



# Thales Microwave & Imaging Sub-Systems

Journées accélérateurs 2023

# Thales MICROWAVE & IMAGING SUB-SYSTEMS expertise



SPACE



**N°1 WORLDWIDE**  
for space amplification

TUBES IN ORBIT  
**23 200**



DEFENCE



**N°1 EUROPE**  
for defence amplification



HEALTHCARE



**A WORLDWIDE LEADER**  
for radiological digital imaging

**50% OF ALL**

interventional X-ray examinations worldwide  
use a Thales detector



SCIENCE



**N°1 WORLDWIDE**  
for scientific amplification

**LONG STANDING PARTNER**  
with the most prestigious  
research centres and laboratories



SECURITY



**A WORLDWIDE PRECURSOR**  
in the Carbon Nano Tubes Technology  
(CNT)

**FIRST**

airport scanners based on CNT  
technology



INDUSTRY



**N°1 WORLDWIDE**  
for industrial amplification

# Our global presence in 2023



Vélizy

Industrial surface: 28 000 m<sup>2</sup>  
Employee: 740



Thonon

Industrial surface: 25 000 m<sup>2</sup>  
Employee: 250



Ulm

Industrial surface: 16 000 m<sup>2</sup>  
Employee: 400



Moirans

Industrial surface: 19 600 m<sup>2</sup>  
Employee: 490



Yokneam

Industrial surface: 2250 m<sup>2</sup>  
Employee: 55



Shanghai

Industrial surface: 1600 m<sup>2</sup>  
Employee: 20

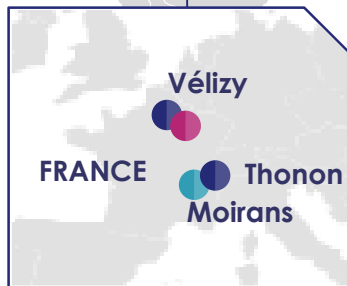
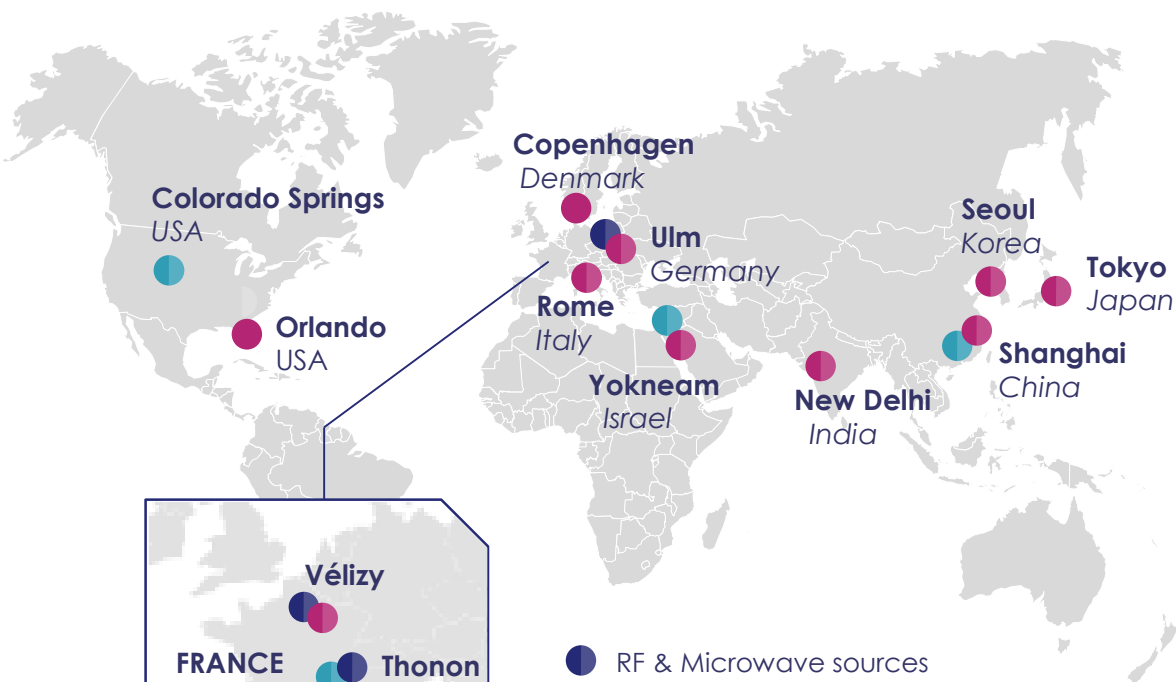


