

The Beta Gauge Method FRM Equivalent Particle
Matter Monitor

SPM-613F

Instruction Manual

KIMOTO ELECTRIC CO., LTD.

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SAFETY INSTRUCTIONS



CAUTION

To reduce the electrical shock, do not remove the cover. No user serviceable parts inside; refer servicing to qualified personnel.

WARNING

To reduce the risk of fire or electrical shock, do not expose this appliance to rain or moisture.



This symbol, wherever it appears, alerts you to the presence of un-insulated dangerous voltage inside the enclosure-voltage that may be sufficient to constitute a risk of shock.



This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature.

Read the manual.

DETAILED SAFETY INSTRUCTIONS:

All the safety and operation instructions should be read before the appliance is operated.

Retain Instructions:

The safety and operating instructions should be retained for future reference.

Heed Warnings:

All warnings on the appliance and in the operating instructions should be adhered to.

Follow instructions:

All operation and user instructions should be followed.

Water and Moisture:

The appliance should not be used near water (*e.g.* near bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool *etc.*).

Ventilation:

The appliance should be situated so that its location or position does not interfere with its proper ventilation. For example, the appliance should not be situated on a bed, sofa rug, or similar surface that may block the ventilation openings; or placed in a built-in installation, such as a bookcase or cabinet that may impede the flow of air through the ventilation openings.

Heat:

The appliance should be situated away from heat sources such as radiations, heat registers, stoves, or other appliance (including amplifiers) that produce heat.

Power source:

The appliance should be connected to a power supply only of the type designed in the operating instructions or as marked on the appliance.

Grounding or Polarization:

Precautions should be taken so that the grounding or polarization means of an appliance is not defeated.

Power-Cord Protection:

Power supply wire should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to wire and plugs, convenience receptacles and the point where they exit from the appliance.

Cleaning:

The appliance should be cleaned only as recommended by the manufacturer.

Nonuse Periods:

The power cord of the appliance should be unplugged from the outlet when left unused for a long period of time.

Object and Liquid Entry:

Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.

Damage Requiring Service:

The appliance should be serviced by qualified service personnel when:

- The power supply cord or plug has been damaged; or
- Objects have fallen, or liquid has been spilled into the appliance; or
- The appliance has been exposed to rain; or
- The appliance does not appear to operate normally or exhibits a marked change in performance; or
- The appliance has been dropped, or the enclosure damaged.

Servicing:

The user should not attempt to service the appliance beyond that is described in the Operating Instructions. All other servicing should be referred to qualified service personnel.

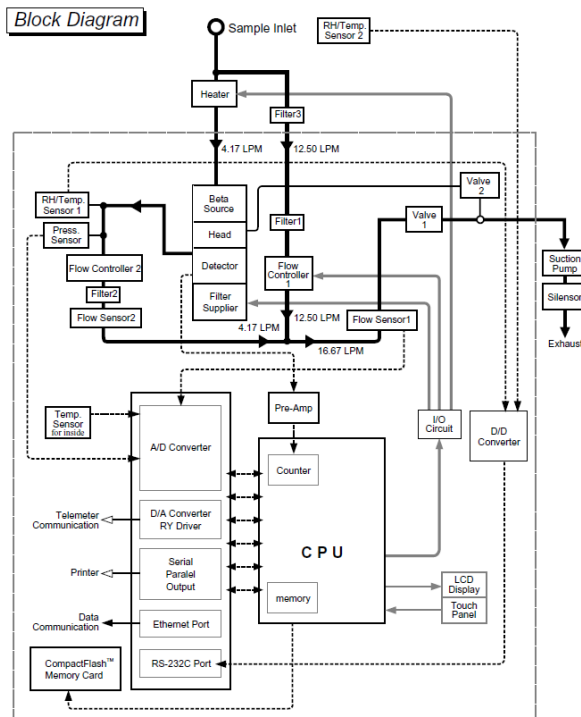
1. INTRODUCTION

1.1 General

Manufactured by Kimoto Electric Co., LTD., the TISCH ENVIRONMENTAL SPM-613F beta gauge is designed to provide the continuous measurement of PM aerosol. SPM-613F aspirates the ambient aerosol through a standard 16.67 LPM inlet. A part of PM sampled introduces to a beta gauge unit in 4.17 LPM.

Fourth part of PM is measured for 24 hours and is translated into the total PM concentration. In order to control the flow rate of two channels, SPM-613F monitored each flow using dual mass flow sensors. The system's flow control system is designed to maintain both the calibrated mass flow rate and true volumetric flow rates through the inlet at actual ambient temperature and pressure conditions. Following each hour of aerosol collection, the attenuation of 147Pm beta rays by each channel's aerosol deposit is quantified using two separate sets of beta sources and detectors. Based on previous span calibrations performed by the user, the theoretical relationship between beta attenuation and collected aerosol mass is used to estimate the mass of each separate aerosol deposit. Because beta rays are also attenuated by condensed water, an external heater is located downstream of the sampler's inlet and maintains the relative humidity of the aspirated airstreams.

SPM-613F has microcomputer that controls every mechanical movement, data processing and diagnostic functions. Just by touching the touch-screen panel of the LCD display, each setting can be controlled on the panel. And the analyzer has a key-lock function to prevent measurement procedures from erroneous key operation. The data are saved to an embedded memory and a CompactFlash™ memory card as CSV (comma separated value) format file. One can also download the data using Ethernet.



1.2 Background

Aerosol particles in the ambient atmosphere are uptaken from open field, sea surface, industrial activity, natural life cycle, traffic, volcanoes, forest fires and combustion processes, residues from the evaporation of cloud and fog, and photochemical conversion of gas to particles (mainly sulfates nitrates). Details of the particle size distribution of these aerosols are shown in figure 1. The well-known trimodal size distribution suggests particles ranging from several nanometers to hundreds of micrometers.

For health effects that are suspected to have arisen from particles entering the body through the nose and mouth during breathing, one must use a sampler whose performance mimics the efficiency with particles enter the nose and mouth and penetrate to the region in the body where the harmful effect occurs. Since the early 1980s an ad hoc working group of the International Standards Organization has been formulating health-related sampling conventions for airborne dusts both in the ambient atmosphere and in the workplace.

The final agreed conventions that comprise four main fractions (inhalable, thoracic, respirable and "high risk" respirable fraction) have passed through all stages of the approval procedure and should soon become available as International Standard IS 7708. Figure 2 shows these fractions. Especially, Thoracic fraction is defined as the mass fraction of inhaled particles penetrating the respiratory system beyond the larynx. As a function of total airborne particles, it is given by a cumulative lognormal curve, with a median aerodynamic diameter of 10 μm and diametric standard deviation of 1.5. Furthermore, "High risk" irrespirable fraction is a definition of the respirable fraction for the sick and infirm, or children. As a function of total air borne particles, it is given by a cumulative lognormal curve with a median aerodynamic diameter of 2.5 μm and a geometric standard deviation of 1.5. In response to increasing evidence of the adverse health effects associated with exposure to ambient fine particles, the United States Environmental Protection Agency (EPA) promulgated in 1997 a national ambient air quality standard (NAAQS) for $\text{PM}_{2.5}$ (USEPA, 1997). Accompanying the standard were strict design and performance requirements which candidate $\text{PM}_{2.5}$ samplers must meet in order to be approved by EPA for use in making compliance measurements (Noble, 2001). The 1997 regulations retained the existing annual PM_{10} standard and made only slight modifications to the statistical basis upon which to assess compliance with the 24-hour PM_{10} standard. Based on subsequent litigation, the U.S. Court of Appeals for the District of Columbia reviewed the 1997 regulations and upheld EPA's promulgation of the $\text{PM}_{2.5}$ standard. While acknowledging the need to regulate coarse particles, the Court vacated the 1997 PM_{10} standard after concluding that PM_{10} is a "poorly matched indicator for coarse particulate pollution" because PM_{10} includes the $\text{PM}_{2.5}$ fraction. EPA did not appeal this ruling and now intends to promulgate a new NAAQS for $\text{PM}_{10-2.5}$ (*i.e.* the coarse fraction of PM_{10}). The $\text{PM}_{10-2.5}$ concentration is calculated as the numerical difference between the measured PM_{10} concentration and the measured $\text{PM}_{2.5}$ concentration.

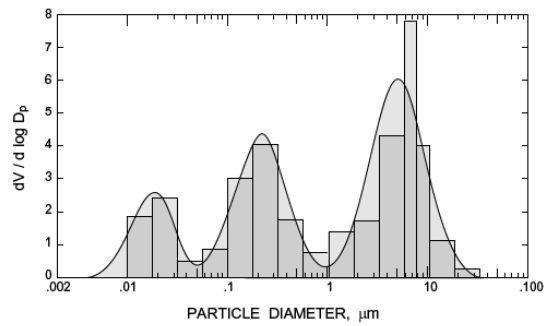


Fig.1 Size distribution of ambient aerosols reported by Whitby*
 *Whitby K. R. (1978) *Atmos. Environ.*, 12, 135-159.

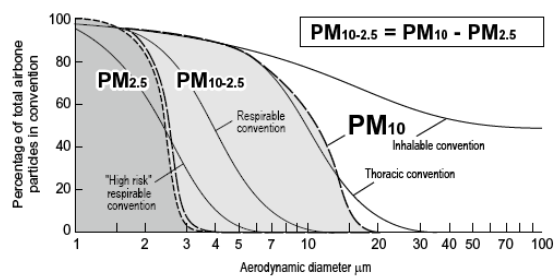


Fig. 2 Definitions of PM₁₀ and PM_{2.5} in relation to the ISO health-related sampling conventions

1.3 Features

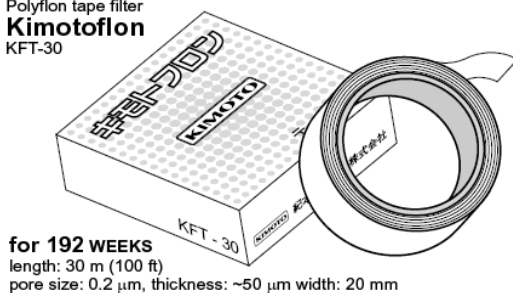
Detector

- SPM-613F has a Beta-ray detector.
- The Beta-ray source of the detector is fixed, and is isolated from the movable filter-pressing unit.

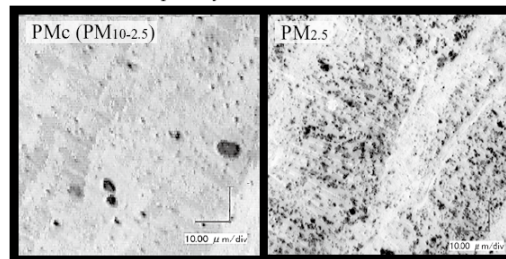
Filter

- Polyflon tape filter (Kimotoflon) is very little affected by humidity.
- Kimotoflon is ~50 μm thick with 0.2 μm pore size. Tape size: 20mm (W) x 30m (L).
 - The glass fiber filter (30mm (W) x 13m) can be set (optional).
 - For metal components analysis;
 - The exchange cycle of the tape filter is half of the 1 spot case.
- The auto reset function in a measuring cycle at the following conditions.
 - When inline pressure decreases to 18 kPa, SPM-613F runs the auto reset.
 - When auto reset works, it takes three minutes in order to move the filter and zero calibration before next sampling.

Polyflon tape filter
Kimotoflon
KFT-30



Microscopically photographs of PMc and PM_{2.5}
sampled by Kimotoflon KFT-30



[Note]

The reference value of maximum sampling weight to maintain the flow rate is 4.17 LPM.

- Urban area (automobile exhaust gas is rich): approx. 100 μg for PM_{2.5}.
- Rural area (natural source is rich): approx. 150 μg

[Caution]

For regions that has soil particle rich, the glass fiber filter is suited, as its retention of PM is larger than the Polyflon filter.

[Note]

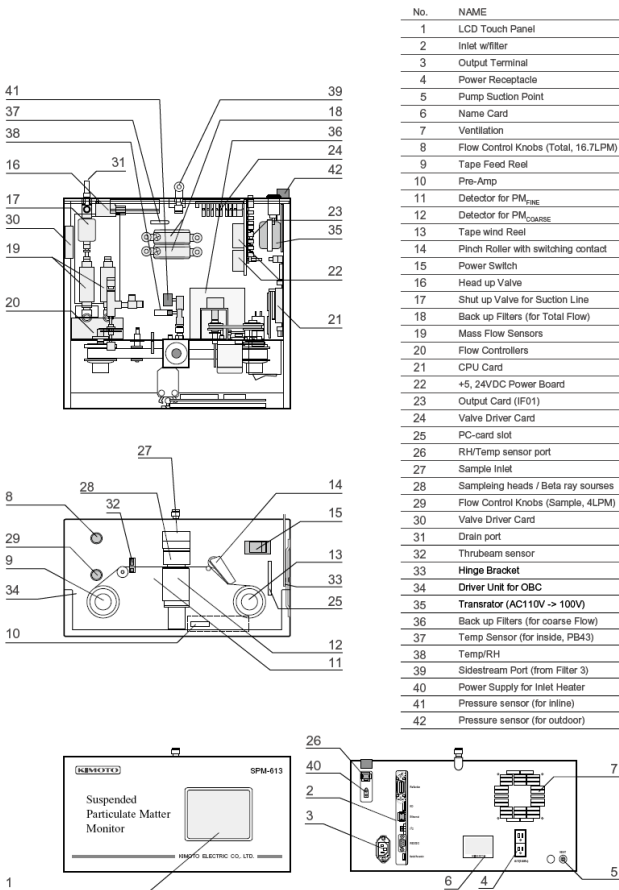
The measuring cycle is fixed 24-hour.

