632-387

GL494
PWM CONTROL CIRCUIT

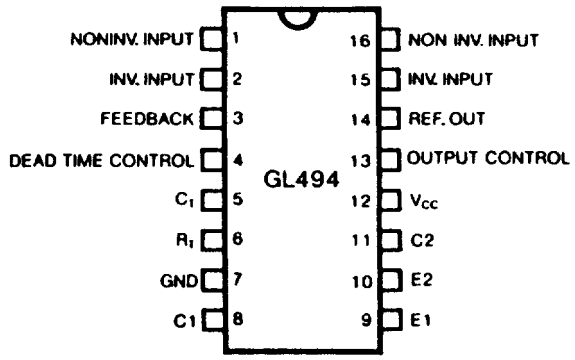
Description

The GL494 incorporates on a single monolithic chip all the functions required in the construction of a pulse-width-modulation control circuit. Designed primarily for power supply control, the GL494 contains an on-chip 5-volt regulator, two error amplifiers, adjustable oscillator, dead-time control comparator, pulse-steering flip-flop, and output-control circuitry. The uncommitted output transistors provide either common-emitter or emitter-follower output capability. Push-pull or single-ended output operation may be selected through the output-control function. The architecture of the GL494 prohibits the possibility of either output being pulsed twice during push-pull operation.

Features

- **Complete PWM Power Control Circuitry**
- **Uncommitted Outputs for 200 mA Sink or Source**
- **Output Control Selects Single-Ended or Push-Pull Operation**
- **Internal Circuitry Prohibits Double Pulse at Either Output**
- **Internal Regulator Provides a Stable 5V Reference Supply**
- **Variable Dead-Time Provides Control Over Total Range**

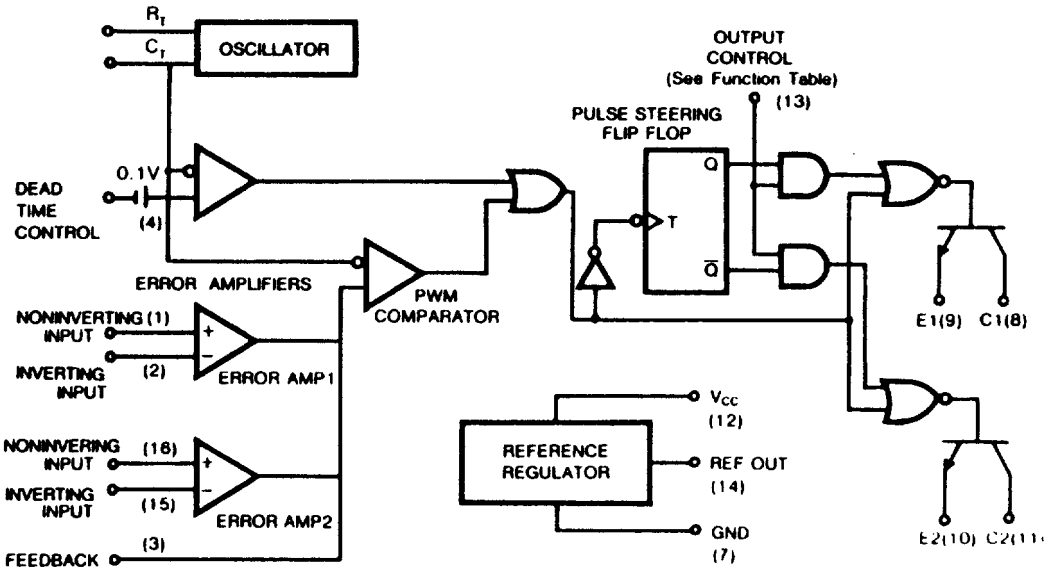
Pin Configuration



Function Table

Output Control	Output Function
Grounded	Single-ended or Parallel Output
At V_{ref}	Normal Push-Pull Operation

