

COBHAM

The most important thing we build is trust



ADVANCED ELECTRONIC SOLUTIONS

AVIATION SERVICES

COMMUNICATIONS AND CONNECTIVITY

MISSION SYSTEMS



ECI DAYS

Roma, September 29th & 30th 2016

Cobham Microwave

COBHAM MICROWAVE GENERAL OVERVIEW

ECI EXPERIENCE



COBHAM MICROWAVE GENERAL OVERVIEW

ECI EXPERIENCE



COBHAM MICROWAVE

Cobham Microwave belongs to Cobham group

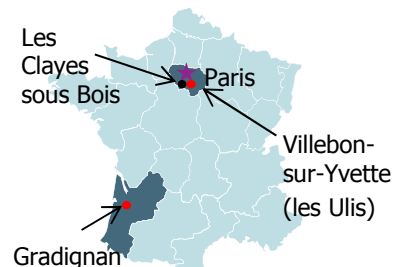
- Cobham group: ~ 12,000 people on 5 continents
- annual revenue approaching £2,3bn

Cobham Microwave profile

- 250 employees

Cobham Microwave facilities

- R&D and Manufacturing is organised on 3 strategic sites



Waveguides



Location:
Les Clayes sous Bois (Paris Region)
Products:
Space & radar waveguides

Microwave Components

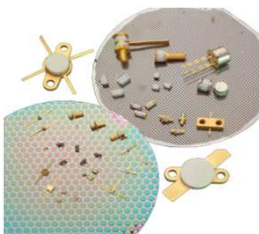


Location:
Villebon-sur-Yvette (Paris Region)
Products:
Diodes, Modules, Circulators & Isolators, Systems

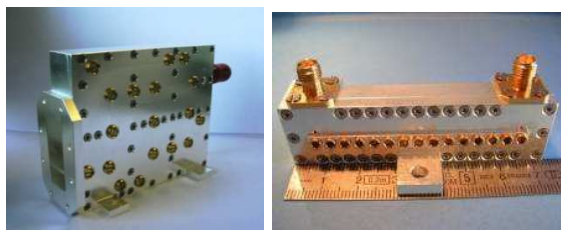


Location:
Gradignan (Near Bordeaux)
Products:
Filters R&D, manufacturing, High Power testing

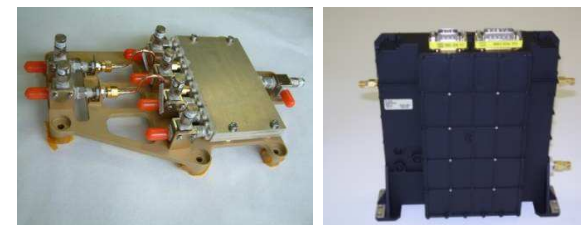
COBHAM MICROWAVE PORTFOLIO



Silicon Diodes

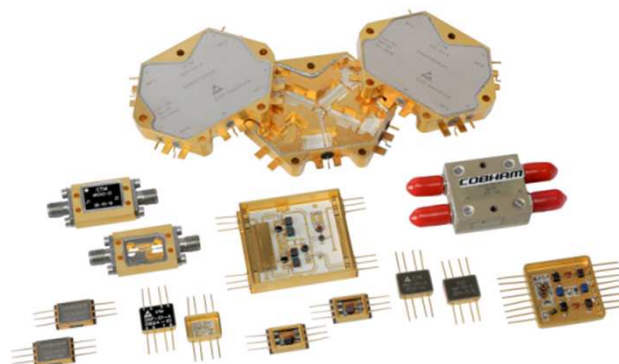


Filtres & Duplexeurs



Systems and Sub-systems

RF & Microwaves Modules



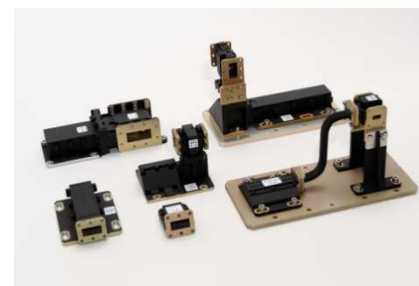
Tests bench



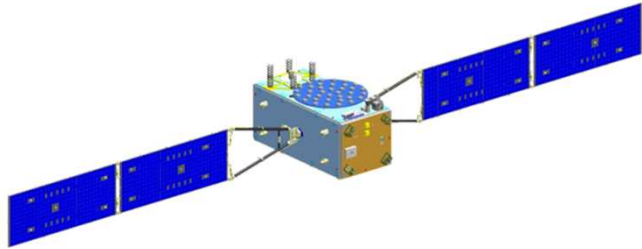
Waveguides components



Circulators et Isolators



COBHAM MICROWAVE SPACE APPLICATIONS



Satellite Payloads

- Telecommunication Systems
- TV Broadcasting
- Navigation: GPS, Galileo
- Military Applications
- Scientific, Exploration



Ground Stations

- Teleport
- Fixed or Mobile SATCOM
- Satellites tracking



COBHAM MICROWAVE HERITAGE

COBHAM

Zero failures
among our space
products

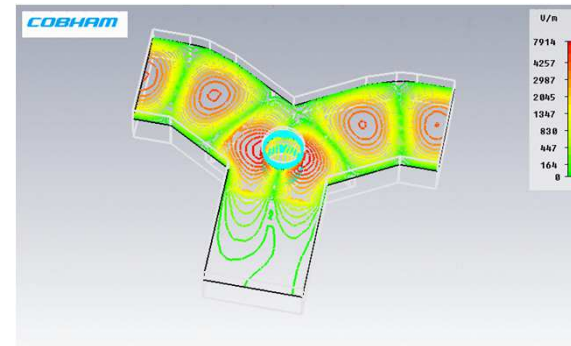
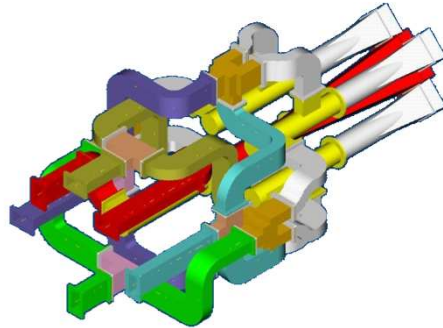




