Best Practices and General Troubleshooting Procedures

When qualified integrators follow best practices, most installations of Valcom equipment go flawlessly. However, occasionally things don’t go according to plan. This document provides information on best practices as well as basic troubleshooting techniques to help you through these learning opportunities. After reviewing this document and employing some of the troubleshooting techniques, if you have not reached a satisfactory conclusion to the issue at hand, then give us a call at 1-540-563-2000.

This document is an ongoing effort with contributions from many. Content is added and edited quite often.

Technology is always evolving. We learn, and share, new troubleshooting techniques all of the time. We strongly encourage you to check for document updates often by following the update link found in the footer.

Collectively we know many things, but no one knows it all. Feel free to contribute, suggest changes, additions or corrections to bfg@valcom.com.
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Best Practices

Experienced integrators know that the best way to avoid or minimize troubleshooting time and effort is to take the time to neatly organize, label and thoroughly document the system during installation. Any existing equipment that will be integrated with the new system (amplifiers, phone system ports, computer networks, wiring, speakers, microphones, etc.) should be independently assessed and those assessment results should be documented before any new equipment is connected. If multiple technicians are involved in the installation, adhering to a common game plan will result in consistency of techniques and quality. Taking the right steps up front can be the difference between a profitable and non-profitable job.

It’s much easier to troubleshoot a system when:

a) All cables are labeled and neatly routed.
b) Unique cable colors and consistent wire pair color codes have been used.
c) All infrastructure terminations are labeled.
d) All equipment is visibly labeled with identifying information (areas served, MAC address, IP addresses, etc.).
e) New and existing subsystems have been independently assessed and the results have been documented.
f) Backups of any programming have been archived and catalogued.
g) A detailed summary of system operation is available.
h) A system of cross-connect blocks and patch cables is employed, allowing technicians to easily make and change direct connections between two different termination blocks (one for field wiring and one for equipment) within a termination closet.

Read all of the equipment manuals.

Never assume that your test equipment, like meters and lineman’s test sets, are working properly. If a test yields unexpected results, then use your test instrument on a known working device to verify that it is working properly.

Always tape and store unterminated conductors.
The twist in UTP wiring serves 2 purposes. One is to promote equal noise coupling into each conductor of a pair so that the noise is cancelled by a differential input. The other purpose is to cancel the inherent electromagnetic field that surrounds ac carrying conductors – the differential signals on the conductors are 180 degrees out of phase with each other, therefore the EMF from the conductors are also 180 degrees out of phase. The out of phase EMFs cancel. For these reasons, the integrity of the twist in UTP should be maintained right up to the termination points. In addition, when combining UTP pairs to increase AWG, all “tip” sides and all “ring” sides should be connected (i.e. W/B & W/O as one conductor and B/W & O/W as a second conductor) as opposed to using whole twisted pairs as a conductor for one side of the signal.

In order to minimize noise, loss and RFI issues, keep all wire runs as short as possible. Locate amplifiers, power supplies, network switches, etc. as close to the endpoints they serve as practical. Remember that the audio source and the power supplies for Valcom Self Amplified speakers and horns are commonly located in different areas. A single power supply, unlike an old fashioned central amplifier, may power speakers and horns in multiple zones.

Do not mount audio equipment or audio equipment power supplies near power transformers, even if they are on the other side of a wall.

Do not mount audio equipment or audio equipment power supplies near high power radio transmitters.

Do not route audio cables near florescent light ballasts.

Be aware that Ethernet based equipment may have specific network requirements.

Do not coil extra cable lengths.

Use uniquely colored cables and patch cords for associated cabling. For example, purple cable for clocks, yellow cable for dc voltage, blue cable for audio. Doing so will save time in identifying cables both during installation and for future maintenance. There are many cable colors available. Many of these have use dictated by ANSI/TIA/EIA-606, so coordination with the facility network administrator will be necessary.
Standardize on a wire pair color code (w/bl pair for audio; w/br pair for call switches, etc.). Standardization eliminates many errors and facilitates troubleshooting.

Use cross-connect blocks and patch cables for MDF and IDF connections in order to facilitate troubleshooting, adds, moves and changes. Terminate all cable pairs on the 66 or 110 blocks for future use.

110 type blocks used for audio connections save space, but may make troubleshooting difficult. It’s much easier to access connections on 66 type blocks.

Always route the 25-pair cable connecting to the Class Connection or MultiPath CPU card separate from all other cables.

Always remove power from equipment before service.

For non-PoE equipment featuring network connectivity, make network connections before applying power.

Consider future maintenance when planning equipment placement and cabling. Always leave enough extra cable to account for adds/move and changes. Plan to facilitate changes. Leave room to work!

For analog intercom systems never mix powered and un-powered system cards on the same ribbon cable.

When installing wireless clocks, always install and power the transmitter first.
When connecting audio from one system to another, take time to make sure that the audio levels and output vs. input impedances are compatible. For efficient signal transfer, a source’s output impedance should be $\leq$ the load’s input impedance. For maximum power transfer a source’s output impedance should be equal the load’s input impedance.

When connecting line level audio from one system to another, consider using VMT-2 Audio Isolation Transformers to avoid ground loops.

Even if your cellphone has good reception onsite, plan for a wired telephone jack near your installed equipment locations. Factory support often requires a dependable, conveniently located, telephone connection.

Computers that are used for programming systems should have Internet access. Factory support often requires remote access via the Internet.

Always **pre-check speaker lines**, new or existing, for transient voltage, short circuits to ground and proper impedance before interconnecting to the intercom equipment. Use a good quality **Impedance Meter**, not an Ohm meter.

<table>
<thead>
<tr>
<th>Speaker Type</th>
<th>Number of speakers</th>
<th>Sum of Tap settings</th>
<th>Expected Impedance Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 Ohm</td>
<td>1</td>
<td>N/A</td>
<td>=&gt; 45 Ohms</td>
</tr>
<tr>
<td>45 Ohm</td>
<td>2</td>
<td>N/A</td>
<td>=&gt; 22.5 Ohms</td>
</tr>
<tr>
<td>25 Volt</td>
<td>Any</td>
<td>&lt;=1 Watt</td>
<td>=&gt; 625 Ohms</td>
</tr>
<tr>
<td>25 Volt</td>
<td>Any</td>
<td>&lt;=½ Watt</td>
<td>=&gt; 1250 Ohms</td>
</tr>
</tbody>
</table>

Always double check card addresses before powering up a Class Connection or MultiPath system.

Power supply wire connections should be tight and secure.

Audio signal wire connections should be tight and secure.

When starting up systems with RIDFs, connect to CPU and view the system configuration screen to see that all cards are present. This quickly verifies VERCA card operation.

V-LPT attenuators should initially have their volume control set to at least half way.
When installing volume controls, adjust the speakers for maximum required volume with the volume control turned all the way up.

When call buttons with volume controls are utilized in classrooms and other areas, the maximum speaker volume will be determined by any volume settings/connections made at the actual speaker. Setting talkback speakers to their maximum tap setting will provide for full range from the call switch volume control.

Call the factory for help before spending hours troubleshooting.

An accessible label on a VoIP device indicating its MAC address can save a lot of time. Once a VoIP device is installed, the MAC address may be inaccessible.

When installing IP based intercom components, it is critical to accurately record each device’s MAC address versus installed location.

Although the practice of using spare conductors in talkback speaker cables to carry 2-wire digital clock correction signal is advisable (in MultiPath and Class Connection ES Systems only) and can represent a significant wiring cost savings, using spare conductors in one way speaker cables to carry 2-wire digital clock correction signal will result in undesirable noise over the speakers. Don’t do it! Telephone circuits should never be run in the same cable as speaker circuits.

If a connection doesn’t seem right, or an assembly does not seem to fit together correctly, call the manufacturer to confirm compatibility before continuing.

When installing equipment, wall speakers and surface mount clocks for example; consider future maintenance by ensuring that external screws are easily accessible. There have been many instances where such equipment is installed before the ceiling tile is in place. Once the ceiling tile is installed, it’s virtually impossible to access the screws required to remove the equipment from the wall.

Paging speakers or horns located by telephones or microphones used to originate page announcements may cause feedback. There are several techniques to avoid such feedback. One technique is simply to delay any page announcements destined for broadcast through local speakers. Another technique is to create different group/all call dial codes for each telephone/microphone that excludes local speakers.

