

# Introduction to:

# *Rocket* **MEMS**

GET THE CHIPS YOU NEED  
Semi-custom MEMS Devices



AMFITZGERALD  
& ASSOCIATES

## Overview

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- ***RocketMEMS™***: What is it?
- ***RocketMEMS™*** vs. Custom
- How ***RocketMEMS™*** works
- Features
- Moving forward & Next steps...



## Your Situation

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**You need a pressure sensor.**

**Nothing on the market fits your needs.**

**Your options:**

- Work with the sensor-that-doesn't-quite-fit**
- Develop a custom pressure sensor**
- Abandon the application**

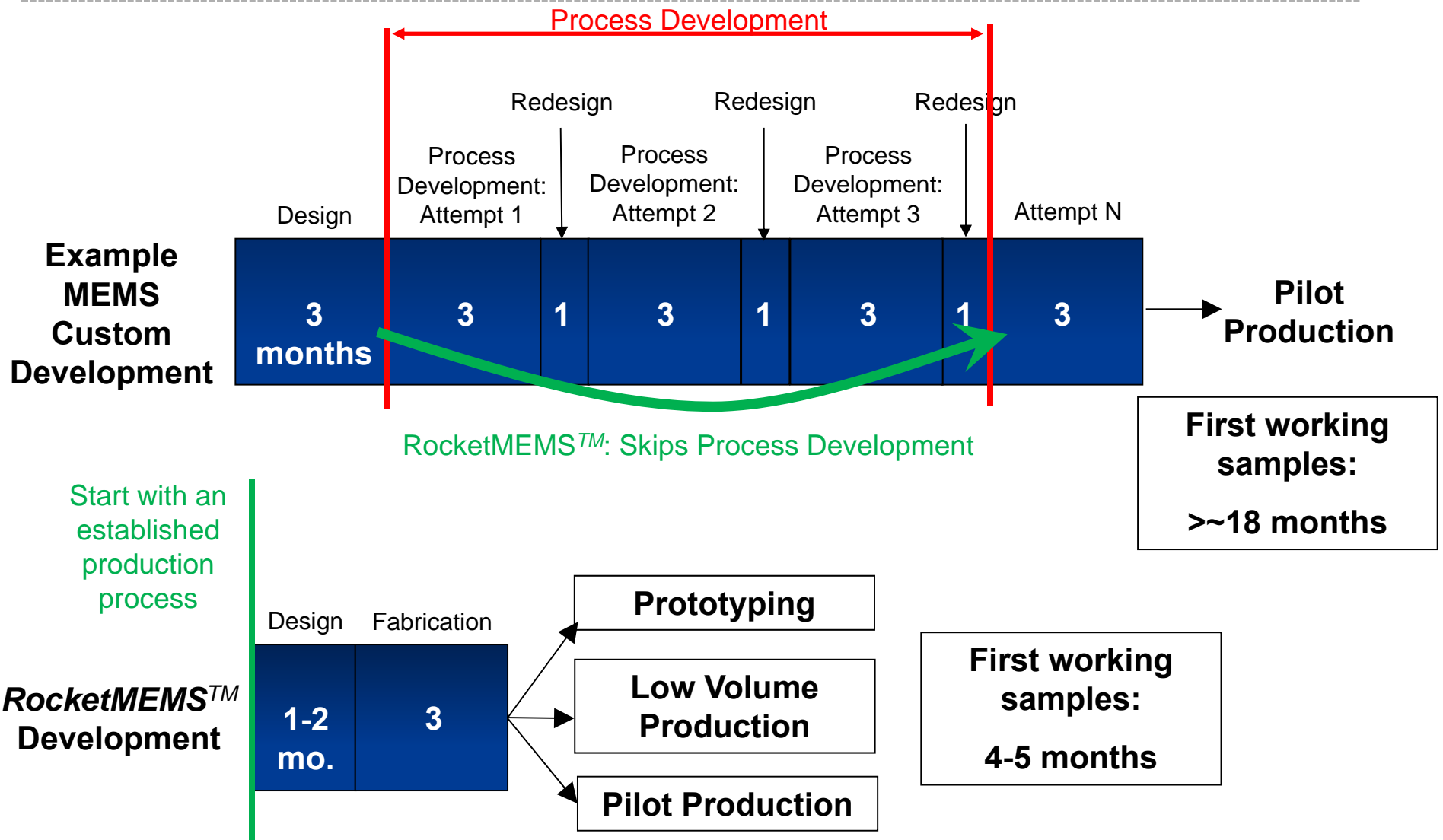
## The *RocketMEMS™* option

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### ***RocketMEMS™* delivers:**

