

FSD23 Series

DISPLACEMENT SENSOR



Specification

● Specifications per measurement range

Part number	FSD23-15-RS485	FSD23-35-RS485	FSD23-100-RS485
Center of measurement range	15mm	35mm	100mm
Measurement range	±5mm	±15mm	±50mm
Light source	Red laser Diode (wave length 655nm)		
	Max. output: 390 μW		Max. output: 1mW
Laser class	IEC/JIS Suffix nul: CLASS 1 / 2: CLASS 2 (Laser Notice No.50)		
Spot size *1	500 * 700μm	450 * 800μm	600 * 700μm
Linearity	0.1% of F.S.	0.1% of F.S.	0.1% of F.S.
Repeatability *2	1μm	6μm	20μm
Sampling period	500μs / 1000μs / 2000μs / 4000μs / AUTO		
Temperature drift (typical value)	±0.02% / °C of F.S. ±0.02% / °C of F.S. ±0.05% / °C of F.S.		
Indicator	Laser indicator: Green / Zero reset indicator: Red Output indicator: Orange / Mode indicator: Red		
Communication I/F	RS-485 Half Duplex (Multi-drop I/F is not supported)		
Power supply	12-24VDC ± 10%		
Current consumption	70mA max.		
Protection circuit	Reverse connection protection, Over current protection		
Protection category	IP67 including connection part		
Operating Temp./Humid.	-10 ~ 50°C / 35 ~ 85% RH without freazing or condensation		
Storage Temp./Humid.	-20 ~ 60°C / 35 ~ 85%/RH		
Ambient illuminance	Incandescent lamp: 3,000 lx max.		
Vibration resistance	10 ~ 55Hz, Double amplitude 1.5mm, X,Y,Z for 2 hours		
Shock resistance	500mm/s ² (approx. 50G) X,Y,Z 3 times each		
Material	Case: Aluminum/SUS316L, Front lens: PPSU, Display: PET		

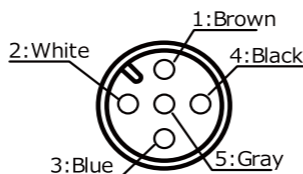
The specifications are based on the condition unless otherwise designated: Ambient temperature: 23°C, Supply voltage: 24VDC, Sampling period: 500μs, Averaging: 64, Measuring distance: Center of the range, Testing object: White ceramic
 *1 Defined with center strength 1/e²(13.5%) at the center. There may be leak light other than the specified spot size. The sensor may be affected when there is a highly reflective object close to the detection area.
 *2 512 averaging time

Pins Configuration and Cable Color

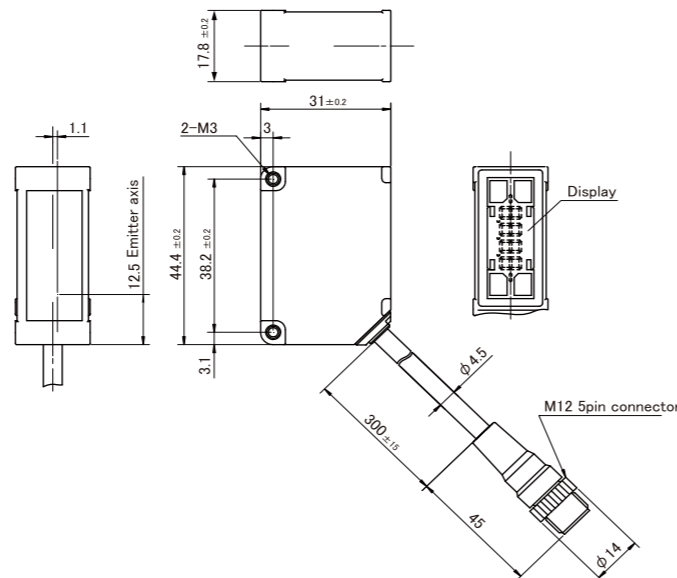
Pins configuration of the connector and cable color are as follows.

