

SG1844/SG1845 Series

CURRENT-MODE PWM CONTROLLER

PRODUCTION DATA SHEET

ABSOLUTE MAXIMUM RATINGS (Notes 1 & 2)

Supply Voltage ($I_{CC} < 30\text{mA}$)	Self Limiting
Supply Voltage (Low Impedance Source)	30V
Output Current (Peak)	$\pm 1\text{A}$
Output Current (Continuous)	350mA
Output Energy (Capacitive Load)	5 μJ
Analog Inputs (V_{FB} , I_{SENSE})	-0.3V to +6.3V
Error Amp Output Sink Current	10mA
Operating Junction Temperature	
Hermetic (J, Y, F, L Packages)	150°C
Plastic (N, M, D, DM Packages)	150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 Seconds)	300°C
RoHS / Pb-free Peak Package Solder Reflow Temp. (40 second max. exposure)	260°C (+0, -5)

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 DATA

M PACKAGE:

THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	95°C/W
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N PACKAGE:

THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	65°C/W
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DM PACKAGE:

THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	165°C/W
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D PACKAGE:

THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	120°C/W
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Y PACKAGE:

THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	130°C/W
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J PACKAGE:

THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	80°C/W
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F PACKAGE:

THERMAL RESISTANCE-JUNCTION TO CASE, θ_{JC}	80°C/W
THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	145°C/W

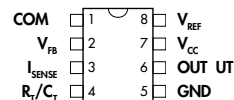
L PACKAGE:

THERMAL RESISTANCE-JUNCTION TO CASE, θ_{JC}	35°C/W
THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA}	120°C/W

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

The θ_{JA} numbers are guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow.

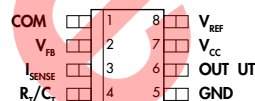
PACKAGE PIN OUTS



M & Y PACKAGE

(Top View)

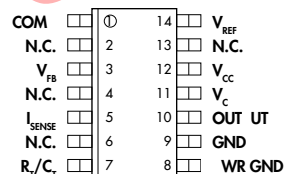
M Package: RoHS / Pb-free 100% Matte Tin Lead Finish



DM PACKAGE

(Top View)

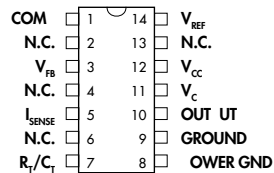
RoHS / Pb-free 100% Matte Tin Lead Finish



D PACKAGE

(Top View)

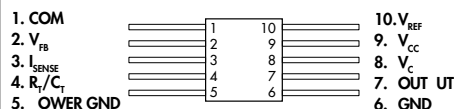
RoHS / Pb-free 100% Matte Tin Lead Finish



J & N PACKAGE

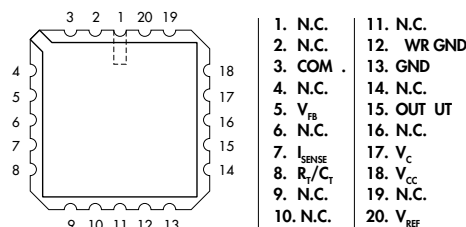
(Top View)

N Package: RoHS / Pb-free 100% Matte Tin Lead Finish



F PACKAGE

(Top View)



L PACKAGE

(Top View)

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RECOMMENDED OPERATING CONDITIONS (Note 3)

Parameter	Symbol	Recommended Operating Conditions			Units
		Min.	Typ.	Max.	
Supply Voltage Range			30		V
Output Current (Peak)			±1		A
Output Current (Continuous)			200		mA
Analog Inputs (Pin 2, Pin 3)		0		2.6	V
Error Amp Output Sink Current			5		mA
Oscillator Frequency Range		0.1		500	kHz
Oscillator Timing Resistor	R_T	0.52		150	kΩ
Oscillator Timing Capacitor	C_T	0.001		1.0	μF
Operating Ambient Temperature Range:					
SG1844/45		-55		125	°C
SG2844/45		-25		85	°C
SG3844/45		0		70	°C

Note 3. Range over which the device is functional.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG1844/SG1845 with $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$, SG2844/SG2845 with $-25^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, SG3844/SG3845 with $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, $V_{CC} = 15\text{V}$ (Note 7), $R_T = 10\text{k}\Omega$, and $C_T = 3.3\text{nF}$. Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

