

Safety Precautions

- 1) Capacitors can hold a charge of electric current. If the capacitor is charged and you touch it, you might get a slight shock. To prevent this, when the phone is disconnected from the phone line, discharge the capacitor by shorting it with a wire, a small spark is normal.
- 2) Ringing voltage on the phone line can shock you. Disconnect the phone from the phone line when you work on it. You could keep both hands in your pocket, but holding a screwdriver in your mouth and working is not easy.
- 3) Ring generators produce 90 to 110 Volts AC and if you touch the terminals well, you will see stars and say bad words. This is also called a shock.

This book belongs to:

Note: This booklet is the simplified explanation without extensive technical details. Some liberty was taken in providing explanations. The theory of this topic goes far beyond most Electronic Engineers. Only very old telephone collectors with a strong Telecommunications and Electronic backgrounds can explain this in detail.

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Telephone Ringer Equivalence The Real Story

Back in the olden days, everyone had only one telephone installed. If you were rich, you might have 2 telephones connected on your line. As time went on, people had many phones installed in their homes. At that time the only business in town was the phone company and they charged for each phone. Extra phones were billed at \$1.25 a month.

The telephone companies, so as not to lose revenue, began testing the number of phones you had on your line. This was done in a very primitive way, the telephone line was disconnected from the equipment at the central office and then “charged” with 48 Volts DC and “discharged” into a meter. The longer the line or the more phones on the line the greater the deflection on the meter. It was a quick and dirty way of determining the number of working ringers.

Only the smart people knew how to disconnect ringers so the telephone company could not detect them. About this time more telephones were in the hands of the public. A problem started to occur, the connection of so many phones meant on some lines the ringer load would be too great. In the older telephone central offices the large ringer load on a line would cause the equipment to think the line had been answered and the ringing would stop.

FCC Part 68 came along allowing the public to buy and install their own telephones. The ringer load was now a very serious problem. Part 68 required that all phones be labeled with their ringer load or equivalence. The standard was the a Western Electric 500 Set with a ringer equivalence of 1.0 REN (ringer equivalent number).

After Part 68 all telephones, answering machines and other devices connected to a telephone line had to be tested and approved for connection and had to show the REN on the label and the FCC Registration Number.

There are two types of REN, A is for 20 Hz and B is for 20 to 66 Hz, the frequency selective ringing system that is no longer used for party lines.

The simple explanation is that every modern telephone with a bell that rings has an REN of 1.0 A.

Older telephones have a much higher REN. A Candlestick Telephone with the big metal ringer box typically has an REN of 1.5 to 2.5, depending on the ringer capacitor and the ringer.

The telephone company limit for how many ringers you can have is determined by the REN of each device. The maximum ringer load you can have is 5.0 REN. If you are very very far from the Central Office you may be limited to 4.0 REN or less.

If you have any modern devices connected, such as a Cordless Telephone, check the instruction book or look on the bottom of the main telephone for the REN, typically it will 0.4 REN or less. Then add up the ringer loads of everything you have connected.

Example: (A typical telephone collector)

2500 Telephone	1.0 REN
500 Telephone	1.0 REN
Candlestick	2.0 REN
Cordless Phone	0.4 REN

Total REN	4.4 REN

You can consider a WE 300 to have an REN of 1.0, but it has not been officially rated. AE phones have similar values.

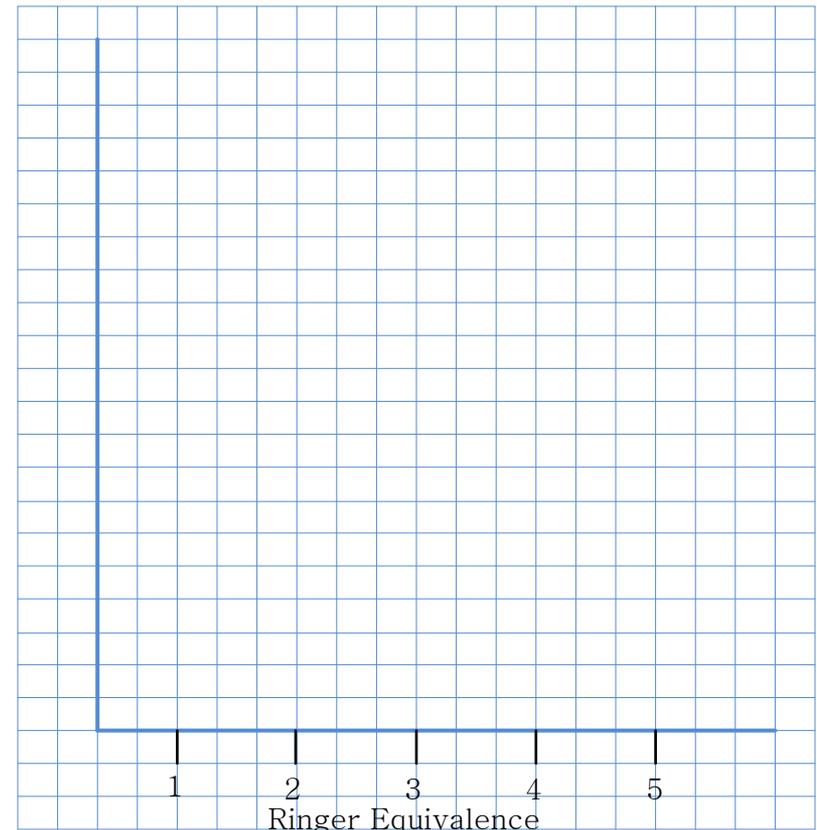
There are several problems if you add more phones. (1) add them and see what happens, if you still have all phones ringing you are ok, (2) if one phone stops ringing, you could have a problem, (3) if your phone line rings once and stops you have a serious problem.

