



NEW IMAGING TECHNOLOGIES



1 Impasse de la Noisette
Verrières le Buisson
91370
FRANCE

Recent Advances in SWIR Focal Plane Arrays at NIT : Toward Pitch Reduction, large surface area focal plan arrays and high Dynamic Range


Bogdan Arion

A LEADING SUPPLIER
OF SWIR & HDR IMAGING SOLUTIONS

COMPANY OVERVIEW

 **SME**
PARIS, FRANCE

 **SWIR & CMOS
SENSORS & CAMERAS**

 **> 80%** EXPORT

 **INDUSTRY**

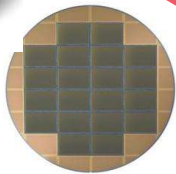
 **DEFENSE &
SECURITY**

 **AIR & SPACE**

 **SCIENCE**

A DEDICATED IN-HOUSE InGaAs SWIR PRODUCTION

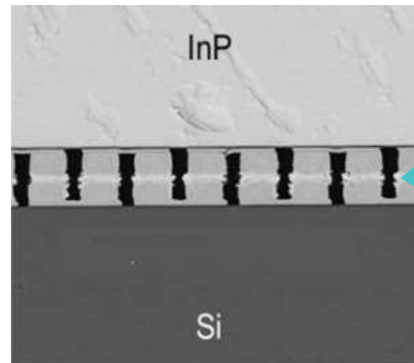
FROM ROIC TO CAMERA



Readout CMOS Circuit
/ PD array

In house Design &
High Volume foundry

Low Dark current



An innovative cost-
effective and scalable
flip-chip process for
Hybridization

pixel pitch in production :
10 μ m, 15 μ m & 25 μ m
In R&D: 8 μ m

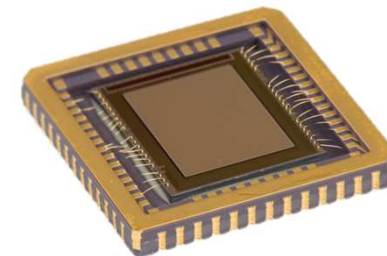
A full line of
configurable cameras

USB3.0
CameraLink
GigE
Analog
SDI



Custom Solutions

Fully customized SWIR
sensor solutions for specific
& strategic customer needs

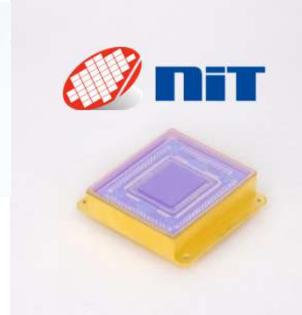
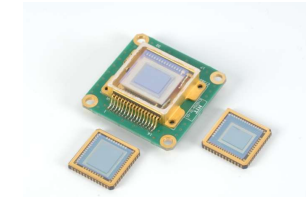


●○ PRODUCTS

NIT has developed a range of sensors:

<i>Sensor</i>	<i>Resolution</i>	<i>Pitch</i>	<i>Mode</i>	<i>Speed</i>	<i>Noise</i>	<i>Gated</i>
<i>NSC1201</i>	<i>640x512</i>	<i>15μm</i>	<i>HDR</i>	<i>120Hz</i>	<i>~150^{e-}</i>	<i>Yes</i>
<i>NSC1601</i>	<i>640x512</i>	<i>15μm</i>	<i>Linear & HDR</i>	<i>250Hz</i>	<i><50^{e-} (CDS)</i>	<i>Yes</i>
<i>NSC1902</i>	<i>640x512</i>	<i>15μm</i>	<i>Linear</i>	<i>250Hz</i>	<i><40^{e-} (CDS)</i>	<i>No</i>
<i>NSC1801</i>	<i>2048x1</i>	<i>7,5μm</i>	<i>Linear</i>	<i>70KHz</i>	<i>250^{e-}</i>	<i>No</i>
<i>NSC1901</i>	<i>1280x1024</i>	<i>10μm</i>	<i>Linear</i>	<i>80Hz</i>	<i><30^{e-} (CDS)</i>	<i>No</i>
<i>NSC2001</i>	<i>320x256</i>	<i>15μm</i>	<i>Linear & HDR</i>	<i>1000Hz</i>	<i><50^{e-} (CDS)</i>	<i>Yes</i>

And is continuing the development of new designs...



