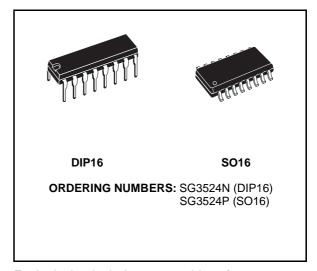


REGULATING PULSE WIDTH MODULATORS

- COMPLETE PWM POWER CONTROL CIR-CUITRY
- UNCOMMITTED OUTPUTS FOR SINGLE-ENDED OR PUSH PULL APPLICATIONS
- LOW STANDBY CURRENT 8mA TYPICAL
- OPERATION UP TO 300KHz
- 1% MAXIMUM TEMPERATURE VARIATION OF REFERENCE VOLTAGE

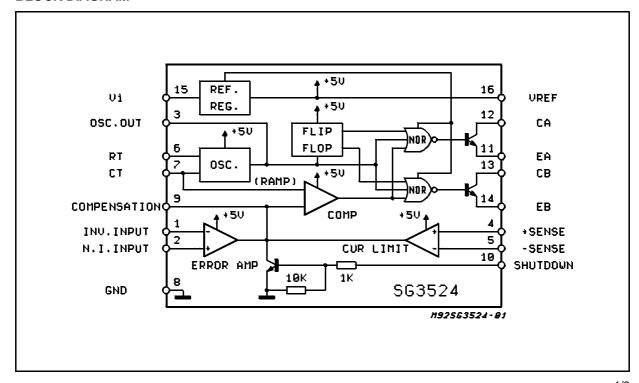
DESCRIPTION

The SG3524 incorporates on a single monolithic chip all the function required for the construction of regulating power supples inverters or switching regulators. They can also be used as the control element for high power-output applications. The SG3524 family was designed for switching regulators of either polarity, transformer-coupled dcto-dc converters, transformerless voltage doublers and polarity converter applications employing fixed-frequency, pulse-width modulation techniques. The dual alternating outputs allows either single-ended or push-pull applications.



Each device includes an on-ship reference, error amplifier, programmable oscillator, pulse-steering flip flop, two uncommitted output transistors, a high-gain comparator, and current-limiting and shut-down circuitry.

BLOCK DIAGRAM

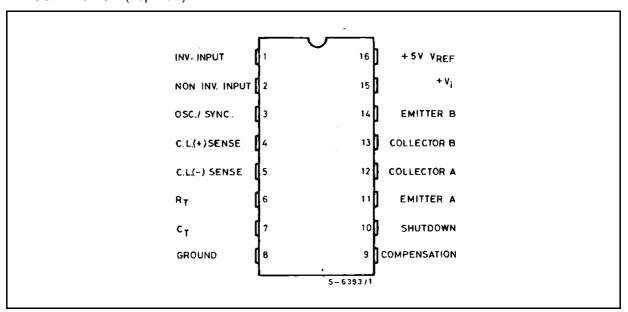


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ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{IN}	Supply Voltage	40	V
lc	Collector Output Current	100	mA
I _R	Reference Output Current	50	mA
ΙΤ	Current Through C _T Terminal	-5	mA
P _{tot}	Total Power Dissipation at T _{amb} = 70°C	1000	mW
T _{stg}	Storage Temperature Range	- 65 to 150	°C
T _{op}	Operating Ambient Temperature Range:	0 to 70	°C

PIN CONNECTION (Top view)



THERMAL DATA

Symbol	Parameter		DIP16	SO16	Unit
R _{th j-amb} R _{th i-alumina}	Thermal Resistance Junction-ambient Thermal Resistance Junction-alumina	Max. Max.	80	- 50	°C/W

^(*) Thermal resistance junction-alumina with the device soldered on the middle of an alumina supporting substrate measuring 15 x 20mm; 0.65mm thickness with infinite heatsink.

ELECTRICAL CHARACTERISTICS (unless otherwise stated, these specifications apply for Tj = 0 to 70°C, V_{IN} = 20V, and f = 20KHz).

