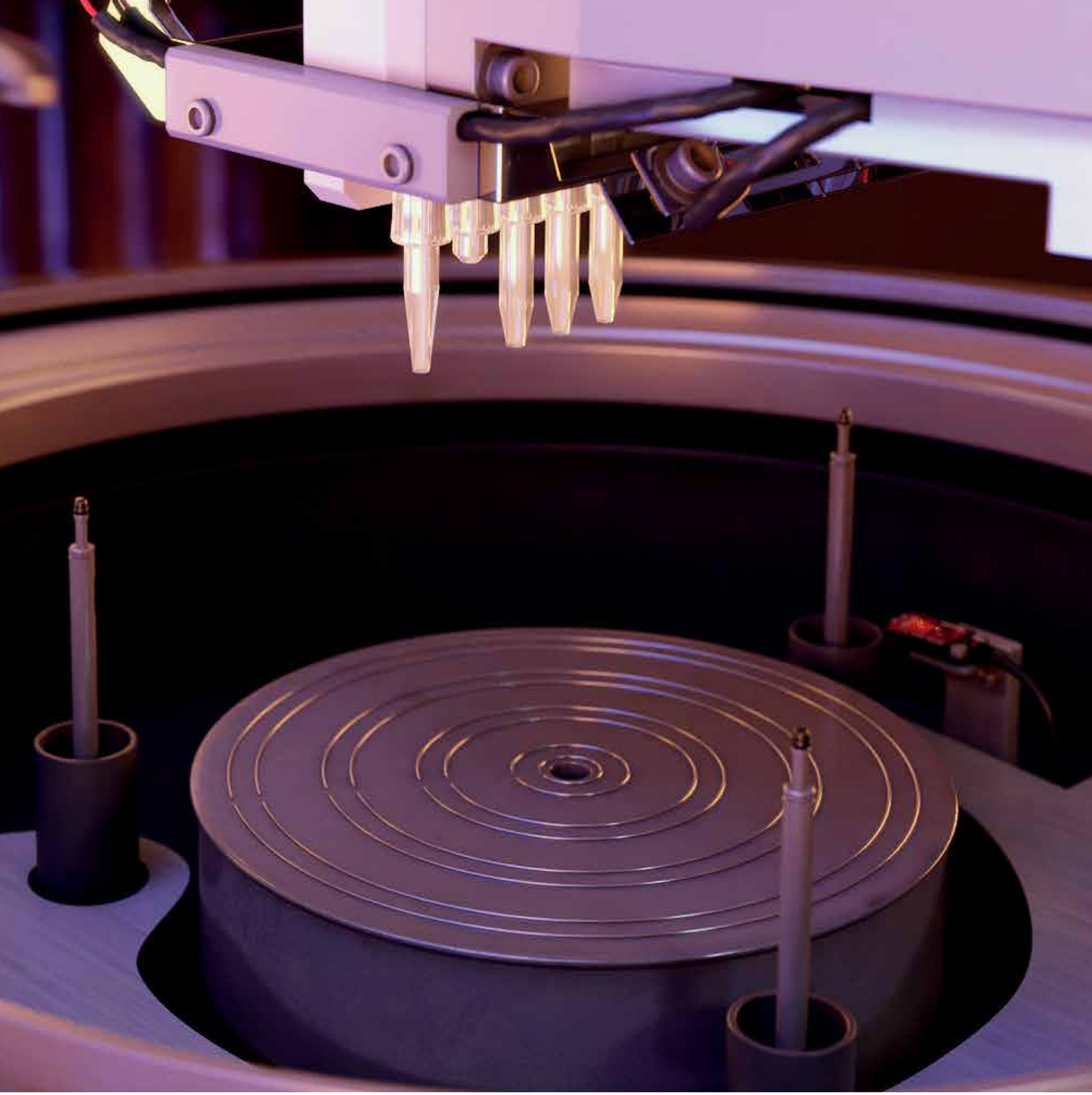


Semiconductor Production Process

Oxidizing / Thin Film | Photo | Etching | Test | Packaging | Assembly Process

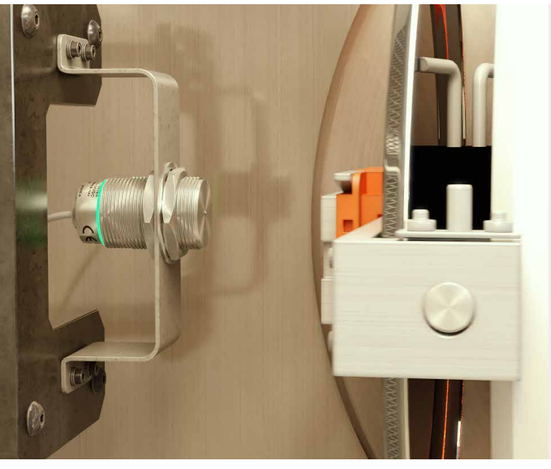
Contents

1. Oxidizing / Thin Film Process

Process for forming an oxide film on the surface of wafers with high heat using horizontal furnace equipment to create semiconductor characteristics.

Proximity sensors are used to control the movement of wafer boat and robot arms by detecting the opening of wafer chamber door on the horizontal furnace equipment.

Graphic panels are used to control settings and monitor status of horizontal furnace equipment.



Full-Metal Cylindrical Inductive Proximity Sensors (Cable Type)

PRF Series

- High resistance to impact and wear caused by contact with workpieces or wire brushes
- Reduced risk of malfunction caused by aluminum chips
- 360° ring type operation indicator (red LED)
- Oil resistant cable
- IP67 protection structure (IEC standard)

10.4-Inch Color LCD Graphic Panels

GP-A104 Series

- Horizontal/vertical installation
- Various communication interface support: RS232C, RS422/485, Ethernet, CAN
- Device monitoring of connected device possible without screen data
- 10.4-inch TFT LCD True Color display capable up to 16,777,216 color variations

1. Oxidizing / Thin Film Process

Process for forming an oxide film on the surface of wafers with high heat using horizontal furnace equipment to create semiconductor characteristics.

Temperature controllers are used to control high temperature heat in the horizontal furnace.

Power controllers can be used to control the current of heaters to maintain stable temperature during heating control.

High Performance PID Temperature Controllers

TK Series

- 50 ms high-speed sampling rate and ±0.3 % display accuracy
- Simultaneous heating/cooling control and automatic/manual control option
- Switch between current output and SSR drive output
- SSR drive output (SSRP function) control options : ON/OFF control, cycle control, phase control

Slim Single-Phase Power Controllers with LED Display

SPR1 Series

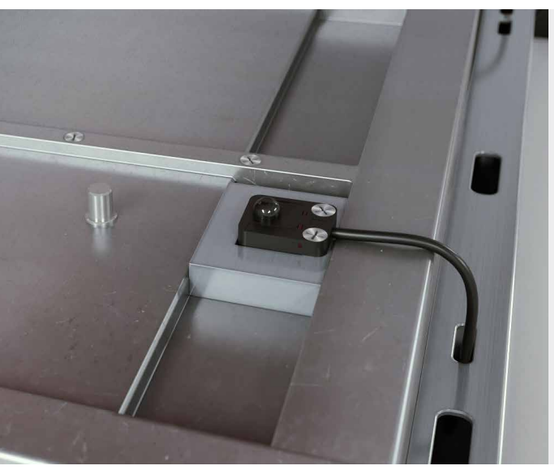
- LED display allows real-time monitoring and parameter configuration
- Stable control with feedback control (constant current, constant voltage, constant power)
- Various alarm functions (alarm output) : overcurrent, overvoltage, heater disconnection, fuse break, heat-sink overheat, diode(SCR) error

2. Photo Process

Process for creating semiconductor circuit patterns by applying a sensitizing solution to the surface of wafers.

Photomicro sensors are used to detect whether wafer carriers are mounted on trays to be moved into the equipment.

Photoelectric sensors located at the bottom of the spin coaster are used to detect whether wafer is mounted before applying the solution.



Push Button Type Photomicro Sensors

BS5-P Series

- Button switch operation ensures accurate detection regardless of material, color, or reflectivity of target object
- Optical detection by button operation guarantees mechanical life cycle of 5 million operations
- 4 red LED operation indicators (side : 2, top : 2) for higher visibility of operation status

Ultra-Compact, Thin Type Photoelectric Sensors

BTF Series

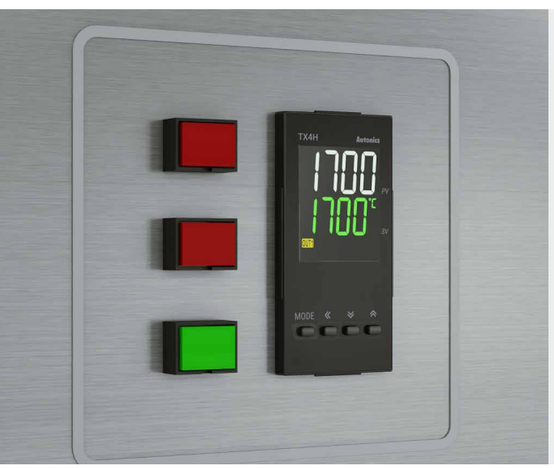
- Ultra-thin size of only 3.7 mm
- Minimum target size Ø2 mm
- BGS reflective type
- Maximum detection distance : 1 m (through-beam type)
- IP67 protection structure (IEC standard)

3. Etching Process

Process for selective removal and cleaning of unnecessary parts using chemical solutions.

Temperature controllers are used to control the temperature of the cleaning solution in the equipment for cleaning foreign substances or oxide film.

Power controllers are used to control power of heating devices to maintain stable temperature of the cleaning solutions.



LCD Display PID Temperature Controllers

TX Series

- 50 ms high-speed sampling rate and ±0.3 % display accuracy
- Large LCD display with easy-to-read white PV characters
- Switch between current output and SSR drive output
- SSR drive output (SSRP function) control options : ON/OFF control, cycle control, phase control

Digital Thyristor Power Controllers

DPU Series

- High speed and high accuracy by digital control using high speed CPU
- Various controls
  : Phase control, feedback control (constant voltage/constant current/ constant power)
  : Zero crossing cycle control (fixed/variable cycles)
  : Zero crossing ON/OFF control
- Various control inputs and DI inputs
- Various alarm output

3. Etching Process

Process for selective removal and cleaning of unnecessary parts using chemical solutions.

Liquid level photoelectric sensors are used to detect the amount of cleaning fluid in the cleaning equipment.

Pressure transmitter are used to check the hydraulic pressure of the solution in the pipe and transmit the current value.

Liquid Level Photoelectric Sensors

BL Series

- Detects presence of liquid in transparent pipes (external diameter Ø6 to 13 mm, < 1 mm think)
- Compact size : W23×H14×L13 mm
- Light ON/Dark ON operation mode switch
- Operation status indicator (red LED)

Display Type Pressure Transmitters

KT-302H Series

- HART protocol
- Display rotation in 330 ° range
- Excellent corrosion resistance with stainless steel housing
- High accuracy ±0.3 % F.S.
- Explosion-proof specification : Ex d IIC T6
- Protection structure : IP67 (IEC standard)

4. Test Process

Process of removing contaminants by applying heat and taping surfaces, then using laser marking to print information on wafers that have finished grinding.

Temperature controllers are used to control the temperature of the heating device used to remove metal contaminants on wafers by applying heat.

Solid state relays are used to achieve accurate temperature control.

