PHANTOM®
T-SERIES

DATASHEET

PHANTOM T3610 T2410 T2110

HIGH-SPEED CAMERA

1280 x 800 up to 38,040 fps (T3610)
up to 24,270 fps (T2410)
up to 21,010 fps (T2110)
BSI sensor architecture

FEATURES & BENEFITS

ULTRAHIGH FRAME RATES IN AN UPDATED COMPACT PLATFORM

- A custom back side illuminated (BSI) sensor drives the camera's speed and sensitivity, optimizing image performance for high-speed motion analysis.
- Exposure times down to 190 ns with FAST Option, independent of frame rate, eliminates motion blur for fast-moving applications like ballistic research and spray dynamics.
- The camera's Binned mode combines pixels for increased vertical resolution at the highest frame rates.
- The convenient T-Series platform provides premium I/O connectivity and workflow features in a compact housing.

WORKFLOW FLEXIBILITY

- 10Gb Ethernet (optional) allows for the fastest data download directly from the camera's RAM buffer, up to 256 GB.
- On-camera controls and an optional CineMag interface allows for complete standalone operation, eliminating the need for a computer. Offload later from the camera body or a dedicated CineStation

VISION BY FORZA

VISION RESEARCH / AMETEK®

IMAGE & SENSITIVITY

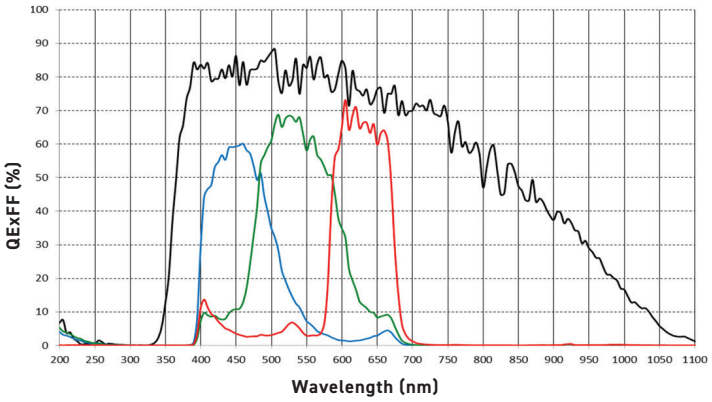
Sensor Type	CMOS, Back Side Illuminated (BSI) with Global Shutter	
Maximum Resolution	1280 x 800	Binned 640 x 384
CAR Increments	256 x 32	Binned 128 x 64
Pixel Size	18.5 µm	Binned 37 µm
Sensor Size	23.7 x 14.8 mm	
Bit Depth	12 bit	
	EMVA 1288 Measurements (at 533 nm) Standard Mode	Binned Mode
Quantum Efficiency %	84.6% mono 77.0% color	83.0%
Max. SNR (dB)	39.9	45.8
Absolute Sensitivity Threshold (e-)	23.9 mono 26.6 color	56.3
Saturation Capacity (e-)	9,675 mono 9,968 color	37,882
Temporal Dark Noise (e-)	23.4	55.8
Dynamic Range (dB)	52.2	56.5

- *Reported measurements were taken at 533 nm with both monochrome and color cameras, using the EMVA 1288 4.0 standard*
- *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 (T2110), 64GB, 128GB, 256GB RAM Options		
Multi-Cine	Up to 63 Partitions		
Capture Duration**	**T3610**: 64GB 1.1s; 128GB 2.2s; 256GB 4.4s	**T2410:** 64GB 1.8s; 128GB 3.5s; 256GB 7.0s	**T2110:** 64GB 2.0s; 128GB 4.0s; 256GB 8.0s; 32GB 1.0s
Non-Volatile Media	Phantom CineMag 5 optional. Supports auto-save, direct record and video playback.		
Media Transfer Rates	2TB CineMag = 1 Gpx/s 8TB CineMag = 1.3 Gpx/s		

FRAME RATES & EXPOSURE

Top FPS at Max Resolution	**T3610:** 38,040	**T2410:** 24,270	**T2110:** 21,010
Maximum FPS	3610: 525,000 (875,000 w/ FAST Option*)	2410: 525,000 (558,330 w/ FAST Option*)	2110: 483,330
Minimum FPS	100		
Minimum Exposure	1.1 µs Standard, 190ns w/ FAST Option*		
PIV Features	Shutter-off mode with a straddle time of 230ns (T3610 & T2410) and 201ns (T2110). 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.

Maximum Frame Rate - FPS

	T3610		T2410		T2110 & T2110-E225	
Resolution (H x V)	**Standard Mode**	**Binned Mode (Mono Output Only)**	**Standard Mode**	**Binned Mode (Mono Output Only)**	**Standard Mode**	**Binned Mode (Mono Output Only)**
1280 x 800	38,040	-	24,270	-	21,010	-
1280 x 640	47,510	-	30,310	-	26,460	-
1280 x 480	63,250	-	40,360	-	34,930	-
1280 x 384	78,940	-	50,370	-	43,600	-
1280 x 320	94,590	-	60,360	-	52,250	-
1280 x 256	117,970	-	75,280	-	65,160	-
1280 x 192	156,710	-	100,000	-	86,560	-
1280 x 128	233,330	-	148,880	-	128,880	-
1280 x 96	308,820	-	197,050	-	170,580	-
1280 x 64	456,520	-	291,300	-	252,170***	-
1280 x 32	525,000 std; 875,000 w/FAST*	-	525,000 std; 558,330 w/ FAST*	-	483,330***	-
640 x 384	-	156,710	-	100,000		86,560
640 x 256	-	233,330	-	148,880		128,880
640 x 192	-	308,820	-	197,050		170,580
640 x 128	-	456,520	-	291,300		252,170***
640 x 64	-	525,000 std; 875,000 w/ FAST*	-	525,000 std; 558,330 w/ FAST*		483,330***

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

***Record times shown are with the top FPS at max resolution*

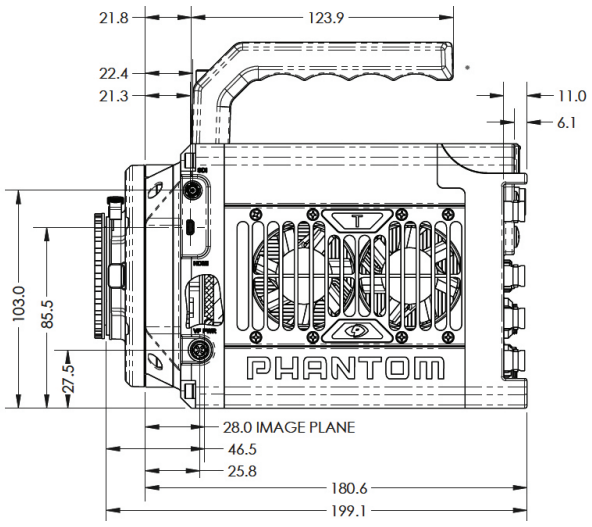
****T2110-E225 maximum frame rate is 225,000 fps*

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	CineMag and Non-CineMag Compatible Variants
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	9.4 lbs (4.3 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	225W max with CineMag; 170W max typical without CineMag
Battery Options	Works with 20-28V 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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