■**General**

The Unified Controller nv series, a line of Toshiba's industrial controllers, takes over the traits of the "Integrated Controller V series," the existing controller lineup which has gain a favorable reputation. The nv series is equipped with an I/O system called "TC-net I/O," which is based on the industry's first 100-Mbps double loop network. As a result, the high speed performance required in the electric control field as well as the online maintainability required in the instrumentation field can be simultaneously achieved by the same hardware. Thus, the nv series provides the unified supervisory control system featuring the high speed performance, reliability and economic efficiency not just in the instrumentation field but also in the electric control and electric power fields.

The controller also enables to continue the use of application resources accumulated by users over many years, while allowing the succession of engineering tool, supervisory control network and operator station from the existing model.

As the successor S model of the Integrated Controller V series, the type 1 controller of the Unified Controller nv series is mainly used for high-speed sequence control.

■**Features**

The type 1 controller has the following features.

(1) Equipped with the industry's first high speed serial I/O system "TC-net I/O"

It is the industry's first field I/O system that enables a transmission speed of 100 Mbps and the double loop configuration. The system can collect high speed I/O data, and the minimum preset time for collection cycle is 100 μs. In the standard setup, the transmission path has a double loop configuration (with sending and receiving lines). Furthermore, the double-loop network may be provided as a duplexed configuration.
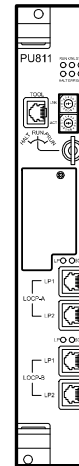

Fig.1　type1 controller (PU811)

(2) Computing power enhanced by the direct execution of IEC language by hardware

The controller is designed to execute the international standard language IEC 61131-3 instructions by ASIC on a hardware basis. Thus, the minimum execution time for the sequence instruction word is 20 ns (1/2 that of Toshiba's existing models). Also, the control cycle can be set to 0.5 ms at the minimum.

(3) Higher reliability enabled by the redundant module configuration and the use of ECC circuit in the internal memory

The controller is applicable to the duplexed system configuration with two sets of power supplies, CPUs and transmission modules. In addition, an ECC circuit in the internal memory of each module makes it possible not just to detect errors but also correct the values in erroneous areas. Furthermore, a highly integrated ASIC design is adopted to reduce the number of parts used in complicated circuits, thereby minimizing the failure rate.

⚠ **SAFETY INSTRUCTIONS**

- This product was designed and manufactured for use in general manufacturing equipment systems (for process control, production line control, etc.). It was not designed or manufactured for use with equipment employed under circumstances which pose a direct threat to human life, or with systems consisting of such equipment. Before using this product for such purposes, please consult a sales representative.

- This product was manufactured under rigorous quality control. However, when employing this product with facilities which may pose a threat to human life, or with facilities for which serious consequences may be foreseen, please tale special care to ensure the construction of a system which is safe with respect to system operation, maintenance and management.

- This product requires electrical and mechanical installation. Please consult your vendor, a specialized service provider, or a Toshiba sales representative regarding installation. Improper installation may result in electric shocks or fire.

- Please read all related documentation prior to use of this product, and use product only as described in the documentation.

nv series type1

(4) Higher reliability enabled by a redundant, gigabit configuration for the supervisory control network

The supervisory control network supports a 1-Gbps Ethernet transmission, and the transmission path can be provided as a duplexed configuration. In addition, the global standard Real-Time Ethernet "TC-net 100" can be used for the network among controllers. The existing products can be connected via a switching hub or a gateway.

(5) Ensures the succession in the supervisory control system

- Engineering tool:

  The engineering tool is compliant with the international standard IEC 61131-3, which has been adopted since the existing model. In order to enhance the usability, users are allowed to customize symbols to their taste.

- Supervisory control network:

  The supervisory control network is compliant with the Open Network Ethernet and supports a transmission speed of 1 Gbps. The existing "TC-net 100" Real-Time Ethernet can also be used.

