5.4 MC33262 Power Factor Controller

5.4.1 Scope

The purpose of this analysis is to model MC33262 Power Factor Controller.

Analysis:	Power Factor Controller Model
Performed by:	
Last Rev Date:	11-27-2001
Publication Number:	MC33262/D
Revision	March, 2001-Rev. 2
SPICE File	MC33262.LIB

5.4.2 Functional Description

MC33262 device is an active power factor controller. It uses current mode topology to regulate the output voltage and correct input signal power factor.

The controller has an error amplifier. The output voltage of a preconverter is feedback to the amplifier inverting input and compared to a 2.5Vinternal reference voltage source connected to non-inverting input of the amplifier. The error amplifier output and the converter input voltages are multiplied. The product controls the converter input peak current threshold and ON time and then regulates the output voltage. The product also corrects the power factor by forcing the input current directly proportional to the input voltage.

Once the inductor current feedback to the controller current sense input pin exceeds the threshold current, the output driver is off, and the off time is a function of the inductor zero current crossing. The inductor voltage is feedback to the MC33262 Zero Current Detect Input. When the inductor voltage changes polarity during off time, the controller internal RS flip-flop latches ON. However, if the output driver has been off for more than 620us after the inductor current has been less than or equal to zero, the controller has a built in watchdog timer that automatically latches the flip-flop ON thereby turning ON the controller output driver.

Over voltage protection feature is also built in to the controller. It monitors the voltage level at the voltage feedback input pin. The over voltage threshold is 108% of the 2.5V reference voltage.
The controller also has a built in Under Voltage Lockout feature. It monitors the controller VCC input voltage terminal.

5.4.3 Assumptions

1. The temperature for this model is 25 degrees centigrade.

5.4.4 Methods of modeling

PSpice was used to model the device.

5.4.5 Model Tests

The model was tested and the results were correlated to the actual data points. The Spice test fixture for the Error Amp Transconductance and Phase is shown in figure 5.4.1, and the Spice net List is shown in figure 5.4.2. The SPICE simulation results are shown in figure 5.4.3. The results were correlated to the specification data points shown in figure 5.4.4

The MC33262 model was also tested with the application diagram shown in figure 5.4.5. The output waveforms are shown in figure 5.4.7 and the simulation results are tabulated in table 5.4.1 and correlated to the actual test points reported in the Publication Order Number MC34363/D.

