

REGULATING PULSE WIDTH MODULATORS

IP1525A, IP3525A, IP1527A, IP3527A

SEAGATE MICROELECTRONICS

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".

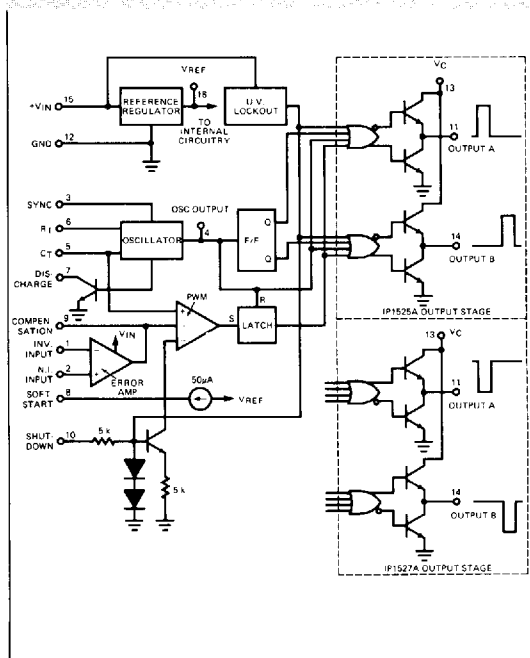
FEATURES

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- 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

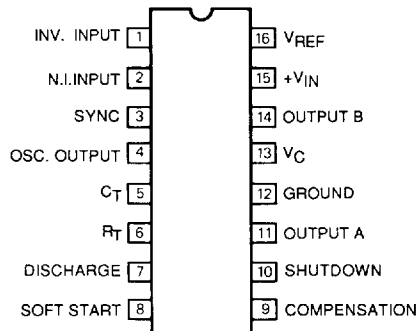
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BLOCK DIAGRAM



CONNECTIONS

(Top View)



N, J and D (300) Package



REGULATING PULSE WIDTH MODULATORS**ABSOLUTE MAXIMUM RATINGS**

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Input Voltage (+V _{IN})	+40V
Collector Voltage	+40V
Logic Inputs	-0.3V to +5.5V
Analog Inputs	-0.3V to +V _{IN}
Output Current, Source or Sink	500mA
Reference Output Load Current	Internally Limited

Power Dissipation at	
T _A = +25°C (Note 1)	1000mW
T _C = +25°C (Note 2)	2000mW
Operating Junction Temperature	-55°C to +150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	+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 (V _{IN})	+8V to +35V
Collector Voltage	+4.5V to +35V
Sink/Source Load Current (steady state)	0 to 100mA
Sink/Source Load Current (peak)	0 to 400mA
Reference Load Current	0 to 20mA
Oscillator Frequency Range	100Hz to 400kHz

Oscillator Timing Resistor	2kΩ to 200kΩ
Oscillator Timing Capacitor	470pF to 0.1μF
Deadtime Resistor Range	0 to 500Ω
Operating Ambient Temperature Range	
IP1525A/IP1527A	-55°C to +125°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)

Parameter	Test Conditions	IP1525A IP1527A			IP3525A IP3527A			Units	
		Min	Typ	Max	Min	Typ	Max		
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



REGULATING PULSE WIDTH MODULATORS

ELECTRICAL CHARACTERISTICS (CONTINUED)

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Parameter	Test Conditions		IP1525A IP1527A			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)			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	8.0	V
Output Leakage	$V_C = 35\text{ V}$	•			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 $f_{OSC} = 40\text{ kHz}$ ($R_T = 3.6\text{ K}\Omega$, $C_T = 0.01\text{ }\mu\text{F}$, $R_D = 0\Omega$).

