

## REGULATING PULSE WIDTH MODULATOR

### DESCRIPTION

The SG1524B 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. The SG1524B is specified for operation over the full military ambient temperature range of -55°C to 125°C. The SG2524B is characterized for the industrial range of -25°C to 85°C, and the SG3524B is designed for the commercial range of 0°C to 70°C.

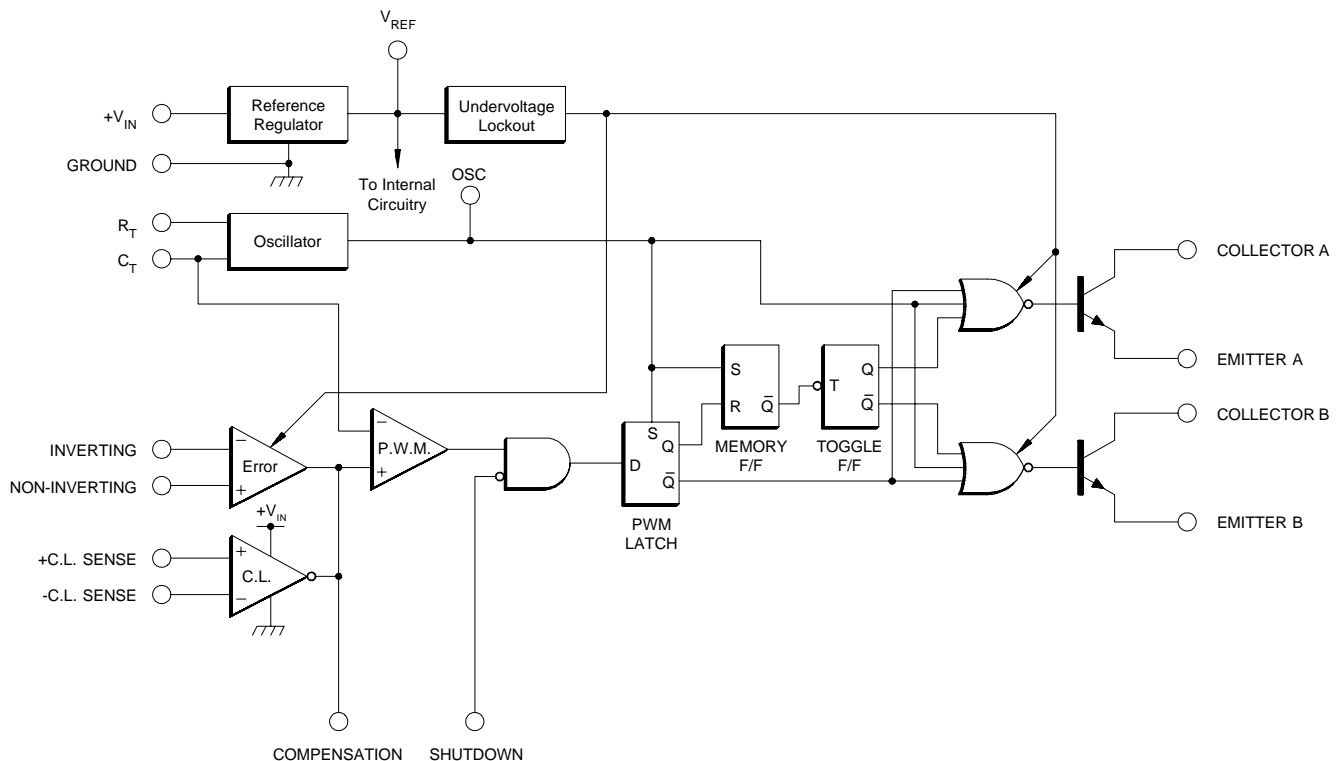
### FEATURES

- 7V to 40V operation
- 5V reference trimmed to  $\pm 1\%$
- 100Hz to 400KHz oscillator range
- Excellent external sync capability
- Dual 100mA output transistors
- Wide current limit common mode range
- DC-coupled toggle flip-flop
- PWM data latch
- Undervoltage lockout
- Full double-pulse suppression logic
- 60V output collectors

### HIGH RELIABILITY FEATURES - SG1524B

- ◆ Available to MIL-STD-883 and DESC SMD
- ◆ Scheduled for MIL-M-38510 QPL listing
- ◆ Radiation data available
- ◆ LMI level "S" processing available

### DESCRIPTION



## ABSOLUTE MAXIMUM RATINGS (Note 1)

Input Voltage (+V <sub>IN</sub> )	42V
Collector Voltage	60V
Logic Inputs	-0.3V to 5.5V
Current Limit Sense Inputs	-0.3V to V <sub>IN</sub>
Output Current (each transistor)	200mA
Reference Load Current	50mA

Note 1. Values beyond which damage may occur.

