SPARK SP-20000

UNDERSTANDING THE BENEFITS

The latest technology in High Resolution CMOS cameras

Read a specification summary

The new Jai SP-20000 is the latest technology in high resolution CMOS cameras.
It uses the next generation of CMOS sensor technology. What makes the SP-20000's performance noteworthy is that it comes with a level of image quality well beyond that found in older CMOS-based cameras. It represents a major step forward in CMOS design, utilizing 8 transistors per pixel (8T technology) as opposed to most traditional CMOS imagers which feature only 4-6 transistor designs. This advanced pixel technology is used in a variety of ways to make the SP-20000's image quality suitable for many applications that may not have previously been considered using a CMOS-based camera.

BASIC FEATURES

- 5120 (H) x 3480 (V) - 20 million effective pixels
- 6.4 µm square pixels offer excellent light sensitivity
- S/N 53dB for monochrome and 51dB for colour (traditional method)
- 41 mm diagonal CMOS imager with global shutter
- Dual Mini Camera Link interface with "Power Over" capability (can accept power via the Mini Camera Link connectors or via the 12-pin connector)
- Capable of running at 30 fps with full resolution for 8-bit or 10-bit output (15 fps for 12-bit output) with monochrome or raw Bayer output
- Supports ROI (Region Of Interest) modes for faster frame rates
- Horizontal and vertical binning (monochrome only) for added sensitivity

- 10 µs (1/100,000) to 8 seconds exposure control in 1 µs step
- PIV and sequential trigger modes for specific applications
- ALC control with combined function of AGC and auto exposure
- Built-in HDR (High Dynamic Range) function (monochrome only)
- On-chip and in-camera pattern correction to minimize CMOS pattern noise
- Various pre-processing circuits including LUT, flat field correction, blemish compensation, Bayer white balance, etc.
- F-mount for lens mount

POWER OVER CAMERALINK

The SP-20000M-PMCL and SP-20000C-PMCL comply with "Power over Camera Link" which enables power to be supplied to the cameras through the Camera Link cable(s).The power requirements of these cameras exceed the amount of power which can be provided over a single PoCL connection so power must be supplied via both Camera Link cables. in order to utilize the PoCL capabilities the frame grabber board must support power over both CL connections. Please talk to Adept Turnkey for the selection of an appropriate frame grabber. Alternatively the SP-20000-PMCL can be powered via a separate power supply connected to the 12-pin Hirose connector. Adept Turnkey supplies appropriate power supplies.

20 MEGAPIXELS AT 30FPS

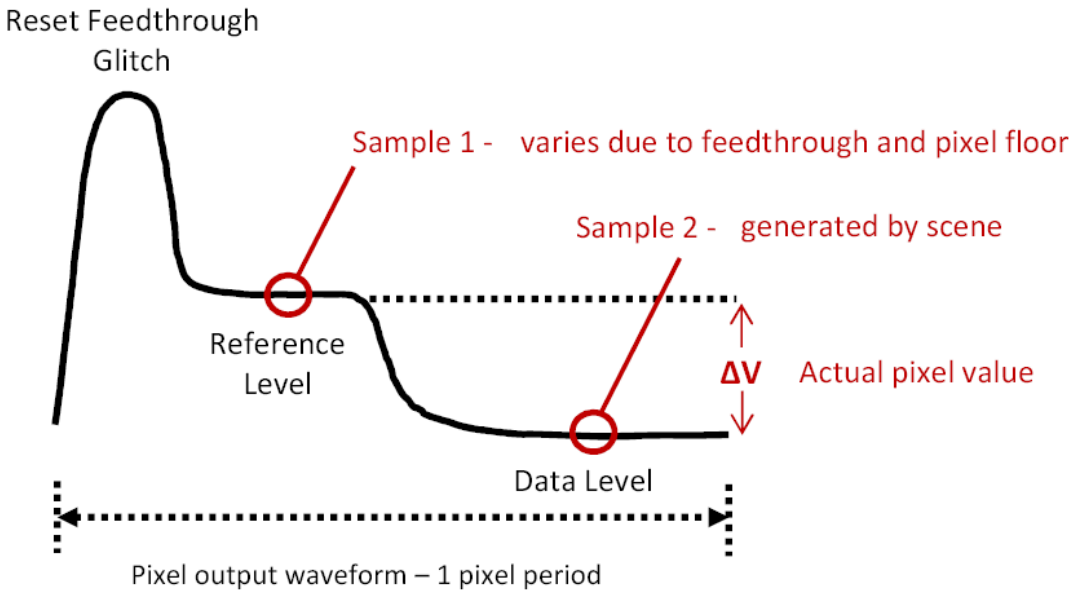
While the 30fps frame rate itself is not regarded as high speed, considering the resolution of the sensor, the bandwidth of this camera is extremely high. High resolution CCD cameras don't come close to this frame rate. 16MP and 29MP CCD cameras typically run at less than 5 fps. There are few high resolution CMOS cameras capable of this resolution and frame rate and those that come close do not compare with regards the quality of images produced.

