UNITRODE

UC1842/3/4/5
UC2842/3/4/5
UC3842/3/4/5

Current Mode PWM Controller

FEATURES

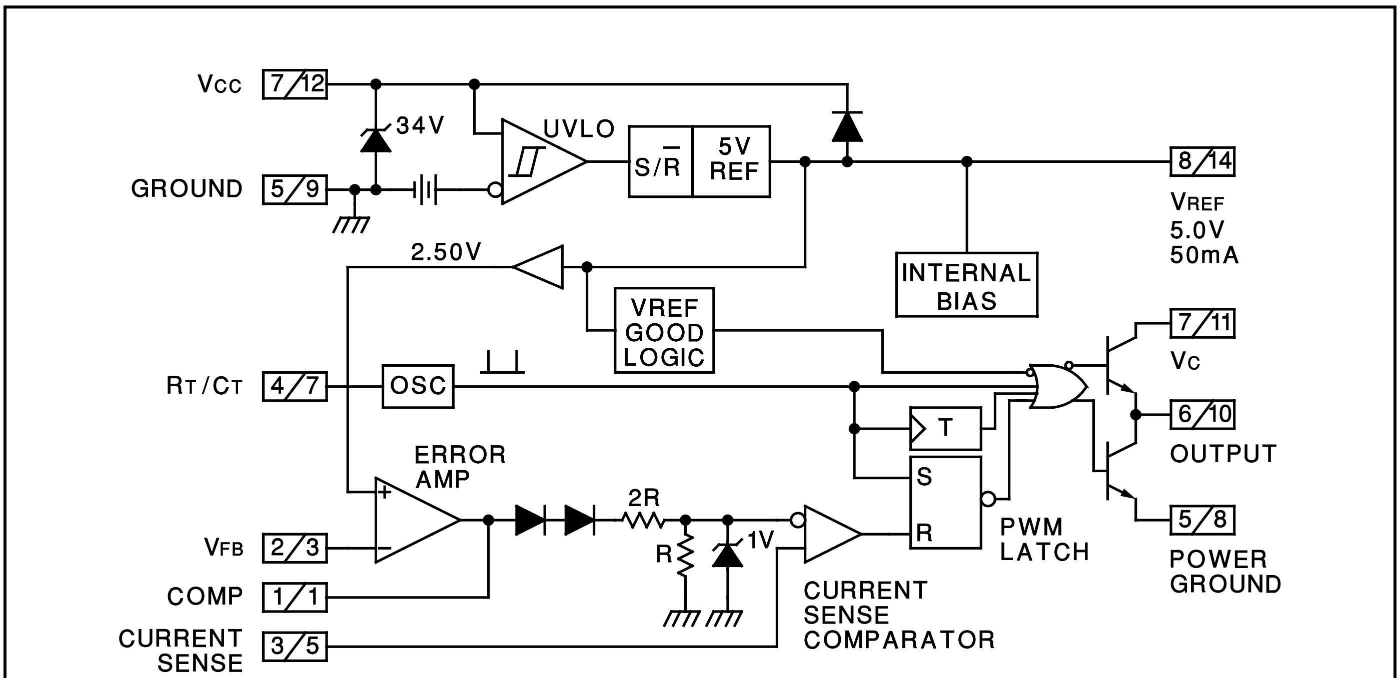
- Optimized For Off-line And DC To DC Converters
- Low Start Up Current (<1mA)
- Automatic Feed Forward Compensation
- Pulse-by-pulse Current Limiting
- Enhanced Load Response Characteristics
- Under-voltage Lockout With Hysteresis
- Double Pulse Suppression
- High Current Totem Pole Output
- Internally Trimmed Bandgap Reference
- 500khz Operation
- Low RO Error Amp

DESCRIPTION

The UC1842/3/4/5 family of control ICs provides the necessary features to implement off-line or DC to DC fixed frequency current mode control schemes with a minimal external parts count. Internally implemented circuits include under-voltage lockout featuring start up current less than 1mA, a precision reference trimmed for accuracy at the error amp input, logic to insure latched operation, a PWM comparator which also provides current limit control, and a totem pole output stage designed to source or sink high peak current. The output stage, suitable for driving N Channel MOSFETs, is low in the off state.

