

ESCCON Conferences

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March 2013

**From Earth Observation to Astronomy and Science,
with CCD and CMOS sensors, the sustainability of
the visible imaging supply chain**

Sustainability of the visible Imaging supply chain for Space

Topics to address



- E2V who are we?
- Specific market requirements for space visible imaging detectors
- Visible imaging supply chain steps
- CCD manufacturing model
- CMOS manufacturing model
- Market needs?
- Summary

E2V - UK company with International business

3 Divisions

e2v

High performance imaging

ESA's GAIA mission includes a billion pixel camera made from a 1m diameter e2v sensor array from 106 sensors. It will fly in 2013 and will map over 1 billion stars in the Milky Way

An e2v camera system can inspect four tons of beans or rice per hour and is the fastest in the world in terms of data generated: the equivalent to producing 3 MPEG-4 movies a second

L3 vision sensors are the most sensitive in the world, making them ideal for high magnification research microscopes where traditional laser lighting could damage the specimens

e2v has imaging devices in more than 150 operational space missions, including 10 star trackers and 57 science exploration missions

London Olympic park
Image courtesy Pleiades

Specific market requirements for space visible imaging detectors



- High specification performances on many optical & electrical parameters
- Large detector size, with “large pixel”
- Serving many different applications
 - E.O. Scanning & Science, Astronomy, Exploration Science, Meteo, Star Tracker
- Space environments: radiation, thermal, mechanical
- High Reliability products
- Electronic components space manufacturing standard
- Almost each imaging satellite is unique, with few detectors to manufacture
- Small market size

Interaction between all the steps



&
management of this complex supply chain
are vital

Major CCDs suppliers

- Vertically integrated
- In house front end; waferfab tools and post processing
- In house back end assembly and testing
- Dedicated to imaging
- Supporting high end professional imaging
- Still available for several years: as long as required by the market

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- Currently space projects are served with non European CMOS waferfabs
 - Manufacturing industrial model is more open, with some players wanting to manage some manufacturing steps
 - Many design houses available
 - All players are waferfabless
 - Most players are back end manufacturing fabless
 - With only very few players offering
 - in house post process, assembly, tests solutions
 - and can propose Prime Detector Management role
 - Technical trend of manufacturing CMOS waferfabs is managed by consumer markets
 - Million of pieces
 - Detectors with very small pixels size are preferred
 - Manufacturing process technology is smaller and smaller (Moore law)

CMOS manufacturing model European Waferfabs and technology projects



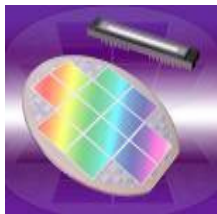
- The CMOS waferfabs is at the heart of the manufacturing steps
- Several imaging CMOS developments projects running in Europe:
 - FP7 EuroCIS - Platform for European CMOS Imagers - IMEC
 - ESA - European High Flux CIS – IMEC & ESPROS and European Low Flux CIS (selection in progress)
 - French PIA - High Performance CMOS Detectors - LFoundry
 - CNES, waferfab evaluations: ST Micro, ESPROS & IMEC
 - UK RGF (Regional Growth Fund) - Enhanced CMOS technology development
 - No specific EU wafer fab
 - EU - PLAT4M (**P**hotonic **L**ibraries & **T**echnology for **M**anufacturing) – CEA LETI, IMEC, STM : Not for space imaging

CMOS manufacturing model Back end services & Testing



From wafer to the detectors

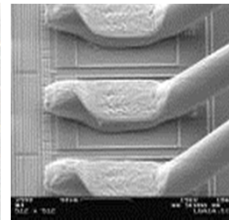
- Back end services manufacturing is major to deliver high reliability flight model detectors