■System Configuration

The Unified Controller nv series type 1 can be used in single system configuration or in duplex system configuration.

●Single system configuration

In single system configuration, power supply module, controller module and station bus module are installed into base unit (BU816).

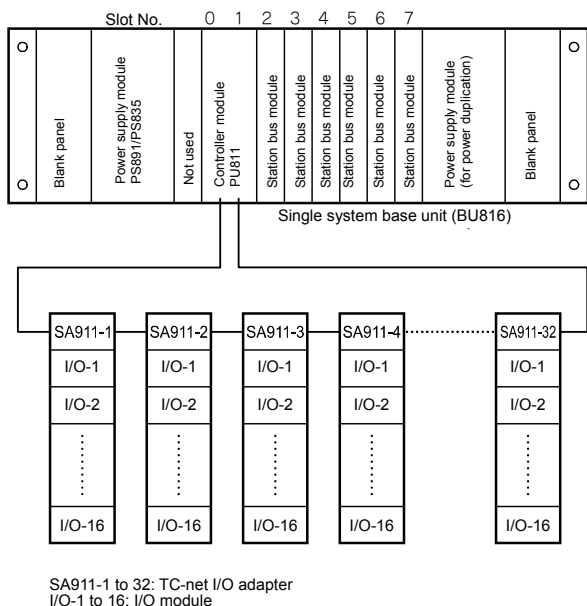I/O signals are connected to the high-speed serial TC-net I/O module adopting remote I/O method. (See Fig.2)

SA911-1 to 32: TC-net I/O adapter
I/O-1 to 16: I/O module

Fig.2   Single system configuration

●Duplex system configuration

In duplex system configuration, some modules are installed into base unit (BU825). The duplex system is a system with duplex basic units of the controller. The duplex system has two basic units of the controller of the same configuration. When an error occurs on one controller, the control of the system is switched to another controller.

In the duplex system, the running system (that currently is executing the control) is called as the on-line system, the waiting system (that is in standby status and executing diagnosis) is called as the standby system, and the other system (the system other than the running system and the standby system) is called as the off-line system respectively. When these systems are started up at the same time, the system that is assigned to the on-line system taking priority to other systems is called as the primary system, and the system that is assigned to standby is called as the secondary system. (See Fig.3)
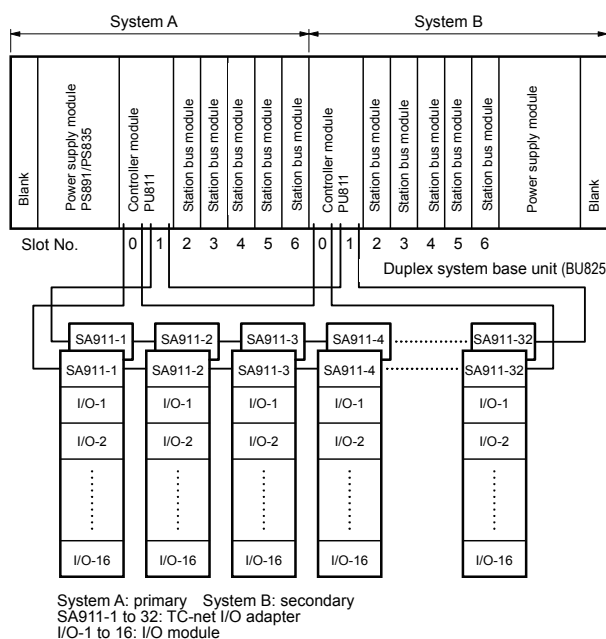

System A: primary   System B: secondary
SA911-1 to 32: TC-net I/O adapter
I/O-1 to 16: I/O module

Fig.3   Duplex system configuration

■Controller Unit Configuration

Fig.4 shows the modules that can be installed to the base unit.

