Helium Purity Monitor
HPM-02

User's Manual

4681　　Rev.9

TSUJICON

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1. Specifications

1-1. abstract

This Helium Purity Monitor uses a pirani gauge.
This unit can measure helium gas purity by less than 1% error on the condition of 50 - 100% degree.
HPM-01 type has a screen that that shows purity of helium gas (20～100%),
and temperature of outer wall sensor (DEG). Analog signal (0～1V) connected with the purity outputs.
HPM-02 type has all function of HPM-01, and LAN communication for reading purity and temperature.
E-mail sending system is avalable from the firmware version 1.10.

1-2. Mechanism

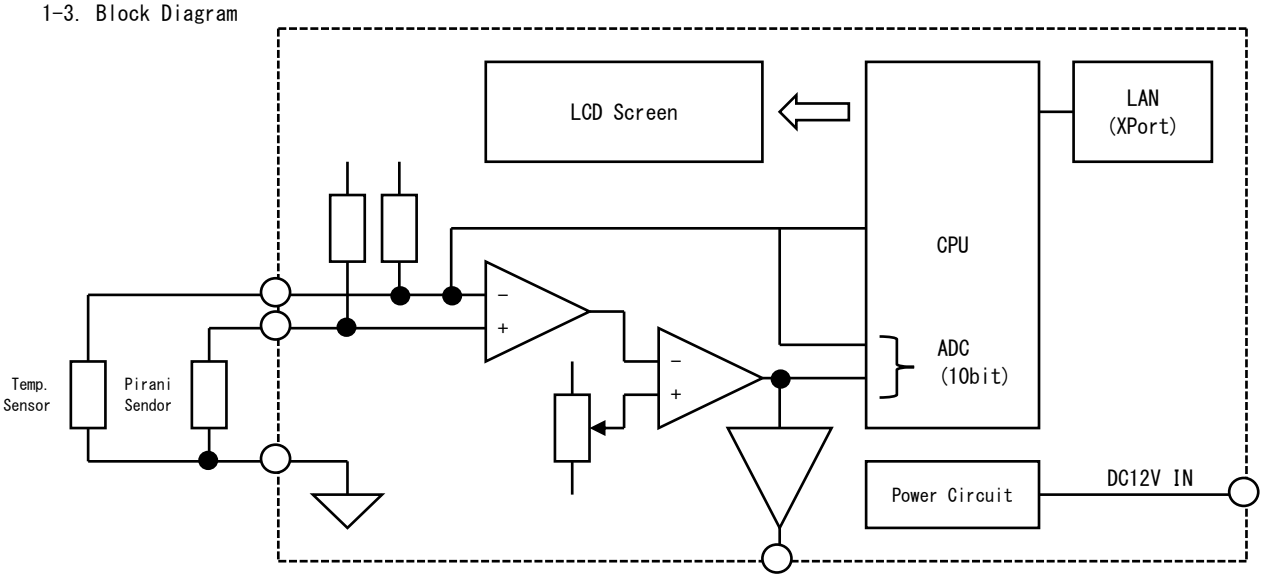
You set pirani sensor under 1 atmospheric pressure at 100% helium and at mixture of X% helium
and air, and pass an electrical current (200mA), then terminal voltage of sensor is calculated
this formula. (Over 60% degree, less than 1% error accuracy)

$$V = 3211 + 7.13T + 13.3(100-X) \ [mV]$$

T:Temperature[℃] X:Purity of Helium Gas[%]

In this way, you can acquire the analog data being in proportion to helium gas purity with using
temperature-compensated circuit, amplification, and offset subtraction. This unit converts
this analog data into digital, shows it, and enables you to read via LAN.
Outer wall sensor temperature is calculated by converting analog data for
temperature-compensated analog to digital.

