PHILIPS

MEMS & Micro Devices

# Choose your **MEMS partner**

## Use our top-8 selection criteria as a practical guide

# Choose Your **MEMS** Partner - **Eight Key Criteria**

## Executive summary

**Innovation launch?**

**Tight time to market?**

**Scaling to production?**

**Alternative sourcing?**

| Eight Key Criteria | University Lab | R&D Institute | Low Volume Foundry | High Volume Foundry |
|---|---|---|---|---|
| | Focus Areas of Your MEMS Partner | | | |
| 1. Project Objectives | Proof of concept | R&D programs | Custom processes | High yield processes |
| 2. Manufacturing Capacity | Limited repeat samples | Often multi-user | Flexible manufacturing | Mass manufacturing |
| 3. Engineering Services | High flexibility | Critical time to innovation and proto | Short lead times | Critical time to market |
| 4. System integration | | | | |
| 5. IP Aspects | | | | |
| 6. Quality Systems | | | | |
| 7. Business Model | | | | |
| 8. Flexibility | | | | |

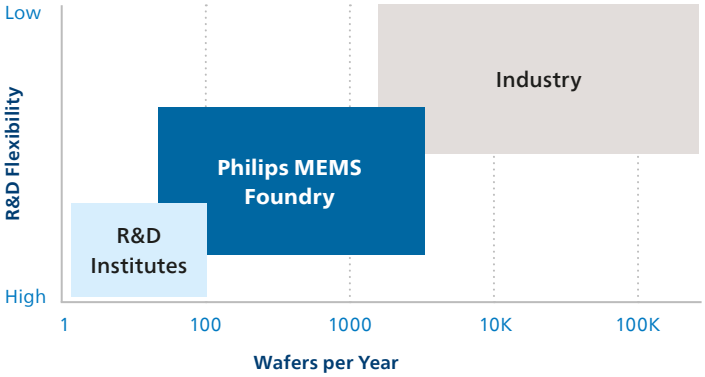
**Philips MEMS Foundry**

For innovators, from prototype to manufacturing

Conciliation of engineering and niche production

MEMS Foundry
Philips Engineering Solutions

### Philips MEMS Foundry Position



# **How to select** your MEMS partner

## Choose the right partner based on eight key selection criteria

### Your MEMS challenge

Choosing the right MEMS partner to suit your specific needs can be daunting. To help you make the right choice for you, we have identified eight key criteria to guide you through the MEMS marketplace. These will help you define and understand what is important to you and support you as you select a partner.

Understanding which types of MEMS a supplier can develop or produce is an important factor. But there are other key points to clarify, too: "How will they handle my project? How will they onboard my request? What form will our collaboration take? Are they capable of designing a dedicated fabrication process for me? What about IP? Can I re-use existing IP, processes and platforms? What is the dominant business model of the foundry and how will this impact my project? What quality systems are in place and which quality systems do I require for my product? What time-to-volume, time-to-proto, and time-to-market possibilities are there, and what do I need to meet my ambitions and expectations? What happens if I have nonstandard, complex requirements for a specific MEMS application, process, or capability?"

**So many questions! And it is our aim to help you find answers – and support you in finding the right partner for your MEMS challenge.**

### Table of contents



### Contact information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# 1. **What to expect** when starting a MEMS project

## Preparation is key

### It all starts with you

So what exactly is your challenge? Do you have a groundbreaking innovation and want to start your very first MEMS project? Or do you have tight targets to scale-up your current volume within a short time frame? Perhaps your current production requires more capacity. Or maybe you're unhappy with your current MEMS supplier.

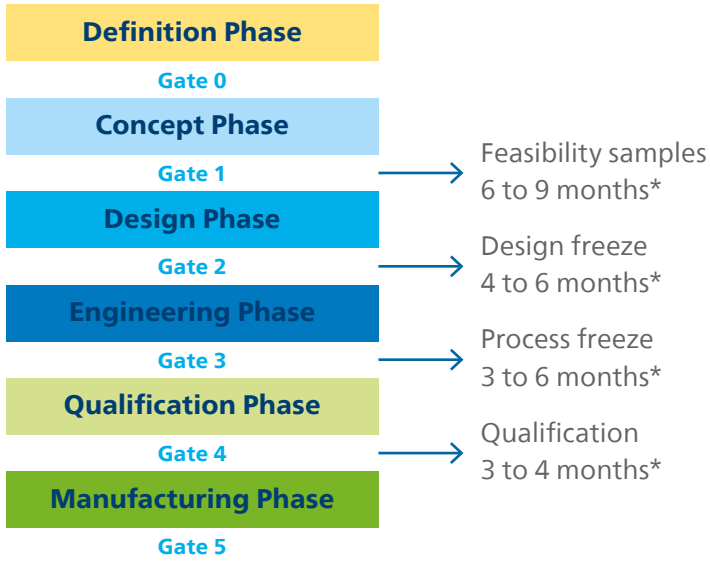
Whatever your reason, good preparation pays off when contacting a MEMS foundry. Typical questions you may need to respond to are:

- **What is the maturity of your product?**
  Are you at the idea, concept or prototype stage? Or do you already have a fabricated product?
- **What are your device specifications?**
  What wafer types, substrate sizes, process capabilities, materials, etc. do you need?
- **What is your requested deliverable?**
  Are you looking for a prototype, or samples from a manufacturable process, or high-volume production of wafers?
- **What is your project plan?**
  Do you have a time schedule for production?

If you would like to learn more what questions to expect, please see the MEMS Industry Group's self-evaluation checklist.

### A typical MEMS development project

There are various ways to describe a typical MEMS development project. While they are all relatively similar, they vary in the way the individual phases are divided (e.g. where one ends and another starts). We use the process outlined below. Its focus is on delivering a quality product in high volumes if needed. Depending on your challenge and the required deliverable, you may follow the entire process from start to finish, or you may follow parts of it. The order, however, is always the same:




* Timelines depend on product type and reuse of the process flow, which can result in major time gains. These timelines can be expected if we are able to reuse to a large extend (no guarantees).

# 2. Top eight **partner-selection criteria**

## Key questions to ask your MEMS partner

### 1. Your overall project objective

This first criterion touches the core of why you need a MEMS partner, and reflects where you are in your product lifecycle. Roughly, we divide MEMS projects into three types:

1. **Prototyping** – The proof-of-concept phase where you are looking for a partner to help demonstrate feasibility and functionality.
2. **Process development** – The next stage where short time-to-market with samples from a manufacturable process will make – or break – your product.
3. **Volume production** – The phase when you require short time-to-volume, at the right cost and quality levels. Here, a high-volume foundry can best meet your production ramp-up needs.

### 2. Manufacturing capacity

What is your roadmap and what level of maturity has your product reached? In addition to your current manufacturing capacity demands, you need to consider your future requirements and assess whether the foundry can meet your expected production volumes – based on the number of wafers or projects you intend to run in a year.

### 3. Services

You're looking for a foundry that matches the process capabilities and skills needed for your specific situation. But what kind of additional services do you need? Most foundries offer a MEMS process design service by default. Even if you have a process in place, any transfer (within a foundry's production line, or involving a change in wafer size or switch to another foundry altogether) will require process requalification and project redevelopment. Other services to look for:

1. MEMS product and process design and manufacturing
2. Wafer characterization and testing
3. Material analysis
4. Back-end services, including (wafer-level) packaging and micro-assembly

### 4. CMOS integration

The fourth criterion when it comes to selecting a foundry is its capabilities in integrating MEMS with CMOS electronics. If your application requires either hybrid or monolithic integration with CMOS electronics, special care must be taken to assess which fabrication techniques best suit your application's needs. Typically, a higher level of on-wafer integration saves time and effort in assembly of your device. Usually, higher wafer volumes demand manufacturing processes with fewer intermediate steps and less complexity.

# 2. Top eight **partner-selection criteria**

## Key questions to ask your MEMS partner

### 5. IP aspects

MEMS intellectual property (IP) is a multifaceted topic and needs to be addressed wisely. Do you have pre-existing IP that you want to bring with you into the development project or do you expect to create new IP in the course of the project?

Or maybe you will choose to use the MEMS foundry's IP library to speed up your project. Mostly, the IP will be related to processing steps. We recommend building your knowledge on the implications of the MEMS foundry IP into your end-product.

The ownership of IP created and used during your project needs to be defined from the start.

### 6. Quality systems

Knowing upfront what type of quality system your organization needs is an important factor when selecting a suitable MEMS partner. Your precise quality requirements will depend on your product. For example, medical product development needs to follow the ISO 13485 quality management system. If you require strict quality management control, find out whether the foundry outsources any processes to third parties as this may be considered an uncontrolled risk factor.

### 7. Dominant business model

High-volume foundries are known for cost efficiency per MEMS, which is ideal if you are in the cost-down and yield optimization phase. Highvolume foundries work with wafer-based pricing. Making high cost and taking risks on MEMS process development is not in the interest of highvolume foundries. University labs, research institutes and low/medium volume foundries are more likely to undertake proof-of-concept work with you based on a non-recurring engineering (NRE) cost model, and will accept low-volume orders.

