BAXALL

Guide to Cameras and Lenses

PRODUCT SAFETY

⚠ WARNING

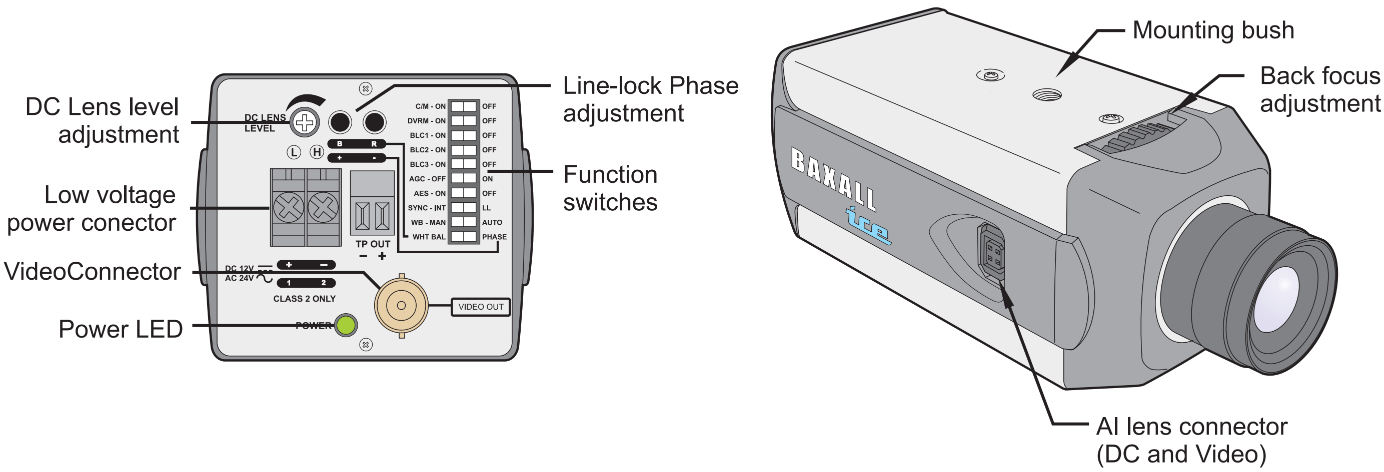
- **Installation and servicing of cameras is only to be carried out by suitably qualified and experienced personnel.**
- **Mains cameras contain hazardous voltages**
- **Do not remove camera covers as there is a risk of injury or death by electric shock.**
- **Cameras connected to mains supplies must be earthed.**
- **Only power low voltage cameras from a class 2 isolated power supply.**

Contents

INTRODUCTION

This short guide is aimed at trying to assist installers and engineers to correctly set up and understand the many advanced features of Baxall cameras.

Almost all of Baxall's cameras have similar features and functions whether they're a monochrome or colour version. Usually, the features are controlled using dip switches that are located either on the rear of the camera or behind a hinged door on the side of the camera. A label on the camera shows the settings for each feature.



Typical Camera Layout

Some cameras in the Baxall range (OSD Series), are set up remotely by means of an on-screen menu system. All the functions of these cameras can be changed or set via the video coaxial connection.

COLOUR BALANCE

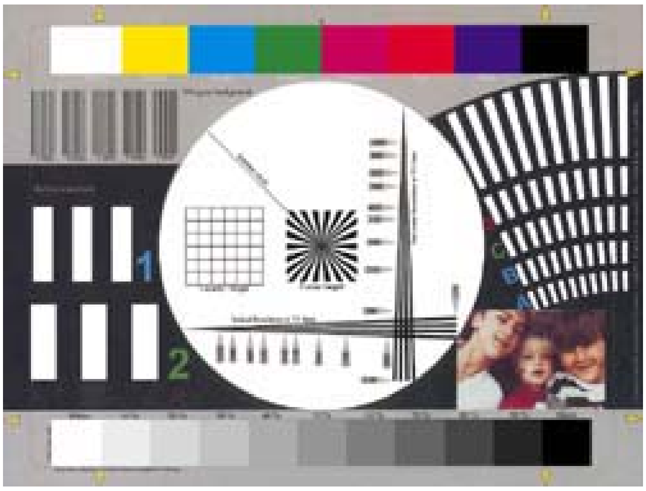
As the name implies, this feature is common to colour cameras only. Cameras that have the colour balance feature generally have four modes of use; **Indoor**, **Outdoor**, **Fluorescent** and **Auto**.

The white balance feature compensates for the temperature colour ‘casts’ that different light sources can cause. Colour casts can make white appear with a slight hue under different light sources (e.g. tungsten and fluorescent). To see the effects caused by different lighting conditions, point a camera set to auto colour mode out of a window. Allow the camera ten seconds or so to balance to the outside lighting, then point the camera indoors at a room scene lit with artificial lighting. Any white areas in the scene will show a distinct colour tint. After a few seconds the camera will automatically compensate and the white areas will be rendered correctly.

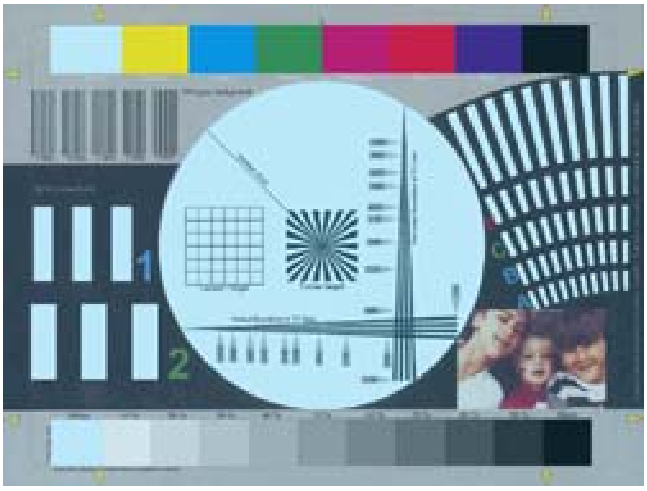
The camera cannot do this unless the colour mode is set to auto colour balance. If it isn’t set to auto, it will only correctly reproduce white for the specific lighting type it is set for. Baxall adjust the three fixed colour modes on their cameras to compensate for indoor (tungsten), outdoor (daylight) and fluorescent lighting types.

Because no single lighting type has a fixed colour temperature, accurate rendering of white cannot be guaranteed. Colour compensation should only be used if the scene being viewed contains a number of different lighting types and this causes the auto white balance circuit to ‘hunt’ as it tries to balance itself. For cameras fitted with this feature, Baxall recommend that it is always set to Auto. Figure 1 below shows typical colour casts for everyday lighting spectra.

