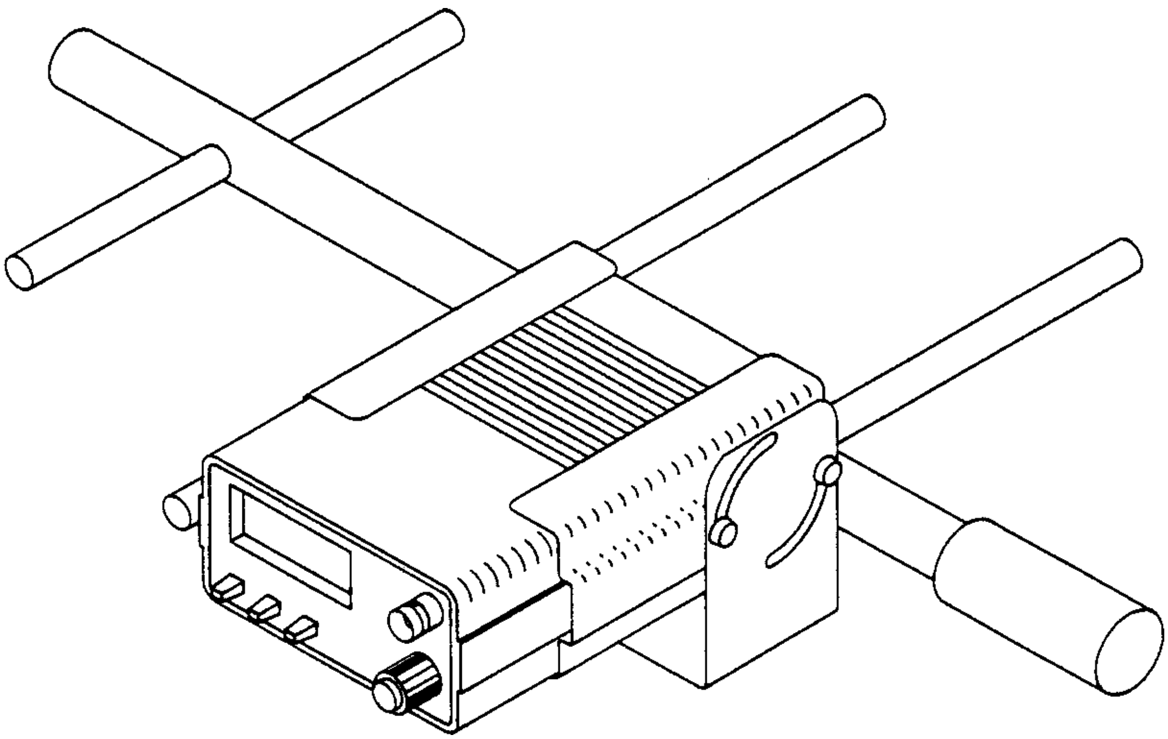
PLI-150
Power Interference Locator System

Operation Manual



TRILITHIC

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Indianapolis, IN 46236

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TRILITHIC

TRILITHIC, Inc., one of the fastest growing privately held companies in the U.S. (Inc. 500, #10), is a leading supplier of test equipment to the CATV industry. Through the years, we have introduced a range of products to make CATV maintenance simpler, faster and more precise. Our contributions include the first PRACTICAL CATV sweep system (1976), the first CATV return adjustment system (1981), the SEARCHER PLUS for leakage measurement (1989) and the SUPER PLUS for overbuilt leakage and ingress measurement (1994).

Among our most popular products are the TRICORDER series of CATV analyzers (led by the new TRICORDER III, the most versatile member of the popular TRICORDER family).

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TRILITHIC products are designed and manufactured at our facility in Indianapolis, Indiana. These products are distributed by sales agents in over 40 countries.

Should you have any questions or need our service, please contact us at the address or telephone numbers below:

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DESCRIPTION

The TRILITHIC PLI-150 Interference Locator System is specifically designed to find AC power distribution structures that emit radio/TV interference. The system has both the sensitivity and directionality to quickly identify and locate all types of power TVI sources, and to “grade” suspect sources according to their interference potential.

The PLI-150 System consists of the following:

Model EM-15 Interference Receiver
AVM-3 Mobile Antenna
Mobile Mount
AFS-5 Directional Antenna

MODEL EM-15 INTERFERENCE RECEIVER

The EM-15 is a rugged, portable interference receiver optimized for detecting and measuring power TVI. The EM-15 is designed to make calibrated, repeatable TVI measurements, allowing the operator to evaluate possible TVI sources and to grade them for interference potential.

The EM-15 receiver is equipped with two types of detector: a PEAK detector and an EFFECTIVE detector. Select the detector type from the front panel.

Peak Detector

A PEAK detector measures the peak amplitude of the individual spikes in the TVI noise burst. See *THE CAUSES OF AC POWER-RELATED TVI* on page 8 for more information on the composition of power line noise.

The PEAK detector offers the maximum sensitivity but does not differentiate between the occasional noise spike and dense bursts containing hundreds of spikes. It is most useful for detecting weak sources and for work close to the headend where even low-power sources cause visible interference.

Effective Detector

The EFFECTIVE detector interprets the interference the way the eye sees it.

The EFFECTIVE detector accounts for both the density and the peak amplitude of the TVI. It is used for most calibrated measurements and for comparing the relative interference potential of several sources. The effective detector is factory calibrated so that barely visible TVI will measure at levels equivalent of – 40 dB below picture carrier levels.

Specifications

The specifications for the EM-15 are listed below.

Operating Frequency	149 MHz to 152 MHz, crystal selectable 150 MHz standard
Input Sensitivity	– 40 dBmV/meter in PEAK detector mode – 30 dBmV/meter in EFF detector mode
Amplitude Accuracy	Approximately ± 1.5 dB at 25°C
Output Indicators	Meter, calibrated in dBmV; 2 ranges. Internal loudspeaker and headphone output. Oscilloscope Output.
Power	Rechargeable NiCad battery. Internal charger options from vehicle power.
Size	1.75" x 3.5" x 5.25" (H x W x D)
Weight	1 lb. (0.45 kg)

Controls and Connectors

Refer to Figure 1 below for the operating controls and connectors.

