REGULATING PULSE WIDTH MODULATORS

CURRENT MODE

IPX842A, IPX843A, IPX844A, IPX845A

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DESCRIPTION

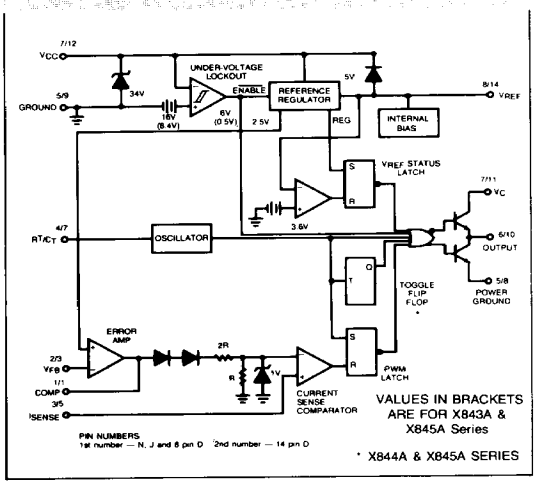
The IPX84XA series of switching regulator control circuits contains all the functions necessary to implement off-line, current mode switching regulators, using a minimum number of external parts. Functions included are voltage reference, error amplifier, current sense comparator, oscillator, totem-pole output driver and under-voltage lockout circuitry. In addition the IPX844A and IPX845A have a toggle flip-flop which blanks the output on every second clock pulse, thereby ensuring that the duty cycle never exceeds 50%. For applications requiring more flexible control all devices feature an on-chip trimmed oscillator discharge current, allowing accurate control to maximum-duty-cycle by selection of timing components. This can be beneficial even if using the IPX844A or IPX845A series, as it allows optimum safety margins to be designed into the application.

Although pin compatible with the 'non A' parts, these devices offer improved performance in several areas. They also offer tighter specification and improved performance over the UCX84X series, whilst retaining complete compatability.

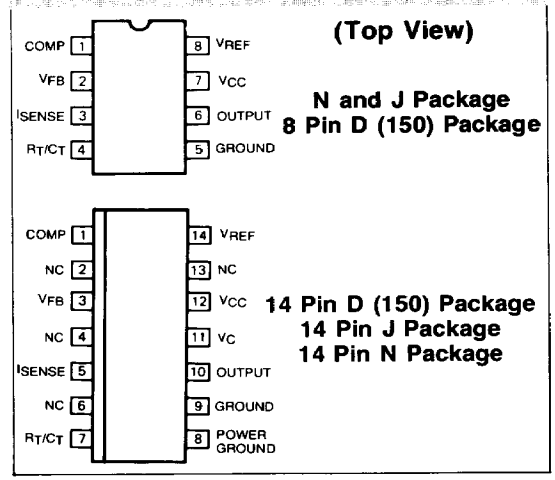
FEATURES

- Guaranteed ± 1% reference voltage tolerance
- Accurate oscillator discharge current
- Guaranteed ± 10% frequency tolerance
- Low start-up current (< 500 µA)
- Under voltage lockout with hysteresis
- Output state completely defined for all supply and input conditions
- Interchangeable with UC1842/43/44/45 series for improved operation
- 500 kHz Oscillator operation
  250 kHz Output operation (IPX844A & IPX845A)

BLOCK DIAGRAM



CONNECTIONS



REGULATING PULSE WIDTH MODULATORS

ABSOLUTE MAXIMUM RATINGS

Supply Voltage ($+V_{CC}$) (low impedance source) +30V
Supply Voltage (V_{CC}) (I_{CC} <30mA) Self limiting
Output Current ±1A
Output Energy (capacitive load) 5µJ
Analog Inputs (pins 2 and 3) −0.3V to $+V_{CC}$
Error Amp Output Sink Current 10mA

Power Dissipation at
T_A = +25°C (Note 1) N and J Packages 1000mW
T_C = +25°C (Note 2) D Packages 725mW
T_C = +25°C (Note 3) N and J Packages 2000mW
Storage Temperature Range −65°C to +150°C
Lead Temperature (Soldering, 10 seconds) +300°C

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 ($+V_{CC}$) (Note 5) ≤30V
Output Current 0 to ±200mA
Analog Inputs (pins 2 and 3) −0.3V to 3V
Error Amp Output Sink Current 0 to 2mA

Operating Ambient Temperature Range:
IP184XA −55°C to +125°C
IP284XA −25°C to +85°C
IP384XA 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.
Note 5. Lower limit set by under voltage lockout specification.

