Radio Guide

Radio's Technology Forum

April 1994

WANTED: YOUR TECH TIPS

For **Radio Guide** to become a successful technical forum, it needs your help — and your tech tips. This month, I'm asking each of you to take the time to write down a tech tip and send it in to **Radio Guide**.

In the two months since the re-start of **Radio Guide**, we've received over 200 subscriptions. It's satisfying to know that you like what **Radio Guide** has to offer. There's just one problem — we can't continue to offer it to our readers if we don't continue to receive tech tips and articles.

George and I have spent enough years in radio to have learned that it's not a pleasant thing to have to think about a problem you've just spent a couple of late nights trying to fix, much less having to write about it for publication. Nevertheless, that's the only way that you are going to help the **Radio Guide** develop into a real-world, effective tool for radio engineers.

Most of us, at one time or another, have griped about the lack of hard nuts-and-bolts info in other radio publications. Now is your chance to do something about it — right here in your own technical forum.

Please, don't ever feel that your tech tip is not worthy of publication. If it solved your problem, then it will certainly help someone else solve theirs. At the very least, it may give others a new direction to an different problem.

Call either George or myself. We're ready to help you get your tech tips into print. They don't have to be fancy or hi-tech. Often the best tech tips are found when you're in a bind, and you have to make do with what you've got on hand. Most of the time it's not pretty, but it keeps us on the air, and reminds us that it's experience and innovation that have always been the mark of a good engineer. But why keep it to yourself?

Much of the technical information in the radio industry becomes lost to us each year because it is simply not written down. That forces us to continually re-invent the wheel, when all that we really needed was a place to store this information. It's here now, and it's called **Radio Guide**. The only thing missing are your tech tip. How about it? *Ray Topp*

Inside This Issue

Radio Guide

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— Tech-Tips should be 200-500 words —

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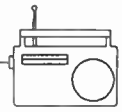
The Radio Forum

George Whitaker — Editor



FCC Measurements

Things seem to go in circles with the FCC. When I first got into radio back in 1957, we had what was called a box-top license for announcers, similar to what we have today. All you had to do was sign your name and you got your license. The engineer had to have a first class license, however. Then the third class license with broadcast endorsement was required. This, at least, required some knowledge on the part of the operator. Now, we are back to a box-top and engineers are not required to be licensed at all. The box-top made a full circle.

This brings us to something else that has come full circle, the proof-of-performance. For years all stations were required to have annual measurements of their audio chain and harmonics. Then, the audio proof was dropped and the only requirement for a proof was on AM harmonics or when major changes were made to the transmitting system such as installation of a new transmitter.

Under 73.44 however, all AM stations are now required to make an annual proof. This time it is not the audio chain that is measured each year. Instead it is required that you prove compliance with the NRSC standards for "out-of-band" emissions. This is to be done annually with no more than 14 months between measurements. This goes into effect July 1 of this year.

The equipment for doing this is quite expensive, so most stations will probably hire someone to do the measurements for them. Even the Dallas stations find it hard to spend five to twenty thousand dollars for equipment to use once a year.

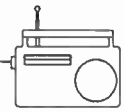
Dave, my assistant at KRVA, and I have formed a new company called DAG ENGINEERING for the purpose of providing these measurements at a reasonable cost. Dave will be doing most of the traveling since he is single. We plan on making tours all over the country making measurements as we go. This way each station will pay a flat rate ($250) with no travel expense added.

If your station would like to be included in a tour, you may call us at (800) 572-8394 or write to DAG ENGINEERING, 3505 Daniel Dr., Arlington, TX 76014.

We are trying to lessen the financial impact of having to have this done. We hope we have good idea. Time will tell.

George

Tascam CD-401 Problem Solving



Lewis Downy — KRCL, Salt Lake City, Utah

Having come out of the era of the Magnacord PT-6, and some other equipment, where simplicity was the watchword and "close enough" was reasonable tolerance, I have had to learn over the years that +/- 0.5 volt can make it work or not and .001 inch can be important.

Lewis Downy of KRCL in Salt Lake City helps us with some of these tolerances with his contribution of:

Problem Solving on the Tascam CD-401

After some use, our hardy TASCAM CD-401's began to exhibit some problem behaviors. The CD tray would not remain open, but would open momentarily and then close again. This required our volunteer programmers to be quick to get their CD's in and out.