Block Diagram



Absolute Maximum Ratings

Supply Voltage, V_{CC} ..... 41 V
Amplifier Input Voltage ..... V_{CC}+0.3 V
Collector Output Voltge ..... 41 V
Continuous Total dissipation at (or below) 25°C ..... 1000 mW
Operating Free-Air Temperature Range ..... −20 to 85 °C
Storage Temperature Range ..... −65 to 150 °C
Collector Output Current ..... 250 mA

Recommended Operation Conditions

PARAMETER	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 Feed back Terminal		0.3	mA
Timing Capacitor, C_T	0.47	10,000	nF
Timing Resistor, R_T	1.8	500	KΩ
Oscillator Frequency	1	300	KHz
Operating Free-Air Temperature	−20	85	°C

Electrical Characteristics (Temperature −20~85°C, V_{CC}=15V, f=10KHz)

Reference Section

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Output voltage (V_{ref})	I_O=1 mA	4.75	5	5.25	V
Input regulation	V_{CC}=7V to 40V, T_A=25°C		2	25	mV
Output regulation	I_O=1 to 10mA, T_A=25°C		1	15	mV
Output Voltage change with temperature	T_A=−20°C to 85°C		0.2	1	%
Short-circuit output current(2)	V_{ref}=0		35		mA

Oscillator Section

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Frequency	C_T=0.01μF R_T=12kΩ		10		KHz
Standard deviation of frequency (3)	All values of V_{CC}, C_T, R_T, T_A Constant		10		%
Frequency change with voltage	V_{CC}=7V to 40V, T_A=25°C		0.1		%
Frequency change with temperature	C_T=0.01μF, R_T=12kΩ T_A=−20°C to 85°C			2	%

Dead Time Control Section

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Input bias current (pin 4)	V_I=0 to 5.25V		−2	−10	μA
Maximum duty cycle, each output	$V_{I(pin\ 4)}$=0V	45			%
Input threshold voltage (pin 4)	Zero duty cycle		3	3.3	V
	Maximum duty cycle	0			V

Error Amp Sections

PARAMETER	TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
Input offset voltage	$V_{O(PIN3)}$=2.5V			2	10	mV
Input offset current	$V_{O(PIN3)}$=2.5V			25	250	nA
Input bias current	$V_{O(PIN3)}$=2.5V			0.2	1	μA
Common-mode input voltage range	V_{CC}=7V to 40V	LOW	−0.3			V
		HIGH	V_{CC}−2			
Open-loop voltage amplification	ΔV_O=3V, V_O=0.5 to 3.5V		70	95		dB
Unity-gain bandwidth				800		KHz
Common-mode rejection ratio	V_{CC}=40V, T_A=25°C		65	80		dB
Output sink current (pin 3)	V_{ID}=−15mV to −5V, $V_{O(pin\ 3)}$=0.7V		0.3	0.7		mA
Output source current (pin 3)	V_{ID}=15mV to 5V, $V_{O(pin\ 3)}$=3.5V		−2			mA

PWM Comparator Section

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Input threshold voltage (pin 3)	Zero duty cycle		4	4.5	V
Input sink current (pin 3)	$V_{O(PIN3)}$=0.7V	0.3	0.7		mA

Switching Characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Output voltage rise time	Common-emitter configuration, See Test Circuit 3		100	200	ns
Output voltage fall time			25	100	ns
Output voltage rise time	Emitter-follower configuration, See Test Circuit 4		100	200	ns
Output voltage fall time			40	100	ns

Output Section

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Collector off-state curent		V_{CE}=40V, V_{CC}=40V		2	100	μA
Emitter off-state current		V_{CC}=V_C=40V, V_E=0			−100	μA
Collector-emitter saturation voltage	Common-emitter	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

Total Device

PARAMETER	TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
Standby supply current	All other inputs & outputs open	V_{CC}=15V		6	10	mA
		V_{CC}=40V		9	15	mA
Average supply current	$V_{(pin\ 4)}$=2V, See Test Circuit 1			7.5		mA

Notes:

(1) All typical values except for temperature coefficients are at T_A=25°

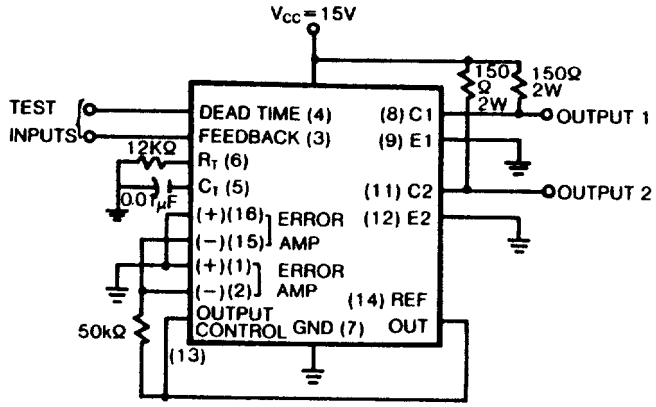
(2) Duration of the short circuit should not exceed one second.

(3) Standard deviation is a measure of the statistical distribution about the mean as derived from the formula

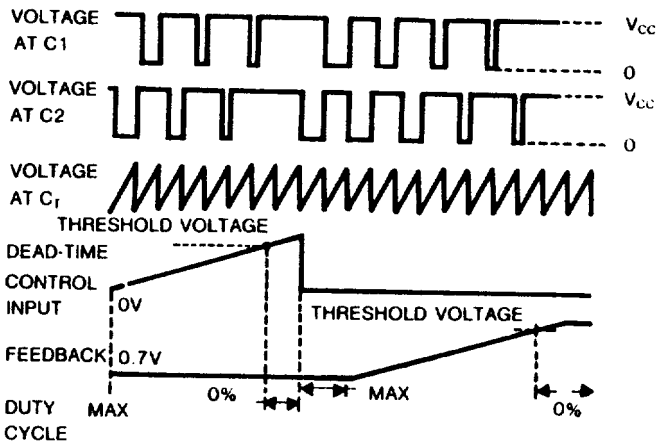
$$\sigma = \sqrt{\frac{\sum_{n=1}^{N} (X_n - \bar{X})^2}{N-1}}$$

