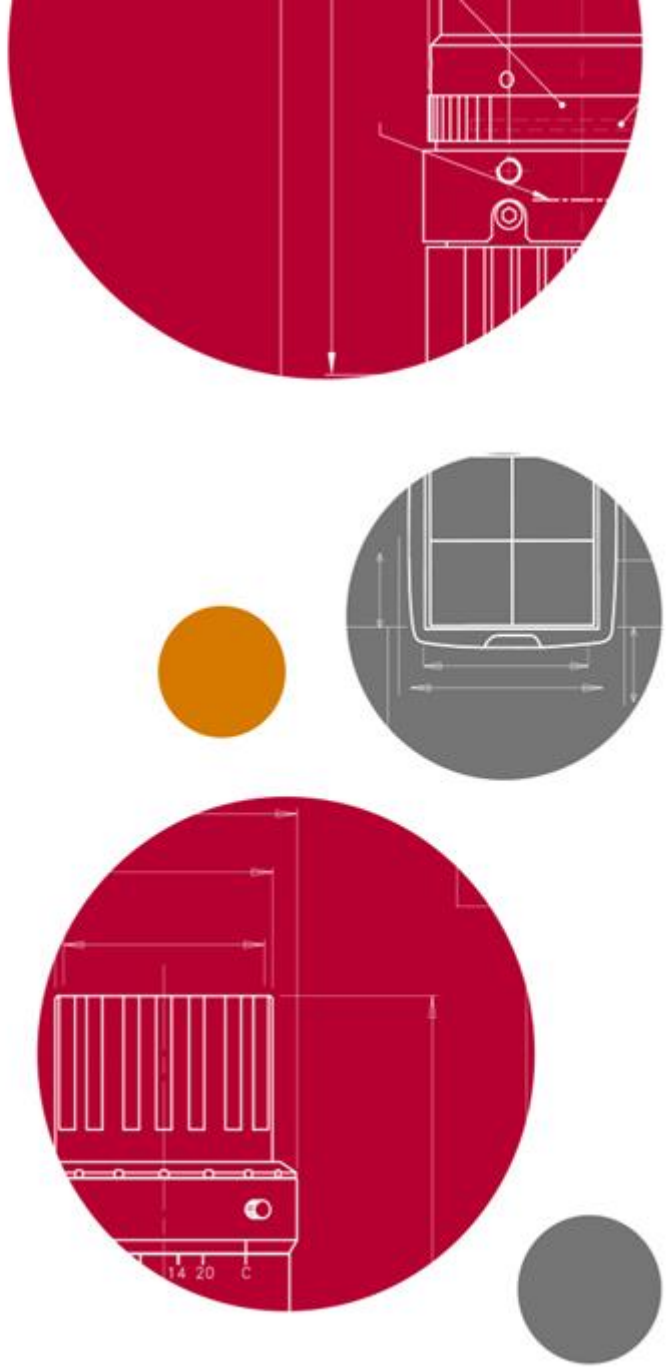
vieworks

Hybrid TDI Cameras Technology



VIEWORKS

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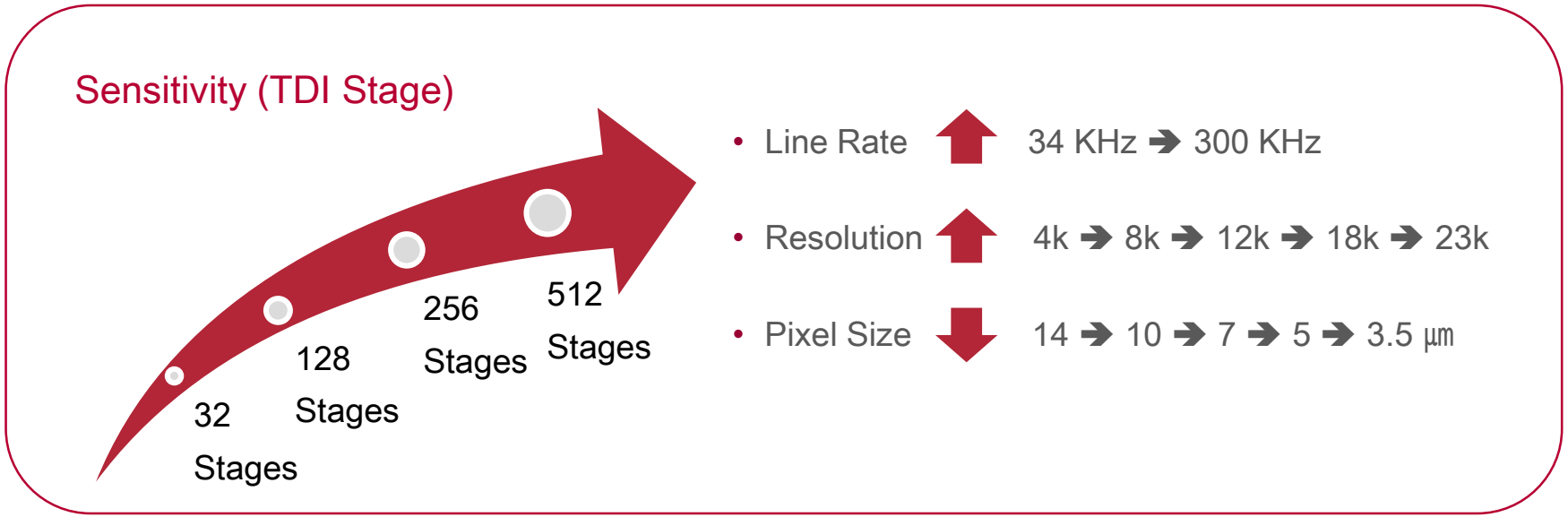
1/ HYBRID TDI CAMERAS TECHNOLOGY

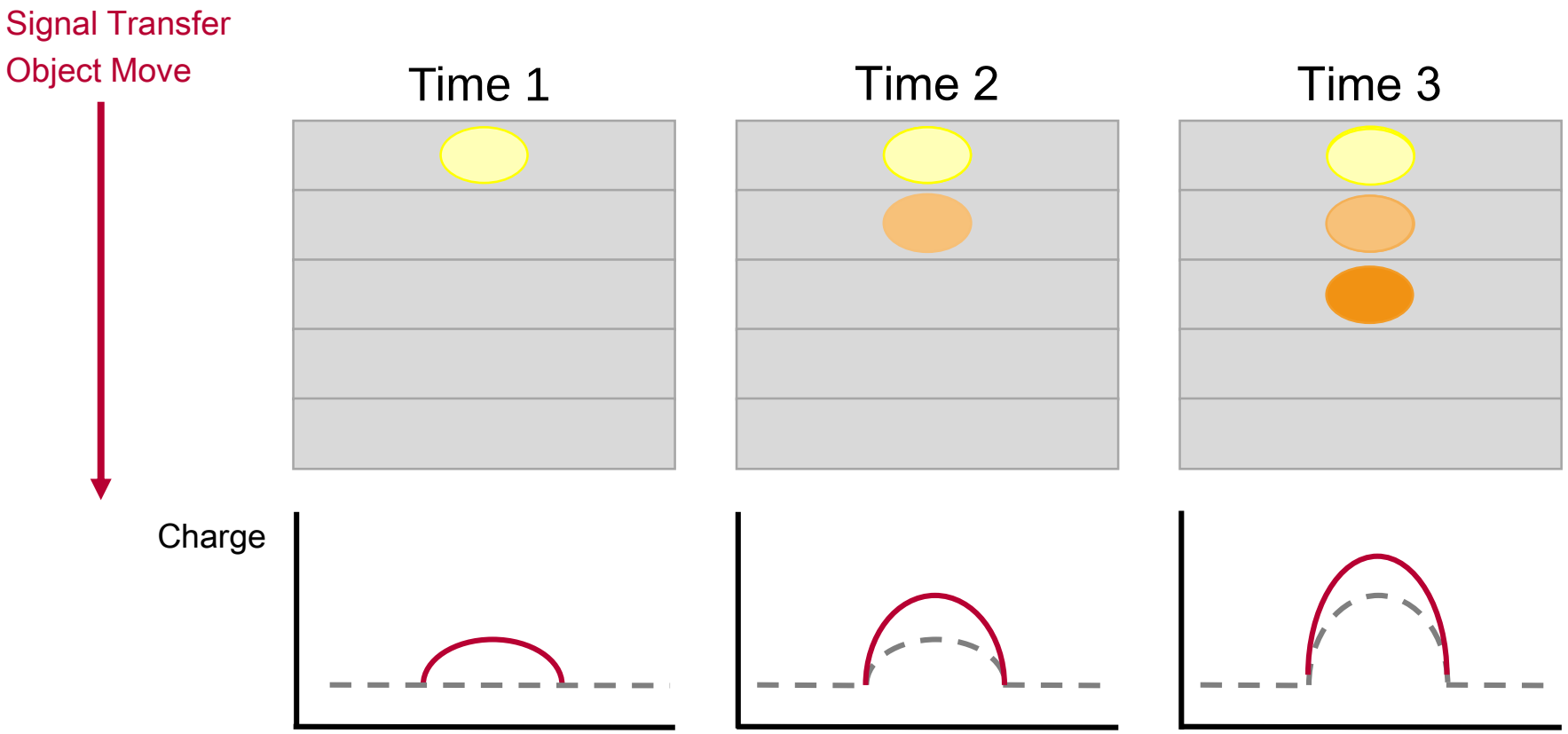
TDI Sensor Concept

Time Delay and Integration (TDI)

- Sensor design that uses multiple line scan stages (up to 512)
- Captures an image of a moving object while transferring integrated signal charges synchronously line by line with the object's movement
- The collected signal increases by a factor equivalent to the number of TDI stages or transfers