HGH IMAGE QUALITY

The combination of next generation CMOS sensor technology plus in-camera image pre-processing produces remarkably high image quality – well above typical CMOS offerings, and competitive with CCD cameras for many applications.

The factors that contribute to this high image quality include:

- **Correlated double sampling (CDS)** The 8T technology in the sensor enables the application of true correlated double sampling techniques at the pixel level. A common practice in CCD cameras, CDS produces better uniformity by using two measurements to remove reference voltage variations. Less robust imagers simply take a single signal measurement of each pixel and output that value. But this assumes that the reference level of every pixel is the same – which is not the case. In reality, feed-through noise from the reset signal and surface variations on the sensor itself create subtle pixel-to-pixel variations in pixel depth and the corresponding reference voltage. It makes these cameras unsuitable for some applications and generally contributes to the overall noisiness of the image.



- **In-camera pattern correction** the readout methodology used on CMOS imagers can produce repetitive noise patterns due to slight gain and offset variations in the circuitry used to readout the columns of pixels. The SP-20000 utilizes both on-chip routines and in-camera pattern correction algorithms to minimize the appearance of fixed pattern noise.

- **6.4 um pixels** - The large pixel size provides the space needed for the 8T technology and provides extra photosensitive area. This contributes to better photon capture and a higher signal-to-noise ratio.

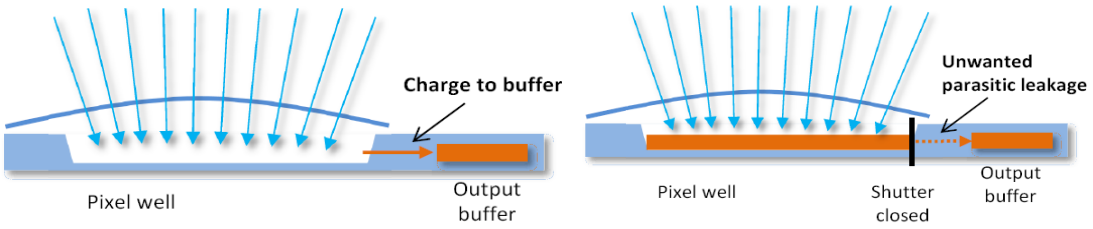
- **12-bit output** - For applications requiring high precision, a 12-bit output mode provides 4096 possible gray scale values.

- **50000:1 parasitic light sensitivity** – Earlier (4T) CMOS cameras featured "rolling" shutters where individual rows of pixels were read out before the next line was exposed. While suitable for still photography or slowly-moving objects, in typical machine vision applications this resulted in unacceptably "skewed" images.

  Newer CMOS imagers feature global shutters where, similar to CCDs, all pixels are exposed simultaneously, and buffers are used to store the pixel values until they can be read out. During this time, photons continue to strike the pixel well and this produces some "leakage" of additional electrons into the buffer. This phenomenon is referred to in data sheets as "parasitic light sensitivity" (PLS). If the amount of leakage is high, dynamic range is lost and images become "washed out," especially under bright conditions where the exposure time is considerably less than the readout time.