1-3. Block Diagram



1-4. Electrical Specification

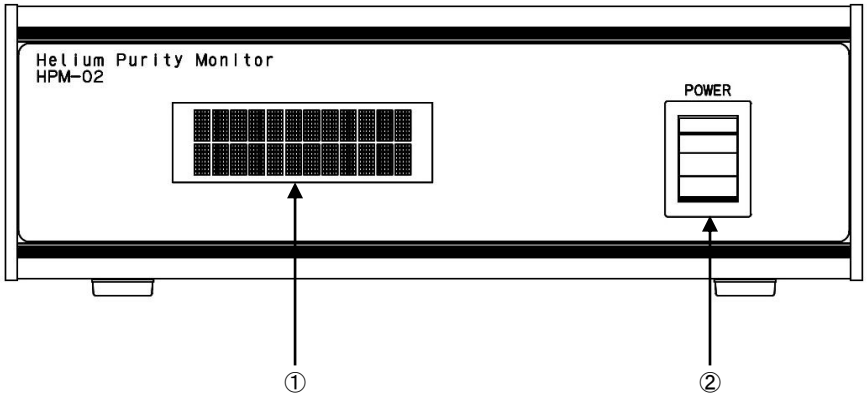
AC Adapter (Type: HPM-02AC)	AC100 - 240V to DC12V/1A cable is attached.
Power Supply	DC12V supplied from AC Adapter. Generates DC15V for analog calculate circuit, DC5V, and DC3.3V for digital circuit at DC/DC Converter.
Sensor	MAX Voltage : 15V MAX Current : about 200mA
Monitor	12 character - 2 lines LCD screen
Communication	Purity of helium gas, and temperature of outer wall sensor can be read via LAN.

2. How to Use

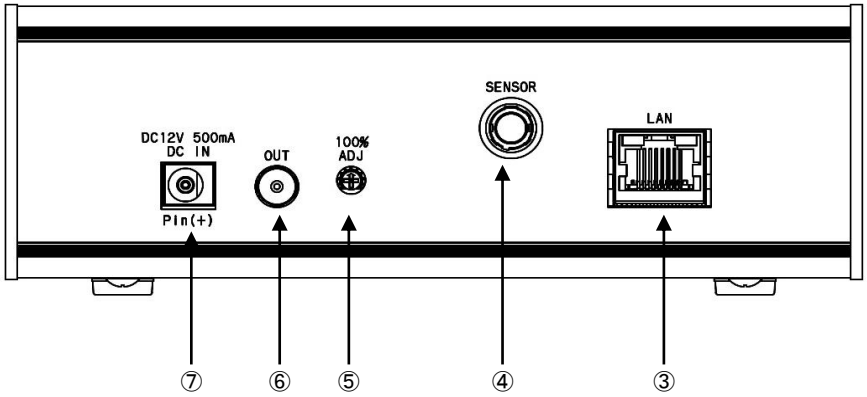
2-1. Appearance

Size: W150 × D125 × H50 [mm]

[Front]

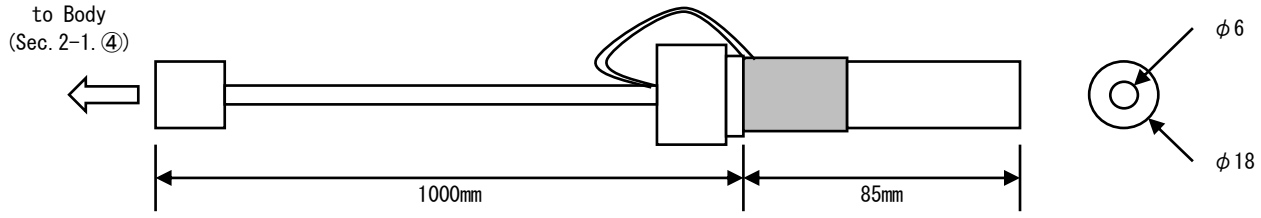


[Rear]



① LCD screen	Purity of helium gas and temperature of outer wall sensor are shown here.
② [POWER]Switch	Upper is power on.
③ [LAN]Connector	LAN cable connector
④ [SENSOR]Connector	Connect the sensor cable (See Sec.2-2.).
⑤ [100% ADJ]Connector	Adjust purity to 100% with variable resistance (See Sec.2-4.).
⑥ [OUT]Connector	LEMO Connector(EPL.00.250.NTN). This connector outputs 0 - 1V (Purity of helium 0 - 100%) analog signal.
⑦ [DC IN]Connector	Connect attached AC adapter here.

2-2. Sensor Cable



The sensor is attached to the gauge port of φ18.

2-3. Preparation for Using

1. Connect AC Cable
   If you have checked that power switch is off, connect attached AC cable.

2. Connect Sensor Cable
   Connect the sensor cable to the sensor connector.

3. Connect LAN Cable
   If necessary, connect the LAN cable.
   Before using LAN communication, it is necessary for LAN setting. (See Sec.2-5.)

