Camera and Communication Systems for hazardous Areas

SAMCON Topical Booklet No. 0001

SAMCON
Prozessleittechnik GmbH

See

...what cannot be seen.

Why use a camera when practically nothing can be seen through an inspection window with the naked eye?

How much light does your eye need in order to reliably identify information?

How well can you still identify an object if it is illuminated by a candle burning at a distance of two meters? How well can you see by the light of a full moon?

The illumination strength of a candle at a distance of two meters is roughly 0.20 lx (Lux). The illumination strength of a full moon is measured as roughly 0.25 lx. Modern high-performance day/night cameras, like our special model ExCam miniZoom nite, are equipped with infrared band-elimination filters that move into place and high-resolution 1/3“ CCD sensors, giving them the capability to take extremely sharp images in lighting as low as 0.0004 lx!

This corresponds almost to the illumination level of a cloudy night sky. Can you see in such light?

Our cameras can see what otherwise cannot be seen!

Even through your inspection window!

See

...what cannot be measured.

Physical values can be measured.

The fill level of a container, the speed of a rotating machine or the rate of liquids flowing through pipes can all be measured.

The physical values are measured in order make use of them in subsequent automation-related processes. For example, the fill level of a container can be depicted in the form of a rising bar on the monitor of a process control system.

The most fundamental human measurement device is the eye with which we see.
It is possible to look through an inspection window in a container to see how full it is. However, more information than simply the fill level can be obtained by looking through the inspection window. Is the surface calm or in motion? Is the medium clean or contaminated? Is there foam or floating solids on the surface?

All this information can be seen but is very difficult to measure.
What if you did not have to be physically present in order to "see"? Cameras record the information on-site and make it available to you. Wherever you are.

As video-optical sensors, cameras are finding their way into hazerdous areas.
We are the experts in this area!

See

...what has gone unseen.

Working in hazardous areas is dangerous. Protective gear and gas warning devices are required. Many areas may only be entered in pairs and in full protective gear. Communication with the control room, if even possible, takes place via explosion-safe mobile telephones or handheld radios.

How quickly is it possible to respond if something actually happens?

How would it be to constantly have an eye on-site?

How would it be if you could speak to the people in the hazardous area in telephone quality regardless of where you are?

How would it be if you could save all this information in order to discover later what you overlooked the first time?

Our ExCam 360°, or our ExCam miniZoom in connection with an ExConnection Rail X DECT, are complete communication systems for explosion risk zones. They transport video and audio signals from hazardous areas to you and, when something important must be said, audio signals from you to the hazardous area. All of this can be digitally recorded.

All you have to do is look, listen and speak.

In 2004, we planned our first IP-based camera system, which at the time was something exceptional. Eventually, IP-based video networks will replace analogue network structures. Today, one frequently finds hybrid networks in which analogue video sources are digitised after the signal transmission.

What are analogue systems?
Analogue camera systems refer to systems in which the image signal is transmitted as analogue. This image signal has many names: FBAS, CVBS, television signal, composite, etc.
The most important format standards are PAL and NTSC.

How are analogue systems controlled?
High-performance cameras, such as our ExCam miniZoom, can be controlled. This does not take place in analogue but rather via digital bit-serial interfaces (RS-232, RS-485, RS-422) in a protocol language (VISCA®, PELCO®, Panasonic®). No manufacturer-independent standards exist here.

Analogue camera systems.

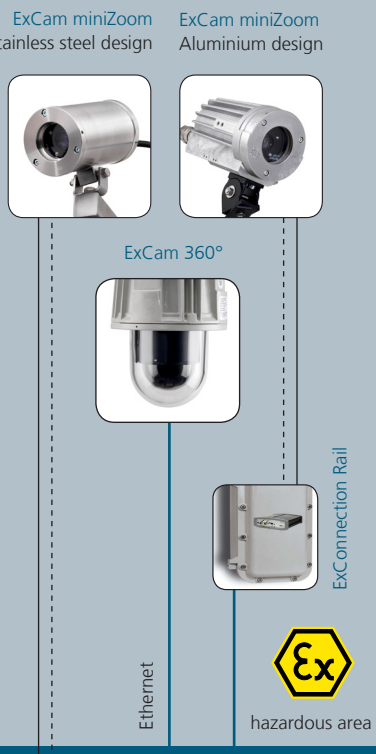
What are the advantages of analogue camera systems?

- In contrast to IP-based camera systems, analogue camera systems are real-time systems. This means that the images appear on the monitor at the same time as they occur.

What are the disadvantages of analogue systems?

- The control interfaces are not standardised, which makes system integration very difficult.
- Additional functions, such as recording or image switching, can only be realised with difficulty and with additional hardware.
- Integration into process control systems is not possible.

Our ExCam miniZoom delivers a real-time image signal and is controlled via the RS-232 interface using the VISCA® protocol. As such, it is well-suited for integration into your existing analogue video system. If your video system uses the PELCO® protocols, a protocol converter can be used for translation.



