# Digital Laser Sensor | Amplifier-separated

## LS-400 SERIES

**User-friendly, high precision laser sensing!**

We offer 6 types of laser sensor heads for various applications

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</tbody>
</table>

### Amplifiers
- LS-401/401P/403
- LS-401-C2/LS-401P-C2

### Connectors
- LS-401/401P/403

### LS-400 SERIES
- LS-400 SERIES

### LS-500 SERIES
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**Related Information**
- General terms and conditions............ F-7
- Sensor selection guide ................. P.211~
- SC-GU3 / SC-GU2-C................. P.985~ / P.999
- Glossary of terms / General precautions .......................... P.1455 / P.1456~
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- Korea’s S-mark.......................... P.1506

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**Panasonic.net/id/pidsx/global**

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**Notice**

This product complies with 21 CFR 1040.10 Laser Notice No. 50, dated July 26, 2001, issued by CDRH (Center for Devices and Radiological Health) under the FDA (Food and Drug Administration).

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**Related Information**
- LS-H□-A Class 1 laser in compliance with IEC / JIS / GB standards and FDA regulations

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### Notes:
1) The spot diameter is a typical example. The measurement values given here were determined with a center light intensity of 1/e² (13.5%).
2) This is the reference value from visual observation.
APPLICATIONS

Detecting objects with a complex shape
Its linear sensing area enables more stable detection of objects with complex shapes.

Detecting the remaining amount of sheet rolls
The coaxial retroreflective sensor with a spot diameter of approx. ø1 mm ø0.039 in (at a 1 m 3.281 ft sensing distance), can measure amounts remaining on sheet rolls with high precision.

Sheet rolls

Detecting electronic component pins
Because its spot shape can be adjusted in accordance with the object, it can be easily set to detect even the minutest object from a remote location.

NOTE: The applications given in this catalog are examples for reference only. Stable sensing may not be possible under certain setup conditions and environmental conditions, so be sure to check the actual sensor before use.

Industry standard mounting pitch
The mounting pitch for sensor heads is 25.4 mm 1.000 in, the same industry standard as the CX-400 series general purpose photoelectric sensors. Hence, existing mounting brackets can be used even when replacing general purpose sensors with laser sensors.

Easy and accurate adjustments
A spot-size adjuster is built into the back of the sensor head allowing the user to adjust the sensor easily while viewing the spot. The adjuster is adjustable with a screwdriver to avoid accidents during maintenance or any other time the sensors are handled.

Line-up of FDA / IEC / JIS
Class 1 type LS-H91(F)-A, LS-H21(F)-A
Visible light spot using the Class 1 type. This makes beam axis alignment much easier.

Sensor mounting bracket for beam axis alignment is available MS-CX-11
It is possible to make a minor adjustment for the bracket by 4 degrees up, down, right or left, even after setting up the sensor. The bracket can be mounted in both longitudinal and lateral directions.
**Easy setting, dual display**

Equipped with 2 large 4-digit digital displays. While checking the current incident light intensity (red display), the optimal threshold value (green display) can be set easily.

![Image of Easy setting, dual display]

**Wiring and space saving**

The quick-connection cables enable reductions in wiring. The connections and man-hours for the relay terminal setup can be reduced and valuable space is saved. Also, LS-400 series sensors can be connected side-by-side, up to 16 units, with a connector type of FX-500/300 series digital fiber sensors and DPS-400 series digital pressure sensors.

Note: Because the transmission method varies depending on the amplifiers, check the instruction manual for the amplifiers when connecting them.

**Threshold tracking function saves maintenance time**

This function seeks changes in the light emitting amount resulting from changes in the environment over long periods (such as dust levels), so that the incident light intensity can be checked at desired intervals and the threshold values can be reset automatically. This helps to reduce the man-hours for maintenance.

**Amplifier with upper communication function is available.**

The amplifier with upper communication function LS-403 enables data communication through CC-Link / DeviceNet / EtherCAT by using with a communication unit for open network (SC-GU2-C / SC-GU3 series) together. As for communication unit for open network, other than LS-403, laser sensor LS-501, digital fiber sensors FX-501/502/301/305 and digital pressure sensors DPS-401/402 are also connectable. It is possible to carry out batch data communication.

* Please refer to communication unit for open network for details.
4 new modes enabling wide array of sensing

Hysteresis mode
Window comparator mode
2 independent output modes
Differential sensing mode

By adjusting the hysteresis, convexo-concave parts of uneven objects can be cancelled enabling more stable sensing.

The sensor judges any object outside the range of incident light intensity established by two set threshold values.

By combining two outputs, wide array of control is possible, allowing you to detect meandering objects, for example.