Parameter	Symbol	Test Conditions	SG1844/45			SG2844/45			SG3844/45			Units
			Min.	Typ.	Max.	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	4.90	5.00	5.10	V
Line Regulation		12 ≤ V _{IN} ≤ 25V		6	20		6	20		6	20	mV
Load Regulation		1 ≤ I _o ≤ 20mA		6	25		6	25		6	25	mV
Temperature Stability (Note 4)				0.2	0.4		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	4.82		5.18	V
Output Noise Voltage (Note 4)	V _N	10Hz ≤ f ≤ 10kHz, T _j = 25°C		50			50			50		μV
Long Term Stability (Note 4)		T _A = 125°C, 1000hrs		5	25		5	25		5	25	mV
Output Short Circuit			-30	-100	-180	-30	-100	-180	-30	-100	-180	mA
▶ Oscillator Section												
Initial Accuracy (Note 8)		T _j = 25°C	47	52	57	47	52	57	47	52	57	kHz
Voltage Stability		12V ≤ V _{CC} ≤ 25V		.02	1		0.2	1		0.2	1	%
Temperature Stability (Note 4)		T _{MIN} ≤ T _A ≤ T _{MAX}		5			5			5		%
Amplitude		V _{RT/CT} (Peak to Peak)		1.7			1.7			1.7		V
Discharge Current		T _j = 25°C	7.8	8.3	9.1	7.5	8.4	9.3	7.5	8.4	9.3	mA
		T _{MIN} ≤ T _A ≤ T _{MAX}	6.8		9.3	7.2		9.5	7.2		9.5	mA
▶ Error Amp Section												
Input Voltage		V _{COMP} = 2.5V	2.45	2.50	2.55	2.45	2.50	2.55	2.42	2.50	2.58	V
Input Bias Current				-0.3	-1		-0.3	1		-0.3	-2	μA
Open Loop Gain	A _{VOL}	2 ≤ V _O ≤ 4V	65	90		65	90		65	90		dB
Unity Gain Bandwidth (Note 4)		T _j = 25°C	0.7	1		0.7	1		0.7	1		MHz
Power Supply Rejection Ratio	PSRR	12 ≤ V _{CC} ≤ 25V	60	70		60	70		60	70		dB
Output Sink Current		V _{FEB} = 2.7V, V _{COMP} = 1.1V	2	6		2	6		2	6		mA
Output Source Current		V _{FEB} = 2.3V, V _{COMP} = 5V	-0.5	-0.8		-0.5	-0.8		-0.5	-0.8		mA
V _{OUT} High		V _{FEB} = 2.3V, R _L = 15K to gnd	5	6		5	6		5	6		V
V _{OUT} Low		V _{FEB} = 2.7V, R _L = 15K to V _{REF}		0.7	1.1		0.7	1.1		0.7	1.1	V

(Electrical Characteristics continue next page.)

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ELECTRICAL CHARACTERISTICS (Cont'd.)

Parameter	Symbol	Test Conditions	SG1844/45			SG2844/45			SG3844/45			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Current Sense Section												
Gain (Notes 5 & 6)			2.85	3	3.15	2.85	3	3.15	2.85	3	3.15	V/V
Maximum Input Signal (Note 5)		V _{COMP} = 5V	0.9	1	1.1	0.9	1	1.1	0.9	1	1.1	V
Power Supply Rejection Ratio (Note 5)	PSRR	12 ≤ V _{CC} ≤ 25V		70			70			70		dB
Input Bias Current				-2	-10		-2	-10		-2	-10	μA
Delay to Output (Note 4)				150	300		150	300		150	300	ns
Output Section												
Output Low Level		I _{SINK} = 20mA		0.1	0.4		0.1	0.4		0.1	0.4	V
		I _{SINK} = 200mA		1.5	2.2		1.5	2.2		1.5	2.2	V
Output High Level		I _{SOURCE} = 20mA	13	13.5		13	13.5		13	13.5		V
		I _{SOURCE} = 200mA	12	13.5		12	13.5		12	13.5		V
Rise Time (Note 4)		T _J = 25°C, C _L = 1nF		50	150		50	150		50	150	ns
Fall Time (Note 4)		T _J = 25°C, C _L = 1nF		50	150		50	150		50	150	ns
Under-Voltage Lockout Section												
Start Threshold		1844	15	16	17	15	16	17	14.5	16	17.5	V
		1845	7.8	8.4	9.0	7.8	8.4	9.0	7.8	8.4	9.0	V
Min. Operation Voltage After Turn-On		1844	9	10	11	9	10	11	8.5	10	11.5	V
		1845	7.0	7.6	8.3	7.0	7.6	8.2	7.0	7.6	8.2	V
PWM Section												
Maximum Duty Cycle			46	48	50	46	48	50	46	48	50	%
Minimum Duty Cycle					0			0			0	%
Power Consumption Section												
Start-Up Current				0.5	1		0.5	1		0.5	1	mA
Operating Supply Current		V _{FB} = V _{ISENSE} = 0V		11	17		11	17		11	17	mA
V _{CC} Zener Voltage		I _{CC} = 25mA		34			34			34		V

