■Summary

The single-loop controller LC531 is a panel instrumentation controller capable of supporting different applications through the use of the user program. The controller offers Toshiba's highly-reliable single-loop controller technology, usability and improved features. Just like the preceding models, the controller can be installed in a small space and is also width and panel cut-out compatible with other devices.

■Features

● **High-speed processing**

The controller processes data about twice as fast as the preceding models. The processing cycle can be set from 50ms.

● **Energy-saving**

The controller achieved approximately 40% reduction in electric power compared with the preceding models, resulting in 50% reduction of the 24V power supply capacity.

● **Network**

The controller supports Ethernet communication and RS485 communication. In Ethernet communication, the controller establishes inter-controller communication among single-loop controllers, monitoring and control system by OIS-DS/smart and OIS-DS monitoring and control system via the PLC server. RS485 communication supports EC bus transmission and can be connected to the EC300 series.

● **Color liquid crystal display**

The panel is provided with color liquid crystal display for enhanced visibility. You may display and control up to 8 loops through front panel operation.

● **PID control**

For PID control, our proprietary hyper PID control, an enhanced type of 2 degrees of freedom PID, is adopted to control up to 8 loops.
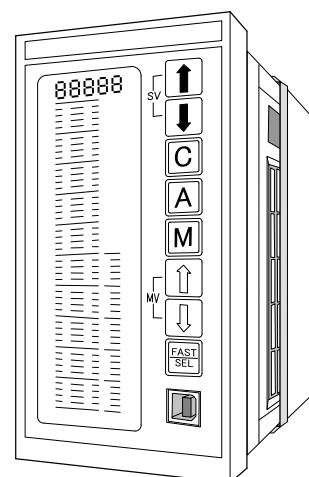

Figure 1   Outer view of LC531

● **Programming**

The controller supports IEC 61131-3-compliant program and allows general programming using LD (ladder diagram) and FBD (function block diagram) as well as full graphic programming. The controller provides highly effective development of application programs.

● **Compatibility for operation**

The controller is compatible with the single-loop controller LC510 series/LC520 series, and TOSDIC series in operation and setting.

■Product lineup

Table 1   LC531 models

Model	Specifications
LC531S*S	Current output depth 450mm type
LC531E*S	Current output depth 250mm type

⚠ Safety Precautions

· This product is designed/manufactured for use in systems with general industrial equipment (process control, manufacturing line control and others). This product is not designed/manufactured for use with devices utilized under circumstances which would directly affect human life or in systems containing such devices.
· Consult our representative before using this product for such purposes.
  This product is manufactured under strict quality control procedures. However, special consideration must be taken to establish a safety system for operation, maintenance and management of the system if your are utilizing this product in facilities in which failure of electronic devices would affect human life or cause grave influence over other systems.
· This product requires electrical and installation works. Please consult our agent, expert or sales representative. Inappropriate work may result in electric shock and fire.
· Please read the related instruction manuals thoroughly before using the product and use the product correctly.

■Configuration

The LC531 has built-in RS485 communication port and Ethernet communication port which allow flexible system configuration in accordance with the scale and purpose of the plant. LC531 has I/Os and requires no additional I/O modules.

● **Ethernet transmission system**

Up to 32 LC531s can be connected to the OIS-DS/SMART, monitoring system for small scale systems via Ethernet transmission.
1) OIS-DS/SMART can operate, display and monitor LC531.
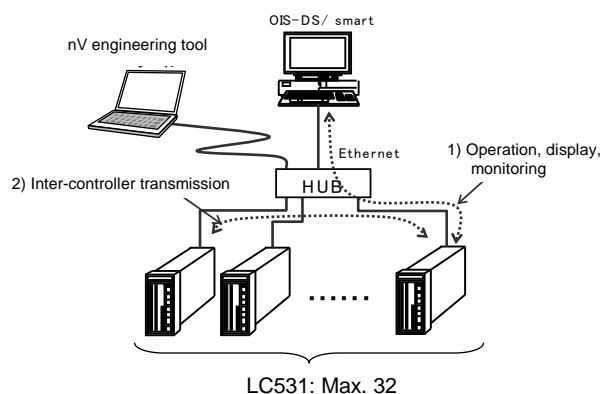2) Inter-controller transmission is enabled among LC531s via Ethernet transmission.