COBHAM

COBHAM MICROWAVE HERITAGE



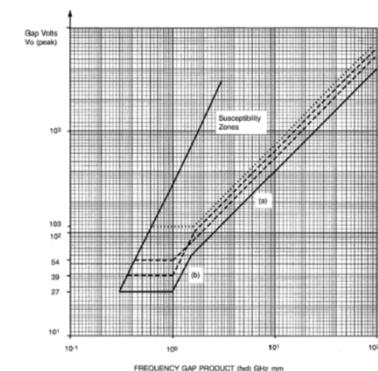
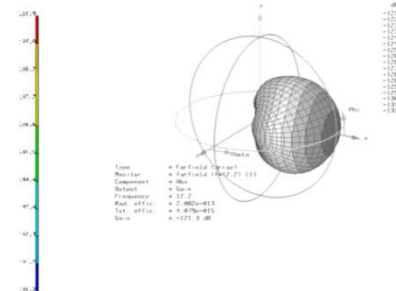
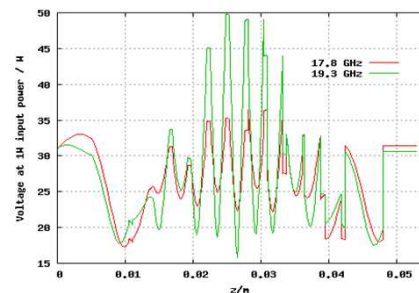


Cobham Microwave R&D

- engineering team know-how includes skills in electrical, mechanical, thermal, semiconductor processes, ferrite non-linear effects, Multipactor, intermodulation, system integration,...

Rapid development of prototypes

- allowed by both the use of state of the art softwares and I of R&D engineers nearby the mechanical workshop.



COBHAM MICROWAVE CAPABILITIES

Cobham Microwave

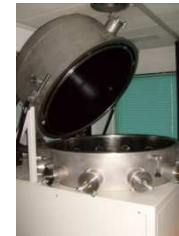
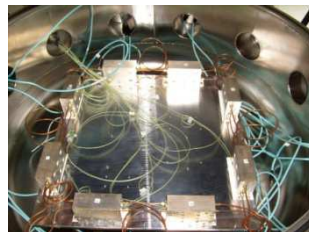
- in-house Space and MIL qualified processes include microelectronics, milling, fitting, assembling, brazing,
- surface treatment, painting,...



COBHAM MICROWAVE CAPABILITIES

Cobham Microwave in-house Space and MIL screening processes

- electrical testing,
- thermal vacuum cycling, High power testing,
- semiconductor testing, Life tests (HTRB, PBI,...), Die shear tests, Pull tests,
- Gross and fine leakage,
- Vibrations and accelerations test, PIND tests (Particle Impact Noise detection)....



COBHAM MICROWAVE GENERAL OVERVIEW

ECI EXPERIENCE



European Components Initiatives Experience

Cobham Microwave had won 5 contracts

- 2006 – contract # 19455/NL/IA: development and qualification of General Purpose Amplifier
 - AGT-01 : 5 to 250 MHz, 31 dB Gain
- 2006: – contract # 19454/05/NL/IA: development and qualification of Double Balance Mixer
 - 2 types:
 - MXF-01 : (RF/LO): 0,5 – 500 MHz; IF: DC-500 MHz
 - MXF-02 : (RF/LO): 0,5 – 1500 MHz; IF: DC-1500 MHz
- 2007 – contract # 20204 development and qualification of Image Reject Mixer
 - MRF-01: RF : 1500-1650 MHz; LO : 1360-1510 MHz; IF : 90-190 MHz
- 2008 – contract #22209 development and qualification of Terminaison Insensitive Mixer
 - MXF-03: (RF/LO): 0.001 – 3.5 MHz; IF: 5-1500 MHz
- 2012 – contract #22617/09/NL/CP: development and qualification of Triple Balanced Mixers
 - MXC-01: (RF/LO): 2 – 18 GHz; IF: 0,5 – 8 GH

European Components Initiatives Experience

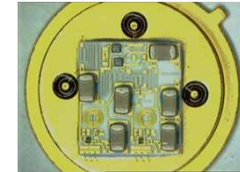
Status

- General Purpose Amplifier *design Successful and qualified*
 - AGT-01 : 5 to 250 MHz, 31 dB Gain
- Double Balance Mixer *designs Successful and qualified*
 - 2 types:
 - MXF-01 : (RF/LO): 0,5 – 500 MHz; IF: DC-500 MHz
 - MXF-02 : (RF/LO): 0,5 – 1500 MHz; IF: DC-1500 MHz
- of Image Reject Mixer *design Successful and qualified*
 - MRF-01: RF : 1500-1650 MHz; LO : 1360-1510 MHz; IF : 90-190 MHz
- Terminaison Insensitive Mixer *design Successful and qualified*
 - MXF-03: (RF/LO): 0.001 – 3.5 MHz; IF: 5-1500 MHz
- Triple Balanced Mixers *design Successful and qualified*
 - MXC-01: (RF/LO): 2 – 18 GHz; IF: 0,5 – 8 GHz

European Components Initiatives Experience

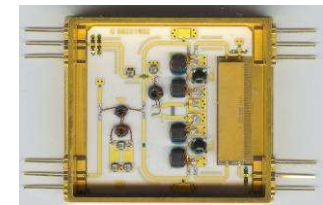
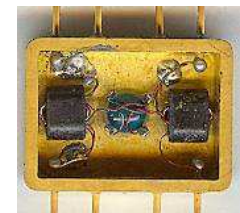
Cascadable amplifier:

