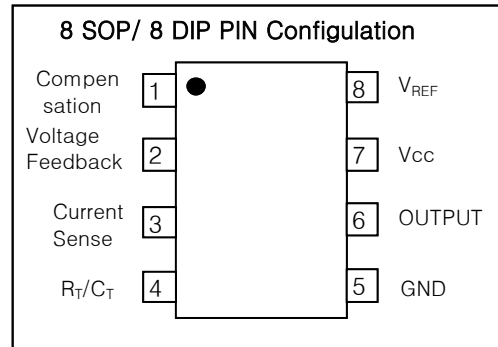


# CURRENT MODE PWM CONTROLLER

# LM3842A/3A/4A/5A

## FEATURES

- Automatic feed forward compensation
- Optimized for offline converter
- Double pulse suppression
- Current mode operation to 500 KHz
- High gain totem pole output
- Internally trimmed bandgap reference
- Undervoltage lockout with hysteresis
- Low start up current : < 0.3 mA



## ORDERING INFORMATION

Device	Package
LM3842A/3A/4A/5A D	8 SOP
LM3842A/3A/4A/5A N	8 DIP

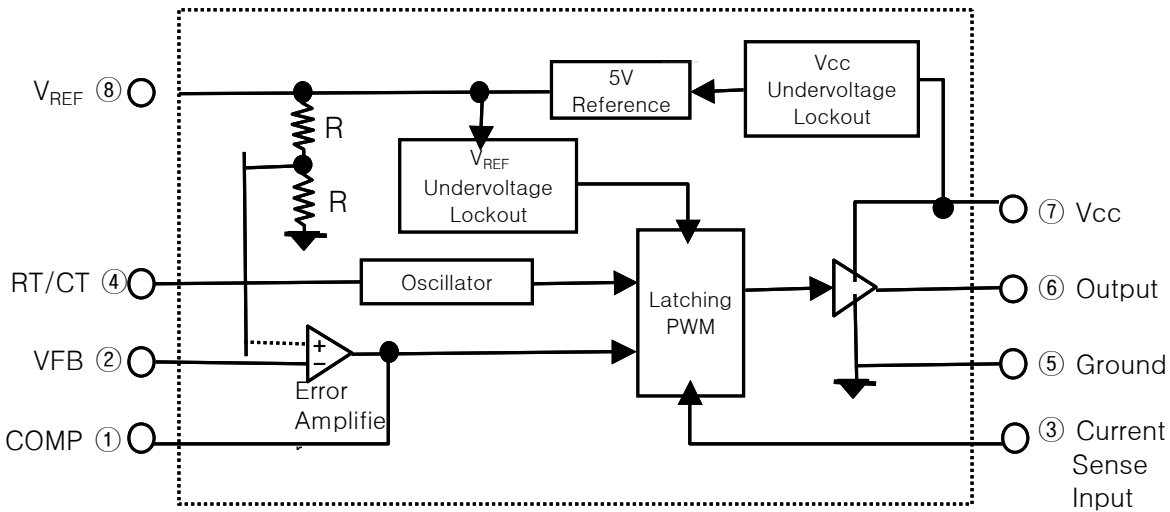
## DESCRIPTION

The LM3842A is fixed frequency current-mode PWM controller. It is specially designed for Off-Line and DC-to-DC converter applications with minimal external components.

This integrated circuit features 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.

Protection circuitry includes built in under-voltage lockout and current limiting.

## SIMPLIFIED BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C)

Characteristic	Symbol	Value	Unit
Power Supply Voltage	V <sub>CC</sub>	30	V
Output Current	I	± 1	A
Analog Inputes Voltage	V <sub>IN</sub>	-0.3 to 5.5V	V
Error Amp Output Sink Current	I <sub>SINK</sub>	10	mA
Power Dissipation	P <sub>D</sub>	1	W
Storage Temperature Range	T <sub>stg</sub>	-65 to 150	°C
Lead Temperature (soldering 5 sec)	T	260	°C

