

Optical Transmitter

SOT-ES100 Series

Operation Manual

TOYO ELECTRIC CORP.

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1. Introduction

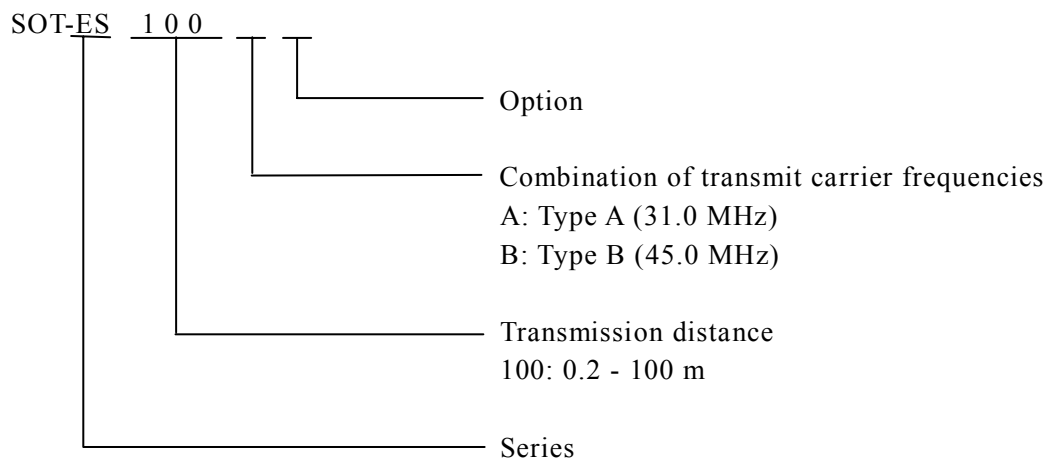
Thank you for choosing our SOT-ES100 Series transmitter.
 For correct operation of the product, this manual must be read carefully before use.

2. Outline

This equipment transmits data utilizing the light transmitted through the space.
 It can handle serial data through a full-duplex, bi-directional 10BASE-T.
 Since connection with external devices is made by means of a connector, maintenance can be performed easily.
 This equipment is specified for use in DC24V power.

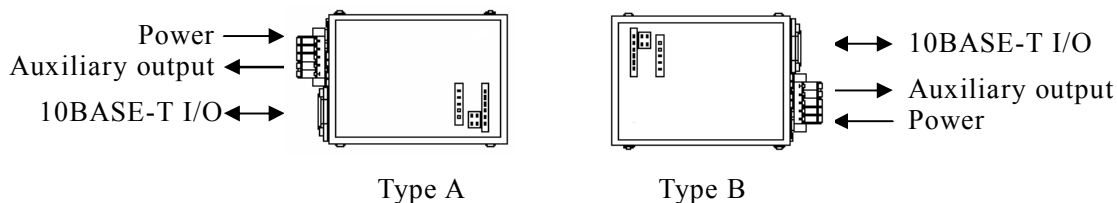
3. Configuration

(1) Model



(2) Combination

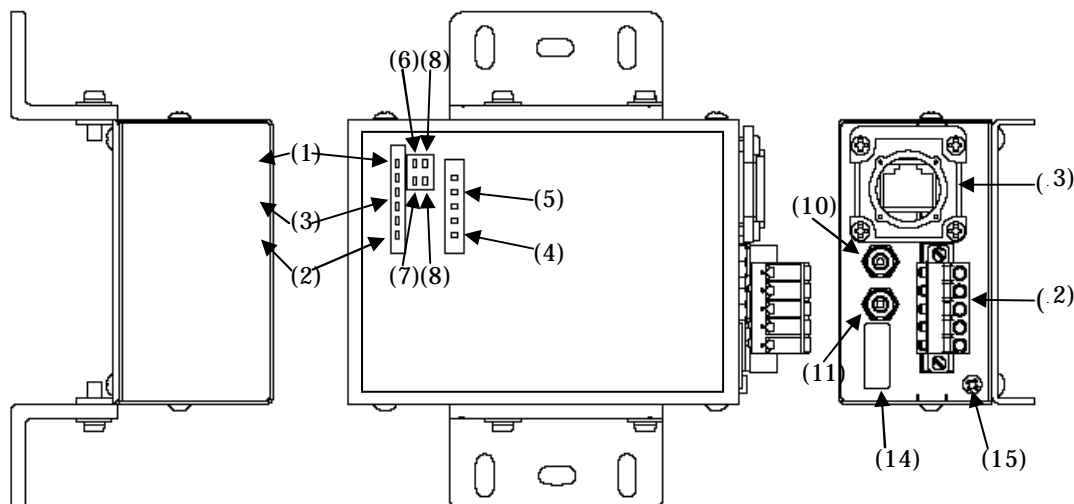
- 1) Use this equipment in the combination with Type A or B.
- 2) ES100 Series is not compatible with other SOT or Clean Net in optical communication side.



