

Review of Electrical Noise on 120/240 volt Power Systems

May 29, 2001

cforster@forstereng.com

1

The electrical noise this
investigation covers are the
frequencies other than 60
Hertz that exist on a typical
secondary power system.

May 29, 2001

cforster@forstereng.com

2

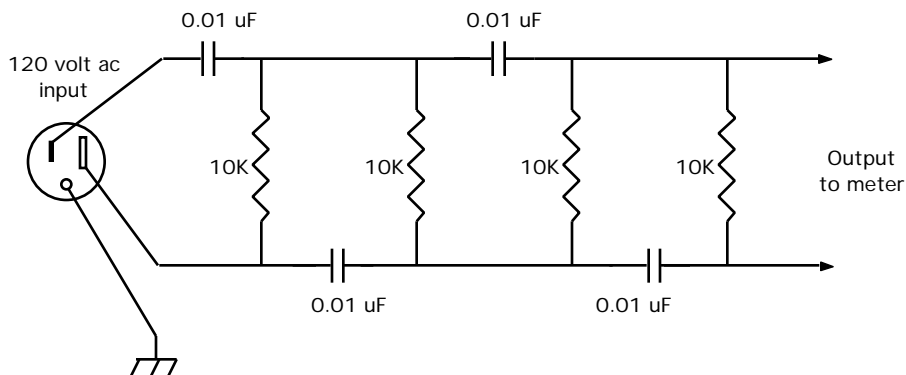
To measure the electrical noise some people are using a high pass filter to suppress the 60 Hertz and low order harmonics, leaving only the higher frequencies to pass through to the filter to the measuring device.

May 29, 2001

cforster@forstereng.com

3

The filter is constructed and connected as follows:



May 29, 2001

cforster@forstereng.com

4

Response of the filter to Sinusoidal and Non-linear Voltage Waveforms

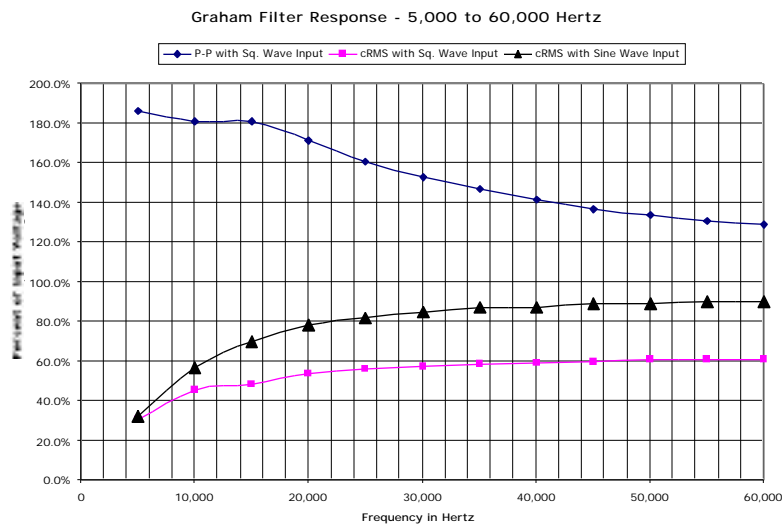
(In other words compare what goes into the filter and what comes out.)

May 29, 2001

cforster@forstereng.com

5

Looking at a broad range of frequencies...



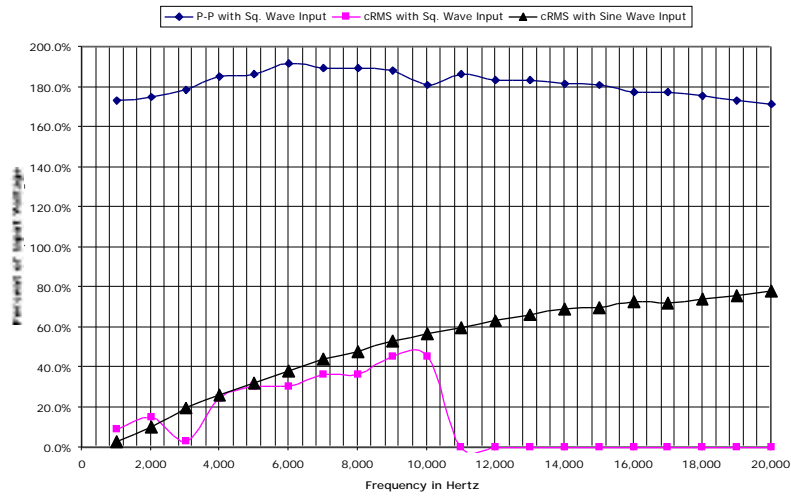
May 29, 2001

cforster@forstereng.com

6

Looking at a narrower range of frequencies...