Video servers are used for conversion of analogue image signals into digital network video streams. These are available in a wide range of physical dimensions from various manufacturers. They are also available as small circuit boards that are installed directly into the camera or as modularly expandable 19" solutions.

Which video server solution is best for you depends on many planning factors:

Are analogue cameras already in use and, if so, where?

How far are the installation distances in the explosion risk zone?

Is Ethernet already available in the plant?

Will the plant be expanded later?

Digitalisation.

Our ExCam 360° was developed for very long installation routes. It has an internal video server and converts the 100BASE-TX (copper) signal to a 100BASE-FX (fibre-optic) signal with ignition protection type optical intrinsic safety [op is]. As a result, installation paths of 2.5 km in hazardous areas are no problem.

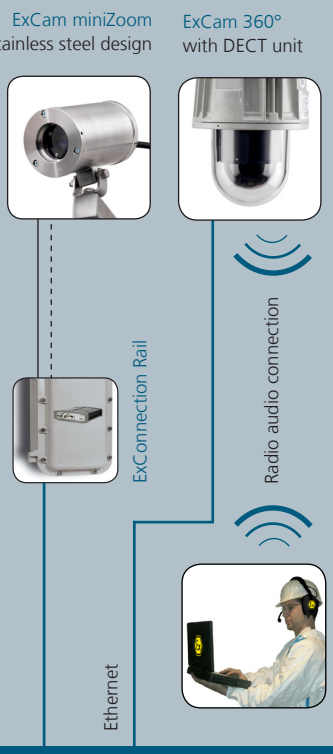
For our ExCam miniZoom, digitalisation requires only a video server with RS-232 interface and VISCA® protocol drivers.

To arrange the digitalisation of the ExCam miniZoom signals as simply as possible, we have developed our Connection Rail. The Connection Rail is a plug & play digitalisation solution for the ExCam miniZoom. It is only necessary to run the cable of the ExCam miniZoom to the terminal strip of the Connection Rail. We do the rest!

The following design variants have established themselves as standards in practical planning:

Connection Rail - S	Connection Rail for one camera in safe areas
Connection Rail - Q	Connection Rail for four cameras in safe areas
ExConnection Rail - S	Connection Rail for one camera in hazardous areas
ExConnection Rail - Q	Connection Rail for four cameras in explosion risk zone

The options of "radio audio connection" and „fibre-optic media converter" are available in various design types .



IP-based camera networks.

The terms IP-based camera systems or CCTV (closed circuit television) systems are used when the image information or any voice information is transmitted with the help of the TCP/IP protocol (Video over IP, Voice over IP). Eventually, IP-based camera networks will replace analogue camera networks with the exception of only a few special applications. The most important reasons for this are:

1. Standard network components (cables, switches, media converters, etc.) of various manufacturers can be used during installation.

2. All Ethernet media (copper, fibre-optic cable, WLAN) can be used. The information is transmitted in the form of TCP/IP packets.

3. Typical PCs, notebooks or PDAs can be used for visualisation of the camera images. These are either already present at the plant locations or can be purchased inexpensively. Expensive special hardware such as control panels or analogue monitors is not required.

4. Software solutions become important tools and replace expensive additional hardware. For example, video recorders are no longer required for recording of the camera images and switching between images is only a program function.

5. Software solutions allow a very high level of individualisation. The overview images can be individually adapted and integrated into site plans, for example.

6. True integration into process control systems can be realised.

7. The intelligence of the camera network is decentralised in digital camera systems. This further increases the performance of the camera network considerably. For example, a digital camera can decide for itself whether or not a recording is important. As a result, only the data actually needed is saved.

8. IP-based camera systems offer world-wide access (for example via secure VPN tunnels). This means that the cameras can be viewed and controlled from any location in the world. In addition, the camera can send its information directly to your workstation, for instance from a remote biogas plant.

Complex camera networks should be planned in detail. Terms such as network capacity utilisation, WLAN bridges, media converters, CPU load, etc. play important roles. Our core competence lies in the planning of complex camera networks! The following descriptions assume IP-based camera systems.

Photo: Hubert Link, Bundesarchiv, Mai 1982

Viewing and controlling.

How should the camera images be displayed and processed? Who should be able to control the cameras? Should all camera images be displayed at the same time? Do priorities exist with regard to important or less important camera images?

Various software products are offered by various manufacturers. The functionality and performance of these solutions differ greatly. Many options are available, from inexpensive variants to video management systems with a large number of interfaces. The functions of off-the-shelf software products are often sufficient for a good visualisation concept. For CCTV networks of greater complexity or for highly individual needs, the limits of these programs can be exceeded.

SAMCON ViewScriptbox

The visualisation of digital camera images is based on Web technologies such as Java, Active-X and html scripts. With the help of standardised components, such as a zoom bar, it is possible to program individual visualisation pages similar to an Internet homepage.

