
Some of the schematics for PHONE-IN-USE indicators have been confirmed to be defective or plain useless. I will upload a corrected version in the near future. Until then, use CAUTION!

This one has been confirmed to work and work well.

Telephone-related ASCII Schematics V1.01

Contents:

[Document Version: **1.00**] [Last Updated: **12/12/96**]

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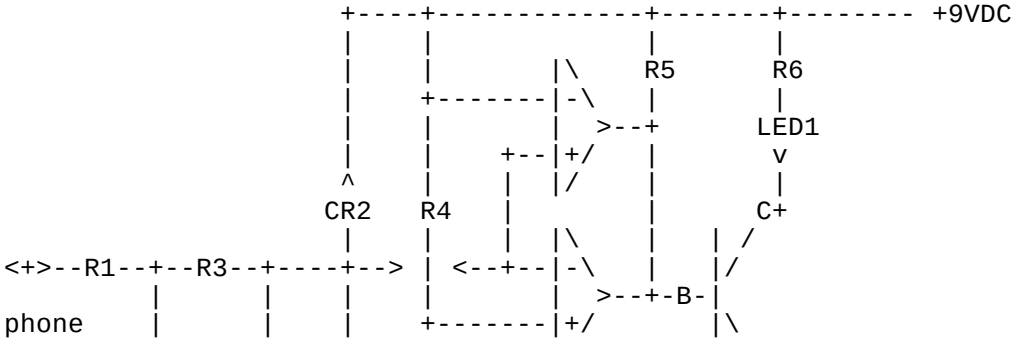
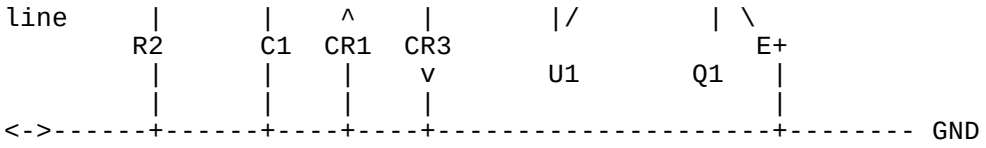
1. Telephone in use light

From: dthomas@bbx.basis.com (Dave Thomas)





R1,R2	1 Meg
R3	10 K
R4	1 K
R5	4.7 K
R6	470 ohm
C1	.005 uF
CR1-3	1N914 diode
LED1	any old led
Q1	2N2222 or 2N3904
U1	LM339 quad comparator (be sure to connect power and ground)
--> <--	are connected (jump)
^ or v	cathode of diode
+	connection
9VDC	any old 9VDC wall transformer works nicely

Circuit description

R1 and R2 form a voltage divider, insuring that the phone line sees a high impedance load and that high voltages (such as the ring voltage) are easily dissipated by the protective diodes (CR1 and CR2). Also (obviously) they serve to divide all incoming voltages by two. Capacitor C1 filters out some of the audio signals that might otherwise make the LED flicker with speech.

The voltage across a busy line is generally 5-10 volts, whereas a free line sits at more like 48 volts, and a dead line (definitely not in use!) sits at 0. This circuit uses two comparators (sections of U1) to detect when the voltage is either too high or too low. Normally Q1 is kept turned on by pullup resistor R5, keeping LED1 illuminated. If either comparator detects incorrect voltage, its open-collector output goes into saturation and forces Q1 (and thus the LED) off.

The top comparator section has its negative input connected to the +9V supply, so it will force the LED off if the voltage at its positive pin should exceed 9V. Remember that we are dividing by two, so the phone line voltage would have to exceed 18V in order for this comparator to force the LED off. This would normally happen when the phone is not in use (48V, remember?).

The bottom comparator section has its positive input connected to the anode of a forward biased silicon diode, so it is sitting at 0.6V. If its negaive pin is ever lower than 0.6V, this comparator's output will go into saturation and force the LED off. Remember, again, that we are dividing the phone line voltage by two, so the phone line voltage would have to drop below 1.2V in order for this comparator to turn off the LED. This is clearly a dead line.

Serving Suggestion: Install the circuit in an out-of-the-way place, then connect the collector pin of Q1 and the +9VDC to unused (yellow or black) conductors in your home or office phone wiring. Then you can place additional LEDs (with current limiting resistors like R6) at each phone. I once used a power transistor for Q1 and peppered our electronic repair shop with LEDs at every workstation.

If you have any difficulty understanding my ascii art, the circuit theory, or anything about this posting, please feel free to contact me.

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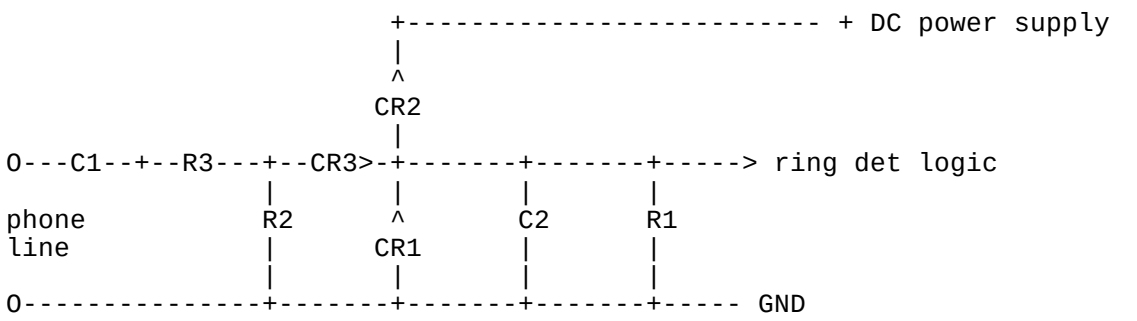
2. Detecting a telephone RING

From: dthomas@bbx.basis.com (Dave Thomas)

When a phone line rings, there's 90 V RMS AC at 20 HZ on the line. It's enough to give you a jolt you won't soon forget. Thus, it's hard to miss!

