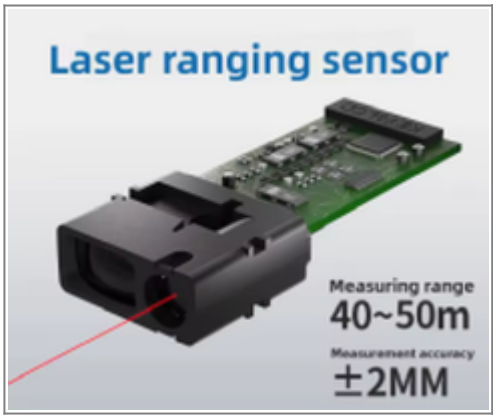
LamaPLC: M01 - V0.4 Laser ranging sensor with UART communication

A laser ranging sensor is a device that measures distances to objects by emitting a focused laser beam and detecting the reflected light. These sensors typically operate on principles such as Time-of-Flight (ToF) or triangulation. They are valued for their high accuracy, fast response times, and versatility across industrial and commercial applications, including automation, robotics, surveying, and quality control.




GitHub: https://github.com/Andres-ros/laser-m01-esp32

Pin colors

function	wire color
GND	black
Vin (2.5V .. 3.3V)	red
TxD UART	yellow
RxD UART	green

Technical data

measuring distance	0.2 .. 5 / 10 / 20 / 30 / 40 / 50 meter
measuring time	0.3..4 sec
laser classification	Class II
laser power	< 1mW
laser wave length	620 .. 690 nm
laser life maximum	> 50000 h
work power consumption	60 mA
input voltage	**2.5 .. 3.3V**
default baud rate	9600 bps

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Original documentation

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M01 laser ranging module has small size, high ranging accuracy, adapt to all kinds of harsh environment, can be adapted to a variety of ranging equipment, such as unmanned aircraft, robots, handheld laser ranging instrument and other equipment. The ranging module can quickly and accurately provide distance measurement for the main control system;

This module uses 650nm semiconductor laser, the ranging resolution is 0.001m. The ranging accuracy is ±2mm, the farthest range is 60m; it has UART (TTL level) communication interface; it is a high integration, low power consumption and light weight ranging sensor.

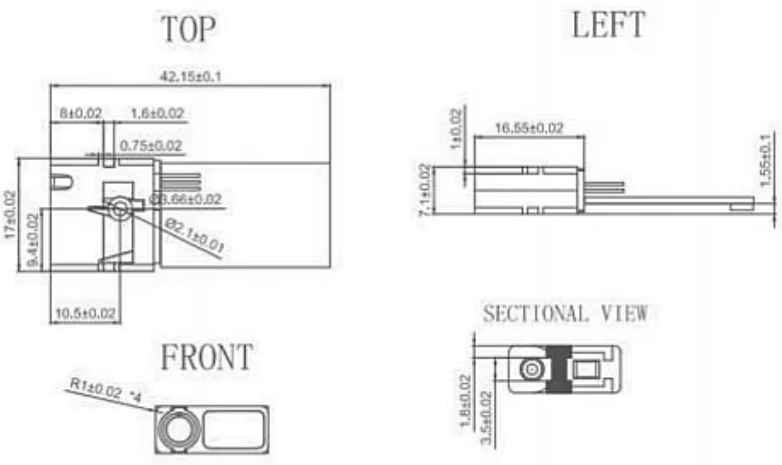
1. Module parameters

1.1 Performance indicators

accuracy	±2mm
unit	millimetre
measuring distance	0.2~60m
MT	0.3~4 seconds
Laser classification	Class Ⅱ
laser power	<1mW
laser wave length	620~690nm
Laser life	>50000H
Work power consumption	60mA
quiescent dissipation	20uA
size	42.15mmx17mmx7.1mm
input voltage	2.5~3.3V
working temperature	-10~40℃
storage temperature	-20~65℃
weight	3.5G
Default baud rate	9600bps (can be modified by setting)

