Mitsubishi Electric Industrial Robot 3D Robot Simulator

### Product Configuration

<table>
<thead>
<tr>
<th>Name</th>
<th>Model</th>
<th>Quantity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MELFA-Works Version2</td>
<td></td>
<td>1</td>
<td>English version</td>
</tr>
</tbody>
</table>

*Note: MELFA-Works is an add-in tool for SolidWorks® products. The customer needs to purchase or already have SolidWorks®.*

The personal computer support software (RT Toolbox mini) is pre-installed in the MELFA-Works CD-ROM. When MELFA-Works is installed, RT Toolbox mini is also installed automatically.

### Operating Environment

#### Operating environment of MELFA-Works

<table>
<thead>
<tr>
<th>Item</th>
<th>Required</th>
<th>Recommended</th>
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<tr>
<td>CPU (*4)</td>
<td>Intel® Pentium™4 or compatible processor of 2.0 GHz or higher</td>
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<td>1024 MB or more</td>
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<td>Graphic display (*4)</td>
<td>XGA (1024x768) or higher</td>
<td>With graphic board installed</td>
</tr>
<tr>
<td>Hard disk (*4)</td>
<td>Available disk space of 1 GB or more</td>
<td></td>
</tr>
<tr>
<td>Disk drive (*4)</td>
<td>Any device that operates in the Microsoft Windows® environment</td>
<td></td>
</tr>
<tr>
<td>Pointing device (*4)</td>
<td>Any device that operates in the Microsoft Windows® environment</td>
<td></td>
</tr>
<tr>
<td>Keyboard (*4)</td>
<td>Full-sized keyboard</td>
<td></td>
</tr>
<tr>
<td>OS (*4)</td>
<td>Microsoft Windows® 2000 Professional/SP3, Microsoft Windows® XP Professional/SP2</td>
<td>Microsoft Windows® 2000/SP3 or later, Microsoft Windows® XP/SP1 or later, Microsoft Windows® 2003/SP1, Microsoft Windows® XP/SP2, Microsoft Windows® 2003/SP1 or later</td>
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</table>

#### Operating environment of the calibration tool

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<tr>
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<td>Keyboard (*4)</td>
<td>Full-sized keyboard</td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td>Microsoft Windows® 2000 Professional</td>
<td>Microsoft Windows® XP Professional</td>
</tr>
<tr>
<td>3D-CAD</td>
<td>Not required</td>
<td>As of October, 2006, SolidWorks® 2007 SP0.0 &lt;As of October, 2006&gt;</td>
</tr>
</tbody>
</table>

*4) Please refer to the system requirements that SolidWorks® recommends: [http://www.solidworks.com/]

*5) Due to the design specifications of SolidWorks®, data created in a higher version of SolidWorks® cannot be transferred to a lower version of SolidWorks®.

*6) Use this application when simulating I/O signals with ladders.

#### Notes

- MELFA-Works is an add-in tool for SolidWorks® products.
- Microsoft®, Windows®, SolidWorks® are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
What is MELFA-Works?

MELFA-Works is an add-in tool for the 3D CAD software “SolidWorks®” (hereafter “SolidWorks®”). By adding MELFA-Works to your SolidWorks® platform, you can add new features to, and extend the existing functions of, your current robot simulation system.

Features

- **Automatic robot program generation function**
  
  You can automatically generate teaching position data and robot operation programs, which are required to operate your robot, by simply loading 3D CAD data into the applicable programs of MELFA-Works. This function is ideal if you are dealing with works of complex shapes, since you can automate the operations for your system requiring numerous sets of teaching position data.

- **Display of robot movement path**
  
  Robot movement path can be displayed in space as trace lines.

- **Interference check**
  
  Interference between the robot and peripheral devices can be checked. A target of interference check can be specified simply by clicking it on the screen. You can also save information explaining the condition of interference that occurred (such as the contacted part, program line that was being executed when the interference occurred, and corresponding robot position), to a log.

- **Saving of video data**
  
  Simulated movements can be saved to video files (AVI format).

- **Cycle time measurement**
  
  The cycle time of robot movement can be measured using an easy-to-use function resembling a stopwatch.

- **Robot program debugging functions**
  
  The following functions are provided to help you debug robot programs.
  - **Step operation**
    A specified program can be executed step by step.
  - **Breakpoint**
    Breakpoints can be set in a specified program.
  - **Direct execution**
    Direct robot commands can be executed.

- **Teaching aid**
  
  The robot shown in SolidWorks® can be jogged just like you normally jog a robot using a teaching pendant.

- **Traveling axis**
  
  A traveling axis can be added to a robot to verify the operation of your system equipped with a traveling axis.

- **Calibration**
  
  Point-source data of CAD coordinates created by the CAD link function can be converted to robot coordinate data. Operation programs and point-source data can also be transferred to robots.