Modular Multi-Channel High Performance Temperature Controllers

TMH Series

- Easy maintenance with detachable body and base terminal
- Power supply and communication with expansion connectors (up to 32 units)
- Various module expansion
  : Analog input/output option modules, Digital input/alarm output option modules, CT input option modules, PLC ladder-less communication (RS422/RS485), Ethernet communication

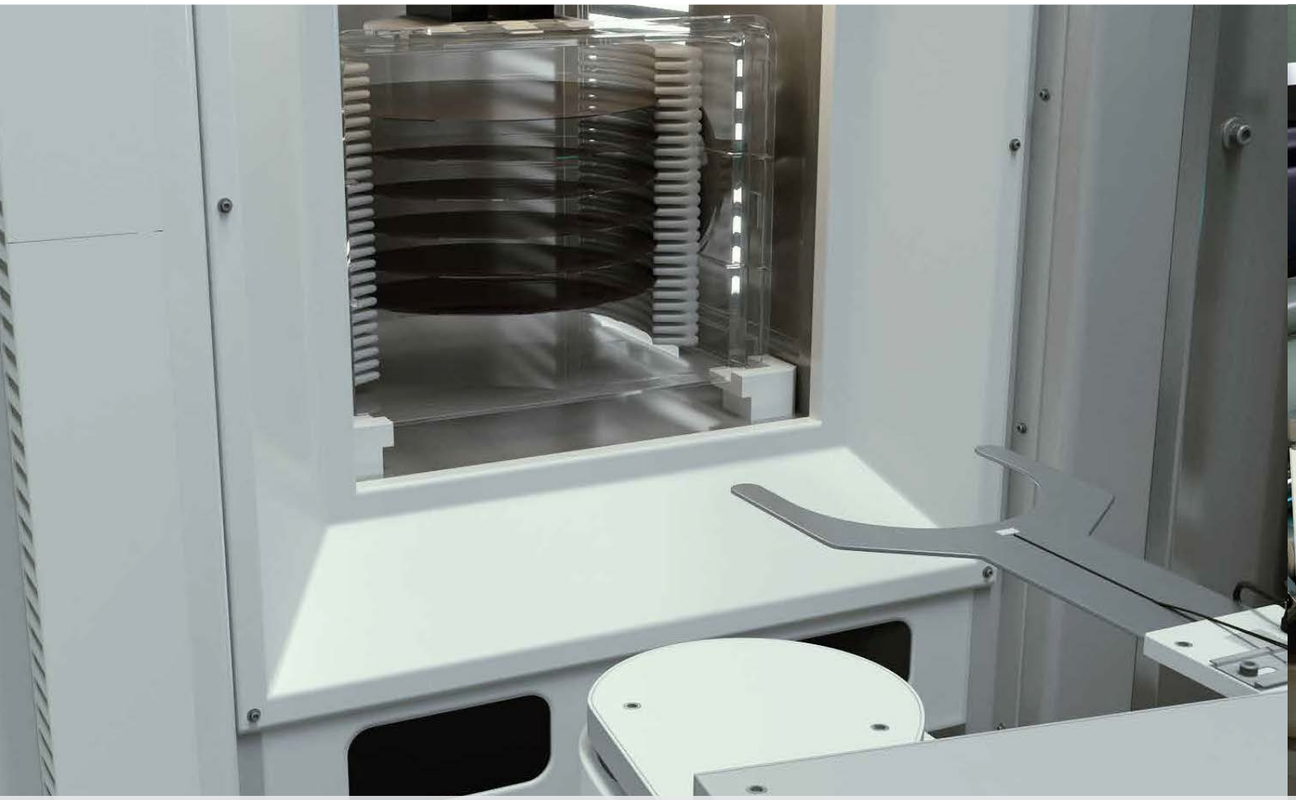
Single-Phase Solid State Relays (Integrated Heat-sink, Left/Right Terminal Type)

SRHL1 Series

- Rated input voltage : 10-30 VDC, 90-240 VAC
- Rated load voltage : 24-240 VAC, 48-480 VAC
- Rated load current : 10 A, 15 A, 20 A, 25A, 40 A
- Zero cross turn-on, random turn-on models available
- Alarm function (overheating)

4. Test Process

Process of removing contaminants by applying heat and taping surfaces, then using laser marking to print information on wafers that have finished grinding.



Fiber optic units are used to detect whether wafer is settled on the handler equipment for wafer taping before grinding.

Fiber optic amplifiers are used to check the received light amount depending on the presence of wafers and transmit control signals.

Fiber Optic Units

FT/GT, FD/GD, FL/GL Series

- 9 Head types for various environments
  : Area detection type, perpendicular type, flat type, cylindrical type, thread type, plastic type, L-shaped type, stainless steel type, U-shaped type
- Various cable types for diverse environments
  : Standard type, break-resistant type, flexible type, vacuum-resistant type, heat-resistant type
- Flexible type (R1), Ideal for installation environments with contours

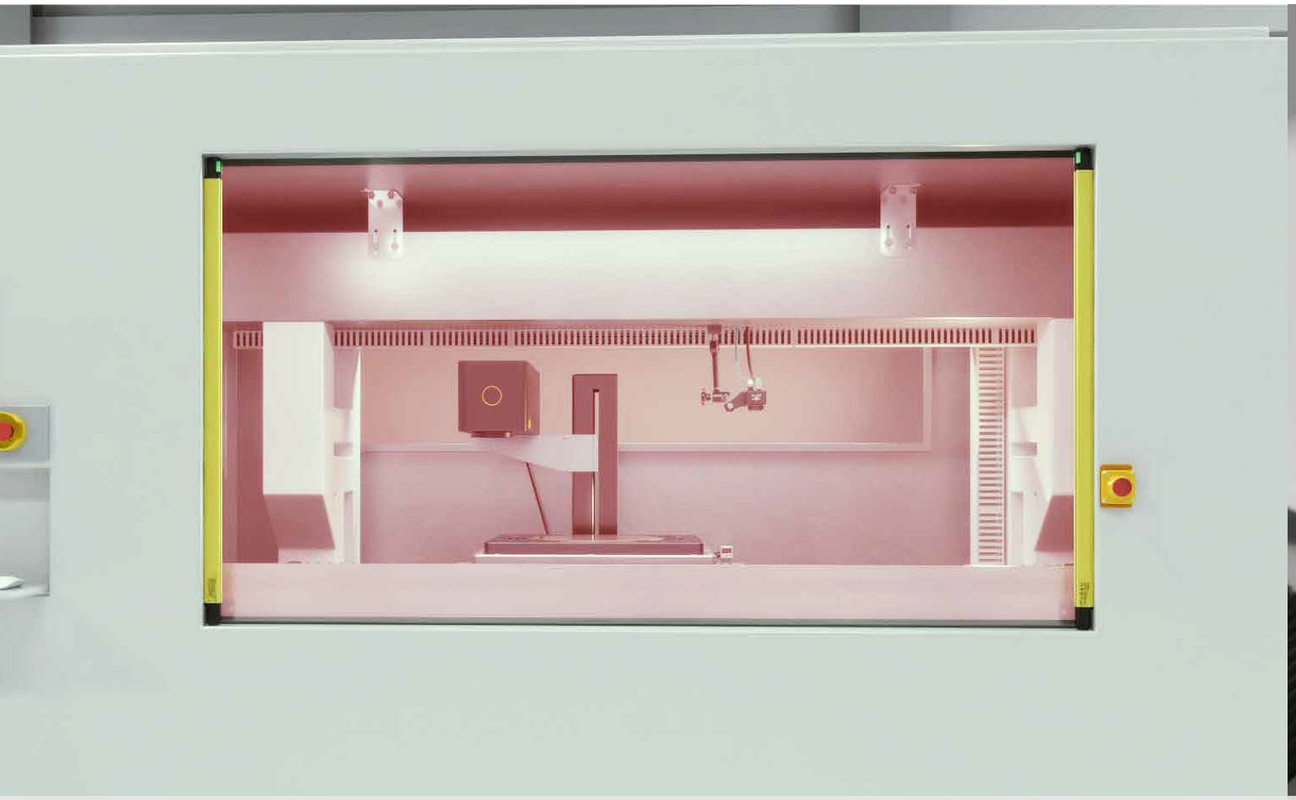
LCD Display Digital Fiber Optic Amplifiers

BFX Series

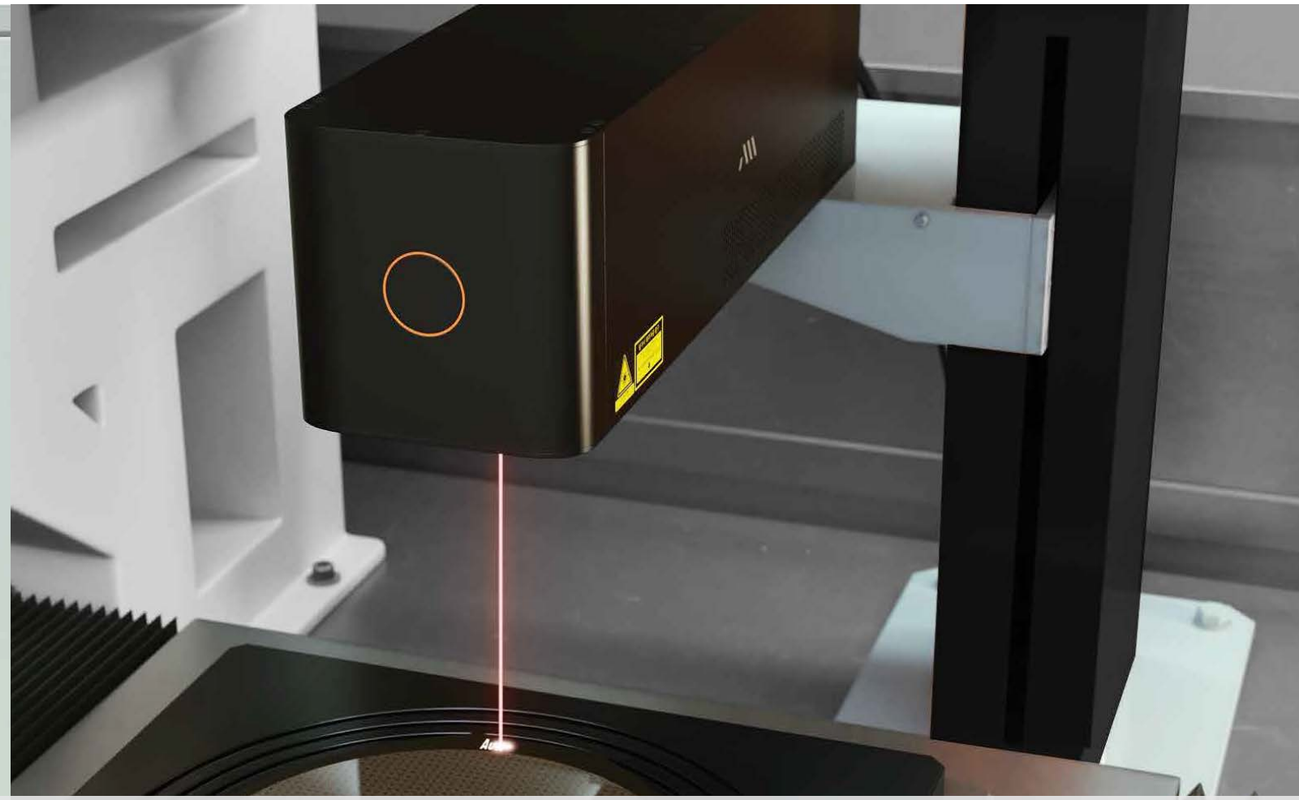
- LCD dual display for displaying present value and set value
- High resolution (1/10,000) for detecting tiny targets
- Ultra-fast response speed for detecting fast moving targets
- 5 response speeds
  : Ultra-fast mode, fast mode, standard mode, long-distance mode, ultra-long-distance mode

5. Packaging Process

Process for packing processed wafers with buffer materials for post-processing.



Safety light curtains can be used to detect human access to hazardous areas while equipment is operating.



Laser marking system can be used to mark product information on wafers.