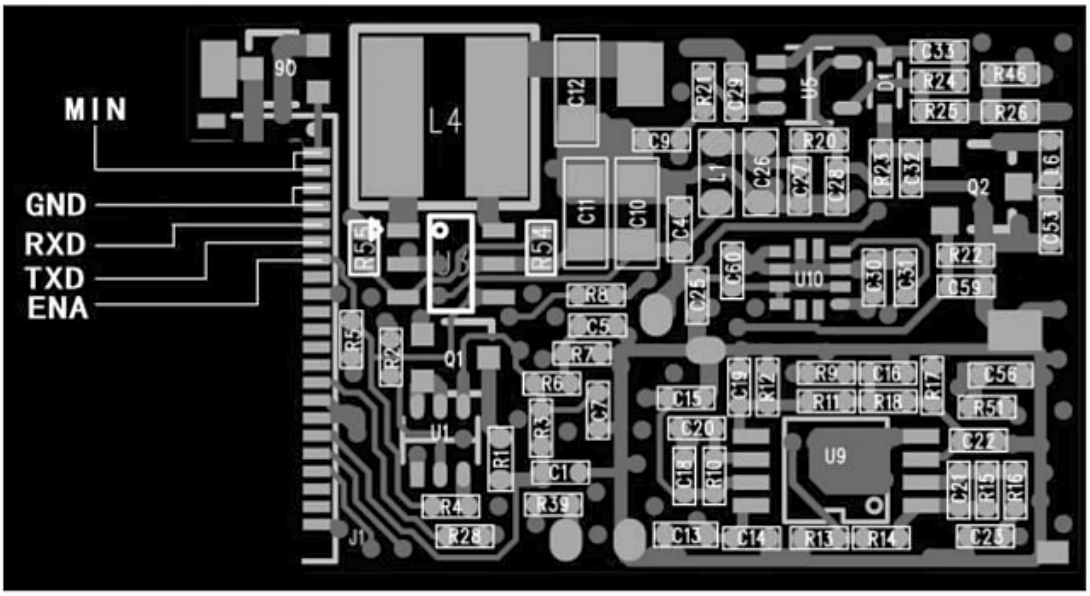
Note: The ranging accuracy and distance are based on the medium reflecting target. The actual measurement accuracy will be affected by the increase of distance and different reflecting targets, ± (2mm+D/10000).

1.2 Size

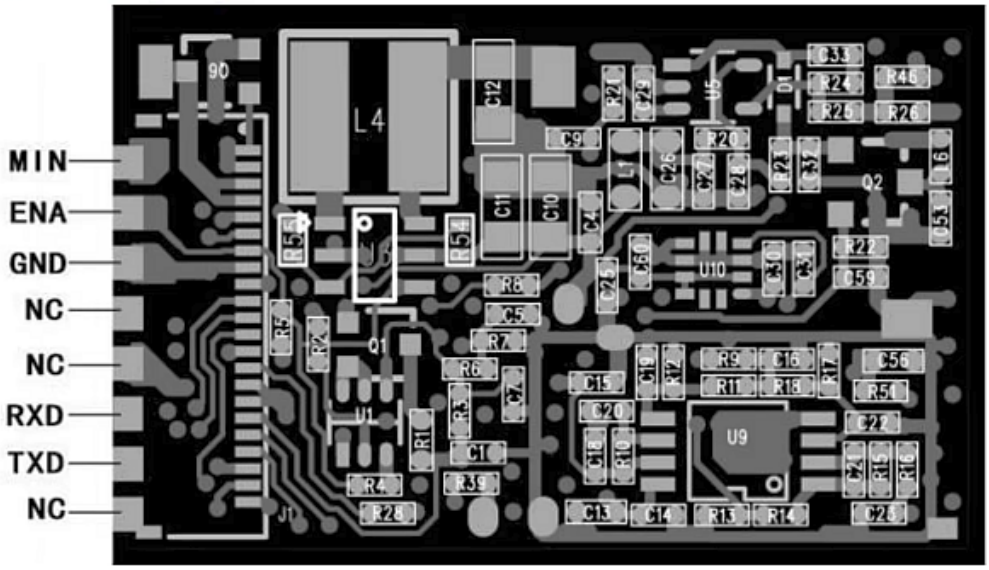


1.3 Pins

1.3.1 FPC output pin definition



1.3.2 Definition of stamp hole pins



Communication protocol

- Power and other pin levels should be guaranteed within the allowable range of the module, exceeding the range may cause permanent damage;
- To order this module, you need to provide the power parameters that can be provided externally;
- For example, the power supply of laser rangefinder is lithium battery or dry battery.