4. Major Specifications

Item	Specification	
Model	SOT-ES100A	SOT-ES100B
Environment	IEEE802.3(Ethernet)	
Transmission rate	Cable side 10 Mbps	
Power voltage	Rated voltage: 24VDC Power ripples 10% or less Voltage: 18 - 30VDC Peak voltage including ripples: Within 30V	
Consumption current	Less than 150 mA (at 24 VDC input)	
Interface	10BASE-T (Auto negotiation, AutoMDIX compatible)	
Transmission method	Full-duplex, bi-directional	
Communication control method	Bit forward	
Connected to:	Network card or switching hub	
Transmission distance	0.2-100m	
Directivity	1.2 degrees	
Modulation method	FSK	
Lighting element	Near infrared light emitting diode (light emitting wavelength 870 nm)	
Receiving element	Photo diode	
Auxiliary output	DL: "ON" when communication is permitted ALM: "OFF" when the reception level is low Photo coupler insulated NPN open collector outputs Output rating: 30VDC 50mA MAX	
Connection	For signal: RJ-45 modular jack Up to category 3 or more twist pair cable 100 m Automatic switching between straight/crossing cables by means of AutoMDIX For power/aux. output: 5-polar connector terminal block (Phoenix MSTB2.5/5-GF-5.08)	
Indicators	POW: Power indicator lamp (red); Shows red when power supply is on LINK: Link indicator lamp (green); Shows green when Ethernet is connected normally SD: Sending data indicator lamp (red); Shows red when sending data input is on. RD: Receiving data indicator lamp (green); Shows green when received data output is on. FDX: Full-duplex indicator lamp (red); Shows red in full-duplex connection. Own unit CD: Clear data indicator lamp (red); Shows red at a sufficient reception level of own station for communication. Own unit LEVEL: Reception level indicator lamp (4 points) (green); Shows green according to own station reception level. Receiving unit CD: Clear data indicator lamp (red); Shows red at a sufficient reception level of receiving unit for communication. Receiving unit LEVEL: Reception level indicator lamp (4 points) (green); Shows green according to receiving unit reception level.	
Check terminals	DC voltage corresponding to the reception level is provided. (Use the DC voltage range with a 10kΩ/V or higher tester.)	
Setting switches	4-pin dip switch SW1: Auto negotiation ON/OFF SW2: Communication mode full-duplex/half duplex SW3: 10BASE-T link ON/OFF in light shielding SW4: Not used	
Operating ambient illumination	Solar beam: 10,000 lx or less Fluorescent, incandescent lamps: 3,000 lx or less No externally disturbed light shall directly enter the receiver.	
Operating ambient temperature	-10 - +55°C No freezing allowed	
Operating ambient humidity	10 - 85% RH No condensation allowed	
Resistance to vibration	Frequency: 10 - 55 Hz, complex amplitude: 1.5 mm, sweep: 5 min X · Y · Z 20 cycles in each of X, Y and Z directions (per JIS C0040)	
Resistance to impact	500 m/s ² 10 times in each of 3 directions X · Y · Z (per JIS C0041)	
Protection class	IP40	
Outside dimensions (weight)	See Outside Drawing (weight 350 g).	
Accessories	Fixture (1 set), screws for fixture (4 pcs), power/aux. output plug (1 pc)	