My favorite detection scheme looks like this. This is off the top of my head so you may have to twiddle component values a bit. Also, this is for driving logic circuits. I'll treat your specific problem in a bit.

Detector Schematic



C1	.1 uf
CR1,CR2,CR3	1N914
C2	10 uF
R1	100K
R2	10K
R3	100K

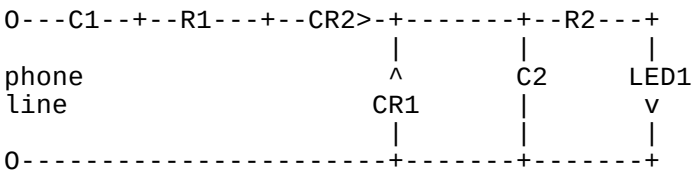
Mostly, there is only DC or small signal AC (audio) on the phone line. C1 blocks the DC, and the R3-R2 voltage divider prevents the low level AC from having any effect.

When the ring signal comes along (90V RMS) enough voltage is developed at the juncture of R3 and R2 that some charge is pumped into C2 via CR3. Protective diodes CR1 and CR2 ensure that the output of this circuit will not grossly exceed the power supply levels and thus damage the logic circuits it may drive.

C2 and R1 have a time constant of 1 second, so one second after each ring ends, the output will fall to a logic zero again. This circuit could easily drive a counter, to count rings. A timer with a longer period could be used to reset the counter if no rings have come in within say 10 seconds.

For the specific problem in the post I'm answering, (" LED should stay ON while the phone rings") you would want to change the design somewhat. Here's how I would make a ring

indicator light that stays on until the phone acutally stops ringing:

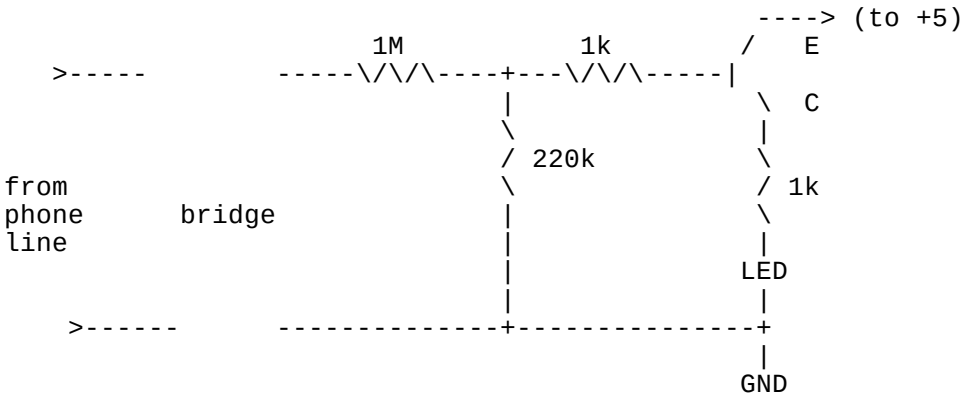


C1	1 uF, decent voltage
C2	see text
R1	10 K
CR2	1N914
CR1	zener -- 9v or higher
R2	1 K
LED1	any old LED

I haven't built this, but here's my theory: C1 blocks DC, R1 limits the current that the ring voltage could cause. The ring voltage is rectified by CR2, filtered by C2, and limited in amplitude by zener CR1. Then the charge stored in C2 is slowly used to light LED1. As long as C2 is large enough (I'd start with 10 uF and experiment from there) to keep the LED on between rings, and small enough that the LED goes off within a reasonable amount of time after the last ring, you're set.

(From no-idea)

I took ideas from schematics posted here a few days ago and constructed a telephone "line in use" indicator. Here's the circuit...



The transistor is a PNP Motorola 3638 with hFE of around 100 (probably doesn't matter). Also, you could use this with different supply voltages if you change the 220k resistor.

Also, in case anybody's interested, I found the on-hook open-circuit voltage of my phone line to be 48.7V, and the short circuit current to be 72.8mA. This leads to the conclusion that the line has a resistance of about 670 ohms. There have been a few calls recently in sci.electronics for phone in use circuits (ie a circuit that lights a LED when an extension phone is off hook).

Following are two circuits I archived some time ago from sci.electronics. The first appears

pretty complete and requires an external 5V power supply. The second seems to be a loop current trap that enables you to move from one extension phone to another without leaving the first phone off hook. I don't know how well either of these circuits work as I haven't actually built them.