Examples of Functions and Screens

**System Configuration**

**RT-Toolbox mini**

- Personal computer support software
- MELFA-Works add-in tool

**Core functions**

- CAD link
- Operation simulation
- Condition setting
- Motion simulation
- Robot calibration
- Jogging
- Teaching aid
- Traveling axis
- Display of robot movement path
- Interference check
- Saving of video data
- Cycle time measurement
- Robot program debugging functions
- Traveling axis

**Examples of Functions and Screens**

- Display of robot movement path
- Interference check
- Saving of video data
- Cycle time measurement
- Robot program debugging functions

**Product Configuration**

MELFA-Works is an add-in tool for the 3D CAD software “SolidWorks®”. It consists of the following components.

- **Personal computer support software (RT ToolBox mini)**
- **MELFA-Works add-in tool**

**Compatible Robots**

MELFA-Works supports Mitsubishi industrial robot S Series and RP Series.

**List of applicable models**

<table>
<thead>
<tr>
<th>Model Type</th>
<th>Model</th>
<th>Model</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV-5S Series</td>
<td>RV-5S</td>
<td>RV-5L</td>
<td>RV-5L</td>
</tr>
<tr>
<td>RV-12 Series</td>
<td>RV-12S</td>
<td>RV-12SL</td>
<td>RV-12SL</td>
</tr>
<tr>
<td>RP Series</td>
<td>RP-1AH</td>
<td>RP-2AH</td>
<td>RP-2AH</td>
</tr>
</tbody>
</table>

**I/O simulation setting screen**

- I/O simulation setting
- Line cursor (line currently being measured)
- Line cursor (device to be measured)

**Video output screen**

- RT-Toolbox mini
- Video output

**MELFA-Works Screens**

- MELFA-Works Calibration tool
- RT-Toolbox mini
- Personal computer support software
- MELFA-Works add-in tool

**List of Functions**

- Loading of part data from peripheral devices and rearrangement
- Installation of hands
- Work handling
- CAD link
- Offline teaching
- Creation of robot programs (template)
- Specification of robot programs
- Simulation of robot movement
- Display of robot movement path
- Interference check
- Saving of video data
- Cycle time measurement
- Robot program debugging functions

**Calibration tool**

- RT-Toolbox mini
- Personal computer support software
- MELFA-Works add-in tool

**Notes**

1) SolidWorks® is a registered trademark of SolidWorks Corporation.
2) “Add-in tool” is a software program that adds specific functions to application software.
3) Formats that can be loaded into SolidWorks® software is not installed.

Accordingly, the calibration tool can be operated effectively on a notebook computer in which SolidWorks® software is not installed.

- Of the RH-SH Series, the mist specification model and clean specification model are not supported. (These models will be supported by future releases.)
- The CAD link tool cannot be used with 4-axis models (RH-5H Series, RP Series) and 5-axis model (RH-6L).
- It is recommended that you install an extension memory optional to a robot.
- You can create operation programs using RT-Toolbox.

For robots without an extension memory
- Approx. 17 sec

For robots with an extension memory
- Approx. 10 sec

- Operating time varies depending on the job conditions.

**Examples of Functions and Screens**

- Display of robot movement path
- Interference check
- Saving of video data
- Cycle time measurement
What is MELFA-Works?

MELFA-Works is an add-in tool for the 3D CAD software “SolidWorks®” (hereinafter “SolidWorks®”).
By adding MELFA-Works to your SolidWorks® platform, you can add new features to, and extend the existing functions of, your current robot simulation system.

*1) “SolidWorks®” is a registered trademark of SolidWorks Corporation.
*2) “Add-in tool” is a software program that adds specific functions to application software.

Features

**Automatic robot program generation function**
You can automatically generate teaching position data and robot operation programs, which are required to operate your robot, by simply loading 3D CAD data *1) for the applicable works into SolidWorks® and then setting processing conditions and areas, using MELFA-Works. This function is ideal if you are dealing with works of complex shapes, since you can automate the operations for your system requiring numerous sets of teaching position data.

- **Instant On/Off**
- **Load definition of robot position data**
- **Robot program creation**
- **Interference check**
- **I/O simulation (1)**

**Display of robot movement path**
Robot movement path can be displayed in space as trace lines.

**Interference check**
Interference between the robot and peripheral devices can be checked. A target of interference check can be specified simply by clicking it on the screen. You can also save information explaining the condition of interference that occurred (such as the contacted part, program line that was being executed when the interference occurred, and corresponding robot position), to a log.

**Saving of video data**
Simulated movements can be saved to video files (AVI format).

**Cycle time measurement**
The cycle time of robot movement can be measured using an easy-to-use function resembling a stopwatch.

**Robot program debugging functions**
The following functions are provided to help you debug robot programs.
- **Step execution**
  A specified program can be executed step by step.
- **Breakpoint**
  Breakpoints can be set in a specified program.
- **Direct execution**
  Direct robot commands can be executed.

