Wide dynamic logarithmic InGaAs sensor suitable for eye-safe active imaging

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A World Class Supplier of CMOS Sensors™

Presentation Agenda

- Active Imaging Scenarios
- Basic requirements on Active Imaging
- NIT's logarithmic ROIC for InGaAs sensor
- Analysis of ROIC's behavior under short gating
- Conclusion: NIT Solution for Short Gated Active Imaging

Active Imaging Scenarios

❑ Continuous Illumination for

- ✓ (covered) surveillance at night
- ✓ wavelength based discrimination capability

❑ Pulsed Illumination for

- ✓(covered) surveillance at day/night
- ✓ retrodiffusion suppression by distance indexed gating
- ✓ low interception probability
- ✓ target designation/recognition

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Basic Requirements on Imaging Sensor

❑ Under Continuous Illumination

- ✓ High dynamic range against NEAR-FAR effect
- ✓ Low noise for lower illumination power
- ✓ Low dark current for long exposure time

❑ Under Pulsed Illumination

- ✓ Short exposure time with good shutter efficiency
- ✓ Low triggering delay
- ✓ Low Jitter
- ✓ High dynamic range with no blooming
- ✓ Ambient background suppression

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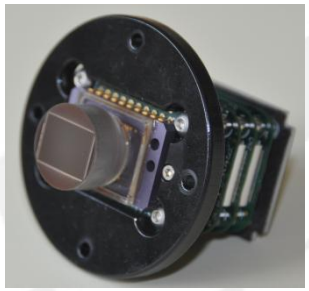
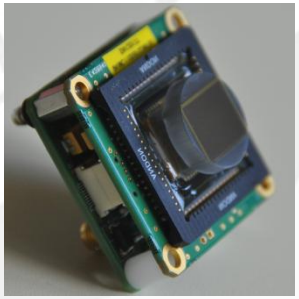
Active Imaging needs WDR 1

I2 Tube Gated Active Imaging



GE1380H
(Sony CCD)

NIT
IMAGIC



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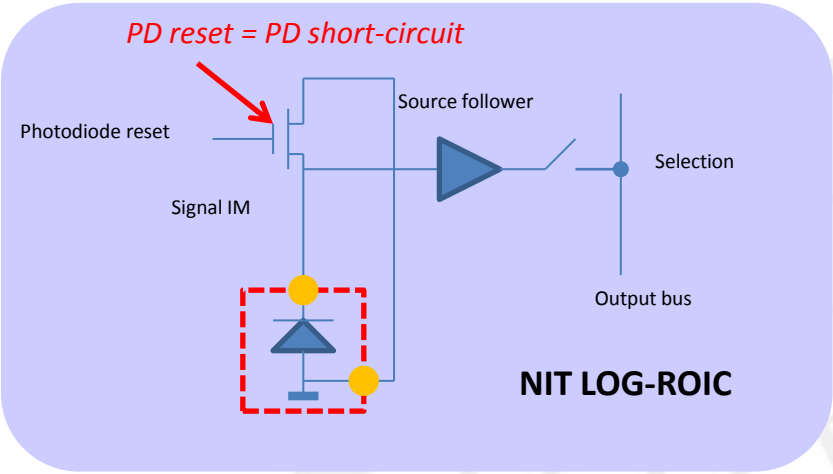
Active Imaging needs WDR 2

Continuous active imaging with NIT Widy InGaAs Sensor



- Photodiode generates active voltage signal
- Very precise/repeatable logarithmic response
- High uniformity due to forward biasing
- Simple design for > 120dB instant DR

Adequate for

continous illumination active imaging

- **Proprietary InGaAs photodiode array**
- Active dark current reduction
- Active Cross-Talk suppression
- 3 international patents filed

