



Plasma Etch Systems

Tactras™

RLSA™ Theory of Operation Manual

Document Number: CX97-100215-21
Revision 3.2.1 [GRX] 2016-04-01
Original Instructions



RLSA™ Theory of Operation Manual

Plasma Etch Systems
Tactras™

► Preface 4501M.20160301

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Published in Japan

Publisher: Tokyo Electron Limited

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2.1 Liability for operation of the Products

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► Enrollment in TEL–Made Equipment Training A587M.20130701

The TEL–made equipment you have purchased requires routine maintenance for stable operation. These maintenance activities require sufficient basic knowledge on TEL equipment and latest maintenance information.

We offer an equipment training curriculum focusing on operation and maintenance that helps you acquire the necessary knowledge.

For enrolling in our equipment training, see the following:

1. Application

Contact the local TEL training department or sales/service office to request training. Your enrollment reservation will be registered after the schedule is arranged.

2. Training Fee

2.1 When You Have Training Credit

The training credit can be used on the condition provided in section “3. Use of Training Credit”.

2.2 When You Do Not Have Training Credit

The specified training fee is charged.

2.3 Other Expenses

- For equipment training provided at customer's site: Basically, separate costs are charged such as transportation and accommodation costs.
- Cancellation fee is charged if the enrollment reservation is canceled or the schedule is changed within two weeks of the expected training start date. The cancellation fee can be paid by the training credit.
- An additional fee will be charged when we provide equipment training outside of our standard service hours such as nighttime and non-business days.

3. Use of Training Credit

3.1 What is Training Credit?

For one unit of equipment purchased, the specified number of training credits is provided. One training credit allows one trainee to enroll in the training for the equipment purchased for one day (normal hours for providing training).

3.2 Issuance and Expiration Date

Training credit is issued together with the equipment serial number when the equipment is allocated to you according to your equipment purchase order sheet. Training credit is valid for one year after the CST date of the equipment purchased.

3.3 Scope of Application

The training credit applies to the standard training course for the equipment purchased. It is available only to the customer of the factory where the equipment purchased is installed.

Note that when the equipment is relocated within the same company, any valid training credit shall be transferred to the destination. Training credit becomes invalid when the equipment is sold or transferred to a company other than the original purchasing company.

3.4 Deduction of Credit Used (Utilization)

Any of the following cases assumes one training credit is used for one person for one-day training (within normal training hours). In this case, an appropriate number of credits are deducted from the remaining balance.

- Completion of equipment training (including discontinuation and early termination by the trainee)
- Cancellation by customer of enrollment within two weeks of the expected equipment training start date and the cancellation fee is paid by training credit (excluding the case when there is an alternative trainee)
- Change by customer to the schedule within two weeks of the expected equipment training start date and the cancellation fee is paid by training credit

3.5 Others

- A separately made agreement (e.g., in a contract), if any, is prioritized.
- Training credit has no cash value and cannot be exchanged or equivalent-exchanged with non-training items (e.g., services, parts, transportation and accommodation costs).
- For more information, contact the sales representative assigned to you.

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Introduction

This chapter describes the outline, purpose, and organization of this manual, and other information necessary for using this manual. It also includes contact information and important notices.

1.1 About the Contents of This Manual

10377M.20140201

The manuals provided with this system include the information about the installation, operation, and preventive maintenance for TEL manufactured equipment as well as its support equipment. Please keep the manuals in a location close to the equipment so that it is easily accessible when it is needed.

Some of the manuals are separated into volumes according to purpose and contents and the users are required to refer to other related manuals. Please use the manuals after understanding the content and how to use each manual.

WARNING

General

Do not perform any tasks other than as described in this manual. TEL accepts no responsibility for damage arising because the tasks were performed other than as described in this manual.

CAUTION

Equipment Damage

Failure to perform the tasks described in this manual may affect the normal operation of the equipment. Perform all the tasks described in this manual.



NOTE

If there are any questions regarding the content of this manual, please contact TEL's service center. The design of this tool is being researched and improved continuously so there may be differences in the appearance, instrumentation, and screens on your tool. This manual contains the information on standard type.



NOTE

The original language of this manual is English. The TEL authorized editions of this manual are the English edition and the Japanese edition. Other editions of this manual which are written in any language other than English or Japanese are created for the user's convenience only. In the event of any discrepancy or conflict between the authorized editions of this manual and an edition of this manual which is written in any other language, the authorized editions shall prevail.

1.2 Before Operating the Equipment

00101M.20150801

WARNING

Chemical/Electric Shock/Mechanical Drive/Equipment Damage

There is the possibility of serious injury, death, and tool damage if the equipment is used improperly. The system is designed to process silicon wafers and should not be used for any other purpose.

WARNING

Strong Magnetic Field

Units equipped with magnets generate a strong magnetic field that can adversely affect the operation of electronic medical implanted devices such as pacemakers. People with pacemakers or other implanted medical electronic devices should maintain a safe distance of at least 1 m(3 ft) from units equipped with magnets.

CAUTION

Strong Magnetic Field

Units equipped with magnets generate a strong magnetic field that can attract metal accessories and potentially cause bodily injury when pulled strongly to the magnets. If you wear metal accessories such as body piercing or necklace, maintain a safe distance of at least 1 m(3 ft) from units equipped with magnets.

CAUTION

Equipment Damage

Units equipped with magnets generate a strong magnetic field that can adversely affect objects susceptible to magnetism (such as electronic devices and magnetic cards). Do not place objects susceptible to magnetism (such as electronic devices and magnetic cards) near units equipped with magnets.

CAUTION

Equipment Damage

Network in the equipment may be infected with a virus. Do not connect to the free port of hub on the equipment.

To prevent loss or corruption of data and damage to the equipment due to improper operation and ensure safe operation of the system, this system has three equipment operation levels (normal operation, process operation, and equipment operation) so that a user can access only the screens and functions that are allowed for the user, according to the operation level that has been assigned to the user according to his/her position, knowledge of the equipment, and skills. Therefore, the manuals you should read vary according to your operation level.

Before operating the equipment, you must carefully read and thoroughly understand the contents of applicable TEL manuals, as well as completing the necessary training classes. All the TEL manuals are prepared on the assumption that the operator has received the necessary trainings.

The following table lists the manuals and training courses that TEL require for each operation level.

▼ Operation Level and Applicable Manuals

Office Organization	Operation Level	Applicable Manuals	Required Training Courses
General operators	Normal operation (To operate production processing)	<ul style="list-style-type: none"> • TEL Safety and Environmental Guidelines • System Safety Manual • Process Module Safety Manual • Basic Operations Manual 	Training course level 1

Office Organization	Operation Level	Applicable Manuals	Required Training Courses
Process operators	Process operation (To edit process recipes)	<ul style="list-style-type: none"> • TEL Safety and Environmental Guidelines • System Safety Manual • Process Module Safety Manual • Basic Operations Manual • Advanced Operations Manual • Process Manual • System Theory of Operation Manual • Process Module Theory of Operation Manual 	Training course level 1
Maintenance operator	Equipment operation (To perform maintenance, inspection, and adjustment)	<ul style="list-style-type: none"> • TEL Safety and Environmental Guidelines • System Safety Manual • Process Module Safety Manual • Basic Operations Manual • Advanced Operations Manual • Advanced Operations Parameter Manual • System Maintenance Manual • Process Module Maintenance Manual • System Theory of Operation Manual • Process Module Theory of Operation Manual 	Training course level 1 and 2
Installation worker	—	<ul style="list-style-type: none"> • TEL Safety and Environmental Guidelines • System Safety Manual • Process Module Safety Manual • System Installation/Startup Manual • Process Module Installation/Startup Manual 	—

**CAUTION****General**

TEL provides TEL Safety and Environmental Guidelines and Safety Manuals to establish a basic knowledge of important safety and environmental concerns. Thoroughly read and fully understand these manuals before performing installation, maintenance, and process.

**NOTE**

Installation engineers can only move, install, and connect the equipment. However, they can not operate the machine as they do not belong to any of the operation levels in the preceding table.

1.3 How to Use this Set of Manuals 10378M.20131001

1.3.1 How to Use Each Manual 10379M.20131001

The equipment and support equipment must be properly installed and operated for proper processing. In addition, maintenance work must be performed periodically to keep the equipment and support equipment in good working condition.

Refer to the appropriate manuals for specific instructions on installing the equipment and the support equipment, processing, and maintaining the equipment.

Each manual is prepared on the premise that the users fully understand the content of the manual regarding the safety.

1.3.1.1 Before Beginning Work 10380M.20131001

Although this system is designed to protect workers and the environment, improper or incorrect operation may jeopardize workers or the environment.

Anyone operating this system must fully understand and always be aware of the system's potential hazards and possible impact on the environment.

Personnel should also know how to operate the system so that the environment is not harmed.



CAUTION

General

TEL provides TEL Safety and Environmental Guidelines and Safety Manuals to establish a basic knowledge of important safety and environmental concerns. Thoroughly read and fully understand these manuals before performing installation, maintenance, and process.

1.3.1.2 Signal Word Definitions 10381M.20131001

Signal words are used in this manual to indicate that certain hazards exist, and signal words are also printed on the safety labels that are affixed to the equipment.

