Elektronische Bauelemente

SPW3842D

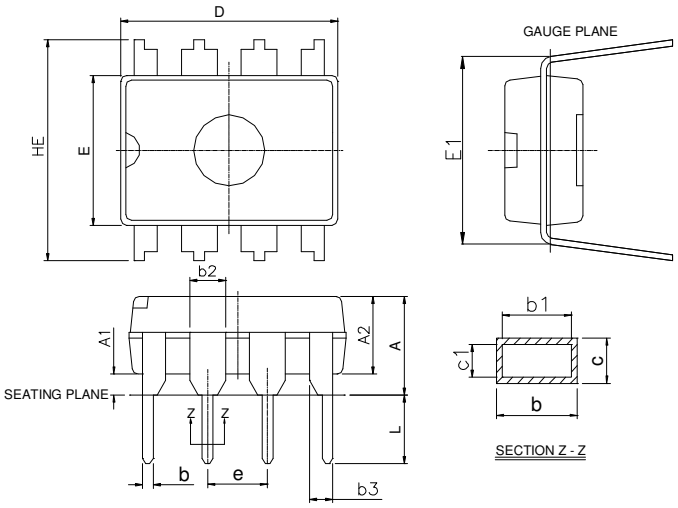
High Performance Current Mode Controlers

RoHS Compliant Product

Description

The SPW3842D is high performance fixed frequency current mode controllers. This is specifically designed for Off-Line and DC TO DC converter applications offering the designer a cost-effective solution with min. external components. These integrated circuits feature a trimmed oscillator for precise duty cycle control. A temperature compensated reference, high gain Error amplifier, current sensing comparator, and a high current totem pole output ideally suited for driving a power MOSFET. Also included are protective features consisting of input and reference undervoltages lockouts each with hysteresis, cycle-by-cycle current limiting, proprammable output deadtime, and latch for single pulse metering.

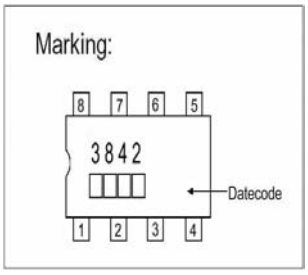
DIP-8

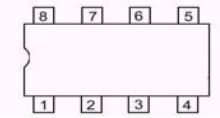


Features

* Low Startup And Operating Current
* Automatic Feed Forward Compensation
* High Current Totem Pole Output
* Trimmed Oscillator For Precise Frequency Control
* Oscillator Frequency Graranteed At 250kHz
* Undervoltage Lockout With Hysteresis
* Current Mode Operation To 500kHz
* Internally Trimmed Reference With Undervoltage Lockout
* Iatching PWM For Cycle-By-Cycle Current Limiting

REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	-	0.5334	c1	0.203	0.279
A1	0.381	-	D	9.017	10.16
A2	2.921	4.953	E	6.096	7.112
b	0.356	0.559	E1	7.620	8.255
b1	0.356	0.508	e	2.540 BSC	
b2	1.143	1.778	HE	-	10.92
b3	0.762	1.143	L	2.921	3.810
c	0.203	0.356			



DIP-8L	Function	Description
	Pin1:Compensation	This pin is the Error Amplifier output and is made available for loop compensation.
	Pin2:Voltage Feedback	This is the inverting input of the Error Amplifier. It's normally connected to the Switching power supply output through a resistor divider.
	Pin3:Current Sense	A voltage proportional to inductor current is connected to this input .The PWM uses this information to terminate the output switch conduction.
	Pin4:RT/CT	The oscillator frequency and maximum output duty cycle are programmed by connecting resistor RT to Vref and capacitor CT to ground. Operation 500kHz is possible.
	Pin5:Ground	This pin is the combined control circuitry and power ground.
	Pin6:Output	This output directly drives the gate of a power MOSFET. Peak currents up to 1 A are sourced and sunk by this pin.
	Pin7:Vcc	This pin is the positive supply of the control IC.
	Pin8:Vref	This is the reference output. It provides charging current for capacitor CT through resistor RT.

Absolute Maximum Ratings at Ta = 25℃

Parameter	Symbol	VALUE	Unit
Total power Supply and Zener current	(ICC+Iz)	30	mA
Output current,source or sink(note1)	Io	1.0	A
Output energy(capacitive load per cycle)	W	5.0	μJ
Current sense and voltage feedback inputs	Vin	-0.3 to 5.5	V
Error Amplifier Output Sink Current	Io	10	mA
Power Dissipation at Thermal characteristics	PD PθJA	702 178	mW ℃/W
Storage Temperature Range	Tstg	-65 to 150	℃
Operating Junction Temperature	TJ	+150	℃
Operating ambient Temperature	TA	0~+70	℃

Electrical Characteristics (0℃≤TA≤70℃,Vcc=15V[note 2],RT=10k,CT=3.3Nf,unless otherwise specified)

