UNITRODE

UC1524A
UC2524A
UC3524A

Advanced Regulating Pulse Width Modulators

FEATURES

- Fully Interchangeable with Standard UC1524 Family
- Precision Reference Internally Trimmed to ±1%
- High-Performance Current Limit Function
- Under-Voltage Lockout with Hysteretic Turn-on
- Start-Up Supply Current Less Than 4mA
- Output Current to 200mA
- 60V Output Capability
- Wide Common-Mode Input Range for both Error and Current Limit Amplifiers
- PWM Latch Insures Single Pulse per Period
- Double Pulse Suppression Logic
- 200ns Shutdown through PWM Latch
- Guaranteed Frequency Accuracy
- Thermal Shutdown Protection

DESCRIPTION

The UC1524A family of regulating PWM ICs has been designed to retain the same highly versatile architecture of the industry standard UC1524 (SG1524) while offering substantial improvements to many of its limitations. The UC1524A is pin compatible with “non-A” models and in most existing applications can be directly interchanged with no effect on power supply performance. Using the UC1524A, however, frees the designer from many concerns which typically had required additional circuitry to solve.

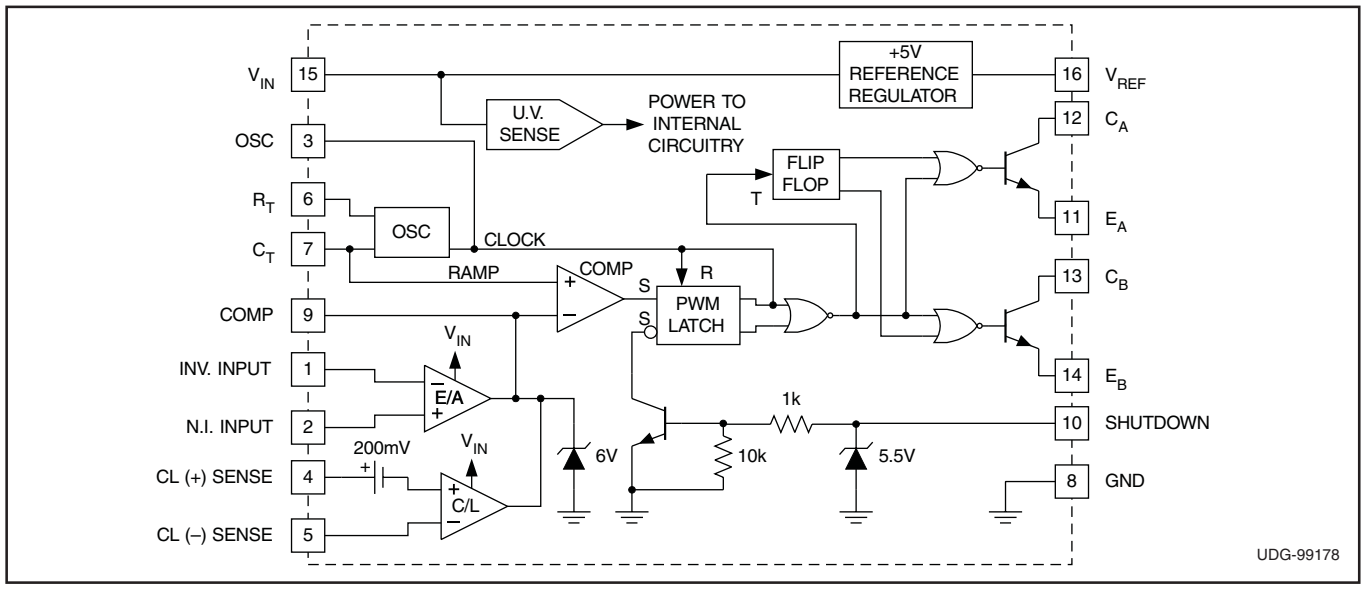
The UC1524A includes a precise 5V reference trimmed to ±1% accuracy, eliminating the need for potentiometer adjustments; an error amplifier with an input range which includes 5V, eliminating the need for a reference divider; a current sense amplifier useful in either the ground or power supply output lines; and a pair of 60V, 200mA uncommitted transistor switches which greatly enhance output versatility.