	Slot 0/1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Controller module							
PU811	○	–	–	–	–	–	–
Station bus module (transfer module) (Note 1)							
EN85** (Ethernet)	–	○	○	○	○	○	○
TN81** (TC-net100)	–	○	○	○	○	○	○

(Note1) Maximum 4 transmission modules can be installed.
*Refer to Bus Module Description for ** in the pet name.

Fig.4   Modules that can be installed to the base unit

■ I/O Configuration

I/O signals are connected to the high-speed serial TC-net I/O module adopting remote I/O method. Also existing G3 I/O can be connected using G3 I/O adapter.

●High-speed serial TC-net I/O series configuration

1) Single system configuration

For the controller of single system configuration, the high-speed serial TC-net I/O loop configuration is connected as a single loop configuration as shown in the following figure.
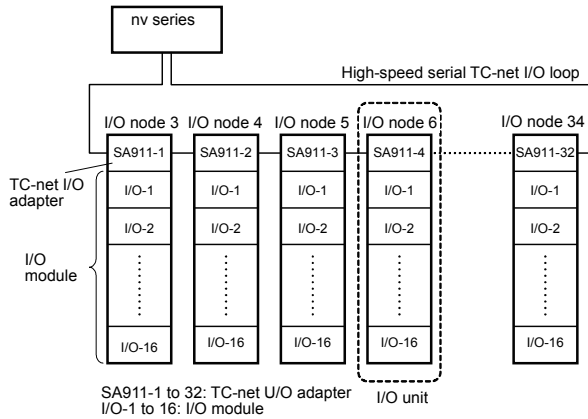

Fig.5   Single system configuration

2) Duplex system configuration

For the controller of duplex system configuration, the high-speed serial TC-net I/O loop configuration is connected as a dual loops configuration as shown in the following figure.
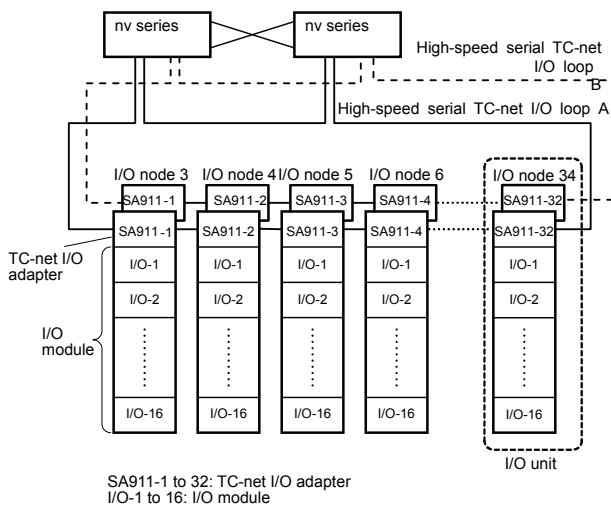

Fig. 6   Duplex system configuration

■Network Configuration

The unified controller nv series supports the de facto standard network.

Therefore the system can be configured to the system scale. An example of system configuration is shown in Fig. 7
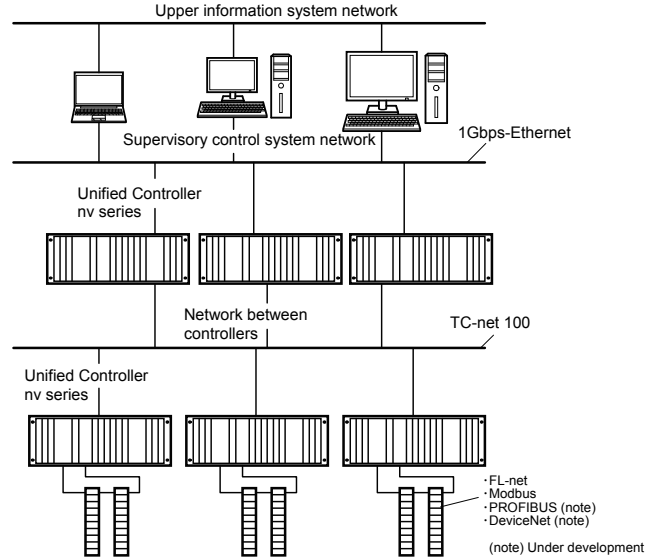