Only rapid changes in light received are detected, which enable the edge of glass, etc. to be detected accurately. Optimal for positioning.

MODE NAVI customized function

Frequently used functions such as response time, M.G.S. function, data bank load, emission halt function and D-CODE values can be stored in CUSTOM mode. The settings are changed easily.

Accurately sense the minutest variations (M.G.S. function)
When sensing at close range or when the target objects are transparent or minute, adjust the sensor receiving sensitivity to one of 3 levels (U-LG mode: 4 levels) for the optimal setting. In addition, changing the receiving sensitivity will not effect the response time.

Cable type allows external input
The LS-401-C2 cable-type amplifier is equipped with an external input wire (5-core). It is ideal to use the laser sensor at places where external teaching or laser light emission halting is to be carried out, or at the places where the laser sensor is to be used separately.

Interference prevention function
The automatic interference prevention function prevents against interference among up to 4 sensors.

Setting conditions viewed at a glance (D-CODE)
The amplifier setting is shown as an 8-digit code. Handy for remote indications and follow-ups.
## ORDER GUIDE

### Sensor heads

<table>
<thead>
<tr>
<th>Type</th>
<th>Appearance</th>
<th>Model No.</th>
<th>Conforming standards</th>
<th>Sensing range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaxial retroreflective</td>
<td>Class 2</td>
<td>LS-H92</td>
<td>IEC / JIS / GB</td>
<td>0.2 to 30 m 0.656 to 98.425 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H92F (Note 1)</td>
<td>FDA / IEC / JIS</td>
<td>0.2 to 20 m 0.656 to 65.617 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2 to 10 m 0.656 to 32.808 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H91</td>
<td>IEC / JIS / GB</td>
<td>0.1 to 7 m 0.328 to 22.966 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1 to 5 m 0.328 to 16.404 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1 to 3 m 0.328 to 9.843 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H91F (Note 1)</td>
<td>FDA / IEC / JIS</td>
<td>0.1 to 3 m 0.328 to 9.843 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1 to 1 m 0.328 to 3.281 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H91-A</td>
<td>IEC / JIS / GB</td>
<td>0.1 to 5 m 0.328 to 16.404 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1 to 3 m 0.328 to 9.843 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H91F-A (Note 1)</td>
<td>FDA / IEC / JIS</td>
<td>0.1 to 1 m 0.328 to 9.843 ft (Note 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H21</td>
<td>IEC / JIS / GB</td>
<td>30 to 1,000 mm 1.181 to 39.370 in</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>30 to 500 mm 1.181 to 19.685 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 300 mm 1.181 to 11.811 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H21F (Note 1)</td>
<td>FDA / IEC / JIS</td>
<td>30 to 1,000 mm 1.181 to 39.370 in</td>
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<tr>
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<td></td>
<td>30 to 300 mm 1.181 to 11.811 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H21-A</td>
<td>IEC / JIS / GB</td>
<td>30 to 500 mm 1.181 to 19.685 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 250 mm 1.181 to 9.843 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 150 mm 1.181 to 5.906 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H21F-A (Note 1)</td>
<td>FDA / IEC / JIS</td>
<td>30 to 1,000 mm 1.181 to 39.370 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 500 mm 1.181 to 19.685 in</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 300 mm 1.181 to 11.811 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H22</td>
<td>IEC / JIS / GB</td>
<td>30 to 1,000 mm 1.181 to 39.370 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 500 mm 1.181 to 19.685 in</td>
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<td></td>
<td></td>
<td></td>
<td>30 to 300 mm 1.181 to 11.811 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-H22F (Note 1, 3)</td>
<td>FDA / IEC / JIS</td>
<td>30 to 1,000 mm 1.181 to 39.370 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 500 mm 1.181 to 19.685 in</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 to 300 mm 1.181 to 11.811 in</td>
</tr>
</tbody>
</table>

### NOTE: Mounting bracket is not supplied with the sensor head. Please select from the range of optional sensor head mounting brackets.

Notes:
1) This product complies with 21 CFR 1040.10 Laser Notice No. 50, dated July 26, 2001, issued by CDRH (Center for Devices and Radiological Health) under the FDA (Food and Drug Administration). For details, refer to the Laser Notice No. 50.
2) The sensing range is the value for the diffuse reflective type sensor head. Hence, the response time or incident light sensitivity.
3) LS-H21(F) is the model No. for LS-H21(F) long sensing range reflective type sensor head combined with the LS-MR1 lens attachment for line reflective type sensor head. Hence, LS-H21(F) appears on the sensor head itself.

