TELEDYNE DALSA
Everywhereyoulook™

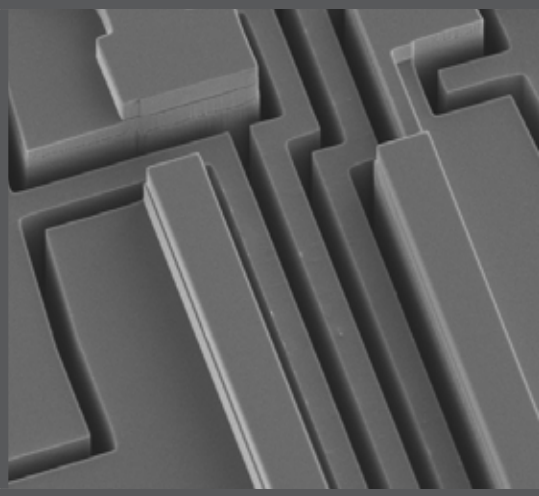
TELEDYNE MICRALYNE
Everywhereyoulook™

TELEDYNE MEMS FOUNDRY SERVICES

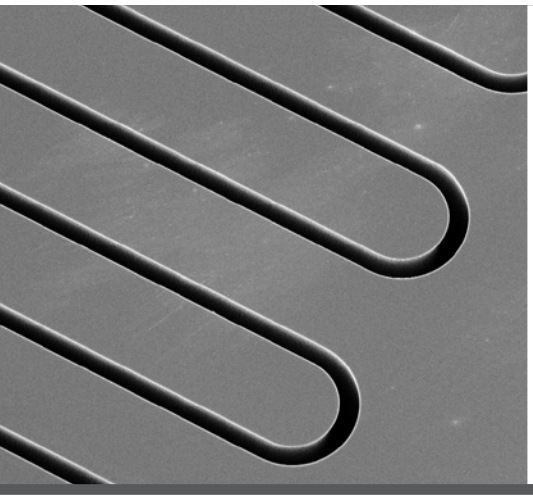
MEMS for Today & Tomorrow

NUMBER 1 INDEPENDENT PURE PLAY MEMS FOUNDRY.

All Designs. All Materials.
All Applications.



Rank based on Yole Developpement report 2019



Why Teledyne MEMS?

Teledyne offers an unmatched MEMS and microfabrication capability, from design to prototyping right through high volume 200 mm production.

With state-of-the-art facilities, mastery of materials from silicon to specialty metals to non-conventional substrates, Teledyne DALSA and Teledyne Micralyne combine to collaborate with customers, offering decades of experience across a vast process portfolio.

Skill and Scale

The combination of our two foundries boasts more than 60,000 square feet / 5,600 m^2 of clean rooms that operate 24/7 and deliver over 100,000 wafers per year in both 150 mm and 200 mm formats. Our state-of-the-art processes and industry-leading quality systems allow us to exceed our customer's requirements.

Capacity alone did not make us the market leader. Our mastery of custom MEMS wafer fabrication and years of devoted R&D have earned us a profound understanding of the physics and materials science that make MEMS possible. Teledyne's expanded R&D team adds further depth to our expertise. This expertise, coupled with our increased volume and materials capabilities, makes Teledyne's MEMS capabilities truly exceptional.