Signal words tell the users and workers around the system the extent of potential hazards. Depending on the level of danger, four types of signal words that comply with ANSI Z535.4-1988 are used in the manual for this system, and are defined as follows: In addition, Note indicates reference information.



DANGER

Danger

Danger indicates an imminently hazardous situation which, if not avoided, **WILL** result in death or serious injury.



WARNING

Warning

Warning indicates a potentially hazardous situation which, if not avoided, **COULD** result in death or serious injury.



CAUTION

Caution

Caution indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to personnel.

CAUTION**Caution**

Caution indicates a potentially hazardous situation which, if not avoided, may result in property damage to the equipment or to the product.

**NOTE**

Note indicates necessary or useful information for the system operations and maintenance. This does not indicate any hazardous situation.

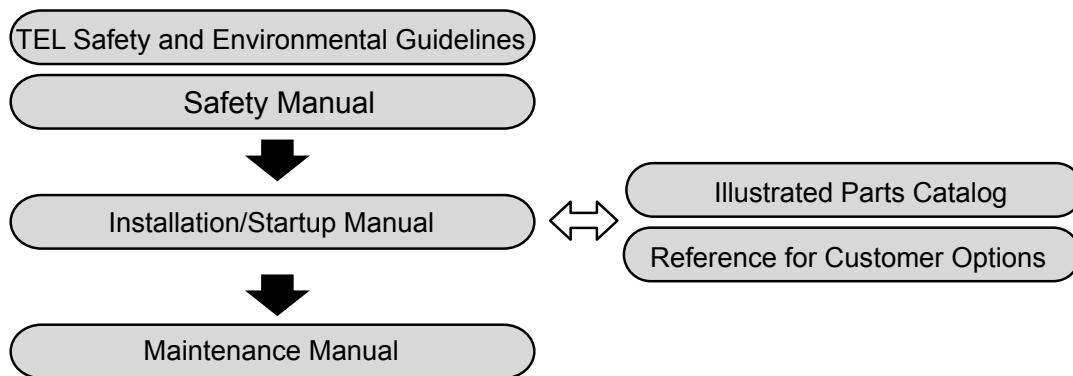
1.3.1.3 Installing the Equipment and Support Equipment 10382M.20131001

Only personnel who specialize in installing the equipment and support equipment are authorized to perform an installation.

Maintenance operators who install the equipment and support equipment should refer to the Illustrated Parts Catalog and the Reference for Customer Options for information on cable connections and the equipment dimensions needed for the installation.

After the installation is complete, maintenance operators who conduct the installation must verify that the system is installed properly by referring to the appropriate maintenance manuals.

▼ **Manuals to Reference During an Installation**



c_installationdoc_kai_e

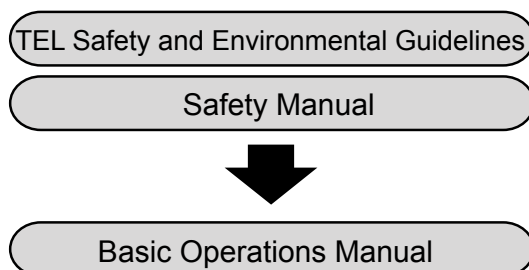
**CAUTION****General**

TEL provides TEL Safety and Environmental Guidelines and Safety Manuals to establish a basic knowledge of important safety and environmental concerns. Thoroughly read and fully understand these manuals before performing installation, maintenance, and process.

1.3.1.4 Processing Wafers 10383M.20131001

General operators, process operators, or maintenance operators processing wafers should refer to the Basic Operations Manual.

▼ Manual to Reference When Processing Wafers



c_operationsdoc_kai_e

CAUTION

General

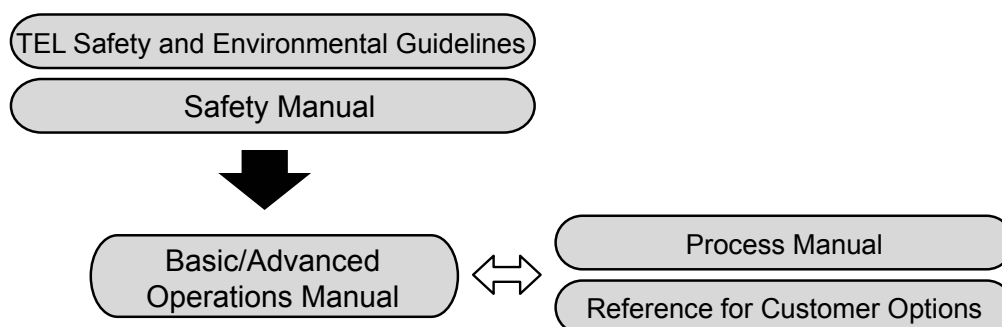
TEL provides TEL Safety and Environmental Guidelines and Safety Manuals to establish a basic knowledge of important safety and environmental concerns. Thoroughly read and fully understand these manuals before performing installation, maintenance, and process.

1.3.1.5 Editing Recipes 10384M.20131001

Only process operators and maintenance operators can edit recipes.

Refer to the appropriate process manuals or the Reference for Customer Options for information needed to edit recipes.

▼ Manuals to Reference When Editing Recipes



c_opsrecipeediting_kai_e

CAUTION

General

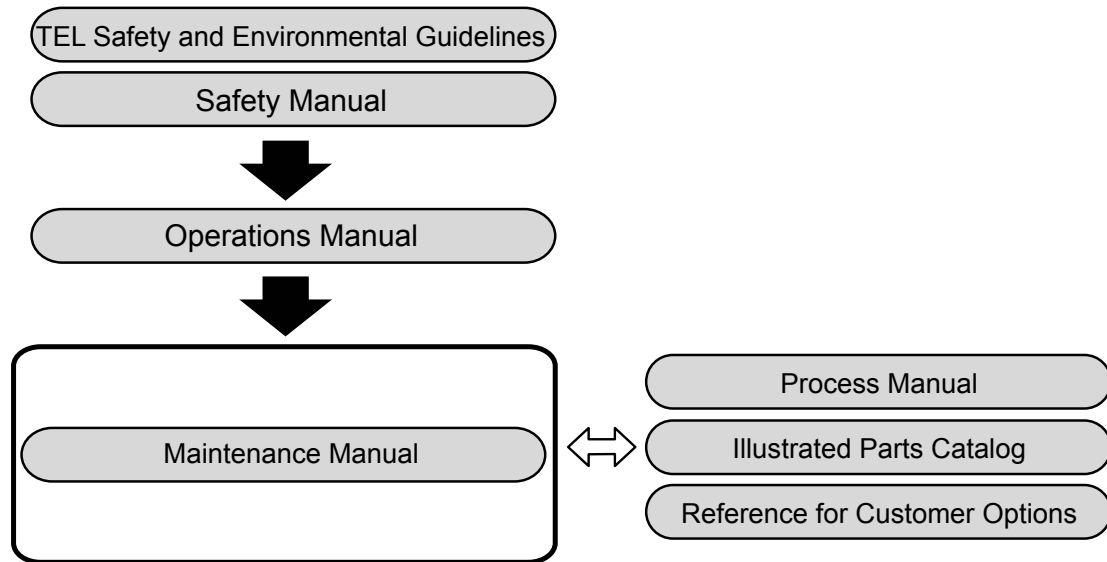
TEL provides TEL Safety and Environmental Guidelines and Safety Manuals to establish a basic knowledge of important safety and environmental concerns. Thoroughly read and fully understand these manuals before performing installation, maintenance, and process.

1.3.1.6 Performing Maintenance 10385M.20131001

Only personnel in charge of maintenance should perform maintenance on the system and support equipment.

Refer to the appropriate process manuals, the Illustrated Parts Catalog, and the Reference for Customer Options for needed information, such as part numbers and recipes.

▼ Manuals to Reference When Performing Maintenance



c_opsmaintprocessdoc_kai_e

CAUTION

General

TEL provides TEL Safety and Environmental Guidelines and Safety Manuals to establish a basic knowledge of important safety and environmental concerns. Thoroughly read and fully understand these manuals before performing installation, maintenance, and process.



NOTE

As the equipment parts may vary depending on the specifications, refer to the Illustrated Parts Catalog and Reference for Customer Options for details.

1.4 About This Set of Manuals

00102M.20131001

▼ About This Set of Manuals

Manual	Target Readers	Description
TEL Safety and Environmental Guidelines	General operators, maintenance operators, process operators, installation workers	This manual includes general descriptions of safety issues, types of potential hazards, visible and audible warnings, hazard control, and instructions for system transport and/or disposal of the TEL manufactured equipment.
System Safety Manual	General operators, maintenance operators, process operators, installation workers	This manual includes general descriptions of safety issues, types of potential hazards, visible and audible warnings, hazard control, and instructions for system transport and/or disposal for the loader module and the vacuum transfer module.
Process Module Safety Manual	General operators, maintenance operators, process operators, installation workers	This manual includes information on types of potential hazards inherent to process module, AC DIST box, RF unit, and chiller, and instructions for hazard control. You should have a separate safety manual for each type of process module that you have. If you need to order additional manuals, refer to 1.8.3 Ordering Documentation (see page 33) provided in the standard manual.
Basic Operations Manual	General operators, maintenance operators, process operators	This manual includes information about preparing the equipment for operation, operating the operation controller, and handling the equipment alarms.
Advanced Operations Manual	Maintenance operators, process operators	This manual includes information about creating system and process recipes, accessing and using data logs, and accessing other system information. In addition, this manual includes information about the main menu and item menu choices, system parameters, and maintenance operations. This manual also describes the major software program modules and gives a hierarchy of the screen menus.
Advanced Operations Parameter Manual	Maintenance operator	This manual describes parameters specific to the equipment.
System Maintenance Manual	Maintenance operator	This manual includes both preventive maintenance procedures and corrective maintenance procedures for the loader module and vacuum transfer module. This manual also includes the TEL-recommended intervals for performing each procedure and information about the basic tasks required to complete maintenance operations.
Process Module Maintenance Manual	Maintenance operator	This manual includes both preventive maintenance procedures and corrective maintenance procedures for the process module, the RF unit, the chiller, the gas supply module, and the AC DIST box. This manual also includes the TEL-recommended intervals for performing each procedure and information about the basic tasks required to complete maintenance operations. You should have a separate maintenance manual for each type of process chamber that you have. If you need to order additional manuals, refer to Ordering Documentation (see page 33) provided in the standard manual.

