

Seagate Microelectronics Limited

REGULATING PULSE WIDTH MODULATORS

CURRENT MODE IP1844, IP2844, IP3844, IP1845, IP2845, IP3845

T-58-11-31

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DESCRIPTION

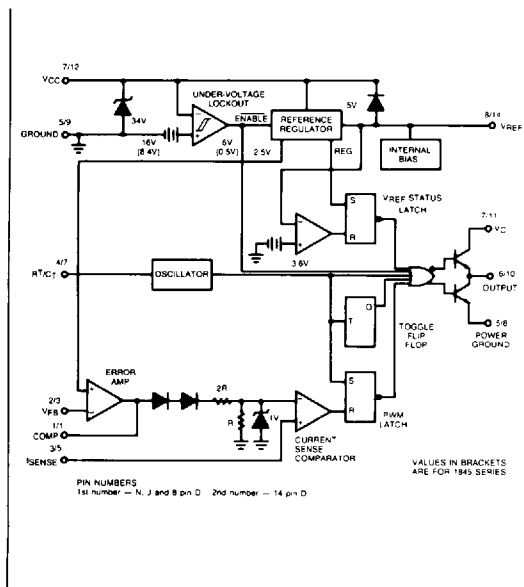
The IP1844 and IP1845 series of switching regulator control circuits contain all the functions necessary to implement off-line, current mode switching regulators, using a minimum number of external parts. Functions included are voltage reference, error amplifier, current sense comparator, oscillator, totem-pole output driver and under-voltage lockout circuitry. In addition there is a toggle flip-flop which blanks the output on every second clock pulse, thereby ensuring that the duty cycle never exceeds 50%.

Although pin compatible with the UC1844 and UC1845 series, Seagate Microelectronics has incorporated several improvements in the IP1844 and IP1845 series allowing tighter and more complete specification of electrical performance.

FEATURES

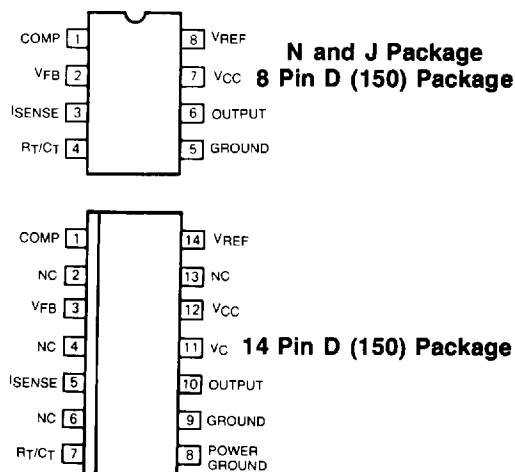
- Guaranteed $\pm 1\%$ reference voltage tolerance
- Guaranteed $\pm 10\%$ frequency tolerance
- Low start-up current ($< 500 \mu\text{A}$)
- Under voltage lockout with hysteresis
- Output state completely defined for all supply and input conditions
- Interchangeable with UC1844 and UC1845 series for improved operation
- 500 kHz Oscillator operation
250 kHz Output operation

BLOCK DIAGRAM



CONNECTIONS

(Top View)



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ABSOLUTE MAXIMUM RATINGS

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Supply Voltage (+V _{CC}) (low impedance source)	+30V	Power Dissipation at T _A = +25°C (Note 1) N and J Packages	1000mW
Supply Voltage (V _{CC}) (I _{CC} < 30mA)	Self limiting	T _C = +25°C (Note 2) D Packages	725mW
Output Current	+1A	T _C = +25°C (Note 3) N and J Packages	2000mW
Output Energy (capacitive load)	5μJ	Storage Temperature Range	-65°C to +150°C
Analog Inputs (pins 2 and 3)	-0.3V to +V _{CC}	Lead Temperature (Soldering, 10 seconds)	+300°C
Error Amp Output Sink Current	10mA		

Absolute maximum ratings are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The electrical characteristics provide conditions for actual device operation.

RECOMMENDED OPERATING CONDITIONS (Note 4)

Supply Voltage (+V _{CC})	≤30V	Operating Ambient Temperature Range:	
Output Current	0 to ±200mA	IP1844, IP1845	-55°C to +125°C
Analog Inputs (pins 2 and 3)	-0.3V to 3V	IP2844, IP2845	-25°C to +85°C
Error Amp Output Sink Current	0 to 2mA	IP3844, IP3845	0°C to +70°C

Note 1. Derate at 10 mW/°C, for N and J packages, for ambient temperatures above +50°C.
 Note 2. Derate at 7.25 mW/°C for D packages, for ambient temperatures above +50°C.
 Note 3. Derate at 16 mW/°C for case temperatures above +25°C.
 Note 4. Range over which the device is functional and parameter limits are guaranteed.