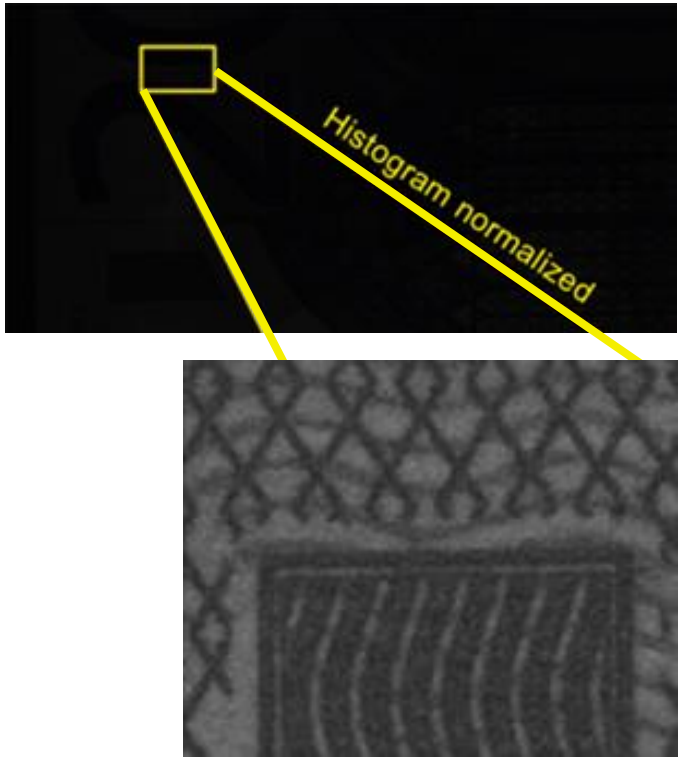
TDI Sensor Concept



TDI Sensor Concept

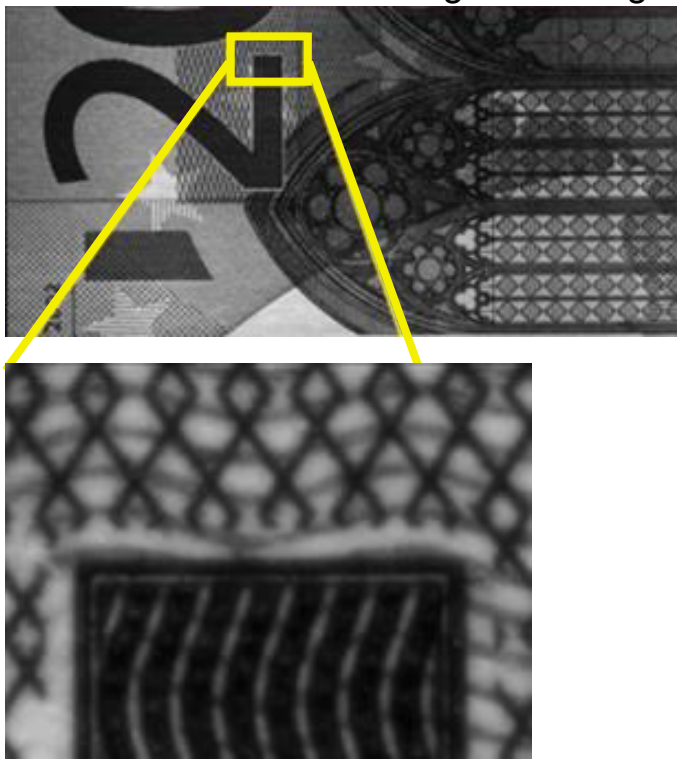
✓ Single Line Image vs 256 TDI Image

16K Line Scan Image



SNR 5.9

18K 256 Stage TDI Image

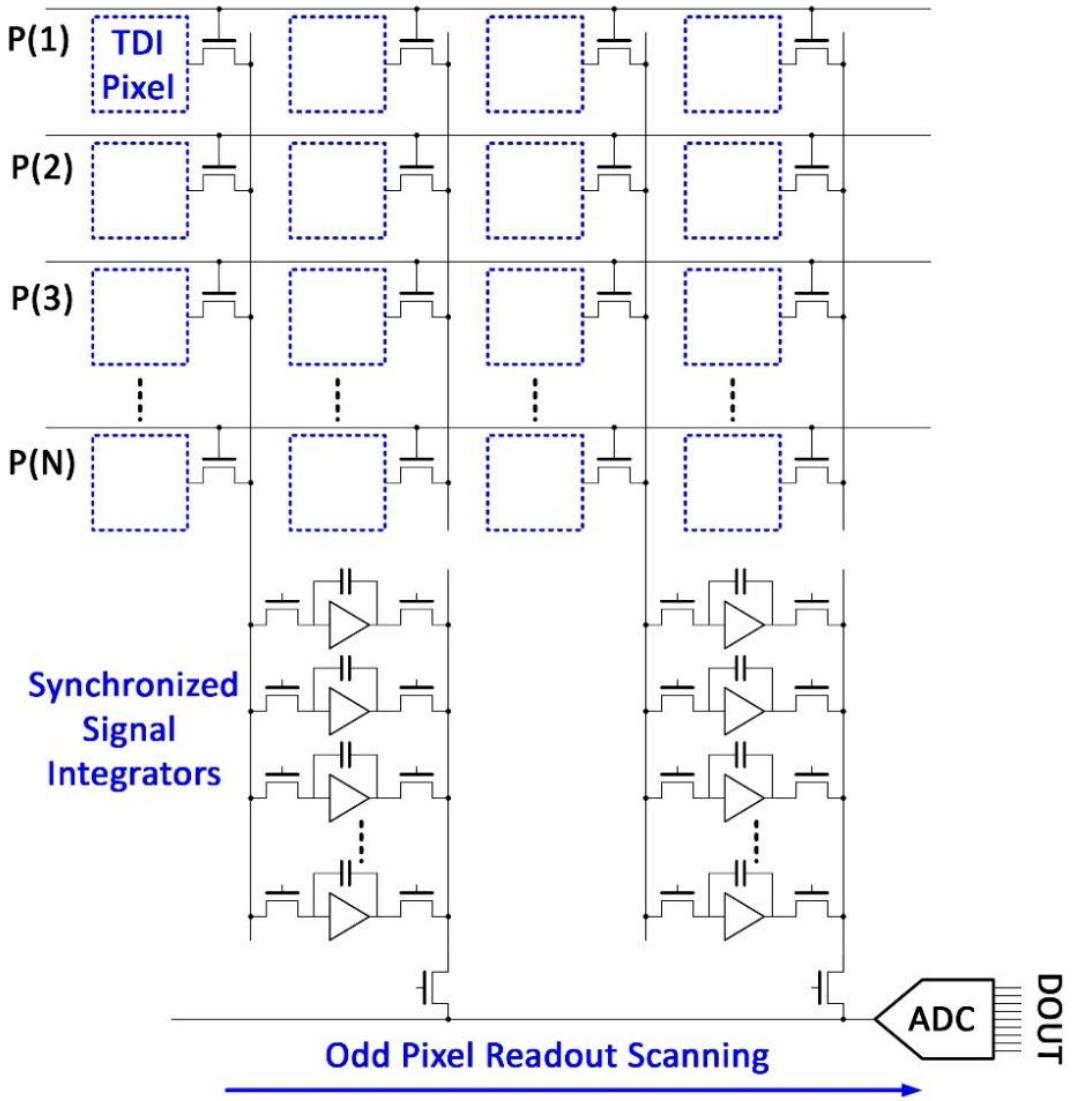


SNR 73.1

Conventional CMOS TDI Sensor

✓ Features of CMOS TDI Linear Sensor

- Faster Speed
- Higher Noise
- Built-in ADC
- Lower Power Consumption
- Digital Output

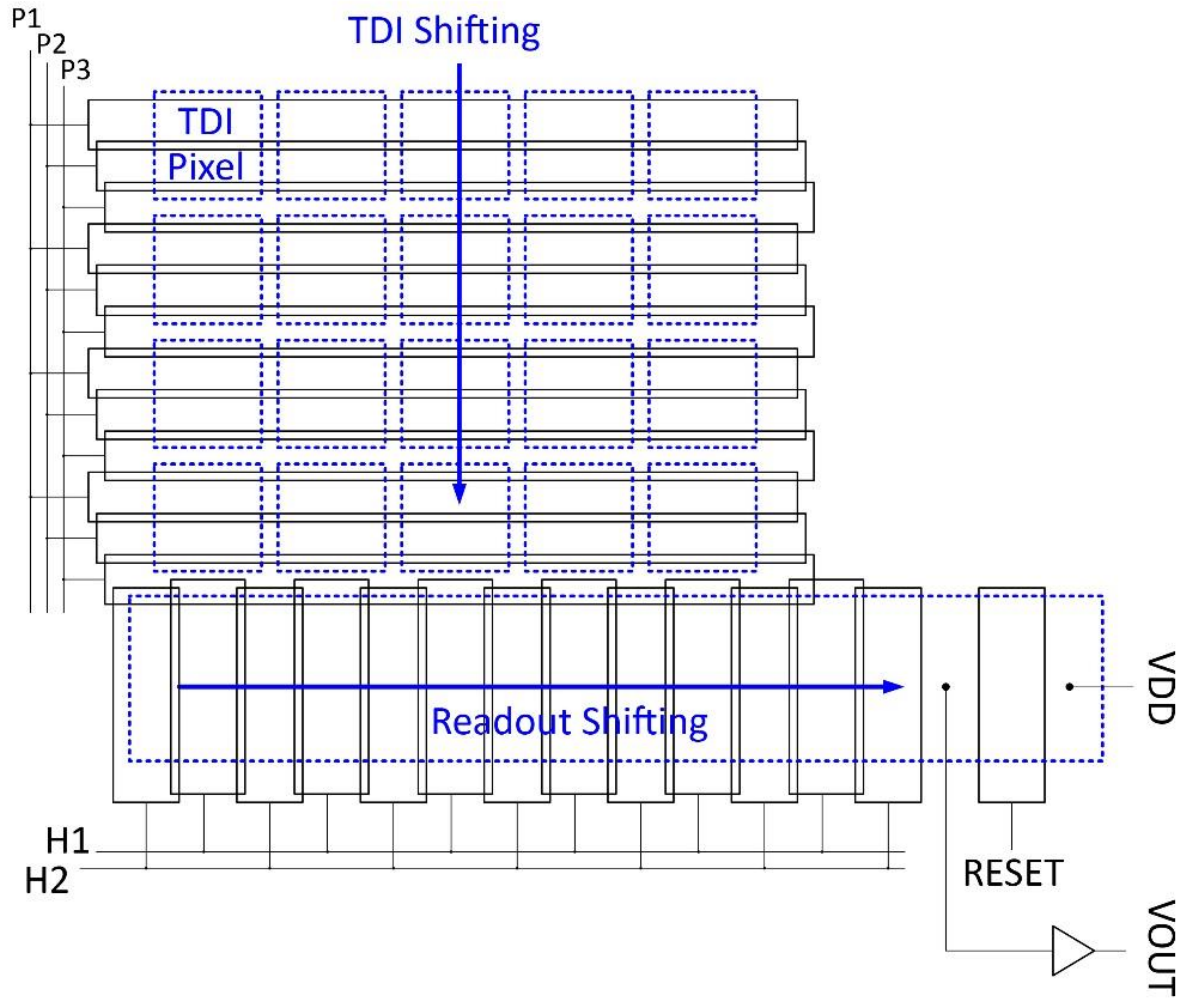


Accumulating the signal electronically, increasing sensitivity

Conventional CCD TDI Sensor

✓ Features of CCD TDI Linear Sensor

- Noiseless charge transfer & accumulation
- Complex additional external circuitry
  (ADC, H-Driver, Vertical Driver, CCD Amp etc.)
- High signal-to-noise ratio
- High power consumption
- Analog Output



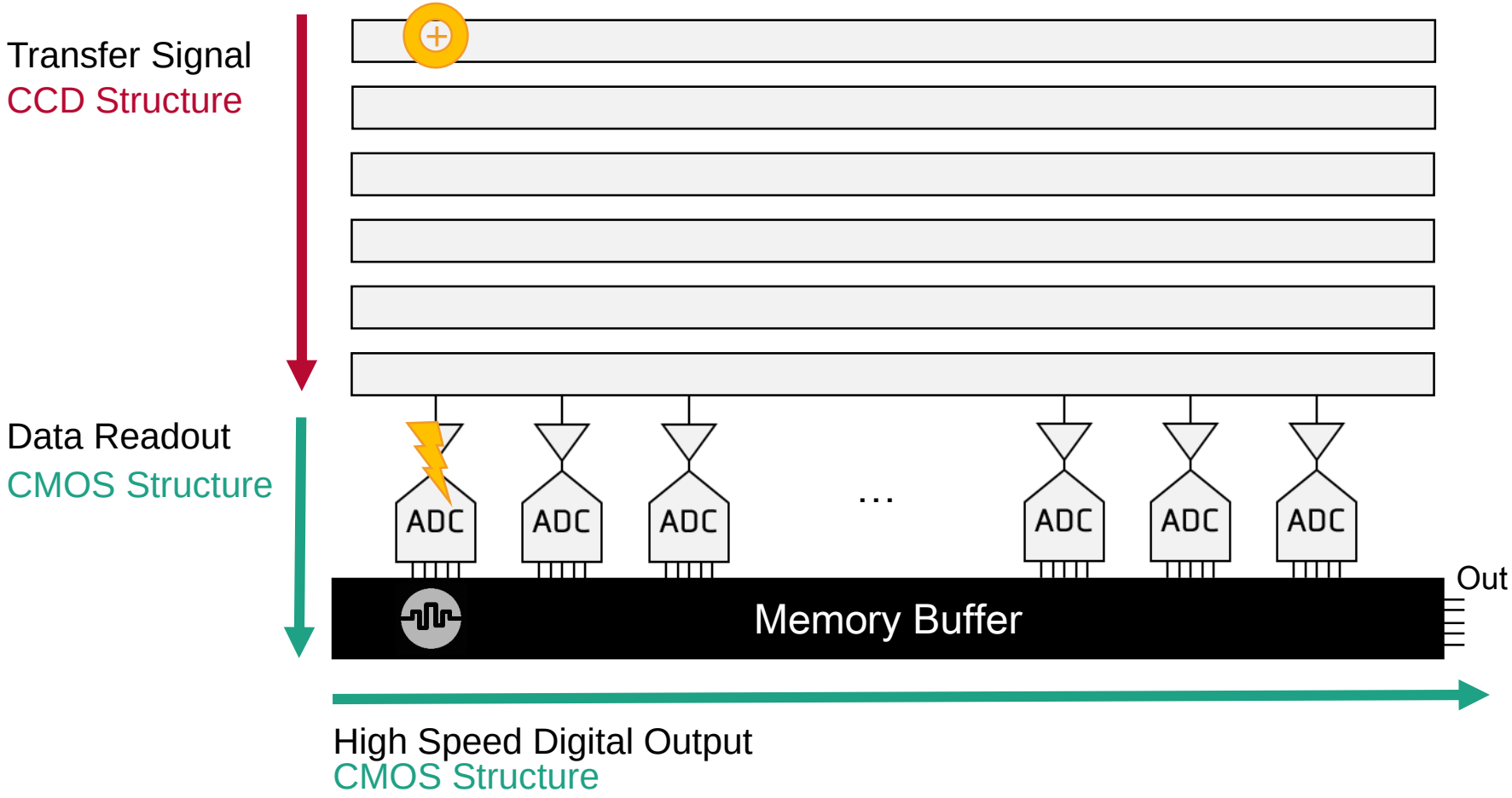
Hybrid TDI Sensor Technology

Vieworks' Hybrid TDI

High Sensitivity (Advantage of CCD) + High Speed (Advantage of CMOS)