Manual	Target Readers	Description
Process Manual	Process operators	This manual explains plasma etching theory, etching applications, process recipes, and methods for collecting etching data. It also explains how the process module works and how to troubleshoot process problems. You should have a separate process manual for each type of process module that you have. If you need to order additional manuals, refer to Ordering Documentation (see page 33) provided in the standard manual.
System Theory of Operation Manual	Maintenance operators, process operators	This manual provides an overall description of the equipment and explains the functions of each subsystem. It describes how the etcher subsystems interact with each other and with the support equipment.
Process Module Theory of Operation Manual	Maintenance operators, process operators	This manual provides an overall description of the process module and explains the functions of each unit. You should have a separate theory of operation manual for each type of process module that you have. If you need to order additional manuals, refer to Ordering Documentation (see page 33) provided in the standard manual.
System Installation/Startup Manual	Installation worker	This manual includes information about installing, connecting, and setting up the loader module and the vacuum transfer module at your facility.
Process Module Installation/Startup Manual	Installation worker	This manual includes information about installing, connecting, and setting up the process module, AC DIST box, and chiller at your facility. You should have a separate installation manual for each type of process chamber that you have. If you need to order additional manuals, refer to Ordering Documentation (see page 33) provided in the standard manual.
Supplemental Manuals to the Standard Manual Set	Maintenance operators, process operators, installation workers	Appendices and option manuals which include specifications and maintenance information for nonstandard equipment.
Illustrated Parts Catalog	Maintenance operators, installation workers	This manual includes exploded views of the equipment corresponding to the customer's specifications, with each part numbered.
Reference for Customer Options	Maintenance operators, installation workers	This manual includes information about the specifications of the customer's equipment.

1.5 Purpose and Target Readers of this Manual

01057M.20090901

This manual is aimed to supplement System Theory of Operation Manual, and give information on the specific process module configuration and functions.

This manual is intended for maintenance operators and process operators.

⚠ WARNING**Strong Magnetic Field**

Units equipped with magnets generate a strong magnetic field that can adversely affect the operation of electronic medical implanted devices such as pacemakers. People with pacemakers or other implanted medical electronic devices should maintain a safe distance of at least 1 m(3 ft) from units equipped with magnets.

⚠ CAUTION**Strong Magnetic Field**

Units equipped with magnets generate a strong magnetic field that can attract metal accessories and potentially cause bodily injury when pulled strongly to the magnets. If you wear metal accessories such as body piercing or necklace, maintain a safe distance of at least 1 m(3 ft) from units equipped with magnets.

⚠ CAUTION**General**

Read the Safety Manual and fully understand its contents before servicing.

CAUTION**Equipment Damage**

Units equipped with magnets generate a strong magnetic field that can adversely affect objects susceptible to magnetism (such as electronic devices and magnetic cards). Do not place objects susceptible to magnetism (such as electronic devices and magnetic cards) near units equipped with magnets.

1.6 Overview

01058M.20140201

The **Process Module Theory of Operation Manual** consists of the following chapters:

Chapter 1, Introduction

This chapter provides chapter overviews, explanation of conventions that are used throughout this manual, explanation of how to use the manual set, how to order manuals, how to request that changes be made to a manual, and contact information for TEL's sales and service offices worldwide.

Chapter 2, Characteristics of the Process Module

This chapter provides the characteristics of the process module.

Chapter 3, Main Units and Parts

This chapter provides the configuration and each function of the process module.

Chapter 4, Main Sequences

This chapter provides the main sequences.

**NOTE**

To request that changes or additions be made to the manuals provided with the system, complete the Document Change Request form provided at the end of each manual. For more information on filling out and submitting a Document Change Request form, refer to A Note to Our Customers.

1.7 How to Use this Manual

3203M.20070801

This manual provides background declarative or explanatory information instead of procedural or action information to help you understand the principles that underlie the system's operation. This information may later help you perform maintenance tasks faster, and aid reasoning, allowing faster troubleshooting.

1.8 Notices 00301M.20131001

1.8.1 A Note to Our Customers 00302M.20071101

TEL has made every effort to ensure that this manual is accurate. However, because the designs of the machines are continually being revised and improved, you may occasionally find that some information is missing from a manual. If you find that needed information is missing from this manual or if there is information that your company would like to see added, please send or fax to TEL the Document Change Request form at the back of this manual with your proposed changes. For TEL addresses and fax numbers, refer to [1.9 Sales and Service Offices \(see page 34\)](#).

We appreciate any feedback you can give us. Your feedback helps us keep our manuals as accurate and up-to-date as possible.

1.8.2 Typographical Conventions 00303M.20071101

1.8.2.1 Text Formatting 00304M.20071101

Typographical conventions used in this manual include text formatting for: **HARDWARE SWITCHES**, **SOFTWARE BUTTONS**, *menus*, *menu items*, and *screen names*.

1.8.2.2 Numeric Subscripts 00305M.20090501

Each procedure and section title includes the object document number and revision of that section or procedure. The digits to the left of the decimal (00305M for this section) make up a unique document number, and the digits to the right of the decimal indicate the date the section was last revised in a year, month, day format (YYYYMMDD). When comparing information, keep in mind that the information with the most recent date supersedes information with the same document number having an earlier date. This information may also supersede earlier information with a different document number that is directly related.

1.8.2.3 SI Units 00306M.20071101

This manual uses SI units as the standard. Non-SI units are listed in parentheses. The values in the parentheses are reference values.

1.8.2.4 Document Number 00307M.20131001

The document number is described in each manual cover or CD-ROM label. Please tell us this document number when you contact us with the Document Change Request form.

1.8.2.5 Model Number Abbreviations 00308M.20110301

TEL etcher model numbers indicate the equipment configuration for delivery to the customer. The following tables show examples of model names and explain the abbreviations that are used in the model numbers.

▼ **Example of Model Numbers and Abbreviations: 3WWZZWW**

Number	Alphabet
The first digit indicates the wafer size. 3: 12 inches or 300 mm 2: 8 inches or 200 mm	Alphabets indicate the chamber type and numbers indicate the number of chamber connection. W: Vigus Z: Without chamber

1.8.3 Ordering Documentation 00309M.20131001

An additional manual set for this system can be ordered.

Normally, only the CD-ROM will be provided. If you prefer a normal paper copy or a cleanroom paper copy of the manual, please contact TEL's service center.

1.8.4 Application of the Manual 00310M.20131001

There are crossreferences in the manual. The user is expected to read all linked and cross referenced materials. Important safety related information may be presented in the referenced material and may have been updated since the last revision of the manuals. Failure to read the referenced material may expose the user to unexpected hazards and potential for injury.

If any content in this manual is unclear, refer to [Sales and Service Offices \(see page 34\)](#) and contact one of TEL's service centers.

Because the design of the equipment is continuously being revised and improved, the appearance of the equipment and other detailed specifications that are shown in the manual may differ slightly from your equipment. Screen display details shown in the manual may also differ slightly from those seen on your equipment depending on your equipment's specifications.

This manual describes the TEL recommended procedures at the time of publication. Always confirm with the TEL service center that the information regarding procedures and parts is appropriate for your specification before servicing.

1.9 Sales and Service Offices 0015M.20160301

In the event of an emergency, contact your nearest TEL sales and service office. They are listed in the tables that follow.

For the most up-to-date information, visit one of the following web sites:

Japanese: <http://www.tel.com/jpn/about/locations.htm>

English: <http://www.tel.com/eng/about/locations.htm>

▼ TOKYO ELECTRON U.S. HOLDINGS, INC.

Office	Address	Telephone	Fax
U.S. Headquarters	2400 Grove Boulevard Austin, Texas 78741 U.S.A.	512-424-1000	512-424-1001

▼ TOKYO ELECTRON AMERICA, INC.