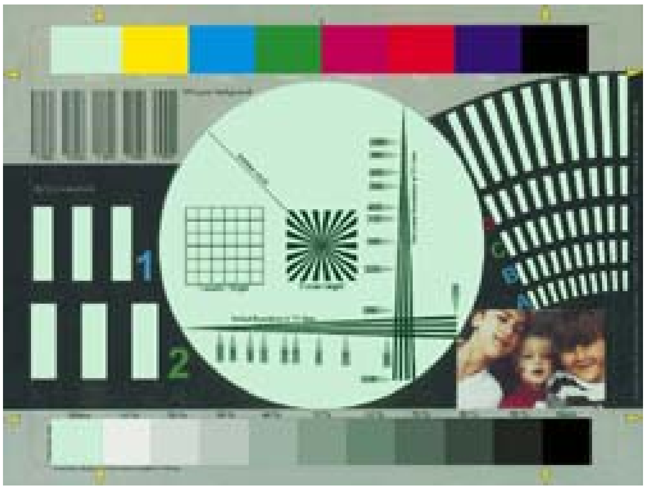
Fig. 1. Typical colour casts



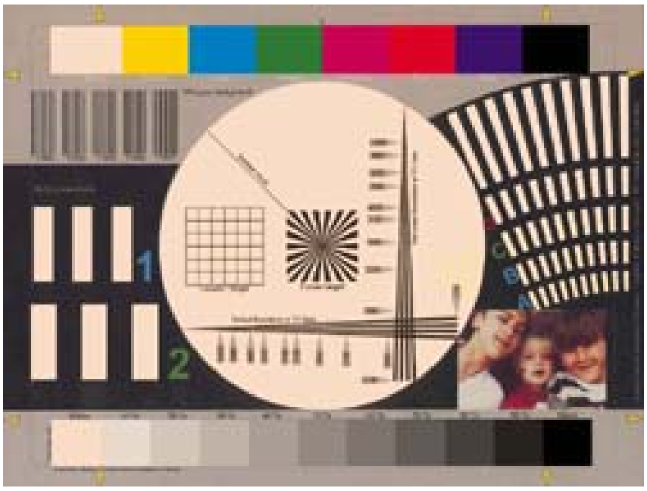
Auto White Balance on



Outdoor (natural) lighting



Fluorescent lighting



Tungsten lighting

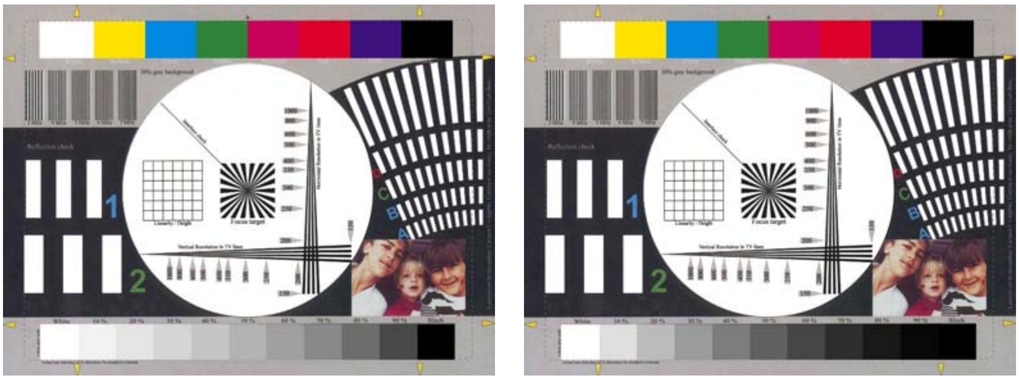
GAMMA

The reproduction characteristics of most cameras and video displays are not linear. For example, imagine a scene lit with low ambient lighting, a small change in the light level falling on the CCD will produce a given output signal. However, the same change in light level within a scene lit with strong ambient lighting will not produce the same magnitude of output signal. This non-linearity is known as gamma and it usually results in poor discrimination of grey areas in the scene at low light levels.

To compensate for this and improve linearity of the system, Some Baxall cameras have a built-in gamma correction circuit which normally has two settings. Usually specified as **Normal (0.45)** and **Linear (1.0)** (but sometimes **High** and **Low** respectively), you can choose the optimum setting for the scene being viewed.

The Normal setting has the effect of stretching the camera's response to the black and mid-grey components of the scene whilst compressing the white copmonents. This makes it easier to see differences in those shades of grey that are close to each other, and is therefore useful when more visibility is required in darker areas of the scene. However, the white compression can make it more difficult to differentiate shades of white in lighter areas of the scene. Compare the grey bars in the two images (figure 2) and notice how the Normal setting seems to reveal more of them.

Fig. 2



Normal setting **Linear setting**

AUTOMATIC GAIN CONTROL (AGC)

Baxall cameras contain a video amplifier which applies gain to the video signal as required (up to a maximum of 28dB). The circuit is designed to compensate for fluctuations in scene illumination which would cause the video output level to be too low. If the video level is adequate, the circuit will not apply any gain to the signal. As the video level drops (e.g. the scene illumination level falls), more and more gain is applied by the AGC circuit to the video signal. The camera only applies as much gain as is necessary to bring the video signal up to a reasonable level (typically 1V peak to peak).

It should be understood that the AGC circuit cannot work miracles and some light must be present within the scene. Note that as a consequence of amplifying a poor signal, the noise present in the signal is also amplified. Therefore a poorly lit scene with a lot of gain applied to it will appear noisy or grainy. This is usually accepted to the alternative of having no picture at all. The ideal solution is to provide adequate illumination for the scene wherever possible.

It is recommended that the AGC feature is left permanently switched on since it will have no effect as long as the scene illumination is adequate. When setting lens levels, switch the AGC off. This way you can be sure that the picture you are seeing is not due to the effects of the AGC circuit. After the lens level has been set up, switch the AGC back on.

ELECTRONIC IRIS (EI)

In contrast to the Automatic Gain Control, the Electronic Iris (EI) feature is used to compensate for increases in the video level. Consider a camera fitted with a manual iris lens that is being used for low light surveillance. The iris has to be left fully open so the camera's performance is not degraded. However, in bright daylight conditions, the video output level will be excessive and the resulting video display will be overexposed (white-out). The electronic iris can overcome this problem. The electronic iris feature continuously varies the shutter speed between 1/50s and 1/100,000s (1/60 and 1/100,000s for NTSC cameras) according to the light level. The 'shutter' in a CCTV camera actually regulates the time light is allowed to fall onto the imaging CCD element. Shorter duration shutter speeds allow the CCD less time to gather light (or charge) thus preventing overexposure. The EI circuit is designed to ensure the camera's video output level is maintained at the optimum value of 1V peak to peak.

