Microwave & Imaging Sub-Systems
Main markets

Radio Frequency & Microwave sources
Space, telecoms, TV and radio broadcast, defense, security/NDT, science

- Traveling Wave Tubes, grid tubes, X-ray sources, klystrons, gyrotrons
- Space amplifiers, defense transmitters, atomic clock, ion thrusters

Large Instruments
Scientific applications for civil and defense markets

- Couplers, energy storage, high power amplifiers
- Design, development and integration of systems

Radiology
Radiography, fluoroscopy, 3D dental imaging, veterinary, security/NDT

- IIR, imaging units, flat digital detectors
- Complete imaging solutions
<table>
<thead>
<tr>
<th><strong>Communication</strong></th>
<th><strong>Defense</strong></th>
<th><strong>Industry</strong></th>
<th><strong>Science</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Space - Telecoms</td>
<td>Radars</td>
<td>Laser</td>
<td>Light sources</td>
</tr>
<tr>
<td>Uplinks and</td>
<td>Counter-measures</td>
<td>Industrial heating</td>
<td>Accelerators</td>
</tr>
<tr>
<td>downlinks</td>
<td>Missiles</td>
<td>Sterilisation</td>
<td>Thermo-nuclear Fusion</td>
</tr>
<tr>
<td>TV radio broadcast</td>
<td>Datalinks</td>
<td>Non Destructive Control</td>
<td>High power lasers</td>
</tr>
</tbody>
</table>

**Traveling Wave Tubes**
- Grid tubes
- Space amplifiers
- Ion thrusters
- Atomic clock

**Traveling Wave tubes**
- Transmitters
- Klystrons, CFAs

**Grid tubes**
- X-ray tubes
- X-ray detectors

**Power tubes and amplifiers**
- klystrons, gyrotrons, tetrodes
- Energy storage, couplers

**Accelerators**

**Industry**

**Science**
Radiography
General radiography
RAD room (bone/chest)
Tables and mobiles

Radioscopy
Radiography / Fluoroscopy
Surgical mobiles
- Cardiovascular
- Neurology, urology
- 3D dental imaging (CNCT)

Other applications
Veterinarian Radiology
- Fixed and mobile equipment
- Security / NDT
  - Industrial radiography
  - Suspicious object control

Large-format flat digital detectors
Portable (WiFi) flat digital detectors
Digital X-ray imaging sub6systems

Flat digital detectors
Conventional imaging units
CCD cameras
Digital X-ray imaging sub6systems

Flat digital detectors
X-ray tubes
Conventional imaging units
CCD cameras
Associated software
Expertise unrivalled worldwide

- **Sustainable presence**: over 60 years of experience in the design and manufacture of microwave tubes and image intensifiers

- **High technology**: 10 patents per year (167 valid industrial patents) - mastering key technologies - 2D 3D electron trajectory in vacuum, very high tension, thin layer deposition, deposition of emitting materials…

- **Know-How**: mastering processes and manufacturing methods of products sometimes unique in the world

- **Expertise**: Design and delivery of prototype systems and related infrastructures for large programs

- **Industrial means**: significant industrial means, manufacturing, control and test equipment tailor-designed
2009 Turnover: 407 M€

2009 Turnover breakdown:

- Germany: 30.5%
- France: 16%
- Rest of Europe: 16%
- Asia: 13%
- North America: 6.5%
- Rest of the world: 18%

By Industry:
- Communication: 33%
- Digital radiology: 29.2%
- Conventional radiology: 12.3%
- Defense: 17%
- Science: 3.5%
- Industry Security NDT: 5%
2009 turnover breakdown (including Large Instruments)

2009 turnover including Large Instruments: 430 M€

- **Germany**: 29%
- **France**: 20.5%
- **Rest of Europe**: 15%
- **Rest of the world**: 6.3%
- **North America**: 17%
- **Asia**: 12.2%

**Industry**
- **Communication**: 31%
- **Science Including Large Instruments**: 8.5%
- **Industry Security NDT**: 4.5%
- **Defense**: 16%
- **Conventional Radiology**: 28%
- **Digital Radiology**: 12%

**Governments**
- **Defense**: 16%
- **Industry**: 31%
- **Science**: 8.5%
- **Industry Security NDT**: 4.5%
- **Industry Security Space**: 31%
- **Industry Security Telecoms Broadcast**: 31%

**Applications**
- **Telecoms Broadcast**: 31%
- **Space**: 31%
- **Radiology**: 28%
- **Conventional Radiology**: 12%
- **Digital Radiology**: 12%
- **Industry Security**: 31%
- **Industry Security NDT**: 4.5%
- **Industry Security Space**: 31%
- **Industry Security Telecoms Broadcast**: 31%