### 5 m 16.404 ft cable length type

5 m 16.404 ft cable length type (standard: 2 m 6.562 ft) is also available. When ordering this type, suffix “-C5” to the model No.

- LS-H91-C5
- LS-H91-A-C5
- LS-H21-C5
- LS-H22-C5

### Package without reflector

The LS-H91(F), LS-H91(F)-A and LS-H92(F) are also available without the reflector (RF-330 or RF-230). When ordering this type, suffix “-Y” to the model No.

- LS-H92-Y
- LS-H92F-Y
- LS-H91-Y
- LS-H91F-Y
- LS-H91-A-Y
- LS-H91F-A-Y
## ORDER GUIDE

### Amplifiers

<table>
<thead>
<tr>
<th>Type</th>
<th>Appearance</th>
<th>Model No.</th>
<th>Output</th>
<th>Connection method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector type</td>
<td></td>
<td>LS-401</td>
<td>NPN open-collector transistor two outputs</td>
<td>Use quick-connection cable (4-core) (optional)</td>
</tr>
<tr>
<td>With upper communication function (Note 2)</td>
<td></td>
<td>LS-401P</td>
<td>PNP open-collector transistor two outputs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-403</td>
<td>NPN open-collector transistor two outputs</td>
<td></td>
</tr>
<tr>
<td>Cable type (With external input)</td>
<td></td>
<td>LS-401-C2</td>
<td>NPN open-collector transistor two outputs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS-401P-C2</td>
<td>PNP open-collector transistor two outputs</td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1) Obtained Korea’s S-mark certification.
2) For upper communication, a communication unit for open network (SC-GU2-C / SC-GU3 series) is needed separately.

### Quick-connection cables

Quick-connection cable is not supplied with the connector type amplifier. Please order it separately.

<table>
<thead>
<tr>
<th>Type</th>
<th>Appearance</th>
<th>Model No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main cable (4-core)</td>
<td></td>
<td>CN-74-C1</td>
<td>Length: 1 m 3.281 ft 0.2 mm² 4-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN-74-C2</td>
<td>Length: 2 m 6.562 ft 0.2 mm² 4-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN-74-C5</td>
<td>Length: 5 m 16.404 ft 0.2 mm² 4-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in</td>
</tr>
<tr>
<td>Sub cable (2-core)</td>
<td></td>
<td>CN-72-C1</td>
<td>Length: 1 m 3.281 ft 0.2 mm² 2-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in Connectable to a main cable up to 15.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN-72-C2</td>
<td>Length: 2 m 6.562 ft 0.2 mm² 2-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in Connectable to a main cable up to 15.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN-72-C5</td>
<td>Length: 5 m 16.404 ft 0.2 mm² 2-core cabtyre cable, with connector on one end Cable outer diameter: ø3.3 mm ø0.130 in Connectable to a main cable up to 15.</td>
</tr>
</tbody>
</table>

### End plates

End plates are not supplied with the amplifier. Please order them separately when the amplifiers are mounted in cascade.

<table>
<thead>
<tr>
<th>Type</th>
<th>Model No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MS-DIN-E</td>
<td>When cascading multiple amplifiers, or when it moves depending on the way it is installed on a DIN rail, these end plates clamp amplifiers into place on both sides. Make sure to use end plates when cascading multiple amplifiers together.</td>
</tr>
</tbody>
</table>