Inspection of the front limit switch ("Tray SW-F" on Fig 4-4 of our service manual) revealed that a moveable piece of nylon in the far left corner of the sliding CD tray did not protrude far enough below the tray to reliably hit the front limit switch when the tray was extended to its maximum limit. This is the piece of white nylon with a piece of rubber on the bottom that you slide to the left in order to pull the tray completely out of the machine. A call to TEAC/TASCAM revealed no admission of design error for which subsequent corrective action had been made. The always helpful and friendly TEAC technical assistance person did suggest that, "maybe you could tilt the switch up a little bit."

That's exactly what I did with a piece of flexible plastic that comes with the STANTON styli, the one with the holes in it that holds onto the stylus. The smaller hole is just the right size to fit over a plastic protrusion that helps control the location of the front limit switch in the CD-401. Just trim the excess of your plastic shim with scissors, install it in the bottom of the front limit switch locator, and push the switch in on top of the shim. For those who may have to use some other material, the shim I came up with is 0.35 inch thick. You probably don't want to use something so thick that the limit switch can't fit under the plastic clip that holds it down.

To quickly determine if the limit switch is doing its job, check that pin 26 of U407 goes from 5 VDC to ground potential when the sliding tray hits the switch. I found it easier to measure this at the right side of R459.

Some hints on alignment: the laser diode current can be checked by measuring the voltage drop across R001 (22 Ohms) not R101 as stated in some manuals. Our version of the 401 has TP5 placed across R001. When adjusting the tracking gain and focus gain, I found it more convenient to determine the phase difference of the 1 kHz test signals with individual displays of the signal rather than a Lissajou figure. For the tracking gain, Pin 1 lags Pin 3 (on TP2) by 0.34 ms (122 degrees at 1 kHz) and for the focus gain, Pin 2 lags pin 4 (on TP-1) by 0.28 ms (100 degrees at 1 kHz).

Is there some way to embarrass TEAC into providing a service manual with what is, otherwise, a professional grade TASCAM product, instead of requiring users to order (and pay for) them separately?

Finding a Coax Cable Break

Stuart Engelke — WZZD, Lafayette, PA

Coaxial Cable Break Locator

At some point, a wire or coax is going to break in an unknown location, either due to construction, an accident or gremlins. Here is an easy way to find the location of the break, using simple test equipment.

Put a square wave (around 1kHz) or a fast swept square wave (200-3000 Hz) into one end of the line. Go out with a receiver and listen for the tone on either 1 mHz, or all over the dial in the case of the swept wave.

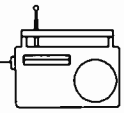
If you connect the tone generator from the shield to ground, you can follow the the wire with the receiver even if it's buried. If the radio has a ferrite stick antenna, remember it's directional and use that to your advantage. A field strength meter will also work. The tone will fade or stop at the break in the cable.

Connecting the tone generator from the center conductor to ground may help find the exact location of a break, as the signal will "leak out of the break" but you probably won't hear it until you are very close to the problem. I have used this procedure several times with buried cables, and only had to dig one hole to find the problem and repair it.

Radio Guide Quick-Tip

If you have to splice a coaxial cable under the ground, don't rely on distance measurements to find the location later. Drive a permanent stake next to the splice.

Generator Remote Control



Sid Schweiger — WXLO/WFGL, Fitchburg, OK

Many years ago, it was part of my job as engineer at KWHW in Altus, OK to go to the transmitter as soon as the thunderstorms started and switch over to the generator. In tornado alley the lightning and tornadoes come quickly and viciously. We did not, at that time, have automatic changeover and really did not want to wait until the power failed to start the generator. I remember, one afternoon, standing outside watching eight different funnels scattered around in the storm. Then I almost got decapitated by a piece of sheet metal from a gin down the road and decided that sightseeing time was over and headed back to my hiding place.

Anyway, switching to the generator before the storm gets bad, makes a lot of sense. Sid Schweiger of WXLO/WFGL in Fitchburg, MA has a much better way than the way we used to do it back in Oklahoma. He tells us how to get:

Generator Start & Transfer by Remote Control

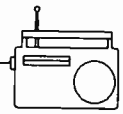
WXLO's tower is situated in the middle of a forest, and is the tallest structure for miles around (sound familiar?). As a result, we are a natural target for lightning, and often the lightning will jump over to our AC power feed, blowing the fuses on the pole. Thus, until our generator starts and the transfer switch transfers, we are off the air.

