



CAMRAPID500 - XM

Specifications, ver. 1.4

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FAST DIGITAL VIDEO CAMERA WITH EXTENDABLE MEMORY



CamRapid500-XM is a fast video camera. It comes in 2 versions: a standard version with up to 16 GB memory and a split version with **unlimited memory** which can record several minutes of fast video. The CMOS sensor has 1280 x 1024 x 10 bits resolution. A standard USB2 link is used for control, image display and transfer of recorded images. A B&W NTSC/PAL live video output is also available.

Camrapid500-XM features :

- The acquisition rate goes from 518 images/s at 1280x1024 resolution to 250 000 images/s at 1200x2 resolution. It can go down to 1 Hz.
- Image exposition by full frame shutter can go down to 2 μ s.
- Sensor's reference voltages controlled by software to adjust gain, noise, offset
- Real time image analysis can trigger acquisitions. An internal calculator detects movements and sparks in real time to start or stop recording.
- Asynchronous external control of exposition, which can be used for PIV applications (Particle Image Velocimetry): Image couples can have exposition delays down to 5 μ s. Details in **Application note 3**.
- The camera comes in 2 versions:
 - Compact camera with up to 16 GB memory
 - Split camera with a sensor head and a memory box. They can be up to 3 meters apart. A standard SCSI3 cable is used to transfer the images and control signals.

The split version can be custom designed with **unlimited memory**, the limiting factors being the volume, weight, power consumption and price. A standard version with up to 64 GB memory is already available. The split version also allows to have one B&W head and one colour head which can be used as necessary.

- A monochrome live video output is available.
- A video sync. input may be used to synchronize images to multiples of 60 / 50 Hz.
- A configurable input signal may be used to time-stamp the images.
- An optional battery can save the images in case of power failure.
- Optional analog inputs enable the acquisition of 4 analog signals at a rate of 45 KHz, with 12 bits resolution to record additional parameters.

The software controls the acquisition, display, image archival and compression. Application modules can be added to process sequences as required by our customers. The control PC can send and receive messages on ethernet for control and monitoring purposes.

SPECIFICATIONS

Sensor	CMOS, monochrome or colour (Bayer filter) 1280 (H) x 1024 (V) pixels, 10 bits digital outputs. Web page: http://www.micron.com/imaging/Products/MI-MV13.html
Acquisition window	Rectangular acquisition windows, horizontal size by 20 pixel steps (20, 40, ... 1280) and even vertical size (2, 4 ... 1024).
Acquisition rate	Up to 518 images/s at 1280 x 1024 resolution. Down to 1 image/s. Maximal rate increases linearly with decreasing vertical images size. Examples: 5000 images/s for 1280 x 102. 250 000 images/s at 1280 x 2. This rate can be reached only for monochrome images, colours are being obtained using several lines.
Gain / noise	The sensor's reference voltages come from DACs controlled by software. These voltages determine analog to digital conversion parameters as gain, noise, offset ...
Memory	The memory boards have 4 standard DDR DIMM connectors (184 points). Any number of these boards can be linked together in split version. The standard version houses only 2 boards. Configuration examples: - 4 GB (minimum standard version) - 16 GB (full standard version) - 4GB to 64GB (standard split version) - unlimited (custom split version)

Memory size	4 GB	16 GB	80 GB
Image number (duration*) at 1280x1024 x 10bits	2340(4.7s)	9360 (18s)	46K (93s)
Image number (duration*) at 1280x1024 x 8bits	2920 (5.8s)	11700 (23s)	58K (1min 56s)
Image number (duration*) at 512x512 x 8bits	14300 (28s)	57K (1min54s)	286K (9min 30s)

* at 500 im/s

The acquisition window's size and position are programmables. It's vertical size determines the maximum acquisition rate, it's size determines the maximum number of images which can be stored.

Acquisition

Single, fixed: single sequence acquisition.

In **Circular buffer** mode, images are written continuously in memory, in a circular buffer. The trigger stops the acquisition after a programmable number of images. This way, the number of images written before and after the trigger are known. Several sequences may be stored in memory.

