

4825898 INTEGRATED POWER

82D 00166 D

INTEGRATED POWER SEMICONDUCTORS, LTD.

Regulating Pulse Width Modulators

T-58-11-31

Section 2 - Pulse Width Modulators
IP1525A, IP2525A, IP3525A, IP1527A, IP2527A, IP3527A

Description

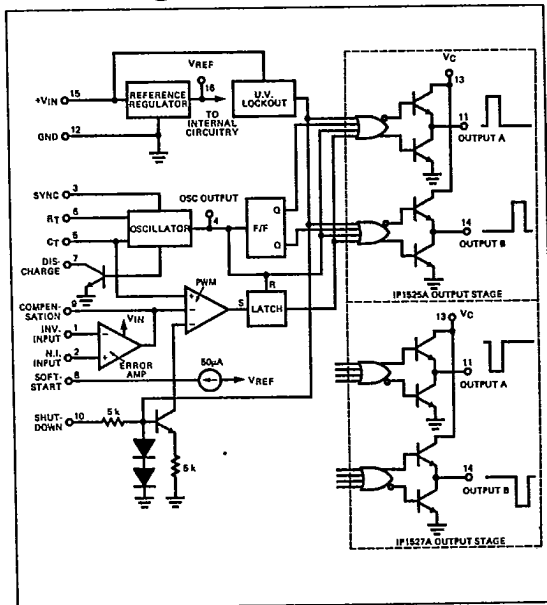
The IP1525A and IP1527A families of PWM switching regulator control circuits offer improved performance and lower parts count when used in designing switching power supplies. Included are 5.1 volt reference, error amplifier, adjustable dead-time oscillator with synchronization capability, latched PWM comparator, totem-pole output drivers, shutdown, soft-start, and undervoltage lockout.

The IP1525A and IP1527A differ only in output phasing. The IP1525A output is low when "off", while the IP1527A output is high when "off".

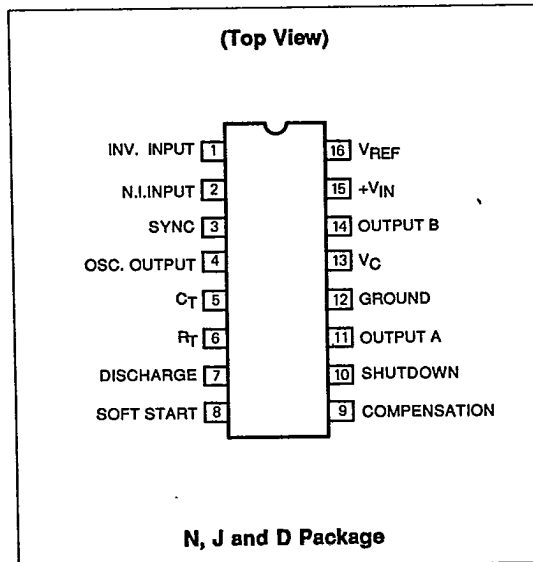
Features

- 8 to 35 volt operation
- 5.1 volt reference trimmed to $\pm 1\%$
- 100Hz to 500kHz oscillator range
- Separate oscillator sync terminal
- Adjustable deadtime control
- Internal soft-start
- Input undervoltage lockout
- Latching PWM to prevent multiple pulses
- Dual source/sink output drivers

Block Diagram



Connections



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Absolute Maximum Ratings

Input Voltage (+V _{IN})	+40V	Power Dissipation at	
Collector Supply Voltage (+V _C)	+40V	T _A = +25°C (Note 1)	1000mW
Logic Inputs	-0.3V to +5.5V	T _C = +25°C (Note 2)	2000mW
Analog Inputs	-0.3V to +V _{IN}	Operating Junction Temperature	-55°C to +150°C
Output Current, Source or Sink	500mA	Storage Temperature Range	-65°C to +150°C
Reference Output Load Current	Internally Limited	Lead Temperature (Soldering, 10 sec.)	+300°C
Oscillator Charging Current	5mA		