3 Specifications

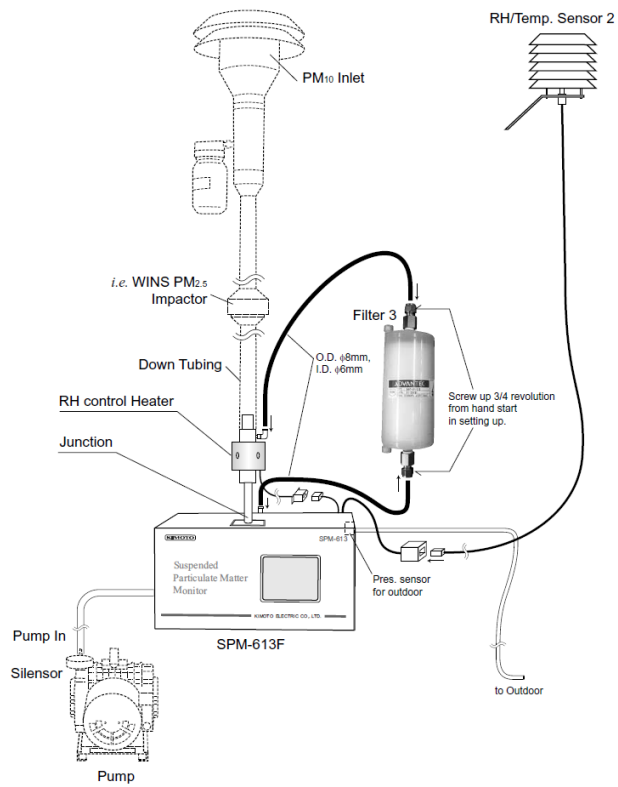
Measuring object:	Suspended Particulate Matter Relative humidity (RH) and Temperature (Stream and Outdoor)
Principal:	Beta-ray attenuation method Beta ray source ^{147}Pm , less than 10 MBq
Detector:	Plastic scintillation method
RH/Temp sensor:	Range: 0 - 100% RH, -40 - 123.8 °C Accuracy: +/- 2% RH (10 - 90% RH), +/- 0.3°C (5 - 40 °C) Repeatability: RH: +/- 0.1% RH, +/- 0.1°C
Sampling method:	Filter method (Roll tape filter: w20 mm x 30 m, Max. 192 weeks in 1-hour normal sampling cycle)
Measuring range:	0 – 1000 ug/m ³
Measuring cycle:	24-hour
Sample flow rate:	4.17 LPM for measure (Total 16.67 LPM)
Flow control method:	Mass-flow control or Actual-flow control RH control Adaptable (max. heating: 70°C)
Power requirement:	AC100V 50/60 Hz (as specified AC115V/220V)
Power consumption:	Analyzer unit: approx. 80 VA Pump unit: approx. 450 VA
Operating temperature:	0 - 40°C
Minimum detectable concentration:	Less than 2 ug/m ³ (24 hour value)
Repeatability:	within +/-2% FS
Zero drift:	within +/-3 ug/m ³ /day
Span drift:	within +/-2% FS/day
Linearity:	within +/-3% FS/day
Measuring signal:	0 - 1V DC and Ethernet
Recorder range:	3-ranges (auto, manual range selection) Status signal Reset, Master stop, Adjusting, Power down, Operation error, Tape error
Weight:	Analyzer: approx. 25 kg Pump: approx. 14 kg
Dimensions:	Approx. W470 x H220 x D400 mm Approx. W570 x H1080 x D750 mm (Outdoor Enclosure)
Option Data:	Transmission system via the Internet. CSV file is available from Ethernet port to a PC CompactFlash TM memory card Telemeter (Optional) Concentration signal: 0 - 1 VDVC Measuring range 3 ranges (Auto / Man selectable) Status signal Reset, Master stop, Adjusting, Power down, Operation error, Tape error

3. CONFIGURATION

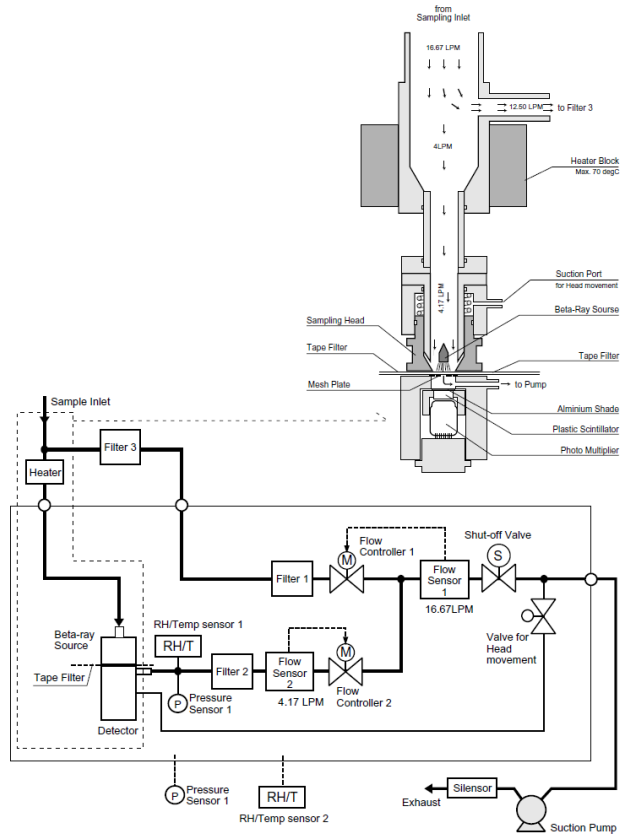
3.1 Configuration and names



3.2 External View and Assembly



3.3 Flow Diagram



4. INSTALLATION

4.1 Start Up

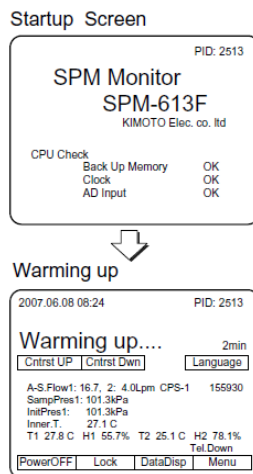
Turn on the power switch, then SPM-613F starts as shown in the right figure.

4.1.1 Hard Check

Self-diagnostics of CPU functions starts.

4.1.2 Warm-up

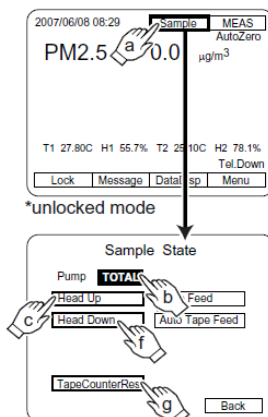
Wait until the measuring conditions are ready. The items that are not still ready are displayed in white (reversal) letter.



[Note]

RH/Temp sensor is the smallest sensor measures temperature and relative humidity, simultaneously. The monitoring the data of RH sensor is available in 'Monitor Screen' as shown right figure. T1 and H1 are indicated the temperature and relative humidity data of RH/Temp sensor 1 (inside), respectively. T2 and H2 are also the data for RH/Temp sensor2 (outside).

4.2 Setting of Tape Filter



Setting of tape filter should be taken such as below procedure, (a) - (g).

(a) Touch [SAMPLE] button in main screen (under the unlocked mode), then the sample state is displayed.

(b) Touch [TOTAL] to turn off the pump. (Reversal [TOTAL] letters shows pump-on position.)

(c) Turn the roller holder with handle to the clockwise direction (1) and the pinch roller stands up. Next, press [Head Up] button to move up the head (2).

(d) According to the figure on the panel, hang the tape on each roller, and wind it around the winding reel (3), (4).

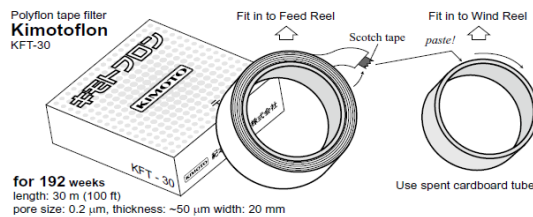
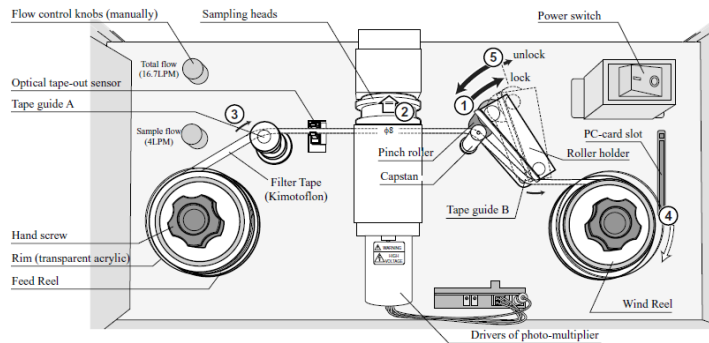
(e) Lift the roller holder once to unlock it, and then it holds down filter tape (5).

[Caution]

Make sure the roller holder holds the tape steady. If you forget this handling, the tape winding will not work. For the last time, it will lead the breakdown of the detectors by the filter clogged altogether.

(f) Press the [Head Down] button to move the head down, and close the front panel.

(g) Press the [TapeCounterRes] button to reset the tape remaining ratio to 100%.



[Caution]

Make sure that no tape is protruding from the tape guides. If not, it will cause in danger of cutting off or miss winding of the tape.

[Note]

The tape filter rest is judged by the number of the tape filter feeding including the calibration procedure and the pressure reset (Over-vacuum pressure make a tape-reset). So, please take care of the filter rest volume in the case of the manual tape feeding and the abnormal condition on the tape feeding.

[Starting to measure]

When all items clear each set values, measurements are started. The warm-up is continued for 2 minutes from the power on, even all items clear each set values.

If the hard check is not ended, the CPU is in a problem. Please contact to the service section.

Even tough all items do not clear each set values, the measurement starts after 1-hours from the power on.

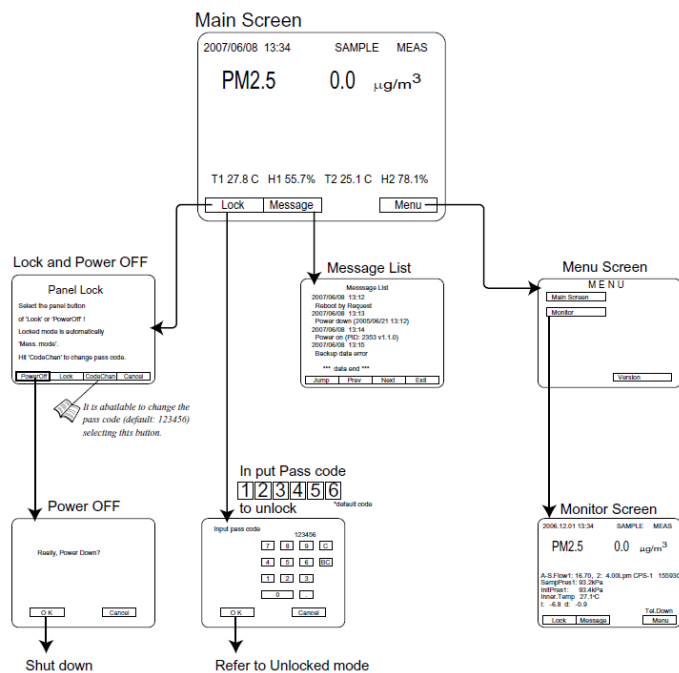
In the measuring mode, each item is checked with the set value. If any item differs from the set value, the abnormal work signal is output. The abnormal item is displayed in reversal letter as error. Please contact our service section to inform the item of reversal letter on the monitor screen 2.

4.3 Locked mode

Use this locked mode usually for display only except for calibration and check. This measuring mode shows concentration, measuring conditions and messages. You can select from main screen, to the menu screen, monitor screen 1, monitor screen 2 and telemeter.

In case of calibrating and checking, it needs to switch from Locked mode to Unlocked mode. Refer to the Panel Lock at next page for details.

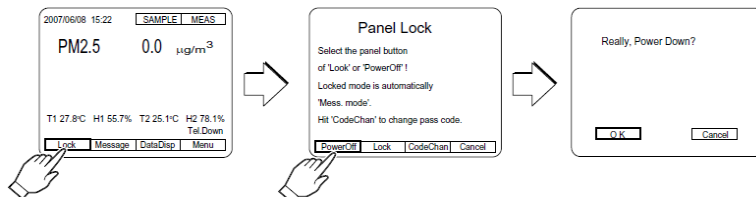
Flow diagram of locked mode



4.4 Panel Lock

Touch [Lock] button, and the Panel Lock screen appears.

- Power off: Use this button to turn off for simple maintenance.
- Lock/Unlock: This button is to set the panel in the Locked or Unlocked mode.
- Locked mode: This mode is to display only; locked all settings.
- Unlocked mode: This mode allows to change settings and to adjust for calibration, etc.
- Cancel: This button is to cancel erroneous handling.



4.5 Mode Switching

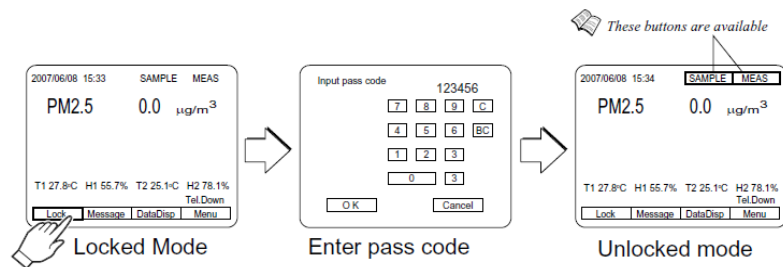
In the main screen, the monitor Screen 1, the monitor Screen 2, the Unlocked mode have [Lock] button, and the Locked mode has [Unlock] button.

To switch from Unlocked mode to Locked mode

- Touch [Lock] in the main screen.
- Then touch [Lock] in the [Panel lock] screen.

To switch from Locked mode to Unlocked mode

- Touch [Unlock] in the main screen.
 - Enter [1 2 3 4 5 6]* with ten-key in the pass cord, and touch [OK] to return to the [Main screen].
- (* Pass cord is changeable.)

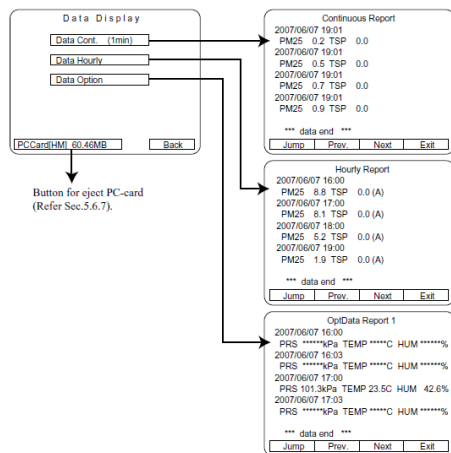


In the Locked mode of measurement, touch [Unlock] and enter the password and press [OK]. In the Unlocked mode you can select screens and change settings as below. Refer to each section for detail operation.