Office	Address	Telephone	Fax
U.S. Headquarters	2400 Grove Blvd. Austin, Texas 78741 U.S.A.	512-424-1000	512-424-1001
Manassas Office	9501 Innovation Drive Manassas, VA 20110 U.S.A.	571-921-3900	571-921-3901
Boise Office	9095 S. Federal Way, Suite 100 Boise ID 83716 U.S.A.	208-672-6000	208-672-6001
Phoenix Office	2545 W.Frye Rd., Suite 1, Chandler, AZ 85224 U.S.A.	480-539-2000	480-539-2001
Fishkill Office	20 Corporate Park Drive, Suite A Hopewell Junction, NY 12533 U.S.A.	845-202-5410	845-897-9548
Portland Office	20175 NW Amberglen Court Suite 140, Beaverton, OR 97006 U.S.A.	503-617-7800	503-617-7801
Fremont Office	3100 West Warren Ave., Fremont, CA 94538 U.S.A.	510-624-3450	510-624-3451
Lehi Office	3300 North Running Creek Way, Bldg D200, Lehi UT 84043 U.S.A.	801-753-4900	801-753-4916
Malta Office	2 Bayberry Drive, Suite 2-200, Malta, NY 12020 U.S.A.	518-289-3100	518-289-3101

▼ TEL TECHNOLOGY CENTER, AMERICA, LLC (TTCA)

Office	Address	Telephone	Fax
Office	NanoFab 300 South 255 Fuller Road, Suit 214, Albany, NY 12203 U.S.A.	518-292-4200	518-292-4300

▼ TEL VENTURE CAPITAL, INC. (TVC)

Office	Address	Telephone	Fax
Office	3100 West Warren Ave., Fremont, CA 94538 U.S.A.	510-624-3450	510-624-3451

▼ TEL EPION, INC. (TEI)

Office	Address	Telephone	Fax
Office	900 Middlesex Turnpike, Building 6 Billerica, MA 01821	978-436-2300	978-436-2301

▼ TEL NEXX, INC. (TEN)

Office	Address	Telephone	Fax
Office	900 Middlesex Turnpike, Building 6 Billerica, MA 01821-3929	978-436-4600	978-436-4601

▼ TEL FSI INC. (TEF)

Office	Address	Telephone	Fax
Office	3455 Lyman Boulevard, Chaska, MN 55318-3052, U.S.A.	952-448-5440	952-448-2825

▼ TOKYO ELECTRON EUROPE LTD

Office	Address	Telephone	Fax
Head Office	Pioneer, Crawley Business Quarter, Fleming Way, Crawley, West Sussex, RH10 9QL, England U.K.	+44-1293-655800	+44-1293-655888
Italian Branch Milano	C/O Energy Park, Building 03 Via Monza 7/A 20871 Vimercate Monza e Brianza, Italy	—	—
Italian Branch Avezzano	Via Cavour, 74C, Avezzano 67051, Italy	—	—
Italian Branch Catania	C/O Sviluppo Italia Sicilia, Zona In- dustriale Pantano D'Arci, Blocco Tor- razze 95121 Catania, Italy	—	—
French Branch Grenoble	Les Jardins d'Entreprise, Batiment Ali- cante, 1, Chemin De La Dhuy, 38240 Meylan, France	4-7604-1244	4-7604-1243
Irish Branch Dublin	Unit 1, Block K, Maynooth Business Campus, Maynooth, Co.Kildare, Ire- land	—	—
Netherlandish Branch Nijmegen	Kerkenbos 10-15, Unit C, 6546 BB, Nijmegen, The Netherlands	+31-243-726630	+31-243-726640
German Branch Dresden	Moritzburger Weg 67, Haus D, 01109 Dresden, Germany	351-88385700	351-88385788
Austrian Branch Villach	Europastrasse 8-10 Gebaude T02, 9524 Villach, Austria	—	—

▼ TEL SOLAR SERVICES AG

Office	Address	Telephone	Fax
Main Office	Hauptstrasse 1a, 9477 Trubbach, Swit- zerland	+41-81-784-8000	+41-81-784-8044

▼ TEL MAGNETIC SOLUTIONS LIMITED

Office	Address	Telephone	Fax
Main Office	Unit J, Furry Park Industrial Estate, Santry, Dublin 9 Ireland	+353-1-854-7900	+353-1-862-0042

▼ TOKYO ELECTRON ISRAEL LIMITED

Office	Address	Telephone	Fax
Main Office	1 Leshem street 1st Floor, West Entrance, Gat 2000, Kiryat Gat Israel	+972-8-681-0860	+972-8-681-0862

▼ TOKYO ELECTRON KOREA LIMITED

Office	Address	Telephone	Fax
Hwaseong Office (HTSC)	56, Samsung 1-ro 1-gil, Hwaseong-si, Gyeonggi-do, 18449 Korea	+82-31-260-5000	+82-31-260-5290
Balan Factory	51, Jangangongdan 6-gil, Jangangmyeon, Hwaseong-si, Gyeonggi-do, 18579 Korea	+82-31-260-5000	+82-31-260-5290
Cheonan Office	4Fl., Miraecity Bldg., 46, Geomeundeul 3-gil, Seobuk-gu, Cheonan-si, Chungcheongnam-do, 31163 Korea	+82-41-522-3328	—
Cheongju Office	2Fl., Daejin Bldg., 28, Deogam-ro, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do, 28463 Korea	+82-31-8077-6800	—
Gumi Office	4Fl., Parkjaedal-Tower Bldg., 115, Indongbuk-gil, Gumi-si, Gyeongsangbuk-do, 39439 Korea	+82-54-472-9704	—
Icheon Office	3Fl., Hyundai Park Bldg., 2060, Gyeongchung-daero, Bubal-eup, Icheon-si, Gyeonggi-do, 17332 Korea	+82-31-8077-6600	—
Paju Office	9Fl., Cheongwon Central-Tower Bldg., 84, Geumneungyeok-ro, Paju-si, Gyeonggi-do, 10915 Korea	+82-31-8077-6300	—

▼ TOKYO ELECTRON TAIWAN LIMITED

Office	Address	Telephone	Fax
Office	No.7, Dusing Rd., Hsinchu Science Park, Hsinchu City 30078, Taiwan, R.O.C.	+886-3-666-2266	+886-3-666-2277

▼ TOKYO ELECTRON (SHANGHAI) LIMITED

Office	Address	Telephone	Fax
Head Office	No.555 Gaosi Rd., Zhangjiang Hi-Tech Park, Shanghai 201203, China	+86-21-3895-4800	+86-21-5027-2002
Beijing Office	Rm 608, Block B Building 1, No.19, Ronghua Middle Road, BDA, Beijing, 100176, China	+86-10-6787-2288	+86-10-6787-2286

Office	Address	Telephone	Fax
Wuxi Office	B507, IC Design Tower, No.33-1 Xinda Road WND, Wuxi, Jiangsu, 214111 China	+86-510-8534-6166	+86-510-8534-6169
Xi'an Office	RM712, Linnking International Building, No.38 Technology Rd., High-Tech District, Xi'An, Shanxi, 710075 China	+86-29-8188-7170	+86-29-8188-7195

▼ TOKYO ELECTRON (SHANGHAI) LOGISTIC CENTER LIMITED

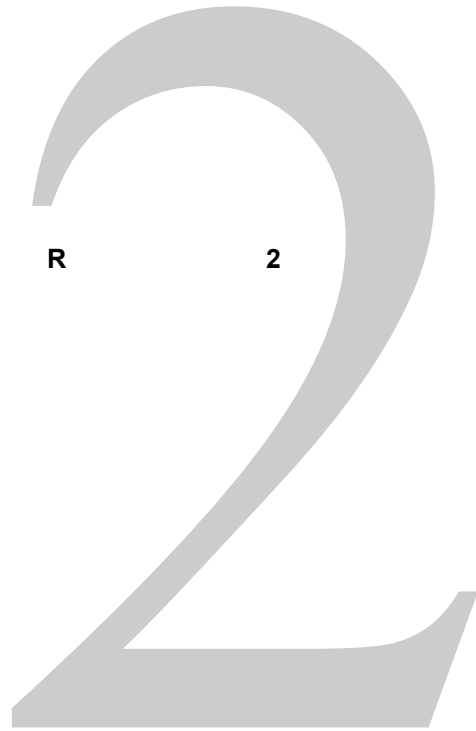
Office	Address	Telephone	Fax
Office	Level 1, No.126 Hedan Rd., Waigaoqiao FTZ, Pudong, Shanghai 200131, China	+86-21-5868-1626	+86-21-5868-1629

▼ TOKYO ELECTRON (KUNSHAN) LIMITED

Office	Address	Telephone	Fax
Office	No.8, Dongguang Road, Kunshan Economic & Technical Development Zone Jiangsu 215300, China	+86-512-5500-8000	+86-512-5500-7000

▼ TOKYO ELECTRON SINGAPORE PTE. LIMITED

Office	Address	Telephone	Fax
Office	4 Changi North Street 1, Hermes Epitek Centre, Singapore 498816	+65-6439-7000	+65-6439-7001



Characteristics of the Process Module

The following describes the characteristics of the process module.

The information contained in this chapter has been prepared based on the specifications of the standard equipment. Throughout the manual, figures provided in this manual, including operation screens and appearances, may vary from the equipment installed at your site.

2.1 Characteristics of the Process Module 01059-376.20121201

2.1.1 Characteristics of RLSA™ Plasma Etcher 03971-376.20121201

The process module is the plasma etching process unit.

This process module uses the microwave-excited plasma, which is generated by using RLSA™, to etch the surface of the wafer (13.56 MHz is applied to the lower electrode).

In this process module, the microwave power is applied to the upper section and the RF power is applied to the lower section (ESC).