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

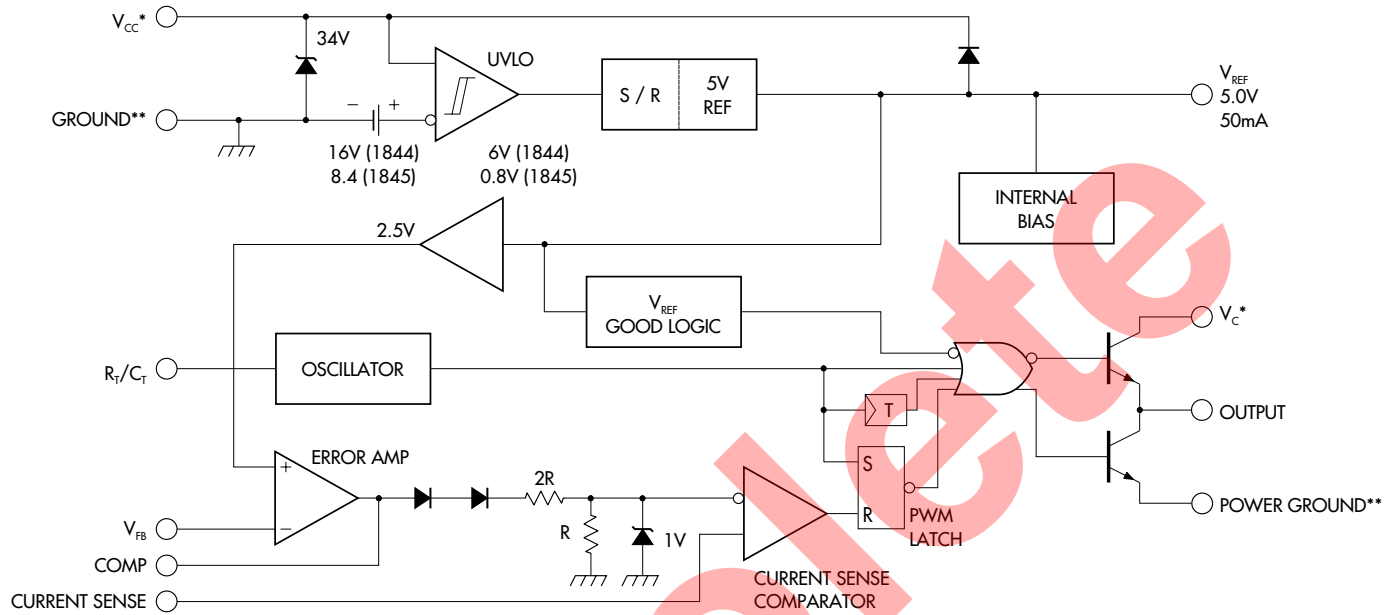
5. Parameter measured at trip point of latch with $V_{VFB} = 0$.

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

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

8. Output frequency equals one half of oscillator frequency.

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.

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2. OSCILLATOR TEMPERATURE STABILITY
3. CURRENT SENSE TO OUTPUT DELAY vs. TEMPERATURE
4. START-UP CURRENT vs. TEMPERATURE
5. REFERENCE VOLTAGE vs. TEMPERATURE
6. START-UP VOLTAGE THRESHOLD vs. TEMPERATURE
7. START-UP VOLTAGE THRESHOLD vs. TEMPERATURE
8. OSCILLATOR DISCHARGE CURRENT vs. TEMPERATURE
9. OUTPUT SATURATION VOLTAGE vs. OUTPUT CURRENT AND TEMPERATURE (SINK TRANSISTOR)
10. CURRENT SENSE THRESHOLD vs. ERROR AMPLIFIER OUTPUT
11. OUTPUT SATURATION VOLTAGE vs. OUTPUT CURRENT AND TEMPERATURE (SOURCE TRANSISTOR)

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16. BIPOLAR TRANSISTOR DRIVE
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19. EXTERNAL DUTY CYCLE CLAMP AND MULTI-UNIT SYNCHRONIZATION
20. OSCILLATOR CONNECTION
21. ERROR AMPLIFIER CONNECTION