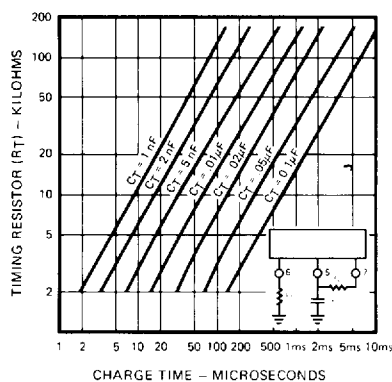
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TYPICAL PERFORMANCE CHARACTERISTICS

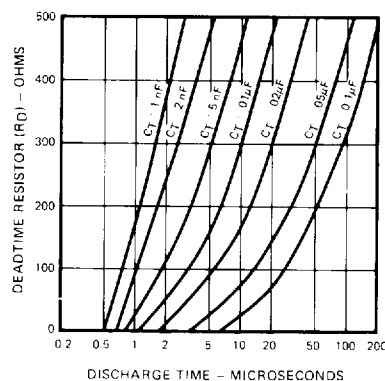
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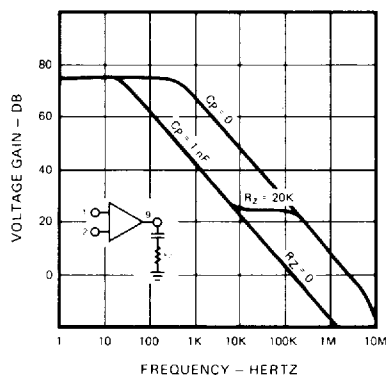
Oscillator Charge Time vs.
 R_T and C_T



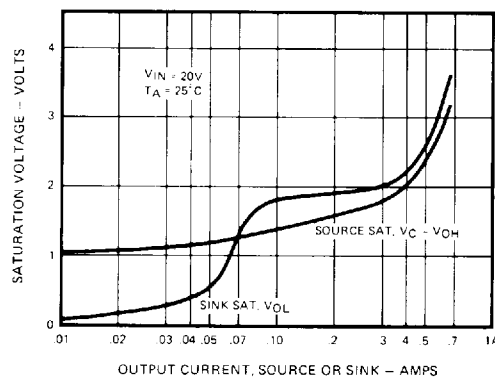
Oscillator Discharge Time vs.
 R_D and C_T



Error Amplifier Open-loop
Frequency Response



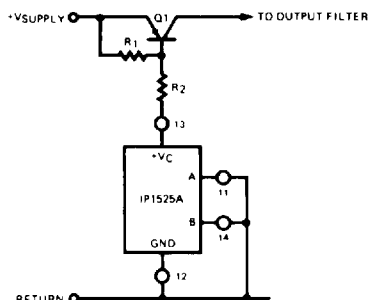
IP1525A Output Saturation
Characteristics



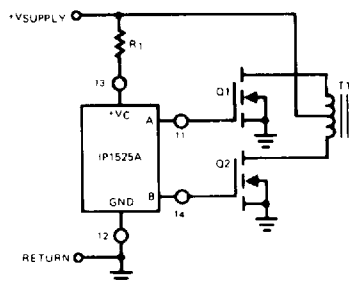
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REGULATING PULSE WIDTH MODULATORS**APPLICATIONS INFORMATION**

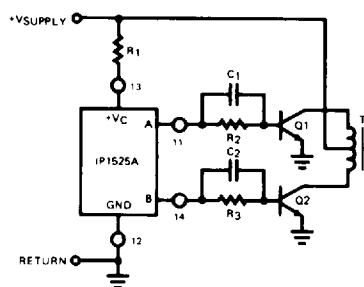
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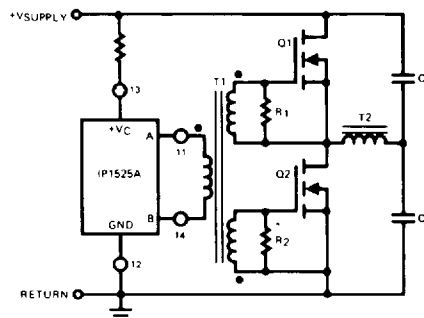
For single-ended supplies, the driver outputs are grounded. The V_C terminal is switched to ground by the totem-pole source transistors on alternate oscillator cycle.



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



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 .



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.

ORDER INFORMATION**Part Number**

IP1525AJ
IP3525AD
IP3525AJ
IP3525AN

Temperature Range

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

Package

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

IP1527AJ
IP3527AD
IP3527AJ
IP3527AN

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

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