[illegible]

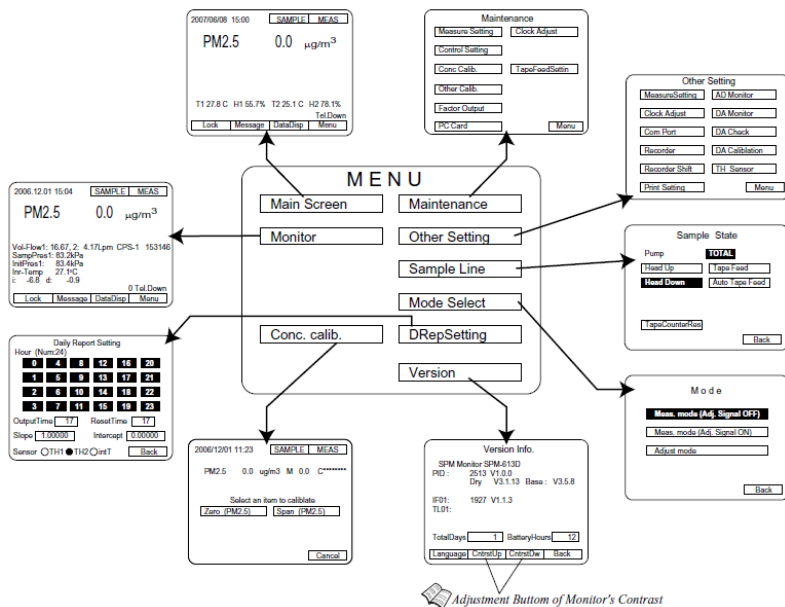
4.7 Data Display

In the Locked mode of measurement, touch [Unlock] and enter the password and press [OK]. In the Unlocked mode you can select screens and change settings as below. Refer to each section for detail operation.



4.8 MENU screen

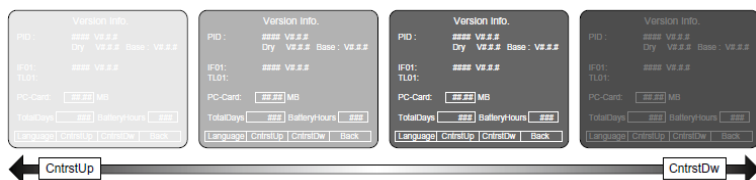
Flow diagram of menu screen



[Note]

Contrast Control of the LCD Display:

It is necessary to change the contrast of the screen when the screen is difficult to read due to the temperature drop etc. First, push the "Version" button in the MENU screen, and then the screen is changed to "Version Information" screen. "ContrstUp" and "ContrstDw" buttons are indicated bottom of the screen. Since screen contrast changes by gradation when these buttons are pushed, please adjust to the optimal state using one or other of two. After adjustment, it is able to return the MENU screen, when "Back" button is pushed.



5. OPERATION

5.1 Clock Adjustment

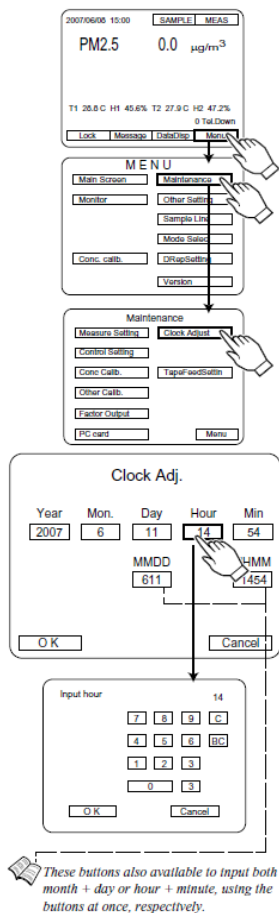
It is available to adjust the clock at the warm-up time and in Unlocked mode.

During the warm-up time before starting to measure, it is allowed to adjust the clock. So check the time of the clock and adjust if necessary.

The Clock Adjust screen is handled by 2 ways: one is to change each column and the other is to input one all for Month & Day (MMDD) or Hour & Minute (HHMM).

Enter the present time with ten-key by either way of the two. Wait until the time is now, and then press [OK]. The clock is adjusted by this action.

Adjust in the Unlocked mode



[Caution]

If the clock adjustment is executed in a sampling period, the instrument reboots and starts new measurement.

5.2 Meas/Adj Mode Select

This mode selection is used for maintenance. In [Meas. mode (Adj. Signal OFF)], the instrument measures normally.

Select [Meas. mode (Adj. Signal ON)] when you want to output adjust signal within the next hourly

reset (a telemeter substrate is needed) to Telemeter (optional). It is available to select [Adjust mode], when out-put the adjust signal, forcibly.

Mode

Mess. mode (Adj. Signal OFF)

Mess. mode (Adj. Signal ON)

Adjust mode

Back

[Caution]

You should check turning off of adjust signal or selecting [Lock] after finished any adjustment. The measuring mode starts automatically by the locking of the screen.

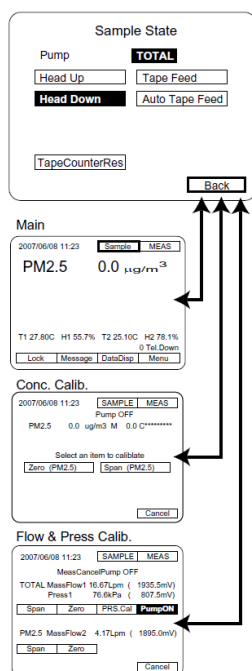
[Note]

In the Adj. Mode, the instrument indicates the value of 3 minutes moving average. (In the Meas. Mode, the concentration is indicated as 15 min. moving average.)

5.3 Sample Line Select

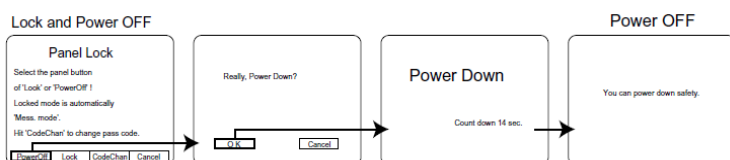
This screen is used when zero calibration, span calibration and blank test are done, respectively. Then, the instrument become in adjust mode automatically. When each button is chosen (ON), it is indicated as inverted text.

ALL:	for ON/OFF the pump suctioning
Head Up/Head Down:	for lifting of the sampling heads
Tape Feed:	for feeding the tape manually
Auto Tape Feed:	for feeding the tape automatically (HeadUp -> Feeding -> HeadDown).
TapeCounterRes:	Reset the tape remaining to 100% (One should make it, when the tape replacement is done)
Back:	Back to previous screen.



5.4 Power Down

If you power the instrument down, choose the [Power Off] menu in the Panel Lock screen. Next screen is shown. When you choose the [OK] button, the instrument shows the count down screen to do the safety power down for 15 seconds. After countdown end, you can power down safety.

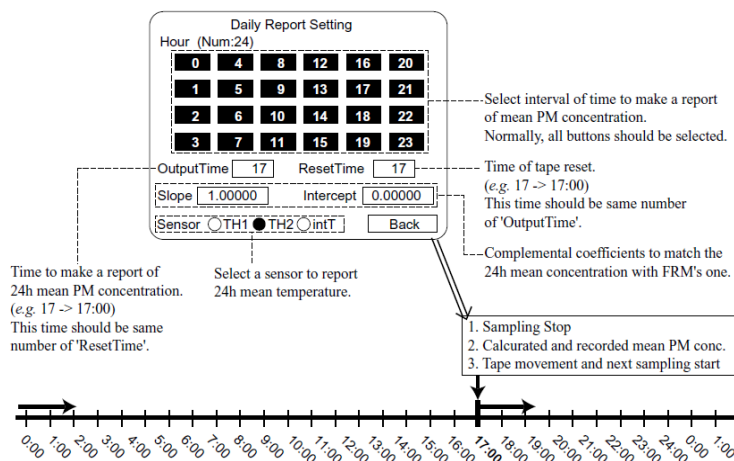


[Caution]

The back up battery of the instrument consumed quickly when the instrument's power is downed. After power down, the battery keeps the data of memory for 3 - 6 months. If you stop monitoring for a long time, get rid of the battery from the CPU card after committing to paper the setting values.

5.5 Daily Report Setting

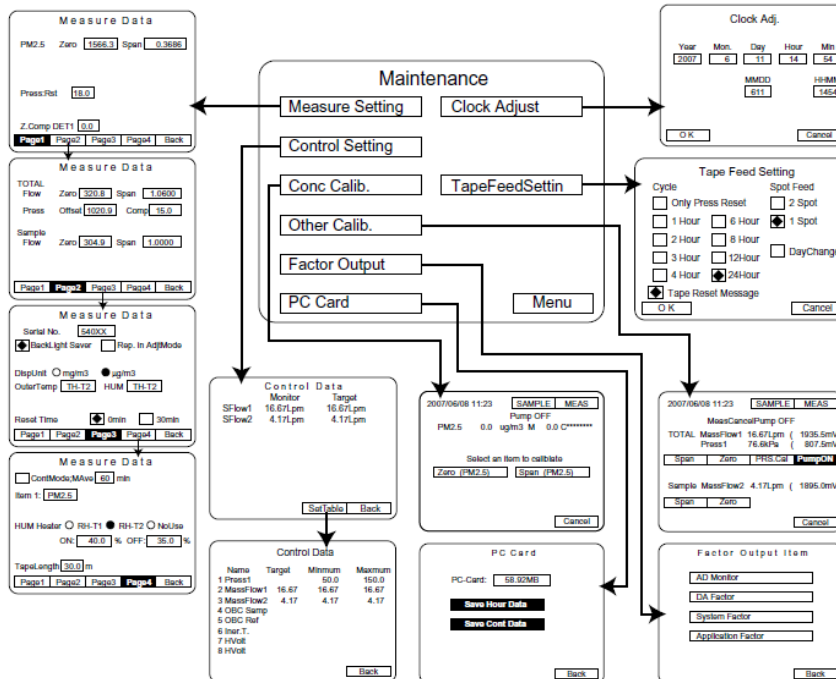
Daily (24h) mean PM concentration can be calculated. In this screen, you can change the setting of daily report.



[Caution]

If actual (volumetric) flow control mode is selected, SPM-613F updates the ambient pressure number every 24-hour at tape reset time. That is, the flow controlled in the same number of pressure through 24-hour. SPM-613F has only one pressure sensor, yet. In the future, adding more pressure sensor will solve this problem.

Maintenance Diagram



5.6.1 Clock Adjust

See 5.1 Clock adjustments.

5.6.2 Concentration Calibration

See 6.1 Calibration of SPM Concentration.

5.6.3 Other Calibration

See 6.2 Calibration of Flow Rate.

5.6.4 Setting Data for Measurement

It displays serial number, zero, span coefficient, the offset value of sensors and references in Measure Data screen. If the analyzer is in any trouble, let know serviceman about these data.

Page1

In Measurement Data screen Page1, one can see the calibration coefficients (Zero/Span) PM concentration. Using these values, SPM-613F overwrites only a 'slope' number. Zero number is always overwritten after tape reset. PressReset value means the limit pressure. When the tape filter is clogged and pressure of the sample line decreases till setting value (18.0 kPa), the instrument resets the new filter spot. The values of Z.Comp mean offset (intercept) of each concentration. They are not needed to touch normally.

Page2

In Measurement Data screen Page2, one can see the calibration coefficients of flow and pressure (Zero/Span/Offset/Comp) for total flow (16.67 LPM) and sample flow (4.17 LPM). These values are also not needed to change manually, because they are overwritten when each flow/pressure calibration is done.

Page3

In Measurement Data screen Page3, each item means as blow.

Serial No.:

Serial number of instrument (Do not change)

BackLightServer:

It is available to turn off the backlight of touch panel after 5 minutes from last operating.

Rep. in AdjMode:

Choose whether you need the report in AdjMode.

DispUnit:

You can choose the unit either mg/m^3 and mg/m^3 . Setting is reflected by all PM concentration indication.

OuterTemp/HUM:

Set sensor that is used for a sensor as an ambient temperature. You can choose a sensor among "pb43-Temp", "THSensor-T1" and "THSensor-T1" by touch the item.

Reset Time:

Change of reset time (default: 0 min = o'clock).

Measure Data

PM2.5

Zero

501.2

Span

0.6884

Press:Rst

18.0

Z.Comp DET1

0.0

Page1

Page2

Page3

Page4

Back

Measure Data

TOTAL

Flow

Zero

271.5

Span

0.9895

Press

Offset

1025.6

Comp

16.2

Sample

Flow

Zero

304.9

Span

1.0000

Page1

Page2

Page3

Page4

Back

Measure Data

Serial No.

540XX

BackLight Saver

Rep. In AdjtMode

DispUnit

mg/m3

ug/m3

OuterTemp

TH-T2

HUM

TH-T2

Reset Time

0min

30min

Page1

Page2

Page3

Page4

Back

Measure Data

ContMode;MAve

60

min

Item 1:

PM2.5

HUM Heater

RH-T1

RH-T2

NoUse

ON:

40.0

%

OFF:

35.0

%

TapeLength

30.0

m

Page1

Page2

Page3

Page4

Back

[Caution]

It is not recommended for users to change zero/span on this screen because they have been calibrated in the factory. However, when the battery of back up memory runs out, these values are initialized by the standard values. In this case, it is necessary to input proper values referring to the last calibration data.

ENGINEER'S MODE

Measure Data

ContMode;MAve

60

min

Item 1:

PM2.5

HUM Heater

RH-T1

RH-T2

NoUse

Use AutoLock

ON:

40.0

%

OFF:

35.0

%

TapeLength

30.0

m

SpotPitch

15

mm

Page1

Page2

Page3

Page4

Back

Page4

In Measurement Data screen Page4, each item means as blow.

Item:

It is available to change the name of PM for fine and coarse concentration, respectively (see right figure). These setting reflect changes in indicate and title name in the saved data.

Change uRPName:

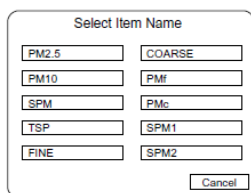
This is used for rename the item of an analog recorder.

HUM Heater:

This instrument has a heater to control relative humidity (RH). Choose the sensor to use the RH control: TH-T1 (inside), TH-T2 (outdoor), or No Use. One can set the range of RH-control any two points (On/Off).

Tape Length:

Input the filter-tape length (default: 30.0m). This number is used for calculation of tape remaining. Use AutoLock (only indicated in "engineer's mode").

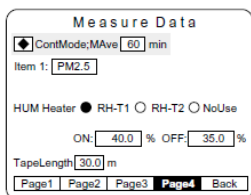


A dialog box titled "Select Item Name" with a grid of input fields for selecting PM items. The fields are arranged in two columns: PM2.5, COARSE, PM10, PM1, SPM, PMc, TSP, SPM1, FINE, and SPM2. A "Cancel" button is at the bottom right.