Safety Light Curtains (Standard Type)

SFL Series

- 3 detection type models available (finger, hand, hand-body detection)
- Various models by protection height (144 to 1,868 mm)
- Expand up to 3 sets and 300 beams with serial connection
- Various safety-related functions
- Easy beam adjustment with top and bottom beam indicators

UV Laser Marking System

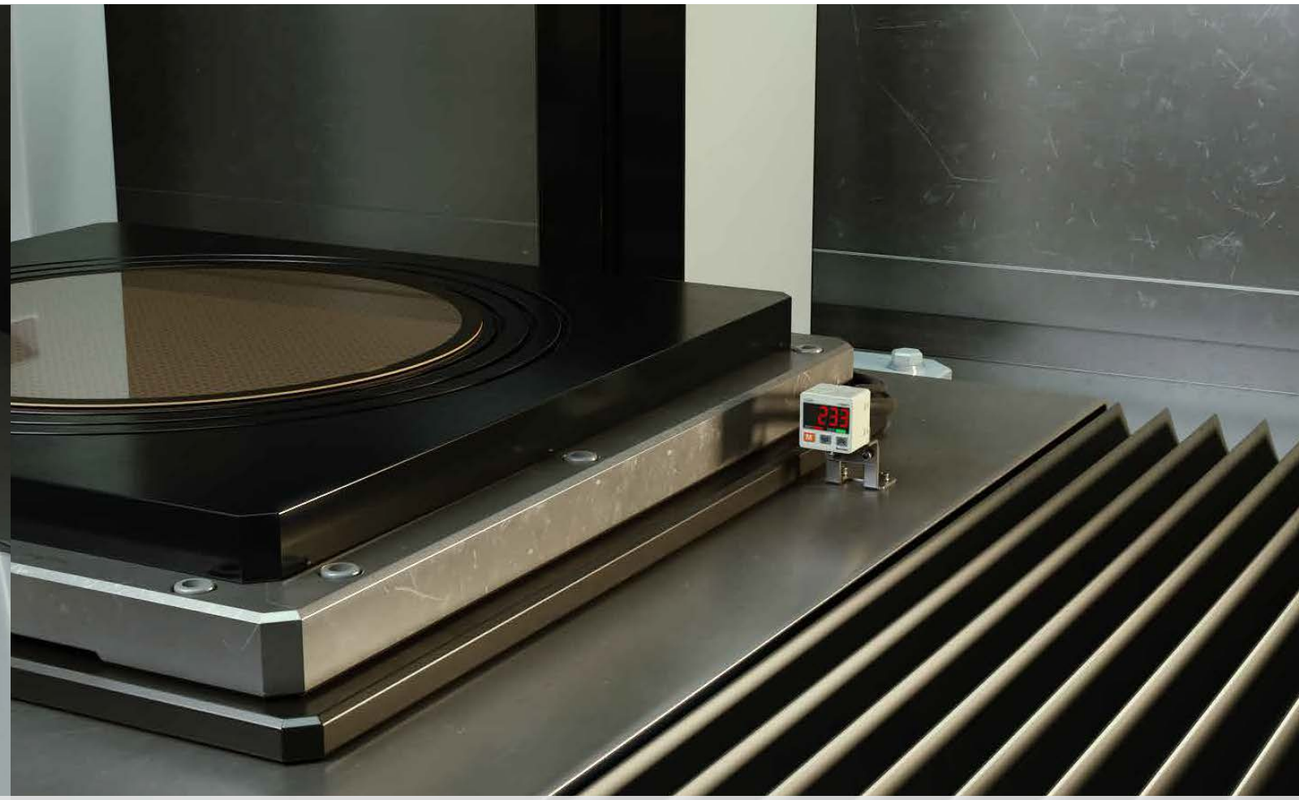
ALU Series

- High performance YVO4 laser marking system
  : Minimal heating damage with high absorption (Cold Marking)
  : High quality small-sized marking with micro beam
  : High legibility with high quality marking
- High powered laser allows various applications including marking, cutting, hole drilling, etc.
- Customized solutions for various requirements

5. Packaging Process

Process for packing processed wafers with buffer materials for post-processing.

Vision sensors are used to check presence and status of laser marking on wafers.



Pressure sensors are used to monitor and control the pressure for mounting and securing the wafer on the plotter.

Vision Sensors

VG Series

- Vision sensors with integrated LED lighting
- Global shutter method for accurate image capturing with minimal motion blur
- Various inspection functions
  : Alignment, brightness, contrast, area, edge, shape, length, angle, diameter, object counting, color identification, color area, color object counting
- Set up to 32 separate work-groups (64 inspection points per work-group)

Digital Display Pressure Sensors

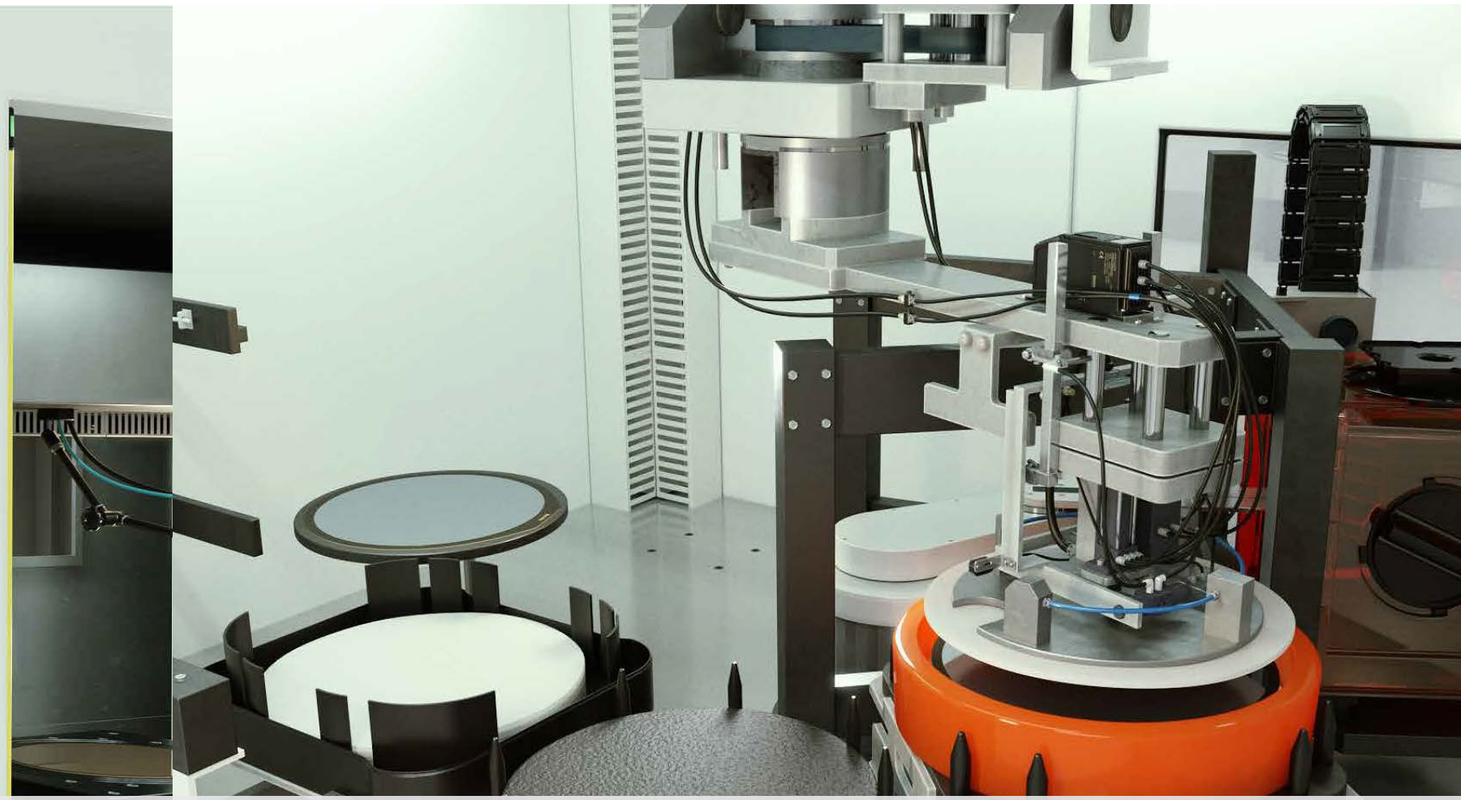
PSAN Series

- Pressure measurement of any gas, liquid or oil
- Auto shift function
- Hold function : hold current display value or control output
- Zero-point adjustment function, peak value monitoring function, chattering prevention function

5. Packaging Process

Process for packing processed wafers with buffer materials for post-processing.

VisionMaster software can be used to monitor and log data of vision sensors.

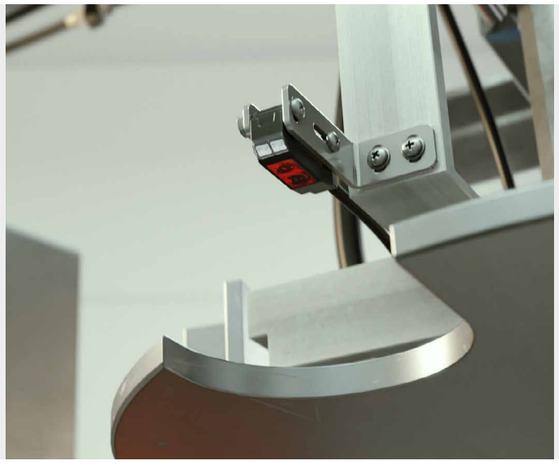


Photoelectric sensors attached to the robot in the packaging equipment are used to identify the presence of wafer buffers.

10.1-Inch Panel PC

APC-1011 Series

- Microsoft Windows 10 included
- Quad-core processor
- 10.1 inch IPS TFT LCD with true color display (16,777,216 colors)
- Supports various connection interfaces
  : Ethernet, Serial (RS232C/RS485/RS422), USB, VGA, HDMI, Audio



Ultra-Compact, Slim Type Photoelectric Sensors

BTS Series

- Ultra-slim width of only 7.2 mm
- Minimum target size : Ø0.15 mm
- Maximum detection distance : 1 m (through-beam type)
- IP67 protection structure (IEC standard)

6. Assembly Process

Process for assembling semiconductor chips to ship them as complete products after attaching the chip cut from the wafer to the PCB and molding.

Emergency stop button switches can be used to manually stop operation of the equipment before opening the door.

Door lock switches can be used to prevent door being opened during equipment operation.

Ø22/25 mm Emergency Stop Button Switches

SF2ER Series

- Install up to 3 contact blocks on a single switch
- Compatible with O type and Y type terminals
- Direct opening mechanism allows interruption of circuit flow to prevent errors such as contact welding

Safety Door Lock Switches

SFDL Series

- Head unit can be rotated to change insert direction of operation key
  : Operation key can be inserted from 5 directions (top/sides)
- Connector type (easy installation) and terminal type (easy maintenance) available
- Various contact types
  : 4-contact (connected), 4-contact (not connected), 5-contact, 6-contact
- Minimized solenoid heat with stable current supply

6. Assembly Process

Process for assembling semiconductor chips to ship them as complete products after attaching the chip cut from the wafer to the PCB and molding.

Non-contact door switches can be used to check open or closed status of doors.

Displacement sensors can be used to detect the height change of attached chips while attaching chip cut from wafer to the PCB.

