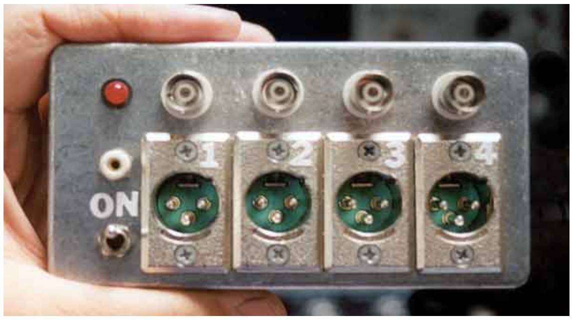
Radio World Magazine

Build Your Own Regency Tester

by Gary Palamara



From time to time, I find myself needing to check the continuity of audio or video lines which have been run over long distances. Many times this work requires a helper and a two-way radio to do efficiently. But every so often either through necessity or desire, I end up working alone and must devise a scheme for checking wire continuity. You could, of course, solder and crimp everything and just hope for the best. But since most of us enjoy sleeping at night that just won't work. If you've ever been in the business of installing and maintaining studio or control wires, building the Regency tester may be of interest.

New York job **- The Regency hotel in New York City was in the midst of renovations when its staff approached me to design and assist in the installation of audio/video wiring on several floors. The hotel is frequently used for media tours, radio roundtables, press junkets for movies and other promotions. In the past, thousands of feet of temporary wires would have to be run through hallways, down stairwells and out windows to interconnect rooms on several floors for such events. This wiring was dangerous, intrusive and ugly and it also required extra time and labor to install and remove.**

With the hotel undergoing major renovations, it seemed a perfect time to install permanent wiring into the ceilings and walls. The electrical contractor who was hired for the renovation work would also pull the A/V wires and I was hired to spec out the job, terminate the cable ends and test out the installation.

Management of the hotel decided that each suite on the top three floors of the hotel would be equipped with an audio and video panel. Each panel had three XLR and three BNC type connectors. Generally only two audio and two video lines would be needed per room; the third cable was added as a backup line. Each floor's wiring would

terminate in an electrical closet and Tie lines would be run for the interconnections between floors. Using this arrangement, all three floors could be used either independently or tied together into one system. The video tie lines were BNC to BNC but audio tie lines would have both male and female XLR connectors on each end so that audio signals could be run in either direction from floor to floor. All XLR and BNC jacks would be insulated from chassis ground to avoid ground loops.

Belden 8281 was specified for the video lines, and 8760 was used for the audio. The 8760 cable is 18 gauge, twin conductor cable with a foil shield and drain wire. Normally, for audio work I might use 20 or 22 AWG wire. But since some of these cable runs might have to carry DC voltage for intercom lines, I decided 18 AWG would give slightly less loss per foot. You only get one chance to do this a job like this correctly, so you might as well give yourself an extra margin of safety. Besides, on any installation, the cost of the cable is perhaps the cheapest part of the job.

The installation went smoothly with few delays. We were working against an inflexible deadline that was less than two months away. The hotel was booked for a major motion picture promotion, and everything had to be ready to go. I knew that a massive effort would be required to test for continuity, phase reverses, opens and shorts in the newly run wires. A careless worker could have easily put a sheetrock screw through an entire bundle of wires. The XLR connectors alone represented more than 1,000 connections and there were thousands of opportunities for either failure or greatness.

Then, after months of planning and consultation with everyone involved in the project, a potential problem arose when the local union representative insisted that their personnel terminate all cable ends. Despite the fact that I've been a union member since 1972, the rep insisted that their local technicians must do the work. My function then, reverted to that of advisor, overseer and quality control manager. The work was hard enough without the added pressure of having someone whose work I didn't know, solder and crimp all the audio and video connections. Overnight the deadline seemed to be in jeopardy.

Time and money **- Wiring of the type that most electricians encounter every day does not generally lend itself to the skills that are required to terminate shielded audio and video cables. The good news was however, although not strictly skilled in the broadcast field, the assigned electrician had done a fair amount of this type of work in the past. He was eager to learn and accepted guidance and that made the job easier. So, for the moment, the situation was defused and the work proceeded.**

Actually, assigning a tech to complete the installation meant that I could concentrate on the massive job of checking the wiring. For several days I thought about how best to approach the task. What I needed was a way to check both phase and continuity of all

of the connections that emanated from several floors and terminated in one of three equipment closets. Both ends of the wire would have to be checked as well as continuity from end to end. I knew that I could always enlist a help of another technician with a two-way radio, ohmmeter or buzz box. But that meant more cost for the hotel and another potential labor negotiation. So, I began to think about different schemes to check the wiring while working alone.