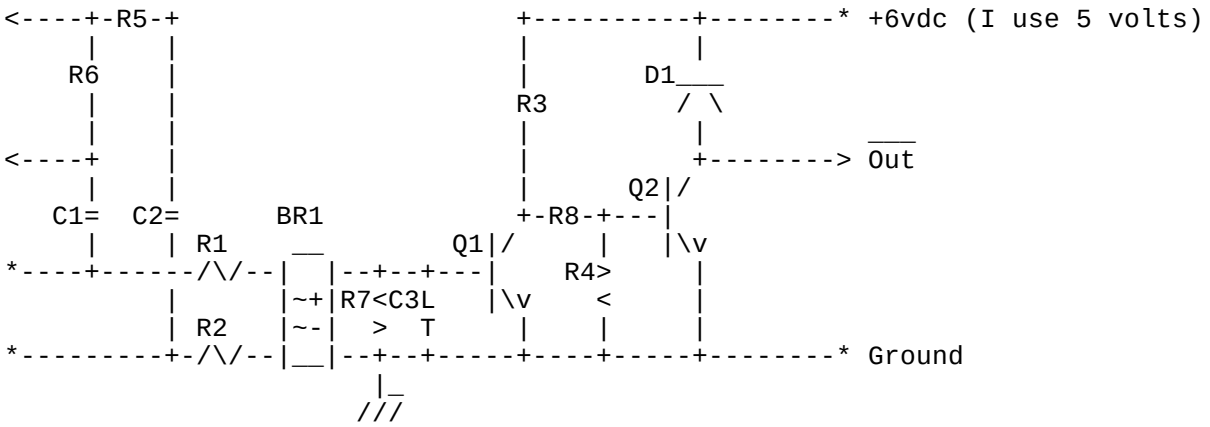
(From no-idea)

I thought I would try to post the schematic. This circuit requires a separate 5 volt supply. The branch of the circuit that contains C1, C2 & R5, R6 is only used as a passive tap. (So you can record the line when the rest of the circuit says 'off hook'. It can be removed if not needed. If used, it can directly drive a microphone input to a portable recoreder.

The Output of Q2 completes a path to ground when the phone lines gives an off hook reading. This can drive a relay (for a tape recorder motor) or an LED. Be sure to include a current limiting resistor if an LED is used. Also, D1 may be ommited if a non-inductive load is used (Relays and incandescent (sp?) lamps are inductive)

The LED thingy like this that I made for my phone flashes nicely when the phone rings (at the 20..25 Hz ring freq), so I can turn the ringer off, and still get silent ring indication (a feature, not a bug)

Well, its not exactly postscript(tm), but if you stand back and squint, you'll get the idea.




```
R1, R2  2.2M                            Reproduced (kind of) without
R3, R4  470K                            permission.   Copyright 1980
R5      470                             TAB BOOKS Inc.
R6      100
R7      100K
R8      220K
C1, C2  0.01uf, 100V
C3      1.0 uf
BR1     Full wave Bridge Rectifier, about 200 VDC (or higher)
D1      HEP R0052 (I use 1N400*)
Q1, Q1  HEP S9100 -or- NTE-172a
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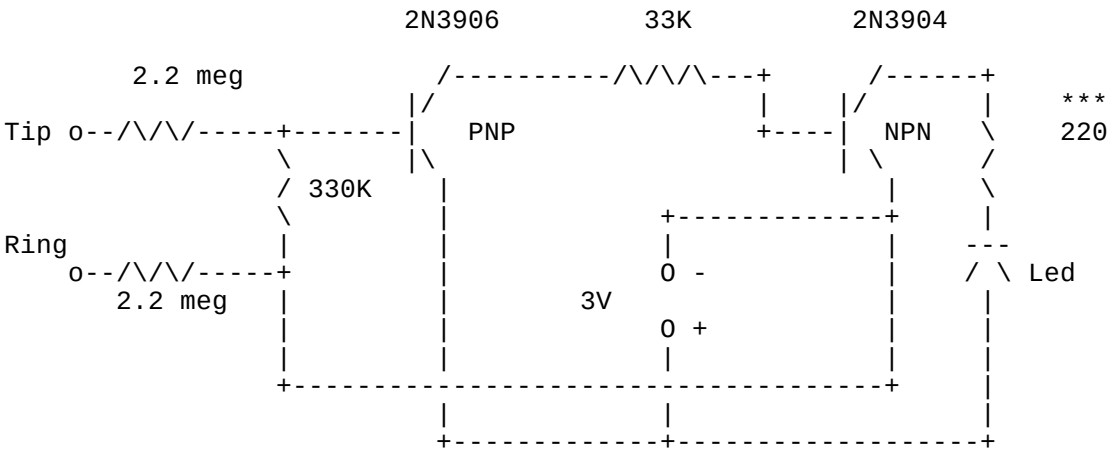
(From Aurel Boisvert)

My computer is in the basement and this device tells me if the phone line is in use. I have inserted a N/O switch in the battery connection so that the batteries will last longer as sometime my sons spend a lot of time on the phone. Prior to using my modem I press the switch to find out if the line is busy.



** This resistor may have to be lowered to match the led used. Use alkaline battery, they last longer.

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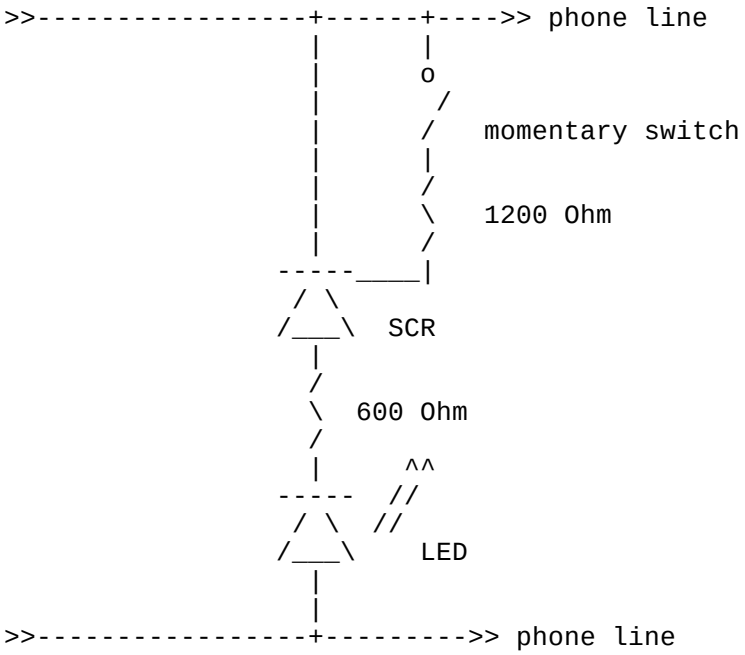
3. (manual) Phone In-Use Light

From: barber@beowulf.ucsd.edu (Terri Barber)



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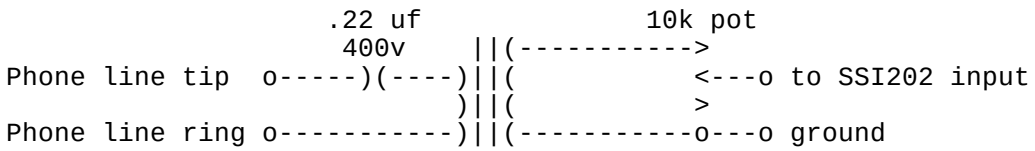
4. Phone to audio interface (SSI202 input)

From: jre@earldom.UUCP (Jim Earl)

You have to isolate the chip from the phone line, or you'll have all kinds of problems. Let's see how I can do this with ascii art:



The transformer is a 600-ohm to 600-ohm line transformer. I use the circuit as-is, and works fine. Doesn't take the phone off hook, you'll need to add some circuitry for that. To set the pot, turn it down all the way, (for minimum audio into the decoder) then hold down a tone on the phone while you slowly advance the pot up until the VALID DIGIT line changes on the chip. Then advance the pot a little past that point. That should do it.

Also, it might not be a bad idea to put a couple of diodes back-to-back across the secondary of the transformer. I'm not sure if enough voltage will be generated to harm the SSI chip when the phone rings or not. Mine has never had a problem, but it might be worth the cost of the two diodes for good luck.

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5. Phone Off-Hook Indicator

Author: Roger Petersen Created: June 1985 or so Overview - What is it?

Runs off 9V battery, Plugs into phone jack, Lights an LED when any phone on the line is off-hook.

Phone Information

Measuring the voltage across the telephone line shows (typical numbers):

