

REGULATING PULSE WIDTH MODULATORS

IP1526, IP3526

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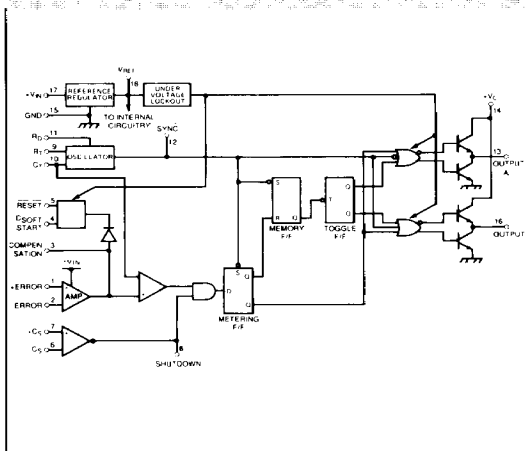
DESCRIPTION

The IP1526 and IP3526 high performance monolithic pulse width modulator circuits are designed for fixed-frequency switching regulators and other power control applications. Included in an 18-pin dual-in-line package are a temperature compensated voltage reference, sawtooth oscillator, error amplifier, pulse width modulator, pulse metering and steering logic, and two low impedance power drivers. Also included are protective features such as soft-start and under-voltage lockout, digital current limiting, double pulse inhibit, a data latch for single pulse metering, adjustable deadtime, 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.

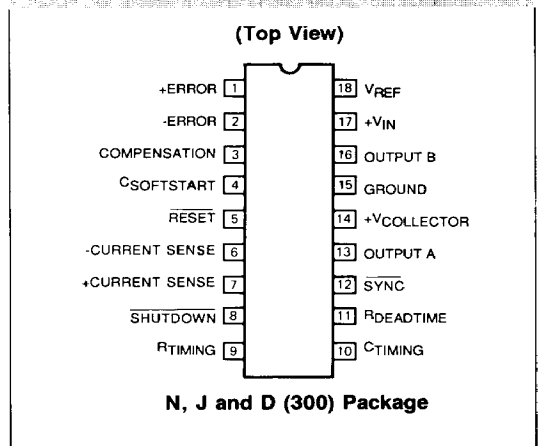
FEATURES

- 8 to 35 volt operation
- 5 volt reference trimmed to $\pm 1\%$
- 1Hz to 400kHz oscillator range
- Dual 100 mA source/sink outputs
- Digital current limiting
- Double pulse suppression
- Programmable deadtime
- 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



REGULATING PULSE WIDTH MODULATORS

ABSOLUTE MAXIMUM RATINGS

Input Voltage (+ V _{IN})	+40V	Logic Sink Current	15mA
Collector Supply Voltage	+40V	Power Dissipation at	
Logic Inputs	-0.3V to +5.5V	T _A = +25°C (Note 1)	1000mW
Analog Inputs	-0.3V to +V _{IN}	T _C = +25°C (Note 2)	3000mW
Source/Sink Load Current	200mA	Operating Junction Temperature	-55°C to +150°C
Reference Load Current	Internally Limited	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 3)

Input Voltage	+8V to +35V	Oscillator Timing Resistor	2kΩ to 150kΩ
Collector Voltage	+4.5V to +35V	Oscillator Timing Capacitor	470pF to 20μF
Sink/Source Load Current (each output)	0 to 100mA	Available Deadtime Range at 40kHz	3% to 50%
Reference Load Current	0 to 20mA	Operating Ambient Temperature Range	
Oscillator Frequency Range	1Hz to 400kHz	IP1526	-55°C to +125°C
		IP3526	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	IP1526			IP3526			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	+VIN = 8 to 35V	•		2	20		2	30	mV
Load Regulation	IL = 0 to 20 mA	•		5	30		5	50	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	VREF = 0 V	•	25	80	140	25	80	140	mA
Undervoltage Lockout									
RESET Output Voltage	VREF = 3.8 V	•		0.2	0.4		0.2	0.4	V
RESET Output Voltage	VREF = 4.8 V	•	2.4	4.8		2.4	4.8		V
Oscillator Section (Note 5)									
Initial Accuracy				±3	±8		±3	±8	%
Voltage Stability	+VIN = 8 to 35 V	•		0.5	1		0.5	1	%
Temperature Stability (Note 4)	Over Operating Range	•		3	10		7	10	%
Minimum Frequency	RT = 150 kΩ, CT = 0.2 μF	•			100			100	Hz
Maximum Frequency	RT = 2 kΩ, CT = 470 pF	•	400			400			kHz