### Accessories

- **RF-330** (Reflector)
- **RF-230** (Reflector)
- **CN-EP1** (Connector for amplifier)
  - 5 pcs. per set (Note)
- **LS-MR1** (Lens attachment for line reflective type)
  - Note: One is attached to each sensor head according to standard.
### OPTIONS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Model No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor head mounting bracket</td>
<td>MS-CX-1</td>
<td>Foot angled mounting bracket</td>
</tr>
<tr>
<td></td>
<td>MS-CX-2</td>
<td>Foot biangled mounting bracket</td>
</tr>
<tr>
<td></td>
<td>MS-CX-3</td>
<td>Back angled mounting bracket</td>
</tr>
<tr>
<td></td>
<td>MS-CX-4</td>
<td>Protective mounting bracket</td>
</tr>
<tr>
<td>Sensor mounting bracket for beam axis alignment</td>
<td>MS-CX-11</td>
<td>Mounting bracket that makes fine beam axis alignment possible after setting the sensor head.</td>
</tr>
<tr>
<td>Universal sensor mounting stand (Note 1)</td>
<td>MS-AJ1</td>
<td>Horizontal mounting type</td>
</tr>
<tr>
<td></td>
<td>MS-AJ2</td>
<td>Vertical mounting type</td>
</tr>
<tr>
<td></td>
<td>MS-AJ1-A</td>
<td>Horizontal mounting type</td>
</tr>
<tr>
<td></td>
<td>MS-AJ2-A</td>
<td>Vertical mounting type</td>
</tr>
<tr>
<td>Amplifier mounting bracket</td>
<td>MS-DIN-2</td>
<td>Mounting bracket for amplifier</td>
</tr>
<tr>
<td>Reflector mounting bracket</td>
<td>MS-RF23</td>
<td>Mounting bracket for RF-230</td>
</tr>
<tr>
<td>Amplifier protection seal</td>
<td>FX-MB1</td>
<td>10 sets of 2 communication window seals and 1 connector seal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communication window seal prevents malfunctions due to transmission signal from another amplifier as well as prevents effects on another amplifier.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connector seal prevents contact of any metal, etc., with the pins of the quick-connection cable.</td>
</tr>
<tr>
<td>Reflector</td>
<td>RF-310</td>
<td>For coaxial retroreflective type</td>
</tr>
<tr>
<td></td>
<td>RF-33</td>
<td>For coaxial retroreflective type</td>
</tr>
<tr>
<td></td>
<td>RF-31</td>
<td>For coaxial retroreflective type</td>
</tr>
<tr>
<td>Bank selection unit (Note 2)</td>
<td>FX-CH</td>
<td>NPN input type</td>
</tr>
<tr>
<td></td>
<td>FX-CH-P</td>
<td>PNP input type</td>
</tr>
</tbody>
</table>

Notes: 1) Refer to p.979 the universal sensor mounting stand MS-AJ series. 2) Please see the website for details of the bank selection unit FX-CH.

### Sensor head mounting bracket
- **MS-CX-1**
- **MS-CX-2**
- **MS-CX-3**
- **MS-CX-4**

### Sensor mounting bracket for beam axis alignment
- **MS-CX-11**

### Amplifier mounting bracket
- **MS-DIN-2**

### Bank selection unit
- **FX-CH**
- **FX-CH-P**

### Sensor mounting bracket for beam axis alignment
- **MS-CX-11**

### Reflector mounting bracket
- **MS-RF23**

### Amplifier protection seal
- **FX-MB1**
- **FX-CH-P**

### Bank selection unit
- **FX-CH-P**

### Notes:
1) Refer to p.979 the universal sensor mounting stand MS-AJ series.
2) Please see the website for details of the bank selection unit FX-CH.


## SPECIFICATIONS

### Sensor heads

<table>
<thead>
<tr>
<th>Type</th>
<th>Coaxial retroreflective</th>
<th>Diffuse reflective</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC / JIS / GB standards conforming type</td>
<td>Class 2</td>
<td>Class 1</td>
</tr>
<tr>
<td>Model No.</td>
<td>LS-H92</td>
<td>LS-H91</td>
</tr>
<tr>
<td>LS-H21</td>
<td>LS-H92F</td>
<td>LS-H91F</td>
</tr>
</tbody>
</table>

Applicable amplifiers:
- LS-401(P), LS-401(P)-C2, LS-403

- **U-LG mode**
  - 0.2 to 30 m
  - 0.569 to 18.425 ft (Note 4)

- **STD mode**
  - 0.2 to 20 m
  - 0.569 to 65.017 ft (Note 4)

- **FAST mode**
  - 0.2 to 10 m
  - 0.569 to 32.600 ft (Note 4)

- **H-SP mode**
  - 0.1 to 3 m
  - 0.328 to 9.843 ft (Note 4)

**Operation indicator**
- Orange LED (lights up when the amplifier output is ON)

**Laser emission indicator**
- Green LED

**Spot-shape adjuster**
- Multi-turn adjuster

### Environmental resistance

- **Protection**
  - IP40 (IEC)

- **Ambient temperature**
  - –10 to +55 °C +14 to +131 °F (No dew condensation or icing allowed), Storage: –20 to +70 °C –4 to +158 °F

- **Ambient humidity**
  - 35 to 85 % RH, Storage: 35 to 85 % RH

- **Ambient illuminance**
  - Incandescent light: 3,000 ℓx at the light-receiving face

- **Voltage withstandability**
  - 1,000 V AC for one min. between all supply terminals connected together and enclosure

- **Insulation resistance**
  - 20 MD, or more, with 250 V DC megger between all supply terminals connected together and enclosure

- **Vibration resistance**
  - 10 to 500 Hz frequency, 1.5 mm 0.059 in (10 G, max.) amplitude in X, Y and Z directions for two hours each

- **Shock resistance**
  - 100 m/s² acceleration (10 G approx.) in X, Y and Z directions for three times each