Differences between members of this family are the under-voltage lockout thresholds and maximum duty cycle ranges. The UC1842 and UC1844 have UVLO thresholds of 16V (on) and 10V (off), ideally suited to off-line applications. The corresponding thresholds for the UC1843 and UC1845 are 8.4V and 7.6V. The UC1842 and UC1843 can operate to duty cycles approaching 100%. A range of zero to 50% is obtained by the UC1844 and UC1845 by the addition of an internal toggle flip flop which blanks the output off every other clock cycle.

BLOCK DIAGRAM



Note 1: A/B A = DIL-8 Pin Number. B = SO-14 Pin Number.
Note 2: Toggle flip flop used only in 1844 and 1845.

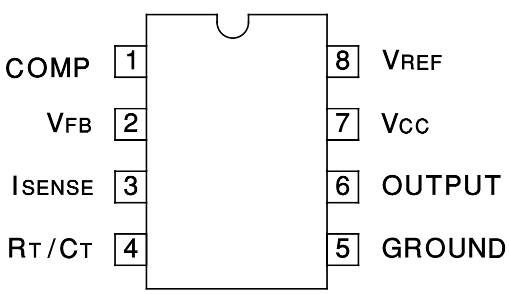
ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage (Low Impedance Source)	30V
Supply Voltage (I_{CC} <30mA)	Self Limiting
Output Current	±1A
Output Energy (Capacitive Load)	5µJ
Analog Inputs (Pins 2, 3)	-0.3V to +6.3V
Error Amp Output Sink Current	10mA
Power Dissipation at $T_A \leq 25°C$ (DIL-8)	1W
Power Dissipation at $T_A \leq 25°C$ (SOIC-14)	725mW
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 Seconds)	300°C

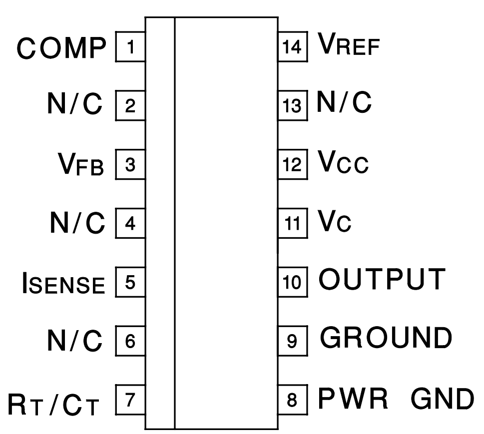
Note 1: All voltages are with respect to Pin 5.
All currents are positive into the specified terminal.
Consult Packaging Section of Databook for thermal limitations and considerations of packages.

CONNECTION DIAGRAMS

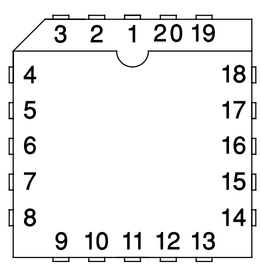
DIL-8, SOIC-8 (TOP VIEW)
N or J Package, D8 Package



SOIC-14 (TOP VIEW)
D Package



PLCC-20 (TOP VIEW)
Q Package



PACKAGE PIN FUNCTION	
FUNCTION	**PIN**
N/C	1
COMP	2
N/C	3
N/C	4
VFB	5
N/C	6
ISENSE	7
N/C	8
N/C	9
RT/CT	10
N/C	11
PWR GND	12
GROUND	13
N/C	14
OUTPUT	15
N/C	16
VC	17
VCC	18
N/C	19
VREF	20

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for -55°C ≤ T_A ≤ 125°C for the UC184X; -40°C ≤ T_A ≤ 85°C for the UC284X; 0°C ≤ T_A ≤ 70°C for the 384X; V_{CC} = 15V (Note 5); R_T = 10k; C_T =3.3nF, T_A=T_J.