Hybrid TDI Sensor Technology

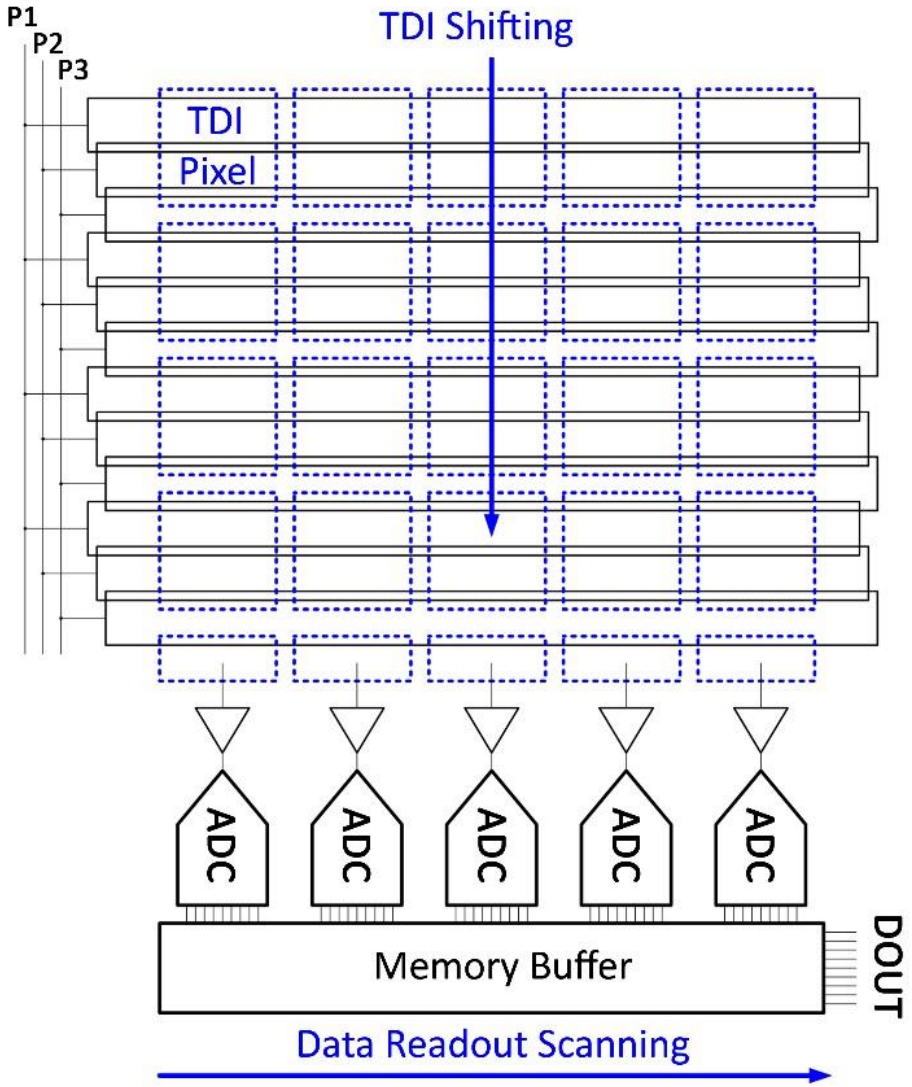
✓ Combine Advantage of CCD and CMOS



Hybrid TDI Sensor Technology

✓ Features of Hybrid TDI Linear Sensor

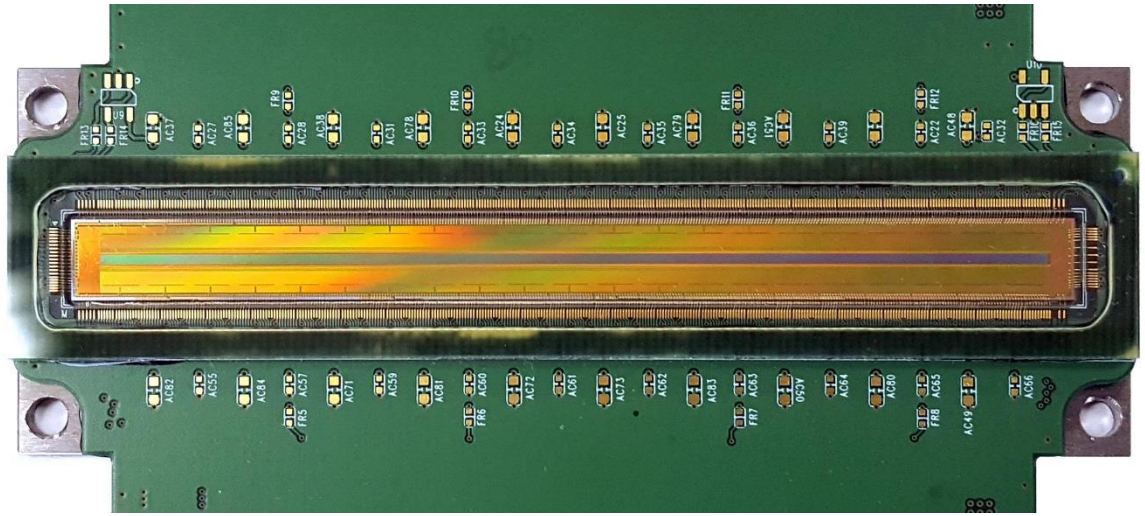
- CCD + CMOS Structure
- Combines a light sensitivity CCD-based TDI pixel array with CMOS readout electronics
- CCD pixel structure delivers low-noise, high dynamic range
- CMOS technology enables low-power consumption, fast readouts



Hybrid TDI Sensor Technology Advantages

✓ Combination of best features of CCD and CMOS

- Better Sensitivity
- Higher Dynamic Range
- Higher Speed
- Lower Power Consumption



2/ VIEWORKS TDI CAMERAS

Vieworks Hybrid TDI Camera Lineup

VTDI

VT Series

High Sensitivity &
High Speed TDI Line Scan Cameras

Vieworks Hybrid TDI Camera Lineup

VTDI

M42 mount

Camera Link

- VT-3K7C-E100
- VT-3K7C-H100
- VT-4K5C-E100
- VT-4K5C-H100
- VT-6K3.5C-E100
- VT-6K3.5C-H100

CoaXPress

- VT-3K7X-E250
- VT-3K7X-H250
- VT-4K5X-E200
- VT-4K5X-H200
- VT-6K3.5X-E160
- VT-6K3.5X-H160

M72 mount

Camera Link

- VT-4K7C-H120
- VT-4K14C-H120
- VT-9K7C-H80
- VT-12K5C-H60
- VT-18K3.5C-H40

CoaXPress

- VT-6K10X-H170
- VT-9K7X-H120
- VT-9K7X-H250
- VT-12K5X-H100
- VT-12K5X-H200
- VT-18K3.5X-H80
- VT-18K3.5X-H140

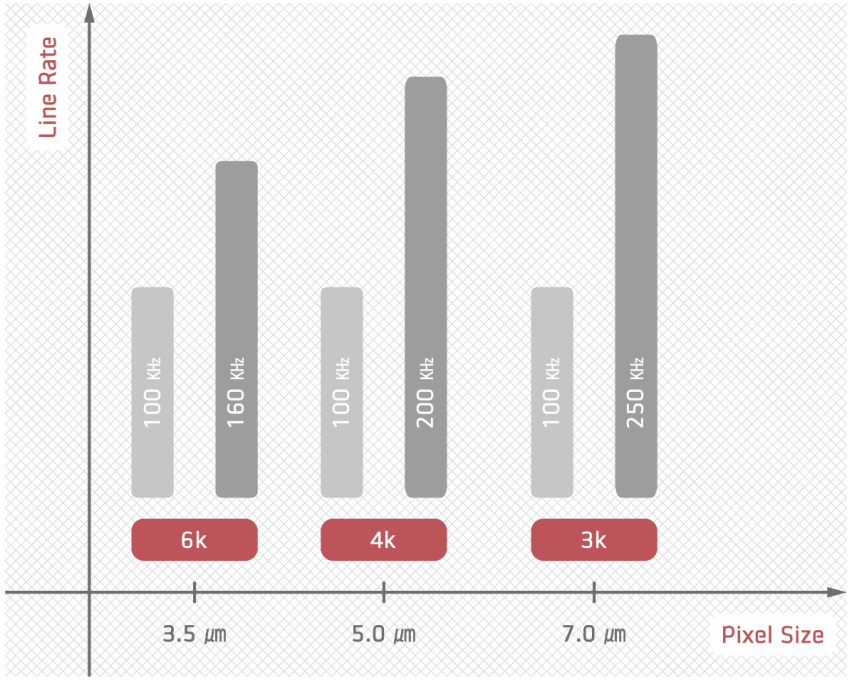
M95 mount

CoaXPress

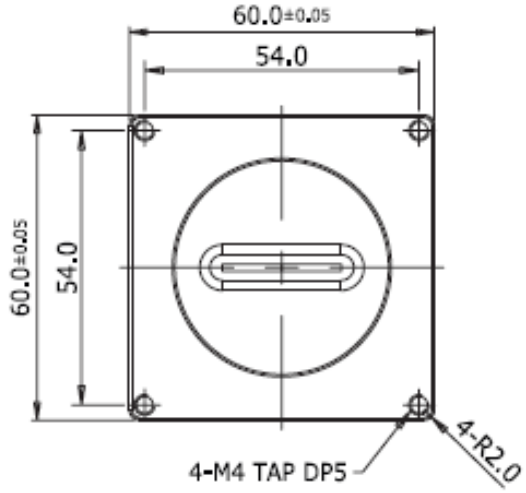
- VT-16K5X-H140
- VT-23K3.5X-H100

Vieworks Hybrid TDI Camera Lineup

VTDI - M42 Mount



[Mechanical Dimension in ㎜]



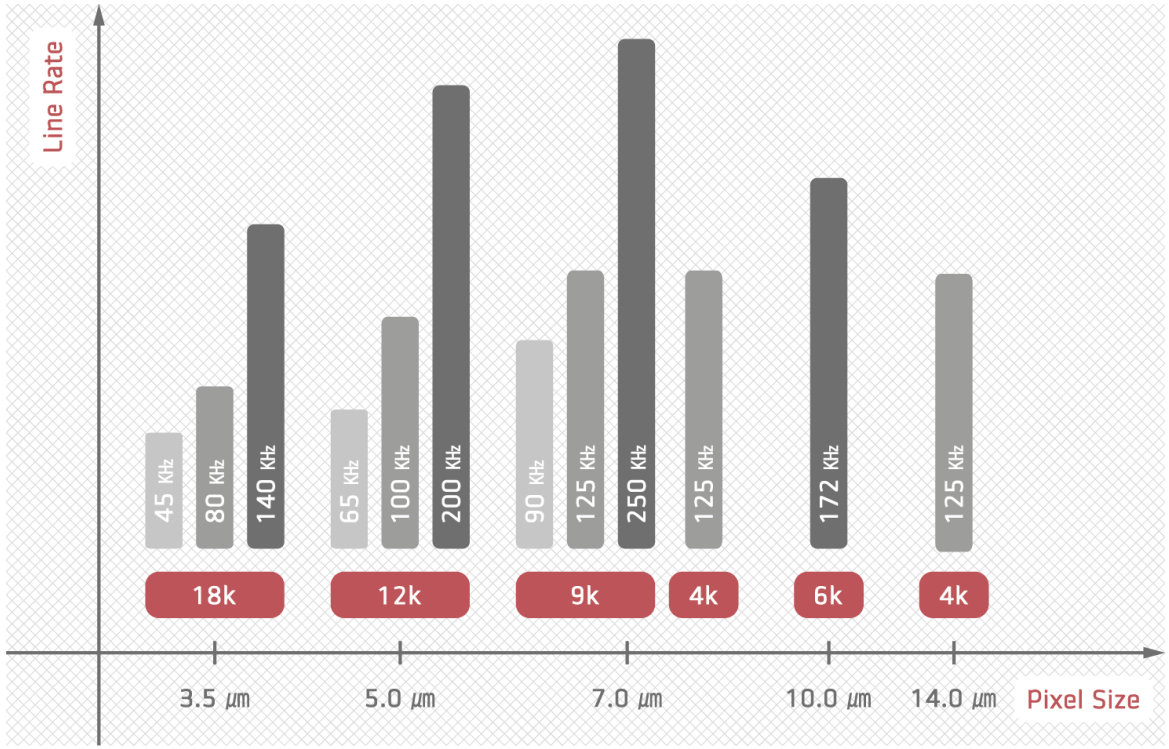
- Supporting M42 / F mounts
- Dimension: 60 ㎜ × 60 ㎜ × 36 ㎜
- Cost effective
- Up to 256 TDI stages

- Microscopy
- Compact size and design
- Dedicated strobe controller (optional)