- 2-500 MHz, general purposes: Spec. detail AGT-01



Mixers:

- Double balanced:
 - 0.5 To 500 MHz: Spec. Detail MXF-01
 - 10 to 1500 MHz: Spec. detail MXF-02
- Terminaison Insensitive
 - 0.001 to 3500 MHz : Spec. Detail MXF-03
- Image reject: Spec. detail IRM
 - 1.500 MHz to 1650 MHz with IF @ 90 to 190 MHz
- Triple Balanced
 - 2 to 18 GHz: qualification in progress, Spec detail MCX-01



All items now on EPPL: European Preferred Part List

In progress for TBM

European Components Initiatives Experience

Design activity:

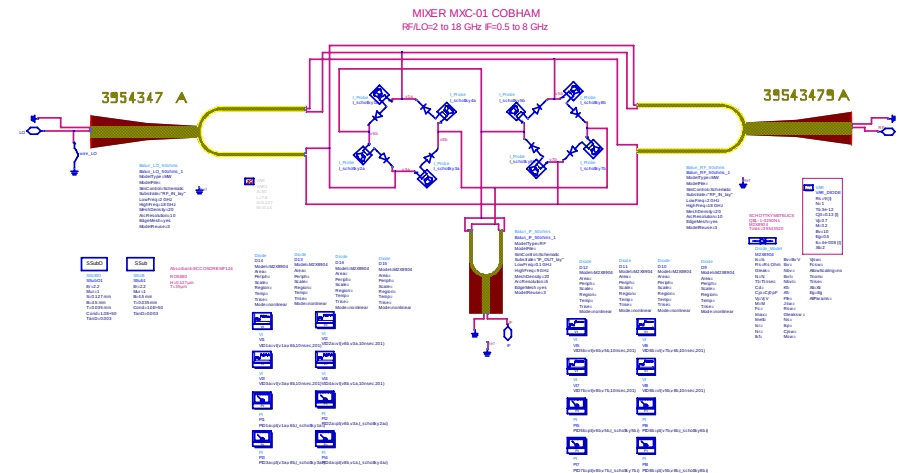
- Simulation, analysis
- Component evaluation, derating
- FMECA, WCA
- reliability calculation
- Step stress tests, max ratings

Hybrid documentation:

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

Adaptation to end user needs

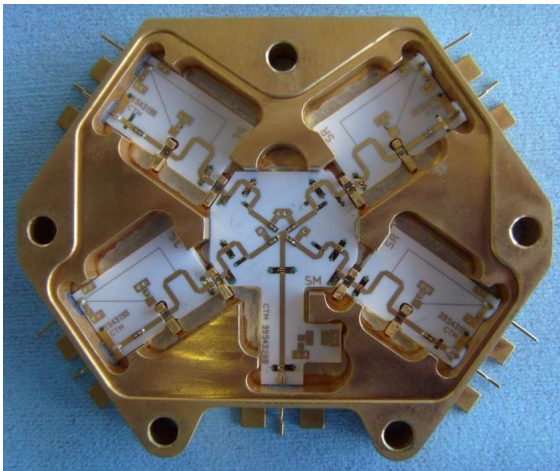
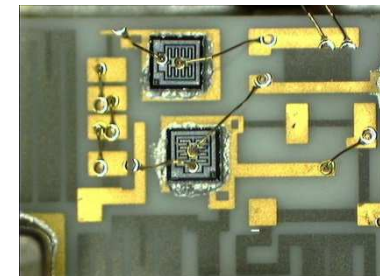
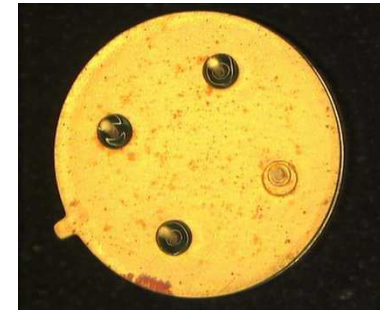
- Flexibility of design for specific requirements
 - Variant introduction
 - Management of specification amendments



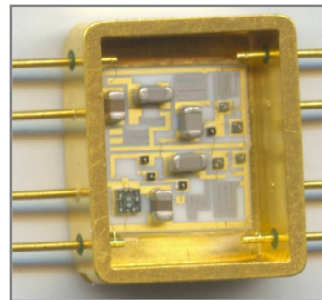
COBHAM ECI IMPACT MARKET

General Purpose Amplifier: AGT-01 : 5 to 250 MHz, 31 dB Gain

- Direct market impact
 - Some demand
- Undirect market impact
 - Significant
 - Based on hybrid technologie of AGT-01
 - Switches and Drivers



Prisma & Proba III programs



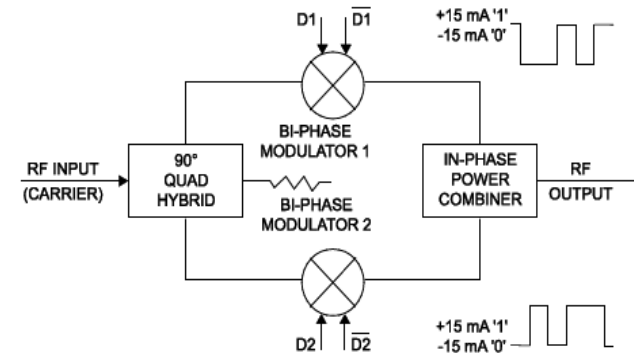
- Switch:
 - SP2T & SP4T
 - 2 to 2,3 GHz
 - Up to 10 W CW handling power
- Drivers
 - Full TTL logic

European Components Initiatives Experience

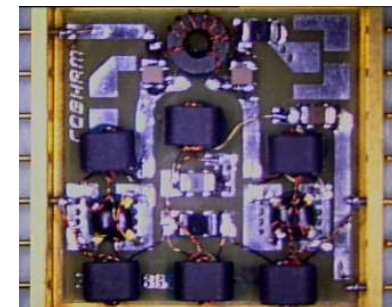
MRF-01: RF : 1500-1650 MHz; LO : 1360-1510 MHz; IF : 90-190 MHz