Colorado Springs

Industrial surface: 16 700 m<sup>2</sup>  
Employee: 130



3



● RF & Microwave sources  
Production centres

● Radiology  
Production centres

● Sales offices

THALES

# Our specific skills & expertise

TWT  
Klystrons  
Gyrotrons  
Amplifiers  
SSPA



## RF power solutions



Grid Tubes  
Tetrodes  
Diacrodes

## More than 50 skills

<b>Technical expertise</b>	<b>Heterogeneous assembly</b> Soldering, welding, thermal treatments	<b>Carburation</b>	<b>Chemistry</b> Metallisation Thin films Coatings	<b>Strong electric fields and high voltage tests, Extreme conditions</b>
<b>Metallisation of ceramics</b>		<b>Ultra-high Vacuum (UHV) techniques</b>		
<b>Amplification</b> by RF waves / electron beam interaction	<b>Emission and focussing of beams:</b> cathode, grid, electron gun, line	<b>Precision mechanics</b>		<b>Materials</b> metals/ceramics nanostructures, HT insulation
<b>RF Conception &amp; Tests</b>	<b>Monitoring software &amp; integrated tests</b>		<b>Sub-system integration, Customer Support, on-site test</b>	

# Science: our solutions

- RF Sources for particle **accelerators** and **fusion reactors**
- Thales power tubes and engineering systems contribute to **high-tech scientific** applications in the areas of particle physics, nuclear physics, particle therapy and fusion



MULTI BEAM  
KLYSTRON



TETRODE &  
ASSOCIATED  
CAVITIES



KLYSTRON



GYROTRON

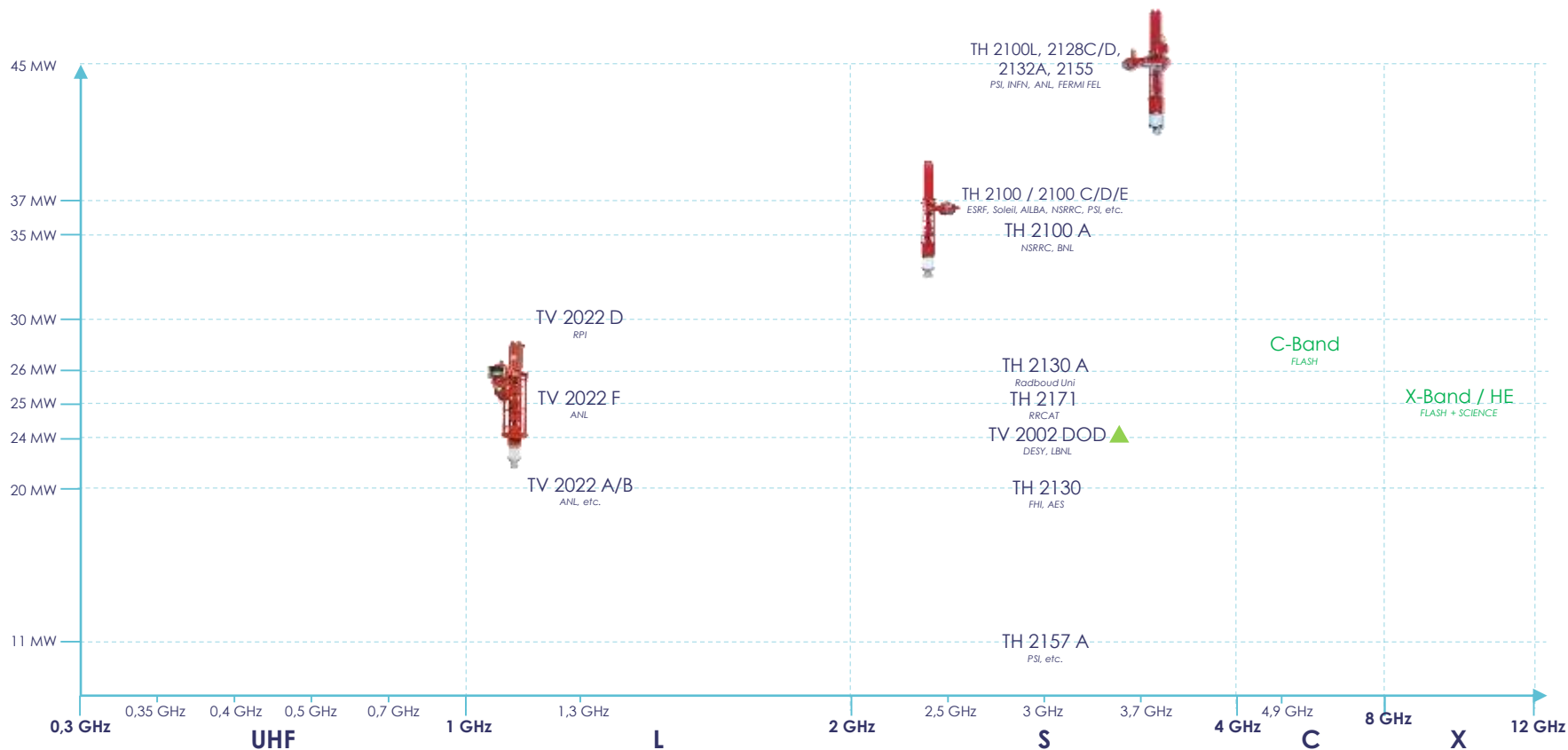
**THALES, A LONG-STANDING PARTNER TO THE MOST PRESTIGIOUS  
LABORATORIES AND RESEARCH CENTRES**



