ULVAC

Software for Gas Analysis

Qulee QCS Rev.2.1

Startup Operation Manual

Read this manual before operation and keep it at your hand for immediate reference.

Qulee

The name of "Qulee" is derives from image of a quadrupole mass spectrometer leading to four leaf clover that implies the good fortune of the owner. ULVAC Inc,will release new quadrupole mass spectrometer "Qulee" series in near future. "Qulee" series will offer many benefit and good fortune to you

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1. Introduction

This software is the gas analysis software for the ULVAC residual gas analyzer/process monitor (CGM / BGM / HGM / RGM / SEPION).

This software has following features.

· It corresponds to most version of Windows.　(Win95 OSR2.5 and later / Win98 / WinNT / Win2000 / Win Me / Win XP)

· User interface corresponds to general Windows application and it makes to operate simple and easy.

· It would be possible to correspond to various model of the mass analyzer of our products.

· It would be possible to connect up to 8sets of multi sensor.　(The RS232C / RS485 converter is needed to connect second or more multi sensor.)

2. Installation

(1) Specification of PC

Please verify PC specification if it meets with following items.

OS : Win95 (OSR2.5 and later) and Win98, WinMe, WinNT4, Win2000 , and WinXP
　　　(WinMe, WinNT4 and later is recommended)

PC : HDD has 2MB of empty capacity (not including measurement data)
　　　More than 128MB RAM (When the data is obtained continuously and kept long term, it is recommended to install memory as much as possible.)
　　　CPU is Celeron 500MHz and more
　　　Screen display area is 800 x 600 and more.(1024 × 768 recommendation)
　　　Floppy Drive is available.
　　　COM port (RS232C) is available.　If the host communication function (optional) is used, however, two or more COM ports are required.

(2) Installation procedure

(1) Insert the install disk into the CD drive of PC. "Qulee QCS Software for Gas Analysis SETUP" window appears. If not, execute "AutoRun.exe" of CD drive.

(2) Click "Install" in the SETUP window.

(3) According with displayed dialog box, install the software.
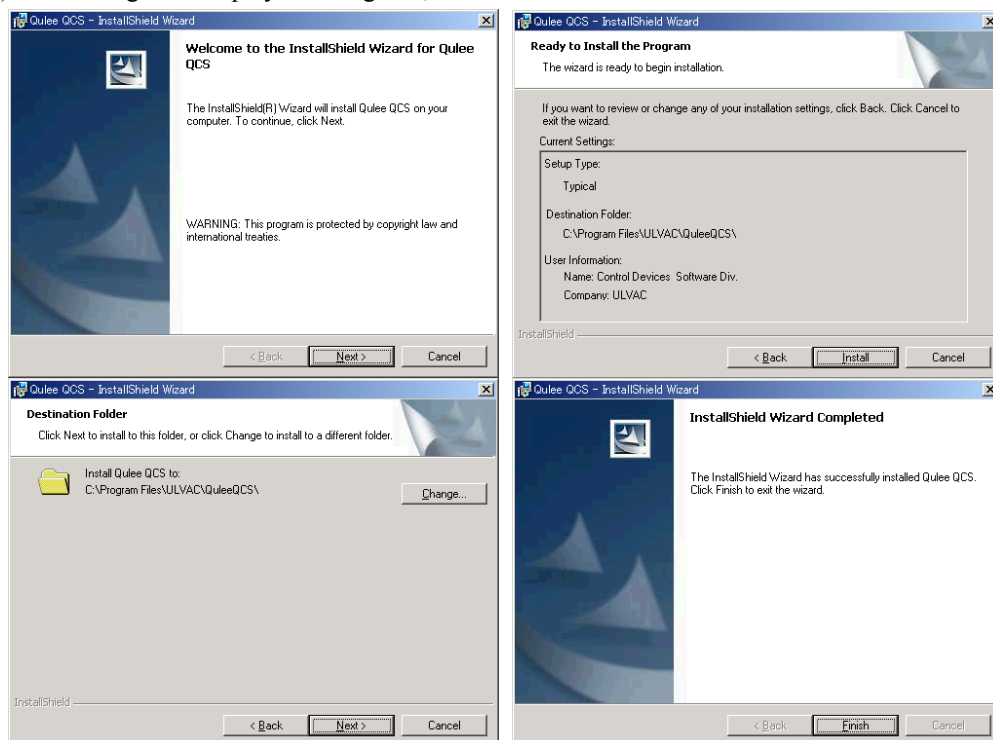
· The installation folder becomes C:¥Program Files¥ULVAC¥QuleeQCS by default.

　In this folder are created folders [S1] – [S8] for storing data and folders [CommLog] and [HostCommLog] for storing the history of communication commands sent and received.

　The data from No.1 to No.8 of sensor would be saved in [S1] – [S8] folders.

　Moreover, an arbitrary folder could be specified with the icon of data folder selection　in the dialog box of sensor type.

　For the folders [CommLog] and [HostCommLog], refer to "5. Others (1-2) Setting of the communication log file" for more information.

(3) Setup PC

· Be sure to turn the setting off like as power save and sleeve of PC.　Please note that the data would not be obtained during the mode when the sleeve mode works during measurement.

· Verify COM port if it is available for this software.

　(It is possible to verify COM port in clicking "Windows start" → "control panel" → "system" → "hardware" → "device manager" → "ports (COM&LPT)" → "COM port" → "properties" → "port settings".　Please refer to next figure for the recommendable setting value of Advanced port settings.)

· When the COM port is used for other usages such as modems, the port cannot be used for this software.
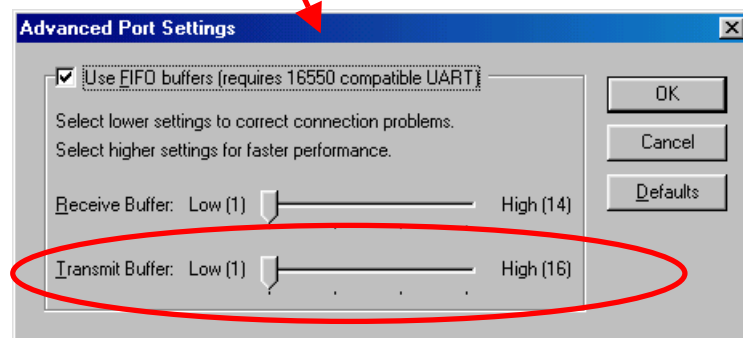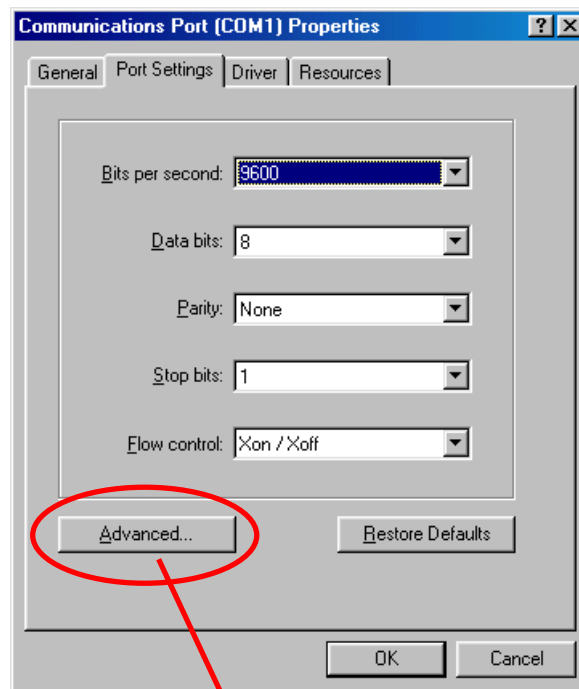
* This setting is not applied to the host communication function.

3. Flow for easy operation

(1) Startup Qulee QCS

Double-click the icon [icon] that is displayed on desktop and then start program.

(2) Connection with sensor

After verifying the connected sensor number, check the number and select sensor type and then click <OK> icon.   (When only single sensor is connected and used to measure, check basically only Sensor 1.)
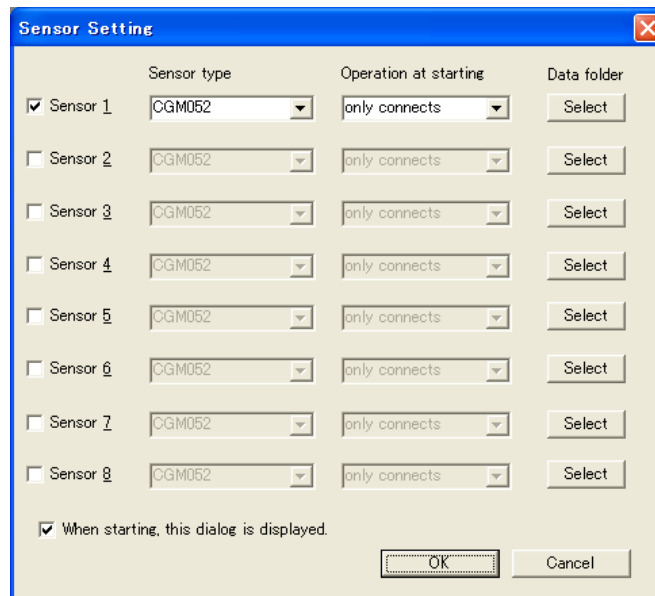
In "Operation at starting", it is selectable from "only connects", "filament on" and "start measurement".

only connects	:	Connect only to communicate with sensor. Please operate with this condition for standard operation.
filament on	:	After connecting sensor communication, turns filament on.
Start measurement	:	After connecting sensor communication, turns filament on and start measurement.

Please check usually "When starting, this dialog is displayed.".

* Immediately after connecting the sensor by clicking the [OK] button, check if the model selected by [Sensor Setting] and the model of the actually connected sensor are the same. If not, the message shown in the figure below will appear and the connection will be interrupted. Set a correct model.
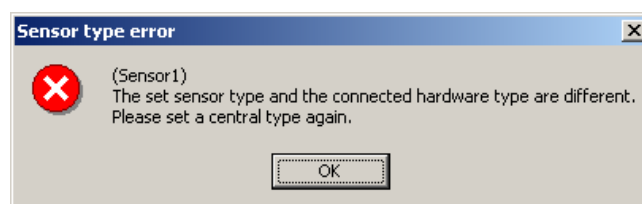
(3) Toolbar and display screen

Screen just after starting
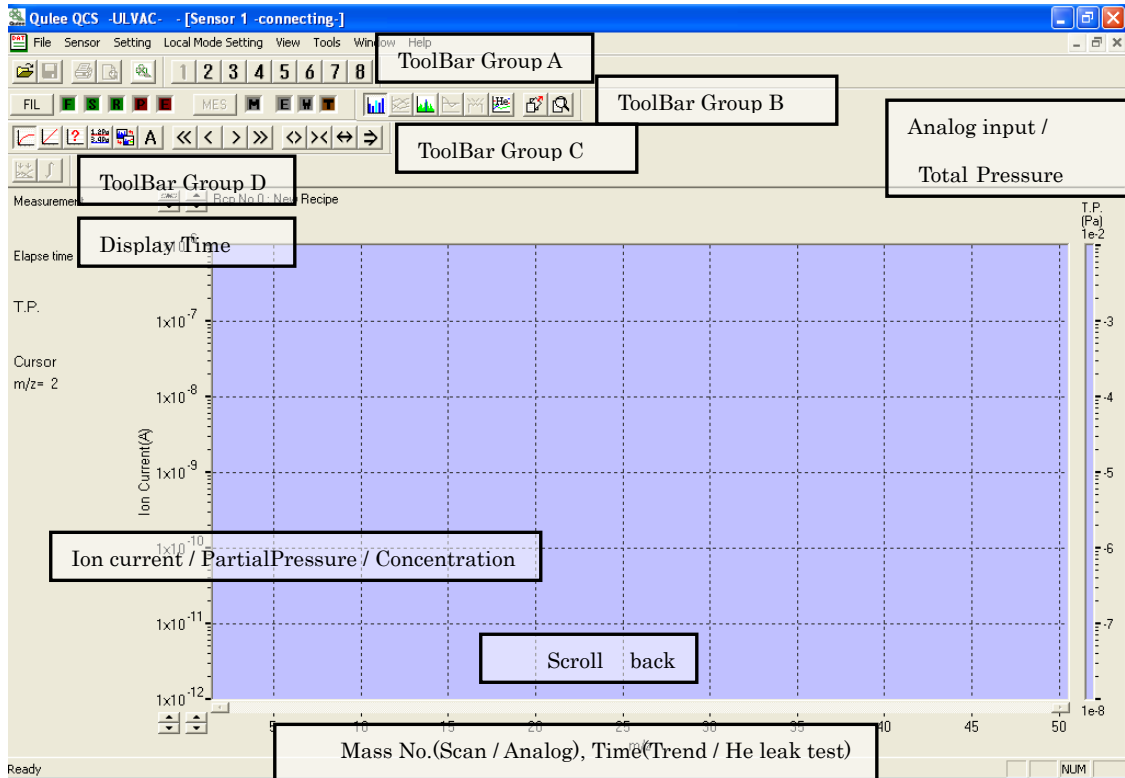
Toolbar group A : Displayed when the program is started

  (1) (2)   (3) (4)   (5)   (6) (7) (8) (9) (10)(11)(12)(13)

In "View" menu, "Main bar" means from (1) to (5), "Sensor connection bar" means from (6) to (13).

(1)Open and display saved data.

(2)Save the displayed data.

(3)Print out the displayed data.　(It is effective only that the printer driver is installed.)

(4)Display preview of data print image.　(It is effective only that the printer driver is installed.)

(5)Display version information of this software.

(6) to (13)Connect the communication with sensor from 1 to 8.　Please verify if each sensor is connected and power turns on.　(When 2pcs and more sensors are connected, RS232C/RS485 converter is needed.)

(The same operation can be done by clicking "Sensor" → "Sensor Setting" in menu.)

Toolbar group B : Setup the direction for each sensor

(1)   (2) (3) (4) (5) (6)   (7)   (8) (9)(10)(11)   (12)(13)(14)(15)(16) (17) (18)(19)
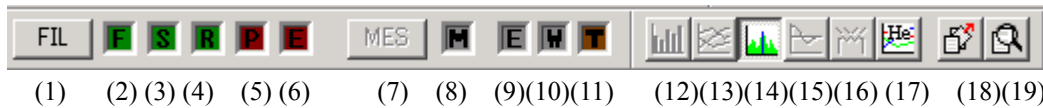
In "View" menu, "Sensor control bar" means from (1) to (11) and "Recipe bar" means from (12) to (19).

(1)The filament and RF of the connected sensor are turned on.

    To set the operation during turning on, follow "Operation setting of FIL button" in "Sensor" →
"Control Panel" of the menu.

    However, synchronizes with the movement of "MES"button of (7) about SEM.

    (Measurement = SEM ON / Measurement stop = SEM OFF)

    (The same operation can be done also in clicking "sensor" → "filament ON/OFF" of the menu)

(2)Turn light on at filament ON of the sensor.

(3)Turn light on at SEM ON of the sensor.

(4)Turn light on at RF ON of the sensor.

(5)Read total pressure measurement value of sensor (CGM / BGM), and turn light red on when total pressure interlock works.　During lighting, the filament dose not turn light on and it could not measure.　This is available only when the sensor is connected with CGM and BGM.

    (Setting value is determined by clicking "Sensor" → "T.P. interlock setting" of the menu.　It works only when　"active" is checked.)
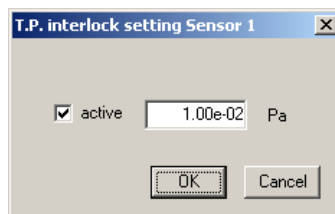
(6)Read set point output of external vacuum gauge and turn light on during filament interlock of sensor works.　It is available only during reading set point of external vacuum gauge.

(7)Start measurement.　The measurement begins.

    (The same operation can be done by clicking "Sensor" → "Mes. Start / Stop" of the menu.)

(8)Turn light on after starting measurement.

(9)Turn light on when the value is over the setting partial pressure value(Error setting) during trend / He leak test mode.

(10)Turn light on when the value is over the setting partial pressure value(Warning setting) during trend / He leak test mode.

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(11)Turn light on when total pressure setting value of sensor (CGM / BGM) is read and the value is over total pressure set point value.   This is available only when the sensor is connected with CGM and BGM.

  (Setting value is determined by clicking "Sensor" → "T.P. setpoint setting" of the menu.   It works only when "Active" is checked.)
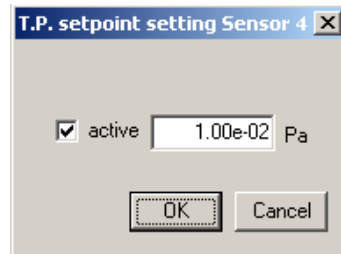
(12)Send the recipe of the Scan mode selected in previous measurement and switch measurement mode to Scan mode.

(13)Send the recipe of the Trend mode selected in previous measurement and switch measurement mode to Trend mode.

(14)Send the recipe of Analog mode selected in previous measurement and switch measurement mode to Analog mode.