- Undirect
 - Development of I&Q Demod

I&Q Mod / Demodulator



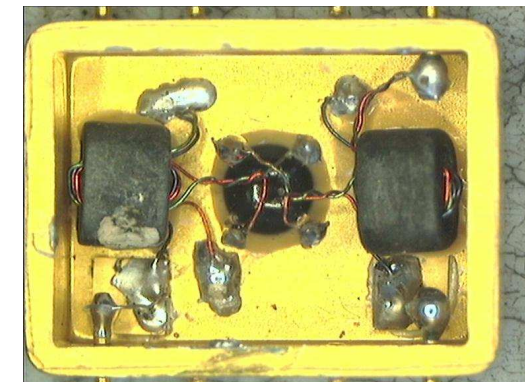
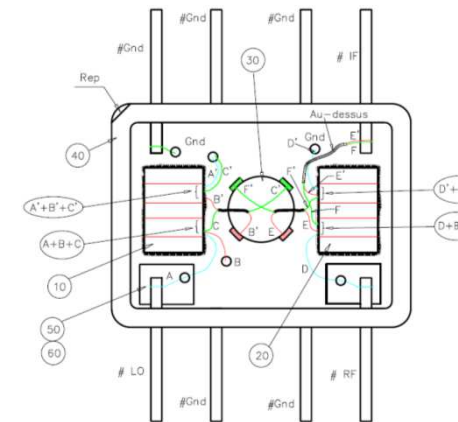
PARAMETERS	Min.	Max.	UNIT
LO frequency range, 10% bandwidth	30	-	MHz
RF frequency range	5	100	MHz
I & Q bandwidth frequency range	DC	100	MHz
Conversion Loss @ 30 MHz		11	dB
Amplitude balance		± 0.5	dB
Phase balance		90 ± 5	°
Isolation OL to RF		45	dB
Isolation OL to IF and Q		45	dB
Isolation RF to IL		30	dB
Temperature range	-55	+ 85	°C



European Components Initiatives Experience

MXF-01 : (RF/LO): 0,5 – 500 MHz; IF: DC-500 MHz

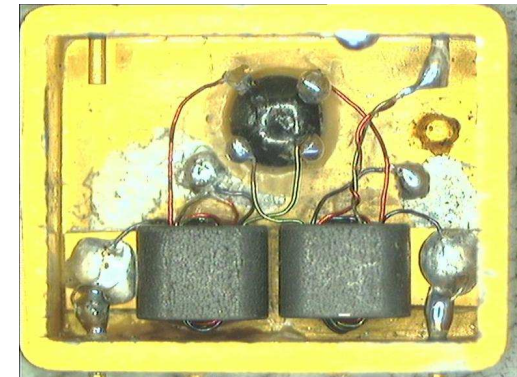
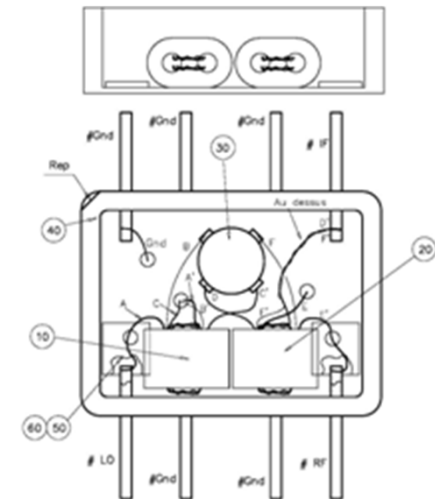
- Direct market impact
 - real succes, regular demand
 - various programs
 - Galileo
 - Real potential on this program (> 300 FM)
 - Scientific missions:
 - JACSA
 - Mars Explorer
 - Amazonas 5...
- Undirect market impact: see next pages



European Components Initiatives Experience

MXF-02 : (RF/LO): 0,5 – 1500 MHz; IF: DC-1500 MHz

- Direct market impact
 - Higher succes than MXF-01
 - Sentinel III
 - Yahsat
 - Saocom...
- Undirect market impact: see next pages

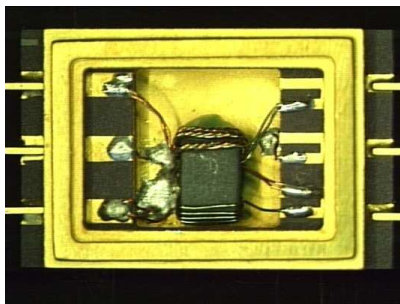


European Components Initiatives Experience

MXF-01 MXF-02 Undirect market impact

Impedance Transformers

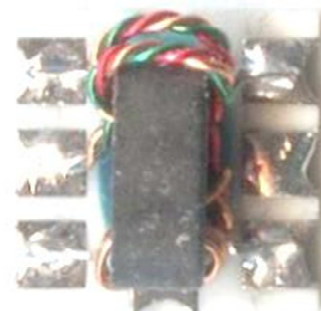
- Analog/Digital Converter (CAD)
- Flat pack package, no glass seal
 - 2 to 1200 MHz
 - Sub bandwidth
 - 1:1, 1:2, 1:4 Ratio



Artes & Artemis, Cosmo programs

Impedance Transformers

- Digital Clock application
- SMD devices
 - 30 to 3500 MHz
 - 1 bandwidth
 - 1:1, 1:2, 1:4 Ratio