Modern classrooms contain a myriad of electronic systems. These systems may interfere with each other. It is advisable to fully test the interoperability of all electronic systems in a model classroom before deploying systems facility wide. This includes smartboards, occupancy sensors, projectors, intercom, network endpoints, wireless systems and sound systems.

Test self-amplified speaker lines as you install them with a tone generator. Speakers in common areas should all initially be set to the same volume level.
In the course of installing new non-Valcom network endpoints, or network maintenance, others may move Valcom endpoints from assigned VLAN ports thus rendering them inaccessible. The use of locking RJ45s may be used to discourage this practice.

When reusing existing site equipment, such as speakers, call buttons and wiring, that equipment should be tested and recertified before connecting to the new Valcom equipment. Sometimes existing speakers are tapped improperly or have cracked cones, existing wiring may be shorted to ground or have an inadequate number of conductors for the new system, etc.

Never upgrade firmware in a device that is functioning as desired.

Pretest any equipment that would be time consuming to reinstall.

Pre install the latest versions of all required software programming and diagnostic software prior to visiting a jobsite. Software install issue caused by protection software or lack of administrative rights can cause extensive site work delays.

Witness reported troubles firsthand. It is quite common for trouble reports to be inaccurate or incomplete. For example, you may receive a report that users are unable to make announcements in a certain building, where in reality; they are dialing an incorrect access code that will not allow them to make announcements anywhere.

As is true of many things, audio amplifiers, speakers and horns are not typically intended to operate at full rated capacity/volume 100% of the time. A system design requiring audio devices to continuously operate at maximum volume is a poor design and much more likely to experience audio quality troubles and premature equipment failure.

System ports that provide dial tone must not be directly connected to any other ports that simultaneously provide dial tone.

System outputs that provide voltage must not be connected in parallel to any other outputs that simultaneously provide voltage.

System outputs that provide audio must not be directly connected to any other outputs that simultaneously provide audio.

Transformer isolate system audio inputs before connecting them to a common audio source. Valcom’s VMT-2 1:1 Isolation Transformers may be used in this capacity. Simply connect each system audio input to the audio output of a dedicated VMT-2, and then connect the common audio source to the audio inputs of all of the VMT-2s.
Default VoIP endpoints before moving them from one system to another, Endpoints retain their programming and moving them from one system to another without defaulting will pollute the new system with undesired audio groups and dial codes.

Make it a habit to backup all programming (VIP-102B Snapshots, all system server(s) programming, system programming) whenever you begin work on an existing system and whenever you complete programming or maintenance of a system. Always save all backups with names identifying what they are and the date and time they were saved. Some integrators will even include a text document in the folder describing the changes that were implemented. Keep copies of backups both on site, and off site.
Troubleshooting - General Approach

This document is not specific to one product and its content will not apply to all troubleshoots. The document is intended to provide a list of best practices designed to help avoid troubleshooting in the first place. It is also intended is to provide a summary of tools needed for general troubleshooting and then to provide techniques for applying those tools to a variety of trouble scenarios. There are hyperlinks throughout the PDF version that will lead you to additional resources.

Divide and Conquer

As is true of most top tier facility systems, Valcom communication systems are comprised of multiple subsystems. Trying to troubleshoot an issue while looking at the system as a whole can be overwhelming. Subsystems are typically much easier to assess. Often, a logical approach to troubleshooting involves isolating and testing these subsystems individually in order to determine the cause or causes of the trouble.

Initially attempt to troubleshoot by changing one variable in the subsystems at a time. For example, if a speaker does not work properly and the trouble is resolved by moving the speaker to a different speaker output and a different cable in one step, you won’t know if the trouble was caused by the cabling or the initial speaker output.

Occasionally, however, there are multiple contributing factors and subsystems must be evaluated in various combinations. The subsystems may include the actual Valcom equipment, the telephone system, the network, the cabling, amplifiers, etc.
This document will show you techniques for evaluating many types of subsystems:

a) Given the right tools, the integrity of speakers and speaker cabling is easily evaluated while disconnected from the system.

b) Clock or common speaker circuits are easily reduced to the bare minimum, one clock or one speaker, to check for cabling issues. For example, if undesired noise is heard from common speakers, temporarily connecting just one of those speakers next to the audio source with a short cable can prove if the noise is being induced in the field wiring.

c) System audio outputs may be affected by connected subsystems (speaker lines, amplifiers, etc.). Assessing these audio outputs with and without the subsystems is very simple.

d) System relay outputs can be tested for proper operation by removing the load and checking with a meter.

e) Functions associated with date and/or time may be forced for testing by changing a system’s date and time as required.

f) Power supplies should produce adequate, quiet voltage at full load. It’s easy to check the supply output under full load (perhaps an all call announcement or a bell tone broadcast everywhere) and to verify that the output is stable and quiet.

Remember that while some troubles are caused by malfunctioning equipment, more often, the problem is due to environmental, design, or installation issues. Assume nothing.

Intermittent issues have been the result of cleaning services temporarily unplugging equipment to plug in their vacuums, once they are done the trouble magically clears. For IP based equipment, an IP address conflict with a PC that is switched on and off has been known to cause intermittent issues. The trouble would only occur when the PC was turned on.

Crosstalk issues have been the result of installers adding 25 volt transformers when none were required.

Noise issues have been the result of equipment being installed next to a facility’s main ac power transformer.

We’ve even experienced troubles caused by newly purchased defective CAT 6 UTP! Everything is a variable. Assume Nothing!
Analyze the troubles and patterns may emerge to lead you to their cause. What changed when the troubles began? Network maintenance? Power outage? Something new installed? Are the reported troubles occurring:

a) Within specific buildings or areas?
b) From specific wiring closets?
c) With specific equipment?
d) With specific people?
e) On specific cables?
f) With work done by a specific technician?
g) On certain days?
h) At certain times of the day?
i) After certain events?
j) Before certain events?

Assumptions are based upon past observations. However, what was true then may not be true now. Don't let your assumptions become roadblocks between you and the truth.

“Your assumptions are your windows on the world. Scrub them off every once in a while, or the light won't come in.”
— Isaac Asimov
Test tools and resources you will need

Current Product Manuals

When manufacturers wish to advise customers of product tips, proper installation and caveats, they quite often give notice in the product’s manual. The author of this document has observed many long troubleshoots that could have been avoided by simply referring to the current documentation.


Lineman’s test set

In communication systems accessed via FXO port, Loop Start Trunk ports or C.O. line ports, this invaluable tool may be used in place of the telephone system to determine if it is the source of volume, noise or access issues. Simply connect the lineman’s test set directly to the unterminated FXS or Tip/Ring I/O of the Valcom system (the I/O that provides dial tone), go off hook with the lineman’s test set and dial the access digits required by the Valcom unit under test (VUUT). If the test is successful then the VUUT is operating properly and cabling to the telephone system, or the telephone system itself, should be investigated as the source of the trouble.

Always test phone system inputs and outputs with both cabling attached and cabling removed to identify cabling related faults. Direct short circuits will kill a signal, high impedance in cabling will reduce the level of a signal and open circuits will prevent the signal from passing.

System ports that provide dial tone must not be directly connected to any other system ports that simultaneously provide dial tone.

Audio Monitoring

Need to hear low level audio signals in a cable or from an audio source?

A lineman’s test in monitor (hi-z) mode may be used to:

a) “listen” to dc power supply outputs to verify that they are quiet
b) verify the presence of audio on cabling to Valcom Speakers
c) verify the presence of audio from any system music sources.
Remember to test at the point of entry (on the actual speaker or music input) and/or point of exit (on the music source or VUUT audio output).

In order to identify cabling short or open circuits, always test for audio on the terminated audio source point (to check field connections for short circuits) and on the unterminated destination cabling (to check wiring for open circuits). Direct short circuits in cabling will kill a signal, high impedance in cabling will reduce the level of a signal in the receiving device, and open circuits in cabling will prevent the signal from passing to the receiving device. Refer to the section on impedance meters for instructions on measuring cable impedance.

Always check your lineman’s test set on a known working circuit to determine if it is functioning properly. The author of this document has encountered more than one defective lineman’s test set.
**Toner**

Cable toners are marketed for identifying cables. They generate an audio tone in the cable and an inductive amplifier is then used to identify the cable at some other point. They are also useful in the role of portable audio source to check audio inputs such as music inputs, self-amplified speaker runs and line level amplifier inputs. Some integrators routinely test and document speaker audio runs as they are installed by powering the amplifiers or self-amplified speakers and sending tone from the beginning of the audio wire pair. Great idea!