(15)Send the recipe of the Sensitivity Calibration mode selected in previous measurement and switch measurement mode to the Sensitivity Calibration mode.

(16)Send the recipe of Degas mode selected in previous measurement and switch measurement mode to Degas mode. (Degas mode is effective except when the connecting sensors are HGM402 and RGM402.)

(17)Send the recipe of the He leak test mode selected in previous measurement and switch measurement mode to He leak test mode.

(18)Edit or send the recipe that is send to connected sensor.   (The same operation can be done by clicking "Setting" → "Recipe" of the menu.)

(19)Display recipe that is selected currently.

Toolbar group C : Set displayed data.   Click "View" → "Display bar" to display.

   (1) (2) (3) (4) (5) (6)   (7) (8) (9) (10) (11)(12)(13)(14)

(1)Display data log of Y-axis.

(2)Display data linear of Y-axis.

(3)Set various display of data.

  (The same operation can be done by clicking "setting" → "display" of the menu.)

(4)Display and non display the legend of data.

(5) Switches over the trend graph display ratio when simultaneously displaying the bar graph and trend graph of the scan mode data to "1/2", "1/3", "1/4", "1/5" and "No display" in that order. Switches over the bar graph display ratio when simultaneously displaying the trend graph and

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bar graph of the trend / He leak test mode data to "1/2", "1/3", "1/4", "1/5" and "No display" in that order.

(6)Edit the comment that displayed in data.

(The same operation can be done by clicking "Setting" → "Input a comment" of the menu.)

(7) to (10)Scroll displayed data to previous or next.

(11) to (12)The expansion and the reduction of the range of the display of a horizontal axis of data are done. A center position of the expansion and the reduction is the points to have clicked the mouse on data.

(13)Optimize the data display of horizontal axis range.

(14)Display the latest data.

Toolbar group D : Execute post-processing of data. Click "View" → "Toolbar" to display.
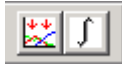
(1) (2)

(1)Subtract the designated data from all data.

(The same operation can be done by clicking "Tools" → "Background" of the menu.)

(2)Conducts integral calculation of a designated range.

(The same operation can be done by clicking "Tools" → "Integrate" of the menu.)

(4) Recipe Selection

In starting up just after the installation, the recipe of the Analog mode (It is called the default recipe) is set.

Also the default recipe of the He leak test mode is registered and can be selected.

Recipe can be edited and be set with the icon of (18) and (19) in toolbar group B.

Please refer to "4. Details (2) Create, edit and send recipe" for more information.

(5) Lighting sensor filament on

After clicking (1) icon of toolbar group B, turn lamp from (2) and (4) on and it means sensor filament, RF are turned on.

It is available to set up if turn ON/OFF both of FIL and RF or one half of them synchronizes with (1) icon motion. Set up at "Operation setting of FIL button" group after displayed "Control Panel" dialog by click "Sensor" → "Control Panel" of the menu. However, it is turn SEM ON/OFF synchronizes with (7) icon of toolbar group B. (Measurement = SEM ON / Measurement stop = SEM OFF)

And, in the dialog of the "Control Panel", setting Ion Collector selection (FC or SEM. However, FC is effective with models other than HGM402 and RGM402.), the SEM voltage (-1kV ~ -3kV. However, Only CGM is – 0.5 kV to -1.5 kV.), selecting filaments (1 or 2. However, With CGM and RGM, only 1 is effective.) and setting emission current (100 or 400uA. However, only CGM is effective.)

(Control Panel dialog)
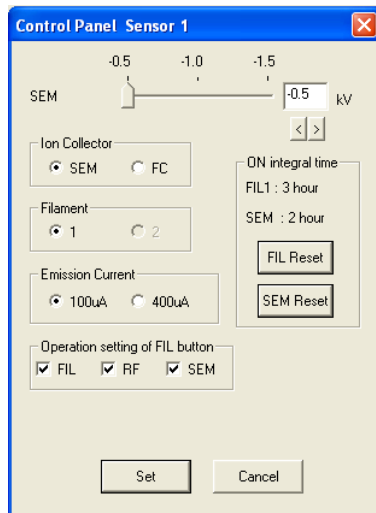
(6) Start Measurement

After clicking (7) icon of toolbar group B, turn lamp (3) and (8) on and indicate to start measurement.

(7) Stop Measurement

After clicking (7) icon of toolbar group B during measuring condition, turn lamp (3) and (8) off and stop measurement.

And, turn lamp (3) and (8) off and stop measurement in the case of total pressure measurement value is over SEM interlock setting value during measure SEM interlock in effective state. Refer to "4.Details (9) About SEM interlock function" for more information.

(If the type of data to save is set to "Confirmation" by recipe setting, the file saving dialog is displayed in stopping measurement.)

(8) Exit of Qulee QCS

After stopping measurement, click exit windows icon or click "File" → "exit" of the menu to Quit this software. Turn filament, etc OFF at the same time as the program is Ended.

4. Details

(1) Measurement mode

In this software, there are six measurement modes.

· Scan mode	: Mode to scan arbitrary range continuously and measure mass spectrum. The setting mass number is depending on the specification of connected sensor.
· Trend mode	: Mode to measure arbitrary mass number selectively and measure the change per time of each measurement mass number. It is available to measure maximum 20ch. The setting mass number is depending on the specification of connected sensor.
· He leak test mode	: Mode to measure the change per time of mass number 4 only. The measurement mass number is fixed at 4, but other conditions can be changed arbitrarily.
· Analog mode	: Mode to provide peak top setting value of analog spectrum of sensor that is used on scan mode or trend mode. This is called mass number adjust. In this mode, analog spectrum of sensor is verified.
· Sensitivity Calibration mode	: Mode to calibrate sensitive of SEM of sensor. The supplied voltage to SEM is moved up or down to keep setting ion current.
· Degas mode	: Mode to degas ion source of sensor. Degas mode is effective except when the connecting sensors are HGM402 and RGM402.

(2) Create, edit and send recipe

Recipe can control and manage various sensor setting items on analyzing gas. This software would be available for user to setup and control 70 recipes.

(Recipe 0-69:These recipes are recipes which the user can edit. 70-99:These recipes are the default recipes which cannot be edited with this software.)

After clicking (18) icon of toolbar group B, following dialog box to select recipe is displayed and it can setup, display and send a recipe.
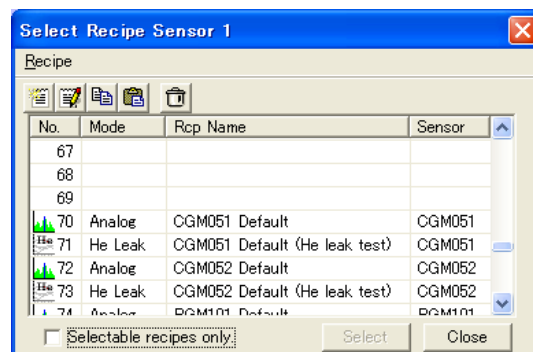
(After checking "Selectable recipes only", display only recipe that could be received by connected sensor.)

Toolbar in recipe setting dialog

     (1)   (2) (3) (4)   (5)

(1)Create a new recipe.

(2)Edit a recipe that is selected in dialog box.

(3)Copy a selected recipe.

(4)Paste recipe that was copied.   Click this icon in clicking blank recipe.

(5)Delete a selected recipe.

(2-1) Create recipe

   · After double-clicking a blank recipe or clicking (1) icon of toolbar of recipe select dialog box,

    following dialog to set a recipe.

Recipe NO.	:	Display number of editing recipe.
Sensor type	:	Display type of connecting sensor.
Recipe name	:	Input name of editing recipe. The input text is displayed on top of measurement screen or dialog of selecting recipe.
Mode	:	Select scan mode for editing recipe. (The degas mode cannot be selected when the HGM402/RGM402 sensor is connected.)
Ionization voltage	:	Set ionized voltage in editing. (Ionized voltage can not be changed when the sensor is not RGM.)

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Sweep speed	:	Select speed of a measurement for each 1mass. It is selectable 50, 100, 200, 500, 1000, and 2000ms. Setting 200ms or more is recommended because of varying of data according to the measurement speed.
Total pressures and analog inputs	:	Set analog input, record data of total pressure of sensor. (Total pressure data cannot be recorded when a sensor other than CGM or BGM is connected.)
Unit of Y-axis	:	Set the unit of data record. Select one of ion current [A], partial pressure [Pa] (or [Torr]) and concentration [ppm]. However, ion current [A] is fixed in the analog/sensitivity calibration/degas mode.

When partial pressure [Pa] (or [Torr]) is selected, pressure is displayed based on the data that is set in following "Ref. to pressure display".

Selecting concentration [ppm] conducts calculation, where the maximum ion current value in a mass number under measurement is 100%, and displays it on a graph.

<Concentration calculating formula> $Cn = (In / Imax) / 1E.6$

Cn : Concentration of mass number n

In : Ion current value of mass number n

$Imax$: Maximum ion current value in mass number bunder measurement

| Ref. to partial Pressure | : | Select reference data when unit of data record is selected partial pressure. |

[Calibration value]	:	Display partial pressure of all gas based on the correlation of the ion current and pressure that is set in sensitivity calibration mode.
[Total pressure]	:	When the connected sensor is CGM or BGM, the partial pressure of all gases is displayed according to the total pressure data of CGM or BGM.
[Analog ch1]	:	Display partial pressure of all gas based on pressure measurement value that is recorded in analog 1 input.
[Analog ch2]	:	Display partial pressure of all gas based on pressure measurement value that is recorded in analog 2 input.

| Measurement end time | : | Sets the method of terminating measurement. |

[Cont.]	:	Continues measurement unless measurement terminating processing is conducted by the user.
[Spec.]	:	Measurement ends automatically with elapse of the set time.
[Repeat]	:	Data file is automatically updated with elapse of the set time (when data is saved). After updating the data file, clear the data and continue measurement, where the next data is the first time of measurement. This action is repeated unless measurement terminating action is taken by the user.

[Cont.] will be selected forcibly when the ending time is 0 hour 0 minute even if [Spec.] or [Repeat] is selected.

Sampling interval	:	When [Auto] is checked, measurement data is updated and is saved each time measurement is repeated by one scan (when saving data).
		Removing the check mark from [Auto] and setting a time updates the measurement data at each set time and saves the data (when saving data).
		Normally, [Auto] is set, but when saving data for a long time, set an arbitrary time.
		The set value range when the check mark is removed from [Auto] is 0.5 sec (trend / He leak test) and 1 sec (scan) to 1000 sec, but the measurement data updating interval may slightly be longer depending on the number of sensors connected and set conditions of recipe. It also varies slightly depending on the condition of PC or application start condition.
Data save	:	Set the method to save data.

	[AutoSave]	:	The file name is generated from the clock of PC automatically, and when the measurement stops, the measurement data is written in HDD when the measurement is completed.

(Example)
Start sensor 1 measurement on 10:10 January 13, 2001 by scan mode, the file name would be
S1_010113_101000.qss

	[Confirmation]	:	The data saving dialog appears when measurement is stopped. The default filename is assigned according to the same file naming rule as [Autosave]. Save the data by clicking the [Save] button and close the dialog by clicking the [Cancel] button without saving the data.
	[at Sampling]	:	Save data at each measurement sampling. The filename is assigned according to the same file naming rule as [AutoSave]. Unlike [AutoSave] or [Confirmation] which saves data in a batch when measurement has stopped, this mode saves data in real time during measurement. Therefore, even if any problem like stop of PC action occurs during measurement, data can be saved by selecting [at Sampling]. **If data is always saved or continuous measurement is made for an extended time, it is recommended to select [at Sampling].**
	[No Save]	:	The confirmation dialog appears when data is not saved but the connection window is closed. Clicking the [Yes] button saves data and clicking the [No] button shuts off the sensor without saving data. Clicking the

[Cancel] button stops sensor shutoff processing.

* Data displayed on the screen can be saved by clicking [File]->[Save] in any setting of [AutoSave], [Confirmation] or [NoSave].   The default filename displayed at this time is assigned according to the same file naming rule as [AutoSave], but it is assigned at the current time of PC rather than the measurement start time.

Ranges   of   sweep   mass   number
: In Scan/Analog mode, set first mass number of measurement and last mass number of measurement.
In Trend mode, set arbitrary mass number.   Mass number can be set to any channel number regardless of its magnitude, but checked mass numbers are automatically arranged in order of increasing number by clicking the [Save] button.

In the he leak test mode, Ch1 is fixed at mass number 4, and Ch2 - Ch20 are set to the measurement prohibition and cannot be changed.

Pressure warning
: In setting mass number to measure by Trend / He leak test mode, set the value of arbitrary Error and warning output. After checking "Active" and click "Setting", set each setting value by following dialog.

· The input value should be "Error(↓)" < "Warning(↓)" < "Warning(↑)" < "Error(↑)".

· Only checked item is available for each setting value.

· When "Keep output" is checked, error output is saved even though measuring data clears each setting value.

· An error is output when the value is over setting Error or warning value and recognized continuously the setting number in "Judgment counts".

Linearity correction : Selects whether linearity correction by total pressure measurement is made or not.　Effective when the connected sensor is CGM and is in the scan mode or trend mode.

* The linearity correction function is optional. It cannot be used by the standard function.

(Create Sensitivity Calibration recipe)

Mass number : Set mass number of object to calibrate sensitivity.
Calib. Pressure : Set pressure value to calculate partial pressure.
Calib.current : Set target setting value for ion current.

(Create Degas recipe)

Degas mode : Set arrival time until maximum degas output.　Check "Slow" for standard operation.
Max power : Set maximum degas output.　Set 15% or less for standard operation.
Degas time : Set time to Degas.

When recipe is set completely about all contents, click "Apply" or "Save".　Click "Apply" to save when setting recipe description and to send to sensor.　Click "Save" to save setting recipe description, but it is not to send to sensor.

(2-2) Send recipe

After selecting sending recipe in the dialog on recipe selection, click "Select" icon.

(2-3) Verify recipe

After clicking (19) icon of toolbar group B, display dialog to set recipe (2-1), description of current setting recipe is displayed.

The description of recipe could be amended in this dialog.　After amending and click "Apply", setting description of recipe is amended, saved and send it to sensor.　But default recipe is not enable to change the setting description.

(2-4) Other notice in setting recipe.

· In the multi sensor connection, the recipe is not enable to change when it is used in active window sensor or another window.

· It is not available to change recipe during measurement.

· A recipe that is created new is referring default recipe.

· In depending on connected sensor type, the item that can be set is different.

(3) Display on screen

(Please refer to another description if there is no explanation about the part.)

(3-1) Scan mode
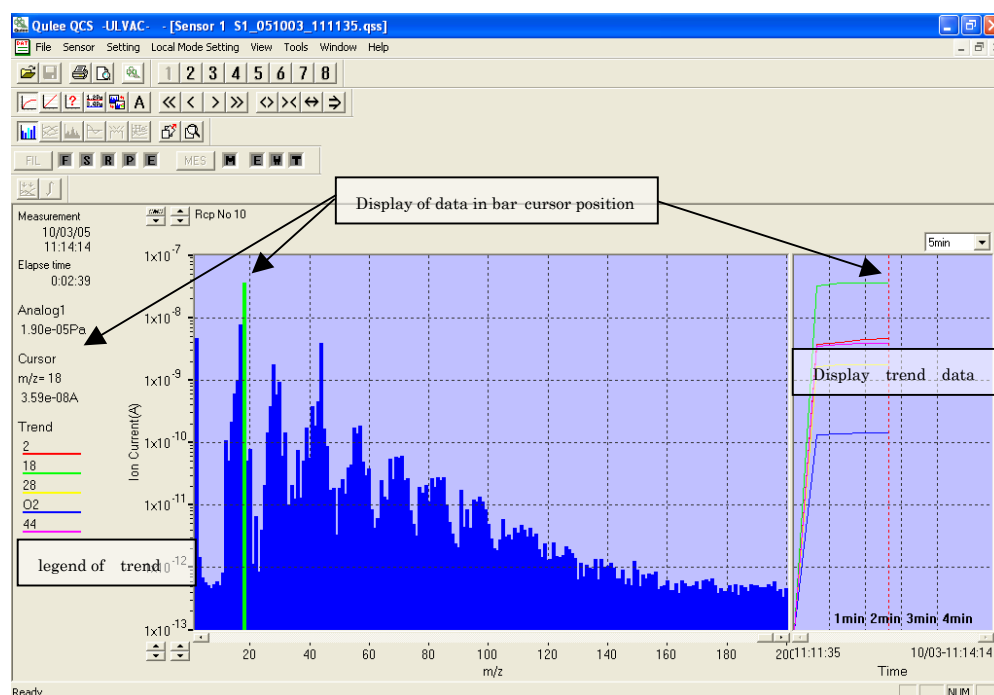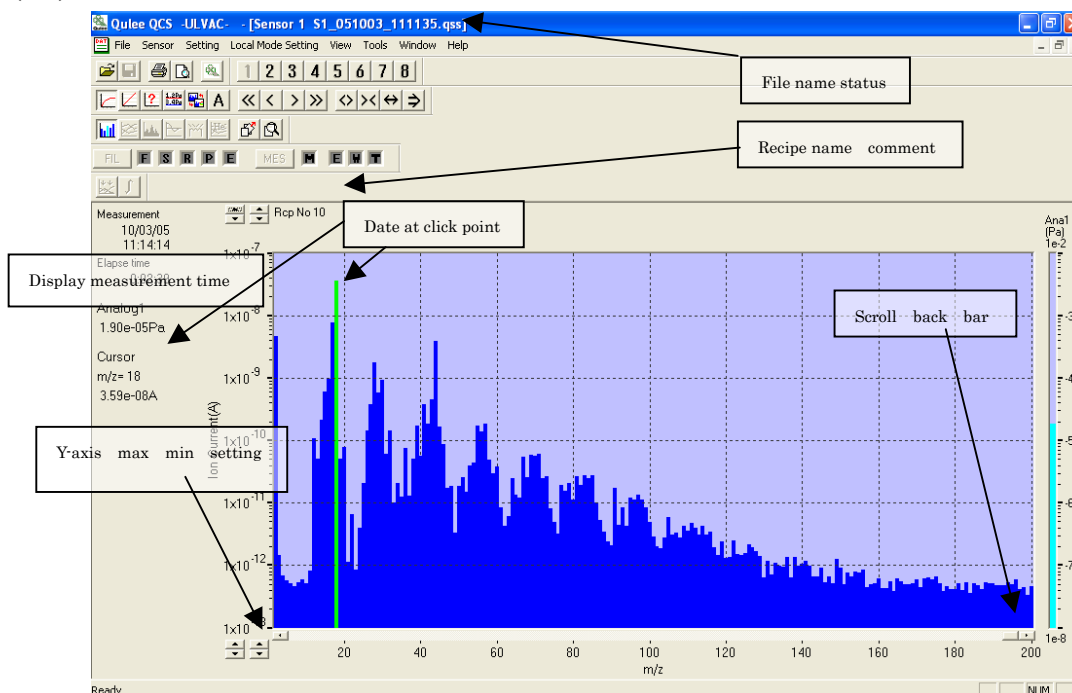
file name, status	:	Display in the condition of connecting sensor and display "data file name" when the obtained data is displayed in the window.
The recipe name, comment	:	Display recipe of displaying data and Comment. The comment can be input by using toolbar group C (6) icon.

