INTEGRATED CIRCUITS
UNITRODE

UC494A/AC
UC495A/AC

Advanced Regulating Pulse Width Modulators

FEATURES

- Dual Uncommitted 40V, 200mA Output Transistors
- 1% Accurate 5V Reference
- Dual Error Amplifiers
- Wide Range, Variable Deadtime
- Single-ended or Push-pull Operation
- Under-voltage Lockout With Hysteresis
- Double Pulse Protection
- Master or Slave Oscillator Operation
- UC495A: Internal 39V Zener Diode
- UC495A: Buffered Steering Control

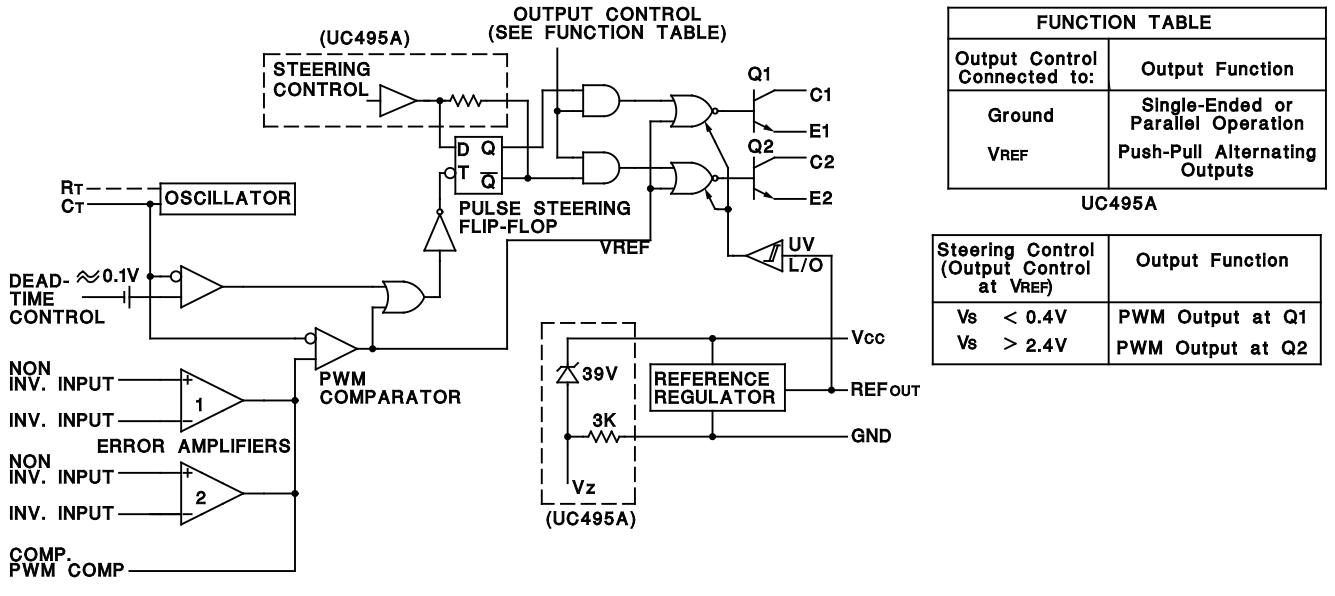
DESCRIPTION

This entire series of PWM modulators each provide a complete pulse width modulation system in a single monolithic integrated circuit. These devices include a 5V reference accurate to ±1%, two independent amplifiers usable for both voltage and current sensing, an externally synchronizable oscillator with its linear ramp generator, and two uncommitted transistor output switches. These two outputs may be operated either in parallel for single-ended operation or alternating for push-pull applications with an externally controlled dead-band. These units are internally protected against double-pulsing of a single output or from extraneous output signals when the input supply voltage is below minimum.

The UC495A contains an on-chip 39V zener diode for high-voltage applications where V_{CC} would be greater than 40V, and a buffered output steering control that overrides the internal control of the pulse steering flip-flop.

The UC494A is packaged in a 16-pin DIP, while the UC495A is packaged in an 18 pin DIP. The UC494A, UC495A are specified for operation over the full military temperature range of -55°C to +125°C, while the UC494AC, UC495AC are designed for industrial applications from 0°C to +70°C.