CHARACTERISTIC CURVES

FIGURE 1. — DROPOUT VOLTAGE vs. TEMPERATURE

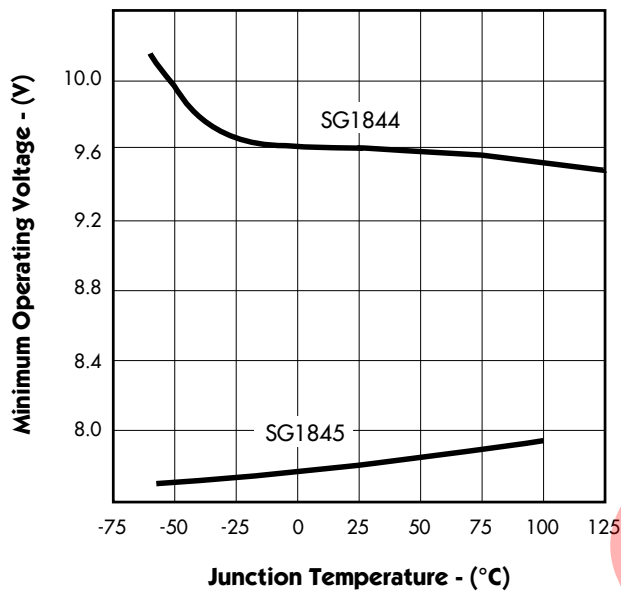


FIGURE 2. — OSCILLATOR TEMPERATURE STABILITY

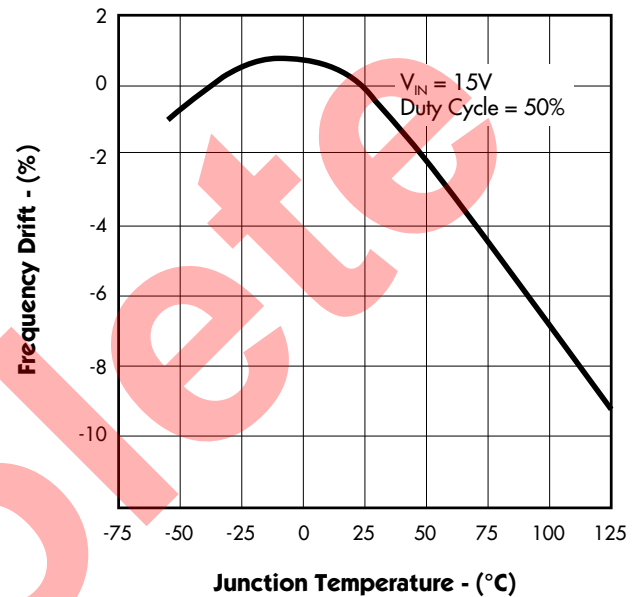


FIGURE 3. — CURRENT SENSE TO OUTPUT DELAY vs. TEMPERATURE

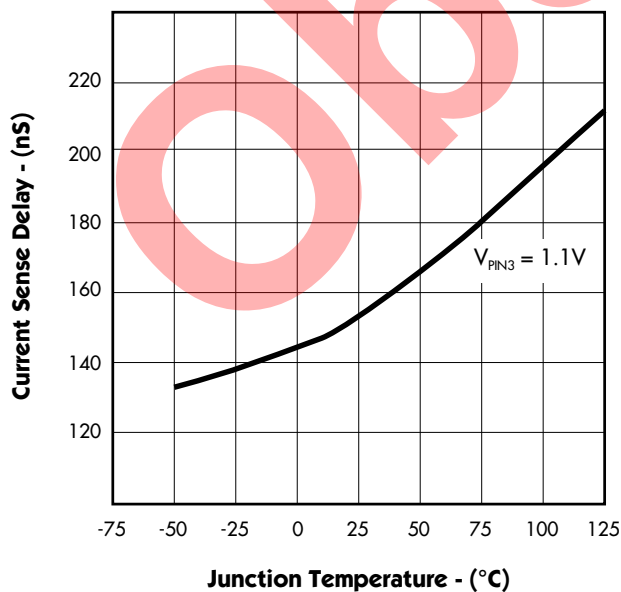
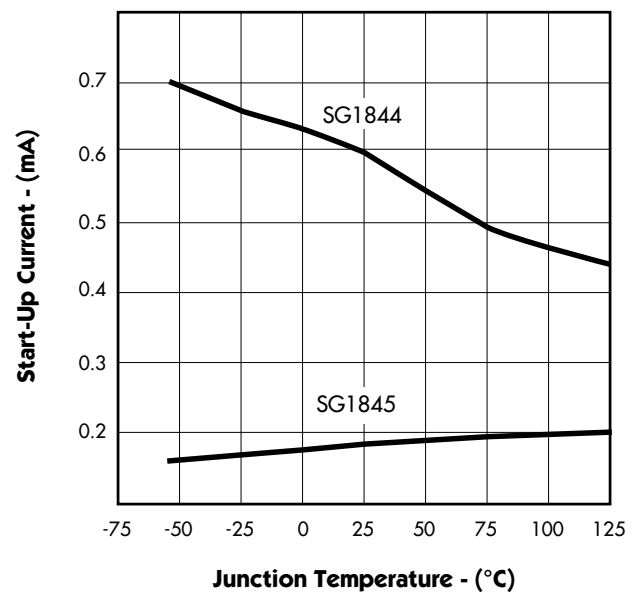


