SILICON GENERAL

LINEAR INTEGRATED CIRCUITS

SG1842B/3B/4B/5B
SG2842B/3B/4B/5B
SG3842B/3B/4B/5B

FUTURE PRODUCT RELEASE

CURRENT-MODE PWM CONTROLLER

DESCRIPTION

The SG1842B/3B/4B/5B family of control IC's are improved versions of the earlier non-B devices. These products offer all the necessary features to implement off-line fixed frequency current mode switching power supplies with a minimum number of external components. Current mode architecture demonstrates improved line and lead regulation, a simpler compensation circuitry and a pulse by pulse current limiting to protect the external power MOSFET.

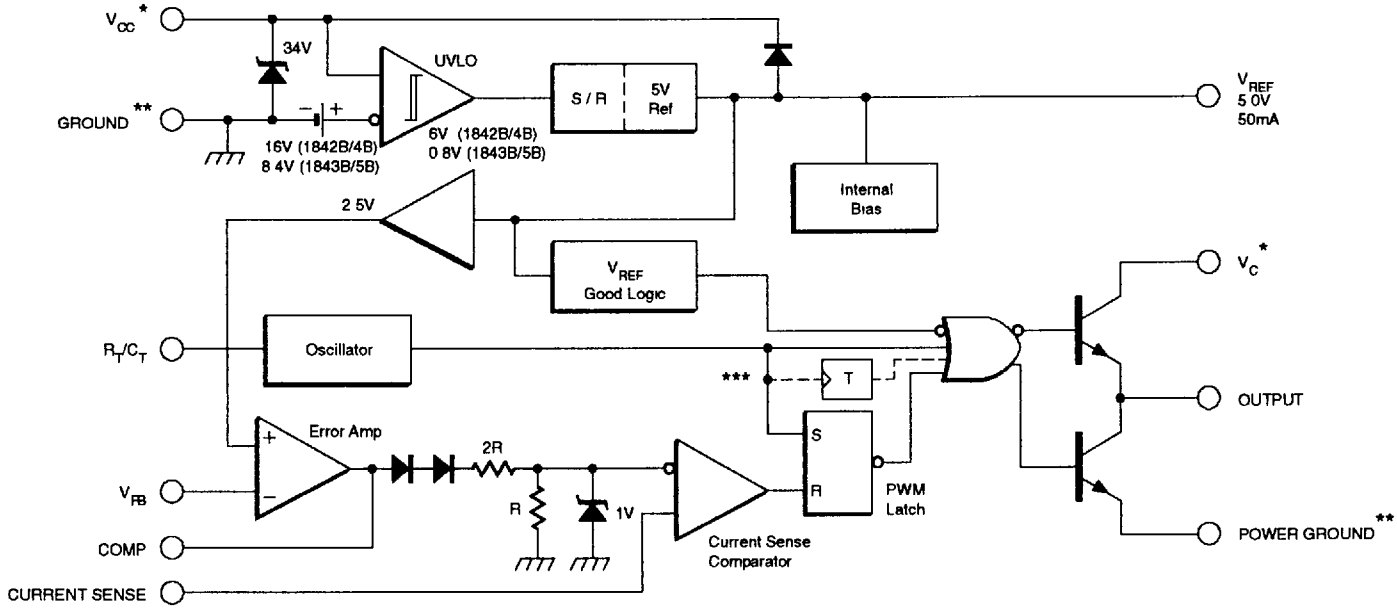
Included in this integrated circuit are a temperature compensated bandgap reference trimmed to ±1%, an undervoltage lockout with hysteresis, an externally programmable oscillator, an error amplifier, a current sense compensator and a totem pole output stage optimized for direct driving of the external power MOSFET. The improved features of these devices are shown in "BOLD" type in the features column.

The SG184X is specified for operation over the full military ambient temperature range of -55°C to 125°C. The SG284X is specified for the industrial range of -25°C to 85°C, and the SG384X is designed for the commercial range of 0°C to 70°C.