Parameter	SYMBOL	Test Conditions	Min	Typ.	Max.	Unit
Reference Section						
Output Voltage	VREF	Tj=25℃,Io=1mA	4.90	5	5.1	V
Line Regulation	Regline	Vcc=12V to 25V		2.0	20	mV
Load Regulation	Regload	Io=1mA to 20mA		3.0	25	mV
Temperature. Stability	Ts			0.2	-	mV/℃
Total Output Variation	VREF	Line, Load, Temperature	4.82	-	5.18	V
Output Noise Voltage	Vn	F=10kHz to 10Hz,Tj=25℃	-	50	-	μV
Long Term Stability	S	TA=125℃,1000Hrs	-	5	-	mV
Output Short Circuit current	ISC		-30	-85	-180	mA
Oscillator Section						
Frequency		Tj=25℃	49	52	55	KHz
		TA=0℃ to 70℃	48		56	
		Tj=25℃(RT=6.2k,CT=1.0nF)	225	250	275	
Frequency Change with Voltage	Δfosc/ΔV	Vcc=12V to 25V		0.2	1.0	%
Frequency Change with Temperature	Δfosc/ΔT	TA = 0℃ to 70 ℃		0.5		%
Oscillator Voltage Swing(Peak to Peak)	VOSC			1.6		V
Discharge Current	Idischg	Tj=25℃ TA = 0℃ to 70℃	7.8 7.6	8.3	8.8 8.8	mA
Error Amplifier Section						
Voltage Feedback Input	VFB	Vo =2.5V	2.42	2.50	2.58	V
Input Bias Current	IIB	VFB=5.0V		-0.1	-2.0	μA
Open Loop Voltage Gain	AVOL	Vo=2V to 4V	65	90		dB
Unity Gain Bandwidth	BW	Tj=25℃	0.7	1.0		MHz
Power Supply Rejection Ratio	PSRR	Vcc=12V to 25V	60	70		dB
Output Sink Current	Isink	Vo=1.1V,VFB=2.7V	2.0	12		mA
Output Source Current	Isource	Vo=5.0V,VFB=2.3V	-0.5	-1.0		mA
Output Voltage Swing High State	VOH	VFB=2.3V,RL=15K to GND	5.0	6.2		V
Output Voltage Swing Low State	VOL	VFB=2.7V,RL=15K to Vref		0.8	1.1	V

Current Sense section						
Current Sense Input Voltage gain	Av	(Note 3,4)	2.85	3.0	3.15	V/V
Maximum Current Sense Input Threshold	Vth	(Note 3)	0.9	1.0	1.1	V
Power Supply Rejection Ratio	PSRR	V_{CC}= 12 to 25V (Note 3)		70		dB
Input Bias Current	I_{IB}			-2	-10	μA
Propagation Delay	Tplh(in/out)	Current Sense Input to Output		150	300	ns
Output Low Voltage	V_{OL}	Isink=20mA		0.1	0.4	V
		Isink=200mA		1.6	2.2	V
Output High Level	V_{OH}	Isource=20mA	13	13.5		V
		Isource=200mA	12	13.4		V
Output Voltage with UVLO Activated	VOL	VCC=6.0V,Isink=1.0mA		0.1	1.1	V
Output Voltage Rise Time	tr	Tj=25℃,C_L=1nF		50	150	ns
Output Voltage Fall Time	tr	Tj=25℃,C_L=1nF		50	150	ns
Under-Voltage Lockout Section						
Startup Threshold	Vth		14.5	16	17.5	V
Min. Operating Voltage After Turn-on(VCC)	$V_{CC(min)}$		8.5	10	11.5	V
PWM Section						
Maximum Duty Cycle	DC(MAX)		94	96		%
Minimum Duty Cycle	DC(MIN)				0	%
Total Device						
Power Startup Supply Current	I_{CC}+I_C	V_{CC}=14V		0.3	0.5	mA
Power Operating Supply Current	I_{CC}+I_C	Note 2		12	17	mA
Power Supply Zener Voltage	Vz	I_{CC}=25mA	30	36		V

Note 1: Maximum Package power dissipation limits must be observed.

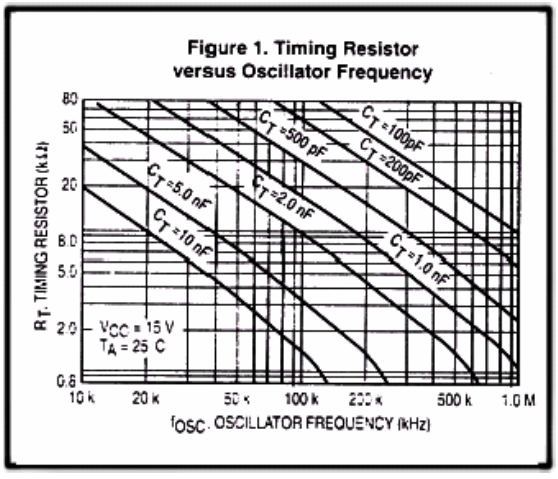
Note 2: Adject Vcc above the Startup threshold before setting to 15V.

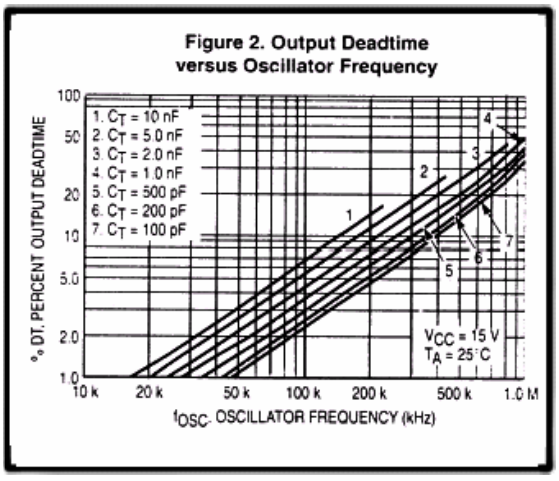
Note 3: This parameter is measured at the latch trip point with VFB=0V.