Parameter Measurement Information

1. Dead time and Feedback Control

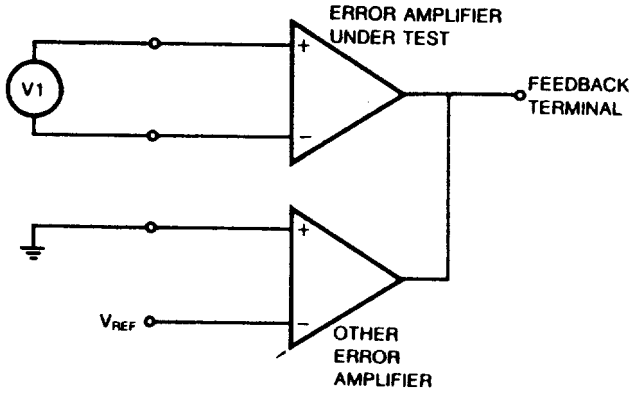


TEST CIRCUIT

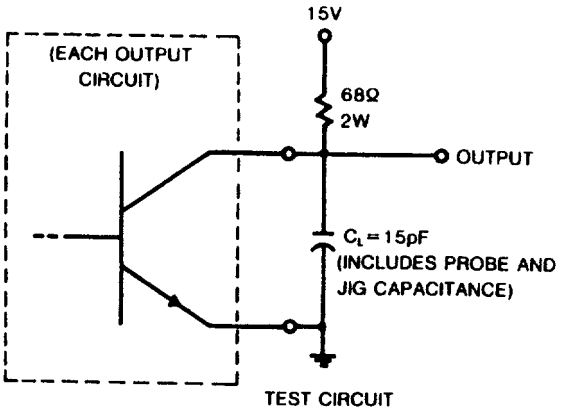


VOLTAGE WAVEFORMS

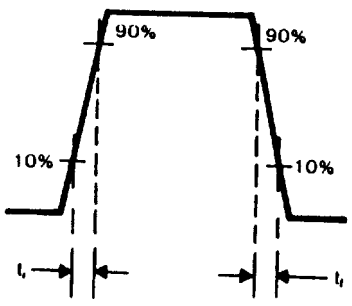
2. Error Amplifier Characteristics



3. Common-Emitter Configuration

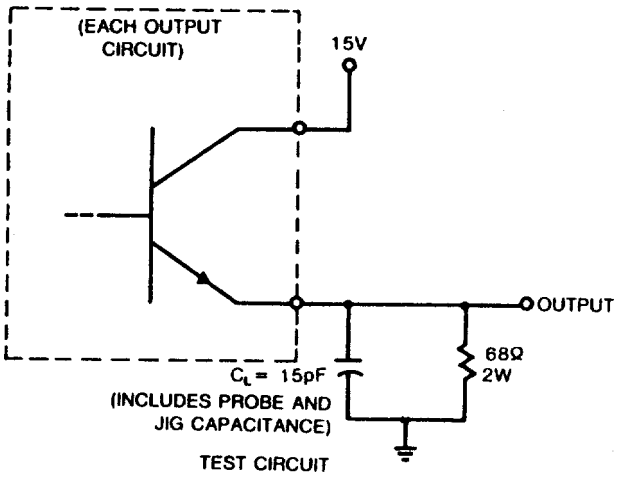


TEST CIRCUIT

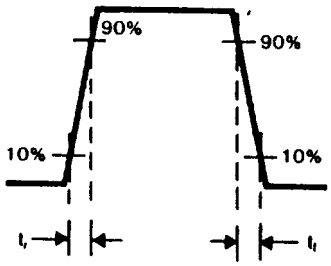


OUTPUT VOLTAGE WAVEFORM

4. Emittre-Follower Configuration



TEST CIRCUIT



OUTPUT VOLTAGE WAVEFORM

Typical Performance Curves

FIGURE 1 - OSCILLATOR FREQUENCY versus TIMING RESISTANCE

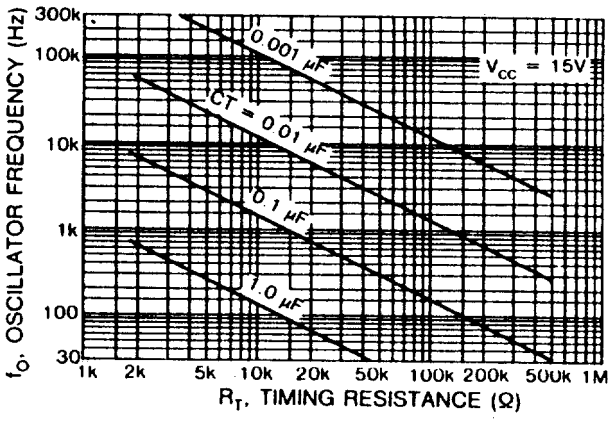


