RF Admittance Level Sensor
（with alarms）

Operation Manual

Version: 2023-07

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1. Introduction

RF admittance level sensor uses a unique and advantageous level measuring technology. A capacitor will be formed when the sensor installed in the vessel. The probe (measuring electrode) acts as one plate of the capacitor, and the vessel acts as another plate of the capacitor . (a reference electrode should be added if the vessel is an insulating material). When level increased, the capacitance between these two plates will be changed, this change will cause a change in the radio waves which is acting on the probe of the RF admittance level sensor. This change of radio wave will be detected by the RF circuit and be converted into a linear current output. Since RF admittance level sensor is working based on the capacitance measurement, each working condition environment is different, so each sensor should be installed and calibrated on site before use normally.

2. Features

1. There are no moving parts, measuring range 10pf - 5000 pf .
2. Capacitance value can be directly input for calibration without filling liquid
3. With any two point calibration function
4. Signal output could be customized 4-20mA / 0-5v / RS485 / switch etc.

■ simple structure, without any moving or elastic components, so gains high reliability and minimal maintenance. Usually it is not necessary to carry out regular large, medium, small maintenance.

■ various of signal outputs, convenient for different system configurations.

■ suitable for measuring the material level of high temperature or high pressure vessels, and the measured value is not affected by the temperature, gravity of the medium also the shape and pressure of the container.

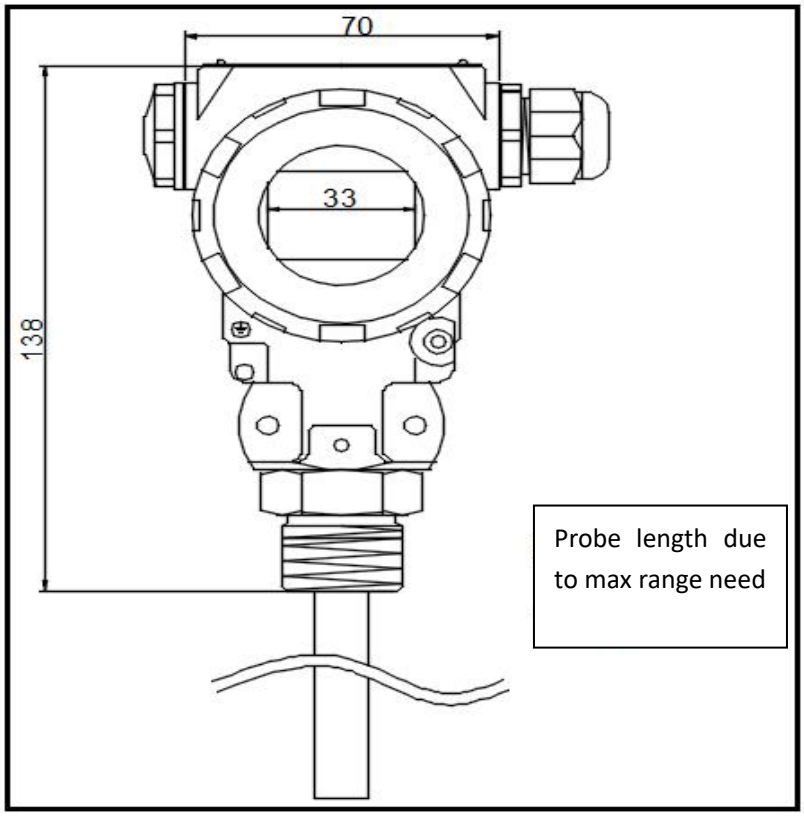
■ especially being suitable for the measurement of acid, alkali and other highly corrosive liquids.

■ completely protection of over-current, over-voltage, power polarity.