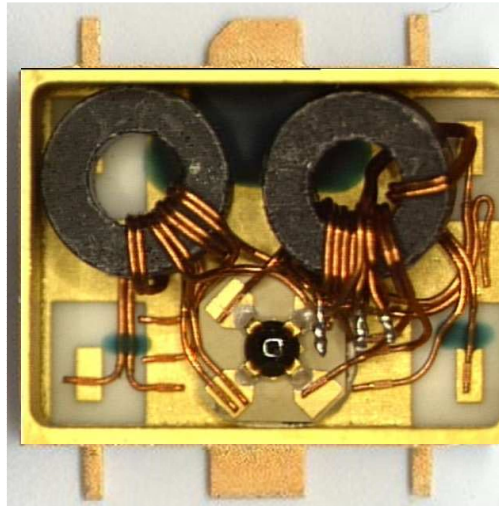


European Components Initiatives Experience

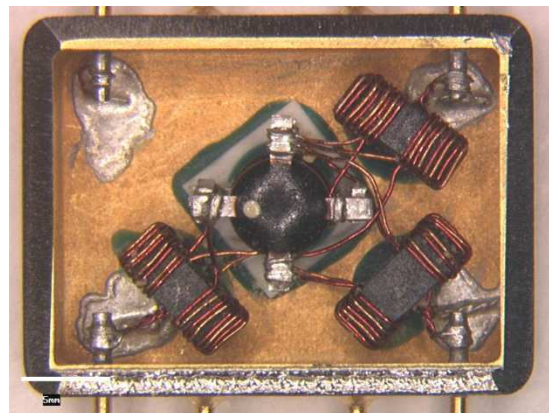
MXF-01 MXF-02 Undirect market impact

SMD Mixers

- 2 models are running
 - 10 to 1500 MHz
 - 200 to 800 MHz



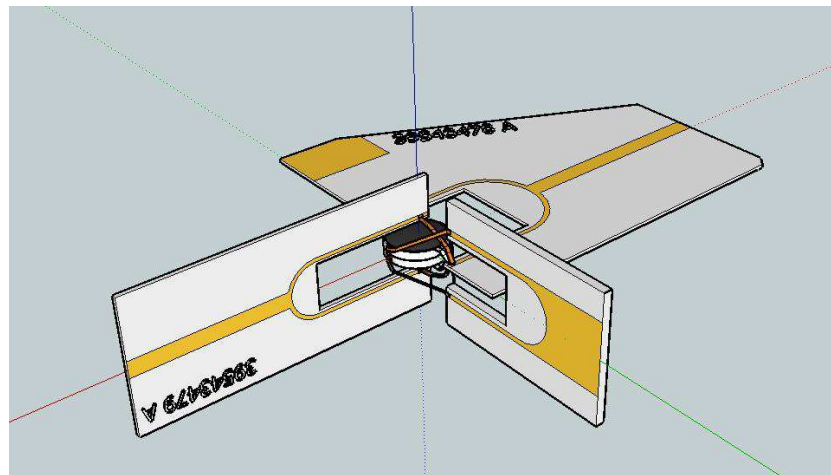
- Direct market impact
 - High runner
 - Baseline for few customers
 - Few variant with performances specific tuning



European Components Initiatives Experience

MXC-01: (RF/LO): 2 – 18 GHz; IF: 0,5 – 8 GHz

- Direct market impact
 - Very strong start
 - 2 current customers
 - Various request from the market coming



European Components Initiatives Experience

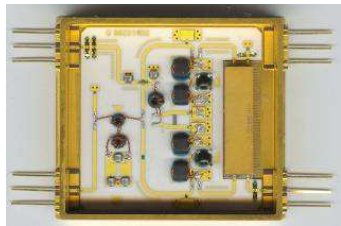
Conclusion

- Every p/n developped in the frame of ECI has been succesfull
 - On a direct way
 - Or via modules developped from non succesful unit
- ECI experience had build a very positive image of our company and allowed to develop a full line of space components, including passives Modules

Thanks to ESTEC for its very strong support!!!

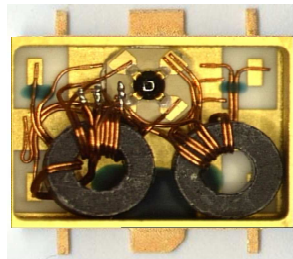
Current Cobham Space Modules Portfolio

Drop In modules: Up to 4 GHz



- ☐ Amplifier (ESA heritage)
- ☐ Mixer (ESA Heritage)
- ☐ Switch
- ☐ Power Divider
- ☐ 3 dB 90° & 180° Coupler
- ☐ Transformer
- ☐ Driver
- ☐ I&Q Demodulator

