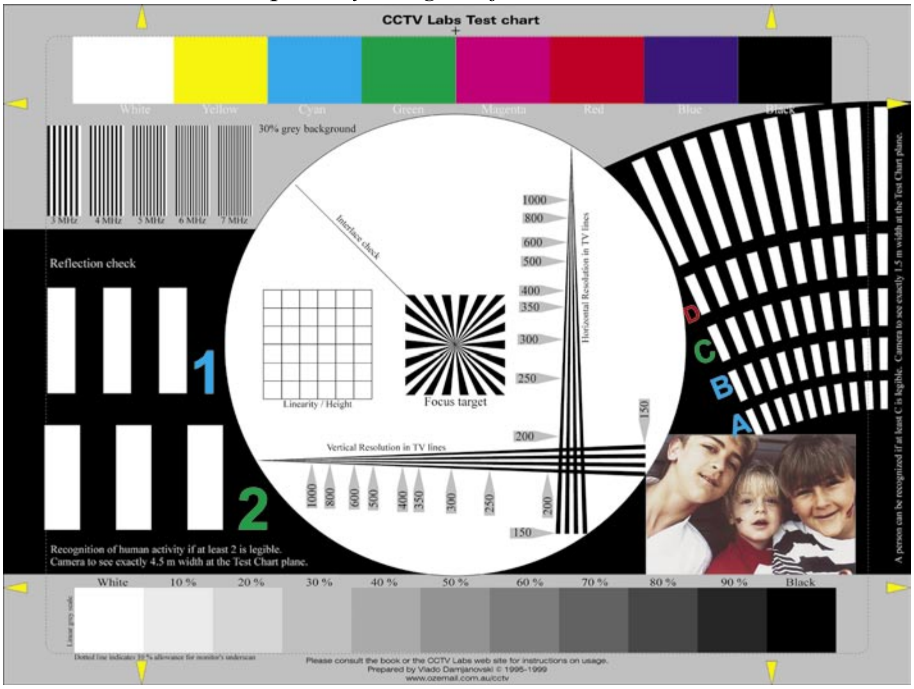
Using the CCTV Labs Test Chart

Vlado Damjanovski explains how to use this test chart, specially designed for CCTV



In order to help you determine your camera resolution, as well as check other video details, CCTV Labs has designed a special test chart.

This test chart is very accurate and informative. Various CCTV parameters can be measured with it including camera resolution, transmission bandwidth, image linearity, colour reproduction and, most interestingly, human activity and face recognition . This could be extremely useful for testing various digital recorders, video transmitters and image compression techniques.

This test chart is the second edition and appears on the back cover of the new edition of the book "CCTV" by Vlado Damjanovski, the editor of this magazine, and is now published by Butterworths Heinemann. The stand alone A3 format (300×420 mm) is the one we used for this workshop corner.

The main difference between the 1st and this test chart edition is in the additional white reference lines designed to check whether you can recognise a person at a certain distance. This procedure is based on the recommendations of **VBG (Verwaltungs-Berufsgenossenschaft)**: Installationshinweise für Optische Raumüberwachungs-anlagen (ORÜA) SP 9.7/5.

Before you start testing

For the best quality picture reproduction of your camera you first have to select a very good lens (that has much better resolution than the CCD chip itself). In order to be able to control the optical resolution of the lens, the best choice would be a fixed focal length manual iris lens.

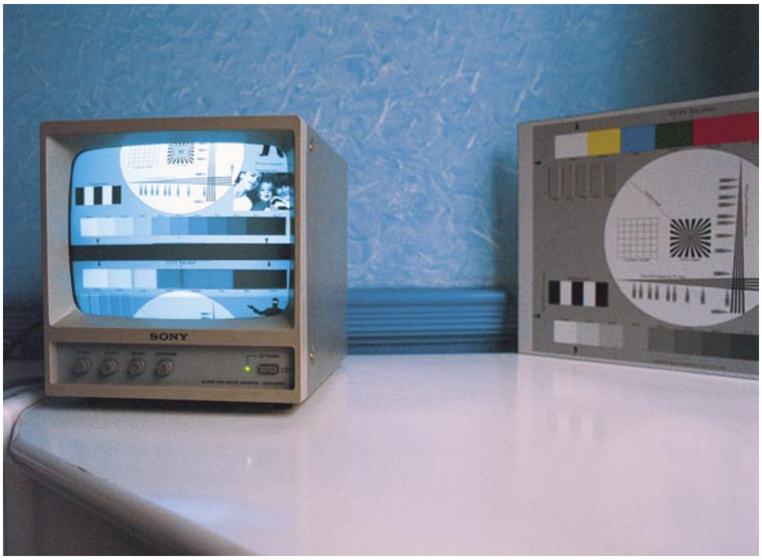
Shorter focal lengths, showing angles of view wider than 30°, should usually be avoided because of the spherical image distortion they may introduce. A good choice for 1/2" CCD cameras would be an 8 mm, 12 mm, 16 mm, or 25 mm lens. For 1/3" CCD cameras a good choice would be when 6mm, 8mm, 12mm or 16mm lens is used.

