ESCCON 2011

European Space Components Conference
ESA ESTEC
(Newton 1 and 2 Conference Rooms)

Final Programme of Wednesday 16 March 2011
Chairman: Ralf de Marino / ESA

09:00 – 09:25	The business roadmap. Trends for the future F. Caizzone , IMS-Group Vice President, Business Management and Operation General Manager, STMicroelectronics
09:25 – 09:50	Roadmaps for III-V in Europe U. Meiners, Chief Technology Officer, UMS
09:50 – 10:15	The business roadmap. Trends for the future P. Sauvage, General Manager, Atmel Aerospace
10:15 – 10:40	(Digital) Packaging for the future. Supply chain of packaging solutions. J. Vernet, ATMEL, and T. Gouvernel, e2v
10:40 – 11:00	The business roadmap, a Design House perspective P. Danielson, Executive VP and Managing Director, Aeroflex Gaisler AB
11:15 – 11:45	The European Components Initiative M. Labrunee and J-L. Venturin, CNES; A. Jain, DLR; M. Nikulainen, L. Marchand, ESA
11:45 – 12:15	The experience in expanding operations in Europe and the business roadmap R. E. Reddy, CTO, and P. Le Bohec, Managing Director Europe, PEREGRINE
12:15 – 12:45	Lessons learnt from ECI vs business roadmap J-M. Bureau, Project Manager, Cobham Microwave

ESCC

European Space Components Conference

ESCCON 2011

16 March 2011

Francesco Caizzone

IMS-Group Vice President

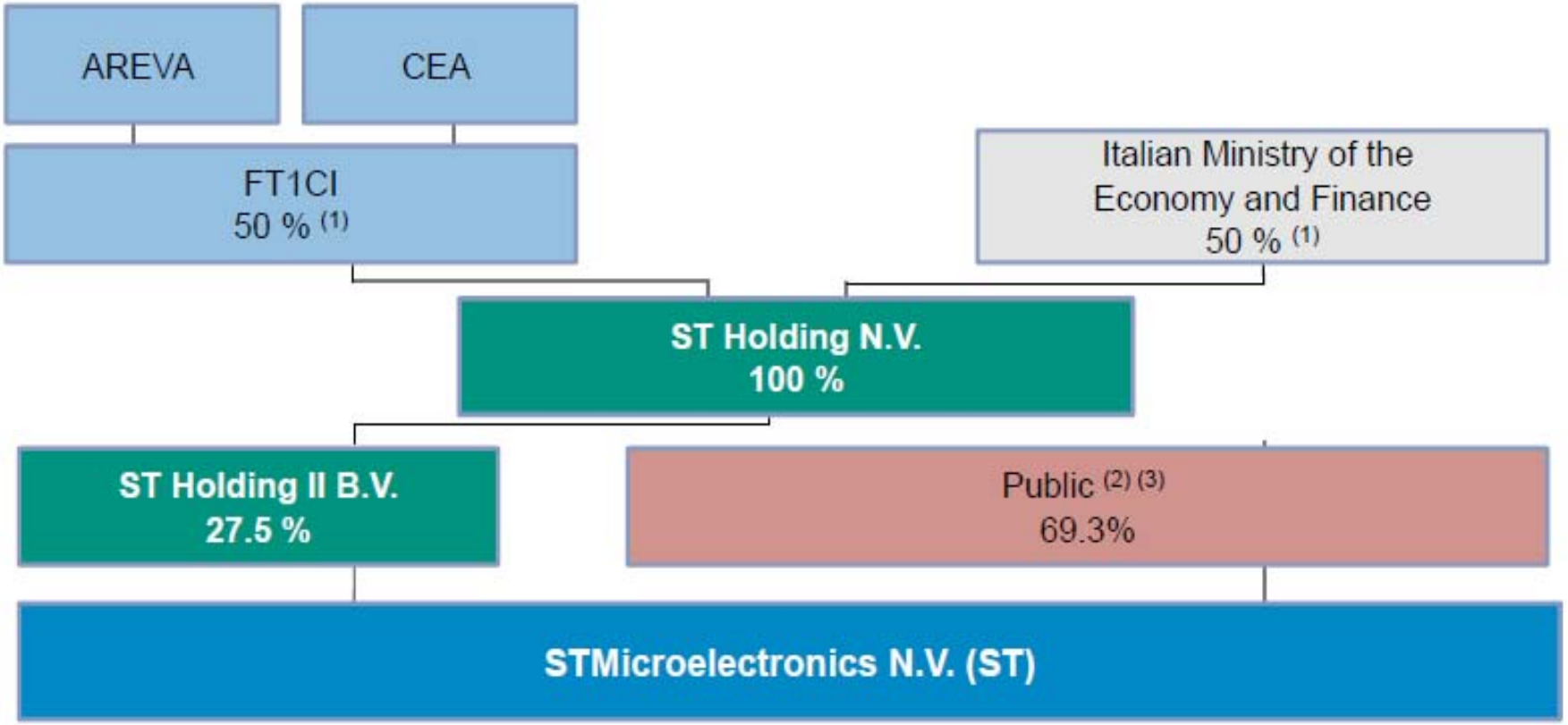
Business Management and Operation

General Manager

Mission

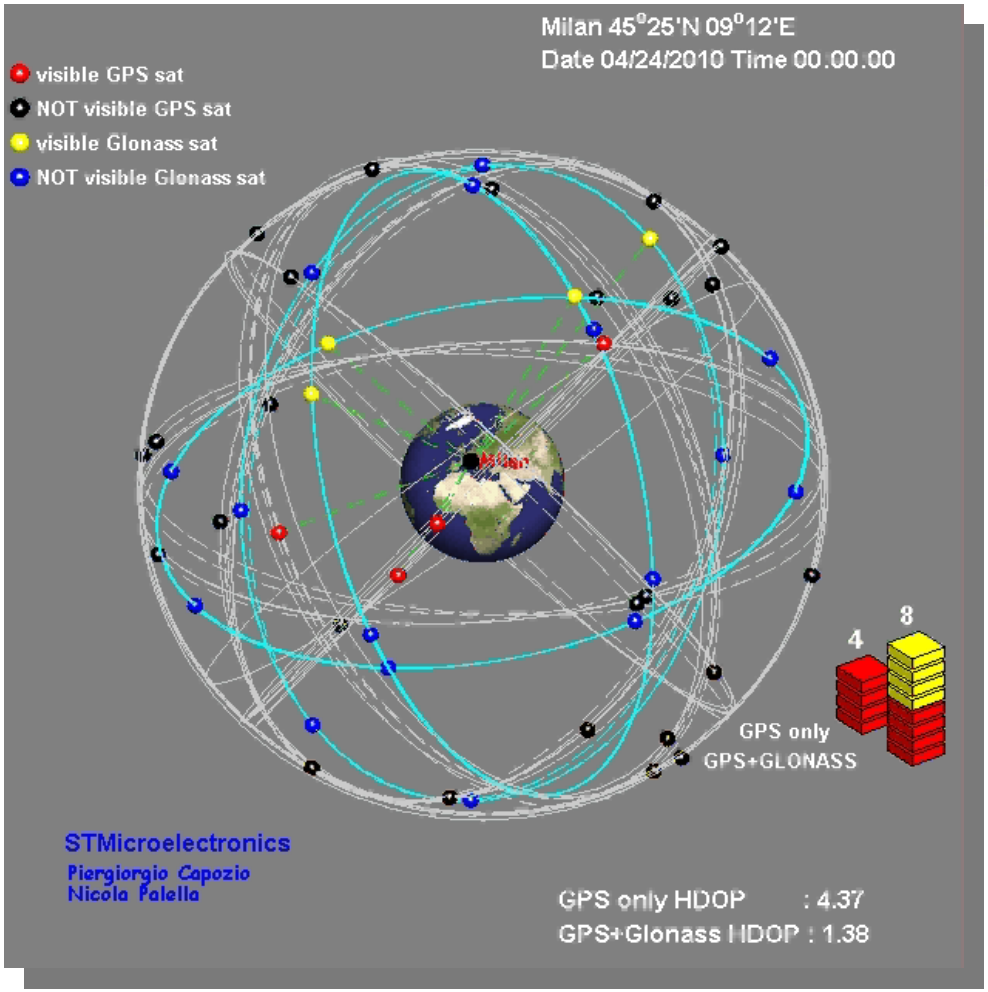
To offer strategic independence
to our partners worldwide,
as a profitable and viable broad range
semiconductor supplier.

Shareholding Structure*



* At December 31, 2010
(1) Based on Corporate Governance rights pursuant to STH Shareholders' Agreement.
(2) New York Stock Exchange, Euronext, Paris and Borsa Italiana, Milano
(3) In addition to the 27.5% held by ST Holding II B.V. and the 69.3% held by the Public, 3.2% are held by the Company as Treasury shares

ST - Pioneer on new Navigation Systems



TeseoII is the 1st MONOLITIC DEVICE able to use multiple satellite constellation as: GPS (USA), GALILEO (EU) & GLONASS (RUS)

For a reliable and accurate Navigation

Key Customers

GARMIN

Continental

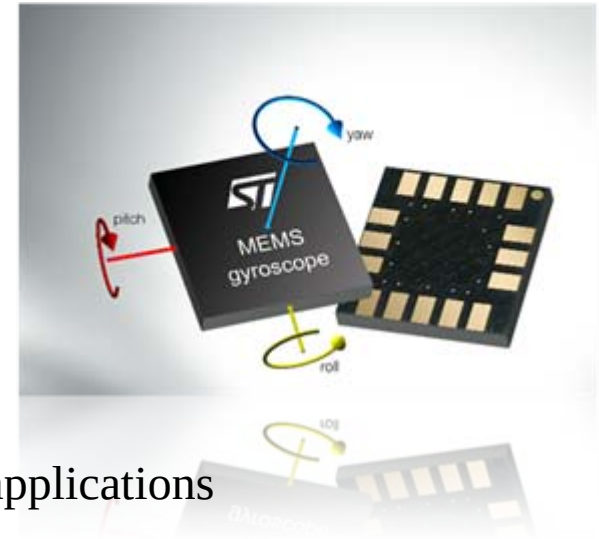
MAGNETI MARELLI

META SYSTEM

Products Priorities for 2011

Innovative products in highly successful applications continue to grow

- MEMS gyroscopes & accelerometers
- General and secure 32-bit microcontrollers families
- ICs for Automotive
- Products for Space



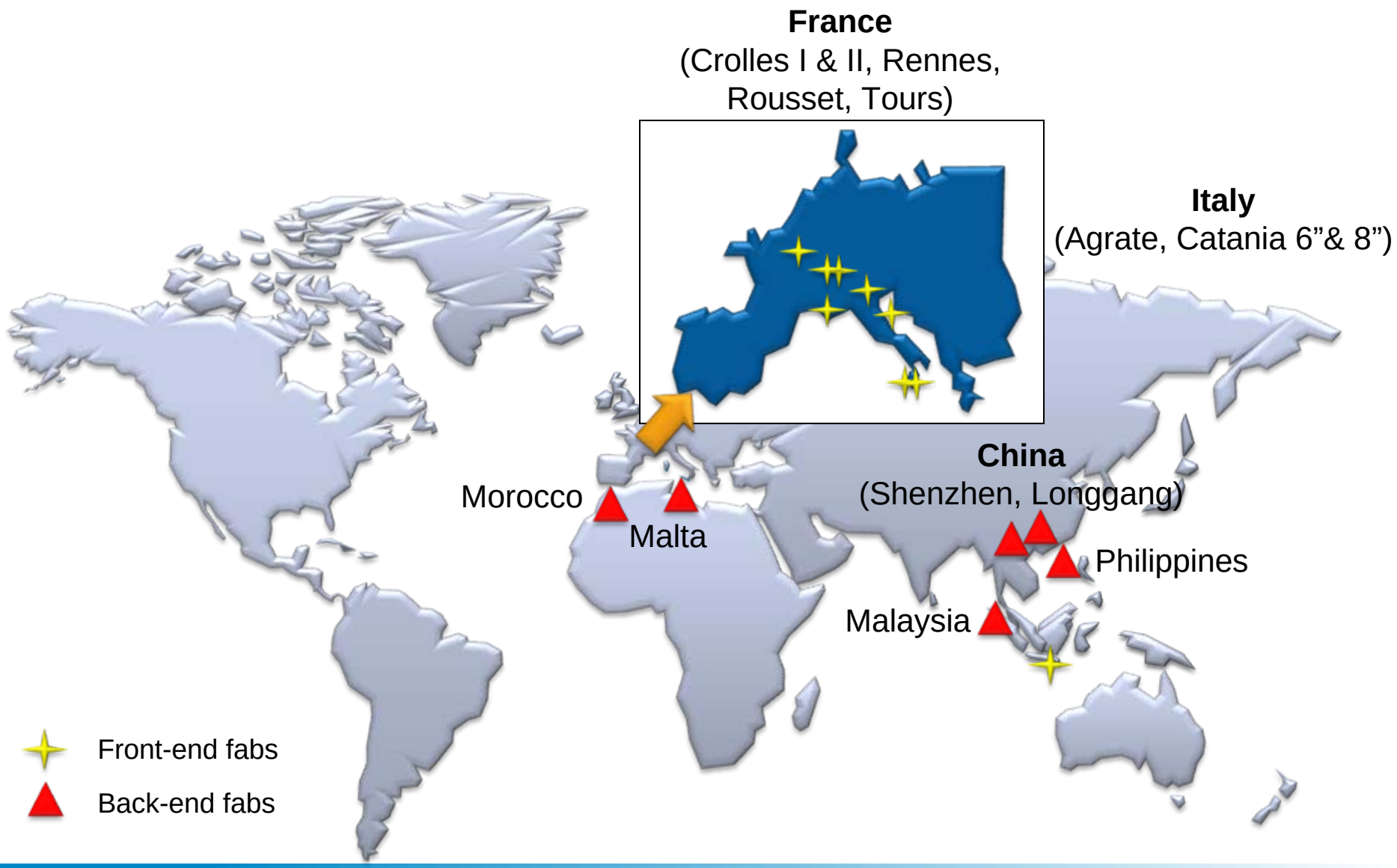
Breakthrough in new products

- SoCs for 3-D and connected TVs
- MEMS microphones and pressure sensors
- Advanced analog products for Medical and Smart Grid applications
- 32-bit Power PC microcontrollers

We are ready for the next wave…

- Energy Management & Saving / Healthcare & Wellness / Trust and Data Security / Smart

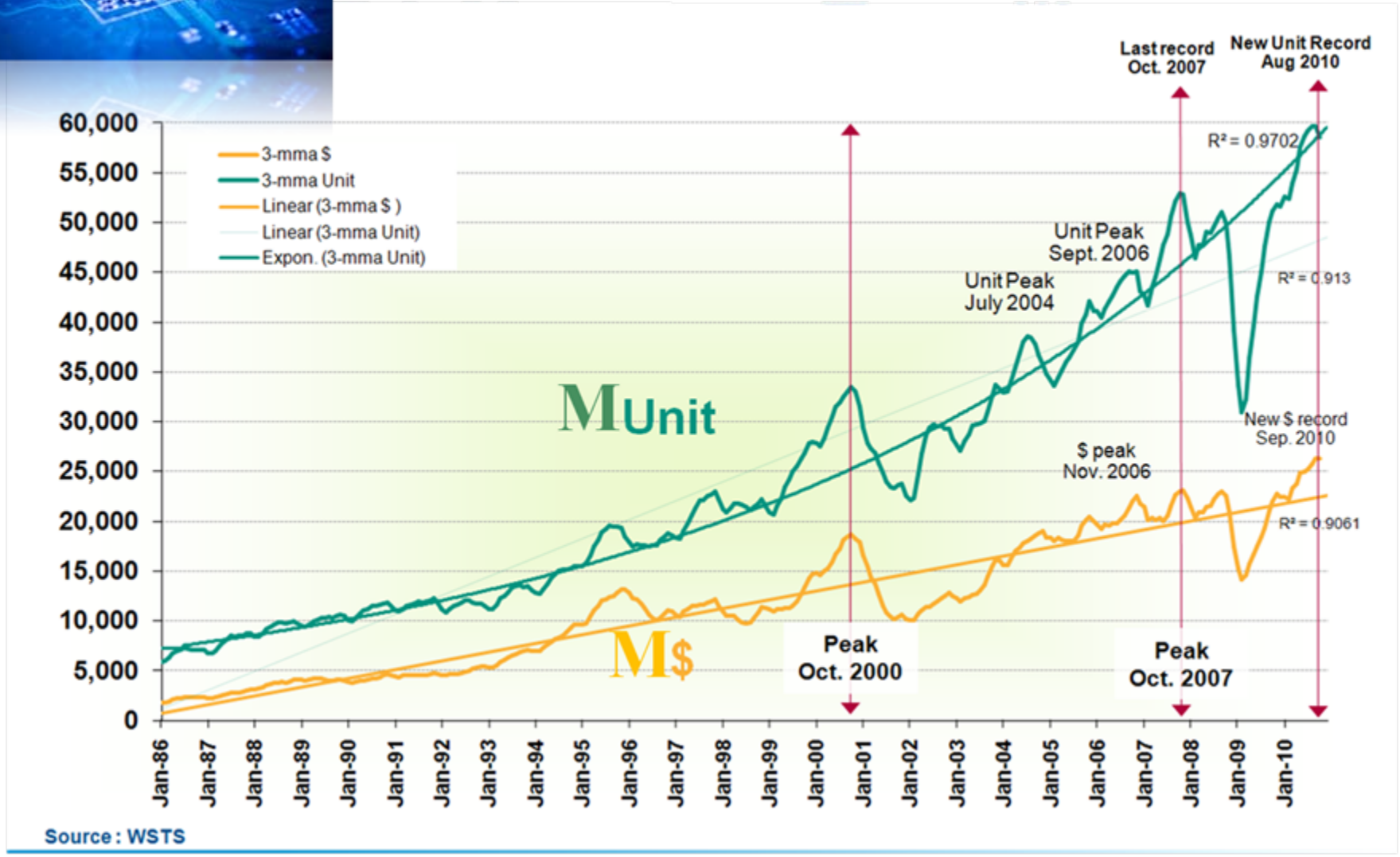
Manufacturing locations



STMicroelectronics in everyday life

MARKET

Semiconductor



Source : WSTS

Y2010 Seminconductors Market Share

(Preliminary)

Preliminary Worldwide Ranking of the Top 20 Suppliers of Semiconductors in 2010
(Ranking by Revenue in Millions of U.S. Dollars)

2009 Rank	2010 Rank	Company Name	2009 Revenue	2010 Revenue	Percent Change	Percent of Total	Cummulative Percent
1	1	Intel	32,187	40,020	24.3%	13.2%	13.2%
2	2	Samsung Electronics	17,496	28,137	60.8%	9.3%	22.4%
3	3	Toshiba	10,319	13,081	26.8%	4.3%	26.7%
4	4	Texas Instruments	9,671	12,966	34.1%	4.3%	31.0%
9	5	Renesas Electronics Corporatior	5,153	11,840	129.8%	3.9%	34.9%
7	6	Hynix	6,246	10,577	69.3%	3.5%	38.4%
5	7	STMicroelectronics	8,510	10,290	20.9%	3.4%	41.7%
13	8	Micron Technology*	4,293	8,853	106.2%	2.9%	44.7%
6	9	Qualcomm	6,409	7,200	12.3%	2.4%	47.0%
15	10	Elpida Memory	3,948	6,878	74.2%	2.3%	49.3%
14	11	Broadcom	4,278	6,506	52.1%	2.1%	51.4%
8	12	Advanced Micro Devices (AMD)	5,207	6,355	22.0%	2.1%	53.5%
11	13	Infineon Technologies	4,456	6,226	39.7%	2.0%	55.6%
10	14	Sony	4,468	5,336	19.4%	1.8%	57.3%
18	15	Panasonic Corporation	3,243	5,128	58.1%	1.7%	59.0%
17	16	Freescale Semiconductor	3,402	4,329	27.2%	1.4%	60.4%
19	17	NXP	3,240	4,021	24.1%	1.3%	61.8%
23	18	Marvell Technology Group	2,572	3,680	43.1%	1.2%	63.0%
16	19	MediaTek	3,551	3,595	1.2%	1.2%	64.1%
20	20	nVidia	2,826	3,189	12.8%	1.0%	65.2%
		Top 20 Companies	141,475	198,207	40.1%	65.2%	
		All Others	88,031	105,799	20.2%	34.8%	
		Total Semiconductor	**229,506**	**304,006**	32.5%	100.0%	

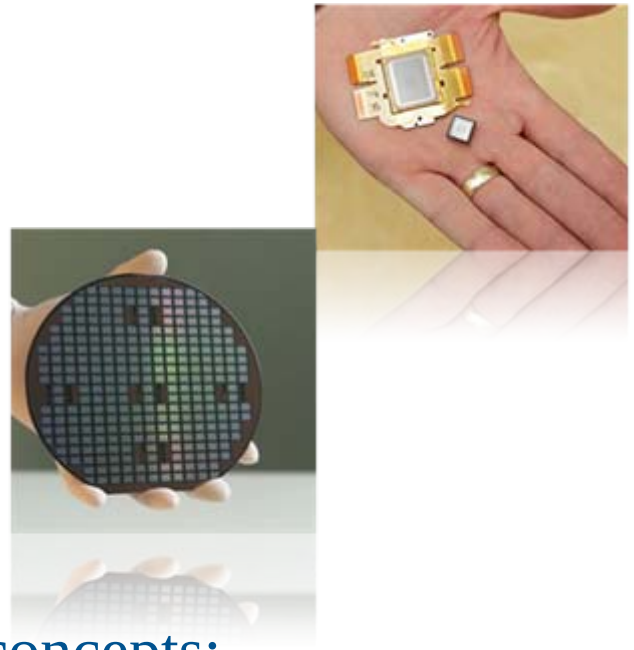
Source: iSuppli, January 2011

Renesas Electronics = Renesas Technology Corp and NEC Electronics
Micron Technology = Micron and Numonyx

Technology highlights

Technology Highlights

- Discrete
  - IPAD: Application specific customer networks,
  - New Materials:
    - Silicon Carbide SiC: Diodes
    - Gallium Nitride GaN: Power Devices
  - New Functionalities:
    - On-chip Solar Cells,



New Integrated Circuit concepts:

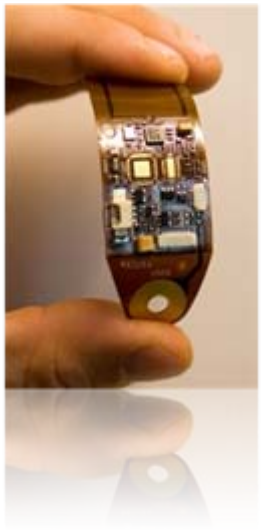
Stand alone super Smart Cards:

Level-1:	Solar Cells
Level-2:	Li-ion battery
Level-3:	DC-DC converter
Level-4:	Sensors (MEMS, others,..)
Level-5:	Miroprocessor ,and analog conversion
Level-6:	Non Volatile Memory
Level-7:	RF transmitter

Anti-colliding Automotive Radars

Technology Highlights

- Continuing Digital High density integration: now 22nm
- System-On-Chip requires more and more 2 or 3 Mixed Technologies
- Silicon on Insulator: SOI Technology
- Enormous R&D investments at each integration step:
  - Silicon design,
  - Supportive softwares (lay out, routing, simulation,…)
  - Discovery and resolution / simulation of new unknown effects,

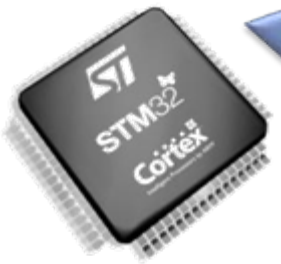


- Related to Space:
  - 65nm demonstrated usable in worst space conditions
  - 45nm is the valuable next integration generation
  - 32nm seems so far, impossible to use in Space (under internal evaluation),

PRODUCT HIGHLIGHTS

Microcontroller “STM32W”

- **IEEE 802.15.4 Open flexible reconfigurable platform**



… embedding radio frequency function

IEEE 802.15

ZigBee

RF4CE

Low power microcontroller product family, …

Target Applications:

- Smart Meters
- Home & Building Automation
- Wireless Sensor Networks
- Healthcare
- Consumer
- Remote Control
- Home Automation

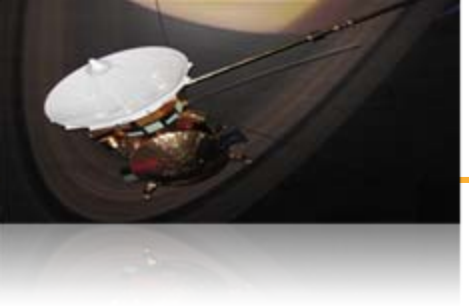
System on Chip Solution
Microcontroller, Radio and Firmware

Source: WSTS
(*) With Automotive

SPACE

Space Suppliers trends:

- *STM opinion only:*
- Growing demand for really RadHard devices makes Space parts suppliers to fully master design and Wafer Fab:
  - Times of «lucky radiation commercial wafers « are gradually going to an end, as a result of conflicting high volume v. radiation requirements,
  - STM space policy is to ensure 100% radiation yield success of every die by design or process, otherwise Radiation cannot be honestly guaranteed to Users, even for a low 50krad level.
  - High density Asic chips cannot be designed nor produced without a deep technology understanding (inclusive of confidential data) as traditional Designer's radhard « rules » make die size and power consumption explode.
- Consequences:
  - More and more specialized Suppliers, less and less traditional Suppliers
  - ITAR restriction should make Europe/US sourcing ratio to evolve in favor of Europe



Steps forwards

- Users master orbiting stuff needs and design,
  - *But usually have little access to Semiconductor fast developing capabilities.*
- Semiconductor manufacturers perfectly know technology capabilities,
  - *But still have superficial understanding of deep Space User challenges and needs*
- Working together makes INNOVATION to burst,

Atmel Corporation
Enabling Unlimited Possibilities

ESCCON 2011 March 16
Documentation

Patrick Sauvage

 /

Content

- Why is Atmel involved in the space business.
- Atmel Aerospace: Trends for the Future

Why is Atmel involved in Space business?

Why is Atmel involved in Space business?

- **Dear Customers we apologize for our poor delivery performances during the last two years.**
- **Atmel appreciates your long standing patience in this matter and shares your concerns over the stability and sustainability of this portion of the supply chain .**
- **Atmel has taken the option of being totally transparent to Space Agencies and Customers with the aim to manage the best we can your priorities.**
- **We apologize for all inconvenience caused.**

Why is Atmel involved in Space business?

- **It is a great pleasure to share with you lessons learned in the next section Trends for the Future, what has been completed and what is in progress to recover standard business conditions in Q3.2011.**

Why is Atmel involved in Space business?

- **Long heritage of space business in Europe; more than 25 years with large in flight legacy products.**
- **Long term partnership with Space Agencies.**
- **Long term partnership with top tier Customers.**
- **Atmel has Customers in Space business and has made commitments to these customers.**
- **Atmel will fulfil its commitments to support the European Space Agencies and the European Space Customers.**

Why is Atmel involved in Space business?

- **Recognized leadership in Europe for digital space ICs by Customers.**
- **Almost sole source of supply for digital products in Europe qualified strategic supplier by Customers.**
- **Trusted supplier with in house expertise and skills and Space Customers strong expectations and requirements.**

Why is Atmel involved in Space business?

- **Space business is a niche market.**
- **Space business is a very demanding niche market with long life time and harsh environment requirements. Its very low volume characteristic forces searches for internal synergies.**
- **Space business is a profitable business and must remain profitable to all parties.**

Why is Atmel involved in Space business?

- **Atmel Aerospace Vision:**
  - **Become a world wide top tier space supplier focused on the digital space market segment.**
  - **Enhance the value of all space R&D efforts in all other Aerospace market segments and industrial market segment with harsh environment.**

Why is Atmel involved in Space business?

