Radio Guide

Radio's Technology Forum June 1994

Valuable Lessons

The valuable lessons learned from practical experience should not go to waste. While you're reading **Radio Guide**, have you stopped to consider where the majority of the tech tips come from. They come from other readers, who are no more qualified than you to submit tech tips for publication.

As you know by now, part of my job is to convince you that your technical experiences are important to the rest of us. And that they should be set down in print as a valuable reference source for the radio industry.

It's easy to assume that others have cornered the market on technical expertise, but nothing could be further from reality. Of course we all have different levels of proficiency, but the fact that we all troubleshoot, install and maintain different equipment brands on a regular basis, gives each of us specific experiences that others just don't have.

It's your equipment-specific, problem solutions that we need to have published in **Radio Guide**, so that we can prevent others from having to "re-invent the wheel."

You are an essential part of your **Radio Guide**. With your tech tips, we will be able to supply the broad range of experiences that will help to make **Radio Guide** a representative technical forum. Please make it a point to submit your tech tips this month.

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The **Radio Guide BBS** is designed to act as an extension of the **Radio Guide** publication, and not as a large repository of computer programs. Althouth various technical library files will be found on-line, as well as valuable used equipment listings from **Radio Shopper** and other sources, the primary purpose of the **Radio Guide BBS** is to allow you to up-load your tech tips for publication in **Radio Guide**.

Call the BBS today, leave your tech tips, and take advantage of the technical data.

Ray Topp - Publisher

Inside This Issue

Radio Guide

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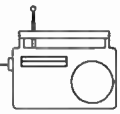
The Radio Forum

George Whitaker — Editor



NRSC Measurements

After talking to a lot of broadcasters about the required measurements, I find there is a lot of confusion about what is required by Part 73.44.

The rule says that measurements will be taken with a spectrum analyzer using peak hold, for ten minutes at 300 Hz resolution. These are pretty stiff qualifications for the spectrum analyzer. When we went shopping for ours, we found that the analyzers having the peak hold function did not have the 300 Hz resolution, and the ones we found that had the 300 Hz resolution did not have the peak hold function.

When all was said and done, the analyzer was going to cost over $10,000, to get one capable of meeting the specs. We got a Tektronix 2712 with plotter for $12,000 and found a used Tektronix 7603 mainframe with a 7L5 module for $8,000. I understand that RFR makes one that sells new for under $10,000, but I haven't seen the specs on it and I don't know for sure that it will do the job correctly. I mention this because I have had a number of guys tell me that they were using military surplus or some of the other less expensive analyzers such as the Tektronix 2710. The 2710 will not meet the specifications of 73.44 unless you also have a couple of options that then make it cost as much as the 2712. The same is true for the 2711.

Section (d) of 73.44 also says that you will make the measurements one kilometer away from the transmitter. This means that you have to battery operate the equipment in most cases.

Now, this brings up the kicker with the splatter monitor from Delta. The basic unit is designed for routine monitoring of the transmitter proper and, in order to do the measurements as required by 73.44, you have to have the antenna option and the filter option. By the time you get these, the actual cost of the monitor is around $5,000. You are also required to check your harmonics. The splatter monitor is not designed to do this. Therefore, you will need something like a Potomac FIM-41 at $5,500. This brings your total equipment cost to around $10,000, any way you look at it.

I have mentioned all this because I have been astounded at the number of stations who tell me they have used equipment in the three to five thousand dollar range. We researched this fairly well and could not come up with anything that would meet the spec for anywhere near this price. If you know how to do it, please let me know. On the other hand, if you are one of these who went that route, I suggest that you go back and carefully compare what is required by 73.44 with what your test equipment is capable of.

Another thing that floored me, when talking to all of these stations, was the number of stations that did not have a set of the rules. I would tell them that the specifications were laid out in 73.44 and the time requirements in 73.1590 so they could study them for themselves. They would respond that they didn't have a set of the rules. This, of course, is a requirement for all stations.

If your station fits the categories I have described above, I certainly suggest that you get a set of the rules and do some research. The FCC needs money and fines are a ready way of raising it.