Oscillator Charging Current	5mA
Operating Junction Temperature	
Hermetic (J, L Packages)	150°C
Plastic (N, DW Packages)	150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 seconds)	300°C
RoHS Peak Package Solder Reflow Temp. (40 sec. max. exp.)	260°C(+0, -5)

## THERMAL DATA

### J Package:

Thermal Resistance-Junction to Case, $\theta_{JC}$	30°C/W
Thermal Resistance-Junction to Ambient, $\theta_{JA}$	80°C/W

### N Package:

Thermal Resistance-Junction to Case, $\theta_{JC}$	40°C/W
Thermal Resistance-Junction to Ambient, $\theta_{JA}$	65°C/W

### DW Package:

Thermal Resistance-Junction to Case, $\theta_{JC}$	40°C/W
Thermal Resistance-Junction to Ambient, $\theta_{JA}$	95°C/W

### L Package:

Thermal Resistance-Junction to Case, $\theta_{JC}$	35°C/W
Thermal Resistance-Junction to Ambient, $\theta_{JA}$	120°C/W

Note A. Junction Temperature Calculation:  $T_J = T_A + (P_D \times \theta_{JA})$ .

Note B. The above numbers for  $\theta_{JC}$  are maximums for the limiting thermal resistance of the package in a standard mounting configuration. The  $\theta_{JA}$  numbers are meant to be guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow.

## RECOMMENDED OPERATING CONDITIONS (Note 2)

Input Voltage (+V <sub>IN</sub> )	7V to 40V
Collector Voltage	0V to 60V
Error Amp Common Mode Range	2.3V to V <sub>REF</sub>
Current Limit Sense Common Mode Range	0V to V <sub>IN</sub> -2.5V
Output Current (each transistor)	0 to 100mA
Reference Load Current	0 to 20mA
Oscillator Charging Current	25µA to 1.8mA

Note 2: Range over which the device is functional.

Oscillator Frequency Range	100Hz to 400KHz
Oscillator Timing Resistor (R <sub>T</sub> )	2KΩ to 150KΩ
Oscillator Timing Capacitor (C <sub>T</sub> )	1nF to 0.1µF
Operating Ambient Temperature Range	
SG1524B	-55°C to 125°C
SG2524B	-25°C to 85°C
SG3524B	0°C to 70°C

## ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG1524B with -55°C ≤ T<sub>A</sub> ≤ 125°C, SG2524B with -25°C ≤ T<sub>A</sub> ≤ 85°C, SG3524B with 0°C ≤ T<sub>A</sub> ≤ 70°C, and +V<sub>IN</sub> = 20V. Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

Parameter	Test Conditions	SG1524B/2524B			SG3524B			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
<b>Reference Section (Note 3)</b>								
Output Voltage	T <sub>J</sub> = 25°C	4.95	5.00	5.05	4.90	5.00	5.10	V
Line Regulation	V <sub>IN</sub> = 7V to 40V		3	20		3	30	mV
Load Regulation	I <sub>L</sub> = 0 to 20mA		5	30		5	50	mV
Temperature Stability (Note 7)	Over Operating Temperature Range		15	50		15	50	mV
Total Output Voltage Range	Over Line, Load and Temperature	4.90		5.10	4.80		5.20	V
Short Circuit Current	V <sub>REF</sub> = 0V	25	50	120	25	50	120	mA
<b>Undervoltage Lockout Section</b>								
Threshold Voltage		4.3	4.5	4.7	4.2	4.5	4.9	V