**IEC / JIS / GB standards conforming type**
- Red semiconductor laser, Class 2 (IEC / JIS / GB)
- Max. output: 3 mW
- Peak emission wavelength: 655 nm 0.026 mil

**FDA / IEC / JIS standards conforming type**
- Red semiconductor laser, Class 2 (FDA / IEC / JIS)
- Max. output: 3 mW
- Peak emission wavelength: 655 nm 0.026 mil

**Material**
- Enclosure: PBT (Mounting part: PEI), Lens cover: Acrylic

**Cable**
- 0.1 mm², single core two parallel shielded cables, 2 m 6.562 ft long (Connector for amplifier attached) (Note 5)

**Weight**
- Net weight: 30 g approx. Gross weight: 45 g approx.

**Accessories**
- RF-230(Reflector): 1 pc.
- Warning label: 1 set
- Labels are written in Japanese, English and Chinese for compliance with various standards.

- RF-330(Reflector): 1 pc.
- Warning label: 1 set
- Labels are written in Japanese, English and Chinese for compliance with various standards.

- RF-330(Reflector): 1 pc.
- Explanation label: 1 set
- Labels are written in Japanese and Chinese for compliance with various standards.

**Notes:**
1. Where measurement conditions have not been specified precisely, the conditions used were an ambient temperature of +23 °C +73.4 °F.
2. This product complies with 21 CFR 1040.10 Laser Notice No. 50, dated July 26, 2001, issued by CDRH (Center for Devices and Radiological Health) under the FDA (Food and Drug Administration). For details, refer to the Laser Notice No. 50.
3. LS-H22F is the set model No. for LS-H21(F) long sensing range spot reflective type sensor head combined with the LS-MR1 lens attachment for line reflective type. Hence, LS-H21(F) appears on the sensor head itself.
4. The sensing range is the value for the RF-330 [RF-230 for the LS-H92(F)] reflector. In addition, the sensing range is the possible setting range for the reflector. The sensor can detect an object less than 0.1 m 0.328 ft [LS-H92(F): 0.2 m 0.656 ft] away. Note that if there are white papers or specular objects near the sensor head, reflected light from these objects may be received. In such cases, use the M.G.S. function of the amplifier unit to change the response time or incident light sensitivity.
5. Cable cannot be extended.
Amplifiers

<table>
<thead>
<tr>
<th>Component</th>
<th>Type</th>
<th>Connector type</th>
<th>Cable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>12 to 24 V DC ±10 %</td>
<td>Ripple P-P 10 % or less</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>Normal operation: 950 mW or less (Current consumption 40 mA or less at 24 V supply voltage)</td>
<td>ECO mode: 780 mW or less (Current consumption 33 mA or less at 24 V supply voltage)</td>
<td></td>
</tr>
</tbody>
</table>

Outputs (Output 1, Output 2):

- **<NPN output type>**
  - PNP open-collector transistor
  - Maximum sink current: 100 mA (LS-401: Note 2), 50 mA (LS-403: Note 3)
  - Applied voltage: 30 V DC or less (between output and 0 V)
  - Residual voltage: 1.5 V or less at 50 mA (Note 2) sink current (Note 4)
- **<PNP output type>**
  - PNP open-collector transistor
  - Maximum source current: 100 mA (Note 2)
  - Applied voltage: 30 V DC or less (between output and +V)
  - Residual voltage: 1.5 V or less at 100 mA (Note 2) source current

Output operation:
- Selectable either Light-ON or Dark-ON, with jog switch

Response time:
- 80 μs or less (H-SP), 150 μs or less (FAST), 500 μs or less (STD), 4 ms or less (U-LG) selectable with jog switch

Operation indicator:
- Orange LED (lights up when output 1 and output 2 are ON)

Laser emission indicator:
- Green LED (lights up during laser emission)

Select indicator:
- Yellow LED (lights up when either output 1 or output 2 is selected)

MODE indicator:
- RUN: Green LED, TEACH • LCD • TIMER • CUST • PRO: Yellow LED

Digital display:
- 4 digit (green) + 4 digit (red) LED display

Sensitivity setting:
- Normal mode: 2-level teaching / Limit teaching / Full-auto teaching / Manual adjustment
- Window comparator mode: Teaching (1-level, 2-level, 3-level) / Manual adjustment
- Hysteresis mode: Teaching (1-level, 2-level, 3-level) / Manual adjustment
- Differential mode: 5-level settings (LS-403: 8-level settings)

Fine sensitivity adjustment function:
- Incorporated

Timer function:
- Incorporated with variable ON-delay / OFF-delay / ONE SHOT timer, switchable either effective or ineffective.
- Timer period: 1 to 9,999 ms approx.
- 0.5 ms approx. to 9.999 ms approx.
- 1 to 9,999 ms approx.