Fig. 7   Network configuration

■Engineering Tool

The engineering tool (nV-Tool) includes a new instrumentation function block, a new instrumentation tag editor, a full graphics editor, a text editor and a custom symbol editor. These are software for creating control programs of the Unified Controller nv series and the Integrated Controller V series, and for performing operation check and maintenance of the controllers. The engineering tool is compliant with the international standard IEC 61131-3, and can be used for online programming as well as offline programming in stand-alone mode without the connection to the main unit.
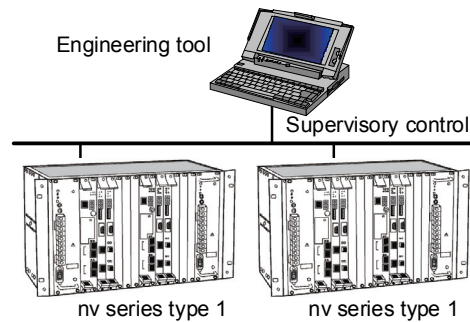

Fig. 8   Configuration of engineering tool

No. EJV-218

■Specifications
●General specifications

Table 1   General specifications

Item	Specification	Remarks
Operating ambient temperature	0°C to 55°C; 40°C or less on average over 24 hours	(Note 1)
Storage temperature	-40 to 70°C	
Operating ambient relative humidity	10% to 95%RH, Level RH2 (no condensation)	(Note 2)
Dust	Dust 0.3 mg/m^3 (no conductive dust permitted)	
Pollution level	2 (usually no conductive pollution) or less	IEC 61131-2
Corrosive gas	No corrosive gas permitted. No silicone-containing material permitted.	(Note 3)
Operating altitude	2,000 m or less	
Resistance to vibration (vibration immunity)	IEC 60068-2-6, test Fc compatible, X, Y, Z 10 cycles each	(Note 4)
Impact resistance (impact immunity)	IEC 60068-2-27, test Ea compatible 147 m /s^2 (3 orthogonal axes, 3 times each)	
Insulation resistance	500 VDC Megger 10 MΩ or more	Between Power and GND terminals I/O: Refer to the Individual Specification.
Dielectric strength	2,000 VAC 1 min	Between Power and GND terminals I/O: Refer to the Individual Specification.
Free fall	Shipping package: 1,000 mm For product package: 300 mm	

Item	Specification	Remarks
Noise immunity		
Fast transient	AC power: 2 kV DC power: 2 kV (section of 10 m or less is unnecessary) I/O power DC: 1kV (section of 10 m or less is unnecessary) AC-I/O: 2 kV (unshielded cable) DC-I/O: 1 kV (unshielded cable) Analog I/O: 1 kV (shielded cable)	
Electrostatic discharge	4 kV (contact discharge) Level ESD-3	
Radiated electromagnetic field	10 V/m	
Impulse noise	Power wire Noise voltage: 1,500 V Pulse width: 1μs/100 ns	
EMC zone	Zone B (including Zone A)	
Ground	D-class grounding with ground resistance of 100Ω or less (prescribed by the Japanese Ministerial Ordinance)	(Note 5)
Structure	Open type	
Installation site	In indoor control board	
Cooling system	Standard: Forced air cooling	
Weight	Approx. 16 kg BU825 (duplexed chassis, full slot installed)	
Outside dimensions	Primary block 431.8 (W), 482.6 (W1) x 265.9 (H) x 238 (D)	W1 dimensions include the support bracket.
Standard satisfied	IEC 61131-2, CE marking, C-tick mark UL508	