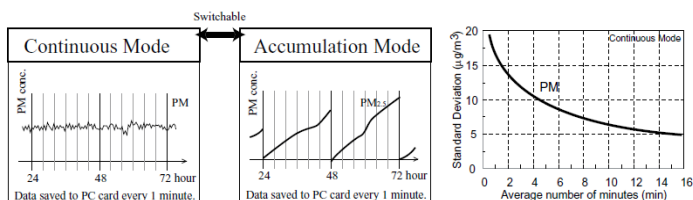
ContMode;MAve##min (Page4):

You can switch data whether accumulating number or actual 1 min average based on 10 sec average, with one touch of a button. The actual 1 min average data are also reflected changes in main screen, monitor screen, 1 min data screen, and saved data in PC card (file name: CNyyyyymm.csv). You can also change the averaging period from 1 minute through 60 minutes. If you choice 5 minutes, the instrument outputs 5 minutes moving average number every 1 minutes. During the tape movement, the last number is held in order to calculate the moving average.

You can see that the actual 1 min data has wild swing ($\pm 15 \text{ mg/m}^3$) as PM concentration, because intensity of the beta source fluctuates quickly. If you set the averaging time longer, the swing of data is decreased according to square root of averaging time (See sec. 8.2.8).



The "Measure Data" screen shows settings for "ContMode;MAve" set to 60 min and "Item 1" set to PM2.5. It includes options for "HUM Heater" (RH-T1, RH-T2, NoUse), "ON" and "OFF" percentages (40.0% and 35.0%), and "TapeLength" (30.0 m). Navigation buttons for Page1, Page2, Page3, Page4, and Back are at the bottom.



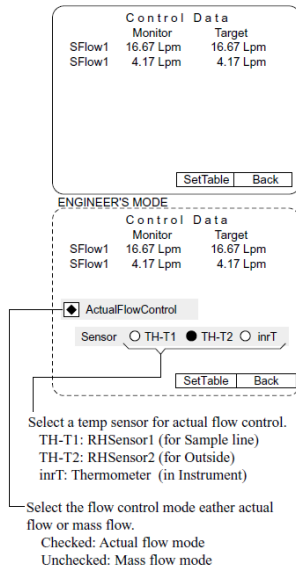
ENGINEER'S MODE

Ask to our serviceman for a change method to the engineer's mode.

5.6.5 Setting of Actual Flow Control

It is available to choose the control mode either actual (/volumetric) flow or mass flow, only in "engineer's mode". Furthermore, it is also available to change a temperature sensor in order to control for actual flow.

First, in order to move the "Control Data" screen, select the "Control Setting" button on "Other Setting" screen. When a radio button of "Actual Flow Control" is checked, the instrument controls the flow by actual flow. Second, select a temperature sensor for actual flow control. When "Back" button is selected, the control mode is changed.

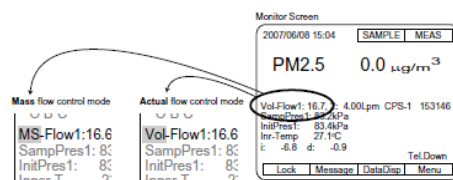


ENGINEER'S MODE

Ask to our serviceman for a change method to the engineer's mode.

[Note]

You can also check the flow control mode on Monitor Screen. If the flow control mode is mass flow, the item of flow1 is indicated: "MS-Flow1...", as below figure.



[Set Table Screen]

This screen shows only the normal ranges of the flow rate and pressure for a sample line. If the flow rate or pressure exceeds this range, the instrument returns error.

5.6.6 Tape Feed Setting

Tape Reset Message: If the filter is clogged in a sampling period, the filter is changed automatically. Then, the instrument adds the message to the data file.

[Caution]

Recommend using default setting as right figure.

Tape Feed Setting

Cycle

☐ Only Press Reset

☐ 1 Hour ☐ 6 Hour ☒ 1 Spot

☐ 2 Hour ☐ 8 Hour

☐ 3 Hour ☐ 12Hour ☐ DayChange

☐ 4 Hour ☒ 24Hour

☒ Tape Reset Message

Span Cancel

[Caution]

Above setting (default) should not be changed in the normal measurement.

[Note]

Tape Reset Message: If the filter is clogged in a sampling period, the filter is changed automatically. Then, the instrument adds the message to the data file.

5.6.7 PC-Card

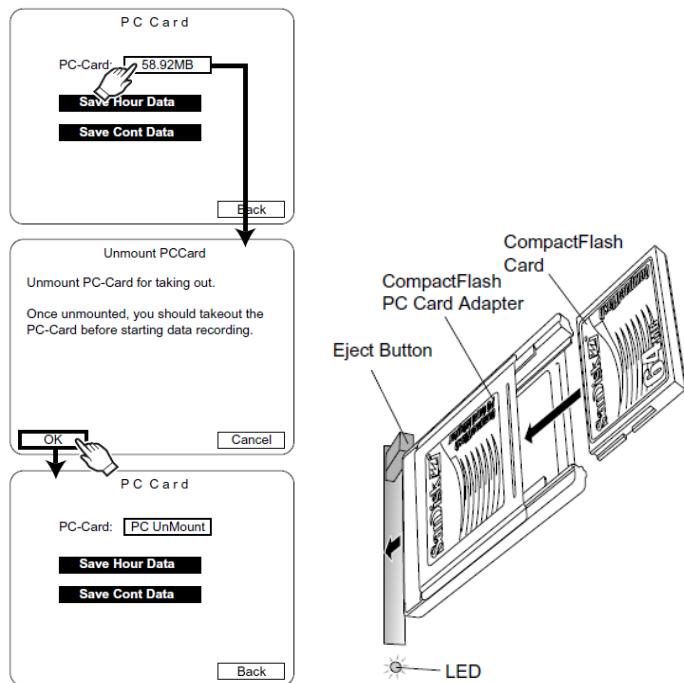
When you inject the PC-card, The item (PC UnMount) in the PC Card screen changes to the disk space. If you need to eject the PC-card, push this item. Select [OK] button in the next screen, this item changes [PC UnMount]. Then, you can eject it safety.

[Save Hour Data] button

If this button is inverted, the instrument saves the hourly data every one hour.

[Save Cont Data] button

If this button is inverted, the instrument saves the continuous data every one minute.



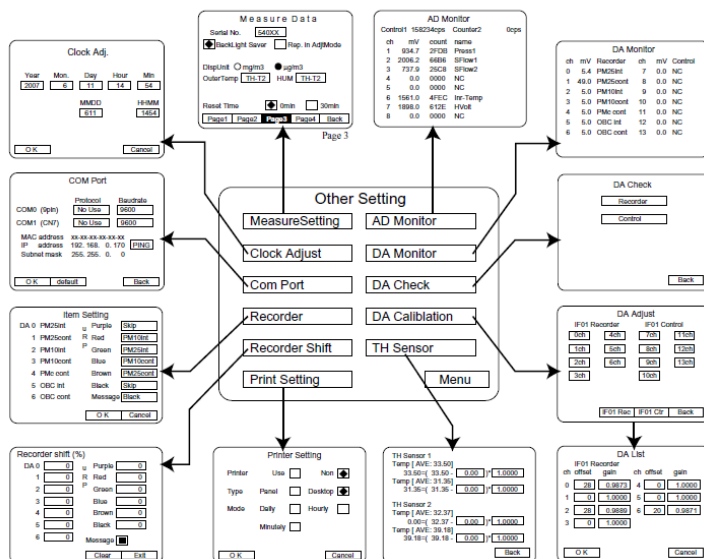
5.5.8 Factor Output

This instrument has a function that the setting value for AD Monitor, DA Factor, System Factor and Application Factor, respectively. These functions are convenient to backup the system factors. When you choose these buttons, each system factor file is saved to "FDyyyyymm" folder in PC card. These data can be downloaded using by FTP Extractor (see 9.2).

The screenshot shows the "Factor Output Item" screen. It contains four input fields for selecting factors: "AD Monitor", "DA Factor", "System Factor", and "Application Factor". A "Back" button is located at the bottom right of the screen.

5.7 Other Settings Screen

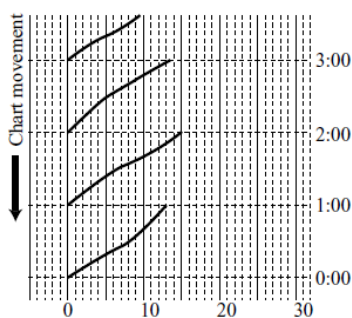
Flow diagram of other settings



[Caution]

[Recorder] and [Recorder Shift] items are for only adjustment of an optional Data Recorder respectively.

Data Recorder



5.7.1 COM Port Setting

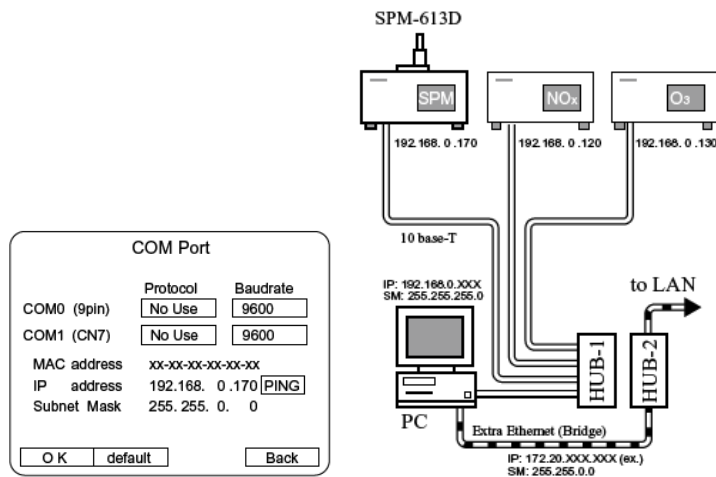
SPM-613F has an Ethernet port (10 base-T), and has a unique IP address (changeable). It is available to download from both data on the CPU (1h data, 1min data, messages and DA data) and PC-card (1h data only) in the instrument, when the instrument and PC are connected to the LAN and so on. In order to download the data, it is needed to install the 'FTP Extractor' software to the PC. Refer to chapter 9.2 'Communication Tool'.

[Caution]

It should not use same IP address for every instrument, if some instruments made by our company are used all together.

[Note]

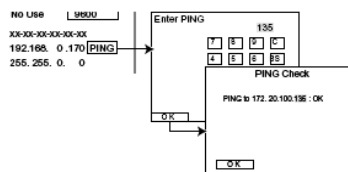
In order to avoid communicatory problems, it had better use a HUB between an instrument and PC, than direct connection using crossing cable. (It is unavailable to download the data using serial cable in this model.)



[PING] button...

PING button is a function that is available to check the communication with PC connected. Input the 4th number of IP address of PC, when you need to check the communication.

SPM-613F also behaves as DHCP (dynamic host configuration protocol) server (see Sec. 9.3).



5.7.2 Printer Setting

Set the printer information like as type, printing item etc. The data printing direction is up to down direction in the PC recorder and reverse direction in the panel-mounted printer.

Printer Setting

Printer Use ☐ Non ☒

Type Panel ☐ Desktop ☒

Mode Daily ☐ Hourly ☐ Minutely ☐

5.7.3 Recorder Setting

For the serial recorder, the printing letter color, the color of the message (Message, 1 hour data etc.) can be set. (For a recorder connected with more than 2 analyzers) If another analyzer is connected with this SPM-613F by [KNET], the recorder setting for another analyzer can be done from this SPM-613F.

Recorder shift (%)

DA 0	<input type="text" value="0"/>	u	Purple	<input type="text" value="0"/>
1	<input type="text" value="0"/>	R	Red	<input type="text" value="0"/>
2	<input type="text" value="0"/>	P	Green	<input type="text" value="0"/>
3	<input type="text" value="0"/>		Blue	<input type="text" value="0"/>
4	<input type="text" value="0"/>		Brown	<input type="text" value="0"/>
5	<input type="text" value="0"/>		Black	<input type="text" value="0"/>
6	<input type="text" value="0"/>		Message	<input checked="" type="checkbox"/>

5.7.4 AD Monitor

This screen is used to check the AD inputs. Hexadecimal numbers shows count-number.

AD Monitor

Control1 158014cps

ch	mV	count	name
1	940.0	3020	Press1
2	2040.2	6870	SFlow1
3	737.9	5EAB	SFlow2
4	0.0	0000	NC
5	0.0	0000	NC
6	1592.0	517F	In-Temp
7	2000.9	987A	HVlt
8	0.0	0000	NC

5.8 DA Check and Calibration

Using DA Check screen, checking and calibration of DA are available.

First, select [DA check] (1) from Other Setting screen.

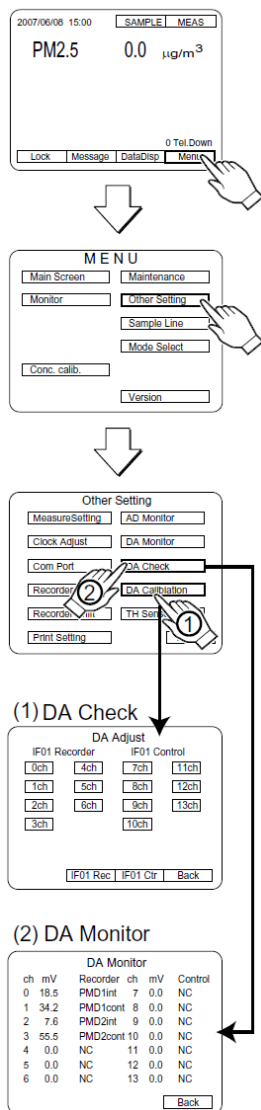
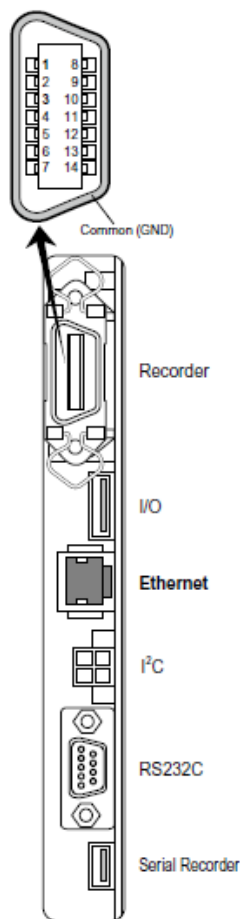
DA output signals are from 01ch = 0 mV to 08ch = 700 mV as initial values respectively.

To change the output, touch the mV value of each channel and input a new value with ten-key.

To recover the initial values touch [Clear]. To check DA outputs of the analyzer during measurement, select [DA monitor] (2). If you want to re-cord data, touch [Printer] or [Recorder] to print out.

To adjust DA outputs, touch [DA Adjust], and choose a channel that you want to calibrate.

