

Yokogawa Solution Service presents
Minimal Fab One-stop Solution

minimal

Many think that “semiconductor manufacturing requires a mega fab and huge investment in facilities,” or that “mass production is required in order to achieve financial break-even.”

But what if semiconductors could be manufactured even in places like offices, and on demand, in just the quantities required?

Minimal fab is a new semiconductor production system that achieves just that, overturning all such presumptions.

Yokogawa Solution Service Corporation provides comprehensive support for customer requirements, ranging from device prototyping and process development through selection and introduction of facilities and after-sales support.

That is a **one-stop solution for minimal fab.**

Solutions through numbers

Minimal Fab - The Basics -

Minimal fab is a completely new concept in production systems that is not bound by the conventional wisdom of mass production. Here are some number-based facts about minimal fab that clearly portray its many features.

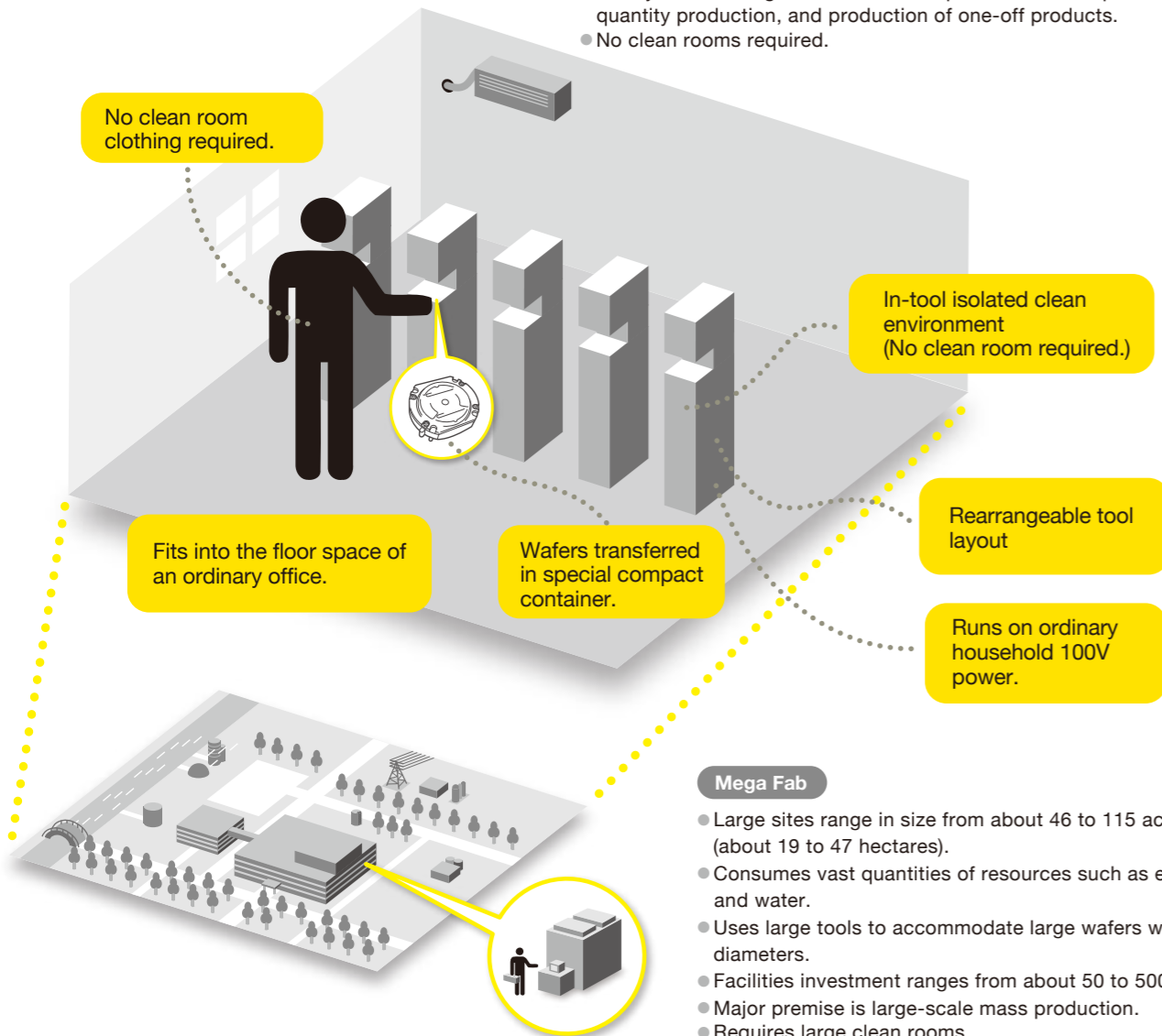
1/10000

Minimal fab is a system that is optimized for high-mix low-volume production of semiconductors that can be as small as a single chip. "Localized clean technology," which simultaneously shuts out both particles and gas molecules, is used to achieve localized clean room conditions in an environment that is "1/1000 the scale of a mega fab" with respect to factory construction cost,

scale of production, cost of raw materials, tool size, and all aspects of the fabrication process. Minimal fab thus greatly reduces the overhead of manufacturing compared to the large sites, the huge investments, and the vast resources that are required by mega fab facilities, allowing all processing tools to be compactly accommodated in an ordinary office environment.

Minimal Fab

- Comfortably fits into the floor space of an ordinary office.
- Minimizes resource consumption.
- Compact tools are ideally suited to low-volume semiconductor production.