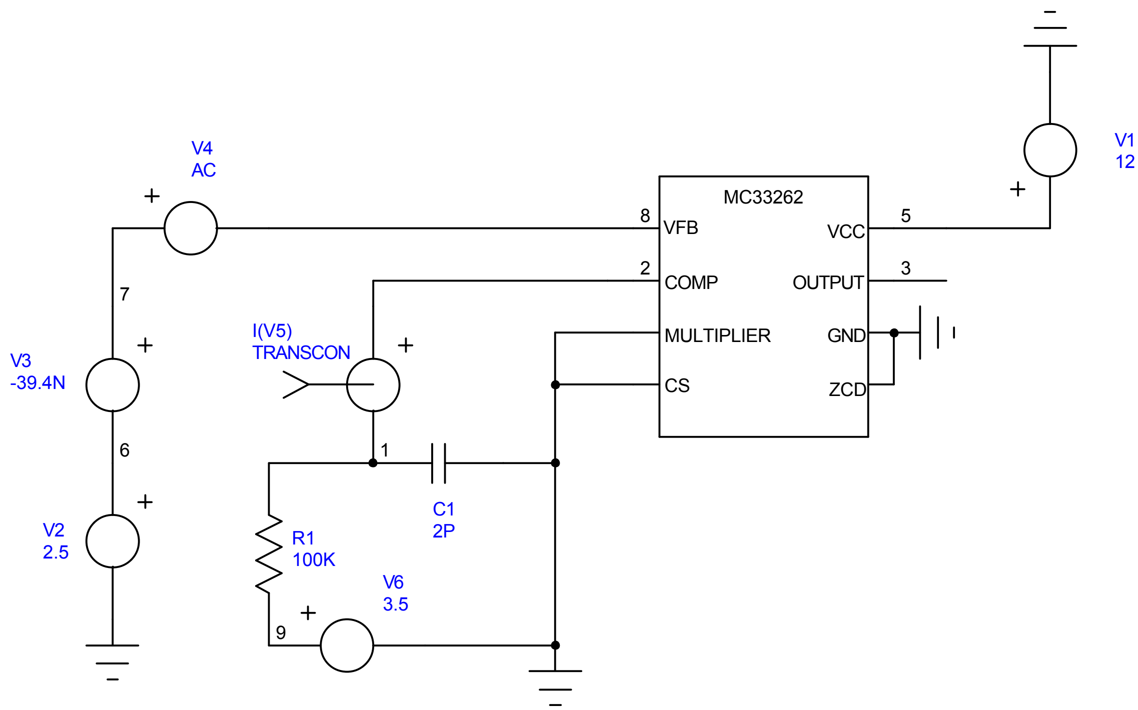

Figure 5.4.1. Error Amp Transconductance and Phase Test Fixture.