Safety Non-Contact Door Switches

SFN Series

- Electromagnetic induction method
- Control up to 30 units with a single controller (SFC-N)
- Stable detection of actuators in front/rear, top/bottom, right/left direction doors
- U-shaped design with 2-color operation indicators visible from 3 sides

Laser Displacement Sensors (Sensor Head and Amplifier Unit)

BD Series

- Easy maintenance with detachable sensor head/amplifier unit
- Maximum resolution : 1㎛
- Accurate measurement regardless of target color or material
- Interconnection of up to 8 sensor amplifier units
- Various calculation functions supported (addition, subtraction, average)
- Various filter functions for stable measurement (movement average, differential, median)

Communication Converter for Laser Displacement Sensors

BD-C Series

- Supports both RS232C and RS485 communication in one device : Separate ports for RS232C and RS485
- Connect up to 8 amplifier units
- Can be powered directly by amplifier units without additional wiring
- Support for dedicated device management software (atDisplacement)

Product Overview

Ultra-Compact, Thin Type Photo-electric Sensors

BTF Series

Model							
	NPN open collector output	BTF1M-TDTL	BTF1M-TDTD	BTF30-DDTL	BTF30-DDTD	BTF15-BDTL	BTF15-BDTD
	PNP open collector output	BTF1M-TDTL-P	BTF1M-TDTD-P	BTF30-DDTL-P	BTF30-DDTD-P	BTF15-BDTL-P	BTF15-BDTD-P
Type		Through-beam		Diffuse reflective		BGS reflective	
Sensing distance		1m		5 to 30mm[1]		1 to 15mm[1]	
Sensing target		Opaque material over Ø2mm		Translucent, opaque materials			
Min. sensing target		Opaque material of Ø2mm		Ø0.2mm (sensing distance 10mm)		Ø0.2mm non-illuminated objects (sensing distance 10mm)	
Hysteresis		-		Max. 20% at sensing distance		Max. 5% at sensing distance	
Reflectivity characteristics (black/white error)		-		-		Max. 15% of maximum sensing distance	
Response time		Max. 1ms					
Power supply		12-24VDC⎓ ±10% (ripple P-P: max. 10%)					
Current consumption		Max. 20mA (this is for each emitter and receiver of through-beam type.)					
Light source		Red LED (650nm)					
Operation mode		Light ON	Dark ON	Light ON	Dark ON	Light ON	Dark ON
Control output		NPN or PNP open collector output • Load voltage: max. 26.4VDC⎓ • Load current: max. 50mA • Residual voltage - NPN: max.1VDC⎓, PNP: max.2VDC					
Protection circuit		Power reverse polarity protection circuit, output short over current protection circuit					
Indicator		Operation indicator: red LED, stability indicator: green LED					
Connection		Cable type					
Insulation resistance		Over 20MΩ (at 500VDC megger)					
Noise immunity		±240V the square wave noise (pulse width:1μs) by the noise simulator					
Dielectric strength		1,000VAC 50/60Hz for 1 minute					
Vibration		1.5mm amplitude at frequency of 10 to 55Hz in each X, Y, Z direction for 2 hours					
Shock		500m/s² (approx. 50G) in each X, Y, Z direction for 3 times					
Environment	Ambient illu.	Sunlight: max. 10,000lx, incandescent lamp: max. 3,000lx (receiver illumination)					
	Ambient temp.	-25 to 55°C, storage: -40 to 70°C					
	Ambient humi.	35 to 85%RH, storage: 35 to 85%RH					
Protection		IP67 (IEC standards)					

1) Non-glossy white paper 50×50mm.
※ The temperature or humidity mentioned in Environment indicates a non freezing or condensation.

Ultra-Compact, Slim Type Photo-electric Sensors

BTS Series

Sensing type		Through-beam		Retroreflective type		Convergent reflective type			
Model	NPN open collector output	BTS1M-TDTL	BTS1M-TDTD	BTS200-MDTL	BTS200-MDTD	BTS30-LDTL	BTS30-LDTD	BTS15-LDTL	BTS15-LDTD
	PNP open collector output	BTS1M-TDTL-P	BTS1M-TDTD-P	BTS200-MDTL-P	BTS200-MDTD-P	BTS30-LDTL-P	BTS30-LDTD-P	BTS15-LDTL-P	BTS15-LDTD-P
Sensing distance		1m		10 to 200mm [1]		5 to 30mm [2]		5 to 15mm [2]	
Sensing target		Opaque materials of min. Ø2mm		Opaque materials of min. Ø27mm		Opaque materials, translucent materials			
Min. sensing target		Opaque materials of Ø2mm		Opaque materials of Ø2mm [3] (sensing distance 100mm)		Ø0.15mm (sensing distance 10mm)			
Hysteresis distance		-		-		Max. 15% of maximum sensing distance			
Response time		Max. 1ms							
Power supply		12-24VDC⎓ ±10% (ripple P-P: max. 10%)							
Current consumption		Max. 20mA (in case of through-beam type, this value is for each emitter and receiver.)							
Light source		Red LED (650nm)							
Operation mode		Light ON	Dark ON	Light ON	Dark ON	Light ON	Dark ON	Light ON	Dark ON
Control output		NPN or PNP open collector output • Load voltage: max. 26.4VDC⎓ • Load current: max. 50mA • Residual voltage -NPN: max. 1VDC⎓, PNP: max. 2VDC							
Protection circuit		Power reverse polarity protection circuit, output short over current protection circuit							
Indicator		Operation indicator: red, stability indicator: green							
Connection		Cable type							
Insulation resistance		Over 20MΩ (at 500VDC megger)							
Noise immunity		±240V the square wave noise (pulse width: 1μs) by the noise simulator							
Dielectric strength		1,000VAC 50/60Hz for 1 min.							
Vibration		1.5mm amplitude at frequency of 10 to 55Hz in each X, Y, Z direction for 2 hours							
Shock		500m/s² (approx. 50G) in each X, Y, Z direction for 3 times							
Environment	Ambient illumination	Sunlight: max. 10,000lx, incandescent lamp: max. 3,000lx (receiver illumination)							
	Ambient temp.	-20 to 55°C, storage: -30 to 70°C							
	Ambient humi.	35 to 85%RH, storage: 35 to 85%RH							
Protection structure		IP67 (IEC standard)							

1) The sensing distance is specified with the MS-6 reflector.
When using reflective tapes, the reflection efficiency will vary by the size of the tape. Please refer to the catalog or website.
2) It will vary by the installation environment and sensing conditions. Please refer to the catalog or website.
3) non-glossy white paper 50×50mm

Liquid Level Photoelectric Sensors

BL Series

Model		
	NPN open collector output	BL13-TDT
	PNP open collector output	BL13-TDT-P
Sensing type		Through-beam
Applicable pipe		• Using binding band: Ø6 to 13mm, • Using protection bracket: Ø12.7mm(1/2 inch) transparent pipes in 1mm thickness (FEP (fluoroplastic) or with equivalent transparency)
Standard sensing target		Liquid in a pipe [1]
Response time		Max. 2ms
Power supply		12-24VDC⎓ ±10% (ripple P-P: max. 10%)
Current consumption		Max. 30mA
Light source		Infrared LED (950nm)
Operation mode		Light ON/Dark ON switching by operation mode switching button
Control output		NPN or PNP open collector output • Load voltage: max. 30VDC⎓ • Load current: max. 100mA • Residual voltage: max. 1VDC⎓
Protection circuit		Reverse polarity protection circuit, output short over current protection circuit
Indicator		Operation indicator: red LED, Operation mode indicator: green LED
Insulation resistance		Over 20MΩ (at 500VDC megger)
Noise immunity		±240V the square wave noise (pulse width: 1μs) by the noise simulator
Dielectric strength		1,000VAC 50/60Hz for 1 minute (between all terminals and case)
Vibration		1.5mm amplitude at frequency of 10 to 55Hz in each X, Y, Z direction for 2 hours
Shock		500m/s² (approx. 50G) in each X, Y, Z direction for 3 times
Environment	Ambient illumination	Sunlight/Incandescent lamp: max. 3,000lx for each (receiver illumination)
	Ambient temperature	10 to 55°C, storage: -25 to 65°C
	Ambient humidity	35 to 85%RH, storage: 35 to 85%RH
Protection structure		IP64 (IEC standard)

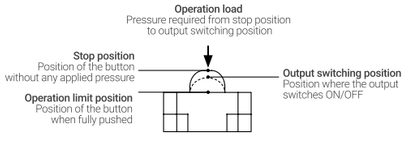
1) This may not detect the liquid with low transparent, with high viscosity, or with floating matters.
2) The temperature or humidity mentioned in Environment indicates a non freezing or condensation environment.

Push Button Type Photomicro Sensors

BS5-P Series

Model	BS5-P1M□-□
Sensing type	Push button type
Button stop position [1]	5.0 ± 0.4 mm
Button output switching position [1]	4.0 ± 0.5 mm
Button operation limit position [1]	≤ 0 mm
Operation load [1]	≤ 3 N
Light source	Infrared LED
Peak emission wavelength	940 nm
Emitter OFF	YES (External input [2])
Check stable operation	YES (External input [2])
Operation mode	Light ON (Unpressed button, indicator + output ON) / Dark ON (Pressed button, indicator + output ON) mode model
Indicator	Operation indicator (red LED)

1)



2)

External input	NPN output	PNP output
Emitter OFF	Short at 0 V or ≤ 0.25 VDC⎓ (outflow current ≤ 30 mA)	Short at +V or +V ≥ -0.25 VDC⎓ (absortion current ≤ 30 mA)
Emitter ON	Open (leakage current ≤ 0.4 mA)	Open (leakage current ≤ 0.4 mA)
Response time	≤ 1 ms	

Power supply	12-24 VDC⎓ ±10 % (ripple P-P: ≤ 10 %)
Current consumption	≤ 35 mA
Control output	NPN open collector output / PNP open collector output model
Load voltage	≤ 26.4 VDC⎓
Load current	≤ 50 mA
Residual voltage	NPN: ≤ 1.5 VDC⎓, PNP: ≤ 1.5 VDC⎓
Protection circuit	Reverse power protection circuit, output short overcurrent protection circuit
Insulation resistance	≥ 20 MΩ (250 VDC⎓ megger)
Noise immunity	±240 VDC⎓ the square wave noise (pulse width: 1 μs) by the noise simulator
Dielectric strength	1,000 VAC∼ at 50/60 Hz for 1 min
Vibration	1.5 mm amplitude at 10 to 55 Hz frequency in each X, Y, Z direction for 2 hours
Shock	500 m/s² (≈ 50 G) in each X, Y, Z direction for 3 times
Mechanical life cycle	≥ 5,000,000 operations (1 operation = stop position - operation limit position - stop position)
Ambient illumination	Fluorescent lamp: ≤ 1,000 lx (receiver illumination)
Ambient temperature	-20 to 55 °C, storage: -25 to 70 °C (a non freezing or condensation environment)
Ambient humidity	35 to 85 %RH, storage: 35 to 85 %RH (a non freezing or condensation environment)
Protection structure	IP40 (IEC standard)
Connection method	Cable type
Cable	Ø 3 mm, 4-wire, 1 m
Core	AWG26 (0.08 mm, 30-core), insulator outside diameter: Ø 0.93 mm
Material	Case: PC + G, button: POM, sleeve: SUS304

Product Overview

LCD Display Digital Fiber Optic Amplifiers

BFX Series

Model		NPN open collector output	PNP open collector output
		BFX-D1-N	BFX-D1-P
Light source		Red LED (660nm, modulated)	
Power supply		12-24VDC⎓ ±10%	
Current consumption		Max. 50mA	
Operation mode		Light ON/Dark ON selectable	
Control output		NPN or PNP open collector output • Load voltage: max. 24VDC⎓ • Load current: max. 100mA • Residual voltage - NPN: max. 1VDC⎓, PNP: max. 3VDC	
Protection circuit		Reverse power polarity protection, output short over current protection circuit, surge protection	
Response time		Ultra Fast: 50μs, fast: 150μs, standard: 500μs, long: 4ms, ultra Long: 10ms	
Display method		7 Segment (PV: red, SV: green) LCD Display, control output indicator (red) LED method	
Display function		Incident light level/SV display [4,000/10,000 resolution], standard / percentage display, high/low peak value display, normal/reversed display	
Sensitivity setting		• Manual sensitivity setting • Teaching sensitivity setting (sensitivity setting by button or external input) : Auto-tuning, 1-point, 2-point, positioning	
Timer function		OFF, OFF Delay, ON Delay, One-shot (time setting: 1 to 5000ms)	
External input function		Remote sensitivity setting, peak value reset, emitter OFF, control output setting (Keep/ON/OFF), energy saving OFF (operates applying over 2ms of external input signal)	
Insulation resistance		Over 20MΩ (at 500VDC megger)	
Dielectric strength		1,000VAC 50/60Hz for 1min	
Vibration		1.5 mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours	
Shock		500m/s² (approx. 50G) in each X, Y, Z direction for 3 times	
Environment	Ambient illumination	Sunlight: max. 11,000lx, incandescent lamp: max. 3,000lx (received illumination)	
	Ambient temp.	-10 to 50°C, storage: -20 to 70°C	
	Ambient humi.	35 to 85%RH, storage: 35 to 85% RH	
Protection		IP40 (IEC standard)	

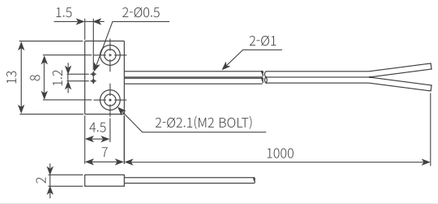
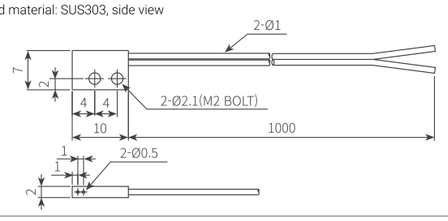
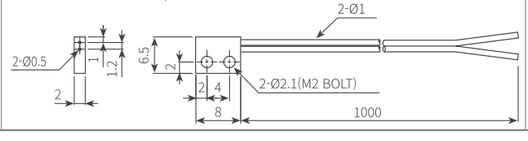
1) The temperature or humidity mentioned in Environment indicates a non freezing or condensation environment.