FEATURES (Bold type indicates improved feature)

- Optimized for off-line control
- **Low start-up current (150µA Typ.)**
- Automatic feed forward compensation
- **Trimmed oscillator discharge current (±3% Typ.)**
- Pulse-by-pulse current limiting
- Enhanced load response characteristics
- Under-voltage lockout with hysteresis
- Double pulse suppression
- High current totem pole output (±1Amp peak)
- Internally trimmed bandgap reference
- 500 KHz operation
- **Current sense delay to output 100ns (typ.)**
- **Voltage reference trimmed to ±1% for 384X series**
- **Initial oscillator frequency better than ±2% (typ.)**
- **Output fall time 100ns max. (384X series)**
- **Output pulldown during UVLO**

BLOCK DIAGRAM



* - V_{CC} and V_C are internally connected for 8 pin packages.

** - POWER GROUND and GROUND are internally connected for 8 pin packages.

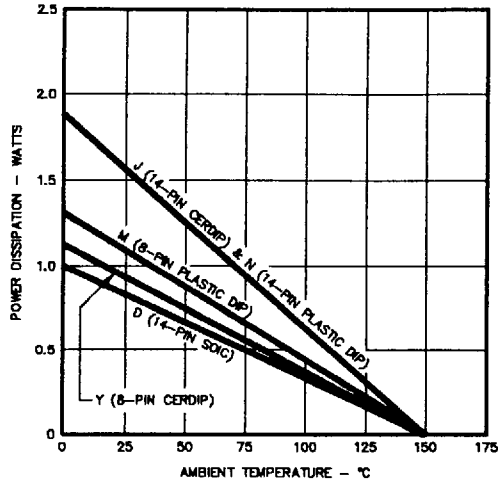
*** - Toggle flip flop used only in X844B and X845B series.

ABSOLUTE MAXIMUM RATINGS (Notes 1 & 2)

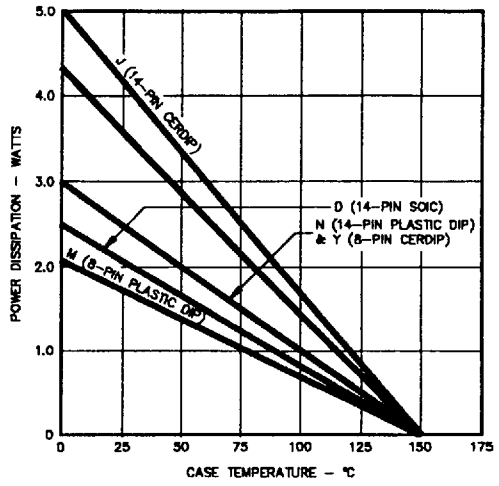
Supply Voltage (I_{CC} < 30mA) ..... Self-limiting
Supply Voltage (Low Impedence Source) 30V
Output Current (peak) ..... ±1A
Output Current (continuous) 350mA
Output Energy (Capacitive Load) 5µJ
Analog Inputs (Pin 2, Pin 3) ..... -0.3V to 6.3V
Error Amp Output Sink Current 10mA
Operating Junction Temperature
Hermetic (J, Y, F - Packages) ..... 150°C
Plastic (N, M, D - Packages) ..... 150°C
Storage Temperature Range ..... -65°C to 150°C
Lead Temperature (Soldering, 10 Seconds) ..... 300°C

Note 1. Exceeding these ratings could cause damage to the device.
Note 2. All voltages are with respect to Pin 5. All currents are positive into the specified terminal.

THERMAL DERATING CURVES



MAXIMUM POWER DISSIPATION vs AMBIENT TEMPERATURE



MAXIMUM POWER DISSIPATION vs CASE TEMPERATURE

RECOMMENDED OPERATING CONDITIONS (Note 3)

Supply Voltage Range 30V
Output Current (peak) ..... ±1A
Output Current (continuous) 200mA
Analog Inputs (Pin 2, Pin 3) ..... 0V to 2.6V
Error Amp Output Sink Current 5mA
Oscillator Frequency Range ..... 100Hz to 500KHz
Oscillator Timing Resistor (R_T) ..... $520\Omega \le R_T \le 150k\Omega$
Oscillator Timing Capacitor (C_T) ..... $1000pF \le C_T \le 1\mu F$
Operating Ambient Temperature Range:
SG1842B/3B/4B/5B ..... -55°C to 125°C
SG2842B/3B/4B/5B ..... -25°C to 85°C
SG3842B/3B/4B/5B ..... 0°C to 70°C

Note 3. Range over which the device is functional.