# CURRENT MODE PWM CONTROLLER

# LM3842A/3A/4A/5A

## ELECTRICAL CHARACTERISTIC

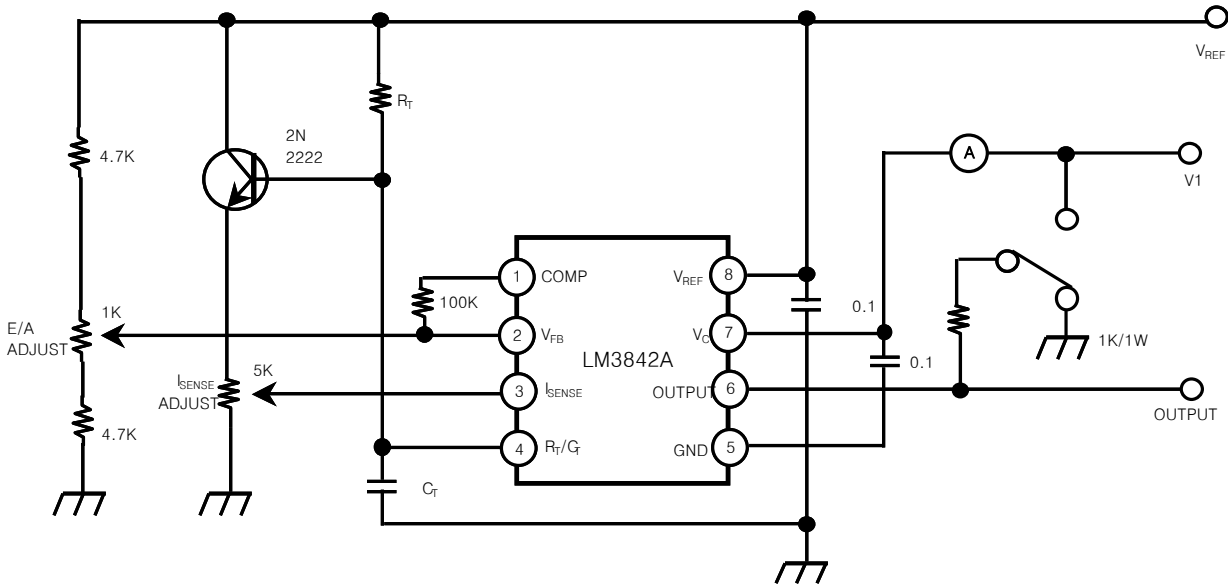
(V<sub>CC</sub>=15V(Note 1), R<sub>T</sub> = 10kΩ, C<sub>T</sub>=3.3nF 0 ≤ T<sub>A</sub> ≤ 70 °C ; unless otherwise specified)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
<b>REFERENCE SECTION</b>						
Reference Output Voltage	V <sub>REF</sub>	T <sub>j</sub> = 25 °C, I <sub>O</sub> =1 mA	4.90	5.00	5.10	V
Line Regulation	V <sub>O</sub>	12V ≤ V <sub>CC</sub> ≤ 25V		2	20	mV
Load Regulation	V <sub>O</sub>	1mA ≤ I <sub>O</sub> ≤ 20mA		3	2.5	mV
Output Short Circuit Current	I <sub>SC</sub>	T <sub>A</sub> = 25 °C		-85	-180	mA
<b>OSCILLATOR SECTION</b>						
Normal Frequency	F <sub>OSC</sub>	T <sub>j</sub> = 25 °C	47	52	57	kHz
Voltage Stability	S <sub>V</sub>	12V ≤ V <sub>CC</sub> ≤ 25V		0.2	1	%
Amplitude	V <sub>OSC</sub>			1.6		Vp-p
<b>ERROR AMPLIFIER SECTION</b>						
Input Bias Current	I <sub>IB</sub>			-0.1	-2	μA
Feedback Input Voltage	V <sub>FB</sub>	V <sub>O</sub> =2.5V	2.42	2.50	2.58	V
Open Loop Voltage Gain	A <sub>VOL</sub>	2V ≤ V <sub>O</sub> ≤ 4V	65	90		dB
Power Supplier Rejection Ratio	PSRR <sub>EA</sub>	12V ≤ V <sub>CC</sub> ≤ 25V	60	70		dB
Output Sink Current	I <sub>SI</sub>	V <sub>FB</sub> =2.7V, V <sub>O</sub> - 1.1V	2	7		mA
Output source Current	I <sub>SO</sub>	V <sub>O</sub> = 2.3V, V <sub>O</sub> =5V	-0.5	-1.0		mA
Output Voltage High	V <sub>OH</sub>	V <sub>FB</sub> =2.7V, R <sub>L</sub> =15kΩ to GND	5	6		V
Output Voltage Low	V <sub>OL</sub>	V <sub>FB</sub> =2.7V, R <sub>L</sub> =15kΩ to V <sub>RGR</sub>		0.8	1.1	V
<b>CURRENT SENSE SECTION</b>						
Input Voltage Gain	A <sub>V</sub>	(Note 2 & 3)	2.85	3	3.15	V/V
Maximum Input Signal	V <sub>MAX</sub>	V <sub>O</sub> =5V (Note 2)	0.9	1	1.1	V
Power Supply Rejection Ratio	PSRR <sub>SC</sub>	12V ≤ V <sub>CC</sub> ≤ 25V		70		dB
Input Bias Current	I <sub>IB</sub>			-2	-1.0	μA
<b>OUTPUT SECTION</b>						
Output Voltage Low	V <sub>OL</sub>	I <sub>sink</sub> = 20mA		0.1	0.4	V
		I <sub>sink</sub> = 20mA		1.5	2.2	V
Output Voltage High	V <sub>OH</sub>	I <sub>source</sub> = 20mA	13	13.5		V
		I <sub>source</sub> = 20mA	12	13.0		V
Rise Time	T	T <sub>j</sub> = 25 °C, C <sub>L</sub> =1nF		45	150	nS
Fail Time	T	T <sub>j</sub> = 25 °C, C <sub>L</sub> =1nF		35	150	nS
<b>UNDERVOLTAGE LOCKOUT SECTION</b>						
Start-up Threshold	V <sub>th</sub>	3842A / 3844A	14.5	16	17.5	V
		3843A / 3845A	7.8	8.4	9	V
Minimum Operating Voltage (After Turn-On )	V <sub>CC(MIN)</sub>	3842A / 3844A	8.5	10	11.5	V
		3843A / 3845A	7.0	7.6	8.2	V
<b>TOTAL STANDBY CURRENT</b>						
Start-up Current	I <sub>st</sub>	V <sub>CC</sub> =14V		0.17	0.3	mA
Operating Supply Current	I <sub>CC</sub>			13	17	mA
Zener Voltage	V	I <sub>CC</sub> = 25mA	30	38		V