(Note 1)   The reference temperature was measured at the 50 mm position below the underside of the base unit.
(Note 2)   For long-term storage, store spares in a dark location while avoiding high temperature and humidity.
  For long-term storage of the product, adjust the temperature and humidity to 0°C to 40°C and 20% to 80%RH (no condensation), and adjust the rate of change in temperature to 10°C/h.
  Especially for the battery or power supply, a high ambient temperature affects the available period. Store the product at the room temperature (25°C) or less.
(Note 3)   None of the following constituents must be contained hydrogen sulfide, sulfurous acid gas, chlorine gas, nitrogen oxides (NOx), sulfur oxides (SOx), ammonia, silicon gas, and other corrosive gas
(Note 4) $5 \leqq f < 9$ Hz   : Half amplitude 3.1 mm
  $9 \leqq f < 150$ Hz : Constant acceleration 9.8m/s^2
  ($10 \leqq f < 57$ Hz : Half amplitude 0.075 mm)
  ($57 \leqq f < 150$ Hz : Constant acceleration 9.8 m/s^2)
(Note 5)   Grounding other than D-class grounding (e.g., mesh ground) may apply to the system, provided that the same effect as for D-class grounding can be obtained.   For grounding other than D-class grounding, the client verifies the effect of grounding.

●**Function specifications**

Table 2   Controller module PU811 function specifications

Item			Specification
Control method			Stored program/cyclic scan
Processor	Control processor		General-purpose processor
	Language processor (LP)		Dedicated LSI
	I/O processor		Dedicated LSI
Execution method	Scan method — SS task	Fixed time scan	0.5 to 500 ms (by 0.1 ms unit)
	HS task		0.5 to 500 ms (by 0.1 ms unit)
	RIO task		0.5 to 500 ms (by 0.1 ms unit)
	MS scan		0.5 to 1000 ms (by 0.1 ms unit)
Task switching time			60 μs
Input/output	Batch I/O		Equipped
	Direct I/O		Equipped
Interruption	IP task		16 lines
	Interruption detection performance		20 μs × n interruption + 100 μs or less n: Detected number of status change
Program size (Note 1)			256 k step
User data size	Local variables/User global variables		256 k word
	IQ register		16 k word
	Special register (S register)		1 k word
	Data register (D register)		8 k word
I/O	Built-in I/O	Number of nodes	32
		Max. No. of units	32 (32 nodes × 1 unit)
		Max. No. of slots	512 (32 units × 16 I/O modules)
	G3 I/O (Note 1)	Number of nodes	4
		Max. No. of units	28 (4 nodes × 7 units)
		Max. No. of slots	308 (28 units × 11 I/O modules)
	Batch I/O performance	I/O updating time	1 μs/word or less
		Station bus updating time	3 μs/word or less
	Direct I/O performance	I/O updating time	1 μs/word or less
		Station bus updating time	3 μs/word or less
	RIO I/O performance		5 μs/word or less

Item			Specification
Programming language			LD, FBD, SFC, ST
Duplex function	Tracking time		2 ms/K word
	Duplex switching time		50 ms or less
Execution time	Bit	Contact	0.02 μs
		Coil	0.06 μs
	Integer	Transfer	0.02μs
		Addition/ Subtraction	0.02μs
		Multiplication	0.06μs
		Division	0.48μs
	Floating point	Addition	0.12μs
		Subtraction	0.06μs
		Multiplication	0.12μs
		Division	0.54μs
Transmission port	nV-Tool connection		Directly connected to the controller
	nV-Tool connection (network)		Via Ethernet module of station bus
	Socket communication (instruction word)		Via Ethernet module of station bus
	Computer link		
	Synchronous trend		
Supported network	Station bus module		Ethernet (EN811, EN821), TC-net100 (TN821, TN822)
	TC-net I/O bus module		MODBUS (Note 2), FL-net (FL911), Ethernet (Note 2), Profibus-DP (Note 2)
	G3 I/O bus module (Note 2) (Note 3)		DeviceNet, FL-net, Profibus-DP
RAS function	Diagnosis		Power fail check, parity check, LP function check, I/O processor function check, illegal instruction detection, WDT, system ROM BCC check, peripheral LSI check, ECC check of all memories, station bus access parity check and time out, I/O status check.
	Monitoring		System status display (incl. I/O status display), trace (error, event, transmission), program run time measurement, program execution congestion detection
	Debug/maintenance		Online status display, backup/restore function, defrag, online maintenance function, simulation function