- Facilities investment of 0.5 to 3 billion yen
- Ideally suited to high-mix low-volume production, multiproduct variable quantity production, and production of one-off products.
- No clean rooms required.

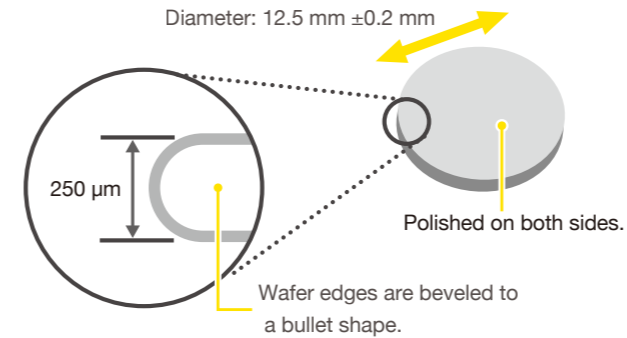


Mega Fab

- Large sites range in size from about 46 to 115 acres (about 19 to 47 hectares).
- Consumes vast quantities of resources such as electricity and water.
- Uses large tools to accommodate large wafers with 12-inch diameters.
- Facilities investment ranges from about 50 to 500 billion yen.
- Major premise is large-scale mass production.
- Requires large clean rooms.

0.5

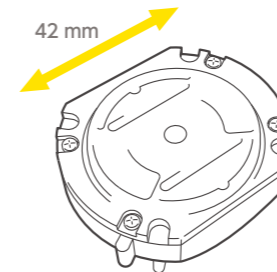
Minimal fab uses wafers with a half-inch diameter. These are very small compared to the 12-inch wafers used in mega fab facilities. Minimal fab's use of such small wafers makes it possible to fabricate even a single semiconductor chip.



With minimal fab, one tool is provided for each stage of processing, and wafers are transferred between tools using "minimal shuttle," a special sealed transfer container. All minimal fab tools are also equipped with Particle-Lock Air-tight Docking (PLAD) system as a shared specification, ensuring that wafers are always completely isolated from the external environment. This makes it possible to fabricate semiconductors in an office-like environment, without the need for clean rooms or clean room clothing.

42

With a diameter of just 42 mm the "minimal shuttle" container is an important part of the system that makes clean rooms unnecessary.



100

All minimal fab tools operate on 100VAC household mains power. Based on the concept of "producing just the required quantity at the

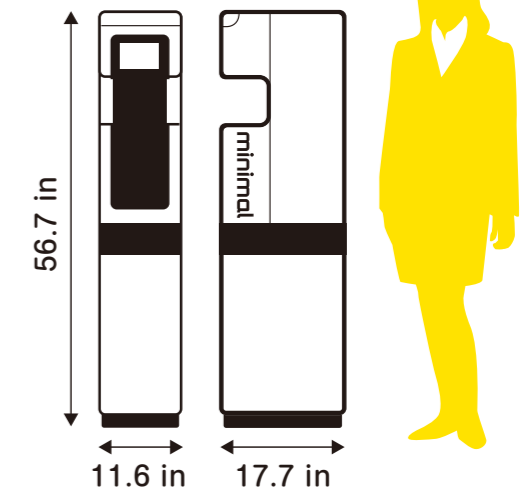
required time," minimal fab achieves a high level of energy efficiency, consuming minimum power needed for high-frequency power and plasma generation. Consumption of required gasses and chemicals is also minimized, and the tools do not require a factory with large-scale utilities, but can be installed in office-like spaces.