*Figure 2   Example of configuration
for OIS-DS / SMART and LC531*

● **EC bus transmission system**

The LC531 allows EC bus transmission using the RS485 communication port. LC531s can be connected to a system with the EC300 series controller via EC bus transmission. Up to 31 LC531s and EC300 series controllers can be connected in combination. LC531 supports migration of the existing system with the EC 300 series controller through EC bus transmission.
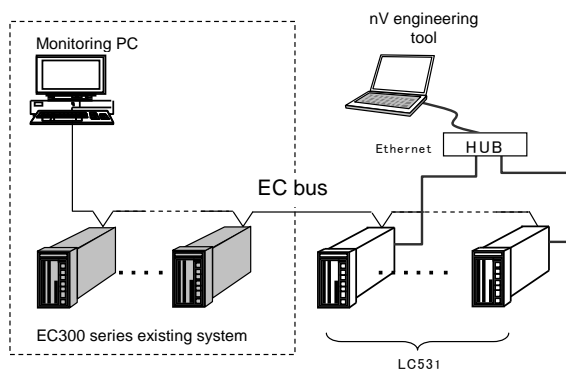

*Figure 3   Example of configuration
for EC300 series and LC531*

● **PLC server system**

The LC531 can be connected to the CIEMAC-DS control LAN (Ethernet) via the PLC server. The PLC server can monitor (connect to) up to 64 LC531s. This configuration allows transmission shown as below.
1) The OIS-DS, monitoring system of CIEMAC-DS, operates, displays and monitors LC531 via the PLC server.
2) Inter-controller transmission is possible among the unified controller connected to the control LAN and LC531s via the PLC server.
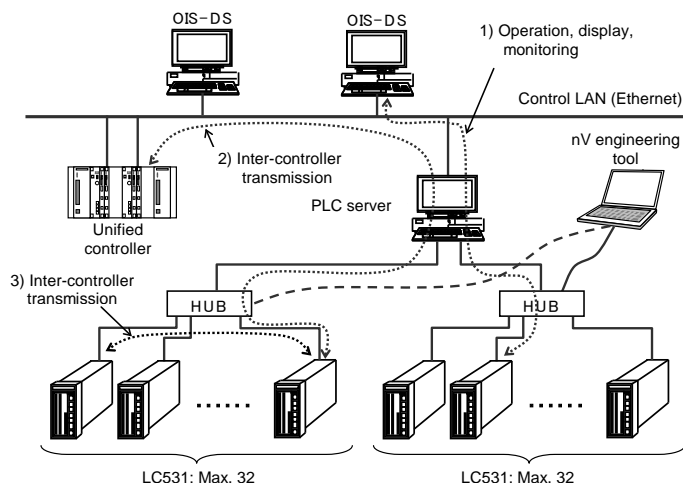3) Inter-controller transmission is possible among LC531s via Ethernet transmission.

*Figure 4   Example of configuration
for CIEMAC-DS and LC531*

■Software specifications

● Functional specifications

Table 2   Functional specifications

Item		Specifications
Operation mode		RUN/HALT
Programming language		Compliant with international standard IEC 61131-3
Program capacity		64POU
Program type		1 task (main scan only)
Program processing	Control loop	8 loops
	Program capacity	6k step
	Performance (*1)	1 loop /100ms, 8 loops /500ms
Main scan cycle		50 to 5000ms (by 50ms)
Engineering tool		Ethernet/USB connection
Power failure judgment		None (long power outage only)
Network service		Ethernet, EC bus
Inter-controller transmission		Ethernet : 64W×32 stations/ 1 sec. cycle
		EC bus: V parameter 32 points (16 stations or less/within 4 sec.) (31 stations or less/within 8 sec.)
Self diagnosis function		Watch dog timer monitoring (WDT), memory diagnosis (RAM/ROM), peripheral LSI diagnosis, analog input diagnosis, MV read back diagnosis
Monitoring function		Program congestion monitoring, battery monitoring
Alarm function		System alarm, process alarm
Maintenance function		Online monitor, system log (error log, event log, intervention event log, transmission event log)

*1: Differ according to applications.