The individual frequency RF application for upper and lower sections has been adopted to permit the plasma density and the ion energy to be controlled individually, improving the etching characteristics.

For the high-frequency power in the upper section, the microwave generates a high-density plasma from the low-pressure up to high-pressure regions.

The most efficient low-frequency power in the lower section directs the positive ions in the plasma onto the wafer.

For the plasma etching method to obtain the anisotropic etching shape, the etching, which increases the reaction speed by the ion irradiation based on the principle of the ion-assisted etching, is required. This means that high-speed etching to the vertical direction is possible by generating a great amount of the low-active radicals and ions, and irradiating the ions, which are accelerated by their surface adsorption and the low-frequency power (RF) in the lower section, to the surface of wafer.

The microwave-excited plasma has a high-density plasma generation area with high electron temperature (T_e), which is similar to the existing high-density plasma equipment, however, the microwave cannot propagate or travel through the high-density plasma so that it attenuates in a few millimeters. Due to this, the plasma is diffused to be carried from the generation area to the processing area, and the electron temperature is decreased. The density of electrons (N_e) also attenuates due to diffusion, however, the high-density plasma can be maintained even in the diffusion area because the density of electrons in the plasma generation area is extremely high.

- Generating the plasma of high-density and low electron temperature is possible.
- Generating the plasma in the non-magnetic field with a wide pressure area is possible (few mTorr–few Torr).
- By etching in the plasma diffusion area, there is no electronic field on the wafer.
- A great amount of low electron energy distribution controls the energy of ion which is directed onto the wafer.
- Because the plasma potential applied inside of the etching chamber is low, it is competitive in parts consumption.

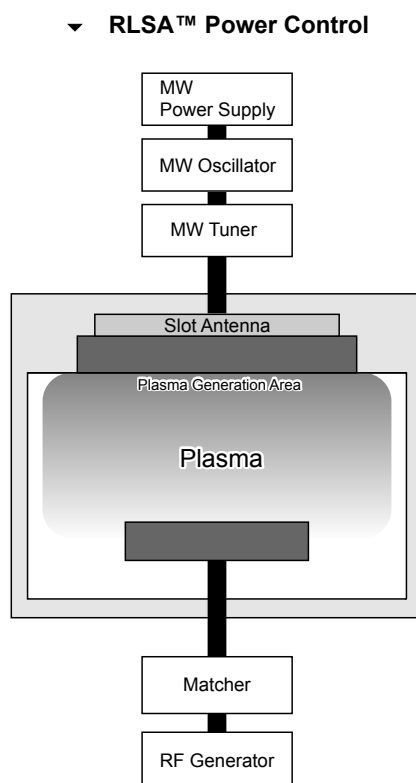
2.1.1.1 Characteristics of RLSA™ Plasma Etcher Hardware 03972M.20130701

The hardware in this process module has the following features:

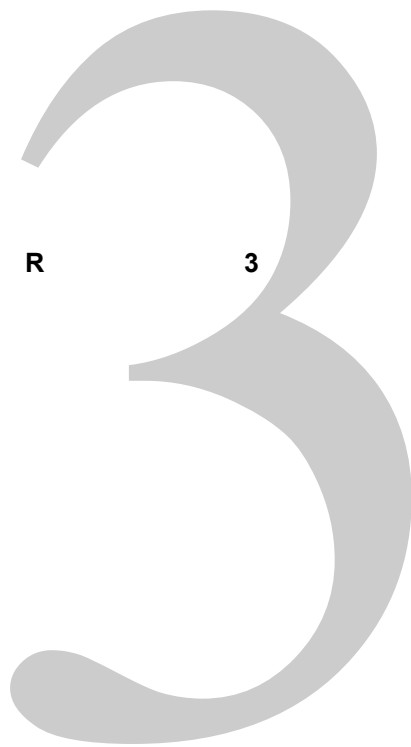
- The microwave power is applied to the upper section and the RF power is applied to the lower section.
- The temperatures of the top and bottom electrodes can be controlled independently in a range between room temperature and 80 °C.

Also, the temperature at the center and edge of the bottom electrode can be controlled independently.

- A highly efficient turbo molecular pump (TMP) and high-conductance exhaust ports are used, so the system is compatible with low-pressure processes.



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Main Units and Parts

This chapter describes the components and functions of the main units and parts.

The information contained in this chapter has been prepared based on the specifications of the standard equipment. Throughout the manual, figures provided in this manual, including operation screens and appearances, may vary from the equipment installed at your site.

3.1 Parts/Unit Configuration of Process Module

01060-376.20121201

3.1.1 Overview

01061M.20070801

The configuration of the units and parts around the process chamber may vary depending on the process module specifications. This chapter describes the units and parts specific to this process module.

Refer to the [System Theory of Operation Manual](#) for other units and parts. It describes the parts that have in common of the process module.

3.1.2 Configuration

09792.20121201

The units and parts that are specific to this process module are shown below.

▼ Configuration of the Parts and Units

Module		Units and Parts
Process module	3.2 Process Module (see page 45)	3.3 RF Unit (see page 51)
		3.4 Cooling Water Circulation (see page 54)
		3.5 Chiller Coolant Fluid Circulation (see page 56)

3.2 Process Module 01063-376.20121201

3.2.1 Overview of the Process Module 03974M.20120101

The process module is the plasma etching process unit.

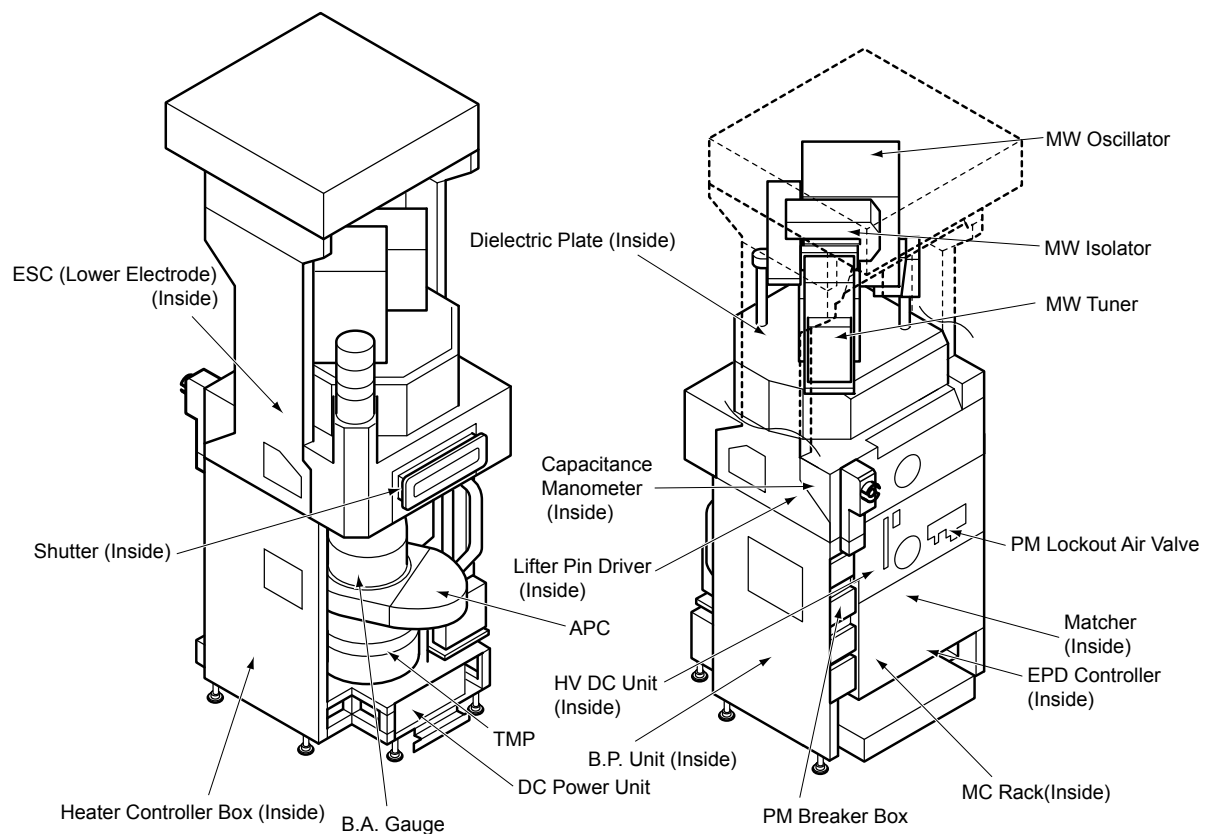
This process module uses the microwave-excited plasma, which is generated by using the slot antenna, to etch the surface of the wafer.

In this process module, the microwave power is applied to the dielectric plate in the upper section, and the RF power is applied to the ESC in the lower section.