  The SP-20000 imager utilizes its 8T technology to achieve a 1:50,000 PLS rating – the highest among CMOS imagers (only 1 out of every 50,000 photons "leaks" into the

buffer). By comparison, competitive imagers have a PLS rating between 1:700 and 1:900 – more than 50 times worse than the CMOSIS chip.



- **Built-in Automatic Level Control (ALC)** – The SP-20000 includes advanced modes designed to handle difficult lighting situations such as gradual lighting changes that occur throughout the course of a day, as well as much more sudden changes that can be caused by weather conditions (passing clouds), surroundings (trees, buildings), and the changing orientation of the camera itself – particularly on vehicle-mounted systems.

  The ALC (Automatic Level Control) mode combines the auto gain function with the auto shutter function, enabling the camera to automatically adjust to changing light conditions and achieve proper exposure while minimizing both image noise and motion blur. The user can setup and define both the range and priority of shutter and gain variations.

  Under dark conditions, the auto-shutter remains fixed at an exposure time selected by the user to avoid unacceptable motion blur. Meanwhile, the AGC function applies as much gain as needed to achieve an acceptable exposure level, up to the maximum amount of gain deemed acceptable from a noise perspective. As illumination increases, gain is automatically reduced until it reaches zero, thereby eliminating any noise it may have introduced. As conditions continue to brighten, the auto shutter continues to reduce the exposure time until it reaches its minimum. The user can adjust the acceptable minimums and maximums for both shutter and gain based on the requirements of the application.

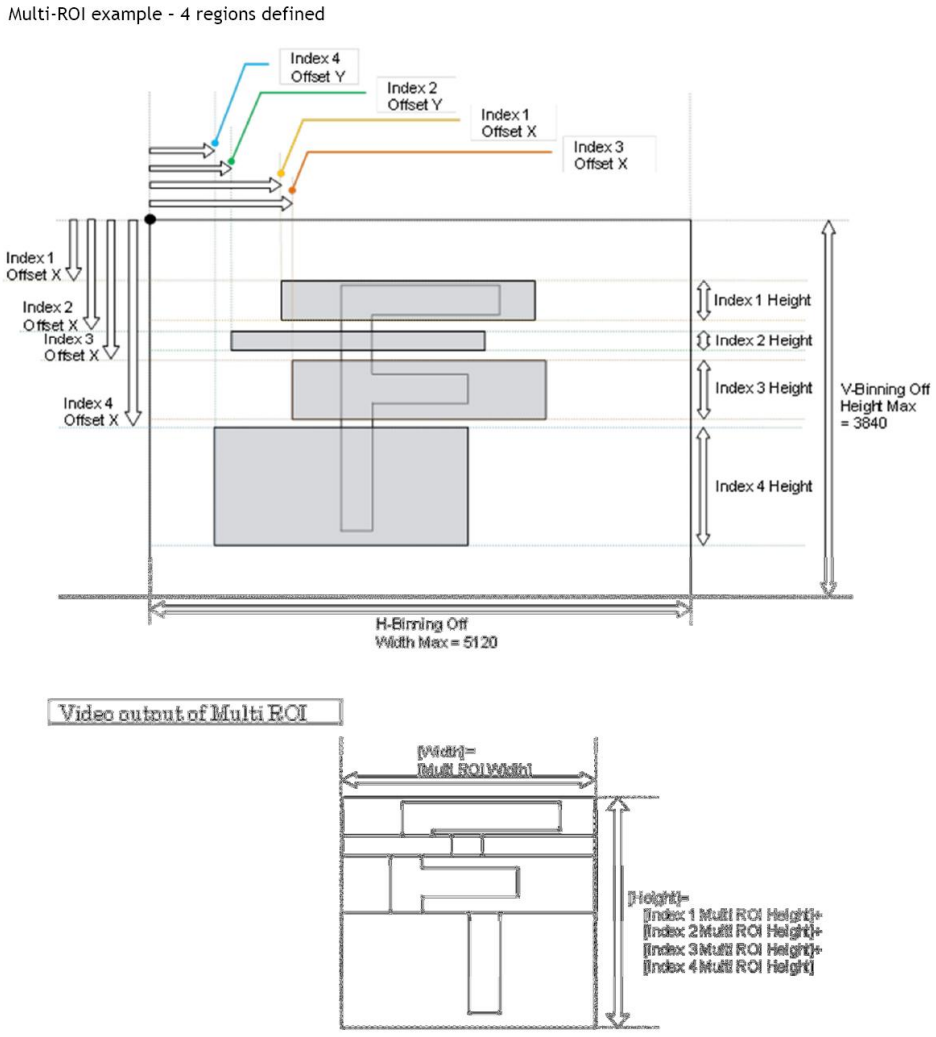
  A video iris signal is also provided which can be used to drive auto-iris lenses in connection with the ALC function, however in the SP-20000, this is not a fully integrated component of ALC, so extra care must be taken to set the video level of the auto-iris lens such that it is only applied after the auto shutter has reached its maximum point and won't cause oscillations to occur.

