

REGULATING PULSE WIDTH MODULATOR

DESCRIPTION

The SG1529 series of pulse width modulator integrated circuits are designed to provide all the operational features of the SG1524B series with the added advantage of an uncommitted input to the PWM comparator. This allows the device to be used in Feed-Forward regulation schemes to achieve better line regulation as well as improved dynamic response. A 5V bandgap reference trimmed to $\pm 1\%$ tolerance, an error amplifier, and a current limit comparator with a high common mode range are included in the I.C.

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 SG1529 is specified for operation over the full military ambient temperature range of -55°C to 125°C . The SG2529 is characterized for the industrial range of -25°C to 85°C and the SG3529 is designed for the commercial range of 0°C to 70°C .

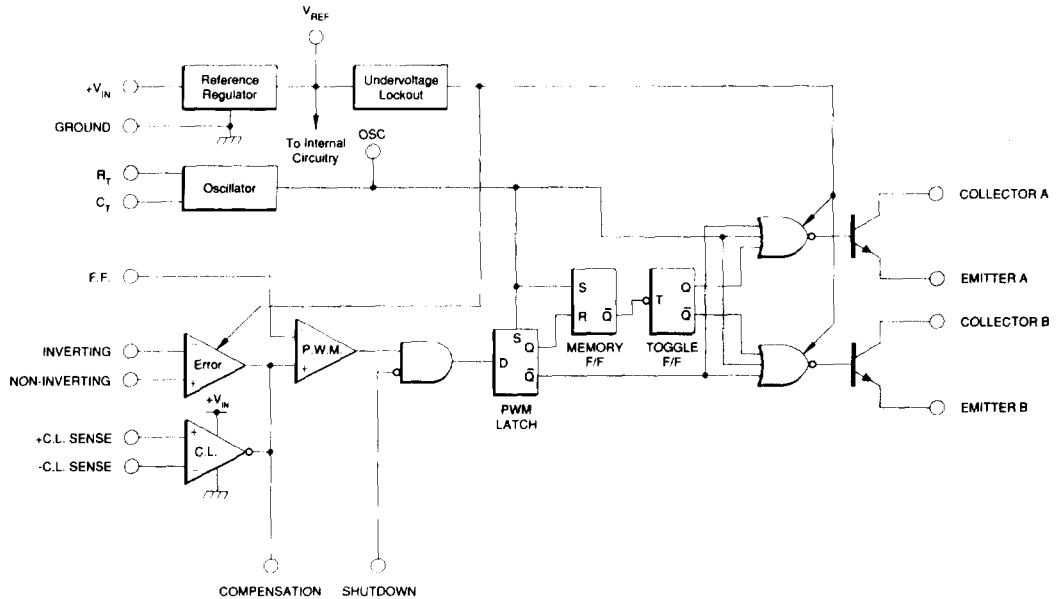
FEATURES

- Feed forward capability
- 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 - SG1529

- ◆ Available to MIL-STD-883
- ◆ SG level "S" processing available

BLOCK DIAGRAM



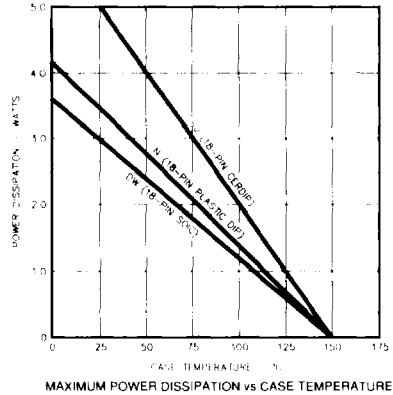
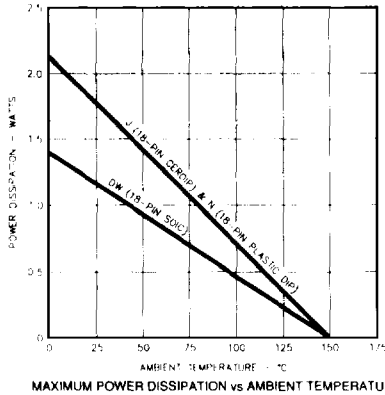
ABSOLUTE MAXIMUM RATINGS (Note 1)

Input Voltage (+V _{IN})	42V
Collector Voltage	60V
Logic Inputs	-0.3V to 5.5V
Current Limit Sense Inputs	-0.3V to V _{IN}
Output Current (each transistor)	200mA
Reference Load Current	50mA

Oscillator Charging Current	5mA
Operating Junction Temperature	
Hermetic (J Package)	150°C
Plastic (N, DW Packages)	150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Note 1. Values beyond which damage may occur.