FIGURE 4. — START-UP CURRENT vs. TEMPERATURE



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CHARACTERISTIC CURVES

FIGURE 5. — REFERENCE VOLTAGE vs. TEMPERATURE

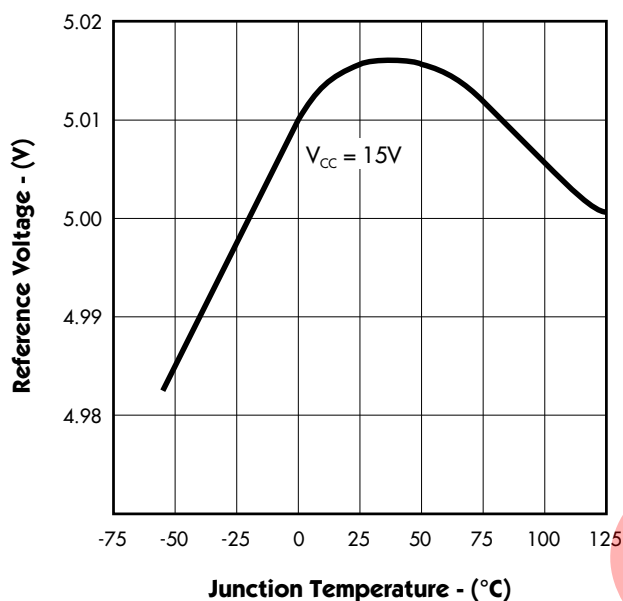


FIGURE 6. — START-UP VOLTAGE THRESHOLD vs. TEMPERATURE

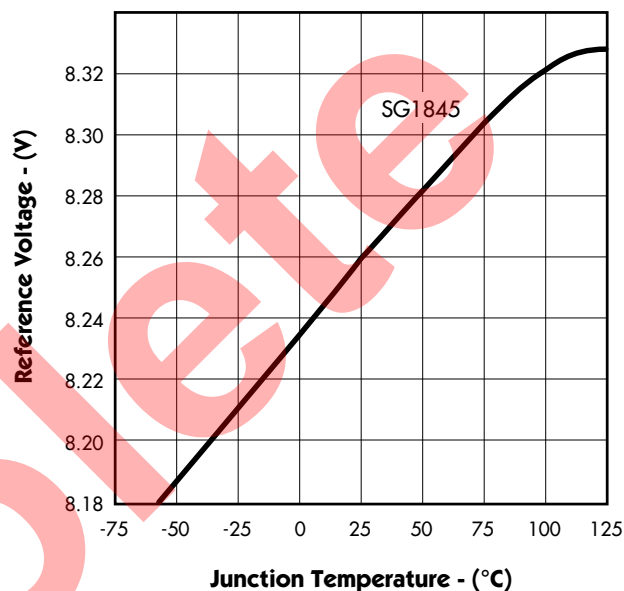


FIGURE 7. — START-UP VOLTAGE THRESHOLD vs. TEMPERATURE

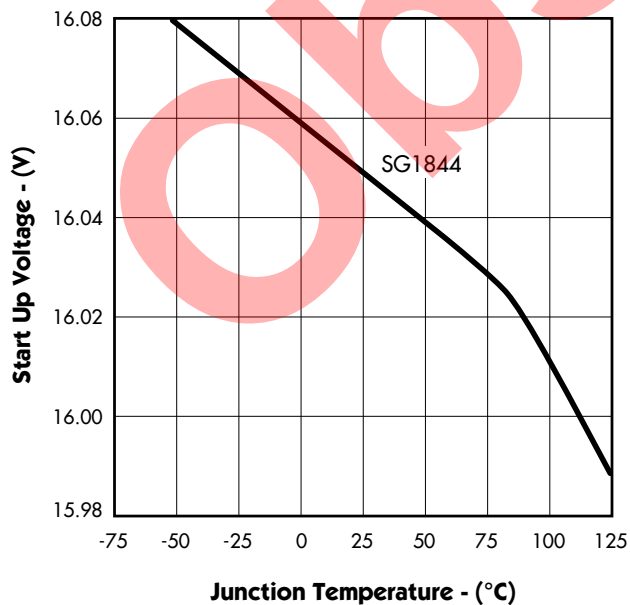
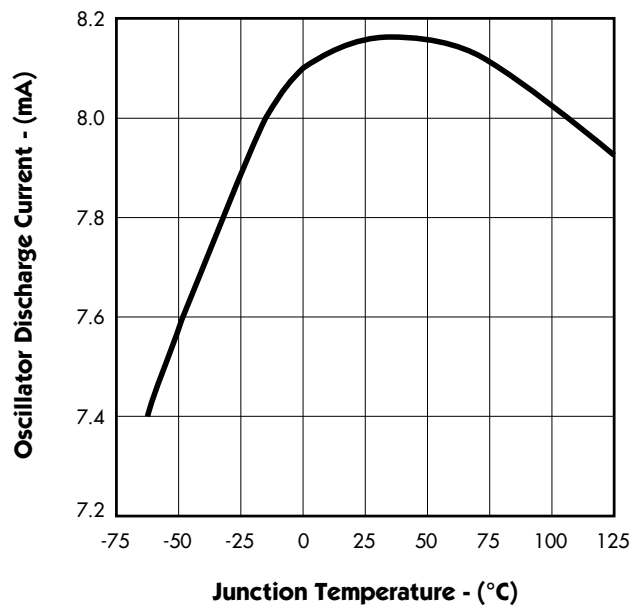