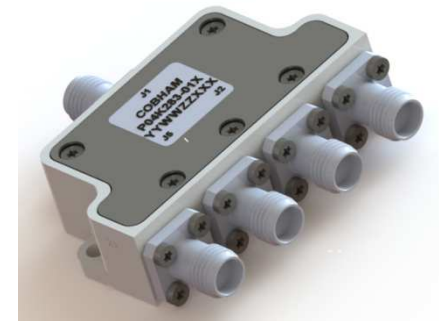
SMD modules: Up to 4 GHz



- ☐ Mixer
- ☐ Impedance Transformer



Connectorized modules: Up to 32 GHz

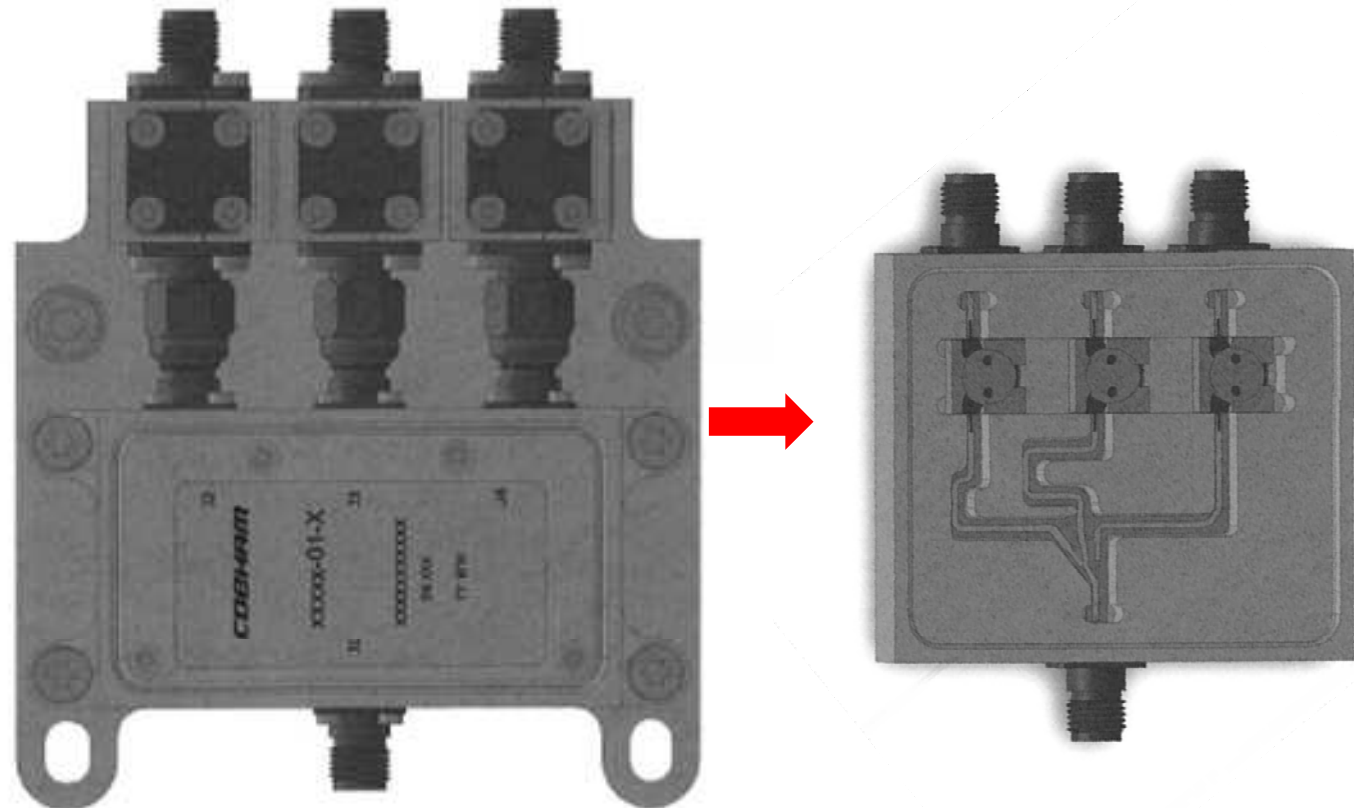


- ☐ Mixer (ESA Heritage)
- ☐ Switch
- ☐ Power Divider
- ☐ Directional Coupler
- ☐ 90° Hybrid Coupler

Roadmap : IsoDivider

Objectives:

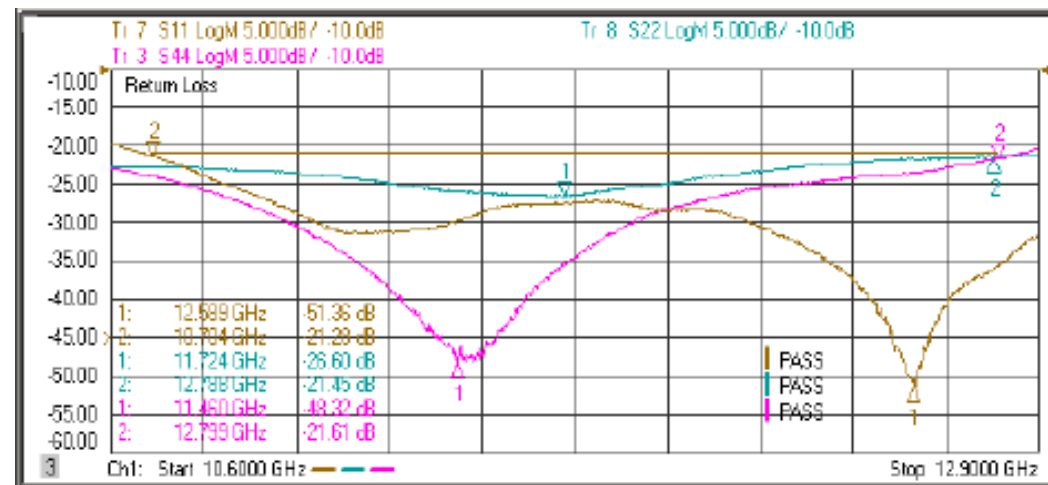
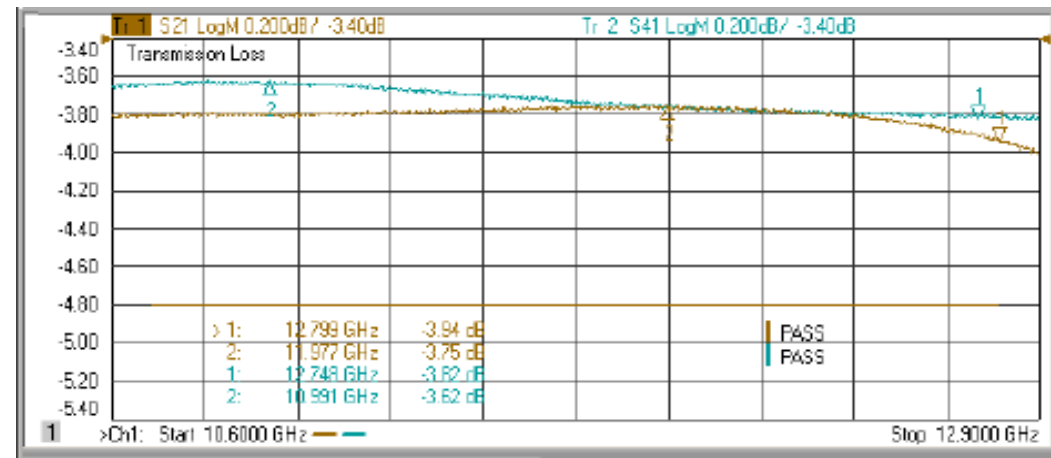
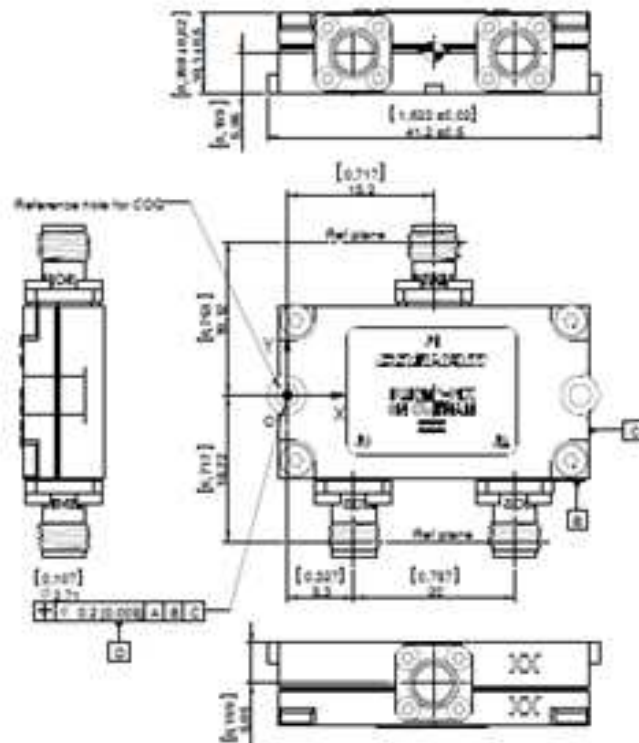
- Smaller size
- Lower mass
- Higher performances



