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TECHNICAL NOTE #12 – CARRIER CURRENT SYSTEM IMPROVEMENT

Suppose your school did everything right – your carrier current system was designed by an LPB on-site engineer, installed by the school electricians following the LPB Consulting Report and it worked great.

Now it's 3, 4, or more years later, the station sounds awful, except in the dorms where they can't hear it at all! Everyone that was involved in staring the station has graduated and the faculty advisor doesn't want to talk to you…

How did this happen and how can you fix it?

The most common responses we hear when we start asking questions are:

- I don't know what Carrier Current stuff is or where it is.
- I think I know where the stuff is but no one will let me into the rooms
- I know where all of it is, but we lost the manuals
- The station has always sucked

The translation for these is – NO ONE HAS CHECKED ON THE SYSTEM IN YEARS

Why do you think that commercial radio stations employee engineers? To keep the equipment in top condition all the time. If you ignore it, even professional equipment will eventually get out of tune.

Fortunately, LPB equipment is easy to tune and has metering that makes it a breeze. We also printed and attached the tuning and setup instructions to the inside of all the equipment lids – just in case you lost the manuals!

You have several options at this point. You can fix things yourself, for free, with our help by phone and email. You can hire a local contract engineer to help you. You can hire LPB to come to the campus and sort things out.

- **FREE SOLUTION**

We'll start with the lowest price option: FREE. Find all of the equipment, itemize it, and draw the best diagram you can of the current conditions. Find the manuals and read them. They are probably still around, and buried in your station files. If not, they're available from LPB for $35. The manuals include troubleshooting and tuning information. Assuming the equipment still has its lids, the instructions are located on the inside of the lids for all LPB transmitters, couplers and linear amplifiers.

When performing a general system inspection, it is suggested that you set a CD in "repeat" and feed the station audio out to the system. You will probably need a flashlight, notepad, fuse puller, test speaker, multimeter, screwdrivers, and some other simple tools to perform the test/inspection. Since most Carrier Current transmitters live in nasty rooms, don't wear a suit!

Inspect the Transmitters and Linear Amplifiers (if you have them) for elementary stuff – is it plugged in? is it turned on? Are the LEDs lit showing that it has power? Make sure the circuit breaker is on. Make sure there are no obvious blown fuses, components smoking and the like. Are the meters moving? Note these findings.

Inspect the Coupling Units for blown fuses. Check the connection to the AC power. Is the unit set to "Operate"? Is the breaker it is connected to turned on? Note these findings.

Inspect the Coaxial Cables that interconnect the units. Check for breaks, scrapes, tears, water, and similar potential problems.

Inspect the Audio Input lines at the Transmitter. Is there audio present? Radio Shack sells a number of small testing speakers that you can clip to the audio line for testing this.

If you find any problems please note them in detail and email, fax or call LPB for feedback before proceeding. If they are simple problems, like a bad fuse, PLEASE use proper electrical safety precautions when making any changes.

If you find that all is in reasonable shape (for being in a boiler room for 5 years!) and appears to work, the next step is to adjust the coupling units. Before you make ANY adjustments, read the instructions on the lids of the Transmitter (or Linear Amp) and the Coupling Unit. Follow the Transmitter instructions from 1-7, and then the Coupling Unit instructions. Note your final settings and matching VSWR from the meter. DO NOT FORGET TO RETURN THE COUPLING UNIT TO "OPERATE" !!!!

If these procedures fail to return the station to good operating order, please contact LPB or a professional engineer with all of your findings and actions (IN DETAIL) so that they can assist you. Don't give up – Carrier Current is a bit of an esoteric art and very few folks in the country get it right the first time!

- **PAID SOLUTION #1**

If you would like to hire local assistance for the station, please contact LPB. We have worked with engineers all over the world and probably have a few suggestions for you.