- **Atmel Aerospace Goals:**
  - **Revenue in all geographical zones.**
  - **Maintain world class technology offering.**
  - **Invest in all digital space market sub-segments; ASIC, FPGA, Processors and Memories.**

Atmel Aerospace
Trends for the Future

Atmel Aerospace
Trends for the Future

- **Space dedicated Business Unit.**
- **With all R&D activities located in Europe.**
- **Benefits from Atmel strategy and develops internal synergies.**
- **Invests and builds its own critical capacities.**
- **Develops strategic partnerships.**

Atmel Aerospace
Trends for the Future

- **Has doubled its R&D workforce in the last 3 years.**
- **Keeps hiring new talents and experts to better service European Space industry.**
- **Is the only one Company in Europe having all semiconductor expertises and skills in its headcount focused on the space market and its specific requirements.**
- **Has established closer and stronger relationships with Atmel Central Engineering Organization.**

Atmel Aerospace
Trends for the Future

- **Commits to offer state of the art technology to Space market.**

- **Aligns space technology requirements with automotive market requirements.**

- **Benefits from Atmel automotive R&D efforts and business activity and adds with its own resources the space valued added to meet the space Customers requirements and expectations.**

Atmel Aerospace
Trends for the Future

- **Has adopted the Corporate Fab-lite business model for servicing the Space market and will develop strategic foundry partnerships.**
- **Today 350 and 180 nm at LFoundry Rousset, ESCC qualified Atmel proprietary technologies.**
- **Tomorrow 150 nm Atmel proprietary, 150 nm SOI from OSC, 90 nm from UMC and 65 nm.**

Atmel Aerospace
Trends for the Future

- **Invests in developing in house high reliability test expertises and skills.**
- **Invests in building its own high reliability test floor capacity.**
- **Invests in state of the art test equipments.**
- **Maintains test strategy with best practises design tools and Test Program Generator allowing product test portability and design for test.**
- **Will develop strategic partnerships with critical test suppliers and build an efficient network.**

Atmel Aerospace
Trends for the Future

- **Invests in maintaining and developing in house assembly expertises and skills linked to a worldwide Atmel assembly expert network.**

- **Has issued a medium / long term assembly and packaging R&D roadmap aligned with its long term space strategy (see next cession).**

- **Will develop strategic partnerships with critical assembly and package suppliers and build an efficient network.**

Atmel Aerospace
Trends for the Future

- **Will enhance its space products and services portfolio;**
  - **Reprogrammable FPGA**
  - **FPGA retargeting to ASIC service**
  - **ASIC (digital and mixed mode).**
- **Improve customer freedom to design its specific products.**

Atmel Aerospace
Trends for the Future

- **Will enhance its space products and services portfolio;**
  - **Processors**
  - **Memories: SRAM and NVM.**
- **Improve customer freedom to design its specific applications.**

Atmel Aerospace
Trends for the Future

- **Wants to consider top tier Customers as strategic partners with dedicated resources.**
- **Aligns R&D efforts to support Customer business trends and future requirements.**
- **Improves consolidation of medium term customer requirements (18 months horizon) to allow capacity alignment.**
- **Wishes to service Customers with project management support, application engineering and technical problem solving.**

Atmel Aerospace
Trends for the Future

- **Gets rid of old technologies (6 inches wafer facility) and from disappearing equipment and suppliers.**
- **Must follow Space business trends in more advanced technologies in 8, 12 and 15 inches wafer facility.**
- **Must co-develop with Space Agencies, Customers and Partners very focused ambitious space strategy which brings the expected value added to European Space Industry.**

Atmel Corporate Vision:

Create technology that enables unlimited possibilities for our customers

Atmel Aerospace
Trends for the Future

Atmel Aerospace creates technologies, products and services that enable unlimited possibilities for our space Customers in the digital space market segment.

Thank you !

(Digital) Packaging for the future

ESCCON, 16-Mar-2011

Space products versus commercial

- The trend towards

  more speed / performance

  more complexity

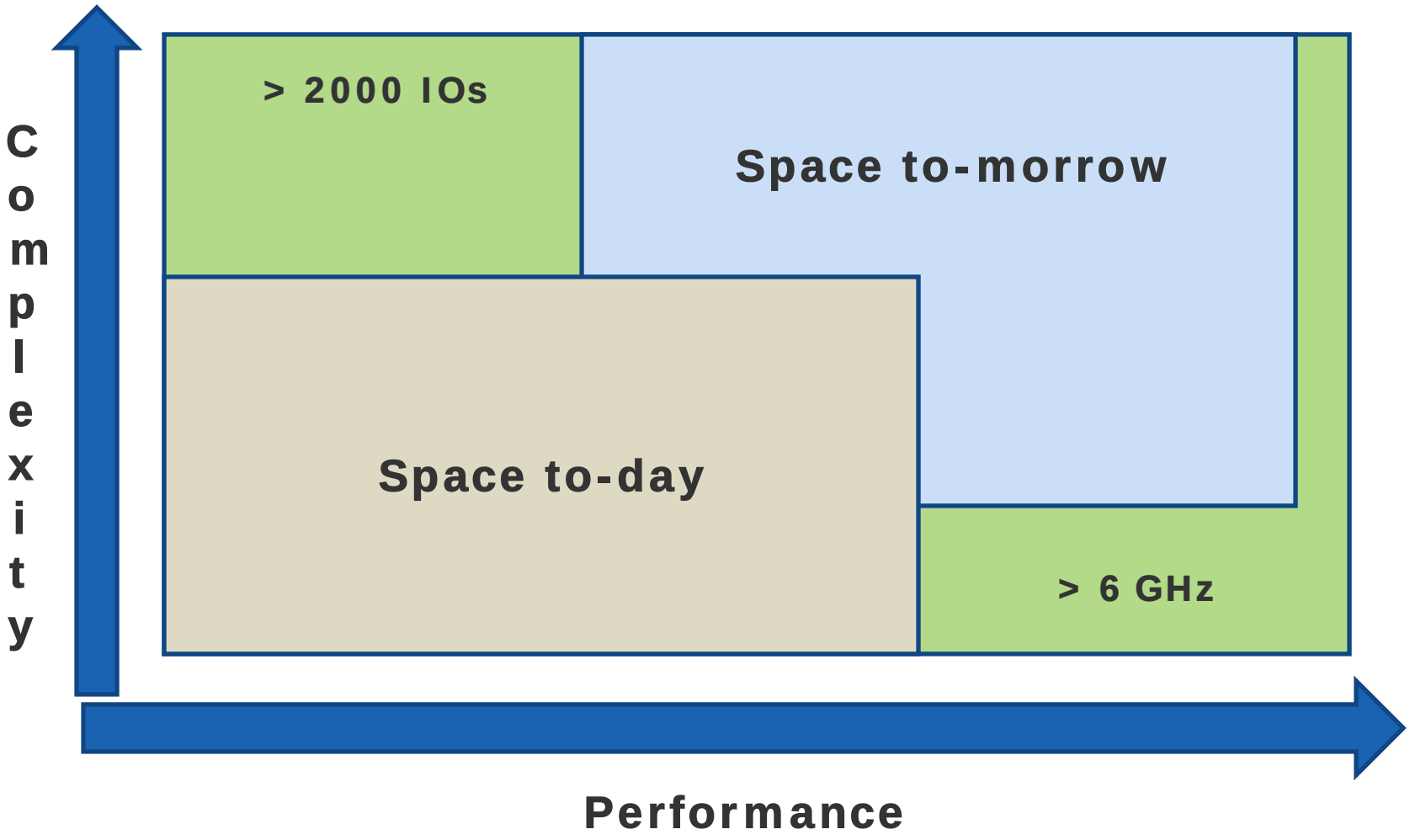
  applies to all semiconductor products

- Space digital products do not differ and

  do not use older technologies anymore

  must achieve high pincount capability

Space products versus commercial



Reliability

- Proven reliability is a must that

  cannot be achieved anymore by screen of low volume series

  and must be based on stabilized volume manufacturing techniques

  with added checks and statistically based process controls

Package reliability

- While wafer technology can piggy back established wafer manufacturing lines

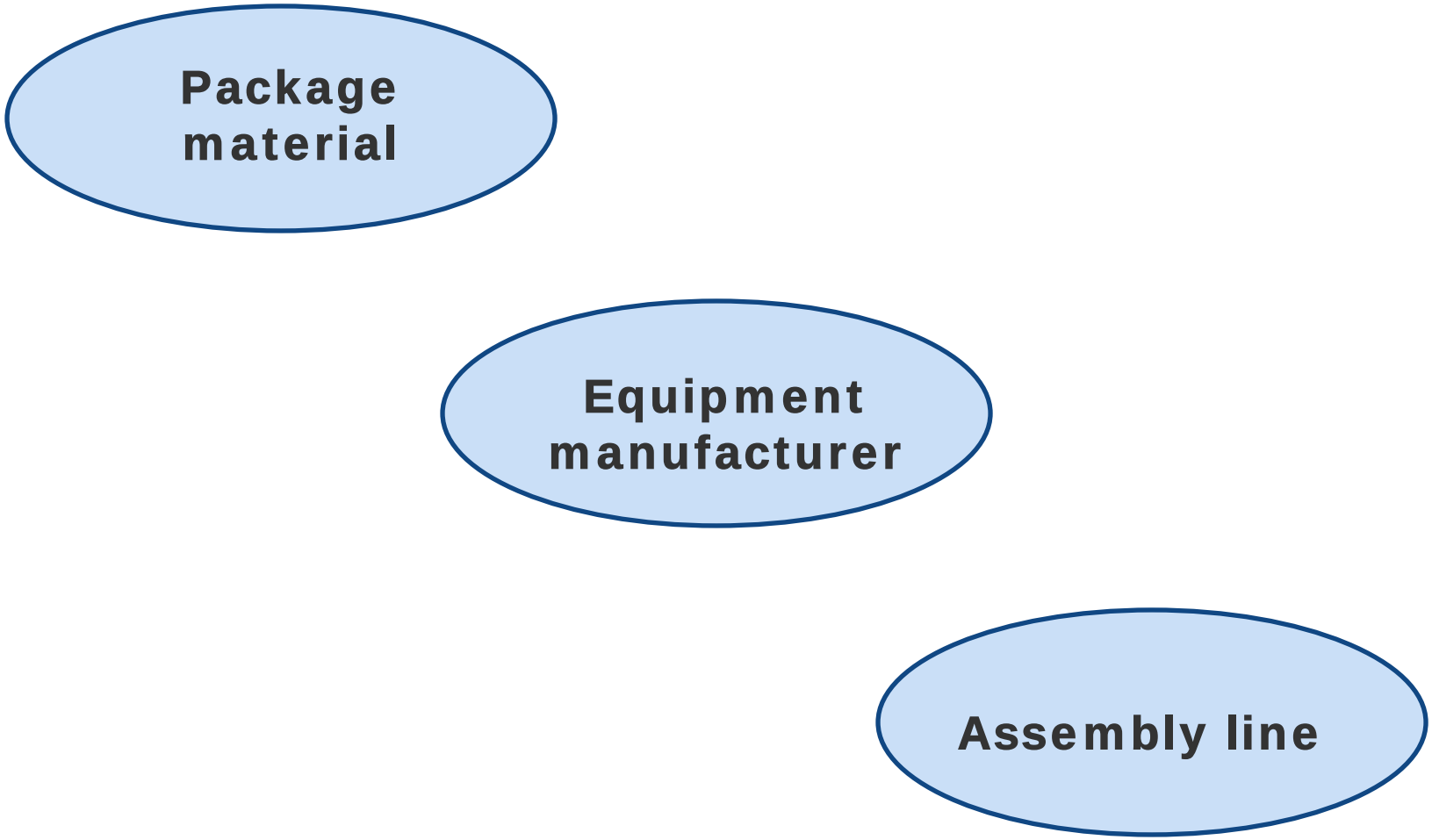
  packaging technology is still bounded by

  hermiticity requirement

  conventional packaging material

  that are not supported by commercial market

The package supply chain



The critical points

- Package material suppliers are phasing out some materials that are not called by commercial high volume market
- The assembly equipment manufacturers focus on large series and drop the specific or old fashioned equipment
- Assembly lines must manufacture regular volume in order to deploy efficient process controls

The packaging performance

	Commercial	Space
More IO's	BGA	QFP or Columns
Higher Speed	Copper traces Low K material	Tungsten traces Ceramic interlayers
More power	Underfills Exposed die	Dissipation by the leads
Multi-die	Stack dice	Multi-cavity

The future / Next steps

- Pushing the packaging technology limits for space applications shall require:
  - development of new material,
  - development of new techniques

- Steps to achieve this objective:
  - selection of potentially use able solutions,
  - customization to space requirement,
  - assessment of their reliability capability

Short / medium term requirement

- Requirement for higher pin count is already here
- Column attachment technique shows it's limits
- Flip-Chip or BGA solutions are expected

- Some products are reaching the power dissipation limits, more shall come soon
- Conventional package material are not enough to fix the problem

- Deep Sub Micron technologies are emerging for Space
- Pad to lead connection improvement is mandatory

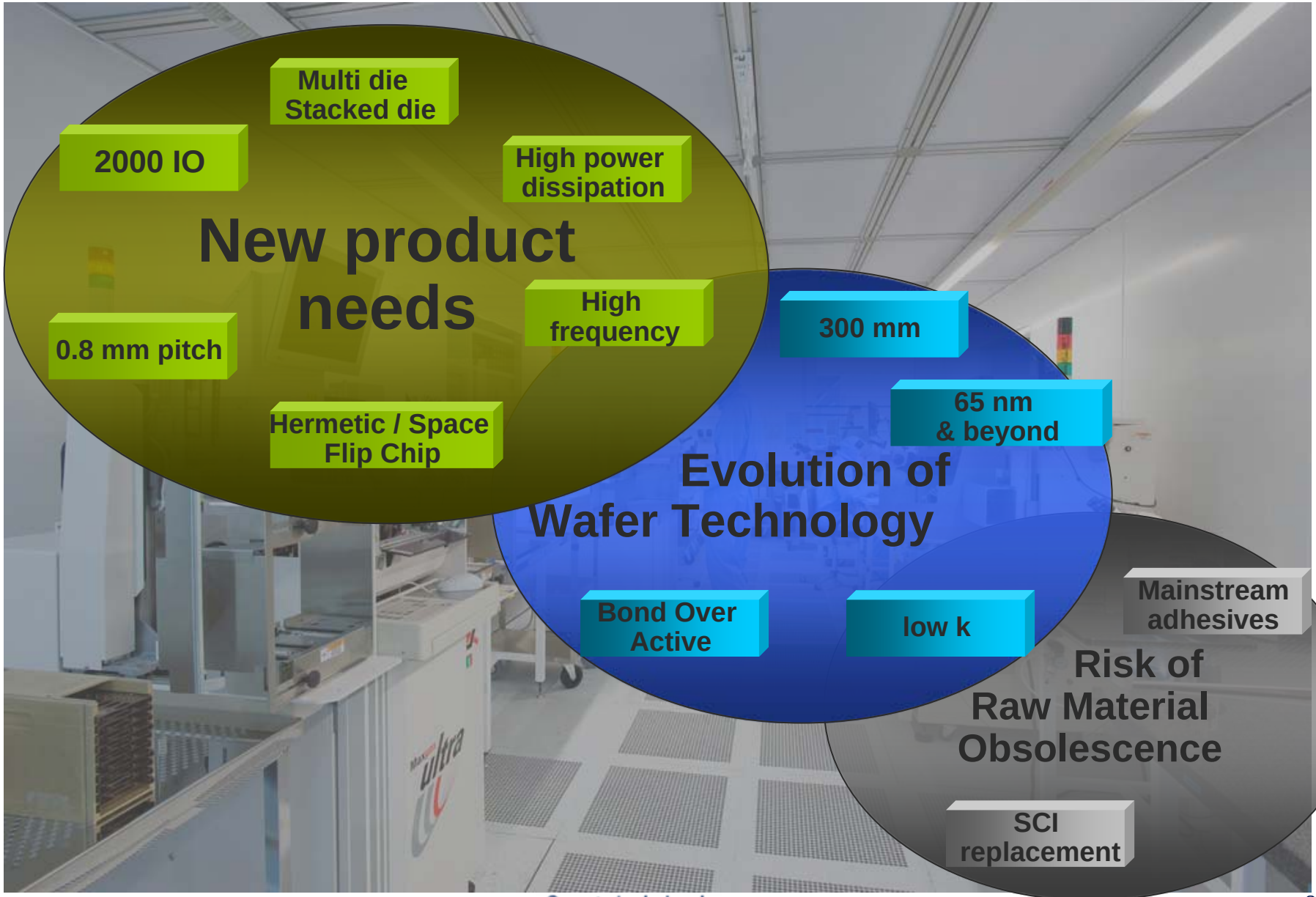
Thank you !

ICs packaging: Road Map and Trends for Space applications

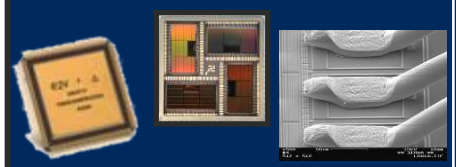
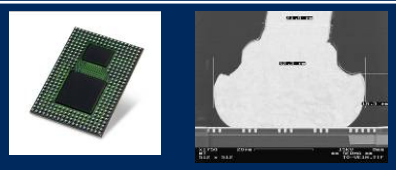
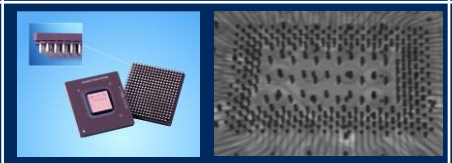
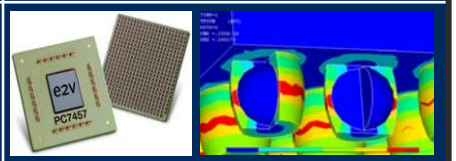
Thierry Gouvernel, Head of Strategic Business Development
e2v Grenoble




Needs



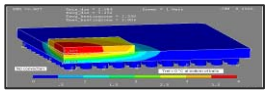
Packaging products & process
Where are we today?

Wire bonding		Flip Chip	
Hermetic	Non hermetic	Al2O3	HiTCE
Ceramic DIL, PGA, QFP, BGA.. ➔ 352 leads (800 wires) 32 µm aluminium wedge	EBGA ➔ 380 I/O Ball bonding SAC balls	High lead bumps ➔ 1 cm² die ➔ 25 x 25 mm LGA Solder column interposer	High lead bumps ➔ 1 cm² die ➔ 33 x 33 mm LGA High lead balls
			

600 m², class ISO5 (100)
500 m², class ISO6 (1000)
nb : preseal in class ISO 4 (10)

Road Map
Package Design & Assembly Process Capabilities

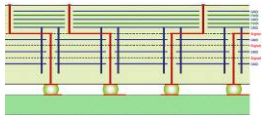
Thermal Interface Material



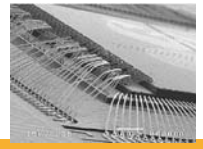
Mainstream adhesive materials (die bond)

Seam welding

High density routing

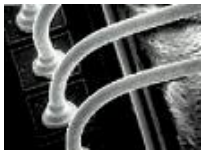


Die stacking

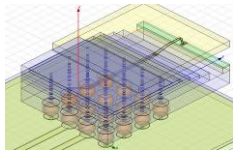


2011 | 2012 | 2013 | …

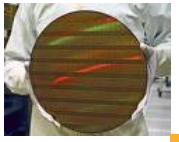
Fine pitch Au ball bonding 50um

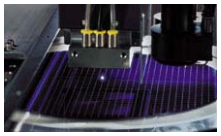


Increased signal / power integrity



300 mm saw & die bond





Laser saw

65 nm | 45 nm | Next technology nodes

Package Road Map

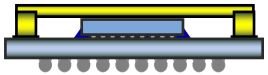
Kovar ring packages (Seam welding)

Stacked die

SIP, WLCSP,..

MCM flip chip

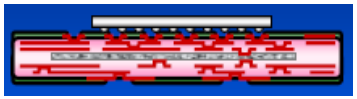
Hermetic flip-chip (Seam Welding)



2011 2012 2013 …

Heatspreader flip chip

Large Hi Rel quasi hermetic flip chip



Hi-rel organic

speed

3 Ghz 6 GHz …

1200 2000 …

I/O count

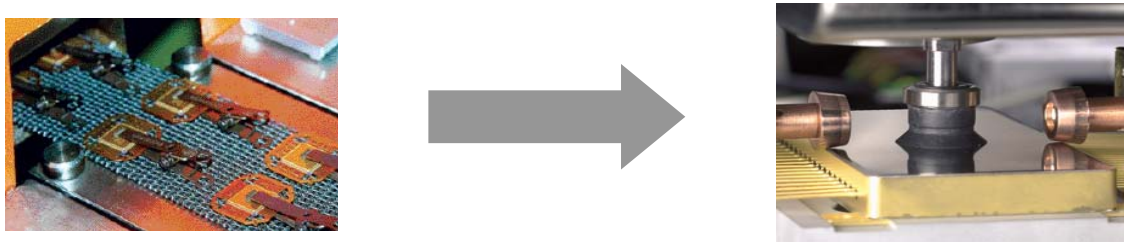
Technical Solutions
Focus on : seam welding

Current seal technology for hermetic packages (AuSn reflow) is performed at more than 300°C.

This temperature is now an important drawback, and seam welding becomes mandatory for :

- ➔ gold wire bonding (condition for very fine pitch)
- ➔ hermetic flip chip / underfill
- ➔ use of mainstream die attach adhesives (epoxies,..) instead of high temperature specific materials, such as silver glass
- ➔ and, more generally, use of organic materials in the cavity for specific applications (getters, stacked die, Thermal Interface..)
- ➔ compatibility with some wafer technologies which cannot withstand high temperature

For future products, this will lead to the addition of a kovar ring on package.

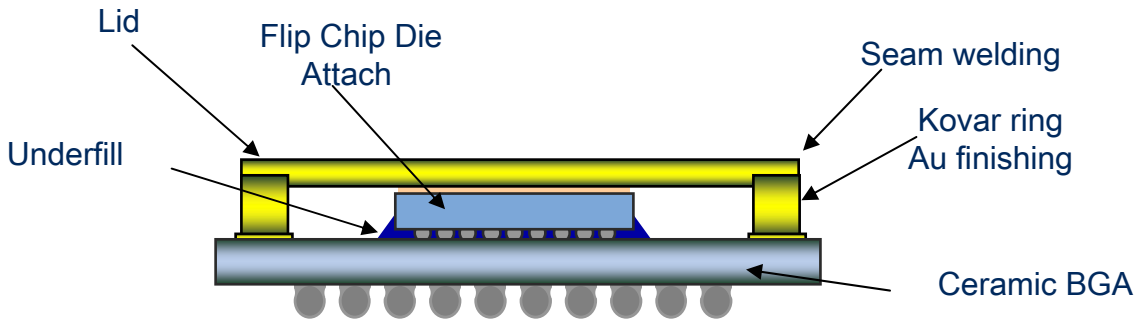


Technical Solutions
Focus on : Extended flip chip – Hermetic flip chip

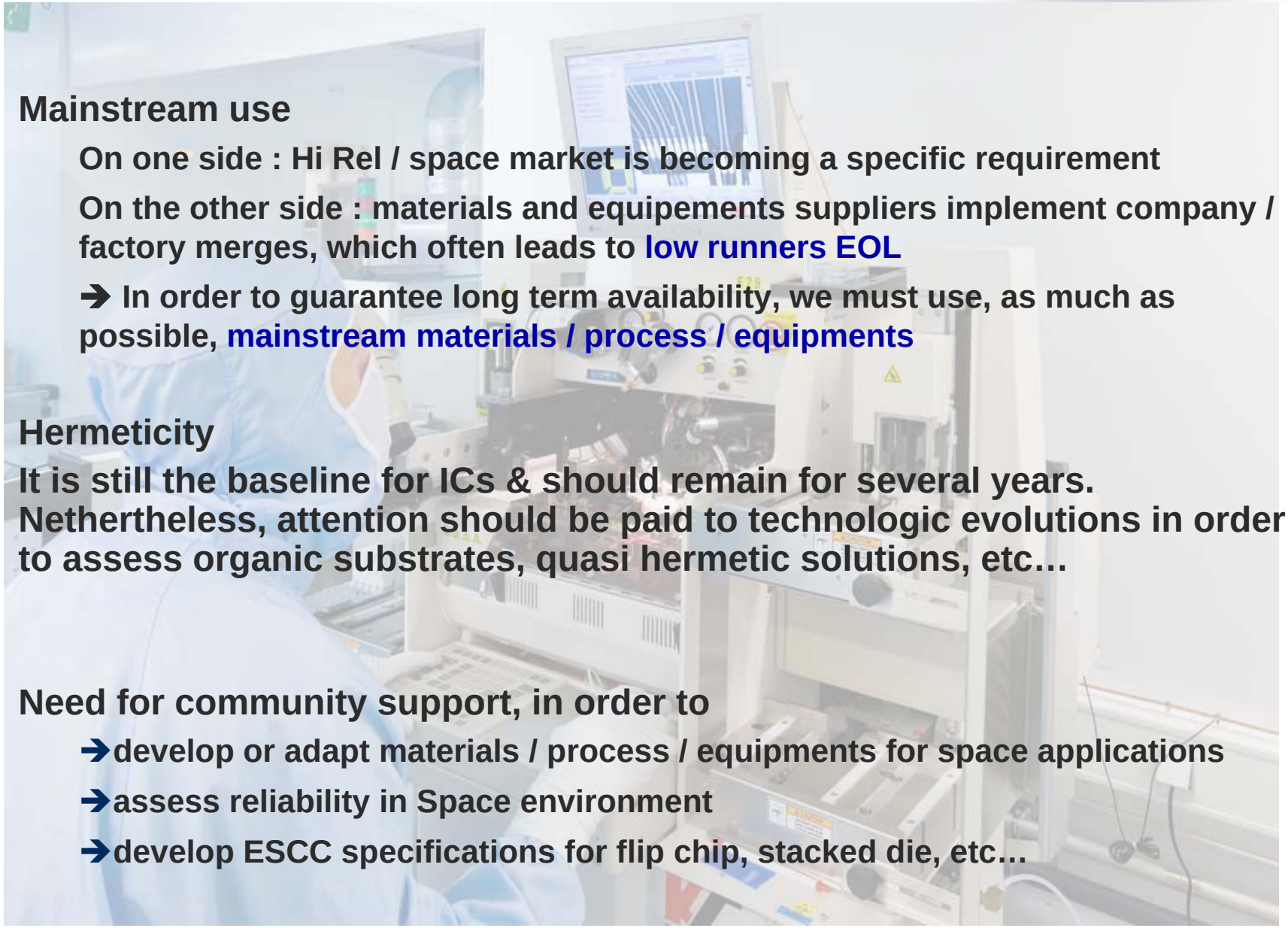
Flip chip assembly has been performed at e2v for more than 10 years for military grade, up to 1 cm², 1200 bumps.

