



# 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

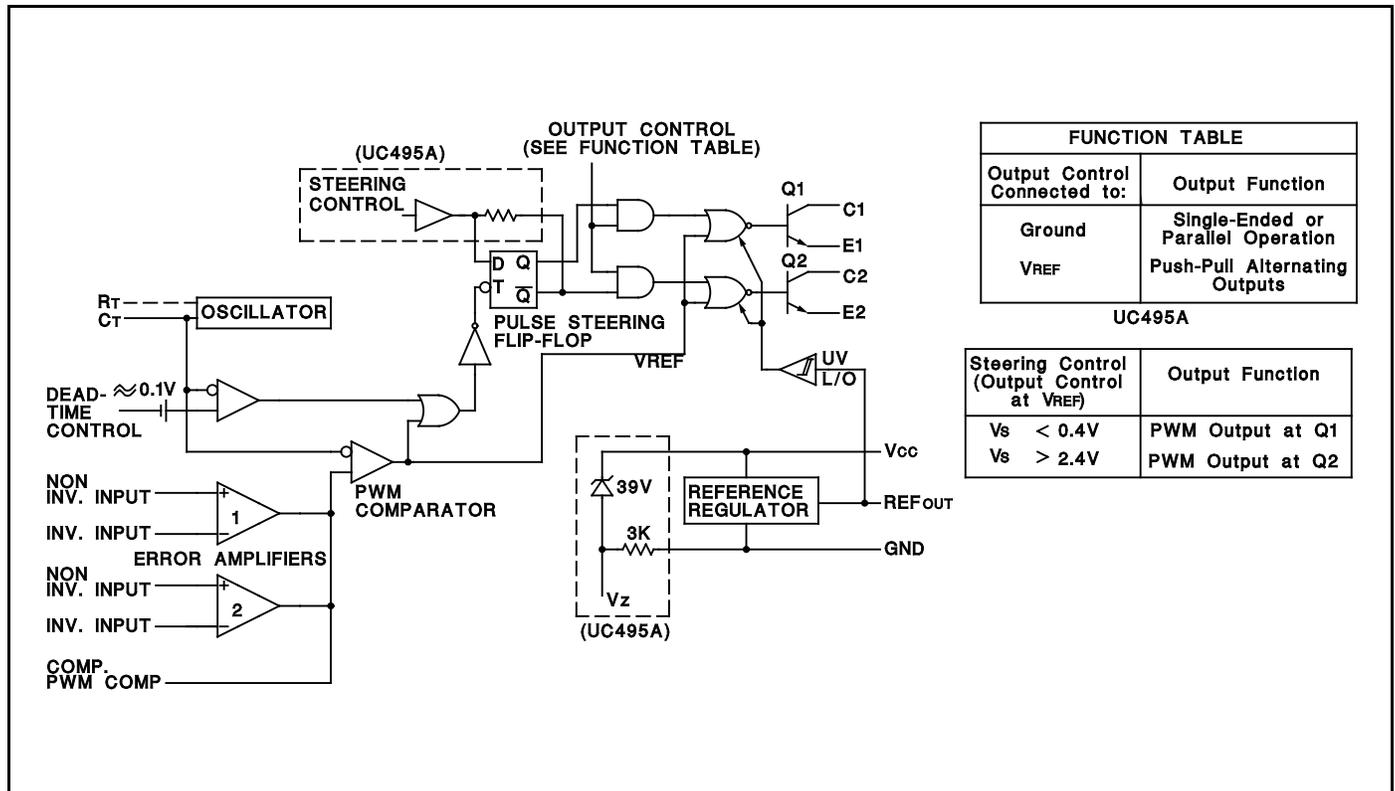
## DESCRIPTION

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  $\pm 1\%$ , 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  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , while the UC494AC, UC495AC are designed for industrial applications from  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ .

## BLOCK DIAGRAM



### ABSOLUTE MAXIMUM RATINGS (Note 1, 2, 3)

Supply Voltage, Vcc (Note 2)	45V
Amplifier Input Voltages	Vcc + 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.

