

4825898 INTEGRATED POWER

82D 00160 D

INTEGRATED POWER

SEMICONDUCTORS, LTD.

Advanced Regulating Pulse Width Modulator

T-58-11-31

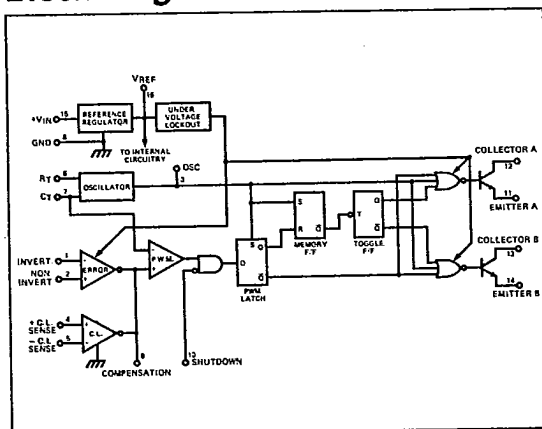
Description

The IP1524B is a pulse width modulator for switching power supplies which features improved performance over industry standards like the SG1524. A direct pin-for-pin replacement for the earlier device, it combines advanced processing techniques and circuit design to provide improved reference accuracy, and extended common mode range at the error amplifier and current limit inputs. A DC-coupled flip-flop eliminates triggering and glitch problems, and a PWM data latch prevents edge oscillations. The circuit incorporates true digital shutdown for high speed response, while an undervoltage lockout circuit prevents spurious outputs when the supply voltage is too low for stable operation. Full double-pulse suppression logic insures alternating output pulses when the shutdown pin is used for pulse-by-pulse current limiting.

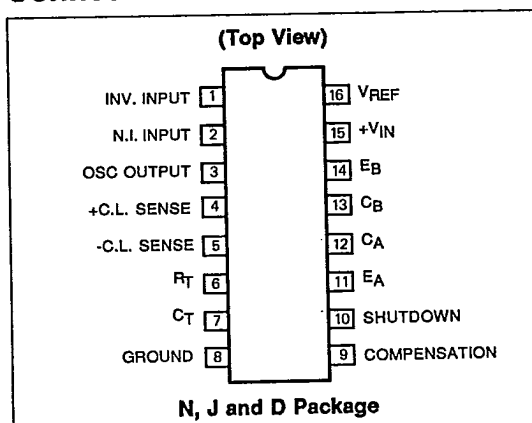
Features

- Pin compatible with 1524 series
- 7 to 40 volt operation
- 5 volt reference trimmed to $\pm 1\%$
- Undervoltage lockout
- Excellent external sync capability
- Wide current limit common mode range
- +5V error amplifier common mode
- PWM data latch
- Full double-pulse suppression logic
- 50ns shutdown function
- Dual 200mA, 60 volt output transistors
- Fully specified over temperature

Block Diagram



Connections



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Section 2 - Pulse Width Modulators
IP1524B, IP2524B, IP3524B

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Absolute Maximum Ratings

Input Voltage (+V _{IN})	+40V	Power Dissipation at T _A = +25°C (Note 1)	1000mW
Collector Voltage	+60V	T _C = +25°C (Note 2)	2000mW
Logic Inputs	-0.3V to +5.5V	Operating Junction Temperature	+150°C
Current Limit Sense Inputs	-0.3V to +V _{IN}	Storage Temperature Range	-65°C to +150°C
Oscillator Charging Current	5mA	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 (+V _{IN})	+7V to 40V	Reference Load Current	0 to 20 mA
Collector Voltage	0V to +60V	Oscillator Charging Current	25 µA to 1.8 mA
Error Amp Common Mode Range	+2.3V to V _{REF}	Oscillator Frequency Range	50Hz to 500kHz
Current Limit Sense Common Mode Range	0V to V _{IN} -2.5V	Oscillator Timing Resistor (R _T)	2kΩ to 150kΩ
Output Current (each transistor)	0 to 200 mA	Oscillator Timing Capacitor (C _T)	1nF to 0.1µF
		Operating Ambient Temperature Range	
		IP1524B	-55°C to +125°C
		IP2524B	-25°C to +85°C
		IP3524B	0°C to +70°C