Fiber Optic Units

FD Series

Retroreflective Type: Flat head

■ **Flexible**

Model	Bend radius	Ambient temperature	Sensing distance (Testing amplifier)	Min. target size	Dimensions (unit: mm)	FREE CUT / Adaptor
FDF-210-05R	R1	-40 ~ 60 °C	30 mm (BF5)	Ø 0.0125 mm	• Hood material: SUS303, flat view 	FREE CUT/ Adaptor
FDFN-210-05R	R1	-40 ~ 60 °C	30 mm (BF5)	Ø 0.0125 mm	• Hood material: SUS303, side view 	FREE CUT/ Adaptor
FDFU-210-05R	R1	-40 ~ 60 °C	35 mm (BF5)	Ø 0.0125 mm	• Hood material: SUS303, top view 	FREE CUT/ Adaptor

Laser Displacement Sensors (Sensor Head and Amplifier Unit)

BD Series

Model	BD-030	BD-065	BD-100
Beam shape	Standard		
Spot diameter (near)	≈ 290×790 ㎛ (25 mm)	≈ 360×1,590 ㎛ (55 mm)	≈ 480×1,870 ㎛ (25 mm)
Spot diameter (reference)	≈ 240×660 ㎛ (30 mm)	≈ 290×1,180 ㎛ (65 mm)	≈ 410×1,330 ㎛ (30 mm)
Spot diameter (far)	≈ 190×450 ㎛ (35 mm)	≈ 210×830 ㎛ (75 mm)	≈ 330×950 ㎛ (35 mm)
Resolution [1]	1 ㎛	2 ㎛	4 ㎛
Reference distance	30 mm	65 mm	100 mm
Maximum measurement range	20 to 40 mm	50 to 80 mm	70 to 130 mm
Rated measurement ranges [2]	25 to 35 mm	55 to 75 mm	80 to 120 mm
Linearity [1] [3]	± 0.1% of F.S.	± 0.1% of F.S.	± 0.15% of F.S.
Temperature characteristic [4]	0.05% F.S./°C	0.06% F.S./°C	
Power supply [5]	-		
Light source	Red semiconductor laser (wavelength: 660 nm, IEC 60825-1:2014)		
Optical method	Diffuse reflection		
Laser class	Class 1 (IEC/EN), Class I (FDA (CDRH) CFR Part 1002)	Class 2 (IEC/EN), Class II (FDA (CDRH) CFR Part 1002)	
Output	≤ 300 μW	≤ 1 mW	
Operation Indicator	Power Indicator (red), Laser emission indicator (green), NEAR/FAR indicator (green)		
Connection	Connector type		
Insulation resistance	≥ 20 MΩ (500 VDC⎓ megger)		
Noise immunity	Square shaped noise by noise simulator (pulse width: 1μs) ±500V		
Dielectric strength	1,000 VAC~ 50/60 Hz for 1 minute		
Vibration	1.5 mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours		
Shock	300 m/s² (≈ 30 G) in each X, Y, Z direction for 3 times		
Ambient illumination	≤ 10,000 lx Incandescent lamp		
Ambient temperature	-10 to 50 °C, Storage: -15 to 60 °C (no freezing or condensation)		
Ambient humidity	≤ 85%RH, Storage: ≤ 85%RH (no freezing or condensation)		
Protection structure	IP67 (IEC Standards, except connector of extension cable)		

1) When measuring fixed non-glossy white paper (reference temperature: 25°C, reference distance, response time: 1ms, average 128 times).
2) The rated measurement range guarantees linearity.
3) Value indicates the error with respect to the ideal straight line.
4) Value measured by using an aluminum jig fix the sensor head and non-glossy white paper.
5) Using power from the amplifier unit.

Communication Converter for Laser Displacement Sensors

BD-C Series

Model	BD-CRS
Power supply [1]	-
Power Consumption	≤ 2.3 W
Communication Protocol	Modbus RTU
Connection type	RS-232C, RS-485
Communication speed	9600, 19200, 38400, 115200 bps (default)
Function	Executes every BD-Series feature, sets parameter and real-time monitoring by external device (Master)
Ambient temperature	-10 to 50 °C, Storage: -15 to 60 °C (no freezing or condensation)
Ambient humidity	≤ 85%RH, Storage: ≤ 85%RH (no freezing or condensation)
Vibration	1.5 mm amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 2 hours
Shock	300 m/s² (≈ 50 G) in each X, Y, Z direction for 3 times
Protection structure	IP40 (IEC standard)

1) Using power from the amplifier unit. To use BD-C Series communication converter, the amplifier unit needs 12-30 VDC⎓ power supply.
• It is recommended to use Autonics communication converter. Please use twisted pair wire, which is suitable for RS485 communication.

Product Overview

Display Type Pressure Transmitters

KT-320H Series

Series		KT-302H
Measured materials		Vapor, Liquid, Fluid (except corrosive environment of SUS316)
Power supply		9-45 VDC⎓
Display method		PV display part: 7-segment 5-digit, Bar LED: 52 Parameter display part: 16-segment 8-digit
Display range		-9999 to 99999
Output		DC4-20 mA (2-wire) Low-limit 3.8 mA, High-limit 22.8 mA
Accuracy [1]		±0.3% of F.S.
Setting method		Setting by front push keys and HART-protocol
Sampling cycle		200ms
Environment	Ambient temperature	-20 to 70 °C, storage: -40 to 85 °C
	Ambient humidity	0 to 85%RH, storage: 0 to 85%RH
Protection structure		IP67 (IEC standard)

1) F.S.: Rated pressure range.
※ Environment resistance is rated at no freezing or condensation.

Digital Display Pressure Sensors

PSAN Series

Pressure type		Gauge pressure			
		Negative pressure	Standard pressure		Compound pressure
Model [1]	Voltage output	PSAN-(D)V01C(P)V- □	PSAN-(D)01C(P)V- □	PSAN-(D)1C(P)V- □	PSAN-(D)C01C(P)V- □
	Current output	PSAN-V01C(P)A- □	PSAN-01C(P)A- □	PSAN-1C(P)A- □	PSAN-C01C(P)A- □
	Hold/Auto shift input	PSAN-V01C(P)H- □	PSAN-01C(P)H- □	PSAN-1C(P)H- □	PSAN-C01C(P)H- □
Rated pressure range		0.0 to -101.3kPa	0.0 to 100.0kPa	0 to 1,000kPa	-101.3kPa to 100.0kPa
Display pressure range		5.0 to -101.3kPa	-5.0 to 110.0kPa	-101.3 to 1,100kPa	-101.3kPa to 110.0kPa
Min.display unit		0.1kPa	0.1kPa	1kPa	0.1kPa
Max. pressure range		2 times of rated pressure	2 times of rated pressure	1.5 times of rated pressure	2 times of rated pressure
Applied fluid		Air, Non-corrosive gas			
Power supply		12-24VDC⎓ ±10%(ripple P-P:Max. 10%)			
Current consumption		Max. 50mA(Analog Current Output type Max 75mA)			
Control output		NPN or PNP open collector output • Load voltage: Max. 30VDC⎓ • Load current: Max. 100mA • Residual voltage - NPN: Max. 1VDC⎓, PNP: Max. 2VDC			
Hysteresis [2]		Min. display range			
Repeat error		±0.2%F.S. ± Min. display range			
Response time		Selectable 2.5ms, 5ms, 100ms, 500ms, 1000ms			
Short circuit protection		Built-in			
Analog output [3]	Voltage output	• Output voltage: 1-5VDC⎓ ±2% F.S. • Linear: Max. ±1% F.S. • Output impedance: 1kΩ • Zero point: Max. 1VDC⎓ ±2% F.S. • Span: Max. 4VDC⎓ ±2% F.S. • Response time: 50ms • Resolution: Automatically changed to 1/1000 or 1/2000 by pressure unit			
	Current output	• Output current: DC4-20mA ±2% • Linear: Max. ±1% F.S. • Zero-point: Max. DC4mA ±2% F.S. • Span: Max. DC16mA ±2% F.S. • Response time:70ms • Resolution: Automatically changed to 1/1000 or 1/2000 by pressure unit			
Display method		7segment LED Display			

Min. Display interval [4]	Resolution / Pressure unit	Negative pressure 1000	Negative pressure 2000	Standard pressure 1000	Standard pressure 2000	PSAN-(D)1C(P)V- □ 1000	PSAN-(D)1C(P)V- □ 2000	Compound pressure 1000	Compound pressure 2000
	MPa	-	-	0.001	-	0.001	-	-	-
	kPa	0.1	-	0.1	-	1	-	-	0.1
	kgf/cm²	0.001	-	0.001	-	0.01	-	-	0.001
	bar	0.001	-	0.001	-	0.01	-	-	0.001
	psi	-	0.01	-	0.01	-	0.1	-	0.02
	mmHg	-	0.4					-	0.8
	inHg	-	0.02					-	0.03
	mmH_2O	0.1	-					-	0.1

Display accuracy		0°C to 50°C : Max. ±0.5% F.S., -10 to 0°C : Max. ±1% F.S.
Dielectric strength		1000VAC 50/60Hz for 1 minute
Insulation resistance		Over 50MΩ(at 500VDC megger)
Vibration		1.5mm amplitude at frequency of 10 to 55Hz(for 1 min.) in each of X, Y, Z direction for 2 hours
Environment	Ambient temp.	-10 to 50°C, storage : -20 to 60°C
	Ambient humi.	30 to 80%RH, storage :30 to 80%RH
Protection		IP40(IEC specification)

1) In model name, (D) is bottom port type, (P) is PNP output type,
□ is as pressure port. Refer to '▣ Dimensions' to check the supported pressure port per type.
2) In hysteresis output mode, detection difference is variable.
3) It is allowed to select one analog output type only.
4) Resolution(1000/2000) of min. Display interval is automatically selected depend on pressure units.

※ F.S.: Rated pressure.
※ There may be ±1digit error in hysteresis by pressure unit calculation error.
※ For using mmH_2O unit, multiply display value by 100.
※ Environment resistance is rated at no freezing or condensation.