- Note: 1. Adjust V<sub>CC</sub> above the start threshold before setting at 15V.  
2. Parameter measured at trip point of latch with V<sub>FB</sub> = 0.

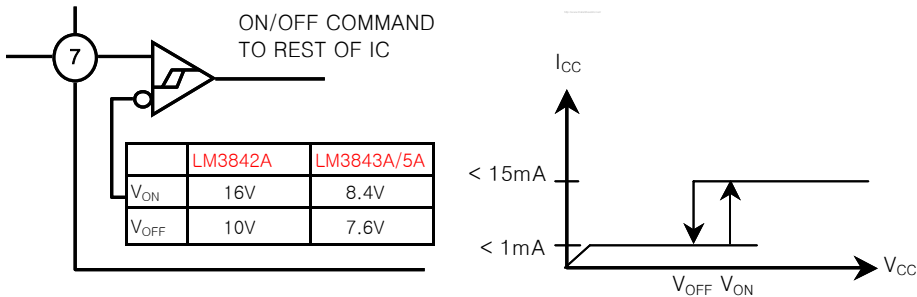
3. Comparator Gain defined as:  $A_V = \frac{-\Delta V_{\text{Output Compensation(pin FB)}}}{\Delta V_{\text{Current Sense input(pin CS)}}}$  ;

Fig.1 Open Loop Test Circuit



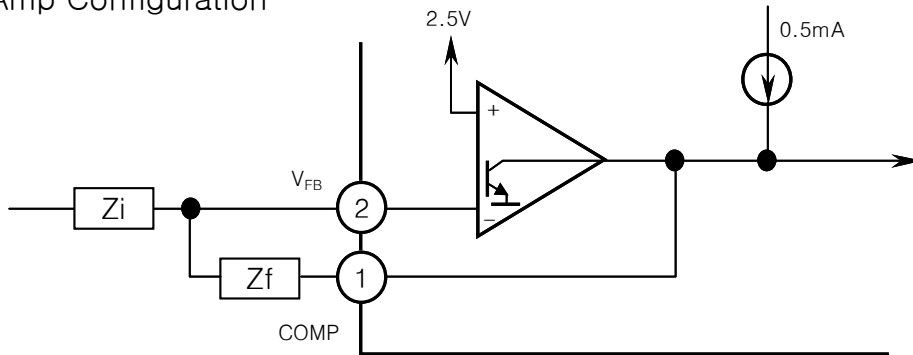
High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close to pin 5 in a single point ground. The transistor and 5KΩ potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