4. Connect Analog Signal Monitor Cable
   If necessary, connect the cable with a standard.

5. Turn on the Power
   Turn on the power with connecting AC cable, and HPM-02 works immediately.

6. Show Purity of Helium Gas and Temperature of Outer Wall Sensor
   If the power turn on, purity of helium gas and temperature of outer wall sensor is shown at regular intervals.

   [LCD Screen]

P	U	R	I	T	Y	1	0	0	.	0	%	←Purity of Helium Gas
		T	E	M	P		2	5	D	E	G	←Temperature of Outer Wall Sensor

2-4. Helium Gas Purity Adjustment

It is necessary for adjustment to 100% for accurate measurement of helium gas purity.
First, put the sensor into 1 atmosphere pressure, 100% purity helium gas with
the power turned off. If finished, turn on the power, the purity is shown at screen.
Adjust the variable resistance "100% ADJ" to 100% with the screwdriver.
If you turn clockwise it, purity decreases. If counterclockwise, increases.

2-5. Caution

1. Helium gas purity measurement is premise under the atmospheric pressure
   because it uses difference of gas thermal conductivity.
   Sensor will have BURNED OUT if using under the VACUUM,you must use under the atmospheric pressure.
   From firmware version 1.20, sensor protection function has been added.
   Please refer to See Sec.2-8. for more details.

2. Without purity adjustment, the purity calculation may result in over 100%.
   You cannot know correct helium gas purity, you must adjust it before using.

2-6. LAN Communication Setting

HPM-02 supports external communication via LAN.

2-6-1. Preparation

To control this one by LAN communication, it's need to some setting items by 10BASE-T/100BASE-T communication cable. Setting protocol is telnet protocol by TCP/IP connection.
To connect network by this one, IP address, subnet mask, and Port NO must be set to this unit.
Factory setting is

IP Address:	192.168.1.55
Subnet Mask:	255.255.255.0
Port No:	7777

When connecting PC directly, you have to use cross cable.But using HUB module, you don't have to.
The way of connecting PC directly is as follows. It's need to set IP address and subnet mask to your PC.

ex.)IP Address:	192.168.1.10
ex.)Subnet Mask:	255.255.255.0

about the way of setting address to your PC, see your PC manual.

Select Command Prompt and access command "ping" in Command Prompt.

```
C:¥Windows>ping 192.168.1.55

    Pinging 192.168.1.55 with 32 bytes od data:

    Reply from 192.168.1.55: bytes=32 time=2ms TTL=255
    Reply from 192.168.1.55: bytes=32 time=2ms TTL=255
    Reply from 192.168.1.55: bytes=32 time=2ms TTL=255
    Reply from 192.168.1.55: bytes=32 time=2ms TTL=255

C:¥Windows>
```

If replies are listed above, physical connection is correct.
If physical connection is not correct, communication replies are these.

```
C:¥Windows>ping 192.168.1.55

    Pinging 192.168.1.55 with 32 bytes od data:

    Request timed out.
    Request timed out.
    Request timed out.
    Request timed out.

C:¥Windows>
```

In this case please retry the connection again after confirming the cable connection.

2-6-2. Change Setting Condition for Network

Once you check connection is correct, enter new IP address and new telnet port No. of HPM-02.
(If default No. is OK, you don't have to do this operation.)
Default

IP Address: 192.168.1.55
Port No: 7777

IP address must to be changed according to your network system.
If there is no need to change port No. , you may use No. 7777.
If you need to change port No., the recommended port is No. 10000 to 10999.

Press [Windows] key + [R] to display "Run" and enter the following.

telnet 192.168.1.55 9999

No. 9999 is port number of HPM-02.
Click OK button and screen changed to telnet mode immediately.

MAC address 0080A3466A75 ←It depends on each unit.
Software version V7.0.0.3 (210714) XPTEXE ←It depends on each unit.

Press Enter for Setup Mode

Push Return button in 3sec.
More than 3 sec, this connection is automatically cut off. Then try again from beginning.
Next,

Change Setup:
0 Server
1 Channnel 1
3 E-mail
5 Expert
6 Security
7 Defaults
8 Exit without save
9 Save and exit Your choice ?