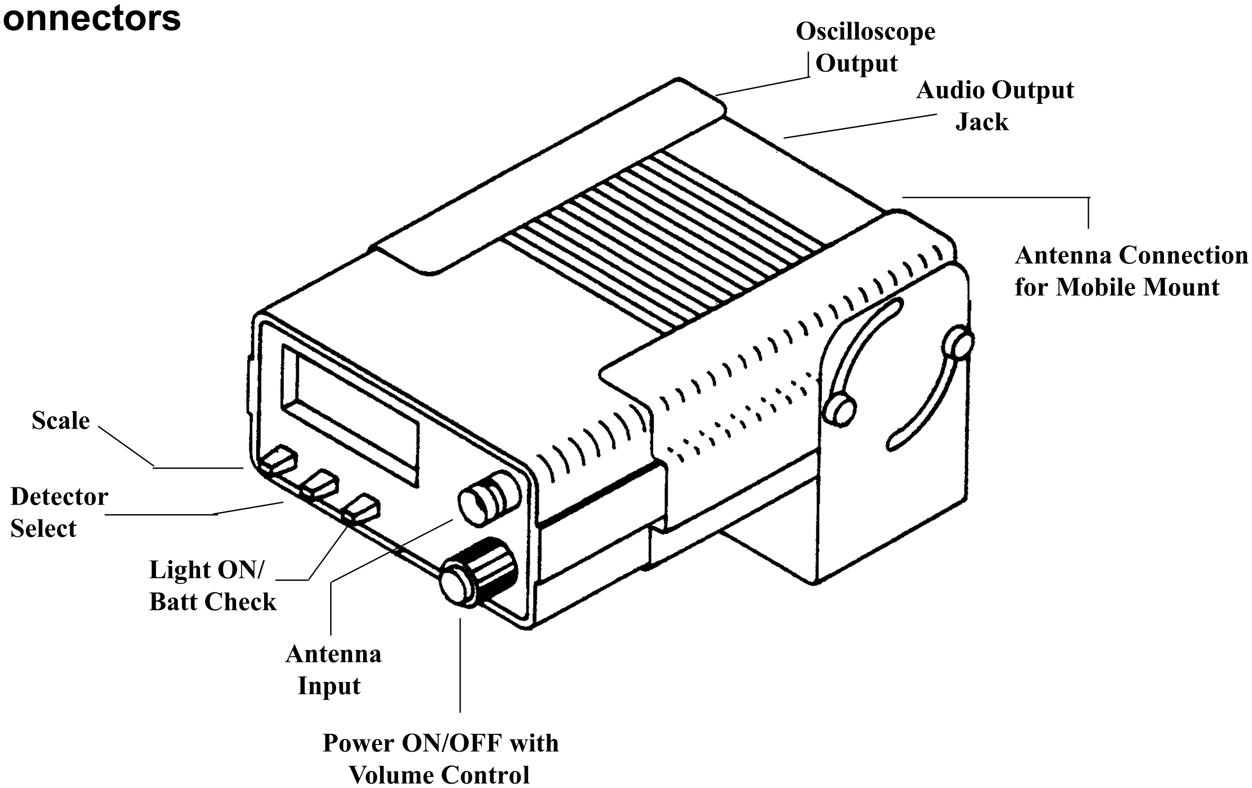


Figure 1. EM-15 Operating Controls and Connectors.

Controls and Connectors (Continued)

ON/OFF with Volume Control
Use this switch to turn the Unit ON or OFF and to adjust the Volume.

DETECTOR SELECT
This switch is used to select the PEAK or EFFECTIVE detectors.

SCALE
Use this switch to select the Receiver's sensitivity range.

LIGHT ON/BATT CHECK
Use this switch to turn the meter's back light ON. Use it to also check the battery's level.

ANTENNA INPUT (Front Panel)
Use this input to connect an antenna to the Unit.

> **NOTE:** When the Unit is installed in the Mobile Mount, this input is overridden by the antenna connection on the REAR panel.

ANTENNA INPUT (Rear Panel)
Use this connection when the Unit is installed in the Mobile Mount. It also connects the Receiver to the vehicle's power.

AUDIO OUTPUT JACK
Use this jack to connect headphones or an external audio amplifier to the Unit.

OSCILLOSCOPE OUTPUT
Use this jack to connect an oscilloscope or other test equipment to the Unit.

MOBILE MOUNT

The Mobile Mount is used to mount the EM-15 securely to the vehicle. It connects the Receiver to the vehicle's power and to the AVM-3 whip antenna.

This mount also permits connection of a user-provided oscilloscope. The Receiver may be easily removed from the mount for use outside the vehicle.

AVM-3 ANTENNA

The AVM-3 is a magnetically-mounted, quarter-wave whip antenna typically used during the vehicle survey phase of a TVI hunt. For measurement and calculation convenience, the AVM-3 is specifically designed to have a gain similar to a dipole.

AFS-5 ANTENNA

The AFS-5 is a highly directional Yagi-type antenna used to separate closely spaced, interference sources and to pinpoint sources to the nearest pole.

AFS-5 Antenna Specifications

The AFS-5 is equipped with a handgrip for easy pointing.

Operating Frequency	149 to 152 MHz. (Specify when ordering) 150 MHz standard.
Gain	6 dB vs dipole antenna.
Directivity	Mainlobe width: < ± 25 Deg @ 3 dB points. Front to Back Ratio: > 20 dB
Dimensions	35" x 39"
Weight	2 lbs (1 kg)

INSTALLATION

Refer to Figure 2 below when following the installation procedure.

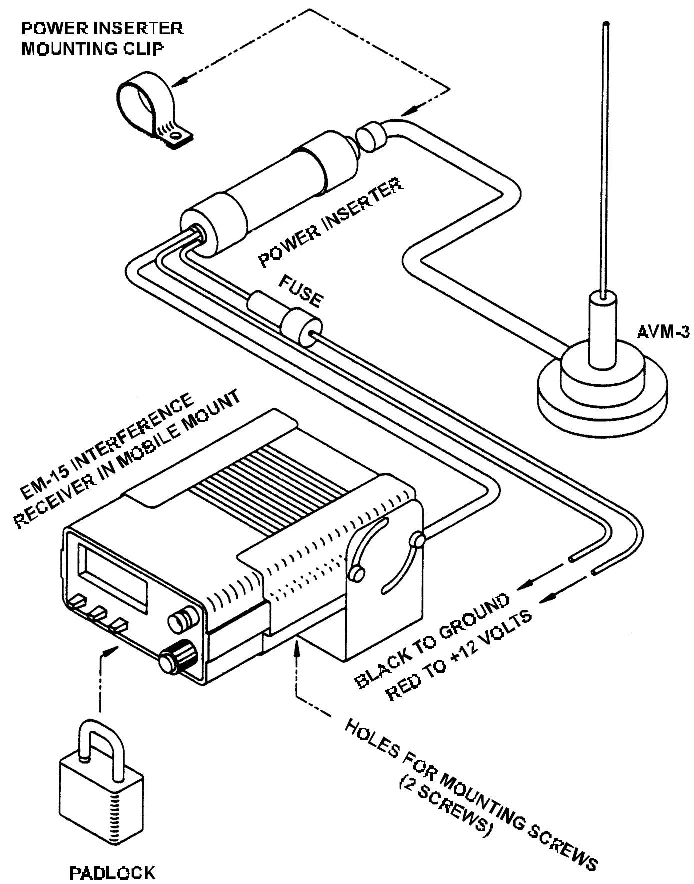


Figure 2. Installation Diagram.