(Note 1)   This means the capacity of program saving memory, but not the allowable maximum steps of the user program. The user program and the control information for its operation are included in this program saving memory.
(Note 2)   Under development
(Note 3)   Only scan transmission is supported. Also some modules are not available.

●Power module specifications

Table 3   Power module specification

Item	Specification		Remarks
Model	PS891	PS835	
Rated voltage	100/110/120/200/220/240 VAC	24VDC	
Voltage tolerance range	85 to 132 / 170 to 264 VAC	20.4 to 28.8 VDC	
Rated frequency	50/60 Hz	DC	
Frequency tolerance	47 to 53 / 57 to 63 Hz	—	
Permitted duration of instantaneous power failure	0.5 cycle (10ms) or less	10ms or less	
Permitted percentage of waveform distortion	10% or less	—	For rated input voltage
Ripple percentage tolerance	—	5% or less	For rated input voltage
Maximum power consumption	220 VA (200W) or less With power factor improved	200 W or less	
Rated current	2.5 A	10 A	
Leakage current	1.5 mA or less	—	
Rush current	25 A max 10 ms	10 A or less 10 ms	For rated input voltage After 5 sec. or longer halt
Dielectric strength	500 VDC Megger 10 MΩ or more		Between Power and GND terminals

Item	Specification	Remarks
Withstand voltage	2,000 VAC 1 min	Between Power and GND terminals
Ground	D-class grounding with ground resistance of 100Ω or less (prescribed by the Japanese Ministerial Ordinance)	
Output rating	5 V, 25 A (for internal logic) 12 V, 1 A (for fan)	
Protection circuits	Overvoltage, overcurrent, and overheat protection	
Duplexing of power output	Supported.	When BU816 is used
Ancillary functions		
Status display LED	POWER (green) ALARM (red)	
RUN contact	Dry A contact	
Switch	Switch with a lock	
Slot width	3 slots occupied (approx 60 mm)	
Weight	2,000 g	
Outside dimensions	Approx. 262 x 165 x 60.6 mm (excluding protrusions)	
External wire terminal block	10 terminals - M3.5 machine screw (fixed)	
Overhaul	Recommended replacement cycle of aluminum electrolytic capacitor: 8 years Requirements: Average ambient temperature 40 °C, forced air cooling	Desired value

●**Controller module specifications**

Table 4   Controller module specification (hardware)

Item		Specification	Remarks
Model		PU811	
Substrates		2 sheets	
MPU		SH7751R(SH4)	
	Bus width	32bits	
	Operating frequency	66MHz	
	Throughput	360MIPS/1.4GFLOPS (for an operating frequency of 200 MHz/hr)	From MPU data book ADJ-602-215 A(H)
Arithmetic processor		LP	
	Bus width	32bits	
	Operating frequency	50MHz	
	Throughput	20 ns /contact	
Current consumption		6A(typical)	
Slot width		2 slots occupied	8HP
Weight		800g	
Outside dimensions		Approx. 262 x 237 x 40.30 mm (excluding protrusions) Substrate size: 233.35 x 160.00 mm	
Status display LED		RUN、ONL、STBY、 HALT、ERR、BATT	
Bus I/F			
	Station bus	C-PCI-compatible	
	Tracking bus	LVDS (electrical level)	
	TC-net I/O loop	TC-net 100 loop	
Switch			
	Operation mode switch	HALT/RUN/P-RUN	
	Setting switch	Dip switches 8 poles (front panel) 8 poles (on substrate)	
Connector		2 rotary switches, hex	Address setting of IP address
	nV-Tool	RJ45 1 piece	Ethernet 10BASE-T
	TC-net I/O loop	RJ45 4 pieces (dual loop)	
	Maintenance	Dedicated	Not disclosed to users
Data backup		Shutdown sequence plus battery	
Shutdown sequence		Secure the time of execution with the capacitor	PT8C1 Recommended replacement cycle: 8 years
Battery		Equivalent to ER3 3.6 V, 1,000 mAh	
	Backup time	Total period of power outage 90 days	
	Maximum replacement cycle	5 years (availability factor 95%)	