FIGURE 8. — OSCILLATOR DISCHARGE CURRENT vs. TEMPERATURE



CHARACTERISTIC CURVES

FIGURE 9. — OUTPUT SATURATION VOLTAGE vs. OUTPUT CURRENT & TEMPERATURE

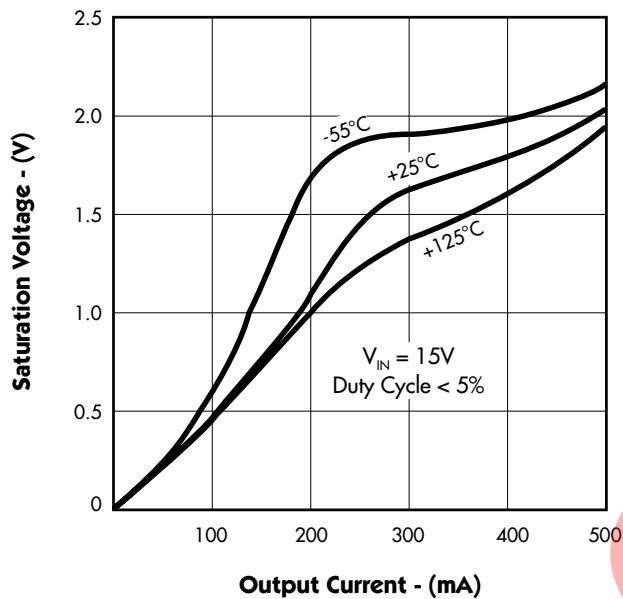


FIGURE 10. — CURRENT SENSE THRESHOLD vs. ERROR AMPLIFIER OUTPUT

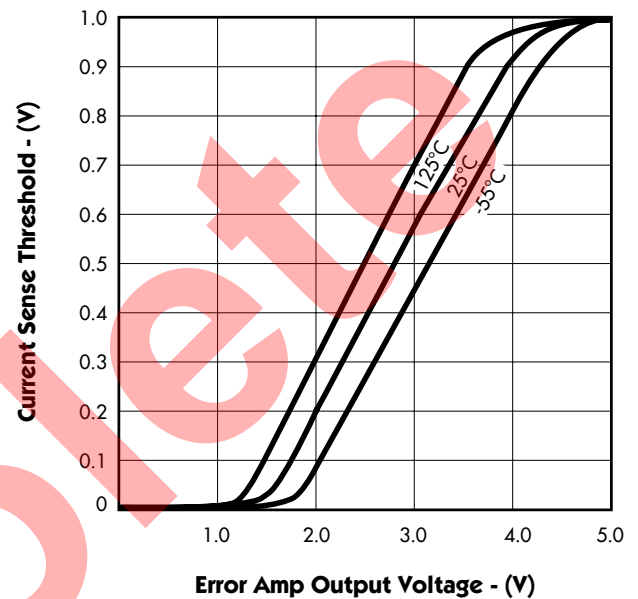
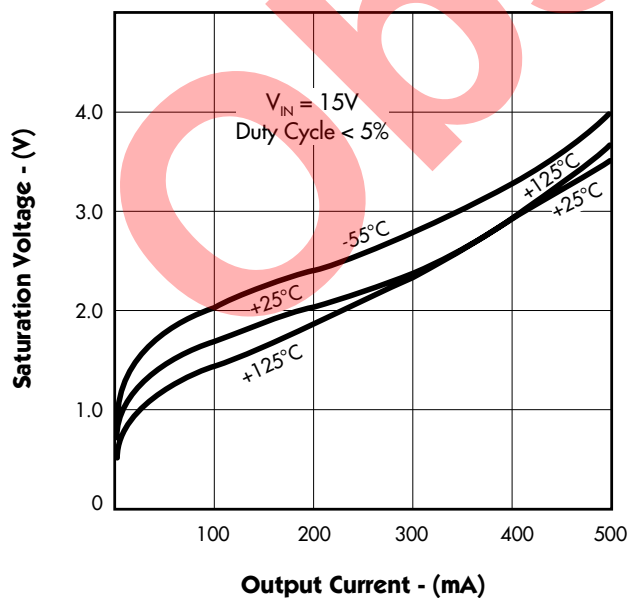


FIGURE 11. — OUTPUT SATURATION VOLTAGE vs. OUTPUT CURRENT & TEMPERATURE



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APPLICATION INFORMATION

OSCILLATOR

The oscillator of the 1844/45 family of PWM's is programmed by the external timing components (R_T , C_T) as shown in Figure 13.