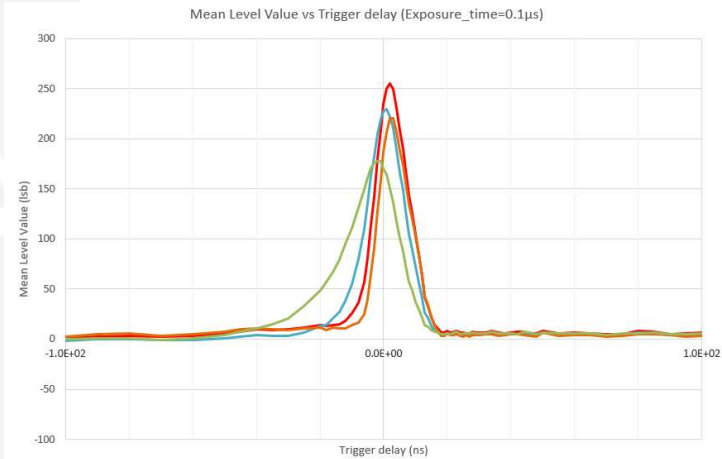
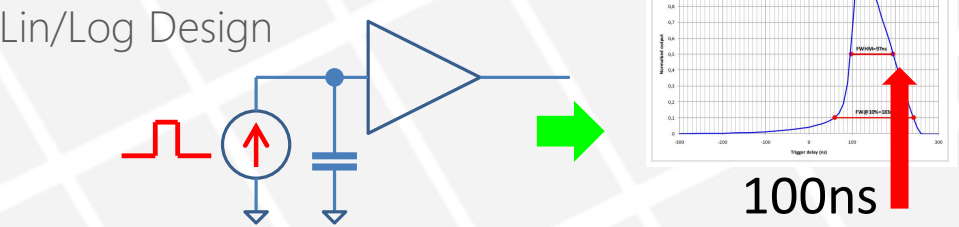
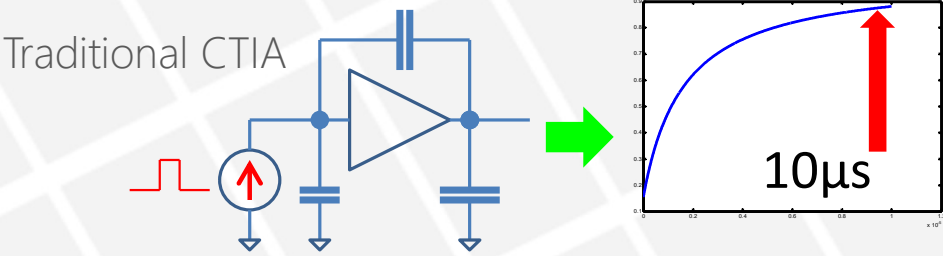
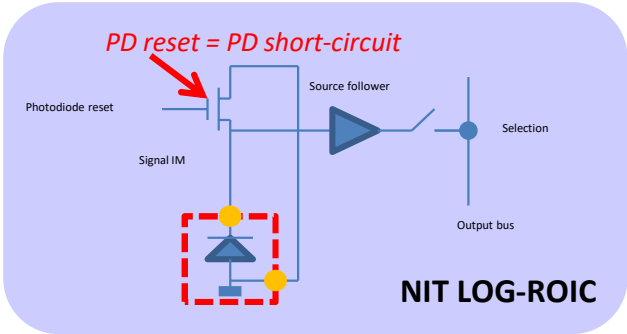
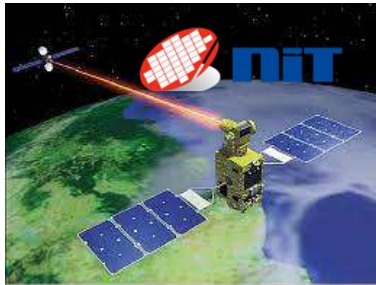
DESIGNS ASSETS FOR SPACE APPLICATIONS

Native Logarithmic Pixel:

Unique patented design to ease laser alignment and tracking for optical
Combined Linear/log design for all situations

High Efficiency Shutter

Close design between InGaAs PD design and pixel ROIC architecture
Well suited for laser applications to reject stray or undesired lasers