- **Semi-custom bare die silicon pressure sensors**
- **Reduced cost**
- **Reduced time to market**
- **Reduced risk**
- **Pathway to large volume production**

# RocketMEMS™ vs. Custom Development



## ***RocketMEMS™: Design House-Foundry Cooperation***

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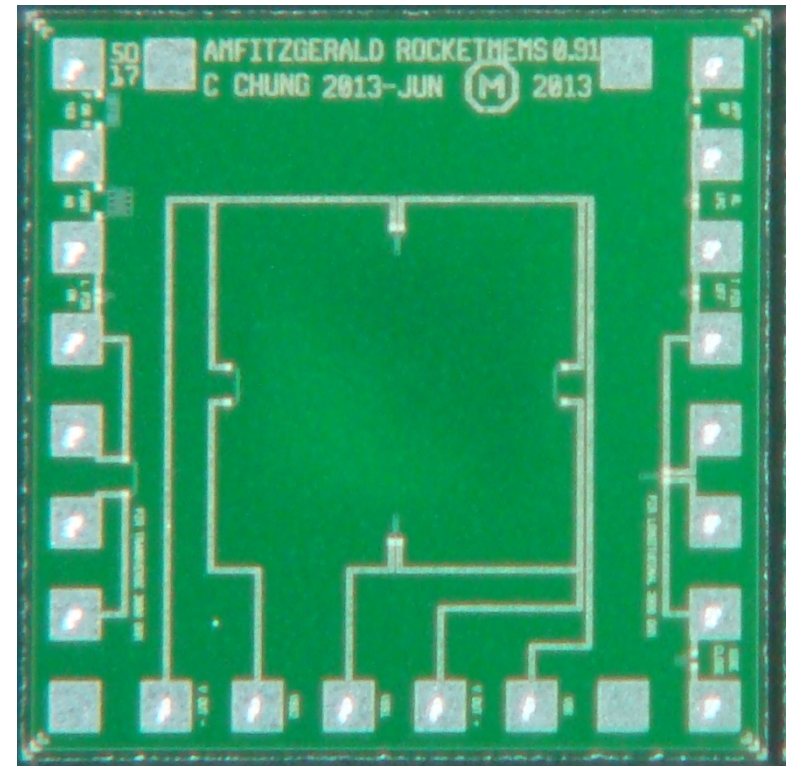


- **Fixed, stable, established production process**
- **Design for manufacture**
- **No process development**
- **Fully characterized production process**
- **ISO certified, qualified foundry**
- **Many pressure sensor needs may be met without changing the process**

# ***RocketMEMS™*: Start with a great architecture**

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- **Single crystal silicon membrane**
  - Strong, high quality, stable material
  - Intrinsically free of hysteresis & creep
  - High burst pressure
- **Silicon-on-Insulator (SOI) wafers**
  - Precise membrane thickness
  - Consistent uniformity from device-to-device, run-to-run
- **Piezoresistive transduction**
  - Well understood
  - High sensitivity
- **Low cost readout electronics**
  - Simple Wheatstone bridge circuit
- **100% Test coverage for all guaranteed specifications**