Roadmap : IsoDivider

Iso Power Divider by 2

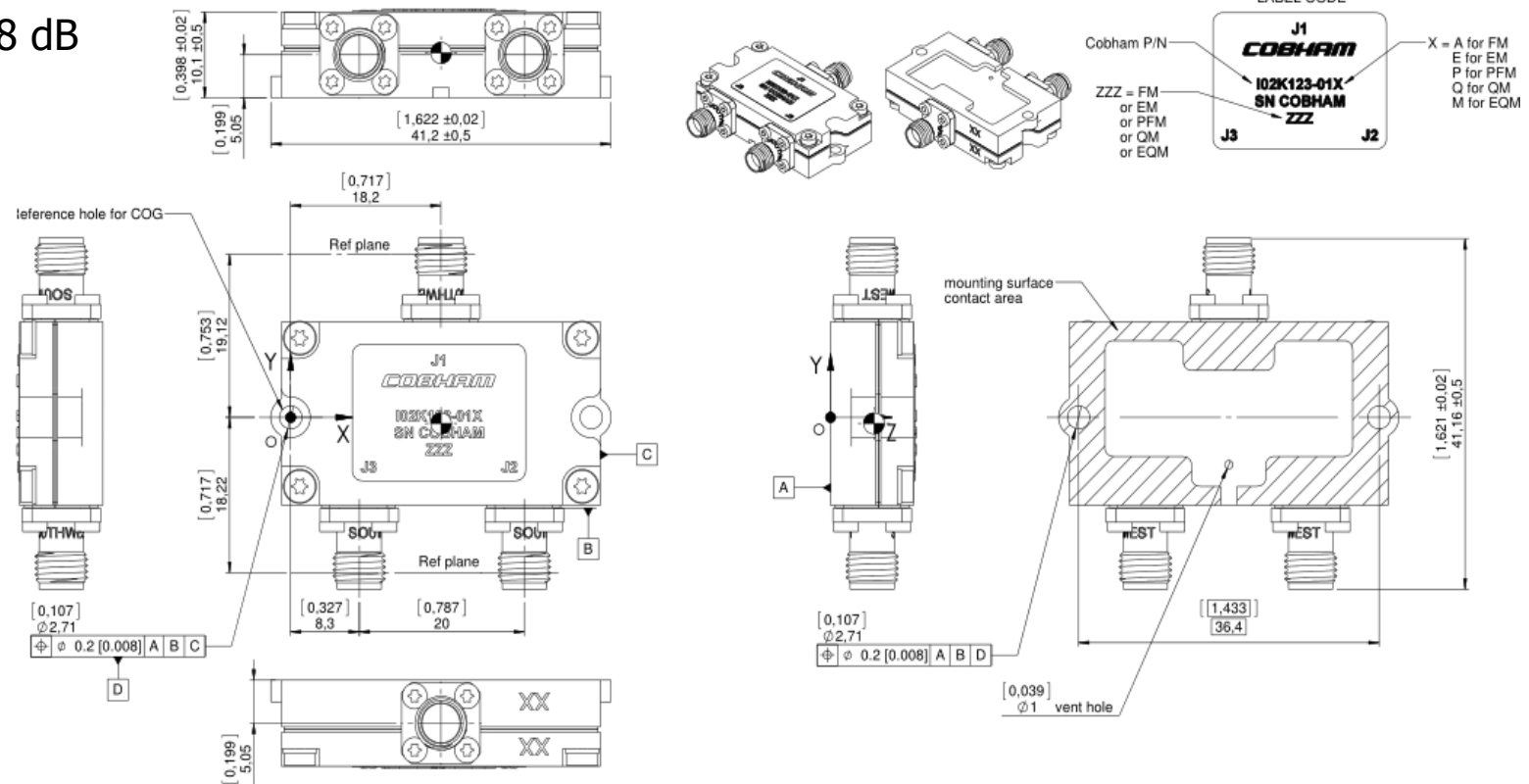
- 10,5 to 14,5 GHz:
- VSWR: 20 dB
- Isolation: > 38 dB, 40 dB typical



Roadmap : IsoDivider

Iso Power Divider by 2 Ka Band

- 17,3 to 18,6 GHz & 18,3 to 20,2 GHz
- VSWR: > 18 dB
- Isolation: > 38 dB



- Prototype step (target Sept 2016)

Roadmap : low VSWR, High Isolation Power Divider

- Power divider by 2, Ka band:

Target:

To meet low VSWR and high isolation.