Symbol	Parameter	Test Condition	Min.	Тур.	Max.	Unit		
REFERE	NCE SECTION		ł		Į.			
V _{REF}	Output Voltage		4.6	5	5.4	V		
ΔV_{REF}	Line Regulation	VIN = 8 to 40V		10	30	mV		
ΔV_{REF}	Load Regulation	IL = 0 to 20mA		20	50	mV		
	Ripple Rejection	f = 120Hz, T _i = 25°C		66		dB		
	Short Circuit Current Limit	V _{REF} = 0, T _i = 25°C		100		mΑ		
$\Delta V_{REF}/\Delta T$	Temperature Stability	Over Operating Temperature range		0.3	1	%		
ΔV_{REF}	Long Term Stability	Tj = 125°C, t = 1000Hrs		20		mV		
	TOR SECTION	· · · · · · · · · · · · · · · · · · ·						
f _{MAX}	Maximum Frequency	$C_T = 0.001 \mu F, R_T = 2K\Omega$		300		KHz		
	Initial Accuracy	R _T and C _T Constant		5		%		
	Voltage Stability	V _{IN} = 8 to 40V, T _i = 25°C			1	%		
Δf/ΔΤ	Temperature Stability	Over Operating Temperature Range			2	%		
	Output Amplitude	Pin 3, T _i = 25°C		3.5		V		
	Output Pulse Width	$C_T = 0.01 \mu F, T_i = 25^{\circ} C$		0.5		μs		
ERROR A	AMPLIFIER SECTION	1	ı	ı	ı			
Vos	Input Offset Voltage	V _{CM} = 2.5V		2	10	mV		
I _b	Input Bias Current			2	10	μΑ		
G _V	Open Loop Voltage Gain		60	80		dB		
CMV	Common Mode Voltage	T _i = 25°C	1.8		3.4	V		
CMR	Common Mode Rejection	T _i = 25°C		70		dB		
В	Small Signal Bandwidth	$A_V = 0$ dB, $T_i = 25$ °C		3		MHz		
Vo	Output Voltage	T _i = 25°C	0.5		3.8	V		
	ATOR SECTION		ı	ı	ı	ı		
	Duty-cycle	% Each Output On	0		45	%		
V _{IT}	Input Threshold	Zero Duty-cycle		1		V		
	•	Maximum Duty-cycle		3.5		V		
I _b	Input Bias Current			1		μA		
CURREN	T LIMITING SECTION	•						
	Sense Voltage	Pin 9 = 2V with Error Amp. Set for Max. Out. $T_i = 25^{\circ}C$	180	200	220	mV		
	Sense Voltage T.C.			0.2		mV/°C		
CMV	Common Mode Voltage		-1		1			
	OUTPUT SECTION(each output)							
	Collector-emitter Voltage		40			V		
	Collector Leackage Curr.	V _{CE} = 40V		0.1	50	μΑ		
	Saturation Voltage	I _C = 50mA		1	2	V		
	Emitter Output Voltage	V _{IN} = 20V	17	18		V		
t _r	Rise Time	$R_C = 2K\Omega$, $T_i = 25^{\circ}C$		0.2		μs		
t _f	Fall Time	$R_C = 2K\Omega$, $T_j = 25^{\circ}C$		0.1		μs		
l _q (*)	Total Standby Current	V _{IN} = 40V		8	10	mA		

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Figure 1: Open-loop Voltage Amplification of Error Amplifier vs. Frequency

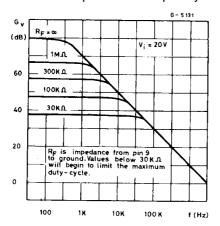


Figure 3: Output Dead Time vs. Timing Capacitance Value.

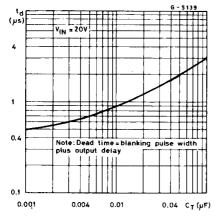


Figure 2: Oscillator Frequency vs. Timing Components.

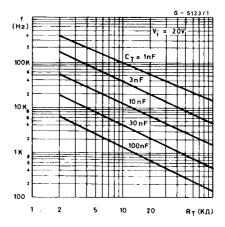


Figure 4: Output Saturation Voltage vs. load Current.

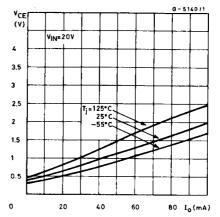
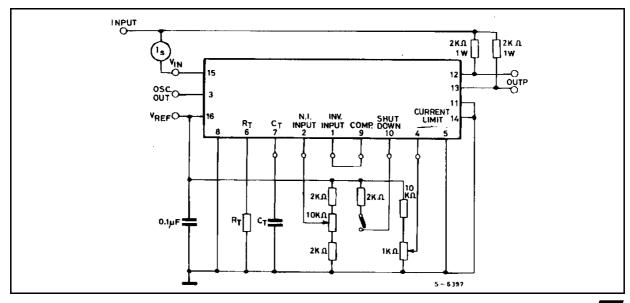


Figure 5: Open Loop Test Circuit.