The longer focal length will force you to position the camera further away from the test chart. For this purpose it is recommended that you get a photographic tripod for the camera.

Next, you must use a high resolution monitor with an underscan feature. Most standard CCTV monitors don't have this feature.

When testing camera resolution the best choice would be a high quality monochrome (B/W) monitor since their resolution reaches 1000 TV lines in the center.

Color monitors are acceptable only if they are of broadcast, or near-broadcast, quality. To qualify for this, a monitor should have at least 500 TV lines of horizontal resolution. Understandably, B/W cameras having over 500 TV lines of horizontal resolution cannot have



their resolution tested with such a monitor, but the majority of color cameras (which have up to 480 TV lines) should be OK for testing with such a monitor.

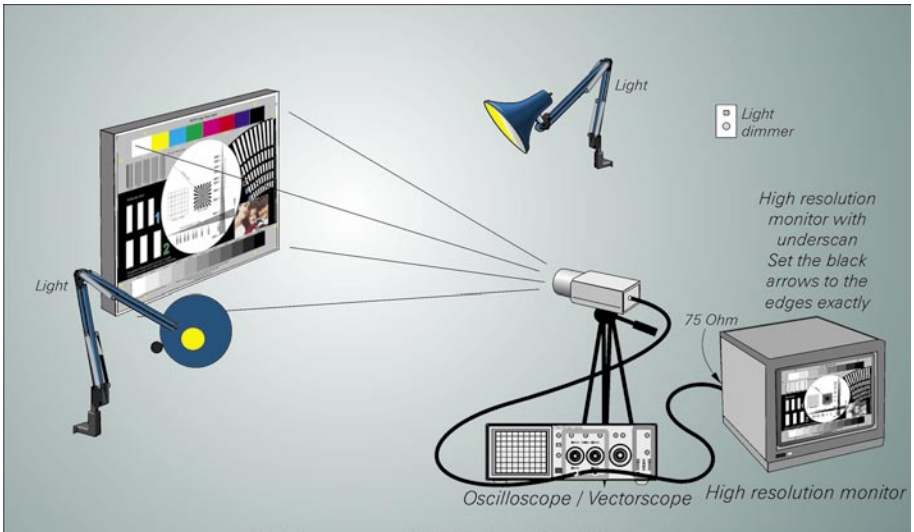
Setup procedure

Position the chart horizontally and perpendicular to the optical axis of the lens (see the diagram on the right). The camera has to see a full image of the chart **exactly** to the yellow triangular arrows. To see this you must switch the monitor to the underscan position in order to see 100% of the image.

If you do not have a monitor with an underscanning feature the dotted line around the perimeter of the chart indicates 10% narrower view, which might be close to what a normal overscanning monitor would show. This is, however, not precise for checking resolution. So, if you only have a standard monitor, the following little trick might substitute the expensive underscanning monitor:

Position the camera with its tripod as closely to displaying the full image as possible. Set the vertical hold on the monitor so as to view the vertical blanking sync signal (the horizontal black bar in between TV fields). You should be able to set the V-hold button to such a position so as to have a steady horizontal bar somewhere in the middle of the screen. Then, try to adjust the camera with its tripod and/or lens so you can see both the top and bottom positional triangles on the test chart touching the edge of the black vertical blanking bar. Once you adjust the vertical camera position it is easy to adjust the horizontal so the test chart picture is in the middle of the monitor screen. Then and only then can you read precise data from the test chart.

Illuminate the chart with two diffused tungsten lights (approximately 60 W each) on either side to avoid light reflection off the chart. It would be an advantage to have these two lights controlled by a light dimmer, because then, you can also test the camera's minimum illumination. Naturally, if this needs to be tested, this whole operation would need to be conducted in a room without any additional light. Also, if you want to check the low light level performance of your camera you would need to obtain a precise lux-meter.



Setting up a CCTV chart test bench

Position the camera on a tripod, or a fixed bracket, at a distance which will allow you to see a sharp image of the full test chart. Make sure the arrows' tips touch the underscanned picture edge or the black vertical sync bar, if you are using the alternative method described above.

Set the lens' iris to the middle position (F/5.6 or F/8) as this is the best optical resolution in most lenses and then adjust the light dimmer to get a full dynamic range video signal. In order to see this, an oscilloscope will be necessary. Don't forget to switch off all the video processing circuits in the camera you are testing, i.e., AGC, CCD-iris, BLC.