Graham Filter Response - 1,000 to 20,000 Hertz



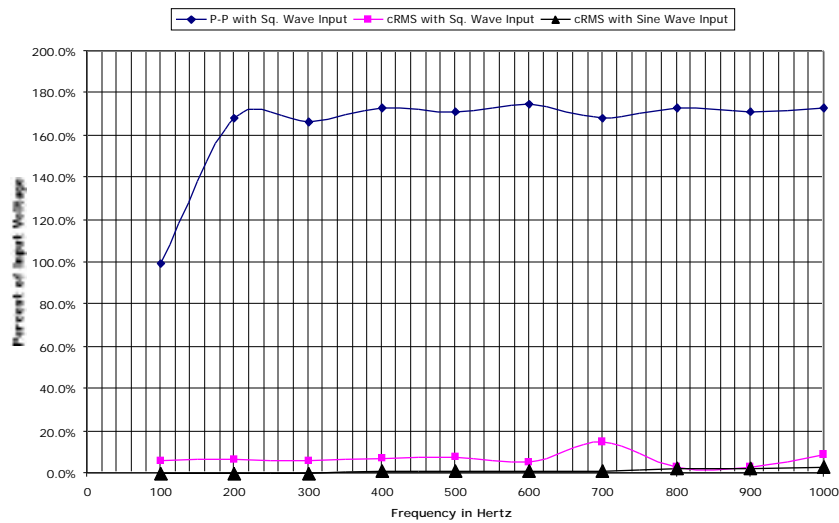
May 29, 2001

cforster@forstereng.com

7

Looking at just above 60 Hertz and common harmonics...

Graham Filter Response - 100 to 1,000 Hertz



May 29, 2001

cforster@forstereng.com

8

What do the response charts show???

Using peak to peak output meters with very distorted input voltages results in values that are disproportionately higher than they should be.

Using true RMS output meters with very distorted input voltages results in values that are disproportionately lower than they should be, plus the spiking produced by the filter prevents reliable readings by a true RMS meter.

Using peak to peak output meters with normal noisy input voltages results in values that are about 2.8 times higher than RMS values. This is expected.

Using true RMS output meters with normal noisy input voltages results in values that are acceptable.

May 29, 2001

cforster@forstereng.com

9

**Lets take a look at what
the filter is trying to
measure.....**

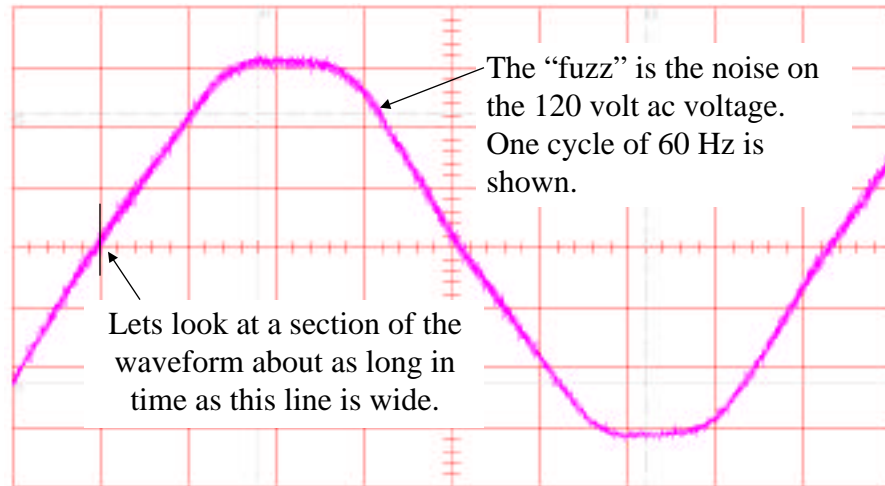
May 29, 2001

cforster@forstereng.com

10

Phasor Labs

This is what the input voltage from my home looks like....

