

INTEGRATED POWER

SEMICONDUCTORS, LTD.

Advanced Regulating Pulse Width Modulators

T-58-11-31

Section 2 - Pulse Width Modulators
IP1526A, IP2526A, IP3526A

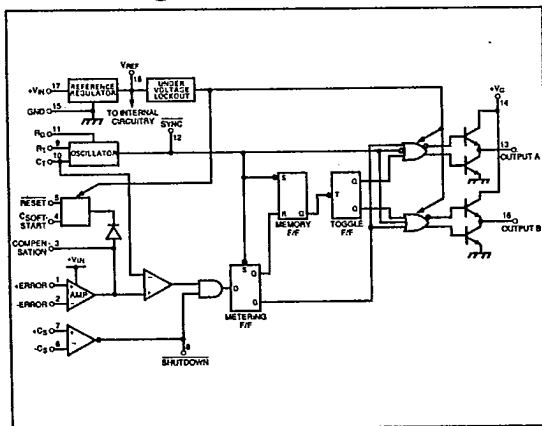
Description

The IP1526A series of high performance pulse width modulator circuits is a direct replacement for the IP1526 series in all applications and features improved performance in several key areas. Functions included are a temperature compensated voltage reference, sawtooth oscillator, error amplifier, PWM comparator, pulse metering and steering logic, and two low impedance power drivers. Also included are protective features such as soft-start, undervoltage lockout, digital current limiting, double pulse inhibit, a data latch for single pulse metering, adjustable dead-time and provision for symmetry correction inputs. For ease of interface, all digital control ports are TTL and B-series CMOS compatible. Active LOW logic design allows wired-OR connections for maximum flexibility. This versatile device can be used to implement single-ended or push-pull switching regulators of either polarity, both transformerless and transformer coupled.

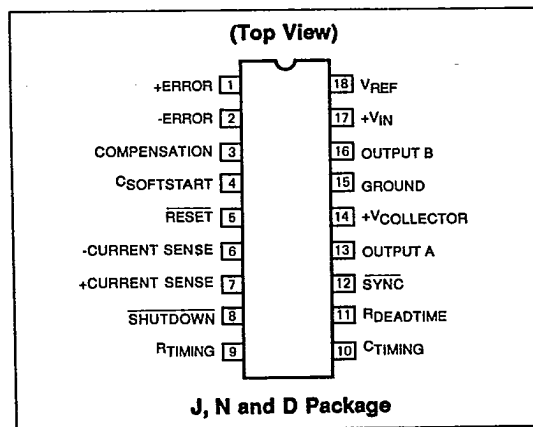
Features

- Low drain current
- 8 to 35 volt operation
- High performance 5V ±1% reference
- Low t.c. 1Hz to 400kHz oscillator
- Dual 100 mA source/sink outputs
- Digital current limiting
- Double pulse suppression
- Programmable deadtime
- Accurate current limit sense voltage
- Undervoltage lockout
- Single pulse metering
- Programmable soft-start
- Wide current limit common mode range
- TTL/CMOS compatible logic ports
- Symmetry correction capability
- Guaranteed 6 unit synchronization

Block Diagram



Connections



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Absolute Maximum Ratings

Input Voltage (+V _{IN})	+40V	Logic Sink Current	15mA
Collector Supply Voltage (+V _C)	+40V	Power Dissipation	
Logic Inputs	-0.3V to +5.5V	T _A = +25°C (Note 1)	1000mW
Analog Input	-0.3V to +V _{IN}	T _C = +25°C (Note 2)	3000mW
Source/Sink Load Current (Each output, continuous)	200mA	Operating Junction Temperature	+150°C
Reference Load Current	Internally Limited	Storage Temperature Range	-65°C to +150°C
		Lead Temperature (Soldering, 10 sec.)	+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 3)

Input Voltage	+8V to +35V	Oscillator Timing Resistor	2kΩ to 150kΩ
Collector Supply Voltage	+4.5V to +35V	Oscillator Timing Capacitor	470pF to 20 μF
Sink/Source Load Current (each output)	0 to 100 mA	Available Deadtime Range at 40kHz	3% to 50%
Reference Load Current	-5mA to 20 mA	Operating Ambient Temperature Range	
Oscillator Frequency Range	1Hz to 400kHz	IP1526A	-55°C to +125°C
		IP2526A	-25°C to +85°C
		IP3526A	0°C to +70°C

Note 1. Derate at 10 mW/°C for ambient temperatures above +50°C.

Note 2. Derate at 24 mW/°C for case temperatures above +25°C.

Note 3. Range over which the device is functional and parameter limits are guaranteed.