The trigger may come from :

- mouse, keyboard;
- external signal;
- intensity variations in a rectangular Region of Interest (RI) in the image. The embedded hardware analyses up to 255 points, sub-sampling the region by 10 horizontal pixels or more. The variation amplitude threshold and minimum number of points to enable the trigger are programmables;
- « spark » type events. In this mode an intensity threshold is applied to all points of a RI. The threshold and number of points to enable the trigger are programmables;
- signal edges at analog inputs;
- other CamRapid cameras.

Exposition	The full frame electronic shutter can go down to 2 μ s, by 2 μ s steps. Exposition can also be controlled by an external signal. The timing error is less than +/-50ns. The mean image rate can not exceed the rate permitted by the image size, but couples of successive images can be exposed 5 μ s apart (an image can be exposed during the transfer of the previous one). This feature can be used in PIV (Particle Image Velocimetry) applications. (Application note 3)
Synchronisations	Expositions & triggers of any number of cameras can be synchronized. In this mode, the cameras are chained and each camera introduces a delay of approximately 100ns. The first camera synchronizes the images of all others. The acquisition trigger can come from any camera, from the one which senses a spark, for example.
NTSC/PAL live video	The camera outputs a B&W live video for monitoring purposes.
NTSC/PAL Synchro	The image acquisitions can be synchronous to a NTSC video input, at rates multiple of 60 Hz. A PAL version is in development
Image date	A TTL input can be used to time-stamp the images using a 1Hz timing signal along with UDP messages for precise timing. An IRIG-B input is in development.
Analog inputs (optional)	4 signals are sampled at 45 KHz (or less) at 12 bits resolution, and can be recorded together with the images. Each recorded value has a corresponding image.
Lens mount	C, or other upon customer specification
Lenses	Any lens for 1" CCD.
Power	16GB, standard version: 12 V, 5A. Split version (64 GB): 220/230VAC 150W or 12V 13A . Both are available and any one can be used.
Dimensions	Standard 140 x 140 x 300 mm, without lens Split version (64 GB): 120 x 120 x 60 mm sensor head and 19" memory box for.
Tripod mount	1/4" (photo), M6
Weight	1,5 kg (standard)

INPUT / OUTPUT

Notations :	(i) input (o) output (i/o) input or output
"Trigger" (i)	Differential, isolated by optocoupler. Starts image counter for end of record.
" Man. Trigger" (i):	Contact switch input, NOT isolated by optocoupler.
"Syncln" (i)	Differential, isolated by optocoupler. Signal input for exposition control (Application note 3).
"SyncOut" (o)	TTL output. Exposition signal, can be used to trigger a flash.
"TP" (i)	"Time Pulse" input. Differential, isolated by optocoupler.
Analog in (i) x4	12 bits sampling at 45 KHz (or less). +/- 10 V or +/- 3.3 V.
"CameraSync" (i/o) x 2	LVDS signals between cameras. Synchronises exposition & triggers of several cameras.

Connectors Trigger, Man.trigger, SyncIn, SyncOut and TP signals use BNC connectors; CameraSync signals are input/output using RJ45 connectors; Analog signals are on a DB9 connector.

INTERFACES

- 1) USB2, 480 Mbits/s, 3 or 5m cables. Extensions possible up to 20m. Fiberoptic interfaces are available up to 10km.
- 2) Optional ethernet connection between the control PC and a remote Host PC. Custom development as user requirements.

CONTROL SOFTWARE

OS Windows 2000 / XP

Display Approximately 4 i/s (RGB, 1280x1024) using a 3 GHz PC, in acquisition mode.
Colour display for colour version, B&W or false colours display for monochrome version.
A calibration is required to suppress the “fixed form noise” of the sensor.
Remarks:

- A **B&W live video** display is output for monitoring purposes.
- Acquisition and display can be simultaneous.

Configuration The camera is fully configurable by software, even the sensors reference voltages.

Sequences Image sequences are displayed using a DVD type user interface: reverse, forward, fast, slow, 1 image step ...
Each sequence can be named and commented.
Acquisition parameters and comments are saved with image files.

Image file types binary (8 or 10 bits), BMP, PPM, TIFF, JPEG, AVI...

Other displays Intensity profiles, histogram, ...

Region of interest Definition by mouse or keyboard on the image

Remote host The control software (a PC controls the camera) can exchange UDP messages with a remote host for control and monitoring purposes. The acquisition, rate, exposition, archival ... can be controlled this way.

Applications Software modules can be added to process recorded images or images archived to files. These modules can be developed upon requests from our customers.