***RocketMEMS™* pressure sensor die (2 x 2 mm) with test structures**

# What can be customized?

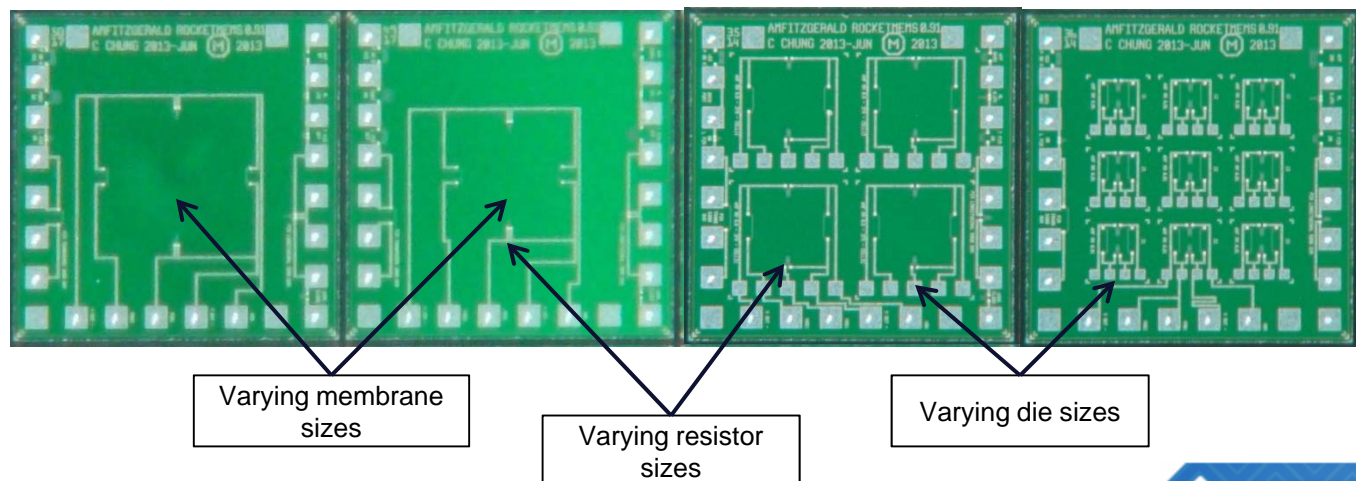
## Customizable:

- Pressure range
- Sensitivity
- Die size & thickness
- Bondpad location & size
- Bridge resistance
- Full vs. Half bridge

## Not customizable:

- Very high or low resistances
- Very wide dynamic range
- Very high sensitivities
- Very low noise

Examples of various  
*RocketMEMS™*  
pressure sensors  
(with test structures)





## Range of performance specifications

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	Medical	Consumer Electronics	Industrial or Aerospace
<b>Pressure range, absolute (atm)</b>	0.2 - 0.5 (38-380 mmHg)	0.2 – 2	0.2 – 10 (1.5-105 psi)
<b>Resistor value (K<math>\Omega</math>)</b>	1 – 10	1 – 10	1 – 10
<b>Chip length (mm)</b>	1 – 4	0.5 – 4	0.33 – 6
<b>Thickness (mm)</b>	0.3 - 1	0.3 - 1	0.3 - 1

Please note: these are example specifications,  
and not the boundaries of process