An additional feature of the UC1524A is an under-voltage lockout circuit which disables all the internal circuitry, except the reference, until the input voltage has risen to 8V. This holds standby current low until turn-on, greatly simplifying the design of low power, off-line supplies. The turn-on circuit has approximately 600mV of hysteresis for jitter-free activation.

Other product enhancements included in the UC1524A’s design include a PWM latch which insures freedom from multiple pulsing within a period, even in noisy environments, logic to eliminate double pulsing on a single output, a 200ns external shutdown capability, and automatic thermal protection from excessive chip temperature. The oscillator circuit of the UC1524A is usable beyond 500kHz and is now easier to synchronize with an external clock pulse.

The UC1524A is packaged in a hermetic 16-pin DIP and is rated for operation from -55°C to +125°C. The UC2524A and 3524A are available in either ceramic or plastic packages and are rated for operation from -25°C to +85°C and 0°C to 70°C, respectively. Surface mount devices are also available.

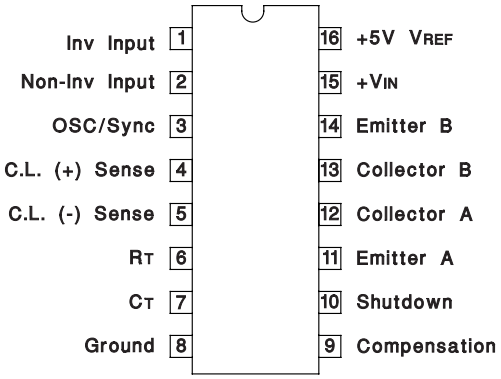
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

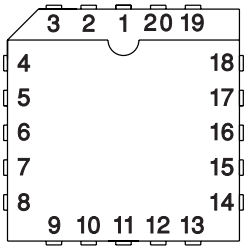
Supply Voltage (V_{IN}) 40V
Collector Supply Voltage (V_C) 60V
Output Current (each Output) 200mA
Maximum Forced Voltage (Pin 9, 10) . . . . . -3 to +5V
Maximum Forced Current (Pin 9, 10) . . . . . ±10mA
Reference Output Current 50mA
Oscillator Charging Current 5mA
Power Dissipation at T_A = +25°C. 1000mW
Power Dissipation at T_C = +25°C 2000mW
Operating Temperature Range . . . . . -55°C to +125°C
Storage Temperature Range. . . . . -65°C to +150°C
Lead Temperature, (Soldering, 10 seconds) . . . . . +300°C
Note: Consult packaging section of Databook for thermal limitations and considerations of package.

DIL-16, SOIC-16 (TOP VIEW)
J or N Package, DW Package



CONNECTION DIAGRAMS

PLCC-20, LCC-20 (TOP VIEW)
Q or L Package



PACKAGE PIN FUNCTION	
FUNCTION	**PIN**
N/C	1
Inv. Input	2
Non-Inv. Input	3
OSC/SYNC	4
C.L. (+) sense	5
N/C	6
C.L. (-) sense	7
R_T	8
C_T	9
Ground	10
N/C	11
Compensation	12
Shutdown	13
Emitter A	14
Collector A	15
N/C	16
Collector B	17
Emitter B	18
+V_{IN}	19
+5V V_{REF}	20

ELECTRICAL CHARACTERISTICS:

Unless otherwise stated, these specifications apply for T_A = -55°C to +125°C for the UC1524A, -25° to +85°C for the UC2524A, and 0°C to + 70°C for the UC3524A; V_{IN} = V_C = 20V, T_A = T_J.