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 200kΩ
Collector Supply Voltage	+4.5V to +35V	Oscillator Timing Capacitor	470pF to 0.1μF
Sink/Source Load Current (steady state)	0 to 100mA	Deadtime Resistor Range	0 to 500Ω
Sink/Source Load Current (peak)	0 to 400mA	Operating Ambient Temperature Range	
Reference Load Current	0 to 20mA	IP1525A/IP1527A	-55°C to +125°C
Oscillator Frequency Range	100Hz to 400kHz	IP2525A/IP2527A	-25°C to +85°C
		IP3525A/IP3527A	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, unless otherwise specified)

		IP1525A/IP2525A IP1527A/IP2527A			IP3525A IP3527A			
Parameter	Test Conditions	Min	Typ	Max	Min	Typ	Max	Units
Reference Section								
Output Voltage		5.05	5.10	5.15	5.00	5.10	5.20	V
Line Regulation	V _{IN} = 8 to 35 V	•	2	10		2	20	mV
Load Regulation	I _L = 0 to 20 mA	•	5	50		5	50	mV
Temperature Stability (Note 4)	Over Operating Range	•	20	50		20	50	mV
Total Output Variation	Over Line, Load and Temp.	•	5.00	5.20	4.95		5.25	V
Short Circuit Current	V _{REF} = 0		80	100		80	100	mA
Output Noise Voltage (Note 4)	10 Hz ≤ f ≤ 10 kHz		40	200		40	200	μVrms
Long Term Stability (Note 4)			1	10		1	50	mV/kHr
Oscillator Section (Note 5)								
Initial Accuracy			2	6		2	6	%
Voltage Stability	V _{IN} = 8 to 35 V	•	0.3	1		1	2	%
Temperature Stability (Note 4)	Over Operating Range	•	3	6		3	6	%
Minimum Frequency	R _T = 200 kΩ, C _T = 0.1 μF	•	90	120		90	120	Hz
Maximum Frequency	R _T = 2 kΩ, C _T = 470pf	•	400	600		400	600	kHz

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Electrical Characteristics (Cont.)