Note 3. I<sub>L</sub> = 0mA

## ELECTRICAL CHARACTERISTICS (continued)

Parameter	Test Conditions	SG1524B/2524B			SG3524B			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
<b>Oscillator Section</b> (Note 4)								
Initial Accuracy	$T_J = 25^\circ\text{C}$	42	45	48	40	45	50	KHz
Voltage Stability	$V_{IN} = 7\text{V to }40\text{V}$		0.1	1		0.1	1	%
Temperature Stability (Note 7)	Over Operating Range		1	2		1	2	%
Minimum Frequency (Note 7)	$R_T = 150\text{K}\Omega, C_T = 0.1\mu\text{F}$		50	140		50	120	Hz
Maximum Frequency	$R_T = 2\text{K}\Omega, C_T = 470\text{pF}$	400	600		400	600		KHz
Sawtooth Peak Voltage	$V_{IN} = 40\text{V}$		3.5	3.9		3.5	3.9	V
Sawtooth Valley Voltage	$V_{IN} = 7\text{V}$	0.6	1		0.6	1		V
Clock Amplitude		3.0	4.0		3.0	4.0		V
Clock Pulse Width		0.2	0.5	1.2	0.2	0.5	1.2	$\mu\text{s}$
<b>Error Amplifier Section</b> (Note 5)								
Input Offset Voltage	$R_S \leq 2\text{K}\Omega$		0.5	5		2	10	mV
Input Bias Current			1	5		1	10	$\mu\text{A}$
Input Offset Current				1			1	$\mu\text{A}$
DC Open Loop Gain	$R_L \geq 10\text{M}\Omega$	60	78		60	78		dB
Output Low Level	$I_{\text{SINK}} = 100\mu\text{A}; V_{\text{PIN}1} - V_{\text{PIN}2} \geq 150\text{mV}$		0.2	0.5		0.2	0.5	V
Output High Level	$I_{\text{SOURCE}} = 100\mu\text{A}; V_{\text{PIN}2} - V_{\text{PIN}1} \geq 150\text{mV}$	3.8	4.2		3.8	4.2		V
Common Mode Rejection	$V_{\text{CM}} = 2.3\text{V to }V_{\text{REF}}$	70	90		70	90		dB
Supply Voltage Rejection	$V_{IN} = 7\text{V to }40\text{V}$	76	100		76	100		dB
Gain-Bandwidth Product (Note 7)	$T_J = 25^\circ\text{C}$	1	2		1	2		MHz
<b>P.W.M. Comparator</b> (Note 4)								
Minimum Duty Cycle	$V_{\text{COMP}} = 0.5\text{V}$			0			0	%
Maximum Duty Cycle	$V_{\text{COMP}} = 3.9\text{V}$	45	49		45	49		%
<b>Current Limit Amplifier Section</b> (Note 6)								
Sense Voltage		180	200	220	170	200	230	mV
Input Bias Current			-3	-10		-3	-10	$\mu\text{A}$
<b>Shutdown Input Section</b>								
HIGH Input Voltage		2.0			2.0			V
HIGH Input Current	$V_{\text{SHUTDOWN}} = 5.0\text{V}$		0.1	1		0.1	1	mA
LOW Input Voltage				0.6			0.6	V
<b>Output Section</b> (each transistor)								
Collector Leakage Current	$V_{\text{CE}} = 60\text{V}$			50			50	$\mu\text{A}$
Collector Saturation Voltage	$I_C = 10\text{mA}$		0.2	0.4		0.2	0.4	V
	$I_C = 100\text{mA}$		1.0	2.0		1.0	2.0	V
Emitter Output Voltage	$I_E = 10\text{mA}$	17.5	19		17.5	19		V
	$I_E = 100\text{mA}$	17	18		17	18		V
Emitter Voltage Rise Time (Note 7)	$R_E = 2\text{K}\Omega, T_A = 25^\circ\text{C}$		0.2	0.5		0.2	0.5	$\mu\text{s}$
Collector Voltage Fall Time	$R_C = 2\text{K}\Omega, T_A = 25^\circ\text{C}$		0.1	0.2		0.1	0.2	$\mu\text{s}$
<b>Power Consumption</b>								
Standby Current	$V_{IN} = 40\text{V}, V_{\text{SHUTDOWN}} = 2.0\text{V}$		5	12		5	12	mA

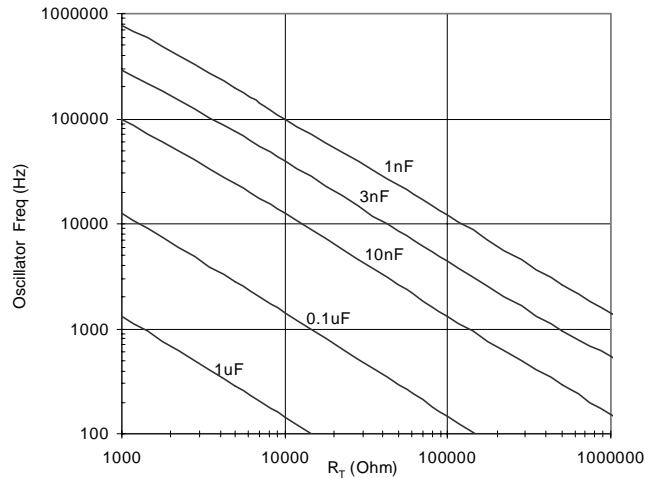
Note 4.  $F_{\text{OSC}} = 45\text{KHz}$  ( $R_T = 2700\Omega, C_T = .01\mu\text{F}$ )