3.2.2 Process Module Main Components 09744.20130701

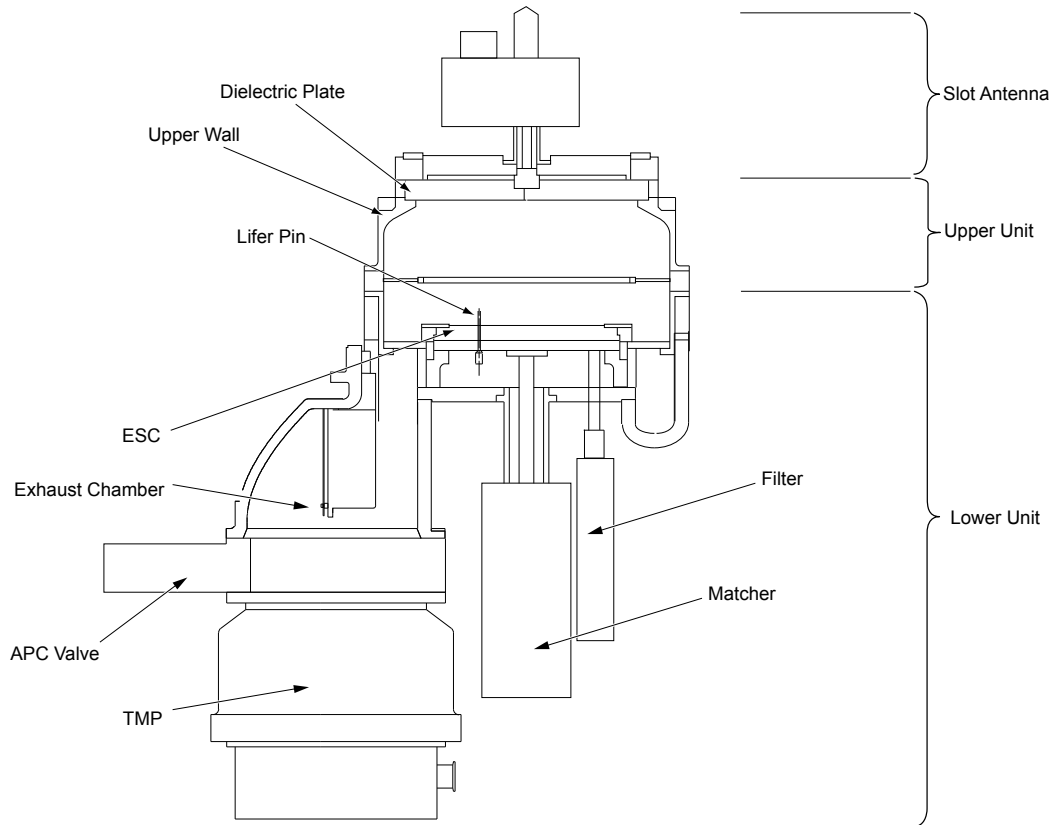
The following figures show the process module parts.

▼ Process Module Configuration



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▼ Sectional View of the Process Module



g039753190

3.2.2.1 Upper Unit 09745.20121201

The upper unit consists of the process gas supply lines from the gas box and the dielectric plate.

The components of the upper unit are shown in the following table.

▼ Upper Unit Components

Component	Description
Dielectric Plate	The dielectric plate discharges the high-frequency RF into the process chamber to etch the wafers. The dielectric plate supplies process gases into the process chamber.
EPD controller	It detects changes in plasma wavelength generated while etching and judges the etching completion.
Upper unit	There are tiny holes surrounding the process chamber through which process gases are supplied to the process chamber.
Slot Antenna	The microwave generated by the MW oscillator is transmitted to the dielectric plate evenly by the slot antenna.
MW Isolator	The microwave which is flowed backward from the load side will be blocked before the MW oscillator.
MW Tuner	Adjusts the MW oscillator output impedance and the chamber impedance.

The lower unit is comprised of the ESC, the lifter pin up/down mechanisms, the matcher, and the back pressure unit. The distance between the dielectric plate and the ESC is called the gap, the distance of which cannot be changed.

The components of the lower unit are shown in the following table.

▼ Lower Unit Components

Component	Description
Electrostatic chuck (ESC)	<p>Chucks a wafer to the ESC by static electricity. With the RF application to the ESC, the high frequency discharge takes place to etch a wafer.</p> <p>Adjusts the ESC temperature by circulating coolant fluid from a chiller and using an internal heater.</p> <p>Forms the gas layer of high thermal conductivity between the ESC and back of a wafer to cool the wafer evenly and efficiently.</p>
Lifter Pin Up/Down Mechanisms	<p>Mounted in ESC. When a wafer is transferred in/out of the process chamber, the lifter pins are raised by the motor drive to pass the wafer to/from the transfer arm.</p> <p>The lifter pin up/down speed and acceleration are controlled to achieve better throughput and less impact to wafers (no damage or dislocation).</p>
Matcher	Adjusts the RF generator output impedance and the chamber impedance.
RF generator	Generates and amplitudes RF power and supplies it to the process chamber.
B.P. unit (back pressure unit)	<p>During processing, the back pressure unit supplies helium gas, which has a high heat conductivity, to the back side of the wafer so that the ESC's temperature is passed to the wafer uniformly.</p> <p>A pressure control valve (PCV) controls the helium supply pressure.</p> <p>The back pressure unit consists of a gas supply line, a pneumatically operated valve that opens and closes the exhaust line, and a filter that cleans the supplied helium.</p>
Shutter	Located at the wafer transfer port of the process chamber. The shutter opens and closes for wafer transfer and is used to prevent plasma from swirling into the bonnet gate valve opening (which isolates the process chamber from the transfer chamber). Vertically moved by an air cylinder.
PM lockout air valve	The system is equipped with a lockout mechanism for the process module's air source.
PM Breaker Box	The PS lockout box has power supply breakers equipped with a lockout mechanism for RF generator, process module, heater and capacitance manometer.
Heater Box	The heater box controls the temperature of the parts inside the process chamber.
DC power unit	It supplies DC power to each unit of the process module.
HV power supply	The HV power supply supplies high DC voltage in order to adsorb the wafer to the ESC surface by static electricity.

3.2.2.3 Vacuum/Exhaust Unit 01068M.20080315

The vacuum/exhaust unit is used to ensure that uniform plasma is generated. The vacuum/exhaust unit is made up of the turbo molecular pump (TMP) that create a high vacuum in the chamber, the adaptive pressure control valve (APC valve) that controls the pressure in the chamber, and the exhaust chamber that exhausts used gas.

After the dry pumps draw a rough vacuum, the turbo molecular pumps draw a high vacuum. The APC valve controls the chamber pressure to the pressure value set in the recipe.

The APC valve also shuts off the vacuum piping connected to the chamber. It exhausts, vents, draws a vacuum, performs cycle purging, and performs acid exhaust from the process chamber during processing.

▼ The Vacuum/Exhaust Unit Components

Component	Description
APC valve (Adaptive Pressure Control Valve)	The APC valve maintains a constant vacuum pressure within the chamber by adjusting the angle of the valve opening.
TMP (Turbo Molecular Pump)	The TMP creates a high vacuum in the process chamber. The TMP is controlled by the TMP controller in the power rack.
Exhaust chamber	The APC valve and exhaust line are connected to the manifold.

3.2.2.4 Process Chamber Sensors 03978M.20070720

The following table provides information about the various sensors and switches that monitor the process chamber activity.

▼ Process Chamber Sensors

Name	Function	Device	Remarks
B.A. Gauge	Monitors process chamber pressure	B.A. Gauge	—
Capacitance Manometer (Process Chamber) (CM1)	Monitors process chamber pressure	Capacitance Manometer	Up to 30 Pa (0.25 Torr)
Top Temperature Sensor	Monitors upper unit temperature	Platinum Sensor	—
Side Wall Temperature Sensor	Monitors wall temperature on the side of the process chamber	Platinum Sensor	—
Bottom Temperature Sensor	Monitors lower electrode temperature	Fiber Thermometer	—
APC Temperature Sensor	Monitors APC heater temperature	Platinum Sensor	—
Top Open Sensor	Interlocks if the upper unit is open	Microswitch	—
Process Chamber Pressure Switch (VAC PSW)	Detects whether a vacuum is present.	Pressure switch	1.33E+3 Pa (10 Torr)
Process Chamber Pressure Switch (ATM PSW)	<ul style="list-style-type: none"> Monitors atmospheric pressure Ends venting 	Pressure switch	—
Upper Water Leak Sensor	Monitors the leakage at the fitting of the upper electrode and the cooling water line	—	—

Name	Function	Device	Remarks
Shutter Open/Close Sensor	Checks the shutter open/close position	Microswitch	—
Matcher Seating Sensor	Checks that the matcher is properly mounted	Microswitch	Stops the chiller if the matcher is not properly seated
RFD	Plasma emission check unit	Photo Diode	Starts processing after plasma emission
TMP Back Pressure Switch (Exhaust Line PSW)	Monitors the TMP exhaust pressure, and closes the TMP exhaust side valve when it is higher than the preset value	Pressure switch	1.33E+3 Pa (10 Torr)
TMP Back Valve Open/Close Sensor	Detects that the TMP back valve is closed	Proximity Sensor	—
Capacitance Manometer (CM2)	Monitors process chamber pressure	—	1.33E+3 Pa (10 Torr)
Helium Back Pressure Final Valve Open/Close Sensor (Center)	Detects whether the He BP final valve is open or closed	—	—
Helium Back Pressure Final Valve Open/Close Sensor (Edge)	Detects whether the He BP final valve is open or closed	—	—

3.2.3 Components in Chamber 03979M.20070720

Components in this process chamber are shown in the following figure.