ELECTRICAL CHARACTERISTICS

V_{CC} = 15V, f = 52kHz, R_T = 10k, C_T = 3.3nF unless otherwise specified (Note 7)

Parameter	Test Conditions		IP184XA IP284XA Min	IP184XA IP284XA Typ	IP184XA IP284XA Max	IP384XA Min	IP384XA Typ	IP384XA Max	Units
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 6)	●		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 6)			50			50		µV
Long Term Stability	T_j = 125°C 1000 Hrs (Note 6)			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	$\triangle T_A$ = Min to Max (Note 6)	●		5			5		%
Amplitude	$V_{PIN\ 4}$ Peak to Peak	●		1.7			1.7		V
Discharge Current			7.8	8.3	8.8	7.8	8.3	8.8	mA
	$\triangle T_A$ = Min to Max (Note 6)		7.0		9.0	7.0		9.0	mA

REGULATING PULSE WIDTH MODULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameter	Test Conditions		IP184XA IP284XA Min	IP184XA IP284XA Typ	IP184XA IP284XA Max	IP384XA Min	IP384XA Typ	IP384XA Max	Units
Error Amp Section									
Input Voltage	$V_{PIN\ 1}$ = 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	V_O = 2 to 4V	●	65	90		65	90		dB
Unity Gain Bandwith	(Note 6)	●	0.7	1		0.7	1		MHz
Supply Voltage Rejection	V_{CC} = 12 to 25V	●	60	70		60	70		dB
Output Sink Current	$V_{PIN\ 2}$ = 2.7V, $V_{PIN\ 1}$ = 1.1V	●	2	6		2	6		mA
Output Source Current	$V_{PIN\ 2}$ = 2.3V, $V_{PIN\ 1}$ = 5.0V	●	-0.5	-0.8		-0.5	-0.8		mA
V_{OUT}High (See Note 11)	$V_{PIN\ 2}$ = 2.3V, R_L = 15k	●	5.0	6.0		5.0	6.0		V
V_{OUT}Low	$V_{PIN\ 2}$ = 2.7V, R_L = 15k	●		0.7	1.1		0.7	1.1	V
Current Sense Section									
Gain	(Notes 8 and 9)	●	2.85	3	3.15	2.85	3	3.15	V/V
Maximum Input Signal	$V_{PIN\ 1}$ = 5.0 (Note 8)	●	0.9	1	1.1	0.9	1.0	1.1	V
Supply Voltage Rejection	V_C = 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	I_{SINK} = 20mA	●		0.1	0.4		0.1	0.4	V
	I_{SINK} = 200mA	●		1.5	2.2		1.5	2.2	V
Output High Level	I_{SOURCE} = 20mA	●	13	13.5		13	13.5		V
	I_{SOURCE} = 200mA	●	12	13.5		12	13.5		V
Rise Time	C_L = 1nF	●		50	150		50	150	ns
Fall Time	C_L = 1nF	●		50	150		50	150	ns
UVLO Saturation	V_{CC} = 6V, I_L = 1mA	●		0.7	1.1		0.7	1.1	V
Under-voltage Lockout Section									
Upper Threshold	IPX842A/IPX844A Series	●	15	16	17	14.5	16	17.5	V
(V_{CC})	IPX843A/IPX845A Series	●	7.8	8.4	9	7.8	8.4	9	V
Lower Threshold	IPX842A/IPX844A Series	●	9	10	11	8.5	10	11.5	V
(V_{CC})	IPX843A/IPX845A 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	$V_{PIN\ 2}$ = 0V 42/44 Series	●		11	15		11	15	mA
	$V_{PIN\ 3}$ = 0V 43/45 Series	●		14	17		14	17	mA
V_{CC} Zener Voltage	I_{CC} = 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 6. These parameters, although guaranteed over the recommended conditions,are not 100% tested in production.

Note 7. Adjust V_{CC} above start threshold before setting at required level.

Note 8. Parameter measured at trip point of latch with $V_{PIN\ 2}$ = 0V.

Note 9. Gain defined as

$$A = \frac{\triangle V_{PIN\ 1}}{\triangle V_{PIN\ 3}} \quad ;0 \leqslant V_{PIN\ 3} \leqslant 0.8$$

Note 10. The output frequency is half the oscillator frequency for IPX844A and IPX845A Series.

Note 11. V_{OH} MIN 4.6V for 42A, 43A.