Vieworks Hybrid TDI Camera Lineup

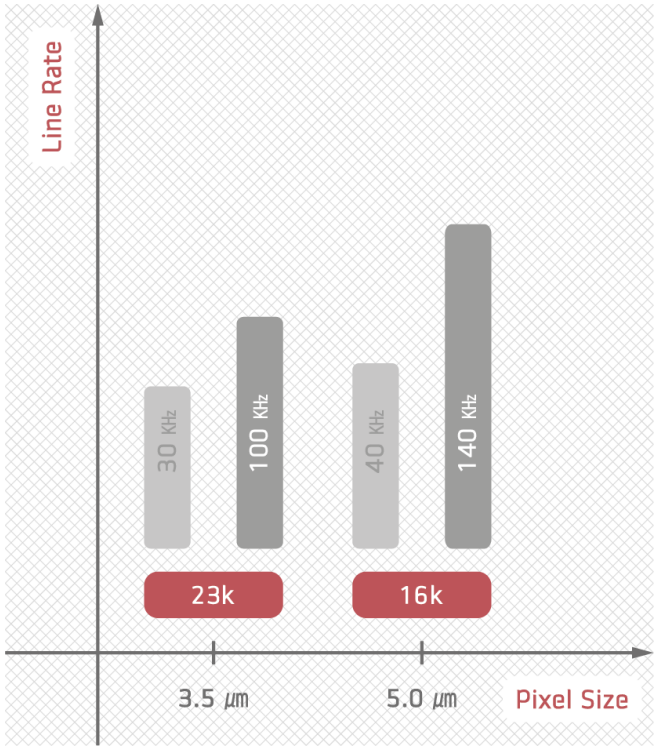
VTDI - M72 & M95 Mount

M72



- M72: 90 ㎜ × 90 ㎜ × 43 ㎜
- M95: 100 ㎜ × 100 ㎜ × 42 ㎜

M95



- High Quality & High Performance
- Up to 256 TDI Stages

Vieworks Next Generation TDI

NEW PRODUCT

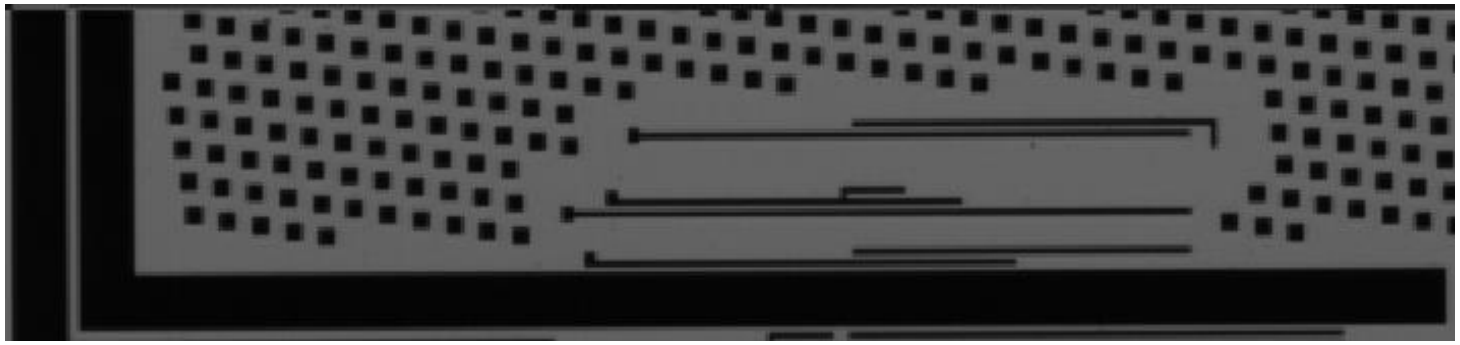
VT-DI Series

Dual Imaging Hybrid TDI

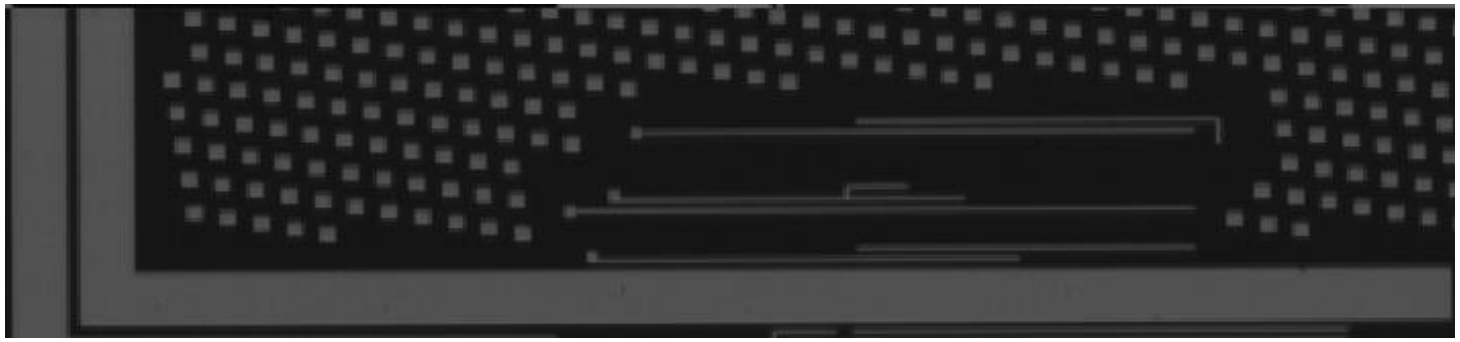
- ✓ Two Images at once
- ✓ High Sensitivity

VT- DI Dual Imaging Hybrid TDI

Acquiring two different images at once!



Bright Field (General)

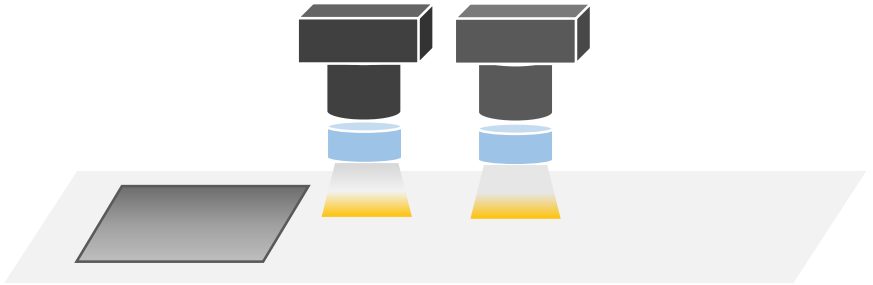


Dark Field (Specializing for Defect)

VT- DI Dual Imaging Hybrid TDI

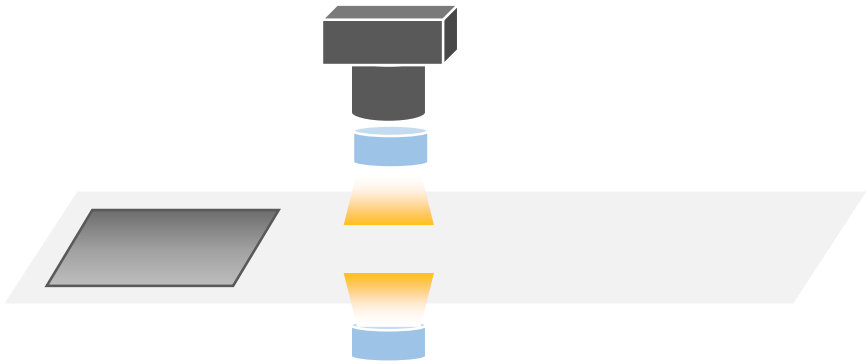
If you want to get two different images…

1) Use 2 cameras



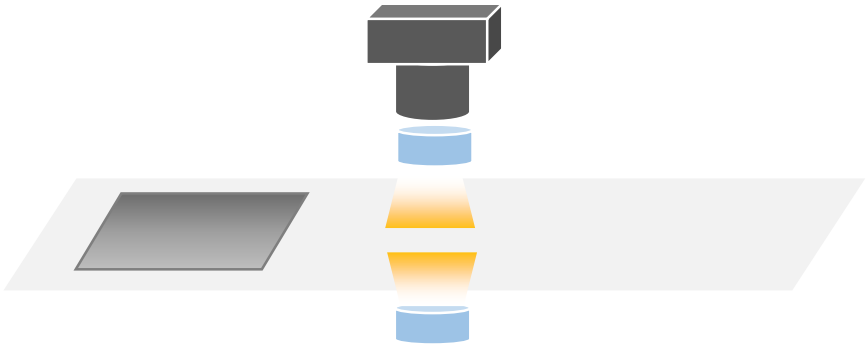
OR

2) Inspect 2 times



VT- DI Dual Imaging Hybrid TDI

If you use Dual Imaging TDI…



Acquiring two images at once!

Costs
Saving

Time
Reducing

Detection Rates
Increasing

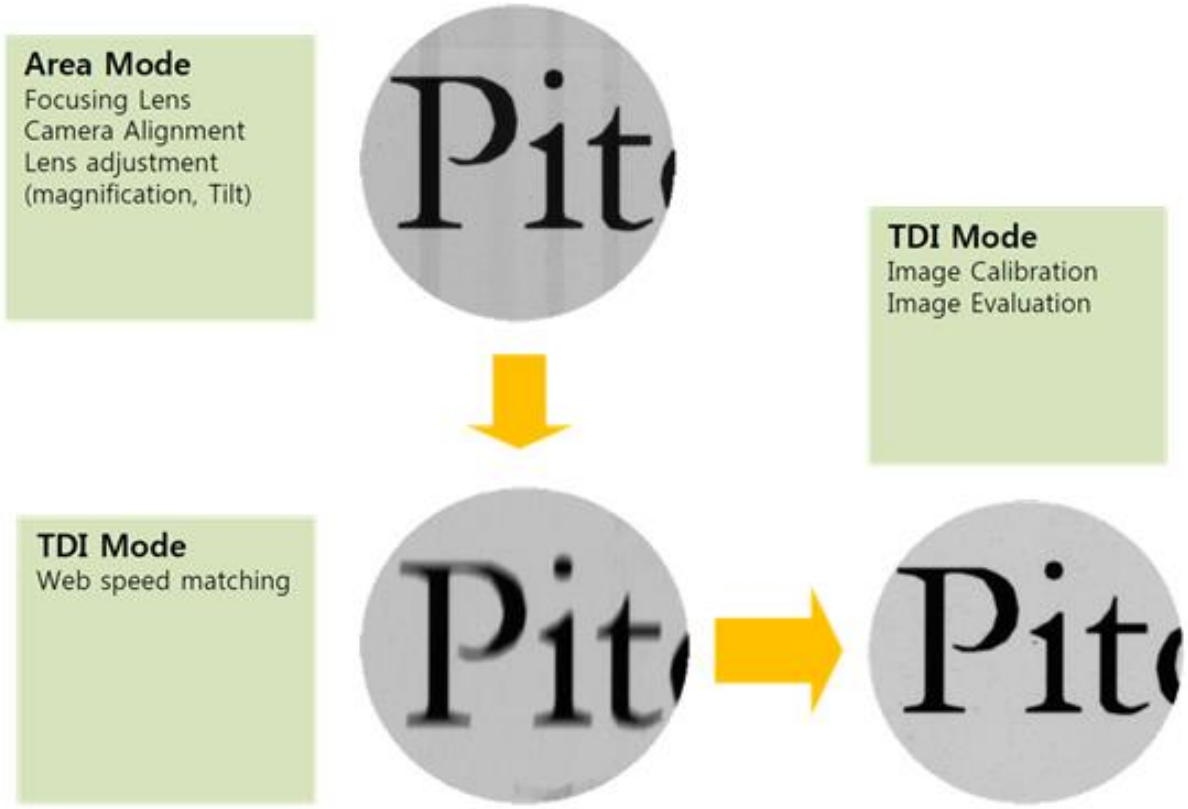
3/ TECHNICAL FEATURES

VT Series Technical Features_ Summary

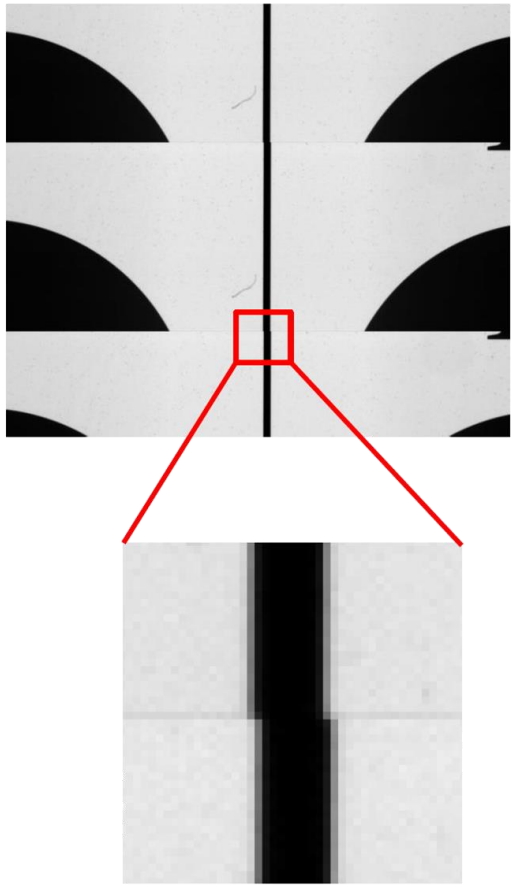
- 8/10/12 bit Pixel Format
- Programmable TDI Stage Count (256 /192 /128 / 64 / 32)
- Advanced PRNU, DSNU Correction
- Pre-emphasis Output for Camera-Link (10m cable @ 85MHz)
- Bi-direction Scanning
- Coax-Express Interface(4 CH, 25Gbps)
- Area Scan Mode for Camera Alignment
- Built-in Trigger Sync Converter
- Built-in Programmable Strobe control
- X2 Binning(H & V), ROI, Horizontal Flip, LUT Function