INSTALL THE MOBILE MOUNT

The mobile mount may be installed in any vehicle with a +12 Volt *negative* grounding electrical system. Choose a spot in the vehicle where the receiver's front panel is readily accessible to the driver.

NOTE: Make sure that the front panel is NOT in direct sunlight.

Suitable locations include:

- The underside of the dash.
- The top of the transmission hump.
- The engine cowling in the van.

CAUTION: Do NOT install the mobile mount overhead or anywhere on the ceiling of the vehicle since the receiver may be dislodged during an accident and cause injury.

INSTALL THE MOBILE MOUNT (Continued)

The power inserter connects the receiver to the vehicle's 12 Volt system and to the downlead of the whip antenna. Securely fasten the power inserter to the vehicle with the power inserter mounting clip.

CAUTION: The EM-15 is NOT protected against reverse polarity. Make sure that the power inserter is installed correctly BEFORE you place the unit in the mobile mount.

Remember to install the optional locking feature to prevent the receiver from being dislodged in an accident.

You may also install a padlock on the device to reduce the chance of theft.

The receiver can be recharged overnight using the vehicle's power. Connect the RED and BLACK power leads to a point in the vehicle's electrical system which stays energized even when the ignition is turned OFF. The receiver will NOT drain the vehicle's battery if it is left on overnight.

CAUTION: Make sure that you route the coax and power wires so that they do NOT interfere with the safe use of the vehicle.

POSITION AVM-3 MOBILE ANTENNA

An AVM-3 mobile antenna is supplied with the PLI-150 system. Select a location on the vehicle roof which is clear of obstructions and free of interference from the vehicle's electrical system.

Place the AVM-3 at this location. Connect the downlead to the mobile mount.

INSTALL EM-15

Install the EM-15 receiver into the mobile mount. Turn the unit ON.

Select the PEAK detector and observe the meter reading. The meter should stay at the LOW end of the scale. If it does not, you may be near a source of power line interference. Move your vehicle to a quieter location and try again.

Start the vehicle's engine, heater blower and windshield wipers. The needle on the EM-15's meter should remain at the LOW end of the scale. If it does not, move the antenna to another point on the vehicle and try again.

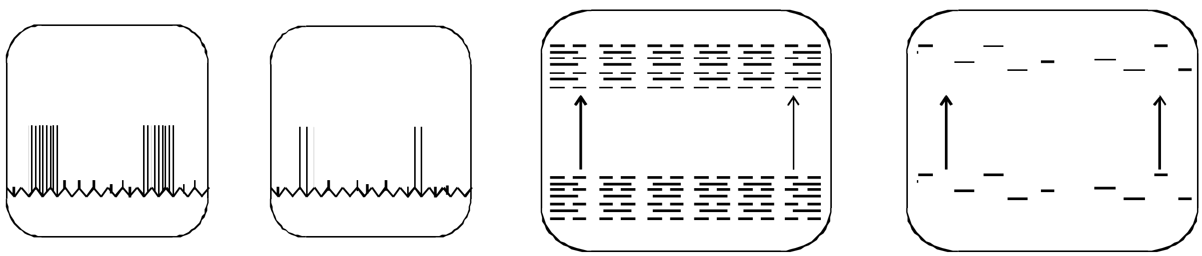
If none of the antenna locations correct the problem, you may need additional grounding on the vehicle. Install resistor spark plugs or other noise-reducing components.

TELEVISION INTERFERENCE

Power line TVI is composed of very short pulses or "spikes". These occur in bursts at the peaks of the AC sine wave. Usually, the bursts occur 120 times per second. This gives TVI its familiar, raspy "buzz" when heard in the TV audio.

Each spike in the burst produces one dot of interference on the TV screen; with a given burst containing from one to several hundred spikes.

The densest bursts, containing many pulses, produce bands of interference on the TV screen that look like noise. Dense burst interference just becomes visible at a carrier-to-spike ratio of 43 dB, when measured with an SLM, which is about the same ratio as carrier-to-noise. Dense burst interference is clearly visible at 40 dB. See Figure 3 below.



Oscilloscope Display | Oscilloscope Display | T.V. Picture Dense Bursts | T.V. Picture Low-Density Bursts

Figure 3. Television Interference Examples.

The peak amplitude of bursts containing only one or two spikes is less noticeable and must be another 8 dB stronger to be objectionable to the average viewer. See Figure 4 below.

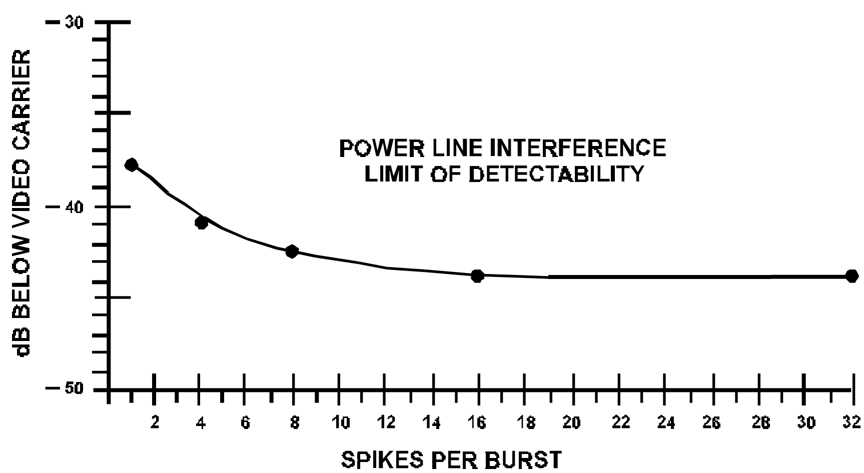


Figure 4. Relative Power vs. Number of Spikes.