PARAMETER	TEST CONDITIONS	UC1842/3/4/5 UC2842/3/4/5			UC3842/3/4/5			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Reference Section								
Output Voltage	T_J = 25°C, I_O = 1mA	4.95	5.00	5.05	4.90	5.00	5.10	V
Line Regulation	12 ≤ V_{IN} ≤ 25V		6	20		6	20	mV
Load Regulation	1 ≤ I_O ≤ 20mA		6	25		6	25	mV
Temp. Stability	(Note 2) (Note 7)		0.2	0.4		0.2	0.4	mV/°C
Total Output Variation	Line, Load, Temp. (Note 2)	4.9		5.1	4.82		5.18	V
Output Noise Voltage	10Hz ≤ f ≤ 10kHz, T_J = 25°C (Note2)		50			50		µV
Long Term Stability	T_A = 125°C, 1000Hrs. (Note 2)		5	25		5	25	mV
Output Short Circuit		-30	-100	-180	-30	-100	-180	mA
Oscillator Section								
Initial Accuracy	T_J = 25°C (Note 6)	47	52	57	47	52	57	kHz
Voltage Stability	12 ≤ V_{CC} ≤ 25V		0.2	1		0.2	1	%
Temp. Stability	T_{MIN} ≤ T_A ≤ T_{MAX} (Note 2)		5			5		%
Amplitude	$V_{PIN\ 4}$ peak to peak (Note 2)		1.7			1.7		V
Error Amp Section								
Input Voltage	$V_{PIN\ 1}$ = 2.5V	2.45	2.50	2.55	2.42	2.50	2.58	V
Input Bias Current			-0.3	-1		-0.3	-2	µA
A_{VOL}	2 ≤ V_O ≤ 4V	65	90		65	90		dB
Unity Gain Bandwidth	(Note 2) T_J = 25°C	0.7	1		0.7	1		MHz
PSRR	12 ≤ V_{CC} ≤ 25V	60	70		60	70		dB
Output Sink Current	$V_{PIN\ 2}$ = 2.7V, $V_{PIN\ 1}$ = 1.1V	2	6		2	6		mA
Output Source Current	$V_{PIN\ 2}$ = 2.3V, $V_{PIN\ 1}$ = 5V	-0.5	-0.8		-0.5	-0.8		mA
V_{OUT} High	$V_{PIN\ 2}$ = 2.3V, R_L = 15k to ground	5	6		5	6		V
V_{OUT} Low	$V_{PIN\ 2}$ = 2.7V, R_L = 15k to Pin 8		0.7	1.1		0.7	1.1	V
Current Sense Section								
Gain	(Notes 3 and 4)	2.85	3	3.15	2.85	3	3.15	V/V
Maximum Input Signal	$V_{PIN\ 1}$ = 5V (Note 3)	0.9	1	1.1	0.9	1	1.1	V
PSRR	12 ≤ V_{CC} ≤ 25V (Note 3) (Note 2)		70			70		dB
Input Bias Current			-2	-10		-2	-10	µA
Delay to Output	$V_{PIN\ 3}$ = 0 to 2V (Note 2)		150	300		150	300	ns

Note 2: These parameters, although guaranteed, are not 100% tested in production.
Note 3: Parameter measured at trip point of latch with $V_{PIN\ 2}$ = 0.
Note 4: Gain defined as

$$A = \frac{\Delta\, V_{PIN\,1}}{\Delta\, V_{PIN\,3}},\ 0 \le V_{PIN\,3} \le 0.8V$$

Note 5: Adjust V_{CC} above the start threshold before setting at 15V.
Note 6: Output frequency equals oscillator frequency for the UC1842 and UC1843.
Output frequency is one half oscillator frequency for the UC1844 and UC1845.
Note 7: Temperature stability, sometimes referred to as average temperature coefficient, is described by the equation:

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

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

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for –55°C ≤ T_A ≤ 125°C for the UC184X; –40°C≤ T_A ≤ 85°C for the UC284X; 0°C ≤ T_A ≤ 70°C for the 384X; V_{CC} = 15V (Note 5); R_T = 10k; C_T =3.3nF, T_A=T_J.

