



# USER MANUAL

ONE-STOP SOLUTION

ONE-STOP SERVICE

# User Manual for MQ1000 Radar Level Sensor

Version 2.0

## 1. Product overview

MQ1000 radar distance/level sensor is developed by millimeter-wave radar detection technology. It has the characteristics of high measurement accuracy and low power consumption of pulse radar. It is stable and reliable, not affected by dust, smoke, light, temperature, gas and other environmental conditions. On-site installation does not require calibration. The protection level of the main structure is IP67, with standard M30/M39 thread and M12 4pin waterproof connector design. It's small in size, convenient for users to install and fix in various measurement environments.

MQ1000 can be used for measurement of liquids, and distance, process control and other fields.

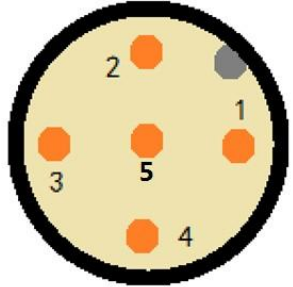


## 2. Product parameters

Product Model No.	MQ1000
Measuring range	Static water surface: 0-10m; Diesel: 0-7m; Gasoline: 0-5m
Measurement accuracy	±5mm
Operating Voltage	3.3~5.5V DC(M30) ; 5.5-24V(M39)
Average power consumption	≤35mA
Beam angle	~20°/~10°
Operating temperature	-40°C~+80°C
Temperature compensation	Temperature compensated
Output	TTL, RS485, 0~5V/10V, 0/4~20mA
IP rating	IP67
Housing material	M39: 304 stainless steel & PTFE; M30: PA12/nickel-plated copper

### 3. Interface definition

The M30 model has a standard 4-pin M12 aviation male connector, and the M39 model has an optional 4-pin or 5-pin M12 aviation male connector (with analog voltage or current output). The definitions of each PIN are shown in the following table:

Wire color	Wire name	Wire definition	Diagram
Brown ①	VCC	Sensor power input terminal, power supply voltage 3.3~5V /5~24V , power supply current must be greater than 200mA	
Blue③	GND	Power ground	
Black④	TX/A+	Serial port communication, when it is TTL, it is the data sending end, when it is RS485, it is the differential signal A+, with TVS protection	
White ②	RX/B-	Serial port communication, when it is TTL, it is the data receiving end, when it is RS485, it is the differential signal B-, with TVS protection	
Grey⑤	VIout	Analog voltage or current output, can be configured to 0~5V, 0~10V or 4~20mA output, analog output power supply needs to be 12~24V, this interface only supports M39 shell radar.	

### 4. Communication Protocol

The sensor interacts with the host through a serial port and can be configured to use either TTL or 485. The initial ID is set to 1, with a default baud rate of 115200, 8 data bits, no parity, no flow control, and 1 stop bit. The communication protocol can be either the manufacturer-defined protocol or the standard Modbus protocol. The sensor automatically detects and switches between communication protocols

#### 5.1 Custom protocol description

Command(ID=1)	MQ1000 answer	Command description	Remarks
S001@ID=x\r\n	A001#ID-OK\r\n	Set sensor ID	The initial value is 1, x is 1~128
S001@Baud=x\r\n	A001#Baud-OK\r\n	Set communication baud rate	The initial value is 115200, x range is 2400~256000
S001@SENS=x%\r\n	A001#Stv-OK\r\n	Set sensor detection sensitivity	The initial value is 80%, x is 1%~100%, the larger the value, the higher the sensitivity, and vice versa
S001@AVERAGE=x%\r\n	A001#AVERAGE-OK\r\n	Set filter coefficient	x is 1%~100%
S001@THOLD=x\r\n	A001#THOLD-OK\r\n	Set threshold	$1 < x < 30$ , the initial value is 1.7, x is the strength of the radar reflection signal, which is related to SNR
S001@Time=x\r\n	A001#Time-OK\r\n	Set detection time	The initial value is 100 milliseconds
S001@Mode=x\r\n	A001#Mode-OK\r\n	Set data acquisition method	When $x > 1$ , the measured value needs to be read by sending a command. When it is 0, it is the time interval for actively outputting the measurement result, in mS ( $> 50\text{mS}$ )
S001@Offset=x\r\n	A001#Offset-OK\r\n	Manually calibrate measurement distance	The initial value is 0, calibration range $-2000\text{mm} < X < 2000\text{mm}$
S001@State=x\r\n	A001#State-OK\r\n	Stop and start detection	When X is 0, stop detection, 1 is to start detection
S001@TargetNub=x\r\n	A001#TargetNub-OK\r\n	Set number of detection targets	Maximum 10 targets ( $x \leq 10$ ), output according to the actual number of detected targets
S001@EmptyLevel=x\r\n	A001#EmptyLevel-OK\r\n	Set liquid level mode space height	X is the space height of the liquid level, which must not exceed the detection range. After this value setting takes effect, the sensor output value is x-radar measurement distance value
S001@Rest\r\n	A001#Rest -OK\r\n	Sensor reset	NC
G001@Msg\r\n	A001#MQ1000xx (V3.3)-msg: Baud=X1,SENS=X2%,T HOLD=X3, AVERAGE=X4,	Get sensor configuration	NC