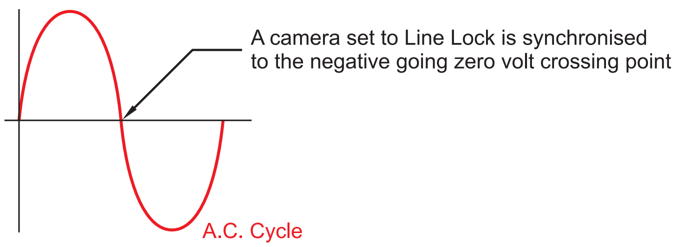
Once again, the electronic iris feature has its limitations. If too much light falls onto the CCD, it can result in the phenomena of ‘smearing’. Usually the result of bright point-sources of light such as car headlights, smearing appears as a bright band above and below the point source. The onset of smearing has reduced as CCD technology has improved, but it can still occur when the CCD is overexposed.

SYNCHRONISING CAMERAS

There are many surveillance applications where more than one camera is used—to cover a large site for example. Normally, some means of switching between cameras is employed. If the cameras are not synchronised correctly, the image on the monitor will roll as the video switcher is used to select different cameras. This is because the video output from each camera is essentially free running and frames arrive at the video switcher at different times. Baxall cameras provide several features to ensure synchronisation. The first of these is **Line Locking** and is selected by a switch on the side of the camera. When the camera is line-locked, it is synchronised using a fixed point on the A.C. supply’s cycle—usually the point that the A.C. cycle passes through zero (figure 3). Setting all of the cameras to line lock mode will ensure that they all output video frames at the same time relative to one another. Obviously, to utilise this feature, cameras must be operating from an A.C. supply and be on the same mains supply phase.

NOTE: Cameras on different mains phases can still be synchronised (see **LL-Phase Adjust** below).

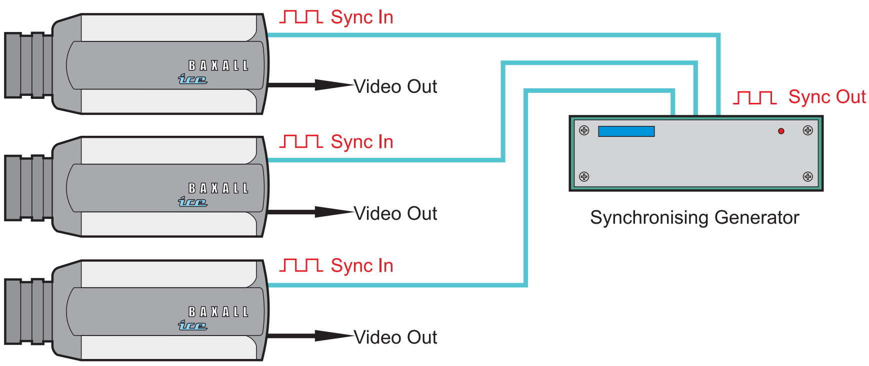
Fig. 3



The other way to achieve synchronisation is to use **Genlocking** (generator locking). Genlocking requires an externally generated synchronisation signal which is sent to each camera via a separate coaxial connection. Many Baxall cameras are fitted with a Genlock BNC to allow the connection of such a device. The generator produces an accurately clocked set of video timing signals.

Although genlocking is the best way to synchronise cameras, it has obvious disadvantages such as the need for an extra cable for each camera which can add significantly to the installation costs. In addition, the video generator will need as many outputs as there are cameras in the system. Figure 4 shows a typical genlock setup.

Fig. 4

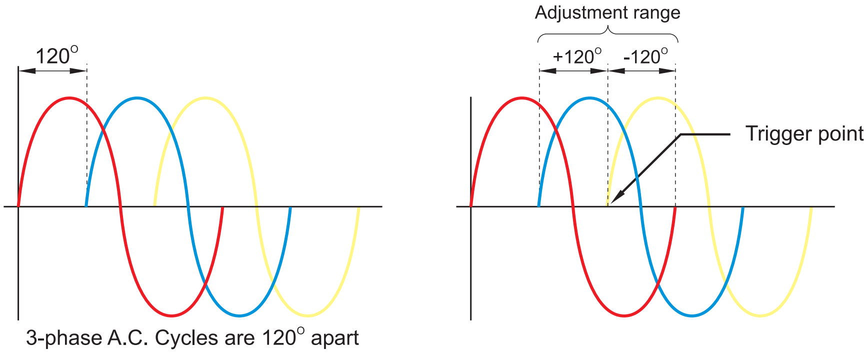


Baxall cameras also have an internal oscillator which is selected using the **Internal** mode switch. This feature can be especially useful where the camera is designed to run off a D.C. supply or if a camera designed to operate at 50Hz (e.g. PAL standard), is installed in a country where the mains supply frequency is at 60Hz. Ordinarily the camera would not be able to use the Line Lock mode. Setting it to synchronise to its internal oscillator will overcome this problem. A side effect of such a setup however may be that the lighting in the scene seems to flicker. This is caused by the discrepancy in the frequency of the camera (50Hz) and the frequency at which the lights are running (60Hz) resulting in a mild strobing effect.

LINELOCK PHASE ADJUST (LL-PH)

Cameras can often be supplied from different A.C. phases especially when they are physically remote from one another or because of the way the site's A.C. supply is distributed. However, as we have already mentioned, it is still possible to line-lock these cameras together. A dip switch allows you to select between **Fixed** or **Adjustable**. Either setting provides line-locking, however the Adjustable setting permits the point of synchronisation on the A.C. supply cycle to be shifted. A potentiometer, (usually located on the rear panel of the camera), provides up to 120^{O} of adjustment either side of the zero volt point. Since supply phases are 120^{O} out of phase with one another, this control allows enough adjustment to enable accurate camera synchronisation (figure 5).

Fig. 5



BACKLIGHT COMPENSATION (BLC)

Backlight compensation is a feature that is often misunderstood or applied incorrectly. Situations frequently arise where the brightest light in the scene is coming from behind the subject of interest. Imagine a camera monitoring a doorway. In this example, the light outside the door is much brighter than the ambient light in the room where the camera is located. The camera's exposure system sets itself according to the average light level in the scene. However as someone opens the door the exposure system reacts to the increased light level and as a result, anybody entering the room is seen in silhouette. The backlight compensation feature can help to overcome this problem and figures 6 and 7 serve to illustrate BLC control.

Fig. 6 Backlight Compensation off

Fig. 7 Backlight Compensation on

Normally, the exposure circuit within the camera takes an average reading from the illumination present in the entire scene and uses this to adjust the electronic iris (or the lens iris in the case of a motorised lens). Ideally, the camera would calculate the exposure based on the light level in the part of the scene that is of interest to the viewer. The backlight compensation feature uses a 'window' to set the exposure. Everything outside the window is ignored by the exposure system.