Customer Success

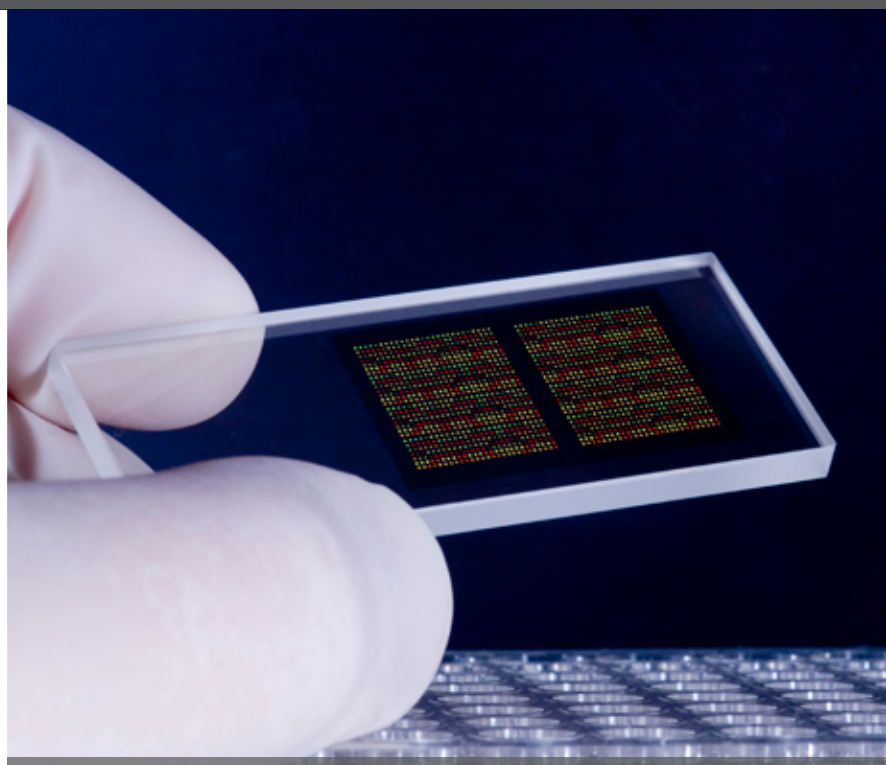
We aim for customer success, driven by our commitment to rigorous quality systems, great service, and the protection of customer intellectual property.

We are proud of our history of moving customer designs to volume production quickly and smoothly.

When you work with us, we offer you a strategic partnership with extensive technical knowledge and fabrication capabilities. Our customers leverage our experience to add value to their project.

MEMS FOR TODAY & TOMORROW.

AUTOMOTIVE Airbag sensors, LiDAR, engine sensors, inertial MEMS, tire pressure sensors, keyfob, etc.



BioMEMS Lab on chip, diagnostics, implantable devices, DNA sequencing, etc.

CONSUMER ELECTRONICS Acoustic MEMS, RF chips, orientation sensors

HEALTHCARE
Personalized medicine, wearable technology

You Design the Future. We'll Build it.

Whether your breakthrough MEMS design serves automotive safety, autonomous vehicles, consumer electronics, personalized medicine, telecom, next generation chipmaking, or something completely unique, we have the microfabrication expertise, platforms, and facilities to make it real. We have decades of experience with MEMS for these applications and many more.

SMART GLASSES
Advanced optical MEMS

ENVIRONMENTAL Pressure, gas, flow, temperature

TELECOM
Optical networking, RF transceivers

DRONES Inertial sensors, IMUs, thermal sensors, imagers

THERMAL SENSING
Microbolometers

OUR MEMS TECHNOLOGIES

- **Largest portfolio (non-captive) of microfabrication technologies available in the world**
- **Technologies for all type of sensors and markets**
- **150 mm and 200 mm lines**

Our World-Class Toolbox

Teledyne offers customers a truly unmatched toolbox of dozens of proven and patented MEMS and micromachining process modules and techniques. Our proven design, prototyping, and high-volume manufacturing expertise, as well as our extensive testing and packaging services, can help you realize the full potential of your market.

We are proud of our toolbox, but even more proud of our mastery of it. The greatest value we offer you is our ability to leverage and integrate individual foundry processes to bring your break-through MEMS designs into production.

MEMS Technology Portfolio

Silicon Sophistication

We have honed our craft in silicon for decades, fabricating some of the most complex MEMS in the world and meeting extremely tight specifications with record performance. The same production lines have also produced hundreds of millions of high volume devices with outstanding yield.

Beyond Silicon

Teledyne's MEMS foundry in Edmonton offers non-traditional 150 mm substrates like glass and ceramic, as well as deposition and etching of thin films, including gold. These specialty compound materials and processes are evaluated for contamination risk and isolated from our mainstream processes as required to ensure the purity of your wafers.

Protoypes to Production

With our two development and manufacturing sites, your product can be manufactured where it makes most sense for your business, design, and volume requirements. Both of our locations have successfully delivered devices for aerospace, automotive, biomedical, consumer, industrial, and telecom. Our integrated, highly experienced teams have the expertise to bring your design to production efficiently and assist you in your development decisions. We provide a unique path from early prototyping to high volume production.

