WHY AND HOW TO MEASURE CCTV CAMERA OUTPUT IMPEDANCE

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WHY THE 75 OHM STANDARD

The vast majority of coaxial cables are either 50 Ohm or 75 Ohm Characteristic Impedance. This Characteristic Impedance is determined by the ratio of the diameters of the shield and core wire and the Dielectric Constant of the insulating material between the core wire and the shield. The CCTV Industry chose to use the 75 Ohm standard for coaxial cable.

Since a coaxial cable must be terminated at both ends of the cable with resistances equal to the cable Characteristic Impedance to prevent reflections from impairing the picture, cameras must have an internal source impedance of 75 Ohms, and Monitors must be provided with a 75 Ohm termination.

THE PROBLEM

In the past, CCTV cameras could be counted on to have proper 75 Ohm source impedances, but recently there have been a rash of cameras showing up on the market that do not have a 75 Ohm source impedance. In fact they exhibit an almost zero output impedance even though the specification sheets that come with them specify 75 ohms! Clearly the cameras do not meet their own specifications and thus could be returned for not meeting their own published specifications.

PROBLEMS CAUSED BY INCORRECT TERMINATIONS

The worst of mis-termination problems occur when the camera has a zero source impedance, or the 75 Ohm impedance is left off at the Monitor location. By far the worst effects occur when both zero Ohm source impedance exists and the 75 Ohm termination is removed at the Monitor.

Ghosts and Ringing become more evident as the length of the coaxial cable becomes greater. The ringing effect (where a white-to-black or black-to-white transition in the picture is repeated many times in close succession) occurs with short cable runs of 50 to 200 feet. Obvious Ghosts appear when the cable is 500-1000 feet long. The first of many successive Ghosts will be about 1/2 inch to the right of the original object on a TV monitor screen with about 1000 feet of cable.

Another problem caused by zero source impedance cameras is that signals placed on the coaxial cable to control Pan and Tilt of the camera will be shorted out by the zero Ohm output of the camera and may cause remote Pan and Tilt systems to be intermittent or fail.

The same intermittent or failed condition may be induced into other equipment that is using the same coaxial cable to transmit special signals. The key idea here is that such intermittent or failed conditions are caused by a CCTV camera with a zero output impedance, not a failure in the Pan and Tilt or other equipment.

THE SOLUTION

Buy only CCTV cameras that exhibit 75 Ohm output impedance! But how can you be sure a particular camera really has 75 Ohm output impedance when the spec sheets for that camera proclaim 75 Ohms? The answer of course is to test the output impedance yourself before installing them in the field. Unfortunately this measurement cannot be made directly with your trusty Volt-Ohmmeter. The output impedance of a CCTV camera is not a static Resistance reading, but a dynamic AC Reactance measurement.

CORRECT METHOD FOR MEASURING CCTV CAMERA OUTPUT IMPEDANCE

Connect the camera to be tested through a short 75 Ohm coaxial cable to an Oscilloscope, Waveform Monitor or CM-1 Camera Master. Arrange to be able to place a precision Termination (75 Ohms +/- 1%) at the Oscilloscope or meter. Measure the amplitude of the sync pulse with the termination in place. The sync pulse should read about 40 I.R.E (0.286 Volts Peak-to-Peak). Now remove only the 75 Ohm Termination. The sync level will Double (80 I.R.E 0.571 Volts Peak-to-Peak) if the camera has a correct source impedance. A typical defective camera well read almost the same amplitude with or without the termination on it.

An actual output impedance measurement may be made by using the formula in the following TABLE 1.

PASS / FAIL TEST (TABLE 1)

SYNC PULSE UNTERMINATED		SYNC PULSE TERMINATED			SOURCE IMPEDANCE
Vp-p	IRE	Vp-p	IRE		
0.571	80	0.286	40	PASS	75 Ohms (=/- 5%)
0.286	40	0.286	40	FAIL	NEAR ZERO Ohms

Even though exact readings will vary between various CCTV cameras, this test will suffice as a PASS/FAIL test. If a more exact measurement is desired, the following formula may be used.

CALCULATION OF PRECISE SOURCE IMPEDANCE

$$S = \frac{U - T}{T} \times 75$$

U = Unterminated Reading of Sync IRE or Voltage.
T = Terminated Reading of Sync IRE or Voltage.
S = Internal Source Termination in Ohms.