ELECTRICAL CHARACTERISTICS

V_{CC} = 15V, f = 52kHz, R_T = 10k, C_T = 3.3nF unless otherwise specified (Note 6)

Parameter	Test Conditions	IP1844/IP1845 IP2844/IP2845			IP3844/IP3845			Units
		Min	Typ	Max	Min	Typ	Max	

Reference Section

Output Voltage	I _O = 1mA		4.95	5.00	5.05	4.90	5.00	5.10	V
Input Regulation	V _{CC} = 12 to 25V	●		6	20		6	20	mV
Output Regulation	I _O = 1 to 20mA	●		6	25		6	25	mV
Temperature Stability	(Note 5)	●		0.2	0.4		0.2	0.4	mV/°C
Total Output Variation	Line, Load, Temp	●	4.90		5.10	4.82		5.18	V
Output Noise Voltage	f = 10Hz to 10kHz (Note 5)			50			50		μV
Long Term Stability	T _j = 125°C 1000 Hrs (Note 5)			5	25		5	25	mV
Output Short Circuit Current	V _{REF} = 0	●	30	80	160	30	80	160	mA

Oscillator Section

Frequency	Note 10		47	52	57	47	52	57	kHz
Voltage Stability	V _{CC} = 12 to 25V	●		0.2	1		0.2	1	%
Temperature Stability	ΔT _A = Min to Max (Note 5)	●		5			5		%
Amplitude	V _{PIN} 4 Peak to Peak	●		1.7			1.7		V
Discharge Current				8.3			8.3		mA
	ΔT _A = Min to Max (Note 5)			8			8		%



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ELECTRICAL CHARACTERISTICS (CONTINUED)

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Parameter	Test Conditions		IP1844/IP1845 IP2844/IP2845			IP3844/IP3845			Units
			Min	Typ	Max	Min	Typ	Max	
Error Amp Section									
Input Voltage	VPIN 1 = 2.5V	●	2.45	2.50	2.55	2.42	2.50	2.58	V
Input Bias Current		●		-0.3	-1		-0.3	-2	μA
Open Loop Voltage Gain	VO = 2 to 4V	●	65	90		65	90		dB
Unity Gain Bandwidth	(Note 5)	●	0.7	1		0.7	1		MHz
Supply Voltage Rejection	VCC = 12 to 25V	●	60	70		60	70		dB
Output Sink Current	VPIN 2 = 2.7V, VPIN 1 = 1.1V	●	2	6		2	6		mA
Output Source Current	VPIN 2 = 2.3V, VPIN 1 = 5.0V	●	-0.5	-0.8		-0.5	-0.8		mA
VOUTHigh	VPIN 2 = 2.3V, RL = 15k	●	5.0	6.0		5.0	6.0		V
VOULow	VPIN 2 = 2.7V, RL = 15k	●		0.7	1.1		0.7	1.1	V
Current Sense Section									
Gain	(Notes 7 and 8)	●	2.85	3	3.15	2.85	3	3.15	V/V
Maximum Input Signal	VPIN 1 = 5.0 (Note 7)	●	0.9	1	1.1	0.9	1.0	1.1	V
Supply Voltage Rejection	VC = 12 to 25V	●	60	70		60	70		dB
Input Bias Current		●		-2	-10		-2	-10	μA
Delay to Output		●		150	300		150	300	ns
Output Section									
Output Low Level	ISINK = 20mA	●		0.1	0.4		0.1	0.4	V
	ISINK = 200mA	●		1.5	2.2		1.5	2.2	V
Output High Level	ISOURCE = 20mA	●	13	13.5		13	13.5		V
	ISOURCE = 200mA	●	12	13.5		12	13.5		V
Rise Time	CL = 1nF	●		50	150		50	150	ns
Fall Time	CL = 1nF	●		50	150		50	150	ns
UVLO Saturation	VCC = 6V, IL = 1mA	●		0.7	1.1		0.7	1.1	V
Under-voltage Lockout Section									
Upper Threshold (VCC)	1844 Series	●	15	16	17	14.5	16	17.5	V
	1845 Series	●	7.8	8.4	9	7.8	8.4	9	V
Lower Threshold (VCC)	1844 Series	●	9	10	11	8.5	10	11.5	V
	1845 Series	●	7	7.6	8.2	7	7.6	8.2	V
Total Standby Current									
Start-Up Current		●		0.3	0.5		0.3	0.5	mA
Operating Supply Current	VPIN 2 = 0V	1844 Series	●	11	15		11	15	mA
	VPIN 3 = 0V	1845 Series	●	14	17		14	17	mA
VCC Zener Voltage	ICC = 25mA	●	30	34	40	30	34	40	V

The ● denotes the specifications which apply over the full operating temperature range, all others apply at T_J = 25°C unless otherwise specified.

