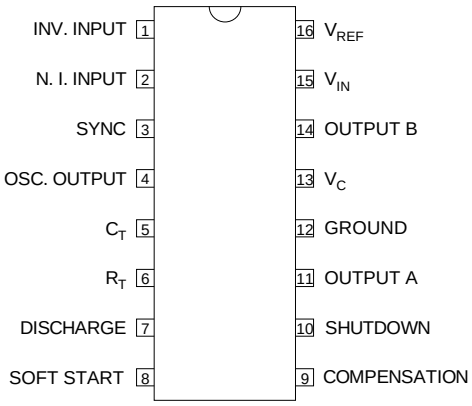
IP1525A SERIES
IP1527A SERIES

TOP VIEW



J Package – 16 Pin Ceramic DIP
N Package – 16 Pin Plastic DIP
D Package – 16 Pin Plastic (300) SOIC

REGULATING PULSE WIDTH MODULATORS

FEATURES

- **8 to 35V operation**
- **5.1V reference trimmed to ±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**

Order Information

Part Number	J–Pack 16 Pin	N–Pack 16 Pin	D–16 16 Pin	Temp. Range
IP1525A	✔			-55 to +125°C
IP1527A	✔			-55 to +125°C
IP3525A	✔	✔	✔	0 to +70°C
IP3527A	✔	✔	✔	0 to +70°C

Note:
To order, add the package identifier to the part number.
eg. IP1525AJ
IP3527AD–16

ABSOLUTE MAXIMUM RATINGS (T_{case} = 25°C unless otherwise stated)

$+V_{IN}$	Input Voltage		+40V
	Collector Voltage		+40V
	Logic Inputs		–0.3 to +5.5V
	Analogue Inputs		–0.3 to $+V_{IN}$
	Output Current, Source or Sink		500mA
	Reference Output Load Current		Internally Limited
	Oscillator Charging Current		5mA
P_D	Power Dissipation	T_A = 25°C	1W
		Derate @ T_A > 50°C	10mW/°C
P_D	Power Dissipation	T_C = 25°C	2W
		Derate @ T_C > 25°C	16mW/°C
T_J	Operating Junction Temperature		See Ordering Information
T_{STG}	Storage Temperature Range		–65 to +150°C
T_L	Lead Temperature	(soldering, 10 seconds)	+300°C

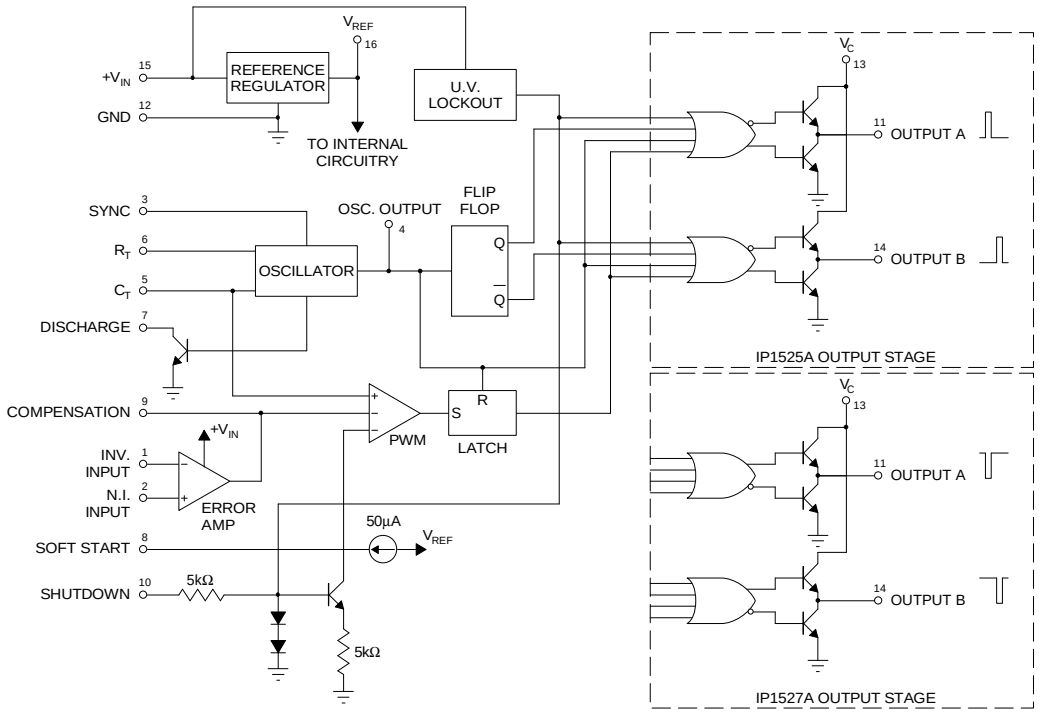
IP1525A SERIES
IP1527A SERIES

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 synchronisation 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”.