Pin No.	Color	Description
1	Brown	DC12-24V ± 10%
3	Blue	0V
5	Gray	(N.C.)
4	Black	RS-485(A)
2	White	RS-485(B)

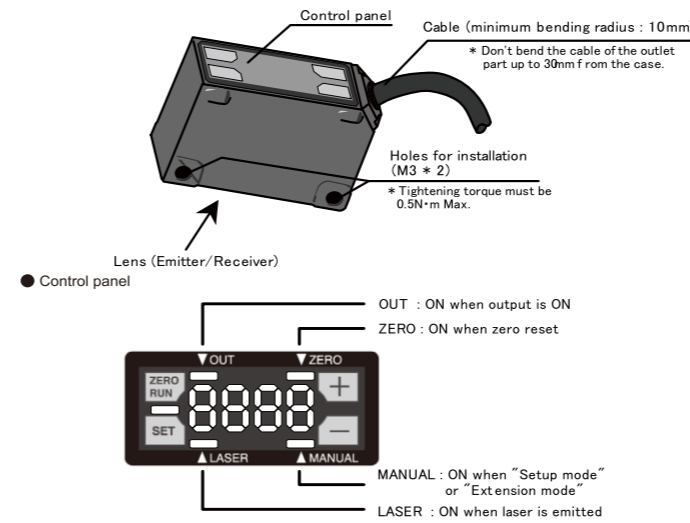
■ Pins configuration (sensor side)



Dimensions

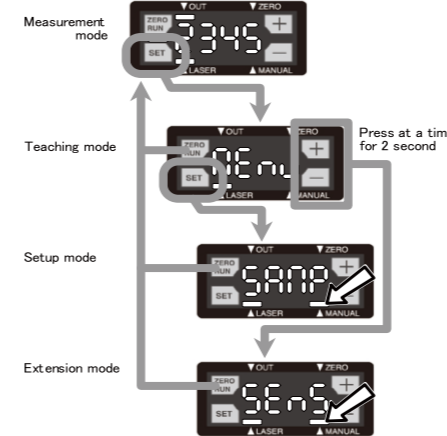


Functions of Components



Setup

● Changing mode
 While it's "Teach mode", "Setup mode" or "Extension mode", you can change the mode to "Measurement mode" by pressing "ZERO/RUN" button.
 While it's "Setup mode" or "Extension mode", the LED "MANUAL" is lit.

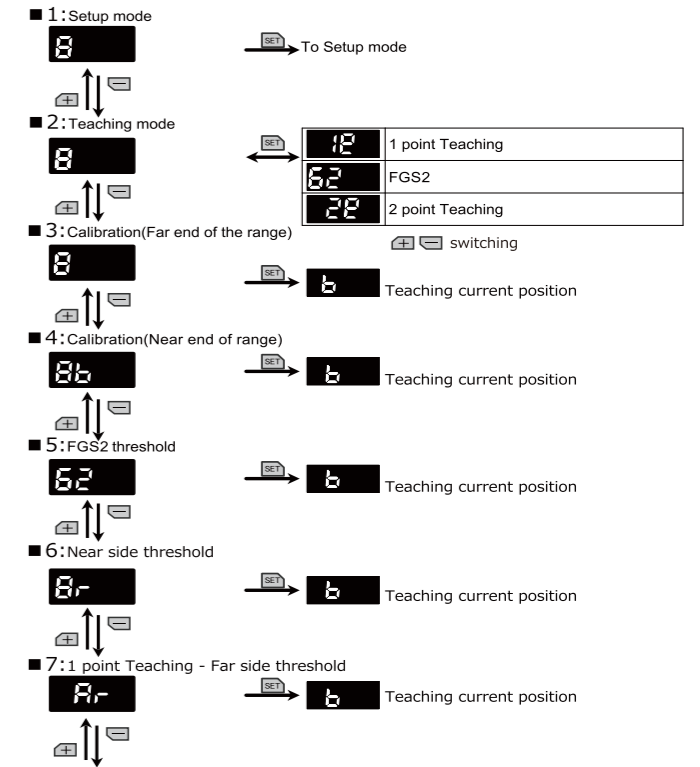


● Changing parameters

You can choose and adjust the parameters by pressing "+" and "-" buttons. The mode will be changed to "Measurement mode" by pressing "ZERO/RUN" button.