**Other**
- **Rest of the world**: 12.2%
- **Rest of Europe**: 15%
- **North America**: 17%
Key figures

- 2009 turnover: 407 M€
- 10% of turnover dedicated to R&D
- 2,600 employees
- 40% of managers, engineers and highly qualified technicians
- 7 industrial sites (Production, R&D)
- 100,000 m² industrial surface, including 9,000 m² clean rooms
- 1,500 clients
- 13 sales offices in the world
- 167 valid industrial patents
- 2,000 product references

World # 1 for microwave & imaging sub-systems for professional applications
Customer references

Over 1,500 clients trust our technologies.
International implantation

RF & Microwave sources
Production centres
Radiology
Production centres
Sales offices
Large Instruments design & prime contracting centers

USA
San Francisco, CA
Colorado Springs
Palo Alto
Totowa, NJ

France
Vélizy
Moirans (x2)
Thonon
Toulouse

United-Kingdom
Basingstoke

Germany
Ulm

Sweden
Stockholm

Russia
Moscow

Korea
Seoul

Japan
Tokyo

China
Shanghai

India
New Delhi

Singapore

USA

Mexico

Canada

Argentina

Brazil

Australasia

Thales

Microwave & Imaging Sub-Systems
Radiology: 5 production centres
Thales - Moirans (France)

- Development and production of imaging solutions based on conventional imaging units or flat detectors
- The largest industrial capacity worldwide for the design and production of conventional imaging units
- 16 700 m² industrial surface, including 3 000 m² clean rooms
- ISO 9001 V 2000
  ISO 13485 V 2003
  ISO 14 001
- 350 employees
- 44 industrial patents

World # 1 for X-ray imaging solutions

Conventional imaging units

Image pre-processing software

Flat detector and processing unit
Trixell is a JV created in 1997 between Thales (51%) Philips (24.5%) and Siemens (24.5%)

Trixell designs and manufactures flat detectors for the new digital radiology systems

- 8,000 m² of industrial surface, including 2,000 m² clean rooms
- ISO 9001 V 2000
- ISO 13485 V 2003
- 410 employees
- 30 industrial patents

World #1 for digital flat detectors
Shanghai Thales Electron Tubes (STET) is a JV created in 1996 between Thales (51%) and Shanghai Medical Instruments Group (49%)

STET manufactures conventional imaging units mainly for the Chinese market

5 000 m² industrial surface, including 300 m² clean rooms

ISO 9001 v 2000

100 employees

China # 1 for X-ray imaging

9” conventional imaging unit
CMT Medical Technologies - Yoqneam (Israel)

- CMT Medical Technologies is a Thales subsidiary since April 2009
- CMT is an expert in the development of digital X-ray imaging subsystems
- 2 245 m² industrial surface
- 90 employees

World expert in clinical X-ray imaging
dpiX is a JV between Thales, Philips, Siemens and Varian

Design and production of high-resolution amorphous silicon sensor arrays

31,100 m² industrial surface, including 4,200 m² clean rooms

ISO 9001:2000, ISO 14001

248 employees

Flat detectors based on amorphous silicon sensor arrays

The world’s leading source for high-resolution amorphous silicon sensor arrays for radiology
Radiology: main applications
Medical radiography

- Pixium flat digital detectors designed for all X-ray exams: Bone/Chest RAD rooms, tables, mobiles
- Pixium RAD 4600: the benchmark in large-format digital detectors
- Pixium Portable 3543: the world’s first wireless (WiFi) digital detector
- Complete digital X-ray imaging subsystems

Innovative solutions designed for all X-ray exams
Medical radioscopy

- Conventional imaging units and Pixium digital flat detectors for radioscopy applications: RF, surgical mobiles – cardiovascular, neurology, urology – 3D dental imaging (CBCT)

- Pixium RF 4343: the world’s first multipurpose, large-format, real-time detector

- Conventional imaging units: available in many formats and versions

- Complete digital X-ray imaging sub-systems

One out of every two exams worldwide uses a Thales detector
Radiology: from X-ray detection to imaging solution

- X-ray Source
- Mechanics
- Detector
- Pre processing
- Post processing
- User Interface
- System Interface

Initial Thales offer:
- Raw image
- Clean image

Enlarged Thales offer with CMT:
- Image clinique

Microwave & Imaging Sub-Systems
Veterinary radiology

- Flat digital detectors, designed to be used at examination tables (small animals) or carried on-site (horses…)
- Fast image acquisition process and excellent image quality
- Benefits of digital radiography applied to veterinary medicine

User-friendly solutions based on digital flat detectors
Security & Non Destructive Control (NDT)

- Detectors and X-ray generators for Non Destructive Control and security
- Applications: real time control of luggage in ports and airports, industrial quality control
- Ruggedised solutions tailored for multiple demanding industrial applications

Medical radiology expertise applied to NDT & Security
RF & Microwave sources

3 production centres
- Design and production of Traveling Wave Tubes, klystrons, gyrotrons, generators, space amplifiers, defense transmitters, energy storage...

