TOSHIBA MACHINE

VERTICAL ARTICULATED ROBOT

TVL/TV Series

⚠ **Caution** Before operating the industrial robot, read through and completely understand the instruction manuals.
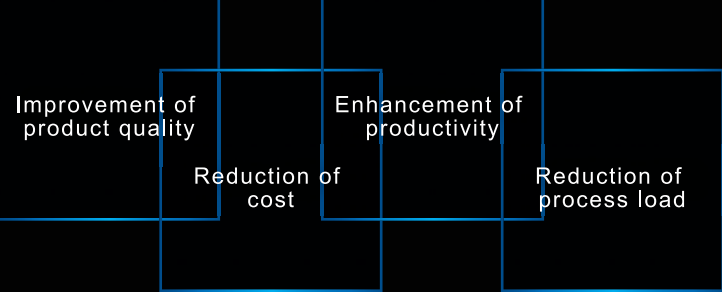
■ The contents included in this catalog are subject to change without prior notice to reflect improvements.

Brings overwhelming competitiveness to your production site

VERTICAL ARTICULATED ROBOT **TVL/TV Series**

A vertical articulated robot allows flexible and three-dimensional motion similar to that of a human being. Based on advanced technologies cultivated with industrial machinery and plenty of expertise gained through a lot of experience of production sites, Toshiba Machine provides high-quality vertical articulated robots for improvement in customer productivity that attain high-speed capability, complete weight saving, and a lot of functionalities, and realize durability and expandability capable of being applied to a wide range of production environments.

Our articulated robots contribute to process automation, labor-saving, and cost reduction in a wide range of the fields including assembly of electronic equipment and inspection/carrying of food and medicinal products.

Improvement of product quality

Enhancement of productivity

Reduction of cost

Reduction of process load

TVL500   TVL700   TV600   TV800   TV1000

Application examples of TVL/TV Series

Application examples in our manufacturing sites

Examples of automation in our manufacturing sites using cell production robots
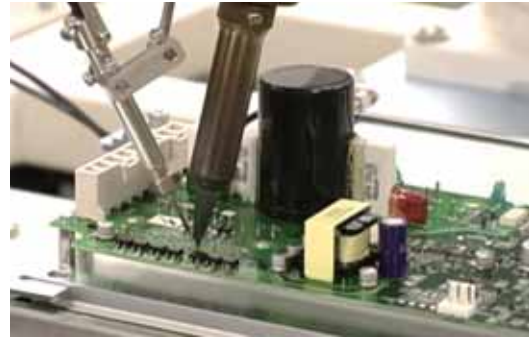
Soldering process
The robot enables stable soldering that produces high quality products efficiently.

Screw tightening process
Sensorless compliance control technologies is utilized in screw tightening.

Examples of injection molding machine systems

Toshiba Machine has accumulated many automation system examples and considerable understanding of corporation between injection molding machines and robots.

Supply of metal nut parts for insert molding

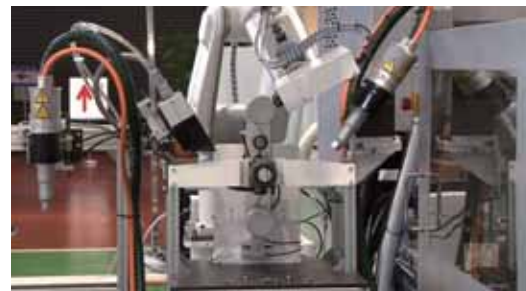Thickness measurement and appearance inspection of a 10.1-inch thin light guide plate

Sprue cutting of a CFRTP molded item

Picking up of a C(G)FRTP hybrid molded item

Inserting of a semifinished laminated lens product

Print decorating in a decoration system

Low-cost robot with top-class performance
Highly cost-effective compact model

Vertical articulated robot TVL Series

The TVL Series robot achieves high productivity in assembling and transfer processes in small spaces, combining top-class performance with low cost for superior cost effectiveness. A variety of options for convenience and the enhancement of workability, plus suitability for a wide range of work environments, are available.

World-class performance
(standard cycle time of less than 0.4 seconds)

TVL500   TVL700

Special features

Tap holes
Tool fixture tap holes are provided at four locations on the arm, upper and lower positions. They are useful for fixing external cabling and peripheral devices.
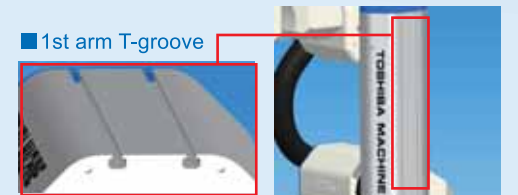
Alternative installations
Tap holes on the side of the base unit allow for the robot to be installed sideways. This reduces the need for installation space.

1st arm equipped with a T-groove as standard
The T-groove can be used to place tools, cabling and DIN rails in position.

■1st arm T-groove

Variety of options

I/O panel options
The I/O panel can be selected from three options.
An optional elbow type plug is available on the hand-side connection. [Optional]
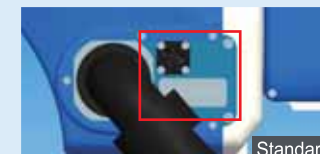
■The second arm side [Standard]

■The second arm top surface [Optional]

■The third arm side [Optional]

■Hand side connector elbow type [Optional]

Robot controller cable options
In addition to the standard cabling at the back, cabling can be routed through the base. This eliminates the need for installation space at the rear, and increases flexibility relating to the application and the space available.
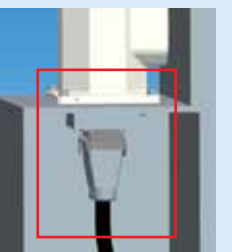
IP65 option
Dust-proof and drip-proof protection is available.

Compact controller

Controller TSL3100 specifically designed for the vertical articulated robot.
[For details, refer to page 11.]