	TargetNub=X5, Offset=X5,Mode=X6,Temp=X7 Level=X8		
G001@Dist\r\n	A001#Dist=xmm ,SNR=y	Get measurement distance value and target signal strength	x is the distance value measured by the sensor, y is the signal-to-noise ratio, and multiple targets are output in order from near to far
G001@FctyRst\r\n	A001#FactoryReset\r\n	Restore factory settings	All settings are restored to the factory defaults

Note: 001 is the sensor address, the value is 001~128, and 000 is the broadcast address. The set data will take effect after reset.

## 5.2 Modbus Protocol Description

MQ1000 sensor supports the standard Modbus-RTU protocol. In this mode, the sensor is a slave. The protocol is divided into two parts: the host sends the message and the sensor returns the message. The message information sent by the host includes the read and write parts. After receiving the information from the host, the sensor will do the corresponding processing. If the message is correct, there will be a relevant response, otherwise there will be no response. In addition to using the sensor address to read and write, the host can also use the broadcast address 0xFF for reading and writing.

The function codes supported by the sensor are shown in Table 4-1. The power-off save data set needs to be reset to take effect.

Function code	Register address	Register content	Read/write (R/W)	Remarks
0x03 <sup>①</sup>	0x00	Target 1 distance value	R	Unit: mm, when the number of detected targets is 1, target 1 is the distance of the target with the strongest echo
	0x01	Target 1 signal-to-noise ratio	R	SNR, the high digit is an integer, the low digit is a decimal
	0x02	Target 2 distance value	R	Unit: mm, when the number of detected targets is 1, target 2 is the farthest distance target detected by the radar
	0x03	Target 2 signal-to-noise ratio	R	SNR, the high digit is an integer, the low digit is a decimal
	0x04	Target 3 distance value	R	Unit: mm, when the number of detected targets is 1, target 2 is the closest distance target detected by the radar
	0x05	Target 3 signal-to-noise ratio	R	SNR, the high digit is an integer, the low digit is a decimal
	.	Target n distance value	R	The n <sup>th</sup> echo distance value
	.	Target n signal-to-noise ratio	R	SNR, the high digit is an integer, the low digit is a decimal
	0x12	Target 10 distance value	R	The tenth echo distance value
	0x13	Target 10 signal-to-noise ratio	R	SNR, the high digit is an integer, the low digit is a decimal
0x04	0x00	Device address	R/W	ID range 1~128
0x06	0x01	Baud rate	R/W	Power-off preservation, 1~9 represents baud rate 2400~256000, see Table 4-2 for details
0x10	0x03	Filter coefficient	R/W	1%~100%
	0x04	Echo threshold	R/W	The high digit is an integer, the low digit is a decimal
	0x05	Manual sensor calibration	R/W	The calibration value is expressed as a negative number in 16-complement code
	0x06	Sensor version number	R	NC
	0x07	Space height distance in liquid level mode, disabled when 0	R/W	Set the space height of the sensor working in liquid level mode, unit mm

Table 4-1 Modbus protocol function code and register description

① When there is only one target within the detection range, the strongest echo target has the same value as the farthest and closest targets.