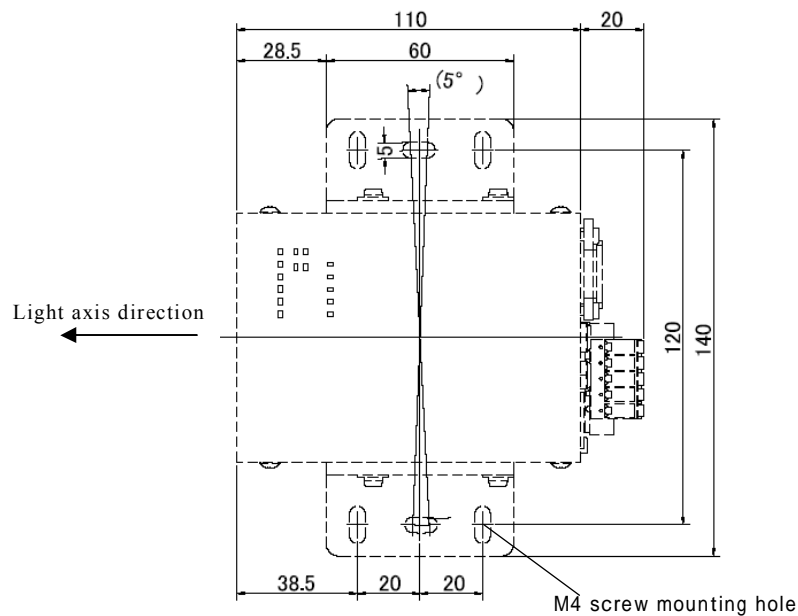
5. Names and Functions of Components



- (1) Power indicator lamp (POW)
Shows red when power is supplied to the main unit.
- (2) Own unit clear data indicator lamp (CD)
Shows red when the transmitter becomes able to receive data.
- (3) Own unit reception level indicator lamps (LEVELS 1 ~ 4)
Shows green according to reception level.
- (4) Receiving unit clear data indicator lamp (CD)
Shows red when the transmitter installed in the receiving side becomes able to receive data, and works only when own unit clear data indicator lamp is ON.
- (5) Receiving unit reception level indicator lamps (LEVELS 1 ~ 4)
Shows green according to the reception level in the receiving side, and works only when own unit clear data indicator lamp is ON.
- (6) Sending data indicator lamp (SD)
Blinks red when sending data input is ON.
- (7) Receiving data indicator lamp (RD)
Blinks green when the received data output is ON.
- (8) Link indicator lamp (LINK)
Shows green when 10BASE-T link is established.
- (9) Full-duplex indicator lamp (FDX)
Shows green when 10BASE-T link is in full-duplex operation.
- (10) + check terminal (length 10 mm or less for $\Phi 2$ -pin terminal)
Used when measuring light reception level by optical axis adjustment or others.
Use DC voltmeter of input resistance of $10K\Omega/V$ or more.
- (11) - check terminal (length 10 mm or less for $\Phi 2$ -pin terminal)
- (12) Power/aux. output connector
Power supply/aux. output signal and grounding wires are connected.
Applicable connectors: FKCT 2.5/5-STF-5.08 mfd by Phoenix Contact or equivalent items
- (13) Signal (Ethernet) connector
Used to communicate with 10BASE-T compatible equipment.
Applicable connectors: RJ45 plug (category 3 or more)
- (14) Setting switches
Used to set the 10BASE-T side and switch the transmit/receive frequencies.
- (15) FG terminals

6. Installation

(1) Mounting hole dimensions



Use the mounting fixture provided to avoid the effect of inductive noise.

(2) Caution in choosing the installation place

Do not use the transmitter in any of the following places to keep the performance.

- 1) A place where water, oils, particles, dust and/or chemicals may scatter.
- 2) A place where aqueous vapor, fumes and/or corrosive gases may cause optical signal attenuation.
Do not use any thinner type solvent for cleaning since the spotlight and acceptance surfaces consist of plastics.
- 3) A place where the equipment may be exposed to a temperature, humidity, vibration or impact out of the rated range.
Anti-vibration measures are required if the equipment is continuously exposed to vibration or impact even within the rated range.
- 4) A place near a magnet, motor or other devices that generate a strong magnetic field or an inverter or another devices or electric wire that generate a strong noise.
- 5) A place where the sunlight or candescent light containing strong infrared rays enters the receiver section within an angle not larger than 10 degrees from the center of the optical axis of the equipment. Use this equipment indoors.
- 6) A place where a person or an obstacle possibly interrupts optical path, or where aqueous vapor or fumes may be generated in the optical path between the transmitter and the receiver to dampens the optical signals.
- 7) A place where any reflected beam or light beam from another photoelectric switch is on the optical path of the transmitter, thus causing optical interference on this equipment.
- 8) A place where the optical axis may deviate 1.5 degrees or more by the meandering, vibration or impact of a moving body during communication with the moving body.