▼ Components in Chamber

Component	Description
Chamber Wall	Wall of chamber
Electrostatic Chuck (ESC)	Applied with the high DC voltage to chuck a wafer Applies the RF power.
Focus ring	Material differ depending on usage <ul style="list-style-type: none"> Insulator: makes plasma concentrate on a wafer; an effective cathode is the size of the electrostatic chuck. Conductor and semiconductor: makes plasma spread over a wafer; an effective cathode is the size of the electrostatic chuck combined with the focus ring.
Exhaust plate	Connected to ground potential to prevent the plasma from extending into the bottom of the process chamber. Also exhausts process gases and by-products through many tiny holes.
Insulator ring	A ring made of an insulating material that protects peripheral parts from being exposed to the plasma. Reduces the amount of chamber cleaning needed because it covers the gap between the lower electrode holder and the lower electrode.
Lifter pin	Receives a wafer from the transfer arm when the wafer is transferred into the process chamber. Is not seen even if the chamber is vented under normal conditions.
Window	Used to check plasma emission with EPD.

▼ Upper Electrode

Component	Description
Dielectric Plate	The microwave is applied to the dielectric plate. The dielectric plate supplies process gases into the process chamber.

3.3 RF Unit_{01072-376.20121201}

3.3.1 Overview_{03980M.20070720}

In this process module, radio frequency (RF) is applied to the lower electrode (ESC) in the process chamber through the matcher and microwave (MW) is applied to the dielectric plate in the process chamber through the tuner to generate plasma.

RF matcher matches RF power before RF power is supplied to the process chamber.

MW tuner matches MW power before MW power is supplied to the process chamber.

3.3.2 Configuration_{01074-376.20121201}

3.3.2.1 Matcher_{09746.20121201}

The matcher matches the impedance, which includes the loads (plasma, chamber) and the matcher circuit, to the RF generator output impedance and the transmission line characteristic impedance, in order to eliminate power reflected back to the RF generator.

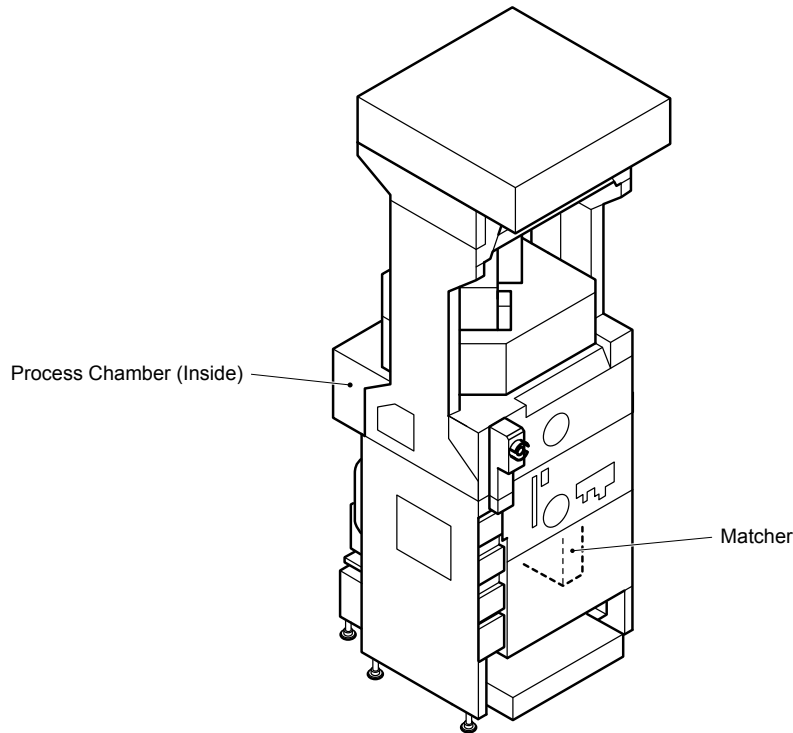
The matcher is located just below the process chamber.

The RF matchers are forced-air-cooled.

The MW tuner matches the impedance, which includes the loads (plasma, chamber) and the matcher circuit, to the MW oscillator output impedance and the transmission line characteristic impedance, in order to eliminate power reflected back to the MW oscillator.

The MW tuner is located just above the process chamber.

▼ Location of the Matcher



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3.3.2.2 RF Generator 09747.20121201

The RF generator generates high-frequency power and applies it to the process chamber.

The RF generator is mounted on the power rack. The RF generator supplies RF power to the process chamber through RF coaxial cable.

Heat generated during RF generation is removed by the cooling water lines. Each RF generator has one flow meter on which the cooling water is monitored.

The MW oscillator generates microwave power and applies it to the process chamber.

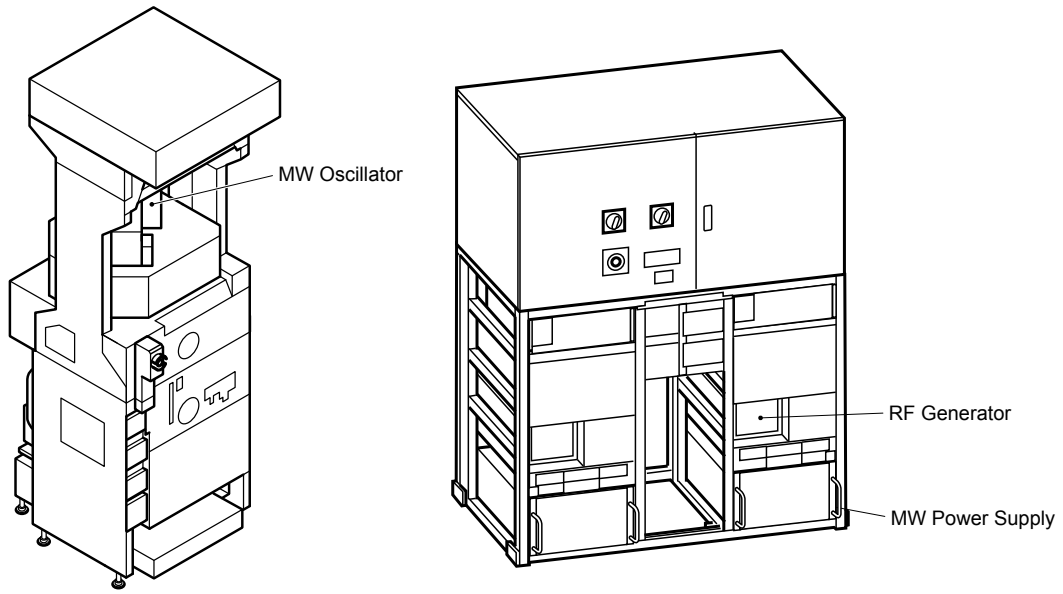
The MW oscillator is divided into MW oscillator and MW power supply in order to eliminate losses in power transmission between the MW oscillator and the process chamber. The MW oscillator is mounted at the top of the process module, and the MW power supply is mounted on the power rack. DC power is transmitted between the MW oscillator and the MW power supply, and the MW power is transmitted between the MW oscillator and the MW tuner through a waveguide.

Heat generated during MW generation is removed by the forced air cooling or the cooling water lines.

The MW oscillator is water-cooled. The flow meter monitors the water flow rate.

The cooling water is connected from factory facilities to the vacuum transfer module, and the water is plumbed to the MW oscillator through the rear of the process module.

▼ RF Generator



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3.4 Cooling Water Circulation 01077-376.20121201

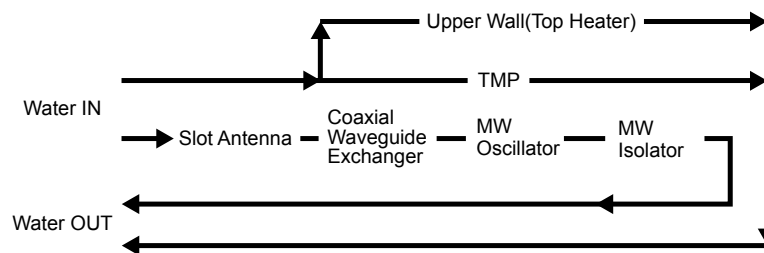
3.4.1 Overview 03983M.20150801

Cooling water cools the upper wall (top heater), turbo molecular pump (TMP), slot antenna, coaxial waveguide exchanger, MW oscillator, and MW isolator.

3.4.2 Configuration 09748.20140201

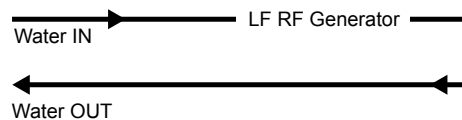
The cooling water flows to the exhaust port via the following circulating paths. The cooling water circulating path is shown in the following figure.