S/N	1	2	3	4	5	6	7	8	9
Baud rate	2400	4800	9600	19200	38400	57600	115200	128000	256000

Table 4-2 Baud rate corresponding values

#### 4.2.1 Reading measurement data

The data measured by the sensor is read through the 0x03 function code, and the corresponding registers are 0x00 to 0x13. When only one target is set to be detected, the first six registers are the distance and signal strength of the target with the strongest signal, the farthest target, and the closest target. When multiple targets are set to be detected, the register values are the distance and signal strength values of the measured targets in order from near to far, see Table 4-1 for details.

Host message format:

Description	Address code	Function code	Start address	Number of registers	CRC	Remarks
Data length	1 byte	1 byte	2byte	2 byte	2 byte	NC
Example	01	03	00 00	00 02	C4 0B	NC

Example explanation: Read the values of two consecutive holding registers of the sensor with address 01 starting at 0x0000.

Response format:

Description	Address code	Function code	Data size	Register value	CRC	Remarks
Data length	1 byte	1 byte	1byte	2 *N byte	2 byte	N is the number of registers
Example	01	03	04	07 F9 12 25	E6 0D	NC

Example explanation: The effective data length of the response is 6 bits, corresponding to the sensor's measured distance of 0X07F9 (i.e. 2041 mm), the SNR value is 0X1225 (i.e. 18.37), the high bit is an integer, and the low bit is a decimal.

#### 4.2.2 Reading the setting parameters

The sensor setting parameters are obtained through the 0x04 function code. The data in the message follows the high bit first and the low bit last. See Table 4-1 for details.

Host message format:

Description	Address code	Function code	Start address	Number of registers	CRC	Remarks
Data length	1 byte	1 byte	2byte	2 byte	2 byte	NC
Example	01	04	00 02	00 01	90 0A	NC

Example explanation: Read the value of a continuous holding register of the sensor with address 01 starting at address 0x0002. Sensor response format:

Description	Address code	Function code	Data length	Register value	CRC	Remarks
Data length	1 byte	1 byte	1byte	2 *N byte	2 byte	N is the number of registers
Example	01	04	02	00 0A	39 37	NC

Example explanation: The effective data length of the response is 2 bits, that is, 0x000A, which corresponds to the sensor sensitivity of 10%

#### 4.2.3 Setting a single parameter

The host can write to a single register with a writable function through the 0x06 function code. The register address is 0x0000 to 0x0007, see Table 4-1 for details.

Host message format:

Description	Address code	Function code	Register address	Register value	CRC	Remarks
Data length	1 byte	1 byte	2byte	2 byte	2 byte	NC
Example	01	06	00 04	FF9C	89 92	NC

Example explanation: Write the register value of the 0x0004 address of the 01 device to 0xFF9C, and the manual calibration value of the sensor can be set to 0xFF9C (-100mm)

Response format

Description	Address code	Function code	Register address	Register value	CRC	Remarks
Data length	1 byte	1 byte	2byte	2 byte	2 byte	NC
Example	01	06	00 04	FF9C	89 92	NC

#### 4.2.4 Setting multiple parameters

The host can write to multiple consecutive registers with writable functions through the 0x10 function code. The register addresses are 0x0000 to 0x0007. See Table 4-1 for details.

Host message format:

Description	Address code	Function code	Start address	Qty of registers	Number of bytes	Register value	CRC	Remarks
Data length	1 byte	1 byte	2 byte	2 byte	1 byte	2*N byte	2 byte	NC
Example	01	10	00 00	00 03	06	00 02 00 02 00 01	FF 40	NC

Example explanation: Write 6 bytes of valid data to the first 3 registers of the 0x0000 address of device 01, that is, write 0x0002, 0x0003, and 0x000A to the addresses 0x0000~0x0002 respectively. Response format:

Description	Address code	Function code	Start address	Number of registers	CRC	Remarks
Data length	1 byte	1 byte	1byte	2 byte	2 byte	NC
Example(9)	01	10	00 08	00 03	01 CA	NC

## 5. Dimensions