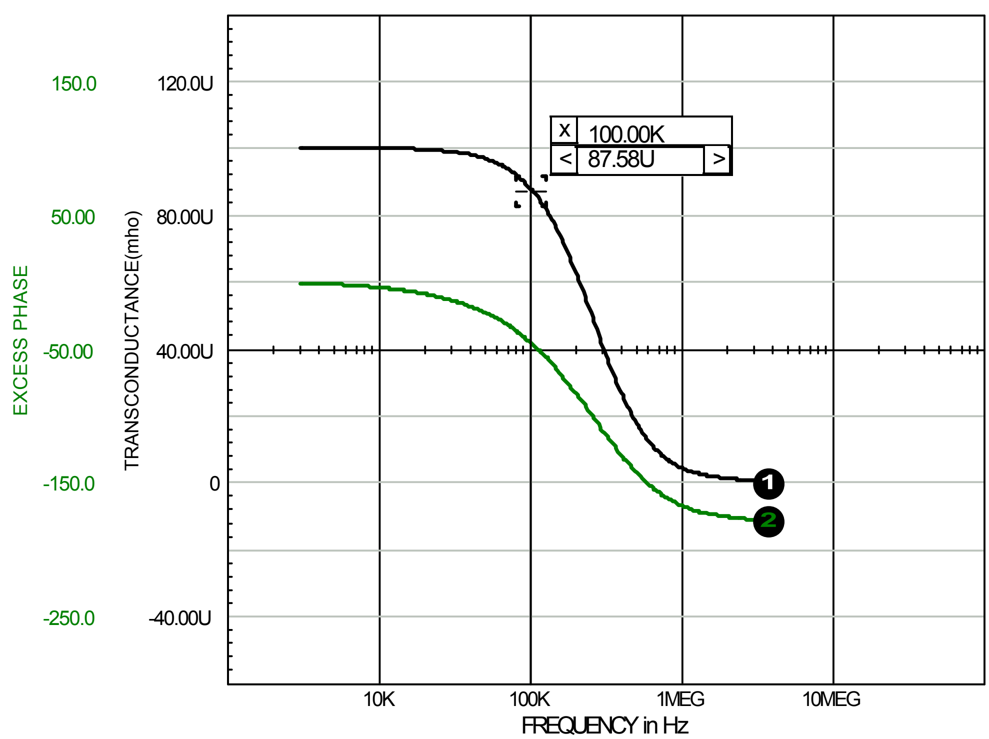

Figure 5.4.3. Error Amp Transconductance & Phase versus frequency plots

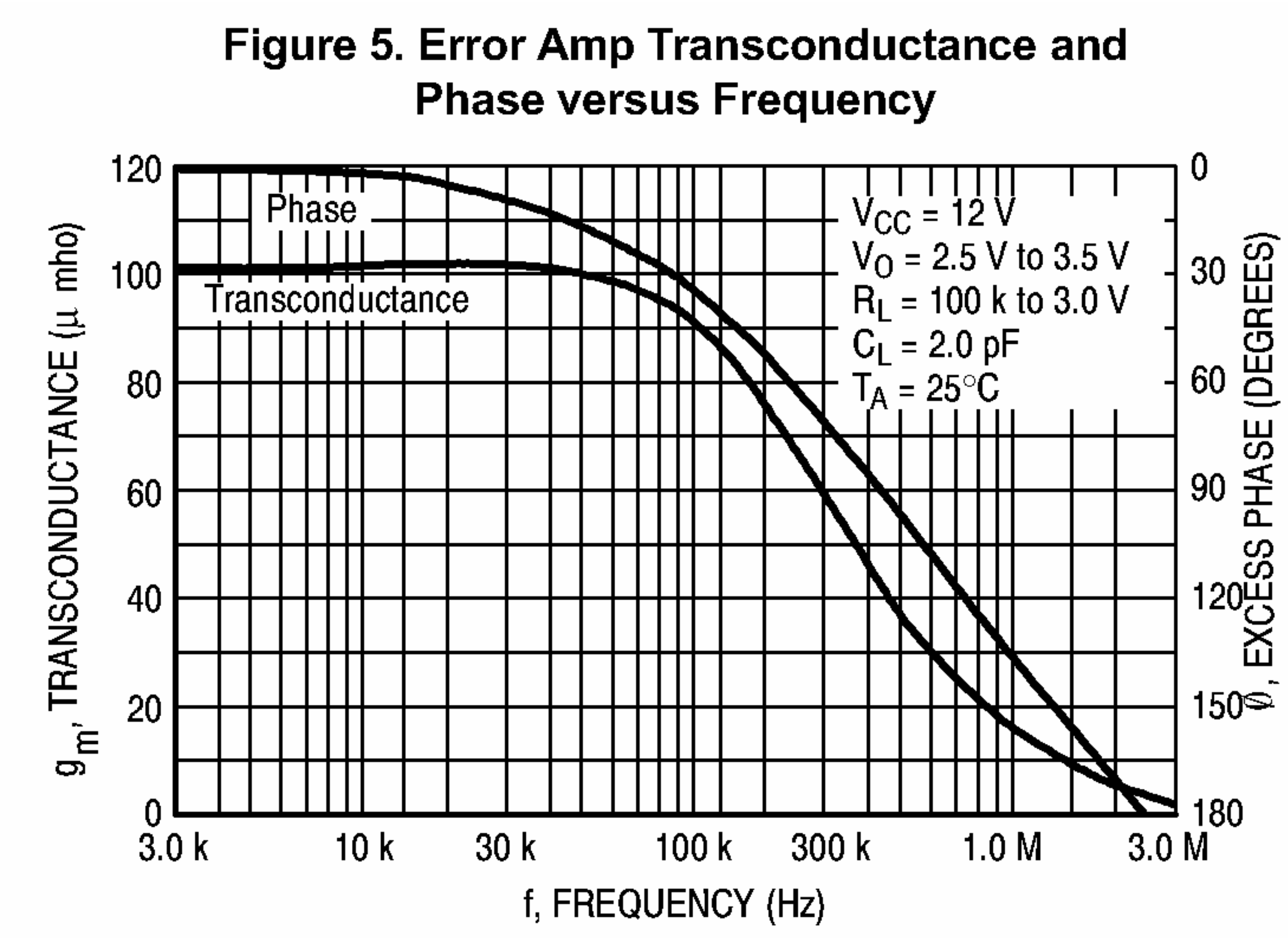

