2D SPDR Scanner for the Imaging of 5G and energy materials

Your partner in MHz to THz design, modelling, and characterisation

Innovation Radar Prize 2021

Key Highlights in high-frequency electromagnetic engineering

Electromagnetic waves are everywhere!

Our mission is to assist in their use for the best of human wellbeing:

- Safety, health, and nutrition
- Efficient work and clean environment
- Scientific progress from nanoscale to the universe
- Social interactions, travel and entertainment

We assist **electronics engineers and researchers** in their quest for better and cheaper devices operating in MHz to THz frequency range, for multiple applications

We provide **two complementary technologies:**

- Computer Multiphysics Simulators:

  which form a **virtual laboratory**, where novel EM devices are efficiently designed
- Material Test Instruments:

  where **materials are validated** for use in such designs.

Problem addressed by our innovation

Current state of the art

- **Two product categories exist on the market:**
  - **computer-aided-design of devices** (via modelling, simulation, optimisation)
  - **experimental characterisation of materials**
- **...but developed independently and insufficiently correlated**
- **Many electronic designs fail, because they are based on inconsistent material data** and need to be corrected in an iterative cut-and-try process.

Altered efficiency of the products

- **Strong economic losses :** (some electronic designs are based on **false premises** and fail)
- **Loss in research money :** (material developments are not correlated to the industry needs)
- **Delay in the product-to-market path, decreased quality of products** and wasted human resources

Our **Solution** to **HF Problems** is a **unified CAD approach**

The unified CAD system

Coupling computer multiphysics simulations with materials' characterisation:

- Material test-fixtures and characterisation protocols are developed with the same modelling and simulation tools as used in the target device design,
- CAD simulators and optimisers import material data obtained under compliant conditions and assumptions.

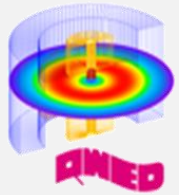
Additionally, our Solution:

- **Opens way to standardisation,** following the recommendations of the European Materials Modelling (EMMC) and Characterisation (EMCC Councils) – e.g. MODA-CHADA documentation formats, as well as standards' institutes worldwide (e.g. METAS CH, NIST US, GUM PL)
- **Feeds into Open Platforms** (in accordance with the EU's Open Science Policy), fostering education and dissemination of the EU's innovative products and projects.

Solution Graph

Commercial since 1997
QuickWave™ Simulation Software
~1000 licences implemented

THE EUROPEAN ICT PRIZE WINNER



Applicator design
& model for
parameter extraction

Modelling (EM, MW, multiphysics,...)
- waves in free space is "easy" Maxwellian
- wave interaction with matter is "complicated"...

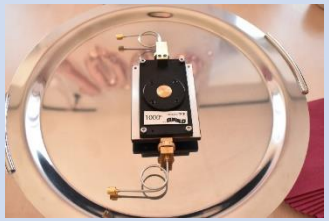
INNOVATION

Material measurements

Accurate material
parameters
(constitutive
relations)

Commercial resonator test-fixtures since 2001

1000th unit sold in 2020



Open Platform Examples & Tools

QW-Modeller for QuickWave
Free general purpose 3D CAD modeller for QuickWave.

Open Platform Examples:

SMM tip presented at Numerical Electromagnetic

European Standard:
IEC 61189-2-721:2015
CEN-CENELEC Workshop 2021

Solution Demonstrator for 5G and energy

Note: all blocks of this system are being further developed in NanoBat.

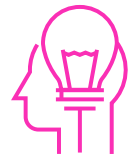
The SPDR scanner from MMAMA (for high-resistivity materials) is replaced by a new SiPDR scanner for high-conductivity materials in NanoBat.

Favourable market evolutions

Strong opportunities from 2 fast-growing markets

- Global EM simulation market estimated at **500 MEUR** (2020)
- Estimated to grow at a **CAGR of 9%** during the forecast period (2020-2025)

- Global market of EM testing of materials estimated at **2,3 Bn EUR** (2016)
- Estimated to grow at a **CAGR of 5%** during the period (2017-2023)



An innovation solution present on both market

Our innovative solution coupling EM / multiphysics simulation with material measurements is expected to:

- increase QWED share in both above markets individually,
- and create new markets by dissemination, training, and synergy effects.

The emerging technologies (5G and Green Energy) form a new market for our solution, estimated at 5 MEUR and rapidly growing.

A unique unified solution

There is NO direct competitor offering a unified modelling-characterisation CAD system.