George

House Audio Monitors

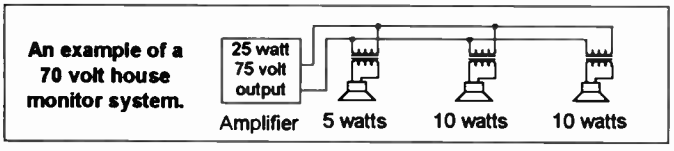
George Whitaker — Editor

Many stations seem to have house monitor systems that are, to say the least, somewhat embarrassing to listen to. They have generally been wired with no regard for impedance matching, and the result is low output and distortion.

Understanding the system is really not that difficult. Just remember that an 8 ohm output tap on an amplifier wants to see an 8 ohm load, and a 70 volt line tap wants to see a 70 volt transformer load. Secondly, resistances in parallel divide. Therefore, two 8 ohm speakers in parallel exhibit 4 ohms resistance. Three 8 ohm speakers in parallel exhibit 2.6 ohms. You can sometimes get away with two 8 ohm speakers paralleled on an 8 ohm tap, if you don't need a lot of volume. This results in some mismatch, but, in most cases, the amplifier will accept it. However, if you try to parallel more than two, the mismatch will be great enough that the sound will be distorted, and the volume will be low. Plus, the amplifier will run hotter than normal.

To properly set up multiple speakers, you really need to use the 70 volt tap on the amplifier, and then match the draw of the speakers to the size of the amplifier. Looking at the diagram, you can see that we have three speakers connected to a 25 watt amplifier.

On a speaker matching transformer (70 volt to 8 ohm) you will have a choice, on the 70 volt side, of different power levels. The total for the system should match the output of the amplifier (in this case 25 watts).



An example of a 70 volt house monitor system.

In our example we have two speakers set for 10 watts and one set for 5. The two 10 watt speakers will be louder. You set your overall balance of the system with the transformer taps and then adjust the amplifier gain for a level that gives a reasonable volume for each of the areas. For example, the two 10 watt speakers might be in office areas where the room is large and there is a lot of activity. The 5 watt might be in the rest room where less volume is called for because the room is small and generally quiet. Just make sure that the total wattage settings for all the transformers matches the wattage rating for the amplifier (in this case, 5+10+10=25).

Note that the amplifier volume certainly does not need to be run "full tilt," at 25 watts, and very likely would not be run that way. However, by being properly matched, it will provide proper operation at all volume levels.

If you need to control the volume of an individual speaker, a simple 8 ohm volume control would be placed on the speaker side of the transformer. This will allow speakers to be adjusted individually without affecting the others in the system.

Satellite Dish Alignment

Barry Magrill — Fairfield, FL

Barry Magrill, a PE working out of Fairfield, FL, and I were talking the other day and I mentioned some problems I had encountered with some of my satellite dishes. He sent me some information that has proved to be enlightening. He pointed out that it had been written about before, but I didn't seem to have it in my file. If your dish doesn't seem to be "up to snuff," try these tips for:

Satellite Dish Mechanical Alignment

Begin by inspecting the dish for obvious deformities. At C band 4000 mHz, any deviation from a perfect curve larger than a quarter inch will degrade the performance of the dish. Deviations greater than a tenth of an inch will degrade Ku dishes.

Next, check to see if the dish circumference is a perfect circle. An easy way to find out is to attach two strings at the edges of the dish so that they cross each other at right angles. If the dish is OK, the two strings will cross each other nearly or barely touching. The dish is warped and has astigmatism if the strings are more than a quarter of an inch apart. One way to bring it back into round is to measure both strings, and then connect a wire with a turnbuckle along the path of the longer string. The wire is attached to the edges so that it will remain attached even under some pressure. Tightening the turnbuckle should force the dish back into alignment. One word of caution: Careful! Excessive force will damage the dish.

While the strings are in place, measure between the point where the strings cross and the base of the dish at its center. This dimension is called the depth of the dish. To calculate the focal length, take the diameter of the dish, multiplied by itself, then divide that quantity by sixteen times the depth. The math formula is: **$f=(Dia)^2/(16)(depth)$**. Be sure that both measurements are in the same units. For example you have a twelve foot dish with a twenty seven inch depth, first convert everything to the same units (in this case, feet). Twenty seven inches equals two and a quarter feet. Multiply the diameter by itself. Twelve times twelve equals one hundred forty four. Multiply the depth times sixteen. Sixteen times two and a quarter equals thirty six. Divide 144 by 36 which equals four. The focal length is four feet. The distance between the feedhorn and the base of the dish should be four feet, give or take no more than an inch.