Display measurement time	:	Display real time during measuring and display time when data is obtained in displaying obtained data. Display an elapsed time from starting measurement in Elapse time.
Data at click point	:	Click peak point of spectrum and then turn color to green and display ion current, partial pressure and concentration on that point.
Y-axis max · min setting	:	Set maximum and minimum value of the Y-axis by using arrow key.
Scroll back bar	:	Enable to display old data by scrolling back. To display the latest data, drag the scroll button to the right end position.
Display trend data	:	Enable to display trend for arbitrary mass number in the Scan mode by setting toolbar group C (3). Refer to "3.6 Display setting dialog (scan / Analog mode) trend tab" for more information about setting. The trend graph display ratio can be switched over from "1/2", "1/3", "1/4", "1/5" and "no display" in that order with the tool bar group C (5).
Display of data in bar cursor position	:	Data in the bar cursor position on the trend graph is the bar graph displayed data and the data of the peak selected on the bar graph is displayed numerically at the left of the bar graph. Therefore, if the bar cursor is in the position of the latest data during measurement, the measurement data is displayed and updated in real time. If the bar cursor is in the past (intermediate) data position, display of the data in the bar cursor position continues regardless of updating of the measurement data (latest data)

(3-2) Trend mode / He leak test mode
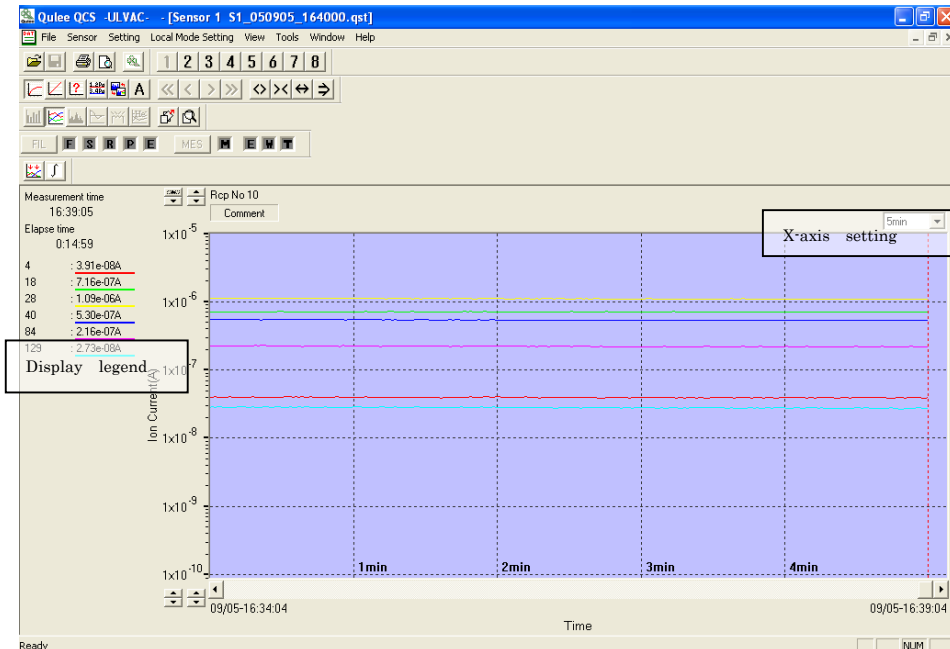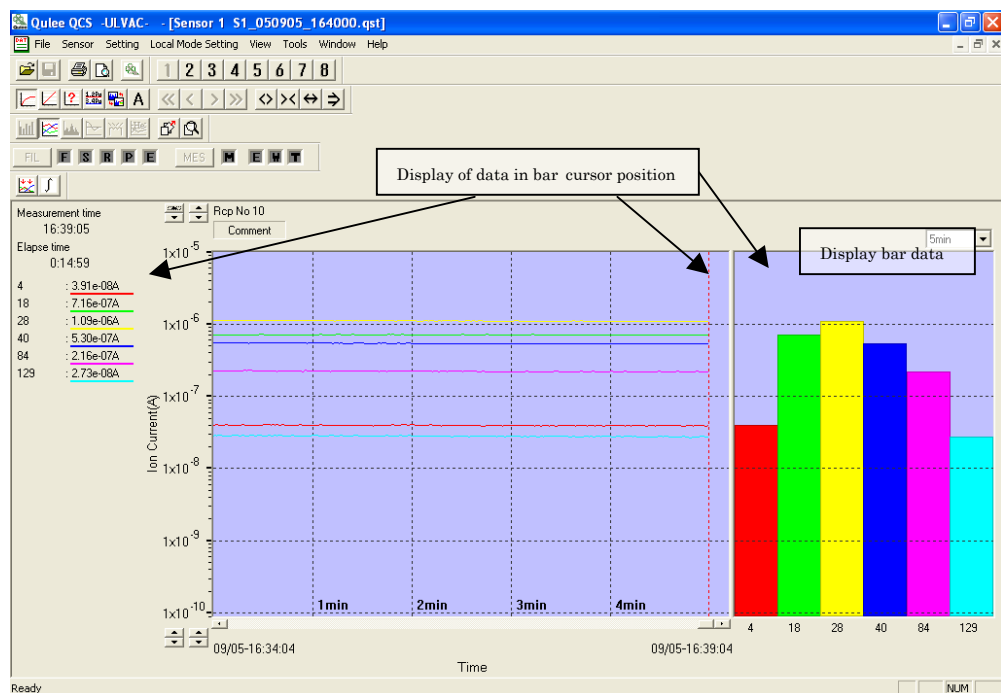
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X- axis setting	:	Set display range of time for X axis.
Display legend	:	Display the value of ion current, partial pressure and concentration for each mass number. Enable to select display or non display by using toolbar group C (4).
Display bar data	:	Enable to display bar for arbitrary mass number in the Trend / He leak test mode by setting toolbar group C (3). Refer to "3.6 Display setting dialog (trend mode / He leak test mode) bar tab" for more information about setting. The bar graph display ratio can be switched over from "1/2", "1/3", "1/4", "1/5" and "no display" in that order with the tool bar group C (5).
Display of data in bar cursor position	:	Data in the bar cursor position on the trend graph is the display data of the bar graph and numerical data of legend.

(3-3) Analog mode
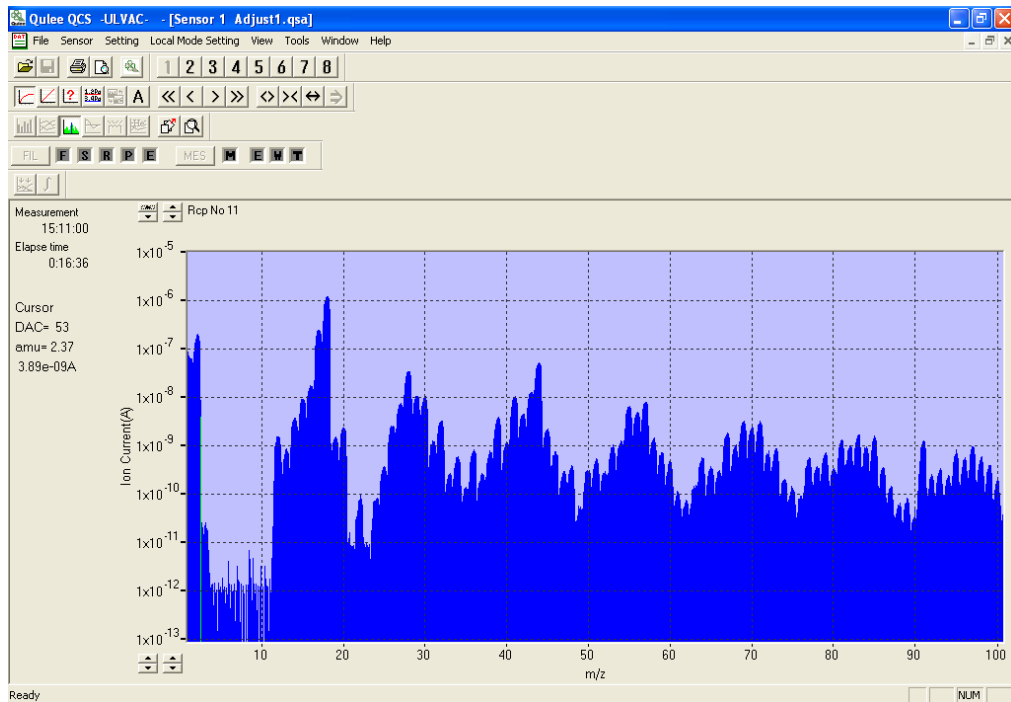
(3-4) Sensitivity Calibration mode
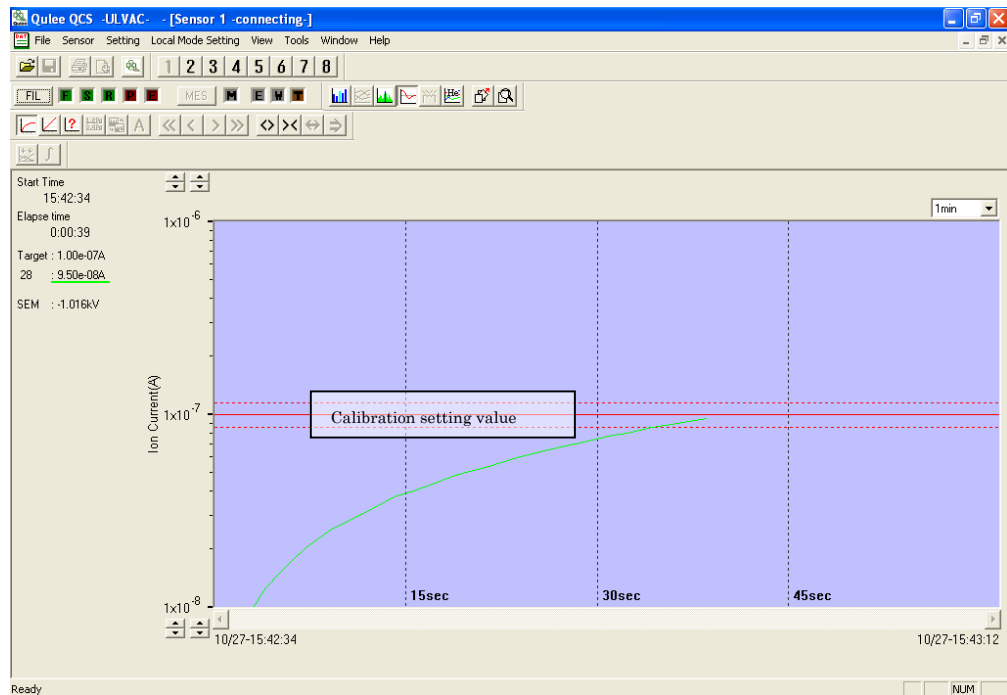
| Calibration setting value | : | Display setting value of sensitive calibration with red solid line and permissible value for setting value with red dotted line. |

(3-5) Degas mode
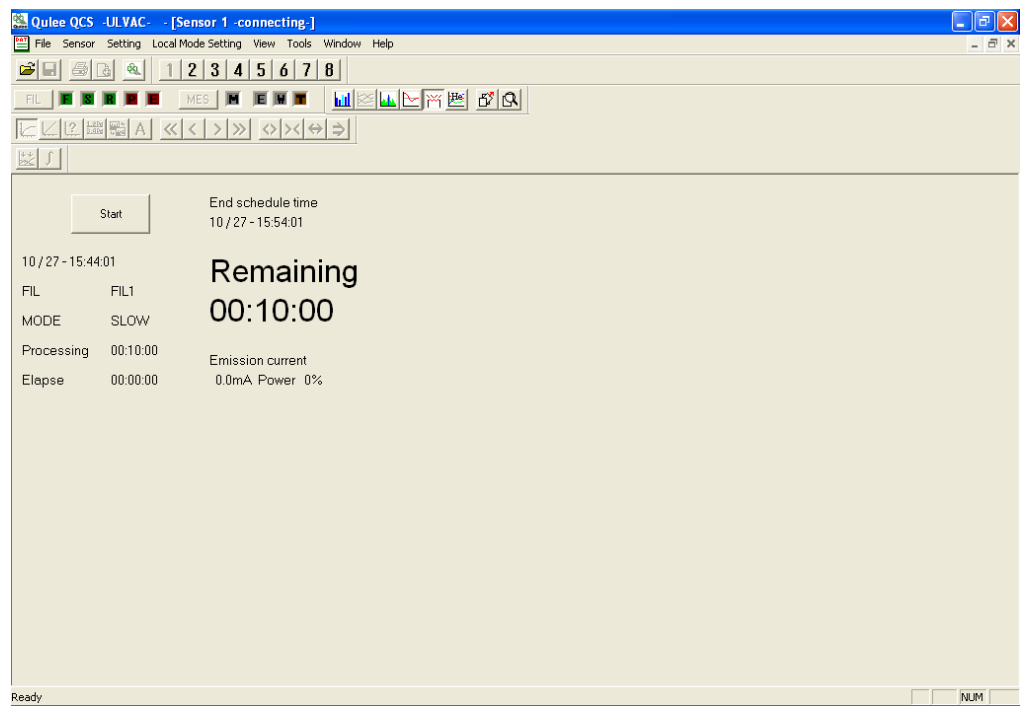
Start	:	Start to degas.
Status	:	Display filament, degas mode (SLOW, FAST), processing time, and elapsed time, etc.
Remaining time	:	Display remaining time of degassing.
Emission current	:	Display emission current in degassing.