(3) Installation intervals

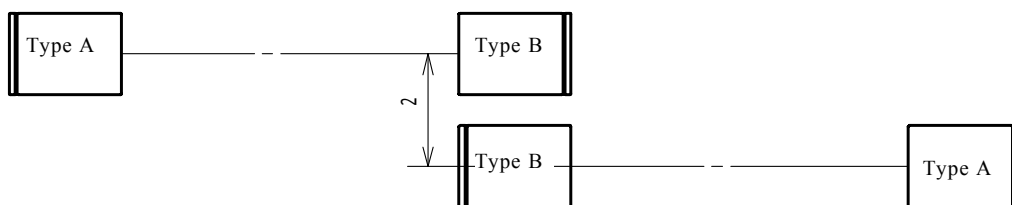
When plural transmitters are to be installed or a transmitter is used near another photoelectric sensor, they shall be installed at sufficient intervals to prevent optical interference.

Example 1



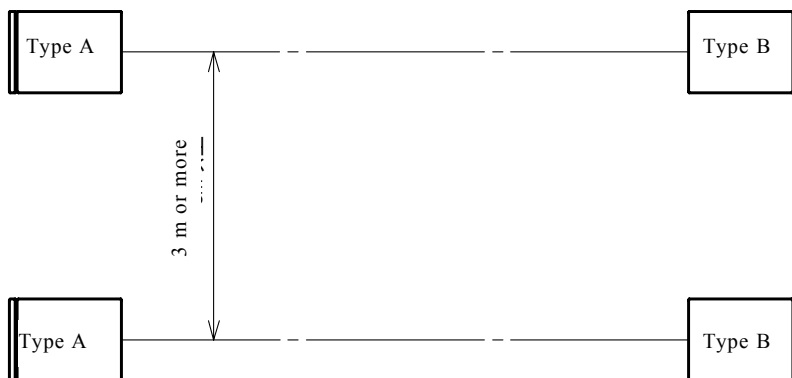
*1. Though data interference does not occur, the display of light reception level may be affected mutually.
(In time of optical axis adjustment/optical level check, turn off the power of unadjusted couple.)

Example 2.



*2. If no reflecting object exists, no interference occurs.
If distance is short between the opposing two of type A, the display of reception level may be affected.
In such a case, turn off the power of unadjusted couple and make an adjustment.

Example 3.



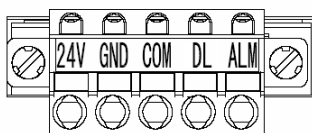
Note:

The optical axis deviation due to optical axis adjustment, vibration, impact, etc. may affect the optical interference. When installing the equipment on a moving carrier, check before use that the equipment can normally communicate throughout the communication area after adjustment of the optical axis according to section 9 “Adjustment of the Optical Axis.”

7. Electric Connections and Wiring

(1) Power/aux. output connectors

Signal name	Brevity code	Terminal No.
Power supply	24V	1
	GND	2
Aux. output	DL	4
	ALM	5
	COM	3

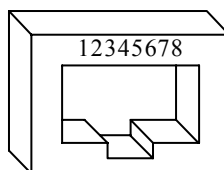


1 2 3 4 5
Cable insertion

- 1) Conforming connector (enclosed in package)
 - a. Plug FKCT 2,5/5-STF-5,08 (1902330) mfd by Phoenix Contact or equivalent items
- 2) Recommended cable
For power/aux. output cables, any cable of 0.3 mm² or more must be used.
(Check the voltage drop, and then use within the total length of 50 m.)

(2) Signal (Ethernet) connectors

Signal name	Brevity code	Terminal No.
Transmission output	TD+	1
	TD-	2
Reception input	RD+	3
	RD-	6
Not connected	-	4
	-	5
	-	7
	-	8

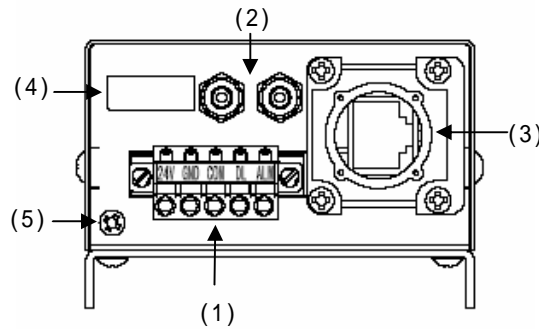


Transmission output and reception input may be exchanged according to the connected cable (AutoMDIX function). Polarity of reception input may be exchanged according to the connected signal (polarity detection function).