1440

The housing size of each minimal fab tool is determined according to the minimal fab standard.

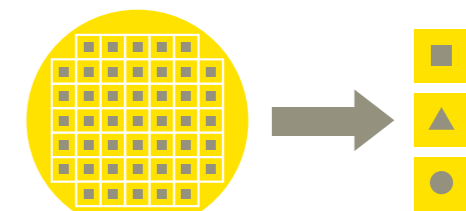
Whatever the process of each tool, all tools are the same size. The tool height is 56.7 in. This height is based on the premise that an adult of average size will be standing at the front of the tool. When standing before an array of these tools, the process name is prominently displayed above the touch screen, making it easy to identify the process that each tool performs at a glance.

The tool width is not imposing, and the touch screen is located at a height that allows easy operation even by a person of small stature. The compact housing is an integral aspect of a human interface that facilitates ease of operation and a feeling of easy accessibility.



Minimal fab can be used to fabricate even a single chip. Unlike mega fab tools, which use large-diameter wafers and are not profitable unless they fabricate a large number of chips from a single wafer, minimal fab is optimized for low-volume production. While mega fab tools are built for production in high volumes, minimal fab meets the need for high-mix, low-volume production.

1



Mega Fab

Minimal Fab

Minimal Fab Symbol



Minimal Fab Logo

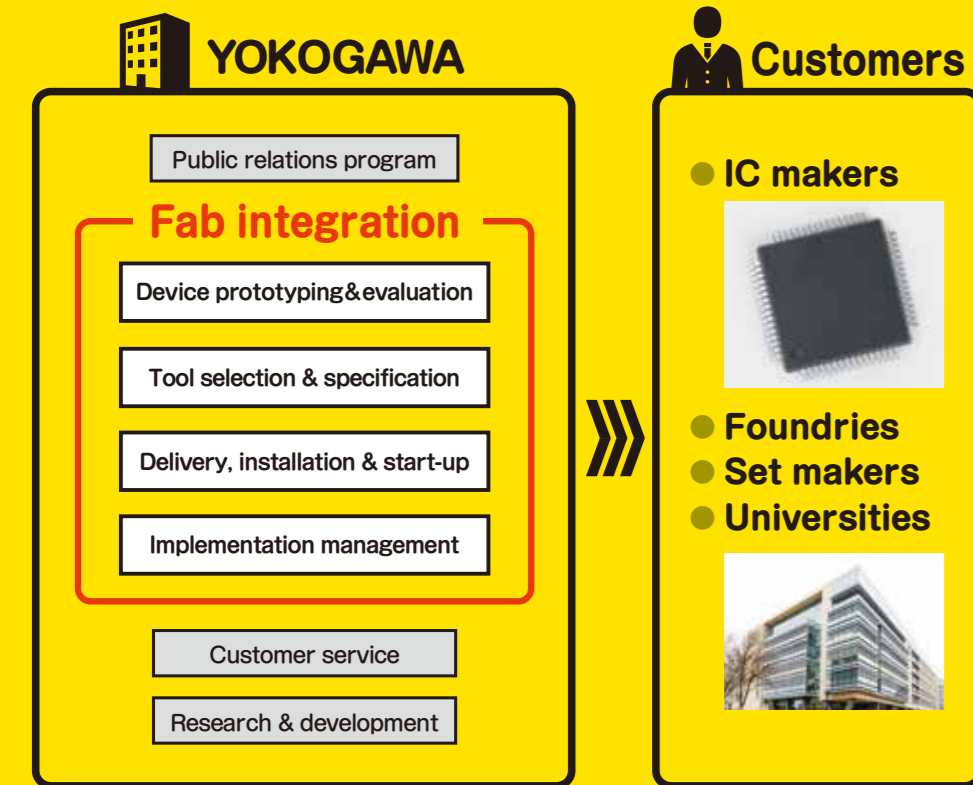
minimal®

Minimal® is a registered trademark of the Minimal Fab Promoting Organization.