PRINCIPLES OF OPERATION

The SG3524 is a fixed frequency pulse-withmodulation voltage regulator control circuit. The regulator operates at a frequency that is programmed by one timing resistor (RT) and one timing capacitor (C_T). R_T established a constant charging current for C_T . This results in a linear voltage ramp at C_T, which is fed to the comparator providing linear control of the output pulse width by the error amplifier. the SG3524 contains, an on-board 5V regulator that serves as a reference as well as powering the SG3524's internal control circuitry and is also useful in supplying external support functions. This reference voltage is lowered externally by a resistor divider to provide a reference within the common mode range the error amplifier or an external reference may be used. The power supply output is sensed by a second resistor divider network to generale a feedback signal to error amplifier. The amplifier output voltage is then compared to the linear voltage ramp at C_T. The resulting modulated pulse out of the high-gain comparator is then steered to the appropriate output pass transistors (QA or QB) by the pulse-steering flip-flop, which is synchronously toggled by the oscillator output. The oscillator output pulse also serves as a blanking pulse to assure both output are never on simultaneously during the transition times. The width of the blanking pulse is controlled by the value of C_T. The outputs may be applied in a push-pull configuration in which their frequency is half that of the base oscillator, or paralleled for single-ended applications in which the frequency is equal to that of the oscillator. The output of the error amplifier shares a common input to the comparator with the current limiting at shutdown circuitry and can be overridden by signals from either of these inputs. This common point is also available externally and may be employed to control the gain of, or to compensate, the error amplifier, or to provide additional control to the regulator.

RECOMMENDED OPERATING CONDITIONS

Supply voltage V _{IN}	8 to 40V
Reference Output Current	0 to 20mA
Current trough C _T Terminal	- 0.03 to -2mA
Timing Resistor, R _T	1.8 to 100KΩ
Timing Capacitor, C _T	0.001 to 0.1μF

TYPICAL APPLICATIONS DATA

OSCILLATOR

The oscillator controls the frequency of the SG3524 and is programmed by R_T and C_T ac-

cording to the approximate formula:

$$f = \frac{1.18}{R_T C_T}$$

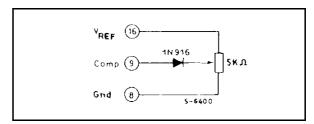
where: R_T is in $K\Omega$ C_T is in μF f is in KHz

Pratical values of C_T fall between 0.001 and 0.1 μ F. Pratical values of R_T fall between 1.8 and 100 $K\Omega$. This results in a frequency range typically from 120Hz to to 500KHz.

BLANKING

The output pulse of oscillator is used as a blanking pulse at the output. This pulse width is controlled by the value of C_T . If small values of C_T are required for frequency control, the oscillator output pulse width may still be increased by applying a shunt capacitance of up to 100pF from pin 3 to ground. If still greater dead-time is required, it should be accomplished by limiting the maximum duty cycle by clamping the output of the error amplifier. This can easily be done with the circuit below:

Figure 6.



SYNCRONOUS OPERATION

When an external clock is desired, a clock pulse of approximately 3V can be applied directly to the oscillator output terminal. The impedance to ground at this point is approximately $2K\Omega.$ In this configuration R_T C_T must be selected for a clock period slightly greater than that the external clock.

If two more SG2524 regulators are to be operated synchronously, all oscillator output terminals should be tied together, all C_T terminals connected to a single timing capacitor, and timing resistor connected to a single R_T terminal. The other R_T terminals can be left open or shorted to V_{REF} . Minimum lead lengths should be used between the C_T terminals.

Figure 7: Flyback Converter Circuit.