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

Note 2. Derate at 16 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} = 20V, I_{REF} = 0 mA unless otherwise specified)

		IP1524B/IP2524B			IP3524B			Units	
Parameter	Conditions	Min	Typ	Max	Min	Typ	Max		
Turn-on Characteristics									
V _{IN} Undervoltage Threshold	V _{IN} Rising	•	4.3	5.2	6.5	4.3	5.2	6.5	V
Turn-on Hysteresis		•	0.1	0.3	0.6	0.1	0.3	0.6	V
Operating Current	V _{IN} = 7 to 40V	•		7	10		7	10	mA
Reference Section									
Output Voltage			4.95	5.00	5.05	4.90	5.00	5.10	V
Output Voltage	V _{IN} = 7 to 40V, I _L = 0 to 20mA	•	4.90		5.10	4.85		5.15	V
Line Regulation	V _{IN} = 7 to 40V	•		1	10		1	15	mV
Load Regulation	I _L = 0 to 20 mA	•		5	15		5	25	mV
Temperature Stability (Note 4)	Over Operating Range	•		15	50		15	50	mV
Short Circuit Current	V _{REF} = 0V	•	25	70	120	25	70	120	mA
Long Term Stability (Note 4)				1	10		1		mV/yr
Oscillator Section (Note 5)									
Initial Accuracy			41	43	45	39	43	47	kHz
Voltage Stability	V _{IN} = 7 to 40 V	•		0.1	1		0.1	1	%
Temperature Stability (Note 4)	Over Operating Range	•		1	2		1	2	%

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Electrical Characteristics (Cont.)

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Section 2 - Pulse Width Modulators
IP1524B, IP2524B, IP3524B

Parameter	Conditions		IP1524B/IP2524B			IP3524B			Units
			Min	Typ	Max	Min	Typ	Max	
Minimum Frequency	$R_T = 150\text{ k}\Omega$, $C_T = 0.1\text{ }\mu\text{F}$	•		80	140		80	140	Hz
Maximum Frequency	$R_T = 2\text{ k}\Omega$, $C_T = 470\text{ pF}$	•	500	700		500	700		kHz
Clock Amplitude	Output, Pin 3 $C_T = 0.01\text{ }\mu\text{F}$	•	3.0	4.0		3.0	4.0		V
Clock Pulse Width	Output, Pin 3 $C_T = 0.01\text{ }\mu\text{F}$	•	0.4	0.5	1.0	0.4	0.5	1.0	μs
Sawtooth Peak Voltage	$C_T = 0.01\text{ }\mu\text{F}$	•		3.7	4.0		3.7	4.0	V
Sawtooth Valley Voltage	$C_T = 0.01\text{ }\mu\text{F}$	•	0.6	1	1.1	0.6	1	1.1	V
Sawtooth Valley T.C.				-1.0			-1.0		mV/ $^{\circ}\text{C}$
Error Amplifier Section									
Input Offset Voltage	$V_{cm} = 2.3\text{ V to }V_{REF}$	•		0.1	5		2	10	mV
Input Bias Current	$V_{cm} = 2.3\text{ V to }V_{REF}$	•		1	5		1	10	μA
Input Offset Current	$V_{cm} = 2.3\text{ V to }V_{REF}$	•		0.1	1		0.1	1	μA
DC Open Loop Gain	$\Delta V_O = 1\text{ to }3\text{ V}$, $R_L \geq 10\text{ M}\Omega$	•	60	75		60	75		dB
Common Mode Rejection	$V_{cm} = 2.3\text{ V to }V_{REF}$	•	70	90		70	90		dB
Supply Voltage Rejection	$V_{IN} = 7\text{ to }40\text{ V}$	•	76	120		76	120		dB
Output Low Level	$I_{SINK} = 100\text{ }\mu\text{A}$	•		0.2	0.5		0.2	0.5	V
Output High Level	$I_{SOURCE} = 100\text{ }\mu\text{A}$	•	3.8	4.2		3.8	4.2		V
Gain Bandwidth Product (Note 4)			1	2		1	2		MHz
PWM Comparator									
Minimum Duty Cycle	$V_{PIN\ 1} - V_{PIN\ 2} \geq 150\text{ mV}$	•			0			0	%
Maximum Duty Cycle	$V_{PIN\ 2} - V_{PIN\ 1} \geq 150\text{ mV}$	•	45	49		45	49		%
Current Limit Amplifier									
Sense Voltage	$V_{cm} = 0\text{ to }17.5\text{ V}$ $V_{IN} = 7\text{ to }40\text{ V}$	•	180	200	220	180	200	220	mV
Input Bias Current	$V_{cm} = 0\text{ to }17.5\text{ V}$, $V_{IN} = 7\text{ to }40\text{ V}$	•		-1	-10		-1	-10	μA
Shutdown Input									
High Input Voltage		•	2.0			2.0			V
High Input Current	$V_{SHUTDOWN} = 5.0\text{ V}$	•		0.1	1		0.1	1	mA
Low Input Voltage		•			0.6			0.6	V
Shutdown Delay	Pin 10 to Output			50			50		ns
Output Section (Each Transistor)									
Collector Leakage Current	$V_{CE} = 60\text{ V}$	•		0.1	20		0.1	20	μA
Collector Saturation Voltage	$I_C = 20\text{ mA}$	•		0.2	0.4		0.2	0.4	V
	$I_C = 200\text{ mA}$	•		1.0	2.2		1.0	2.2	V
Emitter Output Voltage	$I_E = 50\text{ mA}$	•	17	19		17	19		V
	$I_E = 200\text{ mA}$	•	16.5	18		16.5	18		V
Emitter Voltage Rise Time	$R_E = 2\text{ k}$			0.2	0.4		0.2		μs
Collector Voltage Fall Time	$R_C = 2\text{ k}$			0.1	0.2		0.1		μs