PD Optimisation

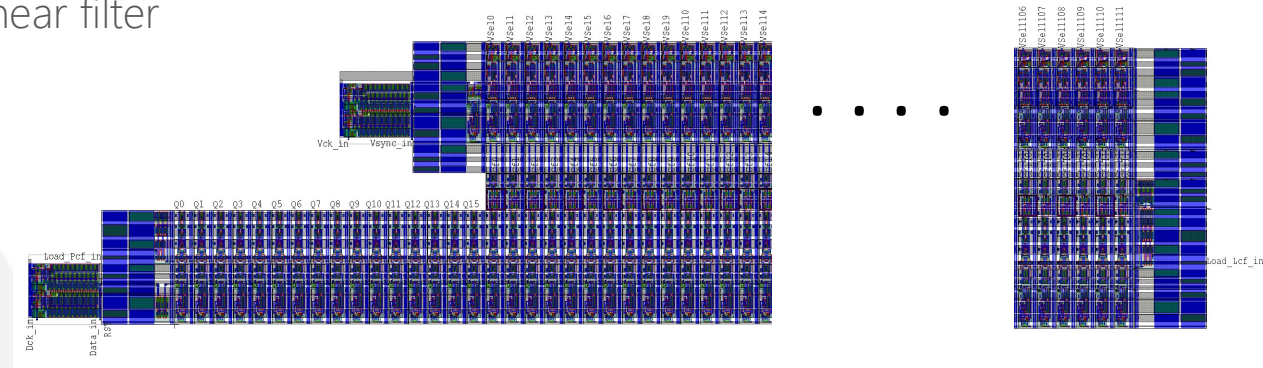
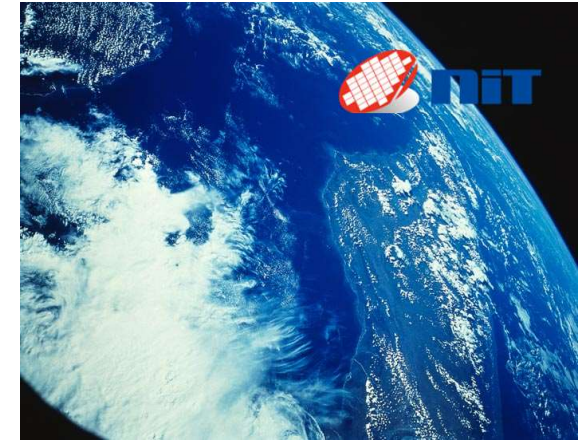
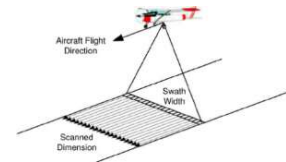
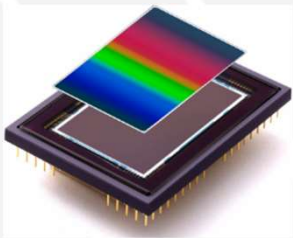


DESIGNS ASSETS FOR SPACE APPLICATIONS

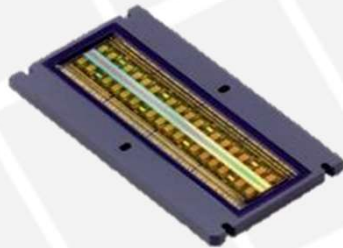
High Resolution Formats:
Earth Observation solutions

1280x1024 10 μ m pixel format available

Line Selection for hyperspectral imaging with linear filter



2048x1 7,5 μ m Line scan Sensor => Evolution towards multi-line multi exposure time sensor



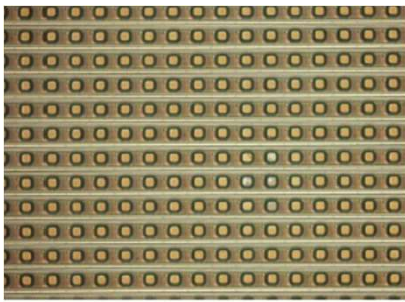
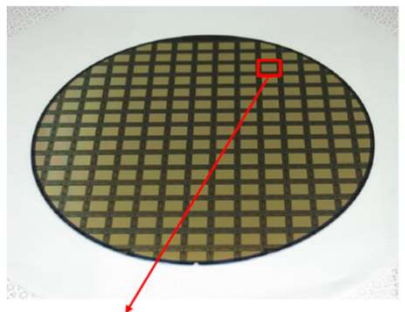
●○ PROCESS ASSETS

Indium Bump hybridization is the historic mainstream method
 Requires expensive tools
 Requires precise process control
 Difficult to switch from one pitch to another

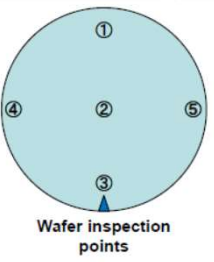
This is a main strain to reach bigger-sized formats while maintaining reasonable prices along with small pitch ROIC

NIT has developed a specific process **shrinking** μ -electronics stacking technology
 In production since 2018.