Fig.2 Under Voltage Lockout



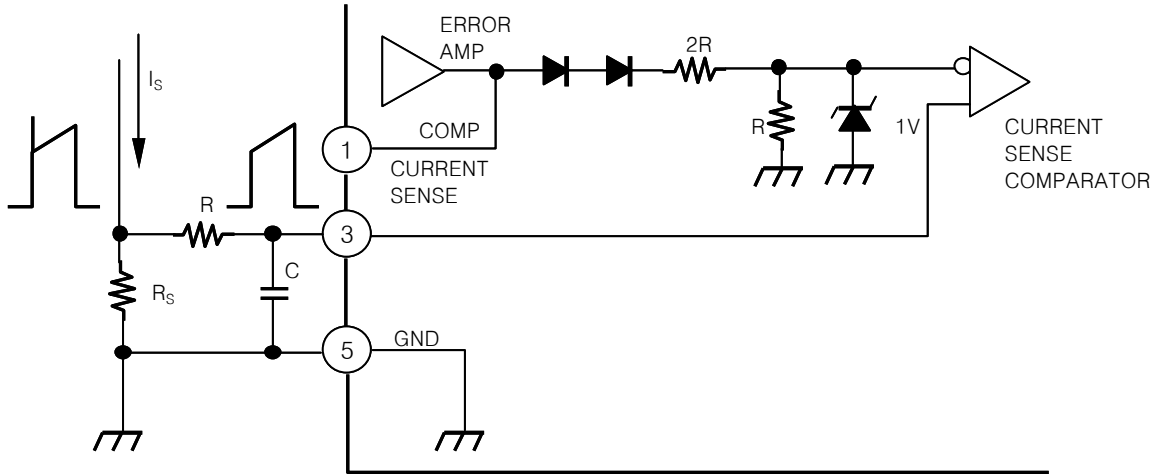
During Under-Voltage Lock-Out, the output driver is biased to a high impedance state. Pin 6 should be shunted to ground with a bleeder resistor to prevent activating the power switch with output leakage current.

Fig.3 Error Amp Configuration



Error amp can source or sink up to 0.5mA

Fig.4 Current Sense Circuit

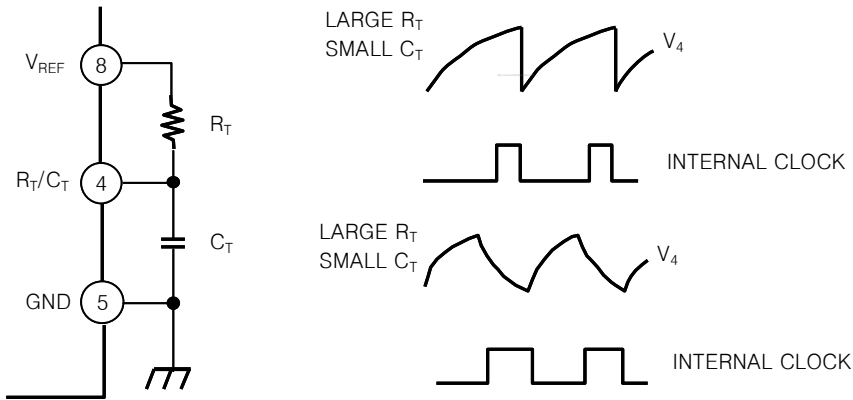


Peak current ( $I_s$ ) is determined by the formula:

$$I_{S(MAX)} \approx \frac{1.0V}{R_s}$$

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

Fig.5 Oscillator Waveforms and Maximum Duty Cycle



Oscillator timing capacitor,  $C_T$ , is charged by  $V_{REF}$  through  $R_T$ , and discharged by an internal current source. During the discharge time, the internal clock signal blanks the output to the low state. Selection of  $R_T$  and  $C_T$  therefore determines both oscillator frequency and maximum duty cycle. Charge and discharge times are determined by the formulas:

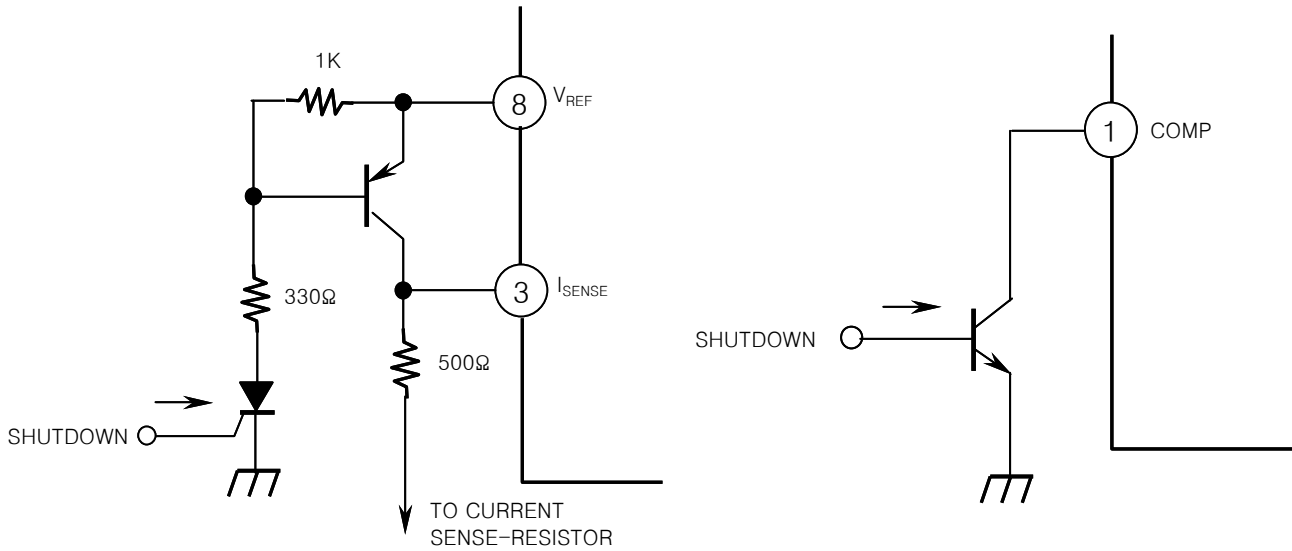
$$t_c \approx 0.55 R_T C_T$$

$$t_d \sim R_T C_T \ln\left(\frac{0.0063 R_T - 2.7}{0.0063 R_T - 4}\right)$$

Frequency, then, is:  $f = (t_c + t_d)^{-1}$

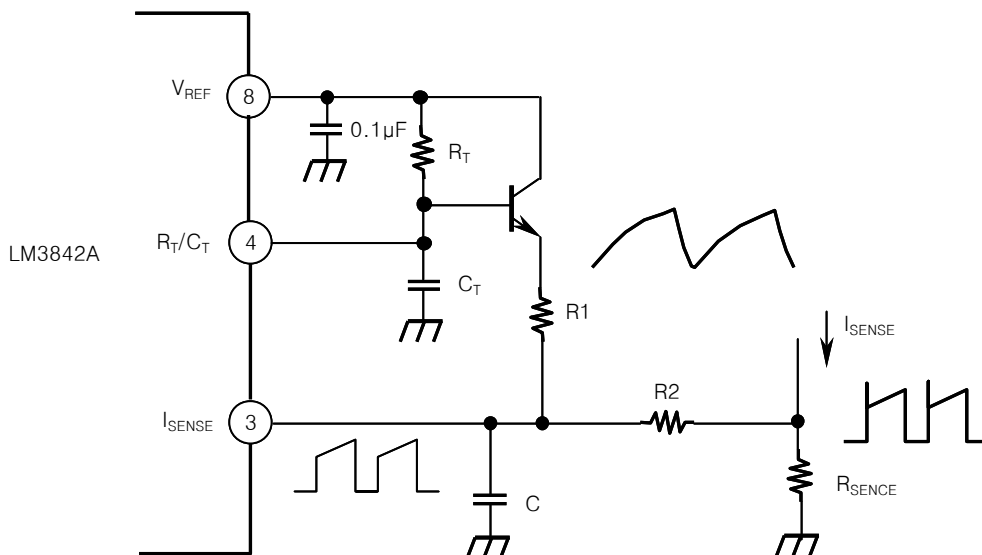
$$\text{For } R_T > 5K\Omega, f \approx \frac{1.8}{R_T C_T}$$

Fig.6 Shutdown Techniques



Shutdown of the LM3842A 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 pins 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  $V_{CC}$  below the lower UVLO threshold. At this point the reference turns off, allowing the SCR to reset.