### 8. Flexibility

Flexibility in tools, materials and substrate types is a key decision factor when selecting the right MEMS partner. If you know your requirements are complex or unusual, a low-to-medium-volume foundry offers the highest flexibility. This low-to-medium-volume type of foundry is especially suitable if you require flexibility in tools, materials (including CMOS-forbidden) and substrates on the one hand, while looking for a fixed way of working, with high quality and yield on the other.

# 3. **Score card** to define your requirements

## Discover your MEMS profile

| Partner selection criteria | Possible options | | |
|---|---|---|---|
| | A | B | C |
| 1. Your overall project objective | Proof of concept | Short time-to-market with samples from a manufacturable process | Short time-to-volume, with the right cost and quality levels |
| 2. Manufacturing capacity | < 50 wafers / project / year | 50-5,000 wafers / project / year | > 5,000 wafers / project / year |
| 3. Services | • Feasibility study of process, component and assembly<br>• TRL 1-4(*) | • Design of process and manufacturing<br>• Wafer characterization and testing<br>• TRL 3-9(*) | • Design of product and process and manufacturing<br>• Wafer characterization and testing<br>• Material analysis<br>• Back-end services, e.g. (wafer-level) packaging, and micro-assembly<br>• TRL 3-9(*) |
| 4. CMOS integration | Hybrid (MEMS and CMOS on carrier) | MEMS on top of CMOS | MEMS integrated in CMOS process |
| 5. IP aspects | All process IP remains with foundry | Customer owns product designs, as well as relevant process foreground IP within a field of use | Customer receives rights to relevant foreground IP |
| 6. Quality systems | ISO9001:2015 | • ISO9001:2015<br>• ISO13485:2016 or ISO/TS16949:2016 | • ISO9001:2015<br>• ISO13485:2016<br>• ISO/TS16949:2016 |
| 7. Business model | NRE | NRE and wafer-based pricing | Wafer-based pricing |
| 8. Flexibility | Flexibility in tools, materials (incl. CMOS-forbidden) and substrates. Fixed, defined way of working when high quality and yield are important | Limited flexibility determined by strategic profile and business case, e.g. potential CMOS activities or tool set | Little flexibility in tools, materials, and substrates due to manufacturing focus |

(*) Technology Readiness Level (TRL)

# 4. MEMS **supplier types**

## Making the right choice

### Typical profile of a **university lab**

Focus on research samples and proof-of-concept; limited continuity and repeatability, high flexibility, no need for time-to-market.

TRL 1-4 (*)

Typical profile of a **university lab**

| Partner selection criteria | Possible options A | B | C |
|---|---|---|---|
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### Typical profile of a **low/medium volume foundry**

Focus on development of manufacturable custom processes, followed by manufacturing.

TRL 3-9 (*)

Typical profile of a **low/medium volume MEMS supplier**

| Partner selection criteria | Possible options A | B | C |
|---|---|---|---|
| 1. Your overall project objective | Proof of concept | Short time-to-market with samples from a manufacturable process | Short time-to-volume, with the right cost and quality levels |
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### Typical profile of a **research institute**

Focus on technology R&D programs, often multi-user.

TRL 1-5 (*)

Typical profile of a **research institute**

| Partner selection criteria | Possible options A | B | C |
|---|---|---|---|
| 1. Your overall project objective | Proof of concept | Short time-to-market with samples from a manufacturable process | Short time-to-volume, with the right cost and quality levels |
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### Typical profile of a **high-volume foundry**

Focus on high yield processes, mass manufacturing and fast time-to-market.

TRL 4-9 (*)

Typical profile of a **high volume MEMS supplier**

| Partner selection criteria | Possible options A | B | C |
|---|---|---|---|
| 1. Your overall project objective | Proof of concept | Short time-to-market with samples from a manufacturable process | Short time-to-volume, with the right cost and quality levels |
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(*) Technology Readiness Level (TRL)

 

# Contact and further information

## Key questions to ask your MEMS partner

### Feel free to contact us for more information

**Contact us ›**

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### Share your score card with us

This is what ours looks like:

Profile of **Philips MEMS Foundry**

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### Further information

- Make sure you're prepared with this self-evaluation checklist
- Get an overview of MEMS foundry companies
- See the latest MEMS industry reports via Yole
- Find out more about Technology Readiness Levels (TRL)




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# Typical profile of a **university lab**

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# Typical profile of a **low/medium volume MEMS supplier**

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# Typical profile of a **high volume MEMS supplier**

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# Profile of **Philips MEMS Foundry**

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