3. Technology parameters

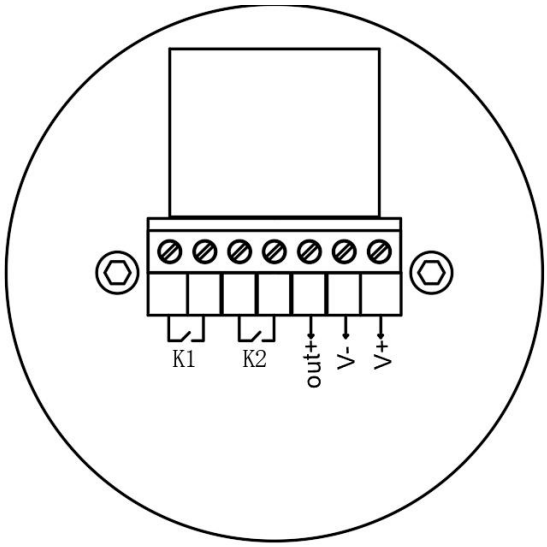
- Detection range: 0.1-30m
- Capacitance measurement range: 10PF to 5000PF
- Accuracy: 0.1 level, 0.2 level, 0.5 level, 1 level
- Pressure range: -0.1MPa to 2MPa
- Extreme temperature resistance: -50~150 ℃
- Environmental temperature: -40~85 ℃
- Storage temperature: -55 ℃ to+85 ℃
- Output signal: 4-20mA, 4-20mA combined with HART communication, 485 communication, etc
- Power supply voltage: 15-36V DC
- Material of liquid level gauge: 316 stainless steel, 1Gr18Ni19Ti or polytetrafluoroethylene
- Long term stability: ≤ 0.1% FS/year,
- Temperature drift: ≤ 0.01% FS/℃ (within the range of 0-70 ℃)
- Explosion proof grade: ExibIICT6
- Protection level: IP67

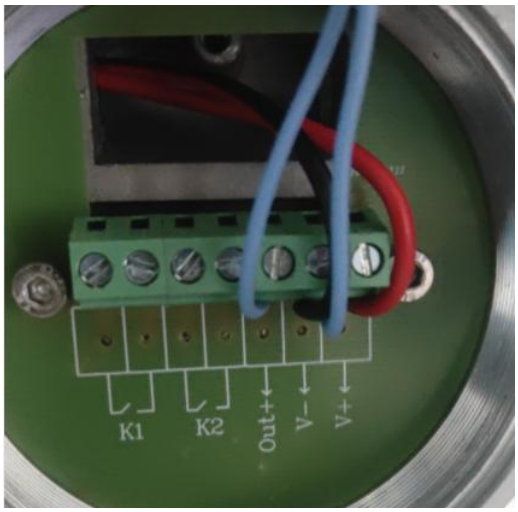
4. Structure



5. Wiring

Wiring diagram of RF level sensor with alarms （3-wire）:





Note:

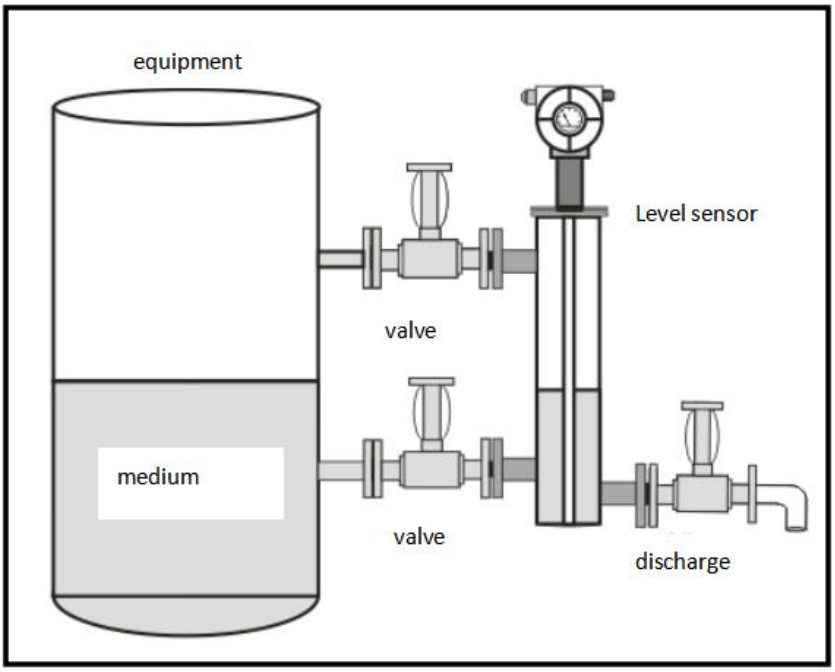
1. The alarm output is switching signal output, with limited load capacity. Can't control device with high-power directly, the contact capacity is 24VDC 1A or 220VAC 1A.