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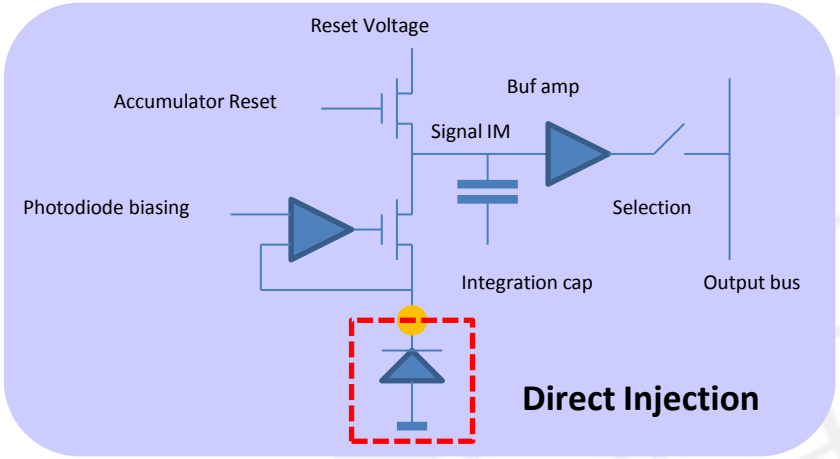
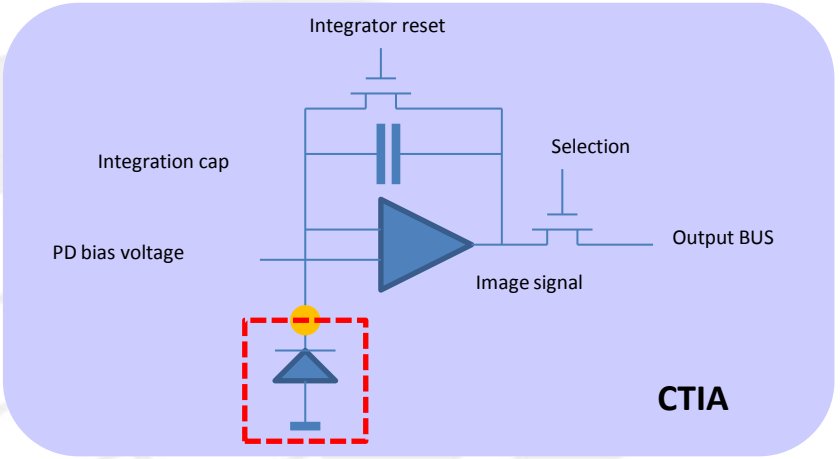
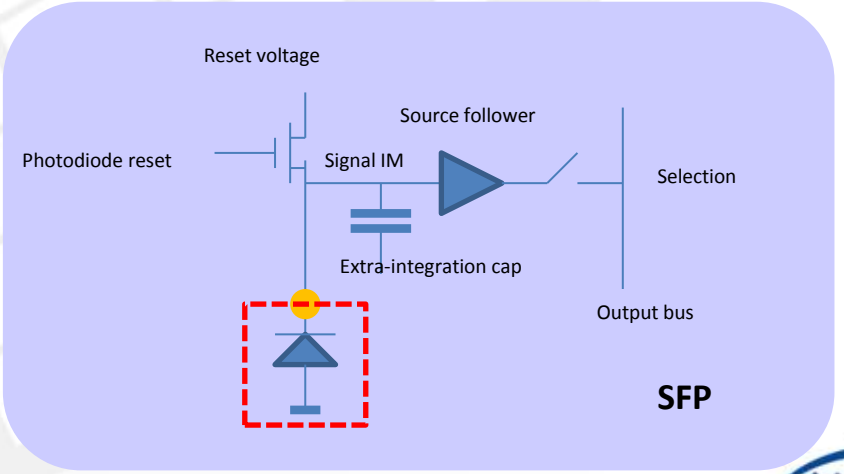
Fast Gating in ROIC





- **Fundamentally voltage based designs**
- **KTC & 1/f noise can be compensated by CDS (ITR)**
- **1/f noise can be a problem with long exposure**
- **What is the impulse response ??**
- **How to do simple analysis ??**



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How to analyze ROIC with fast gating

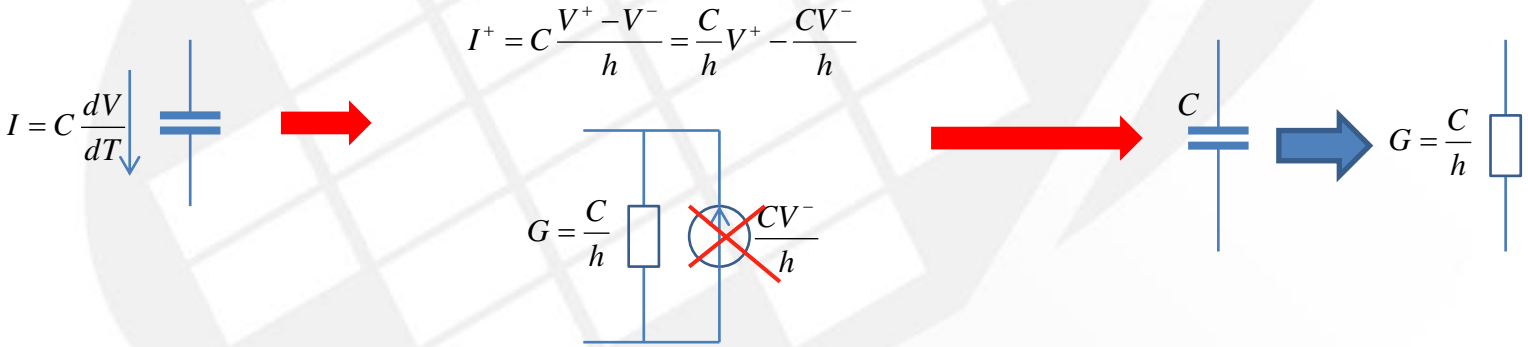
Companion model based method

For efficient & powerful design, we need

- ✓ More general design guidance analysis
- ✓ Simple modelling giving optimization possibility