We recently made the discovery that the Kohler fast-action transfer switches use a normally-closed string of switches and relay contacts to tell the switch that incoming AC power is working. When that string is interrupted, the generator starts and the load transfers. The string, not unlike the interlock and control ladders on most transmitters, consists of a normally-closed test switch on the front door of the transfer switch cabinet, and several relays inside the cabinet, one for each leg of the incoming AC power.

A simple relay added to your remote control enables the duty operator to start the generator and transfer the load before the lightning storm moves into the area. All you need do is interrupt the control string with a normally-closed set of relay contacts, with the relay coil controlled by an unused position on the remote control. We used an AMF latching relay rather than electrically latching a standard relay, because an electrical latch will drop out during the load transfer.

This scheme can also be used to provide a means of exercising the generator and transfer switch. Kohler says that one-month intervals are recommended, however I have been exercising at one-week intervals. The spring in the transfer mechanism is not annealed and, if left in one position for too long, will not exert enough force to effect the transfer when called for. Before I knew this, I had gone about six weeks between transfers. We were hit by lightning, (before the relay had been installed), and the transfer switch threw about halfway before giving up. We were thus off the air until I could reach the site (about 35 minutes) and throw the switch the rest of the way manually. This little incident, which was not so little to management, points out the importance of exercising your backups.

Transmitter Neutralization Tips



George Whitaker — Editor

More than once, in my career as a consultant, I have run into the following situation. So, I thought I would share a word about:

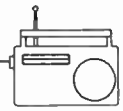
Neutralization

Some transmitting tubes require neutralization. If the neutralization is not correct, the tube will go into oscillation.

The transmitter will operate normally for a day, a week, maybe two weeks. Then, it will suddenly go down hard and probably trip circuit breakers. If you push the "go" buttons it will come back up and operate normally again. Nothing appears to be wrong, but, occasionally, it will dump violently. On the Collins 21-E it used to trip the bias breaker, on the Harris-Gates T,G, and H series AM transmitters, it will usually trip the main breaker.

If these symptoms sound familiar, you should get the instruction manual for your transmitter and look up the neutralization procedure. Normally, once a transmitter is neutralized, it is good for years. However, aging components and changed components can upset the neutralization and you get the symptoms described above. On some transmitters it is a tunable capacitor, on some you will find little moveable segments of the tube socket assembly, or it could be some other device. At any rate follow the instructions in the manual and you probably will eliminate your dumping problem. Be sure to follow the safety precautions in the manual carefully as you will be dealing in an area of potentially lethal voltages.

Power Line Fluctuation



Edward Dulaney — KYKK/KZOR, Hobbs, NM

At KRVA we had a problem similar to the next item. In fact, at one point I was watching the incoming voltage meter, when the power company pinned it past the 300 volt full scale. We had things bursting into flames and flying into pieces. They caused us thousands of dollars in damage over a three or four week period and, even though the problem ceased after I called them daily for a while, they said, "We never found a thing wrong, must have been your equipment."

At any rate, Edward C. Dulaney of KYKK/KZOR in Hobbs, NM tells us about his battle with:

Power Line Fluctuation

How many times have you gone to your transmitter site, only to find that your filament voltage had jumped through the roof, or fallen into the basement? Here at KYKK/KZOR, this was a recurring problem that had to be corrected. After all, management does not appreciate seeing boxes of tubes being delivered (it depletes the checking account rapidly), and engineering doesn't like to see them because it means another long night at the transmitter.

When I first noticed the readings bouncing around, I checked the AC line voltage at the primary breaker. It was 242 volts, which meant the voltage was about 12 volts above what I considered normal for the station. After all, when I measured the voltage a few months previous, it was 230 volts. At that time, I adjusted all the taps of the transformers to their 230 volt position. I then re-tapped everything for the higher voltage and left it alone.

Within a couple of weeks, my filament voltage dropped to a very low point. I checked the line voltage and found it to be 232 volts. Immediately I went to the telephone to call our local power company and they assured me that they were experiencing no problems with their service, and suggested that I check my equipment. I politely thanked them for their "assistance" and began double checking my metering.