■Teach pendant [Optional]

TSL3100   TP1000-6ax   TP3000

TVL500

World-class performance
(standard cycle time of less than 0.4 seconds)

● **Arm length 500 mm**
● **Maximum payload mass 3 kg**
● **Standard cycle time 0.3 sec level**
● **IP65 option**

■Specifications

Model		TVL500
Type		Vertically articulated robot
Number of controlled axis		6 axes
Arm length	Total length	500 mm
	1st arm	260 mm
	2nd arm	240 mm
	Reach	602 mm
Working envelope	Axis 1 (J1)	±170°
	Axis 2 (J2)	-64~+165°
	Axis 3 (J3)	0~+150°
	Axis 4 (J4)	±190°
	Axis 5 (J5)	±120°
	Axis 6 (J6)	±360°
Maximum speed *1	Axis 1 (J1)	435°/s
	Axis 2 (J2)	348°/s
	Axis 3 (J3)	348°/s
	Axis 4 (J4)	422°/s
	Axis 5 (J5)	422°/s
	Axis 6 (J6)	696°/s
	Composite *2	7.98 m/sec
Maximum payload mass *1		3 kg (rated: 1 kg)
		(Downward: 5 kg)
Standard cycle time *3		0.3 sec level
Allowable moment of inertia *1	Axis 4, 5	0.15 kg·m²
	Axis 6	0.2 kg·m²
Positioning repeatability (X-Y-Z) *4		±0.02 mm (each direction)
Driving system		AC servo motors
Power supply		1.5 kVA
Robot body	Mass	28 kg
	Color *5	White/blue

*1: Acceleration rates are limited depending on motion patterns, payload mass, and offset value.
*2: Under rated load
*3: Continuous operation of standard cycle motion pattern is not possible beyond the effective load ratio.
(Horizontal 300 mm, vertical 25 mm, round-trip, coarse positioning)
*4: When the environment temperature is constant.
*5: Color and surface treatment of the robot body may vary slightly for each production batch.
This causes no problem with the product quality.

■External view

External dimensions and operation range

TVL700

Dealing with a wide range of needs in assembling and
transfer processes while realizing high cost effectiveness.

● **Arm length 700 mm**
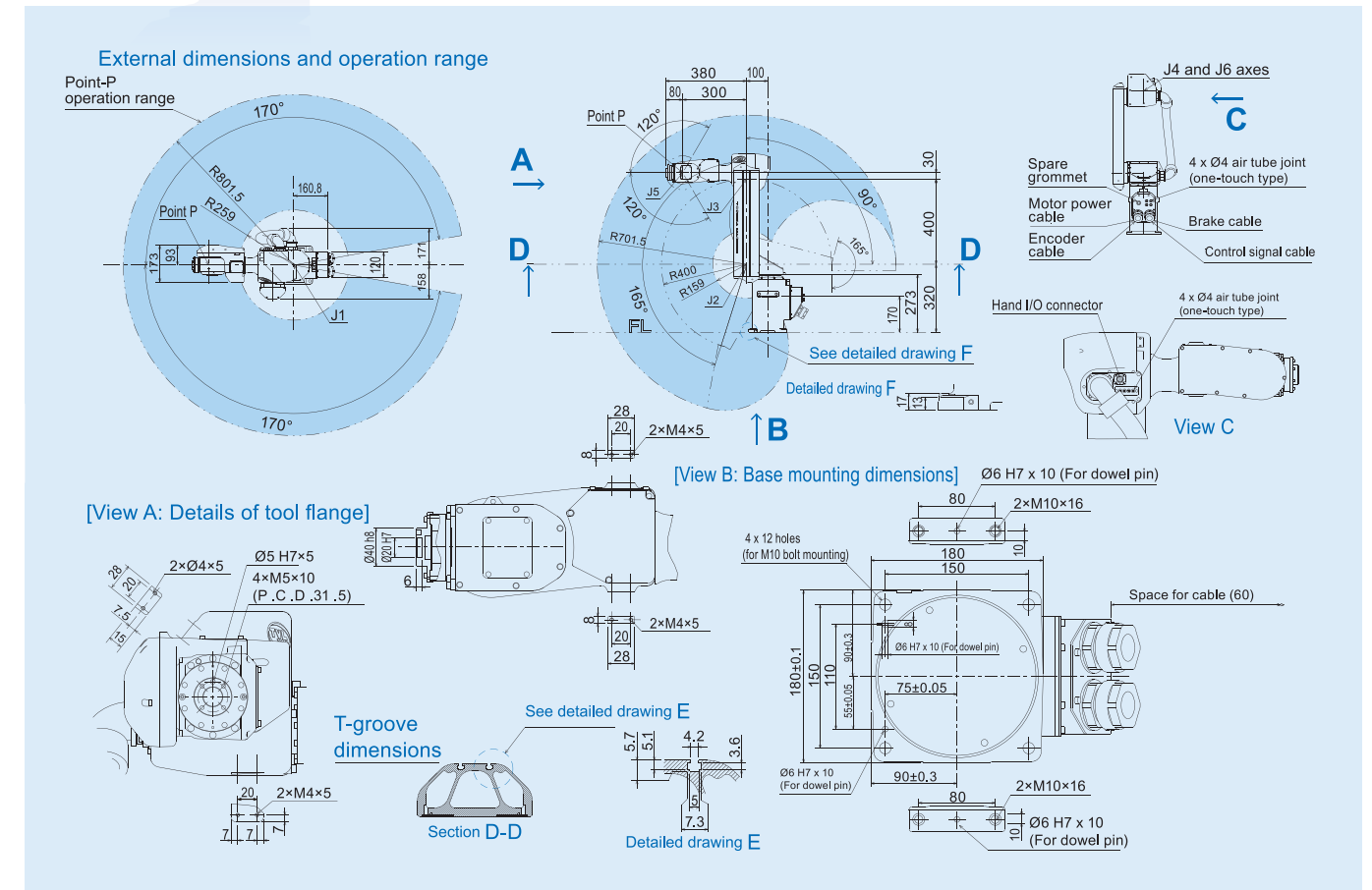● **Maximum payload mass 4 kg**
● **Standard cycle time 0.4 sec level**
● **IP65 option**

■Specifications

Model		TVL700
Type		Vertically articulated robot
Number of controlled axis		6 axes
Arm length	Total length	700 mm
	1st arm	400 mm
	2nd arm	300 mm
	Reach	801 mm
Working envelope	Axis 1 (J1)	±170°
	Axis 2 (J2)	-90~+165°
	Axis 3 (J3)	0~+165°
	Axis 4 (J4)	±190°
	Axis 5 (J5)	±120°
	Axis 6 (J6)	±360°
Maximum speed *1	Axis 1 (J1)	295°/s
	Axis 2 (J2)	270°/s
	Axis 3 (J3)	295°/s
	Axis 4 (J4)	422°/s
	Axis 5 (J5)	422°/s
	Axis 6 (J6)	696°/s
	Composite *2	7.71 m/sec
Maximum payload mass *1		4 kg (rated: 1 kg)
		(Downward: 5 kg)
Standard cycle time *3		0.4 sec level
Allowable moment of inertia *1	Axis 4, 5	0.09 kg·m²
	Axis 6	0.1 kg·m²
Positioning repeatability (X-Y-Z) *4		±0.03 mm (each direction)
Driving system		AC servo motors
Power supply		1.5 kVA
Robot body	Mass	31 kg
	Color *5	White/blue

*1: Acceleration rates are limited depending on motion patterns, payload mass, and offset value.
*2: Under rated load
*3: Continuous operation of standard cycle motion pattern is not possible beyond the effective load ratio.
(Horizontal 300 mm, vertical 25 mm, round-trip, coarse positioning)
*4: When the environment temperature is constant.
*5: Color and surface treatment of the robot body may vary slightly for each production batch.
This causes no problem with the product quality.