BLOCK DIAGRAM



FUNCTION TABLE	
Output Control Connected to:	Output Function
Ground	Single-Ended or Parallel Operation
V_{REF}	Push-Pull Alternating Outputs

UC495A

Steering Control (Output Control at V_{REF})	Output Function
V_S < 0.4V	PWM Output at Q1
V_S > 2.4V	PWM Output at Q2

ABSOLUTE MAXIMUM RATINGS (Note 1, 2, 3)

Supply Voltage, V_{CC} (Note 2) 45V
Amplifier Input Voltages . . . . . V_{CC} + 0.3V
Collector Output Voltage 41V
Collector Output Current 250mA
Continuous Total Dissipation 1000mW
@ (or below) 25°C free air temperature range (Note 3)
Storage Temperature Range . . . . . -65° to +150°C
Lead Temperature 1/16" (1.6mm) from case for 60 seconds,
J Package . . . . . 300°C
Lead Temperature 1/16" (1.6mm) from case for 10 seconds,
N Package . . . . . 260°C

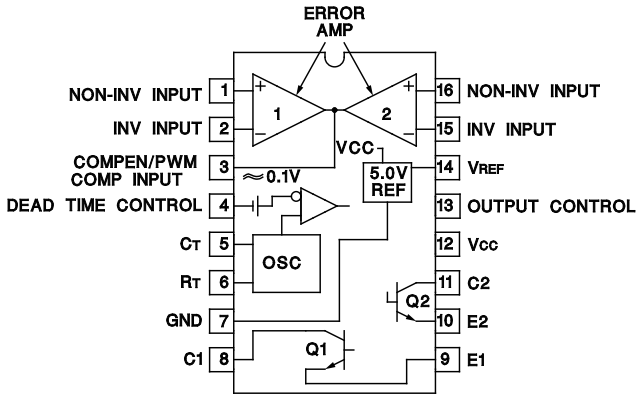
Note 1: Over operating free air temperature range unless otherwise noted.
Note 2: All voltage values are with respect to network ground terminal 3.
Note 3: Consult Packaging Section of Databook regarding thermal specifications and limitations of packages.

RECOMMENDED OPERATING CONDITIONS

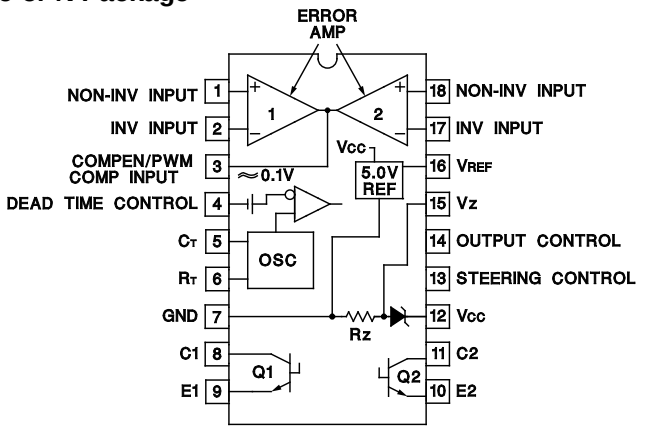
Supply Voltage V_{CC} . . . . . 7V to 40V
Error Amplifier Input Voltages . . . . . -0.3V to V_{CC}-2V
Collector Output Voltage 40V
Collector Output Current (each transistor) 200mA
Current into Feedback Terminal 0.3mA
Timing Capacitor, C_T . . . . . 0.47nF to 10,000nF
Timing Resistor, R_T . . . . . 1.8kΩ to 500kΩ
Oscillator Frequency . . . . . 1kHz to 300kHz
Operating Free Air Temperature
UC494A, UC495A . . . . . -55°C to +125°C
UC494AC, UC495AC . . . . . 0°C to +70°C

CONNECTION DIAGRAMS

DIL-18 (TOP VIEW) **UC494A/AC**
J or N Package



DIL-18 (TOP VIEW) **UC495A/AC**
J or N Package



ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, over recommended operating free-air temperature range, V_{CC} = 15V, f = 10kHz, T_A = T_J.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reference Section					
Output Voltage V_{REF}	I_O = 1mA, T_A = 25°C	4.95	5	5.05	V
Input Regulation	V_{CC} = 7V to 40V		2	25	mV
Output Regulation	I_O = 1mA to 10mA		1	15	mV
Output Voltage Over Temperature	ΔT_A = Min. to Max.	4.90		5.10	V
Short Circuit Output Current	V_{REF} = 0, T_A = 25°C (Note 1)	10	35	50	mA
Oscillator Section					
Frequency (Note 2)	C_T = 0.01µF, R_T = 12kΩ		10		kHz
Standard Deviation Of Frequency (Note 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, ΔT_A = Min. to Max.			2	%
Deadtime Control Section (Output Control Connected to V_{REF})					
Input Bias Current (Pin 4)	$V_{(PIN\ 4)}$ = 0V to 5.25V		-2	-10	µA
Maximum Duty-Cycle (Each Output)	$V_{(PIN\ 4)}$ = 0V	45			%

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, over recommended operating free-air temperature range, V_{CC} = 15V, f = 10kHz, $T_A = T_J$.