It's What We Do: Minimal Fab One-stop Solution

Offering full solutions to customers who need minimal fab

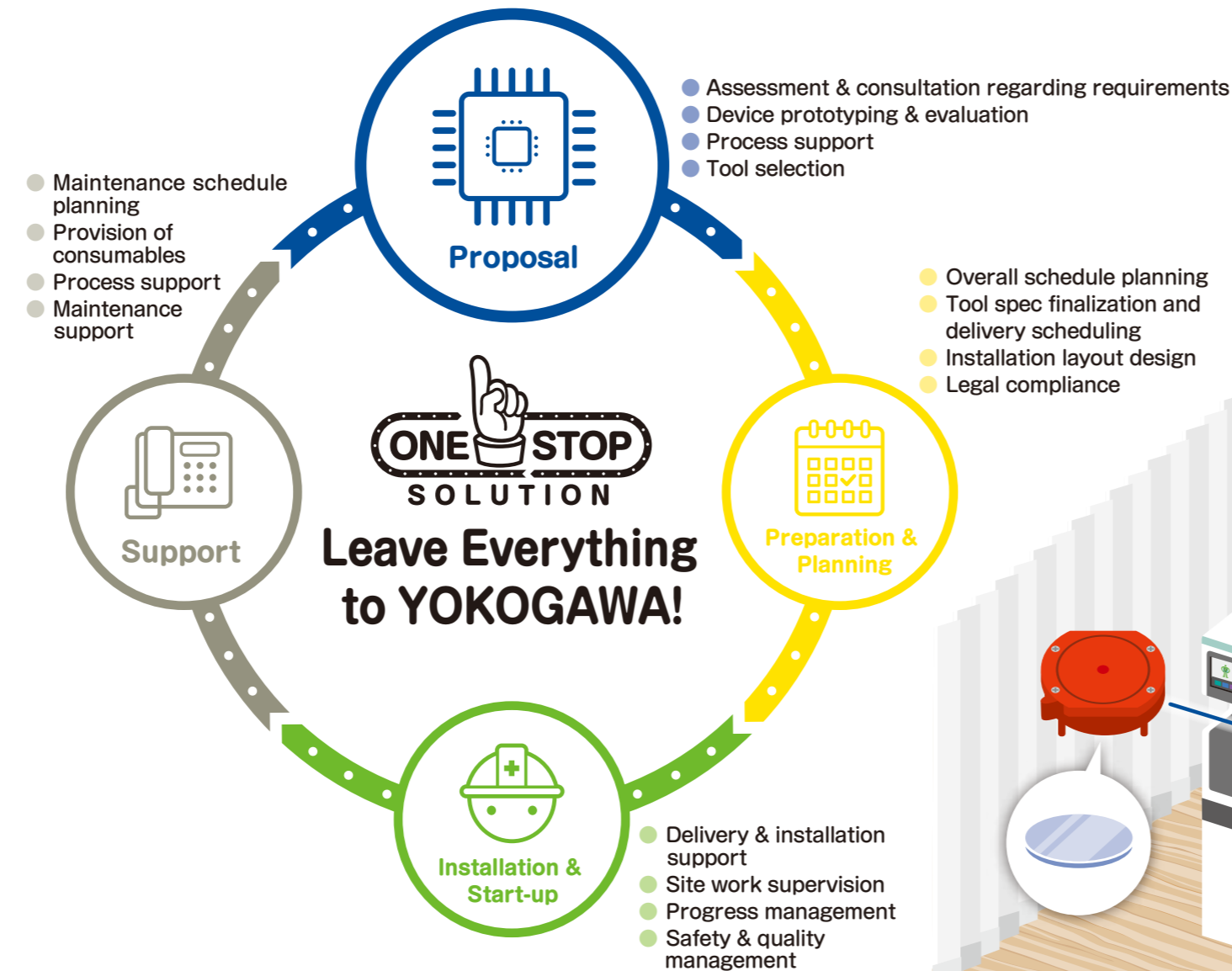
Taking advantage of know-how developed through many years of experience in the semiconductor industry, engineers who are thoroughly familiar with minimal fab provide customers with comprehensive solutions.