PARAMETER	TEST CONDITIONS	UC1524A / UC2524A			UC3524A			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Turn-on Characteristics								
Input Voltage	Operating Range after Turn-on	8		40	8		40	V
Turn-on Threshold		6.5	7.5	8.5	6.5	7.5	8.5	V
Turn-on Current	V_{IN} = 6V		2.5	4		2.5	4	mA
Operating Current	V_{IN} = 8 to 40V		5	10		5	10	mA
Turn-on Hysteresis*			0.5			0.5		V
Reference Section								
Output Voltage	T_J = 25°C	4.95	5.00	5.05	4.90	5.00	5.10	V
	Over Operating Range	4.9		5.1	4.85		5.15	V
Line Regulation	V_{IN} = 10 to 40V		10	20		10	30	mV
Load Regulation	I_L = 0 to 20 mA		20	25		20	35	mV
Temperature Stability*	Over Operating Range*		20	25		20	35	mV
Short Circuit Current	V_{REF} = 0, 25°C ≤ T_J ≤ 125°C		80	100		80	100	mA
Output Noise Voltage*	10Hz ≤ f ≤ 10kHz, T_J =25°C		40			40		μVrms
Long Term Stability*	T_J =125°C, 1000 Hrs.		20	50		20	50	mV

** These parameters are guaranteed by design but not 100% tested in production.*

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PARAMETER	TEST CONDITIONS	UC1524A / UC2524A			UC3524A			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Oscillator Section (Unless otherwise specified, R_T = 2700Ω, C_T = 0.01 mfd)								
Initial Accuracy	T_J = 25°C	41	43	45	39	43	47	kHz
	Over Operating Range	40.2		45.9	38.2		47.9	kHz
Temperature Stability*	Over Operating Temperature Range		1	2		1	2	%
Minimum Frequency	R_T = 150kΩ, C_T = 0.1mfd			140			120	Hz
Maximum Frequency	R_T = 2.0kΩ, C_T = 470pF	500			500			kHz
Output Amplitude*		3	3.5		3	3.5		V
Output Pulse Width*		0.29	0.5	1.0	0.3	0.5	1.0	µs
Ramp Peak		3.3	3.5	3.7	3.3	3.5	3.7	V
Ramp Valley	T_J = 25°C	0.7	0.8	0.9	0.7	0.8	0.9	V
Ramp Valley T.C.			-1.0			-1.0		mV/°C
Error Amplifier Section (Unless otherwise specified, V_{CM} = 2.5V)								
Input Offset Voltage			0.5	5		2	10	mV
Input Bias Current			1	5		1	10	µA
Input Offset Current			.05	1		0.5	1	µA
Common Mode Rejection Ratio	V_{CM} = 1.5 to 5.5V	70	80		70	80		dB
Power Supply Rejection Ratio	V_{IN} = 10 to 40V	70	80		70	80		dB
Output Swing (Note 1)		5.0		0.5	5.0		0.5	V
Open Loop Voltage Gain	$\Delta V_{O=\ 1\ to\ 4V,\ R_L} \geq 10M\Omega$	72	80		64	80		dB
Gain-Bandwidth*	T_J = 25°C, A_V = 0dB	1	3		1	3		MHz
DC Transconductance*§	T_J = 25°C, 30kΩ ≤ R_L ≤ 1MΩ	1.7	2.3		1.7	2.3		mS
P.W.M. Comparator (R_T = 2kΩ, C_T = 0.01mfd)								
Minimum Duty Cycle	V_{COMP} = 0.5V			0			0	%
Maximum Duty Cycle	V_{COMP} = 3.8V	45			45			%
Current Limit Amplifier (Unless otherwise specified, Pin 5 = 0V)								
Input Offset Voltage	T_J = 25°C, E/A Set for Maximum Output	190	200	210	180	200	220	mV
	Over Operating Temperature Range	180		220	170		230	mV
Input Bias Current			-1	-10		-1	-10	µA
Common Mode Rejection Ratio	$V_{(pin\ 5)}$ = -0.3V to + 5.5V	50	60		50	60		dB
Power Supply Rejection Ratio	V_{IN} = 10 to 40V	50	60		50	60		dB
Output Swing (Note 1)	Minimum Total Range	5.0		0.5	5.0		0.5	V
Open-Loop Voltage Gain	ΔV_O = 1 to 4V, $R_L \geq 10M\Omega$	70	80		70	80		dB
Delay Time*	Pin 4 to Pin 9, ΔV_{IN} = 300mV		300			300		ns
Output Section (Each Output)								
Collector Emitter Voltage	I_C = 100µA	60	80		60	80		V
Collector Leakage Current	V_{CE} = 50V		.1	20		.1	20	µA

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§ DC transconductance (g_M) relates to DC open-loop voltage gain according to the following equation: $A_V = g_M R_L$ where R_L is the resistance from pin 9 to the common mode voltage.