In the next years, this capability shall extend to :

- Larger dice (up to 2 cm²), high pin count
- Smaller bump pitch
- Low k wafers
- Hermetic flip chip or Quasi hermetic (HiTCE ceramics)



Global trends - Discussion



Mainstream use

On one side : Hi Rel / space market is becoming a specific requirement

On the other side : materials and equipements suppliers implement company / factory merges, which often leads to **low runners EOL**

➔ In order to guarantee long term availability, we must use, as much as possible, **mainstream materials / process / equipments**

Hermeticity

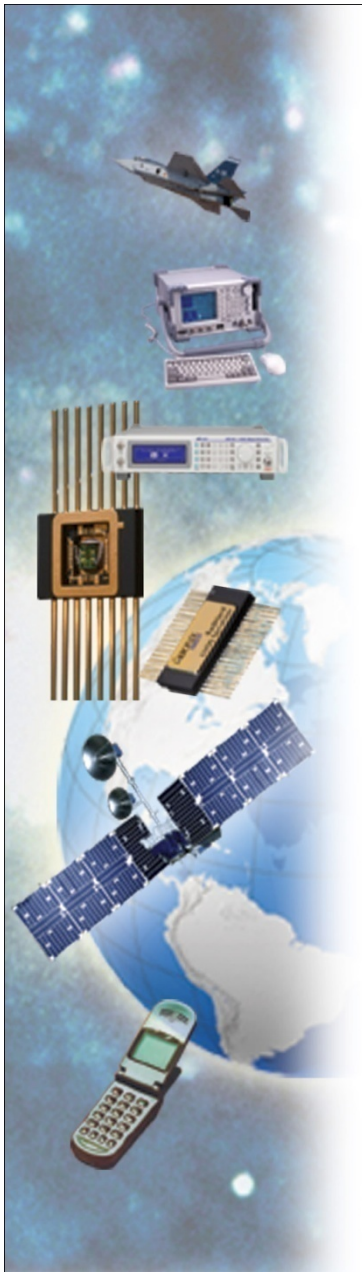
It is still the baseline for ICs & should remain for several years. Nethertheless, attention should be paid to technologic evolutions in order to assess organic substrates, quasi hermetic solutions, etc…

Need for community support, in order to

➔develop or adapt materials / process / equipments for space applications

➔assess reliability in Space environment

➔develop ESCC specifications for flip chip, stacked die, etc…



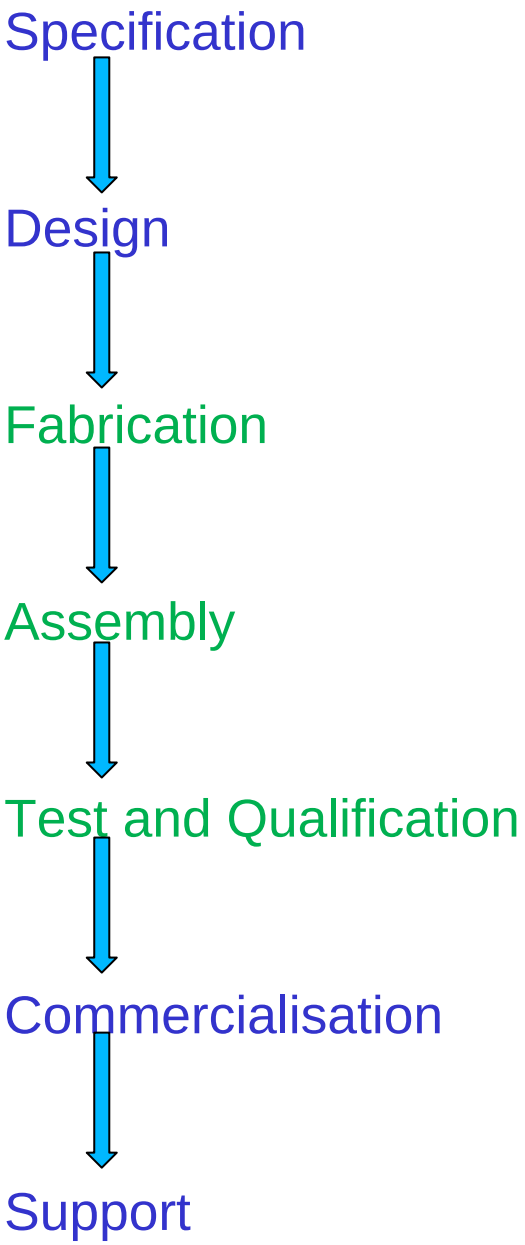
The Business Roadmap, a Design House Perspective

ESCCON, March 16, 2011

Aeroflex Gaisler

- Design house since 2001 focused on microprocessors (LEON)
- Rich IP portfolio with 80 IP cores (GRLIB)
- The IP is provided with test benches, tools, SW drivers and support
- Business model:
  - To license customers IP for inclusion in ASICs and FPGAs.
  - To provide customers with radiation tolerant FPGAs pre-programmed with our IP.
  - To act as an fab-less supplier of space components
  - To provide customers with tools, SW environment and support

Aeroflex Gaisler Fab-less Model



- Aeroflex Gaisler has the capabilty for Specification, Design, Commercialisation and Support

- Aeroflex Gaisler relies on partners for Fabrication, Assembly and Test/Qualification

- Specification to test/qualification must be done outside the US to not be affected by ITAR. If a component designed for space enter the US it can not re-exported outside the US without DoD approval

Specification and Design

- To date Aeroflex Gaisler has performed 100's of ASIC and FPGA designs
- The cost to design/fabricate/qualify of an "Space ASIC" is very high (MEURO)
- It is vital that extensive verification is done to validate the design before fabrication is started:
  - Simulation
  - Full functional validation on FPGA board
  - Analysis
- Understanding of customer requirements is necessary to generate a specification/design that allows multiple customers to purchase the components

Fabrication

- All our IP is technology independent and can be synthesized to any ASIC or FPGA technology. Thus Aeroflex Gaisler can use any foundry.
- Radiation hardened ASIC cell library is a must.
- Today there are (non-US) libraries available from:
  - Atmel (France)
  - IMEC (Belgium)
  - Ramon Chip (Israel)
  - ST Microelectronics (France, under preparation)
- Possible (non-US) foundries are:
  - Atmel (France)
  - ST Microelectronics (France)
  - Tower (Israel)
  - UMC (Taiwan)

Assembly and Test

- Aeroflex Gaisler reuse existing or develop and procure new packages
- Aeroflex Gaisler use external companies for assembly
- Aeroflex Gaisler use external companies for test and qualification
- SEU/SEL testing is performed in Belgium or Finland by Aeroflex Gaisler
- Aeroflex Gaisler use external companies for total dose test

Commercialization and Support

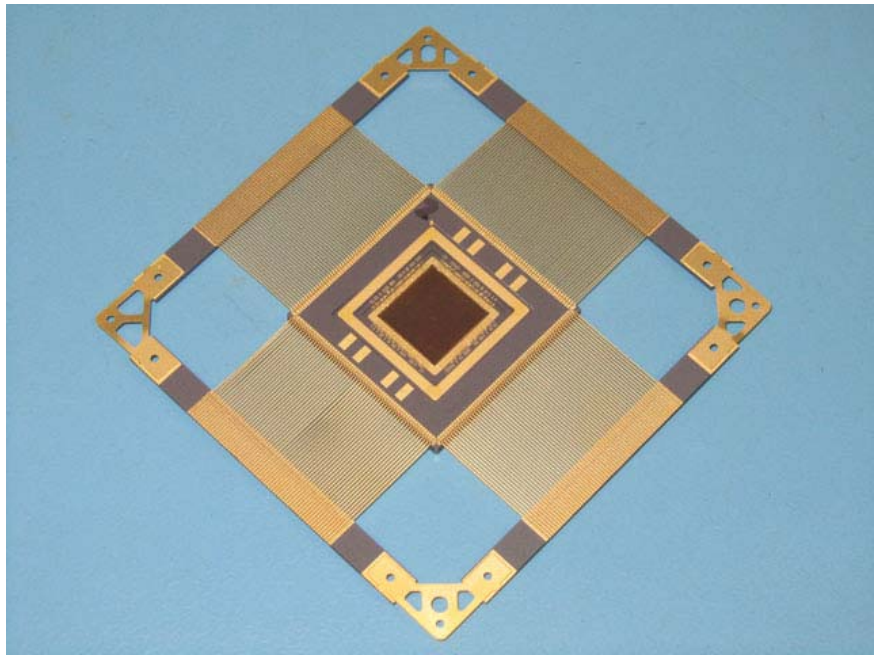
- To get return on investment the world market needs to be addressed (Europe, US and Asia)
- Aeroflex Gaisler have access to the Aeroflex Inc world wide sales organisation
- This world market needs also to be served with competent and timely support
- Today four engineers work full time with support at Aeroflex Gaisler
- Example, the LEON3/RTAX solution is now used by 33 different space projects (Europe 14, US 12, Asia 7). The LEON3 - UT699 is used in 23 projects.

Challenges

- To get a ESCC approved process (from design to qualified chip)
- Access to (non-US) radiation hard libraries for new processes (90, 65, 40 nm)
- Qualified high density packages. Today we are limited to 352 pin quad flat package. Next generation microprocessor will require 600+ pins and possible also flip-chip technology

GR712

- The GR712RC is a high-performance (125 MHz) dual core microprocessor for a wide range of space applications
- Developed in co-operation with Ramon Chips and Tower (Israel)
- Features:
  - High-performance dual-core LEON3FT (300 DMIPS, 250 MFLOPS)
  - Radiation-hard (300 krad)
  - On chip peripherals: SpaceWire, 1553, Can, I2C, SPI, Eth, TM/TC
  - Software compatibility with LEON family
  - Less than 2 W @ 125 MHz,
    two CPU's/FPU's under full load
  - Robust packaging: CQFP-240
  - Class-S (tested according
    Mil-std-883)



ESCCON 2011

European Components Initiative
Part 1: ESA

M. Nikulainen, L. Marchand

16th of March 2011

European Components Initiative Introduction

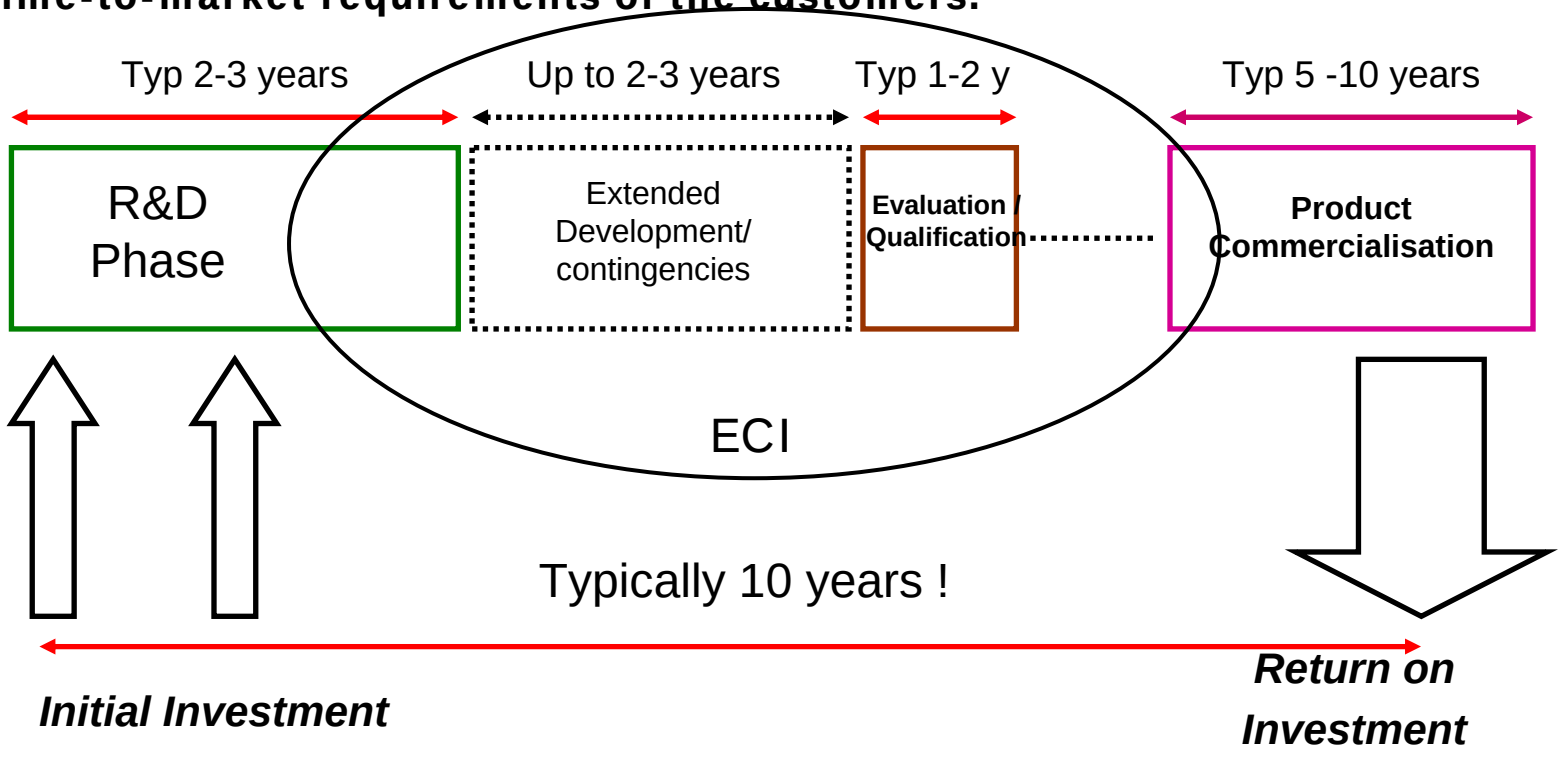
ECI started in 2004

- **Combined effort of the Agency supported and complemented by National Initiatives by the Member states, most notably CNES (F) and DLR (D).**
- **ECI Phase 1** (2004-2010)
  - Reduce the dependence on the supply of EEE components from sources subject to export restrictions
  - Target was “Pin to Pin” compatible replacements for US ITAR devices.
  - Key developments: Power Mosfets, Fuses, Relays , MMICs, Mixers, PLL, 1553.
- **ECI Phase 2** (2009-2011)
  - Competitive alternatives (cost and time to market) in Europe.
  - Key developments: MMICs, PLL(s), Capacitors, Fuses, Optical connectors. FPGA(s).
- **ECI Phase 3** (2011-2014) **(To be approved)**
  - Access to strategic components and technologies
  - Key developments: DSM, large FPGA, High Pin Count assembly Technologies.

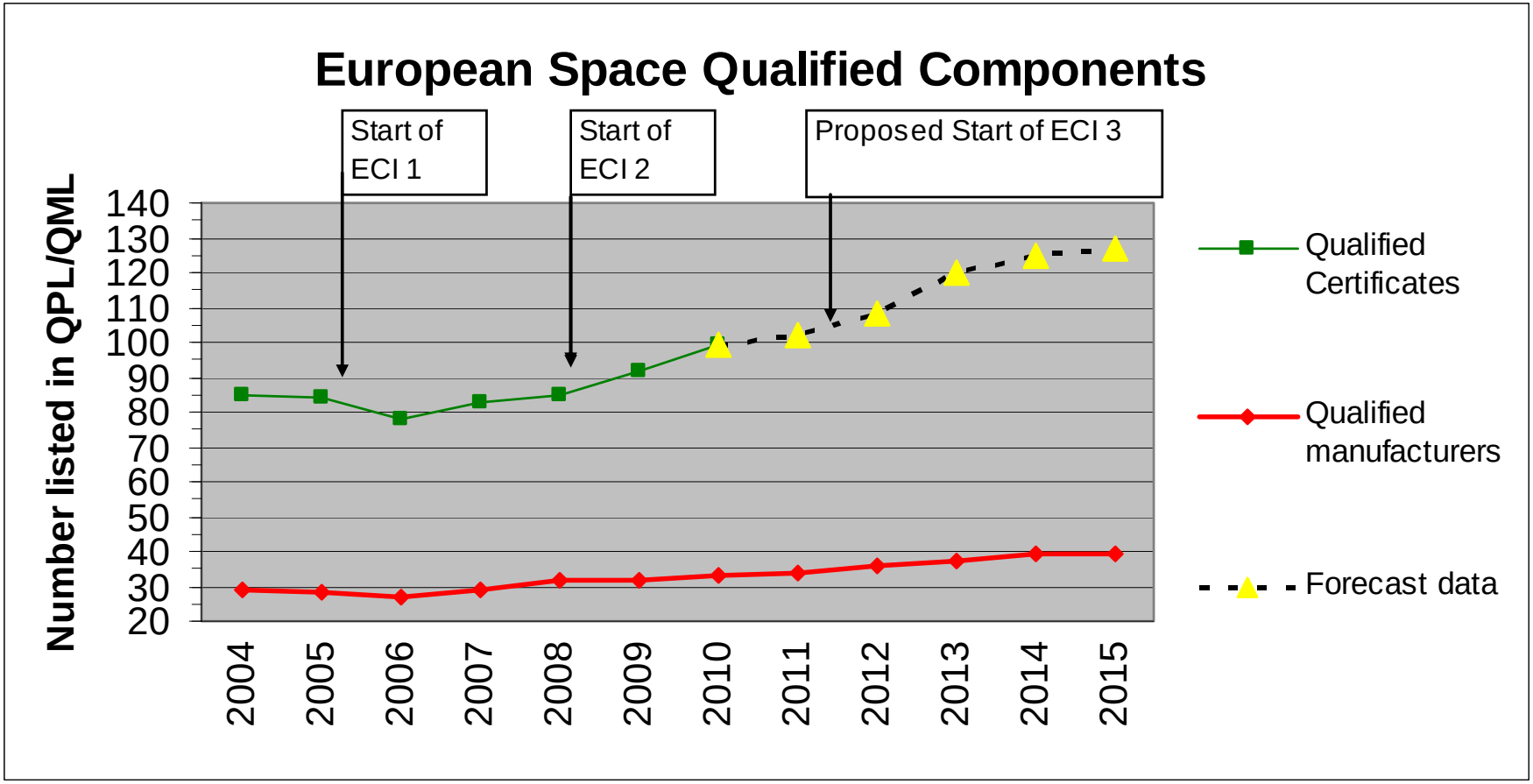
For full listing of components developed or in development through the European Components Initiative see:
……https://spacecomponents.org/public/eci/

Typical Strategic New Component Technology Timeline from R&D to Commercialization

Investment must be timed carefully in order to meet the time-to-market requirements of the customers.

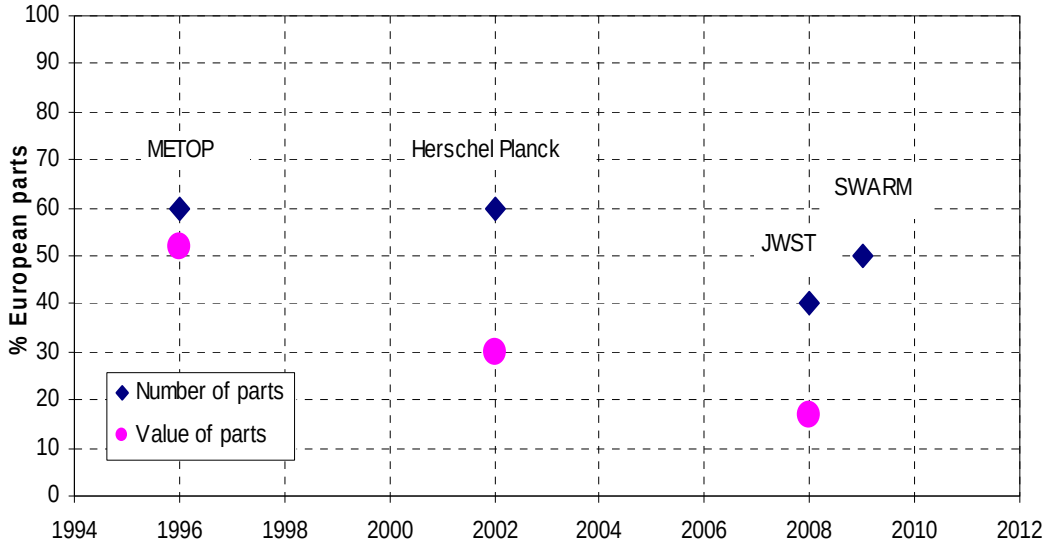


Expected impact of ECI on the availability of European Qualified Components



European Component Initiative

Between 2000 and 2006 the number of European components used in European satellites had steadily declined
Today the Trend is turning: e.g. European (47%) to non-European (53%) EEE parts used on the ESA SWARM project.



Challenge to commit end-users for ECI Parts !

ECI: Market Success Stories

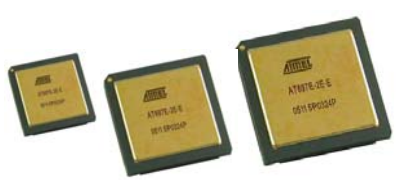
- **ATMEL (F)** : AT697(E&F) microprocessor
  - Rapidly increasing world-wide sales
- **Schurter (CH):** MGA-S Fuses (PCB,SMT Mount)
  - 27000+ Fuses (Spain, GB, Germany, France, Italy, USA, India, Israel, Russia).
- **Peregrine (F):** ITAR free PLL (3.5 Ghz factional N):
  - TAS-F, NT space, TESAT, TOPREL, Spur, Astrium.
- **UMS (F) :** European Schottky diode BES Process
  - 100+ wafers manufactured
- **CTM (F):** Hybrid Mixers (MXF-01, MXF-02, MXF-03)
  - TAS, TESAT, Mier, CNRS,Sentinel 3, Galileo, Exomars
- **OMMIC(F) :** MMIC Mixers (CGY2180, CGY2182, CGY2183)

ECI Phase : Lessons Learnt (….and taken into account for ECI Phase II and Beyond)

- **“Pin to Pin” replacements difficult to sell to existing designs.**
- **The pace of terrestrial component developments is accelerating and consequently product life cycles are getting shorter, leading to obsolescence issues. Need to intensify dialogue with technology providers for terrestrial applications.**
- **Need to streamline the governance to get ECI activities kicked off earlier and have products available when required by the market, active dialogue with member states.**
- **Need to continue working together with other Agencies, Industry and Global partners, to maximise our resources and budget available.**
- **Need to invest time and money into investigating the potential and testing commercial technologies.**
- **Need for balanced investment across the entire EEE Component supply capabilities.**

Balanced Investment - Required Capabilities/ Competencies

e.g. ATMEL (F), STm (I), TESAT (D), Alter (ES)



EUROPEAN COOPERATION
ECSS
FOR SPACE STANDARDIZATION

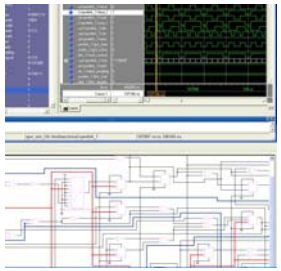
Commercialization, Quality control

e.g.
System Integrtaors (F),(D),(I),(F),(UK)

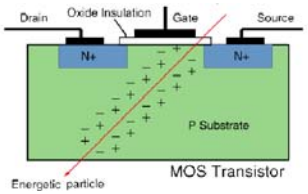
Equipment Suppliers

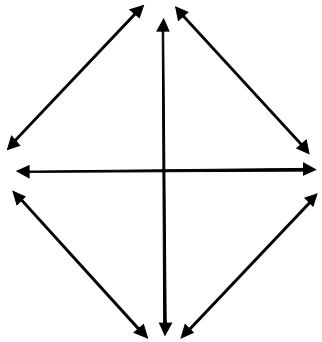
CAD vendors

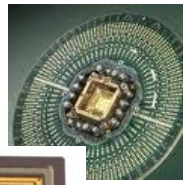
Design Houses

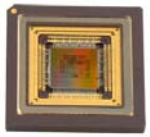


IC Design expertise + space reqs









Assembly, Packaging, test

e.g.
MHS (F)

SERMA (F)

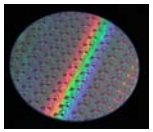
E2V (F), (CH)

HCM(F)

Alter (ES)

EGGA (CZ)

IC Manufacturing fabs

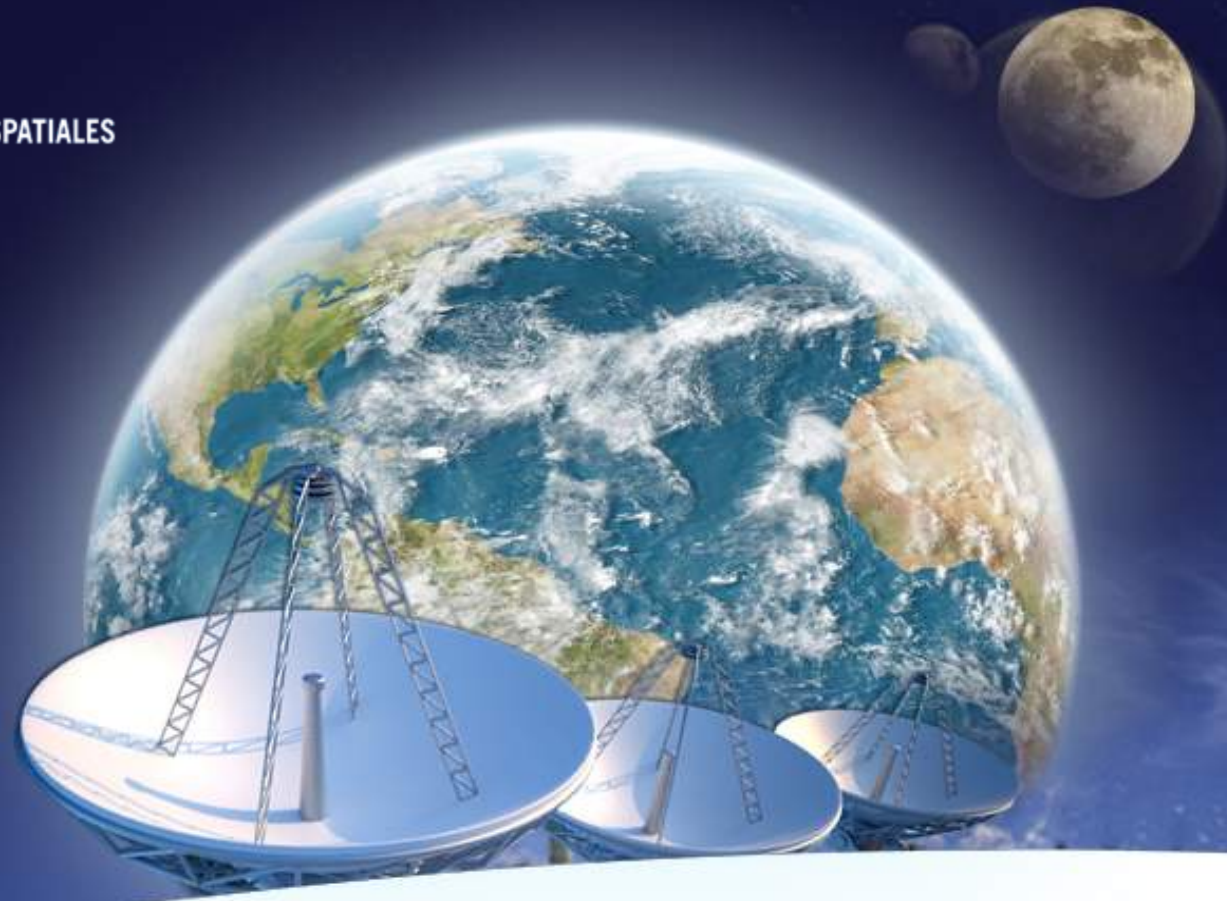


e.g. Lfoundry (D)/(F), STm (I)/(F), XFab (UK)/(D), AMS (A) Infineon (D),ON (B), IHP (D)
Plus start cooperation with foundries in Far East

ECI Phase 3: Process and Current Status

- **ECI 3 work-plan**
  - **created by ESA, CNES,DLR, Component manufacturers and end users**
  - Work-plan prioritised and endorsed by SCSB **.**
  - ESA TECNET has confirmed the importance of the highest priority items to ESA future programmes.
- **Approval Process**
  - 2010 : IPC Information note / Informal meeting with IPC delegates, ESA, Eurospace, System Integrators and Equipment suppliers.
    - **The importance of the strategic EEE Components and the need for long term stable and sustainable funding for EEE-Components has been unanimously agreed !!.**
  - 2011: Mechanism for providing short term funding (2011-2012) has been agreed at the Administration and Finance Committee (AFC), and “Decision paper” submitted to ESA Council for the short term funding **and** inviting ESA to build up a proposal for long term stable and sustainable funding for Ministerial Council in 2012.
    - **Council meeting is TODAY !!**

CENTRE NATIONAL D'ÉTUDES SPATIALES



CNES contribution to ECI

Michel Labrunée, Jean Louis Venturin CNES Quality Assurance Sub Directorate

Summary

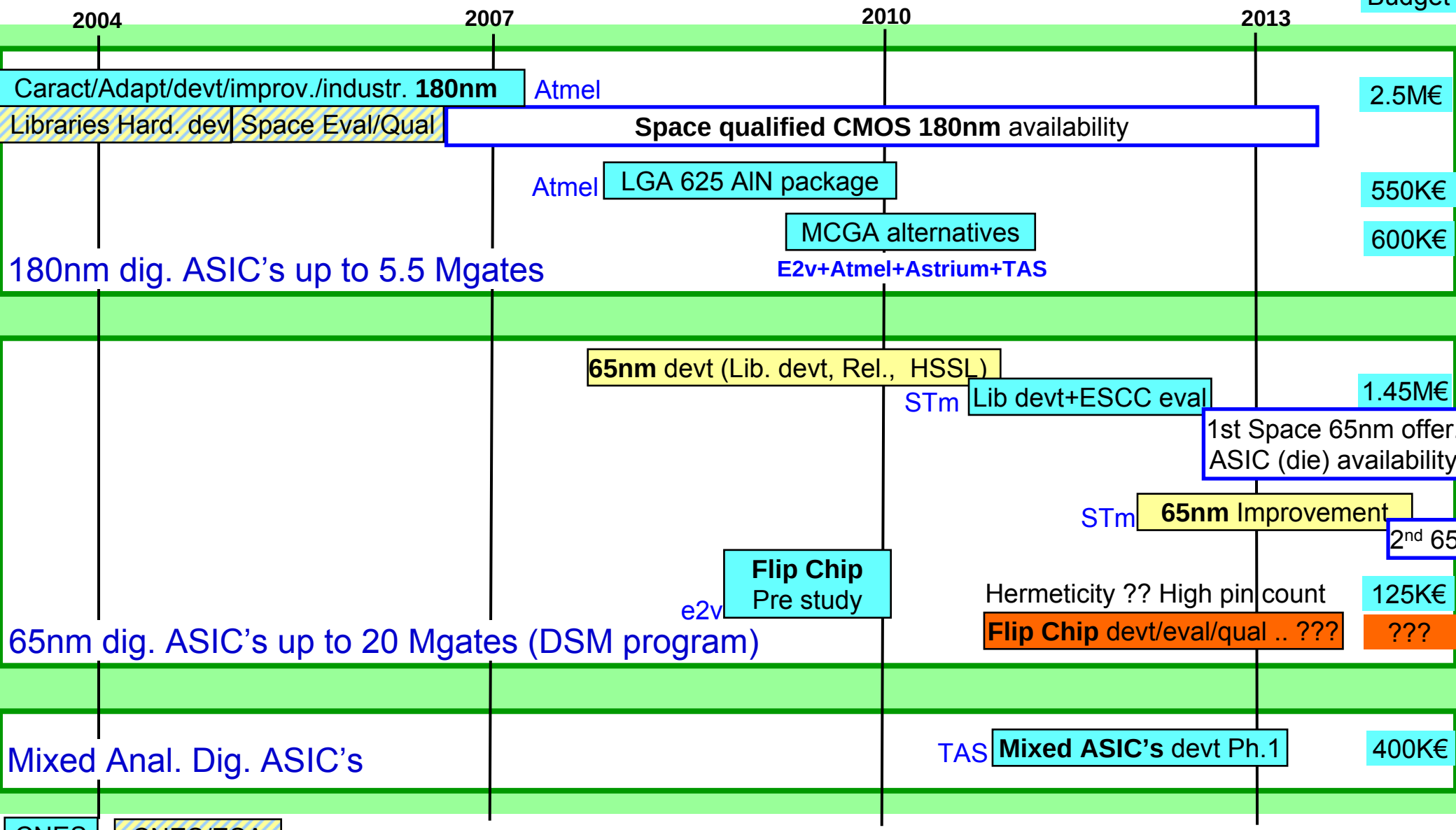
- CNES R-CS Introduction
  (In french: **C**omposants **S**tratégiques)
- CNES contribution to the ECI since 2004

CNES R-CS Introduction

- Support the competitiveness of European Space industry
- Program harmonized through the ESCC/CTB and coordinated with ESA
- Collaboration with JAXA
- Dedicated to “generic” components
- Develop a reliable components supply chain
  (The manufacturer takes the complete responsibility from the development to the final delivered products)
  and make available competitive components for all the projects
- Reduce the gap of performances between European and non European space components and the dependence of Europe on the following families :
  - Microprocessors, Digital Signal Processors, Memories, ASIC’s (< 0.18 microns), linear IC, FPGA, A/D & D/A converters, Power Trans, RF Power transistors and MMIC’s, passives components (relays, fuses, …), …
- Budgets : Approx. 2M€ per year
  - Annual commitment
  - CNES funding participation target : 50 %

