

SI-1280F- M & RGB MegaCamera™
1.3 Megapixel, 12-Bit, 60MHz
Ultra-Fast Full-Frame Shutter Digital Camera

Silicon Imaging Inc.



Silicon Imaging is proud to continue its innovation in ultra-high speed machine vision camera. Driven by the growing demand for consumer Digital Still Cameras, CMOS sensors are continuing to break technical barriers and surpass the performance characteristics of CCD's in many photonic, imaging and consumer applications. By utilizing a single highly integrated CMOS device, which incorporates Megapixel sensing areas, timing generation, signal processing and high bandwidth outputs, Silicon Imaging has developed a very compact, low-power, ultra high speed Megapixel digital camera system.

1280 x 1024 Megapixel Imaging - Ultra Speed

The SI-1280F is the worlds first 1.3 Million pixel Full-Frame Shutter, all-digital CMOS camera capable of running at video rates of 40 frames/second at its full 1280 x 1024 resolution and over 500 frames/per second at 320 x 240 resolution. The entire package is only 45 x 52 x 50mm and is small enough to placed on a robot for semiconductor machine vision inspection, embedded into a portable medical instrumentation for cell biology or placed in an aerial drones for remote surveillance.

12-Bit Pixel Clock Sampling – Sub-Pixel Accuracy

The MegaCamera uses 12-Bit digitizers to sample the pixel data at up to 60MHz to achieve 40 Frames/sec data throughput at its full Megapixel resolution. Converting the pixel data directly to digital at the sensor head eliminates pixel-sampling jitter and enables accurate sub-pixel metrology, image analysis and improved live video reconstruction.

Full-Frame Triggered Shutter – Stop the Motion

Most common CMOS sensors only have a "Rolling Shutter" to control the exposure time for each line in the image. This method can produce unwanted motion tilts or jagged edges, as each row ends integration after the previous one above it. The SI-1280F provides a Full-Frame triggered shutter, which completely stops any motion artifacts by exposing all pixels simultaneously and holding the exposed value until it is progressively readout.

Dual Slope Exposure - "Super-Dynamic Range"

The SI-1280F can be used in a dual slope bi-linear mode, extending the useful dynamic range in scenes where detail in bright areas are to be preserved at the same time as maintaining details in darker regions. In normal linear response, a camera requires a short exposure to keep the bright areas from saturation. However, the darker regions of the image would not have enough time to integrate charge. If the exposure is set longer the detail in the dark areas will become visible by the brighter areas will become saturated. The dual-slope operation combines the transfer of nominal integration time (steep slope, high sensitivity) with the transfer curve obtained from a short electronic shutter (shorter exposure time, lower sensitivity), into a single exposing operation.

2400 Frames per Second - Windowing & Subsampling

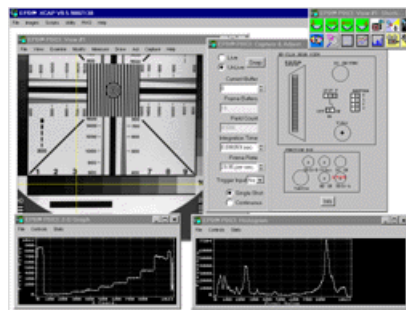
Ideal for object tracking and high-speed Motion analysis, the SI-1280 is capable of generating imagery at over 2400 frames per second by reducing the size of the readout image (ex. 100x100). This windowed Region-of-Interest (ROI) can be moved dynamically, creating an entirely electronic pan/tilt/zoom function within the camera field-of-view.

CameraLink Digital Interfaces

An industry standard forum has adopted CameraLink, for low cost connectivity and cabling at very high speeds. The SI-1280F-CL can output 1280 x 1024 12 bit data at 40 frames per second (865 Mb/second) continuously to a frame grabber. The single cable includes image data, vertical and horizontal synch, LVDS Triggering and 9600 baud Serial communication. As this camera complies with the standard, it is compatible with many popular frame grabber and image processing hardware devices and fiber-optic extender for extended distance transmission.

GigE-Cameralink – Gigabit Ethernet Connectivity

Now you can capture high-speed MegaCamera images to your PC from distance of a 100-meters using CAT-5 wire using the Silicon Imaging [GigE-Cameralink](#) Interface. The GigE-Cameralink captures MegaCamera digital images and transmits them via 10/100/1000 Gigabit Ethernet directly to your PC at speeds over 100MB/sec.