Then select 0

IP Address:(192) 192.(168) 168.(001) 1.(55) 50
Set Gateway IP Address (N) N
Netmask: Number of Bits for Host Part (0=default) (8) 8
Set DNS Server IP Addr (N) N
Change Telnet/Web Manager password (N) N

Set IP address as above (Above is the sample for setting 192.168.1.50)
Set Gateway IP address if you need.
Netmask is to be set 8(255.0.0.0), 16(255.255.0.0), 24(255,255.255.0) etc.

In case of displaying command twice, select terminal→settings, and remove the checkbox at local echo.

Again,

```
Change Setup:
   0 Server
   1 Channnel 1
   3 E-mail
   5 Expert
   6 Security
   7 Defaults
   8 Exit without save
   9 Save and exit    Your choice ?
```

Then select 1

Baudrate (38400) ?	→ Push Return.
I/F Mode (4C) ?	→ Push Return.
Flow (00) ?	→ Push Return.
Port No (7777) ?	→ Enter port address of Telnet, then push return (7777 is default, if you change, recommend to set 10000～10999)
ConnectMode (C0) ?	→ Push Return.
Send '+++' in Modem Mode (Y) ?	→ Push Return.
Show IP addr after 'RING' (Y) ?	→ Push Return.
Auto increment source port (N) ?	→ Push Return.
Remote IP Address : (000) .(000) .(000) .(000)	→ Push Return Three Times.
Remote Port (0) ?	→ Push Return.
DisconnMode (00) ?	→ Push Return.
FlushMode (80) ?	→ Push Return.
Pack Cntrl (10) ?	→ Push Return.
DisConnTime (00:00) ?	→ automatically power down set time when in no connection. (default data 00:00 means 5999s = 99min 59sec)
SendChar 1 (0D) ?	→ Push Return.
SendChar 2 (0A) ?	→ Push Return.

Again,

```
Change Setup:
   0 Server
   1 Channnel 1
   3 E-mail
   5 Expert
   6 Security
   7 Defaults
   8 Exit without save
   9 Save and exit    Your choice ?
```

Select 9, then finished setting works

In these setting items, only IP address must be set. Other items may be no change to set.
If you enter wrong number by mistake, you'd better to restore above data.

2-6-3. Turn Back PC Set Data

If you change setting data of PC, turn back PC data to initial condition.

2-6-4. Connection Test

Let's try connecting test by optional Windows software such as "Telnet".

Press [Windows] key + [R] to display "Run" and enter the following.

telnet 192.168.1.55 7777

When in telnet operation, send data "VER?" which are expected reply data.

If reply data is like "2.00 26-02-03 HPM-02", then communication line is OK.

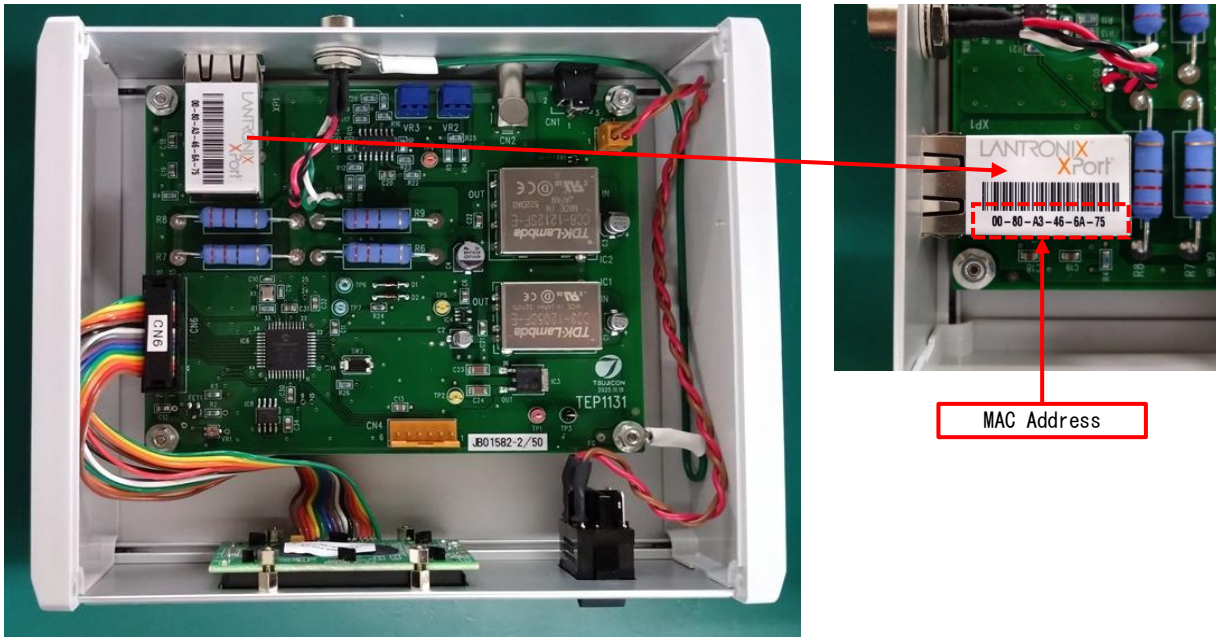
"Telnet" function contains hardware and software function, when disconnect line,