BLOCK DIAGRAM



RECOMMENDED OPERATING CONDITIONS

V_{IN}	Input Voltage		+8 to +35V
	Collector Voltage		+4.5 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
R_T	Oscillator Timing Resistor		2kΩ to 200kΩ
C_T	Oscillator Timing Capacitor		470pF to 0.1µF
	Deadtime Resistor Range		0 to 500Ω
	Operating Ambient Temperature Range	IP1525A / IP1527A	–55 to +125°C
		IP3525A / IP3527A	0 to +70°C

ELECTRICAL CHARACTERISTICS (T_J = Over Operating Temperature Range unless otherwise stated)

Parameter	Test Conditions	IP1525A IP1527A			IP3525A IP3527A			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
	REFERENCE SECTION							
Output Voltage	T_J = 25°C	5.05	5.10	5.15	5.0	5.1	5.2	V
Line Regulation	V_{IN} = 8 to 35V		2	10		2	20	mV
Load Regulation	I_L = 0 to 20mA		5	50		5	50	
Temperature Stability			20	50		20	50	mV
Total Output Variation	Over Line, Load and Temp.	5.0		5.2	4.95		5.25	V
Short Circuit Current	V_{REF} = 0		80	100		80	100	mA
Output Noise Voltage	f = 10 Hz to 10kHz		40	200		40	200	µVrms
Long Term Stability			1	10		1	50	mV / kHr
	OSCILLATOR SECTION [2]							
Initial Accuracy			2	6		2	6	%
Voltage Stability	V_{IN} = 8 to 35V		0.3	1		1	2	
Temperature Stability			3	6		3	6	
Minimum Frequency	R_T = 200kΩ C_T = 0.1µF		90	120		90	120	Hz
Maximum Frequency	R_T = 2kΩ C_T = 470pF	400	600		400	600		kHz
Current Mirror	I_{RT} = 2mA	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	T_J = 25°C	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 = 3.5V		1.0	2.5		1.0	2.5	mA
	ERROR AMPLIFIER SECTION [3]							
Input Offset Voltage			0.5	5		2	10	mV
Input Bias Current			1	10		1	10	µA
Input Offset Current				1			1	
DC Open Loop Gain	R_L ≥ 10MΩ	60	75		60	75		dB
Gain Bandwidth Product	T_J = 25°C	1	2		1	2		MHz

NOTES

1. Test Conditions unless otherwise stated:
   V_{IN} = 20V
   T_J = –55 to +125°C for IP1525A / IP1527A
   T_J = 0 to +70°C for IP3525A / IP3527A
2. Oscillator Section Test Conditions:
   f_{OSC} = 40kHz (R_T = 3.6kΩ , C_T = 0.01µF , R_D = 0)
3. Error Amplifier Section Test Condition:
   V_{CM} = 5.1V
4. Output Driver Section Test Condition:
   V_C = 20V

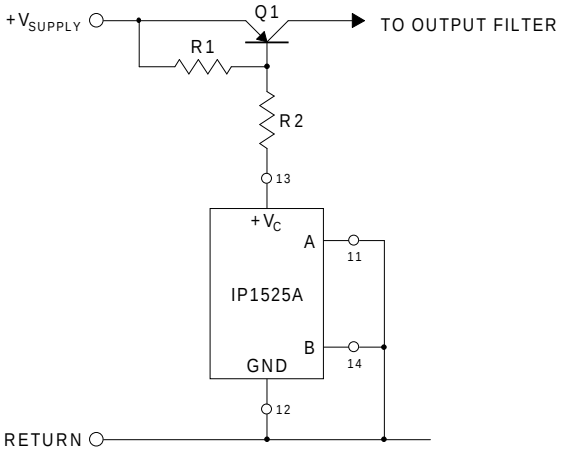
ELECTRICAL CHARACTERISTICS (T_J = Over Operating Temperature Range unless otherwise stated)