```
On Hook:        40 to 50 VDC
Off Hook:       4 to 6 VDC
Ringing:        100 VAC
```

The "standard" impedence of a telephone, when off-hook, is 680 ohms. Hanging a 680 ohm resistor across the telephone line will drop the voltage from 48V to about 5V, causing the line to go "active". This is how HOLD switches work. This probably means that it is bad to load down the phone line when the phone is off hook. I wouldn't want to hang less than a 100Kohm load across it. Should probably measure this, and see how it affects the on-hook voltage.

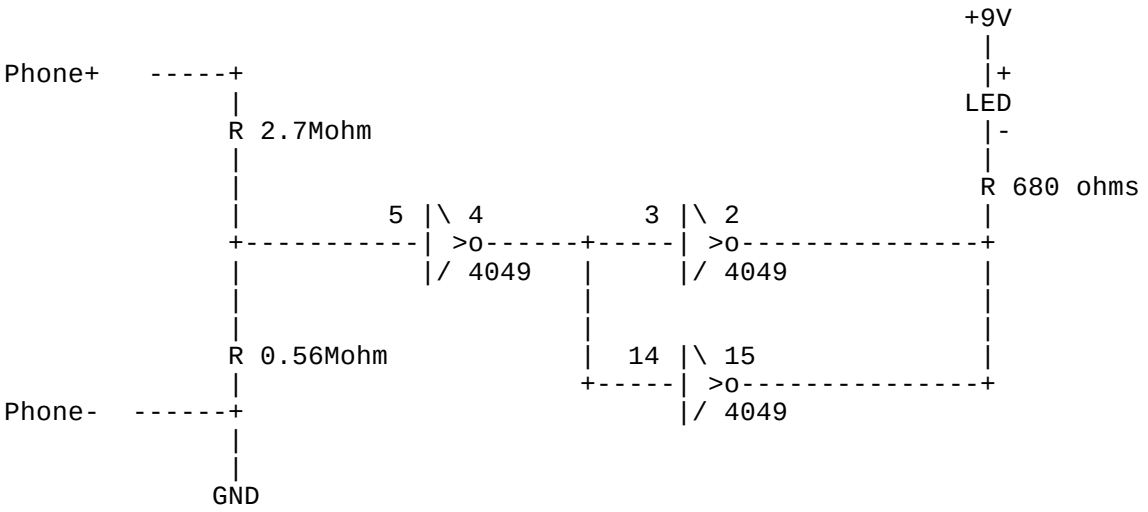
I haven't seen any official documentation on these numbers. They're empirically derived.

The next question is: What are these voltages referenced to? If anything? It's possible that the most positive phone wire is tied to the GND in your house, or else maybe the neutral wire in your 120VAC outlet. So measuring the phone line voltages with respect to your household GND should show 0V and -48V when the phone is on-hook. But I don't know. It's probably best to not rely on this behavior.

Circuit Design - Off-hook Indicator

Could probably use some sort of transistor design, but I'm a digital weenie.

I used a CMOS 4049 Hex Interter. This part (supposedly) has high drive output. And since it's CMOS, it can operate with Vcc from +3 to +15V. And it has a high input impedence.