Note 4: Comparator gain is defined as::

$$AV \quad \frac{\Delta V \text{ Output Compensation}}{\Delta V \text{ Current Sense Input}}$$

Characteristics Curve





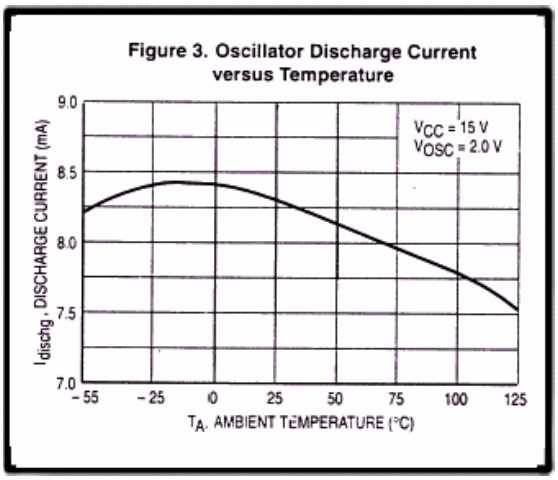


Figure 3. Oscillator Discharge Current versus Temperature
I_{dischg}, DISCHARGE CURRENT (mA)
9.0
8.5
8.0
7.5
7.0
V_{CC} = 15 V
V_{OSC} = 2.0 V
−55
−25
0
25
50
75
100
125
T_A, AMBIENT TEMPERATURE (°C)

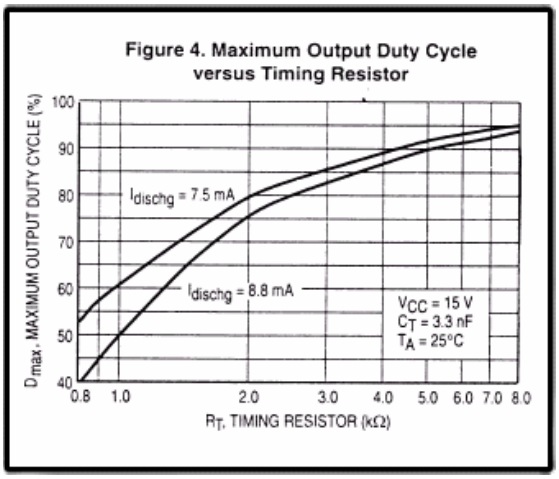


Figure 4. Maximum Output Duty Cycle versus Timing Resistor
D_{max}, MAXIMUM OUTPUT DUTY CYCLE (%)
100
90
80
70
60
50
40
I_{dischg} = 7.5 mA
I_{dischg} = 8.8 mA
V_{CC} = 15 V
C_T = 3.3 nF
T_A = 25°C
0.8
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
R_T, TIMING RESISTOR (kΩ)

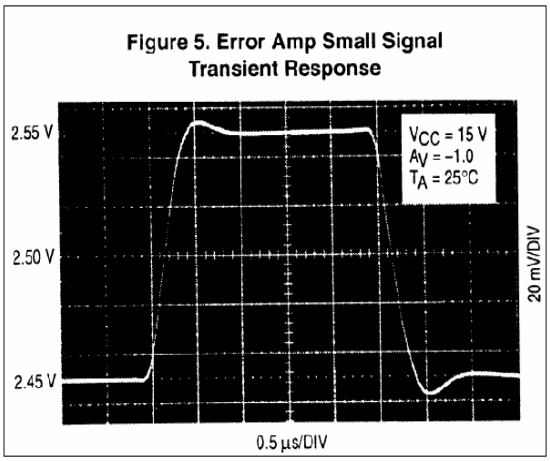


Figure 5. Error Amp Small Signal Transient Response
2.55 V
2.50 V
2.45 V
V_{CC} = 15 V
A_V = −1.0
T_A = 25°C
20 mV/DIV
0.5 μs/DIV

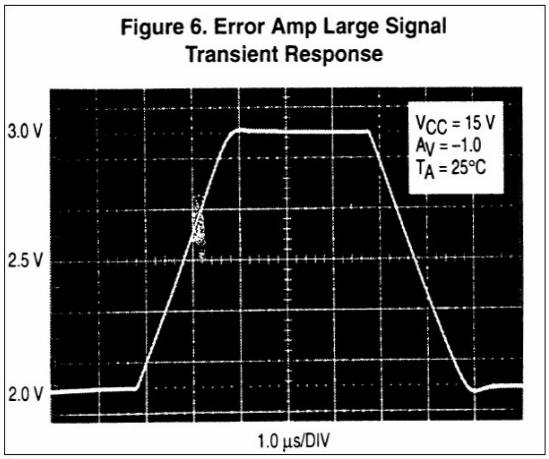


Figure 6. Error Amp Large Signal Transient Response
3.0 V
2.5 V
2.0 V
V_{CC} = 15 V
A_V = −1.0
T_A = 25°C
1.0 μs/DIV

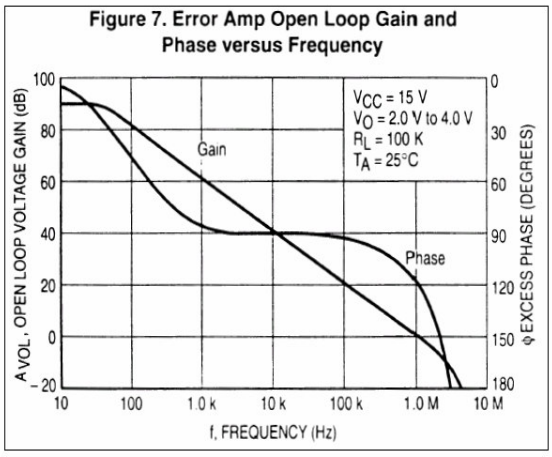


Figure 7. Error Amp Open Loop Gain and Phase versus Frequency
A_{VOL}, OPEN LOOP VOLTAGE GAIN (dB)
100
80
60
40
20
0
−20
V_{CC} = 15 V
V_O = 2.0 V to 4.0 V
R_L = 100 K
T_A = 25°C
Gain
Phase
0
30
60
90
120
150
180
φ EXCESS PHASE (DEGREES)
10
100
1.0 k
10 k
100 k
1.0 M
10 M
f, FREQUENCY (Hz)