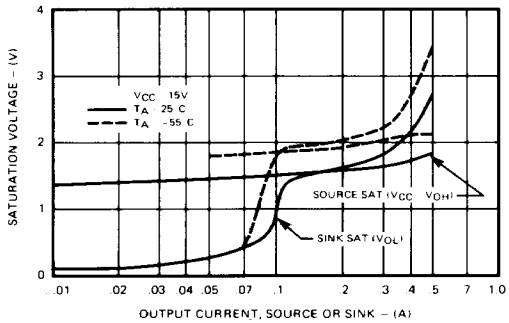
REGULATING PULSE WIDTH MODULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

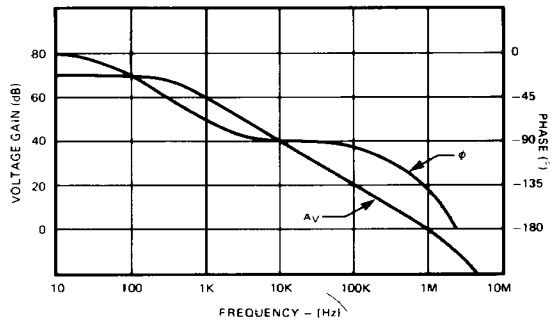
Parameter	Test Conditions		IP184XA IP284XA Min	IP184XA IP284XA Typ	IP184XA IP284XA Max	IP384XA Min	IP384XA Typ	IP384XA Max	Units
PWM Section									
Maximum Duty Cycle	IPX844A/IPX845A Series	●	47	48	50	46	48	50	%
Maximum Duty Cycle	IPX842A/IPX843A Series	●	95	97	100	95	97	100	%
Minimum Duty Cycle		●			0			0	%

TYPICAL PERFORMANCE CHARACTERISTICS

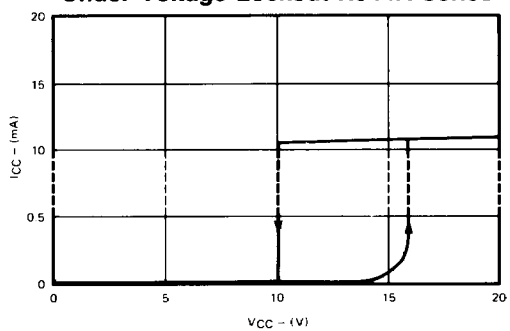
Output Saturation Characteristics



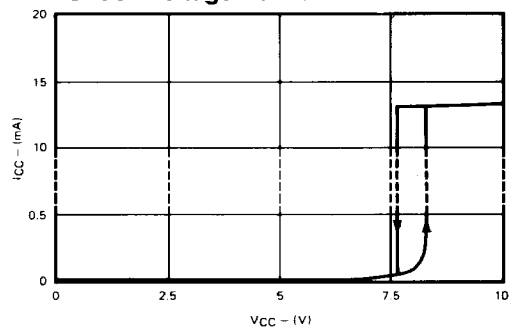
Error Amplifier Open-Loop Frequency Response



Under Voltage Lockout X844A Series



Under Voltage Lockout X845A Series



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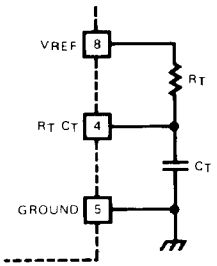
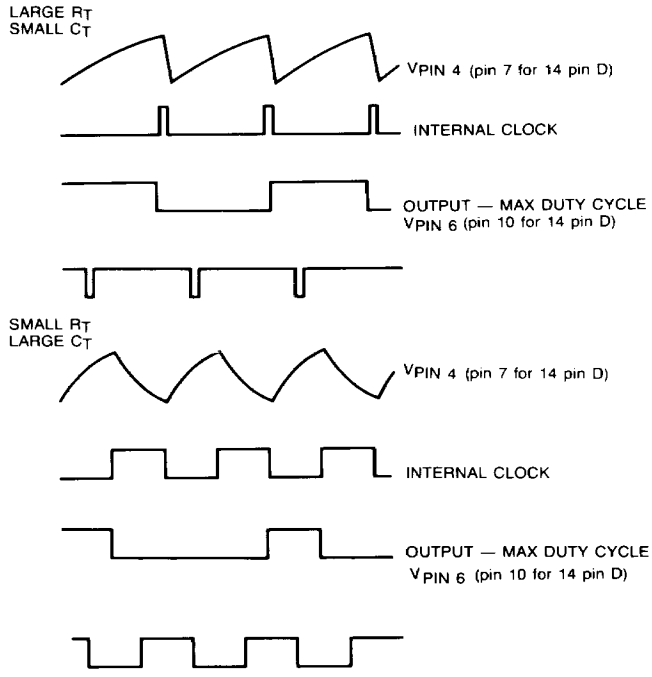
Oscillator Waveforms and Maximum Duty Cycle