Analog DA port



(1) DA Check

DA Adjust

IF01 Recorder				IF01 Control			
0ch	4ch	7ch	11ch				
1ch	5ch	8ch	12ch				
2ch	6ch	9ch	13ch				
3ch		10ch					

[IF01 Rec] [IF01 Ctr] [Back]

(2) DA Monitor

DA Monitor

ch	mV	Recorder	ch	mV	Control
0	18.5	PM01int	7	0.0	NC
1	34.2	PM01cont	8	0.0	NC
2	7.6	PM02int	9	0.0	NC
3	55.5	PM02cont	10	0.0	NC
4	0.0	NC	11	0.0	NC
5	0.0	NC	12	0.0	NC
6	0.0	NC	13	0.0	NC

[Back]

6. CALIBRATION

6.1 Calibration for SPM Concentration

Make the calibration according to below sequence indicated.

[Caution]

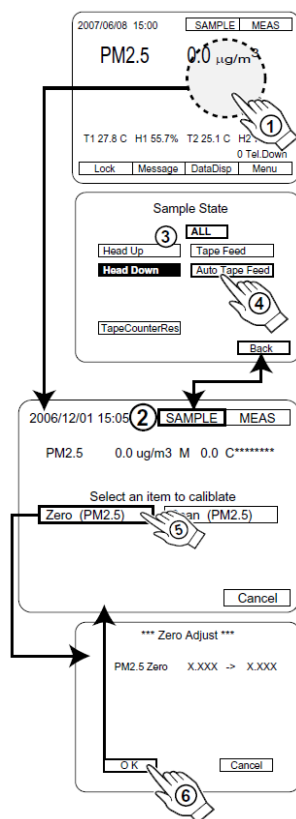
Zero and span calibration should be done together in a sequence, however, it is available to make zero or span calibration individually. It must not move the filter tape or aspirate during the Zero and span calibration (Make the calibrations on the same spot of the filter tape and on the same pressure).

6.1.1 Zero Adjustment for SPM conc.

Manually zero calibration is not needed normally, because zero-point of SPM-613F is automatically calibrated at the start time for every sampling periods. However, this operation is necessary in order to do at the start time of 'blank test' under 'Adj. mode'.

Procedure of Zero Adjustment

1. Touch the area that indicated SPM concentration on the main screen.
2. Be sure to feed to new filter using [Auto Tape Feed] button in 'Sample State' screen.
3. Feed the filter by [Auto Tape Feed]. Check the pump keeps OFF.
4. Touch the [Back] button in order to back to previous screen.
5. Touch [Zero (PM_{2.5})] in 'CAL mode select' screen, when the distribution of concentration (PM_{2.5}) becomes steady within +/- 10 mg/m³. More than 3 minute need for steady.
6. Touch [OK] button, then zero point of PM_{2.5} concentration are adjusted.



6.1.2 Span Adjustment for SPM conc.

The span calibration is necessary every 1 month. Follow the procedure as bellow. It is preferable that span calibration is implemented after the zero adjustment (see chapter 6.1.1).

Procedure of Span Adjustment

1 After the zero calibration, head up the detector head by [Head up] button, soon suctioning is stopped and two sampling heads are uplifted automatically.

2 For PM_{2.5} (left of sampling block), open a front panel and insert a span film between the tape filter and the detection block until its stopper reaches to the end.

3 Close the front panel, and head down by [head down] button, and then go back to the monitor screen.

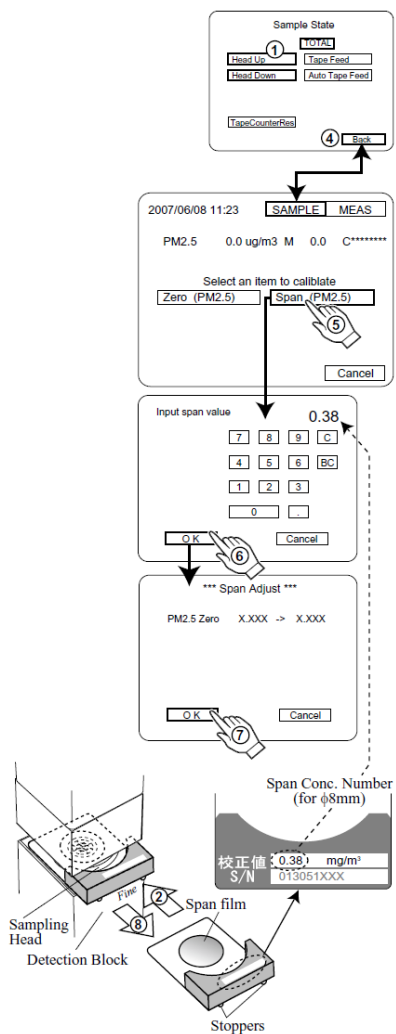
4 Touch [Back] button to back to previous screen. When the span value is within $\pm 3\%$, be over without the span calibration. If the span value is more than $\pm 3\%$, try again the zero calibration.

5 When the concentration at the monitor screen is stabilized, touch the [Span (PM_{2.5})] button.

6 Enter the standard film's value by ten keys. For example, if the film's coefficient is 0.73 mg/m³, enter [C -> 0 -> . -> 7 -> 3]. If the span coefficient is proper, press [OK] in order to return to the calibration screen.

7 When touch the [OK] button in 'Span Adjust' panel, the span calibration for PM_{2.5} is finished.

8 Take out the standard film.



6.2 Calibration of Flow Rate

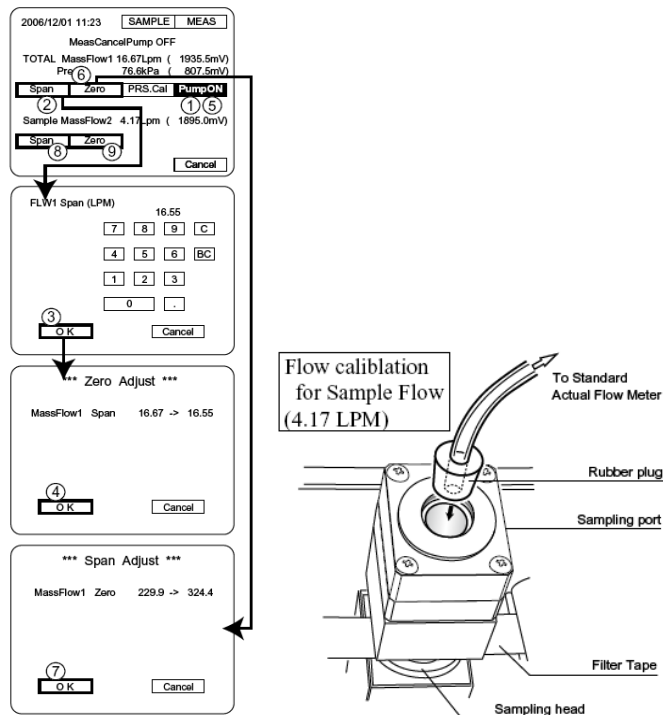
SPM-613F has a function that is able to change the flow control mode to Mass flow control or Actual flow control. They are not same sequence of span calibration while same method for zero calibration. Regarding change flow control mode, refer Sec. 5.5.5.

6.2.1 Flow Calibration Procedure on Mass Flow Control Mode

SPM-613F has two mass flow controllers. It should be needed the conversion reading of the standard mass flow meter and the wet standard test gas meter as under 20 degC, 1 atom.

6.2.1.1 Procedure of the blank calibration of flow rate

1. Touch [Menu] -> [Maintenance] -> [Other Calib] to indicate the calibration screen. And stop suctioning (Pump OFF).
2. Touch [Zero] button for total flow, after the flow rate becomes steady.
- 3., 4. Touch [OK] button in the next screen to act the zero calibration.
8. Calibrate again for blank flow rate of 'Sample line'.



6.2.1.2 Procedure of the span calibration of flow rate

(Total: 16.67 LPM, Sample line: 4.17 LPM)

5. Attach a standard mass flow meter to the sampling inlet. And begin aspirating with touching the [Pump] button on the calibration screen.
6. Touch [Span] button for total mass flow, after the mass flow rate becomes steady.
7. Input the value of standard mass flow rate (LPM) with ten keys. Then, touch [OK] button to act the span calibration, when the span value is within 1 +/- 0.05 LPM.
9. Calibrate again for span flow rate of 'Sample' as same sequence of 'TOTAL'. However, it is needed to attach another plug (rubber) such as below figure, after removing a heater unit.

[Note]

It is important to check the setting of standard flow meter (20degC, 1atom), and check the leaking between the sampling inlet and mass flow sensor. If the instrument still has some problem, please contact our service desk.

6.2.2 Flow Calibration Procedure on Actual Flow Control Mode

First, a standard actual flow meter such as TriCal is needed to calibrate the flow rate on the actual flow mode.

6.2.2.1 Procedure of the blank calibration of flow rate

Refer to Sec. 6.2.1.1 (same sequence of the mass flow control mode).

6.2.2.2 Procedure of the span calibration of flow rate

1. Attach a standard actual flow meter such as TriCal to the sampling inlet. And begin aspirating with touching the [Pump] button on the calibration screen.

2. Touch [Span] button for total flow, after the flow rate becomes steady.

3. Input the value of ambient pressure indicated the standard actual flow meter, and touch [OK].

4. Input the value of ambient temperature indicated the standard actual flow meter, and touch [OK].

5. The rates of actual flow and mass flow calculated are indicated, and touch [OK].

6. Calculated coefficient for flow rate is indicated, and touch [OK] to finish then return to the main screen of flow calibration.

7. Calibrate again for span flow rate of 'Sample line' as same sequence of 'TOTAL'. However, it is needed to attach another plug (rubber), after removing the virtual impactor unit (Refer to Sec. 6.2.1.2).

Offset adjustment of mass flow sensor.

At '6.2.1.1. Checking of zero flow rate', if the voltage is less than '50mV', the offset of the flow sensor should be done. Confirm the flow rate is stable at pump off, and do the offset adjusting by following method. After the offset adjusting of the flow sensor, please do the zero calibration of the flow rate certainly. Please refer to '6.2.1.1 Checking of zero flow rate' for the calibration method.

Adjust the voltage to 150 - 200mV by the trimmer rotation. The voltage is gained once a second. To avoid time lag, please wait about 5 seconds, and confirm indications. If necessary, adjust by the trimmer rotation.

2006/12/01 11:23 SAMPLE MEAS

MassCancelPump ON

TOTAL MassFlow1 16.67Lpm (1935.5mV)
Press1 76.6kPa (807.5mV)

Span Zero PRS.Cal **PumpON** ①

Sample MassFlow2 4.17Lpm (1895.0mV)

Span Zero ②

③

Cancel

Input Ambient Press. (kPa)

101.3

7 8 9 C

4 5 6 BC

1 2 3

0 .

③ OK Cancel

Input Ambient Temp. (°C)

22.3

7 8 9 C

4 5 6 BC

1 2 3

0 .

④ OK Cancel

Flow Exchange (Actual -> Mass)

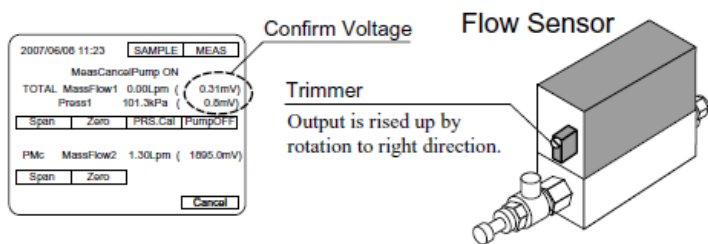
Actual 16.67 -> 15.96

⑤ OK Cancel

*** Span Adjust ***

FLWTotal Span 1.0000 -> 0.9967

⑥ OK Cancel

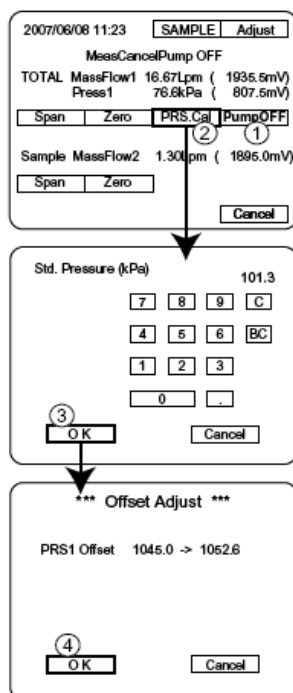


6.4 Calibration of Pressure

To calibrate the pressure sensor, it is needed a standard pressure sensor.

Procedure of Pressure calibration

1. Touch [Menu] -> [Other setting] to indicate the calibration screen. And stop suctioning (Pump OFF).
2. Touch [PRS.Cal] button, after the pressure becomes steady.
3. Input the pressure value of standard sensor in the unit of kPa.
4. Touch [OK] button in the next screen to act the pressure calibration.

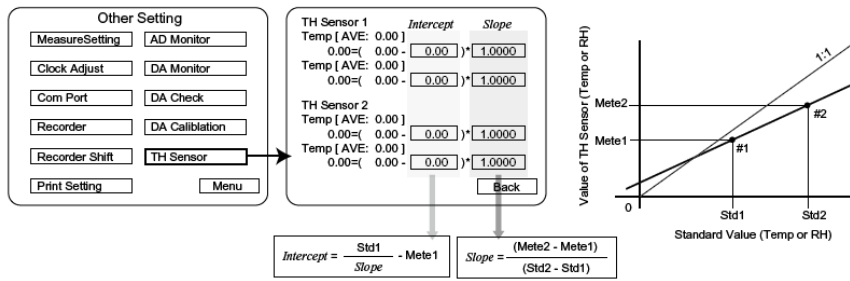


6.5 Calibration of RH and Temperature

The operator is able to calibrate RH/T sensor, if the sensor is needed calibration. All sensors are calibrated in the factory before shipping.

Procedure of RH/T sensor calibration

Using a standard temperature and RH monitor, set up the slope and intercept for the RH/T sensor's data. Touch [Menu] -> [Other setting] -> [TH Sensor] to indicate the calibration screen. Input them on the RH/T calibration screen. The two-point data that measured different situation (different temperature or different relative humidity for each TH Sensor) with standard barometer or standard thermometer are necessary to calibrate, preliminarily. These data had better not so close. Using below equation, you can input the slope and intercept, respectively.