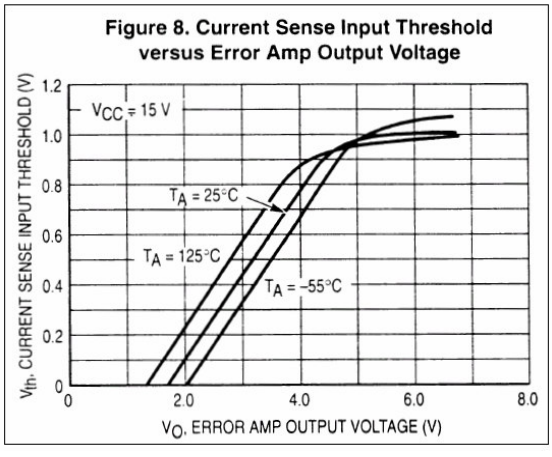


Figure 8. Current Sense Input Threshold versus Error Amp Output Voltage
V_{th}, CURRENT SENSE INPUT THRESHOLD (V)
1.2
1.0
0.8
0.6
0.4
0.2
0
V_{CC} = 15 V
T_A = 25°C
T_A = 125°C
T_A = −55°C
0
2.0
4.0
6.0
8.0
V_O, ERROR AMP OUTPUT VOLTAGE (V)

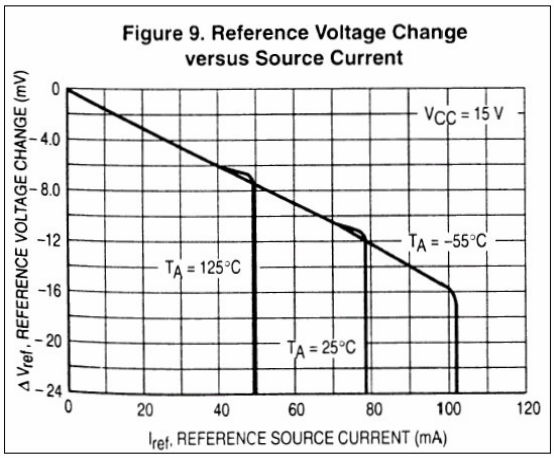


Figure 9. Reference Voltage Change versus Source Current
Δ Vref, REFERENCE VOLTAGE CHANGE (mV)
0
-4.0
-8.0
-12
-16
-20
-24
VCC = 15 V
TA = -55°C
TA = 125°C
TA = 25°C
0
20
40
60
80
100
120
Iref, REFERENCE SOURCE CURRENT (mA)

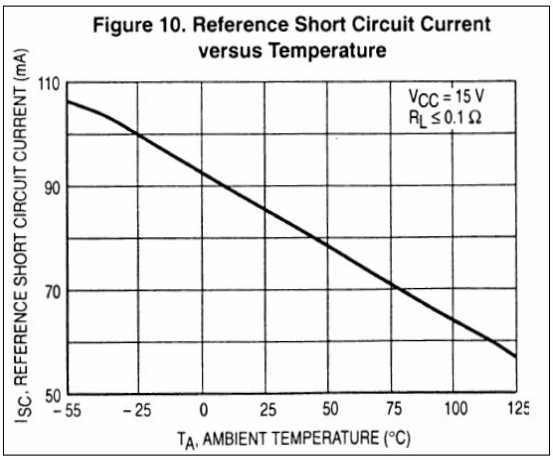


Figure 10. Reference Short Circuit Current versus Temperature
ISC, REFERENCE SHORT CIRCUIT CURRENT (mA)
110
90
70
50
VCC = 15 V
RL ≤ 0.1 Ω
-55
-25
0
25
50
75
100
125
TA, AMBIENT TEMPERATURE (°C)

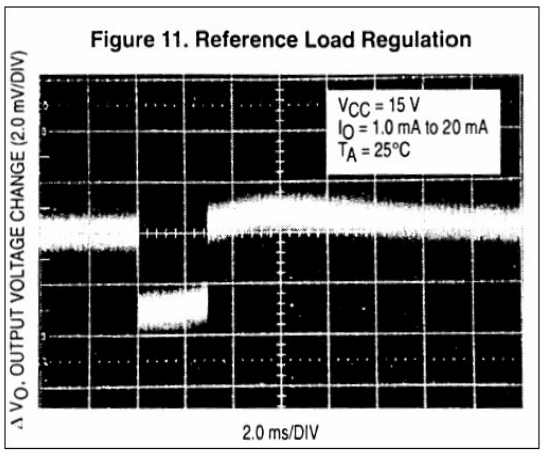


Figure 11. Reference Load Regulation
Δ VO, OUTPUT VOLTAGE CHANGE (2.0 mV/DIV)
VCC = 15 V
IO = 1.0 mA to 20 mA
TA = 25°C
2.0 ms/DIV