Radio Guide Quick-Tip:

Always secure your nitrogen tanks to the wall, with a chain. A loose tank can fall and break the valve, with disastrous results.

Converting Recorder Mixers to Broadcast Use

William Weisinger — Kent, Ohio

Today there are a number of relatively inexpensive, feature-packed recording consoles available that make low-cost production studios a reality for stations that would otherwise not be able to afford a production studio upgrade.

With the donation of a Yamaha MC1203 from Bradley Broadcast, one of my stations, WSTB (a noncommercial FM), was finally able to upgrade an old mono production studio into a more modern stereo facility. The only problem was that the new production console, like many other recording consoles in its class, was not designed to go on the air or provide the frills that broadcast consoles take for granted.

While this console was a *huge* improvement, it still lacked microphone on-off switches, speaker muting and tally light switching. Since the station had little or no money, my mission was to install these features at little or no expense.

Although this involves the Yamaha console, with a little console "redesign" you could add these features to any such console. The key to adding mic switching, muting and tally control is to either add a noiseless latching DPDT push-button switch to each mic channel or to "steal" an existing switch from each channel. With the Yamaha, I was able to use the "CUE" switch (located directly above the slider pot) as the on-off switch. Fortunately it was a DPDT switch. This allowed one side to short the slider pot to ground (simulating the pot being pulled all the way down) while the other side of the switch was to be used to trigger the muting and tally functions (**Fig. 1**).

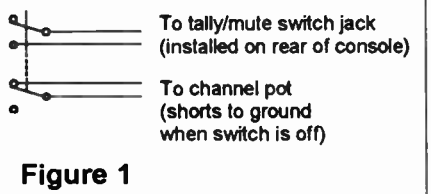


Figure 1

Make sure that the removal of the switch doesn't affect anything critical (who needs a cue switch on a mic channel?), and jumper anything that switch removal will affect (fooling the console into thinking the switch is still there). The actual tally/mute switching is accomplished with an external relay box (**Fig. 2**).

Since space inside the console was tight and I wanted to keep the AC tally voltage external to the console, I drilled a small hole on the rear of the console to accommodate an 1/8" stereo phone jack that connected to the tally-side of the converted "CUE" switch. Connections are made to the tip and ring which avoid any potential chassis/ground problems.

The relay box can be remotely located from the console and is connected to the console with a 1/8" male plug. Stereo audio feeds from the console "monitor output" jacks are interrupted by Relay 1 before being fed into the PA input. A pair of contacts on Relay 2, a 4PDT relay, switches the AC to the tally lights and still allows a pair of other switch contacts for additional tasks such as muting RPU two-way audio and EBS speaker audio.

The relay box can be built using Radio Shack parts and a cheap 12 VDC power supply, for less than $25. I chose a two-relay design to allow all AC to switch separately from the audio. The 4PDT relay also keeps all AC off external terminals when the mike is off regardless of how the electrician mis-wired your outlets. Even if you have no use for them now, I'm sure you'll find those aux switched terminals will be needed sooner or later.

On More Deluxe Cconsoles

Some of these recording consoles may already have channel (mic) switching installed which could make the project even less involved if there are spare switch contacts to switch tally functions. However, if all switch contacts are used, then conversion requires a slightly different approach.

WDOK (Cleveland), had a production recording console that had channel audio switches, yet still required muting and tally control from these mic channel switches. On this console, each channel had an LED that switched on with the audio. I found that the voltage (and current) to those LED's was enough to drive an opto-isolator which switched relays that provided muting and tally switching. Here too, I used 1/8" stereo jacks to bring the bridged LED terminals to the rear of this tightly-packed console and used an external box to do the actual switching.

These are just a couple of approaches to taking a recording console and cheaply converting it into something more broadcast-friendly. Now, when WSTB personnel use the production studio, there won't be feedback from monitor speakers, people won't walk in on them when the mic is on, and RPU/EBS audio will be muted.