● Basic performance

Table 3   Execution time of instruction (TYP)

Instruction	Execution time(μs)	Remarks
LD	26	
ST	163	
Normally open contact input	53	
Coil output	61	
Add	131	Real number
Subtract	123	Real number
Multiply	131	Real number
Divide	125	Real number
PID	786	

● Tag processing time

Table 4   Tag processing time (TYP)

Tag	Points	Processing time (ms)
Indicator tag (PV)	1	0.35
Controller tag (LP)	1	1.50
Push button tag (PB)	1	0.47

● Standard input/output

The standard input/output processing provides correction calculation, conversion processing and alarm processing for input/output data of the I/O module in accordance with the tag (instrument variable) parameter.
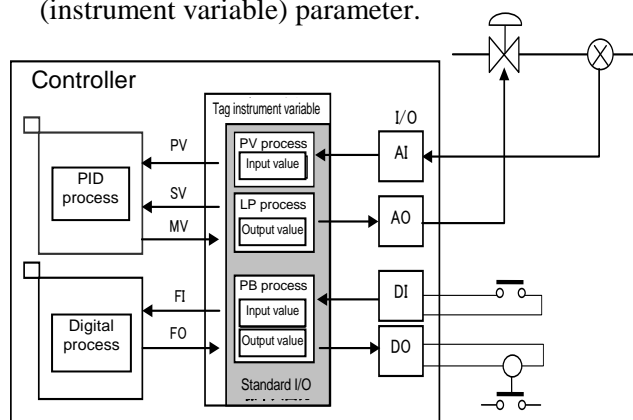

Figure 5   Standard I/O processing and tag

● Tag types

Table 5   Tag types and points

Tag instrumental variable	Points	Description
Indicator variable (PV)	48	Variable for analog input (instantaneous value and integrated value).
Controller variable (LP)	8	Variable for analog output. Controller variable is used with indicator variable.

● Process alarm

Table 6   Process alarm

Tag instrument variable	Process alarm	
Indicator variable (PV)	DPL	(PV change rate) alarm
	PL	(PV lower limit) alarm
	PH	(PV upper limit) alarm
	PRE	(PV process error) alarm
	PVI	(Sensor error) alarm
	PDE	(Device error) alarm
Controller variable (LP)	VPI	(Value position error) alarm
	DVE	(Deviation) alarm
	MVL	(MV lower limit) alarm
	MVH	(MV upper limit) alarm
	MVE	(MV error) alarm
Push button (PB)	IOE（DI/DO module error）alarm	

■Display, operation

The LC531 has a loop display, side display/side keyboard, and switch setting/battery area.
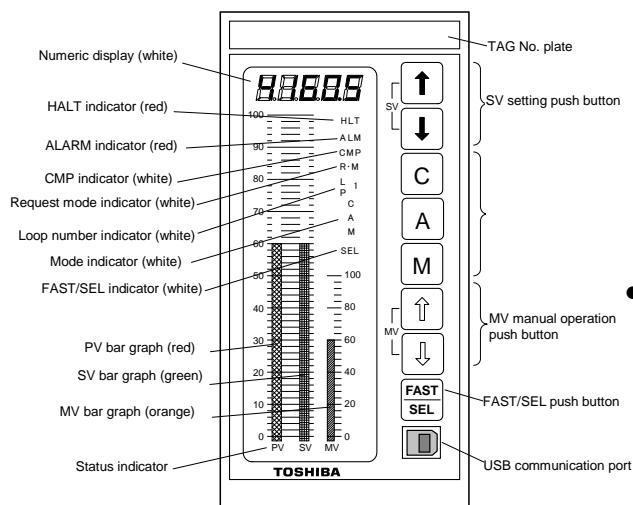
● **Loop display**

