GL494

PWM CONTROL CIRCUIT

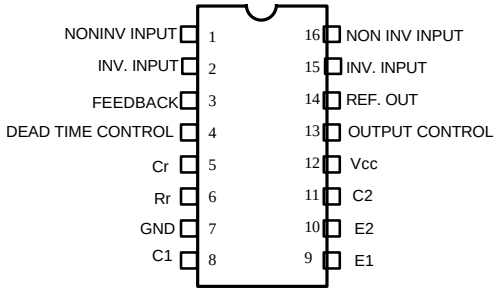
Description

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 pro-vide either common-emitter or emitter-follower output capability. Push-pull or single-ended output operation may be selected through the output-control function. The ar-chitecture 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 200mA 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

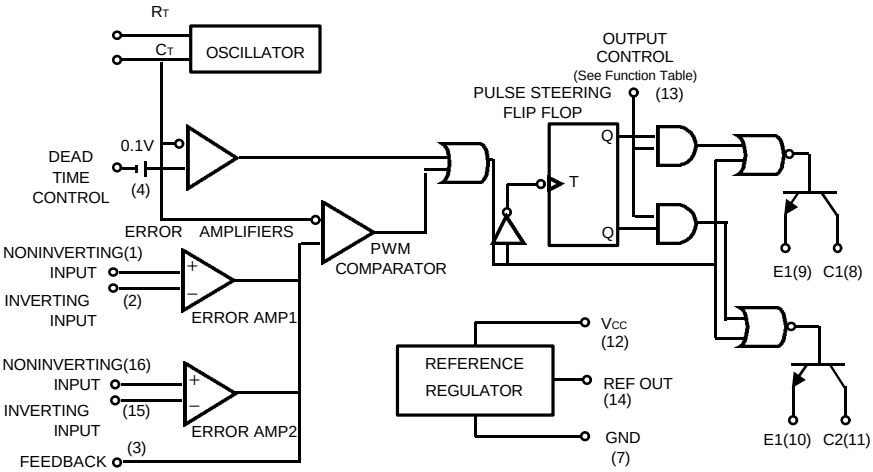
Pin Configuration



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 Voltage …… 41 V
Continuous Total dissipation at (or below) 25℃ ……. 1000 mW
Operating Free-Air Temperature Range …… -20 to 85 ℃
Storage Temperature Range ……..… -65 to 150 ℃
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, Vo		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	℃

Electrical Characteristics (Temperature $-20 \sim 85℃$, V_{CC} =15V, f=10KHz)

Reference Section

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Output voltage (V_{ref})	I_O = 1mA	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	$V_{I(pin4)}$ =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 to3. 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, $V_{O(pin3)}$ = 0.7V		0.3	0.7		mA
Output source current (pin 3)	V_{ID} = 15mV to 5V, $V_{O(pin3)}$ = 3.5V		-2			mA

PWM Comparaor 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 current		$V_{CE} = 40V, V_{CC} = 40V$		2	100	mA
Emitter off-state current		$V_{CC} = V_C = 40V, V_E = 0$			-100	mA
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	$V_{(pin4)} = 2V$ See Test circuit 1			7.5		mA

Notes:

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

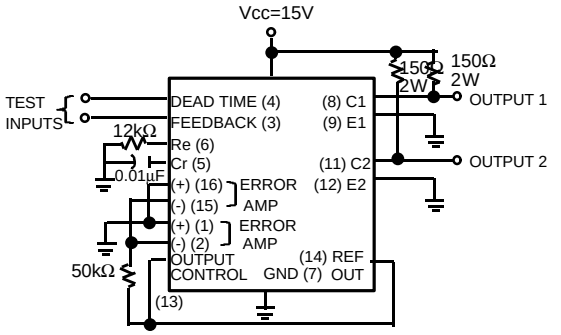
(2) Duration of the short circuit should not exceed one second.