2. Alarming point can be configured, code 555. Enter into setting there will be AH and AL options. AH is high level alarm , AL is low level alarm.

3. The terminals inside K1 is low level alarm, K2 is high level alarm. Power supply need 24V DC.

4. Switch contact is normally open type. When level is lower than low level alarm point or be higher than high level alarm point, the switch contact will close and work.

6. Installation



Because RF admittance level sensor only has difference on appearance and material compared with capacitance level sensor, but both of them are level measuring instruments. So the installation method is more or less same.

Generally speaking, the installation is very easy and simple. Only need to thread it on the top of tank by installed by flange which is required by the customer and nominated before producing. Of course when use flange, you need use bolts to fix it well and tightly, better add an sealing washer between flanges connection.

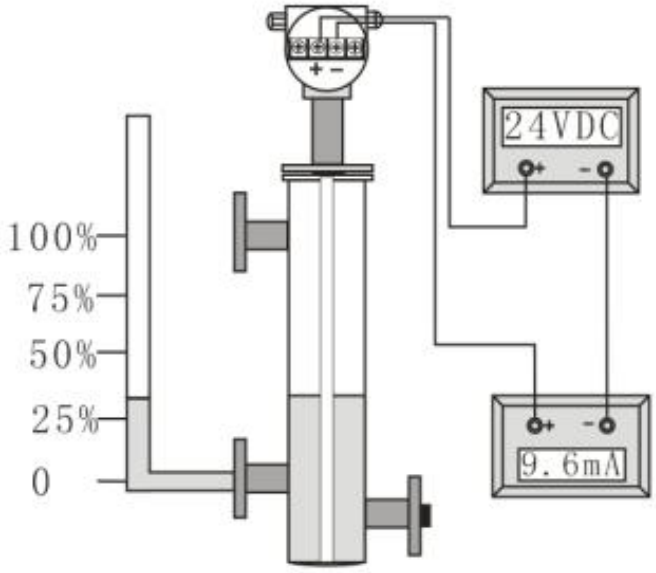
Note:

1. **The valves can be added in order facilitate the disassembly of the sensor during maintenance or replacement.**
2. **When installed on metal tank, make sure the sensor is contacted with the tank. If the tank is non-conductive material , you must add auxiliary electrode or install it through metal pipe.**

7. Calibration

Although the factory products have been simulated calibrated before leaving the factory, in order to further experience the performance of the factory products before use, it is recommended that users perform simple calibration, in addition, if in use, the performance of the factory products have concerns, you can also remove the whole set of instruments to check. (But do not disassemble the parts of our products)

Calibration steps as below shows:



1) .Prepare one transparent tube / water pipe with scale numbers, in order to observe the actual water level when calibrate. And one ampere meter (DC) with 3 digits or above.

2) Connect the transparent tube like above pic shows with water tank or tube, Connect 24V DC power supply to the terminals of level sensor, serial connect the ampere meter into the wiring and power it on.

3) Filling water from the top of transparent tube which will also goes into water tank at same level. Add the water level into several different positions of height and read the actual data of ampere meter accordingly. Then according to the output standard 4-20mA signal corresponding to the height ratio and the acquisition current value compared, you can check the accuracy of the level meter. (suggest points 0% , 25%, 50%, 75%, 100% which should match with 4mA , 8mA, 12mA, 16mA, 20mA)

8. Keyboards instructions

8.1 keys and functions

C (setup): enter the setting status and set data to confirm

S (range): set the increase data and measuring range

Z (zero) : set the decrease data and zero level.