PARAMETER		TEST CONDITION		MIN	TYP	MAX	UNITS
Deadtime Control Section (cont.) (Output Control Connected to V_{REF})							
Input Threshold Voltage (Pin 4)		Zero Duty-Cycle			3	3.3	V
		Maximum Duty-Cycle		0			V
Amplifier Section							
Input Offset Voltage		$V_{O\ (PIN\ 3)}$ = 2.5V			2	10	mV
Input Offset Current		$V_{O\ (PIN\ 3)}$ =2.5V			25	250	nA
Input Bias Current		$V_{O\ (PIN\ 3)}$ = 2.5V			-0.2	-1	µA
Common-Mode Input Voltage Range		V_{CC} = 7V to 40V		.03 to V_{CC} -2			V
Open Loop Voltage Gain		ΔV_O = 3V, V_O = 0.5V to 3.5 V		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, $V_{(PIN\ 3)}$ = 0.7V		0.3	0.7		mA
Output Source Current (Pin 3)		V_{ID} = 15mV to 5V, $V_{(PIN\ 3)}$ = 3.5V		-2			mA
Output Section							
Collector Off-State Current		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	V
Output Control Input Current		V_I = V_{REF}				3.5	mA
PWM Comparator Section							
Input Threshold Voltage (Pin 3)		Zero Duty-Cycle			4	4.5	V
Input Sink Current (Pin 3)		$V_{(PIN\ 3)}$ = 0.7V		0.3	0.7		mA
Steering Control (UC495A, See Function Table)							
Input Current		$V_{(PIN\ 13)}$ = 0.4V, Q_1 ACTIVE				-200	µA
		$V_{(PIN\ 13)}$ = 2.4V, Q_2 ACTIVE				300	µA
Deadband					500		mV
Zener Diode Circuit (UC495A)							
Breakdown Voltage		V_{CC} = 45V, I_Z = 2mA		36	39	45	V
Sink Current		$V_{(PIN\ 15)}$ = 1V		0.2	0.3	0.6	mA
Total Device							
Standby Supply Current		Pin 6 at V_{REF}, All other inputs and outputs open	V_{CC} = 15V		6	10	mA
			V_{CC} = 40V		9	15	mA
Under Voltage Lockout				3.5		6.5	V
Hysteresis					300		mV
Switching Characteristics (T_A = 25°C)							
Output Voltage Rise Time		Common-Emitter Configuration			100	200	ns
Output Voltage Fall Time		R_L = 68Ω, C_L = 15pF			25	100	ns
Output Voltage Rise Time		Emitter-Follower Configuration			100	200	ns
Output Voltage Fall Time		R_L = 68Ω, C_L=15pF			40	100	ns

Note 1: Duration of the short circuit should not exceed one second.

Note 2: Frequency for other values of C_T and R_T is approximately $f = \frac{1.1}{R_T C_T}$