Clean room for wafers handling



Assembly



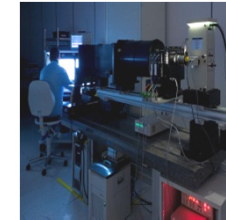
Bouding



Visual inspection

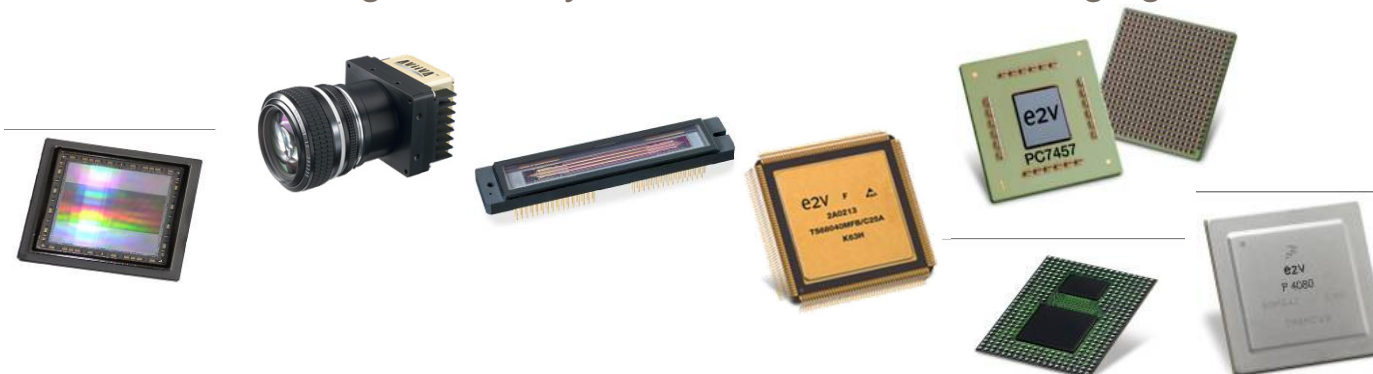


Screening



Tests &
Characterisation

- Specialised operators for space standard qualified environments
- e2V offers these high reliability back end services for Imaging and Electronic Components



- * ADC
- * DAC
- * Microprocessors

Succeeding in Space

BroadBand Data Converters ADC & DAC

→ Value Proposition to the Space industry

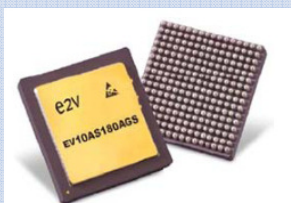
e2v

Feb 2013



EV12DS130A
12B 3Gps
MuxDAC

ESCC Evaluation completed
soon on EPPL



EV10AS180A
10B 1.5Gps
L band ADC

ESCC Evaluation completed
soon on EPPL

12B 1.5Gps
L band ADC

ESCC Evaluation
priority 2013

Frequency
Up-converter

\$100K+

Freq. Up-conv. are optional in L-, S- and C-Band when choosing e2v data converters.

⇒ B.O.M. savings.

Frequency
Down-converter

\$100K+

Freq. Down-conv. are optional in L-Band when choosing e2v data converters.

⇒ B.O.M. savings.



- Design, IP, Assembly & Test.



- Silicon technology.



Market needs?



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- Prime components leaders to manage the complex supply chain steps and to commit to full specification detector compliance
 - Reliable components for space missions
 - Reliable CMOS Waferfab(s)
 - Open to our specific technical needs, small quantities, with acceptable costs
 - Not serving only space applications, but not serving only consumer market
 - Supply chain prime detector management
 - To manage key manufacturing process tools
 - To commit delivery of full specified space qualified detectors
 - With focus on
 - Design, Waferfab interface, post processing (Back Thinning, AR Coating)
 - Backend services
 - Long lead time procurement

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- E2V European CCD supply chain still available
 - CMOS supply chain already serving space applications with non European waferfabs
 - Interesting bricks are yet in place in Europe to serve visible imaging missions
 - Several projects currently running to evaluate European CMOS imaging waferfabs
 - Sustainable full European CMOS supply chain is still under construction
 - We shall not underestimate back end services manufacturing steps, being very demanding to answer specific space imaging applications

Thank you for your attention