REGULATING PULSE WIDTH MODULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameter	Conditions		IP1526			IP3526			Units
			Min	Typ	Max	Min	Typ	Max	
Sawtooth Peak Voltage	$+V_{IN} = 35\text{ V}$	•		3.0	3.5		3.0	3.5	V
Sawtooth Valley Voltage	$+V_{IN} = 8\text{ V}$		0.5	1.0			1.0		V
Error Amplifier Section (Note 6)									
Input Offset Voltage	$R_S \leq 2\text{ k}\Omega$	•		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	$R_L \geq 10\text{ M}\Omega$	•	64	72		60	72		dB
High Output Voltage	$V_{PIN\ 1} - V_{PIN\ 2} \geq 150\text{ mV}$, $I_{SOURCE} = 100\text{ }\mu\text{A}$	•	3.6	4.2		3.6	4.2		V
Low Output Voltage	$V_{PIN\ 2} - V_{PIN\ 1} \geq 150\text{ mV}$, $I_{SINK} = 100\text{ }\mu\text{A}$	•		0.2	0.4		0.2	0.4	V
Common Mode Rejection	$R_S \leq 2\text{ k}\Omega$	•	70	94		70	94		dB
Supply Voltage Rejection	$+V_{IN} = 12\text{ to }18\text{ V}$	•	66	80		66	80		dB
PWM Comparator (Note 5)									
Minimum Duty Cycle	$V_{PIN\ 1} - V_{PIN\ 2} \geq 150\text{ mV}$	•			0			0	%
Maximum Duty cycle	$V_{PIN\ 1} - V_{PIN\ 2} \geq 150\text{ mV}$	•	45	49		45	49		%
Digital Ports (SYNC, SHUTDOWN and RESET)									
HIGH Output Voltage	$I_{SOURCE} = 40\text{ }\mu\text{A}$	•	2.4	4.0		2.4	4.0		V
LOW Output Voltage	$I_{SINK} = 3.6\text{ mA}$	•		0.2	0.4		0.2	0.4	V
HIGH Input Current	$V_{IH} = +2.4\text{ V}$	•		-125	-200		-125	-300	μA
LOW Input Current	$V_{IL} = +0.4\text{ V}$	•		-225	-360		-225	-500	μA
Current Limit Comparator (Note 7)									
Sense Voltage	$R_S \leq 50\text{ }\Omega$	•	90	100	110	80	100	120	mV
Input Bias Current		•		-3	-10		-3	-10	μA
Soft-Start Section									
Error Clamp Voltage	$\overline{\text{RESET}} = +0.4\text{ V}$	•		0.1	0.4		0.1	0.4	V
C_S Charging Current	$\overline{\text{RESET}} = +2.4\text{ V}$	•	50	100	150	50	100	150	μA
Output Drivers (Each Output) (Note 8)									
HIGH Output Voltage	$I_{SOURCE} = 20\text{ mA}$	•	12.5	13.5		12.5	13.5		V
	$I_{SOURCE} = 100\text{ mA}$	•	12	13		12	13		V
LOW Output Voltage	$I_{SINK} = 20\text{ mA}$	•		0.2	0.3		0.2	0.3	V
	$I_{SINK} = 100\text{ mA}$	•		1.2	2.0		1.2	2.0	V
Collector Leakage	$V_C = 40\text{ V}$	•		50	150		50	150	μA
Rise Time	$C_L = 1000\text{ pF}$	•		0.3	0.6		0.3	0.6	μsec
Fall Time	$C_L = 1000\text{ pF}$	•		0.1	0.2		0.1	0.2	μsec
Power Consumption (Note 9)									
Standby Current	$\text{SHUTDOWN} = +0.4\text{ V}$	•		18	30		18	30	mA

The • denotes the specifications which apply over the full operating temperature range, all others apply at $T_J = 25^\circ\text{C}$ unless otherwise specified.

Note 4. These parameters, although guaranteed over the recommended operating conditions, are not 100% tested in production.

Note 5. $F_{OSC} = 40\text{ kHz}$ ($R_T = 4.12\text{ k}\Omega \pm 1\%$, $C_T = 0.01\text{ }\mu\text{F} \pm 1\%$, $R_D = 0\Omega$).

Note 6. $V_{CM} = 0\text{ to }+5.2\text{ V}$.

Note 7. $V_{CM} = 0\text{ to }+12\text{ V}$.

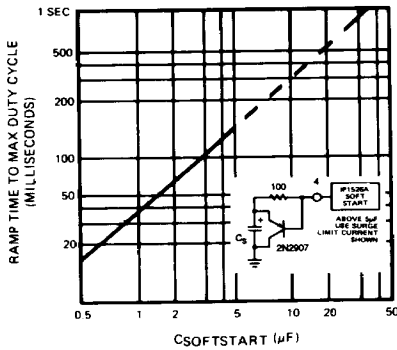
Note 8. $V_C = +15\text{ V}$.