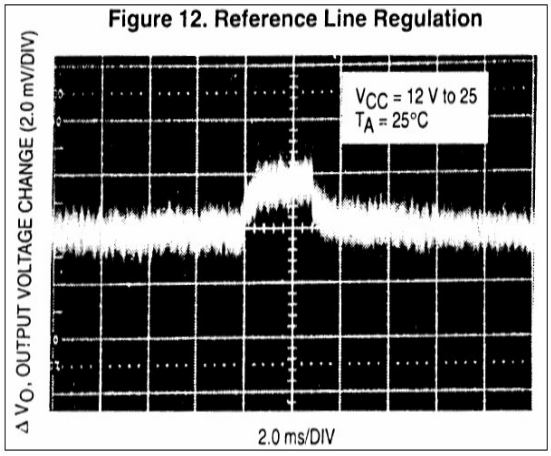


Figure 12. Reference Line Regulation
Δ VO, OUTPUT VOLTAGE CHANGE (2.0 mV/DIV)
VCC = 12 V to 25
TA = 25°C
2.0 ms/DIV

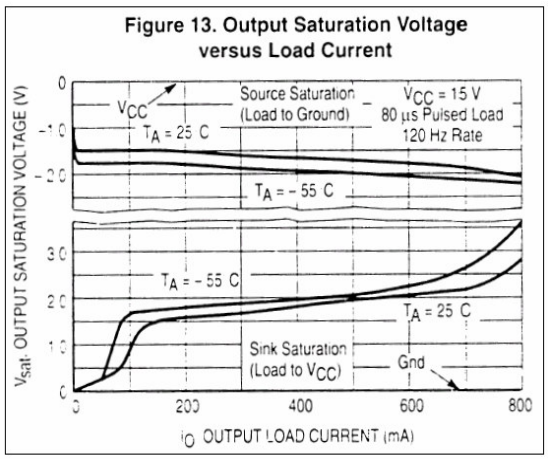


Figure 13. Output Saturation Voltage versus Load Current
Vsat, OUTPUT SATURATION VOLTAGE (V)
0
1.0
2.0
3.0
2.0
1.0
0
VCC
Source Saturation (Load to Ground)
VCC = 15 V
80 μs Pulsed Load
120 Hz Rate
TA = 25°C
TA = -55°C
TA = -55°C
TA = 25°C
Sink Saturation (Load to VCC)
Gnd
0
200
400
600
800
IO, OUTPUT LOAD CURRENT (mA)

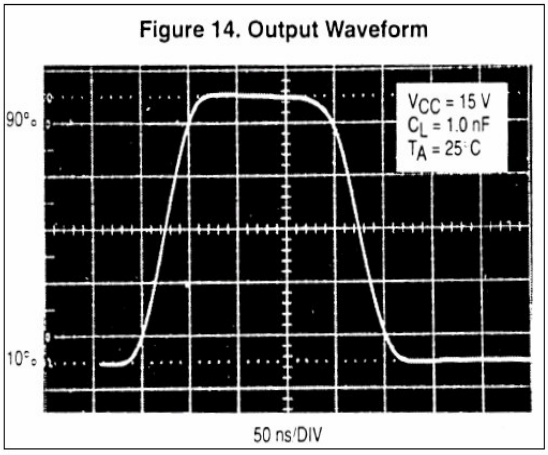
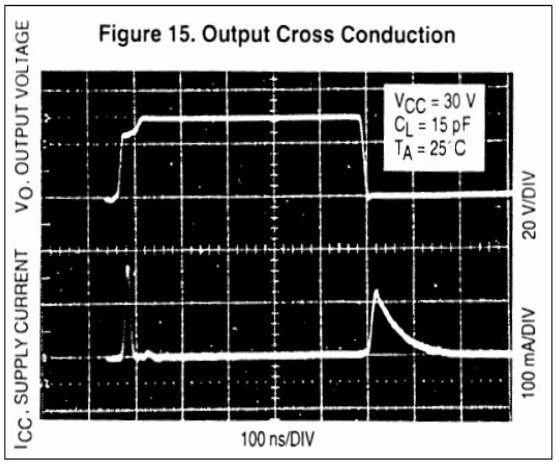
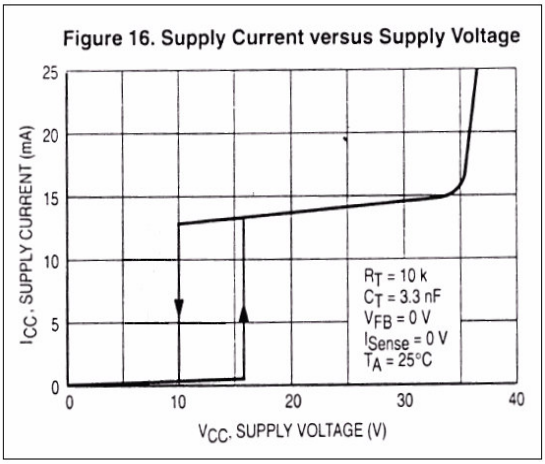
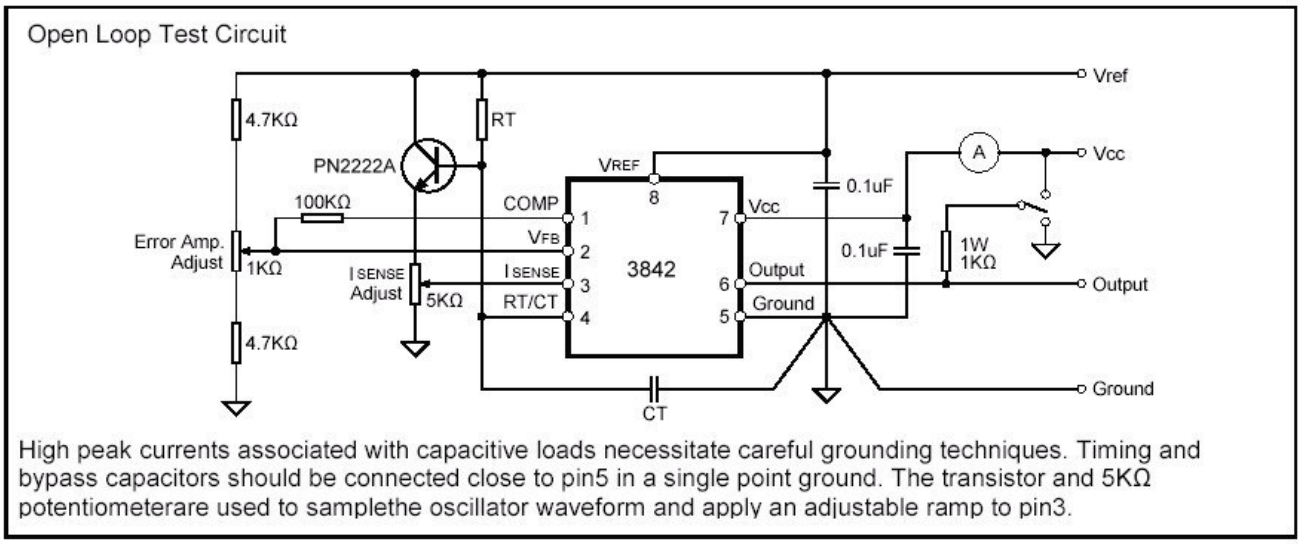