The minimum g_M specification is used to calculate minimum A_V when the error amplifier output is loaded.

Note 1: Min Limit applies to output high level, max limit applies to output low level.

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PARAMETER	TEST CONDITIONS	UC1524A / UC2524A			UC3524A			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Output Section (cont.) (Each Output)								
Saturation Voltage	I_C = 20mA I_C = 200mA		.2 1	.4 2.2		.2 1	.4 2.2	V V
Emitter Output Voltage	I_E = 50mA	17	18		17	18		V
Rise Time*	T_J = 25°C, R = 2kΩ		120	400		120	400	ns
Fall Time*	T_J = 25°C, R = 2kΩ		25	200		25	200	ns
Comparator Delay*	T_J = 25°C, Pin 9 to output		300			300		ns
Shutdown Delay*	T_J = 25°C, Pin 10 to output		200			200		ns
Shutdown Threshold	T_J = 25°C, R_C = 2kΩ	0.6	.7	1.0	0.6	.7	1.0	V
S/D Threshold Over Temp.	Over Operating Temperature Range	0.4		1.2	0.4		1.0	V
Thermal Shutdown*			165			165		°C

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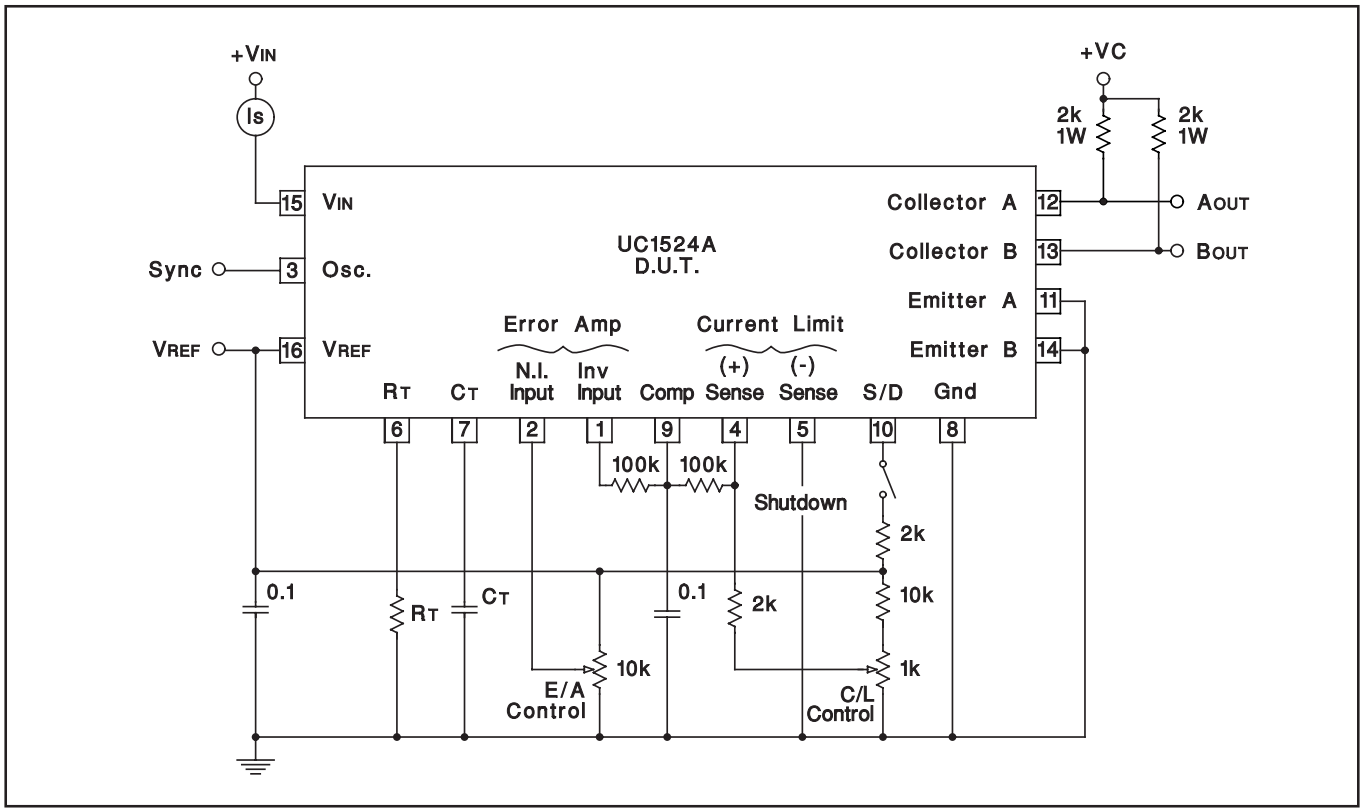
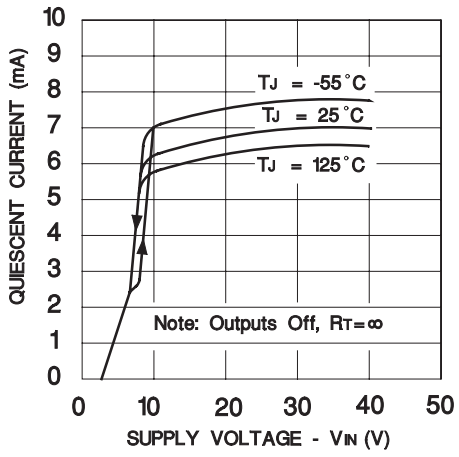
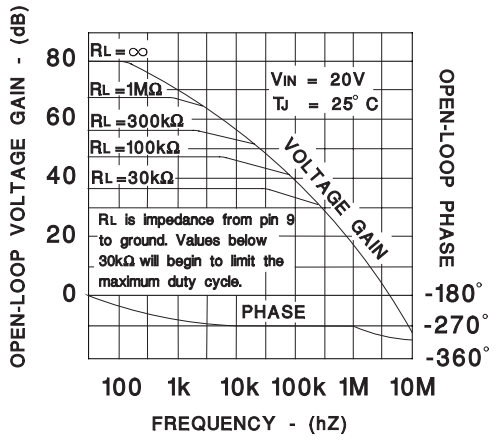
OPEN-LOOP CIRCUIT