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

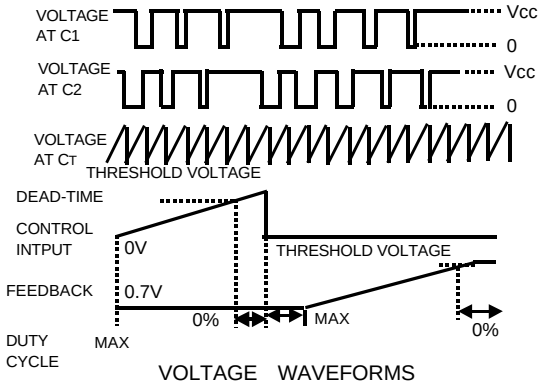
$$\sigma = \sqrt{\frac{\sum_{n=1}^{N} (X_n - \overline{X})^2}{N-1}}$$

Parameter Measurement Information

1.Dead time and Feedback Control

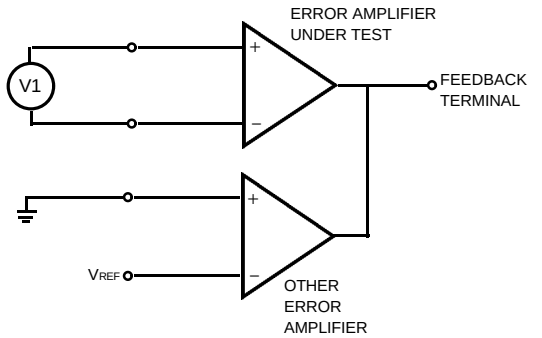


TEST CIRCUIT

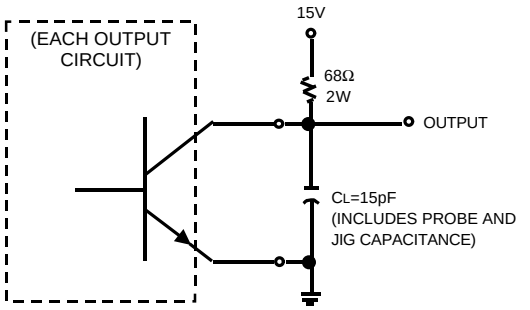


VOLTAGE WAVEFORMS

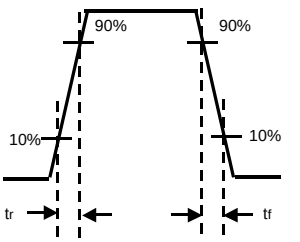
2. Error Amplifier Characteristics



3. Common-Emitter Configuration

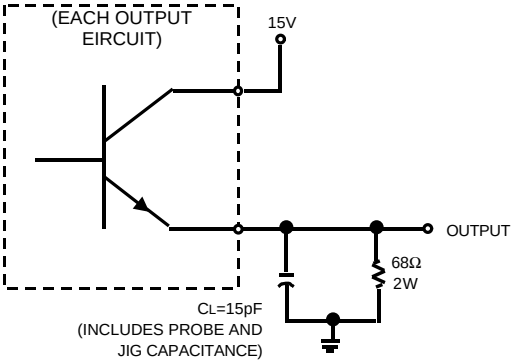


TEST CIRCUIT

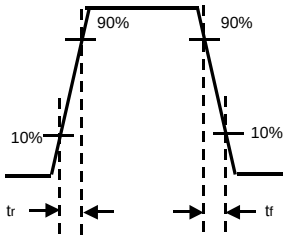


OUTPUT VOLTAGE WAVEFORM

4. Emitter-Follower Configuration



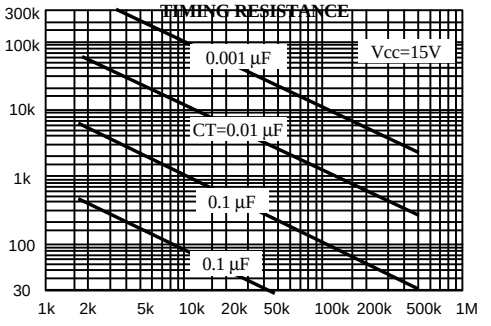
TEST CIRCUIT



OUTPUT VOLTAGE WAVEFORM

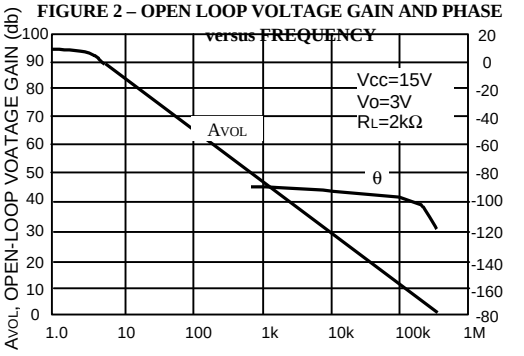