●**TC-net I/O supporting specifications**

Table 5   TC-net I/O supporting specification

	Single system configuration	Duplex system configuration
Loop configuration	1 loop	2 loops
Nodes	max. 32 nodes	
Node no.	3 to 34	
Units per one node	1 unit	
Number of installable I/O modules per unit	max. 16 modules	
Number of installable special I/O modules (Note 1)	max. 16 modules/controller	

(Note 1)   Special I/O module means the module for FL-net, MODBUS (Note 2) and Ethernet (Note 2). Refer to High-speed Serial I/O System TC-net I/O Instruction Manual (6F8C1240) for the details.

(Note 2)   under development

* Refer to "High-speed Serial I/O System TC-net I/O (EJV-220)" General specifications, for detailed specifications of TC-net I/O module.

●**Special Register (S register)**

Table 6   List of special registers (S registers)

Address	Name	Function
SW[0 to 10]	Station configuration	—
SW[11 to 13]	Switch setting status	—
SW[14 to 15]	Operation mode	—
SW[16 to 22]	Date and time	—
SW[23]	Timing relay	—
SW[24 to 33]	Instruction word execution status	—
SW[64 to 95]	nV-Tool setting information	—
SW[96]	Communication flag	—
SW[230 to 231]	Interlock group status	—
SW[240 to 255]	Computer linkage status	—
SW[256 to 265]	Representative alarm information	—
SW[266 to 299]	Duplex information	—
SW[300 to 332]	Program degeneracy-related information	—
SW[340 to 356]	I/O degeneracy-related information	—
SW[360 to 671]	I/O degeneracy-related detailed information	—

nv series type1
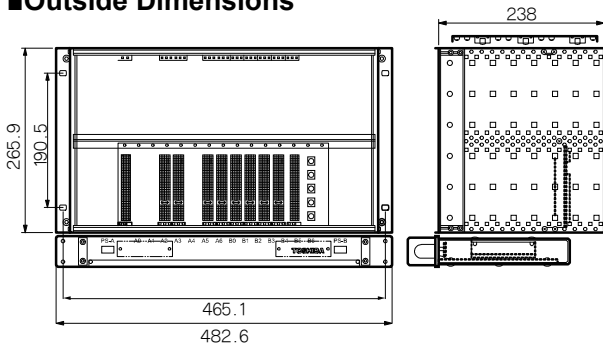
■Outside Dimensions

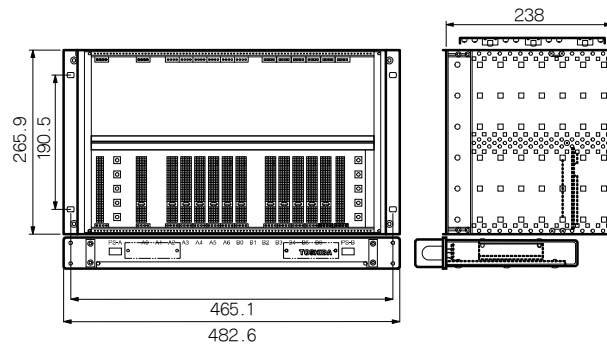**Fig. 9   Outside dimensions of base unit BU816 and fan unit FA813**