- 1) Conforming connectors
Plug: Category 3 or more RJ-45 plug or
VS-08-ST-RJ45 (1688573) manufactured by Phoenix Contact or equivalent items
Shell: VS-08-T-RJ45/IP67 (1688696) manufactured by Phoenix Contact or equivalent items

When using this equipment under the environment where there is a lot of vibration, use a plug and a shell manufactured by Phoenix Contact.
- 2) Recommended cables
Twist pair cable (UTP) cable of category 3 or more without shield or twist pair (STP) cable with shield shall be used. (Total length within 100 m)

(3) Connector arrangement (on the rear panel)



1) Power/aux. output connector
Pin terminal

2) Check terminal

The Check terminal on the rear panel shall be checked on the DC range of a tester of 10 k Ω /V or more.

The Check terminal is used to insert a tester bar of $\Phi 2$.

Pin terminal length: 8 - 10 mm recommended

Note: The output voltage may also be triggered by an external disturbance or reflected light. If the output voltage remains high with the projector shaded, the system must have been affected by an external disturbance or reflected light.

3) Signal (Ethernet) connector

4) Setting switch

Rubber cover shall be opened from the check terminal side.

5) FG terminal

(4) Notes

- 1) When using a shield cable, connect it (braided) to FG terminal in either the machine (optical transmitter) or external device.
- 2) For power supply, use one conforming to the specification of this machine.
- 3) For the load of aux. output, connect one within the output rating (30VDC, 50mA) of this machine. When connecting any inductive load including aux. relay, attach a diode to protect reverse voltage.
- 4) As for the cables, pay attention to the following points to prevent noises or surging induction.
 - a. Do not bring the cable near any of the main circuit, high-tension power supply and load wires or bundle it together with any of them. Keep it away from any of them by 100 m or more and wire it separately.
 - b. The same applies to intermediate cables.
 - c. The power and signal wires shall not be extended by more than 50 m within the same cable.
- 5) As associated with the transmission through space, loss or damage of data frame could occur. For the communication protocol in the network, use TCP, etc. applicable to re-transmission.
- 6) When connecting to a hub, a switching hub is recommended.

8. Setting Switches

(1) Ethernet settings

Auto negotiation	Effective Factory setting	Ineffective
SW1	OFF	ON

Full-duplex/half duplex	Full-duplex Factory setting	Half-duplex
SW2	OFF	ON

10BASE-T link when optical axis is shielded	Connection continued Factory setting	Disconnected
SW3	OFF	ON

Set items so that the communication mode of Full-duplex/Half-duplex may conform to the device connected in the receiving side across the optical transmitter.

Special care must be taken when connecting to the device not compatible with auto negotiation or when set to invalid.

If the mode is not the same, loss of data frame could occur.

* If any setting has been changed, turn off the power once, and then restart.

(2) An extra

An extra	Factory setting
SW4	OFF

Please use an extra switch in OFF.

9. Adjusting of the Optical Axis

During the adjustment of optical axis, damaged data could come out of signal (Ethernet) connector. Remove the cable from the connector, or make sure that there will be no problem if any damaged data flows to the network, then start adjustment.

- (1) After checking that wires have been correctly connected, turn on the power supply to the main unit.
The power indicator lamp (POW) shows red.
- (2) Loosen the main unit mounting screws and move the main unit in the vertical and horizontal directions until the clear data indicator lamp (CD) on the receiving unit shows red.
<Note> Reception levels at the receiving unit on the main unit will not be displayed if the own unit reception level fails to be CD or more. First, adjust by referring to the display of reception level on the receiving unit.
- (3) Make further fine adjustment until the reception level indicator lamps on the receiving unit show green up to LEVEL 3 or higher.
Detailed reception levels are checked by the tester connected to the check terminal of receiving unit. Reception levels are measured by a tester (input resistance being 10 k Ω /V or higher in DC voltage range 10V or so). Tester bars of Φ 2 shall be inserted into (+) and (-) of check terminal.
- (4) Max value of check terminal voltage is 4.2V or so.
In operation, fix at the position of max voltage by referring to 2.2V or higher in the case of the max transmission distance.
- (5) Adjust the receiving unit in the same manner.
- (6) When installing either unit on a moving body such as a stacker crane, check that the reception level indicator lamps up to LEVEL 3 or higher show green at both moving and fixed units across the moving areas.