The sensitivity of the eye to visible television interference or TVI varies both with the peak amplitude of the TVI "bursts" and the number of noise "spikes" per burst.

TELEVISION INTERFERENCE (Continued)

The "Effective Detector" of the PLI-150 mimics the way the eye sees interference. It includes circuitry that compensates automatically for variations in both parameters. This simplifies TVI measurements by allowing the minimum visible "carrier-to-TVI" ratio of all types of power TVI to be represented by one weighted figure, – 40 dBc.

CAUSES OF POWER-RELATED TVI

Nearly all power-related TVI is associated with HIGH voltage or "primary" power lines. RF energy is produced through the following three mechanisms:

1. **CORONA** – Corona, or "brush discharge", occurs at sharp edges and points on hardware in contact with the line. The high voltage potential at these sites ionizes the surrounding air. Since ionized air is conductive, a current flows into the atmosphere. As the individual air molecules charge and discharge, they generate RF energy. Corona is associated most commonly with lines operating at 46 KV and above.

2. **MICROGAP DISCHARGE** – Microgap discharge occurs when the field around the primary lines charge pieces of hardware that are separated by a narrow gap or a layer of corrosion. If the charge is large enough, sparks jump the gap. This ionizes the intervening air and creates RF energy. Direct contact with the primary line is not necessary so any loose pole hardware (or even the occasional rain gutter or chain link fence) near the line can be a site for microgap discharge.

3. **DEFECTIVE/DIRTY INSULATORS** – Defective or dirty insulators are a common source of noise in older power distribution systems. Water and dirt enter cracks or thin spots in the ceramic glazing. This sets up a thin path from line to ground. To the electrical current, the path looks like a series of microgaps. This may produce a TVI with a similar pattern.

THE TVI "THRESHOLD"

To be visible, TVI power can be no more than 40 dB below the affected video carrier. Consequently, the minimum power of visible TVI can be deduced by measuring the video carrier strength and subtracting 40 dB. The actual TVI power reaching the headend may be greater than this amount but, to be visible, it cannot be less.

This "TVI threshold", when adjusted for the frequency and antenna type of the PLI-150, can be used to estimate the effect of any located TVI source on the headend's picture quality; regardless of its distance or direction from the headend.

This is due to the fact that TVI "signal strength" DECREASES with distance from the source in a predictable manner, just as the strength of a video carrier does. A few simple calculations will indicate if the signal from a given TVI source will arrive at the headend stronger than the TVI threshold. Any source that does so will cause visible TVI.

PROCEDURE FOR LOCATING TVI SOURCES

The ideal search strategy would pinpoint the power line TVI source to the nearest pole; close enough to call in the power company for troubleshooting and repair. The following procedure will usually accomplish this. It does not require previous TVI-hunting experience or knowledge of the potential TVI sources in the search area.

The search strategy consists of four procedures:

- Calculate the amount of interference power arriving at the headend

HOT TIP
You can use a TV to estimate TVI. See ESTIMATING AMOUNT OF TVI USING A TV *on page 22*).

- Conduct a methodical field survey to find possible sources.
- Estimate the strength of TVI from the detected sources arriving at the headend.
- Revisit each likely source to determine which is the cause of the current TVI problem.

CALCULATE THE TVI THRESHOLD

The object of this procedure is to develop a "yard stick" against which you may determine if a source found during your field survey could be the cause of your TVI problems.

Use a signal level meter to measure the TV carrier of the affected channel at the output of the headend antenna.

1. Subtract 40 dB from the reading to obtain an estimate of the minimum visible TVI signal level.
2. Refer to the data sheet for the affected headend antenna. Subtract the gain of the headend antenna from the results obtained in step 1 above.
3. Look up the appropriate frequency correction factor in Table 1 below.

Table 1. Frequency Correction Factors for VHF Channels.

Frequency Factor = 20*Log (150 MHz/Ch. Frq.) – 20*Log (0.021*Ch. Frq.)

Channel		Frequency Factor dB
2	55.25	7.4
3	61.25	5.6
4	67.25	4.0
5	77.25	1.6
6	83.25	0.3
7	175.25	– 12.7
8	181.25	– 13.3
9	187.25	– 13.8
10	193.25	– 14.4
11	199.25	– 14.9
12	205.25	– 15.4
13	211.25	– 15.9

CALCULATE THE TVI THRESHOLD (Continued)

4. Correct for the difference between the affected channel's frequency and that of the PLI-150 by subtracting the factor found in step 3 from the results obtained in step 2. This should give you the TVI threshold.

5. Retain the TVI threshold for later use in analyzing TVI sources.

FIELD SURVEY

Once you have estimated the threshold TVI, you need to conduct a methodical field survey. During this procedure, you will conduct a systematic search to identify sources of TVI around your system's headend. These sources will then be measured to determine which are close enough and strong enough to contribute to the problem.

Preparation

There are two ways to organize a search: the Drive/Cruise Method and the Search Map Method.

DRIVE/CRUISE METHOD

In the Drive/Cruise Method, you drive near primary lines and substations; jotting down the locations and measured TVI power ("hotspots") whenever the readings pass through a peak.

After the search, each of these "hotspots" is evaluated individually using calculations (see *ANALYSIS OF SURVEY DATA* on page 18,) to decide which locations are potential causes of interference. The advantage is that this method requires little preparation. The disadvantage, however, is that most analysis must be postponed until the drive out has been completed.

This approach is most appropriate when the headend is located in a rural or residential area which has little commercial development and few potential sources of interference.

SEARCH MAP METHOD

In the Search Map Method, you can pre-calculate the interference levels to look for at various distances and angles; marking them on a map before you even begin the survey. The advantage of this method is that this precomputed search map equips you to evaluate sources as they are found. Its disadvantage is that it does require more effort with regard to preparation.

This approach is most efficient for urban, industrialized areas which have many potential TVI sources per square mile.

Preparing a Search Map

A typical search map is created by adding notations for distance from the headend and angle from the main lobe to an ordinary strand map (see Figure 6 below). For each distance, the TVI threshold is indicated for several angles.