- 32 000 m² of industriell surface, including 3 000 m² clean rooms

- ISO 9001 v 2000
- ISO 14 001

- 890 employees
  (central services included)

- 34 industrial patents

World # 1 for space and science tubes
Europe # 1 for telecom and defense tubes
- Production of grid tubes, x-ray sources, TWTs and various sub-assemblies
- 25,000 m² of industrial surface, including 200 m² clean rooms
- ISO 9001 v 2000
- ISO 14 001
- 370 employees
- 27 industrial patents

World # 1 for industrial and broadcast tubes
- Design and production of traveling wave tubes, space amplifiers and ion thrusters
- 13 400 m² industrial surface, including 1 300 m² clean rooms
- ISO 9001 v 2000
  ISO 14 001
- 400 employees
- 32 industrial patents

World # 1 for space tubes – Europe # 1 for defense tubes
RF & Microwave sources
Main applications
Radio and hadron therapy

- High-power RF sources for radiotherapy and medical particle accelerators
- Thales klystrons are installed in hundreds of linacs
- A safe and reliable operation that is indispensable in hospitals

Power sources for cancer therapy systems
World’s first manufacturer of TWTs and amplifiers for satellites

Products designed for all commercial and military applications: TVHD, radio, data, telecoms, internet, earth observation and navigation

The most complete range on the market, from L to V band, with power up to 275 W, with the highest level of reliability demanded by our customers

More than half of all images and data transmitted worldwide go through a Thales tube
- **Ion thruster**: Thales has developed a new ion propulsion system for position control of satellites, in partnership with DLR (Germany). First project: SmallGeo

- **Atomic clock**: Time/Frequency standard designed to synchronize several systems (ex: telecoms). Production of the first magnetic deflection tubes which are at the heart of atomic clocks.
Telecommunications

- Leader in TWTs for commercial (TVHD…) and military (multimedia data links…) telecom uplinks

- Thales tubes contribute to reliability and performance of telecom systems in the whole world since 60 years ago

- A Product offer unique in the world
  - Ku band range, until DBS
  - Only manufacturer to offer a 750W DBS tube
  - Complete Ka band range

Only manufacturer in the world to offer a 750W DBS tube and a complete Ka band range
World leader for transmitters and tubes (TWTs, klystrons) for radars, electronic counter-measures, missiles and data links

These transmitters cover a large range of frequencies, from C to EHF band, with power up to several hundreds of kW

A strong development capacity and a large portfolio to cover all Defense requirements
Radio & TV Broadcast

- High power tubes for amplification in radio and TV transmitters
- Long-lasting, high reliability products
- Close partner of broadcasters for new transmitters based on digital radio standard (IBOC, DRM…)

The benchmark supplier of grid tubes to major operators in many countries
A complete range of grid tubes for numerous industrial applications: induction and dielectric heating, laser CO2 and plasma cutting

High performance, high reliability products

Distribution agreement with Richardson for industrial tubes

Tens of thousands of Thales tubes are used daily in industrial equipment worldwide
RF power tubes

- RF Sources for particle accelerators and fusion reactors
- Thales power tubes contribute to high-tech scientific applications in the areas of particle physics, nuclear physics and fusion
- Solutions to expand the state-of-the-art

Thales, a long-standing partner to the most prestigious laboratories and research centres
Large Instruments for science: Main applications
High-power subsystems

- RF power couplers for particle accelerators
- RF amplifiers (SSRF, IHEP, PAL, IN2P3…)
- MegaJoule Laser Energy Storage System (CEA)

Thales’s expertise in RF, high tension and complex system integration serving large instruments
Design and delivery of prototype systems and related infrastructures for large programs

- MegaJoule Laser Experimental Hall Equipment and Integration (CEA)
  - Support structures
  - Opto-mechanics interface
  - Pumping
  - Vacuum and fluids

- Turnkey supply of the CEA radiography machine accelerator (AIRIX)

- On-demand test or logistic equipment based on various technologies:
  - Submarine rudder test facility
  - Handling equipment for missile assembly
  - Airborne drop systems
  - All multi technologies projects
Thales Components & Subsystems
At the Source of Excellence