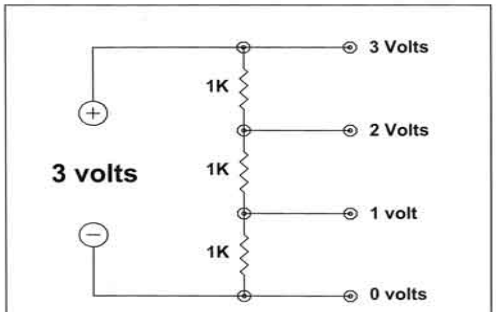


Figure 1

The concept - Although the problem is difficult the solution turned out to be quite simple. Before viewing the completed circuit, let's discuss the concepts involved. It's more important to understand the concept of what's happening because after you think about your own situation, you may want to alter the tester's circuitry to suit your needs.

Figure 1: Three equal-value resistors are placed across a 3-volt DC power source. Each resistor in our example is 1 k ohm. The resistors could be any value as long as they are equal. As you know from your school days, a 3-volt source voltage, divided by three equal-value resistors in series, will drop 1 volt across each resistor. So if we measure between the bottom or negative side of the circuit, (Pin 0), and the junction of each resistor, our voltage will increase by 1 volt as we go up the chain until we reach the top connection and our 3-volt source.

In practice, the exact voltage change is dependent on how closely the resistors are matched to each other. The closer they are in value, the more closely each measured voltage will change by exactly 1 volt. The circuit in Figure 1 is at the heart of the continuity tester used throughout the Regency project. Now let's hang long wires on our basic circuit and see what happens.

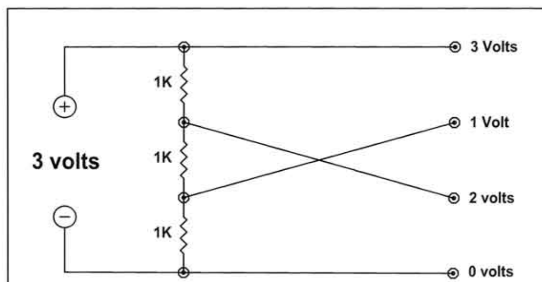


Figure 2

Figure 2: This scenario will allow us to move to the other end of the line and measure the same voltages that we saw at the tester itself. If all is well, the 3-volt voltage drop should magically reappear on the other side of the wire in the same order. Any incorrectly installed wire or cable will lead to a faulty reading at the other end. If two cables are reverse wired, open or shorted, the voltages will be wrong at the other end. The only way you can start at the zero point and get an increase of exactly 1-volt as you go up the line is if all connections are wired correctly. With a little practice, you can easily spot the mistakes.

The circuit - Figure 3 shows my completed tester circuit. Two 9-volt batteries in series provide a portable voltage source. The approximately 18-volt source is regulated

down to 12 volts by an LM-7812 positive voltage regulator. You can use the batteries alone without the chip regulator, but a constant voltage source is important if you want repeatable voltages that develop an exact voltage drop of 1 volt across each resistor. In my design a string of twelve 2200-ohm resistors are placed across the regulator's 12-volt output.

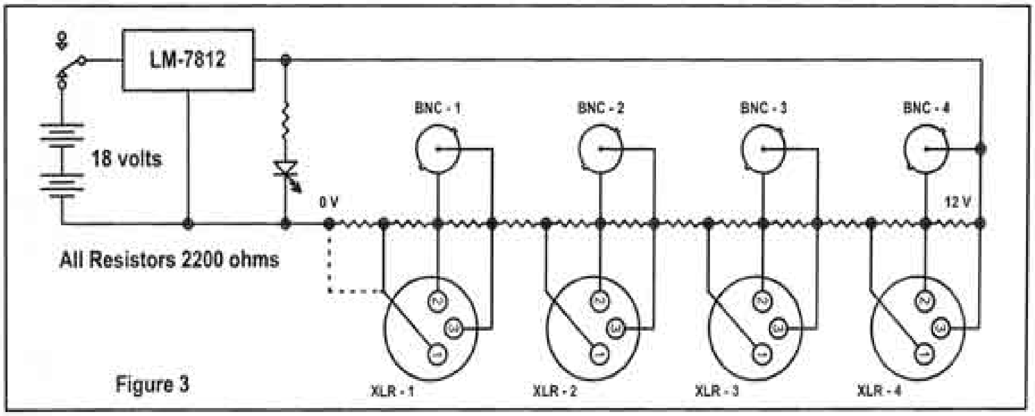


Figure 3

My resistors were not precision tolerance. Junk-box resistors that were checked for the closest match I could find, seems to work well enough. You could use any resistor value, but remember the 12 resistors are ultimately across the battery output and are going to draw some current. So, if you want the batteries to last for more than a few minutes, use resistors of 1k ohm or greater. In my tester the twelve 2.2 k ohm resistors equals approximately 26 k-ohms of total resistance. With 26,000 ohms of resistance across the source voltage, the biggest draw on the batteries is the LED indicator.

The tester needed to work for audio and video lines, so I built my unit using XLR and insulated BNC connectors. At the junction of each resistor in the string, a wire was attached to the appropriate connector pin. With every pin of each connector attached to a different voltage point along the resistor string, you will notice that no two audio or video pins carry the same voltage potential! For example, using Pin 1 of the first XLR as our common point, if you measure the voltage between Pins 1 and 2, you are actually measuring the voltage drop across one of the 12 equal resistors, or 1 volt. If you measure between Pins 1 and 3, you will get a drop of 2 volts and so on down the line until you get back to the voltage source.