When you are surveying the search area, you can use the map notations to determine if a detected TVI source might cause interference problems. You only need to record a located source if its power is greater than the noted threshold for its location. Later, you can return to each of the "hotspots" to pinpoint the exact location of the TVI and to confirm the survey measurement.

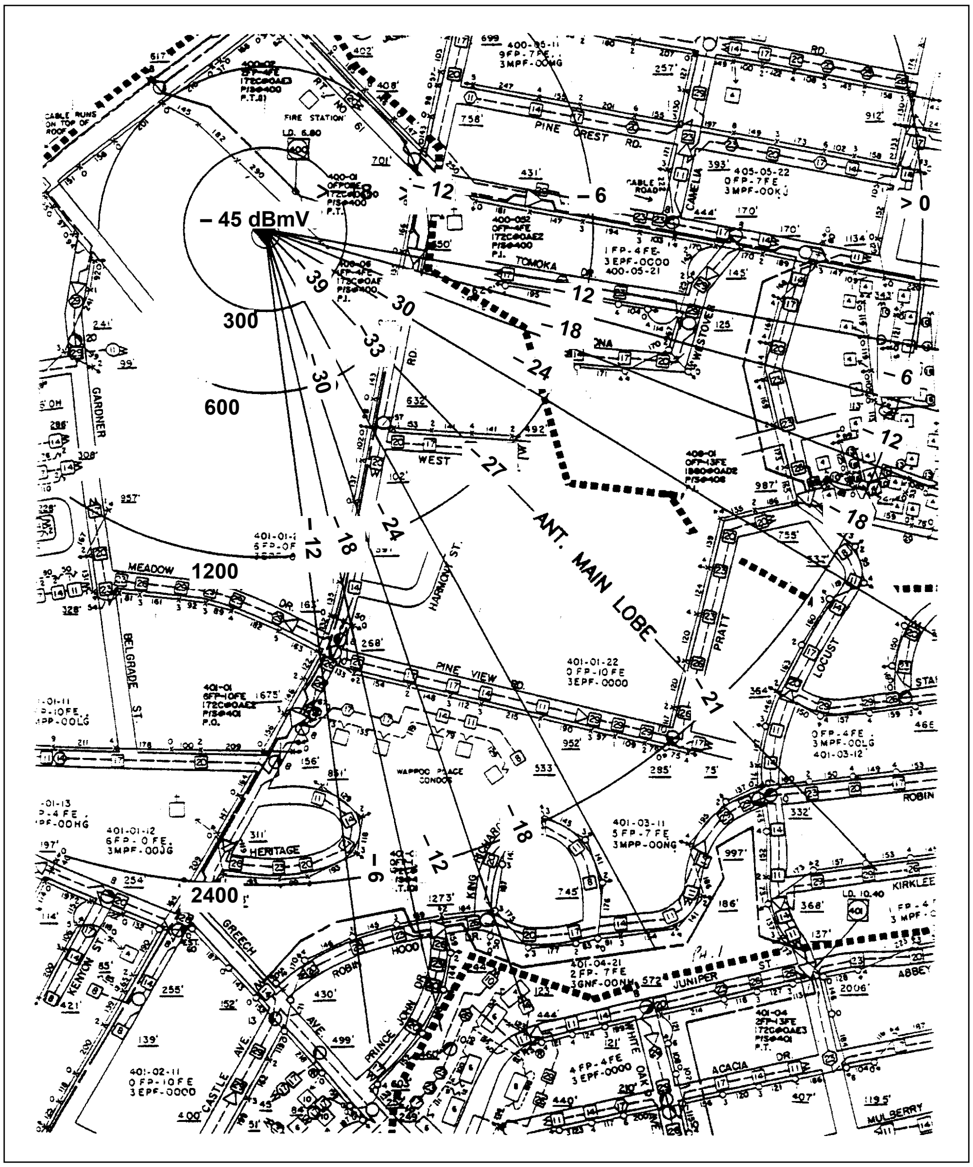


Figure 6. Sample Search Map.

Preparing a Search Map (Continued)

Use the following procedure to prepare your search map. The following calculations, computed in order, will first determine the TVI Threshold along the headend's antennas' line-of-sight. Further calculations will then determine corrected thresholds for various angles from the line-of-sight.

1. Obtain a large scale map of the area to be searched. The map must include the headend site as well as show distances of at least 5000 feet in front of the antenna and 1000 feet behind.

2. Draw a line from the headend to the edge of your map; in the direction of the off-air source being interfered with. This line represents the center of your antenna's "main lobe" or the direction in which the antenna is most sensitive.

3. Using the headend as the focus, draw rings on the map which represent distances of 300 feet, 600 feet, 1200 feet, 2400 feet and 4800 feet from the headend.

4. Tables 2 and 3 below show the relationship between distance and path loss. These two charts allow you to compute your calculations for different measurement distances between PLI-150's measurement antenna and the TVI source.

   Table 2 requires a measurement distance of 30 feet while Table 3 requires a measurement distance of 50 feet.

Table 2. Path Loss/Measurement Distance = 30 Feet.

Add to H.E. Level	FT. From Headend	Add to H.E. Level	FT. From Headend	Add to H.E. Level	FT. From Headend
dB: 0	30	26.0	600	35.6	1800
4.4	50	27.4	700	36.5	2000
7.4	70	28.5	800	38.1	2400
10.5	100	29.5	900	39.4	2800
16.5	200	30.5	1000	40.6	3200
20.0	300	32.0	1200	41.6	3600
22.5	400	33.4	1400	42.5	4000
24.4	500	34.5	1600	44.4	5000

Table 3. Path Loss/Measurement Distance = 50 Feet.