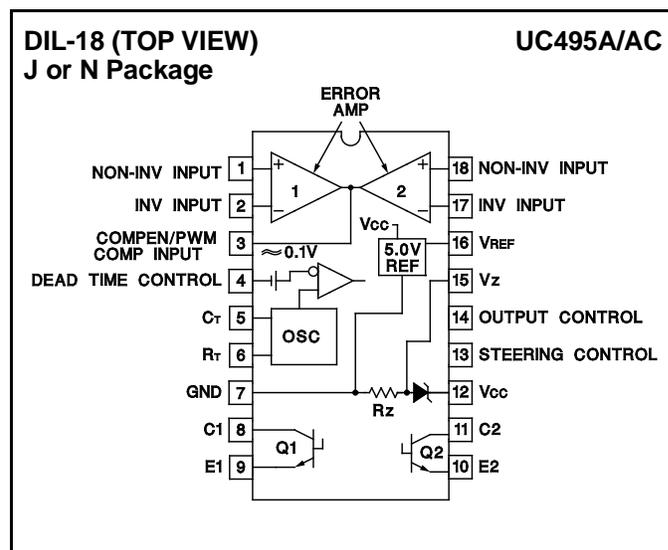
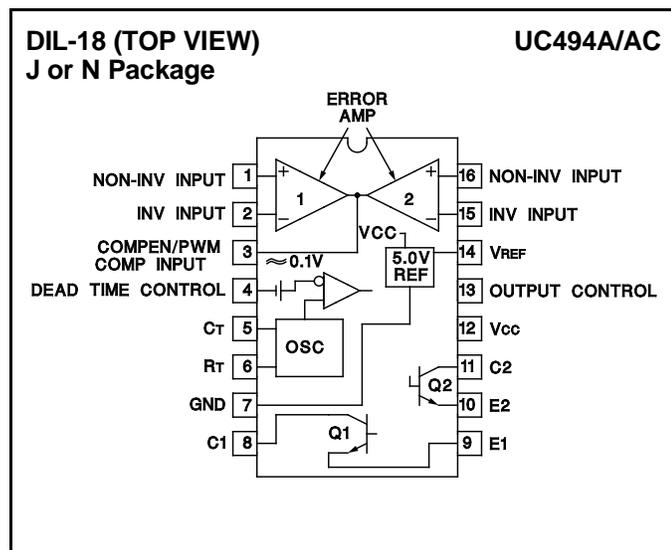
Note 2: All voltage values are with respect to network ground terminal 3.

Note 3: Consult Packaging Section of Databook regarding thermal specifications and limitations of packages.

### RECOMMENDED OPERATING CONDITIONS

Supply Voltage Vcc	7V to 40V
Error Amplifier Input Voltages	-0.3V to Vcc-2V
Collector Output Voltage	40V
Collector Output Current (each transistor)	200mA
Current into Feedback Terminal	0.3mA
Timing Capacitor, CT	0.47nF to 10,000nF
Timing Resistor, RT	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