line must be cut off by "telnet" software operation before hardware disconnection.

2-6-5. When You Forget an IP Address

When you forget an IP address, you can reset it using MAC address(hardware address).

If a top-side board is opened, the MAC Address is shown at the lower part of a LAN connector.



(Ex.) When a MAC Address is "00-80-a3-46-6a-75" and an IP address is set as "192.168.1.50".

Start Windows and set Command Prompt.

Key in the command "arp (address resolution protocol) command".

C:¥Windows>arp -s 192.168.1.50 00-80-a3-46-6a-75

Next key in

C:¥Windows>telnet 192.168.1.50 1

Then connection error will appear on the screen.

Close the telnet screen, again key in next command.

C:¥Windows>telnet 192.168.1.50 9999

Run this command and soon telnet screen appears.

MAC address 0080A3466A75

Software version V7.0.0.3 (210714) XPTEXE

Press Enter for Setup Mode

Above content appears, then put on "RETURN" key within 3s.

Otherwise the connection will be cut off automatically. In this case try again.

Next operation is as same as the previous explanation of telnet command.

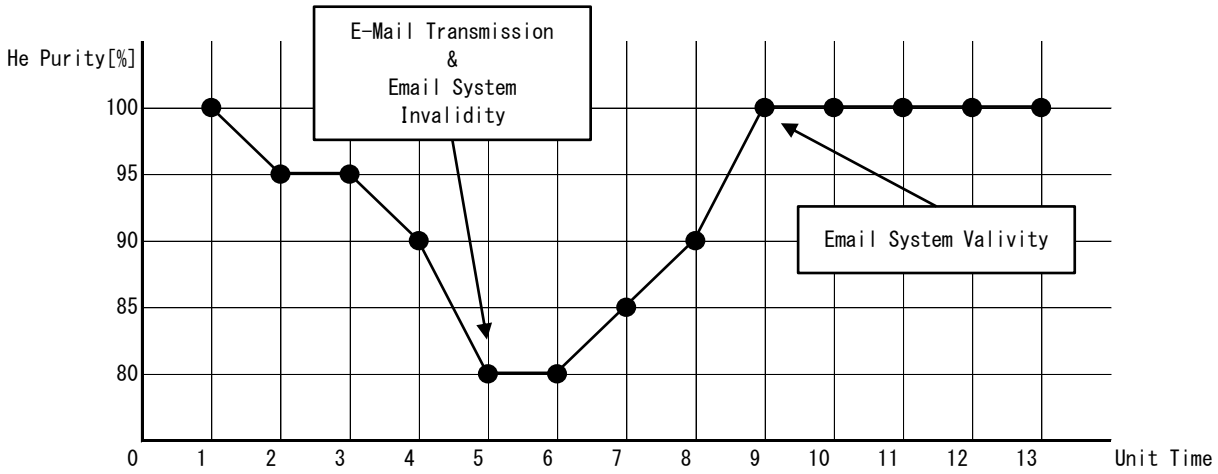
At this stage IP address 192.168.1.50 is a temporary address.

IP address must be set to a new address number.

2-7. E-Mail Sendimg System　　※This function is HPM-02. It is mounted after the firmware version 1.10.

E-mail can be sending to the mail address (two address is maximum) specified when less than the specified purity.
Once it is less than a threshold, E-mail will be sending and an E-mail function will be invalid.
If a threshold + hysteresis value will be exceeded in this state, an E-mail function will become valid automatically.
A threshold and a hysteresis value are set up with a communication command.