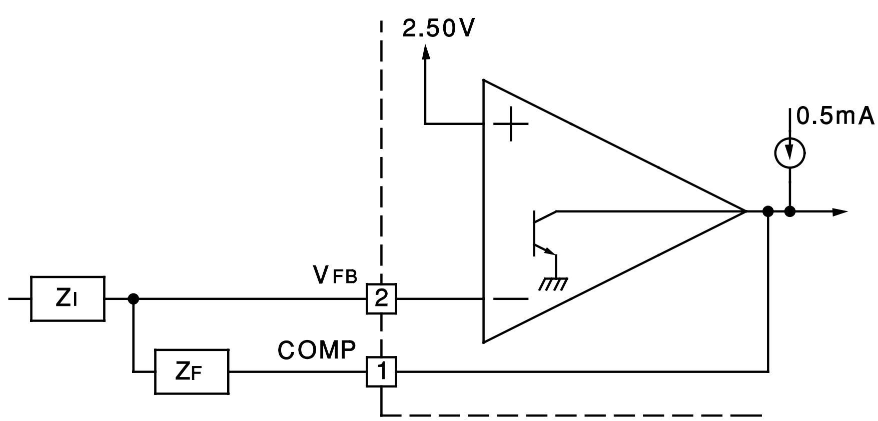
PARAMETER	TEST CONDITION	UC1842/3/4/5 UC2842/3/4/5			UC3842/3/4/5			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Output Section								
Output Low Level	I_{SINK} = 20mA		0.1	0.4		0.1	0.4	V
	I_{SINK} = 200mA		1.5	2.2		1.5	2.2	V
Output High Level	I_{SOURCE} = 20mA	13	13.5		13	13.5		V
	I_{SOURCE} = 200mA	12	13.5		12	13.5		V
Rise Time	T_J = 25°C, C_L = 1nF (Note 2)		50	150		50	150	ns
Fall Time	T_J = 25°C, C_L = 1nF (Note 2)		50	150		50	150	ns
Under-voltage Lockout Section								
Start Threshold	X842/4	15	16	17	14.5	16	17.5	V
	X843/5	7.8	8.4	9.0	7.8	8.4	9.0	V
Min. Operating Voltage After Turn On	X842/4	9	10	11	8.5	10	11.5	V
	X843/5	7.0	7.6	8.2	7.0	7.6	8.2	V
PWM Section								
Maximum Duty Cycle	X842/3	95	97	100	95	97	100	%
	X844/5	46	48	50	47	48	50	%
Minimum Duty Cycle				0			0	%
Total Standby Current								
Start-Up Current			0.5	1		0.5	1	mA
Operating Supply Current	$V_{PIN\,2}$ = $V_{PIN\,3}$ = 0V		11	17		11	17	mA
V_{CC} Zener Voltage	I_{CC} = 25mA	30	34		30	34		V

Note 2: These parameters, although guaranteed, are not 100% tested in production.
Note 3: Parameter measured at trip point of latch with $V_{PIN\,2}$ = 0.
Note 4: Gain defined as:

$$A = \frac{\Delta\, V_{PIN\,1}}{\Delta\, V_{PIN\,3}};\ 0 \le V_{PIN\,3} \le 0.8V.$$

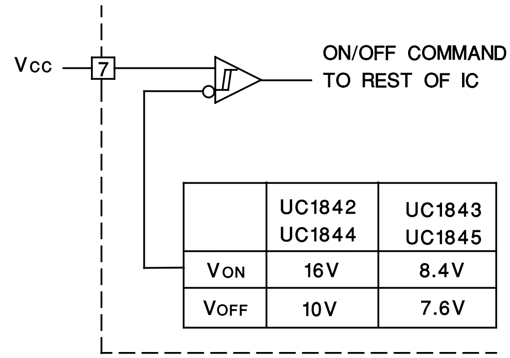
Note 5: Adjust V_{CC} above the start threshold before setting at 15V.
Note 6: Output frequency equals oscillator frequency for the UC1842 and UC1843.
Output frequency is one half oscillator frequency for the UC1844 and UC1845.