■External view

External dimensions and operation range

High-end robot with high speed and high rigidity

Vertical articulated robot TV Series

Excellent rigidity, durability, and expandability.
Superior operability with due easy to use software.
Compliance control using no force sensor.
Elimination of necessity for external sensors allows force control at a low cost.

Excellent rigidity

Excellent durability

**Excellent expandability**

TV600　　　TV800　　　TV1000

Capable of inserting and achieving compliance actions without force sensor (sensorless compliance control)

Automation of processes that require force control can be realized without force sensors.

What is the sensorless compliance control?

The TV Series robot attains compliance control without using force sensors. Misalignment is absorbed by the flexible hand with the control that can adjust the force. As a result, stable work processes with less temporary stops can be realized.
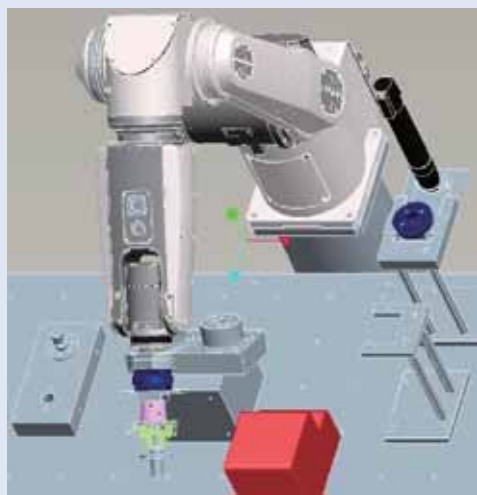
Examples of work process
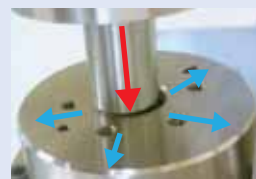
1 Inserting process

Smooth insertion is realized by loosening horizontal force while pushing vertically with constant insertion force.

2 Pin hole searching process

Even when a hole position cannot be figured out exactly, the robot can find it by turning the wrist while pushing vertically.

3 Screwing process

Synchronization with the screw feed rate is unnecessary. Stable screwing without sticking or failure of a screw can be performed by screwing while pushing vertically with constant force.

High-performance controller

Controller TS3100 specifically designed for the vertical articulated robot.

For details, refer to page 12.

■Teach pendant Optional

TS3100　　　TP1000-6ax　　　TP3000

Compact and light-weight robot that can be introduced into production facilities with ease.
Suitable for assembling work such as fitting processes due to the flexible hand control.
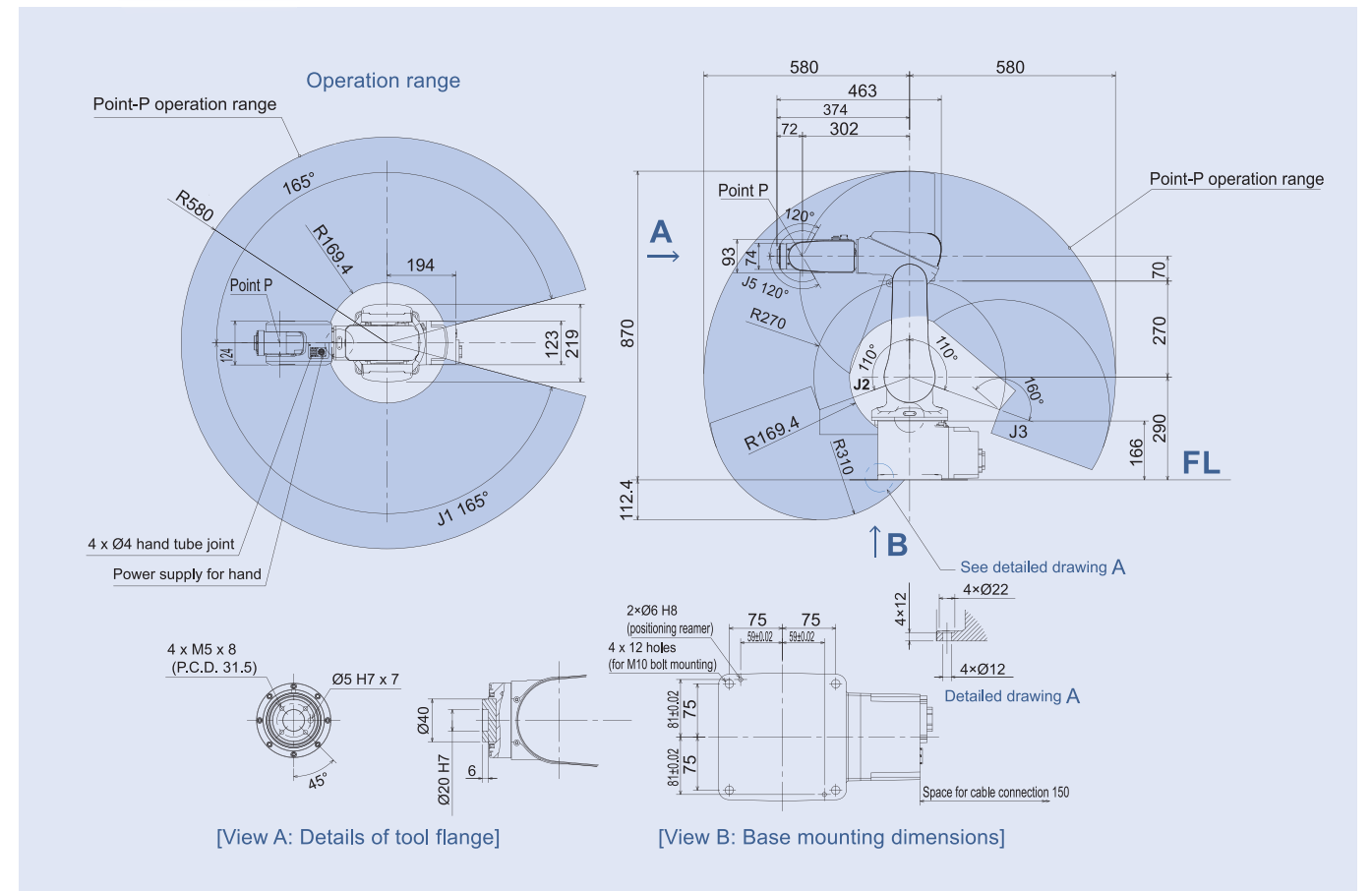
TV600