An image of operation is indicated below.
(Ex.) Case of threshold=85%, hysteresis=10%



Since purity was less than 85% of the threshold, E-mail is sending at unit time 5.
At this time, an E-mail function becomes invalid.
Since purity exceeded the threshold + hysteresis value, an E-mail function becomes valid automatically at unit time 9.
When purity is less than a threshold again after the unit time 9, E-mail is sending and an E-mail function becomes invalid automatically.
If an E-mail function is invalid with a communication command, an E-mail function will not be concerned with the state of purity, will become invalid.

【Important】
When E-mail is send,HPM-02 sends out character string"E-mail ALARM" to LAN, asynchronously with command.This character string is received at the terminal which TCP/IP connection has established to this timing.

2-7-1. Setting

It is the same as that of 2-6 clause, sets up by making telnet connection from 9999 port of HPM-02.

```
Change Setup:
   0 Server
   1 Channnel 1
   3 E-mail
   5 Expert
   6 Security
   7 Defaults
   8 Exit without save
   9 Save and exit    Your choice ?
```

Then select 3.

```
Mail server (0.0.0.0) ?          → Specify the IP address of the SMTP server for sending E-Mail.
Unit name () ?                   → Specify the account name for the sending E-Mail address of HPM-02.
                                     (Ex.) In the case of an email address such as
                                           "hpm@test.local", the "hpm" part
Domain name () ?                 → Specify the domain name of the sending E-Mail address for HPM-02.
                                     (Ex.) In the case of an email address such as
                                           "hpm@test.local", the "test.local" part
```

```
   Recipient 1 () ?                    → Specify the first destination E-Mail address.
                                         (Ex.) 「info2@tsuji-denshi.co.jp」
                                               Accounts and domains are not separate

   Recipient 2 () ?                    → Specify the second E-Mail address.
                                         If only one item is required, return it as is.

   - Trigger 1
   Enable serial trigger input (Y) ?   → Push Return.
      No. of bytes (2) ?               → Push Return.
      Match (41,4C) ?                  → Push Return.
   Trigger input1 [A/I/X] (X) ?        → Push Return.
   Trigger input2 [A/I/X] (X) ?        → Push Return.
   Trigger input3 [A/I/X] (X) ?        → Push Return.
   Message () ?                        → Specify the subject of the E-Mail you want to send.
   Priority (L) ?                      → Push Return.
   Min. notification interval (1 s) ?  → Push Return.
   Re-notification interval (0 s) ?    → Push Return.

   - Trigger 2
   Enable serial trigger input (N) ?   → Push Return.
   Trigger input1 [A/I/X] (X) ?        → Push Return.
   Trigger input2 [A/I/X] (X) ?        → Push Return.
   Trigger input3 [A/I/X] (X) ?        → Push Return.
   Message () ?                        → Push Return.
   Priority (L) ?                      → Push Return.
   Min. notification interval (1 s) ?  → Push Return.
   Re-notification interval (0 s) ?    → Push Return.

   - Trigger 3
   Enable serial trigger input (N) ?   → Push Return.
   Trigger input1 [A/I/X] (X) ?        → Push Return.
   Trigger input2 [A/I/X] (X) ?        → Push Return.
   Trigger input3 [A/I/X] (X) ?        → Push Return.
   Message () ?                        → Push Return.
   Priority (L) ?                      → Push Return.
   Min. notification interval (1 s) ?  → Push Return.
   Re-notification interval (0 s) ?    → Push Return.
```

Again,

```
   Change Setup:
      0 Server
      1 Channnel 1
      3 E-mail
      5 Expert
      6 Security
      7 Defaults
      8 Exit without save
      9 Save and exit    Your choice ?
```

Then select 5.

TCP Keepalive time in s (1s - 65s; 0s=disable): (45) ? → Push Return.
ARP Cache timeout in s (0s - 600s) : (600) ? → Push Return.
CPU performance (0=Regular, 1=Low, 2=High): (0) ? → Push Return.
Disable Monitor Mode @ bootup (N) ? → Push Return.
RS485 tx enable active level (0=low; 1=high): (0) ? → Push Return.
HTTP Port Number : (80) ? → Push Return.
SMTP Port Number : (25) ? → The port number of a transmitting mail server is specified.
MTU Size (512 - 1400): (1400) ? → Push Return.
TCP Re-transmission Timeout (500 - 4000) (ms): (500) ? → Push Return.
Enable alternate MAC (N) ? → Push Return.
Ethernet connection type: (0) ? → Push Return.

