PHANTOM®
T-SERIES

PRELIMINARY DATASHEET

PHANTOM TE2010

HIGH-SPEED CAMERA

1280 x 832 at 19,250 fps
640 x 384 Binned at 82,440 fps
256 x 64 at over 1M fps*

FEATURES & BENEFITS

20 GPX/S IMAGING IN A COMPACT PLATFORM

- A custom Backside Illuminated (BSI) sensor optimizes image performance for high-speed motion analysis
- FAST option* increases max frame rate to over 1M fps and a minimum exposure time of 185 ns
- Convenient T-Series platform provides premium connectivity in a compact housing
- The TE2010-K225 model has a reduced maximum frame rate of 225,000 fps

FAST & EFFICIENT WORKFLOW

- 10Gb Ethernet provides the fastest data download directly from RAM.
- Partition the RAM with multi-Cine. When combined with Image-based auto trigger (IBAT) and PCC's continuous recording feature, the workflow becomes fully automated.

**with export controlled FAST option*

VISION RESEARCH / AMETEK®

VISION BY FORZA

IMAGE & SENSITIVITY

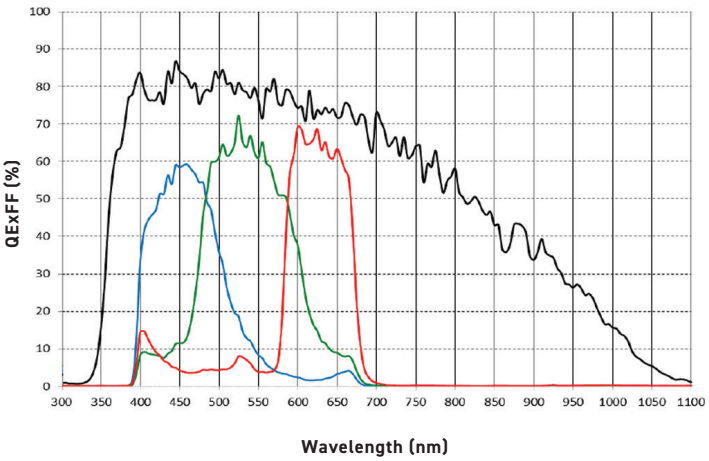
Sensor Type	CMOS, Backside Illuminated (BSI) with Global Shutter	
Maximum Resolution	1280 x 832	Binned 640 x 384
CAR Increments	256 x 32	Binned 128 x 64
Pixel Size	18.5 µm	Binned 37 µm
Sensor Size	23.9 x 15.4 mm	
Bit Depth	10-bit	
	EMVA 1288 Measurements (at 532 nm)	
	Standard Mode	**Binned Mode**
Quantum Efficiency %	59.9% mono 53.6% color	35.5 mono
Max. SNR (dB)	38.5	42.4
Absolute Sensitivity Threshold (p)	32.9 mono 39.1 color	108.6
Saturation Capacity (e-)	7014 mono 7445 color	17,258
Temporal Dark Noise (e-)	19.05	37.72
Dynamic Range (dB)	51.0	53.0

- *Reported measurements were taken at 532 nm with both monochrome and color cameras*
- *Visit: www.phantomhighspeed.com/emva for more information on EMVA 1288*

Back Panel

SPECTRAL RESPONSE

Quantum Efficiency Monochrome and Color



CONNECTIVITY & SIGNALS

Ethernet	Gigabit and 10Gb Ethernet (standard)
Timecode	IRIG-B Modulated and Un-modulated
Port Descriptions	Fischer 8-pin Ethernet; Fischer 3-pin for Primary and Backup Power; Fischer 5-pin for Remote; Fischer 8-pin for Range Data; USB for WiFi Dongle; 3 Dedicated BNCs for Trigger, Timecode-in and SDI Video; 3 BNCs for Programmable I/O
I/O Signals	Programmable I/O (3 ports) for Fsync, Strobe, Ready, Timecode-out, Event, Pretrigger Assign and define signals in PCC
Hardware Trigger	Dedicated BNC
Software Trigger	Trigger button; via Ethernet; via Remote port; via Image-based auto trigger (IBAT)
Synchronization	External Sync via FSync or IRIG Timecode
Recording Features	Burst Mode; Image-based Auto Trigger, Continuous Recording
Video Output	3G-SDI via BNC (rear), Din (front); Micro HDMI type D
Accessory Power	4-pin Hirose (front) for 12V monitors up to 1 Amp

MEMORY & STORAGE	
RAM Buffer	32GB, 64GB, 128GB RAM Options
Multi-Cine	Up to 63 Partitions
Non-Volatile Media	N/A
Media Transfer Rates	N/A

FRAME RATES & EXPOSURE		
Top FPS at Max Resolution	19,250 at 1280 x 832	
Maximum FPS	TE2010: 469,560 standard parameters; 675,000 fps in shutter-off mode; 1,080,000 fps with FAST option*	TE2010-K225: 225,000 fps
Minimum FPS	100	
Minimum Exposure	1 µs Standard, 185ns with FAST Option*	
PIV Features	Shutter-off mode with a straddle time of 123ns; Supports Burst Mode	
Exposure Features	EDR (Extreme Dynamic Range); Auto-Exposure	

FRAME RATE CHART

Table provides examples of common resolutions and frame rates. Additional resolutions are available, reducing horizontal resolution increases record time. The record times shown are for 64GB RAM at the frame rate shown. Duration will be ½ for 32GB and double for 128GB RAM.

