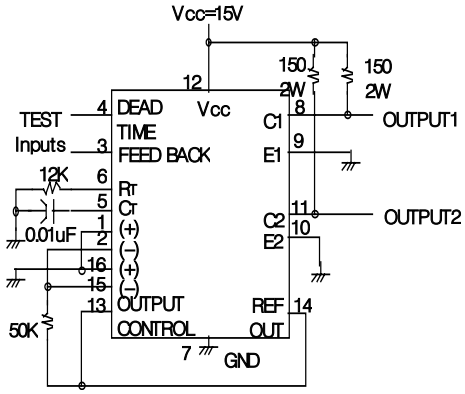
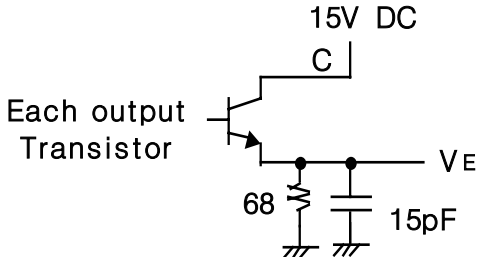
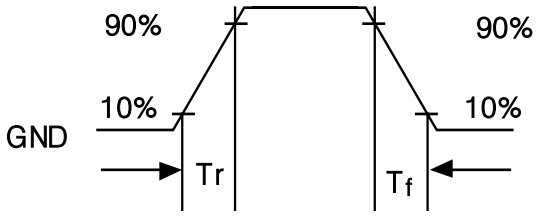


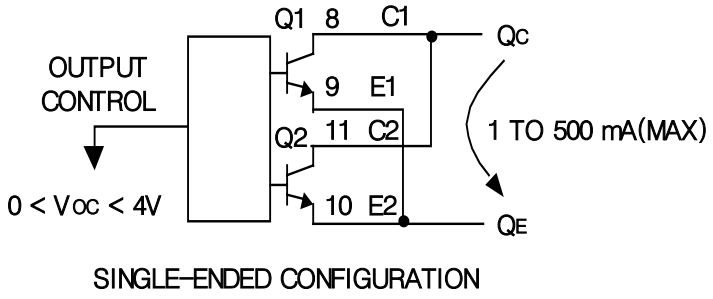
Fig. 4 Emitter-Follower Configuration Test circuit and waveform Voltage waveform





APPLICATION CIRCUIT

Fig. 6 Output Connections for Single-Ended and Push-Pull Configurations



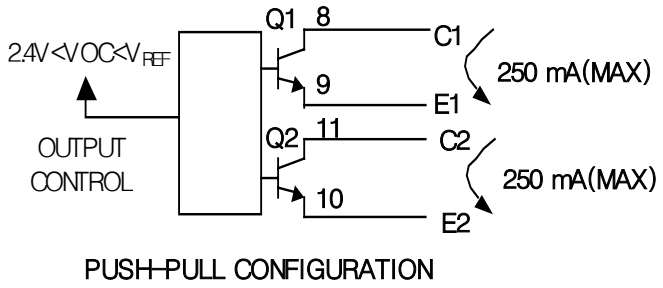
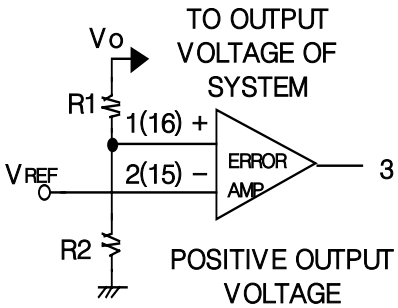