FOR MORE DETAILS see our Process Capability brochure or visit www.teledyneimaging.com/mems

MEMS Toolbox Highlights

Teledyne offers all the advanced processes and fabrication equipment you would expect from an industry leader. Explore some of our particular highlights below.

DRIE

Our silicon DRIE capabilities include high aspect ratio and high throughput DRIE, with depths to 1,000 µm and etch rates up to 35 µm/min for 1:1 aspect ratio cavities.

METAL DEPOSITION BY SPUTTER

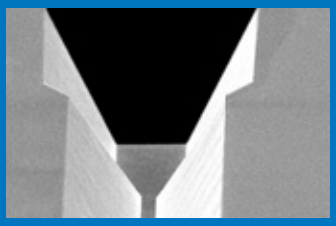
We can sputter the following compounds: Al, Au, Cr, Ti, TiW, Cu, NiV, TiN, Ta, Pt, AlN, V, Vox.

METAL DEPOSITION BY EVAPORATION

We are able to use evaporation for Al, Ti, Pt, Au, AlSi, AlCu, Cr, Nb, NiCr, NiV, Pt, Sn, Ta, and more.

GLASS / QUARTZ WET ETCHING

We can make shallow etches (a few microns) to very deep (100 microns).

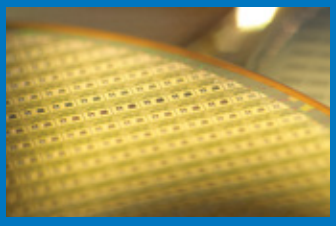


Si ANISOTROPIC WET ETCHING – KOH, TMAH

We are able to use KOH, TMAH for Si anisotropic wet etching. This enables structuring of silicon substrates with tight tolerances.

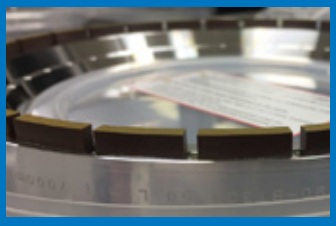
RIE PLASMA ETCHING

Our RIE Plasma Etching materials include silicon, photoresist, quartz, oxide, nitride, polysilicon, oxynitride Ti, TiW, Nb.



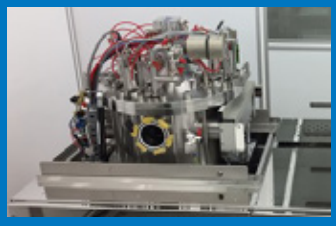
TEST & AUTOMATIC OPTICAL INSPECTION (AOI)

Our AOI solutions ensure the highest level of product quality. Custom tools allow inspection of wafers and dies in visible, infra-red, front side and/or back side for either in-line metrology or end-of-the-line quality control.



BACK-END PROCESSES

Our unique process toolbox also includes solder bumping (including Ni/Pd UBM), CMP, backgrinding, dicing, die attach and wirebonding.



BONDING

Our vast repertoire includes direct bonding Si-Si, Si-SiO2, SiO2-SiO2, Si-glass, fusion, eutectic, solder, anodic, thermo-compression, glass frit sealing, vacuum, plasma-assisted, polymer and temporary bonding.

OVER 25 YEARS OF MEMS EXPERTISE

- **25 + years MEMS history**
- **120+ engineers and scientists with extensive microfabrication and simulation expertise**
- **Success in a broad range of applications: photonics, telecom, biomedical, automotive, industrial and military applications**
- **Access to deep expertise in materials process, combined with state-of-the-art facilities, and collaborative R&D resources (C2MI) to drive continuous improvement, learning and innovation**