**Jogging**
A target of interference check can be jogged just like you normally jog a robot using a teaching pendant.

**Traveling axes**
A traveling axis can be installed to a robot to verify the operation of your system requiring a traveling axis.

**Calibration**
Point-source data of CAD coordinates created by the CAD link function can be connected to robot coordinate data. Operation programs and point-source data can also be transferred to robots.
To provide greater convenience for operators who perform calibration frequently on site, the calibration tool is provided as an application independent of MELFA-Works. Accordingly, the calibration tool can be operated effectively on a notebook computer in which SolidWorks® software is not installed.

Features

**Loading of part data from peripheral devices and rearrangement**
Part data created in SolidWorks® can be loaded. The positions of loaded parts can be rearranged relative to the CAD origin and other parts. Part positions can also be changed via numerical input.

- **Installation of hands**
  Hands designed/created in SolidWorks® can be installed on robots. An ATC (Auto Tool Changer) can also be specified for each hand.
- **Work handling**
  You can simulate hand signal control using a robot program to handle works.
- **CAD link**
  You can easily operate data needed to perform teaching and other operations requiring many teaching steps. All you need is to select the target area to be processed from 3D CAD data. Since operation data is created from 3D CAD source data, complex three-dimensional curves can be recreated with ease. This leads to significant reduction in teaching time-hours.

**Offline teaching**
You can teach the robot position on the screen in advance.

**Creation of robot programs (template)**
You can create a template for simulating the offline teaching and CAD link functions, and then convert it into a robot program.

**Specification of robot programs**
You can directly use the programs you are using with actual robots. You can also specify a different robot program for each task slot.

**Simulation of robot movement**
Robot programs, including I/O signals, can be simulated. This means that movements of the actual system can be recreated directly and accurately. The following two methods are provided to simulate I/O signals of your robot controller.
1) Create simple definitions of operations associated with I/O signals
2) Link I/O signals with UI Interpreter

- **I/O simulation setting screen**
- **Simulation setup with traveling axes**
- **Video output screen**

Product Configuration

MELFA-Works is an add-in tool for the 3D CAD software “SolidWorks®”. It consists of the following components.

- **Personal computer support software (RT ToolBox mini)**
- **Calibration tool**
- **MELFA-Works add-in tool**

Compatible Robots

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<th>Notes</th>
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<tbody>
<tr>
<td>RV Series</td>
<td>RV-12S, RV-12SL</td>
<td>Approx. 17 sec operating time depending on the job condition.</td>
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<tr>
<td>SVS Series</td>
<td>SVS-2002, SVS-2008</td>
<td>Approx. 17 sec operating time depending on the job condition.</td>
</tr>
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<td>RP-1AH, RP-2AH</td>
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Examples of Functions and Screens

I/O simulation setting screen

Simulation setup with traveling axes

Video output screen

Introducing A Desktop Virtual Factory!
Mitsubishi Industrial Robot / 3D Robot Simulator

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<tbody>
<tr>
<td>MELFA-Works Version</td>
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<tr>
<td>3D-2TC-MWME</td>
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<tr>
<td>Manual (bound)</td>
<td>EFP-A28T</td>
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Operating Environment

Operating environment of MELFA-Works

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<tr>
<td>OS (4)</td>
<td>Microsoft Windows® XP Professional SP4</td>
<td>Microsoft Windows® XP Professional SP2</td>
</tr>
<tr>
<td>3D-CAD (10)</td>
<td>SolidWorks® 2006 SP4 or later, SolidWorks® 2005 SP5 or later</td>
<td>SolidWorks® 2006 SP4 or later, SolidWorks® 2005 SP5 or later, SolidWorks® 2004 SP3 or later, SolidWorks® 2003 SP4 or later, SolidWorks® 2002 SP3 or later, SolidWorks® 2001 SP6 or later, SolidWorks® 2000 SP4 or later</td>
</tr>
<tr>
<td>External application</td>
<td>SolidWorks® Simulation Version 7.0</td>
<td>SolidWorks® Simulation Version 7.0</td>
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Note: The calibration tool can be operated independently of MELFA-Works.

Operating environment of the calibration tool

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<tr>
<td>OS (4)</td>
<td>Microsoft Windows® 2000</td>
<td>Microsoft Windows® XP Professional</td>
</tr>
<tr>
<td>3D-CAD (2)</td>
<td>Not required</td>
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</table>

Note: The calibration tool can be operated independently of MELFA-Works.

For CR-500 Series

Option

Corresponded to SolidWorks®2006/2007

MELFA-Works

Changes for the Better

Mitsubishi Electric Corporation, has acquired certification for systems of environmental management under ISO 14001, and for quality management systems under ISO 9001.

Nagoya works, Mitsubishi Electric Corporation, has acquired certification for systems of environmental management under ISO 14001, and for quality management systems under ISO 9001.

Date of issue: Nov. 2006

This brochure has been issued in Nov. 2006. The contents of this brochure are subject to change for improvements without notice. Contact with Mitsubishi when referring to this brochure.