Fig. 7 Error Amplifier Sensing Techniques



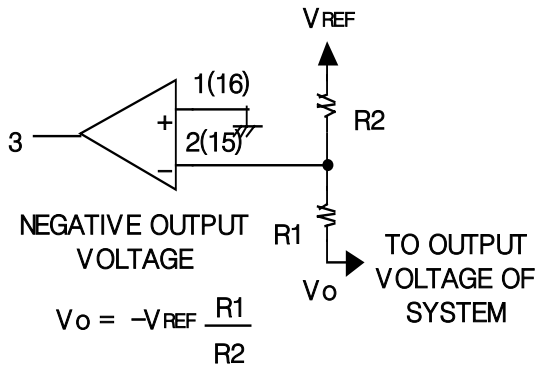


Fig. 8 Slaving Tow or More Control Circuits

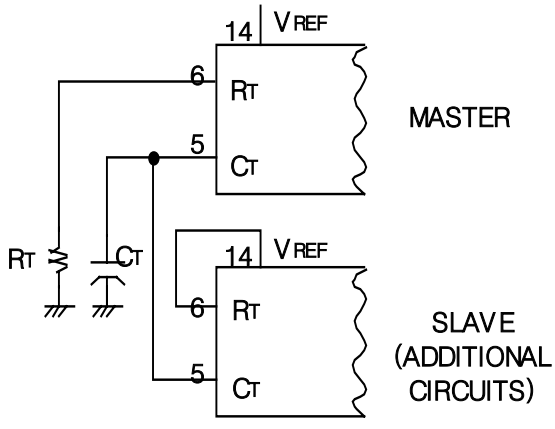
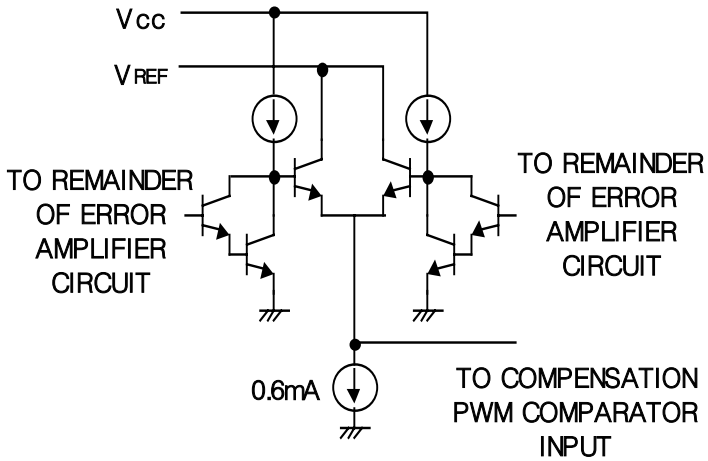


Fig. 9Error Amplifier and Current Limit Sense Amplifier Output Circuits



Electrical Characteristic Curves

Fig. 1 $V_{CE(sat)}$ -I_C

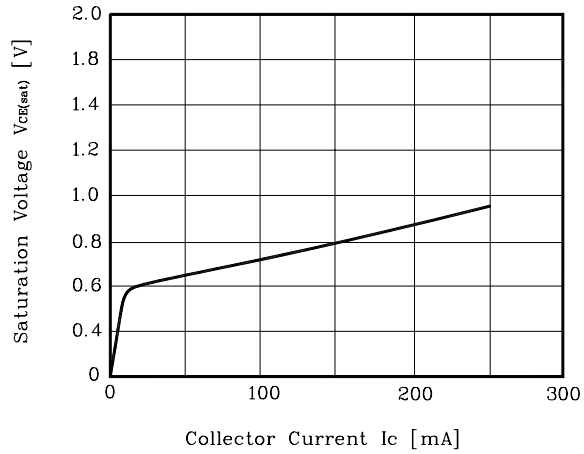


Fig. 2 V_{CE} -I_E

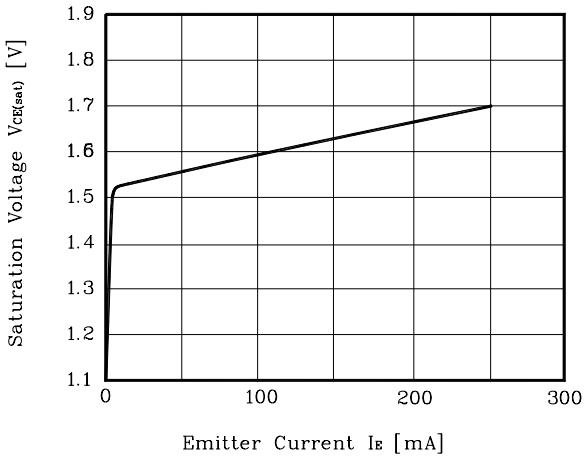


Fig. 3 t_{OSC} - R_T

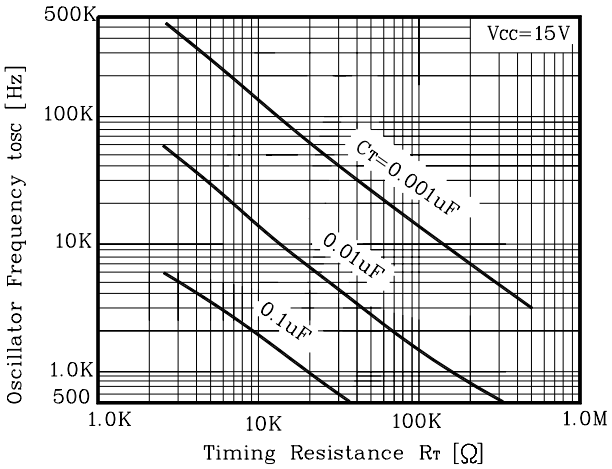


Fig. 4 A_{VOL} , Phase - f

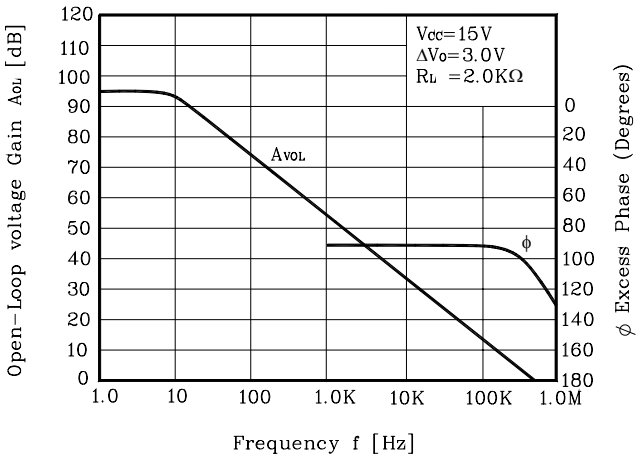


Fig. 5 I_{CC} - V_{CC}