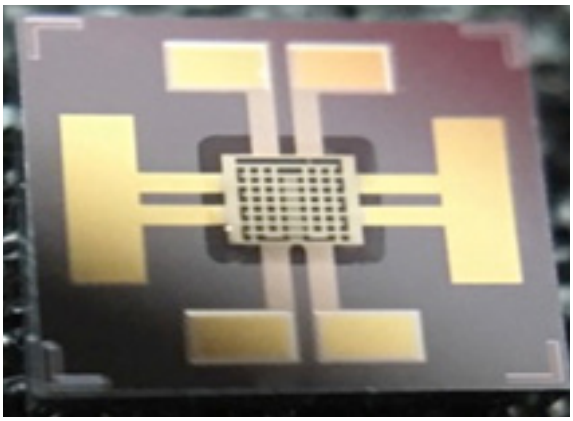
Reduce Development Risk

Teledyne's MEMS design rules reduce customer risk and cost during prototyping. By providing process and electrical parameters guidance, we fast-track our customers understanding of MEMS development so you can get your product on the market. Our customers leverage our decades of MEMS development experience to become market leaders.

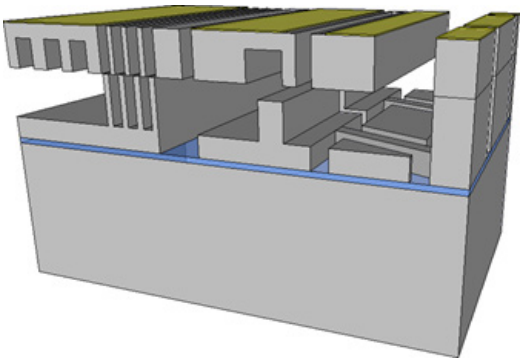
Ask us about our design rules for devices including micromirrors, optical switches, resonators, inertial and bio sensors.

Accelerate Time to Market with Proven Platforms

We offer dozens of proven and patented process modules, techniques and platforms. Their use accelerates customer's time-to-market and provide an advantage over competitors. **Some of Teledyne's exclusive platforms include:**

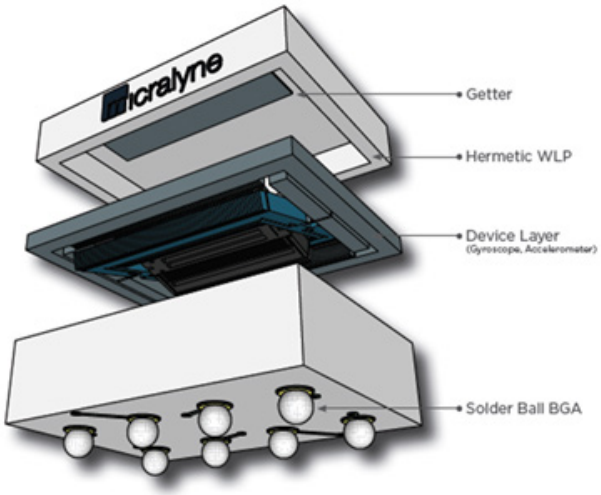


1 ENVIRONMENTAL GAS MONITORING
Teledyne's metal oxide gas sensor process platform, MicraMOx™, has a metal oxide sensing layer, an electrode, and an integrated microheater to reach optimal sensing temperature. It is ideal for environmental gas monitoring applications, industrial safety and smart city, home, and office applications.



2 PROCESS PLATFORMS FOR OPTICAL APPLICATIONS

Our optical platform, MicraGem-Si™, is a Silicon-On-Insulator (SOI) based process platform for advanced MEMS devices. It is well-suited to micromirrors, optical cross connects, and wavelength selective switches.

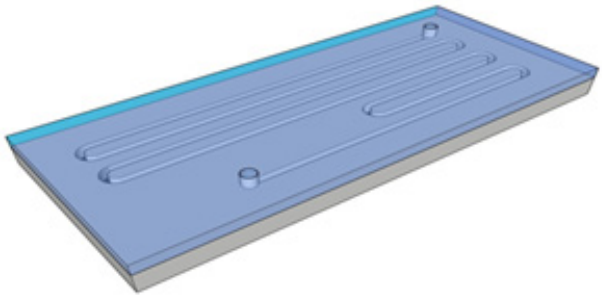


3 ADVANCED WAFER-LEVEL PACKAGING

Teledyne's advanced wafer-level packaging technologies have application in inertial MEMS, both accelerometers and gyroscopes. Our MIDIS™, Super MIDIS™ and MicraSilQ™ platforms are integrated wafer-level high-vacuum hermetic packages with through silicon vias. MIDIS has a smaller feature size and a thinner 30 µm silicon mass layer while Super-MIDIS has a larger feature size and a silicon mass layer ranging from 30 µm to 300 µm depending on the applications. MicraSilQ™ has a medium feature size and a silicon layer of 60 µm. MIDIS and Super-MIDIS are getterless technologies, while MicraSilQ™ incorporates a getter into the wafer level package.