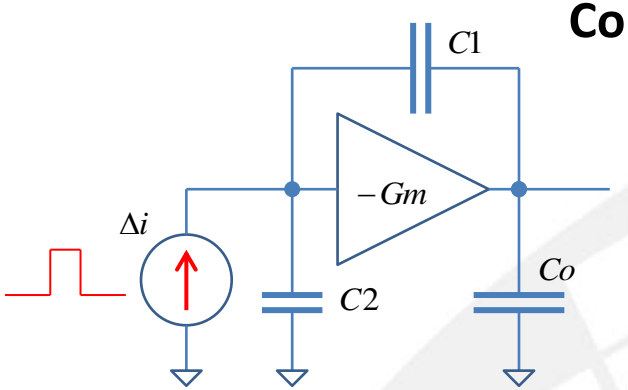
Most of pixel design is based on Gm-C structures

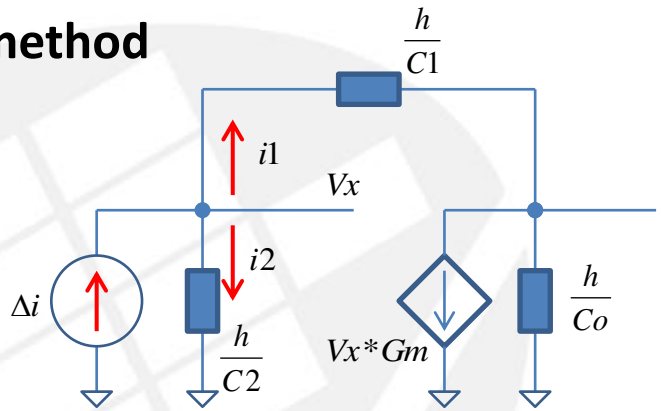
- ✓ impulse width is small (in general)
- ✓ circuit evolution is similar to one time step in SPICE simulation

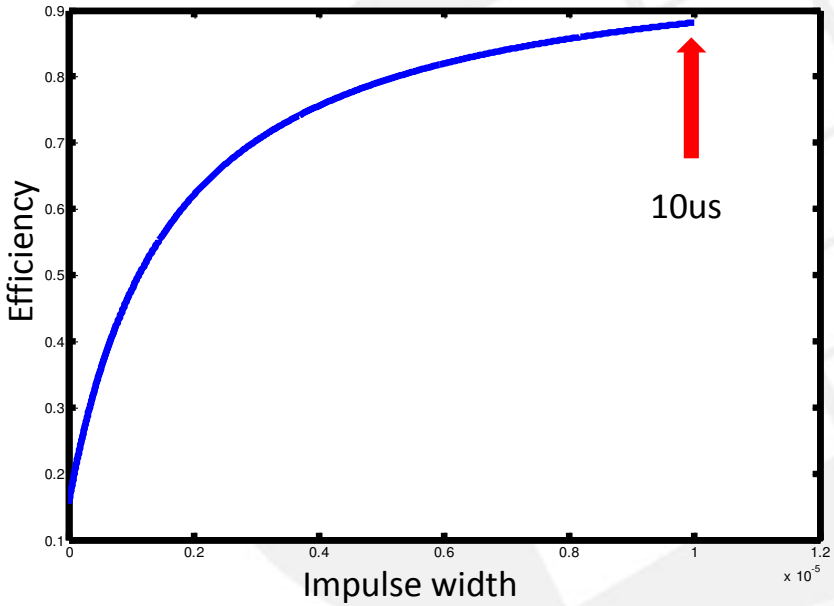


Injection Efficiency of CTIA under gating

Companion model method







$$\eta = \frac{i1}{i1+i2} = \frac{C1*Co + C1*Gm*h}{(C1+Co)*C2 + C1*Co + C1*Gm*h}$$

$$C1 = 10fF, C2 = 50fF, Co = 100fF$$
$$Gm = 0.4uS(Id = 0.1uA, Veff = 0.5)$$

- ✓ Loss of integration efficiency with pulse width in CTIA
- ✓ Loss of integration efficiency with conversion gain
- ✓ High Gm device is needed