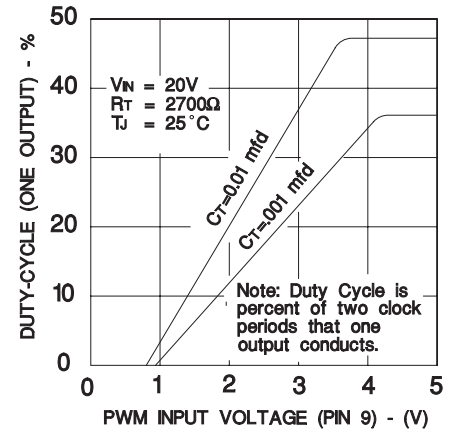
Supply Current vs Voltage



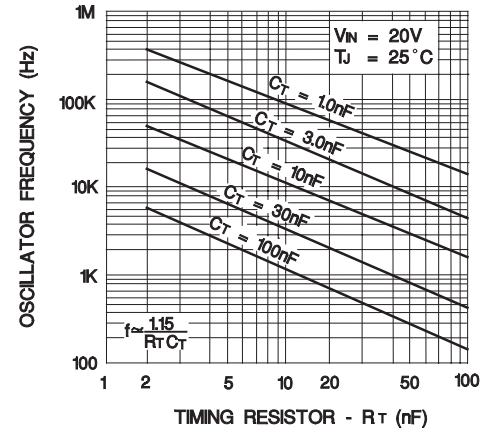
Error Amplifier Voltage Gain and Phase vs Frequency