**Volt Ohm Meter**

Volt Ohm Meters are commonly used to check for voltage from power supplies and to check for dc short circuits in cabling. Voltage measurements should always be made under maximum system load conditions. In public address systems, a solid mid frequency tone playing everywhere at a volume mimicking the maximum required audio level will create a maximum load condition. True RMS Volt Ohm meters are a better choice for measuring ac voltage. Voltage level measured at different points on a cable will drop as distance from the power source increases. This is due to the relationship described by Ohm’s Law.

System outputs that provide voltage must not be connected in parallel to any other outputs that simultaneously provide voltage.

**PoE Load Meter**

PoE (Power over Ethernet) testers are commercially available to evaluate the load on PoE switch ports.

**Impedance Meter (Goldline)**

Audio is an ac signal. Speakers and cabling have capacitive and inductive characteristics which react to ac signals by changing their opposition to current flow or impedance. Therefore, properly checking a subsystem’s (speaker line, audio input, etc.) response to audio must be made with an ac signal. Impedance meters measure the ac impedance of cable pairs, loudspeakers and entire distributed loudspeaker systems. This allows you to determine the actual wattage of speaker lines or to find ac short circuits. Some will also calculate the wattage that will be produced on an installed loudspeaker system.
Volt Ohm meters are not a substitute for impedance meters as the capacitive and inductive characteristics of speakers and cabling do not react to the meter’s dc voltage output.

To measure cable impedance, simply disconnect both the source and load from the cable. Leave connectivity parts (blocks, jacks) in place. Short the point where the load would normally connect and measure the impedance through the loop from where the source would normally connect.

Non-Configured Multiport PoE switch

Much like a lineman’s test set can be used to prove or disprove the telephone system’s potential role in troubles, a non-configured multiport PoE switch can be used to prove or disprove a network’s potential role in troubles. If a piece of Valcom equipment is not working properly through the network, then testing it through a non-configured multiport PoE switch removes all of the potential network variables to indicate if the trouble is in the network configuration/hardware or in the Valcom endpoint. Note that changes to your PC’s IP address may be required for testing.

As an example, a Valcom audio gateway is at default and its IP address is 192.168.6.200. You connect this gateway to the network, scan with the VIP-102B IP Solutions Setup Tool, but the gateway is not discovered. Is there an issue with the gateway, or the network setup? You remove the gateway from the network, plug it into your non-configured multiport PoE switch, and then plug your PC into the non-configured multiport PoE switch. You change the IP address of your PC to 192.168.6.201, and then scan again with the VIP-102B IP Solutions Setup Tool. Voila, the gateway appears in the scan. Now you’ve confirmed that there are issues in the network setup, in the network ports, or the original Ethernet cables.

2-way Radios

Testing internal communication systems often require multiple technicians working together in different parts of the facility. For example, one technician may be walking around a facility verifying that speakers in different areas receive group announcements while a second technician is at the head end to initiate the announcements. Having the ability to instantly communicate can expedite the testing process significantly.
**Long Range cordless phones** ([Engenius](https://www.engenius.com/))

Long range cordless phones offer a convenient method of testing out a Valcom communication system. They may be connected to an FXS or Tip/Ring input of the system to allow technicians to initiate announcements from any part of the facility. This can save massive amounts of labor time.

**1:1 Audio Isolation Transformers**

Audio Line Isolation Transformers, such as Valcom’s [VMT-2](https://www.valcom.com/products/audio-line-isolation-transformers), are used to electrically isolate audio outputs from audio inputs in order to prevent ground loops.

**Ground Lift Plugs**

Ground lift plugs are useful when troubleshooting issues such as ground loops or hum. They should only be used to identify the cause of an issue, never as a permanent solution.

**A Non Blocked Laptop PC**

You may need a laptop PC running a current version of Microsoft Windows, PuTTY and Wireshark. This is often required to program systems and assess network connectivity and setup. The PC must have an RJ45 accessible NIC and be unencumbered by restrictive “protection” software. The author has witnessed many a wasted hour caused by “protection” software preventing required software installation or blocking required ports.

**A Hotspot**

Remote tech support often requires Internet connectivity for remote sessions and firmware updates. A readily available hotspot can save significant troubleshooting time.

**A Cellphone**

A quick call to Valcom Technical Support can also save significant troubleshooting time. Please call 1-540-563-2000 from the jobsite with the resources required for troubleshooting available. Remote tech support often
requires Internet connectivity for remote sessions and firmware updates. If your cellphone is a smartphone, then a bonus is having the ability to send pictures, video and sound recordings to help communicate troubles to technical support.

A Labeler and Permanent Marker

Labeling cables, connections and equipment as they are installed, or identified, will help in preventing connection errors and assist with future maintenance.

A Sound Level Meter

A sound level meter, as the name implies, is used to measure sound levels (pressure). The sound level is displayed in terms of dBspl value. Most sound level meters have multiple weighting filters that can be applied. ‘A’ weighting is a standard weighting of audible frequencies and is designed to reflect the audible response of the human ear. C-frequency-weighting however is still used in the measurement of the peak value of sound pressure.

Your Eyes and Ears

Witness reported troubles firsthand. It is quite common for trouble reports to be inaccurate or incomplete. For example, you may receive a report that users are unable to make announcements in a certain building, where in reality; they are dialing an incorrect access code that will not allow them to make announcements anywhere.

If you get a report that something is not working properly and you cannot reproduce the reported trouble, have the reporting party duplicate it for you. You may see that they are simply not following the steps required for proper operation.

The author recalls a situation where an end user reported that the system time on her Class Connection ES Intercom was off by 3 minutes every morning. This forced her to correct the system time every morning. Upon investigation, it was noted that the Class Connection system was correcting to a time server every morning at 2:45 a.m., and that its time was completely accurate.

The end user would look at a battery operated clock every morning and notice a variation between the clock’s time display, which was inaccurate, and the Class Connection ES time. The only trouble was her choice of time standard! Assume nothing.
Hot Equipment
Valcom equipment should not feel uncomfortably hot to the touch. If this occurs remove power from the unit, remove all field wiring, reapply power and see if the heat condition returns with no field wiring. If it does, then return the Valcom equipment for repair. If the equipment feels cool without field wiring, then assess your field wiring for grounds, short circuits and excessive load before reconnection.

Products not operating properly
If you have a Valcom product that is not operating as it should then double check all connections. Make certain that they are correct, and secure. Verify all switch settings, programming, volume adjustments, etc. If you have another identical product that works properly, swapping the location and programming of the 2 may help to determine if the trouble is install related or equipment related. If the trouble stays with the location, then it’s most likely not equipment related. If an individual input or output (I/O) of a piece of equipment is experiencing trouble, but others are not, evaluate whatever is connected to that I/O as a possible cause. Swap cabling with a working I/O to see if the trouble follows the I/O or cabling. If testing indicates that the trouble is equipment related then contact technical support.

No group/all call audio from speaker
This may be a cabling issue, a network issue or a hardware issue. In IP based systems this is a classic example of improperly configured multicast (refer to the IP6000 Initial Setup Procedure, the Valcom VoIP Initial Setup Procedure or the Testing Multicast section of this document).

When troubleshooting analog speaker circuits, trace through the speaker circuit with your lineman’s test set as described previously. It’s possible to be able to successfully call an individual audio output, however, have that same output fail during group/all call announcements. Disconnect the speaker wiring from the audio output and connect your lineman’s test set (in monitor (hi-z) mode) to the audio output. Try calling the individual audio output as part of a group and by its own unique access code. If both successfully page into the lineman’s test set, then you have a wiring issue.

No sound from speaker
This may be a cabling issue, a network issue or a hardware issue. For IP speakers, check programming, volume control, PoE port stability and network settings (refer to the IP6000 Initial Setup Procedure or the Valcom VoIP Initial Setup Procedure).

When troubleshooting analog speaker circuits, trace through the speaker circuit with your lineman’s test set as described previously. Disconnect the speaker wiring from the audio output and connect your lineman’s test set (in monitor (hi-z) mode) to the audio output. Try calling the individual audio output as part of a group and by its own unique
access code. If both successfully page into the lineman’s test set, then you have a wiring issue or suspect speaker.