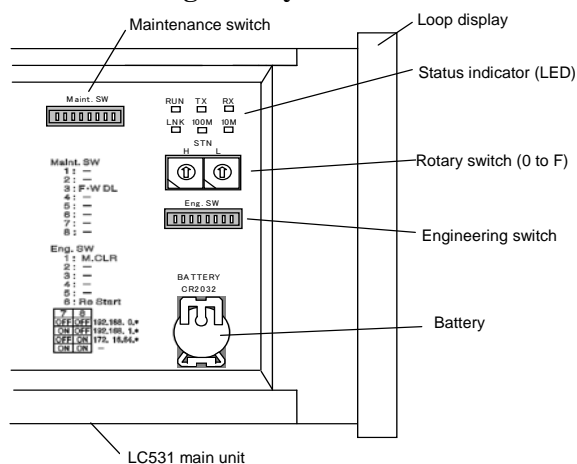Figure 6 Loop display (front)

● **Switch setting/battery area**

Figure 7 Switch setting/battery area (left side)

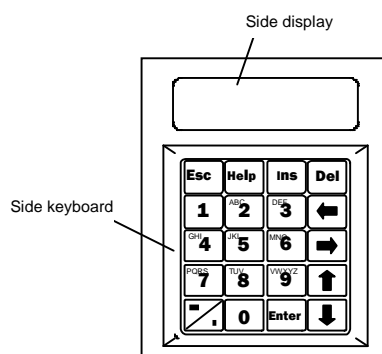● **Side display/keyboard**

Figure 8 Side display/key board (right side)

● **Maintenance switch**

The switch is utilized for updating the firmware version.

Table 7 Maintenance switch signal table

SW No.	Content
1	Reserved
2	Reserved
3	Firmware DL (ON)
4	Reserved
5	Reserved
6	Reserved
7	Reserved
8	Reserved

● **Engineering switch**

The switch is selected to configure the Ethernet class, clear memories and configure the start mode in case of error down.

Table 8 Engineering switch signal table

SW No	Content		
1	Clear memory (ON)		
2	Reserved		
3	Reserved		
4	Reserved		
5	Reserved		
6	Specify operation after error down. ON: Restart　OFF: Error stop		
7	Setting Ethernet Class		
8	7	8	Class
	OFF	OFF	ClassC(192.168.0.*)
	ON	OFF	ClassC(192.168.1.*)
	OFF	ON	ClassB(172.16.64.*)
	ON	ON	-

● **Rotary switch**

The switch to set an Ethernet IP address. The lowest address of the IP address is set in hexadecimal (2 digits) numbers.

Table 9 Rotary switch

STN	Content
H	Set upper digit (0 to F)
L	Set lower digit (0 to F)

$$\text{Address} = H \times 2^4 + L$$

"H=1", "L=0" in the class B system, the IP address is as follows:

172.16.64.16

■Hardware specifications

● Environmental specifications

Table 11   Environmental specifications

Item		External specifications
Environment	Ope ambient temp.	0 to 55°C
	Preservation temp.	-40 to 70°C
	Relative humidity	10 to 95% RH (no condensation)
	Dust	0.3 mg / m^3 (no conductive dust)
	Corrosive gas	No corrosive gases
	Vibration resistance	5≤ f<8.4Hz : Half amplitude 3.5mm 9≤ f<150Hz : Constant acceleration 9.8m/sec^2
	Shock resistance	147m/S^2
	Altitude	2000m or less
	Ground	D-class grounding with ground resistance of 100Ω or less
	Installation site	Inside indoor control panel
	Cooling method	Natural cooling

● General specifications

Table 12   General specifications

Item		External specifications
Electrical conditions	Supply power	24Vdc +10%-15% (ripple 1% or less)
	Consumption current	Power for main unit 24VDC-app.0.2A Power for DI/O 24VDC-50mA or less
	Permissible power failure period	Within 1ms
	Memory backup	Data retention: 1 year (lithium battery) temperature 25°C
	Online installation/ removal	Online installation/removal of the LC531 main unit is possible. Installation in/removal from housing.
Exterior	Outer dimension LC531E*S	72W×144H×250D(mm)
	Outer dimension LC531S*S	72W×144H×450D(mm)
	Weight LC531E*S	App. 2 kg
	Weight LC531S*S	App. 3.5kg
	Mounting hole size	68W×138H(mm) square hole, plate thickness 8mm or less
	Panel exterior material	Panel: ABS resin (UL94-V0)- black Case: steel plate, painted in black
	External line connection terminal	Power, input/output signal, RS485 transmission: M3.5 screw terminal
		Ethernet：RJ45 connector
	Fix/removal of LC531 body	Fix/remove is possible with 2-stage stopper mechanism.