FEATURES

- 1280 x 1024 Resolution (1.3 Million Pixels)
- Full Frame Triggered Shutter, Progressive scan
- 2/3" Imaging Format , 6.7um Square Pixel
- Windowing and Subsampling
- 12 Bits per Pixel, 55MHz Sampling
- High Speed Readout (30 ~ 3000FPS)
- Region-of-Interest (ROI) windowing
- Progressive Rolling Shutter Mode
- 1usec-4sec Precision High Speed Shutter
- Long Integration (up to n-Frame Times)
- Programmable Gain, Offset, Clock, Shutter & ROI
- External Clock Synchronization (FrameLock)
- Monochrome & Color Bayer RGB Models
- 5VDC Low Power, Small Package
- C-Mount Housing or PCB versions
- CameraLink™ Digital Interface

SI-1280F MegaCamera™ Specifications

Sensor:

Active Pixels	1280 (H) x 1024 (V)
Optical Imaging Format	2/3" (8.576mm X 6.861mm)
Pixel Size (pitch)	6.7um x 6.7um
Pixel Type	CMOS
Aspect Ratio	1 : 1
Spectral Response	400 ~ 1000 nm
FPN (on chip corrected)	<0.5%
PRNU	10%p/p; 1.1%RMS

CameraLink Frame Grabber Control:

Serial Communication	RS-232 Protocol 9600bps
Signaling	TX & RX (LVDS)
Asynchronous Triggers	LVDS – CC1, 2, 3, 4 (-CL) TTL Trigger-In & Strobe-Out (-U)
High Speed Shutter	1usec ~ 4sec, in 1usec increments
Trigger-to-Exposure	128 clocks (3.2usec @40MHz)
Long Integration	n-Frame Times
Region-of-Interest	Programmable Horiz & Vertical
Gain & Offset	7 Settings (1.0x, 1.33x, 2.0x, 4x)

Conversion Gain	12 $\mu\text{V}/\text{electron}$
Sensitivity	1.85V/Lux.sec (visible) or 336 V.m2/W.s
Fill Factor	~55%
Read Noise	80-90 e^- (sync shutter);70-80 e^- (rolling)
Dark Current	2100 pA/cm^2 at RT or 5900 e^-/s
Saturation Charge	120,000 e^-
Windowing (ROI)	Programmable row/column
Sub-sampling	1:2 for color and monochrome
Noise Reduction	Correlated Double Sampling (CDS)
Readout Method	Progressive Scan
Readout Types	Destructive
Shutter	Full Frame Shutter or Rolling Shutter
Shutter Speed / Integration	Variable, 1 to 1280 Line times
Minimum Blanking	150 Clocks/line

Programmable Modes	Full-Frame, Window, Subsampling Long Integration & Single-Shot
Setting Timing	Next top of Frame
Ext Clock Sync	Clock in or Clock Out (-X Option)

Power

Input Voltage	+5 VDC +/- 10%
Power	2.5 Watts
Power/Trigger Connection	Tajimi RO3-PB3M 3Pin (-CL) Tajimi RO3-PB5M 5Pin (-X)

Mechanical

Lens Mount	C-Mount, 7mm Back focus Adj.
Enclosure Size	45mm W x 52mm H x 50mm L
Weight	12 oz.
Camera Mount	1/4" x 20standard tripod mount
Cable Connector	Cameralink MDR-26 (-CL) High-Speed 3-meter USB Cable with Type-A Connector (-U)

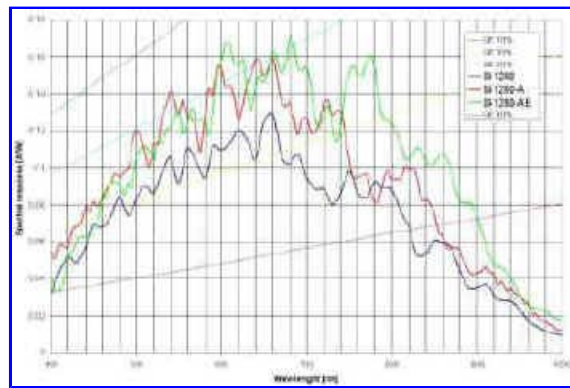
A/D Conversion & Sampling Clock Synthesizer

A/D Conversion	30MHz (Nominal), 60MHz (max)
Vertical Resolution	12 Bit
Pixel Clock Frequency	20 - 60Mhz Programmable
Adjustment Method	Serial command Protocol
A/D SNR	67.5dB
Output Noise	0.2 LSB rms

Digital Video Output

Readout Rate	60 MHz Maximum, PCI 8 bit @ 60MHz, PCI 12 bit @ 50MHz; PCI-X @ 60Mhz USB @ 45MHz		
Readout Format	CL-12 Bit (Ports A, B)		
Frame Rate @ Max Clock	USB 8 bit	PCI-CL(12)	PCI-X-CL(12) And PCI-CL(8)
1280 x 1024	24	34	41
1280 x 720	36	48	58
768 x 768	45	70	85
640 x 512	75	123	148
512 x 512	85	147	177
360 x 300	150	326	392
320 x 240	180	443	532
256 x 256	190	481	577
64 x 64	375	3650	4380
Line Readout Rate	23.9 usec per line @ 55MHz		
Signal-to-Noise	> 60dB (fc=20MHz, Gains=1.0)		
Connector	MDR 26-pin (3M 10226-6212VC) (-CL) USB 2.0 Integrated cable (-U)		