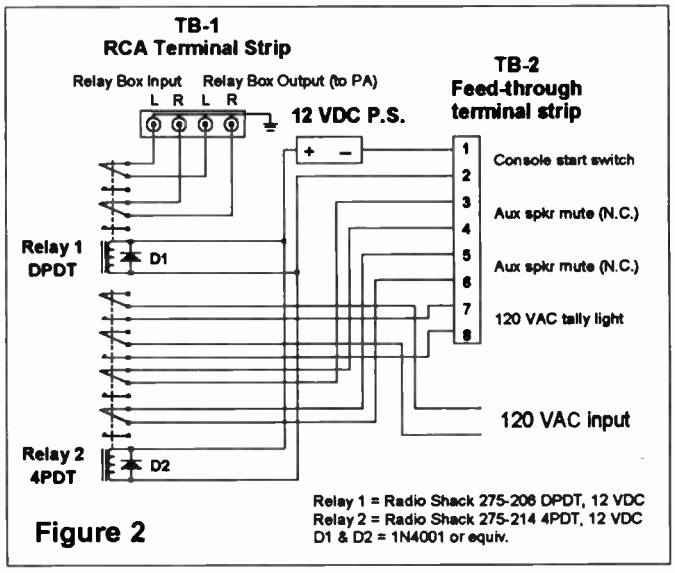
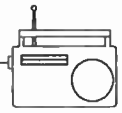


Figure 2

Harris BC 500-H Notes



Geroge Nicholas — Cedar Rapids, IA

A recent suggestion of adding a muffin fan to a 500-H brought the following additional information about this series. George Nicholas of Cedar Rapids, IA has some:

Further Notes on the 500-H

In the 500-H, the 807's are prone to failure primarily due to their position (horizontal) and, yes, their lack of cooling. The muffin fan is an excellent idea. I also suggest the use of the 5933 military-spec tube as a substitute for the 807's. The 5933 tube appears to be more rugged and will generally outlast the 807's two to one. The cost, however, is also about two to one, but the transmitter will have less problems.

When the 807's fail, they usually take out a fuse somewhere on the unit. Be patient — there are several fuses "hidden" throughout the chassis.

One other area on the BC-500H is the audio driver circuit. There are two 4uF/450V coupling capacitors, along with a couple of paralleled 2 watt resistors, in the audio driver/modulator circuit that controls audio levels and modulation. Because these caps are mounted near the IPA tubes, they have a tendency to dry out. The resistors run hot, so if the resistors are replaced, use the proper wattage/value, and use a carbon composition, not a wirewound.

DRS-1 Remote Readings

Steve Tunwall — Shenandoah, IA

Sometimes really wild things can happen that result in a lot of head scratching and mumbling. I have a feeling that, had I been facing this one, it would have added a few new words to my vocabulary. Steve Tunwall of KMA in Shenandoah, IA finally got a handle on:

DRS-1 Remote, Erratic Readings

Our remote control had been "acting up" occasionally for about 5 years. For a day or so at a time, all readings would drift up and down, and then it would behave normally most of the time.

Eventually, I measured the sample DC at the input of the ADC at the transmitter unit, which is basically a digital voltmeter. The DC itself was erratic, so the ADC was not at fault. I figured I was getting RF on one of the sample lines, and wasted a lot of time looking for it.

It turned out that there are plastic strips on the top surface of the motherboard that keep the relay clips from shorting the traces. The traces had oxidized under the strips which caused some strange things to happen to the DC sample voltages. I cleaned up the oxidation and replaced the strips with black tape, and the readings have been fine since.

Transmitter Neutralizing

George Fresein — Wenachee, WA

In an earlier issue I mentioned the symptoms of improper neutralization. This brought a most interesting story from George Frese in Wenatchee, WA. He tells us how a:

Transmitter Wouldn't Stay Neutralized

For a number of years I, along with others, had fought the problem of a Wilkinson FM-25-E that would show the classic signs of lack of neutralization. It would run fine for days, weeks, or months, and then suddenly go down with a bang.

All you had to do was go through the neutralization process and the rig would perform beautifully for a while. Then, same thing all over again. Finally, it occurred to me that the problem was power sensitive. As the tubes would begin to age, and the drive between stages would change, the thing would un-neutralize. A bit of experimentation showed that you could neutralize at one power level, change power, and neutralization was lost.

Even after this was established, there was considerable head scratching and discussion. Finally, I realized that the grid lead to the final passed right under an air hole that was also directly beneath the plate of the tube. As the drive on the grid would be changed, the amount of leakage to the plate would change and down it would go. We put a piece of screen over the air hole to allow the ventilation to continue and, at the same time, shield the plate from the grid lead.