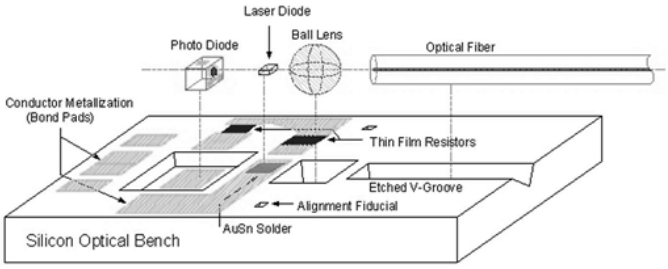
4 HIGH-PERFORMANCE SILICON TSV MODULE

Through-Silicon-Via (TSV) allows electrical connections to be formed through a silicon wafer or multi-wafer devices. When combined with Wafer Level Packaging (WLP), TSVs minimize die size, allow conventional or flip-chip bonding, and help minimize assembly cost of the final device.



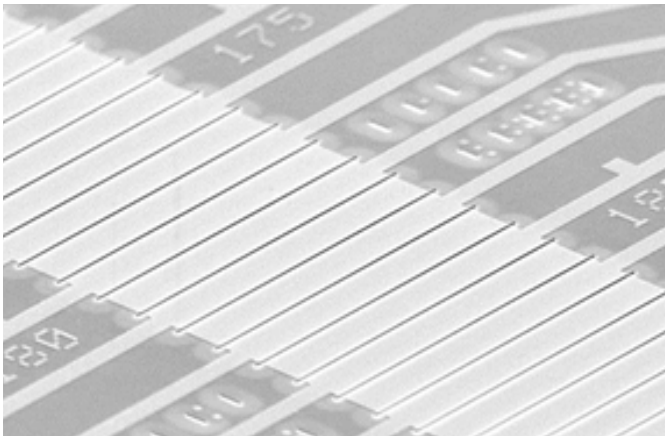
5 SILICON MICROFLUIDICS

Our silicon microfluidics platform, MicraFluidics™, involves custom deep channel microfluidics in silicon with a glass cap. It is widely used in biomedical applications, including lab-on-a-chip and organ-on-a chip, among others.



6 SILICON OPTICAL BENCH PLATFORMS

Our silicon optical bench systems serves as platforms to integrate optical components and subsystems while, at the same time, reducing development and manufacturing costs.



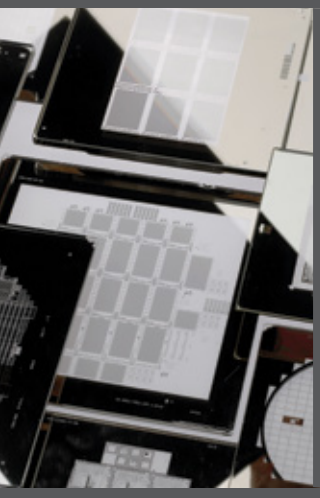
7 SPATIAL LIGHT VALVE

Teledyne's MEMS-based SLV is a diffractive spatial light modulator that can control light at extremely high speeds on a pixel-by-pixel basis. It is ideal for several digital imaging applications such as high-resolution displays and lithography tools.

SCALABILITY. QUALITY. VALUES.

Everything that you need in a quality and inovative MEMS partnership.

Teledyne MEMS.