Checking Valcom Self Amplified speakers or horns is incredibly easy. First of all, verify that the integrated volume control is not turned all the way down. Next, place your volt ohm meter on the voltage input of the speaker or horn. Simultaneously, attach your lineman’s test set in monitor (hi-z) mode to the audio input of the speaker or horn. Have someone initiate a test announcement*. With the volume control turned up, if you hear audio on the audio input through your lineman’s test set, and measure adequate voltage on the voltage input then the speaker or horn should broadcast sound. If not, replace it. If the dc voltage at idle is adequate, but significantly drops (drops more than 6 VDC directly at the speaker or horn power input) during the announcement, then either the power supply or wiring is undersized for the speaker wire run. Refer to the following Power Pair Run Chart.

* Loud audio from speakers, especially common when in close proximity, can cause hearing damage.

### Power Pair Run Chart

<table>
<thead>
<tr>
<th># of Speakers/Horns Per Power Run</th>
<th>15-Watt &amp; 30 Watt</th>
<th>5-Watt Signature Series™</th>
<th>Interior Speakers</th>
<th>24 AWG</th>
<th>22 AWG</th>
<th>20 AWG</th>
<th>18 AWG</th>
<th>16 AWG</th>
</tr>
</thead>
<tbody>
<tr>
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<td>-</td>
<td>-</td>
<td>1</td>
<td>1000</td>
<td>1600</td>
<td>2500</td>
<td>4000</td>
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<td>200</td>
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<td>1</td>
<td>2</td>
<td>7</td>
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<td>800</td>
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<td>4</td>
<td>15</td>
<td>400</td>
<td>640</td>
<td>1010</td>
<td>1610</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>6</td>
<td>30</td>
<td>100</td>
<td>160</td>
<td>250</td>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>

**Low Quality Background Music**

Most music sources have left and right channel stereo outputs. Stereo audio, by definition, cannot be supported by public address systems. Therefore, the source’s left and right channels must be mixed together to form a single monophonic output. It’s not unusual to visit sites where only one of the stereo channels is connected to the PA system or where both stereo channels are connected to one music input. Either will result in poor music quality and possible damage to the audio source.

Valcom’s Remote Input Module (V-9130-W) provides an inexpensive means to properly mix stereo audio to monophonic audio.

Remember that background music, as the name implies, is low level audio intended for subliminal recognition. High fidelity is not often a requirement.
Foreground music, music intended to be blatantly obvious to the listener, often requires high fidelity sources and speakers. This equipment is typically more costly, and less versatile than audio paging equipment.

**Noise/Feedback**

There are 2 common types of noise that may occur in audio systems, 60 Hz hum and feedback squeal. Hum is typically related to either:

a) The physical location of the installed equipment and its proximity to other equipment and/or wiring

b) A mismatch in ground potential between a device sending audio and a device receiving audio

c) “Dirty” ac voltage

d) Lightly loaded dc power supplies

The way to determine if the hum is physical location related is to move the equipment in question to a different environment and test. The author has witnessed equipment that exhibited hum due to high voltage transformers of the other side of the equipment wall and also from high voltage cabling routed near the Valcom equipment.

a) The intent of using UTP wiring with a differential audio input is to reject noise. Not maintaining the integrity of the twist in UTP renders it ineffective. The twist in UTP pairs should be maintained right up to the termination points.

b) Ac power wiring and audio signal input wiring should be routed separately whenever possible. The electromagnetic field surrounding conductors carrying ac voltage increases in strength following increases in current. This electromagnetic field induces crosstalk into surrounding conductors.

c) Improper grounding can cause 60 Hz hum.

Mismatches in ground potential between a device sending audio and a device receiving audio are easily remedied by routing the line level audio through isolation transformers. Valcom [VMT-2](#) 1:1 isolation transformers have solved many hum problems and should be standard issue to all audio technicians.

“Dirty” ac voltage is ac voltage with a significant amount of electrical noise superimposed. The condition may be proved by powering the equipment experiencing the hum by an adequately charged, unplugged UPS. A licensed electrician should be contacted to rectify “dirty” ac issues.

Lightly loaded power dc supplies may require some additional load for internal filtering to work properly.
Hum from microphone initiated announcements is often the result of connecting the microphone via UTP cabling. Microphones connections should always utilize good quality microphone cable. (Belden 8424 or equal)

Improper signal to noise ratio often results in noise troubles. For example, when providing an excessively low audio signal to an amplifier, the ratio of noise to desired audio signal in the cabling can become significant. In order to have acceptable broadcast levels for the desired signal, the amplifier gain must be increased, which of course increases the volume of the noise as well.

By increasing the desired signal into the amplifier, assuming that the induced noise level remains constant, the amplifier gain can be lowered thus lowering the noise while still providing adequate broadcast levels for the desired signal.

As is true of many things, audio amplifiers, speakers and horns are not typically intended to operate at full rated capacity/volume 100% of the time. A system design requiring audio devices to continuously operate at maximum volume is a poor design and much more likely to experience audio quality troubles and premature equipment failure.

**Squeal**

A high pitched squeal through paging speakers and horns is often the result of acoustic feedback. This results when amplified audio loops back into the originating microphone or telephone increasing its gain with each successive loop until the system amplifiers reach saturation. This results in the high pitched squeal. Remedies include delaying the announcements through feedback eliminators, lowering or eliminating the sound level near the originating microphone or telephone and using noise cancelling microphones or telephones. System speaker grouping can often be used to create separate all call groups for each paging initiation area eliminating speakers in that area during general announcements.

**Low sound from speaker**

Low audio from a speaker, if unrelated to volume control setting or a low output from the audio source, is typically a cable length or connection issue (for example, a bad connection on a punch down block). Prove it by temporarily moving the speaker in question into the equipment room and connecting it to the source with a short piece of cable. If the low audio condition is alleviated, then the cabling/connectivity are suspect.

**Distorted sound from speaker**

Distorted sound from a speaker is almost always the result of overdriving the speaker, or overdriving the device sourcing the audio to the speaker. Overdriving the input of an amplifier or self-amplified speaker will result in distorted speaker audio. For Valcom Self amplified speakers, exceeding the Valcom Power Wiring Chart (shown previously) or
not providing enough Valcom Power units (inadequately sized power supplies/cabling) may also result in distorted audio.

As stated previously, audio amplifiers, speakers and horns are not typically intended to operate at full rated capacity/volume 100% of the time. A system design requiring audio devices to continuously operate at maximum volume is a poor design and much more likely to experience audio quality troubles and premature equipment failure.

**Broken or Choppy Audio**

For analog speaker circuits, intermittent connections or overloaded power supplies/amplifiers may result in broken or choppy audio. Use a lineman’s test set in monitor mode to determine where the choppy audio first occurs in the system (at the source, after the amplifier/zone controller, etc.). For networked equipment, poorly terminated RJ45s, 110 blocks and/or variances in network traffic can cause issues. Heavy network traffic can result in broken or missed audio and unreliable system operation. This is why Valcom always highly recommends a dedicated **VLAN**, or a VLAN shared with the telephone system. You can test for network issues by temporarily moving the Valcom endpoints to a dedicated, non-configured multiport PoE switch for testing.

If using **VERCA** cards and all network requirements have been met, refer to the echo cancellation procedure in the manual.

**Reverberant Sound**

Reverberation is a function of an area’s acoustic characteristics (**RT60**). The ultimate solution is always **acoustically treating** the area with sound absorbent materials. Short of that some simple suggestions include:

a) Use low mounted ceiling or suspended speakers spaced at the ceiling height.

b) When using high powered horns, use as few as possible.

c) If personnel only occupy a small area, place a speaker or horn in that area so that they are in the direct field of sound.

d) Direct all points of sound in the same direction.

e) Angle horns directly down or directly up (if protected from weather).

f) Turn speakers/horns down to the minimum acceptable volume.

**Delayed sound** is often mistaken for reverberation. When delayed sound is noticeable, a listener will hear sound from a close sound point before they hear sound from a further sound point. Sometimes an area is plagued with both delayed sound *and* reverberation.

Delayed sound is a function of an individual’s proximity to two or more sound points (typically horns) that are broadcasting the same audio. If the individual's distance from
each sound point varies by ≈40 feet or less, then the listener will not perceive sound delay from the farther sound point (Haas Effect). Otherwise, any audible sound level from the further sound point may appear as an echo. Possible solutions:

a) If possible, place all sound points in a single location directed outward in a 360 dispersion pattern.
b) If using horns, angle them down and/or, horn placement permitting, turn the volume down so that the sound level at a point equidistant from all other sound points is no more than 3 dBspl above the ambient noise level.
c) If the listeners are always a fixed distance from the sound points, then delay lines may be used to delay the sound points closer to the listeners.