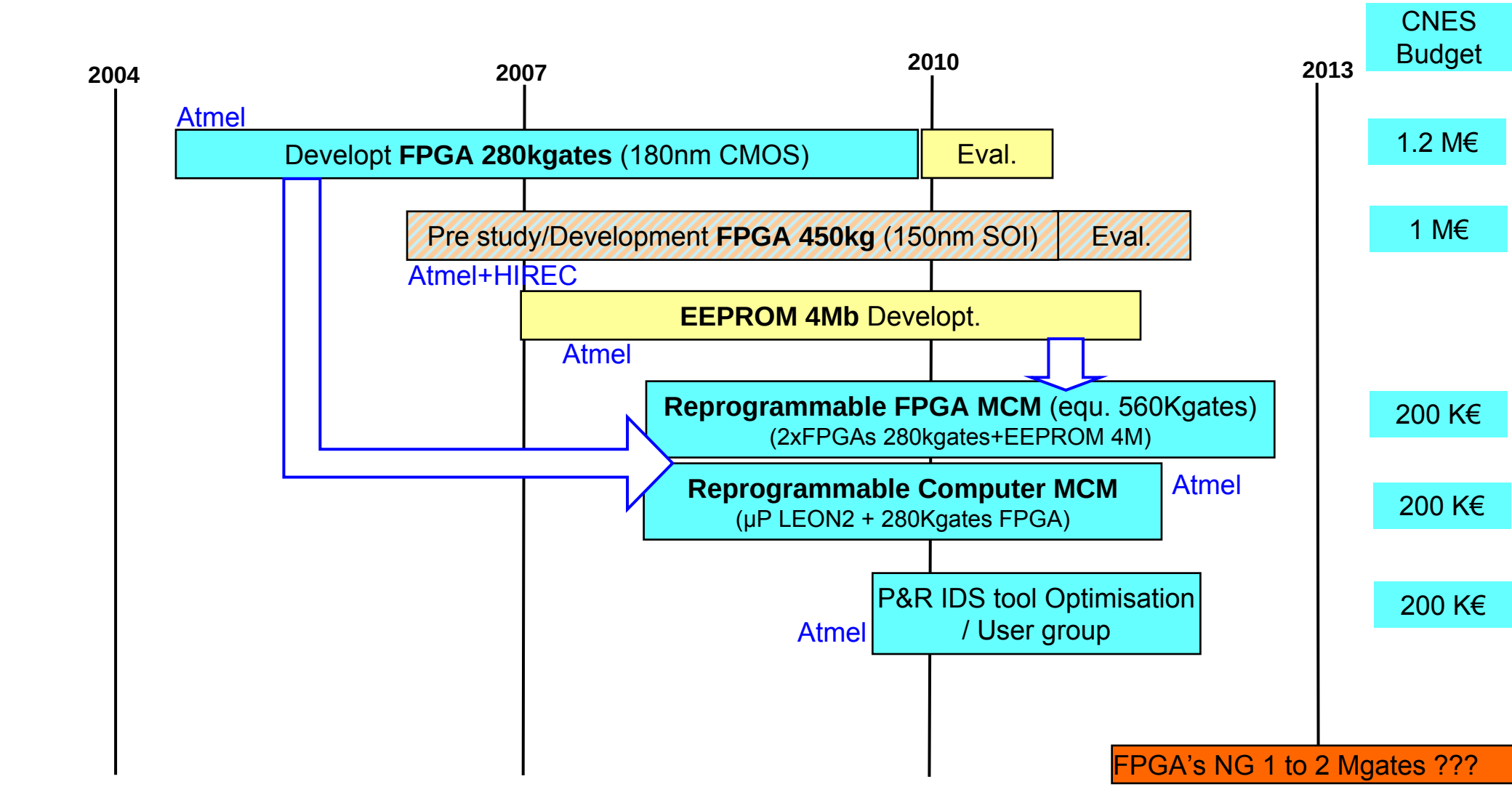
CNES contribution to the ECI since 2004

ASIC's offering (incl. packages)



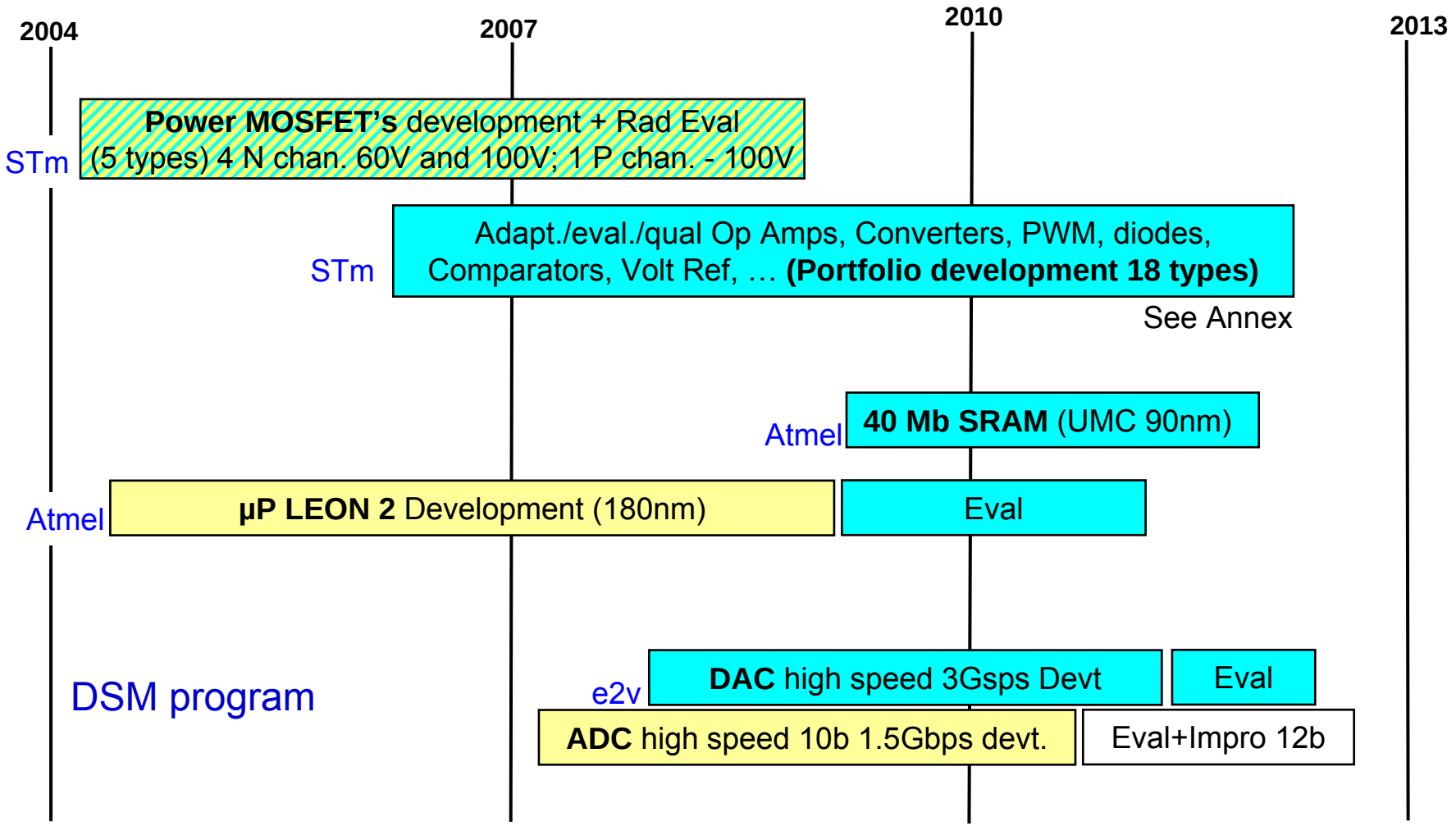
CNES contribution to the ECI since 2004

Reprogrammable FPGA offering (stand alone, MCM's, Place and Route tool)



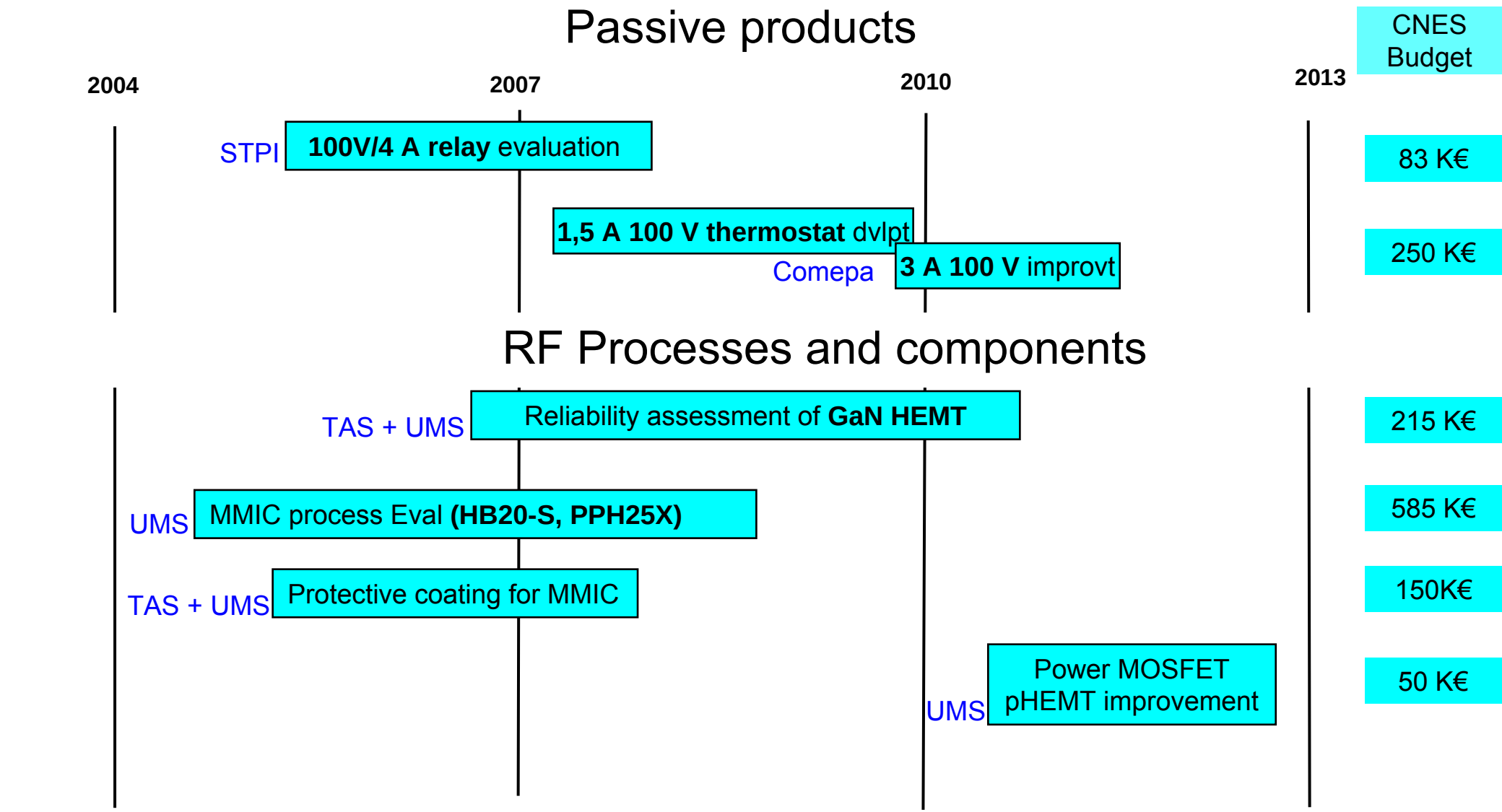
CNES contribution to the ECI since 2004

Standards products



CNES | CNES/ESA
ESA | CNES/JAXA

CNES contribution to the ECI since 2004



CNES | CNES/ESA
ESA | CNES/JAXA

Conclusions

- CNES contribution to ECI for 6 years up to now,
- Many activities in different technological domains
- Good collaboration/coordination :
  - within the CTB and between CNES and ESA
  - with JAXA (FPGA 450Kgates on 150nm OKI SOI CMOS process)
- A step forward to make available the future components necessary to improve the competitiveness of the European space industry in the international market.
- Remark : Additional CNES R&T budget committed to complete activities mainly in the passive and RF components


Thank You

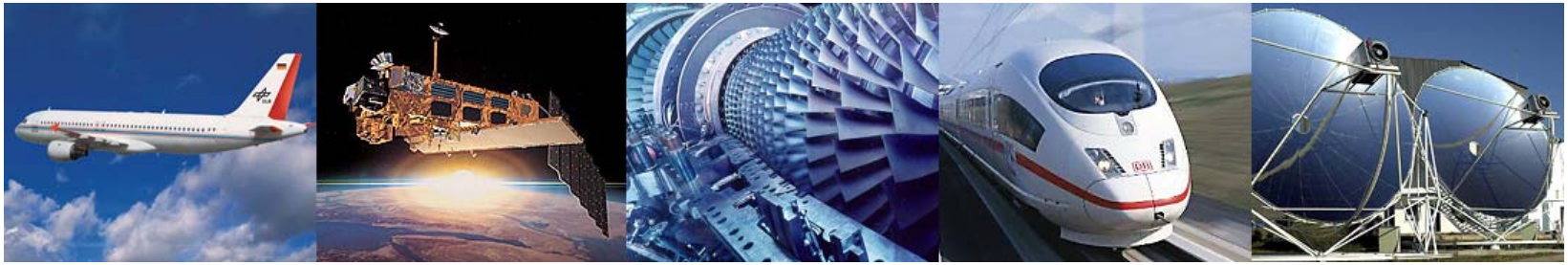
Annex : STm portfolio development and Evaluation

- RHF801 Comparator development
  - Response time of 4ns, Low consumption: 1.8mA, Single supply: 2.5V to 5V
  - HF7CMOS 0.25µm technology from Crolles
- UC2843 and UC2845 PWMs ESCC evaluation (ST) End : Q3/2010
- RHF100 Voltage reference development
  - 1.25V, 30ppm/°C, +/-0.5%,
  - HF7CMOS 0.25µm technology from Crolles
- RHF200 Differential amplifier development
  - Slew rate : 740V/µs, Input noise : 2.8nV/√Hz, Output « Enable » Function, 20mA max.
  - BiCMOS 0.25µm technology Crolles
- LDO regulator development SET free
  - HF2CMOS 2 from Singapore
- Development and ESCC qualification of diodes family (low and medium power) in LCC2 package
  - 1N5806, 1N5811, 1N5819, 1N5822, 1N6640, 1N6642
- A to D high precision converters Evaluation
  - RHF1401 -14bits, 20Msps
  - RHF1201 – 12bits, 50Msps
- Evaluation VCXH Logic IC Family (Low voltage BUS drivers)
- Op amps Evaluation
  - RHF43 – Precision OP Amp
  - RHF310 - 400µA High-Speed Op Amp
  - RHF330 - 1.1 GHz Low-Noise Op Amp
- RHF711 Op Amp development
  - Single, Rail to rail input, output stable with G=1, Supply from 3 to 12V, Low consumption
  - DIB-12 SOI technology from AMK

The European Components Initiative (ECI) Contribution by DLR

Dr.-Ing. Andreas K. Jain (andreas.jain@dlr.de),
Jürgen Tetzlaff (juergen.tetzlaff@dlr.de),
ESCCON, Noordwijk, 15. - 17. March 2011

German Aerospace Center (DLR)



Aeronautics Space Transportation Energy

- Research Institution
- Space Administration
- Project Management Agency
- 6500 employees across 29 research institutes and facilities at 13 sites
- Total budget (2011) : 2980 Mio €

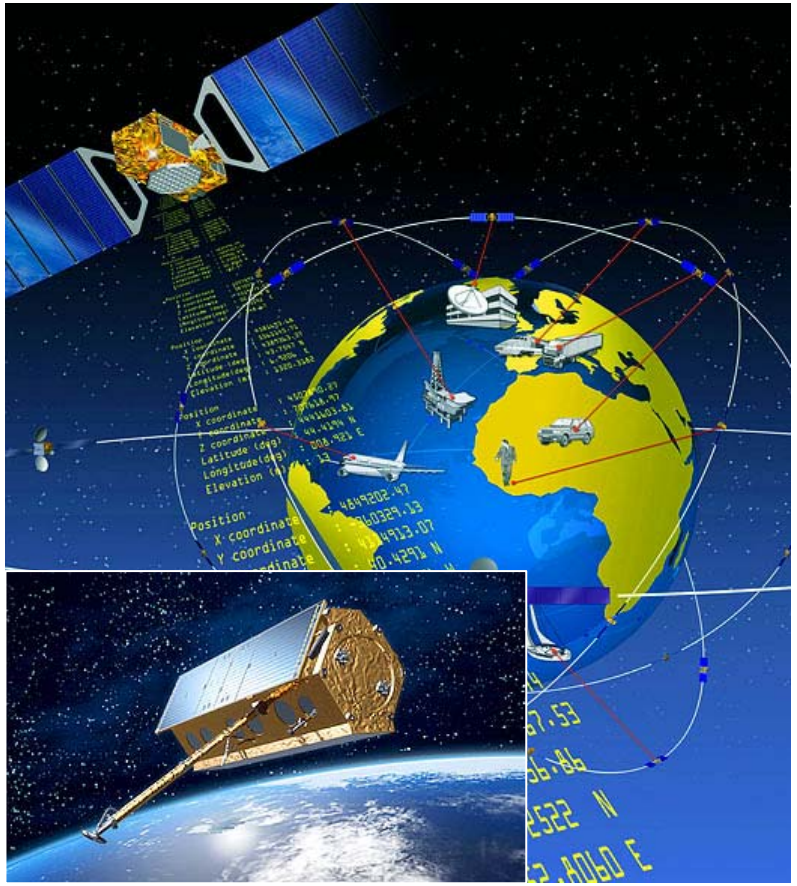
DLR Space Research and Technology Area

- Space exploration
- Zero gravity research
- Earth observation
- Communication and navigation
- Space transport
- Technology of space systems

More information see http://www.dlr.de

DLR's Tasks as the National Space Administration

- Defining German space planning on behalf of the federal government
- Representing German space-related interests in the international arena, in particular in ESA
- Tendering, award, and support of space projects in the context of the National Space Program



Tasks and Responsibilities within the DLR EEE-Parts Section on behalf of the Space Administration

- Determination and prioritization of the national EEE-parts demand → National technology development and qualification program → increasing EEE-part availability
- Launching EEE-part qualifications
- Performing qualification and re-qualification audits with manufacturers
- Establishing strategies to increase the availability of EEE-parts in the frame of the European programs (ECI, ESCC, FP7 …)
- Representation of the German Space Administration, German manufacturers and users within the European Space Components Coordination (ESCC)
- EEE-part conferences for user and supplier needs and interests consolidation

Contribution to ECI :

- Since 2004, seven projects with a budget of 10.8 M€ were launched :
  - 2 finished
  - 5 in progress
  - 4 in preparation or planned
- Contribution by providing a national budget for :
  - Technology development
  - Evaluation & Qualification activities

  of needs identified by the ESCC space market size evaluation (2006)
- As part of the National program to be performed by German manufacturers

DLR EEE Parts ECI Contribution

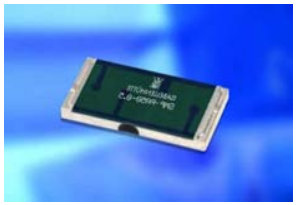
Activity	Term	Status
Evaluation and Qualification of Shunt-Resistors	2005 - 2007	finished
Development, Assembly, Manufacturing, and Evaluation of an LDO-Regulator	2005 - 2007	finished
Qualification of Quartzes and Oscillators	2005 - 2011	in progress
Certification of an Assembly and Test House	2006 - 2011	in progress
Qualification of MMIC Local Oscillator	2007 - 2011	in progress
Development and Qualification of PowerMOSFETs	2008 - 2011	in progress
Development of a GaN 1000V Switching Transistor	2006 - 2011	in progress
Capability Approval of L-Foundry	2011 - 2013	Contracting phase
Capability Approval of IHP‘s SG13 Technology	2011 - 2013	planned
Qualification of a fully automatic LTCC Line	2011 - 2013	planned
Feasibility Study of the SiC Diodes Technology	2011 - 2013	planned

All projects under : www.dlr.de/qp/en/desktopdefault.aspx/tabid-3091/4699_read-6881/

Evaluation and Qualification of Shunt-Resistors

Currently, space-qualified shunts (current measurement resistors) were not available on the European parts market. However, the non-qualified, low-impedance precision resistors of the company Isabellenhütte were already used in space projects for years. In order to avoid complex and expensive project qualifications, the shunt resistors have been ESCC qualified generally.

SMR, SMV



SMS, SMT, SMP

Info : www.isabellenhuette.de

Development, Assembly and Evaluation of an LDO-Regulator in a suitable Package for Space Applications

The future increase of 2.5-V components on the market indicates an increasing need of a 2.5-V regulator. In order to improve this situation, a DLR-project was conducted, in which commercially available components were assembled in a hermetically sealed housing followed by successful characterization and evaluation tests.

8 Pin Version (3 Pin possible)

Info : www.jena-optronik.com

Qualification of Quartzes and Oscillators

Within the scope of this project, KVG Quartz Crystal Technology performs a qualification of quartzes and oscillators. Quartzes from 2,5 - 140 MHz in TO-5 or TO-7 package and oscillators in hybrid technology (SMD and DIL), XO (8 - 125 MHz), and VCXO (10 - 90 MHz).
The qualification tests are finalized for quartzes and in preparation for oscillators.

Info : www.kvg-gmbh.de

Quartz, SMD-, and DIL-Oscillator

Development and Qualification of PowerMOSFETs

After the positive results of the various studies performed, the Infineon Power MOFSET process has been modified in such a way that the manufactured transistors are RadHard while keeping good electrical performance (target types 250V 12A, or 47A, R_{DSon} 25mΩ SMD2/130mΩ SMD0.5). Prototypes will be available 1. Q. 2011, followed by qualification.

Info : www.infineon.com/cms/en/ -> discretes

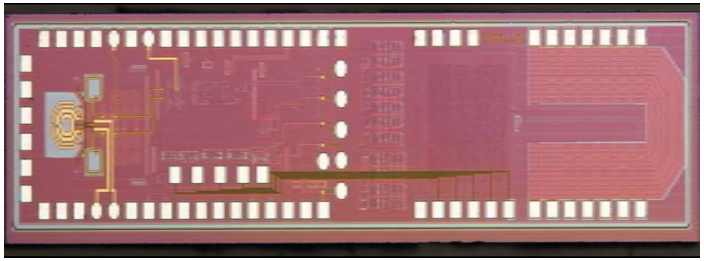
Certification of an Assembly and Test House

In fact, many semiconductor manufacturers are able to deliver suitable chips but have no intention or no chance to perform the complex chip assembly in space suitable housings and the required extensive tests for qualification and screening. The ATH shall take over these actions and act as sales organization for these components. Evaluation will start soon.

Info : www.lewicki-gmbh.de

Qualification of a MMIC Local Oscillator

For broad band satellite communication, modern MMIC-LOs are needed. Therefore, a Capability Domain Approval of the chip manufacturing and package process has started. First application is a MMIC-LO, but further RF-applications are possible within this domain.

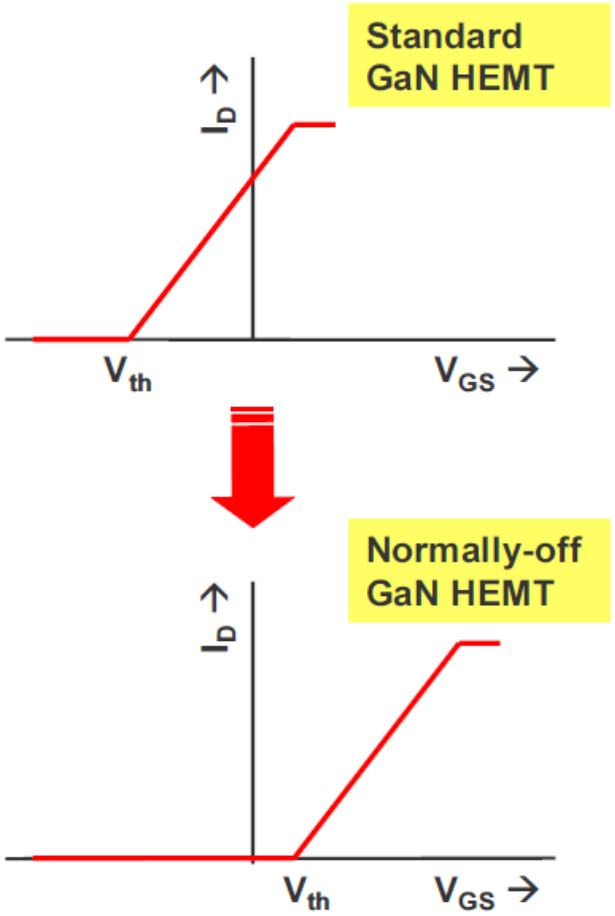


Info : www.kayser-threde.com/en/
www.ihp-microelectronics.com/

Development of a GaN 1000V Switching Transistor (1)

Targets

- **Normally-off GaN transistor technology for space borne power conditioning**
- **Requirements**
  - low on-state resistance
  - high breakdown voltage up to 1000V)
  - Threshold voltage Vth > +1 V
  - Large gate swing > 3 V
  - Low leakage currents
  - Reproducible process
  - Radiation hardness
  - High Reliability

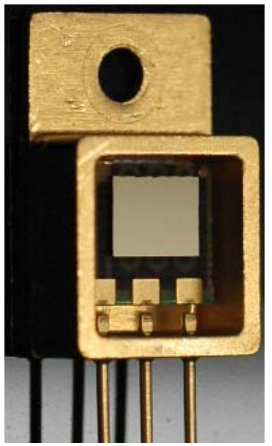


Development of a GaN 1000V Switching Transistor (2)

Actual Results

- Stable 3” GaN process
- Positive threshold voltage (+1.2 V)
- Large gate voltage swing (5 V)
- High IDS-max (0.5 A/mm) ➔ good trade-off to normally-on devices)
- Low leakage :
  - off-state drain leakage 10 µA/mm @ VGS = 0 V
  - on-state gate leakage 10 µA/mm @ VGS = +5 V
- Good saturation properties
- Transistor-channel conductive if operated in reverse direction
  - 3rd quadrant operation
  - May be used for “self protection” when switching inductive loads
- Safe transistor operation up to 200°C ambient
  - IDS decreases with T _ CT = -1.3 mA/(mm K)
  - RON increases with T _ CT = 43 mWmm/K
  - Vth constant with T _ CT = -0.24 mV/K

➔ **No thermal run-away situation in p-GaN gate power-transistors**



50 A device flip-chip mounted in
TO 220 package

Thank you for your attention!