Area Mode

✓ Area Scan mode for camera alignment



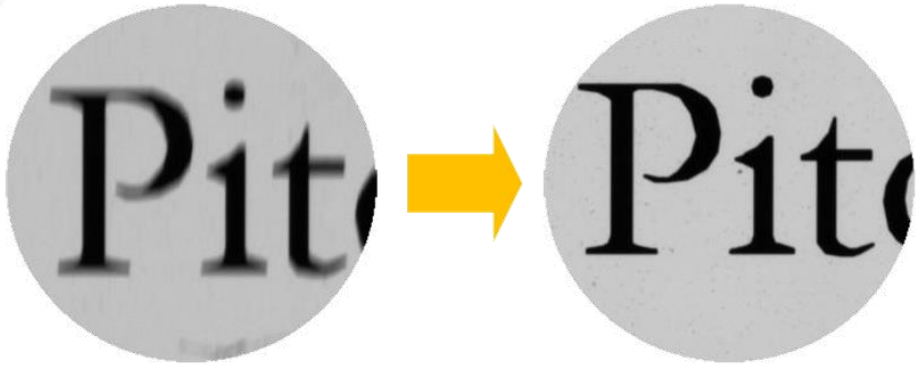
Area Mode Output Image



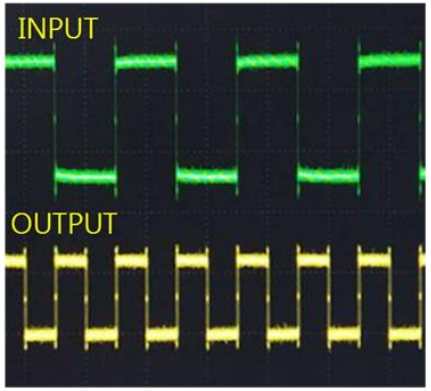
300% Image

Trigger Rescaler Function

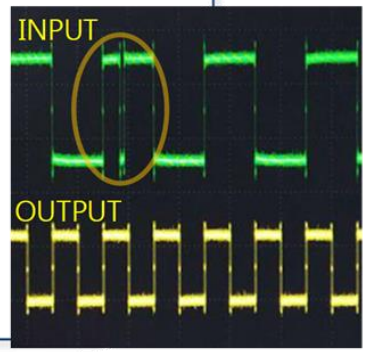
✓ Correct Encoder Trigger Input



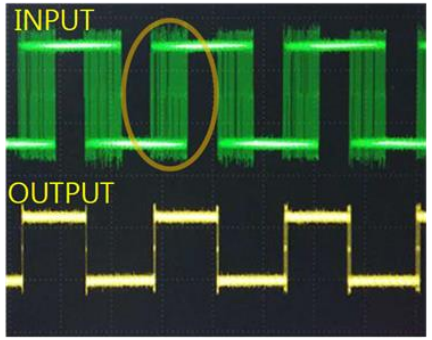
Trigger regenerating Function
- Encoder speed corrections
 (confirm lens magnification)
- Selectable Noise filter16 ~ 512



Web speed change (X2)



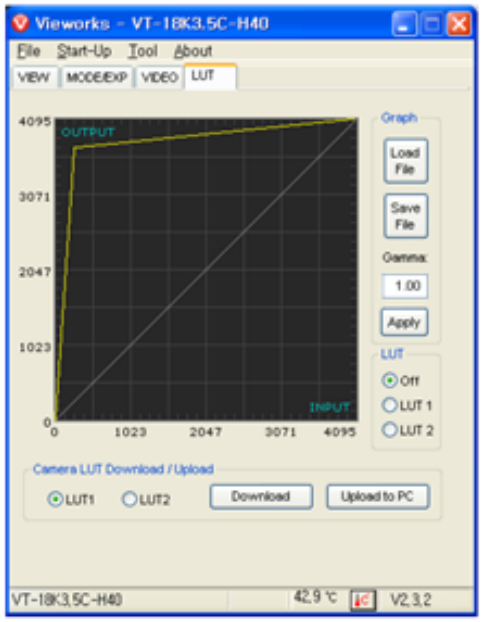
Glitch removal



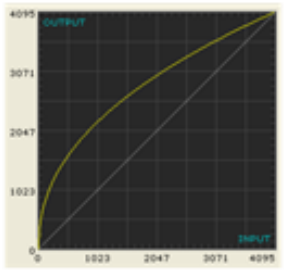
Jitter reduction

LUT Function

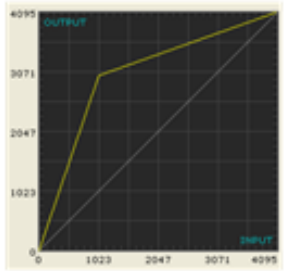
✓ WDR, Gamma, Histogram Preprocessing



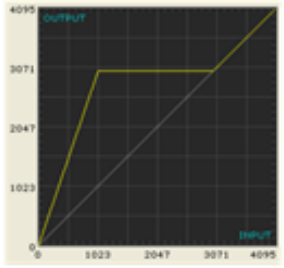
LUT Setting User Interface



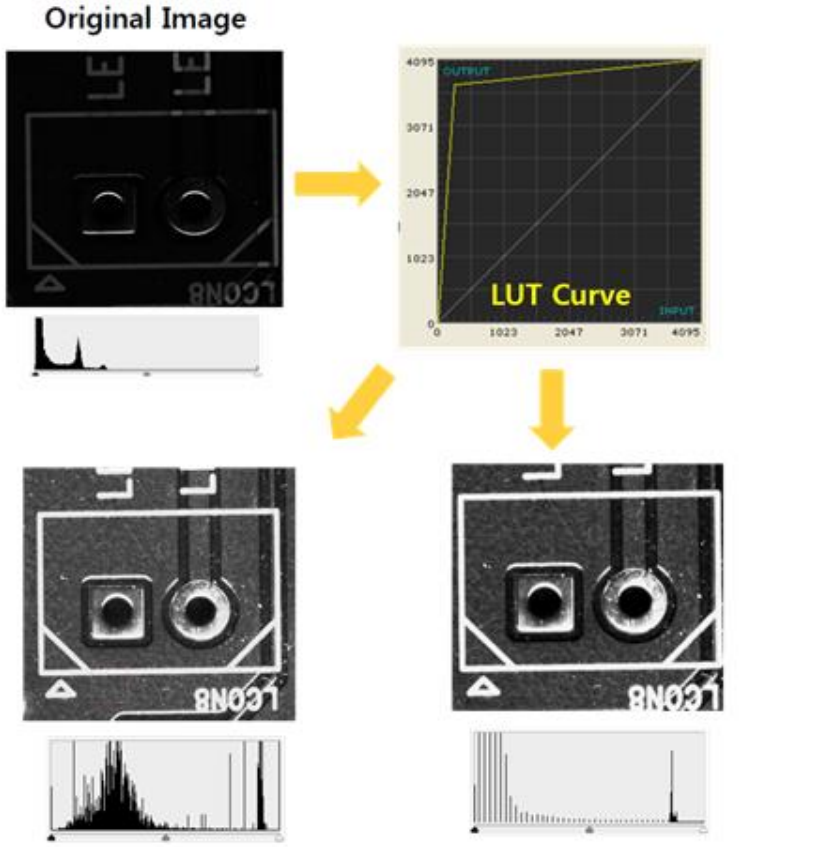
Gamma



Single Knee (HDR)



Dual knee(Level jump)



LUT Output(at Camera)

- 12bit LUT Processing
- Dynamic range increased

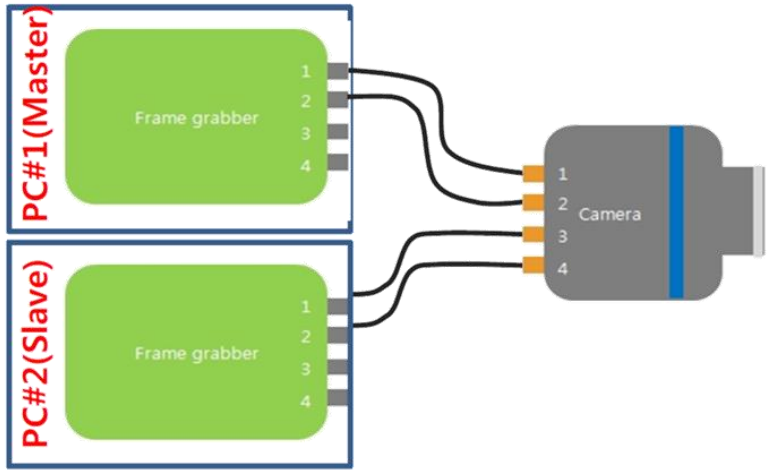
LUT Output(at Frame Grabber)

- 8 bit Processing
- Dynamic range Limited

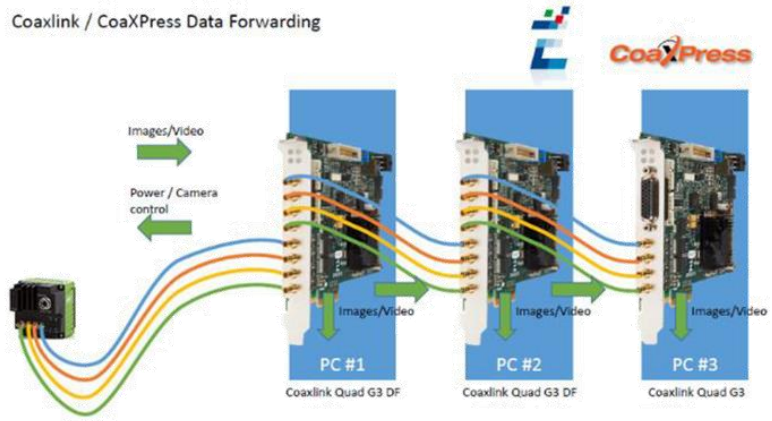
Multi Link

✓ Support Multi-Link Functions (1 : 2 output Functions)

- When required 2 PCs per 1 Camera for faster processing
- Euresys DF board Solution: 4 channel bandwidth and Data forwarding



Multi Link Configure



Data Forwarding Configure

Master PC	Slave PC
Image Streaming Camera Control	Image Streaming

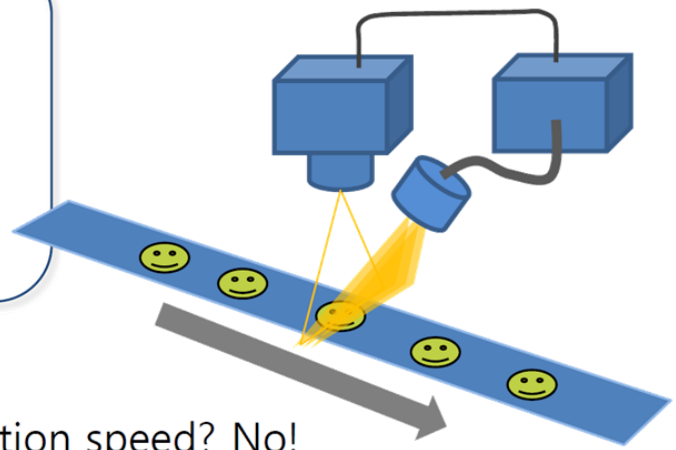
Strobe Output Control

✓ Strobe Output Control for Exposure Changing

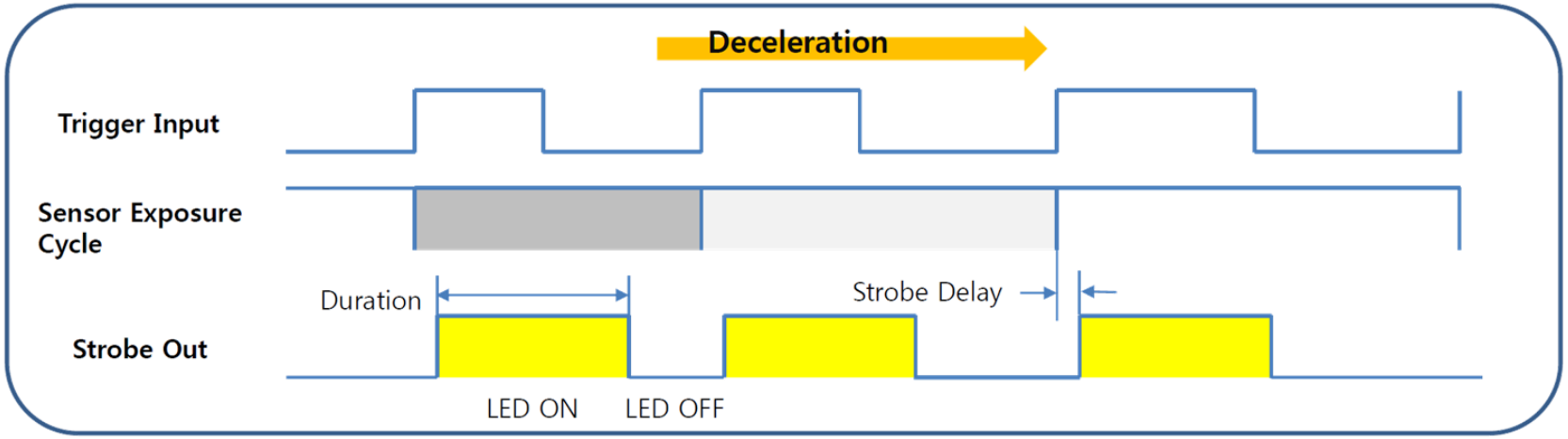
Strobe Output Control

✓Exposure control is possible via an Lighting control.

- **Strobe Duration** : 1 ~ 1000 us
- **Strobe Delay** : 0 ~ 1000 us
- **Strobe Polarity**



❖ TDI Camera should be taken only in uniform motion speed? No!