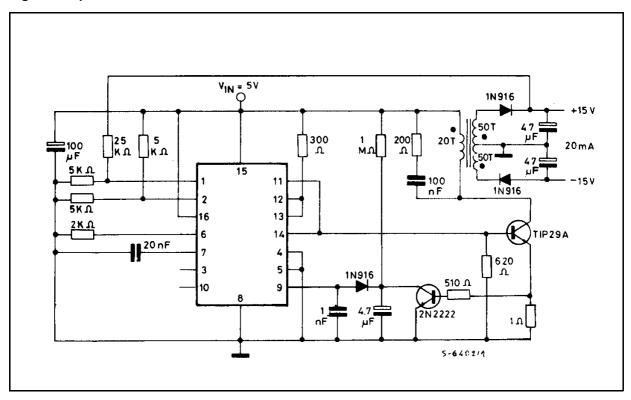
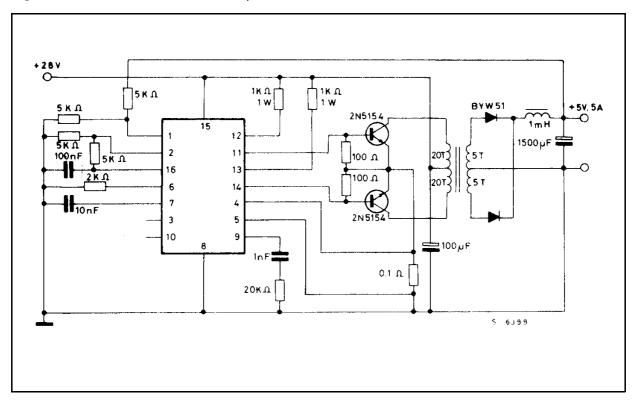
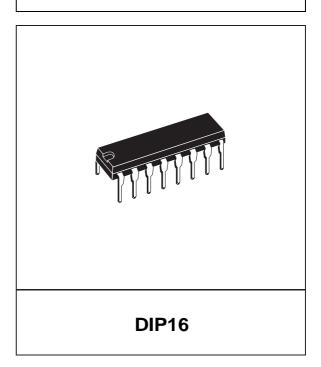


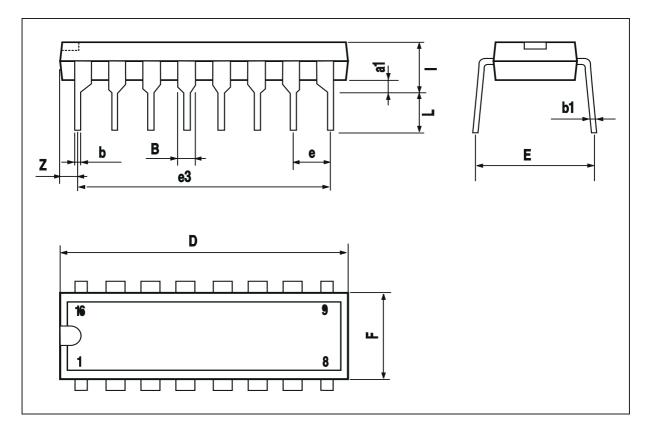
Figure 8: PUSH-PULL Transformer-coupled circuit.



DIM.		mm			inch	
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
В	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
Е		8.5			0.335	
е		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
1			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

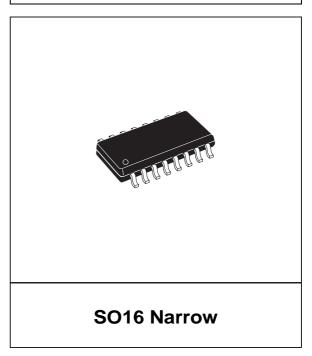
OUTLINE AND MECHANICAL DATA



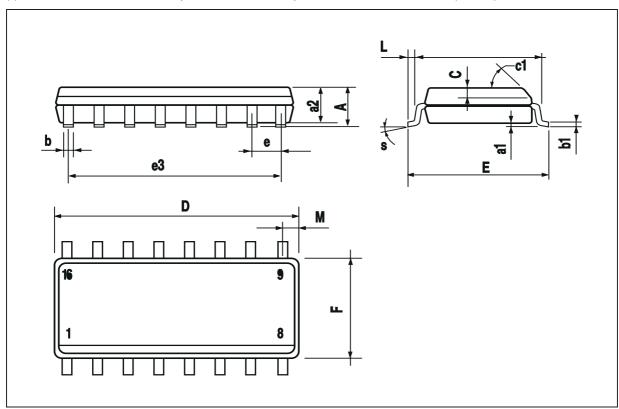


DIM.		mm			inch	
Dilvi.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
Α			1.75			0.069
a1	0.1		0.25	0.004		0.009
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
С		0.5			0.020	
c1			45° (typ.)		
D (1)	9.8		10	0.386		0.394
Е	5.8		6.2	0.228		0.244
е		1.27			0.050	
e3		8.89			0.350	
F (1)	3.8		4	0.150		0.157
G	4.6		5.3	0.181		0.209
L	0.4		1.27	0.016		0.050
М			0.62			0.024
S	8°(max.)					

OUTLINE AND MECHANICAL DATA



(1) D and F do not include mold flash or protrusions. Mold flash or potrusions shall not exceed 0.15mm (.006inch).



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