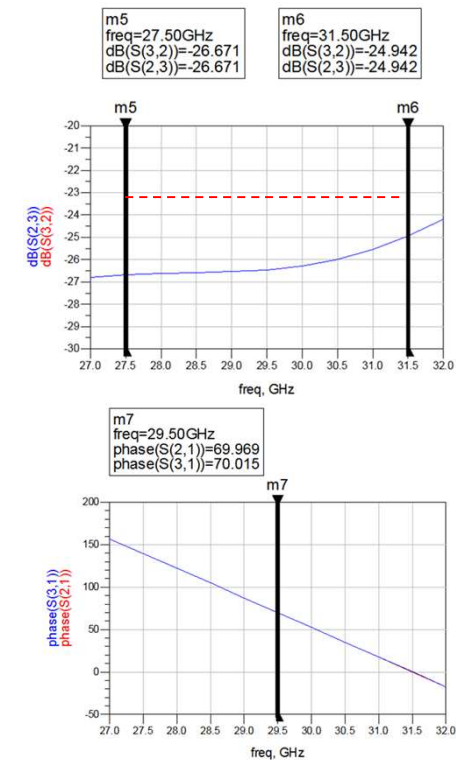
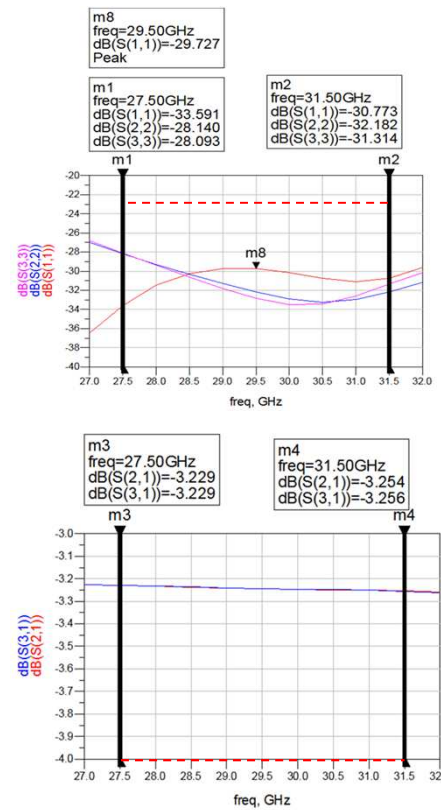
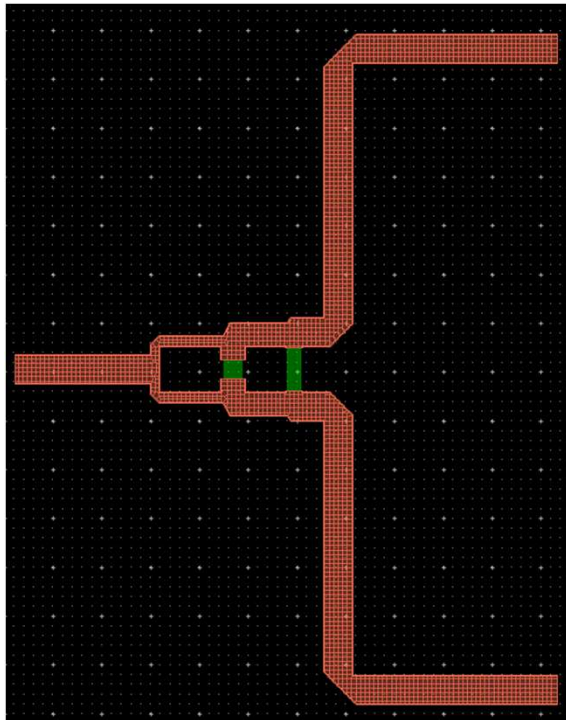
goal

To eliminate need of isolators

No	CHARACTERISTICS	SYMBOL	REQUIRED	UNIT
1	Frequency Range	f	27.5– 31.5	GHz
2	Number of input ports	-	1	-
3	Number of output ports	-	2	-
4	RF Power	P	1	w
5	Insertion Loss (including coupling)	IL	4	dB
5a	Insertion Loss Variation (in the frequency band)	IL vr	0.3	dBpp
5b	Insertion Loss Stability (over the temperature range)	IL st	0.2	dBpp
5c	Insertion Loss Stability over any 3° C	IL st	0.05	dBpp
5d	Insertion Loss Stability over any 10° C	IL st	0.1	dBpp
6	VSWR Input: Output:	Rli RLo	1.15 (23dB) 1.15 (23dB)	
7	Amplitude Unbalance pk-pk	AMb	0.3	dB
8	Phase Unbalance pk-pk	PHb	5	°
9	Isolation		23	dB
10	RF Leakage	E	75	dB
11	Interfaces			
	Input	-	SMA 2.9 female	-
	Output	-	SMA 2.9 female	-
12	Operating Temperature range	Top	-55/+85	°C
13	Storage Temperature Range	Tst	-55/+85	°C

Roadmap : low VSWR, High Isolation Power Divider

- Layout:



Simulation results:

- TOS= 28dB max
- IL=3,2 dB
- Isolation=25dB min

COBHAM

COBHAM

The most important thing we build is trust



**AEROSPACE AND
SECURITY DIVISION**

- Aerospace Communications
- Antenna Systems
- Commercial Systems
- SATCOM
- Tactical Communications and Surveillance



**DEFENCE SYSTEMS
DIVISION**

- Defence Electronics



**MISSION SYSTEMS
DIVISION**

- Aviation Services
- Life Support
- Mission Equipment

THANK YOU

Visit us at: www.chelton-tm.com