```
R = resistor.  Those other things are inverters.
Connect 9V battery across +9V and GND, above.
Tie all unused inputs (pins 7,9,11) of the 4049 to GND!  Don't let 'em float.
Tie Vcc (Pin 1) of 4049 to +9V
Tie GND (Pin 8) of 4049 to GND

Voltage going into pin 4 of 4049 is:
        Phone voltage   Voltage at pin 4
        6V              1V
        48V             8V
        100V            16V
```

Fancy Features

Not all phone jacks are wired the same way. Some have the two wires reversed. In the old days, before touch-tone, it didn't matter. In the early days of touch-tone, some phones didn't dial when the polarity was backwards. Now days, most phones don't care any more.

But the circuit above does. It requires the phone wires to be connected as shown. If you connect them backwards, it won't work. The light will just stay lit. And the 4049 may eventually be damaged. (4049's seem pretty resilliant). So it would be nice to have an easy way to switch the phone wires

Design Analysis

The 4049 probably takes a lot of abuse in this design. When the phone rings, the 4049 probably sees bursts of 16V. When the battery goes low, the voltage on pin 5 of the 4049 may exceed Vcc on the 4049, which is probably bad. It shouldn't be hard to improve on this circuit.

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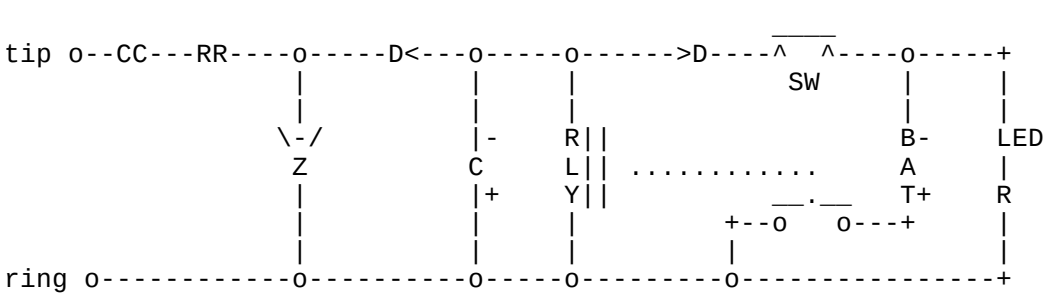
6. 'phone rang' indicator light

From: massoud@chemteca.sdsu.edu (Massoud Ajami)

This, will detect the ring signal, energize the relay which latches up, and the LED comes on and stays on till you push SW.




