

4825898 INTEGRATED POWER

82D 00184 D

INTEGRATED POWER

SEMICONDUCTORS, LTD.

Power Supply Supervisory Circuits

T-58-11-31

Section 2 - Pulse Width Modulators
IP1543, IP2543, IP3543, IP1544, IP2544, IP3544

Description

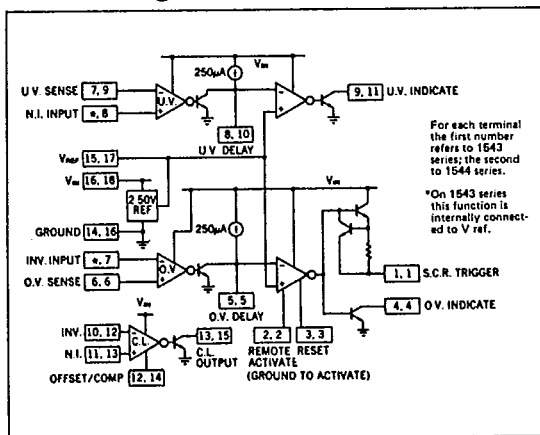
The IP1543, IP2543, IP3543 power supply supervisory circuits contain all the functions necessary to monitor and control the output of a sophisticated power supply system. Included on the chip are over-voltage (O.V.) sensing with externally programmable delay used to trigger an external SCR "Crowbar", under-voltage (U.V.) sensing with externally programmable delay used to sense either the power supply output or the line input voltage, a third op-amp/comparator with provision for external compensation and/or offset programming used for either current limiting or as an additional voltage monitor, and a voltage reference trimmed to $\pm 1\%$.

The IP1544, IP2544, IP3544 circuits contain all of the features of the IP1543 series and have the added flexibility of completely uncommitted inputs to the O.V. and U.V. sensing comparators so that voltages less than 2.5V may be monitored by dividing down the reference voltage.

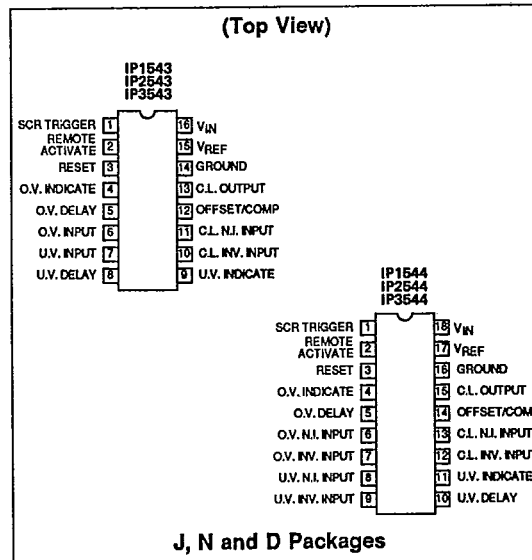
Features

- 4.5 to 40V operation over full temperature range
- Reference voltage trimmed to 1% accuracy
- Includes over-voltage, under-voltage and current sensing
- Programmable time delays
- SCR "Crowbar" drive of 300mA
- Remote activation capability
- Optional over-voltage latch capability
- Uncommitted comparator inputs for low voltage sensing (IP1544 series only)

Block Diagram



Connections



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Absolute Maximum Ratings

Input Supply Voltage (V_{IN})	+40V	Power Dissipation at	
Sense Inputs	V_{IN}	$T_A = +25^\circ\text{C}$ (Note 2)	1000mW
SCR Trigger Current (Note 1)	Internally Limited	$T_C = +25^\circ\text{C}$ (Note 3)	2000mW
Indicator Output Voltage	+40V	Operating Junction Temperature	+150°C
Indicator Output Sink Current	50mA	Storage Temperature Range	-65°C to +150°C
		Lead Temperature (Soldering, 10 sec.)	+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.

- Note 1. At higher input voltages, a dissipation limiting resistor, R_G , is required.
- Note 2. Derate at 10mW/°C for ambient temperatures above +50°C.
- Note 3. Derate at 16mW/°C for case temperatures above +25°C.

Recommended Operating Conditions (Note 4)

Input Supply Voltage (V_{IN})	+4.5 to +40V	Indicate Output Current	0 to 10mA
Current Limit Common Mode		Operating Ambient Temperature Range	
Input Voltage Range	0 to $V_{IN} - 3V$	IP1543, IP1544	-55°C to +125°C
Reference Load Current	0 to 10mA	IP2543, IP2544	-25°C to +85°C
		IP3543, IP3544	0°C to +70°C

Note 4. Range over which the device is functional and parameter limits guaranteed.