Automatic interference prevention function:
- Incorporated [Up to four sets of sensor heads can be mounted close together. (However, LS-401: is disabled when in H-SP mode, up to two sets of LS-403 can be mounted close together when in H-SP mode)]

Environmental resistance:
- 98 m/s

Notes:
1) Where measurement conditions have not been specified precisely, the conditions used were an ambient temperature of +23 °C ±73.4 °F. 2) In case of LS-401(P), 50 mA if 5 to 8 amplifiers are connected in cascade, and 25 mA if 9 to 16 amplifiers are connected in cascade. 3) In case of LS-403, 25 mA if 5 to 16 amplifiers are connected in cascade. 4) The cable is not supplied as an accessory for connector type. Be sure to purchase the optional quick-connection cables given below. When connecting to SC-GU2-C, be sure to purchase the optional non-line connector.

Main cable (4-core): CN-74-C1 (cable length 1 m 3.281 ft), CN-74-C2 (cable length 2 m 6.562 ft), CN-74-C5 (cable length 5 m 16.404 ft)
Sub cable (2-core): CN-72-C1 (cable length 1 m 3.281 ft), CN-72-C2 (cable length 2 m 6.562 ft), CN-72-C5 (cable length 5 m 16.404 ft)
Non-line connector: CN-70
There is a page from a technical manual discussing the I/O circuit diagram and wiring diagrams for a digital laser sensor. The page contains diagrams, text, and tables, which are not transcribed here. The text is about the connection and wiring of the sensor, including the use of different cables and connectors for power supply and signal transmission. The diagrams illustrate the connections and pinouts for various models of the laser sensor, highlighting the correct wiring for external input and power supply. The page is part of a larger manual that covers multiple aspects of the sensor's usage and configuration.
PRECAUTIONS FOR PROPER USE

Cautions for laser beams

- These products are class 2 (LS-H□-□-F, LS-H□-A) in compliance with IEC / JIS / GB standards and FDA* regulations. Do not look at the laser beam directly or through optical system such as a lens.
- The following label is attached to the product. Handle the product according to the instruction given on the warning label.

Safety standards for laser beam products

- A laser beam can harm human being’s eyes, skin, etc., because of its high energy density. IEC has classified laser products according to the degree of hazard and the stipulated safety requirements. LS-H□-(F) is classified as Class 2 laser. LS-H□-(F)-A is classified as Class 1 laser.

Classification by IEC 60825-1

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.</td>
</tr>
<tr>
<td>Class 2</td>
<td>Lasers that emit visible radiation in the wavelength range from 400 nm to 700 nm where eye protection is normally afforded by aversion responses, including the blink reflex. This reaction may be expected to provide adequate protection under reasonably foreseeable conditions of operation including the use of optical instruments for intrabeam viewing.</td>
</tr>
</tbody>
</table>

Safe use of laser products

- For the purpose of preventing users from suffering injuries by laser products, IEC 60825-1 (Safety of laser products). Kindly check the standards before use.

Cautions when connecting amplifiers in cascade

- Refer to connecting conditions written below when connecting amplifiers in cascade.
- When amplifiers are installed, refer to "Cautions on communication function" and use communication function.

Connecting conditions

<table>
<thead>
<tr>
<th>Cascading order</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

Notes: 1) The previous version unit is manufactured before June 2004. The updated version unit is manufactured after June 2004.
2) Be sure to install FX-305 behind FX-301.

Cautions when connecting amplifiers in cascade

- Refer to connecting conditions written below when connecting amplifiers in cascade.
- When amplifiers are installed, refer to "Cautions on communication function" and use communication function.

Part description (Amplifier)

- Select 1 indicator (Yellow)
- Select 2 indicator (Yellow)
- MODE indicator / TIMER (Yellow)
- Digital display (Green, Red)
- Jog switch
- MODE indicator / RUN (Green)
- MODE indicator / LD ON (Yellow)
- MODE indicator / PRO (Yellow)
- MODE indicator / TEACH (Yellow)

Spot-shape adjuster (Only for LS-H21□, LS-H22□)

- The diffuse reflective type LS-H21□ and LS-H22□ incorporate the spot-shape adjuster to adjust the shape of spots.