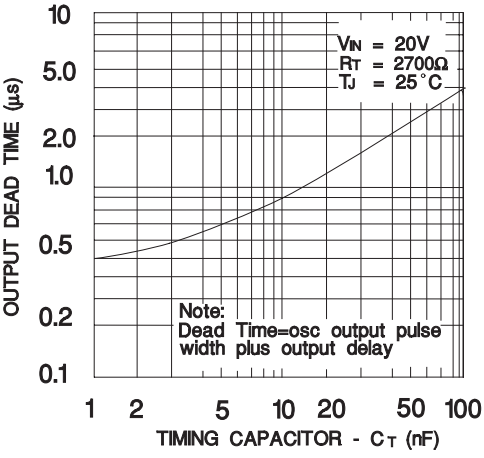
Pulse Width Modulator Transfer Function



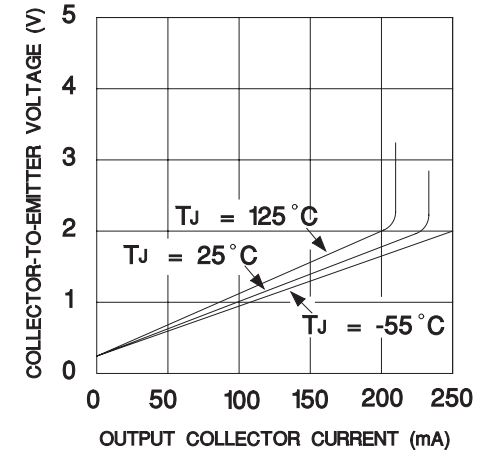
Oscillator Frequency vs Timing Components



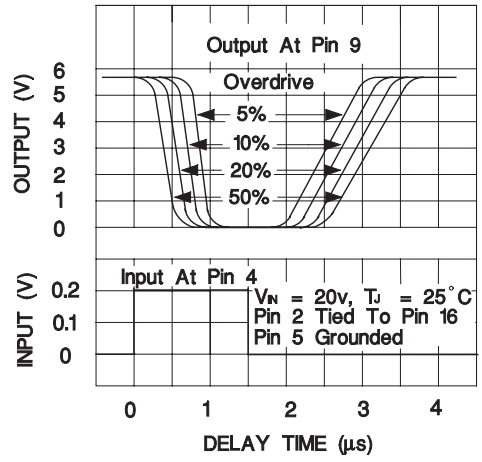
Output Dead Time vs Timing Capacitor Value



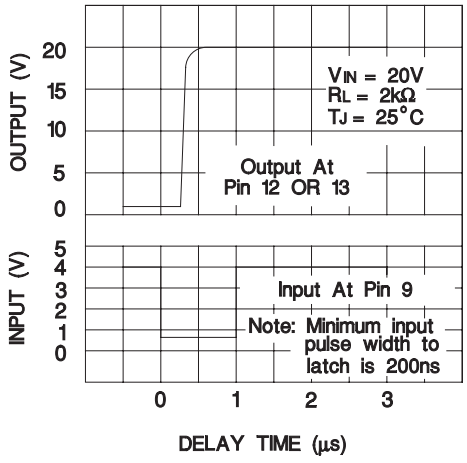
Output Saturation Voltage



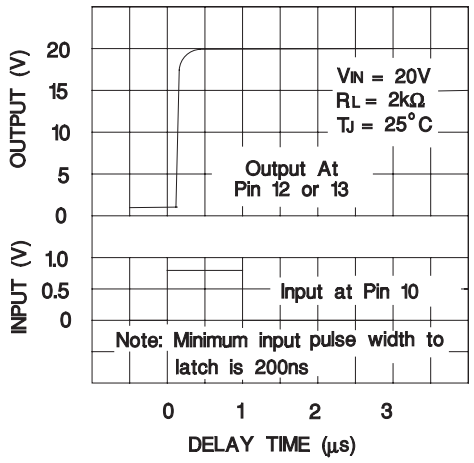
Current Limit Amplifier Delay



Shutdown Delay From PWM Comparator - Pin 9



Turn-Off Delay From Shutdown - Pin 10



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