Audio systems that transport audio digitally over a computer network have natural latency due to the time required to encode and decode the audio,

**Uneven audio coverage**
Balancing audio in systems that offer multiple volume settings (channels, group offsets, event offsets, etc.) does not have to be difficult. An important step is choosing a baseline around which all other volumes are adjusted. For example, all self-amplified speakers should all be installed with their integrated volume controls set for approximately ½ volume. Centrally amplified speakers should all be tapped equally.

Next, choose areas that are representative of most of the facility, find acceptable volume settings for one of these areas and mirror those settings to all similar areas. Note that on 45 Ohm Class Connection and MultiPath systems, all call is not adjustable at the system level. Therefore, talkback speakers should initially be set for “normal” or mid-range volume and all call must be used as your baseline volume.

Once you’ve established a baseline audio level, fine adjustments can be made on a per area basis as required.

Audio coverage by speakers and horns is a function of mounting height and the area’s ambient acoustic characteristics and noise level. Refer to the recommended spacing chart below. Note that, for horns, the chart is based upon an 18 foot mounting height.
When working with old fashioned centrally amplified systems (100v, 25v or 70.7v), uneven sound coverage is often the result of improper design resulting in a significant differential in sound pressure from identically tapped speakers. For any given speaker wire run, identically tapped speakers closest to the amplifier are always louder than those further down the line. A professional audio design engineer will have taken these losses into account in the initial design so that all speakers will provide enough audio to acoustically overcome the ambient noise where they are installed. However, it’s common for the function, and therefore the ambient noise level in different areas to change over time. Users attempt to compensate by adding more speakers and/or re-tapping existing speakers. This changes the loss of the line from the original design and affects the audio level on all other speakers on the line.

Note that Valcom’s V-1095 70 Volt Expander works on 100v, 25v or 70.7v speaker lines to allow the addition of Valcom Self Amplified Speakers without affecting the line’s balance.

Simply changing the tap setting of a single speaker/horn, or adding more reduces the volume at all speakers!
Inadequate audio coverage

Inadequate audio coverage is a function of a design that requires:

a) More speakers or horns  
b) Louder speakers or horns  
c) Better placement of speakers or horns

Most manufacturers offer guidelines for sound point (horn/speaker) type and spacing vs. audio coverage for typical areas. However, these guidelines cannot take every variable into account. There is a whole engineering discipline, as well as modeling software, built around choosing audio sound points based upon an area’s dimensions, the materials used in construction (every material has a coefficient of sound absorption), how those materials are finished, (unpainted concrete block walls absorb sound while painted concrete block walls do not), the expected content of the area (high sound blocking shelves, sound absorbent inventory, etc.) and anticipated ambient sound levels. In many areas, these variables change on a regular basis requiring dynamic audio adjustment via automatic volume controls. Because of the unique qualities of each area, a manufacturer’s recommendations for typical areas must often be tailored.

Some basic knowledge of sound will help in correcting for inadequate coverage:

a) For voice announcements, the audio from a public address system should overcome the ambient noise level by at least 6 dBspl throughout any area (at average ear level).
b) Sound pressure (volume) from a sound point is typically greatest directly in front of the dispersion cone.
c) Doubling the distance away from a sound point will result in approximately 6 dBspl less sound pressure.
d) Doubling the power to a sound point will only yield an additional 3 dBspl of sound pressure.
e) A 3 dBspl difference in sound pressure is barely perceptible, a 10 dBspl difference in sound pressure is perceived as twice as loud.
f) Sound pressure also diminishes as listeners move away from the on axis sound directly in front of the dispersion cone. The total angle over which the sound pressure level diminishes by 6 dBspl compared to the direct sound directly in front of the dispersion cone (on axis level and at some given frequency) is known as the dispersion angle.
g) When dispersion angles of adjacent sound points meet, in phase sound pressures will sum resulting in a 3 dBspl boost (sound will only be 3 dBspl down). This is the basis of the manufacturer’s spacing charts for typical areas.
h) Equal sound pressure that is 180 degrees out of phase will null or cancel. This can occur when speakers are wired backwards from each other.

i) Manufacturer’s spacing charts are based upon horns being mounted approximately 18 feet high.

**No Voltage from Power Supply**

If you determine that a system power supply is not providing output voltage, remove the wiring from the output, cycle power to the supply, and test again. If you measure voltage on the unterminated output of the power supply, then there is either excessive load on the supply, or there is a short circuit in the power cabling.

**Phantom Calls**

Phantom calls are call-ins from talkback speaker locations that occur without initiation. A common cause is when one of the conductors for the call switch wire pair is shorted with one of the conductors in the audio wire pair. Phantom calls often occur immediately after a general announcement (like all call). Troubleshooting involves temporarily removing the call switch wiring for the station in question and then trying to reproduce the phantom call. Call switch wiring with intermittent short circuits can also cause this phenomenon.

**Crosstalk**

Crosstalk, hearing audio intended for other audio paths, is not common in Valcom systems due to the low audio transmission signals involved. When it occurs, there are some typical reasons:

a) Splitting UTP pairs. The intent of using UTP wiring with a differential audio input is to reject noise. Crosstalk is considered noise as it is undesired signal. Not maintaining the integrity of the twist in UTP renders it ineffective. The twist in UTP pairs should be maintained right up to the termination points.

b) Signal output wiring and signal input wiring routed in parallel. The electromagnetic field surrounding conductors carrying ac signals (audio) increases in strength following audio signal strength. This electromagnetic field induces crosstalk into surrounding conductors, including inputs to other circuits.

c) Improper grounding can cause crosstalk.

d) On rare occasion crosstalk can occur before the wiring is ever a factor. Not enough physical separation between the equipment that is the source of the undesired audio and the equipment that is the recipient of the undesired audio (crosstalk) may experience crosstalk. Audio transformers can both induce and receive electromagnetically coupled audio and noise.
e) Excessive signal in the source wire pairs can cause crosstalk. Turning source signals down in the cabling inducing the crosstalk and compensating at the load end (speaker, audio input) is often a remedy.

f) Low signal to noise ratio in the cables where crosstalk is observed. Increasing desired signal may make the undesired crosstalk signal less evident.

g) Underminated audio outputs/speaker lines may contribute to crosstalk.

h) Excessive cable lengths and loops in cables. Keep cables as short as is practical and avoid loops.

Note that the audio level on the loaded audio source outputs, such as speaker outputs from intercoms or amplifiers, is typically much lower than on unloaded audio source outputs. Technicians troubleshooting crosstalk may be inclined to isolate cables by disconnecting speakers or speaker lines. The higher signal levels of these unloaded audio outputs can actually cause crosstalk.

When testing for crosstalk, the disconnected outputs should always be terminated with resistors sized to represent the actual load. Connect these load resistors as close to the audio output as is practical.

Troubleshooting crosstalk involves determining its source(s) and its destination(s). The author experienced a site where crosstalk occurred whenever certain combinations of zones were called as audio groups. While it appeared random at first glance, a pattern soon emerged. In order to troubleshoot, a new audio group was created by adding the speaker zones one at a time and testing for crosstalk after each addition. If crosstalk was present, then the last speaker added to the group was noted and removed from subsequent tests. In this particular case, 5 speaker zones were identified that caused crosstalk. Those 5 speakers were the only ones installed by a particular technician. He thought that the speakers needed 25 volt transformers, so he added them. He had left the unused speaker taps uninsulated and all touching the ceiling tile grid thus creating the crosstalk path.
Cannot connect to network based equipment
Connecting to network based equipment requires:

a) That your PC be routable to the network based equipment
   1) Using your non-configured multiport PoE switch, assign an IP address to your PC that is on the same subnet as the equipment and connect both your PC and the equipment to your test switch. If you can connect using this method, but not through the network, then the problem lies in the network configuration. If you cannot access using this method, then try pinging the network based equipment to verify its IP address.

b) That your PC is utilizing the correct NIC
   1) Disable all unused network interface cards, such as wireless cards

c) That your PC is not blocking required ports
   1) Temporarily disable your firewalls and any port blocking (antivirus/PC protection) software.

d) For non-browser based access, that you are using the right PC software tool.
   1) Class Connection ES and Multipath software tools are unique. Using the wrong one will result in connection failures.

e) That there are no IP address conflicts.
   1) Disconnect the network based equipment and ping its address on the network. If you receive a response, then there is an IP address conflict. The author has experienced situations where an IP address assigned to Valcom equipment was also assigned to a computer that was not always turned on. In this case, connectivity and functional issues only occurred when the offending PC was turned on. Assume nothing.

f) That all infrastructure is properly terminated. Poorly crimped RJ45s have often been the root cause network connectivity troubles.