Note 9. $+V_{IN} = +35\text{ V}$, $R_T = 4.12\text{ k}\Omega$.

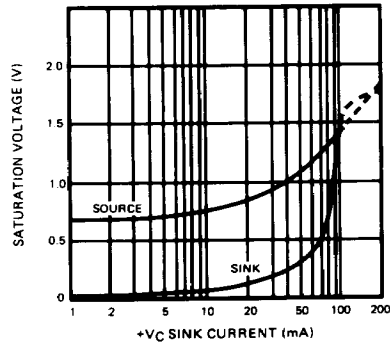
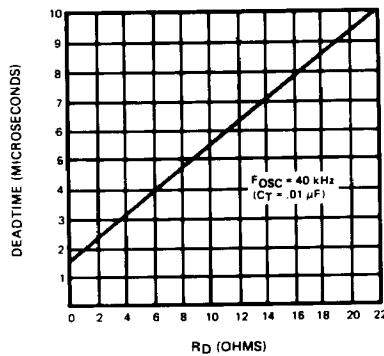
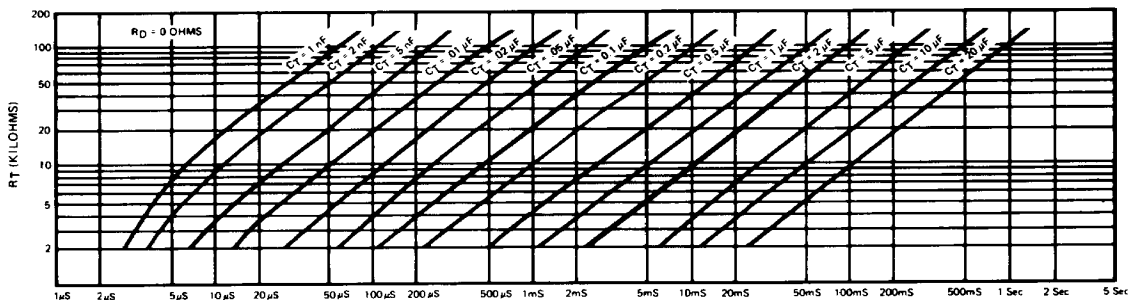


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TYPICAL PERFORMANCE CHARACTERISTICS

Soft-start Time vs. C_S 

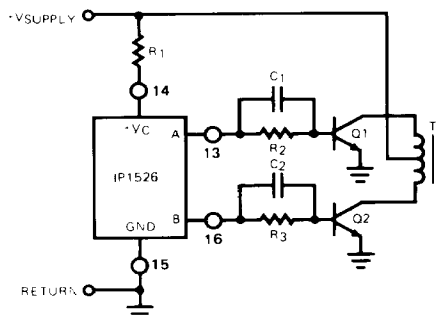
Output Driver Saturation Voltage

Output Driver Deadtime vs. R_D ValueOscillator Period vs. R_T and C_T 

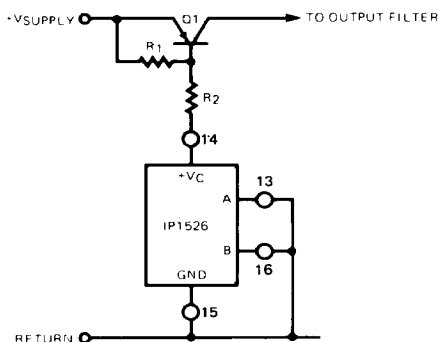
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APPLICATIONS INFORMATION

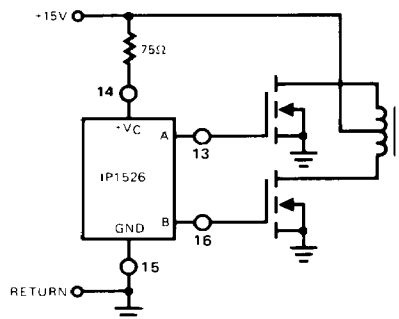
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Push-Pull Configuration



Single-Ended Configuration



Driving N-Channel Power MOSFETS

ORDER INFORMATION

Part Number

IP1526J
IP3526D
IP3526J
IP3526N

Temperature Range

-55°C to +125°C
0°C to +70°C
0°C to +70°C
0°C to +70°C

Package

18 Pin Ceramic DIP
18 Pin Plastic (300) SOIC
18 Pin Ceramic DIP
18 Pin Plastic DIP