Electrical Characteristics

(+V_{IN} = 15V unless otherwise specified)

Parameter	Conditions	IP1526A/2526A			IP3526A			Units	
		Min	Typ	Max	Min	Typ	Max		
Reference Section									
Output Voltage		4.95	5.00	5.05	4.90	5.00	5.10	V	
Line Regulation	+V _{IN} = 8 to 35V	•	2	10		2	15	mV	
Load Regulation	I _L = -5 to +20 mA	•	5	10		5	20	mV	
Temperature Stability (Note 4)	Over Operating Range	•	15	50		15	50	mV	
Total Output Voltage Range		•	4.90	5.00	5.10	4.85	5.00	5.15	V
Short Circuit Current	V _{REF} = 0V	•	30	80	140	30	80	140	mA
Undervoltage Lockout									
RESET Output Voltage	V _{REF} = 3.8 V	•		0.2	0.4		0.2	0.4	V
RESET Output Voltage	V _{REF} = 4.8 V	•	2.4	4.8		2.4	4.8		V
Oscillator Section (Note 5)									
Initial Accuracy				±3	±8		±3	±8	%
Voltage Stability	+V _{IN} = 8 to 35 V	•		0.5	1		0.5	1	%
Temperature Stability (Note 4)	Over Operating Range	•		1	6		1	3	%
Minimum Frequency	R _T = 150 kΩ, C _T = 0.2 μF	•			100			100	Hz
Maximum Frequency	R _T = 2 kΩ, C _T = 470 pF	•	400	650		400	750		kHz



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Electrical Characteristics (Cont.)

Parameter	Conditions	IP1526A/2526A			IP3526A			Units	
		Min	Typ	Max	Min	Typ	Max		
Sawtooth Peak Voltage	+V _{IN} = 35V	*	3.0	3.5		3.0	3.5	V	
Sawtooth Valley Voltage	+V _{IN} = 8V	*	0.3	1.0		0.3	1.0	V	
Error Amplifier Section (Note 6)									
Input Offset Voltage	R _S ≤ 2 kΩ	*	2	5		2	10	mV	
Input Bias Current		*	-350	-1000		-350	-2000	nA	
Input Offset Current		*	35	100		35	200	nA	
DC Open Loop Gain	R _L ≥ 10 MΩ	*	64	72		60	72	dB	
High Output Voltage	V _{PIN 1} - V _{PIN 2} ≥ 150 mV, I _{SOURCE} = 100 μA	*	3.6	4.2		3.6	4.2	V	
Low Output Voltage	V _{PIN 2} - V _{PIN 1} ≥ 150 mV, I _{SINK} = 100 μA	*		0.2	0.4		0.2	0.4	V
Common Mode Rejection	R _S ≤ 2 kΩ	*	70	94		70	94	dB	
Supply Voltage Rejection	+V _{IN} = 12 to 18 V	*	66	80		66	80	dB	
PWM Comparator (Note 5)									
Minimum Duty Cycle	V _{PIN 2} - V _{PIN 1} ≥ 150mV	*		0			0	%	
Maximum Duty cycle	V _{PIN 1} - V _{PIN 2} ≥ 150mV	*	45	49		45	49	%	
Digital Ports (SYNC, SHUTDOWN and RESET)									
HIGH Output Voltage	I _{SOURCE} = 40 μA	*	2.4	4.0		2.4	4.0	V	
LOW Output Voltage	I _{SINK} = 3.6 mA	*		0.2	0.4		0.2	0.4	V
HIGH Input Current	V _{IH} = +2.4 V	*		-125	-200		-125	-200	μA
LOW Input Current	V _{IL} = +0.4 V	*		-225	-360		-225	-360	μA
Current Limit Comparator (Note 7)									
Sense Voltage	R _S ≤ 50 Ω	*	90	100	110	80	100	120	mV
Input Bias Current		*		-3	-10		-3	-10	μA
Soft-Start Section									
Error Clamp Voltage	RESET = +0.4 V	*		0.1	0.4		0.1	0.4	V
C _S Charging Current	RESET = +2.4 V	*	50	100	150	50	100	150	μA
Output Drivers (Each Output) (Note 8)									
HIGH Output Voltage	I _{SOURCE} = 20 mA	*	12.5	13.5		12.5	13.5	V	
	I _{SOURCE} = 100 mA	*	12	13		12	13	V	
LOW Output Voltage	I _{SINK} = 20 mA	*		0.2	0.3		0.2	0.3	V
	I _{SINK} = 100 mA	*		1.2	2.0		1.2	2.0	V
Collector Leakage	V _C = 40 V	*		50	150		50	150	μA
Rise Time	C _L = 1000 pF	*		0.3	0.6		0.3	0.6	μs
Fall Time	C _L = 1000 pF	*		0.1	0.2		0.1	0.2	μs
Power Consumption (Note 9)									
Standby Current	SHUTDOWN = +0.4 V, V _{IN} = 35 V	*		14	20		14	20	mA

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

- Note 4. These parameters, although guaranteed over the recommended operating conditions, are not 100% tested in production.
- Note 5. FOSC = 40 kHz (R_T = 4.12 kΩ ± 1%, C_T = .01 μF ± 1%, R_D = 0Ω).
- Note 6. V_{CM} = 0 to +5.2V.
- Note 7. V_{CM} = 0 to +12V.
- Note 8. V_C = +15V.
- Note 9. +V_{IN} = +35V, R_T = 4.12kΩ.