Fig. 8 Fixed BLC window

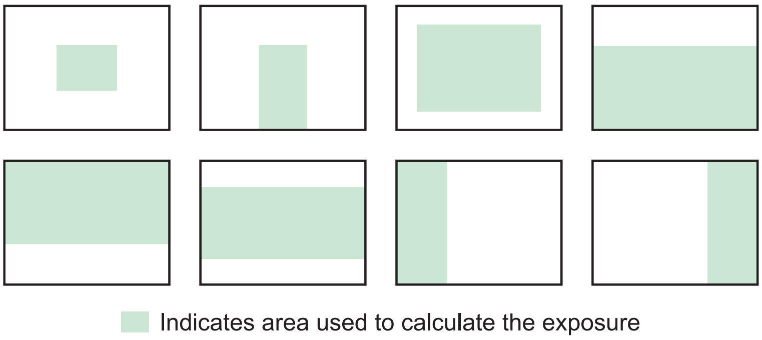


Fig. 9 User-selectable BLC windows

On most cameras, the exposure window is fixed to the central portion of the scene (figure 8). Some Baxall cameras allow you to choose several different windows, and some cameras allow you to completely control the size/position of the window and the amount of exposure compensation applied to the selected area (OSD series cameras).

The window at the top right in figure 9 would be ideal where the surveillance target is a street scene. The bright sky area would normally cause the camera to bias the exposure and the street would appear dark in comparison. Setting a window that forces the camera to ignore the sky will ensure that detail in the street is retained. Note that because the camera is calculating its exposure based on the lighting in a darker area of the scene, the lighter areas will overexpose and, in some cases, 'white out' completely. This effect can be seen in the background of figure 7.

FLICKERLESS

In some lighting conditions, particularly fluorescent, the image can be seen to flicker. This is usually caused by the interaction of the shutter with the A.C. frequency of the lighting. The **Flickerless** setting changes the shutter speed of the camera to a value that will not cause flicker (1/120s for PAL system cameras; 1/100s for NTSC). The disadvantage to fixing the shutter speed in this way is that the sensitivity of the camera will be reduced. This is because the electronic iris feature has effectively been turned off and it will no longer control the optimum exposure setting for the available light conditions.

SHUTTER SPEEDS

The electronic shutter available on some Baxall cameras is analogous to the shutter in a conventional 35 mm camera. The shutter speed is usually selected using a bank of dip switches located on the side of the camera. A faster (i.e. briefer) shutter speed can arrest the motion of a fast moving object rendering it sharp. Fast shutter speeds allow less light to fall on the CCD and can darken the image. If fast shutter speeds are required, ensure that there is adequate lighting. Selecting a shutter speed manually will override features such as the electronic iris and flickerless settings.

Fig. 10

Slow shutter speed

Fast shutter speed

SENSITIVITY

The sensitivity of a CCD camera, broadly speaking, is a measure of its performance in low light conditions. Baxall quote the sensitivity levels of their cameras as the minimum scene illumination required at a given lens aperture to provide a useable video output. A typical figure may be **0.1 lux @ f1.2**. This means that at a lens aperture setting of f1.2, the minimum scene illumination would need to be 0.1 lux (approximately equivalent to the full moon) in order to provide a useable video output from the camera. Some manufacturers quote sensitivity figures that require expensive, 'faster' lenses (e.g. f1 or better) in order to achieve them. The table below shows some typical lux levels that can be expected under common lighting conditions.

LIGHTING	LUX LEVEL
Unobstructed sun	100,000
Sun with light cloud	70,000
Sun with heavy cloud	20,000
Home/office lighting	100 - 1000
Sunrise/sunset	500
Street lighting	1 - 10
Twilight	4
Full moon	0.2
Quarter moon	0.02
Overcast moon	0.007
Clear night sky	0.001
Average starlight	0.0007
Overcast night sky	0.00005

RESOLUTION

Resolution is the ability of a camera to discriminate fine detail in a scene. The resolution of a camera is usually expressed in terms of horizontal **TV Lines** (TVL). Cameras specifications quote resolution based on the number of horizontal elements that can be captured by the camera and, confusingly, this relates directly to the number of vertical lines that can be discerned for an equivalent picture height. Typical video display devices have the proportions of 4:3, therefore *equivalent picture height* means that only ¾ of the horizontal line is used to quote resolution. This is done to preserve the natural proportions of the image.

In effect, a camera with a resolution of 570 TVL being is able to display ¾ of a single horizontal line as 570 individual segments. The higher the number of segments used to display the line, the more fine detail can be resolved in the image. Obviously the number of horizontal lines displayed vertically (i.e. the vertical resolution) in a given system is fixed according to the CCTV standard in use (approximately 400 lines for PAL/CCIR; 330 lines for NTSC; etc.).

Cameras are often described as medium, high and ultra resolution. For colour cameras, this is typically 330 TVL for medium resolution, 480 TVL for high resolution and 540 TVL for ultra resolution. For monochrome cameras typical figures are 380 TVL for medium resolution and 570 TVL for high resolution. If it is important to be able to resolve fine detail in an application, choose a camera with an appropriate resolution.

PEAK WHITE INVERSION

Some surveillance applications naturally contain many point sources of light — one such being highway monitoring during night-time where oncoming vehicles have their headlights on. This can cause the camera's electronic iris, or the iris of an automatic lens, such as a Direct Drive or Video Drive type, to react and close thereby losing detail in the darker areas of the scene.

The Peak White Inversion feature can resolve this problem. It allows the user to render selected areas of the scene above a certain predefined threshold level as black. This stops the camera or lens reacting to the 'peak' white areas which would normally cause it to incorrectly control the iris mechanism thus preventing underexposure of the scene. Figure 11 shows a typical application of the Peak White Inversion feature.

Fig. 11

Peak White Inversion off **Peak White Inversion on**

DIGITAL RECORD MODE

When utilised, digital record mode can reduce the amount of video storage required on some digital recording units. The effect is most noticeable on systems employing conditional update compression techniques.

The digital record setting will reduce the amount of noise in a picture by reducing the sharpness / edge enhancement and the amplification / gain applied. The resulting noise decrease in a picture will appear as less movement in each video frame to be transmitted or stored digitally, especially with conditional update compression.

COMMON LENS TERMINOLOGY

Aperture - The 'opening' of a lens indicating the measure of its light gathering capability or performance. Relative Aperture is a ratio between its focal length and effective aperture and is measured in **f** numbers e.g. f1.4, f1.3, etc. Generally, the lower the f number, the more light gathering capability the lens has.

Aspherical Lens - A lens designed with special curvature so that the image distortion inherent at the edges of a conventional lens are lessened.

Auto Iris (AI) - An electronic circuit controlling the iris of a lens to help compensate for large changes in illumination levels.

Back Focus - The mechanical aligning of the imaging device with the focal point of the lens. Correct back focus setup is particularly important on zoom lenses to ensure the image stays in focus throughout the zoom range of the lens.

Depth of Field - The zones in front of and behind the principal focus point that will remain in focus at a given setting.

Direct Drive (DD) - A lens that takes a reference DC voltage from the camera to open or close the iris aperture. The video level control is part of the camera.

Electronic Iris (EI) - This is a system that uses the camera's electronic shutter to control how much of the light falling on the CCD sensor is used to produce a picture. The system allows manual or fixed iris lenses to be used in a wider range of applications.

Field or Angle of View - The part of the scene visible with a particular lens. Generally, shorter focal length lenses will have a wider field of view than those with longer focal lengths.