Add to H.E. Level	FT. From Headend	Add to H.E. Level	FT. From Headend	Add to H.E. Level	FT. From Headend
dB: 0	50	22.9	700	32.0	2000
2.9	70	24.1	800	33.6	2400
6.0	100	25.1	900	35.0	2800
12.0	200	26.0	1000	36.1	3200
15.6	300	27.6	1200	37.1	3600
18.1	400	28.9	1400	38.1	4000
20.1	500	30.1	1600	40.0	5000
21.6	600	31.1	1800		

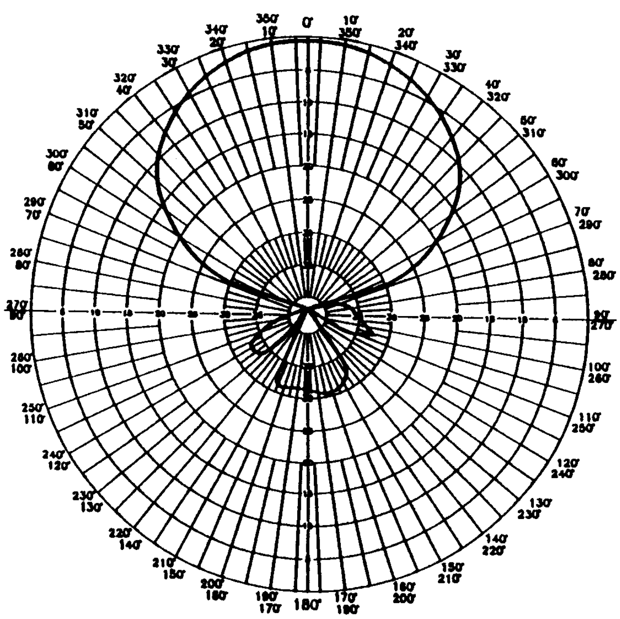
Preparing a Search Map (Continued)

Look up the path loss in Table 2 for each of the distances which you marked on your search map in step 3 on page 13.

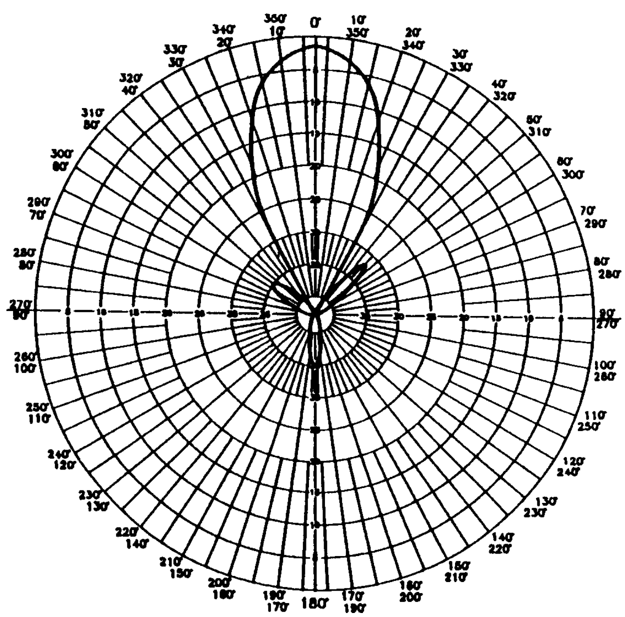
5. Look up the path loss in Table 3 for each of the distances which you marked on your search map in step 3 on page 13.

   On the appropriate points along the main lobe line, mark the sum of the estimated TVI threshold (see *CALCULATE THE TVI THRESHOLD* on page 10) and the path loss for the respective distance.

6. From the antenna manufacturer's catalog, obtain a polar plot of your headend antenna (see Figure 7 below for examples of one-bay and four-bay antennas).



Typical 2-Bay Antenna



Typical 4-Bay Antenna

Figure 7. Sample Polar Plots.

READING POLAR PLOTS

Antenna directivity attenuates signals arriving at angles to the antenna's main lobe. To calculate the amount of attenuation, you need to know the signal source's angle and the pattern of the antenna. Antenna manufacturers supply pattern information in a convenient form called a "polar plot".

Preparing a Search Map (Continued)

This plot shows angles as lines radiating from a central point which represents the antenna site and levels of attenuation as concentric circles. The inner circles represent progressively greater attenuation.

In the 4-Bay antenna in Figure 7 on page 14, the plot shows that a signal arriving from directly in front of the antenna would not be attenuated. A signal at 10 degrees would be attenuated 3 dB while a signal at 25 degrees would be attenuated 18 dB.

7. Determine the approximate angles on the polar plot that correspond to attenuations of 3, 6, 12 and 18 dB, as indicated on the polar plot.

8. On the search map, draw radial lines at these angles from the headend through the distance rings on both sides of the line-of-sight.

9. Where each radial line crosses a distance ring, mark the sum of the attenuation for the corresponding angle and the line-of-sight TVI threshold power for that distance. Do this for all intersecting points.

   REMINDER: As you move to the side of the line-of-sight, you are moving out of the more direct line of interference. Therefore, a greater TVI signal is needed to cause interference.

   For example: Refer to the search map on page 13. Locate the 2400 distance marker. The main lobe TVI threshold is – 21. The first line on either side of the main lobe marks the angle where the antenna gain falls off by 3 dB. Therefore, the TVI required at this angle to the antenna would be:

– 21 + 3 = – 18 dBmV/m

Conducting a TVI Survey

Once your search map is prepared, you can proceed with conducting a TVI survey. Basically, you need to start at the headend to seach for TVI sources and then sweep out in progressively greater distances up to several miles.

SURVEY THE HEADEND SITE

You should start your search in the immediate area of the headend.

REMINDER: Very low intensity sources close to the tower will cause as much interference as a powerful source at a distance.

Conducting a TVI Survey (Continued)

1. Turn OFF compressors, fluorescent lights and other auxiliary equipment in the headend building itself; watching a TV monitor while you do so.

   If any of these actions cause a decrease in the TVI, turn the equipment back ON. Use the EM-15 receiver with a "rubber duck" antenna (optional purchase available for the PLI-150 system) to pinpoint the exact point of radiation.

   WARNING: When using your antennas, be EXTREMELY careful to ensure that the antenna does NOT come into contact with any power lines. Such contact results in serious injury or death.

   Power Lines + Antennas = 

2. If you determine that the TVI source is not in the headend building, survey the surrounding "yard" carefully.

   Since the area involved is small, no more than 100 yards on all sides of the tower, you can cover the area on foot; using the EM-15 receiver and the AFS-5 directional antenna. Almost any detectable source, being so close to the antenna, is a potential source of interference.

   Record the level and location of any detected TVI sources for later analysis.

   NOTE: When using the AFS-5 antenna, subtract 6 dB from all meter readings to compensate for antenna gain. When you make sensitive measurements near the headend, use the PEAK DETECTOR Mode.

VEHICLE SURVEY

If you determine that the interference is NOT in the area of the yard, you should proceed with the vehicle survey.

1. Insert the EM-15 receiver into the mobile mount and place the AVM-3 whip antenna on the roof of the service vehicle.

   Set the DETECTOR switch to EFF. Verify that the vehicle's engine, heater fans, alternator, etc., do NOT generate enough noise to disturb the meter of the receiver. If the vehicle noise is to HIGH, see *INSTALLATION* on page 6.