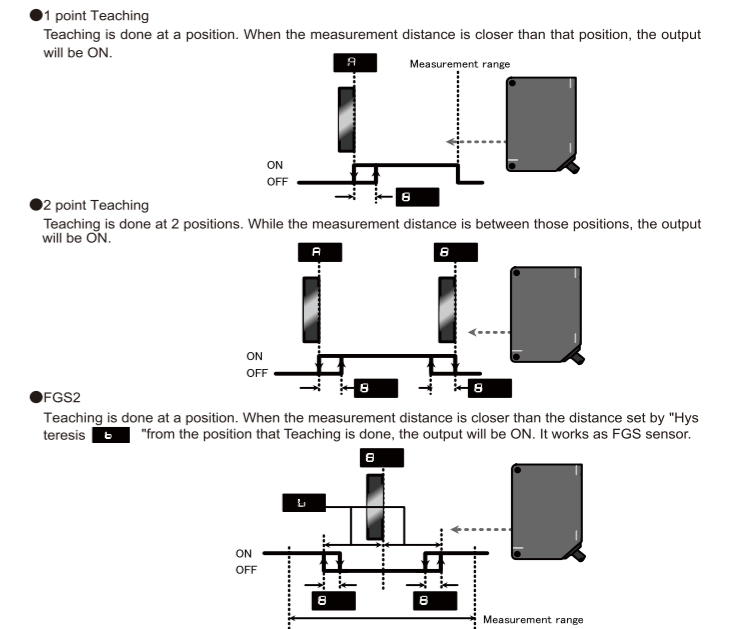


Teach mode



Measurement Mode

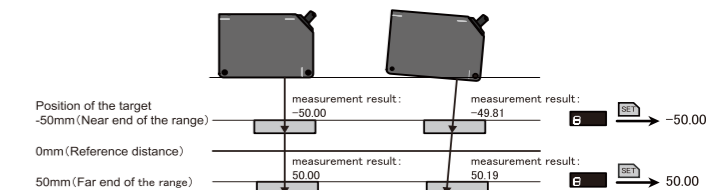
FSD23 has 3 measurement mode. The mode is chosen by "Teach mode". Output can be reversed by setting "Output polarity". Following output shows its ON/OFF status as "Light ON".



● Calibration (Far end of the range/ Near end of range)
 The sensor can be calibrated by "Calibration" mode at both far and near end of the measurement range. This feature is very useful especially when you can't mount the sensor head parallel to the object surface.

● Example of Calibration of FSD23-100

A) Calibration condition at the factory B) When the sensor is mounted tilted



Just calibrate the sensor by "Calibration" mode at far end and near end of the measurement range. Then, you will get calibrated result if the sensor head is tilted.

Precautions

- Please make sure that the power supply voltage is within the rated voltage range before powering on
- The time from powering-on to normal detection of the sensor is 100ms, please ensure that the sensor is used after 100ms of powering-on
- When using different power sources for the sensor and load, be sure to turn on the power of the sensor first
- When the sensor is not used, it is recommended to cut off the power of the load first and then turn off the power of the sensor
- Do not subject the sensor to severe external forces (such as hammer hits, etc.) during installation, so as not to damage the sensor performance
- Avoid using thinner, alcohol or other organic solvents when cleaning

Safety Warning

- Do not use in an environment with flammable, explosive or corrosive gases.
- Do not use in an environment with oil or chemicals.
- Do not use in an environment with high humidity.
- Do not use in direct sunlight.
- Do not use under other environmental conditions that exceed the rated value.
- Do not disassemble, repair or modify the product without permission.

End-of-life Disposal

When the product is disposed of, please dispose of it as industrial waste.

Analog Output

Setup mode is chosen by pressing "SET" button from "Menu". (* means default value)

1: Baud rate

bAud	96	9,600bps *
	192	19,200bps
	384	38,400bps
	576	57,600bps
	1152	115,200bps
	2304	230,400bps
	3125	312,500bps
	4688	468,750bps
	5000	500,000bps
	6250	625,000bps
	8333	833,333bps
	9375	937,500bps
	1250	1,250,000bps

2: Near side threshold

nEAR	23	Set the value	Default: FSD23-15□ □ -1.000 FSD23-35□ □ -03.00 FSD23-100□ □ -10.00
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3: 1 point Teaching - Far side threshold

fAR	23	Set the value	Default: FSD23-15□ □ 1.000 FSD23-35□ □ 03.00 FSD23-100□ □ 10.00
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4: FGS2 threshold

FGS2	23	Set the value	Default: FSD23-15□ □ 0.000 FSD23-35□ □ 00.00 FSD23-100□ □ 00.00
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5: Teaching mode

ModE	1Pt	1 point Teaching
	FGS2	FGS2
	2Pt	2 point Teaching *

6: FGS2 hysteresis

tol	0.123	Set the value	Default: FSD23-15□ □ 0.000 FSD23-35□ □ 00.00 FSD23-100□ □ 00.00
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7: Sampling period

SAMP	500	500μs (2kHz) *
	1000	1000μs (1kHz)
	2000	2000μs (500Hz)
	4000	4000μs (250Hz)
	Auto	AUTO (Sensor will optimize automatically)

8: Output polarity

Act	Lon	Light ON: ON when exceeds the threshold *
	d on	Dark ON: ON when less than the threshold

9: Averaging number

Avg	1	Once
	8	8 times
	64	64 times *
	512	512 times

10: Alarm setting

ALrn	clmp	Clamp : display "9999" *
	hold	Hold : Keep previous value

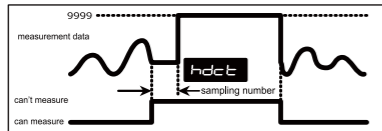
10-2: Alarm-Hold and Clamp

hdct	0000	
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When Alarm is set as **hold** measurement data will be as follows for Alarm

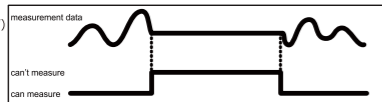
● "Hold and Clamp" is active

※ Keep the previous data for the period and clamp to "9999" after that.