Focal Length - The distance in millimetres, between the lens's secondary principal point and its focal point. The higher the number the greater the magnification and the narrower the field of view.

Focal Point - The point on the axis of a lens at which rays of light entering the lens will converge.

Iris (iris diaphragm) - Mechanically adjustable leaves or plates that regulate the amount of light passing through a lens.

CHOOSING A LENS

Few things can the impair the performance of a CCTV camera more than an incorrect or poorly chosen lens. Lens choice depends upon several factors such as the physical position of the camera, the available scene illumination and the type of view of the scene that is required.

The easiest way to select the correct lens for a given application is to use a viewfinder. This is an optical tool along the lines of a simple telescope that will give the user an exact representation of the scene that can be expected with a given lens/camera combination.

If a viewfinder is not available (or practical), a lens calculator may be used. This is often a circular device with rotating scales that represent the field of view. Usage varies from manufacturer to manufacturer but usually the desired horizontal and vertical scene dimensions are entered and the necessary focal length of the lens required to achieve this can be read directly off the calculator.

If neither of these aids is available, the only alternative is to measure the distances and angles that are required and use the specification sheets and tables provided by the lens manufacturers.

FOCAL LENGTH

The focal length of a lens determines its field of view at a given distance. A wide angle lens as its name suggests has a wide field of view at a given distance. This means that it can 'see' a wide area of the scene in both the horizontal and vertical planes. Because of this, objects in the scene will appear far away and show little detail. The opposite is true of a telephoto lens. Most lens manufacturers provide tables or charts for their lenses providing the necessary data. Broadly speaking, the focal length of a lens falls into two categories: fixed or variable.

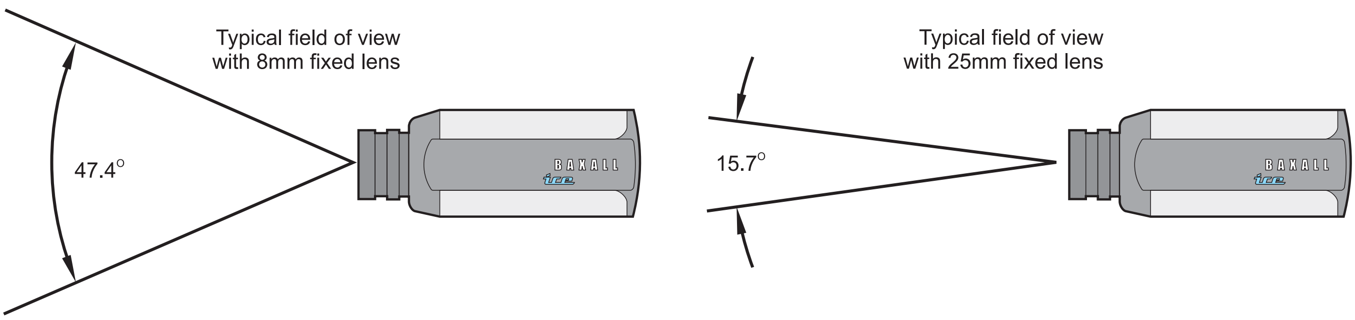
Fig. 12

Field of view with an 8mm lens **Field of view with a 25mm lens**

Fixed Focal Length

A lens having a fixed focal length is often the least expensive. Since the focal length is fixed, so is the field or angle of view. This means that accurate calculations will have to be performed in order to correctly select a lens for a given application. A change in the requirements of the application will often result in a change of lens.

Fig. 13



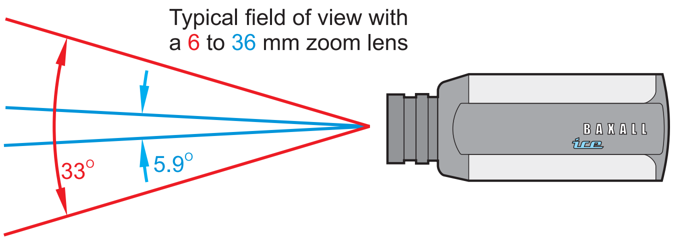
Variable Focal Length

Although more expensive, these lenses are easier to use, set up and change. It is much simpler to obtain the correct view of a scene when it is possible to vary the focal length (and therefore the angle of view) of the lens. Variable focal length lenses should not be confused with zoom lenses which have a much larger adjustment range.

Zoom Lenses

Zoom lenses are the next step up from variable focal length lenses and offer the greatest functionality. They can be continuously adjusted throughout their range, usually remotely, to vary the focal length and field of view (figure 14). Note that because the depth of field is also dependent upon the focal length of the lens, it will continuously vary throughout the zoom range being at its greatest when the lens is zoomed fully out (wide angle). Remotely controlled zoom lenses are often used by the operator to closely examine critical areas of the scene.

Fig. 14



LENS FORMATS

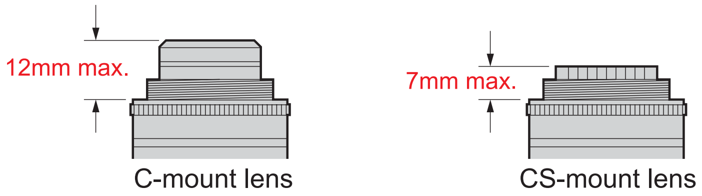
The format of a lens, often quoted as 1”, 1/2”, 1/3”, is derived from the ratio of the diameter of the lens to the image size produced. The usual practice is to match the lens format to the CCD sensor size but it is possible to use larger format lenses on cameras with smaller CCD sensors (e.g. a 1/2” format lens on a camera with a 1/3” CCD). The rule when choosing which format to use is that the image size produced by the lens must always match or be larger than the CCD sensor. In practice, this means that a 1/3” format lens would not be compatible with a camera fitted with a 1/2” CCD. The image projected by such a lens would not entirely cover the surface of the CCD and the corners would be truncated (vignetting).

Larger format lenses can offer advantages such as greater depth of field and the image produced by such a lens will have less distortion at the edges than one with a smaller format.

LENS MOUNTS

Historically, the larger format cameras such as 1” and 2/3” have used the C-mount type lens system to physically couple the lens to the camera. With the advent of smaller CCDs such as 1/2” and 1/3”, the CCTV industry has adopted the CS-mount. The main dimensional difference in the two systems is the distance that the back (or flange) of the lens protrudes (figure 15). The unique back-focussing mechanism on Baxall cameras allows both types of lens mount to be used—see **adjusting the lens back focus**. This is because the CCD assembly can be physically moved backwards and forwards in relation to the back of the lens. If this were not the case, the flange of a C-mount lens would mechanically interfere with the CCD causing damage. CS-mount lenses are often less expensive and, in general terms, for a given focal length, a CS-mount lens is physically smaller than an equivalent C-mount lens.