ELECTRICAL SPECIFICATIONS

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG1842B/3B/4B/5B with $-55°C \le T_A \le 125°C$, SG2842B/3B/4B/5B with $-25°C \le T_A \le 85°C$, SG3842B/3B/4B/5B with $0°C \le T_A \le 70°C$, V_{CC} = 15V (Note 7), R_T = 10KΩ, and C_T = 3.3nF. Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

Parameter	Test Conditions	SG184XB/284XB			SG384XB			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Reference Section								
Output Voltage	T_J = 25°C, I_O = 1mA	4.95	5.00	5.05	4.95	5.00	5.05	V
Line Regulation	$12V \le V_{IN} \le 25V$		6	20		6	20	mV
Load Regulation	$1 \le I_O \le 20mA$		6	25		6	25	mV
Temp. Stability (Notes 4 & 9)			0.2	0.4		0.2	0.4	mV/°C
Total Output Variation (Note 4)	Line, Load, Temp.	4.90		5.10	4.90		5.10	V
Output Noise Voltage (Note 4)	$10Hz \le f \le 10kHz$, T_J = 25°C		50			50		µV
Long Term Stability (Note 4)	T_A = 125°C, 1000 Hrs.		5	25		5	25	mV
Output Short Circuit		-30	-100	-180	-30	-100	-180	mA
Oscillator Section								
Initial Accuracy (Note 8)	T_J = 25°C	47	52	57	49.4	52	54.6	kHz
	T_J = 25°C, R_T = TBD, C_T = TBD	465	500	535	465	500	535	KHz
Voltage Stability	$12 \le V_{CC} \le 25V$		0.2	1		0.2	1	%
Temp. Stability (Note 4)	$T_{MIN} \le T_A \le T_{MAX}$		5			5		%
Amplitude	$V_{PIN 4}$ (peak to peak)		1.7			1.7		V
Discharge Current	T_J = 25°C, $V_{PIN 4}$ = 2V	7.8	8.3	8.8	8.0	8.3	8.6	mA
	$V_{PIN 4}$ = 2V	7.0		8.8	7.8		8.8	mA

ELECTRICAL SPECIFICATIONS (continued)

Parameter	Test Conditions	SG184XB/284XB			SG384XB			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Error Amp Section								
Input Voltage	V_{PIN1} = 2.5V	2.45	2.50	2.55	2.470	2.50	2.530	V
Input Bias Current			-0.3	-1		-0.3	1	µA
Open Loop Gain (A_{VOL})	$2 \le V_O \le 4V$	65	90		65	90		dB
Unity Gain Bandwidth (Note 4)	T_J = 25°C	0.7	1		0.7	1		MHz
PSRR	$12 \le V_{CC} \le 25V$	60	70		60	70		dB
Output Sink Current	V_{PIN2} = 2.7V, V_{PIN1} = 1.1V	2	6		2	6		mA
Output Source Current	V_{PIN2} = 2.3V, V_{PIN1} = 5V	-0.5	-0.8		-0.5	-0.8		mA
V_{OUT} High	V_{PIN2} = 2.3V, R_L = 15K to ground	5	6		5	6		V
V_{OUT} Low	V_{PIN2} = 2.7V, R_L = 15K to Pin 8		0.7	1.1		0.7	1.1	V
Current Sense Section								
Gain (Notes 5 & 6)		2.85	3	3.15	2.85	3	3.15	V/V
Maximum Input Signal (Note 5)	V_{PIN1} = 5V	0.9	1	1.1	0.9	1	1.1	V
PSRR (Note 5)	$12 \le V_{CC} \le 25V$		70			70		dB
Input Bias Current			-2	-10		-2	-10	µA
Delay to Output (Note 4)	V_{PIN3} = 0 to 2V			150			150	ns
Output Section								
Output Low Level	I_{SINK} = 20mA		0.1	0.4		0.1	0.4	V
	I_{SINK} = 200mA		1.5	2.2		1.5	2.2	V
Output High Level	I_{SOURCE} = 20mA	13	13.5		13	13.5		V
	I_{SOURCE} = 200mA	12	13.5		12	13.5		V
Rise Time	T_J = 25°C, C_L = 1nF		50	150		50	120	ns
Fall Time	T_J = 25°C, C_L = 1nF		50	150		50	100	ns
UVLO Saturation	V_{CC} = 5V, I_{SINK} = 10mA		0.7	1.2		0.7	1.2	V
	V_{CC} = 4V, I_{SINK} = 4mA			0.6			0.6	V
Under-Voltage Lockout Section								
Start Threshold	X842B/4B	15	16	17	15	16	17	V
	X843B/5B	7.8	8.4	9.0	7.8	8.4	9.0	V
Min. Operating Voltage	X842B/4B	9	10	11	9	10	11	V
After Turn On	X843B/5B	7.0	7.6	8.2	7.0	7.6	8.2	V
PWM Section								
Max. Duty Cycle	X842B/3B	94	96	100	94	96	100	%
	X844B/5B	47	48	50	47	48	50	%
Min. Duty Cycle				0			0	%
Total Standby Current								
Start-Up Current				250			250	µA
Operating Supply Current	$V_{PIN2} = V_{PIN3}$ = 0V		11	17		11	17	mA
V_{CC} Zener Voltage	I_{CC} = 25mA		34			34		V