FIGURE 2 - OPEN LOOP VOLTAGE GAIN AND PHASE versus FREQUENCY

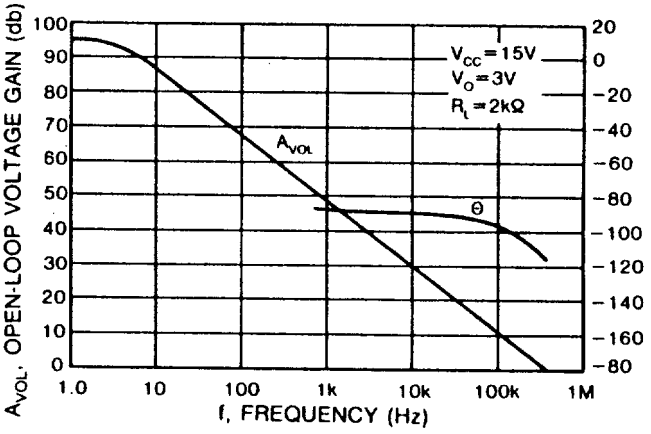


FIGURE 3 - PERCENT DEAD TIME versus OSCILLATOR FREQUENCY

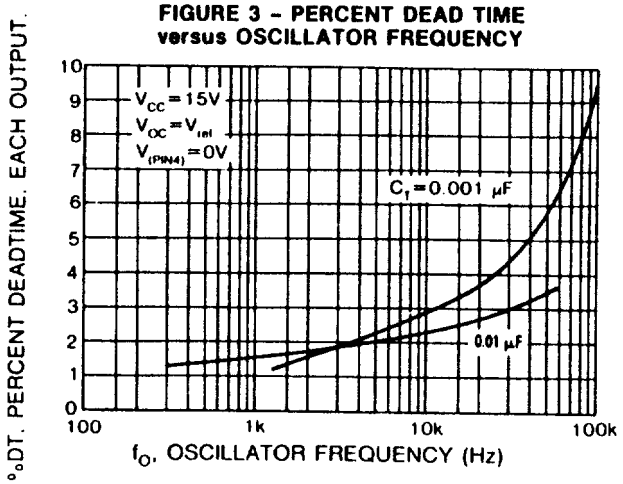


FIGURE 4 - PERCENT DUTY CYCLE versus DEAD-TIME CONTROL VOLTAGE

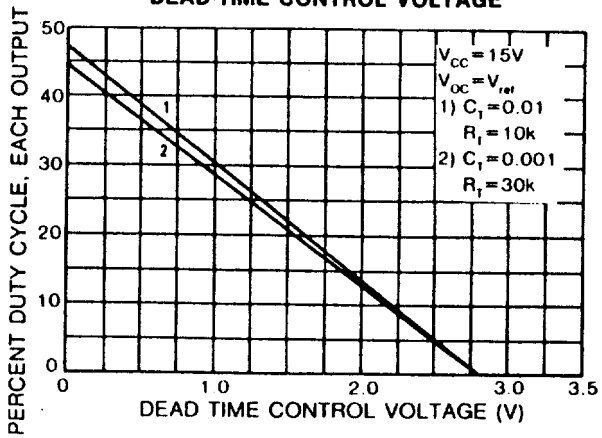


FIGURE 5 – EMITTER-FOLLOWER CONFIGURATION, OUTPUT-SATURATION VOLTAGE versus EMITTER CURRENT

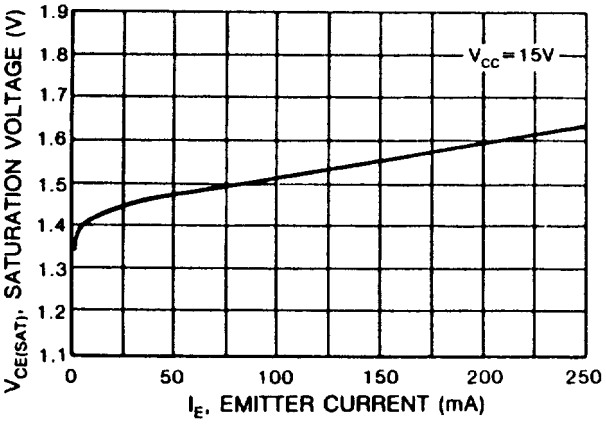


FIGURE 6 – COMMON-EMITTER CONFIGURATION OUTPUT-SATURATION VOLTAGE versus COLLECTOR CURRENT

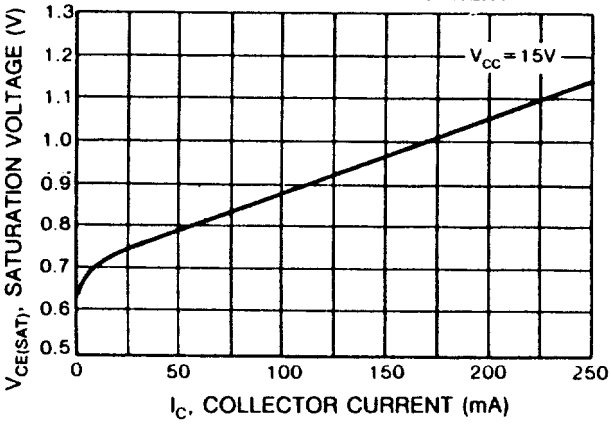


FIGURE 7 – STANDBY-SUPPLY CURRENT versus SUPPLY VOLTAGE