Figure 5.4.4. Error Amp Transconductance & Phase of Actual Data plots

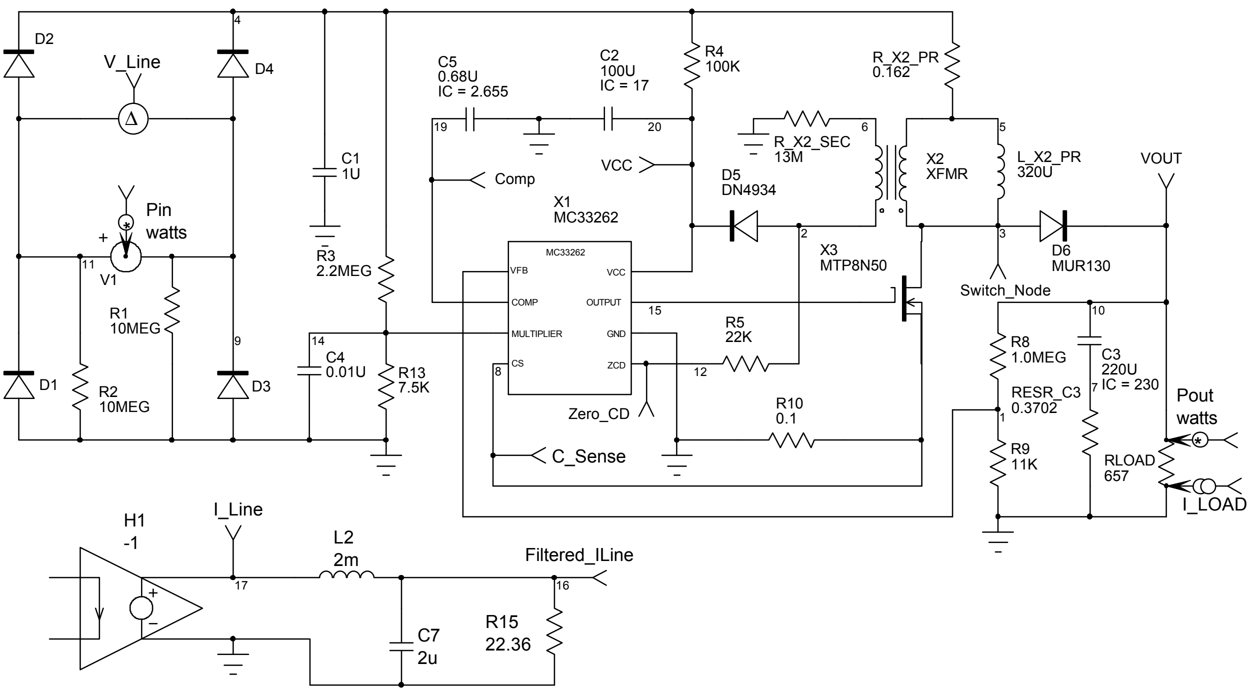

Figure 5.4.5: 230V/0.35A Power Factor Spice Application Diagram.