**ELECTRICAL CHARACTERISTICS:** Unless otherwise stated, over recommended operating free-air temperature range, Vcc = 15V, f = 10kHz, TA = TJ.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>Reference Section</b>					
Output Voltage VREF	Io = 1mA, TA = 25°C	4.95	5	5.05	V
Input Regulation	Vcc = 7V to 40V		2	25	mV
Output Regulation	Io = 1mA to 10mA		1	15	mV
Output Voltage Over Temperature	ΔTA = Min. to Max.	4.90		5.10	V
Short Circuit Output Current	VREF = 0, TA = 25°C (Note 1)	10	35	50	mA
<b>Oscillator Section</b>					
Frequency (Note 2)	CT = 0.01μF, RT = 12kΩ		10		kHz
Standard Deviation Of Frequency (Note 3)	All Values of Vcc, CT, RT, TA Constant		10		%
Frequency Change With Voltage	Vcc = 7V to 40V, TA = 25°C		0.1		%
Frequency Change With Temperature	CT = 0.01μF, RT = 12kΩ, ΔTA = Min. to Max.			2	%
<b>Deadtime Control Section (Output Control Connected to VREF)</b>					
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	
<b>Deadtime Control Section (cont.)</b> (Output Control Connected to VREF)							
Input Threshold Voltage (Pin 4)		Zero Duty-Cycle		3	3.3	V	
		Maximum Duty-Cycle	0			V	
<b>Amplifier Section</b>							
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	$\mu A$	
Common-Mode Input Voltage Range		$V_{CC} = 7V$ to $40V$	.03 to $V_{CC} - 2$			V	
Open Loop Voltage Gain		$\Delta V_O = 3V$ , $V_O = 0.5V$ to $3.5V$	70	95		dB	
Unity Gain Bandwidth				800		kHz	
Common-Mode Rejection Ratio		$V_{CC} = 40V$ , $T_A = 25^\circ C$	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	
<b>Output Section</b>							
Collector Off-State Current		$V_{CE} = 40V$ , $V_{CC} = 40V$		2	100	$\mu A$	
Emitter Off-State Current		$V_{CC} = V_C = 40V$ , $V_E = 0$			-100	$\mu A$	
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	
<b>PWM Comparator Section</b>							
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	
<b>Steering Control</b> (UC495A, See Function Table)							
Input Current		$V(PIN 13) = 0.4V$ , Q1 ACTIVE			-200	$\mu A$	
		$V(PIN 13) = 2.4V$ , Q2 ACTIVE			300	$\mu A$	
Deadband				500		mV	
<b>Zener Diode Circuit</b> (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	
<b>Total Device</b>							
Standby Supply Current		Pin 6 at VREF, 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	
<b>Switching Characteristics</b> ( $T_A = 25^\circ C$ )							
Output Voltage Rise Time		Common-Emitter Configuration		100	200	ns	
Output Voltage Fall Time		$R_L = 68\Omega$ , $C_L = 15pF$		25	100	ns	
Output Voltage Rise Time		Emitter-Follower Configuration		100	200	ns	
Output Voltage Fall Time		$R_L = 68\Omega$ , $C_L = 15pF$		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  $f = \frac{1.1}{RTCT}$

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

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

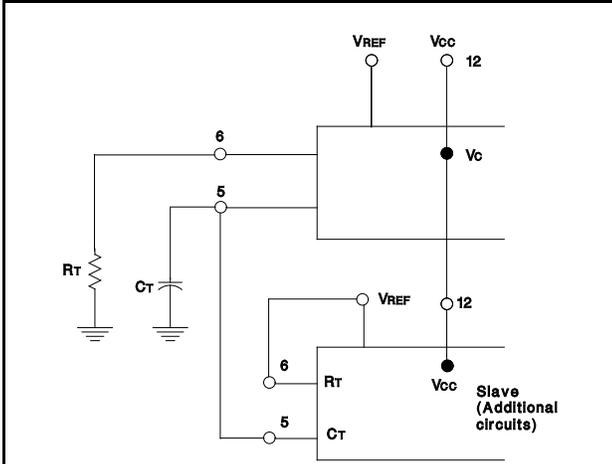


Figure 1. Slaving Two or More Control Circuits

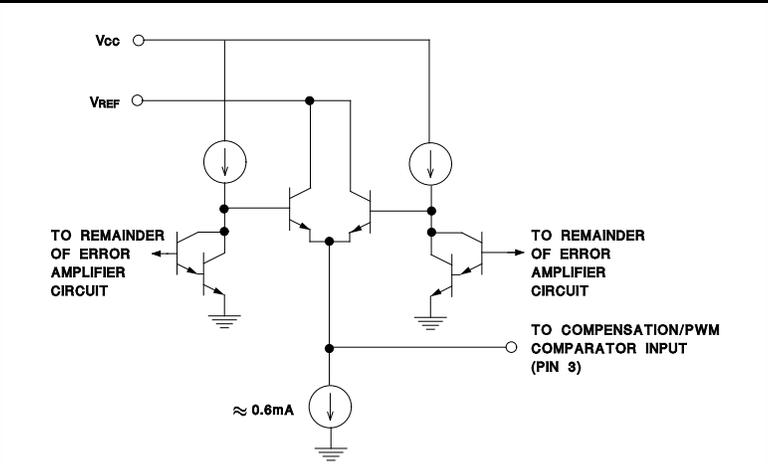
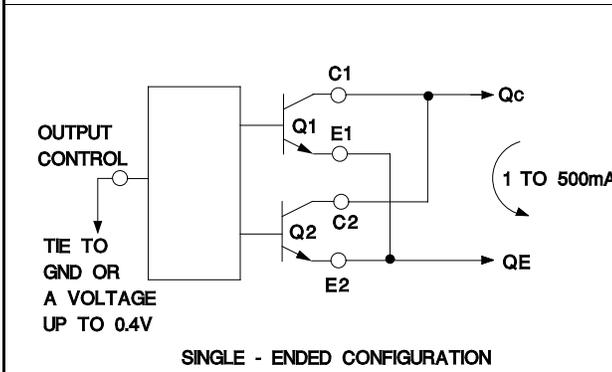
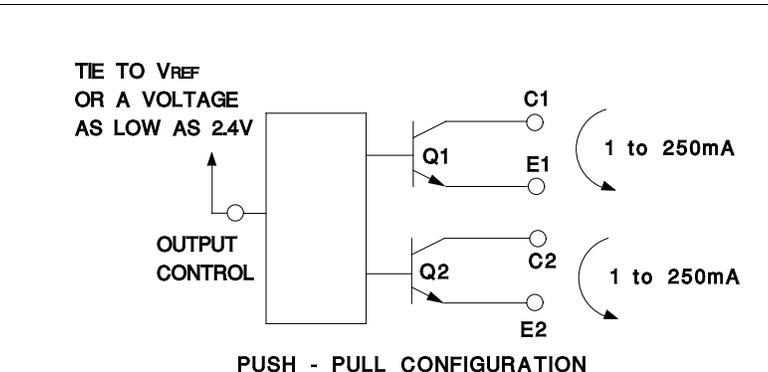