2.1 Directive structure

byte	0	1		2	3	4	5	6	7	8
Position	[7:0]	[7]	[6:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]
name	Head	R/W	Addr	Function		data count		data		checksum
data	0xAA	0	0x10	0x00	0x12	0x00	0x01	0x33	0x44	0x9A

Requests always start with a fixed first byte 0xAA
R/W indicates that 0: the host writes data to the slave; 1: the host reads data from the slave. The address of the slave in the table is 0x10, and the address range is only 7 bits, ranging from 0x00 to 0x7F.0x00 is the default address for each module, and 0x7F is the broadcast address;
Function indicates the operation command content of the host to the slave;
Data count indicates the number of data written to the slave;
Data indicates the data to be written to the slave;
Checksum = R/W addr + function byte + data count + data.

2.2 Control function

order number	Function code	name	function
0	0x0000	FUNC_ERR_CODE	system mode
1	0x0006	FUNC_BAT_VLTG	input voltage
2	0x0007	FUNC_TEMP	Read the temperature on the board
3	0x000A	FUNC_HARDWAR_VER	Read the hardware version
4	0x000C	FUNC_SOFTWARE_VER	Read the software version
5	0x000E	FUNC_SERIAL_NUM	Read the serial number
6	0x0010	FUNC_SET_ADDR	From the machine address setting
7	0x0012	FUNC_SET_OFFSET	Set the measurement offset
8	0x0014	FUNC_SET_BAUD	Set the baud rate
9	0x0020	FUNC_MEAS_SINGLE	single measurement
10	0x0021	FUNC_MEAS_CONTINUOUS	continuous measurement
11	0x0022	FUNC_MEAS_RESULT	Read the measurement results
12	0x01be	FUNC_CTLR_LD	Turn the laser tube on/off

2.3 Detailed description of control instructions

2.3.1 Read the latest status of the module

Bytes	0	1	2	3	4
Name	Head	RW/ADDR	Func_Code		checksum
Data	0xAA	0x80	0x00	0x00	0x80

Read command (e.g., aa80000080)
From machine address: 0x00 Function:
Read the status return message: AA 80 00 00 00 01 FF FF 7F

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x80	0x00	0x00	0x00	0x01	0xYY	0xZZ	Checksum

2.3.2 Read the hardware version

Bytes	0	1	2	3	4
Name	Head	RW/ADDR	Func_Code		checksum
Data	0xAA	0x80	0x00	0x0A	0x8A

Command: (e.g., aa80 00 0a8a, return message: AA 80 00 0A 00 01 25 02 B2)

Bytes	0	1	2	3	4	5	6	7	8

Data	0xAA	0x80	0x00	0x0A	0x00	0x01	0xYY	0xVV	Checksum

YYVV is the hardware version, such as 2502.

2.3.3 Read the software version

Bytes	0	1	2	3	4
Name	Head	RW/ADDR	Func_Code		checksum
Data	0xAA	0x80	0x00	0x0C	0x8C

Command: (e.g., aa80 00 0c8c, return message: AA 80 00 0C 00 01 25 03 B5)

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x80	0x00	0x0C	0x00	0x01	0xYY	0xVV	Checksum

YYVV is the software version, such as 2503

2.3.4 Read the module serial number

Bytes	0	1	2	3	4
Name	Head	RW/ADDR	Func_Code		checksum
Data	0xAA	0x80	0x00	0x0E	0x8E

Command: (e.g., aa80 00 0e8e, return message: AA 80 00 0E 00 01 25 04 B8)

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x80	0x00	0x0E	0x00	0x01	0xSS	0xNN	Checksum

2.3.5 Read the input voltage of the module

Bytes	0	1	2	3	4
Name	Head	RW/ADDR	Func_Code		checksum
Data	0xAA	0x80	0x00	0x06	0x86

Command: (e.g., aa 80 00 06 86)

Return message

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x80	0x00	0x06	0x00	0x01	0x32	0x25	Checksum

Input voltage: 0x3225 means 3.225V

2.3.6 Read the current temperature of the module

Bytes	0	1	2	3	4
Name	Head	RW/ADDR	Func_Code		checksum
Data	0xAA	0x80	0x00	0x07	0x87

Command: (e.g., aa80000787)

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x80	0x00	0x07	0x00	0x01	0x02	0x25	Checksum

0x225 indicates the current

temperature on the board 22.5℃

0x1015 indicates-1.5℃.