```
   CC=.47 uF 200 V. capacitor
   RR= 3k (depends on relay)
   D = 200V diode  ( < > direction od diodes)
   Z = 12 zener
   RLY= any small relay
   SW= normally closed switch
   K = relay's contacts
   BAT= 9 V. battery
   R = 500 ohm (for LED)
   C = some (10) uF capacitor
```

Components are not critical. It should latch on first ring, if not reduce RR. If it took too long to deenergize, reduce the C.

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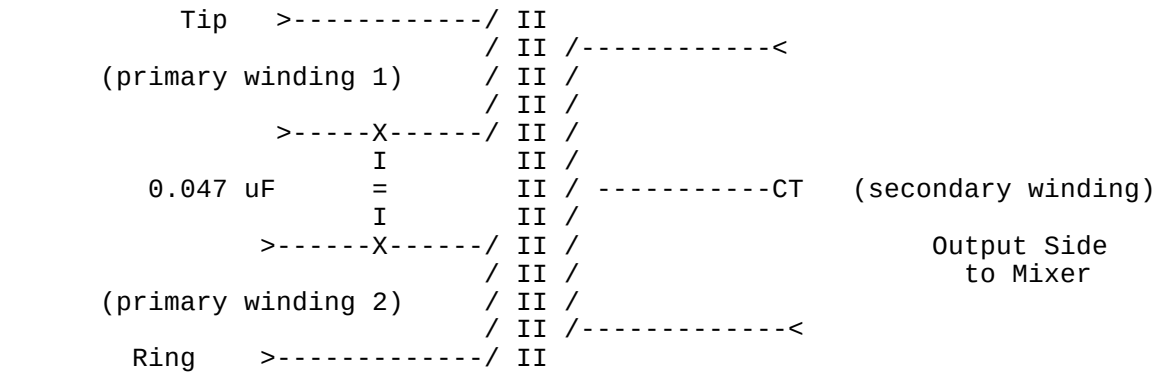
7. Phone Line to Audio

From: tpappas@hamp.hampshire.edu

We use telephone audio in our studio all the time. And yes, it's an off the shelf design. I designed and built such a device with scrap door components. I used an audio coupling transformer and a capacitor. The primary windings add in series to 500 ohms. Instead of connecting them directly together I added a cap between them. I think it was somthing like 0.047 micro farads with a 600vlt rating. And the secondary which is 500 ohms runs into the

control room mixer.



Try this circuit it works great for us in the studio. Just make sure you use properly rated components.

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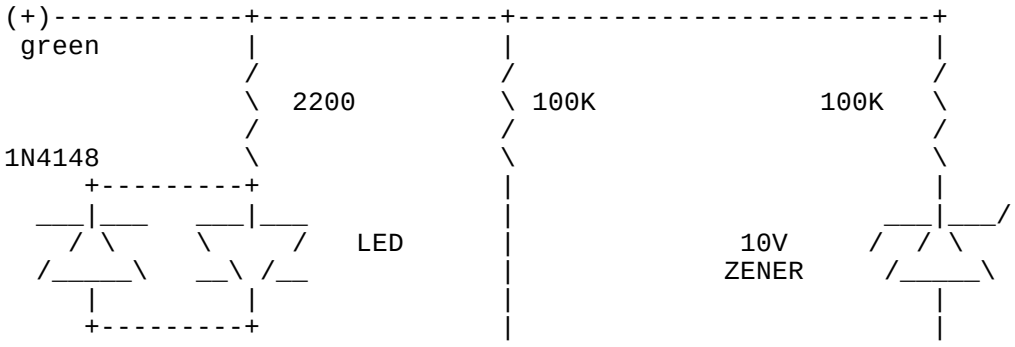
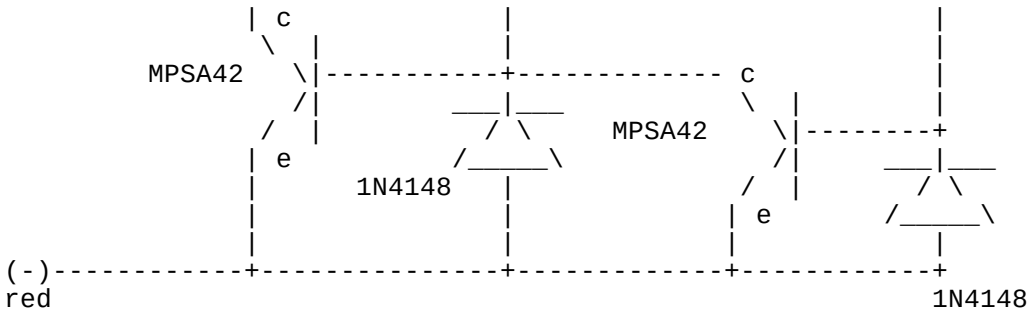
8. Phone in-use

From: kcarver@nmsu.edu (Kenneth Carver)

The circuit I built gives a visual indication at each extension when any extension is off-hook. It is line-powered, and the maximum number that can be used on our system is three. Since they all draw power at the same time to light the LEDs, any more indicators would cause an off-hook condition. Some changes could be made to reduce the current draw, to allow using more indicators, but the brightness of each led would suffer. The LEDs I used are tiny, but amazingly bright on just a couple milliamps. I picked them up from a surplus catalog, I can't remember which one. If you were to use battery power for the circuit, you could use almost any number of indicators. I had use only for three, and I did not want to worry about replacing batteries. If I remember correctly, our pbx required a load of about 20 milliamps before the line failed to hang up. This circuit draws about 5 milliamps when off- hook, much less when on-hook. It senses the drop in line voltage from about 46 volts to 6 volts when an extension is picked up. The zener voltage should be well above the off-hook voltage of your system, and well below the on-hook voltage. The transistors are small high-voltage npn types I had on hand. The LED also flashes with the ring voltage. Putting a suitable MOV across the line is a good precaution to prevent lightning damage.

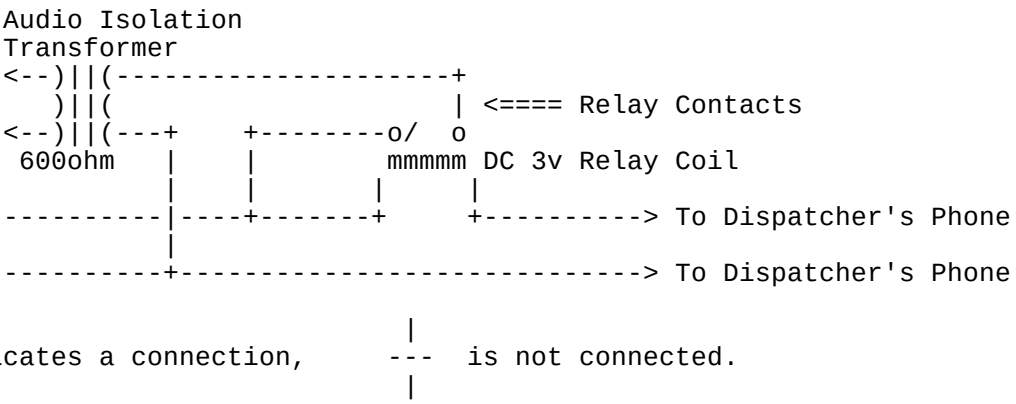




9. Telephone Line Monitor (Plans)

From: jna@geech.gnu.ai.mit.edu (while you were out)

Get yourself a low-voltage DC relay, like a 3v relay... Set it up as follows:



You may have to use a Diode or two to make this telephone-line FCC clean... I'm not saying this is a clean circuit at all. It's cheap and dirty! You may have to use a Op-Amp (Use an LM386, they're good for speakers) on the speaker. Depends. Experiment!

Circuit Theory:

When the Dispatcher picks up the phone (in a standard circuit, I have NO clue what your PBX does.. this will work on standard home phones, and I used to use it for a tape-recording controller) Hey, there's an Idea - spend $25 on a telephone recording device, and hitch it to a nice loud amp and speaker combo, instead of a tape deck. It'll save you loads of time...