Parameter	Test Conditions		IP1525A/2525A IP1327A/2527A			IP3525A IP3527A			Units
			Min	Typ	Max	Min	Typ	Max	
Current Mirror	$I_{RT} = 2\text{mA}$	•	1.7	2.0	2.2	1.7	2.0	2.2	mA
Clock Amplitude		•	3.0	3.5		3.0	3.5		V
Clock Width		•	0.3	0.5	1.0	0.3	0.5	1.0	μs
Sync Threshold		•	1.2	2.0	2.8	1.2	2.0	2.8	V
Sync Input Current	Sync Voltage = 3.5 V	•		1.0	2.5		1.0	2.5	mA
Error Amplifier Section ($V_{CM} = 5.1\text{ V}$)									
Input Offset Voltage		•		0.5	5		2	10	mV
Input Bias Current		•		1	10		1	10	μA
Input Offset Current		•			1			1	μA
DC Open Loop Gain	$R_L \geq 10\text{ M}\Omega$	•	60	75		60	75		dB
Gain-Bandwidth Product (Note 4)	$A_V = 0\text{ dB}$	•	1	2		1	2		MHz
Output Low Level		•		0.2	0.5		0.2	0.5	V
Output High Level		•	3.8	5.6		3.8	5.6		V
Common Mode Rejection	$V_{CM} = 1.5\text{ to }5.2\text{ V}$	•	60	75		60	75		dB
Supply Voltage Rejection	$V_{IN} = 8\text{ to }35\text{ V}$	•	50	60		50	60		dB
PWM Comparator									
Minimum Duty Cycle	$V_{PIN1} - V_{PIN2} \geq 150\text{ mV}$	•			0			0	%
Maximum Duty Cycle	$V_{PIN2} - V_{PIN1} \geq 150\text{ mV}$	•	45	49		45	49		%
Input Threshold (Note 5)	Zero Duty Cycle	•	0.6	0.9		0.6	0.9		V
Input Threshold (Note 5)	Max Duty Cycle	•		3.3	3.6		3.3	3.6	V
Input Bias Current (Note 4)		•		.05	1.0		.05	1.0	μA
Shutdown Section									
Soft Start Current	$V_{SHUTDOWN} = 0\text{ V}$	•	25	50	80	25	50	80	μA
Soft Start Low Level	$V_{SHUTDOWN} = 2\text{ V}$	•		0.4	0.6		0.4	0.6	V
Shutdown Threshold	To Outputs	•	0.6	1.3	2.0	0.6	1.3	2.0	V
Shutdown Input Current	$V_{SHUTDOWN} = 2.5\text{ V}$	•		0.1	1.0		0.1	1.0	mA
Shutdown Delay	$V_{SHUTDOWN} = 2.5\text{ V}$	•		0.2	0.5		0.2	0.5	μs
Output Drivers (Each Output) ($V_C = 20\text{ Volts}$)									
Output Low Level	$I_{SINK} = 20\text{ mA}$	•		0.2	0.4		0.2	0.4	V
	$I_{SINK} = 100\text{ mA}$	•		1.0	2.0		1.0	2.0	V
Output High Level	$I_{SOURCE} = 20\text{ mA}$	•	18	19		18	19		V
	$I_{SOURCE} = 100\text{ mA}$	•	17	18		17	18		V
Undervoltage Lockout	$V_{COMP} = \text{High}$	•	5.0	7	8.0	5.0	7	8.5	V
Collector Leakage (Note 6)	$V_C = 35\text{ V}$	•			200			200	μA
Rise Time	$C_L = 1\text{ nF}$			100	600		100	600	ns
Fall Time	$C_L = 1\text{ nF}$			50	300		50	300	ns
Total Standby Current									
Supply Current	$V_{IN} = 35\text{ V}$	•		10	20		10	20	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. Tested at $f_{OSC} = 40\text{ kHz}$ ($R_T = 3.6\text{ k}\Omega$, $C_T = 0.01\text{ }\mu\text{F}$, $R_D = 0\Omega$).

Note 6. Applies to IP1525A/2525A/3525A only, due to polarity of output pulses.



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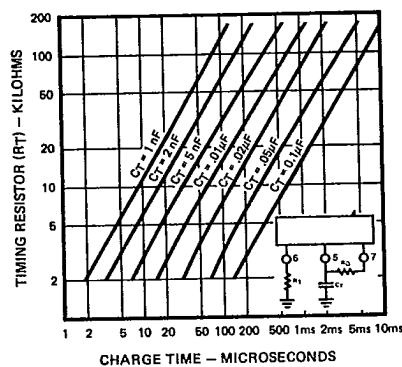
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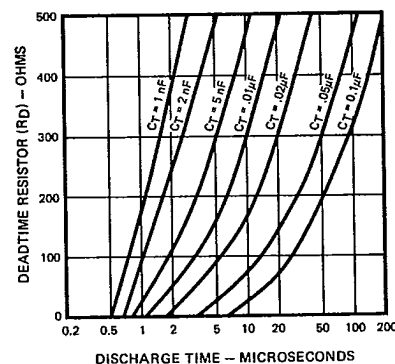
Typical Performance Characteristics

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IP1525A, IP2525A, IP3525A, IP1527A, IP2527A, IP3527A

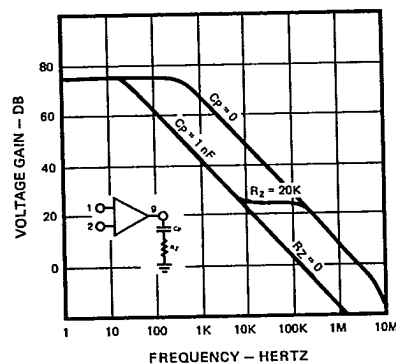
Oscillator Charge Time vs. R_T and C_T



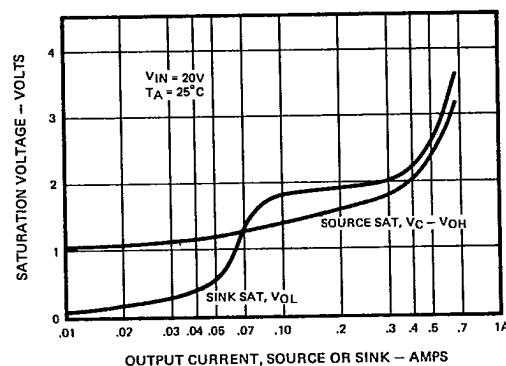
Oscillator Discharge Time vs. R_D and C_T