This did the trick and the transmitter has remained stable ever since.

Radio Guide Quick-Tip:

Make sure that 3-phase motor protection circuits drop out on the loss of any single phase, or the motor may overheat.

Revox A-77 Speed Ctrl.

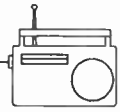
Gerry Gibbs — Sioux City, IA

Here are a few things I have come to find that cause speed control problems in the venerable Revox A-77.

1. No speed regulation at all, and machine runs at the same speed on both 7 1/2 and 3 3/4 IPS — change capacitor C-209. 2. Motor runs fast all the time — shorted C-210 or open D-203 or D-204. 3. Motor won't run at all — C-204 open.

I'm sure there are other cures and symptoms, but these are some I have encountered over the years that maybe someone can benefit from.

A Regulator That Works



Darel Vanderhoof — Mt. Pleasant, MI

One of the biggest continuing pains around some stations is the problem of trying to keep pressure on the feed line. About half the ones I ever worked with leaked, and no amount of effort could ever stop them. The other half would hold pressure for years without losing a pound. Anyway, whether you are using a dehydrator or nitrogen, the regulators generally available are hardly adequate for the task. Darel Vanderhoof with the Central Michigan University Public Broadcasting service in Mt. Pleasant, MI has found a much better:

Regulator That Really Does

All of us have had difficulty at sometime in our life with setting the transmission line pressure where we wanted it. This holds true for nitrogen users as well. The Fisher model 67AFR/206 natural gas regulator is an excellent addition to your existing regulation. It is very well built, and regulates tightly. It will go to total shut-off 1/2 pound above your set point, and to full open 1/2 pound below it. Set your existing regulator to about 15 pounds, to assure that it will not restrict CFM when the Fisher calls for it. To set pressure at the Fisher, close off the output and set the pressure with confidence. If you can't find one locally, they are available from Midway Supply in Mt. Pleasant, MI. 517-773-5995. Cost is about $100.

S/A Power Supply Fix

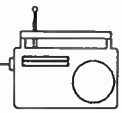
Sean Mattingly — Muncie, IN

The Scientific Atlanta satellite receivers, like the 7300 and 7325 combination, are in use everywhere. I use mine to pull in Unistar's digital, Adult Rock and Roll format. When one of two power supplies quits on you, there are some alternatives to getting them repaired. Rule out fixing one yourself, because Scientific Atlanta does not furnish schematics for these (seemingly top secret) power supplies.

I found F.L.E. Electronics Corp., out of Bohemia, New York. Mario Skinner will repair a 15 volt section for $125, flat rate, and a 5 volt section for $90, flat rate. Compare that to Scientific Atlanta's 1991 price of $608. You can reach F.L.E. at 516-244-6903.

It's easy to run two Scientific Atlanta receivers off one power supply. Just solder a multi-conductor wire onto the innards of the good unit (just inside the back of it, where the DC voltages leave the unit). The other end of this wire plugs into the little holes in the ribbon cable, where the failed supply was. I ran my satellite receiver in this condition for a couple of months. It worked, although the single supply was hot to the touch.

Tuning an FM



David Stewart — El Paso, TX

Recently, I was talking with David Stewart of KBNA in El Paso, TX, and he told me about a good, simple way to tune for minimum AM noise in your FM transmitter. It was presented in a paper at the 1992 NAB, but I missed it. In case you did also, here is a:

Slightly Better Way to Tune an FM

We used to tune FM transmitters simply for efficiency. Over time, we realized that some of what we thought was multipath distortion was actually incidental AM noise. Tuning suddenly got much closer scrutiny. Discussions of method took on an almost magical or superstitious air. This was complicated by the fact that each of these improved ways to tune required better and better monitoring equipment.

We were told, "After tuning for efficiency, adjust for minimum synchronous AM noise." Special monitors are built for this purpose, and late model modulation monitor designs usually work OK. However, be careful of the "AM Noise" positions on older monitors. Any monitor is only as good as it's sample. Poor directivity of the sample device, or standing waves on coax runs will completely invalidate your measurements. However, there is a better way.

In Improving FM Modulation Performance by Tuning for Symmetrical Group Delay*, Geoffry Mendenhall of Broadcast Electronics proposed tuning a transmitter for minimum demodulated even order harmonic distortion. This will optimize the group delay through the system. This results in the fewest errors in the demodulated signal, and lowest received distortion. Best of all, it only requires minimal equipment, and nothing esoteric.