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

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

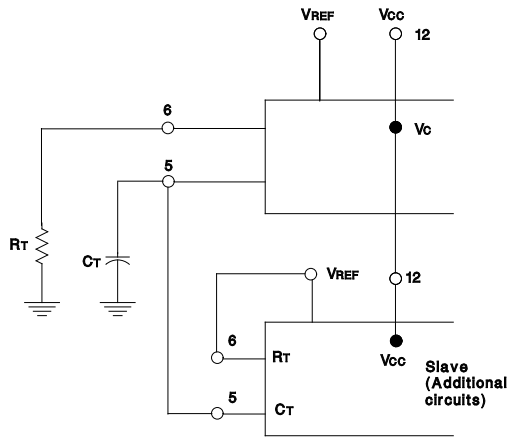


Figure 1. Slaving Two or More Control Circuits

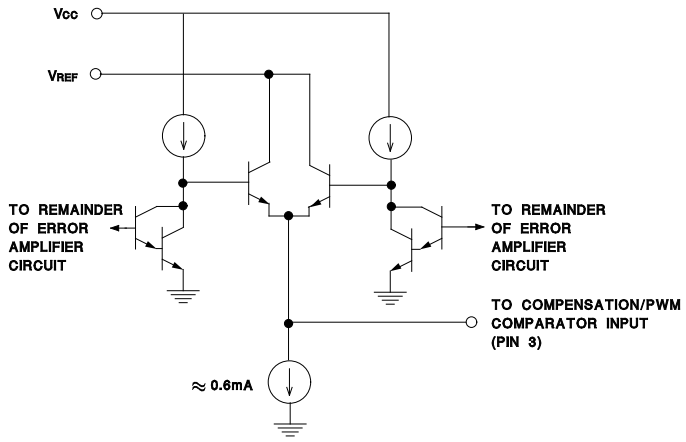
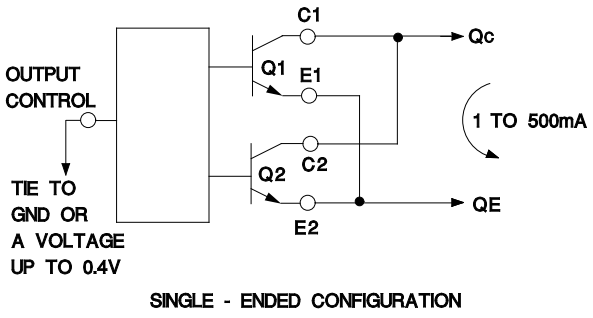


Figure 2. Output Circuit of Error Amplifiers



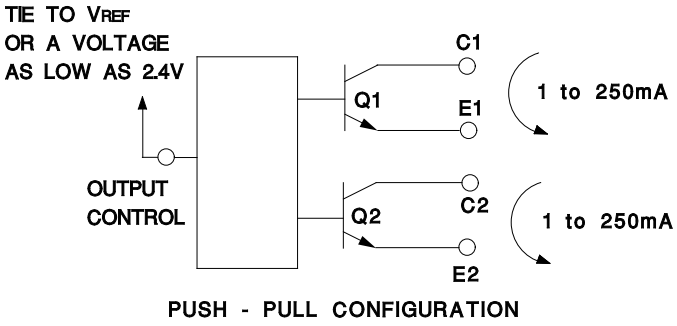


Figure 3. Output Connections for Single-Ended and Push-Pull Configurations

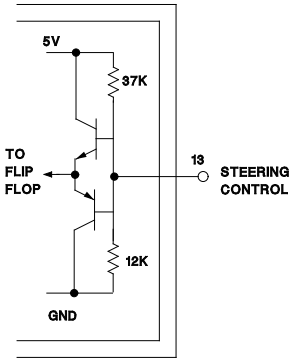


Figure 4. Internal Buffer with Deadband for Steering Control on UC495A

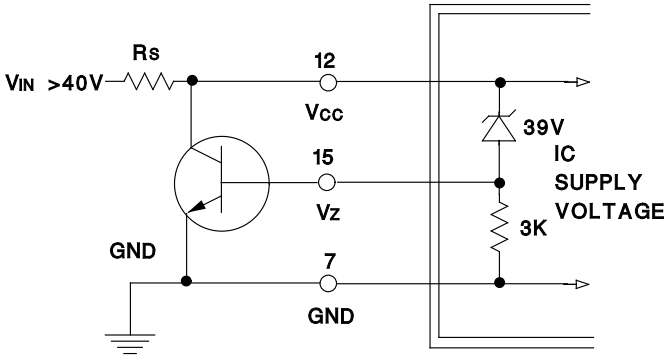


Figure 5. Operation with V_{IN} > 40V Using Internal Zener

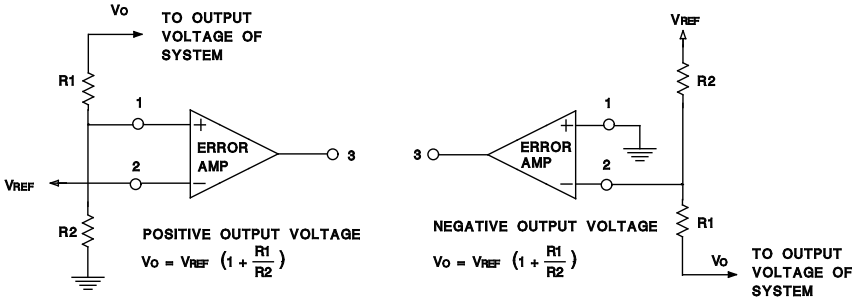


Figure 6. Error Amplifier Sensing Techniques

UNITRODE INTEGRATED CIRCUITS
7 CONTINENTAL BLVD. • MERRIMACK, NH 03054
TEL. (603) 424-2410 • FAX (603) 424-3460

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.

Copyright © 1999, Texas Instruments Incorporated