Notes: 4. These parameters, although guaranteed, are not 100% tested in production.

5. Parameter measured at trip point of latch with V_{FB} = 0.

6. Gain defined as: $A = \frac{\Delta V_{COMP}}{\Delta V_{ISENSE}}$; $0 \le V_{ISENSE} \le 0.8V$.

7. Adjust V_{CC} above the start threshold before setting at 15V.

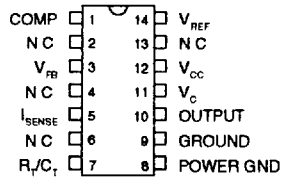
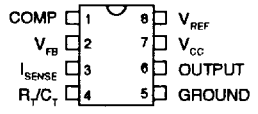
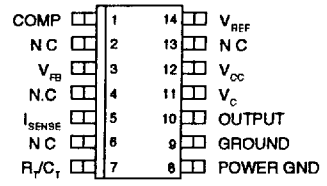
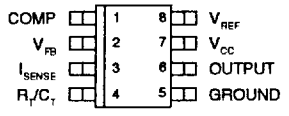
8. Output frequency equals oscillator frequency for the SG1842B and SG1843B.
Output frequency is one half oscillator frequency for the SG1844B and 1845B.

9. "Temperature stability, sometimes referred to as average temperature coefficient, is described by the equation:

$$\text{Temp Stability} = \frac{V_{REF}\,(\text{max.}) - V_{REF}\,(\text{min.})}{T_J\,(\text{max.}) - T_J\,(\text{min.})}$$

V_{REF} (max.) & V_{REF} (min.) are the maximum & minimum reference voltage measured over the appropriate temperature range. Note that the extremes in voltage do not necessarily occur at the extremes in temperature."

CONNECTION DIAGRAM & ORDERING INFORMATION (See notes below)

Package	Part No.	Ambient Temperature Range	Connection Diagram
14-PIN CERAMIC DIP J - PACKAGE	SG184XBJ/883B SG184XBJ SG284XBJ SG384XBJ	-55°C to 125°C -55°C to 125°C -25°C to 85°C 0°C to 70°C	
14-PIN PLASTIC DIP N - PACKAGE	SG284XBN SG384XBN	-25°C to 85°C 0°C to 70°C	
8-PIN CERAMIC DIP Y - PACKAGE	SG184XBY/883B SG184XBY SG284XBY SG384XBY	-55°C to 125°C -55°C to 125°C -25°C to 85°C 0°C to 70°C	
8-PIN PLASTIC DIP M - PACKAGE	SG284XBM SG384XBM	-25°C to 85°C 0°C to 70°C	
14-PIN PLASTIC S.O.I.C. D - PACKAGE	SG284XBD SG384XBD	-25°C to 85°C 0°C to 70°C	
8-PIN PLASTIC S.O.I.C. DM - PACKAGE	SG284XBDM SG384XBDM	-25°C to 85°C 0°C to 70°C	

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