There are network requirements available for all Valcom endpoints. In order to ensure proper operation, it's important to adhere to these requirements.

Other PC Connection Troubles
Every PC that has been in service for some period of time is unique. Occasionally the programs that have been installed on a PC or PC settings may cause connection troubles. If troubles persist after disabling all unused NICs (wireless and other) and firewalls/protection software, the fastest course of action is to try a different PC.

Incorrect System Time
Most Valcom systems that require accurate time have some provision for obtaining that time and automatically adjusting it for time zone and Daylight Saving Time (DST). Sometimes fixing incorrect time on a Valcom system is as simple as entering the correct
time server address, time zone or DST setting. Sometimes, is it related to the network settings.

Class Connection ES (rev 4 and higher) and MultiPath systems may be directed to a Daytime Protocol Server. They correct once a day at a time defined by the user.

Valcom IP servers and equipment use Network Time Protocol (NTP), they correct on boot up and periodically throughout the day.

Although both services may be available from a single time server, these are 2 different protocols and are not interchangeable. NTP uses port 123 and daytime protocol uses port 13.

Regardless of whether your time server of choice is part of the local network, or located on the Internet, the network port connected to the Valcom equipment must be properly routed to that time server in order to successfully obtain time. If resolving a domain name (like us.pool.ntp.org), then valid DNS entries will be required for the endpoint attempting to obtain time.

Time servers may be tested by plugging a PC into the switch port that was being used by the Valcom endpoint, setting the PC’s network credentials (IP address, gateway, subnet mask) to match the Valcom endpoint and disabling all PC network ports except for the one connected to the switch. Refer to the following examples:

If testing a Daytime Protocol server, telnet to the server on port 13 and it should return a time string:
If a reliable source of daytime protocol cannot be found, then any PC or **Windows based server** can be provide daytime protocol through Simple TCP/IP services. This way the Windows PC can obtain time via NTP and serve it via daytime protocol.

For an NTP server, first, **ping** the server’s address it to verify that it replies.

For some later versions of Windows (tested on Win 7 and 10*), the command prompt: `w32tm /stripchart /computer:<IP of the NTP Server that you are using> /dataonly` will return time. In the author’s testing, the time returned was automatically adjusted for the PC’s time zone.

![Command Prompt](image)

As of this writing, us.pool.ntp.org (67.18.187.111) is a valid Internet based NTP server.

*Windows 10 required the higher privilege Command Prompt (Admin). Press the Windows key and x to access the menu offering command prompt access.

**PoE Ports Shutting down**

If PoE switch ports shut down or reboot, the powered endpoint may be drawing **excessive current**. For VoIP endpoints that source audio inputs (on amplifiers or other systems), this is sometimes a function of a ground loop between the audio output of the endpoint and the audio input of the receiving device. In this case, the ground loop should be isolated. Mismatches in ground potential, or ground loops, are easily remedied by routing the line level audio through isolation transformers. Valcom **VMT-2**
1:1 isolation transformers have solved many ground loop problems and should be standard issue to all audio technicians.

For VoIP endpoints that source audio to analog speakers, like 8 Port Retrofit Gateways, excessive PoE current draw may be a function of excessive speaker load, short circuits or ground loops in the speaker cabling. Always pre-check speaker lines, new or existing, for transient voltage, short circuits to ground and proper impedance before interconnecting to the intercom equipment. Use a good quality Impedance Meter to measure impedance, not an Ohm meter.

<table>
<thead>
<tr>
<th>Speaker Type</th>
<th>Number of speakers</th>
<th>Sum of Tap settings</th>
<th>Expected Impedance Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 Ohm</td>
<td>1</td>
<td>N/A</td>
<td>=&gt; 45 Ohms</td>
</tr>
<tr>
<td>25 Volt</td>
<td>Any</td>
<td>&lt;=½ Watt</td>
<td>=&gt; 1250 Ohms</td>
</tr>
</tbody>
</table>

Valcom PoE audio endpoints draw very little power at idle. However, when they begin to broadcast audio the current required from the PoE port increases significantly. Some PoE switches have default settings that detect sudden increases in current draw and shut the port down as a means of protection against defective endpoints. If PoE switch ports only shut down following an attempted page announcement, then PoE power management features may need to be set to static or high priority. This pre-allocates power to the endpoint, even when power requirement is at a minimum. This guarantees that when the endpoint requires more power, it will be available.

Additionally, PoE+ devices use LLDP-MED protocol to advertise their extended power preference. Some LAN switches that cannot provide the extended PoE+ power may shut down or reboot the network port. On some PoE switches, the default configuration is for PoE requests to be ignored if detected through LLDP or LLDP-MED.

Some PoE switches can provide PoE load information and PoE current, voltage and power testers are also commercially available.

Be aware that PoE switches have power budgets that must not be exceeded. Full power may not be available from all ports simultaneously.
Radio Frequency Interference

Radio frequency interference (RFI) rarely occurs in Valcom Systems. The author has never experienced RFI in an IP based system and only occasionally in analog systems. Steps for troubleshooting RFI vary from case to case.

If your equipment is reacting to nearby amateur radio or CB transmitters then you will have interference during the broadcast half of the conversation. If this is the case, survey the area surrounding your facility for an antenna mounted on a nearby house or car. Advise the Federal Communications Commission of your findings.

Some common steps in troubleshooting include:

a) Assuring that system power supplies and amplifiers, basically anything with an ac electrical cord, is connected to a direct Earth ground. Valcom power supplies outputs are not referenced to Earth ground, therefore a strap from the supply common outputs (the + output on -24vdc supplies) must be strapped to Earth ground. The 3rd prong in electrical outlets may or may not provide an adequate ground dependent up how a building ac power is wired. Bonding to a known good ground, such as a ground rod with as short as is practical 18 AWG+ gauge copper wire is your best bet.

b) Connect all system ac power inputs through suitably sized Tripp Lite Isobar RF filtering surge suppressors. Follow Tripp Lite’s instructions.

c) For shielded cable, ground the shields on one end only – the end closest to your direct Earth ground.

d) Earth ground one end of all unused conductors in cables.

e) Terminate all unused audio inputs with a short piece of wire.

f) Make certain that equipment racks and metal enclosures are Earth grounded to the manufacturer’s requirements.

g) Maintain the integrity of UTP wiring right up to its termination points.

h) Install ferrite beads on audio cables connecting equipment. Ferrite beads work by increasing the serial inductance of the wire to effectively filter out high frequency RFI. There are many references to using ferrite beads in RFI elimination on the Internet.

i) Keep wire runs as short as possible.

j) Use good quality shielded cable for all microphone connections.

k) If known, contact the owner of the RFI source or the Federal Communications Commission for assistance. Unlicensed radio stations operating at higher than legal power have been known to cause RFI issues in the past.
I) If RFI is affecting self-amplified one way speakers that are only connected to dc voltage, then with the speaker/horn Tip and Ring disconnected from the source, measure the dc voltage from:
   a. Tip to GND
   b. Tip to Earth GND
   c. Tip to -24VDC or -48VDC
   d. Ring to GND
   e. Ring to Earth GND
   f. Ring to -24VDC or -48VDC

**All should measure zero.** Next measure the resistance from:

   a. Tip to GND
   b. Tip to Earth GND
   c. Tip to -24VDC or -48VDC
   d. Ring to GND
   e. Ring to Earth GND
   f. Ring to -24VDC or -48VDC

**All should measure infinity** (open circuit).

If you measure otherwise, contact tech support.

To eliminate the power supply as a contributor to the RFI, try powering the speaker from batteries instead of the DC power supply. 9-volt batteries are easily connected in series, each adding 9 volts to the total voltage. Valcom one watt interior speakers make be temporarily powered by a couple of 9-volt batteries placed in series (18vdc).

m) If RFI occurs when certain audio inputs are connected, then low pass filters may be used as close as possible to the audio inputs of the system receiving the RFI. The filter shown below will roll off any frequencies above 23 KHz. The ground shown must be a direct Earth ground.

![Filter Diagram](image-url)
Strong radio frequency interference (AKA Electromagnetic Interference) trouble can manifest itself in non-audible ways as well.