Figure 14. Output Waveform
90%
10%
VCC = 15 V
CL = 1.0 nF
TA = 25°C
50 ns/DIV

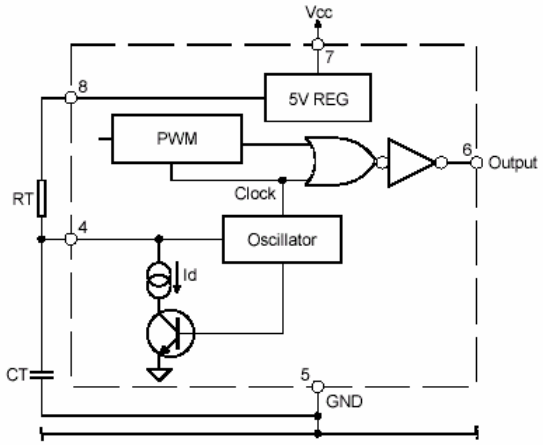


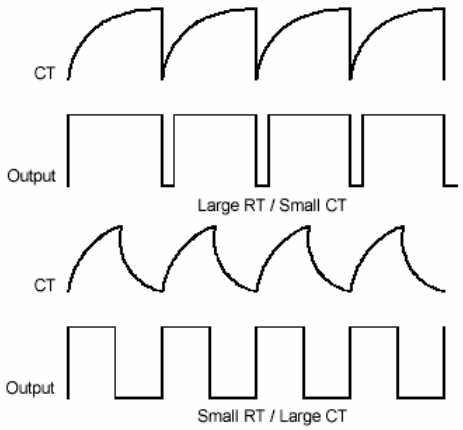


Application Information

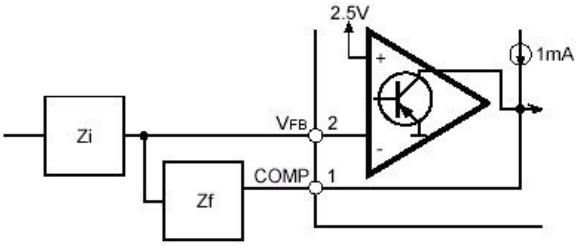


Oscillator and Output Waveforms

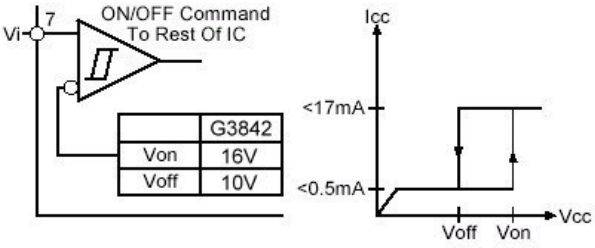




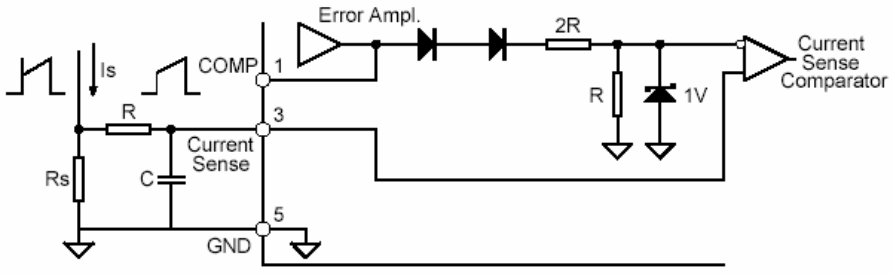
Error Amp Configuration



Under Voltage Lockout

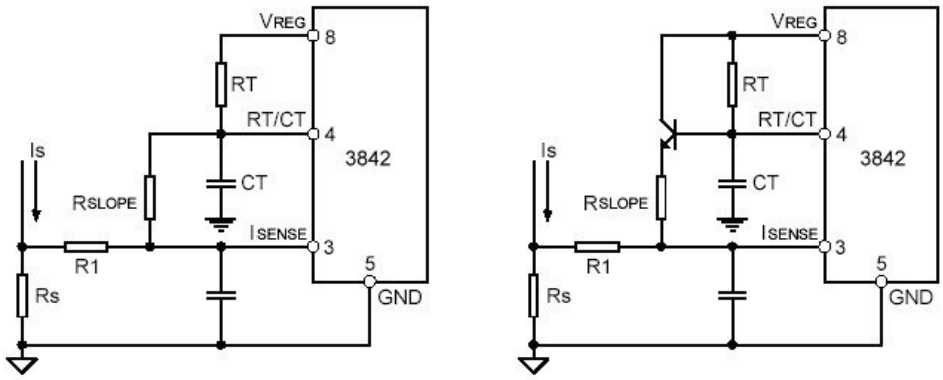


Current Sense Circuit

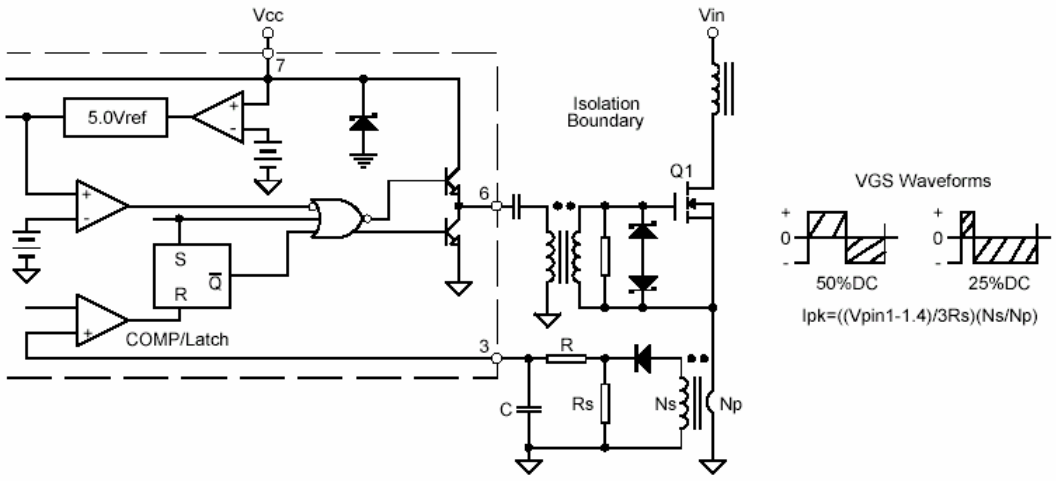