I wasn't surprised when I tested the filament voltage inside my transmitters. They both read exactly what the front panel meter read. Everything agreed.

After getting everything together again, I hit the high voltage buttons. I couldn't believe my eyes! The high voltage on my FM20-H3 was 9200 volts. A few minutes before it had been 9075.

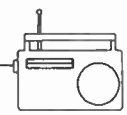
I went back and measured the voltage at the service breaker again — 245 volts. It was time for a systematic approach to this problem.

After a couple of months of tracking the voltage at the transmitter, I saw that the fluctuations seemed to follow some sort of pattern; there was a visible rhythm. Time to call the power company again.

Well, it took over a month, but they tracked down the problem. It was a capacitor on the line that was being turned on and off by a timer. When it was on-line, our voltages went high, and when it was off-line, our voltages dropped. These capacitors are used by the power company to shift the current phase and keep the voltage and current together, thereby maintaining the power factor. However, unless the power company plans carefully, you can be caught with wildly fluctuating voltages. By changing the size and/or location of these capacitors they can usually solve the problem for you.

The main thing is, if you are seeing the same type of voltage variations, and the power company tells you it's in your equipment, cover all your bases completely. That way, when you go back to them with all the variables pointing their way, they probably will fix the problem.

Hook-Up Wire Tangle Tip



George Whitaker — Editor

Dave, my assistant at KRVA, gave me the following tip. He said it wasn't original with him so we don't know who to credit for the idea. However, I was purchasing some hook-up wire for use at Ferengi Bros. and mentioned that the stuff always seemed to get tangled on the reel. He told me a cheap and easy way to:

Keep Hook-Up Wire Untangled

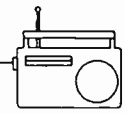
First thing you have to do is put the wire spools on a holder that will allow them to turn freely. I used two pieces of scrap lumber as uprights and a piece of curtain rod I found somewhere for the spools to turn on. I put it all on a small piece of scrap plywood for a base. The real nifty part comes next.

Get a DB-9 (or 25) without the pins in it. Screw this to the edge of the base and thread the hook-up wire through the holes. A slight bend each time you cut off a piece will keep the wire from pulling back through and tangling on the reel. I know you can buy commercial racks that will do this, but, we did the whole thing out of the junk on hand.

Show Radio Guide to Your Friends

Continental 816R Transmitter Notes

Richard Douglas — KBPI, Denver, Colorado



These are my notes from the Continental Ennes Workshop at the 1990 SBE National Conference in St. Louis and some operating observations. This Ennes Workshop was a very worthwhile day-long session, lead by Dave Chenoweth of Continental's Field Services Division. I hope something in this article is useful to you — Richard D.

PA Tube Clarification

1) Do run the YC130 filament at 7.50 volts for the first 200 hours.

2) Do reduce the filament voltage after the first 200 hours. Use this method: reduce the filament voltage in increments of 0.20 volt or so, waiting a few minutes, after each adjustment, to allow the filament temperature to stabilize. Watch for a measurable (50-mA) decrease in plate current, then increase the filament voltage by no more than 0.20 volts. When the tube nears the end of its life, begin to bring the filament voltage back up.

3) An Econco rebuilt YC130 is preferable to a new Eimac tube. Reason: Eimac builds the tube to withstand lots of shock and vibration. They do this to meet military specs, and attain their "ruggedized filament" by using a lesser amount of irradiation. This also limits the filament's electron emission life. Econco knows that their tubes won't see military service and increases the irradiated tungsten in their filaments, raising filament emission and thus producing longer tube life.

4) A YC130 tube operated at its maximum filament voltage will eventually build up a large amount of material on its control grid, causing "shadowing" which partially blocks electron flow. The symptom of this condition is reduced screen current. The tube may be restored to proper operation by temporarily bypassing the 1,000 ohm control grid resistor (R80). Remove the bypass when the screen current returns to normal (about 1-week or less).

5) EEV 4CX15000A vs. Eimac YC130: Filament construction is almost identical, but you may have to replace the neutralization straps on the top side of the socket which connect the screen ring to chassis ground. The EEV filament consumes 1,000 watts vs. EIMAC's 1,200 watts. The rebuilt Econco YC130 (actually a 4CX15000J) is a better tube (and less expensive) than the Eimac or the EEV and requires no neutralization changes.