Parameter	Test Conditions	IP1525A IP1527A			IP3525A IP3527A			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
	ERROR AMPLIFIER SECTION (cont.) [3]							
Output Low Level			0.2	0.5		0.2	0.5	V
Output High Level		3.8	5.6		3.8	5.6		
Common Mode Rejection	V_{CM} = 1.5 to 5.2V	60	75		60	75		dB
Supply Voltage Rejection	V_{IN} = 8 to 35V	50	60		50	60		
	PWM COMPARATOR							
Minimum Duty Cycle	$V_{PIN1} - V_{PIN2} \geq 150mV$			0			0	%
Maximum Duty Cycle	$V_{PIN2} - V_{PIN1} \geq 150mV$	45	49		45	49		
Input Threshold	Zero Duty Cycle	0.6	0.9		0.6	0.9		V
Input Threshold	Max. Duty Cycle		3.3	3.6		3.3	3.6	
Input Bias Current			0.05	1.0		0.05	1.0	µA
	SHUTDOWN SECTION							
Soft Start Current	$V_{SHUTDOWN}$ = 0V	25	50	80	25	50	80	µA
Soft Start Low Level	$V_{SHUTDOWN}$ = 2V		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	
Shutdown Input Current	$V_{SHUTDOWN}$ = 2.5V		0.1	1.0		0.1	1.0	mA
Shutdown Delay	$V_{SHUTDOWN}$ = 2.5V T_J = 25°C		0.2	0.5		0.2	0.5	µs
	OUTPUT DRIVERS (each output) [4]							
Output Low Level	I_{SINK} = 20mA		0.2	0.4		0.2	0.4	V
	I_{SINK} = 100mA		1.0	2.0		1.0	2.0	
Output High Level	I_{SOURCE} = 20mA	18	19		18	19		V
	I_{SOURCE} = 100mA	17	18		17	18		
Undervoltage Lockout	V_{COMP} = High	5	7	8	5	7	8	V
Output Leakage	V_C = 35V			200			200	µA
Rise Time	C_L = 1nF T_J = 25°C		100	600		100	600	ns
Fall Time	C_L = 1nF T_J = 25°C		50	300		50	300	
	TOTAL STANDBY CURRENT							
Supply Current	V_{IN} = 35V		10	20		10	20	mA

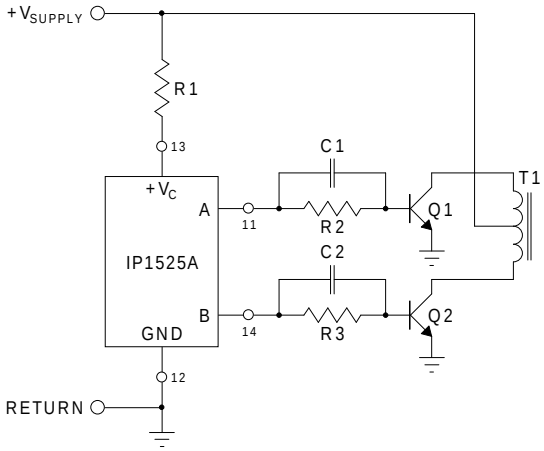
NOTES

1. Test Conditions unless otherwise stated:
   V_{IN} = 20V
   T_J = –55 to +125°C for IP1525A / IP1527A
   T_J = 0 to +70°C for IP3525A / IP3527A
2. Oscillator Section Test Conditions:
   f_{OSC} = 40kHz (R_T = 3.6kΩ , C_T = 0.01µF , R_D = 0)
3. Error Amplifier Section Test Condition:
   V_{CM} = 5.1V
4. Output Driver Section Test Condition:
   V_C = 20V