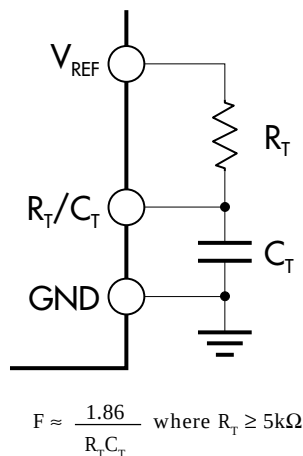


FIGURE 12 — OSCILLATOR TIMING CIRCUIT

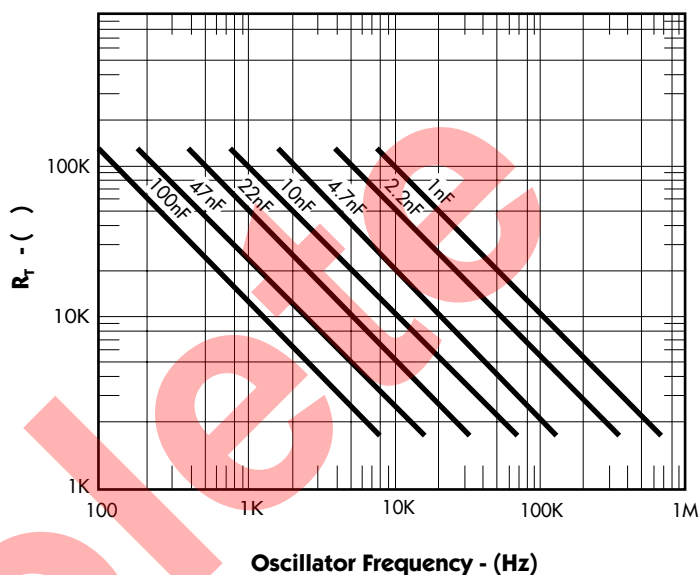


FIGURE 13 — OSCILLATOR FREQUENCY vs. R_T FOR VARIOUS C_T

TYPICAL APPLICATION CIRCUITS

Pin numbers referenced are for 8-pin package and pin numbers in parenthesis are for 14-pin package.

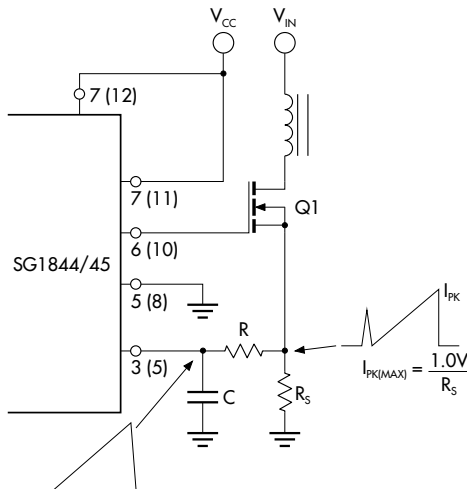


FIGURE 14. — CURRENT SENSE SPIKE SUPPRESSION

The RC low-pass filter will eliminate the leading edge current spike caused by parasitics of Power MOSFET.

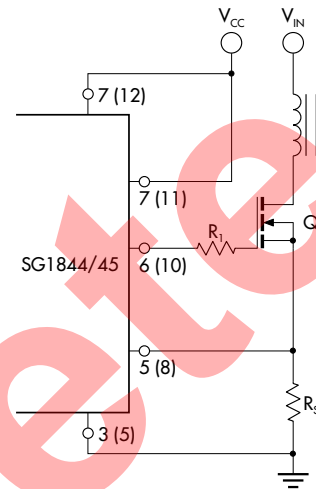


FIGURE 15. — MOSFET PARASITIC OSCILLATIONS

A resistor (R_1) in series with the MOSFET gate reduce overshoot and ringing caused by the MOSFET input capacitance and any inductance in series with the gate drive. (Note: It is very important to have a low inductance ground path to insure correct operation of the I.C. This can be done by making the ground paths as short and as wide as possible.)

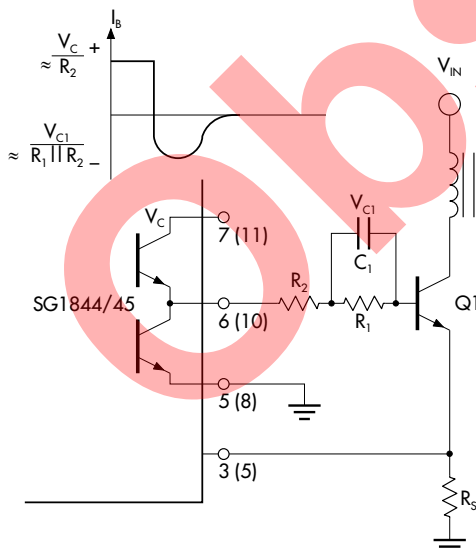
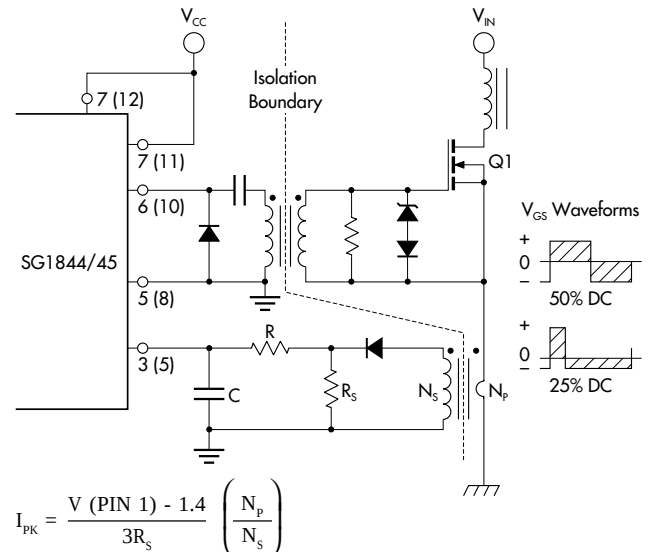


FIGURE 16. — BIPOLAR TRANSISTOR DRIVE

The 1844/45 output stage can provide negative base current to remove base charge of power transistor (Q_1) for faster turn off. This is accomplished by adding a capacitor (C_1) in parallel with a resistor (R_2). The resistor (R_1) is to limit the base current during turn on.



$$I_{PK} = \frac{V(PIN\ 1) - 1.4}{3R_S} \left(\frac{N_P}{N_S} \right)$$

FIGURE 17. — ISOLATED MOSFET DRIVE

Current transformers can be used where isolation is required between PWM and Primary ground. A drive transformer is then necessary to interface the PWM output with the MOSFET.