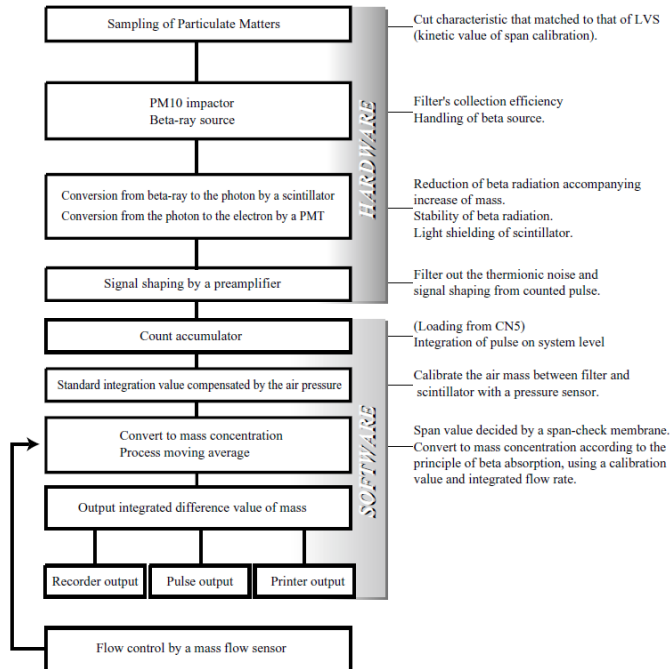


7. PRINCIPLE

7.1 Structure

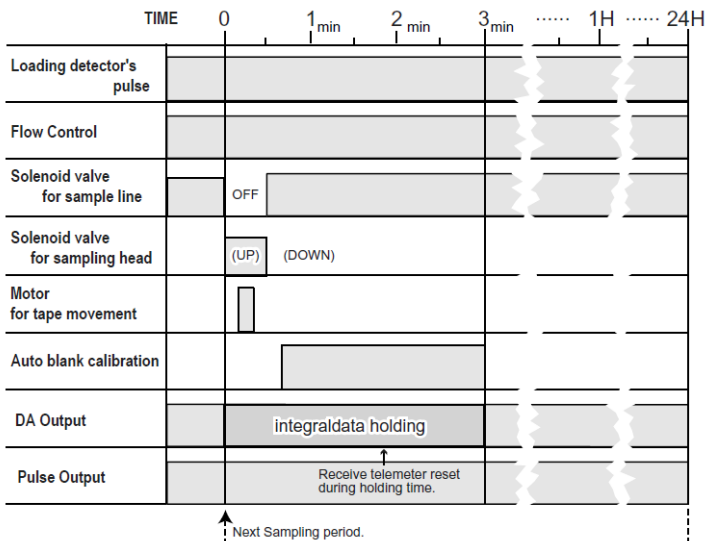
The principle and structure of the analyzer is described as below.

Principle of Operation



7.2 Sequence

Sequence of measurement



[Note]

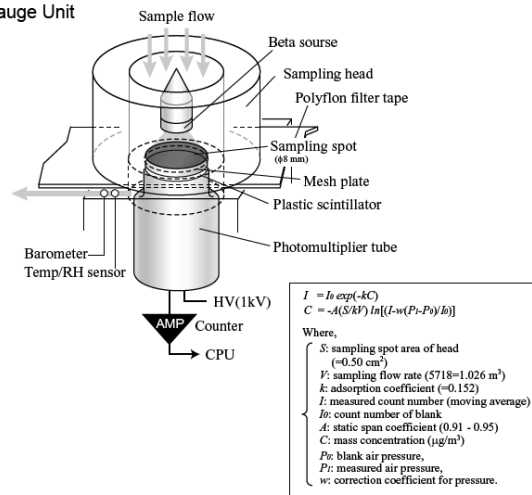
In 'Adj. mode', the value of PM concentration is calculated by 15 min moving average. So, when the new sampling starts, the instrument brings the data of past 15 min from previous sampling period. Therefore, the instrument holds the value of end time of previous period during blank calibration (3 minute).

[Filter tape reset]

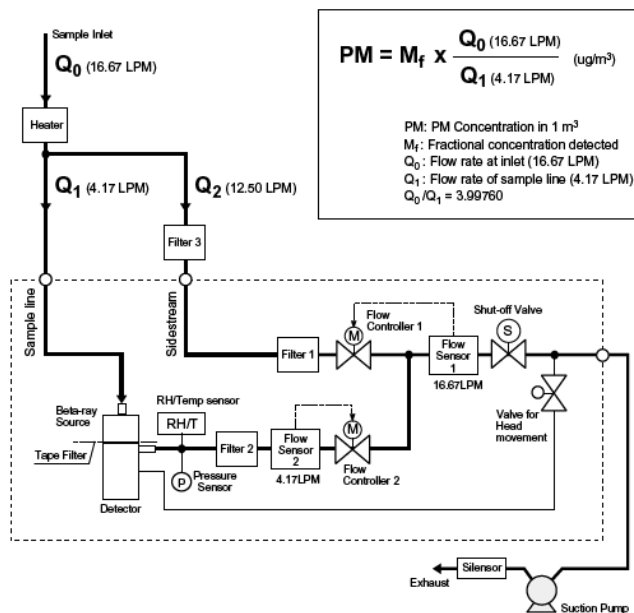
If SPM-613F works under the condition of very dirty air sample with near 1 mg/m^3 , the filter will be clogged immediately. However, SPM-613F will moves the filter by itself, when sample pressure is decreased till 18 kPa. After tape reset, it holds the last concentration for 3 minute. Moreover, the tape reset will be done many times, if you select the sample with over 1 mg/m^3 .

7.3 Detectors

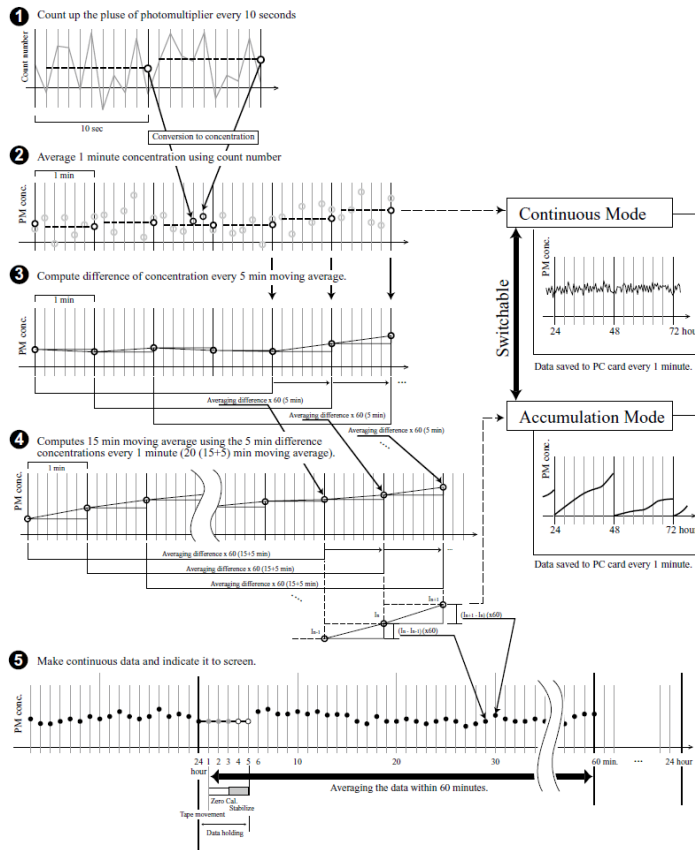
Beta Gauge Unit



7.4 PM Concentration Conversion



7.5 Summary of the Data Processing Algorithm



8. MAINTENANCE

8.1 Maintenance Table

To maintain the analyzer in good condition for long time, the instrument is necessary regular upkeep according to the contents of periodic check as bellow.

Recommended Maintenance Table

Object	Item	Contents	Install	Period					Remarks
				2 W Week	1 M Month	3 M Month	6 M Month	1 Y Year	
1	Tape Filter	1. Check	Tape Feed	○	○				
		2. Replace	Change Tapes	○	□				
2	Sampling Tube	1. Check	Dirty	○	○				
		2. Wash	Clean Inner Wall	○		△			
3	Cyclone	1. Check	Dirty	○	○				
		2. Wash	Clean Inner Wall	○		△			
4	Pump	1. Operation	Flow Rate, Sounds	○		○			
		2. Replace	Diaphragm, Valve					□	Normally 1 Year
5	Sampling Head	1. Cleaning	Clean Inner Wall	○		△			
6	Flow Controller	1. Function	Normal	○		○			
7	Flow Rate	1. Reading	Check, Calibrate	○				△	Cross-check by Standard Flow Meter (20°C, 1 atmos. Press.)
8	Pressure	1. Reading	Check, Calibrate	○				△	Check by Atmospheric Pressure
9	Calibration	1. Calibration	Check by Parity Filter	○	○				within ±5%
10	Blank Test	1. Check	Check by Zero Filter					△	<0.01mg/m3 /day
11	Beta Source	2. Replace	Replace						Normally (5years)
12	Bypass Filter	1. Replace	Replace					□	
13	Line Filter	1. Replace	Replace						Normally (3years)

Periodical maintenance ○ Check □ Periodic replace △ Cleaning

8.2 Maintenance Procedure

8.2.1 Cleaning and Replacement of Tubing

When the sampling pipe is too dirty, wash inside or replace it to new one.

8.2.2 Replacement of Tape Filter

A new tape filter is long enough for 1 month in the case of two spots feeding per hour normally. The consumption of the tape subjects to change in a field of high concentrations because of the additional tape-reset, such as [pressure reset] (Over-vacuum pressure make a tape-reset) or [OBC] reset.

The rest count of tape filter is shown in the monitor screen. Refer to chapter 4.2 'Setting of Tape Filter' for details.

[Note]

Tape remaining is calculated from the number of automatic tape movement. Therefore, remaining time is subject to change when you move the filter-tape manually, or when error of tape movement occurs. (Default of filter duration is 1 month approximately.)

8.2.3 Cleaning Procedure of Beta Source Unit and Sampling Head

Maintenance cycle is every 3-6 months. It should be done the cleaning work with the gloved hands.

Cleaning tools

Rubber gloves,

Camera cleaner,

Soft clothe or paper towel,

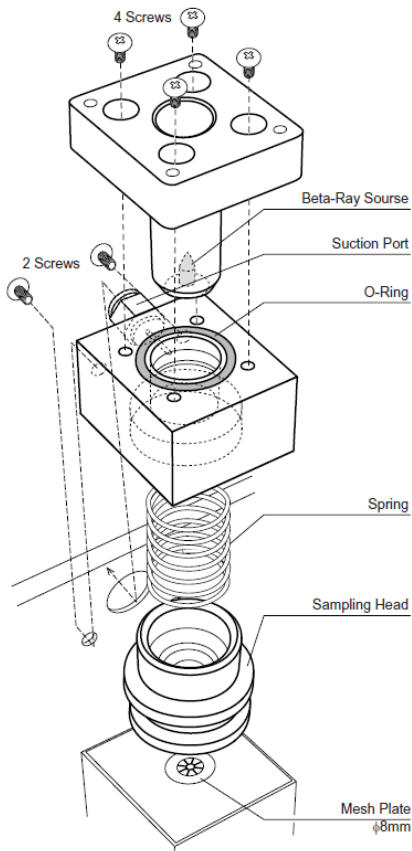
Alcohol.

Procedure of cleaning

1. Turn the power of instrument off.
2. Remove the pipe at the top of impactor.
3. Release two latches on both side, and take off the impactor from detector.
4. Loosen 4 screws at the top.
5. Wash by the water or Alcohol, clean and dry up with soft cloth or paper not to scratch inside.
6. And after finished washing, clean and dry up with cloth or paper.
7. After cleaning, put them back to assemble again.

8.2.4 Head Cleaning

It is needed to clean the beta-ray source once in 3 to 6 months as follows.



Preparation

Gum grooves, Camera cleaner,
Soft clothe of paper to wipe, Alcohol.

Procedure

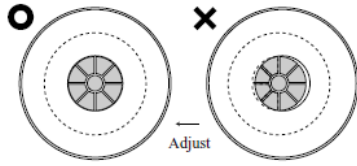
1. Wear the gum grooves in consideration of breaking the ray source during cleaning.
2. Turn off the power.
3. Remove the sampling pipe of the sampling head. Take off the two screws behind the sampling head with holding it by hand (Be careful of popping out of a head with the spring).
4. Loosen the four screws to take out the beta-ray source and keep it in any safety box away from human bodies.
5. Clean inside of the head with a camera cleaner (blower blush). In the case of strong stain, clean again inside with cloth and alcohol. And also clean outside bottom of the head carefully not to scratch it.
6. Clean the beta-ray source by the same way but use the camera cleaner only to clean the window of the source. At that time be careful not to break the window of thin film.

[Caution]

In case of breaking the window of a beta-ray source, seal up the source to prevent from scattering away. Cover this ray source with any cushion, and keep it in a box.

The position of the sampling port should be lined up in collector's sights at the time of an assembly.

Port Adjustment ($\phi 8\text{mm}$)

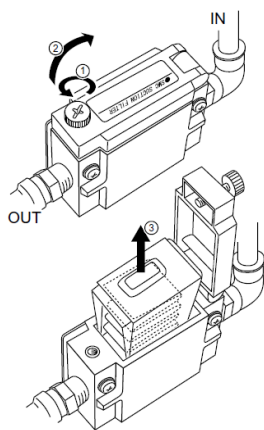


8.2.5 Exchange of Dust Filter

When the top cover of instrument is opened with loosening the screws, a dust extractor like as the following figure can be seen. If this filter is clogged, the air flow rate would be out of control. Therefore, it is necessary to replace the filter element in the extractor.

Procedure of replacement (for Total Flow)

1. Loosen a fixing screw (1).
2. Uplift the top cap (2).
3. Put the element (3) off.
4. Mount a new element. Then, beware of the position of element.



[Note]

If the IN-OUT side of element is reverse, the top cap is not close-fitting enough

8.2.6 Checking for Flow Sensor, Manometer and Thermometer

The sensor of the flow rate and air pressure should be calibrated every 6 through 12 months. Thermometer is used to the monitoring of air temperature sampled.

Checking procedure of the flow sensor

It is necessary to check a standard mass flow meter or wet standard test gas meter. The flow rate is brought the checking and calibration into operation with connecting a standard mass flow meter or wet standard test gas meter to the sampling inlet. If the flow rate has decreased so much, it is necessary to check the leakage of cyclone and sampling head. Use measuring table as follows for the check of flow rate, air pressure and ambient temperature.