● Arm length 572 mm
● Maximum payload mass 3 kg
● Compact and light-weight
● User friendly software

■Specifications

Model		TV600
Type		Vertically articulated robot
Number of controlled axis		6 axes
Arm length	Total length	572 mm
	1st arm	270 mm
	2nd arm	302 mm
	Reach	580 mm
Working envelope	Axis 1 (J1)	±165°
	Axis 2 (J2)	+110°
	Axis 3 (J3)	0~+160°
	Axis 4 (J4)	±160°
	Axis 5 (J5)	±120°
	Axis 6 (J6)	±400°
Maximum speed *1	Axis 1 (J1)	250°/s
	Axis 2 (J2)	250°/s
	Axis 3 (J3)	250°/s
	Axis 4 (J4)	320°/s
	Axis 5 (J5)	320°/s
	Axis 6 (J6)	420°/s
	Composite *2	5.9 m/sec
Maximum payload mass *1		3 kg (rated: 1 kg)
		(Downward: 5 kg)
Standard cycle time *3		0.58 sec level
Allowable moment of inertia *1	Axis 4, 5	0.02 kg·m²
	Axis 6	0.015 kg·m²
Positioning repeatability (X-Y-Z) *4		±0.03 mm (each direction)
Driving system		AC servo motors
Power supply		1.0 kVA
Robot body	Mass	25 kg
	Color *5	White

*1: Acceleration rates are limited depending on motion patterns, payload mass, and offset value.
*2: Under rated load
*3: Continuous operation of standard cycle motion pattern is not possible beyond the effective load ratio.
   (Horizontal 300 mm, vertical 25 mm, round-trip, coarse positioning)
*4: When the environment temperature is constant.
*5: Color and surface treatment of the robot body may vary slightly for each production batch.
   This causes no problem with the product quality.

■External view

Operation range

Point-P operation range

R580　165°　R169.4　194
Point P　J1 165°
123　219
4 x Ø4 hand tube joint
Power supply for hand

4 x M5 x 8
(P.C.D. 31.5)　Ø5 H7 x 7
45°　Ø40　Ø20 H7　6

[View A: Details of tool flange]

580　580
463
374
72　302
Point P　120°
A→　93　74　J5 120°　Point-P operation range
R270　110°　110°　70
870　J2 110°　160°　270
R169.4　J3
112.4　R310　166　290
FL
B↑　See detailed drawing A
4×Ø22
4×12
2×Ø6 H8
(positioning reamer)
4 x 12 holes
(for M10 bolt mounting)
75　75
4×Ø12
75　75
Detailed drawing A
Space for cable connection 150

[View B: Base mounting dimensions]

Plenty of options available for various environments.
Applicable to a wide range of needs including production lines and assembly processes

TV800

Plenty of options available for various environments.
Lightest robot in class.

TV1000

■Specifications

Model		TV800
Type		Vertically articulated robot
Number of controlled axis		6 axes
Arm length	Total length	800 mm
	1st arm	380 mm
	2nd arm	420 mm
	Reach	892 mm
Working envelope	Axis 1 (J1)	±170°
	Axis 2 (J2)	−100~+150°
	Axis 3 (J3)	−127~+167°
	Axis 4 (J4)	±190°
	Axis 5 (J5)	±120°
	Axis 6 (J6)	±360°
Maximum speed *1	Axis 1 (J1)	237°/s
	Axis 2 (J2)	240°/s
	Axis 3 (J3)	288°/s
	Axis 4 (J4)	350.5°/s
	Axis 5 (J5)	484°/s
	Axis 6 (J6)	576°/s
	Composite *2	8.06 m/sec
Maximum payload mass *1		5 kg
Standard cycle time *3		0.4 sec level
Allowable moment of inertia *1	Axis 4, 5	0.3 kg·m²
	Axis 6	0.05 kg·m²
Positioning repeatability (X-Y-Z) *4		±0.02 mm (each direction)
Driving system		AC servo motors
Robot body	Mass	45 kg
	Color *5	White/Light gray

● Arm length 800 mm
● Maximum payload mass 5 kg
● Standard cycle time 0.4 sec level

*1: Acceleration rates are limited depending on motion patterns, payload mass, and offset value.
*2: Under rated load
*3: Continuous operation of standard cycle motion pattern is not possible beyond the effective load ratio.
　　(Horizontal 300 mm, vertical 25 mm, round-trip, coarse positioning)
*4: When the environment temperature is constant.
*5: Color and surface treatment of the robot body may vary slightly for each production batch.
　　This causes no problem with the product quality.

Optional
● Dust and drip proof (IP65)
● Clean
● Safety category 3
● Ceiling mount

■External view

Operation range

[View A: Details of tool flange]

[View B: Base mounting dimensions]

■Specifications

Model		TV1000
Type		Vertically articulated robot
Number of controlled axis		6 axes
Arm length	Total length	1000 mm
	1st arm	480 mm
	2nd arm	520 mm
	Reach	1090 mm
Working envelope	Axis 1 (J1)	±170°
	Axis 2 (J2)	−100~+150°
	Axis 3 (J3)	−127~+167°
	Axis 4 (J4)	±190°
	Axis 5 (J5)	±120°
	Axis 6 (J6)	±360°
Maximum speed *1	Axis 1 (J1)	237°/s
	Axis 2 (J2)	240°/s
	Axis 3 (J3)	288°/s
	Axis 4 (J4)	350.5°/s
	Axis 5 (J5)	484°/s
	Axis 6 (J6)	576°/s
	Composite *2	9.61 m/sec
Maximum payload mass *1		5 kg
Standard cycle time *3		0.6 sec level
Allowable moment of inertia *1	Axis 4, 5	0.3 kg·m²
	Axis 6	0.05 kg·m²
Positioning repeatability (X-Y-Z) *4		±0.03 mm (each direction)
Driving system		AC servo motors
Robot body	Mass	47 kg
	Color *5	White/Light gray

● Arm length 1000 mm
● Maximum payload mass 5 kg
● Standard cycle time 0.6 sec level

*1: Acceleration rates are limited depending on motion patterns, payload mass, and offset value.
*2: Under rated load
*3: Continuous operation of standard cycle motion pattern is not possible beyond the effective load ratio.
　　(Horizontal 300 mm, vertical 25 mm, round-trip, coarse positioning)
*4: When the environment temperature is constant.
*5: Color and surface treatment of the robot body may vary slightly for each production batch.
　　This causes no problem with the product quality.