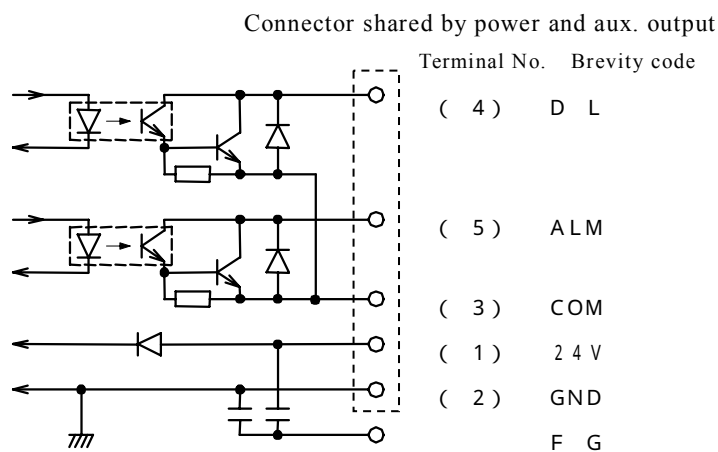
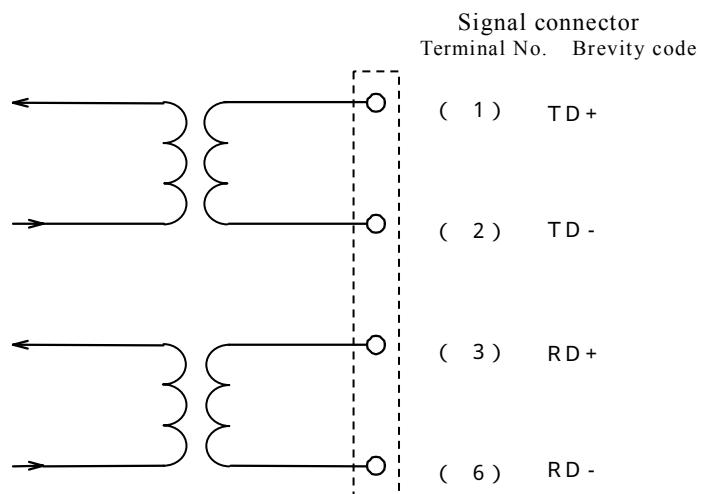
10. Operation

- (1) The data frame to be transmitted to the receiving unit is sent as soon as it is input to this equipment from an external device. Data equivalent to 1 frame is not accumulated inside the equipment.
- (2) Data frame sent from the receiving unit is sent to an external device as soon as it is received.
- (3) Functions of sending data indicator lamp (SD) and receiving data indicator lamp (RD)
 Sending data indicator lamp (SD) blinks in red when sending input is active.
 Receiving data indicator lamp (RD) blinks in green when receiving input is active.
- (4) When optical path is shielded, the receive indicator lamp goes off, and no data can be sent any longer. Reception level is not displayed, either, at the receiving unit.
- (5) Functions of link indicator lamp (LINK) and full-duplex indicator lamp (FDX)
 Link indicator lamp (LINK) shows green when the network connection with the external device connected to the signal connector is normal.
 Full-duplex indicator lamp (FDX) shows green when the network connection with the external device connected to signal connector is in full-duplex mode.
- (6) Aux. output operates as shown below.
 1) DL: Transistor turns on when the data link is normal.
 2) ALM: Transistor turns off when the reception level indicator lamp (LEVEL 1) is off.
- (7) The statuses of indicators and subsidiary outputs change as shown below when the beam is received or interrupted.

Condition	Unit 1				Unit 2
	Light intensity received by this unit	Light intensity received by the other unit	DL output	ALM output	Light intensity received by this unit
Normal	L1 or more	L1 or more	ON	ON	The same with (1)
Insufficient light intensity (cleaning or beam adjustment required)	CD only	CD or more	ON	OFF	The same with (1)
Interrupted (cleaning or beam adjustment required)	Off	Off	OFF	OFF	Off
Affected by external disturbance or reflected light	CD or more	Off	OFF	OFF	CD or more
	L1 or more	Off	OFF	OFF	CD or more

Note: If the system is affected by an external disturbance or reflected light, different values will be indicated by units 1 and 2 to represent the light intensity received by unit 2.

11. Signal Interface



- *Note 1: For signal wires, use UTP (Unshielded twist pair) or STP (Shielded twist pair) cable of category 3 or higher. Extension of cable shall be within 100 m.
- *Note 2: For power wire, use electric wire of 0.3 mm² or more. Extension of power wire shall be within 50 m if power voltage is 24VDC.
- *Note 3: Voltage between DL – COM or ALM – COM shall be 30VDC or lower in OFF, and the residual voltage in ON shall be 2V or so.