Figure 2. Output Circuit of Error Amplifiers



SINGLE - ENDED CONFIGURATION



PUSH - PULL CONFIGURATION

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

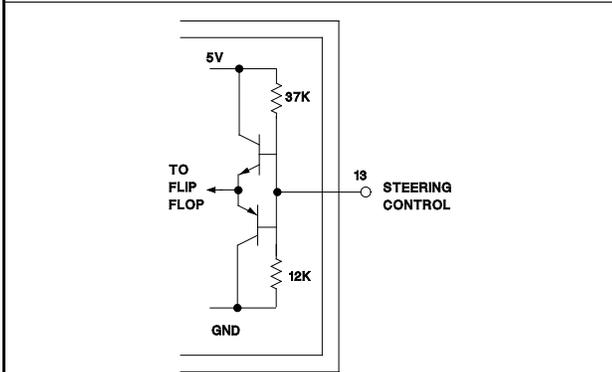


Figure 4. Internal Buffer with Deadband for Steering Control on UC495A

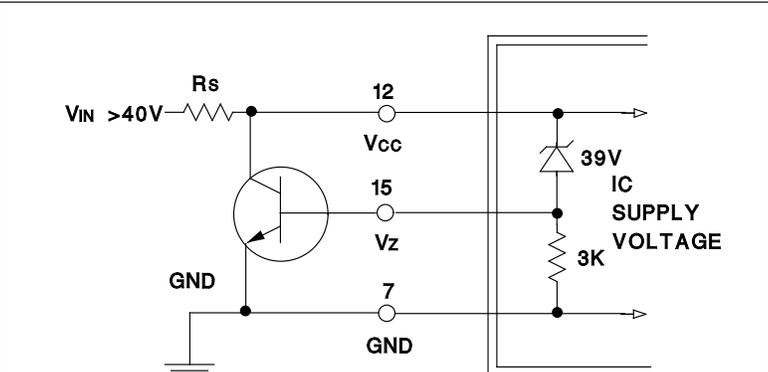


Figure 5. Operation with VIN > 40V Using Internal Zener

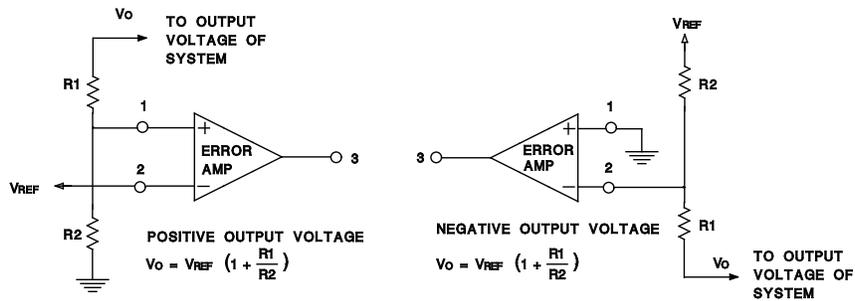


Figure 6. Error Amplifier Sensing Techniques

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