Peak current (Is) is determined by the formula
Is(max.) ≈ 1V/Rs
A small RC filter may be required to suppress switch transients.

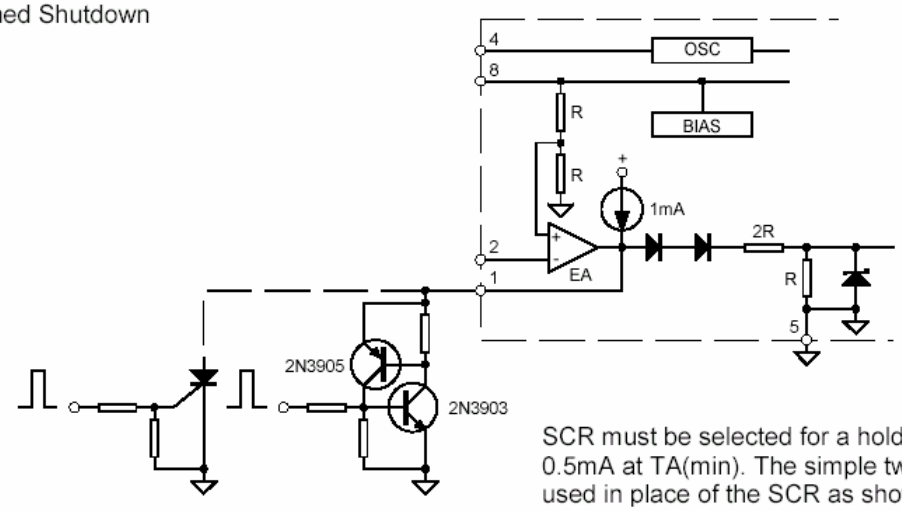
Slope Compensation Techniques



Isolated MOSFET Drive and Current Transformer Sensing

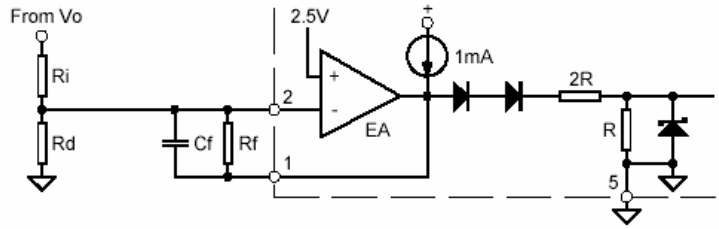


Latched Shutdown

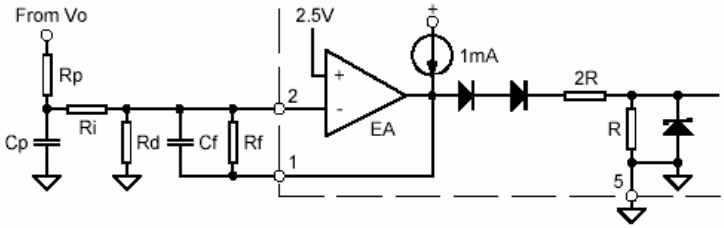


SCR must be selected for a holding current of less than 0.5mA at TA(min). The simple two transistor circuit can be used in place of the SCR as shown. All resistors are 10K.