Make sure that all the impedances are matched, i.e., the camera sees 75 Ohms at the end of the coaxial line.

What you can test

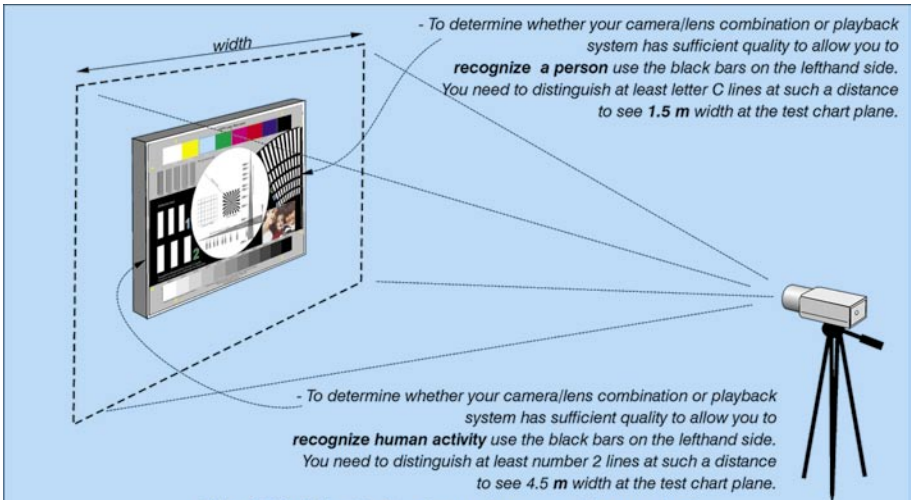
To check the **camera resolution** (either vertical or horizontal) you have to determine the point at which the four sharp triangular lines inside the circle converge into three. That is the point where the resolution limits can be read off the chart. For a more precise reading of the horizontal resolution, as per the broadcast definition, you would need an oscilloscope with a line selection feature.

If you want to check the **video bandwidth** of the signal, read the megahertz number next to the finest group of lines where black and white lines are distinguishable.

The small concentric lines in the center square of the test chart can be used for easy **focusing** and/or **back-focus adjustments**. Prior to doing this, you should check the exact distance between the camera and the test chart. In most cases, the distance should be measured to the plane where the CCD chip resides. Some lenses though, may have the indicator of the distance referring to the front part of the lens.

The circle reproduction below will show you the **linearity** of your monitor only, since CCD cameras have no geometrical distortion by design. Sometimes, linearity can be more easily checked by measuring the vertical and horizontal length of the 6 × 6 squares, left of the focus square.

The wide black and white bars on the left-hand side have a twofold function. Firstly, they will show you if your impedances are matched properly or if you have **signal reflection**, i.e., if you have a spillage of the white into the black area (and the other way around), which is a sign of reflections from the end of the line. The same can be used to test long cable run quality, VCR playback and other transmission or reproduction media. Secondly, you can determine whether your camera/lens combination gives sufficient details to **recognise human activity**, such as intrusion or holdup. For this reason you must position the camera at such a distance so as to see 4.5 m width at the test chart plane. If you can distinguish the bars, then your camera/lens combination is good for recognising activity. Obviously, reading bars at number 1 is better than number 2. Use one of the formulas in the book "CCTV" to find out the distance you have to go to with the lens you have.



The CCTV test chart can be used to evaluate practical quality of a system

The white tilted bars on the right-hand side have a similar purpose as the thicker ones on the left-hand side. If you recognise the lines near the green letter C, or even better B and A when the camera is at a distance to see 1.5 m width at the chart, then you can **recognise a person** at such a distance. A is better than B, which is better than C. Again, to find out at what distance you need to position the camera so as to see 1.5 m width, use the same formula men tioned earlier. This test can be very useful to find out if your camera/lens combination gives sufficient details. Such measurement is even more informative in determining the playback quality of a digital video recorder since there is no objective method of determining compression/decompression quality in CCTV.

The color picture of the three kids will give you a good indication of the color of human flesh, so if you are using a color camera you can check the light source color temperature and the **automatic white balance** of the camera, if any. Have in mind in that case to take into account the color temperature of your light source, which, in the case of tungsten globes, is 2800° K.

For an even more accurate color test of your camera, use the color scale on the top of the chart, which are printed colors matching the **color bars** produced by a typical broadcast **test generator**. If you have a vectorscope you can check the color output on one of the lines scanning the color bar. Like with any color reproduction system, the color temperature of the source is very important and in most cases it should be a daylight source. The gray background is set to be exactly 30% gray, which, together with the **gray scale** at the bottom, can be used to check the gamma setting of the camera/monitor. This gray scale is a linear one, as opposed to some

logarithmic scales you may find. The reason for choosing a linear scale is the fact that the majority of today's cameras are with linear response and this makes it easy to adjust various levels on an oscilloscope. The gray scale can also be used to set up the optimum **contrast/brightness of a monitor**.