● Input-output specifications

Table 13   Input/output specifications

Item	Specifications	External specifications
Analog input (AI)	Input points	6 points
	Input range	1 to 5 Vdc
	Insulation unit	Non insulated among channels
	Input impedance	1MΩor more
	Resolution	16-bit
	Conversion data	12800 to 64000 counts
Operation output (MV)	Output points	2 points
	Output range	4 to 20mA
	Insulation unit	Non insulated among channels
	Resolution	16-bit
	Conversion data	12800 to 64000 counts
	Load resistance range	0 to 600Ω
Analog output (AO)	Output points	2 points
	Output range	1 to 5Vdc
	Insulation unit	Non insulated among channels
	Resolution	16-bit
	Conversion data	12800 to 64000 counts
Digital input (DI)	Input points	3 points
	External signal	Non voltage contact 24V 5mA
Digital output (DO)	Output points	5 points
	Output format	FET open drain output
	Maximum rating	30V - 0.1A
Watchdog timer output (WDT)	Output points	1 point
	Output format	FET open drain output
	Output signal	Normal: ON Error :OFF
	Maximum rating	30V - 0.1A

● Ethernet transmission specifications

Table 14   Ethernet transmission specifications

Item		External specifications
Transmission path specifications	Function	PLC server connection, OIS-DS/smart connection, inter-LC531 connection, nV engineering tool 4 connection
	Standards	10Base-T, 100Base-T
	Topology	Star
	Protocol	PCMP
	Transmission speed	10Mbps/100Mbps
	Transmission path length	10Mbps : max. 100m 100Mbps : max. 40m
	Connector	RJ45 modular connector
	No. of LC531 connected	OIS-DS/smart : 16 PLC server: 64
	Insulation	Insulation between power supply and internal circuit.
Transmission cable		UTP cable (Cat5e or more)

● RS485 transmission specifications

Table 15   RS485 transmission specifications

Item		External specifications
Transmission path specifications	Specifications	ECBUS/H
	Function	EC300 series, connection among LC531s
	Standard	RS485
	Topology	Bus
	Protocol	ECBUS (MODBUS base)
	Transmission speed	300/1200/2400/4800/9600 /19.2K/38.4K/208K (pbs)
	Transmission path length	300 to 19.2K(bps):1Km 208K(bps):200m
	Connection method	M5.3 screw terminal block
	Numbers connected	32
	Insulation	Insulation between power supply and internal circuit.
Communication method		2-wire method
Transmission method		Start stop synchronization
Transmission cable		Shielded twisted pair cable

● USB specifications

Table 16   USB bus specifications

Item		External specifications
Transmission path specifications	Standard	USB2.0
	Function	nV tool connection
	Topology	1:1 (connection with PC)
	Transmission speed	12Mbps
	Transmission path length	2m
	Insulation	Insulation between power supply and internal circuit.

Table 17   USB cable specifications

Item	Specifications
Standard	USB2.0 supported
PC-side connector	USB A terminal (male)
LC531-side connector	USB B terminal (male)
Cable length	Within 2m (use of extension cable not allowed).