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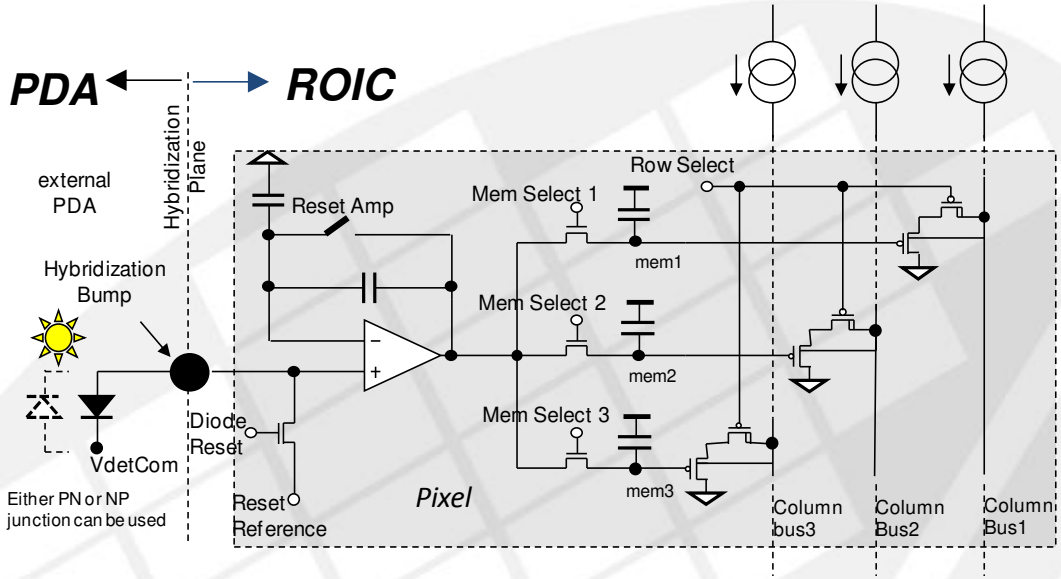
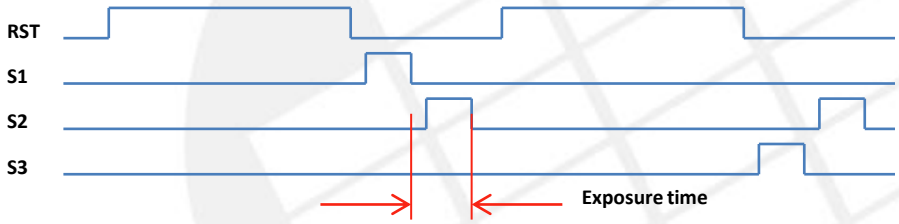
NIT New GS ROIC with gating capability

VGA 15um & QVGA 25um





IWR with in-pixel CDS

- ✓ **3 in-pixel memory for true CDS**
- ✓ **Flexible control for multi-mode operation**
- ✓ **Short exposure time (<200ns possible)**
- ✓ **Low noise (<150 electrons)**
- ✓ **Low power consumption**

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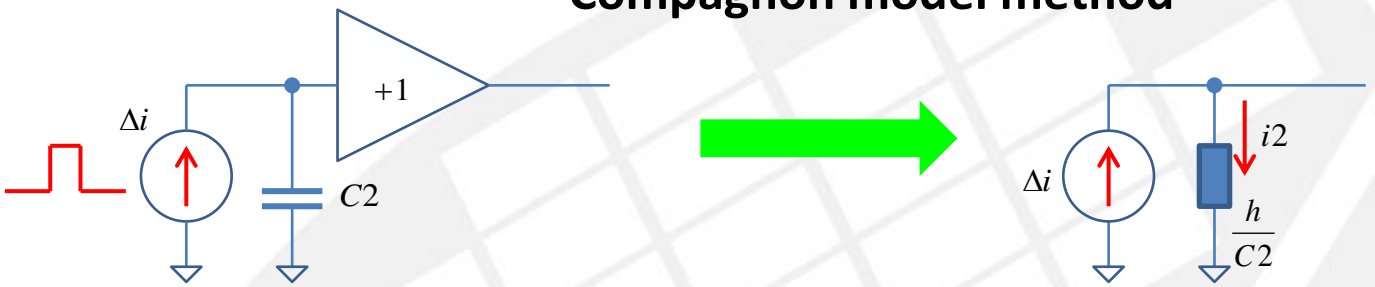
Injection Efficiency of SFP under gating