Optional
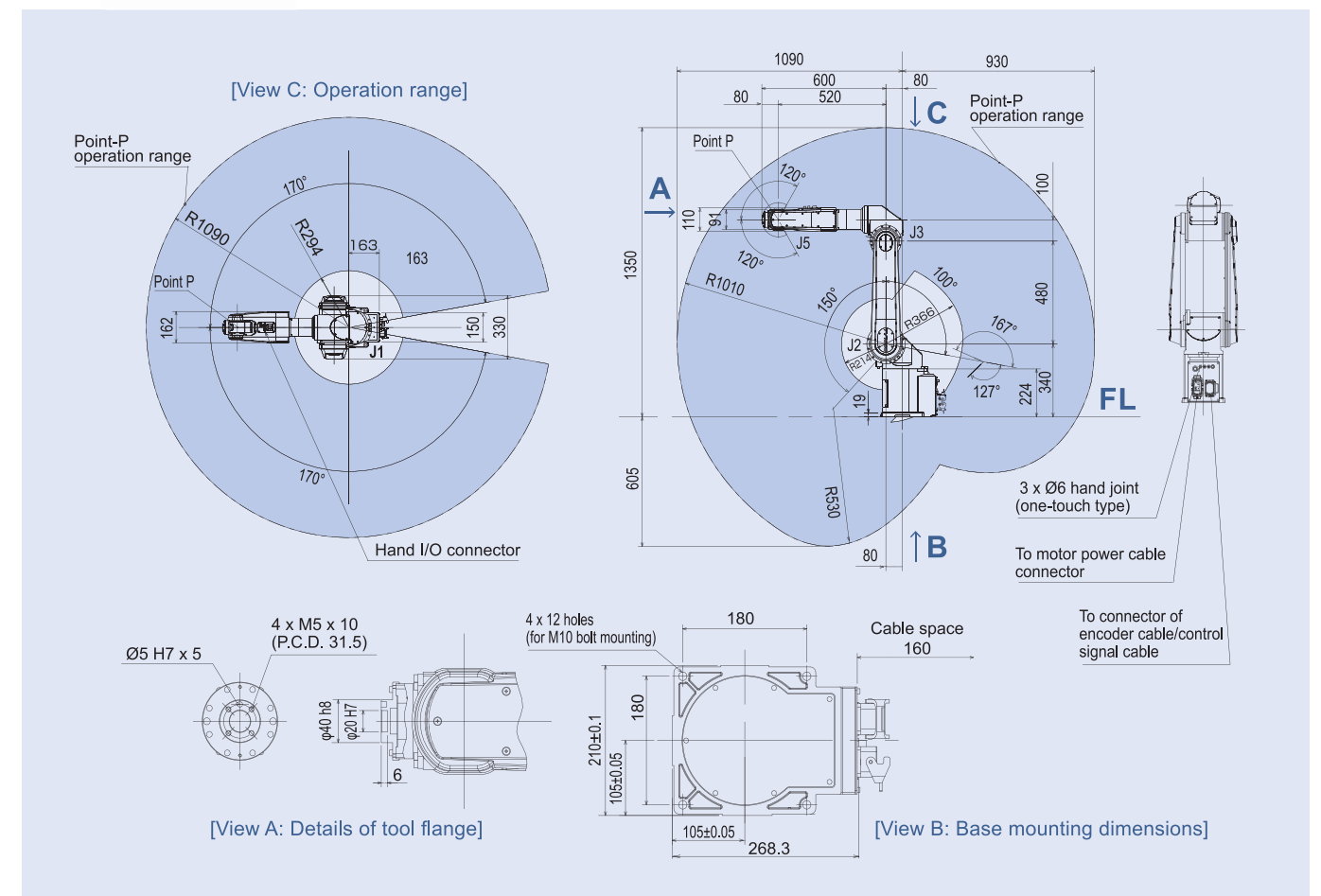● Payload mass 10 kg (TV1000H)
● Dust and water proof (IP67)
　* only for wrist of TV1000H
● Dust and drip proof (IP65)
● Clean
● Safety category 3
● Ceiling mount

■External view

[View C: Operation range]

[View A: Details of tool flange]

[View B: Base mounting dimensions]

Controllers and teach pendants
specifically designed for the vertical articulated robot

For TVL Series
TSL3100
Cost effective compact controller

For TVL Series [NEW]
TSL3100E
Low-cost and compact CE compliant controller [CE compliant]

For all TVL Series robots

Teach pendant [Optional]

TP1000-6ax
Standard teach pendant

TP3000
Teach pendant equipped with graphic operation keys

TP1000-6ax   TP3000

For TV600
TS3100V2
Controller for vertical articulated robot TV600 with up to six axes simultaneous control.

For TV Series
TS3100
High performance controller with up to six axes simultaneous control.

For all TV Series robots

Teach pendant [Optional]