2.3.7 Read the measurement results

Bytes	0	1	2	3	4

Name	Head	RW/ADDR	Func_Code		checksum
Data	0xAA	0x80	0x00	0x22	0xA2

Bytes	0	1	2	3	4	5	6 : 9	10: 11	12
Name	Head	RW/ADDR	func_code		Data code		Data	Signal	Checksum
Data	0xAA	0x80	0x00	0x22	0x00	0x04	0xAABBCCDD	0xYYZZ	Checksum

AABBCCDD are both BCD codes;
For example, 0xAABBCCDD = 0x12345678, which means: 12345.678m; 0xYYZZ represents signal quality, and the larger the data, the better the signal;

2.3.8 Set module address

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x10	0x00	0x01	0x00	0xYY	Checksum

Command: (e.g., aa0000100001000112. Note: After the module address is modified, it needs to be re-powered on, and other corresponding commands are also modified)

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x10	0x00	0x01	0x00	0xYY	Checksum

0xYY is the module address, which ranges from 0 to 127; address 0x7F is the broadcast address

2.3.9 Set the module to measure the offset

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x12	0x00	0x01	0xXX	0xYY	Checksum

Command: (e.g., aa0000120001006477)

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x12	0x00	0x01	0xXX	0xYY	Checksum

If ZZYY = 0x0064 (100mm), the measurement result is +100mm; if ZZYY =0xFF9C (-100mm), the measurement result is-100mm;

2.3.10 Turn on and off the laser tube

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x01	0xbe	0x00	0x01	0x00	0xZZ	Checksum

Command: (e.g., aa0001be00010001c1 to turn on red light / aa0001be00010000c0 to turn off red light)

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x01	0xbe	0x00	0x01	0x00	0xZZ	Checksum

ZZ = 0x1: Turn on the laser; ZZ = 0x0: Turn off the laser tube;

2.3.11 Angle measurement

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x23	0x00	0x01	0x00	0x00	Checksum

return information：

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x23	0x00	0x01	0xSX	0xYZ	Checksum

S: Symbol bit, the positive value of the Angle is 0, and the negative value is 1;
The XYZ is the BCD code: XYZ = 235, expressed as 23.5 °.

2.3.12 Start a normal measurement

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x00	0x21

Command: (e.g., aa0000200001000021, return message: AA 00 00 20 00 04 00 00 04 84 02 3D EB)

Bytes	0	1	2	3	4	5	6：9	10：11	12
Name	Head	RW/ADDR	func_code		Data code		Data	Signal	Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x04	0xAABBCCDD	0xYYZZ	Checksum

AABBCCDD are both BCD codes;
For example, 0xAABBCCDD = 0x12345678, which means: 12345.678m; 0xYYZZ represents signal quality, and the larger the data, the better the signal;

2.3.13 Start a quick measurement

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x22	0x00	0x01	0x00	0x00	0x23

Command: such as aa0000220001000023, return message: AA 00 00 22 00 04 00 00 04 91 03 2F ED)

Bytes	0	1	2	3	4	5	6：9	10：11	12
Name	Head	RW/ADDR	func_code		Data code		Data	Signal	Checksum
Data	0xAA	0x80	0x00	0x22	0x00	0x04	0xAABBCCDD	0xYYZZ	Checksum

AABBCCDD are both BCD codes;
For example, 0xAABBCCDD = 0x12345678, which means: 12345.678m; 0xYYZZ represents signal quality, and the larger the data, the better the signal;
The accuracy of the measurement result is slightly worse than that of a normal measurement

2.3.14 Start automatic continuous measurement

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x21	0x00	0x01	0x00	0x00	0x22

Command: (e.g., aa0000210001000022) The module returns the command after receiving it

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xAA	0x00	0x00	0x21	0x00	0x01	0x00	0x00	0x22

Enter continuous measurement mode and continuously send data to the host

Bytes	0	1	2	3	4	5	6：9	10：11	12
Name	Head	RW/ADDR	func_code		Data code		Data	Signal	Checksum
Data	0xAA	0x00	0x00	0x21	0x00	0x04	0xAABBCCDD	0xEEFF	Checksum

The information content is the same as a single measurement;

Repeat the command to stop continuous measurement;
If an error occurs during the measurement process, an error message will be returned. See module error report for details.

2.3.15 Other functions

The baud rate setting returns information

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Baud code		Checksum
Data	0xAA	0x00	0x00	0x14	0x00	0x01	0x00	0x0Y	Checksum

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Baud code		Checksum
Data	0xAA	0x00	0x00	0x14	0x00	0x01	0x00	0x0Y	Checksum

The default baud rate of the module is 9600. Users can change the baud rate according to their own needs. At present, there are two types of baud rates available: 0x0Y = 0: 9600 baud rate
0x0Y = 1: Porter rate
115200 needs to be
rebooted and refreshed.