Electrical Characteristics

+ $V_{IN} = +10V$

Parameter	Test Conditions	IP1543/2543 IP1544/2544			IP3543 IP3544			Units
		Min	Typ	Max	Min	Typ	Max	
Input Voltage Range		4.5		40	4.5		40	V
Supply Current	$V_{IN} = 40V$		7	10		7	10	mA
Reference Section								
Output Voltage		2.48	2.50	2.52	2.45	2.50	2.55	V
		2.45		2.55	2.40		2.60	V
Line Regulation	$V_{IN} = 4.5$ to 30V		1	5		1	5	mV
Load Regulation	$I_{REF} = 0$ to 10 mA		1	10		1	10	mV
Short Circuit Current	$V_{REF} = 0$	12	25	40	12	25	40	mA
Temperature Stability	Over Operating Range		50			50		ppm/°C
SCR Trigger Section								
Peak Output Current	$V_{IN} = 5V, R_G = 0, V_O = 0$	100	200	400	100	200	400	mA
Peak Output Voltage	$V_{IN} = 15V, I_O = 100$ mA	12	13		12	13		V
Output Off Voltage	$V_{IN} = 40V$		0	0.1		0	0.1	V
Remote Activate Current	Pin 2 = Gnd		-1	-8		-1	-8	mA
Remote Activate Voltage	Pin 2 = Open		1.5	6		1.5	6	V

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Electrical Characteristics (Cont.)

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Parameter	Test Conditions	IP1543/2543 IP1544/2544			IP3543 IP3544			Units	
		Min	Typ	Max	Min	Typ	Max		
Reset Current	Pin 3 = Gnd, Pin 2 = Gnd	*	-.1	-.8		-.1	-.8	mA	
Reset Voltage	Pin 3 = Open, Pin 2 = Gnd	*	1.5	6		1.5	6	V	
Output Current Rise Time	$R_L = 50\Omega$		400			400		mA/μS	
Prop. Delay from Pin 2	$C_D = 0$ $V_{(Pin 2)} = 0.4V$		300			300		ns	
Prop. Delay from Pin 6	$V_{(Pin 6)} = 2.7V$		500			500		ns	
Comparator Sections									
Input threshold (Input Voltage Rising on Pin 6, falling on Pin 7)			2.45	2.50	2.55	2.40	2.50	2.60	V
		*	2.40		2.60	2.35		2.65	V
Input Hysteresis			25			25		mV	
Input Bias Current	Sense Input = 0V	*	-0.3	-1.0		-0.3	-1.0	μA	
Delay Saturation		*	0.2	0.5		0.2	0.5	V	
Delay High Level		*	6	8		6	8	V	
Delay Charging Current	$V_D = 0V$	*	200	250	300	200	250	300	μA
Indicate Saturation	$I_L = -10 mA$	*	0.2	0.5		0.2	0.5	V	
Indicate Leakage	$V_{IND} = 40V$	*	.01	1.0		.01	1.0	μA	
Propagation Delay	$V_{(Pin 6)} = 2.7V$ $C_D = 0$		400			400		ns	
	$V_{(Pin 7)} = 2.3V$ $C_D = 1\mu F$		10			10		ms	
Current Limit Section									
Input Voltage Range		*	0		V_{IN-3}	0		V_{IN-3}	V
Input Bias Current	Pin 12 = Open, $V_{CM} = 0V$	*	-0.3	-1.0		-0.3	-1.0		μA
Input Offset Voltage	Pin 12 = Open, $V_{CM} = 0V$	*	0	10		0	15		mV
	10kΩ from Pin 12 to Gnd	*	70	100	130	70	100	130	mV
CMRR	$0 \leq V_{CM} \leq 12V$, $V_{CM} = 15V$	*	60	70		60	70		dB
AVOL	Pin 12 = Open, $V_{CM} = 0V$	*	72	80		72	80		dB
Output Saturation	$I_L = -10 mA$	*	0.2	0.5		0.2	0.5		V
Output Leakage	$V_{IND} = 40V$	*	.01	1.0		.01	1.0		μA
Small Signal Bandwidth	$A_V = 0 dB$		5			5			MHz
Propagation Delay	$V_{overdrive} = 100 mV$		200			200			ns