No In-bumps=> Extremely flat surface adapted to large surfaces
Hybridization Operability achieved with this process > 99,99%



× 500



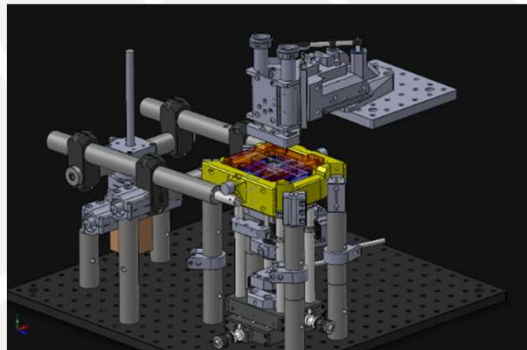
Metal	Thickness (μ m)						Ave.	Max.	Min.
	target	①	②	③	④	⑤			
Total	3.05	2.92	2.76	2.92	2.76	2.99	2.87	2.99	2.76

●○ PROCESS ASSETS

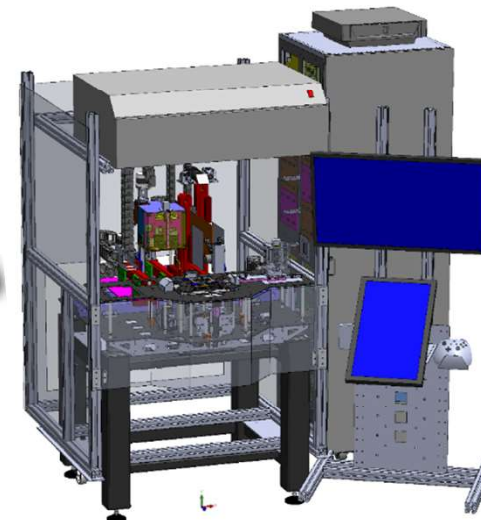
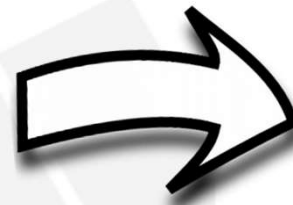


NIT has developed internally a dedicated automated machine to process this hybridization process.

This highly flexible process and tool also enables us to easily tune and best adapt our InGaAs Process to the performances requested... even with High Resolution and smaller pitches.