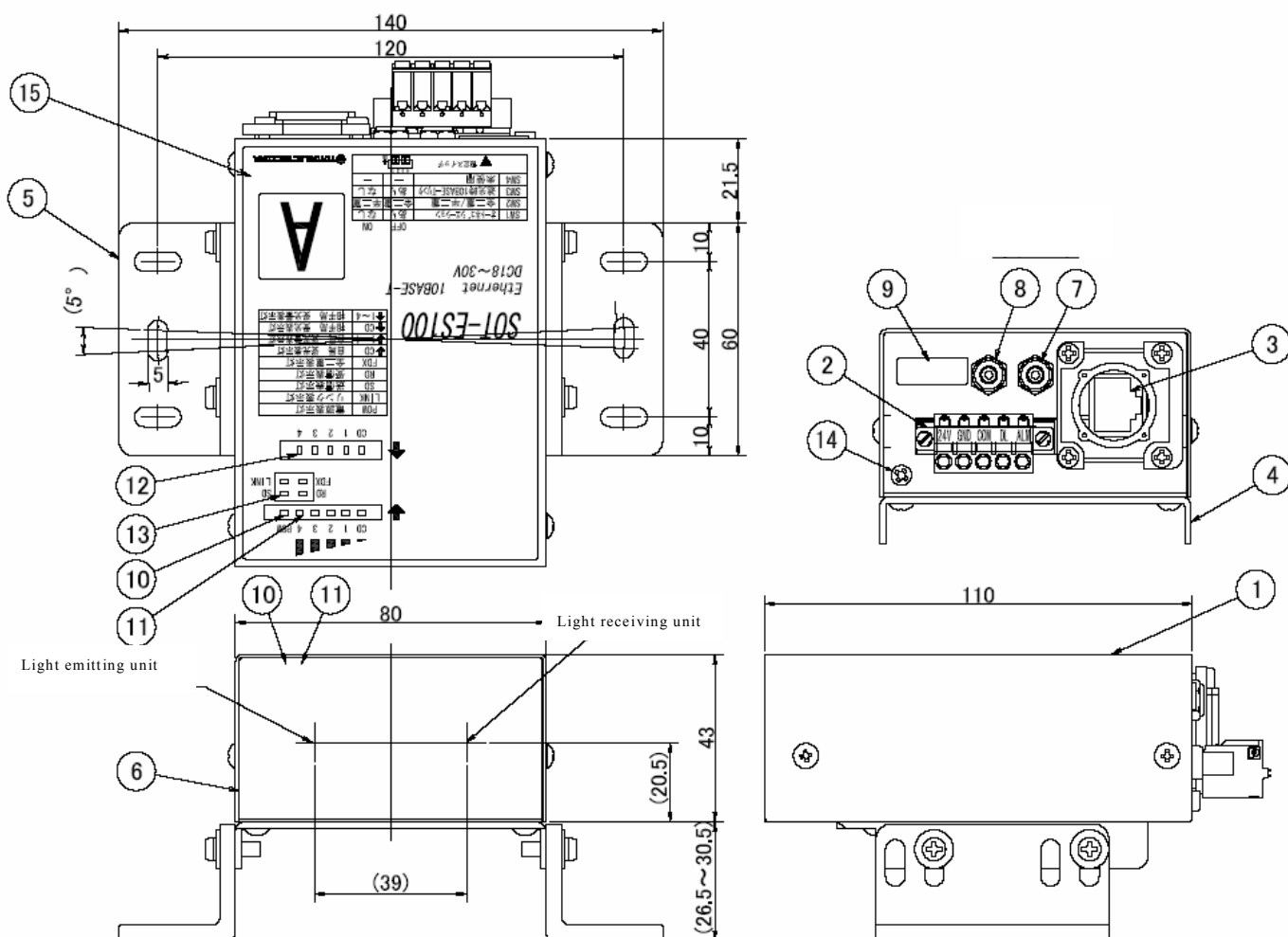
12. Maintenance and Inspection

- (1) Check for any stain on the front cover periodically.
The equipment optically transmits data, and stain on the front cover may cause a communication error. Wipe off the cover with dry cloth or such if stained heavily.
The spotlight and acceptance surfaces consist of plastics. Do not use any toluene-containing solvent for cleaning it.
- (2) Check for any loose or chattering mounting screws. Re-tighten mounting screws if necessary.