■Installation
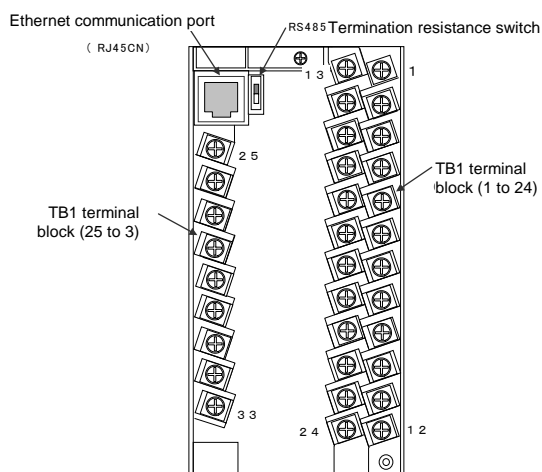
● External connecting terminal

Figure 9   Back of LC 531 and terminal blocks

● TB1 terminal block

The terminal block to supply power to the LC531, and to connect process I/O signals, WDT output signals and RS485 communication signals.

Table 10   TB1 terminal block signal

Terminal No.	External connection	Remarks
1	Ground	
2	+24Vdc power supply	Device power supply input +24Vdc
3	Power supply common (0V)	
4	DIO DC24Vpower supply	DIO power supply input +24Vdc
5	DIO power supply common	
6	Signal common (SC)	Analog signal common
7	Analog input 1(+)	1 to 5V input (between SC)
8	Analog input 2(+)	
9	Analog input 3(+)	
10	Analog input 4(+)	
11	Analog input 5(+)	
12	Analog input 6(+)	
13	Analog output 1(+)	1 to 5V output (between SC)
14	Analog output 2(+)	
15	MV current output 1(+)	4 to 20mA output (between 0V)
16	MV current output 2(+)	
17	Contact input1	Connect one side of the contact (-) to terminal No. 5 or 30.
18	Contact input2	
19	Contact input3	
20	Digital output1	Connect one side of the load (+) to terminal No. 4.
21	Digital output2	
22	Digital output3	
23	Digital output4	
24	Digital output5	
25	WDT output	Connect one side of the load (+) to terminal No. 2.
26	Power supply common (0V)	Connected to terminal 3 inside.
27	-	Do not connect.
28	-	
29	-	
30	DIO power supply common	Connected to terminal 5 inside.
31	RS485(+)	Signal terminal for RS485 communication port.
32	RS485(-)	
33	RS485(FG)	RS485 transmission cable shield connection terminal

● RS485 termination resistance switch

When EC bus transmission is used, the LC531 situated at the terminal sets the RS485 termination resistance switch to ON. The switch is OFF otherwise.
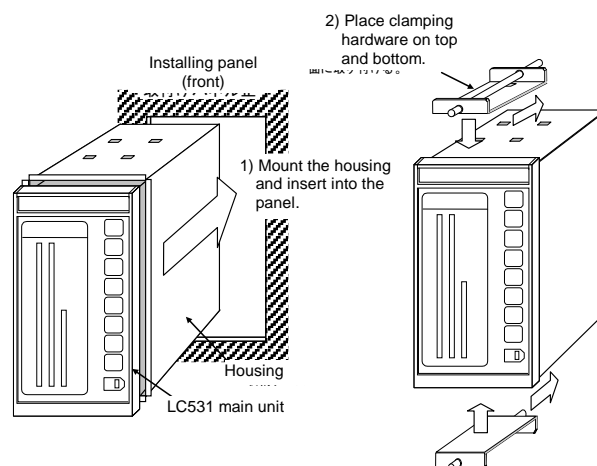
● Installation of LC531E*S