▼ Cooling Water Circulating Path (Process Module)



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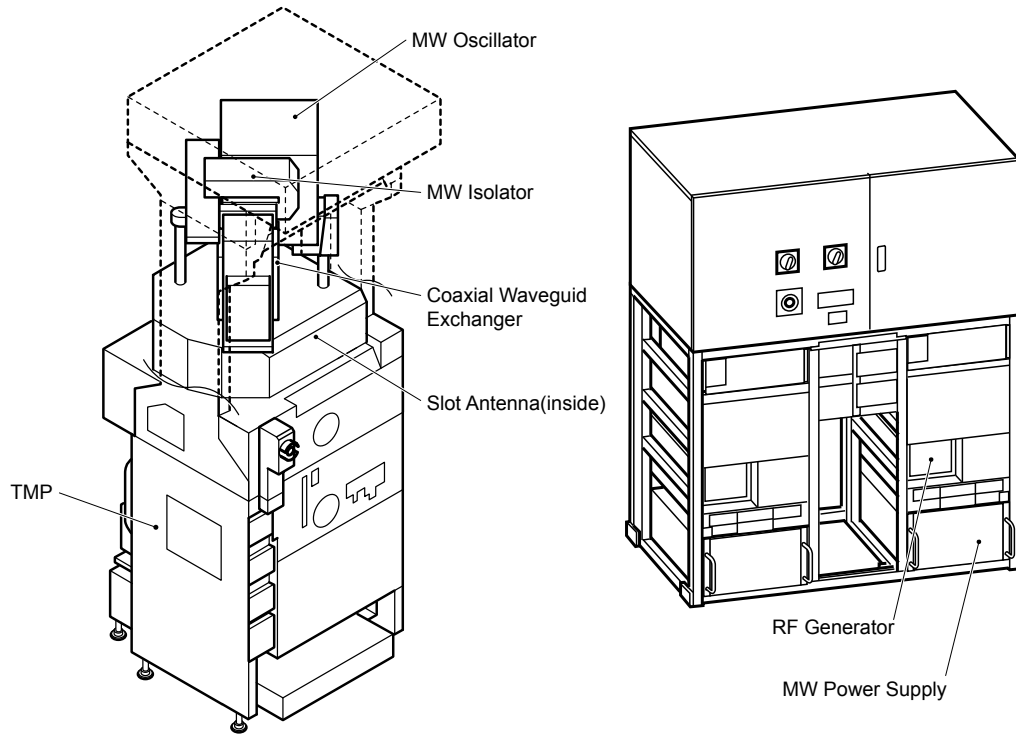
▼ Cooling Water Circulating Path (Power Rack)



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Coolant circulates in the following units:

▼ Cooling Water Circulating Units



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3.5 Chiller Coolant Fluid Circulation 04105-376.20121201

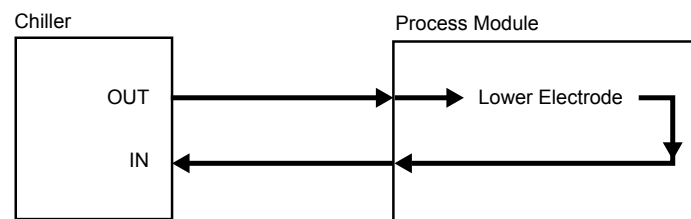
3.5.1 Overview 04106M.20080401

Chiller coolant fluid controls the temperature of the lower electrode.

3.5.2 Configuration 09749.20121201

The chiller coolant fluid, which has been cooled down at the chiller, runs through the chiller hose, circulates in the lower electrode, and returns to the chiller. The chiller coolant fluid circulating path is shown in the following figure.

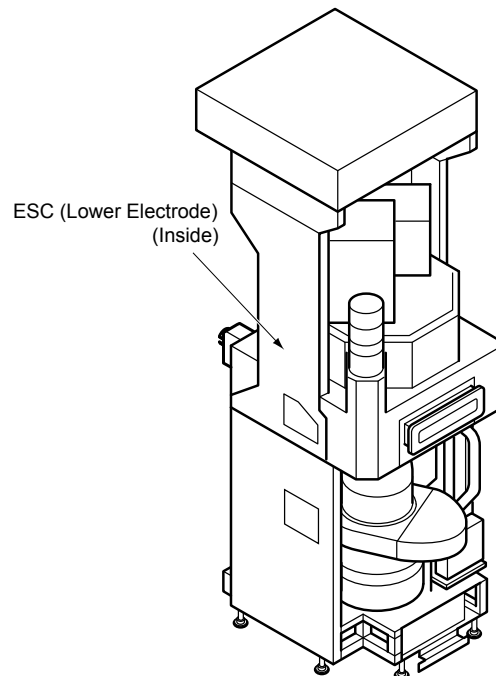
▼ Chiller Coolant Fluid Circulation



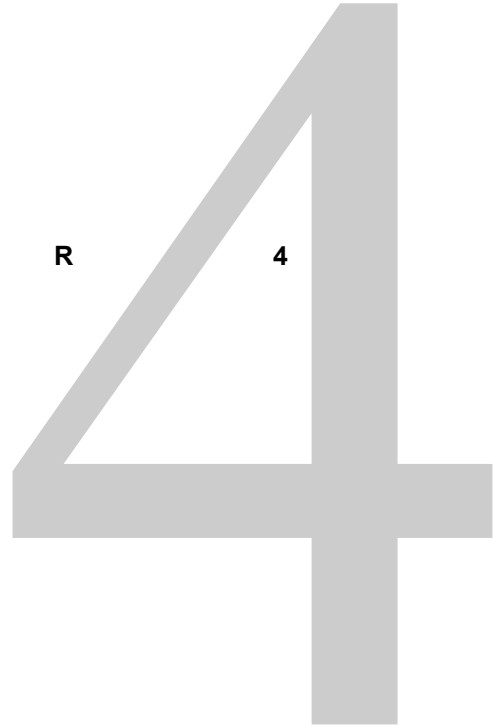
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Coolant circulates in the following units:

▼ Chiller Coolant Fluid Circulating Units



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Main Sequences

This chapter provides the main sequences.

The information contained in this chapter has been prepared based on the specifications of the standard equipment. Throughout the manual, figures provided in this manual, including operation screens and appearances, may vary from the equipment installed at your site.

4.1 Process Sequence 00852-376.20121201

4.1.1 Process Execution 00853M.20090215

The phrase **Process execution** refers to the sequence that begins when the wafer is transported into the process chamber and ends when the recipe is completed. When a single wafer is processed, the sequence can be described as follows:

CAUTION

Equipment Damage

The details of the following sequence and recipe settings are one example of use, and may differ depending on the customer's usage. In actual use, confirm if it is appropriate for the customer's specifications.

1. The wafer is moved into the process chamber.
2. The process is performed according to the recipe.
3. The processed wafer is removed from the process chamber.
4. Electrical discharge is conducted according to the programmed parameters to remove residual charge in the ESC.

The following parameters can be set in the recipe for the process.

▼ Process Parameters Set in Recipe

Recipe	Setting
Process chamber vacuum system	Pressure
Gas supply system	Gas flow rate
RF system	RF power
Wafer cooling pressure	Cooling gas pressure

4.1.2 Executing Recipes 00854M.20090215

The process is performed according to the recipe that was set. The following is a standard recipe performance sequence.

CAUTION

Equipment Damage

The details of the following sequence and recipe settings are one example of use, and may differ depending on the customer's usage. In actual use, confirm if it is appropriate for the customer's specifications.

1. The process gas flow, the process pressure, the wafer cooling pressure, and the ESC voltage are set.
2. The process gas flow, the process pressure, and the wafer cooling pressure are stabilized.
3. Radio frequency (RF) power is applied, and electrical discharge commences.
4. When the set time has elapsed or the completion of discharging has been detected by the end-point detection (EPD), the RF power is turned off.
5. The supply of wafer cooling gas is stopped, and the ESC is turned off.
6. The process gas supply is turned off, and a vacuum is applied.

4.1.3 Monitoring During the Process 03991M.20080818

The following items are monitored every 100 ms while the process executes.

▼ Monitored Item

Monitored Item	Detector
Upper electrode, chamber side wall, and lower electrode temperatures	Temperature sensors attached to the respective parts
Process gas flow rate	Output signal from the flow control system (FCS)
Process chamber pressure	Output signal from a capacitance manometer installed in the chamber
Opening of pressure control valve	Adaptive pressure controller
RF related items (forward power, reflected power, Vpp, matching position)	Generator, matcher
MW related items (forward power, reflected power, matching position)	MW Tuner
Wafer cooling pressure	Wafer cooling unit pressure gauge
Electrostatic chuck (ESC) voltage and current	HV unit

4.1.4 Process Interlocks 03992M.20090501

If a monitoring value is outside the range set for the parameter stabilization conditions or the interlock conditions, processing will be suspended as follows:

CAUTION

Equipment Damage

The following process interlock is one example of use, and may differ depending on the customer's usage. In actual use, confirm if it is appropriate for the customer's specifications.

1. The wafer cooling gas supply will be turned off.
2. The electrostatic chuck (ESC) voltage will be turned off.
3. The MW power supply will be turned off.
4. The RF power supply will be turned off.
5. All gas supplies will be turned off.
6. All pressure control valves will be opened.

Revision History

Revision No.	Description of Document Changes	Date
3.2.1	Updated content.	2016-04-01
3.1.1	Updated content.	2014-03-01
3.0.2	Updated content.	2013-08-01
3.0.1	Initial release.	2012-12-01

Document Change Request Form

Tokyo Electron has made every effort to ensure that this manual is accurate. However, because the designs of the machines are continually being revised and improved, you may occasionally find that some information is missing from a manual. If you find that needed information is missing from this manual, or if there is information that your company would like to see added, please send or fax to us this Document Change Request Form with your proposed changes to the address below, or refer to the list of Sales and Service Offices and send to your regional TEL FE Service Center.

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