Simply apply a 9.5 kHz tone to the mono input of your exciter. Adjust the level to 100%. The second harmonic at 19 kHz will look like a stereo pilot to your stereo monitor. Tweak the tuning and loading (input controls seem to the most critical) for minimum 19 kHz indication. Reconnect the stereo input and revel in the improved sound.

**Presented at the 1992 NAB convention, and available in the proceedings. For a copy of the paper, call Broadcast Electronics at (217) 224-9600. Please mention Radio Guide.*

Technics SLPG 440 CD Player Remote Control

Art Ginsburg — Hartford, CT

Many stations are using the Technics SLPG 300 CD player. Personally I use one at home as well as having bought them for KRVA when I was there. Art Ginsburg with WCCC in Hartford, CT has some very good observations about the change from the 300 to the 440. There are some differences in:

Remoting the SLPG 440

For years, I've been using the Technics SLPG 300 CD payers in all kinds of studio situations, both in production and on-air, with almost unheard of reliability. Last year, however, Technics changed the model number, and some of the guts as well.

You still can't beat them for price/features. However, one problem I've run into on the "new" SLPG 440 is that the logic circuits don't seem to like having a "remote start" connected directly across the PLAY switch; it'll work for a while, but after a few hours, the whole machine locks up. No logic function will work — not even the Open/Close switch.

Since I always use 1/8" TRS jacks for connection to the console switches, without connecting the sleeve at all, I knew I wasn't inadvertently zapping anything to ground. If I unplugged the remote start cable, and tried a clip lead instead, the thing would work all day. *Something* about the extra zillions of feet of cable was screwing up the logic.

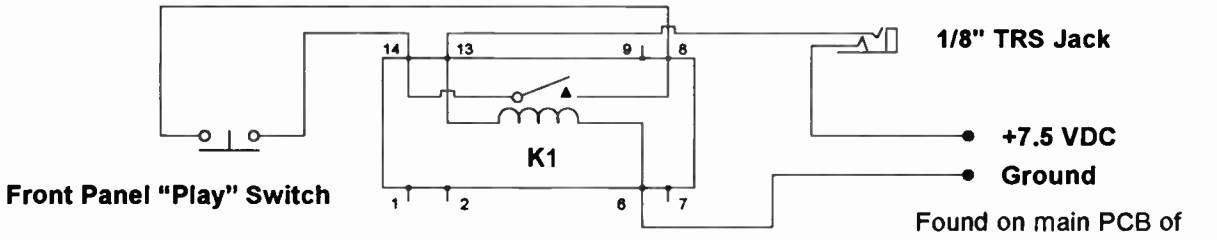
My solution was to use a small 5V reed relay across the play switch, and use the extended remote start switch to fire the *relay*, instead of the machine. (see **fig. 1**) The voltage for the relay coil is conveniently located inside the CD player; just "borrow" +7.5v and ground from the headphone amp circuit. (Just follow the ribbon cable from the headphone jack to the motherboard — it's labeled and everything.)

I strongly recommend this circuit to remotely fire anything using logic levels to command control functions — the days of the 24VDC control circuits are long gone, and I've seen many perfectly good machines fail to run right after a nice long wired remote was tacked across the play switch.

Of course the 1/8" TRS plug and jack combo are a matter of preference. All three of our studios use them, so that's what I worked into the mod. You can use terminal strips, XLR's or hardwire the switch (if you want to do major surgery to swap out an ailing machine) but *don't* use anything that will ground either of the contacts. Without the mod, this screws up the microprocessor — with the mod, it'll cook the +7.5v supply.

If and when the day comes that your SLPG 300 or 440 is ready for the junk pile, make sure you remove the front panel button key inserts, as well as the display PCB before you toss it in the trash. The Open/Close button and switch, as well as the Time Mode button and switch, being the most frequently used, tend to die prematurely. With the extra button inserts and front panels, all you need to do is swap boards, instead of "borrowing" a repeat or peak search switch, and you can save all the fussing with replacing the "chicklet" switches.

Technics SLPG-300/400 Remote Start Modification Circuit **Figure 1**



K1=ECG F1C005 5 volt reed relay, or equiv.

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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.