Typical Performance Curves

FIGURE 1 – OSCILLATOR FREQUENCY versus TIMING RESISTANCE



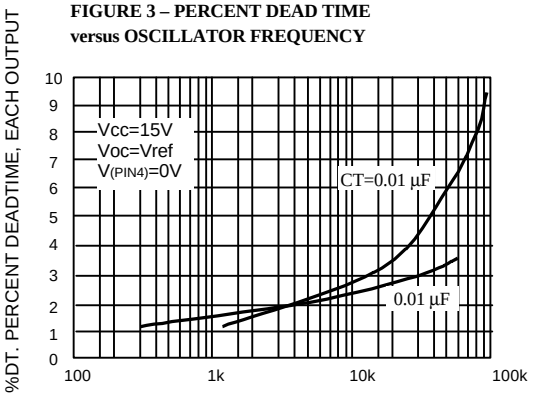
RT, TIMING RESISTANCE (Ω)

FIGURE 2 – OPEN LOOP VOLTAGE GAIN AND PHASE versus FREQUENCY



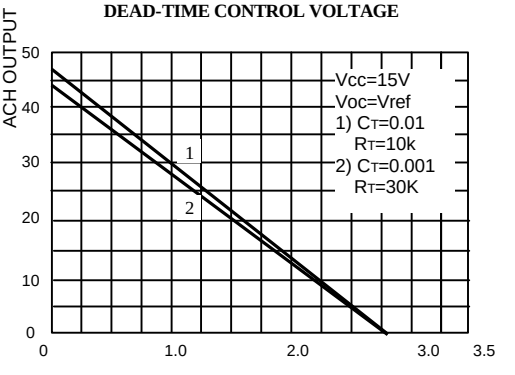
f, FREQUENCY (Hz)

FIGURE 3 – PERCENT DEAD TIME versus OSCILLATOR FREQUENCY



fo, OSCILLATOR FREQUENCY (Hz)

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



DEAD TIME CONTROL VOLTAGE (V)

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

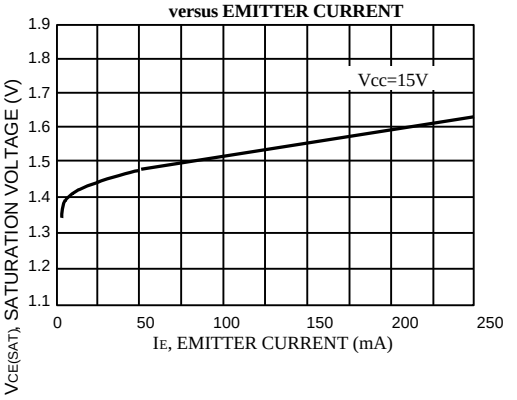
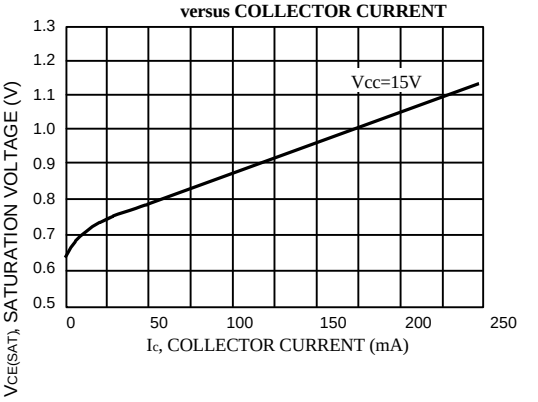


FIGURE 6 – COMMON-EMITTER CONFIGURATION OUTPUT-SATURATION VOLTAGE versus COLLECTOR CURRENT



FUGURE 7 – STANDBY-SUPPLY CURRENT versus SUPPLY VOLTAGE