To have the best possible picture setting on a monitor follow these steps:

- Set the camera to 1 Vpp video signal, while viewing the full image of the CCTV Labs test chart.
- Set the monitor contrast pot in the middle position.
- Set the brightness pot to see all steps of the gray scale. While doing this, readjust the contrast pot if necessary.
- Observe and note the light conditions in the room while setting this up, as this dictates the contrast/brightness setting combination.
- Always use minimum amount of light in the monitor room so that you can set the monitor brightness pot at the lowest position. When this is the case the sharpness of the electron beam of the monitor's CRT is maximum since it uses less electrons. The monitor picture is then, not only sharper, but the lifetime expectancy of the phosphor would be prolonged.

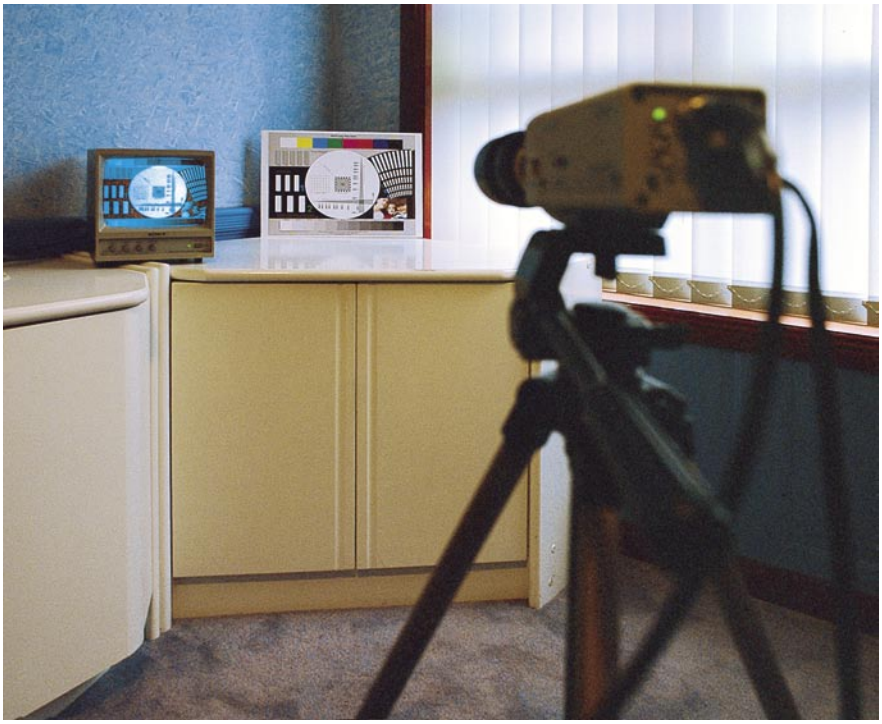
And just to repeat what we said at the very beginning, although this test chart appears on the back cover of the earlier mentioned book "CCTV", for the more dedicated CCTV technicians such a test chart is also available on a bigger A3 format, foam framed and printed on non-reflective chemical proof paper with long duration and stable colors. The cost of such chart is AUD$200 (approximately US$140) plus mail.

If you want to order one, you can use the Acrobat PDF order form on the CCTV Labs web site:

http://www.cctvlabs.com/orderbookchart.pdf

The book "CCTV" can be ordered through Butterworth Heinemann (***http://www.bhusa.com***) or CCTV Labs (http://www.cctvlabs.com).

For the latest updates and instructions on various measurements visit the CCTV Labs web site regularly at ***http://www.cctvlabs.com***. ■



Did you know

** The vertical resolution in CCTV is not usually measured as it is limited by the scanning raster, i.e., can not be increased.*

** The horizontal resolution is measured in TV lines, and not just lines, because of the aspect ratio of the current CCTV system of 4:3.*

** The horizontal resolution of a CCTV system is defined firstly by the source - the camera CCD chip, but it very much depends on the optical resolution (which is usually higher than the CCD chip, but don't take it for granted), the transmission medium quality and the monitor reproduction quality.*

** If the video signal is recorded on an analog device (VCR) its horizontal resolution is reduced to the recording format. S-VHS format has wider recording bandwidth and thus better than VHS, but most of todays CCTV cameras have better resolution than S-VHS, and far better than VHS.*

** If the video signal is recorded on a digital video recorder, the resolution is harder to measure and define as it depends on the compression type and level. The digitising framestore resolution does not mean the same image quality after compression.*

** Most colour cameras in CCTV are designed with a single colour CCD chip. The number and the density of RGB pixels greatly reduces the horizontal resolution compared to the same size chip for B/W cameras.*