TP1000-6ax
Standard teach pendant

TP3000
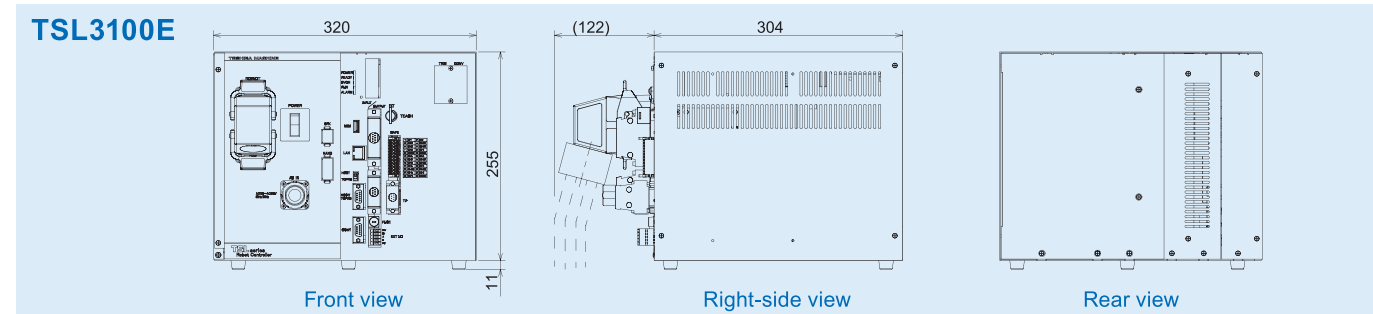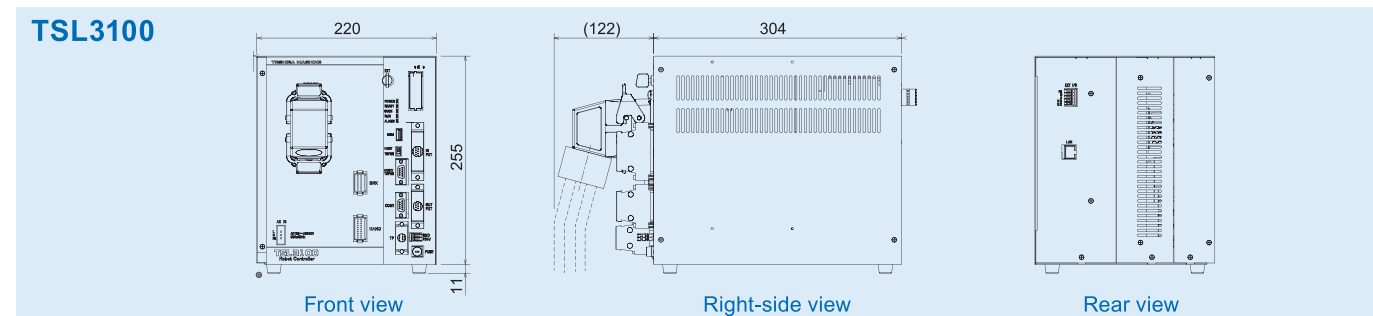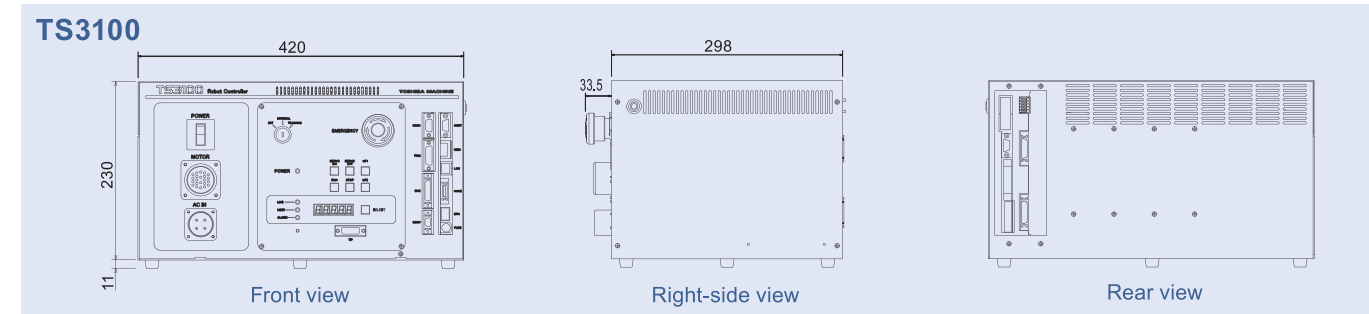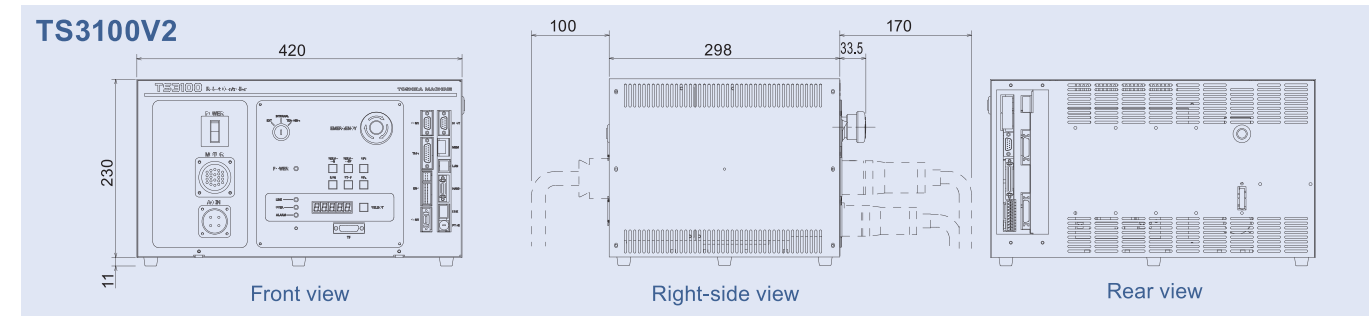Teach pendant equipped with graphic operation keys

TP1000-6ax   TP3000

■Specifications

Model	TSL3100	TSL3100E
Number of controlled axes	Maximum 6 axes	Maximum 6 axes
Motion modes	PTP, CP (Continuous Path; Linear, Circular), Short-Cut	PTP, CP (Continuous Path; Linear, Circular), Short-Cut
Storage capacity	Approx. Total: 6400 point + 12800 steps 1 program: 2000 point + 3000 steps	Approx. Total: 6400 point + 12800 steps 1 program: 2000 point + 3000 steps
Number of registerable programs	Maximum 256	Maximum 256
Programming language	SCOL (similar to BASIC)	SCOL (similar to BASIC)
Teach pendant (optional)	Teach pendants TP3000 and TP1000-6ax (Program can also be written on PC)	Teach pendants TP3000 and TP1000-6ax (Program can also be written on PC)
Extended I/O signals	8 inputs / 8 outputs	8 inputs / 8 outputs
Hand control signals	8 inputs / 8 outputs	8 inputs / 8 outputs
External operation signals	Input: cycle operation mode, start, stop, etc. (13 signals) Output: Servo ON, emergency stop, etc. (11 signals)	Input: cycle operation mode, start, stop, etc. (13 signals) Output: External mode, automatic operation, etc. (9 signals)
Communication port	RS232C: 2 ports, Ethernet*, USB	RS232C: 2 ports, Ethernet*, USB
Other functions	Interruptive functions, self-diagnosis, I/O control and communications during motion, coordinate calculations, built-in PLC, etc.	Interruptive functions, self-diagnosis, I/O control and communications during motion, coordinate calculations, built-in PLC, etc.
Power supply	Single phase AC190 V to 240 V, 50/60 Hz	Single phase AC190 V to 240 V, 50/60 Hz
Outer dimensions and mass	220(W) x 266(H) x 304(D) [mm], 9 kg (including rubber feet)	320(W)x 266(H) x 304(D) [mm], 13 kg (including rubber feet)
PC software for programming support (option)	TSPC: Program editor, teaching, remote operation, etc.	TSPC: Program editor, teaching, remote operation, etc.
I/O and Fieldbus options	I/O extension, I/O cable, Field-network (CC-Link, DeviceNet, PROFIBUS)*	I/O extension, I/O cable, Field-network (CC-Link, DeviceNet, PROFIBUS)*, Conveyor synchronization, Trigger input

*: CC-Link is a registered trademark of Mitsubishi Electric Corporation. DeviceNet is a registered trademark of ODVA. PROFIBUS is a registered trademark of Profibus User Organization. Ethernet is a registered trademark of Fuji Xerox Co., Ltd.