(3-6) Display setting dialog

(Scan mode / Analog mode)
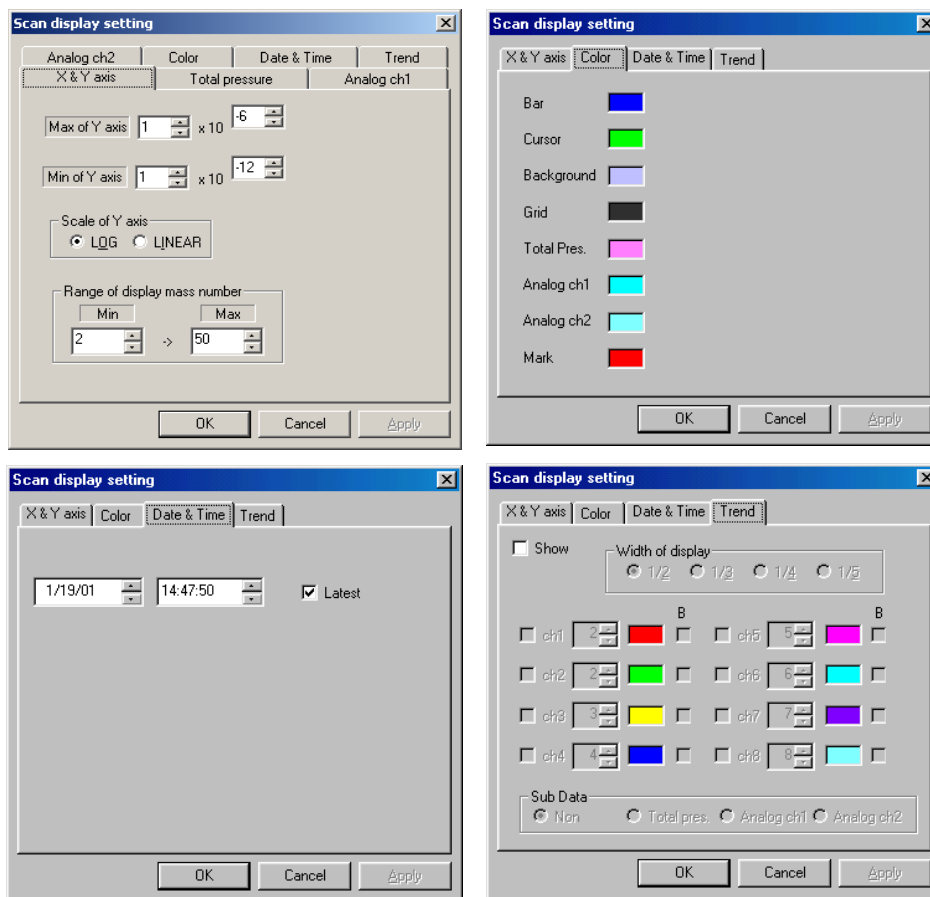
X&Y axis	:	Set display range of X and Y axis to display data.
Color	:	Set display color of data, background, etc. Enable to select arbitrary color in double clicking in the displayed color.
Date & time	:	Set the time to display data. Move to the latest data position when "Latest" is checked.
Trend	:	Set to display trend part in scan mode. Enable to change width of trend display part by "Width of display". Checking [B] displays only the channel (Ch) with a thick line. However, thick line display is not reflected in the printout result.

(Trend mode / He leak test mode)
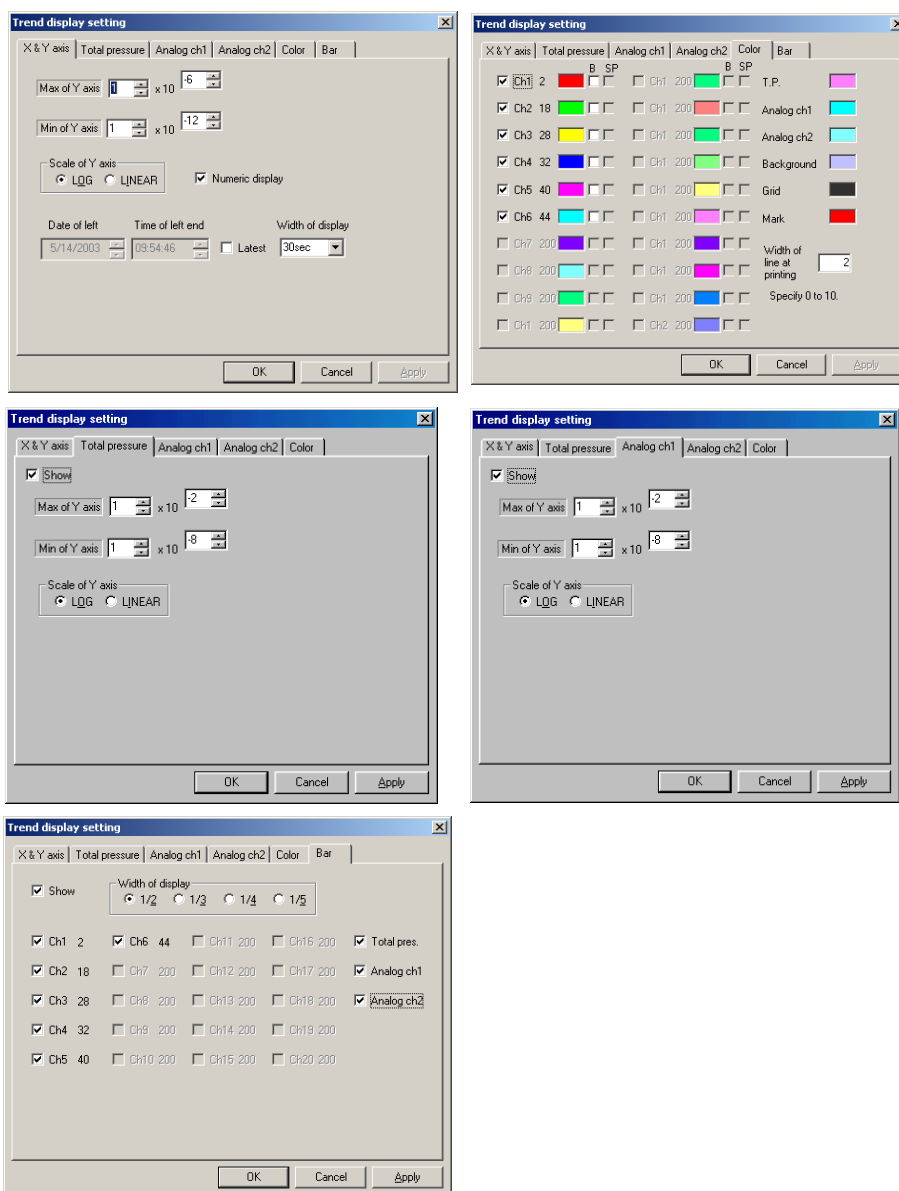
X&Y axis	:	Set display range of X and Y axis to display data.
Color	:	Set display color of data, background, etc. Enable to select arbitrary color in double clicking in the displayed color. Checking [B] displays only the channel (Ch) with a thick line. However, thick line display is not reflected in the printout result. Display marker at right side of Y axis of setting value for abnormal or warning partial pressure that is set on Ch when [SP] is checked.
Total pressure	:	Set to display in measuring total pressure. This is not displayed when the measurement is not set by recipe. Display data only when "Display" is checked.
Analog ch1,2	:	Same function as the above-mentioned "Total pressure".
Bar	:	Set to display bar part in trend / He leak test mode. Enable to change width of bar display part by "Width of display". Only the data with check mark is displayed by bar graph. The bar graph color is the same as the trend display color.

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(4) Displaying gas names of mass number

Displays the gas name on the graph instead of mass number. Printed result is also the gas name.

The gas name is set by clicking "Setting" → "Set gas name" of the menu.
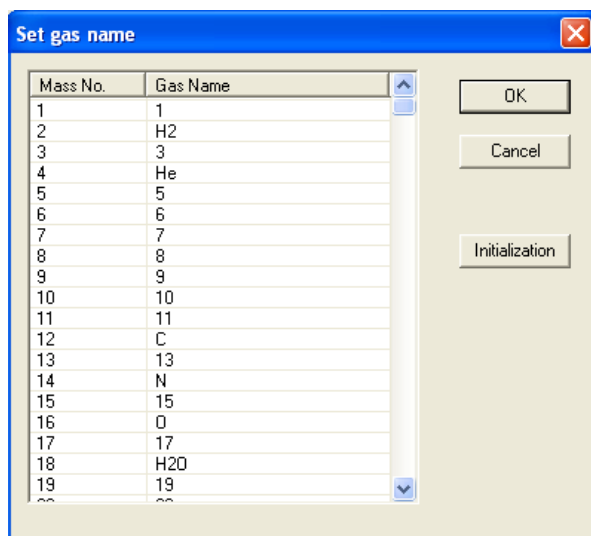
Mass No.	:	The mass number is displayed. It is not alterable.
Gas Name	:	The gas name corresponding to the mass number is displayed. It is alterable within six character length.
Initialization	:	The gas name display is returned to mass number display.

Attention)　　　Data file does not store the gas name information. If the gas name saved in the data file and the currently set gas name differ, the gas name display of the loaded data file will be the current gas name.

<　　Trend graph of scan mode　　>

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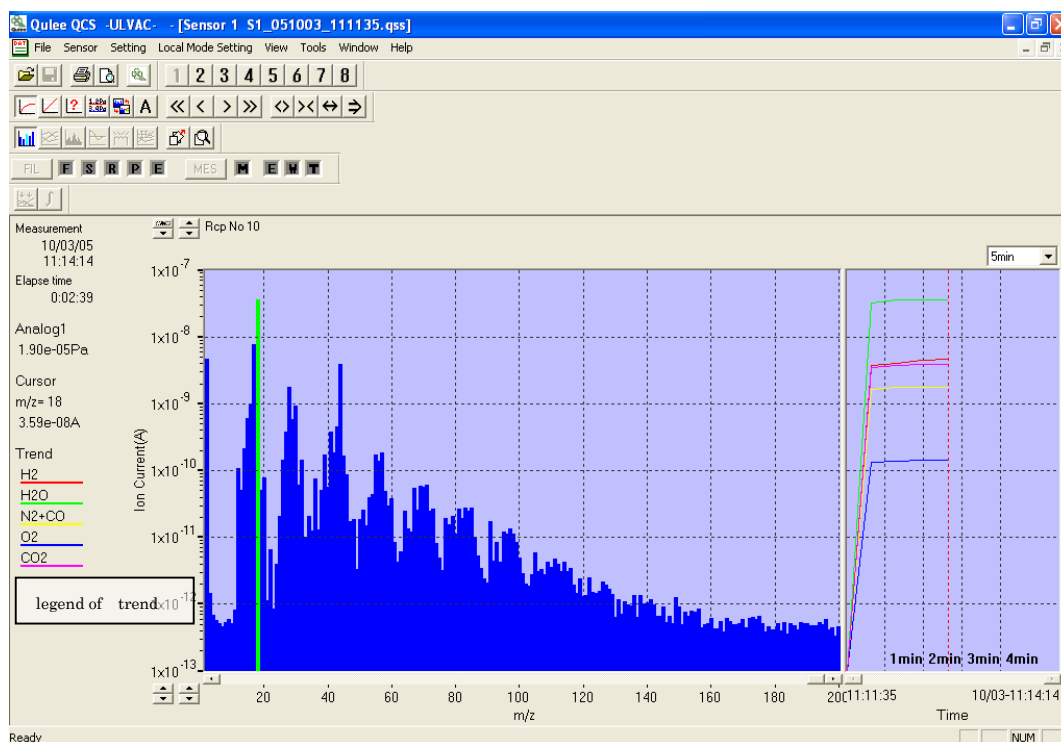
< Trend graph and bar graph of trend mode >
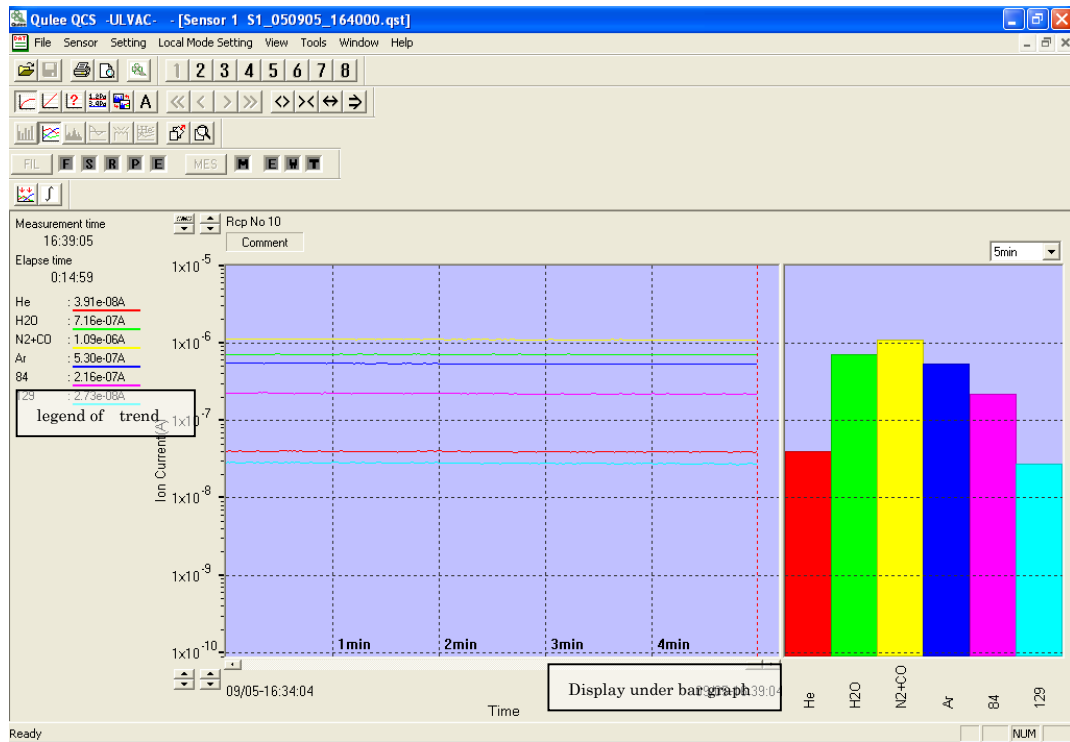
(5) Mass number calibration by Analog mode

The measurement mode of trend & Scan obtains a data after selecting and scan within analog spectrum or vicinity of peak top.　　Therefore, it is necessary to recognize a peak top position of an analog spectrum to an appropriate number of mass.　　This setting is done by Analog mode.

(5-1) Confirmation of analog spectrum

· Create and send a recipe of Analog mode.

· Click "FIL" → "MES" icon and then start measuring analog mode.

· Verify an analog spectrum like as following figure.
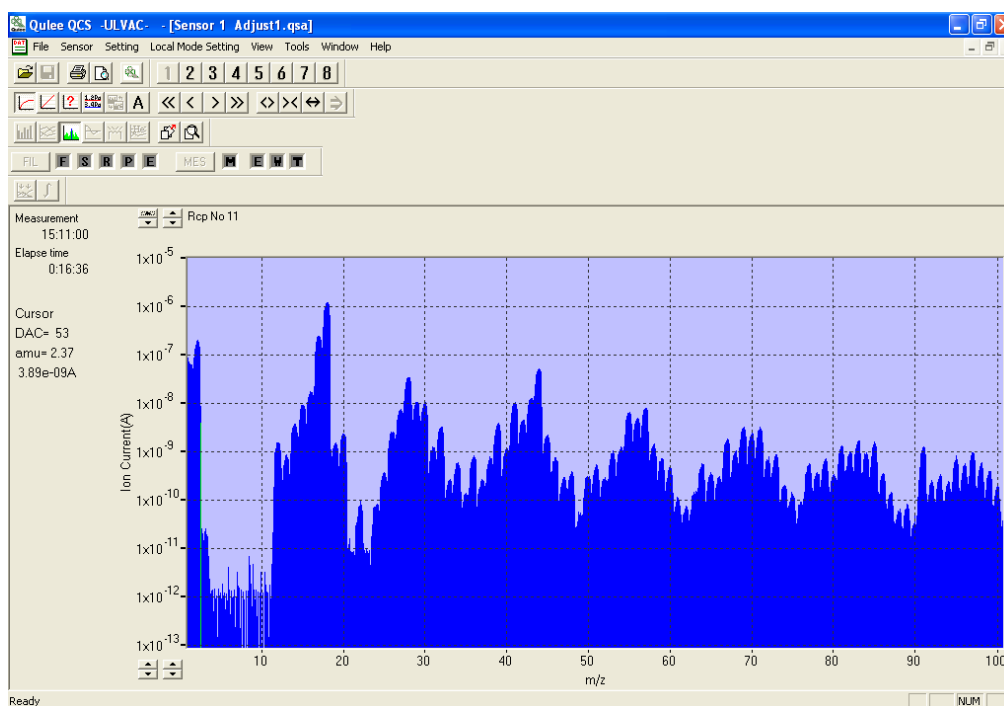
(5-2) Set or delete peak top position

· Terminates measurement.

· Display green line when arbitrary peak top position is selected and clicked by left button. Following dialog displayed when right button is clicked in this condition.　(Example is assumed to click a peak top position of m/e=28.)
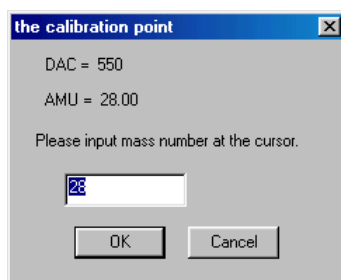
· Verify mass number if it is correct and click [OK] to relate peak position with mass number on software.

· To delete peak position that is related with mass number, click left button on peak position of displayed mass number and then click right.　Display following dialog and enable to delete relation of mass number.
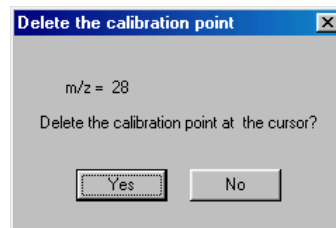
(5-3) Send peak top position (mass number calibration)

· Click "File" → "Send Calibration data" after completing the procedure (5-2) for arbitrary mass number as following figure and send setting value of mass number calibration to sensor.

However, when a set value is transmitted to the sensor, it is necessary to input a set point of three points or more.