Maximum Frame Rate - FPS; (64GB Record Time - Sec)				
	TE2010		TE2010-K225	
Resolution (H x V)	Standard Mode	Binned Mode (Mono Output Only)	Standard Mode	Binned Mode (Mono Output Only)
1280 x 832	19,250 (2.2)		19,250 (2.2)	
1280 x 800	20,030 (2.2)		20,030 (2.2)	
1280 x 640	25,000 (2.2)		25,000 (2.2)	
1024 x 640	30,850 (2.2)		30,850 (2.2)	
768 x 768	34,170 (2.2)		34,170 (2.2)	
1024 x 384	51,420 (2.2)		51,420 (2.2)	
512 x 512	76,050 (2.3)		76,050 (2.3)	
640 x 384		82,440 (2.2)		82,440 (2.2)
768 x 256	101,880 (2.3)		101,880 (2.3)	
512 x 384		101,880 (2.3)		101,880 (2.3)
768 x 128	200,000 (2.3)		200,000 (2.3)	
640 x 128		240,000 (2.3)		225,000 (2.5)
512 x 64	469,560 std; 568,420 w/ FAST*		225,000 (6.1)	
384 x 64		385,710 std; 720,000 w/ FAST*		225,000 (12.1)
512 x 32	469,560 std** (5.8); 1,080,000 w/ FAST* (2.5)		225,000 (12.1)	
256 x 64		469,560 std** (5.8); 1,080,000 w/ FAST* (2.5)		225,000 (12.1)

Certain Phantom cameras are held to export licensing standards. Details available at: **www.phantomhighspeed.com/export*

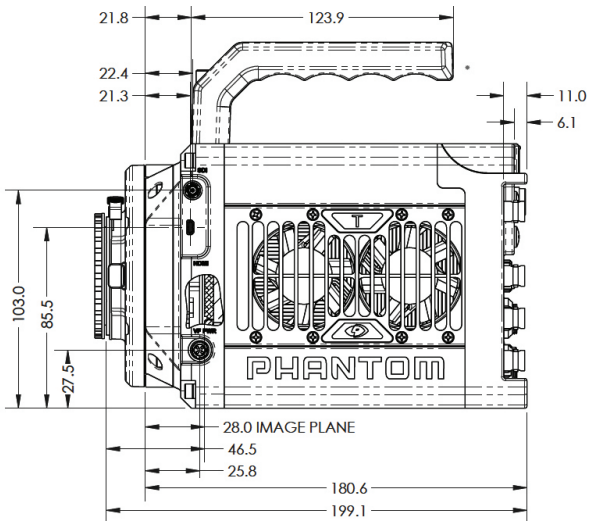
*****Higher frame rate of 675,000 fps is available with shutter-off mode at 512x32 or 256 x 64 binned***

CONTROL

Software & OS	Phantom PCC (Windows x64); SDK available for C/C++, C#, Python, MatLab and LabView
On-Camera Controls	Standard Feature. Access menu system with encoder, viewed on video monitor. Buttons for trigger, play and save – Color indicates current camera state.
Primary File Format	Phantom Cine RAW (.cine)
Alternative File Formats	Easily convert to formats including .mp4, Apple ProRes .mov, .avi, Tiff, JPG, DNG and many more using PCC. Cine files are directly compatible with many major video editing and motion analysis programs.
Software Features	Continuous Recording for automated workflows, Integrated Data Acquisition (NI-DAQ), support for DIC Calibration with Sync-Snapshot menu, advanced Image Tools including Crop & Resample, Tone Curves, Filters and more.

MECHANICAL

Housing Variants	N/A
Size	*5 x 5 x 8" (12.7 x 12.7 x 20.3 cm) (Not including handle. Handle adds 2" (5 cm) to height.)*
Weight	8.6 lbs (3.9 kg)
Lens Mounts	F-Mount standard (aperture support for Nikon G-style lenses). Also available: Canon EF (with electronic focus and iris control), PL, C-mount and universal M42 mount
Mounting Points	Standard 1/4 x 20 and 3/8" mounting points on bottom (2 each). Remove handle and add cheese plate for top mounting. Side mounting bracket available for vertical positioning.
Internal Shutter	Standard, for remote black references
Cooling	Active cooling. Quiet mode disables fans during capture.



POWER

AC Power	100-240 VAC, 280W power supply included
Voltage Range	20-28V
Power Consumption	160W typical
Battery Options	Works with 24V battery sources only, input through dedicated backup power port

ENVIRONMENTAL

Operating Temperature	-10 to +50°C
Storage Temperature	-20 to +70°C
Relative Humidity	≤85% non condensing
Operational Shock	30G, 11msec sawtooth, 3 axes, 2 directions per axis, 10 shocks per direction (60 pulses total)
Operational Vibration	7.5 Grms, 50Hz-2KHz, 3 axes, 15 min/axis, IAW MIL-STD-202H Method 214-I, Test Condition B
Regulatory	Made in the USA **CE Emissions** – CE Compliant EN 61326-1, Class A **CE Immunity** – CE Compliant EN 61326-1, Class A **FCC** – CFR 47, Part 15, Subpart B & ICES-003, Class A **Safety** – IEC 60950-1 (2012)

GLOBAL SUPPORT NETWORK

Phantom cameras are supported by Vision Research's Global Service and Support network, providing PhantomCare services from multiple sites around the globe.

ABOUT VISION RESEARCH

Focused. Since 1950, Vision Research has been designing, and manufacturing high-speed cameras. Our single focus is to invent, build, and support the most advanced cameras possible.

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