Fig.7 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.

Fig.1 Output Dead Time

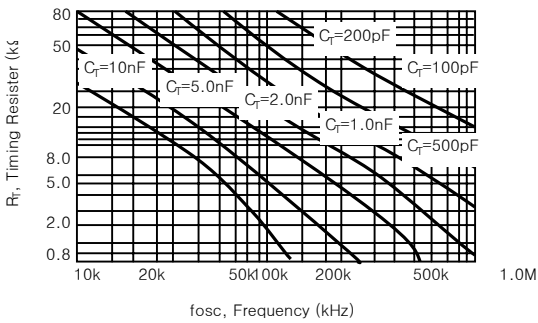


Fig.2 Timing Resistor vs Frequency

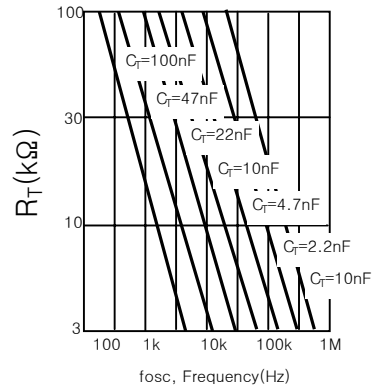


Fig.3 Output Saturation Characteristics

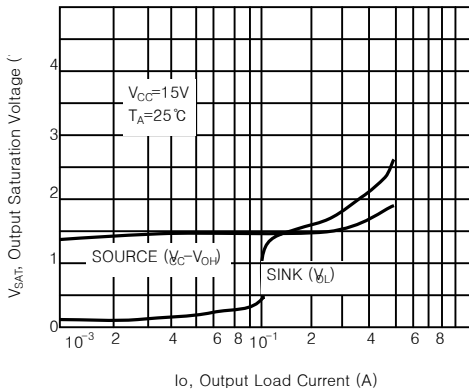
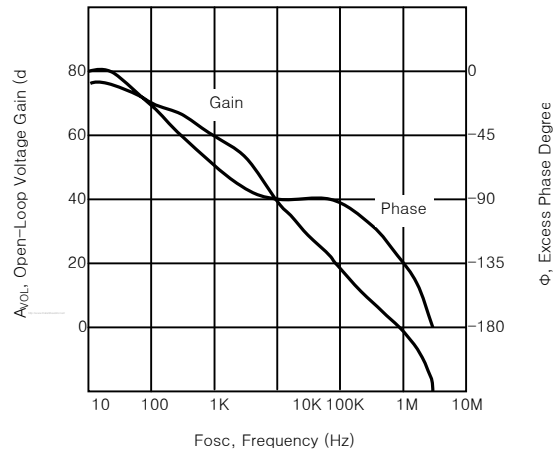


Fig.4 Error Amplifier Open Loop Gain and Phase Frequency



PIN FUNCTION DESCRIPTION

Pin No.	Function	Description
1	Compensation	This pin is the Error Amplifier output and is made available for loop compensation.
2	Voltage Feedback	This is the inverting input of the Error Amplifier. It is normally connected to the switching power supply output through a resistor divider.
3	Current Sense	A voltage proportional to inductor current is connected to this input. The PWM uses this information to terminate the output switch conduction.
4	$R_T/C_T$	The Oscillator frequency and maximum Output duty cycle are programmed by connecting resistor $R_T$ to $V_{REF}$ and capacitor $C_T$ to ground. Operation to 500kHz is possible.
5	GND	This pin is the combined control circuitry and power ground.
6	Output	This output directly drives the gate of a power MOSFET. Peak currents up to 1.0A are sourced and sunk by this pin.
7	$V_{CC}$	This pin is the positive supply of the control IC.
8	$V_{REF}$	This is the reference output. It provides charging current for capacitor $C_T$ through resistor $R_T$ .