Note 5. These parameters, although guaranteed over the recommended conditions, are not 100% tested in production.

Note 6. Adjust V_{CC} above start threshold before setting at required level.

Note 7. Parameter measured at trip point of latch with V_{PIN 2} = 0V.

Note 8. Gain defined as

$$A = \frac{\Delta V_{PIN 1}}{\Delta V_{PIN 3}} \quad : 0 \leq V_{PIN 3} \leq 0.8$$



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ELECTRICAL CHARACTERISTICS (CONTINUED)

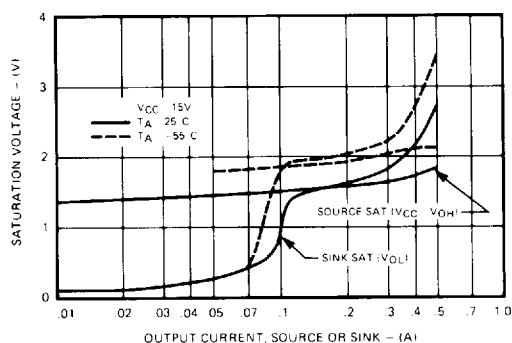
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Parameter	Test Conditions	IP1844/IP1845 IP2844/IP2845			IP3844/IP3845			Units	
		Min	Typ	Max	Min	Typ	Max		
PWM Section									
Maximum Duty Cycle		●	47	48	50	46	48	50	%
Minimum Duty Cycle		●			0			0	%

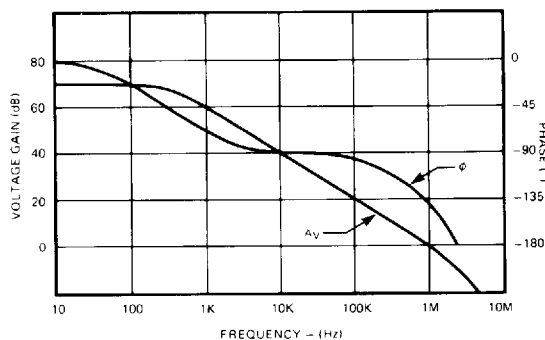
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TYPICAL PERFORMANCE CHARACTERISTICS

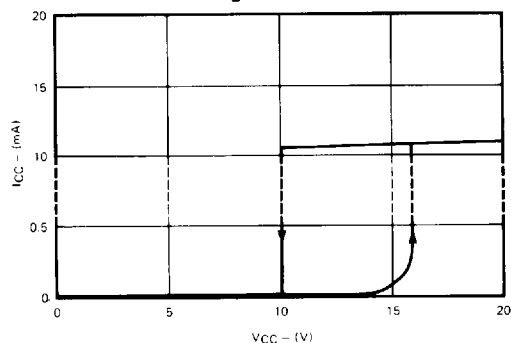
Output Saturation Characteristics



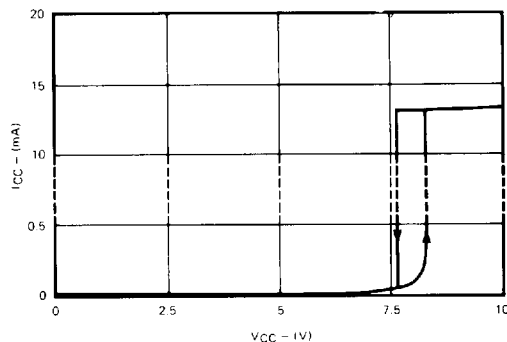
Error Amplifier Open-Loop Frequency Response