● "Hold and Clamp" is not active (When it's set "0000")

※ Keep the previous data while it's Alarm status.



11: Reset (Initializing)

rEst	YES	Initialize the parameters to default setting
	NO	Do nothing

12: Display setting

d.SP	on	Activate the display while "Key lock" *
	off	Desable the display while "Key lock"

Analog Output

Extension mode is chosen by pressing "+" and "-" buttons at a time for 2 second in teach mode top page. Parameters in Extension mode must be set correctly otherwise it might not work correctly.

Please use with default setting when changing parameters is not needed. ("*" means default setting)

1: Hysteresis

hyst	0.123	Set the value	Default: FSD23-15□ □ -1.000 FSD23-35□ □ -03.00 FSD23-100□ □ -10.00
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2: Measurement point

MeoP	NAK	MAX : Maximum distance *
	Pt5	Pt5 : 5th point from sensor side
	Pt4	Pt4 : 4th point from sensor side
	Pt3	Pt3 : 3rd point from sensor side
	Pt2	Pt2 : 2nd point from sensor side
	Pt1	Pt1 : Closest point from sensor side

3: Threshold

thre	base	Base : Set threshold to lowest level *
	P400	P400 : Set threshold to upper level
	P200	P200 : Set threshold to middle level
	P100	P100 : Set threshold to lower level

4: Zero reset value

Zero	0.123	Set the value
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5: Sensitivity

SenS	Auto	Auto : Adjust automatically *
	N_6	6 : Maximum sensitivity
	1	1 : Minimum sensitivity

Analog Output

Zero reset function

● Set Zero reset

While it's measurement mode, press **ZERO RUN** for 2 seconds. Then, **0000** will be shown. The position of decimal point varies by sensor type.

When setting Zero reset, the red indicator LED "ZERO" will be ON.

● Release zero reset

While it's measurement mode, press **ZERO RUN** for 4 seconds to release Zero reset.

Key lock function

● Activate Key lock

While it's measurement mode, press **+** **-** at a time for 2 second. Then, **LOC** will be shown.

While **LOC** is shown, any access except "Releasing Key lock" will be neglected.

● Release Key lock

While Key lock is activated, it will be released by pressing **+** **-** at a time for 3 seconds. Then, **uLOC** will be shown. After this process, every access will be accepted.

Analog Output

Specifications are as follows.

Communication method	RS-485 Half Duplex (Multi-drop I/F is not supported)
Transmission code	Binary
Data length	8bit
Stop length	1bit
Parity check	Nil
Baud rate (bps)	9.6k/19.2k/38.4k/57.6k/115.2k/230.4k/312k/460k/500k/625k/833k/920k/1.25M
Data classification	STX / ETX

Data Format

Transmission data	STX	COMMAND	DATA1	DATA2	ETX	BCC
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Incoming data	STX	ACK	RESPONSE1	RESPONSE2	ETX	BCC
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Incoming data (error)	STX	NAK	ERROR CODE	00h	ETX	BCC
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STX = 02H, ETX = 03H, ACK = 06H, NAK = 15H, BCC = XOR of values hatched

Basic commands	C(43H)	Individual function commands
	W(57H)	Writing the setting
	R(52H)	Reading out setting

Error code table	02H	Address is invalid
	04H	BCC value is invalid
	05H	Invalid command is issued except "C", "W", "R"
	06H	Setting value is invalid (out of specifications)
	07H	Setting value is invalid (out of range)

C(43H) parameter table

Command	Type	DATA1 (upper)	DATA2 (lower)	Description
Reading out Measurement value	Write	B0h	01h	
	Read	Upper data	Lower data	Response in 2 bytes *1
Reading out Output status	Write	B0h	02h	
	Read	00h	Output status	bit:0 = 1 (ON) bit:4 = 0 (the status has been read)
Writing the setting	Write	A0h	00h	Write the setting into EEPROM.
	Read	00h	00h	
Teaching FGS2	Write	11h	05h	
	Read	00h	00h	
Teaching near side point	Write	11h	06h	
	Read	00h	00h	
Teaching far side point	Write	11h	07h	
	Read	00h	00h	
Laser ON	Write	A0h	03h	
	Read	00h	00h	10ms be required until the laser power stable.
Laser OFF	Write	A0h	02h	
	Read	00h	00h	
Execute Zero reset	Write	A1h	00h	
	Read	00h	00h	
Release Zero reset	Write	A1h	01h	
	Read	00h	00h	
Execute Key lock	Write	A1h	04h	
	Read	00h	00h	
Release Key lock	Write	A1h	05h	
	Read	00h	00h	
Initializing	Write	40h	00h	Initialize all parameters except communication speed and re-boot. The communication won't work while initializing.
	Read	00h	00h	

*1 : Measurement and setting value are described as signed hexadecimal.