Checking list, Checking contents, measuring

- Flow rate: Standard deviation of flow rate (16.67 LPM for total, 4.17LPM for sample) within +/- 2%
- Air pressure: SD of pressure compared with ambient air pressure under the non-suctioning within +/- 5kPa
- Temperature: SD of the temperature compared with standard thermometer within +/- 2degC

Checking procedure of the manometer

1. Check the ambient air pressure (use a standard manometer or ask for information to the nearest weather station).
2. Turn the pump off in the "Sample State" screen, then, check the manometer whether the reading is within +/-5 kPa to the ambient pressure.
3. If the reading is not within +/-5 kPa, it is necessary to calibrate the pressure with input the value of ambient pressure with the "Pressure" button on the screen of "Other Calib.".

Checking procedure of the thermometer

1. Prepare a standard thermometer
2. Turn the pump off with the "Sample Line" screen.
3. Compare the reading of thermometer in the instrument with the reference temperature while pull it out from T-connector and set it same position of standard thermometer.
4. If the reading is not within +/-2 degC, please contact our service desk.

8.2.8 Procedure of Blank Test

According to the operation and maintenance of Ministry of the Environment, it is necessary that the blank test implements every 1-year. The blank test implements over 15 hours with attaching the cartridge filter to the sampling inlet. The 1-hour average of blank has not to be within 10 mg/m^3 .

Example of specification of the cartridge filter using

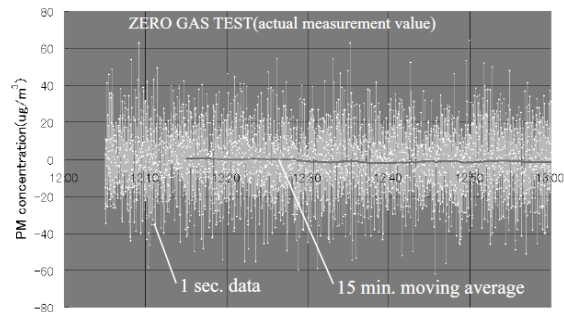
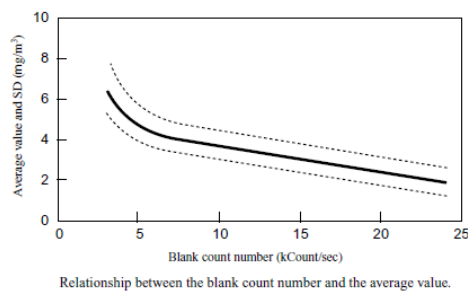
- Particle collection efficiency: 3mm, 99% and over.
- Filtration area: 400cm² and over.

(i.e. Advantec Toyo Kaisha, LTD.: Capsule cartridge filter CCP-FX-C1H (external diameter 13mm))

Treatment of the blank test

The result of blank test shows a tendency that the average value increases with decreasing the count number for blank, as the decreasing of radiation of beta ray generally. The relationship between the count number and average value is shown as following figure.

If the average value and disperse are so different to the count number of blank with referring to this figure, it is necessary to check whether the detector is working normally or instrument has anything leaking.



[Note]

Standard deviation of 1 sec. data = $\pm 20 \text{ ug/m}^3$ (68.26%)

SD x 3 = $\pm 60 \text{ ug/m}^3$ (99.73%)

Consequently, the data spread of 15 minutes (900 sec.) moving average:

$\pm 60 / 900 = \pm 2$ (99.73%)

The data has the error within $\pm 2 \text{ ug/m}^3$, theoretically. Normally, SPM-613F indicates about

$\pm 5 \text{ ug/m}^3$ during zero test with HEPA. There would be some influences of unknown artifacts.

8.2.9 Checking Method of Radiation Dosage of Beta-ray

The checking of beta source should be implemented every 1 year. SPM-613F has ^{147}Pm as the beta source. The rate of decrease of ^{147}Pm ;

$$N/N_0 = (1/2)^{(t/T)}$$

Where, N : present count number, N_0 : initial count number, t : elapsed time, T : the radioactive half-life of ^{147}Pm (=2.62 years).

For example, the radiation of ^{147}Pm a year from now will be estimated;

Since $t/T = 1/2.62 = 0.382$

Therefore, $N/N_0 = (1/2)^{0.382} = 0.767$

Checking procedure

1. Pull the filter tape with lifting the sampling head. After, down sampling head.
2. Check the count number (N_1) that indicated on the main screen.
3. See count number (N_0) describing the test results of SPM-613F.
4. Calculate the estimated count number (N_2) from N_0 using above equation.
(For example, when N_1 is 1500kCount/10sec, the estimated count number (N_2) is calculated;
$$N_2 = 1500 \times 0.767 = 1150.5 \text{ kCount/10sec}$$
5. It is no problem when the comparing N_1 and N_2 are within +/-5%.

Instructions of Calibration by Span Check Membrane

When the blank calibration under the unstable condition of zero is implemented, it would cause the movement of span value. Using the chart and the instrument's reading, it should be performed to calibrate the blank under around the average value, as there is a wandering of zero within +/- 10mg/m³. If the blank calibration were correct, the deviation of span would be within +/- 3%.

Manipulation of the value of span calibration

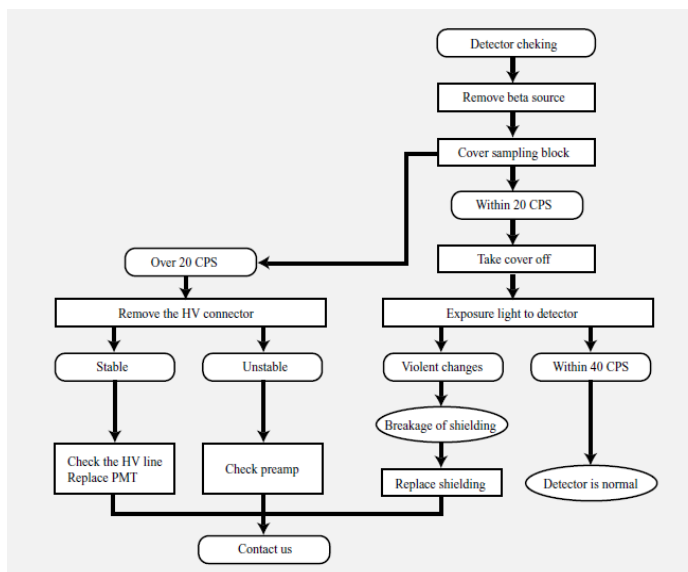
According to the operation and maintenance of Ministry of the Environment, it is unnecessary to calibrate when the value of span moves within +/- 5%. In principle, SPM-613F is the instrument whose span coefficient is stable. The property of span calibration using a membrane is designed to check the sensibility of the detector. Contact our service desk if the reading is not within +/- 5%, as it is considered that the detector has something wrong (ex. Light leaking) or the membrane is dirty.

8.2.10 Checking of Detectors

The checking of the detector should be implemented every 1 year. It is needed to check the light leaking for detector, if the value of blank and span calibration moves significantly.

Procedure of light leaking check

1. Take beta-source unit off from the sampling block with loosening the 4 screws. (Don't close the beta source to human body. Keep the source in a safety place from damage.)
2. Cover top of the sampling block with a thick rubber plate or a metal plate.
3. Check the count number in this state of thing.
 - Normal range: within 20 count per second (CPS).
 - Range within 20 CPS -> Check the light leaking.
 - Range over 20 CPS -> Check the detector.
4. Take the cover off, and exposure the light of fluorescent lamp to the detector.
 - Reading is within 40 CPS -> Normal.
 - Reading moves over 40 CPS -> Light shielding is broken.
5. Take the HV connector off from the bottom of the detection block.
 - Reading is stable -> Check the line of HV or replaces the PMT
 - Reading is unstable -> Check the preamp.



8.2.11 Replacement of Touch Panel

The lifetime of the touch panel (liquid-crystal-display and backlight) that used in SPM-613 is 10000 hours as 50% of initial brightness.

Automatic backlight saving

SPM-613 has the automatic backlight saving in order to prolong. Generally, display is turned off when 15 minute no touch.

Replacement cycle

- Every 3 years

Replacement of touch panel

- If the replacement of the touch panel is needed, please contact our service desk.

[Caution]

- Don't touch the touch panel by a sharp instrument (ex. mechanical pencil), as this could cause breakage.

- Don't shock the touch panel, as this could cause breakage.

- Don't apply the touch panel the solution such as thinner, ammonia and chlorinated solvent, except for the pure water and mild detergent.

8.2.12 Replacement of a Battery for the Backup Memory

SPM-613 has a lithium battery for the backup memory. The replacement cycle of it is every 5 years. If the replacement of the battery is needed, please contact our service desk.

[Caution]

- When the battery doesn't work, the backup data for configuration is cleared. Then the configuration would be default. Especially for the setting of recorder and DA calibration, it is necessary reconfiguration and re-calibrate.

- It is necessary to make the periodic report of the configuration. Refer to the "checking sheet" of endnote.

9. APPENDIX

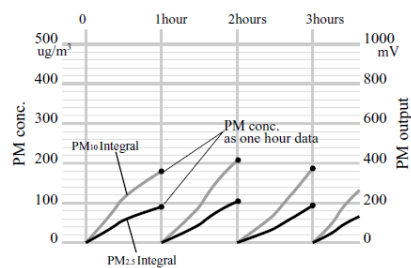
9.1 Terminal

1) Recorder

See sec. 5.6 in order to setting.

DC output to the analog recorder (DC0-1V)

PinNo.	Signal	PinNo.	Signal
1	PM _{2.5} Integral	8	Serial (Purple)
2	PM _{2.5} Continuous	9	Serial (Red)
3	PM ₁₀ Integral	10	Serial (Green)
4	PM ₁₀ Continuous	11	Serial (Blue)
5	OBC Integral	12	Serial (Brown)
6	OBC Continuous	13	Serial (Black)
7	Range Marker	14	Message



2) I/O

Connection with the external device like as the automatic calibrator

3) Ethernet

This port is for the Ethernet communication with the data logger and PC etc.
(10 BASE-T)

4) I2C

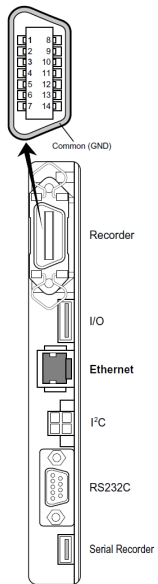
This port is for I2C Communication.
(Unavailable in this instrument.)

5) RS232C

This port for the communication with PC etc. (Unavailable in this instrument.)

6) Serial Recorder

Output connector to the serial recorder (Unavailable in this instrument.)

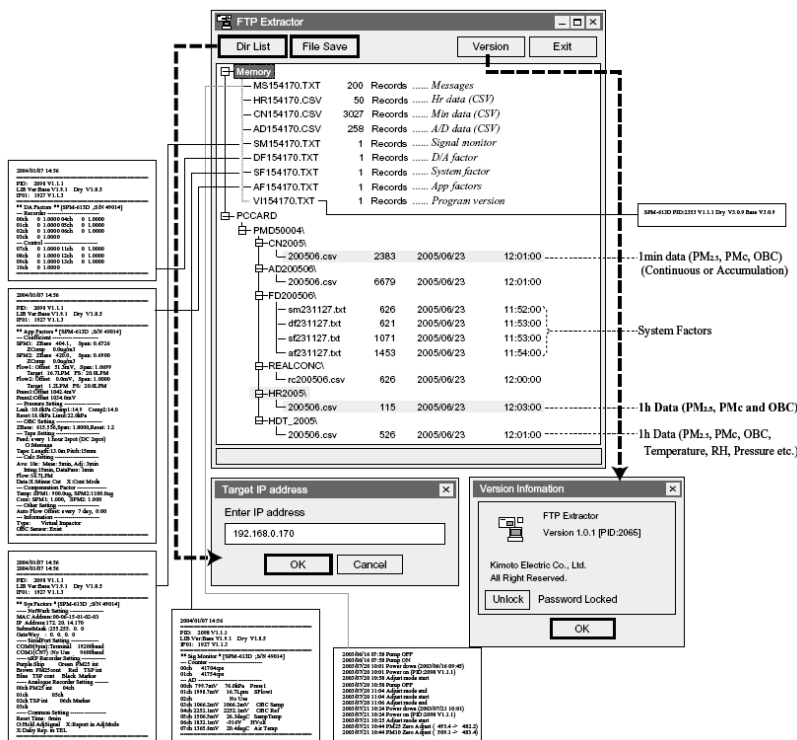


9.2 Communication Tool

FTP Extractor is software that extracts the data from the PC-Card in the SPM-613F to the local disk in PC using a Ethernet cable.

Operation Method

1. First, start up the FTP Extractor with the double click the icon.
2. Click [Dir List] button and set up the IP address of the instruments connected, when a main window of FTP Extractor is open.
3. If a setup is correctitude, the list of directory of the instruments will be displayed. Next, choose a file to download and click [File Save] button, then the data are extracted from SPM-613F to PC.
4. When the data extraction complete, then click the [Exit] button to the quit.



[Note]

Download the newest FTP Extractor

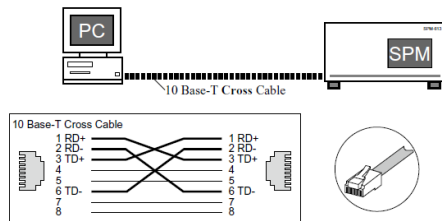
<http://www.kimoto-electric.co.jp/download/index.html>

9.3 Ethernet Connection

There are two ways to connect between SPM613 and PC as follows.

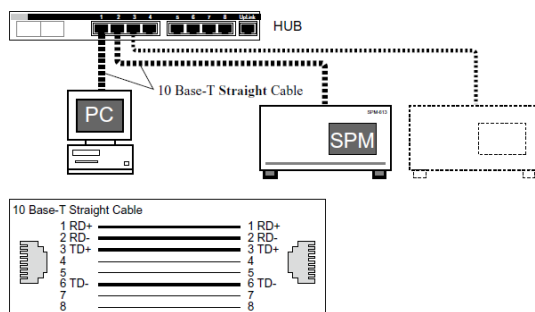
9.3.1 Using SPM613 or SPM613F without HUB

It is able to connect SPM613 series and PC directly using 10 Base-T cross cables. However, direct communication might not be performed depending on the model of PC. In the case which communication does not work by a cross cable, it is needed another way using HUB with two straight cables.



9.3.2 Using SPM613 or SPM613F with HUB

It is available that a PC downloads from a number of KIMOTO analyzers via a HUB. For HUB, the connection stability using a 'bulk type' HUB would be higher than a 'switching type' HUB, empirically.



9.3.3 DHCP function

If the base program's version of your instrument is more than V.3.2.0, your instrument behaves as a DHCP (dynamic host configuration protocol) server. Your PC has an IP address assigned by the ISP from SPM-613F, automatically. However, if your network has already had any DHCP server, SPM-613F's DHCP function does not work. In this case, you should manually set IP address of your PC.