With the SAMCON ViewScriptbox, there are no limits on visualisation: Would you like to integrate live images into a building or plant map? Would you like all camera images shown constantly or only those for which the plant component is marked as "active"? Should it only be possible for specific operators to control the cameras? These and many more options can be implemented with the SAMCON ViewScriptbox.

SAMCONnect

What does one need in order to display and control digital camera images?

One or more networkable computers with monitors and input devices are required. These are generally already present in most control centres in the industry. Control systems from manufacturers such as Siemens, ABB, Emerson and Yokogawa depict complex processes of plants and plant components on multiple monitors. Computers with high-performance graphics cards depict the processes in a way that gives the plant manager or operator all important information at a glance.

Both these hardware structures and the ergonomic arrangement of monitor systems are excellently suited for the visualisation of camera images.

Why install a standalone camera visualisation in addition to the visualisation of the process control system when both systems can be intelligently combined? After all, isn't the point of camera visualisation also to provide the plant manager or operator with important information?

SAMCONnect.

Example:
You would like to monitor the inside of a tank through an inspection window with an **ExCam miniZoom**. You are primarily interested in the filling process because you want to determine whether the medium foams during the filling process.

The filling process is initiated by opening of a slider and displayed in the control system.

In the configuration dialog of **SAMCONnect**, you select the slider state as the criterion for displaying of the camera image. You also select the camera for the corresponding container and the screen position where the camera should be displayed.

SAMCONnect then continuously monitors the state of the filling slider. When this is opened, SAMCONnect displays the associated camera image and control buttons where you want to see them. While the image is displayed, the slider state continues to be monitored. When the slider is closed again because the filling process is completed, SAMCONnect also automatically removes the camera image and its control buttons from the screen.

Naturally, the automatic process can be bypassed and the camera image can be manually opened and operated at any time.

Our SAMCONnect software is based on these ideas:
SAMCONnect is an OPC client software that displays selective camera images in process control systems. Our OPC client software SAMCONnect listens to your control system! If your control system decides that a plant area should be viewed, for example because an overfilling sensor has tripped, SAMCONnect opens the desired camera image on the operator display. It does not matter which control system you use. SAMCONnect requires only an OPC server.

SAMCONnect offers many advantages:

- Only the camera images that are actually important are displayed. The user need not continuously concentrate on all images, which would also have to be visualised in place of other important process information.
- The network utilisation is kept to a minimum since image information is only transmitted when actually needed.
- The plant operator can concentrate entirely on the technical control process. The camera images are displayed by SAMCONnect when and where they are important. In other words, when they are relevant within the process environment.
- SAMCONnect is a fully-featured and extremely powerful visualisation program that can be integrated into existing process control systems without additional hardware requirements.

SAMCONnect turns camera images in process control systems into what they really are: important information for the plant manager or operator that is collected with intelligent sensors.

Recording and archiving.

One important function of CCTV systems is the recording and archiving of video and sometimes audio files.

Recordings can be used to reconstruct past events. Fault analysis is simplified when it is possible to retrace events. When did the surface in container 2 start to foam up? Recording solutions are often integrated into camera software products. But what if neither a PC nor camera software are present in the CCTV network?

The SAMCON Recording tools are Ethernet-based programs that intelligently utilise the functions of digital cameras. The principle is as follows:

You decide per camera how important the information to be recorded by the camera is. For priority 0, the camera sends 25 frames per second to any network storage device. For priority 1, this is reduced to 10 frames per second; at priority 2, just one frame per second. If you are not certain which priority to assign the camera, the camera can decide on its own: if a camera detects motion, it simply switches from recording priority 2 to recording priority 0.

These individual frames can then be collected together into videos at freely definable intervals. The resulting file sizes are kept to a minimum without losing important information! The time required to search for events in the archive is much less than for constant video recordings.

Planning means asking questions.

The more questions are asked prior to technical implementation of a project, the fewer problems arise during installation and commissioning. This is true in general as well as for video monitoring systems in explosion risk zones in particular.

Is the existing lighting sufficient?
Where should the camera be mounted?
What camera angle is required?
How is the signal transmitted? Where does digitalisation take place?
Where does the explosion risk area begin and what zones are declared?
What are the transmission paths, how large are the distances?
What is the optimal visualisation solution?

The list of questions can be expanded as required.

Concepts and planning.

We have planned video monitoring systems in explosion risk zones for a wide range of customers since 2003. The CCTV applications range here from simple system monitoring to controllable digital video monitoring systems with voice transmission for increased work safety in explosion risk zones.

Our entire product spectrum has resulted from work in projects. We produce camera and communication systems in order to optimally implement your projects with these products.

Within the framework of our project planning, our highest priority is technical implementation of the needs of our customer. Our past experience represents only the starting point for the available options since we constantly strive to identify new ways to solve CCTV problems.

Our unwavering goal is to implement your CCTV project and optimally meet your needs using all technical means available to us.
This is our core competence.

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