<table>
<thead>
<tr>
<th>Spot-shape adjuster</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Turn the spot-shape adjuster clockwise or counter-clockwise to adjust the spot shape at your desired detecting distance. However, if the adjuster is turned too far, it may be damaged.</td>
</tr>
</tbody>
</table>

* This product complies with 21 CFR 1040.10 Laser Notice No. 50, dated July 26, 2001, issued by CDRH (Center for Devices and Radiological Health) under the FDA (Food and Drug Administration).
**Mounting**

**Amplifier**

*How to mount the amplifier*

1. Fit the rear part of the mounting section of the amplifier on a 35 mm 1.378 in width DIN rail.
2. Press down the rear part of the mounting section of the unit on the 35 mm 1.378 in width DIN rail and fit the front part of the mounting section to the DIN rail.

*How to remove the amplifier*

1. Push the amplifier forward.
2. Lift up the front part of the amplifier to remove it.

Note: Be careful. If the front part is lifted without pushing the amplifier forward, the hook on the rear portion of the mounting section is likely to break.

*How to mount the sensor head*

1. Insert the sensor head connector into the inlet until it clicks.
2. Fit the cover to the connector.

**Sensor head**

- The tightening torque should be 0.5 N·m or less.
- When placing the sensor head horizontally or vertically, the reflector must also be positioned horizontally or vertically as shown in Fig. 1 below. If the sensor head is placed horizontally or vertically but the reflector is leaned as shown in Fig. 2 below, the reflection amount will decrease, which may cause unstable detection.

*Fig. 1 Proper positioning*

When placing the sensor head horizontally or vertically, the reflector shall also be positioned horizontally or vertically.

*Fig. 2 Improper positioning*

When placing the sensor head horizontally or vertically, but the reflector is leaned.

---

**Lens attachment for line reflective type (LS-MR1)**

- The lens attachment for line reflective type LS-MR1 mounted in the long sensing range line reflective type LS-H2□ is removable. When LS-H2□ is used without LS-MR1, it will provide the equivalent performance to the long sensing range spot reflective type LS-H2□m. In addition, the optional LS-MR1 can be attached to LS-H2□m to obtain the performance equivalent to LS-H2□m.
- Keep the lens clean of dust, dirt, water, oil, grease, etc.
- Do not apply any excessive force to LS-MR1. Such force may cause damage.

**Removing method**

1. Insert a screwdriver into the fixing slot located at the top of sensor head.
2. Lift the screwdriver inserted in Step 1 to remove LS-MR1.

**Mounting method**

1. The size of upper fixing hook of LS-MR1 is not the same as the lower fixing hook. After identifying the upper and lower fixing hooks, insert LS-MR1 upper fixing hook into the fixing slot at the top of sensor head and then insert LS-MR1 lower fixing hook into the fixing slot at the bottom of sensor head.

2. After mounting, check that LS-MR1 is properly fixed to the sensor head.

**Wiring**

- Make sure that the power supply is off while wiring.
- Verify that the supply voltage variation is within the rating.
- Take care that if a voltage exceeding the rated range is applied, or if an AC power supply is directly connected, the sensor may get burnt or damaged.
- Take care that short-circuit or wrong wiring of the load may burn or damage the sensor.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Ensure that an isolation transformer is utilized for the DC power supply. If an auto transformer is utilized, the main amplifier or power supply may be damaged.
- Make sure to use the optional quick-connection cable for the connection of the amplifier [connector type LS-401/P / LS-403]. Extension up to total 100 m 328.084 ft is possible with 0.3 mm², or more, cable. However, in order to reduce noise, make the wiring as short as possible.

**Others**

- Do not use during the initial transient time (0.5 sec. approx.) after the power supply is switched on.
- Because the sensitivity is higher in U-LG mode than in other modes, it can be more easily affected by extraneous noise. Check the operating environment before use.
- These sensors are only for indoor use.
- Avoid dust, dirt, and steam.
- Take care that the product does not come in direct contact with water, oil, grease, or organic solvents, such as, thinner, etc.
- This sensor cannot be used in an environment containing inflammable or explosive gasses.
- Never disassemble or modify the sensor.
Digital Laser Sensor LS-400 SERIES

DIMENSIONS (Unit: mm in)

The CAD data in the dimensions can be downloaded from our website.

LS-H91(-A)  LS-H91F(-A)  Sensor head

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation indicator (Orange)</td>
<td>2-M3 × 1.0</td>
</tr>
<tr>
<td>Laser emission indicator (Green)</td>
<td>2-M3 × 1.0</td>
</tr>
</tbody>
</table>

LS-H21(-A)  LS-H21F(-A)  Sensor head

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation indicator (Orange)</td>
<td>2-M3 × 1.0</td>
</tr>
<tr>
<td>Laser emission indicator (Green)</td>
<td>2-M3 × 1.0</td>
</tr>
</tbody>
</table>

LS-H92  LS-H92F  Sensor head

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation indicator (Orange)</td>
<td>2-M3 × 1.0</td>
</tr>
<tr>
<td>Laser emission indicator (Green)</td>
<td>2-M3 × 1.0</td>
</tr>
</tbody>
</table>