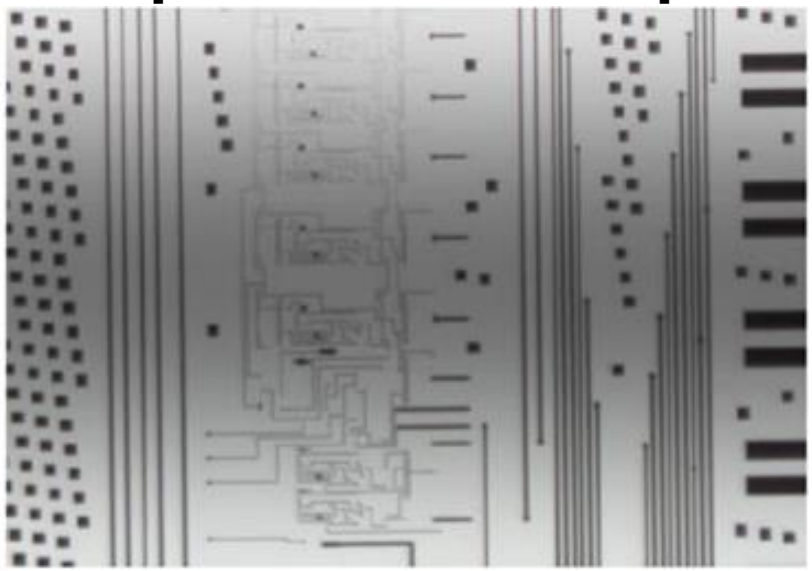


Strobe Output Control

✓ Strobe Output Control for Exposure Changing

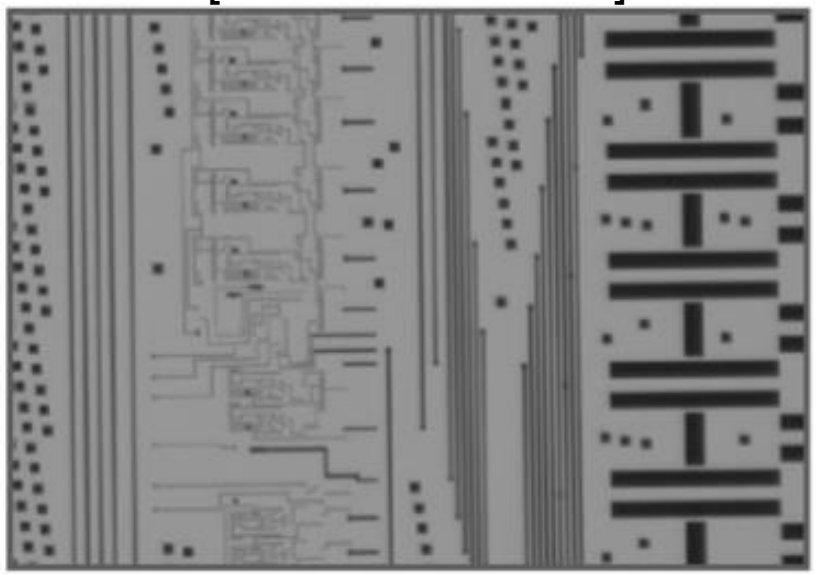
Image output at motion changes

[Continuous illumination]



Output level differs depending on line speed

[Strobe illumination]



Output level is constant

Strobe Output Control

✓ Strobe Controller Module for M42 TDI

- Current Controller
- High efficiency
- Fast response speed (1µs)
- No need of shunt resistance
- Up to 2A DC current (Max. pulse 10A)

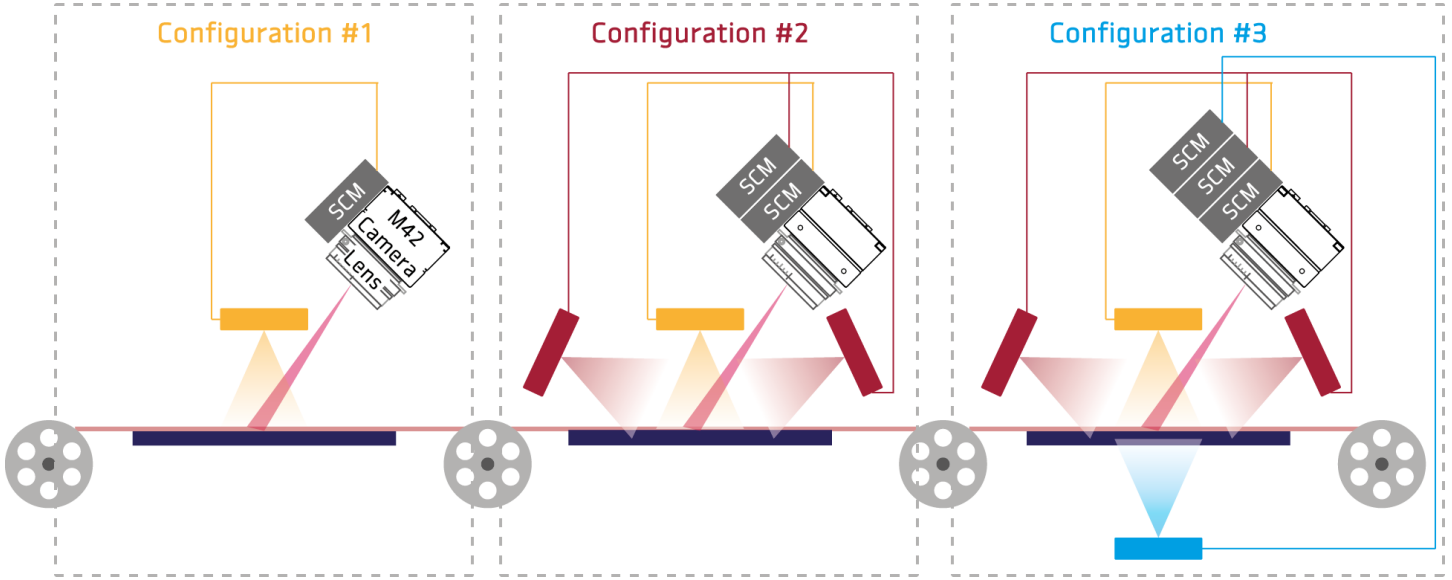
Current	DC (0 ~ 2A), Pulse (0 ~ 10A)
Max. Frequency	300 KHz
Min. Current Pulse Width	1 µs
Strobe Delay	0.5 µs
LED Voltage	Auto (Max. 35V, Max. = Vin)
LED Power Consumption	DC 30W (Pulse 300W)

M42 TDI Line Scan + Strobe Controller + LED

Strobe Output Control

✓ Strobe Controller Module for M42 TDI

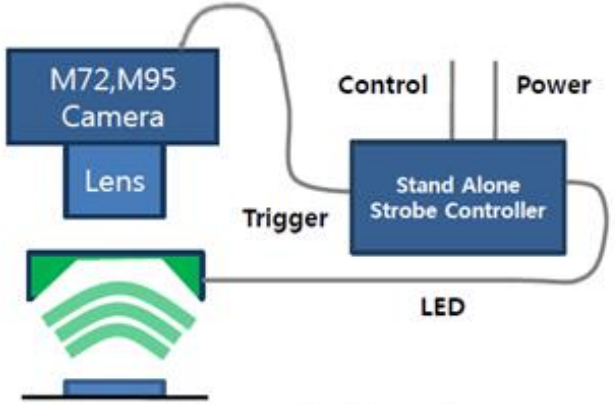
Supporting Multiple Strobes by Combining SCMs



Strobe Output Control

✓ Universal LED Strobe Controller

Strobe Controller Image



System Configuration

Model	VLS-PS-40W	VLS-PS-150W
Current	DC (0 – 2 A) Pulse (0 – 20 A)	DC (0 – 5A) Pulse (0 – 25A)
Max. Frequency	300 KHz	300 KHz
Min. Current Pulse Width	1 us	1 us
Strobe Delay	0.5 us	0.5 us
LED Voltage	Auto (Max 70V)	Auto (Max 48V)
LED Power	DC 30 W (Pulse 1000W)	DC 150 W (Pulse 1000W)

4/ APPLICATIONS

Applications

✓ TDI Cameras are useful for…

- Applications where it is desired to record a linear movement
- Applications which operate under low brightness, requiring high-resolution
- in-line applications requiring high-speed operation with high sensitivity
- High-speed imaging for low light applications i.e. fluorescence imaging
- Semiconductor inspection
- Electronics manufacturing and inspection
- Letter and film scanning
- High-speed scanning for large size samples i.e. flat panel displays
- Continuous imaging of high-speed moving object i.e. satellite imaging
- Fast automatic sorting of letters and parcels
- Glass sorting with glass recycling applications
- Web Inspections

Applications

vieworks

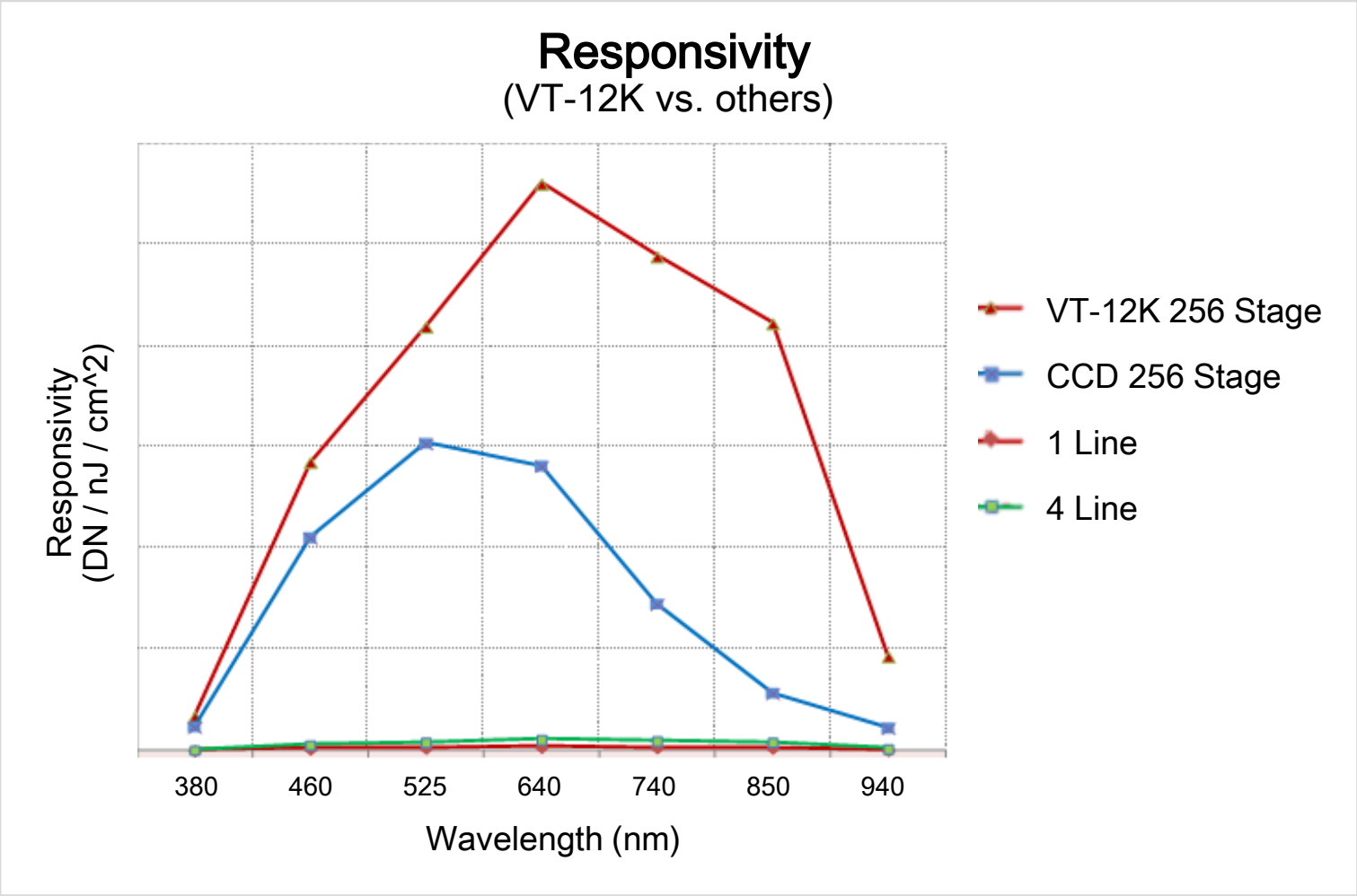
5/ COMPARISIONS

Comparisons of 2 TDI cameras (12K)

Specifications	VT-12K	Comparison TDI
Sensor Type	Hybird (CCD + CMOS)	CCD
Resolution	12480 × 256	12000 × 256
Pixel Size	5.0 ㎛ × 5.0 ㎛	5.2 ㎛ × 5.2 ㎛
Responsivity (nJ/㎠)	550 DN (@620 ㎚)	300 DN (@500 ㎚)
Saturation Capacity	40 Ke-	24 Ke-
Dark Noise	23 e- 13 e- (@ Analog Gain ×4)	33 e-
Dynamic Range	64 dB	57 dB
Max. Line Rate	100 ㎑	90.8 ㎑
Max. Line Rate @ ×2 Binning	100 ㎑	82 ㎑
Trigger Interface	CoaXPress / External	LVDS (Camera Control Port)
Camera Interface	CoaXPress	HSLink
Grabber Compatibility	Euresys, Kaya, Silicon Software, Active Silicon, Matrox	Dalsa (Xcelera-HS)
Power Consumption	9 W (PoCXP Compliant – No need for external power supplies)	36 W (An external power supply is required)
Max. Cable Length	40 m (CXP6 – 2 cables)	10 m (HSLink – 1 cable)
Mechanical Dimension	90 ㎜ × 90 ㎜ × 38 ㎜	180 ㎜ × 90 ㎜ × 92.1 ㎜