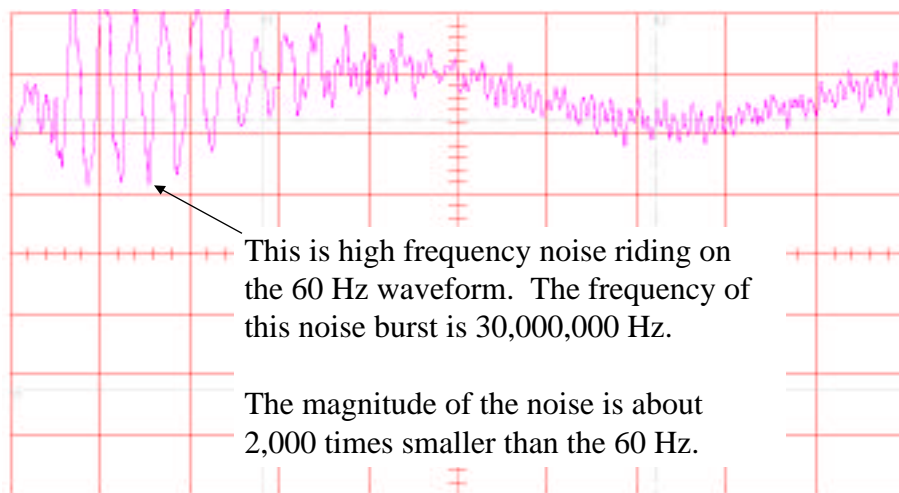


May 29, 2001

cforster@forstereng.com

11

If we look a little closer....

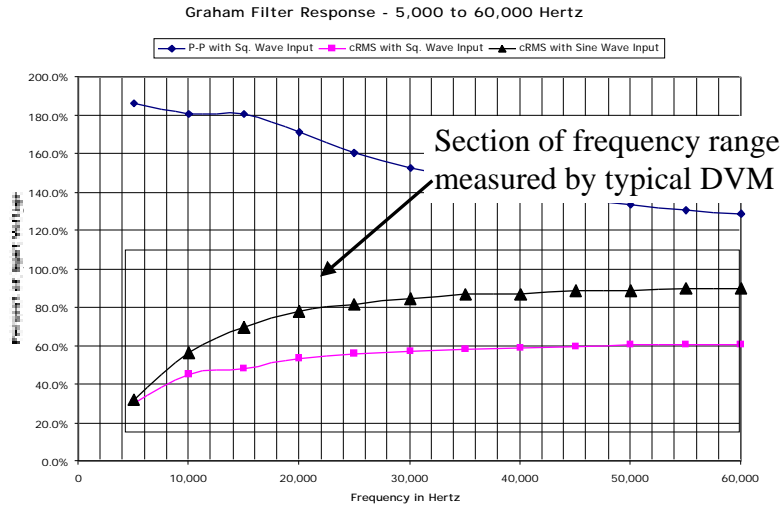


May 29, 2001

cforster@forstereng.com

12

What meter should you use to measure the noise ???



May 29, 2001

cforster@forstereng.com

13

Now that you can measure the noise voltage on the power wiring....

How will that voltage affect you?

May 29, 2001

cforster@forstereng.com

14

Phasor Labs

Since most people do not contact the 120 volt “hot” wire and the “neutral” wire intentionally..



May 29, 2001

cforster@forstereng.com

15

And capacitive coupling will not transfer a significant amount of high frequency energy..



May 29, 2001

cforster@forstereng.com

16

About the only way for you to personally experience this noise voltage is by radiation of the noise from the house wiring.

Let's break down the energy that could be radiated from the house wiring and look at it a section at a time.

May 29, 2001

cforster@forstereng.com

17

For frequencies from 60 to 3,000 Hertz...

The filter blocks the voltage to the meter.

This must not be a frequency range of concern.

This is the frequency range of 60 Hertz harmonics from #1 to #50.

May 29, 2001

cforster@forstereng.com

18

For frequencies from 200 to 20,000 Hertz...

These are “audio” frequencies.

These frequencies are in the same range as those on your Hi-Fi speaker wires.

These frequencies do not radiate off wires very well and have never been considered a concern.

May 29, 2001

cforster@forstereng.com

19

For frequencies from 20,000 to 300,000 Hertz...

As you get above 60,000 Hertz radiation from a wire will occur. There are several international standards on radiated energy that do not consider this frequency range a range of concern.

May 29, 2001

cforster@forstereng.com

20

For frequencies from 300,000 Hertz and above ...