LS-H22  LS-H22F  Sensor head

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation indicator (Orange)</td>
<td>2-M3 × 1.0</td>
</tr>
<tr>
<td>Laser emission indicator (Green)</td>
<td>2-M3 × 1.0</td>
</tr>
</tbody>
</table>

LS-401  LS-401P  LS-403  Amplifier

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select 2 indicator (Yellow)</td>
<td>2.000</td>
</tr>
<tr>
<td>Select 1 indicator (Yellow)</td>
<td>25.4</td>
</tr>
<tr>
<td>Laser emission indicator (Green)</td>
<td>0.039</td>
</tr>
<tr>
<td>Output 1 operation indicator (Orange)</td>
<td>0.039</td>
</tr>
<tr>
<td>Output 2 operation indicator (Orange)</td>
<td>0.039</td>
</tr>
<tr>
<td>Digital display (Red, Green)</td>
<td>3.5</td>
</tr>
<tr>
<td>Jog switch</td>
<td>4.0</td>
</tr>
</tbody>
</table>

LS-401-C2  LS-401P-C2  Amplifier

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select 2 indicator (Yellow)</td>
<td>2.000</td>
</tr>
<tr>
<td>Select 1 indicator (Yellow)</td>
<td>25.4</td>
</tr>
<tr>
<td>Laser emission indicator (Green)</td>
<td>0.039</td>
</tr>
<tr>
<td>Output 1 operation indicator (Orange)</td>
<td>0.039</td>
</tr>
<tr>
<td>Output 2 operation indicator (Orange)</td>
<td>0.039</td>
</tr>
<tr>
<td>Digital display (Red, Green)</td>
<td>3.5</td>
</tr>
<tr>
<td>Jog switch</td>
<td>4.0</td>
</tr>
</tbody>
</table>

CN-74-C1  CN-74-C2  CN-74-C5  Main cable (Optional)

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length L</td>
<td>2-M3 × 0.5</td>
</tr>
<tr>
<td>Single core two parallel shielded cables</td>
<td>2.7</td>
</tr>
</tbody>
</table>

CN-72-C1  CN-72-C2  CN-72-C5  Sub cable (Optional)

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length L</td>
<td>2-M3 × 0.5</td>
</tr>
<tr>
<td>Single core two parallel shielded cables</td>
<td>2.7</td>
</tr>
</tbody>
</table>

The CAD data in the dimensions can be downloaded from our website.
**DIMENSIONS (Unit: mm in)**

**MS-DIN-E**
End plate (Optional)

![Dimensions Diagram](image)

Material: Polycarbonate

**RF-230**
Reflector (Accessory for LS-H92(F))

![Reflector Diagram](image)

Material: Acrylic (Reflector) ABS (Base)

**RF-330**
Reflector (Accessory for LS-H91□)

![Reflector Diagram](image)

Material: Acrylic (Reflector) ABS (Base)

**RF-300**
Reflective tape (Optional)

![Reflective Tape Diagram](image)

Model No. A B
RF-33 25.2 9.92 1.094
RF-31 9.2 0.362 0.362

**MS-DIN-2**
Amplifier mounting bracket (Optional)

![Amplifier Bracket Diagram](image)

Material: Cold rolled carbon steel (SPCC)
(Unchrome plated)

**MS-CX-1**
Sensor head mounting bracket (Optional)

![Sensor Bracket Diagram](image)

Material: Stainless steel (SUS301)
Two M3 (length 12 mm 0.472 in) screws with washers are attached.

**MS-CX-2**
Sensor head mounting bracket (Optional)

![Sensor Bracket Diagram](image)

Material: Stainless steel (SUS304)
Two M3 (length 12 mm 0.472 in) screws with washers are attached.
The CAD data in the dimensions can be downloaded from our website.

**DIMENSIONS (Unit: mm in)**

**MS-CX-3**
Sensor head mounting bracket (Optional)

**MS-CX-4**
Sensor head mounting bracket (Optional)

Material: Stainless steel (SUS304)
Two M3 (length 12 mm 0.472 in) screws with washers are attached.

**MS-CX-11**
Sensor mounting bracket for beam axis alignment (Optional)

Material: Zinc die-cast
Two M3 (length 14 mm 0.551 in) screws with washers are attached.

**MS-RF23**
Reflector mounting bracket for RF-230 (Optional)

Assembly dimensions

Material: Cold rolled carbon steel (SPCC)
(Stainless steel (SUS304))

Two M4 (length 10 mm 0.394 in) screws with washers are attached.