Under Voltage Lockout 1844 Series



Under Voltage Lockout 1845 Series



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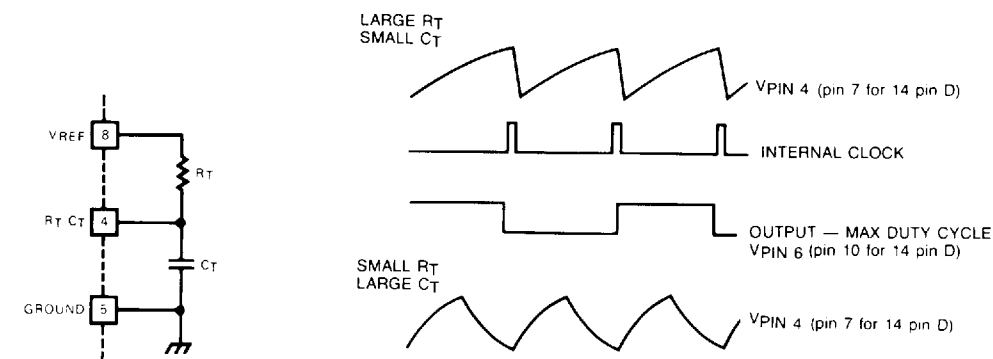
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APPLICATIONS INFORMATION

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Oscillator Waveforms and Maximum Duty Cycle

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Oscillator timing capacitor, C_T is charged by V_{REF} through R_T and discharged by an internal current source. During the discharge time, the internal clock signal blanks the output to the low state. Selection of R_T and C_T therefore determines both oscillator frequency and maximum duty cycle. Charge and discharge times are determined by the formulas:

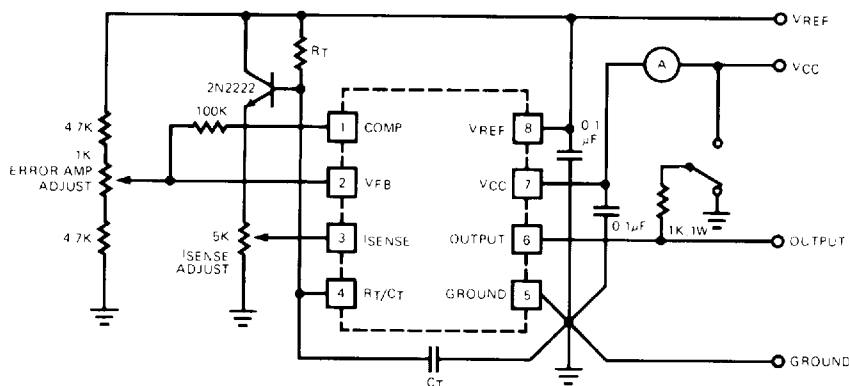
$$t_c \approx 0.55 R_T C_T$$

$$t_d \approx R_T C_T \ln \left(\frac{.0063 R_T - 2.3}{.0063 - 4} \right)$$

$$\text{Frequency, then is: } f = (t_c + t_d)^{-1}$$

$$\text{For } R_T > 5k, f \approx \frac{1.8}{R_T C_T}$$

Open-Loop Laboratory Test Fixture



High peak current associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close to pin 5 in a single point ground. The transistor and 5K potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.



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REGULATING PULSE WIDTH MODULATORS**ORDER INFORMATION**

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Part Number	Temperature Range	Package
IP1844J	-55°C to +125°C	8 Pin Ceramic DIP
IP2844J	-25°C to +85°C	8 Pin Ceramic DIP
IP2844N	-25°C to +85°C	8 Pin Plastic DIP
IP2844D	-25°C to +85°C	8 Pin Plastic (150) SOIC
IP2844D-14	-25°C to +85°C	14 Pin Plastic (150) SOIC
IP3844J	0°C to +70°C	8 Pin Ceramic DIP
IP3844N	0°C to +70°C	8 Pin Plastic DIP
IP3844D	0°C to +70°C	8 Pin Plastic (150) SOIC
IP3844D-14	0°C to +70°C	14 Pin (150) SOIC
IP1845J	-55°C to +125°C	8 Pin Ceramic DIP
IP2845J	-25°C to +85°C	8 Pin Ceramic DIP
IP2845N	-25°C to +85°C	8 Pin Plastic DIP
IP2845D	-25°C to +85°C	8 Pin Plastic (150) SOIC
IP2845D-14	-25°C to +85°C	14 Pin(150) SOIC
IP3845J	0°C to +70°C	8 Pin Ceramic DIP
IP3845N	0°C to +70°C	8 Pin Plastic DIP
IP3845D	0°C to +70°C	8 Pin Plastic (150) SOIC
IP3845D-14	0°C to +70°C	14 Pin (150) SOIC

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