Contact your local AM station and see if you can speak with their Chief Engineer. It is possible that the person is a contract engineer and will not be in the area. Your best resource is the Society of Broadcast Engineers (SBE). Try to look them up via the web at www.sbe.org and find your closest local chapter. Contact the local chapter and ask for help. They will probably be able to get you a contact or two for support. They may even find you a free source of help!

While you have them, also mention that you are always open to the donation of used studio equipment and will happily provide a tax deduction receipt for their stations. You never know what you'll get – but take it all! Eventually you will get something you need. Everything else can be used for training or re-donated to a school that needs it more than you.

Have the engineer contact LPB with all of the details from your inspection and testing. We'll work with them and help you get your signal back. This will also provide you with a future source of local support.

- **PAID SOLUTION #2**

LPB offers on-site technical support and repairs for $600 per man day, plus all expenses. We operate engineering services from Philadelphia, New York City, Tampa and Los Angeles. We will try to get the best travel costs for you, based on everyone's schedule. Before hiring us to do the on-site work, please contact us with all of the details from your inspection and test. A detailed estimate of costs and services can be provided in advance and we are pleased to accept school purchase orders.

TROUBLESHOOTING

Some additional troubleshooting tips follow below as well as a suggestion for an Inspection Sheet that you should maintain. We suggest that the typical Carrier Current system be inspected at least once per semester.

Equipment needed for basic maintenance and troubleshooting should include: Oscilloscope with a x10 probe, Multimeter, RF Dummy Load (50 ohm non-inductive with 50w rating), Tone Generator, Self-powered test speaker.

It is recommended that you maintain a spare transmitter and coupling unit in the event that one of yours requires factory repair.

PROBLEM	POSSIBLE CAUSE
LED Power Indicator is not lit	No power on AC line – check circuit breaker Fuse F1 may be blown
No RF Output indication	Fuse F1 and/or F2 may be blown Output cable to TCU may be shorted RF Drive control R31 is set to minimum Meter Switch S2 is set to %MOD position not REL RF position Crystal is not seated properly

RF Output reading is off the scale when R31 is advanced	Output cable to TCU may be shorted Bad match to TCU or dummy load
Fuse F2 blows after a short period of operation	Bad match to TCU or dummy load Rectifier Q1 is defective
No Modulation indicated with RF output ok	No audio from source Audio input cable is loose, or defective Audio Gain R4 is set at minimum
Audio distorted on radio receiver	Audio modulation R4 is set too high (50% max on peaks) Receiver is too close to the transmitter – move 20ft Limiter (if installed) set too high Audio from source is distorted (use limiter at studio)
Hum is heard on the radio receiver	Audio source has grounding problem Audio feed line has grounding problem RF Modulation is present on AC line from other source See LPB Tech Note #1 and #2 for additional information

Additional Troubleshooting Details

Audio Distortion on Radio Receiver

1. If the radio receiver is too close to the Transmitter it may be overloaded. Move about 20ft away from the transmitter to see if that is the problem.
2. The Transmitter modulation may be set too high – adjust R4 so that the peaks appear at 50% on the meter. The meter should be set to %MOD for this reading.
3. Check the audio level at the studio and the connection point to the transmitter. It may be necessary to add an audio limiter to the studio feed, or reduce the level from your studio amplifier.
4. Check the audio quality being fed to the Transmitter. Ensure that you do not have a problem with a particular source at the studio (such as an overamplified turntable).
5. If the audio is fed through the campus telephone line, it may need to be limited at the studio to prevent overdriving the telephone system – this might also result in audio being heard on telephones on campus.

Audible Hum on Radio Receiver

1. Non-linear modulation, aka 60 cycle noise, may be present in the electrical system. Connect the transmitter to a dummy load (make certain the transmitter is OFF before you do this) and listen with the radio next to the load. If the hum is no longer present, then it is a characteristic of your electrical system. Please see LPB Tech Notes #1 & 2 for more information and ask for diagrams on the Neutral Loading Option.
2. Your Transmitter may be defective. Substitute another transmitter in the same installation and review.
3. Your Audio Source may be defective. Disconnect it and feed the Transmitter with a known good 600 ohm balanced audio source. If the problem is removed, the audio feed line is defective.
4. A small percentage of radio receivers generate their own hum in the presence of Carrier Current systems. Try another receiver just to eliminate that potential.