Anyhow.. the voltage will turn into DC, approx 6-10VDC when the phone is picked up, (which is why you've gotta put it before the dispatcher's phone) and click the relay. The relay will connect the transformer, and feed the speaker. it might be towards your advantage to use a SPDT relay, and connect **BOTH** ends of the transformer, and not just switch one end in and out. That might prevent some line noise...

10. Use old phones as an intercom

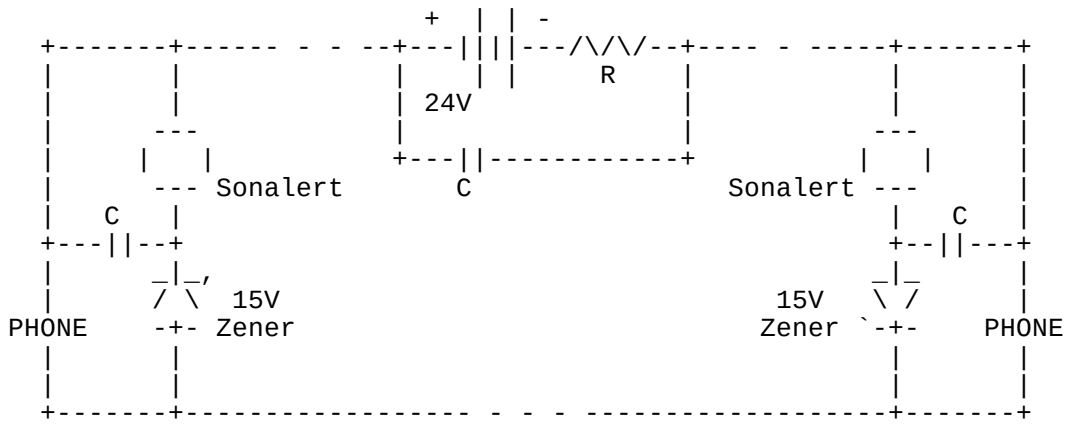
From: mwandel@bnr.ca (Markus Wandel)

I have recently thought about this and come up with a kludgy but workable scheme.

Talking over the phones is easy. You put DC current through the phone and it transmits and receives audio. So two phones and a current source (about 25mA) all in series will give you a talking circuit. A suitable current source can be as simple as a 9V battery and a series resistor whose value is adjusted (with both phones offhook) till about 25mA flows. You can then bypass the battery and the resistor with a capacitor to couple the audio straight across and get a loud and clear connection.

What is much harder is signaling the other end. To ring the bell you need to put 90V (RMS) 20Hz AC into the phone (nominally). Lower voltages will work (down to about 40V) but different frequencies won't. You can't ring the phone at 60Hz. I have a ringing circuit in a PBX I built but it consists of a 20Hz sinewave generator, a push-pull power booster and a big transformer. Much too elaborate for a simple 2-phone intercom circuit, and anyway the ringing voltage could painfully zap a kid.

So forget the bell and look into other forms of signaling. This is what I have come up with:



As before, set R to give you a talking current (both phones offhook) of about 25mA. Start with 1K ohm. Leave it in if the phones work well enough; the current is not very critical. The capacitors C are audio bypass capacitors and should be about 0.47uF.

When the phones are onhook they present an open circuit, and the 24V battery voltage is not enough to overcome the 30V series drop of the Zeners and no current flows. When both phones are offhook they present a very low resistance and the talking current (determined by R) flows.

When only one phone is offhook it places its low DC resistance across the Zener diode on its side so that the full 24V supply is applied to the other side. This overcomes the voltage drop of the other Zener diode so the other Sonalert beeps. The wonderful thing about Sonalerts is that they make a loud noise with only a few milliamps of current so the series resistor R

doesn't matter. Especially nice is a pulsing Sonalert which goes "Beep beep beep" automatically. While the far-end Sonalert is beeping, you hear the beeping in the near-end receiver (at low volume thanks to the bypass capacitor across the far-end Sonalert) to confirm that the line is working and the other end is being signaled.

The power supply can be three 9V batteries in series but since 80% of the power is lost in series resistor R rather than in powering the phones it seems a little wasteful. A 24V wall wart with clean filtering would be better.

The signaling components can be mounted inside the phones. Only two wires are needed to go to each phone, and the power supply can be mounted centrally, out of harm's way. If R is adequately big (1/2 watt) and has enough ventilation then both lines can be indefinitely shorted out without any fire hazard and there is not enough voltage anywhere to hurt anyone.