· Interpolate and extrapolate data for the peak that is not related peak position to relate with mass number.
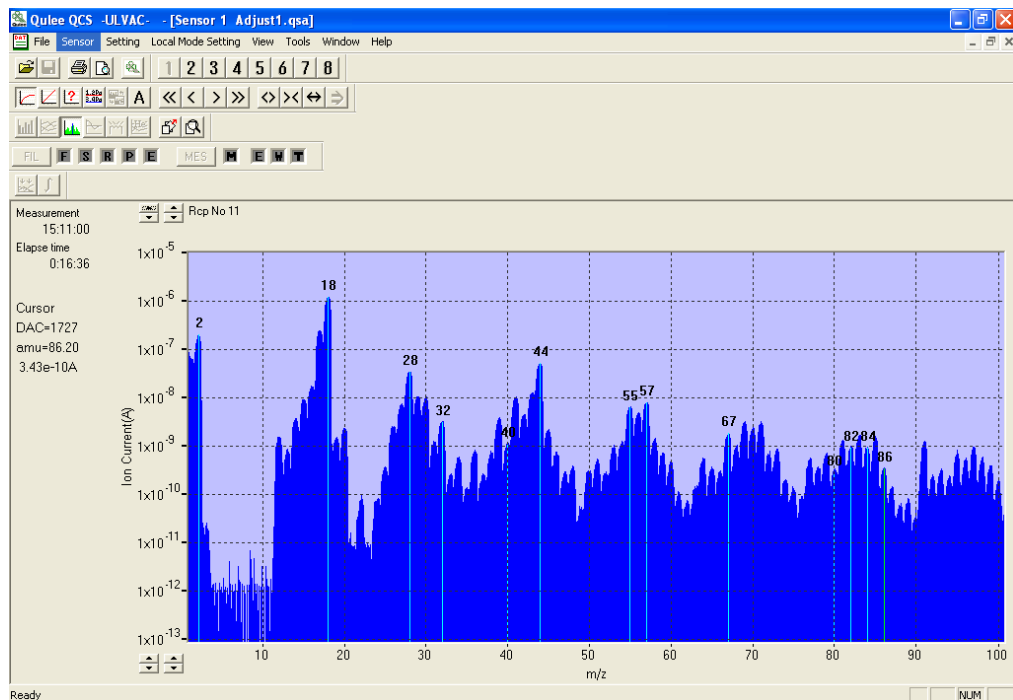
(5-4) Save and open mass number calibration data

Enable to save the result of mass number calibration data in PC.　Enable to save with file name ****.cal by clicking "File" → "Save Calibration data".　After reading this file by clicking "File" → "Open Calibration data" and proceed as (5-3), enable to send saved calibration point data to sensor.

(6) About the sensitivity calibration mode

Calibrate the sensitivity of SEM so that the set constant ion current value is obtained.

Effective except when the connected sensor is other than CGM051/BGM101/BGM201/RGM201.

(6-1) Processing flow of the sensitivity calibration mode

```
┌──────────────────────────────┐
│  Sensitivity calibration mode │
│      measurement start        │
└──────────────────────────────┘
              │
              ▼
┌──────────────────────────────────────┐
│ Collects measurement data at every    │
│ second                                 │
│ No. of calibration += 1                │
└──────────────────────────────────────┘
              │
         ◇ No. of calibration
           times 5 or more ?  ── No ──▶
              │ Yes
         ◇ Is measurement data within
           +-15% of set ion current value
           5 times consecutively ?  ── No ──▶
              │ Yes
┌──────────────────────────────────────┐
│ Sensitivity factor value calculation   │
│ Sensitivity factor value = Calib.      │
│ pressure / Data avg. value of 4 times  │
│ of measurement                         │
└──────────────────────────────────────┘
              │
      ( Sensitivity calibration ends normally
        *1) The factor value is sent )
```

◇ data avg. value of 5 times of measurement < set ion current value ? — No

◇ current SEM voltage value <= Min. SEM voltage value ? — No

◇ 10 times the set ion current value <= data avg. value of 5 times of measurement ? — No

Yes → (Sensitivity calibration end (failure))

SEM voltage -= 1V
No. of calibration = 0

◇ Max. SEM voltage value <= current SEM voltage value ? — No

Yes → (Sensitivity calibration end (failure))

◇ current SEM voltage value −10V < Min. SEM voltage value ? — No

SEM voltage -= 10V
No. of calibration = 0

Yes → SEM voltage = Min. SEM voltage
No. of calibration = 0

◇ 10 times the data avg. value of 5 times of measurement <= set ion current value ? — No

SEM voltage += 1V
No. of calibration = 0

◇ Max. SEM voltage value < current SEM voltage value +10V ? — No

SEM voltage += 10V
No. of calibration = 0

Yes → SEM voltage = Max. SEM voltage
No. of calibration = 0

*1)
SEM sensitivity factor value of local mode is sent to the sensor, except when the connected sensor is HGM402 or RGM402.
(related to "4. Details (8-2-2) Setting of SEM sensitivity factor")

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(6-2) Saving the log of calibration result in sensitivity calibration mode

Saves the information at the end of calibration in the sensitivity calibration mode in the text file (Adjust#.txt: # is the sensor No.) successively. The number of log that can be saved is not limited.

* This software has no function of viewing the log of sensitivity calibration results. To check the log, use a memopad, Microsoft Excel, or other. To check it, exit this software or the sensitivity calibration mode.
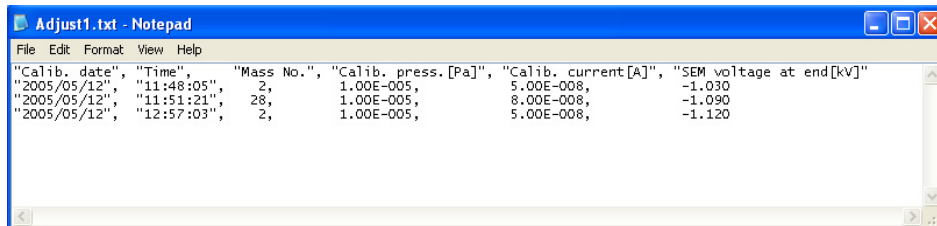
Date of sensitivity calibration	:	Saves the date on which sensitivity calibration was completed.
Time	:	Saves the time when sensitivity calibration was completed.
Measurement mass number	:	Saves the Mass number set with "(Create Sensitivity Calibration recipe) in (2.1) Create recipe".
Sensitivity calibration pressure [Pa]	:	Saves Calib. Pressure set with "(Create Sensitivity Calibration recipe) in (2.1) Create recipe".
Set ion current value [A]	:	Saves the Calib. Current set with "(Create Sensitivity Calibration recipe) in (2.1) Create recipe".
SEM voltage at end [kV]	:	Saves the SEM voltage value at the end of sensitivity calibration.

(7)Display of FIL / SEM ON integrated time

Acquires the time for which FIL and SEM are lit (ON) from the sensor and displays it as a guide for knowing the life expectancy of FIL/SEM.

The integrated FIL1/FIL2/SEM ON time is displayed in hours on the Control Panel dialog. (The latest integrated time is displayed when Control Panel dialog is opened. Keeping the dialog open does not update the display of the integrated time.)
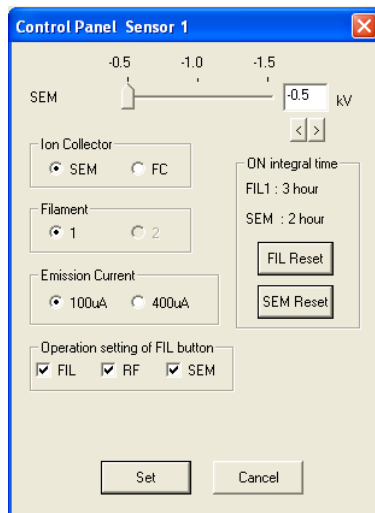
FIL1 (FIL2)	:	Displays the FIL1 ON integrated time in hours when filament 1 is selected, and displays the FIL2 ON integrated time when filament 2 is selected. It cannot be changed.
SEM	:	Displays SEM ON integrated time in hours. It cannot be changed.
FIL reset	:	Initializes the selected filament ON integrated time to zero.
SEM reset	:	Initializes the SEM ON integrated time to zero.

Attention)		If the [Reset] button is clicked and the ON integrated time is initialized, control cannot be returned to a time before initialization. Reset it immediately after replacing FIL / SEM.

(8) About the condition setting for local mode

Function of making measurement using the dip switch on the sensor side without connecting PC (local mode) and the function of making measurement through communication with this software (remote mode) can be changed over.

Here, set the conditions necessary for making measurement in the local mode.

Local mode is effective except when the connecting sensors are HGM402 and RGM402.

(8-1) Setting of mass number

Sets the mass number on the [ANY] button on the sensor side.

The mass number is set by clicking "Local Mode Setting" → "ANY mass number" of the menu.

(This menu cannot be selected if the sensor is connected to HGM402 or RGM402 or measurement is being made or the loaded data is displayed.)
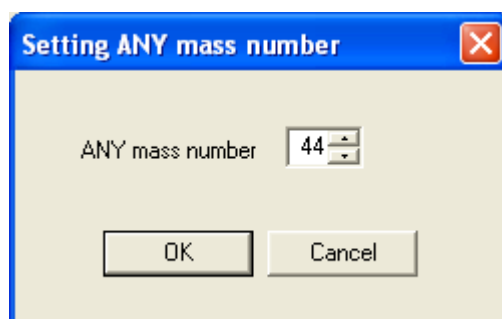
ANY mass number	:	Sets the mass number to be allocated to the [ANY] button. It is 44 as default. The range that can be set varies with the connected sensor.
[OK] button	:	Clicking the [OK] button sends the set mass number to the sensor.

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(8-2) Setting of sensitivity factor

Sets the factor to calibrate the sensitivity of the partial pressure value to display on the indicator on the sensor side.

Setting a factor gives commonality to the partial pressure data in the local mode and in the remote mode.

(8-2-1) Setting of FC sensitivity factor

The sensitivity factor is set by clicking "Local Mode Setting" → "Sensitivity Factor" of the menu.

(This menu cannot be selected if the sensor is connected to HGM402 or RGM402 or measurement is being made or the loaded data is displayed.)
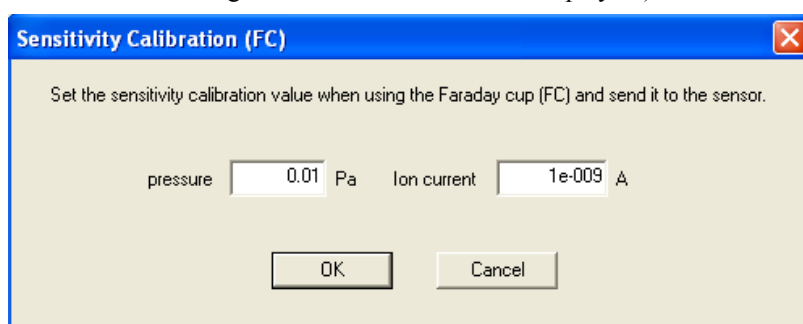
pressure	:	Value common with the pressure of "5. Others (1-4) Calibrate Sensitivity of FC".
Ion current	:	Value common with the ion current of "5. Others (1-4) Calibrate Sensitivity of FC". The range that can be set is 1.00E-5A to 1.00E-14A.
[OK] button	:	Click the [OK] button to send the set factor value to the sensor.

      <Factor calculating formula> $S = P / I$

        S : Factor value of FC

        P : Pressure

        I : Ion current

(8-2-2) Setting of SEM sensitivity factor

Sends the factor value to the sensor immediately after the sensitivity calibration mode has terminated normally.

<Factor calculating formula> $S = P / I$

    S : Factor value of SEM

    P : Calibration Pressure

     (Calib. Pressure set with "(Create Sensitivity Calibration recipe) in (2.1) Create recipe".)

    I : Mean value of data when sensitivity calibration ends normally

Please refer to "4. Details (6-1) Processing flow of the sensitivity calibration mode *1)" for the processing to send factor values to the sensor.

(9) About SEM interlock function

In the case of meeting condition necessary for <SEM interlock function essential condition>, "Over SEM interlock value" massage dialog appears after stopping measurement and OFF SEM compellingly if total pressure measurement value is over interlock setting value.

It is available for SEM interlock to set up in the case of connection sensor is CGM052, BGM102 or BGM202.　The SEM interlock is set by clicking "Sensor" → "SEM interlock setting" of the menu.
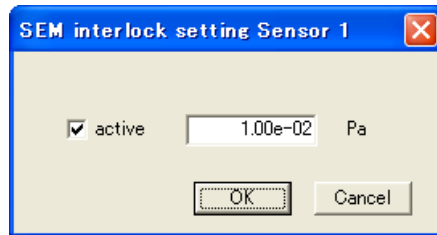
Active	:	Set if SEM interlock function enable or revoke.
Interlock value	:	Set SEM interlock pressure value.

<SEM interlock function essential condition>

· Select SEM at "Ion Collector" group of "Control Panel" dialog .

· Put a checkmark on SEM at "Operation setting of FIL button" group of "Control Panel" dialog.

(It is necessary to synchronizing measurement motion and SEM ON/OFF motion.)

· Put a checkmark on Active at "SEM interlock setting" dialog.
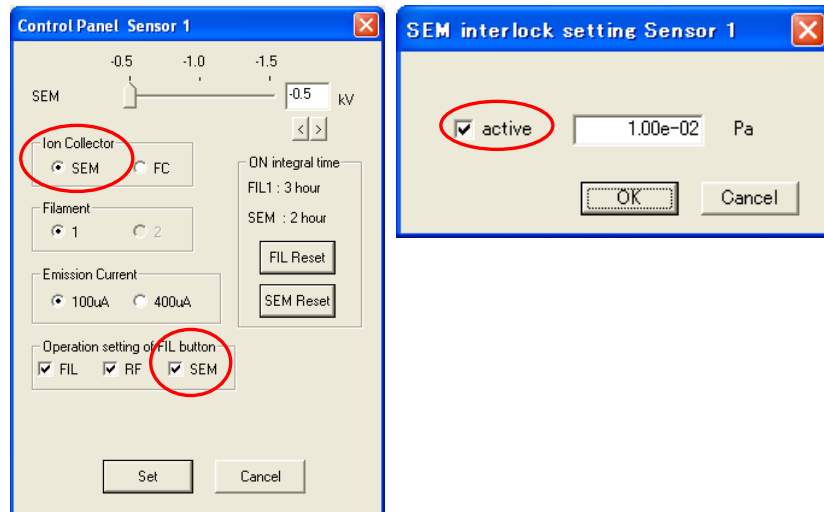
(10) Procedure for abnormal partial pressure and warning

Turn lamp of toolbar group B (9) and (10) on and inform an error or warning when partial pressure error and warning of "(2-1) Create recipe" is set in trend / He leak test mode.
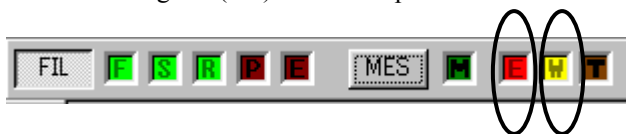
Display following dialog in clicking "Sensor" → "Output of error & warning" and enable to verify abnormal partial pressure and warning output for each mass number.
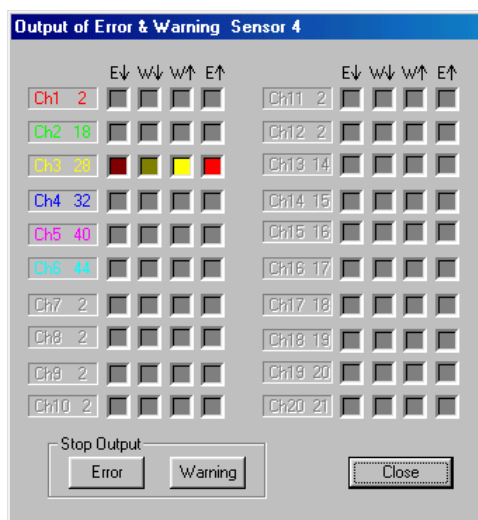
Click "Error" button   in "Stop Output" group and then reset error output and reset output from I/O in control unit.   Click "Warning" button and then works as same as the above.

After resetting, Error and warning output decision processing is not performed during the measuring action.

Please refer to operation manual for hardware (CGM / BGM / HGM / RGM / SEPION control unit, etc.) for output specification for error or warning output of sensor.

(11) Error Correcting Action

Take error correcting action when the sensor is faulty or when the external/internal interlock is actuated (internal interlock is available only for CGM or BGM).

(11-1) Error correcting action

The following is a sequence of actions to be taken when FIL/RF/SEM is faulty or when the total pressure (internal/external) interlock is actuated.

(11-1-1) When host communication function is disabled (standard function)

[1] If measurement is underway, it stops.

[2] FIL/RF/SEM are turned OFF.

[3] The warning state is displayed. (11-2)

(11-1-2) When host communication function is enabled

* The host communication function is optional. It cannot be used by the standard function.

· When error has occurred in other than trend mode measurement
   The same action as (11-1-1) is taken.