Spectral Response Curve



click image to view larger version

SI-1280F CameraLink Frame Rates

The SI-1280F has a Digital Clock Synthesizer capable of generating a range of frequencies from 20MHz to 60MHz. The pixel data output rate is the same as the sampling clock rate. A range of preset frequencies are listed below. There are 150 clocks overhead per row for readout

MHz	SI-1280F Frame Rate							
Clock Rate	1280x1024	1280 x 700	800 x 600	640x480	320x200	240x180	200 x 150	128x128
20 MHz	14	20	35	53	177	285	381	562
25 MHz	17	25	44	66	222	356	476	703
30 MHz	20	30	53	79	266	427	571	843
35 MHz	24	35	61	92	310	499	667	984
40 MHz	27	40	70	105	355	570	762	1124
45 MHz	31	45	79	119	399	641	857	1265
50 MHz	34	50	88	132	443	712	952	1405
55 MHz	38	55	96	145	488	783	1048	1546
60 MHz	41	60	105	158	532	855	1143	1686

Frame Rate Calculation

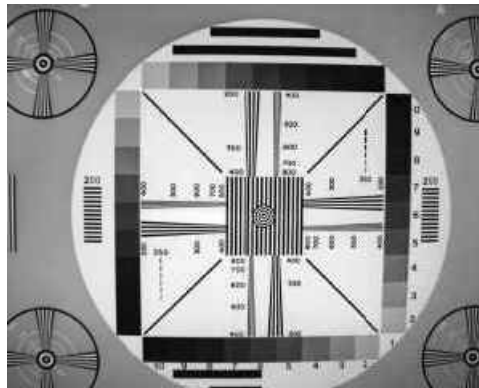
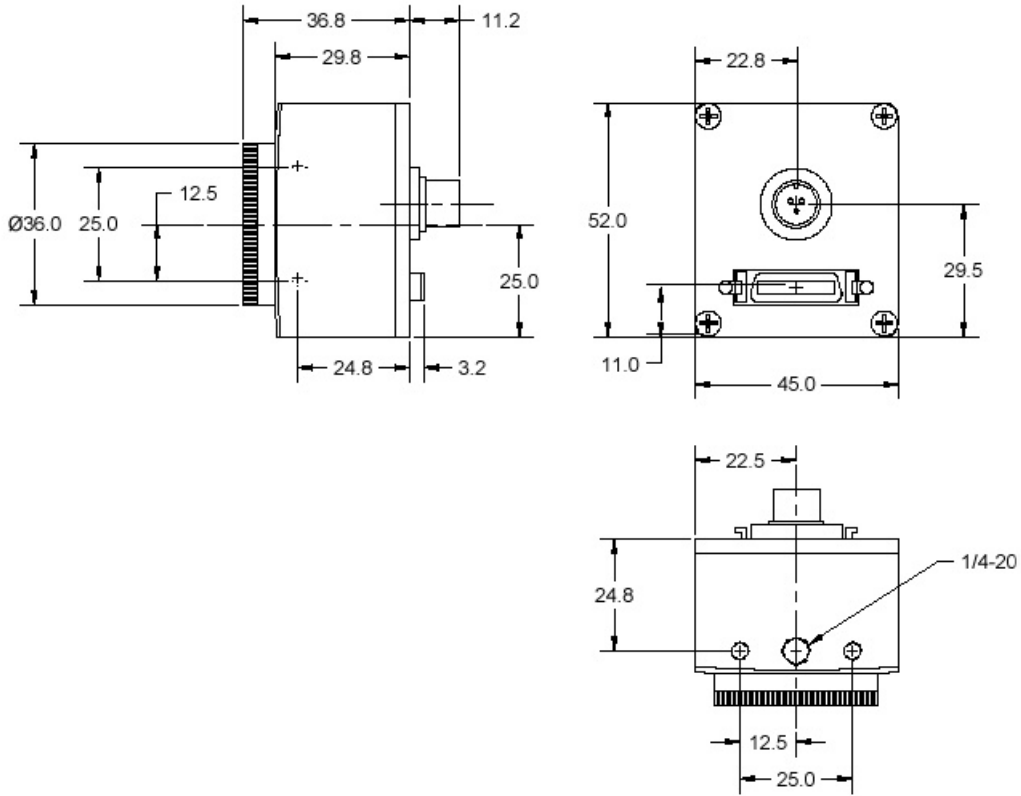
To calculate the frame rate for any clock rate the equation is:

$$\left(\frac{\text{clock rate(Hz)}}{(\# \text{ of columns} + 150) * (\# \text{ of rows})} \right) = \# \text{ Frames Per Second (fps)}$$

Example: What is the frame rate, at 60MHz clock rate for an image size of 800 x 600?

$$\frac{60 \times 10^6}{(800 + 150) * (600)} = 105 \text{ Frames Per Second (fps)}$$

**** FRAME RATES** are based on **ROLLING SHUTTER** operation. Full-Frame Shutter requires the additional time for exposure for each frame. Subsampling frame rates are based on the resulting size of the subsampled image or window.



Test Image - [Click to view full size](#)



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