THERMAL DERATING CURVES



RECOMMENDED OPERATING CONDITIONS (Note 2)

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

Oscillator Frequency Range	100Hz to 400KHz
Oscillator Timing Resistor (R _T)	2KΩ to 150KΩ
Oscillator Timing Capacitor (C _T)	1nF to 0.1µF
Operating Ambient Temperature Range	
SG1529	-55°C to 125°C
SG2529	-25°C to 85°C
SG3529	0°C to 70°C

Note 2: Range over which the device is functional.

ELECTRICAL SPECIFICATIONS

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG1529 with -55°C ≤ T_a ≤ 125°C, SG2529 with -25°C ≤ T_a ≤ 85°C, SG3529 with 0°C ≤ T_a ≤ 70°C, and +V_{IN} = 20V. Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

Parameter	Test Conditions	SG1529/2529			SG3529			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Reference Section (Note 3)								
Output Voltage	T _J = 25°C	4.95	5.00	5.05	4.90	5.00	5.10	V
Line Regulation	V _{IN} = 7V to 40V		3	20		3	30	mV
Load Regulation	I _L = 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 _{REF} = 0V	25	50	120	25	50	120	mA
Undervoltage Lockout Section								
Threshold Voltage		4.3	4.5	4.7	4.3	4.5	4.7	V

Note 3. I_L = 0mA

ELECTRICAL SPECIFICATIONS (continued)

Parameter	Test Conditions	SG1529/2529			SG3529			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Oscillator Section (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	$R_T = 150\text{K}\Omega, C_T = 0.1\mu\text{F}$		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	μs
Error Amplifier Section (Note 5)								
Input Offset Voltage	$R_B \leq 2\text{K}\Omega$		0.5	5		2	10	mV
Input Bias Current			1	5		1	10	μA
Input Offset Current				1			1	μA
DC Open Loop Gain	$R_L \geq 10\text{M}\Omega$	60	78		60	78		dB
Output Low Level	$I_{\text{SENK}} = 100\mu\text{A}; V_{\text{PIN}1} - V_{\text{PIN}2} \geq 150\text{mV}$		0.2	0.5		0.2	0.5	V
Output High Level	$V_{\text{SOURCE}} = 100\mu\text{A}; V_{\text{PIN}2} - V_{\text{PIN}1} \geq 150\text{mV}$	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	$V_{\text{IN}} = 7\text{V to }40\text{V}$	76	100		76	100		dB
Gain-Bandwidth Product (Note 7)	$T_J = 25^\circ\text{C}$	1	2		1	2		MHz
P.W.M. Comparator (Note 4)								
Minimum Duty Cycle	$V_{\text{COMP}} = 0.5\text{V}$ (Note 8)			0			0	%
Maximum Duty Cycle	$V_{\text{COMP}} = 3.9\text{V}$ (Note 8)	45	49		45	49		%
Input Bias Current	$V_{\text{REF}} = 0.5\text{V to }3.9\text{V}$			2			2	μA
Current Limit Amplifier Section (Note 6)								
Sense Voltage		180	200	220	170	200	230	mV
Input Bias Current			-3	-10		-3	-10	μA
Shutdown Input Section (Note 6)								
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
Output Section (each transistor)								
Collector Leakage Current	$V_{\text{CE}} = 60\text{V}$			50			50	μA
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	μs
Collector Voltage Fall Time	$R_C = 2\text{K}\Omega, T_A = 25^\circ\text{C}$		0.1	0.2		0.1	0.2	μs
Power Consumption								
Standby Current	$V_{\text{IN}} = 40\text{V}, V_{\text{SHUTDOWN}} = 2.0\text{V}$		5	12		5	12	mA

Note 4. $F_{\text{osc}} = 43\text{KHz}$ ($R_T = 2700\Omega, C_T = .01\mu\text{F}$)

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 100% tested in production.

Note 8. C, connected to FF.