2.3.16 Module error report

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/ADDR	func_code		Data code		Data		Checksum
Data	0xEE	0x00	0x00	0x00	0x00	0x01	0x00	ERR_CODE	Checksum

2.3.17, Other error codes

ERR_CODE	explain
0x0000(ERR_NO)	inerrancy
0x0001(ERR_HARDWARE)	hardware error
0x0002(ERR_DATA_OVER_FLOW)	No output data
0x0003(ERR_SIGNAL_WEAK)	The reflection signal is too weak
0x0004(ERR_SIGNAL_STRONG)	The reflection signal is too strong
0x0005(ERR_TEMP_HIGH)	The temperature is too high (> 40℃)
0x0006(ERR_TEMP_LOW)	Temperature is too low (-10℃)
0x0007(ERR_BAT_LOW)	Low power supply voltage (<2.5V)
0x0008(ERR_OVER_RANGE)	no to scale
0x0009(ERR_READ)	Reading the message was wrong
0x000A(ERR_WRITE)	Writing a communication error
0x000B(ERR_ADDR)	address error

3. Factors affecting ranging capability, ranging response speed and velocity accuracy

3.1 Target reflectance:

Generally, the higher the target reflectivity, the better the ranging capability and the faster the ranging response speed. For instance, a target with medium reflectivity can be measured up to 40 meters, while a target with high reflectivity can be measured at least 60 meters. A target with low reflectivity may only be measured up to 30 meters. (For targets that are difficult to form diffuse reflection, such as water surfaces, measurement may not be possible.)

3.2 Target shape:

When the reflected surface area of the measured target is too small or uneven, the ranging ability and ranging response speed will be correspondingly reduced;

3.3 Measurement Angle:

3.4 Measurement environment:

Factors affecting ranging capability and response speed include air humidity and suspended particulate matter concentrations. Laser reflectivity and measurement results may vary depending on environmental conditions, target coloration, surface finish, dimensions, actual shape, and other characteristics. Measurement errors or failures may occur under the following circumstances:

- Small or slender targets
- The target is black or darker
- The target has a graded surface
- The target is moving or vibrating
- When measuring the water surface
- The target measured through the glass
- The target is glass or mirror
- The laser is incident at an oblique angle to the target surface

3.5 Measuring reaction speed:

This product uses a red light laser beam for measurement. It measures the time it takes for the laser beam to travel from the ranging telescope to the target and return. The maximum measurement time is 4S and the switching time of the target is less than 0.9S

Note: The inconsistent reflectivity of the target object and the stability of the module locking the target object will affect the response speed of the module

IV. Notes

4.1 Do not look directly at the laser beam when using this module.
4.2 Do not use the eyepiece or other additional optical devices to operate the module to avoid additional eye damage.
4.3 Do not disassemble the module, disassembling the product is not covered by the warranty.
4.4 When transporting, storing and using this product, attention should be paid to avoid humid environment. Working in humid environment such as easy condensation and frost will affect the ranging performance and may cause damage to the module!
4.5 In the process of transportation, sufficient cushioning material should be added in the packing box to avoid damage to the module.
4.6 The module should be placed in a place out of the reach of children, and not placed on an unstable high place to avoid falling and damaging the module.
4.7 Do not place the module in a sun-baked car or near an environment with strong ultraviolet light or heat source, so as to avoid uncontrollable effects on the module.
4.8 In case of drastic temperature change, condensation will occur on the surface of the main lens of the module. Do not use the module at this time.
4.9 If the exposed lens is dirty, it can be wiped clean with a glass cloth gently. Do not use other items to wipe it to avoid scratches on the surface of the lens.
4.10 This module is guaranteed for one year, lifetime warranty; free replacement due to its own quality problems; problems caused by human factors,

According to the actual situation, the cost of charging for maintenance and replacement of parts.

V. The measurement range of the ranging module is defined under the following conditions

5.1 The measured target reflection rate reaches more than 85%.
5.2 The measured target reflector is perpendicular to the laser emission direction.
5.3 Suggestion: When measuring a remote target, you should use a tripod to fix the module to reduce the shaking of the module during the measurement process, so as to obtain better measurement results.
5.4 Other unconventional testing environments and methods not described in the table shall be confirmed by both parties through negotiation and solved with the customer

Related issues. The results of unconventional tests shall not be used as a judgment condition for product quality until they are confirmed.

distance measurement, laser, distance, sensor, M01

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