ERROR AMP CONFIGURATION

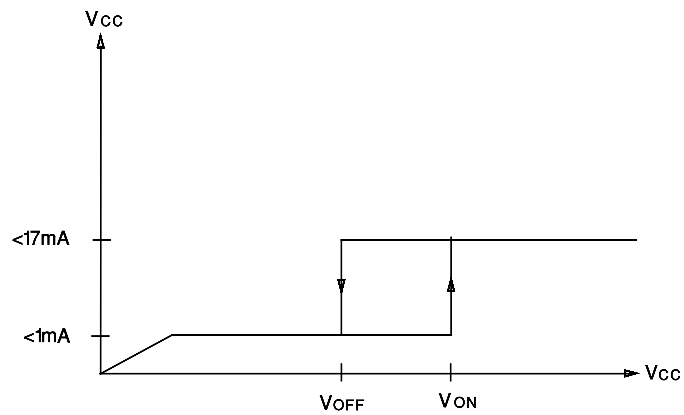


Error Amp can Source or Sink up to 0.5mA

UNDER-VOLTAGE LOCKOUT

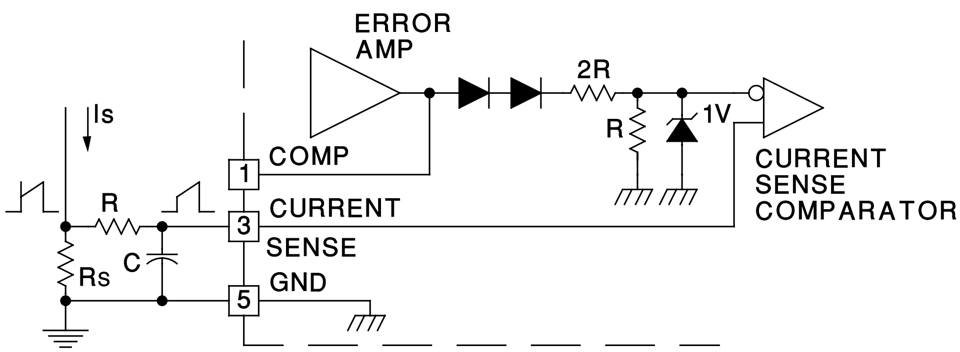


	UC1842 UC1844	UC1843 UC1845
V_{ON}	16V	8.4V
V_{OFF}	10V	7.6V



During under-voltage lock-out, the output driver is biased to sink minor amounts of current. Pin 6 should be shunted to ground with a bleeder resistor to prevent activating the power switch with extraneous leakage currents.