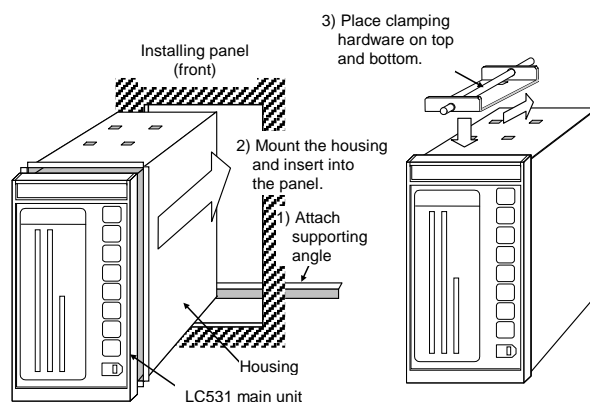*Figure 10   Installation of LC531E*S*

● Installation of LC531S*S

*Figure 11   Installation of LC531S*S*

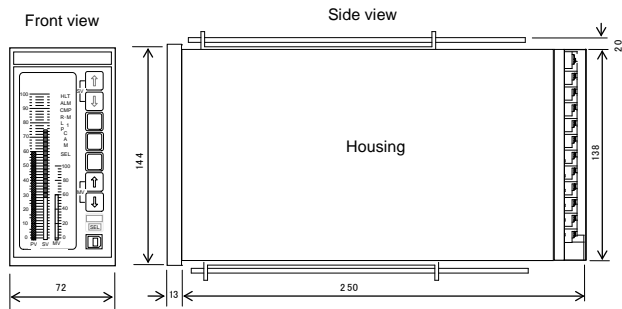## ■Outer view

● LC531E*S type

Front view Side view

Housing

*Figure 12   LC531E*S external dimensions*

● LC531S*S type

Front view Side view

Housing

· Support the bottom with the
supporting angle.

· Dimensions of supporting angle is
shown below (L-shaped)
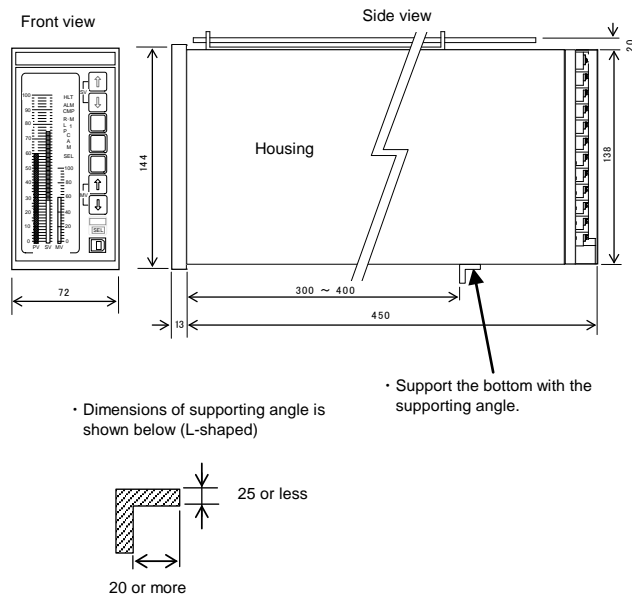
25 or less

20 or more

*Figure 13   LC531S*S external dimensions and
supporting angle dimensions*

● Panel cut dimension

The dimensions of the panel cut opening for installing the LC531 to the panel are shown below.

$68^{+0.7}_{-0}$ $(72.3 \times n-4)^{+1.0}_{-0}$

Stand-alone

Install n units $138^{+1.0}_{-0}$
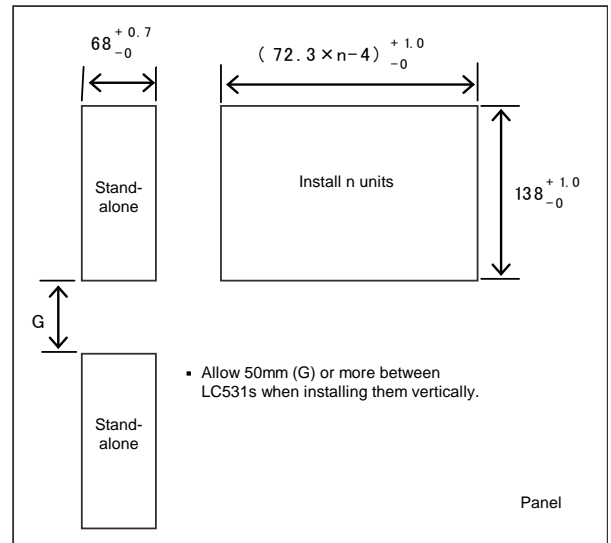
G

Stand-alone

■ Allow 50mm (G) or more between LC531s when installing them vertically.

Panel

Figure 14   Panel cut-out dimensions