Integration

Fab Integration Example

- Collective purchase agreement
- In-lab process development support
- Specification adjustment for installed facilities
- Environmental and legal compliance
- Introduction, start-up schedule planning & adjustment support
- Installation monitoring, inspection and parts supply



Proposals Prepared Using an Application Lab

Device Prototyping & Evaluation

At Yokogawa Minimal Fab Application Laboratory, customers can verify for themselves the processes performed by the tools during device manufacture. Making use of minimal fab's maskless exposure capability, prototyping can be done with minimum turnaround time.

Process Support

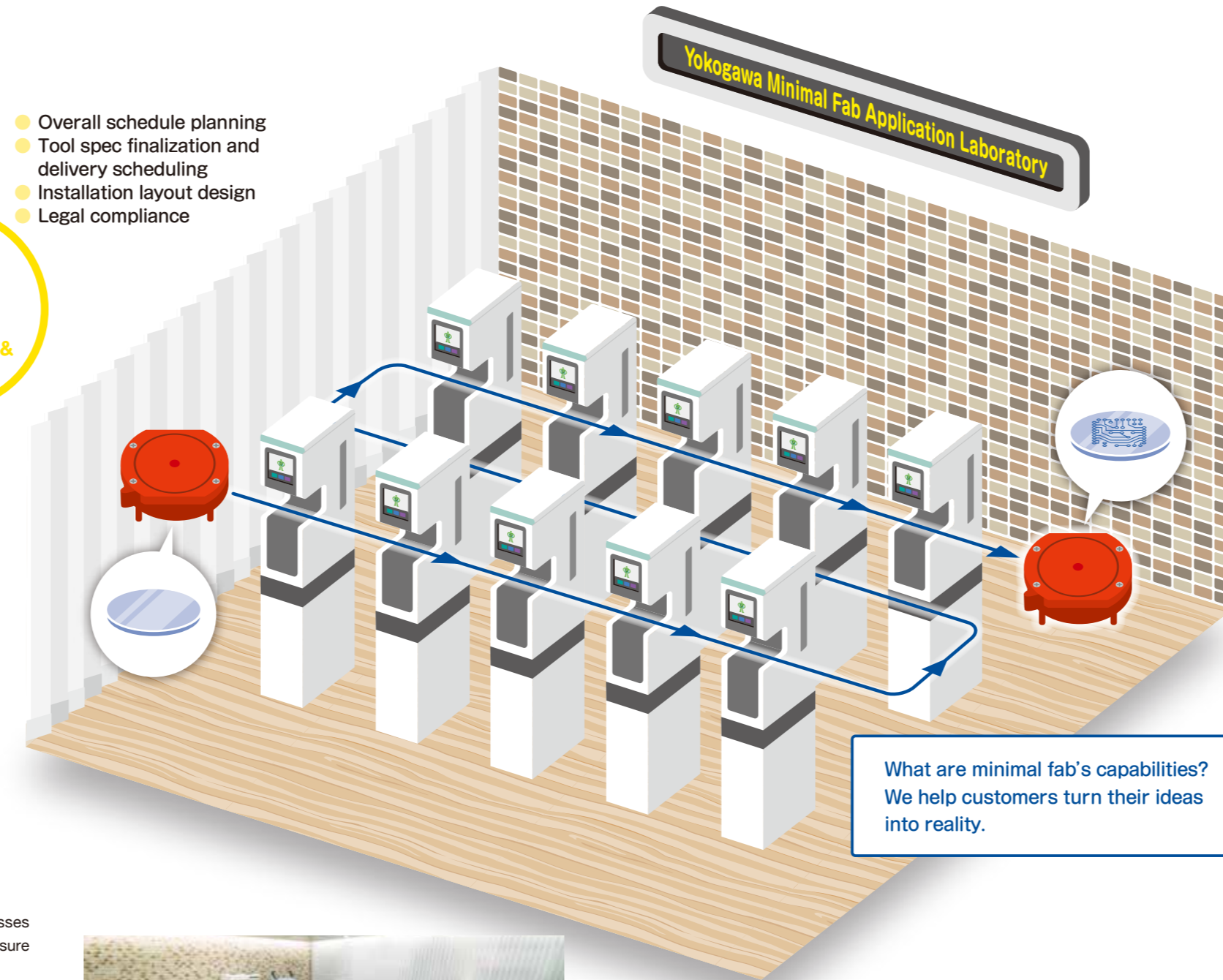
- Prototyping and evaluation trials based on premise of minimal fab introduction
- Elemental process development & evaluation for devices to be manufactured
- Prototyping for R&D purposes
- Sample wafer fabrication for tool evaluation
- Proposal of hybrid processes

Example:

- Prototyping and evaluation on commission
 - Prototyping by Yokogawa engineers
- Time rental of minimal fab
 - Support for prototyping by customer



"What can we do?" At Yokogawa, we constantly ask ourselves this question. Minimal fab offers the world an unlimited range of possibilities, and can be utilized in a wide variety of ways. The mission of Yokogawa Solution Service Corporation is to create new value and make proposals in response to our customers' requirements. In other words, our work begins with the question of how to give form to customers' original ideas.