8.2 Screen display instruction

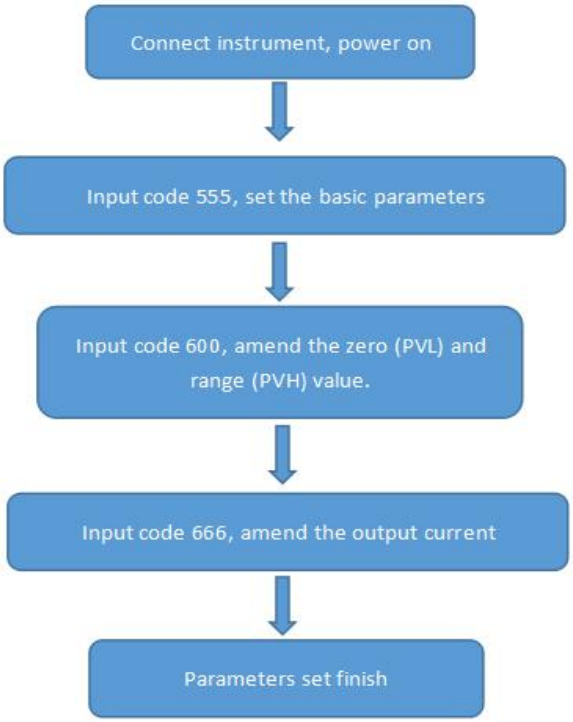
Scale bar: on the top of screen, display the percentage of current liquid level, arrows on left or right means the level increasing or decreasing.

Data bar: in the middle of screen, display the data of current level.

Pormpt bar: at the bottom of screen, there is setup or item displaying, error code and unit.

Special suggestion: if wrong input entered into code 600 setting items caused by special reasons or accidentally, zero level and measuring range must be adjusted, so we suggest modify

this value fixed at one time, and don't change the value of PVH and PVL as will .



Above is parameters setting procedure (not debugging)

9. Operation of menus are divided into 6 parts:

1. Basic operation(code 555) : including the position of decimal point, display mode, damping time, communication address, time interval of wireless transmission.
2. Output calibration(code 666) : including 4mA output calibration, 20mA output calibration.
3. Input capacitance value directly to calibrate (code 800): can input zero and full range capacitance value here, level sensor will calibrate automatically, no need to fill or discharge the liquid level . possible to calculate and input capacitance value of zero level after checking the value of any point.
4. Sensor setting (code 600) : mainly used to modify the zero and range value of sensor.

Every step of these operations need input code firstly: press C key, dispaly PASS , through press (Z,S) to change the code, when code is correct, press C key to enter next operation, finish the setting in order, press C to confirm and enter next step, when finish all settings, press C to quit.

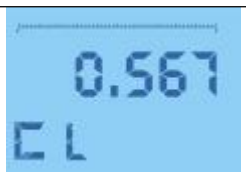
1. Basic parameters list : code 555

Menu sequence	Menus	Content of menu	Representative display
1	DOT	Position of decimal point	
2	DISP	Display modes: %，m，cm，mm	
3	DAMP	Damping time, modify the value to decide the speed of signal output	
4	ADD	485 communication address: modify the ADD to change the communication address	
4	AH	High alarm setting	800
5	AL	Low alarm setting	200
6	DDD	Deviation due to regression	DDD 05

2. output current calibration list,code: 666

Menu sequence	Menus	Content of menu	Representative display
1	DALL	4mA calibration,modify the output current through S,Z keys to make it at 4mA	
2	DAHH	20mA, through Z key to modify the current output to be 20mA	

3. Input capacitance value directly to calibrate, code : 800.

Menu sequence	Menus	Content of menu	Representative display
1	CL--PF	Enter menus and input capacitance value of zero point level via Z S keys	

2	CH--PF	Enter menus and input capacitance value of full point level via Z S keys	

4. Sensor setting list, code:600

Menu sequence	Menus	Content of menu	Representative display
1	PVL	the measuring value minimum is 0, can't exceed max limit	
2	PVH	maximum is 9999	

5. Sensor setting list, code:777

Menu sequence	Menus	Content of menu	Representative display
1	FRE	Value varies from 1-10, capacitance value will increase	1- -0.0 FRE mm

6. The keys function under the status of debugging:

Menu sequence	Menus	Content of menu	Representative display
Zero debugging	570	Zero point calibrate: empty the liquid to zero point level, when it is steady, input code 570	
Range debugging	590	Full range point calibrate: add the liquid to full range point level, when it is steady, input code 590	

7. Input code 222 to check the current capacitance value .

Notes:

In practice, the liquid maybe can't be filled to full range, can only be added to a certain point, we can view the current capacitance value, according to the value calculate out the value of capacitance at full range and zero point. For example the current height is H1, corresponding to the current height the capacitance values

is C1. For every mm ,the variation is Δ C, the full range height is H2, so at the H2 point, the corresponding capacitance is (H2 - H1) X Δ C + C1,.By the same token, the zero level of corresponding capacitance values should be C1 - (H1X Δ C). We can get the Δ C value from the differential capacitance values between any two points divided by the difference in height between the two points.