Vision Sensors

VG Series

Model	VG-M04□-□E			VG-C04□-□E		
Effective focal length	8 mm	16 mm	25 mm	8 mm	16 mm	25 mm
Min. working distance	50 mm	100 mm	200 mm	50 mm	100 mm	200 mm
Image filter	Preprocessing, external filter (color filter, polarizing filter)					
Image element	1/3 inch mono CMOS			1/3 inch color CMOS		
Resolution	752 × 480 pixel					
Image snap camera frame per second	≤ 60 fps [1]					
Shutter	Global shutter					
Exposure time	20 to 50,000 μs					
Inspection work group	32 (simultaneous inspection: 64)					
Inspection camera frame per second	≤ 60 fps [1]					
Dedicated software	Vision Master					
Light ON/OFF method	Pulse					
Light color	White / Red / Green / Blue model [2]					
Trigger mode	External - Internal - Free run setting (software)					
Communication	Ethernet(TCP/IP), 100BASE-TX/10BASE-T					
FTP trans. output	YES					
Indicators	POWER (green), LINK (green), PASS (green), DATA (orange), FAIL (red)					
Approval	CE KC EAC					
Power supply	24 VDC⎓ ±10 %					
Current consumption	1 A					
Rated input signal	24 VDC⎓ ±10 %					
Output signal	NPN-PNP open collector output setting (software)					
Protection circuit	Output short over current protection circuit					
Protection structure	IP67 (IEC standards)					

1) The number of camera frames per second can be different by image setting or inspection item.
2) Available to buy separately and replace.

Full-Metal Cylindrical Inductive Proximity Sensors (Cable Type)

PRF Series

Installation	Flush type			
General	PRF□T08-1.5DO-□	PRF□T12-2DO-□	PRF□T18-5DO-□	PRF□T30-10DO-□
Spatter-resistant	PRFA□T08-1.5DO-□	PRFA□T12-2DO-□	PRFA□T18-5DO-□	PRFA□T30-10DO-□
DIA. of sensing side	Ø 8 mm	Ø 12 mm	Ø 18 mm	Ø 30 mm
Sensing distance [1]	1.5 mm	2 mm	5 mm	10 mm
Setting distance	0 to 1.05 mm	0 to 1.4 mm	0 to 3.5 mm	0 to 7 mm
Hysteresis	≤ 15 % of sensing distance			
Standard sensing target: iron	8 × 8 × 1 mm	12 × 12 × 1 mm	30 × 30 × 1 mm	54 × 54 × 1 mm
Response frequency [2]	200 Hz	100 Hz	80 Hz	50 Hz
Affection by temperature	≤ ± 20 % for sensing distance at ambient temperature 20 °C			
Indicator	Operating indicator (red)			
Power supply	12-24 VDC⎓ (ripple P-P: ≤ 10 %), operating voltage: 10-30 VDC⎓			
Leakage current	≤ 0.8 mA			
Control output	3 to 100 mA			
Residual voltage	≤ 3.5 V			
Protection circuit	Surge protection circuit, output short over current protection circuit, reverse polarity protection			
Insulation resistance	≥ 50 MΩ (500 VDC⎓ megger)			
Dielectric strength	1,000 VAC~ 50/60Hz for 1 minute (between all terminals and case)			
Vibration	1.5 mm amplitude at frequency 10 to 55 Hz in each X, Y, Z direction for 2 hours			
Shock	1,000 m/s² (≈ 100 G) in each X, Y, Z direction for 10 times (DIA. of sensing side Ø 8 mm : 500 m/s² (≈ 50 G) in each X, Y, Z direction for 10 times)			
Ambient temp. [3]	-25 to 70 °C, storage: -25 to 70 °C (non-freezing or non-condensation)			
Ambient humi.	35 to 95 %RH, storage: 35 to 95 %RH (non-freezing or non-condensation)			
Protection	IP67 (IEC standards)			
Connection	Cable type / Cable connector type model			
Cable spec. [4]	DIA. of sensing side Ø 8 mm: Ø 4 mm, 2-wire DIA. of sensing side Ø 12 mm, Ø 18 mm, Ø 30 mm: Ø 5 mm, 2-wire			
Wire spec.	AWG 22 (0.08 mm, 60-wire), insulator diameter: Ø 1.25 mm			
Connector	M12 connector			
Material	Oil resistant cable (dark gray): oil resistant polyvinyl chloride (PVC)			
General	Case/Nut: SUS303, washer: SUS304, sensing side [03] : SUS303			
Spatter-resistant	Case/Nut: SUS303 (PTFE coated), washer: SUS304, sensing side : SUS303 (PTFE coated)			

1) Use accessories (nut, washer) made of SUS. Or, sensing distance cannot be guaranteed.
2) The response frequency is the average value. The standard sensing target is used and the width is set as 2 times of the standard sensing target, 1/2 of the sensing distance for the distance.
3) UL approved surrounding air temperature 40 °C
4) Cable type: 2 m (option: 5 m), cable connector type: 300 mm
5) Thickness: 0.8 mm (DIA. of sensing side Ø 8 mm: 0.4 mm)

Product Overview

Safety Light Curtains (Standard Type)

SFL Series

Type	Standard type		
Models	**SFL14-□**	**SFL20-□**	**SFL30-□**
Sensing type	Through-beam		
Light source	Infrared LED (855 nm)		
Effective aperture angle (EAA)	Within ± 2.5 ° when the sensing distance is greater than 3 m for both emitter and receiver.		
Sensing distance	Short - Long mode (setting switch)		
Short mode	0.2 to 5 m	0.2 to 8 m	0.2 to 8 m
Long mode	0.2 to 10 m	0.2 to 15 m	0.2 to 15 m
Detection capability	Ø 14 mm (finger)	Ø 20 mm (hand)	Ø 30 mm (hand-body)
Detection object	Opaque object		
Number of optical axes [1]	15 to 111	12 to 68	42 to 75
Protective height	144 to 1,008 mm	183 to 1,023 mm	1,043 to 1,868 mm
Optical axis pitch	9 mm	15 mm	25 mm
Series connection	Max. 3 SET (≤ 300 optical axes)		
Power supply	24 VDC⎓± 20 % (Ripple P-P: ≤ 10 %)		
Current consumption [1]	Emitter: ≤ 106 mA, receiver: ≤ 181 mA		
Response time [1]	T_{OFF} (ON → OFF): ≤ 32.3 ms, T_{ON} (OFF → ON): ≤ 76.6 ms		
Safety related output : OSSD output	NPN or PNP open collector Load voltage [2]: ON - 24 VDC⎓ (except for the residual voltage), OFF - 0 VDC⎓, Load current [3]: ≤ 300 mA, Residual voltage [4]: ≤ 2 VDC⎓ (except for voltage drop due to wiring), Load capability: ≤ 2.2 μF, Leakage current: ≤ 2.0 mA, Wire resistance of load: ≤ 2.7 Ω		
Auxiliary output (AUX 1/2) [5]	NPN or PNP open collector Load voltage: ≤ 24 VDC⎓, Load current: ≤ 100 mA, Residual voltage: ≤ 2 VDC⎓ (except for voltage drop due to wiring)		
Lamp output (LAMP 1/2) [5]	NPN or PNP open collector Load voltage: ≤ 24 VDC⎓, Load current: ≤ 300 mA, Residual voltage: ≤ 2 VDC⎓ (except for voltage drop due to wiring), Incandescent lamp: 24 VDC⎓ / 3 to 7 W, LED lamp: Load current ≤ 50 to 300 mA		
External input	Reset input, mute 1/2 input, EDM, external test When setting NPN output ON: 0 - 3 VDC⎓, OFF: 9 - 24 VDC⎓ or open, short-circuit current: ≤ 3 mA When setting PNP output ON: 9 - 24 VDC⎓, OFF: 0 - 3 VDC⎓ or open, short-circuit current: ≤ 3 mA		
Protection circuit	Reverse power polarity, reverse output polarity, output short-circuit over-current protection		
Safety-related functions	Interlock (reset hold), external device monitoring (EDM), muting/override, Blanking (fixed blanking, floating blanking), reduced resolution		
General functions	Self-test, alarm for reduction of incident light level, mutual interference prevention		
Others functions	Change of sensing distance, switching to NPN or PNP, external test (light emission stops), auxiliary output (AUX 1, 2), lamp output (LAMP1, 2)		
Synchronization type	Timing method by synchronous line		
Protection structure	IP65, IP67 (IEC standard)		

1) It may differ depending on the models. For more information, see the "SFL/SFLA User Manual."
2) The values of load voltage were drawn with PNP output, and in case of NPN output, apply these in reverse.
3) Be sure that the load current should be greater than 6 mA.
4) The residual voltage was drawn with 300 mA of load current.
5) It is the non-safety output. Do not use it for safety purposes.

Safety Door Lock Switches

SFDL Series

Model	SFDL-□□□-□□	SFDL-□□□-C□□
Directing opening force	≥ 80 N	
Directing opening distance	≥ 10 mm	
Locking pullout strength	≥ 1,300 N	
Operating speed	0.05 to 1 m/s	
Operating frequency	≤ 20/min	
Mechanical life cycle	≥ 1,000,000 operations (20/min)	
Vibration (malfunction)	0.35mm amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 10 min	
Shock	1,000 m/s² (≈ 100 G) in each X, Y, Z direction for 3 times	
Shock (malfunction)	80 m/s² (≈ 8 G) in each X, Y, Z direction for 3 times	
Ambient temperature	-10 to 55°C [1], storage: -25 to 65 °C (a non freezing or condensation environment)	
Ambient humidity	35 to 85 %RH , storage: 35 to 85 %RH (a non freezing or condensation environment)	
Protection structure	IP67 [2] (IEC standard, except for head)	
Accessory	SFDL-□□□-□□K (Special type release key) : rotating key	
Applicable cable	AWG22	-
Connection type	Terminal type	Connector type

1) UL approved ambient temperature: 50°C
2) Rated protection structure is for the switch body. Be cautious about preventing the head part from entering the foreign materials such as dust and water

Contact block	
Rated voltage/current for load	Resistive load: 1 A/120 VAC∼, 0.22 A/125 VDC⎓ Inductive load (IEC): AC-15 1 A/120 VAC∼, DC-13 0.22 A/125 VDC⎓ Inductive load (UL): C150, R150
Impulse dielectric strength	Between the terminals of same polarity: 1.5 kV Between the terminals of different polarity: 1.5 kV Between each terminal and non-live part: 2.5kV
Insulation resistance	≥ 100 MΩ (500 VDC⎓ megger)
Contact resistance	≤ 200 mΩ
Electrical life cycle	≥ 100,000 operations (125 VAC∼/1 A)
Conditional short-circuit current	100 A
Solenoid	
Rated voltage	24 VDC⎓, class 2
Current consumption	Supplying power: 0.26A Normal: max. 0.2A (approx. 3 seconds after supplying power)
Insulation class	Class E

Safety Non-Contact Door Switches

SFN Series

Model		SFN-M-□
Operating distance [1]	**OFF→ON**	≥ 5 mm
	ON→OFF	≤ 15 mm
Power supply		24 VDC⎓ (± 10 %)
Operating frequency		100 Hz
Power consumption [2]		≤ 400 mA
Auxiliary output		PNP open collector output - 24 VDC⎓, 10 mA
Operation indicator		ON: green, OFF: red
Life expectancy		≥ 20,000,000 times (with low load)
Insulation resistance		≥ 50 MΩ (500 VDC⎓ megger)
Protection circuit		Surge protection circuit, output short over current protection circuit, reverse polarity protection circuit
Dielectric strength		1,500 VAC∼ 50/60Hz for 1 minute
Vibration		1.0 mm amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 2 hours
Vibration (malfunction)		1.0 mm amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 10 min
Shock		300 m/s² (≈ 30 G) in each X, Y, Z direction for 3 times
Shock (malfunction)		300m/s² (≈ 30G) in each X, Y, Z direction in output ON/OFF status for 3 times
Ambient temperature		-10 to 55 °C, storage : -20 to 60 °C (a non freezing or condensation environment)
Ambient humidity		35 to 85 %RH, storage : 35 to 85 %RH (a non freezing or condensation environment)
Protection structure		IP67 (IEC standard)

1) It is rated at 23°C of ambient temperature, and it may be differed up to ±20% by ambient temperature.
2) Power to the load is not included.