# Science Portfolio – Klystron short pulse <math><50\mu\text{s}</math> (35-160 kg)

In development

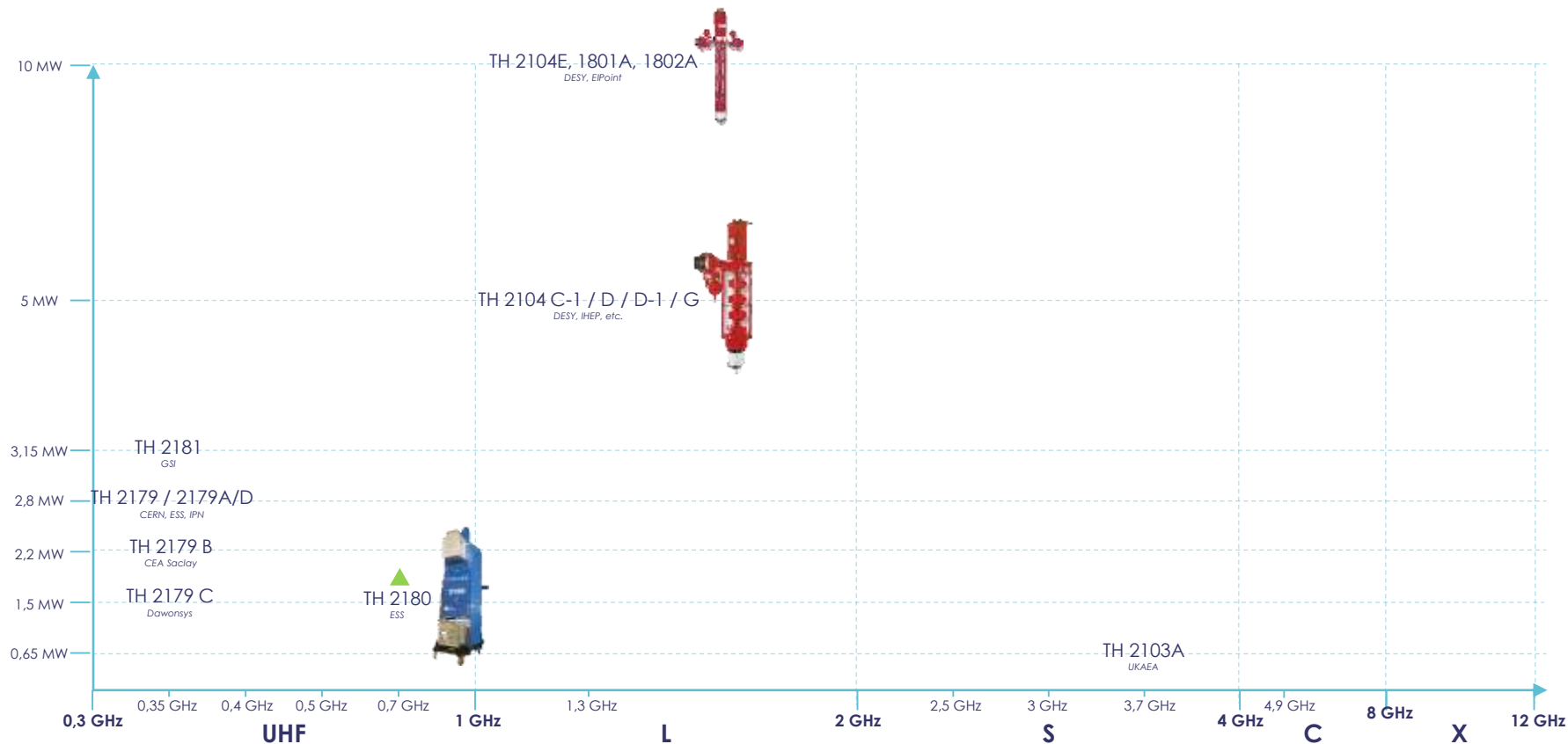
▲ Best-seller



# Science Portfolio – Klystron long pulse $>50\mu\text{s}$ (300-4500 kg)

In development

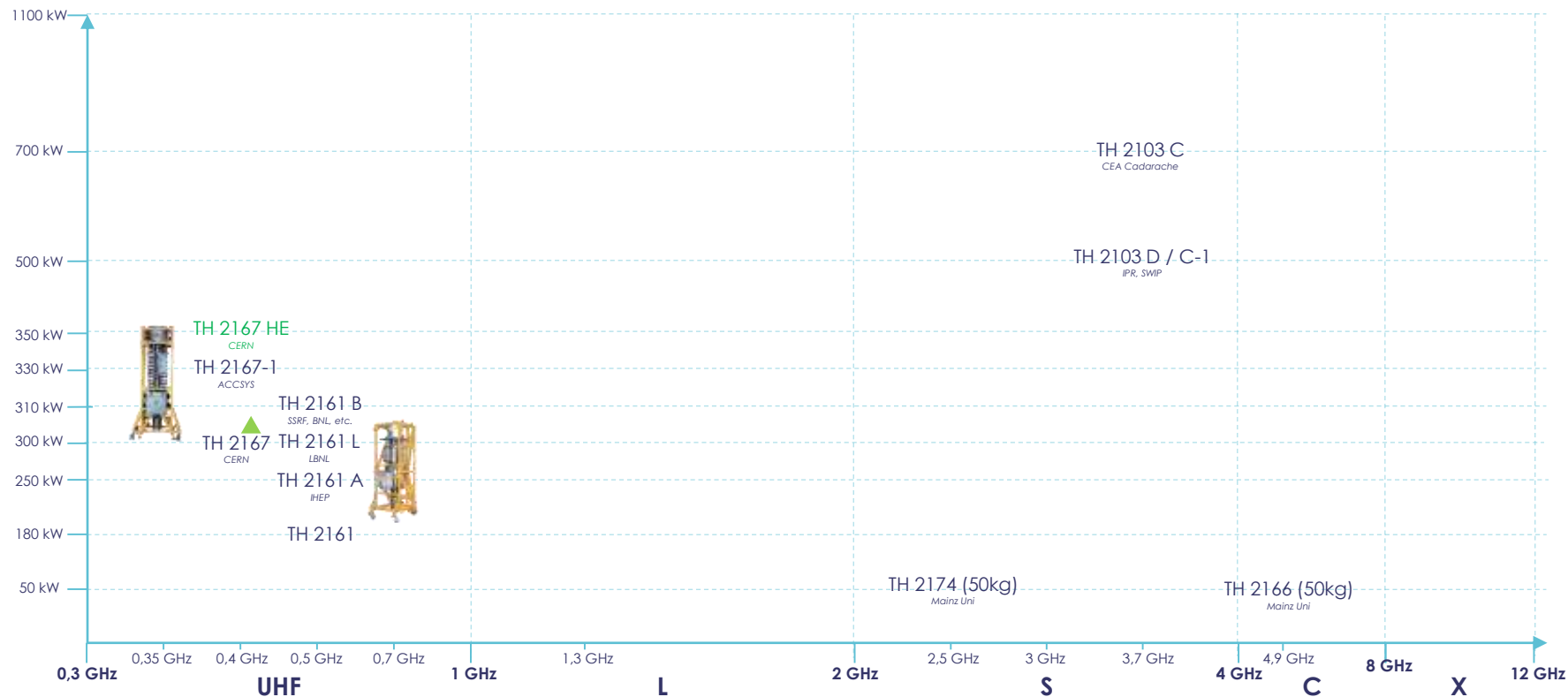
▲ Best-seller



# Science Portfolio – Klystron CW (400-2200 kg)

In development

▲ Best-seller





## Thales proposes tetrodes & IOTS for Accelerators



TH 781 A.



TH 525 A.



TH 561 – 535 – TH526B



Tetrodes	Power out_CW	Power out_Peak & pulse duration
TH561	20 kW @200 MHz	30 kW @400 MHz - Pulse < 1 ms
TH535	100 kW @120 MHz	200 kW @200 MHz - Pulse < 1 ms
TH781	200 kW @200 MHz	400 kW @200 MHz - Pulse < 1 ms
TH525A	1500 kW @57 MHz	2000 kW @70 MHz - Pulse < 30 s
TH526B	1500 kW @157 MHz	2000 kW @80 MHz - Pulse < 30 s 2500 kW @200 MHz – Pulse < 1 ms

IOT	Power out_CW
TH795	80 kW @500 MHz 60 kW @800 MHz

# Klystrons next developments

## Next project developments

### ➤ Klystrons :

#### - Science:

- TH 2167 HE: Increase klystron power & efficiency while keeping the interfaces of the standard TH2167 tube
- UHF-band

#### - **Flashtherapy**

- **C-Band: 25-30MW**
- **X-Band: 25MW**

### ➤ Grid Tubes

- Increase of production capacity of TH 781
- IOT TH 795 evolution (400MHz) for CERN
- Diacrode TH 628 for ICRH

## Thales continuous willingness to find partners and collaborate on klystrons developments