Compagnon model method



- ✓100% integration efficiency
- ✓Low conversion gain
- ✓SF noise is critical !
- ✓ Compatible with NIT Logarithmic Pixel design

NIT Solution for Gated AI

- Compact and low power consumption SWIR camera
- Very short exposure time down to 200ns
- Very low latency : 200ns
- Very low jitter <10ns

- Adjustable trigger delay for spatial scanning with steps <30ns
- Very efficient global shutter gating

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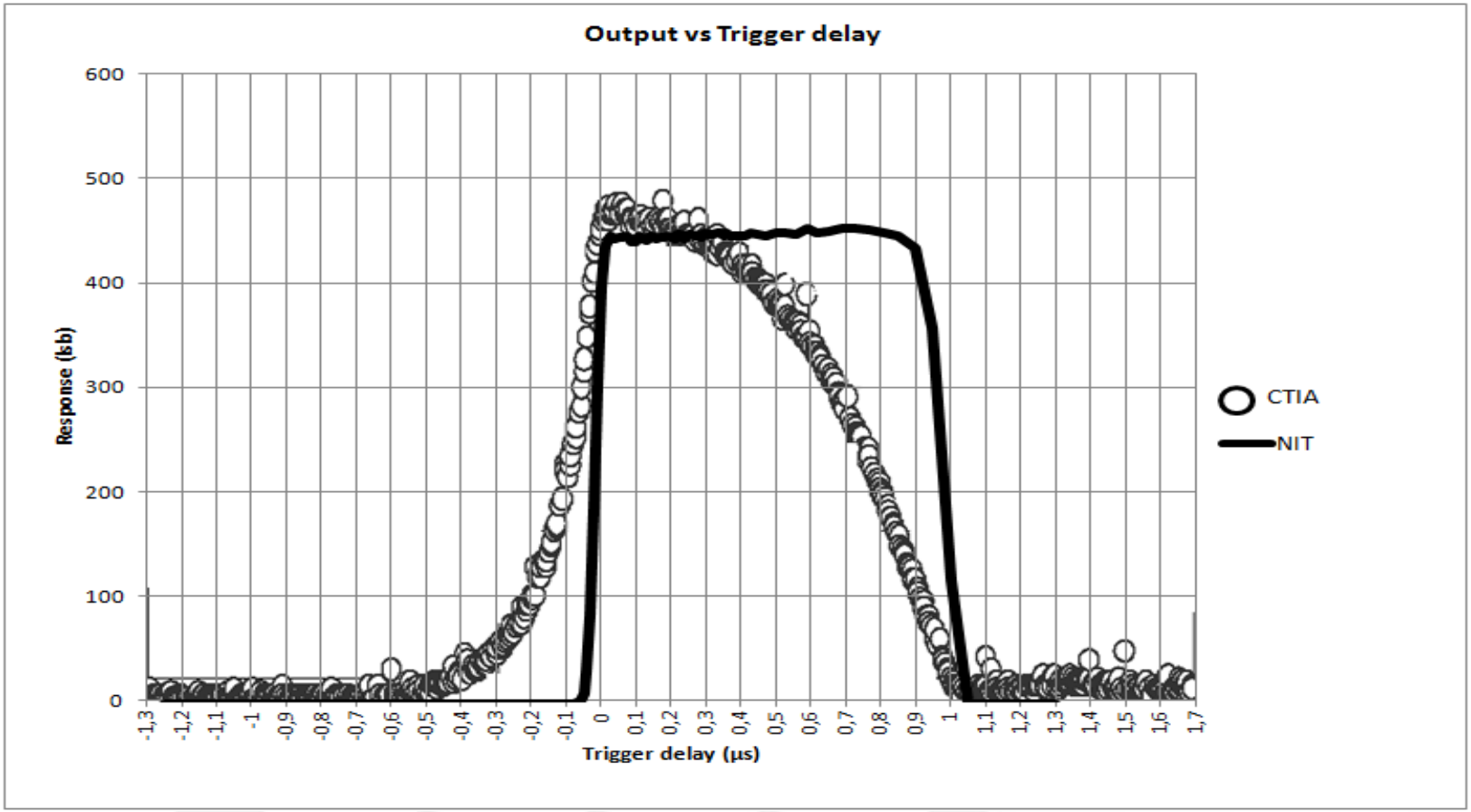
Measured Shutter Efficiency

with a phase shifted 4ns laser impulse



- ✓ **High and Constant injection efficiency**
- ✓ **Highly efficient shutter at high speed**

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Thank you for your attention

Please visit our booth # 302 for live demo

Or for further questions contact:

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