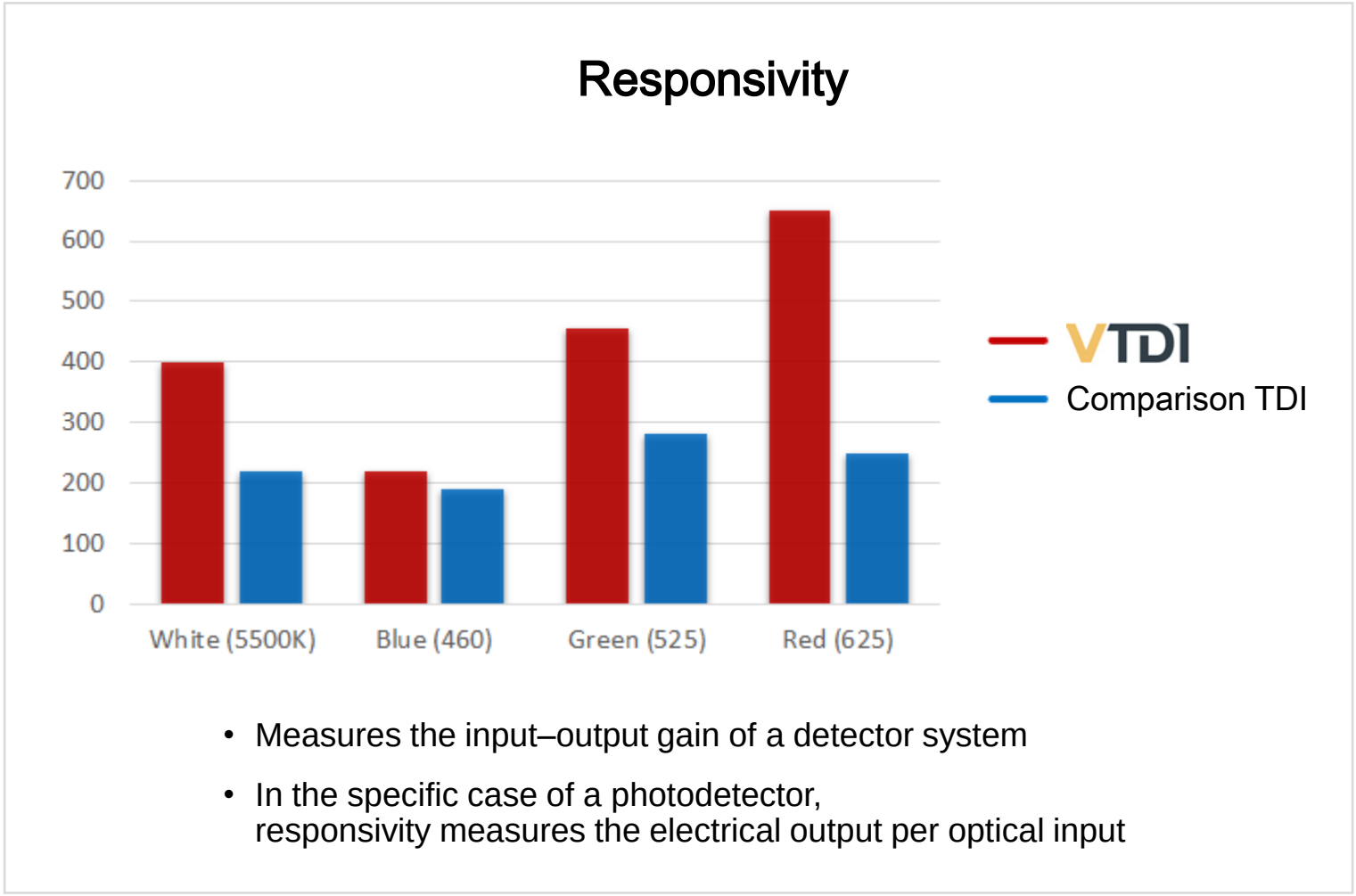
Responsivity

✓ VT-12K has better responsivity at overall wavelength



Responsivity

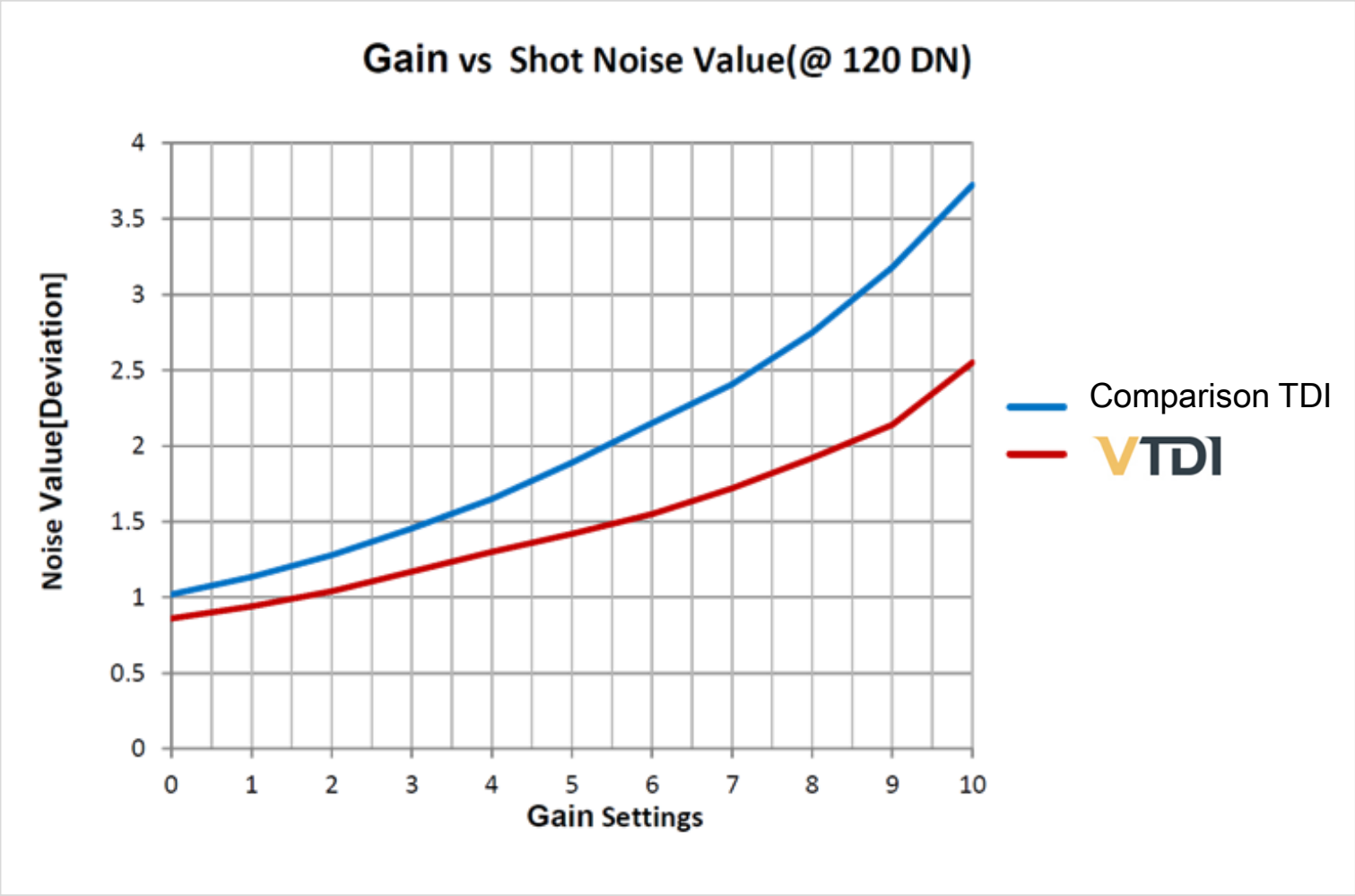
✓ VT-12K has better responsivity at all the colors



- Measures the input–output gain of a detector system
- In the specific case of a photodetector,
  responsivity measures the electrical output per optical input

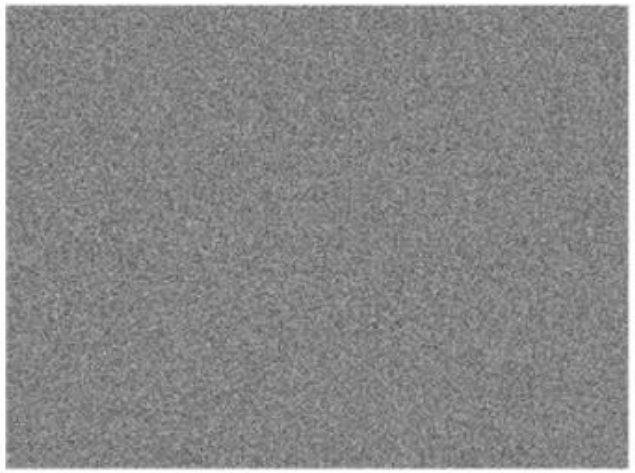
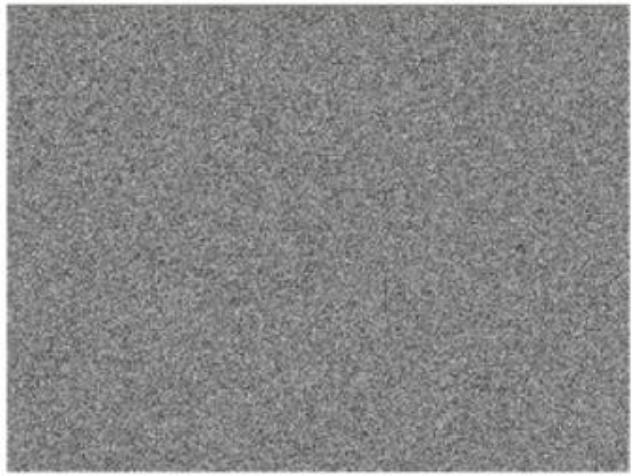
Shot Noise

- ✓ VT-12K has less shot noise



Random Noise

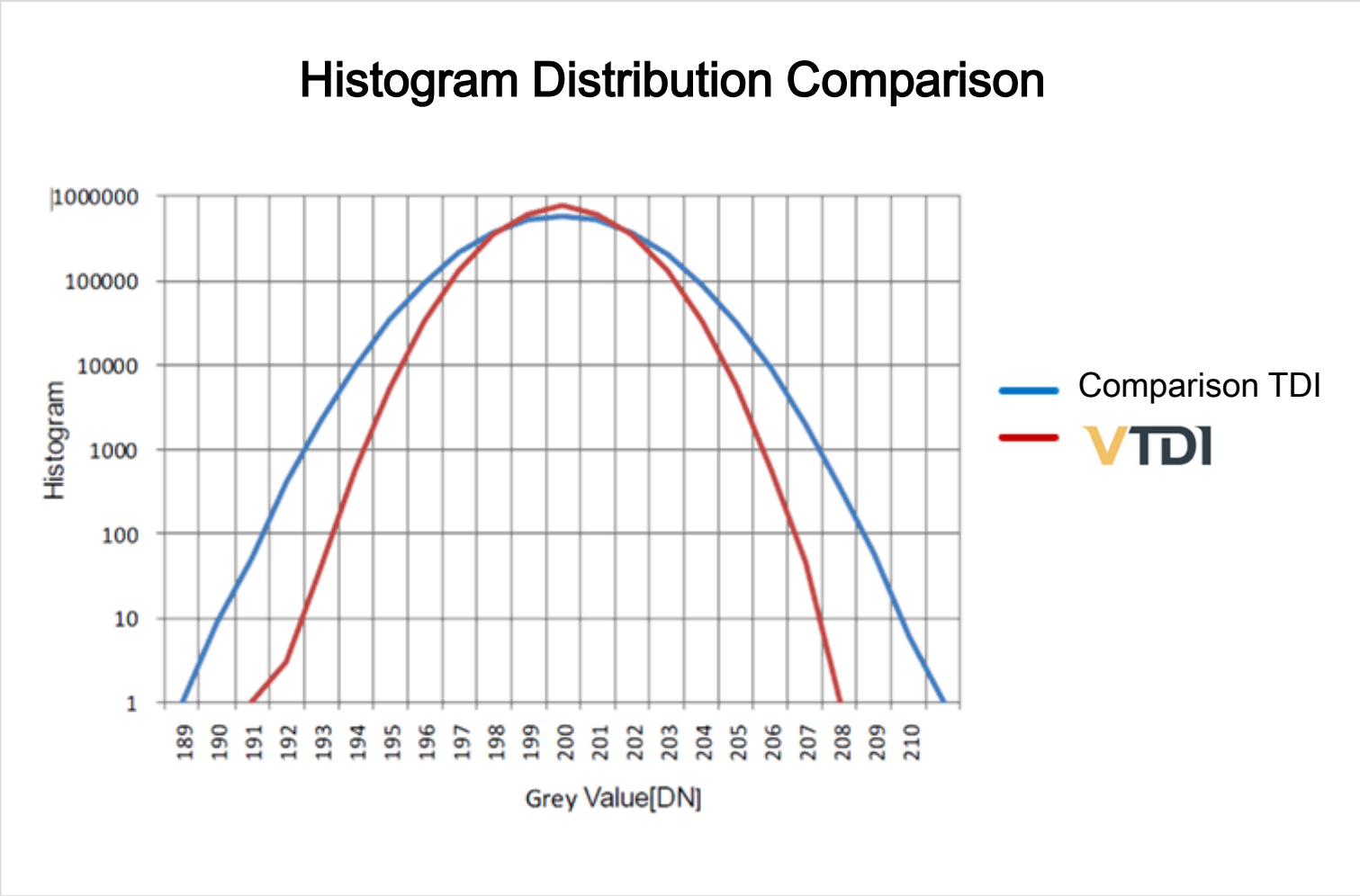
✓ VTDI has less random noise, getting better std. deviation