Carrier Current RF is Strong, but Audio is Low

1. Transmitter modulation is set too low – adjust Audio Drive R4 to show 50% at peaks.

2. Audio feed line loss may be too high. Depending on the system you are using to send the audio to your transmitters, there may be additional amplification required. The Transmitter input should be at least 0.4V peak-to-peak.
3. Studio output levels may be misadjusted. We learned long ago that any knob in the studio WILL get turned, usually by someone that shouldn't. Check to make certain that your audio feed has not been misadjusted and that access to the master level is not easily found!

No Carrier Signal in the Building

1. Someone may have turned off the breakers for your electrical connection, or even unplugged your Transmitter and/or Coupling Unit. This is surprisingly common if your equipment is not very clearly marked.
2. The Coupling Unit may be left in some position other than OPERATE. Quickly change this as long periods in other positions will result in damage to the Coupling Unit.
3. The Transmitter may be defective. Check the fuses first. If the unit is on (LED lit) feel the finned heatsink on the outside of the unit. If it is not warm to the touch, either the output transistors or the fuse have failed. Contact the Factory for assistance.
4. Your output coaxial cable from the Transmitter or the Coupling Unit may be defective. Check for damage, cuts, scrapes, smoke, etc… You can use an Ohmmeter to test the cables for shorting.

RF Signal is Strong in Some Areas, Weak in Others

1. Keep in mind that the electrical system is the carrier of your signal. If you couple to a system that only feeds the East end of a building you will have poor coverage on the West end. Refer to LPB Tech Note #1 and #2 for more information on design and theory.
2. The building may have sections that are covered by different power transformers. Consult with the campus electrical staff to find the best source of full-building wiring. Coupling should be done at that point.
3. Your Coupling Unit connection may be faulty. In most situations, you should be feeding all phases of the electrical system to achieve consistent coverage. The Coupling Unit has 3 line outputs in order to achieve this. If you have the same phase of wiring connected to 2 or more of these outputs part of the building may have poor coverage.
4. WARNING – A QUALIFIED ELECTRICIAN SHOULD DO THE FOLLOWING – Using a Voltmeter, check the AC voltage between each line output and neutral. Each should read about 120VAC. Next measure between outputs 1 & 2, 2 & 3, 1 & 3. In each case you should see about 240VAC. If any of these measurements are zero, the same phase is connected at the two points. BE CAREFUL WHEN MAKING MEASUREMENTS AS THERE ARE HIGH VOLTAGES PRESENT.

Sudden Failure of Studio and/or Transmission Signals

1. A ringer voltage (90V) was inadvertently applied to your audio line. This may have been done by a telecom person working on the system, without knowing about the radio station lines. This could have damaged both the transmitter inputs and the studio outputs. ALL audio lines on campus should be labeled at ALL panels so that no one accidentally does this!
2. A lightning strike may have occurred and induced very high voltages on the audio or power lines. Buried phone lines are equally vulnerable to this kind of damage. Lightning can also follow your coaxial cable lines and power systems.

These are only some of the many troubleshooting tips that we have amassed over the years. Please feel free to email tech support for more assistance at support@lpbinc.com or visit out website for technical notes and tips at www.lpbinc.com

LPB CAMPUS TRANSMITTER TEST FORM

School	
Date	
Test Performed By	
Building Name	
Equipment Location	
Equipment In Use	
Serial Numbers	
Circuit Breaker/Panel #	
3 Phase or Neutral Load	
Transmitter Setting RF	
Transmitter Setting Audio	
Coupling Unit POWER	
Coupling Unit VSWR	
Coupling Unit Tap Settings	
Source Audio	
Test Reception – In Building	
Test Reception – Outside	
Notes and Observations	