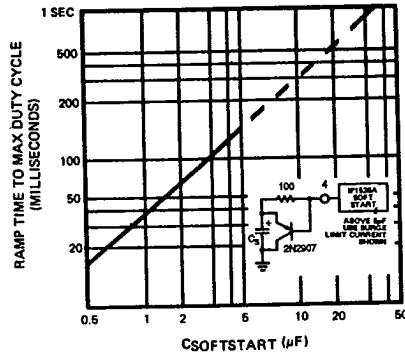
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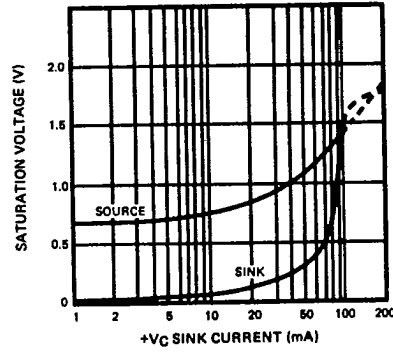
Typical Performance Characteristics

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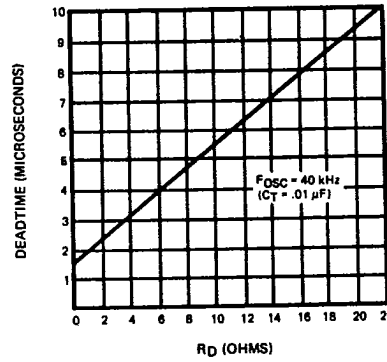
Soft-start Time vs. C_S



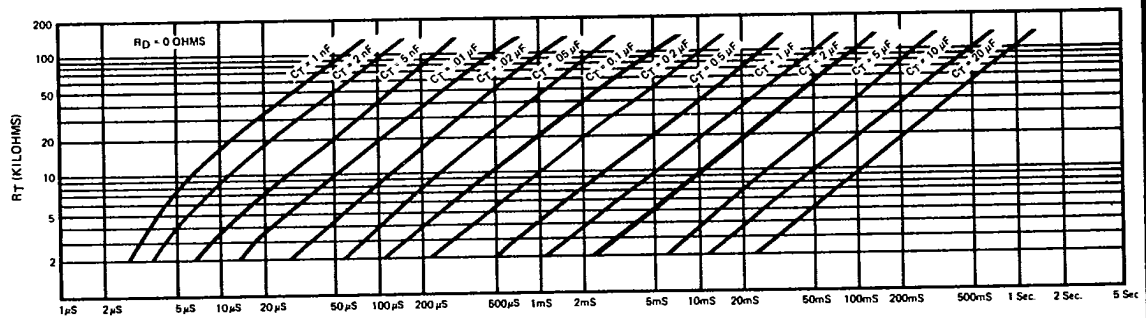
Output Driver Saturation Voltage



Output Driver Deadtime vs. R_D Value

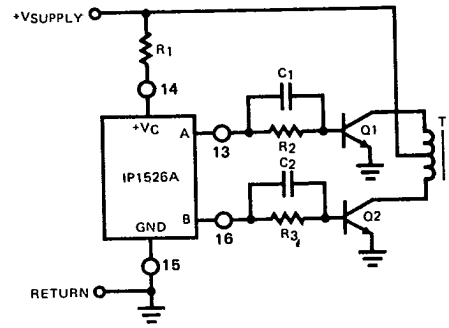


Oscillator Period vs. R_T and C_T

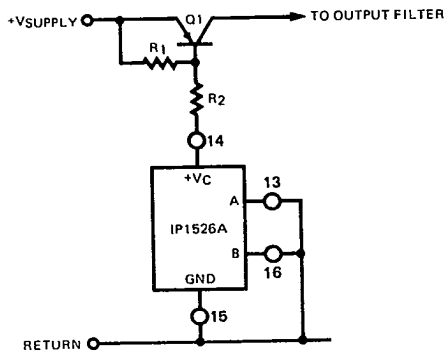


Applications Information

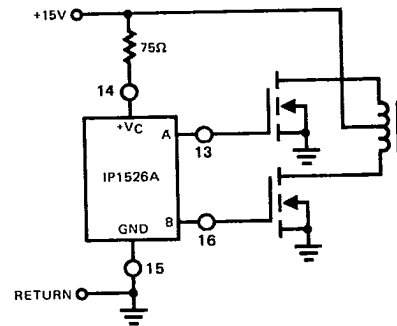
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Push-Pull Configuration



Single-Ended Configuration



Driving N-Channel Power MOSFETS

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Order Information

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Part Number	Temperature Range	Package
IP1526AJ	-55°C to +125°C	18 Pin Ceramic DIP
IP2526AD	-25°C to +85°C	18 Pin Plastic SOIC
IP2526AJ	-25°C to +85°C	18 Pin Ceramic DIP
IP2526AN	-25°C to +85°C	18 Pin Plastic DIP
IP3526AD	0°C to +70°C	18 Pin Plastic SOIC
IP3526AJ	0°C to +70°C	18 Pin Ceramic DIP
IP3526AN	0°C to +70°C	18 Pin Plastic DIP

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