Potential competitors in **simulation and design of MHz to THz devices:**

Stand-alone electromagnetic design

- Inacurate or absent treatment of multiphysics effects
- 5-20x more expensive

CST Studio

XFdtd

Multiphysics simulation:

- Black-box to the user
- Inefficient in electromagnetic simulation
- 5-20x more expensive

COMSOL

Ansys

Potential competitors in **GHz characterisation of materials:**

Japanese manufacturers of material GHz test-fixtures

- Less accurate (5% vs QWED's 0.3%)
- 10x more expensive

AET

KEYCOM

US and EU vendors of EM design and test equipment

- Less acurate
- 5-20x more expensive
- **Coopetitors**: QWED delivering its test-fixtures to their distribution networks

KEYSIGHT TECHNOLOGIES

ROHDE&SCHWARZ

Traction and client basis from 6 continents

> 1mln EUR market revenue **+ 15% R&D co-funding**

Clients in industry

B/S/H/

LYREBIRD ANTENNA RESEARCH

THz Global
Millimeter & Submillimeter-Wave R&D
www.thzglobal.com

Clients in academia

Institute ITACA
Information and Communication Technologies
dimas Microwave Division http://itacadimas.wordpress.com/

WPI

Industry CIMS WPI

Professional associations

INTERNATIONAL MICROWAVE POWER INSTITUTE

IEEE

INEMI International Electronics Manufacturing Initiative

SPACE PL Polish Space Industry Association

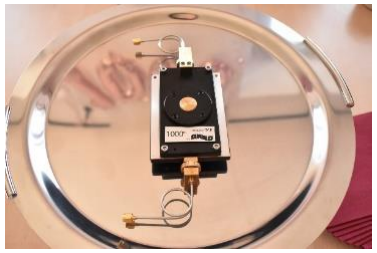
MTT-S IEEE MICROWAVE THEORY & TECHNIQUES SOCIETY

IEEE Women in Engineering We

160 test-fixtures

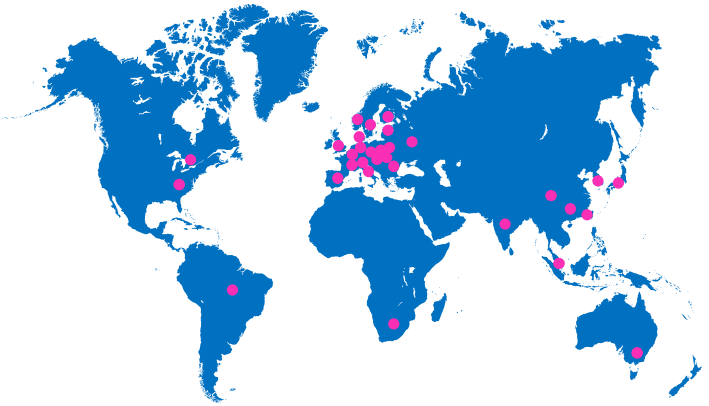
for material characterisation

***milestone:* 1000th unit sold 2020**



50 licence

sales/upgrades



Key partners and achievements

A solution validated by Key partners

Organic & inorganic semiconductors science & manufacture

MATERIA NOVA Materials R&D Center

Łukasiewicz Instytut Mikroelektroniki i Fotoniki

SME in energy material production

dracula technologies

PLEIONE ENERGY

National Metrology institutes

NIST National Institute of Standards and Technology

Industrial and corporate partners

MMAMA NOKIA KEYSIGHT TECHNOLOGIES intel

Other university centers and collaborating academia

Military University of Technology

Warsaw University of Technology

ITRI Industrial Technology Research Institute

Further Development of the solution

METAS KEYSIGHT TECHNOLOGIES CRF Nano Bat

- New R&D project consortia for emerging technologies (e.g. M.ERA-NET Sep 2021: starting ULTCC6G_EPac)
- Entering into new distribution contracts (one in final stage)
- Pilot sales (one contract signed Oct 2021 for a modified unit after the IR version, value 22kEUR)

A team of awarded experts

10
people employed

7
consultants cooperating

50%
female

A happy blend of electromagnetic engineers, multiphysics researchers, IT experts, business analyst, and cross-media specialist

Dr. Malgorzata Celuch
President since 2017, VP 1997-2017
- 35 y experience in mathematical, 25 y in management
- Awards for excellence from e.g. Prime Minister of Poland, Rector of WarsawUnivTech

Dr. Marzena Olszewska-Placha,
VP for R&D
- 15 y of experience in simulation-based MHz to THZ design and consultancy
- 4 y experience in research management

Prof. Wojciech Gwarek,
President 1997-2017
- 22 years of experience in simulation software development

Janusz Rudnicki, MS,
VP for IT
- 22 years of experience in simulation software development

Dr. Andrzej Więckowski
Senior in CAD
- 48 years of experience in computer-aided electronic engineering and engineering software development

Dr. Maciej Sypniewski
Senior in CAE
- 48 years of experience in engineering software development and GHz measurements

TEAMS AWARDS

THE EUROPEAN ICT PRIZE WINNER

MISTRZ TECHNIKI WARSZAWA

25 years of QWED in 2022

We have been successful and we want to scale up.

We seek:

- **distributors** to open up new markets,
- **partners** to develop our Solution for novel materials and emerging technologies.

We remain **open for other proposals** helping us address the above needs.

THANK YOU FOR YOUR ATTENTION!

...and I invite you to consider QWED's products and competencies, hoping to meet you in person at forthcoming scientific conferences, industrial fairs, and policy making events to which QWED often participates

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