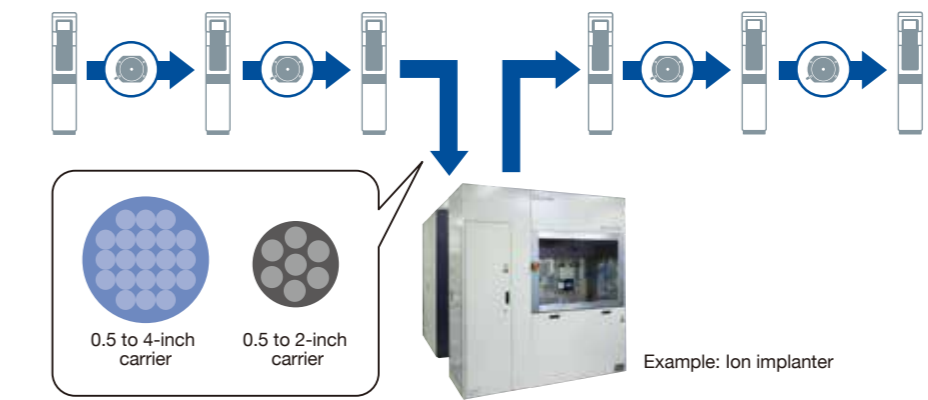


Comprehensive Introduction Support by Experienced Engineers

Experienced engineers participate in minimal fab facility construction. There is no need for customers themselves to engage many engineers. Leave everything to us!

Proposals for Hybrid Processes

A hybrid process proposal is one that combines elements from mega fab tools and minimal fab tools. While mega fab tools can be used for device production during development of minimal fab tools, hybridization also provides flexibility by allowing minimal fab to take on part of the processes of an existing mega fab tools while it is being maintained. For example, the maskless exposure tool that is one of the features of minimal fab can be introduced into the lithographic process, greatly reducing development time over that which would be required using only existing tool.



Total Care, from Preparation for Introduction to Set Up

We provide full support for all considerations related to installation environment, from confirmation of utilities, providing proposals for layouts suitable to actual operational scenarios, and preparation for introduction of tool to actual delivery and installation.



Leave Legal and Compliance Issues to Us

We also provide consulting services regarding storage, handling, safety equipment, and laws and regulations related to the hazardous materials and toxic chemicals used in semiconductor manufacturing and can sell or build necessary equipment. There is no need for customers to be concerned about these matters. Please feel free to consult us for advice.



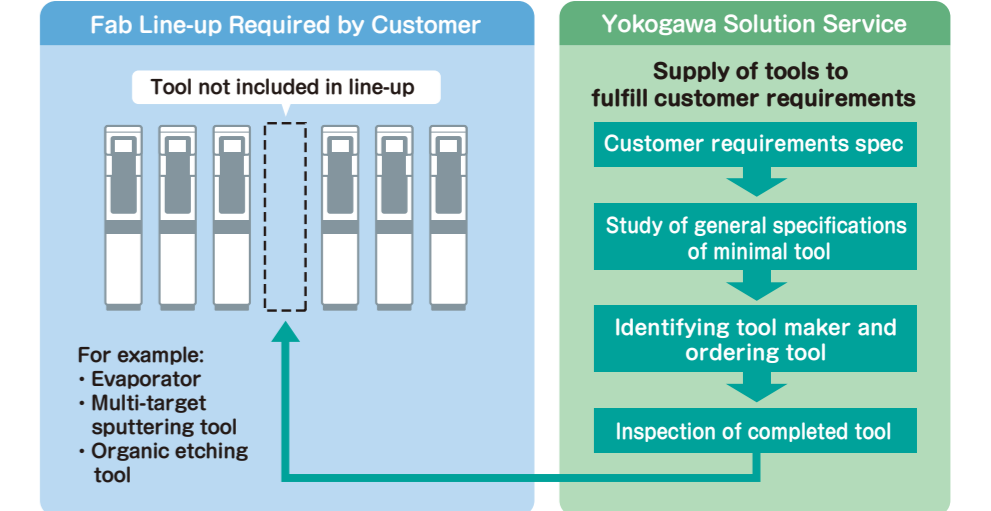
Role of the "Yokogawa Minimal Fab Application Laboratory"