Fig. 15

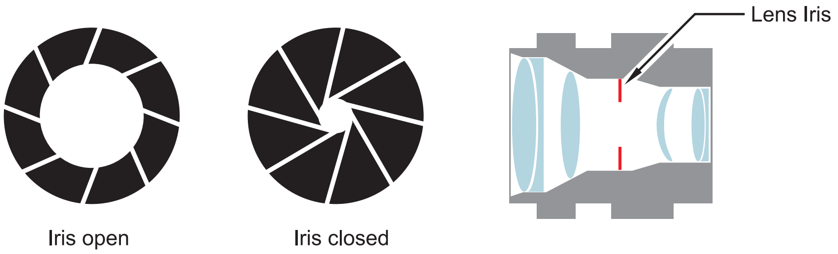


NOTE: A CS-mount lens will not work on a camera designed to be used only with C-mount lenses

LENS IRIS

The amount of light that falls on the surface of the CCD sensor needs to be within certain limits for optimum performance. Too much light and the image is overexposed or washed out. Too little, and the resulting image is dark losing detail in the shadow areas of the scene. The lens iris is used to control the amount of light falling on the sensor. The iris consists of a number of thin metal plates arranged in such a way that they produce a circular opening at their centre (figure 16). This opening, called the iris or aperture, can be made smaller or larger usually in fixed increments called **f-stops**. In addition to controlling the amount of light entering the lens, the iris has a secondary function in controlling the depth of field—see **Depth of Field** below. Lenses can incorporate fixed, manually adjustable or automatic irises.

Fig. 16



Fixed Iris

Fixed iris lenses cannot be adjusted for different lighting conditions. These lenses are most suited to indoor conditions where the lighting level will remain constant. However, the Electronic Iris and Automatic Gain Control features of Baxall cameras can make this lens much more flexible in use.

Manual Iris

The iris on a manual iris lens is usually set up when the camera is installed to suit the prevailing lighting conditions. These lenses cannot react to changes in scene illumination and are best suited to indoor applications where the ambient light will remain constant. The Electronic Iris and Automatic Gain Control features of Baxall cameras can allow this type of lens to be used in a wider range of application areas.

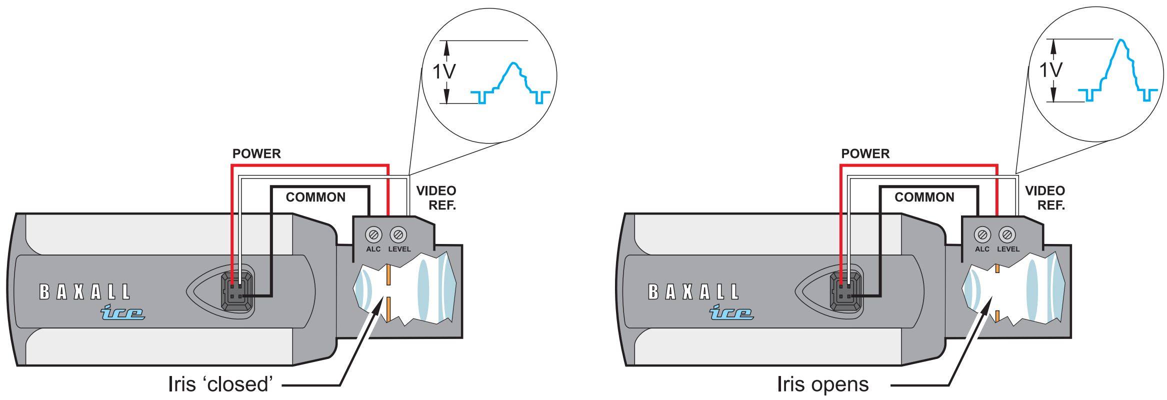
Automatic Iris

For external conditions, and where the scene illumination is constantly changing, a lens with some sort of automatically adjustable iris is preferred. The iris aperture is controlled by the camera and is constantly changed to maintain the optimum light level to the CCD. Automatic iris lenses usually conform to one of several types: **AI** (Automatic Iris), **DD** (Direct Drive) and **Galvanic** drive.

AI

This type of automatic iris lens is usually self-contained with the image analysing circuitry built into the lens itself. A voltage to operate the lens is usually taken from the camera and is supplied to the lens by means of a plug or other type of connector. A video reference signal is sent to the lens from the camera and the lens attempts to maintain this at a 1V pk-pk voltage level by opening or closing the iris as necessary (figure 17). For example, if the light level in the scene is low, the camera's video reference signal will also be low. The lens analyses this and a small motor opens the iris sufficiently to re-establish the optimum 1V peak to peak video output signal.

Fig. 17



PEAK / AVERAGE Adjustment for Automatic Iris Lenses

AI type lenses are usually fitted with two potentiometers **Level** and **ALC** for adjusting the response and type of operation. The Level control sets the iris opening based on the average scene illumination. The level control should be adjusted to take into account both daytime and night-time operation i.e. if it is set incorrectly, the image may be satisfactory during the day but too dark at night. The ALC potentiometer controls the degree to which the Auto Iris responds to bright areas in the picture, e.g. windows, street lamps, car headlights, reflections, etc. The ALC potentiometer usually has two settings **Peak** and **Average** located at the anticlockwise and clockwise ends of its travel respectively.

Fixed focal length lenses

If the ALC control is set at or towards **Peak**, the lens will respond more to any bright highlights. This will have the effect of reducing the overall contrast in the scene but allowing more detail to be seen in the bright areas. If the ALC control is set at or towards **Average**, the lens will respond less to highlights. This will produce over-brightness in the highlights and may cause flare but will improve the contrast in the darker areas of the scene. For most CCTV applications the ALC control should be fully set to Average before attempting to set the level control.

Often, the ALC control is set at Peak during installation and, since there are no peaks in the picture, the control seems to have no effect. However when conditions change and peaks are introduced, the overall contrast is reduced and a site visit has to be made. Therefore it is best to ensure that it is set fully to Average unless in one of the rare occasions it is necessary to see detail in a bright area of the scene.

Zoom Lenses

On most zoom lenses the Peak/Average control functions as little more than a speed control for the iris motor and is best left in the centre of its travel to ensure consistent operation.

DIRECT DRIVE DD

Direct drive type lenses (sometimes referred to as DC-drive) use circuitry within the camera to provide the necessary iris control signals namely a drive signal and a damping signal. The lens contains no signal analysing electronics and is therefore directly driven by the camera. The drive signal controls the iris and the damping signal is used to prevent ‘hunting’—a condition where the iris reacts too quickly to changes in the scene illumination. The camera has to be capable of supplying these signals via the correct connector, and is a common feature of all Baxall cameras. A potentiometer on the side of the camera is used to adjust/set the drive level for the lens.