  The ALC feature is extremely useful for outdoor applications, but can also be valuable in certain indoor machine vision tasks.

- **Region of interest (ROI)** - The SP-20000 features both ROI and multi-ROI capabilities. The standard ROI function operates like partial scanning, increasing the frame rate of the camera proportionally to the number of lines that are read out. Users can also

adjust the width of the image (number of columns), though this does not increase the frame rate as the full line is still read out with the unused pixels being discarded.

The multi-ROI function is designed to take advantage of the SP-20000's large field of view while isolating specific details in up to 8 separate areas in the overall FOV. The width must be the same for all ROIs, but the height and the offset (X & Y) within the field of view can be unique for each. They are then combined into a single image with a width based on the common width, and a height equal to the combined height of all the ROIs. By defining areas of interest in the capture stage, this step can be eliminated from image post processing.



- **High Dynamic Range (HDR) modes**- For high contrast scenes, such as aerial imaging or persistent surveillance, the SP-20000M (monochrome) features a built-in High Dynamic Range (HDR) mode. This dual-slope HDR function lets users specify up to two knee points and two slopes that determine how rapidly different pixels accumulate light and move towards the saturation point. This is then applied on a pixel-by-pixel basis during the exposure period to bring darker pixels into an

acceptable exposure range while keeping brighter pixels from washing out. Utilizing the built-in HDR mode, the SP-20000M can capture images with a dynamic range of greater than 60 dB.

- **Industrial grade construction for** reliable operation – With the Spark Series, JAI has continued its tradition of sturdy products built for the rigors of real-world applications. The SP-20000 raises the JAI shock and vibration standards to 10G for vibration and 80G for shock. In addition, the camera has been designed with advanced thermal management techniques to enable it to operate in an extended temperature range from -45°C to +70°C.

Target applications:
The combination of speed and resolution makes the SP-20000 ideal for aerial surveillance, flat panel display inspection and many others where a large viewing area and high detail is required. In addition the ALC, HDR mode, and 30 fps operation, make the camera well-suited to persistent surveillance, border security, sports imaging, and other outdoor applications.

Additional interfaces:
Currently the SP-20000 is available in the PMCL (Power Over Min CameaLink) interface, however several other versions of this 20-megapixel camera are also under development, featuring different high-speed digital interfaces, including:
SP-20000M-CXP2 & SP-20000C-CXP2 (CoaXPress interface, dual-channel)
SP-20000M-USB & SP-20000C-USB (USB3 Vision interface)
These additional versions will be rolled out over the first and second quarters of 2014.

Common SDK and Control Tool:
As part of the release of this camera, JAI has created a new version of its SDK and Control Tool with a common GenICam interface capable of working with Camera Link, CoaXPress, and USB3 Vision cameras, in addition to GigE Vision cameras. All Spark Series cameras will have the necessary XML file and register interface to utilize this common software package. The software is available for download from the download center and from the SP-20000-PMCL product page on the JAI website.

For more information or to try the SP-20000 please contact your nearest Adept Turnkey office.

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