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 conditions, are not 100% tested in production.

Note 5. $R_T = 2.7\text{ k}\Omega$, $C_T = 0.01\text{ }\mu\text{F}$ unless otherwise specified.

IPS

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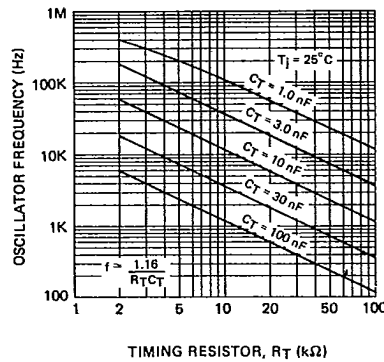
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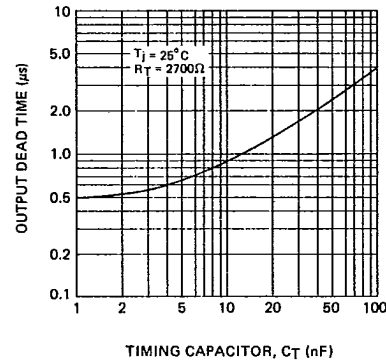
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Typical Performance Characteristics

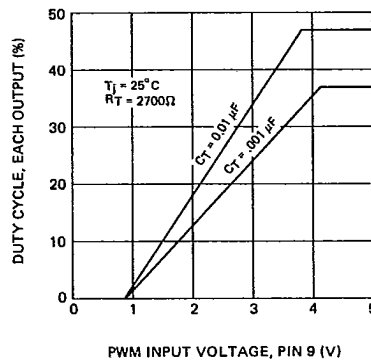
Oscillator Frequency vs. Timing Components



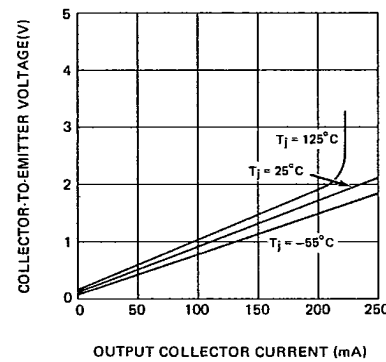
Output Dead Time vs. Timing Capacitor Value