Dr.-Ing. **Andreas K. Jain**
German Aerospace Center

Head - Standardization and EEE Components
Quality and Product Assurance

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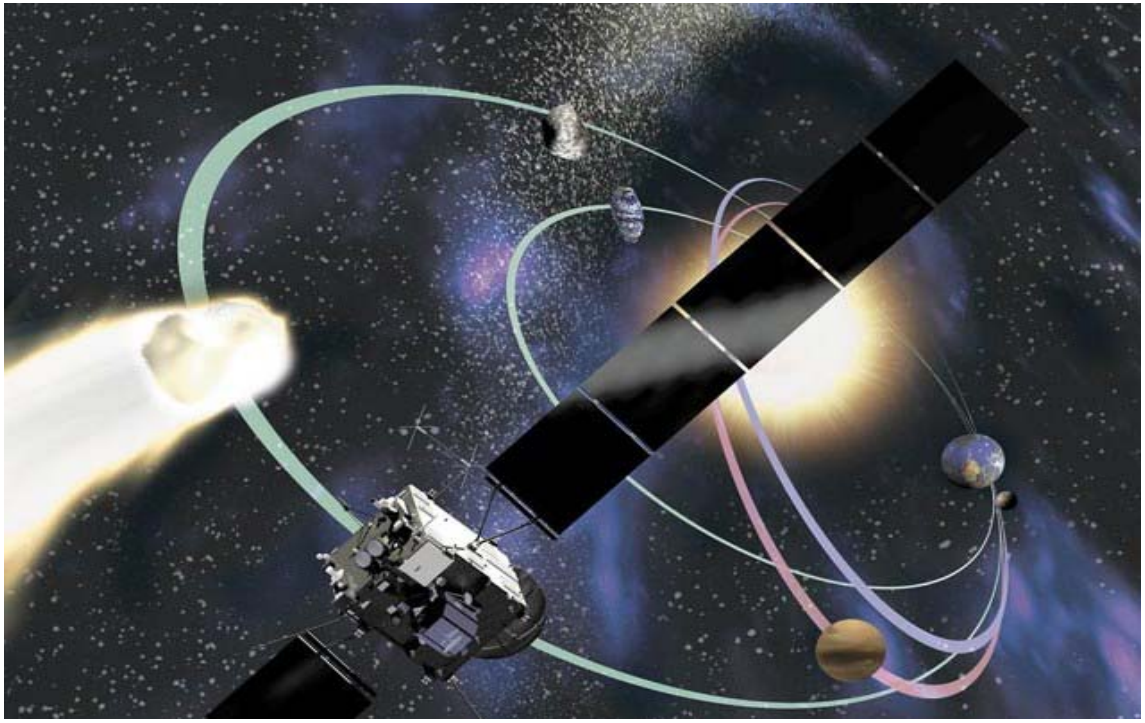
Peregrine Semiconductor

ESCCON 2011: The experience in expanding Operations in Europe and the business Roadmap

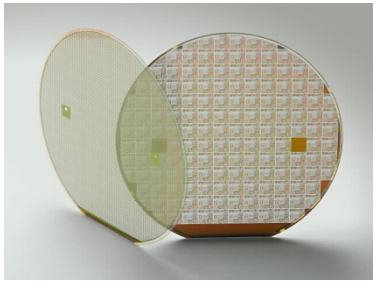


March 16, 2011

Ron Reedy
Pascal Le Bohec

Peregrine Semiconductor Corporation

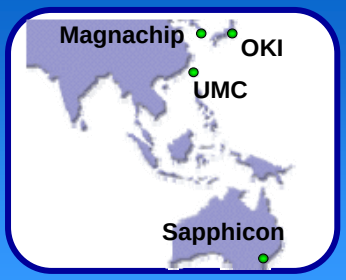
- Patent holder for UltraCMOS™ Technology, a CMOS SOI process fabricated on an insulating sapphire substrate
  - Design methodology inventions including HaRP™ and DuNE™ Technologies
- Strong position in Mobile Wireless and Broadband industries with nearly **180** complementary RFIC products:
  - Switches, Digital Attenuators, PLLs, Prescalers and Mixers
- Design Centers support engineering excellence
  - San Diego, CA
  - Arlington Heights, IL
  - Nashua, NH
  - Aix-En-Provence, France
- Fabless manufacturing model with multiple wafer fabrication sources
  - Silanna Australia
  - Strategic partnership with OKI (Japan)
  - World-class Asian Foundries
- Founded 1990; Headquarters in San Diego, CA USA
- 200 Employees worldwide



Solid UltraCMOS™ Supply Chain

Sapphire Supply

- 3 multinational qualified suppliers
- Peregrine consumes ~6% of the worlds sapphire wafers
- 33% 5 YR CAGR forecasted for world sapphire wafer demand



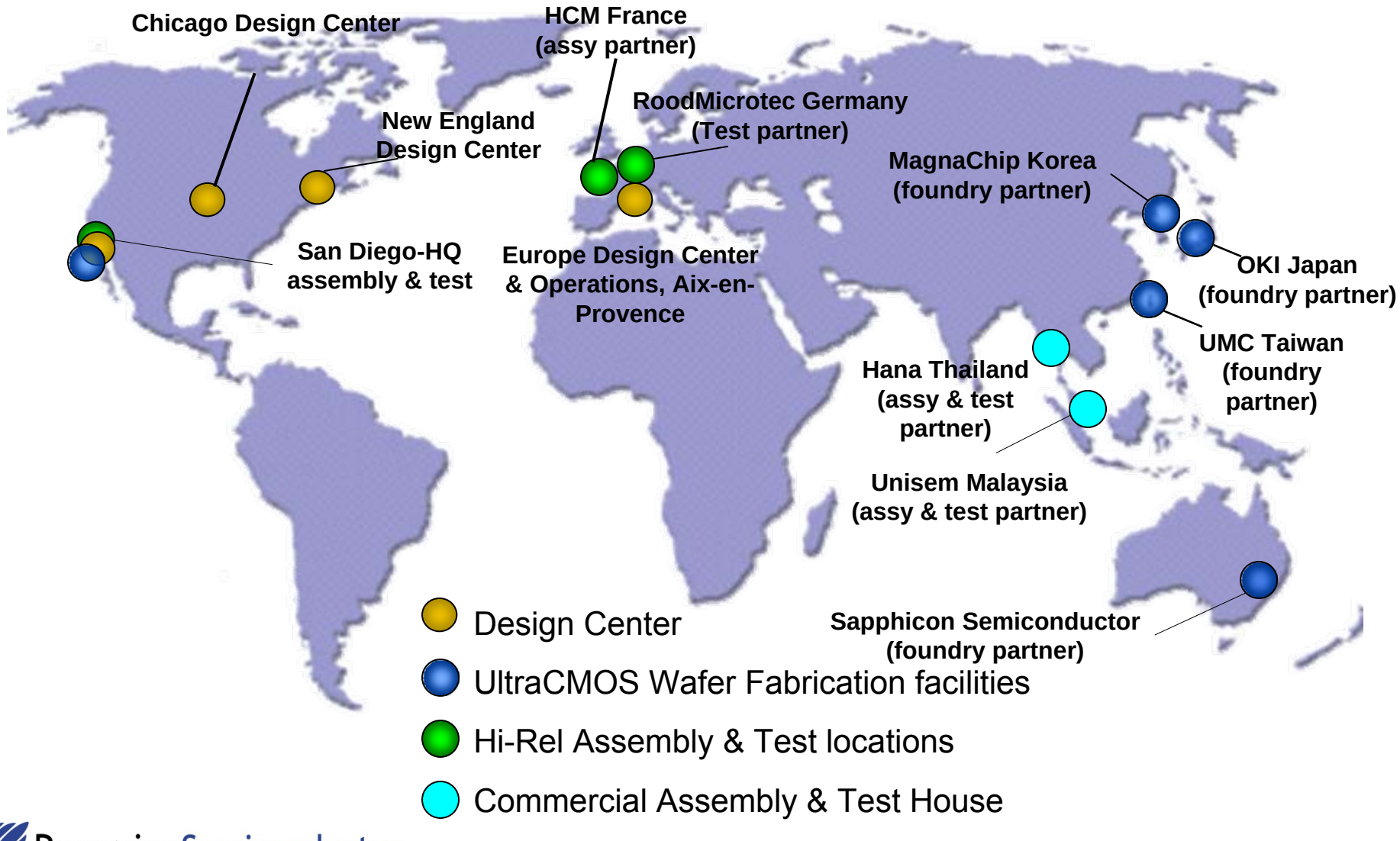
Foundry Model

- 4 qualified CMOS foundry suppliers
- 0.5µm, 0.35µm and 0.25µm processes qualified
- Scalable and near unlimited capacity
- 150mm in production, 200mm in development

Backend

- Proprietary high volume UltraCMOS™ backend processing
- Replicated in San Diego, Malaysia, Thailand
- **High reliability European operations**
- KGD Die, Plastic, Ceramic packaging

Fabless manufacturing on a global basis



Why Silicon on Sapphire?

World's Best Semiconductor Technology + World's Best Substrate Material

Silicon CMOS

- Silicon CMOS is, without question, the optimum technology for building semiconductor devices
- CMOS provides:
  - Highest manufacturability
  - Lowest cost; highest yields
  - Lowest power consumption
  - Most capability for integration
  - Greatest design tools support

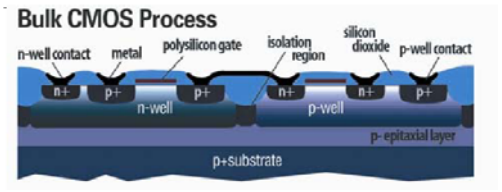
Sapphire

- With outstanding electrical and thermal properties, the highest performance microwave circuits have always been built upon a substrate of ceramic *alumina* (Al_2O_3)
- Sapphire is the crystalline form of alumina
- Same outstanding physical properties of ceramic alumina and enables the deposition of an ultra-thin layer of monocrystalline silicon

UltraCMOS™

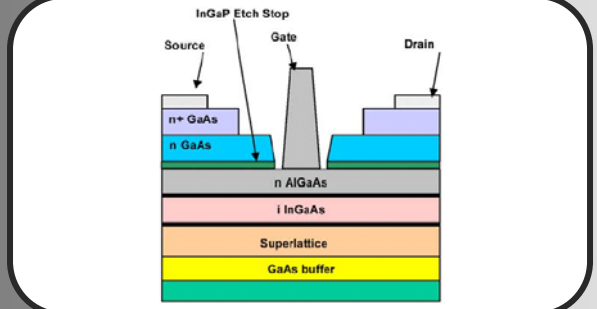
UltraCMOS™ Integrates Best In Class Performance +

Bulk CMOS



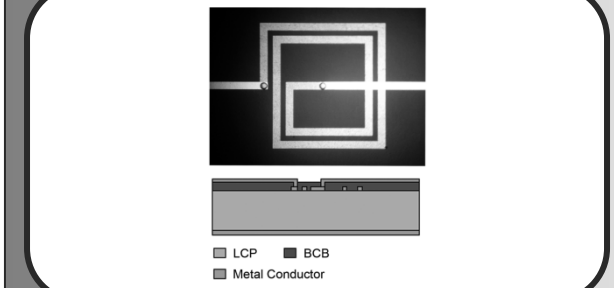
- Monolithic Integration
  - Manufacturable
  - Transferrable
  - Repeatable
  - Scaleable

Gallium Arsenide



- RF Power Applications
  - Good linearity
  - High mobility
  - High power handling
  - Good isolation

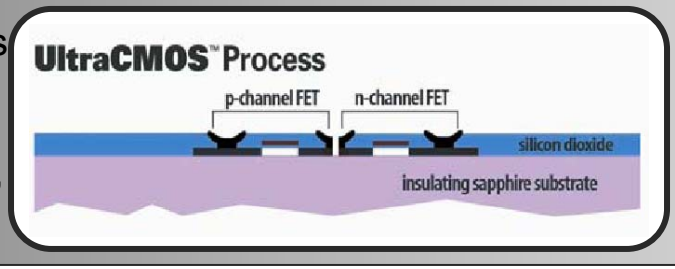
Integrated Passive Device



- Passive Integration
  - Miniaturized passive blocks
  - Minimized parasitics
  - Lithographic interconnect

UltraCMOS™

- All positive attributes of CMOS
- All positive attributes of GaAs
- All positive attributes of IPD
- Additional Unique Properties, best SEU/SEL in industry



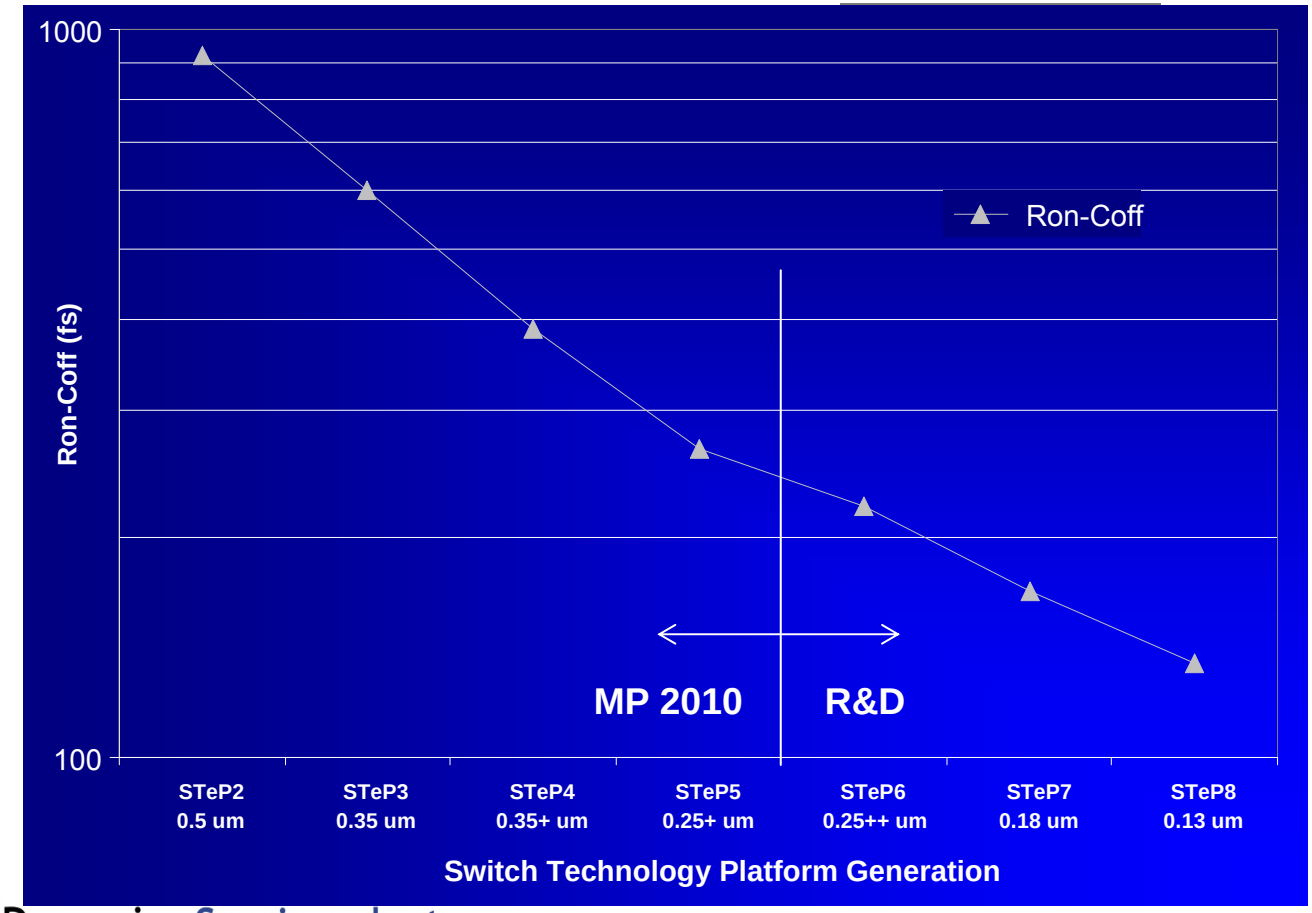
+ Broadband Linearity
+ Unprecedented Isolation
+ High ESD Handling
+ Onboard Memory - EEPROM

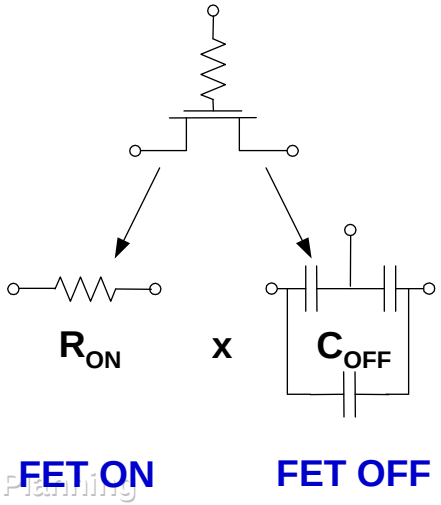
Impact of Technology Scaling

Gate length, um	0.5	0.25	0.18 enh
fT, GHz	20	50	75
fMAX, GHz	50	90	110
IP3, dBm	35	unk	unk
Ron-Coff, ps	900	400	180
kgates/mm2	5	50	100
Proven IP Blocks	~50	<10	N/A
Products (@2 GHz)			
PLL SBN	-218	-225*	-230*
Sw IL	0.6	0.4	0.2
Sw IMD3	-110	-110*	-110*
PA PAE (Sat), %	N/A	55	60*
PA PAE (Lin), %	N/A	45	55*
* simulated			

Peregrine Technology Roadmap

- Ron-Coff is key figure of merit for RFFE switch products
- Most of RFFE is a switch
- LNA NF and g_m improve with gate length



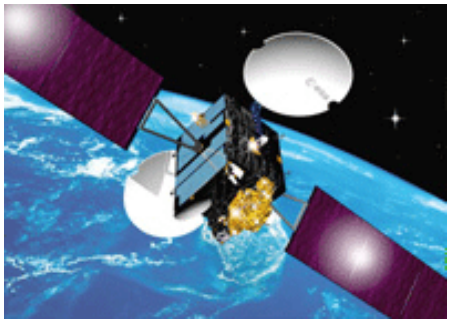


Changing High-Performance RF Across Multiple Vertical Markets

Cellular Handsets and Basestations

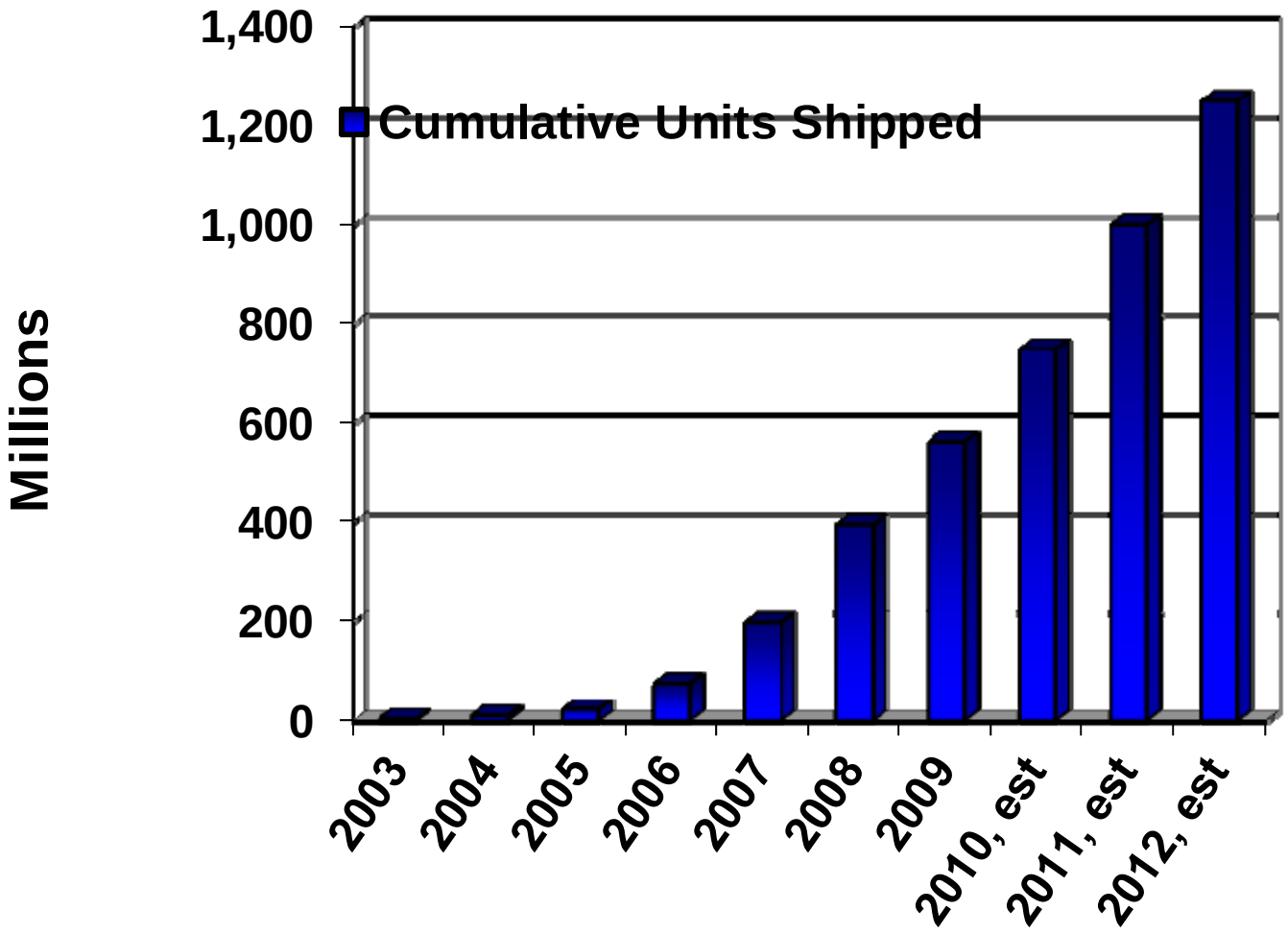
Wired & Wireless Broadband, CA/HDTV

High-Reliability Space/Mil, Auto, Medical



UltraCMOS Technology is Now Mainstream

- More than 800 million units shipped to-date
- Never obsoleted a production process or space product



Deep Space and Satellite End Markets

Radiation Tolerant

Technology tolerant to radiation environments

Total Dose
100 KRads(Si) (& greater if need be)

Single Event Latch-Up
Guaranteed Immunity

Single Event Upset (SEU)
Exceptional Natural Tolerance

Single Event Transient Effects
Not Observed To Date

Neutron Effects
(Displacement Damage) CMOS Insensitive

Dose Rate (Gamma Dot)
Highly Tolerant

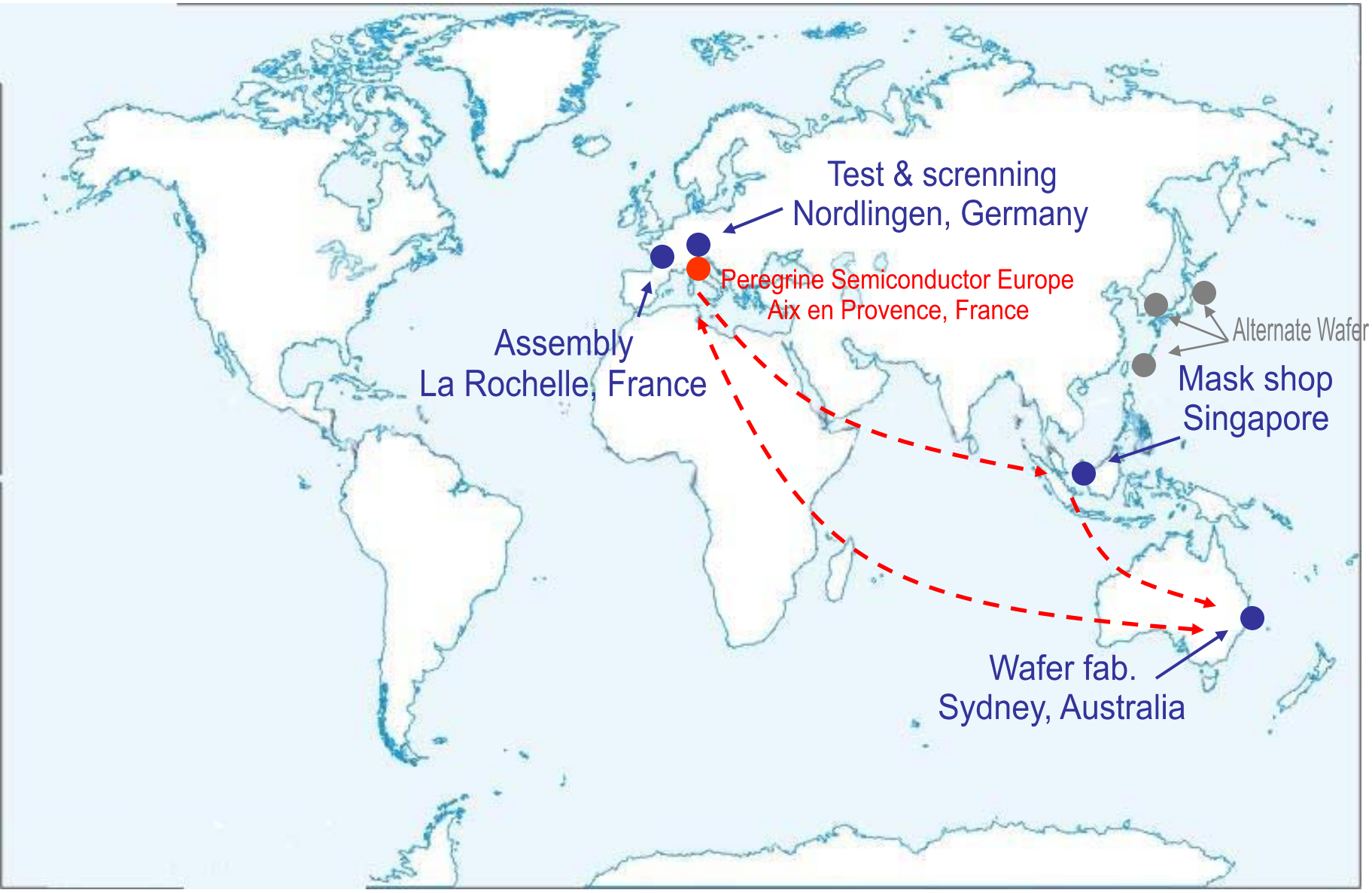
Peregrine Semiconductor support to Hi-Rel Market

- Global company
  - Supporting customers around the world with a variety of products and services since 15 years with high success
  - Global design and manufacturing locations
  - Peregrine is interested in expanding European footprint to support local markets
- Peregrine Hi-Rel markets
  - Great support from European customers
    - Peregrine's product developments have historically been driven by European customers in both Hi-Rel and commercial markets
    - More than 90% of Peregrine's new products have been defined with European customers
  - Unique advantages of UltraCMOS™
    - Integration
    - Radiation hardness
  - Understanding of market requirements
  - Roadmap for long-term success

Peregrine Europe Operation: key factors for success

- European Team in place with more than 50 years experience in development and production of Space products.
  - First Space ASICs design in 1984
  - Digital, Mixed-Mode, RF skills
  - Establishment and Management of Space BU with European Supplier
    - No support needed from Peregrine Hi-Rel US
- Strong relationship and support from ESA (ECI Phase 1 contract)
  - Thanks to Laurent Marchand (ESA) & Jean Luc Roux (CNES)
- Production flow based on well established ESA SCC9000 system.
  - First product qualified through this flow is Peregrine Fractional PLL PE33632 (3.5GHz)
- Strong support from Space Systems Manufacturers.
  - Production flow has been audited and approved
  - Need for more products has been expressed
- High quality subcontractors and efficient management

Peregrine Semiconductor Europe ESCC flow



Peregrine Semiconductor Europe Activities

Peregrine Semiconductor Europe – France

- Overall Program Management
- Product development & Design
- Full documentation set up
- Quality assurance

Mask Shop (Singapore)

- Mask

Foundry (Australia)

Silanna

- Wafer processing
- WAT/WLR
- Backgrinding

HCM – France

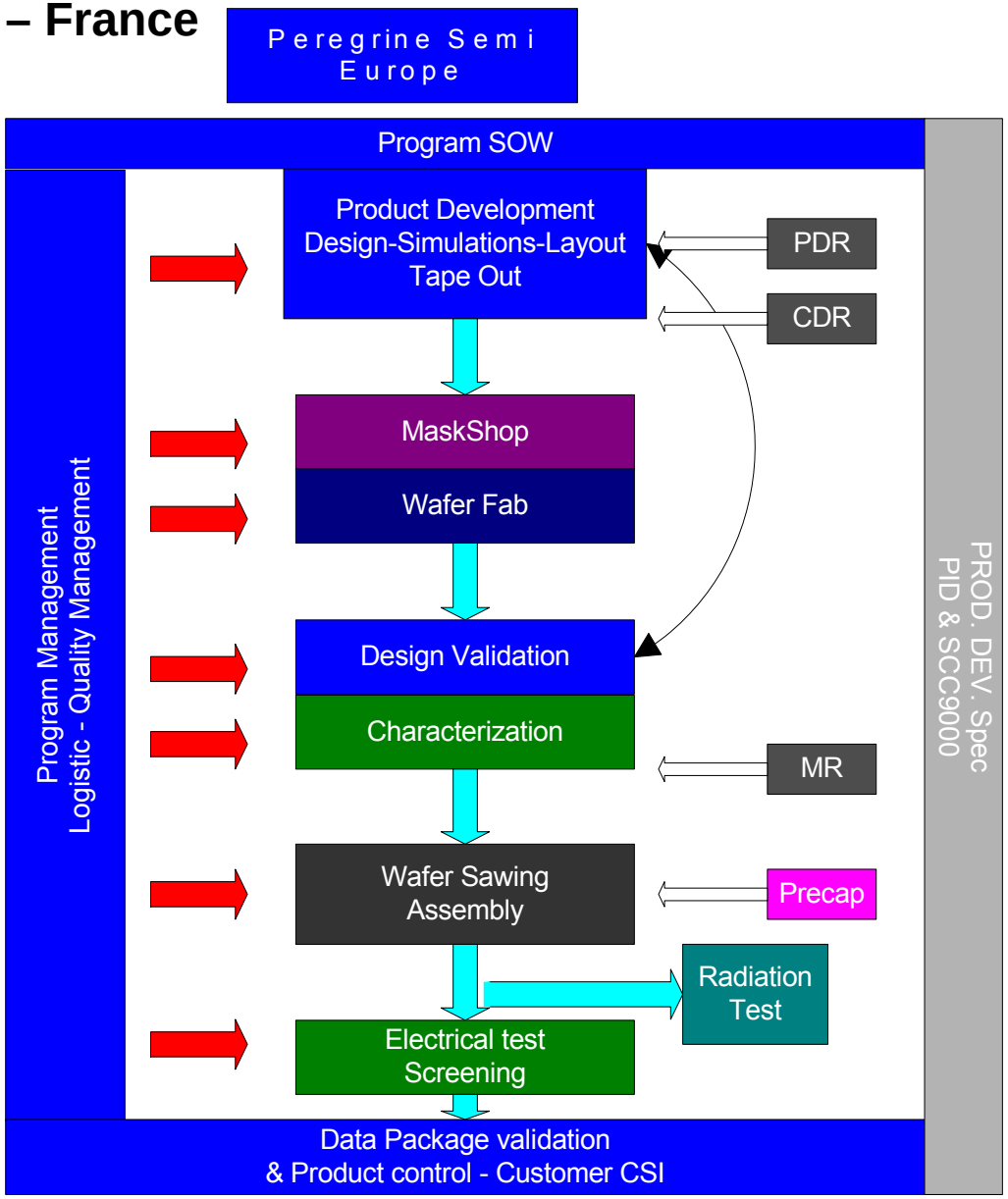
HCM

- Wafer sawing
- Assembly (Packaging and bonding)
- Mechanical screening
  - Thermal cycles
  - PIND test
  - Leakages

ROODMICROTEC – Germany

RoodMicrotec

- Wafer probe
- Electrical test
  - DC, AC, RF and PN
- Electrical screening (Burn in, Life test,…)
- Qualification and Periodic Tests



Wafer Sawing

- Equipment :
- Four 8’’ Disco sawing machines
- Wafer mounting on adhesive/UV films on frames
- Deionised water station / CO2 Bubbler
- Materials : Silicon, GaAs, Ceramic, Glass, Sapphire, SOS, SiC, GaN, Etc..