Model	FSD23-15-RS485	FSD23-35-RS485	FSD23-100-RS485			
Range	±5mm	±15mm	±50mm			
Unit	1μm	10μm	10μm			
Data (Hex)	EC78h	1388h	FA24h	05DCh	EC78h	1388h
Data (Decimal)	-5000	+5000	-1500	+1500	-5000	+5000

Writing Data

Writing is done as following procedure.

1. Read out setting
Execute Command "R" (Reading out setting) on the target parameter. Set "Address" at "DATA1" and "DATA2".

2. Write setting
Execute Command "W" (Writing the setting) on the target parameter. Writing data is done to the address set at "1. Read setting".

Example: Setting "Sampling period" to "AUTO"

1. Read out "Sampling period"	Transmission command	STX (02h)	R (52h)	40h	06h	ETX (03h)	BCC (14h)
	Incoming data	STX (02h)	ACK (06h)	00h	00h	ETX (03h)	BCC (06h)

2. Write the setting	Transmission command	STX (02h)	W (57h)	00h	04h	ETX (03h)	BCC (53h)
	Incoming data	STX (02h)	ACK (06h)	00h	00h	ETX (03h)	BCC (06h)

* Incoming data of command "W" (Writing the setting) will be "00h" and "00h".

Setting parameter table

Setting	Address/Parameter	DATA1 (upper)	DATA2 (lower)	Description
Model type	Address	01h	00h	Return center value of measurement range (only for checking model type)
	Parameter	00h	0Fh	15mm type
		00h	23h	30mm type
Measurement mode	Address	40h	04h	100mm type
	Parameter	00h	00h	2 point Teaching
		00h	01h	1 point Teaching
Near side threshold	Address	41h	00h	FGS2 Teaching
	Parameter	Upper data	Lower data	
Far side threshold	Address	41h	02h	
	Parameter	Upper data	Lower data	
FGS2 threshold	Address	41h	04h	
	Parameter	Upper data	Lower data	
FGS2 hysteresis	Address	41h	06h	
	Parameter	Upper data	Lower data	
Output polarity	Address	40h	08h	
	Parameter	00h	00h	Light ON: ON when exceeds the threshold
		00h	01h	Dark ON: ON when less than the threshold
Sampling period	Address	40h	06h	
	Parameter	00h	00h	500μs
		00h	01h	1,000μs
		00h	02h	2,000μs
		00h	03h	4,000μs
Averaging number	Address	40h	0Ah	
	Parameter	00h	00h	Once
		00h	01h	8 times
		00h	02h	64 times
		00h	03h	512 times
Alarm setting	Address	40h	0Ch	
	Parameter	00h	00h	Clamp
		00h	01h	Hold
Alarm - Hold and Clamp	Address	41h	08h	
	Parameter	Upper data	Lower data	
Display setting	Address	40h	0Eh	
	Parameter	00h	00h	ON
		00h	01h	OFF
Hysteresis	Address	41h	10h	
	Parameter	Upper data	Lower data	
Measurement point	Address	40h	10h	
	Parameter	00h	00h	MAX. : Maximum distance
		00h	01h	Pt1 : Closest point from sensor side
		00h	02h	Pt2 : 2nd point from sensor side
		00h	03h	Pt3 : 3rd point from sensor side
		00h	04h	Pt4 : 4th point from sensor side
Threshold	Address	40h	12h	
	Parameter	00h	00h	Base : Lowest level
		00h	01h	Level 100 : lower level
		00h	02h	Level 200 : middle level
		00h	03h	Level 400 : upper level
Zero reset value	Address	41h	12h	
	Parameter	Upper data	Lower data	
Sensitivity	Address	40h	14h	
	Parameter	00h	00h	AUTO
		00h	01h	1 : Minimum sensitivity
		00h	02h	2
		00h	03h	3
		00h	04h	4
		00h	05h	5
00h	06h	6 : Maximum sensitivity		

* Execute the command "R" (Read out) before executing command "W" (Write).