CURRENT SENSE CIRCUIT

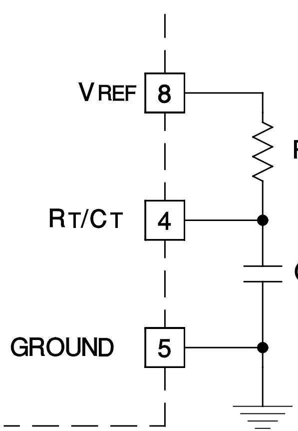


Peak Current (I_S) is Determined By The Formula

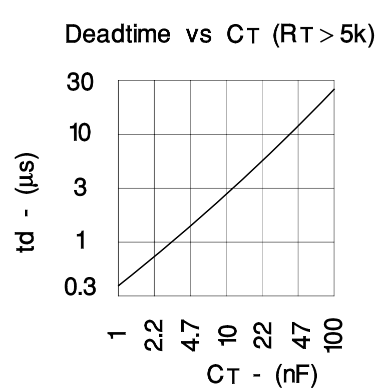
$$I_{SMAX} \approx \frac{1.0V}{R_S}$$

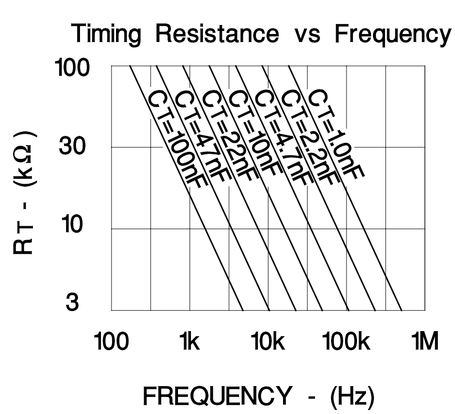
A small RC filter may be required to suppress switch transients.