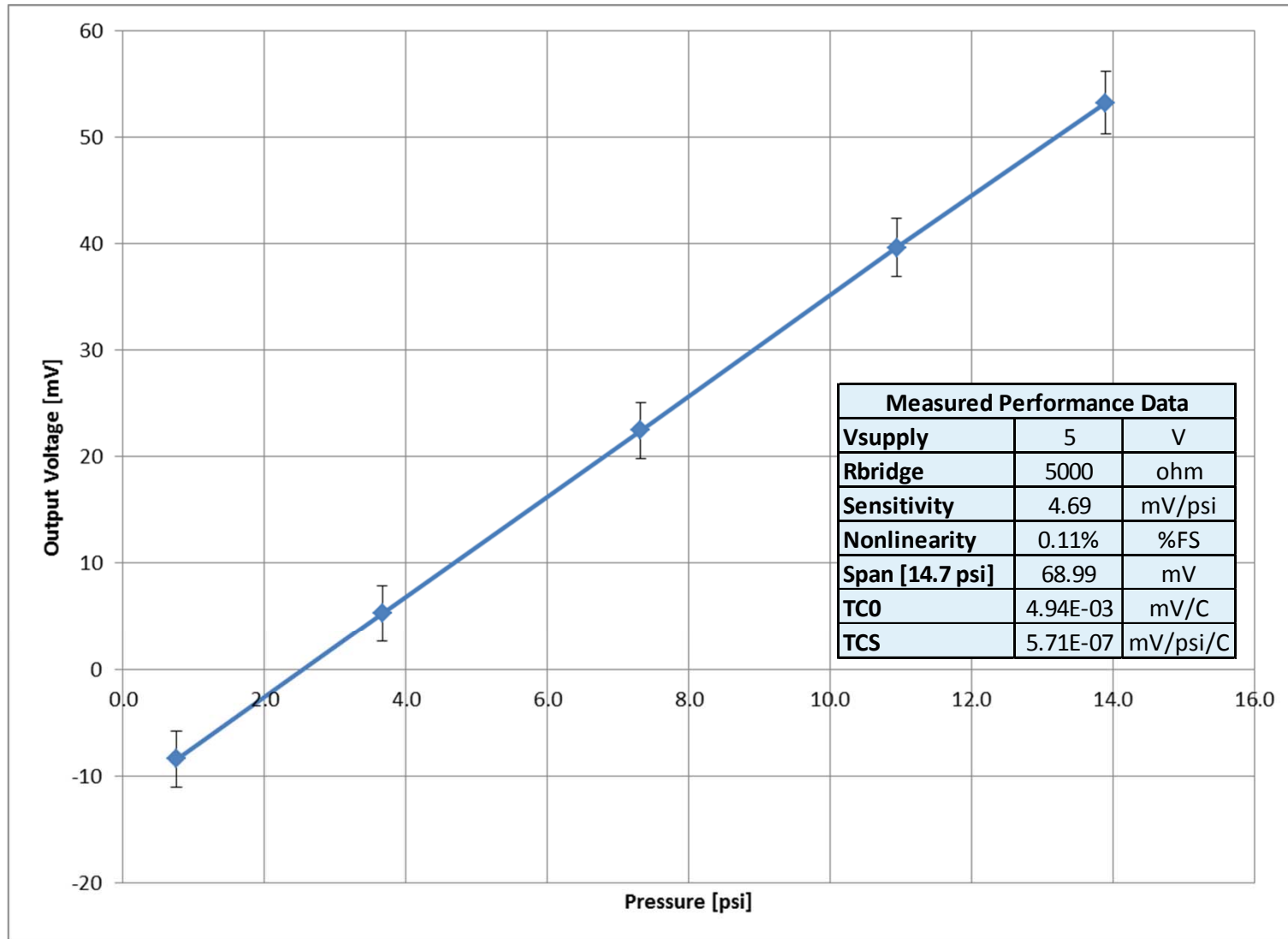
## Pressure sensor applications – some examples

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Medical	Consumer	Industrial or Aerospace
Blood pressure cuff Flow measurement Monitors Spirometer CPAP machine Catheters Endoscopes Infusion pumps Physical therapy	Altimeter (height) Weather (barometers) Appliances Wristwatches Sports equipment	Hydraulic systems Fuel gauge HVAC systems Engine control Exhaust management Pitot tubes Monitors