Again,

Change Setup:
0 Server
1 Channnel 1
3 E-mail
5 Expert
6 Security
7 Defaults
8 Exit without save
9 Save and exit Your choice ?

Select 9, then finished setting works

【supplement】
A setup of Gateway is needed when an E-mail transmitting server is out of a network.
Moreover, HPM-02 does not correspond to the server which needs SMTP authntication.

2-8. Sensor Protection

By the following factors,there are cases where the sensor may burn.

- If you vacuum state while the powering up.
- If energizing for a long time when the helium purity is extremely low.

In order to avoid that the sensor to burn, sensor protection function has been added from firmware version 1.20.
Sensor protection function works purity of helium becomes 20% or less.
Sensor protection function is activated, stop the measurement by shutting down the power to the sensor.

			E	R	R	O	R	!			
C	H	E	C	K		S	E	N	S	O	R

At this time, LCD display looks like this and back light is flashes.
To recover from this state,requires a power cycle.
Turn OFF the power and check the connection of the sensor, the state of the plumbing and please on the power again
※ As from firmware version 1.21 it is also possible to recover using SENSORINIT telnet command.
In case of using the telnet command power cycle is unnecessary.

2-9. Communication Commands

2-9-1. About

Command characters are all ASCII data.
The delimiter of communication command is CR+LF both transmit and receive case.

2-9-2. Commands

Command	Action
VER?	Reply the Software Version of This Unit. (Ex.) "2.00 26-02-03 HPM-02"
PURITY?	Reply Purity of Helium Gas. (Ex.) "100.0%" If the sensor protection function is activated, and the measurement is stopped,reply "---.-%".
TEMP?	Reply Temperature of Outer Wall Sensor. (Ex.) "25DEG" If the sensor protection function is activated, and the measurement is stopped,reply "---DEG".
THRESHOLD n	Set up an E-Mail sending threshold. A setting range (n) is 20-100. Please set up with the value in which an addition result with the hysteresis value by the below-mentioned HYS command does not exceed 100. "Illegal Command" is returned when an addition result exceeds 100. The setting is stored internally even if the power is turned OFF. Factory default setting is "80%". If the sensor protection function is activated, the measurement is stopped and this setting is disabled.
THRESHOLD?	Reply an E-mail sending threshold. . (Ex.) "80%"
HYS n	Set up the hysteresis value for the automatic return after E-Mail sending. A setting range (n) is 0-100. Please set up with the value in which an addition result with the threshold by the above-mentioned THRESHOLD command does not exceed 100. "Illegal Command" is returned when an addition result exceeds 100. The setting is stored internally even if the power is turned OFF. Factory default setting is "10%". If the sensor protection function is activated, the measurement is stopped and this setting is disabled.
HYS?	Reply hysteresis value. (Ex.) "10%"
EMAIL ON or OF	When referred to as "EMAIL ON", an E-mail Sending System is enabled. Please enable an E-mail function with this command after setting up a threshold and a hysteresis value. When referred to as "EMAIL OF", an E-Mail Sending System is disabled. After sending this command, it becomes regardless of purity, a threshold, and a hysteresis value, and an E-Mail Sending System becomes invalid. Please send the EMAIL ON command, when you make it again valid. The setting is stored internally even if the power is turned OFF. Factory default setting is "DISABLE". If the sensor protection function is activated, the measurement is stopped and E-Mail Senging System is disabled
EMAIL?	Reply E-mail ON/OFF status. (Ex.) "ON" (Case of E-Mail Sendimg System is enabled) (Ex.) "OF" (Case of E-Mail Sendimg System is disabled)
TESTMAIL	It is a command which transmits E-mail in a tentative way. When transmitting E-Mail by this command,an E-Mail function does not need to be valid.
SENSORINIIT	Then the sensor protection function is triggered, this command can be used to restore power to the sensor.

※ If you send other commands, replies "Illegal Command!!".

3. Acknowledgements
Hiroshi Hayasaka, Youichi Ootsuka, solid state physics 28 (1993) 230.

The mechanism of helium purity monitor is qwoted from this document.
We express our gratitude to them.

For the further information, feel free to ask us.

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