Packaging

HCM Hybritech Composants MicroElectroniques

ISO 9001 BUREAU VERITAS Certification

1/ Die attach

Adhesive

Eutectic

Soft solder

High temperature solder up to 300°C

Cyanate ester/Silver glass

Etc.

2/ Bonding

- Thermosonic / ball bonding
  - Gold wire
  - 15 to 80 µm
  - Down to 35 µm pitch
- Ultrasonic / wedge bonding
  - Aluminium / gold wire
  - 25 to 500 µm
  - Ribbon
  - Down to 50 µm pitch

3/ Sealing/Potting

- For ceramic or plastic packages:
  - Hermetic (tin/gold alloy)
  - Adhesive
  - Resin
  - Silicon
- For metal packages:
  - Electric
  - Seam Welding

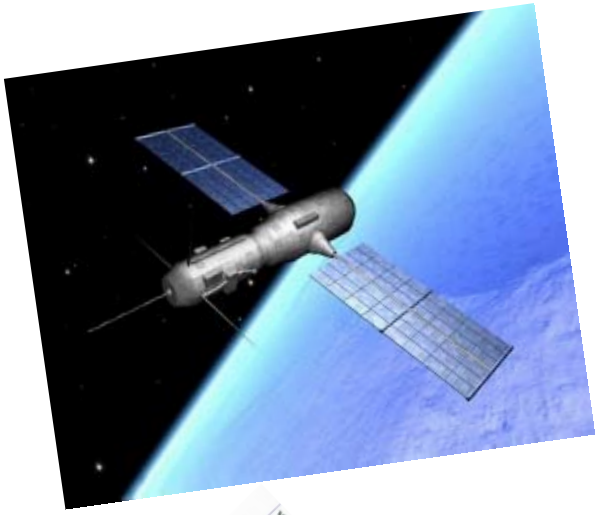
* Mainly used for space applications

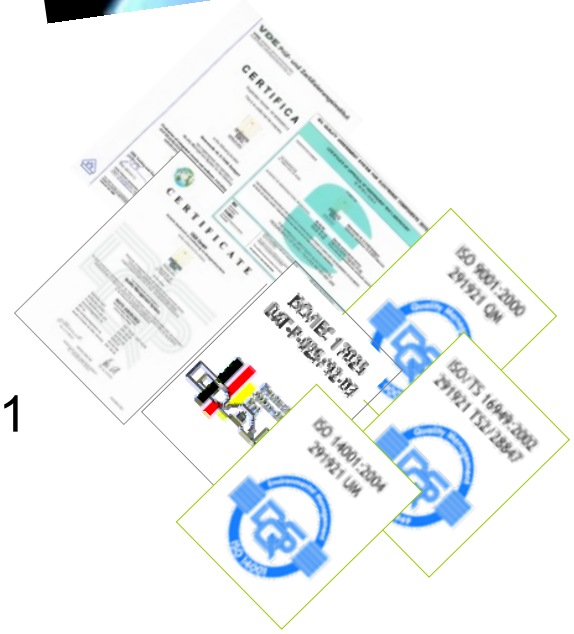
Testing & Screening

RoodMicrotec
powerful solutions

The leading independent European company for semiconductor testing and quality services like:

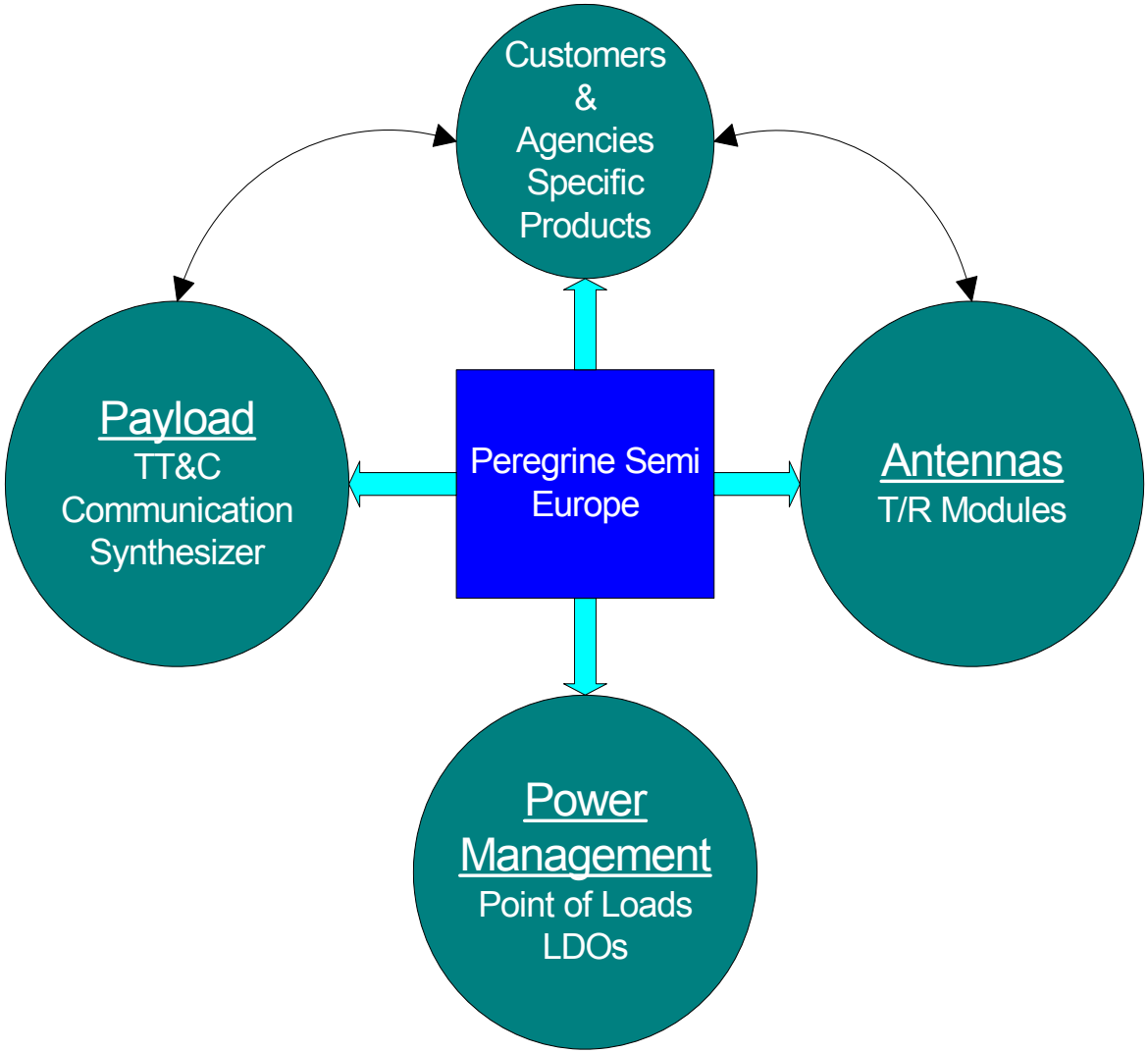
- Test Engineering
  (Soft-Hardware development)
- Monitoring Burn-in
- Electrical Test of
  Mixed Signal, Analog, Digital, Opto, RF ICs
- Integrated Supply Chain Management
- Evaluation tests / up screenings
- Qualification acc. ESCC Standard
- Failure- Technological Analysis
- Reliability Consulting, ESD evaluation
- Approved acc. ISO TS 16949, ISO 17025, ISO 14001





Applications target

Business Roadmap: Applications



Business Roadmap: Products/Applications

- Best class **Phase Locked Loop (PLL)**
- Reference on the market
  - Qualified PE33632 Fractional PLL (ECI contract)
  - Continuous Phase Noise improvement
  - **VCO integration**
- Other functions
  - **Digital Step Attenuators** (ECI contract)
  - **Digital Variable Gain Amplifiers**
  - **Switches**
  - **Mixers**

Payload
TT&C
Communication
Synthesizer

- **Phase Shifters**
- **Digital Step Attenuators**
- **Switches (SPDT, SP4T, …)**
- **Drain Switches**
- **Fully integrated Core Chip** (Full function except LNA & PAs)

Antennas
T/R Modules

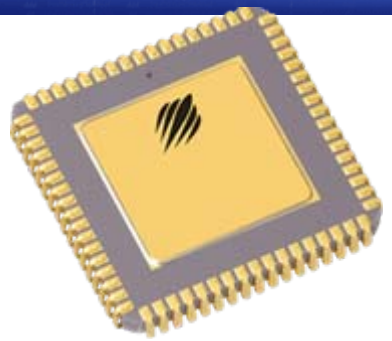
- **DC/DC 2A, 6A, 10A**
- **LDOs**

Power Management
Point of Loads
LDOs

Current Production and On going development

PE33632 Fractional N PLL (ECI 1 - QPL March 2011)

- 3500 MHz operation
- Ultra-Low Phase Noise: -216 dBc/Hz
- Low power 40 mA at 3.3 V
- ÷10/11 dual modulus prescaler
- Phase detector output
- Serial or Direct mode access
- Frequency selectivity: Comparison frequency / 2^{18}
- 1000 V ESD Protection
- 100 Krads (Si) Total dose
- Packaged in 68-lead CQFJ



Peregrine Semiconductor

Product Specification

PE33632

3.5 GHz Delta-Sigma modulated Fractional-N Frequency Synthesizer for Low Phase Noise Applications

Features

- 3.5 GHz operation
- ÷10/11 dual modulus prescaler
- Phase detector output
- Serial or Direct mode access
- Frequency selectivity: Comparison frequency / 2^{18}
- Low power — 40 mA at 3.3 V
- Ultra-low phase noise
- 68-lead CQFJ

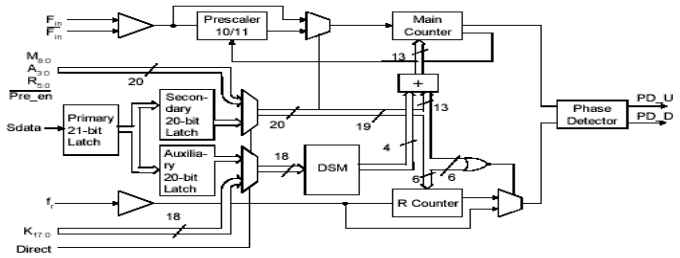
Product Description

Peregrine's PE33632 is a high performance fractional-N PLL capable of frequency synthesis up to 3.5 GHz. The device is designed for superior phase noise performance while providing an order of magnitude reduction in current consumption, when compared with the existing commercial PLLs.

The PE33632 features a 10/11 dual modulus prescaler, counters, a delta sigma modulator, and a phase comparator as shown in Figure 1. Counter values are programmable through either a serial interface or directly hard-wired.

The PE33632 is manufactured on Peregrine's UltraCMOS™ process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate, offering the performance of GaAs with the economy and integration of conventional CMOS.

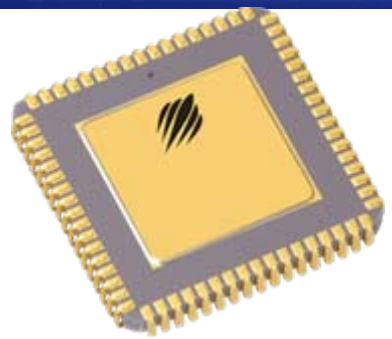
Figure 1. Block Diagram



Document No. 70-02xx-01 | www.psemi.com

PE33362 Integer-N PLL (EPPL)

- 3500 MHz operation
- Ultra-Low Phase Noise: -216 dBc/Hz
- Low Power: 45 mA at 3.3 V
- ÷10/11 dual modulus prescaler
- Internal phase detector
- Serial, Parallel or Direct Mode Access
- 1000 V ESD Protection
- 100 Krads (Si) total dose
- Packaged in a 44-lead CQFJ



Peregrine Semiconductor

Product Specification

PE33362

3500 MHz UltraCMOS™ Integer-N PLL

Features

- Low Power - 45 mA at 3.3V
- 3500 MHz operation
- ÷10/11 dual modulus prescaler
- Internal phase detector
- Serial, parallel or hardwired programmable
- Ultra-Low Phase Noise: -216 dBc/Hz
- Packaged in a 44-lead CQFJ

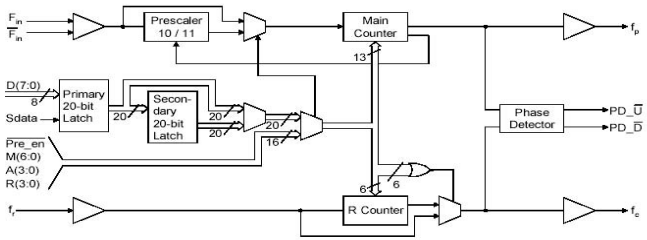
Product Description

Peregrine's PE33362 is a high-performance integer-N PLL capable of frequency synthesis up to 3500 MHz. The device is designed for superior phase noise performance while providing an order of magnitude reduction in current consumption, when compared with existing commercial PLLs.

The PE33362 features a 10/11 dual modulus prescaler, counters and a phase comparator as shown in Figure 1. Counter values are programmable through either a serial or parallel interface and can also be directly hard wired.

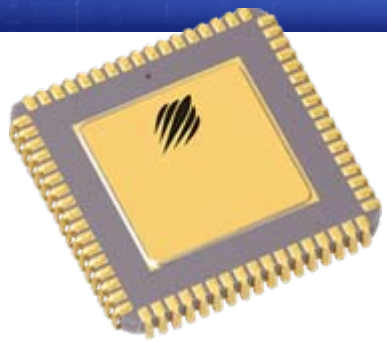
The PE33362 is manufactured on Peregrine's UltraCMOS™ process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate, offering the performance of GaAs with the economy and integration of conventional CMOS.

Figure 1. Block Diagram



PE33382 Integer N PLL (EPPL)

- Low Power: 45 mA Typical
- Ultra-Low Phase Noise: -216 dBc/Hz
- 3500 MHz operation
- ÷10/11 dual modulus prescaler
- 1000 V ESD Protection
- Phase detector output
- Serial interface or hardwired programmable
- 100 Krad (Si) total dose
- Packaged in a 44-lead CQFJ



Peregrine Semiconductor

Advance Information

PE33382

3500 MHz UltraCMOS™ Integer-N PLL

Features

- Low Power: 45 mA Typical
- 3500 MHz operation
- ÷10/11 dual modulus prescaler
- Phase detector output
- Serial interface or hardwired programmable
- Ultra-Low Phase Noise: -216 dBc/Hz
- Packaged in a 44-lead CQFJ

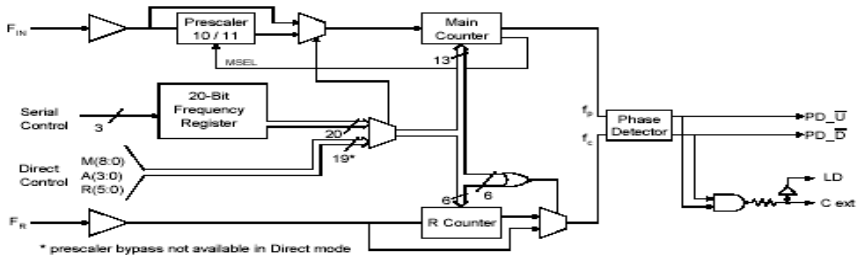
Product Description

Peregrine's PE33382 is a high-performance integer-N PLL capable of frequency synthesis up to 3500 MHz. The device is designed for superior phase noise performance while providing an order of magnitude reduction in current consumption, when compared with existing commercial PLLs.

The PE33382 features a ÷10/11 dual modulus prescaler, counters, and a phase comparator as shown in Figure 1. Counter values are programmable through a serial interface, and can also be directly hard wired.

The PE33382 is manufactured on Peregrine's UltraCMOS™ process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate, offering the performance of GaAs with the economy and integration of conventional CMOS.

Figure 1. Block Diagram

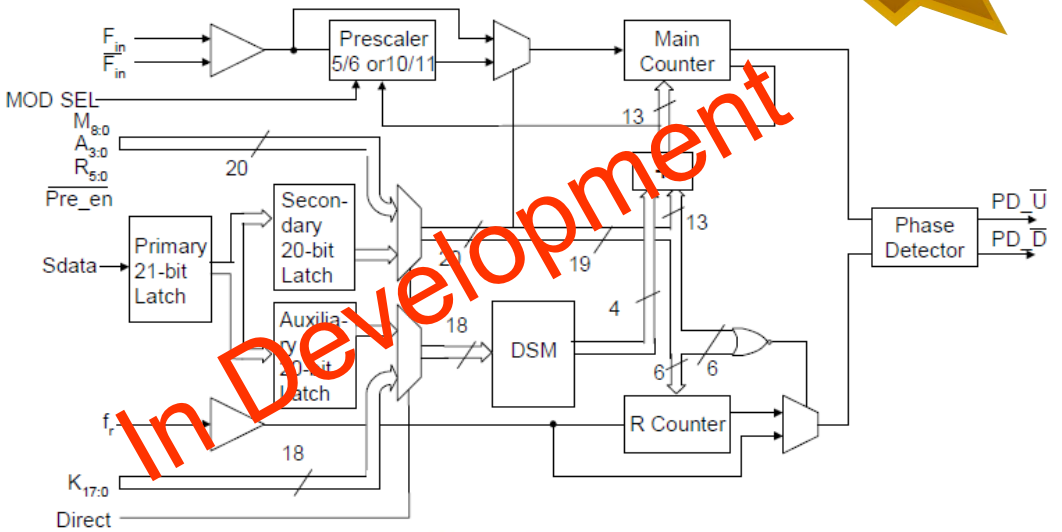


Document No. 70-02xx-01 | www.psemi.com

PE33642 4.0GHz Fractional-N PLL

- 4.0 GHz operation
- Ultra-Low Phase Noise: -221 dBc/Hz
- Low Power: 50 mA at 2.5V
- Selectable prescaler modulus of 5/6 or 10/11
- Internal phase detector
- Serial or hard-wire programmable
- Frequency selectivity: Comparison frequency/2^{18}
- SEU < 10^{-9} errors / bit-day
- 100 Krad (Si) total dose
- Packaged in a 64-lead CQFP
- 1000 V ESD Protection

Ultra-low Phase Noise

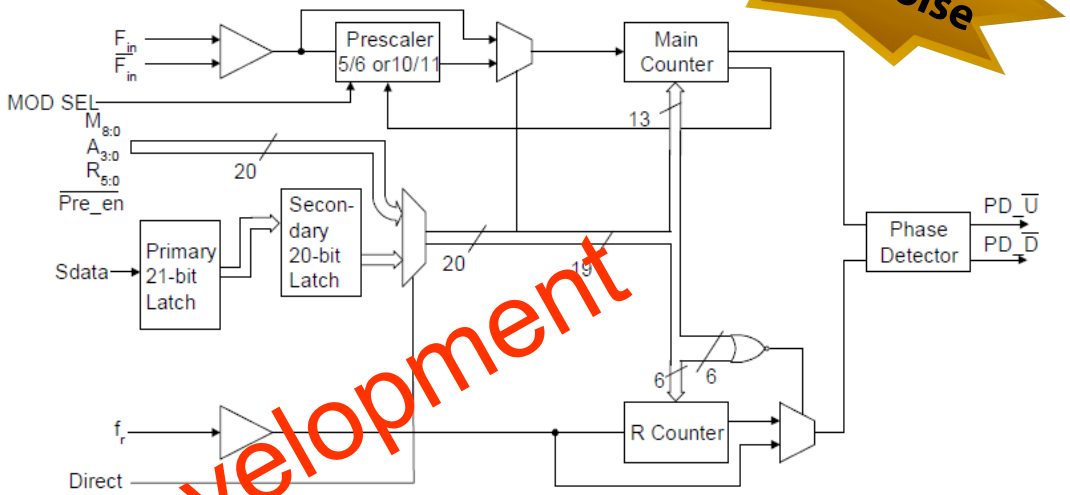


64-Lead CQFP Package

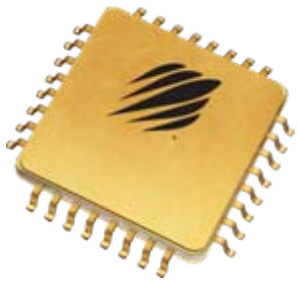
PE33242 4.0 GHz Integer-N PLL

- 4.0 GHz operation
- Ultra-Low Phase Noise: -221 dBc/Hz
- Low Power: 50 mA at 2.5V
- Selectable prescaler modulus of 5/6 or 10/11
- Internal phase detector
- Serial or hard-wire programmable
- SEU < 10^{-9} errors / bit-day
- 100 Krad (Si) total dose
- Packaged in a 44-lead CQFJ
- 1000 V ESD Protection
- 100 Krad (Si) total dose

Ultra-low Phase Noise



In Development



44-Lead CQFP Package

PE43751/43752 7-Bit Digital Step Attenuator (ECI 2)

- **High Linearity**
  - +34 dBm peak P1 dB typical
  - +52 dBm IIP3 typical
  - Flat performance from 1 MHz to 3 GHz
- **Market Leading Accuracy**
  - 31.75dB attenuation range with 0.25dB steps
  - 63.5dB attenuation range with 0.5dB steps
- **3V Supply voltage**
- **Parallel & serial logic control**
- **Low Insertion Loss (1.5 dB)**
- **No coupling caps if RF I/O remains at 0 VDC**
- **High ESD rating**
- **Available as RF Tested Die**

Peregrine Semiconductor

50 Ω RF Digital Attenuator
7-bit, 31.75 dB, 9 kHz - 6000 MHz
Vss_{EXT} option

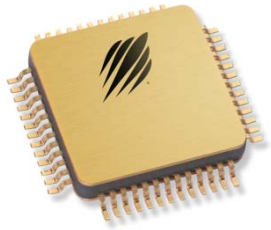
Features

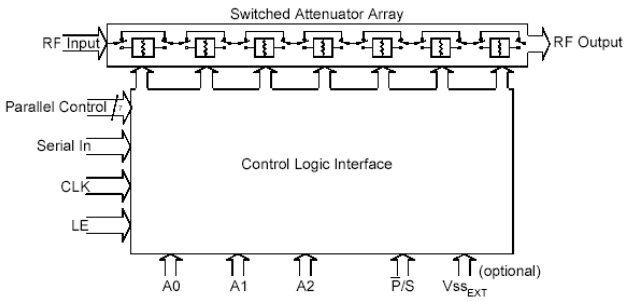
- HaRP™-enhanced UltraCMOS™ device
- Attenuation options: 0.25 dB, 0.5 dB, or 1.0 dB steps to 31.75 dB
  - 0.25 dB monotonicity for ≤ 4.0 GHz
  - 0.5 dB monotonicity for ≤ 5.0 GHz
  - 1 dB monotonicity for ≤ 6.0 GHz
- High linearity: Typical +59 dBm IIP3
- Excellent low-frequency performance
- Optional External Vss Control (Vss_{EXT})
- 3.3 V or 5.0 V Power Supply Voltage
- Fast switch settling time
- Programming Modes:
  - Direct Parallel
  - Latched Parallel
  - Serial-Addressable: Program up to eight addresses 000 - 111
- High-attenuation state @ power-up (PUP)
- CMOS Compatible
- No DC blocking capacitors required

Product Description

The PE43703 is a HaRP™-enhanced, high linearity, 7-bit RF Digital Step Attenuator (DSA). This highly versatile DSA covers a 31.75 dB attenuation range in 0.25 dB, 0.5 dB, or 1.0 dB steps. The customer can choose which step size and associated specifications are best suited for their application. The Peregrine 50Ω RF DSA provides multiple CMOS control interfaces and an optional external Vss feature. It maintains high attenuation accuracy over frequency and temperature and exhibits very low insertion loss and low power consumption. Performance does not change with V_{DD} due to on-board regulator. This next generation Peregrine DSA is available in a 5x5 mm 32-lead QFN footprint.

The PE43703 is manufactured on Peregrine's UltraCMOS™ process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate, offering the performance of GaAs with the economy and integration of conventional CMOS.





PE52100 – Triple Digital Variable Gain Amplifier

- 60 - 200 MHz operation
- 27dB Gain per Stage
- Attenuator Dynamic Range: 31.5dB per Stage
- Attenuator Step accuracy better than 0.1dB
- IF amplifier Output P1dB: 8dBm
- Noise Figure at minimum attenuation: +4.5dB
- Output IP3 +18dBm
- 1000 V ESD Protection
- Rad-Hard
- Packaged 52-lead CQFP

Peregrine Semiconductor

Product Concept

Digital Variable Gain Amplifier

60-200 MHz IF frequency amplifier for Hi-Rel Applications

UltraCMOS™ Triple Digital Variable Gain Amplifier

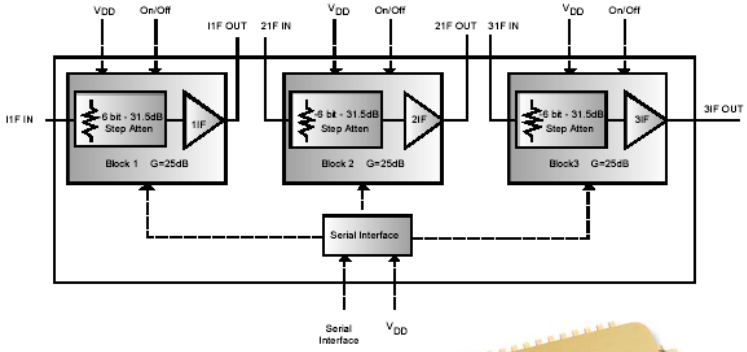
General Description

The Digital Variable Gain Amplifier is a 60-200 MHz IF subsystem. All three gain stages can be cascaded but the total maximum gain cannot exceed 60 dB after substracting any on-chip digital attenuator loss and off-chip inter-stage loss. 3-wire on-chip programmable serial-control attenuators are used as variable gain elements. The device can be used to drive an off-chip peripheral with up to +8 dBm (50 Ohms).

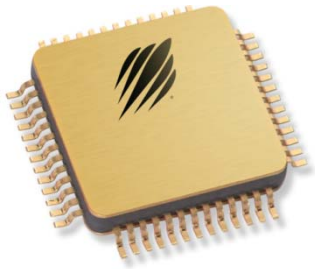
Screening of the Digital Variable Gain Amplifier is available for Hi-Rel applications . Fabricated in Peregrine's patented UltraCMOS™ technology, this part offers high linearity and low distortion.

Product Features

- Gain: +26dB per stage
- Noise Figure at min. attenuation: 5.0 dB
- IF amplifier output P1dB = 8 dBm
- Output IP3 higher than +18 dBm
- Harmonics: <–30 dBc at +3 dBm output power
- Attenuator Dynamic Range: 31.5 dB per stage
- Attenuator Step Accuracy better than 0.1 dB
- 60-200 MHz Operation

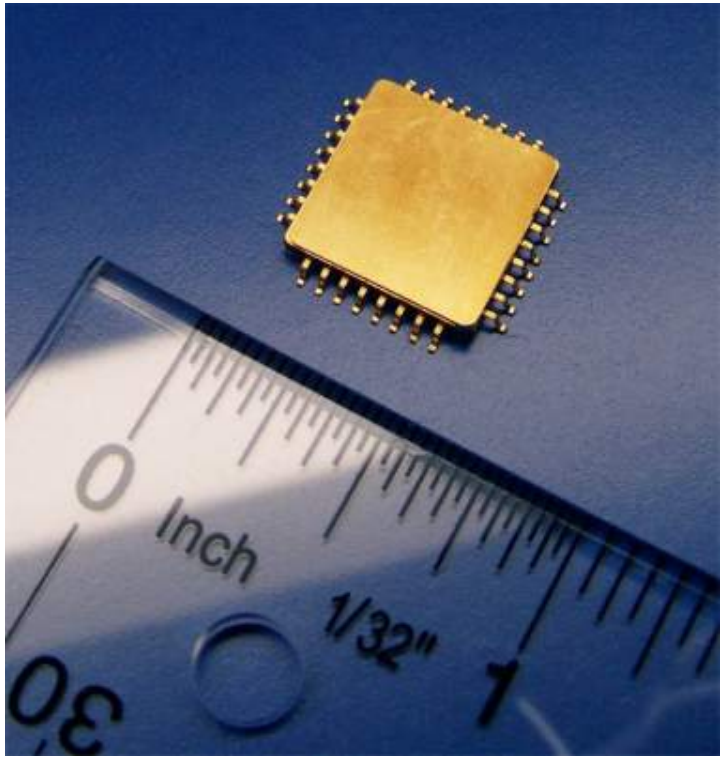


The Digital Variable Gain Amplifier is composed of 3 identical and independent blocks plus a common serial Interface. Each block includes a 6 bit step attenuator and an amplifier. For each block there are accessible I/O pins, a dedicated V_{DD} pin and a dedicated power down pin for the ON/OFF function. Only the serial interface (DATA, CLK, ENABLE) is common to all blocks. Each block exhibits the same electrical performance.