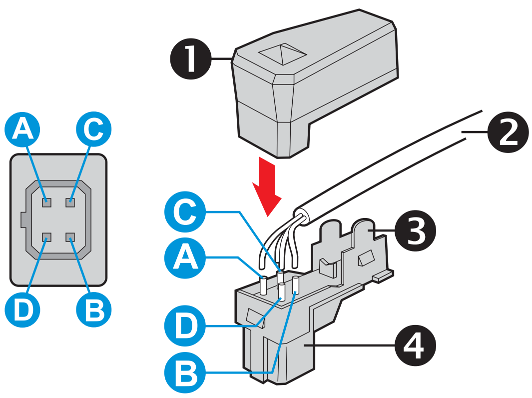
Fitting a Direct Drive Lens Connector

A Direct Drive lens may or may not be fitted with the correct connector. If it is not, use the connector supplied with the camera and connect it as follows:

1. If necessary, remove the old lens plug from the cable.
2. Remove the plug cover **1**, add heat shrink tubing to the wires and solder the lens cable wires **2** to the pins **A** through **D** on the supplied connector. Apply heat to the heat shrink tubing.
3. Replace the connector cover.

Fig. 18

Pin No.	DD-Lens
A	Damping (-)
B	Drive (+)
C	Drive (+)
D	Damping (+)



1 Cover.

2 Lens cable.

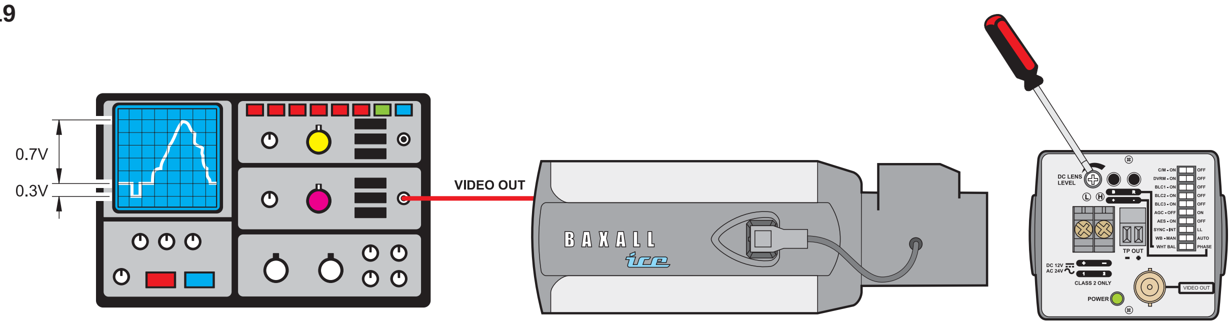
3 Rib (if the cable is too thick and the connector cover does not seat properly, the rib can be cut off).

4 Lens connector.

DD Lens Level Adjustment for Fixed and Zoom Lenses

The only correct method of setting the lens level control is to monitor the camera output on an oscilloscope and adjust the level control for a reading of 0.3 volt sync. and 0.7 volt video = 1 volt peak to peak total (figure 19).

Fig. 19



When an oscilloscope is not available the following method can give some surprisingly accurate results with a little experience. You should have an installation/test monitor, and use a camera known to be set correctly to 1V peak to peak. Connect the camera to the monitor and adjust the contrast and brightness until YOU think the picture is correct. Mark the controls so you can always set them to this position again. As you set up each camera, adjust the 'level' control until you see that the contrast of the picture is similar to that achieved with the test camera. You should then find all the cameras set to equivalent contrast.

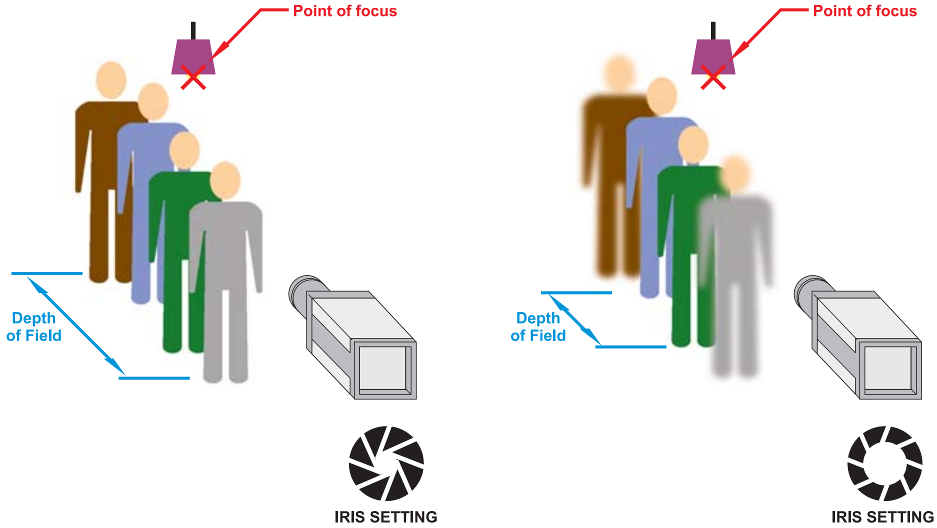
NOTE: Never adjust the monitor controls no matter how tempted.

DEPTH OF FIELD

The focus ring on a lens is usually adjusted so that the object of interest within the scene is sharp. Up to a certain point, objects in front of this setting, and behind it, are also in focus. This zone of focus is referred to as the Depth of Field. As objects get further outside of the depth of field (either further from the lens or closer to it), they will lose focus. The depth of field can be controlled by the iris setting on the camera. As the iris aperture is decreased in size, the depth of field will be greater—that is, more objects either side of the focus point will be in focus.

Figure 20 shows a camera looking along a line of people. The lens is focussed on a point mid way along the line represented by the ceiling light. If the iris is wide open, only a few of the people on either side of the focus point will be in focus. If the iris is closed towards its minimum, more people in the line will be in focus in other words, the depth of field will be greater.

Fig. 20



One disadvantage of increasing the depth of field by closing the iris, is the amount of light admitted to the camera will be reduced and the image will become darker. Depth of field is also dependent upon the focal length of the lens. Wide angle lenses (i.e. those with a small focal length) will have a greater depth of field than telephoto types. The depth of field is inversely proportional to the focal length of the lens so as focal length increases, the depth of field will decrease.

Automatic iris lenses, because of their very nature, will cause the depth of field to vary. Consider an auto iris lens fitted to a camera that is used in a day/night role. During the day when the ambient light is at its strongest, the iris will be narrow. This will represent a good depth of field. As night approaches and the iris opens to compensate for the reduced overall light level, the depth of field will become more shallow. This phenomena should be taken into consideration where the depth of field is an important factor in the performance of the system.