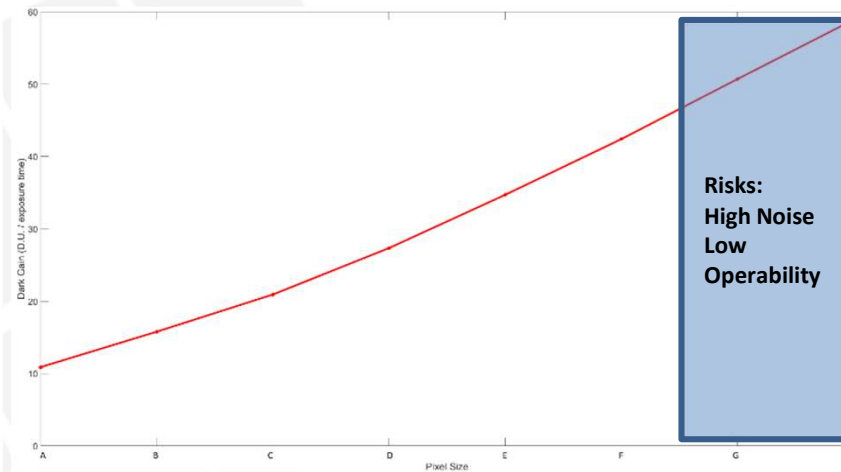
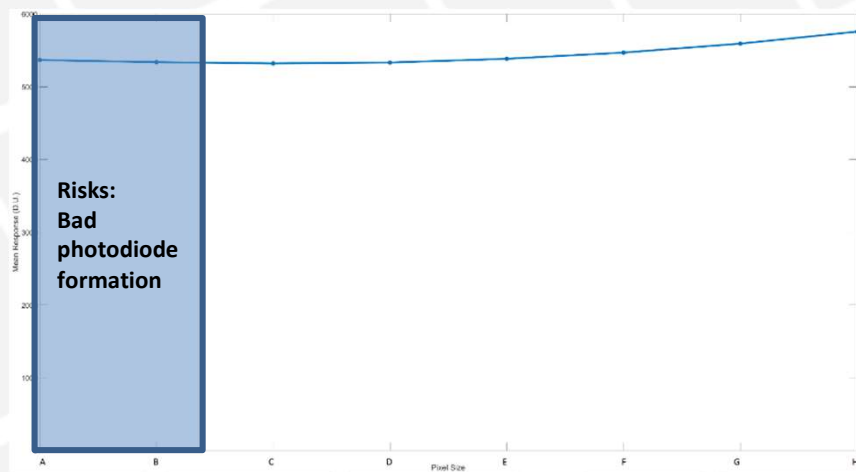
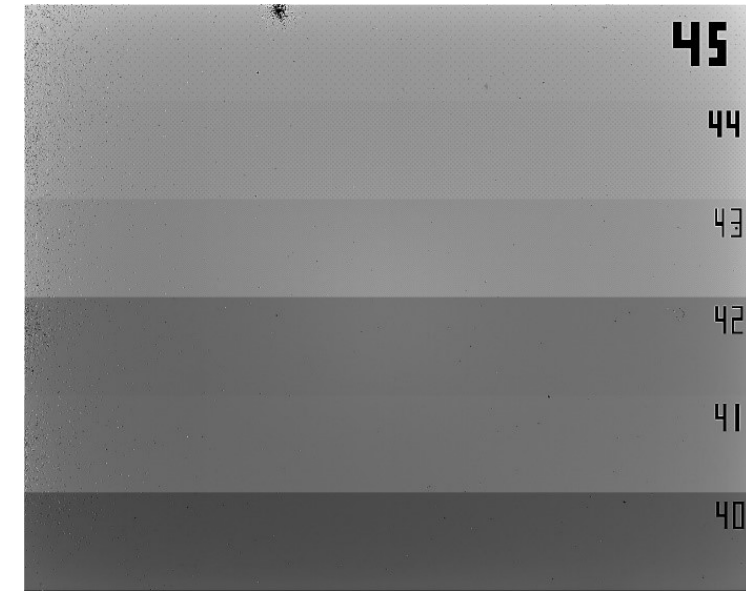
20/day



200/day

●○ PROCESS ASSETS

- This process eases PD evaluation
- **Objective:** Evaluation of the impact of the photodiode geometry on the Megapixel sensor
- **Method:** Production of a special series of PDAs, divided in zones containing pixels with different geometry



●○ OUR SWIR PRODUCTS FOR YOUR APPLICATION



Complete Sensor Portfolio:

320x256 – 15 μ m/25 μ m

640x512 – 15 μ m

1280x1024 -10 μ m

2048x1 – 7,5 μ m

...

Multiple Interfaces:

CameraLink

USB3

GIGE Vision

PAL/NTSC

HD-SDI

...

●○ WORK IN PROGRESS



InGaAs SWIR:

Roadmap targeting: Larger formats, smaller pitches
Extended SWIR (1,9 & 2,2 μ m cut-off)

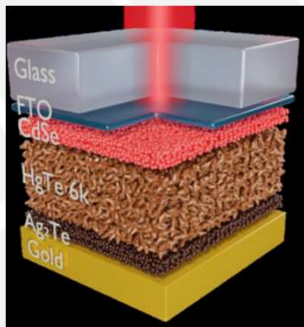
CQD:

ANR project being carried-out with



NIT ROICs are adapted to CQD technology. First sensors packaged with HgTe and with Pbs
A project to evaluate CQD with regards to Space applications is being prepared with a partner

1^{ère} image in Photovoltaic mode



●○ CONCLUSION

NIT is already committed on Space Systems at ground level and LEO atmosphere

Several on-going discussions for higher altitude

Project with CNES is under constructing to qualify our sensors:

- Qualify our unique Lin/Log structure

- Qualify our unique Process

... Very Busy roadmap!



NewImagingTechnoNIT



Grazie

감사합니다

Danke

Dank u

Merci

Gracias

Thank you

Dziękuję

спасибо

Terima kasih

Teşekkür ederiz

谢谢

شكر

σας ευχαριστώ

ありがとう

धन्यवाद