OSCILLATOR SECTION

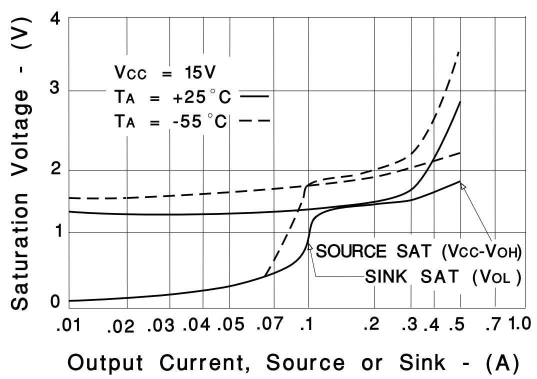


For $R_T > 5k$ $f \approx \frac{1.72}{R_T C_T}$

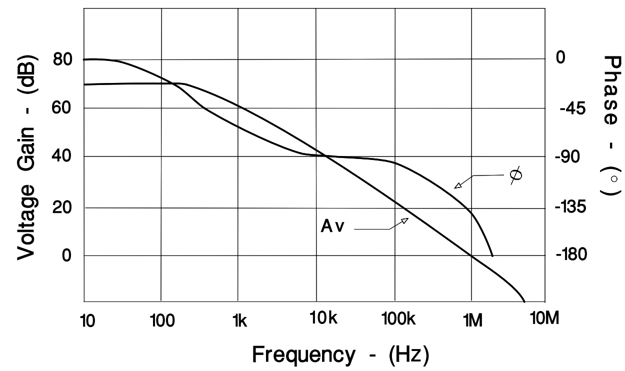




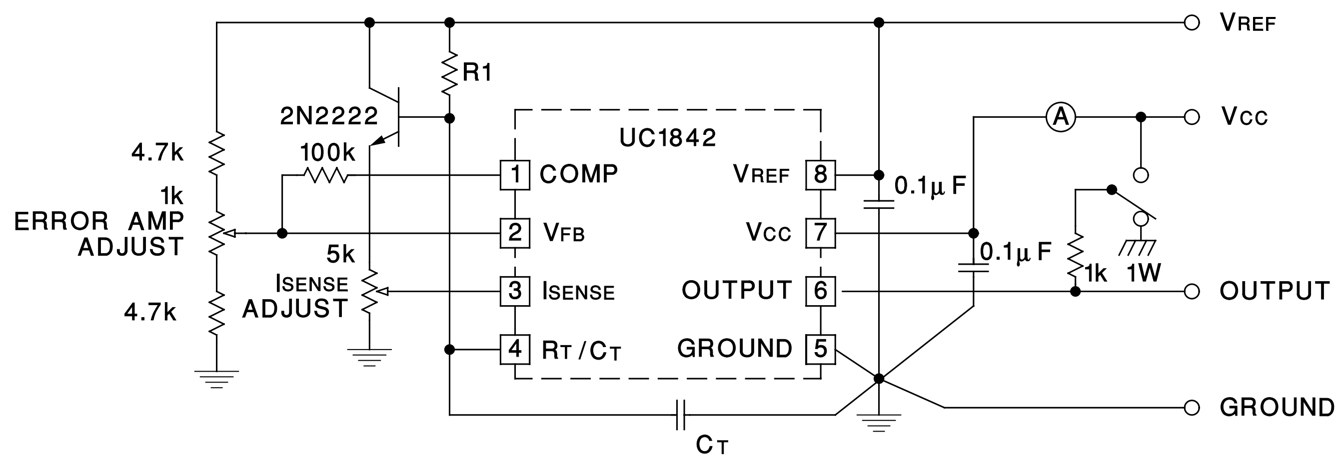
OUTPUT SATURATION CHARACTERISTICS



ERROR AMPLIFIER OPEN-LOOP FREQUENCY RESPONSE

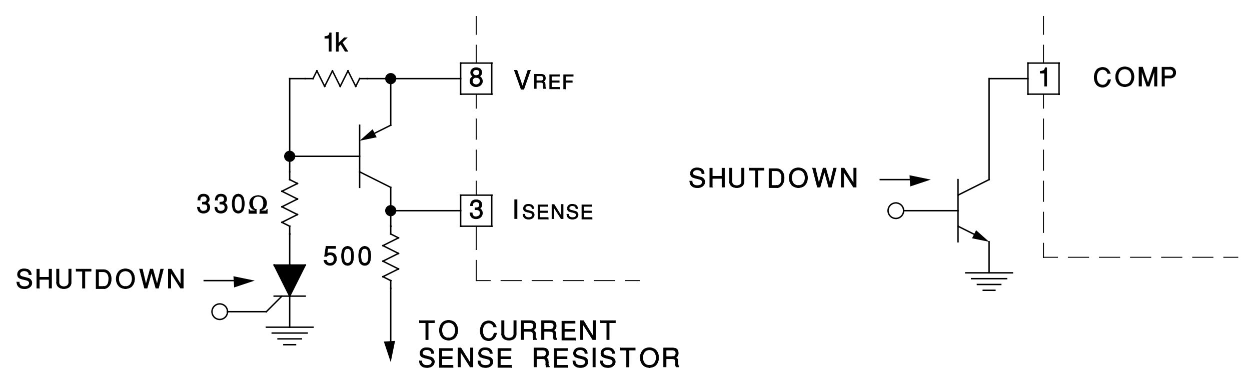


OPEN-LOOP LABORATORY FIXTURE



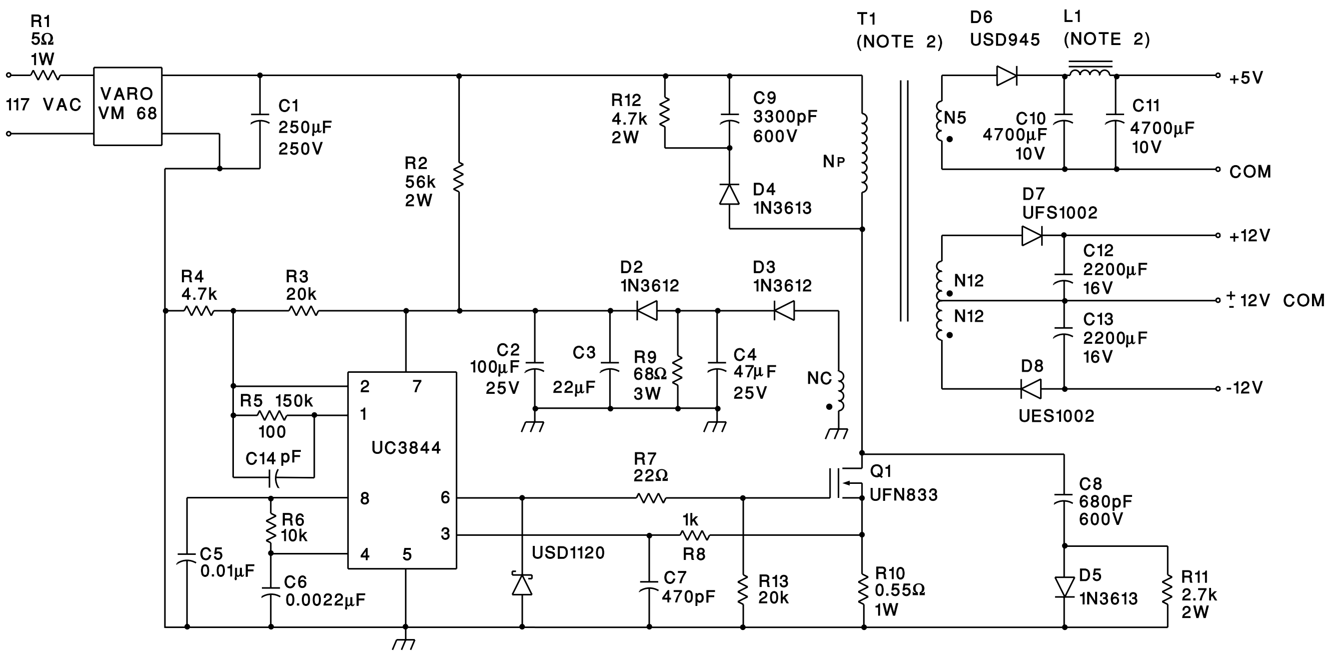
High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close to pin 5 in a single point ground. The transistor and 5k potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

SHUT DOWN TECHNIQUES



Shutdown of the UC1842 can be accomplished by two methods; either raise pin 3 above 1V or pull pin 1 below a voltage two diode drops above ground. Either method causes the output of the PWM comparator to be high (refer to block diagram). The PWM latch is reset dominant so that the output will remain low until the next clock cycle after the shutdown condition at pin 1 and/or 3 is removed. In one