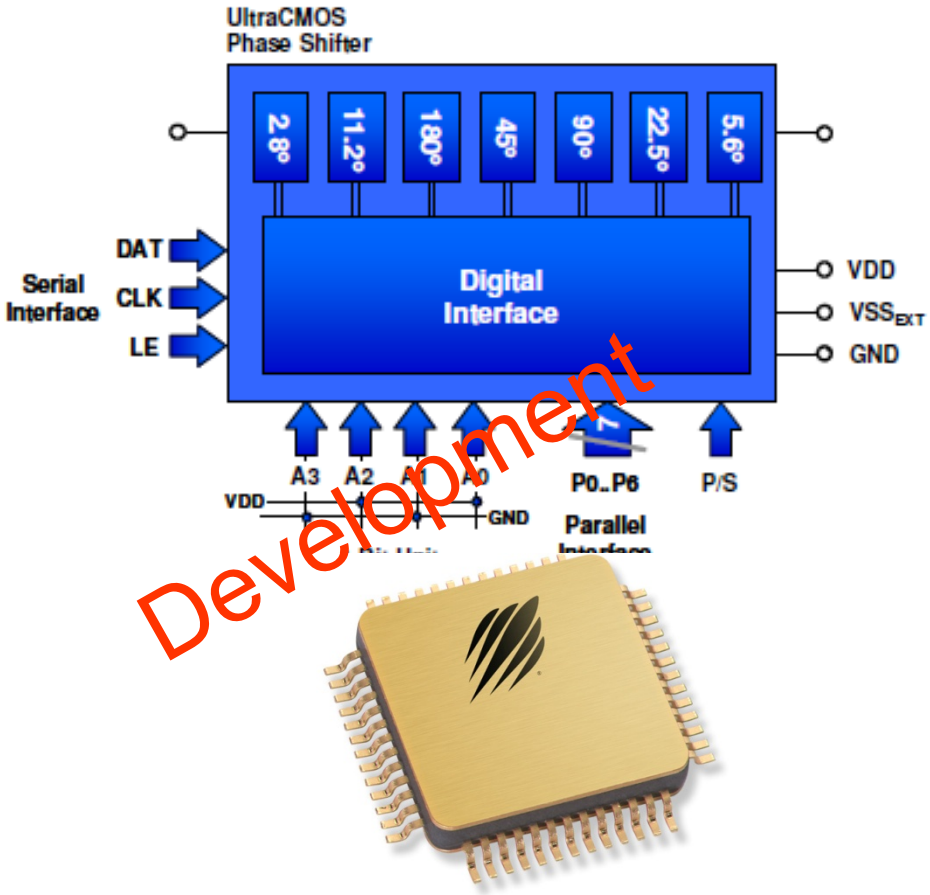
DC-DC Converter: Monolithic Point of Load

- 93% Peak Efficiency
- Better than 1% Accuracy
- Monolithic Design with integrated Power MOSFETs & Control Logic
- 4.5 – 6 V Input (VIN)
- VIN– 1 V Output
- 2A, 6A, 10A
- SYNC function, 100 kHz – 5 MHz lock range with selectable 500kHz / 1MHz free running frequency at no sync
- Current mode control, pulse-by-pulse current limit, current sharing enabled and (N+K) redundancy
- Adjustable Soft-Start
- SEL Immune
- Single Event Effects do not interrupt Power delivery
- 100 Krads (Si) Total Dose



PE892277: 7-Bits L-Band Phase Shifter

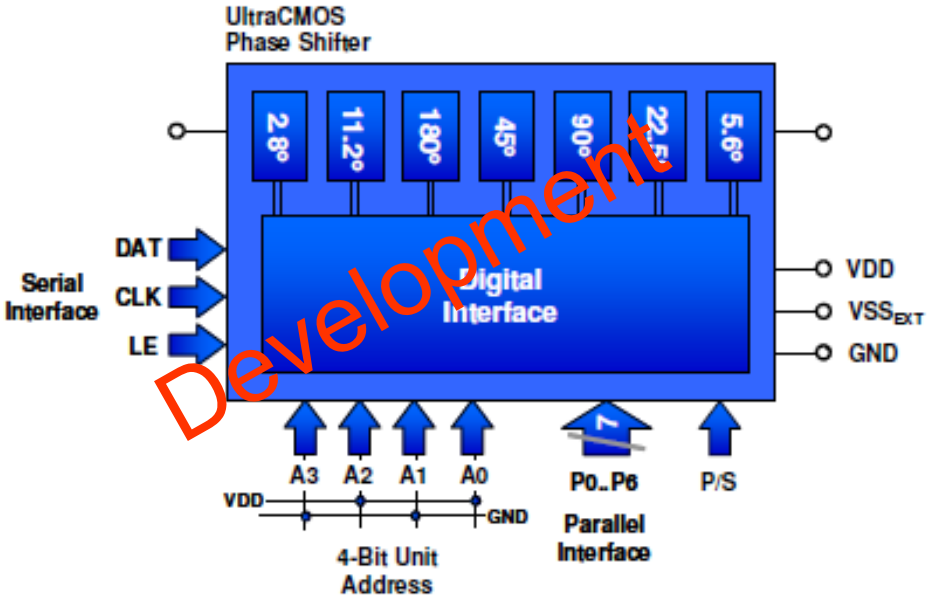
- **1.2 – 1.4 GHz Operation**
- Phase Range: 360 deg 7-Bit
  - 180, 90, 45, 22.5,11.2, 5.6, 2.8 degree bits (LSB)
- Low power : 70 µA at 3.3 V
- Low insertion loss: 4 dB
- Linearity: 50 dBm min
- Fast Settling Time: < 200 ns
- RMS Phase Error: 1 degree
- RMS Amplitude Error: 0.2 dB
- 1000 V ESD Protection
- Rad-Hard
- 32-lead Ceramic Package



Q1'11: Kick-off → Q2'11 → Q3'11 → Q4'11: ES &CS → Q1'12: Production

PE892371: 7-Bit S-Band Phase Shifter

- **2.7 – 3.7 GHz Operation**
- Phase Range: 360 deg 7-Bit
  - 180, 90, 45, 22.5,11.2, 5.6, 2.8 degree bits
- Low power : 70 µA at 3.3 V
- Low insertion loss: < 5 dB
- Linearity: 50 dBm min
- Fast Settling Time: < 200 ns
- RMS Phase Error: < 1 degree
- RMS Amplitude Error: 0.2 dB
- 1000 V ESD Protection
- Rad-Hard
- 32-lead Ceramic Package



PE99311/PE99315: Low-Power and High-Power Positive LDO

Parameters	PE99311 Low-Power LDO	PE99315 High Power LDO
Maximum Power, PWRMAX	100mW	1W
Rated Output Current	100mA	1000mA
Current Limit (max)	150mA	1.5A
IOUT(Shutdown) @ VIN(max)	10uA	100uA
Input Voltage Range	2.3 - 3.6V	2.3 - 3.6V
PSRR DC	80dB	80dB
PSRR 1MHz	40dB	40dB
Programmable Output Voltage	1 to Vin	1 to Vin
Total Ionizing Dose	100 KRad	100 Krad

Conclusion

- Peregrine Semiconductor Europe is developing advanced RF products for Space applications which comply with European Customers requirements as well as European Space Agency system
- Various new products will be introduced within next couple of years: ultra Low Phase Noise PLL, Digital Step Attenuators, Phase shifters, and many other.

THANK YOU

Cobham Microwave

29 avenue de la Baltique
91953 Courtaboeuf, FRANCE

The most important thing we build is trust

Lessons learnt from ECI and business roadmap

Jean-Marc BUREAU — Head of Materials & Process Dept., ECI Project Manager
Laurent ETIENNE — Business Development Manager

CONTENTS

- Short presentation of COBHAM GROUP and of COBHAM MICROWAVE
- Products portfolio and markets
- RF/Microwave Silicon Components and Hybrids
- ECI activities and results
- Other space RF / Microwave Hybrids

COBHAM GROUP

- Focused on Hi Rel Markets
- Employ some 12,000 people on five continents
- FSTE 100 company with annual revenue ~ £2bn
- Specialized in sub-systems, products and services that protect lives and livelihoods
- Capabilities increasingly centred around C4ISR*
- Acquired more than 100 companies in 12 countries, half of these in the last decade
- Transitioned to a single Cobham brand in 2009

*Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance

Sell technically differentiated products and services

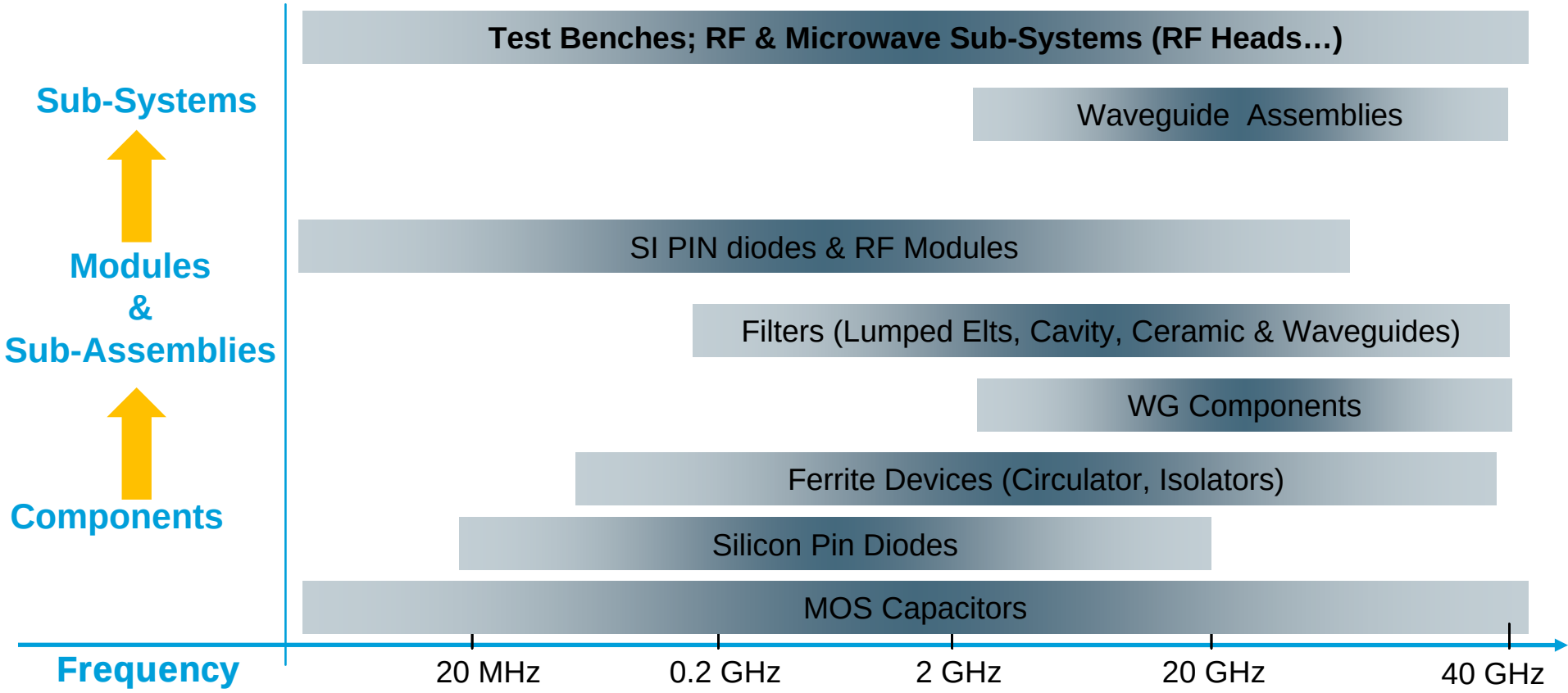
COBHAM MICROWAVE

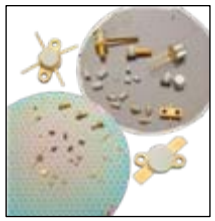
COBHAM

- Aviation Services
- Avionics & Surveillance
- Mission Systems
- Defence Systems

CHELTON TELECOM & MICROWAVE (formerly TEMEX MICROWAVE)
Based in France
250 employees, 35 M€

VERTICAL INTEGRATION





STRATEGY & MARKETS

Prime Targets

Defense

- Ground, marine & airborne radars
- Battle field radios
- Identification & Navigation systems

Space

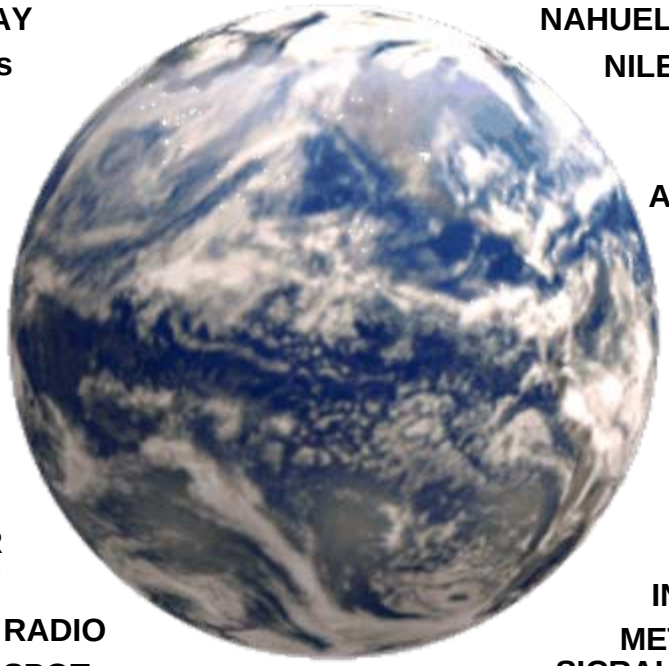
- Payloads:
  - Transceivers
  - MMIC decoupling (Mos)

Medical

- Magnetic Resonance Imaging

High Rel Market

COBHAM MICROWAVE SPACE HERITAGE

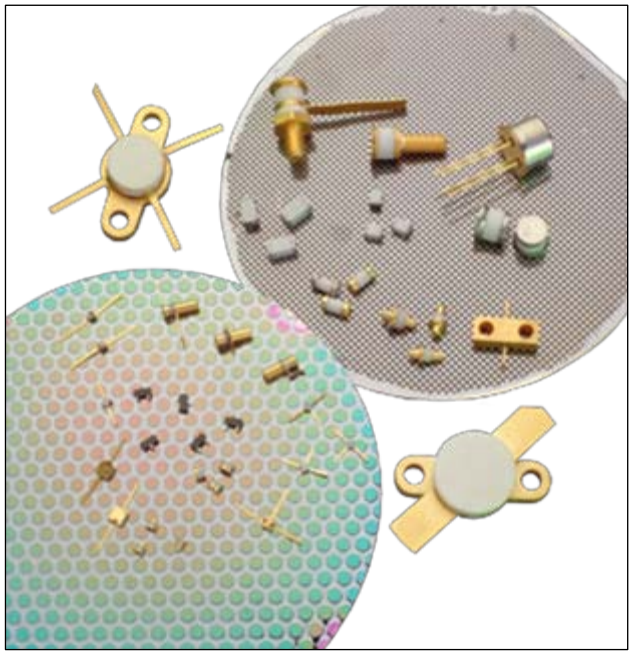


ROSETTA
Cosmo
DFH-3
MT-SAT
ANIK
AMAZONAS
YAMAL 200
AMC
W3A
MABUHAY
NAHUEL
artemis
NILESAT
express
AMOS
eurasiasat
AMOS 2
GE I
ATLANTIC BIRD
Astra 1k
ARABSAT
WORLDSTAR
KTV
TURKSAT
EUTELSAT 1
THAICOM
EUROPSTAR
GE 12
HOT BIRD 7
HOT BIRD 6
FOS 2
TELECOM 1 & 2
MARS EXPRESS
STENTOR
GLOBALSTAR
GE 5
TDF
INTELSAT 10
XM RADIO
METOP
SPOT
SICRAL
GSAT
INSAT 4
INTELSAT 9
HISPASAT 1
GALILEO

RF & MICROWAVE SILICON COMPONENTS

Wide Range of Products :

- PIN diodes : Low, medium & high voltage :
  - 50 V to 3000 V Vbr
  - Low Rs & low Cj
- Varactor diodes
  - 90V, 30 V & 20 V Vbr
- SRD & Multiplier diodes
- MOS capacitors
  - 50 ppm/°C stability



Large choice of Packages :

- Naked dies
- Ceramic
- Plastic
- Custom

RF & MICROWAVE SILICON COMPONENTS

COBHAM

Types	Applications	V_{br}	Junction Capacitance
PIN	High power switching	500 to 2000 V	Low Cj for a good isolation Cj(50v): 0,15 pF to 3 pF
	Fast switching	150 to 400 V	Cj(50v): 0,04 pF to 0,17 pF
	Ultra fast switching	30 to 100 V	Cj(6v): 0,08 pF to 0,17 pF
	AGC, Attenuator		0,3pF to 0,10 pF
	Limiter	25 to 100 V	Cj0: 0,14 pF to 0,45 pF
Varactor	VCO (Voltage Controlled Oscillators)	30 V, Q-factor: 300 to 4500	Cj(Vr4v): 0,4 to 100 pF
		45 V, Q-factor: 250 to 3000	Cj(Vr4v): 0,4 to 100 pF
		20 V	Cj(Vr4v): 1,2 to 15 pF
SRD	Frequency Multiplier	25 V to 30 V	Cj(6v): 0,3 pF to 12,5 pF
MOS Cap	MOS Capacitor	Up to 500V	0,1 to 470 pF






RF & MICROWAVE SILICON COMPONENTS

COBHAM

ESCC European Space Components Coordination

QPL

ESCC5010 Generic specification

Sub-Families	Types	Spec.
Multipliers Varactors,	DH 267, 252, 256, 292, 294	5512/016
Tuning Varactors	DH 76 XXX	5512/023
PIN, Fast Switching	DH 50151 – DH 50157 DH 50201 – DH 50209 DH 50251 – DH 50256	5513/031 5513/033 5513/034
PIN, Ultra Fast Switching	DH 50033 – DH 50037 DH 50052 – DH 50057 DH 50071 – DH 50077 DH 50101 – DH 50107	5513/032 5513/036 5513/037 5513/038
MOS Capacitors	101M, 201M, 400M and 401M	5711/002

ESCC web site: https://escies.org/public/escc/qpl/chelton.htm

Hi-Rel testing Capabilities

Screening and Qualification

- Climatic chambers
- Life tests (HTRB, PBI,...)
- Die shear tests
- Pull tests
- Gross and fine leaks
- Vibration and acceleration tests
- PIND tests (Particle Impact Noise Detection)
- X-Ray, SEM, RGA ...


Pull Test / Die shear


Leak test


Acceleration test

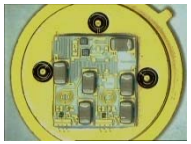

PIND test

RF & MICROWAVE HYBRIDS

Heritage:

- RF & microwave applications (30 years experience, Thomson-CSF)
  - Up to 18 GHz
  - Several packaging technologies
  - Defense markets, customer specifications
- Amplifiers
  - Cascadable, LNA and general purpose
- PIN diode limiters
  - Coaxial, 100 W input power
  - Waveguide: up 15 KW pulse power
- PIN diode switches
  - SPNT up to 8 channels
- Schottky diode mixers
  - Double balanced, up to 18 GHz
- Passive hybrids:
  - Power dividers, couplers, transformers, ...



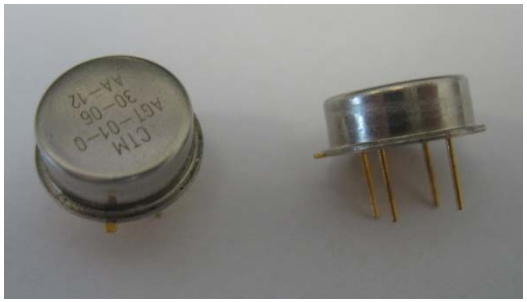
Design flexibility, high performance & reliability

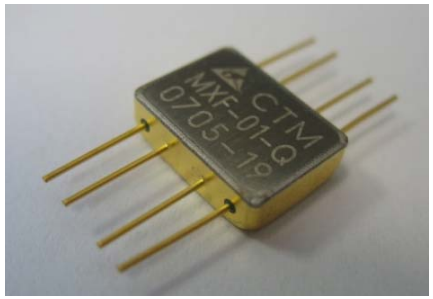
RF HYBRIDS & ECI ACTIVITIES

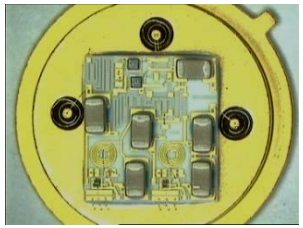
PHASE 1 (2006-2008): 3 PROJECTS

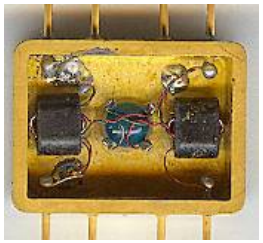
DEVELOPMENT AND QUALIFICATION OF 4 EUROPEAN MICROWAVE HYBRIDS

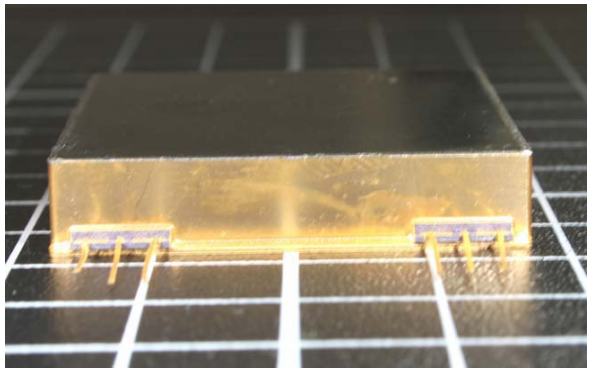
- 1 Cascadable Amplifier (AGT-01)
- 2 Double Balanced Mixers (MXF-01 & MXF-02)
- 1 Image Rejection Mixer (MRF-01)

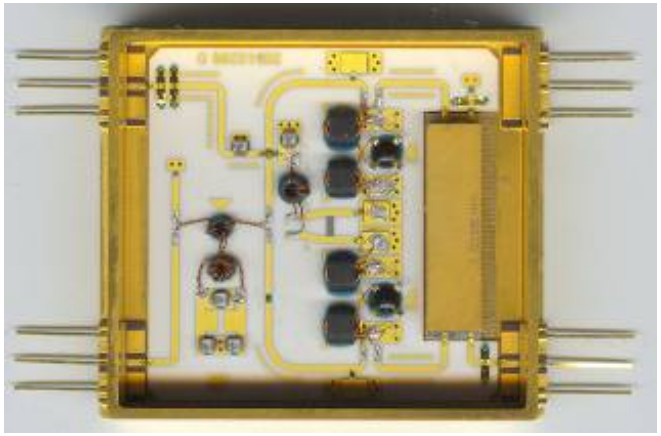










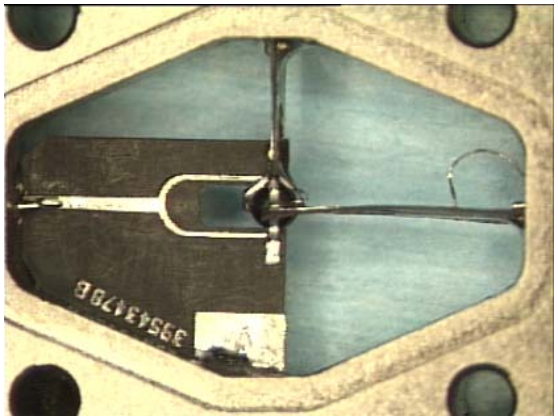


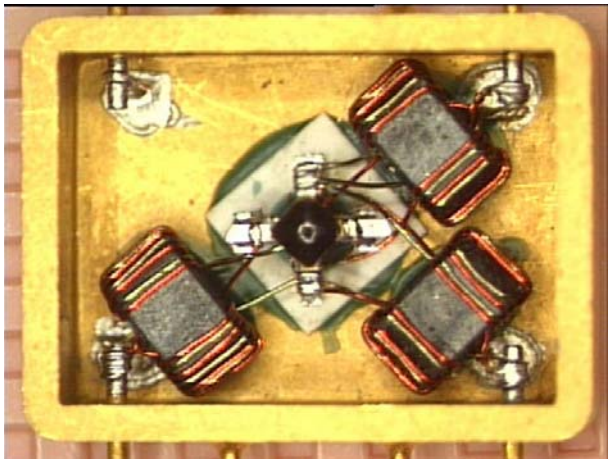
RF HYBRIDS & ECI ACTIVITIES

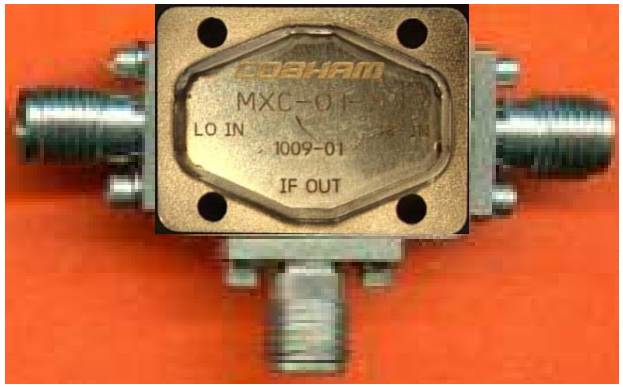
PHASE 2 (2009-2011):

DEVELOPMENT AND QUALIFICATION OF 2 EUROPEAN MICROWAVE HYBRIDS

- 1 Termination Insensitive Mixer (MXF-03)
- 1 Triple Balanced Mixer (MXC-01 in progress)







RF HYBRIDS & ECI ACTIVITIES

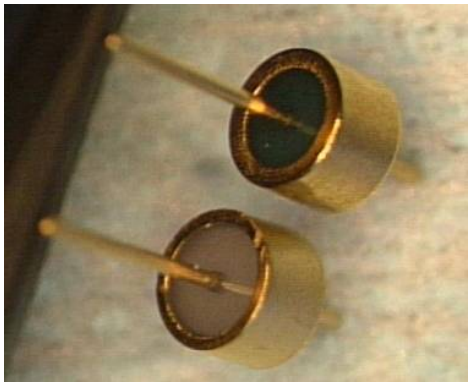
– **OBJECTIVES & KEY ASPECTS:**

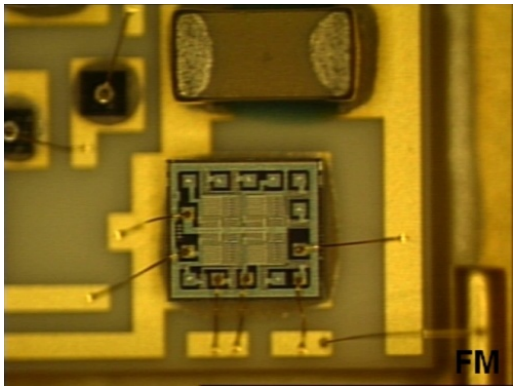
- Availability of EEE Components from European manufacturers
- Alternative to components available only from US -> ITAR free source
- Priority to European parts and technologies
- Design validation and qualification according to ECSS-Q-ST-60-05C
- Delivery of technical documents, full transparency with ESA
- Manufacturer validation (audit by ESA and CNES) -> Category 2
- Procurement, manufacturing, screening and lot testing according to ECSS-Q-ST-60-05C
- Introduction into EPPL
- Commitment for future manufacturing & procurements

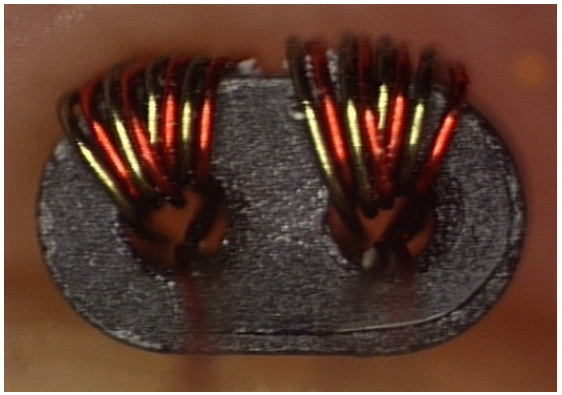
RF HYBRIDS & ECI ACTIVITIES

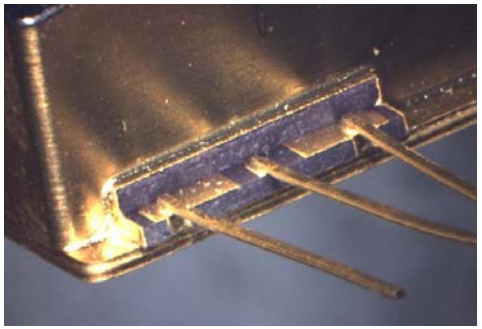
COBHAM MICROWAVE UNIQUE SET OF PROCESSES:

- Hermetic Kovar packages with matched glass or ceramic RF feedthroughs
- Ceramic & organic substrate attachment
- Bare chip attach and wire bonding (diodes and transistors)
- Ferrite core wire winding
- Adhesive and solder attachment of passive devices