■Specifications

Model	TS3100V2	TS3100
Number of controlled axes	Maximum 6 axes	Maximum 6 axes
Motion modes	PTP, CP (Continuous Path; Linear, Circular), Short-Cut	PTP, CP (Continuous Path; Linear, Circular), Short-Cut, Arch motion
Storage capacity	Approx. Total: 12800 point + 25600 steps 1 program: 2000 point + 3000 steps	Approx. Total: 12800 point + 25600 steps 1 program: 2000 point + 3000 steps
Number of registerable programs	Maximum 256	Maximum 256
Programming language	SCOL (similar to BASIC)	SCOL (similar to BASIC)
Teach pendant (optional)	Teach pendant with 5 m cable (Program can also be written on PC)	Teach pendants TP1000 and TP3100 (Program can also be written on PC)
Extended I/O signals	32 inputs / 32 outputs	32 inputs / 32 outputs
Hand control signals	4 inputs / 4 outputs	8 inputs / 8 outputs
External operation signals	Input: program selection, start, stop, program reset, etc. Output: Servo ON, ready for operation, failure, cycle stop, etc.	Input: cycle operation mode, start, stop, reset, etc. Output: Servo ON, ready for operation, failure, etc.
Communication port	RRS232C: 2 ports, Ethernet*: 1 port, USB	RS232C: 2 ports, Ethernet*: 1 port, USB
Other functions	Torque limit, Interruptive functions, self-diagnosis, I/O control and communications during motion, coordinate calculations, built-in PLC, etc.	Torque limit, Interruptive functions, self-diagnosis, I/O control and communications during motion, coordinate calculations, built-in PLC, etc.
Power supply	Single phase AC200 V to 240 V, 50/60 Hz	Single phase AC200 V to 240 V, 50/60 Hz
Outer dimensions and mass	420(W) x 230(H) x 298(D) [mm], approximately 17 kg	420(W) x 230(H) x 298(D) [mm], approximately 17 kg
PC software for programming support (option)	TSPC: Program editor, teaching, remote operation, etc.	TSPC: Program editor, teaching, remote operation, etc.
I/O and Fieldbus options	I/O extension, I/O cable, Field-network (CC-Link, DeviceNet, PROFIBUS)*	I/O extension, I/O cable, Field-network (CC-Link, DeviceNet, PROFIBUS)*

*: CC-Link is a registered trademark of Mitsubishi Electric Corporation. DeviceNet is a registered trademark of ODVA. PROFIBUS is a registered trademark of Profibus User Organization. Ethernet is a registered trademark of Fuji Xerox Co., Ltd.

■External view

TSL3100
220   (122)   304   255   11
Front view   Right-side view   Rear view

TSL3100E
320   (122)   304   255   11
Front view   Right-side view   Rear view

■External view

TS3100V2
420   100   298   170   33.5   230   11
Front view   Right-side view   Rear view

TS3100
420   298   33.5   230   11
Front view   Right-side view   Rear view

Various functions to support the operation

Options and functions that maximize the robot performance and
PC software for efficient robot system building.

Support for Sample Projects

TOSHIBA MACHINE × **Pro-face**
for the best interface

Sample Projects are a collaborative system between Toshiba Machine Co., Ltd. and Digital Electronics Corporation.
They enable users to check the status of the robot on the touch panel display device.

[Features and Advantages]

■ When an error occurs in the robot, the error information or details can be checked on the Alarm Monitor Screen (see the below figure).

■ Additionally, various other screens for functions including Robot I/O Monitor, Current Position Monitor, I/O Time Chart and Connected Device Data Transfer are provided.
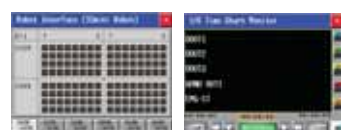
■ The above robot screens can be downloaded from the website of Digital Electronics Corporation free of charge. There is no need to create these screens and they can be used immediately after product purchase.

http://www.pro-face.com/otasuke/download/sample/manufactures.html

■ The status of the robot can be checked even by people who cannot operate the teach pendant.

■ Because the information about both the robot and the system is displayed on the same display device, troubleshooting is much easier.
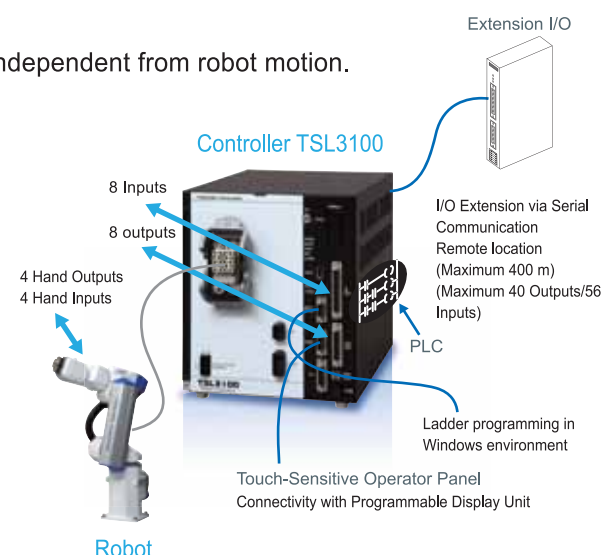
*For product information about the touch panel that is compatible with this system, please contact Digital Electronics Corporation.

http://www.pro-face.com/otasuke/sample/detail/common/connection_robot_con_ts_e.html

Robot unit with touch panel

Main screen (Screen created by customer)

Display device made by Digital

An error has occurred in the robot!

Alarm Monitor Screen

Error details appear on the screen.