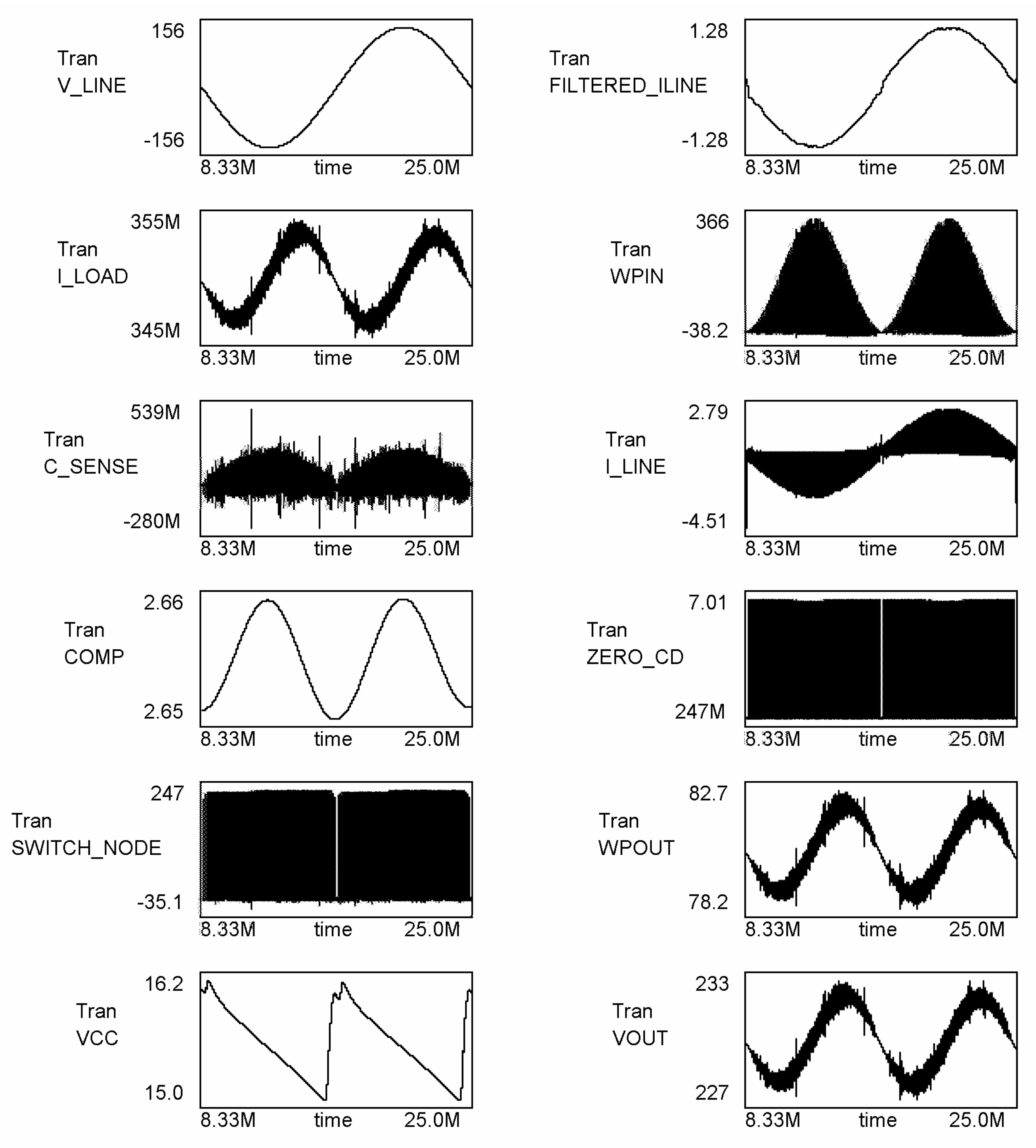

Figure 5.4.7: Spice Application Output Waveforms

5.4.6 Table 5.4.1 Test Summary

Test	Test Conditions	Simulation data	Actual test data
Error Amp Transconductance Excess Phase	Per figure 5.4.1	100µmho 87.58µmho @100kHz 46° @100kHz	100µmho Typ. 90µmho Typ. @100kHz 43° @100kHz
I_Line	V_Line =100Vrms 60Hz	0.828 Arms	0.85Arms
Pin	I_Load=0.350Adc	82.62 Watts	85.3 Watts
PF		0.998	0.999
THD		3.3 %,	2.3%
2nd Harmonic Distortion		0.01%	0.13%
3rd Harmonic Distortion		2.6%	1.0%
5th Harmonic Distortion		1.5%	1.2%
7th Harmonic Distortion		1.4%	0.73%
Vout(pp)		0.828 Arms	0.85Arms
Vout		229.8Vdc	230.7Vdc
I_Load		0.350Adc	0.350Adc
Pout		80.35 watts	80.8 watts
Efficiency		97%	94.7%

5.4.7 Conclusions and Recommendations

The transconductance and excess phase data pints of the MC33262 model are very close to the actual data points of figure 5.4.4. The transconductance and phase at 100kHz are within ±2.7% and ±7% respectively from the actual data points.

All the simulation application data points are also very close to the actual test data points except the harmonic distortion of the input current and the efficiency. The template efficiency is 2.7% higher than the actual test data because the converter inductor switching loss was not included. The harmonics are also different because the parasitic elements in the actual converter were not included in the template.