TYPICAL APPLICATION CIRCUITS (continued)

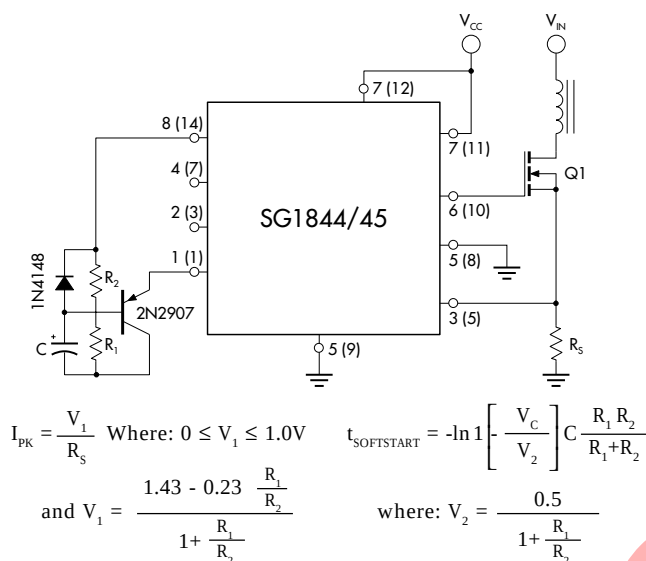


FIGURE 18. — ADJUSTABLE BUFFERED REDUCTION OF CLAMP LEVEL WITH SOFTSTART

Softstart and adjustable peak current can be done with the external circuitry shown above.

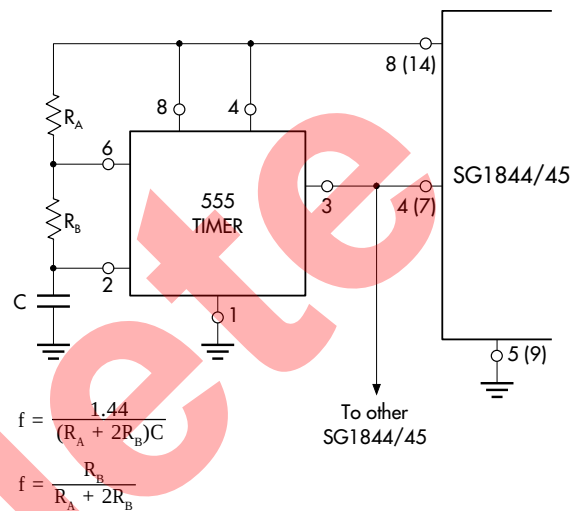


FIGURE 19. — EXTERNAL DUTY CYCLE CLAMP AND MULTI-UNIT SYNCHRONIZATION

Precision duty cycle limiting for a duty cycle of <50%, as well as synchronizing several 1844/45's is possible with the above circuitry.

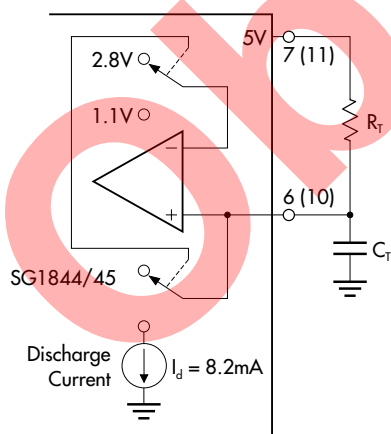


FIGURE 20. — OSCILLATOR CONNECTION

The oscillator is programmed by the values selected for the timing components R_T and C_T . Refer to application information for calculation of the component values.

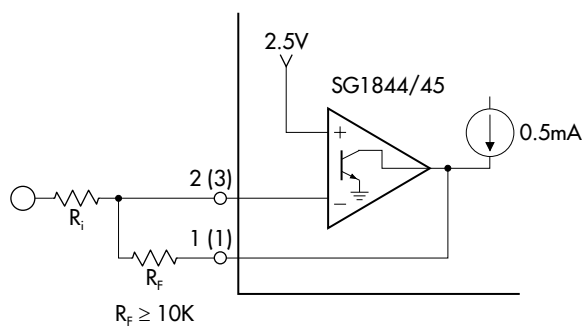


FIGURE 21. — ERROR AMPLIFIER CONNECTION

Error amplifier is capable of sourcing and sinking current up to 0.5mA.