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

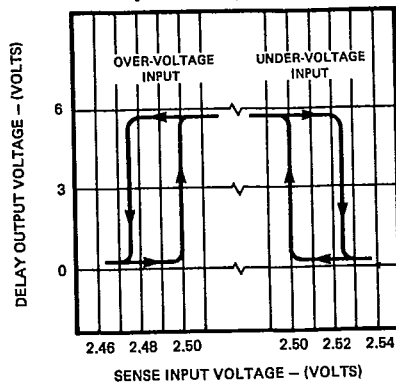
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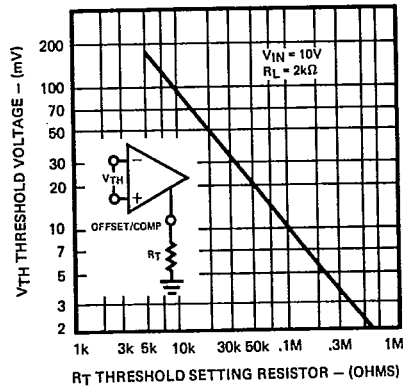
Typical Performance Characteristics

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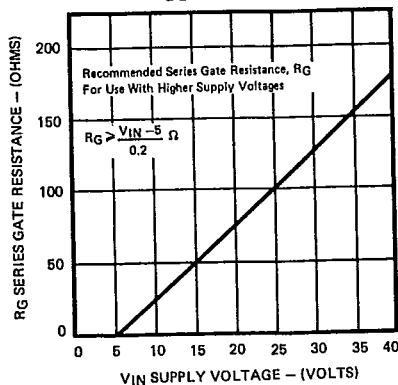
Comparator Input Hysteresis



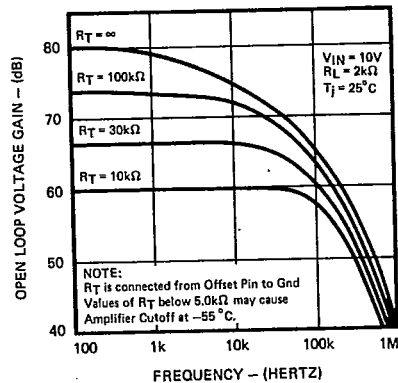
Current Limit Input Threshold



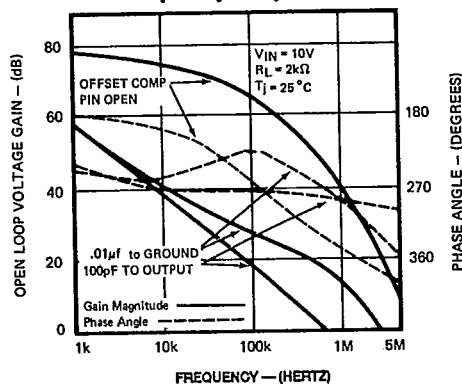
SCR Trigger Power Limiting



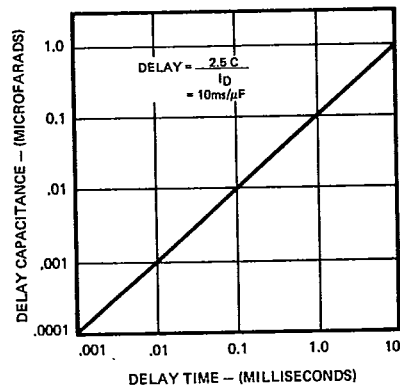
Current Limit Amplifier Gain



Current Limit Amplifier Frequency Response



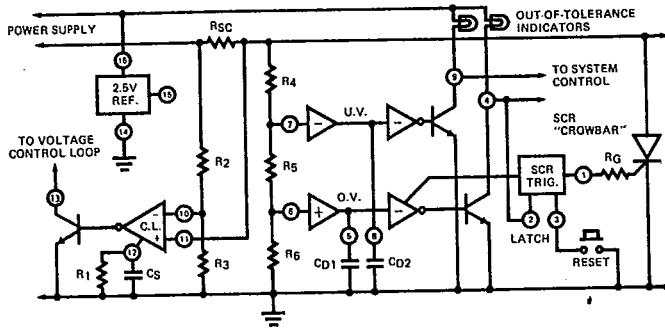
Activation Delay vs. Capacitor Value



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Applications Information

Typical Application



The values for the external components are determined as follows:

Current limit input threshold, $V_{ih} \approx \frac{1000}{RT}$

C_a is determined by the current loop dynamics

Peak current to load, $I_p \approx \frac{V_{ih}}{R_{sc}} + \frac{V_o}{R_{sc}} \left(\frac{R_2}{R_2 + R_3} \right)$

Short circuit current, $I_{sc} = \frac{V_{ih}}{R_{sc}}$

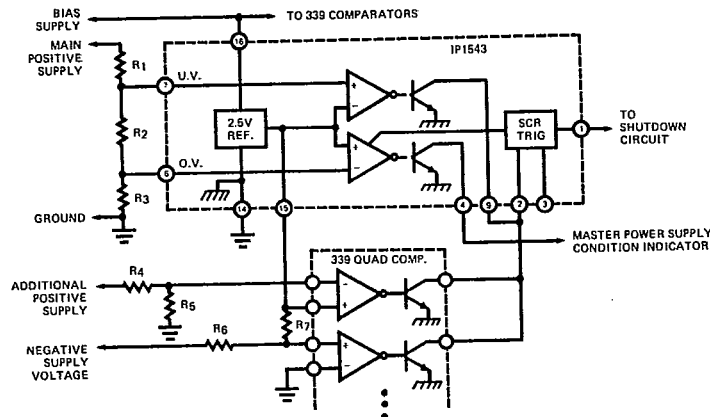
Low output voltage limit, $V_o (Low) = \frac{2.5 (R_4 + R_5 + R_6)}{R_5 + R_6}$

High output voltage limit, $V_o (High) = \frac{2.5 (R_4 + R_5 + R_6)}{R_6}$

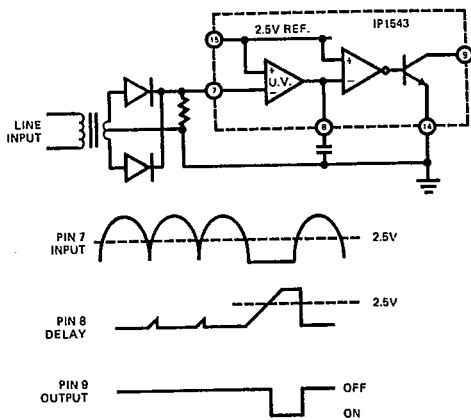
Voltage sensing delay, $t_d = 10,000 C_d$

SCR trigger power limiting resistor, $R_g > \frac{V_{in} - 5}{0.2}$

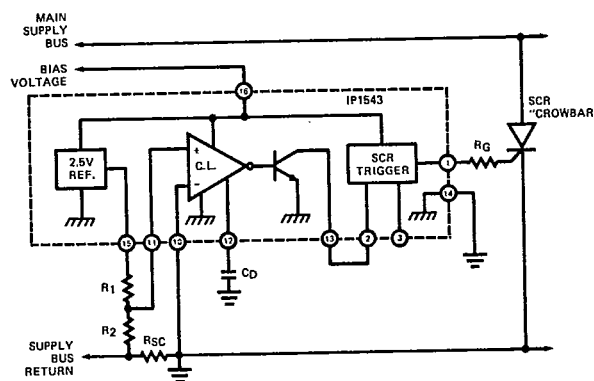
Sensing Multiple Supply Voltages



Input Line Monitor



Overcurrent Shutdown



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Order Information

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Part Number	Temperature Range	Package
IP1543J	-55°C to +125°C	16 Pin Ceramic DIP
IP2543D	-25°C to +85°C	16 Pin Plastic SOIC
IP2543J	-25°C to +85°C	16 Pin Ceramic DIP
IP2543N	-25°C to +85°C	16 Pin Plastic DIP
IP3543D	0°C to +70°C	16 Pin Plastic SOIC
IP3543J	0°C to +70°C	16 Pin Ceramic DIP
IP3543N	0°C to +70°C	16 Pin Plastic DIP
IP1544J	-55°C to +125°C	18 Pin Ceramic DIP
IP2544D	-25°C to +85°C	18 Pin Plastic SOIC
IP2544J	-25°C to +85°C	18 Pin Ceramic DIP
IP2544N	-25°C to +85°C	18 Pin Plastic DIP
IP3544D	0°C to +70°C	18 Pin Plastic SOIC
IP3544J	0°C to +70°C	18 Pin Ceramic DIP
IP3544N	0°C to +70°C	18 Pin Plastic DIP

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