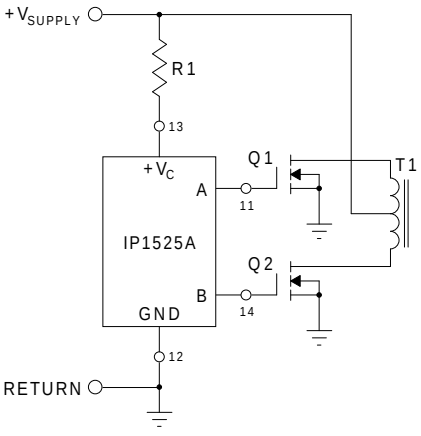
APPLICATIONS INFORMATION



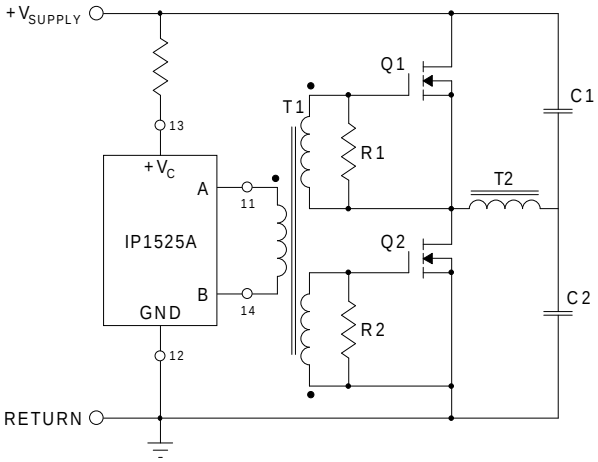
For single–ended supplies, the driver outputs are grounded. The V_C terminal is switched to ground by the totem–pole source transistors on alternate oscillator cycle.



In conventional push–pull bipolar designs, forward base drive is controlled by R1–R3. Rapid turn–off times for the power devices are achieved with speed–up capacitors C1 and C2.



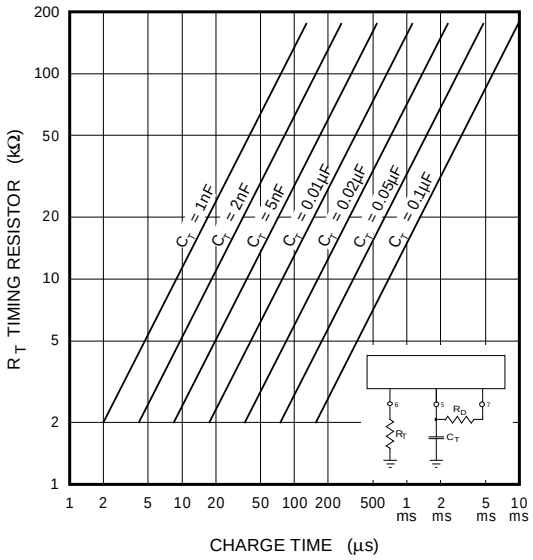
The low source impedance of the output drivers provides rapid charging of power FET input capacitance while minimising external components.



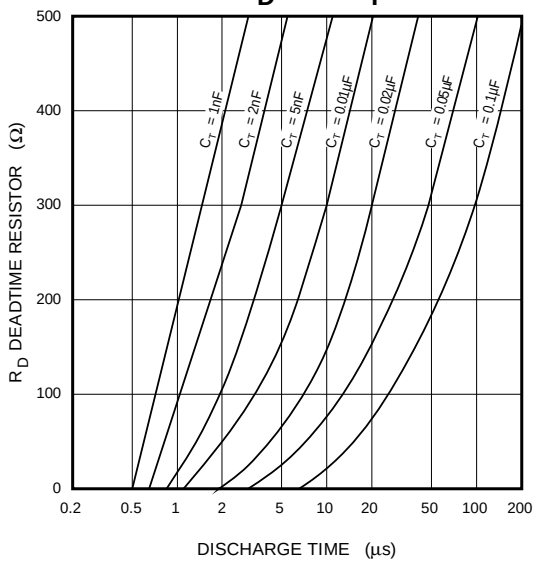
Low power transformers can be driven directly by the IP1525A. Automatic reset occurs during deadtime when both ends of the primary winding are switched to ground.

TYPICAL PERFORMANCE CHARACTERISTICS

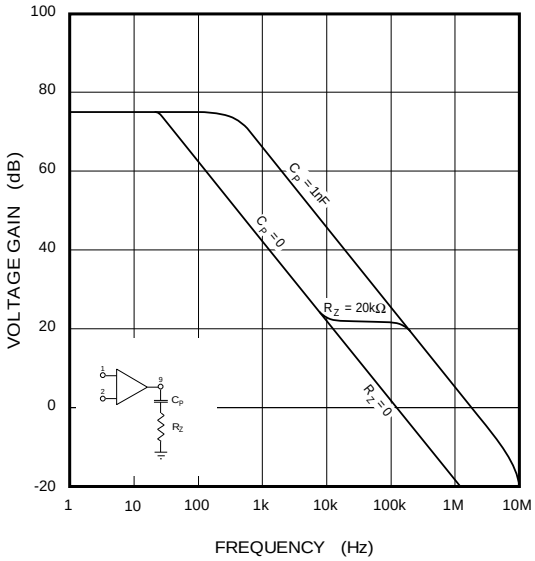
Oscillator Charge Time vs R_T and C_T



Oscillator Discharge Time vs. R_D and C_T



Error Amplifier Open–Loop Frequency Response



IP1525A Output Saturation Characteristics