There are several international standards on radiated energy that do consider this frequency range a range of concern.

There are also very good standards for the level of acceptable radiated energy in this frequency range.

May 29, 2001

cforster@forstereng.com

21

What range of frequencies exist on the power wiring ????

The next slide shows the output of a spectrum analyzer connected to the 120/240 volt power system at my home.

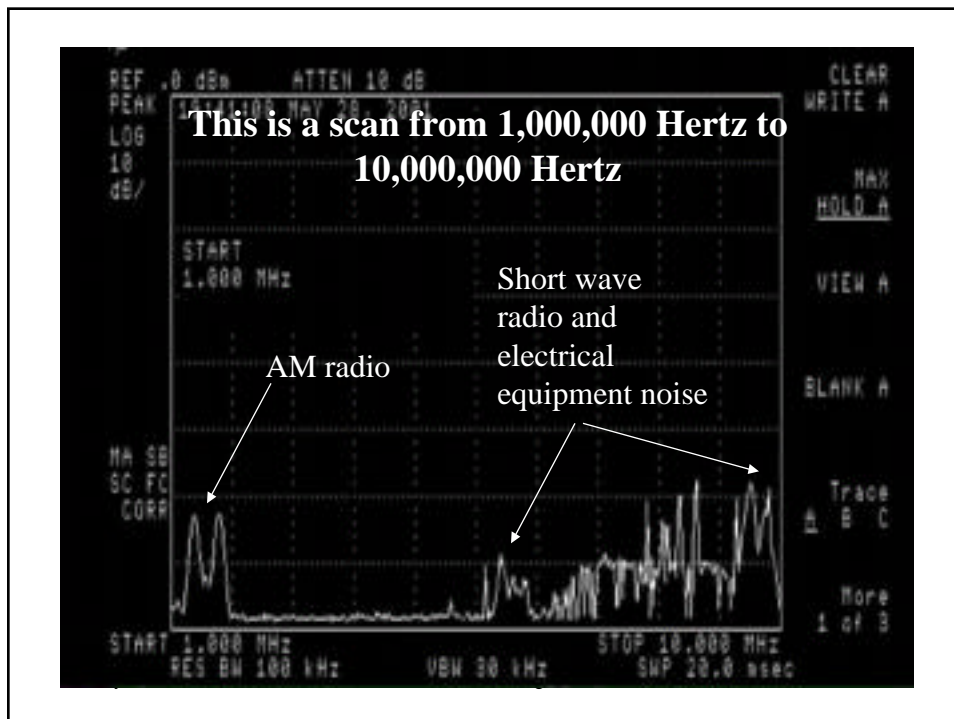
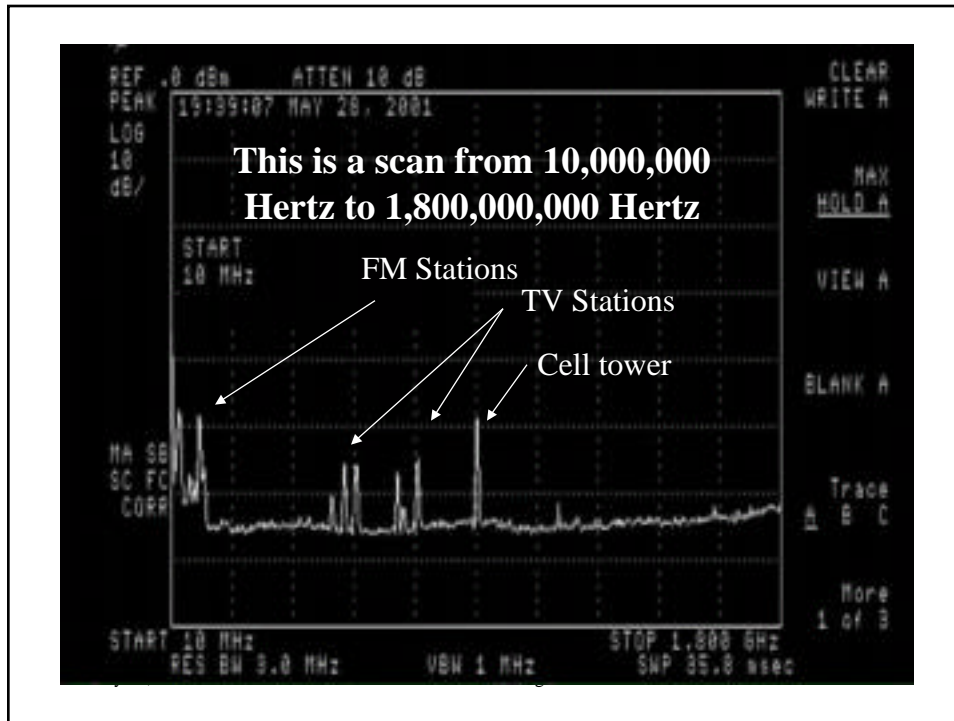
The analyzer trace shows magnitude levels as an increase in vertical deflection and the horizontal span shows the frequency range measured.