The Yokogawa Minimal Fab Application Laboratory fulfills many roles, such as supporting the adoption and development of minimal fab and technological advances. Experienced engineers are permanently assigned to and work with tools at the Lab, which is located at the National Institute of Advanced Industrial Science and Technology in Tsukuba, north of Tokyo. By providing tool makers with feedback regarding problems that arise during lab operation and corresponding countermeasures, the lab works to achieve ever greater operational stability.



Technical Support: Proposal of Tools Not Included in Line-up

Because minimal fab targets the high-mix, low-volume market, there are cases in which a required tool is not included in the current line-up. In such cases, we can leverage a vast fund of experience accumulated over many years, as well as our connections within the industry, to provide tools that meet such requirements within a short period of time.



Customer Service

Rely on us for post-installation management and maintenance. We support customers with a comprehensive service system. We also provide comprehensive support for customer operational management, such as by suggesting and selling consumables and spare parts.



Introduction to the Yokogawa Minimal Fab Application Laboratory

The “Yokogawa Minimal Fab Application Laboratory” opened at Yokogawa Solution Service headquarters is the world’s first incubation center where customers can become directly familiar with minimal fab. Hosting a line of several minimal fab tools within an 861-ft² floor space, the lab is a place where customers can see, touch and actually use minimal fab.

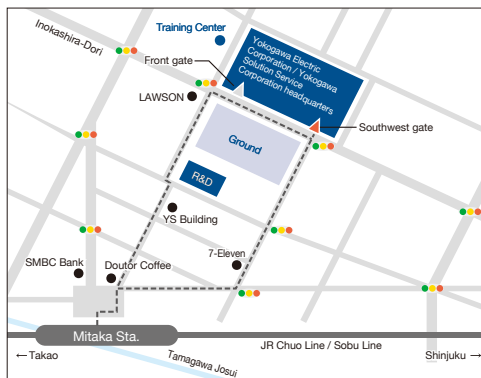
Not only does this lab provide process support to customers, such as device prototyping and process development, but it can also be used for training or for educating engineers.

In-depth knowledge of semiconductors is not needed in order to benefit from the lab. Engineers who were directly involved with development of equipment and processes at the National Institute of Advanced Industrial Science and Technology are permanently stationed at the lab, and can extend comprehensive support to customers.

We hope you will experience minimal fab for yourself in this environment that does not require any clean room. We look forward to seeing you!



Map

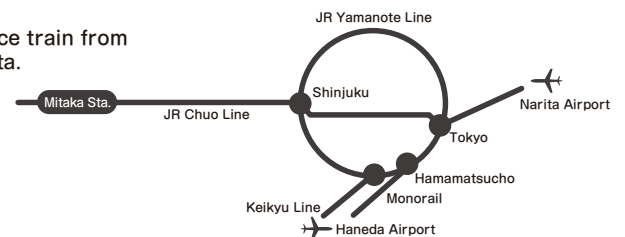


See minimal fab at Yokogawa Solution Service Headquarters
(2-9-32, Nakacho, Musashino-shi, Tokyo 180-8750 Japan)

■ By train

32 minutes by rapid service train from Tokyo Sta. to Mitaka Sta.

17 minutes by rapid service train from Shinjuku Sta. to Mitaka Sta.



Visits by Reservation Only For information and reservations, please contact:

E-mail: minimalfab-sales@cs.jp.yokogawa.com

Yokogawa Solution Service Corporation

Semiconductor Service Business Division,
Minimalfab Business Department

Headquarters: 2-9-32, Nakacho, Musashino-shi, Tokyo 180-8750 Japan

Tachikawa Office: No.7 bldg. 6-1 Sakaecho, Tachikawa-shi, Tokyo 190-0003 Japan

E-mail: minimalfab-sales@cs.jp.yokogawa.com

<https://www.yokogawa.com/yjp/solutions/solutions/minimal-fab/>