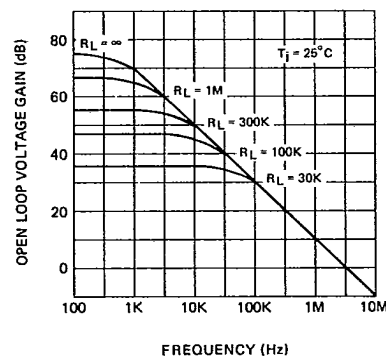
Pulse Width Modulator Transfer Function



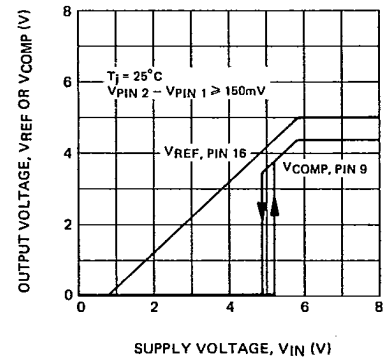
Output Saturation Voltage



Error Amplifier Voltage Gain vs. Frequency



Undervoltage Lockout Characteristic



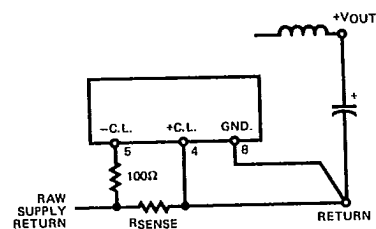
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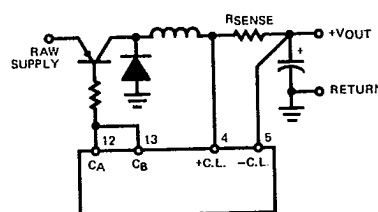
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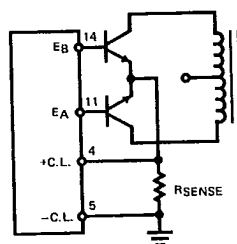
Applications Information



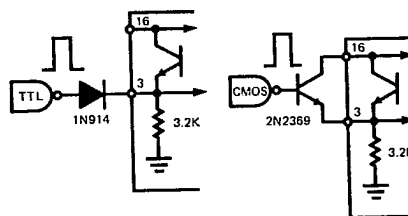
Current Sensing in the Ground Line



Current Sensing in the Output Line



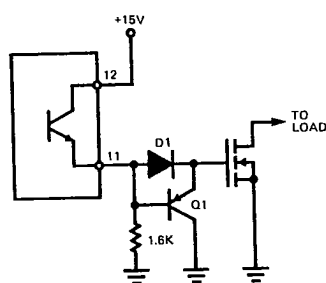
Sensing Primary Current with an Emitter Resistor



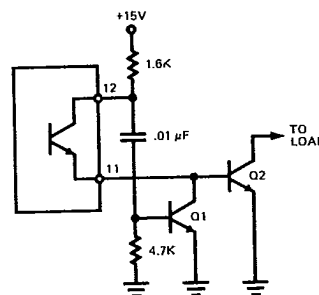
A. TTL LOGIC

B. 5VOLT CMOS LOGIC

Oscillator Sync to an External Clock



Driving Power MOSFETS



Driving Power Bipolar Transistors

Section 2 - Pulse Width Modulators
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Order Information

Part Number	Temperature Range	Package
IP1524BJ	-55°C to +125°C	16 Pin Ceramic DIP
IP2524BD	-25°C to +85°C	16 Pin Plastic SOIC
IP2524BJ	-25°C to +85°C	16 Pin Ceramic DIP
IP2524BN	-25°C to +85°C	16 Pin Plastic DIP
IP3524BD	0°C to +70°C	16 Pin Plastic SOIC
IP3524BJ	0°C to +70°C	16 Pin Ceramic DIP
IP3524BN	0°C to +70°C	16 Pin Plastic DIP

Section 2 - Pulse Width Modulators
IP1524B, IP2524B, IP3524B

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