BROMONT, QUEBEC, CANADA

EDMONTON, ALBERTA, CANADA

CERTIFIED/CERTIFIÉ ISO 9001:2015

CERTIFIED/CERTIFIÉ IATF 16949:2016

CERTIFIED/CERTIFIÉ ISO 14001:2015

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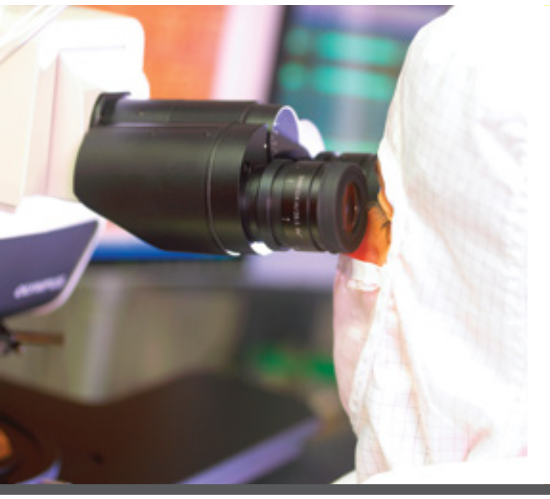
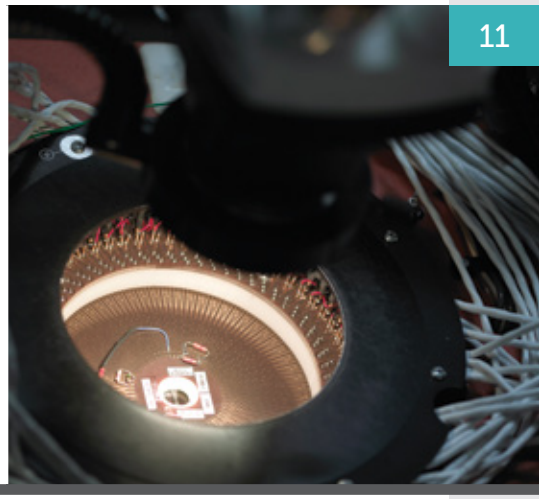
CERTIFIED/CERTIFIÉ ISO 13485:2016





Quality

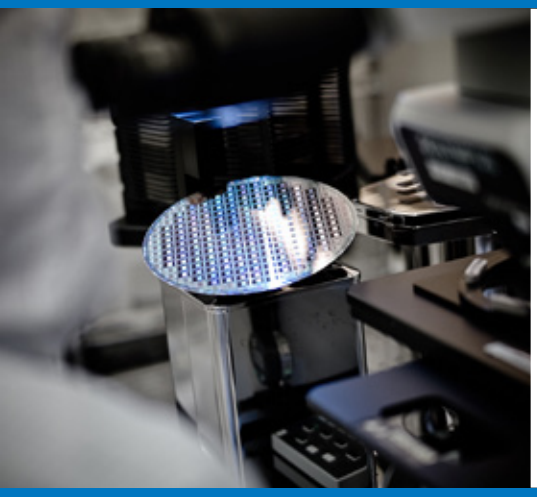
With a technology portfolio as wide and flexible as ours, with deliverables as varied as ours, excellence in planning, quality assurance, and customer interaction are fundamental business requirements. Our long history has embedded stringent quality standards deep into our corporate culture. Our employee dedication to quality is the cornerstone of our enviable record of success. From our engineers, technicians, and operators to our exceptional project, resource, and quality management systems, our quality program meets the highest standards.

Values

We exist to help create better technology, and we are here for the long term. To that end our management, engineers, operators and facilities staff share a commitment to customer success and a culture of excellence. We are proud of our reputation in assuring customer confidentiality and protecting customer intellectual property—both product IP and process IP.

- From product development to high volume production
- 150 mm and 200 mm wafers (from 10-10,000+ wafers/yr)
- Certified for quality management system, environment, automotive and medical
- ISO-9001:2015 (Quality)
- ISO-14001:2015 (Environment)
- IATF 16949:2016 (Automotive)
- ISO-13485:2016 (Medical)
- A trusted development and manufacturing partner for process and product IP protection

Consider Teledyne for your next MEMS project.
CONTACT US for more about what our exceptional capabilities can do for you.



WE ARE... EVERYWHERE YOU LOOK

FOUNDRY LOCATIONS

Bromont, Quebec, Canada | Edmonton, Alberta, Canada
Find details at: **teledyneimaging.com/mems**

CONTACT US

Using your preferred method of communication, at:
teledynedalsa.com/en/contact/contactsales
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