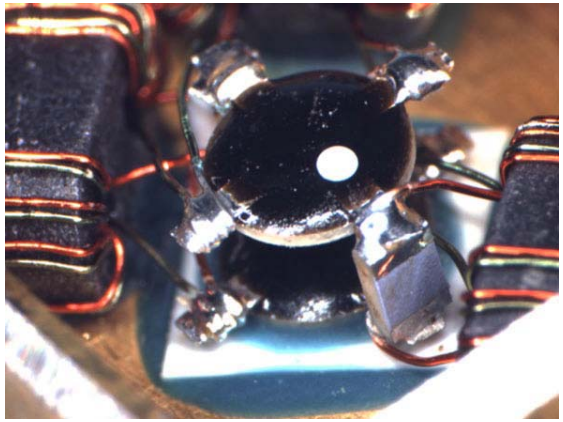


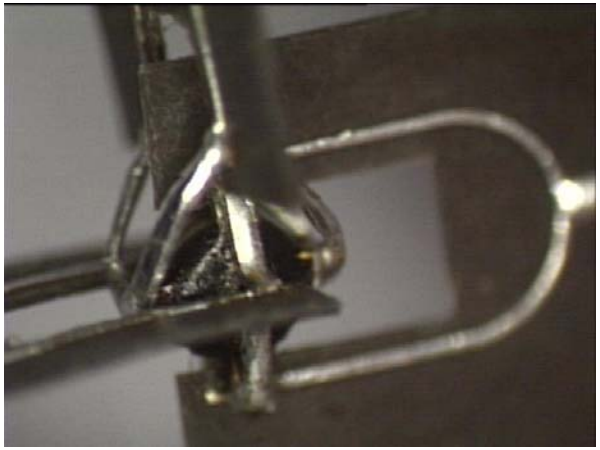


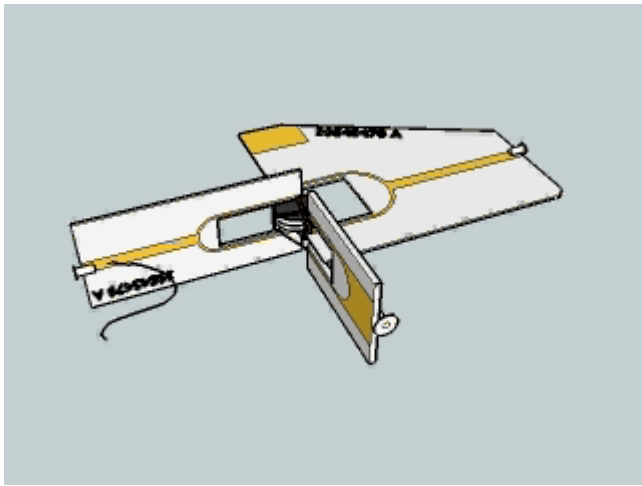
RF HYBRIDS & ECI ACTIVITIES

COBHAM MICROWAVE UNIQUE SET OF PROCESSES:

- Controlled atmosphere soldering (AuSn and soft solder)
- Manual iron soldering for assembly of complex 3D structures
- RF tuning



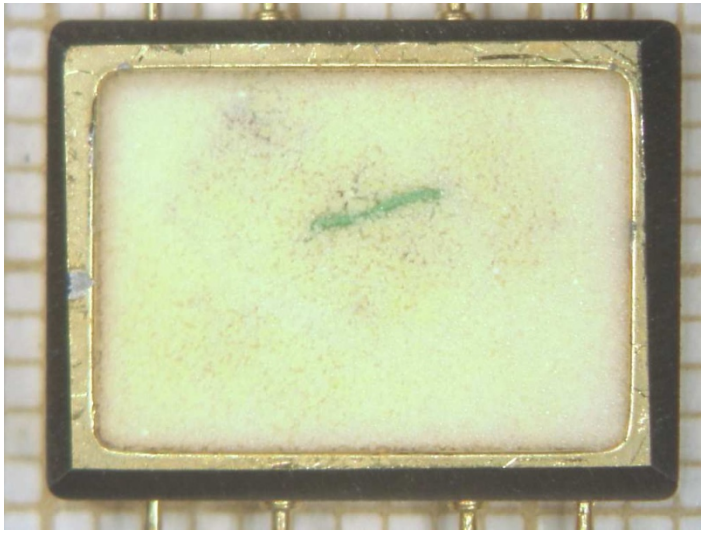




RF HYBRIDS & ECI ACTIVITIES

COBHAM MICROWAVE UNIQUE SET OF PROCESSES

Cavity filling with foam

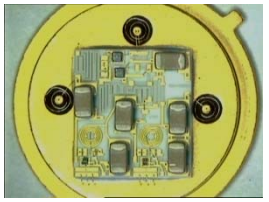


Hermetic sealing (seam, electric, laser)

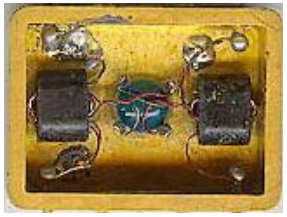
Controlled residual gas (RGA test)

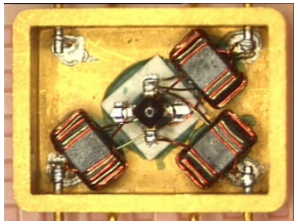
RF HYBRIDS & ECI ACTIVITIES

COBHAM MICROWAVE QUALIFIED MODULES:

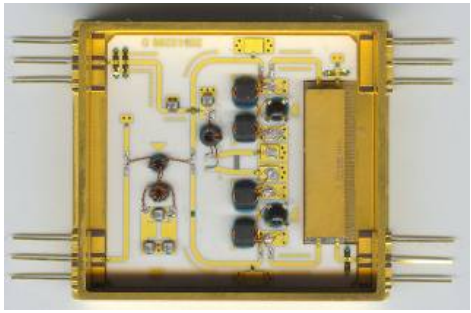


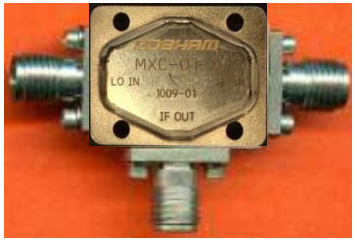
- Cascadable amplifier:
  - 2-500 MHz, general purpose





- Mixers:
  - Double balanced:
    - 0.5 To 500 MHz
    - 10 to 1500 MHz
  - Terminaison Insensitive
    - 0.001 to 3500 MHz
  - Image reject
    - 1.500 MHz to 1650 MHz with IF @ 90 to 190 MHZ
  - Triple Balanced
    - 2 to 18 GHz: qualification in progress





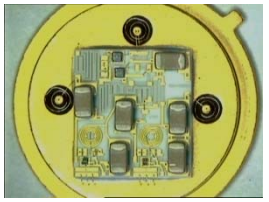
4 Specific PIDs

RF HYBRIDS & ECI ACTIVITIES

COBHAM

esa

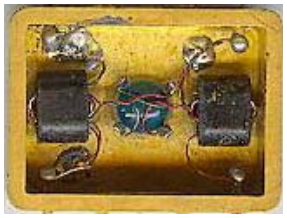
ESCC

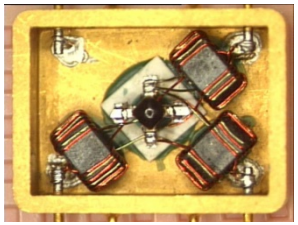


EPPL | *European Preferred Parts List*

Issue: 17

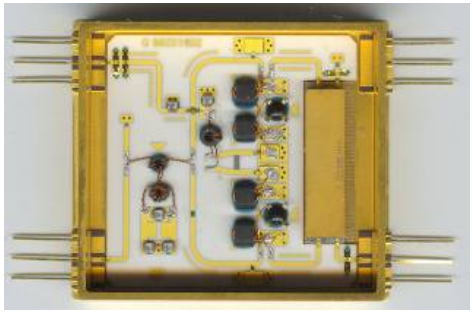
Issue Date: 2010-12-15





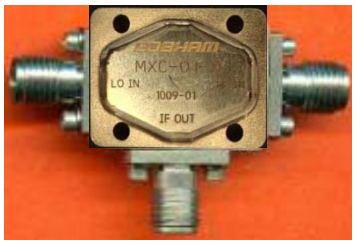
40 HYBRIDS | 02 THIN FILM

Part	Part Type	Description	Det Specification	Package	Manufacturer(s)	Remarks
2	AGT-01	Cascadable Amplifier (5-250 MHz) High Gain two stage 31 dB Medium output level +8.5 dBm Low VSWR < 1.3:1 Supply power range +8V to +15V	TD200368-178	TO-8	CHELTON TELECOM & MICROWAVE	



40 HYBRIDS | 99 MISCELLANEOUS

Part	Part Type	Description	Det Specification	Package	Manufacturer(s)	Remarks
2	MXF-01	Image Reject Mixer, variant V1=RF>LO, variant V2=RF<LO, LO to RF@1500 to 1650MHz=28 dB min., LO to IF@30 to 1510MHz= 35 dB min., Image Reject Ratio = 20 dB min., Hermetically Sealed, Ceramic Flatpack Package. Operating temperature range: -55 to +125 °C	TD200450-178D	FP	CHELTON TELECOM & MICROWAVE	
2	MXF-01	Double Balanced Mixer (0.5 to 500 MHz), Conversion Loss: 7 dB max., Isolation: LO to RF, LO to IF @ midband: 35 dB min., RF to IF @ midband: 25 dB min., Hermetically Sealed. Operating Temperature Range: -55 to +125 °C	TD200369-178 Issue A	FP	CHELTON TELECOM & MICROWAVE	
2	MXF-02	Double Balanced Mixer 10 to 1500 MHz Operating temperature range: -55 to +125 °C	TD200370-178 Issue A	FP	CHELTON TELECOM & MICROWAVE	
2	MXF-03	Termination Insensitive Mixer (1 to 3500 MHz), Isolation:LO to RF and LO to IF: 20 dB min. and RF to IF : 18 dB min., SSB Conversion Loss (RF to IF [60MHz] port): from 7.8 to 9.8 dB max., 3rd order intermodulation ratio degradation @ IF VSWR 3: 1: 3 dB typ., Hermetically Sealed, Metal Flatpack package. Operating Temperature Range: -55 to +125 °C	TD200542-178 Issue B	FP	CHELTON TELECOM & MICROWAVE	



RF HYBRIDS & ECI ACTIVITIES

Design activity:

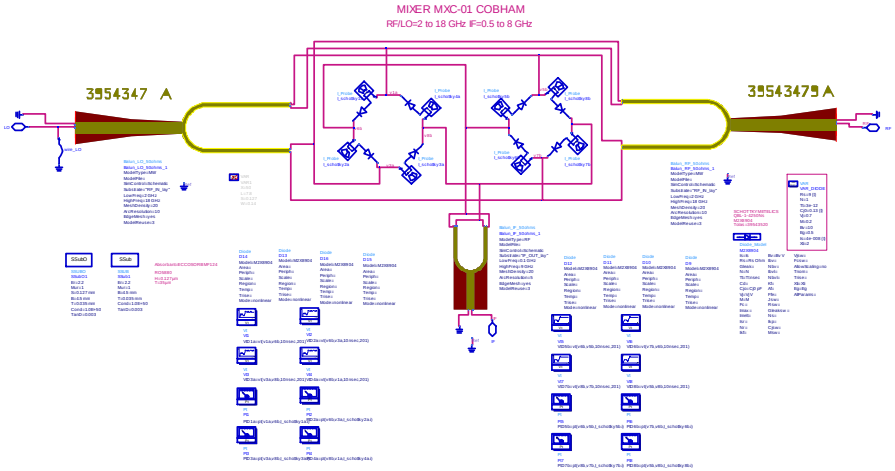
- Simulation, analysis
- Component evaluation, derating
- FMECA, WCA, reliability calculation
- Step stress tests, max ratings

Hybrid documentation:

- Detail specifications
- DCL, DML, DPL
- PADs
- HTIF

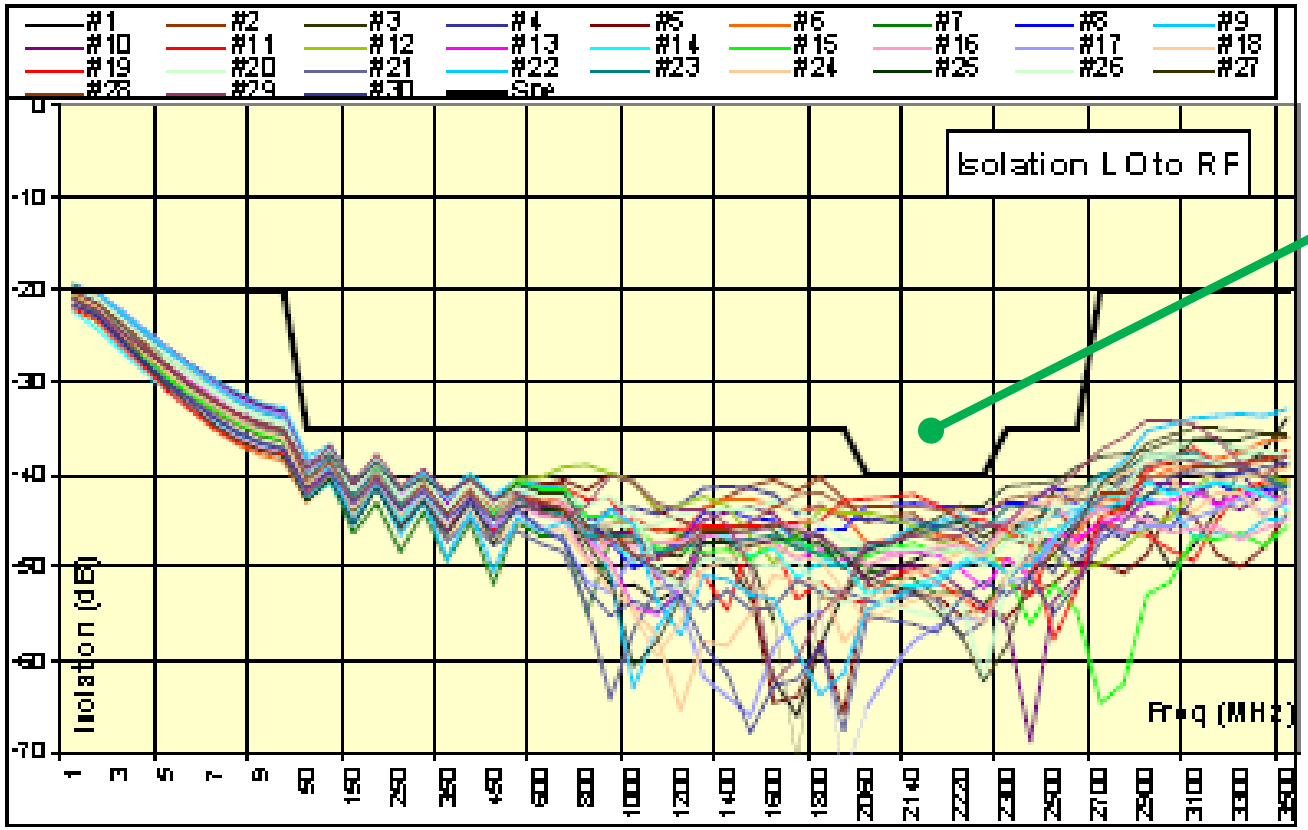
Customer oriented:

- Dialogue with the Agencies and Customers (Microwave CTB)
- Understanding of performance and integration needs
- Flexibility
- Specific tunings or measurements
- Management of specification amendments

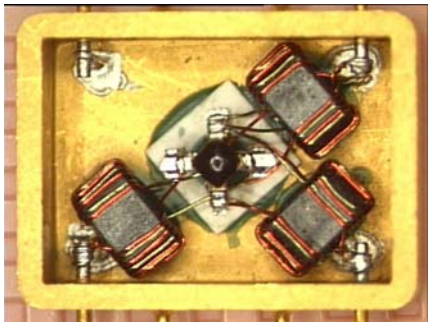


RF HYBRIDS & ECI ACTIVITIES

S/N of units

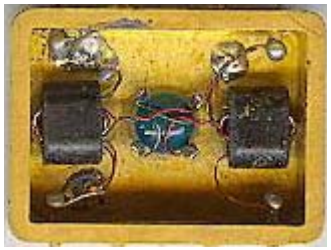


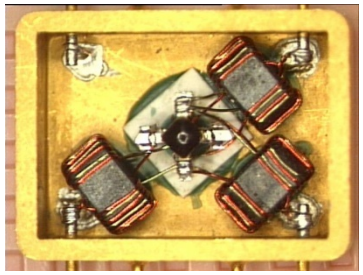
Custom tuning of MXF-03



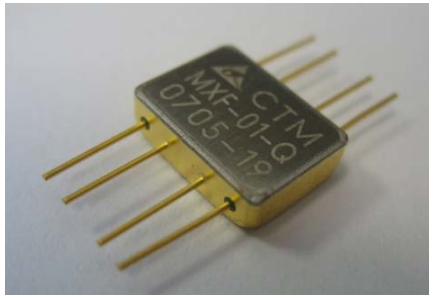
RF HYBRIDS & ECI ACTIVITIES

COBHAM QUALIFIED HYBRIDS PROGRAM SUCCES:





- Mixers:
  - Double balanced:
    - 0.5 To 500 MHz : ***MXF-01***: Galileo, Exomars
    - 10 to 1500 MHz : ***MXF-02:*** Sentinel III
    - \+ various programs
  - Terminaison Insensitive
    - 0.001 to 3500 MHz : ***MXF-03:*** Galileo, Exomars
    - \+ various programs
  - Triple balanced:
    - 2-18 GHz : ***MXC-01:*** Sampling in progress for several programs (e.g. radar altimeters)



- As of today: more than 250 FM already shipped and more than 500 FM to come on existing programs (ie Galileo...)

OTHER RF SPACE HYBRIDS

CAPABILITY TO PROVIDE ALSO:

- VCOs
- Attenuators
- Switches
- I&Q modulators
- Dividers
- Couplers

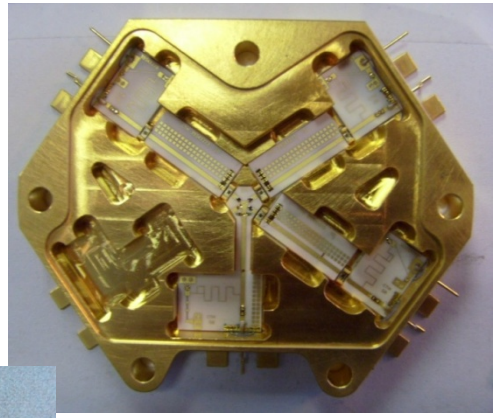
FLAT-PACK, PIN OR CONNECTORIZED PACKAGES

CIRCUIT TYPE APPROVAL / LAT TAILORING DEPENDING ON THE DEGREE OF SIMILARITY

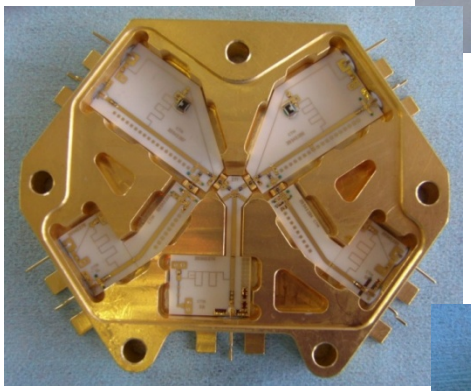
OTHER SPACE RF HYBRIDS

PIN Diode Switches:

- Frequency : 2000 to 2300 MHz
- Isolation : > 50 dB
- Switching speed : < 10 µs
- Phase stability : < 1°
- Bias voltage : +5V (20 mA)
  -12V

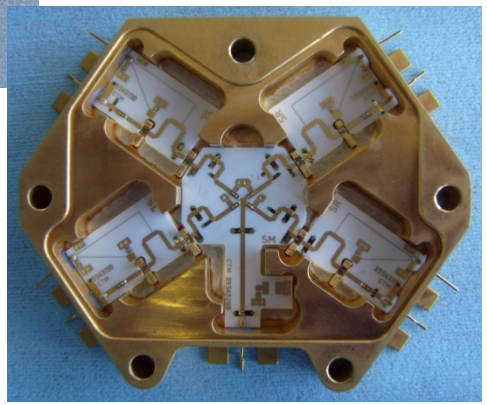


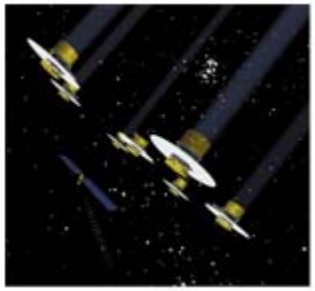
– SP2T (*low power, pseudo absorptive*)
  - Insertion loss : < 0.6 dB
  - Input power : 0 dBm



– SP2T (*high power, absorptive*)
  - Insertion loss : < 1 dB
  - Input power : + 37,5 dBm

– SP4T (*high power, reflective*)
  - Insertion loss : < 1.2 dB
  - Input power : + 37,5 dBm



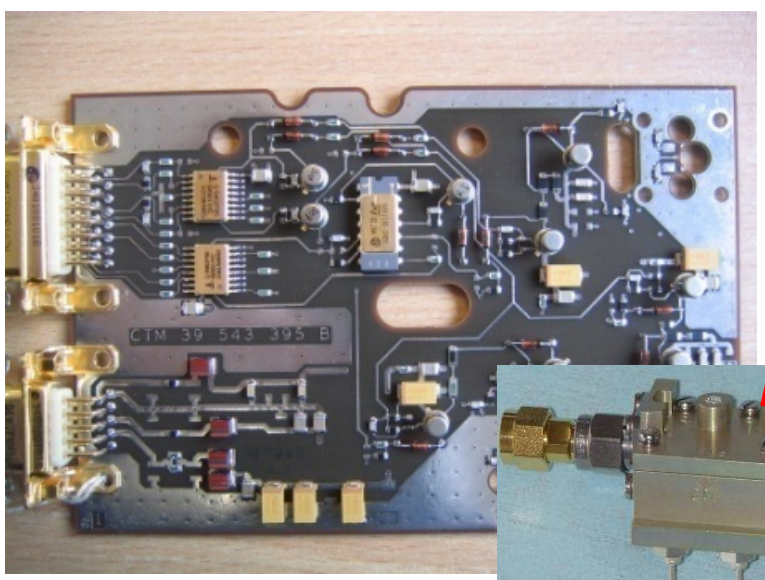


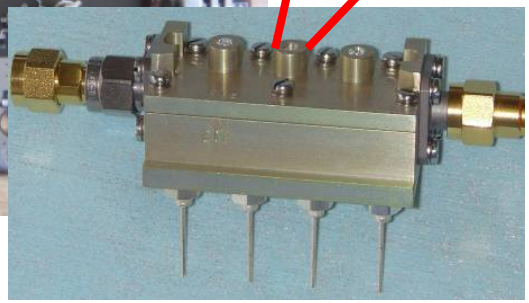
Prisma & Proba III programs

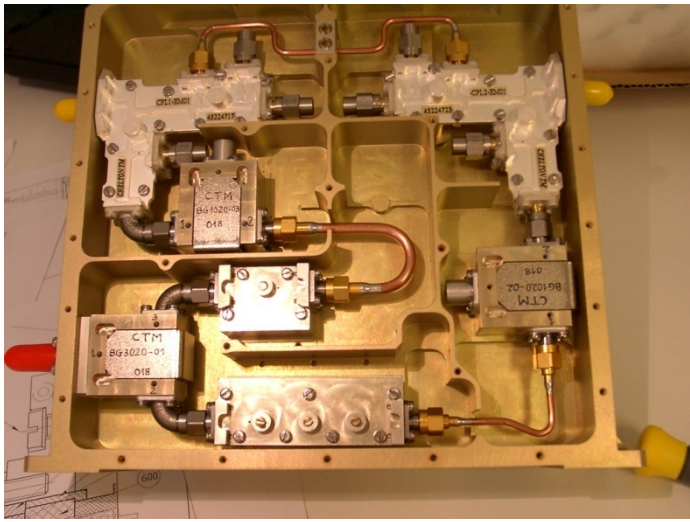
OTHER SPACE RF HYBRIDS

Switch:

- Tx & Rx SPST + Driver
  - Frequency : 5 GHz +/- 50 MHz
  - Insertion loss : < 0.4dB
  - Isolation : > 95 dB, target 100 dB
  - Input power : 40 W peak, 115 µs @ 412 Hz PRF







Full duplexer with:
- Switches
- Couplers
- Circulators/isolators
- Filters

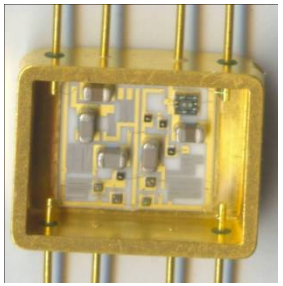
(all from Cobham Microwave)

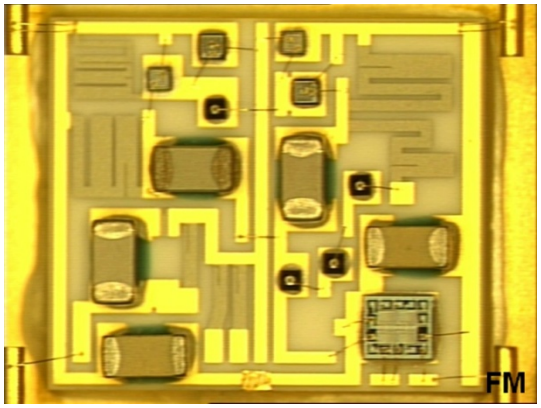
Radar Altimeter for Jason, Poseidon, Sadko and Sentinel3 missions…

OTHER SPACE RF HYBRIDS

PIN Diode Switch Drivers

- TTL or HCMOS
- Flat pack package

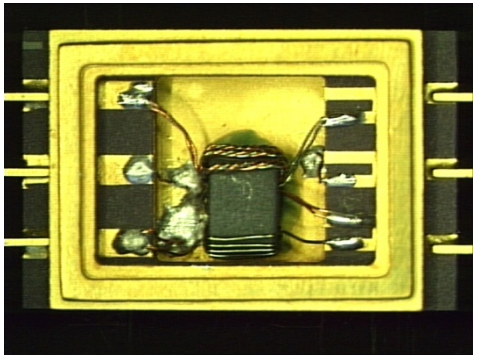


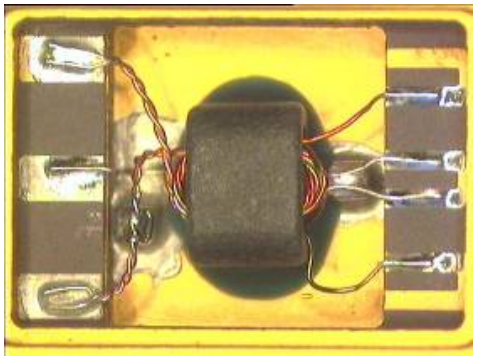


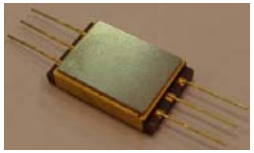
Prisma & Proba III programs

Transformers (EPPL in progress)

- 2 to 1200 MHz
- Ratio: 1:1 & 1:4
- Flat pack package, metal/ceramic
- Analog/Digital adaptor





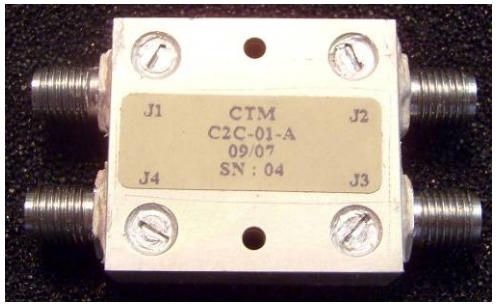


Artes & Artemis programs

OTHER SPACE RF HYBRIDS

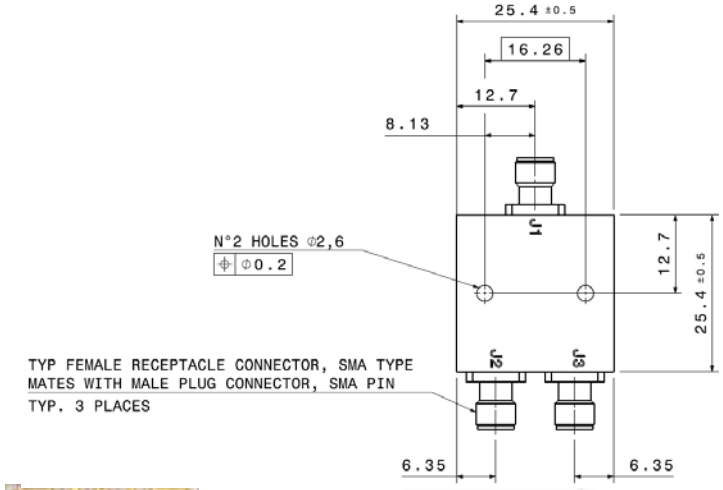
Customer specification

- Coupler
  - US part replacement in very short time
  - 3 dB, hybrid coupler
  - VHF & HUF band
    - **Rascom program**



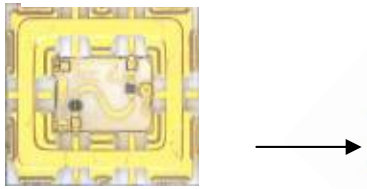
In development

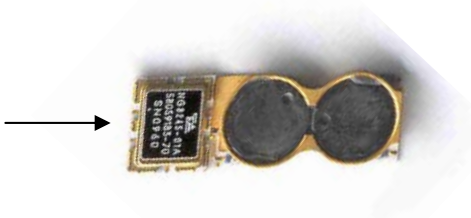
- 3 dB Coupler
  - X band
  - 10 to 20% BW
  - With or without internal load
- Directional coupler
  - X band
  - 30dB main coupling
  - Low loss: < 0,15 dB
  - According to ECSS-3404



CIL

- Circulator Isolator Limiter
- S band
- ASAR program





SPACE RF & MICROWAVE HYBRIDS