Model	VTDI	Comparison TDI
Image		
Standard Deviation	1.6 DN	2.0 DN

*** Test Condition:** 5500K White Lighting / 8-bit pixel format / 200 target level

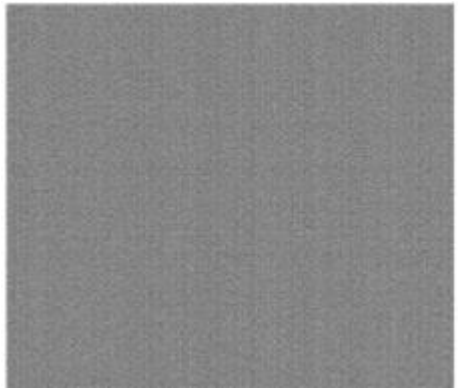
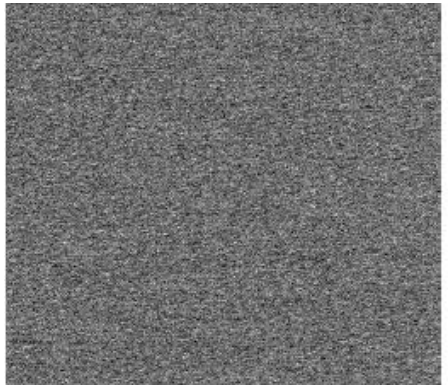
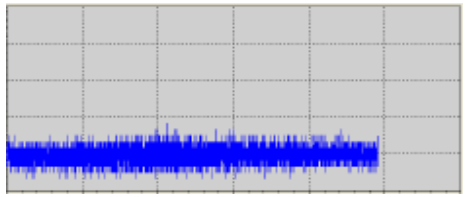
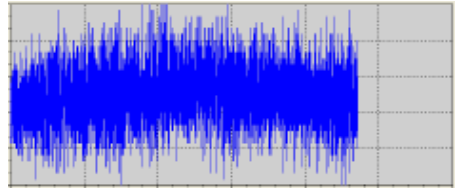
Random Noise

- ✓ VT-12K5X shows the less standard deviation than compared camera
  (i.e VT-12K5X has better random noise characteristics)



Dark Noise

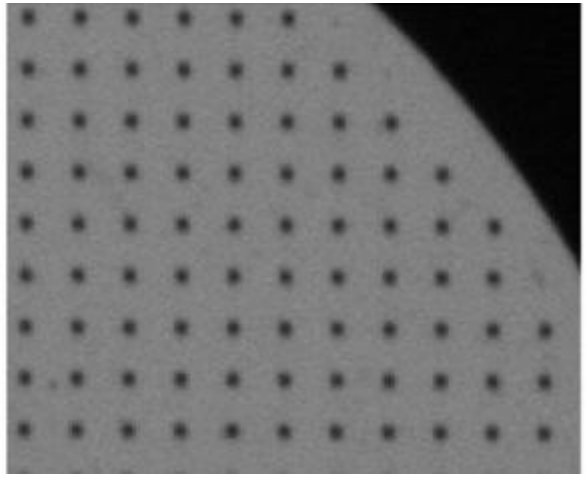
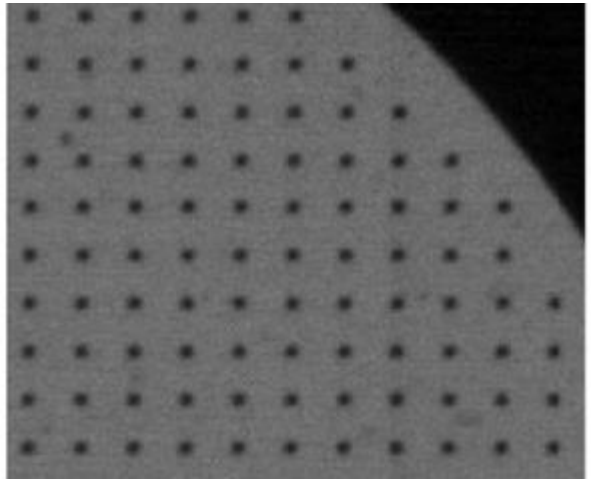
✓ VT-12K has about 2 times less dark noise

Model	VTDI	Comparison TDI
Image		
		
Standard Deviation	13 e 1.24 DN	30 e 2.8 DN

*** Test Conditions:** 10x (20 dB) Gain / Dark Condition

Comparing Images

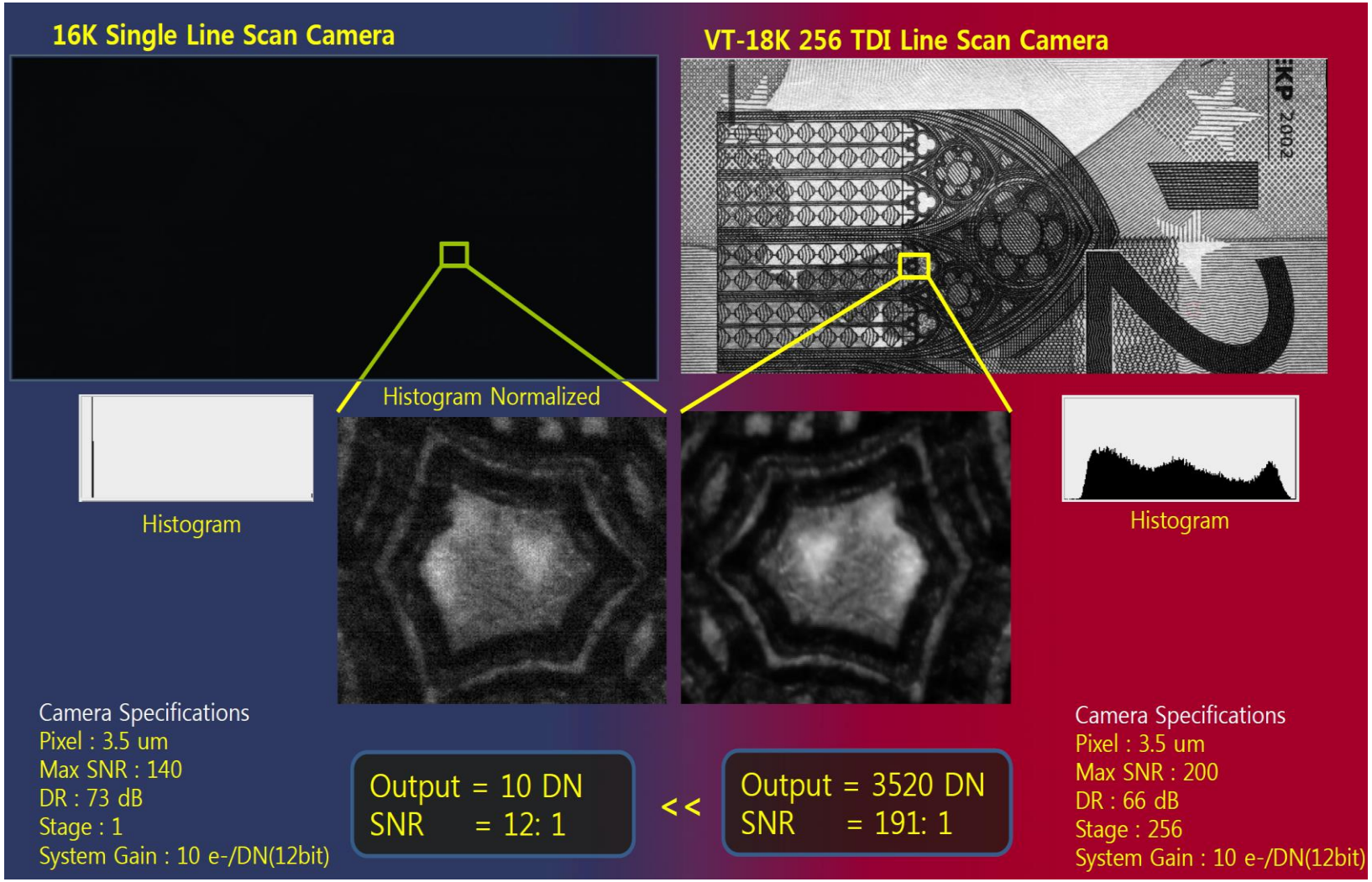
✓ VTDI 12K vs Comparison TDI

Model	VTDI	Comparison TDI
Image		
Standard Deviation	2.5 DN	3.7 DN

*** Test Conditions:** 10x Gain / 120 Target Grey Level

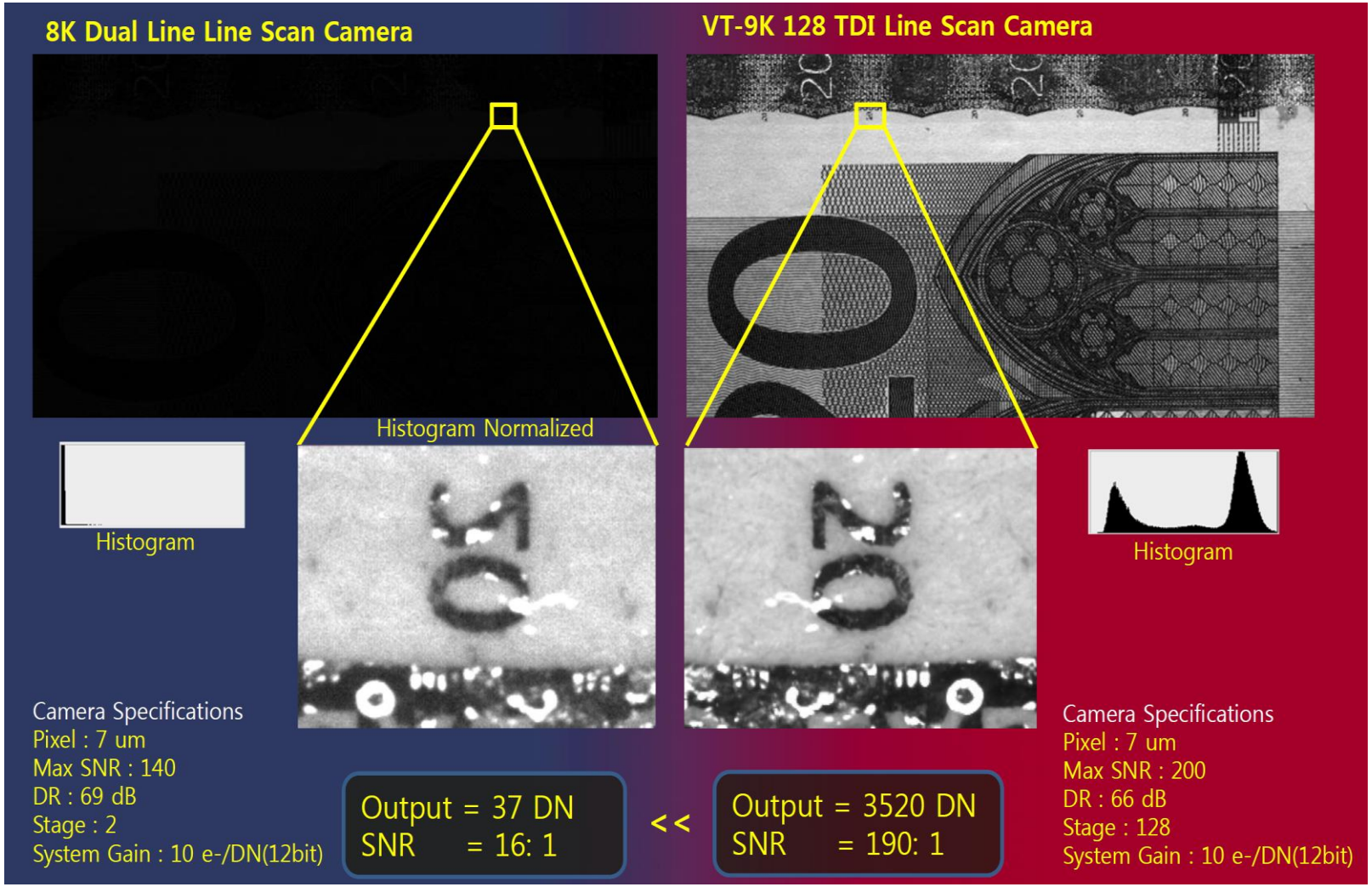
Comparing Images

- ✓ Single line scan vs 256 TDI line scan



Comparing Images

✓ Dual line scan vs 128 TDI line scan



Advantages and Unique features of VTDI

✓ You can get **advantages** from VTDI such as…

- Low power consumption (25% compared to CCD TDI cameras)
- Faster line rate and higher sensitivity
- Higher SNR output (200:1)
- Supporting longer cable distance with CoaXpress interface
- Compact design
- Easy to use and reliable correction features
- Consistent and Superior Image Quality
- No tap mismatch issues typically occurring in the CCD imaging sensors

✓ You can use **unique features** of VTDI such as…

- Trigger Rescaler
- Strobe output mode
- Lookup Table (Knee Control)
- PRNU Auto Target Level

Vieworks Hybrid TDI Cameras

VTDI

VT Series

High Sensitivity &
High Speed TDI Line Scan Cameras

vieworks

Thank You

Hybrid TDI Cameras Technology