Version Info.

SPM Monitor SPM-613F

PID: 2513 V1.0.0

Dry V3.1.13 Base: V3.5.8

IF01: 1927 V1.1.3

TL01:

TotalDays: 1 BatteryHours: 12

Language | CntrlUp | CntrlDw | Back

9.4 Data Detailed Index

The data structure and their contents of SPM-613F are indicated as below figure. Each data is saved to the memory in CPU of SPM-613F and PC card. These data are available to download to your PC using FTP Extractor (see Sec. 9.2) or direct loading from the PC Card, optionally.

Memory on CPU		Data Format	Contents
MS+IP_address.TXT (1st + 4th number)		Text	Operation history (renewed automatically)
HR+IP_address.CSV (1st + 4th number)		CSV (Continuous Integrated Values)	1h data (renewed automatically)
CN+IP_address.CSV (1st + 4th number)		CSV	Continuous integrated value (renewed automatically)
AD+IP_address.CSV (1st + 4th number)		CSV	A/D monitoring data (renewed automatically)
SM+IP_address.TXT (1st + 4th number)		Text	Signal monitoring data (renewed automatically)
DF+IP_address.TXT (1st + 4th number)		Text	D/A factors (renewed automatically)
SF+IP_address.TXT (1st + 4th number)		Text	System factors (renewed automatically)
AF+IP_address.TXT (1st + 4th number)		Text	Application factors (renewed automatically)
VI+IP_address.TXT (1st + 4th number)		Text	Program ID and version (renewed automatically)
PCCARD		Data Format	Contents
PMD+serial#A			
CN+YYYYMM\			
mmdd.csv : (daily)		CSV	Daily continuous (or accumulated) PM data saved every 1 minutes.
AD+YYYYMM\			
mmdd.csv : (daily)		CSV	Daily A/D monitoring data
FD+YYYYMM\			
sm+ddhhmm.txt		Text	Signal monitoring data backup (manually)
df+ddhhmm.txt		Text	D/A factors backup (manually)
sf+ddhhmm.txt		Text	System factors backup (manually)
af+ddhhmm.txt		Text	Application factors backup (manually)
HR+YYYY\			
mm.csv		CSV	1h data for concentration (PM _{2.5} , PM ₁₀ , OBC)
HDT_+YYYY\			
mm.csv		CSV	Comprehensive 1h data (PM _{2.5} , PM ₁₀ , PM ₁₀ , OBC, Temp., RH, Mass flow rate, Actual flow rate, Pressure, and Real 1h concentration)
DAILYREP\			
drep+YYYY.csv : (annual)		CSV	Daily average data (averaging period is selectable).

9.4.1 Data Detailed

ad +yyymmdd.csv (in AD +yyyyymm folda)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	yyyyymmdd	Hhmm	time	cp1	cp2	Pres1	SFlow1	SFlow2			Irr-Temp	HVlt	ugDET1		contSPM					optTH_T1	optTH_H1	optTH_T2	optTH_H2
2	20070608	0	39241.00001	158215	0	925	1781	419			33.5	-943.7	-3.3		2.8					34.34	32.6	0	0
3	20070608	1	39241.00071	158820	0	925	1781	419			33.5	-943.7	-4.1		2					34.33	32.52	0	0
4	20070608	2	39241.0014	157895	0	925	1781	419			33.5	-943.7	-3.9		1.2					34.31	32.53	0	0
5	20070608	3	39241.0021	157878	0	925	1781	419			33.5	-943.7	-3.2		1.6					34.29	32.56	0	0
6	20070608	4	39241.00279	157871	0	924	178	419			33.5	-943.7	-3.8		1.5					34.25	32.58	0	0
7	20070608	5	39241.00348	158188	0	925	1781	419			33.5	-943.7	-3.8		0.3					34.25	32.7	0	0
8	20070608	6	39241.00418	158093	0	925	178	419			33.5	-943.7	-2.7		0.8					34.25	32.7	0	0
9	20070608	7	39241.00487	159041	0	924	178	419			33.5	-943.7	-2.9		1					34.29	32.7	0	0
10	20070608	8	39241.00557	158892	0	925	1781	419			33.5	-943.7	-4.5		-0.8					34.27	32.72	0	0

cn +yyymmdd.csv (in CN +yyyyymm folda)

	A	B	C	D	E	F
1	yyyyymmdd	Hhmm	time	PM25ug/m3	TSP ug/m3	flag
2	20070608	0	39241.00001		1.2	0 N
3	20070608	1	39241.00071		-0.1	0 N
4	20070608	2	39241.0014		-0.2	0 N
5	20070608	3	39241.0021		-0.3	0 N
6	20070608	4	39241.00279		-0.3	0 N
7	20070608	5	39241.00348		-0.3	0 N
8	20070608	6	39241.00418		-0.3	0 N
9	20070608	7	39241.00487		-0.3	0 N
10	20070608	8	39241.00557		-0.2	0 N

drep +yyyy.csv (in DAILYREP folda)

	A	B	C	D	E	F	G	H	I	J	K	L
1	yyyy	mm	dd	Hh	mm	dt	FRM_DRepus(m3)	DRepus(m3)	STMP(degC)	APRS(Pa)	HUM(%)	DNUM
2	2007	6	7	12	3	39240.71042	0	0	27.1	0	0	0

M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
TNUM	Slope	Intercept	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
3	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

yyyyymm.csv (in HDT_ +yyyy folda)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	yyyy	mm	dd	Hh	mm	dt	SPM(ug/m3)	APRS(Pa)	TMP1(degC)	TMP2(degC)	TMP3(degC)	HUM1(%)	HUM2(%)	T-MF1(m3)
2	2007	6	8	0	3	39241.00208	1.2	-9999	-9999	-9999	-9999	-9999	-9999	1.0578
3	2007	6	8	1	3	39241.04375	-0.5	-9999	-9999	-9999	-9999	-9999	-9999	1.0585
4	2007	6	8	2	3	39241.03542	-2.2	-9999	-9999	-9999	-9999	-9999	-9999	1.0587
5	2007	6	8	3	3	39241.12708	2.7	-9999	-9999	-9999	-9999	-9999	-9999	1.0589
6	2007	6	8	4	3	39241.15875	-0.5	-9999	-9999	-9999	-9999	-9999	-9999	1.0592
7	2007	6	8	5	3	39241.21042	0.9	-9999	-9999	-9999	-9999	-9999	-9999	1.0589
8	2007	6	8	6	3	39241.25208	-0.6	-9999	-9999	-9999	-9999	-9999	-9999	1.0583
9	2007	6	8	7	3	39241.25375	1.7	-9999	-9999	-9999	-9999	-9999	-9999	1.0582
10	2007	6	8	8	3	39241.33542	-0.5	-9999	-9999	-9999	-9999	-9999	-9999	1.0585
11	2007	6	8	9	3	39241.37708	4.8	-9999	-9999	-9999	-9999	-9999	-9999	1.0595
12	2007	6	8	10	3	39241.41875	-53.8	-9999	-9999	-9999	-9999	-9999	-9999	-0.0175

O	P	Q	R	S	T	U	V	W	X	Y
T-MF2(m3)	T-VF1(m3)	T-VF2(m3)	MF1(LPM)	MF2(LPM)	VF1(LPM)	VF2(LPM)	massSPM(ug/m3)	volSPM(ug/m3)	W(ug)	Status
0.2515	0.999	0.2353	178	42	16.7	3.9	0.2	0.2	1.02	
0.2512	0.9997	0.235	178	42	16.7	3.9	0.3	0.3	2.55	
0.2512	0.9998	0.235	178	42	16.7	3.9	0.3	0.4	3.49	
0.2515	1	0.2353	178	42	16.7	3.9	0.4	0.4	4.42	
0.2519	1.0003	0.2356	178	42	16.7	3.9	0.4	0.5	5.36	
0.2517	1	0.2355	178	42	16.7	3.9	0.5	0.5	6.29	
0.2515	0.9995	0.2353	178	42	16.7	3.9	0.5	0.5	7.23	
0.2515	0.9994	0.2353	178	42	16.7	3.9	0.5	0.6	8.16	
0.2516	1	0.2354	178	42	16.7	3.9	0.5	0.6	9.1	
0.2512	1.0009	0.235	179	42	16.7	3.9	0.6	0.6	10.03	
0.0153	-0.0156	0.0143	-0.5	0.4	-0.5	0.4	xxxxxx	xxxxxx	xxxxxx	(A)

HR +yymm.csv (in HR +yymm folda)

	A	B	C	D	E	F
1	yyyyymmdd	Hhmm	time	PM25 $\mu\text{g}/\text{m}^3$	TSP $\mu\text{g}/\text{m}^3$	flag
2	20070608	0	39241.00001	12	0	N
3	20070608	100	39241.04168	-0.5	0	N
4	20070608	200	39241.08335	-2.2	0	N
5	20070608	300	39241.12501	2.7	0	N
6	20070608	400	39241.16668	-0.5	0	N
7	20070608	500	39241.20835	0.9	0	N
8	20070608	600	39241.25001	-0.6	0	N
9	20070608	700	39241.29168	1.7	0	N
10	20070608	800	39241.33335	-0.5	0	N
11	20070608	900	39241.37501	4.8	0	N

opt+yymm.csv (in OPT_ +yyyy folda)

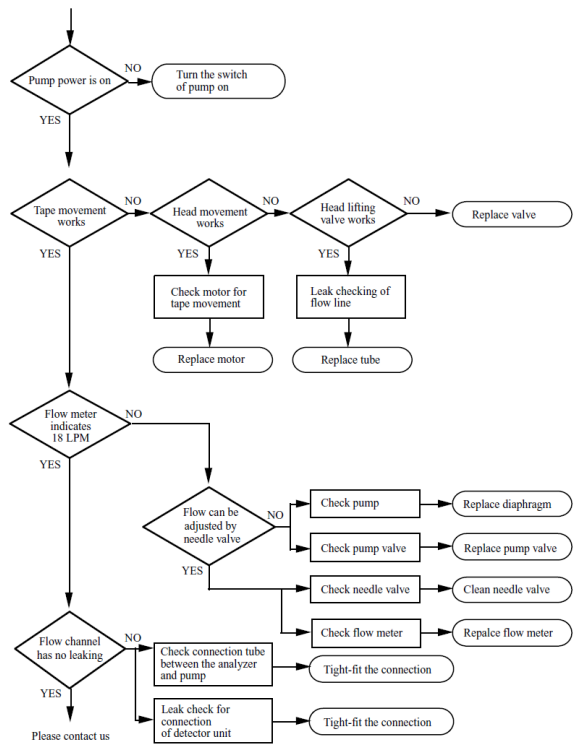
	A	B	C	D	E	F	G	H	I
1	yyyyymmdd	Hhmm	time	APRS Δ Pa)	AHUMQ0	ATEMP Δ degC)	SPM $\mu\text{g}/\text{m}^3$	W1 μg	flag
2	20070608	0	39241.00012	xxxxxx	xxxxxx	xxxxxx	0.2	1.62	N
3	20070608	3	39241.00208	xxxxxx	xxxxxx	xxxxxx	0.2	1.62	N
4	20070608	100	39241.04178	xxxxxx	xxxxxx	xxxxxx	0.3	2.55	N
5	20070608	103	39241.04375	xxxxxx	xxxxxx	xxxxxx	0.3	2.55	N
6	20070608	200	39241.08345	xxxxxx	xxxxxx	xxxxxx	0.4	3.49	N
7	20070608	203	39241.08542	xxxxxx	xxxxxx	xxxxxx	0.4	3.49	N
8	20070608	300	39241.12512	xxxxxx	xxxxxx	xxxxxx	0.4	4.42	N
9	20070608	303	39241.12708	xxxxxx	xxxxxx	xxxxxx	0.4	4.42	N
10	20070608	400	39241.16578	xxxxxx	xxxxxx	xxxxxx	0.5	5.35	N

10. TROUBLE SHOOTING

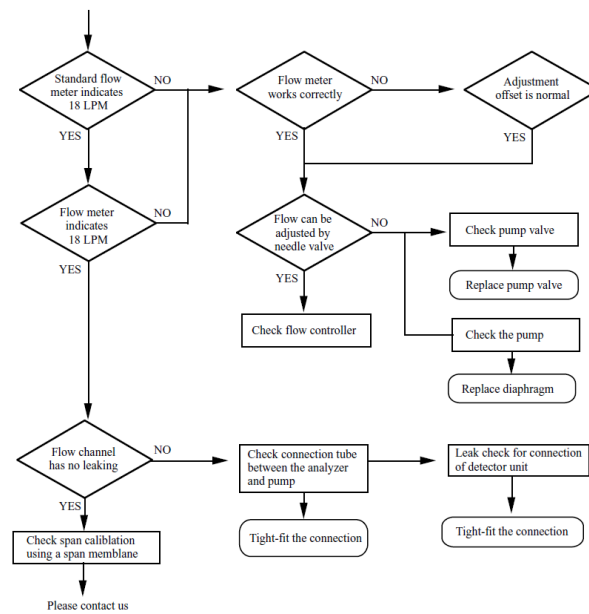
For the following cases, refer to this maintenance manual. For the case without mention in this manual, please contact our service desk.

10.1 The case that SPM concentration does not move from zero.

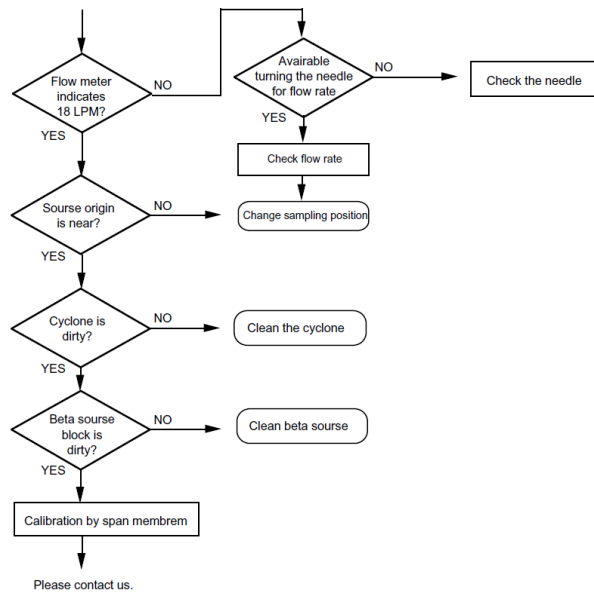
10.2 Measuring value looks like lower



10.3 Measuring value looks like higher



10.4 Tape movement doesn't work



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