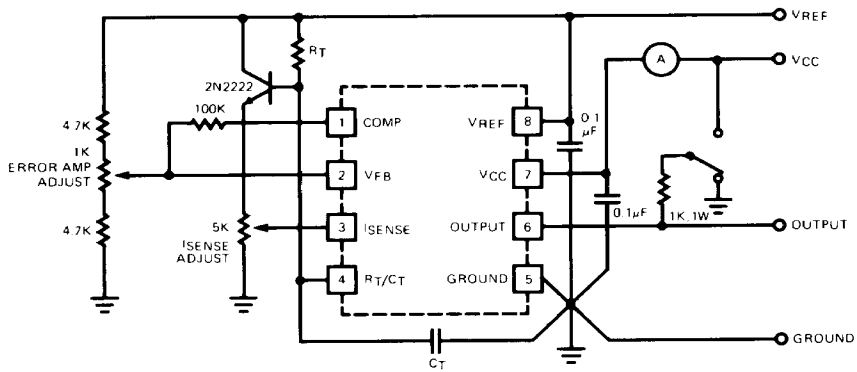
Oscillator timing capacitor, C_T is charged by V_{REF} through R_T and discharged by an internal current source. During the discharge time, the internal clock signal blanks the output to the low state. Selection of R_T and C_T therefore determines both oscillator frequency and maximum duty cycle. Charge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

$$t_c \approx 0.55\, R_T C_T$$

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

Frequency, then is: $f = (t_c + t_d)^{-1}$ 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 wave form and apply an adjustable ramp to pin 3.

REGULATING PULSE WIDTH MODULATORS

ORDER INFORMATION

Part Number	Temperature Range	Package
IP1842AJ	−55°C to +125°C	8 Pin Ceramic DIP
IP2842AJ	−25°C to + 85°C	8 Pin Ceramic DIP
IP2842AN	−25°C to + 85°C	8 Pin Plastic DIP
IP2842AD	−25°C to + 85°C	8 Pin Plastic (150) SOIC
IP2842AD-14	−25°C to + 85°C	14 Pin Plastic (150) SOIC
IP3842AJ	0°C to + 70°C	8 Pin Ceramic DIP
IP3842AN	0°C to + 70°C	8 Pin Plastic DIP
IP3842AD	0°C to + 70°C	8 Pin Plastic (150) SOIC
IP3842AD-14	0°C to + 70°C	14 Pin (150) SOIC
IP1843AJ	−55°C to +125°C	8 Pin Ceramic DIP
IP2843AJ	−25°C to + 85°C	8 Pin Ceramic DIP
IP2843AN	−25°C to + 85°C	8 Pin Plastic DIP
IP2843AD	−25°C to + 85°C	8 Pin Plastic (150) SOIC
IP2843AD-14	−25°C to + 85°C	14 Pin(150) SOIC
IP3843AJ	0°C to + 70°C	8 Pin Ceramic DIP
IP3843AN	0°C to + 70°C	8 Pin Plastic DIP
IP3843AD	0°C to + 70°C	8 Pin Plastic (150) SOIC
IP3843AD-14	0°C to + 70°C	14 Pin (150) SOIC
IP1844AJ	−55°C to +125°C	8 Pin Ceramic DIP
IP2844AJ	−25°C to + 85°C	8 Pin Ceramic DIP
IP2844AN	−25°C to + 85°C	8 Pin Plastic DIP
IP2844AD	−25°C to + 85°C	8 Pin Plastic (150) SOIC
IP2844AD-14	−25°C to + 85°C	14 Pin Plastic (150) SOIC
IP3844AJ	0°C to + 70°C	8 Pin Ceramic DIP
IP3844AN	0°C to + 70°C	8 Pin Plastic DIP
IP3844AD	0°C to + 70°C	8 Pin Plastic (150) SOIC
IP3844AD-14	0°C to + 70°C	14 Pin (150) SOIC
IP1845AJ	−55°C to +125°C	8 Pin Ceramic DIP
IP2845AJ	−25°C to + 85°C	8 Pin Ceramic DIP
IP2845AN	−25°C to + 85°C	8 Pin Plastic DIP
IP2845AD	−25°C to + 85°C	8 Pin Plastic (150) SOIC
IP2845AD-14	−25°C to + 85°C	14 Pin(150) SOIC
IP3845AJ	0°C to + 70°C	8 Pin Ceramic DIP
IP3845AN	0°C to + 70°C	8 Pin Plastic DIP
IP3845AD	0°C to + 70°C	8 Pin Plastic (150) SOIC
IP3845AD-14	0°C to + 70°C	14 Pin (150) SOIC