Built-In PLC

The robot controller has a built-in PLC (TCmini).
Input and output signals can be controlled by a ladder program, independent from robot motion.
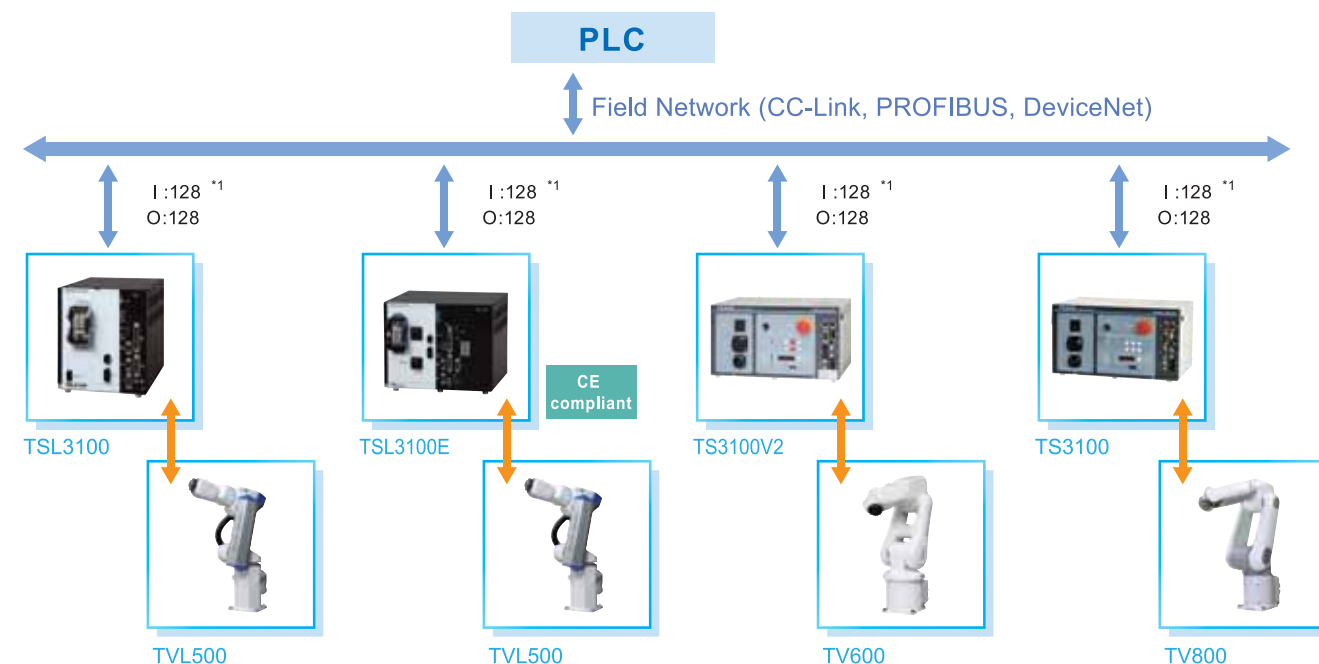
[Features and Advantages]

■ TCmini controls input/output signals of standard I/O, extension I/O and touch-sensitive panel by a ladder program and exchanges data with the robot program.

■ By changing the ladder program, system I/O signals can be used as standard I/O signals, and system I/O signals can be assigned as expansion I/O signals and field network I/O signals.

■ Flexible system design and control of peripheral equipment are possible without the added cost of an outside host PLC.

■ Creation, monitoring and debugging of a ladder program are possible with powerful programming support software "TCPRGOS-W" (optional).

■ The scan time is 5ms per 1 K-Word (TSL3100). Connection is possible with various programmable controllers and display units etc.

Extension I/O

Controller TSL3100

8 Inputs
8 outputs
4 Hand Outputs
4 Hand Inputs

I/O Extension via Serial Communication Remote location (Maximum 400 m) (Maximum 40 Outputs/56 Inputs)

PLC

Ladder programming in Windows environment

Touch-Sensitive Operator Panel Connectivity with Programmable Display Unit

Robot

Field Network

Various field network protocols are supported.

PLC

Field Network (CC-Link, PROFIBUS, DeviceNet)

I :128 *1
O:128

I :128 *1
O:128

I :128 *1
O:128

I :128 *1
O:128

TSL3100   TSL3100E   TS3100V2   TS3100

CE compliant

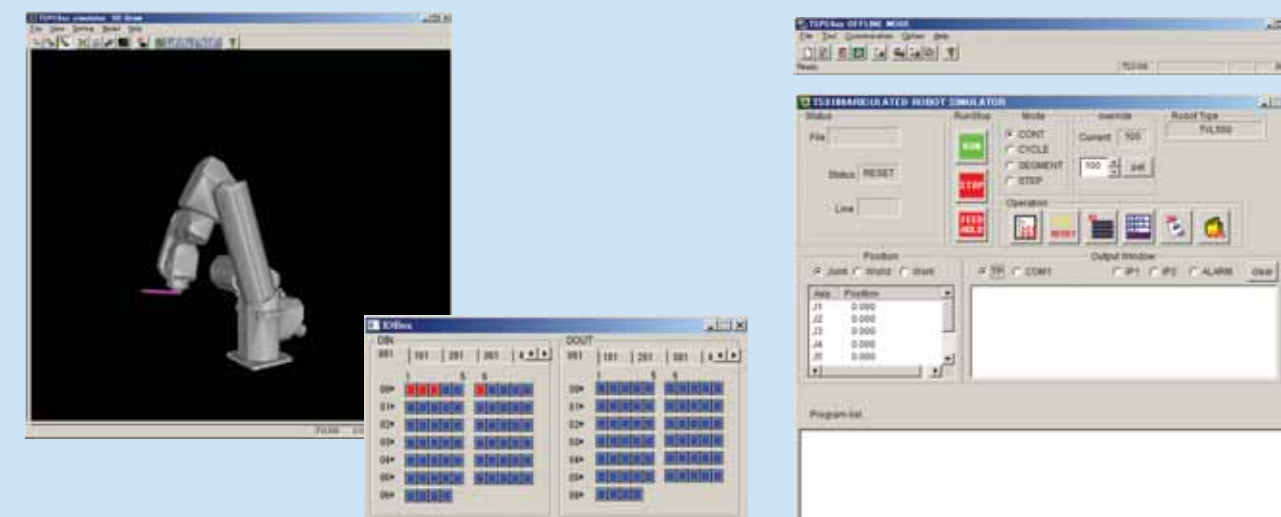TVL500   TVL500   TV600   TV800

*1: I:126 and O:126 for CC-Link

PC Software for Programming Support

The following PC software tools are provided to shorten the time and increase the efficiency of system designing and installation work.

TSPC: For robot programming

1. Powerful simulation function

Off-line robot program creation and simulation, with simulated I/O. Lead time up to the start of robot operation can be shortened. Robot programs can be pre-checked without stopping the production line.

2. User-friendly programming environment

Extensive help information, powerful grammar check, direct, online editing of programs in the controller memory.

3. Multi-functional monitor and support

Monitoring functions such as active program display, position display, motion status monitor by 3D model, and alarm history display. Operation from on-screen operation panel. Connection via Ethernet (optional) is also supported.