I have tested this with 500-type phones and two different types of piezo buzzers (pulsing sonalerts and non-pulsing brand X ones) and it works great. You should be able to get all the needed parts including piezo buzzers at Radio Shack. I love telephones. Too bad I don't have any kids who want an intercom line.

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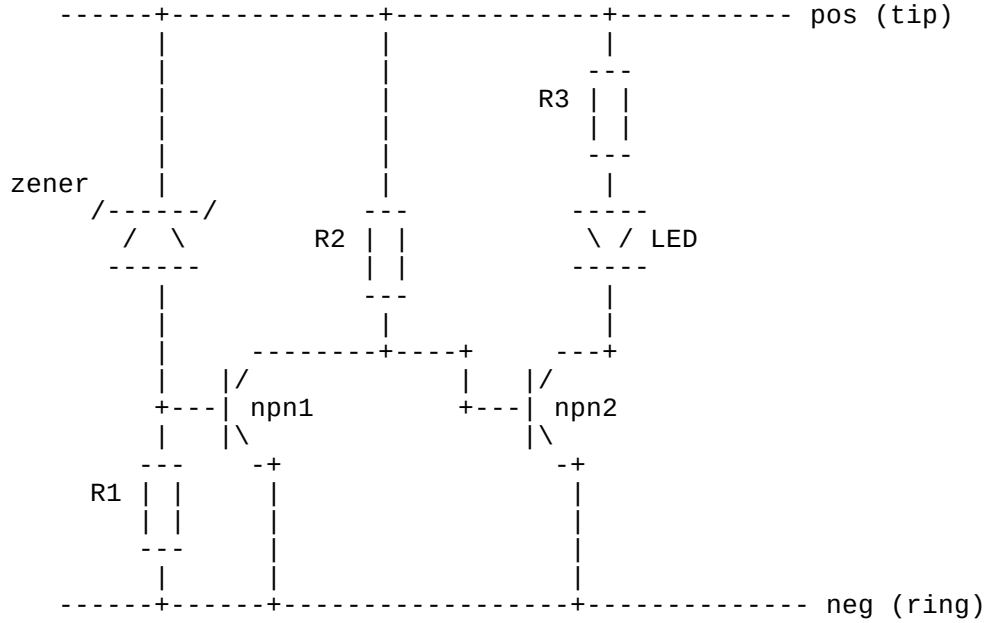
11. Phone-In-Use indicator

From: rstevew@gorn.echo.com (richard steven walz)



Now here's some logic that should work fine with the right zener and the right resistors and a couple of cheap npn's 2n2222A's or 2n3904's (06's?). If you get close to 25 volts with the new smart test boxes, a 20 volt Z may work fine. Choose R1 to limit current through Z and have enough left to turn on npn1 just enough to deprive npn2, choose R2 for that, and you will need to add a resistor R3 to protect the LED from overcurrent as needed, depending on the phone

system you have!

You **MIGHT** need a resistor between the bottom of R2 and the base of npn2 to get it right, but I don't think so because of the B-E 0.7 volt diode junction voltage needed in npn2 to get it out of cutoff.

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12. Telephone Power?

From: henry@zoo.toronto.edu (Henry Spencer)

> " If one were to try [using power from phone line], would phone company had a way of finding out?"

Most assuredly. They aren't in the business of supplying power, and they **ARE** in the business of finding faults in their lines. Any substantial power drain from their lines **WILL** be detected. If it's large, the phone switch will conclude that you've dropped the phone in the bathtub or something like that, and will disconnect your line (and will check periodically to see if the drain has gone away and you can be reconnected). If it's small, the switch will report it to the service people as a possible line problem, to be investigated before it causes a complete failure... and if they investigate and find that you're to blame, they will probably send you a bill for time and trouble. The current you can draw without eventually having it noticed is very small.

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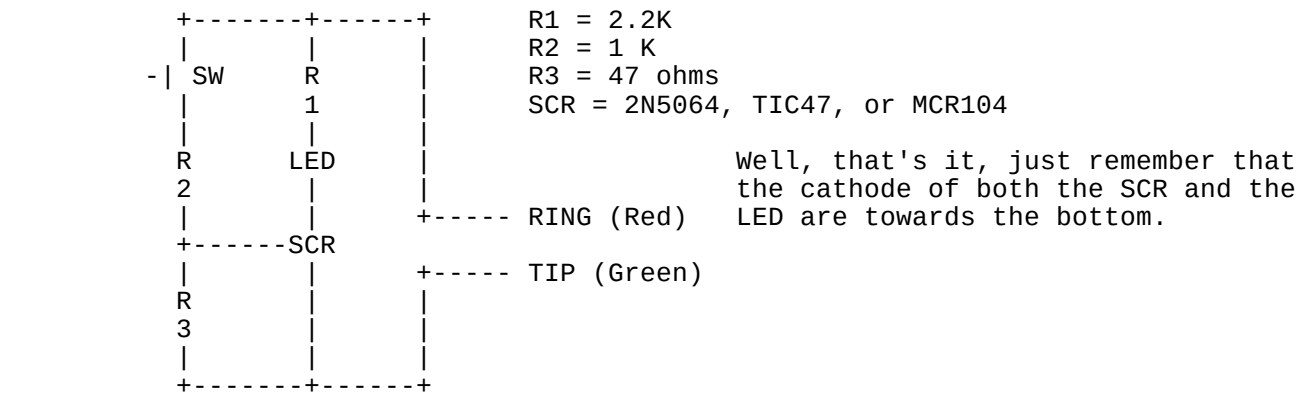
13. Hold function for Telephone

From: figment@wam.umd.edu (.)

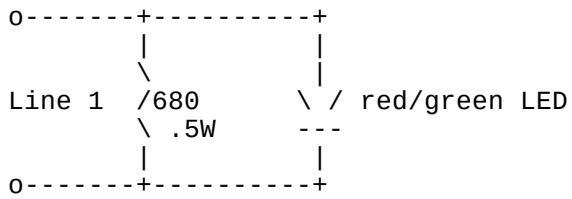
Here's the schematic that was in the November 1992 issue of Electronics Now. (Nobody sue me)



14. Digital/Standard Phone Line Tester

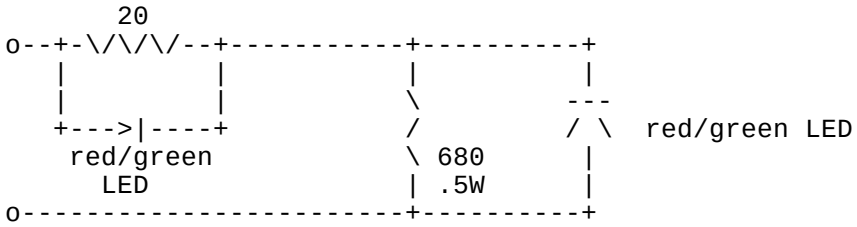
(From Dan Ts'o)

Radio Shack sells a similar device without the high current function. It detects one or two lines on an RJ-11 and tells you its polarity. It costs $6. The schematic is:



The circuit for Line 2 is identical. Note that each red/green LED comes standard as reverse wired (red LED "forward", green LED "reversed).

Based on the above, I think an appropriate modification to include a high current indicator would be: (I've tested it)



You can adjust the 20ohm resistor value to set what is considered "high current". 20ohms lights the LED at around 90ma. Total parts costs under $4, or if you use Radio Shack's $6 line tester and add the above resistor and LED, then under $7. (I'm not faulting IBM for charging $30).

This whole issue really bothers me because it means that I can't bring a PCMCIA modem with me on trips and count on it working at any given hotel. That means I should carry around my pocket modem just in case. So then what's the point of having the PCMCIA modem!

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