Ø22/25 Emergency Stop Button Switches

SF2ER Series

Model	SF2ER-□□□□-□
Rated voltage/current	IEC: AC-15 (220 VAC∼, 3 A), DC-13 (220 VDC⎓, 0.2 A) UL: A300, Q300
Contact operating power	3.0 to 8.0 N/ 1 contact
Operation distance	5.0 mm (0/-0.5)
Rotation angle	CW (clock wise) 52°
Allowable operation frequency [1]	Mechanical: 20 times/minute, electrical: 20 times/minute
Life cycle	Mechanical: ≥ 250,000 times, electrical: ≥ 100,000 times
Applicable wire	AWG 18 (0.823 mm²)
Insulation resistance	≥ 100 MΩ (500 VDC⎓ megger)
Dielectric strength	2,500 VAC∼ 50/60 Hz for 1 minute
Vibration	1.5 mm double amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 2 hours
Vibration (malfunction)	1.5 mm double amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 10 minutes
Shock	1,000 m/s² (≈ 100 g) in each X, Y, Z direction for 3 times
Shock (malfunction)	250 m/s² (≈ 25 g) in each X, Y, Z direction for 3 times
Ambient temperature	-20 to 65°C [2] , storage : -40 to 70 °C (at no freezing or condensation)
Ambient humidity	35 to 85 %RH , storage : 35 to 85 %RH (at no freezing or condensation)
Protection structure	IP65 [3] (oil resistant, IEC standards)

1) Setting and resetting once is counted as one operation.
2) UL approved ambient temperature: 55 °C
3) It is only for part from front of the panel. Protection structure is guaranteed only when the switch is installed on flat and smooth surface with mounting holes Ø22mm.

Product Overview

High Performance PID Temperature Controllers

TK Series

Series		TK4N	TK4SP	TK4S	TK4M	TK4W	TK4H	TK4L
Power supply	AC voltage	100-240VAC~ 50/60Hz						
	AC/DC voltage	-	24VAC~ 50/60Hz, 24-48VDC⎓					
Allowable voltage range		90 to 110% of rated voltage						
Power consumption	AC voltage	Max. 6VA	Max. 8VA					
	AC/DC voltage	-	Max. 8VA (24VAC 50/60Hz), max. 5W (24-48VDC)					
Display method		7-segment (PV: red, SV: green), other display part (green, yellow, red) LED method						
Character size	PV (W×H)	4.5×7.2mm	7.0×14.0mm		9.5×20.0mm	8.5×17.0mm	7.0×14.6mm	11.0×22.0mm
	SV (W×H)	3.5×5.8mm	5.0×10.0mm		7.5×15.0mm	6.0×12.0mm	6.0×12.0mm	7.0×14.0mm
Input type	RTD	JPt 100Ω, DPt 100Ω, DPt 50Ω, Cu 100Ω, Cu 50Ω, Nikel 120Ω (6 types)						
	Thermocouple	K, J, E, T, L, N, U, R, S, B, C, G, PLII (13 types)						
	Analog	• Voltage: 0-100mVDC⎓, 0-5VDC⎓, 1-5VDC⎓, 0-10VDC⎓ (4 types) • Current: 0-20mA, 4-20mA (2 types)						
Display accuracy	RTD	• At room temperature (23°C ±5°C): (PV ±0.3% or ±1°C, select the higher one) ±1-digit [1] • Out of room temperature ranges: (PV ±0.5% or ±2°C, select the higher one) ±1-digit In case of TK4SP Series, ±1°C will be added.						
	Thermocouple							
	Analog	• At room temperature (23°C ±5°C): ±0.3% F.S. ±1-digit • Out of room temperature ranges: ±0.5% F.S. ±1-digit						
	CT input	±5% F.S. ±1-digit						
Control output	Relay	OUT1, OUT2: 250VAC~ 3A, 30VDC⎓ 3A, 1a						
	SSR	Max. 11VDC⎓ ±2V 20mA						
	Current	DC4-20mA or DC0-20mA selectable (resistance load: max. 500Ω)						
Alarm output	Relay	AL1, AL2: 250VAC~ 3A 1a ※TK4N AL2: 250VAC~ 0.5A, 1a (max. 125VA), TK4SP has only AL1						
Option output	Transmission	DC4-20mA (resistance load: max. 500Ω, output accuracy: ±0.3% F.S.)						
	Communication	RS485 communication output (Modbus RTU)						
Option input	CT	0.0-50.0A (primary heater current reading range) ※CT ratio is 1/1000 (except TK4SP)						
	Digital input	• Contact input: ON - max. 2kΩ, OFF - min. 90kΩ • Non-contact input: ON - residual voltage max. 1.0VDC⎓, OFF - leakage current max. 0.1mA • Outflow current: approx. 0.5mA per input ※TK4S/M: 1 (TK4S-D□□□: 2, TK4SP: none), TK4N/H/W/L: 2 (except TK4SP)						
Control method	Heating, Cooling	ON/OFF, P, PI, PD, PID control mode						
	Heating&Cooling							
Sampling period		50ms						
Protection		IP65 (front panel) ※TK4SP: IP50 (front panel)						

1) ◎At room temperature range (23°C±5°C)
- Thermocouple K, J, T, N, E type, below -100°C / Thermocouple L, U, PL II , Cu50Ω, DPt 50Ω: (PV ±0.3% or ±2°C, select the higher one) ±1-digit
- Thermocouple C, G, R, S type, below 200°C: (PV ±0.3% or ±3°C, select the higher one)±1-digit
- Thermocouple B type, below 400°C: there is no accuracy standards.

◎Out of room temperature range
- RTD Cu50Ω, DPt50Ω: (PV ±0.5% or ±3°C, select the higher one) ±1-digit
- Thermocouple R, S, B, C, G type: (PV ±0.5% or ±5°C, select the higher one) ±1-digit
- Others, below -100°C: within ±5°C

In case of TK4SP Series, ±1°C will be added to the degree standard.
※Environment resistance is rated at no freezing or condensation.

LCD Display PID Temperature Controllers

TX Series

Series		TX4S	TX4M	TX4H	TX4L
Power supply		100-240VAC~ 50/60Hz			
Allowable voltage range		90 to 110% of rated voltage			
Power consumption		Max. 8VA			
Display method		11-segments (PV: white, SV: green), other display (yellow) with LCD method [1]			
Character size	PV(W×H)	7.2×14mm	10.7×17.3mm	7.2×15.8mm	16×26.8mm
	SV(W×H)	3.9×7.6mm	6.8×11mm	6.2×13.7mm	10.7×17.8mm
Input type	RTD	DPt100Ω, Cu50Ω (permissible line resistance max. 5Ω)			
	TC	K (CA), J (IC), L (IC), T (CC), R (PR), S(PR)			
Display accuracy [2]	RTD	• At room temperature: (23°C±5°C): (PV ±0.3% or ±1°C, select the higher one) ±1-digit • Out of room temperature: (PV ±0.5% or ±2°C, select the higher one) ±1-digit			
	TC				
Control output	Relay	250VAC~ 3A, 30VDC⎓ 3A, 1a			
	SSR	Max. 12VDC⎓ ±2V 20mA	Max. 13VDC⎓ ±3V 20mA		
	Current	DC4-20mA or DC0-20mA (load resistance max. 500Ω)			
Option output	Alarm output	AL1, AL2: 250VAC 3A~, 30VDC 3A⎓ 1a			
	Trans. output	DC4-20mA (load resistance max. 500Ω, output accuracy: ±0.3%F.S.)			
	Com. output	RS485 communication output (Modbus RTU method)			
Sampling period		50ms			
Protection structure		IP50 (front panel, IEC standards)			

1) When using the unit at low temperature (below 0°C), display cycle is slow. Control output operates normally.
2) ◎ At room temperature(23°C±5°C)
- TC R(PR), S(PR), below 200°C: (PV ±0.5% or ±3°C, select the higher one) ±1-digit , over 200°C: (PV ±0.5% or ±2°C, select the higher one) ±1-digit
- TC L(IC), RTD Cu50Ω: (PV ±0.5% or ±2°C, select the higher one) ±1-digit

◎ Out of room temperature range
- TC R(PR), S(PR): (PV ±1.0% or ±5°C, select the higher one) ±1-digit
- TC L(IC), RTD Cu50Ω: (PV ±0.5% or ±3°C, select the higher one) ±1-digit

※Environment resistance is rated at no freezing or condensation.

Modular Multi-Channel High Performance Temperature Controllers

TMH Series

Model	TMH2	TMH4
No. of channels	2 channels	4 channels
Sampling period	50 ms (2 channels or 4 channels synchronous sampling)	
Input specification	Thermocouple, RTD, Analog (refer to 'Input Specification')	
CT input	• 0.0 - 50.0 A (primary current measurement range) • CT ratio: 1/1,000 • Measurement accuracy: ±5 % F.S. ±1 digit	
Digital input	• Connect input ON: ≤ 1 kΩ, OFF: ≥ 100 kΩ • Solid state input Residual voltage: ≤ 0.9 V, Leakage current: ≤ 0.5 mA • Outflow current: ≈ 0.3 mA per input	-
Control type	Heating, cooling, heating & cooling: ON/OFF, P, PI, PD, PID control	
Control output	• Relay: 250 VAC~ 3 A 1a mechanical life cycle: ≥ 10,000,000 operations, electrical life cycle: ≥ 100,000 operations • SSR: 12 VDC⎓ ±3 V, ≤ 20 mA • Current [1]: DC 4 - 20 mA or DC 0 - 20 mA (Load: ≤ 500 Ω)	
Alarm output	250 VAC~ 3 A 1a Mechanical life cycle: ≥ 10,000,000 operations Electrical life cycle: ≥ 100,000 operations	-
Communication	Modbus RTU	
Power supply [2]	24 VDC⎓	
Allowable voltage range	90 to 110 % of rated voltage	
Power Consumption	≤ 5 W (for max. load)	
Protection structure	IP20 (IEC standard)	

1) When the control output is set to the current output, the heater current value monitoring function through the CT input terminals is not available.
2) The control extension/option/communication module uses the power voltage from the control basic module.

Single-Phase Solid State Relays (Integrated Heat-sink, Left/Right Terminal Type)

SRHL1 Series

Input

Rated input voltage range		10-30 VDC⎓	90-240 VACrms~ (50/60 Hz)
Allowable input voltage range		9-32 VDC⎓	85-264 VACrms~ (50/60 Hz)
Max. input current		15 mA	22 mA
Pick-up voltage		Min. 9 VDC⎓	Min. 85 VACrms~
Drop-out voltage		Max. 1 VDC⎓	Max. 10 VACrms~
Turn-ON time	Zero cross turn-on	Max. 0.5 cycle of load source + 1 ms	Max. 2 cycle of load source + 1ms
	Random turn-on	Max. 1 ms	-
Turn-off time		Max. 0.5 cycle of load source + 1 ms	Max. 2 cycle of load source + 1ms

Output

Rated load voltage range		24-240 VACrms~ (50/60 Hz)					48-480 VACrms~ (50/60 Hz)				
Allowable load voltage range		24-264 VACrms~ (50/60 Hz)					48-528 VACrms~ (50/60 Hz)				
Rated load current	Resistive load (AC-51) [1]	10 Arms	15 Arms	20 Arms	25 Arms	40 Arms	10 Arms	15 Arms	20 Arms	25 Arms	40 Arms
Min. load current		0.15 Arms	0.15 Arms	0.2 Arms	0.2 Arms	0.5 Arms	0.5 Arms	0.5 Arms	0.5 Arms	0.5 Arms	0.5 Arms
Max. 1 cycle surge current (60Hz)		160 A	160 A	250 A	250 A	400 A	300 A	300 A	500 A	500 A	500 A
Max. non-repetitive surge current (I^2t, t=8.3ms)		130 A^2s	130 A^2s	300 A^2s	300 A^2s	910 A^2s	350 A^2s	350 A^2s	1000 A^2s	1000 A^2s	1000 A^2s
Peak voltage (non-repetitive)		600 V					1200 V (Zero cross turn-on), 1000 V (Random turn-on)				
Leakage current (Ta=25°C)		Max. 10 mArms (240 VAC~/60 Hz)					Max. 10 mArms (480 VAC~/60 Hz)				
Output on voltage drop [Vpk] (max. load current)		Max. 1.6 V									
Static off state dv/dt		500 V/⚠									

1) AC-51 is utilization category at IEC60947-4-3.