13. Caution in Use

- (1) Protection from voltage ripples
Use a power supply unit that satisfies the power supply specifications for the equipment.
When supplying power from a power supply unit for PC (sequencer or such), check that the equipment functions normally.
- (2) Caution in resetting the power
Data cannot be transferred for about 500 ms after supplying power to the equipment.
(Data cannot be transferred for further 2 sec or so because of auto negotiation when such auto negotiation is effective.)
- (3) Optical axis adjustments
Do not fail to adjust optical axis after installing the equipment.
Data can be transferred as far as the clear data indicator lamp (CD) is lit and the data link output (DL) is on. While the reception level indicator lamp (LEVEL 1) is not lit, the low reception level signal (ALM) is issued (OFF).
- (4) Power wiring
The power cable shall be 50 m or shorter.
Electric noises are induced into the power cable in various ways from electric devices along the power cable and from power cables to other devices.
The power cable may cause a malfunction even if it is shorter than 50 m.
If any source of such a disturbance exists along the power cable, preventive actions shall be taken including the following:
 - 1) Keep the power unit for the equipment nearby.
 - 2) Reduce the length of the power cable or separately install it.
 - 3) Change the cable to an electromagnetically shielded one.

14. Outside Dimensions



No.	Name or function	Quantity	Remark	No.	Name or function	Quantity	Remark
	Case	1	Aluminum, alumite processing		Power indicator lamp	1	
	Power/aux. output connector	1			Clear data indicator lamp (own unit)	5	CD, LEVEL1-4
	Ethernet connector	1	RJ45		Clear data indicator lamp (receiving unit)	5	CD, LEVEL1-4
	Mounting seat	1			Communication indicator lamp	4	SD, RD, LINK, FDX
	Mounting fixture	2	ABS resin, black		FG terminal	1	M3
	Optical communication unit cover	1	Acryl resin, blue smoke		Nameplate	1	
	Check terminal +	1	Φ2 pin terminal, red				
	Check terminal -	1	Φ2 pin terminal, black				
	Setting switch	1	4P				

15. Guarantee

(1) Guarantee period

One (1) year after delivery to the specified place.

(2) Scope of guarantee

If the equipment is found to have a fault attributable to us during the guarantee period specified above, the faulty part will be replaced or repaired on our risk. This does not apply to:

- 1) the faults resulting from the incorrect handling or misuse by the user
- 2) those resulting from a cause not related with the equipment
- 3) those resulting from the modification or repair by parties other than us, and
- 4) those resulting from a natural disaster or accident beyond our control.

For the purpose of this document, the guarantee applies to the equipment itself and does not apply to the secondary damage caused by the malfunction of the equipment.

16. For Contact

For further information about the product, please contact our sales office nearby or the Machinery Division, Kamiya Factory.



TOYO ELECTRIC CORP., Electric Machinery Div.

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Kanagawa Office	(City Mason, No. 203) Miyata-cho 1-4-17, Hodogaya-ku, Yokohama City, Kanagawa 240-0002 TEL <045> 340-1766 FAX <045> 340-1767
Nagoya Office	156, Ajimi-cho 2-chome, Kasugai City, Aichi 450-0002 TEL <0568> 35-3456 FAX <0568> 34-4666
Toyota Office	1-15-8, Kosaka-honmachi, Toyota City, Aichi 471-0034 TEL <0565> 37-8830 FAX <0565> 37-8832
Osaka Office	(Osaka Godo Bldg, No. 805) 1-5, Doyama-cho, Kita-ku, Osaka City 530-0027 TEL <06> 6361-1626 FAX <06> 6312-6762
Nishi-Nihon Office	(Abundant 90, No. 301) Hakata Eki Higashi 3-11-4, Hakata-ku, Fukuoka City, Fukuoka 812-0013 TEL <092> 413-2300 FAX <092> 413-2312

Website: URL <http://www.toyo-elec.co.jp>

* Specifications, dimensions, etc. shown in this operation manual may be changed to reflect the performance improvement without notice.

17. Revision History

Date	Content of revision	Remark
2006.12.06	First edition	Development
2007.02.13	Addition of consumption current, correction of directivity angle from 1.5 to 1.2, correction of pin number of aux. output	Development
2007.04.20	A power supply / an assistance output connector model change, an error in writing correction, an address change	Development
2007.11.30	Change CDO output to DL output.	Development
2008.07.24	A note regarding the check output added. The light received/interrupted and indicator/output statuses added.	Development 1
	Space to be filled	