A Few Other Things About the Continental 816R Transmitters

1) The transmitter is properly neutralized when changes in plate tuning do not affect grid current or cause a slight decrease in grid current.

Ideal situation: Tune for maximum power, then run the plate tuning capacitance out (full "lower" position). Grid current should decrease 5% to 10% to indicate degenerative feedback. (Note: Grid current is "normally" around 100mA.)

If the amplifier is too degenerative, move the neutralization bars closer together (increasing the inductance), but do not let the amplifier become regenerative (grid current increases with a decrease in tuning capacitance).

2) When tuning, unload the transmitter. Don't exceed 600 mA of screen current (screen current increases as loading decreases. Adjust PA tuning for maximum power output (should agree with a peak in screen current). This should occur at the mid-point in tuning adjustment.

Verify that the plate current decreases as capacitance is decreased ("lower" position of the tuning control).

This will serve to prove the proper placement of the cavity's shorting plane.

Plate tuning has but little effect on synchronous noise; loading has a major effect on synchronous noise. Load the transmitter to obtain the best noise figure.

3) A tripped circuit breaker is an indication of transformer problems. Overloads indicate tube problems.

If the transmitter won't work and the screen overload indicator is on, turn the screen breaker off (leave the plate breaker on). If the overload continues, then the problem is in the tube's anode section or the high voltage supply. This is due to the location of the screen power supply in the DC path, a slight ambiguity in the design of the transmitter. The screen grid is actually at chassis ground.

4) The SCR Power Control Gating Cards were a major source of problems on the original Continental transmitters. A new gating card design has been implemented in the newer 816-R transmitters, easily identified by their use of IC's instead of discrete transistors. Early versions of this new gating card still have a problem, symptomized by occasional unexplained tripping of the Main and/or Plate Circuit Breaker.

If your transmitter has the new gating cards, inspect for two missing capacitors (empty mounting holes) and 1-Megohm resistors in positions R16 and R24. Continental has a modification kit for these cards available at no charge. The modification raises the card sample voltage to increase the accuracy of the SCR firing angle.

Continental also claims to have located some bad diodes in the Screen rectifiers. These may short if the Screen Voltage is allowed to run high (above 700-Volts).

5) If everything points to a short in the high voltage supply, the most likely suspect is C1 (located in the HV transformer housing on 35kW models). Although the transmitter will operate satisfactorily without this capacitor, its purpose is to protect the HV rectifiers and it should be

(continued on page 7)

Continental 816R Transmitter Notes

(continued from page 6)

replaced as soon as practicable if found to be defective.

6) Maintenance of a constant temperature difference between the air intake vs. PA exhaust is the best indication of stable transmitter operation, and thermometers are a good tuning tool. Although the actual temperatures have little meaning, the difference temperature should remain constant over life of the tube.

Don't feel that it's necessary to "tweak" transmitter tuning at each visit to the transmitter. Tuning seldom changes and getting the best synchronous noise is a time consuming task. Log the temperature difference instead.

7) The static drain coil (L15) inside the PA cavity may resonate at the 3rd harmonic, causing the power resistor (R75) in the cavity to overheat. Either change the turns spacing on the coil or remove it. If disconnecting one end of this coil causes a change in tuning or loading, change the spacing or remove the coil if you have a grounded antenna.

8) The grid circuit is the bandwidth limiting factor in the transmitter. Optimum position for the front panel grid tuning control is 3-to-5 turns from the clockwise end stop.

9) A few transmitters equipped with solid-state drivers have slipped through assembly with a driver VSWR overload line connected. If your transmitter trips off with a driver VSWR overload when the transmitter is turned on after a full shut-down, look for this wire and remove it. The protection circuitry built into your transmitter is far superior to the protection in the solid-state driver.

10) The quarter-wave stub (connected via a BNC "T" connector at the input to the PA grid) should be checked if driver VSWR is too high. This stub is not factory tuned and field tuning may slightly improve the transmitter's performance.

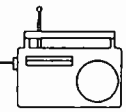
11) Loss of the thyrectors (selenium device across the power supply chokes) is related to possible loss of control symmetry. High ripple voltage across the choke can damage the thyrector (and smell like heck).