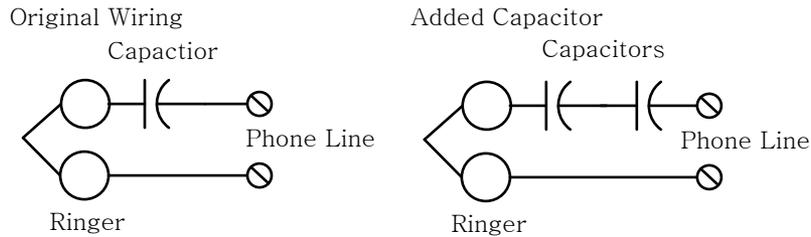
It is now a trade off – What capacitor lowers the REN but still allows adequate ring volume? Remember you do not want to exceed 5.0 REN for all the phones you have connected. Perhaps a lower volume on the bedroom phone will be just fine as well as a lower volume on the 3 phones you have in the living room, but a normal value for the one in the garage might be good. Try the reduced volume for a week and see what you think.

Remember as you reduce the REN there is less power to the bell. You will probably need to adjust the bias spring or the gongs to compensate for this.

Testing will be done at 30 Hz as most key systems use this frequency. Ideally testing would be done using a 20 Hz generator. Since you made comparisons to “standard” telephones the REN values you plotted on your graph are fairly accurate. The frequency used should not be a concern. Central Offices use 20 Hz.

Your Personal REN Graph





For those talented in Math ---- When you put capacitors in series the resulting value is the product over the sum. Look in an electronics book for more information.

This is 0.2209 divided by 0.94 or 0.235. Since both values are equal you can also divide one value by 2, the result is the same.

The drawing on the left shows the original ringer wiring and the drawing on the right shows the wiring when you add a second capacitor. If you put two capacitors in series, the value of the capacitors, as the ringer see it or as the Central Office sees it, is half of the value of one of the capacitors. In a modern phone, like a 500, this would be. 0.47 divided by 2, or a value of 0.235 Mfd.

The same can be done on an older phone. If you are lucky by adjusting the spring tension and the gongs, the phones will ring at reduced volume and still sound good.

Now things are going to start to get a bit more complicated. It is possible to use a different capacitor to put in series. You can use a 1.0 Mfd capacitor rated at 200 VDC. All the capacitors must be non-polarized and NOT electrolytic. Usually this means a mylar capacitor.

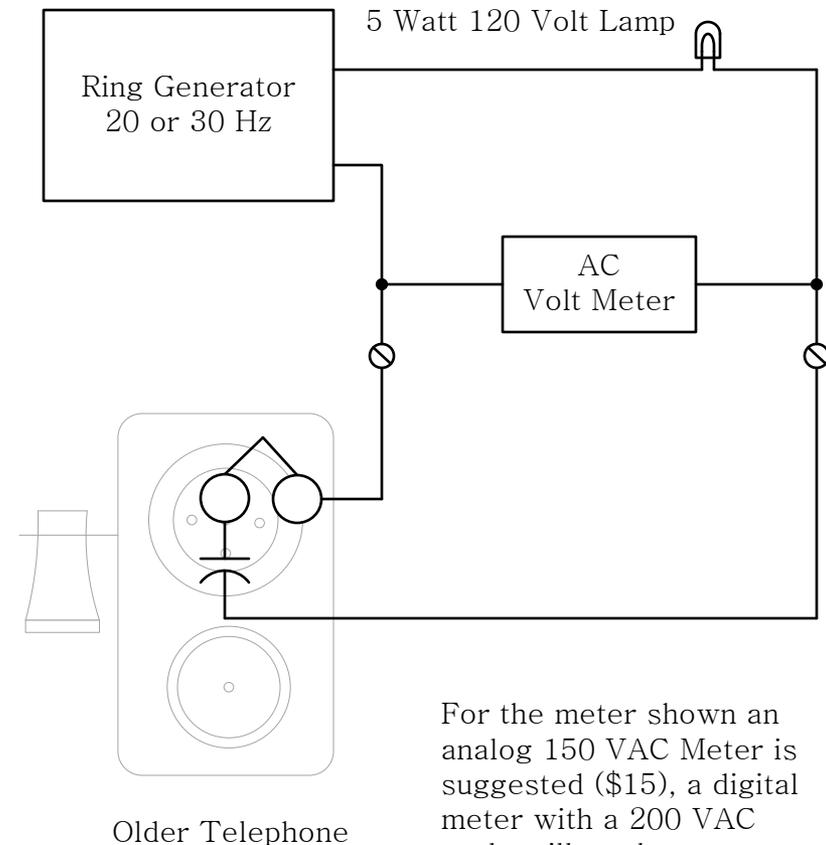
In modern phones there is a 0.47 or 0.5 Mfd capacitor. If you put a 1.0 Mfd capacitor in series you end up with a effective capacitance of about 0.33 Mfd. This might be a better choice and provide acceptable ringer volume. I had you try the 0.47 Mfd first because it a more commonly available value. Telephone collectors usually have extra 0.47 Mfd capacitors.