example, an externally latched shutdown may be accomplished by adding an SCR which will be reset by cycling VCC below the lower UVLO threshold. At this point the reference turns off, allowing the SCR to reset.

OFFLINE FLYBACK REGULATOR

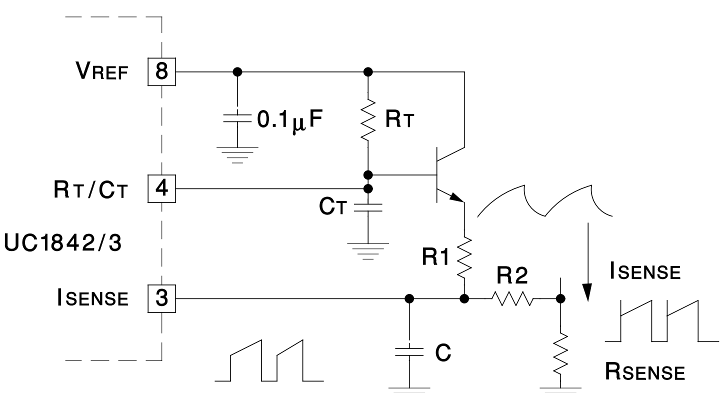


Power Supply Specifications

1. Input Voltage	95VAC to 130VA (50 Hz/60Hz)
2. Line Isolation	3750V
3. Switching Frequency	40kHz
4. Efficiency @ Full Load	70%

5. Output Voltage:
   A. +5V, ±5%; 1A to 4A load
      Ripple voltage: 50mV P-P Max
   B. +12V, ±3%; 0.1A to 0.3A load
      Ripple voltage: 100mV P-P Max
   C. -12V ,±3%; 0.1A to 0.3A load
      Ripple voltage: 100mV P-P Max

SLOPE COMPENSATION



A fraction of the oscillator ramp can be resistively summed with the current sense signal to provide slope compensation for converters requiring duty cycles over 50%.

Note that capacitor, C forms a filter with R2 to suppress the leading edge switch spikes.

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