In Figure 3 you will notice a dashed line running between pin one of the first XLR and the zero voltage point. By connecting Pin 1 of XLR 1 to this point, there are two resistors between Pins 1 and 2 of XLR 1. The reasoning for this change is because your common point on the far end of the line will be Pin 1 of the first XLR connector. So when you are measuring the voltage drop between Pins 1 and 2, we want Pin 2 to read 2 volts and Pin 3 to read 3 volts, and so on along the line. If you have only one resistor between the first two pins, your voltages will be off by 1 volt on the first XLR and that can be somewhat confusing. Likewise, the eight connections for the BNC connectors, can be made anywhere along the resistor line, but for simplicity, I chose to follow the same voltage path as the XLR connectors.

Using Pin 1 on XLR 1 as our common point, you can measure Pin Two as 2 volts and Pin 3 as 3 volts and Pin 1, 2 & 3 on the second XLR as 4, 5 and 6 volts and so on. Also using XLR Pin 1 as our starting point, you will measure the BNC 1's voltages as 2,3 etc. Again, it does not matter if you build your tester exactly as I built mine, only that you understand what's happening and how to use it.

Assess your needs and the parts you have on hand before building your own version of the Regency Tester. Construction is straightforward. The LED indicator may be omitted to extend battery life, but if you remove it, you won't know when current is flowing through the resistor string. I also added a connection point in parallel with Pin 1 of the first XLR. This allows me to plug one end of my meter directly into the tester. That makes things a little easier when I'm testing short cables right next to the tester.

At this point, you may be asking, "Why did this guy use four XLRs and four BNC connectors if he had only three video and audio lines per hotel room?" Well, the answer is that I had a 12-volt regulator, and a box that would fit four XLR connectors. It's as simple as that! If your situation requires you to check only two balanced lines at a time, go for a 6-volt system and two XLRs. Of course, you may use any type of connector to build your tester. Patch panel connectors, pigtails with A3Fs or A3Ms, banana-type binding posts, even RCA connectors if that's what you need to test. When using my tester for the hotel job, I connect two-foot audio and video jumper cables between the tester and the wall. The jumpers were plugged into the wall jacks and the metering took place at the termination point in the electrical closet.

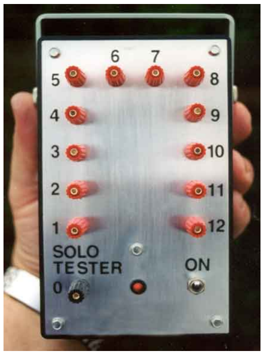
The only wrinkle in this design comes from the fact that you must plug in the jumper cables into the wall outlets in the correct order for metering to be correct at the far end. If you get the jumpers out of sequence, your voltages will be incorrect at the other end of the cables. I must confess I screwed up at least once or twice in my haste to get the job done. If you find a problem, double-check yourself before you start unsoldering any connectors.

In closing, the tester worked great and the hotel's movie promotion weekend went off flawlessly. They've been using the wiring now for about a year everything seems to be holding up pretty well. After I finished the tester, I recalled another situation where I was trying to test continuity across a 25-pin computer cable. I suspected that there might have been a broken wire in the bundle. So, I probably did what most people do in those situations: I tried to hold both ends of the cable in one hand and with the other hand I was juggling the leads to a digital multi-meter. As I touched one lead wire to one end of the cable, I had to count the pins on the other connector to find the mate. While all of this was going on, I was trying to also look at the DMM to see if I had continuity (no audible beep!). The point is: if you have to check a lot of these types of connectors, with a little creativity, you can build a Regency type tester for them.

Using a 24-volt regulator and Pin 25 as your common connector, you can plug one end of a 25 pin "D-sub" connector into the tester and just measure the voltages on the other end pin for pin. Thinking out of the box I even envisioned building a large chassis with every multi-pin connector I could think of, all mounted and ready for testing. You could even include binding posts for checking bare wires, if that's what you need to check. Pretty neat, huh?

Have fun adapting and building your own version of the Regency Tester! Let me know what you come up with.

Addendum - **At the same time (November, 2000) that the Regency Tester article was published in Radio World, a similar article called "The Flying Solo Cable Tester" was published in the Amateur Radio magazine CQ. Both articles have the same circuitry and are essentially identical, but were directed towards two different audiences. The Regency Tester was geared towards professional broadcasters and cable installers, the CQ article was aimed at those Amateur Radio operators who might need to check wire continuity across a piece of rotor or coax cable. With that in mind, the Flying Solo tester was not built using connectors. For this article, binding post connectors and clip leads were used for testing.**



About the Author - **Gary Palamara began his career with Armed Forces Radio and has spent three decades in audio and video. He has worked as a studio and field engineer on national and local events the Olympics, U.S. Open Tennis, the NCAA and NBA Finals and The Miss America Pageant. He owns Morningstar Sound, a professional sound services company in New Jersey as well as being a Radio Amateur. Reach him via e-mail to morningstar938@verizon.net**