Error Amplifier Compensation

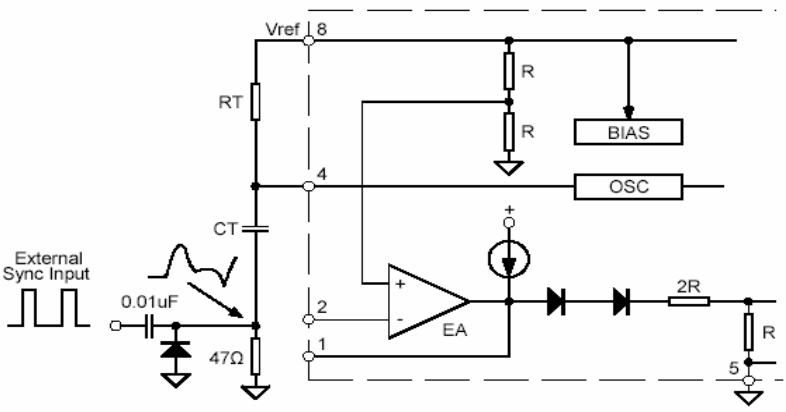


Error Amp compensation circuit for stabilizing any current-mode topology except for boost and flyback converters operating with continuous inductor current



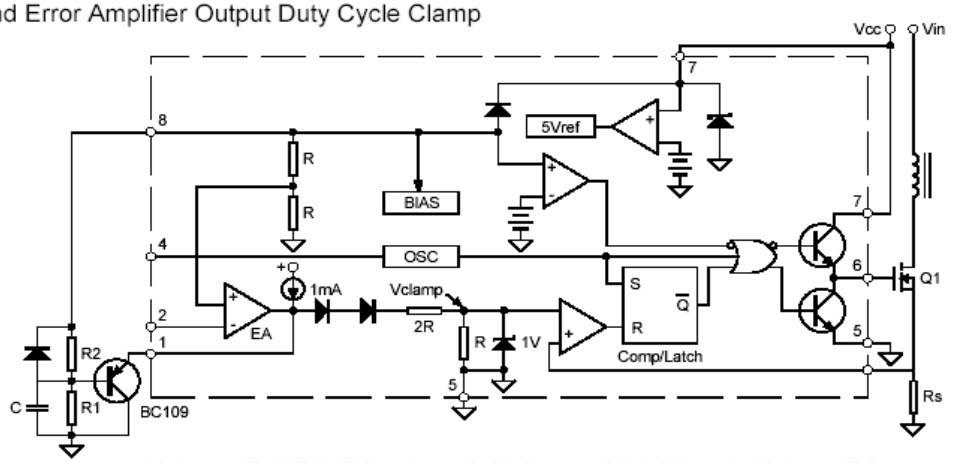
Error Amp compensation circuit for stabilizing current-mode boost and flyback topologies operating with continuous inductor current.

External Clock Synchronization



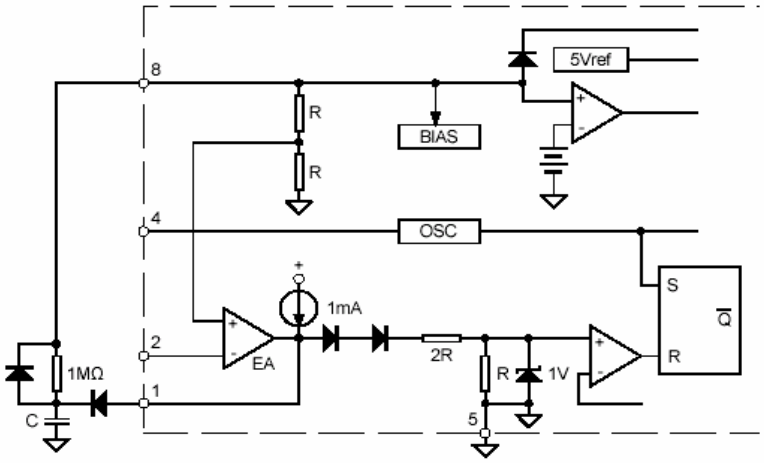
The diode clamp is required if the Sync amplitude is large enough to cause the bottom side of CT to go more than 300mV below ground

Soft-Start and Error Amplifier Output Duty Cycle Clamp

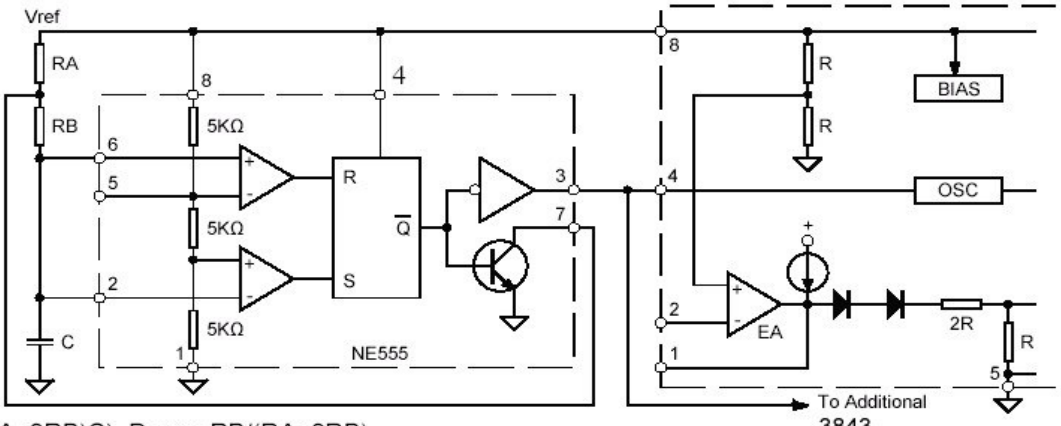


Vclamp=R1/(R1+R2) where 0<Vclamp<1V, Ipk(max)=Vclamp/RS

Soft-Start Circuit



External Duty Cycle Clamp and Multi Unit Synchronization



f=1.44/((RA+2RB)C), Dmax=RB/(RA+2RB)