Note 5.  $V_{\text{CM}} = 2.3\text{V to }V_{\text{REF}}$

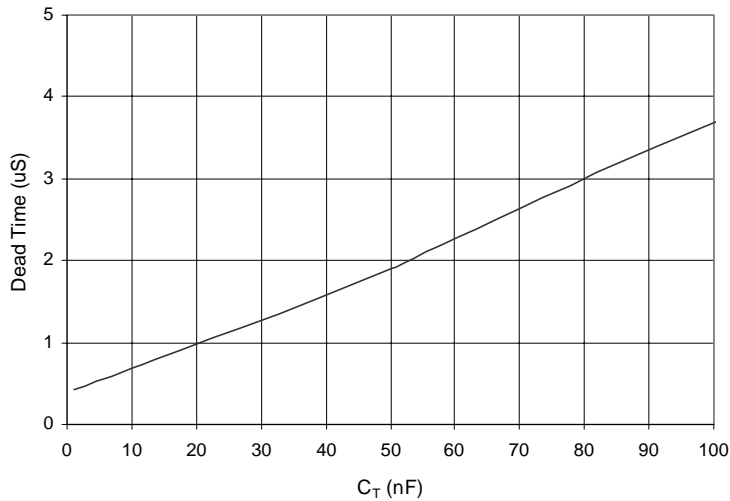
Note 6.  $V_{\text{CM}} = 0\text{V to }17.5\text{V}$

Note 7. These parameters, although guaranteed over the recommended operating conditions, are not tested in production.

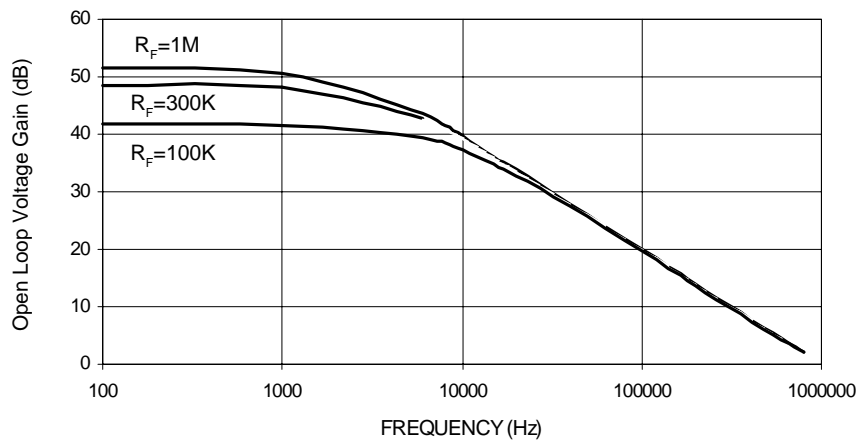
TYPICAL CHARACTERISTIC CURVES



**Figure 1**  
Oscillator Frequency vs. Timing Resistor and Capacitor  
 $V_{IN}=20V, T_A=25^{\circ}C$



**Figure 2**  
SG1524B Dead Time vs. Timing capacitance ( $R_T=2.7k$ )  
 $V_{IN}=20V, T_A=25^{\circ}C$



**Figure 3**  
SG1524B Error Amp Voltage Gain vs. Freq over  $R_F$   
 $V_{IN}=20V, T_A=25^{\circ}C$

# SG1524B/SG2524B/SG3524B

## CONNECTION DIAGRAMS & ORDERING INFORMATION (See Notes Below)

Package	Part No.	Ambient Temperature Range	Connection Diagram
16-PIN CERAMIC DIP J - PACKAGE	SG1524BJ/883B SG1524BJ/DESC	-55°C to 125°C -55°C to 125°C	<p>N Package: RoHS Compliant / Pb-free Transition DC: 0503 N Package: RoHS / Pb-free 100% Matte Tin Lead Finish</p>
16-PIN PLASTIC DIP N - PACKAGE	SG2524BN SG3524BN	-25°C to 85°C 0°C to 70°C	
16-PIN WIDE BODY PLASTIC S.O.I.C. DW - PACKAGE	SG2524BDW SG3524BDW	-25°C to 85°C 0°C to 70°C	<p>DW Package: RoHS Compliant / Pb-free Transition DC: 0516 DW Package: RoHS / Pb-free 100% Matte Tin Lead Finish</p>
20-PIN CERAMIC LEADLESS CHIP CARRIER L - PACKAGE	SG1524BL/883B SG1524BL	-55°C to 125°C -55°C to 125°C	

Note 1. Contact factory for JAN and DESC product availability.  
2. All packages are viewed from the top.