· When error has occurred during trend mode measurement
   [1] The data values for graphic display and for host communication   are held and actions [2] – [4] are taken to reset FIL/RF/SEM fault (reset action) maximum three times.

   [2] FIL/RF/SEM are turned OFF.

   [3] FIL/RF/SEM are turned ON five seconds later.

   [4] Data acquisition restarts five seconds later.

   [5] If the faulty or interlock state continues even after the resetting actions ([2] – [4]) are taken three times, actions [6] to [8] are taken.

   [6] Measurement stops.

   [7] FIL/RF/SEM are turned OFF.

   [8] The warning state is displayed. (11-2)

(11-2) Display of Warning State
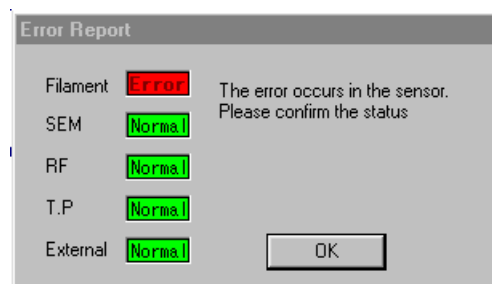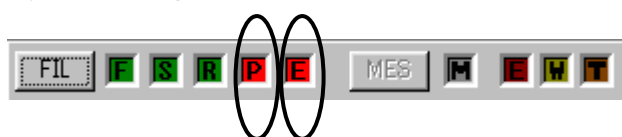
Filament	:	Turn light on when emission current of ion source is not controlled correctly because of cutoff filament or any cause.
SEM	:	Turn light on when SEM has an error.
RF	:	Turn light on when the tune is not correct between analyzer and RF unit or there is a problem.
T.P. (inside)	:	Turn light on when the sensor is CGM or BGM and the total pressure measurement value of CGM or BGM has exceeded the total pressure interlock setting value. (Setting value is determined by clicking "Sensor" → "T.P. interlock setting" of the menu. It works only when "active" is checked.)
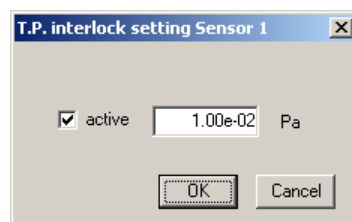
| External | : | Turn light on when set point is over during reading output of setting point for external vacuum gauge. |

(11-3) Actions after Error has occurred

When the filament burnout etc. cause these error, please push the OK button of "Output of Error & Warning Sensor#" dialog and execute following procedures.

[1] Please confirm the cause generates the error, and fix the cause.

[2] Please reset the QMS power supply.

[3] Please push the FIL button again with this software, and confirm the QMS hardware including the analyzer works normally.

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(12) Communication Error Correcting Action

Communication error correcting action is taken if error has occurred in communication with the QMS power supply.

(12-1) Communication error correcting action

The following is a sequence of actions after communication error has occurred.

(12-1-1) When host communication function is disabled (standard function)

[1] Communication error corrective actions are taken against [2] and [3] from the first error (total 3 times, that is, 3 re-trials per error).

[2] If measurement is underway, it stops.

[3] Communication error message is displayed.

(12-1-2) When host communication function is enabled

* The host communication function is optional. It cannot be used by the standard function.

· When error has occurred in other than trend mode measurement
The same action as (12-1-1) is taken.

· When error has occurred during trend mode measurement

[1] Data for host communication holds the data value immediately before without updating the graph display and measurement action continues without taking corrective actions against the communication error. Communication error corrective actions in [2] and [3] are taken four times consecutively (total 12 times, that is, 3 re-trials per error).

[2] Measurement stops.

[3] Communication error message is displayed.

(13) Save data

· Extension to save data

The extension to save data is determined as follows by the measurement mode.   The data is saved with binary but it is possible to resave CSV (file extension:*.CSV) by clicking "File" → "Save by text form".

scan mode   :qss

trend mode / He leak test mode :qst

analog mode   :qsa

Depending on whether the type of data saving is [AutoSave] or [Confirmation] and when in the scan / trend / He leak test mode measurement, data from measurement start to stop are saved in a batch. In the analog mode measurement, only the data displayed on the screen is saved.

When the type of data saving is [at Sampling] and in the scan / trend / He leak test mode measurement, data is saved at each measurement sampling.

· Save data size

Following is an example, please refer it.

Measurement condition is

Scan mode is selected, measurement speed is 200ms, auto is selected for measurement interval, mass number range is from 2 to 200, measurement time is 6hours.   The file capacity would be 432kB.

· Notes to save data

When the type of data saving is [AutoSave] or [Confirmation] and in the scan / trend / He leak test mode measurement or in the analog mode measurement, the measurement data of this software is stored in the PC memory and is saved in a batch when measurement is stopped. In this case, if the PC hangs up during measurement, the measurement data will not be retained. Therefore, use it in a stabilized PC environment (Always save the data or, if measurement is made continuously for an extended time, it is recommended to select [at Sampling].

When exclusive memory for this software in memory of PC becomes full during measurement of long term, stop measurement automatically and save data to file and then restart measuring. The saved file is named automatically the time of PC as same as the above procedure "(2-1) Create recipe".

(14) Display and Print saved data

Click "File" → "opens" to open and "File" → "Print" to print saved data as same as standard Windows software.

When the trend / He leak test data is printed, the width of line for each CH can be set by clicking "trend display set" → "width of the line" in "(3-6) Display seting dialog".

5. Others

(1) Menu before connecting sensor

There are some setting items in "Setting" menu before connecting sensor.

(1-1) Communication port

Set COM port of PC to use this software.
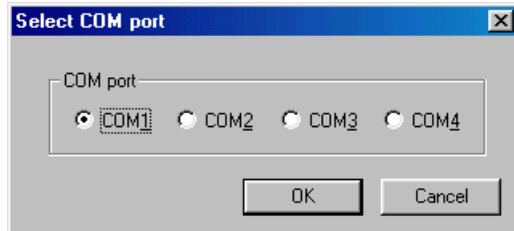
<　Screen of standard function　>　　　　<　Screen of host communication function　>
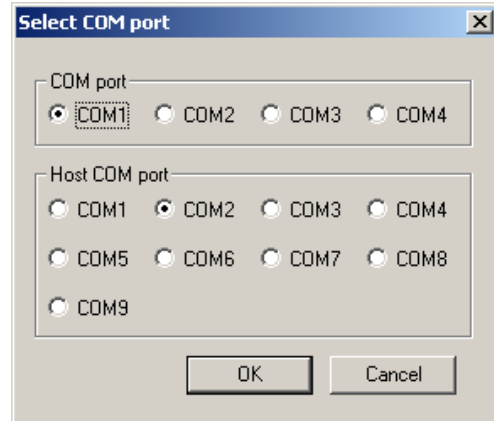
"COM port"group　　　　　:　Set the COM port for communication with the sensor.　In general PC, the COM1 port is used.

"Host COM port"group　　:　Sets the COM port for communication with the host software (host).　In general PC, the COM2 port is used.

* **The host communication function is optional. [Host COM port] cannot be set by the standard function.**
Set a separate COM port for [Communication port] and [Host COM port].
* **The host communication's speed is 9600bps. It cannot be changed.**

(1-2) Setting of the communication log file

Enter the execution condition of the real time storing of the communication command send and recieve history.
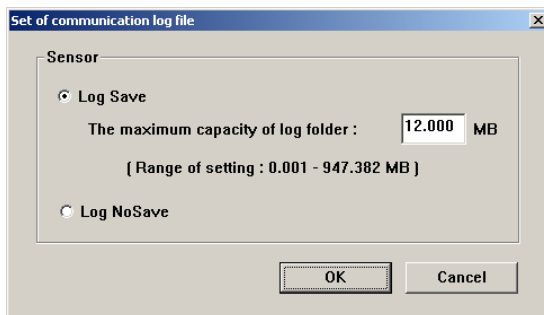
<　Screen of standard function　>　　　　<　Screen of host communication function　>
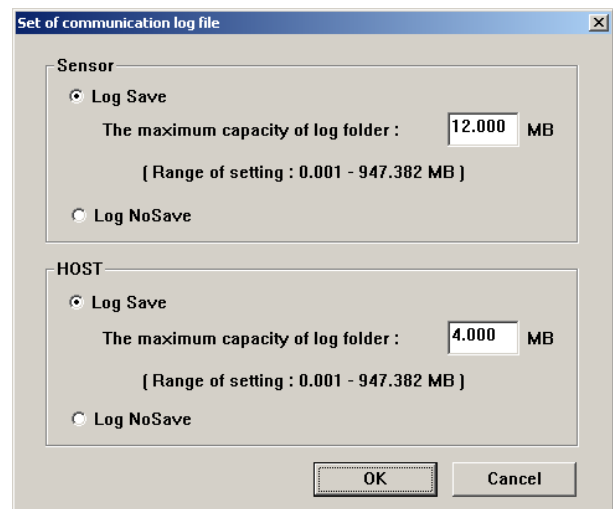
"Sensor"group : Enter the execution condition of storing the sensor communication log.
When "Log Save" is selected, the communication log is stored in the log file named by the following naming rule.
The log file is stored in the CommLog folder.
   < Naming rule of the log file >
    Q_YYMMDD_NN.TXT
       YY : Two subordinate position digits of year at Christian era
       MM : Two digits a month(It is buried during the January-September by 0 like "01".)
       DD : Two digits a day(It is buried during the 1-9 by 0 like "01".)
          The new file is created, when the date is updated.
       NN: Two digits of serial number
          The log file is divided by every about 1.4MB, and serial number is incremented by one.

As far as the log file capacity is less than "The maximum capacity of log folder [MB]", the new log file is created in the log storage folder.
Once the log file capacity is over "The maximum capacity of log folder [MB]", the oldest log file is deleted, and the total capacity of the log file is adjusted within the limit.
"The maximum capacity of log folder [MB]" must be less than 10% of empty capacity of the drive in which this software is installed.
When "Log NoSave" is selected, the communication record is not stored.

"HOST"group : When Host communication (optional) is effective, enter the execution condition of the Host communication log.
When "Log Save" is selected, the communication log is stored in the log file named by the following naming rule.
The log file is stored in the HostCommLog folder.
   < Naming rule of the log file >
    H_YYMMDD_NN.TXT
      The rule is same as   sensor side.
The limitation of the maximum capacity and   "Log NoSave" setting are the same as sensor side.

* The host communication function is optional. It cannot be used by the standard function.

(1-3) Analog input setting

It sets up, when inputting analog ch 1.2.

Choose from "pressure", "temperature" or "linear" the kind of data which changes an analog input value.
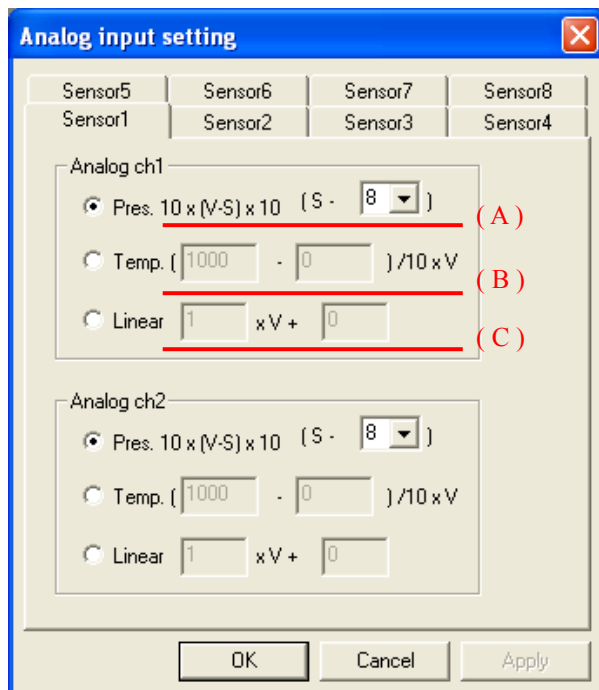
| Pressure | : | Change an analog input value into pressure.   A unit is [Pa]. Choose when taking pseudo log of external vacuum gauge. Please refer to operation manual for operating model because the setting pseudo log output is different for model of vacuum gauge. (A default is the set value of our company GI-M2 vacuum gauge.) |

<About calculating formula (A)>

· V	:	The output voltage value from Qulee power supply. [V]
· S	:	The value which omitted below the decimal point from V. [V]
· List box	:	Choose the set value of a pseudo log output.

If, for example, the output voltage value from Qulee power supply is 2.50V.   And in the case of G1-M2 vacuum gauge.

$$10 * (2.5 - 2) * 10^{(2-8)} = 5.00*10^{-6} \quad [Pa]$$

| Temperature | : | Change an analog input value into temperature.   A unit is [deg]. Choose when taking in temperature using a temperature converter. |

<About calculating formula (B)>

· V	:	The output voltage value from Qulee power supply. [V]
·The left side input edit	:	Input the maximum temperature of a temperature converter.
·The right side input edit	:	Input the minimum temperature of a temperature converter.

40

If, for example, the output voltage value from Qulee power supply is 2.50V. And in the case of the temperature range of the temperature converter is 1000-0 degree.

$(1000 – 0) / 10 * 2.50 = 250$ [deg]

Linear   : Change an analog input value into arbitrary values. A unit is not required.

Choose when you take in the voltage (DC0 $\sim$ 10V(maximum)) in arbitrary measurement machines.

<About calculating formula (C)>

  · V   : The output voltage value from Qulee power supply. [V]

  ·The left side input edit   : Input the value corresponding to 1V.

  ·The right side input edit   : Input a correction value (Y-intercept).

If, for example, the output voltage value from Qulee power supply is 2.50V. In the case of the value corresponding to 50 is 1V, and also correction value is 10.

$50 * 2.50 + 10 = 135$ [   ]

(1-4) Calibrate Sensitivity of FC

Set conversion value to convert measurement value to partial pressure by measuring Faraday cup.

Attention)   When partial pressure is displayed by the reference to the sensitivity proofreading value, it is necessary to set ion current value minus partial pressure value beforehand when partial pressure with a Faraday cup is measured. When this set value is decided, a single gas (N2 and Ar, etc.) is introduced into the vacuum device to become constant pressure, and the vacuum meter instruction value and the ion current value of QMS (N2=28 and Ar=40, etc.) is measured.

(2) Measuring FC (Faraday cup)

There are some difference between using SEM and measuring by Faraday cup.

· Sensitivity calibration in FC measurement

In the FC measurement, set the above procedure "Calibrate sensitivity of FC" to display partial pressure on based sensitive calibration value.

· Switch of SEM · FC in CGM / BGM / RGM

When the measurement is started just after the connection is changed from CGM051 / BGM101 / BGM201 / RGM201 to other model, FC is kept for the setting of detector. To measure with SEM, check "SEM" of Setting for FIL performance at "Control panel" and also check "SEM" for "Detector".

(3) Uninstall Qulee QCS

Click "start" → "control panel" → "Add or Remove Programs" in windows to uninstall this software. This procedure "Add or Remove Programs" is same as standard Windows software.

When this software is needed to reinstall or version up, please follow from the above procedure "uninstall this software" after backup data.

(4) Term explanation

Sensor	:	Analyzer of four pile ultra mass analyzer is generally indicated in this manual. Also, QMS sensor is indicated only for analyzer and Control unit is indicated only for power supply unit.
RF unit	:	Unit to connect directly or proximity with analyzer.
Filament	:	Filament for analyzer. Please take care not to turn on the atmosphere of 1e-2Pa or more, it would be cutoff filament.
SEM	:	Secondary electron multiplier tube. When an ion that is separated mass by Q pole of analyzer collides, electron is multiplied as same as number of colliding on wall and then.
Ionized voltage	:	Voltage to ionize gas. The voltage is generally 40V, 50V or 70V, but sensor RGM is changeable between 20V to 70V. When ionized voltage is lower, the ion dissociation could decrease in ionization.
Emission current	:	It is current flowing into grid from filament.

(5) Operation flow of Qulee QCS

Start Qulee QCS

↓

Connect sensor
Display dialog

↓

Connect sensor

↓

Read recipe for
previous measurement
Display   screen
to display data

↓

Create or select
new recipe

↓

Click [FIL]

↓

Turn lamp on
[F], [R]

↓

Click [MES]

↓

Turn lamp on
[S], [M]

↓

Start to measure
and display

↓

Click [MES] to stop
measurement

↓

Click [FIL]
to turn filament off

↓

Close Qulee QCS
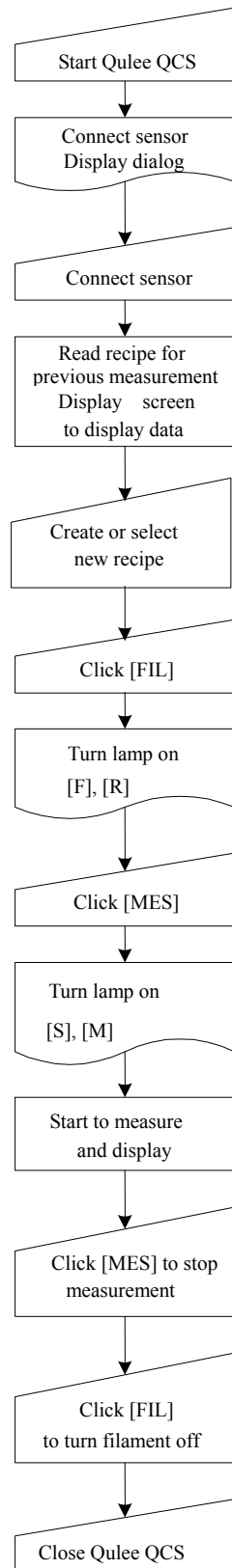
6. Analyzing Function after Loading Data File

(1) Processing the background

Subtracts the background from all data using the designated data as background data.