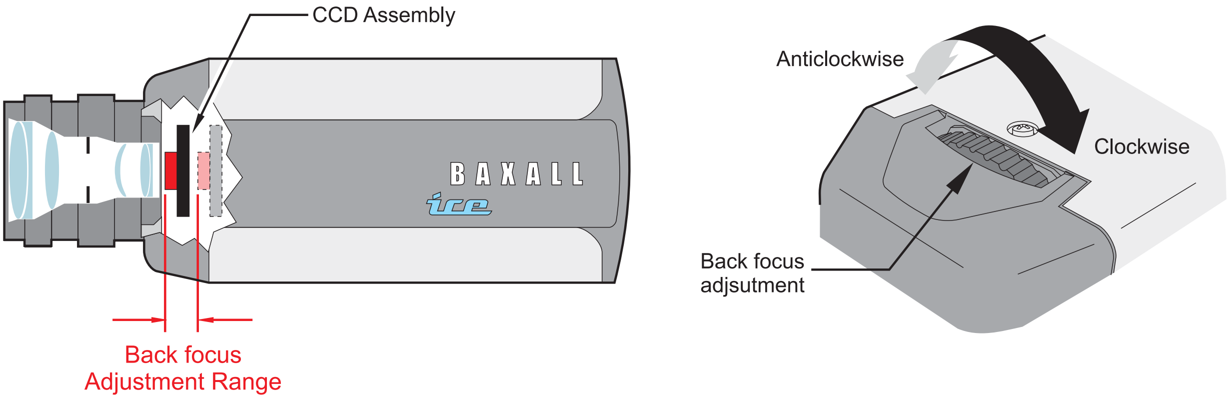
When focussing the lens on a camera, ensure that the lens iris is fully open. If the iris is closed when the lens is focussed, the increased depth of field may give a false impression that the lens is correctly focussed when in fact it is not. This would be seen when the lens iris opened up and focus was lost.

ADJUSTING THE LENS BACK FOCUS

Baxall cameras contain a mechanism for adjusting the position of the CCD assembly in relation to the back of the lens (figure 21). The back focus adjustment points are located on the top and bottom of the case and should be adjusted using the adjustment wheel. If possible, always use the top screw to adjust the back focus mechanism.

Turn the adjuster screw clockwise or anticlockwise to obtain focus. When the focus is sharp, turn the back focus adjustment 2 or 3 turns anticlockwise. The picture will lose sharpness. Turn the back focus adjustment clockwise until focus is once again obtained. If you have turned the back focus adjustment clockwise past the point of best focus, repeat the procedure. **The last turn of the back focus adjustment mechanism must always be in a clockwise direction.** This will ensure that any mechanical lash in the system is taken up. Do not use force or turn the back focus mechanism adjustment further than it is intended to go.

Fig. 21



NOTE: It is important that the lens iris is fully open before the back focus is set. This is because the depth of field will be at its minimum and won't be tending to 'focus' the image.

Fixed iris lenses
Set the lens focus to infinity and view an image greater than two metres away. Focus the image using the back focus screw. Set the lens focus as required.

Manual iris lenses
Open the iris fully and set the lens focus to infinity. View an image greater than two metres away. Focus the image using the back focus screw. Set the lens focus and iris as required.

Automatic Iris and Direct Drive Lenses
Fully open the iris by covering the lens with a suitable neutral density (ND) filter. Set the lens focus to infinity. View an image greater than two metres away. Focus the image using the back focus screw. Remove the ND filter and set the lens focus as required.

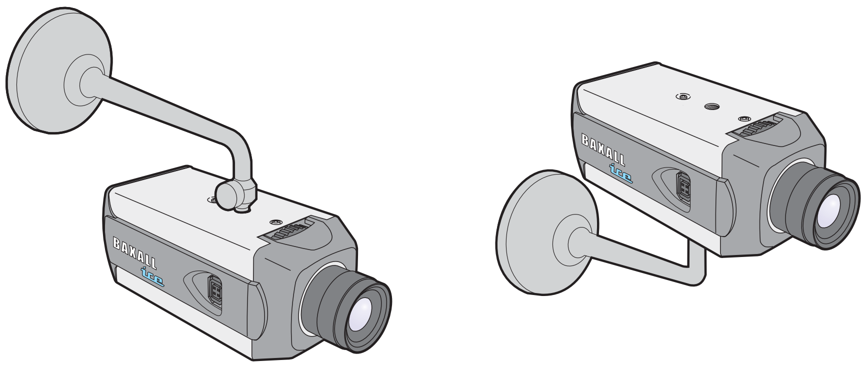
Zoom Lenses
Set the lens focus to infinity and fully open the iris by covering the lens with a suitable neutral density (ND) filter. Zoom out to the widest field of vision and view a distant object. Adjust the back focus screw until the object is in focus. Next, zoom fully in and adjust the lenses focus until the object is again focused. Repeat these steps until the full zoom range may be viewed with the minimum loss of focus.

CAMERA MOUNTING

All Baxall cameras are fitted with mounting points on the top and bottom of the case (figure 22). They are designed to accept standard photographic mounting bolts (1/4” BSW or 20 UNC). The mounting bracket and its fixing, must be capable of supporting the weight of the camera *and* its lens. In cases where the lens is substantially heavier than the camera, it is better to use the mounting bush on the lens itself.

NOTE: In some countries, notably the U.S., installation codes dictate that the mounting bracket and its fixing must be capable of supporting four times the weight of the camera and lens.

Fig. 22



Top Mounting **Bottom Mounting**

CABLES

Always use the highest quality coaxial cable possible from a reputable manufacturer such as Belden. Poor quality cable can result in a noisy picture with interference and cross-talk. As a rule of thumb, typical coaxial cable runs of 250 metres for RG59, and 500 metres for RG11 will give good quality clear pictures. Acceptable pictures can be obtained on cables runs of twice these distances but cannot be guaranteed.

If exceptionally long cable runs are required, a video amplifier will be required at one or both ends of the cable.

Electromagnetic interference (EMI) can be induced into coaxial cables running in close proximity to high voltage or high current carrying cables. This will cause hum bars in the picture and degrade image quality. Because of this, the installation of video cables next to high voltage cables is not recommended.

Cable Type	Max Recommended Length		Typical Nominal DC Resistance (Ω/1000ft)
	Feet	Metres	
RG59	820	250	10.5
RG11	1,640	500	1.24

Table of Maximum Recommended Cable Lengths

Application		Distance	
Indoor	Outdoor	250m	500m
Surface installation	Trunking, Conduit	RG59	RG11 CT125
PTZ Head	Catenary or flexible	URM70	—
—	Ducting	URM70	RG11, CT125
—	Directly buried	—	CT125RBS

Table of Recommended Cables for Common Applications

A CCTV system has to be capable of handling signals that can be at a nominal 5MHz and above in frequency. The coaxial cables in common use exhibit resistive characteristics at such frequencies. The effect of this in real life is to attenuate or reduce the video signal slightly. This attenuation increases with cable length and is commonly measured in decibels (dB). As a rule of thumb, 2dB loss will leave approx. 80% of the signal unaffected.

Cable	Loss in dB/100m @ 5MHz
URM70	2.3dB
RG59	2.2dB
RG11	1.2dB
CT125RBS	1.1dB

Table Showing Typical Cable Losses

Baxall Limited, Stockport, England. Visit our Web site: http://www.baxall.com