May 29, 2001

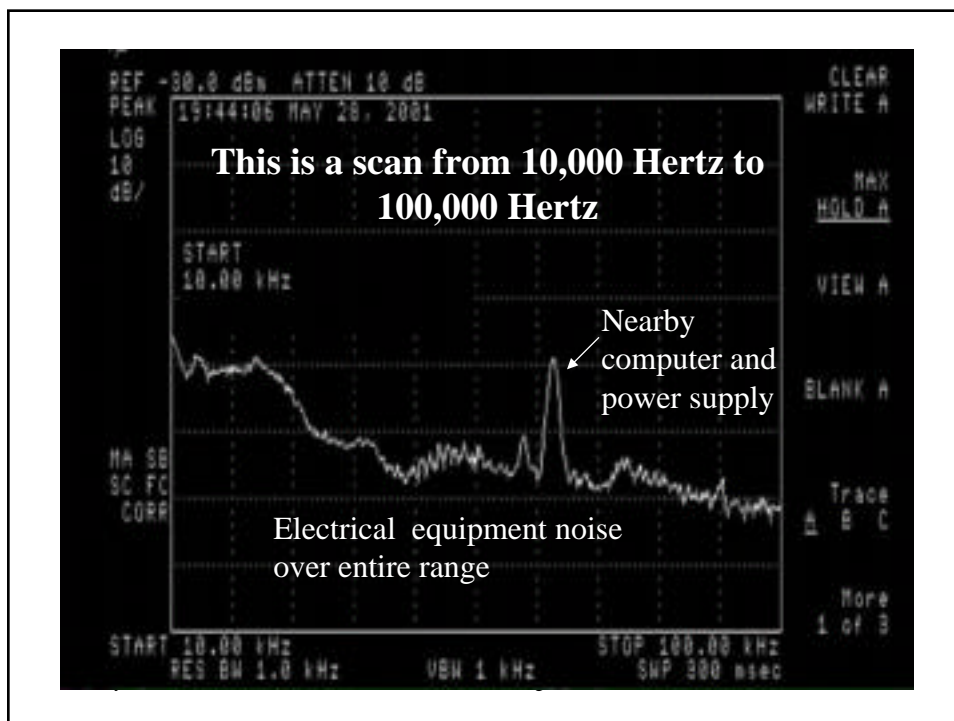
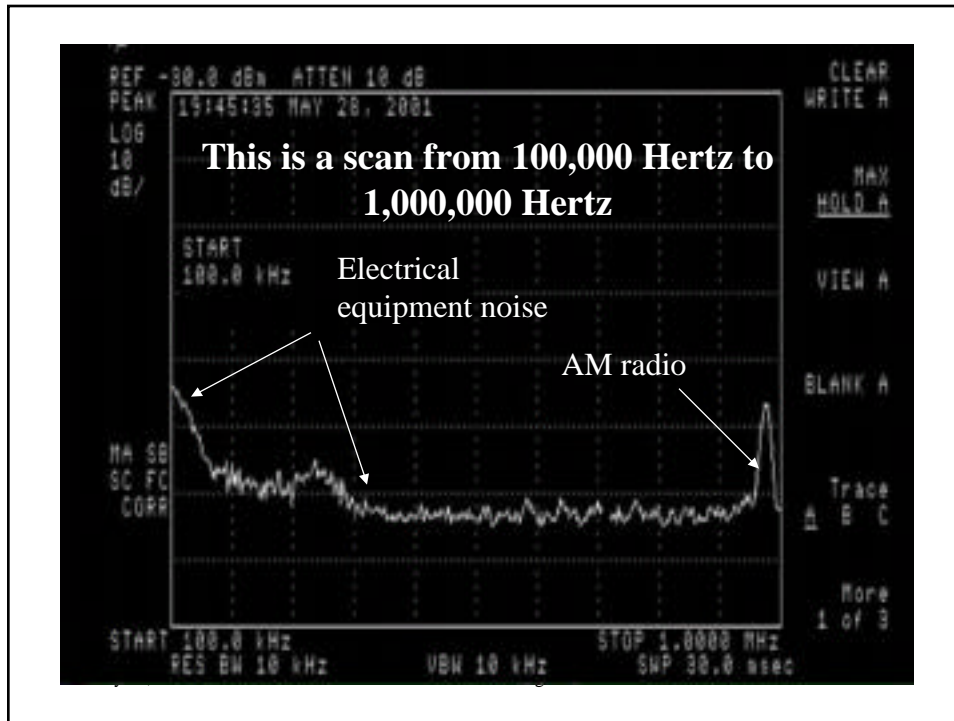
cforster@forstereng.com