Actuated after loading the trend mode data file.

If the data after subtraction is zero or a negative value, it is replaced with 1.00E-14.

Graph printing and data saving processing can be made after background processing.

To save data subjected to background processing, affix "_BG" to the end of the default filename.

(1-1) Background Processing Flow

Load trend mode data file

Click [Background] button or
select "Tools" -> "Background" menu

Background processing going on? — No

Yes

Background processing stop

Designation of background position
· Double-click graph after determining position
· Click on graph and press[Enter] key after
  determining position

Background position determined? — No

Yes

Subtract background from all data
  using the designated data as background data

Displays data after background
  subtraction on graph

Resume data before background
subtraction? — No

Yes

Resume data before background subtraction
Displays data before background subtraction

Background processing end

(2) Integral processing

Conducts integral calculation of a designated range.

Actuated after loading the trend mode data file.

The integral result can be saved in the text format. "_IR" is affixed to the end of the default filename.

(2-1) Integral Processing Flow

```
              ( Load trend mode data file )

         ┌─────────────────────────────────┐
         │  Click [Integrate] button or    │
         │  select "Tools" -> "Integrate" menu │
         └─────────────────────────────────┘
                        │
                   ◇ Integrate processing going on? ◇ ──No──┐
                        │                                   │
                       Yes                                  │
                        │                                   ▼
              ( Integrate processing stop )   ┌─────────────────────────────┐
                                              │ Designate integrating range by drag │
                                              │      & drop of the mouse     │
                                              └─────────────────────────────┘
                                                        │
                                    ◇ Execute integration of designated range? ◇ ──No──┘
                                                        │
                                                       Yes
                                              ┌─────────────────────────┐
                                              │    Integral calculation │
                                              └─────────────────────────┘
                                              ┌─────────────────────────────┐
                                              │ Display of integral calculation result │
                                              └─────────────────────────────┘
                            ┌────────────────────┐        ┌────────────────────┐
                            │ Click [OK] button  │        │ Click [Save] button │
                            └────────────────────┘        └────────────────────┘
                                                          ┌────────────────────┐
                                                          │   Set filename     │
                                                          └────────────────────┘
                                                          ┌───────────────────────────────┐
                                                          │ Save integrated result in text format │
                                                          └───────────────────────────────┘
                                              ( Integrate processing end )
```

(2-2) Displayed Content of Integration Result

The integration result is displayed as shown in the figure below.
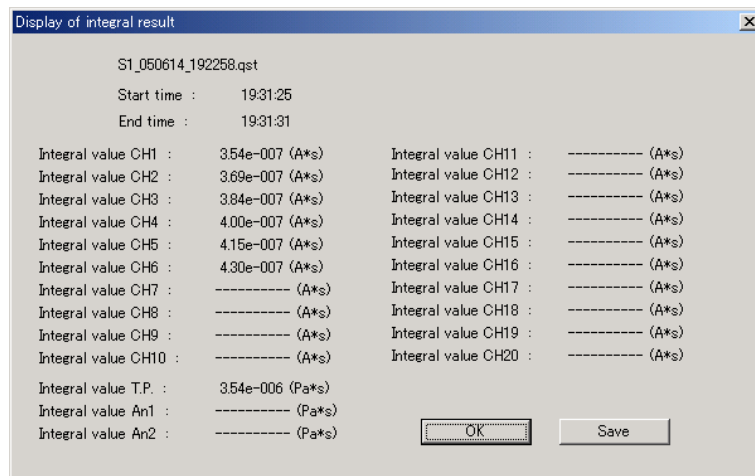
(2-3) Saved Content of Integration Result

The integration result is saved in the text format as shown in the figure below.
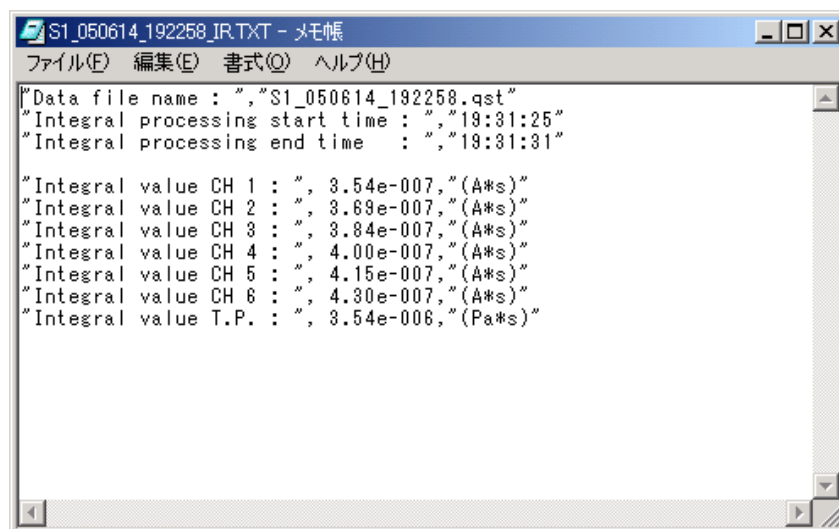
7. Host Communication Functions

(1) Overview

Trend mode measurement data can be sent through RS-232C communication when requested by the host computer.

The measurement mode that sends data is the trend mode only. Data cannot be sent in other modes.

* The host communication function is optional. It cannot be used by the standard function.

(2) Detailed specifications of message

Messages are all in the ASCII code. Checksum is added to both sending side and receiving side.

(2-1) List of commands

#	Content	Command	Command parameter	Response	Response parameter	Remarks
1	Data request	DA	Sensor No. 1 - 8	da	NON ERR Data E00 (E zero zero)	NON: Not available ERR: Error Data: See (2.3) E00: Format error
2	Error return	-	-	er	SUM None	Checksum error When incorrect command is received

(2-2) Data request message format

The data request message is a communication command that requests this software for data from the host computer. The message is made up of command, command parameter, checksum and delimiter.

A command is made up of two uppercase alphabets.

Refer to "(2-8) calculation of checksum" for checksum calculation.

The delimiter is denoted with <CR><LF>. This delimiter must always be added to a command as a terminal character. There is no command other than this.

Command message   DA1B6<CR><LF>

(2-3) Data request return message format (data message format)

(2-3-1) Standard mode

Data message is a measurement data communication message sent from this software for the data request command of the host computer. The data message is made up of response command, data, checksum and delimiter.

Response command   :   da
  (2 characters)   Header code for identification.
Sensor No. (1 character)   :   1 - 8
                           This software can control up to 8 sensors   by one personal computer. It is a sensor identification number.

Unit (1 character)	:	P (for partial pressure), A (for ion current value), M (for concentration)
		This software can select ion current value (intensity) [A], partial pressure value [Pa] and concentration value [ppm] as unit of data. It indicates the unit of transmission data.
CH data (18 characters)	:	Mass number (000 to 400)
		Measurement mass numbers are 001 to 400. Always denoted with 3 digits. The number of channel that is not measured is 000. It is 040 for argon.
		Data value (X.XXE±XX)

Data value	:	The mantissa part is two digits below decimal point and E, followed by the symbol of exponent part, and two digits of exponent part.

		Setpoint alarm value (0000)
		Setpoint alarm value: Indicated with 4 digits like 0000.
		Abnormal value higher limit, alarm value higher limit, alarm value lower limit and abnormal value lower limit from left to right. 1 is set at the digit that exceeds the higher or lower limit of the setpoint. 0011 when the data is lower than the abnormal value lower limit. 0100 when abnormal value higher limit>data value>alarm value higher limit. Setpoint is a value set on the recipe of this software. The set value cannot be acquired through communication.
Checksum (2 characters)	:	00 – FF
		Refer to "(2-8) calculation of checksum".
Delimiter (2 characters)	:	<CR><LF>

Example of data message

da1A,000,0.00E-00,0000,001,1.23E-01,0000,002,2.23E-01,0000,003,3.23E-01,0000,004, 4.23E-01,0000,005,5.23E-01,0000,006,6.23E-01,0000,007,7.23E-01,0000,008,8.23E-01, 0000,009,9.23E-01,0000,010,1.33E-01,0000,011,1.43E-01,0000,012,1.53E-01,0000,013, 1.63E-01,0000,014,1.73E-01,0000,015,1.83E-01,0000,016,1.93E-01,0000,017,2.03E-01, 0000,018,2.13E-01,0000,019,2.23E-01,0000AB<CR><LF>

* Calculation of checksum in the example above is not correct.

(2-3-2) Compatible mode

Data up to 12CH is handled by this function. Data message is a measurement data communication message sent from the QCS2001 for a data request command of the host computer. The data message is made up of response command, data, checksum and delimiter.

Response command (2 characters)	:	Da
		Header coder for identification.
Sensor No. (1 character)	:	1- 8
		This software can control up to 8 sensors by one personal computer. It is a sensor identification number.
Unit (1 character)	:	P (for partial pressure), A (for ion current value), M (for concentration)
		This software can select ion current value (intensity) [A], partial pressure value [Pa] and concentration value [ppm] as unit of data. It indicates the unit of transmission data.

CH data (18 characters) : Mass number (000 to 400)
Measurement mass numbers are 001 to 400. Always denoted with 3 digits. The number of channel that is not measured is 000. It is 040 for argon.
Data value (X.XXE±XX)
Data value : The mantissa part is two digits below decimal point and E, followed by the symbol of exponent part, and two digits of exponent part.
Setpoint alarm value (0000)
Setpoint alarm value: Indicated with 4 digits like 0000.
Abnormal value higher limit, alarm value higher limit, alarm value lower limit and abnormal value lower limit from left to right. 1 is set at the digit that exceeds the higher or lower limit of the setpoint. 0011 when the data is lower than the abnormal value lower limit. 0100 when abnormal value higher limit>data value>alarm value higher limit. Setpoint is a value set on the recipe of this software. The set value cannot be acquired through communication.
Checksum (2 characters) : 00 – FF
Refer to "(2-8) calculation of checksum".
Delimiter (2 characters) : <CR><LF>

Example of data message

da1A,000,0.00E-00,0000,001,1.23E-01,0000,002,2.23E-01,0000,003,3.23E-01,0000,004,

4.23E-01,0000,005,5.23E-01,0000,006,6.23E-01,0000,007,7.23E-01,0000,008,8.23E-01,

0000,009,9.23E-01,0000,010,1.33E-01,0000,011,1.43E-01,0000AB<CR><LF>

* Calculation of checksum in the example above is not correct.

(2-4) Data request return message format (status response message format)

The status response message is a message that returns a status from this software for a data request command from the host computer. The response message is made up of response command, sensor no., parameter, checksum and delimiter.

Response command : Da
(2 characters) Header coder for identification.
Sensor No. (1 character) : 1- 8
This software can control up to 8 sensors by one personal computer. It is a sensor identification number.
Parameter : NON : Not yet measured or under measurement in a mode other than the trend mode.
ERR : SEM, RF, FIL or pressure (inside/outside) error is occurring.
E00 : When the number of received characters of the data request message is incorrect.
erSUM : Checksum is not added to the data request message or checksum is incorrect.
er : Data request message is incorrect.

·If SEM, RF, FIL or pressure (inside/outside) error occurs when in the NON status (not yet measured or during measurement other than in the trend mode), NON will be sent with priority over ERR.

·If SEM, RF, FIL or pressure (inside/outside) error occurs during trend mode measurement, ERR will be sent with priority.

Checksum (2 characters) : 00 – FF
Refer to "(2-8) calculation of checksum".

Delimiter (2 characters)   :   <CR><LF>

Example of communication message:

    da1NON12<CR><LF>

    erSUM12<CR><LF> → erSUM has no response command and sensor no.

* Checksum calculation in the example above is not correct.

(2-5) Data request command sequence

Host	Exchanged information	Qulee QCS
Requests data transmission	DA<CR><LF> Send da data <CR><LF> …	Returns data. Or returns status. NON: Not yet measured or under measurement other than in trend mode ERR: Abnormal FiL, RF, SEM or pressure E00: Number of received characters of data request message is incorrect. erSUM: Checksum of data request message is incorrect er: Data request message is incorrect

(2-6) Exceptional processing

In this communication specification, receive time-out is 5 seconds. Receive time out means the time after the first character is received until delimiter is received. In case of time out, er is returned as with an incorrect command. Send time out is not provided.

Host	Exchanged information	Qulee QCS
Send command	D… er <CR><LF>	If <CR><LF> is not received 5 seconds later, er is sent back.
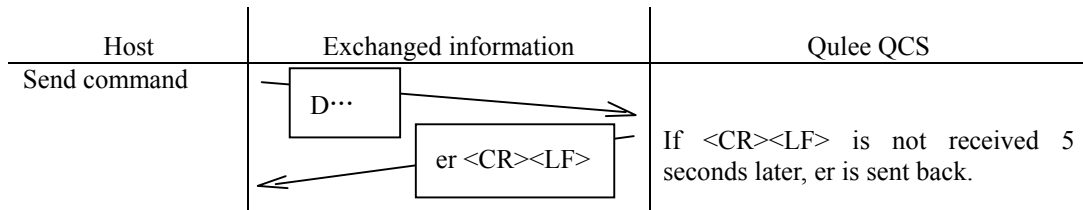
(2-7) Communication interval

The measurement interval of this software is maximum 1 second per sensor. However, it may not be able to communicate at a the maximum speed of 1 second per sensor because of the performance of this software.

(2-8) Calculation of checksum

Character is handled as byte (8-bit integer with no symbol).

The checksum of 1, 2, 3, 4, 5, 6, 7, 8 is calculated as follows.

0x31 + 0x2C + 0x32 + 0x2C + 0x33 + 0x2C + 0x34 + 0x2C + 0x35 + 0x2C + 0x36 + 0x2C + 0x37 + 0x2C + 0x38 = 0x0309

Then the high-order two bytes (0x03) and low-order two bytes (0x09) are added up.

0x03 + 0x09 = 0x000C

The two characters of the low-order two digits of 0x000C are given as a character. Thus the checksum is 0C.

"0C" is annexed to the end of the command.

(2-9) Notes about function

[1] Data is transmitted to the host only when in the trend mode measurement.

[2] To start and end measurement, perform operation on this software personal computer. Communicating operation from the host cannot be performed.

[3] If data is requested at an interval shorter than the measurement interval, the same data may be sent.

(2-10) COM port setting

Set the RS-232C port for host communication with [Setting]-[Com port] in the menu when the sensor is not yet connected. Refer to "5. Miscellaneous (1)Menu before connecting sensor (1-1)Communication port" for more information.

The setting of the host communication should be the following settings.