All Valcom products are designed to minimize the unwanted effects of RFI/EMI; however, in extreme situations (i.e. sites located next door to radio antennas) no level of design preparedness will be sufficient.

Any electronic equipment installed near strong RFI/EMI sources could experience ill effects including malfunctions at the component level.

Significant RFI/EMI sources include:

a. Analog television station transmitters  
b. AM/FM radio transmitters  
c. Solar Magnetic Storms  
d. Lightning  
e. Radar systems  
f. Electrostatic Discharge  
g. High voltage power lines  
h. Arc welders (MIG and TIG welders as well)

On some occasions removing all Earth ground references from system power supplies, Earth grounding all equipment racks/enclosures, unused conductors in system cables or shielding may offer relief from RFI/EMI troubles.

Fortunately, due to Valcom’s preventative design measures, RFI/EMI troubles are very rare and only occur in a very, very small percentage of installations.
DHCP Endpoints Reverting To Static Addresses
Valcom endpoints can be set to acquire IP addresses from a DHCP server or may use static addresses. Static addresses are recommended. In order to make our endpoints that have been set for DHCP accessible offline, when power is cycled and the DHCP server cannot be found, they will quickly return to a default static address in the 192.168.6.X subnet. This is never an issue on robust networks that have alternate power backup for the DHCP server and all of the switches and routers. However, if this is not the case, following a power failure, the Valcom endpoints may not be routable to the DHCP server for an extended period of time, ten minutes or more has been observed. Therefore, they will revert to a static address as described.

Systems Randomly Stop Functioning
Valcom system software programming tools are always backwards compatible. Therefore the latest versions of these tools should always be used. If you program a new system with an older programming tool, it may cause it to randomly stop functioning.

Cannot Access Valcom System
See Lineman’s test set, VoIP Configuration Guides or SIP Registration errors.

It may be that you can access the Valcom system but it immediately disconnects. Refer to Disconnect Troubles.

Busy Signal When Dialing An Intercom Station
For SIP accessed endpoints, a fast busy means that the endpoint dialed is not registered or routable to the SIP server, a slow busy means that the endpoint is in use. It is quite possible for an endpoint to be registered with the SIP server and still return fast busy or a 404 error when called. The SIP server has settings to allow or disallow certain SIP phones from calling certain SIP endpoints.

When accessing through a C.O. Line Port, Loop Start Trunk Port or POTs telephone, a busy may indicate that the station is truly busy. If dialing a code that begins with # through a C.O. Line Port, Loop Start Trunk Port returns busy after the # is dialed, try substituting the digit zero for #.

Low Audio From Amplifier
In order to produce adequate output levels, amplifiers require adequate input levels. The signal level on an amplifier’s input that is required to achieve rated output is referred to as its “sensitivity”. It’s equally important for the source’s output impedance to be <= the amplifier’s input impedance. Maximum signal transfer (amplifier input) occurs when source impedance is zero and input impedance is infinite. Maximum POWER transfer (amplifier output) occurs when output impedance is equal to load impedance.
Disconnect Troubles
Disconnect troubles may be:

a) The Valcom system does not release after the page is complete
   1. If access is via a telephone system FXO Port, Trunk Port or C.O. Line Port, then temporarily replace the phone system with your lineman’s test set and try to reproduce the trouble. If you cannot, then verify the operation, type and programming of the phone system’s port. The FXO Port, Trunk Port or C.O. Line Port should operate just like your lineman’s test set.
   2. If access is via a telephone system station port into a Valcom FXO Gateway, then verify that the station port is providing proper disconnect signaling (Open Loop Disconnect), or, if using silence detection, use your lineman’s test set in monitor mode (Hi-z) to verify that the station port is completely silent after the calling party disconnects.

b) The Valcom system disconnects during an announcement
   1. If access is via a telephone system FXO Port, Trunk Port or C.O. Line Port, then temporarily replace the phone system with your lineman’s test set and try to reproduce the trouble. If you cannot, then verify the operation, type and programming of the phone system’s port. The FXO Port, Trunk Port or C.O. Line Port should operate just like your lineman’s test set. Note that intermittent wire connections may be the culprit.
   2. If access is via a telephone system station port into a Valcom FXO Gateway, then verify (directly on the FXO Gateway Input) that the station port is providing constant voltage for the duration of the connection, that pauses in audio are not exceeding any silence disconnect settings and that there is not an absolute timeout value set in the FXO Gateway.
   3. If access is via SIP, verify that the SIP server does not have any absolute timeout setting enabled. You can do this by monitoring the Paging Diagnostics screen in the VIP-102B IP Solutions Setup Tool during a group or all call announcement. If a Page Stop command is consistently issued for group announcements mid-stream, then the SIP paging Server settings should be investigated.

c) In poor designs, power supplies or PoE ports may enter protection mode during announcements. If overloading is the trouble, then disconnect symptoms will typically be isolated to specific PoE switches, PoE ports or to specific power supplies. Additionally, with analog systems, if the main head end equipment is inadequately powered, then the disconnect will typically manifest itself during long all call announcements. Verify system loads on PoE switches and power supplies with your PoE load and Volt Ohm meters. Measure both before and during the disconnect sequence under investigation.
Intermittent Troubles

Intermittent troubles, troubles that seem to occur at random times and are not reliably reproduced, can be difficult to troubleshoot. Mostly because if you can’t reliably reproduce the trouble, then how will you know if you’ve resolved it? These troubles may be user related, environment related, design related, network related, equipment related or any combination of these. Establishing a pattern of when and where the troubles occur, the users involved, and what changes in the environment while the trouble manifests itself often leads to resolution.

With any equipment, if your install has multiples of any device, and only some exhibit troubles, then swapping the ones that work reliably with the ones exhibiting intermittent troubles can help lead you to a conclusion.

For networked equipment, poorly terminated RJ45s, 110 blocks and/or variances in network traffic can cause issues. Heavy network traffic can result in broken or missed audio and unreliable system operation. This is why Valcom always highly recommends a dedicated VLAN, or a VLAN shared with the telephone system.

Improper or incomplete multicast setup is always a suspect when individual audio channels work, but group audio fails. Dependent upon network design, endpoints may randomly fall in and out of the multicast group required for group audio. The IP6000 Initial Setup Procedure clearly outlines the network requirements for Valcom IP6000 IP based solutions. For standard Valcom VoIP installations, network requirements may be found here.

Valcom’s VIP status monitor may be utilized to monitor our VoIP endpoints and report if they no longer appear on the network and may help to identify intermittent connectivity.

Other factors that can contribute to intermittent troubles include:

a) Mounting locations that exceed the equipment’s rated operating temperature and humidity
b) Intermittent wiring connections/short circuits
c) Wrong programming (example - making scheduled tones lower priority than announcements will result in missed scheduled tones)
d) Excessive load on power supplies or audio outputs
e) People temporarily unplugging equipment
f) Improper equipment grounding
g) Failure to release the system after an announcement (pressing hold instead of release)
h) Failure to program using the most current version of programming software
i) IP address conflicts with PCs or other endpoints that are powered on (conflict occurs) and off (conflict goes away) as needed.
j) Periodic variances in ac voltage
Clock Correction Troubleshooting

Several Valcom intercom products have the ability to correct secondary clocks. In addition, Valcom sells a wireless clock system that can be integrated with many of our intercoms or may be used stand alone.

There are basically 4 categories of clock correction:

a) Wireless  
b) Corrected by relay closures (synchronous, hourly, impulse, etc.)  
c) Digitally corrected  
d) Corrected over Ethernet via NTP

**Wireless clocks**, as the name implies obtain time correction information via a wireless signal. This signal may be received directly from the transmitter or repeater, or may come from adjacent clocks as they transceive. In order to test a wireless clock, apply power to the clock while close to the main transmitter. It should obtain correction signal and display the same time as the transmitter or the system sourcing the repeater. If it does then the clock is functioning properly. If the clock functions properly per the previous test, but will not obtain correct time in its intended location (the process could take a couple of days), then perhaps it is out of range of a transmitting or transceiving device. Performing a wireless clock site survey will determine clock signal coverage in a facility. If an analog wireless clock attempts correction, however, displays an incorrect time, then clock diagnostics, as described in the manual, should be utilized to detect any hardware issues. Wireless clocks typically perform well when <=60’ spacing is used..