22

Phasor Labs



Phasor Labs



So, there you have it. There are lots of frequencies on your power system wiring.

If you do not touch the wires, your not going to sense conducted energy.

If you stand near the wires you may pickup radiated energy, but how much energy is really there?

May 29, 2001

cforster@forstereng.com

27

This meter measures how much.

Anything in the air will be recorded and compared to recognized international standards for un-controlled environments. (That's for people like you)

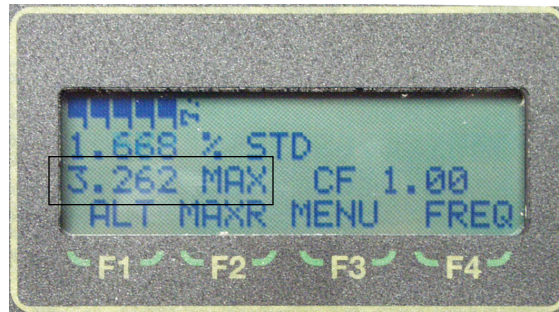


May 29, 2001

cforster@forstereng.com

28

But the levels are well below the level of any reasonable concern.



May 29, 2001

cforster@forstereng.com

29

Lets review what we discussed.....

The filter lets you measure the electrical noise in the frequency range above 60 Hertz.

You will not transfer significant energy to yourself by conduction or capacitive coupling.

The radiated energy you will absorb is not significant.

May 29, 2001

cforster@forstereng.com

30

What is the concern???

What are harmful levels to the body?

How do they reach the body?

How can they be measured on the body?

These are important unanswered questions.

May 29, 2001

cforster@forstereng.com

31

New Topic

May 29, 2001

cforster@forstereng.com

32

**How about adding capacitors to the
120/240 volt ac power system?**

Adding capacitors across the 120 volt circuits
DOES reduce the electrical noise in the
immediate area of the capacitors.

But not without a price for safety.

May 29, 2001

cforster@forstereng.com

33

Some dangers are:

1. If a person purchases an electrolytic capacitor at an electronics shop and applies 120 volt ac power to the unit, it will exploded like a small hand grenade.
2. Capacitors not protected by individual fuses stand a risk of violent rupture when they fail internally.

May 29, 2001

cforster@forstereng.com

34

Some dangers are:

3. Capacitors not protected by individual discharge resistors will maintain a significant charge for a considerable period of time. This can cause quite a shock for the unsuspecting person that touches the units.

4. Capacitors not in a protective enclosure are dangerous from a shock hazard and from a rupture hazard.

May 29, 2001

cforster@forstereng.com

35

Some dangers are:

5. Capacitive filters should be engineered and be listed by UL or other safety testing laboratory. Construction of filters by non-electrical persons is dangerous.

6. Adding excessive capacitors to the secondary of a home or farm distribution transformer will cause over-voltage on the 120/240 volt system during night time hours that could damage other home electrical equipment.

May 29, 2001

cforster@forstereng.com

36

Some dangers are:

7. Adding excessive capacitors to the secondary winding of a distribution transformer may cause resonant circuits that will damage electronic equipment, especially variable speed drives.

8. Inappropriately applied capacitors will rupture. The rupture may cause flying metal from the case or heat adequate to start a fire. It is only a matter of time before this occurs.

May 29, 2001

cforster@forstereng.com

37

End

May 29, 2001

cforster@forstereng.com

38