10. Error code:

No.	Code	Meaning	Treatment
1	EROR1	Sensor short-circuit	Check wiring
2	EROR2	Sensor open-circuit	Check wiring
3	EROR3	Lower than average	Sensor linearity is too slow
4	EROR4	Higher than average	Sensor linearity is too steep
5	EROR5	Low signal	Check sensor short circuit or not
6	EROR6	High signal	Check sensor open circuit or not
7	EROR7	Range setting is too small	Re-calibrate the range
8	EROR8	PV range is too small	Reset the PV value

11. Modbus-RTU communication protocol

When configured Modbus communication protocols for level sensors, it should follow the Modbus communication procedure. Adopts the Modbus-RTU protocol as command subset. Using the register read command (03).

1. Data transmission mode:

   Asynchronous 10 bits -- 1 start bit, 8 data bits, 2 stop bits. No parity bit.

2. Data trasmission rate:

   19200BPS, 9600BPS, 4800BPS, 2400BPS. (default baud rate is 9600, can’t be changed. So if buyer need others, please specify before produce)

3. Address:

   0-63, users could set it by the menus on level sensor.

4. Master computer request datagram format:

Master send	Bytes number	Message sending	Remarks
Slave address	1	XX	Request data from salve address XX
Function Code	1	03	Read register
Start address	2	0000	Starting address is 0000
Data length	2	00XX	Read XX bytes data (total 2XX bytes)
CRC code	2	XXXX	Calcualted by master and get CRC code

For example the datagram like this below : (not real datagram for level sensor)

01H，03H，00H，00H，00H，0DH，84H，0FH

01H，03H，00H，00H，00H，0BH，44H，0DH

01H，03H，00H，00H，00H，09H，85H，CCH

5. Message format responsed by level sensor of reading data command

Slave response	Bytes number	Message return	Remarks
Salve address	1	XX	From slave address XX
Function code	1	03	Read register
Data length	1	XX	XX bytes (2 times data number)
Register data 1	2	DAT1	Sensor parameter 1 data
…	…	…	…
Register data N	2	DATN	Sensor parameter N data
CRC code	2	XXXX	Calculated by slave CRC code

● the calculation method of CRC code：

1. Preset a 16-bit register for hexadecimal FFFF (i.e., all is 1); we call it CRC register;

2. Combine and XOR the first 8-bit binary data (the first byte of the communication information frame) with the low 8-bit of the 16-bit CRC register, put the result in the CRC register;

3. Shift the content of the CRC register one bit to the right (toward the low bit) and fill the highest bit with 0, and check the shifted out bit after the right shift;

4. If the shift out bit is 0: Repeat step 3 (shift one bit to the right again);

If the shift out bit is 1: CRC register is XORed with polynomial A001 (1010 0000 0000 0001);

5. Repeat steps 3 and 4 until the right shift 8 times, so that the entire 8-bit data has been processed;

6. Repeat steps 2 to 5 to process the next byte of the communication information frame;

7. After all the bytes of the communication information frame are calculated according to the above steps, the high and low bytes of the obtained 16-bit CRC register are exchanged;

8. The final content of the CRC register is: CRC code.

6. Communication flow：

一、The communication process of the liquid level transmitter					
Host			Level sensor		
Process	Action	Command	step	Action	Command
1	Send request data command	03H	1	Receive the host command and determine the format and correctness of the command frame	
2	Wait for the sensor to respond to the frame or determine that the communication times out and exit the communication		2	Send a response data frame or silence	03H
3	Receive data from the slave and determine the format and correctness of the data frame		3		
4	Process received data or silence		4		

7. Read register (command is 05) parameters are as follows：

The company's liquid level meter registers only 7, respectively：

NO.	Register	Note
1	Register 1	Liquid level data
2	Register 2	Decimal position
3	Register 3	Unit
4	Register 4	Range value PVH
5	Register 5	current capacitance value (Notice)
6	Register 6	Zero capacitance value (Notice)
7	Register 7	Range capacitance value (Notice)

For example, read 7 register commands: 01 03 00 00 00 07 04 08

For example: if the liquid level data is 1000, the decimal point is 1, and the unit is mm, then the result is 100.0mm data.。

(Notice)

The current capacitance value is an internally processed value, which is a virtual 16-bit value. To read the value, it needs to be divided by 100. For example, if the read value is 22233, then the capacitance value is 222.33PF.