As far as clocks corrected by relay closure, the correct wiring and sequence of closures is required for successful correction. Once you’ve determined the proper correction protocol, generic wiring diagrams for each can be found in the appropriate intercom manual.

Determine if the correction protocol selected in the Valcom intercom is correct for the clock model.

The Valcom intercom simply closes relays on the V-CIO Clock Relay Card. These relays close at times based upon the correction protocol selected in the intercom.

Determining if the Valcom system is properly closing the clock correction relays is as simple as using your Volt Ohm meter to measure for continuity between each relay’s common and normally open contact at the times dictated by the correction protocol.
This test may be expedited by changing the system time to 5 minutes before each correction is supposed to occur. No clocks should be connected during the continuity tests. If the relays are closing at the correct times and for the correct duration, then the Valcom equipment is working properly.

Connecting a single clock in the equipment room (all other clock cable runs disconnected) is a good way to determine if the head end equipment is properly configured and the correct correction protocol has been selected, without introducing clock cabling variables. Note that clock correction by relay closure may take several days to correct the clocks.

If ac clocks periodically jump an hour ahead in time, then resistors R5, R6, R7 and R8 of the V-CIO must be removed.

**Valcom Digitally corrected clocks** (2-wire digital correction) are corrected over a single pair of UTP wiring. The devices that typically source the clocks are a **V-DCPI** Digital Clock Protocol Interface and a **V-CCU** Clock Controller.

The V-DCPI converts BCD data from the Valcom Intercom into RS485.

The V-CCU mixes power and data on a single pair of wires and sends it to the clocks.

In proper operation, the green data LED of the V-DCPI will frequently flicker as it receives and processes BCD data from the intercom. If that BCD data is originating from a V-SER clock card in an analog intercom, then the V-SER will display rapidly flashing LEDs as well.

The V-CCU’s red data error LEDs will not be illuminated and the green output data LEDs will flash every time correction data is sent to the clocks. The rate of correction is determined by dipswitches and is typically set to once a second.

If the V-CCU’s red data Error LEDs are on, then the V-CCU is not receiving input data or the power supply is not properly connected.

If the V-DCPI’s green Data LED is not flashing, it is not receiving data from the intercom, it is not properly connected to the V-CCU or the intercom is not set to send data in a Digital Out/24 Hour Enhanced Mode. The V-DCPI does not require a separate power supply when used with the V-CCU.

In some systems, a master clock will be used in place of the V-DCPI.

The V-CCU must be power cycled before dipswitch changes are recognized.
There are limits for how many clocks can be sourced from each of the V-CCU’s outputs. Refer to the V-CCU* Manual for details. There are also limits for clock quantities per cable run bases upon type, wire gauge and distance. Refer to the following chart:

*The V-CCU is part of the V-VCU package. The V-VCU contains a V-VCU and a power supply.

**IP Clocks** connect to a properly configured network and obtain time from an NTP server. If they do not correct, ensure that the network is properly configured, the PoE switch power budget has not been exceeded and that the port used for the clock is routable to a valid NTP source.

**Testing Multicast**

When working with Valcom IP based systems, a proper installation includes maintenance of multicast forwarding tables using IGMP querying (preferred), IGMP snooping or similar functions. Improper configuration of multicast is one of the most common issues encountered when deploying a Valcom IP Solution and can result in the inability to discover devices on the network and in the inability to perform such routine tasks as group announcements. The IP6000 Initial Setup Procedure and Valcom VoIP Initial Setup Procedure clearly outlines the network requirements for Valcom IP6000 IP based solutions.

Should troubleshooting be required, a multicast diagnostic tool is available at www.valcom.com/esd. This software simultaneously sends and receives multicast packets to/from up to 5 multicast addresses. Installing this program on 2 PCs allows verifying multicast traffic between 2 network switch ports.
The tool is very easy to use:

a) Install the VIP-102B IP Solutions Setup Tool and the Valcom IP Solutions Multicast Diagnostic Tool on each PC that will be used for testing. Disable all firewalls and wireless NICs on these PCs for the duration of the testing.

b) Assign the PCs valid IP addresses for your VLAN and plug the PCs into the VLAN network ports under evaluation.

c) Set the send interval to the same value on all computers involved in the test.

d) Check "Echo Received Packets by Multicast", "Echo Received Packets by Unicast", “Receive All” and “Start” on one or more “remote computers”

e) Check “Send all” and “Receive all” and “Start” on a “control computer”

f) Allow the control computer to receive 50 or more packets from each remote computer.

g) Click “Stop”, then click “Details” on the control computer to verify reception of data and see calculated average round trip times from each remote computer.

This software has been run on Windows XP, 7, 8.1 and 10, but has not been tested extensively.

Unique address/port are required for accuracy (For example, setting multiple multicast addresses to use the same port will probably not return accurate counts. The total number of packets received may be correct, but it is indeterminate which particular thread will get the delivered packet)

There is a performance penalty during startup that will cause the packet delivery time to be inaccurate. Generally, the first packet or two will show a longer RTT (Round Trip Time) due to startup delays. The average RTT becomes more realistic after running for some bit of time. Allow time for 50 or more packets to be received for accurate results.

The round trip time also includes the time used to process the packets by the program itself, which adds some small amount to the total. If RTT is more than 40 milliseconds, which would be 20 milliseconds one-way, then VoIP audio could be affected.

Typically, one "control computer" will be set to "Send All" and "Receive All" but not to "Echo Packets Received By Multicast" or to "Include Unicast Response to Sender".

Other "remote computers" connected to different network ports under test will be set to "Receive All", "Echo Packets Received By Multicast" and to "Include Unicast Response to Sender", but not to send anywhere.

This will allow the "control computer" to test multicast traffic to and from each "remote computer" and also to calculate average RTT from each.

If unicast echoes back from a remote computer, but multicast does not, then the remote computer received multicast from the control computer, but was unable to send multicast back.
If neither multicast nor unicast echo back from a remote computer, then the remote computer did not receive multicast from the control computer, or was unable to send multicast or unicast back.

Refer to the following screenshots:
If successful paging is sporadic,

For example:

The first page is unsuccessful

The second page is also unsuccessful

The third page is successful and subsequent page attempts immediately following the successful page continue to work

However, if you wait for some period of time, the **failure sequence** starts over again.

(or some similar pattern)

Then it is likely that the problem is that the multicast membership in the remote subnets is not being communicated up through the network to the originating subnet. Each page opens a multicast stream (first the control, then the audio) and it all times out after some period of inactivity.

To test with Multicastdiags.exe, Start with the interval set to a value just above the time required to reinitiate the **failure sequence**, then change the interval to 5 or 10 seconds and compare the results.

If the multicast test is consistently successful at the shorter interval, but fails at the longer interval then the multicast membership in the remote subnets is **not** being communicated up through the network to the originating subnet.
Assessing Field Wiring

Audio field wiring should be accessed before connections are made to the source equipment. This is especially true in retrofit situations.

Referring to Figure 1, with points A and B disconnected from equipment,

a) Use your Volt Ohm meter to verify that there is no ac or dc voltage between point A and B. If there is, replace or troubleshoot the cable.

b) Use your Volt Ohm meter to verify that there is no ac or dc voltage between point A and Earth Ground. If there is, replace or troubleshoot the cable.

c) Use your Volt Ohm meter to verify that there is no continuity between point A and Earth Ground. If there is, replace or troubleshoot the cable.

d) Use your Volt Ohm meter to verify that there is no continuity between point B and Earth Ground. If there is, replace or troubleshoot the cable.

e) Use your impedance meter to measure across points A and B to verify that the impedance of the speaker line is suitable for the audio source being used. Refer to the chart in the Best Practices section.
   i) If lower impedance is measured then, referring to Figure 3, measure across point C and D to determine if the speaker coil has abnormally low impedance. If so, then replace the speaker.
   ii) If there is little or no change, then replace or troubleshoot the cable.

2) If the results indicate a lower than expected impedance or short circuit then, referring to Figure 3, measure across point C and D to determine if the speaker coil has abnormally low impedance. If so, then replace the speaker, otherwise replace or troubleshoot the cable.

Wire pairs used for voltage should also be free of short circuits and continuity to audio wiring.
Disclaimer

Note that any applicable standards by official regulatory agencies or ANSI/TIA/EIA/IEEE should always be observed. In the case of conflicting information, these standards shall prevail.

The suggestions provided may or may not be suitable for your intended application. Please consider this information carefully before incorporating it into your system design. Valcom disclaims any responsibility for accuracy or completeness.

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