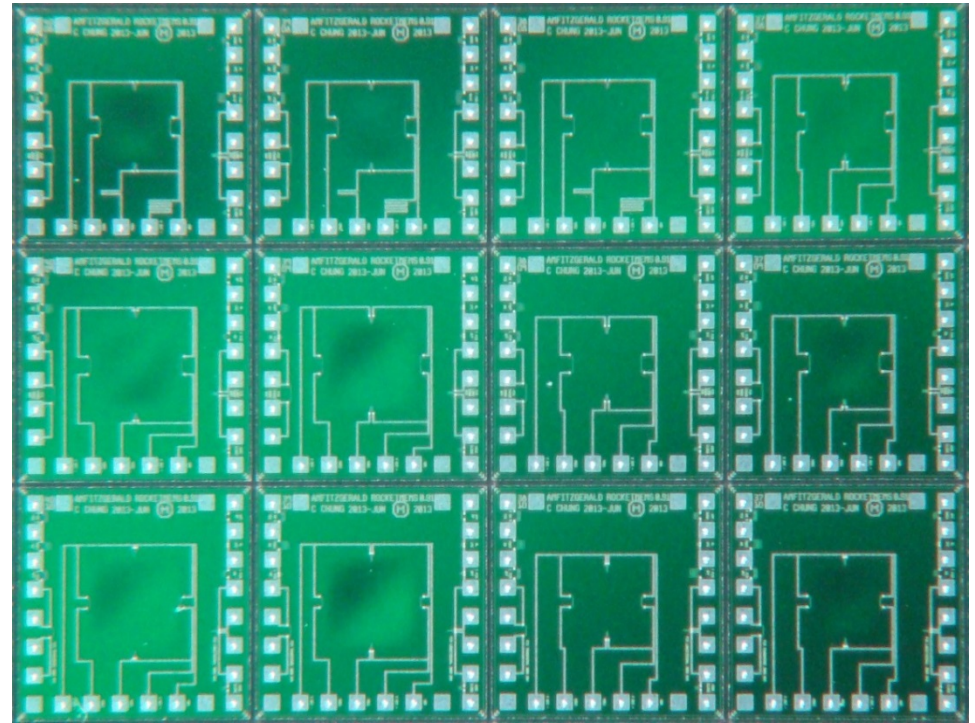
# RocketMEMS™ Reference Pressure Sensor

## Measured Performance Data



# Prototyping to high volume production

- Multiple designs on a run
  - Multi-Project Wafer (MPW)
- Scalable Production Volumes:
  - Rapid prototyping
    - 500+ devices
  - Low Volume Production
    - 10,000+ devices/year
  - High Volume Production
    - Millions of devices/year
- ***RocketMEMS™***: a low-risk path to high volume production
  - Prototype on MPW runs
  - High volume dedicated runs at Silex



Multi-Project Wafer: Many different chip designs are processed on the same wafer

## ***RocketMEMS™*: Our philosophy**

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### **“Design for Verified Process”**

- No process development
- Other MEMS sensor types to be added to *RocketMEMS* soon



## ***RocketMEMS™: How it works***

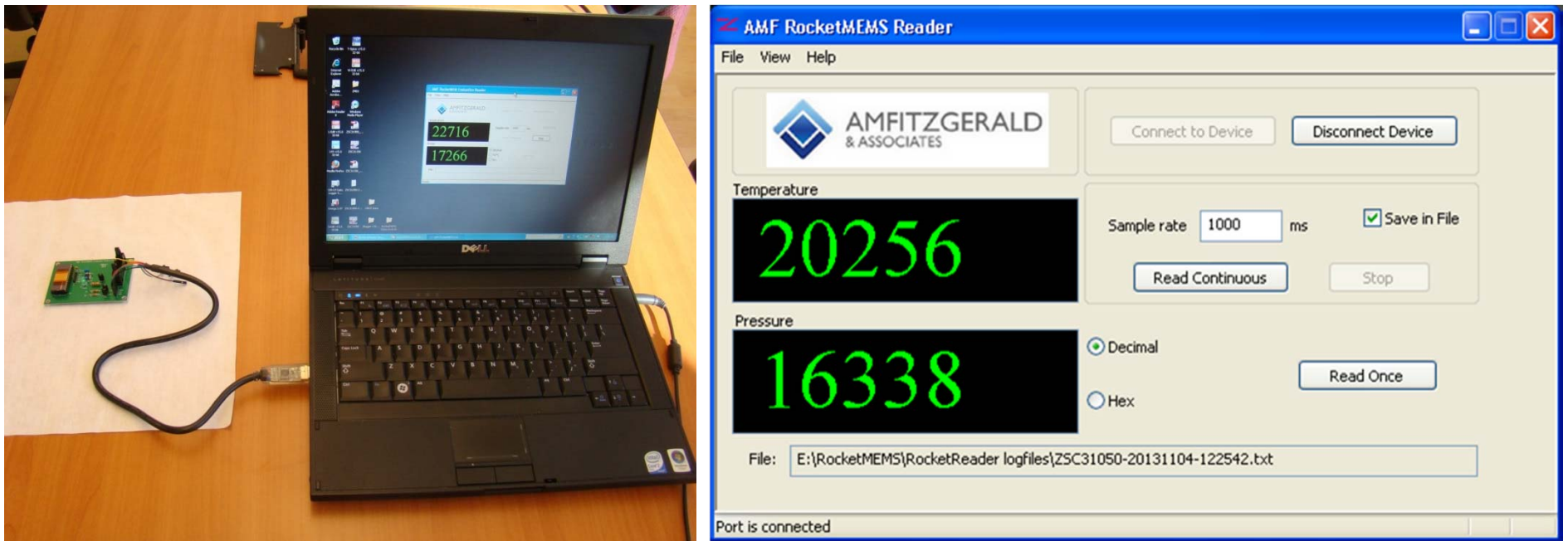
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- **Customer provides specification**
- **AMFitzgerald designs pressure sensors**
- **Silex Microsystems fabricates the chips**
- **Customer receives bare pressure sensor die in 4-5 months**
  - **On tape or in gel packs**