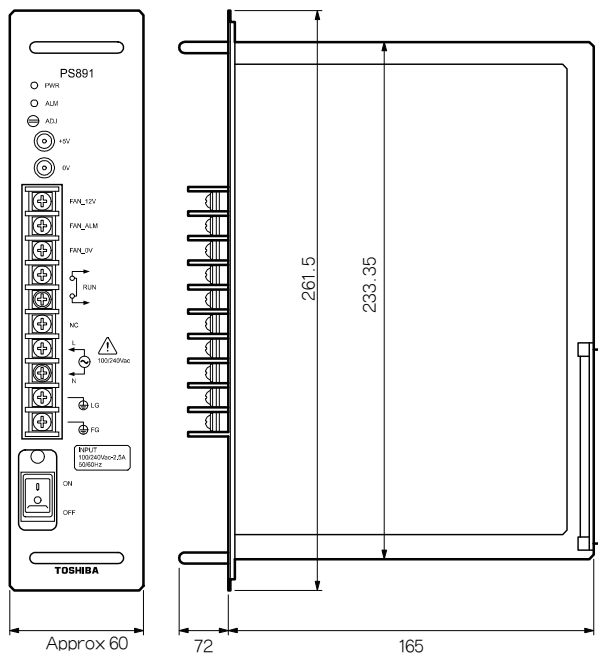**Fig.10   Outside dimensions of base unit BU825 and fan unit FA824**

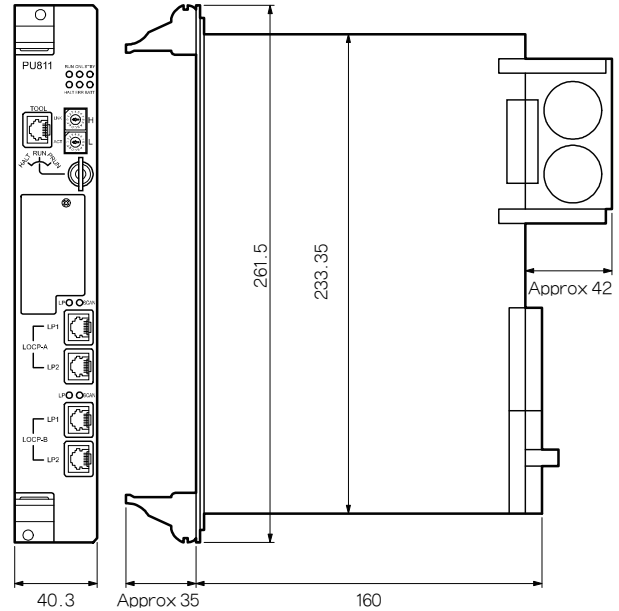**Fig. 11   Outside dimensions of power module PS891**

Fig. 12   Outside dimensions of controller modules PU811

■Cautions for Installation

1. Installation
   When installing the units, please pay due consideration to the operation, maintenance and ambient conditions.
   (1) Install the units in locations where the installation requirements in the specifications are met.
   (2) Do not install the units directly on devices that generate a large amount of heat (heaters, transformers, high capacity resistors, etc).
   (3) Use the units at temperatures from 0-55 °C.
   (4) In dusty places, keep the units in a dust-proof cubicle.
   (5) To ensure the safety upon maintenance and operation, keep the units as far as possible from high-voltage devices or power equipment. Alternatively, shield the units from such devices by using an iron plate or the like.
   (6) To ensure proper ventilation, the distance between the base and expansion units should be at least 100 mm.
2. Wiring
   (1) The extension I/O cable and the I/O line should be placed at least 200 mm away from the power line or power equipment.
   (2) The I/O lines of the heavy current system (AC I/O line) and the weak current system (DC and pulse I/O lines) should be separated from each other. Also, wiring ducts should be separately provided for the both systems.

■Information required upon your order

1. Model numbers and the quantities of the units, modules and peripherals.
2. Input/output list
3. Network configuration if data transmission is performed.

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No. EJV-218