2. Conduct a methodical drive out. Survey to a distance of at least 500 feet behind the headend antenna and 5000 feet in front of it.

Conducting a TVI Survey (Continued)

Survey all lines of poles in the search area that carry primary power lines.

NOTE: If later analysis indicates that no significant TVI sources were found during the survey, increase the search radius and try again. See *ANALYSIS OF THE SURVEY DATA* on page 18.

3. Drive slowly through the search area. Observe the meter readings of the EM-15 and note whenever increasing meter readings indicate that you are approaching a source.

   NOTE: An increase in the EM-15's audio should help to alert you.

   TVI can travel great distances along primary lines so you may need to drive for a block or two after detecting TVI before reaching the source.

4. Measure the source at the point of maximum TVI signal. When you take the measurement, maneuver the vehicle **SAFELY** so that the whip antenna is approximately 30 or 50 feet (which ever distance you used to make your TVI threshold calculation) from the primary lines. This maneuver is necessary to ensure accurate measurements.

5. If you are using a search map, note whether the meter reading exceeds the threshold value noted for the location. Record the measurement on your map ONLY if it exceeds the threshold value.

   If you are not using a search map, record all TVI source readings and locations for later analysis.

POTENTIAL PROBLEMS

As in hunting for signal leakage, TVI hunting requires a little "art".

1. As the point of peak power is approached, standing-wave effects in the primary power lines may cause periodic fluctuations in the meter reading. Make certain that these are not interpreted as peak readings. Drive along the line of poles until you are sure that you have found the point of maximum TVI signal.

2. Two or more sources may be close enough to be received simultaneously by the whip antenna. The EM-15's audio will alert you since you will hear both sources.

   NOTE: The PLI-150 also has an output for an oscilloscope for operators who prefer to work with visual "signature".

   Use the sound and meter readings to resolve the sources.

Conducting a TVI Survey (Continued)

3. If you cannot determine the location of a source, the source may actually be several sources which are spaced very closely together. It may also be a "diffused" source which is caused by many defective insulators in one area.

   If you encounter this situation, map out the general area of the source(s) and defer more precise measurements until you can return to the site with a directional antenna.

ANALYSIS OF SURVEY DATA

Once you have completed your vehicle survey, you need to analyze the resulting data. The object of this procedure is to determine which of the sources you encountered during the drive out could be causing your TVI problem. Later, we will return to those likely areas to make a more precise determination.

Analysis of Search Map

Little post-survey analysis is needed if you used a search map during your vehicle survey. By having compared your readings as you made them to the marks on your map, you have already determined which TVI sources warrant a follow-up with a directional antenna.

Analysis Without Search Map

If you did not use a search map, you need to "grade" each of the sources recorded during the vehicle survey to determine which is capable of causing interference at the headend.

1. First, organize your survey data. Make sure that your notes include the measurement distance (30 or 50 feet) at which each reading was taken.

   Use a map to estimate each source's distance from the headend as well as the angle from the headend antenna's main lobe.

2. Consult Tables 2 and 3 on page 13. If a given source was measured at 30 feet, use Table 2. Use Table 3 if the source was measured at 50 feet.

   Look up the path loss for the source's distance from the headend. Subtract the path loss from the source's reading which you recorded during the survey.

3. Consult the polar plot for the affected headend antenna. Refer to *READING POLAR PLOTS* on page 14. Look up the attenuation value for the TVI source's angle from the main lobe. Subtract this value from the results of step 2 above.

4. Earlier, you calculated the minimum TVI signal that could cause visible interference or the TVI threshold (see *CALCULATE THE TVI THRESHOLD*, page 10). Subtract this amount from the results of step 3 above to obtain the "dB-over-threshold" amount for the subject source.

Analysis Without Search Map (Continued)

5. The interference potential of the source is proportional to the amount calculated in step 4 on page 18.

   If this amount is a *negative* number, the subject TVI source is not strong enough to be a concern (is below the threshold).

   If the amount is a *positive* number, the source is probably strong enough to cause visible interference. For an example, refer to Figure 8 below.

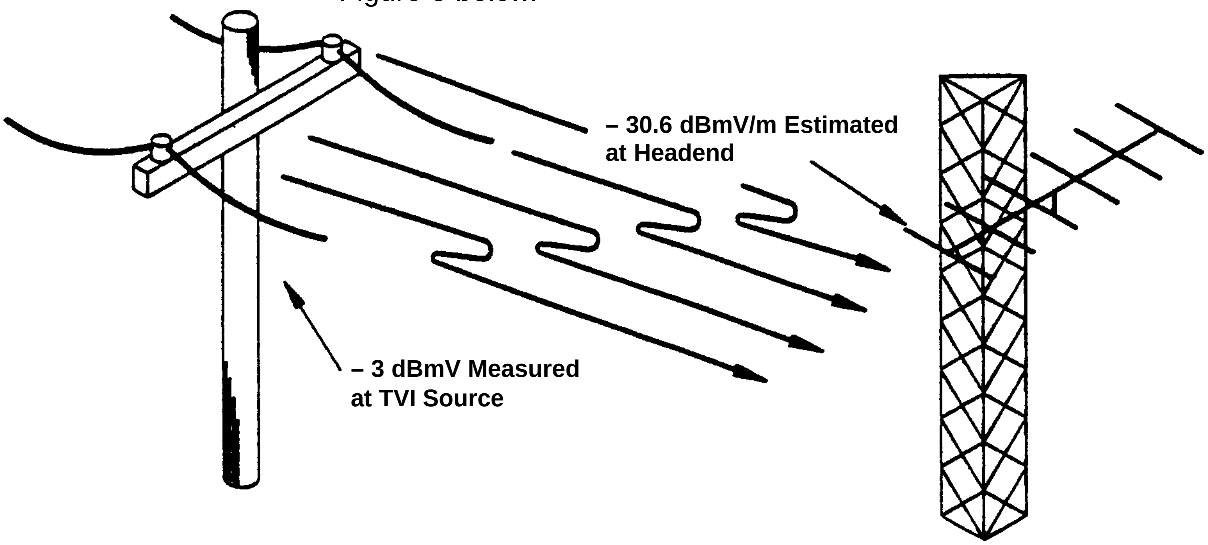


Figure 8. Is This TVI Source Causing Problems?