Bits par second	**: 9600bps**	
Data bits	**: 8bit**	
Parity	**: None**	
Stop bits	**: 1bit**	
Flow control	**: None**	

(2-11) Operation flow

Qulee QCS software start	Qulee QCS internal processing	RS-232C circuit	Host (GPCS)

Trend mode measurement start

Send latest data

Qulee QCS: Measuring

Measurement end

Measurement at stop: NON

DA\<CR>\<LF> — Host: Request data

Da···\<CR>\<LF> — Host: Data receive and processing

DA\<CR>\<LF> — Host: Request data

Da···\<CR>\<LF> — Host: Data receive and processing

DA\<CR>\<LF> — Host: Request data

daNON\<CR>\<LF> — Host: Data receive end
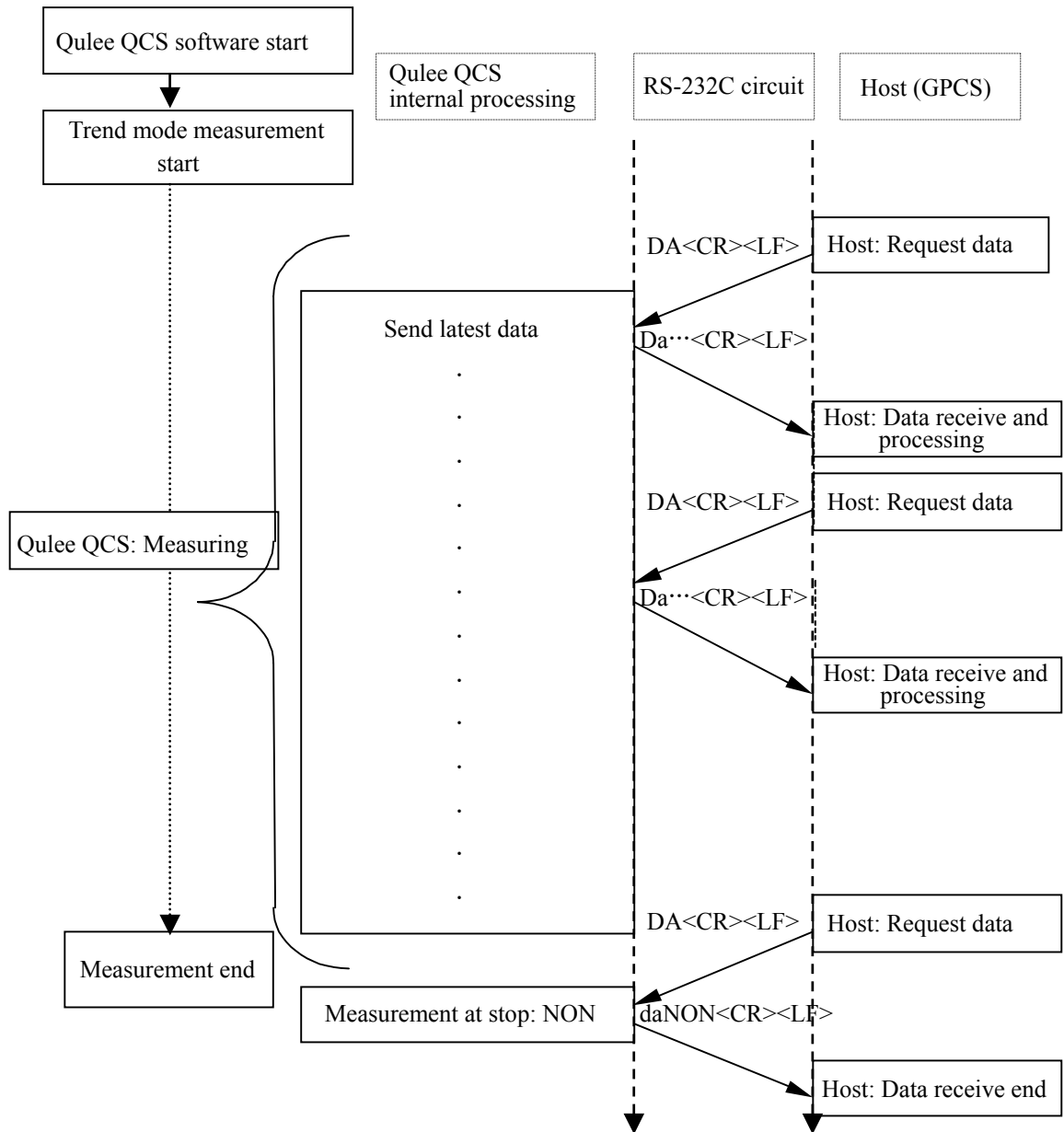
8. Analog Output Function

* The analog output function is optional. It cannot be used by the standard function.

(1) Analog output

The data value of a specified mass number is output at each measurement interval in an analog form during trend mode measurement.

It is output by a linear signal of 0 to 10V with respect to the specified amplifier range.

Resolution of DA conversion is 12 bits.

Output of data not more than $1.0 \times 10\text{-}14$ [A] is 0.0V.

Other output voltages are determined by the measurement data value for the set amplifier range (set range is - 5 to - 14). That is, the output voltage value is a value divided by the set amplifier range (divided by 1.0×10 -6 when the setting is - 6).

If, for example, the amplifier setting is - 6 and the measurement data value is $1.5 \times 10\text{-}6$ [A], 1.5 V is output. If the data exceeds $1.0 \times 10\text{-}5$ [A] at this time, 10V will be output.

Ion intensity [A]	Output voltage [V] (when amplifier setting is - 6)
1.0×10^{-14} or more	0.0
. . .	. .
1.0×10^{-7}	0.1
. .	. .
1.0×10^{-6}	1.0
. .	. .
9.9×10^{-6}	9.9
1.0×10^{-5} or more	10.0

(2) Output state

Analog outputs are indefinite, except during trend mode measurement, such as before startup of this software, immediately after startup, before measurement, after measurement, and during measurement in other mode.

(3) Setting analog output conditions

Select [Setting]-[Set analog output conditions] from the menu to set conditions.

Output ON/OFF	:	Sets whether or not the data value of the specified mass number is to be output in an analog form during trend mode measurement.
Output CH.	:	Sets the output channel number of the analog board.
Mass number	:	Sets a desired mass number for analog output of data.
Range	:	Sets the amplifier range. The setting range is - 5 to - 14.

9. He Automatic Sensitivity Calibrating Function

(1) Overview

Helium sensitivity calibration can be started at an arbitrary time or timing during trend mode measurement to automatically calibrate helium sensitivity while regulating the SEM voltage.
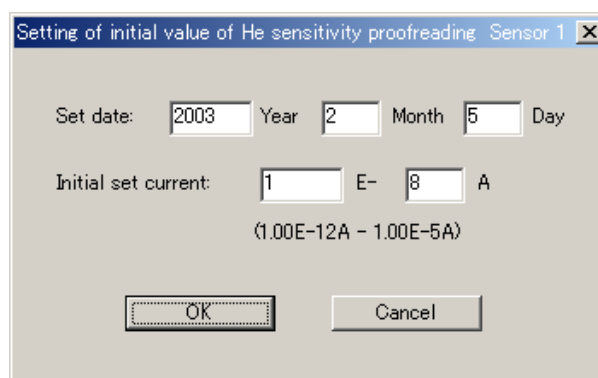
The host communication data value and analog output data value outputs during helium sensitivity calibration are the data values immediately before start of calibration.

(2) Sensitivity calibration processing

Adjust the actually measured ion current value of mass number 4 to a targeted current value while increasing and decreasing the SEM voltage. When the difference between the SEM voltage value closest to the targeted current value and the SEM voltage value before calibration is 0.05 kV or more, return the SEM voltage value to that before calibration and conduct calibration processing for a second time (maximum three times). Calibration processing will be complete when the re-calibration processing has ended three times or the difference between the SEM voltage value closest to the targeted current value and the SEM voltage value before calibration is less than 0.05 kV. However, if the SEM voltage reaches the higher limit or lower limit value before approaching the targeted current value or if alarm or communication error occurs during calibration processing, the message is displayed, terminating the calibration processing. If calibration processing has ended or calibration processing is conducted for a second time when the difference from the SEM voltage value is 0.05 kV or more, the calibration result will be registered in the log.

(3) Initial set item

Select [Setting]-[Initial value setting of He sensitivity calibration] in the menu to set initial conditions.


| Set date | : | Sets the date of setting the initial set current. The number of days from the set date to the measurement date affects the targeted current value of helium sensitivity calibration. (Refer to the calculation expression of "Initial set current".) The input range is January 1, 1980 to December 31, 2100. |

Initial set current	:	Set the reference value for the targeted current value of helium sensitivity calibration.
		Targeted current value = initial set current value x factor to the nth power, where n is the number of elapsed days.
		Factor: 0.9997805
		Number of elapsed days: Number of elapsed days from the date on which the initial set current was set to the measurement date.

(4) Condition set item

Select [Setting]-[Set He sensitivity calibration conditions] from the menu to set conditions.
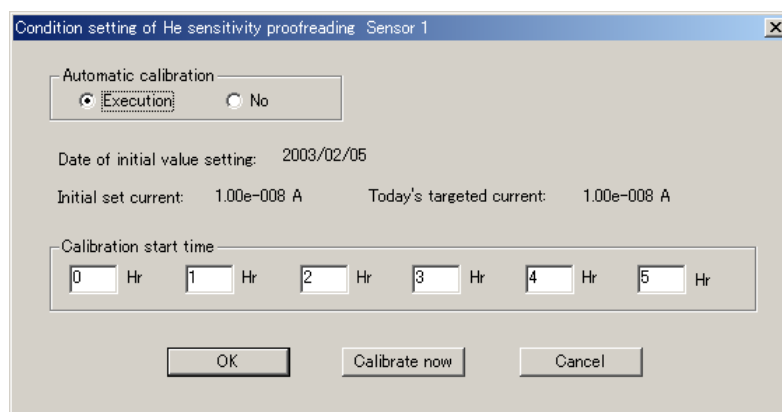
"Automatic calibration" group	:	Sets whether helium calibration is to be conducted or not. Selecting "No" during helium sensitivity calibration and clicking the [OK] button displays the message that confirms the stop of calibration processing.
Date of initial value setting	:	Displays the "Set date" set in the "Initial value setting of He sensitivity calibration" dialog box.
Initial set current	:	Displays the "Initial set current" set in the "Initial value setting of He sensitivity calibration" dialog box.
Today's targeted current	:	Displays the "Set date" set in the "Initial value setting of He sensitivity calibration" dialog box and the targeted current value calculated from the "initial set current".
Calibration start time	:	Sets the automatic start time of He sensitivity calibration for 6 hours. The input range is 0 to 23.
[Calibrate now] button	:	Clicking this button validates the set conditions, terminates the "Set He sensitivity calibration condition" and executes He sensitivity calibration immediately. The button is enabled only when all of the following conditions are met.
		·Measurement is being conducted in the trend mode.
		·He sensitivity is not being calibrated.
		· "Yes" is selected from the "Auto calibration" group.
		·Mass number 4 is being measured.
		·Unit of data is ion intensity [A].
		· "SEM" is selected with "Ion collector" on the "Control panel" dialog box.

(5) Sensitivity calibration state

The "He sensitivity calibration state" screen is displayed during He sensitivity calibration processing and closes automatically when the calibration processing is complete. The "He sensitivity calibration state" screen is updated at every one second.
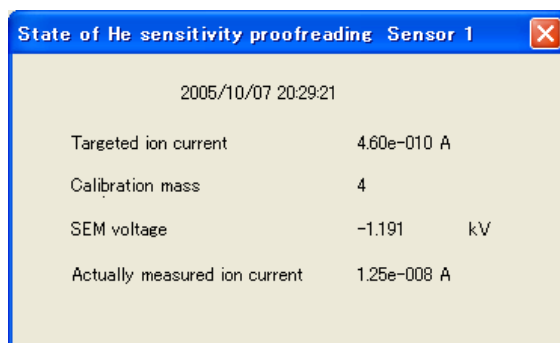
Date/time display	:	Displays the current time and date.
Targeted ion current	:	Displays the targeted ion current value.
Calibration mass number	:	Always displays 4.
SEM voltage	:	Displays the SEM voltage value during calibration.
Actually measured ion current	:	Displays the actually measured ion current of mass number 4 under calibration.

(6) Log display of sensitivity calibration result

Select [Window]-[Sensitivity calibration log] in the menu.

He sensitivity calibration time and date, initial set current value, targeted current value, SEM voltage, and calibration end state are displayed in the "He sensitivity calibration log" window as sensitivity calibration result.

[1] He sensitivity calibration time and date, initial set current value, targeted current value, SEM voltage and calibration end state are saved in the text format file as sensitivity calibration results.

When calibration is complete or calibration is executed again, they are recorded as the calibration result log. If the number of data points exceed 100, the oldest data is deleted and new data is added.

If the sensitivity calibration log does not exist, "No log data" is displayed in the "He sensitivity calibration log". When calibration is complete or calibration is executed for a second time, the display in the "Log display" window is updated.

[2] Display contents

No. ·He sensitivity calibration time and date·initial set current value·targeted ion current value·SEM voltage	:	Time and date and conditions when calibration is complete or when calibration is executed for a second time are recorded.
Calibration end state	:	State at the end of calibration is recorded.

·Normal end : Re-calibration processing has ended three times or when the difference between the SEM voltage value closest to the targeted current value and the SEM voltage before calibration is less than 0.05 kV.

·Retrial: The difference between the SEM voltage value closest to the targeted current value and the SEM voltage before calibration is 0.05 kV or more and re-calibration process is required.

·Forced termination (adoption of SEM value at the end of forced termination): Forcibly terminated because the higher limit and lower limit values of SEM voltage are attained before approaching the targeted current value. This state is caused when the adoption of the SEM value at the end of forced termination is selected in forced termination.

·Forced termination (adoption of SEM value before He sensitivity calibration): Forcibly terminated because the higher limit and lower limit values of SEM voltage are attained before approaching the targeted current value. This state is caused when the adoption of the SEM value before calibration is selected in forced termination. Or when an alarm or communication error has occurred during calibration processing, resulting in forced termination.
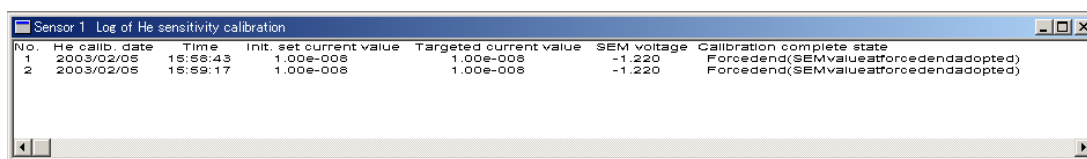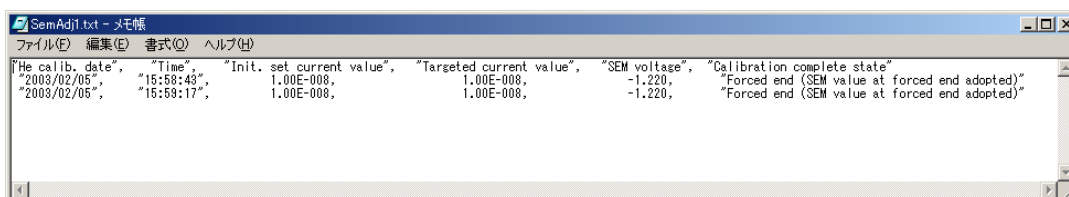
(7) Saving the log of sensitivity calibration results

He sensitivity calibration time and date, initial set current value, targeted current value, SEM voltage and calibration end state are saved in the text format file as sensitivity calibration results.

* The log is saved in the text file (SemAdj#.txt : # represents a sensor No.) immediately after the calibration result is registered in the log. To load the log file with memo-pad, Microsoft Excel or other, disable the He sensitivity calibrating function or stop measurement.

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(8) He sensitivity calibration processing flow

```
        ┌─────────────────────────────┐
        │ Trend mod measurement start │
        │ (M/e=4 has been measured)   │◄──────────────────┐
        └─────────────────────────────┘                   │
        ┌─────────────────────────────┐                   │
        │ Measurement data collection /│                   │
        │ graph display / save        │                   │
        └─────────────────────────────┘                   │
                ◇ He sensitivity calibration   No          │
                  start conditions met ?  *1) ─────────────┘
                        │ Yes
        ┌─────────────────────────────┐
        │ Measurement data collection /│
        │ graph display / save   *2)  │
        └─────────────────────────────┘
```

Is measurement ion current value equal to set current value ? over ? under ? *3) — No

Measurement data value < targeted current value ? — No

Current SEM voltage value <= Min. SEM voltage value ? — No

Yes

Selection of SEM voltage (voltage before or after calibration) *5)

He sensitivity calibration end (failure)

Waiting for stability *4)

Max. SEM voltage value <= Current SEM voltage value ? — No

Yes

Selection of SEM voltage (voltage before or after calibration) *5)

He sensitivity calibration end (failure)

10 times the targeted current value <= measurement data value ? — No

SEM voltage -= 1V

Yes

Current SEM voltage value −10V < Min. SEM voltage value ? — No

Yes

SEM voltage -= 10V

SEM voltage = Min. SEM voltage

10 times the measurement data value <= targeted current value ? — No

SEM voltage += 1V

Yes

Max. SEM voltage value < current SEM voltage value +10V ? — No

SEM voltage += 10V

Yes

SEM voltage = Max. SEM voltage

Difference between current SEM voltage value and SEM voltage value before calibration is less than 50V ? — No

Yes

Retrials 3 times or more ? — No

Number of retrials += 1
Reverts SEM voltage to that before calibration and execute again

Yes

He sensitivity calibration ends normally

*1) He sensitivity calibration starts when the following conditions are met.
     ·Measurement data has been collected three times or more.
     ·Measurement is started within one hour after the set calibration time and the calibration is not made at this time.   Or when the calibration time that was set during measurement has come.

*2) Host communication data value and analog output data value during He sensitivity calibration that are output are the data values immediately before start of calibration.

*3)

set current value

over   under
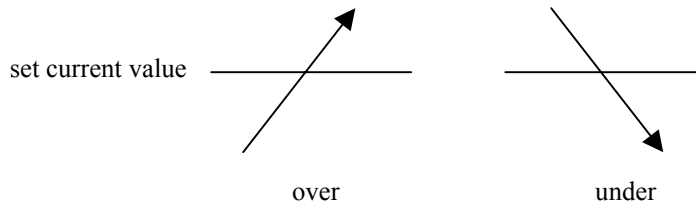
*4) After changing SEM voltage,
     wait for (measurement speed of 1CH. x number of channels + 2) seconds.

*5) State at the end of calibration is recorded.
     ·Select SEM voltage pre-calibration value →
          Forced termination (adoption of SEM value before He sensitivity calibration)
     ·Select SEM voltage post-calibration value →
          Forced termination (adoption of SEM value at the end of forced termination)