Error Amplifier Open-loop Frequency Response



IP1525A Output Saturation Characteristics



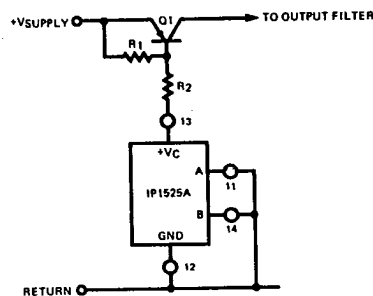
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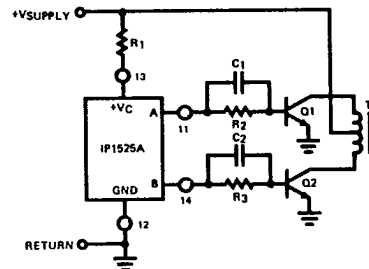
Applications Information

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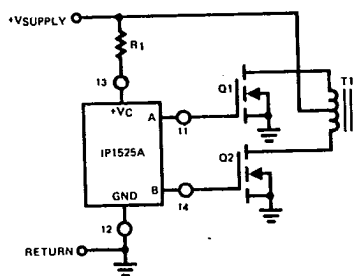
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IP1525A, IP2525A, IP3525A, IP1527A, IP2527A, IP3527A



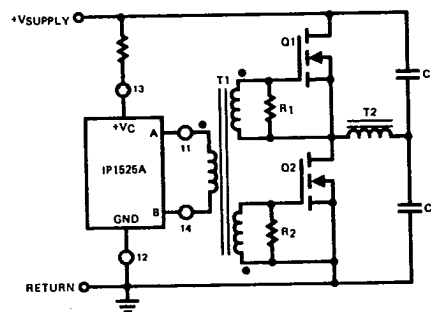
For single-ended supplies, the driver outputs are grounded. The V_C terminal is switched to ground by the totem-pole source transistors on alternate oscillator cycle.



In conventional push-pull bipolar designs, forward base drive is controlled by R_1 - R_3 . Rapid turn-off times for the power devices are achieved with speed-up capacitors C_1 and C_2 .



The low source impedance of the output drivers provides rapid charging of power FET input capacitance while minimizing external components.



Low power transformers can be driven directly by the IP1525A. Automatic reset occurs during deadtime, when both ends of the primary winding are switched to ground.

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Order InformationSection 2 - Pulse Width Modulators
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Part Number	Temperature Range	Package
IP1525AJ	-55° to +125°C	16 Pin Ceramic DIP
IP2525AD	-25°C to +85°C	16 Pin Plastic SOIC
IP2525AJ	-25°C to +85°C	16 Pin Ceramic DIP
IP2525AN	-25°C to +85°C	16 Pin Plastic DIP
IP3525AD	0°C to +70°C	16 Pin Plastic SOIC
IP3525AJ	0°C to +70°C	16 Pin Ceramic DIP
IP3525AN	0°C to +70°C	16 Pin Plastic DIP
IP1527AJ	-55° to +125°C	16 Pin Ceramic DIP
IP2527AD	-25°C to +85°C	16 Pin Plastic SOIC
IP2527AJ	-25°C to +85°C	16 Pin Ceramic DIP
IP2527AN	-25°C to +85°C	16 Pin Plastic DIP
IP3527AD	0°C to +70°C	16 Pin Plastic SOIC
IP3527AJ	0°C to +70°C	16 Pin Ceramic DIP
IP3527AN	0°C to +70°C	16 Pin Plastic DIP

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