For Example: In Figure 8 above, the video carrier of Channel 3 was measured at – 4 dBmV using a signal level meter. Consequently, the interference energy must be arriving at the headend at a level GREATER than – 44 dBmV.

Adding the appropriate Frequency Factor from Table 1 on page 11 converts this figure to the measurement conventions of the PLI-150 receiver. The resulting figure, – 38.4 dBmV/m, is called the "TVI threshold".

During the subsequent search, a suspect source was found 1200 feet from the headend; centered in the headend antenna's main lobe. Using a mobile antenna, the operator measured the source at – 3 dBmV/m from a distance of 50 feet.

Is this TVI source strong enough to cause visible interference?

Taking path loss into consideration, the TVI energy will arrive at the headend with an effective power of:

– 3.0 dBmV/m	(TVI power at source, measured at 50 feet)
– 27.6 dB	(Distance Factor for 1200 feet from Table 3)
– 30.6 dBmV/m	

Since this amount is more than 8 dB above the TVI threshold of – 38.4 dBmV/m, this source is likely to cause visible interference.

Analysis Without Search Map (Continued)

6. Repeat the procedure (steps 2 through 5) for EACH recorded TVI source.

7. Organize the results of the analysis. Rank the detected TVI sources by their relative "dB-over-threshold" values; placing the most disruptive at the top of the list. List the recorded meter reading and location for each source.

PINPOINT TVI SOURCE

Once you have analyzed the survey results, you should be able to pinpoint the TVI sources to the nearest pole. In this procedure, we will conduct more precise, on-foot measurements in order to determine the EXACT location of the potential TVI sources which were noted earlier (see *ANALYSIS OF SURVEY DATA* page 18). We can then verify which of these TVI sources has the highest likelihood of contributing to your TVI problem.

1. Return to the each of the TVI hotspots which indicate a potential interference.

2. Remove the EM-15 receiver from its mobile mount. Make sure that the batteries are charged.

   Connect the EM-15 to the AFS-5 directional antenna.

3. Swing the EM-15 with the attached antenna up and down as well as side to side.

   Watch the receiver readings. Walk in the direction of the increasing TVI strength. Pointing of the EM-15 will become more precise as you move closer to the source.

   Occasionally, rotate the antenna along its axis so that the tips of the elements point up and down. This may also improve pointing accuracy if the TVI RF field is polarized.

   Continue until you have identified the pole which carries the TVI source.

   WARNING: Never place the EM-15 or any of its accessories or antennas closer than 20 feet from any power line. Serious injury or death may occur.

   Power Lines + Antennas = 

4. If your first attempt does not resolve the source, try coming toward the spot from a different angle. If your best efforts are unable to determine the precise site of the TVI source, you may have found an an area containing numerous defective insulators.

PINPOINT TVI SOURCE (Continued)

Fortunately, power field engineers are equipped with ultrasonic devices which can resolve such sources. Mark the general area on the map as a possible insulator problem.

5. With the AFS-5 directional antenna at a distance of 30 or 50 feet from the located source, measure the TVI power. Subtract 6 dB from the reading to compensate for the gain of the directional antenna.

   If the result is different from the measurement made during your survey, repeat the survey analysis (see *ANALYSIS OF SURVEY DATA*, page 18). If the value is still *positive*, record the new "dB-over-threshold" value and mark the source on the map as CONFIRMED.

6. Repeat the procedure for EACH TVI source.

7. Organize your data. Rank the confirmed TVI sources by their relative "dB-over-threshold" values; with the most disruptive one at the top of the list.

   Note the recorded meter reading and the location of each source. This list serves to document your TVI search results and will be useful in discussions with the power company.

FIXING THE PROBLEM

Now that the suspected TVI sources have been pinpointed and the search data has been assembled and organized. It is time to meet with the power company.

> **CAUTION:** Do NOT test your conclusions by heaving on ground-wires, pounding poles or other actions that could damage the pole or distribution hardware.
>
> Such actions can be very dangerous (loose hardware might just come apart). These actions are also unnecessary. Power company troubleshooting crews are equipped to verify your findings and to zero in on the specific insulator or piece of hardware causing the problem.

LONG TERM PROGRAM

It is a good practice to repeat the vehicle survey at regular intervals. Some sources are very intermittent and only pop up every few days or weeks. New sources appear routinely and it is preferable to deal with them as soon as they appear. The groundwork performed earlier will remain valid for a long time. Thus, repeating the survey can be as simple as leaving the receiver turned on as the truck is driven on other business.

ESTIMATING AMOUNT OF TVI USING A TV

You may estimate the amount of TV interference at the headend by observing its effect on TV reception. Having such an estimate of severity may be useful in conducting quick searches for strong sources.

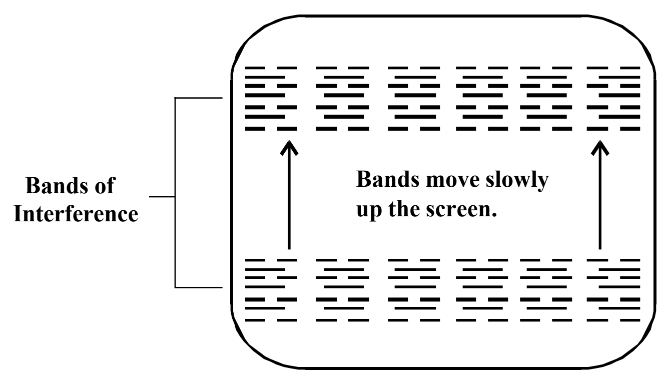
Within very broad limits, you can estimate the TVI-to-Noise ratio by observing the effect of the interference on a TV set. It is sometimes useful to know wether the interference source you are hunting is only slightly above the visibility threshold or considerably above it.

Symptoms vary slightly with the design of the particular TV used to view the interference.

1. At an effective TVI-to-carrier ratio of 40 dBc, the interference is just visible as pale gray dots.

2. As the TVI-to-carrier ratio approaches – 30 dBc, the gray dots become dashes of saturated black and white.
3. By – 20 dBc, the TVI is strong enough to interfere with the video sync and will cause horizontal "pulling". "Buzzing" may be audible in the TV audio during quiet moments.

4. Above – 10 dBc, the TVI will disrupt the set's AGC. White or black streaks and bars of interference will span the screen while overall luminance may be unstable. Sections of the picture may lose sync entirely.



T.V. Picture