Alarm output (Overheat prevention)

Rated input voltage range	10-30 VDC⎓	90-240 VACrms~ (50/60 Hz)
Load voltage	Max. 30 VDC⎓	Max. 30 VDC⎓
Load current	Max. 50 mA	Max. 50 mA
Turn-off time	Max. 50 ms	Max. 100 ms

※ Overheat prevention function: When SSR internal temperature is overheated, the load output is cut off to prevent internal device damage. The alarm indicator turns ON and alarm output turns ON.
※ Alarm output is only for the rated load current 40 A model (SRHL1-□□40□).
In case of the rated load current 10 A/15 A/20A/25 A models (SRHL1-□□10□/□□15□/□□20□/□□25□), the alarm indicator turns ON, regardless of alarm output.
※ To clear alarm, cut OFF the input signal during over alarm output return time at the rated ambient temperature.

General specifications

Dielectric strength (Vrms)		• Input-output: 2500 VAC 50/60 Hz for 1 min • Input/output-case: 4000 VAC 50/60 Hz for 1 min
Insulation resistance		Over 100 MΩ (at 500 VDC megger) (input-output, input/output-case)
Indicator		Input indicator: green LED, alarm indicator: red LED
Vibration	Mechanical	0.75 mm amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 1 hour
	Malfunction	0.5 mm amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 10 min
Shock	Mechanical	300 m/s^2 (approx. 30 G) in each X, Y, Z direction for 3 times
	Malfunction	100 m/s^2 (approx. 30 G) in each X, Y, Z direction for 3 times
Input terminal connection, alarm output terminal connection		Min. 1×0.5 mm^2 (1 × AWG20), max. 1×4 mm^2 (1 × AWG12) or 2 × 1.5 mm^2 (2 × AWG16)
Output terminal connection		• Rated load current 10 A/1 5A/20 A/25 A: Min. 1 × 0.75 mm^2 (1 × AWG18), max. 1×6 mm^2 (1 × AWG10) or 2 × 2.5 mm^2 (2 × AWG14) • Rated load current 40A: Min. 1 × 1.5 mm^2 (1 × AWG16), max. 1 × 16 mm^2 (1× AWG6) or 2 × 6 mm^2 (2 × AWG10) ※Use wires compliant with load current capacity to connect to the terminal.
Input terminal fixed torque		0.75 to 0.95 N·m
Output terminal fixed torque		• Rated load current 10 A/15 A/20 A/25 A: 1.0 to 1.35 N·m • Rated load current 40 A: 1.6 to 2.2 N·m

※ For wiring the terminal, round terminal must be used.

Product Overview

Slim Single-Phase Power Controllers with LED Display

SPR1 Series

Model		SPR1-1□□□□	SPR1-2□□□□	SPR1-3□□□□	SPR1-4□□□□
Control phase		Single-phase			
Rated load voltage (50/60Hz)		110 VAC∼	220 VAC∼	380 VAC∼	440 VAC∼
Power supply		100-240 VAC∼ 50/60 Hz			
Min. load current		1 A			
Permissible voltage range		90 to 110 % of rated voltage			
Power consumption		• Rated load current 25 A/35 A/50 A: max. 7 VA • Rated load current 70 A/100 A/150 A: max. 12 VA			
Display method		3-digit 7-segment LED			
Indicator		• Operation indicator/Manual control indicator: green LED • Alarm indicator/output indicator/unit (V, A) indicator: red LED			
Control method		• Phase control: normal control mode, constant current/constant voltage/constant power feedback control mode • Cycle control: fixed cycle control mode, variable cycle control mode • ON/OFF control			
Applied load		• Phase control, ON/OFF control: resistance load, inductive load • Cycle control: resistance load			
Control input		• Auto control: DC4-20 mA, 1-5 VDC⎓, ON/OFF contact (no-voltage input), pulse voltage (5-12 VDC⎓) • Manual control: outside adjuster (10 kΩ), inside adjuster (output limit)			
Digital input (DI)		RUN/STOP switching, AUTO/MAN switching, RESET			
Output	Alarm	250 VAC∼ 3 A, 30 VDC⎓ 3 A, 1c resistive load			
	Communication	RS485 communication output (Modbus RTU method), max. connection: 31 units			

Digital Thyristor Power Controllers

DPU Series

Series		DPU1	DPU3
Control phase		Single-phase	3-phase
Power supply		110VAC∼/220VAC∼/380VAC∼/440VAC∼ (FAN and control power 220VAC∼ 50/60Hz separately)	
Allowable voltage		90 to 110% of rated voltage	85 to 115% of rated voltage
Rated frequency		50/60Hz (auto recognition), allowable frequency range: ±2Hz	
Min. load current		1A	
Output range		Phase control: 5 to 98%, Z.C. control: 0 to 100%	
Control method 1)		• Phase control : Normal control (Non-Feedback), constant voltage/constant current/constant power control (Feedback) • Cycle control (Z.C.): Fixed cycle control, variable cycle control • ON/OFF control (Z.C.)	
Load		• Phase control: resistance load, inductive load • ON/OFF, Cycle control: resistance load	
Power consumption		Max. 7W (except FAN operation power)	Max. 10W (except FAN operation power)
Display method		• Display value and SV display : 7-segment 4 digit • Status display: 4 LED • Display value percentage display: 11 LED Bar	• Display value and SV display : 7-segment 4 digit • Status display: 6 LED • Display value percentage display: 11 LED Bar
Output accuracy		• Constant voltage feedback control : Within ±3% F.S. of rated voltage (within variable ±10% F.S. of rated voltage) • Constant current feedback control : Within ±3% F.S. of rated voltage (within variable 1 to 10 times of rated resistance) • Constant power feedback control : Within ±3% F.S. of rated voltage (within variable ±10% F.S. of rated voltage and within variable 1 to 10 times of rated resistance) • Normal control: within ±10% F.S. of rated voltage	
Set method		By front keys, by communication	
Control input		• Auto: 4-20mA / 0-20mA / 0-5VDC⎓ / 1-5VDC⎓ / 0-10VDC⎓ / voltage pulse(0/12VDC⎓(24VDC⎓)) / no-voltage input (ON/OFF) / communication input(RS485) • Manual: inside 10kΩ adjuster, outside 3 to 10kΩ adjuster (min. 2W)	
Digital input(DI)		AUTO/MAN switching, RUN/STOP switching, RESET, Output holding, SP setting (SP1 to 6)	
Display content		Control input, load voltage, load current, load power, load resistance, power supply frequency	
Min. display output		Min. 2.5% of rated voltage/current	
Option output		RS485 communication output (Modbus RTU method), [max. 32 units]	
Dielectric strength		2,000VAC 50/60 Hz for 1 min (between input terminal and power terminal)	
Vibration		0.75mm amplitude at frequency of 5 to 55Hz (for 1 min) in each of X, Y, Z directions for 2 hours	
Insulation resistance		Over 200MΩ(at 500VDC megger)	
Noise immunity		±2kV the square wave noise (pulse width 1μs) by the noise simulator	
Environment	Ambient temp.	−10 to 50°C, storage: −20 to 80°C	
	Ambient humi.	5 to 90%RH, storage: 5 to 90%RH	

1) Variable cycle control is only for single-phase model.
2) The weight includes packaging. The weight in parenthesis is for unit only.
※ Environment resistance is rated at no freezing or condensation.

10.4-Inch Color LCD Graphic Panels

GP-A104 Series

	GP-A046	GP-A057	GP-A070	GP-A104
Screen size	4.6 inch	5.7 inch	7.0 inch	10.4 inch
LCD type	TFT Color LCD			
Resolution	800×320 pixel	640×480 pixel	800×480 pixel	800×600 pixel
Display area	108×43.2 mm	115.2×86.4 mm	154.4×93.44 mm	211.2×158.4 mm
Display color	16,777,216 color	262,144 color	16,777,216 color	16,777,216 color
LCD view angle (top/bottom/left/right)	Within 75°/70°/80°/80° of each	Within 70°/70°/80°/80° of each	Within 50°/60°/65°/65° of each	Within 60°/70°/80°/70° of each
Backlight	White LED			
Luminance adjustment	Adjustable by software			
Touch	wn			
Serial interface	RS232C, RS422			
USB interface	USB Host, USB Device(USB2.0)			
Ethernet interface	IEEE802.3(U), 10/100Base-T			
CAN interface	24V CAN transceiver			
External storage	Micro SD up to 32GB (FAT16/32)			
Real-time controller	RTC embedded			
Battery life cycle	3 years at 25°C			
Language	Korean, English			
Number of user screen	100 pages			
Power supply	24 VDC⎓			
Allowable voltage range	90 to 110% of power supply			
Power consumption	4.6 inch : ≤ 4.8 W, 5.7 / 7.0 inch : ≤ 7.2 W, 10.4 inch : ≤ 8.0 W			
Insulated resistance	≥ 100 MΩ (500 VDC⎓ megger) (between all terminals and case)			
Ground	3rd grounding (≤ 100 Ω)			

10.1-Inch Panel PC

APC-1011 Series

Model		APC-1011
Power supply		24VDC⎓
Allowable voltage range		90 to 110% of power supply
Power consumption		Max. 30W
Hard disk		mSATA 64GB SSD
System memory		DDR3L 4GB
Indicator		Power indicator: green LED
Speaker		Stereo speaker 2W+2W
Watch dog timer		Watch Dog Timer (1 to 255 sec, software setting)
Battery life cycle		5 years at 25°C
Real-time controller		RTC embedded
Insulated resistance		Min. 100MΩ (at 500VDC megger)
Ground		3rd grounding (max. 100Ω)
Noise immunity		±0.5kV the square wave noise (pulse width: 1μs) by the noise simulator
Withstanding voltage		500VAC 50/60Hz for 1 minute
Vibration	Mechanical	0.75mm amplitude at frequency of 10 to 55Hz (for 1 minute) in each X, Y, Z direction for 1 hour
	Malfunction	0.5mm amplitude at frequency of 10 to 55Hz (for 1 minute)in each X, Y, Z direction for 10 minutes
Shock	Mechanical	300m/s² (approx. 30G) in each X, Y, Z direction for 3 times
	Malfunction	100m/s² (approx. 10G) in each X, Y, Z direction for 3 times
Environment	Ambient temperature	0 to 50°C, storage: -20 to 60°C
	Ambient humidity	35 to 85%RH, storage: 35 to 85%RH
Language 1)		Korean, English
Protection structure		IP65 (front panel, IEC standard)

1) Supported language can be added by downloading language pack. For more details about language pack, please visit Microsoft website.
※ Environment resistance is rated at no freezing or condensation.

UV Laser Marking System

ALU Series

Specifications

Models		ALU-3/4/5/6	ALU-10/20
Laser Type		YVO₄	
Max output power		2~6W	10W, 20W
Laser wavelength		355nm	
Marking method		Galvanometer scanning method	
Marking speed		Up to 12,000 mm/s	
Pulse length		Pulse width under 15 ns at 50 kHz	
Line width		5 to 20 μm (* Line width may change depending on the material of the target object.)	
Power supply		220VAC, 60Hz	
Environment	Temp.	5~40°C (41~104°F)	
	Humi.	10~90%RH (no condensation)	
	Ground	Length of wire: min. 2.6 mm (5.5 mm), resistance: max. 10 Ω	
Cooling method		Air-cooling	Water-cooling
Preheating time		Max. 10 min	Max. 30 min

※ The laser output is customizable.

Marking Specifications by Lens

Item	Lens	Marking Range	Marking Distance
Standard	160mm	□100mm	196±3mm
Optional	100mm	□55mm	137±3mm
	254mm	□160mm	311±5mm

Autonics

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