12) Tower crew working near the antenna and you have to reduce power? Shut off the screen breaker. Power will drop to about 2-kilowatts. This is far preferable to any method of reducing power by using the manual power adjust control for any extended period of time. The reason being increased ripple due to conduction angle of the power control SCR's.

13) The PA blower's impeller should be placed as close as possible to the blower shroud without scraping it. This space is an air seal and the closer the impeller is to the shroud, the better the air seal.

Note also that there's only one set-screw holding the big heavy impeller onto the motor shaft. Check this from time to time to be certain it's tight. If the set-screw works loose, the impeller could move against the shroud. This makes a horrible racket, shakes things loose inside the transmitter, and sprays the PA grid compartment with little metal filings.

Studio Mike Hum Problem



Lee Waller — WGHQ/WBPM, Kingston, NY

Sometimes the weirdest things can surface when troubleshooting. Lee Waller of WGHQ/WBPM in Kingston, NYdiscovered that things are not always as they seem in a case where:

The Studio Was a Hummer

The first day of my employment here, the owner took me into the talk studio to show me his pet peeve. A couple of years ago someone had installed a Shure M-267 mixer which fed thecontrol room console, and a Tascam 22-2 reel-to-reel, via an LEL combiner pad. The installation was simple, straight forward, and it hummed — only 25 dB down!

Well, I got my high-Z headphone, bridged it across the output of the mixer, disconnected the output line, and it still hummed. I then disconnected the mikes (three of them) and the hum disappeared. Sure enough, I found one of the mikes had RadioShack RG-8/M being used as mike cable. "Got you"' I said to myself, as I proceeded to get new cable.

With the new mike cable properly attached to the mike in question, I tried everything again. The hum was now down to about -45, but still very apparent. I disconnected the mikes again and the hum disappeared. I tried different mikes, but they all hummed. Then, as I sat in frustration, playing with a mike on its stand, I discovered if I rotated the mike on its vertical axis, I could find an axis in which the hum nulled.Some mikes would null in one direction, others of a different model would null 90 degrees from the first.

Cost of the mikes seemed to have an inverse response. Some Radio Shack mikes had less hum than the more expensive Shure and AKG's. Then I found, in a file drawer, a Crown PZM (condenser) mike. No hum at all. There was my clue; there was a strong 60 Hz field in the room, which was being picked up by the dynamic mikes. The better the mike, the louder the hum. Actually, it turned out, the field was in the whole station, coming from power lines just outside the windows on the east side. (we are on the second floor). No one ever noticed the hum from the on-air mikes (SM-7's), but it was there. The mikes just happened to be positioned so as to null the field. I ordered some quality condenser mikes, and the problem was cured.

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FCC Rules on Kahn POWER-side

Motorola tried to deny broadcasters the right to increase coverage by using SSB — Kahn POWER-side™ equipment. But the FCC specifically ruled that the "Kahn POWER-side system... may continue to be operated ..." as a mono improvement system. So you can now use POWER-side with Kahn independent sideband exciters to immediately increase coverage to listeners using any and all type of AM receivers.

See FCC Order ⇨

Federal Communications Commission FCC 93-485

21. Kahn "POWER-side" Operation. Several parties express concern over the continued acceptability under our rules of operating using the Kahn POWER-side AM single-sideband system. POWER-side operation, as distinct from Kahn stereo operation, involves an AM transmitter with two independent sidebands, containing identical program material, but with intentional level and frequency response differences. This system is implemented with a Kahn independent sideband stereo exciter and is claimed to have certain advantages for reception with monophonic receivers, particularly in adjacent-channel interference situations. CTI and Furr argue that adoption of the proposed standard would prohibit such an implementation. Motorola maintains that the Kahn POWER-side mode of operation is not stereophonic and questions its legality under the present rules.

22. Our AM rules do not include a definition of the term "stereophonic." However, generally accepted definitions of stereo service infer two or more channels of audio information designed to produce and audio "image" when demodulated by an appropriate receiver. On this basis, we find that stations employing the Kahn POWER-side system are not subject to the provisions of the stereophonic transmitting standard adopted herein and may continue to be operated, provided that the program material fed to both channels of the exciter is identical in content.