8. Write register (command is 06) parameter as follows：

serial number	Register	Note
1	Register 5	Calibration zero
2	Register 6	Calibration range
3	Register 7	Modify PVH value
4	Register 8	Modify the zero capacitor value (Notice)
5	Register 9	Modify the range capacitance value (Notice)
5	Register 10	Modify filter value

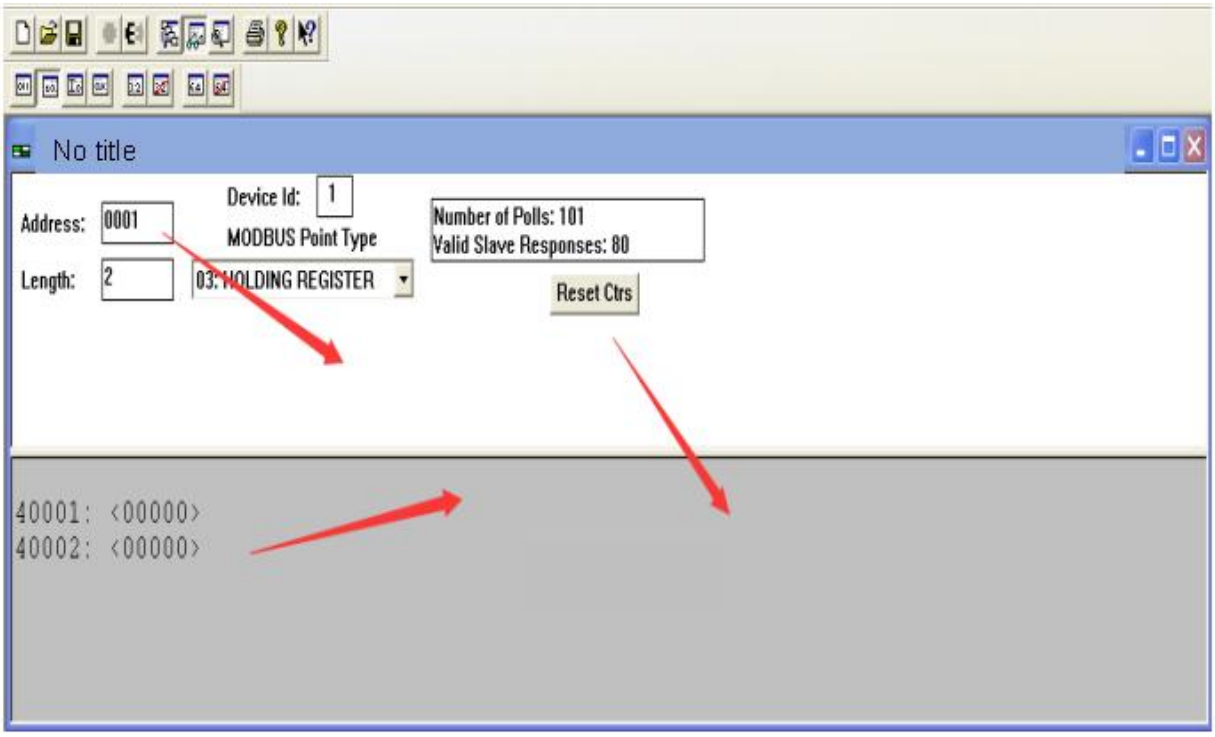
Note:

When inputting the capacitance value, input it to the 16th power of 2, which is between 0 and 65535. For example, if the capacitance value is 200PF, you need to multiply it by 100 and then input it, which is 20000.

The filter value is between 0-9 digits.

9. Screenshot of serial debugging wizard：

Communication command routine：



Reading data：	01 03 00 00 00 05 85 C9
Zero calibration	01 06 00 05 00 00 99 CB
calibrated span	01 06 00 06 FF FF 68 7B
Modify PVH	01 06 00 07 03 E8 38 B5
Modify the zero capacitance value	01 06 00 08 0B B8 0F 4A
Modify measure range capacitance value	01 06 00 09 4E 20 6D B0
Modified filter value	01 06 00 0A 00 01 68 08