There is no way to calculate the REN. The only way to figure it out is to measure it. If you have a ring generator and a meter that will measure 120 VAC then you are set. The only additional item is a small incandescent bulb, a 5 Watt night light.

The advantage of this circuit is that you can measure actual REN. Accuracy of this is very good.

Many key system power supplies have a built in ring generator and this can be used, there is also a separate ring generator used in some key systems.

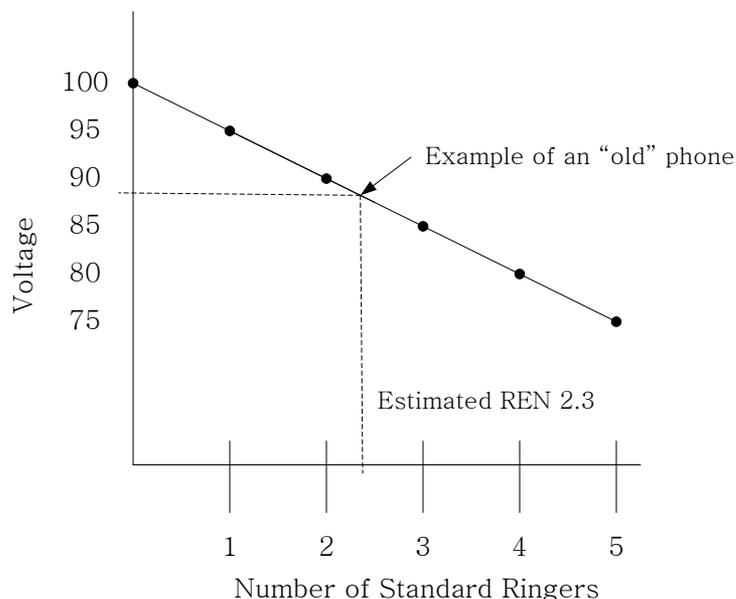
Set up this circuit:



For the meter shown an analog 150 VAC Meter is suggested (\$15), a digital meter with a 200 VAC scale will work.

Measure the voltage without the phone connected and with the phone connected and ringing. Make a note of the values.

Now the ringer tester needs to be calibrated. You will need at least 3 standard 500 or 2500 telephone sets. Start off by connecting one, then two and finally three sets. Measure the voltage each time. You will have three voltages. Plot a graph like this (similar, as it will not have the values shown):



If you have 5 standard telephone sets, you can also use those and put them on the graph.

Then ... locate the voltage you measured on that old set, put it on the graph and you will have the REN.

Save your chart and use the same bulb each time you test and the same ring generator. Test all your phones and make a note of the REN. You can also use different capacitors, maybe substitute a 0.33 Mfd for a 0.47 Mfd and see how the REN changes. Or in the case of a Candlestick, add a 1.0 Mfd capacitor in series with the existing capacitor.

The only real solution to adding more phones is to either disconnect some of the ringers, or reduce the ringing load on your telephone line. The question is, do you really need ALL the phones to ring?

If you want to disconnect a ringer in a phone it is a simple matter to remove one of the bell wires from the terminal it is attached to, just tape the wire and put a note inside the phone explaining where you removed the wire from.

Reducing the ringer load on each phone is not difficult. In the standard 300, 500 or 2500, the ringer capacitor is rated at 0.47 Mfd at 250 VAC. You can add a second capacitor of the that value IN SERIES with the existing capacitor. This will reduce the ringer load. On these phones they will ring a bit less loud, You can adjust the bias spring to the light bias position or adjust the gongs.

This is where a minor problem starts to happen. You can get bell tinkle when an older set (like a Candlestick or Oval Base) dials a rotary number. A light spring on the phone may make the bell respond to the pulses from the dial. So if 8 is dialed you would get 8 ding dongs on another phone. This can also happen on older phones, newer ones like a 500 have a resistor and capacitor across the dial pulse contact to prevent this, older phones do not. Personally I like the bell tinkle when someone dials an old phone.

Ringer capacitors on older phones like Candlesticks and Oval Bases depend on the age of the phone and the date of the wiring. Also the resistance of the ringer, another factor in ringer equivalence, varies. You can still remove one of the ringer leads and add a 0.47 Mfd capacitor and do the same thing you did the 500 set above. Usually the ringer volume of an old set is about one-third if you do that and the REN varies a bit but you can estimate it at 1.0 REN.

All of this is not an exact science. There are too many variations in the older phones. Some ringers age and the magnets become weaker or the springs bend.