### **Options: Readout electronics, ASIC, Packaging:**

- **We can offer support and recommendations**

# Plug and Play Evaluation Kit with ZMDI ASIC



Kits include:

***RocketMEMS™* Pressure sensor**  
**Readout with ZMDI ASIC & Board**  
**Board-to-PC USB Cable**  
**Software & Manual**



# Silex: the world leader in MEMS Manufacture



**Accelerometers**

**Gyros**

**Pressure Sensors**

**Cantilevers**

**Touch Membranes**

**Flow Sensors**

**Filter Structures**

**CMOS Interposers**

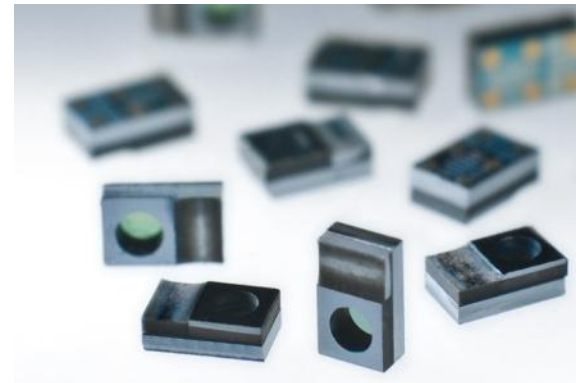
**Needles**

**uBatteries**

**IR Sensors**



Pressure sensors for measuring blood pressure in coronary arteries



Microphones for mobile telephones

**Cell/DNA Analysis**

**Microphones**

**RF Switches**

**Lab-on-Chips**

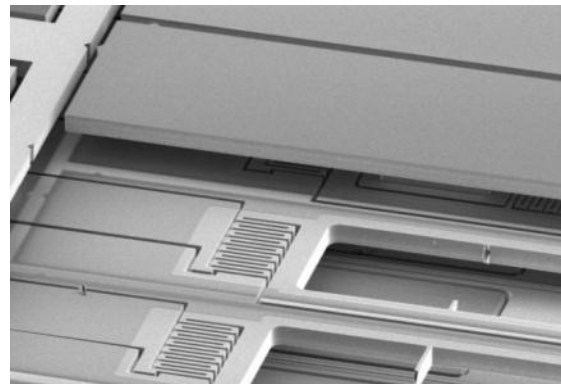
**Print Heads**

**Drug Delivery Devices**

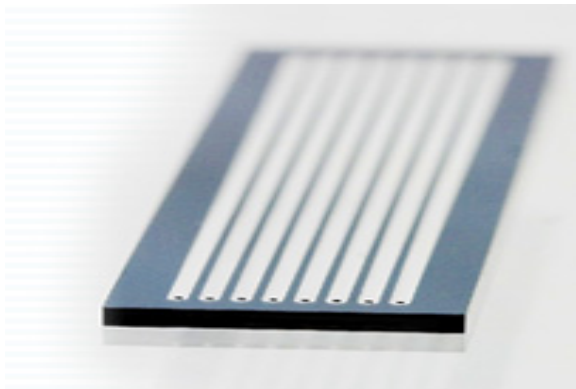
**Mirrors**

**Optical Benches**

**Oscillators**



Mirrors for optical switching



Lab-on-chip for DNA analysis



- Dedicated MEMS foundry with 12 years of volume MEMS production experience
  - Over 350 projects
  - Over 100 international customers
  - Work with over 50% of world's top 30 MEMS companies
- Bringing Innovation in Technology
  - Sil-Via® TSVs in consumer applications since 2006
  - Silicon interposers for all-silicon 2.5G packaging since 2006
  - Advanced wafer level packaging
  - Met-Via® Thick wafer metal TSVs since 2010
- Custom process integration to support the needs of MEMS innovators worldwide



# AMFitzgerald Company Background

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- **MEMS product development firm**
  - Global clientele
  - Over 125 clients served to date
  - Startups to Fortune 100 companies
- **Headquarters in Burlingame, California**
  - Silicon Valley, near SFO airport
- **Consistent growth since founding**
  - Founded in 2003
- **Active member of the MEMS Industry Group**



Headquarters in Burlingame, CA



## Semi-custom Silicon Pressure Sensors

- Reduced cost
- Reduced risk
- Reduced time to market
- Scalable production volumes

*For Inquiries, Samples, Evaluation Kits*

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