APPLICATION CIRCUITS

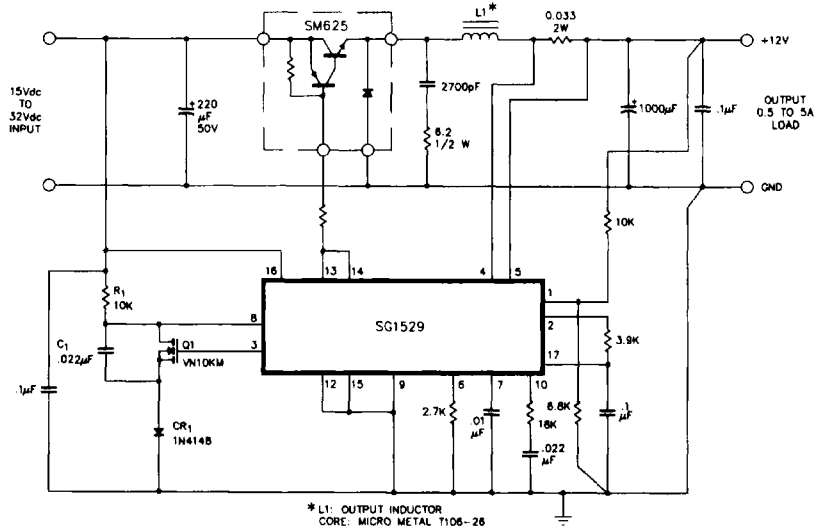


FIGURE 1 - 60V STEP DOWN BUCK CONVERTER

The above schematic describes a 60W step down (Buck) converter where feed forward feature is obtained by generating a ramp with external components R1, C1 and Q1. The slope of the ramp changes with the change in input voltage, which causes the duty cycle to adjust much faster than the conventional fixed slope ramp method resulting in a better line transient response. Rectifier CR1 is used to offset the ramp.

CONNECTION DIAGRAMS & ORDERING INFORMATION (See Notes Below)

Package	Part No.	Ambient Temperature Range	Connection Diagram
18-PIN CERAMIC DIP J - PACKAGE	SG1529J/883B	-55°C to 125°C	INV. INPUT <input type="checkbox"/> 1 <input type="checkbox"/> 16 N.C. N.I. INPUT <input type="checkbox"/> 2 <input type="checkbox"/> 17 <input type="checkbox"/> V _{REF} OSC. OUTPUT <input type="checkbox"/> 3 <input type="checkbox"/> 18 <input type="checkbox"/> +V _{IN} +C.L. SENSE <input type="checkbox"/> 4 <input type="checkbox"/> 15 <input type="checkbox"/> E _B -C.L. SENSE <input type="checkbox"/> 5 <input type="checkbox"/> 14 <input type="checkbox"/> C _B R ₁ <input type="checkbox"/> 6 <input type="checkbox"/> 13 <input type="checkbox"/> C _A C ₁ <input type="checkbox"/> 7 <input type="checkbox"/> 12 <input type="checkbox"/> E _A F.F. <input type="checkbox"/> 8 <input type="checkbox"/> 11 <input type="checkbox"/> SHUTDOWN GROUND <input type="checkbox"/> 9 <input type="checkbox"/> 10 <input type="checkbox"/> COMPENSATION
	SG1529J	-55°C to 125°C	
	SG2529J	-25°C to 85°C	
	SG3529J	0°C to 70°C	
18-PIN PLASTIC DIP N - PACKAGE	SG2529N	-25°C to 85°C	INV. INPUT <input type="checkbox"/> 1 <input type="checkbox"/> 16 N.C. N.I. INPUT <input type="checkbox"/> 2 <input type="checkbox"/> 17 <input type="checkbox"/> V _{REF} OSC. OUTPUT <input type="checkbox"/> 3 <input type="checkbox"/> 18 <input type="checkbox"/> +V _{IN} +C.L. SENSE <input type="checkbox"/> 4 <input type="checkbox"/> 15 <input type="checkbox"/> E _B -C.L. SENSE <input type="checkbox"/> 5 <input type="checkbox"/> 14 <input type="checkbox"/> C _B R ₁ <input type="checkbox"/> 6 <input type="checkbox"/> 13 <input type="checkbox"/> C _A C ₁ <input type="checkbox"/> 7 <input type="checkbox"/> 12 <input type="checkbox"/> E _A F.F. <input type="checkbox"/> 8 <input type="checkbox"/> 11 <input type="checkbox"/> SHUTDOWN GROUND <input type="checkbox"/> 9 <input type="checkbox"/> 10 <input type="checkbox"/> COMPENSATION
	SG3529N	0°C to 70°C	
18-PIN WIDE BODY PLASTIC S.O.I.C. DW - PACKAGE	SG2529DW	-25°C to 85°C	INV. INPUT <input type="checkbox"/> 1 <input type="checkbox"/> 16 N.C. N.I. INPUT <input type="checkbox"/> 2 <input type="checkbox"/> 17 <input type="checkbox"/> V _{REF} OSC. OUTPUT <input type="checkbox"/> 3 <input type="checkbox"/> 18 <input type="checkbox"/> +V _{IN} +C.L. SENSE <input type="checkbox"/> 4 <input type="checkbox"/> 15 <input type="checkbox"/> E _B -C.L. SENSE <input type="checkbox"/> 5 <input type="checkbox"/> 14 <input type="checkbox"/> C _B R ₁ <input type="checkbox"/> 6 <input type="checkbox"/> 13 <input type="checkbox"/> C _A C ₁ <input type="checkbox"/> 7 <input type="checkbox"/> 12 <input type="checkbox"/> E _A F.F. <input type="checkbox"/> 8 <input type="checkbox"/> 11 <input type="checkbox"/> SHUTDOWN GROUND <input type="checkbox"/> 9 <input type="checkbox"/> 10 <input type="checkbox"/> COMPENSATION
	SG3529DW	0°C to 70°C	

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